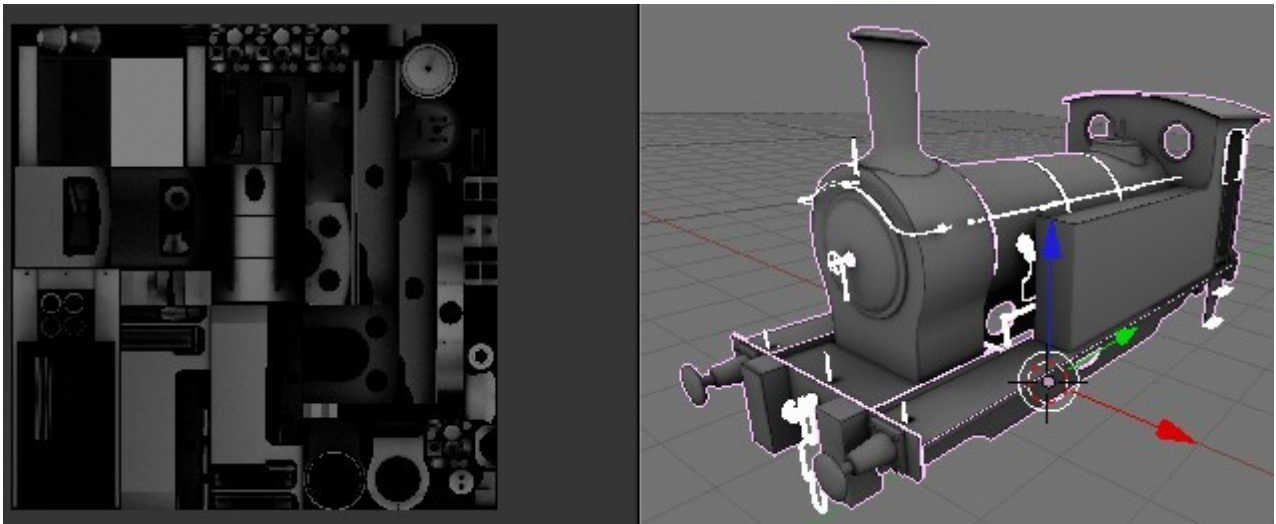


# A Blender Tutorial

## Building a Simple Loco Part 2 Mapping and Texturing © Paul Hobbs 2008



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## What is Mapping?

Put simply, it is defining what areas of the skin (the bitmap that controls the colouring of the model) are 'mapped' to which faces. This has to be done in order to export the model to Trainz, so it is the next logical step after creating the mesh.

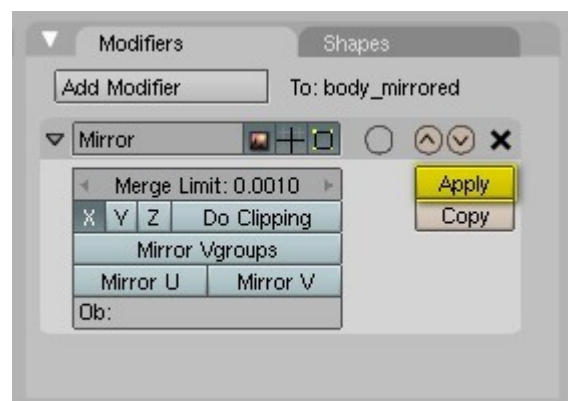
Probably the most efficient way to tackle this is when building the mesh, as the mesh needs to be prepared with mapping in mind.

In this Tutorial I shall be assuming that you have read and worked through the first one.

## A Practical Example Using Auto Mapping

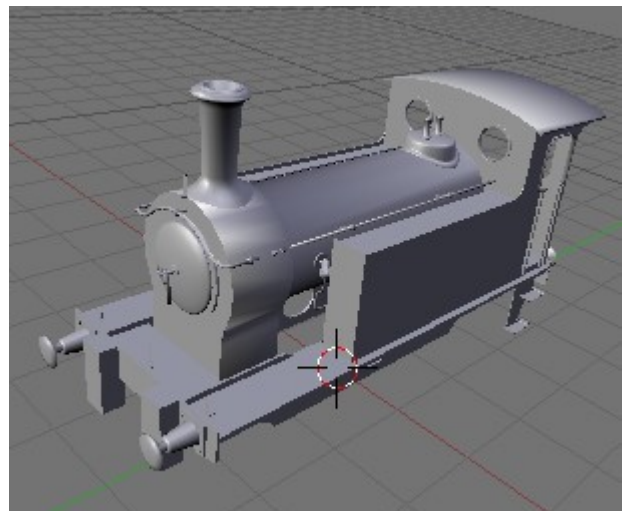
We'll use the LNER Y7 that we built in Part 1 to demonstrate auto mapping. This model is available [here](#).

Some of the objects are mirrored and we need to apply the mirror modifier to each of them so that the right hand side of the mesh can be mapped. If we don't do this only half of the mesh will be mapped with the mapping mirrored to the right hand side. This would mean that any weathering for example will be identical on both sides which is probably not what we want.

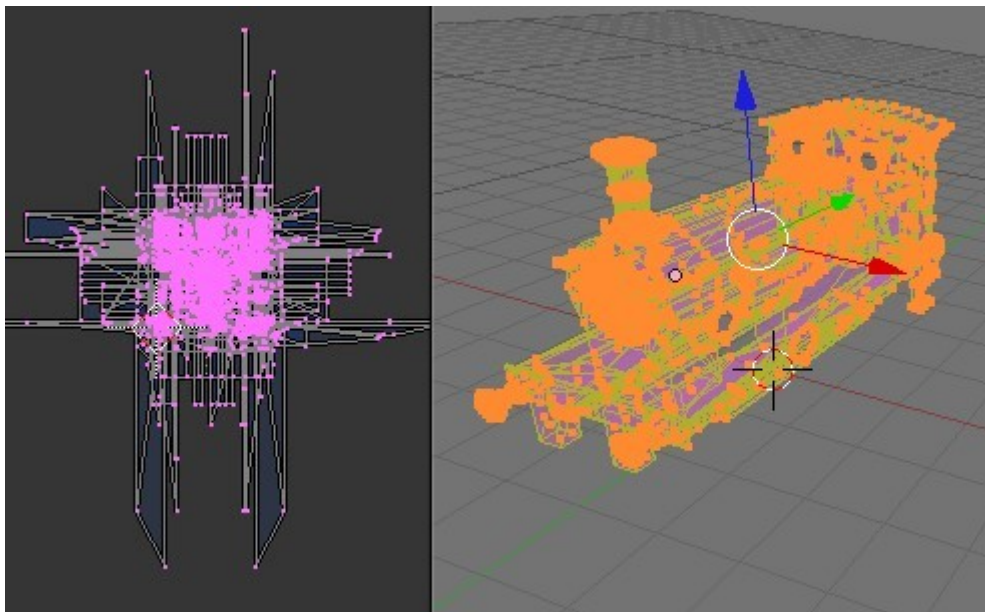


This is what we'll be mapping, the loco body. I've moved the surface detailing such as rivets and boiler bands into an new object called 'sd' as these will be added in the normal map later.

The rest of the mesh objects have been hidden and the mirror modifiers applied – and what you see here has been joined into one mesh object called 'body'. The model in this condition can be downloaded [here](#).

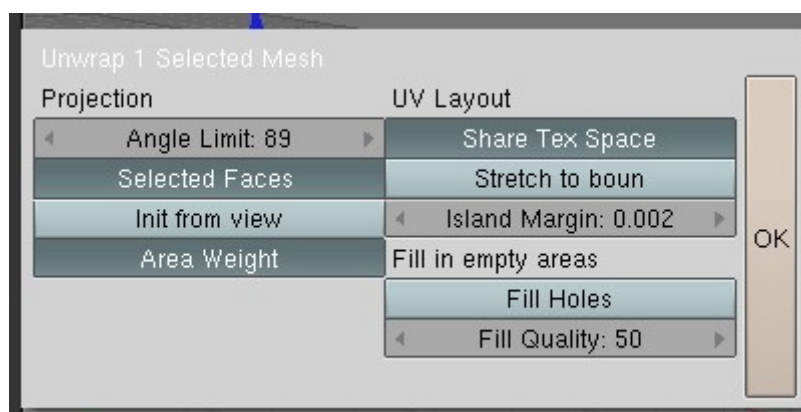


Split the 3D window and change the window type of the new window to 'UV/Image Editor'. Select all the faces of the 'body' object, press U (the mouse cursor must be over the 3D window) and choose 'Cube Projection' from the menu.



As you can see the mapping shown in the U/V Editor window is a complete mess – don't panic.

Now press U again and choose 'Unwrap (smart projections)' from the menu. Change the options to those shown here and hit OK.



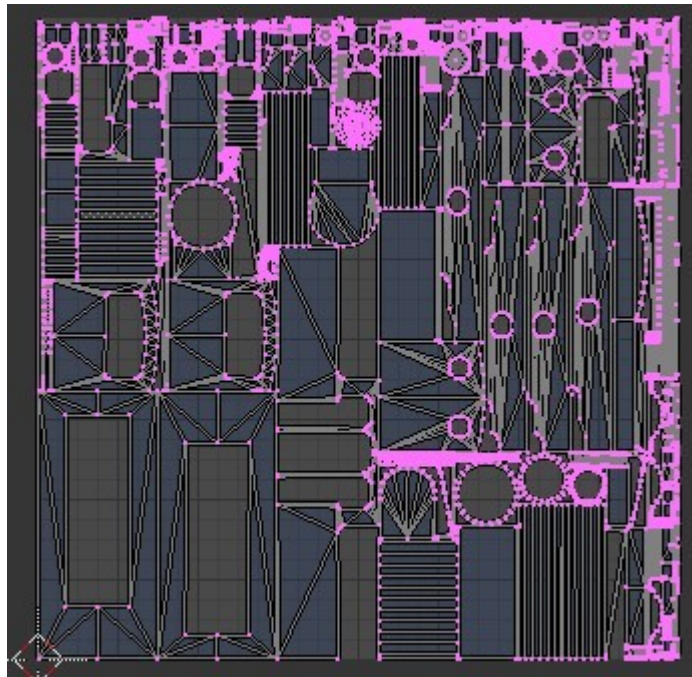
A few remarks on the settings – setting the Angle Limit as high as it will go (89) tends to create fewer islands. The 'Island Margin' separates the islands slightly which I find helps when texturing. 'Stretch to bound' (sic) should be deselected to avoid distorting the mapping.

Unfortunately repacking the UV map afterwards looses the space between the islands which can create problems later with visible seams in the rendered skin. Despite this the auto mapper is useful for creating a result quickly and is very good for models that don't have lots of curved surfaces such as buildings or a typical UK steam loco tender.

The mapping has now been auto-arranged in a pretty efficient manner (try this in Max and see what you get...). Note that the relative sizes of the islands have been retained.

For more efficient packing you can try turning on the 'Fill Holes' option in the 'Unwrap' window, but be warned, on a mesh this complex it could take 10 minutes or longer depending on the specification of your computer. I also haven't had much luck with this option anyway.

I tend not to use this as I would rather optimise the mapping manually.



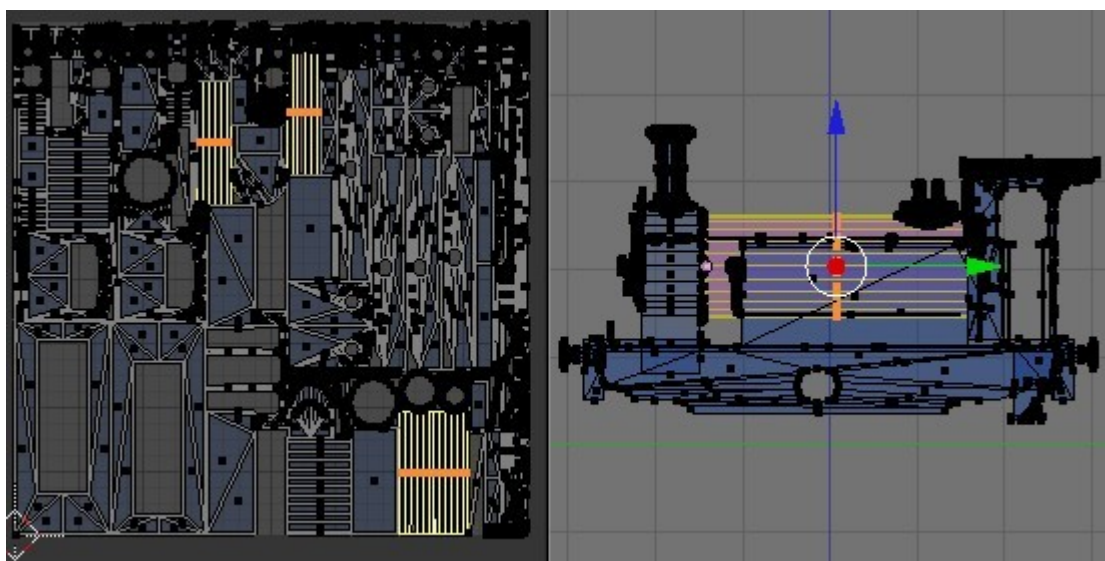
## Optimising the Mapping

A disadvantage of the auto mapping is that objects like the boiler tend to get split up and land in different areas of the map which makes life difficult when you come to create the texture. If for example you want lined boiler bands in the texture then ideally you want the boiler to be mapped to one rectangular area.

A useful icon to have selected is the one highlighted in the picture below, 'sync UV and Mesh Selection' which selects the UVs of the faces selected in the 3D window.

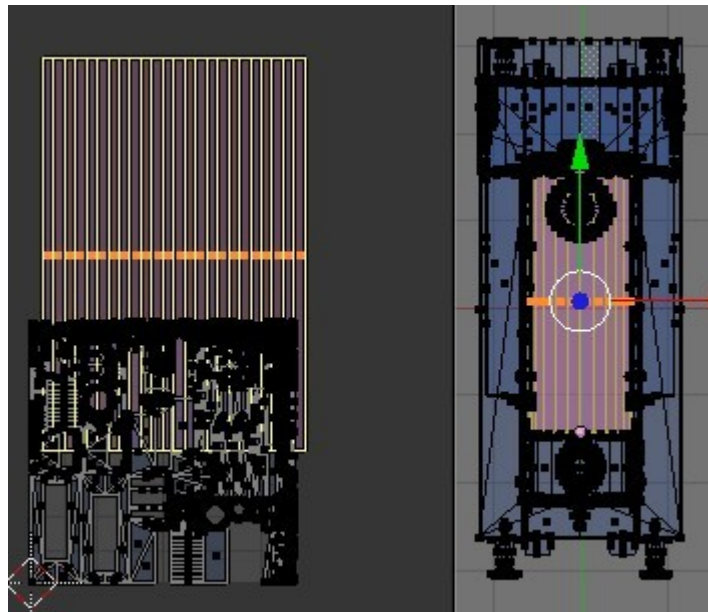


To see why this is so useful click on it to select it and then in the 3D window select the faces that make up the boiler barrel. As you can see the UVs for the boiler are scattered over the map.

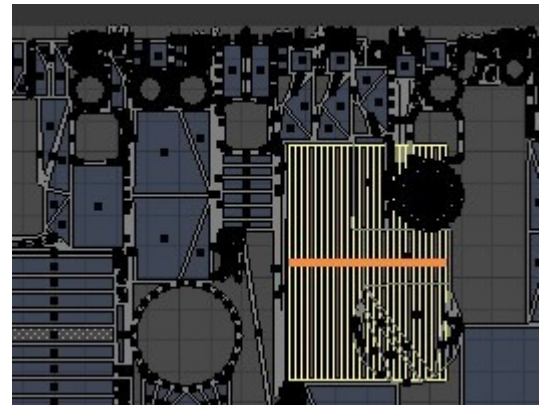




To optimise this switch the 3D view to Top Ortho (press 7 and then 5 if needed to get an Ortho view) then press U with the mouse cursor over the 3D window and choose 'Cylinder from View'.



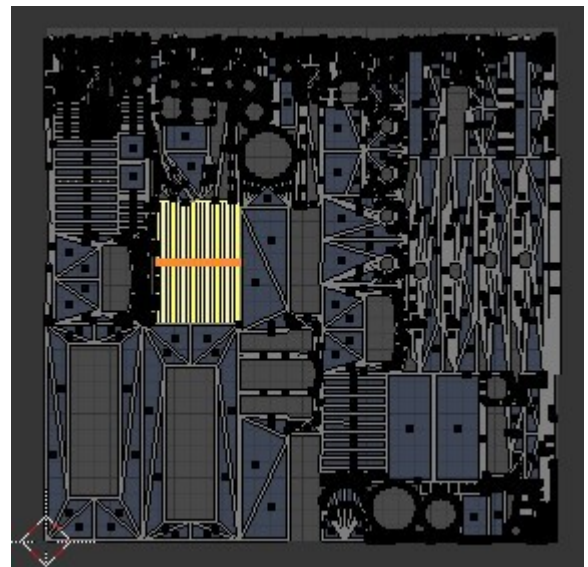
The boiler has now been mapped to a single rectangular area. To make the new mapping for the boiler the right size select all the faces and hit CTRL-A with the cursor in the 'UV/Image Editor' window. This rescales the selected UV maps depending on their relative areas in the 3D window.



Now with the mouse cursor still over the 'UV/Image Editor' window press CTRL-P. The islands are repacked as shown here (this may take a few seconds). You'll lose any spaces between the islands after doing this though.

I've reselected the boiler barrel faces so that you can see where the mapping lies now. **Note that the whole map has been rearranged, therefore you need to do the optimisation before you start painting the skin.**

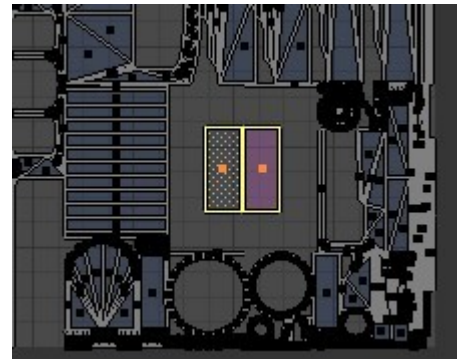
Objects that benefit from this optimisation would be anything that is round or curved, for example the buffers and the smokebox wrapper.



Despite the 'need' for this optimisation – and it may not even be needed at all for some models – the auto mapping function does about 90% of the work in laying out the map.

Another optimisation that we can consider is reducing the size of islands that will not be easily seen on the finished model such as the inside faces of the side tanks. This allows more texture space for things that can easily be seen. Here I've selected the two faces and scaled them down by 50%.

Selecting all the faces and pressing CTRL-P will repack the map again.



The islands can be selected, moved around (key G) rotated (key R) and rescaled (key S) just like mesh objects to make better use of the space. To select an island we can select a face and press CTRL-L, or use the new 'Island Select' mode introduced in version 2.48 (highlighted in the following picture, right click to select a whole island).



## A Suggestion For Optimal Mapping

Having said all that and having mapped a couple of locos in Blender now I wouldn't do it quite as described above now. I recommend separating the main surfaces from the model and auto mapping and arranging these first. All the other bits and pieces are fitted in afterwards where space can be found. The advantage of this is that the major parts of the model all have the same texture resolution and that the largest proportion of the texture is devoted to the most important surfaces.

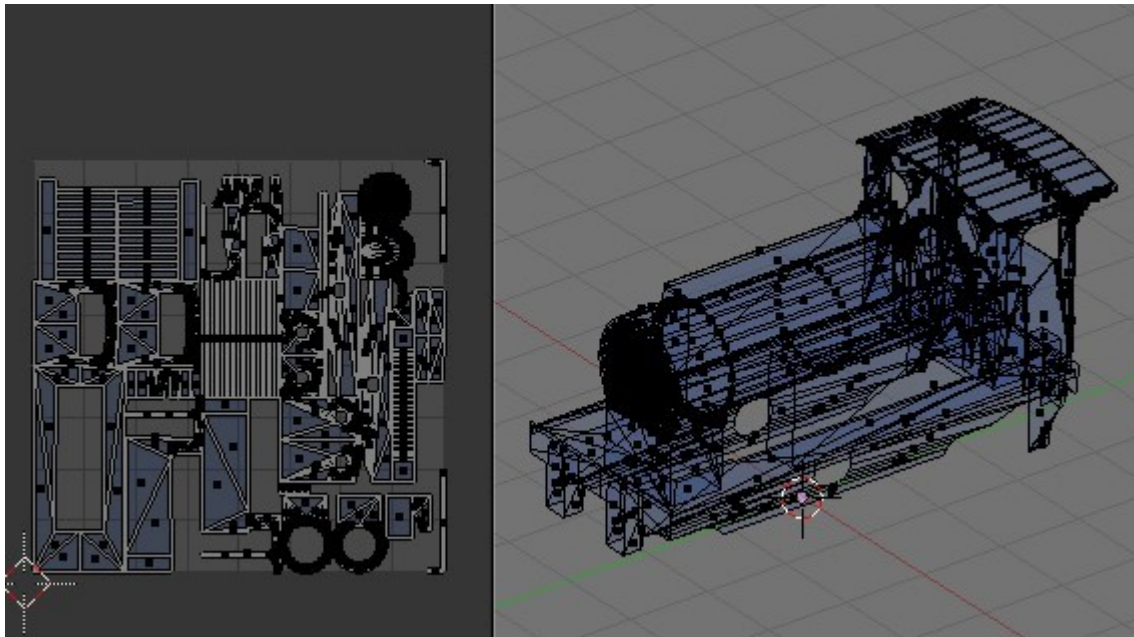
In the case of the Y7 the main surfaces would be the tank sides, fronts and top, the cab front and rear, the cab roof (inside and outside), the cab interior and floor, the outer surfaces of the buffer beams, dumb buffers and mainframes, the smokebox, smokebox door and boiler, the upper surface of the footplate and the outer surfaces of the valances and step backplates.

In the case of other locos I would also include the splasher sides and tops, any sandboxes on the footplate and the bunker rear and inside surfaces.

When selecting flat surfaces (as most of these are) the hotkey CTRL-SHIFT-ALT-F is useful. To use this select one face and then press the hotkey.

Here's the unwrapped body with cube mapping for all the surfaces except the boiler barrel which has a cylinder mapping applied (in the top view). The auto mapping as described previously has done a good job of arranging the map and there is plenty of space left over for the mapping of the smaller details and less important surfaces.

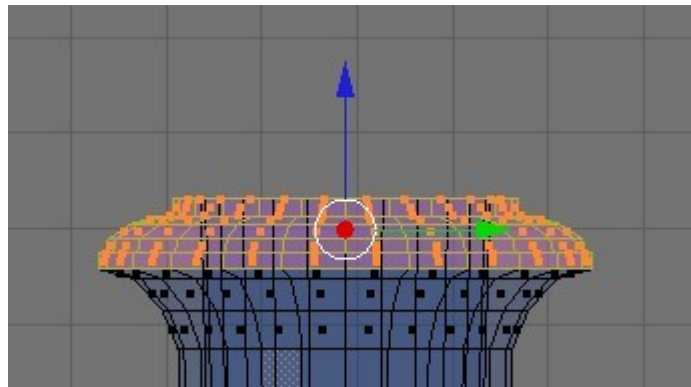
When building the model it pays to make sure that no faces are included that will be covered up by something else, for example the smokebox front should have a hole in it behind the smokebox door to avoid wasting texture space.



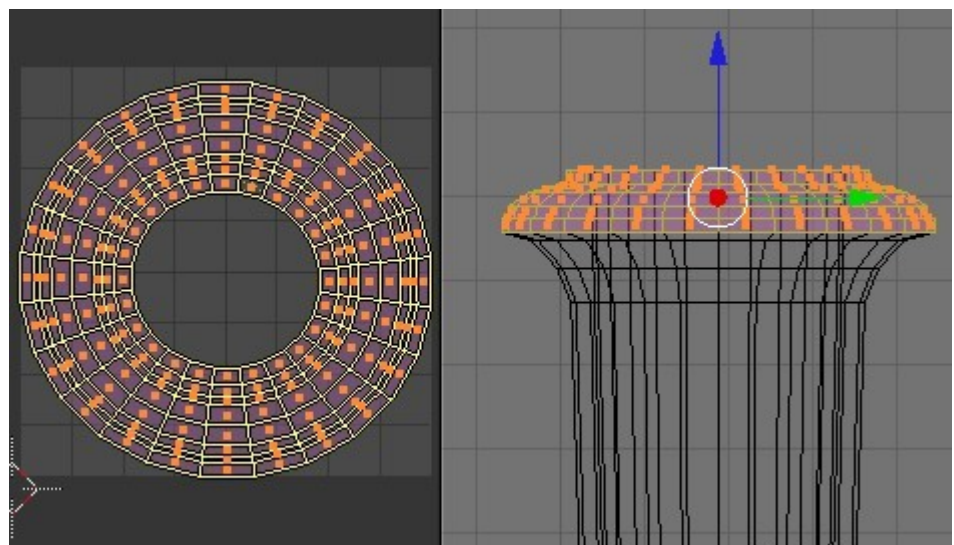
The model with a little manual optimising of the mapping is available [here](#). **Note that the mapped faces are on layer 2, the rest of the mesh on layer 1.** All that remains is to map the rest of the mesh and arrange it on the UV map...

## Marking Seams and Unwrapping

A handy function for dealing with the mapping of the detail parts is 'Unwrap'. To demonstrate this we'll unwrap the chimney. It's easier to split the chimney into three components for mapping, the cap, the inside and the outside. To map the cap select the faces belonging to it in the front or the side view and split it from the mesh by pressing P.



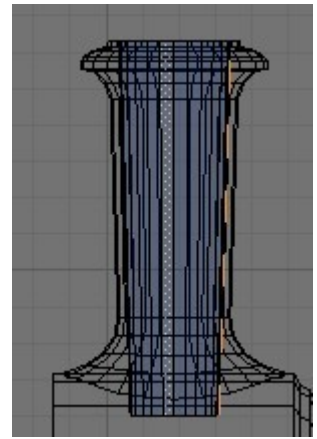
With the faces of the cap selected and the mouse cursor over the 3D window press U and choose 'Unwrap' from the menu. The cap now looks as though it has been flattened in the UV/Image Editor window as shown here.



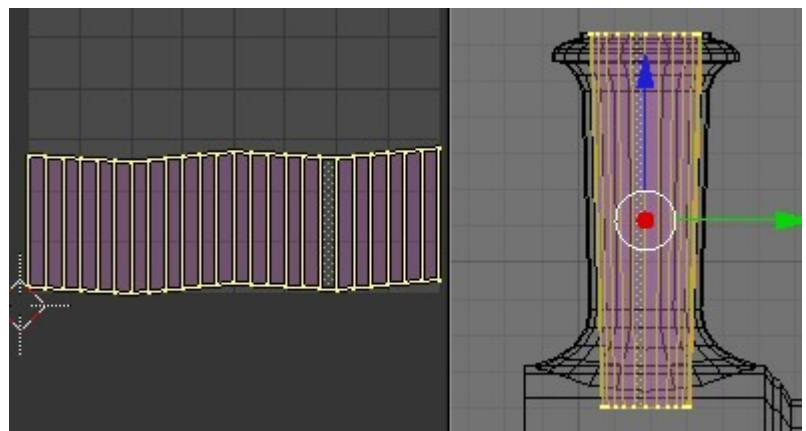


Now select one of the faces on the inside of the chimney and press SHIFT-CTRL-ALT-F to select the rest of the linked faces. Split these from the mesh with P. Now select an edge to define as the seam (this is where the mesh will be divided for the purposes of unwrapping) and press CTRL-E and choose 'Mark Seam' from the menu. The selected edge will turn orange to show it is a seam.

It's a good idea to position the seam where it will not be too obvious in case the texturing highlights it.



Select all the faces belonging to the inside of the chimney and unwrap it.

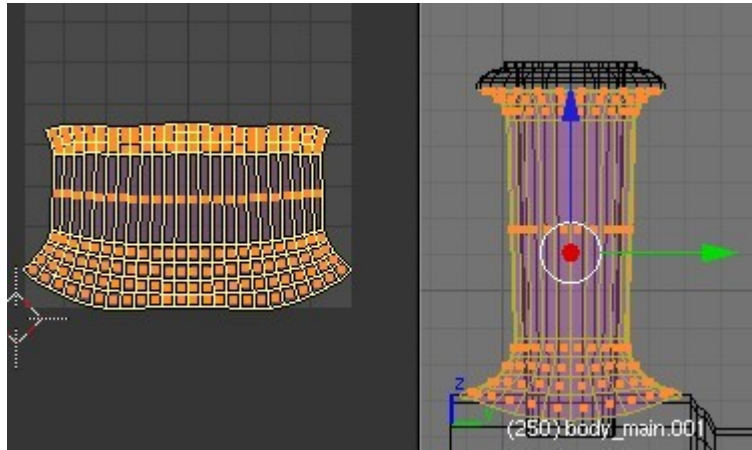


The wavy edges can be tidied up by selecting the vertices in the UV/Image Editor window and pressing W and choosing 'Align Y' from the menu. **Make sure that the two highlighted icons are selected!**

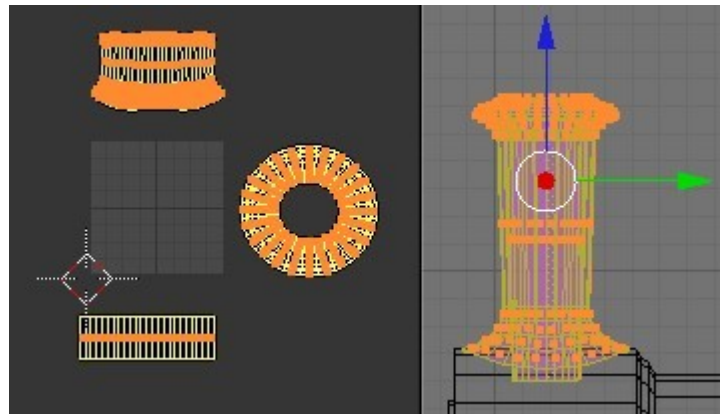


In a similar manner mark the seam for the outside of the chimney and unwrap it.

All we need to do now is scale the UV maps down to fit and find a suitable place on the map for them.

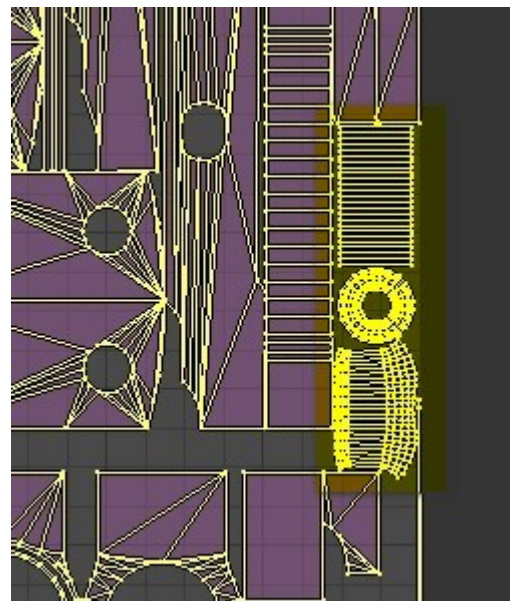


Move the three maps somewhere in the dark grey area of the UV/Image Editor window so that they are not overlapping (to make selecting them again easier) and join the chimney back together again, welding the vertices.



Once the chimney has been joined back to the body mesh the maps can be scaled and positioned as shown here using CTRL-A and CTRL-P to auto pack the map.

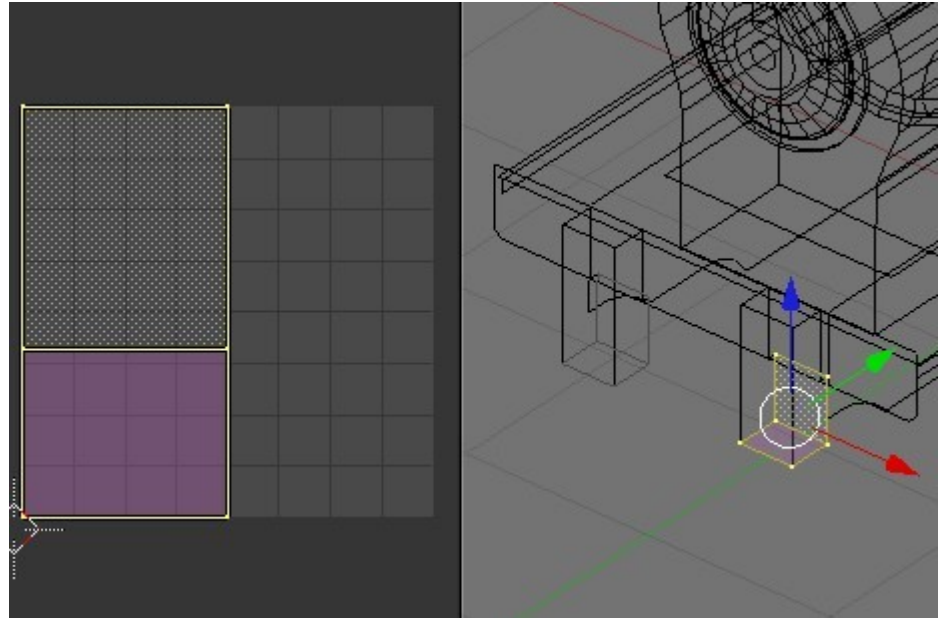
Unwrapping works well for things like the backhead in the cab, smokebox doors and smokebox wrappers.



## Mapping Mirrored Details

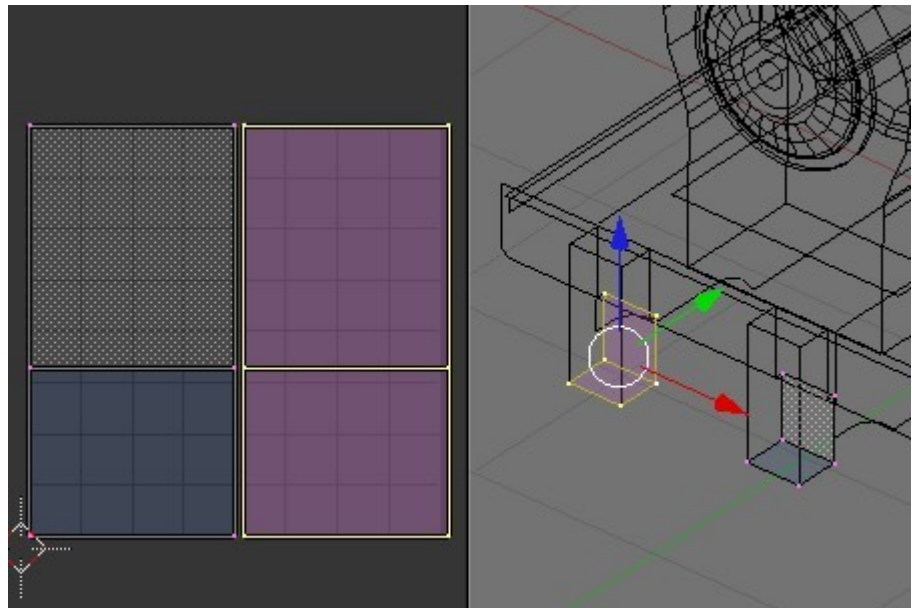
Time can be saved when mapping by mapping a mirrored object. Once the mirror modifier has been applied you will have two sets of UV mapping in the same place. One of these can then be selected and moved somewhere else on the map.

Here I've selected the bottom and rear faces of the left hand front dumb buffer, split it from the mesh and the faces have been unwrapped.



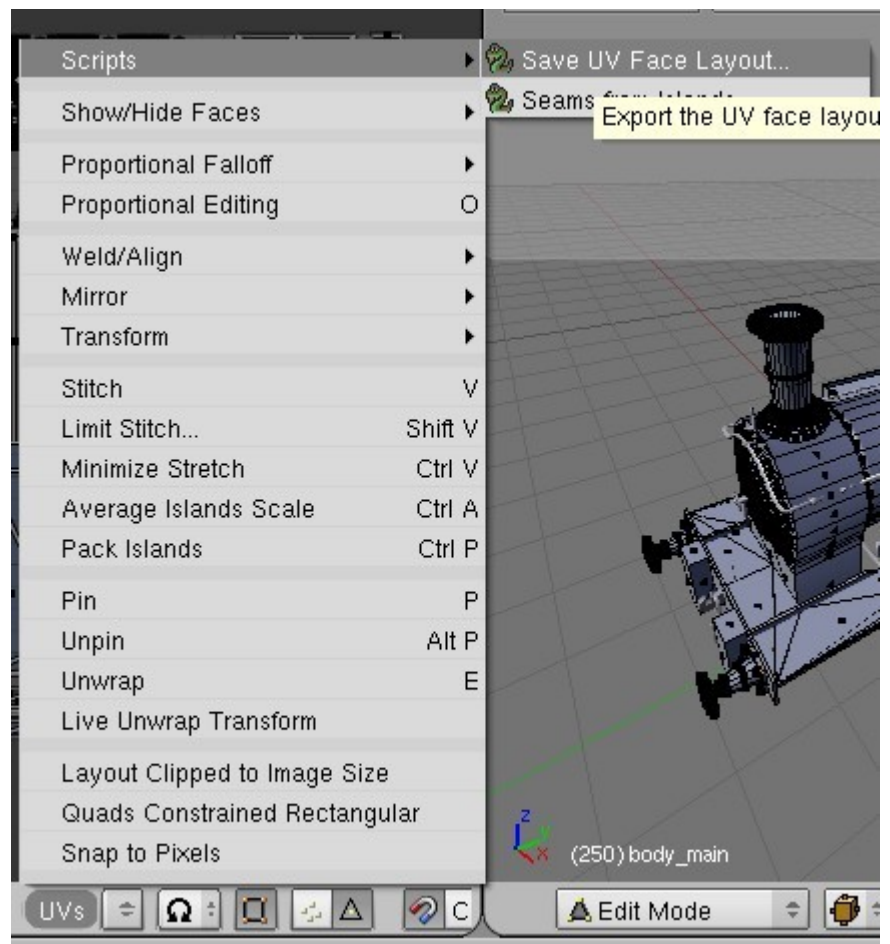
If the mirror modifier is now applied we have UV mapping for both sets of faces.

**In fact generally you can save time by applying the mapping before mirroring or copying faces.**

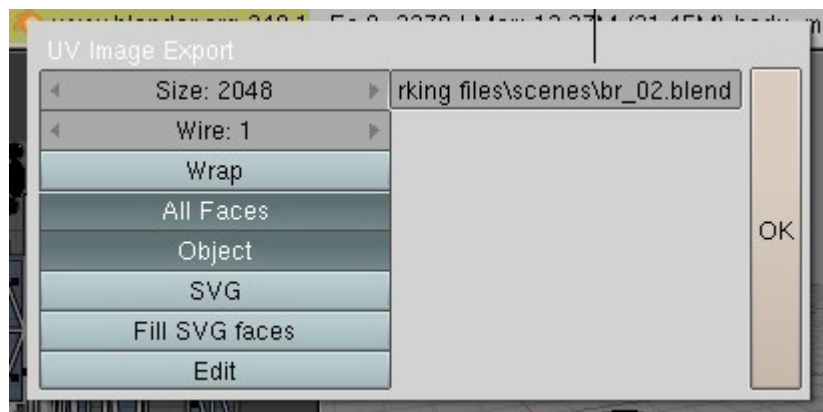


## Saving the U/V Mapping

To create a skin it is useful to be able to save the UV Face Layout - choose 'Save UV Face Layout' from the menu as shown.



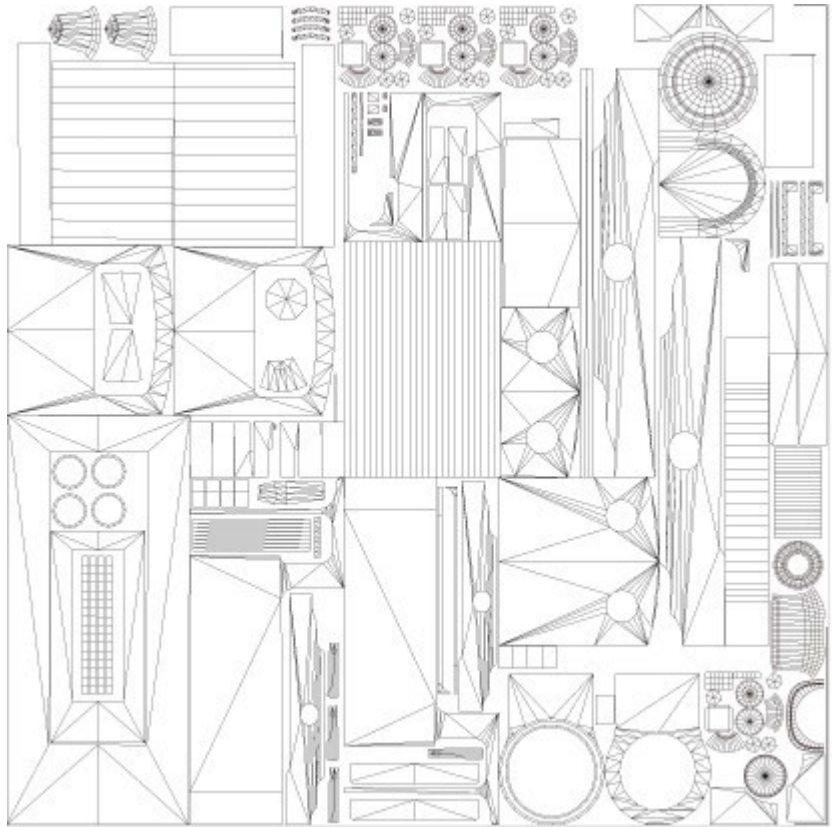
The 'UV Image Export' window opens, here you can input the desired size for the image (**but it assumes that the image is square**) and change the thickness of the lines used to display the mapping. Hit OK, and a file selector opens where you can give the file a name and specify where it should be saved.



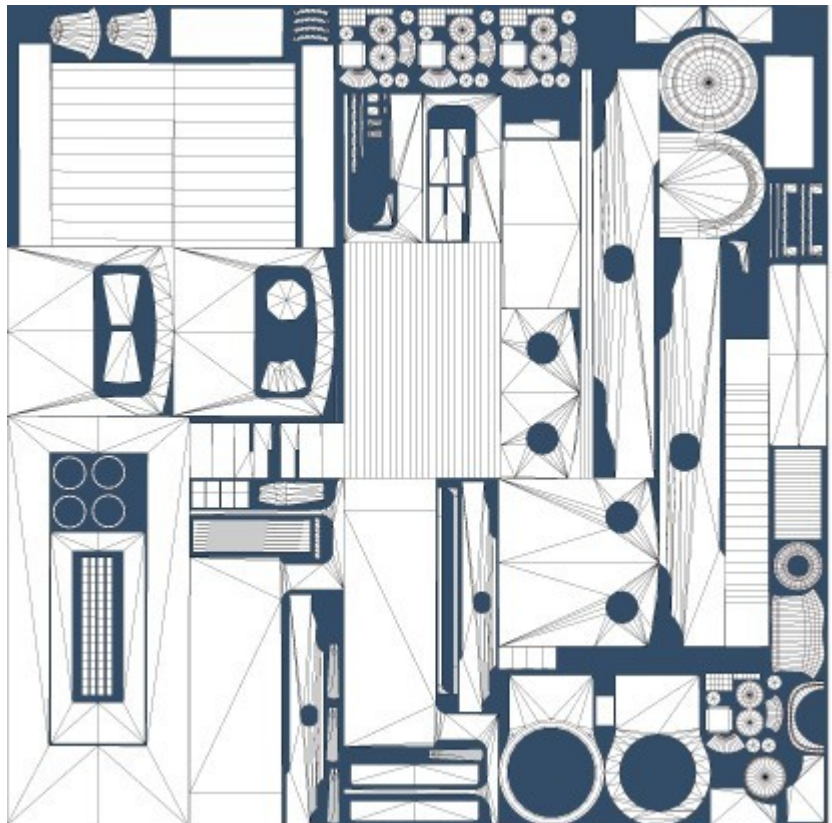


Here's the result loaded into PaintShop Pro:

This will be used to help create the skin later.



Here's the same map with the 'unused' areas coloured dark blue to make them easier to see:



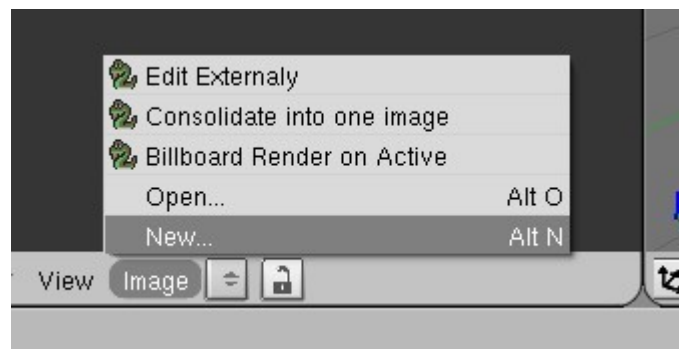
## Creating a Shadow Map

An easy way of doing this is to bake an 'Ambient Occlusion' texture. 'Ambient Occlusion' is a fancy way of saying 'shadows' (grossly simplified, the Wikipedia probably defines it in some other way...) The effect is like shadows generated on an overcast day, and adds a lot more depth to the model and helps to enhance the detailing. The main thing is that it does not rely on a direct light source to calculate the shadows so the effect looks OK no matter what the game lighting is doing.

Before generating the map the model has to be mapped with no overlapping islands and the surface normals have to be pointing the right way (towards the 'outside' or viewable side). If any are wrong select the faces and press W and then 0 (zero) to reverse the normals. **Failure to do this will result in the faces being too light or dark.**

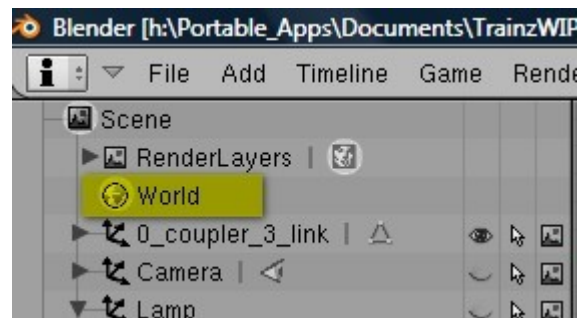
The mapped model is available [here](#) (LNER\_Y7\_c.blend).

To create the map choose 'New' from the 'Image' menu in the UV/Image Editor window.



In the next dialogue input a name and the size of the image (**remember that images must have sizes that are powers of 2 for Trainz!**)

Next, click on the 'World' icon in the 'Outliner' window.



Now select the following icons and set the 'Samples' to about 10 (default is 5, but this will give a relatively coarse effect). To quickly check that all is OK enter 1 or 2 here, this will be very rough but much faster.



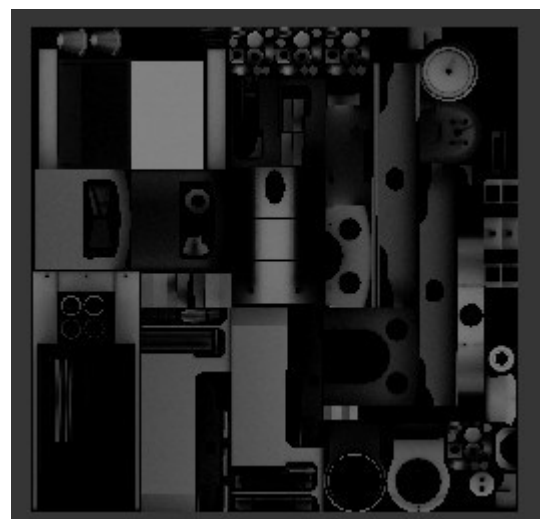
Now with the mapped object selected (in the case of this model it is called 'body\_main') **and all other objects that should cast shadows visible** press F10 to get the following panel to show:

In this panel select 'Ambient Occlusion', the 'Clear' button and 'Margin: 2' don't usually need to be changed. 'Clear' means that a new image will be created, any existing information in the image will be discarded. 'Margin' adds a couple of pixels all around the generated shadows which helps to avoid any obvious lines at any seams.



Now hit the 'Bake' button. If you have a laptop the cooling fan will probably now start(!) and the shadow map will be generated. This needs a lot of processing power and for this mesh on a dual core Athlon 64 laptop with 3Gb ram takes about 10 minutes. A more complicated mesh on a slower machine may well take over an hour to finish. The progress will be shown in the 'UV/Image Editor' window - **the rendering can be interrupted by pressing ESC with the cursor over the window** which is handy if you notice that something is not as expected.

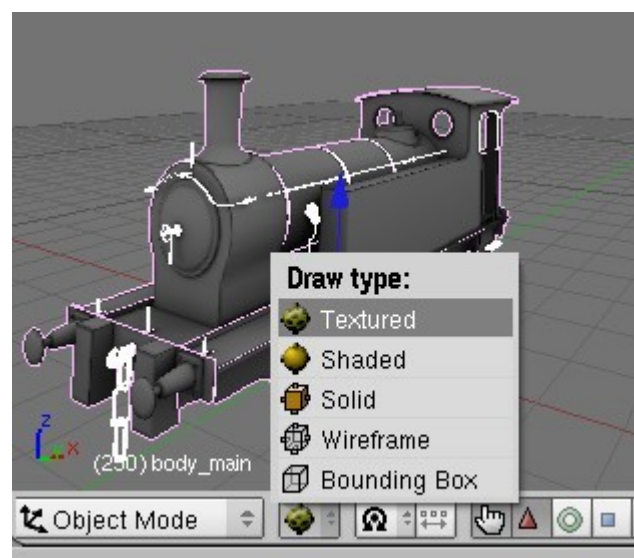
The result looks like this:



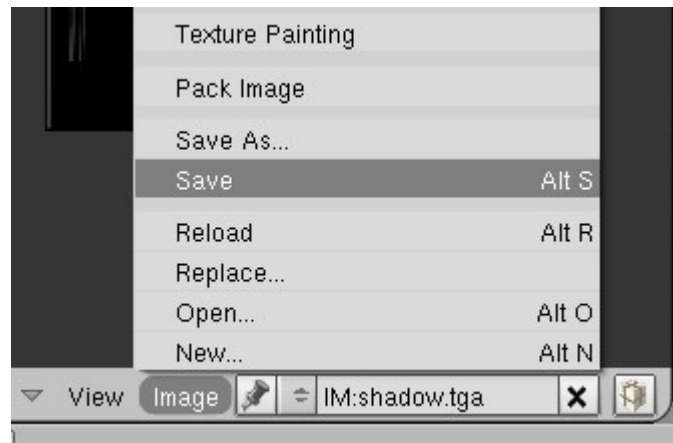
It can be displayed on the mesh by simply choosing the textured display for the 3D window:

The white areas have not been mapped yet, ideally the entire mesh should be mapped and included in the shadow map texture as block textures tend to stand out if present.

Note that the wheels have been hidden as animated objects throwing a static shadow looks odd. I should have had the brake gear visible though when generating the map...



The shadow map can of course be saved:



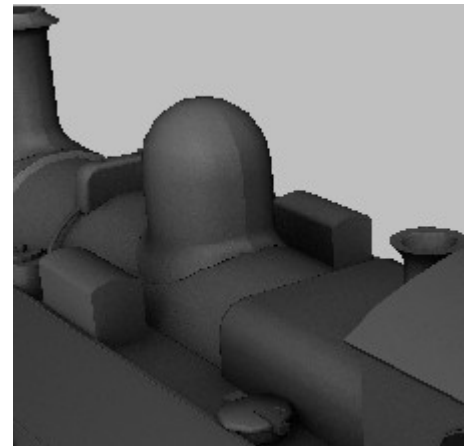
Creating a Normal (bump) Map is not that more complicated incidentally, and we'll go into this later.

## Avoiding Visible Seams and Edge Artefacts

Depending on how the mesh is unwrapped you may find that the seams created when unwrapping are visible on the final texture. These can be seen better when the mesh is rendered or displayed in a mesh viewer as the display in Blender is not of particularly high quality. Here is an example of what can happen (this is a different model obviously):

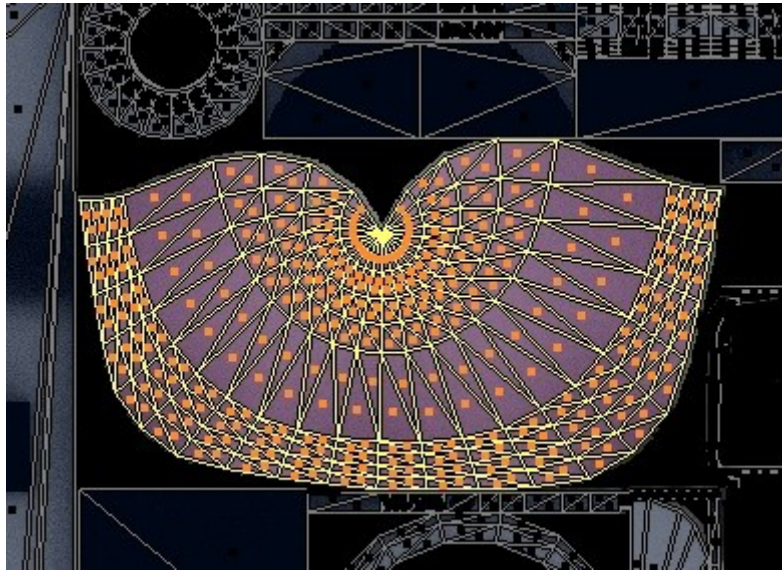
This is a particular problem where relatively large round objects have been mapped using the 'Unwrap' option (chimneys, domes and safety valve covers are prone to this for example).

This is where the options 'Clear' and 'Margin' in the 'Bake' panel come into play. If the 'Clear' button is not selected then objects can be baked on to an existing render. The 'Margin' setting makes the baked render slightly larger than it should be to help avoid visible seams and artefacts caused by jagged edges created by the renderer.





In this case we need to increase the margin for the unwrapped dome object, but as the mapping is so tightly packed we'll need to scale the mapping down to make room for the margin. Here is the mapping for the dome before modification (the original margin of 2 pixels can be seen, the rendered area is slightly larger than the mapping):



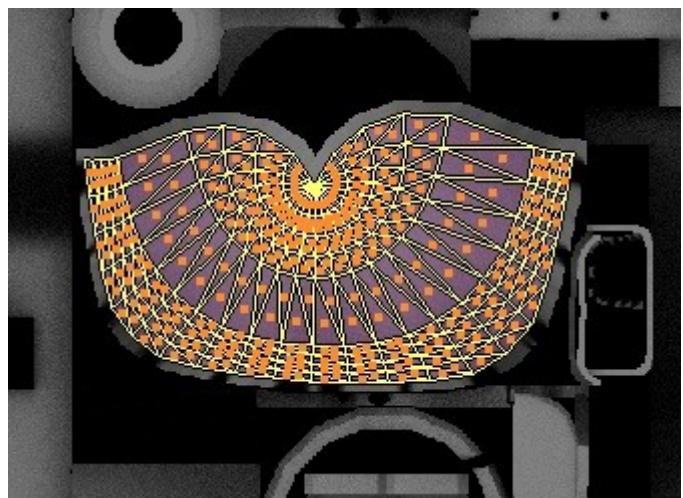
Scale the mapping down by pressing S with the cursor over the UV/Image Editor window (I suggest to 80%) and detach the offending object from the body mesh. The object needs to be detached as there appears to be no option to bake just selected faces. Deselect the 'Clear' button in the 'Bake' panel and change the 'Margin' setting to about 8.

Now hit the 'Bake' button.



The area where the dome mapping was will be rendered with the larger margin without resetting the whole rendered map.

The result is shown here:



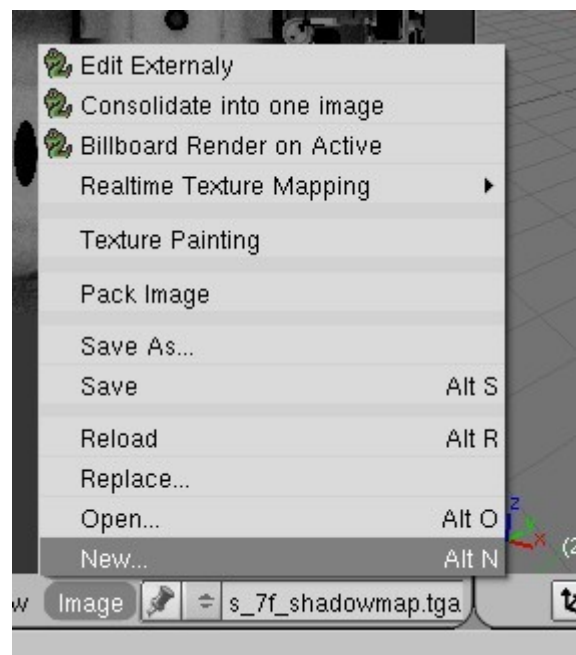
The dome can now be joined back to the body mesh and the process repeated for any other problematic areas.

## Creating Normal Maps

Normal maps are a way of adding surface detail to the mesh, such as flaking paint, rivets or raised/depressed areas. The detail has to be modelled and then 'baked' onto the low poly in-game model. Another possibility is to have a relatively low poly mesh that has the corners rounded by a normal map.

In all of the Blender tutorials I've seen so far it is implied that you need to create a complete high poly mesh and a matching low poly one that are located in the same position in 3D space, but this seems not to be the case. To create rivets on a footplate for example the high poly model can be just the 3D rivets.

To start, create a new image file the same size as the main texture (ALT-N with the cursor over the 'UV/Image Editor' window). **Select the '32 bit' button as this makes the map more accurate.**

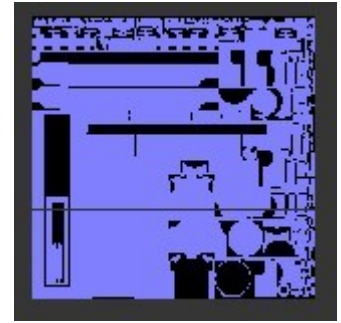


Now change the setting in the 'Bake' panel as shown here:

Note that the settings for the type of normal mapping ('Tangent'), the type of image produced ('Normals') and the 'Margin' have been changed from the default.

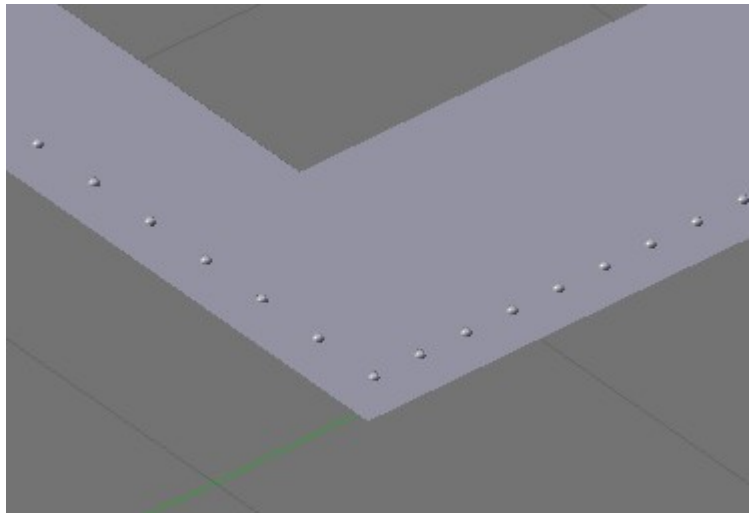


Select the main body object (or whatever you want to normal map) and hit 'Bake' to generate the normal map. Save the map with ALT-S.



Note that we haven't actually created any normal mapped features such as rivets at this stage, we have just created a 'flat' normal map that will not affect the final mesh. The reason for this is that unfortunately you can't (at least at the moment or possibly I just haven't found out how...) create a normal map for the whole object in one go. If you try you'll find that rivets on the top surface of the footplate will also appear reversed on the underside. To overcome this problem it is necessary to normal map the surfaces in groups so that the mapping doesn't get projected on to surfaces where it is not wanted.

This just means for the footplate for example that we split out the top surfaces into a separate object, project the rivets and then join the faces back to the main mesh as shown here.



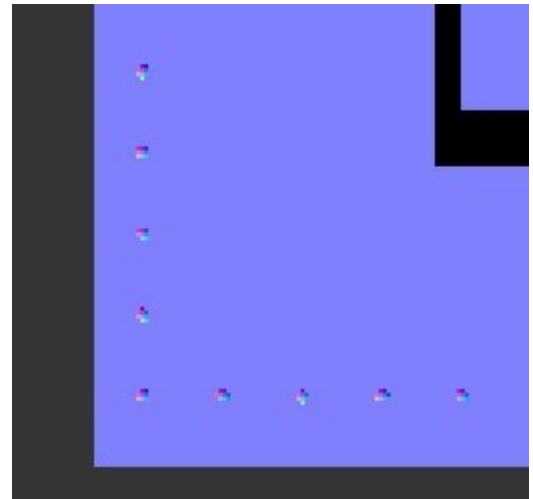
The rivets are just spheres with one half deleted.

To normal map these faces we need to change a couple of things in the 'Bake' panel. Firstly deselect the 'Clear' button – this will overlay the new mapping on the current image without clearing it first. This enables us to create the normal mapping in easy stages. Secondly select 'Selected to Active'. This takes the selected object (the rivets) and projects it on to the active object (the footplate). **Remember that the last object selected is always the active one.**



Hit 'Bake' to generate the normal map. As you can see the rivets have been projected on to the footplate. To make use of the normal map it is necessary to create a material that uses it and apply it to the mesh of course.

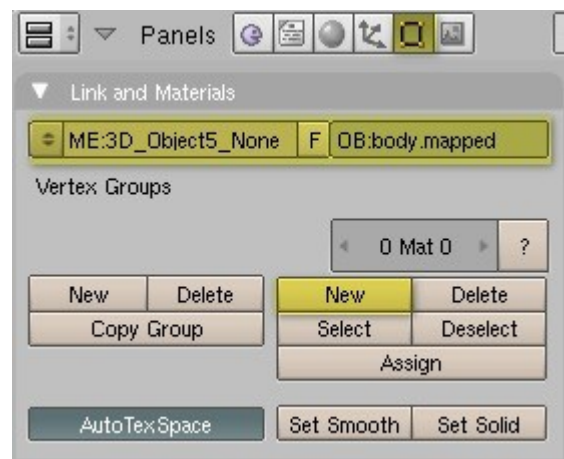
Carry on generating the normal maps for all the surfaces that need it, saving the image file frequently!



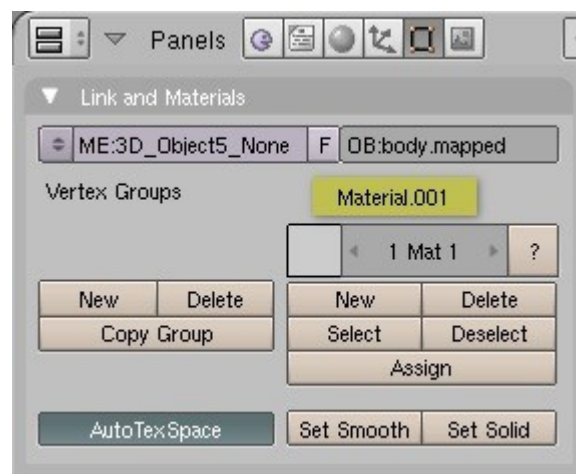
## Creating a Material

The next step is to create a material that can be applied to the object so that it can be exported. I usually use the shadow map as the diffuse texture for starters to check that the mapping is OK before creating the final skin.

Select the object that the new material should be applied to (in this example 'body.mapped'). Press F9 and then choose 'New'.

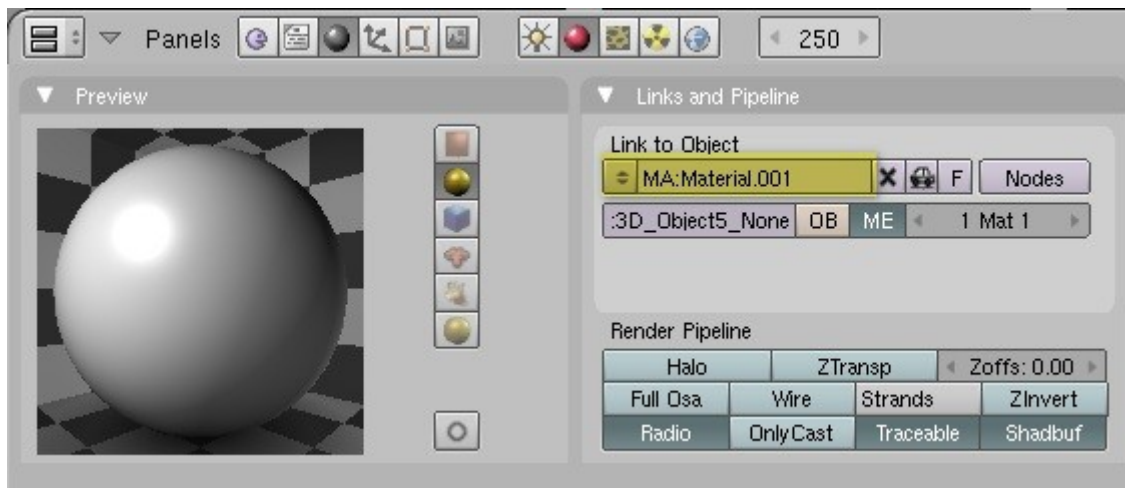


A new material called 'Material.001' has been created.

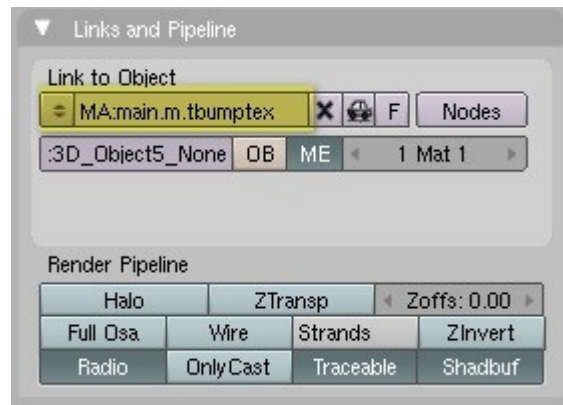




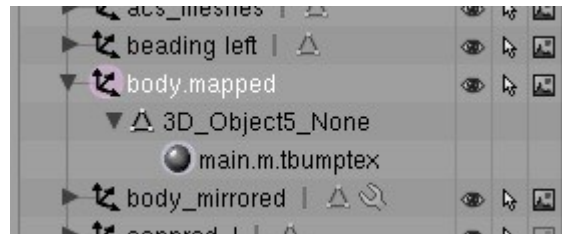
Press F5 to open the 'Shading' panel.



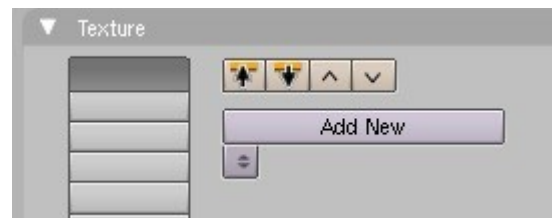
Rename the material to 'main.m.tbumpex' by clicking on the old name and typing the new one in. **The 'm.tbumpex' part of the name is important as otherwise the exporter will throw an error.** For a simple model without normal mapping 'main.m.onetex' can be used.



Looking at the object in the 'Outliner' window we can see that the material has been assigned to the object.



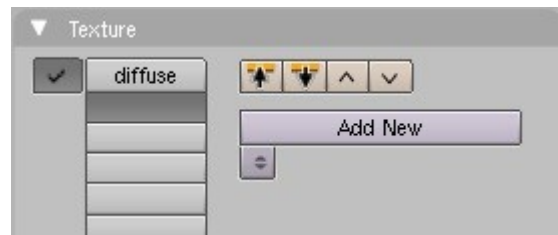
The textures now need adding to the material. In the 'Texture' panel hit 'Add New'.



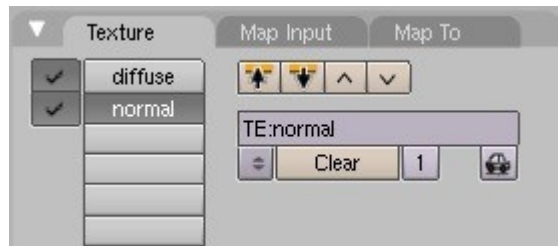
Rename the texture to 'diffuse' (to make it clearer exactly which texture this is) by clicking on the 'TE:Tex' field and typing the new name.



Now click on the second texture slot and hit 'Add New' again. Call the second texture 'normal'.



Here is the result so far:



With the texture channel 'normal' selected open the 'Map Input' tab. Select 'UV' (default is 'Orco').



Open the 'Map To' tab and choose 'Nor' (default is 'Col').



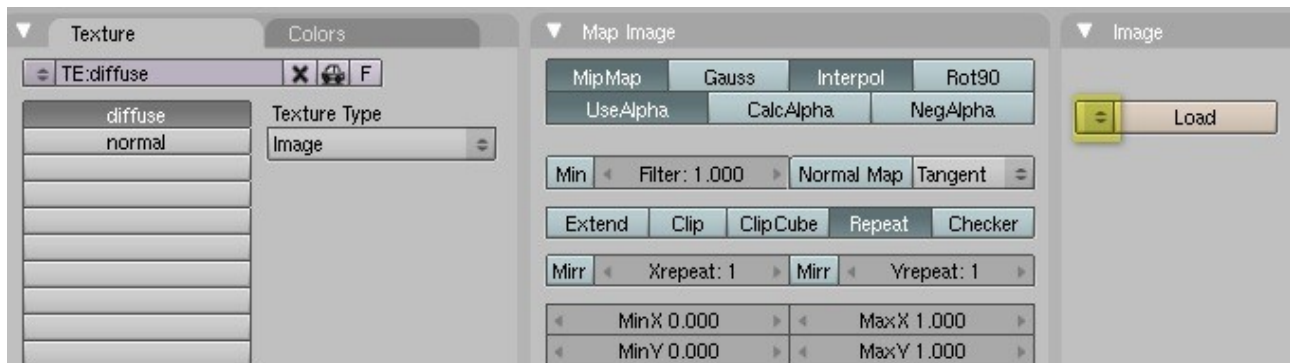
Repeat for the 'diffuse' texture channel, except that in the 'Map To' tab 'Col' should be selected instead of 'Nor'.

Press F6 to open the 'Texture' panel.

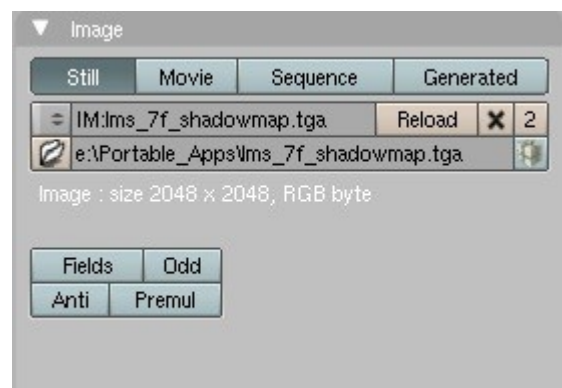


Here we can see the two channels that we have defined, but we actual textures have still not been assigned. The 'Texture Type' for both channels needs to be changed to 'Image' (default is 'None').

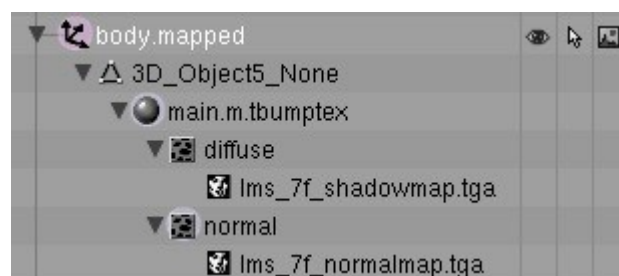
Choose the texture by clicking on the up/down arrows to the left of the 'Load' button.



The chosen texture name appears in the 'Image' panel, and a preview in the 'Preview' panel.



Repeat to assign the texture to the 'normal' channel. In the 'Outliner' window the material with the two texture channels can now be seen.



## To Be Continued

## And Finally

If anybody has any suggestions for improved techniques or problems following this tutorial let me know by mailing me at [paul.hobbs@web.de](mailto:paul.hobbs@web.de) .