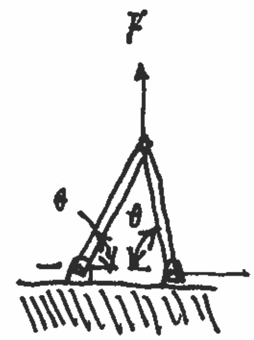
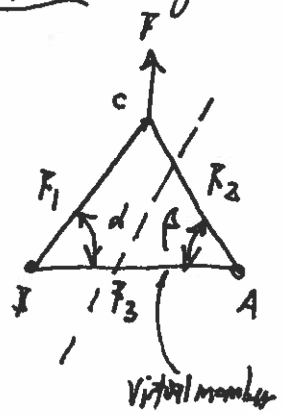
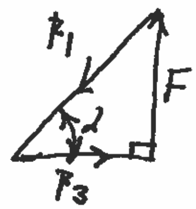
problem: compute member to symmetric assembly as shown.



NOTE: the general case, "virtual member" holding apart footings,



free body diagram



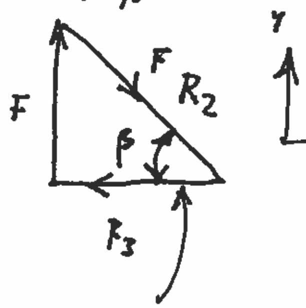
force polygon

F_x	F_y
$R_1 \cos\alpha$	$R_1 \sin\alpha$
R_3	0
0	F
$\rightarrow\sum F_x$	$\uparrow\sum F_y$

$$\rightarrow\sum F_x = R_1 \cos\alpha + R_3 \equiv 0$$

$$\uparrow\sum F_y = R_1 \sin\alpha + F = 0$$

force polygon



F_x	F_y
$R_2 \cos(180-\beta)$	$R_2 \sin(180-\beta)$
$-R_3$	0
0	F
$\rightarrow\sum F_x$	$\uparrow\sum F_y$

$$\rightarrow\sum F_x = R_2 \cos(180-\beta) - R_3 = 0$$

$$= -R_2 \cos\beta - R_3 = 0$$

$$\uparrow\sum F_y = 0 = R_2 \sin(180-\beta) + F = 0$$

$$= R_2 \sin\beta + F = 0$$

$$\left.\begin{aligned} R_1\cos\alpha + R_3 &= 0 \\ R_1 \sin\alpha + F &= 0 \\ -R_2\cos\beta - R_3 &= 0 \\ R_2 \sin\beta + F &= 0 \end{aligned}\right\}$$

statically indeterminant

4 equations in 5 unknowns ($R_1, R_2, R_3, \alpha, \beta$).

(F is known!)

- I need another equation to solve for five unknowns; make the assumption $m\measuredangle\alpha \equiv m\measuredangle\beta$ in a completely symmetric assembly OR consider material qualities.

assumption 1: $m\measuredangle\alpha \equiv m\measuredangle\beta$, F is a known.

$$R_1\cos\alpha + R_3 = 0 \longrightarrow R_3 = -R_1\cos\alpha = \frac{-F}{\sin\alpha}\cdot -\cos\alpha = \frac{+F}{\tan\alpha}.$$

$$R_1 \sin\alpha + F = 0 \Rightarrow R_1 = \frac{-F}{\sin\alpha}$$

$$-R_2\cos\alpha - R_3 = 0 \longrightarrow R_3 = -R_2\cos\alpha = \frac{+F}{\sin\alpha}\cos\alpha = \frac{+F}{\tan\alpha}.$$

$$R_2\sin\alpha + F = 0 \Rightarrow R_2 = \frac{-F}{\sin\alpha}$$

$\Updownarrow$

* clearly R_3 in ΣF_x must equal that ΣF_y!

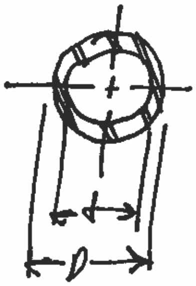
$$\therefore \quad R_1 \equiv R_2 = \frac{-F}{\sin\alpha} \quad \wedge \quad R_3 = \frac{F}{\tan\alpha} \text{ (support reaction)}$$

assumption 2: material performance consideration.

- need to understand something about the member support thru either R_1 or R_2,
- typical to infer load and make a reference to factor of safety given the material properties,

i.e. $FOS = \dfrac{\sigma_y}{\sigma}$ $\forall$ σ_y = material yield strength, σ = stress thru member.

- then I need to know geometry cross section profile of member, say circular for simplicity,
- I suggest tubing, commerical available DOM – seamless carbon steel,



member cross-section profile

polar moment $J = \frac{\pi}{32}(D^4 - d^4)$ since $J = I_x + I_y$ & $I_x \equiv I_y$

consider pure axial load $A = \frac{\pi}{4}(D^2 - d^2)$

$$\sigma = \frac{R_1}{\frac{\pi}{4}(D^2 - d^2)} \quad \& \quad \sigma = \frac{\sigma_y}{FoS}$$

$$\therefore \quad \frac{\sigma_y}{FoS} = \frac{4 R_1}{\pi (D^2 - d^2)} \Rightarrow R_1 = \frac{\pi (D^2 - d^2)}{4} \cdot \frac{\sigma_y}{FoS}$$

- so my material consideration with member geometry gives me extra independence to solve the system of equations.
- these are:

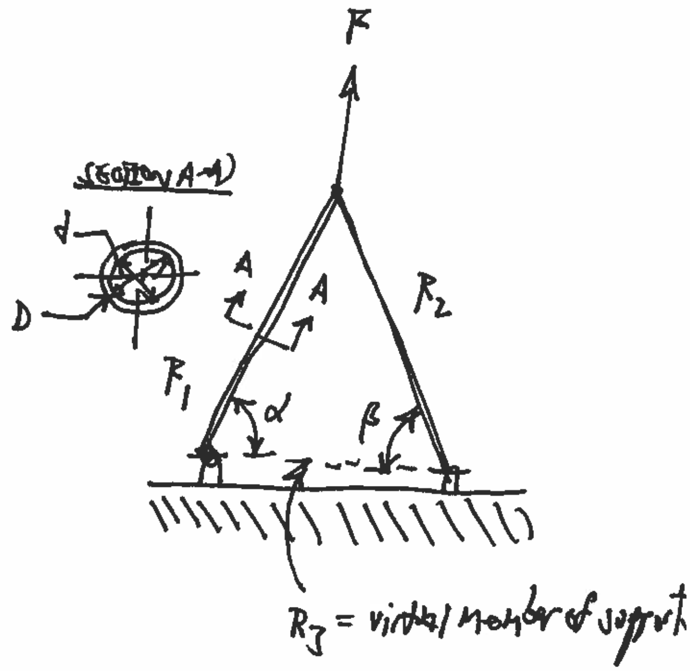
$$R_1 \cos\alpha + R_3 = 0$$

$$R_1 \sin\alpha + F = 0$$

$$-R_2 \cos\beta - R_3 = 0$$

$$R_2 \sin\beta + F = 0$$

$$R_1 = \frac{\pi (D^2 - d^2)}{4} \cdot \frac{\sigma_y}{FoS}$$



09 Jan. 2017