

Simple Machines

Mechanical Advantage (MA)

$$IMA = \frac{D_E}{D_R} \qquad AMA = \frac{F_R}{F_E}$$

$$\% \text{ Efficiency} = \left(\frac{AMA}{IMA} \right) 100$$

IMA = Ideal Mechanical Advantage

AMA = Actual Mechanical Advantage

D_E = Effort Distance D_R = Resistance Distance

F_E = Effort Force F_R = Resistance Force

Lever

1st Class



2nd Class



3rd Class

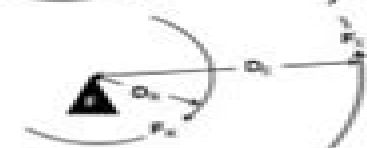


Wheel and Axle

Effort at Axle



Effort at Wheel



Pulley Systems

IMA = Total number of strands of a single string supporting the resistance

$$IMA = \frac{D_E \text{ (string pulled)}}{D_R \text{ (resistance lifted)}}$$

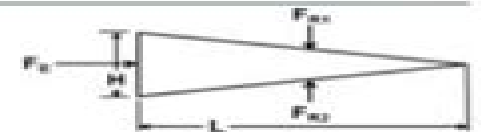
Inclined Plane

$$IMA = \frac{L \text{ (slope)}}{H}$$



Wedge

$$IMA = \frac{L \text{ (L to height)}}{H}$$



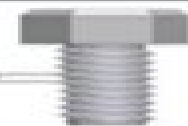
Screw

$$IMA = \frac{C}{\pi r H}$$

$$\text{Pitch} = \frac{1}{\text{TPI}}$$



Pitch



C = Circumference

r = radius

Pitch = distance between threads

TPI = Threads Per Inch

Compound Machines

$$MA_{\text{TOTAL}} = (MA_1) (MA_2) (MA_3) \dots$$

Gears; Sprockets with Chains; and Pulleys with Belts Ratios

$$GR = \frac{N_{\text{out}}}{N_{\text{in}}} = \frac{d_{\text{out}}}{d_{\text{in}}} = \frac{\omega_{\text{in}}}{\omega_{\text{out}}} = \frac{T_{\text{out}}}{T_{\text{in}}}$$

$$\frac{d_{\text{out}}}{d_{\text{in}}} = \frac{\omega_{\text{in}}}{\omega_{\text{out}}} = \frac{T_{\text{out}}}{T_{\text{in}}} \text{ (pulleys)}$$

Compound Gears

$$GR_{\text{TOTAL}} = \left(\frac{B}{A} \right) \left(\frac{D}{C} \right)$$



GR = Gear Ratio

ω_{in} = Angular Velocity - driver

ω_{out} = Angular Velocity - driven

N_{in} = Number of Teeth - driver

N_{out} = Number of Teeth - driven

d_{in} = Diameter - driver

d_{out} = Diameter - driven

T_{in} = Torque - driver

T_{out} = Torque - driven

Civil Engineering Material Quantity Formulas

CO Houle



Civil Engineering Material Quantity Formulas:

Unveiling the Magic of Words: A Report on "**Civil Engineering Material Quantity Formulas**"

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