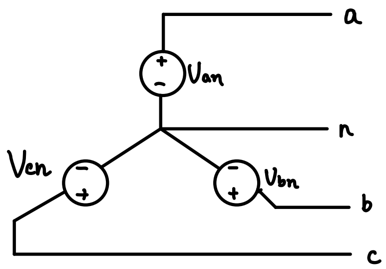
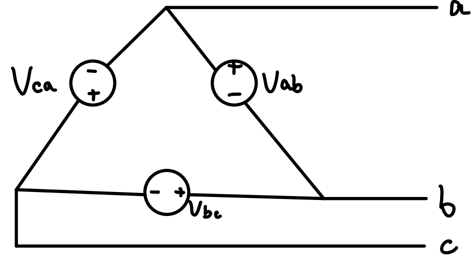
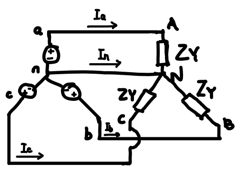
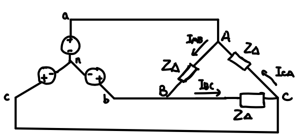
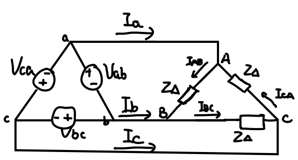
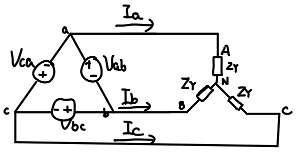


a) Y形联结



b) △形联结

$Z_\Delta = 3Z_Y$, $Z_Y = \frac{1}{3} Z_\Delta$ 进行 Y形联结负载与△形负载转换

联结方式	相电压/电流	线电压/电流	
Y-Y 	$V_{an} = V_p \angle 0°$ $V_{bn} = V_p \angle -120°$ $V_{cn} = V_p \angle +120°$ 同线电流	$V_{ab} = \sqrt{3} V_p \angle 30°$ $V_{bc} = V_{ab} \angle -120°$ $V_{ca} = V_{ab} \angle 120°$ $I_a = V_{an} / Z_Y$ $I_b = I_a \angle -120°$ $I_c = I_a \angle 120°$	指电源/负载 线电压V_L幅度是相电压V_P的$\sqrt{3}$倍，超前相电压30° $I_a+I_b+I_c=0$ $I_n=0$ $V_{nN}=0$.
Y-△ 	$V_{an} = V_p \angle 0°$ $V_{bn} = V_p \angle -120°$ $V_{cn} = V_p \angle +120°$ $I_{AB} = V_{AB}/Z_\Delta$ $I_{BC} = V_{BC}/Z_\Delta$ $I_{CA} = V_{CA}/Z_\Delta$	$V_{ab} = \sqrt{3} V_p \angle 30° = V_{AB}$ $V_{bc} = V_{ab} \angle -120° = V_{BC}$ $V_{ca} = V_{ab} \angle 120° = V_{CA}$ $I_a = I_{AB}\sqrt{3} \angle -30°$ $I_b = I_a \angle -120°$ $I_c = I_a \angle 120°$ 同相电压	线电流I_L幅度是相电流I_p的$\sqrt{3}$倍，滞后相电流30°
△-△ 	$V_{ab} = V_p \angle 0°$ $V_{bc} = V_p \angle -120°$ $V_{ca} = V_p \angle 120°$ $I_{AB} = V_{ab}/Z_\Delta$ $I_{BC} = V_{BC}/Z_\Delta$ $I_{CA} = V_{CA}/Z_\Delta$	$I_a = I_{AB}\sqrt{3} \angle -30°$ $I_b = I_a \angle -120°$ $I_c = I_a \angle 120°$ 同相电压	线电流I_L幅度是相电流I_p的$\sqrt{3}$倍，滞后相电流30°
△-Y 	$V_{ab} = V_p \angle 0°$ $V_{bc} = V_p \angle -120°$ $V_{ca} = V_p \angle 120°$ 同线电流	$I_a = \frac{V_p \angle -30°}{\sqrt{3} Z_Y}$ $I_b = I_a \angle -120°$ $I_c = I_a \angle 120°$ 同相电压	

- 对称系统中的功率

$V_{AN} = \sqrt{2} V_p \cos \omega t$, $V_{BN} = \sqrt{2} V_p \cos(\omega t - 120°)$, $V_{CN} = \sqrt{2} V_p \cos(\omega t + 120°)$ （V_p定义是相电压有效值）

若 $Z_Y = Z \angle \theta$.

$i_a = \sqrt{2} I_p \cos(\omega t - \theta)$, $i_b = \sqrt{2} I_p \cos(\omega t - \theta - 120°)$, $i_c = \sqrt{2} I_p \cos(\omega t - \theta + 120°)$

$P = P_a + P_b + P_c = 3 V_p I_p \cos\theta$. 各项平均功率 P/3

负载 平均功率 $P_p = V_p I_p \cos\theta$.　　视在功率 $S_p = V_p I_p$.

无功功率 $Q_p = V_p I_p \sin\theta$.　　复功率 $\tilde{S}_p = P_p + Q_p j = \tilde{V}_p \tilde{I}_p^*$

又有 $P = \sqrt{3} V_L I_L \cos\theta$.　$(= 3P_p = 3V_p I_p \cos\theta)$

∵ $\begin{cases} \text{Y形} & I_L = I_p,\ V_L = \sqrt{3} V_p \\ \triangle\text{形} & V_L = V_p,\ I_L = \sqrt{3} I_p \end{cases}$

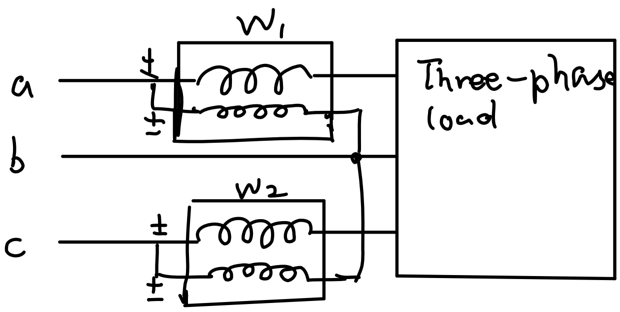
∴ $Q = \sqrt{3} V_L I_L \sin\theta = 3 V_p I_p \sin\theta$

总复功率 $S = 3S_p = 3\tilde{V}_p \tilde{I}_p^* = 3I_p^2 \tilde{Z}_p = \dfrac{3V_p^2}{\tilde{Z}_p^*} = \sqrt{3} V_L I_L \angle\theta$.

The material (transmission line) to deliver the same power and to tolerate the same loss needed is 3/4 times less.

滞后 lagging ⇒ $\sin\theta$ 为正.

$C = \dfrac{|Q_c|}{\omega V_L^2}$



$P_T = P_1 + P_2$

$P_1 = V_L I_L \cos(\theta + 30^\circ)$

$P_2 = V_L I_L \cos(\theta - 30^\circ)$

$P_1 + P_2 = P_T$.　$P_1 - P_2 = V_L I_L \sin\theta = \dfrac{Q_T}{\sqrt{3}}$

∴ $\tan\theta = \dfrac{Q_T}{P_T} = \sqrt{3}\dfrac{P_2 - P_1}{P_2 + P_1}$