# MTE 322 Project One Report

## Angle Grinder Power Tool

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# 1 Introduction

# 2 Assumptions

The following solutions are under the assumption that the $F_{xz}$ is the maximum force that the angle grinder can output. If an external force equal to and opposite of $F_{xz}$ is applied at the contact point, then the angle grinder will not be able to spin. It is also assumed that the force $F_y$ is the normal force on the angle grinder applied by the user.

# 3 Question One

The general expressions for all contact forces of the gears and bearings is found with respect to $\beta$, as that is the only variable present. The value of $\beta$ will affect the output torque, and propagates through the calculations for forces. This will be shown below.

First, the output torque as a function of $\beta$ is found. The distance from the contact point to the centre of the shaft is given to be $\frac{4r}{5}$ where $r$ is the radius. The $z$ component of force, perpendicular to the distance from the radius, can be represented below in Equation 1.

$$F_{xz} \cdot \cos(\beta) \tag{1}$$

$F_{xz}$ is given as $30N$, so the force at the contact point is $30N \cdot \cos(\beta)$. Thus, the torque can be found below in Equation 2 where the radius was given in the SolidWorks assembly as $55mm$.

$$\tau = F_{xz}\cos(\beta) \cdot \frac{4r}{5} = 30N \cdot \cos(\beta) \cdot \frac{4 \cdot 0.055m}{5} = 1.32 \cdot \cos(\beta)Nm \tag{2}$$

The rotational velocity is given as $n = 2550rpm$, and should be converted into units of $rad/s$ for calculations. The conversion is shown below in Equation 3

$$\omega = n \cdot \frac{2\pi rad}{1rev} \cdot \frac{1min}{60s} \rightarrow 2550rpm \cdot \frac{2\pi rad}{1rev} \cdot \frac{1min}{60s} = 267.04rad/s \tag{3}$$

The equation for power and ensuing output power is found below in Equation 4.

$$\mathbb{P} = \omega \cdot \tau \rightarrow \mathbb{P}_{output} = 267.035rad/s \cdot 1.32 \cdot \cos(\beta)Nm = 352.49W \tag{4}$$

It is given that the bevel gear set has an efficiency of 90%. The definition of efficiency is found below in Equation5.

$$\eta = \frac{\mathbb{P}_{output}}{\mathbb{P}_{input}} \tag{5}$$

# 4 Question Two