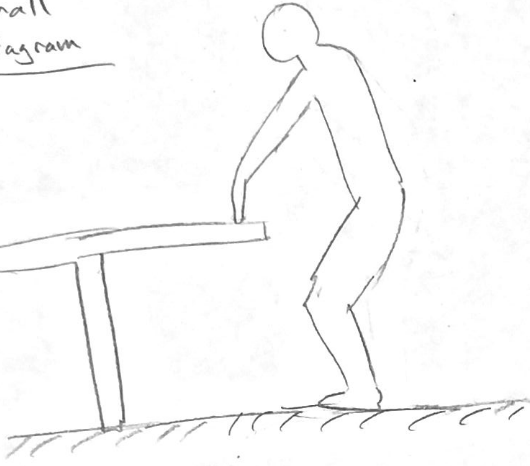
1/14/2016

Stand up and push on desk with finger(s) / thumb(s) / hand(s)

overall diagram

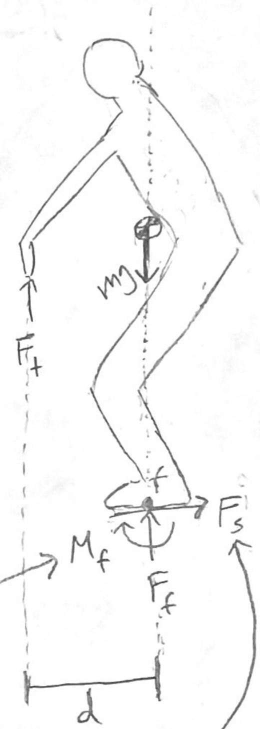


model as being in static eq.

$$\sum \vec{F} = 0$$

$$\sum \vec{M}_{/a} = 0$$

first attempt at FBD



$F_s = 0$ so should erase this

$M_f \leq 0$ so should redraw this in the other direction and make $M_f = dF_t$

$$\sum F_x = F_s = 0$$

$$\sum F_y = F_t - mg + F_f = 0$$

$$F_t + F_f = mg$$

$$\sum M_{/f} = -M_f - dF_t$$

$$M_f = -dF_t$$

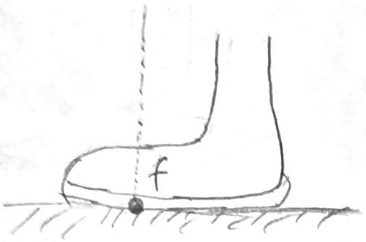
Final FBD

$$F_t + F_f = mg$$

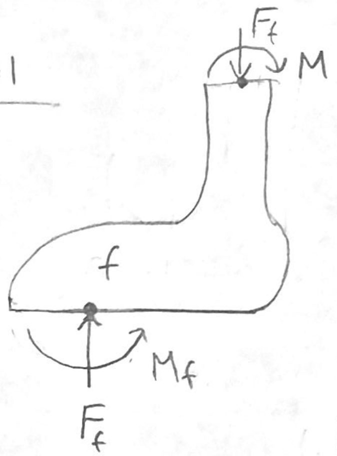
$$M_f = dF_t$$

What is happening at the feet?

Overall diagram



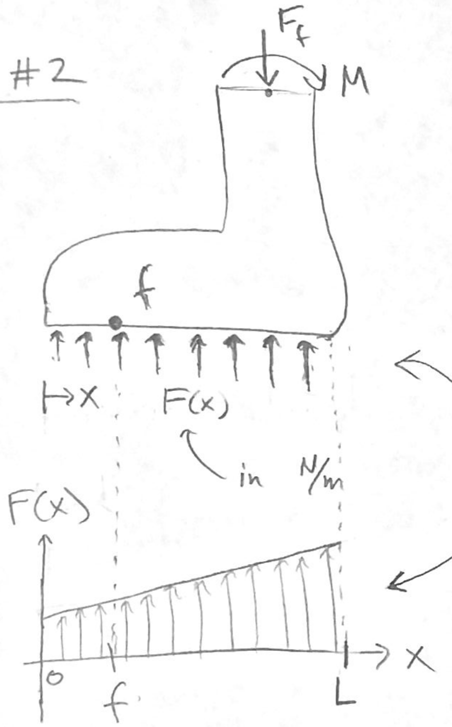
FBD #1



$M_f = dF_t$

$F_f = mg - F_t$

FBD #2



model as a distributed load

$$\underset{N}{F_f} = \int_0^L \underset{N/m}{F(x)}\, \underset{m}{dx} = mg - F_t$$

$$\underset{Nm}{M_f} = \int_0^L \underbrace{(x-f)}_{m}\, \underset{N/m}{F(x)}\, \underset{m}{dx} = dF_t$$

We can also represent this distributed load with just an upward force with no moment by finding the new location, f_{new}, on the foot for which the associated moment is 0.

$$M_{/f_{new}} = \int_0^L (x - f_{new})\, F(x)\, dx$$

find $f_{new} \Longrightarrow M_{/f_{new}} = 0$

$$0 = \int_0^L (x - f_{new})\, F(x)\, dx$$

$$0 = \int_0^L x\, F(x)\, dx - \int_0^L f_{new}\, F(x)\, dx$$

$$\int_0^L \underset{\text{constant}}{f_{new}}\, F(x)\, dx = \int_0^L x\, F(x)\, dx$$

center of pressure →

$$\boxed{f_{new} = \frac{\int_0^L x\, F(x)\, dx}{\int_0^L F(x)\, dx} = \frac{\int_0^L x\, F(x)\, dx}{F_f}}$$