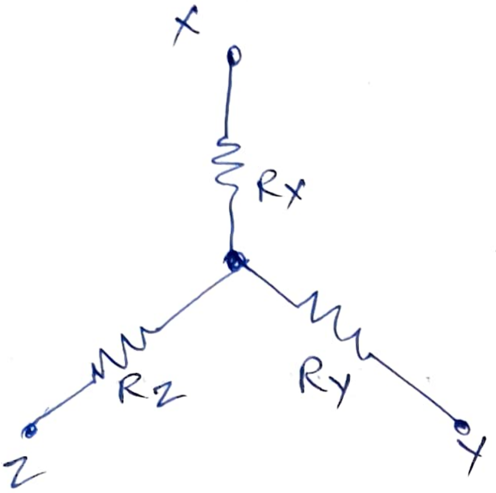
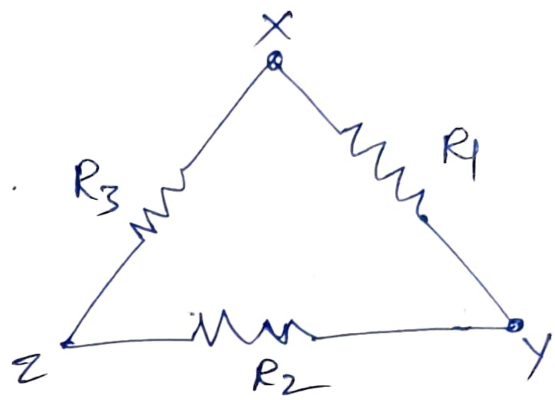
Star - Delta connection:

Star connection



Delta connection



Connection of resistance in star & delta.

* Delta to star

In star connection the resistance between

$XY \Rightarrow R_{X-Y} = R_X + R_Y$ —— (1)

$YZ \Rightarrow R_{Y-Z} = R_Y + R_Z$ —— (2)

$ZY \Rightarrow R_{Z-Y} = R_Z + R_X$ —— (3)

Similarly in Delta connection, the resistance between XY, YZ, ZY

$$R_{X-Y} = R_1 \parallel (R_2 + R_3) = \frac{R_1(R_2+R_3)}{R_1+R_2+R_3} \quad \text{—— (4)}$$

$$R_{y-z} = R_2 \| (R_1 + R_3) = \frac{R_2 \times (R_1 + R_3)}{R_1 + R_2 + R_3} \quad \text{--- (5)}$$

$$R_{z-y} = R_3 \| (R_1 + R_2) = \frac{R_3 \times (R_1 + R_2)}{R_1 + R_2 + R_3} \quad \text{--- (6)}$$

Now equate the resistance in star & delta across appropriate terminals.

$$R_x + R_y = \frac{R_1 (R_2 + R_3)}{R_1 + R_2 + R_3} \quad \text{--- (7)}$$

$$R_y + R_z = \frac{R_2 (R_1 + R_3)}{R_1 + R_2 + R_3} \quad \text{--- (8)}$$

$$R_z + R_x = \frac{R_3 (R_1 + R_2)}{R_1 + R_2 + R_3} \quad \text{--- (9)}$$

Sub eq (7) & (8)

$$R_x + R_y - R_y - R_z = \frac{R_1 R_2 + R_1 R_3}{R_1 + R_2 + R_3} - \left(\frac{R_1 R_2 + R_2 R_3}{R_1 + R_2 + R_3} \right)$$

$$R_x - R_z = \frac{R_1R_2 + R_1R_3 - R_1R_2 - R_2R_3}{R_1 + R_2 + R_3}$$

$$R_x - R_z = \frac{R_1R_3 - R_2R_3}{R_1 + R_2 + R_3} \quad \text{——} \quad (10)$$

Adding equation eq (10) & (9)

$$R_x - R_z + (R_z + R_x) = \frac{R_1R_3 - R_2R_3}{R_1 + R_2 + R_3} + \frac{R_3(R_1 + R_2)}{R_1 + R_2 + R_3}$$

$$2R_x = \frac{R_1R_3 - R_2R_3 + R_1R_3 + R_2R_3}{R_1 + R_2 + R_3}$$

$$2R_x = \frac{2R_1R_3}{R_1 + R_2 + R_3}$$

$$\boxed{\therefore R_x = \frac{R_1R_3}{R_1 + R_2 + R_3}}$$

In a similar way

$$R_y = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_z = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

* star to Delta connection

$$R_x = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$

$$R_y = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_z = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

R_x, R_y, R_z are being the equivalent resistances in star network of the resistances connected in delta network and designated as R_1, R_2 & R_3.

Let us multiple the above two equations ~~and add the~~

$$R_x R_y = \frac{R_1 R_3}{(R_1 + R_2 + R_3)} \times \frac{R_1 R_2}{(R_1 + R_2 + R_3)}$$

$$R_x R_y = \frac{R_1^2 R_2 R_3}{(R_1 + R_2 + R_3)^2} \quad \text{--- (11)}$$

Similarly

$$R_y R_z = \frac{R_2^2 R_1 R_3}{(R_1 + R_2 + R_3)^2} \quad \text{--- (12)}$$

$$R_z R_x = \frac{R_3^2 R_1 R_2}{(R_1 + R_2 + R_3)^2} \quad \text{(13)}$$

adding above three eqn's.

$$R_x R_y + R_y R_z + R_z R_x = \frac{R_1^2 R_2 R_3 + R_1 R_2^2 R_3 + R_1 R_2 R_3^2}{(R_1 + R_2 + R_3)^2}$$

$$= \frac{R_1 R_2 R_3 \cancel{(R_1 + R_2 + R_3)}}{(R_1 + R_2 + R_3)^{\cancel{2}}}$$

$$R_x R_y + R_y R_z + R_z R_x = \frac{R_1 R_2 R_3}{(R_1 + R_2 + R_3)}$$

divide the above eq by R_x

$$\frac{R_x R_y + R_y R_z + R_z R_x}{R_x} = \frac{\cancel{R_1} R_2 \cancel{R_3}}{\cancel{R_1 + R_2 + R_3}} \times \frac{\cancel{R_1 + R_2 + R_3}}{\cancel{R_1 R_3}}$$

$$R_2 = \frac{R_x R_y + R_y R_z + R_z R_x}{R_x}$$

Similarly

$$R_3 = \frac{R_x R_y + R_y R_z + R_z R_x}{R_y}$$

$$R_1 = \frac{R_x R_y + R_y R_z + R_z R_x}{R_z}$$