University of British Columbia

MECH 325 - Mechanical Design I

Assignment 1

Gear Train Design

GROUP C2

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Velocity = 12345 mm/sec
Cost = $1245
Performance Metric = 12345 mm/$s

1 Summary

2 Appendix

2.1 Power Screw Analysis

The objective of this section is to find the minimum required torque and rotational speed needed to lift the 2500 kg load at 4 mm/sec.

The torque required to lift a load with gravitational force F is:

$$\tau = \frac{F d_m}{2}\left(\frac{l + \pi f d_m}{\pi d_m - f l}\right) \tag{1}$$

Parameters			
Symbol	Value	Units	Description
F	2500×9.81	N	Axial compressive force
d_m	57	mm	Mean diameter
l	6	mm	Pitch
f	0.08	N/A	Friction Coefficient

A torque of 79.5 Nm is required to lift the load where efficiency losses in the power screw is accounted for by the friction coefficient, f.

2.2 Worm Gear Efficiency Analysis

Worm gears are used in high torque applications but they are subject to efficiency losses during operation. Calculating this value allows us to find the gear train required to raise the load.

$$\eta = \frac{cos\phi_n - f tan\lambda}{cos\phi_n + f cot\lambda} \tag{2}$$

The helix angle component is as follows:

$$\tan\lambda = \frac{p_x}{\pi d_p} = 0.4074366 \tag{3}$$

Parameters			
Symbol	Value	Units	Description
N_G	18	N/A	Number of teeth on worm drive gear
N_w	2	N/A	2-thread worm
ϕ_n	14.5	degrees	Pressure angle
l	16	mm	pitch
p_x	32	mm	Axial pitch
d_p	25	mm	Worm pitch diameter
d_s	20	mm	Worm shaft diameter

2.3 Motor Torque Analysis

The motor provided has the following torque-speed curve. The maximum power output occurs when the motor operates at 2500 rmp with 2.5 Nm of torque.