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17 EEB 409

GI-2134

GROUP-07

Air clearance Calculations

Air clearance are required to provide adequate clearance of a conductor from the ground & other conductors under all loading conditions so as to ensure realibility of the system & safe operation

Shielding angle → is defined as the angle between the vertical line passing through the ground wire & the line passing through the outermost power conductor.

a = Minimum air clearance b/n phase conductor & tower structure

$2a$ = Length of cross arms

b = width of upper portion of tower

c = Distance of phase conductor from centre of the tower.

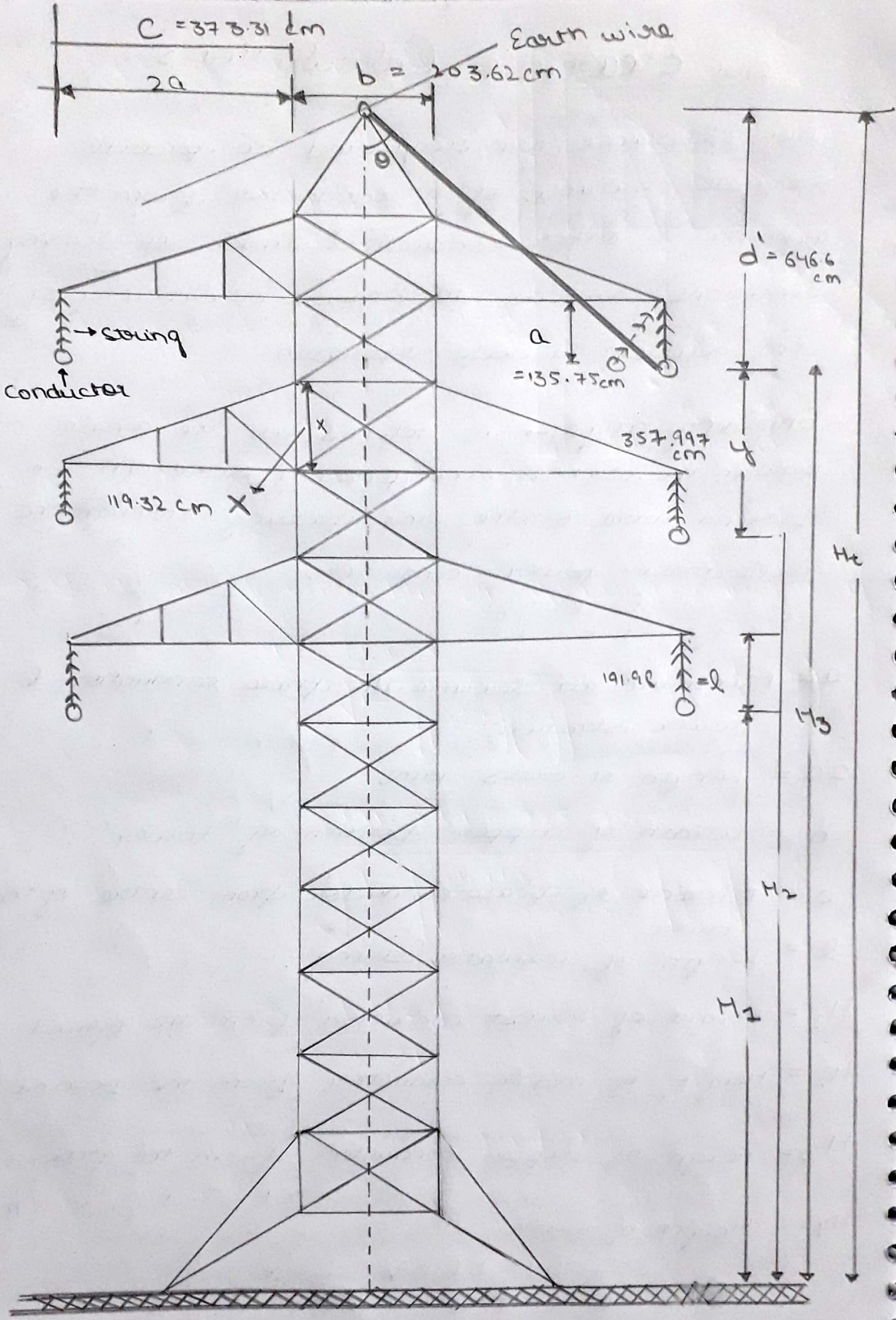
l = Length of insulator string

H_1 = Height of lowest conductor from the ground.

H_2 = Height of middle conductor from the ground.

H_3 = Heigh of upper conductor from the ground

H_4 = Height of tower



C = 378.31 cm
Earth wire
2a
b = 203.62 cm
θ
d' = 646.6 cm
string
conductor
a
= 135.75 cm
x
357.997 cm
y
119.32 cm X
191.98
= l
H_t
H_3
H_2
H_1

θ = shielding angle

X = vertical height of the cross arm

y = vertical distance b/n the conductors

d' = height of the ground wire from the top most conductor.

Calculations

→ Minimum clearance b/n phase conductor & tower structure, a

$$a = (\text{phase voltage} \times 1.65 + 10)\ cm$$

$$a = \frac{V_L(kV)}{\sqrt{3}} \times 1.65 + 10 \quad cm$$

$$= 135.746\,cm$$

$$\boxed{a = 135.75\,cm}$$

→ Width of upper portion of tower, b

$$b = 1.5 \times a\ cm$$

$$= 1.5 \times 135.75\ cm$$

$$\boxed{b = 203.625\,cm}$$

→ Distance of phase conductor from the centre of tower, c

$$c = 2a + \frac{b}{2}\ cm$$

$$c = 2 \times 135.75 + \frac{203.62}{2} \quad cm$$

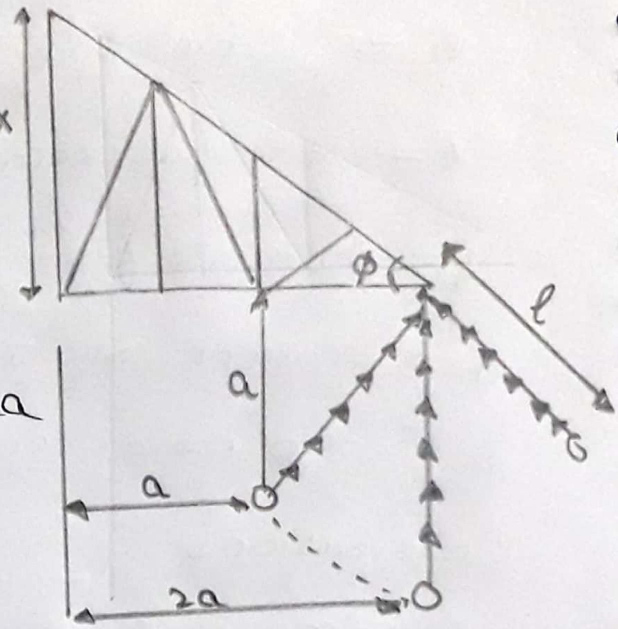
$$c = 271.50 + 101.8125\ cm$$

$$\boxed{c = 373.312\,cm}$$

→ Length of string, l

$$l = \sqrt{2} \times a \text{ cm}$$

$$\boxed{l = 191.98 \text{ cm}}$$



→ Length of cross arm, $2a$

$$m = 2 \times a \text{ cm}$$

$$\boxed{m = 271.50 \text{ cm}}$$

where, m: length of cross arm

→ Vertical distance b/n the phase conductors, y

$$y = \frac{(l+a)}{\sqrt{1 - \left[\left(\frac{l+a}{2 \times a}\right)\left(\frac{x}{y}\right)\right]^2}} \qquad \left(\because \frac{x}{y} = 3\right)$$

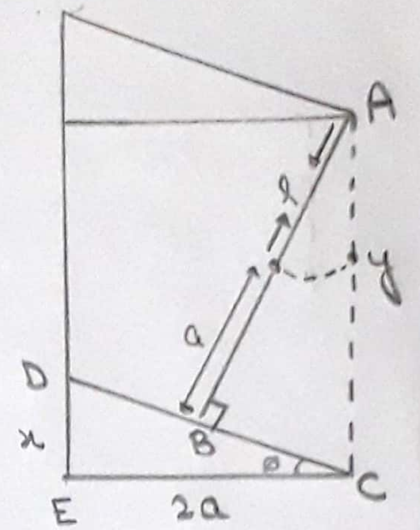
$$= \frac{191.979 + 135.75}{\sqrt{1 - \left[\left(\frac{191.979 + 135.75}{2 \times 135.75}\right)\left(\frac{1}{3}\right)\right]^2}}$$

$$= \frac{327.729}{0.9154}$$

$$\boxed{y = 357.997 \text{ cm}}$$

In triangle ABC,

$$\cos\phi = \frac{a+l}{y} \quad \text{—(1)}$$



In triangle CDE,

$$\tan\phi = \frac{x}{2a} \quad \text{—(2)}$$

from eqn (1)

$$y = \frac{a+l}{\cos\phi} = \frac{a+l}{\sqrt{1-\sin^2\phi}}$$

$$= \frac{a+l}{\sqrt{1-(\cos\phi\tan\phi)^2}} \Rightarrow \frac{a+l}{\sqrt{1-\left(\frac{x}{y}\cdot\frac{a+l}{2a}\right)^2}}$$

→ vertical height of the cross arm, X

$$X = \frac{y}{3} = \frac{357.997}{3}$$

$$\boxed{X = 119.329\text{ cm}}$$

→ Height of the ground wire from the uppermost conductor, d'

$$d' = \frac{c}{\tan\theta^\circ}\text{ cm}$$

$$d' = \frac{373.3125}{\tan 30^\circ}\text{ cm}$$

$$\boxed{d' = 646.6\text{cm}}$$

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