Anicho-Okon Chiemela
15/ENG04/007

EEE 552 Assignment

1) $D = 1500m$, Schedule speed $= 36km/hr = 10m/s$

Braking retardation $\beta = 3 \times 5/18 = 5/6\ m/s^2$

$V = d/t \quad \therefore t = d/v = 1500/10 = 150s$

Actual time of run $= 150 - 25 = 125s$

$$V_a = \frac{1500}{125} = 12m/s$$

$V_{max} = 1.25 \times 12 = 15m/s$

$$K = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}(1.25 - 1)$$

$$= 5/3$$

Recall $K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

$$\frac{5}{3} = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{6}{5}\right)$$

$\alpha = 0.4m/s^2 = 0.47 \times 18/5$

$= 1.7km/h/s$

$\therefore$ acceleration $\alpha = 1.7km/h/s$

2) $V_a = 36km/h = 36 \times 5/18 = 10m/s$

$\alpha = 1.8km/h/s = 1.8 \times 5/18 = 0.5m/s^2$

$\beta = 3.6km/h/s = 3.6 \times 5/18 = 1.0m/s^2$

$t = 2000/10 = 200s$

$$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{(0.5 + 1.0)}{2(0.5 \times 1} = 1.5$$

$$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K} = \frac{200 - \sqrt{200^2 - 4 \times 1.5 \times 2000}}{2 \times 1.5}$$

$= 11m/s = 39km/h$

3) T.S.A of the tank $= 6l^2$

$\therefore 6l^2 = 6, \ l = 6/6 = 1m^2$

Vol. of tank $= l^3 = 1m^3$

Vol. of water to be heated daily $= 6 \times (1 \times 0.9) = 5.4m^3$

Since $1m^3$ of water weighs 1000kg

Mass of water $= 5.4 \times 1000 = 5400kg$

Heat to raise temp of water $= 5400 \times 4200 \times (65 - 20) = 1020MJ$

If 1 kwh = 3.6 MJ

then 1020 MJ = 1020/3.6

= 283.3 kwh

Daily loss from the tank = 6.3 × 6 × (65 − 20) × 24/1000 = 40.8 kwh

Energy Supplied Per day = 283.3 + 40.8 = 324.1 kwh

Loading in kwh = 324.1/24 = 3.5 kw

Efficiency of the tank = $\frac{283.3}{324.1} \times 100$

= 87.4%

4) Secondary Current = $\frac{600 \times 10^3}{20 \times 0.6}$ = 5×10^4 A

If this current is taken as the reference quantity, then the secondary voltage is

$V_2 = 20(0.6 + j0.8) = (12 + j16)$ V

Secondary Impedance Z_2 = $\frac{(12+j16)}{(5 \times 10^4)}$

= $(2.4 + j3.2) \times 10^{-4}$ ohm

Now if the secondary resistance is doubled while reactance remains constant, the impedance when tank is half-full becomes

$Z_2 = (4.8 + j3.2) \times 10^{-4}$ ohm

Now Sec current $I_2 = \frac{20}{(4.8 \times j3.2) \times 10^{-4}}$

$= 3.4666 \angle -33.7^\circ \times 10^4$ A

Now, P_f = Cos 33.7 = 0.832

Hence, Power absorbed = $20 \times 3.4466 \times 10^4 \times 0.832 \times 10^4$

= 5801 kw

5) Without Reflector

a) $E = \frac{300}{20^2}$

= 0.75 lm/m^2

b) $\theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5) = 26.6^\circ$

$\cos\theta = 0.89$, $x^2 = 10^2 + 20^2 = 500$

$\therefore E = \frac{300}{0.89 \times 500}$

$= 0.534$ lm/m²

With reflector

Luminous output of the lamp = $300 \times 4\pi$ lumen

Flux directed by the reflector = $0.5 \times 1200\pi$ = 600π lm

Illumination produced on the disc = $\frac{600\pi}{100\pi}$

= 6 lm/m²

It is the same at every point on the disc