OBILOM CHIDERA
16/ENG04/068
EEE 552 Assignment.

1). $D = 1.5\,km = 1500m$

schedule speed $= 36\,km/h$

$= \frac{36 \times 1000}{3600} = 10\,m/s$

$\beta = 3\,km/h/s = \frac{3 \times 1000}{3600} = 5/6\,m/s^2$

schedule time of run $= \frac{1500m}{10m/s} = 150s$

$T_s = T_{run} + T_{stop}$

$150 = T_{run} - 25$

$T_{run} = 150 - 25 = 125s$

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

$\frac{V_m}{V_a} = 1.25$, $V_m = 1.25 \times 12 = 15\,m/s$

$k = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}\left(\frac{15}{12} - 1\right) = \frac{5}{3}$

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

$\frac{5}{3} / \frac{1}{2} = 1/\alpha + \frac{6}{5}$

$10/3 = 1/\alpha + 6/5$

$\alpha = \frac{15}{32} = 0.469\,m/s^2 = 1.688\,km/h/s$

2) $V_a = 36\,km/h = 36 \times \frac{1000}{3600} = 10\,m/s$

$\alpha = 1.8\,km/h/s = 1.8 \times \frac{1000}{3600} = 0.5\,m/s^2$

$\beta = 3.6\,km/h/s = \frac{3.6 \times 1000}{3600} = 1\,m/s^2$

$D = 2\,km = 2000m$

$V_a = D/t$ ; $t = D/V_a = \frac{2000m}{10m/s} = 200s$

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

$$V_m = \frac{t - \sqrt{t^2 - 4kD}}{2k}$$

$$= \frac{200 - \sqrt{200^2 - 4(1.5 \times 2000)}}{2 \times 1.5}$$

$= 10.889 m/s = 39.2 Km/h$

3) Total surface area $= 6m^2$

$L = \frac{6}{6} = 1m^2$

$L^3 = 1m^3 = 1000 kg$

Volume to be heated 6 times daily $= 6 \times 1 \times 90/100 = 5.4m^3$

mass to be heated daily $= 5.4 \times 1000 = 54\,000 kg$.

Heat required to raise temp of water

$MC\Delta\theta = 5400 \times 4200 \times (65-20)$

$= 1020 \times 10^6 J = 1020 MJ$

Since $1 kwh = 3.6 MJ$, $x = 1020 MJ$ } $x = \frac{(1020)(1)}{3.6} = 283.3 kwh.$

Daily loss per square meter per 1°c temp diff is:

$6.3 \times 6 \times (65-20) \times \frac{24}{1000} = 40.8 kWh.$

Energy supplied per day $= 283.3 kWh + 40.8 kWh = 324.1 kWh$

Loading in kw $= \frac{324.1 kwh}{24h} = 13.5 kw$

Efficiency $= \frac{283.3}{324.1} \times 100 = 87.41\%$

4) $P = IV\cos\theta$

Secondary Current $I_2 = \frac{P}{V\cos\theta} = \frac{600\times10^3}{20\times0.6} = 50\times10^3 A$

Secondary Voltage $V_2 = V(\cos\theta + j\sin\theta)$

$= 20(0.6 + j0.8)$

$= (12 + j16)V$

$\therefore Z_2 = \frac{V_2}{I_2} = \frac{12+j16}{50\times10^3} = (2.4\times10^{-4} + j3.2\times10^{-4})\Omega$

When hearth is half full, resistance is double & reactance the same.

$\therefore Z_2 = 2\times(2.4\times10^{-4} + j3.2\times10^{-4}) = (4.8\times10^{-4} + j3.2\times10^{-4})\Omega$

$I_2 = \frac{V_2}{Z_2} = \frac{20}{4.8\times10^{-4} + j3.2\times10^{-4}} = 28846.15 - j19230.8$

$= \sqrt{28846.15^2 + (-19230.8)^2} \angle \tan^{-1}\frac{-19230.8}{28846.15}$

$I_2 = 34668.78 \angle -33.69° \simeq (3.467\times10^4 \angle -33.7°) A$

P.F $= \cos -33.7 = 0.832$

Power absorbed $= I_2 V_2 \cos\theta$

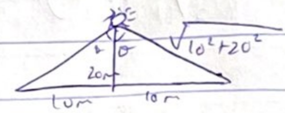
$= 34668.78 \times 20 \times 0.832 = 576888.4992 W$

$\simeq 576.888\times10^3 W$

$\simeq$ 580KW.

5. $E = \frac{I}{h^2} \cos\theta$

(a) $E = \frac{300}{20^2} \cos 0 = 0.75 \, lm/m^2$.




(b) $\theta = \sin^{-1}\left(\frac{10}{\sqrt{10^2+20^2}}\right) = 26.56°$

at the edge, $E = \frac{300}{10^2+20^2} \times \cos 26.56°$

$= 0.537 \, lm/m^2$

with reflector

$I = \Phi/\omega$

$\Phi = I \times \omega = 300 \times 4\pi$ lumen.

Total flux $\Phi = 1200\pi$

flux directed by reflector $= \frac{50}{100} \times 1200\pi = 600\pi$ lumen.

$E = \Phi/A = \frac{600\pi}{\pi \times 10^2} = 6 \, lm/m^2$

The illumination is the same at every point on the disc with the reflector.