CITY COLLEGE

CITY UNIVERSITY OF NEW YORK

Final Project

LINE SCRIBER

ME 462: Manufacturing Process

Spring 2011

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Submitted By:

Group 1

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March 16, 2011

Objective of Project

- The objective of this project was to get hands on experience of various manufacturing tools and equipments and the study of Manufacturing Processes.
  - To safely operate each machine
  - The importance of tolerance
  - Systems of measurement
- To write series of codes or events/cycle commands in MasterCAM to generate the different shape as required.
- To understand and use the machine available in Machine workshop like lathe, mill drill press or other manual machines and develop the model of concept design.

Equipments Used

- Metal working lathes
- Metal working mills
- Drill press
- Band saw
- Center puncher
- Combination Square and Carbide-Tipped Scriber

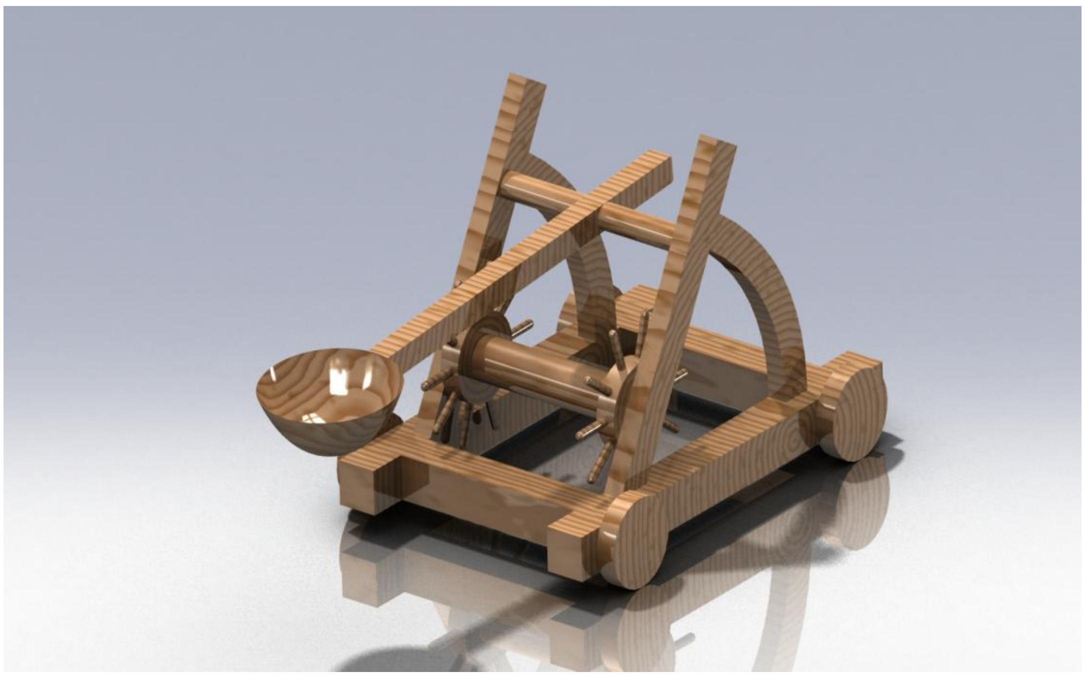
Materials Used

- Polypropylene Sheet
- Black Delrin
- Cast Acrylic
- White Delrin
- Polyethylene (UHMW)
- Loctite ® General Anaerobic Adhesive

- Threadlocker
- 5/8" 2-flute end mill.
- 3/16" drill bit, 1/8" end mill, 1/8" end mill, 1/4" end mill
- F drill bit, 7/64", drill bit, No. 7 drill bit
- 5/16-18 tap, 6-32 tap, 1/4-20 tap

• *Proposed Design*

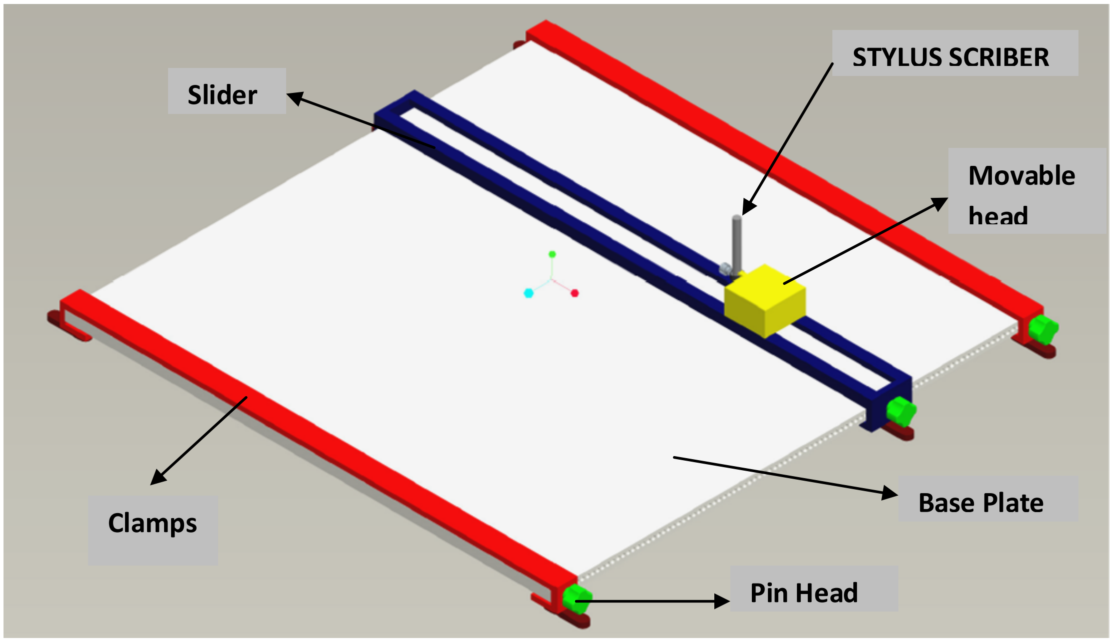
• *Proposal I*



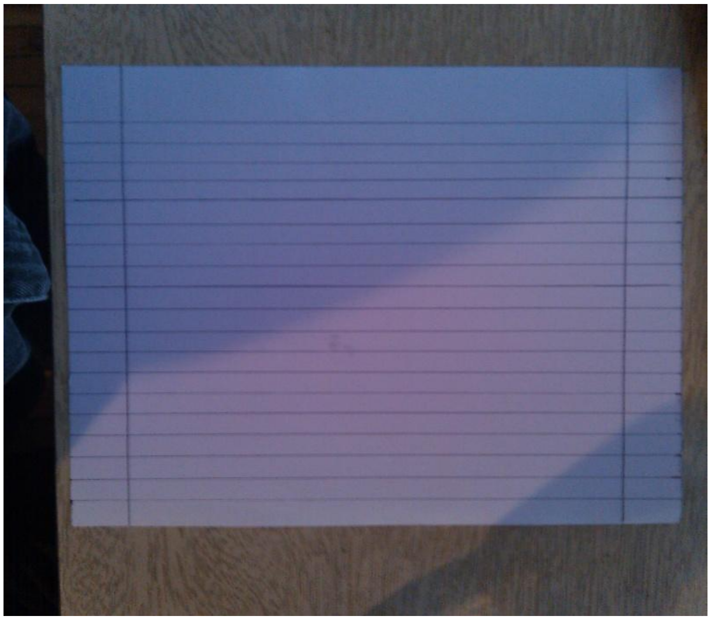
The Catapult is a large machine on wheels with a bowl attached to a long wooden arm (spoon shape) and a power source (spring or gravity) which hurled the object in the bowl like a projectiles. The project was incorporated design and manufacturing techniques involves both manual and CNC machine available in machine shop.

This catapult will work without external power, that is will work like traditional warheads that gain energy from potential energy store in the spring or elastic rubber which is converted into kinetic energy to propel the projectile.

- ***Proposal II (selected)***

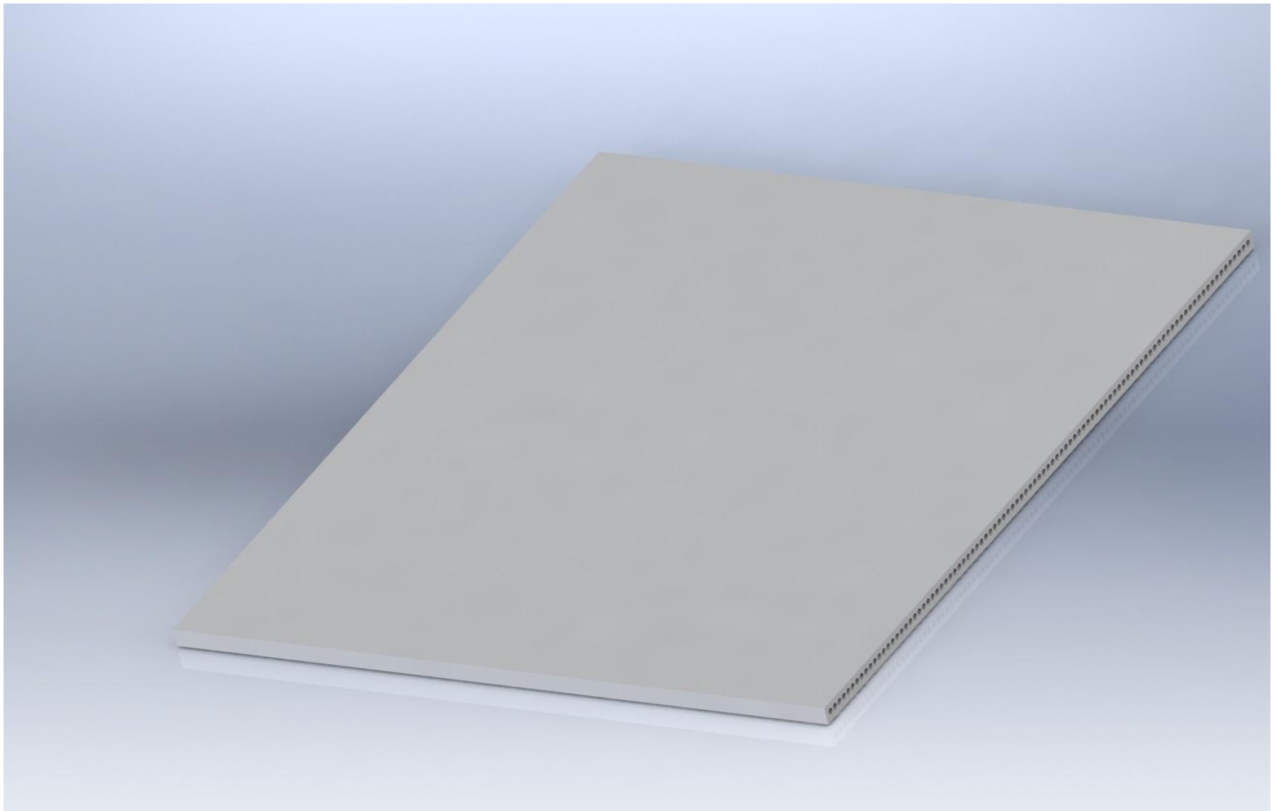


The goal of this project was to use the process of design to construct a line scribe with certain specifications.



The purpose of the line scribe is to make as shown in the picture above such that the lines in the second picture are drawn more quickly, easily and accurately than done by hand, so that calligraphers can use those guides which do not interfere with the look of what they are writing, as opposed to lines made with ink.

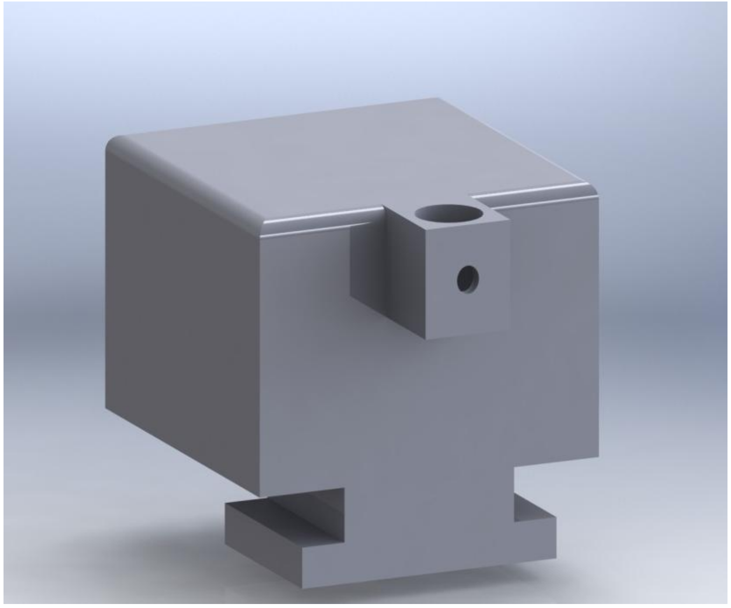
- *CAD Model of Parts and corresponding materials*

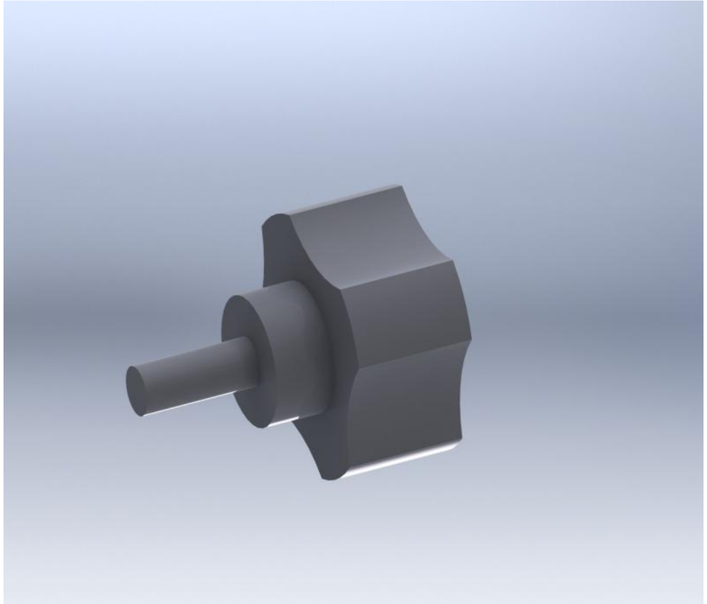


Polypropylene Sheet 1/2" Thick, 24" X 24", Translucent White.

No of Parts: 1

Polypropylene is a thermoplastic polymer used in a wide variety of applications. Its resilience against most forms of physical damage and resistance to fatigue. This material was chose because it was cheap as we purchased one single base plate of 2 ft X 2 ft and was also suggested by Mr. Mike as we had to make several side holes with very less clearance.



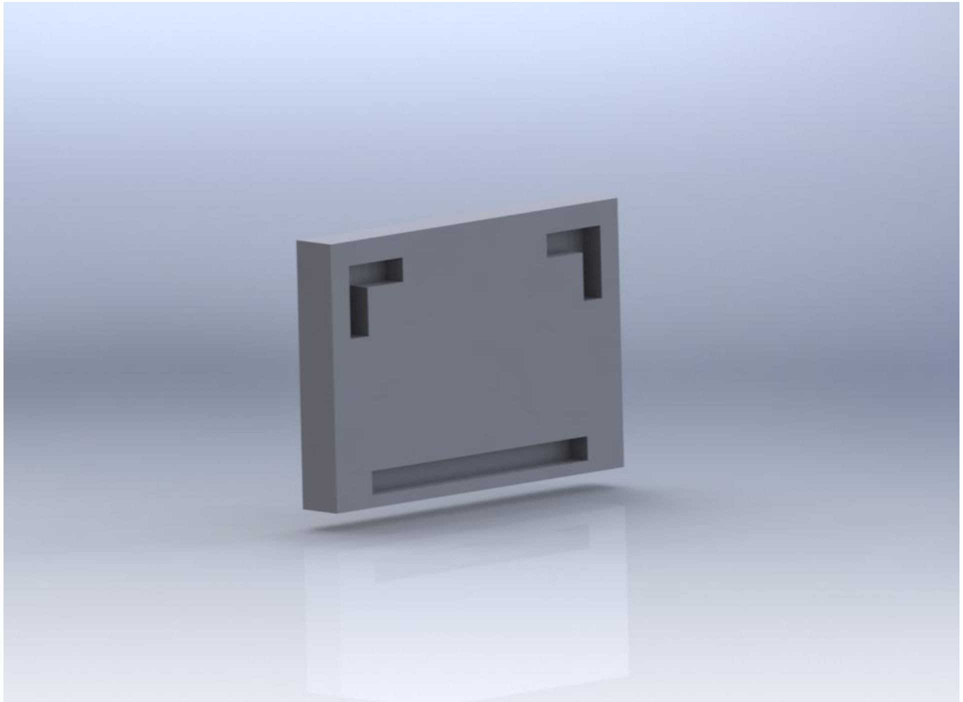


No of Parts: 1

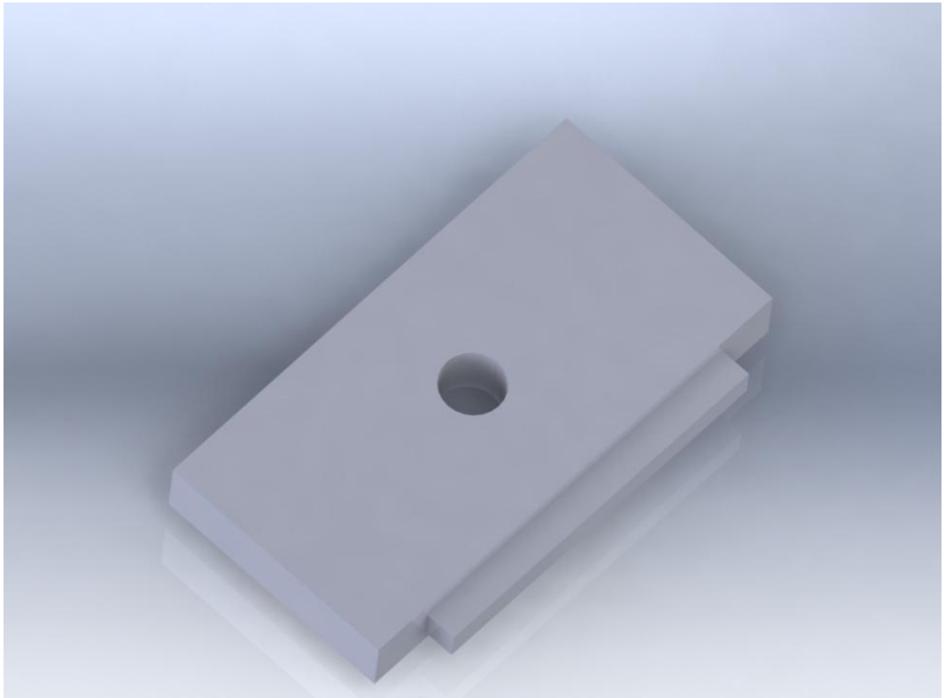
No of Parts: 3

Black Delrin Rectangular Bar 1-3/4" Thick, 2" Wide X1’ Length

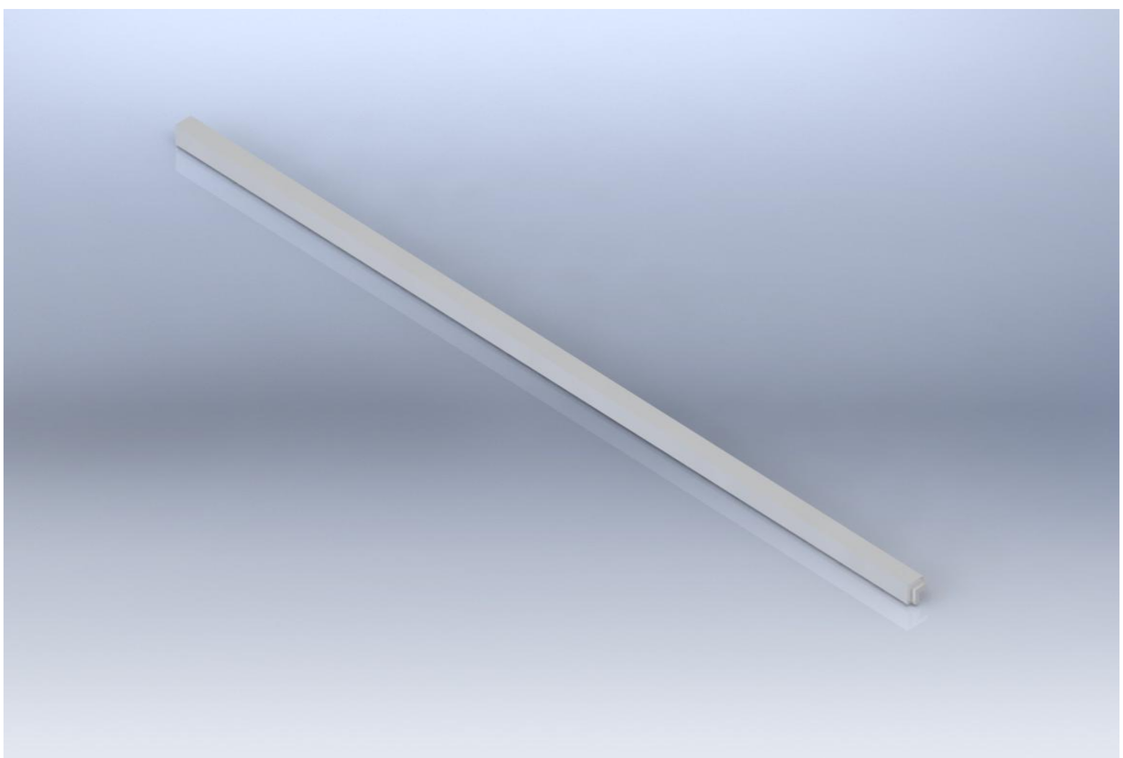
No of Parts: 1



White Delrin Rectangular Bar 1/4" Thick X 2" Width X 1’ length.
No of Parts: 2



White Delrin Rectangular Bar 1/4" Thick X 2" Width X 1’ length.
No of Parts: 2

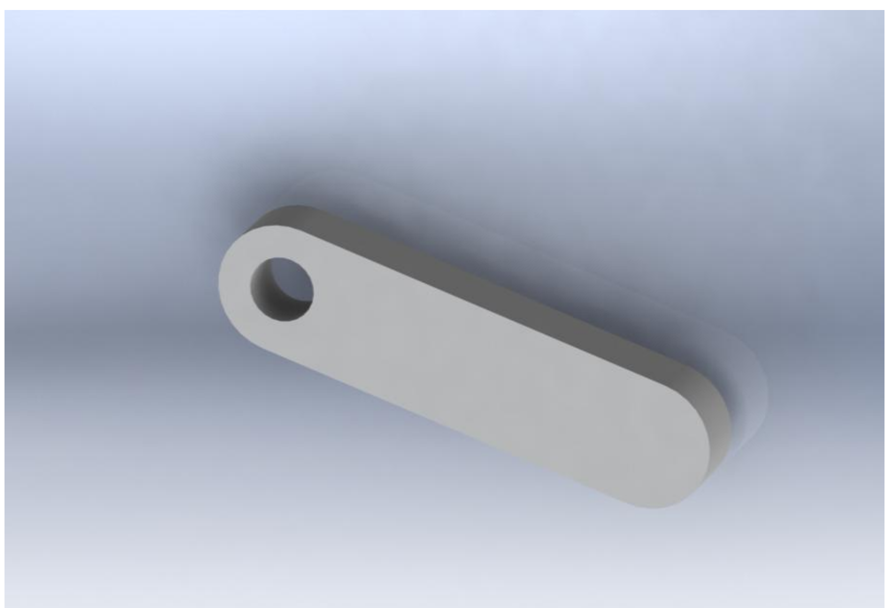


White Delrin Bar 1/2" Thick X 1/2" Width, Square X 5’ length.
No of Parts: 2

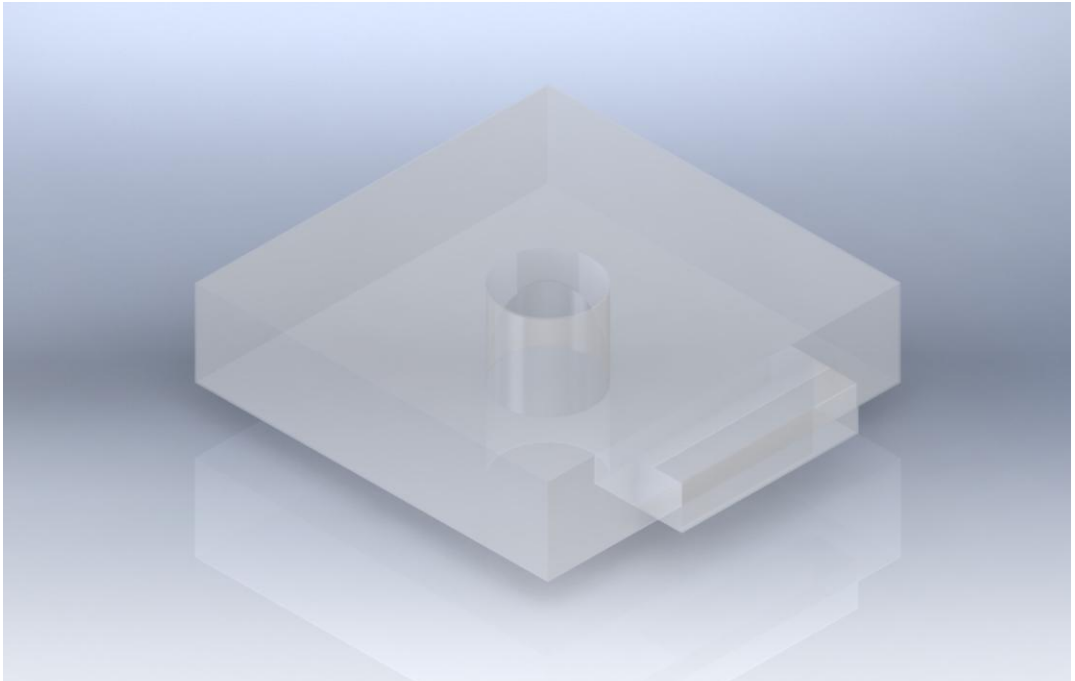
Delrin, the world's first acetal resin, is a highly versatile engineering polymer. It offers an excellent balance of desirable properties that bridges the gap between metals and ordinary plastics. Delrin was chose to make the block because the block is the most critical part of the line scribe as it dimensional stability determines the precision work yield from the equipment; hence material was suggested and purchased. Delrin have following properties:

- High mechanical strength and rigidity
- Toughness and high resistance to repeated impacts
- Long-term fatigue endurance
- Excellent dimensional stability
- Good resilience and resistance to creep
- Natural lubricity

As the block has to slide on the slider rail its need to have natural lubricity to reduce the friction and repeated used should also endure the fatigue and creep.

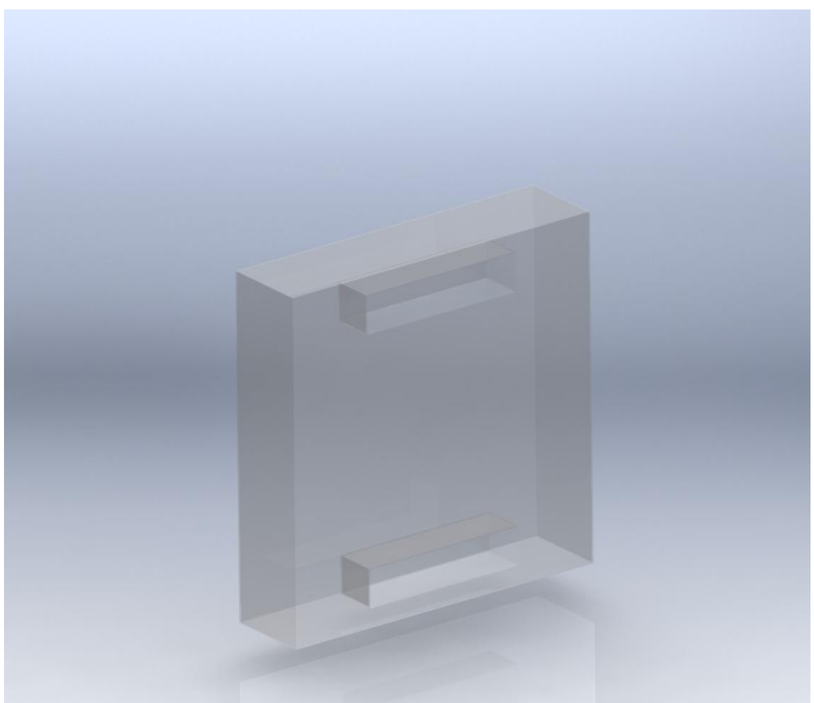


Polyethylene (UHMW) Rectangular Bar 1/4" Thick, 1/2" Width X 5ft length
No of Parts: 6
UHMW PE is very cheap material and doesn't need to be very Machineable.



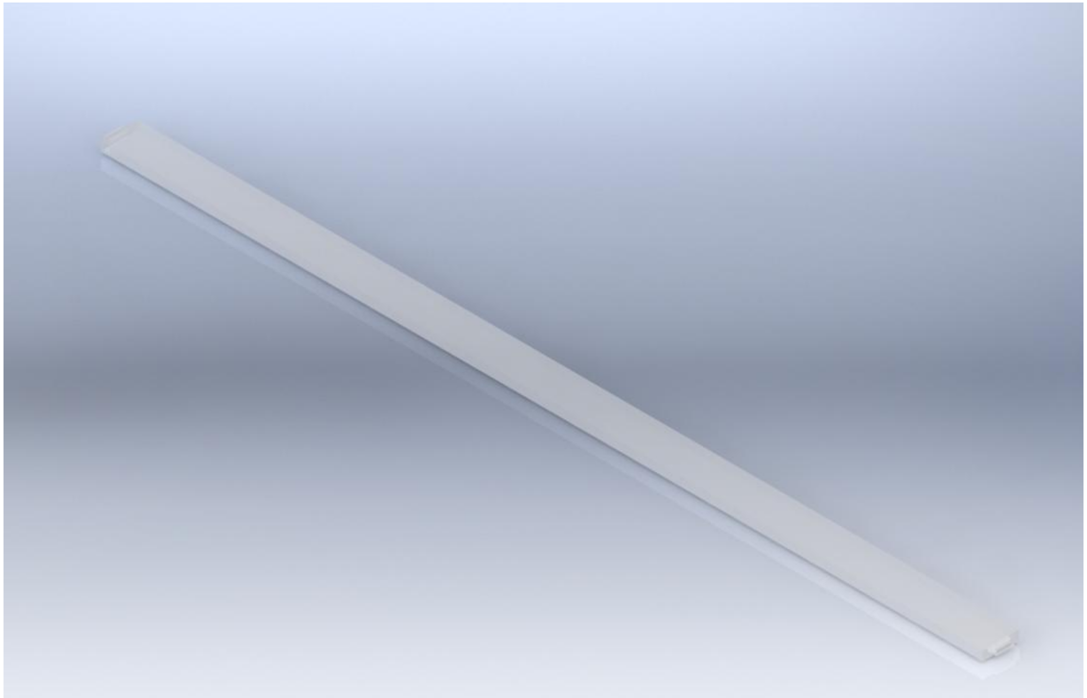
Cast Acrylic Rectangular Bars 1/4" Thick, 1" Width X 4 ft Length

No of Parts: 4



Cast Acrylic Rectangular Bars 1/4" Thick, 1" Width X 4 ft Length

No of Parts: 4



Cast Acrylic Rectangular Bars 1/4" Thick, 1" Width X 4 ft Length

No of Parts: 2

Acrylic is a useful, clear plastic that resembles glass, but has properties that make it superior to glass in many ways. Common brands of high-grade acrylic include cast, Lucite and Plexiglass. Cast acrylic is a higher quality acrylic is a good choice for applications that require the best appearance and hence sometime chosen over glass for many reasons. It is many times stronger than glass, making it much more impact resistant and therefore safer to use for common domestic production and hence was used as the clamp holder.

Material Purchased in its original form

- Carbide-Tipped Scriber with Pocket Clip, 5-1/2" Overall Length
- 18-8 SS Flat Undercut Head Phil Machine Screw 1/4"-20 Thread, 1" Length, packs of 25
- Leveling Mount Nylon Base, 5/16"-18" Thread, 1" Bolt Length, packs of 12.

• *Construction*

- ***Procedure***

Setting up the Bridgeport Mill Machine

1. On the right side of the machine, flip the lever to the “ON” position and press the “START” switch.
2. Choose an end mill to be used for your cutting and find a collar which fits your end mill snugly.
3. Place the collar into the spindle and turn while pushing up until the key hole lines up with the tab and the collar slides up.
4. While holding up the collar, turn the bolt on the top of the machine until it is tight.
5. There are two levers in front of the bolt. The one on the right goes into a slot. Do not touch this lever. Press and hold the left lever to the right and use a wrench to finish tightening the bolt (not too tight though).
6. Place your stock in the vise and tighten using the handle in the front. You may need to use parallels to raise the stock off the floor of the vise or to make it more accessible to the end mill.
7. When the machine is set up, you made need to find the zero position. This is done as follows (for a two-flute end mill):

a. To zero the z-axis (height):

i. Turn the z-axis lever counterclockwise until the top of the stock is lower than the bottom of the end mill.

ii. Move the table so the end mill is somewhere near the middle of the stock.

iii. Turn the z-axis lever clockwise until the end mill is about an eighth of an inch above the stock.

iv. Place a small piece of paper between the stock and the lowest part of the end mill, and while moving the paper back and forth slowly turn the z-axis lever clockwise until the paper can't be moved any more.
v. Loosen the z-axis dial, turn the dial until "0" is at the mark and tighten the dial.
vi. The z-axis is zeroed (although you may want to check by repeating the above steps).

b. To zero the y-axis (left-right):
    i. Turn the z-axis lever counterclockwise until the top of the stock is lower than the bottom of the end mill.
    ii. Turn the x-axis lever until the end mill is somewhere near the middle of the stock's x-axis.
    iii. Turn the y-axis lever until the end mill is off to the right of the stock.
    iv. Turn the z-axis lever clockwise until the bottom of the end mill is just below the top of the stock.
    v. At the top of the mill machine, on the right side there is an opening into the machine. Moving the bottom wheel in the back will turn the end mill. Do this until the cutting edge of the end mill is facing the right side of the stock.
    vi. Turn the y-axis lever (on the right) counterclockwise until the cutting edge of the end mill is about an eighth of an inch from the right of the stock.
    vii. Place a small piece of paper between the stock and the end mill, and slowly turn the y-axis lever counterclockwise while moving the paper up and down until the paper cannot be moved anymore.
    viii. Loosen the y-axis dial, turn the dial until "0" is at the mark and retighten the dial.
    ix. The y-axis is zeroed (although you may want to check by repeating the above steps).

c. To zero the x-axis (front-back):
    i. Turn the z-axis lever counterclockwise until the top of the stock is lower than the bottom of the end mill.
    ii. Turn the y-axis lever until the end mill is somewhere near the middle of the stock's y-axis.
    iii. Turn the x-axis lever until the end mill is at a safe distance from either side of the vise.
    iv. Turn the z-axis lever clockwise until the bottom of the end mill is just above the top of the stock.
    v. At the top of the mill machine, on the right side there is an opening into the machine. Moving the bottom wheel in the back will turn the end mill. Do this until the cutting edge of the end mill is facing the far side of the vise.
    vi. Turn the x-axis lever counterclockwise until the cutting edge of the end mill is about an eighth of an inch from the far side of the vise.

vii. Place a small piece of paper between the vise and the end mill, and slowly turn the x-axis lever counterclockwise while moving the paper up and down until the paper cannot be moved anymore.
viii. Loosen the x-axis dial, turn the dial until "0" is at the mark and retighten the dial.
ix. The x-axis is zeroed (although you may want to check by repeating the above steps).

Clamp Handle

1. Take a 5ft rod of ½" x ¼" HDPE and use a pencil and a caliper to mark off six lengths of approximately 2.5in each.
2. Place the rod in a vise and use a hack saw to cut each of the 2.5in lengths.
3. Paint one end of each piece with blue ink and use a combination square and scribe tool to mark the middle of the ½" width.
4. Set the combination square to 3/8", place it at the end of the piece and mark a line perpendicular the lines made at the middle of the widths.
5. Use a center punch to make a small indentation at the intersection of the two lines. This will be used to center the drill.
6. Once the centers of each of the six pieces have been made we will start drilling.
    a. First place a center drill into the chuck in the drill press and tighten it by hand.
    b. Place the key in the chuck and turn clockwise until the center drill is held firmly in place.
    c. Line up the center mark of the piece with the center drill.
    d. Turn the drill press on and slowly lower the spindle until the bit touches the piece. When the center drill touches the center mark it will move the piece so the center mark is exactly lined up with the center of the drill bit.
    e. Lower the center drill until the beginning of the taper touches the piece then slowly raise it out again.
    f. Turn off the drill press.
    g. Repeat this step for all six pieces.
7. Now that the center holes have been drilled we will drill the main hole.
    a. Remove the center drill bit from the press and replace it with a No. 7 drill bit.
    b. Line up the center hole with the No. 7 drill bit.
    c. Turn the drill press on and slowly lower the spindle until the bit touches the piece. When the drill bit touches the center hole it will move the piece so the center hole is exactly lined up with the center of the drill bit.
    d. Lower the spindle until the bit breaks through the piece then slowly raises it out again.
    e. Turn off the drill press.
    f. Repeat this step for all six pieces.

8. We now have the hole and we can begin tapping.
    a. Remove the No. 7 drill bit from the drill press and replace it with a ¼-20 tap. There is no need to tighten it with the key because we won't be turning on the press. We only use the frill press so the tap will be straight.
    b. Lower the tap until it touched the top of the holes previously drilled in the pieces.
    c. When the tap is touching the hole, apply a small amount of pressure on the feed lever so the tap is pressing lightly on the piece.
    d. While holding the piece in place slowly turn the spindle <u>by hand</u> so it begins to tap the hole.
    e. Once the tap is securely inside the hole, loosen the chuck and remove the tap.
    f. Place the piece with the tap on top into a vise and tighten until held securely in place.
    g. Place the tap wrench onto the tap and tighten.
    h. When all is set, turn the tap wrench in a clockwise direction until the threaded part of the tap is most of the way through the hole. If the tap begins to bind, turn it counter clockwise so any material stuck inside can come out (making sure not to completely remove the tap), then continue clockwise.
    i. Turn the tap counterclockwise until the tap exits the hole.
    j. Repeat these steps for each piece.
9. Use a knife to cut the burrs of the piece, and make it flat.
10. Place a ½" diameter by 1" tall rod on top of the piece so the center of the rod is over the center of the tapped hole. Use a scribe to mark the curve of the circle in the blue die on the piece. Repeat this step on each of the pieces.
11. We will now use the sanding wheel to cut out the radius we marked.
    a. Turn on the sanding wheel by flipping the switch on the left.
    b. Place one of the pieces on the ledge and slowly bring it up against the left half of the wheel.
    c. Press the piece against the sanding wheel until the piece has been shaved down to the curved mark all around the piece.
12. Paint the other end of the piece with the blue die, and use a combination square and a scribe tool to mark a line 2in from the other end. Repeat for each piece.
13. Place a ½" diameter by 1" tall rod on top of the piece so the curve is adjacent to the line marked in Step 11. Use a scribe to mark the curve of the circle in the blue die on the piece. Repeat this step on each of the pieces.
14. Repeat step 12 on this end of the piece.
15. Cut any burrs from the piece and use methanol to clean.
16. The handles are complete.

BASE Steps:

1. Hole centers were found with combination square every ½" along length.
2. Centers were marked with center punch
3. Board clamped vertically in drill press.
4. Center drill made pilot holes.
5. 3/16" drill bit drilled holes.
6. Feet hole centers found with combination square.
7. Pilot holes drilled with center drill.
8. Tap hole drilled with F drill bit.
9. Holes tapped with 5/16-18 tap.
10. 0.1" cut in mill machine in other room using 1.5" end mill:
11. Moved top forward.
12. Pressed against back to make parallel.

BLOCK Steps:

1. Front cut and rough cut of bottom were made in mill machine with 1" end mill.
2. Slots were cut in mill machine with ¼" end mill.
3. Tool hole was cut in mill machine using 3/16" end mill.
4. Set screw hole was centered using a combination square, drilled with center drill followed by No. 27 drill bit and tapped with a 6-32 tap.

SLIDE AND CLAMP BOTTOM Steps:

1. Tabs were cut in mill machine with 5/8" end mill, tab side facing up.
2. Center for holes found using a combination square.
3. Center was marked with center punch.
4. Pilot hole drilled using a center drill in the drill press.
5. Tap hole drilled in the drill press with a No. 7 drill bit.
6. Holes tapped with a ¼-20 tap. We used the drill press to start the tap straight.

SLIDE AND CLAMP SIDE Steps:

1. Slots were cut in the mill machine with a 1/8" end mill.
2. Holes were cut in the mill machine with a 3/16" end mill.

SLIDE TOP Steps:

1. Angle was cut in mill machine in other room with a 5/8” end mill.
    - Needed to use clamps instead of vise.
    - Too long – could only do part of the cut at a time.
2. Tabs were cut same as before.

PIN Steps:

1. Flutes were cut in mill machine with 1” end mill.
2. Diameters were cut in collar lathe.
    - Automatic feed!

CLAMP HANDLE Steps:

1. Holes made same as Clamp and Slide Bottom.
2. ½” metal rod used to mark radii.
3. Radii cut using sanding wheel.

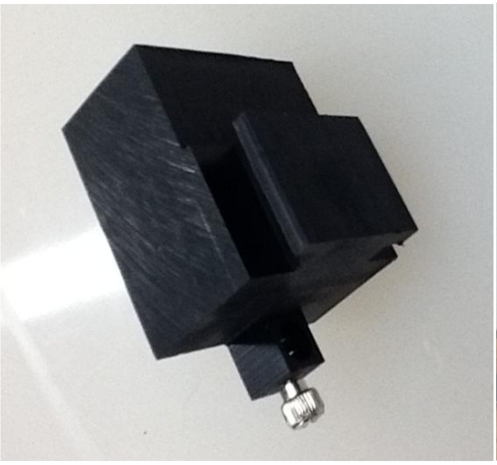
• *Conclusion*

This project was one of the most interesting and involved project out of all we had in Mechanical engineering class. We had a profound hands-on experience with various computer controlled and manual Machines, which are more versatile and have capable of milling, drilling, boring and also tapping with repetitive accuracy . Other than that, we understood the machines ability to produce complex shapes with high dimensional accuracy besides it can reduce the scrap loss.

A lathe can be used to cut pieces of variety of material in different uniform shape what are symmetrical with spindle axis. The main feature of a lathe that distinguishes it from a mill is that the part is rotating about the machine center line and in addition, the cutting tool is normally stationary, mounted in a sliding turret.

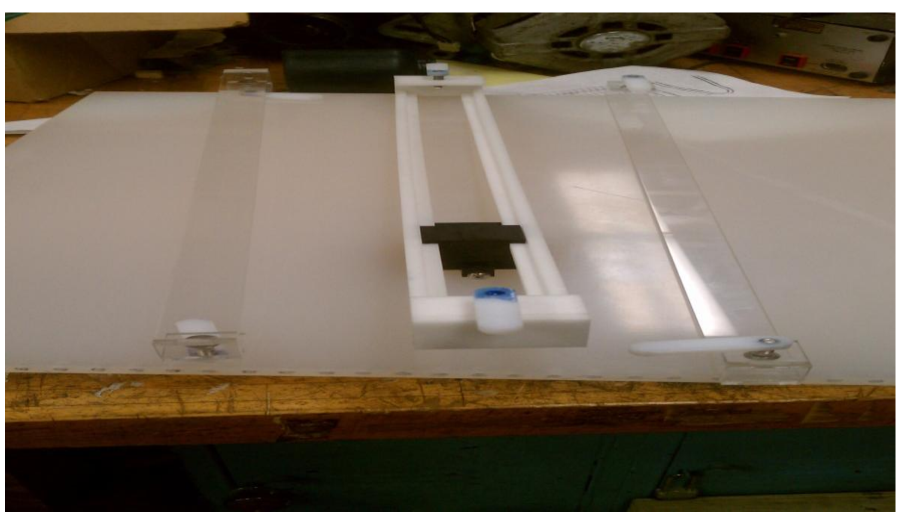
Various problem posed hurdle in the manufacturing process which was overcome with engineering judgment and finally the product was done. Overall this project was thus a very good learning process of engineering manufacturing process.

- *Appendix*

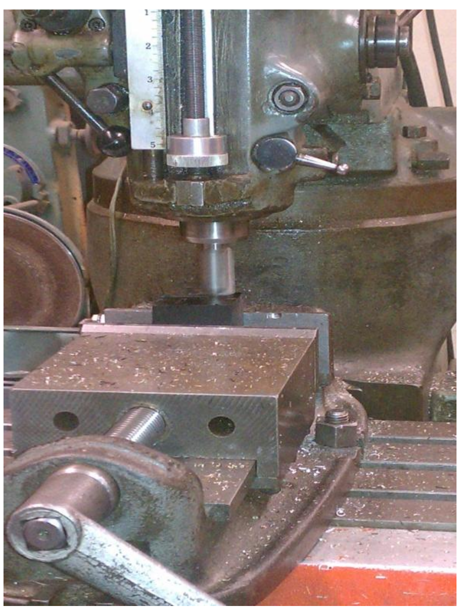








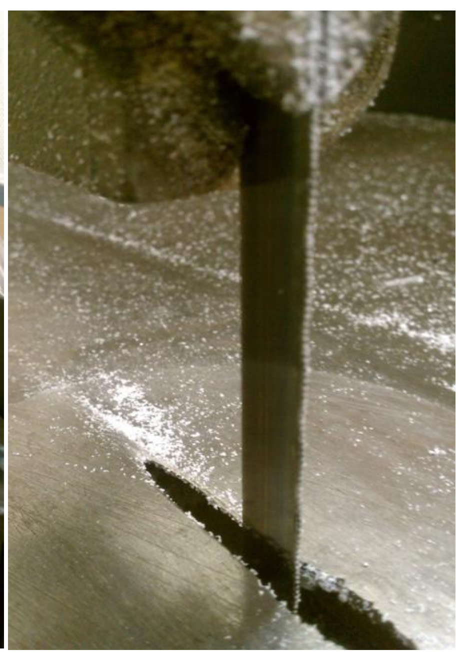


LOCTITE
220™
THREADLOCKER
NET .34 FL. OZ. (10 ml)


TOOLMASTER
CINCINNATI

CAUTION



Bridgeport
ME