3D Modelling

Crash course

Goals

- Modelling
  - Factory floor with two conveyer belts and a robotic arm.
- Texture
  - UVWrapping of textures
- Animation
  - Movement of robot arm placing a box from one conveyer belt to another

Open up 3Ds Max

Keyboard Shortcuts

Manipulating elements in Max is a combination of Keyboard and Mouse. Below are the primary keyboard keys:

The main keys used are:

Q – Select

W – Move

E – Rotate

R – Scale

Ctrl + V – Clone

Del – Delete an object

F9 – Render

H – List Objects

Alt + W – Maximise / Minimise Viewport

For a more in-depth keyboard shortcut list, view here:
https://en.wikibooks.org/wiki/Autodesk_3ds_Max/Shortcuts

Mouse Control

Mouse control is critical when it comes to understanding and manipulating elements in 3Ds Max.

Left Click – Select an element

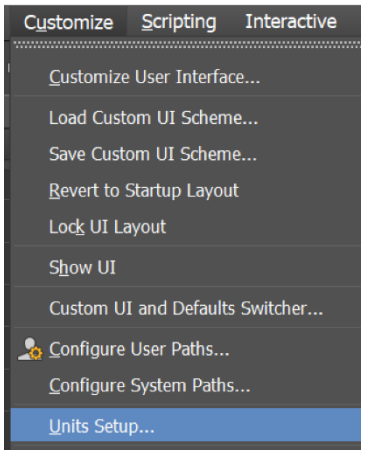
Right Click – Brings up a context menu for an element

Middle Mouse button (MMB) and Move – Provides left/right/up/down movement of the viewport

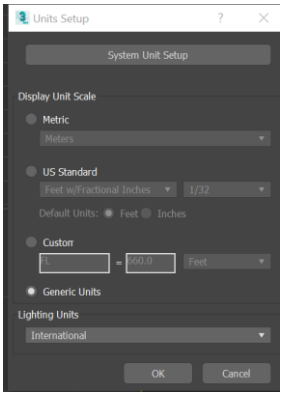
Ctrl + MMB – Provides left/right/up/down movement of the viewport

Alt + MMB – Rotation of the camera around an object

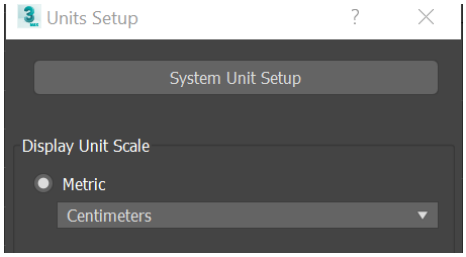
To start with, we will set up the units for our scene. This is done by going customise→ Units Setup



This will produce the following pop-up

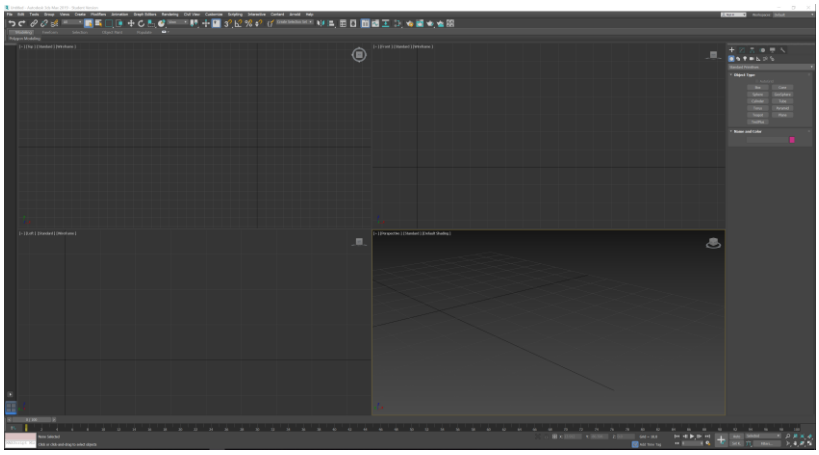


The default is very generic, so select Metric and use the drop down to select centimetres.

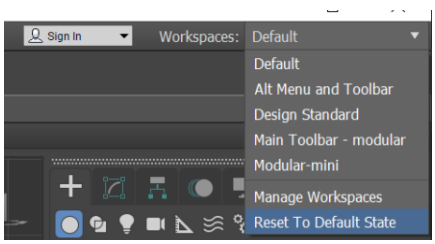


3Ds Max UI

The Max UI looks confusing to start with, and as such, we will start with a brief overview, upon opening you will see the following

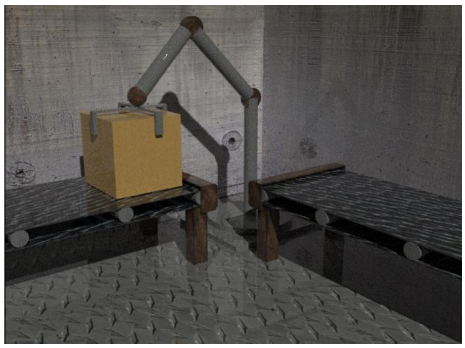


If this is not the view presented, in the top right corner there is a drop down where you can reset the workspace to the default state.



Beginning construction

We will be aiming to create a scene like the following:



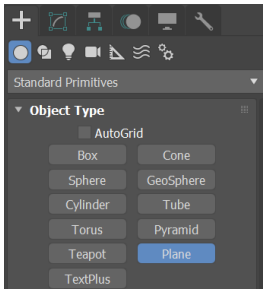
To start with, we will delve into the easy parts of the scene we are going to make. With the start being the floor and walls. For each we will be using different objects, a plane for the floor and two box objects for the walls.

Floor

In the top view right, click on the word Top and then push Alt+W

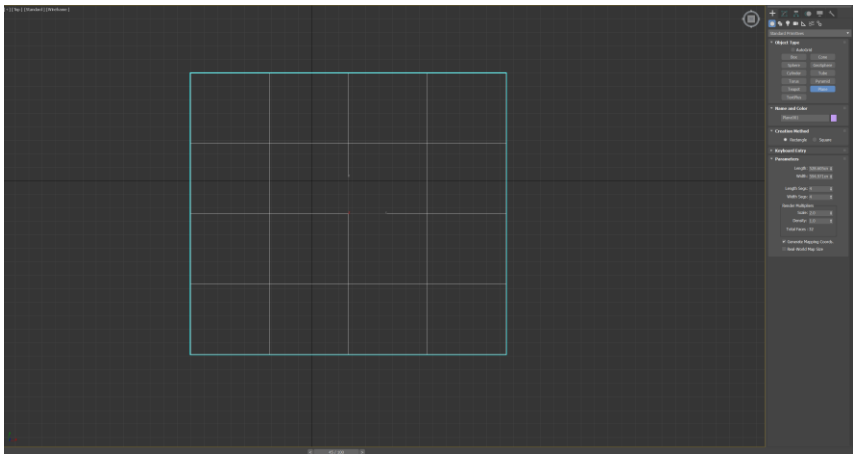
NB – Alt + W will maximise the screen

From here, in the right-hand menu click on the plane button



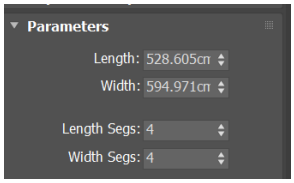
With the pane selected, in the viewport, draw a square.

You should see something like the following:



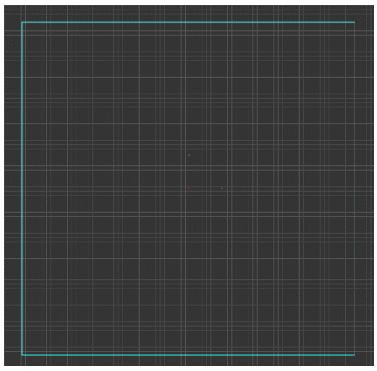
Now, the object has some properties on the right-hand side, that we can manipulate.

So, let's look at them.



As you can see, the floor is reasonably, small. So, let's change it's length and width to 2000cm, and as we aren't going to change it from anything other than a flat square, we can drop the segments of length and width to 1.

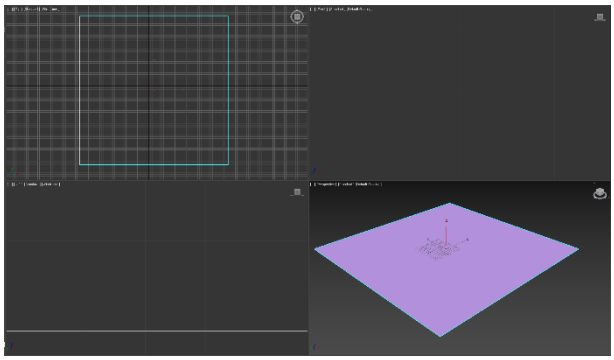
You should end up with the following (You will probably have to scroll out to see.):



As you can see, not very exciting. But, it's a good start.

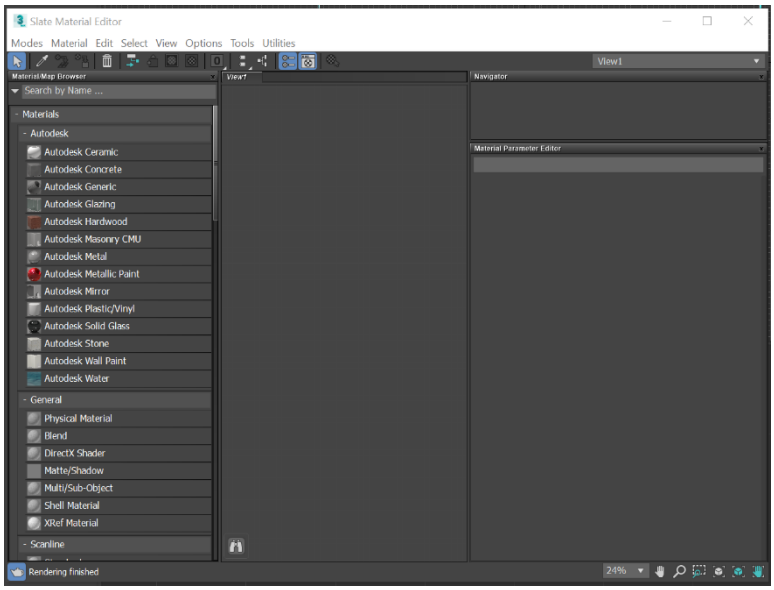
On the desktop is a folder called textures, and what we are going to do, is put a floor texture on this plane. Change the view back to the 4 screens, by pushing Alt+W.

Scroll out as needed.



From here, we will open up the texture mapping capability.

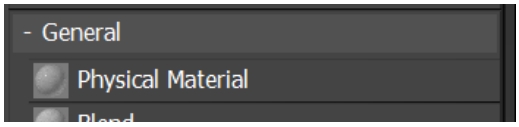
Push M on the keyboard or click on the  icon in the menu system. The following window will appear.



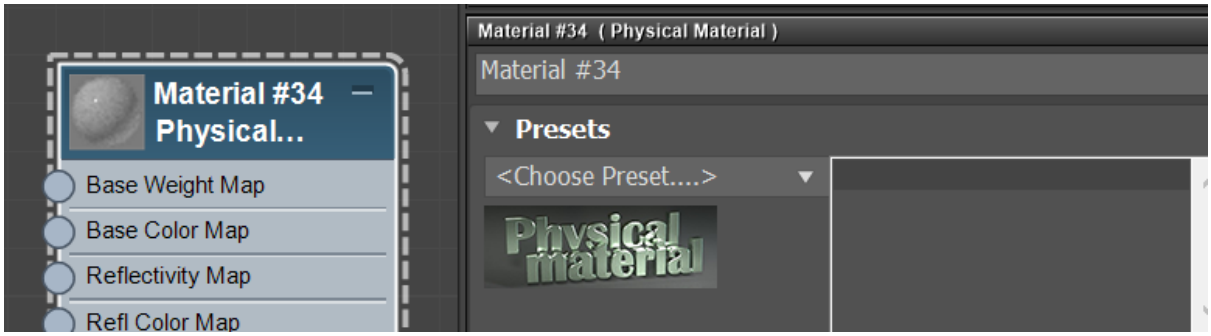
This is the slate material editor, there is a lot of power that can be had by manipulating the textures and attributes that can be applied to objects.

In our case, we will just touch upon the effects briefly.

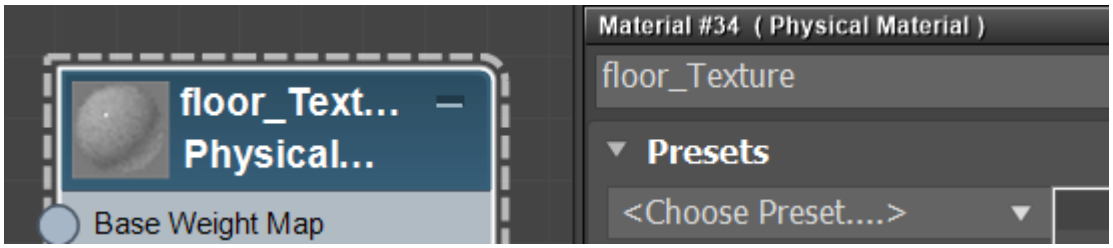
To begin, locate the physical material name on the left-hand side and then drag it into the middle of the view.



From here, double click on the blue bar of the material. Once you have done that, you will be able to rename and then apply some details to the material we a re creating. You should see the following:

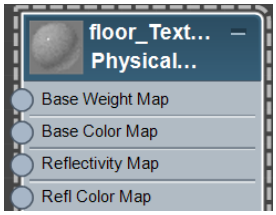


From here, change the name to floor_Texture and hit enter.



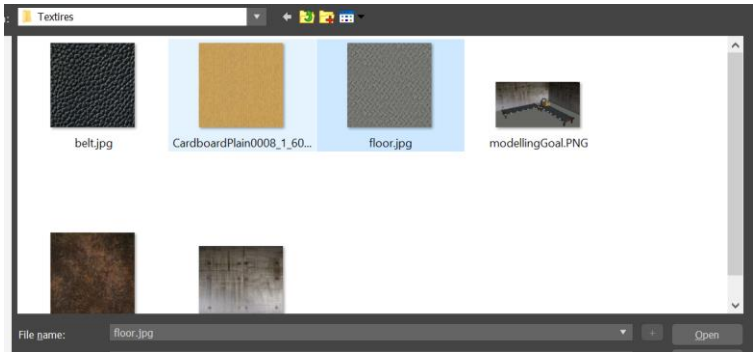
As you can see, the material is now newly named.

What we are going to do is apply a texture to the material, on the material is a circle next to the words Base color map, double click the circle:

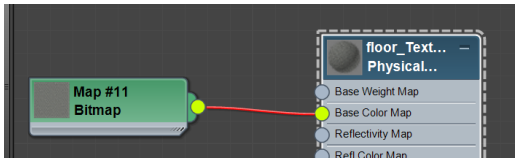


Once you have double clicked a new window will appear with a lot of different options, for the moment, we will stick with bitmap.

Double click bitmap and then navigate to the desktop folder called texture and locate the floor.jpg file. Double click to select that file.



Once you have clicked on open, you will be sent back to the material editor. You can scroll in and out to zoom in the editor and by clicking and dragging the scroll wheel, you can pan around the editor view. You will see that there is now a linked bitmap to the material.

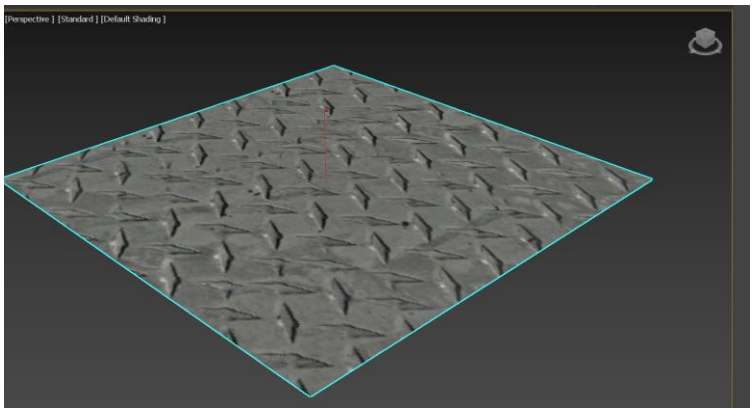


Now that we have done that, make sure the floor plane is selected, click on it in perspective view. It will be the highlighted object. Now, in the material editor, we assign the material and then make it viewable in the viewport. To do this we click two buttons.


This is the assign to button, on the selected object, this assigns that texture. So click this, you will probably notice that the objects colour has changed. Once that is done, you will need to click on the show shaded material in the viewport. icon.

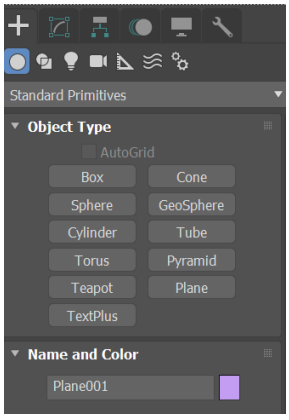

Click the show shaded material next.

You should see the following appear in the perspective view.



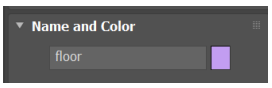
This is good, but we need to scale this down a bit for our scene. To do this, close down the material editor by pushing the X in the corner of the editor.

Now, we go to the right-hand menu system to deal with our object.

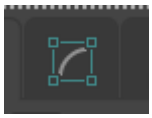


So, what we have here is a create section with is signified by the + sign, and then a modify tab which has a dashed square. These, for the moment, are the ones we will concentrate on.

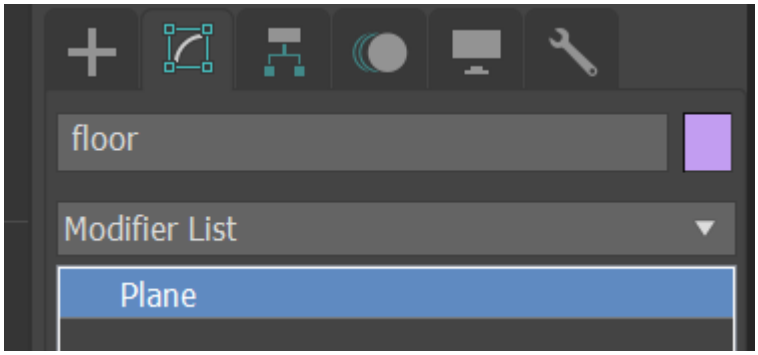
But before we go to the modifier tab, change the name from Plane001 to floor.



Now, click on the modify tab.

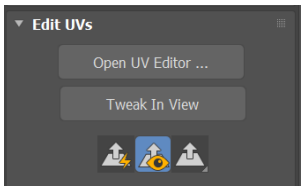


This opens up a whole new set of options. But, our primary one for the moment, is the modifier list.

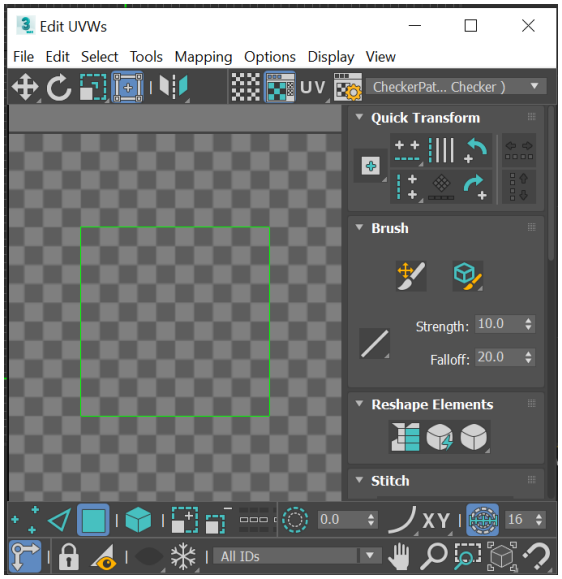


Click on the modifier list and then scroll all the way down until you see the unwrap UVW

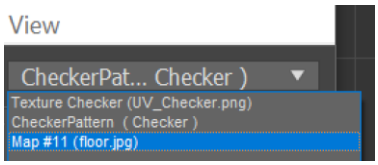
From here, the whole menu system changes, scroll down until you see Open UV Editor and then click on that.



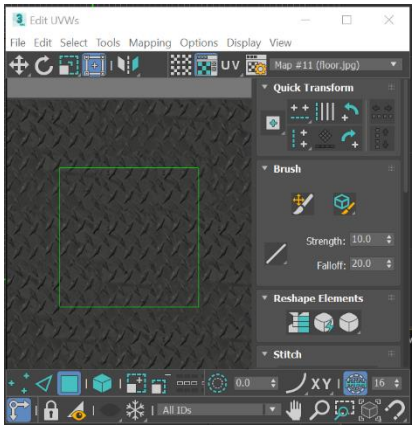
The editor looks like the following:



To make it a bit easier to work with, in the top right corner where it has a drop down menu with checkerPat… Click on that and then select the jpg picture.

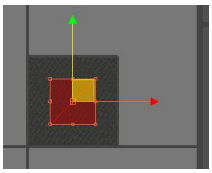


This changes the view to this:



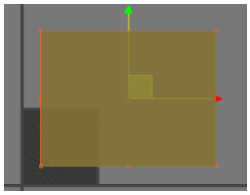
As you can see, our object takes up a small proportion of the texture, so to fix this we are going to scale the texture.

Scroll out on the screen. And click on our object, it should go red as it has been selected.



If you notice, the starting selection is the free transform tool, which is what we want to use. From here, click on the corner of the object in our uv editor and then then scale it up.

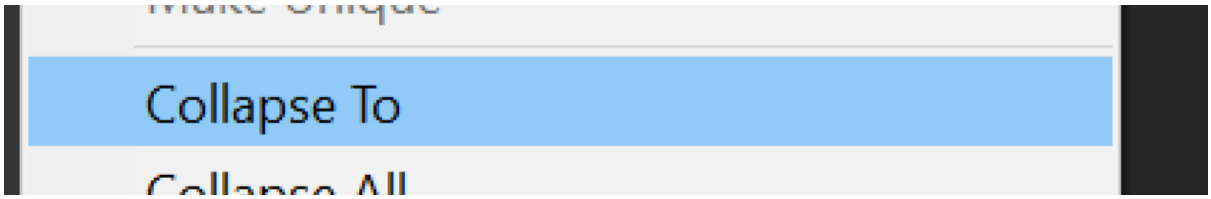
When I scaled it up to look like the following:



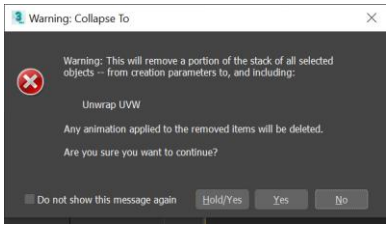
The view in the perspective changed to make he floor texture look better.

Once you are happy with the scaling. Close the editor. Then in the right hand menu, locate the following:

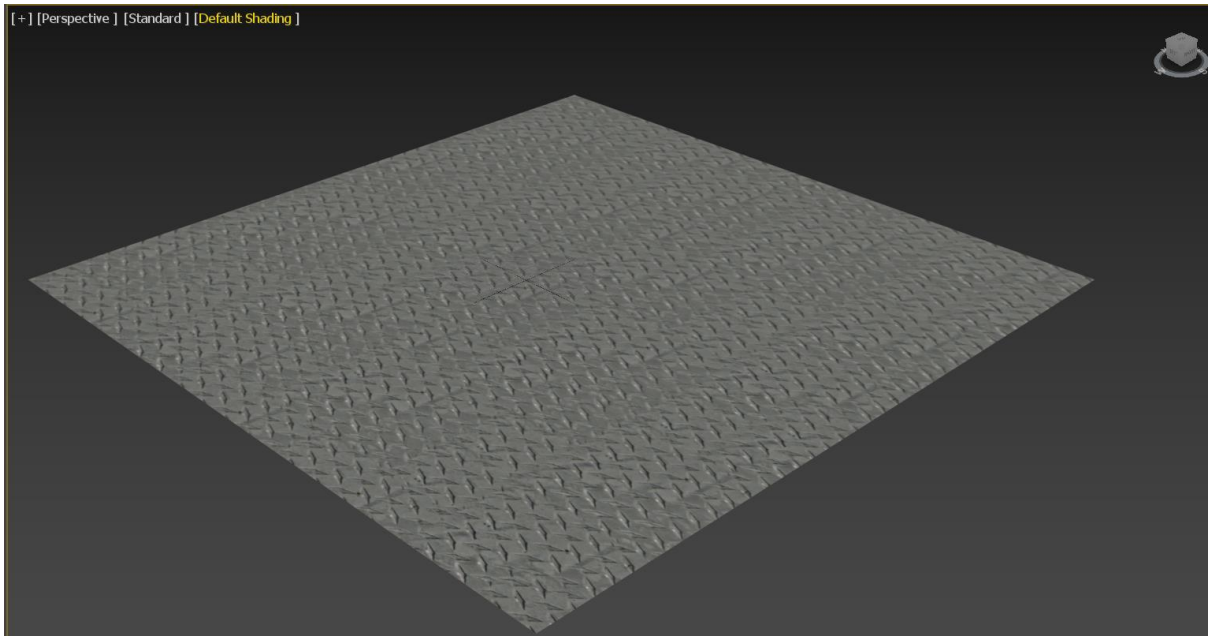
Then right click on the Unwrap and select collapse to.



When the following warning pops up, say yes.



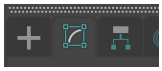
Your view should now look like this:



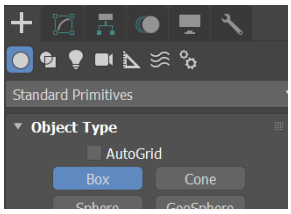
Now that the floor is finished, we will create the walls.

Walls

Click in the top view, then select the + from the right-hand menu.

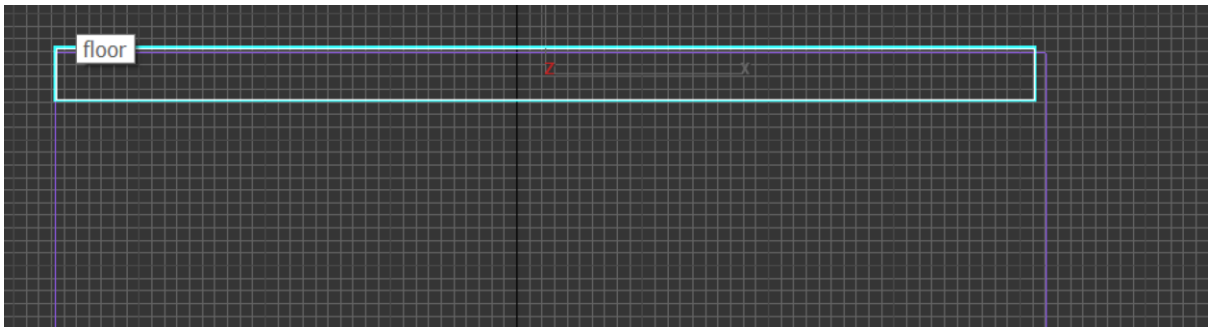


From here, select box.

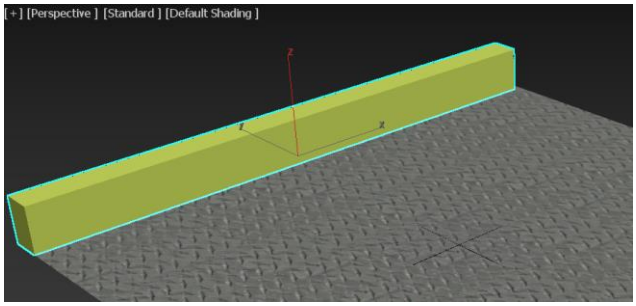


Now, in the top view click on the top corner of the floor and drag it from one side to the other, make it reasonably thin. Once you have finished that part, notice that in the perspective view you still have to add height. As such just drag it up for a little bit.

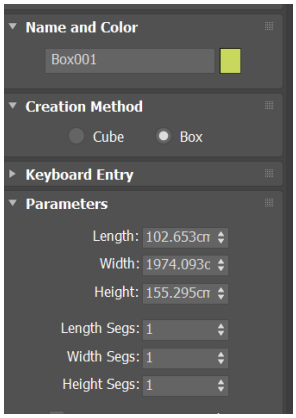
Initial drag in top view:



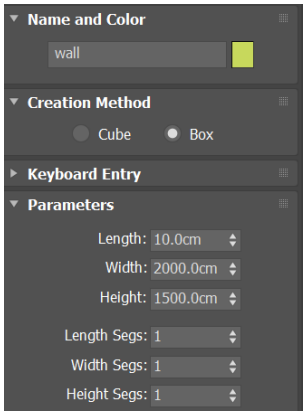
Then when raising, the perspective view:



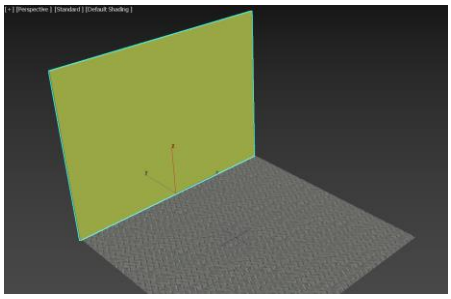
To make this better, we are going to manipulate the parameters of the wall. In the right-hand menu, you will see something like this:



Change to:

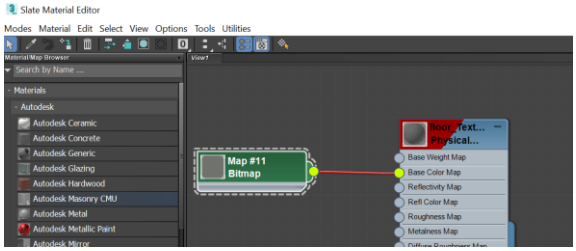


This should give you the following:

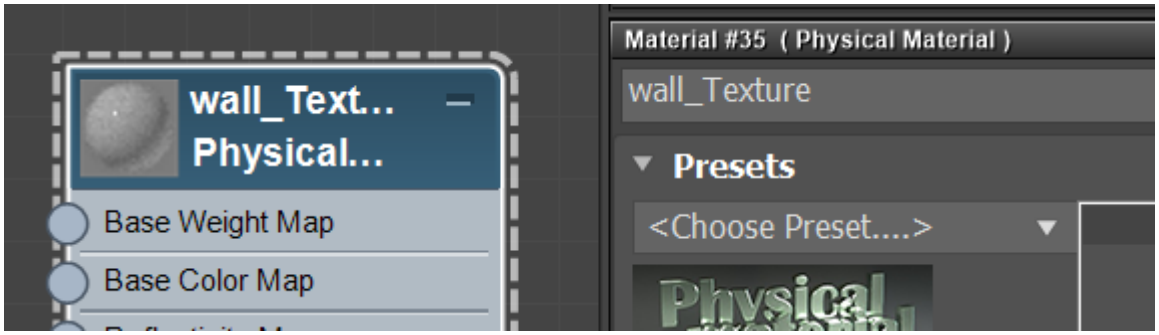


To remove this wonderful colour, we will apply a texture to it.

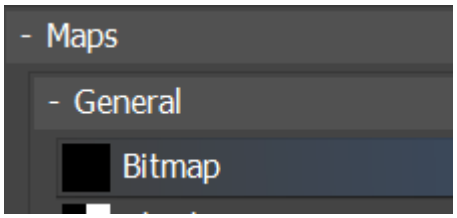
Push M to open up the slate material editor.



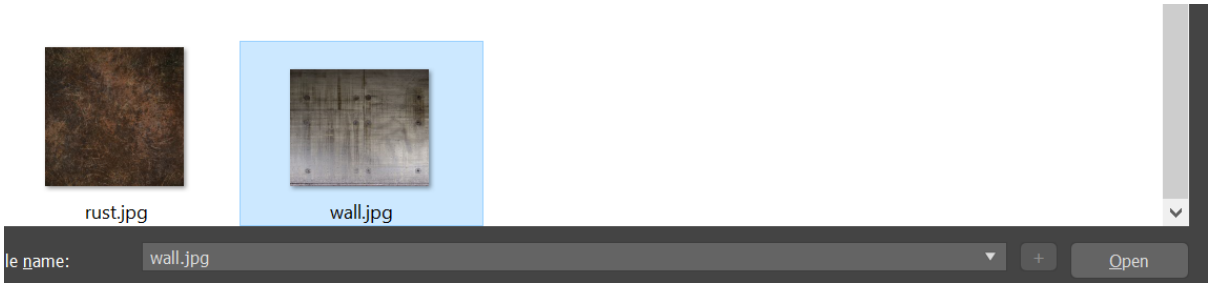
Use the scroll mouse clicked to pan a clear spot in the view. Then drag out a new physical material and rename it to wall_Texture.



As before, double click on the circle next to base color map and select bitmap.

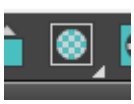


And from there, find the wall texture from the texture folder in the desktop. Click open for the texture.

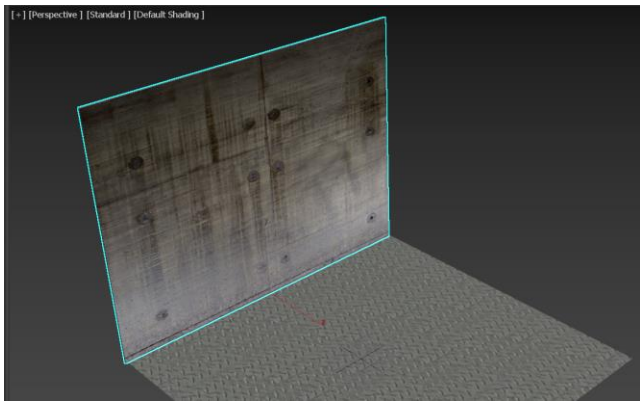


Once again, we need to make sure the wall is selected, it should be highlighted in the view, then click on the assign to icon and then the show shaded material in viewport icon.


This is the assign to button, on the selected object, this assigns that texture. So click this, you will probably notice that the objects colour has changed. Once that is done, you will need to click on the show shaded material in the viewport. icon.

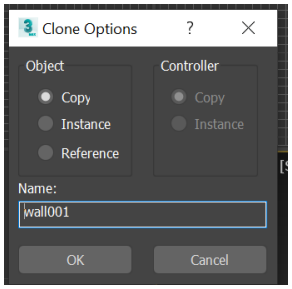

Click the show shaded material next.

You should see the following:



We could play with the texture and tidy up the mapping, but we will leave it for now.

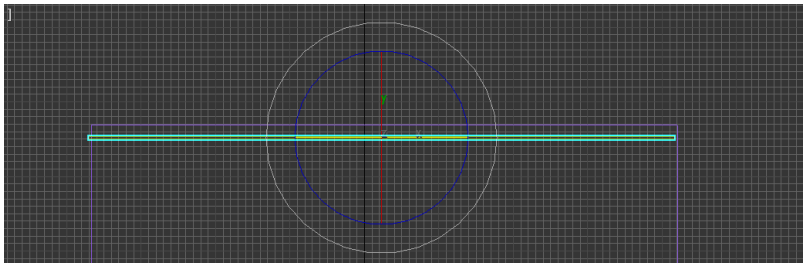
Next, we will copy the wall and rotate it. To do this, ensure the wall is selected in the perspective view, then push Ctrl+V. The following window will appear:



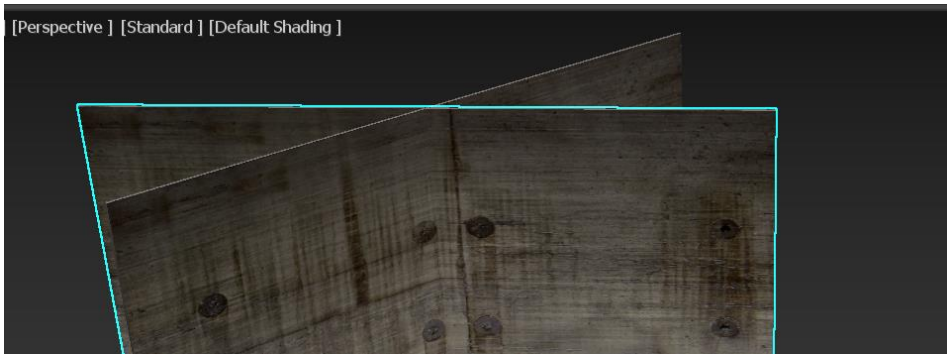
Ensure that copy is selected and then click OK.

The view won't change. This is because the newly created object is sitting in the exact position of the current object. Now we have to manipulate the object using the rotation tools.

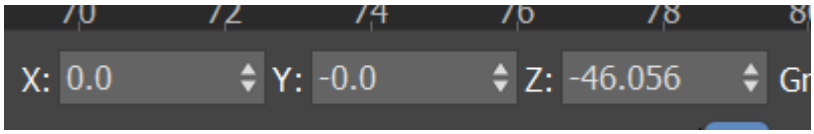
Click on the rotate icon  or push E. If you notice in the top view, you should see the following.



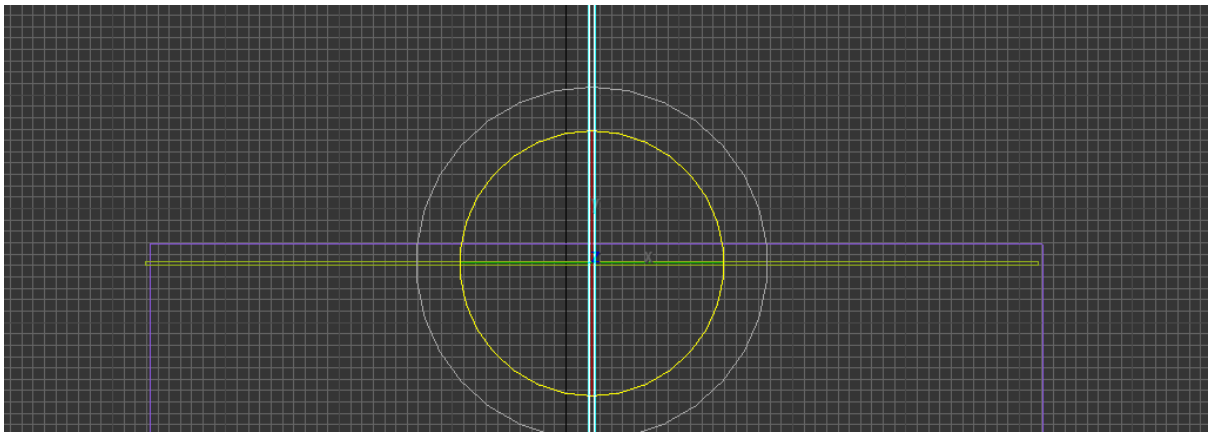
So, we will manipulate the axis of the object in the top view. In this way we can only effect two axis and not 3, which will help avoid mistakes. Click on the blue circle and start to rotate. As you do, you will see that the object appears in the perspective view.



To make a better angle, on the bottom part of the interface, you will see some numbers.



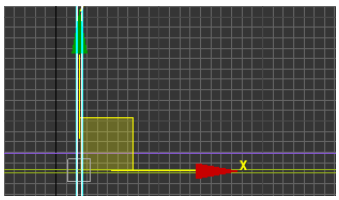
As you can see, the Z axis supplies me with the x shaped objects, as I am wanting a wall, it means the angle should be at 90. So, type in -90 in the Z box and hit enter.



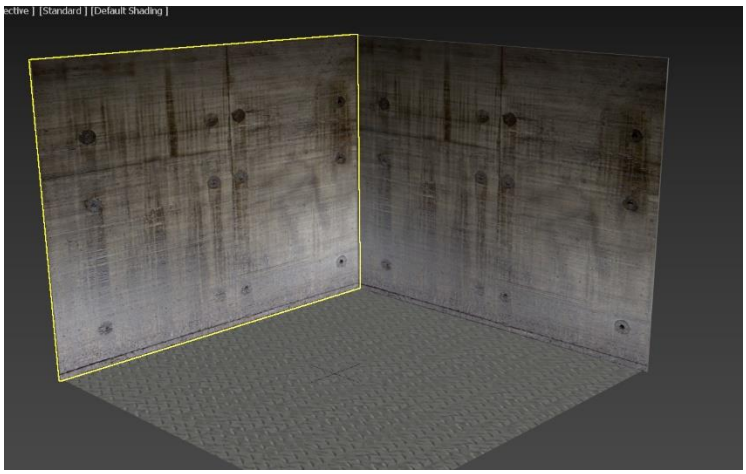
This gives our wall the right position, but not in the right location. To do that we will use the top view and manually move the wall.

Push W or select the move tool icon  .

This now gives out object the following handles:



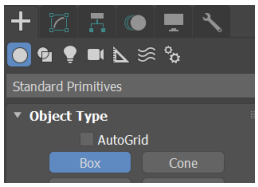
To start with, use the horizontal arrow (red), to move it to the edge of the floor, and then the vertical arrow(green) to pull the wall down to enclose our floor. This should give you the following:

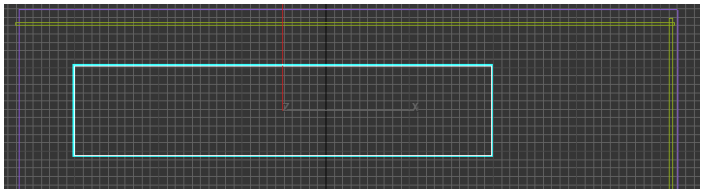


Now that we have completed the walls and floor, we can move onto the conveyer belt.

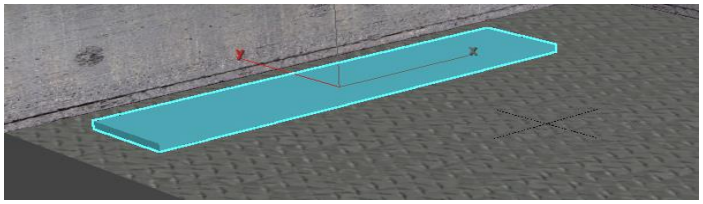
Conveyer Belt

To start with, in the top view, let's create flat box. Click on the create and then box in the right-hand menu. Then in the top view click and drag the width and length of the object and then apply a little bit of height to it.



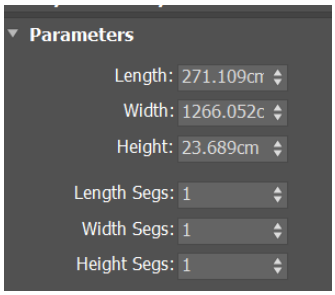


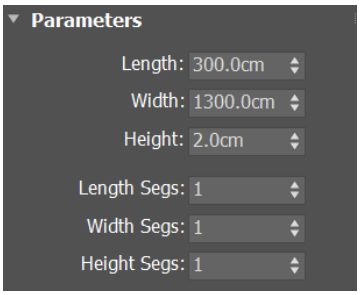
Top view



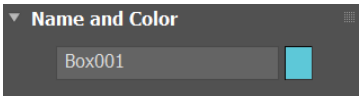
Perspective view

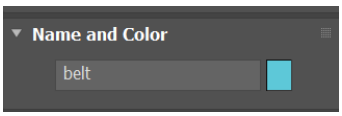
Now, let's change the parameters from the right-hand menu:





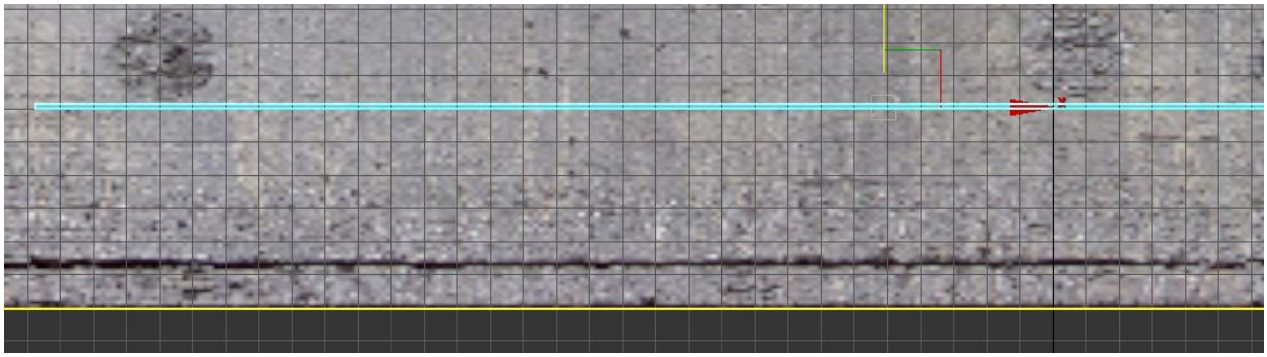
And change the name as well.



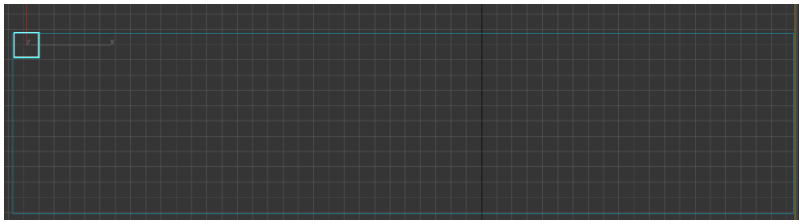


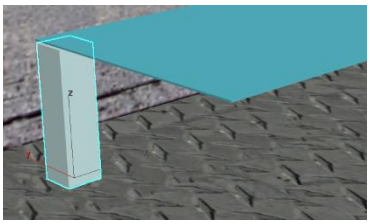
So, what we have here is the base shape of the belt of our conveyer belt. Now, we could add the rubber texture right now, but first, let's build the object.

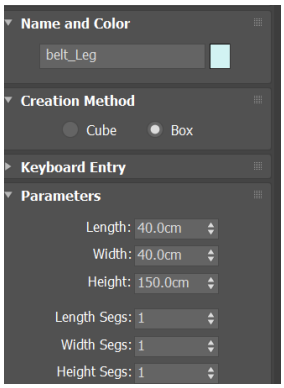
As we have our shape's rough dimensions, we can now build around this object. To start with raise the belt of the ground. Scroll in on the front view and then use the move tool (W) to lift it above the ground.

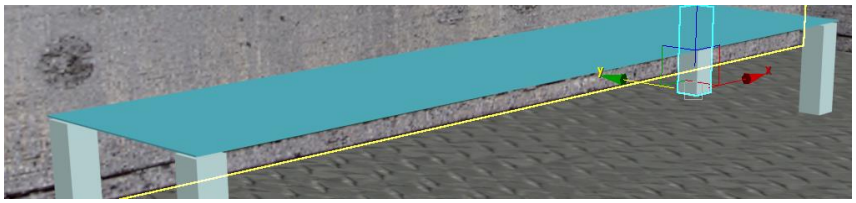


With the belt raise, we will now make some legs, these are just additional boxes. So, in the top view, repeat 4 times. +->box -> top view click and drag to get a shape then raise. Then change to the following parameters.





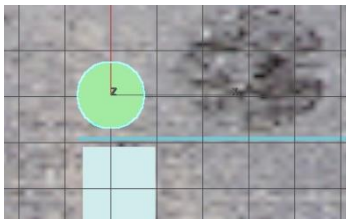


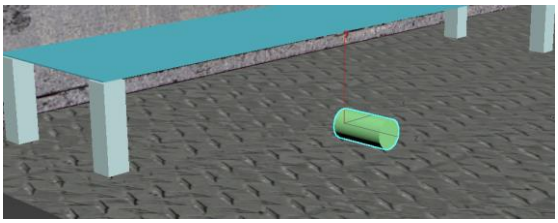


Once you have the 4 legs in position, we will create some rollers to go on the belt.

This is done by using the front view and a cylinder.

In the right-hand menu, select cylinder, then click and drag out the radius of the cylinder in front view, once you have done that, drag it out to give it some width. You will probably find, that the cylinder is not created in the correct spot and you will have to move it around via the top view.

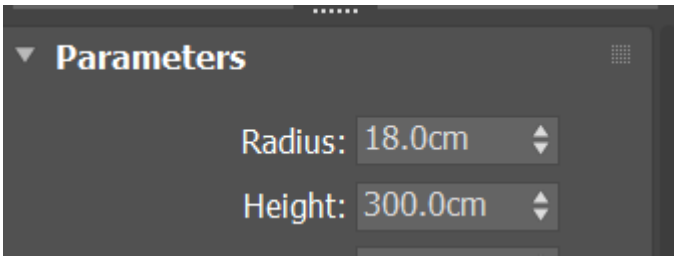




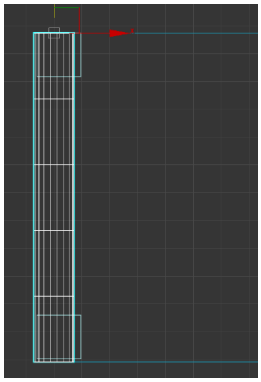
NB – Once you have clicked on the move tool to position the cylinder you will see that the paremeters of the object are no longer in the right-hand menu, this is because the system assumes you have finished with the creation and has moved them into the modify tab.

To make changes, such as the length, go to the modify tab 

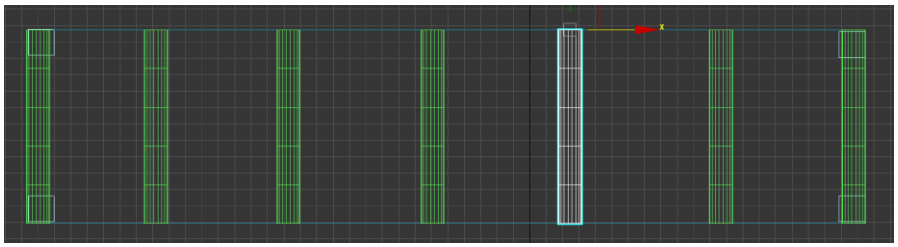
Match the height of the cylinder to the length of the belt, which is 300.



Then use the move tool to position correctly via the top view.

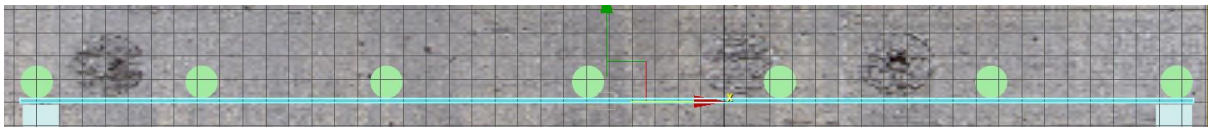


From here, replicate the cylinders all across the belt. This is done using Ctrl + V, create a copy and then use the move tool, to position. It's okay to eyeball the positions for this scene.

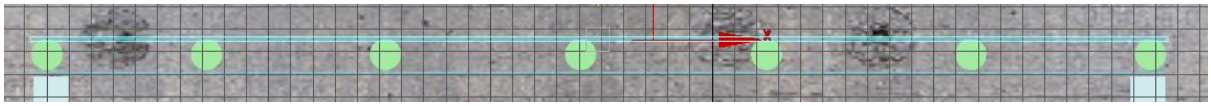


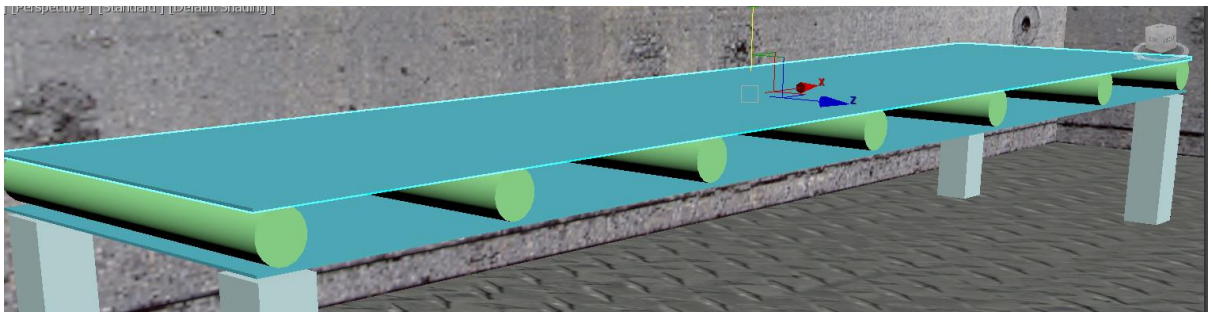
Once this is done, we are almost all finished, we need to make the ends and the top belt. Let's do the top belt first as it is a copy/paste of the current belt.

In the front view select the belt.



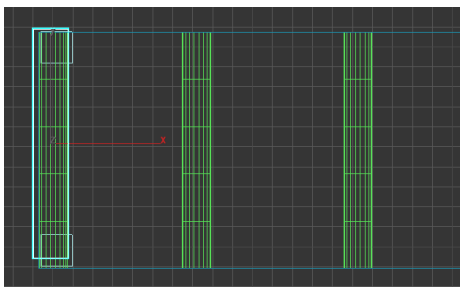
Then do Ctrl+V, select the move tool (W) and then drag the second belt above the cylinders.

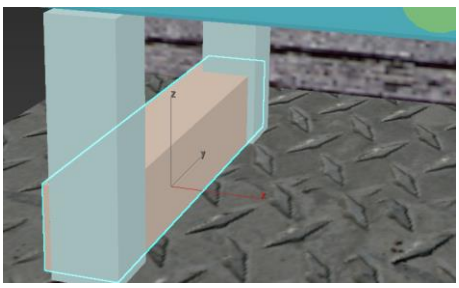




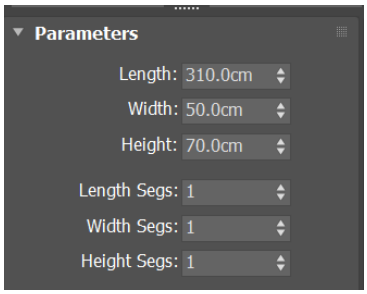
Now, we will make the protective end covers. To do this, we will create a box, then add an additional face, using the inset tool, followed by an extrusion of that face and then a chamfer of a couple of edges.

To start with, in top view create a box, that matched the width of the belt,



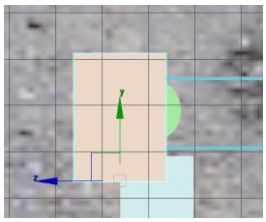


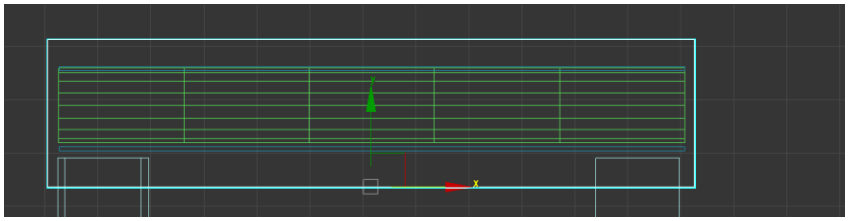
From here, go to the modify tab and set the following numbers.



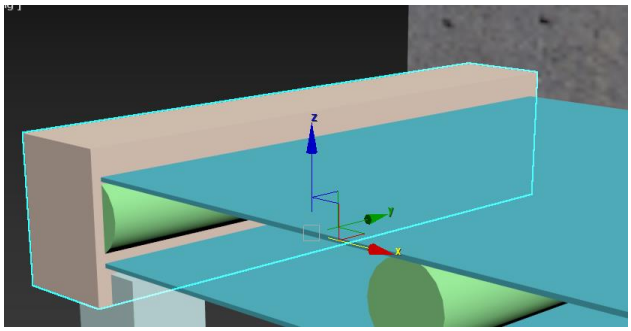
We've set the length to be 310, so it encapsulates belt.

Once you set the parameters, use the move tool to position the box over the conveyer belt end cylinder.



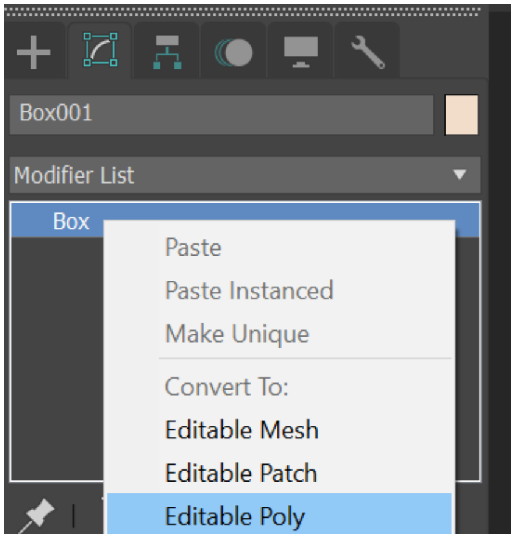


Once you have position the box, rotate the perspective view so you can see the following:

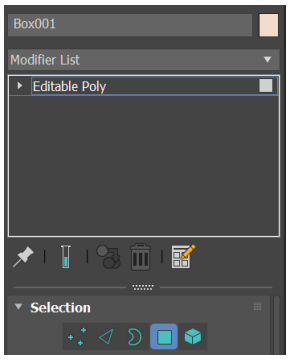


So far, we've been lucky in that we haven't had to change much of the shapes of our objects, in this case we have to.

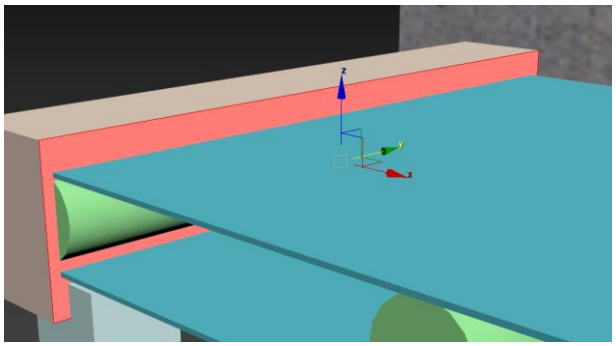
So, go to the modify tab, and then right click on the box object and select editable poly.



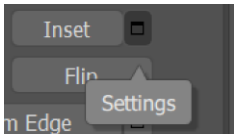
Once you have done this, it will change the menu system, in our case, we only need to deal with the polygon (face) of the object. So, we need to select this. To do this click on the square in the selection section.



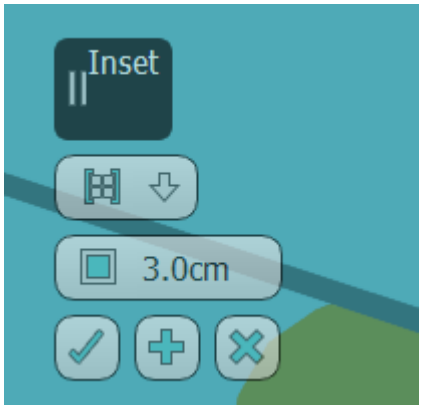
With polygon selected, click on the side of the box in which the cylinder interacts. It should go red and look like the following.



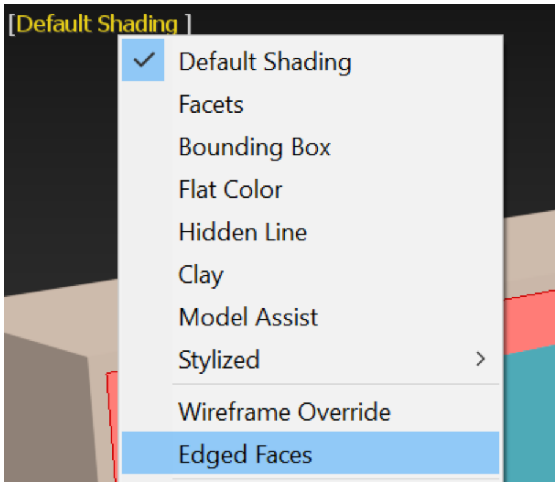
Now, if you scroll the right-hand menu, you will see a button called inset, next to it is a settings box. Click on that box.



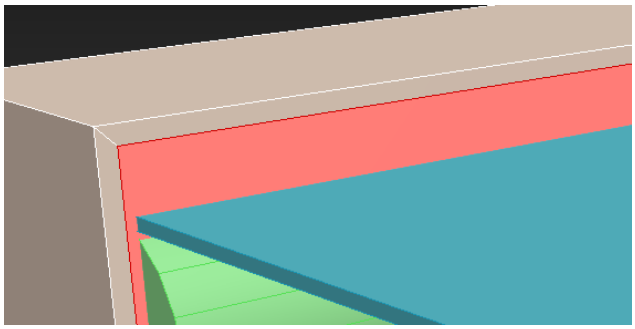
This will produce the following box in the perspective view. Change the number presented to 3cm.



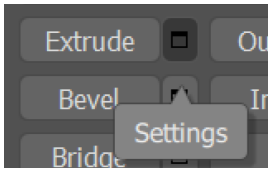
Then, click on the tick. What this has done, has added more faces to the object. To see this, click on the default shading menu in the viewport and select edged faces.



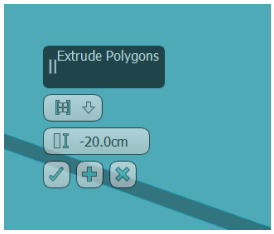
As you can see in the perspective view, our simple box, now has additional line son it. The lines are the edges. Of the object. Where the edges link, it is called a vertex.



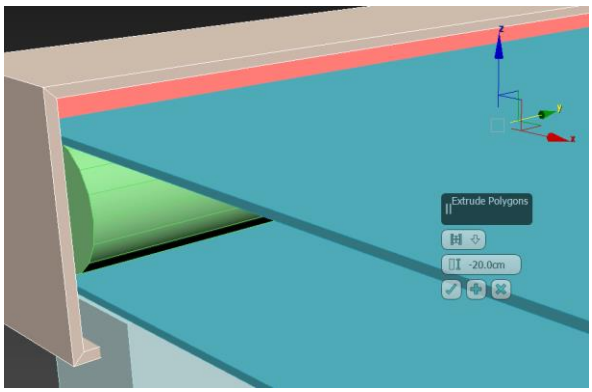
Next, click on the settings icon next to extrude.



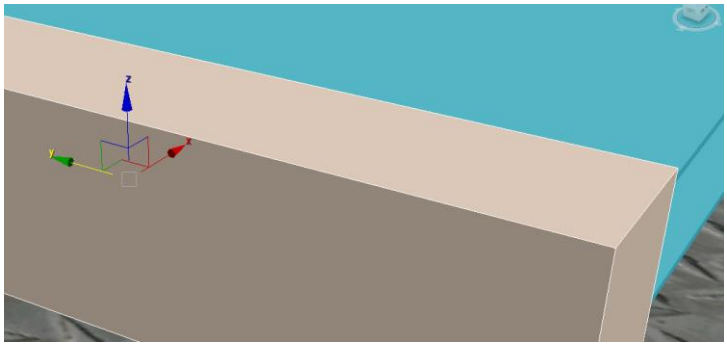
This will produce a similar pop up menu that inset did, change the number to – 20 and click on the tick to accept.



As you can see, this has now create an internal component to the box.

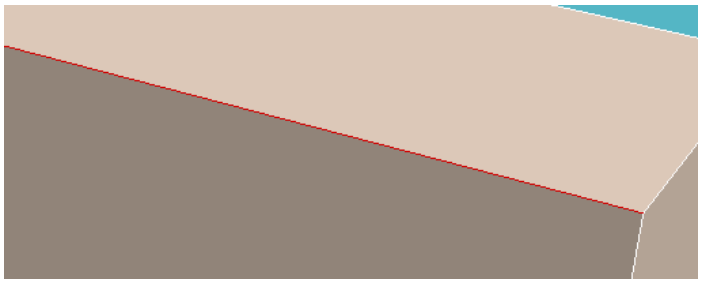


Next we will round the edges of the box, in perspective mode, rotate to see the back of the box.

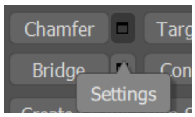


Now, in the right-hand menu, select edges.

And then click on the top edge of the box. It should become red as it is selected.



From here, select the settings box next to chamfer



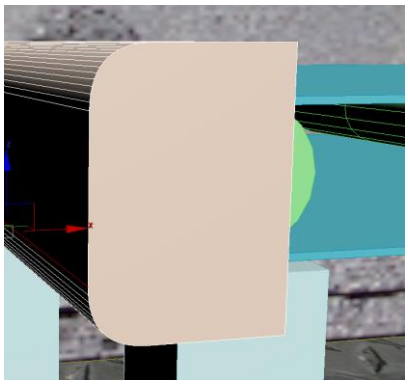
This produces the following pup-up menu

Change the numbers to 15 and 15, then click on the tick.

As you can see, it has added additional faces to the object, and create a rounded edge.

Repeat the chamfer process for the bottom edge.

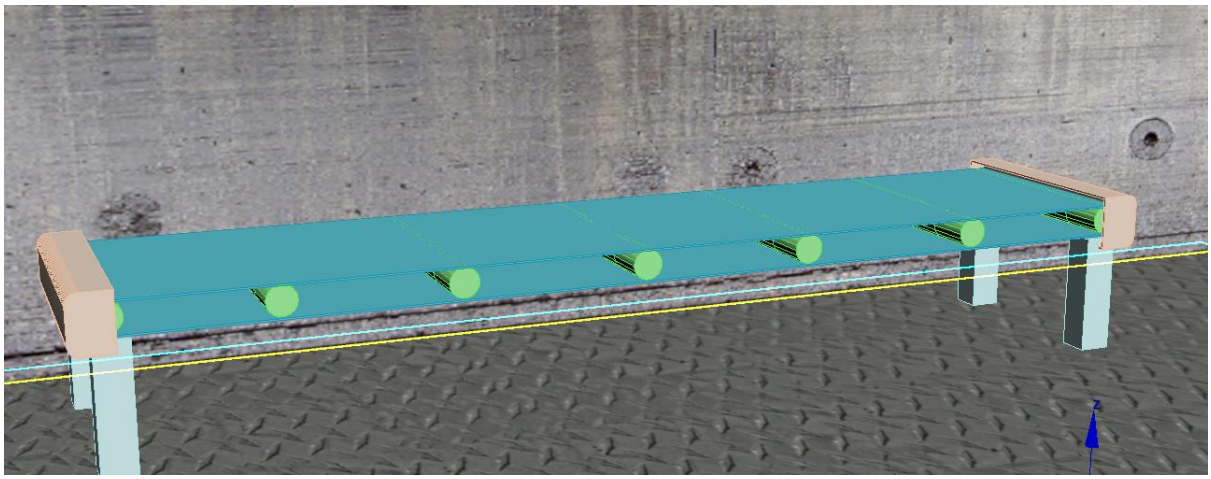
You should end up with the following:



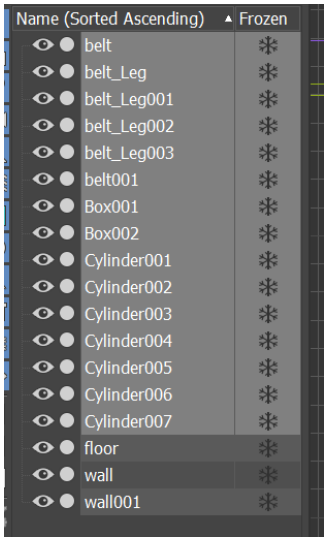
Now that we have one protective cover done, copy it and drag it to the other side of the belt and rotate it, so the inside area of the box covers half the end cylinder.

Use which ever view you are comfortable with… hint, the front view is a good choice.

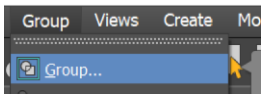
You should end up with something like this:



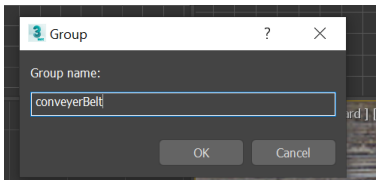
Now we need to make the second conveyer belt. To do this, we will group all of the objects in the one we have just made and create a copy. The easiest way to do this, is to select all of the objects in the hierarchy view.



From here, go to the menu, select group->group

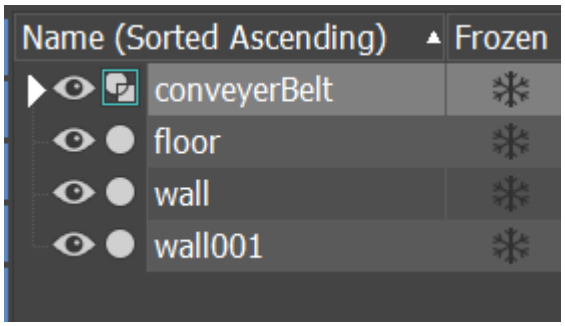


Give it a name



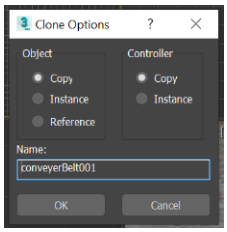
And click OK

In the hierarchy section you should see the following:

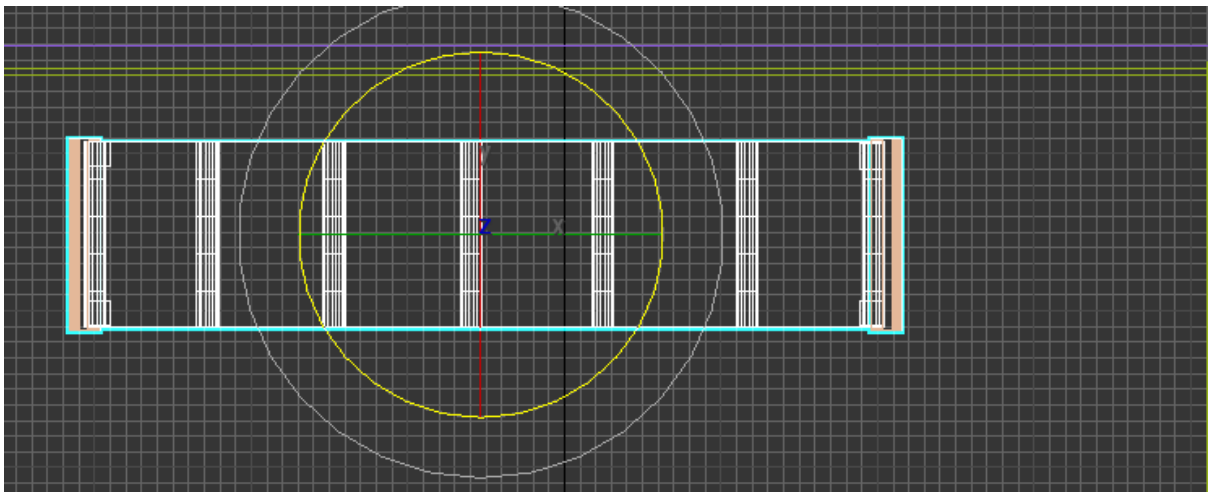


With the conveyerBelt group being able to be toggled so you can see all of the objects.

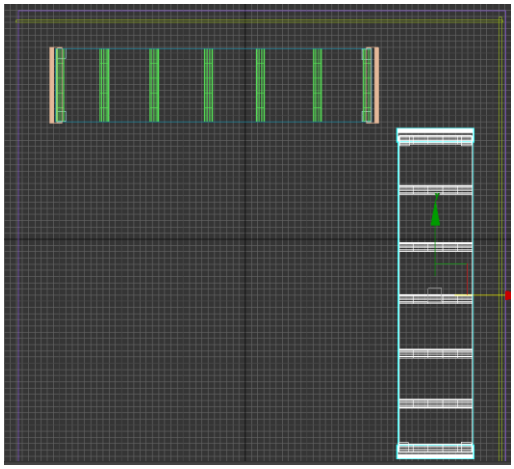
So, with the group selected, hit Ctrl+V, create a copy.

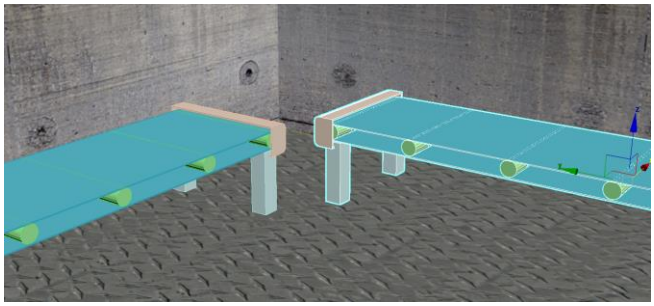


Then in top view, change to rotate and rotate the new conveyerBelt object.



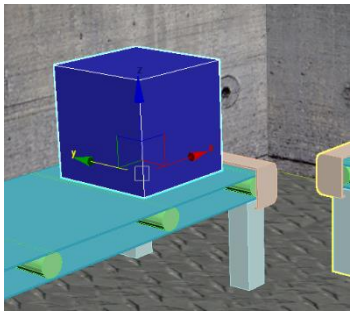
Once rotated, use the move tool to position it along the other wall.

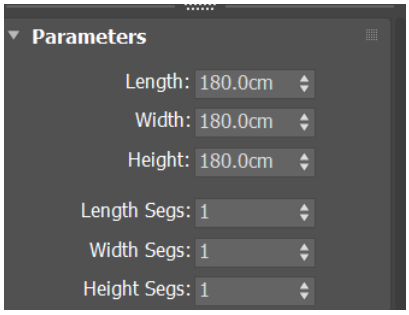




Box

This one is a nice simple one, this is the box that sits on the conveyer belt. In the top down view, just create a box smaller in width and length then the belt.

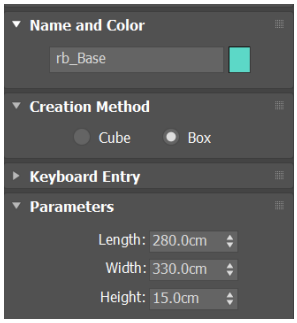


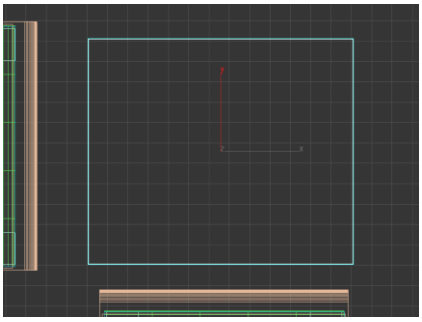


Robot Arm

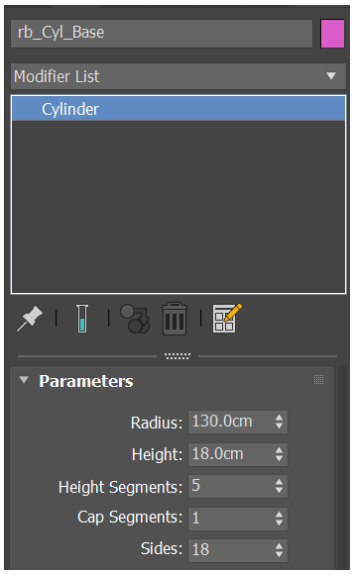
With the robot arm, we will use some basic shapes to create the overall design. The base of the robot will be a flat cube, with a cylinder on top of it, from there, we will use cylinders indifferent views to generate the arm until we get to the claw section where we will use boxes to generate the claw components.

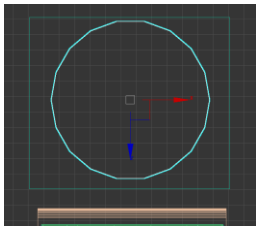
From the top view, generate a box with the following dimensions.

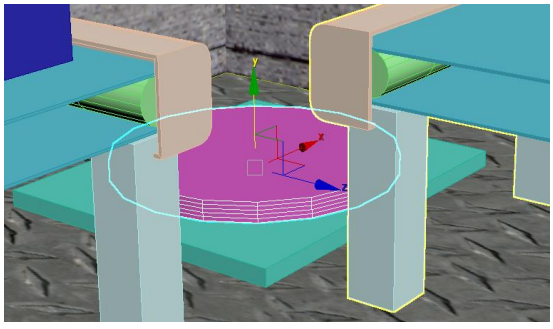




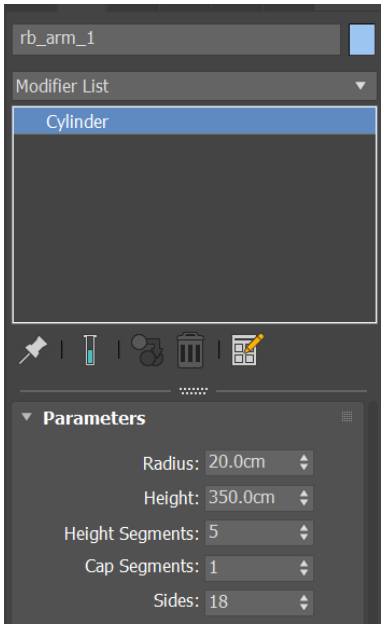
Next, we will put a flat cylinder, roughly in the central aspect of out rb_Base.

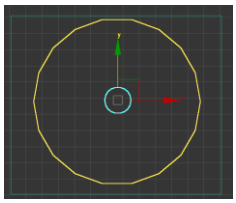


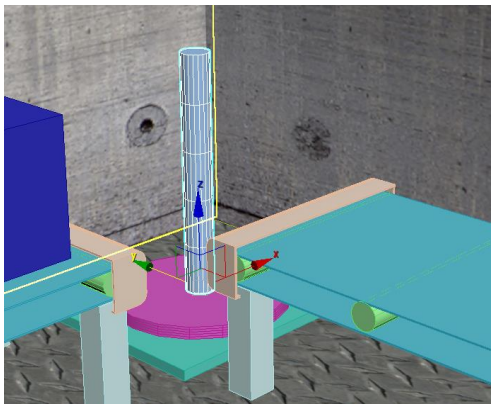




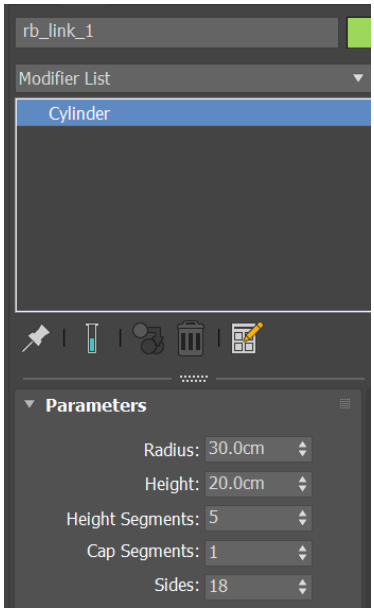
Now we will generate a cylinder coming from the base.

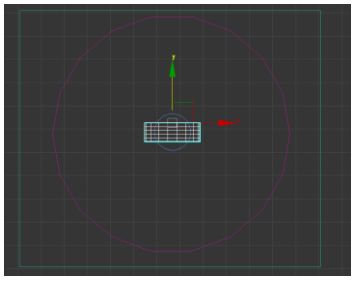


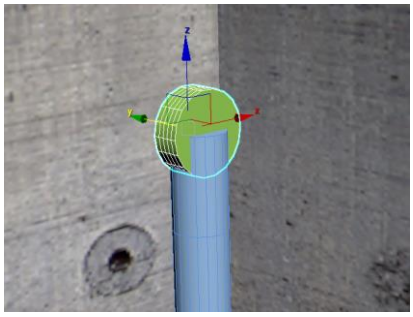




Now, we need to create a hinge, time permitting we would actually create proper hinges between out arms, but for the sake of speed, we will just use cylinders on their sides. To create these, we will do this in the front view.

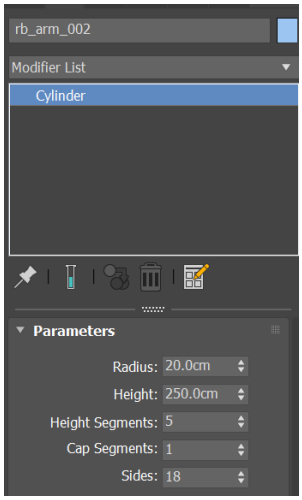


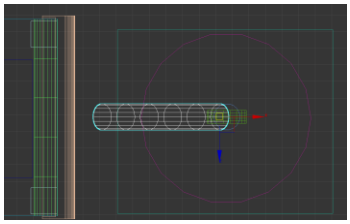


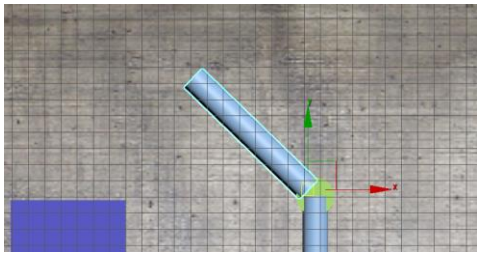


Now that we have an arm piece and a joint, we can copy and paste them to create additional sections to the overall robot arm.

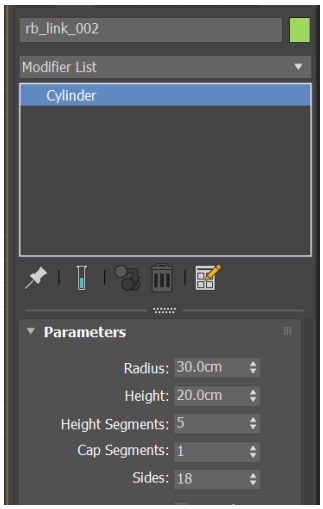
Start with a new arm piece. In the modifier section, drop it's height to 250. Once you have placed it vertically on the 1st joint, use the rotate tool to position it pointing towards the box.

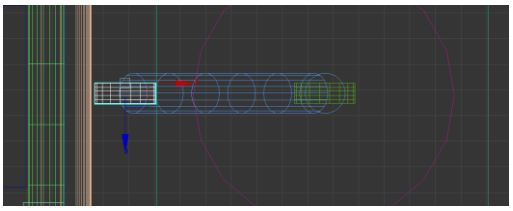


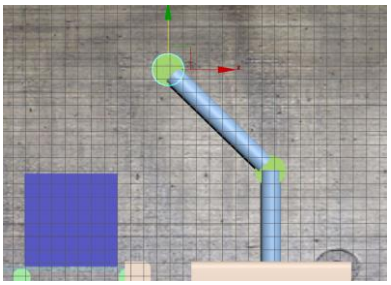




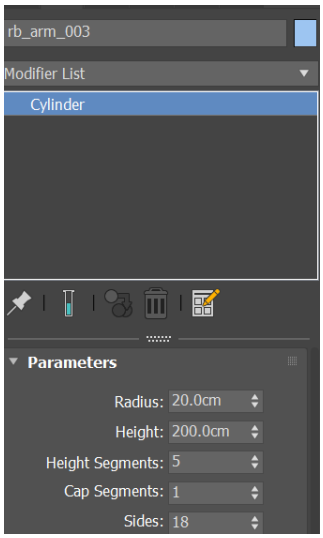
Next, duplicate the joint and position it. You'll find the front view is best for this.

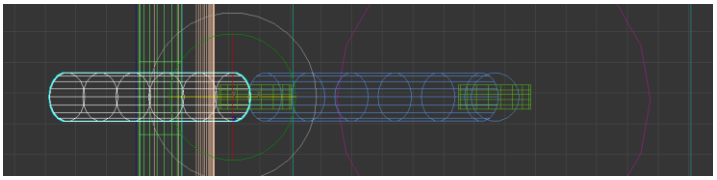


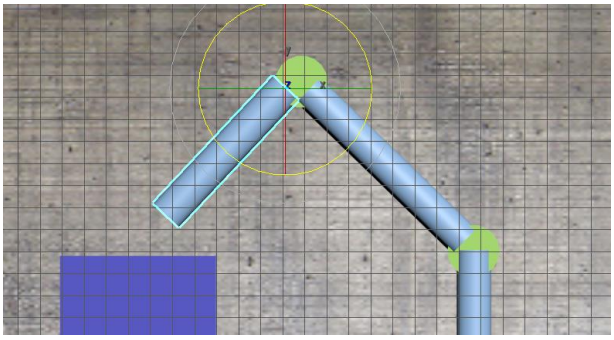




Now, we add in one more arm piece and then we can look at creating the claw. So, copy and paste one of the arms, and then move it into position.

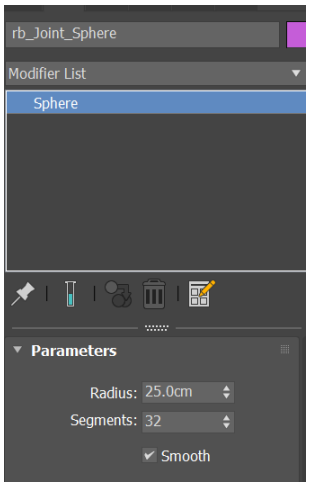


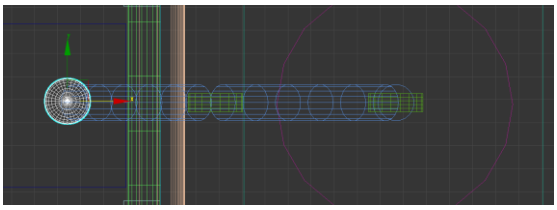


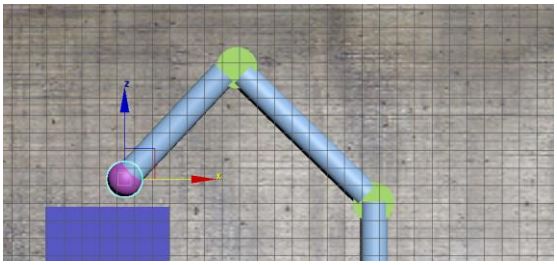


Next, we work on the claw, so with the claw, we will create a sphere and put on the end of the robot arm and then build the claw, the claw is just shaped and positioned cubes.

Sphere joint first. Go to tht create menu on the right-hand side select sphere. Then build it on the end of the robot arm.

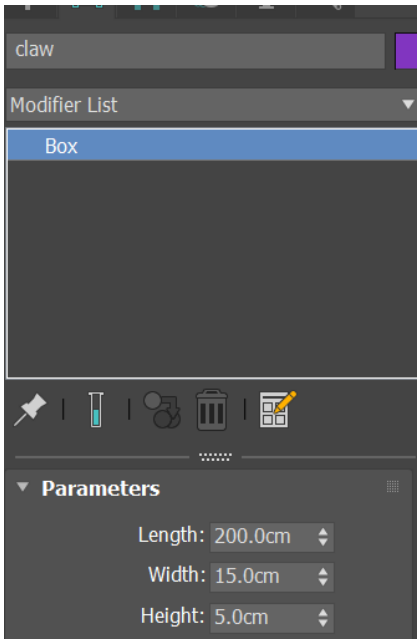


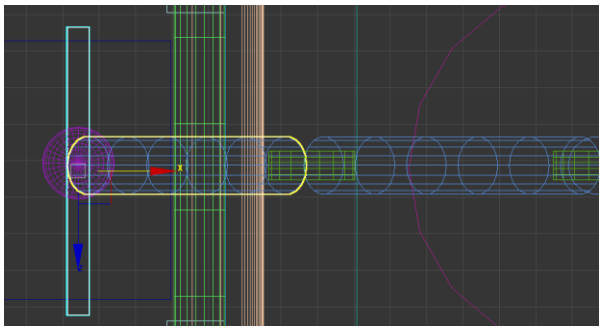


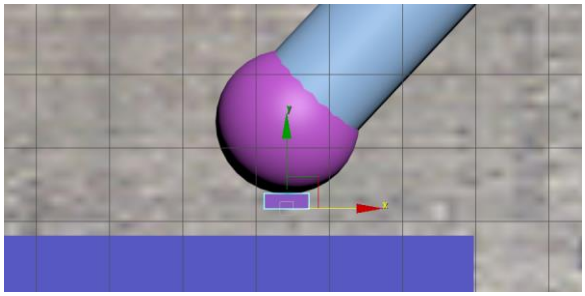


Next, we add a claw, this claw is very simple, as we will have intersecting cubes. Once the cubes are all in position, we will use a Boolean to link all of the components together.

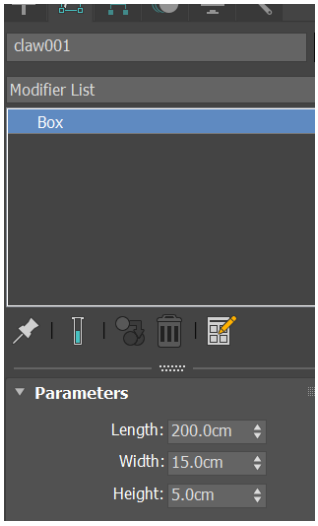
To start with, go Create->box in top view, give it the following parameters and position like so.

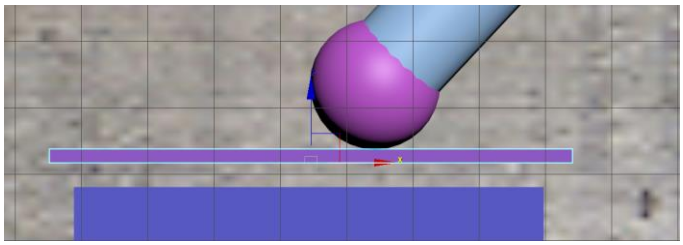


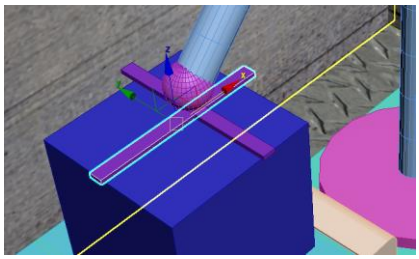




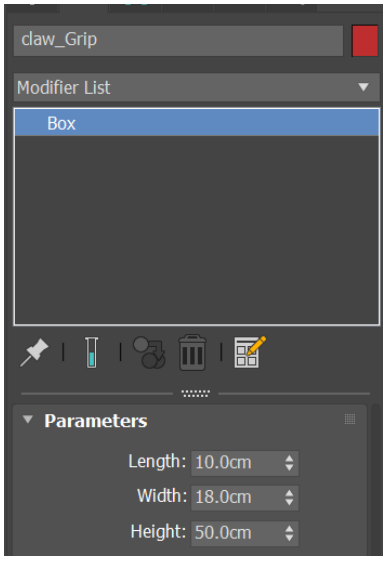
Now, duplicate that first piece and rotate 90 degrees. Then position like so:

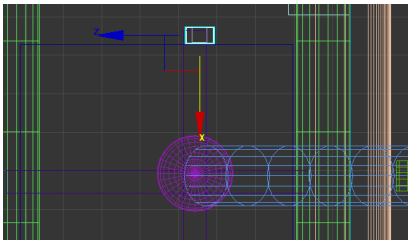


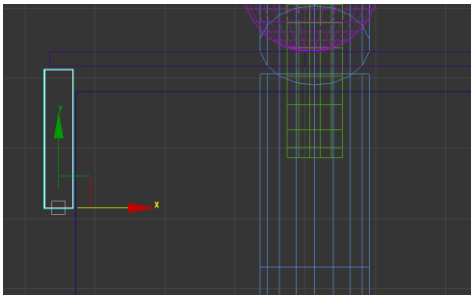




Next, we apply vertical boxes to surround the package box.

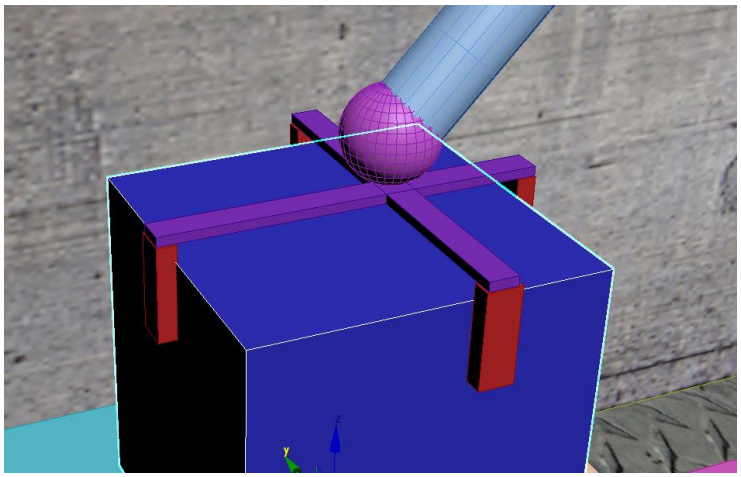






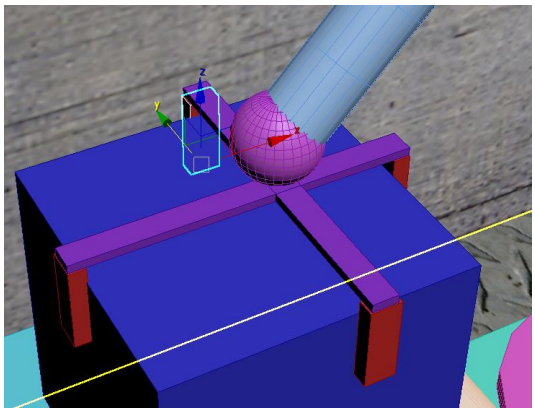
Notice how the views have changed, once you have one positioned, then copy and paste the remaining claw grips.

You should end up with the following:

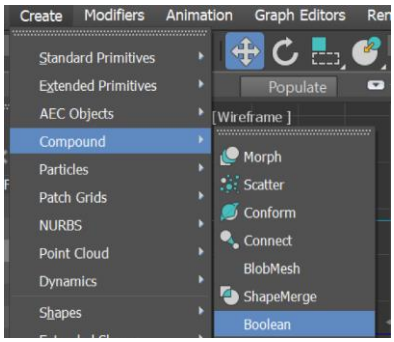


Now that you have the objects position, we will link all of the claw components into a singular element.

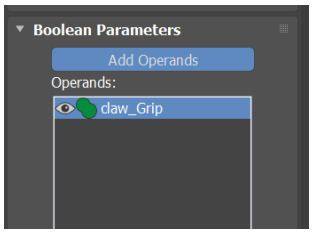
In perspective mode, click on the furthest claw grip.



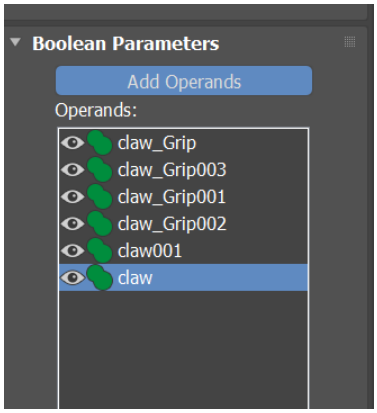
From the menu select Create ->Compound->Boolean



This will change all of the details in the right-hand menu. As such, look for the section that says Add Operands. Then click on it.

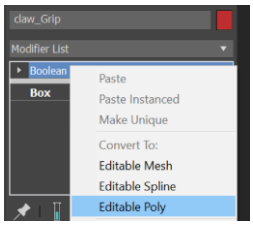


From here, click only on the claw components. This is all of the claw grips and both arms. You should end up with a list like the following.



Once you have done this, you will see that all of the objects have changed into the same colour. Now, unclick add Operands, to ensure you don't accidently link additional objects.

Then, go to the modify tab, right click Boolean and select editable poly.



This turns the claw back into a singular object. With which we can then animate.

Linking Objects

To animate an object cleanly we need to link objects together, to do this we create what is called Parent-child relationships. So, we link a child object to it's parent object in that when we move or manipulate the parent object that child object is effected by this action. For our robot arm, we will link objects in the following manner:

Box-> claw->rb_sphere->rb_arm->rb_joint->rb_arm->rbjoint->rb_arm->rb_cylinder_base->rb_base

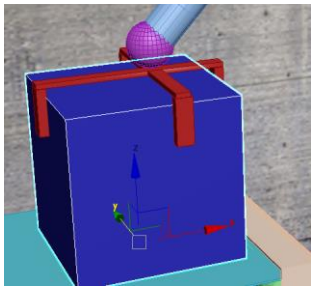
This way if we manipulate the rb_cylinder_base then all of the arm/joint objects ate manipulated as well.

The linking icons are:

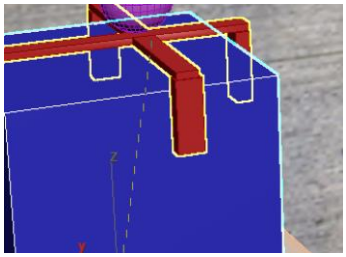
 to link, click on the child and drag to the parent.

 to unlink objects.

To start with, select the box in perspective mode.

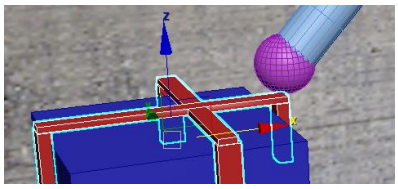


Click on the link (chain) icon and then drag the cursor onto the claw object. You should see a dashed line between the objects.



Once you have created the link, click on the move tool. 

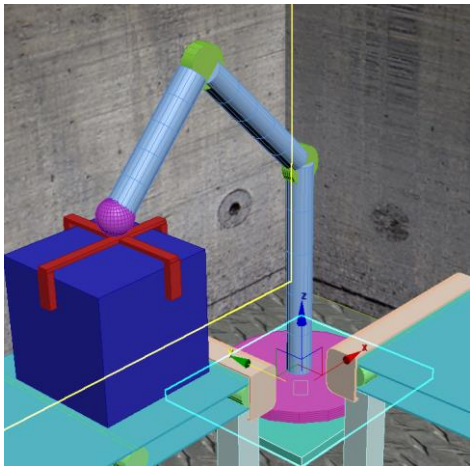
Select the claw and then slightly move it to see if the objects are linked. If it didn't work, try again. Once you have moved it, remember to Ctrl + Z once to return the object back to it's original position without breaking the link.



From here, repeat the click object, select link and drag to the next object. And test for the objects in the robot arm.

Box-> claw->rb_sphere->rb_arm->rb_joint->rb_arm->rbjoint->rb_arm->rb_cylinder_base->rb_base

You will end up with the image looking the same, but each time you test a rotation or a move, a group of objects will change position.



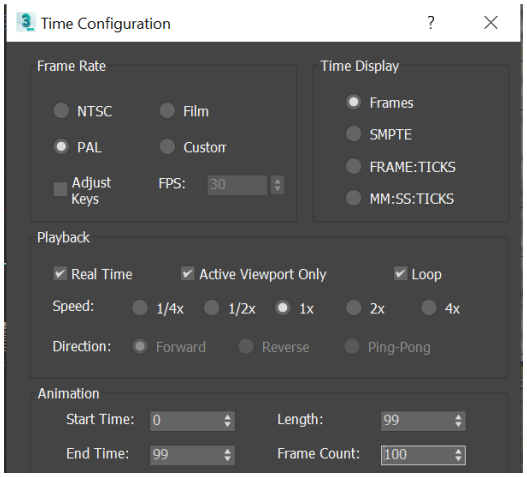
Now that they are linked, we move onto animation.

Animation

Animation is based on key framing, on the bottom of the interface we have a timeline. This timeline represents how many frames we have. The first thing we have to do is set the frames to work in Australian format, which is PAL (24 frames per second).

To do this, we click on time configuration.

This opens up the following pop-up

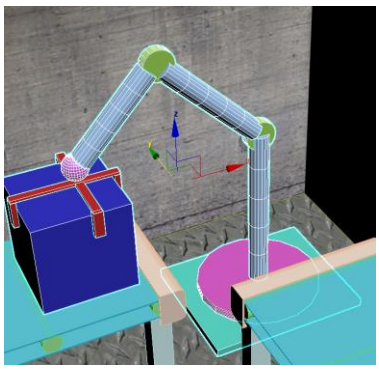


Select PAL

Change the frame rate to 100, this gives us 4 seconds

Once you have done this, click on OK.

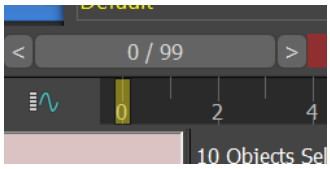
Now we have to select all of the arms objects, hold down Ctrl whilst doing this to keep each element selected.



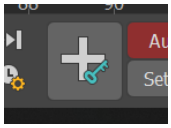
Now that we have all of these objects selected. We can set a base position.

Click on Auto, from the bottom interface.

You will see a red bar appear on the timeline. Then ensure the slider is at frame 0



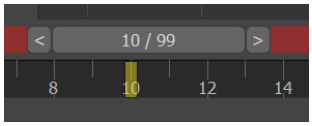
Then click on set Key



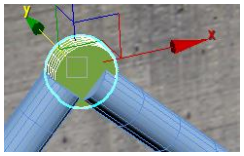
What this has done, has given us a starting point.

Now, here we will move the slider forward in time and then rotate an object.

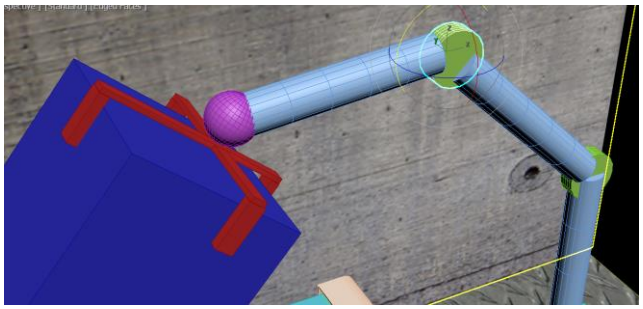
So, move the slider to 10



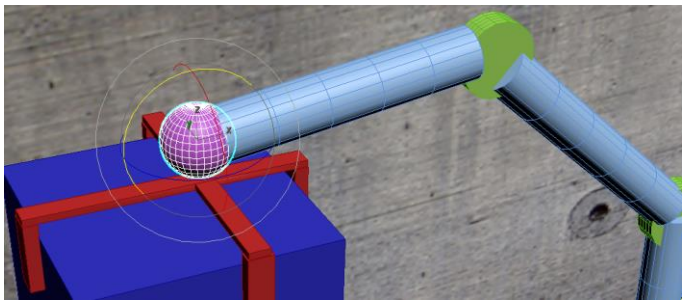
Select the top joint



Go to rotate and rotate the arm up

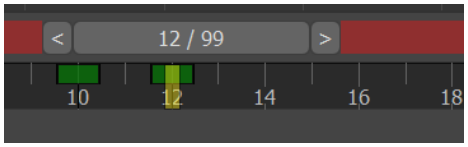


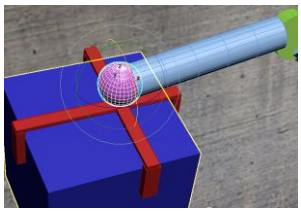
Now, also on the same frame, select the joint sphere and rotate it, so the box is still horizontal.



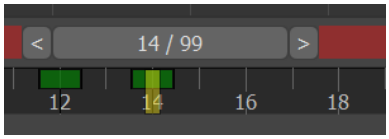
One of the most interesting things about animation in max is that each object has it's own timeline, so when we manipulate an object, the scene can do a lot of different animations at the same time.

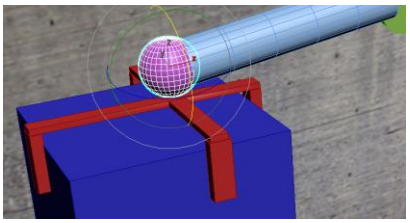
Now, move the time slider up to 12 and add a side rotation to the claw.



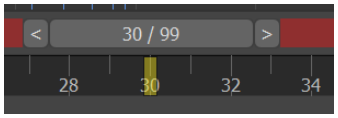


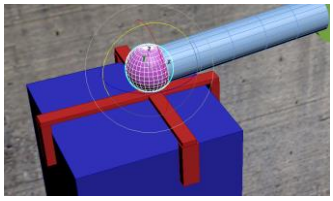
Then go to 14 and swing the box back



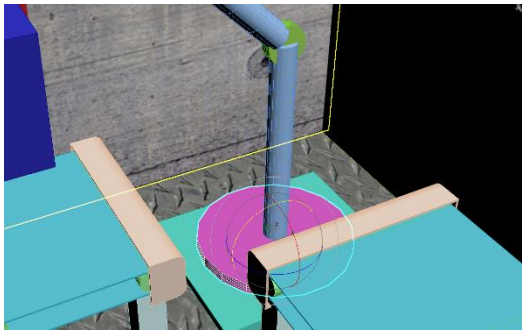


Then move the slider to 30, rotate the sphere so the box is back to it's horizontal position.

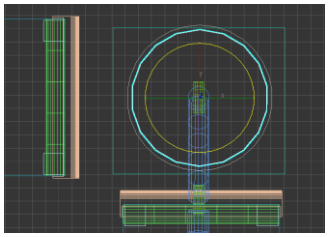




Whilst still on frame 30, select the robot base

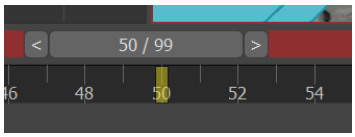


And rotate it so the box is above the other conveyer belt.

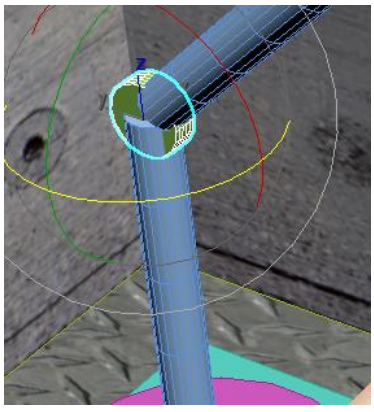


If you use top view, the positioning is reasonably easy.

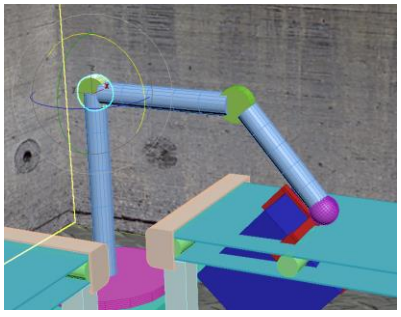
Next, move the time slider up to 50.



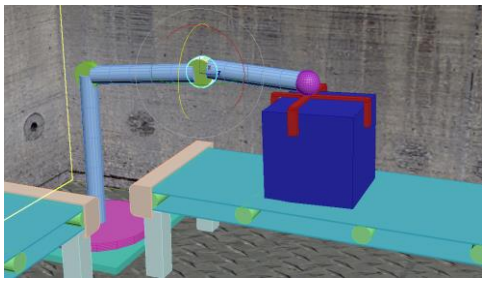
Then select the first join of the arm. And rotate it to bring the arm further over the belt.



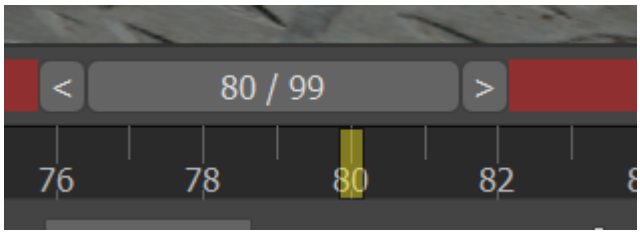
We can put the box through a bit of the belt at this point in time, as we will move the other joint in a second.

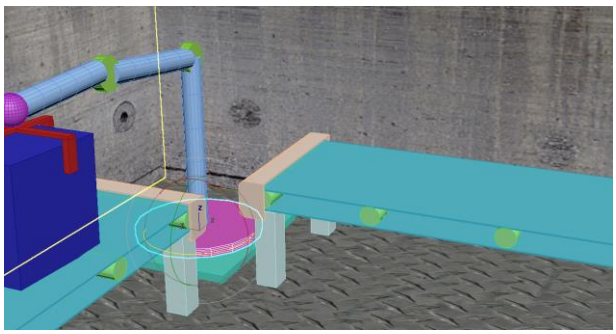


At the same time frame of 50, click on the second arm joint. And rotate it to pull the box out of the belt. You might have to re-position the joints while you try to flatten the arm out.

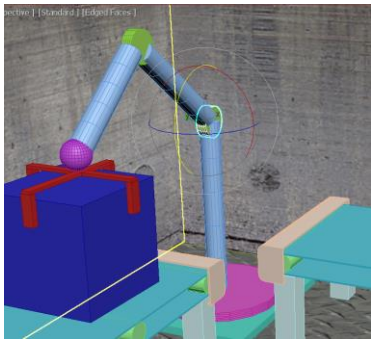


Then from here, move the time slider up to 80 and rotate the base cylinder so the arm is back where it started from.

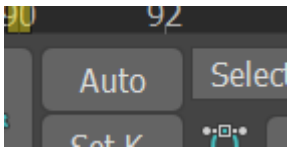




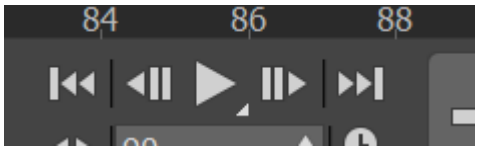
From here, go to 90 and rotate the joints to get the arm back to close to its original position.



Next, click off Auto.



Now, use the video controls



Click on the go to start icon |<< and then push play > to see your animation.

Once you are happy with the animation. Go to the material editor and apply the materials to each object.

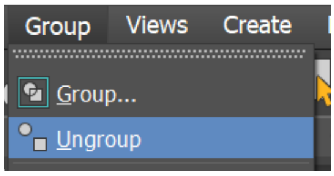
Apply texture to the Box -> cardboard material.

Apply texture to the Belt -> belt texture Remember, there are 4 of these items.

To apply the texture to an item individually from a group, you will have to break the group.

In the hierarchy click on the belt

Then in the file menu, click on group->ungroup



Do that for both conveyer belt groups and then then apply textures.

Apply texture to the Protective overs and legs->Rust

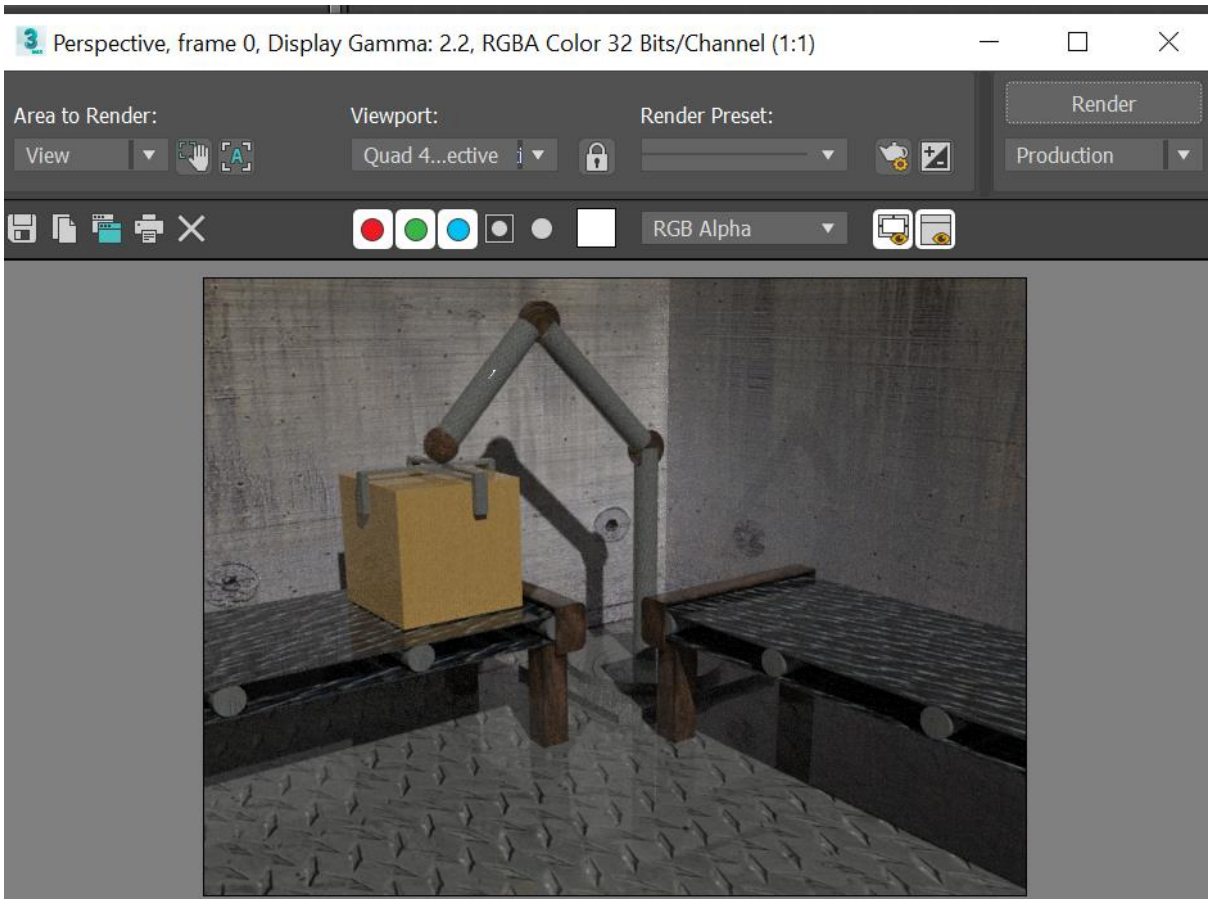
Then, we will put rust on the joints and the floor texture on the remaining objects of the robot arm.

Then finally, we will apply the floor texture to the rollers in the conveyer belt.

Render

To finalise the scene, we will render the scene out, move the camera around in the perspective view until you find an angle you like, then click on the render icon. 

Clicking on that will bring up a new pop-up, from there click on render and you should have a scene like this:



Of course, there could be a lot of improvements, such as removing the reflections, finding better textures for the robot arm and rollers. But as a starting point, a lot was covered. If you made it all the way through. Well done.