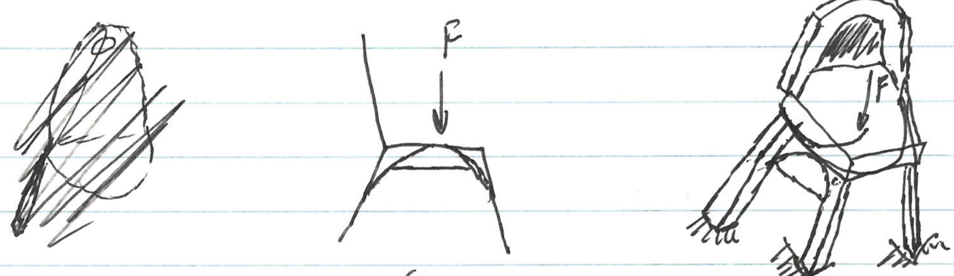
5. ~~[illegible]~~

Q. 1. Photo

2. I want to know the deflection at each of the legs of the chair.

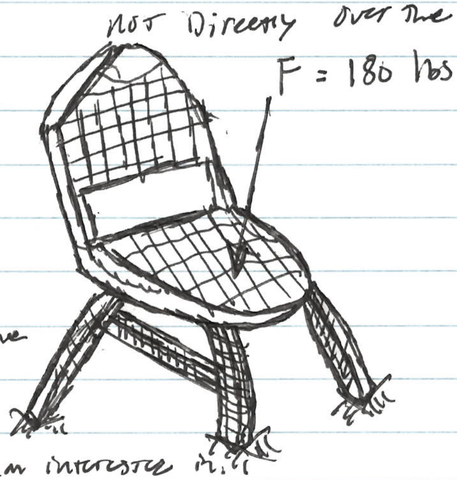
3.



4. Assumptions: – Constant / Uniform force at center of chair so all the legs experience same force
   – The legs are fixed at the ground
   – Uniform material so E = constant.
   – Cross sectional area is constant as well.

5. I think there would be a stress concentration where the legs connect to the chair, also there would be symmetry when cutting the chair in half. Also the moment that can be caused since the force is not directly over the chair (at center of chair).

6.



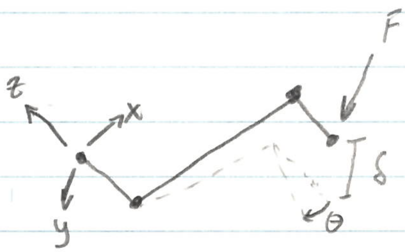
Ideally I would put more mesh at the legs b/c that is what I am interested in.

7. on sketch

8. Ans. I don't know if I could have included more surroundings or less but I could have done a distributed load over the chair to better model a person sitting.

d. $$\begin{bmatrix} 3.67 \cdot 10^{6}, & 0, & 0 \\ 0 & 0, & 1.27 \cdot 10^{6} \\ 0, & 1.27 \cdot 10^{6}, & 0 \end{bmatrix}$$

assume rigid for δ Then assume

3. 

Known: $L = .17\,m$ $\quad E = 200\,GPa$

$W = .09\,m$ $\quad d = .0174\,m$

$w = .065\,m$ $\quad F = 400\,N$

E or Shear modulus, for steel 6ITC

Statics book apendix D:

$$I = \frac{\pi d^4}{64}$$

a. $$\theta = \cancel{\frac{Pab(L+b)}{6EIL}} \; \frac{-PL^2}{8EI}$$

$$\theta = \cancel{(400)(}$$

Textbook equations

$$= \frac{-(400)(2W)}{8\,(200\,GPa)\left(\frac{\pi(.0174)^4}{64}\right)} = \cancel{-.01}\; -9.4 \cdot 10^{-4} \text{ radians.}$$

b. $$\delta = \frac{-5PL^3}{48EI} = \frac{-5(400\,N)(2w)^3}{48\,(200 \cdot 10^{9})\left(\frac{\pi(.0174)^4}{64}\right)} = -1.32 \cdot 10^{-5}\,m$$

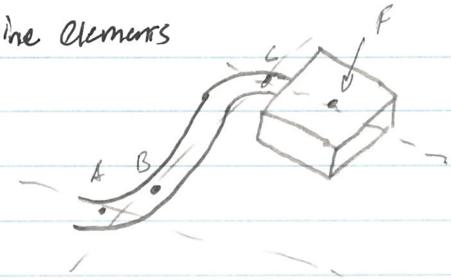
~~&~~

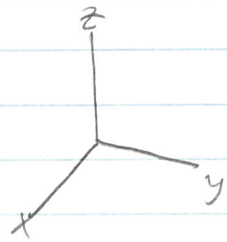
c. Angular Deflection would be more Problematic because you want a horizontal Surface while riding and not a sloped one off to the side so your feet point inwards.

Matthew Donaldson

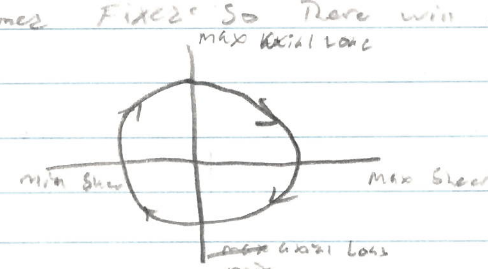
Machine elements HW 3. ~~2~~ Feb. ~~4~~, 2020.

1.

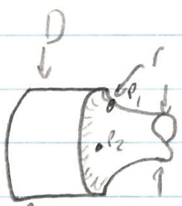




a. @ Point A The Linear reaction Force would be F_z.
b. @ Point A The Torque about axis AB $\vec{\tau}_{AB} = \vec{F} \cdot L = \vec{F}L$
c. @ Point A The bending moment about The arm is $\boxed{\vec{M}_{BC} = \vec{F}W}$
D. The moment Perpendicular To AB, BC would be 0 Since The force is in The Same Direction.
E. As you rotate 90° To the bottom, The Torque would Decrease To a magnitude FW and The moment around BC would be ~~0 when~~ ~~F_z~~ and Smaller as well. And The Reaction Force @ A STAYS The Same.
I Think There would be a Shear Force ~~in The~~ When The arm is not vertical and There would be an axial force when The arm is not horizontal.
This is because The spindle is assumed Fixed. So There will be Shear and axial Loads as you spin around



2.

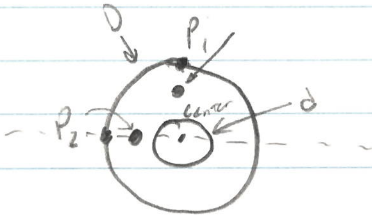


Known: $D = 19$ mm, $d = 17.4$ mm, $r = .8$ mm

$K_{tB} = \cancel{1.07}\ 1.9$

$K_{tT} = \cancel{0.044}\ 1.3$

a.



b. ~~$\sigma = -\frac{My}{I}$~~ ~~So @ P_2 y=0 so σ=0~~ ~~@ P_1 σ = M...~~

$\sigma = \frac{32M}{\pi d^3}$

$\sigma_{P_1} = \frac{32M}{\pi (d/2)^3} K_t = 3.67 \cdot 10^6 M$ ~~P_1 $\sigma = \frac{Md}{2I}$~~

$\sigma_{P_2} = 0$

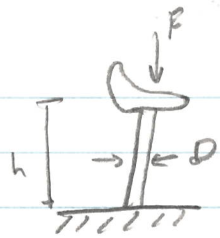
c. $\tau = \frac{Tc}{J} = \frac{16T}{\pi d^3} K_{tT}$

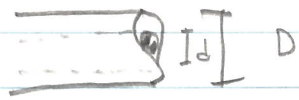
$\tau_{P_1} =$ ~~...~~

$\tau_{P_2} = \frac{16 T K_T}{\pi (d/2)^3} =$

$\frac{16 K_T T}{\pi (d/2)^3} = 3.56 \cdot 10^6 T$ $\tau_{P_1} = \tau_{P_2} = 1.27 \cdot 10^6 T$

assume $\sigma_c = \sigma_T = \sigma_y$

4. 



Knowns: $D = 1.5\text{ in}$ $K = 2$ Fixed End Free end

$H = 25\text{ in}$

$E = 29{,}000\text{ ksi} = 29 \cdot 10^6\ \text{lb/in}^2$

a. $$F = \frac{\pi^2 EI}{(KL)^2} = \frac{\pi^2 (29 \cdot 10^6\ \text{lb/in}^2)\left(\frac{\pi(D^4 - d^4)}{64}\right)}{(K(25))^2}$$

$$F = \frac{29 \cdot 10^6 (\pi)^3 (D^4 - d^4)}{625 K^2\ 64} = 3.59 \cdot 10^5 (1.5^4 - d^4)$$

$$F = \cancel{1.8 \cdot 10^6 - 3.59 \cdot 10^5 d^4}\ 28450 - 5614.8 d^4$$

we used 1 fixed end and 1 free end to make $K = 2$.

b. $$P = \sigma A = (66915.8\text{ psi})\left(\pi \left(\tfrac{1.5}{2}\right)^2 - \pi\left(\tfrac{d}{2}\right)^2\right)$$

$$= 107647.1 - 47843.2\, d^4$$

c. $$\frac{1}{P_{max}} = \frac{1}{P_{cr}} + \frac{1}{P_y}$$

$$\frac{1}{P_{max}} = \frac{1}{28450 - 5614 d^2} + \frac{1}{107647.1 - 47843.2 d^2}$$

d. $P = 200\text{ lbs.}$

S.F 3 $\rightarrow P = 600\text{ lbs}$

$$\frac{1}{600} = \frac{1}{(28450 - 5614 d^4)} - \frac{1}{(107647.1 - 47843.2 d^2)}$$

$\boxed{d = 1.5\text{ in}}$ Use Mathematica Solve Function.

e. Yes because it also uses the Buckling Load which would also be a factor in its overall max load.