Cutter Thickness = 0.075 m
Cutter Di = 0.650 m
Cutter Hth Depth = 0.080 m
Hex Size = 0.225 m across flat
RPM out = 158 rpm
RPM in = 1440 rpm
Cut Steel?
A36 Low Carbon Steel

.6 - .7 Tensile Strength around 400 MPa Stress required to cut (pressure)

**How determine cross section**

\[ \text{Area} = \pi \cdot (\text{Dia}/2)^2 \]
\[ = \pi \cdot (0.65/2)^2 \]
\[ = 0.360 m^2 \]
\[ \text{Steel} = 2.4 \times 10^{-4} m^2 \]
\[ 3 \text{ mm thickness} = (2.4 \times 10^{-4}) \text{ m} \]

\[ 0.00024 \text{ m}^2 \]

\[ \frac{1}{2} \text{ pressure coming from one cutter and other half from other cutter but 100% pressure coming from motor, but when testing blade failure use } \frac{1}{2} \text{ pressure.} \]

So \[ 100,000,000 \text{ Pa} = \frac{F}{A} \]

\[ 40,000,000 \text{ Pa} = \frac{F}{0.00024} \]

\[ 400,000,000 (0.00024) = F \]

\[ q \approx 6000 N = F \] (Newtons)

Now we need to find force. We are going to use worst case and find it at blade tips.

\[ \tau = \frac{F r}{(1 + \ell)} \]

\[ \tau = F (0.650) \]

New Section 1 Page 2
\[ F = \frac{r}{\sqrt{u^2 + v^2}} \]

\[ C = \frac{F(0.650)}{2} \]

\[ = 96000 \left( \frac{0.650}{2} \right) \]

\[ = 31200 \text{ N.m} \]

How much hp required
so \( 31200 \text{ N.m} \) at 15

\[ \frac{1440}{15} = 96 \text{hp} \]

Efficiency of this gear train is around 70% (30% of energy is lost as heat)

So take \( 31200 \) and divide by gear ratio. \( \frac{31200}{96} = 325 \text{ N.m} \)

Now take into account 1-u 70% efficiency.

\[ \frac{325}{10} = 46.5 \text{ N.m in all} \]
\[ \text{Power (KW)} = \frac{\text{Torque (N.m) x Speed (RPM)}}{9.5488} \]

\[ \frac{465 \times 1440}{9.5488} = \frac{70123 \text{ watts}}{70.12 \text{ kW}} \]

\[ \approx 750 \text{ watts} = 1 \text{ hp} \]

\[ \frac{70123}{750} \approx 93.5 \text{ hp} \]

So to recap in order to reduce this number:

1. Bigger gear ratio
2. Smaller diameter belt
Smaller cross section material
softer material

Now all this is assuming the bias/shuttle/gear do not fail. I will do that later enjoy.