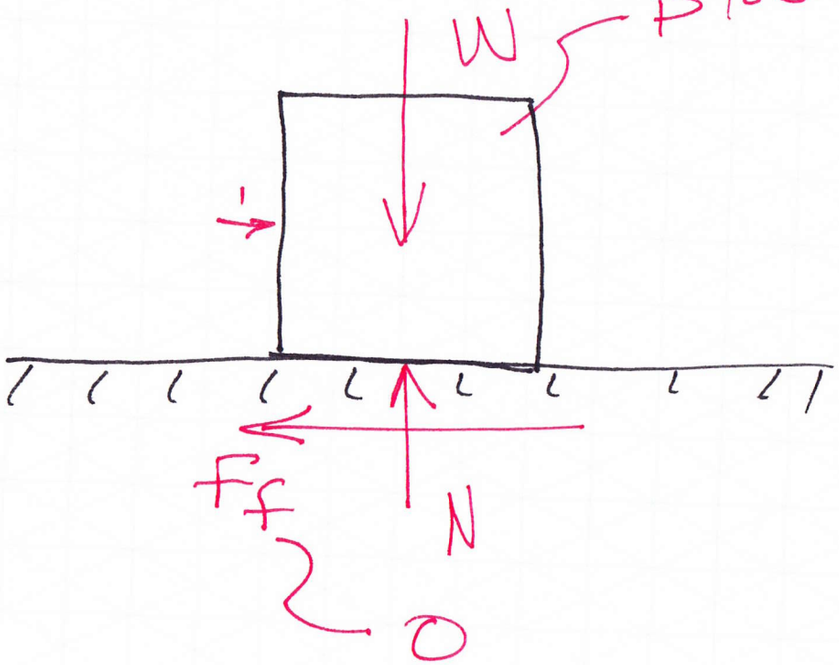
Dry Friction Coulomb Friction



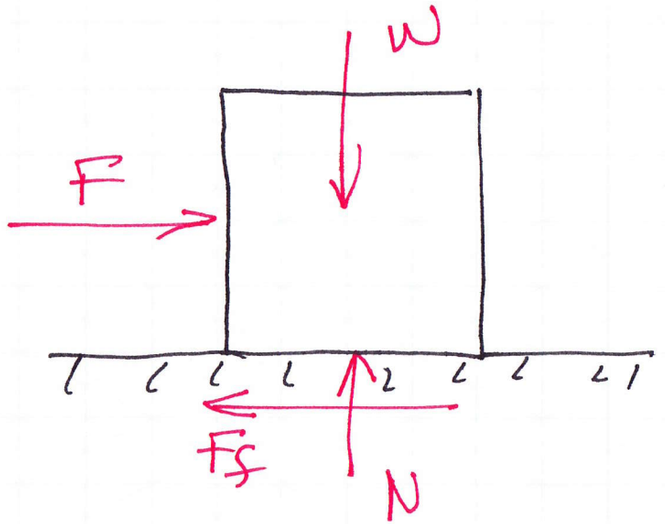
μ - coefficient of friction

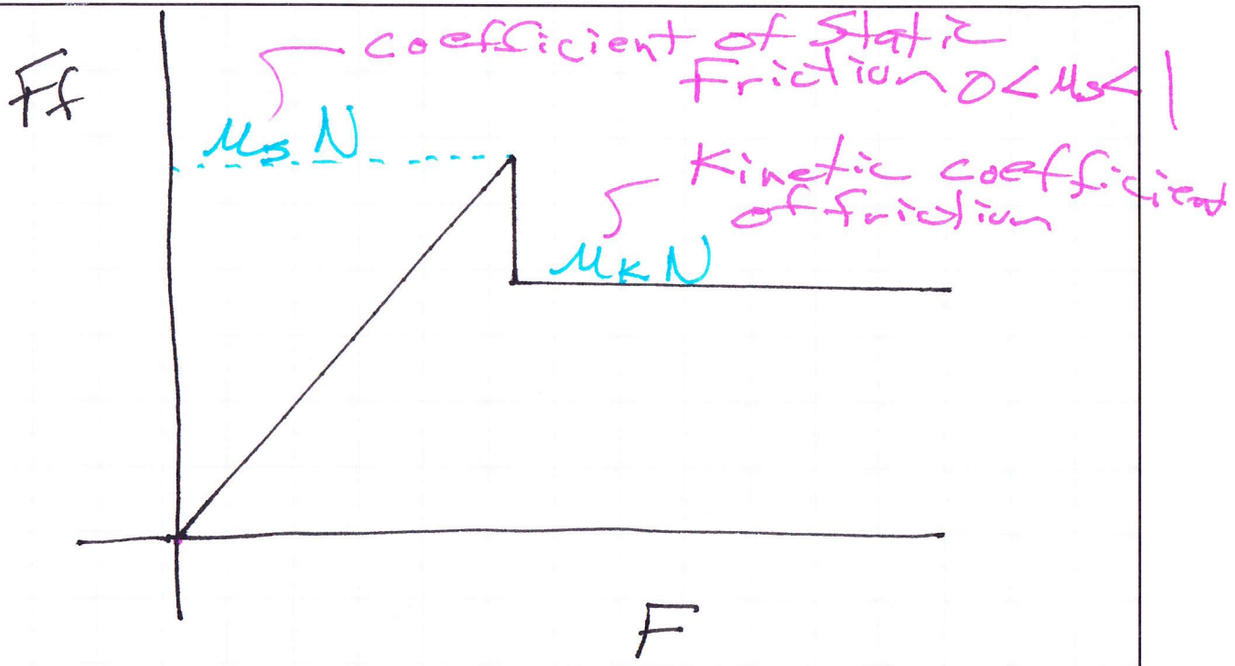
$F_f = \mu N$

F_f - always resists motion.

Impending Motion

$F_f = \mu N$ The maximum that the Friction Could be





Assume Equilibrium

$+\uparrow \sum F_y = 0$

$-W + N = 0$

$N = W$

$\pm\rightarrow \sum F_x = 0$

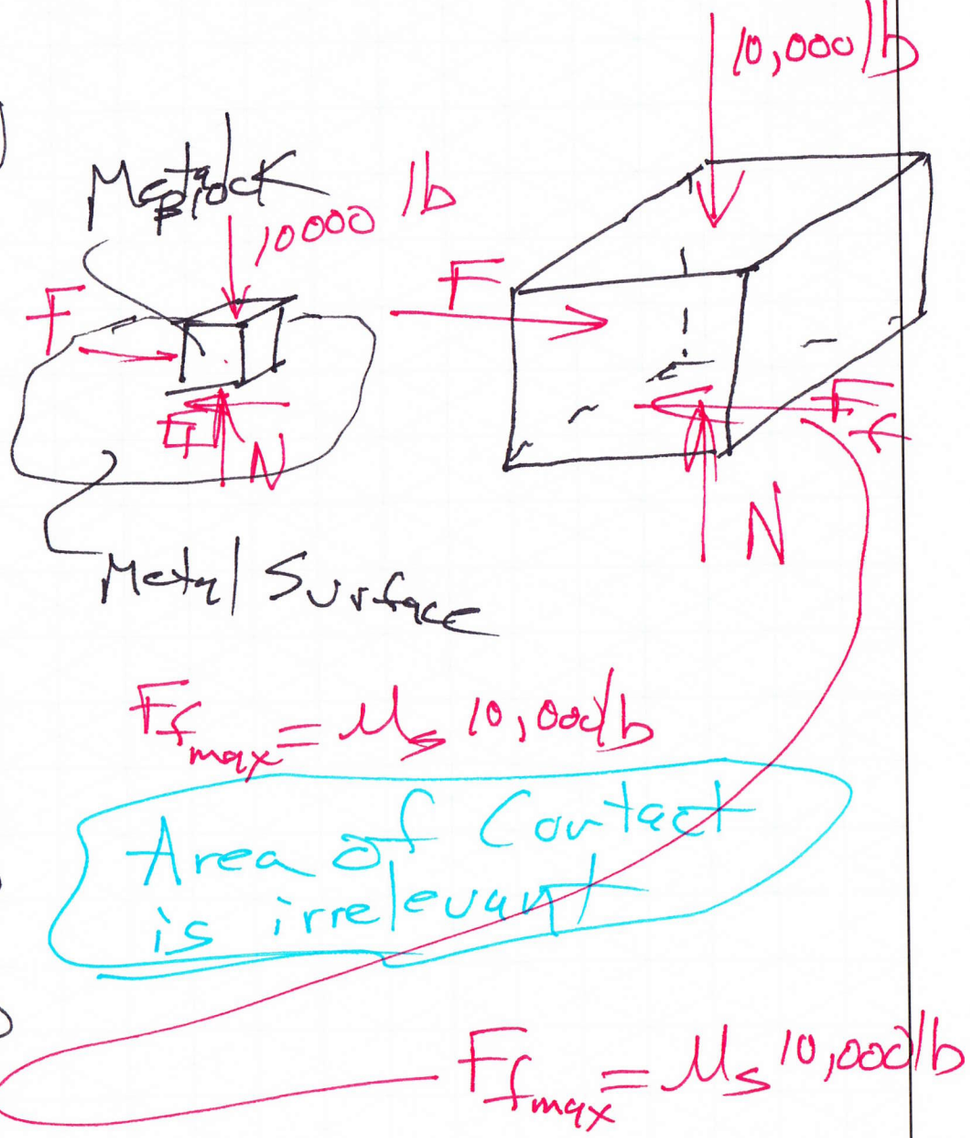
$F - F_f = 0$

$F_f = F$

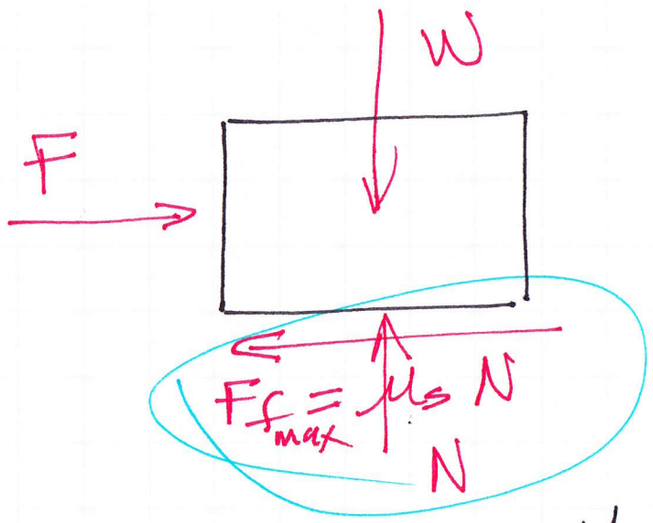
$$F_f \leq \mu_s N$$

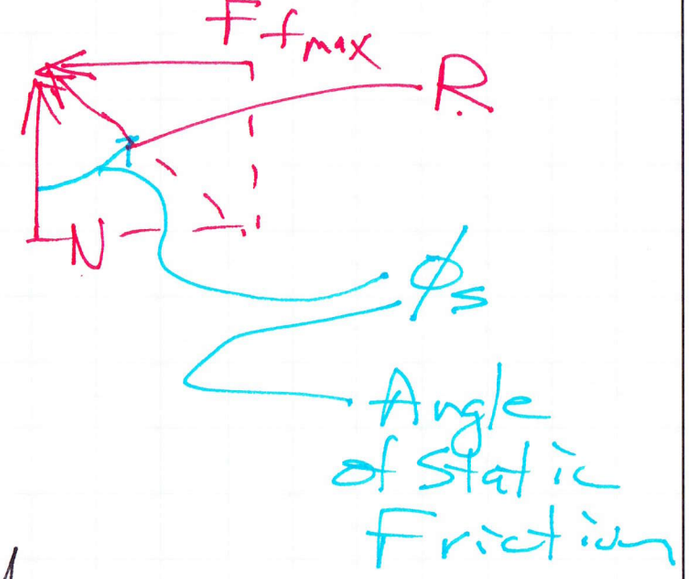
Tables

Metal on Metal	0.15 – 0.60
Metal on Wood	0.20 – 0.60
Stone on Stone	0.40 – 0.70
Earth on Earth	0.20 – 1.00
Rubber on Concrete	0.60 – .90



Angles of Friction



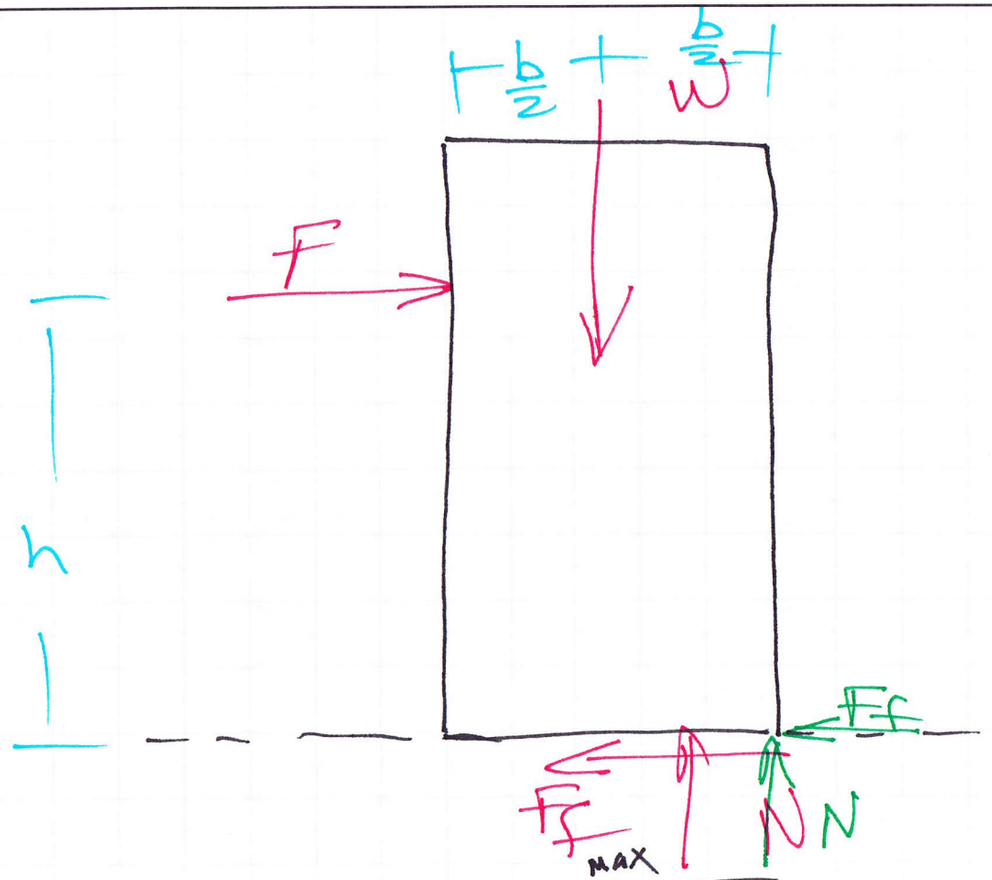


$$\tan \phi_s = \frac{\mu_s N}{N} = \mu_s$$

$$\tan \phi_s = \mu_s$$

$\tan \phi_k = \mu_k$

Angle of kinetic friction



Impending Motion

1. Nothing

2. Slip

$\uparrow \Sigma F_y = 0$

$-W + N = 0$

$N = W \rightarrow \Sigma F_x = 0$

$F_{f_{max}} = \mu_s N$

$F - \mu_s N = 0$

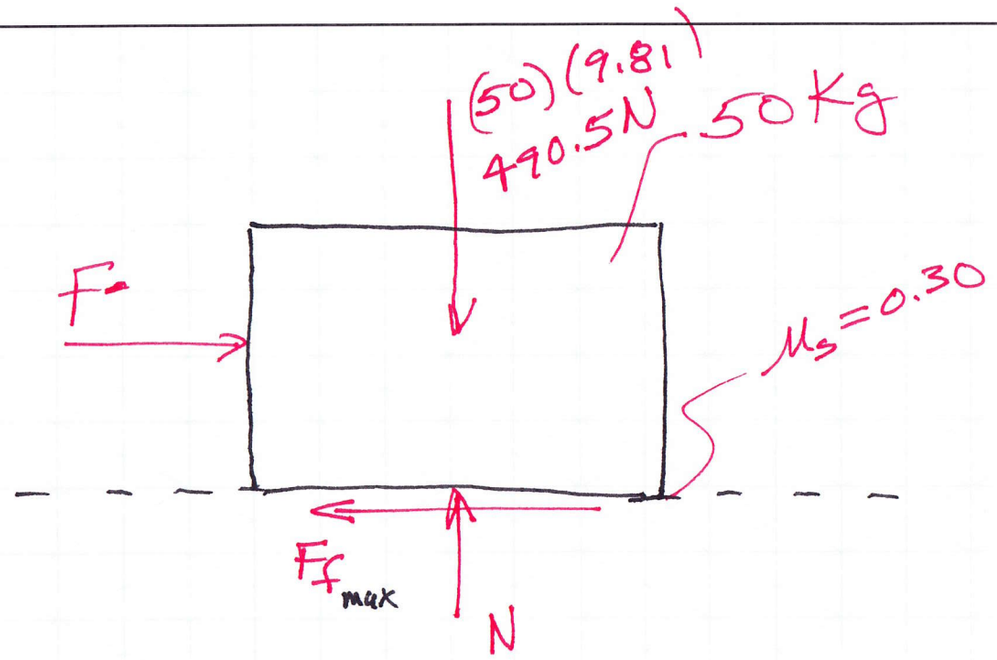
$F = \mu_s N$

3. Tip

$\circlearrowleft \Sigma M_{corner} = 0$

$W \frac{b}{2} - F h = 0$

$\frac{W b}{2} \leq F h$



What is the maximum value of F without inducing motion

Impending Motion

$+\uparrow \sum F_y = 0$

$-490.5 + N = 0$

$N = 490.5\ N$

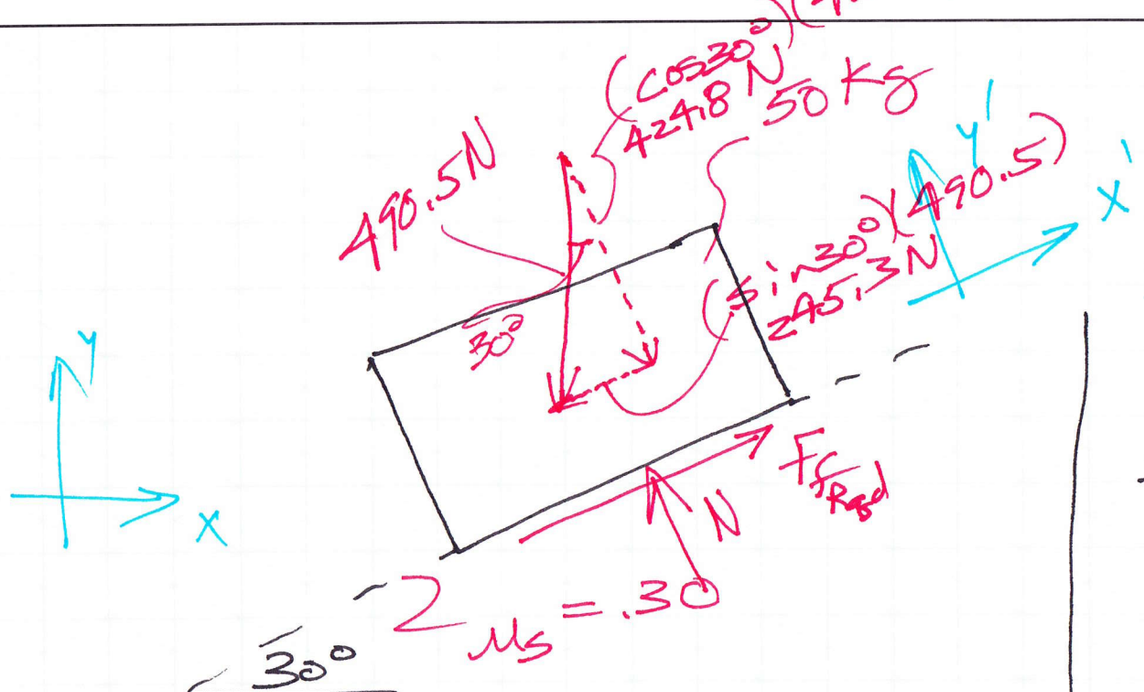
$F_{f_{max}} = \mu_s N = 0.30(490.5)$

$F_{f_{max}} = 147.15\ N$

$\rightarrow \sum F_x = 0$ 147.15 N

$F - F_{f_{max}} = 0$

$F = 147.15\ N$



Reality

$F_{f_{max}} = \mu_s N$

$F_{f_{max}} = (0.30)(424.8\ N)$

$F_{f_{max}} = 127.4\ N$

What happens?

Assume Equilibrium in this Position

$+\uparrow \Sigma F_y' = 0$

$-424.8 + N = 0$

$N = 424.8\ N$

$+\nearrow \Sigma F_x' = 0$

$-245.3 + F_{f_{Rsd}} = 0$

$F_{f_{Rsd}} = 245.3\ N$

$127.4 < 245.3$

$F_{f_{max}} < F_{f_{Rsd}}$

The Block slips — Dynamics Problem