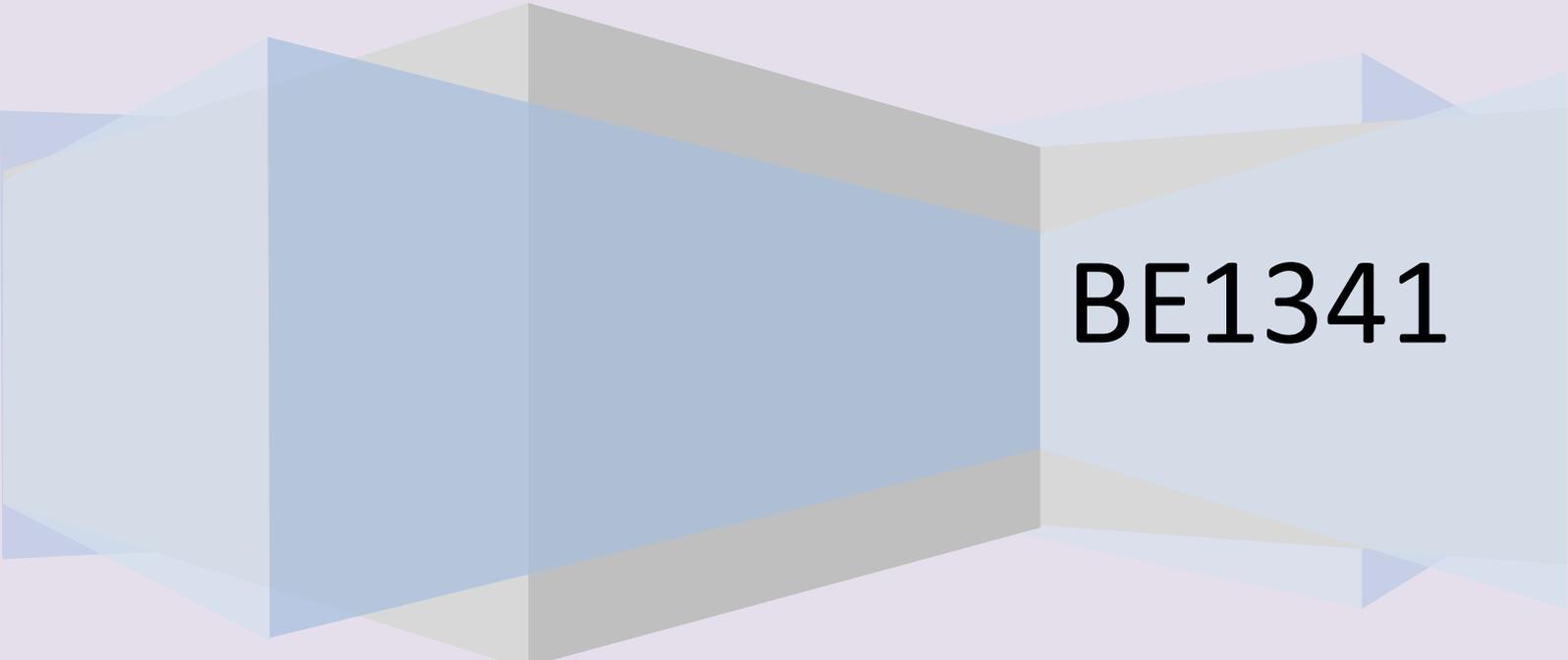


**Northumbria University**

# **POD Creation**

**Screenshots and explanation.**

**W12010294**

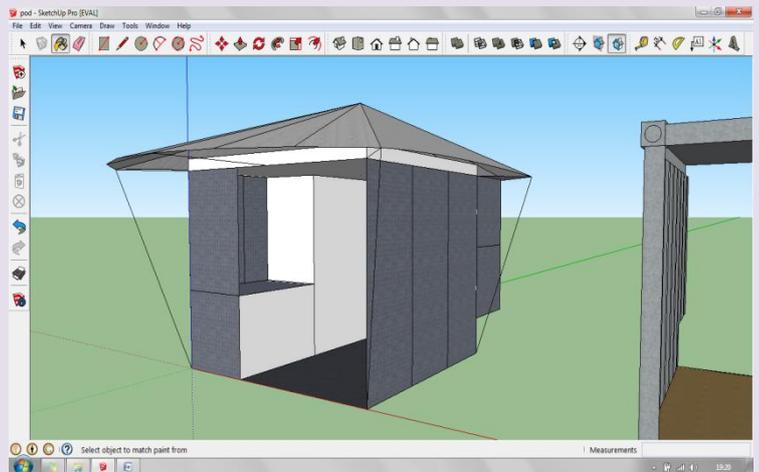


**BE1341**

## Initial Design

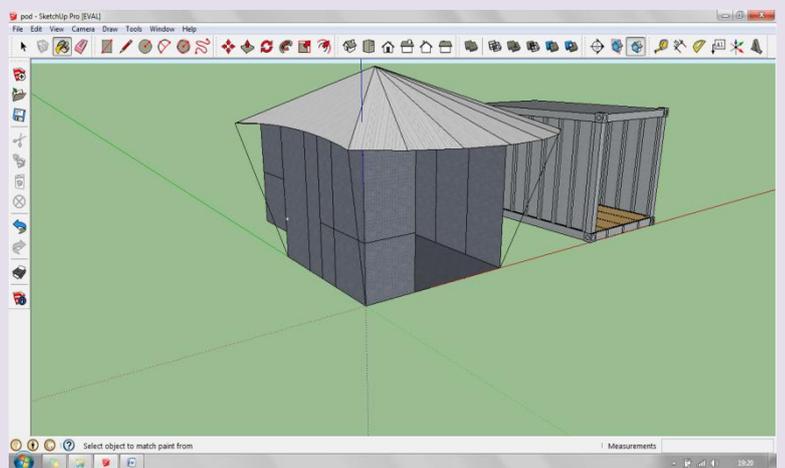
### Step 1

After doing my initial research into various different types of pod living I decided that I would like to base the pod on a shipping container and incorporate some type of tensile fabric roof system. This is the first initial design that I made, experimenting with the shape I could use and where some of my areas could be located.



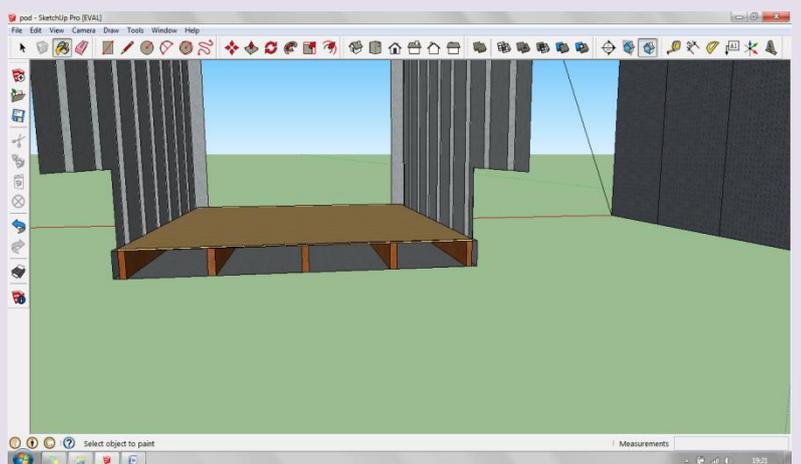
### Step 2

After creating my initial design, creating a more detailed model would be necessary to show how it would be made and where insulation etc. will be located. To do this I downloaded a shipping container from the 3D workshop and started to copy my design over.



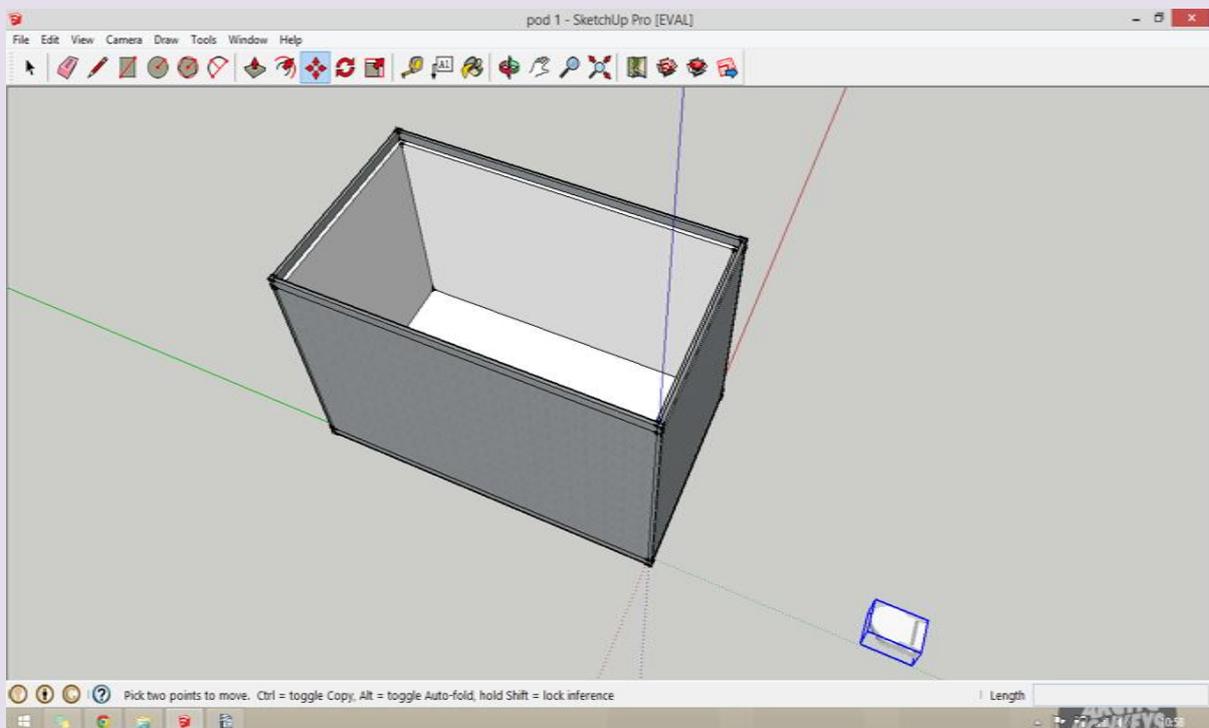
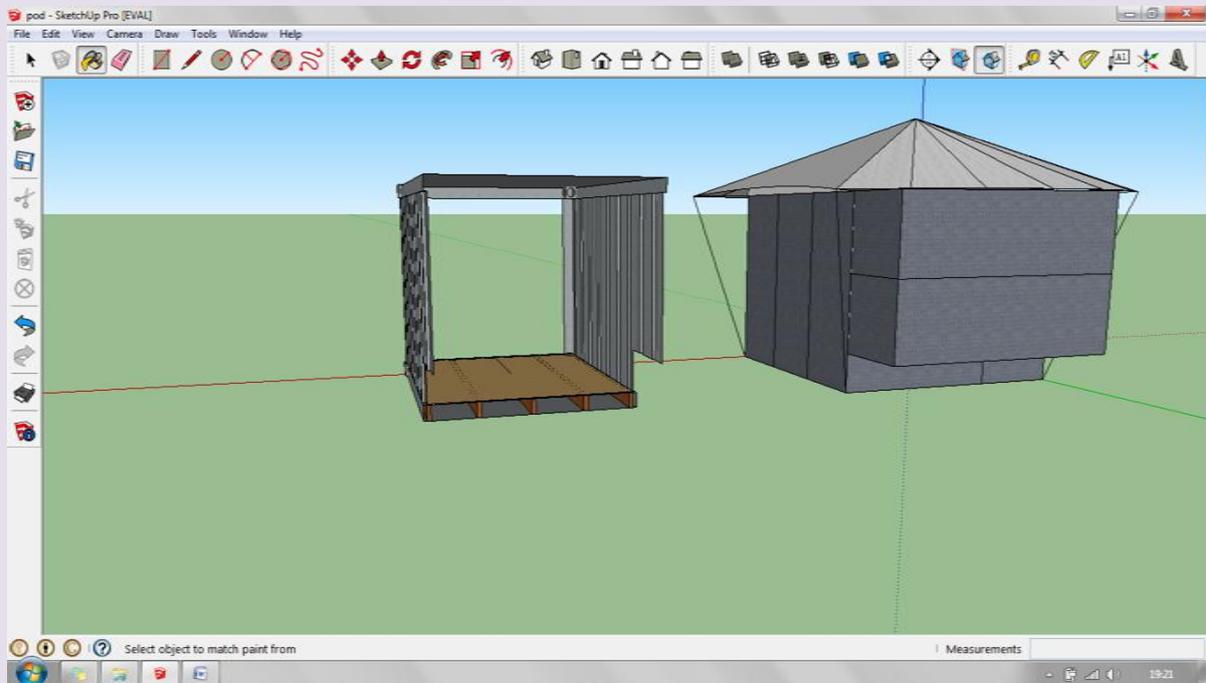
### Step 3

I then started to build up the container as it would if being really made, starting by showing how the floor would be built up.



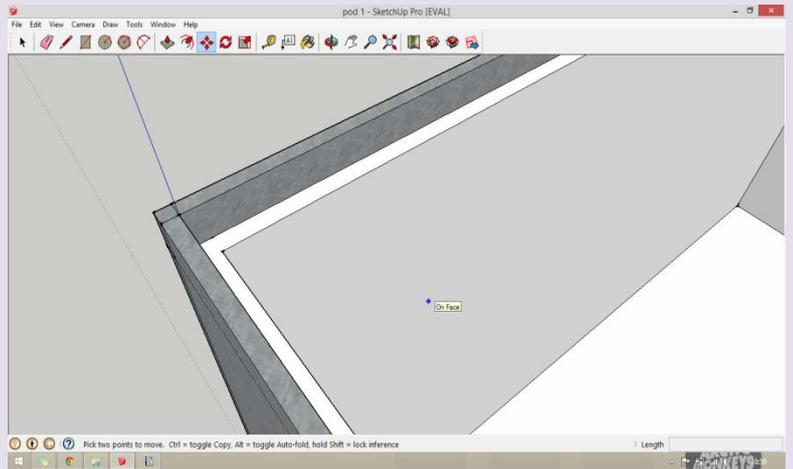
## Step 4

I found it hard to model the existing container that I downloaded, especially thinking of how the overhang at the rear would be created and what structural properties would be needed, so I decided to scrap my initial idea and the downloaded container and start from fresh.



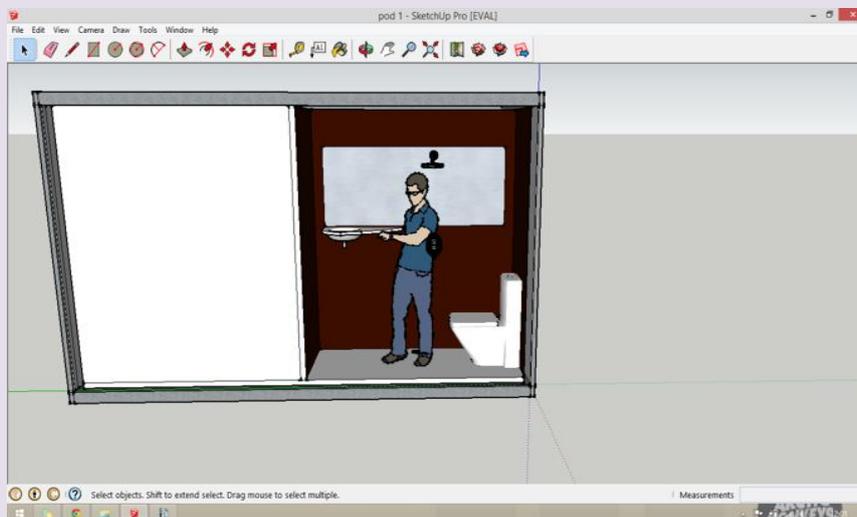
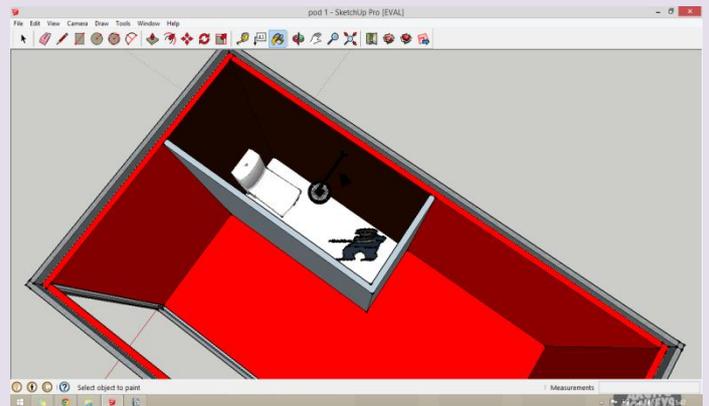
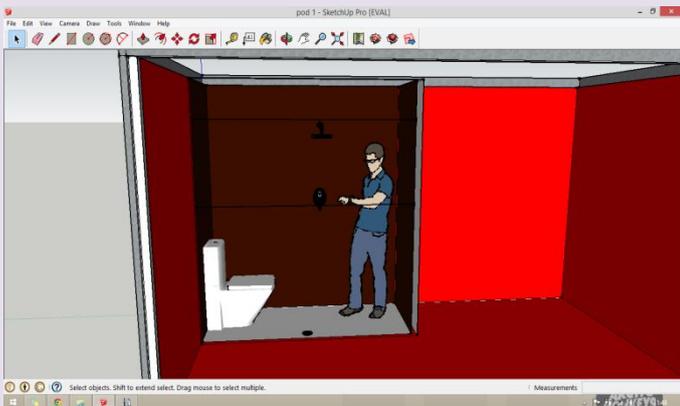
## Step 5

I built up the container using the correct dimensions and then added a layer 50mm thick, giving a 90mm void for services, plaster board and finishes.



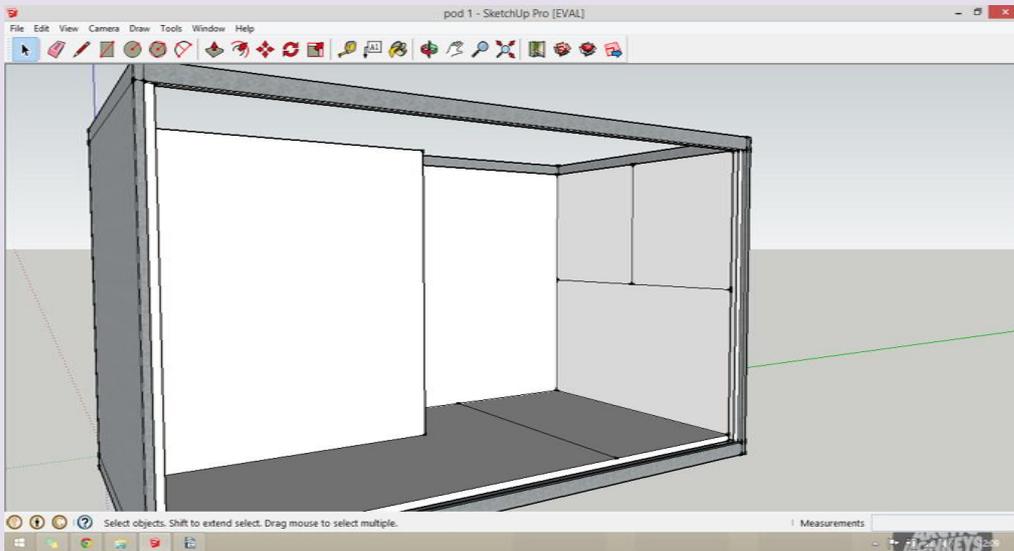
## Step 6

The first part I started to create was the bathroom; I did not have any specific dimensions that my bathroom had to be, so I created it making sure there was enough room for the door opening and the sleeping area. The bathroom is also a wet room; to save space as fitting an actual shower unit would take up more space.

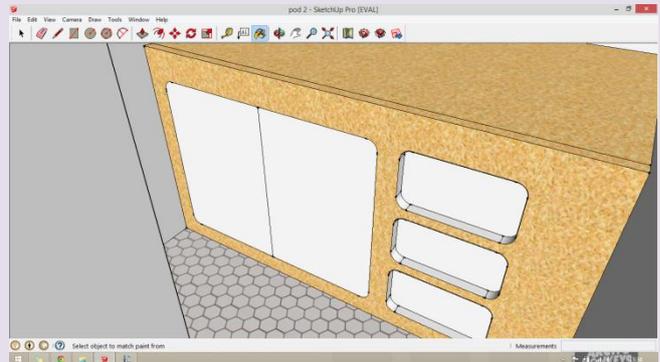
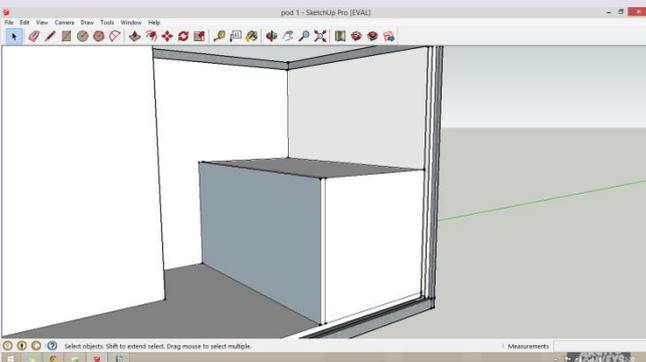


## Step 7

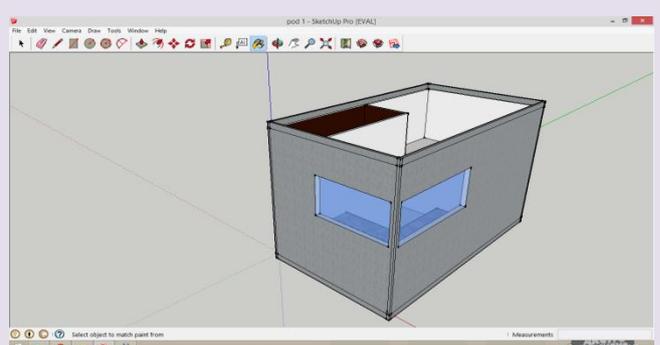
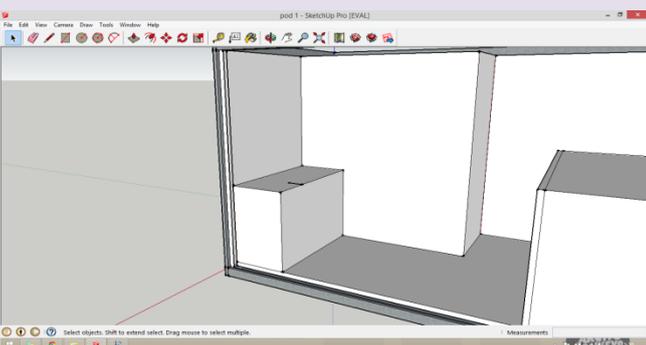
After fitting the bathroom area, the next step was to add the sleeping area and the kitchen area.



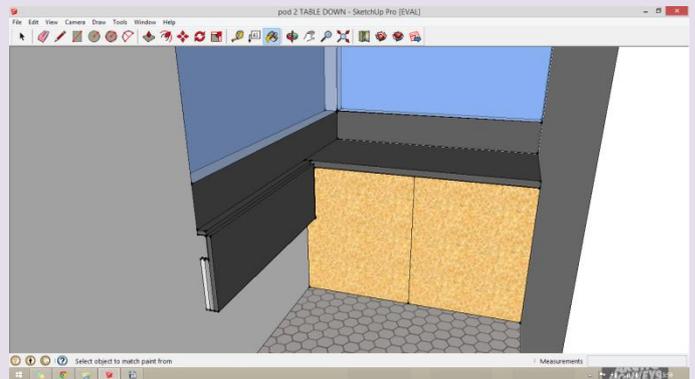
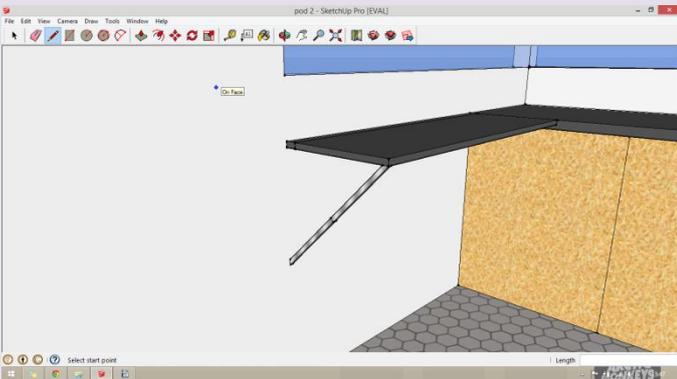
The sleeping area is raised up to provide storage space beneath yet keeping enough room to sit up.



The kitchen area will sit in the space on the other side of the room next to the bathroom, as the pod does not need to follow any rules or restrictions from building regulations or any other government document it does not matter about a bathroom opening up into a cooking area.

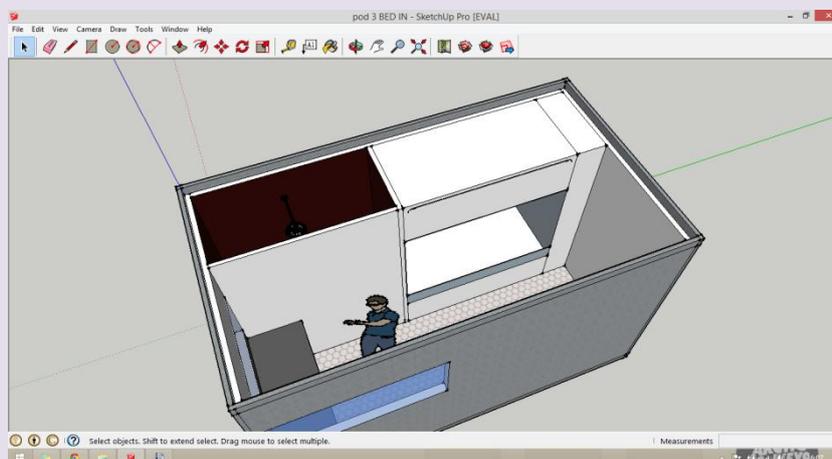
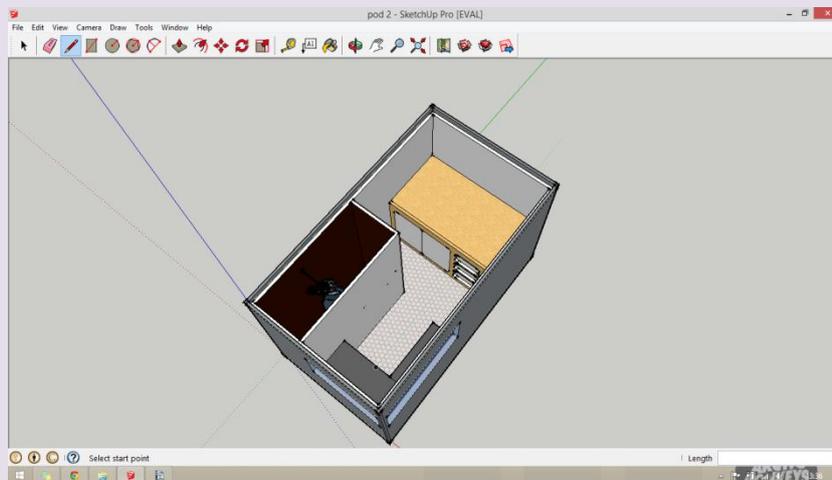


To create extra space for food preparation and eating space I added a fold up bench so floor space can still be maintained to allow as much movement as possible.



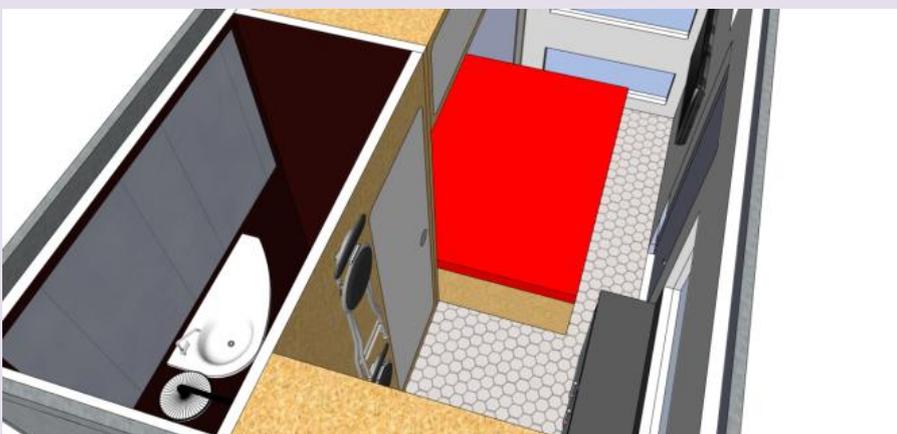
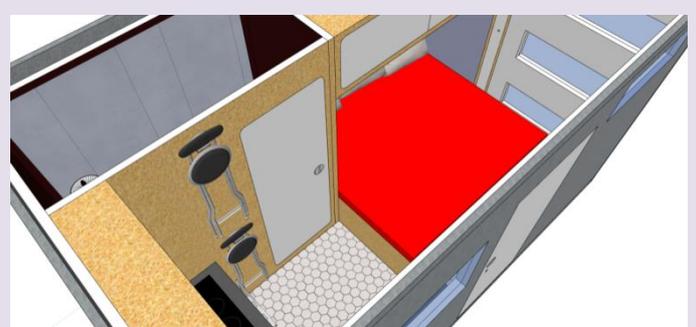
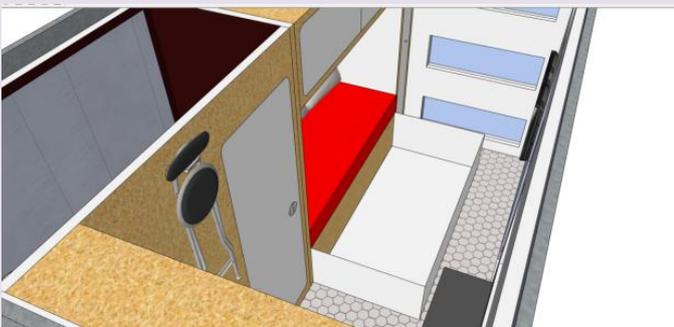
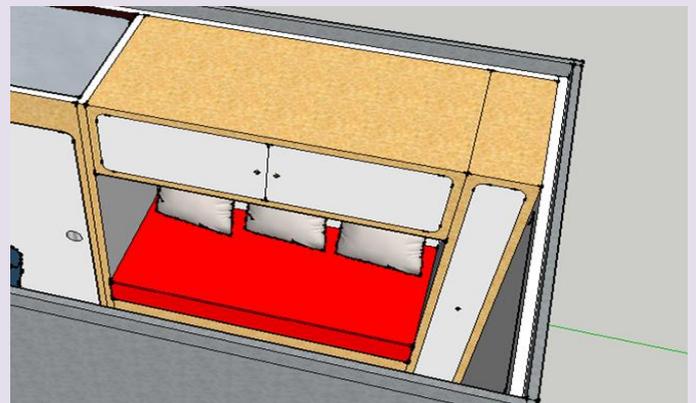
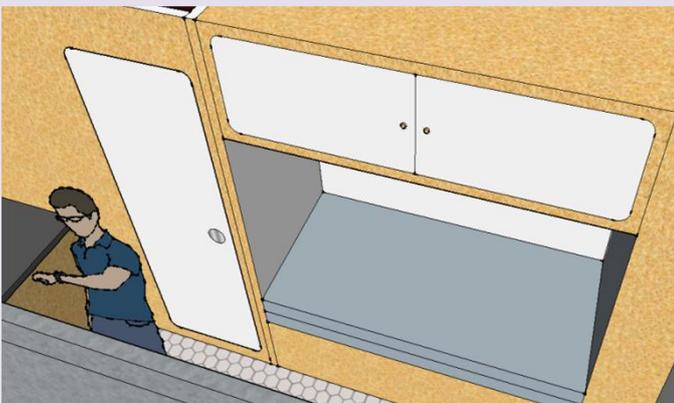
### Change in Design

I was not very happy about my design after I had created all the elements so decided to shift the sleeping area around to create a better floor space what would allow more movement and room for storage.



## Sleeping space

After looking on the internet at different types of fold away furniture, I decided to incorporate a folding bed into my design. After changing the interior lay out of my bed, I decided that the sofa could be a day bed. This is basically a single bed that can act as a sofa as well, saving space instead of having both pieces of furniture. The day bed can also fold out, seen in the images below into a double bed, if the pod was home to two occupants or if any guests came around. Also as the bed slides out it acts as a very large draw creating a good space for storage. The mattress is a double think mattress that folds down when the bed is fully pulled out. Storage also found in the two cupboards above the bed and slide out cupboard to the right. An example of an IKEA pull put day bed, where the inspiration was taken from is also show in the images below.

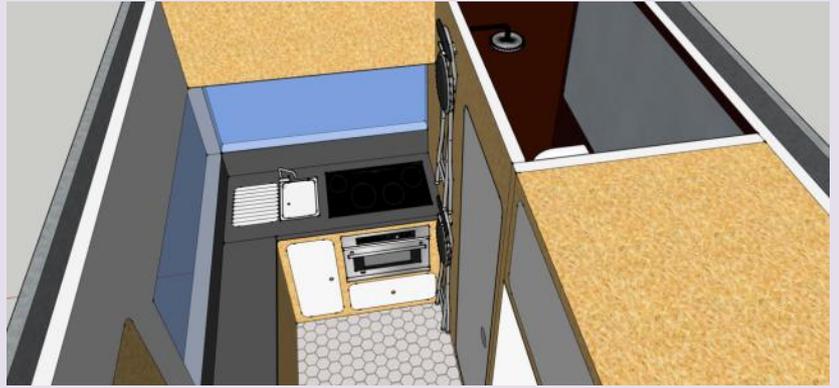


IKEA (2013) *Hemnes* [Online] Available at: <http://www.ikea.com> (Accessed date: 30/01/14)

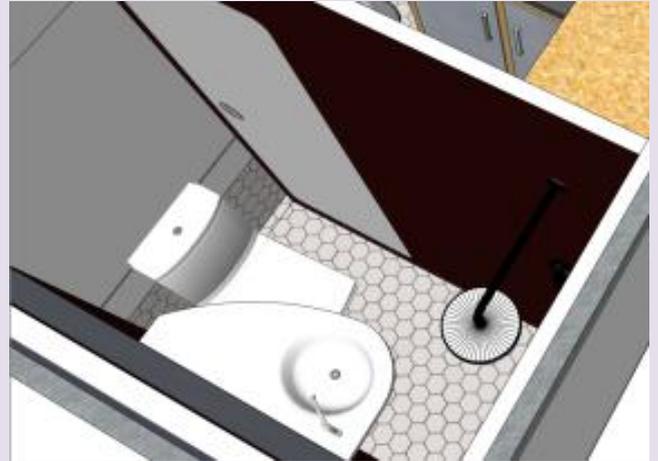
## Eating/Working space

The eating and working space is also made up of a fold away element along with the sleeping area. The smaller 30cm bench of the kitchen what holds the bespoke fridge and freezer that will be fitted in all of the pods, also has a slide out bench that can be used as a table or work bench. This allows a 60cm space that would normally be using up valuable floor space. Two folding stools are hung on the wall behind the bench, also to keep floor space at a maximum.

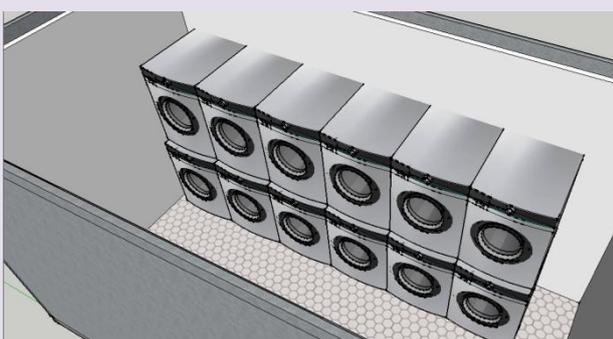
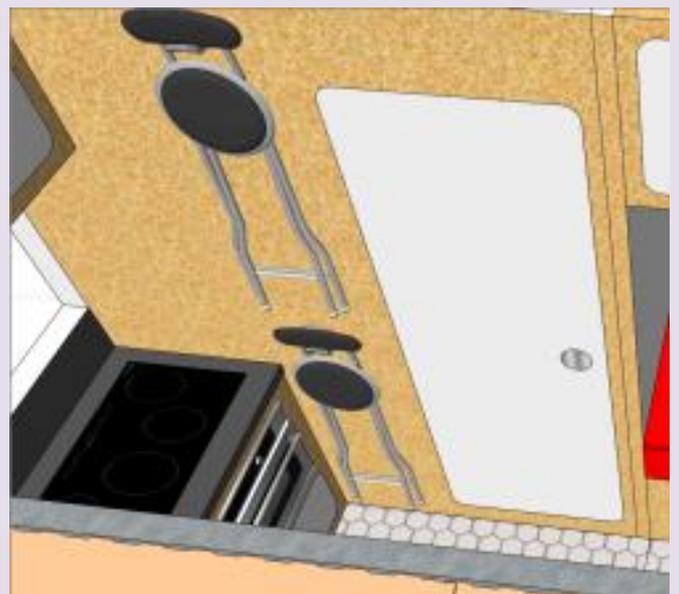
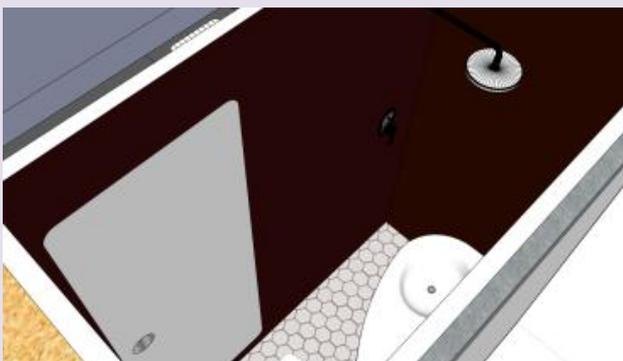
All normal kitchen appliances are still included in this small kitchen, an oven, hob, sink, fridge, freezer and cupboards. I could have saved space and made a much simpler kitchen, but I wanted to create a pod that was as similar as possible as a normal dwelling.



## Washing and showering



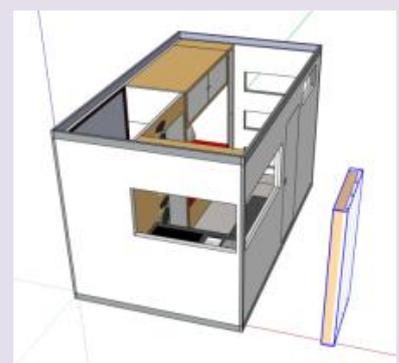
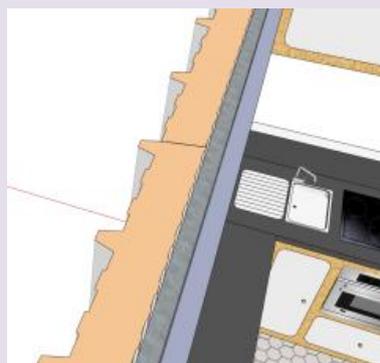
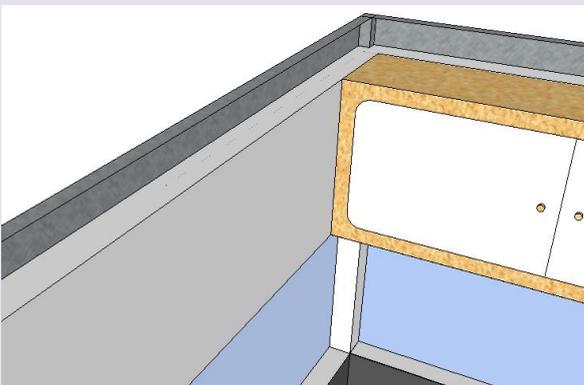
To maximise space else where I decided to create wet room as my bathroom. A wet room is a completely waterproof room with an open shower, toilet and sink included. This means the bathroom can be made smaller as there is no need to have a shower cubicle and a dry area including the sink and toilet. As the pod does not need to comply with building regulations it meant I could have my bathroom door open up into my kitchen space. The bathroom door is also a sliding door as a normal door would need a free space to move in, that could be used for something else. As it is a student accommodation and there are a few pods paced on one roof, one pod could be fitted out with just washing machines and tumble dryers for washing clothes, fitting those appliances in my pod would have taken up a lot more room.



## Ease of build

The reason I chose to use a shipping container as the base for my pod, was not because of the size but to up cycle a unwanted item. "*Upcycling is the process of converting waste materials or useless products into new materials or products of better quality or for better environmental value.*" Unlike recycling there is no manufacture process included, nothing is broken down and made into something else, making it better for the environment. The container is not 3x3m wide, the width is 2430mm and the lengths can vary, so it will still have to be cut down to size, but unlike creating a pod from scratch there is no manufacture process is included. Inside the pod, there is a void of 90mm what will include the timber studs, plaster board and any services. This is shown by a white layer on the inside of the pod as the model size would have been too large and it would have been hidden anyway. All of the pod will be built off site and manoeuvred onto the rooftop by crane. As the shipping container would have to be craned on, the rest of the pod might as well be fitted out offsite as well, to minimise difficult building conditions on site.

I decided to add an exterior insulation and cladding to keep as much space on the interior as even using a foil base or spray on insulation could take up 120 mm. Hiding the exterior of the shipping container is not very honest as the same cladding could have been added to a steel or timber frame pod, but the point in using the container, is that they are readily available items that are already built up and provide a structure for a dwelling to be built inside. The insulation and cladding is a product made by Kingspan and will be covered in more detail further in the document.



## Insulation

My original plan for insulation was to use a foil based system, where there are many layers of thin foil to make up a product that is much thinner than a normal mineral wool but can provide the same u value. Or a polyurethane spray that is sprayed on the inside of the walls and provides an insulation and water proofing, what would also be thinner than a mineral wool solution.

However both types of insulation are usually used in normal masonry construction, so the u value takes into consideration the u value of the brickwork and block work and a shipping container is made of a very thin layer of metal, so the depth of the insulation plus the timber stud work and plaster board would still take up a depth of around 120mm so it made sense to put the insulation on the exterior of the pod. The system is a product by Kingspan, KS1000 RW Trapezoidal Roof/Wall System, made up from a corrugated style metal the look of the shipping container is maintained.

Part L of building regulations state that the u value of a wall has to be 0.28 and the panels I am using with a width of 100mm provides a u value of 0.21, 0.07 lower than what is needed. Also if the container is not in very good shape it may prove more difficult water proofing it, when these panels also include a rain screen. If necessary a water proof membrane could be fitted on the inside of the pod.

Kingspan (2010) *KS1000 RW Trapezoidal Roof System*  
 [Online] Available at: <http://www.productspec.net>  
 (Accessed date: 30/01/14)

**KS1000 AWP Wall Panel**

Applications  
 Dimension and Weight  
 Materials  
 Seals and Fillers  
 Performance

**Thermal Insulation**

Panel Thickness (mm)	U value (W/m <sup>2</sup> K)
50	0.41
60	0.35
70	0.30
80	0.26
100	0.21

**Biological**  
 Kingspan insulated sandwich panels are immune to attack from mould, fungi, mildew and vermin. No urea formaldehyde is used in the construction, and the panels are non-deleterious.



Kingspan (2009) *Design Flair from Kingspan* [Online]  
 Available at: <http://www.kingspanpanels.asia>  
 (Accessed date: 30/01/14)

Kingspan (2014) *KS1000 RW Trapezoidal Roof System* [Online] Available at: <http://www.kingspan.info/> (Accessed date: 30/01/14)

**Table 2 Standards for new thermal elements**

Element <sup>1</sup>	Standard (W/m <sup>2</sup> .K) <sup>2</sup>
Wall	0.28
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.18
Flat roof or roof with integral insulation	0.18
Floors <sup>3</sup>	0.22 <sup>4</sup>
Swimming pool basin	0.25



HM Government (2013) *Building Regulations 2000, Conservation of Fuel and Power, Approved Document L*  
 [Online] Available at: <http://www.planningportal.gov.uk>  
 (Accessed date: 28/11/13)

## Weight of pod

The full weight of the pod will include, the weight of the shipping container, solar, panels, cladding and interior fittings. Together they make the fully calculated load of the pod. Going back to my first case study link I posted on my blog, one of the pods on that link is a container house, what initially showed me that it may be possible to put a fully fitted out shipping container could be put on to a roof. The type of roof also affects if the pod can be situated. Most buildings in the city will be flat roofed, but may not all be able to take the weight, a concrete flat roof is the most sensible idea, however calculations could be done on other types of roof systems to ensure that they could carry the pods weight.

The weight of a 2.44 x 2.44 x 6.1m shipping container is 2,200kg, as mine is around 2m shorter the load will minimise, with it fitted out and with the insulation/cladding panels attached it will be over.



FPS Architecture (2009) *Rooftop Home Addition in Buenos Aires* [Online] Available at: <http://weburbanist.com> (Accessed date: 03/02/2014)



FPS Architecture (2009) *Prefab Rooftop Buildings*[Online] Available at: <http://weburbanist.com> (Accessed date: 03/02/2014)



Kosmograd Newsfeed (2010) *In the box* [Online] Available at: <http://newsfeed.kosmograd.com/> (Accessed date: 03/02/2014)

## Cost of the pod

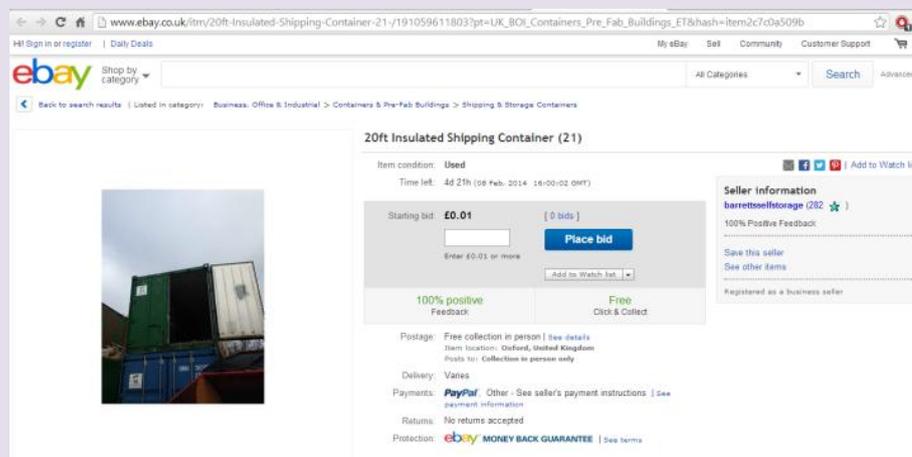
Trying to keep the cost down on my pod simply means that if it is cheaper to build, then it will be cheaper to buy or rent for the student users. A 20ft shipping container that can hold one pod, with a small amount of waste material that could be used in the pods manufacture, recycled into another product, or up cycled, can be bought from £20 pounds or bid on from anything from a penny upwards from the site eBay. A vast search will not be done to find the best and cheapest container as the proof that they are relatively cheap has been shown.

As my pod is not a normal dwelling, a lot of its furnishings will be bespoke made to certain sizes. This may cost a little extra, however a lot of money has been saved on the purchase of the container. As I will mention under the material choice section, I am going to use plywood as one of my interior choices to create a contemporary environment that can be customised by the students easily. The other benefit of using plywood as a material choice is that it is an easy to get cheap material that is easy to manipulate and build together with timber battings, meaning bespoke sized furniture can be made on a budget.

The bulk of the cost will be on the insulating panels by specialists from Kingspan, the price will include the measuring and cutting the panels to size and then getting fitted, it may not be job that could be done by general contractors.



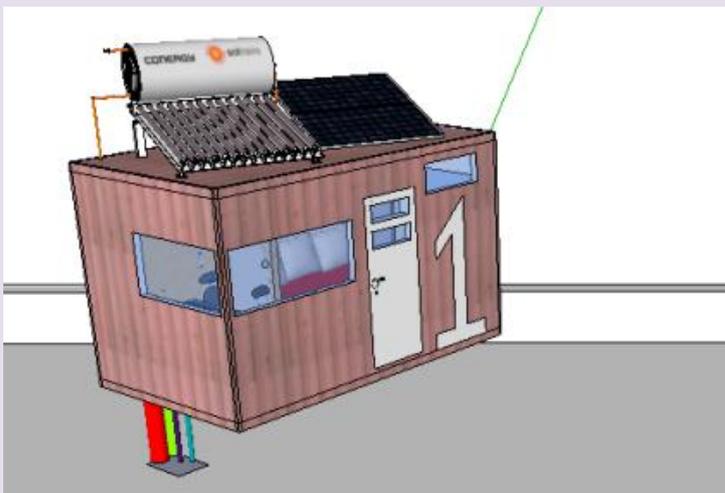
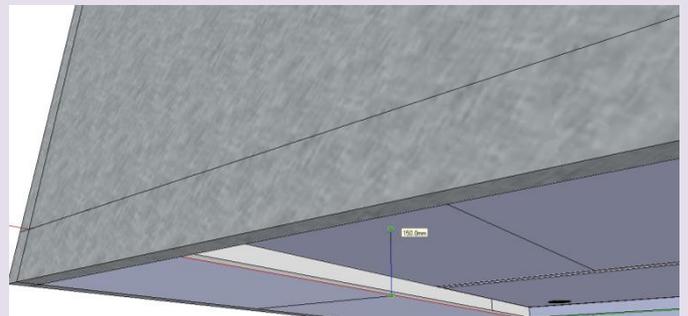
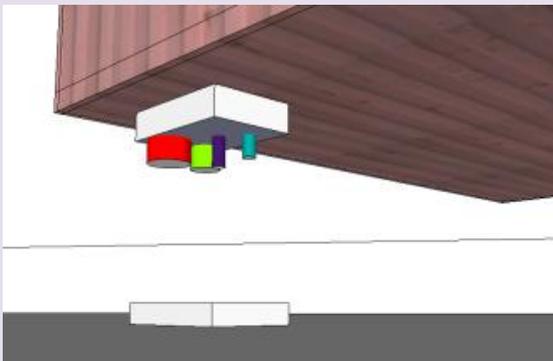
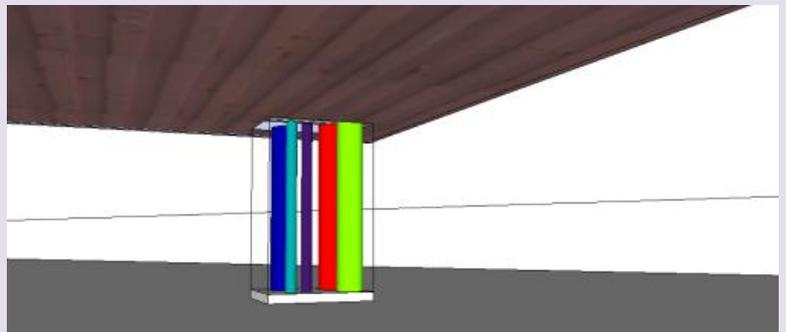
Ebay (2014) *KS1000 20ft Shipping Container* [Online] Available at: <http://www.ebay.co.uk>(Accessed date: 04/02/14)



Ebay (2014) *KS1000 20ft Insulated Shipping Container* [Online] Available at: <http://www.ebay.co.uk>(Accessed date: 04/02/14)

## Services

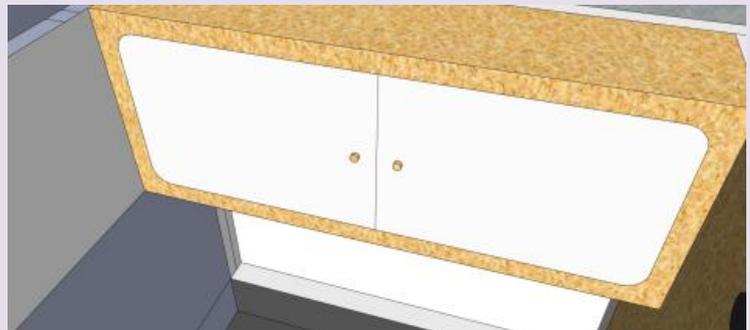
When designing the layout of my pod I tried to keep all the main services to one side of the pod to minimise the path of services to the exit point under the floor to the corner underneath the bathroom area. The pod has two types of solar panels on its roof, one to heat up water for washing and the other for electricity to try and power the pod as much as possible. However with no accurate calculations the two solar panels may not be enough for full use, so mains services have been added. The idea I had to connect the services was by a coupling system. On the bottom of the pod all the services are grouped together in one area. Then on the face of the roof the same collection of grouped services are on show. Therefore when the pod is craned into position, it is lowered down for the services to meet up. The roof will have to be set up previously to the pods been lifted in, what does create on site labour, but compared to building of the pod, that is all done offsite.



## Material choices

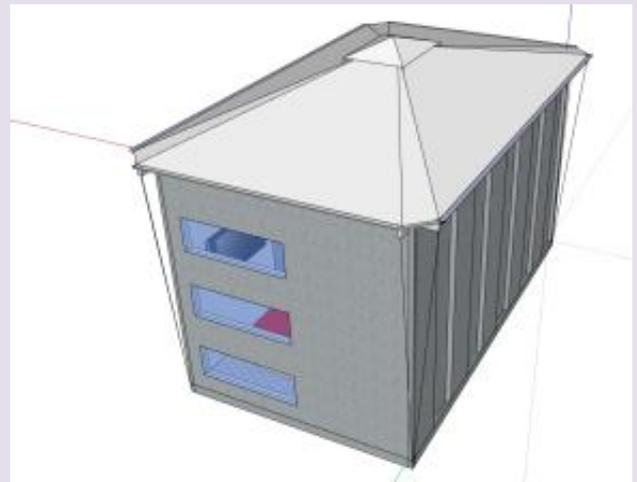
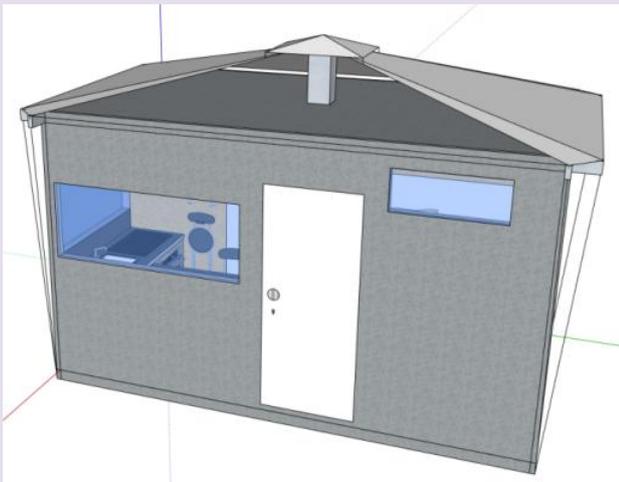
As I explained with the external cladding, I chose an exterior cladding that was made up of a metal skin to keep the pod looking like a shipping container. It may look quite brutal, just been made up of metal however, different colour panels can be chosen to make each container stand out and different unique colour schemes could be designed for each individual user.

Internally the pod needs a layer of stud work on the walls, floor and ceiling to create a void for services and to create a better aesthetically pleasing finish like in a normal house. After looking at some case studies of pods and various different interior designs I have decided to keep a plywood and white finish within the pod. As well as keeping a contemporary feel within the pod it is a very cheap material, so finishing each pod will not be an expensive job, even with the bespoke fittings as the material is also easy to cut and shape. I modelled the pod using OSB as it was already in the paint pallet, for the final renders a plywood finish will be applied.

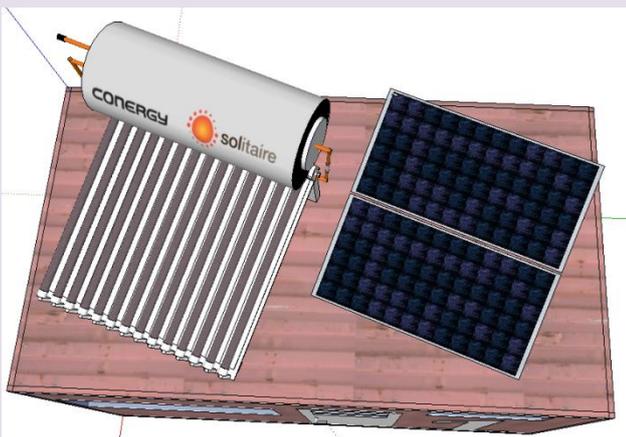
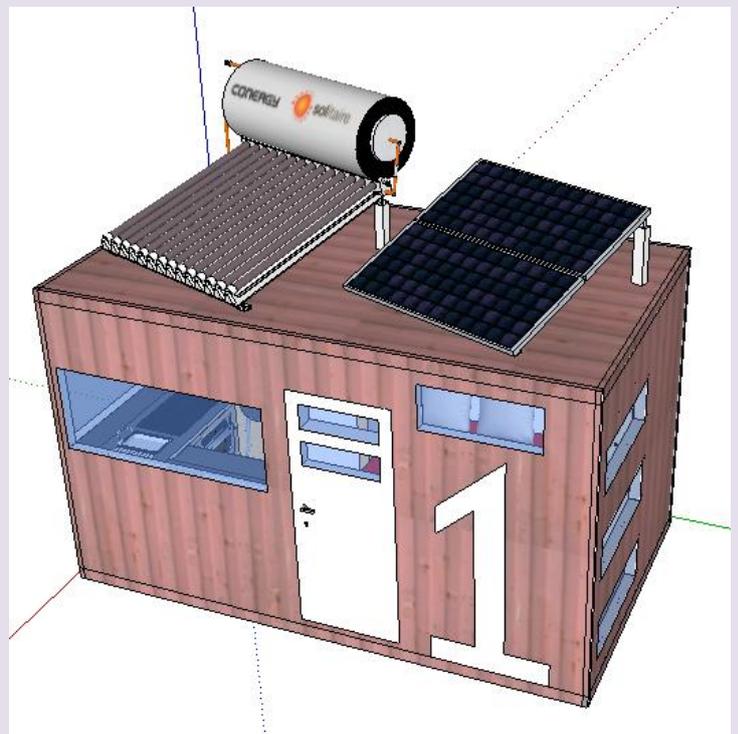


## Roof System

My original plan for the roof design was to have a tensile fabric system, to repel the water from the roof and provide a loft space underneath for extra storage. However after initially drawing the design up on sketch up it started to cause more problems of how it would structurally stand up, how the loft space would be accessed and where the water would flow to, making me design guttering systems etc. So I decided to just keep it simple and use the same Kingspan panel system as used on the walls as there is a roof version of it, of 120mm with a u value of 0.18 what meets the requirements of the current building regulations for a normal dwelling. I also decided to add solar panels to the roof to power as much of the pod as possible, one photovoltaic for electricity and one solar water heater.



Kingspan (2010) KS1000 RW Trapezoidal Roof System [Online] Available at: <http://www.productspec.net> (Accessed date: 30/01/14)

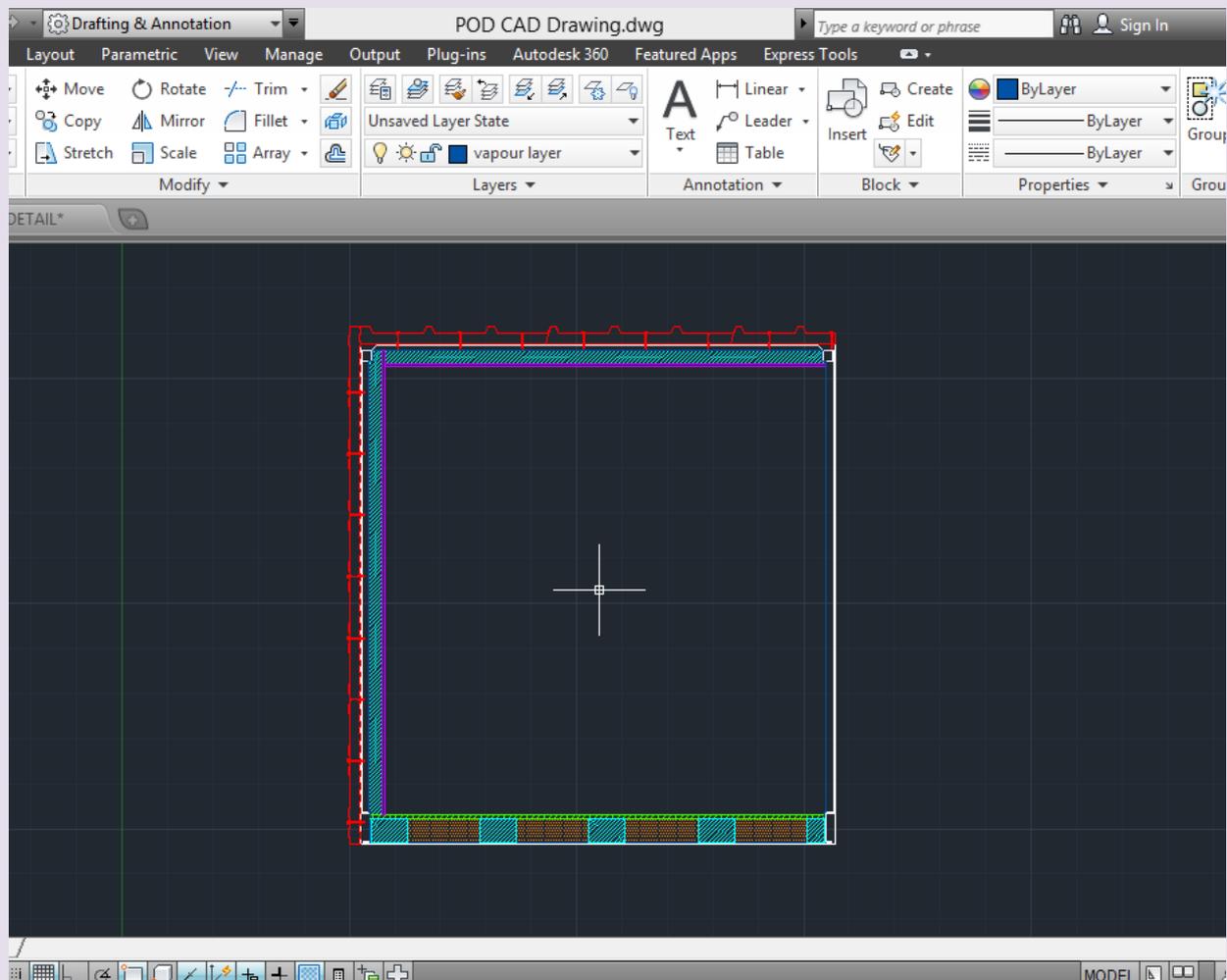


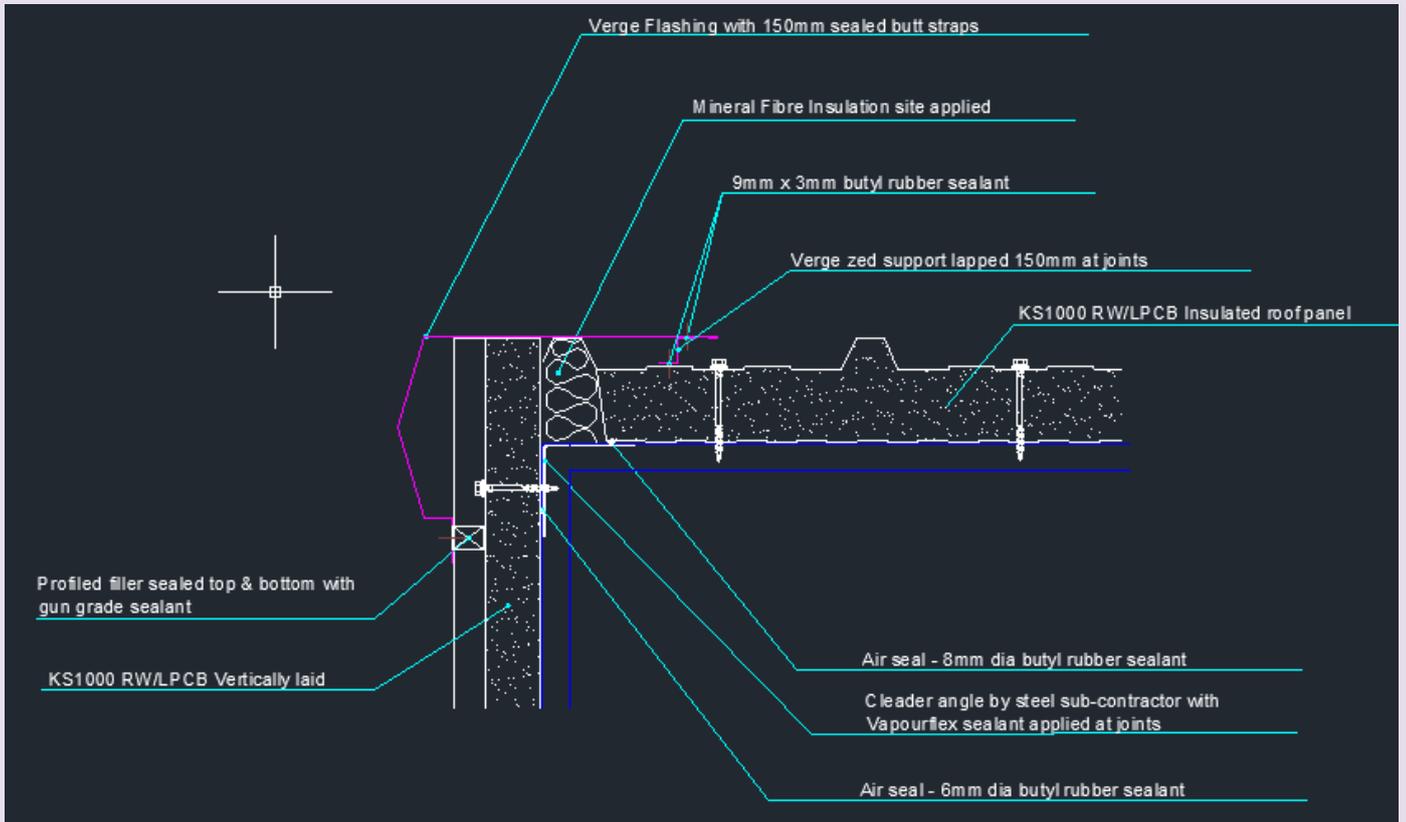
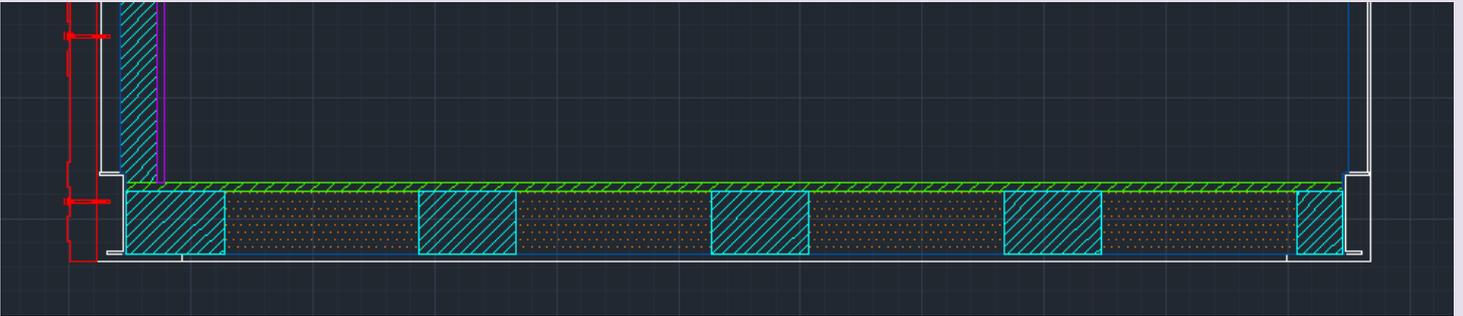
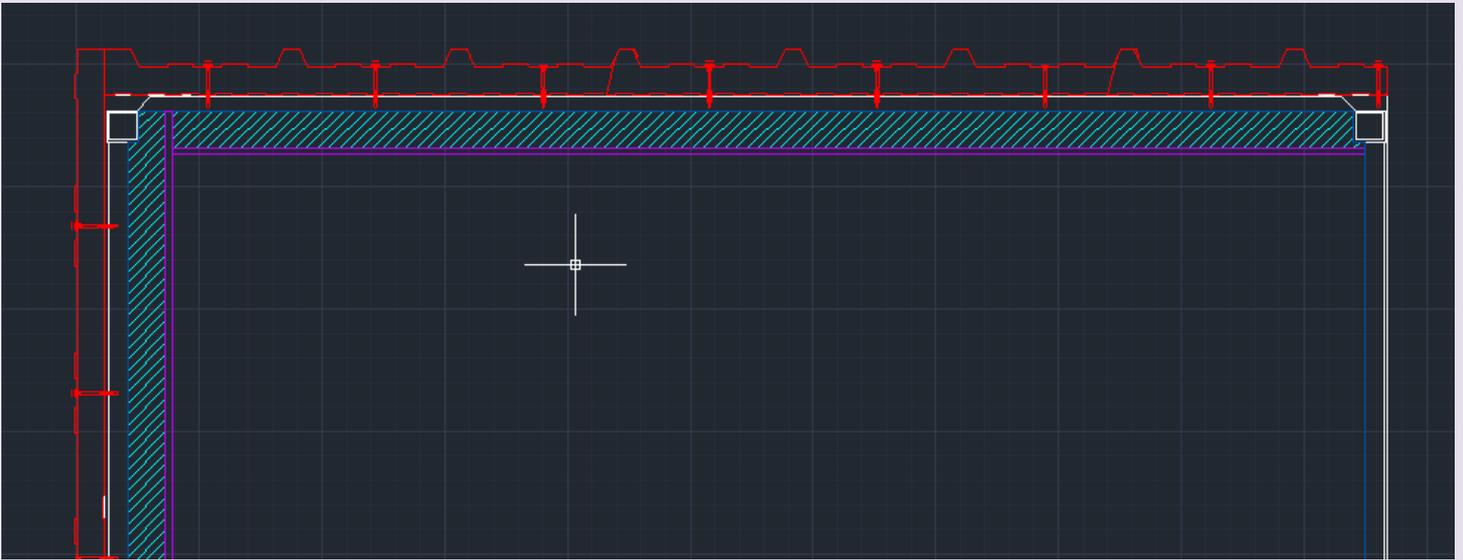
## Detailing

The details of my pod have been made on Auto Cad and they show the roof, eaves, floor and wall elements through a section of the end of the building. The main cad drawing is shown below with closer up labelled drawings below it.

### Key:

- White lines show the build up of the container.
- Dark blue line represents a vapour barrier that covers all of the inside of the container, taped at the joints.
- Red line represents the Kingspan Trapezoidal roof and wall panels with insulation.
- The light blue hatched line shows the timber stud work crating the service void and to hold the plywood finish.
- The purple line shows the plywood attached to the timber stud work.
- Green hatched line shows the floorboards.
- Orange hatched line represents the mineral wool insulation between the floor joists.





Kingspan (2010) *KS1000 RW - Verge Detail* [Online] Available at: <http://www.kingspan.co.uk> (Accessed date: 04/01/14)

## Renders

