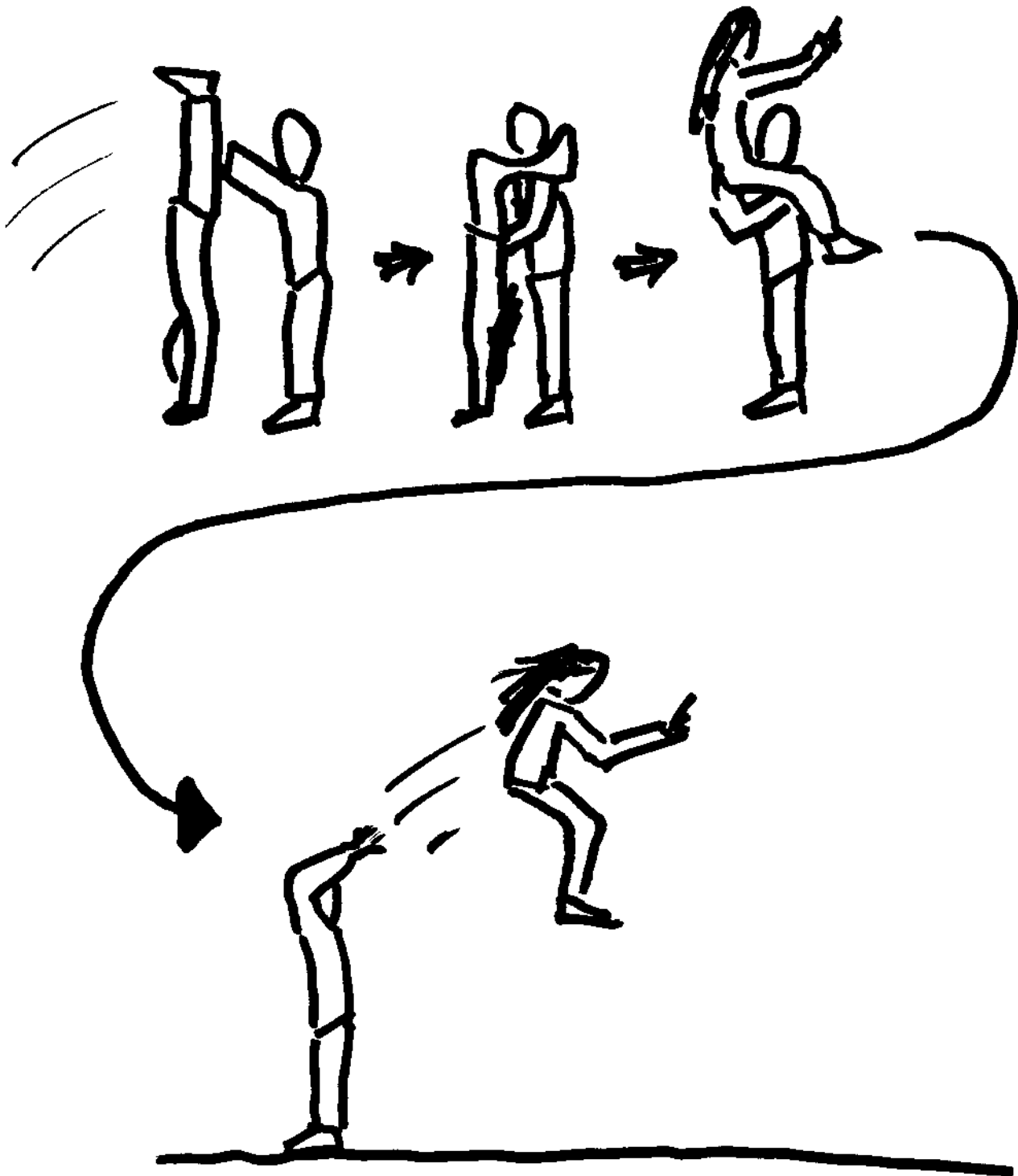
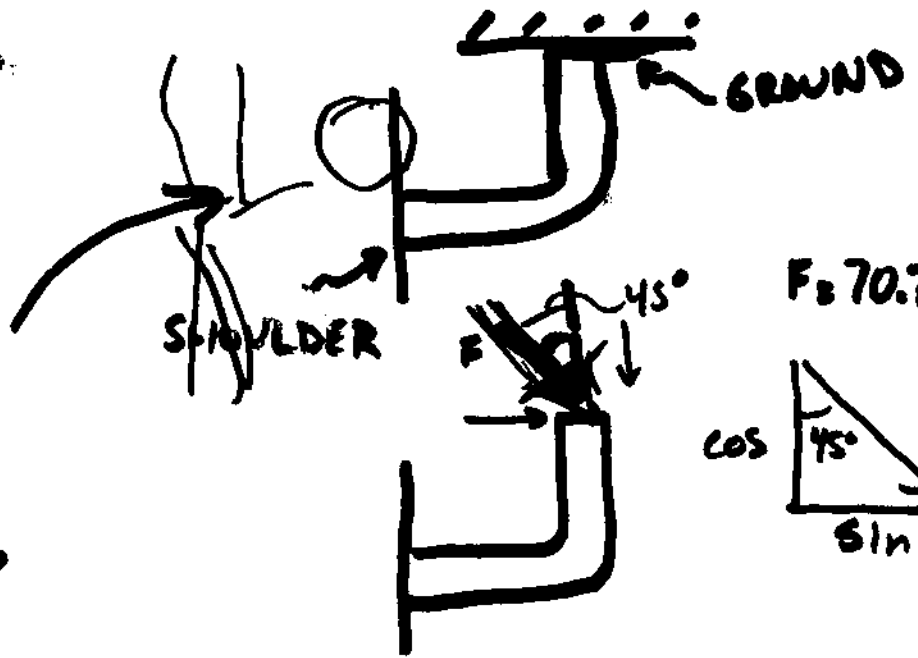
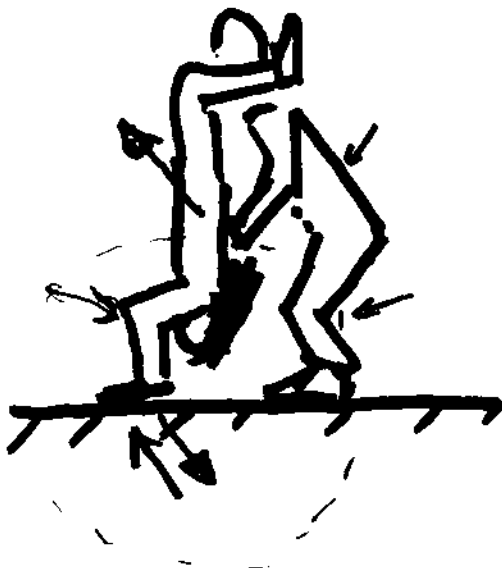


The ME111 Way to Solve “Like Totally Impossible” Problems

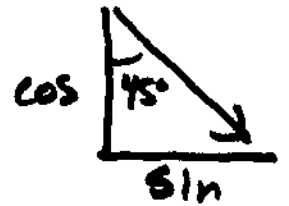
1. Draw a Free Body Diagram (FBD) – Look at the EXTERNAL forces and moments acting on the whole object, then break it down into sub-assemblies. **GOAL: ALL EXTERNAL FORCES & MOMENTS.**
 - a. Shear and bending moment diagrams
 - b. Method of joints/sections
 - c. Static equilibrium conditions ($\Sigma F=0$, $\Sigma M=0$ ← in 3-D even!)
 - d. Right Hand Rule to figure out moments – use pens, tinker toys...
 - e. Make basic assumptions (no deformation under load...)
 - f. Make a mock-up of it...cardboard, paper, foam, wood
2. Get Data – Tables in the book, the Web, other books, your company.
 - a. Things like E, I, Z, \bar{c} (listed as \bar{y} sometimes in the back), S_u , S_y**GOAL: KNOWLEDGE ABOUT SPECIFIC PROBLEM**
3. Based on educated guesses/directions cut assembly into pieces and analyze critical sections.
 - a. Often sections with curves, notches, cracks, holes, parts attached to walls...
 - b. Look at Bending, Torsion, Shear (Juvinal 4.2 – 4.8) See where the stresses add up (look at #1)**GOAL: INTERNAL FORCES & STRESSES**
4. Find maximum stresses and strains.
 - a. Mohr’s circle in 2 & 3-Dimensions
 - b. Maximum Stress Theories**GOAL: FIND IF IT’LL BEND OR BREAK**
5. Use fracture mechanics and failure theory to check other failure modes
GOAL: FIND IF IT’LL BREAK OVER TIME
6. Optimize for safety factors, weight constraints, cost, color, etc...
GOAL: MAKE IT BE THE BEST IT CAN BE!

ANALYZING A SWING AERIAL





$$F = 70.71 \text{ N}$$



$$\sum F_x = 0$$

$$R_x + F \sin 45 = 0$$

$$R_x = -50 \text{ N}$$

$$\sum F_y = 0$$

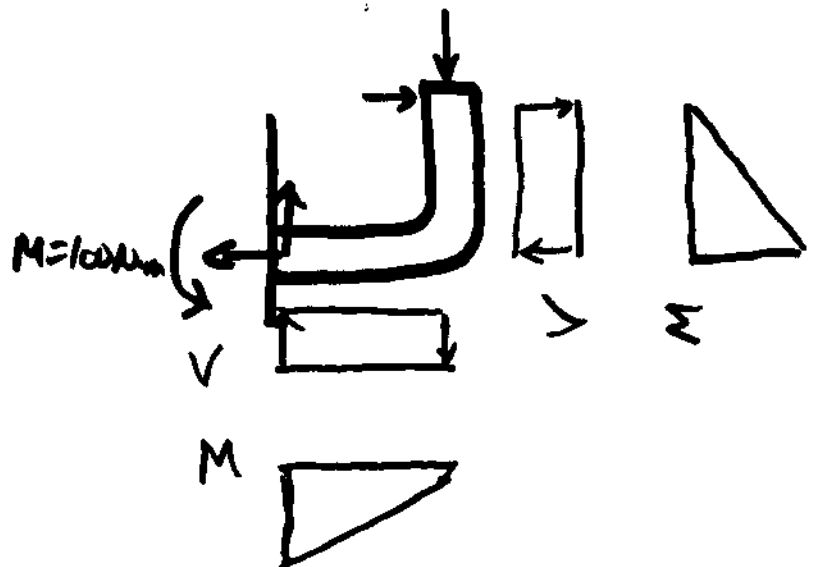
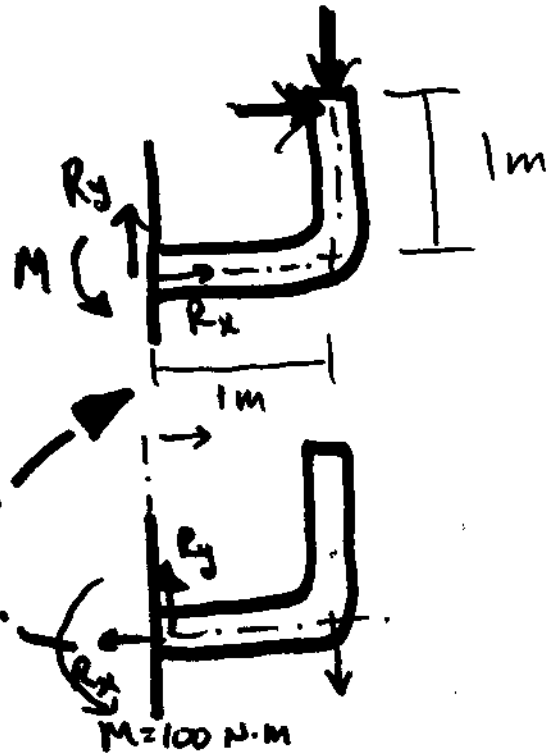
$$R_y - 50 \text{ N} = 0$$

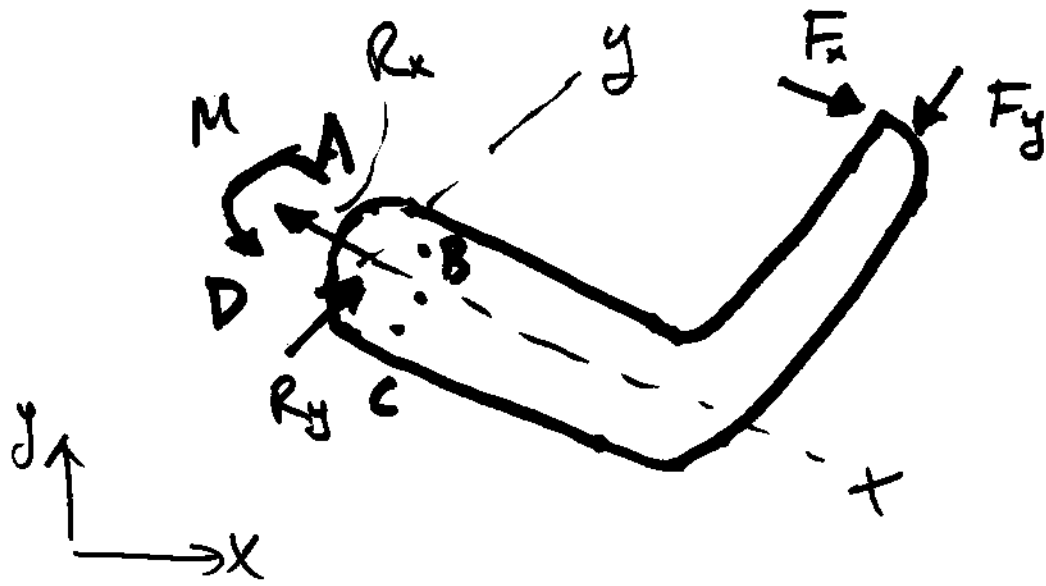
$$R_y = 50 \text{ N}$$

$$\sum M = 0$$

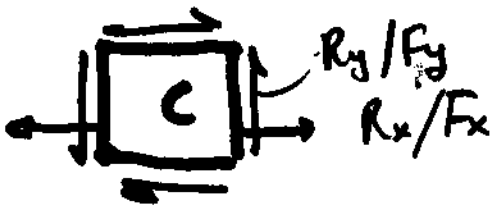
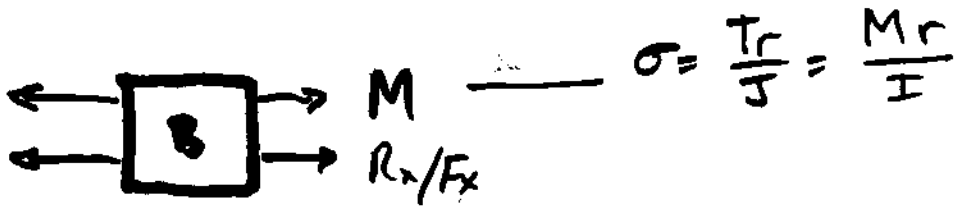
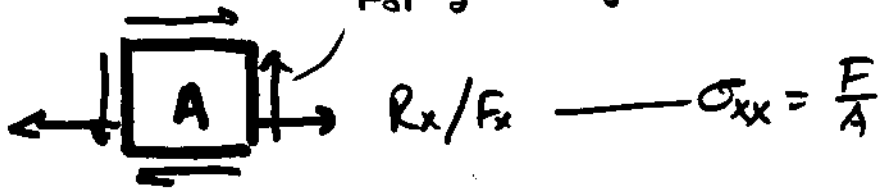
$$-(50 \text{ N})(1 \text{ m}) - (50 \text{ N})(1 \text{ m}) + M = 0$$

$$M = 100 \text{ N}\cdot\text{m}$$





$$R_y/F_y = \tau_{xy} = \frac{4}{3} \frac{V}{A}$$



NOTE: THESE STRESSES MIGHT NOT BE MAXIMA! ...