

# An Approach to Content Creation for Trainz

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**Part 7**

**The First Loco ('Primus')**

(Updates and sample files available from <http://www.44090digitalmodels.co.uk/>)

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## Foreword

Having read through Part 1 (Setting up Gmax) and Part 6 (Gmax Basics) we are now ready to tackle our first loco. Remember, this is something anybody can do...

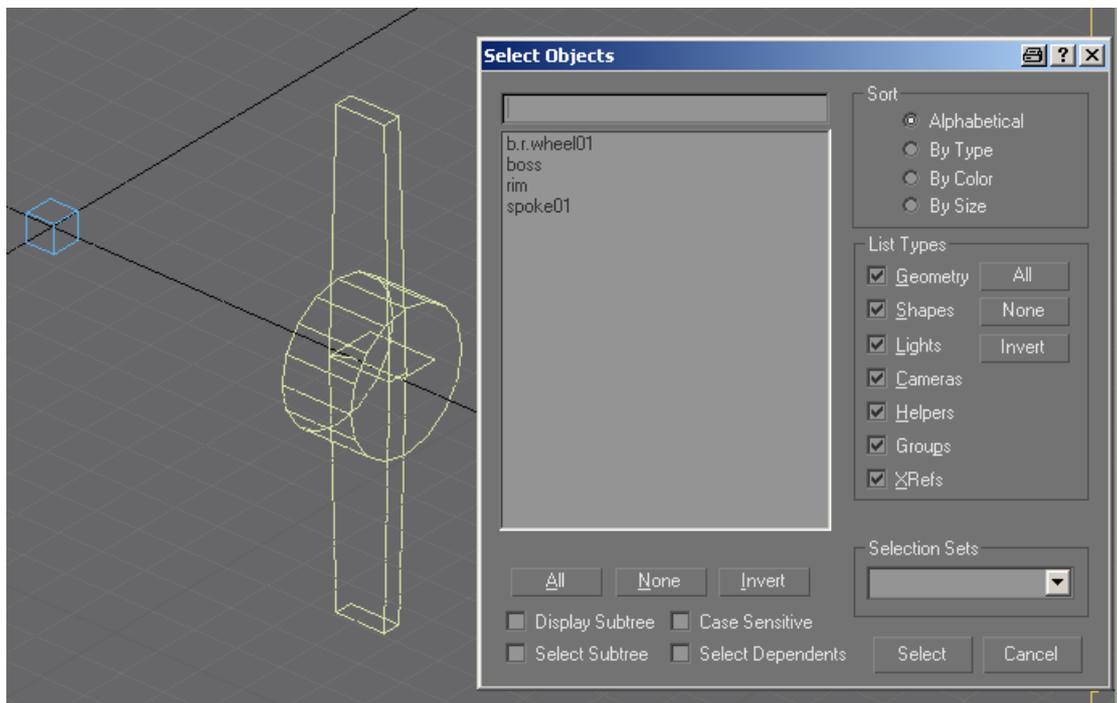
Although I'll be going into more detail in this part it's probably going to be frequently updated as you tell me where more explanation and/or illustrations are needed – so check my web site for updates and make sure you have the latest one.

This loco will not be a model of any particular prototype for because it will be easier. It will be in any case fairly easy to change it afterwards to resemble something else. I've also given it a snappy name in the style of 'LBSC' (the most successful locomotive designer of all time) whose biography I've been reading of late. 'Primus' as all fans of Stargate SG1 will know means 'the first one' in Latin.

Creating freelance models was very popular in the 1940s and 1950s, unfortunately the current obsession with exact scale has tended to make the art of freelancing a dying art. Even if a model is freelance it should be at least plausible in an engineering sense, so I'll be mentioning a few things that should be avoided if you want to make the model believable. Also while 'Primus' will be British outline there is no reason why the basic design could not be altered to make it American outline or even narrow gauge.

## Wheels

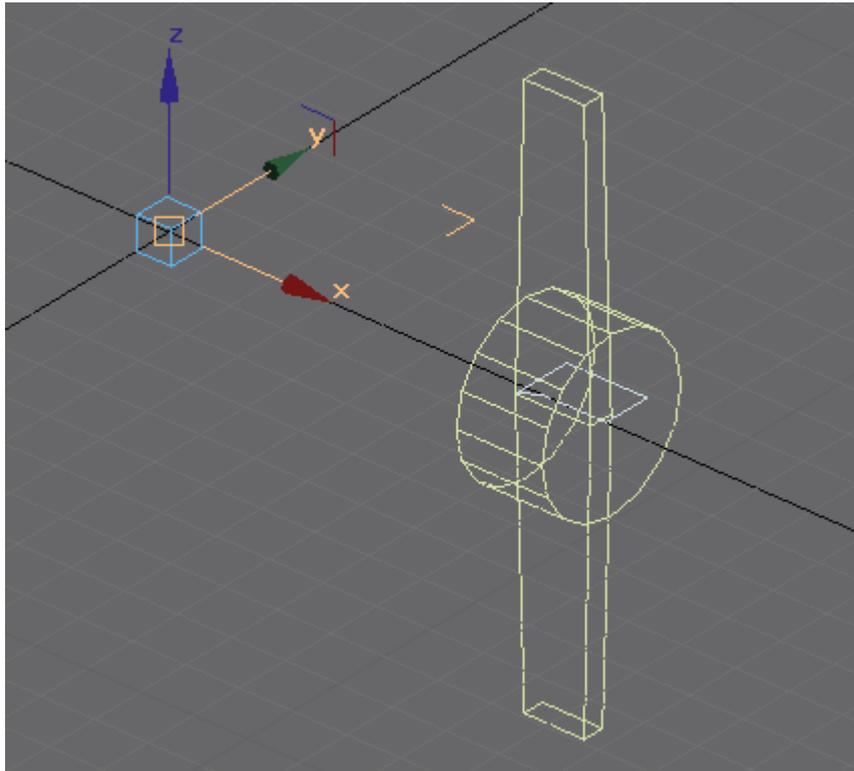
I usually start with the wheel sets, for the good reason that parts of the superstructure need to be built with reference to the wheel centres. I have a 'wheel kit' on my website [here](#) that allows the construction of wheels of any diameter so download this GMax file and open it.



Pressing 'H' will open the 'Select Objects' dialog box so you can see what we have loaded. There's a dummy (which to prove want a nice bloke I am is already animated as described in Part 5), and objects for the boss, rim and spoke.

**Before we go any further, make sure GMax is set up as described in Part 1, especially the bit about incremental saving and automatic backups!**

The first thing to do is to decide on the wheel diameter. A typical six coupled industrial tank like 'Primus' would have had wheels of around 3'9" diameter, so select the rim object by pressing 'H', choosing the rim and then 'Select'. **It's good practice by the way always to select things using the 'Select Objects' dialog box rather than 'Select and Move' on the top toolbar – the reason being it's very easy to slightly move something away from it's starting position with 'Select and Move'.**

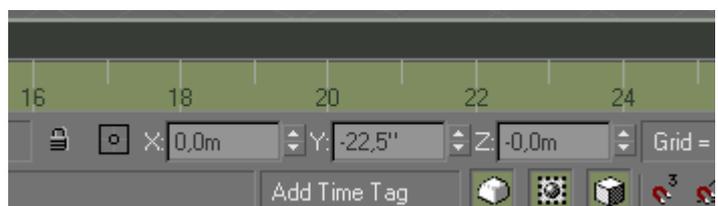


Here the rim object has been selected. Note that the X,Y,Z axis appears at the 0,0,0 position in 3D space (see Part 6 if this is unclear). This is because I've moved the pivot point of the rim object to 0,0,0. The rim object itself is correctly positioned for a standard gauge wheel i.e. we don't need to move it in X, and is simply a closed spline object which we looked at in Part 6.

The first thing to do is to move the 'rim' object to the correct Y position. Having selected it choose 'Select and Move' on the top toolbar. Now type the radius of the wheel into the Y input field at the bottom of the GMax window.



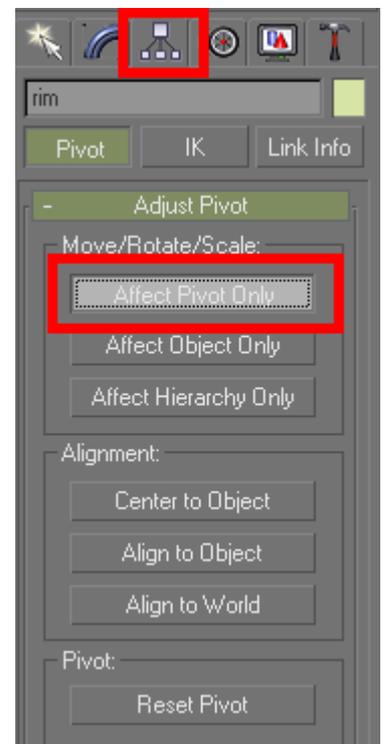
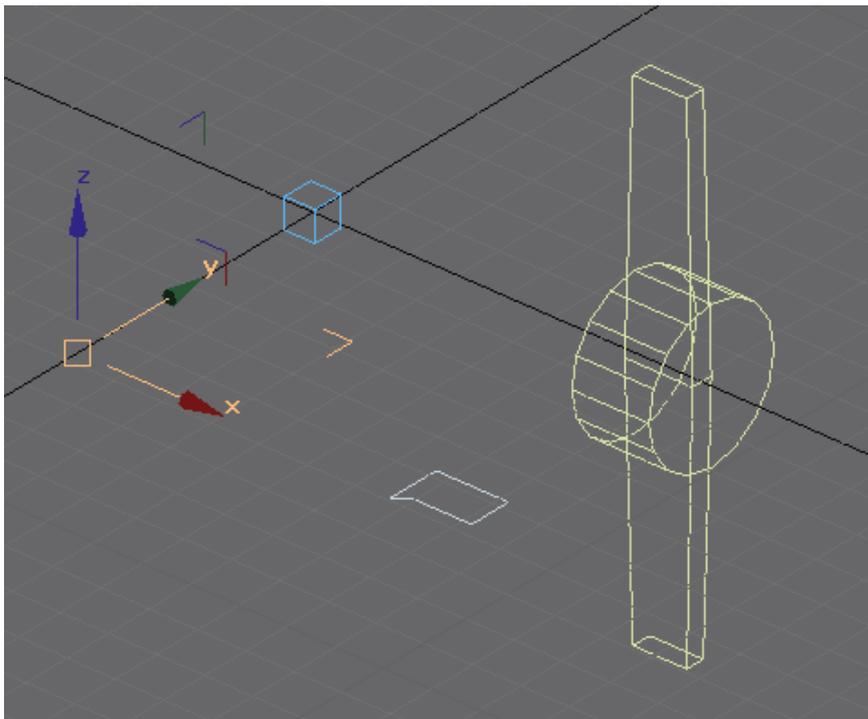
Another dying art these days is doing sums in your head so a few of you will probably need a calculator at this point. Anyway, 3'9" is 45", half of which is 22,5".

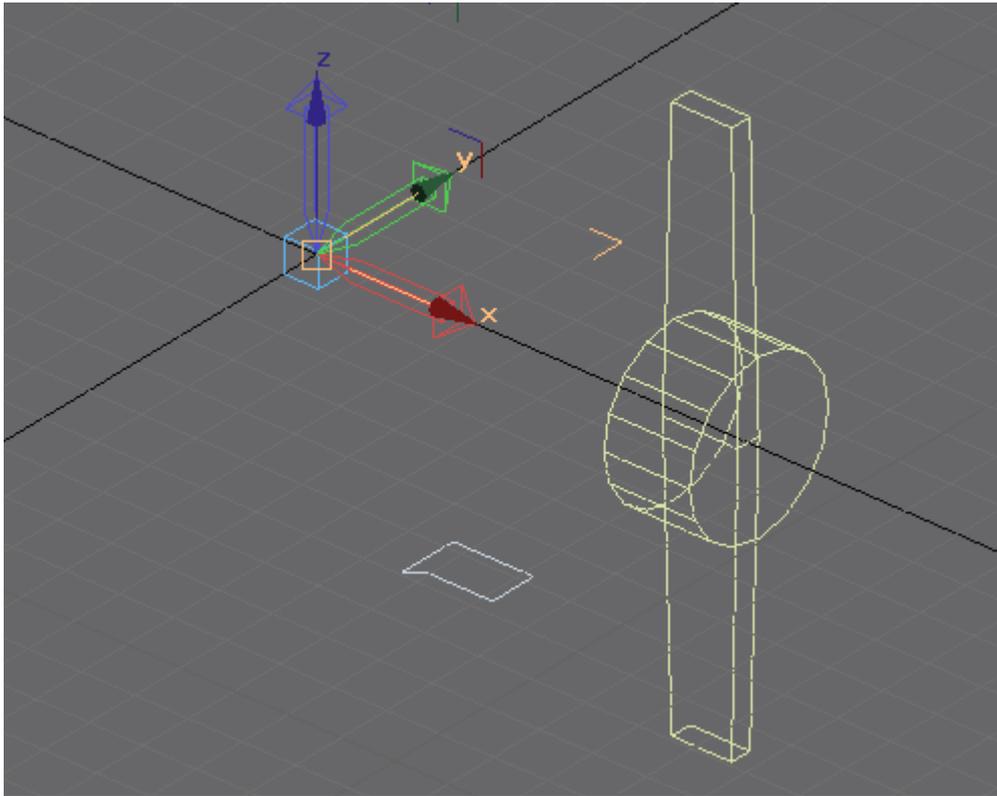


Note that the value is negative as we want to move the rim towards the front of the loco.

The rim has moved 22,5" (**we always build things full size in GMax**) forwards. Note that the pivot point has also moved which we didn't want so we'll have to move it back to 0,0,0.

So, go to the 'Hierarchy' tab and choose 'Affect Pivot Only' and in the coordinate boxes at the bottom of the GMax window set the Y value to 0 by right click on the spinner arrows or by typing " into the Y field.

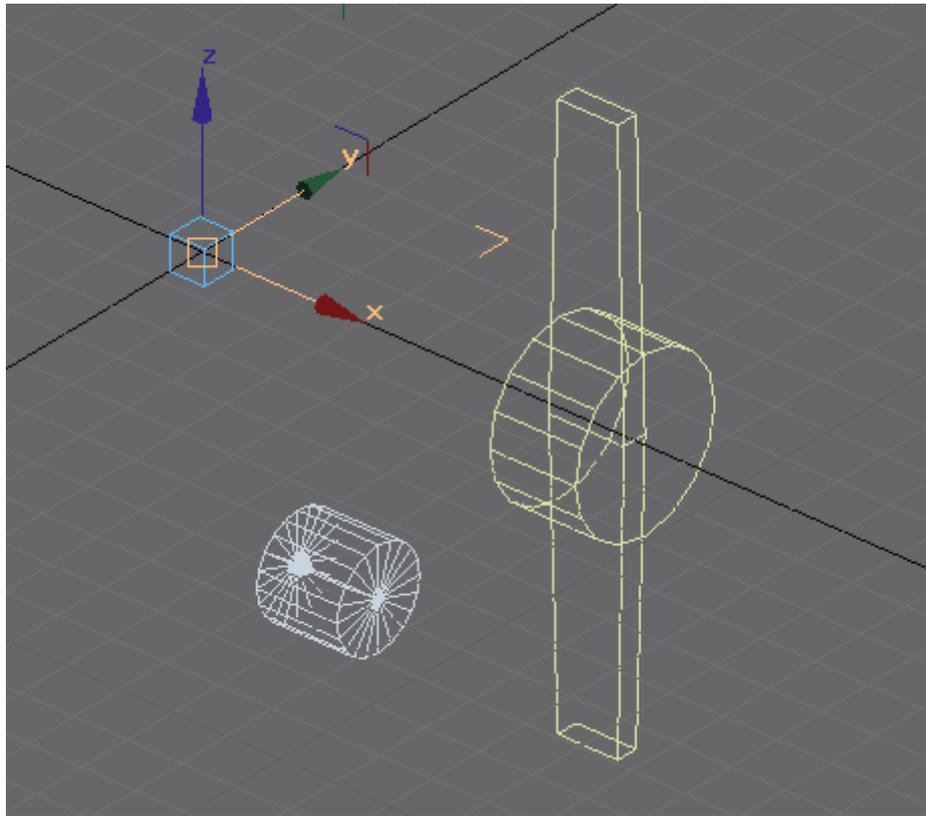




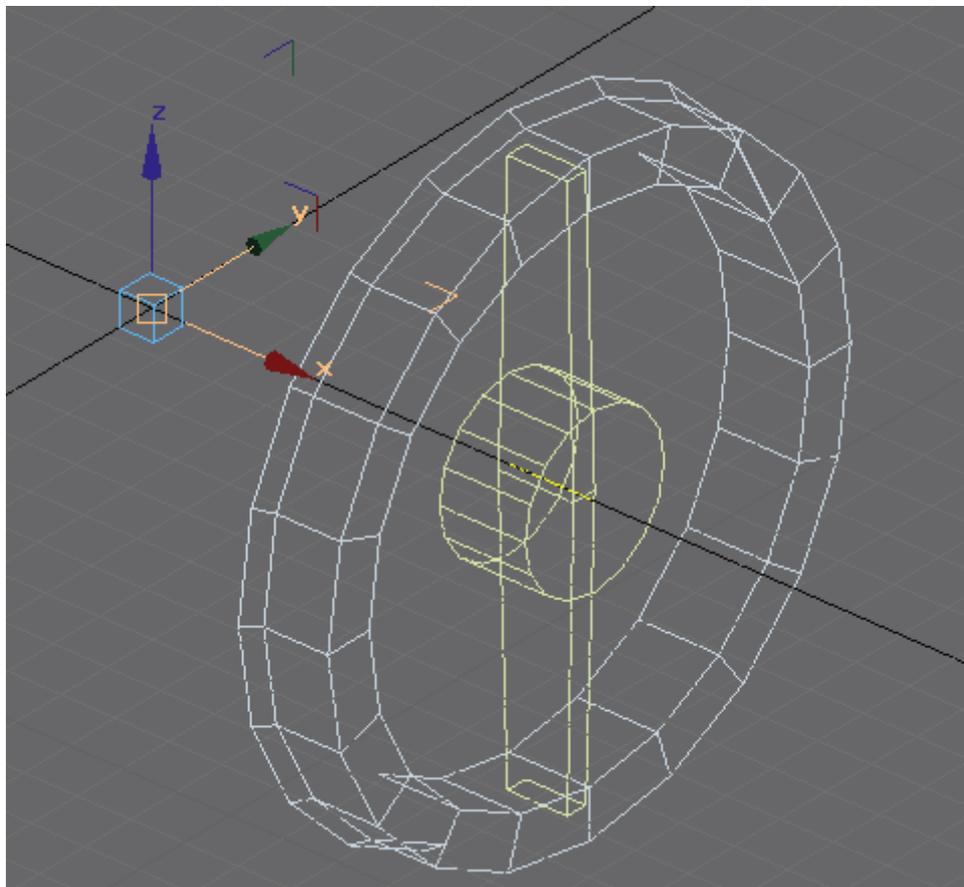
The pivot point has been moved to 0,0,0.

Now we can create the rim mesh by lathing the spline. The 'Lathe' modifier has already been applied to the rim but it was deactivated – activate it now by clicking on the light bulb. Doesn't look quite right yet though.





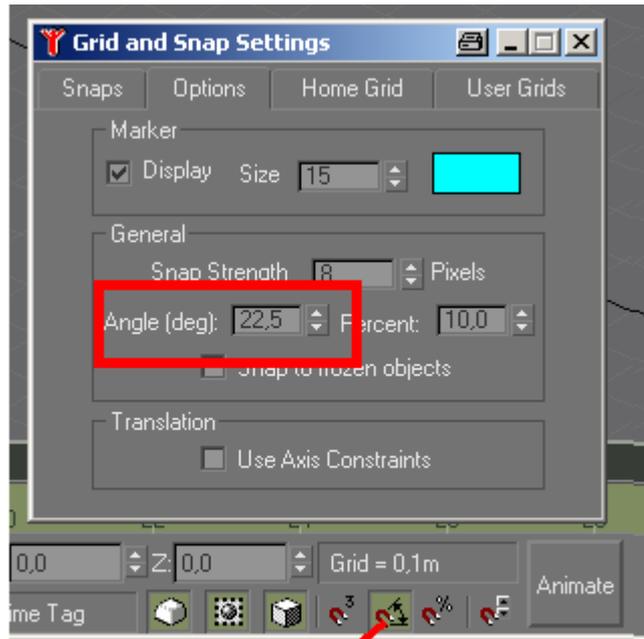
We have to modify the centre point of the 'Lathe' modifier to get the expected result, so open the 'Lathe' modifier in the stack and click on 'Axis'. Making sure that the 'Select and Move' tool is still active set the coordinates of the centre point back 0,0,0 (right clicking on the X,Y and Z spinners is quickest).



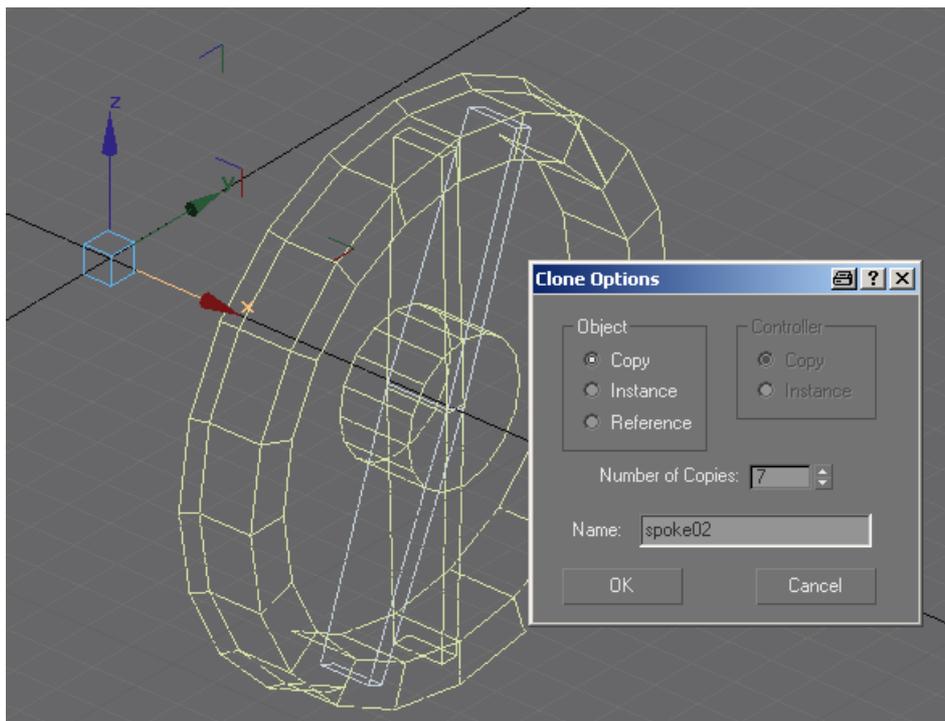
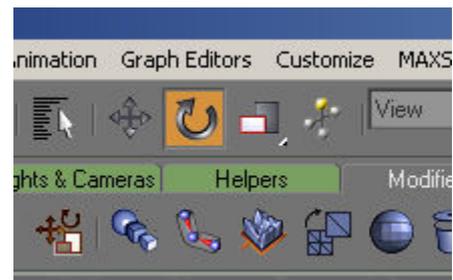
That's more like it. Now, a warning about polys. **The 'Lathe' modifier has parameters for 'segments' – setting this too high will drive the poly count up which we don't want.** Larger wheels will need more segments but for a wheel of this size 20 is about right.

Now to create the rest of the spokes – about 16 would be ok, so select the spoke01 object and left click on the 'Angle Snap Toggle' icon to select it and then right click the same icon to open the settings dialog. The angle between the spokes will be  $360/16 = 22,5$  degrees.

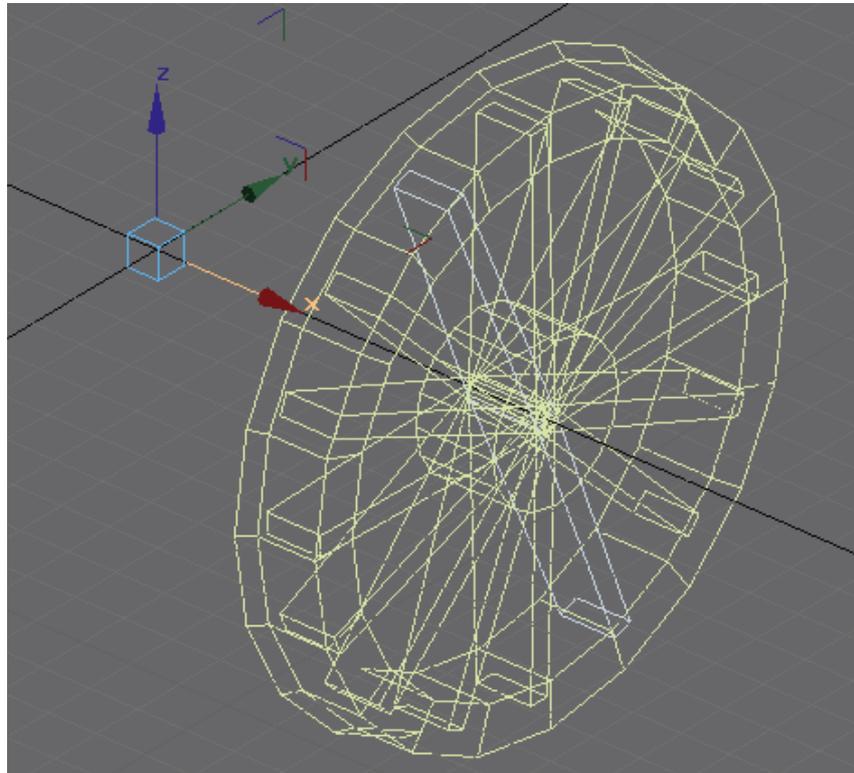
Now select the 'Rotate' tool in the top toolbar and holding down the SHIFT key drag on the X axis to create a copy of the 'spoke01' object. Just drag long enough so that the copy snaps to 22,5 degrees from the original spoke. Let go of the left mouse button when the copy appears. Another dialog box opens now:



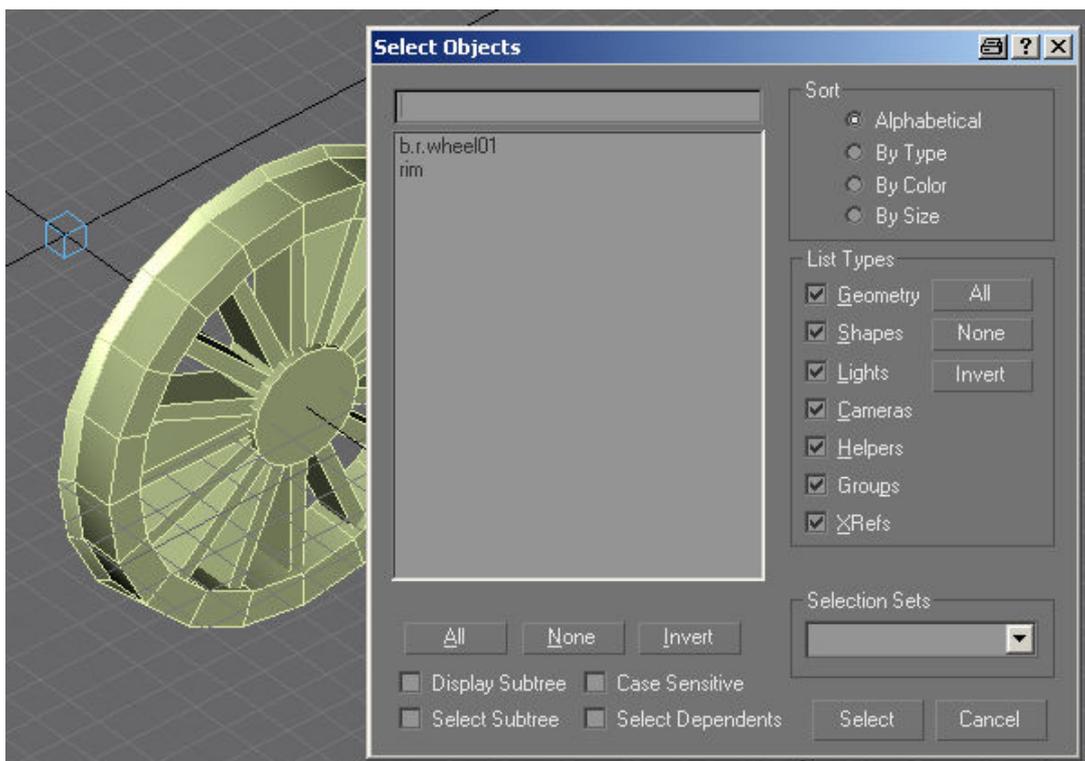
**Angle Snap Toggle**



Change the value in 'Number of Copies' to 7 (we need 7 copies as each spoke is actually two spokes). For a 15 spoke wheel I'd have deleted the top half of the spoke of course and made 14 copies. A larger diameter would also mean making the spokes longer.



Now to join everything together to make a single object, select the 'Lathe' object, right click over it in the modifier stack and choose 'Collapse All'. In the 'Modify' tab choose 'Attach List' and select everything, finally choosing 'Attach' in the 'Attach List' dialog box. **Note: I've pressed 'F3' here to turn on the shading in the viewport...**

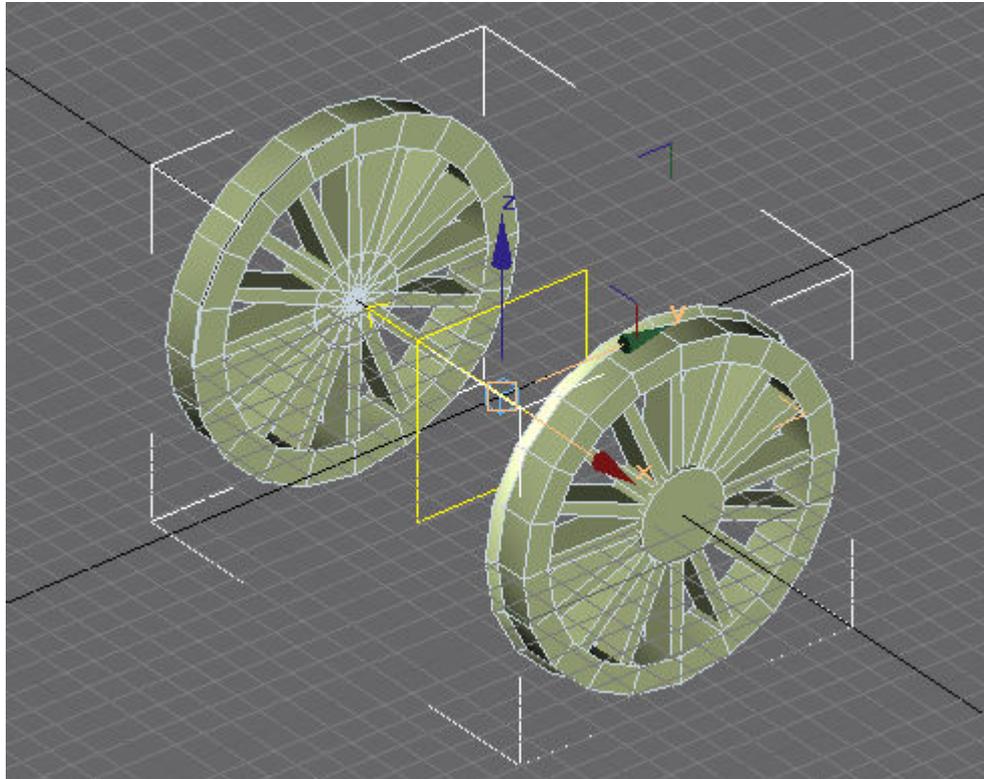
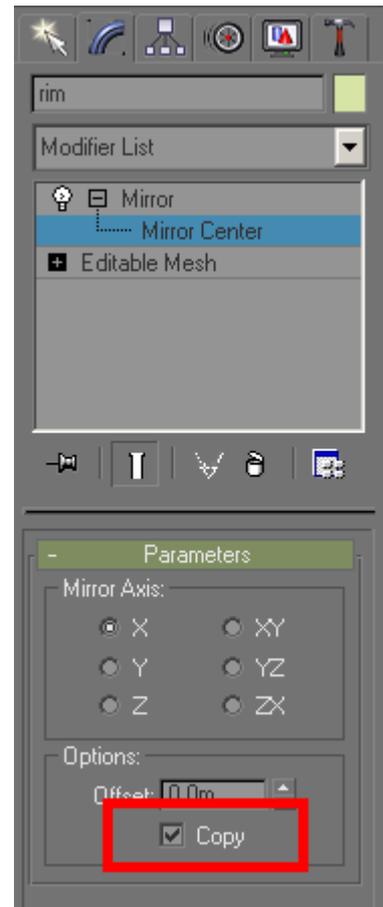


We now have just two objects in the model, the wheel and the dummy. The 'rim' object can be mirrored over now to create the right hand wheel. Select the 'rim' object and add a 'Mirror' modifier to the stack.

Make sure that the 'Copy' box is ticked, and that the 'Mirror Centre' is at X=0 (click on it in the stack, choose 'Select and Move' on the top toolbar and check the coordinates at the bottom of the GMax window).

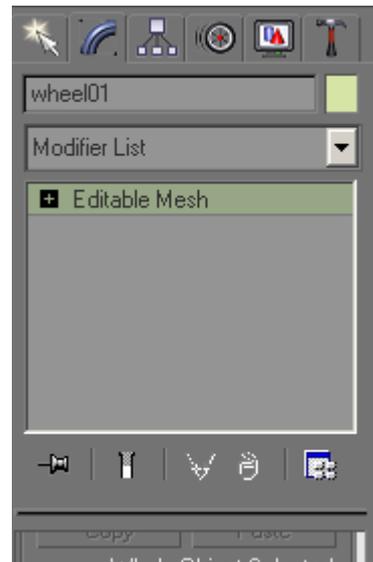
As the pivot point of the 'rim' object was set to 0,0,0 there should be no need to change anything.

**Warning! There is also a 'Mirror Selected Objects' icon in the top toolbar – this should not be used, as it tends to turn meshes inside out when exporting to Trainz.**

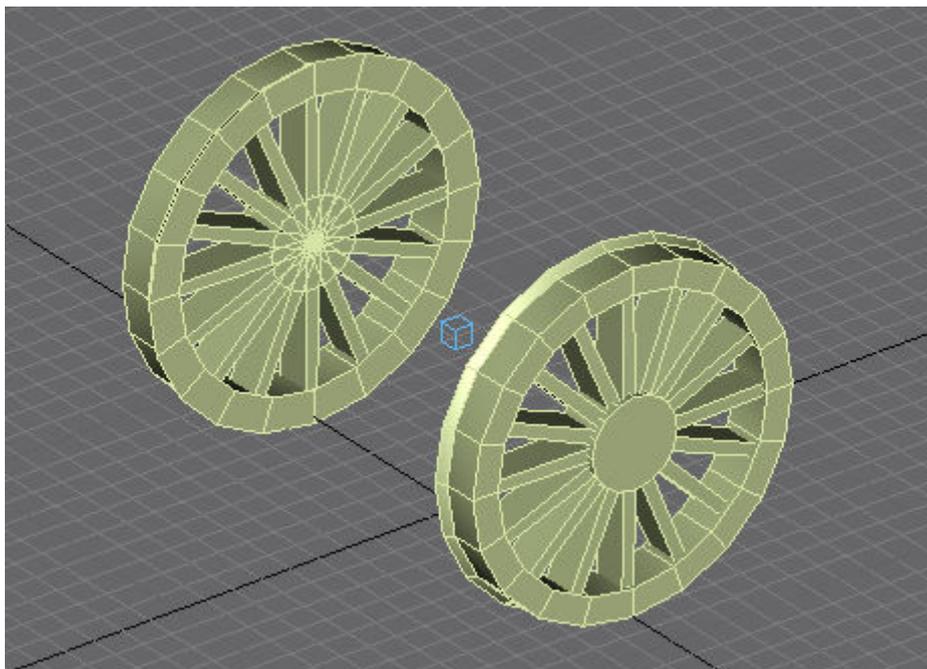


Collapse the stack of the rim object and rename it to 'wheel01'.

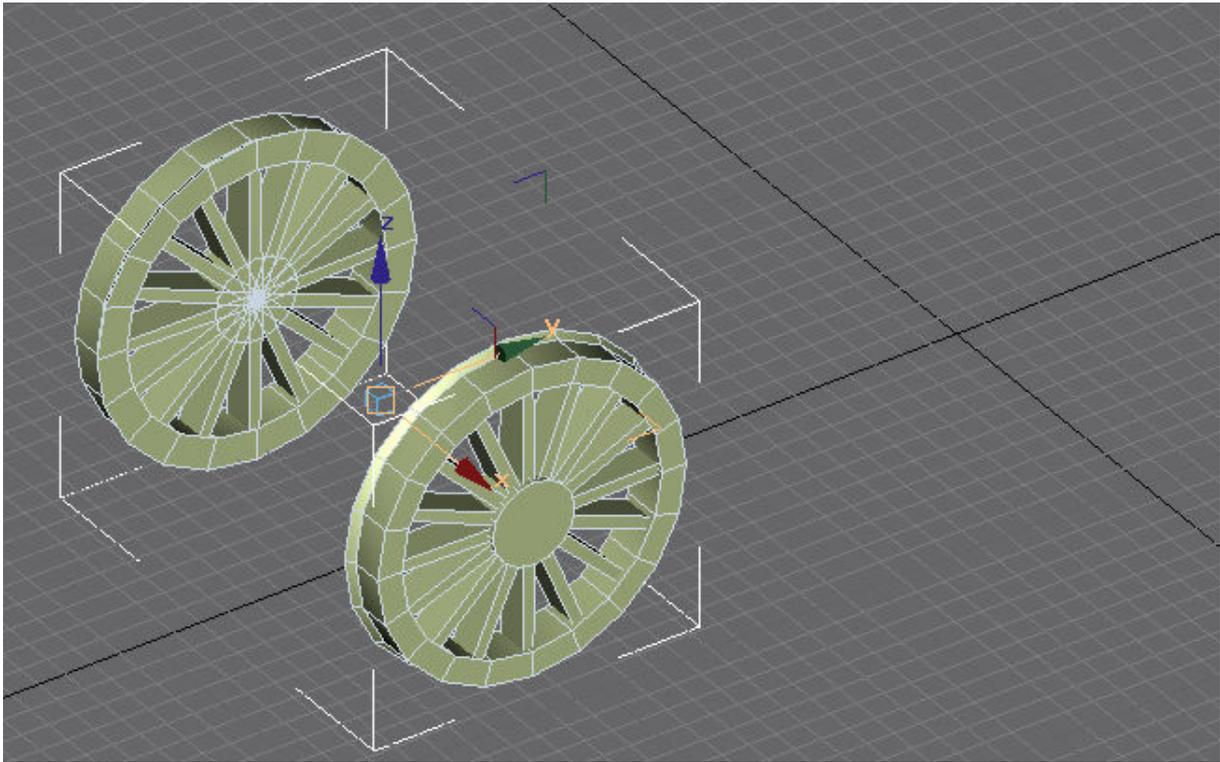
This might have seemed a bit long winded to create a wheel set but we have covered quite a bit of ground so far.



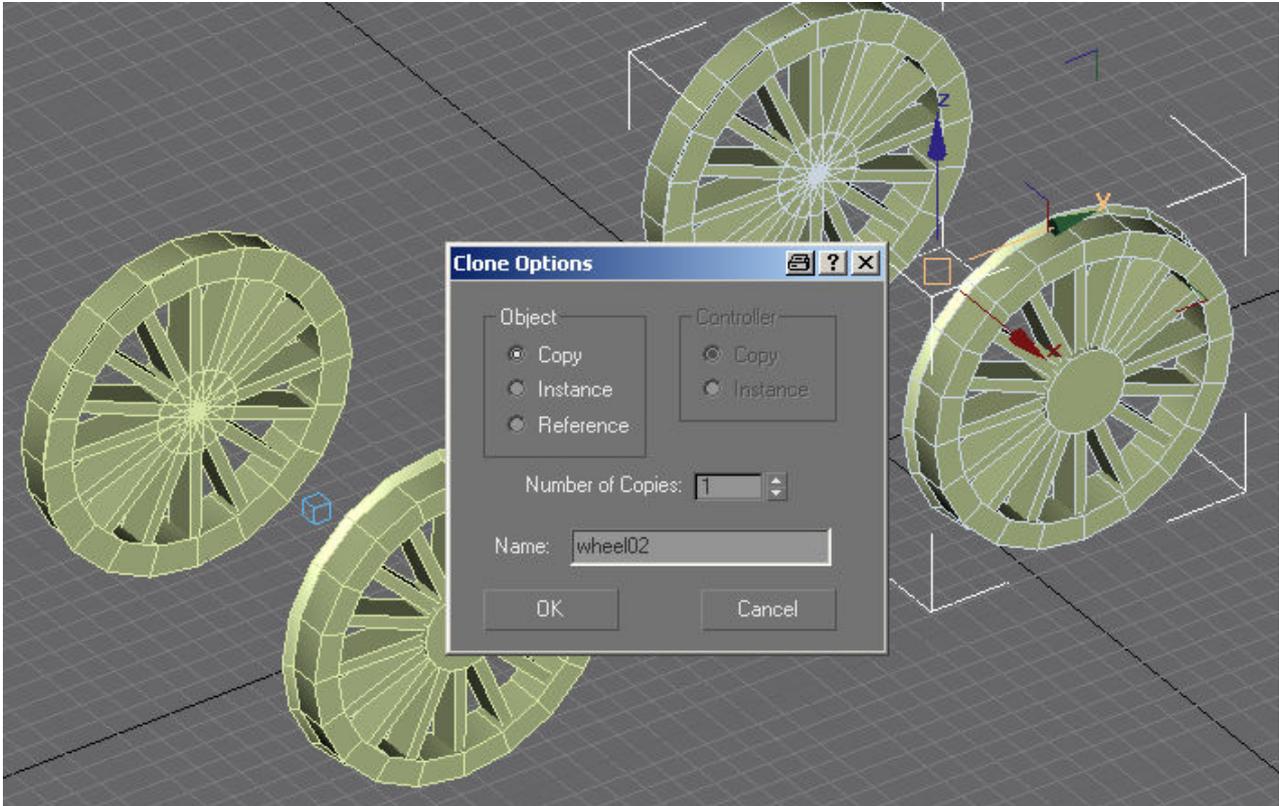
The wheel set is still at 0,0,0 so the next step is to move it (and the dummy 'b.r.wheel01') up 22,5", the radius of the wheel you'll remember. Press 'H', select the wheel01 object and make the 'Select and Move' tool active. In the Z coordinate field type 22,5" and hit ENTER to move the wheel. Do the same for 'b.r.wheel01'.



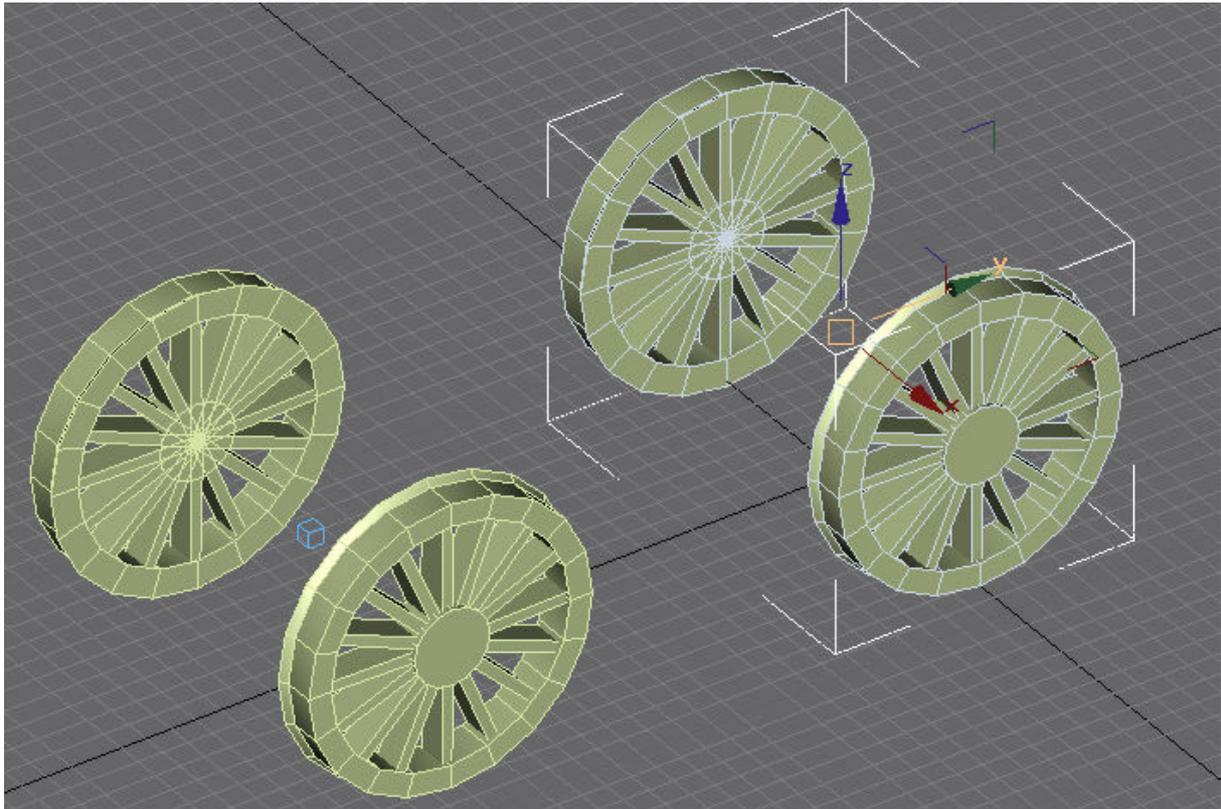
Now to create the other two wheel sets. First move 'wheel01' and 'b.r.wheel01' forward by 7' (or wherever you want the front driver to be). This should be no problem if you've been following the steps so far! Don't forget that 'forward' means in the -Y direction.



Now with the 'Select and Move' tool active and the SHIFT key held down drag on the Y axis to create a clone of 'wheel01'. The clone will be named automatically 'wheel02'.

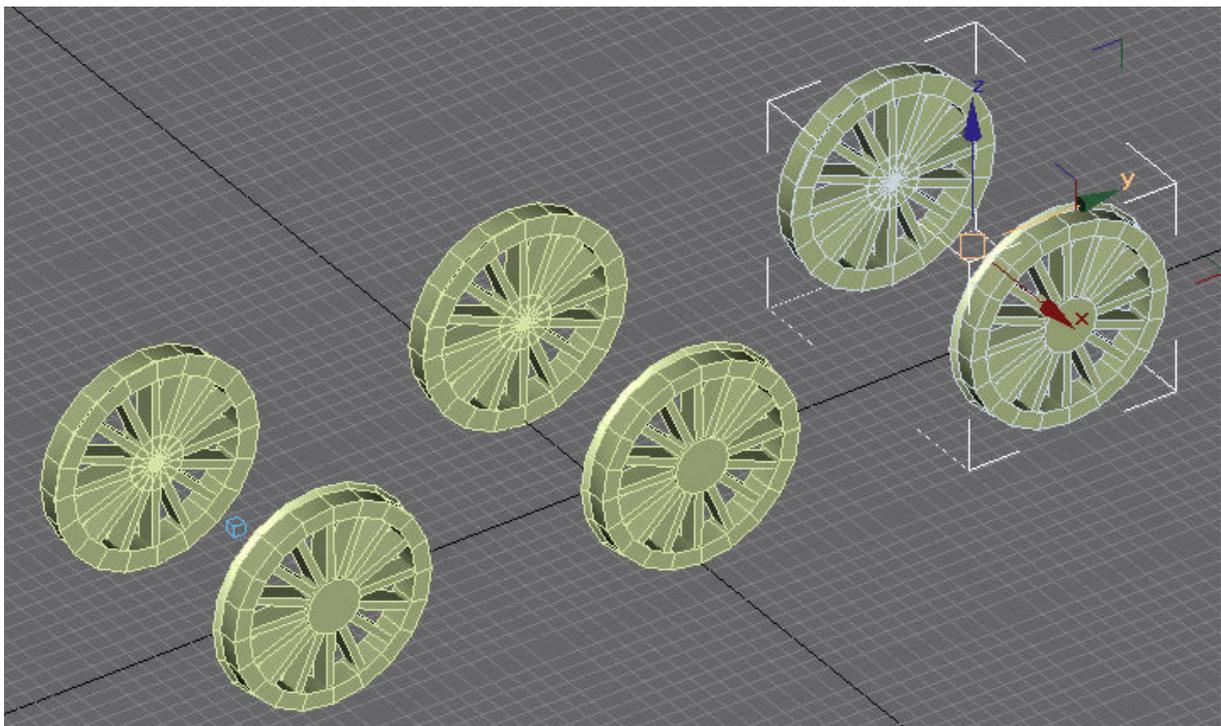


Click on 'OK' to create the copy, and with 'wheel02' still selected change the Y coordinate back to 0 to put 'wheel02' at Y=0.



Create a third wheel set called 'wheel03' by copying 'wheel02' rearwards 7'. This can be done just by clicking on the Y axis when 'wheel02' is selected while holding down the SHIFT key with the 'Select and Move' tool active – don't drag, just click.

This will create a copy in the same position as the original. Now just enter 7' in the Y coordinate box to move 'wheel03' rearwards.



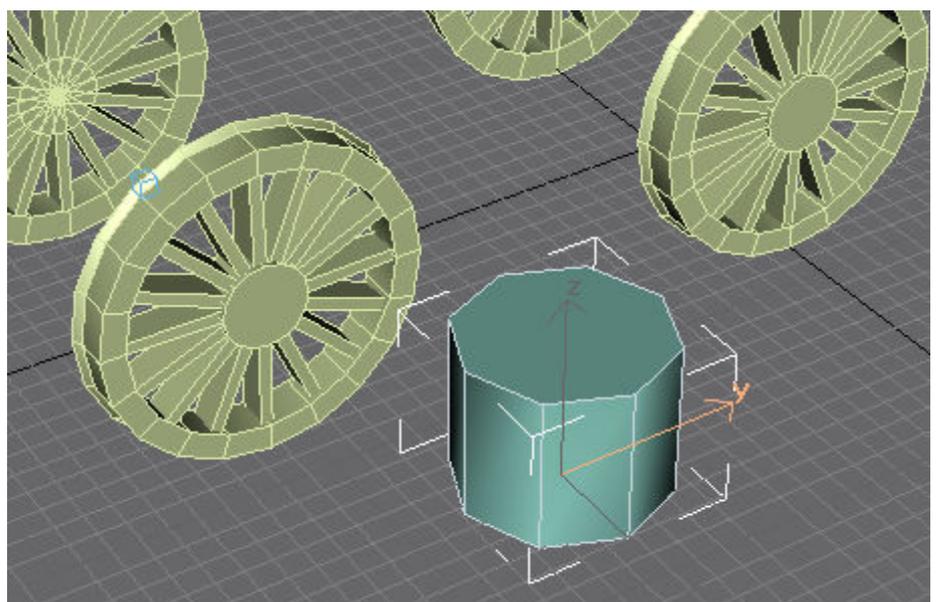
Now we have all three wheels I'm beginning to think that 7' + 7' wheelbase is a bit long, but no matter, we can easily change this later. Pity the poor guy building a physical model when he finds out that the wheelbase is wrong...

## Coupling Rods

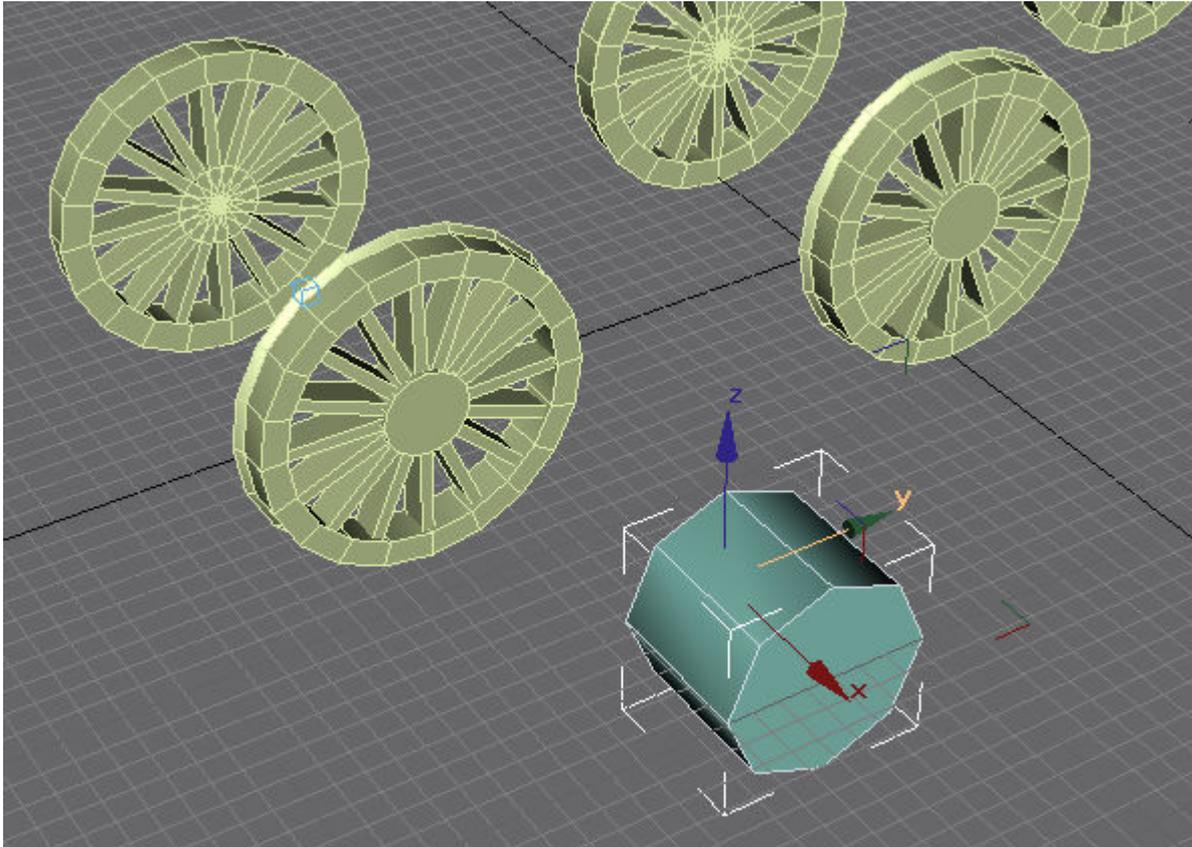
On to the coupling rods now, first create a cylinder with the parameters as shown. Note that I've changed the standard parameters for 'Height Segments' and 'Sides' to something more reasonable – the defaults are much too high.



I'm not worrying about the actual size of the cylinder, we'll scale it down in a minute.

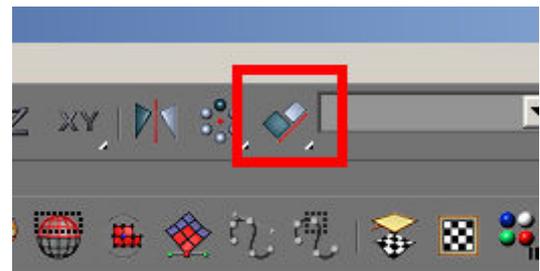


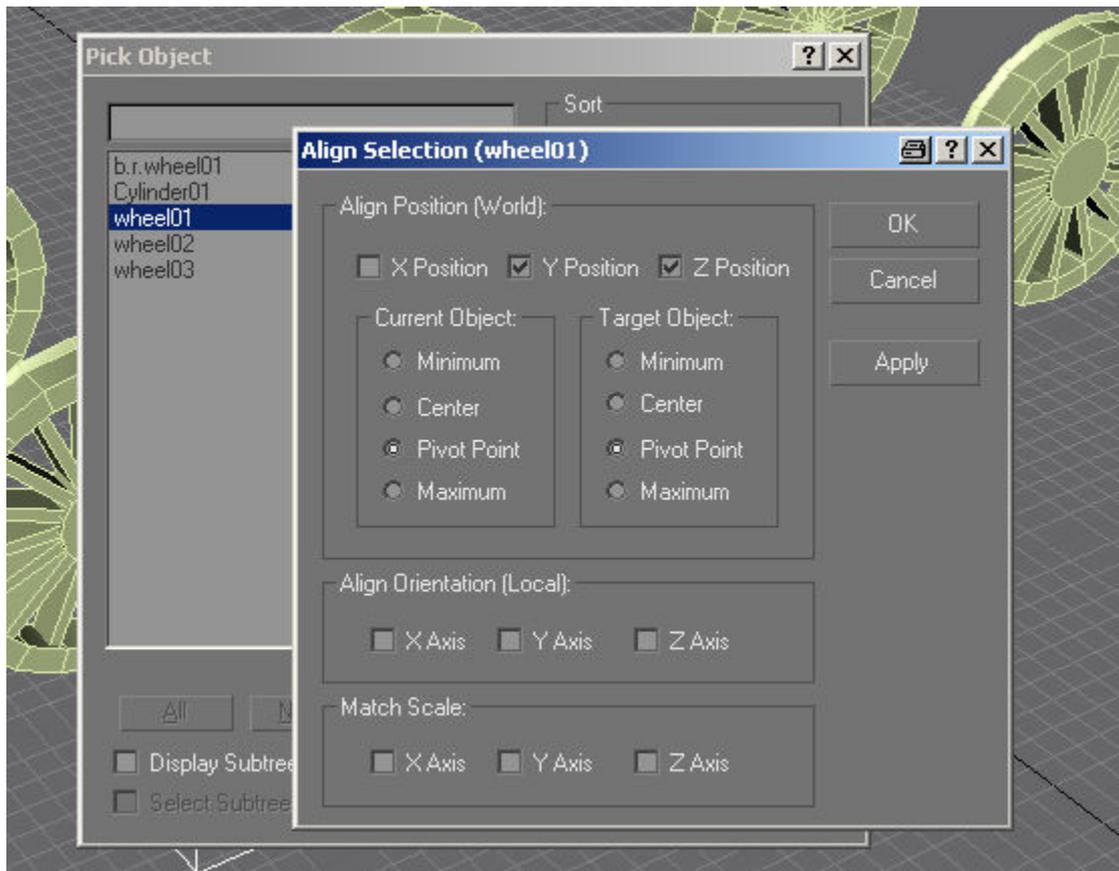
Select the 'Select and Rotate' tool in the top toolbar, and rotate the cylinder 90 degrees around the Y axis.



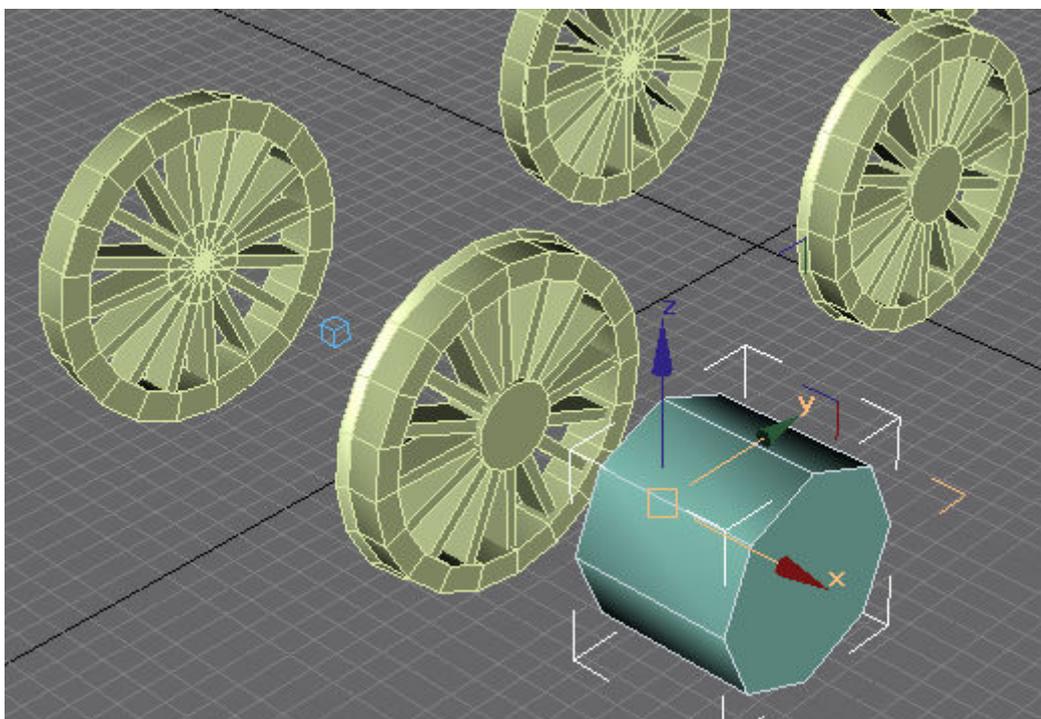
As we've still got the 'Angle Snap Toggle' icon selected the rotation will be in steps of 22,5 degrees, but this is no problem. When this icon is not selected it allows much finer control, but we don't need it in this case.

Time to look at another very useful icon in the top toolbar, 'Align'. With the cylinder selected choose 'Align' and then select 'wheel01'.

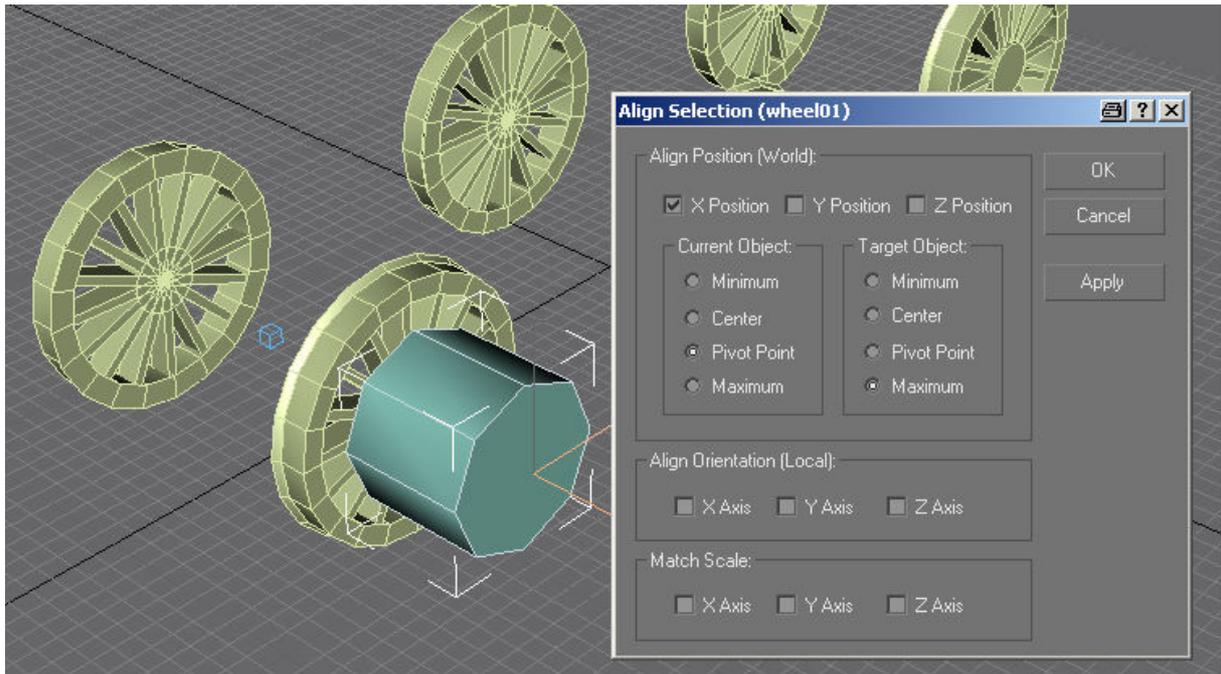




Check the Y and Z boxes of 'Align to World', and select 'Pivot Point' for 'Current Object' and 'Target Object'. Click on OK to align the cylinder.

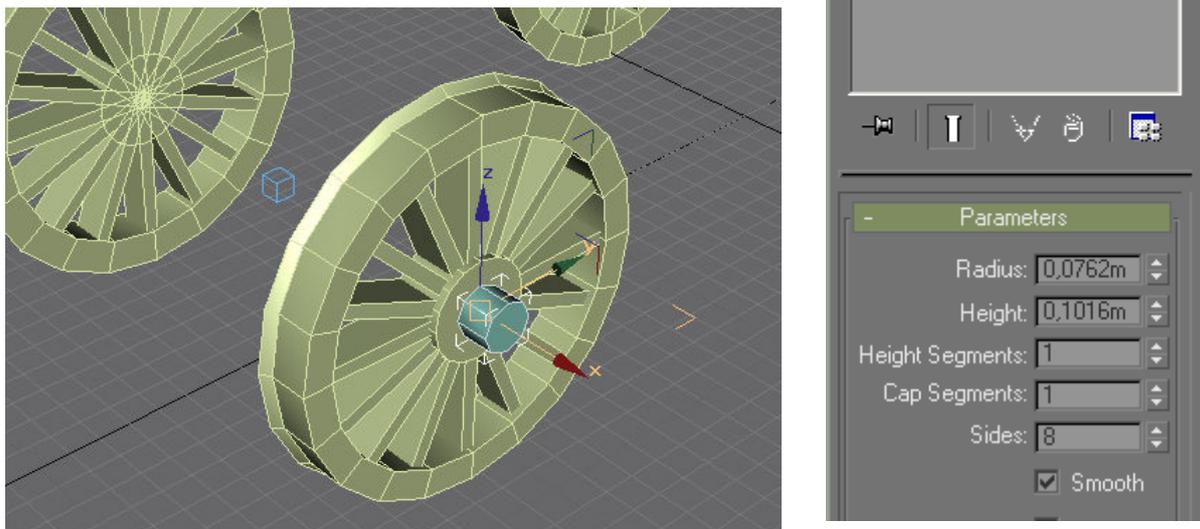


Now to align it to the face of the wheel boss. Select 'Align' again and select 'wheel01' again. This time check the X box of 'Align to World' and select 'Pivot Point' for the 'Current Object' and 'Maximum' for the 'Target Object'.



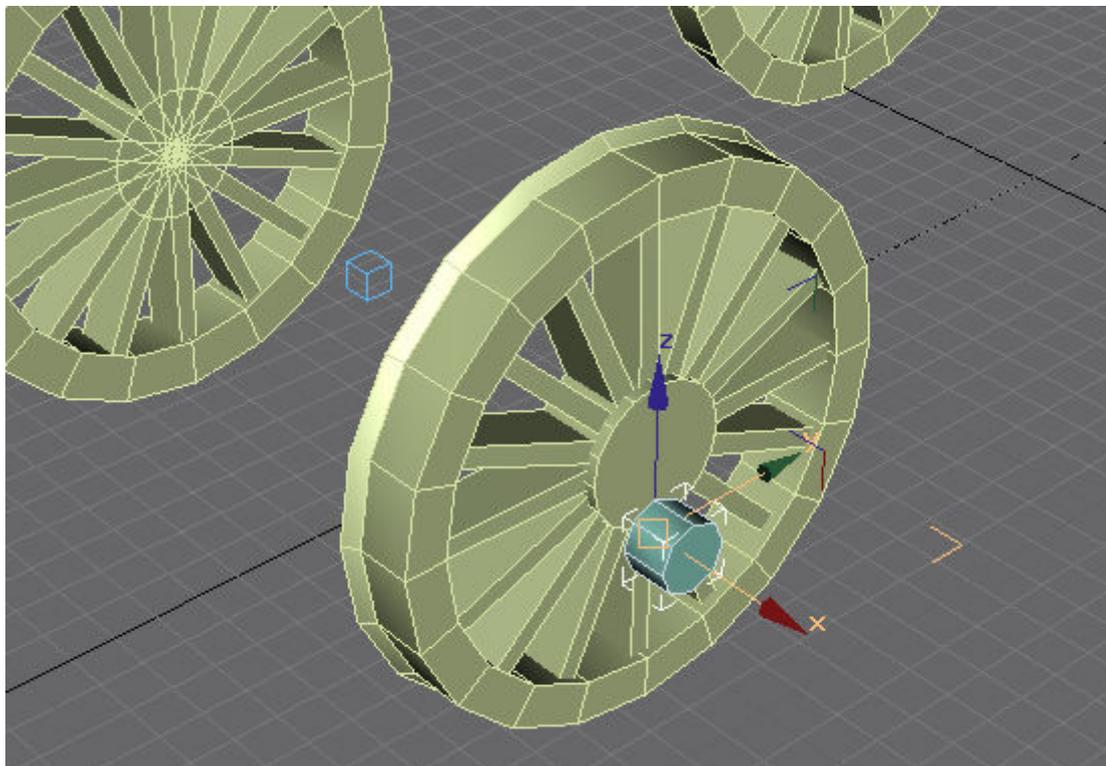
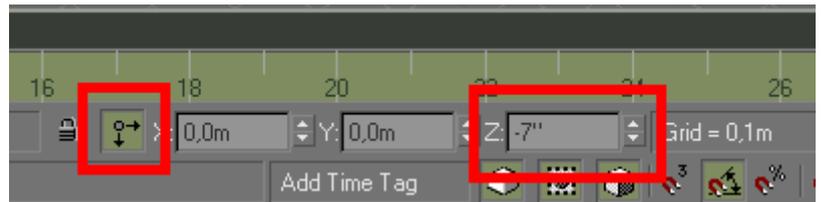
This simply aligns the pivot point with the maximum X coordinate of the 'wheel01' object. The cylinder now lies on the leftmost face of the wheel boss.

Select the 'Modify' tab now and change the parameters of the cylinder. The height should be around 5"-6" for a standard gauge loco and the diameter about 3". In the picture GMax has converted these values to metres automatically.

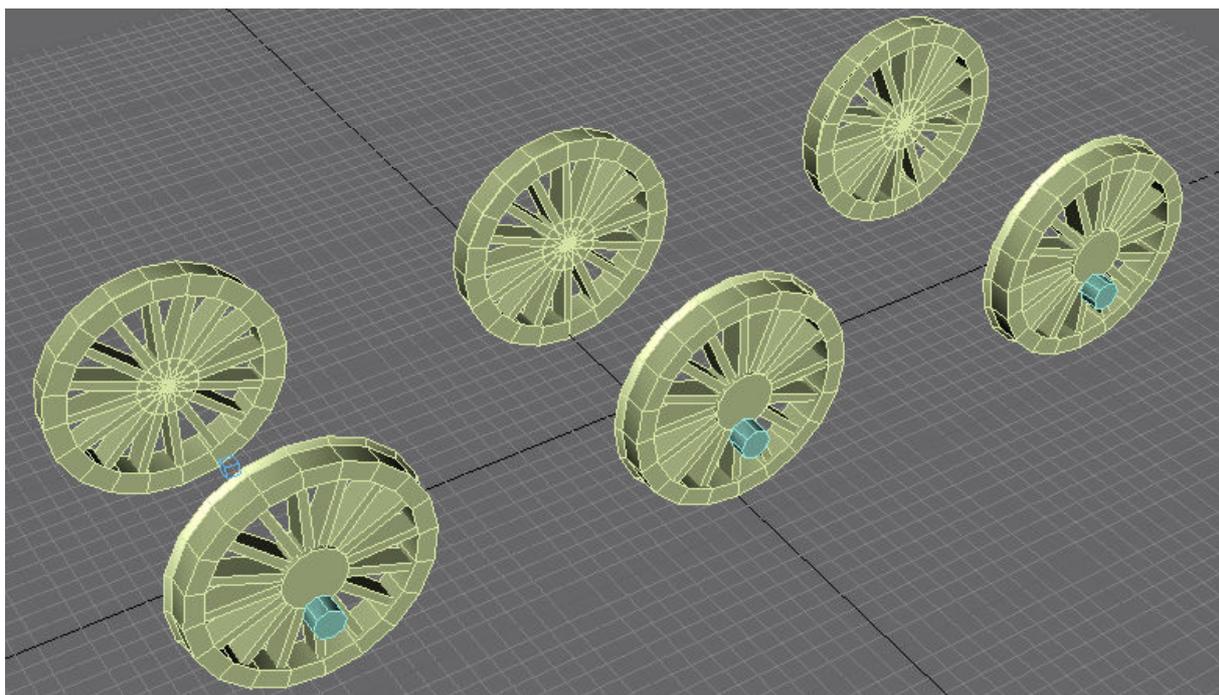


Now move the cylinder down by the amount of the crank throw. For an outside cylinder loco this will always be half the piston stroke, but an inside cylinder loco could be different. A good figure would be 7" if you were not working from scale drawings. If you are then you will know what the crank throw should be.

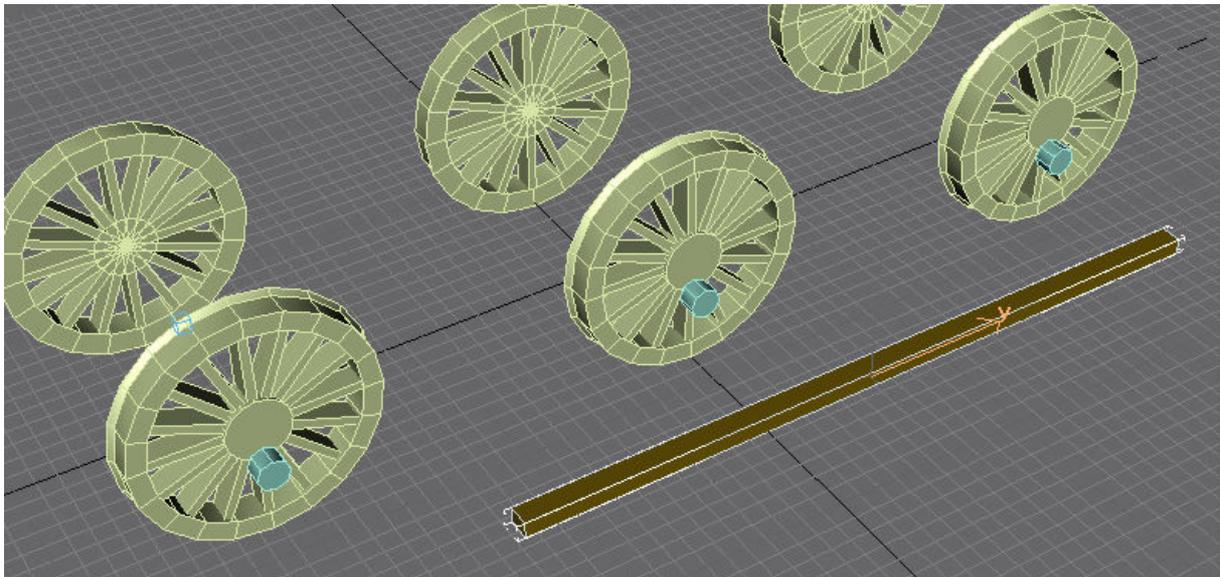
Turn on the 'Offset Mode Transform Type-in' icon and enter 7" in the Z coordinate box. This tells GMax to move the object 7" down from its current position.



Copy the cylinder rearwards twice (same way as we copied the wheel sets), aligning the pivot points of the copies with the Y pivot points of 'wheel02' and 'wheel03'.

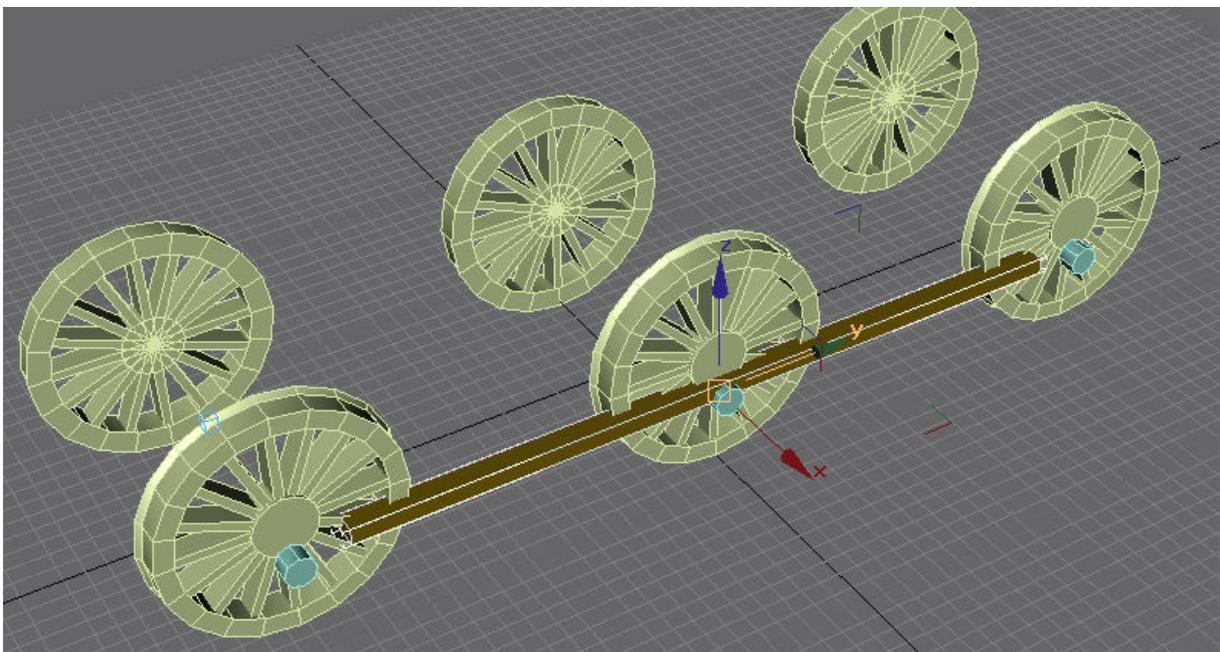


For the coupling rods we'll create a box like so, again not worrying about the actual sizes:

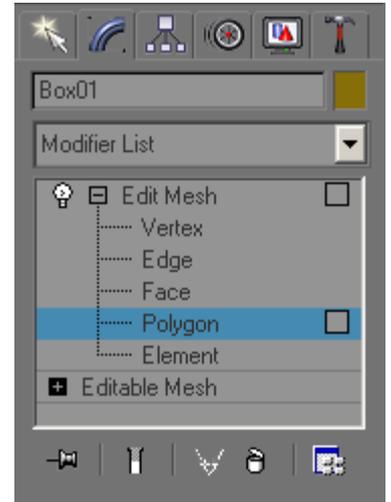
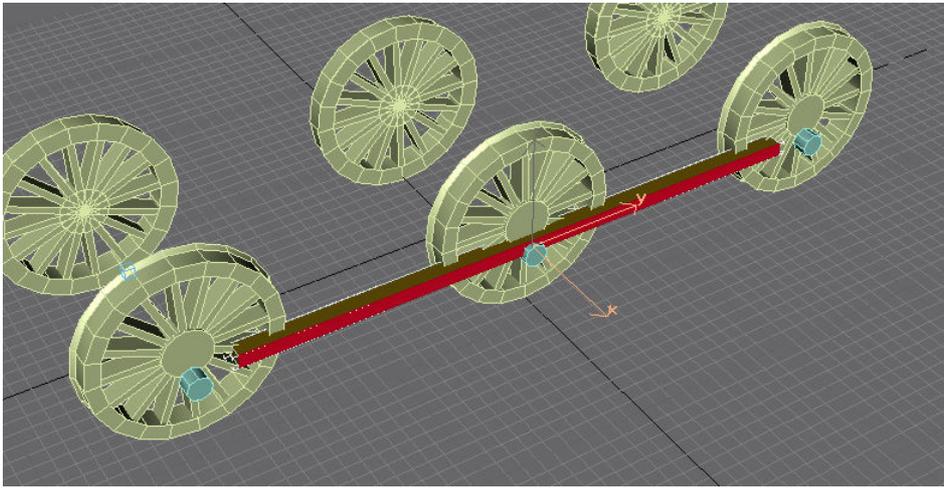


Centre the pivot point of 'Box01' to the object itself (Hierarchy tab, 'Affect Pivot Only' and 'Centre to Object')

Using our newfound knowledge align the box to the centre coupling rod boss 'Cylinder02'. (Align X,Y and Z, current and target 'Pivot point').

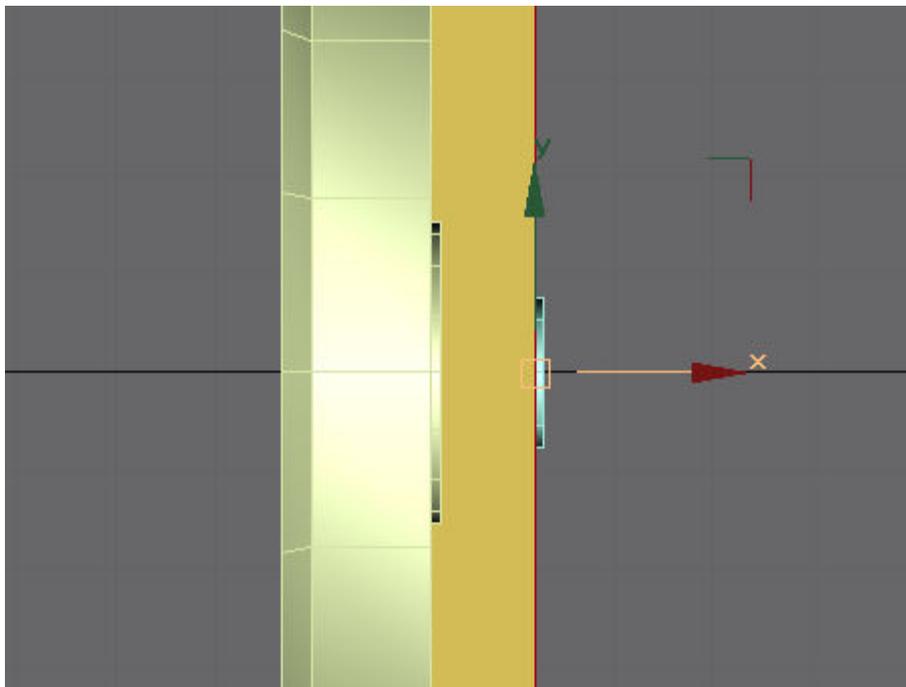


Convert 'Box01' to editable mesh and add an 'Edit Mesh' modifier to the stack. Open the modifier and select 'Polygon'. We can now select the outer face of 'Box01' to move it to the correct position.



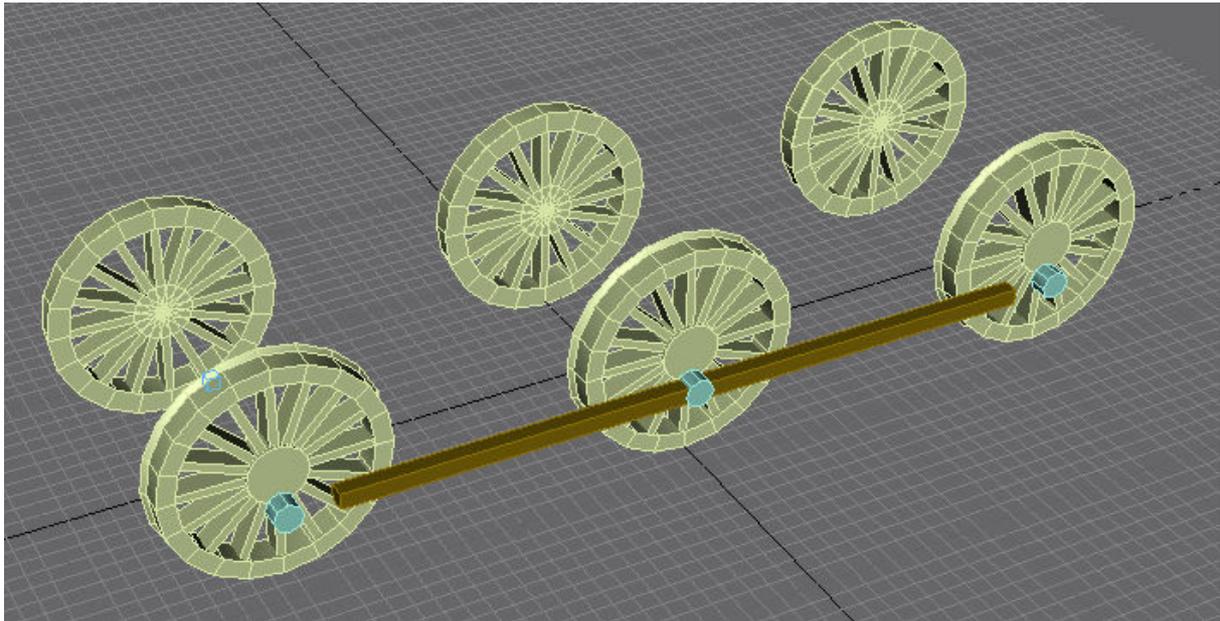
**If the polygon doesn't turn red like this hit 'F2' to turn it on – it's easier to see what is selected.**

Switch to top view (press 'T') and choose the 'Select and Move' tool.



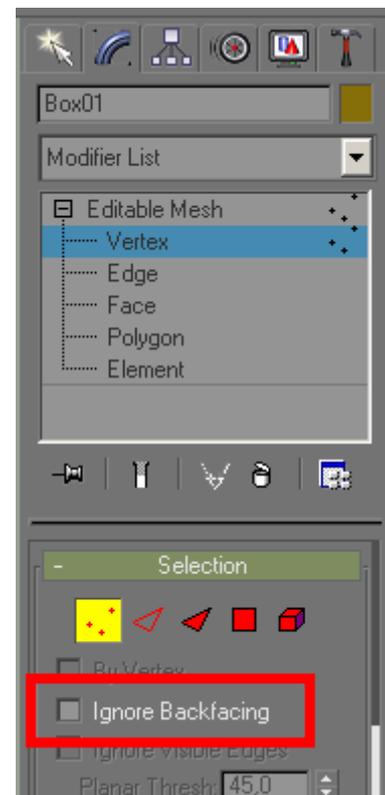
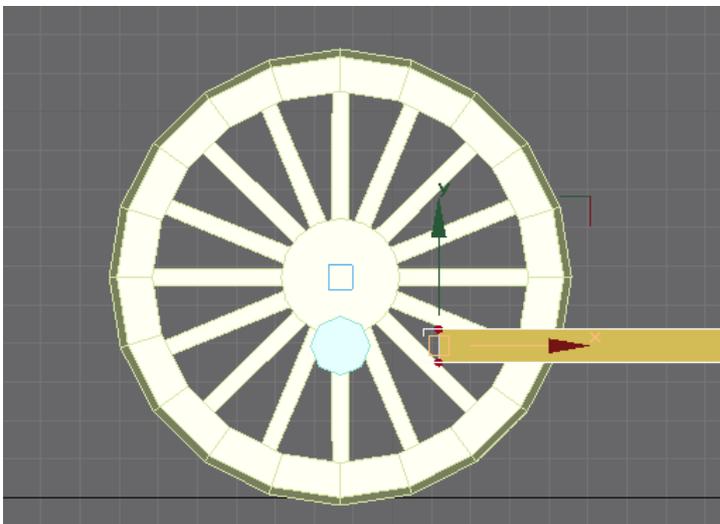
Move the face until it is just inside the outer face of Cylinder02'. Switch back to perspective view (press 'P') and repeat for the inside face of the coupling rod (it might be easier to turn off shading with 'F3' while doing this).

Collapse the stack when you are finished.



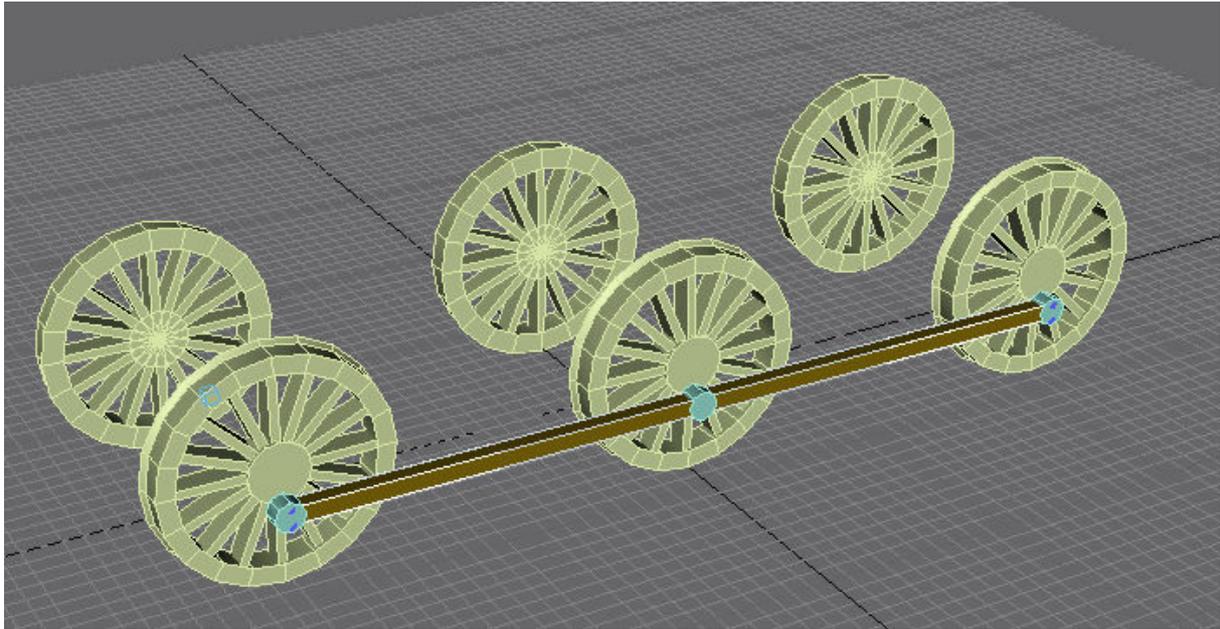
Switch to side view now (press 'R'). With 'Box01' selected open the object in the stack and choose 'Vertex'.

**Make sure that 'Ignore Backfacing' is not selected as otherwise you won't select the vertexes on the rear face of the rod!**



With 'Select and Move' selected drag select the vertexes at the front end of the rod until they line up with the centre of the front wheel (no need to be dead accurate).

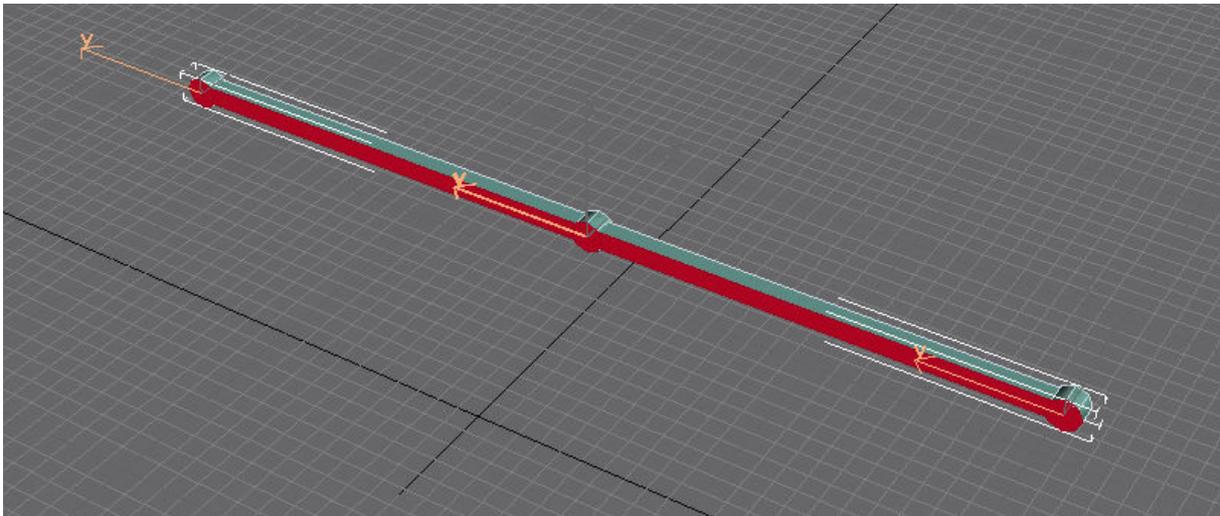
Repeat for the rear end of the rod.



Select 'Cylinder01', convert it to editable mesh and attach 'Box01', 'Cylinder02' and 'Cylinder03' to it. Rename 'Cylinder01' to 'rod\_left'.

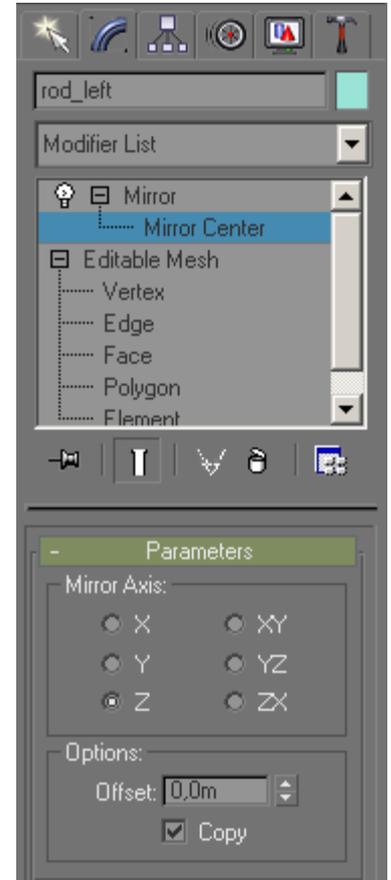
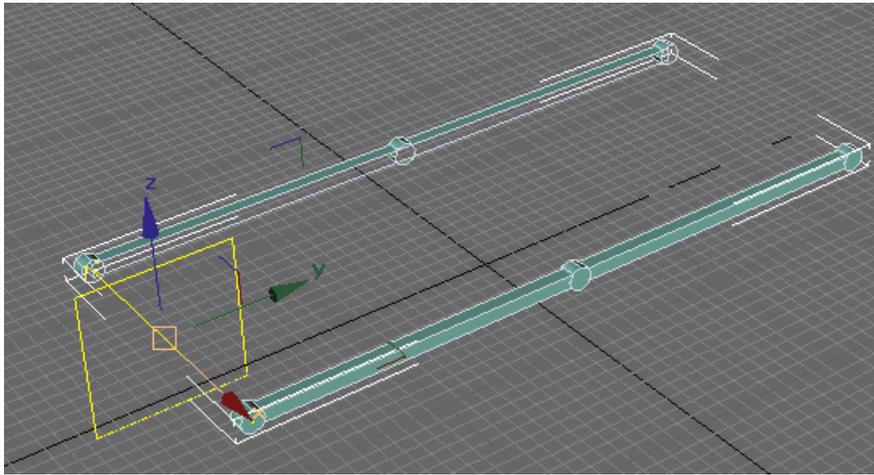
Before we mirror the rod over to the right side we should delete a few extra polys – no point in deleting them twice... With 'rod\_left' selected hit the right mouse button somewhere in the main GMax window and choose 'Hide Unselected'. Now only the left rod is visible.

Rotate the view so that you can see the rear side of the rod and select the rear faces of the rod and the bosses (ALT-middle mouse button).



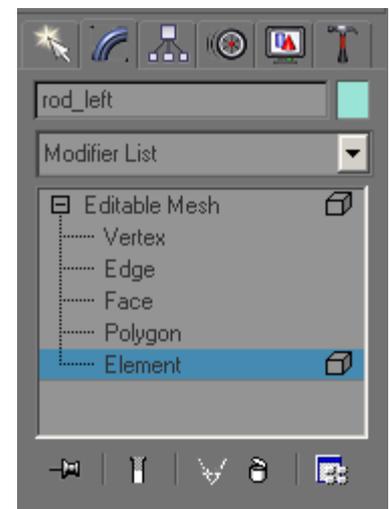
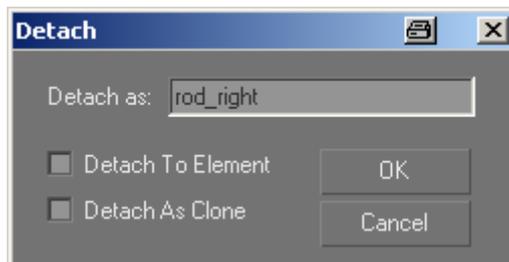
This time it might be useful to have 'Ignore Backfacing' on to avoid picking the front faces accidentally. Hit DEL to delete these faces.

Now we can create the right rod by mirroring as we did for the first wheel set.



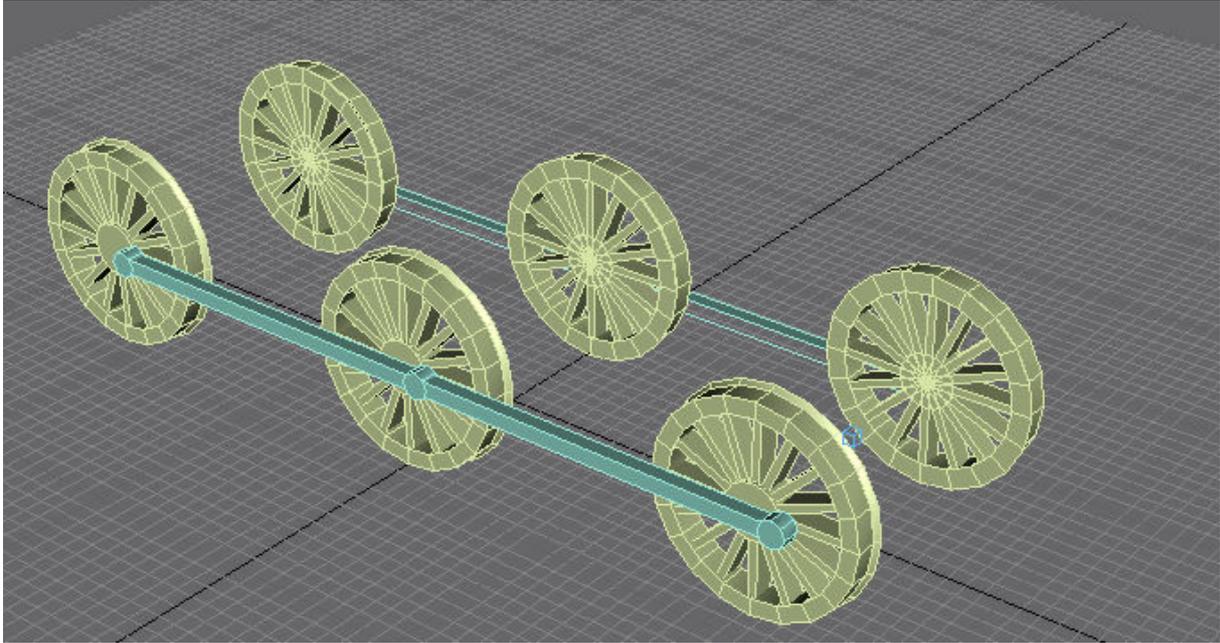
This time you'll have to move the mirror centre to X=0, and to select Z as the mirror axis.

Collapse the stack and choose 'Element'. The right rod will turn red to denote it is selected. With the right button menu choose 'Detach' and name the new object 'rod\_right'.



Right button menu again, choose 'Unhide All'. Nearly there, we just need to 'quarter' the rods now. On a steam loco (or a diesel loco with coupling rods) the rods are never, ever positioned as they are in or model at the moment (are you listening Auran?). If they were the loco could get the rods in a position that would mean they could jam. Generally the right hand rods would be 90 degrees ahead of the left hand ones (bearing in mind that left and right are from the driver's point of view looking forward).

To achieve this we need to move the right hand rod forward and up 7" (our crank throw).



That's about it for now, it's taken a while to get this far, but using the techniques you have learned so far the rest of it won't take as long.

It's certainly harder writing about it than doing it, to get this far shouldn't take more than a couple of hours if that. Now you can get hold of Part 5 of this opus and animate it....

For the impatient or the bone-idle the model so far is downloadable [here](#). I'd recommend that you make your own version though, it's the best way to learn.

I'll assume that you've now animated the bogey using the instructions in Part 5 to save going through it all again – with practice this should take about five minutes. The animated bogey is available [here](#) if you want to have a look at it to compare it with yours.

## Footplate

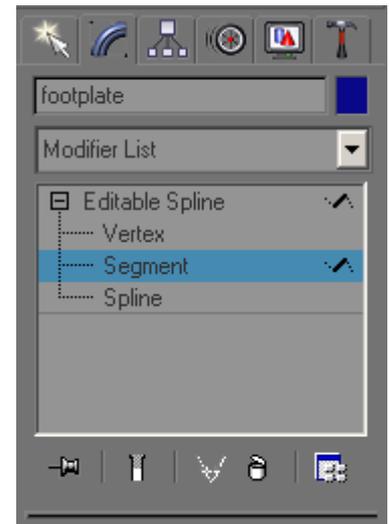
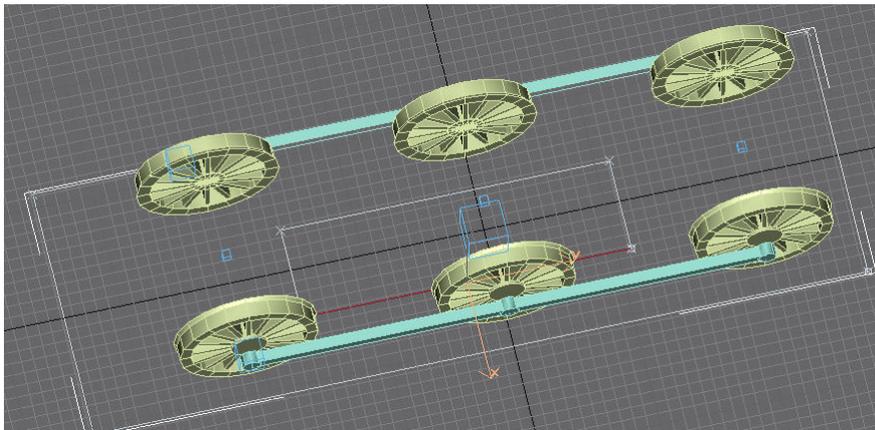
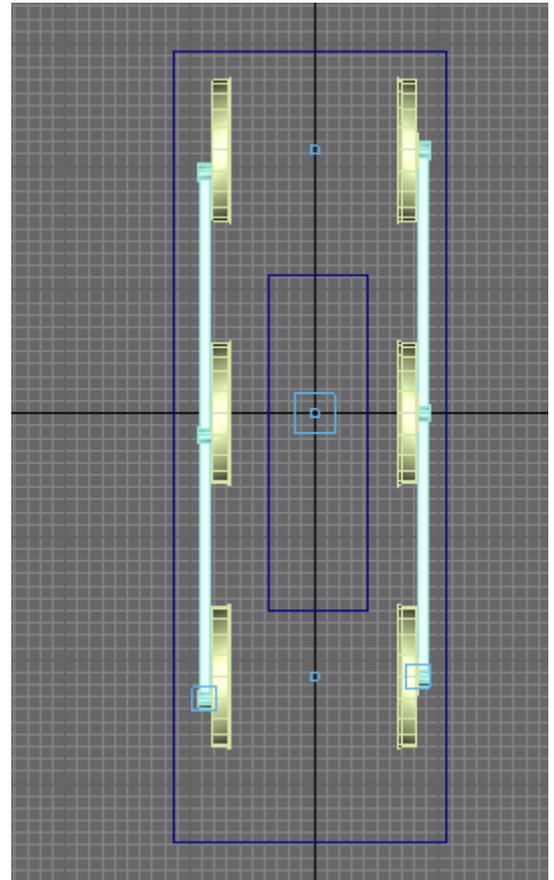
Now we'll make a start on the superstructure, beginning with the footplate. As this is a freelance loco I can make things nice and easy for myself by making the footplate straight.

Building on the information in Part 6, we'll just sketch a footplate in the top view using two rectangles, joining these together as one editable spline object named 'footplate'. Don't worry about getting the dimensions right, we'll correct these as we go.

The footplate is the two blue rectangles which we will now modify so that has the correct size and position.

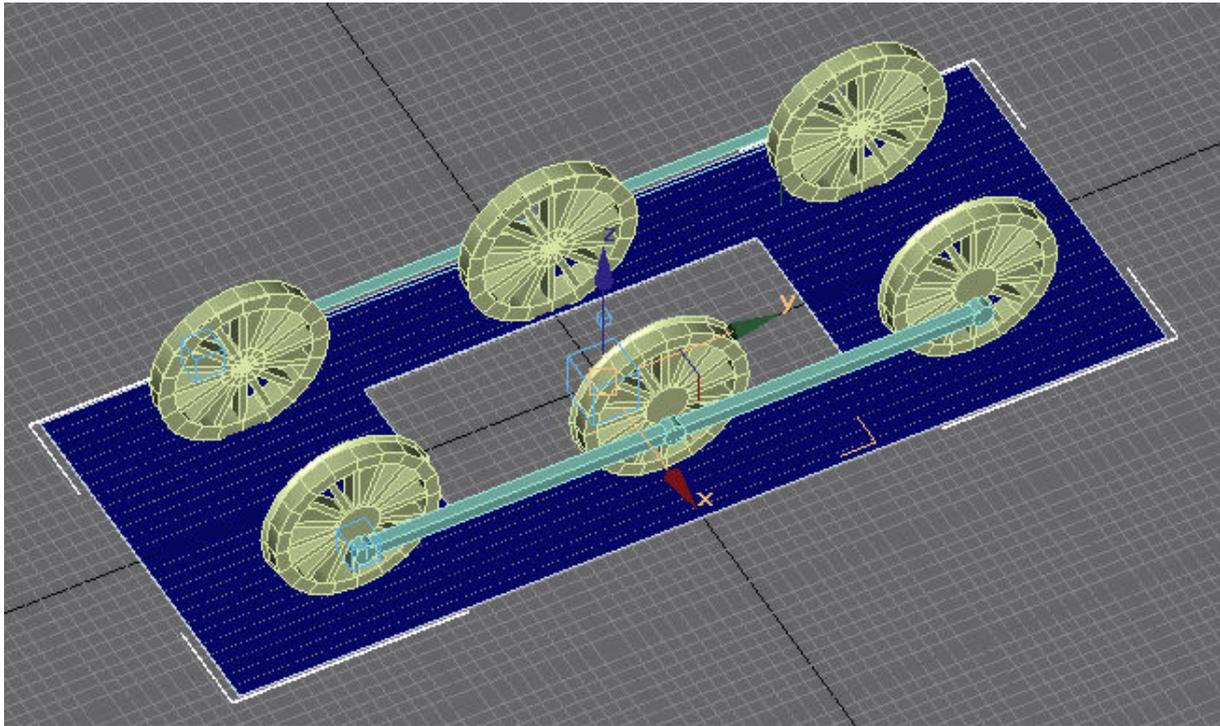
The rectangle in the centre represents the opening between the frames that was always present for access to the inside valve gear and other components. Frames were usually 4'1" apart on standard gauge locos, so select the footplate object and choose 'Segment' in the stack window.

Pick one edge of the opening as shown and select the 'Select and Move' tool - the edge will turn red. In the X coordinate box enter 24,5" (half of 4'1").

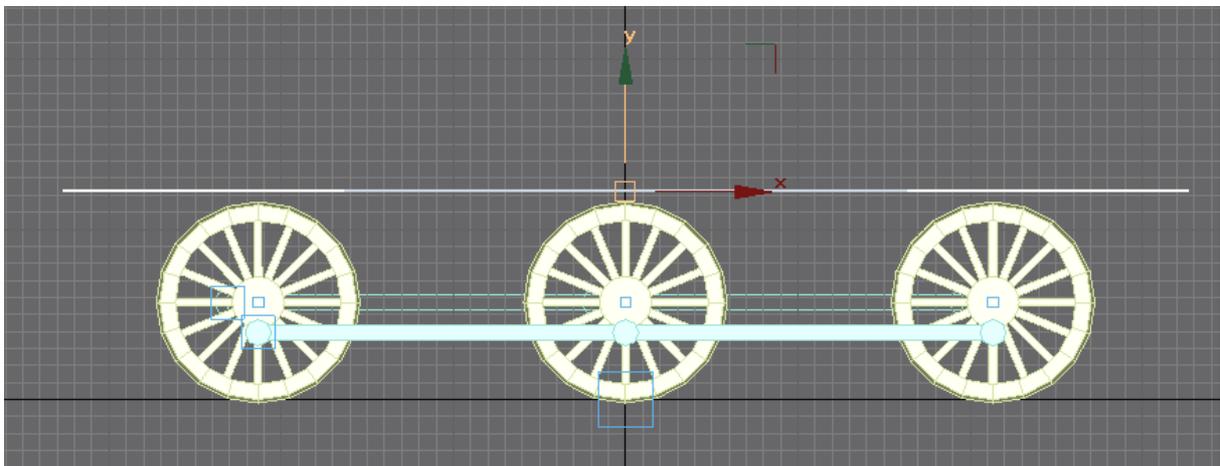


The line segment will jump to the correct position. Repeat for the right hand side of the opening remembering that the X coordinate will be negative.

Do the same to set the width of the outer rectangle to 8'6" (the usual width of a British loco) and recentre the pivot point of 'footplate' back to 0,0,0. Extrude the 'footplate' object 10mm to create a solid body.



In side view (press 'R') move the footplate up so that it is above the wheels (don't want to have to make splashers do we?)

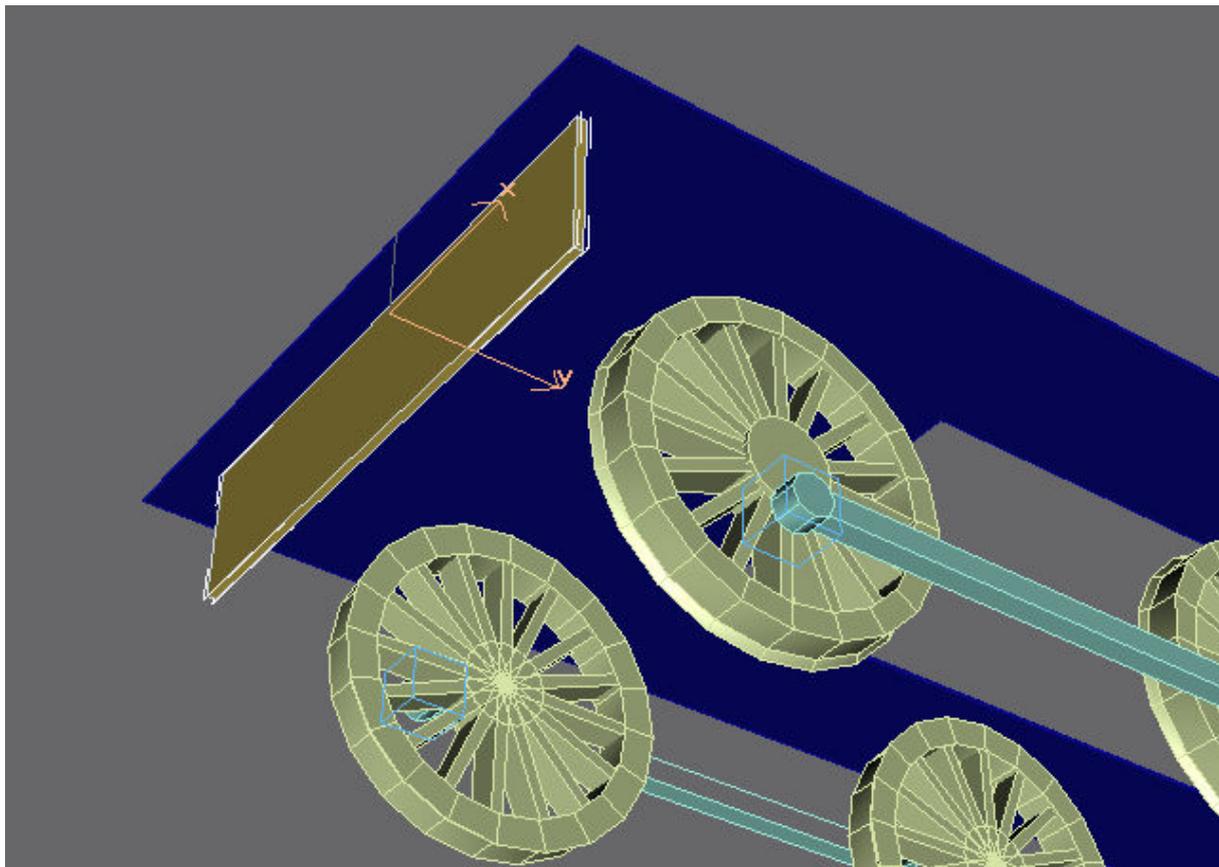


We'll adjust the final height and length once we've got the buffer beams, buffers and valances on.

## Buffer Beams

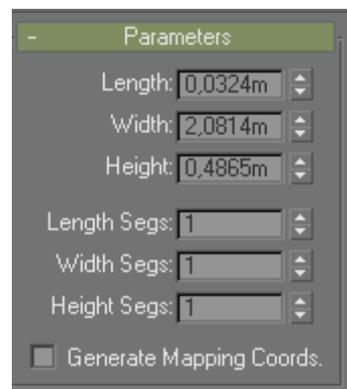
For the buffer beams it's easiest to use a box as this can be directly built on the underside of the footplate. Turn the model round so you can see the underside of the footplate and create a box. Make sure that 'Auto Grid' is turned on, this enables you to use an existing face to create the new object on.

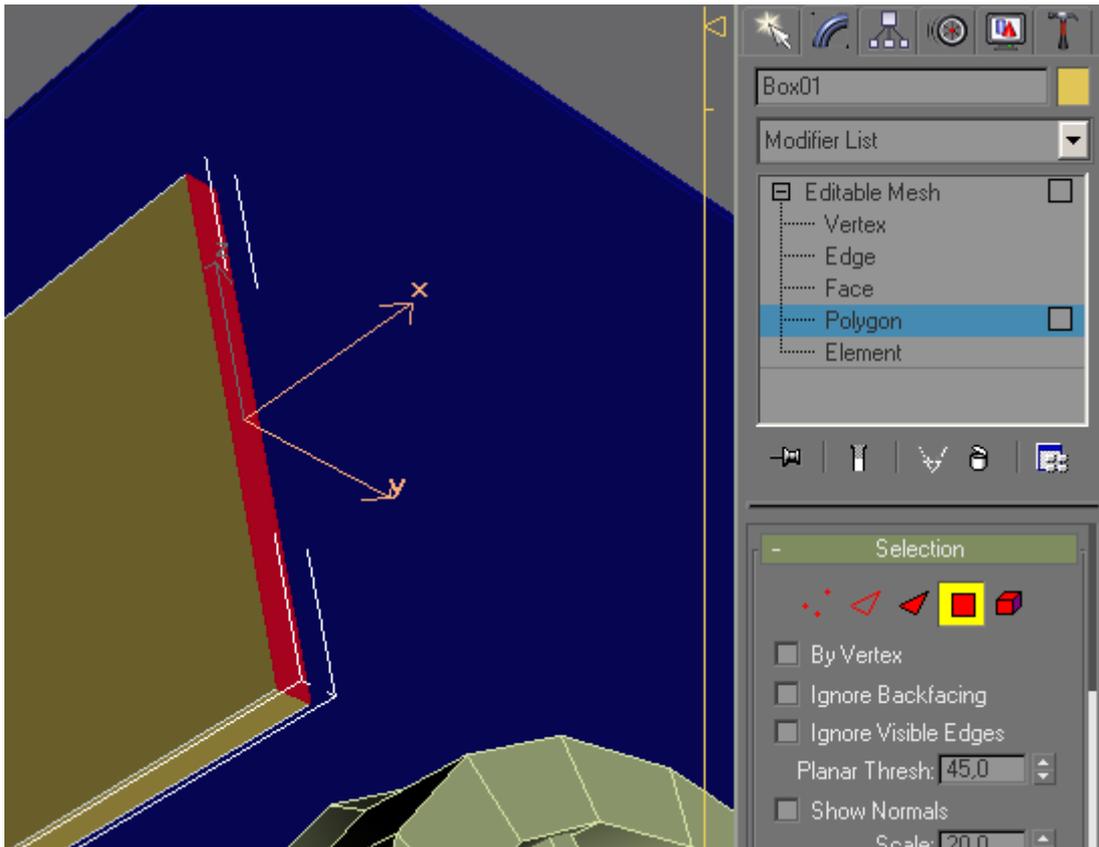
I've turned off the grid with the 'G' key as it was getting in the way when looking from underneath.



Go to the 'Modify' tab now and adjust the thickness of the beam – in this case the 'Length' parameter. Actually I got it about right for a steel beam, these would normally be made out of the same material as the mainframes at about 1 ¼" thick (around 32mm). Trainz models often seem to have buffer beams that are much too thick for some reason.

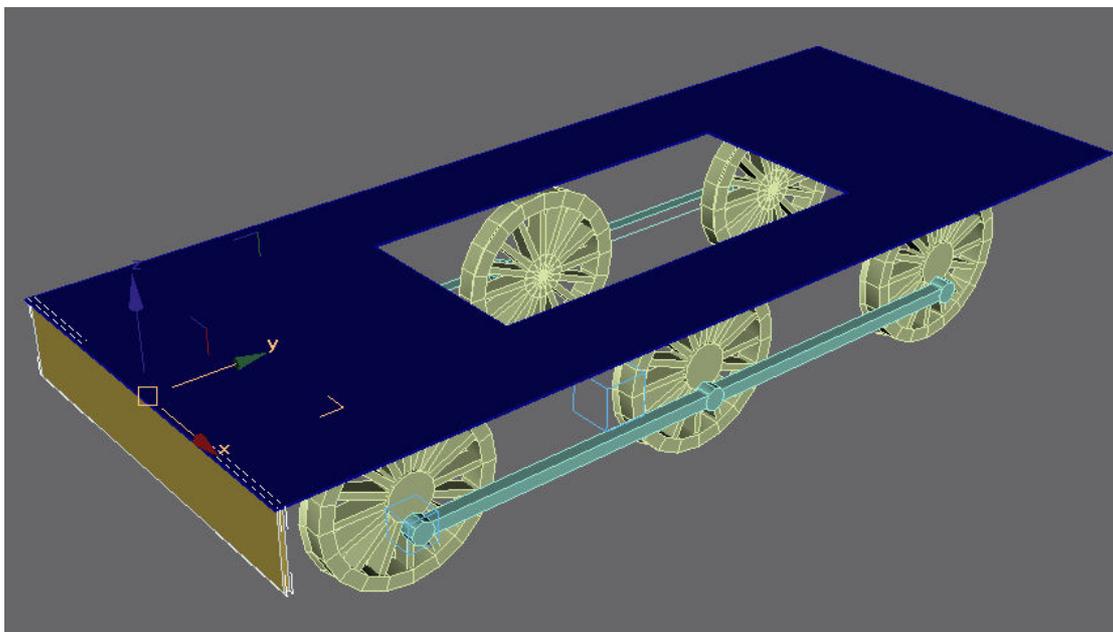
We now have to adjust the width to be say 20mm less than the footplate each side. Convert the 'Box01' object to editable mesh and select the left hand face.





Using the 'Align' tool make the beam the same width as the footplate (Align to maximum X of the footplate). While the polygon is still selected turn on 'Absolute Mode Transform Type-in' and move the poly 20mm in the -X direction. Repeat for the right hand side.

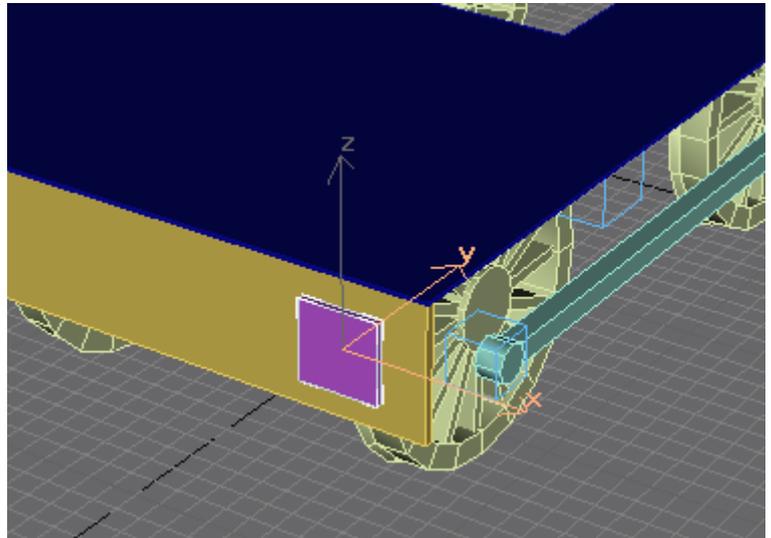
Now move the whole beam to the front edge of the footplate using 'Align' (Align min Y to min Y) and then rearwards 20mm. **Make sure that 'Editable Mesh' is active in the stack this time and not 'Polygon' as we want to move the whole object.**



That's the buffer beam positioned, now for the buffers.

## Buffers

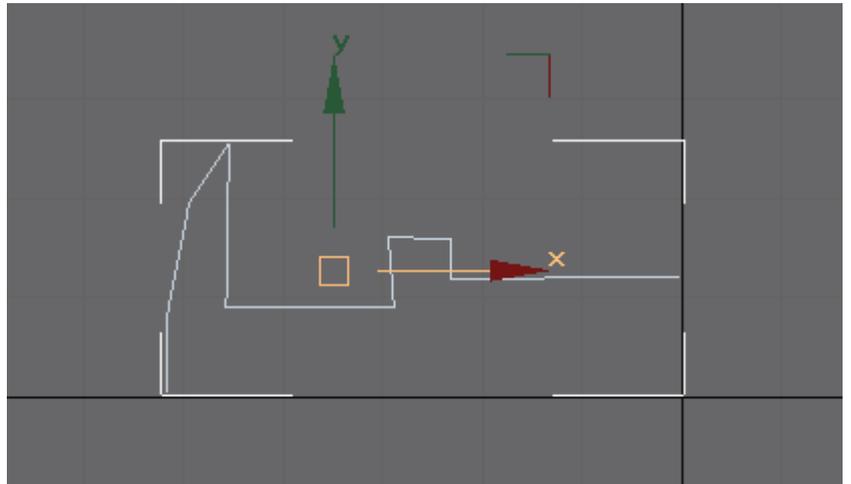
Create a box on the front face of the buffer beam using 'Auto Grid' (I don't need to explain that again do I?). In the 'Modify' tab change the parameters for the length to 11", width 11" and height 1". These are fairly typical dimensions for British locos.



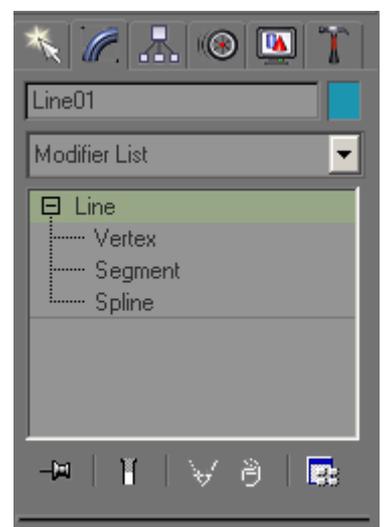
The buffers are always positioned in the same place, on 5'8" centres and 3'5¼" above the rail level (obvious really that the buffers have to have a standard position, although very early locos had the buffers an inch or two lower).

Move the pivot point of the box back to the centre of the object. 5'8" is 68", half of which is 34" and the height is 41,25". Select the 'Select and Move' tool and move the box to this position.

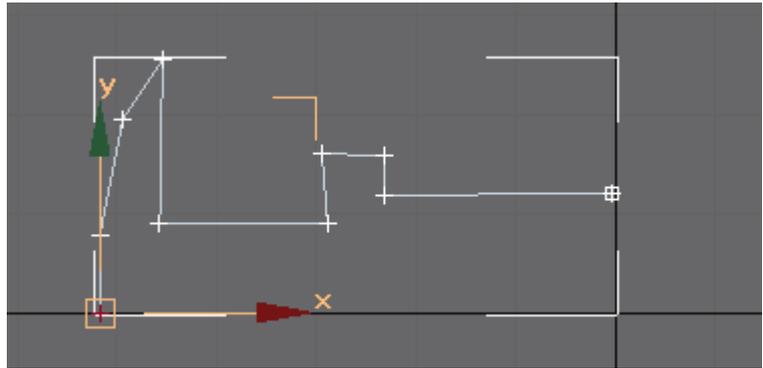
For the buffer housing and head I've hidden everything and have sketched (in the side view) the rough shape. The right hand end of the buffer is at 0,0. Sketching around the 0,0,0 point makes it easier to relocate the lathe axis later as we'll see.



Open the 'Line01' element in the modifier stack and select 'Vertex'. Now we have to correct the position of each of the vertex points.

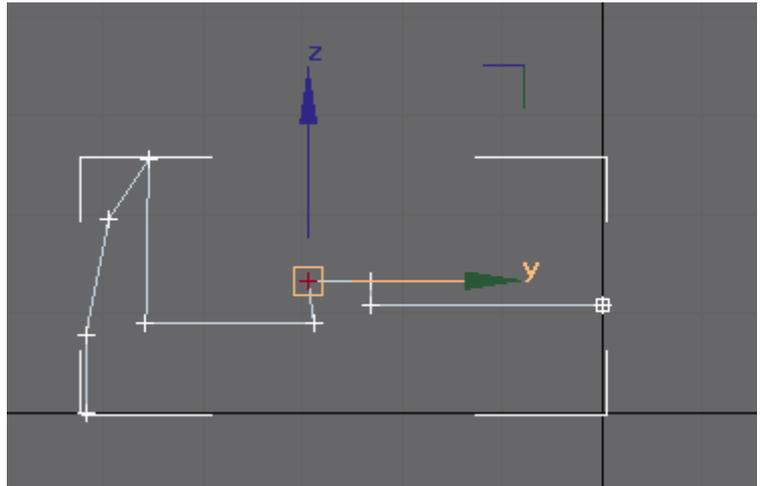


The right hand point should be at  $X=0$ , and the other end point at the centre of the buffer head should be at  $Z=0$ , so position these two points first.



The diameter of the housing will be 9,5", to the two rightmost points should be at  $Z=4,25$ " (see what I mean about it being easier to build the buffer at the 0,0,0 point?).

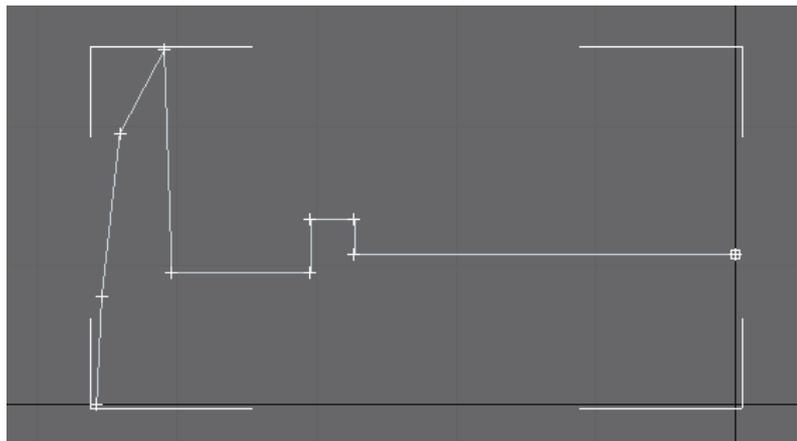
Don't forget that once you have the value you want in the coordinate boxes you can copy it with CTRL-C and paste it back in again for the second point with CTRL-V – saves typing.



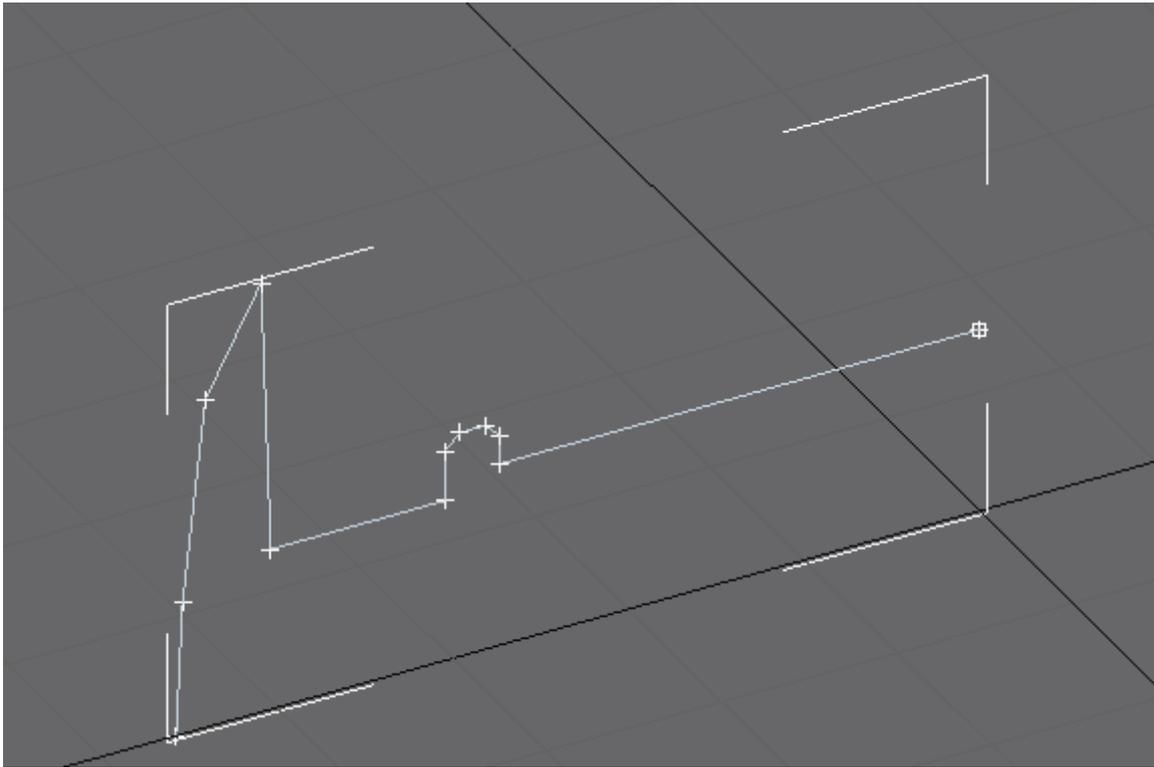
Carry on correcting the shape of the buffer until you are happy with it. The overall length from buffer beam to buffer head should be about 1'6"-1'8" although if you are planning to use BlueStar couplers (working ones) then the distance should be 1'6" to match the couplings.

Also note that the buffer head has been sketched as three line segments rather than using a curve. This is more than accurate enough and keeps the poly count down.

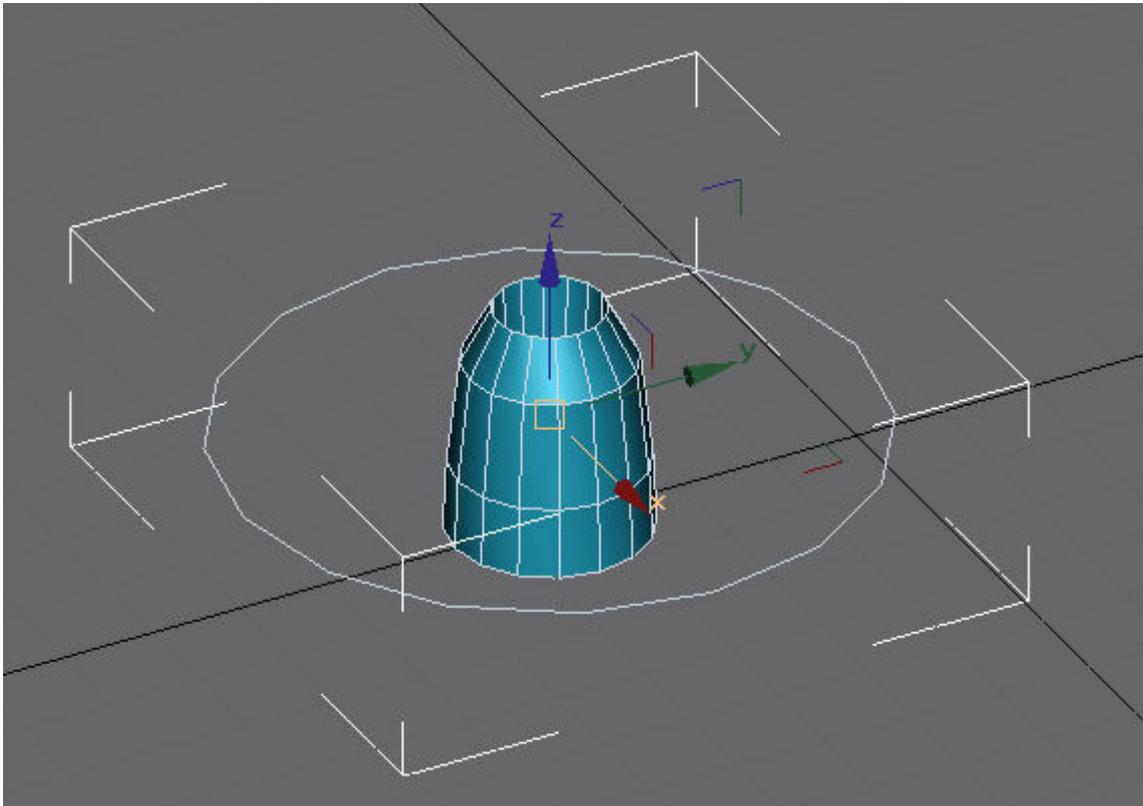
The buffer head diameter should be about 1'8".



Now we can lathe the line to create or buffer mesh.

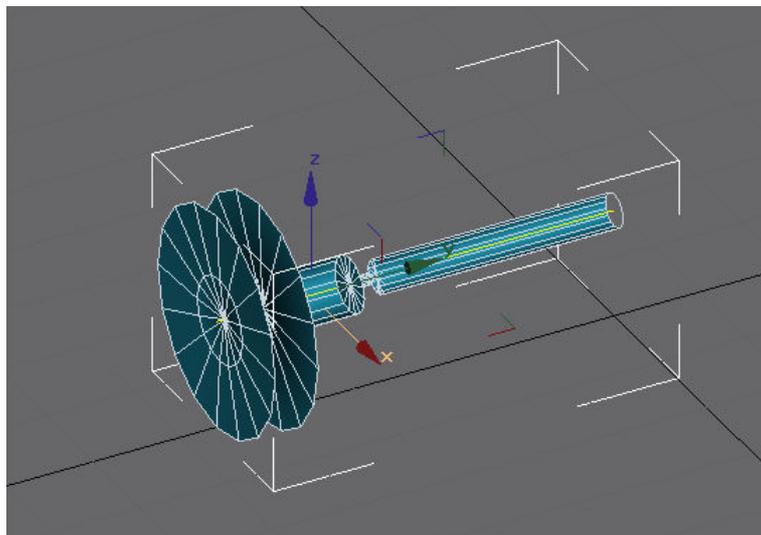
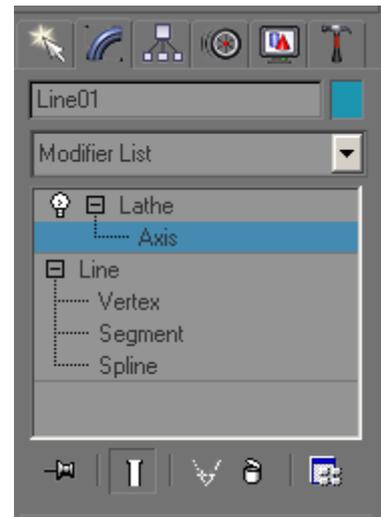


Before we do though I've added a chamfer to two of the vertexes to round them off – again not a fillet to save polys.

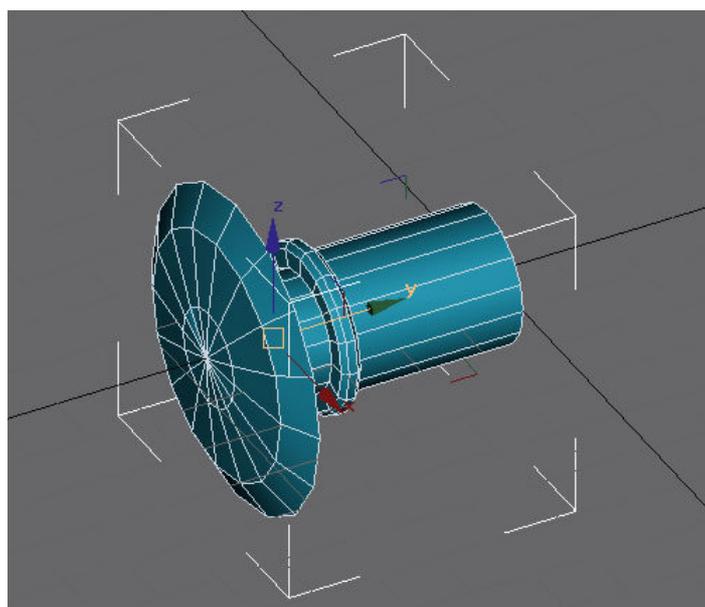


The 'Lathe' modifier has once again produced a strange result, the axis needs manipulating.

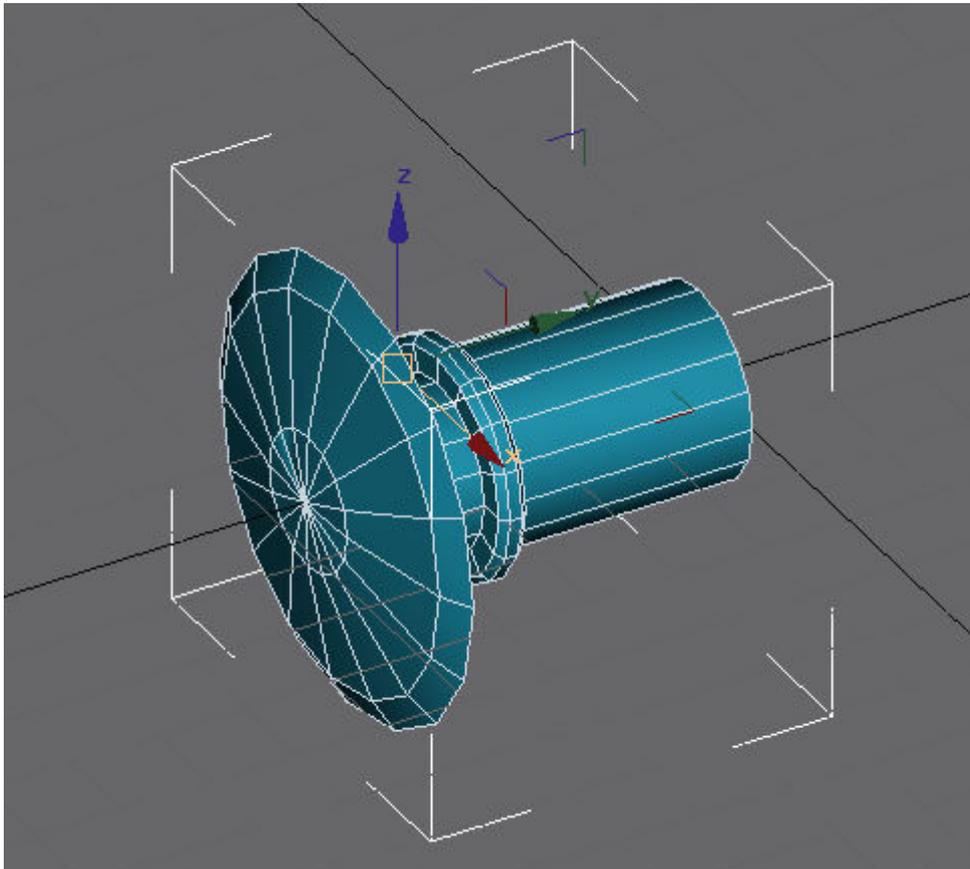
Open the 'Lathe' modifier and select 'Axis'. Rotate the axis 90 degrees about X.



Now move the axis to Z=0. That's more like it.



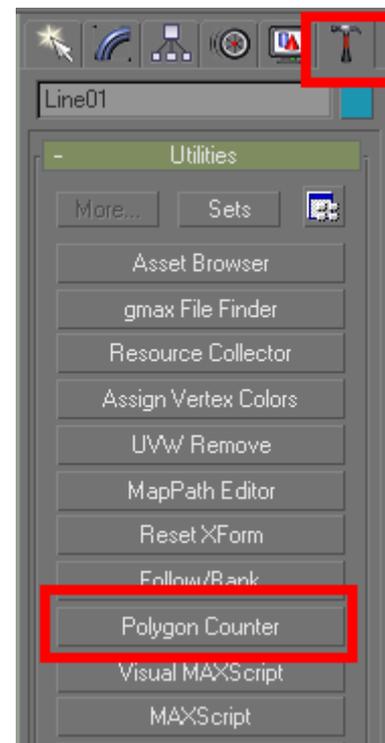
If you select 'Line01' in the modifier stack again you'll be able to move the vertex points of the line around to correct the shape. Selecting 'Lathe' will display the edited mesh again. Here I've corrected the shape a little.



Let's have a look at the poly count for this object – the counter is found on the 'Utility' tab.

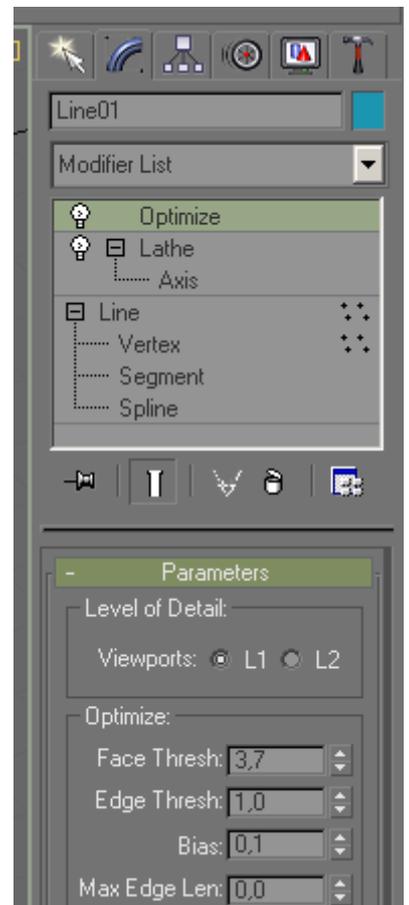
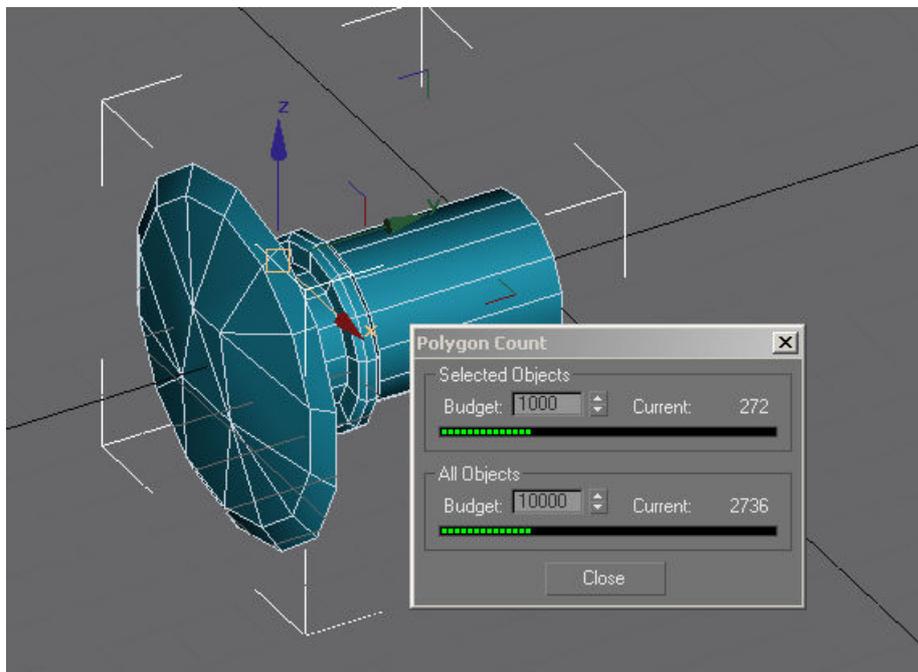
352 is on the high side bearing in mind we'll have 4 of them...

**Especially with round objects you should keep the number of segments as low as possible.**



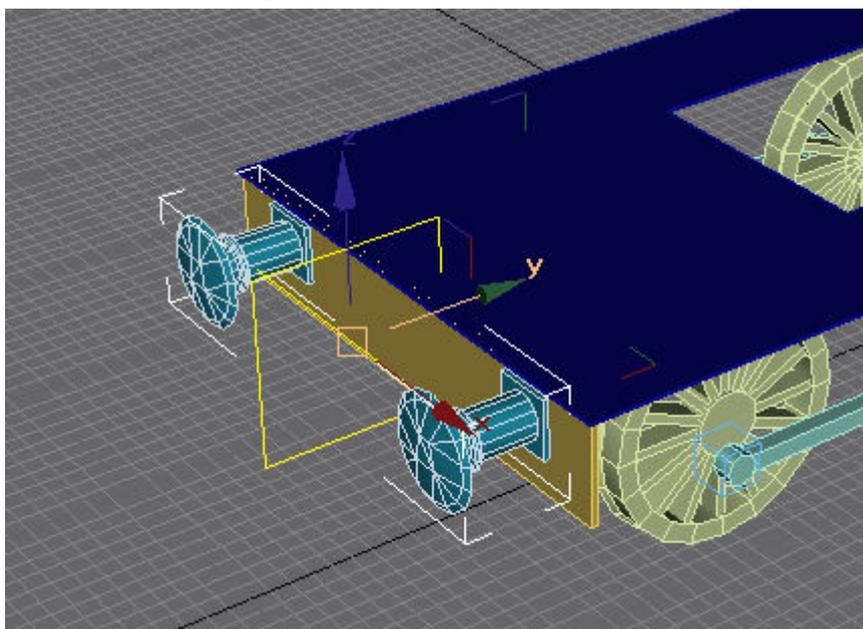
In the 'Modify' tab have a look at the parameters for the 'Lathe' modifier. In fact just selecting 'Weld Core' reduces the poly count to 336. Reducing the number of segments to 14 as well brings us down to 294. If you are unsure of what you can get away with it's a good idea to save the buffer object at this stage while you can still easily modify it. Once to has been converted to editable mesh it won't be so easy.

Something else that can help with the poly count on round objects is the 'Optimise' modifier, a little playing around here can also save a few polys.

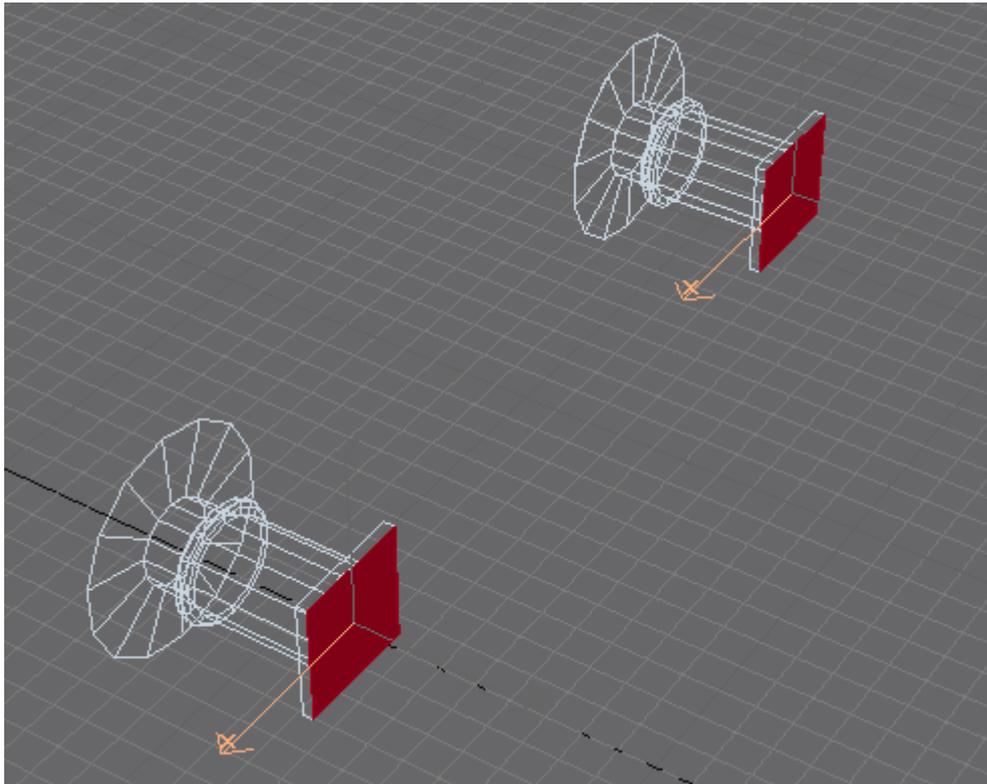


Down to 272 now, a saving of 320 for the whole loco. There are other possibilities for reducing the count still further, we'll look at these another time.

Move the pivot point to the centre of the buffer and align it to the box we added to the buffer beam. Rename 'Line01' to 'buffer', attach the box to it and then mirror the completed buffer over to the right side.

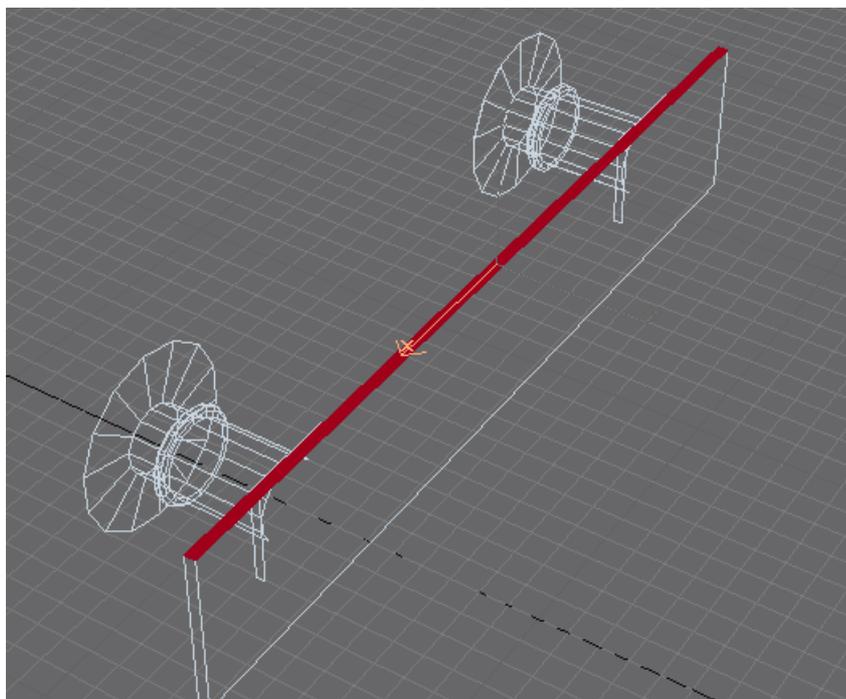


Hide everything but the 'buffer' object.

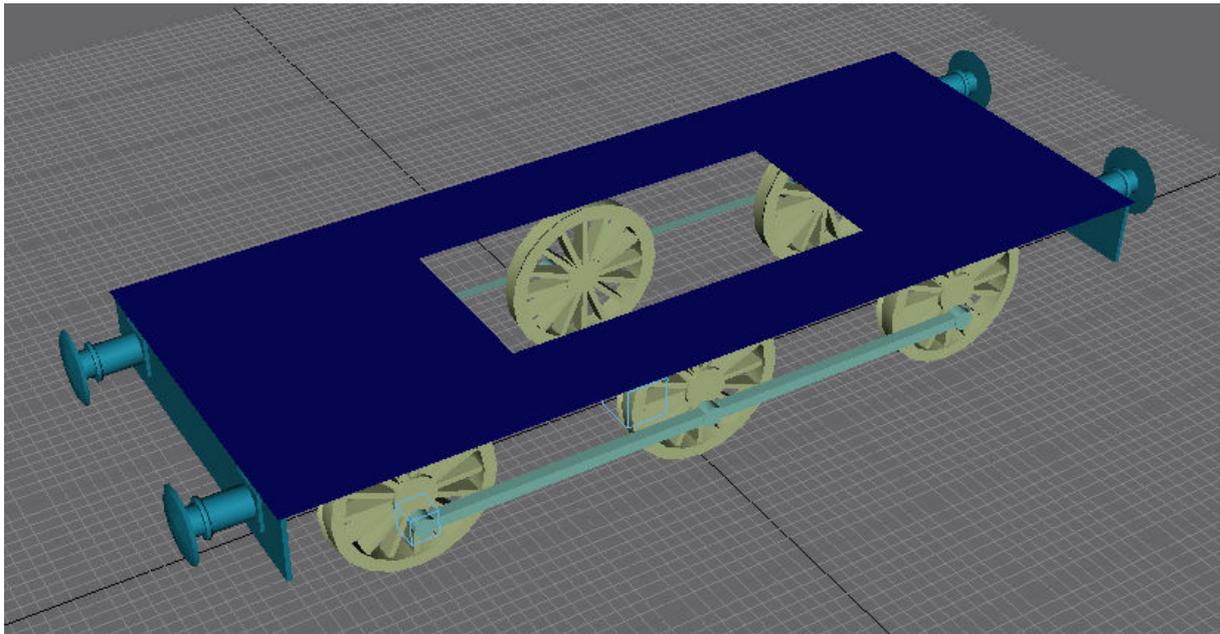


There are a couple of faces on the rear of the buffers that can't be seen in the finished model, so select and delete them.

Now unhide everything and hide everything but the buffers and the buffer beam. Attach the beam to the 'buffer' object and delete the face on the top edge of the beam.



The buffer beam complete with buffers can now be mirrored to the rear of the loco.

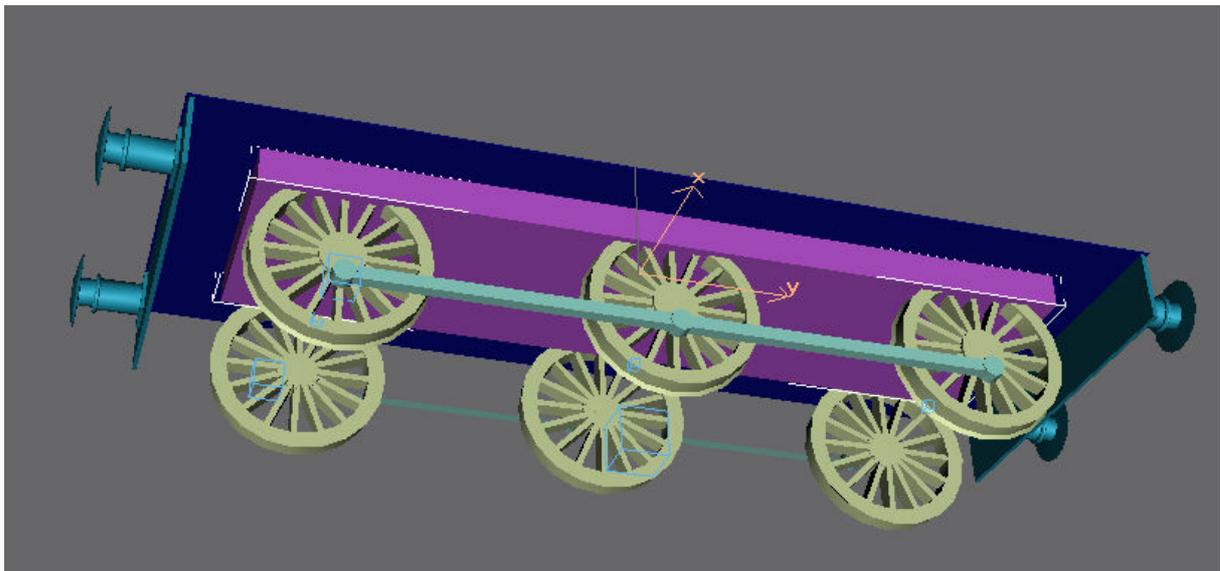


Quite a few of the basic techniques have been covered now, **it's worth practising as much as possible though to save time and effort later. Especially important are moving pivot points, aligning objects to each other and the use of the 'Mirror' modifier. All of these should become second nature!**

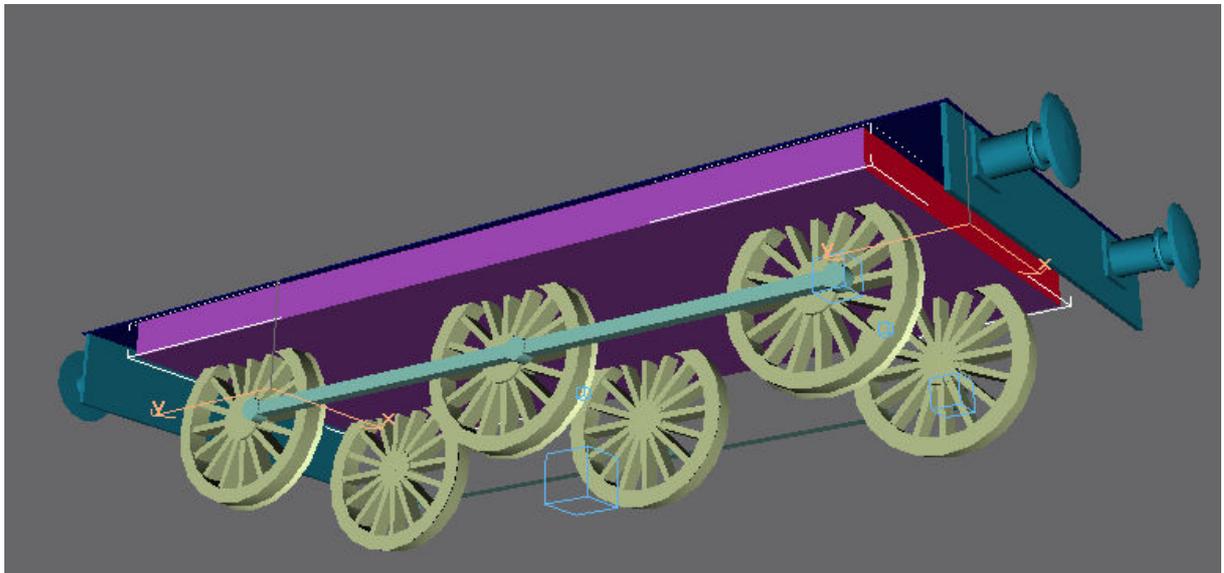
## Valances

These are the reinforcing angles beneath the footplate between the buffer beams. If they have a complicated shape I'd sketch the shape as a spline in side view, but here we're making life easy for ourselves so we'll use a box.

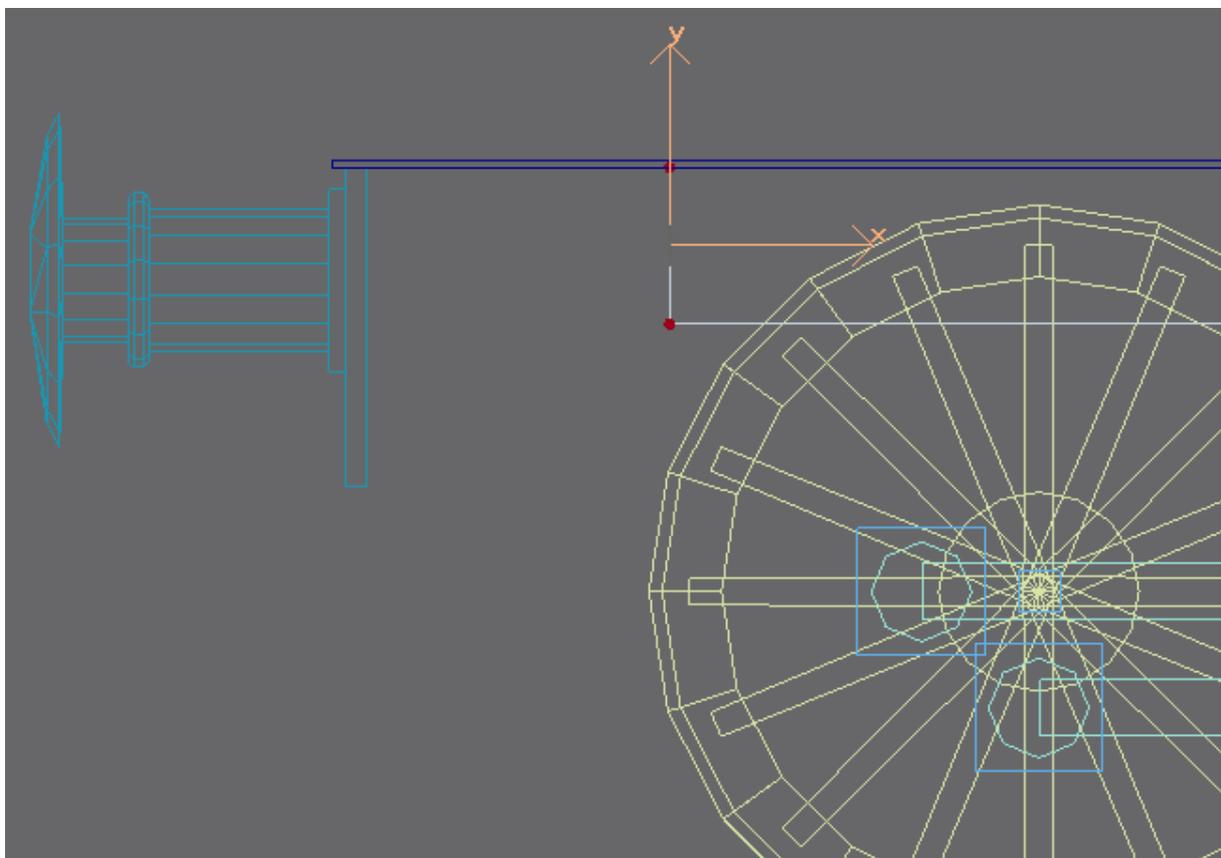
In the same way that we did the buffer beam, sketch a box on the underside of the footplate using 'Auto Grid'.



Modify the width of the box to be 50mm or so less than the width of the footplate on both sides. Select and delete the faces at each end, as they won't be visible later. **You can use the CTRL key to select several faces at once by the way.**

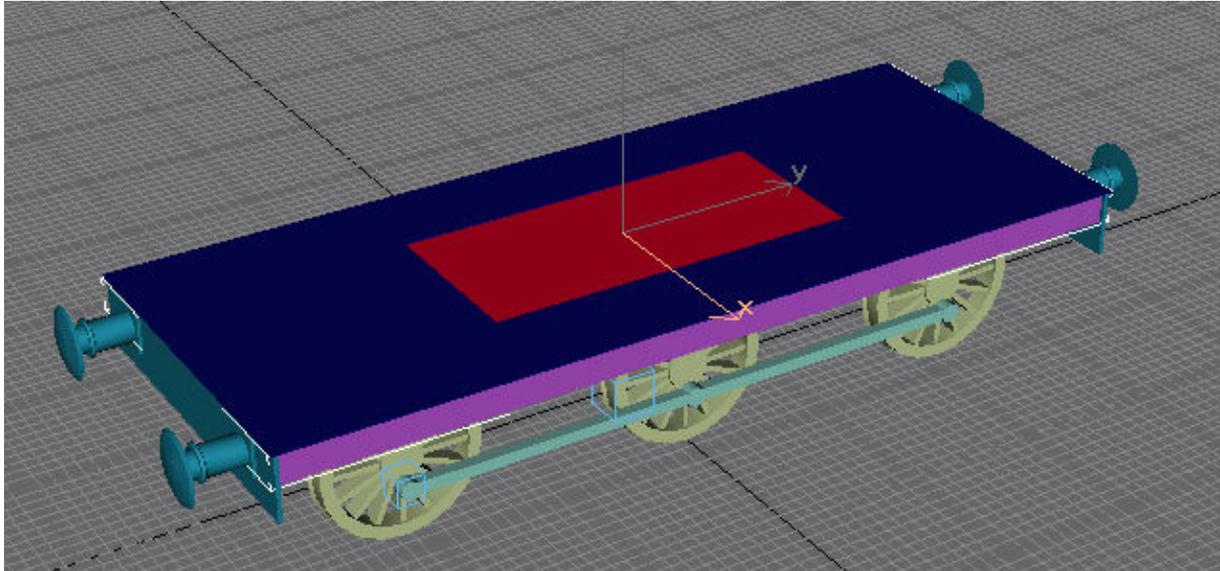


To lengthen the box so that it butts up against each buffer beam we could use 'Align', but as both buffer beams are one object this is not so easy. We could create two temporary boxes using 'Auto Grid' on the back faces of the buffer beams, but in this case we'll just eyeball it in the side view.

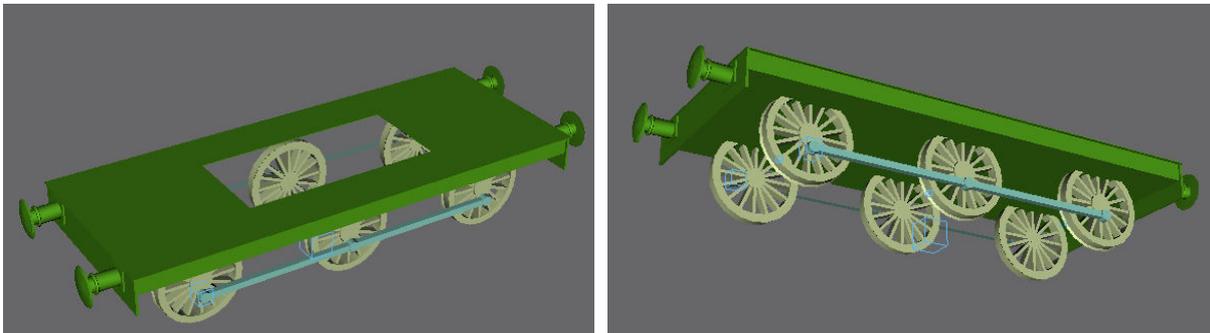


I've turned off the shading with 'F3' and selected 'Vertex' in the modifier stack for the valance object. Select and drag the vertexes until they butt up against the buffer beams.

**Make sure that 'Ignore Backfacing' is turned off otherwise you won't select all of the vertexes!**



Now select and delete the top polygon of the valance object, it's blocking the opening in the footplate. Select the footplate object, collapse the stack and attach the buffers and valances to it to make one object.

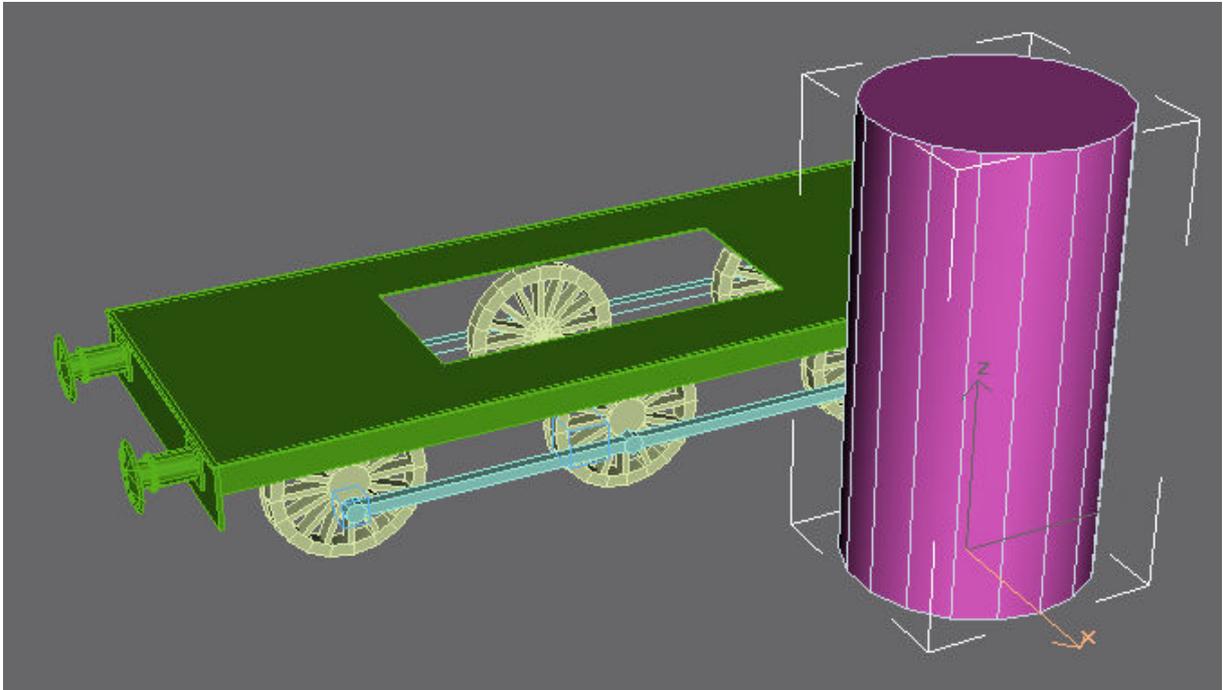


A useful side effect of the fact that GMax normally produces single sided polygons can be seen when viewing the footplate from the top and from underneath. From the top the footplate is open because the bottom poly of the valance is facing downwards. Only when looking from underneath can this poly be seen which is exactly what we want.

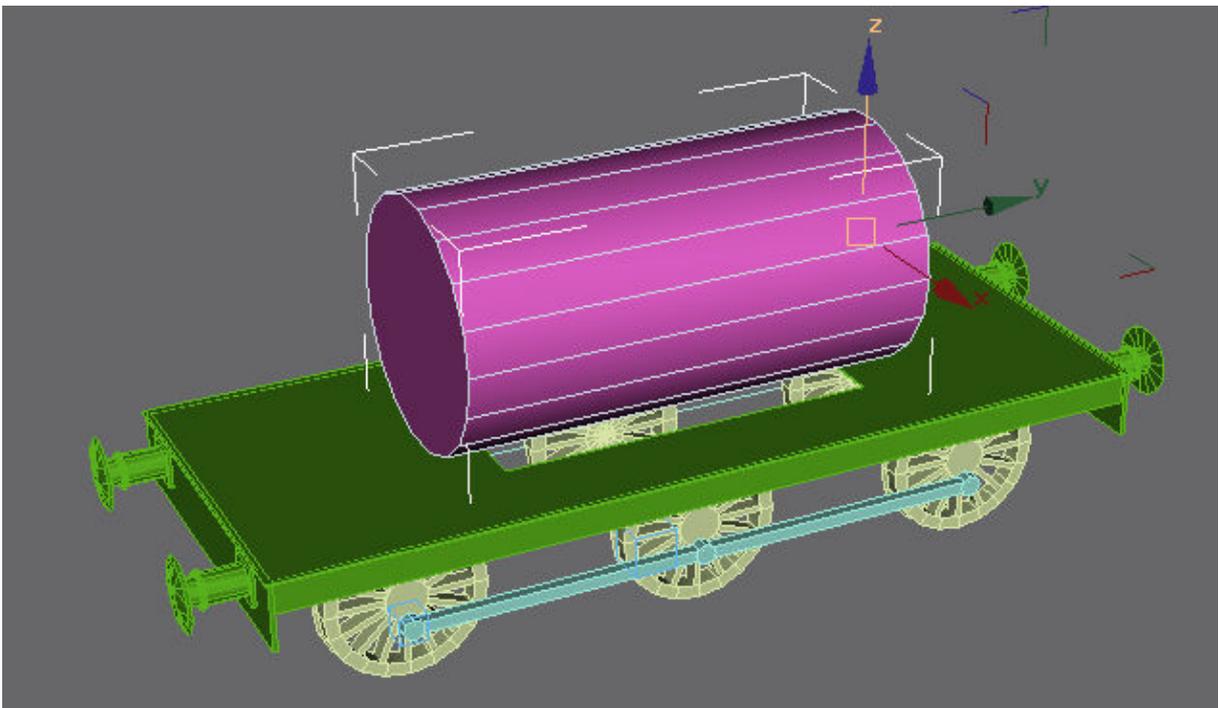
The model at this stage can be downloaded [here](#).

## Boiler and Smokebox

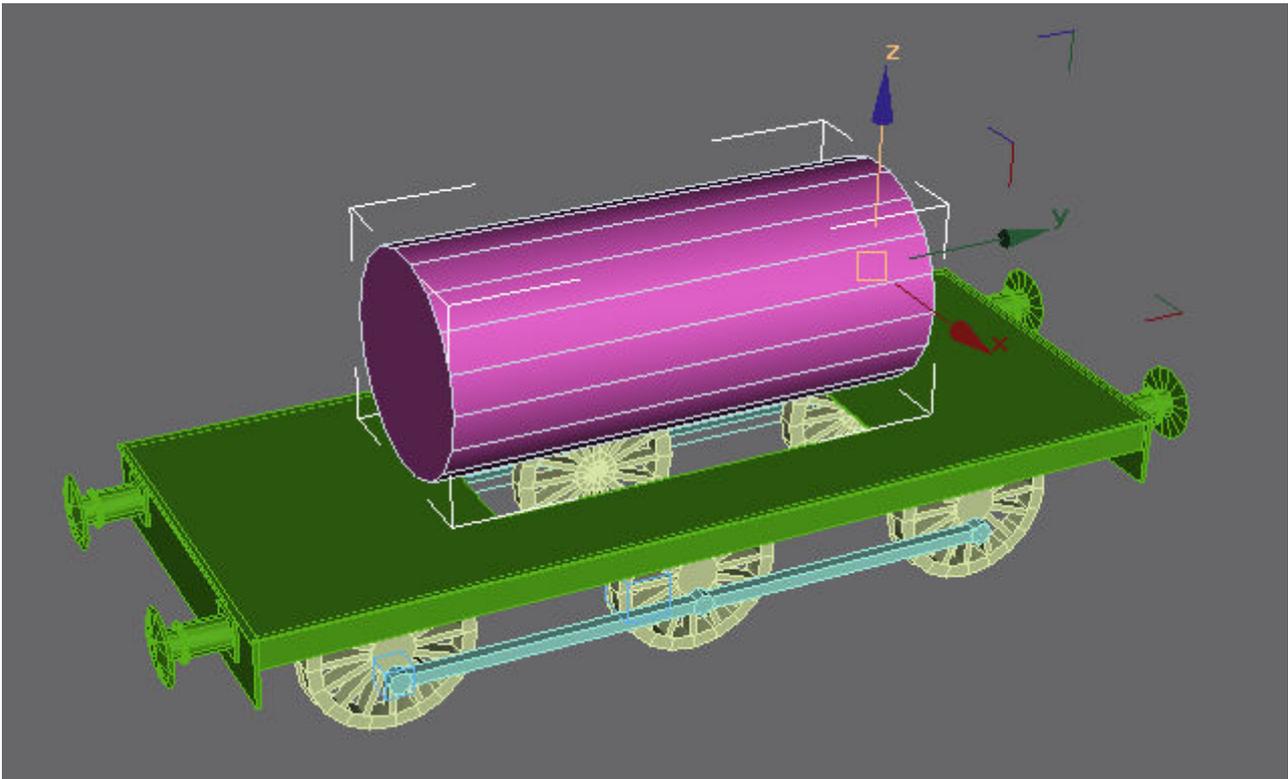
Now on to the parts that start really making it look like a steam loco. Create a cylinder making sure that 'Height Segments' is set to 1.



Rotate the cylinder and position it at  $X=0$ , moving it up so that it sits above the footplate

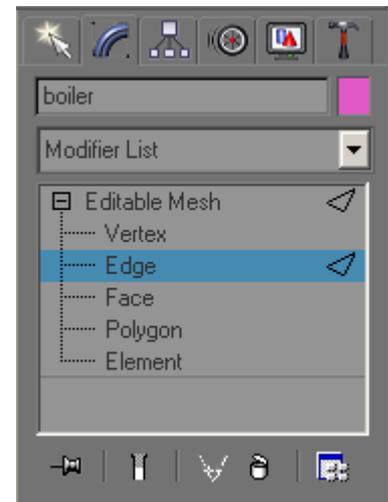
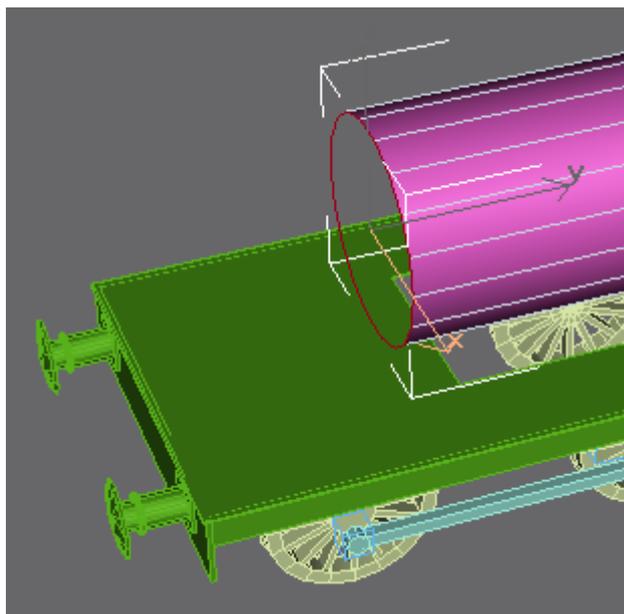


A bit on the big side, we'll change the cylinder's parameters to reduce the diameter to about 5'. (It would be a lot easier with a drawing).



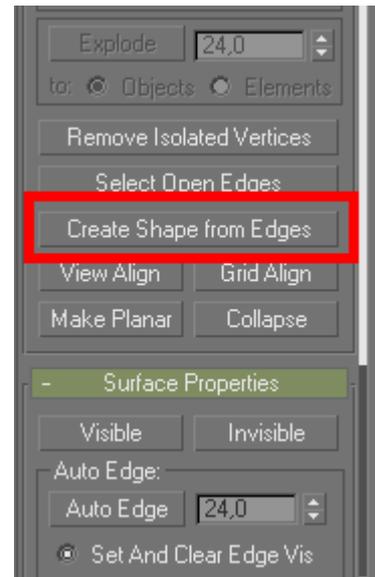
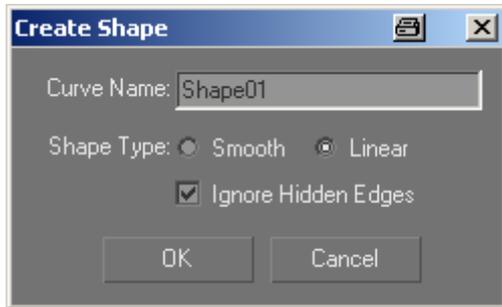
Rename the cylinder to 'boiler', convert it to editable mesh and delete the two end polygons.

In the modifier stack choose 'Edge' and drag select the edges at the front end of the boiler – they will turn red

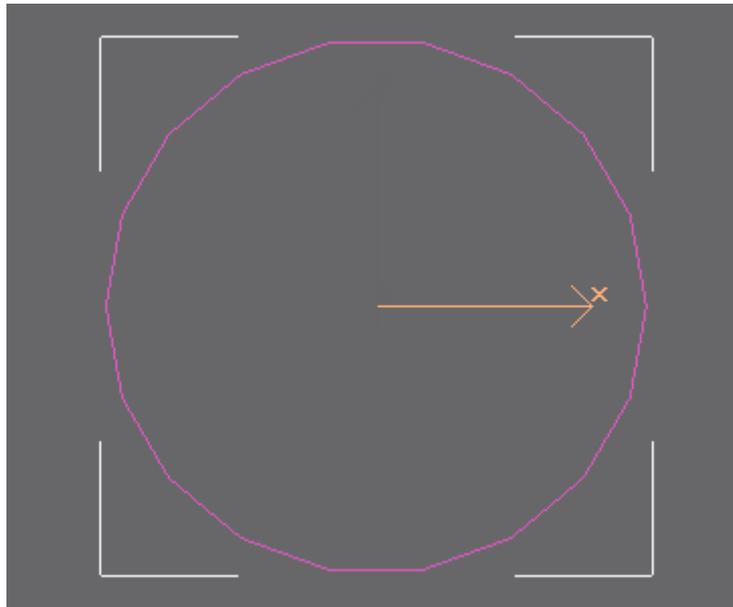


In the rollout under the modifier stack find and choose 'Create Shape from Edges'.

This will create a new spline from the selected edges called 'Shape01'. Select 'Linear' before clicking 'OK'.

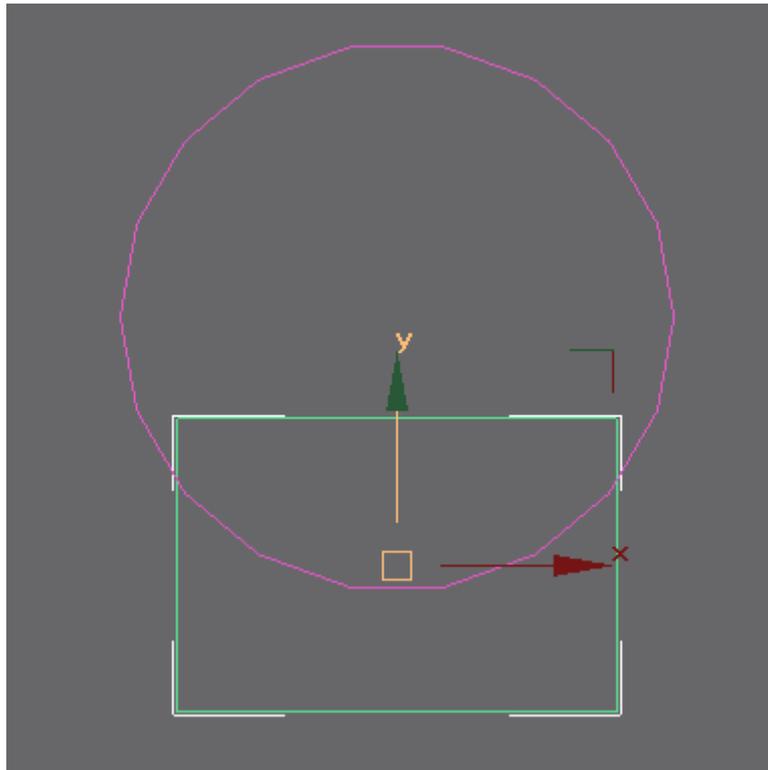


Hide everything but 'Shape01' and switch to the front view with the 'F' key.

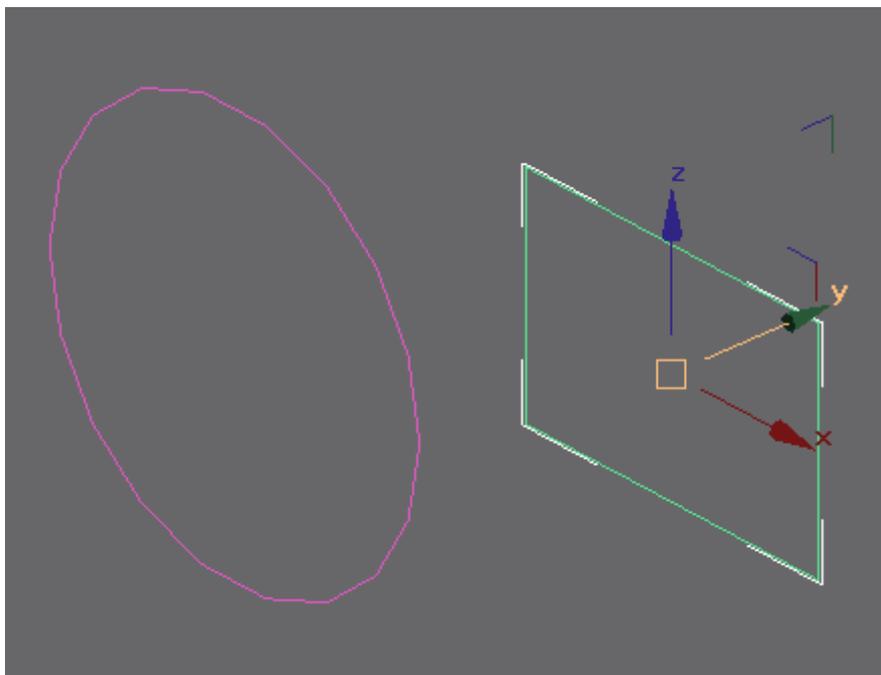


Move the pivot point of 'Shape01' to the centre of the object and rescale 'Shape01' to be slightly larger, the 'Uniform Scale' icon on the top toolbar looks like this:  About 103% should do it, so that the smokebox is larger than the boiler.

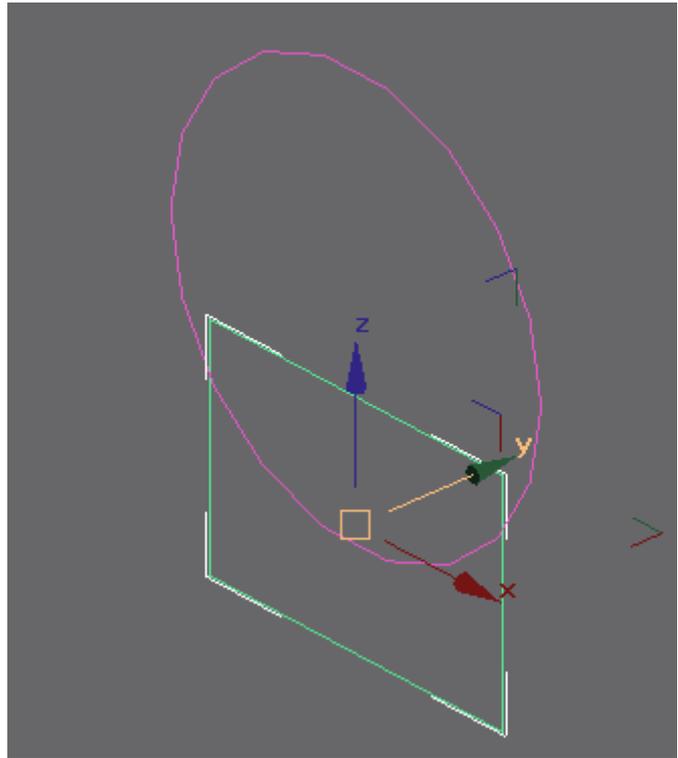
Now create a rectangle 4'1" wide (the smokebox almost always has to fit between the frames) and centre it at X=0.



Turn the view to look at the objects in 3D:



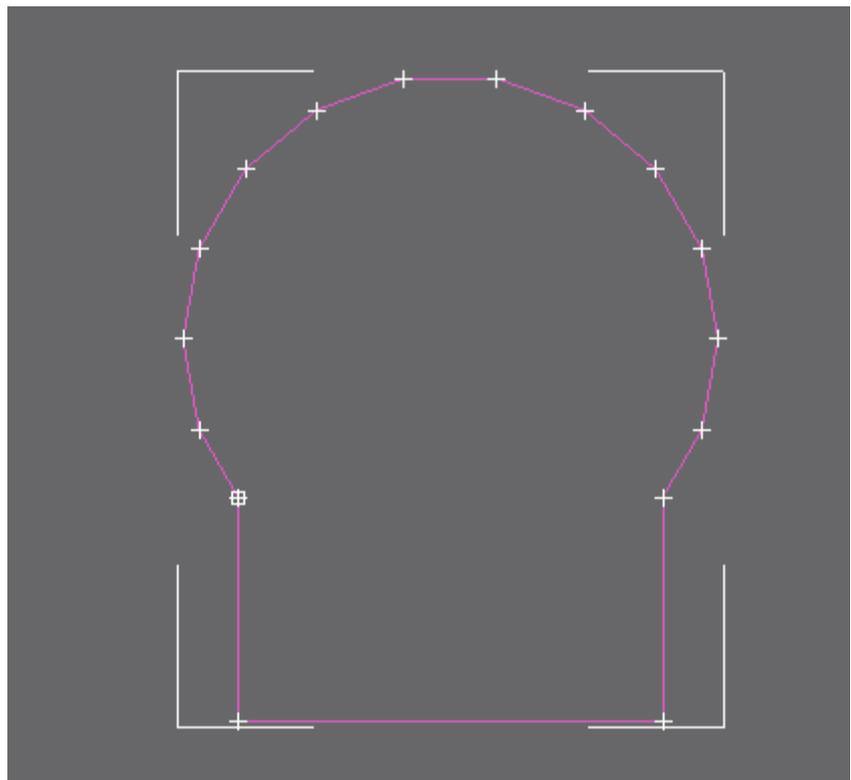
They are lying on different planes, so align the rectangle to the circle in the Y direction.



Here the shapes have been attached together and trimmed as described in Part 6.

I've also welded all the vertexes together ready for extruding.

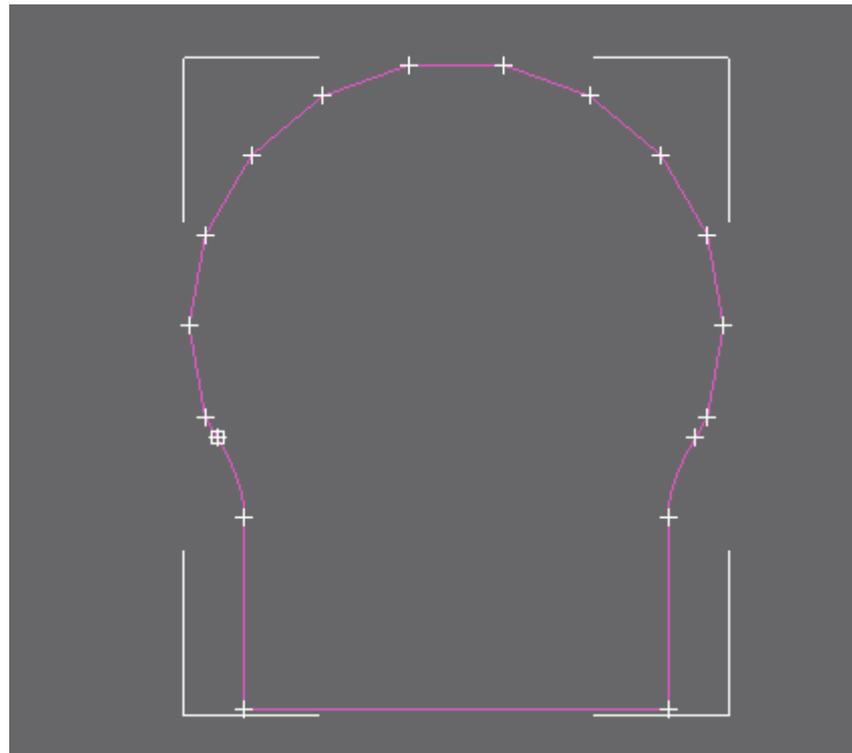
**Important! If you forget the welding the filleting and extruding will not work!**



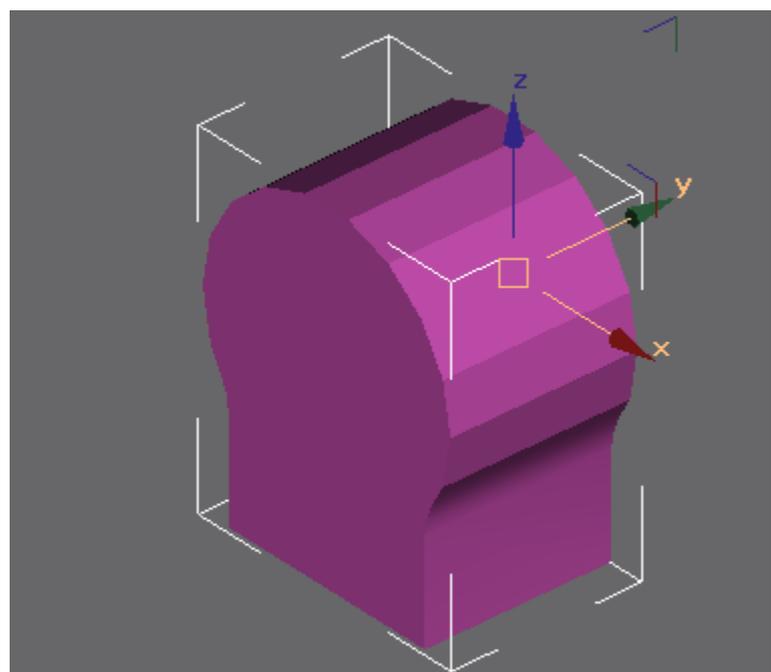
Select the two vertexes at the joint between the circle and the rectangle and add a fillet.

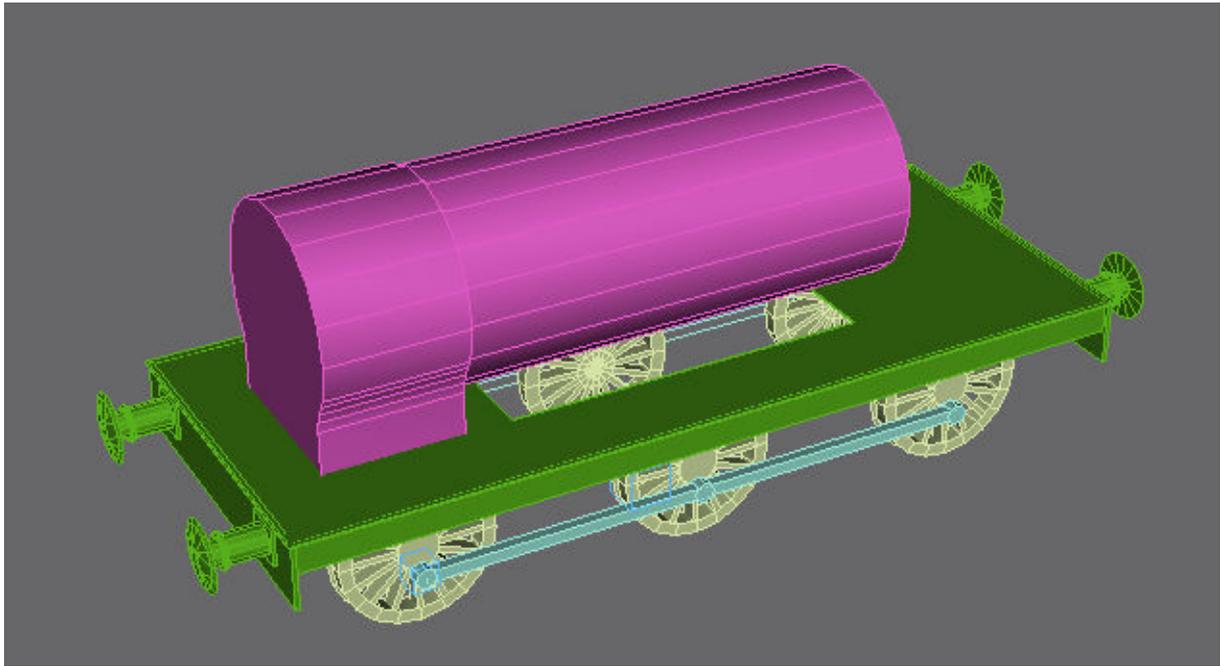


Change the 'Steps' in the Interpolation rollout to 2 to reduce the poly count (see part 6).



Add an 'Extrude' modifier to the stack to create the smokebox.

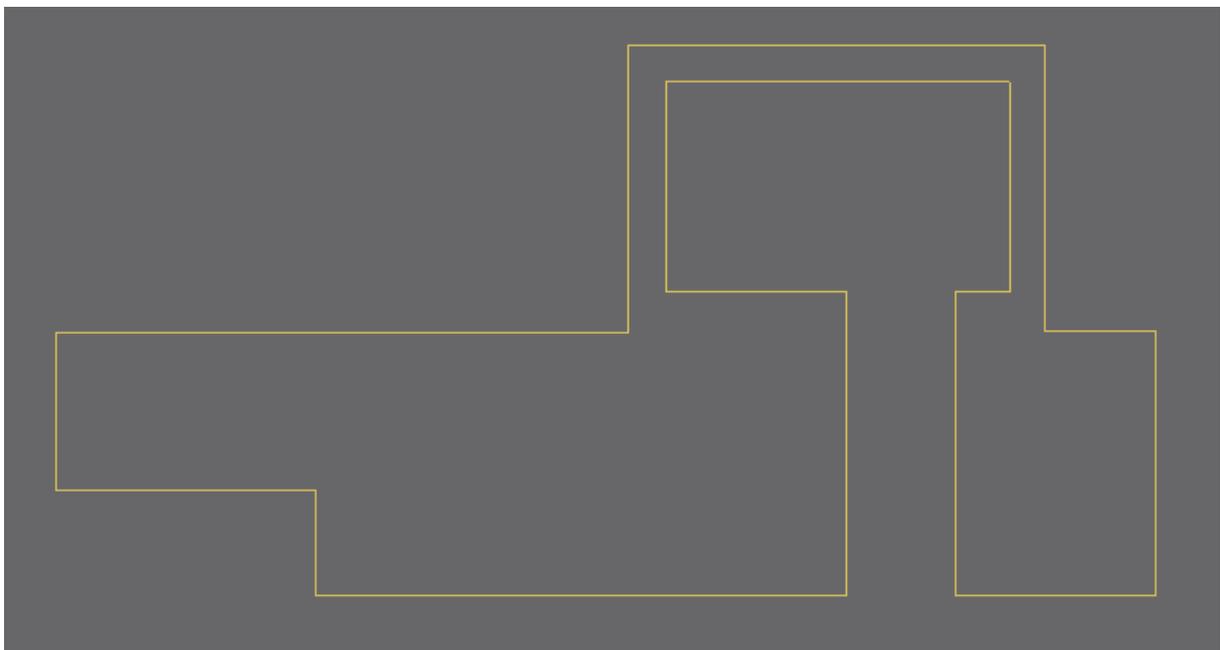




Sit back and admire the chunky lines...

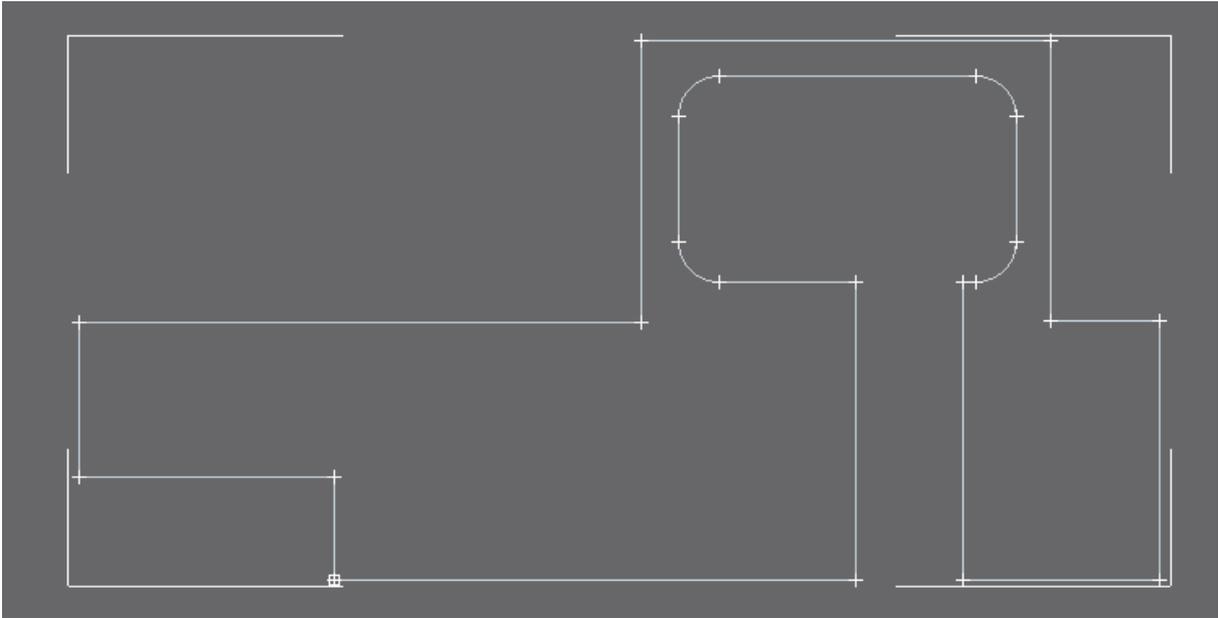
## Cab, Tanks and Bunker

I'm going to do these parts as one line using holding down the SHIFT key to force horizontal/vertical segments. This has the advantage that you just need to ensure the end point of the line is welded to the start point - otherwise the fillets won't work and we won't be able to make a mesh out of it.

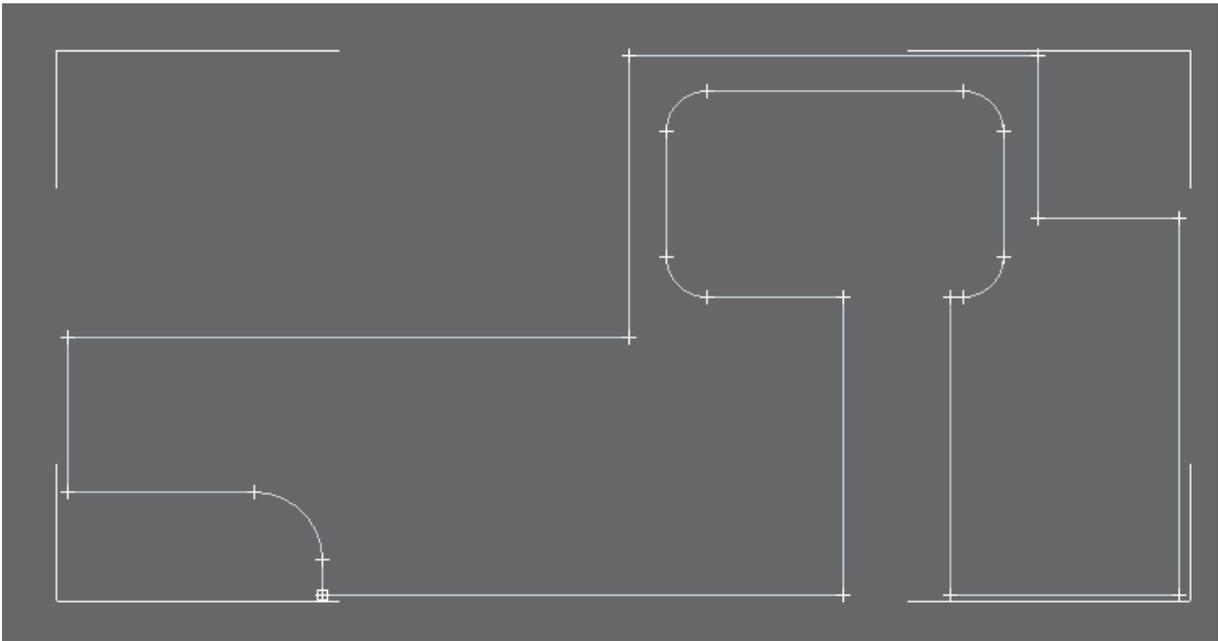


I'm not worrying too much about the dimensions yet, and the sketch is square cornered. Also note that the bunker rear is straight. An extended bunker (wider at the top) would probably look better but doing the animated coal load is then more complicated. The bunker is a bit low, but that is also easily changed. Next step is to

add some curved corners. If we select all four corners in the cab cutout together they can all be filleted at the same time with the same radius.

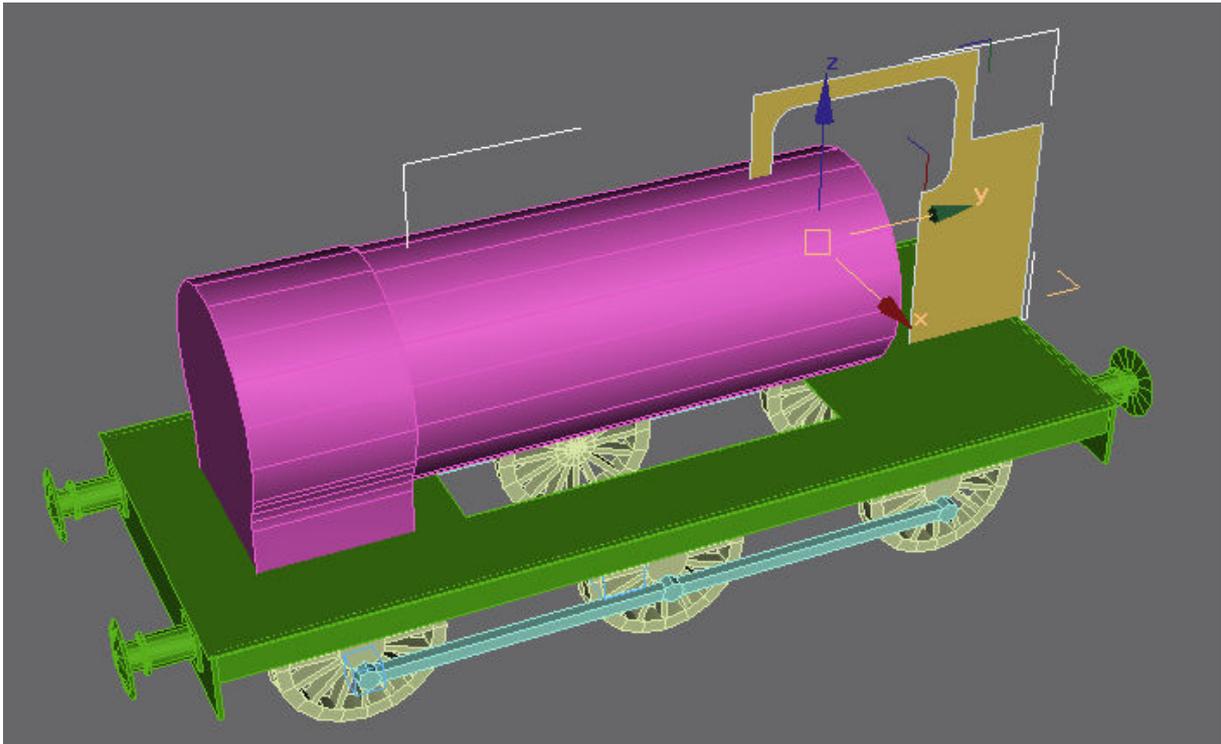


I've increased the size of the coal bunker as well now.

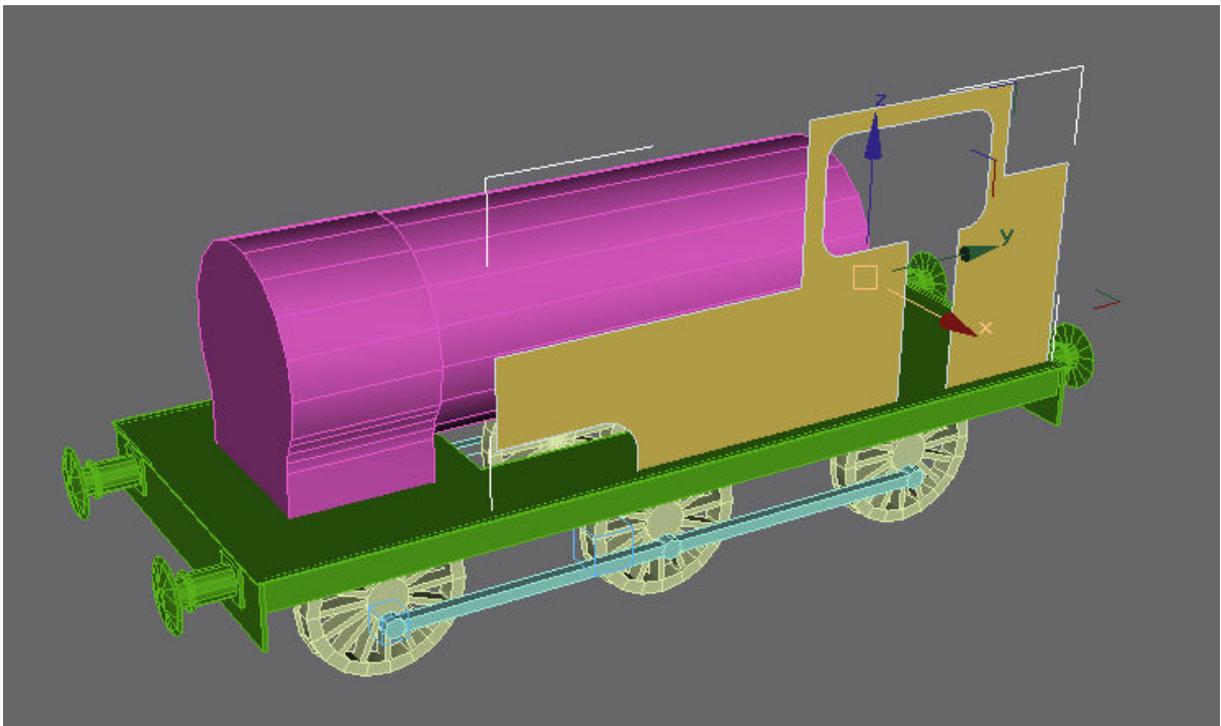


**Don't forget to reduce the number of steps in the interpolation rollout to reduce the number of segments in the curves.**

With steps=2 we have 31 polys, the default steps=6 would give us 51 (40 extra for the loco).

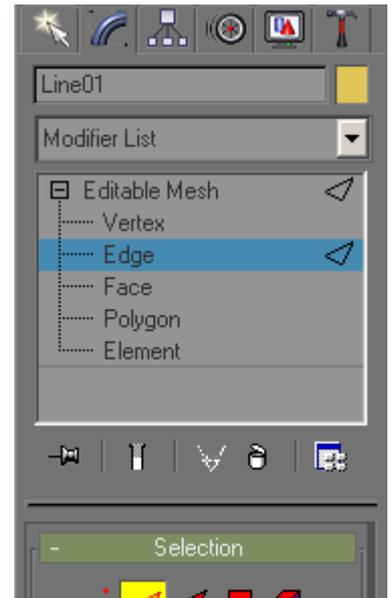
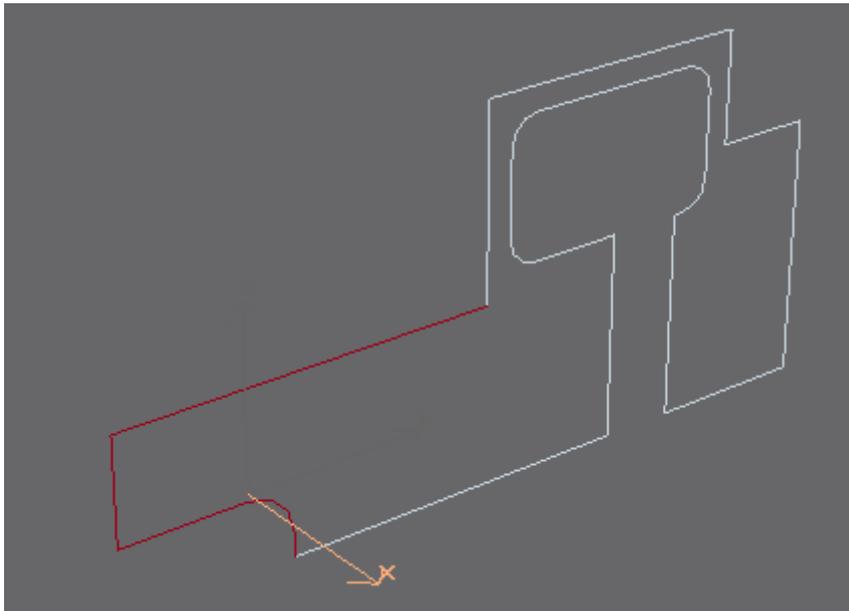


We have to move the tank/cab/bunker to its final position of course.



The proportions are still a bit of a disaster which is why it's easier to work from drawings. The important thing at this stage though is to get the basic model done so that we can correct it later – if we were working from drawings we'd try and build it right in the first place of course.

Hide everything but the tank side and in the modifier stack select 'Edge'. Choose the edges as shown in red.

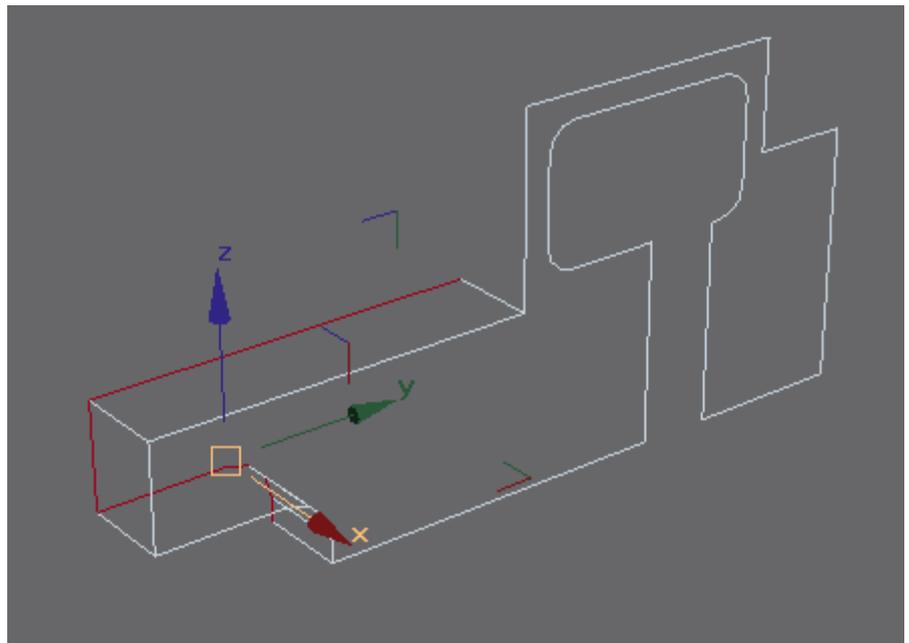


We are going to drag these edges to create new polygons. With 'Select and Move' active and the SHIFT key held down drag the edges in the -X direction.

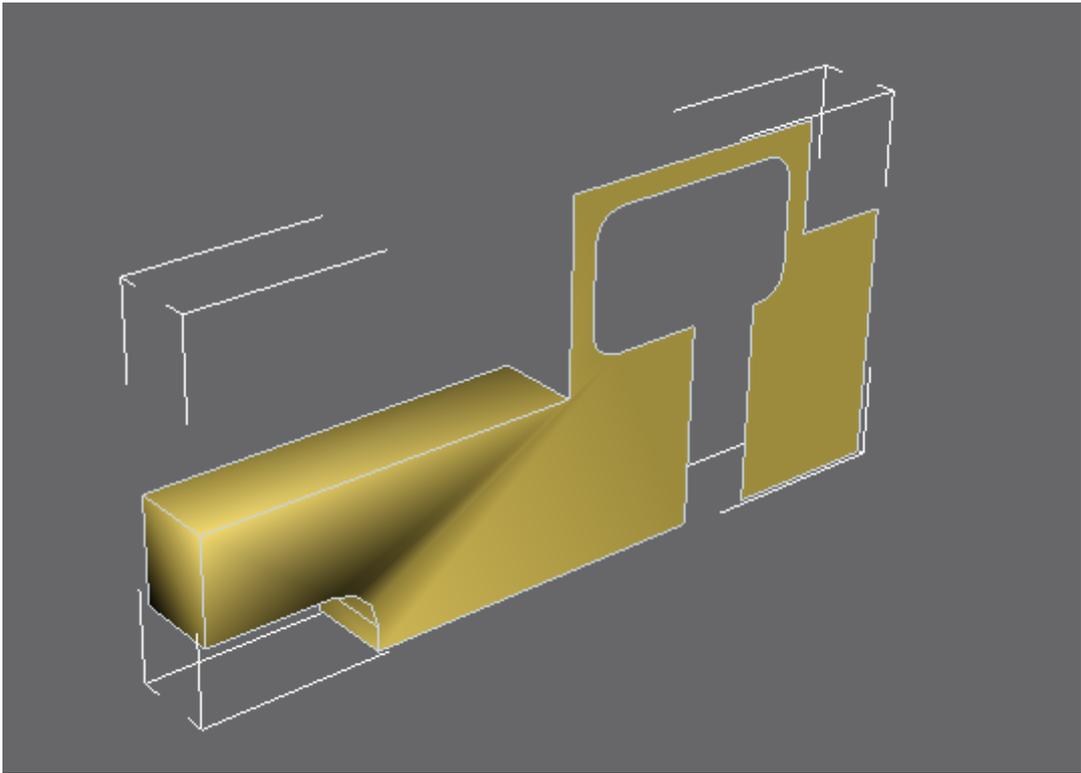
This is a very easy way of creating polygons based on existing geometry.

Releasing the SHIFT key leaves the new edges selected so we can position them straight away.

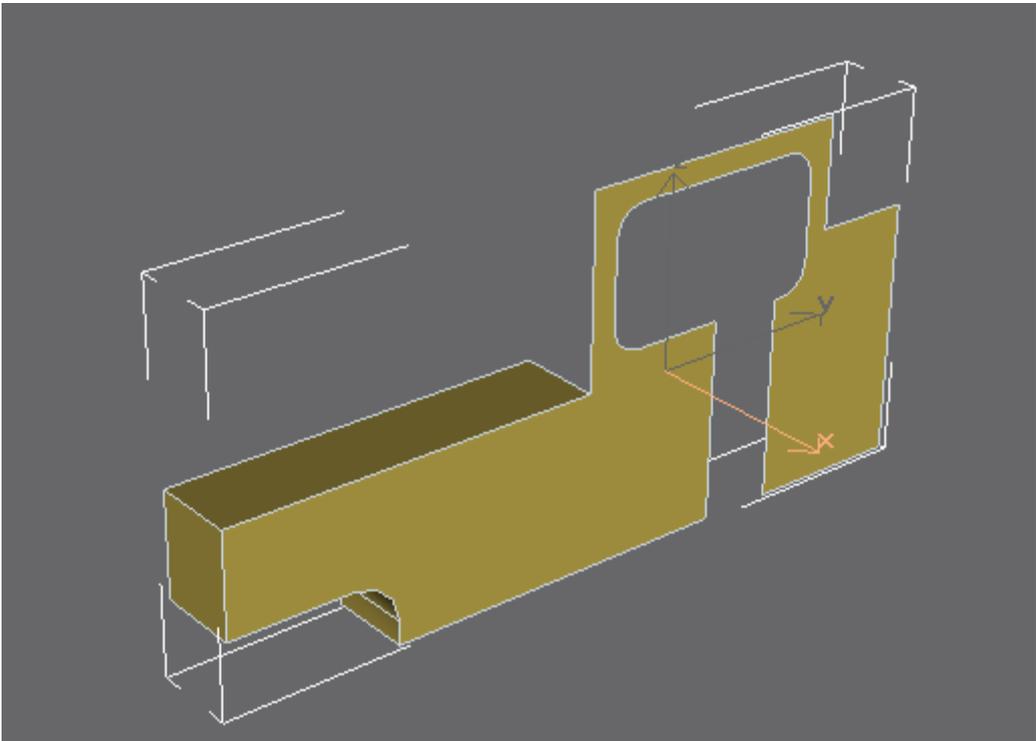
The tanks on steam locos do not usually go from one side to the other, they are two separate tanks that stop at the outboard face of the frames.



These ones will end at 2'1" from the loco centreline so we can just type this into the X coordinate box.

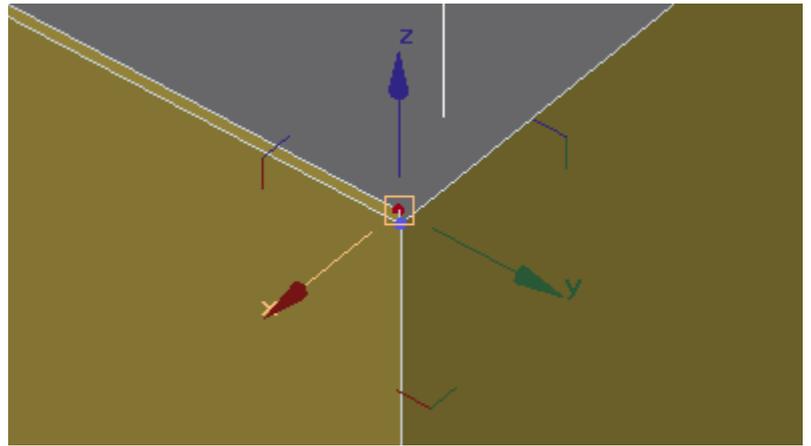


Oops, a few smoothing problems here, we need to apply a 'Smooth' modifier to sort this out.

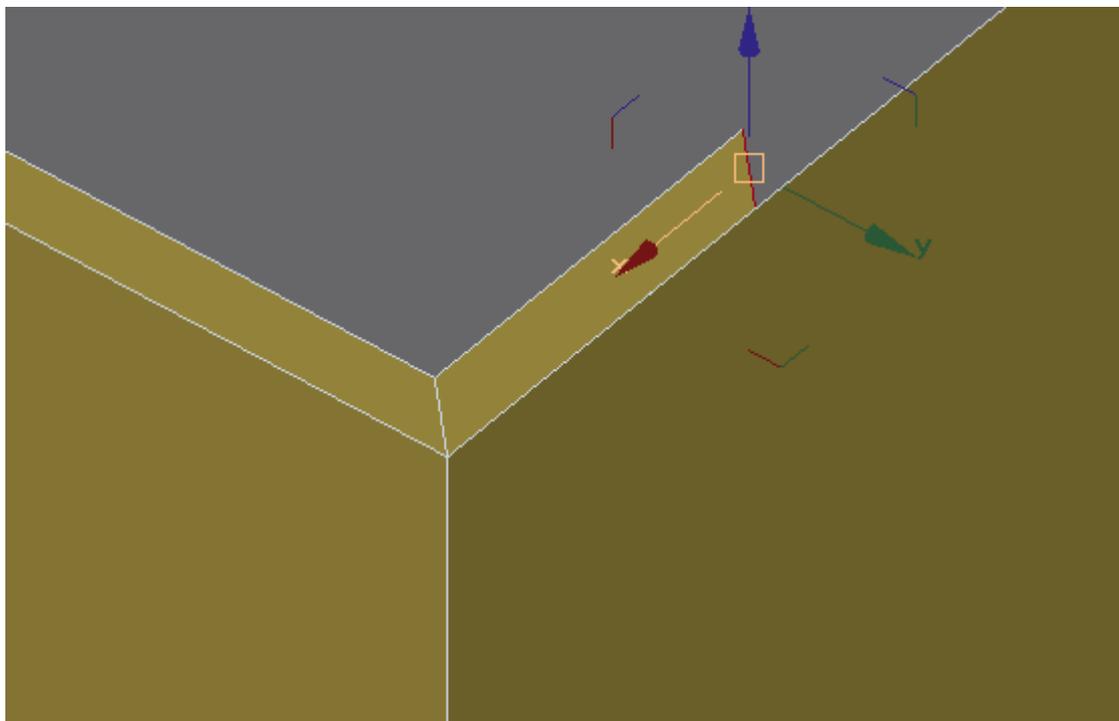


I'd carry on in this manner, extruding edges to create new polygons as needed, bearing in mind that we only need to create one tank side which can be mirrored over when it is finished.

This is the rear corner of the bunker, the edge has been extruded in the - X direction 10mm to create the thickness and then the rear vertex point moved 10mm in the Y direction.

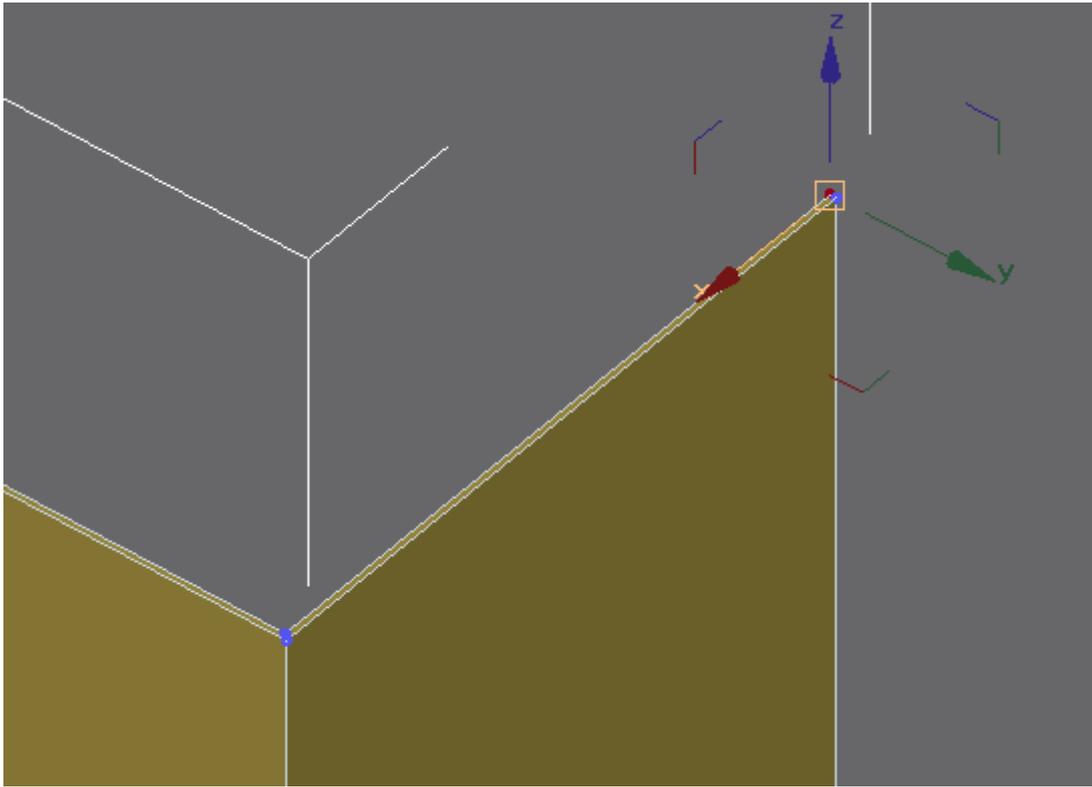


Zooming in a bit closer I'll create the top rear edge of the bunker by extruding the edge of the last poly I created.

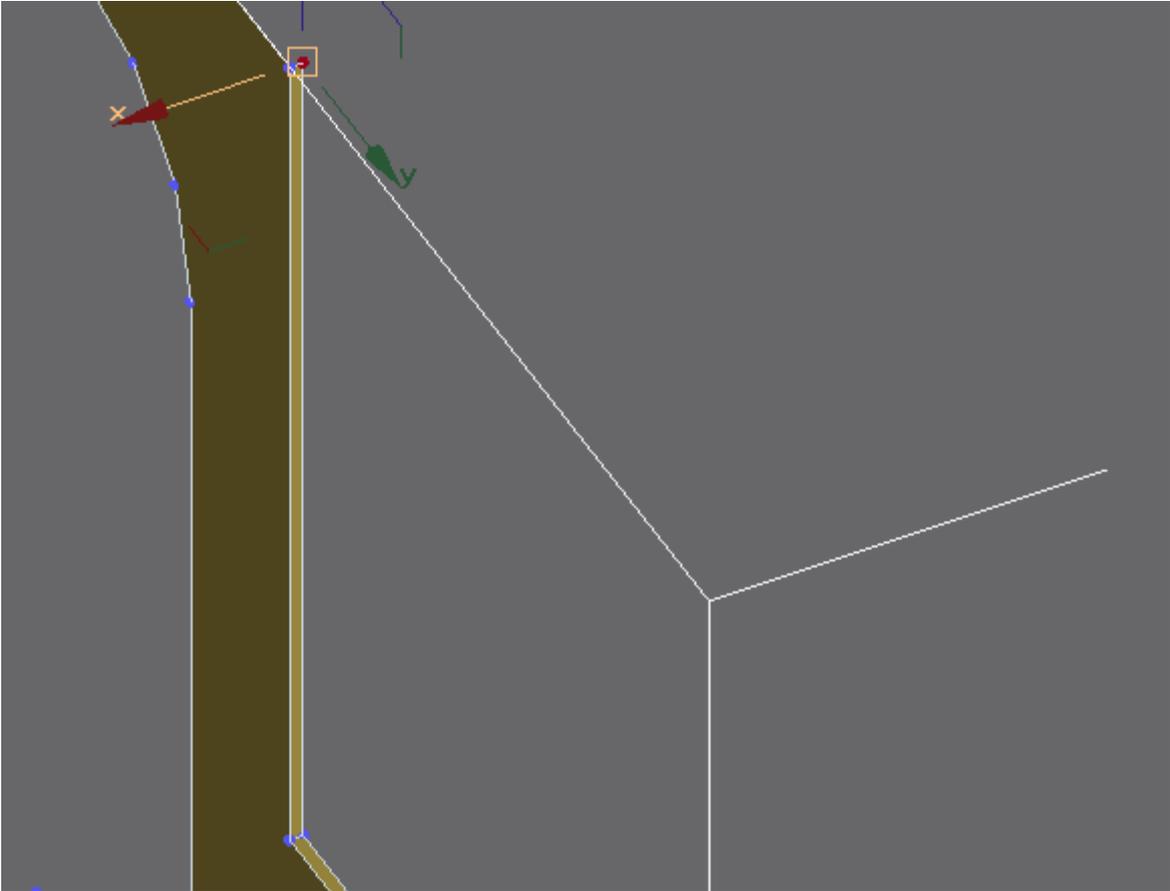


Remember to select the edge with the 'Select' tool and not 'Select and Move'. With 'Select and Move' it's very easy to move the edge in a direction that you didn't want..

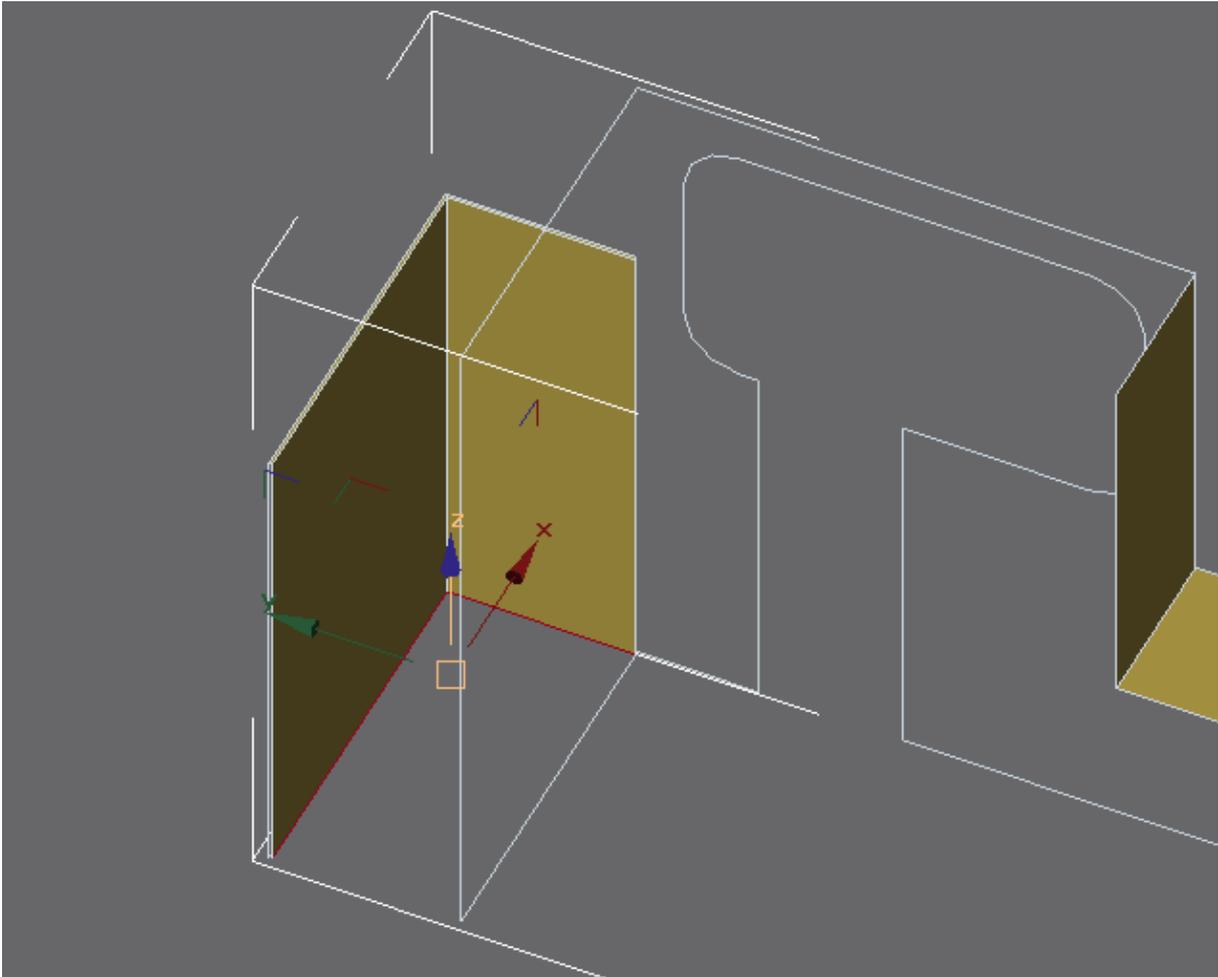
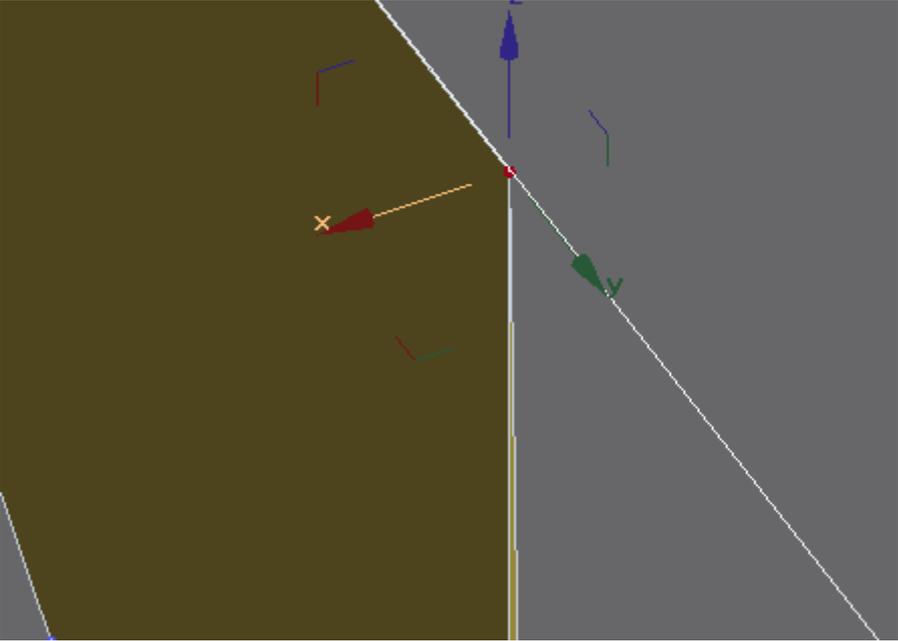
The new angled edge can easily be placed on the loco centreline by going the vertex mode and setting the X coordinate of both points to 0.

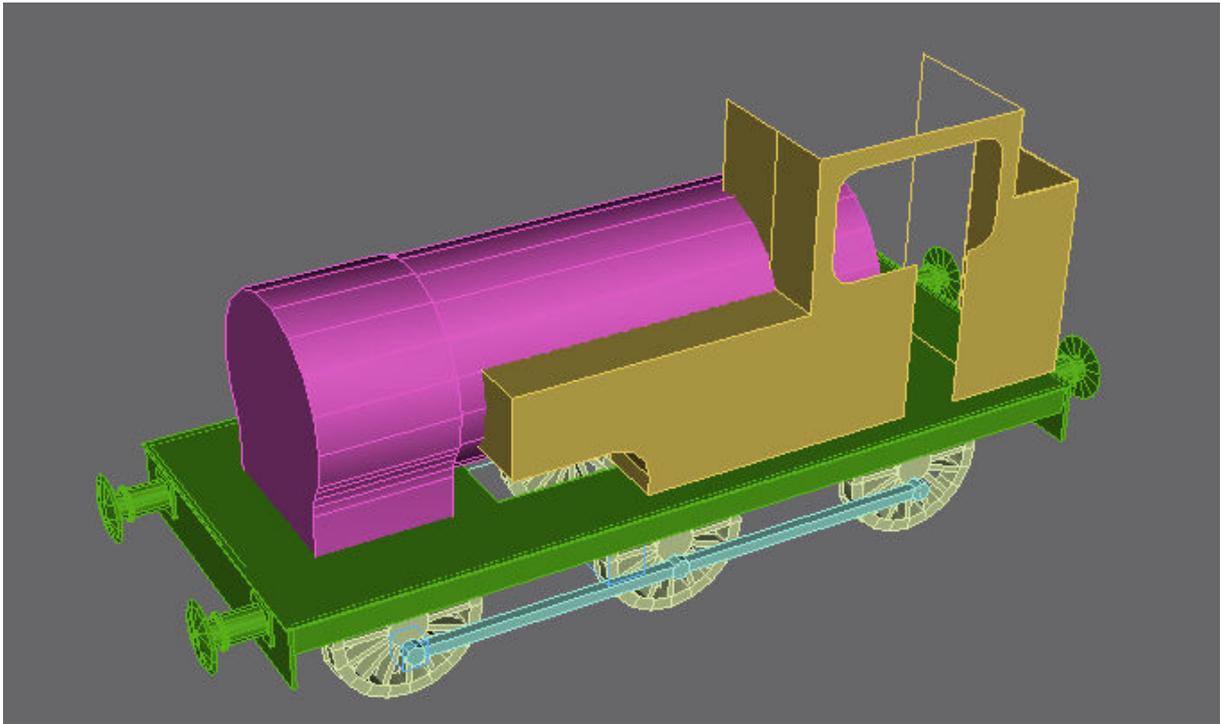


Sometimes this technique will create more edges than you really need as it creates four sided polys. If you want a three sided one you'll have to weld points together like this:

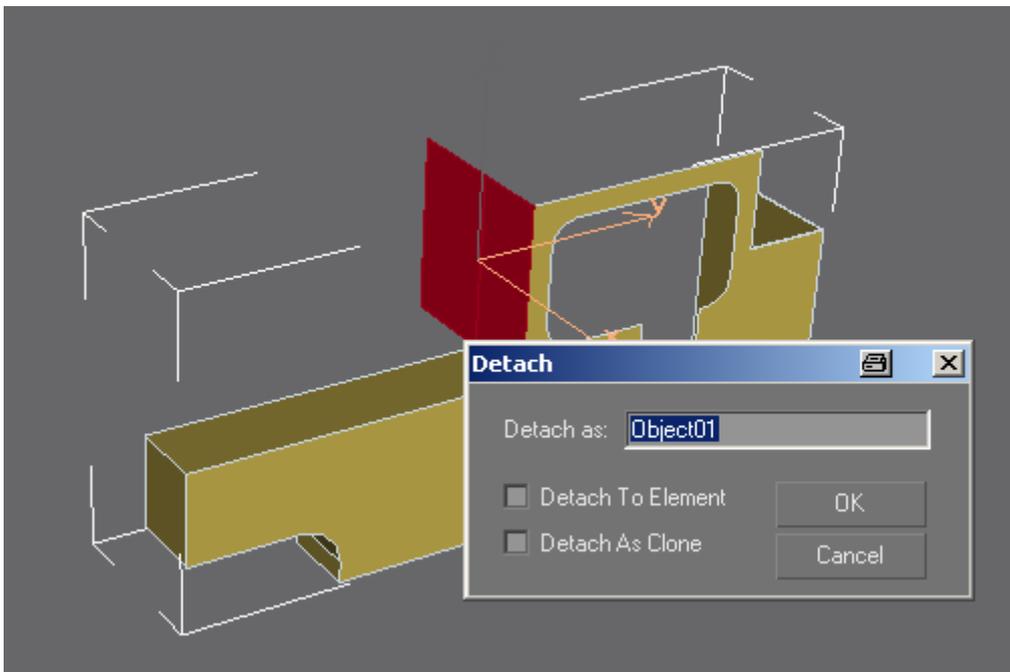


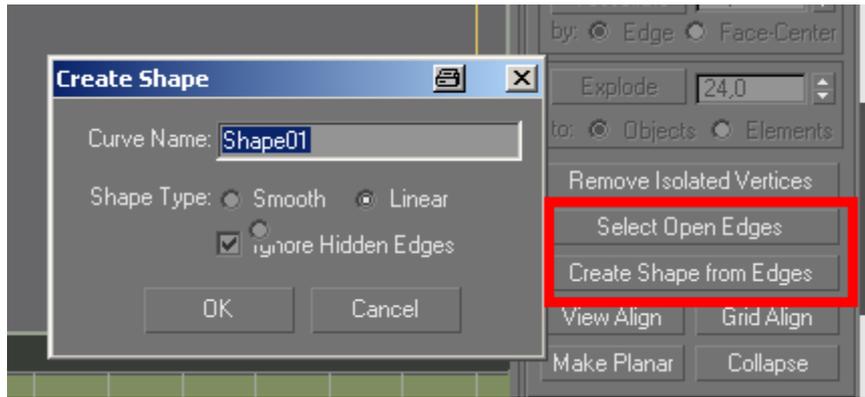
Select the vertex you want to weld and then with the 'Select and Move' tool active choose 'Weld Target' on the right button menu. Drag the extra point over so that it is on top on the one you want to weld it to.



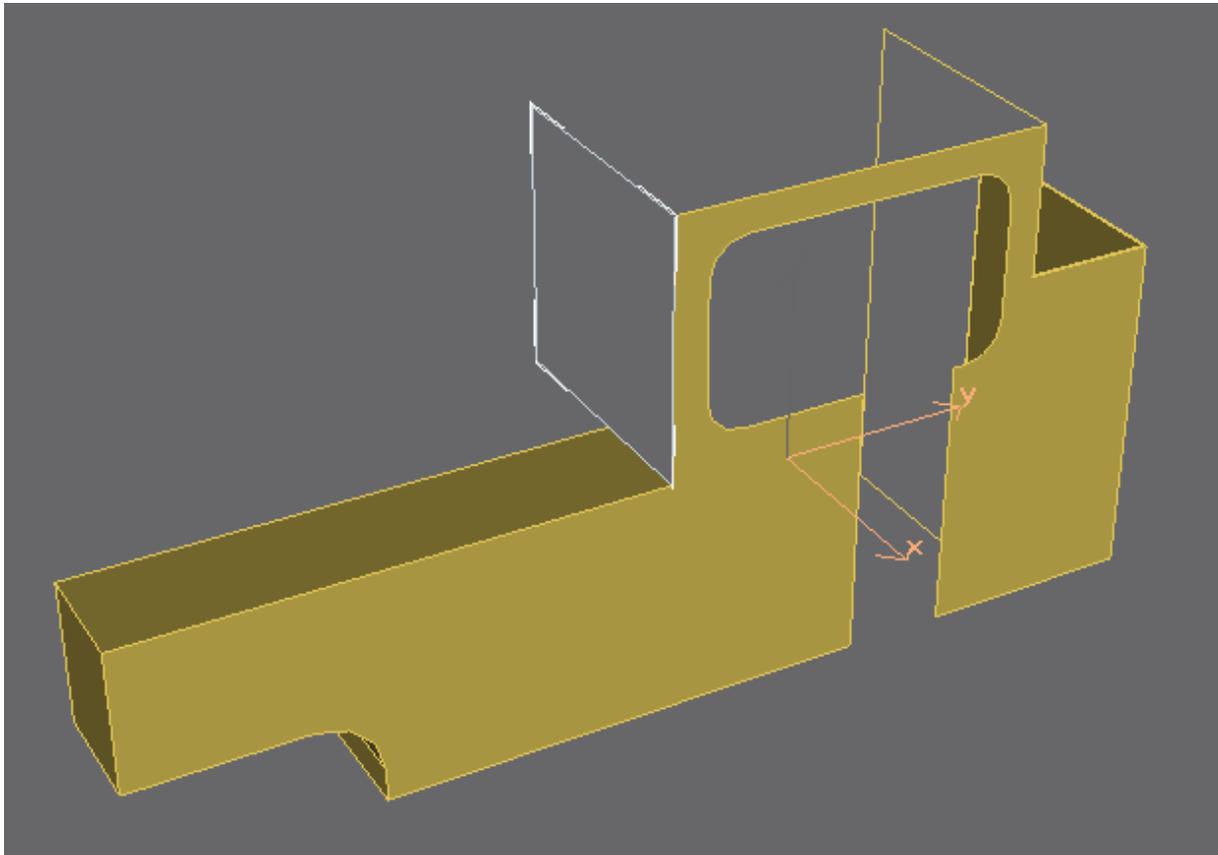


Now for the curve of the cab roof and the front cab windows. There are several possibilities here but I prefer one that doesn't involve a Boolean operation to cut the window out. Start by detaching cab front and then create the edge curves.

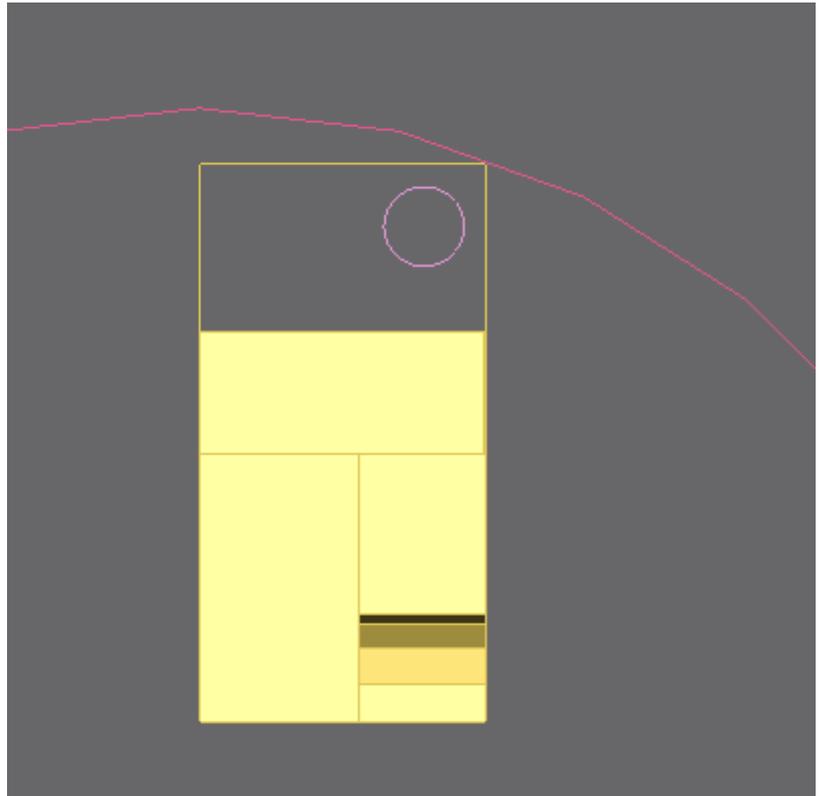




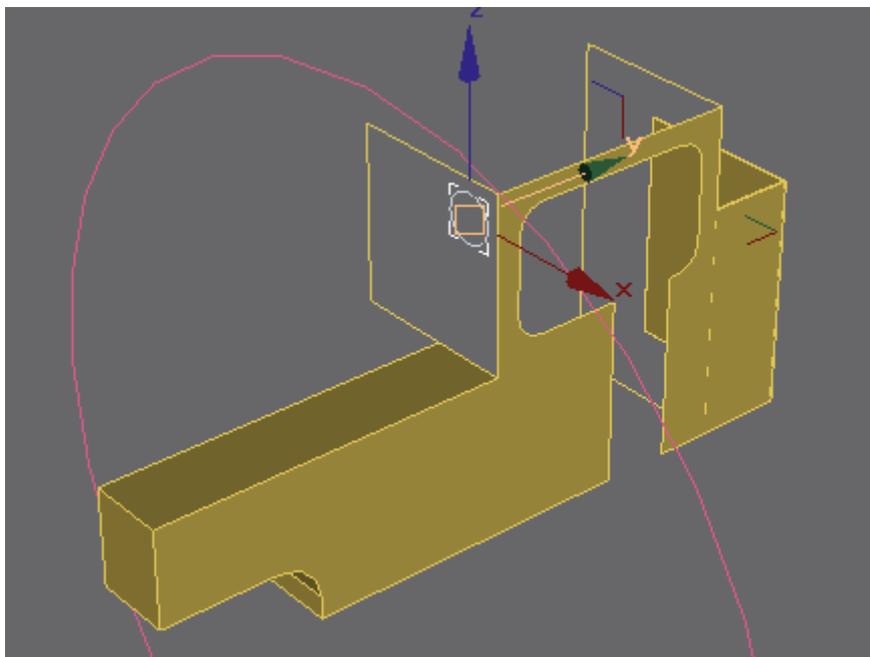
Choose 'Select Open Edges' and then 'Create Shape from Edges' to create the shape. Delete the cab front polygons.



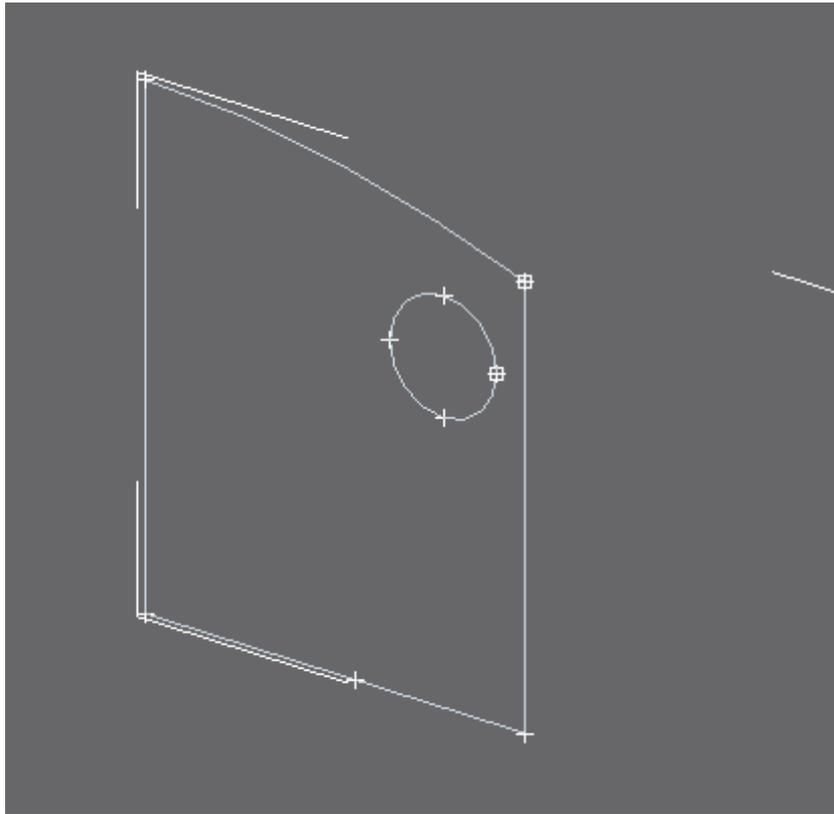
Switch to the front view with 'F' and add the curve of the cab roof and the opening for the window using circles.



Move the two new circles to the same Y coordinate as the cab front.

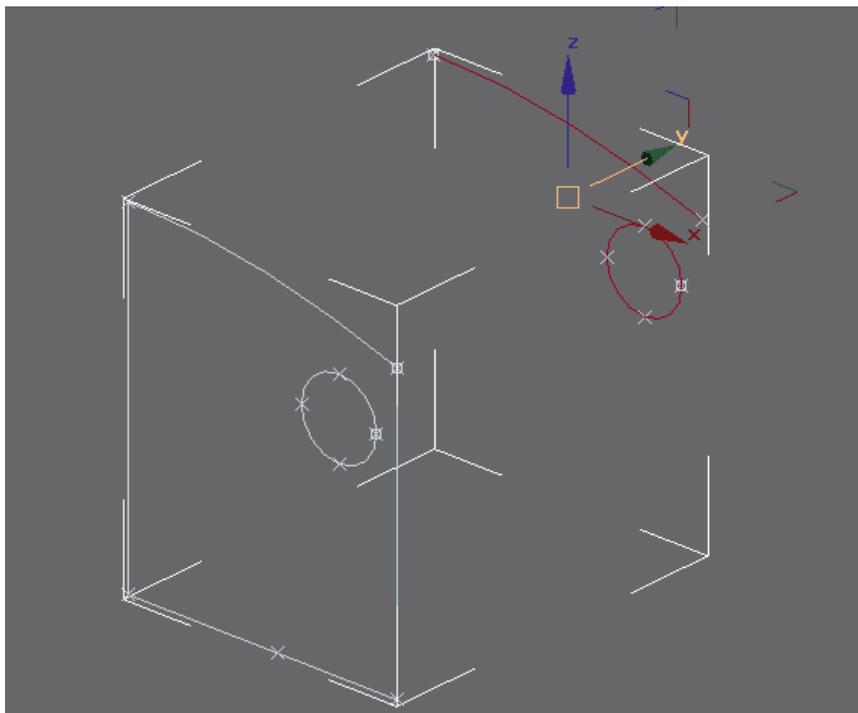


Delete the top segment of the rectangle ('choose 'segment ' in the modifier stack and select and delete the segment.) Join all the cab front elements together and trim them.



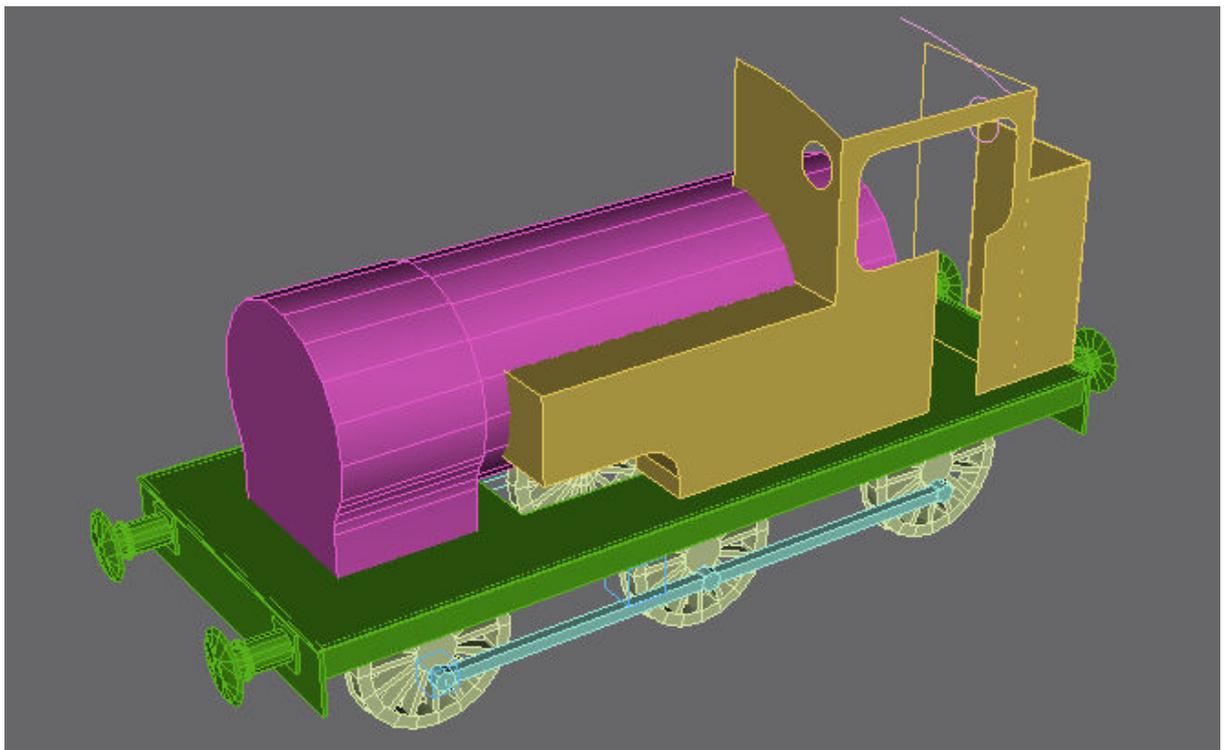
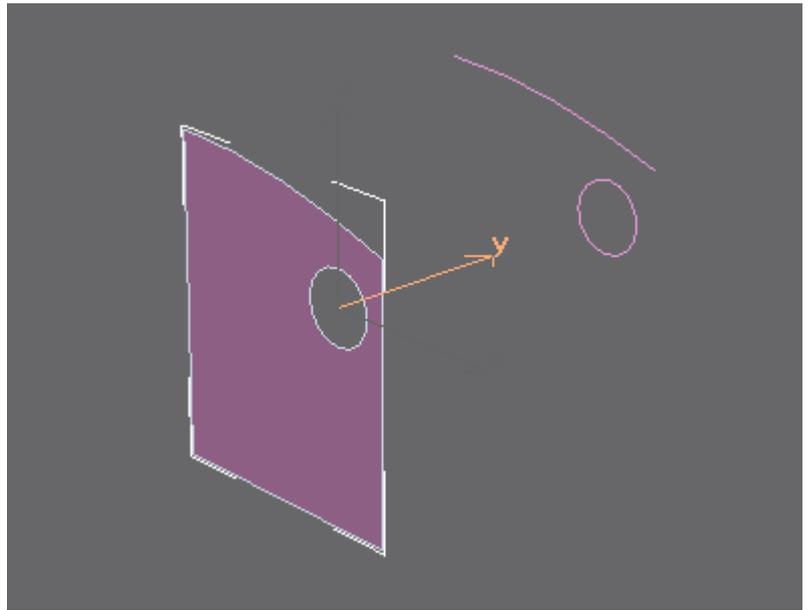
Set the interpolation for the spline to 3 in this case, and weld the vertexes. Check the vertexes really are welded together by selecting each segment of the shape and dragging it. If the shape remains connected together then it is OK. Hit CTRL-Z to undo the change.

Copy the window opening and the curve of the cab roof as a new element, we'll need this for the rear of the cab. Select the segments and SHIFT drag them rearwards to duplicate them.

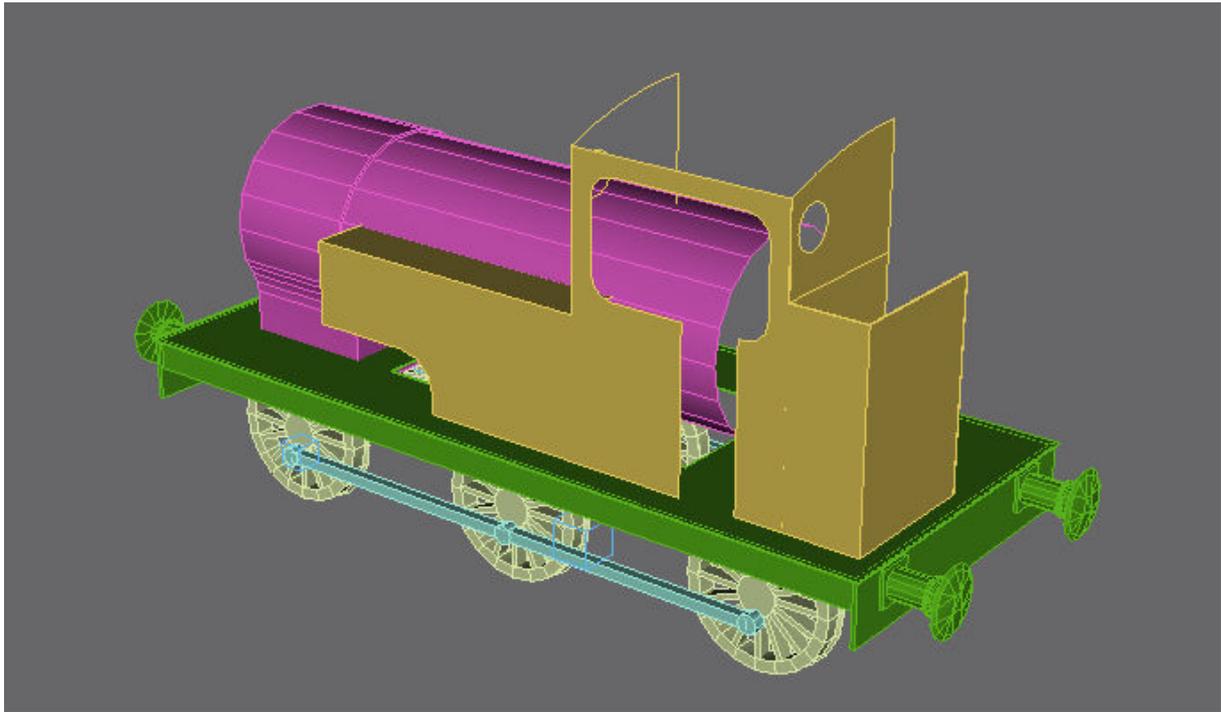


Detach these new curves and convert the cab front to editable mesh. **If this part doesn't work it's probably because the shape wasn't welded together** – check the welding again. A typical symptom is that the shape disappears when you try to create the mesh.

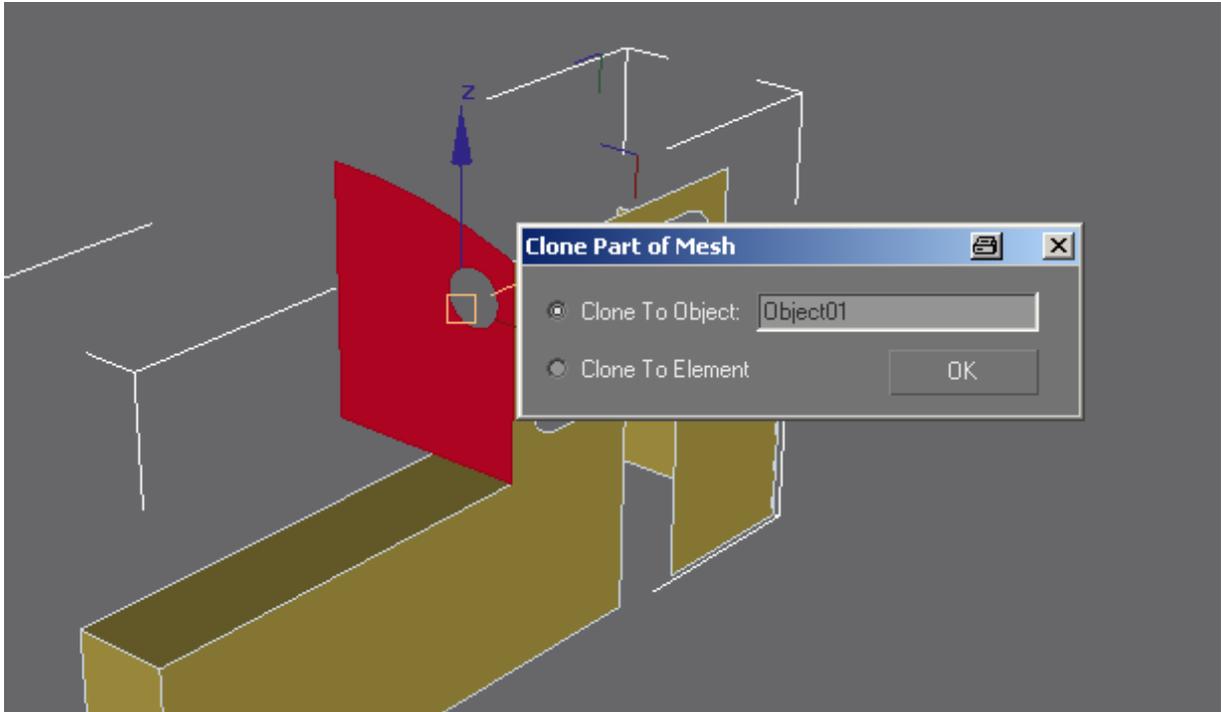
It's also possible that the mesh may be created inside out. To correct this try creating a line in the front view and attach the shape to it. This is because the shape needs to be reoriented to the front view. Delete the line segment and try creating the mesh again. This trick is also useful if an extrusion goes in an unexpected direction.



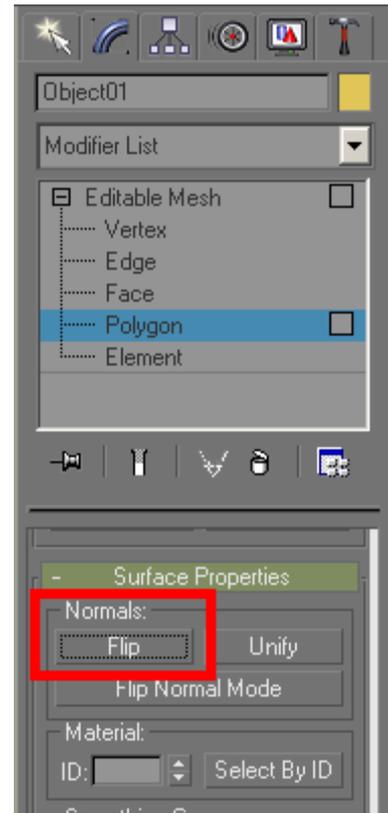
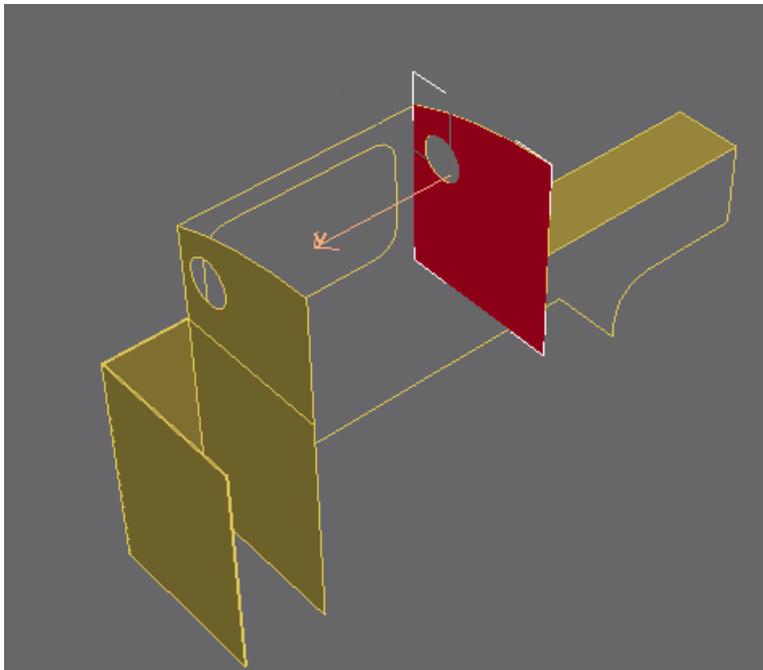
Repeat for the rear cab panel.



To make the inside of the cab we'll clone the front and rear panels (note 'Clone to Object' is selected).

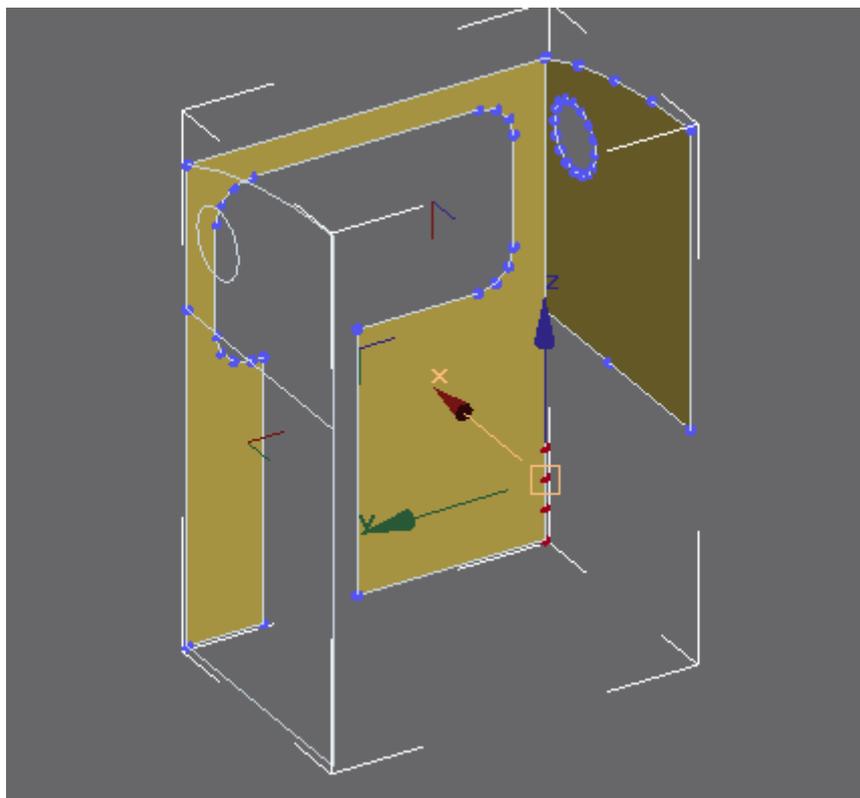


This will create a copy as a new object in the same position. Move the copy rearwards 10mm and flip the faces. You have to be in polygon mode to see the 'Flip' icon in the rollout and you have to select the polygons you want to flip.

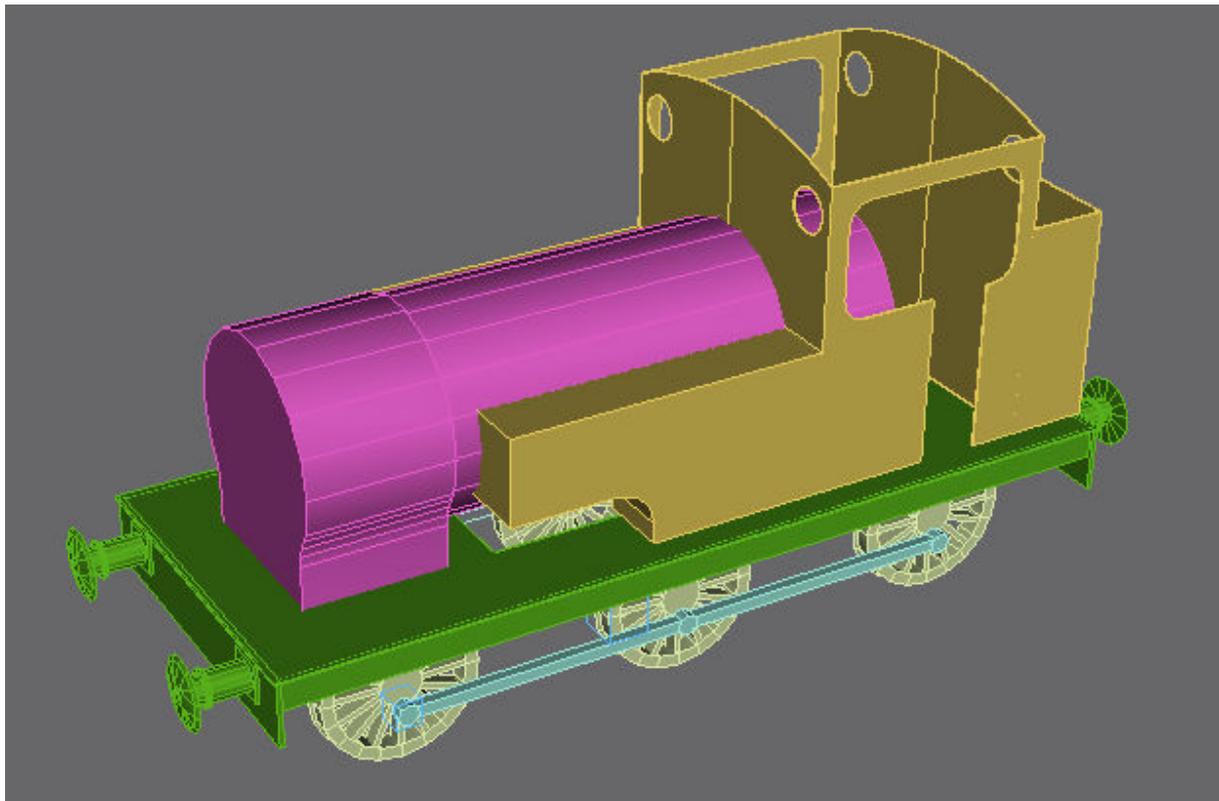
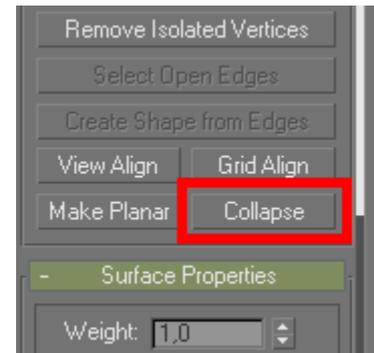


The outboard edge of this new object should be moved 10mm in the  $-X$  direction now to the thickness of the cab side sheets.

The rest of the cab interior is built up the same way, by copying existing polys, moving and flipping them.



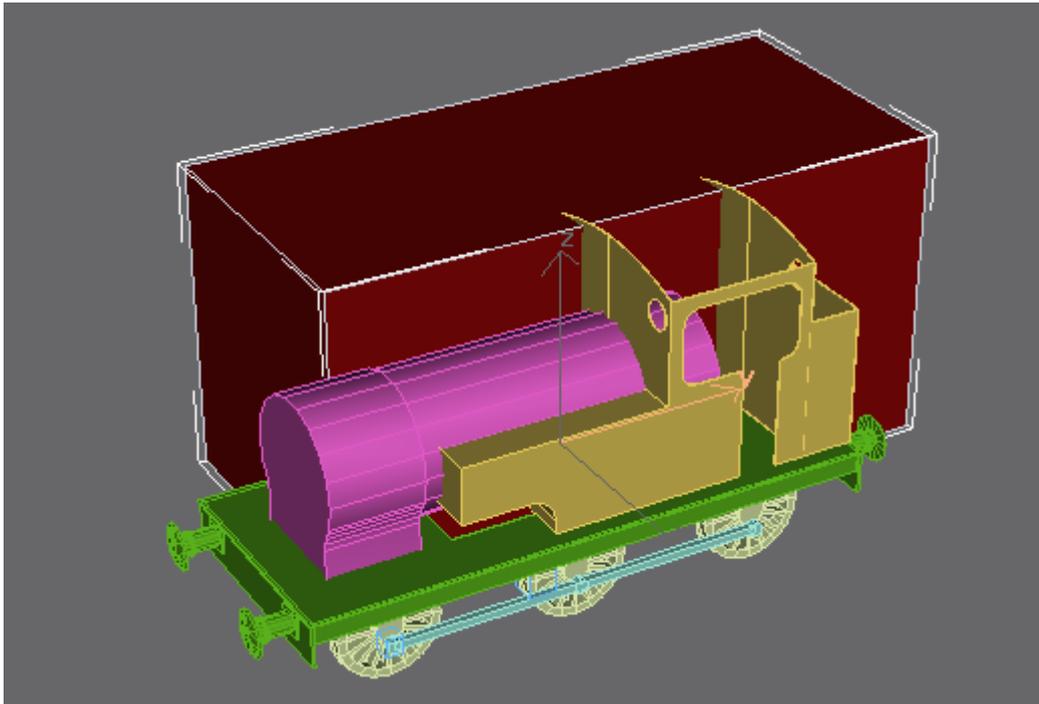
A handy option in vertex mode is 'Collapse' which welds the selected points together no matter how far apart they are. Naturally if you select the whole model it will collapse the whole thing down to one point...



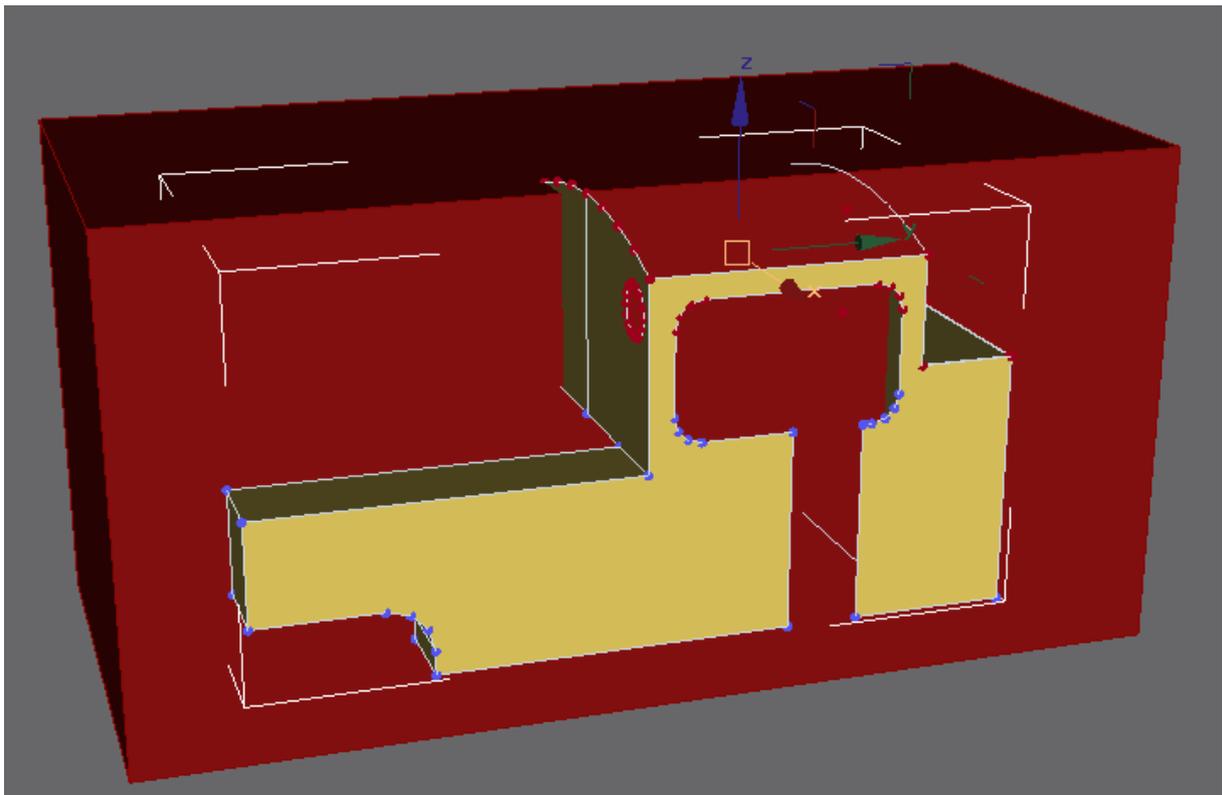
## Correcting the Proportions

Time I think to correct some of the major howlers in the proportions Obviously when working from a plan you won't need to do this, but it demonstrates how easy it would be to edit the model to look completely different.

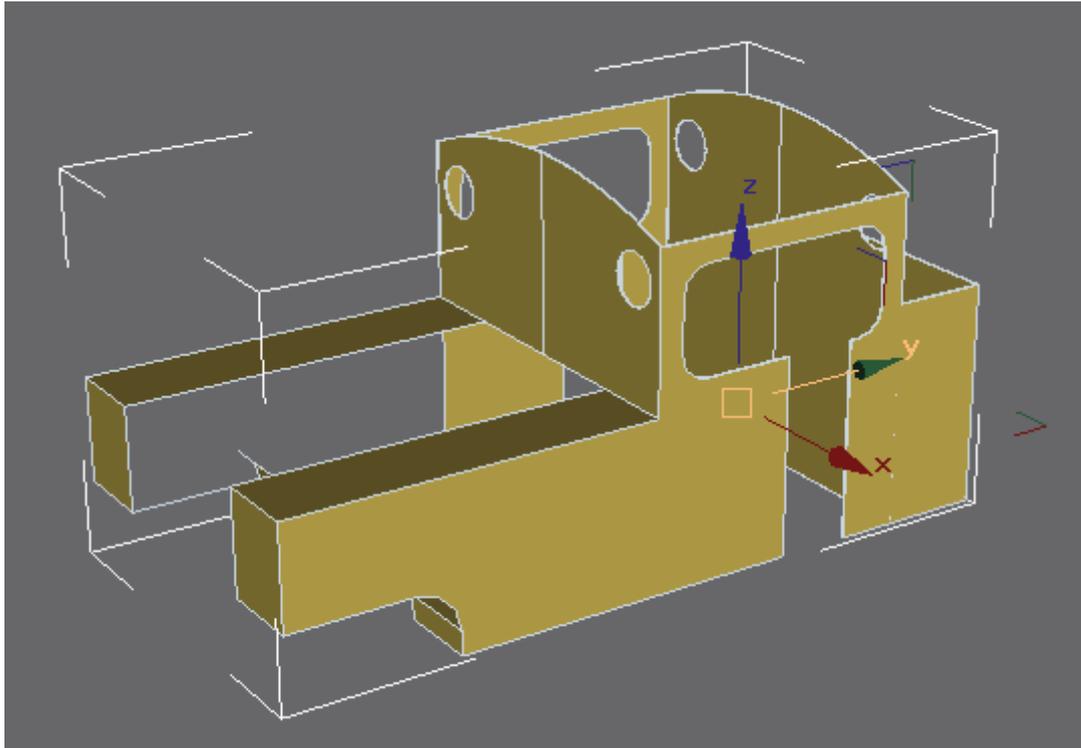
We'll check the height of the cab first as it looks too high. A British mainline loco would be about 13' high, an industrial shunter like this around 12'. Create a box 12' high to see where we are at the moment.



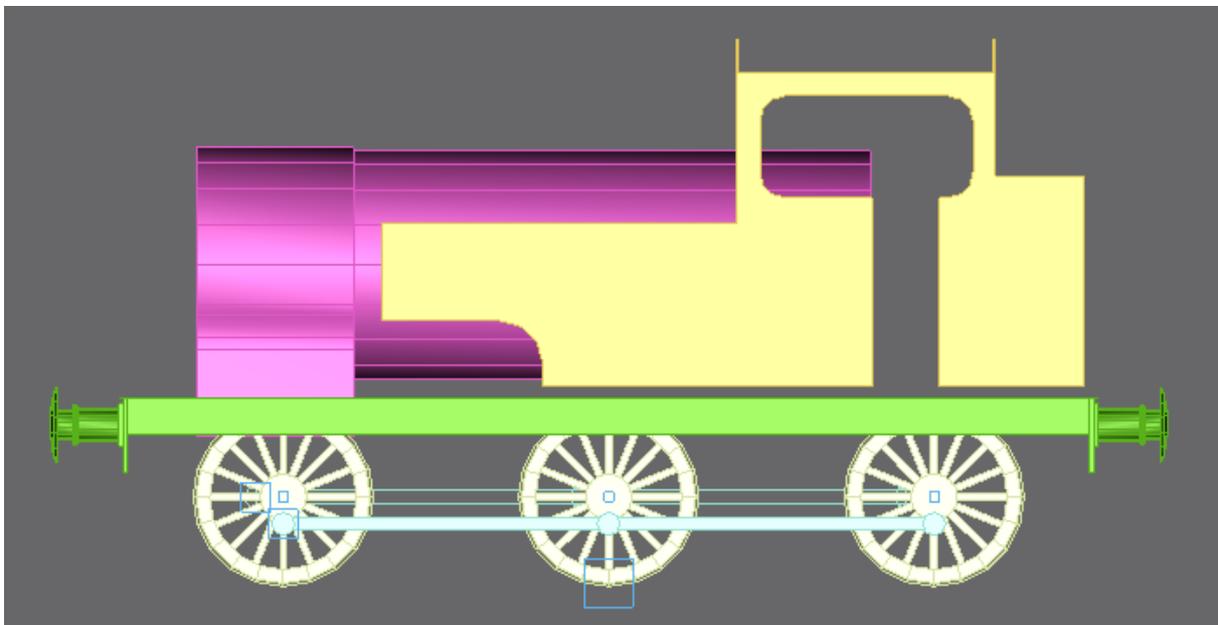
Actually not far out.



Select the vertexes of the cab and move them down. I've attached the cab interior to the tank object so I can move the whole lot in one go. If we need to we can always select and detach it again.

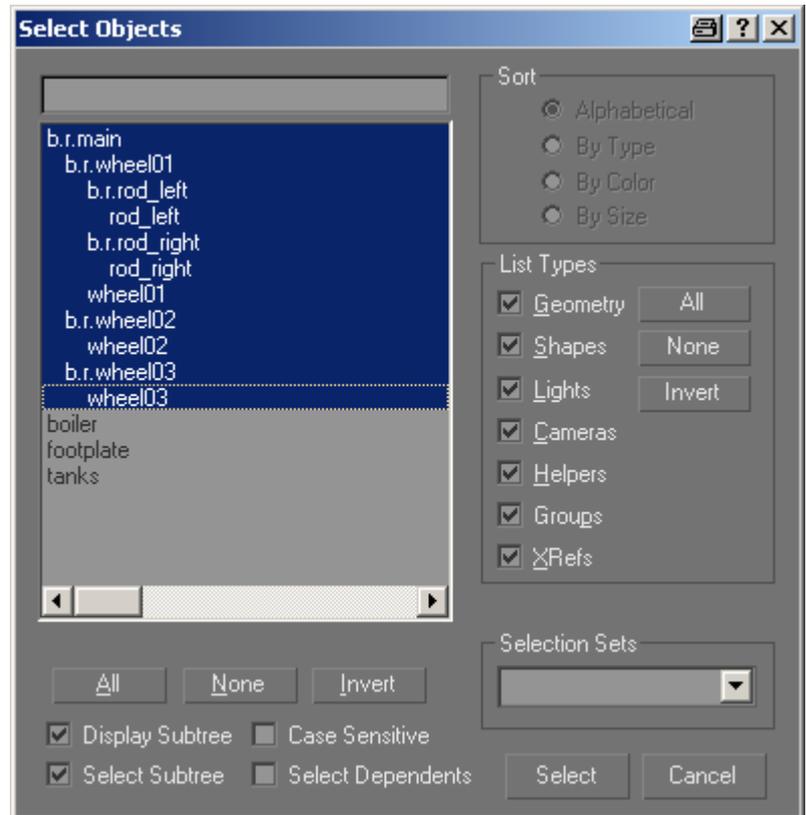


Looking from the side now the wheelbase seems too long, and you'd be unlikely to see a steam loco with the front axle in this position as in real life the cylinders and steam chest would be between the frames under the smokebox.



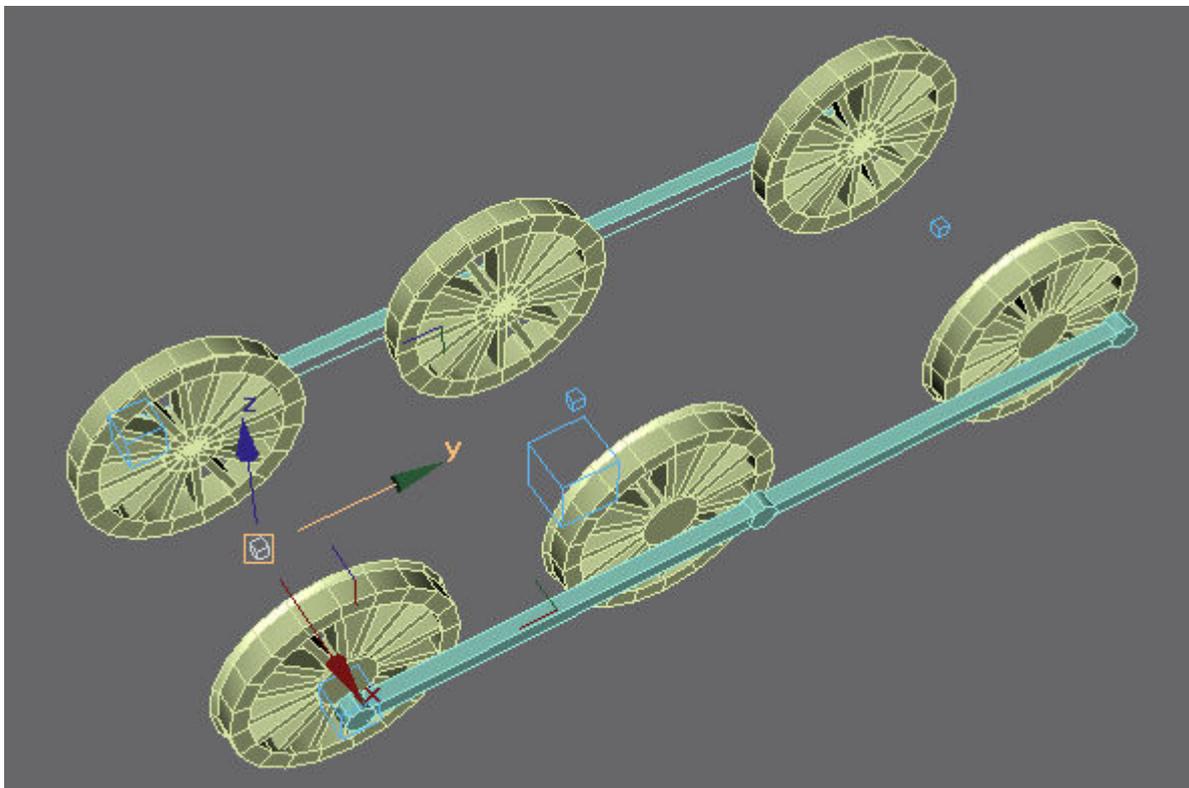
Press 'H' to open the 'Select Objects' dialog box and ensure that 'Display Subtree' and 'Select Subtree' are selected. Selecting b.r.main will automatically select all the linked objects as well.

Hide everything that is not selected to leave just the bogey on screen.



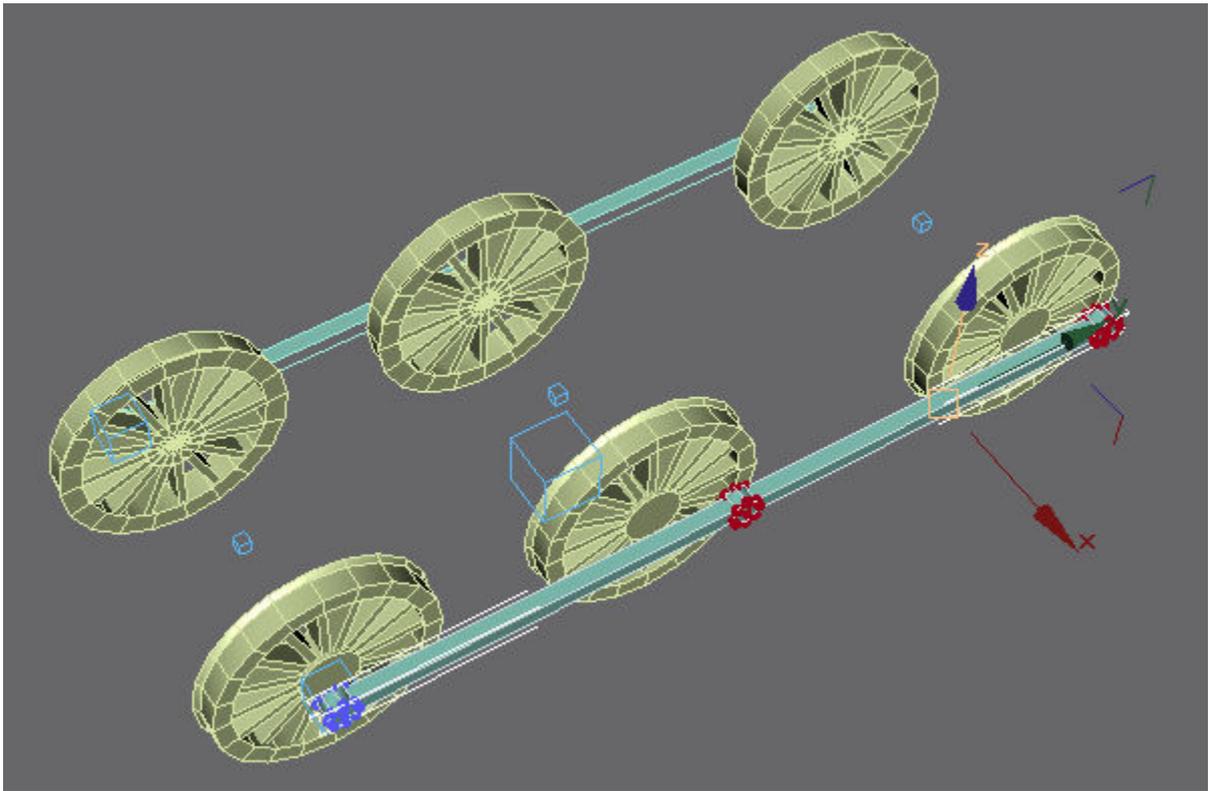
**We don't want to mess with the wheels directly as they are linked to animated dummies. Always move the dummies in this case!**

I'm going to select the 'b.r.wheel01' object and move it rearwards 1'6" for starters.



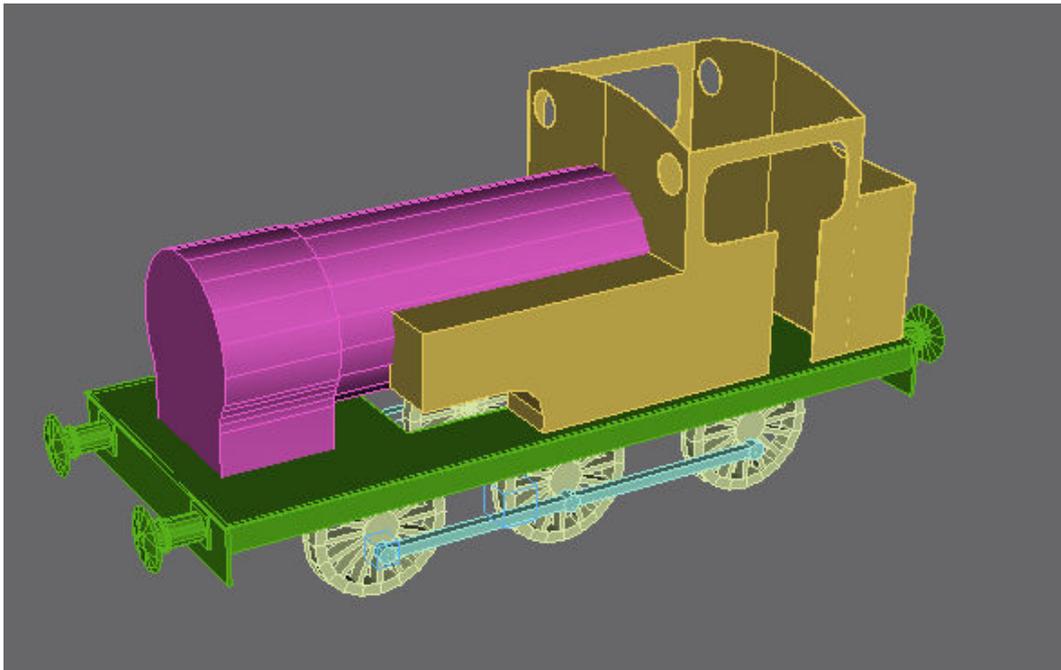
Note that as the dummies for the left and right rods were also linked to 'b.r.wheel01' they have also moved rearwards and are now 1'6" too long for the new wheelbase.

Select the rods and in vertex mode move the bosses on each of them 1'6" forwards.

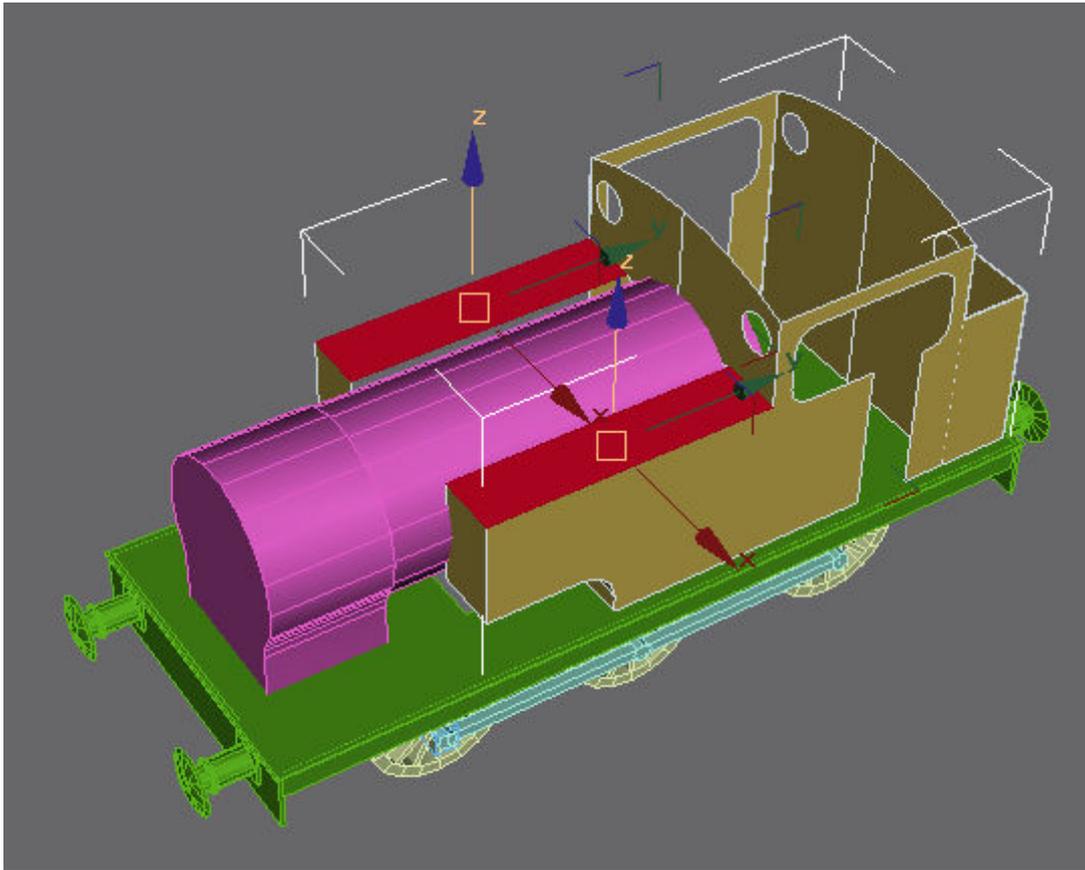


I'll move the rear wheels 1' forwards in a similar manner. The rear wheelbase was often more than the front wheelbase to allow more space for the firebox.

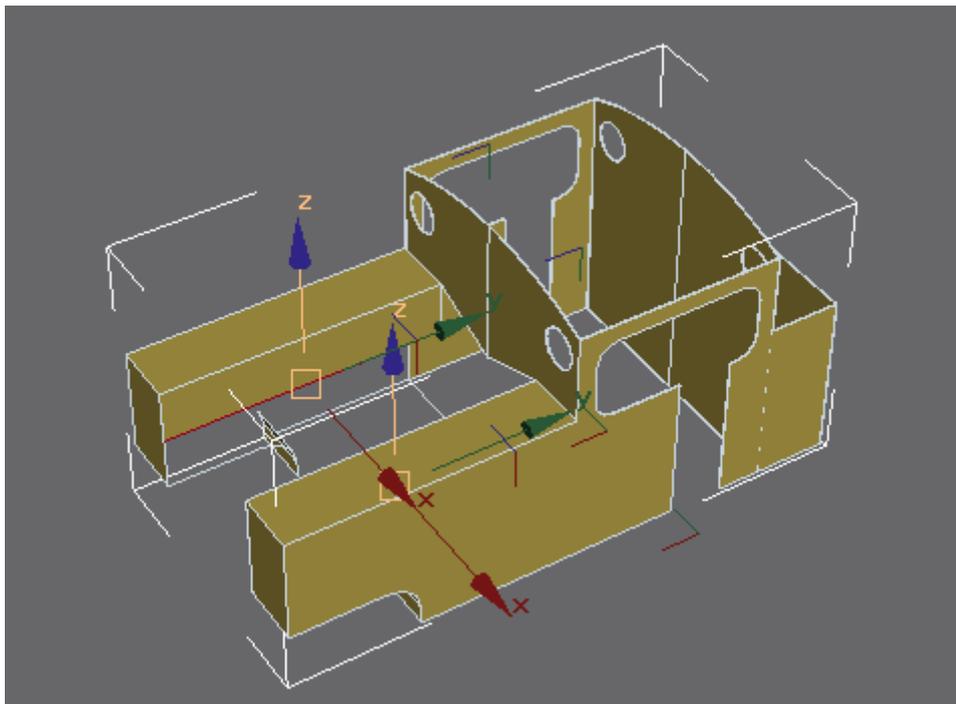
In the next picture I've scaled the boiler and smokebox down as they seemed too large:



Maybe make the tank tops a little higher?

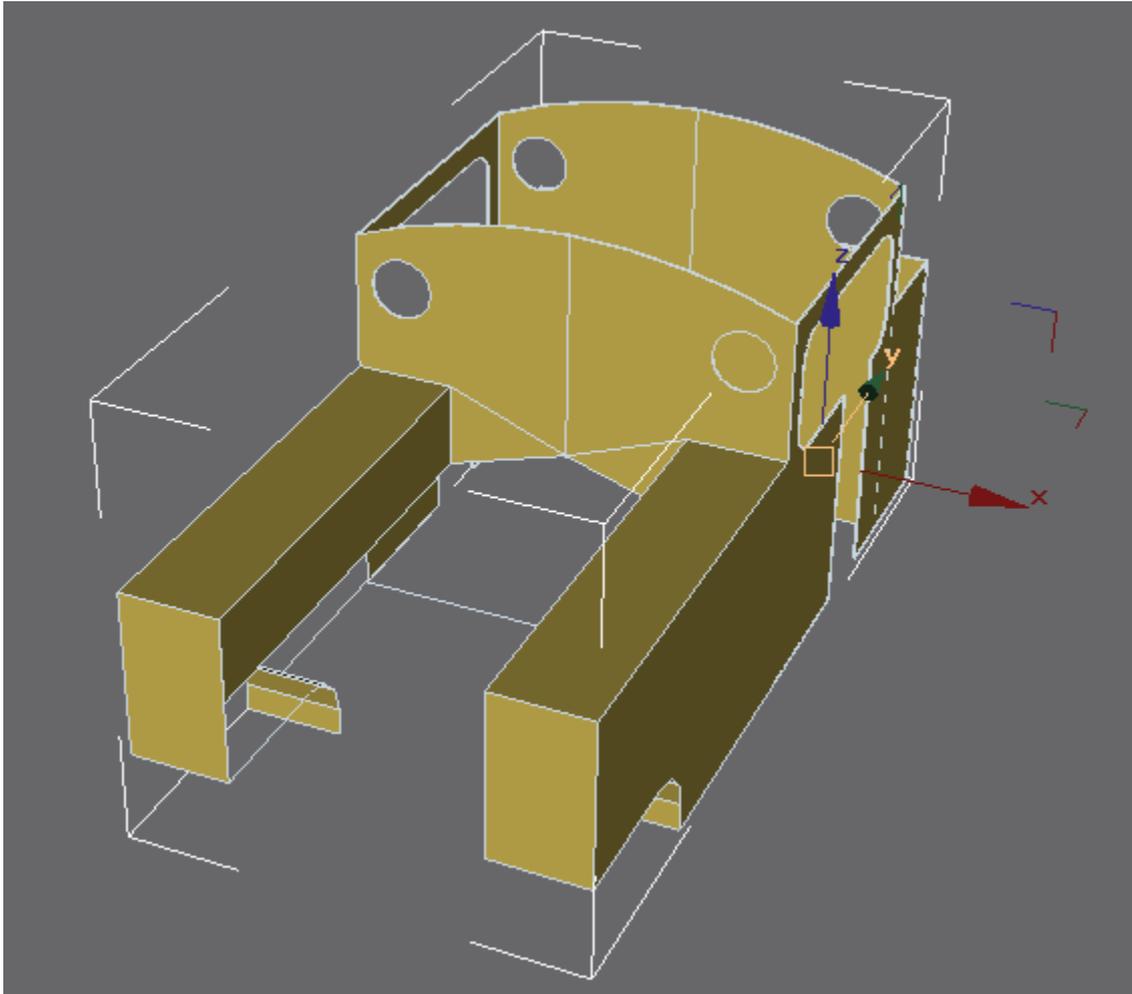


Here I've simply selected and dragged the polys at the top of the side tanks upwards.. Note that as they are now above the centreline of the boiler now you can see a gap between them and the boiler which will need filling with a couple of new polys created by SHIFT dragging the edges.



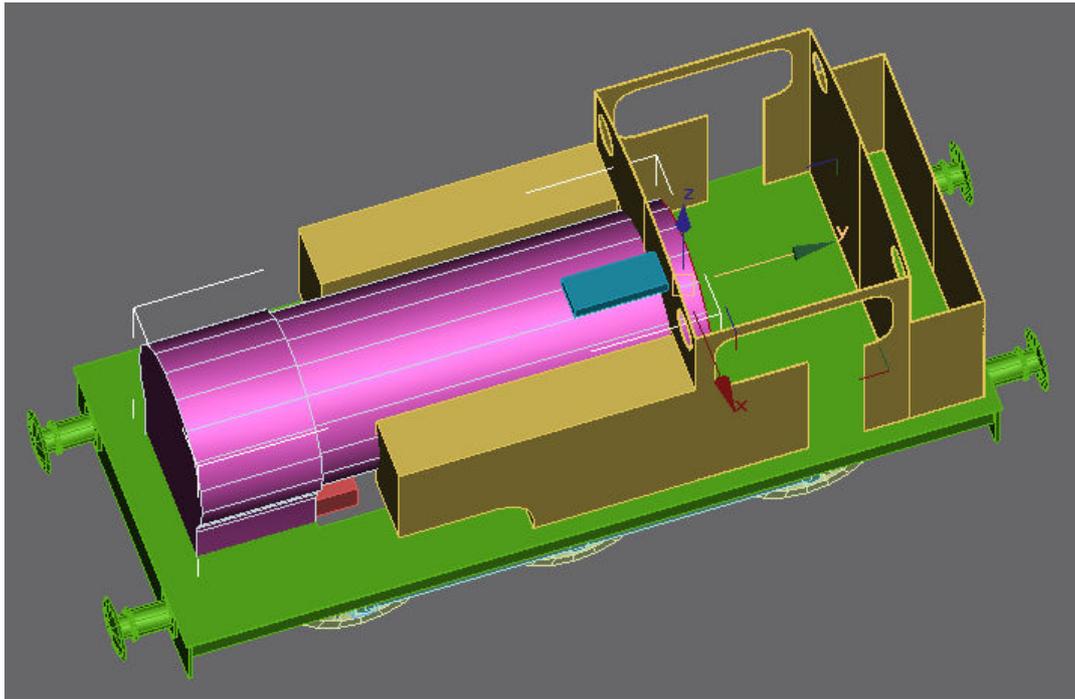
The new polys only need to be long enough to cover the gaps.

Another couple of edges need SHIFT dragging to extend the cab front as otherwise we'll have a gap here as well.

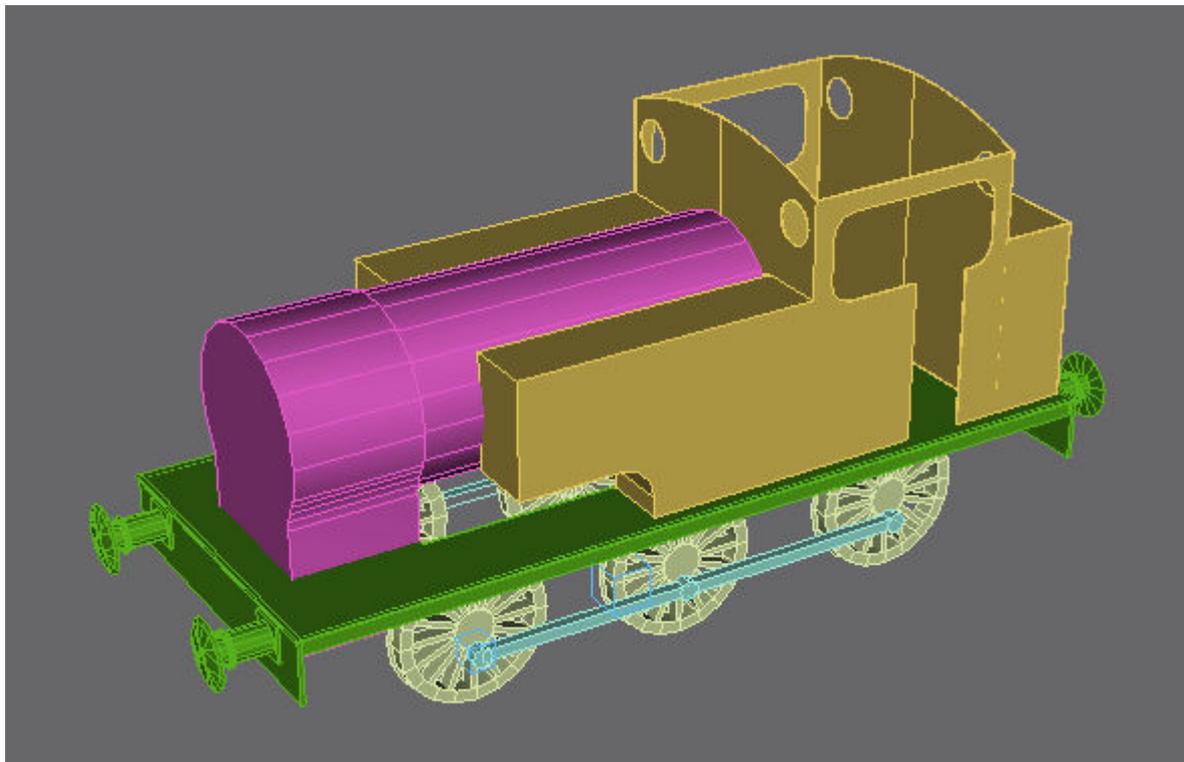


I've scaled the boiler down a little more now, this means that it moves away from the rear of the smokebox. To get the front edge of the boiler back in line with the rear of the smokebox I've added a temporary box to the rear of the smokebox so that I can align the front edges of the boiler to the min Y coordinate of the box.

In a similar manner I'll align the rear of the boiler to the front of the cab.



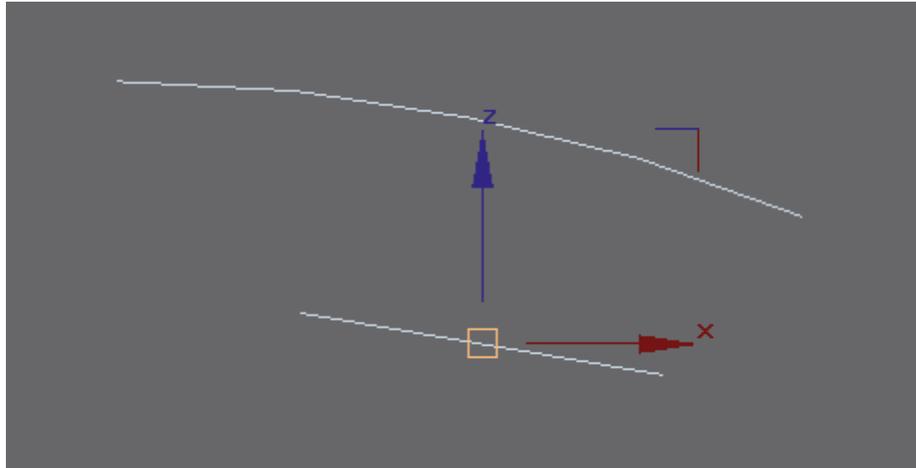
The position of the cutout in the footplate has also been adjusted and the valances made a little less deep.



That's better – this freelancing lark is not as easy as it looks. Download the model [here](#) to take a look at it.

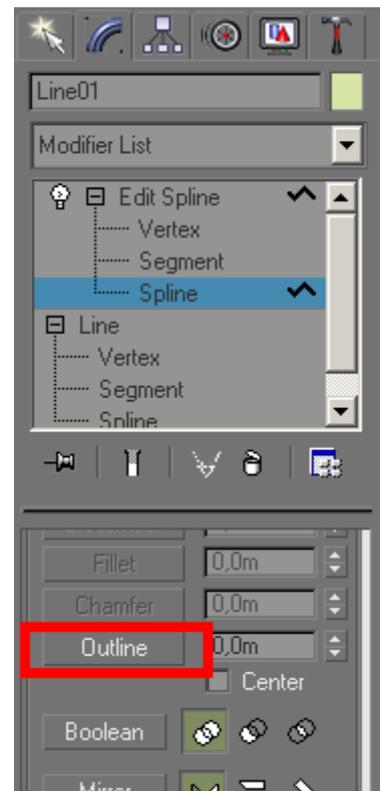
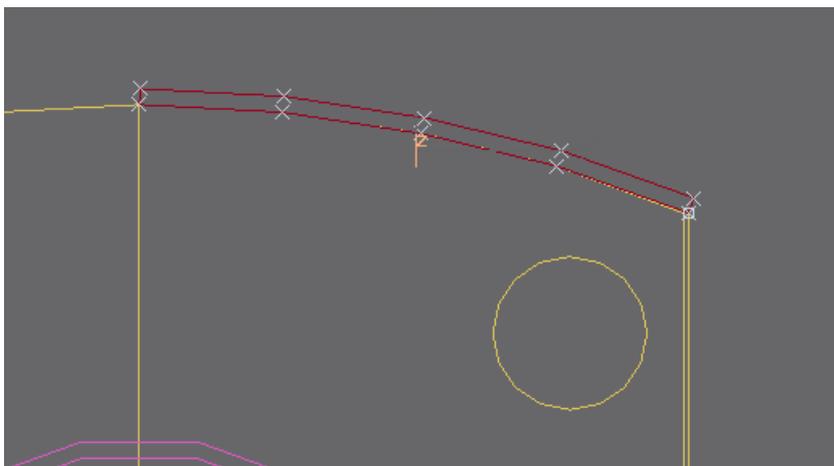
## Cab Roof

Now for something easy, select the edges of half of the cab front (if that makes any sense) and choose 'Create Shape from Edges' to extract a shape. Switch to front view with the 'F' key and hide everything but the new shape. Create a line in the front view and attach the shape to it. This is because the shape needs to be reoriented to the front view. Delete the line segment.

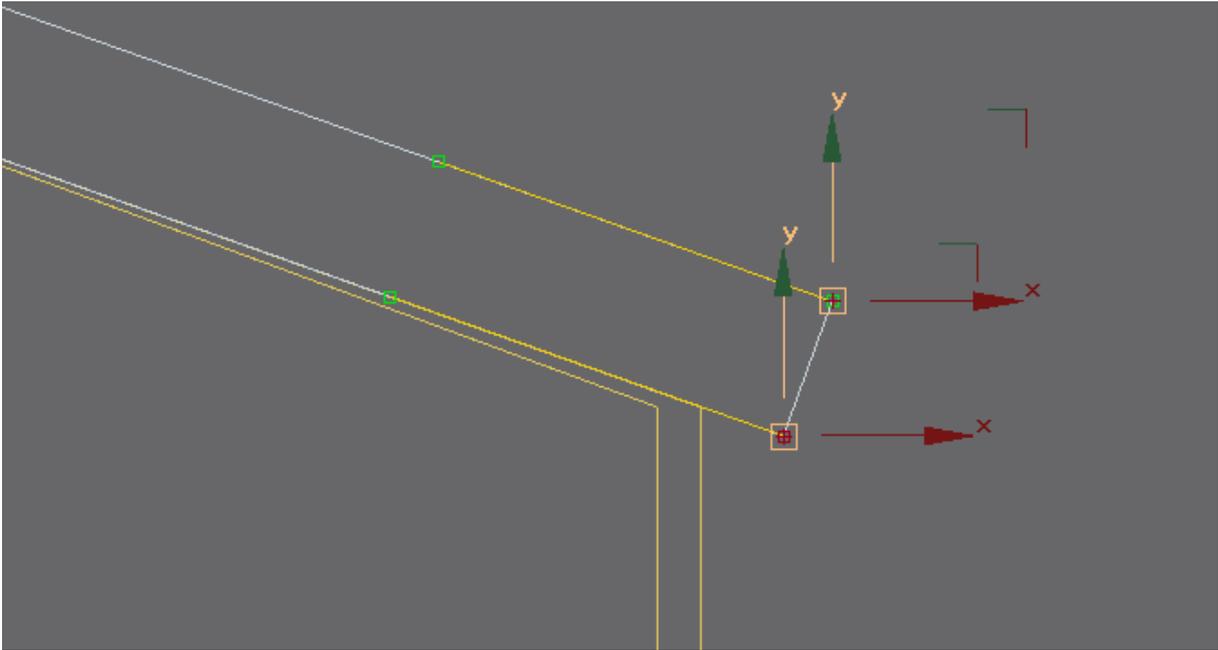


Add an 'Edit Spline' modifier to the stack and select 'Spline' in the modifier. Choose 'Outline' and drag the shape to create a thickness. You wouldn't believe how many models I made without knowing this trick - it was hard work (about the only useful thing I found in the GMax Bible actually).

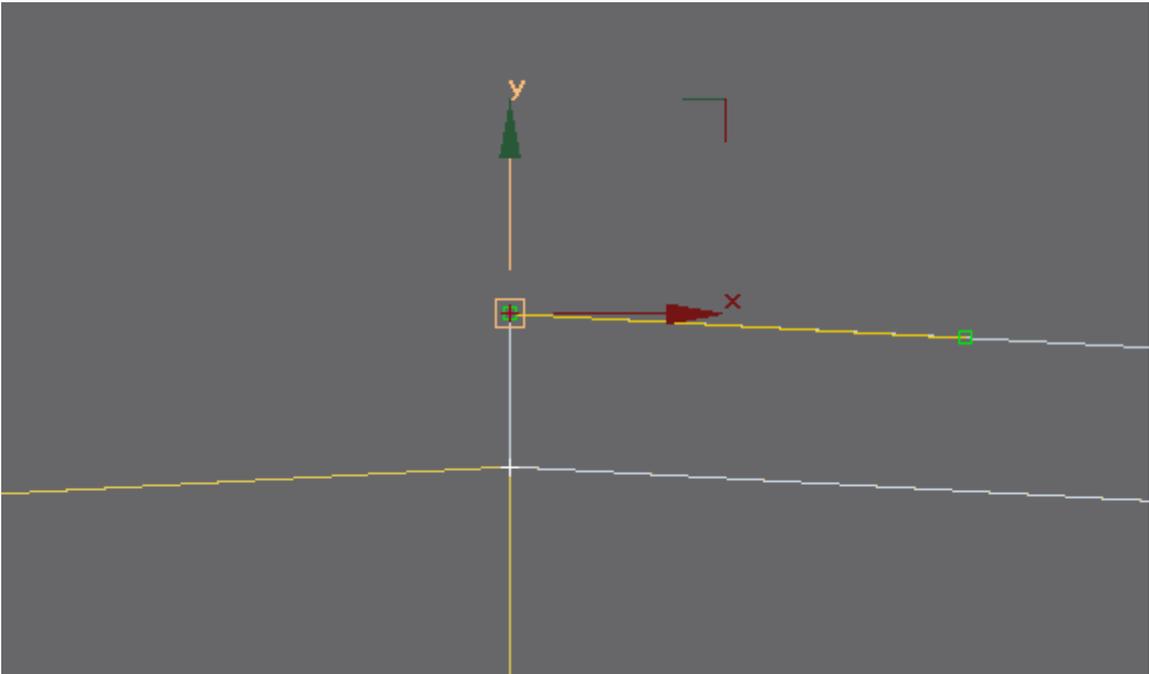
**The 'Edit Spline' modifier is there so that you can delete it and get back to the original shape if you get the thickness wrong.**



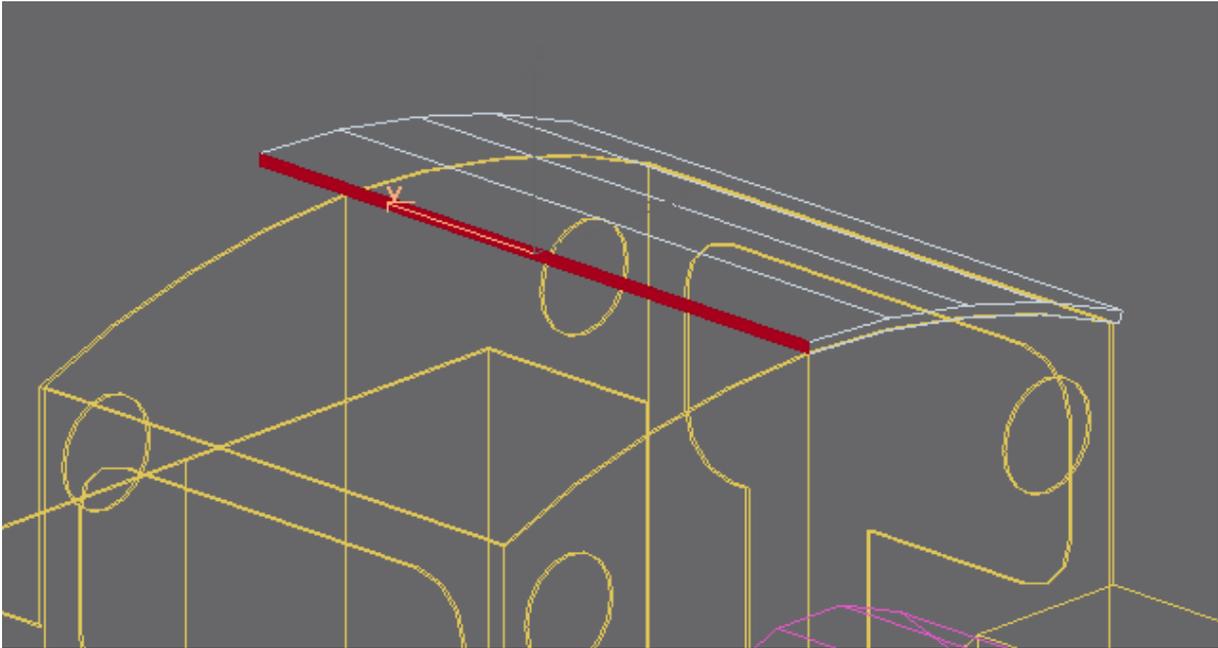
Drag the vertexes to create a bit of overhang for the roof, this can just be eyeballed.



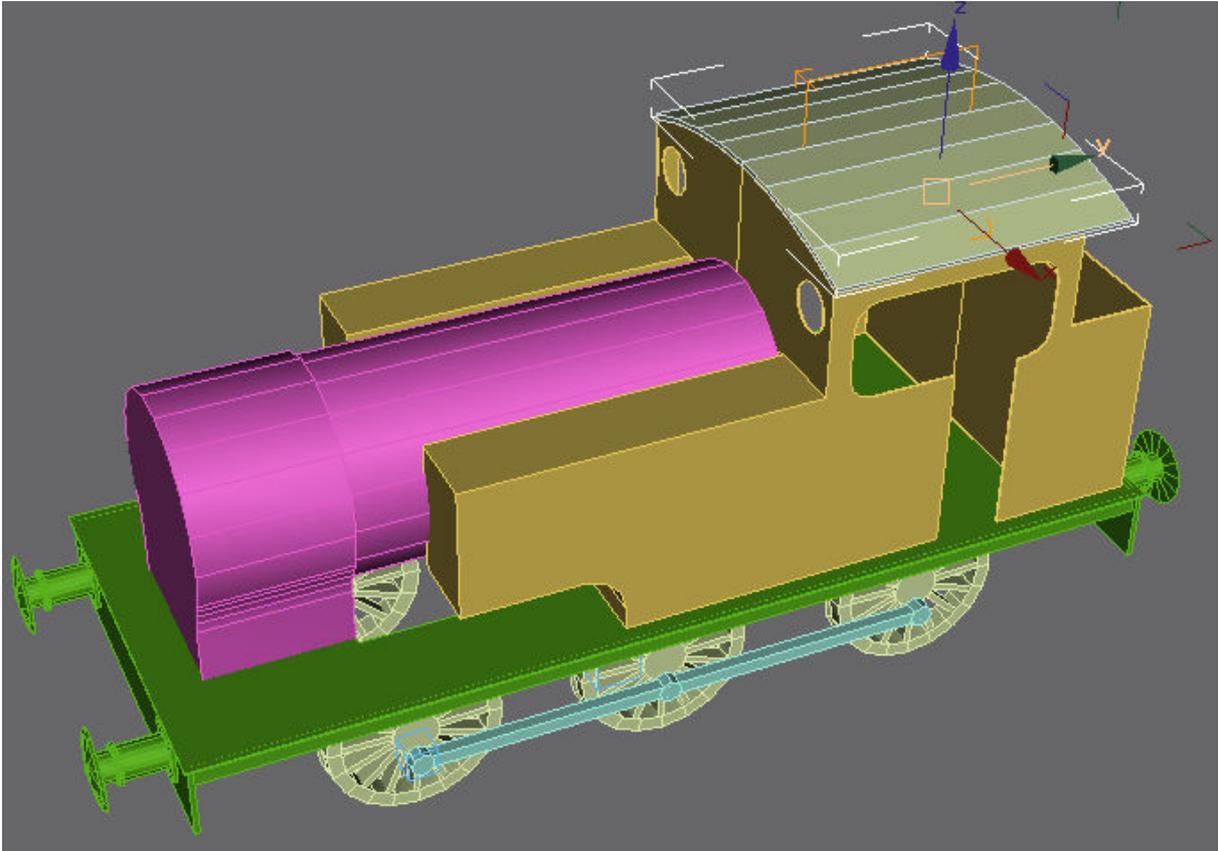
Move the vertex at the roof centreline to X=0 to avoid having a gap.



Now extrude the shape to produce half of the cab roof.



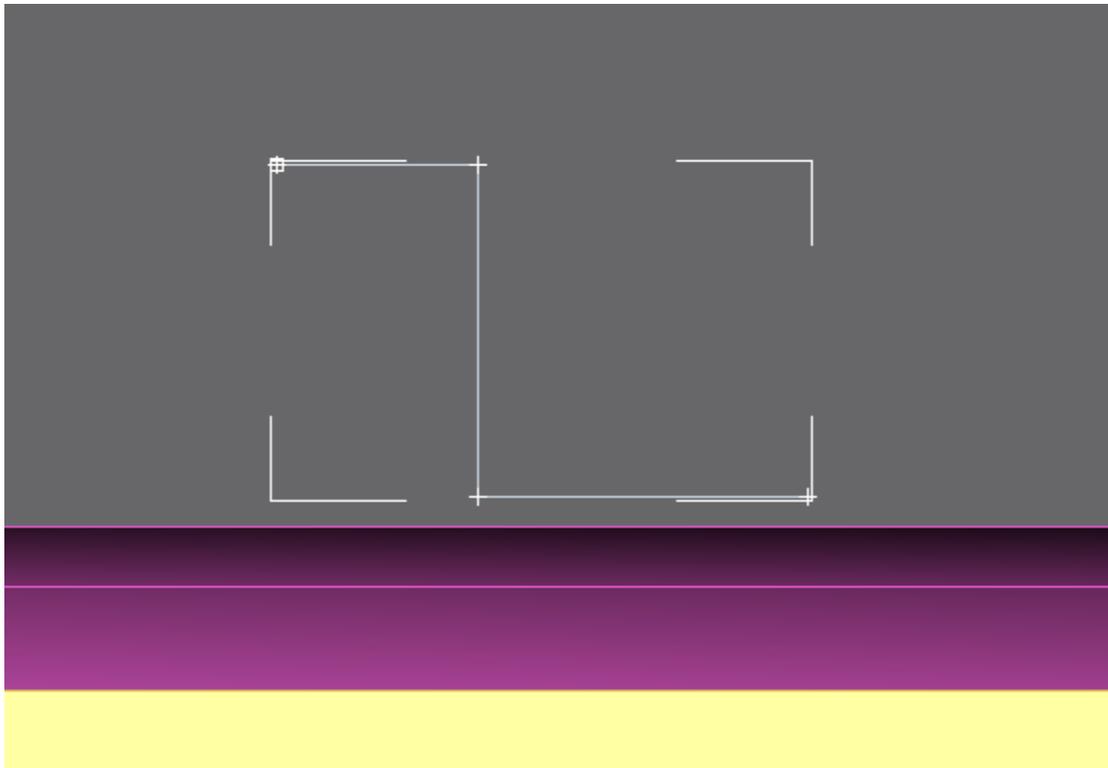
Delete the extra poly on the roof centreline and mirror the roof over.



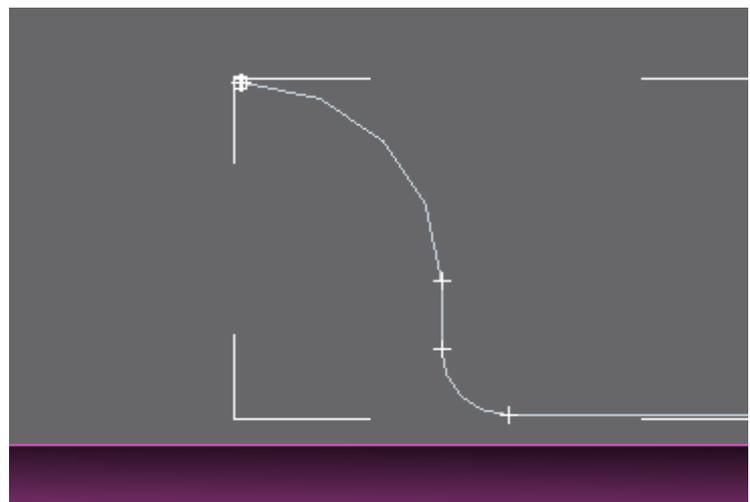
Adjust the roof overhang front and back by dragging vertexes.

## Chimney and Dome

In the side view sketch a line as shown.

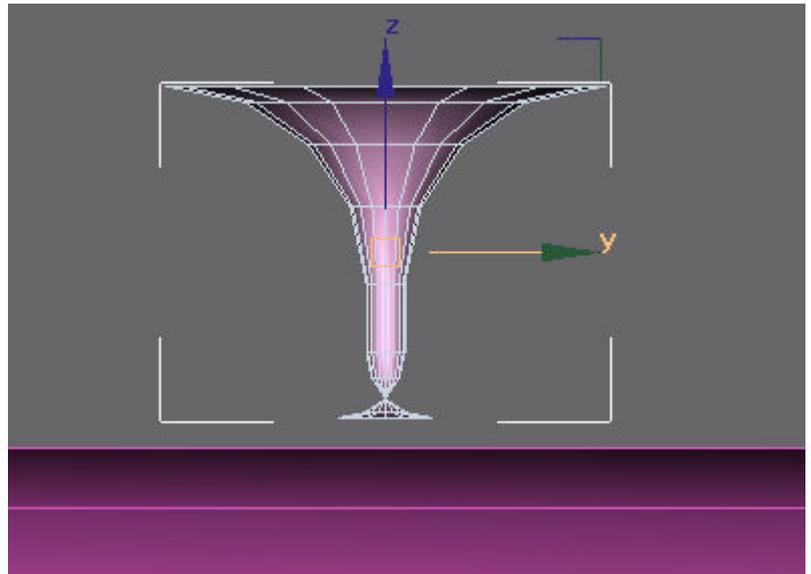


Add fillets and change the interpolation to 3 or so.

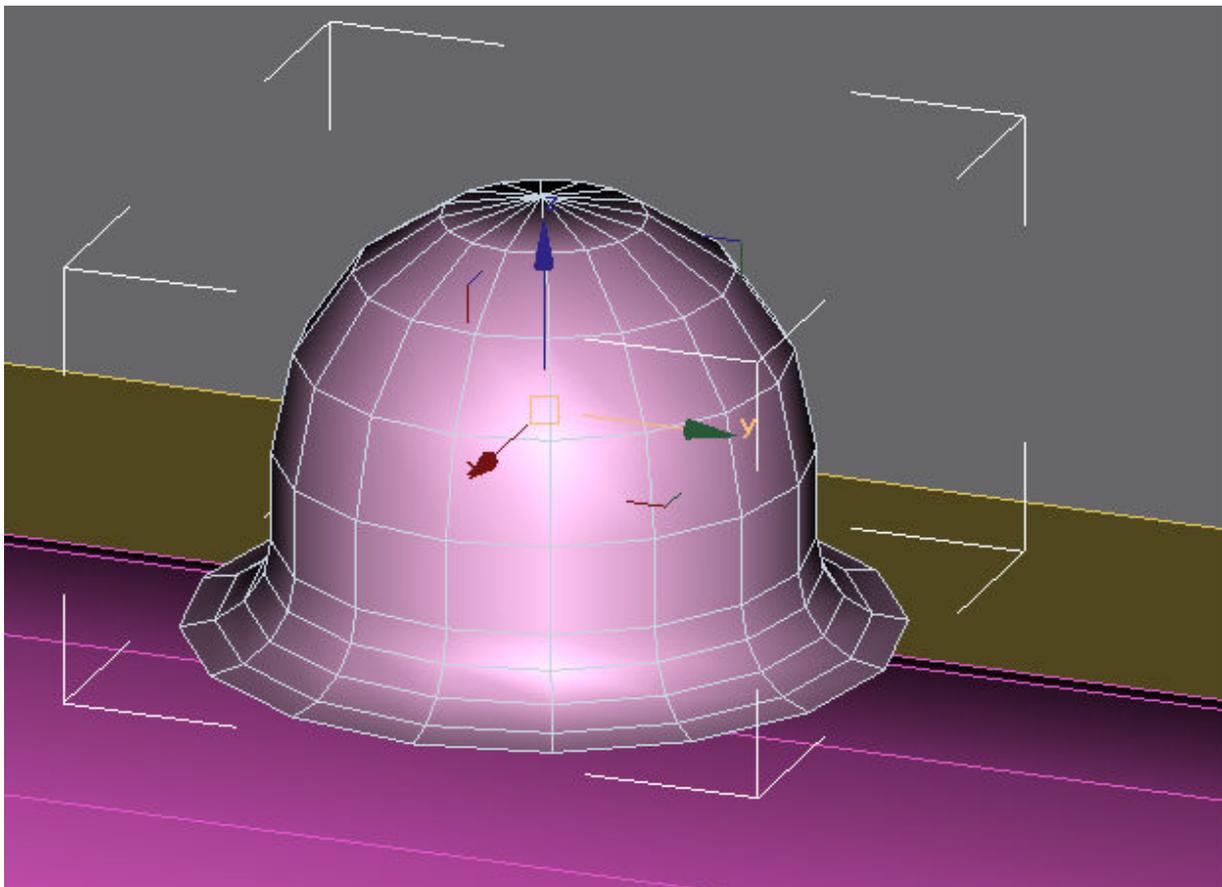


Delete the horizontal line segment at the base of the dome.

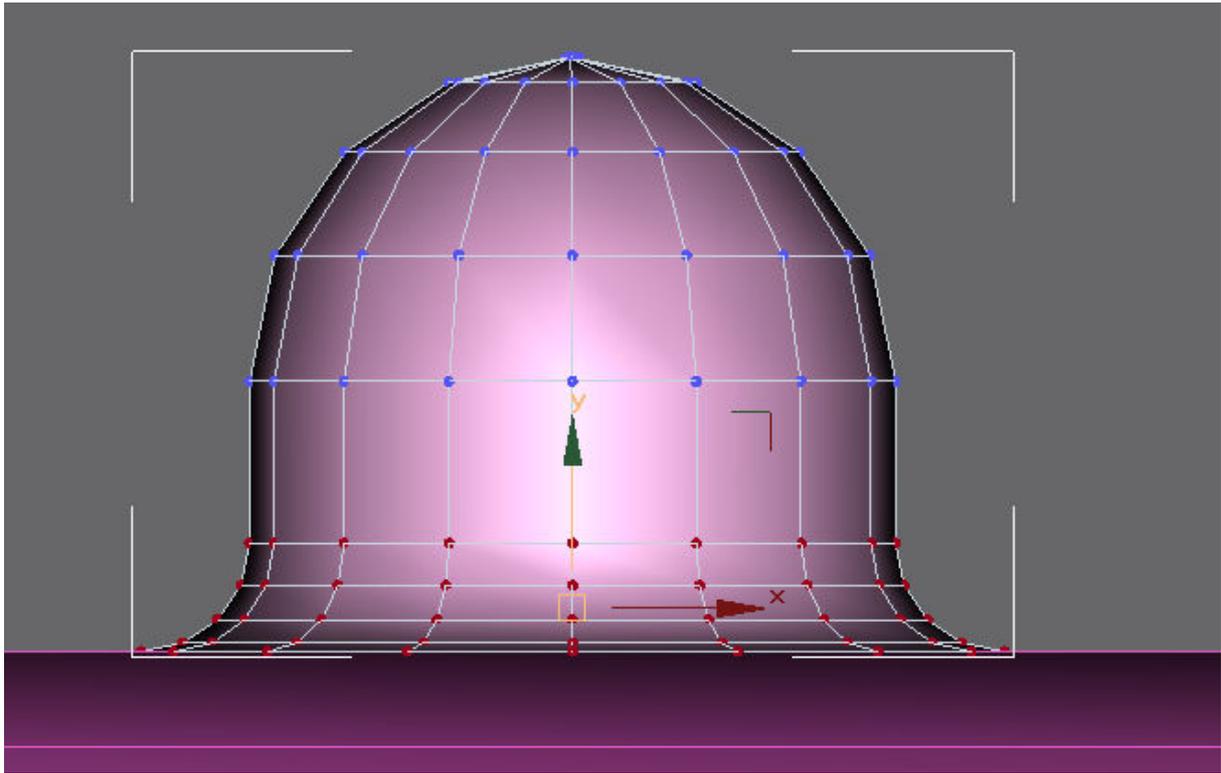
Add a 'Lathe' modifier.



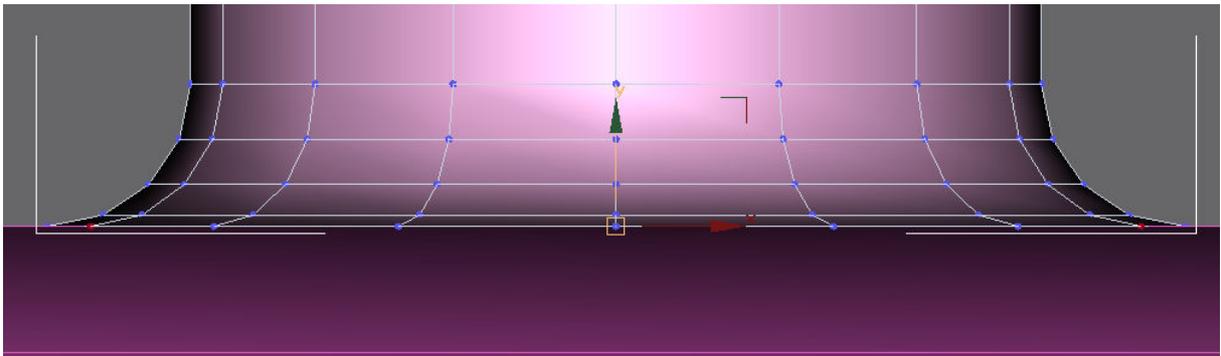
Align the lathe axis with the min Y coordinate of the dome by dragging. Just before the dome mesh turns inside out stop dragging. Choose 'Weld Core' in the rollout.



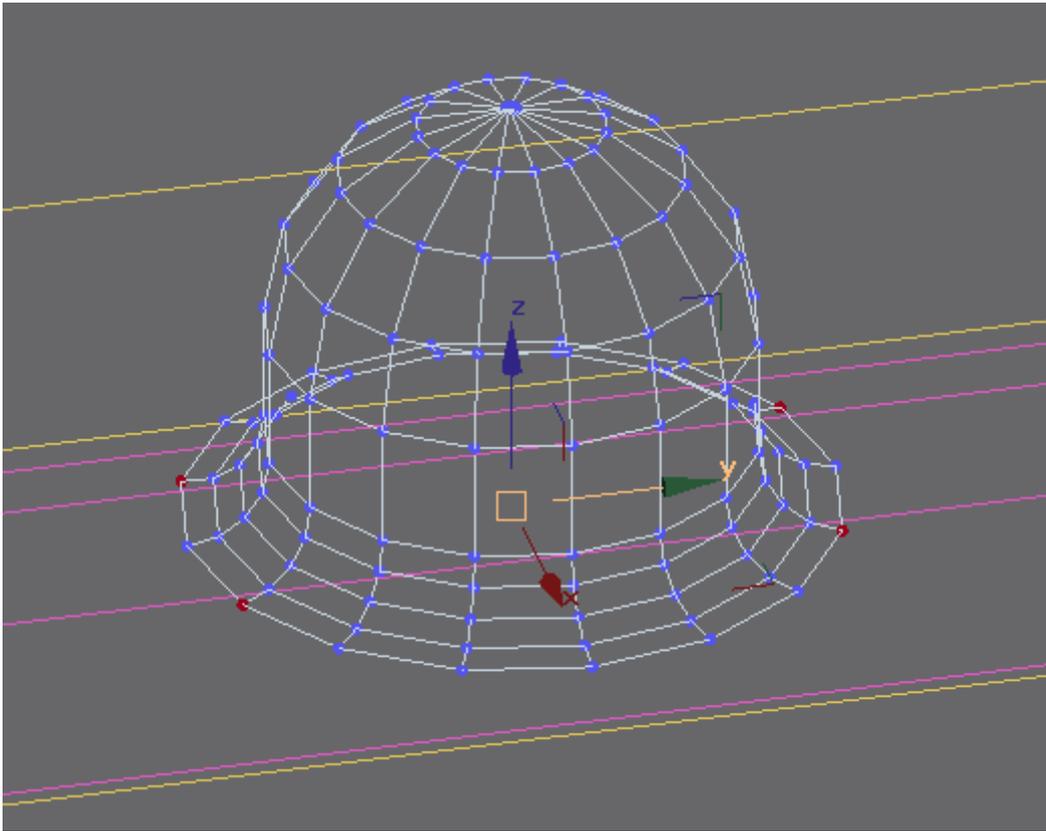
In side view move down the dome until it just touches the boiler.



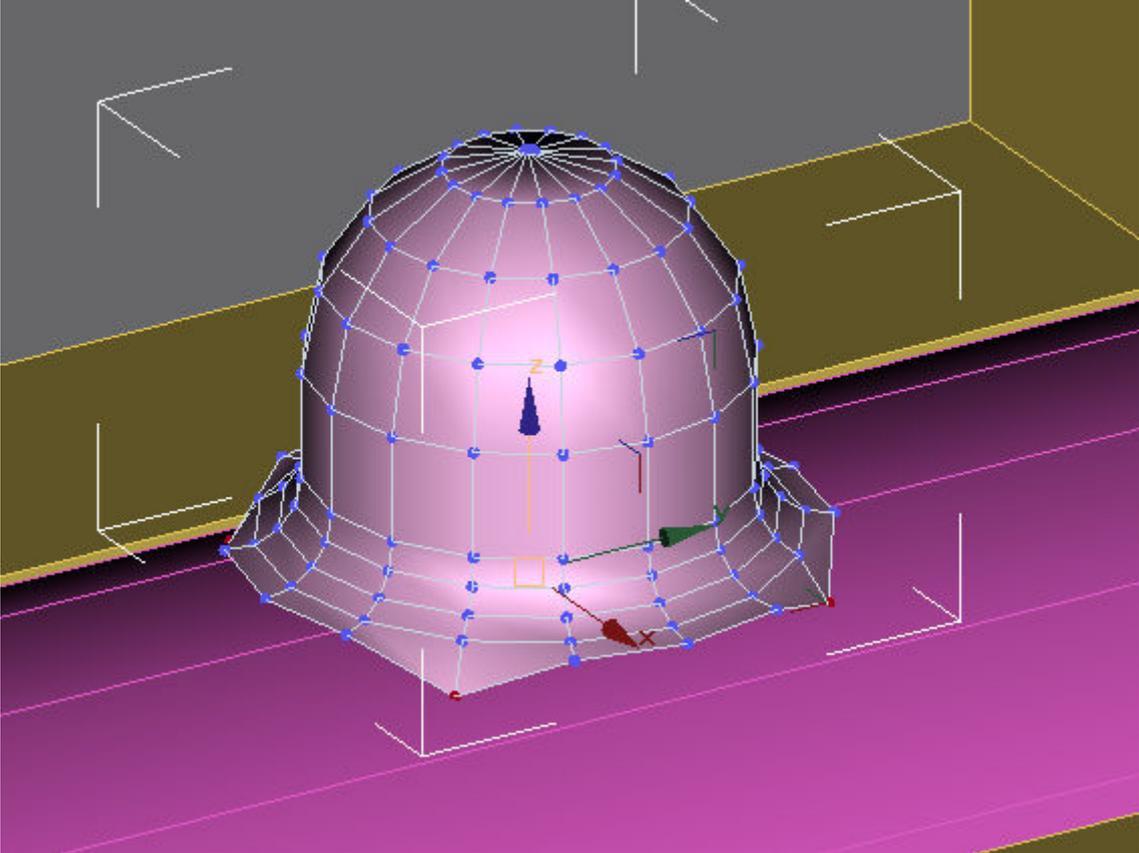
Now tweak the other vertexes down until they just touch the boiler.

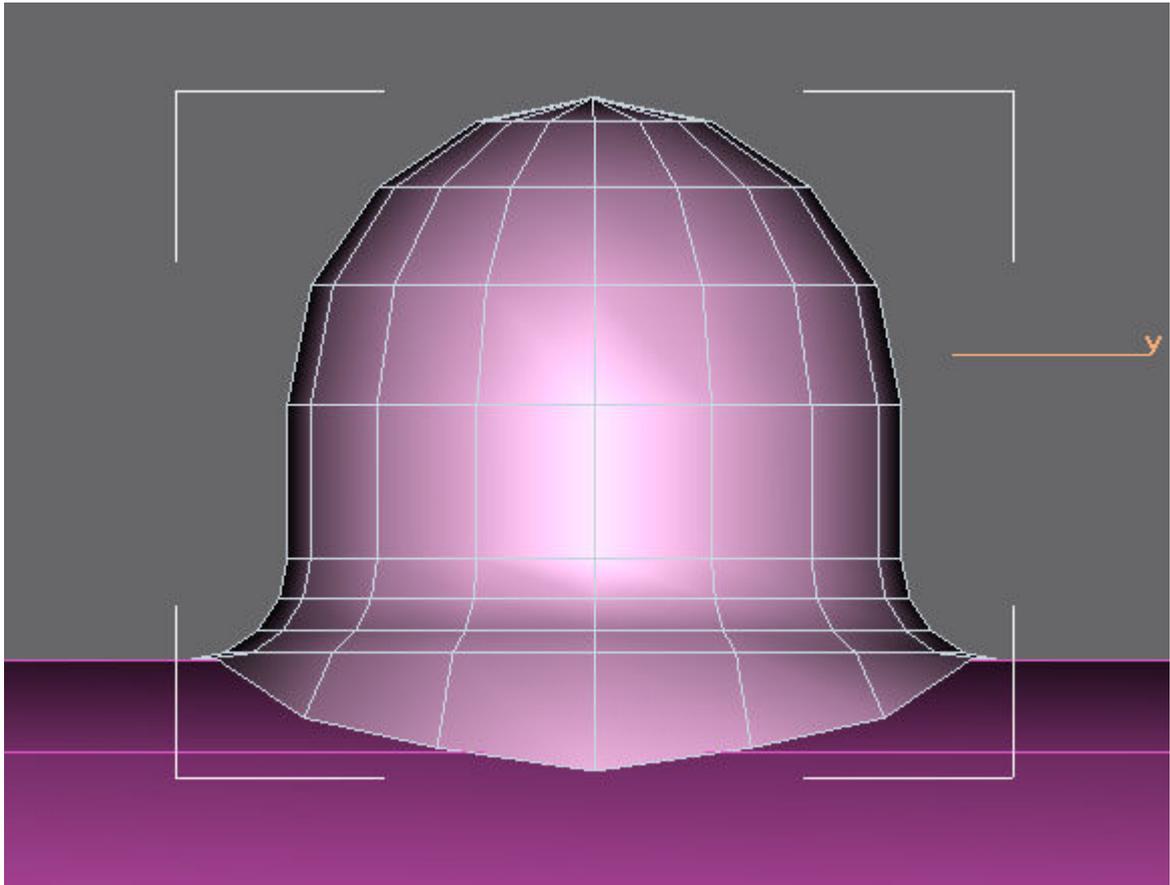


Always select the vertexes in pairs, front and back. We've actually selected four vertexes as you can see here:

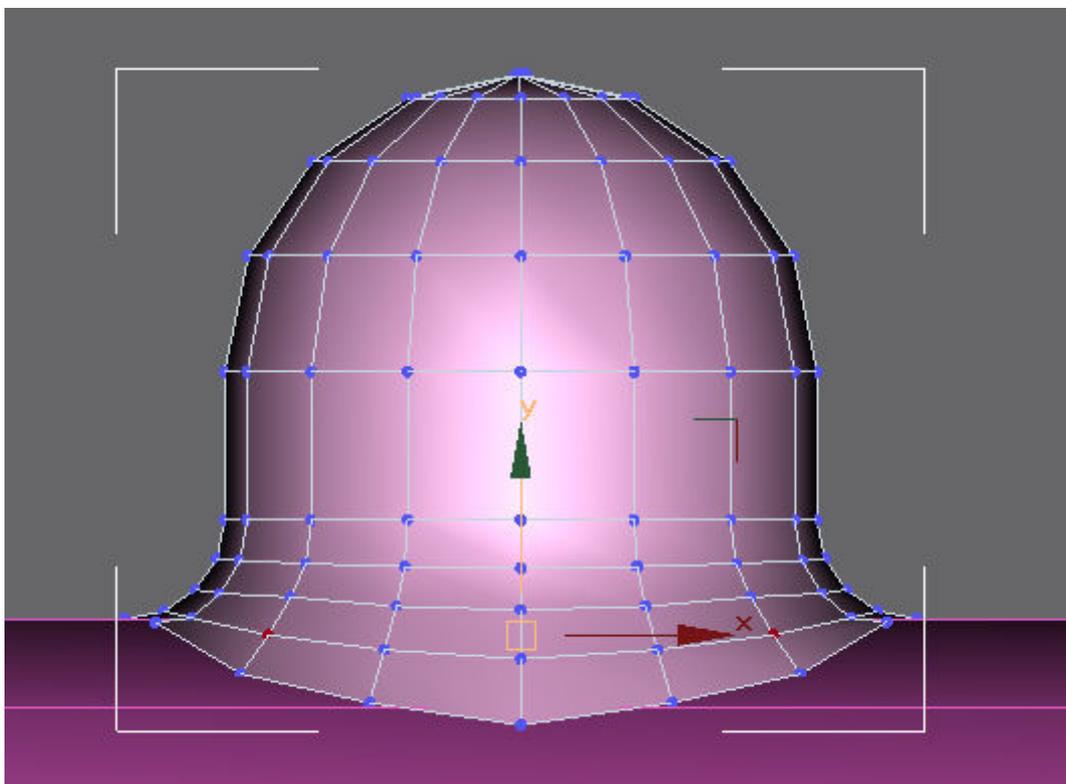


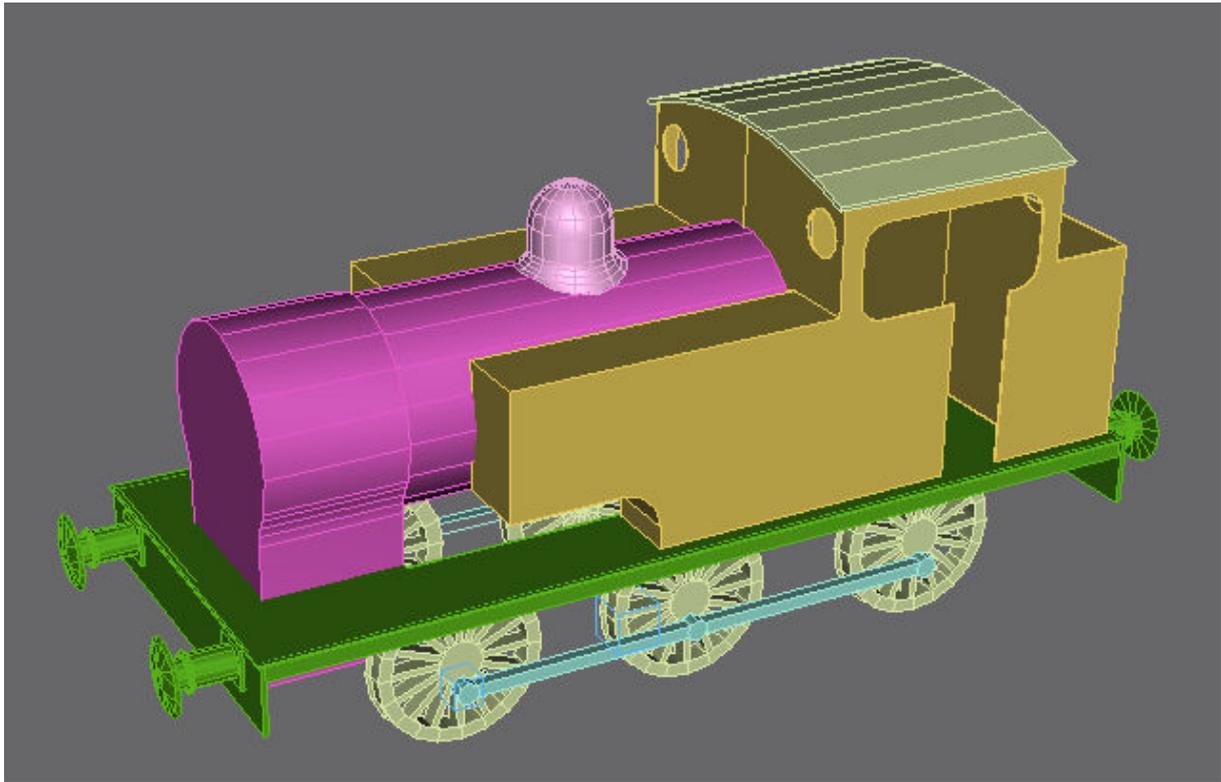
Carry on moving the vertexes until the skirt of the dome is sitting on the boiler. This tweaking is best done in a 3D view with contrasting colours for boiler and dome.



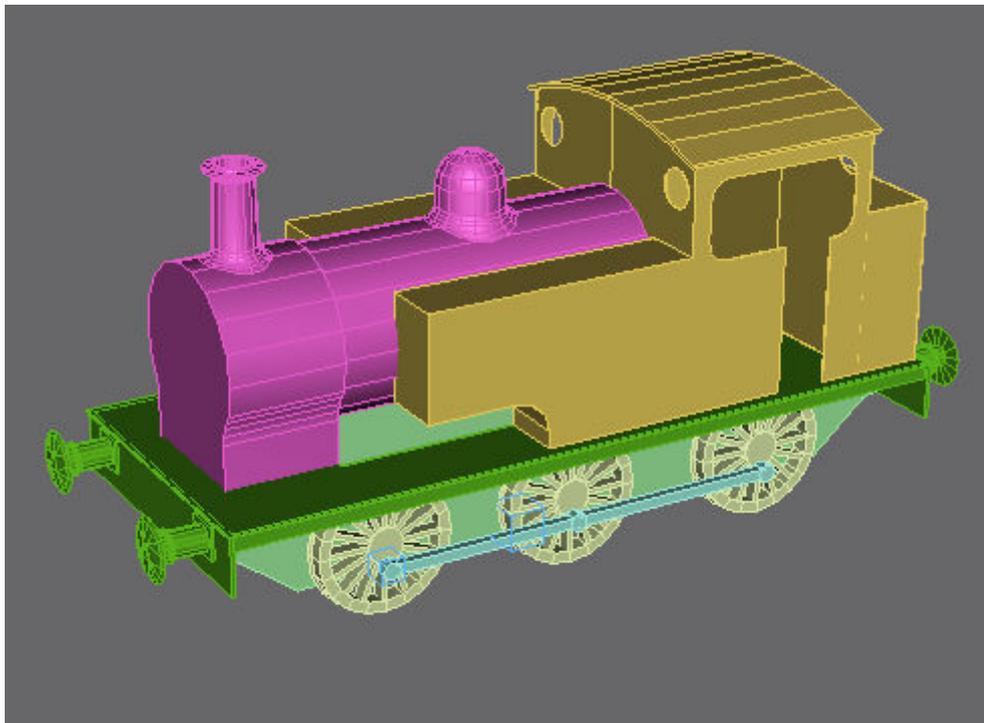


Now adjust the next lines of vertexes to smooth the skirt out:





The chimney is made the same way of course as would safety valve bases etc etc. Here is 'Primus' in all his glory – well there are still lots of things that could be added (like brakes!) but constructing such things would mean repeating a lot of what has gone before. I think he looks quite cute in a Thomas the Tank Engine kind of way...



Before we look at exporting the model into Trainz a quick word about structuring the model. In the same way we linked everything in the bogey to 'b.r.main' I've linked all the body parts to 'boiler'. This enables the selection of either the bogey or body components for the purposes of hiding and exporting them, as I build everything in the one model (easier to make sure everything fits together and to keep track of the poly count).

The poly count by the way is 4994 but handrails etc will drive that up quite a bit although less than 7000 should be easy to achieve.

Note as well that the mainframes are being treated as part of the body, the reason being it will make using the bogey for something else easier. I also didn't mention how the frames were built but you should be able to figure that out for yourself.

The model in this condition can be downloaded [here](#).

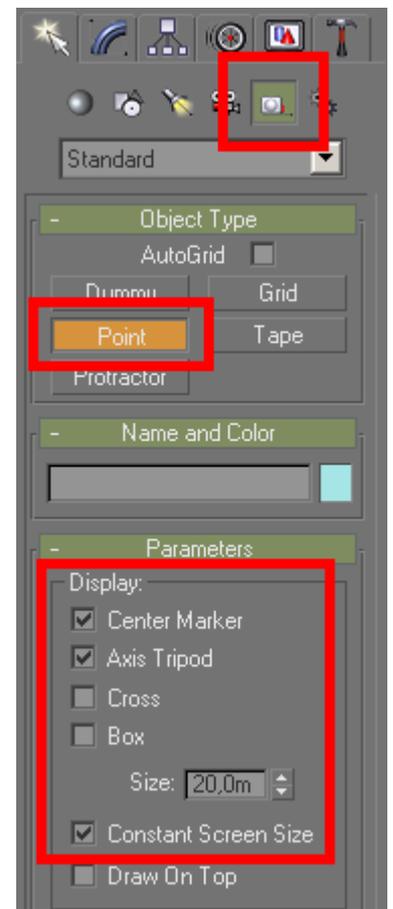
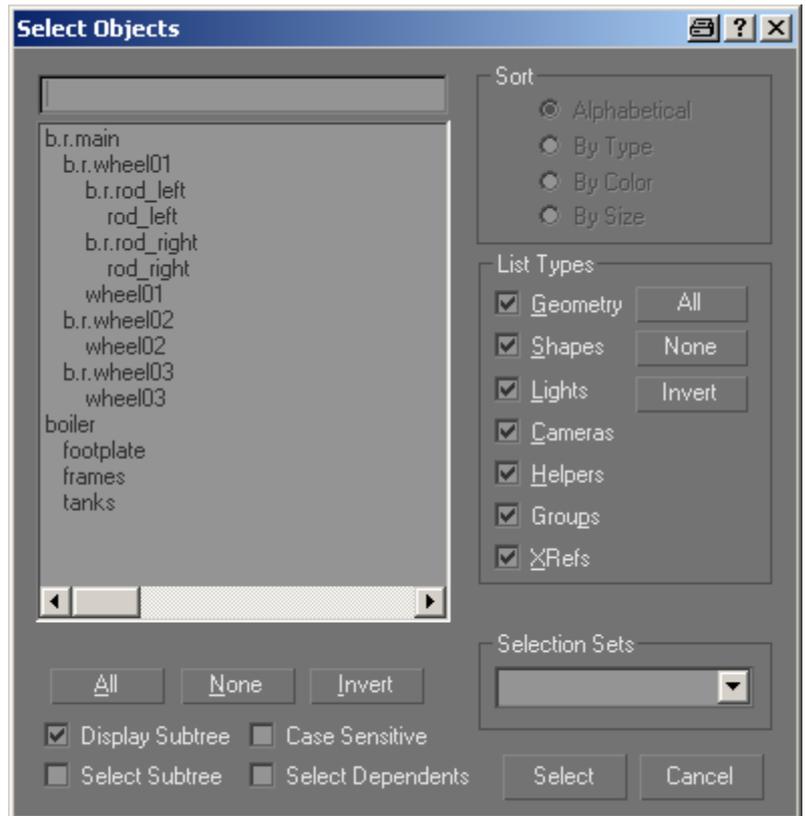
## Adding Attachment Points

Before we can export the model into Trainz there is the matter of the attachment points to consider. These tell Trainz where the loco starts and ends, where smoke comes out of it and where the bogey is attached for example.

Attachment points are found in the 'Helpers' tab (where the animation dummies are) and the settings I normally use are shown here.

A point looks like an X,Y,Z axis and should usually be created in top view.

**They also need to have particular names that Trainz will be looking for, misspelled and/or misplaced attachment points will cause a lot of grief. You have been warned.**

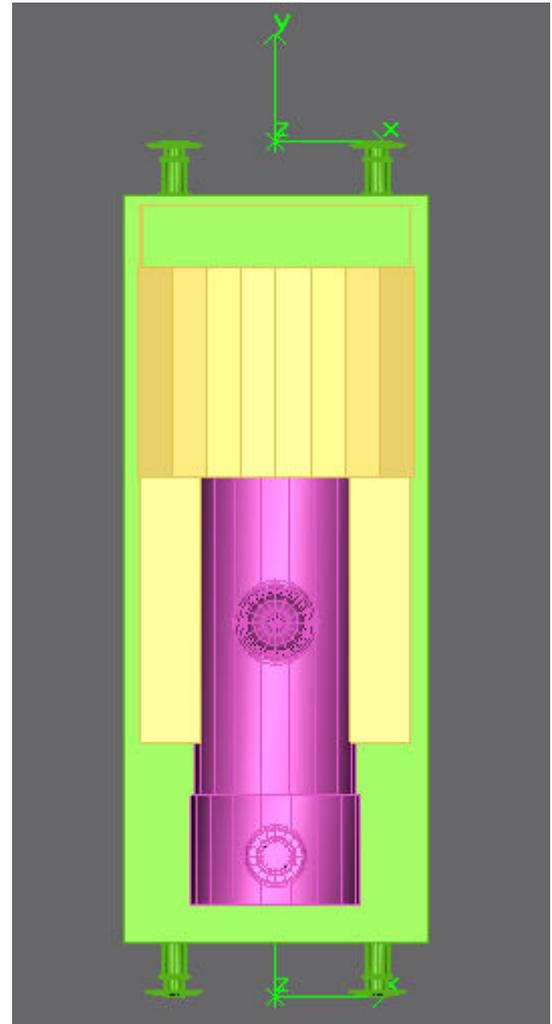


Two of the most important points are called 'a.limfront' and 'a.limback'. These are the virtual coupling points that Trainz uses when coupling to other stock. These should be equidistant from the 0,0,0 point of the model and **it's vital that 'a.limfront' is at the bottom when looking at the model in top view.**

**If when you look in top view the front of the loco is at the top of the screen (or worse to the left or the right) you've built the model the wrong way round and you'll need to correct it before continuing.**

Here we see 'Primus' and the first two points. The X coordinate of both should be 0 (i.e. on the loco centreline), the **Z coordinate 0,89m**. The Y coordinates should coincide with the buffer faces front and rear and **should be equidistant from Y=0.**

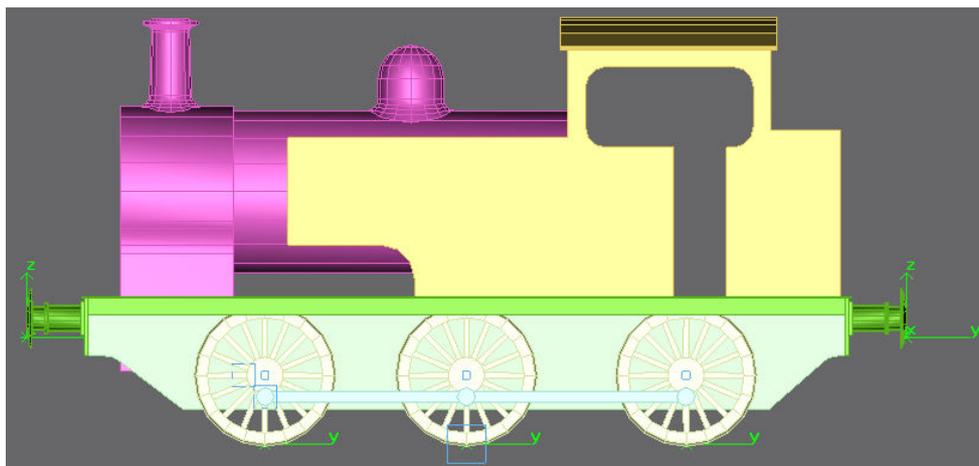
**Link these two points to the 'boiler' object, or the object you are using as the base object for the body. This is to ensure that the points get exported with the rest of the model – if they don't you'll have all sorts of problems.**



The next points are called 'a.bog0', 'a.bog1' and 'a.bog2'. 'a.bog' and 'a.bog1' control how the loco sits on the track, 'a.bog2' just goes along for the ride and is where the bogey that you can see is attached. A built-in invisible bogey will be attached to the other two points.

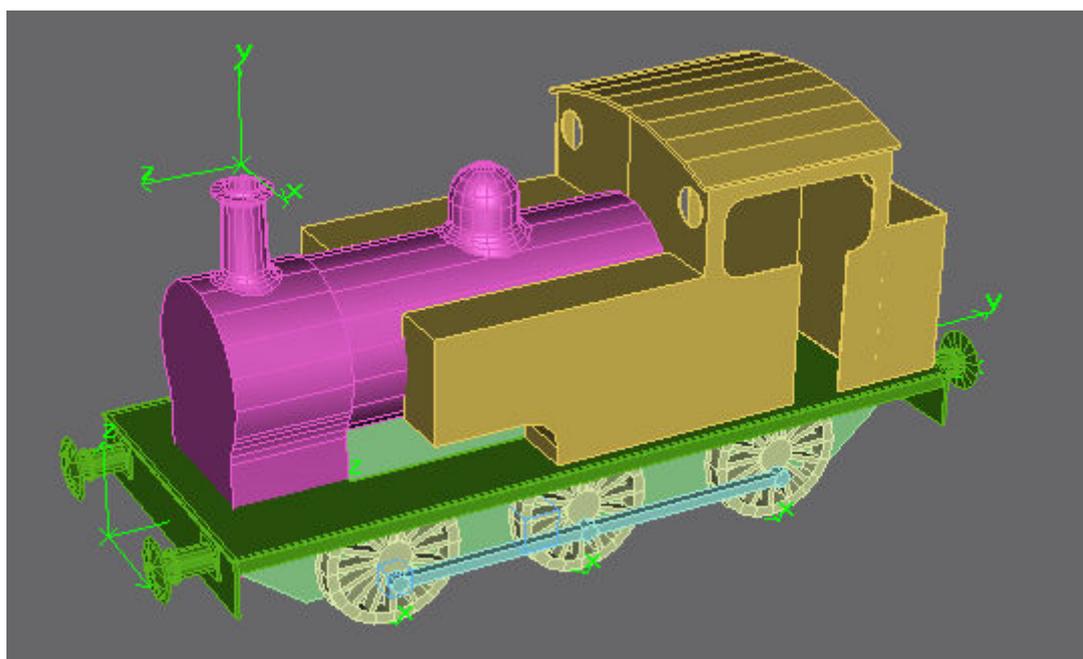
'a.bog0' should be at X=0, Z=0 and aligned to the Y coordinate of the frontmost driving wheel. 'a.bog1' is at X=0, Z=0 and aligned to the Y coordinate of the rearmost driving wheel.

'a.bog2' should be at 0,0,0. **Again, link these three points to 'boiler'.**



We'll want to see some smoke come out of the chimney so we'll need a point called 'a.smoke0' just above the chimney.

**Unlike the other points this one needs to have a special orientation. The smoke goes in the +Y direction of the point. Again, link this to 'boiler'.**



Finally a point called 'a.cabfront' will be needed to attach an interior. This should be created in top view and aligned to the centre of the cab interior. It's easiest to detach the interior from the model, set the pivot point to the centre of the object and align the point 'a.cabfront' to the pivot point. The interior can then be reattached or left separate and linked to 'boiler'.

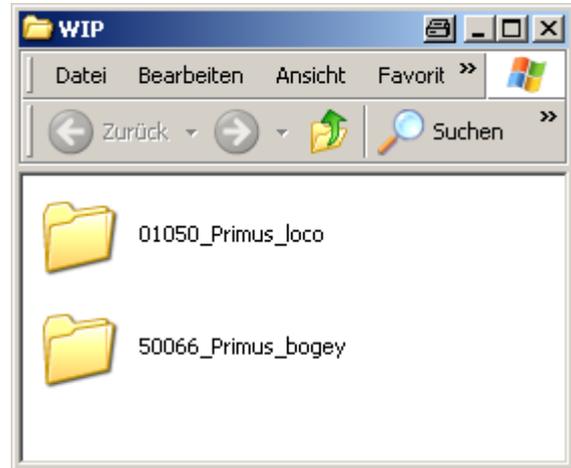
That's it for the points, these are the bare minimum for a steam loco.

## Setting up the Working Directories

I'd suggest creating working directories somewhere outside TRS, preferably not on the C: drive in case Windows goes belly up and it's necessary to reinstall it. Being

paranoid I also have an automatic backup program that copies anything that has changed during the day to another drive, but as this is German software I won't go into further detail. It shouldn't be hard to find a differential backup utility on the Internet somewhere. I'd avoid one that uses some weird format for the backups though - this means you'll always need the original backup program to recover the data.

Creating the working directories outside TRS also has other benefits, especially if you are using TRS2006. CMP is relatively slow to work with when you are constantly opening and editing files and worse, if the asset is open for editing when CMP decides to rebuild the database (which it does fairly often) some of your files may go walkies. Hence it's good to have everything stored somewhere else which also makes backing up easier - just back up your 'work in progress' folder.



A further benefit is that I create a folder 'working files' in each of the working directories. Here I have GMax models, reference pictures, PSP files etc so that everything I need for the model is in one place. CMP can import the whole working directory and will ignore any file types it doesn't understand so the GMax and PSP files get stripped out. Just delete the 'working files' directory in CMP by opening the asset for editing in explorer and everything is tidy.

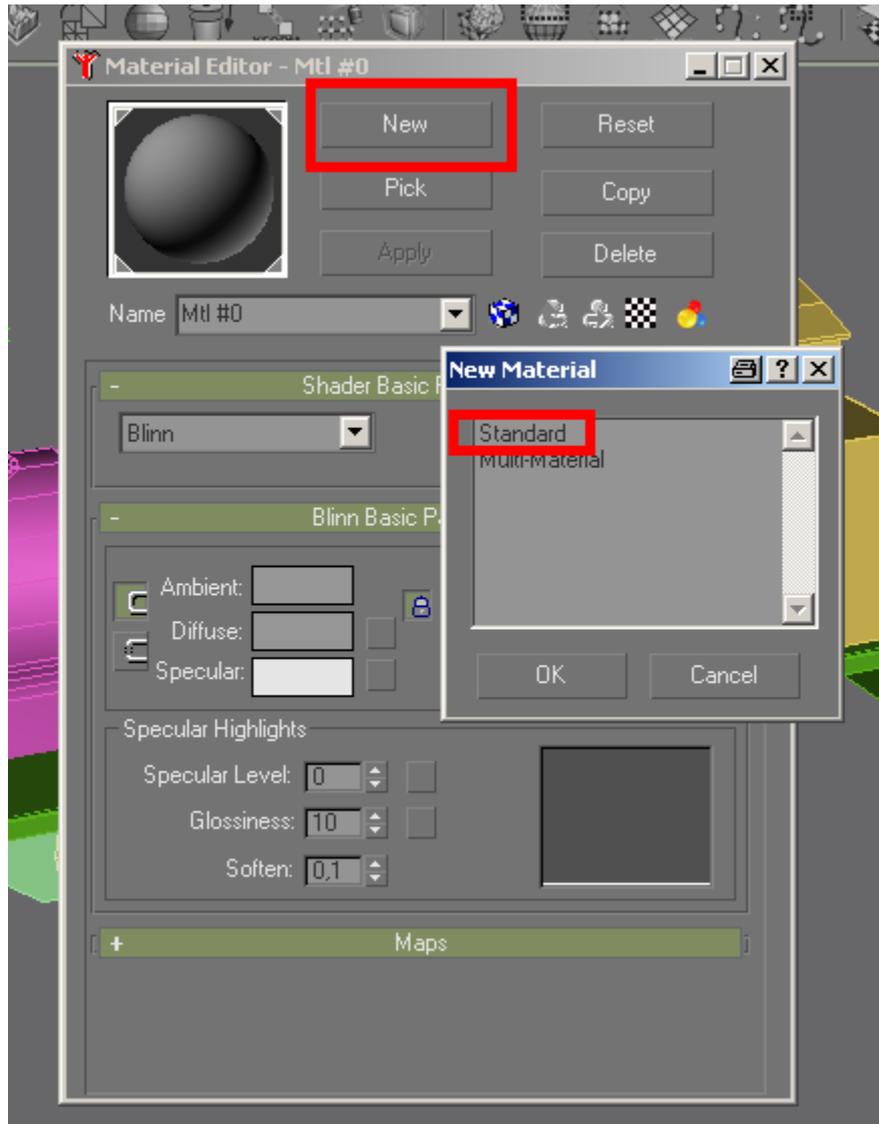
With TRS2004 I'd still work like this and copy the working directory to 'Custom/Trains etc. Much easier in TRS2006 though.

I've created skeleton working directories for the body [here](#) and the bogey [here](#). I like to give the working directories the kuid number and a description to make it easier to see which is which in the 'work in progress' folder. I also give the exported files standard names such as 'bogey.im' or 'asset\_body.im' to reduce the amount of editing the config file needs if you copy it to use for another asset. Before you import into TRS2004 or TRS2006 it's important to change the kuid number in the configs though, don't use mine. Also the loco config will need changing to reflect the kuid of the bogey. We'll go into this in more detail later when we export the models.

Download the skeleton working directories and put them somewhere logical so you can find them again. Creating a desktop shortcut to the 'work in progress' folder is also a good idea. Copy your GMax files of the loco into the 'working files' folder of the loco.

## Exporting the Body

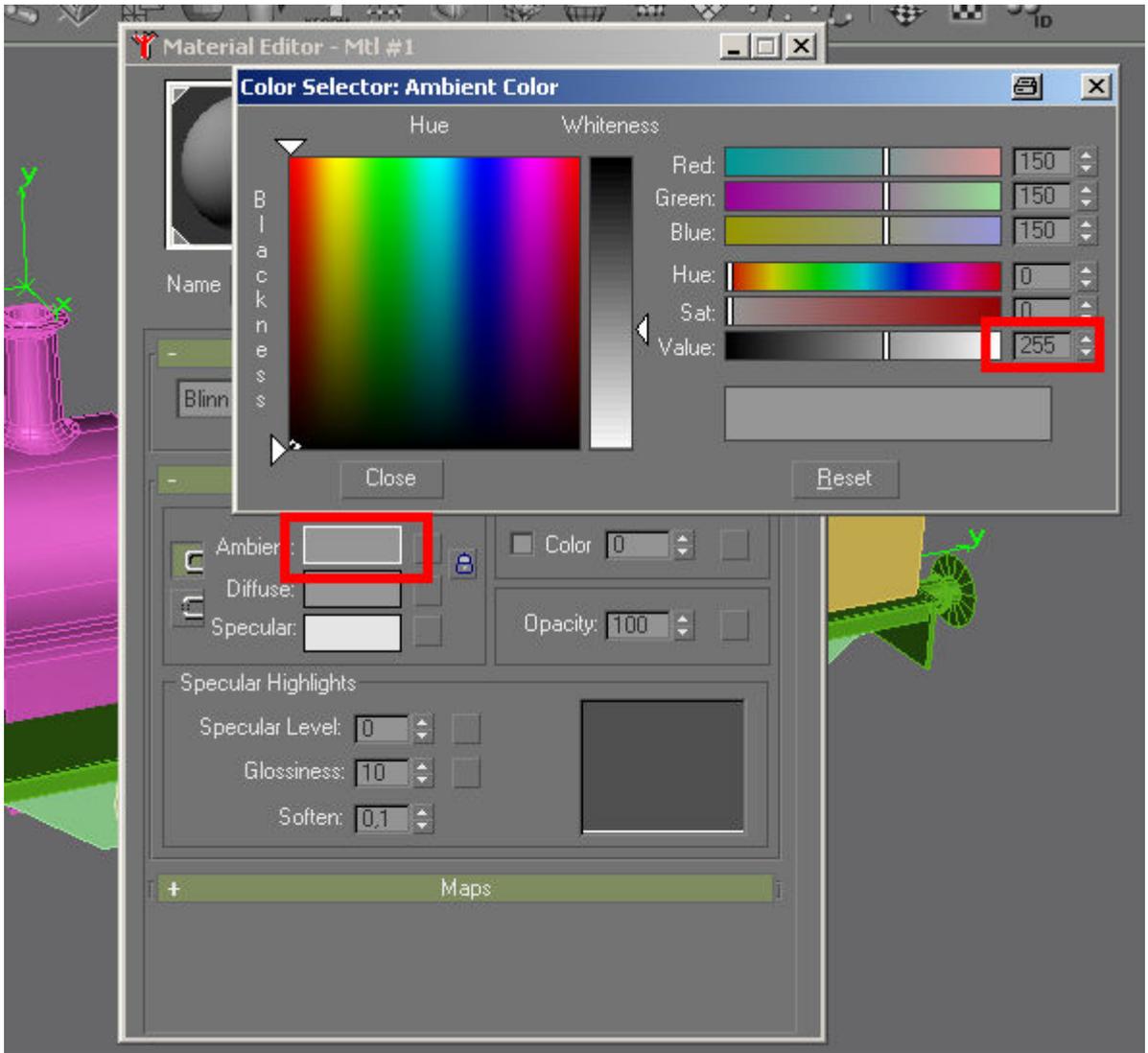
**Before exporting we must apply a texture to the parts.** Open the Material Editor and create a new Standard material.



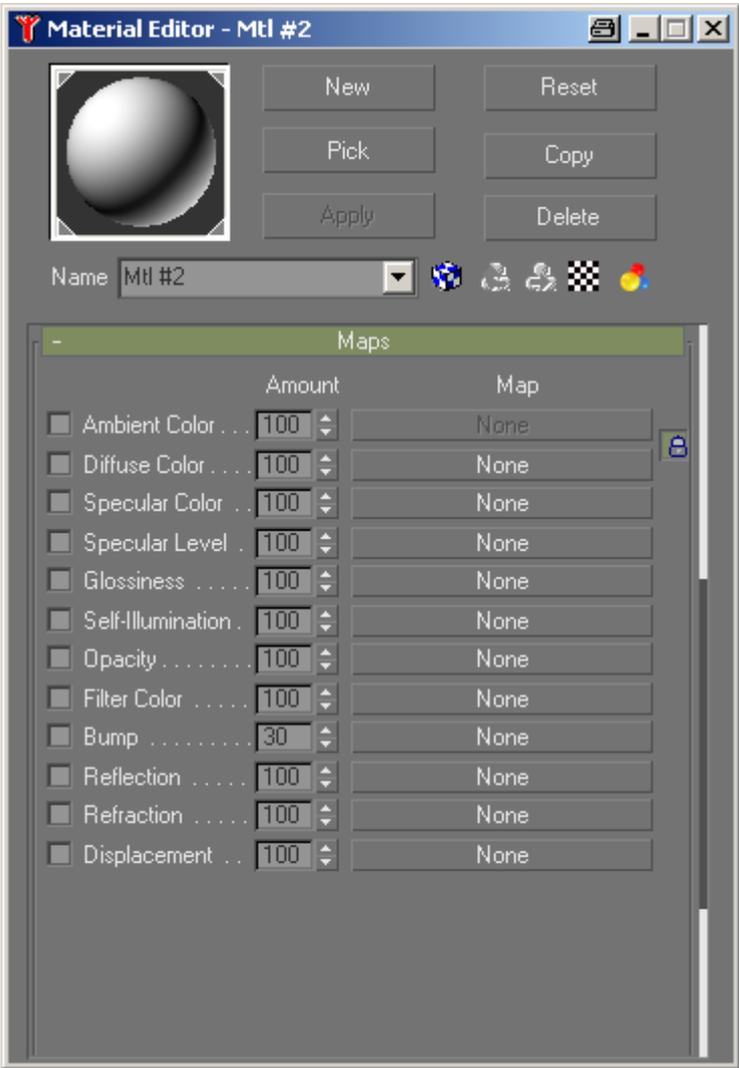
Click on the 'Ambient' colour patch and set the colour value to 255 (pure white). The diffuse colour will also change at the same time.

In the same way change the Specular colour value to 80. Set the Specular level to about 20 and then open the 'Maps' rollout to choose the texture file to use.

The forgoing presupposes that you are using the specular exporters set up as described in Part 1, if you are using the standard exporters you can skip this bit.

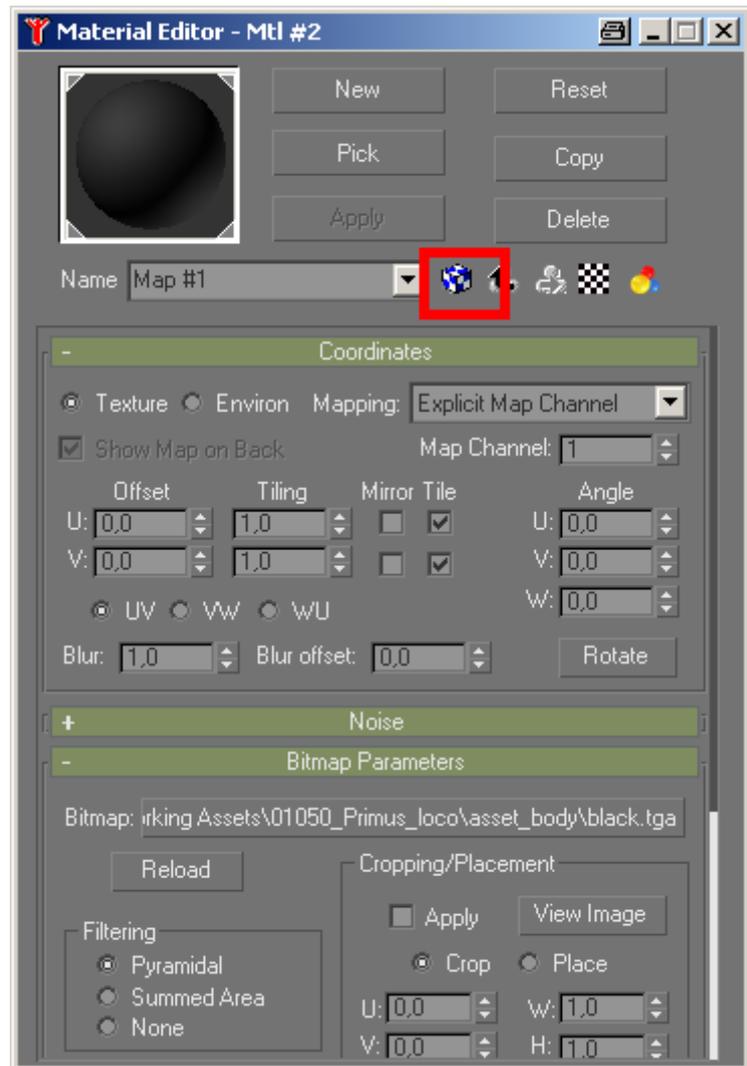


Click on the icon 'None' next to 'Diffuse Colour' to select the texture file. In the skeleton directory in the asset\_body folder is a 4x4 black \*.tga file. Select this as the texture.



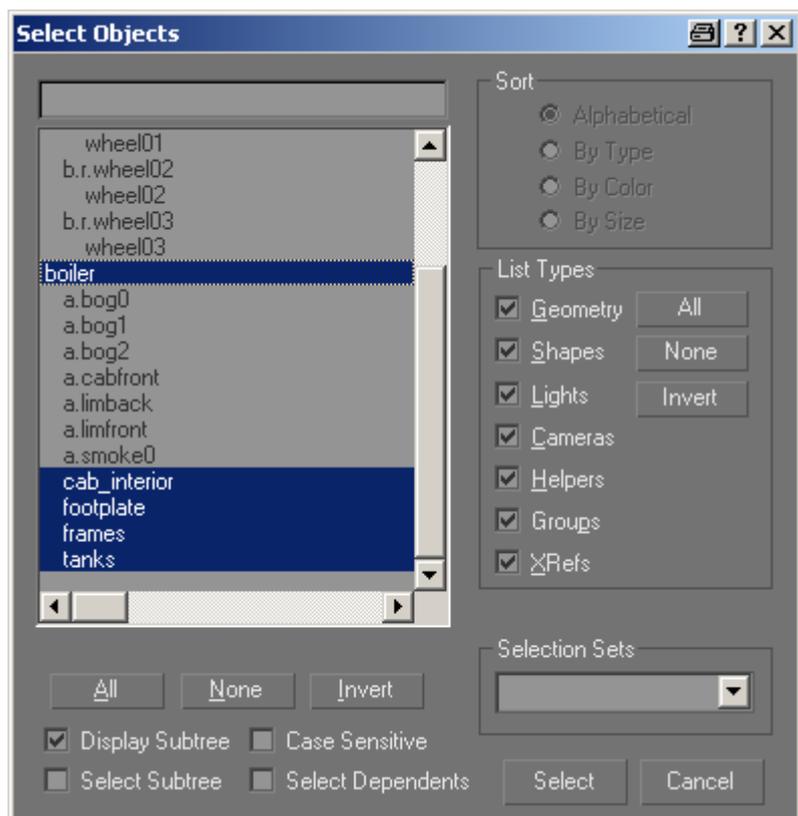
The window changes to show the selected texture wrapped around a sphere.

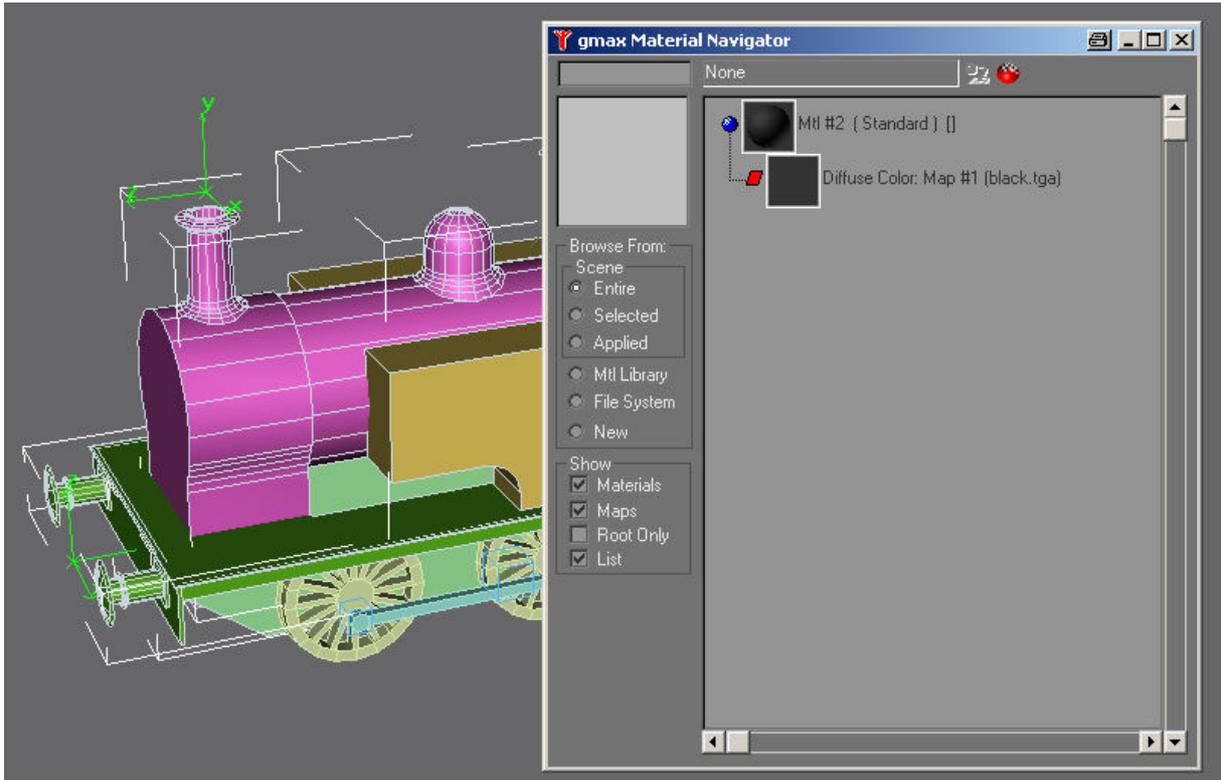
**Important! Click on the blue/white icon to activate the texture! If you don't do this the texture will not be displayed in GMax.**



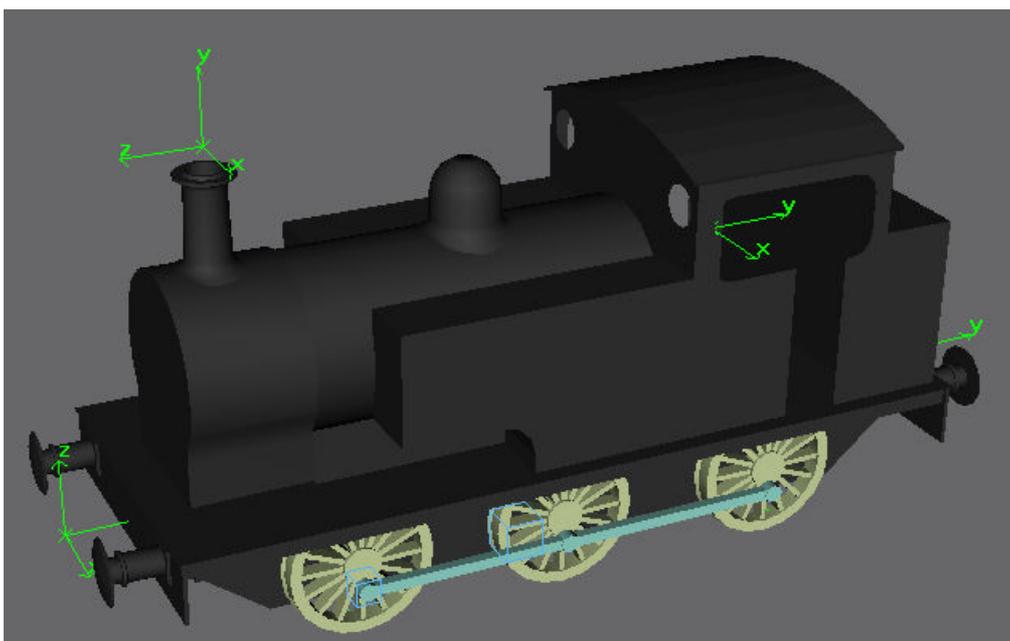
Select all the body parts one after the other and apply a UVW Mapping modifier and choose 'Box' from the list of possible types.

Then using the Select Objects' dialog box select all of the body parts.



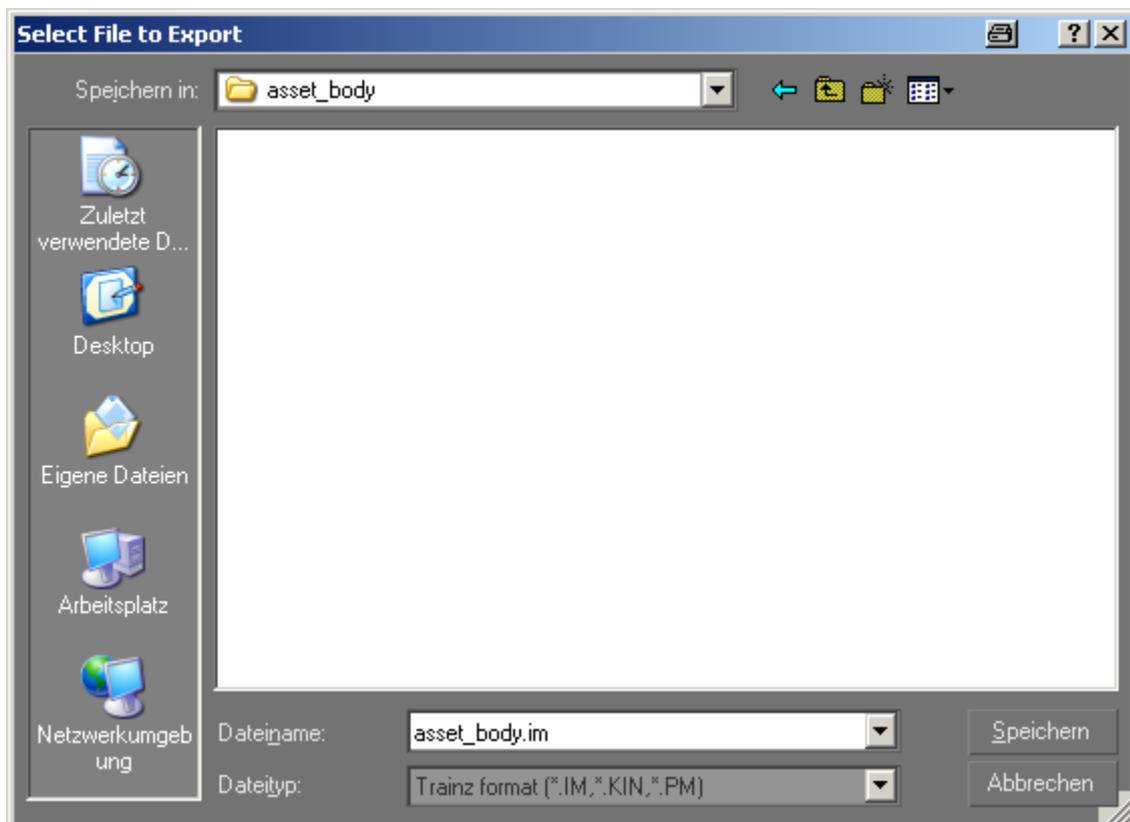
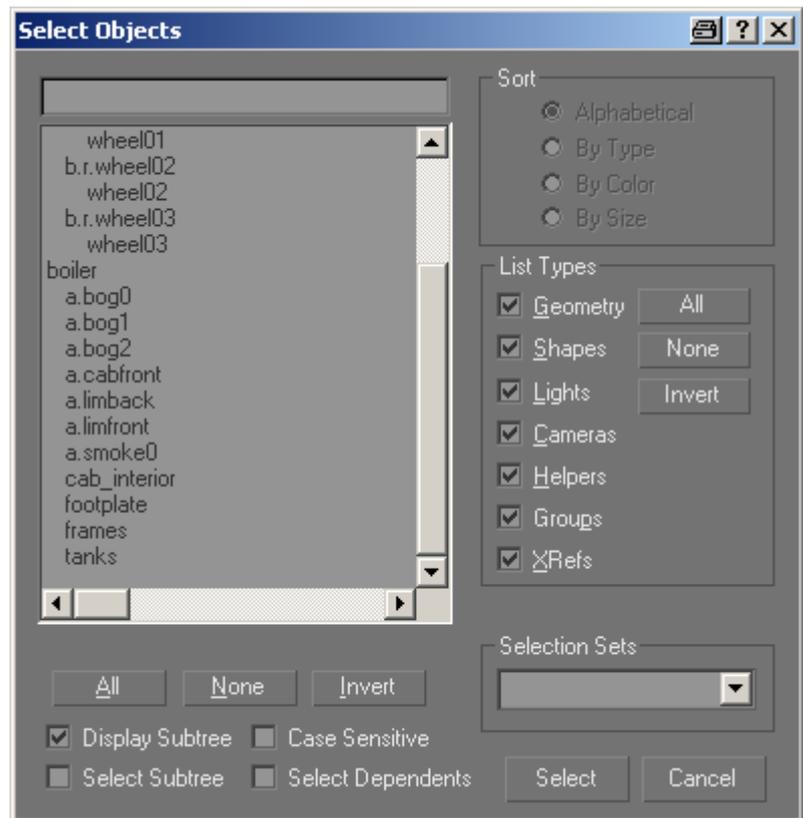


Open the Material library and drag the material to the selection. Choose 'Assign to Selection'. The body has now been textured (not very well, but it will do for the purposes of testing the loco in Trainz).

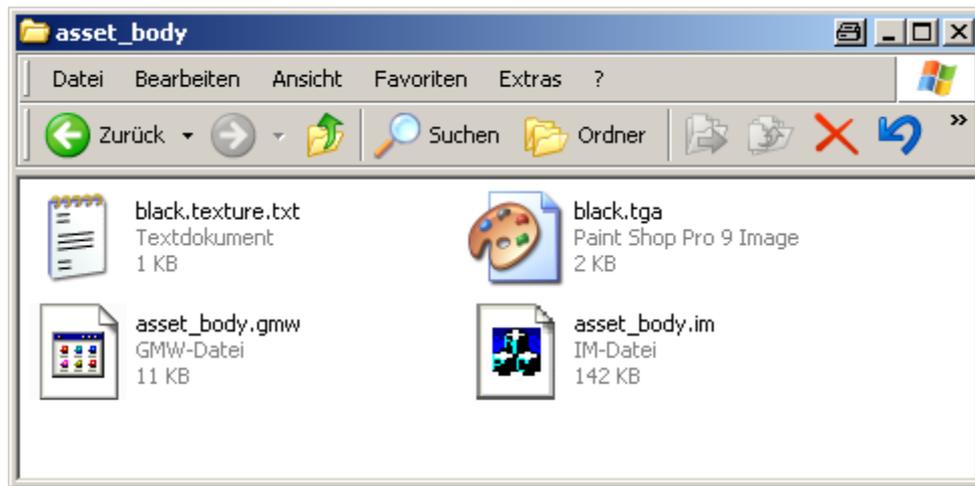


Make doubly sure that the structure of the GMax model is similar to that shown here - all of the body parts and attachment points linked to a particular mesh, in this case 'boiler'.

Select the 'boiler' mesh ensuring that 'Display Subtree' and 'Select Subtree' in the 'Select Objects' dialog box are selected. This will select the 'boiler' mesh and everything linked to it. Now go to 'File -> Export Selected....' in the top menu bar of GMax and navigate to the body folder of the loco in your 'work in progress' directory.



Export the model as 'asset\_body.im'. **The name is important, if you change it you'll need to edit the config file to match.**



The file 'asset.gmw' is created by GMax during the export process, as is 'black.texture.txt'. The \*.gmw' is not required and can be deleted although CMP will ignore it during importing anyway. The texture file 'black.tga' was already in the skeleton that you downloaded.

## Exporting the Bogey

Texture the bogey in the same manner and with the same material.

This is exactly the same as exporting the body, the only difference is that the animation needs to be exported separately. After exporting the mesh into the working directory of the bogey export again and save the file as 'anim.kin' (**The name is important, don't change it!**)

## Config Files

There are a couple of things that must be changed in the config files of both body and bogey. Firstly in the bogie you'll need to change the kuid from mine (kuid2:44090:50066:1) to yours. I'd suggest just changing the creator id part of the kuid, i.e. kuid2:xxxx:50066:1) where xxxxx is the id that Auran issued you when registering your copy of Trainz. This can be found in your Auran Profile or in every post you make on the Auran Forum. The 50066 part of the kuid is the asset id and while it is not enforced anymore the range 50000-59999 was originally reserved for bogies. It makes sense to follow this convention so it's easier to know what the asset is if you just see the kuid number (in the Dispatcher directory of TRS2004 for example). TrainzObjects also uses the ranges to tell you what kind missing assets are.

In the bogey this number is only found once, so edit it now. If the wheels of your loco are not 3'9" diameter you'll also have to edit the 'animdist' value, which is the distance in metres, the bogey travels along the track with one revolution of the wheels. You'll have to calculate this from the formula  $\text{animdist} = 3.1416 * (\text{diameter of the wheel in metres})$ . Not essential but useful is to change the author, description and username entries as these will be displayed by CMP in the main window and in the 'Asset Details' rollout.

In the config for the body file the bogey kuid is in two places, once in the 'bogey-2' tag and once in the 'kuid-table'. **Change these references to match your bogey kuid.**

Note that the trainz-build in both config files is 2.4, this is deliberate so the assets will be useable in TRS2004 as well. There is no earthly reason for making simple models like this TRS2006 only.

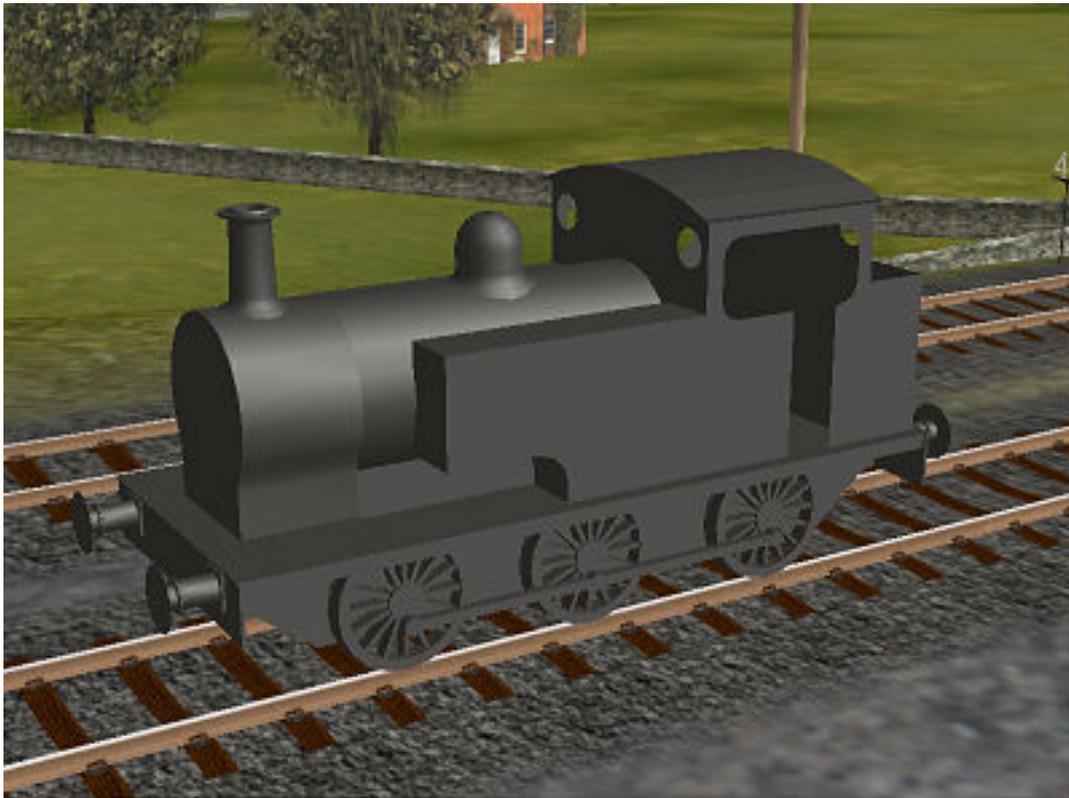
## Importing the Assets into TRS2006

Fire up CMP and make sure that the kuids you have given the body and the bogey are not already in use. **If they are the old asset will be overwritten by the new ones without warning.** Using 'File -> Import Content' navigate to where you have the working directories and import the body and then the bogey. Select the 'Open for Edit' tab and select both assets and commit them with CTRL-M. With any luck the assets will not show any errors and you are ready to try 'Primus' out in TRS2006. Remember to look for it under the name you gave it in the 'username' tag.

**Do not edit the assets with CCP, this will break them.**

## Importing the Assets into TRS2004

Copy the working directory for the body into <your trainz installation path>/World/Custom/Trains and the bogey into <your trainz installation path>/World/Custom/Bogeyes. Better delete the 'working files' folder from both of these though, I don't know what TRS2004 will do if it sees them (probably fall over). It really is easier with TRS2006 honestly.



Please mail me if anything is unclear at [paul.hobbs@web.de](mailto:paul.hobbs@web.de).