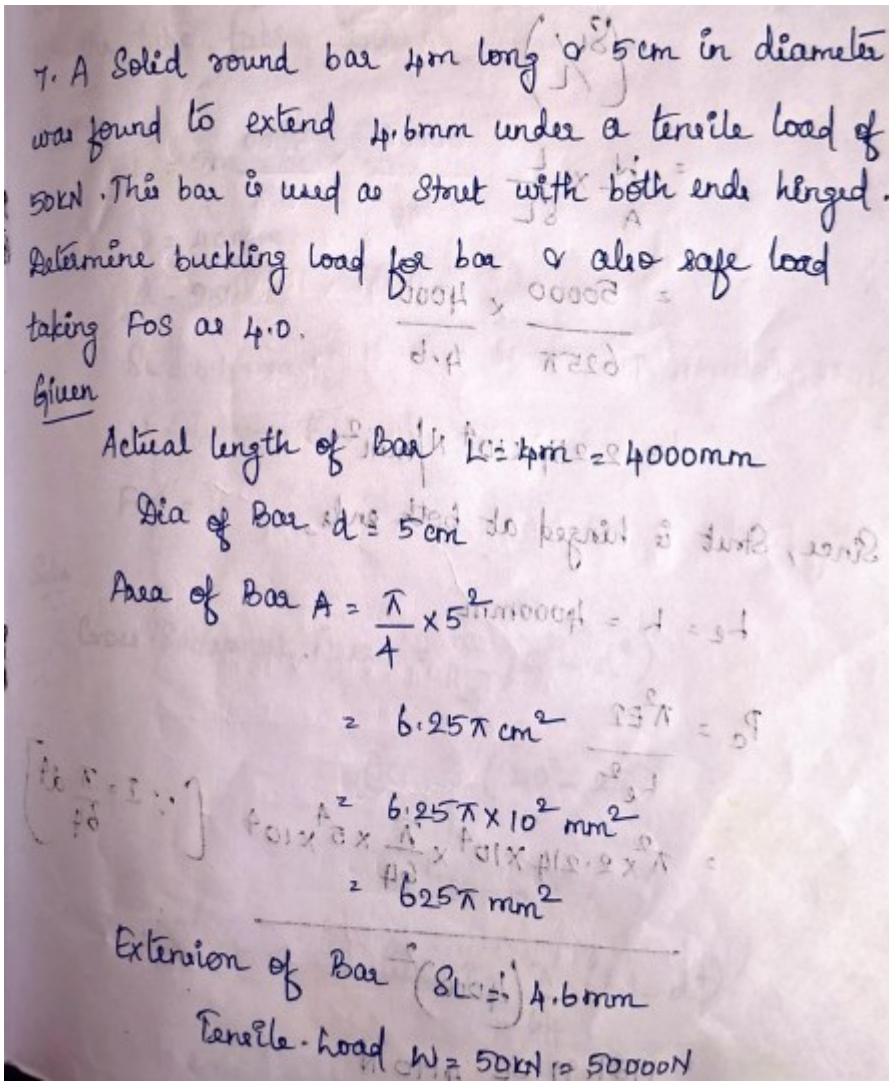
SNS COLLEGE OF TECHNOLOGY

DEPARTMENT OF AGRICULTURAL ENGINEERING

23AGT205-STRENGTH OF MATERIALS FOR AGRICULTURAL ENGINEERING

NOTES UNIT IV



7. A Solid round bar 4m long & 5cm in diameter was found to extend 4.6mm under a tensile load of 50KN. This bar is used as Strut with both ends hinged. Determine buckling load for bar & also safe load taking FOS as 4.0.

Given

Actual length of Bar $L = 4m = 4000mm$

Dia of Bar $d = 5cm$

Area of Bar $A = \frac{\pi}{4} \times 5^2$

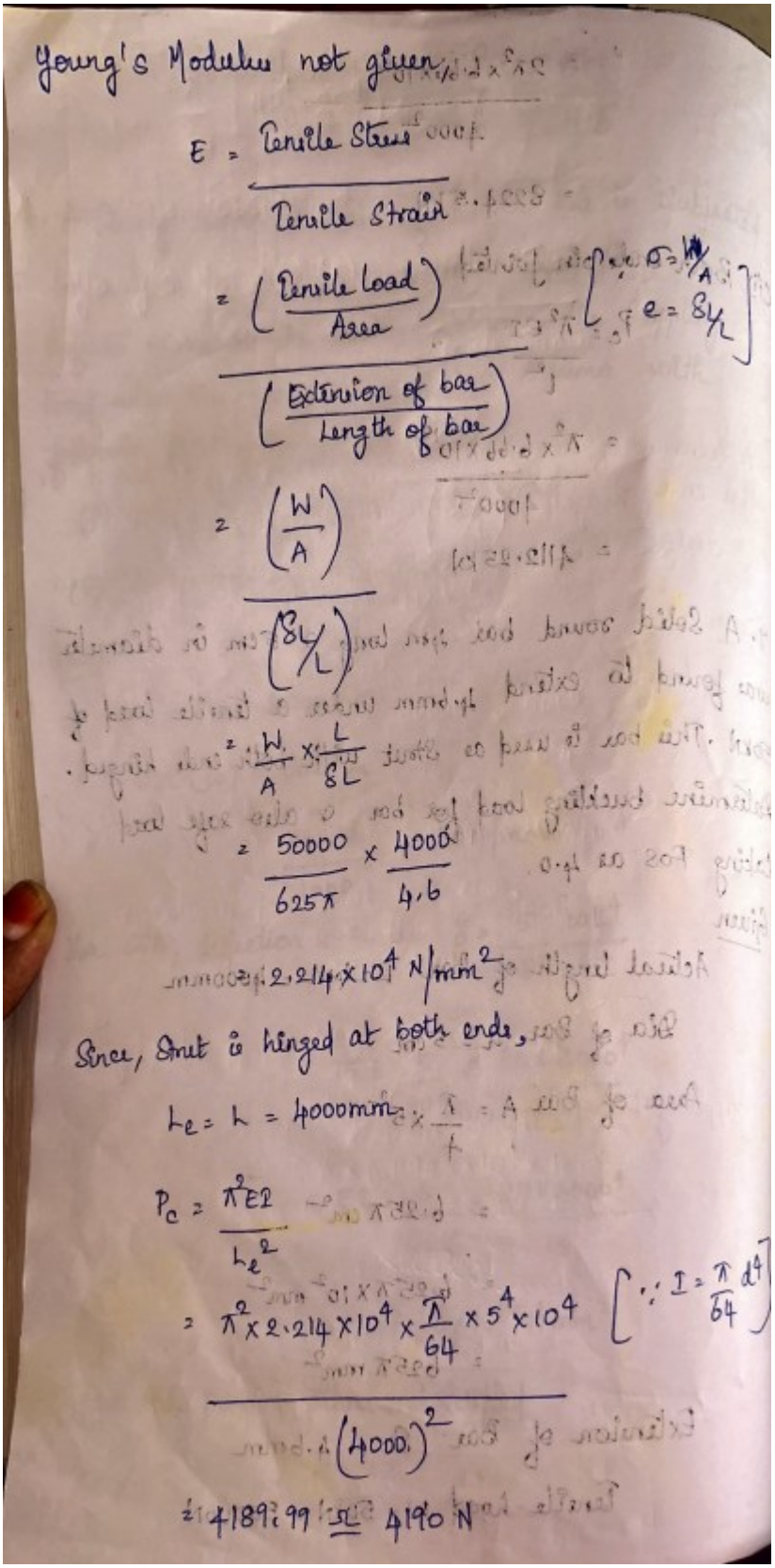
$= 6.25\pi\ cm^2$

$= 6.25\pi \times 10^2\ mm^2$

$= 625\pi\ mm^2$

Extension of Bar $(\delta L) = 4.6mm$

Tensile Load $W = 50KN = 50000N$



Young's Modulus not given

$$E = \frac{\text{Tensile Stress}}{\text{Tensile Strain}}$$

$$= \frac{\left(\frac{\text{Tensile load}}{\text{Area}}\right)}{\left(\frac{\text{Extension of bar}}{\text{Length of bar}}\right)} \quad \left[\because \sigma = \frac{W}{A},\ e = \frac{\delta L}{L}\right]$$

$$= \frac{\left(\frac{W}{A}\right)}{\left(\frac{\delta L}{L}\right)}$$

$$= \frac{W}{A} \times \frac{L}{\delta L}$$

$$= \frac{50000}{625\pi} \times \frac{4000}{4.6}$$

$$= 2.214 \times 10^4 \text{ N/mm}^2$$

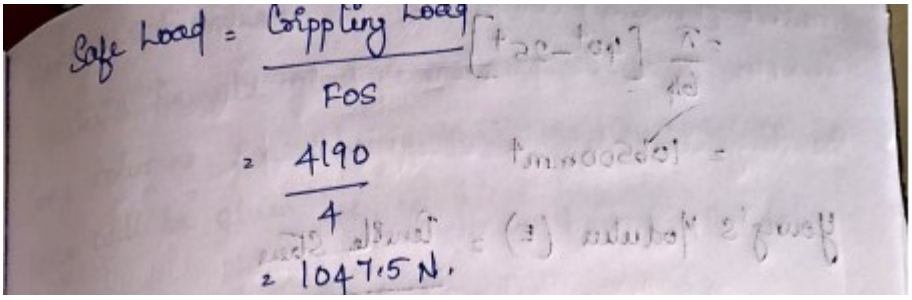
Since, Strut is hinged at both ends,

$$L_e = L = 4000\text{mm}$$

$$P_c = \frac{\pi^2 EI}{L_e^2}$$

$$= \frac{\pi^2 \times 2.214 \times 10^4 \times \frac{\pi}{64} \times 5^4 \times 10^4}{(4000)^2} \quad \left[\because I = \frac{\pi}{64} d^4\right]$$

$$= 4189.99 \simeq 4190 \text{ N}$$


Safe Load = Crippling Load / FOS
= 4190 / 4
= 1047.5 N.