

Functional Requirements	Design Parameters	Analysis	References	Risks	Countermeasures

manipulating

↳ rotating/twisting

bending

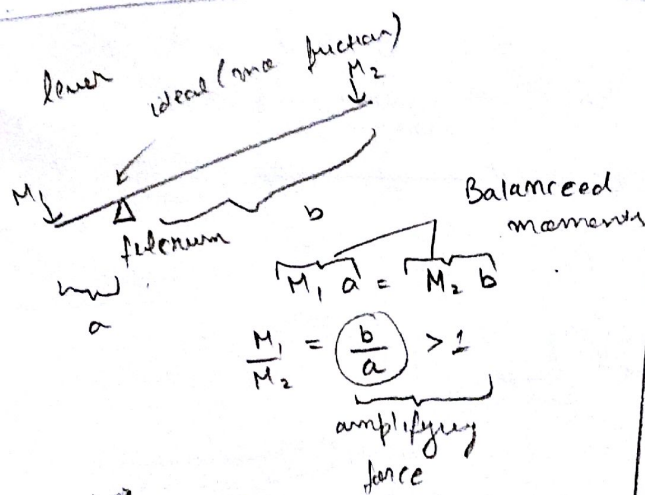
cutting

compressing

pulling

pecking (jamming) watches etc.)

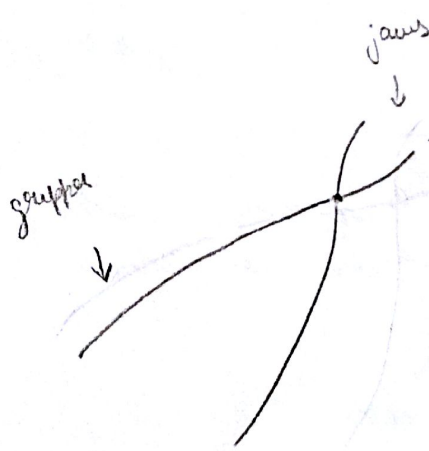
large objects [large bolts/nails, high gauge wires,]
med. objects [med. nuts/bolts, med. gauge wire] deconstruct etc.
 small objects [gas cylinder pins, cables/wires]



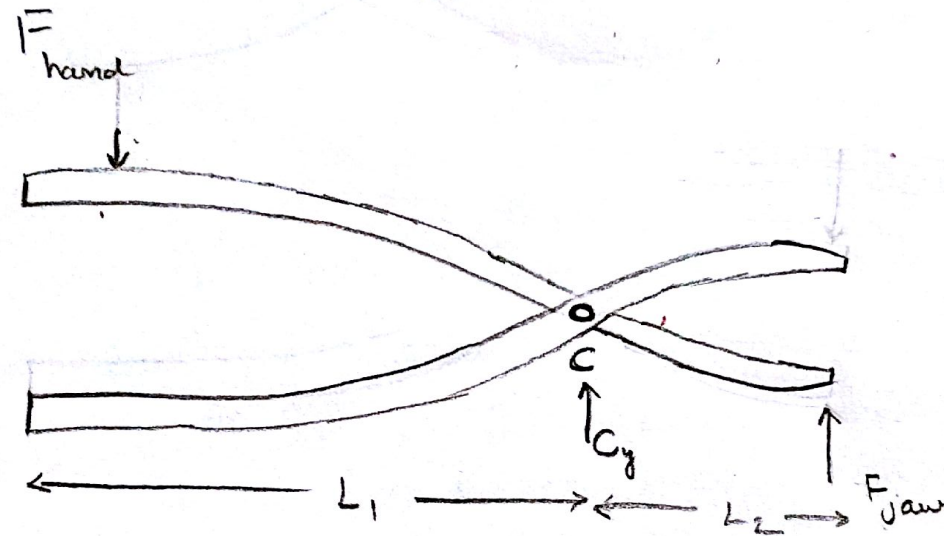
Moment → tendency of body to rotate about a specific point

②

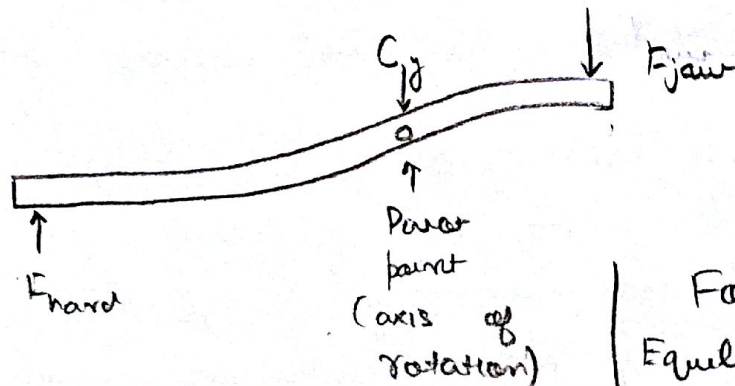
Pliers Stick figure



3 Free Body Diagram



4 Equations



Force on pivot = $(F_{hand} + F_{jaw})$

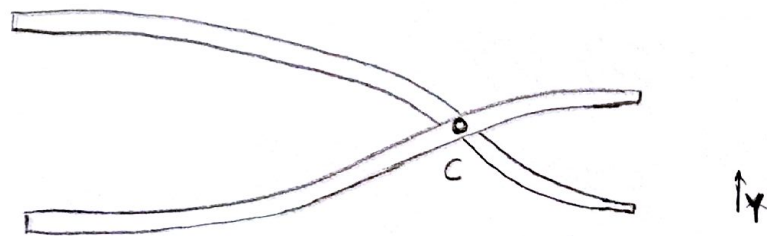
Moment about pivot = $F_{hand} \times \text{dist. } (L_1)$
 Moment about pivot = $F_{jaw} \times \text{dist. } (L_2)$

Force summation of equilibrium /
 Equilibrium of moments (about pivot point)

$$F_{hand} (L_1) = F_{jaw} (L_2)$$

$$F_{jaw} = \frac{L_1}{L_2} \times F_{hand}$$

5.



Revolute joint (C) / rivet

- Problems that could arise at pin joint / C || Resolutions
- Rivet could come loose if huge force is applied (wear and tear over a long period of time)
 - Friction b/w two grippers could increase (oiling should be done)
 - Rivet / C / Pin should be flushed during manufacturing along with ensuring max/z movement while moving grippers
 - Should be made of strong metal (forged steel / chromium) for the rivet on the gripper arms to not get distorted at the points where force is experienced. 1 DOF movement should be preserved.

6.

- Inaccurate fit of rivet at the joint will make for wobbly tips that may not align, especially after long use
- If the grippers are not manufactured with micron accuracy, these might not align after addition of joint.
- If the gripper / pin joint metal is ^{not} strong, it might distort / bend after elongated use (gripper bones might bend) leading to non-alignment.

①

Strategy → make multi-function lineman plier [CHOSEN] for FRDPARC
 → make a single operation plier (bending plier, locking plier etc.)

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1. Manipulation Operations	Rotating / Twisting Cutting Bending Compressing Pulling	→ serrated jaws, 1 mm pitch → Blade strength. [High carbon tool steel] → Min. dia. bend restricted. Doesn't function as nose plier → Leverage eq ⁿ $\frac{a}{b} \times M_1$ where M_1 is applied force → Pulling wire cut of pipes. Narrow width of nose for clearance $(a/b) \times M_1$, where M_1 is hand force Rubber grippers Non-adjustable. Restricted to 45°	Analyzed current serrations on tool Wiki, Metal strengths book Made for medium object's operation Freshman physics wiki, real world usage High density vulcanized rubber Med. object can fit Med. gauge wire thickness [Gauge chart]	Serrations might be destroyed Cost Grippers might be destroyed	Laser hardening Look for alloy if not molybdenum Object should still be polished and usable
2. Ergonomics / Ease of use.	Optimal Leverage → Increasing grip on handles → Range of motion → Narrowing head/jaws for more delicate operations → Cutting blade shouldn't bend → Serrated front for better grip on object → Weight of pliers → Arms / Jaws shouldn't bend after elongated use → Resolute joint should remain fixed after long use.	3-5 mm thickness as opposed to 10 mm thickness of arm High carbon tool steel 1 mm pitch Optimal length / leverage ratio High carbon tool steel → High carbon tool steel → optimal fit to micron	Med. gauge wire thickness Strength of materials book Current serration on real object Made for med. objects. Doesn't have to be long like tongs. Strength of mat. book. YouTube - How to make pliers	Might face abuse with stronger metals Cost	→ Strengthen blade tips with laser → use stronger or lock at all joints → Look at usage of High carbon steel alloy
3. Durability				Cost	