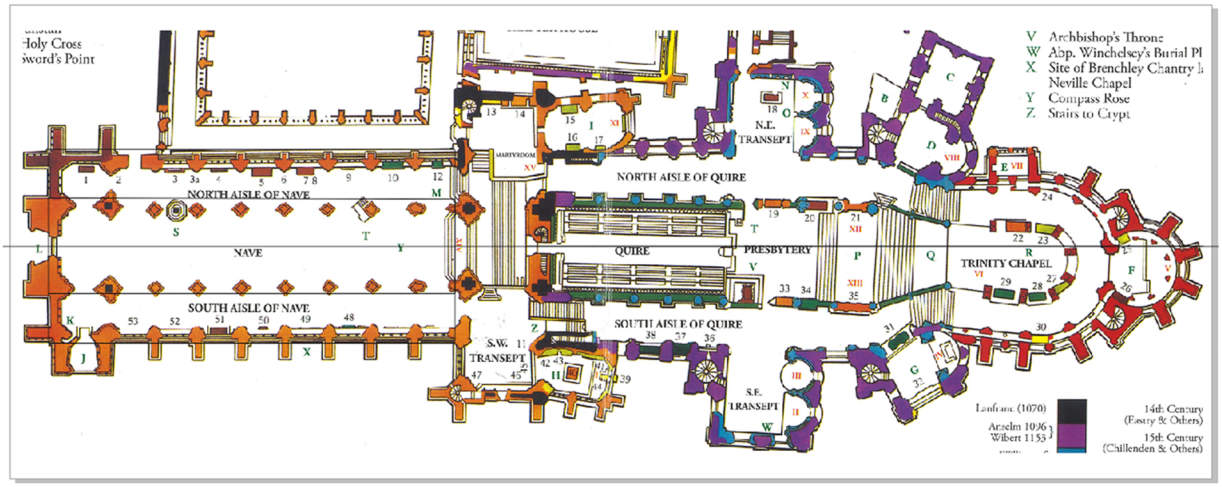
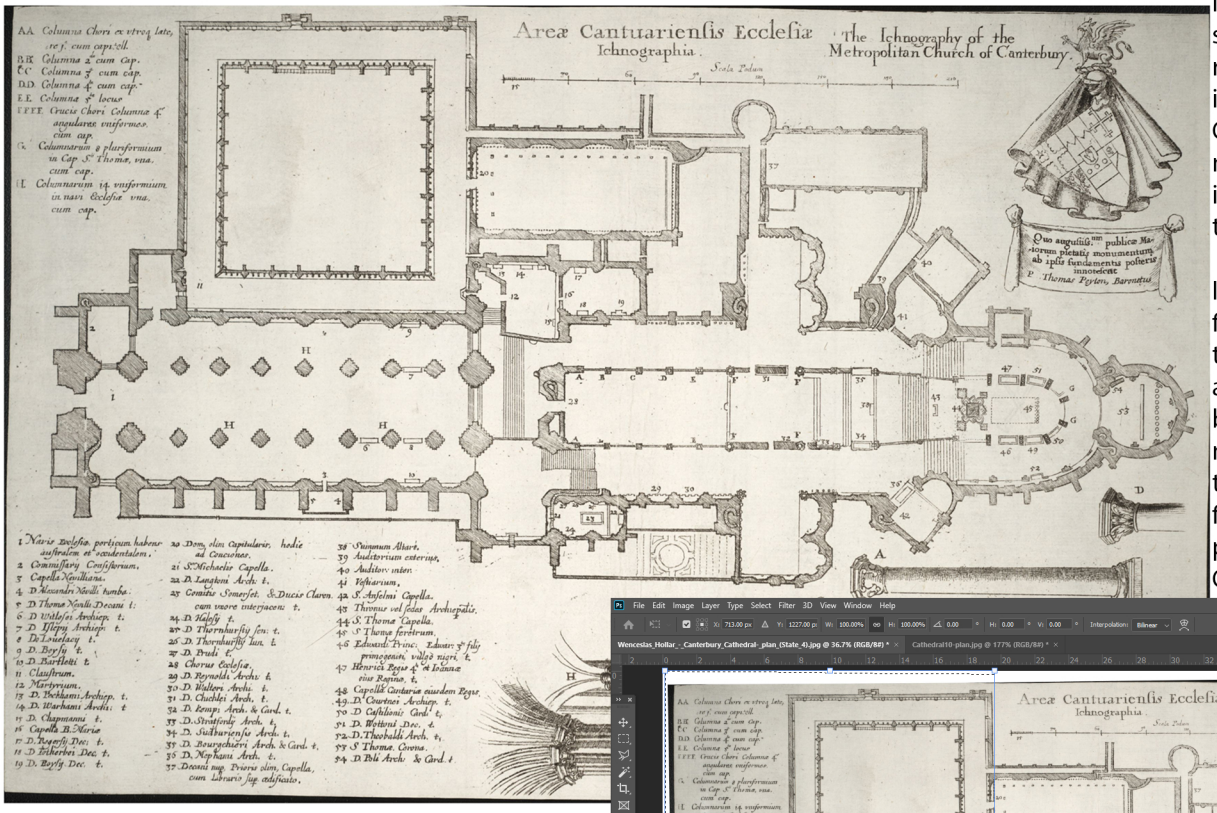
Emily Bond
Tech Log
Professional Context Model
Third Year

Sourcing Blueprints



To the left is the floor plan that I scanned from my Visitor's booklet, from my visit to Canterbury Cathedral. I added the centre line on CorelDraw, and it's clear to see from this that the Cathedral bends slightly down to the right hand corner. When I researched this, it seems that the subtle movements of the ground and the stonework over time has caused this.

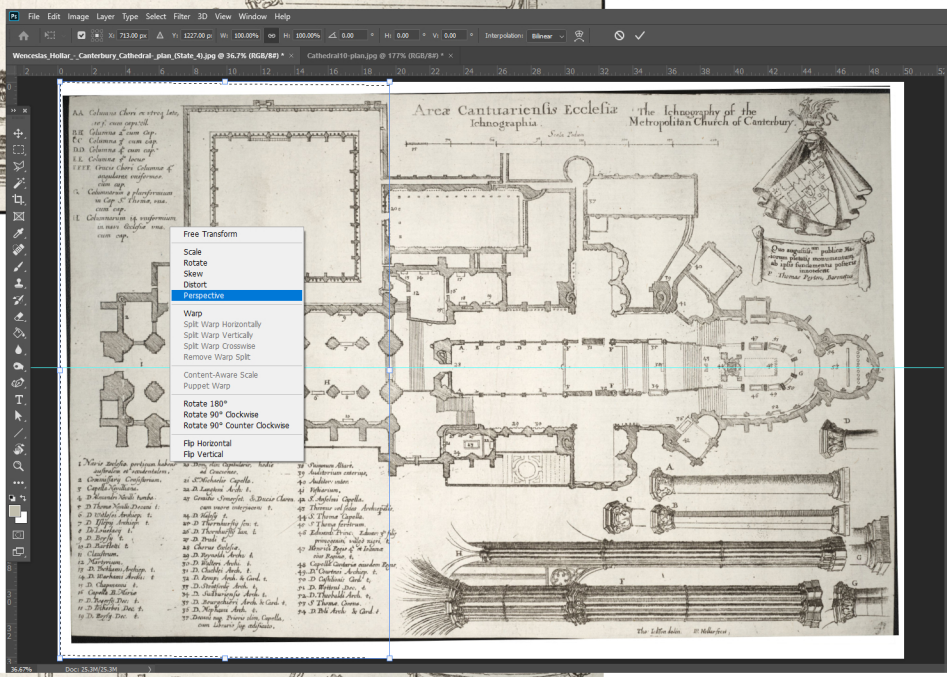
I asked my tutors whether to recreate this slightly bent infrastructure, or whether to straighten it, and they recommended straightening it. I agree, as a symmetrical Cathedral will be simplier to make, and more realistic in my time frame for making this model.

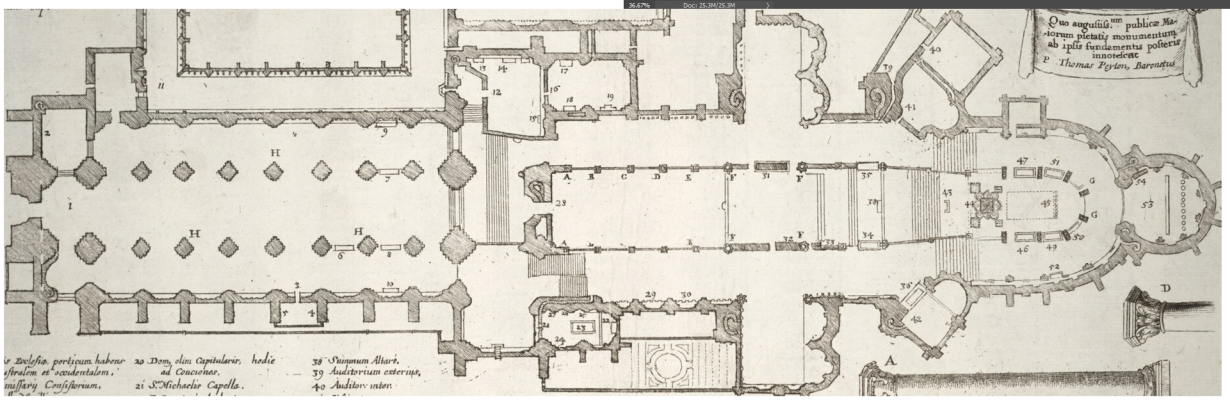


In the meantime, I found the floorplan to the left. I think this floorplan is more useful, as the finer line weight will be easier to trace for making my model. But I will continue to make use of the previous floorplan to check the floor-plan to the left shows the Cathedral in its *current* state.

The screenshot to the right shows the process behind straightening the floorplan. I added guidlines in Photoshop before using the Perspective tool under 'Transform' to slightly warp the image so it was much straighter.

There will still be slight inconsistencies making the Cathedral not perfectly symmetrical, so when I come to create a Sketch model, I will be using one side and then mirroring it, to ensure that my model is symmetrical.



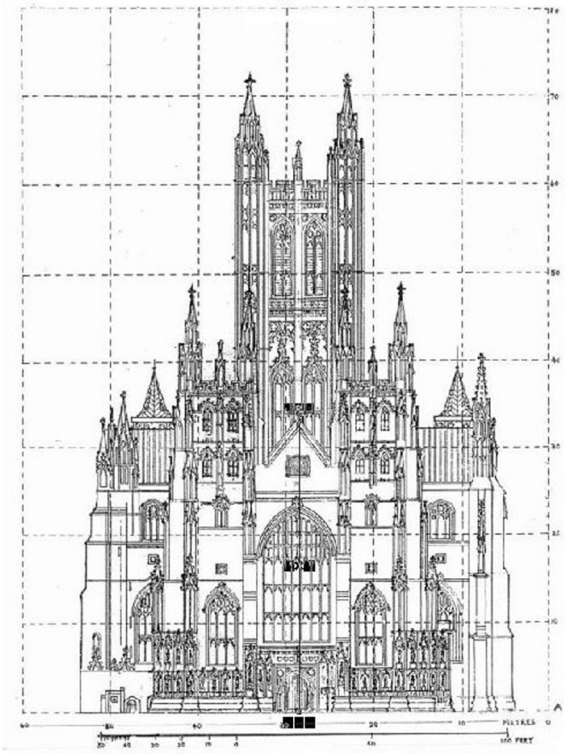


The image to the left is the result of this editing in Photoshop, and thus the floorplan that I will be using henceforth.

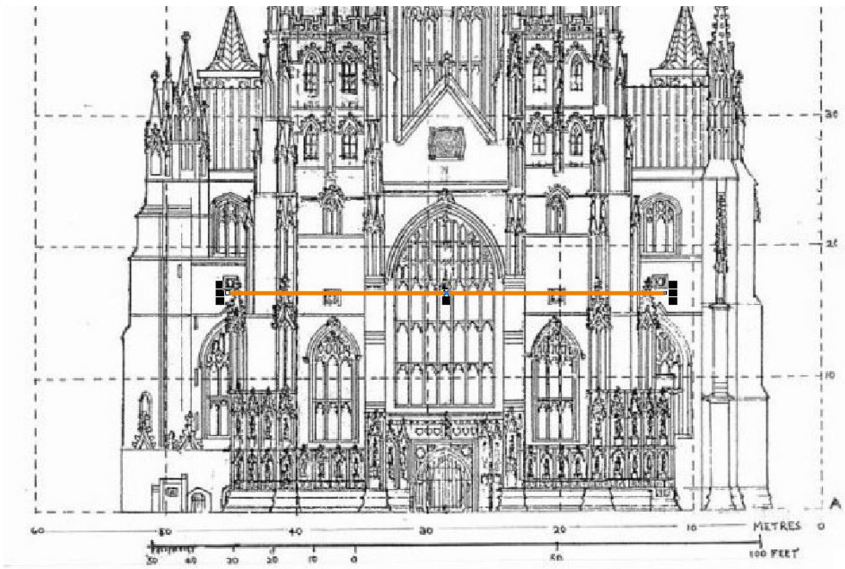
Sourcing a side and front blueprint

I found both of the blueprints to the left on the archive section of the Cathedral's website. I thought at first that I would be able to combine them with the floor plan I had, but then I realised that they are very old (the scan is too blurry for me to be able to read the date it was published, but the fact that the one on the right only has one West Tower supports that idea) so I wasn't sure if they contained all of the current infrastructure information.

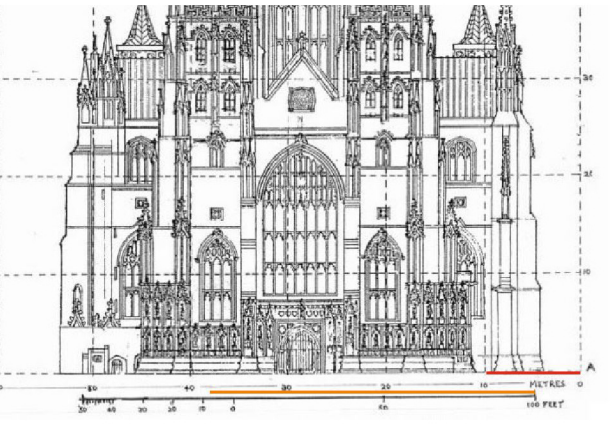
Fig C27
The full western aspect of Canterbury Cathedral, presented within a reference framework. (by C J Dudley)

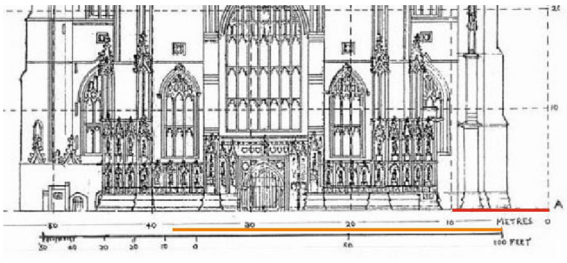


The front blueprint I found to the left seems much more reliable, as it's from a recent Conservation pdf that was made on the Cathedral. There's more information on how it was drawn up in my Design book, but essentially, a drone and mathematical formula were used to mitigate the distortion caused by perspective, as well as cross comparing with the original blueprints (which they unfortunatley did not supply in the pdf).



Above, you can see how I've drawn a black line from the ground to the tip of the roof height. To the right, I've made this line orange and oriented it. I then dragged it down to the scale bar at the bottom of the plan. I then calculated (see below) the real height of the nave, and from this, could calculate the height of my model. This then meant I could scale the blueprint in Rhino, and use it with the floorplan that I had scaled.

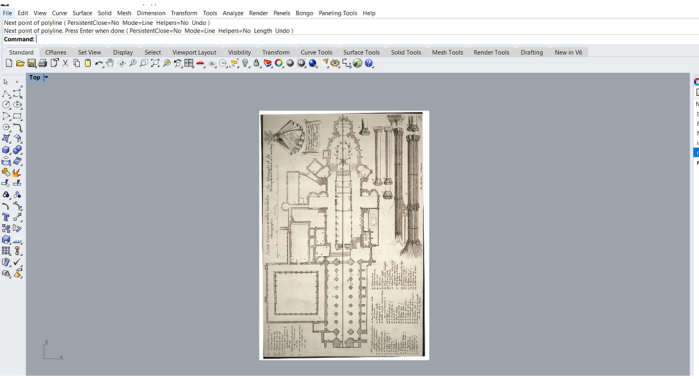




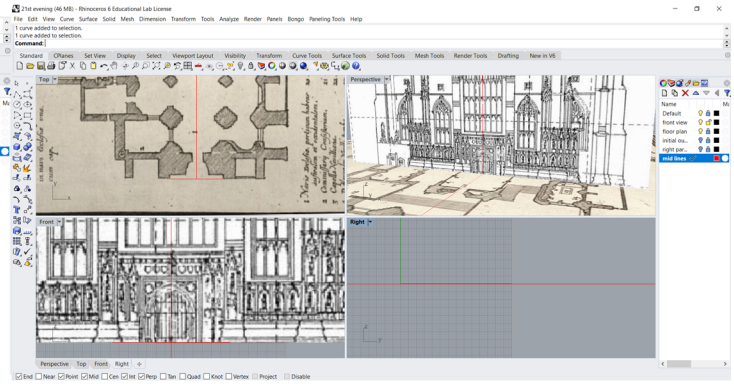
10 metre is 15.8mm
Therefore, 53.8mm (length of orange line) = 34metres

If the roof is 34 metres high in real life, it will be 226.7mm high in my 1:150 scale model.

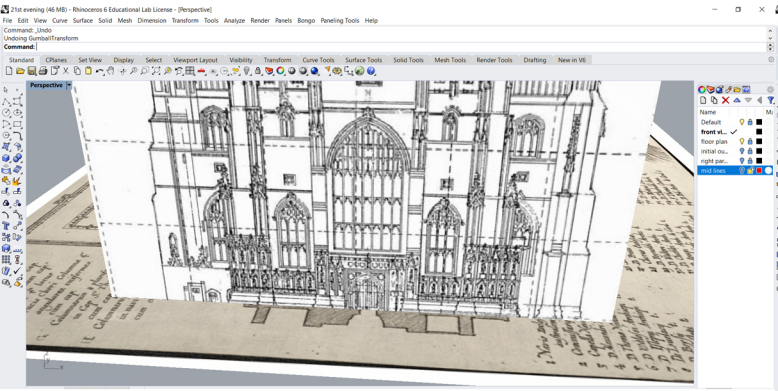
Lining up blueprints and starting a CAD sketch model

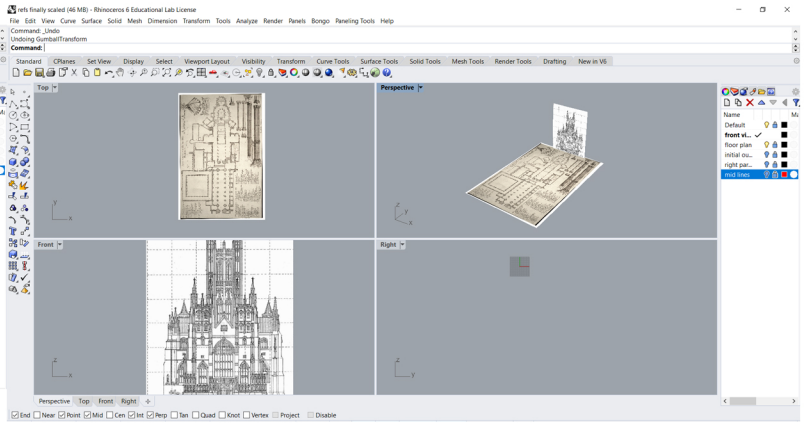


I put my floor blueprint into Rhino and scaled it to the right length. For this, I had found the length of the actual cathedral, and divided by my scale factor (150). More on this in my design book.

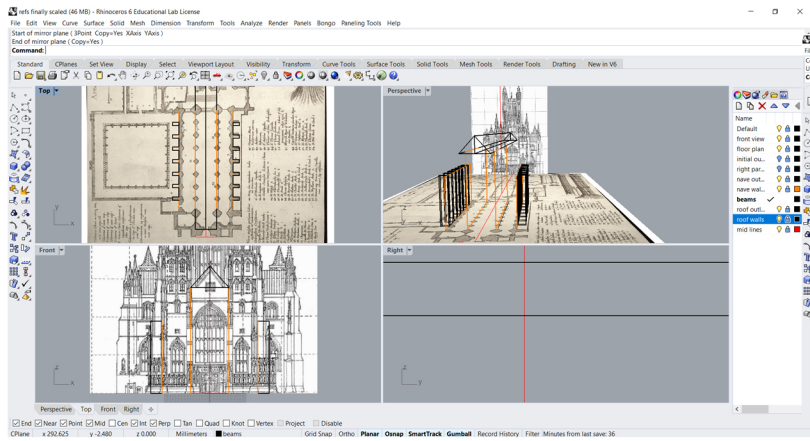


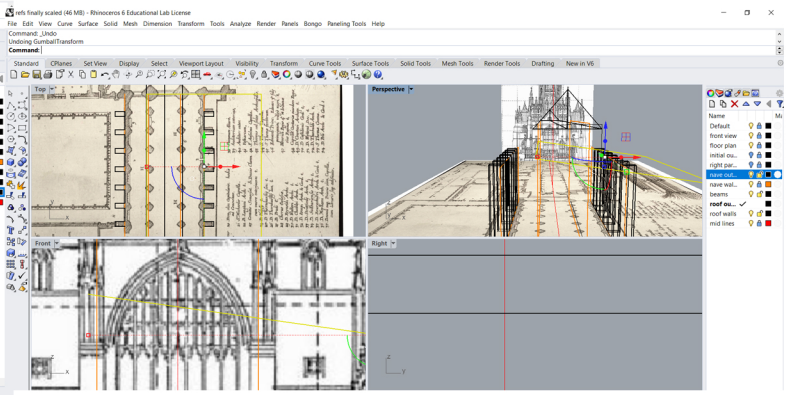
I took my front blueprint (scaled as shown by the previous page) and lined it up against the floor plan, as seen above. It fitted together really well, so I didn't have to make any alterations.





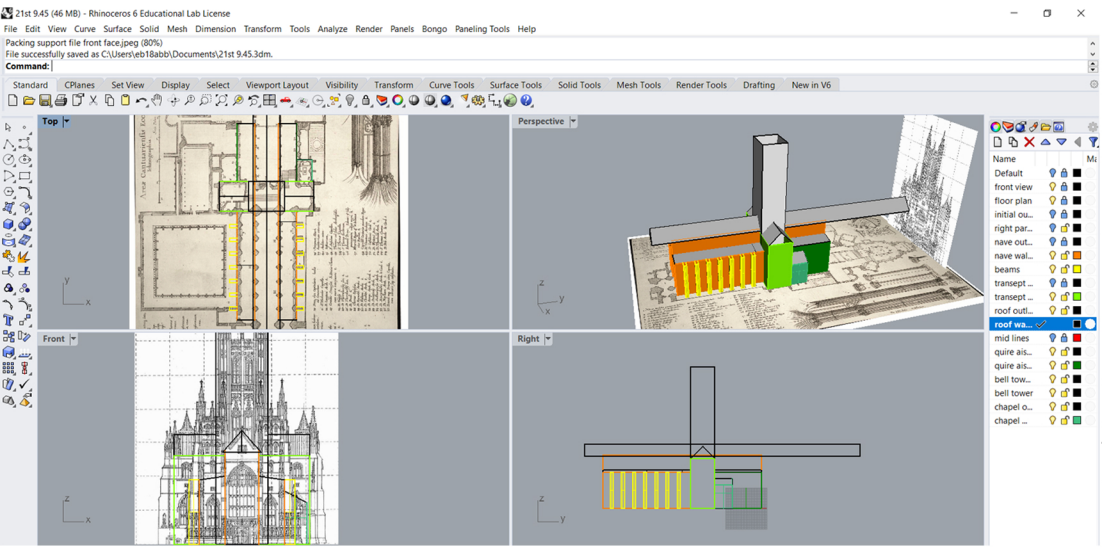
Once I have centered the front blueprint, I could move in to the furthest end of the floor blueprint, so I would be able to model the Cathedral infront. I then locked all the reference photo layers so as to avoid accidentally moving them as I worked. The reference photos were then set up so I was ready to start the CAD.





I added the outline of the Nave, and then used to 'Linear Array' tool to array the pillar type structures that ran along it. I started to add the outline of the roof.

I found the value for the degree at which the Nave aisle roof is angled online, and drew and extruded this across the length of the Nave.

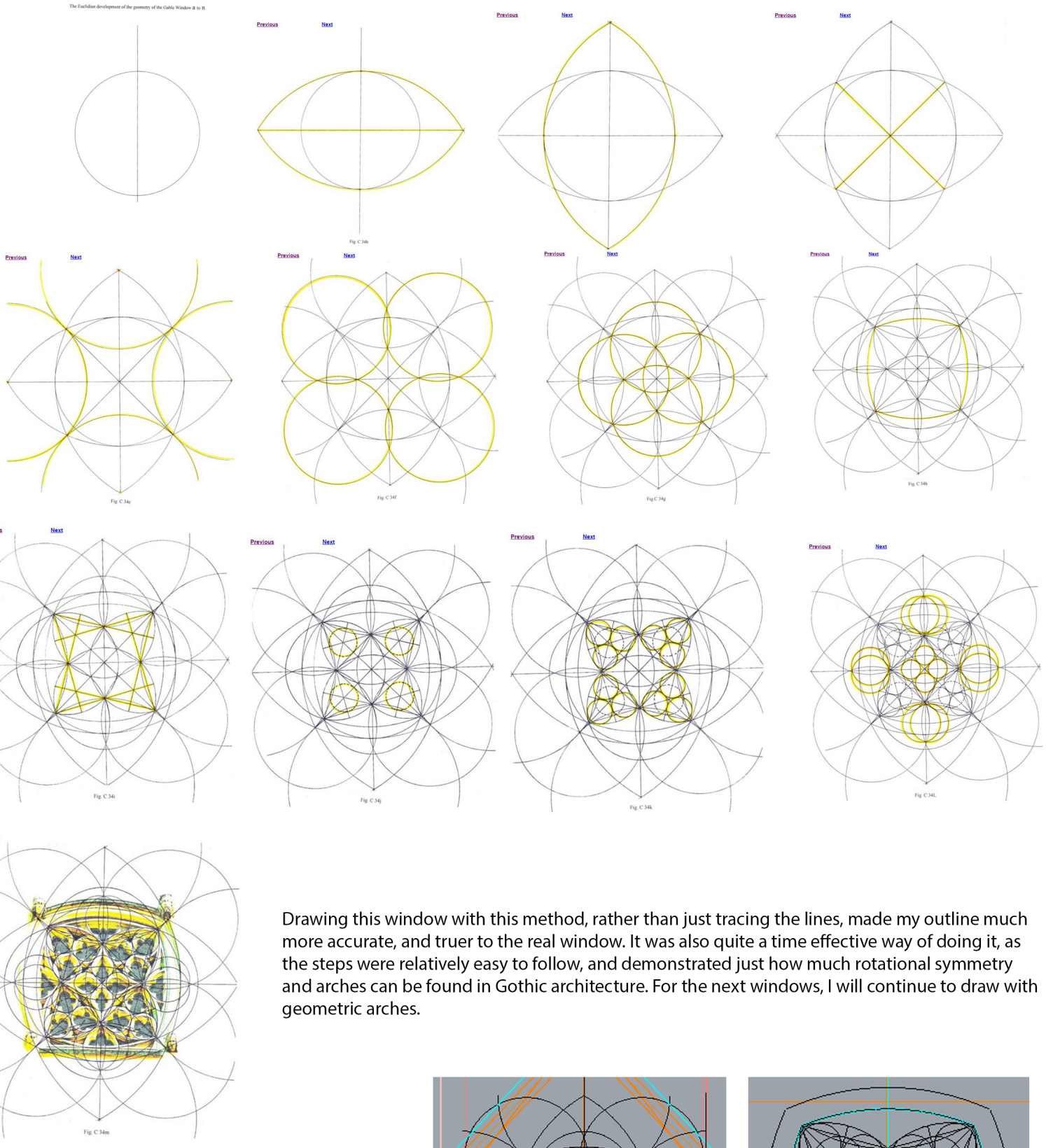


I began, very roughly, mapping out each building section of the Cathedral. Since a lot of the measurements I found online were inaccurate, or took the measurement from the walls *inside* the Cathedral, I mostly stuck to using my blueprints as the main references. I did, however, ensure my model was the accurate length and height according to the data I found on the Cathedral's website.

Colour coding the buildings was important, since there are so many different parts. This will make the process much more time efficient in the long run.

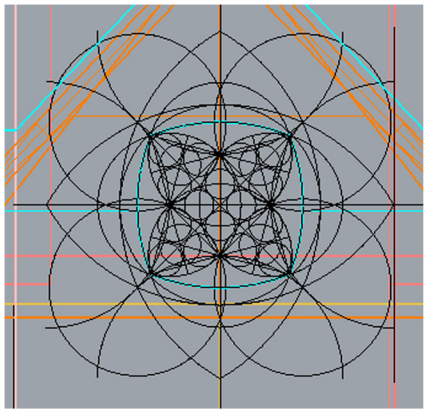
Drawing the Gable Window (located on the Western Front)

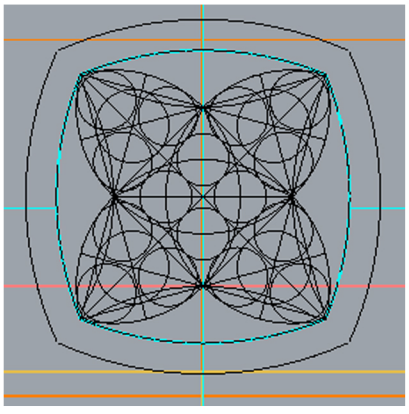
It was important that I started to draw out the windows as soon as possible, so I would know how big the hole for the MDF skeleton behind would need to be,. For the Gable window, I found a very helpful conservation document that went through step-by-step how the plan for the Gable window was drawn in a geometric and mathematical way. The steps are shown below, screenshot from the conservation document:



Drawing this window with this method, rather than just tracing the lines, made my outline much more accurate, and truer to the real window. It was also quite a time effective way of doing it, as the steps were relatively easy to follow, and demonstrated just how much rotational symmetry and arches can be found in Gothic architecture. For the next windows, I will continue to draw with geometric arches.

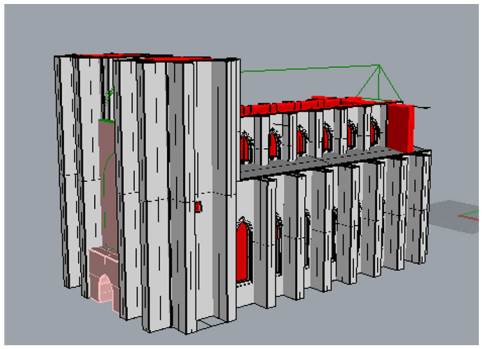
To the right is the result of the step-by-step I found above. The left photo shows all the working lines. I then copied this to another layer, called 'Gable Window Trimmed', and trimmed away at the excess detail.



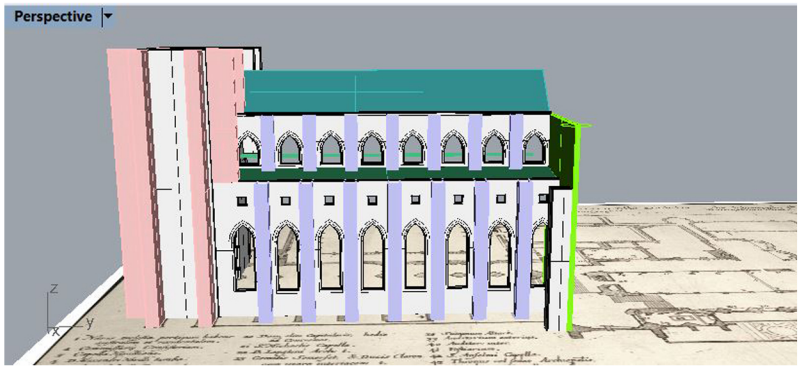


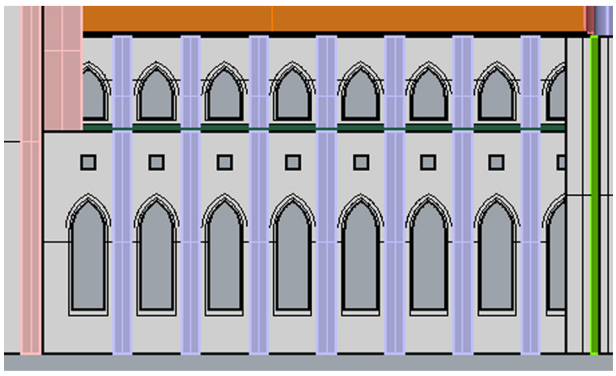
This gives me the basic outline shape, for which I can use to cut out the right size and shape hole in the mdf, as well as being a great basis for the metal etching files which I plan to make for the inner window frame details. I plan to offset a cleaner outline in both directions to create a thickness, and these will become the lines to be 'cut' in metal.

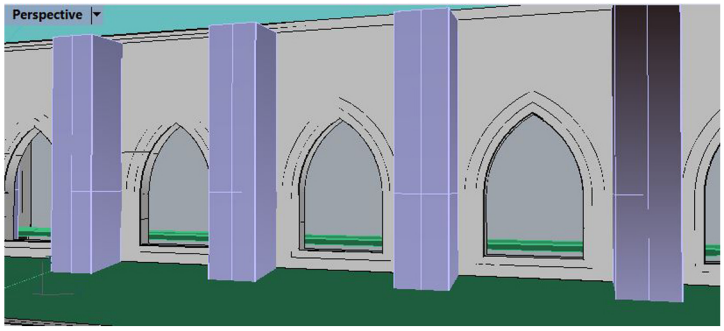
Nave continued, and drawing windows of the Nave



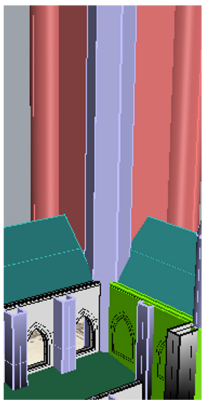
I finished the basic block out of the Nave and so I added the windows. I drew them out in 2D first, using a reference behind, and then extruded the innermost line, and used 'Boolean Difference' to cut out the shape from the wall. I offset this curve by 1.5mm to create the frame. The result is shown below.

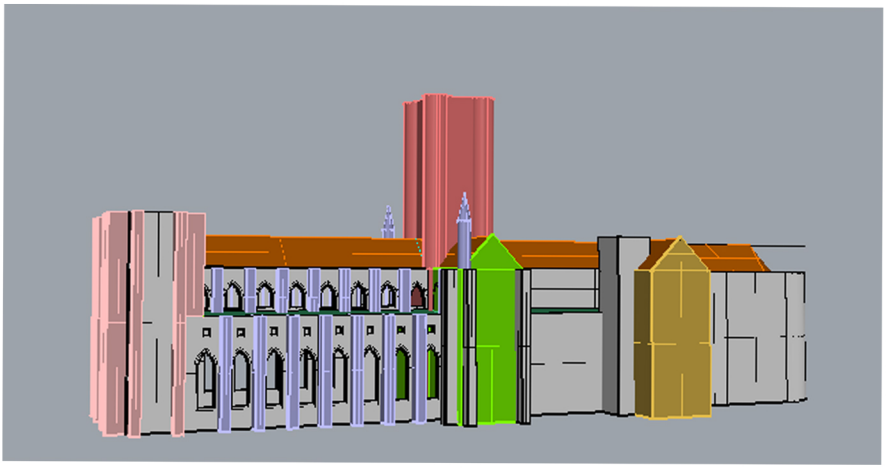




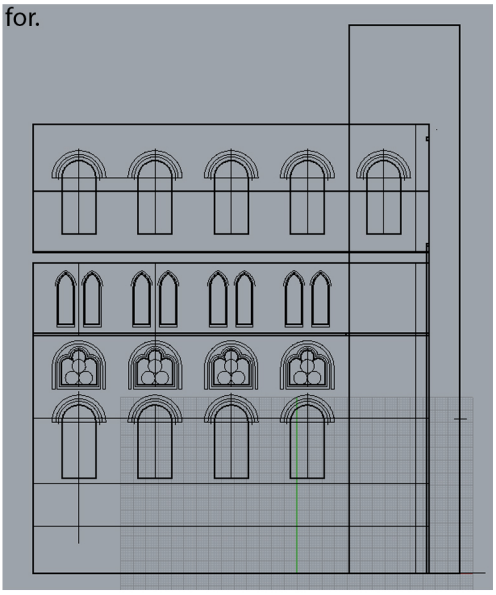


The photo on the right shows the progress on the block out of the Bell Tower and its pillars. I'm experimenting with trying to make the forms of the pillars as simple as possible at this stage, so I used an extruded hexagon. I drew the windows on the side of the transept at this point, to make sure everything fitted okay.

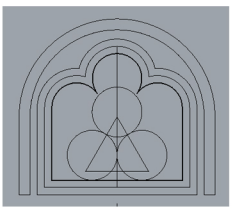




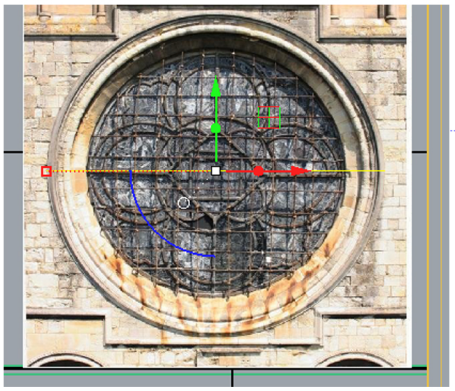
In the meantime, I took the frame I drew and started drawing the detail inside, that I can create the metal etching file for.

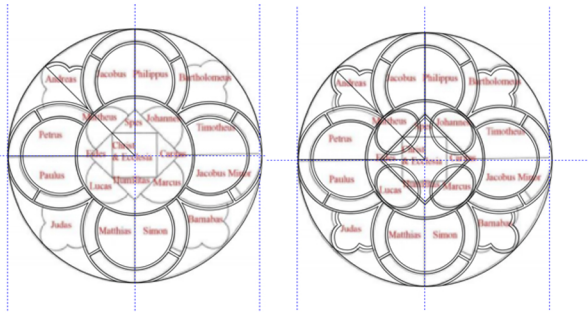


I then drew out the windows of the Choir, shown to the right. They were distributed using the 'Linear Array' tool in Rhino. I used circles distributed equally across an arch to create the foil shaped ones in the middle. I also took note that on this wall, most of the windows became a romanesque shape rather than having a pointed arch shape at the top.



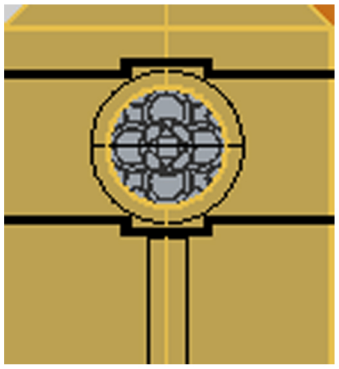
Drawing the South and North Oculus windows, and CAD model of the East Transept

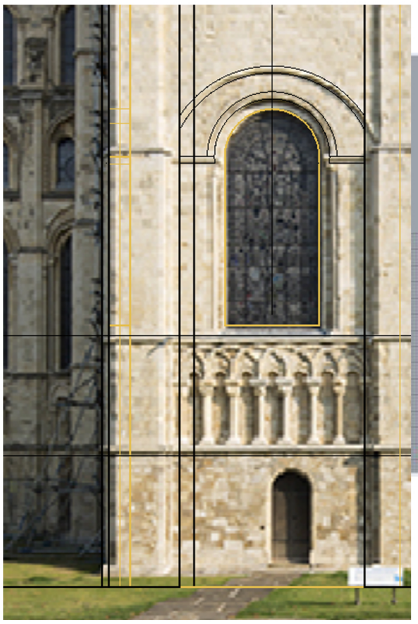


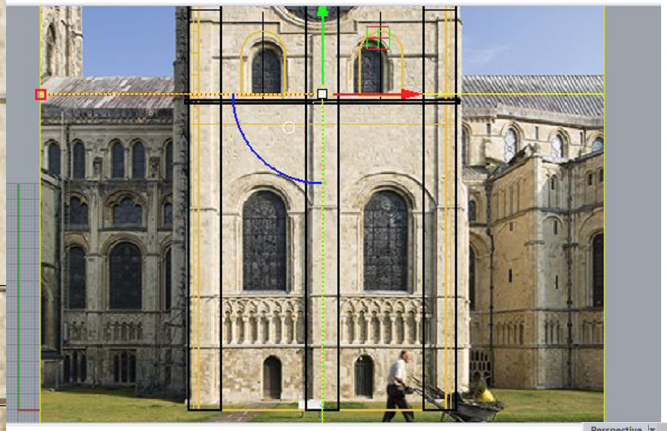


The document to the left was helpful for sourcing the diagram above as a referennce to trace over, and providing some key measurements such as diamater and height from ground level.

In Corel Draw, I traced over this diagram, just focusing on one quarter. I then used the transform docker to rotate and repeat this quarter, polar arraying it around the centre, I saved a copy of just the outline, to use for my metal etching file, but also decided that I could try including this lead detail part in the printed acetate I wanted to use for stained glass windows, incase I could eliminate using metal etching services for the windows that just have lead detail instead of more stone frame.

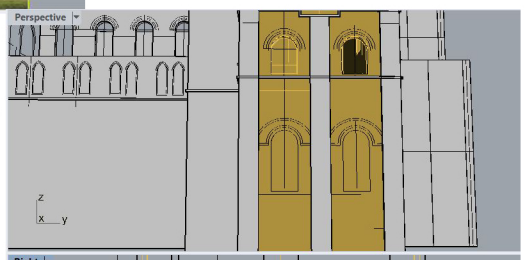




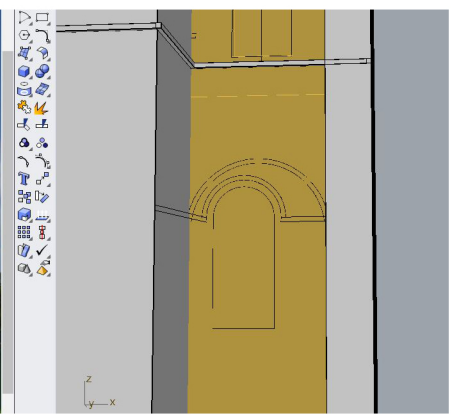


Above, I have added the Oculus window into my CAD drawing. I started to add in smaller details, such as the strip detail above and below. I kept any detail like this at either 1mm or 2mm thick, because I thought it could be a possibility to add this with the Evergreen styrene strips after the piece had been lasercut.

I then started to draw in the windows and mark out where the railing would go, using a reference photo behind, as well as ensuring all the windows were centered. To the right, I have added in the thicker strips of protruding wall either side.

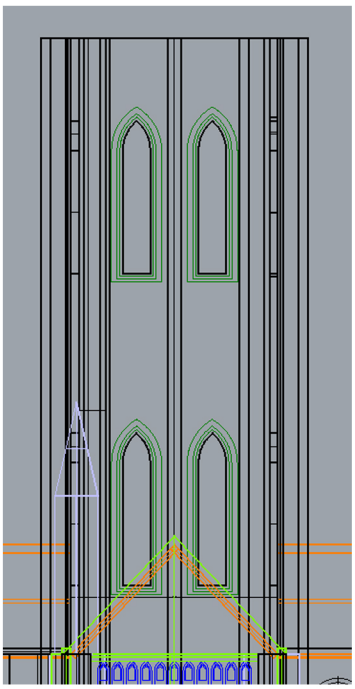


I plan to cut these parts seperatley, and then layer thin styrene behind to create a subtle layering effect. This will therefore allow me to create very thin layers, which will suit the small scale of my model, rather than sticking on an added 1mm thick piece.



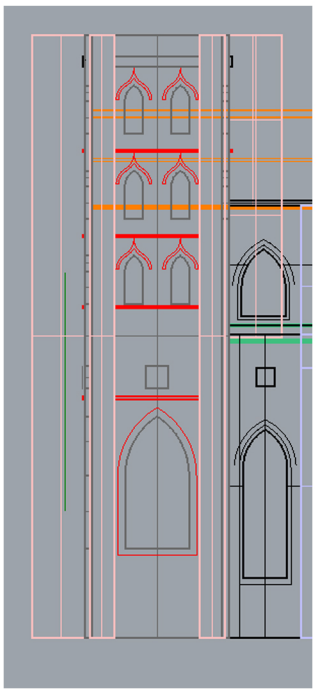
Note that the windows on the side of this transept are off-centre to the semicircle arch that it sits under. So I made sure I did this in my CAD model to ensure accuracy.

CAD model continued: Bell Tower, West Tower, Transept and basic Trinity Chapel

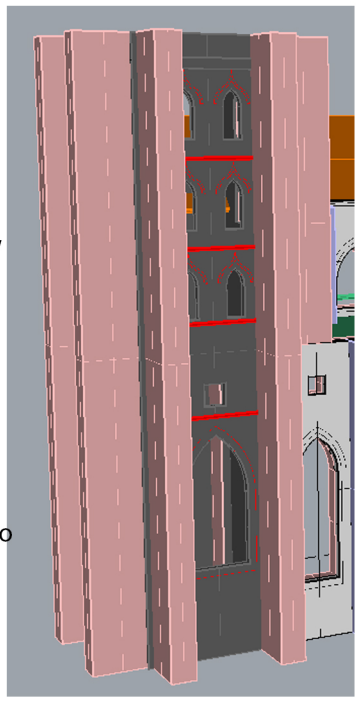


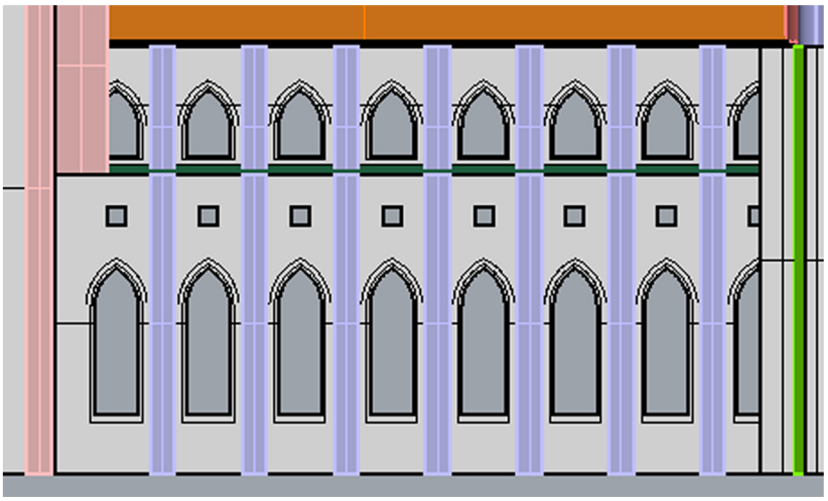
The black outline of these windows show where the window shape will be cut out. The green lines show the outer frame.

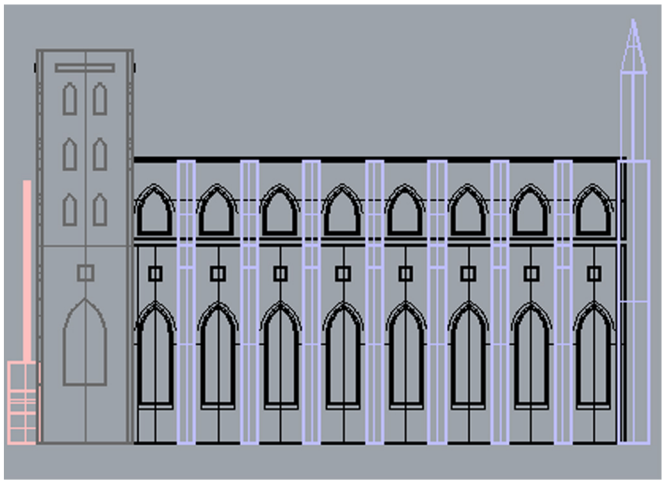
I noted that these window frames are lancet frames, as opposed to the romanesque frames found on the Trinity Chapel (please see Design book for more detail on this)



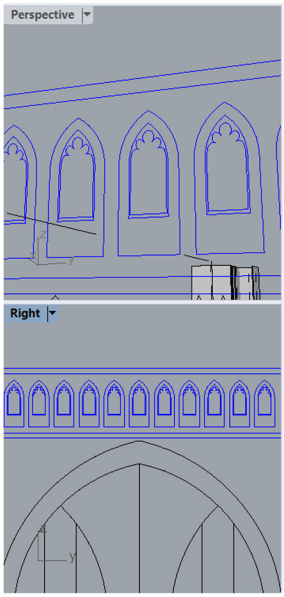
I then modelled the West Towers. The pillars (shown in pink) are just basic block out models at this point. The dark grey line is where the window will be cut out, and the red lines make up the frame. I also started to add in the strip detail (also in red) to help me to see where it might be convenient to split the piece up into smaller panels.

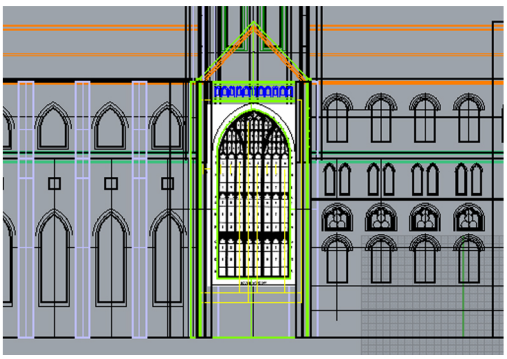


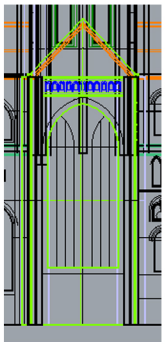




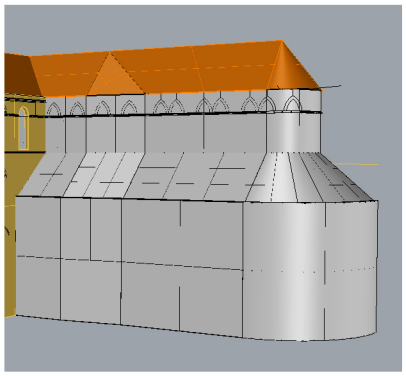
I then did the same thing for all of the Nave windows. Again, the blue pillars are just a basic block out model. The final pillars will be this height and width, so it gives me an idea of where to place everything.



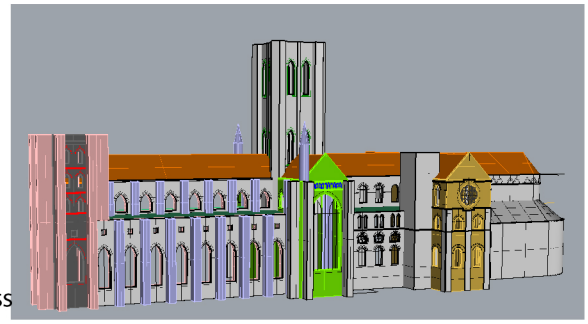




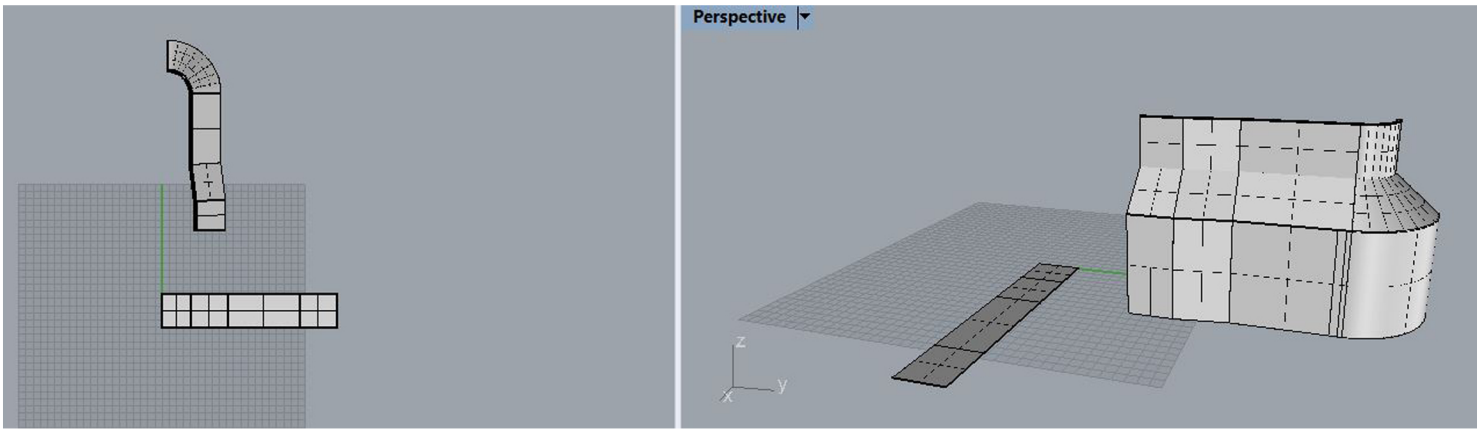
I used a diagram I found for the Great South window on the Transept, shown left. I scaled it correctly to my model and traced over the lines using the arch tool in Rhino. I then added the smaller windows above it, shown right.



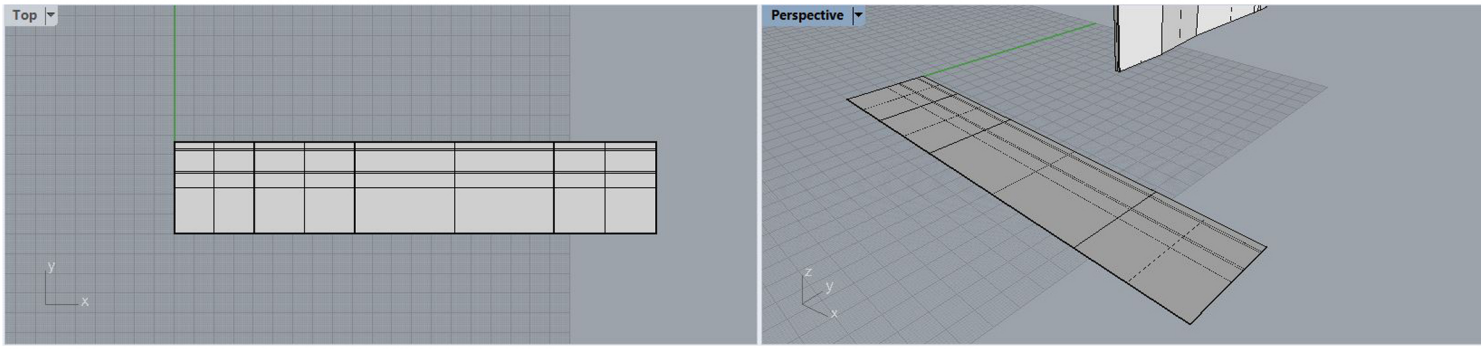
I used my front blueprint, as well as lining up with the windows on the side of the East Transept to mark out the basic Trinity Chapel. I used the loft command to create the slanted roof on the aisle. I started to map out the windows, but struggled because they needed to flow around the curvature of the wall, and I needed to decide whether to have that as identical, or narrower towards the tightest bends, as it in with the real Cathedral. This is written about in my design book - but I went with the first option to make the design process more efficient.



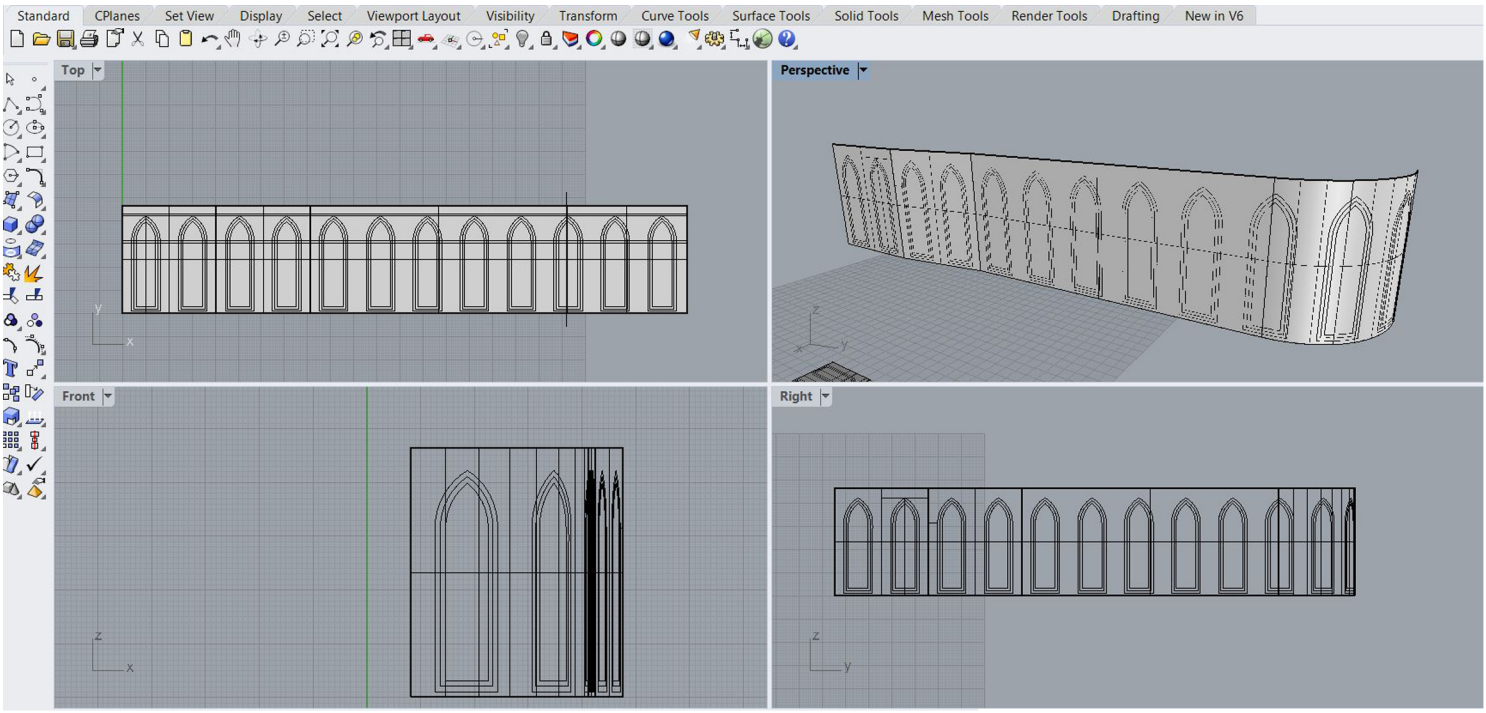
Trinity Chapel CAD model and windows continued

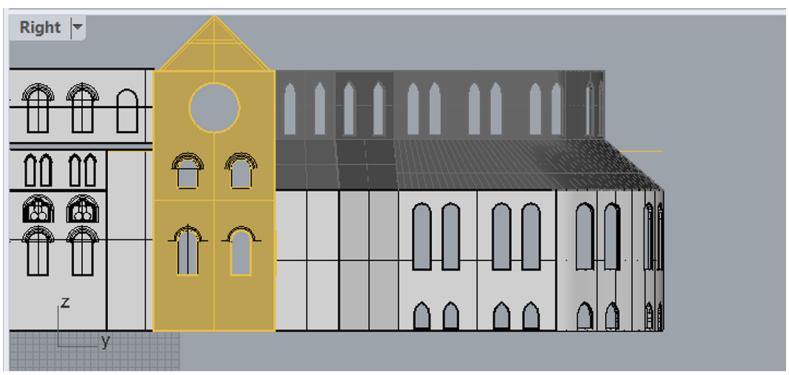


Above is the top and perspective view of the Trinity Chapel. Under the 'Surface' menu, I found 'Surface Flattening', and then under this, I clicked 'Unroll Developable Surface'. I then clicked the walls I had made, firstly just the upper walls, and this flattened the surface. I added some guidlines to show me what height the windows should go to,

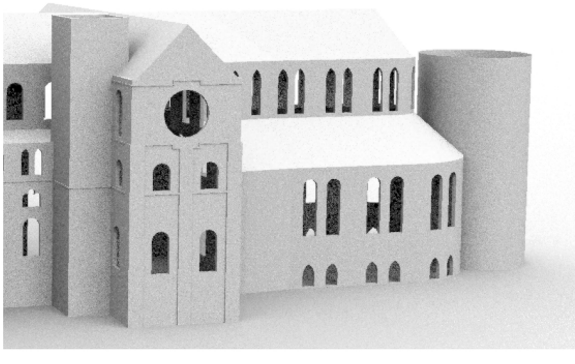


I then evenly distributed (using Linear array) 12 windows and their frames. I then repeated the process for the lower wall of the Trinity Chapel. The screenshots below show the results of this.



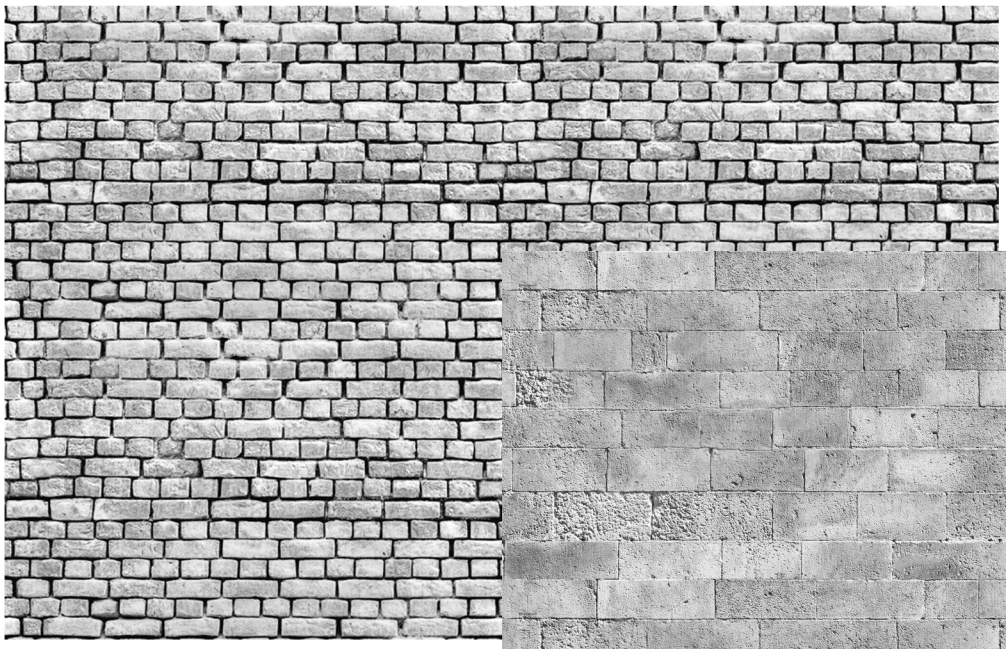


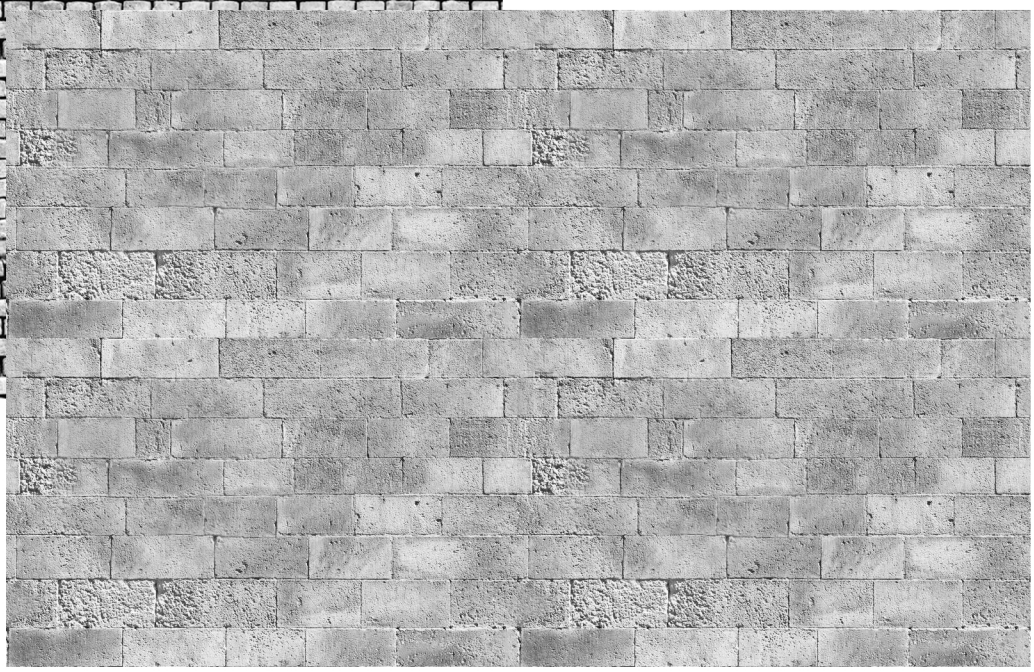
To the right is a render of the Trinity Chapel so far.



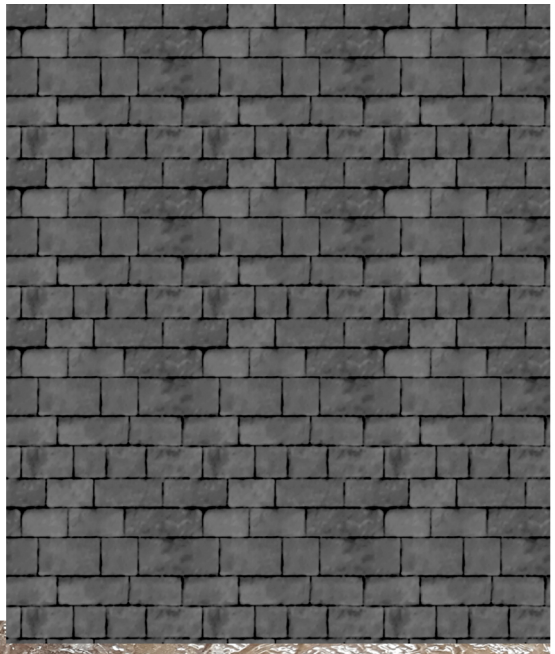
Making an etching file for the texture of the walls

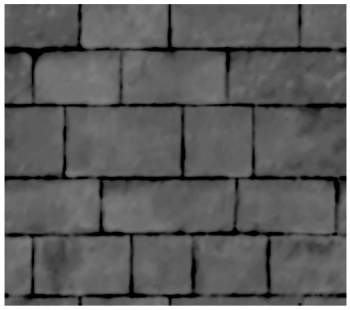
I found an image online of some brickwork that I thought looked similar to the stone slabs at the Catedral and turned it black and white in Phtooshop. I then made it tileable by going to Filter, then Offset, then using the clone stamp tool to blend out the seams. This now means I can tile this bitmap, as demonstrated to the left and below, to etch over larger areas.



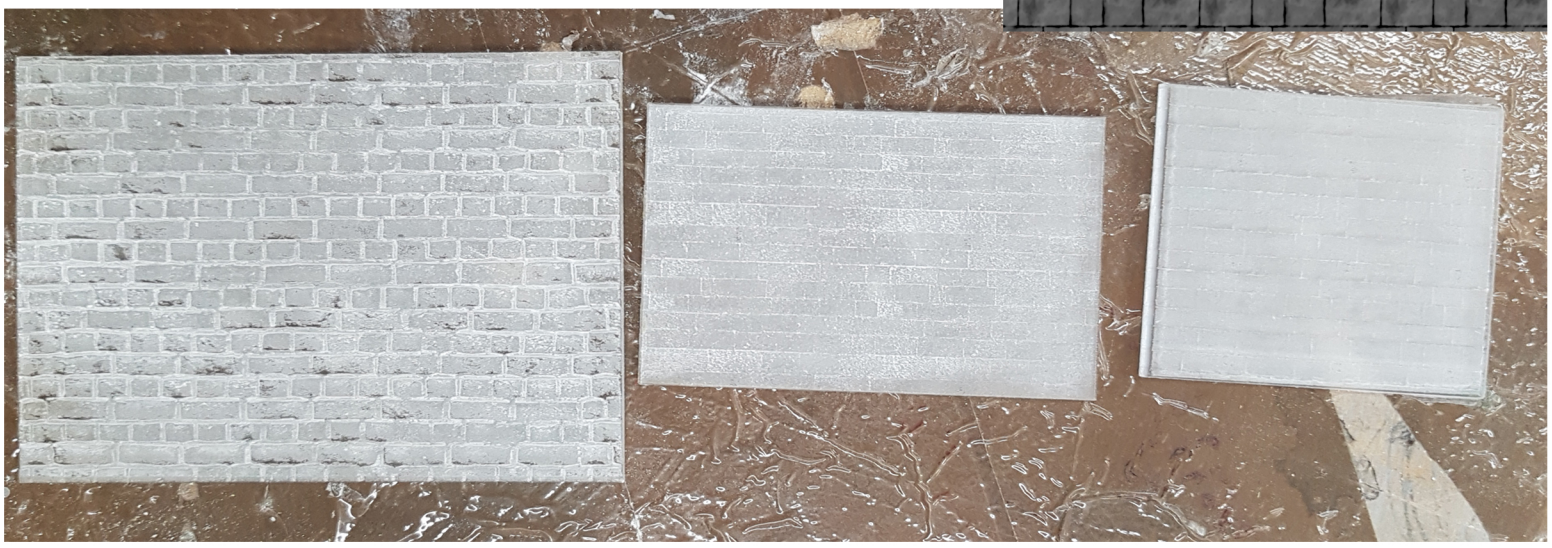


My tutor pointed out that the wallls aren't really made out of the usual bricks a house is, and so I tried to find a photo of some stone slabs. In the end, I used an actual photo of the Cathedral (please see Design book), and again, made it tileable in Photoshop. I then darkened it and darkened its shadows, so it would etch a little deeper.

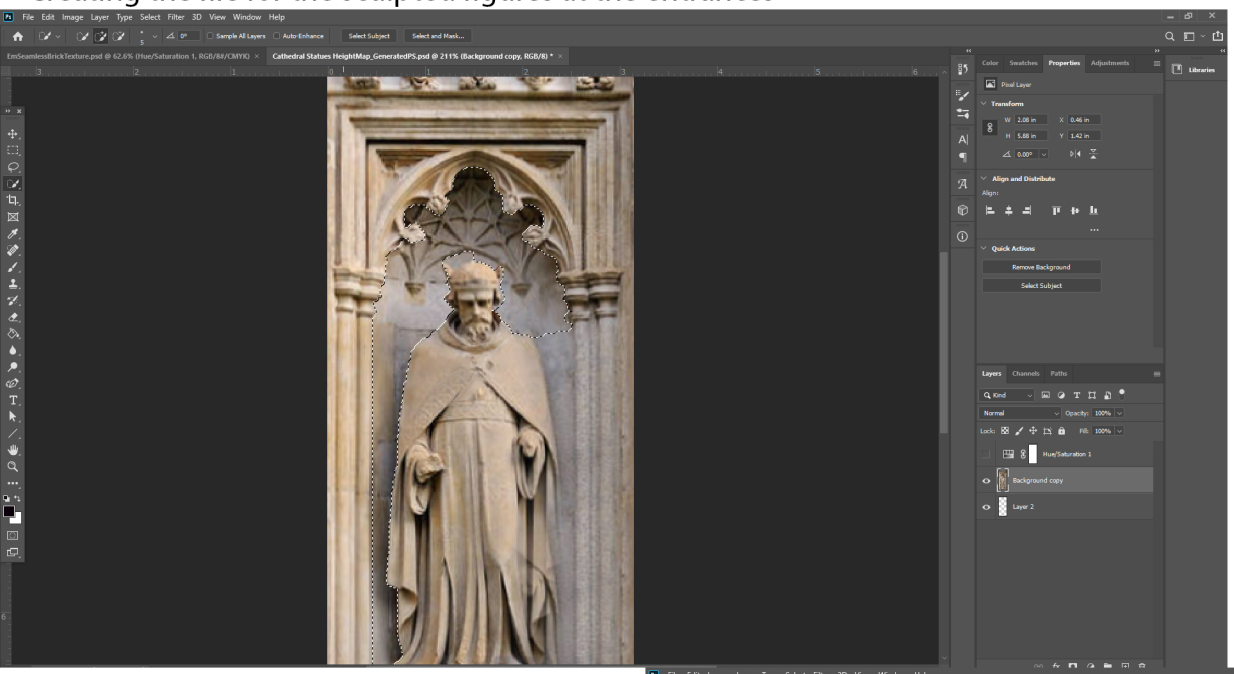




Below are the 3 brick types tested, in the order that the bitmaps appear on this page. The left is too obviously a more modern brick wall, so I won't use this. The middle looks a little too speckled and noisy, and suprisingly, the last came out well considering I doubted using a lower resolution bitmap. It's hard to see from this photo, but painted, the detail will come through. It's also great that it is a very true representation of what the actual wall texture is like.



Creating the file for the sculpted figures at the entrances

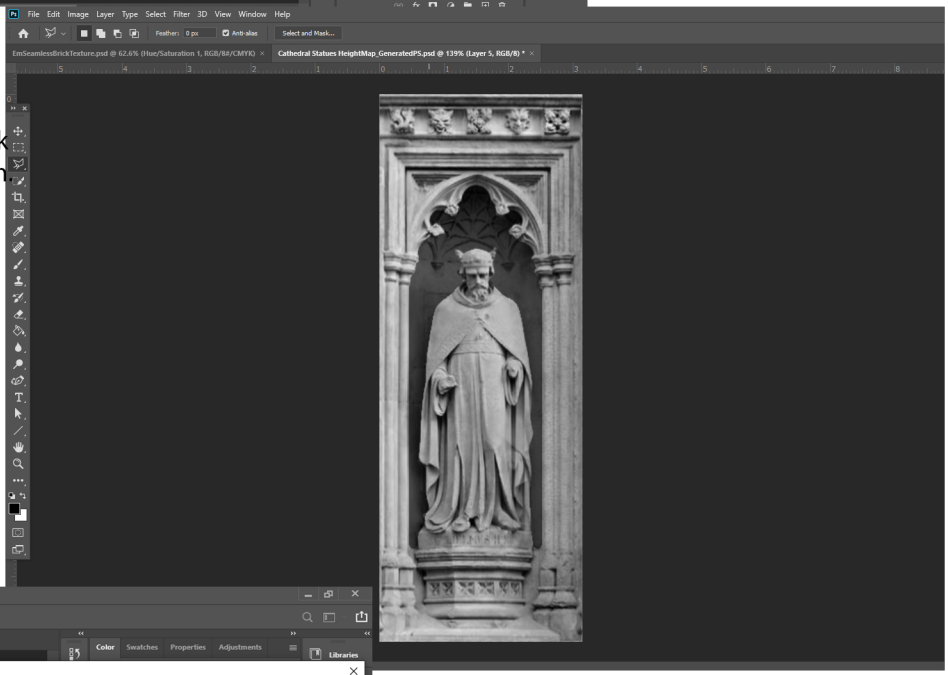


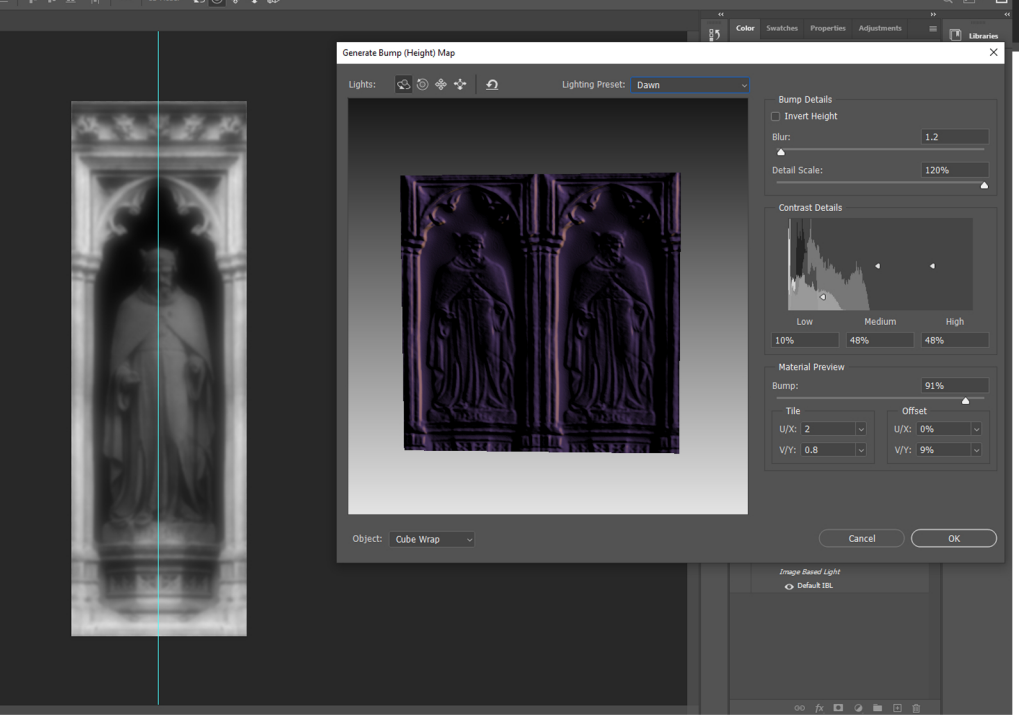
I sourced a picture online of Canterbury;s sculpted figures and used Perspective to make it square. I then realised that etched with these tones, the figure would barely protrude forward against the concave part he stood in. So I made a selection of just the background behind him.

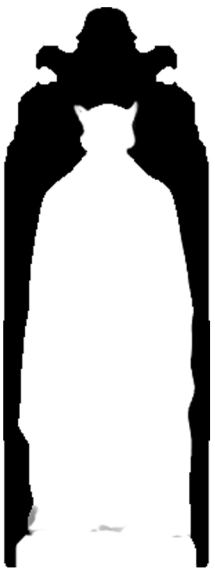
As shown below, I then made the background noticeable darker by changing the brightness in the 'Adjustments' panel.

Below, I've used the 'Generate Bump Height Map' tool in Photoshop, which was really helpful for giving some insight as to how the piece might look when etched. This helped me to colour correct some of the stone work that was aged more or stained, and so etching too much. It also revealed at first that the background would still not etch very deeply with the etching to the right, so I decided to make a new selction and fill this black.

I then selected the whole bitmap, deselected the figure, and chose a half to mirror, so the archway shading and thus etching would be symmetrical and even.

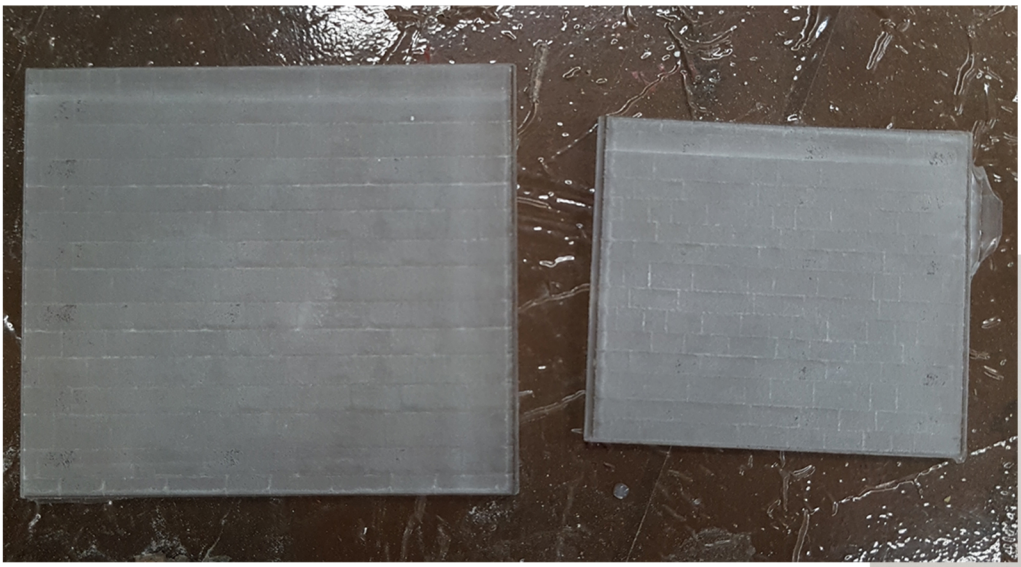






The final etching file is shown right. I demonstrated how this was scaled when etched in my Design book. I also decided to layer over just the black background layer, so I could isolate this and repeat the etch to make the figure stand out more against a further set back background. More on this on the next page.

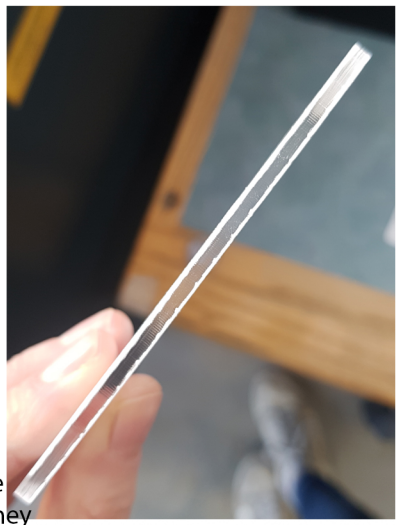
Choosing between materials and problem solving



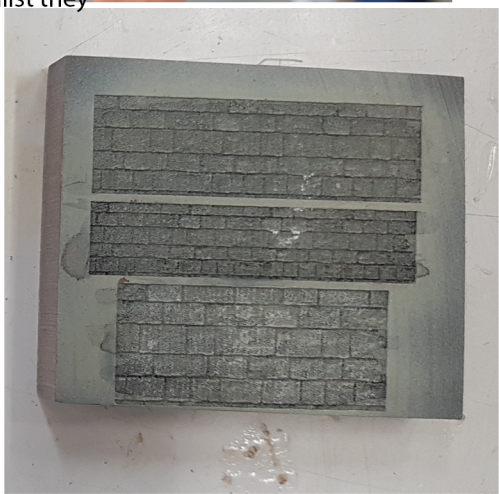
I tested out which scale I would like the bricks to be. On the right, I decided to do 2 slabs per 10mm, as this is quite similar to the scale of the actual Cathedral. I agreed with a lecturer that this was a good size, as any smaller and the texturing would look too busy and complicated on such as small scale.

One big issue I had with etching acrylic was warping. I tried sticking the acrylic to a piece of MDF as it etched to try and prevent it. It still warped, but was at least held flat whilst being etched to avoid distortion. One method I could use to straighten the pieces afterwards would be to use the oven, but due to the Covid restrictions on the workshop, I could only book an hour a day, and I didn't really want to use that hour up on the oven in the casting room if I could help it.

I then tried etching both sides, and as shown to the right, it worked perfectly. The issue though was that it would take twice as long to etch everything, and since I was only able to book 1 hour a day on the lasercutter, I felt this wouldn't be practical with my deadline,

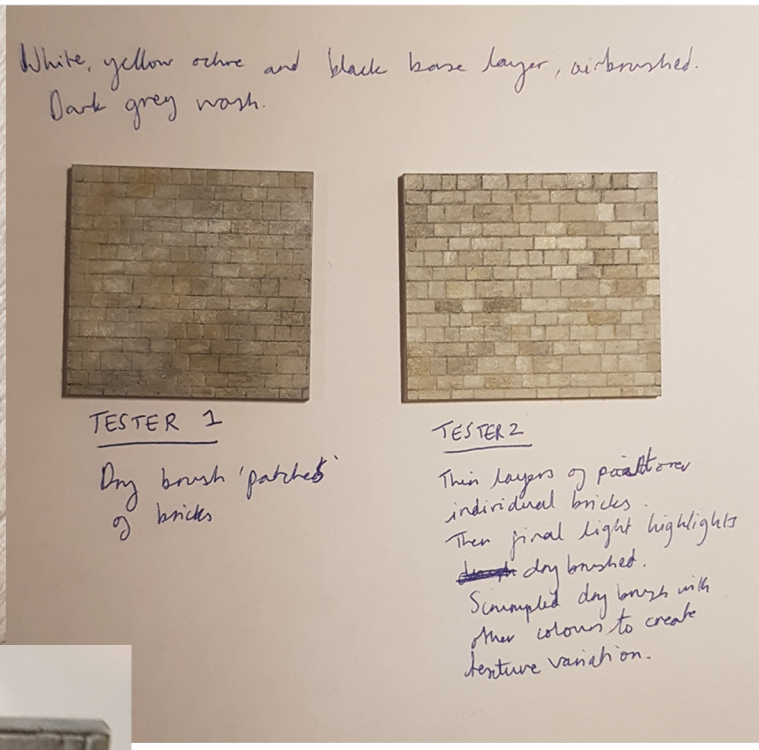


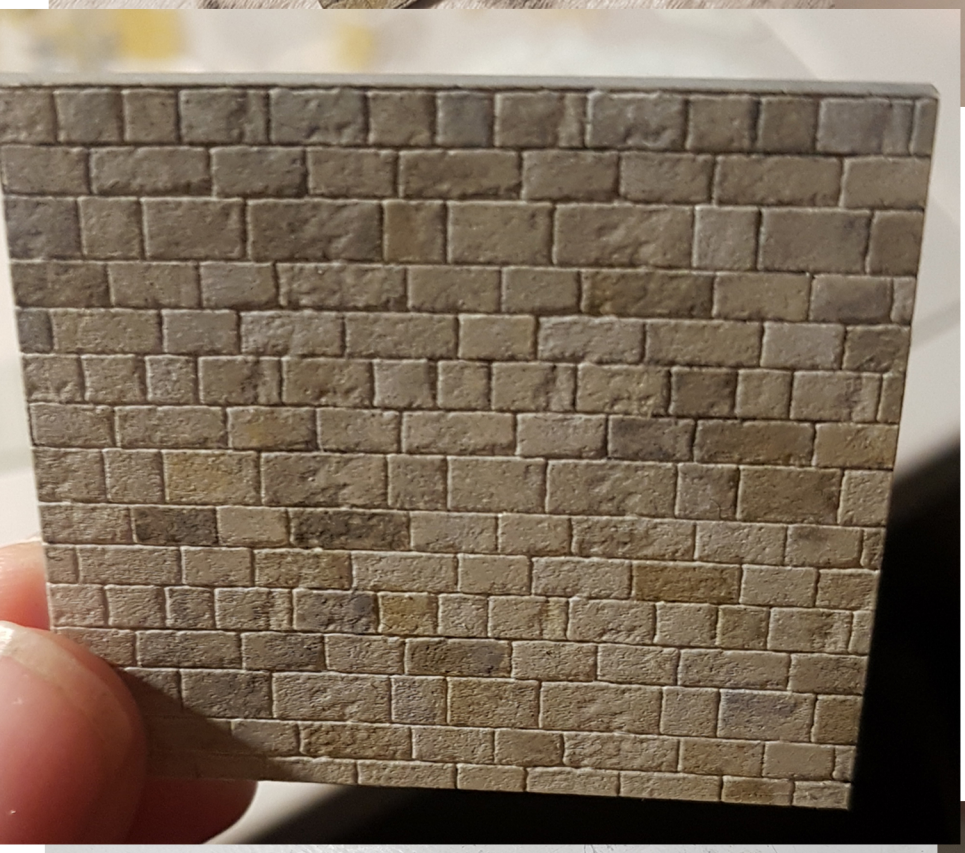
I decided to reduce the issue rather than solve it, by splitting the walls into smaller panels where convenient, so there wouldn't be too much pulling away when glueing. I'll need to make sure that I strongly clip the acrylic walls to the MDF whilst they glue.



I also tried using both orange and brown chemiwood. I thought the orange chemiwood bricks looked good at first, but then when painted, the material was very porous. There were ways I could have sealed it, but I decided that in the long run. it will be much easier to use acrylic.

Paint tests





The image above shows two tests I did for the walls, and the colours that I used (White, yellow ochre and a little black base layer, then a dark grey wash, then varioud finishes depending on the tester).

I decided that the first test looked too fuzzy and rough. So for the second one, I picked out a few individual bricks in yelow ochre and white rather than dry brushing over the whole thing. This worked great, but was a bit more time consuming. A way I may solve this is getting a template cut in thin metal when I get the window frames cut (this is written about in my Design book).

Meanwhile, I'm really happy with the texture itself, this bitmap seems to have picked out a really nice amount of detail.

The left-most image is just etched once, then the second has the background repeated, then the third has the background repeated twice, and the third, which I feel worked best, has the background repeated thrice. To paint them, I applied the same basecoat at the walls, then added a dark wash. I still think I need to do some more tests, because they aren't as defined as I'd like them, and a bit too grey.

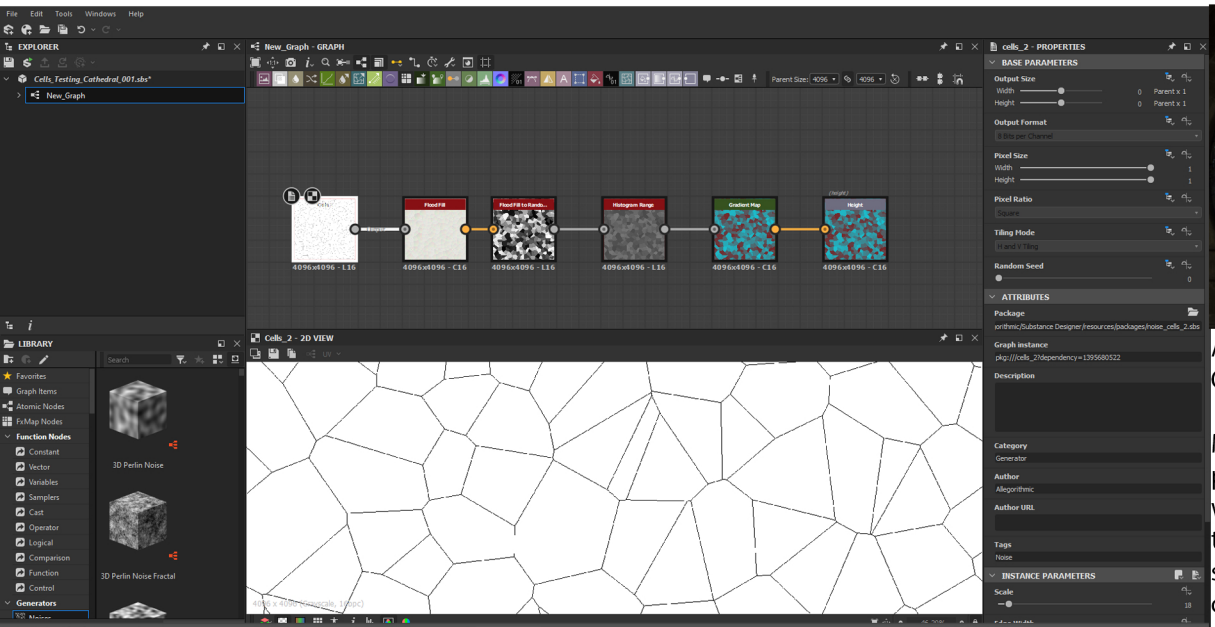
Testing printing Acetate windows (using the South Oculus window as an example)

I wanted to print the stained glass window designs onto acetate, so I would be able to install a lighting system into my Cathedral, that could be turned on and off to reveal what the stained glass windows look like from inside the Cathedral. I emailed the acetate printing company, and the email below instructed me to try making the colours very dark.

As you know we offer two different types of acetate. We have a clear acetate which is clear similar to glass and we have a standard acetate which is transparent but has a misty look to it. Please note: White automatically prints as clear and black is the only colour which prints opaque.

I think the clear will be the appropriate acetate for your print, although when the acetate is fully covered by print, you cannot tell the acetate is the standard one unless you look at the back. Also, both acetates are transparent and once printed are similar to that of a stained glass window when held up to the light.

I have printed a lot for stained glass windows and unless the colours are really vibrant on the original file, the colours print very week and very transparent. It is very hard to explain it, but you need to send as dark as possible and at between 300dpi and 400dpi if possible.

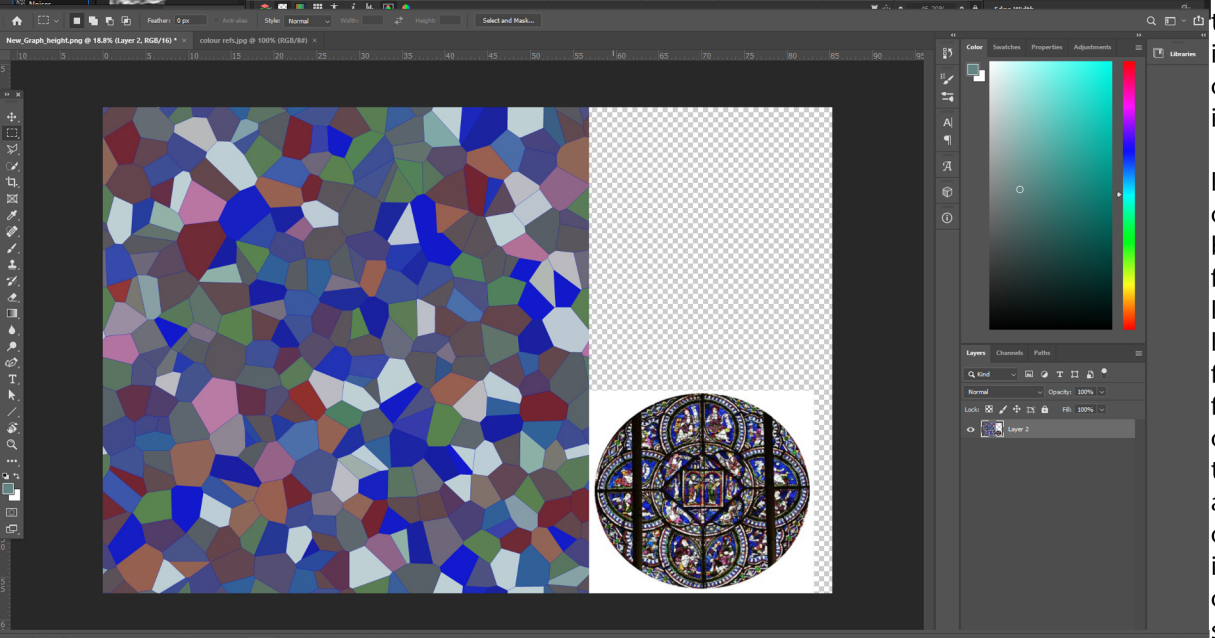


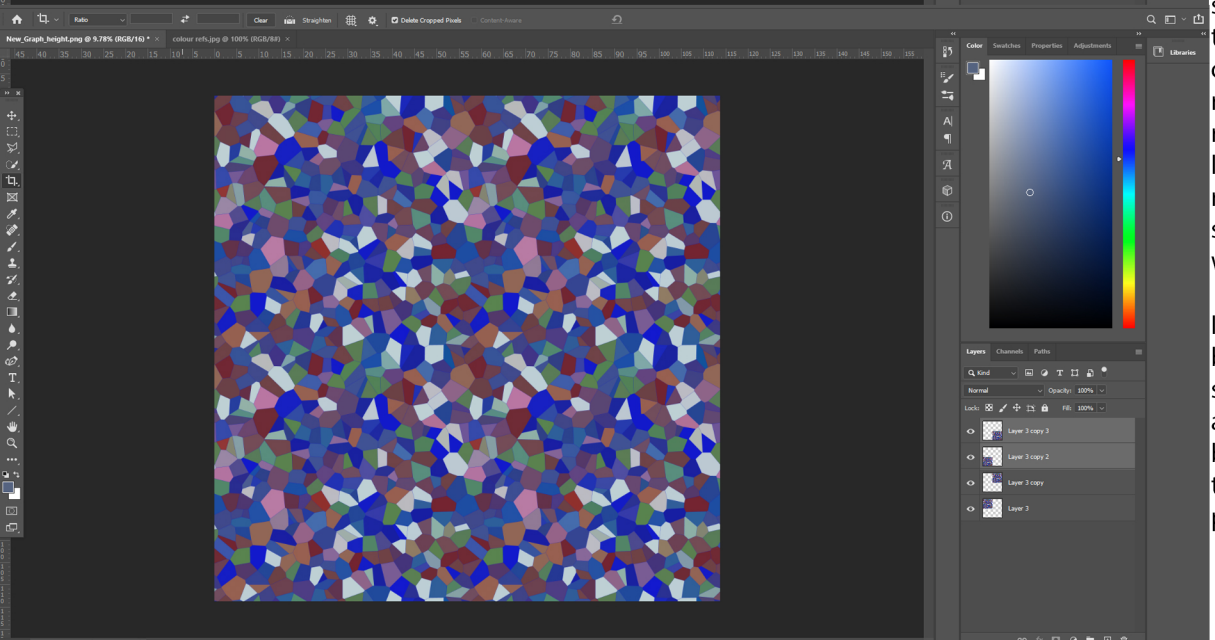
Above is a photo of the South Oculus window for reference.

My first thoughts was that printing the window itself as it was onto the acetate would look too busy when shrunk to a smaller scale, so I wanted to create an artistic impression of the window. I squinted at the image and decided to try and create the more impressionistic image that I saw.

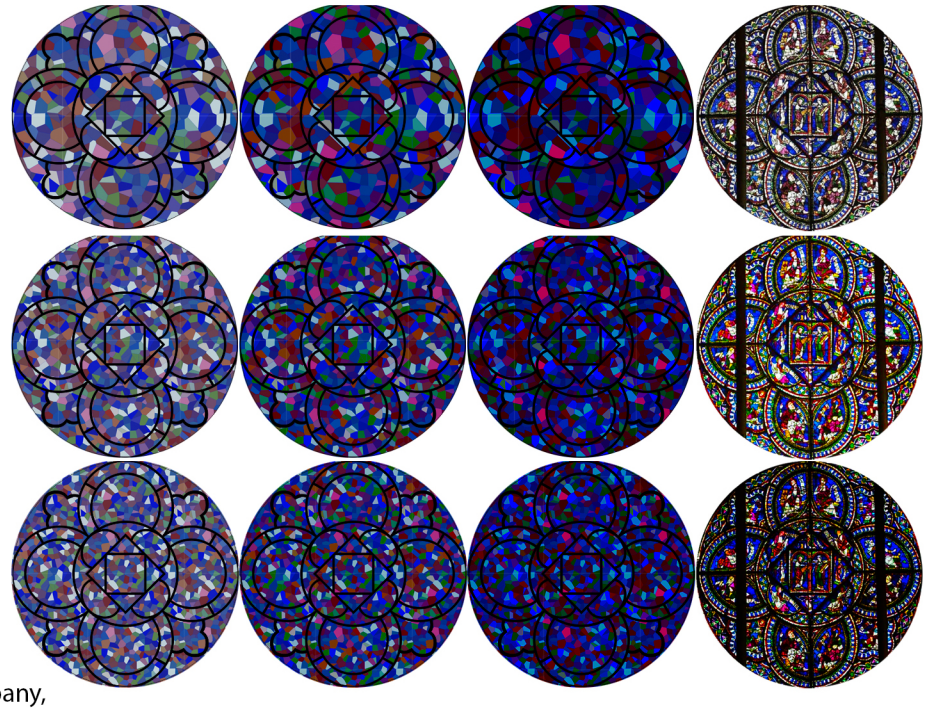
I wanted to learn a new program called 'Substance Designer' because I had heard it's good for creating texture maps that I could use on future projects. It's based on coding a type of flowchart, which is shown by the first picture. I had lots of control over the size and shape of the tesselated shapes. I also added a code to control the amount of tonal variation, which meant in Photoshop, I was able to categorically colour pick a certain shade of grey and then change that shade to a colour, which I colour picked from the actual reference. This meant the resulting material, shown by the last photo, is a good representation of the colour scheme of the real South Oculus window.

If this method works, I will easily be able to take the next stained glass window design, and again change the colours so they become a true representation of the colour scheme of that particular window.



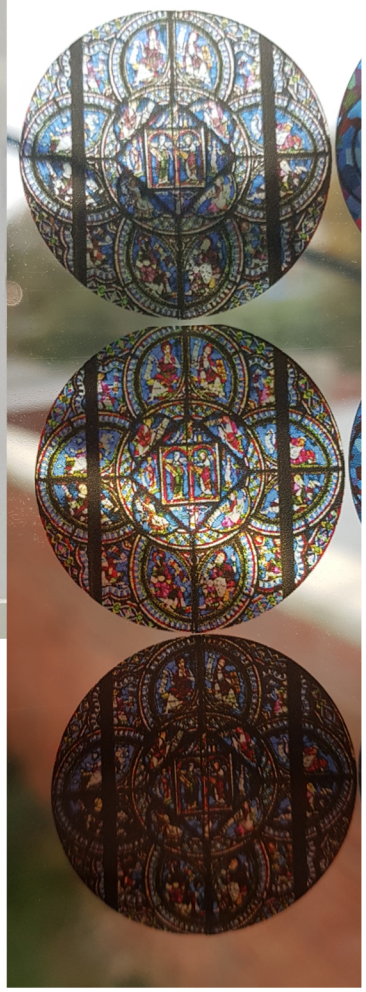


Creating the stained glass window tester file, and testing lighting



Above is the reference again. I also wanted to try printing the picture itself, so I took it into Photoshop and used the perspective tool to correct its shape. I then cut out the picture using the to scale Oculus I had drawn up previously drawn in CorelDraw. To the right is the file I sent to the company, which included tests in varied contrast, vibrance and brightness levels (adjusting in Photoshop)

When I tried the prints with normal daylight, the colours were a little washed out, but when I tried using artificial light, the colours came out a lot brighter and more vibrant, which is a good sign considering I'll be using artifical lights inside my model.

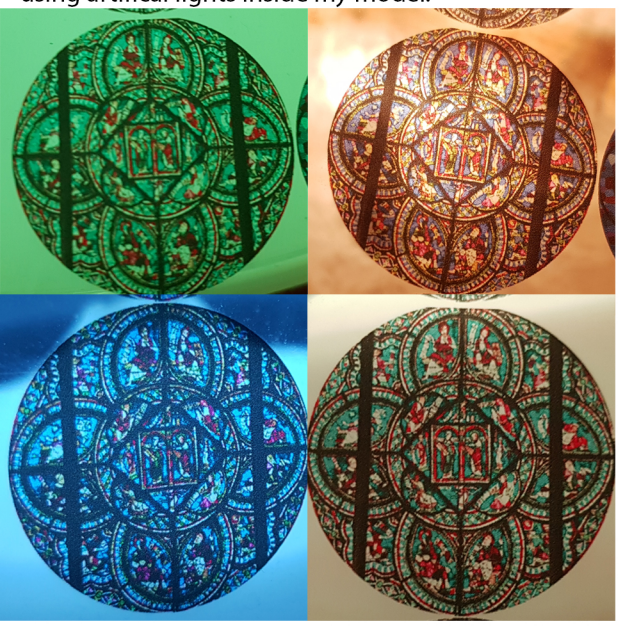


The comany also printed me another test with -20 brightness settings, but the difference isn't noticeable in my opinion. This is included in my Design book, however,

I think that all the tests came out quite well, but the middle row is my favourite, because it's still vibrant but the colours are dark enough to be a good mimic of actual stained glass.

In terms of their design, I feel the realistic one actually looks highly detailed without looking too busy. I discussed with my classmates, and this one was definitely favoured by them also.

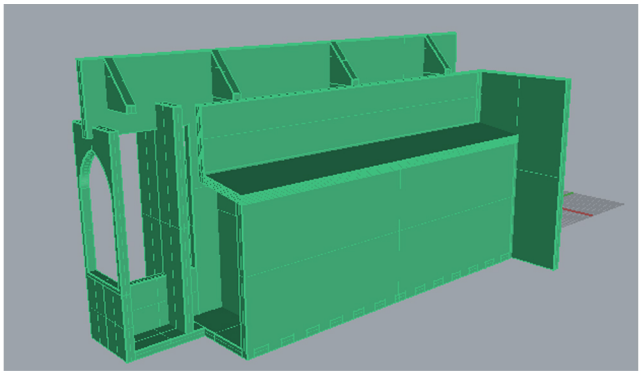
I do, however, think the lead detail (the black thick lines) look too flat, even on this scale, and so I would like to try and have any lead detailing cut in metal, in the same way that I planned to have the inner stone frames of any windows cut in metal (as detailed in my Design book), and then layer this over the acetate.

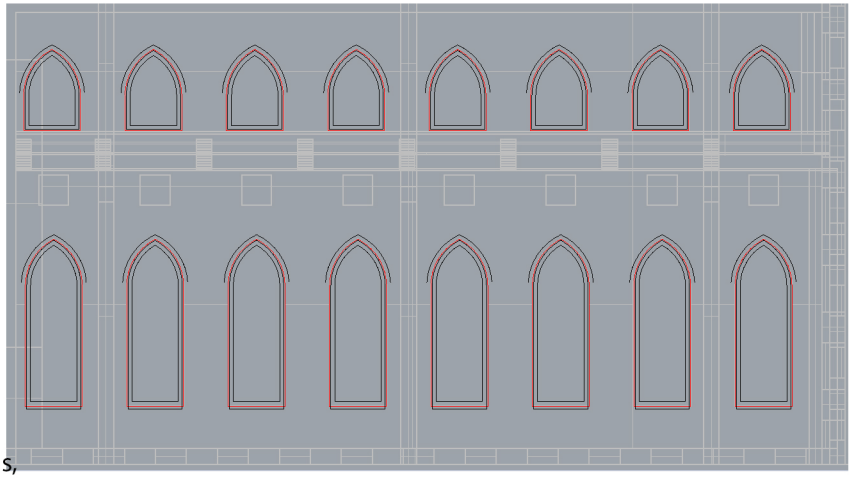


To the left, I have tested the colour lighting I want, with the help of a colour changing lamp. The warm lighting enhances the coloured parts nicely, but it washes out the black a little. The green doesn't look at all close to the reference, and the blue really nicely enhances the blueparts, but as a whole, the colours are all too cold. The white light is quite good - I would prefer the blue parts to look less turqouise, but the rest is pretty similar to the reference, so I will use this lighting and tweak my file so the blue has more purple in it.

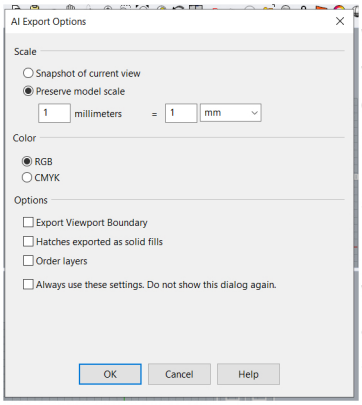
These tests have assured me that I would like to do the other windows using this method of acetate printing, but since it can be quite time consuming, I will prioritse making the large windows using edited photos of the glass, and for the smaller ones (some of which are only several milimetres wide), I can reuse the same designs.

Nave MDF skeleton test piece



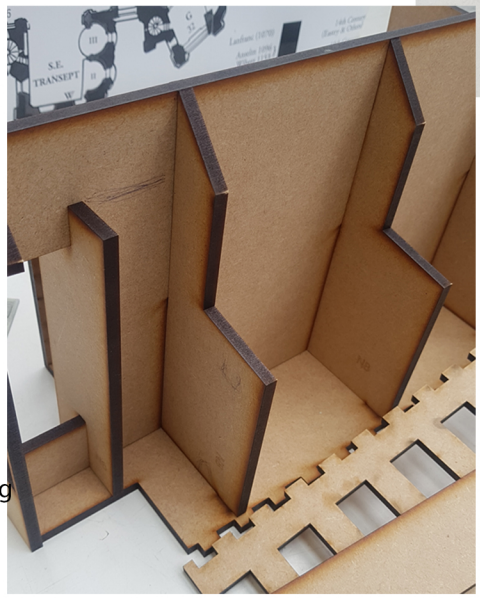


Above is my CAD model I created which represents 6mm MDF sheets, which meant I could take the files directly into CorelDraw ready for lasercutting. To create most walls, I offset the walls by 6mm, and booleaned out windows.



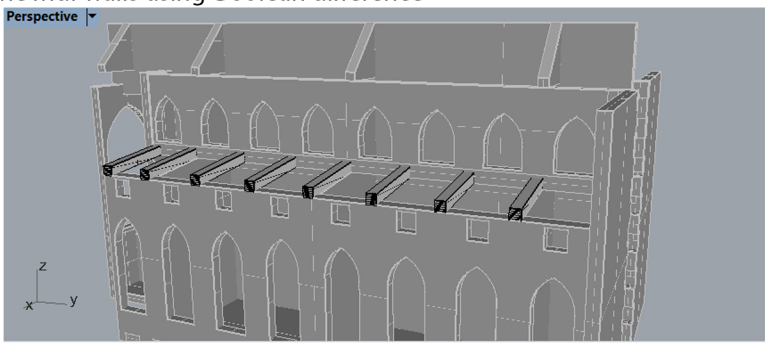
When it came to cutting out the windows from the mdf, my design of the windows with the metal etching (please see more detail in Design book) informed me that I should offset the size window cut in acrylic by a milimetre. This is demonstrated by the red outline in the screenshot above. When I exported from Rhino, I did it as an AI, and made sure to preserve the scale,

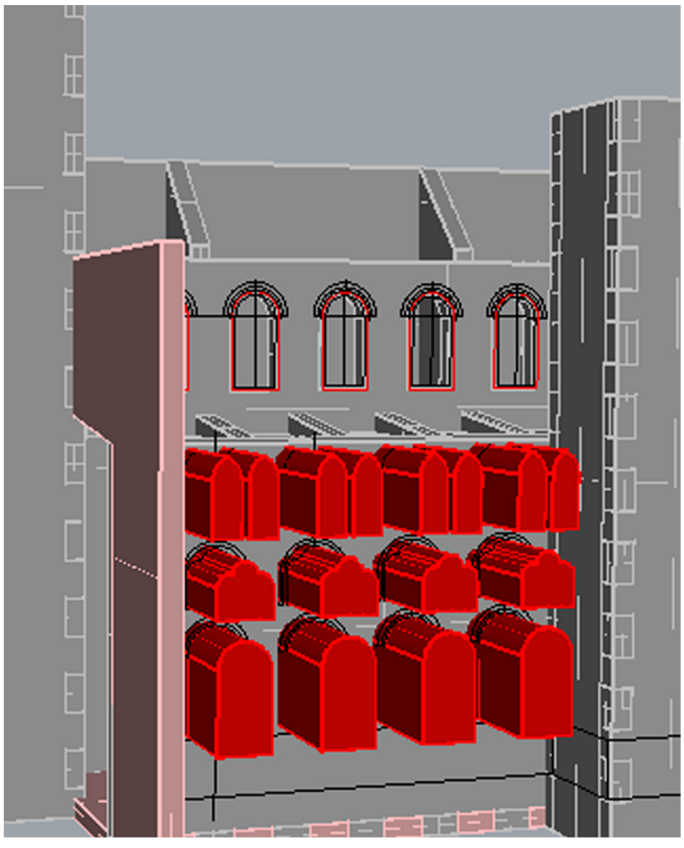
I also realised I hadn't provided a way from me to be able to thread through LED strip. I asked a visiting lecturer who had experience with lighting models from the inside where could be a good place to put them, and the pencil marks to the right was where she suggested. These could be drilled, but since I still haven't lasercut the rest of the structure, I could add this hole on CAD to save time in the long run.



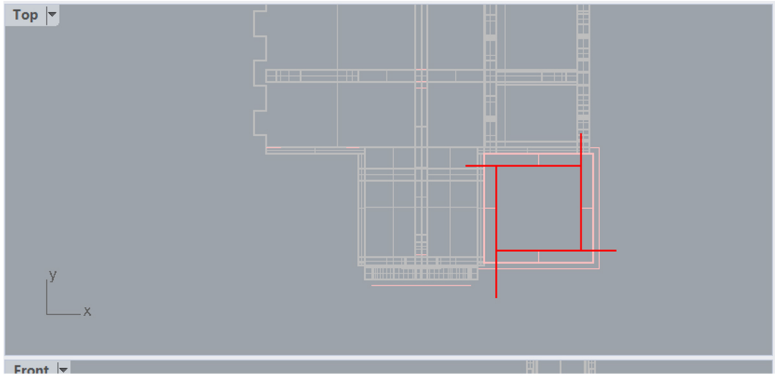
I cut just the Nave out as a test, and realised some issues. Firstly, the aisle roof would need an angle sanded on it, as would any aisle roof on the Cathedral, so to make my design better, I will redesign the aisle roof so it's made up of cross section beams that wont need sanding. I also realised that the windows along the top were slightly off-centre, I imagine from an error when clicking a point to linear array by in Rhino, so I will untrim these and re-boolean them.

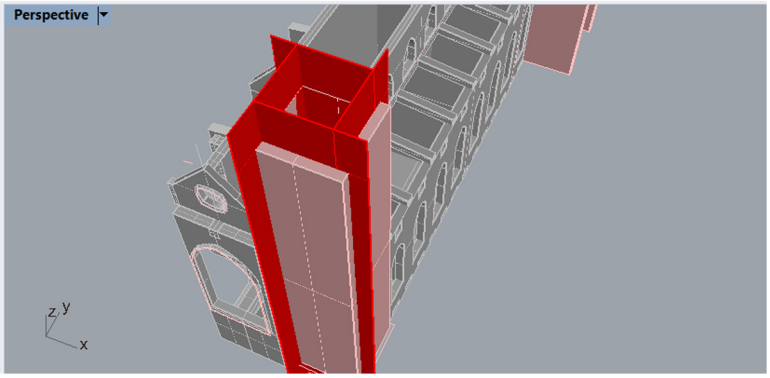
Below is the corrected Nave, along with a progress picture demonstrating how the offset window outline was cut out from the mdf walls using 'Boolean difference'

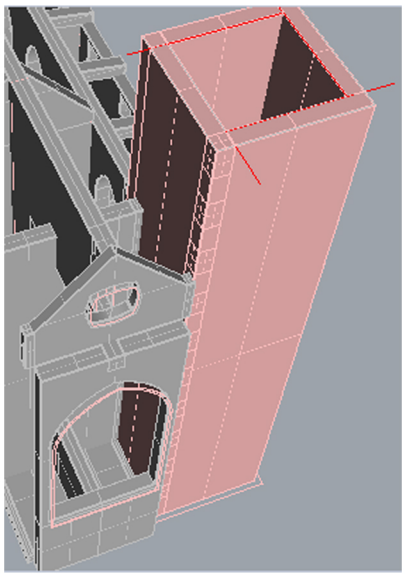


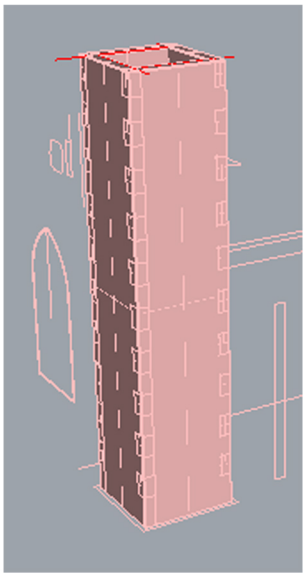


MDF walls in CAD continued





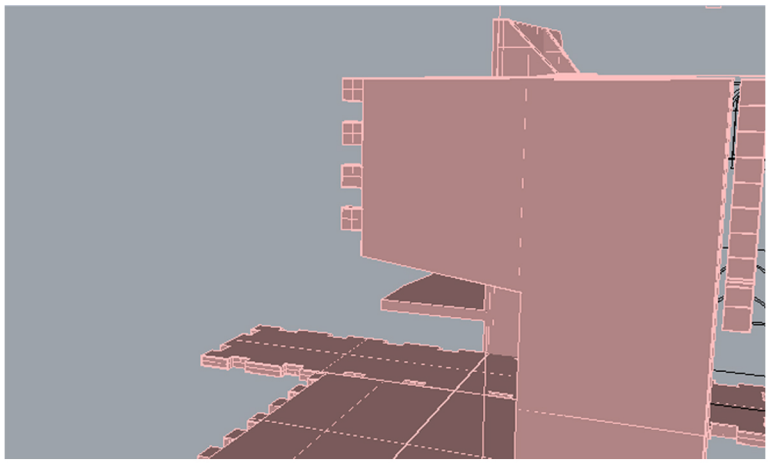


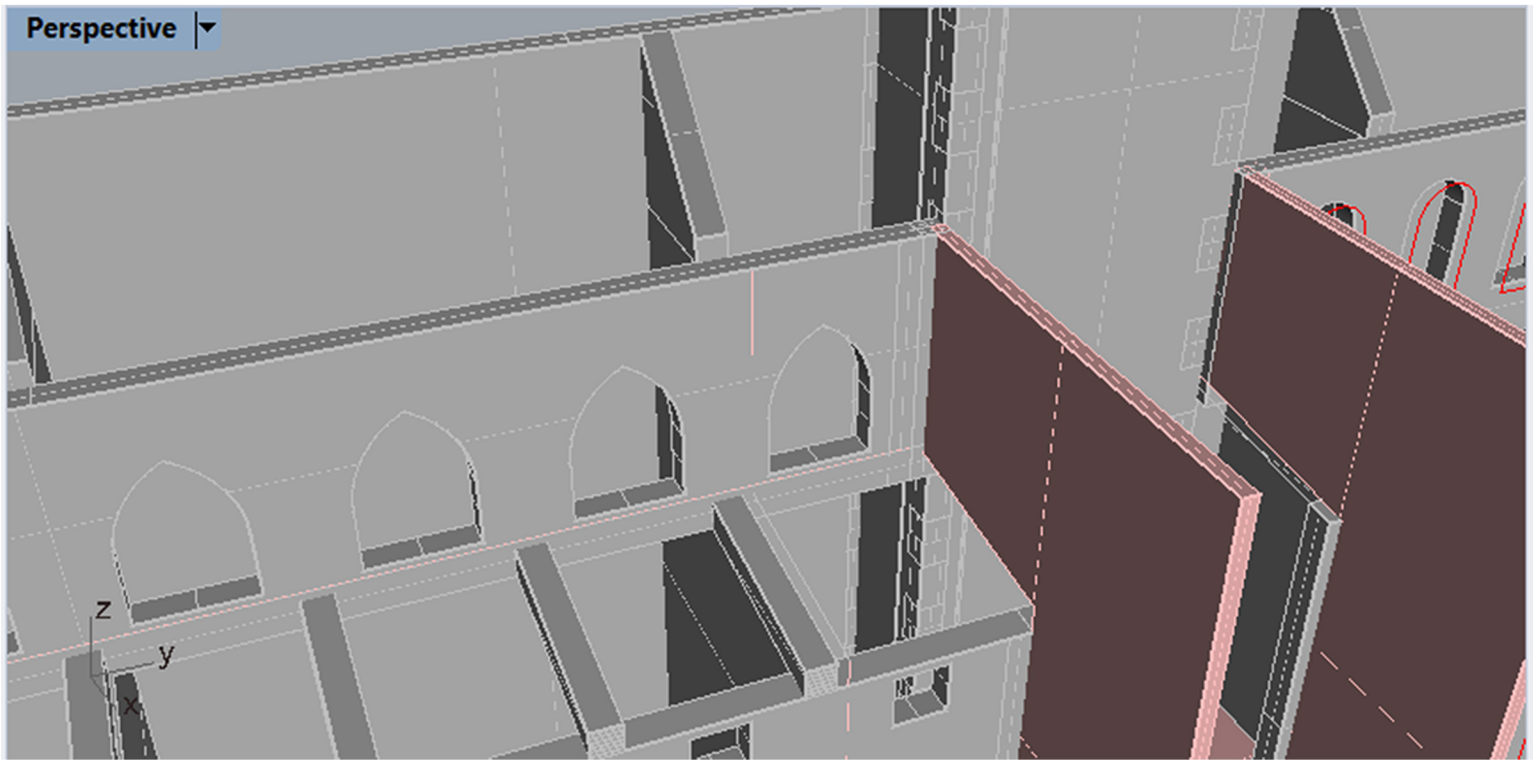


I then went about creating all the 6mm thick MDF walls on my CAD model, including internal profiles to support the Cathedral. There are more details on the MDF structure in the design book.

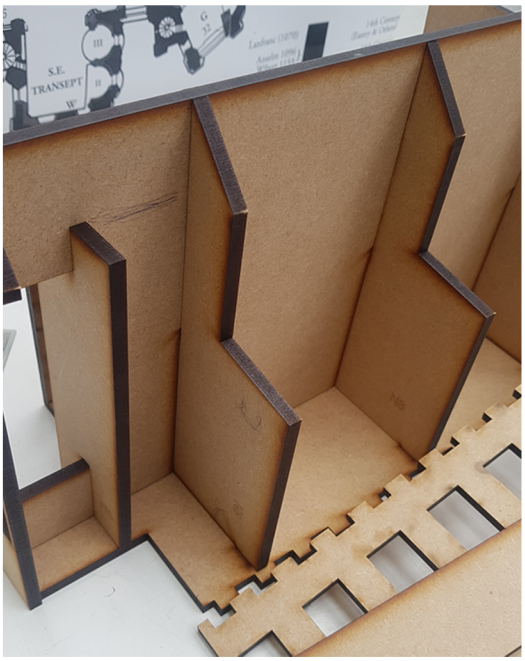
These screenshots show how I created the MDF pieces for the West Towers. The innermost face of the acrylic walls that I previously created were offset by 6mm. The solid walls were split up, as shown by the screenshot above. I then created a castle-turret like edge by arraying a long line of 6mm by 12mm cuboids,, and then booleaning out every other one. One piece could then be used to cut the edge of its intersecting piece, so perpendicular pieces would easily interlock together.

The Transept sides, shown to the right, were modelled as 3mm MDF pieces, as (shown by the screenshot below), this thickness was able to fit next to the upper Nave wall without colliding with the Bell tower. It's slightly less strong, but because the part was only small anyway, I decided it was a good design compromise in order to not have to cut the walls of the Bell tower. Also shown by the screenshot on the right, the base of the MDF model will have little slots cut out of it, where the perpendicular pieces of MDF will have little feet that slot into these holes, in order to make sure everything is in alignment.



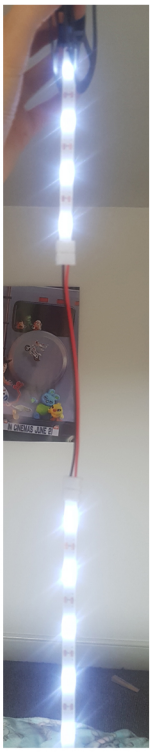


Creating the lighting system

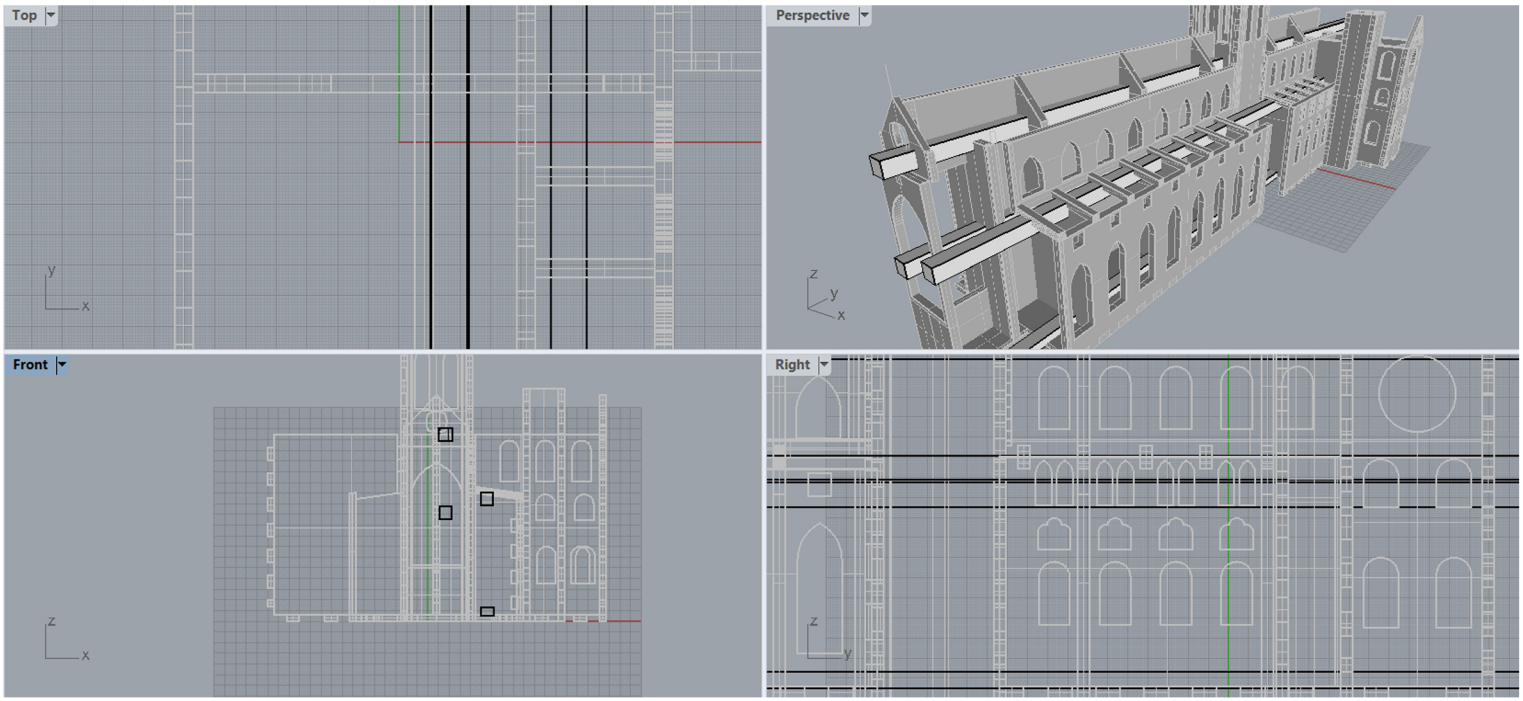


As mentioned previously, I want my Cathedral to light up from the inside in order to illuminate the acetate printed stained glass windows. After my test print, I had decided where I should cut out the holes to add lighting.

I decided to use the LED strip shown to the right, after my lighting tests showed that white light would best shine through the printed acetate. I thought at first that I would have to solder, but then I found some 4 pin soldering clips, that can sandwich over the end of the LED strip, and then be attached to wire. This was a great discovery, as I will be able to add the clip and wire bridge between each seperate building block of the Cathedral, altering the length of the wire bridge as required, so I will be able to dissasmble it and transport it still with the lighting intact.

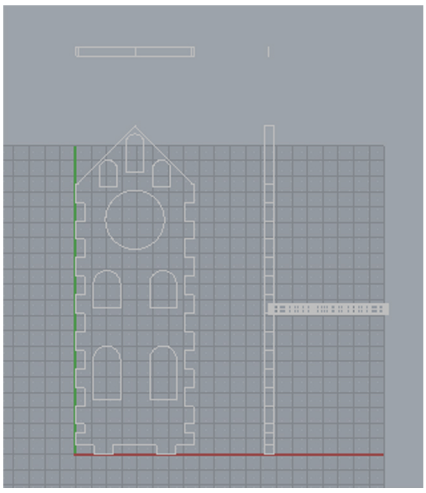


To add the slots, I extruding a long rectangle in the appropriate places, and boolean difference'd.

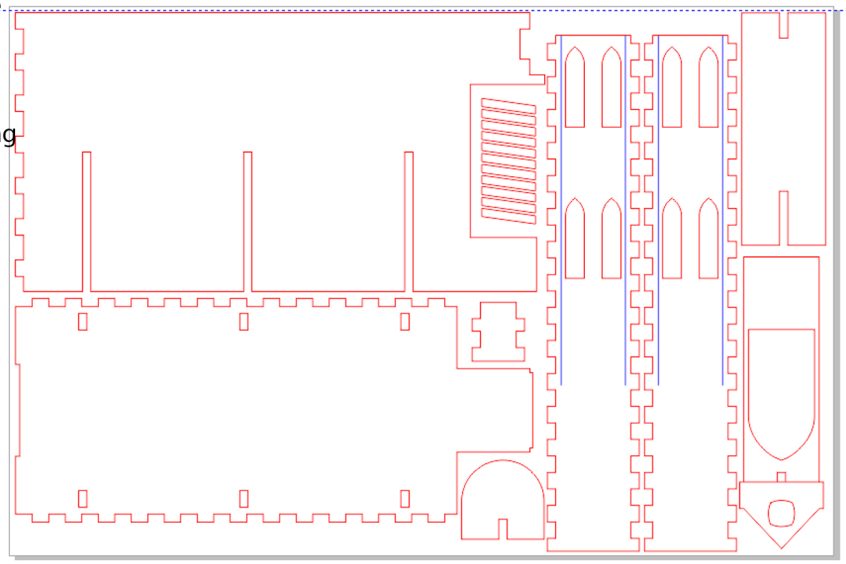


This is a render of the final MDF skeleton model, which I will take the walls from into CorelDraw and prepare for lasercutting.

Lasercutting the final MDF skeleton and assembling



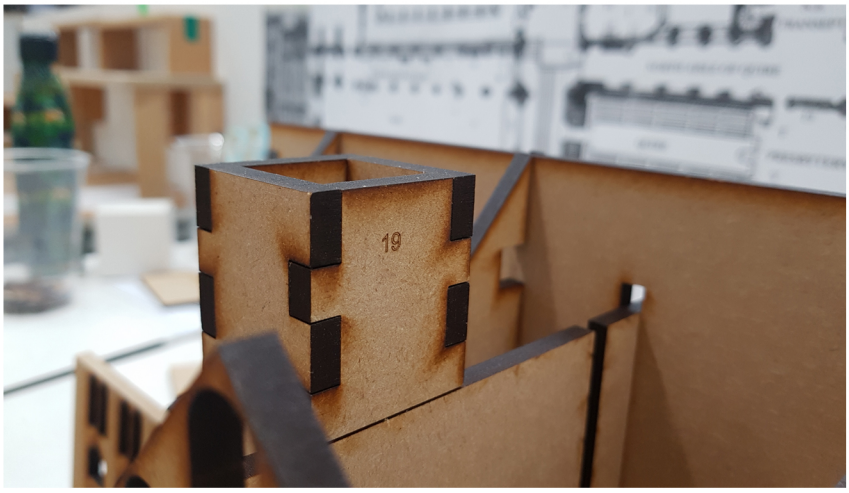
I used the 'Make2D' command on Rhino in order to create a 2D line drawing of each piece, as seen to the left. I then joined the lines, so the lasercutter would cut them much more efficiently, and exported the line drawing as an AI, preserving the scale, as shown previously. To the right is an example of one of my lasercutting files. I added the blue engrave lines so I knew where different panels would stop and start.



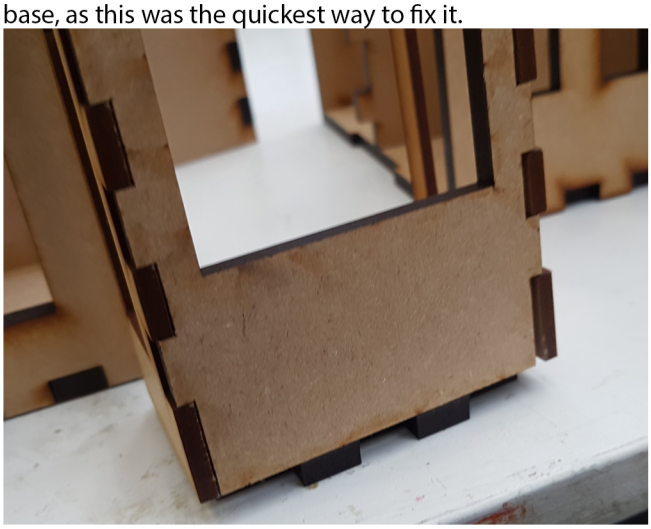
Once lasercut, I glued any pieces that didn't naturally hold themselves together through the structure I had designed with wood glue , and then marked out all pieces which needed an angle sanded on. I created a numerical pairing key, which was really helpful because otherwise, it would've been very confusing.

I lasercut the angle jigs below at the same time, so as to make my sanding as accurate as possible. I then used these at the disc sander. It turned out there were a couple of angles which were the same, so next time, I should check more carefully so I don't have to cut more than necessary.

Assembling MDF skeleton continued, and making corrections

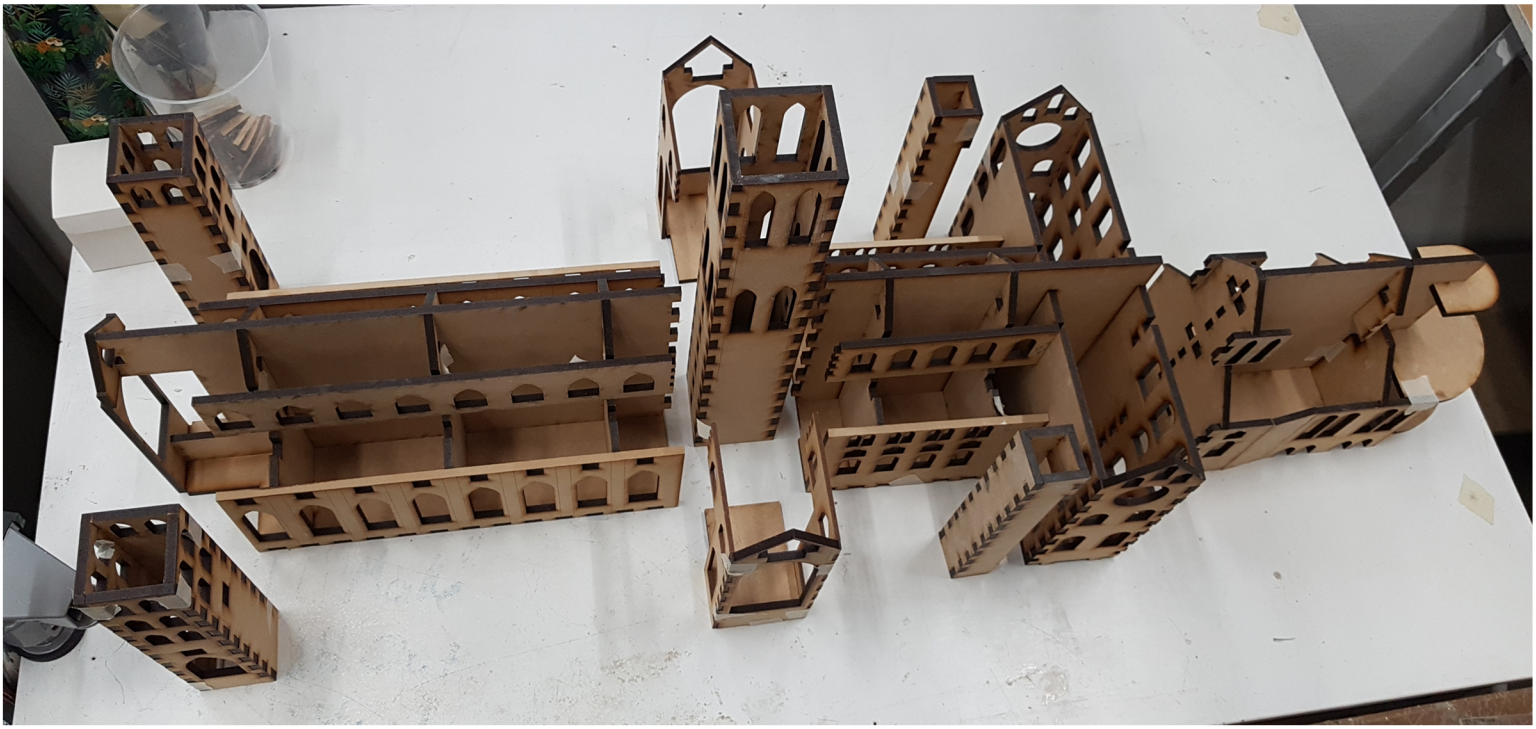


Most of the MDF skeleton went to plan, and slotted together really well, but I had made some mistakes. One was that I forgot to boolean out the bottom edge of the Transept, as shown below. I decided to sand the transept base, as this was the quickest way to fix it.



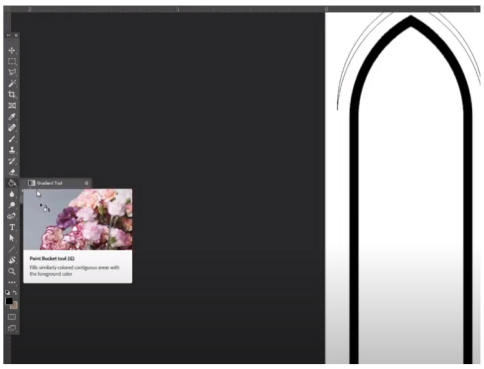
I also learnt to not start glueing late at night when you're in a rush, as this caused me to stick 2 pieces of the West tower together the wrong way round, and by the time I realised, the glue had partly dried. Thus when I tried to pull the pieces apart, it snapped. I had to wait and recut the piece on my next lasercutting slot.

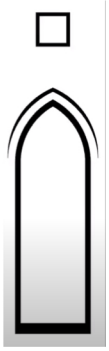
To the right is the assembled MDF skeleton, and I have demonstrated how it splits up into different parts (more on this in my design book). I am quite happy with how well it all fitted together. My interlocking system meant that most is being held firmly together by the way that it is designed, rather than glue, meaning a lot of it is replaceable and repairable.

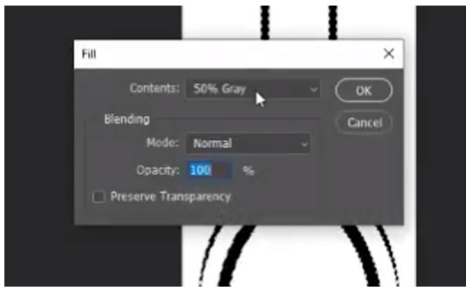


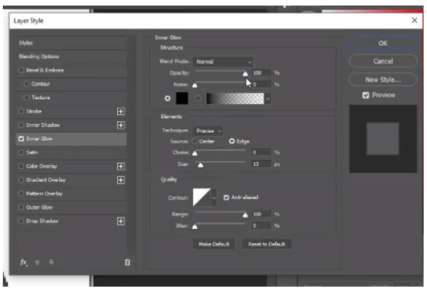
Beginning the acrylic walls

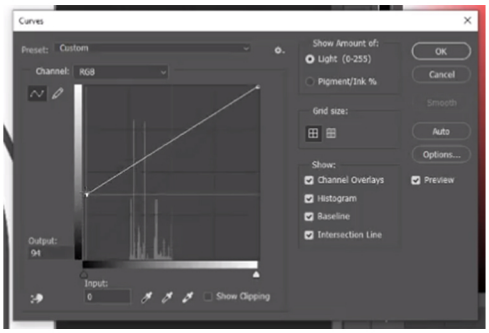
Here, I have started to model the finalised acrylic walls on my CAD file. I already had a basic form of most from my early wall modelling, but I finalised adding all the correct sized windows and shortened/lengthened the pieces so no two pieces would clash or intersect.





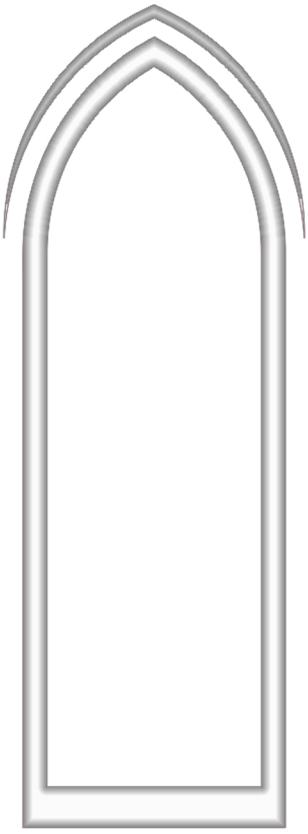






The next step was to make a bitmap that I could etch on the lasercutter that would make a suitable outer frame (note: any of the inner frame - ie. the trscery/lead detail - is the part I'm layering just behind the outer frame as a thin piece of etched metal, so this doesn't need to be included on the laseretching file).

I made the frame on Photoshop. Originally, I wanted something a little more detailed, and then I remembered most of the frames are around a millimetre wide, so I stuck to something relatively simple.

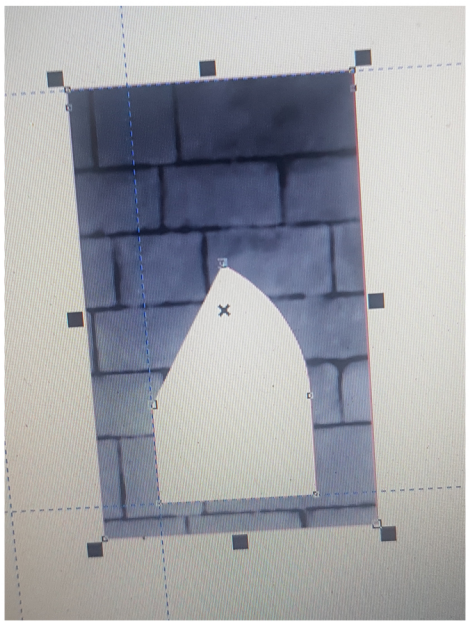


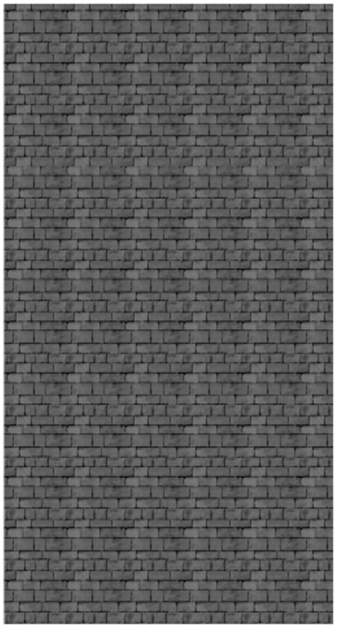
The Process went as followed (illustrated by the screenshots above):
Draw/take the lines for the frame from Rhino model as an AI file (preserve scale).
Open in Photoshop.
Use Bucket tool to fill.
Right click on Layer, then 'Select Pixels'.
Shift F5 - change to 50% gray.
RIght Click, 'Blending Options'.
Tick 'Inner glow'
Change settings to: Precise, Range 100, Size 7. Press Okay.
Image, Adjustments, Curves
Put output to 190. Then Okay.
Right click on layer, then 'Rasterize Layer'.
Then Image, Adjustments, Curves again, and output 30.

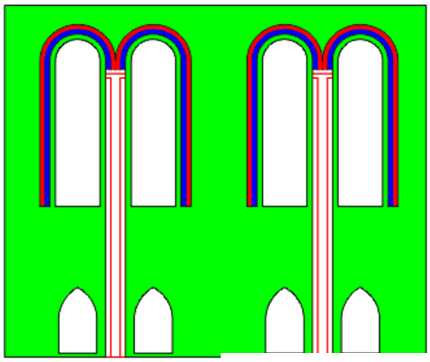
Please note:
The values to the left are what I found to give the best tonal variation to create a slight bevel to my window frame, after experimenting around with the figures for a while.

Trimming issues and how they were solved

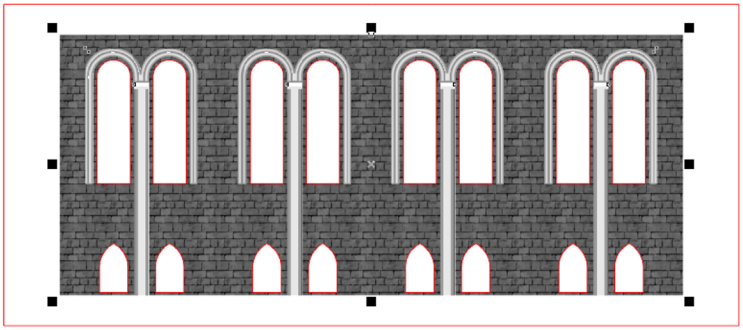
I did this little tester to see how I might add a Bitmap to the shape of the acrylic. At first, I tried trimming in Rhino, because that's what I am most familiar with, but it seems I couldn't then export from Rhino into CorelDraw with just a Bitmap. So I then tried CorelDraw, and tried to use to 'trim' command, but that was causing issues too. Then a lecturer suggested the 'Powerclip inside' too, which did insert my bitmap into the wall shape, but when I tried to trim away where the fram would be (I didn;t want the lasercutter to etch both the frame bitmap and the overlapping wall texture), I got some really strange trimmings, shown either side.

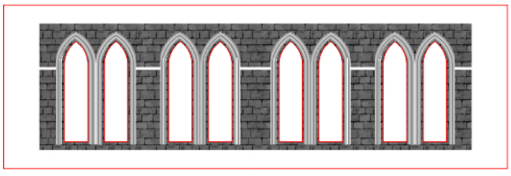






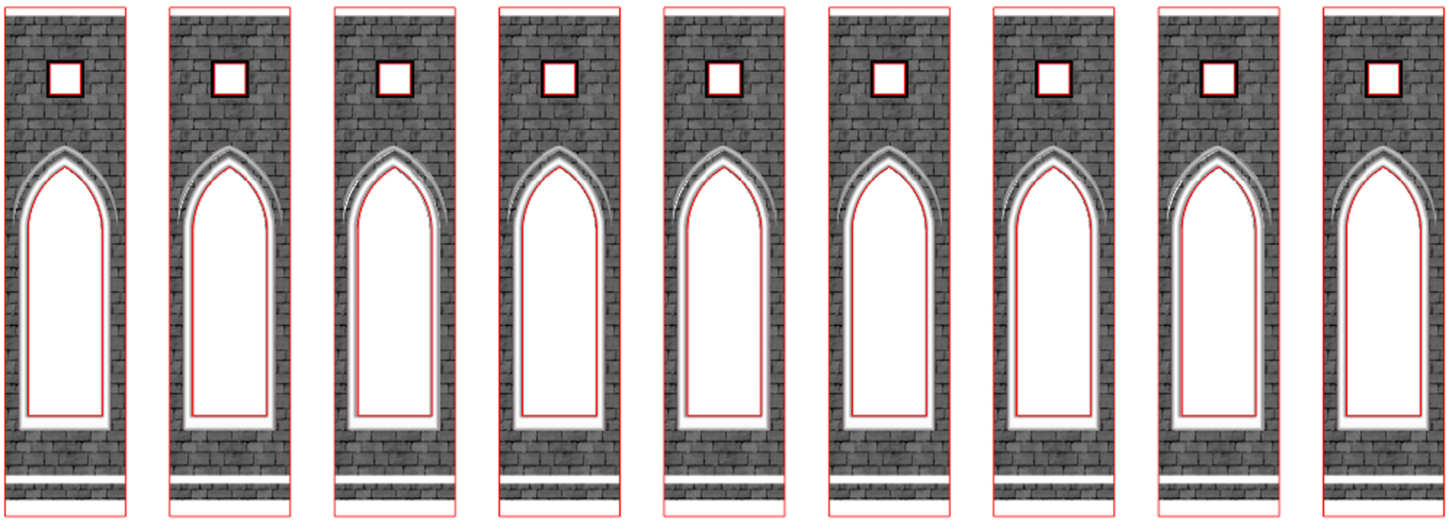
I had already tried filling in the shapes in CorelDraw and Powerclipping inside them, and that hadn't helped, but eventually, and through a lot of problem shooting, I discovered that in Rhino, I should group the linework together, as if making the shape that I need to wall texture in. For example, I would 'Group' the outer window frames with the outer wall. Then in CorelDraw, I used specifically 'SmartFill', and Powerclipped the image inside, and it worked first time every time from that moment on, massively speeding up my process.



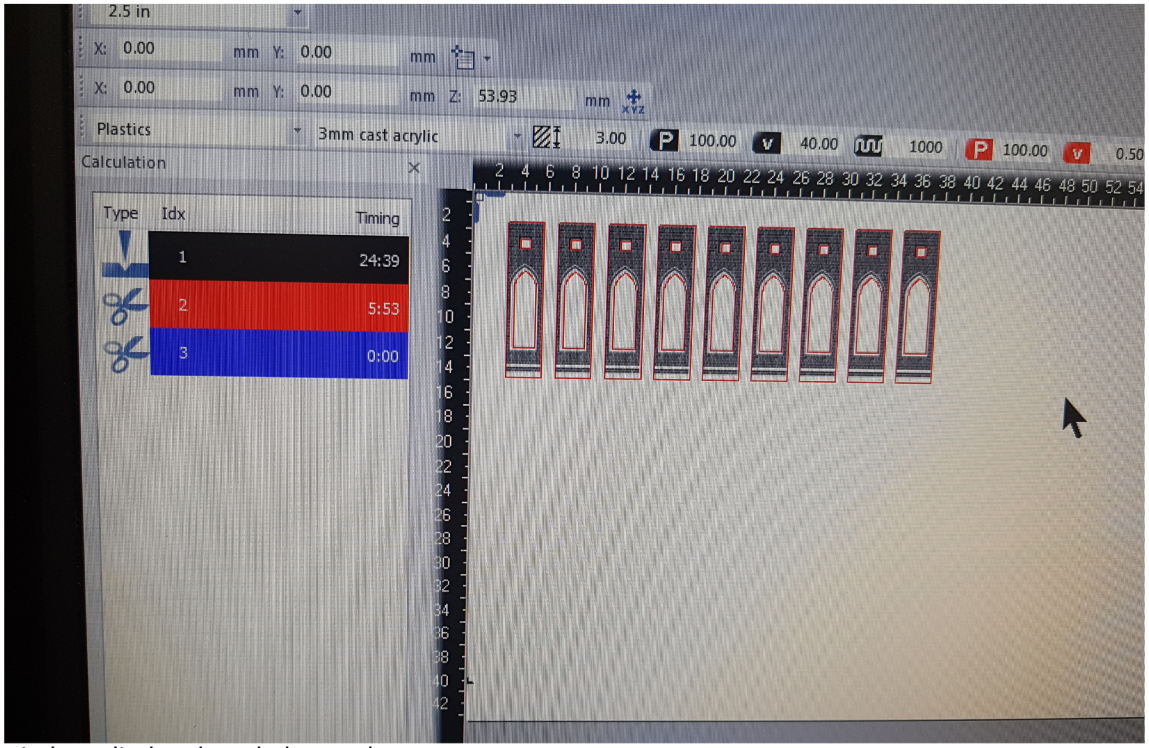


Once the wall texture was added, I added my window frame bitmap from Photoshop.

There are a lot of wall etching files, so I wont add them all to this tech log, but here are a couple of examples, specifically of the Trinity Chapel and the lower Nave.



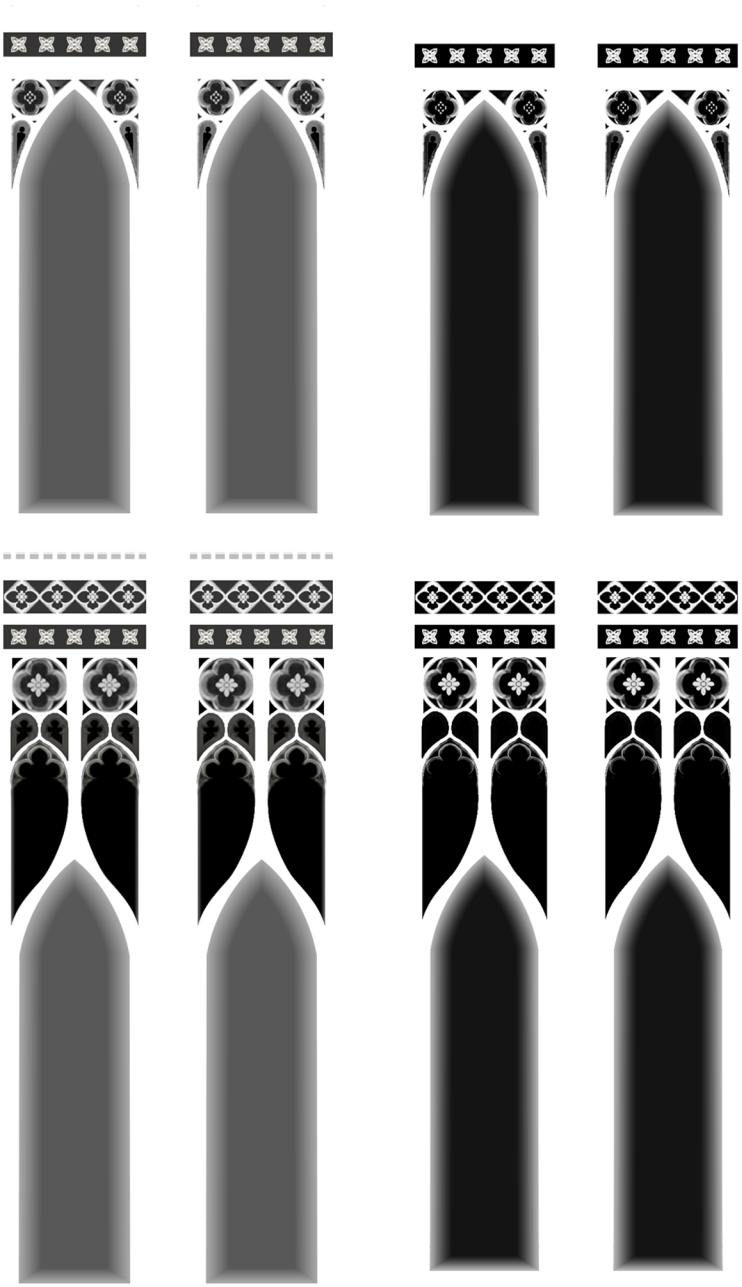
Acrylic etching on the Lasercutter



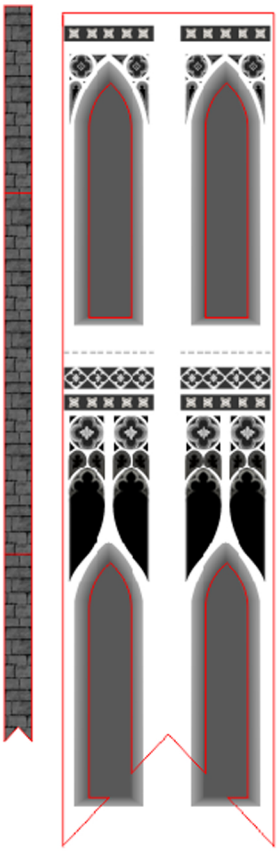
As you can see from the estimated time here just for these panels, the etching took a very long time. From this point, I booked myself an hour on the lasercutter every single weekday to try and get as much etching done as possible, especially as I then found out the deadline was being moved forward, so I wanted to prioritise anything I didn't have access to over the Christmas Break.

A particularly difficult etching file I had to create was for the Bell Tower.

I tried to edit the photo below and just etch a black and white version of this, but I realised there were so many overcast shadows, so this wouldn't etch very accurately. The Bell Tower is also a large piece, so I decided I wanted to make the etching files clean and detailed. So I opted to manual trace over the lines in Photoshop, and fill black the darkest areas. The trickiest parts were hand painting (using a drawing tablet) the small flower designs and the foils, but luckily, once I had done one of everything, I could just mirror it.



The left etching file was etched first. I created the darker etching by colour selecting all of the darkest parts in Photoshop, and then creating this as a seperate etch file. I then etched this file afterwards, and as expected, it deepened all of the further back layers to create much more definition.

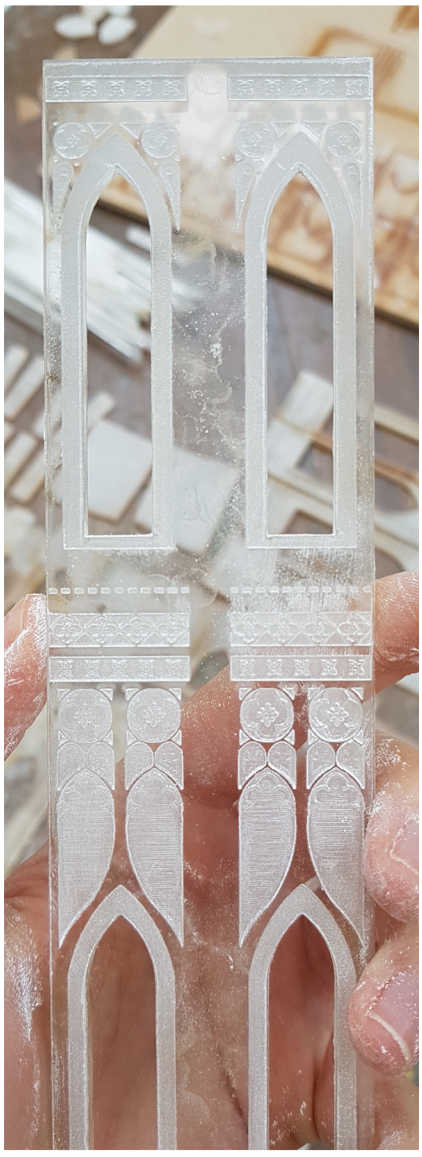


Etching Continued...

Again, there are too many etched walls to document every single one, but as a more interesting wall, the Bell Tower serves as a good example. I'm really pleased with how these came out so I'm happy I took the time perfecting the etching file beforehand.

Please note: The acrylic pieces pictured here are not permenately glued yet - I just stuck them on with double sided sello-tape to test if they fit well. They do!

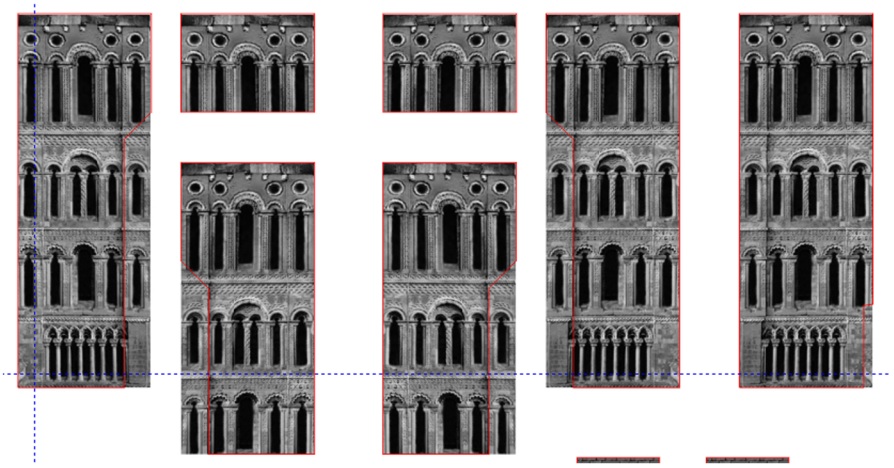
It is a little hard to see all the detail at the moment, but once I bring it out with paint, I think it should work well!

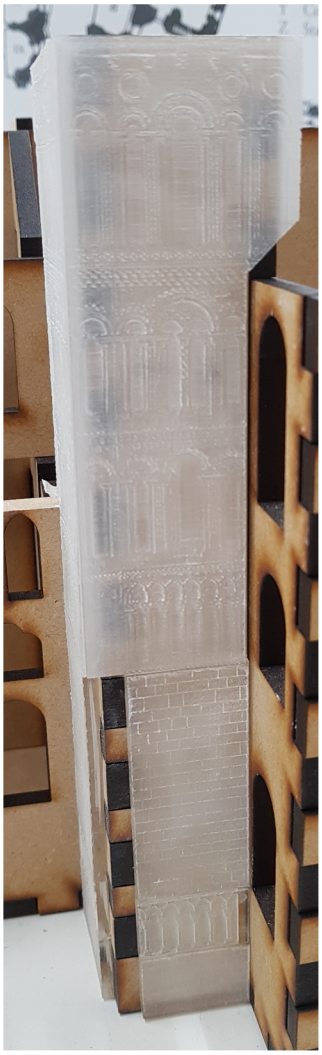


I am, however, a little disappointed with the frame bordering the window, I think it should've been deeper. I will try sanding and using needle files to increase its depth slightly, so as to avoid it looking a little too flat when painted.

Etching files for the Transpet Tower and railing details

I took the photo on the left ans, with the help of rulers in Photoshop, used 'Perspective' until everything lined up straight. I then turned it black and white. Then, with a drawing tablet, I used the 'Burn' and 'Dodge' tool to adjust the tones, For example, I made the tiny organic details at the top, as well as the rims around the circles much lighter, so they would protrude more. I then used the Clone Stamp tool to add/replace some parts, and then even out the tone of the brickwork. I then simply used the paintbrush tool and painted the areas I wanted to be etched the deepest black.
Below, I've added the lines to cut out as according to my CAD model.

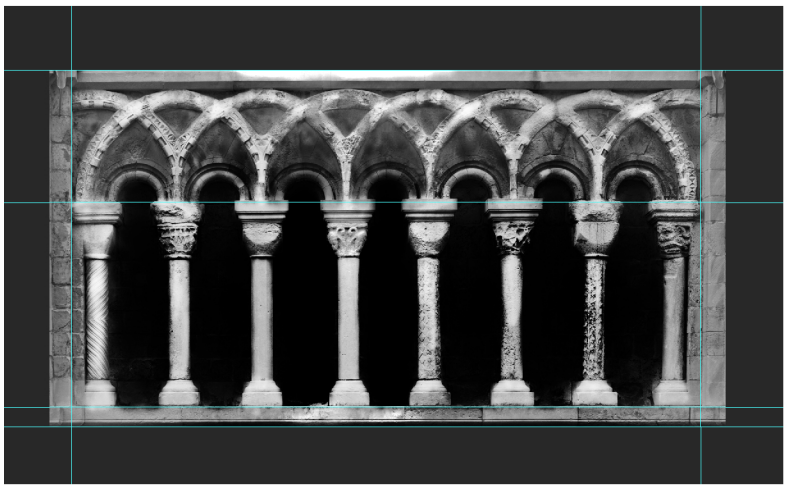




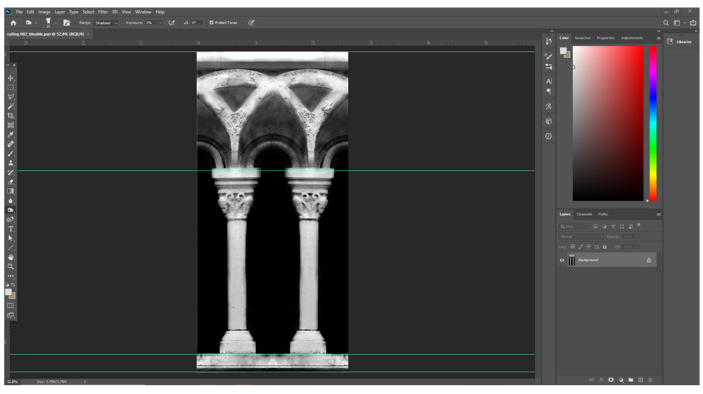
I meanwhile began working on an etching file for the railing detail that occurs a lot on the eastern side of the Cathedral.
I used the photo to the right, and used the same process as described above to alter the tones and make it suitable for a defined etched piece.

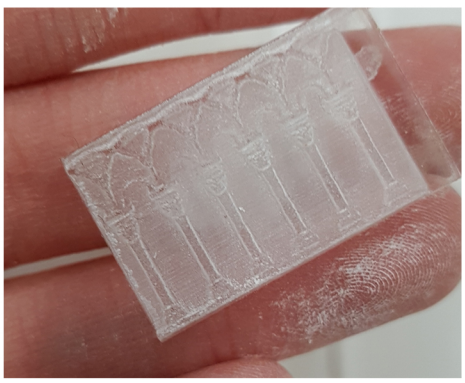
But there was an extra step. Since the railing reoccured at many places, and each time at varying lengths, I decided to make the little pillars tileable.

I used the same method as I did for wall texture files:
Filter, then 'Offset', then moved the seams towards the centre, and then used 'Clone Stamp' to cover the seams up.



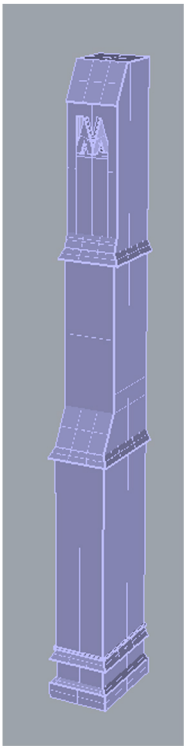
I think the resulting etch is really effective - I'm learning that creating areas of pure black, that etches as deep as possible, although makes for a strangely shaded photograph, definitely creates a more defined etching.

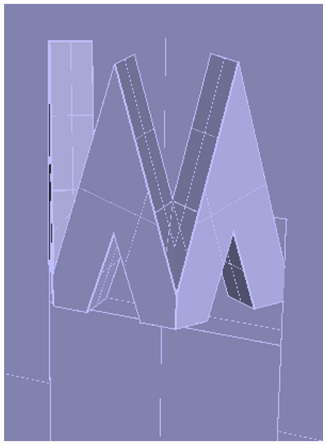


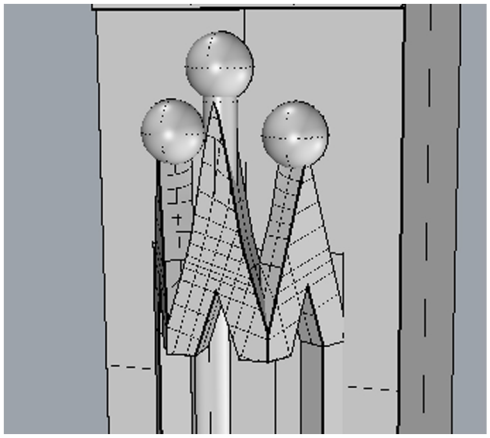


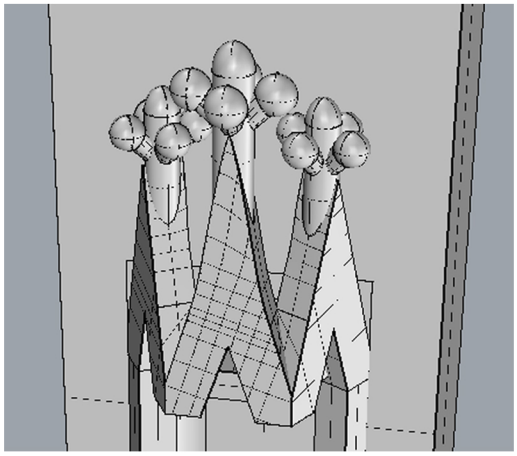
Above shows the resulting etched acrylic from these files, after I sanded each side at a 45 degree angle, using an angle jig that I lasercut. Again, they're just taped on to check it's all going to plan.

Nave pillar CAD model



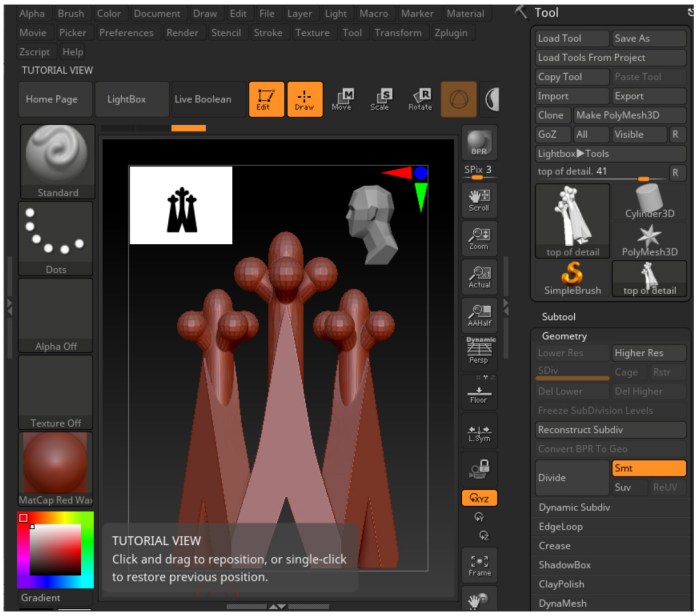


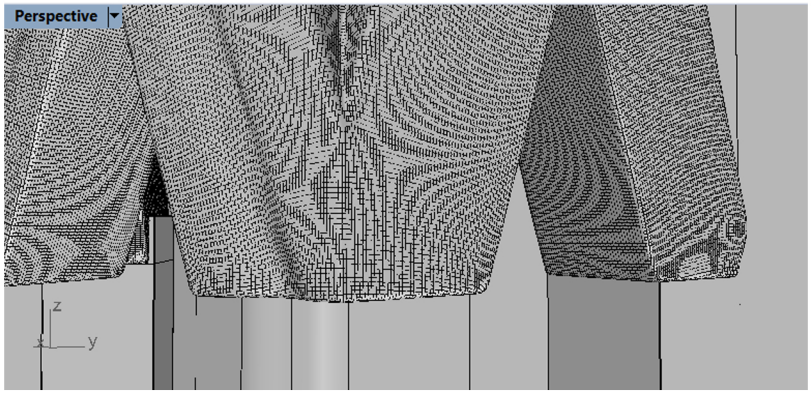


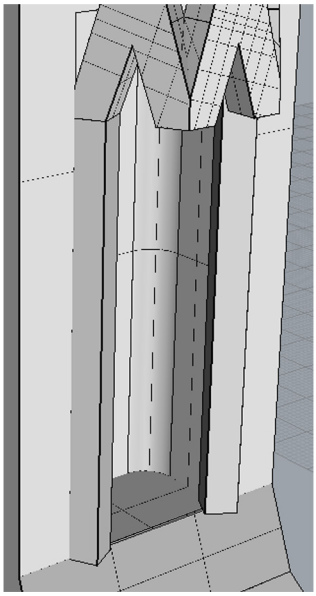


I used the very basic block out model from the beginning of this project for size reference, as this pillar has to fit perfectly between two lower Nave wall pieces. I then created the tiered form, as shown left. The detailed crown shaped part at the top was kept relatively simple, due to its tiny size. I then used pollar array to create the detailed points, and then used gumball stretch and cage edit to shape this part slightly.

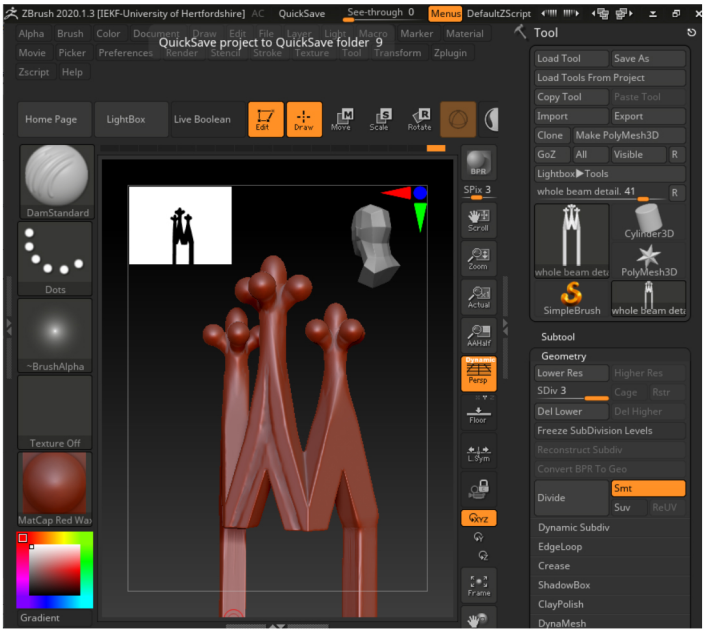
I then took this into ZBrush to add a little more organic detail. I planned to smooth out the tips a little and round the edges slightly. I firstly tried with taking just the top part, because I didn't want to accidentally change any of the rest of the pillar at this point, However, after ZMeshing (in order to lower the density of the mesh, so Rhino wouldn't lag as much) I found out the the join between this part and the extruded rectangles that it connects to had been affected so it would not boolean together.



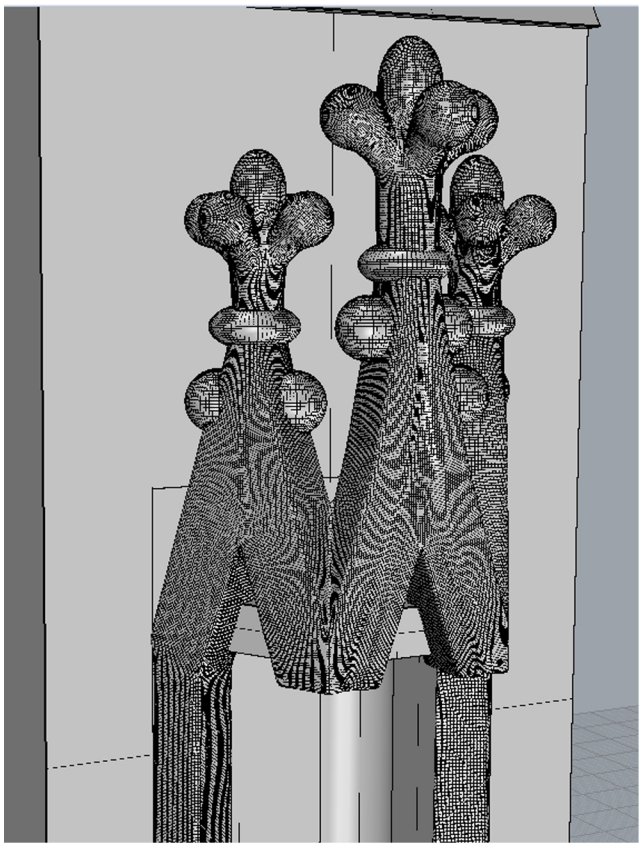




I tried again, this time taking that whole piece, as seen to the right. This then worked much better. I smoothed the joins by holding shift and brushing over them using a drawing tablet. I then added some grooved to the triangle shaped part, for added detail, using the Dam Standard brush. I then ZRemeshed the whole thing, exporting as an OBJ, and added it back into Rhino.
I could then boolean it to the rest of the pillar.

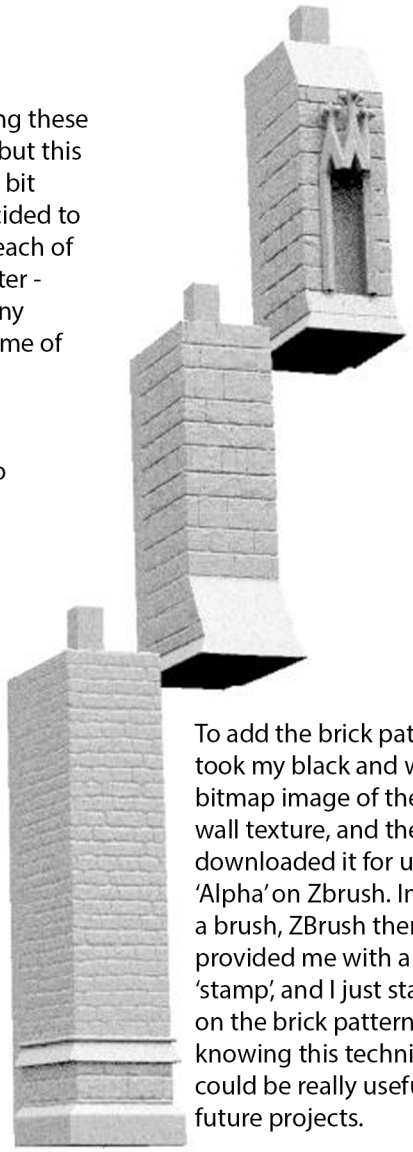


Nave pillar continued,,,

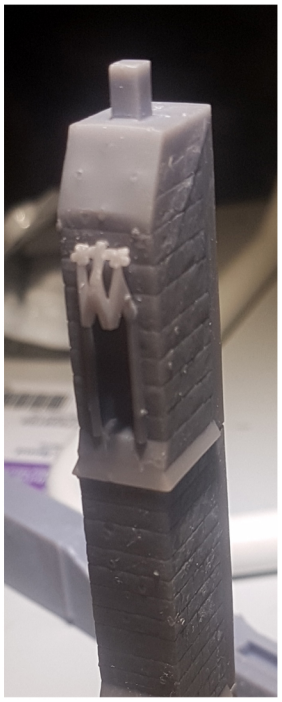


Back in Rhino, I wanted to try adding these little rings, and the extra 'bobbles', but this seemed to split the mesh. I spent a bit of time trying to fix it, but then decided to move on when I reminded myself each of those little balls are 1mm in diameter - so the ring detail was a very very tiny sacrifice to make in the grand scheme of getting the pillar printed.

I then split the pillar into 3 parts, which had a slotting mechanism so they could be easily assembled. I felt splitting them up could mean if it's too hard to mould and cast the top part (and I was imagining I'd have a lot of air bubble troubles if I tried), I could join the bottom and middle section together and just mould and cast them, whilst 3D printing the top part attachments seperatley.



To add the brick pattern, I took my black and white bitmap image of the wall texture, and then downloaded it for use as an 'Alpha' on Zbrush. Instead of a brush, ZBrush then provided me with a kind of 'stamp', and I just stamped on the brick pattern. I think knowing this technique could be really useful on future projects.

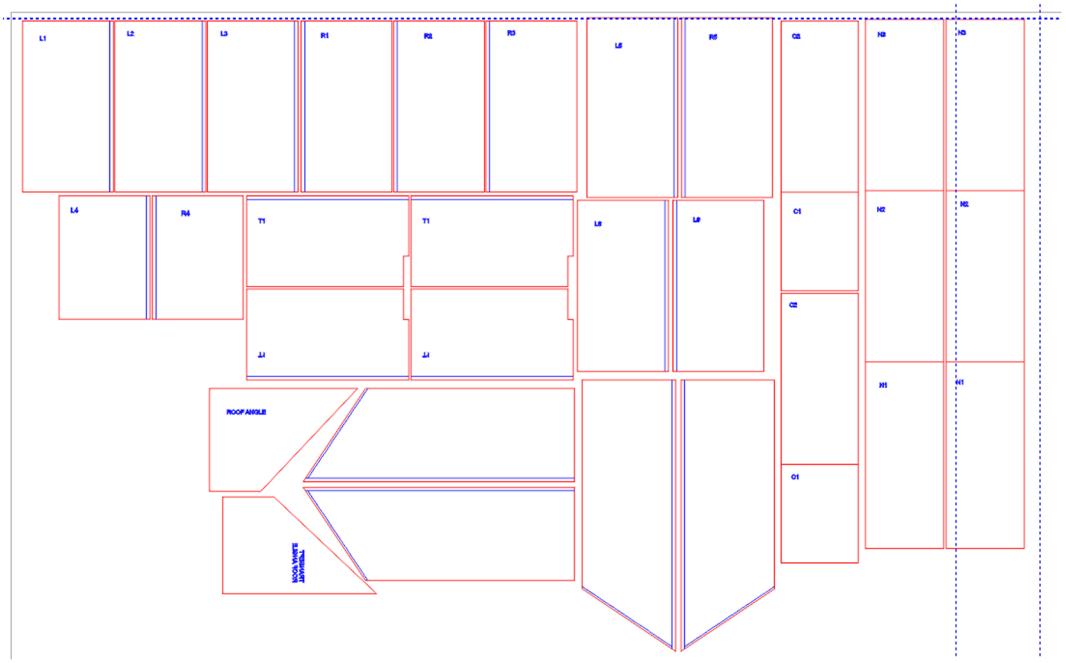


I haven't had my SLA 3D printer very long, so it was challenging to produce a successful print on my own. At first, as noticeable in the photo above, the detailed crown shape part was warping, leaning backwards. When I research this, I found out it was because I wasn't putting supports on in the right place.

I put the print into Chitubox (the slicing program) again and made sure there were no floating islands and that everything was supported. Then there was another issue, as seen by the middle photo - there was a diagonal line going through my print. I showed the technicians downstairs, and they didn't know why this was happening either,

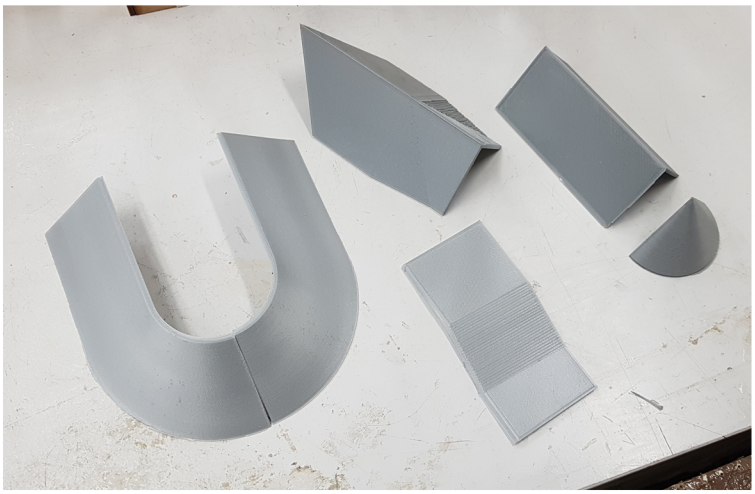
I tried one last time, this time angling the print slightly less, and this seemed to solve the issue. I had some repairing to do on the print where some of the supports had chipped away at the brick pattern as I pulled them off,and I accentally knocked one of the tips of the detail crown part off - but I managed to mostly save the print with miliput and some sanding.

Making the roof



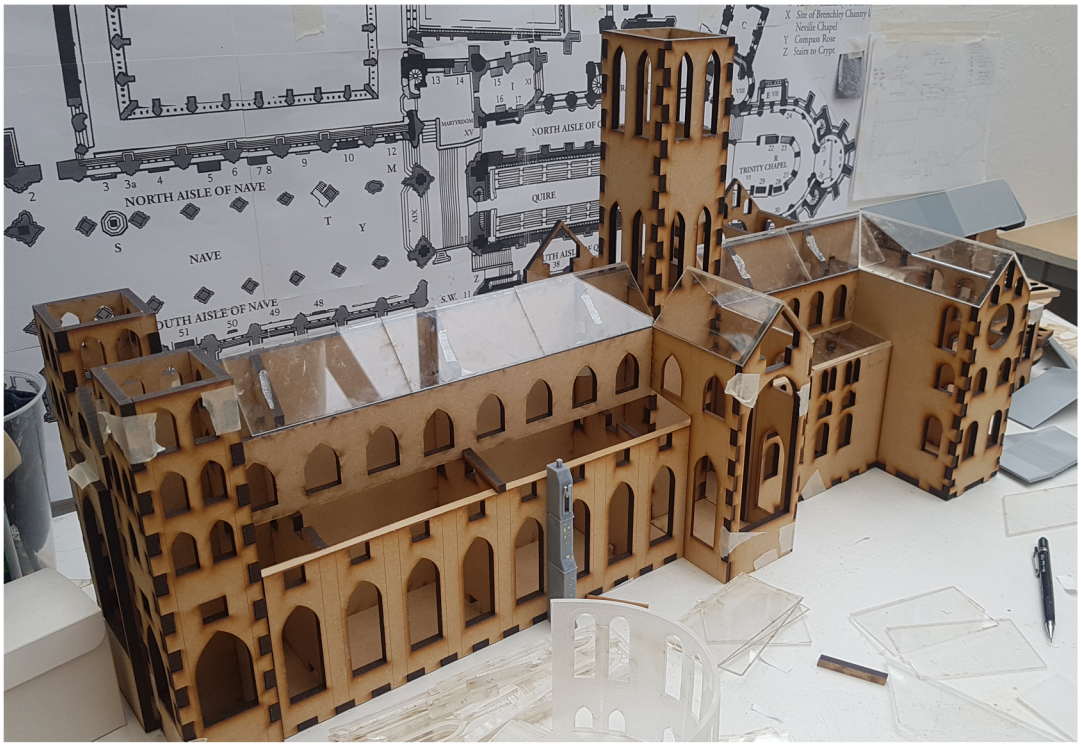
I decided to lasercut the roof in small sections that would be easier to sand on the disc sander. I knew I wanted to add styrene stips for detail, and so I could easily cover up the seam. I also engraved a code on them so I could tell which piece goes where. I also lasercut a 45 degree angle MDF jig at the same time.

I sanded this angle on each piece. The blue etched lines (shown in my files above) allowed me to see where I should be sanding up to, so, as shown to the right, all the pieces fit together really nicely.

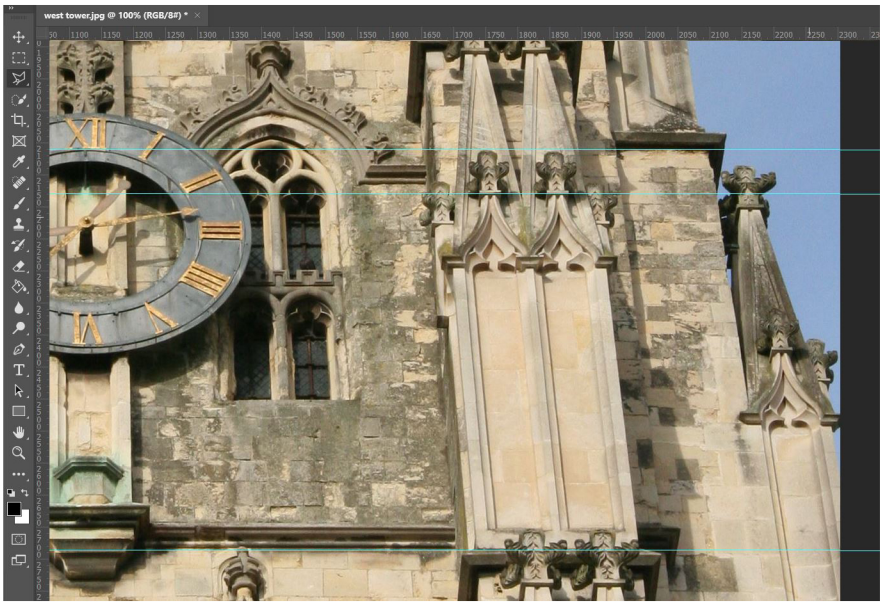


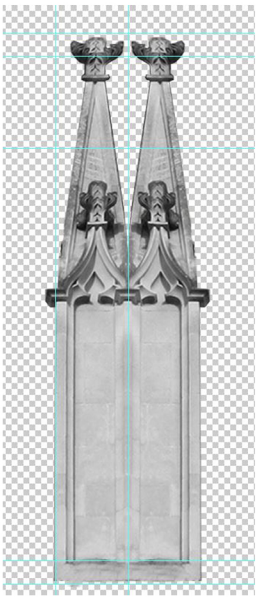
If I had a bit more time I could've spent in the workshop, I would have liked to turn the Trinity Chapel aisle roof on the lathe, and then Vac form it, but due to the Covid restrictions, I decided it could be more sensible and more time efficient to just 3D print these straight from the CAD model I made, in FDM. The pieces still need sanding and some glazing putty/filler primer.

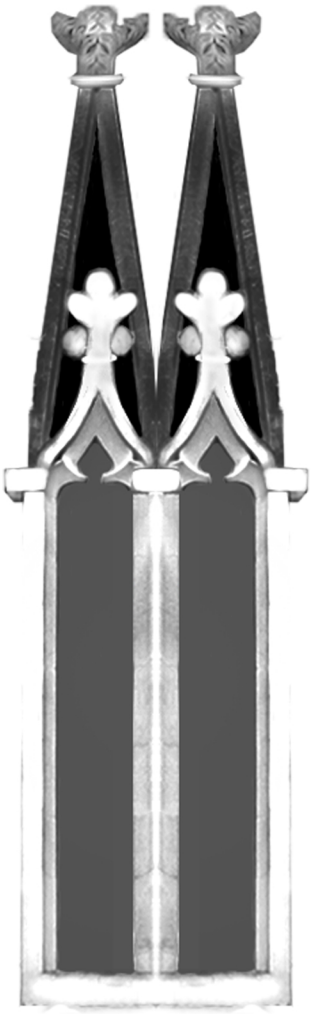
This shows most of the pieces I have made so far. Once again, I have double-side taped the pieces to check they fit, but I plan to to add the styrene details and paint a base colour on these before I stick them on.



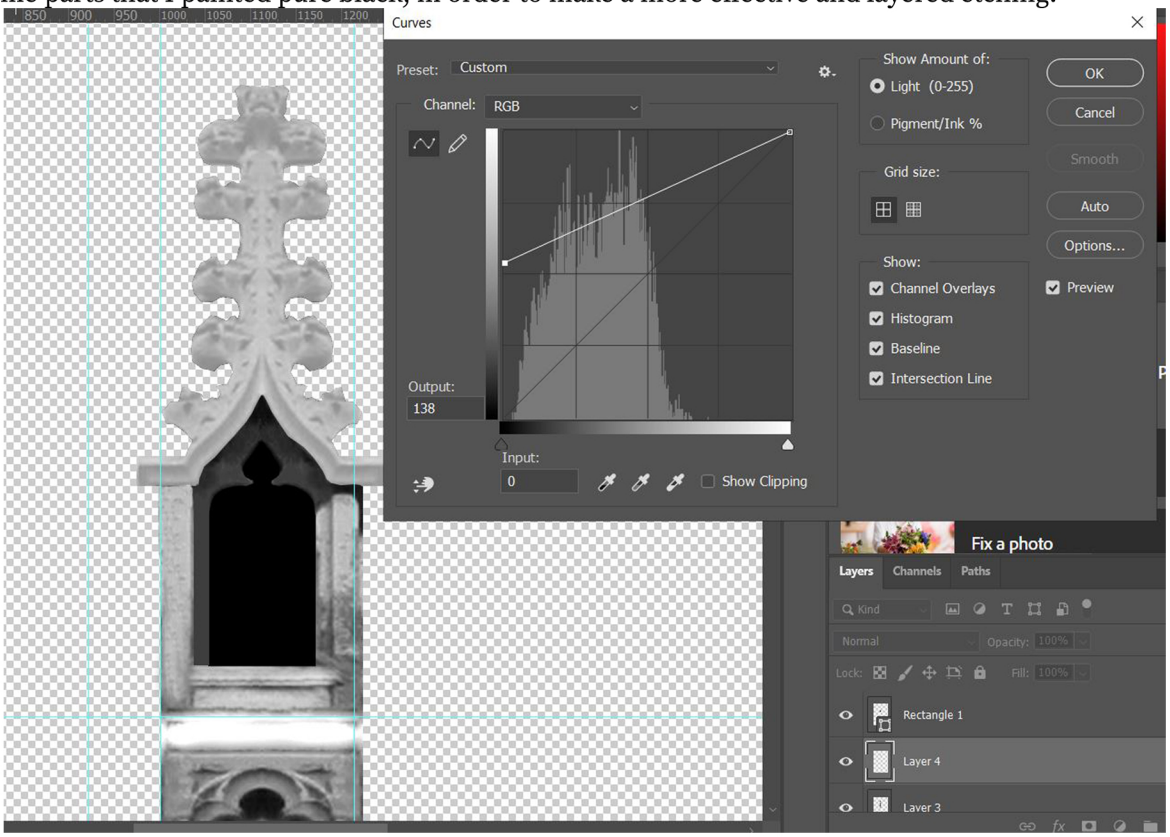
Etching files continued: West Tower details







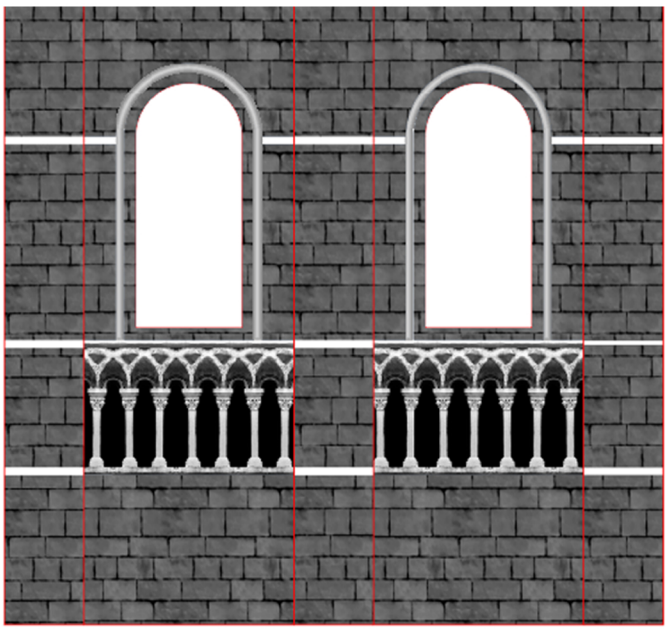
The ‘beam-like’ details on the West Towers (as shown above) were also quite complex etching files to create. I used a similar method as I did for the Transept Tower files, in which I took a photograph and make it the right perspective, then, using Photoshop, I painted on shadows and highlights, as well as some parts that I painted pure black, in order to make a more effective and layered etching.

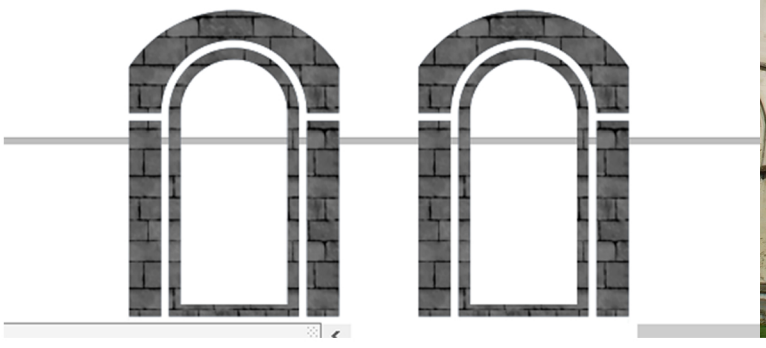


For this one, the detail right at the top (in white) was very dark stone, but yet I wanted to make sure the lasercutter didn’t recognise this as a part to etch deeper, So I inverted just this part (using the quick selection tool and the polygonal lasso tool) and then changed the ‘Curve’ (under Image, then Adjustments).

On my CAD model, I drew out how I would assemble these pieces. The orange shows where a 3mm acrylic piece etched with the usual wall texture, and the Grey parts are 3mm thick sheets of the etchings shown on this page, except the cuboid and cone, which is a blockout of a 3D print I will make.

Etching files continued: East Transept

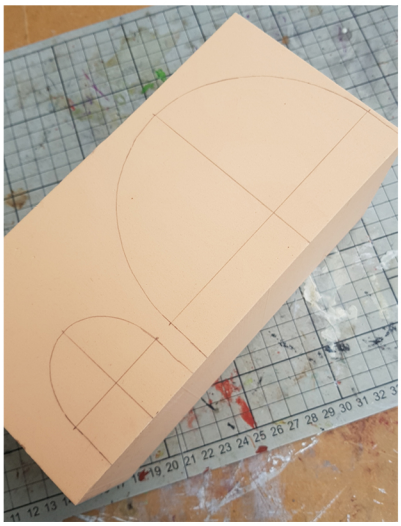


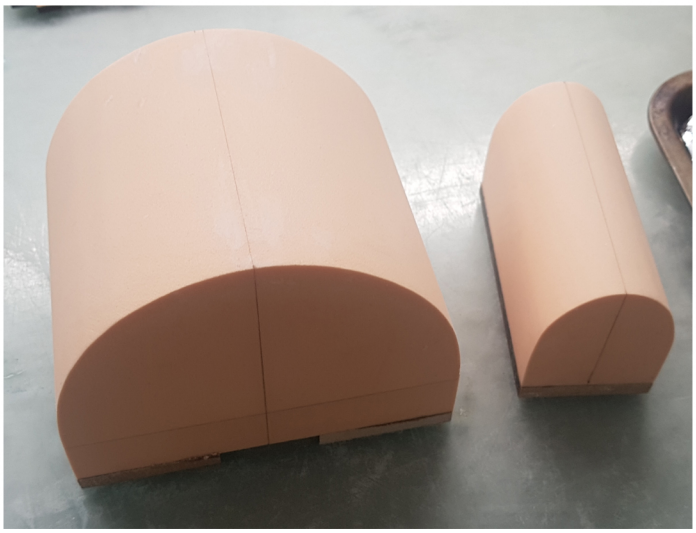


For the East Transept, I combined a lot of what I had already made. I could reuse window frames from the Trinity Chapel if I resized them, and I have already created the tileable railing file. So I used the method described previously which involved 'Powercliping' in order to create the final file.

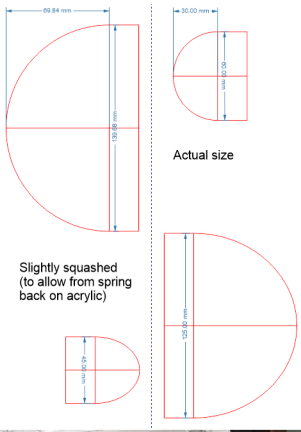
As demonstrated in this image, there is some subtle layering on the lower half on the Transept. To create this, I split this section around the lower windows and created a copy of it, as shown to the left. I kept this positioned in the exact same place, so when I etched it after etching the file at the top of this page, it created slightly more depth to just this area, creating the effect I had hoped for!

Making the curved Trinity Chapel wall jig

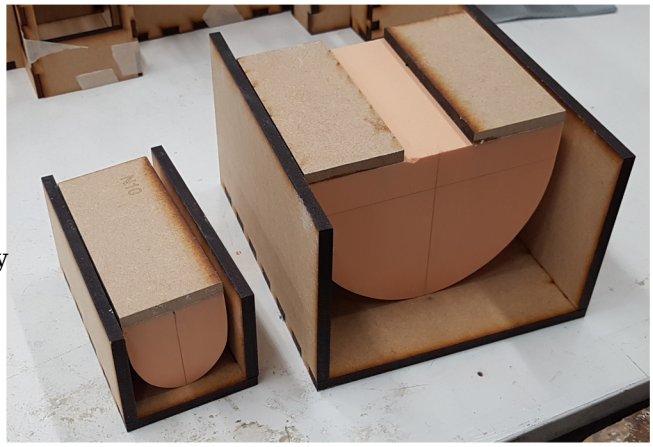


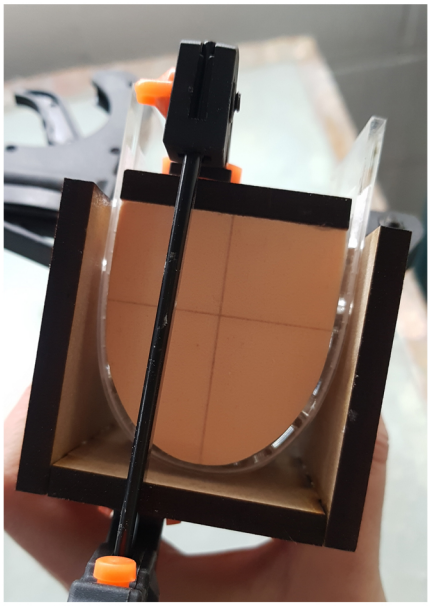


The design for this jig can be found in the design book. From this, I carved chemiwwod to size and shape using the templates I made in CorelDraw.

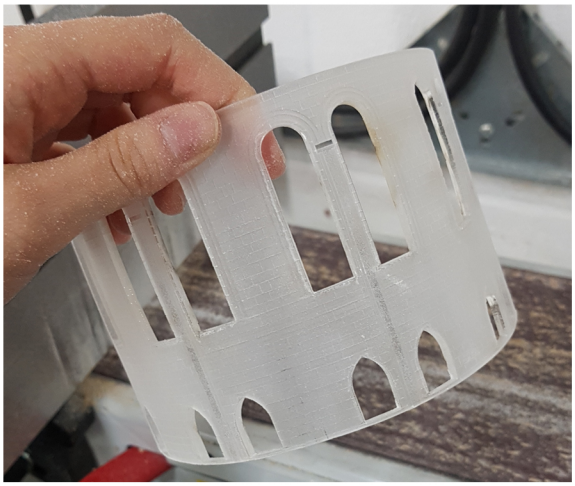


I then lasercut the appropriate size box to sandwich the heated acrylic piece against the jig. I added my acrylic piece (which had been cut slightly too long and wide, deliberately) and placed on a baking tray.





I started with the oven on 90, but my acrylic didn't seem to be softening at all. I kept turning the temperature up in increments, until I reached 130, which semed to be the optimum temperature because my acrylic started to very slowly soften. After a while, I took it out, placed it over the cooresponding jig (I was bending both the upper and lower trinity chapel walls), and then pushed it down into the box, and held it with a clamp.



The larger piece seemed to work realy well, and fitted to the mdf skeleton nicely, but the smaller, upper wall wasn't a very good fit. By trying to use a heat gun to correct it, I snapped the piece, when I should've just booked another slot at the oven and done it this way. I wil need to reetch the piece and heatbend it in the oven again.

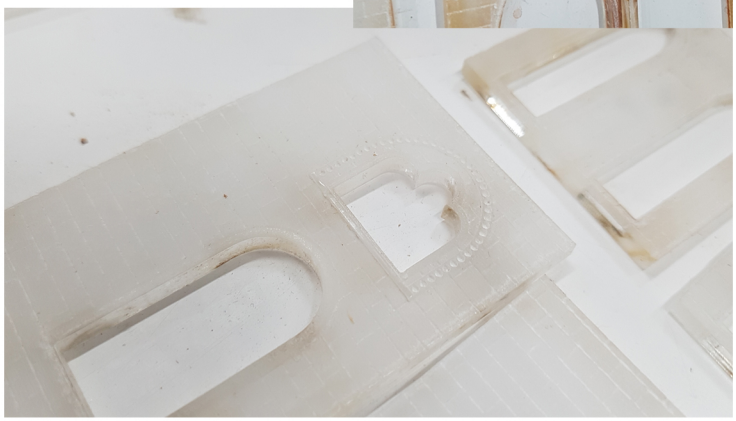
I sanded down and cut to size the larger piece, and I am at least happy with how this one came out.

Progress on producing all the walls

I booked every lasercutting slot avilable to me before the uni closed, but I still wasn't able to get every piece done, but here are some exampled.

I have the West front piece and one of the Transepts to go. But otherwise, all of these pieces (the upper and lower Nave, the West towers, the roof, the side of the west transpet, the entire East transept, every wall of the Trinity Chapel and all those of the Bell Tower) are ready to be primed, painted a base colour, and cladded on. Once cladded on, I will then add washes and dry brush to create subtle weathering for a more realistic look. I decided to do things in this order after a discussion with my visiting lecturer, and we decided it will be easier to get the paint to reach the entire surface if I prime them when they're not yet assembled together.

The etching files and the etching itself has taken up a lot of my time, but I am pleased with the progress I've made on these so far and I'm looking forward to assembling it now and adding my 3D printed beams.



Acrylic walls CAD model complete, and some examples of how the pieces clad on

Below is the acrylic walls CAD model, minus the west Transept Front face (which has some complicated little windows that I didn't have time to complete before the early deadline).

My entire model has relied heavily on this CAD model from the beginning, and that has made the process a lot more efficient, as I've been able to find out dimensions of all the pieces really quickly once I got this CAD model sorted. Rhino has truly been a very helpful tool in the design and making process, and I've learn some new commands that I'm sure will come in handy in future projects.

Below are some non-permanent examples that demonstrate how some of the walls will be cladded on, and everything seems to be fitting quite well. I am pleased that any pieces that required angles being sanded down the sides are also fitting together well, which must mean my lasercut angle jigs ensured a high level of accuracy.

Pricing Table

Name of material	Supplier	Price per unit	Quantity	Overall price	
6mm MDF	UH shop	3.65	5	18.25	
3.2mm MDF	UH shop	2.25	1	2.25	
3mm acrylic	UH shop	14.45	4	57.8	
Acetate test print	Ezeeplan	3.80 inc postage	1	3.8	
FDM roof print	Workshop	9.88	1	9.88	
SLA Nave beam print	Myself	0.74	3 (2 failed prints)	2.22	
Orange chemiwood	UH shop	5	2	10	
Styrene 0.5mm	UH shop	1.2	1	1.2	
Styrene 0.75mm	UH shop	1.6	1	1.6	
Fast cast 1kg	PS Composites	18	1	18	
Silicone 1.1kg	PS Composites	21.72	1	21.72	
3M Acryl-Red Glazing Putty	MDABitec	23.95	1	23.95	
2 Pin 8mm LED strip connector	Alightings UK	8.99 (pack of 10)	1	8.99	
2 Core Black Red Wire Cable	Electrosmart	3.10 for 10m	1	3.1	
Battery Operated LED strip Ligh	CheerLong	10.99	1	10.99	
Aluminium Tape	CTRLTD	3.87	1	3.87	
				Total = £197.62	
This is the total up to this point of the project. I would still need to buy the acetate prints (expected at					
around £12) and the metal etched parts (around £45). Remaining SLA prints will cost around another					
£4.					