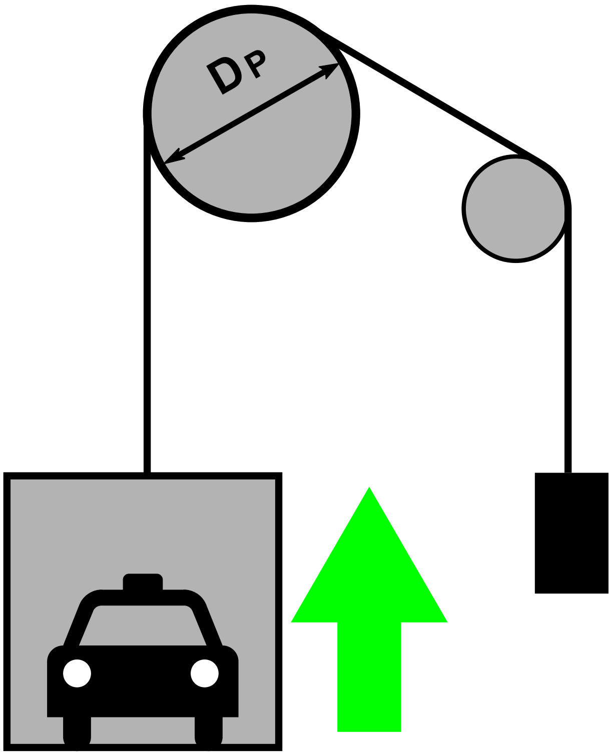
Elevator



Elevation

Belt, chain or cable driven elevators have multiple applications, such as industrial freight elevators, automated automobile parking garages, automated warehouses, production line part buffers, domestic elevators, etc. A counterweight is often used to reduce the required power. For precision applications, we recommend using a rack and pinion system instead.

Disclaimer

This tool has been created to assist engineers with the sizing of the different parts of the system. Calculations might not cover all corner cases. and results should always be checked by a qualified engineer. Under no circumstances shall we beheld responsible to any damages to persons or property due to correct or incorrect use of this tool, or to errors in it.

System Efficiency

$$\eta_t = \eta_e \cdot \eta_g$$

Net mass

$$m = m_{ca} + m_{lo} - m_{co} \quad [kg]$$

Weight Force

$$F_w = m \cdot g \quad [N]$$

Acceleration Force

$$F_a = m \cdot a \quad [N]$$

Total Force

$$F_T = F_w + F_a \quad [N]$$

Total Inertia as Seen by the Motor

$$J_{T1} = 91.2 \cdot (m_{ca} + m_{co} + m_{lo}) \cdot \left(\frac{v}{n_p}\right)^2 \quad [kg \cdot m^2]$$

Load to Motor Inertia Ratio

$$\Lambda = \frac{10000 \cdot J_{T1}}{J_M + J_R}$$

Constants	
Pi	$\pi \simeq 3.141592654$
Acceleration of Gravity on Earth	$g = 9.80665 \ \frac{m}{s^2}$
Inputs	
Drive Pulley Diameter	$D_P \ [mm]$
Elevator Platform Mass	$m_{ca} \ [kg]$
Counterweight Mass	$m_{co} \ [kg]$
Mass to Lift	$m_{lo} \ [kg]$
Linear Speed	$v \ \left[\frac{m}{s}\right]$
Acceleration Time	$t_a \ [s]$
Service Factor	K_A
Elevator Efficiency	η_e
Max. Motor Speed During Cycle	$n_1 \ [rpm]$
Motor Inertia	$J_M \ [kg \cdot cm^2]$
Gearbox Efficiency	η_g
Gearbox Inertia	$J_R \ [kg \cdot cm^2]$
Positioning Accuracy	$A_p \ [mm]$

Acceleration

$$a = \frac{v}{t_a} \ \left[\frac{m}{s^2}\right]$$

Pulley Rotational Speed

$$n_p = \frac{60 \cdot 1000 \cdot v}{\pi \cdot D_P} \ [rpm]$$

Motor Power

$$P_1 = \frac{m \cdot g \cdot v}{1000 \cdot \eta_t} \ [kW]$$

Ideal gearbox ratio

$$i = \frac{n_1}{n_p}$$

Ideal Gearbox Backlash

$$\Delta \phi = \frac{60 \cdot A_p \cdot \frac{180}{\pi}}{\frac{D_p}{2}} \ [arcmin]$$

Required Gearbox Output Torque

$$T_2 = \frac{F_T \cdot D_P}{2000 \cdot \eta_t} \ [N \cdot m]$$

Required Gearbox Output Torque, Adjusted for Service Factor

$$T_{2KA} = T_2 \cdot K_A \ [N \cdot m]$$