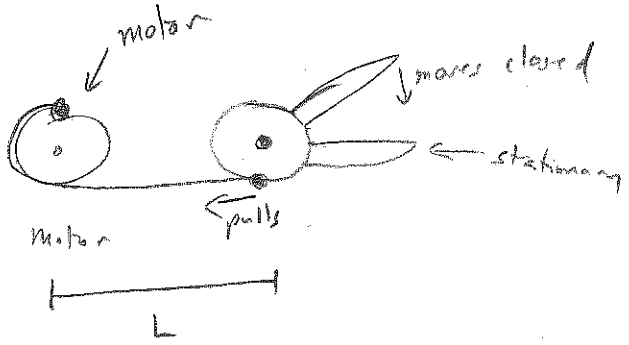
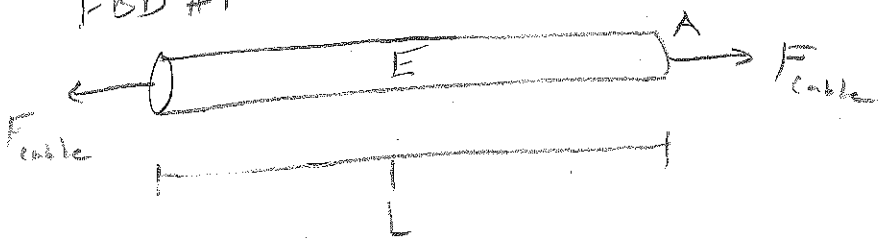
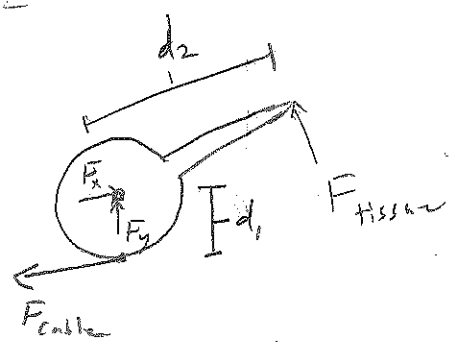
Jan 16, 2014
BMED 3400
Lecture #4



FBD #1



FBD #2



$\Sigma M = 0$

$F_{tissue}\, d_2 = F_{cable}\, d_1$

$F_{cable} = \frac{d_2}{d_1} F_{tissue}$

$F_{tissue} = 10N$ ← from paper

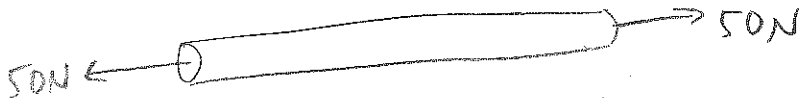
$d_1 = \frac{1}{2}$ cm

$d_2 = 2$ cm

$\Rightarrow \quad F_{cable} = \frac{2}{\frac{1}{2}} 10 = 40N$

$F_{cable} \approx 40N$

25% safety margin $\Rightarrow$ 50N



$P = 50N$

$A = \pi r^2 \approx 3\,(1mm)^2$

$= 3(10^{-3})^2\ m^2$

$= 3 \times 10^{-6} m^2$

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

$\sigma = \frac{P}{A} = \frac{50}{3\times10^{-6}}$

$\boxed{\sigma \approx 17 \times 10^6 = 17 MPa}$

$\delta = \frac{PL}{AE} = \frac{50 \cdot \frac{1}{2}}{3\times10^{-6}} \cdot \frac{1}{E}$

$\boxed{\delta \approx 8 \times 10^6 \cdot \frac{1}{E}}$

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$P = 50N$

$A = 3 \times 10^{-6} m^2$ $\quad \pi r^2 \simeq 3(1mm)^2 = 3(10^{-3})^2 m^2$

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

$$\delta = \frac{PL}{AE} = \frac{50 \cdot \frac{1}{2}}{3 \times 10^{-6}} \cdot \frac{1}{E}$$

$$\boxed{\delta \simeq 8 \times 10^6 \cdot \frac{1}{E}}$$

$$\sigma = \frac{P}{A} = \frac{50}{3 \times 10^{-6}}$$

$$\boxed{\sigma \simeq 17 \times 10^6 = 17 MPa}$$

← 100 MPa

$E_{rubber} = 0.1 GPa = .1 \times 10^9 Pa = 1 \times 10^8 Pa$

$$\delta = \frac{8 \times 10^6}{10^8} = 8 \times 10^{-2} m = \boxed{8 cm}$$ ← bad news!

← 1mm x 6mm

$A = 2 \cdot (10^{-3} \cdot 6 \times 10^{-3})$

$$\boxed{A = 12 \times 10^{-6} m^2}$$

$P = 5N$

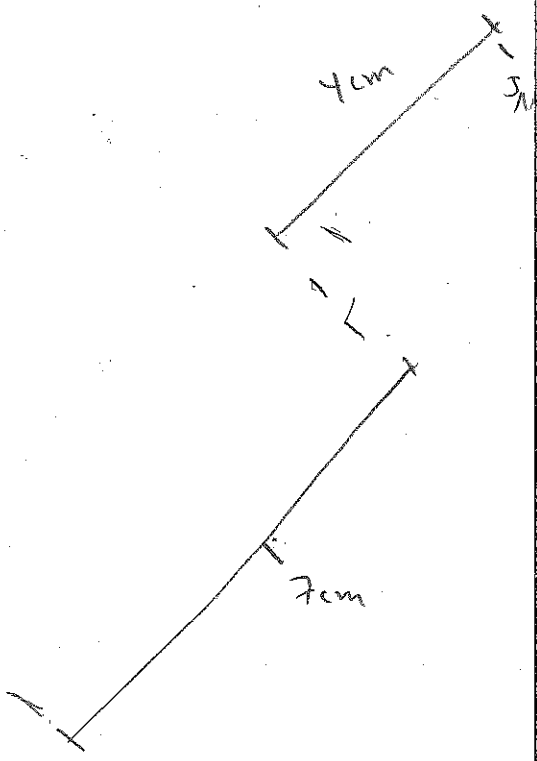
$L = 7cm = 7 \times 10^{-2} m$

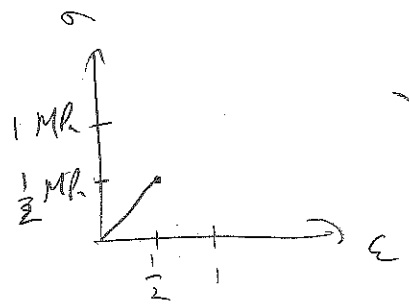
$\delta = 4cm = 4 \times 10^{-2} m$

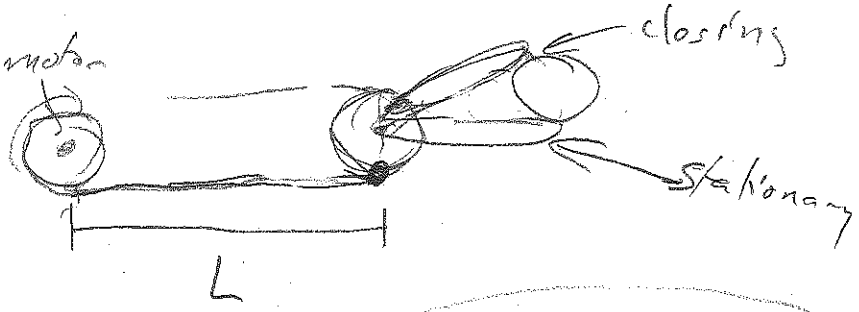
$$\sigma = \frac{5}{12 \times 10^{-6}} \simeq \frac{1}{2} \times 10^6 = 5 \times 10^5 Pa$$

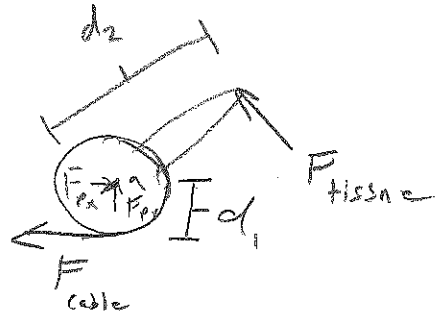
$$\varepsilon = \frac{4 \times 10^{-2}}{7 \times 10^{-2}} \simeq \frac{1}{2}$$

$$E = \frac{\frac{1}{2} \times 10^6}{\frac{1}{2}} = 1 MPa$$?





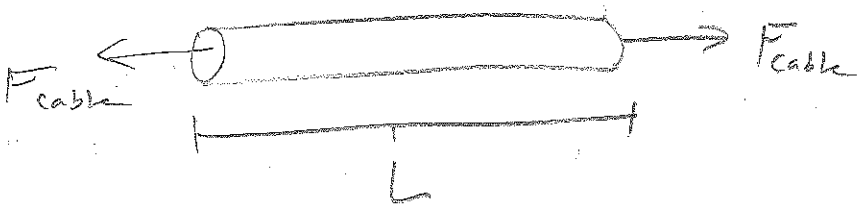




$$\sum M_{/a} = 0$$

$$M_{cable} + M_{tissue} = 0$$

$$d_1 \|\vec{F}_{cable}\| = d_2 \|\vec{F}_{tissue}\|$$



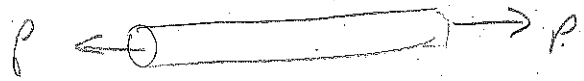
What values should we use?

$d_1 = \frac{1}{2}$ cm $\quad \|\vec{F}_{cable}\| = 2 \cdot 2 \|\vec{F}_{tissue}\|$

$d_2 = 2$ cm $\quad \|\vec{F}_{cable}\| = 4 \|\vec{F}_{tissue}\|$

$\|\vec{F}_{tissue}\| = 10N \quad \|\vec{F}_{cable}\| = 40N$

$\approx 50N$ (for safety $+25\%$)



$P = 50N$