MAE 183A Lab Final Report

Winter 2024

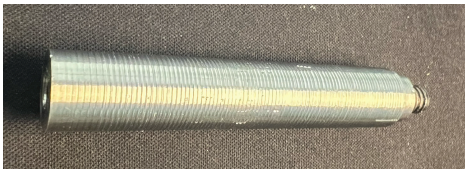
Group C2

I. Manual Machining

1.1 Ilan Berdy

As I look back upon this quarter, I realize that I have learned numerous lessons from my project. I have firstly been reminded of the importance of starting early. Starting early leaves room for error, which gives me the opportunity to fix mistakes and refine my work. It also means that I can have better access to workshop resources, like the machines and helpful staff. By starting ahead of the crowd, I avoided the rush for machinery, which spared me the need to work at inconvenient hours. Moreover, being one of the few people working during the start of the quarter demonstrated my commitment, which led me to create meaningful connections with the shop managers—a relationship I hope to continue past this course.

In addition, I have learned practical knowledge and techniques. One thing I learned is that the fly cutters in the UCLA machine shop are not that sharp, and I am oftentimes better off doing multiple passes with an end mill instead. Additionally, given that this was my first time working with a lathe, I learned that using too high of feed rates can cause irreversible grooves on the workpiece, as shown in the picture below, so slow and steady does indeed win the race!



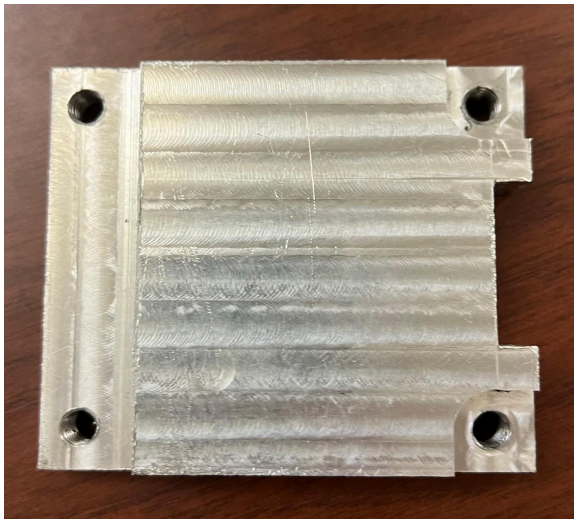
Thankfully, I was able to learn from my mistakes. I had to restart the fabrication of the chair leg because I miscalculated the drilling depth, a trivial error that was a result of oversight in mental arithmetic. However, this experience reminded me of the importance of meticulous calculation verification, even when seemingly straightforward. Through rigorous double and triple-checking, I plan to prevent such avoidable blunders in the future.

I look forward to my future machining projects, and I am grateful for the lessons I have learned in this class!

1.2 Ben Kim

This class was my first exposure to lathe and milling machining processes so I learned a lot. Throughout this process of machining the chair seat and leg, I learned that mistakes were very easy to come by. Mistakes I encountered early (with the lathe mostly) came from cutting too much material. I had to start my leg over twice and chair seat once which allowed me to get plenty of practice with using the machines and taught me to measure precisely before cutting. I found it valuable to be overly cautious and machining less material and making smaller cuts until reaching the correct specifications. While not ideal for times sake, I believe more experience will allow me to become more efficient with using the machines. When using the milling machine,

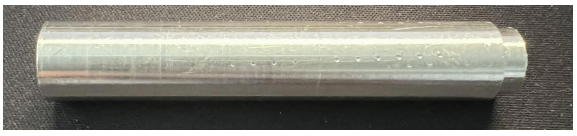
one mistake I made was not making sure the parallels were actually parallel. A small piece of material caused my part to be out of balance which created a slight incline in my chair seat. In the future, with this bit of experience under my belt, I believe I will be able to minimize mistakes and be much more efficient in the machine shop to make clean parts.

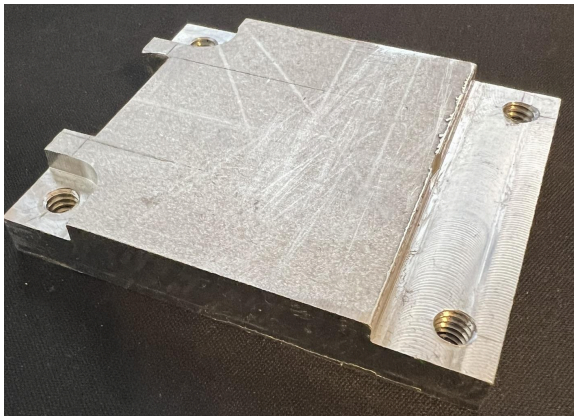



1.3 Tim Jun

I believe the most valuable lesson learned from this project on my part, was being able to ask for help from the staff in the lab and the other students in the lab. There were many times where I was stuck, unable to make any progress due to inexperience with the machinery and equipment. One moment in particular, was with my first failed attempt at the chair seat. I unfortunately made the mistake of using the bandsaw to cut it down to size, without realizing that it was mostly inaccurate, and led to more errors later on. I would have made the same mistake twice following the guide if not for the staff that pointed out that doing the entire job on the mill may be a better idea.

In terms of machining tips/knowledge I learned, I believe the most important is to be cautious, patient, and creative with the tools. When it came to lathing the chair leg, I accidentally removed too much of the stock, resulting in a huge delay in the process. However, using the remaining portion of the chair leg, it was still salvageable, and I was patient and careful with lathing the rest. Another point of caution I learned was checking the direction of movement when manually adjusting the machines. There were many moments where I had to second guess myself, but this is good, as it helped me not make as many mistakes.





From the drawings above, the mistakes are not as visible, but many of the mistakes stemmed from impatience and stress. Starting early was something I should've done, but I unfortunately made mistakes as a result. One of the mistakes I made was not remembering which direction pushed vs pulled. This resulted in a few divots being made into the stock where there shouldn't have been any. Something I could've done to improve is staying calm under pressure. I was stressed by being late, so I ended up making a lot more simple mistakes that could have been easily avoided.

1.4 Milad Mesbahi

Through this project, which happened to be my first experience with these types of manual machining, I quickly learned the significance of correctly using calipers, particularly for measuring circular objects. I often overlooked the necessary precision required for zeroing the device before use, which turned out to be very essential in ensuring the parts met the required tolerance.

My initial struggles occurred with problems securing a previously machined rod back into the lathe. The rod, now smoother and thinner, did not hold as securely as it did before machining. My oversight in not tightening it sufficiently resulted in unwanted and significant vibrations, which caused the rod to become uneven in diameter and develop numerous ridges along its length. I was able to notice this mistake quickly however, and this issue was fixed as I still had enough stock left to work with.

Although I was able to overcome this minor setback, my biggest mistake arose when I began to thread the holes of my chair leg piece. I neglected to use a crucial technique: alternating between screwing in and unscrewing (or "backing out") the piece. This practice helps distribute tension and prevent the build-up of strain on the material, and because I did not take this into account at the time, the continuous screwing action created excessive stress on the threaded piece. This built-up stress accumulated, leading to the unfortunate circumstance of the thread piece breaking off inside the chair leg. Although this was quite upsetting at the time and resulted in a point being taken off my leg piece, I learned the importance of applying proper techniques to

manage strain and avoid damaging components during assembly. A picture of this is shown below.

Another error occurred while using the milling tool; I struggled with positioning my part in the vice for cutting and incorrectly used the side face of the mill cutting tool. This left a part of my work rough and a bit jagged, unwanted when attempting to manufacture a utility like a chair. I later understood that allowing the part to extend out from the side of the vice while clamped would have prevented this mistake, and something important to keep in mind when I use a mill in the future.

II. CNC Machining

2.1 SolidCAM Programing

Our SolidCAM programming went much smoother than many of our manual machining parts as we were able to practice using SolidCAM in a guided manner the week prior. We began the process by ensuring we had an optimal design with our stock in place so we would indeed satisfy all of the tool dimensional requirements, creating a structured and methodical approach in the steps we were going to take to create our final chair back. Despite our precautions and success in this aspect of the lab, there were a couple of important lessons we gained as a group from this experience.

An important lesson we learned while using SolidCAM was forgetting to adjust the Z feed rate and the resulting impacts it had on the machining dynamics and outcome precision of our product. This parameter adjustment, which took us a bit to realize was the source of error,

directly correlated with improved tool performance and product quality, underscoring its significance in CAM processes. Furthermore, the sequencing of our machining operations also emerged as a critical factor for operational efficiency. We were quite effective with this aspect of the project, and were thus able to minimize a lot of tool changes and machining time. Optimizing machining workflows and understanding the interdependencies of various operations is an aspect of machining that is very important in producing an effective G-code and saving lots of time, which is an important skill to have when we work in industry as engineers.

We would also like to point out the limitations of the built-in simulations when working with SolidCAM, and ultimately the inevitable discrepancies that exist between simulated predictions and actual machining results. For example, simulations may inaccurately depict material remnants, which occurred for us during one of our cutting operations and was a point of confusion for a bit as we tried to understand why a small piece of our stock was not fully being cut. After a bit and with the help of our TA, we realized that this was a limitation of the simulation software. Taking all of these points under consideration allowed us to be relatively successful in the SolidCAM part of this project and learn important concepts for producing efficient G-code, which will be helpful for future machining endeavors.

2.2 CNC Machining

With regard to the CNC machining operation for this project, several key lessons emerged from this, particularly focusing on safeguarding the equipment we use and ensuring the accuracy of the overall machining process.

We quickly realized the importance of calibrating equipment before beginning the CNC process. Our TA Ray emphasized this greatly, as proper calibration ensures that measurements are precise and match the intended results of our simulation, thus leading to more accurate machining results. This is key to the success of the machining operation, as all subsequent operations are pretty dependent on these correct measurements and the machine operates exactly how you set it up.

Another important consideration was verifying that the workpiece is level and free from warping. A level and upwarped piece is what allows for uniform machining across the workpiece, and in our case is what produced the even surface of our chairback. Any deviation in the piece can lead to inconsistencies in the machining process, which can ultimately affect the quality and dimensional accuracy of our final chairback, which luckily had a smooth finish thanks to the help of our TA.

The integrity and protection of the vice is another aspect of CNC machining that is important to consider and can be put in jeopardy by the incompatible dimensions and placement of parallels. By making sure we use the right parallels for the given machining task, we can guarantee that the workpiece is held securely without imposing any sort of undue stress on the vice. Taking this precaution helps avoid any accidental drilling into the vice, which would be

quite unfortunate and cause damage to both the tool and the vice, thus resulting in costly repairs or replacements.

Collectively, the entire project greatly emphasized the importance of meticulous preparation and proper handling of equipment during the CNC machining process. By ensuring that the pieces are calibrated, workpiece integrity is maintained, and tool compatibility is necessary to achieve machining precision and safeguarding against equipment damage. We will use the lessons as a foundation for all future machining and engineering projects, and the concepts from this project will be invaluable towards engineering with manufacturing considerations taken into account.