South Metropolitan Tafe
11/2017

M227586
ADV DIP
Of ENGINEERING

COREY WISE

LATHE AUTOMATION

CNC LATHE

CNC LATHE

The Objective of this project is to deconstruct an old manual lathe and reconstruct it as a more modern CNC lathe, which mean an automated system using computers, encoders and newly designed parts by the team

CNC lathes are now a staple and important part of the manufacturing industry since most or all Lathe are CNC because its computerized and easily able to manufacture objects beyond the skill level of most machinists and create otherwise timely and technically challenging materials with ease.

During our time trying to finish this project our main object is to finish the Z-axis and X-axis and possibly the tool changer, unfortunately not all the objectives we aimed for we accomplished

Throughout this report I will identify things I have done and helped with during the duration of the report

The reports body will be separated into three parts design, manufacturing and research

Then I will discuss what could have been done better and more efficiently

The Body will consist of 3 main steps the we took as a whole team during every specific task, which was first to research it then to design either a work around or a better design and lastly to get it manufactured.

RESEARCH

During the starting step of the Project we were tasked with research specific part of a CNC LATHE and compiling that knowledge in a collective program called GITHUB, I personally was tasked with finding out the base prices of CNC lathe and also compiling them into a bill of materials so the cost of such extra materials such as motors and encoders as well as sensors, came into play.

Finding such prices of encoders and servo motors was also a part of my specific research what was there RPM and finding there Torque. Finding a coolant pump and how big we needed it and what specific coolant we would be using was also needed. *See appendix 1*

When researching the ball screws with Miguel we used a formula to make sure it could with stand the load that would be forced upon the axis

Researched ball screws, the formula need and using this calculated the ball screws needed for our lathe

$$Lead = \frac{Chuck\ angular\ velocity\ (RPM) \times Feed\ rate\ \left(\frac{mm}{rev}\right)}{Manual\ angular\ velocity\ (RPM)}$$

$$T_{ball\ screw} = \frac{F_{mot} \times Lead}{2\pi \times \eta_{ball\ screw} \times 1000}$$

With these two formulas and also the breakdown of our forces and determining the cutting forces (produced by Miguel) we were able to obtain the toque on the ball screws. For the z-axis or The Apron we got a total force of <u>**4632.5N**</u>

$$F_{mot} = F_F + F_A = 1182.5N + 3450\ N = \mathbf{4632.5N}$$

Then using the above ball screw formula we get **8.2Nm**

And apply the safety factor we obtain the final **10.9Nm**

Repeating this method for the x-axis or tool post

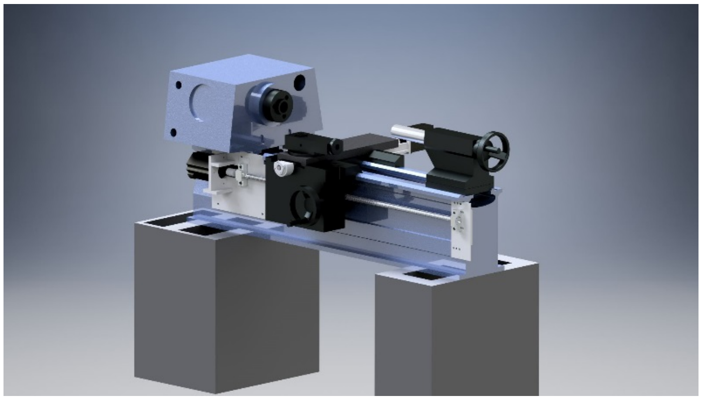
We get $\mathbf{2868.2}\boldsymbol{N}$ for total collective force which makes our ball screw torques **5.1Nm** which makes it **6.8Nm** with a safety factor.

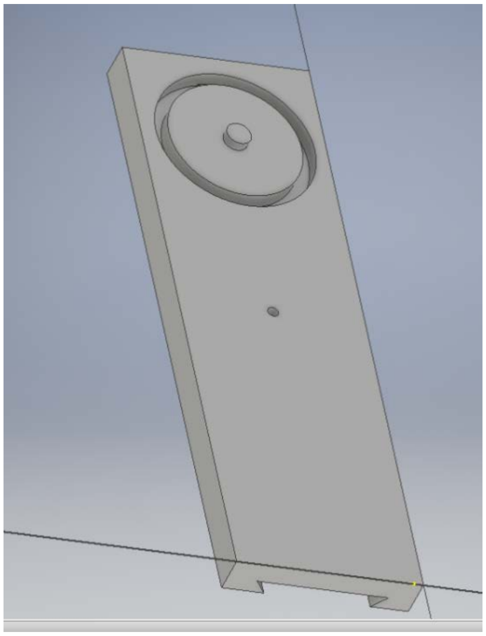
I also did extensive research on the CNC Lathe Cover and what type of material what slide would work the best, and what type of shape would be acceptable for us to build given our motors being unattached to our CNC saddle.

DESIGN

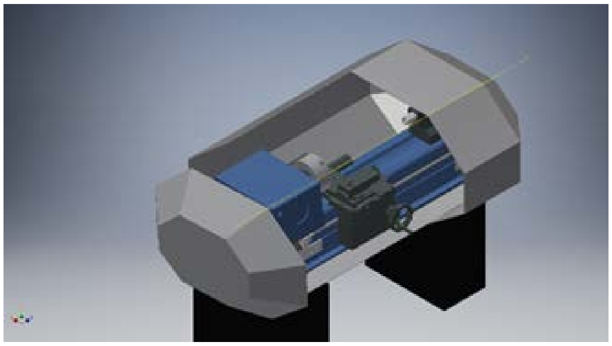
After extensive research we approached the design stage of the project, which started off with pulling apart the CNC lathe and every person taking a few bits of the lathe and designing in AUTO CAD to create a virtual assembly of the lathe so we design any extra bit to add onto the lathe so we could add such thing as the ball screws and servo motors.

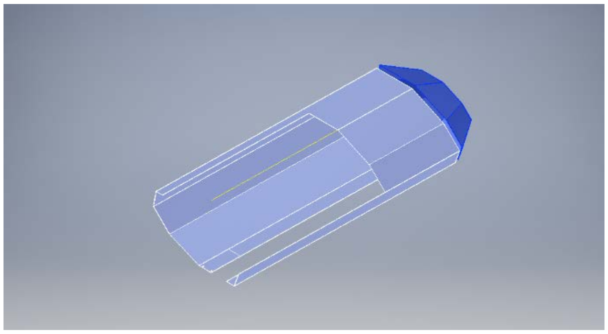
I personally designed the X axis saddle and the Lathe cover, and the old manual tool changer which was not needed for the design so it was scraped before finish.

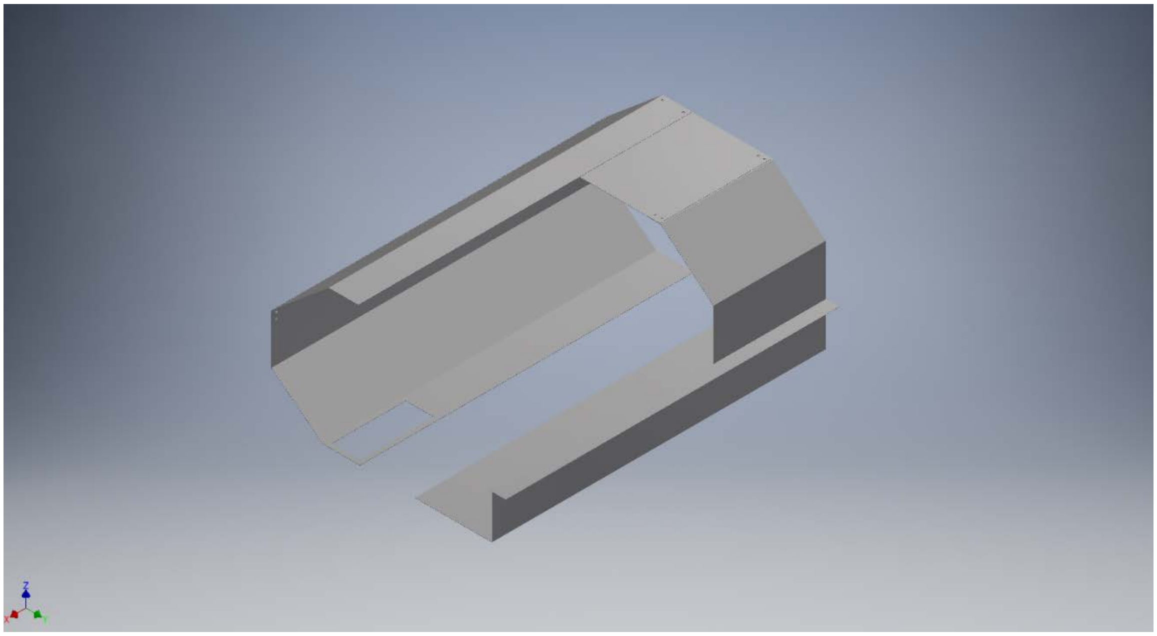




In the pictures to the right you can see the first original design of the CNC lathe Cover and in the bottom you can see the updated design and final design. The end cover for the final design still had to be made and designed. The cover was to be made out of 3mm thick sheet metal and plexi glass as a viewable window to see through whilst watching the machine work. Also bar were to be wielded on the outside in case it ever smashed through the glass.







MANUFACTURING

During my time on the project the only thing I had to manufacture was the lathe cover but was taken over fully by Sean after the first design to make the drawing but it was never manufactured. The design can be easily adapted into a manufactured part later. Things like the ball screw supports were properly manufactured and the ball screws selection were purchased and added which are the main things need to at least get the lathe running to standard but it would not be safe until the cover was installed

CONCLUSION

In conclusion it was obvious that the design and manufacturing process of our project were clearly strung out and ineffective in achieving an end result as a group our efficiency in completing designs and also bring most objects to the manufacturing stage could have been far more desirable.

I could have also be more efficient with my time and help out other parts of the project that I was not actually a part of.

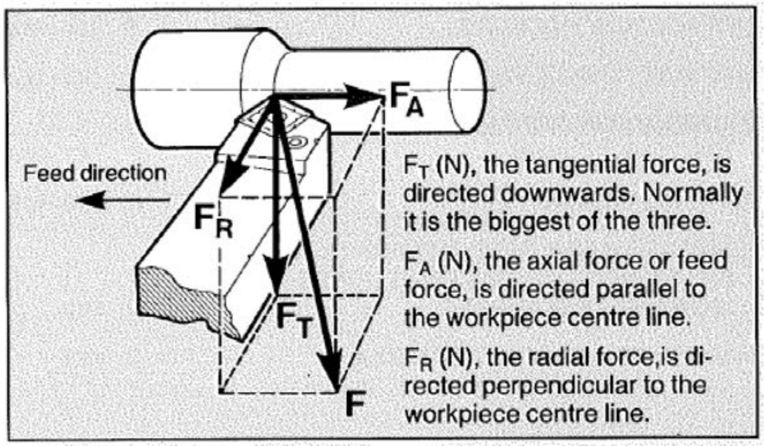
This was about the extent of my input during this year it wasn't as much as it could have been but I was looking forward to getting the assembly stage and getting more hands on because I think that is where I could of displayed more of my practical skill such as wielding and machining to help complete the physical product more than the virtual product.

There was work to be done but our communication as a team was lacking know what was free to be worked on or who needed help or anything that need to be improved.

In regards to the project as a whole the virtual side of things was finished but the physical was not

Reference 1 – Ocean Controls website

Reference 2 – The Engineering toolbox



The approximate relationship of these components to each other is: $F_T : F_A : F_R = 4:2:1$

k_s CORRECTION FACTORS FOR INSERT GEOMETRIES

	T-MAX P + NEGATIVE/POSITIVE											T-MAX U NEUTRAL			T-MAX COPYING	
INSERT GEOMETRY	TNMG CNMG SNMG DNMG 61	TNMG CNMG SNMG DNMG 15	TNMM CNMM DNMM 71	CNMM 62 TNMM 31	TNMM SNMM SNMG 41	TNMG CNMG DNMG VNMG	RNMG SNMG	TNMM CNMM SNMA DNMM	TNMA CNMA DNMA VNMA RNMA	RCMX SCMN	TCMM CCMN SCMN DCMN BCMN 52	TCMN CCMN SCMA DCMN VDMN 53	TCMA -71 KNOX DCMA VBMA	KNMX -12 -11	KNUX
Correction Factor	.95	.95	.85	.87	.85	.97	1.00	1.10	.90	.83	.95	.85	.80		

k_s CORRECTION FACTORS FOR ENTERING ANGLES

ENTERING ANGLE	90°	75°	72°	60°	45°	93° 95°	ROUND
Correction Factor	1.0	.96	.94	.86	.70	1.0	

ROUND (a, D):

a/D	Factor
.05	.22
.10	.32
.20	.43
.30	.52
.40	.58
.50	.63

k_s CORRECTION FACTORS FOR FEED RATES

Feed rate	0.1	0.15	0.2	0.25	0.3	0.35	0.4
Correction Factor	1.49	1.32	1.22	1.14	1.08	1.03	1.00
Feed rate	0.5	0.6	0.7	0.8	1.0	102	1.4
Correction rate	.94	.89	.85	.82	.77	.72	.69

item	Specifications	Unit	Quantity	Price	Sub-Total	GST	Supplier	Delivery	Website
Servo motor	NEMA 34 Easy Servo Motor 8.0 N.m	unit	2	$289.00	$578.00	$57.80	Ocean controls	$62.01	https://oceancontrols.com.
Servo motor driver	ES-D808 Easy servo driver, 80V, 8.2 A	unit	2	$229.95	$459.90	$45.99	Ocean controls		https://oceancontrols.com.
Power Cable (motor-driver)	3.0 Metre Power Extension Cable for Easy Servo Motors (LSK-003)	Unit	2	$21.00	$42.00	$4.20	Ocean controls		https://oceancontrols.com
Encoder Cable (motor-driver)	3.0 Metre Encoder Cable for motor using the ES-D1008 Drives (LSK-010)	Unit	2	$21.00	$42.00	$4.20	Ocean controls		https://oceancontrols.com
Motion Controller	4-Axis Standalone Motion Controller with Ethernet Support G Code	Unit	1	$1,229.00	$1,229.00	$122.90	Ocean controls		https://oceancontrols.com.a
Power Supply	1000W Mena Well RSP-1000-48 Single Output Switching Power Supply: 48VDC	Unit	1	$488.00	$488.00	$48.80	Ocean controls		https://oceancontrols.com.a
Rotary Encoder	Rotary Encoder - 1024P/R (Quadrature) with Shaft Coupler	Unit	1	$74.00	$74.00	$7.40	Ocean controls		https://oceancontrols.com
Coupling Z-Axis	L-Coupling L075 14-12mm bore 10 N.m	unit	1	$0.00	$0.00	$0.00	StateWideBearing	$0.00	http://www.statewidebearings.com.au/ content/uploads/L-COUPLINGS.new_.p
Coupling X-Axis	L-Coupling L075 14-8mm bore 10 N.m	unit	1	$0.00	$0.00	$0.00	StateWideBearing	$0.00	http://www.statewidebearings.com.au/ content/uploads/L-COUPLINGS.new_.p