UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING.

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COMP#: 15069126

COURSE CODE: MEC 3352 (STRENGTH OF MATERIALS)

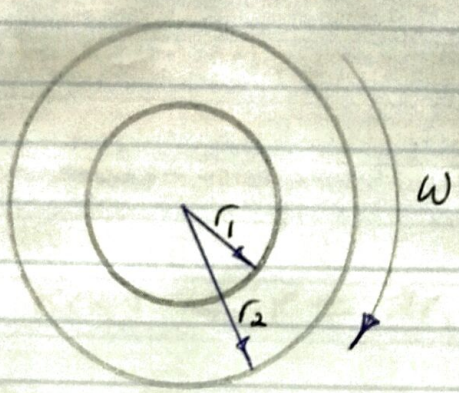
ASSING #: 3 & 4 (ROTATING DISCS)

ATTENTION: MR. C.S. KALUPA

DUE DATE: 24TH SEPTEMBER 2018.

ASSIGNMENT 3

Hollow Rotating Disc



Given that $A = \frac{-(3+\nu)\rho\omega^2}{8(r_2^2+r_1^2)}$ & $B = \frac{(3+\nu)\rho\omega^2}{8(r_2^2 r_1^2)}$

1. Radial stress

$$\sigma_r = \frac{-(3+\nu)\rho\omega^2}{8(r_2^2+r_1^2)} - \frac{(3+\nu)\rho\omega^2}{8(r_2^2 r_1^2)r^2} - \frac{(3+\nu)\rho\omega^2 r^2}{8}$$

$$\sigma_r = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) + \frac{r_1^2 r_2^2}{r^2} - r^2\right]$$

radial stress expression for hollow disc

2. Hoop stress

$$\sigma_\theta = \frac{-(3+\nu)\rho\omega^2}{8(r_2^2+r_1^2)} + \frac{(3+\nu)\rho\omega^2}{8(r_2^2 r_1^2)r^2} - \frac{(1+3\nu)\rho\omega^2 r^2}{8}$$

$$\sigma_\theta = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) + \frac{r_1^2 r_2^2}{r^2} - \frac{(1+3\nu)r^2}{(3+\nu)}\right]$$

3. Maximum σ_θ occurs if $r = r_1$

$$\therefore \sigma_{\theta_{max}} = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) + r_2^2 - \frac{(1+3\nu)r_2^2}{(3+\nu)}\right]$$

$$\sigma_{\theta_{max}} = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) + r_2^2 - \frac{(1+3\nu)r_2^2}{(3+\nu)}\right]$$

4. Maximum σ_θ occurs at $r = r_2$.

$$\sigma_{\theta_{min}} = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) + r_1^2 - \frac{(1+3\nu)}{(3+\nu)}r_2^2\right]$$

5. Maximum σ_r occurs at $r = 2r_1$

$$\sigma_{r_{max}} = \frac{(3+\nu)\rho\omega^2}{8}\left[(r_2^2+r_1^2) - \frac{r_2^2}{4} - 4r_1^2\right]$$

ASSIGNMENT 4

Data.

$r_1 = 0.1$

$r_2 = 0.4$

$\rho = 7800 kg/m^3$

$\nu = 0.3$

$N = 2400 rpm.$

$\omega = \frac{2\pi N}{60}$

$= \frac{2\pi \times 2400}{60}$

$= 251.33.$

* At $r = 0.1m$ $\sigma_r = 0$

$$\sigma_\theta = \frac{(7800)(251.33^2)}{8}(3+0.3)\left[(0.4^2+0.1^2)+\left(\frac{0.1^2 0.4^2}{0.1^2}\right)-\frac{0.1^2(1+3(0.3))}{(3+0.3)}\right]$$

$= 203,259,078.9\ (0.17 + 0.16 - 0.5757)$

$\sigma_{\theta_{max}} = 65.9\ MPa.$

* At $r = 0.2\ m$

$\sigma_r = 203,259,078.9(0.17 - 0.04 - 0.04)$

$= 18.29\ MPa$

$\sigma_\theta = 203,259,078.9(0.17 + 0.04 - 0.023)$

$= 37.99\ MPa.$

* At $r = 0.3\ m$

$\sigma_r = 203,259,078.9(0.17 - 0.0178 - 0.09)$

$= 12.64\ MPa.$

$\sigma_\theta = 203,259,078.9(0.17 + 0.0178 - 0.0518)$

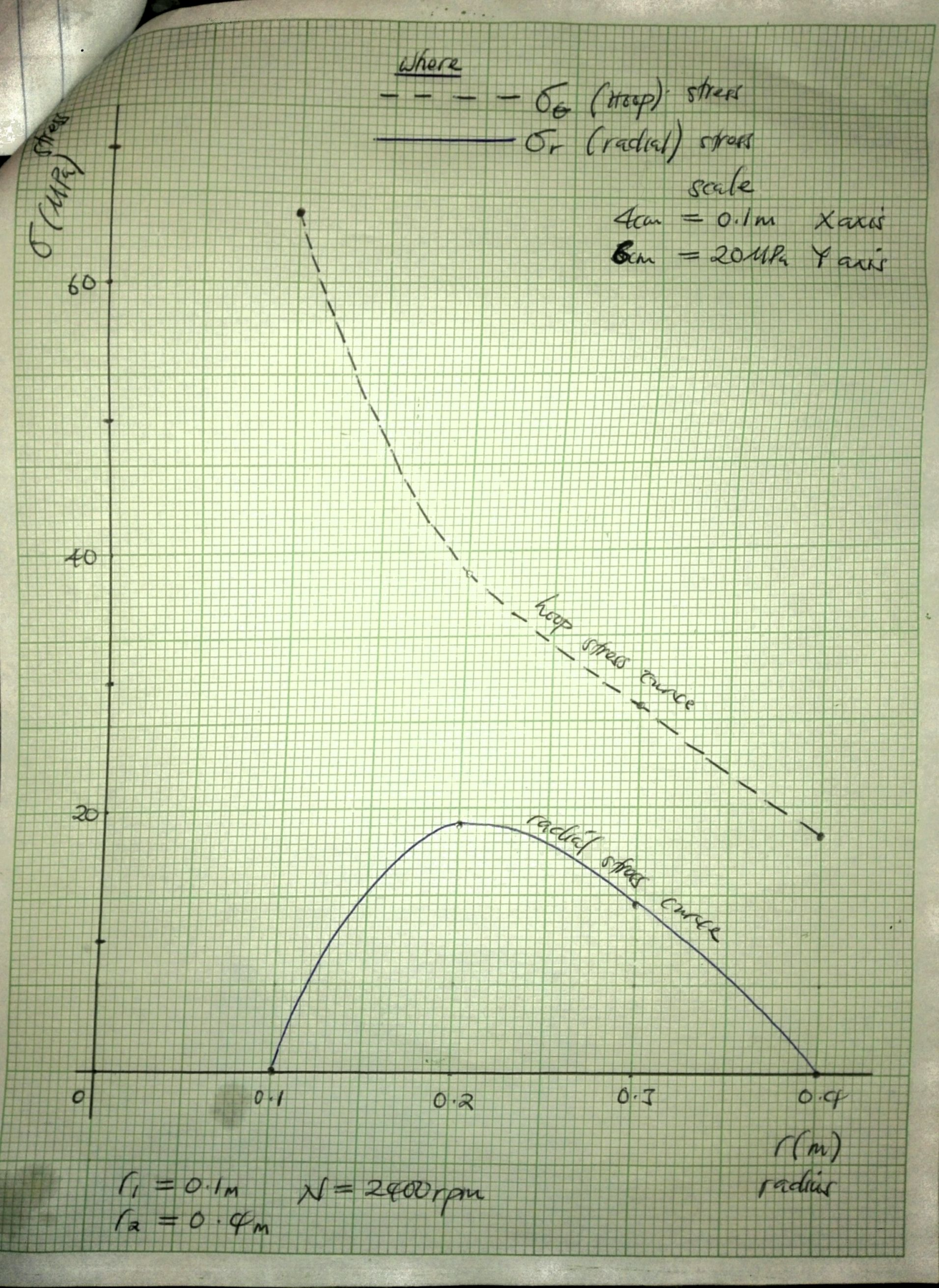
$= 27.64\ MPa.$

* At $r = 0.4\ m$

$\sigma_r = 0$

$\sigma_\theta = 203,259,078.9(0.17 + 0.01 - 0.0921)$

$= 17.86\ MPa$


Where
– – – – σ_θ (Hoop) stress
——— σ_r (radial) stress
scale
4cm = 0.1m X axis
6cm = 20MPa Y axis
σ (MPa) stress
60
40
20
0
0.1
0.2
0.3
0.4
hoop stress curve
radial stress curve
r(m)
radius
$r_1 = 0.1m$
$r_2 = 0.4m$
N = 2400rpm