



RoboJackets



THE ARTHUR M. BLANK
FAMILY FOUNDATION

2007 TE Sessions – Mechanical Power
Transmission
September 25, 2007

www.robojackets.org



Power



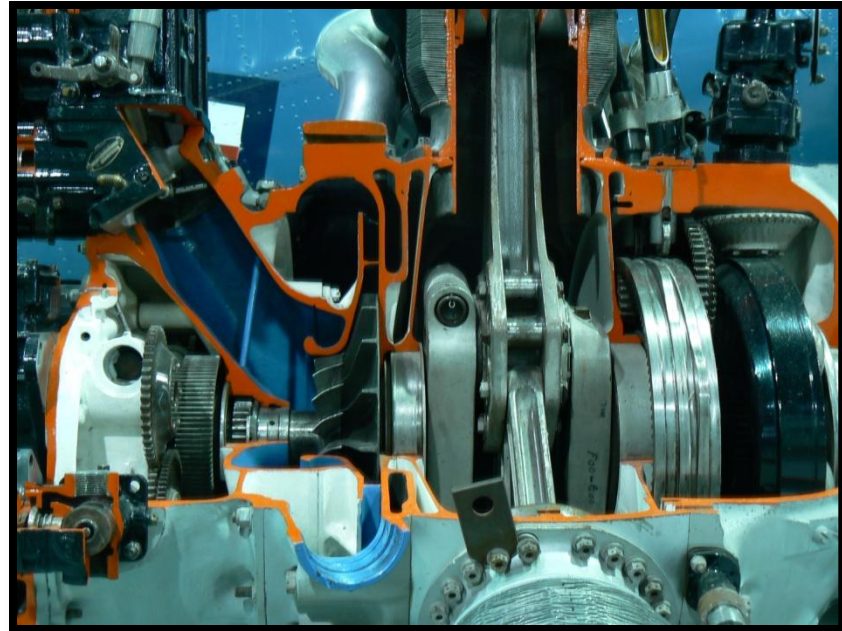
- Physics
 - Work / time
 - Torque x angular speed
 - Force x velocity
- Idea
 - Your robot in motion
 - Make your motors useful



Power (Cont)



- Factors
 - Force
 - Torque
 - Velocity
- Implications
 - Heat
 - Efficiencies
 - Noise = Bad vibrations





Work & Energy



Work

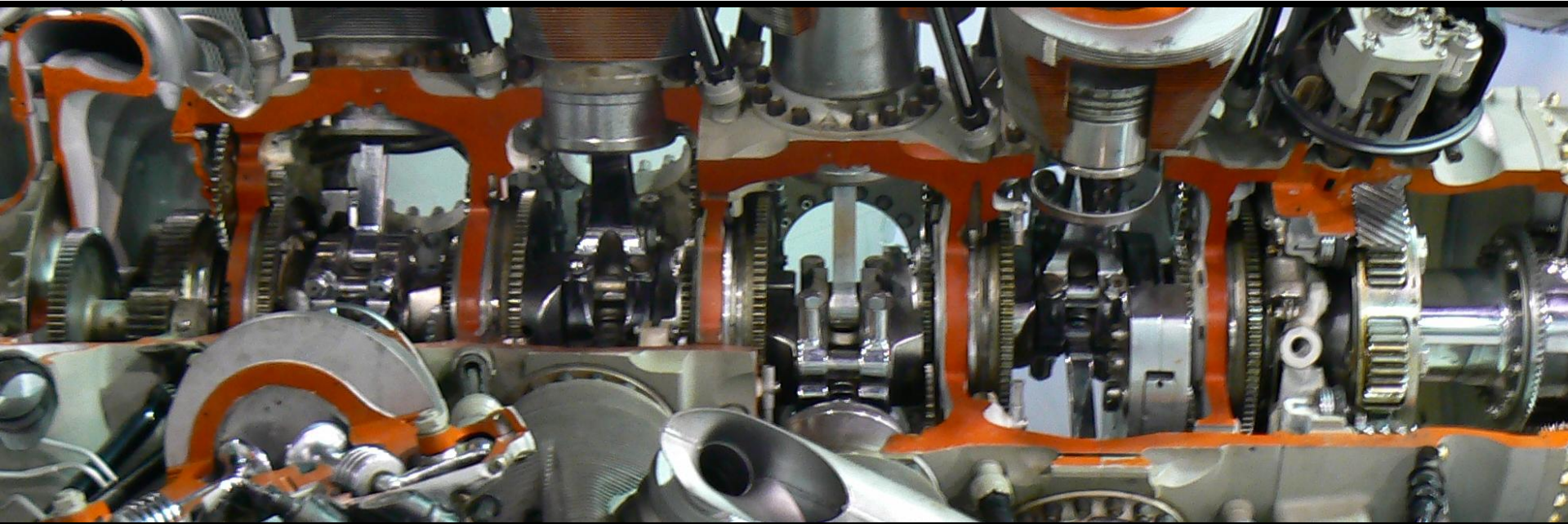
- Applied force x distance
- Δ Energy



A tugboat pulling a ship

Energy

- Mechanical
 - Kinetic
 - Potential
- Is conserved
- Losses to:
 - Efficiency issues
 - Friction
 - Sound
 - Heat



MECHANISMS

*Pratt & Whitney R-4360

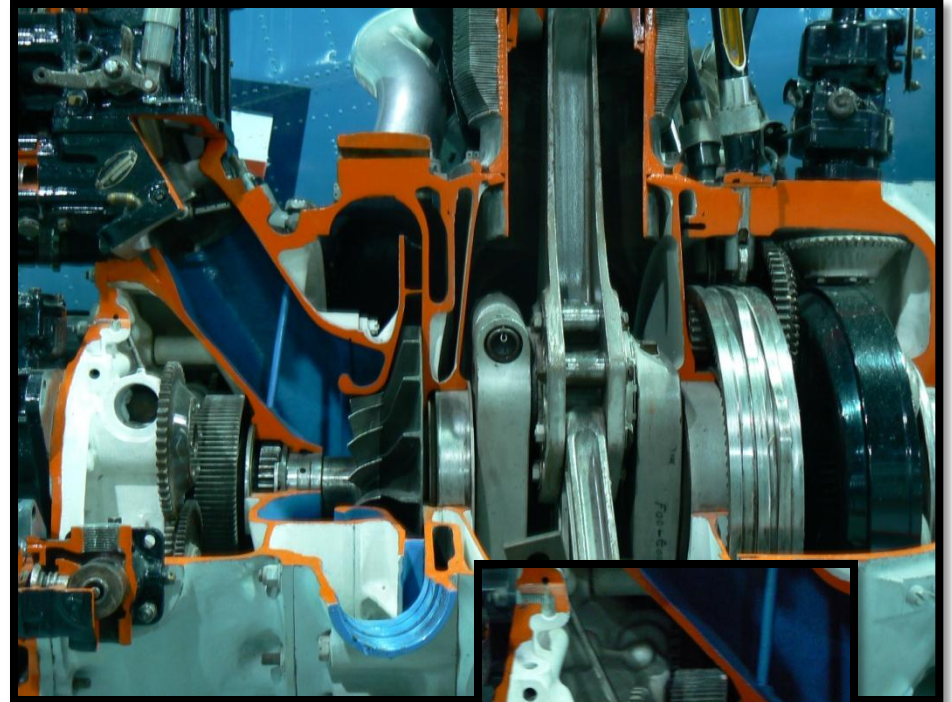
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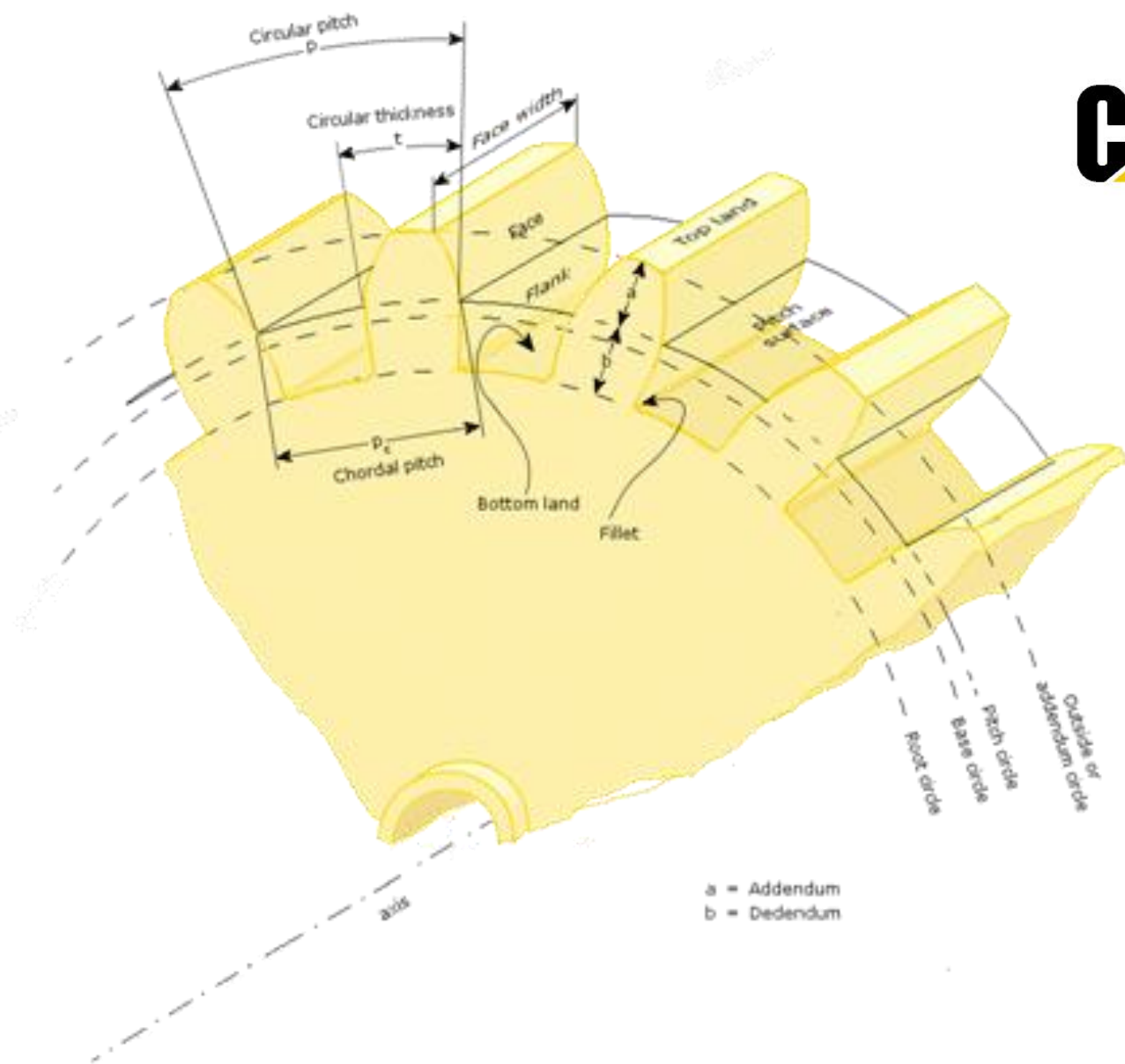


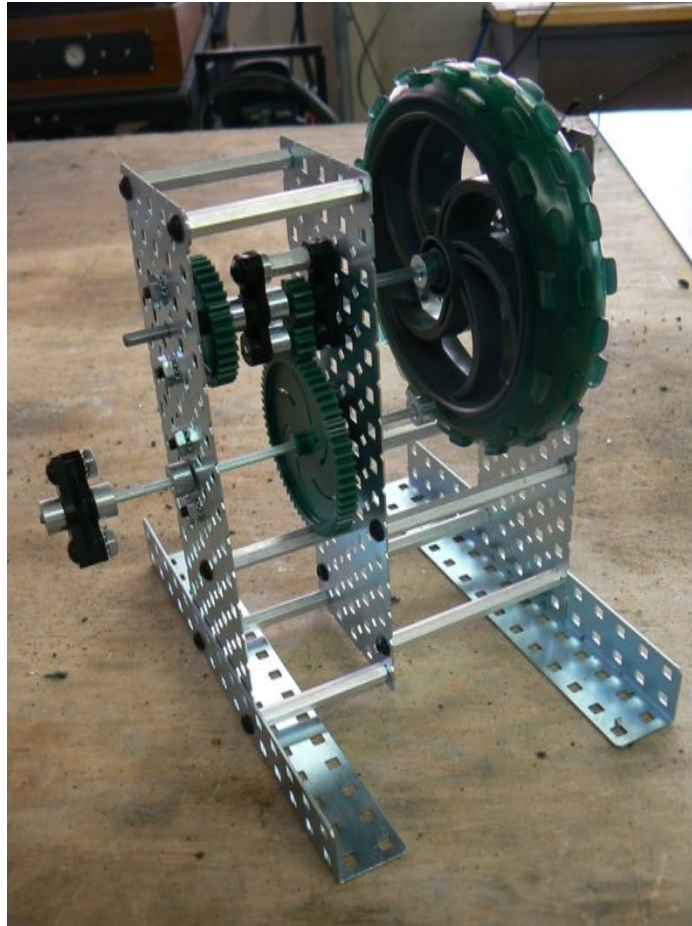
Gears



- Types
 - *Spur*, Helical, Bevel, Internal, More
- How they work
 - Teeth
 - Pitch Diameter
 - Center line of meshing







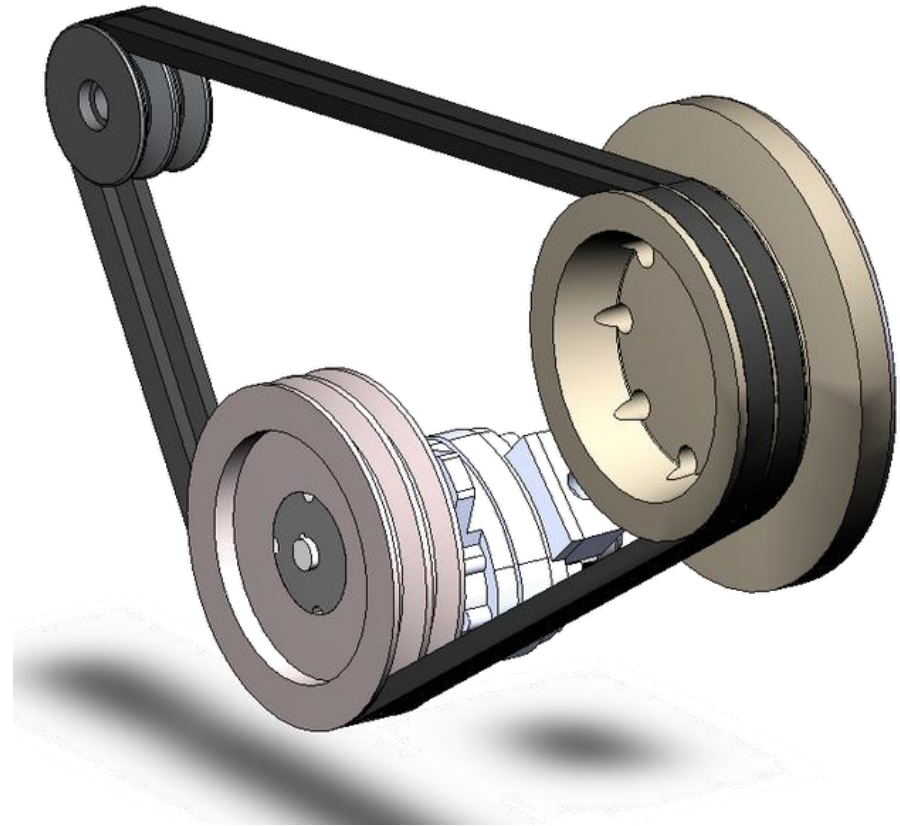
Gears Demo



Belts & Pulleys



- Types
 - V-Belts
 - Timing Belts
- How they work
 - V-Shaped Groove
 - Notches
 - Pitch diameter
 - (outside pulley)

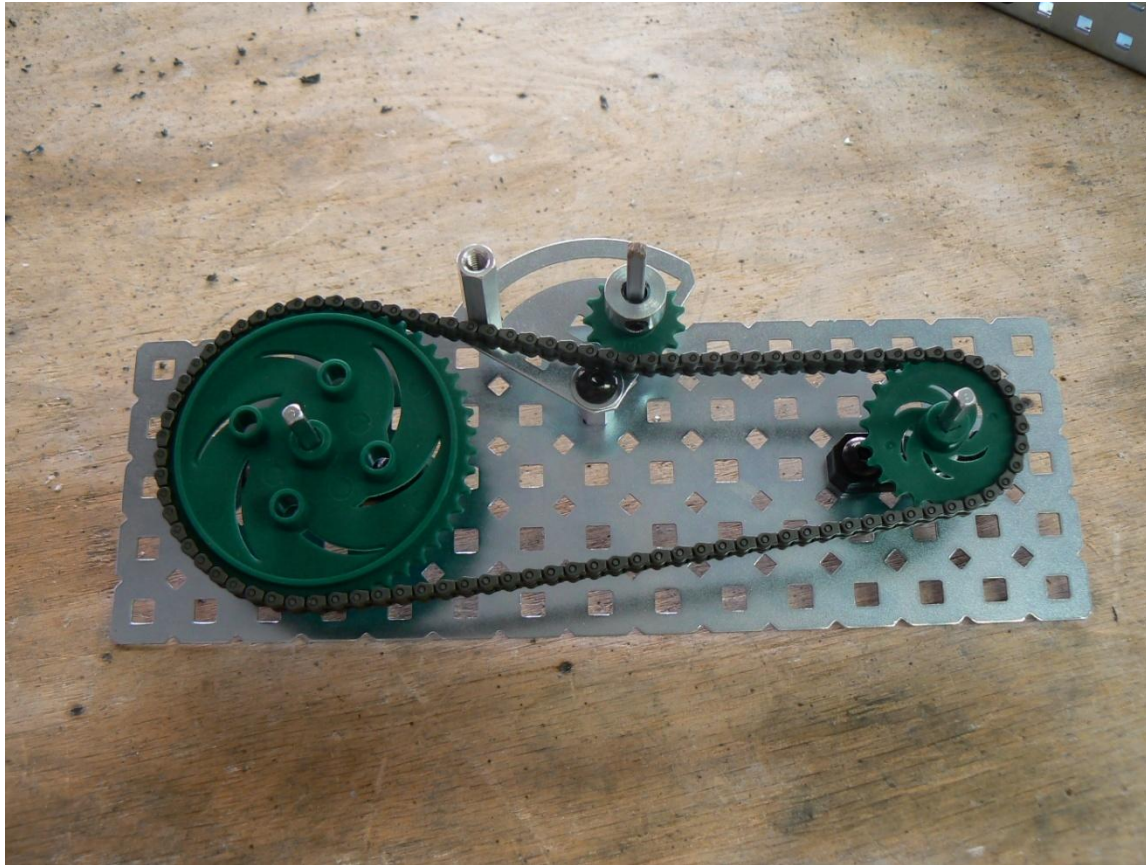




Chains & Sprockets



- How they work
 - Links
 - Master Link
 - Connects ends / links (Full and half)
 - Chain Numbering
 - 35 Larger stronger, but less efficient
 - 25 Smaller, lighter, weaker, but more efficient.
 - Pitch diameter (chain centerline)



Chain Demo



Cable & Pulleys



- Systems
- Compound
- Advantage
 - Increase force



Gear Ratio



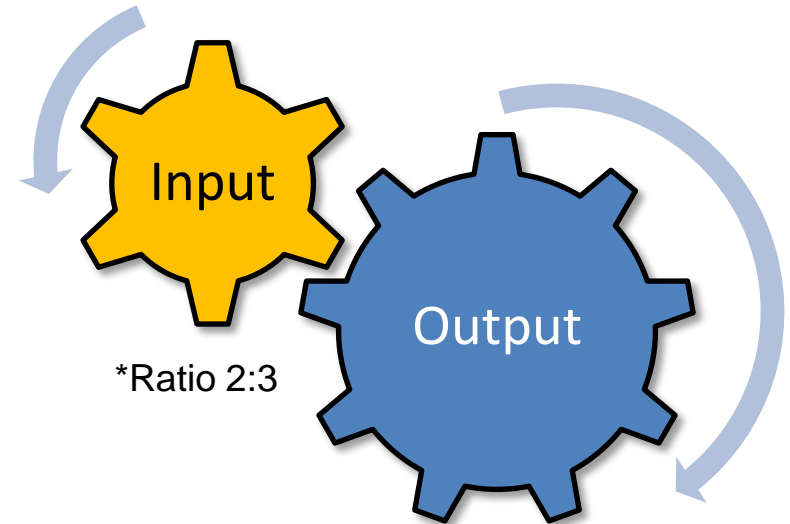
- Input : Output or input/output
- Gears and Sprockets
 - Teeth : teeth
- Pulleys and Belts
 - Diameter : Diameter
 - Can be used in all instances



Gear Ratio (Cont'd)



- Big Input : Small Output
 - Speed Faster
 - Torque Less
- Small Input : Big Output
 - Speed Slower
 - Torque More
- Same In and out
 - Direction Changes

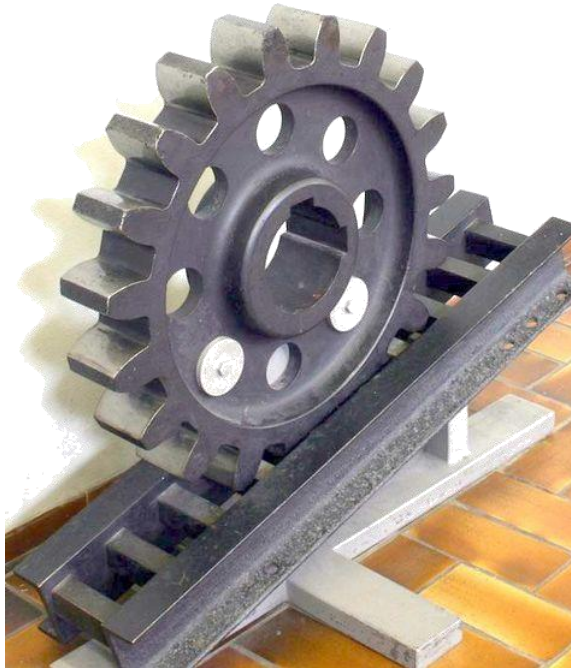




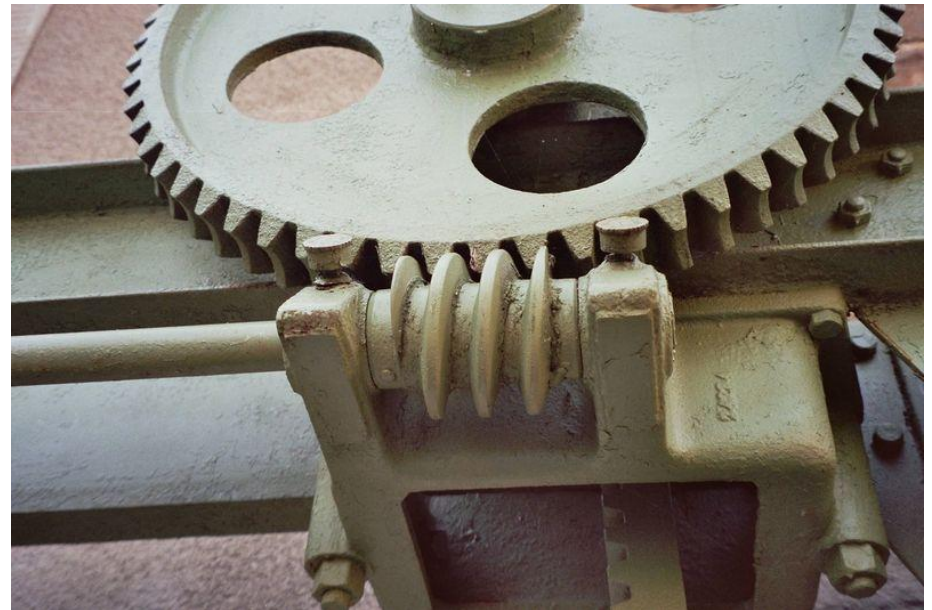
Special Configurations

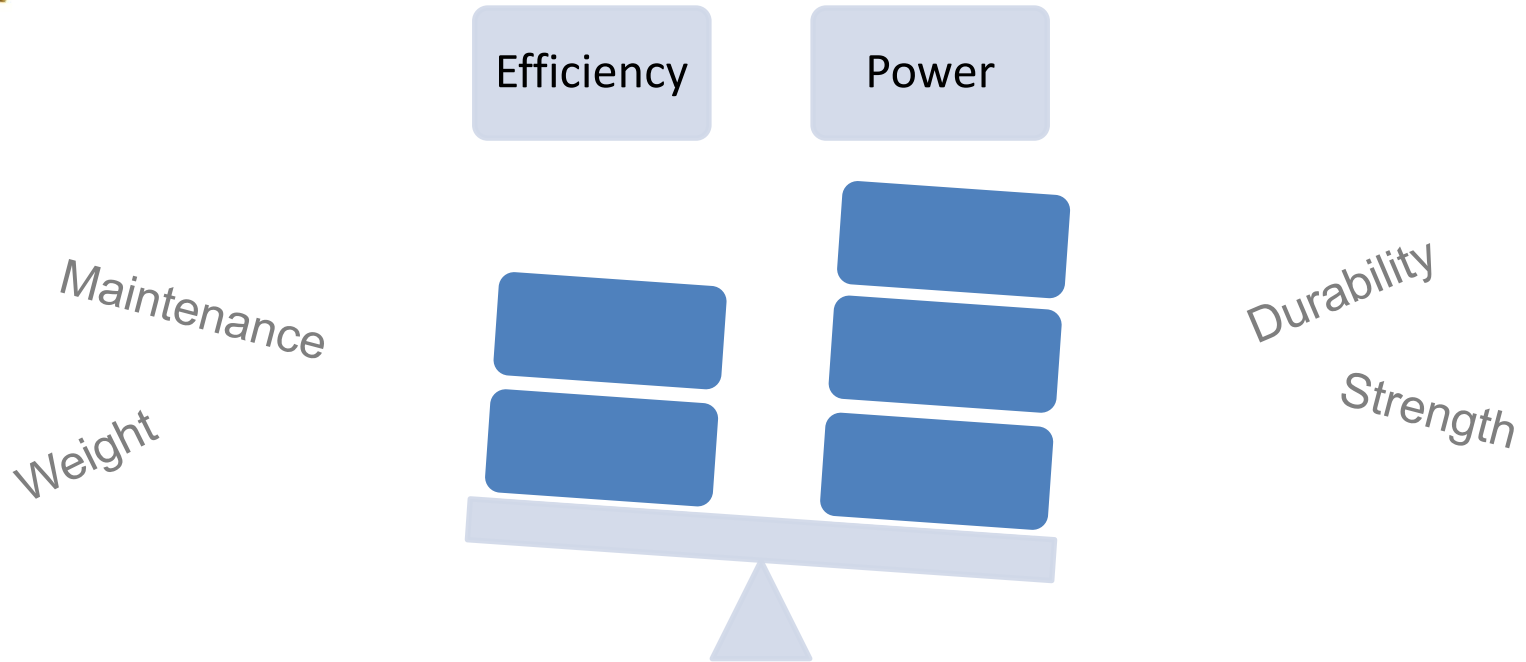


Rack and Pinion



Worm and Worm Gear





ADVANTAGES & DISADVANTAGES



Gears



- Good
 - Easy to design with
- Bad
 - Weight – You will be removing mass
 - Backlash
- Other
 - Location – Motor is close to output



Belts



- Good
 - Weight – Much less / no need to remove mass
- Bad
 - Tensioning – Could skip/slip
 - Deforms more
- Other
 - Location – Motor can be far from output



Chains & Sprockets



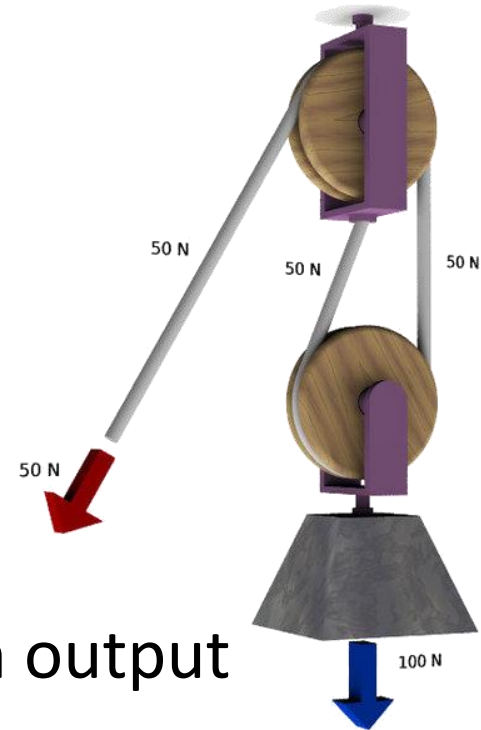
- Good
 - Weight – Much less
- Bad
 - Tensioning & Re tensioning – could skip
 - Less efficient transfer compared to gears
- Other
 - Location - Motor can be far from output



Pulleys



- Good
 - A potentially easy way to gain mechanical advantage
- Bad
- Other
 - Location – Motor can be far from output
 - Need constant tension





Special



Rack and Pinion

- Alignment

Worm and Worm Gear

- Back drive impossible
 - unless failure occurs
- High gear ratios (30:1)
 - Very slow output relative to input



ACTIVITIES





Build Gear Box



- Ratio
 - 3 : 1 (Reduction)
 - 1 : 5
 - Same : Same



Build Drive Base





What to expect



- Gears
 - More than one stage
- Combinations



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