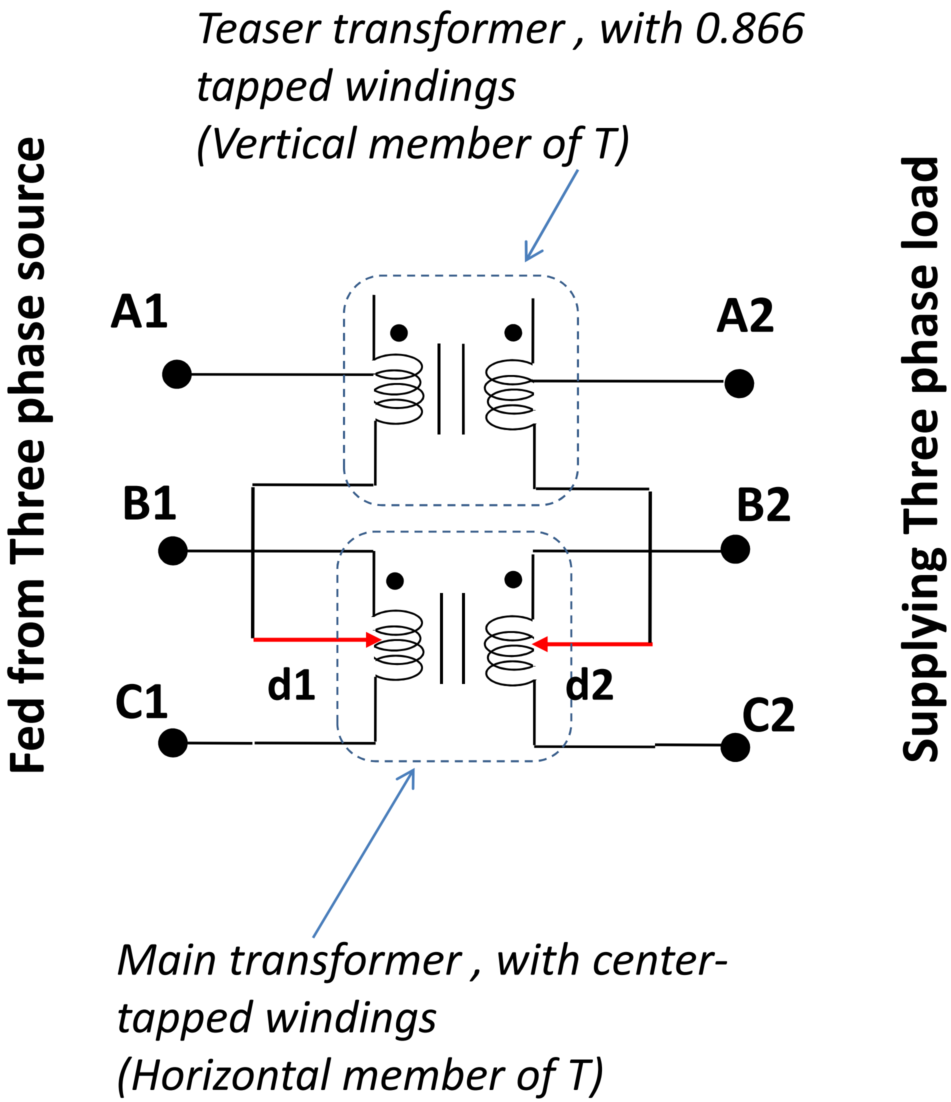
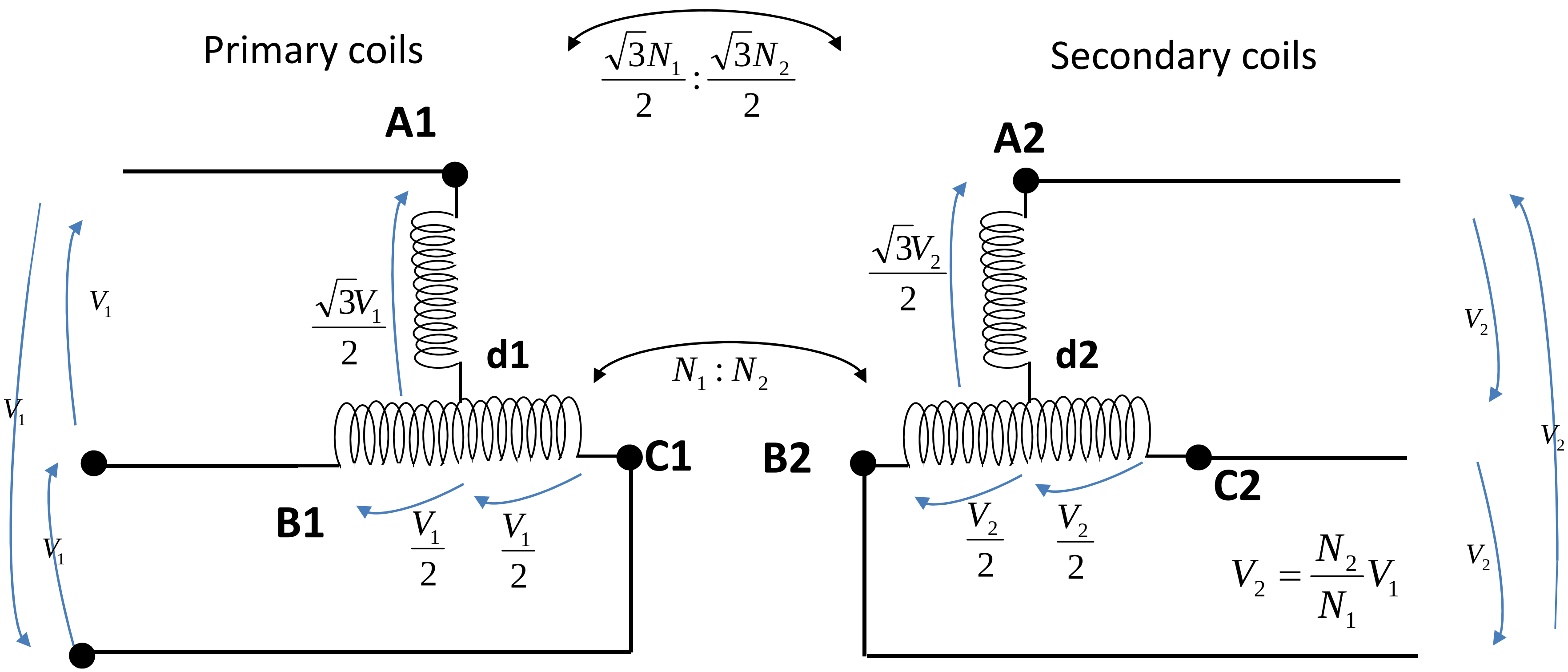
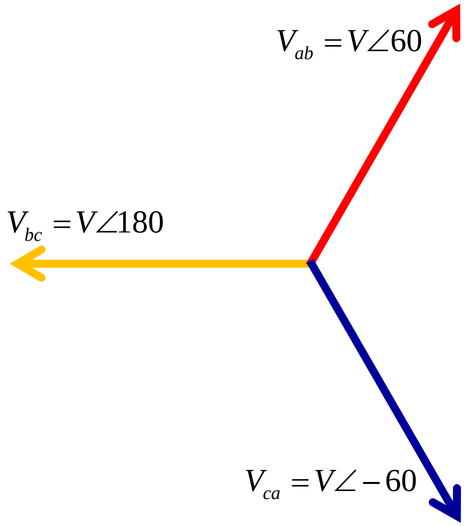
Scott Connection (T-T)

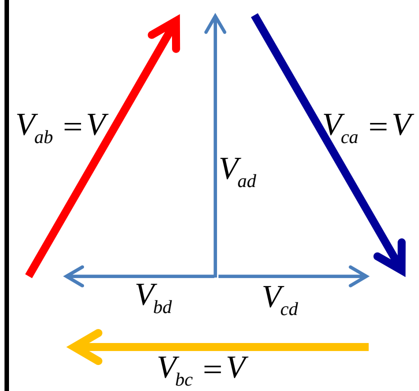


Advantages:

- Compared to open delta and open Y -open delta, a neutral can be connected to both of the primary and secondary sides







KVL in loop $d_1b_1a_1d_1$:

$$V_{a_1d_1} = V_{b_1d_1} + V_{a_1b_1}$$

$$= V_1\angle 60 + \left(\frac{V_1}{2}\right)\angle 180$$

$$= [(0.5 + j\frac{\sqrt{3}}{2}) + (-0.5 + j0)]V_1$$

$$= j\frac{\sqrt{3}}{2}V_1 = \frac{\sqrt{3}}{2}V_1\angle 90$$

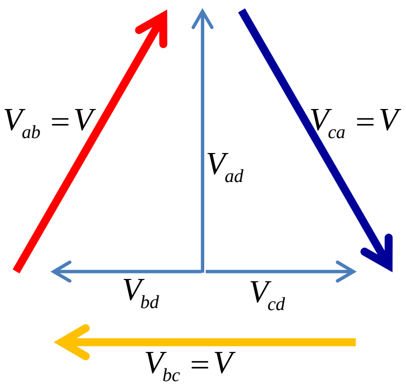
KVL in loop $d_2a_2c_2d_2$:

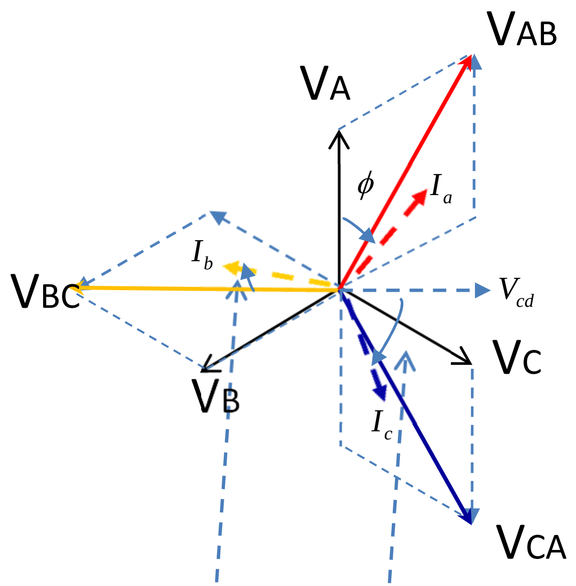
$$V_{c_2a_2} = -V_{a_2d_2} + V_{c_2d_2}$$

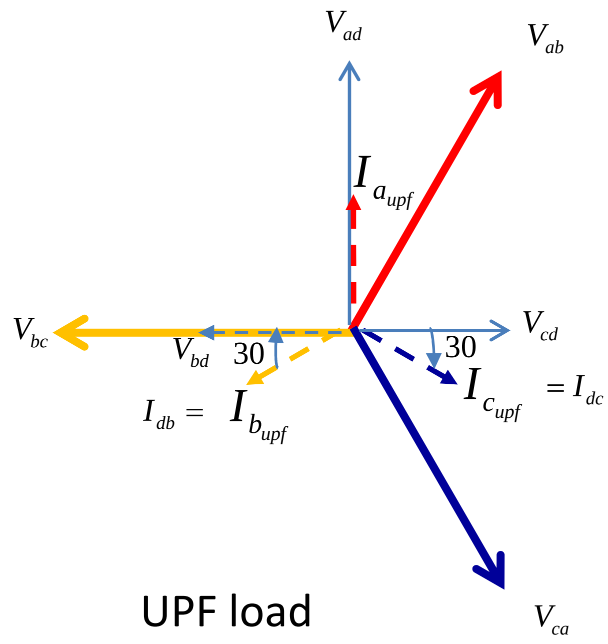
$$= -\frac{\sqrt{3}}{2}V_2\angle 90 + \left(\frac{V_2}{2}\right)\angle 0$$

$$= [-j\frac{\sqrt{3}}{2} + (+0.5 + j0)]V_2$$

$$= [0.5 - j\frac{\sqrt{3}}{2}]V_2 = V_2\angle -60$$

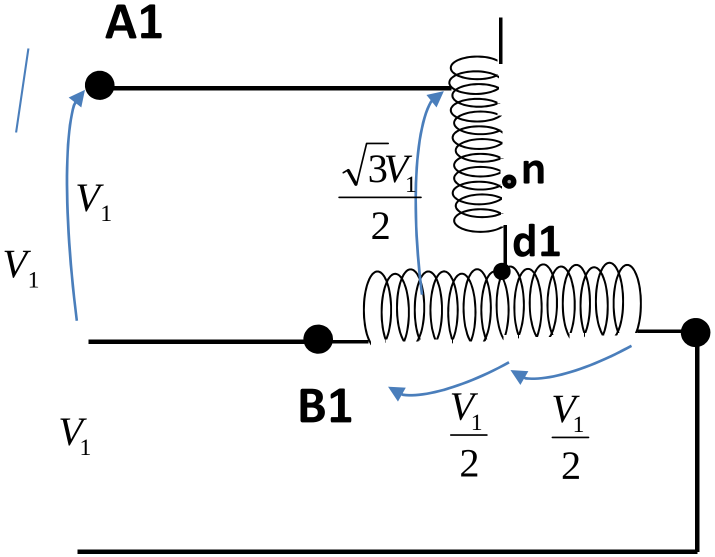


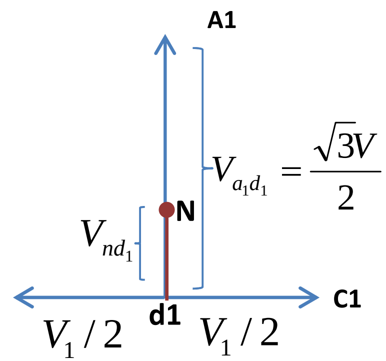




For a balanced load P.F. of *cosϕ*, the teaser current lags or leads the voltage by *ϕ*, while one half of the main transformer has a P.F. of *cos(30-ϕ)*, and the other half has a P.F. of *cos(30+ϕ)*

Location of neutral point "n":





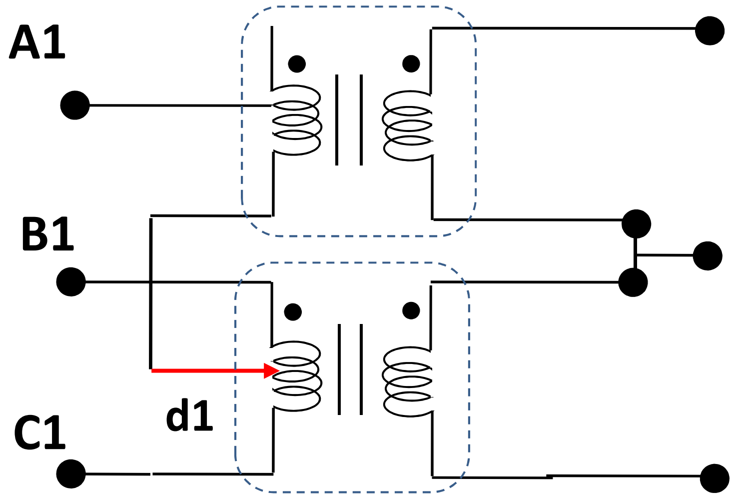
$$V_{a_1n} = V_{b_1n} = V_{c_1n} = \frac{V_1}{\sqrt{3}}$$

$$\because V_{a_1d_1} = \frac{\sqrt{3}V_1}{2} \quad \Rightarrow \quad V_{nd_1} = V_{a_1d_1} - V_{a_1n} = 0.2886V_1$$

$$\Rightarrow \quad \frac{V_{nd_1}}{V_{a_1d_1}} = \frac{0.2886}{0.866} = \frac{1}{3}$$

Three phase to two phase conversion:

<u>Via modified Scott connection:</u>



<u>Turns ratio:</u>

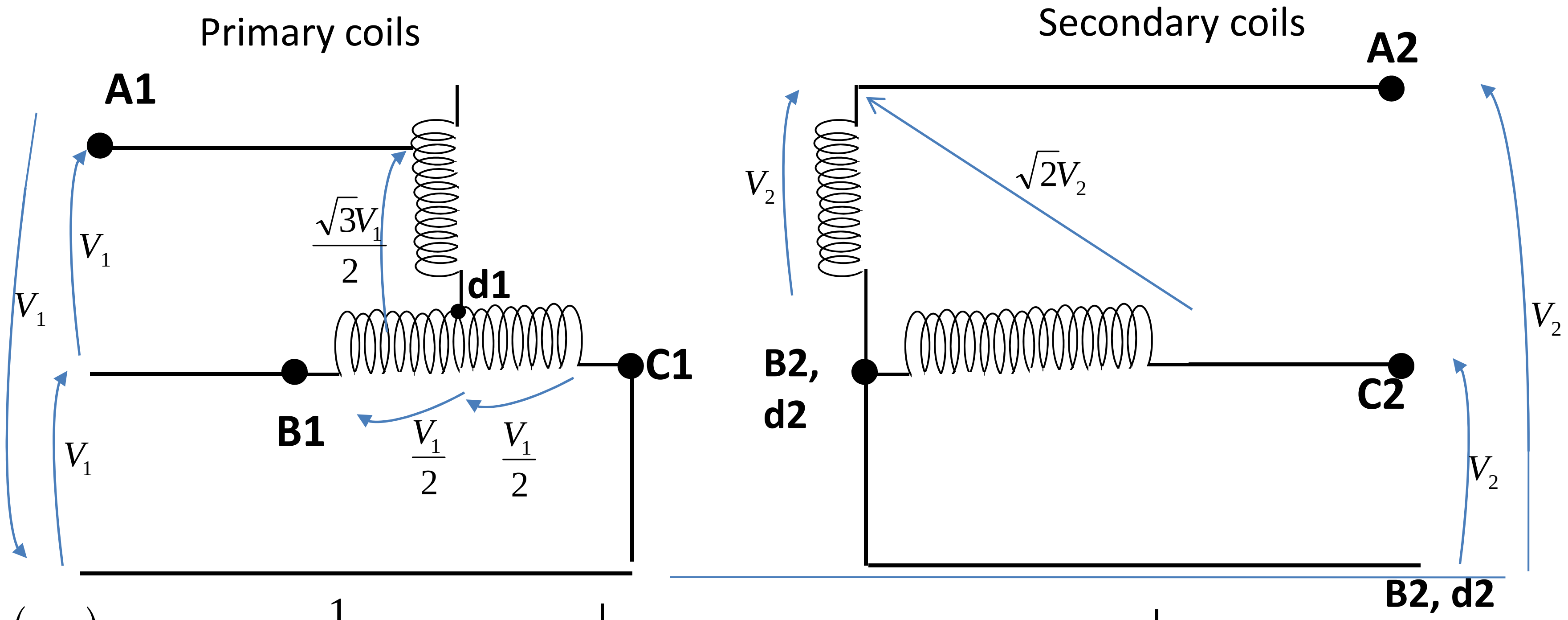
$$Main: \quad N_1 : N_2$$

$$Teaser: \quad \frac{\sqrt{3}}{2} N_1 : N_2$$

$$i.e: \quad N_1 : 1.15 N_2$$

Taps are applied in primary windings only, while full secondary windings are utilized. The teaser primary tap is adjusted to 86.6% to provide equal in magnitude with phase quadrature two phase secondary voltages .

<u>**3ϕ→2ϕ conversion (cont.):**</u>

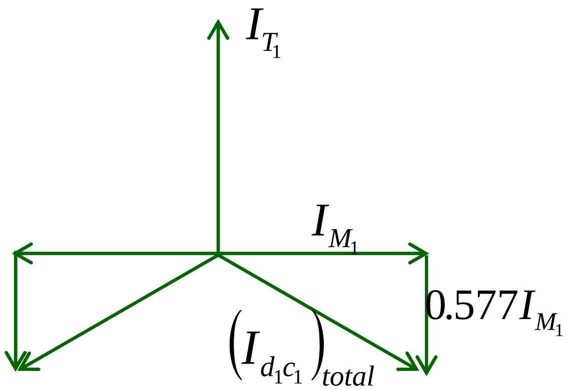


$$(I_{d_1c_1}^{\rightarrow})_{total} = I_{M_1}\angle 0 - \frac{1}{2} I_{T_1}\angle 90$$

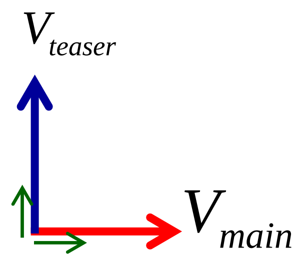
$$= \left(\frac{N_2}{N_1}\right) I_2\angle 0 - \frac{1}{2}\left(\frac{N_2}{(\frac{\sqrt{3}}{2})N_1}\right) I_2\angle 90$$

$$= I_1\angle 0 - \frac{1}{\sqrt{3}} I_1\angle 90$$

$$= \left|\sqrt{I_1^2 + \left(\frac{1}{\sqrt{3}} I_1\right)^2}\right| \angle 30 = \left|\frac{2}{\sqrt{3}} I_1\right| \angle 30$$



Balanced primary currents



Secondary V, I
(for UPF load)

Two transformers fed from a 440 V 3phase supply in a Scott fashion to operate two single phase 200 V loads with a total demand of 150 kVA. Find the necessary turns ratios and the secondary and primary currents.

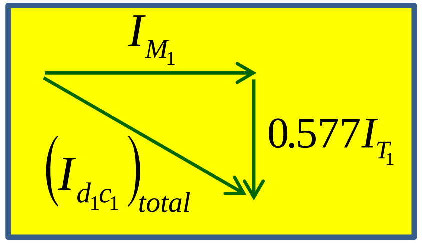
$$\left(N_2 / N_1\right)_{main} = 200/440 = 0.4545$$

$$\left(I_{main}\right)_{Secondary} = \left(I_{teaser}\right)_{Secondary} = \frac{150000/2}{200} = 375A$$

$$\left(I_{main}\right)_{\text{PrimaryBalancingComponent}} = \left(N_2 / N_1\right)_{main} \times \left(I_{main}\right)_{Secondary}$$

$$= 0.4545 \times 375 = 170.45A$$

$$\left(N_2 / N_1\right)_{Teaser} = \frac{N_{2_{Main}}}{\frac{\sqrt{3}}{2} N_{1_{Main}}} \approx 1.15 \times \left(N_2 / N_1\right)_{main} = 0.5227$$



$$\left(I_{teaser}\right)_{\text{Primary}} = \left(N_2 / N_1\right)_{Teaser} \times \left(I_{teaser}\right)_{Secondary} = 0.5227 \times 375 = 196A$$

$$Ineffective\ teaser\ current\ comonent\ in\ primary\ main = \frac{1}{2}\left(I_{teaser}\right)_{\text{Primary}} = 98A$$

$$Total\ current\ in\ each\ half\ of\ primary\ main = \sqrt{(98)^2 + (170.45)^2} = 196\text{A}$$

A two phase, 7.5 kW , 240 V, 60 Hz , 0.8 power factor motor has a 83% efficiency. The motor is fed from 600V three phase distributor through a Scott connected transformer bank. Find the following:

- The current in each 2- phase line
- The current in each 3- phase line