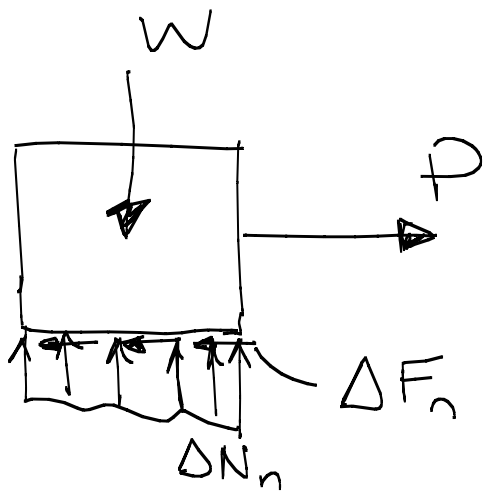
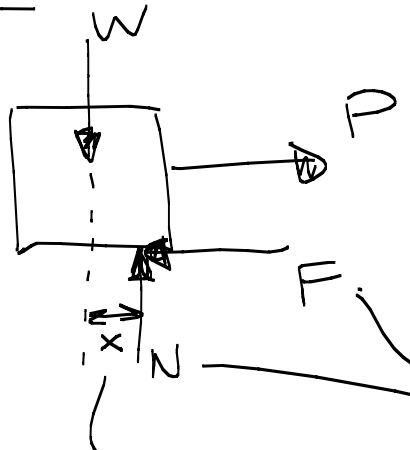
Chapter 8: Friction

Friction: Force of resistance acting on a body that prevents slipping

Dry Friction: No lubricating fluid



Simplification



Resultant Normal & Frictional Forces to prevent instability

Maximum Frictional Resistance

$$F_s = \mu_s N$$

F_s => Maximum Frictional Resistance

μ_s = Coefficient of Static Friction

Impending Motion: Onset of Motion

Once slipping occurs

$$F = \mu_K N$$

μ_K = Coefficient of Kinetic Friction

$$\mu_K < \mu_S \qquad \mu_K \approx 0.75\mu_S$$

μ_S => Table 8.1

$F < F_S$ => No slipping

$F = F_S$ => Impending Motion

$F > F_S$ => Motion

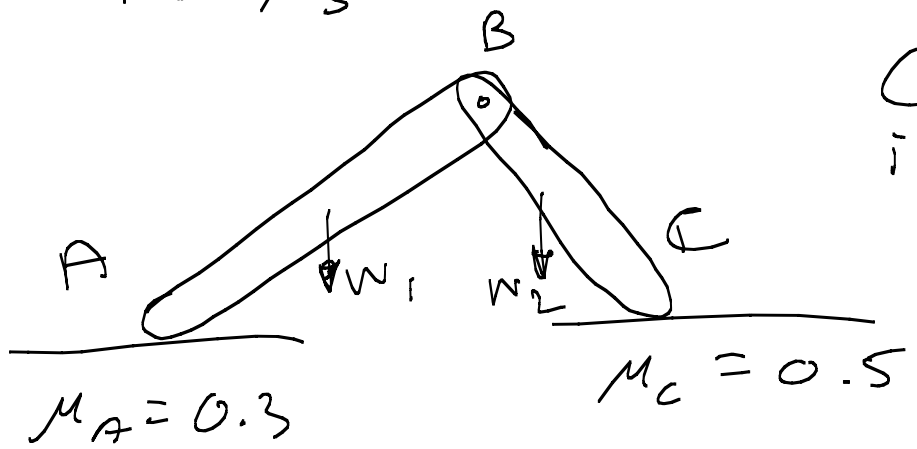
Types of Problems

(1) Equilibrium

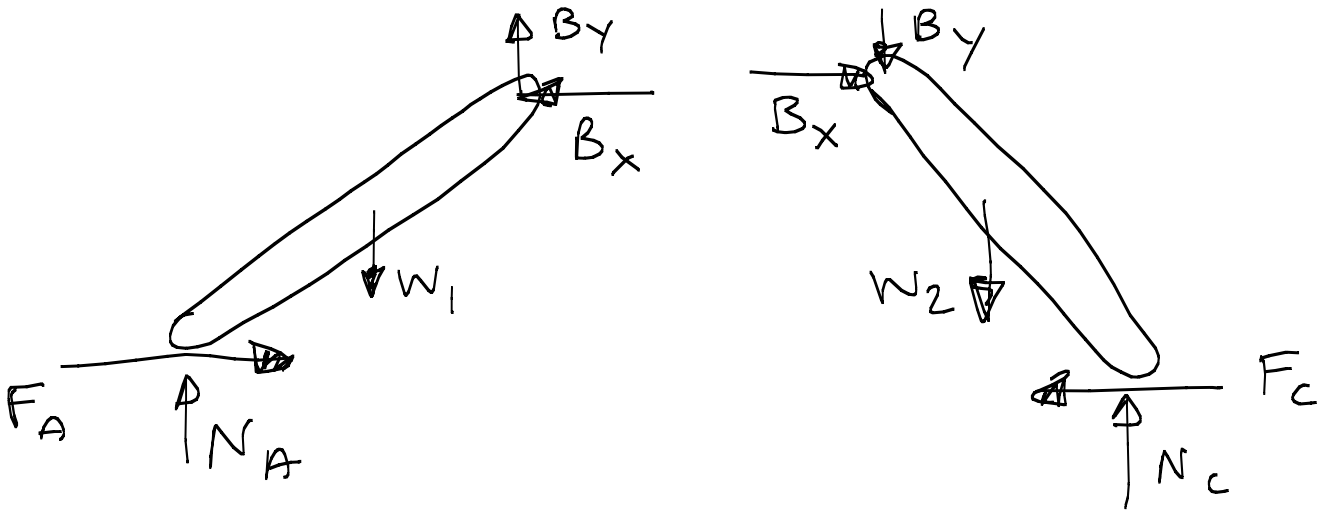
Total Number of Unknowns = Total Number of Equilibrium Equations

Check $F < \mu_s N$

if $F > \mu_s N$ => Not in static equilibrium



Check if the structure is in equilibrium



Unknowns: $F_A, N_A, B_x, B_y, N_C, F_C$ (6)

Equilibrium AB ($\Sigma F_x = 0, \Sigma F_y = 0, \Sigma M = 0$) 3

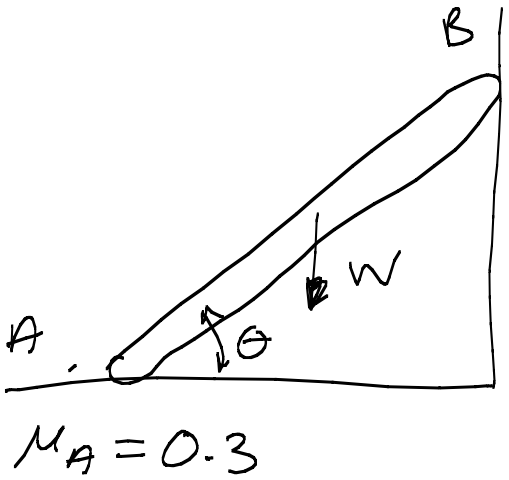
BC (" , " , ") 3

(6)

Check $F_A \overset{?}{\leq} \mu_A N_A$, $F_C \overset{?}{\leq} \mu_C N_C$

(2) Impending Motion at all points

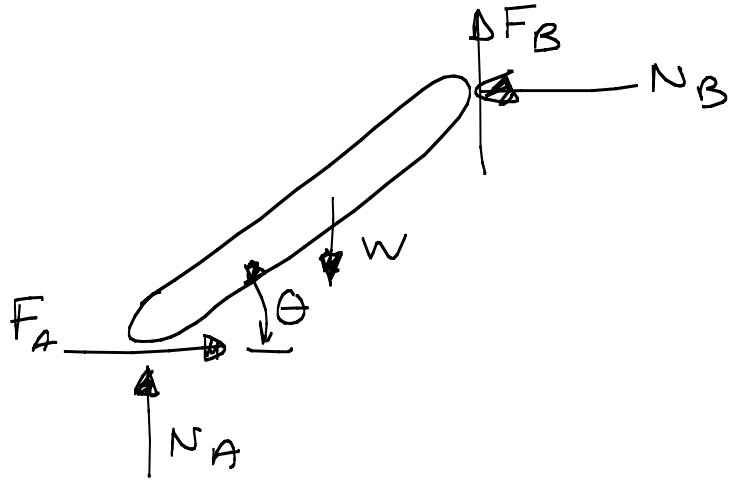
Unknowns = # Equilibrium Equations plus all of the Frictional Equations



$\mu_B = 0.4$

$\mu_A = 0.3$

Find the impending motion θ for



Unknowns: $F_A, N_A, \theta, F_B, N_B$ (5)

Equilibrium: $\Sigma F_x = 0, \Sigma F_y = 0, \Sigma M = 0$ (3)

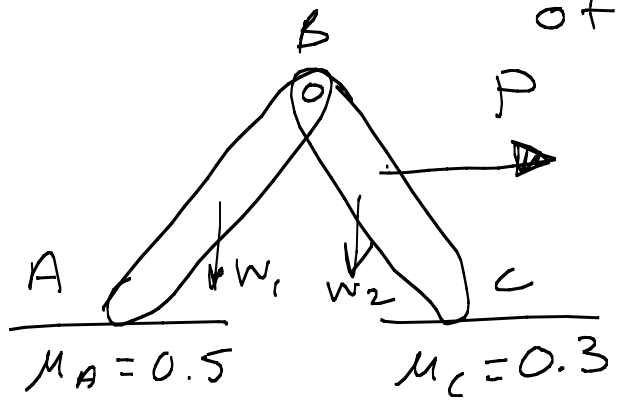
Friction: $F_A = \mu_A N_A, F_B = \mu_B N_B$ (2)

(5)

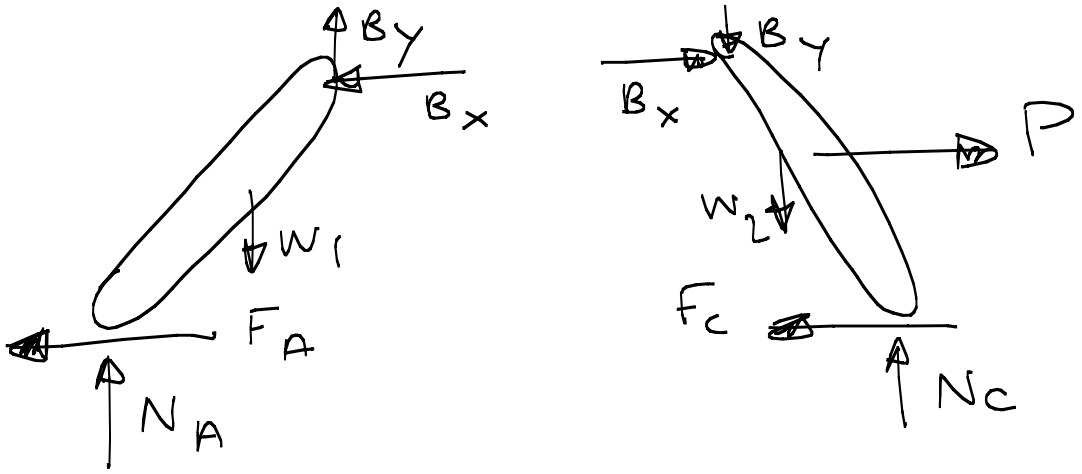
Then THINK about your answers

(3) Impending Motion at some points

Unknowns = # Equilibrium Equations plus some of the frictional Equations



Find P for impending motion



Unknowns: $N_A, F_A, B_x, B_y, F_c, N_c, P$ (7)

Equilibrium: (6)

Friction: $F_A = \mu_A N_A$, $F_c = \mu_c N_c$ (2)

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Need 1 Frictional Equation, but which one?

Either: P will cause slipping at A, and no slipping at C

$$F_A = \mu_A N_A$$

Check $F_C \overset{?}{\leq} \mu_C N_C$

OR: P will cause slipping at C, + no slipping at A

$$F_C = \mu_C N_C$$

check $F_A \overset{?}{\leq} \mu_A N_A$

A + C could also slip simultaneously, but it is unlikely