

TERM 1 2017

Test recess cut into underside of honeycomb to accept steel subframe.



Steel subframe set into honeycomb



Using the random orbital sander to remove the burred edges



My storage table covered in various test pieces and jigs



idea and will make the structure of the honeycomb far stronger resolving the shortgrain. This will however be another machine which I will need to learn and another program I will need to create a Honeycomb template for.

#### WEEKS 7-8

##### DESCRIPTION

After creating the templates over the weekend, I spent the majority of week 7 working with the metal work teacher to be able to create the metal frame out of steel (steel as a first test to see if the idea works). After moving my template over into PlasmaCAM (DesignEdge) I was able to run the Plasma cutter and create the shape which can fit inside of the Honeycomb. I then glued up another board for the next iteration of the Honeycomb to be cut by the CNC. To be able to cut the routed channel in the bottom for the metal frame, I needed to flip the Honeycomb over so the underside faced up, and then run a 6mm deep channel into the underside of the shape. Once both were cut out and the Metal frame was sanded so that it fits easily inside of the shape, I did more tests to see how the strength of the honeycomb compared to one of the test honeycombs I produced last week, and it had far more strength and was not particularly weak in any direction. This eliminated the shortgrain issue of my Honeycomb structure.

##### WHS

Similar to before with the issues presented by the CNC, and the Plasma Cutter can provide a big safety risk. As the machine uses a laser, and it is incredibly hot, I not only wore ear and eye protection, but any handling of the material after it was cut was done by the teacher until the cooling liquid had dried off the metal.

##### EVALUATION

The metal frame inside of the Honeycomb shape is able to strengthen and resolve the structural issue that is created by the Short-grain. I also used the plasma cutter for the first time which was a great learning experience. This now means when I decide my final solid timber I can cut out the Honeycomb and the metal frame straight away and that is two pieces that are done.

#### WEEKS 1-2

##### DESCRIPTION

At the beginning of the first week my initial task was to use the plasma cutter so that I would be able to test fit the Aluminium frame into the Honeycomb structure. Unfortunately, due to the 3mm thickness of the Aluminium the Plasma cutter did not cut directly perpendicular to the metal sheet and on a slight angle so I needed to sand down the angled surfaces to fit in the Honeycomb's channel. After being happy with how the Aluminium has fit into the Honeycomb structure, I then used the same template on the CNC for the honeycomb, but only had the machine cut the outline of the shape on my table top. I did this so I could get an identical shape on both the table top and the honeycomb so that I did not have to make the shape by hand and it fit perfectly.

##### WHS

When using both of these machines, Ear and Eye protection was worn in case something went wrong with the machine (ie; a drill bit

Successful test pieces from using the CNC and plasma.



Test leg pieces. I was trying to determine the best method for cutting the legs out.



Wearing the correct safety equipment for the right machine.



One of many jigs to try and create a stable environment for me to be able to work on the legs.



breaking). I was also standing a significant distance away from the machine, but had the controller so I would stop either machine at any time. As I was not familiar with the Plasma cutter I also had some assistance from a Metal Working Teacher to help me with using and operating the machine.

#### EVALUATION

The CNC machine worked perfectly and no immediate issues arose from cutting my table top – as it fit perfectly to the Honeycomb. However, after some reworking in the middle of Term 2, I have realised that one of the lines cannot be reworked as it has already been cut, which has created an issue. The only issues with the Plasma cutter was the issue of not cutting straight however this is minor and does not affect anything.

#### WEEKS 3-4

##### DESCRIPTION

At the beginning of Week 3 I glued up the first block for the initial leg prototype. It was about 7x19mm thick boards on top of each other about 850mm long. I found out quickly when I went to bandsaw the block that I was wasting almost 70% of the block, and the way that I had cut it meant I could not make 2 legs from it. After drawing on all of the projection lines again to double check, I then planed down each of the four outer surfaces which took roughly a week. Whilst the process was a bit tedious it had a good finish and was accurate.

##### WHS

I had to wear safety glasses and ear muffs when operating the bandsaw.

##### EVALUATION

For the next leg I have to think more about the way I use the Pine to create the leg, either by getting two legs out of each block or to decrease the amount of timber used in each leg.

#### WEEKS 5-6

##### DESCRIPTION

After completing the outer 4 faces of the legs I began to plane the inner 4 faces. This worked well and efficiently until I moved closer to the join line between the upper and lower sections of the leg, where the plane cannot get into due to the two sections being on an angle. To try and overcome this issue I tried to use a chisel and a scraper. However, by doing this I was not able to make the line straight, or level, as well as it taking almost a week to do just two faces.

My next thought was to use a router and for the last half of Week 6 I began to create a jig which would effectively 'hug' the leg either side creating walls or rails for the handheld router to run over and cut out the inner faces to the correct depth. It was made by putting many pieces of timber together with bracing at the end of the leg and over the upper section, which ran along the join line.

Before gluing up the second leg, I also made adjustments to its dimensions, and the first prototype whilst looked good in modelling

I was able to reduce the laminations for the legs from 7 to 5 to 4, which saved a lot of material.

My first run at test pieces for the upper portion of the legs.

Sitting the two sections of test legs on top of each other to see if it works.

Eye protection and ear muffs being worn whilst using the router.



software, looked too angular and 'over the top', so I decreased the angles of the leg so they were more subtle.

#### EVALUATION

This was critical to the overall outcome of the legs as it has had a big impact on the way they will be manufactured. Unfortunately, this problem will also set me back a long way from how long I was projecting this process to take, which is the biggest issue. The router should be a quick and easy solution to cutting out the inner faces of the legs and getting the line perfect.

#### WEEKS 7-8-9

##### DESCRIPTION

At the beginning of the 7th week in this term I glued up the second block for my next leg prototype. This time instead of using 7 pieces laminated together I only used 5, I also arranged the leg in a specific way that if necessary I could also produce another leg quickly, but I ended up using this extra timber to edit the jig for the router. Similar to the first prototype, I planed the outer 4 faces flat, and then did the majority of the inner sections (so that the jig can clamp on a flat surface, then put the leg into the jig for the router. This worked incredibly quickly and effectively until I reached the join line where the base plate of the router which sat on the rails was not big enough, so it would slip off and dig into the leg. Unfortunately, there were no bases wide enough to work with the jig and so this method also became obsolete.

The main issue with the previous 2 iterations of the leg was that when it was manufactured in one piece I could not reach the standards to keep my project at a high quality, so I decided to split the leg into two sections, the upper and lower section designated by what is above or below the join line. This means that I am able to work on each face individually without having the angles interfere with the finishing of the leg. I then glued up a 3rd block to create the next prototype of these legs, which was slightly longer at 950mm long, which means that from the block I was able to cut out the top section, and the lower section individually.

##### WHS

This biggest WHS issue during these weeks was when the router jumped off the rails and dug into the leg. The jig was setup in a way which housed the router bit when it was in use. I was wearing Safety glasses and earmuffs when using the router. I did not continue to use the router after it dug in the first time as this was a safety concern.

##### EVALUATION

Overall this process of manufacturing the legs has become incredibly long and has taken far more time than I expected. These setbacks have cost me time which I could have used for other parts of my project down the track. In spite of this, I feel breaking up the legs into two sections will work well and will be far quicker than the methods that I have been using before. I think it will also give a better finish and will be far more accurate.

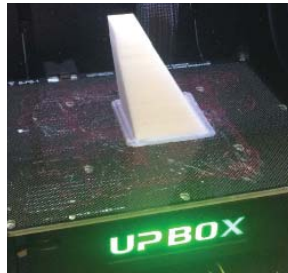
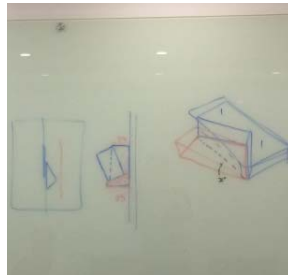
## TERM 2 2017

Brainstorming on a whiteboard to come up with solutions for creating a jig to cut the legs on the table saw.

The finished 3D printout of the upper section of the leg.

The 3D printout of the upper section of leg next to my attempts using the saws.

I marked the angled lines on the blocks to establish where the cuts needed to be.



### WEEKS 1-2-3-4

The first 3 weeks of this term consisted of my Half Yearly exams, and little progress was made during this time. During this time I also received my delivery of Rock Maple. Transporting this I got help from 2 other people due to it being incredibly heavy until we were able to leave it in the shed, where it is protected from the weather.

#### DESCRIPTION

I began week 3 by gluing up the four blocks which make up the legs, 2 parts in each block. (ie; two lower section blocks and two upper section blocks). Whilst the blocks were drying, I began creating a jig which allowed me to cut the lower sections of the leg on the bandsaw and then the table saw. I projected the shape of the leg on the block, using the bandsaw cut the block into two pieces and then cut the final two faces off the lower sections using the jig on the table saw. The jig had the shape of the leg cut into it so when the actual leg would be put in it, it would cut the excess off leaving a finished face. The first cut however left some saw marks, so we cut 1mm further outside the jig, and then did a second cut which only took off the 1mm, this gave a far better finish. In the last half of week 4, I started to project lines to cut up the upper pieces of my legs. However, as the angles are incredibly complex, I took my 3d model from Google SketchUp and 3D printed the upper section, allowing me to trace off the shape onto the block.

#### WHS

Only a staff member could use the table saw, but whilst being near it I would wear safety goggles in case of any chips flying off the cuts. When moving my timber when it was still packaged from the supplier, I had help from multiple people as it was incredibly heavy.

#### EVALUATION

This process of producing the legs as individual sections is far easier to make and is much quicker. The pieces are also being done by the table saw which is accurate down to 0.1mm, making the leg incredibly accurate. The upper sections of the legs are going to be incredibly complex however and may take some time due to the compound cuts.

### WEEKS 5-6

#### DESCRIPTION

The process of producing the upper sections was far more complex than the lower sections. After projecting the lines across from the 3D printed model, I used the bandsaw to then cut each block into the four pieces for the legs. I then took each section, and marked out which face would be cut and in what order to minimise the amount of compound cuts there were, as all four faces are sloped on an angle. I then band sawed off the excess on the first cut for all four parts, and then went to a large belt sander and sanded them to the projected lines, then did the same for the second cut on all four pieces.

For the third and fourth cut however, when sanding they pieces would rest on a finished face which is sloped, and would create a compound cut. So I used Google SketchUp to create a shape with the right dimensions, so I could create a wedge which would fit onto the piece, and bring it effectively back to a square block – and remove the compound cut. I reversed the wedge and used it again

Cutting the upper sections of the legs on the band saw.



Multiple blocks cut out.



Legs being clamped together. It took a number of goes to determine the best way to apply pressure.



The timber and aluminium frame have been epoxyed.



for the fourth compound cut, as I cut the two inner faces first so I only needed one wedge for this second compound cut to re-square the piece.

#### WHS

I had to use the bandsaw and then the belt sander to complete the upper section as trying to use a similar jig to the lower section on the table saw is too dangerous. There is not sufficient distance to hold onto the block, and the blade made the piece want to fly out of the machine., hence we did not cut the pieces via the table saw. When using the bandsaw, I had all guards in place as well as eye protection, and for the belt sander I rested the block on the metal clamp on the machine so the piece did not fly off. I wore eye protection, ear protection and a dust mask as there was a significant amount of dust.

#### EVALUATION

Overall, the legs are almost done, fitting the two pieces together without joining them together they fit incredibly well and have a perfect join line. This method should have been done in the first place – far quicker, easier and more efficient. If this method was done first I would have almost an extra 6-7 weeks.

#### WEEKS 7-8-9

##### DESCRIPTION

Cutting out the honeycomb in the next two weeks and preferably getting it glued into the table top was my goal. The first part of week 7 consisted of each period getting a new one of the 4 legs and clamping it up to give as much pressure in the joint as possible. The problem is that the legs are completely off centre from all of the tapers and so if the pressure is not applied down its centre axis then it can open up on one side of the joint. As seen in the photo of the jig, it clamps around the upper section so that the sash clamp can apply the linear force closer to the legs centre axis. By week 8 all four legs had been glued, and of a night I am slowly chiselling and sanding down the legs. This process took almost a month of perfecting all 4 legs on all 4 sides. I then cut out the aluminium on the plasma cutter and cut out my first honeycomb in Rock Maple. Whilst cutting I also did a few tests of epoxy in an older frame to see the effect it will have and the best ways of handling it. Before setting the aluminium in the channel, I cleaned up the shape from the plasma cutter and then used a hydraulic pan brake to bend the ends of the frame to create prongs which would stick into the rails for more support. As week 9 was short, I only managed here to epoxy in the aluminium frame into the back of the maple, and until it set, worked perfectly. But after taking the honeycomb home we found very quickly that it cupped in a matter of hours after setting.

#### WHS

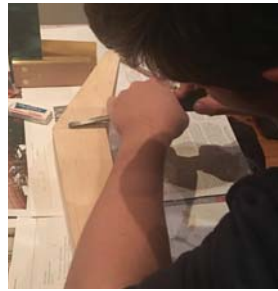
Special care had to be taken whilst using the CNC router again and also the plasma cutter. I Used multiple machines and tools to clean up the aluminium frame such as the linisher and the hydraulic pan brake to bend the prongs on the end of the aluminium. Both of these metalworking machines are very dangerous and all eye and ear protection was work as well as being shown how to use the machines.

#### EVALUATION



## TERM 3 2017

Working at home chiselling out the leg to get a smooth finish



A jig was set up to hold the rail in place for the Domino machine



Drawer pieces have been cutout with the box joints ready for assembly



Drawer unit with box joints ready for assembly



These few weeks were very productive. I managed to get all of the legs glued up and ready for rails which will begin the following term and the honeycomb was all epoxy set in.

### WEEK 1-2

#### DESCRIPTION

The majority of the first few weeks of term 3 were spent on the legs, frame (including rails and joining to the legs) as well as making the drawer. In the first week I spent a lot of time working on cleaning up the joint line between the upper and lower sections. This whilst did not take as long as I thought it would, still took a long time. As soon as this was done I could get onto joining the rails and the legs together. For this I used three small dominos that could fit in the width of the rails, which was only about 10mm on the front and right rail (the ones with the honeycomb in them). I created a small block that could sit on the top face of the leg, and would set the alignment of the slots off the top edge of the block and top corner in the rails to sit at the same height. The block was squared on the three faces it was being used on and we used chemical double sided tape to hold this template down. Once this was all down I could put glue in and domino the whole frame and have it all glue together. Whilst this was drying I moved on to creating the drawer. As the cleats will incorporate dovetails, for times sake I decided to box joint the drawer. The machine allows you to hit a pin and then cut though the box shape, then shuffle the block up and over the pin so the finger created now hits the pin, and so on until all are cut. The front of the drawer was created the same way as it is on the same angle as the rails, but I put a thin plywood sheet behind it to prevent blowout from the router ripping the grain. However as the pin was bent and so when I added the sheet in, each cut would get more off centre and so would not fit any other joints. We realised this afterwards and bent the pin back, recalibrated the box router and recut the front of the sides, as well as the front piece on the angle.

#### WHS, TOOLS AND MACHINES

There were very few machines that I used in these few weeks. The main machines that I used were the domino machine and the box router. The main safety concerns with these are having the router bit poke through the back of the box jig after the whole pass had been made through the timber and the domino machine not having sufficient pressure and can bite into the grain around it.

#### EVALUATIONS

This week went rather quickly unfortunately and I would have liked to have moved a bit quicker through these tasks. The box router mistake was very simple and should've been picked up on and that just set me back a couple of days figuring out the problem. I would've liked to have been able to cut out the next Honeycomb to save myself that time in the next week but unfortunately the CNC machine was broken and not working.

### WEEK 3-4

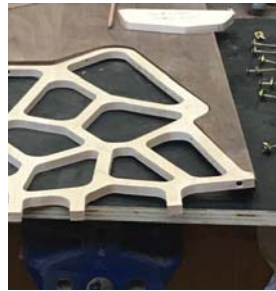
#### DESCRIPTION

The third week into term three began by cutting out the next honeycomb from maple. The cut performed perfectly but unfortunately

Second iteration of the honeycomb top. Trying to ensure it glues flat.



The honey comb has bowed again.



A steel plate under part of the frame is the new approach



It works extremely well and adds to the aesthetics.



after the extensive epoxy'ing process the honeycomb still decided to cup very badly. This turned out very bad when we tried to fix it into the table top, and the pressure was too much for the frame with far less epoxy in it, and it cracked in a few spots. This then sparked the research into what was making the honeycomb bend so quickly and strong, and I found out that but adding a channel into the back of the honeycomb has a difference in surface area to the top and hence creates a large cup one way. Therefore on the third honeycomb that was cut out we removed the channel from the underside and added in a steel bracing which ran along the outer edge of the honeycomb to support it further. Whilst this was happening I was also cutting out the channel and shapes of the cleats and fixed the cleats to the frame, which allows the table top to sit down, but allow for movement if it needs to expand. I then added the block which sit in the corner to hold the glass in and then glued everything together in one go. Once everything had dried, I cleaned up all fo the joints and sanded the table back to 400 grit sandpaper. I then put a Wipe on Poly over the table numerous times to give the table its finish.

#### WHS, TOOLS AND MACHINES

Few machines were used in this last week as it mainly consisted of piecing everything together and cutting out the honeycomb numerous times. The glues that I used were not good if it were to touch skin until it was set so gloves were worn when everything was being glued up together.

#### EVALUATIONS

Whilst many thing in these last weeks went very slowly, the table got finished, And that is the big thing. All the parts of the table that I wanted to have in there were done and nothing was left out. I picked up the glass in this week also and it fit the shape perfectly for custom glass that only one place in Sydney could create. I'm very impressed with how the project came out and how it came together.