

4.8 CAPACITANCE OF 3-CORE CABLES

The capacitance of a cable system is much more important than that of overhead line because in cables (i) conductors are nearer to each other and to the earthed sheath (ii) they are separated by a dielectric of permittivity much greater than that of air. Fig.4.8.1 shows a system of capacitances in a 3-core belted cable used for 3-phase system. Since potential difference exists between pairs of conductors and between each conductor and the sheath, electrostatic fields are set up in the cable as shown in Fig.4.8.1 (i). These electrostatic fields give rise to core-core capacitances C_c and conductor- earth capacitances C_e as shown in Fig.4.8.1 (ii). The three C_c are delta connected whereas the three C_e are star connected, the sheath forming the star point.

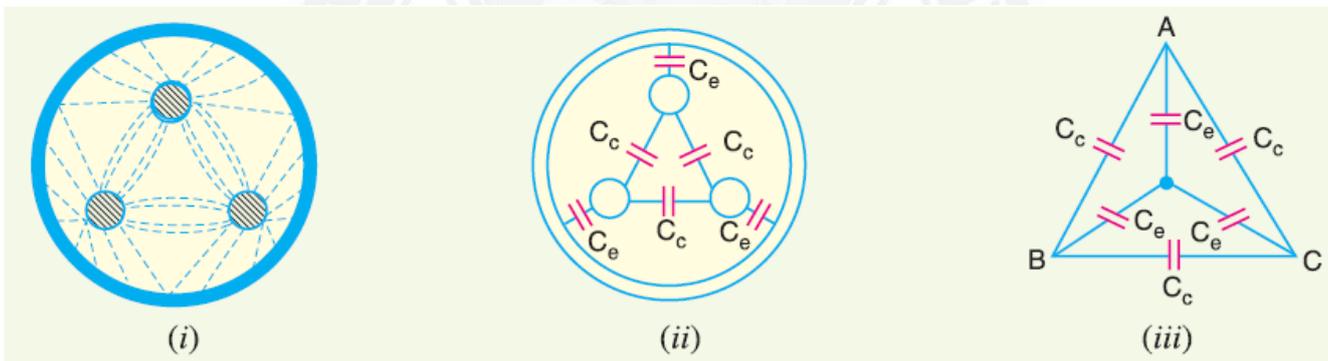


Figure 4.8.1 Capacitance of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

They lay of a belted cable makes it reasonable to assume equality of each C_c and each C_e . The three delta connected capacitances C_c [See Fig. 4.8.2 (i)] can be converted into equivalent star connected capacitances as shown in Fig. 4.8.2 (ii). It can be easily *shown that equivalent star capacitance C_{eq} is equal to three times the deltacapacitance C_c i.e. $C_{eq} = 3C_c$.

The system of capacitances shown in Fig. 4.8.1 (iii) reduces to the equivalent circuit shown in Fig.4.8.3 (i). Therefore, the whole cable is equivalent to three star-connected capacitors each of capacitance,

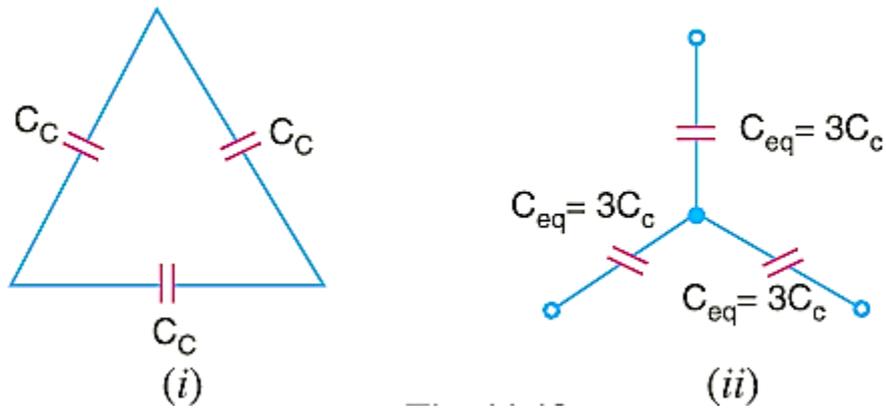


Figure 4.8.2 Delta Connected Capacitor of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

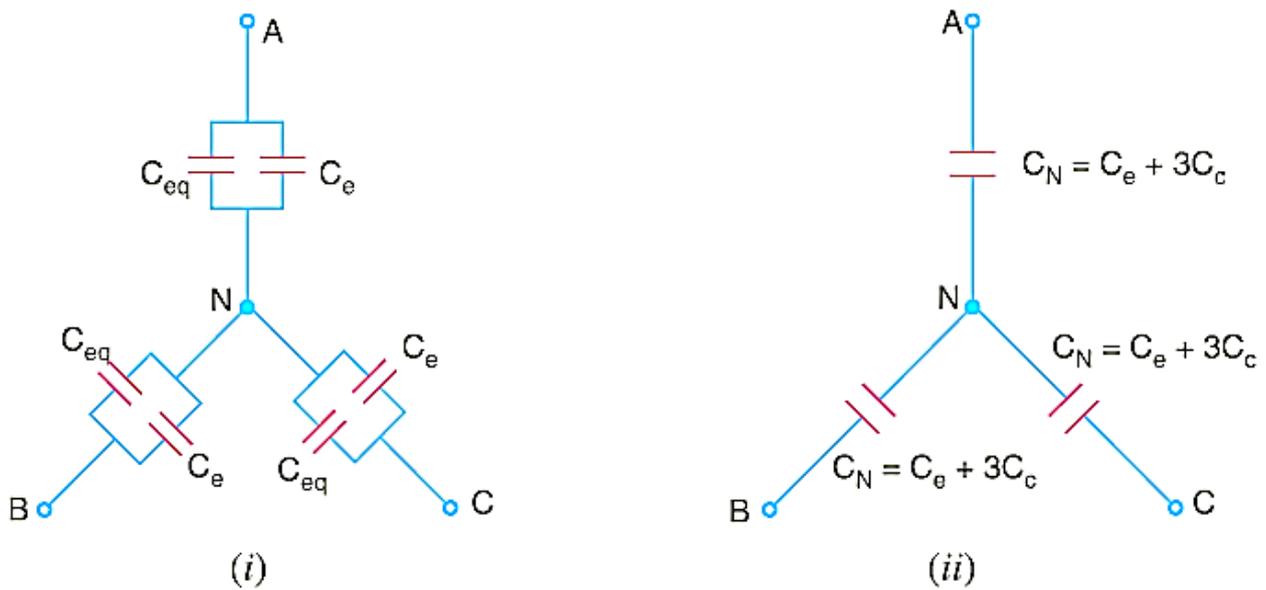


Figure 4.8.2 Star Connected Capacitor of 3-Core Cables

[Source: "Principles of Power System" by V.K.Mehta Page: 288]

$$C_N = C_e + C_{eq}$$

$$= C_e + 3C_c$$

If V_{ph} is the phase voltage, then charging current I_C is given by ;

$$I_C = \frac{V_{ph}}{\text{Capacitive reactance per phase}}$$

$$= 2 \pi f V_{ph} C_N$$

$$= 2 \pi f V_{ph} (C_e + 3C_c)$$