Design For Manufacture

Coolest Pencil Case

By Raj Oak

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1. Executive Summary

Design For Manufacture is a class offered at Oregon State University which offers key insight in the process of product design and encourages its participants to design an existing product or work on a completely new product using different prototyping techniques and produce a full-fledged video depicting the design methodology and processes used while designing the product. The project that I have selected is a stationary holder for securely carrying my high end mechanical pencils and other writing instruments. The case that I currently use is made up of cheap polyester fiber material and does not provide adequate protection for my belongings. This prompted me to design a new product which I can make use of on a daily basis and serve the purpose with my own style. My goals in completing this project are that the case should be quite sturdy to withstand the normal pressure experienced in the carry bag, safely store all the stationary items, organize the items and have a good aesthetic appeal.

The class notes and the general comments by Dr. Bryoni DuPont, the class instructor, proved to be the key takeaways for finding the right manufacturing process and for material selection. Studying different online resources and videos helped me to select the exact material which is safe for usage with minimum safety equipments and right prototyping process to use. Also taking into consideration the manufacturing process that can be used for high volume production gave an insight into the industrial product designing field.

The product is a cuboidal shaped case for storing the regular stationary material like pencils, pens, ruler scale, eraser and thumb drives. This is a product which I decided to redesign as it is used by me on a daily basis and the existing design does not prove to meet my requirements. The main overarching design decision is to make the case out of hard material which can be aesthetically pleasing and having high workability along with providing a means to store items securely. It was found that there is no pencil case available in the market today which possess all the requirements for securely storing stationary items in an organized way. It was designed to be prototyped with the existing equipments involving multiple manufacturing processes to gain an experience for working on them.

The key takeaways from this report are the methods in which several design decisions were taken, why a particular material was selected over others and what were the benefits of the choosing a specific design procedure as compared to other methods, what were the lessons learned from the failures and design modifications done henceforth. The report also explains the design decisions failures and how they were identified and dealt with. It shows how important it is to think ahead of time into the possible failures and have a plan B ready to implement.

2. Background

I want to advance my career in the field of industrial product design and learn the key skills that are necessary for a product design engineer. The course Design For Manufacture encompasses most of the aspects that I wanted to study. This course gave me methodologies for design thinking, material selection, professional documentation, industrial experience of product design through two comprehensive think tanks and hands on experience while working on my final product. My goals were to learn all these skills and now I have an edge over my earlier experience in product design.

After deciding to design a new case for all the stationary items I read several reviews of the same product in order to know whether my issues are shared by any other users. I got interested in high end writing instruments like the mechanical pencil and fountain pens about three years back. It is very essential to store these items securely away from sharp objects in order to prevent scratching. For storing them I purchased a fabric pencil case which seemed to secure the items properly. But with the subsequent use of the product I was not satisfied with the quality of the product and wanted to design something which could meet my expectations.

3. Literature Review

(1)Additive manufacturing is a growing field and is rapidly developing in product design industry. Berman [1] has illustrated the applications of the 3D printing technology and compares such a technology with the current methods of mass custom made goods and some other processes. He has discussed the potential future application in terms of companies that can manufacture made to order parts specifically for the customers demand in very low volume thus having almost no inventory. The author also mentions the possible scenario where this rapid prototyping technology can take over the small lot manufacturing firms in countries having low wages. The main advantage of such a technology as mentioned is that the process can continue without the intervention of any humans. Current mass customization methods are team based and 3-D printing is largely automated and make use of CAD software. Comparing to different manufacturing methods author specifies the advantages of 3D printing like low cost over injection molded parts, also the cost of modifying the product is minimum. The possible use of 3D printing is also in medical industry like the dental fixtures can also be designed in-house without the need of conventional procedure used.

In contrast to prototyping, another branch which specifically deals with the prototyping is the branch of reverse engineering which was heavily used in the world war 2 era to know the technology of captured machinery from the enemies. Otto and Wood [2] discuss yet another approach or methodology for reverse engineering. The author indicates the connection of a product design when comparing the market value of the product and how it naturally follows an S – curve in its cycle and how this can be changed by going in a nonlinear way with respect to the curve and be competitive in the market. The adaptive and parametric redesign methodology is illustrated in the paper using an electric wok example which involves the documentation of exact customer demands and then hypothesize the working of the product or consult the design team and select their suggestion.

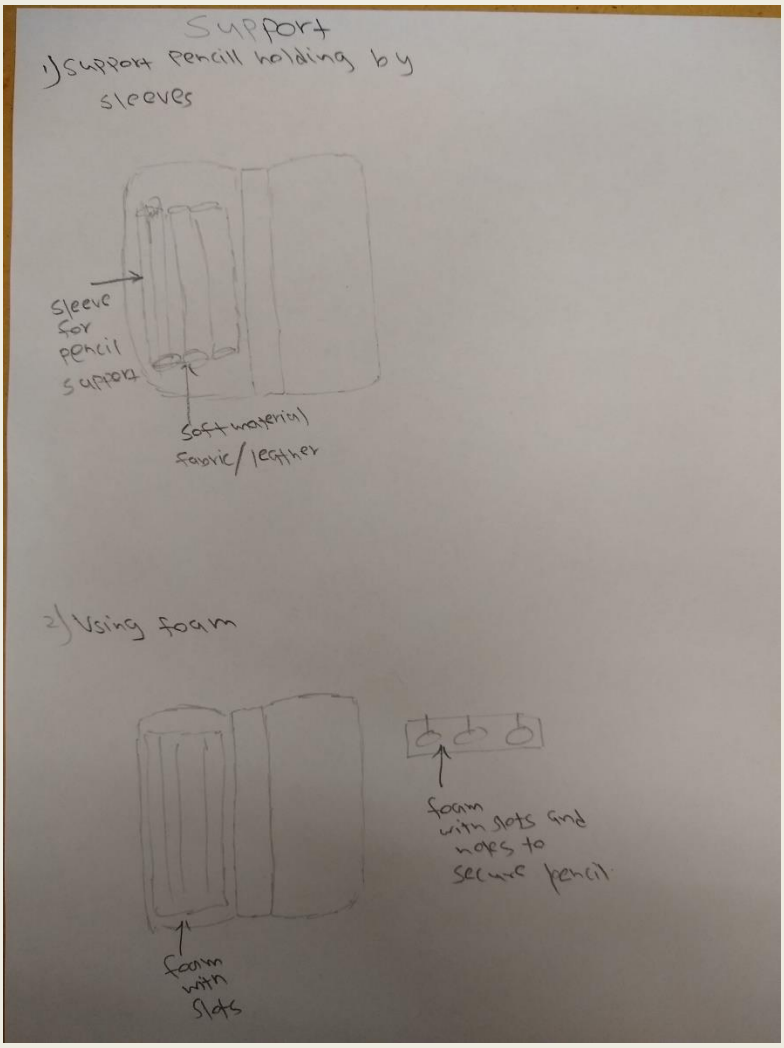
In accordance with the design procedure it is very important to consider the user preference for a particular design. Kleef, Trijp and Lunig [3] elicit the importance of the ‘voice of consumer’ in their paper which explains how important it is to listen to the customer while the early stages of the company. They also specify that the customer may not be always aware of what he wants (Ulwick, 2002). Researching the exact consumers can help you exceed in the market. The paper discusses a model for Opportunity identification, the subsequent Development phase and Optimizing the idea and finally launching the business or the product in the market. The paper is focused towards developing a kind of categorization scheme for different methods, to describe the methods along with the features and provide guidelines while choosing appropriate methods.

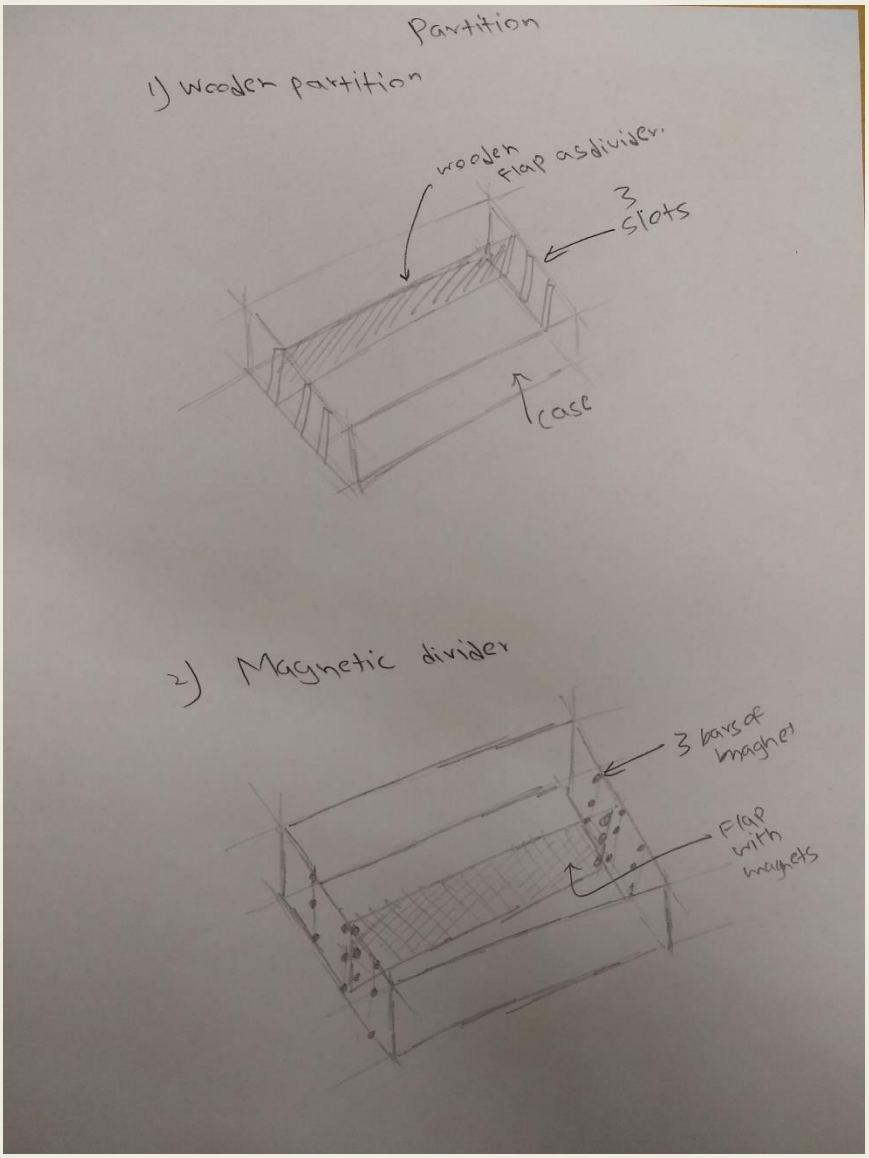
4. The Product

The product is the pencil case for holding all the stationary items that a student carries on a daily basis to school. It is designed to have maximum capacity and store all the items securely. It has a vintage vibe attributing to its custom made hinges and locking system along with the 3D decorative pattern embedded in the case to make the Coolest Pencil Case for the Coolest Kid in school.

5. Redesign Process

The main goals in redesigning the product were to eliminate the pain points to the greatest extent possible. The major point was to make the outer shell of the case of the hard material which will not get squeezed in when it is transported in a backpack, second have enough space to store all the items securely, third organize all the items stored inside and finally provide an aesthetically appealing look. I wanted to design a case having aesthetics which are never being used in a storage box which exemplify my interests and passion in a creative way. The main pain points that I intended to design out were the inadequate space for storage, no facility to securely store the items as the items get disoriented after taking them out for use, no useful facility for organizing all the stationary products and less aesthetic appeal and quality of the overall design.

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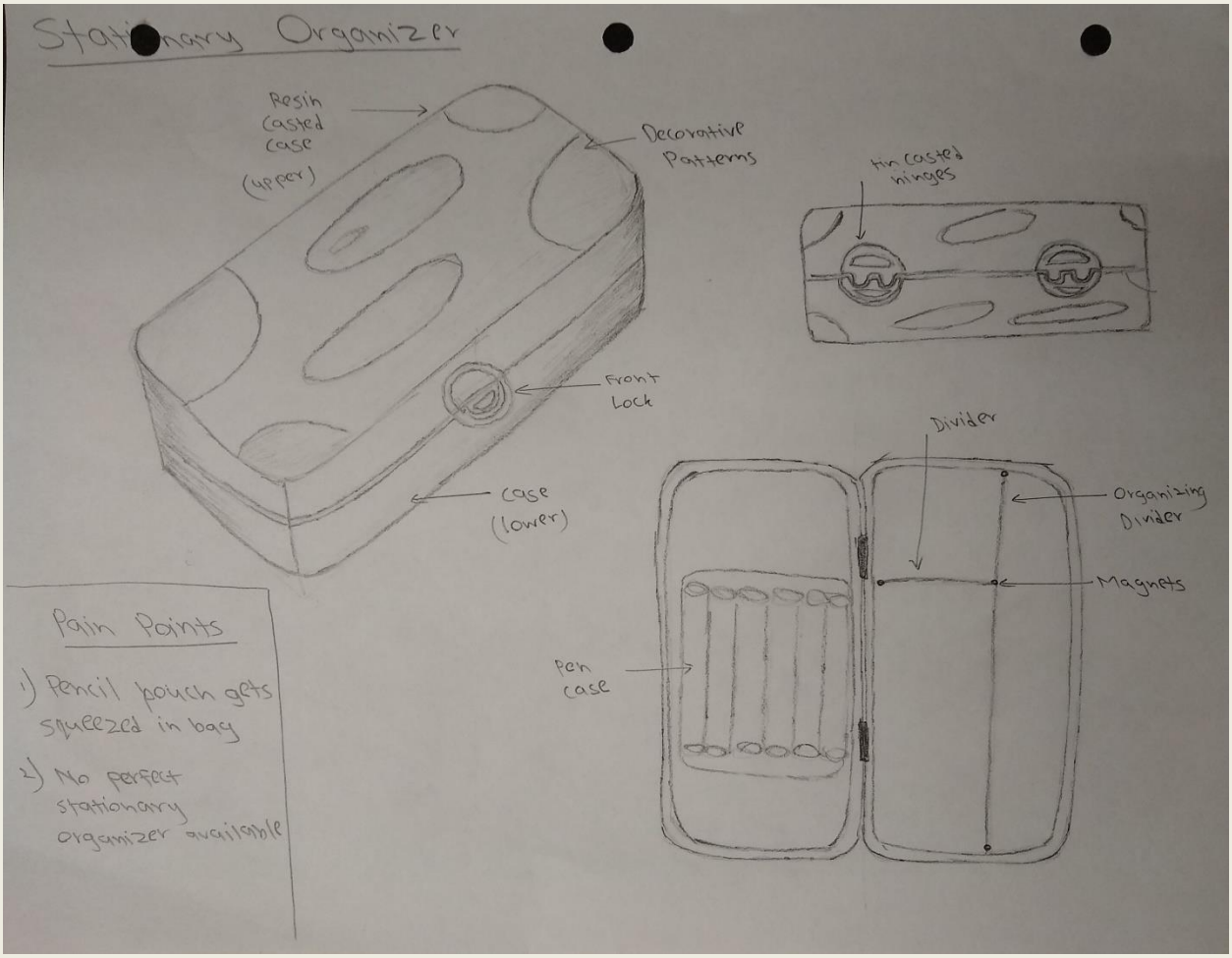
case
2) Magnetic divider
3 bars of magnet
Flap with magnets



5.1 Design Intent

How deciding specific parameters makes other parameters change and how you should decide that.

The main intent of the case was to store the pencils and pens securely, for this keeping adequate space between the items was essential. The dimensions of the case are greatly depended upon the quantity of the pens that could be stacked together and the space between them. Accordingly the case was designed to store 4 pens besides each other. Also, one of the factor to be considered is the diameter of the pen. Cheap pens are slender while high end pens are more robust and has a bigger diameter Considering these parameters an internal lateral length of 18 cm and 9 cm width was selected.

First it started with getting the goals clear about what I needed from my final product and then planning the suitable material and the manufacturing process that can be applied. The case should provide the mechanical stability and rigidity to the entire structure while protecting the contents of the case. For satisfying this requirement I needed some hard material. Couple of materials which are safe for usage and workable that I researched were high density foam, carbon fiber laying, ABS. The manufacturing process for heat molding the foam was not readily available and making a separate equipment for that was not conducive to the available time frame. The carbon fiber laying could have proven to be an effective solution for rigidity, but considering the high amount of post processing and finishing operations that would be needed for such a part, the decision was made not to include that material as it is not favorable for high volume production. The ABS was the best option available as the equipment for thermoforming was available and it could provide high rigidity as needed. The only thing that made me think of other material was the aesthetic appeal. A cuboidal box made from ABS would look like a traditional box and will not be unique enough to stand out. Hence the case was decided to manufacture from clear epoxy resin which can be casted out from a silicone mold. I also wanted it to be aesthetically exuberant and a unique creation which is never seen before and which exemplifies my likings towards mechanical watches and entrepreneurial attitude. For this I was going to embed decorative items inside the clear resin to give it a stunning look.

The hinges were initially planned to be made of casted tin metal to give a very vintage look. The mold was also made from silicone and then the casted pieces were machined and finished. After the post processing was completed and the hinges were about to be installed, I realized that they could rotate only through 90 degrees as the thickness of the hinges was much higher compared to their length. Due to this I decided to make them out of other materials. Wood was the next choice but the thickness was the dominating factor and I needed to reduce the thickness. I decided to use a steel sheet, but the workability of the steel is poor and hence cannot be bent around small radius with preliminary tools. The perfect material for this was the brass sheet that I selected as it is highly workable and can be bent around the hinge pin. A circular hinge was designed and formed and given a post finishing operation to enhance the visual appeal.

The center lock needed to be secure and one that will not open accidentally thus securing all the materials inside the case. The lock was casted as a round billet made of tin along with earlier hinges and then it was cut in exactly middle to make two parts of the lock. Later two holes were drilled and two snap buttons were used as locking agents for tightly securing the lock. The initial plan for securing was to think about neodymium magnets. Though, the magnets would have secured it properly with my own experience working with magnets and neodymium magnets in particular, I have observed that if these magnets are allowed to collide on each other frequently, due to their high force of attraction, after a period of usage they wear out much faster and get broken due to the formation of cracks. Also, cost is a major factor to be considered, as buying individual pieces can prove to be much costlier and hence snap buttons were chosen.

5.2 Prototyping Process

Bill Of Materials

Product Name	Part Number	Part Name	Quantity	Materials	Manufacturing Processes
Pencil Pouch	1	Casing	2	Two Part Epoxy Resin	Casting
	2	Decorative Items	Assorted	Watch movements, sparkle, wooden tabs	Embedding in resin, laser engraving wooden tabs
	3	Hinges	2	Brass Sheet Metal	Sheet Metal Working
	4	Hinge Pin	2	Zinc Coated Carbon Steel	Outsourced
	5	Hinge Connector	4	Wood	Wood Working
	6	Lock	1	Tin	Casting
	7	Snap Buttons	4	Nickel plated brass	Outsourced

The main objective of this project was to learn maximum number of different prototyping processes available. Accordingly the case of the product was made by making two resin casted hollow blocks which formed the upper and lower part of the case. This was to be done using a two part silicone mold. Decorative articles were to be embedded to give it a distinct look.

The hinges are made from Brass sheet metal which offers high workability and a good aesthetic appeal. The hinge pin is a zinc coated carbon steel nail which is latter machined according to the requirements.

The center lock is made from Tin metal which is casted in a silicone mold. As the working temperature for silicone is upwards of 300 degrees Celsius, Tin with lower melting point can easily be worked with. The unit would be made in a single piece and then cut into two pieces and then finished. These two sections will form the upper and the lower part of the lock attached to the casing. I made use of two snap buttons for creating a locking mechanism which could hold the case securely. Apart from this the hinge pin would be salvaged from scrap or machine shop.

There are some components to be purchased readymade for increased functionality. The snap buttons used in the lock for the case and the decorative articles like the watch movement and small watch parts are to be purchased

6. Case Design

6.1 Material

The following table shows various materials that would be used in the manufacturing process of the case of the product.

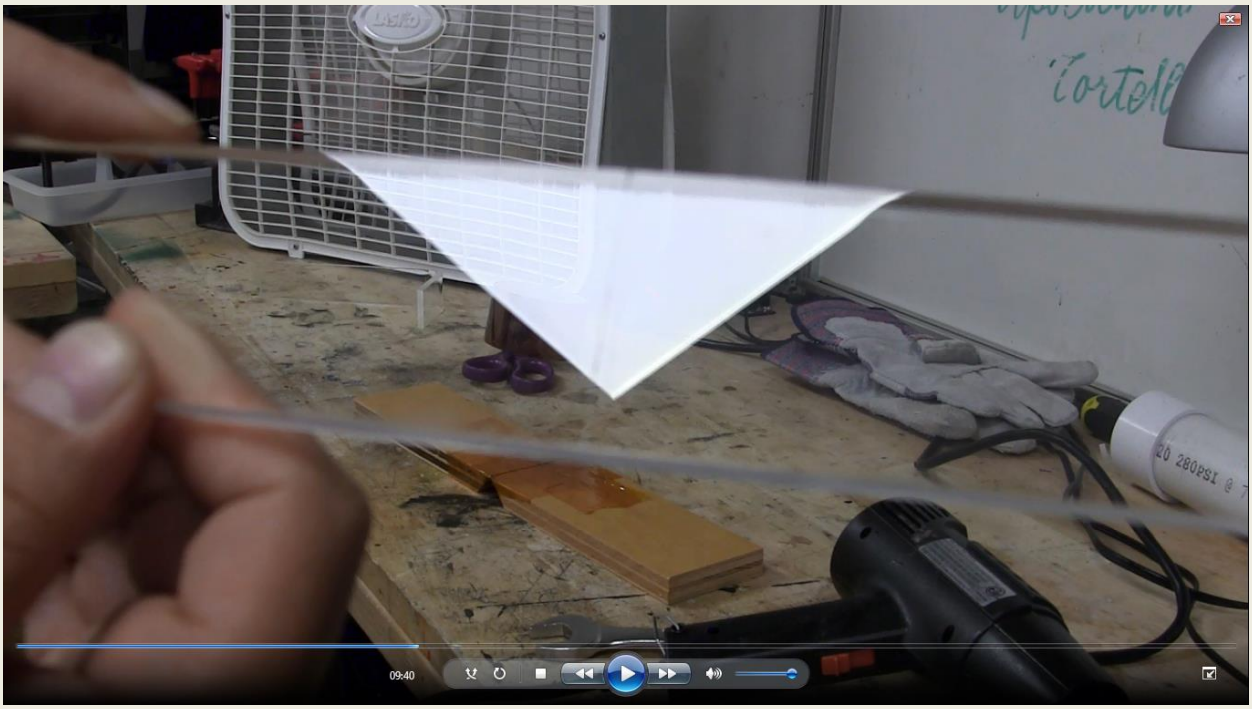
Sr. No.	Materials	Specifications	Quantity
1	Resin	Two part epoxy resin	16 Oz (~450 ml)
2	Silicone	Tin Cure Silicone	32 Oz (~900 ml)
3	Acrylic sheet	1/4th inch	15 X 15 inch
4	Wood	5 X 3 X ½ hard wood or plywood	2
5	Decorative items	Mechanical watch parts	Assorted

Following table shows the tools that are needed for making the case

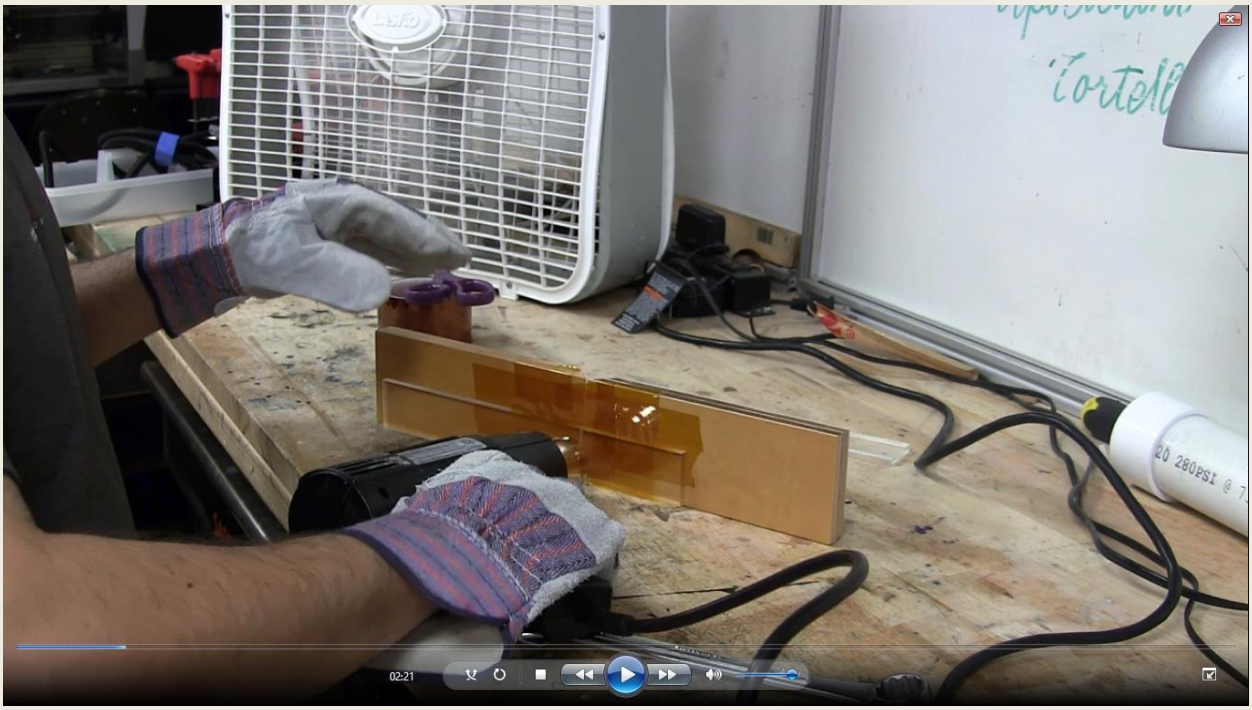
Sr. No.	Tools	Specifications
1	Hot Blow Gun	Standard
2	Hot Glue Gun	Low/High Temperature
3	Glue	Super Glue
4	Tweezers	Small
5	Scissor	Long
6	Sticky Tape	Heat Resistant Tape
7	Blow Torch	Butane Torch

6.2 Process

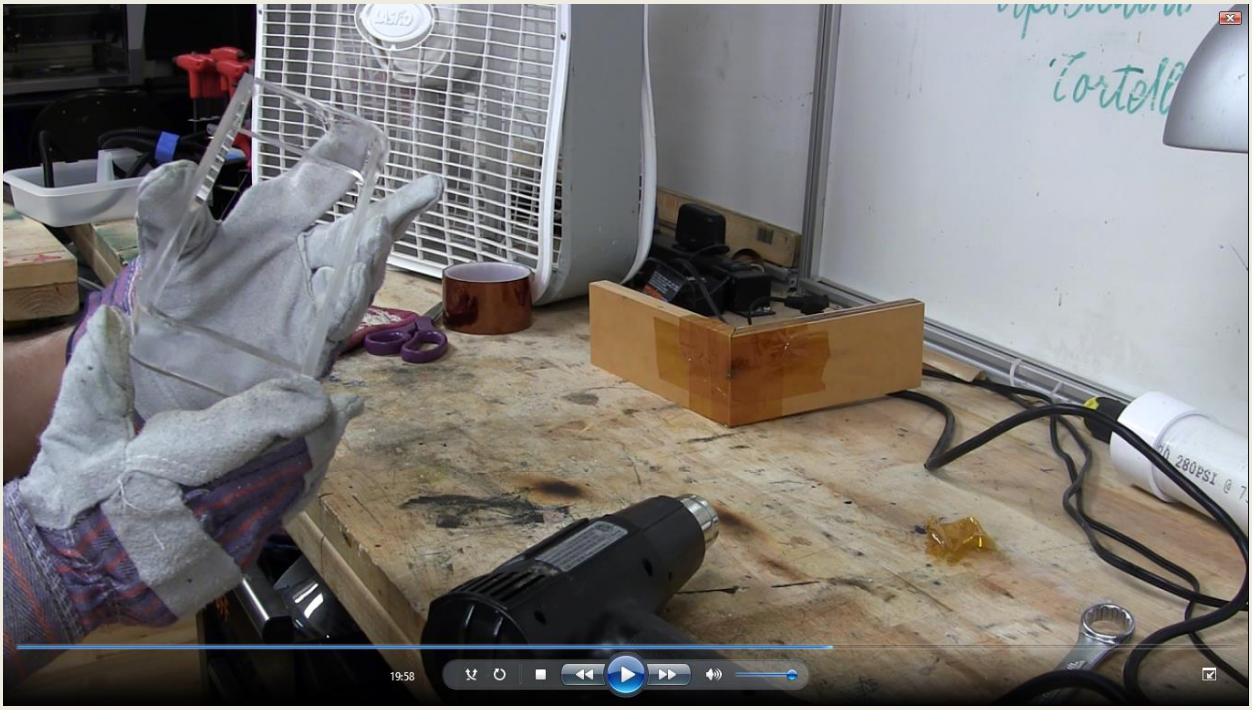
The main design required a pattern to be made which was made to form the mold. Selecting the material of the pattern was the challenging part as it needed to be workable, dimensionally stable, not forming a bond with silicone and having a very high surface finish as this finish would be transferred to the mold and in turn to the final casted part. For this reason acrylic sheet was used. This had a high gloss finish as you can see in the image below. Also the thickness of the sheet required to be similar to that of the final product, hence a 1/16th inch sheet was used.



The figure below shows a make shift wooden jig that was made to bend the sheet through 90 degrees. A heat resistant yellow colored sticky tape was used for holding the sheet to the jig.

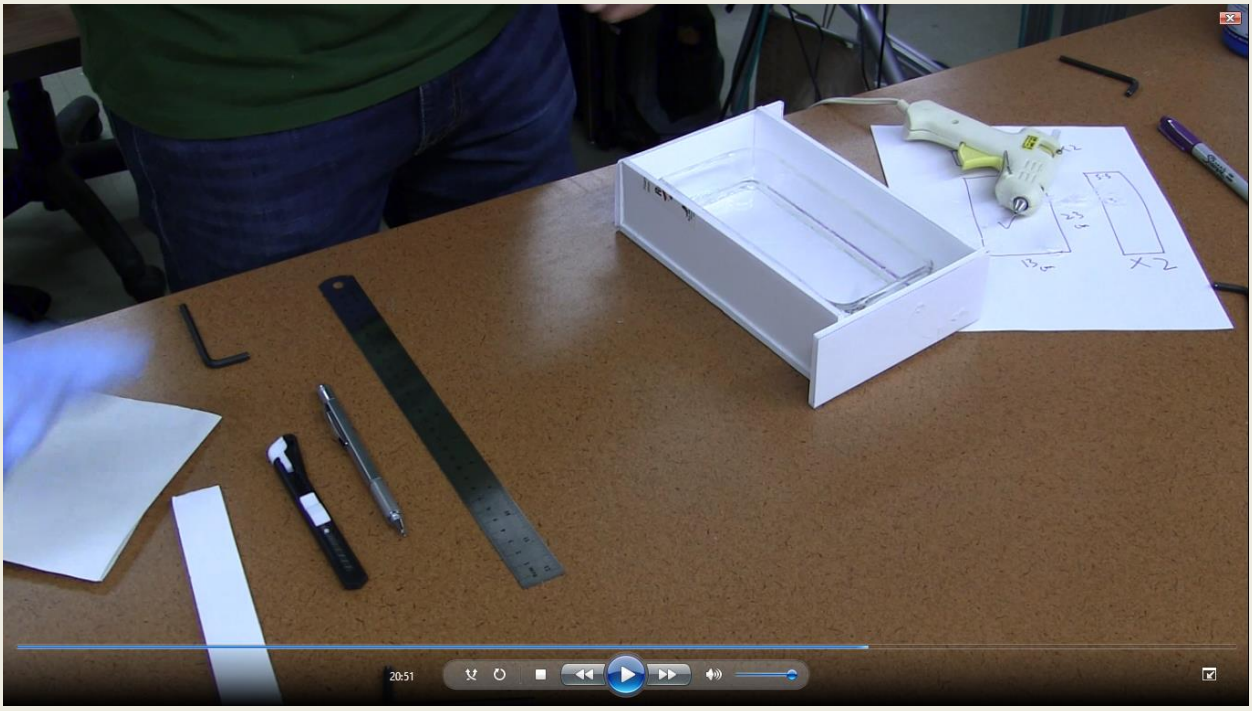


With the help of hot blow gun the acrylic sheet was heated and then bent around the jig to get an exact 90 degree shape as shown in the picture below.

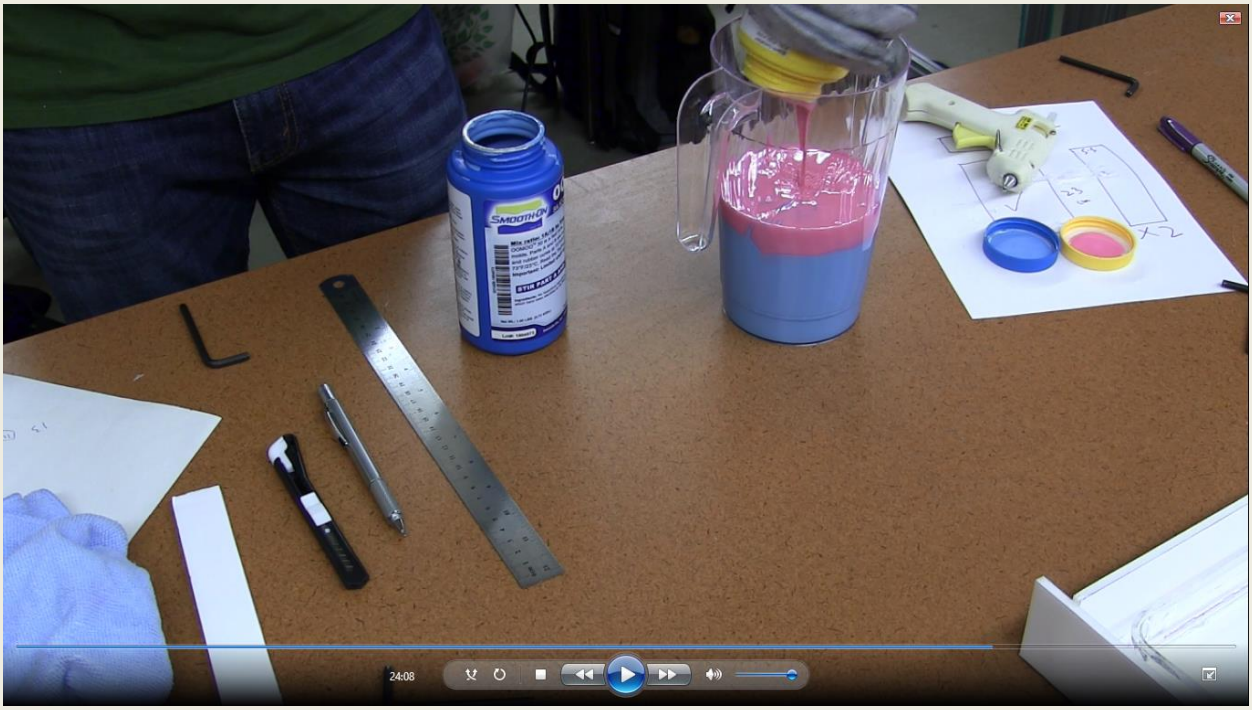


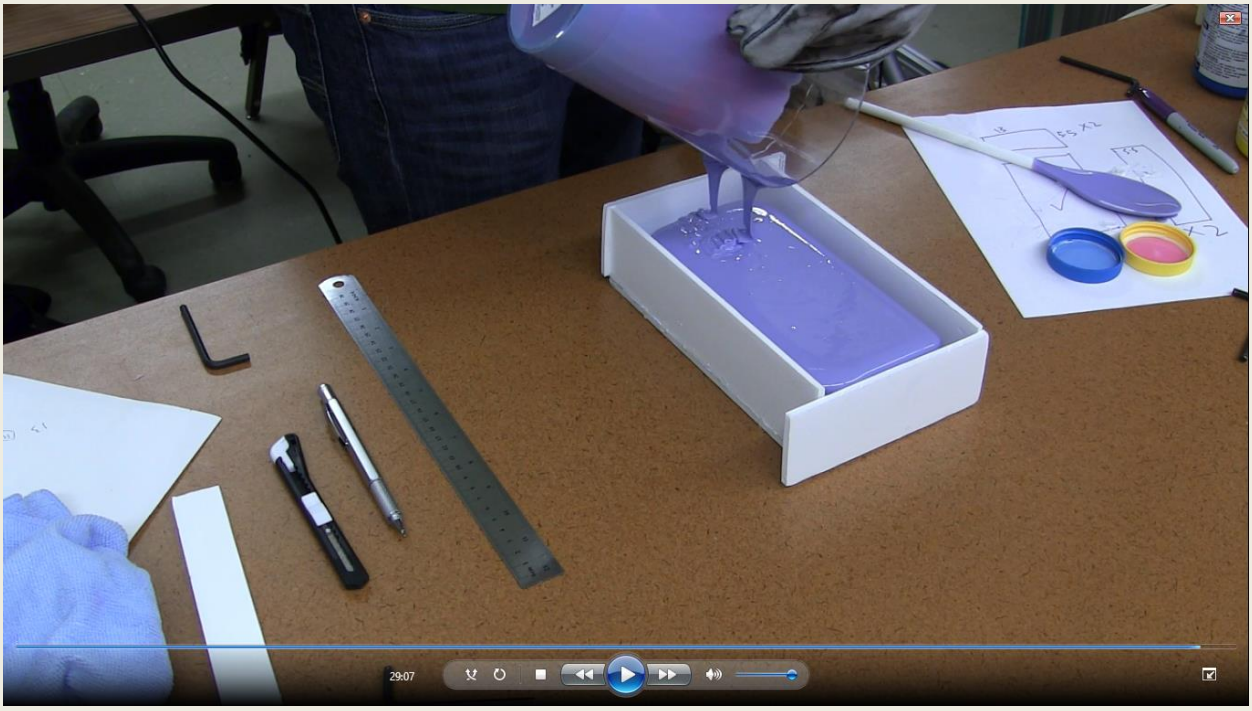
Similarly a second piece was made and then they were glued together with hot glue, thus completing the pattern for molding.

A foam casing was made for pouring the silicone for forming the mold.



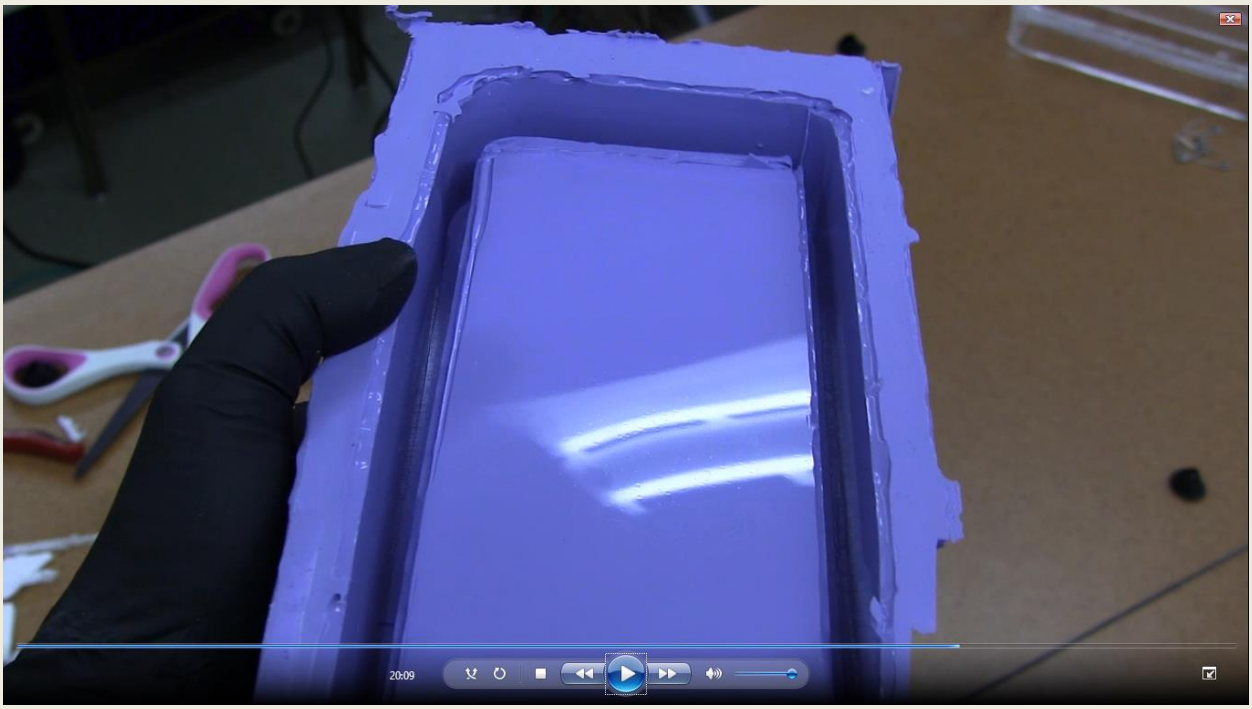
A two part silicone was mixed thoroughly and poured over the pattern.



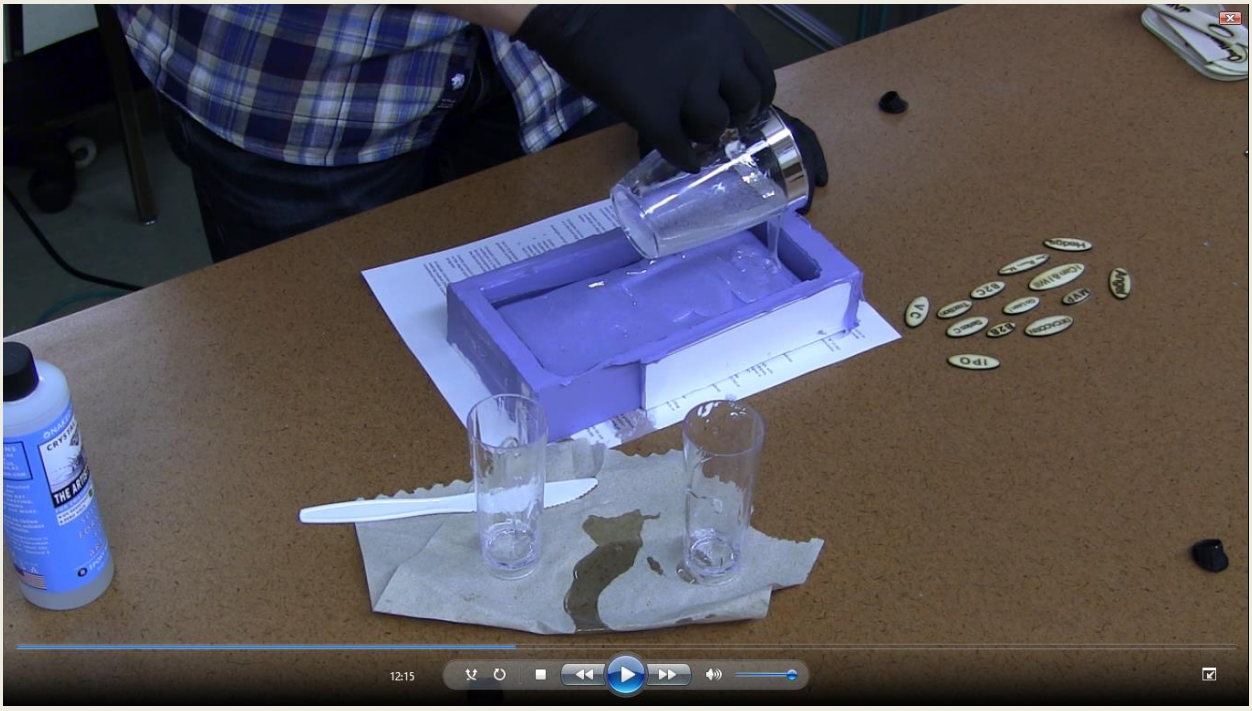


After curing the silicone overnight the pattern was removed from the silicone and the mold was prepared for casting.

Making use of acrylic sheet was the right choice as it gave a high gloss surface to the mold which can in turn be transferred to the final casted product.



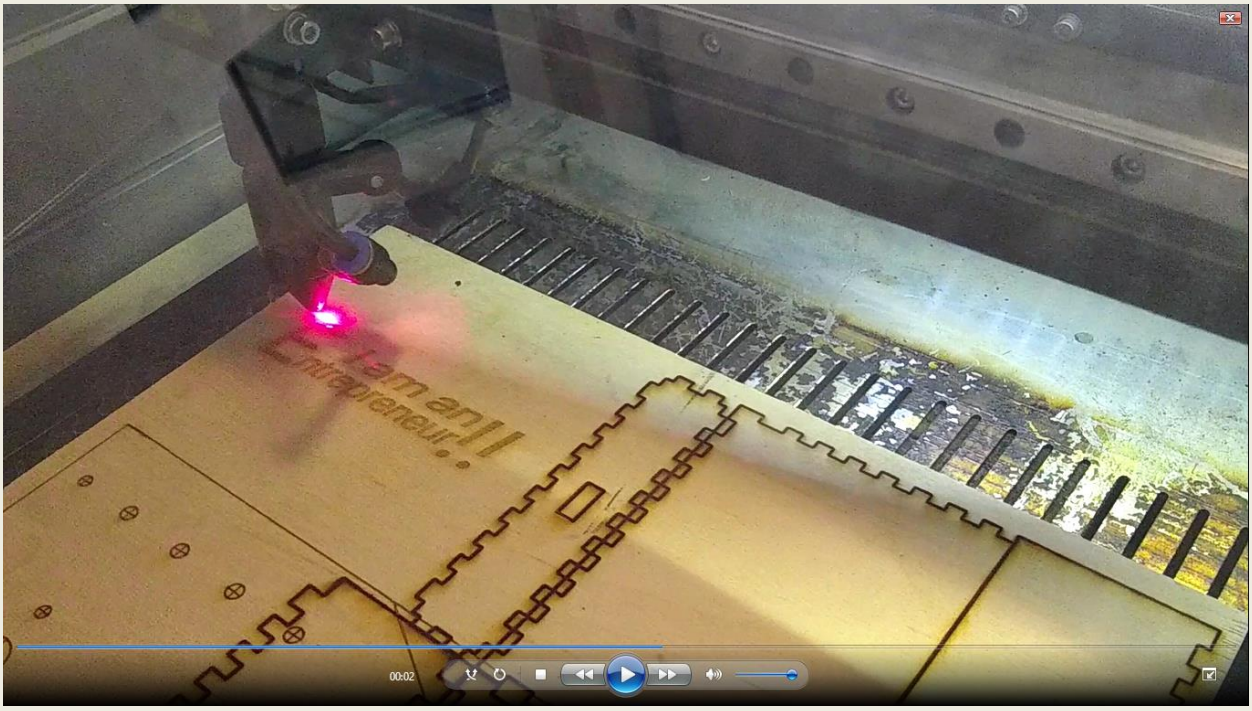
A two part clear cast epoxy resin was mixed in equal quantities and then poured over the mold.



After the pouring was completed the decorative items were embedded in the resin while it was still wet to be worked with.

In the similar way another section of the casting was made for the upper section and then carefully removed from the mold.

The image below shows the laser engraving process that was used for making the decorative articles.



6.3 Issues

There were two main issues that were encountered in the case prototyping.

The first one was related to the bubbles that were forming in the resin solution. These bubbles were formed during the mixing of the two part resin. As the solution has very high viscosity once mixed the trapped air bubbles were getting released at a much slower rate. For this as depicted in the image above a butane blow torch was used pop the bubbles which expanded that surfaced on the solution.

The next issue was related to the joining of the two parts for the case as seen in the image below. Since the two parts were to be placed on top of one another the pattern for the case should have been mirror image of the other. As there were minor defects in making the pattern, these dimensional defects got transferred casted parts and when they were fixed on top of each other some overhang is visible in the end product.

6.4 General Impression

This was the first time I had casted resin. It gave me a good experience with this material as I have a better understanding of this material and can make use of it for any future projects. The process of selecting the casting mold material and the pattern making allowed me to though in a unique way thinking ahead of what might the causes be of my earlier actions while making the pattern. The issues that arose will allow me to make a more informed decision in future.

6.5 Takeaway

The takeaway for the reader could be how important it is to think ahead of time particularly while making the pattern as all the impressions in the pattern are going to be exactly copied to the mold and in turn to the final casting. Also it would be recommendable to use a vacuum chamber to remove all the bubbles in the casting and give it a clear and distinct look. Also while designing two parts which are going to fit one over the other, it is highly advisable to either make two patterns for getting a perfect fit over each other or designing the pattern considering the mirror effect that would be imposed in the two parts which are going to be fitted together like the upper and lower section of the case.

7. Hinge Design

7.1 Materials

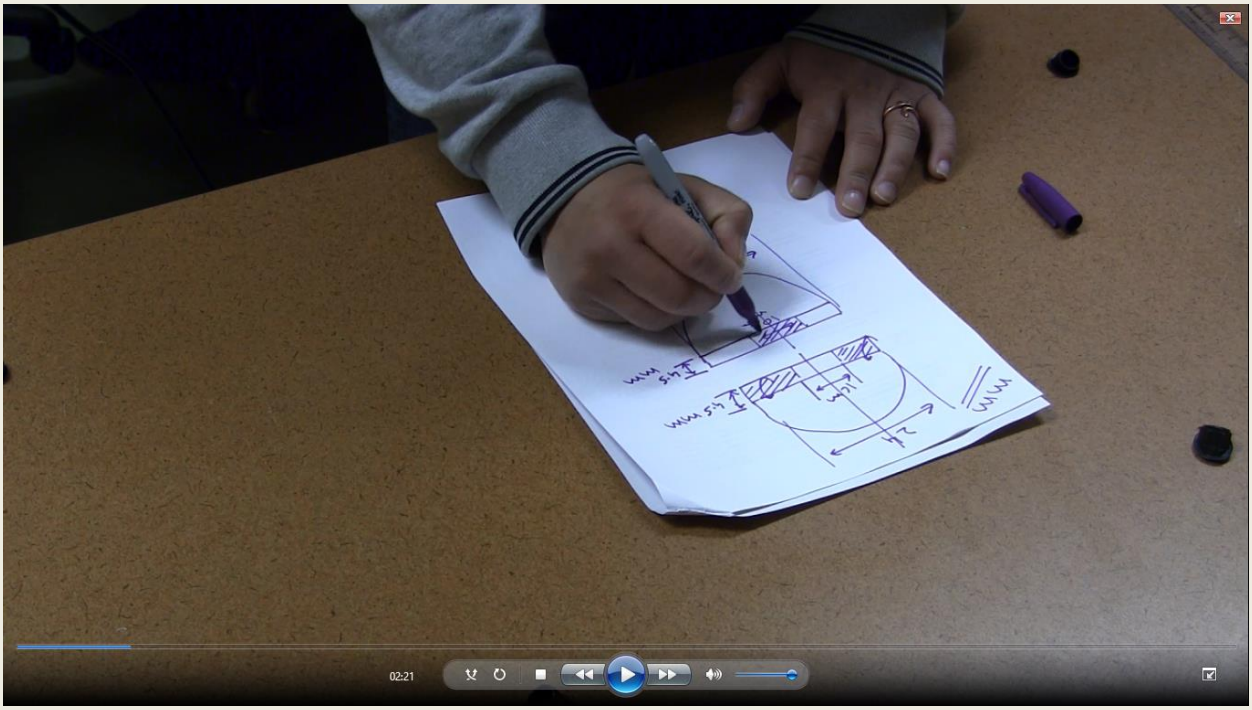
Sr. No.	Material	Specification	Quantity
1	Brass sheet metal	15 X 5 , 1/32 thick inch sheet	1
2	Iron nail	Zinc coated carbon steel	2

Tools

Sr. No.	Tools	Specification
1	Soldering Equipment	Standard
2	Glue	Super Glue
3	Plier	Long Nose Plier

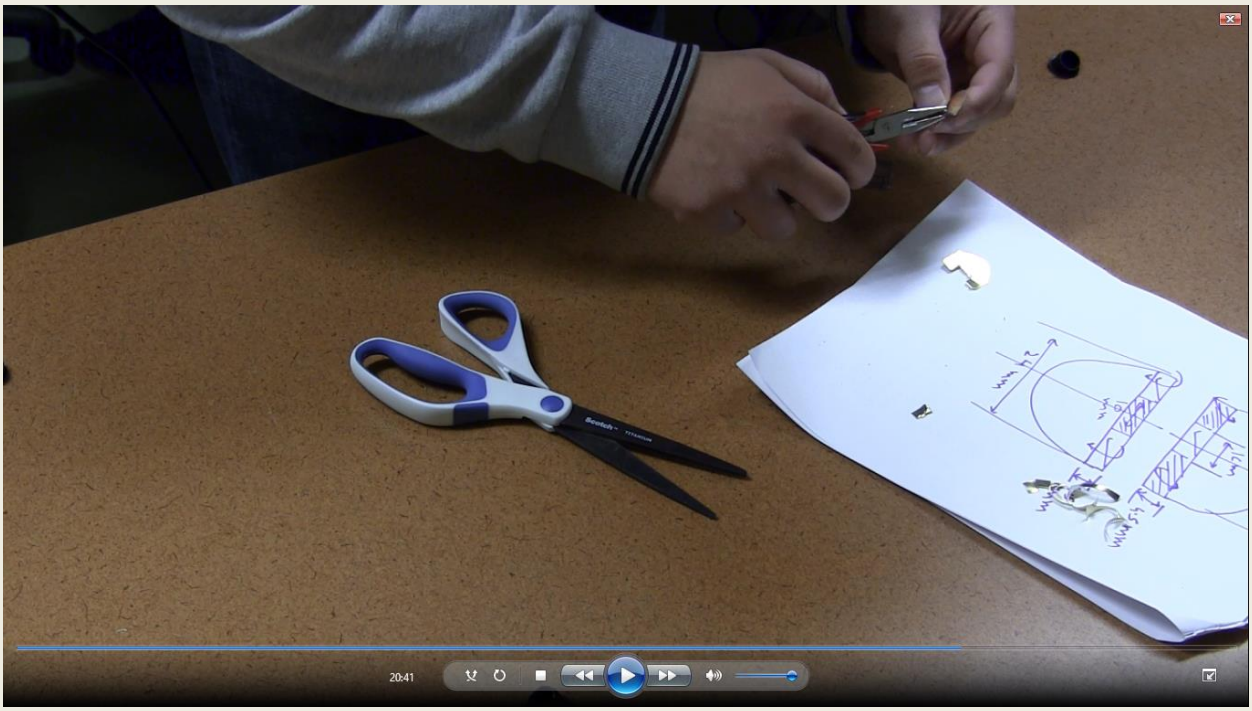
7.2 Process

The design process started by sketching and dimensioning the look of the hinges. I designed the hinges with a round profile to get along with the rounded edges of the case and round central lock.

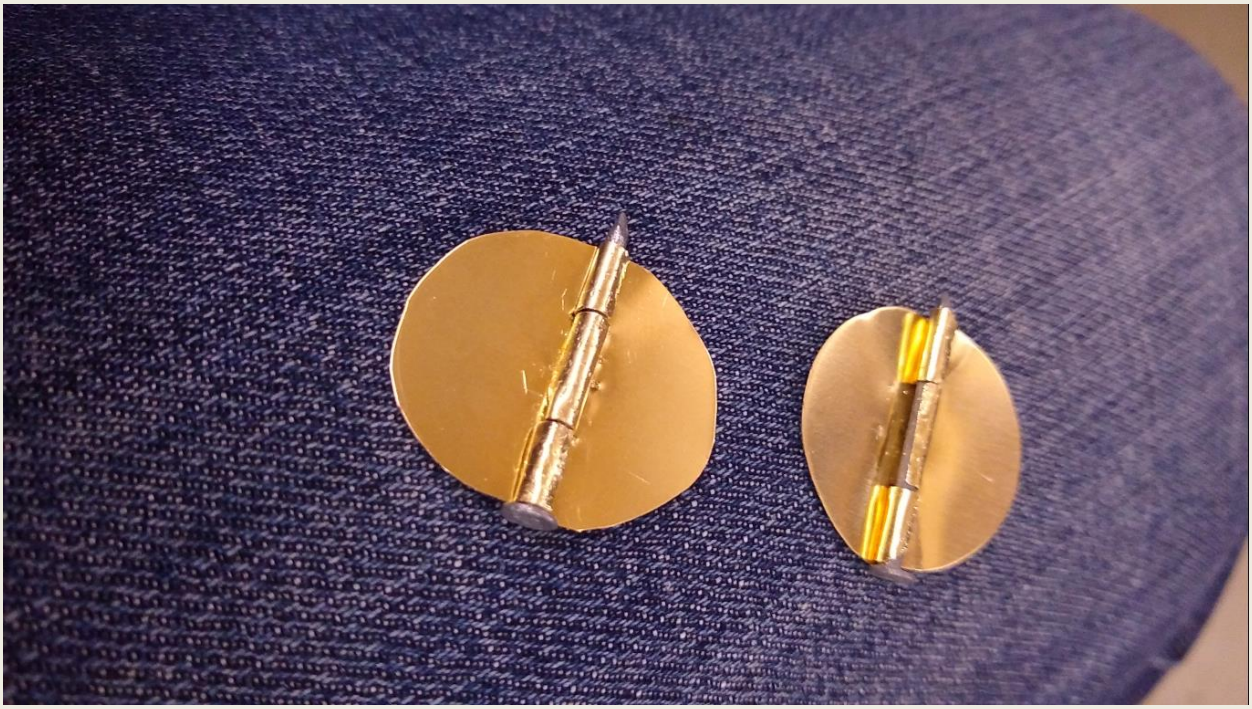


I decided to use the brass metal as it is more workable and has a vintage look to it. I made use of titanium scissors to cut the brass sheet metal according to the sketch that I had made earlier.

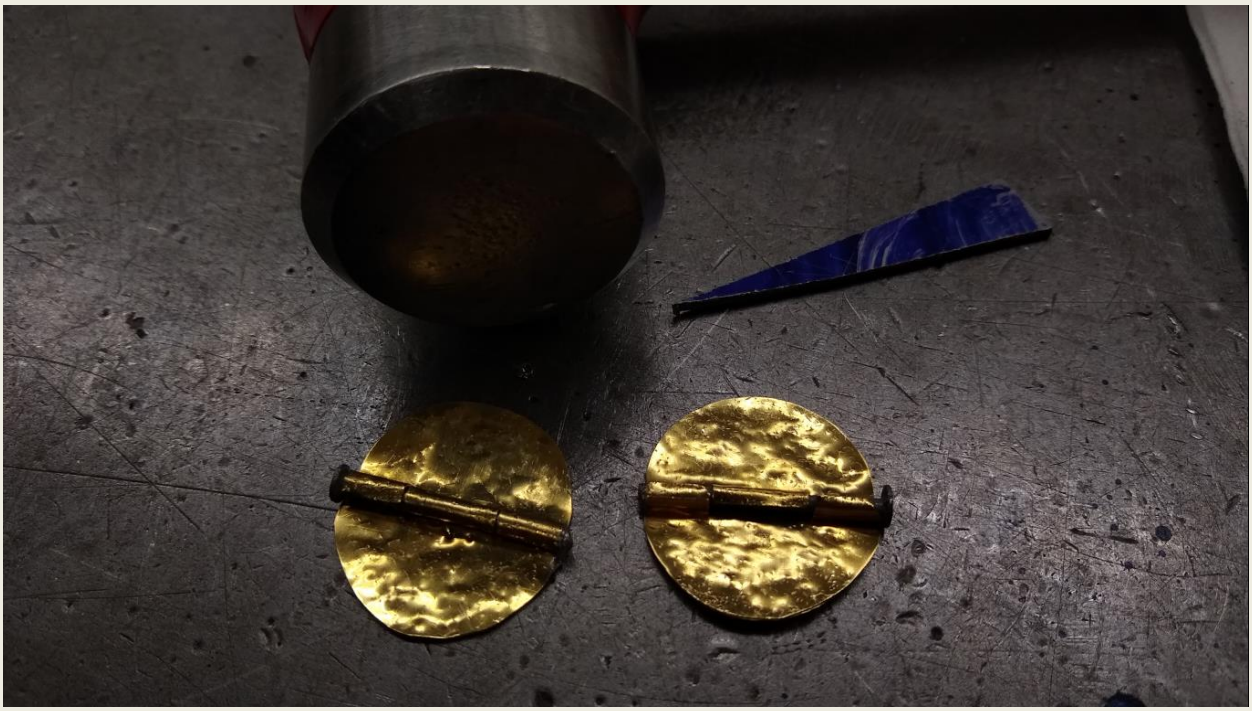
The nose plier was used for bending the hinge endings to accommodate the hinge pin between the two combining sections of the hinge.



I was able to get the nail which was the hinge pin between the two parts as shown in the image below. This looked good but was having a plain finish and I wanted to get a rustic look.



For the rustic look I gave the hinges a beating with the hammer and a metal pointed chip. This made the hinge look exactly as I wanted.



7.3 Issues

The earlier design comprised of casting the entire hinge by tin metal to match the locking section. Accordingly the hinge pieces were casted and finished as shown in the figure below.

I realized that the thickness of these hinges was large as compared to their length and hence it was not possible to turn them through 180 degrees as it was expected to function for the product. As it can be noticed from the image below that the hinge can turn only through 90 degrees which is not desirable and hence needed to modify the design and make them with brass sheet metal.

7.4 General Impressions

Hinge prototyping gave me an experience with sheet metal working and allowed me to understand the importance of the allowances that needs to be considered while working with sheet metal which involves multiple operations. I was absolutely unaware of the challenge that might arise due to the casted hinge but it gave me a casting experience which is explained latter in detail.

7.5 Takeaway

The main takeaway for the reader is the design consideration that could be evaluated before making any parts which rotate and interact with one other such as the hinge section. Also while making the sheet metal small bends around a small radius it is better to consider bigger allowances as the material can be removed if it is in excess.

8. Central Lock Design

8.1 Material

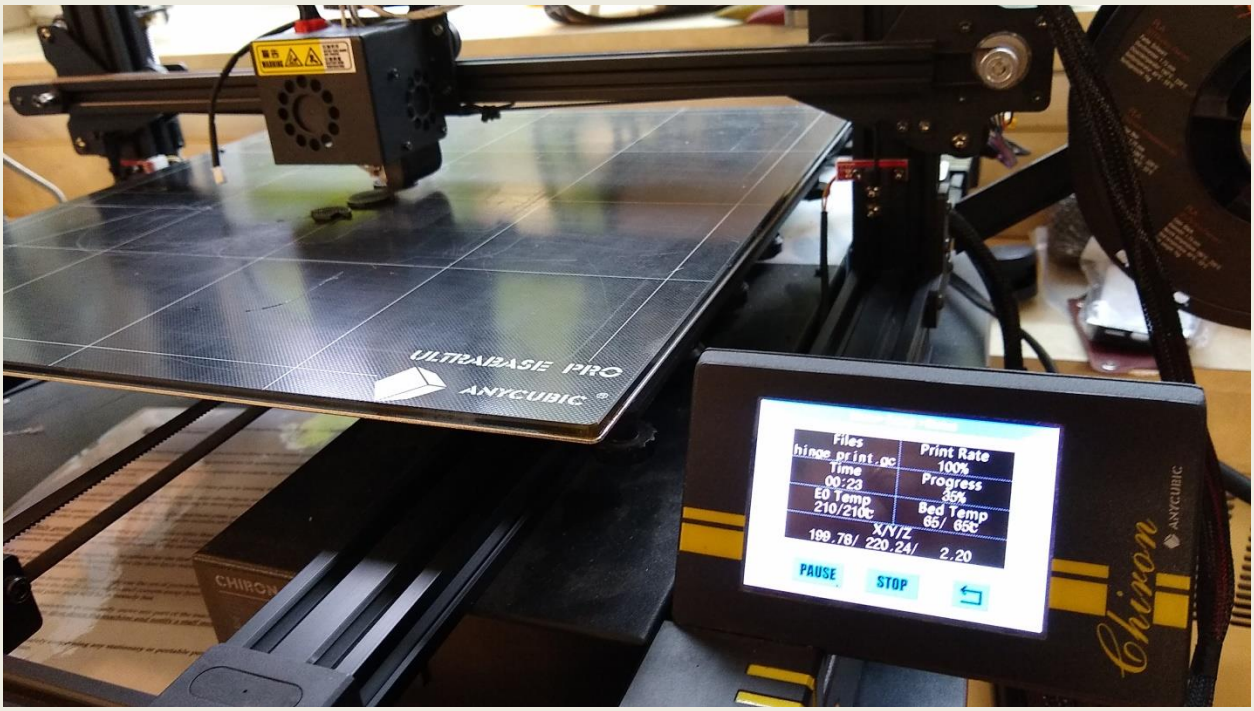
Sr. No.	Material	Specification	Quantity
1	Metal Billets	Tin Metal	5-6 50gm each
2	Iron Skillet	Enough to hold the metal	1
3	Snap Button	6mm diameter	2
4	Silicone	Tin Cure	32 Oz
5	Corn Floor	Standard	1 Oz

Sr. No.	Tools	Specification
1	Hot Plate Stove	Standard
2	Heavy duty gloves and shoes	1 pair each
3	3D printer	Standard
4	Metal Cutting Band Saw	Standard
5	Drilling Machine	Hand Held

8.2 Process

The central lock was the section that would attract the attention of the viewer after the casing and hence it had to be designed appropriately. The design would be comprised of two semicircular sections that would be fixed to the upper and lower section of the case. I chose a circular profile to maintain a continuous and smooth aesthetic throughout the product.

The prototyping started with making a CAD model of the circular part which would be 3D printed and then it can act as a pattern to the final casting. The image below shows 3D printing the pattern to be formed.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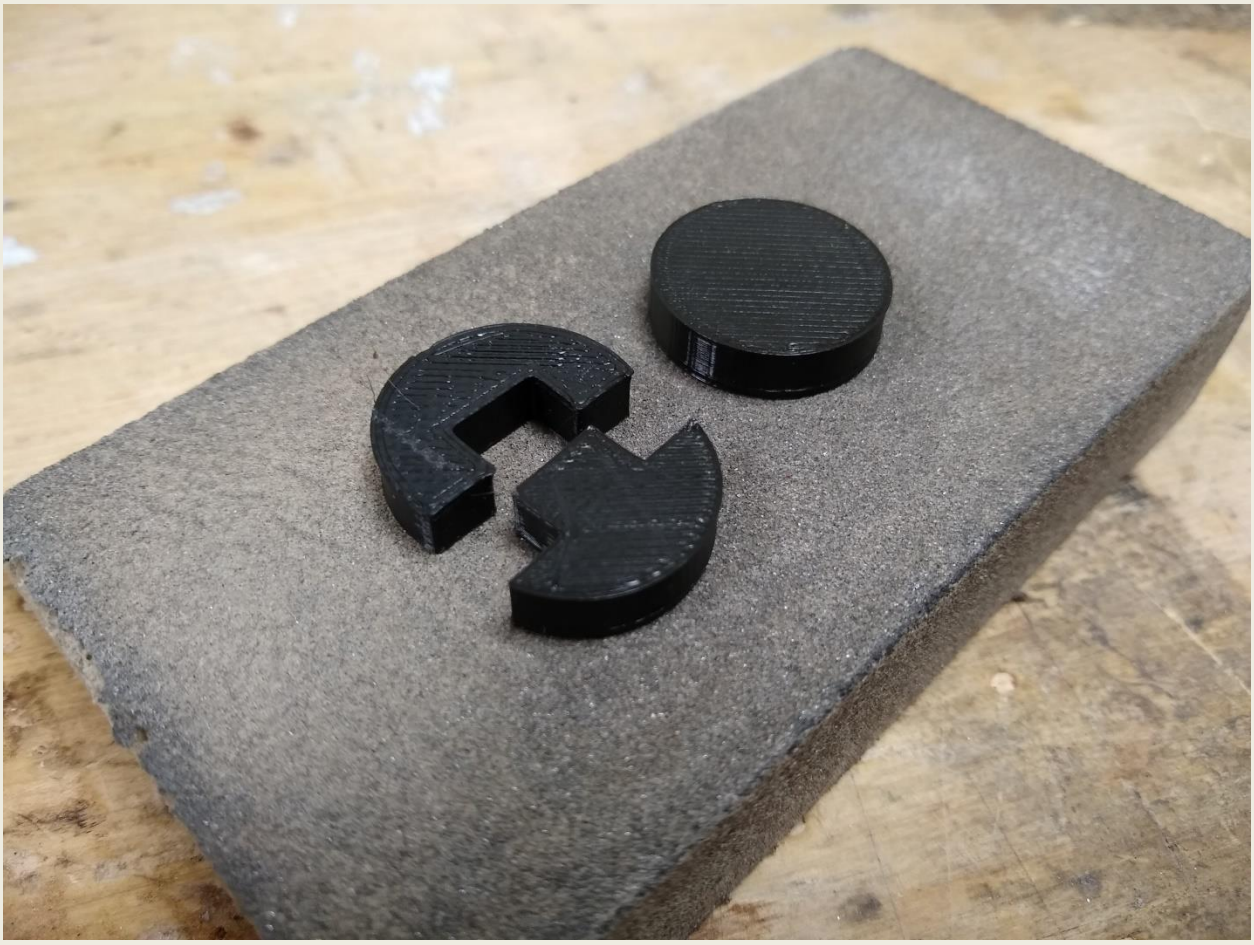
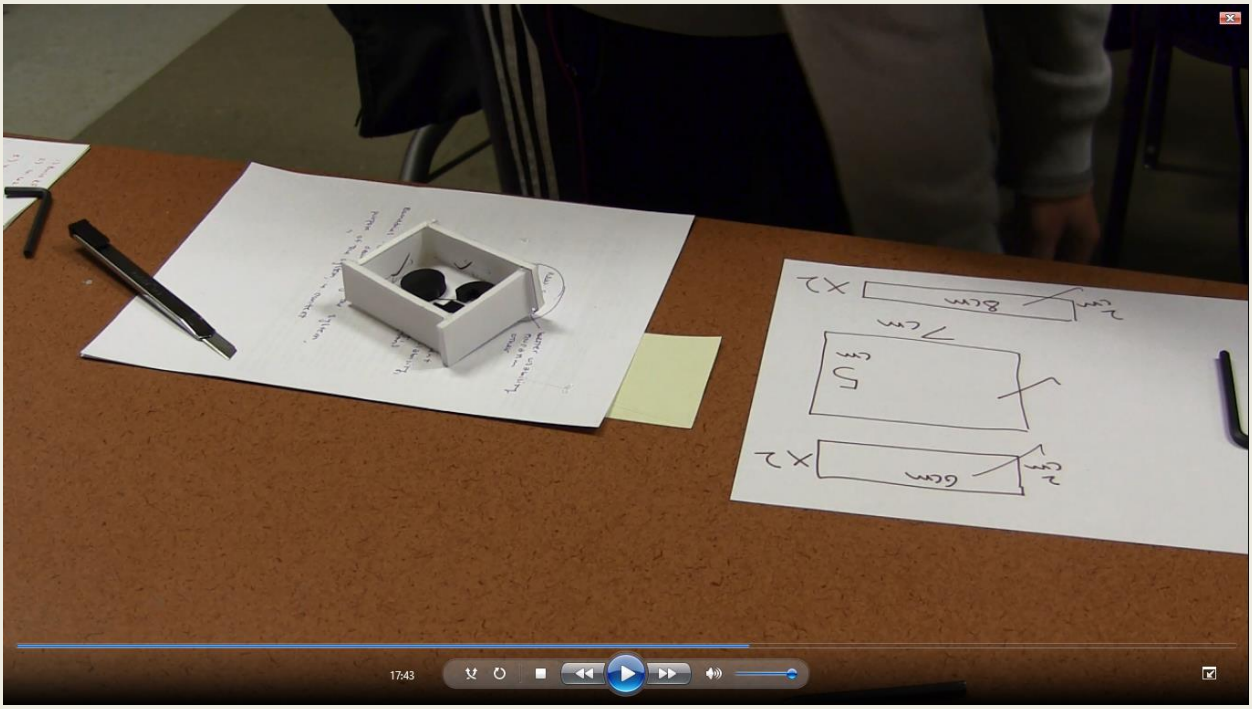
PAUSE
STOP
Chiron
ANYCUBIC

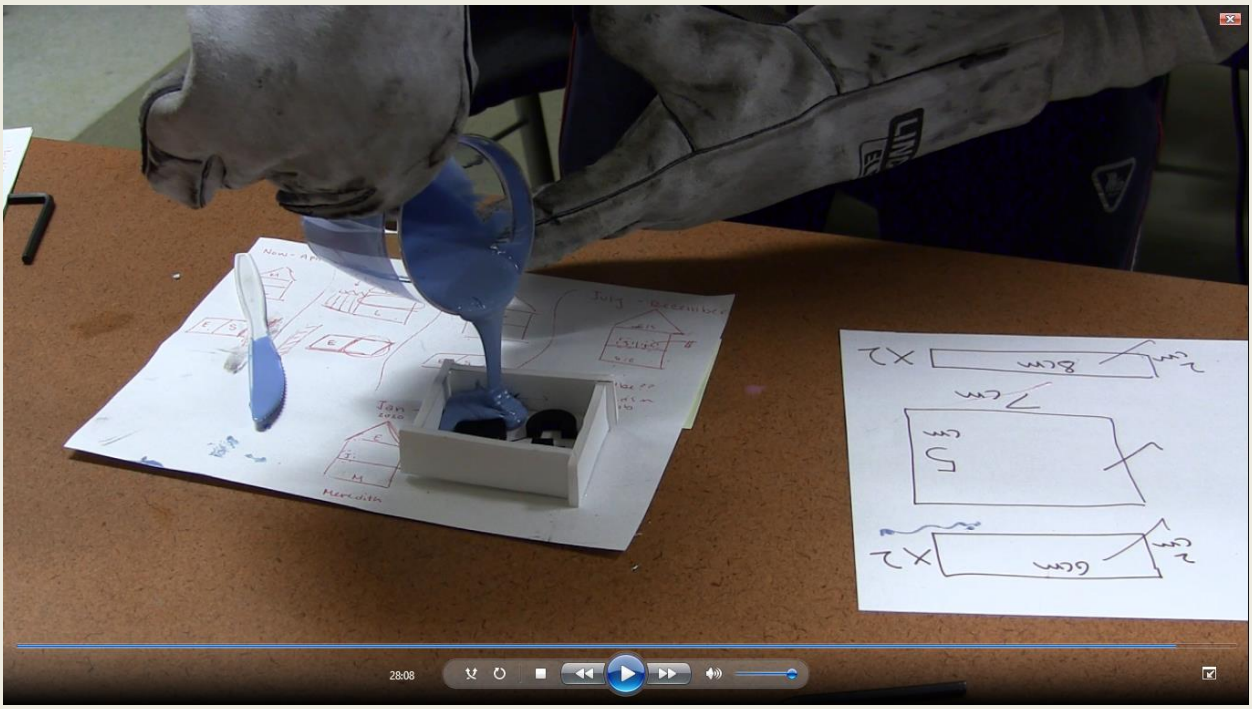


After the printing the parts were post processed with minor finishing operations and made ready for making the mold.



The image above shows a foam casing made with the parts to be casted in middle. The walls of the foam casing were glued using a hot glue so that they can make the case leak proof and can be removed easily.

The figure below shows the mixture of two part silicone that was mixed and poured over the mold and left overnight for curing.



Once the silicone was cured the 3D printed parts were removed and the detail of the pattern can be traced on the mold formed. I applied some corn floor as a de-molding agent which would help while casting it with tin metal.

The figure below shows the way in which the metal was melted in an iron skillet.

The figure below shows the way in which the metal was poured till all the cavities were completely sealed with tin.

The casted pieces were removed from the mold and then were finished to form the final products as shown in the figures below.

After the two semicircular sections were ready, two snap buttons as shown in the figure below were added to the sections to make a secured lock. Also a small piece of metal was added to the upper section to provide a grip section to remove the lock and open the case.

8.3 Issues

It was very difficult to secure the snap buttons on the tin metal. Due to this two holes were drilled and then the snap buttons were glued to the section for a secured fit.

8.4 General Impressions

A general option would be to buy the readymade hasp locks made from brass, but as I wanted to design all the parts on my own I designed this lock. The snap buttons proved to work according to the requirements and have a perfect clicking sound when locked.

8.5 Takeaway

The takeaway for the reader is that it is very important to decide before hand exactly which sections have to be designed in a specific way otherwise there could be further problems as it arose with the fixing of the snap lock buttons.

9. Manufacturing Discussions

For mass manufacturing, this product would need substantial design modifications. This product was custom designed for my own design aesthetics. For high volume production, a general appeal of the products is needed to be considered.

For high volume production the design requirements should be restated clearly which covers a broad spectrum of users.

Design Requirements

1) The case should be of hard and impact resistant material

2) It should hold adequate stationary items, that is the volume of the case should be optimum

3) It should be capable to organize the items

4) It should be light in weight and durable

For this the case could not be made from casted resin as it involves long curing times exceeding 24hr and has a substantial weight. The best material that can be used for high volume production is the EVA foam. It is Ethylene Vinyl Acetate which is a copolymer made from Ethylene and Vinyl Acetate. Its foam sheet can be shaped into the desired shape using heat and pressure under a press. The edged of the product can be trimmed off in the mold itself and hence involves minimum post processing operation thus saving time and increasing production.

Figure from Amazon Website [4]

This image depicts a typical EVA foam hard shell case that can be used for making the pencil case.

Different partitions can be added inside the case for storing pens, pencils, eraser, and other items properly. The locking mechanism can be either metallic or a simple chain zipper can be sewed directly to the foam. Otherwise a non-metallic lock can be designed and added at the front.

For making the hinges for the case, the foam can be heat pressed in a specific manner in order to produce a live hinge out of foam. If the use of a zipper chain is made for locking, the fabric piece can be extended to form a hinge between two cases. For holding the pencils and pens a separate stretchable material can be sowed inside the case.

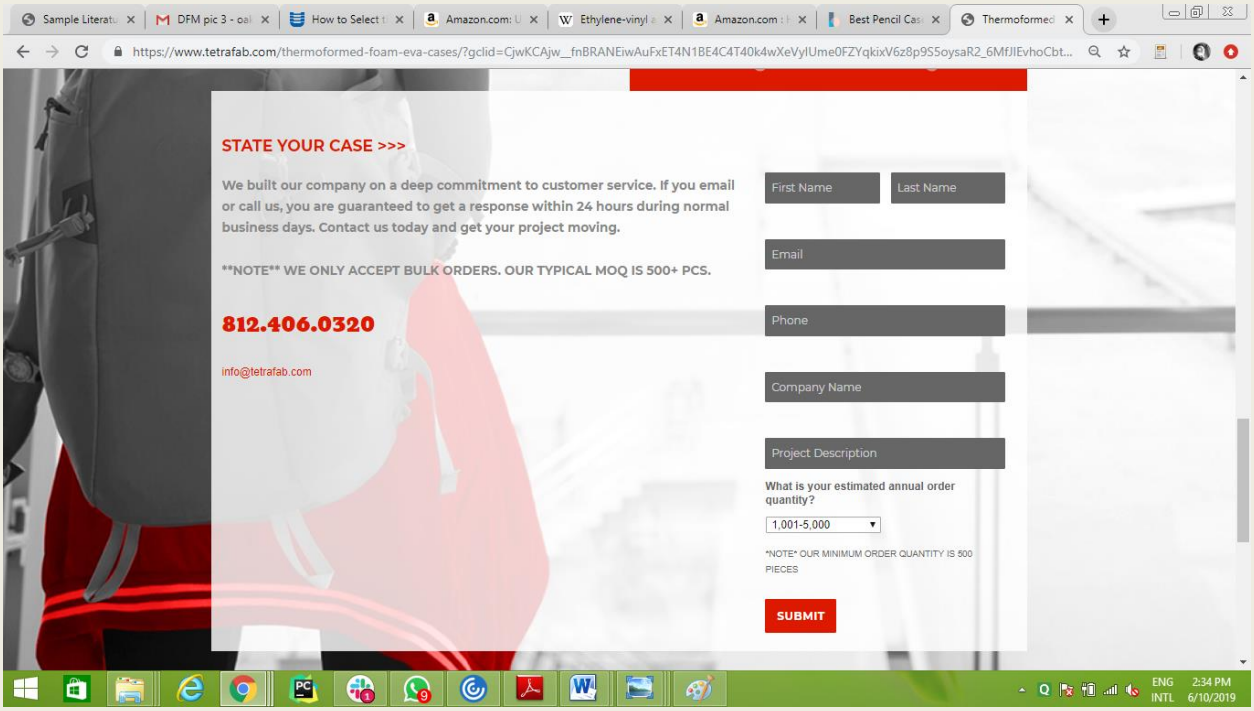
The Foam casing can use multiple design patterns based on the in-mold design layout which can be added to the mold.

The dimensions of the product need not be changed as they were well thought of to provide ample space for all the items to be stored. These dimensions were based on the internal space equivalent of 18x9x5 cm^3 and can be kept constant for high volume production.

10. Target Market

The target market for this product are primarily the high school, university students and hobbyist who like to carry essential stationary items with them. This case could also be made use of by the artists who want to store all the items in an organized manner. Also office workers whose work involves illustrations can also make use of them. After the study of the reviews for the similar product it was found that such cases are also used by some doctors and nurses who store the first aid kit and other equipments if they need to go for an emergency visits. Along with this some people are also making use of such similar cases for storing their daily medicines in an organized way. Though this market is niche as compared to students and hobbyist market, it can be considered for design puposes.

Such cases can be directly ordered from the mass manufacturing companies like Tetrafab - custom cases who can manufacture upwards of 10,000 cases annually. If at all this product was to be made into a startup venture, I would not consider ordering 10,000 units, but rather start small by about 1000 units annually and then based on the feedback from the customers modify and order the product for about 5000 pieces.



11. Concluding Discussions

The design process had its origin in the need of a solution to store my high end mechanical pencils in which I had developed an interest in past couple of years. Dissatisfied by the market available solution which claimed to work well but did not offer good quality led me to the designing of my own solution. Design started by listing the requirements that the final product should satisfy. After the list was ready a rough sketch was made to illustrate the design that I was thinking. Think tanks that were conducted in class helped a lot to get a firsthand feedback on the initial design and the plausible flaws and ways to overcome them. After the dimensions and the overall look of the case was decided, I searched different materials that could be worked with. After this the prototyping was conducted and the final product was made. It has come to my notice that for manufacturing it several design changes are required which are mentioned earlier.

The final product was successful in meeting most of my requirements. The hard resin case provided ample of support so that the case is not squeezed when I remove it from my backpack. The hinges are working good and the locking mechanism has a characteristic clicking sound to it which is very satisfying. The aesthetics which were an important design requirement is well satisfied by exemplifying my liking towards watches. The initial design also included a soft leather belt to hold the pens and pencils more firmly. Due to time constraints I was not able to finish that part which is my only regret.

This course has definitely helped me shape my design skills and prepared a strong base for a career in industrial product designing which I am aspiring to contribute my efforts in. The material research that was needed to be conducted in the earlier part of the course gave me an introduction about plethora of materials along with considering their manufacturability. Different products that were studied based on their overall design and a general appeal to their users allowed me to come up with my own design. The think tanks that were organized as in-activities allowed me to get a feedback on my design methodology and hear what others have to offer to enhance my product design. Finally the video that was to be made explaining the manufacturing procedure gave me a massive experience with video recording and formatting. This course allowed to peep into the world of product design career and I am glad that I liked it and looking forward to design more products by implementing all the skills that I have gained along way.

12. Appendix

[1] [155-162] Barman Barry, 2012, “3-D printing: The new industrial revolution”, SciVerse ScienceDirect

[2] [10:226-243] Otto Kevin and Wood Kristin, 1998, “Product Evolution: A Reverse Engineering and Redesign Methodology”, Research in Engineering Design

[3] [181-201] Kleef Ellen, Trijp Hans and Luning Pieternel, 2005, “Consumer research in the early stages of new product development: a critical review of methods and techniques”, Food quality and Preference, ScienceDirect

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https://www.amazon.com/Prismacolor-Premier-Colored-Pencils-Hermitshell/dp/B01M8IBNQE/ref=asc_df_B01M8IBNQE/?tag=hyprod-20&linkCode=df0&hvadid=223276970335&hvpos=1o1&hvnetw=g&hvrand=14243587092641009584&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=1024429&hvtargid=pla-390814987660&psc=1

[5] EVA casing manufacturer, Tetrafab Custom Casses, Url-

https://www.tetrafab.com/thermoformed-foam-eva-cases/?gclid=CjwKCAjw__fnBRANEiwAuFxET4N1BE4C4T40k4wXeVyIUme0FZYqkixV6z8p9S5oysaR2_6MfJlEvhoCbt4QAvD_BwE