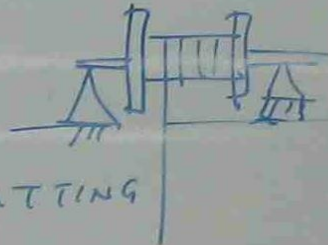


STRESS IN UNDER GROUND CABLE

Q ~~###~~

How will you reduce the stress on electrical cable?

(1) STAND PROPERLY



(2) CAREFUL IN BENDING, CUTTING
AND REMOVING THE INSULATION

(3) PROPER PROCEDURE IN CONNECTION

(4) TAKE ACCOUNT ON TEMPERATURE

(5) TAKE ACCOUNT ON INSTALLATION CONDITION

(6) SET APPROPRIATE TENSION

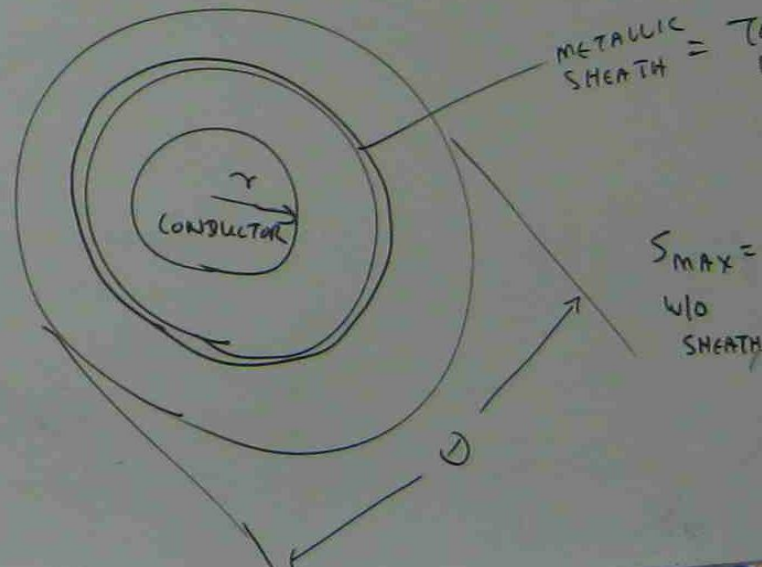
(7) SELECT APPROPRIATE MATERIAL TO ENCLOSE CABLE

CAUSE OF STRESS IN UNDERGROUND CABLE

HIGH VOLTAGE

UG CABLE

DIELECTRIC SUFFERS THE ELECTRICAL STRESS CAUSED BY HIGH VOLTAGE



$$S_{\text{MAX WITHOUT METALLIC SHEATH IN UG CABLE}} = \frac{E}{\frac{1}{2} d \ln \frac{D}{d}}$$

$$E = \text{PEAK TO PEAK VOLTAGE/ph} \\ \approx \sqrt{2} \times \frac{\text{SUPPLY VOLTAGE (LINE)}}{\sqrt{3}}$$

$$d = \text{CONDUCTOR DIAMETER} = 2r \\ D = \text{OVER ALL DIAMETER OF CABLE}$$

BY INSERTING THE METALLIC SHEATH,
THE STRESS IS REDUCED.

$$S_{\text{MAX WITH METALLIC SHEATH}} = \frac{S_{\text{MAX WITHOUT SHEATH}}}{(1 + \alpha + \alpha^2)^{1/3}}$$

$$\alpha^3 = \frac{D}{d} \rightarrow \alpha = \sqrt[3]{\frac{D}{d}}$$

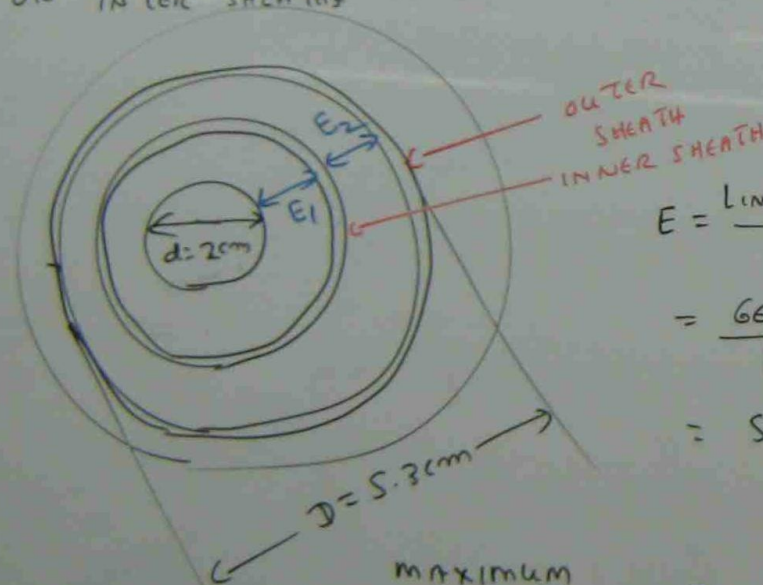




ph

A SINGLE CORE 66 KV CABLE HAS A CONDUCTOR DIAMETER OF 2cm AND A SHEATH OF INSIDE DIAMETER 5.3cm.

FIND THE MAXIMUM STRESS. IF TWO INTER SHEATHS ARE USED, FIND THE BEST POSITION, THE MAXIMUM STRESS AND THE VOLTAGE ON INTER SHEATHS



$$E = \frac{\text{LINE VOLTAGE} \times \sqrt{3}}{\sqrt{3}}$$

$$= \frac{66 \text{ kV} \times 1.4142}{1.7321}$$

$$= 53.8 \text{ kV}$$

maximum
STRESS
WITHOUT SHEATH

$$S_{\text{max}} = \frac{E}{\frac{1}{2} d \ln \frac{D}{d}}$$

$$= \frac{53.8}{\frac{1}{2} \times 2 \text{ cm} \ln \frac{5.3}{2}}$$

$$E_2 = \frac{E}{1 + \frac{1}{\alpha} + \frac{1}{\alpha^2}}$$

$$E_1 = E_2 \times \left(1 + \frac{1}{\alpha} \right)$$

$$E_2 = \frac{53.8 \text{ kV}}{1 + \frac{1}{1.384} + \frac{1}{(1.384)^2}}$$

$$= 23.9 \text{ kV}$$

$$E_1 = E_2 \left(1 + \frac{1}{\alpha} \right)$$

$$= 23.9 \left(1 + \frac{1}{1.384} \right)$$

$$= 41.1 \text{ kV}$$

$$= \frac{53.8}{\ln 2.65} = \frac{53.8}{0.974} = 55.2 \text{ kV/cm}$$

By inserting the inner sheath, the stress can be reduced

$$\alpha = \sqrt[3]{\frac{D}{d}} = \sqrt[3]{\frac{5.3}{2}} = \sqrt[3]{2.65} = 1.384$$

$$\begin{aligned} \text{Maximum stress with sheath} &= \frac{S_{\text{max without sheath}}}{\frac{1}{3}(1 + \alpha + \alpha^2)} \\ &= \frac{55.2}{\frac{1}{3}(1 + 1.384 + 1.384^2)} \\ &= 38.7 \text{ kV/cm} \end{aligned}$$

$$E_2 = \frac{E}{1 + \frac{1}{\alpha} + \frac{1}{\alpha^2}}$$

$$E_1 = E_2 \times \left(1 + \frac{1}{\alpha}\right)$$

$$E_2 = \frac{53.8 \text{ kV}}{1 + \frac{1}{1.384} + \frac{1}{(1.384)^2}}$$

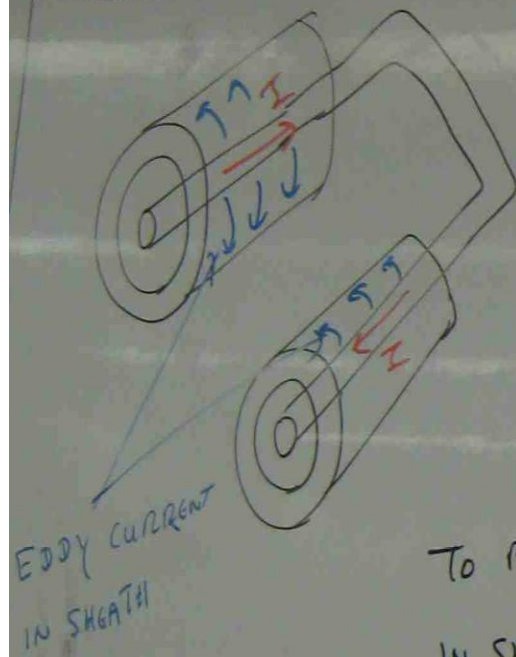
$$= 23.9 \text{ kV}$$

$$E_1 = E_2 \left(1 + \frac{1}{\alpha}\right)$$

$$= 23.9 \left(1 + \frac{1}{1.384}\right)$$

$$= 41.1 \text{ kV}$$

SHEATH CURRENT



SHEATH CURRENTS MAY BE DIVIDED INTO TWO KINDS NAMELY

(a) THE CURRENTS WHOSE OUTWARD AND RETURN PATH LIE ENTIRELY IN THE SHEATH OF ONE CABLE - SHEATH EDDIES

(b) CURRENTS WHOSE OUTWARD AND RETURN PATHS ARE FORMED BY THE SHEATH OF SEPARATE CABLE - SHEATH CIRCUIT EDDIES

TO REMOVE THE HEAT PRODUCED BY CIRCULATING CURRENTS FLOWING IN SHEATH, APPROPRIATE COOLING METHOD SUCH AS OIL COOLING, GAS COOLING NEED TO BE APPLIED.

