Engineering Graphics and Design
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Week 12: Animation
Lecture 2
Example 11

Welcome back, we are in week 12 of this NPTEL online course. In this week we are looking at animations. In the previous lecture we already looked into one example of animation where we have assembled as well as animated that device. In this lecture we will look at another example.

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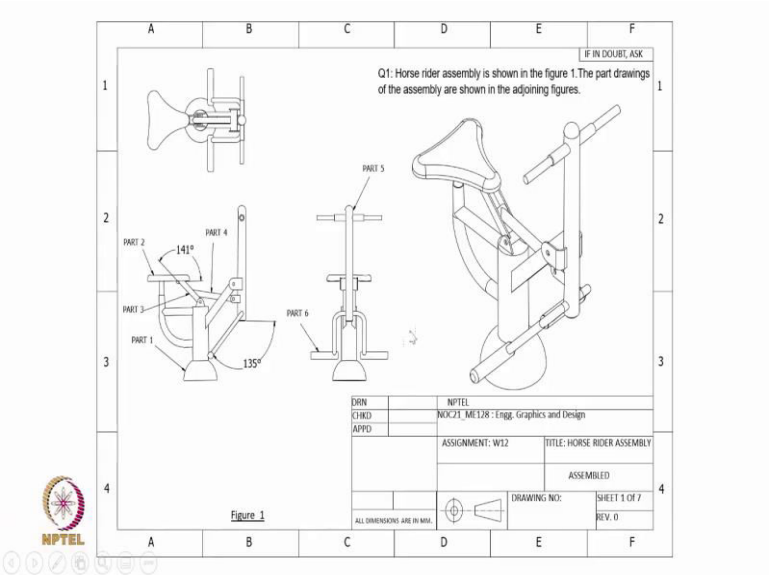

Here is the example of the assembly here we have an isometric view of the assembly as well as three orthographic views of the assembly. First let us try to understand what this device is and then we look into how to model it using the inventor software. So, first let us see how many parts we have. We have part 1 part 2, 3, 4, 5 and 6. So we have 6 parts, essentially what this device does is probably you might have seen it in an outdoor park where they have gyms. So this is one of a device where it is very close to a horse riding where you hold the bar and pull it, the moment you pull it the seat you are sitting on rises up and then the leg rests are also moving.

So, this device has one degree of freedom the moment you pull the bar, the seat rises and leg rest also moves accordingly. So again, going back to these parts let us see these parts one at a time.

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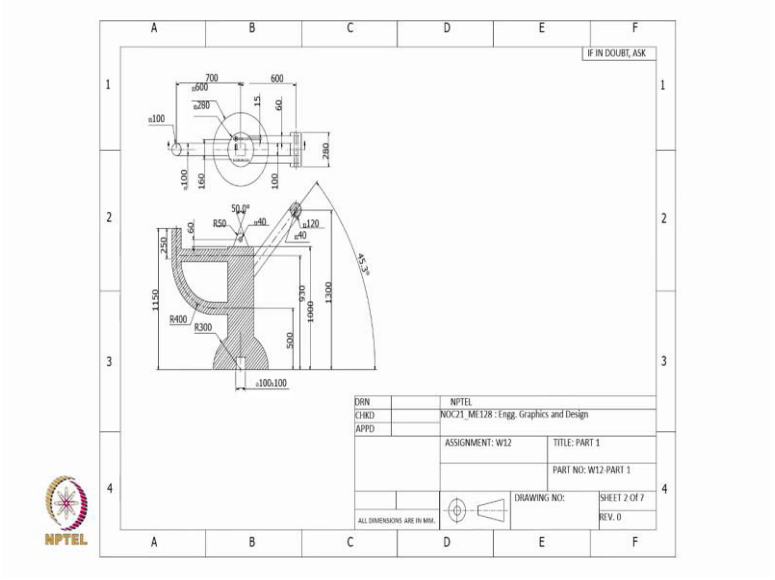

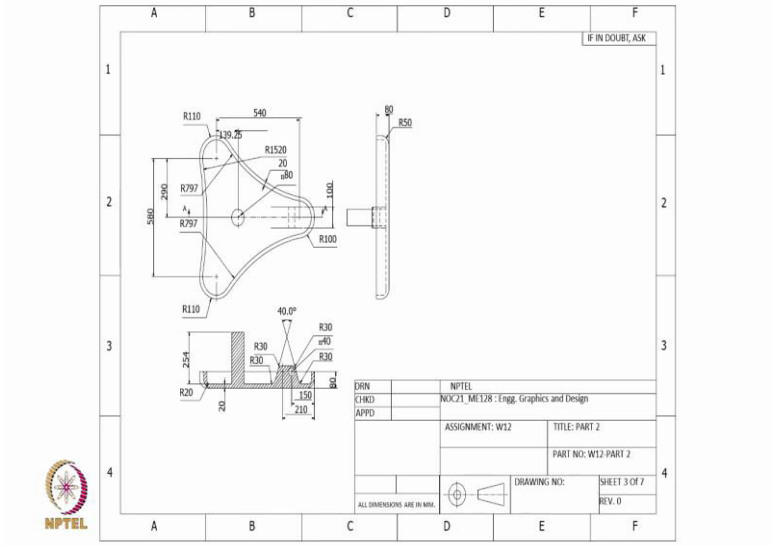

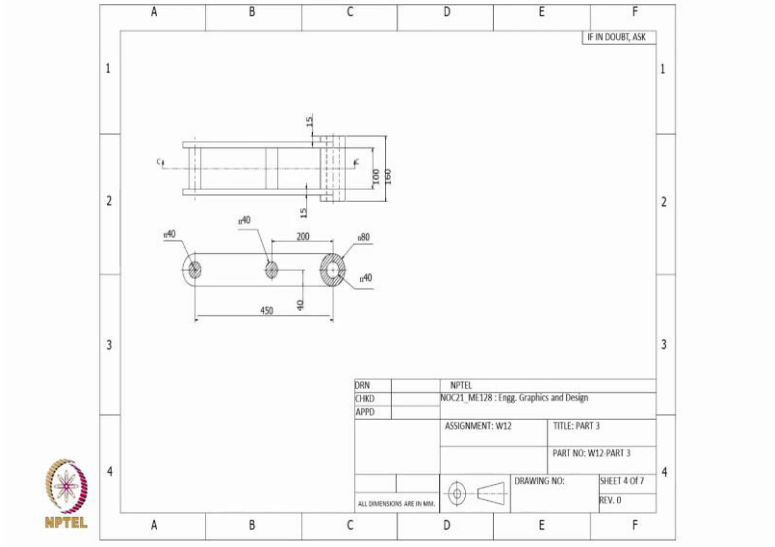

So we have the base which is sitting on the ground and then the seat where the rider sits. There are two links this is the link one a smaller link.

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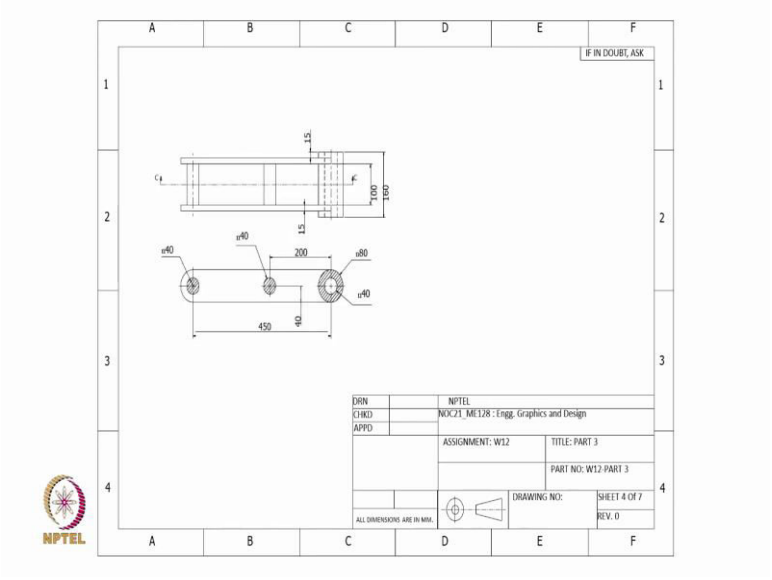

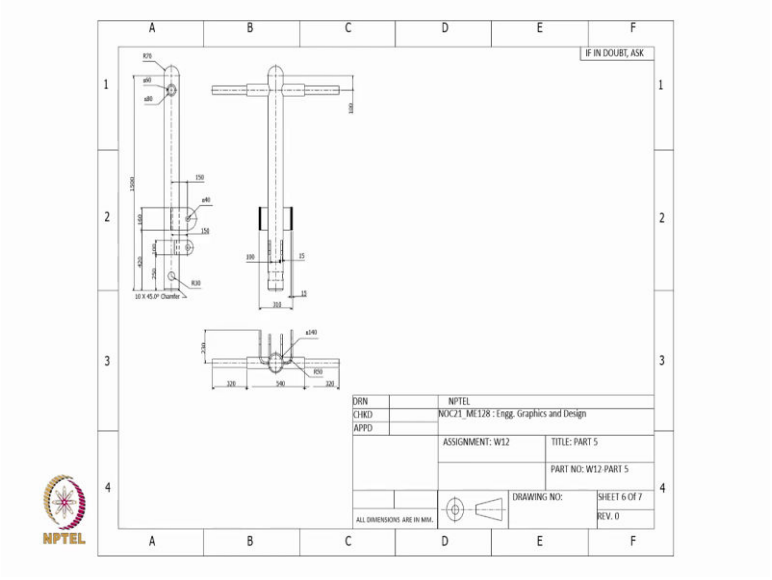

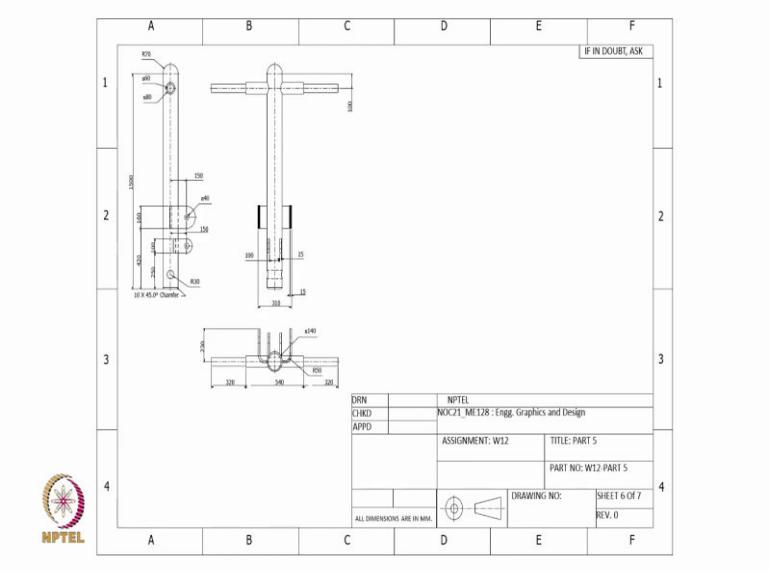

And then a longer link we also have this vertical handle where the person holds the machine or the device and lastly the leg rest.

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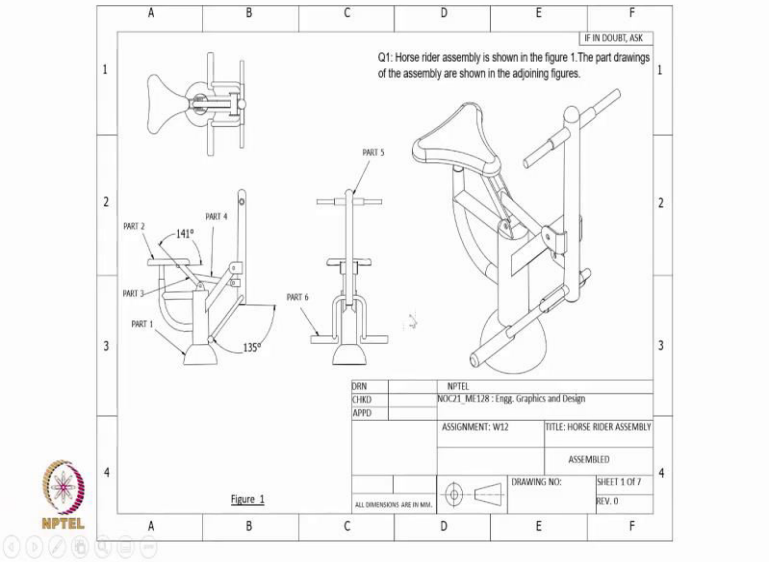

So now let us go back to the assembly and then see what we have just discussed we said there is this bass which is sitting on the ground and then we have the seat and then there are two links, one link connecting your base to the seat with this is the short link and there is another longer link which connects your small link to the handle. So, this vertical and the horizontal combined together is the handle where the rider holds and lastly the leg rest is shown here. So, this is the part 6 which is the leg rest.

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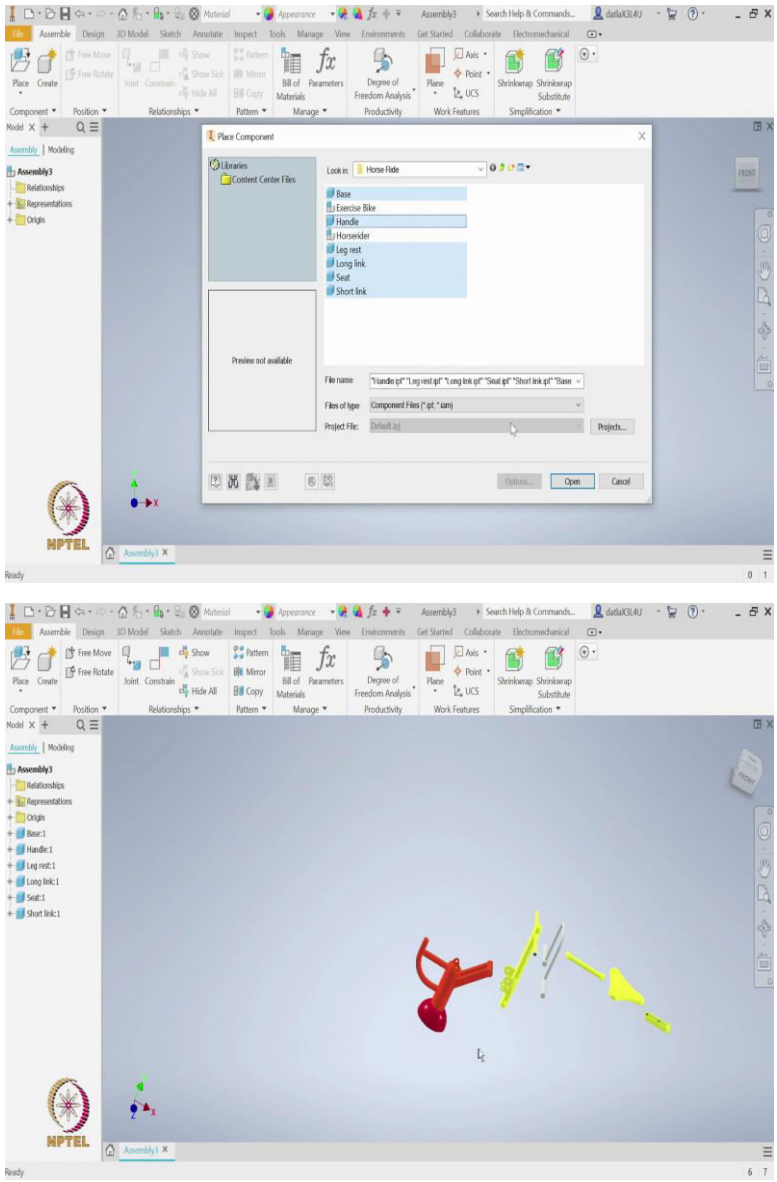

So now let us get started with the software I will go to the Inventor software and we are at the initial interface so let us start an assembly file the standard mm .iim. So again, we are following the bottom app approach where we already created the part models we are importing them into this assembly environment we do that using this place tool.

So here are my part models let me choose one at a time the starting with the base. So here is the base, then seat, then short link, long link, leg rest and lastly the handle. So let me place them here, right click and say okay. So here are all the parts the 6 parts we need to start working with this assembly.

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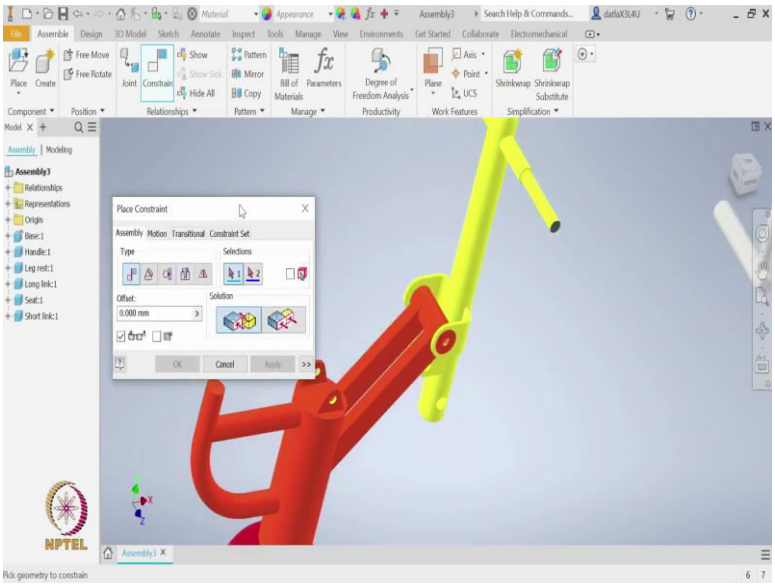

So now let us see how to get started. So, what I will do first is first attach the handle to the base. So how do we attach that? Those are attached at this holds on the handle. So, what I mean is this axis of this base should match with this small little pair of holds. So for that we can okay before we get started let us ground the base.

And then we can go ahead and apply this constraint. So this is 1 axis, let us zoom in this is the other axis. And now apply the constraint. So after this, let us make sure that this bar currently if you will see that it is free to once one is it is free to rotate about the axis, and it is free to move in this direction. So let us constrain that.

So now we need to constraint by saying that this handlebar should be vertical for that, I will apply an angle constraint using this directed angle between the axis of the handlebar and the axis of the base. And let us specify it is zero degrees and apply. And so we are mating the surface of this thing with the other side of the base and apply that constraint.

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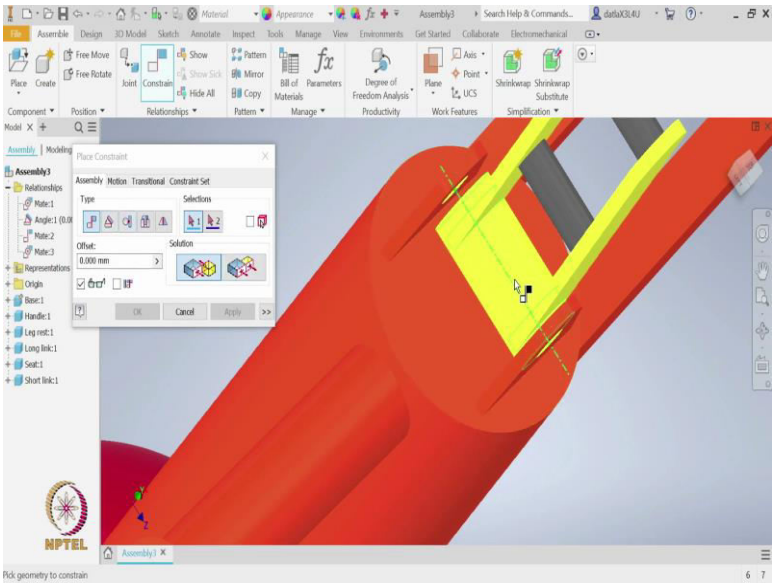

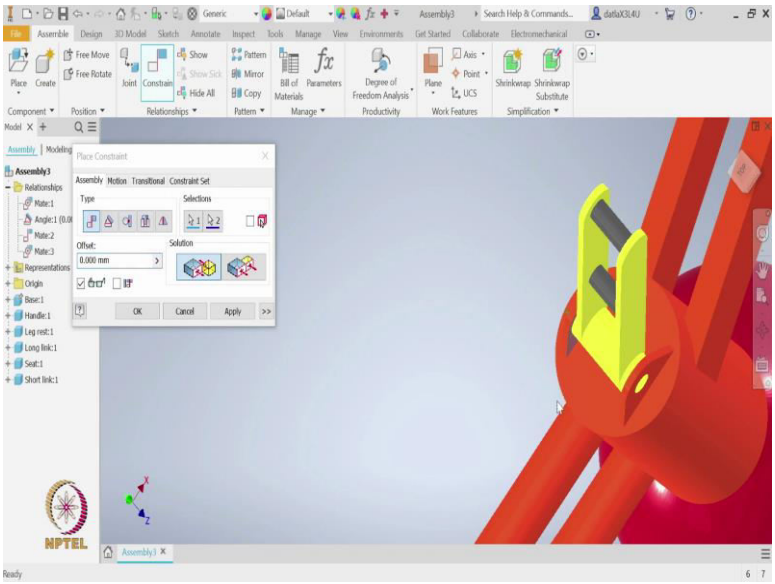

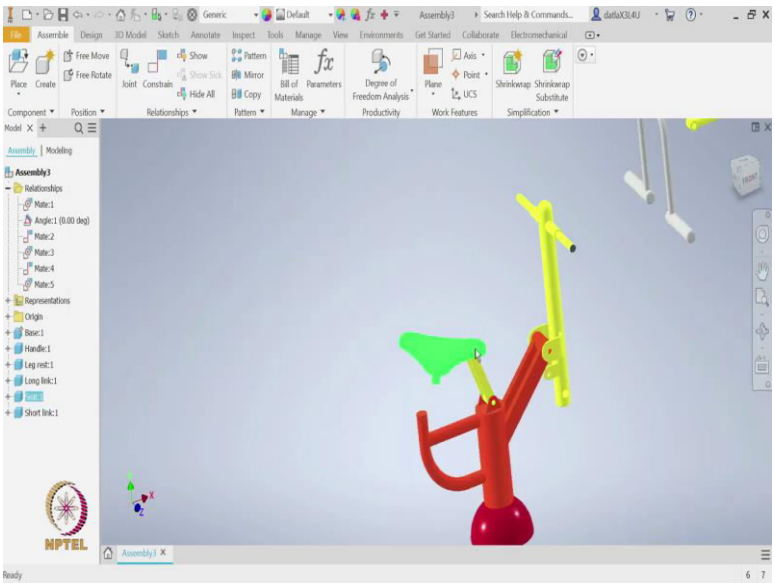

So now let us work with the smaller link we see that the smaller link shares a common axis with the top of this base. So let us constraint that first. So let us go to constraint select the axis first. And similarly, this axis of the code and let us apply the constraint. Now let us worry about how to place this with respect to the base.

So that we can do by using the mate so before I apply, let me drag it out so that we can have access to the surfaces. So I will apply a constraint between this face of the base and the other end of this small link. And apply, so now let us see what degrees of freedom we have for this link. So we see that it is free to move the other end of this link will be connected to the seat so let us bring in the seat closer. let us zoom in and see where exactly that goes.

We see that at the bottom of the seat, there is a hole that corresponds to this the other end of the link so again, let us apply the mate constraint we will choose the axises, first for the axis of this hole below the seat and then how to find this axis at the other end of this link.

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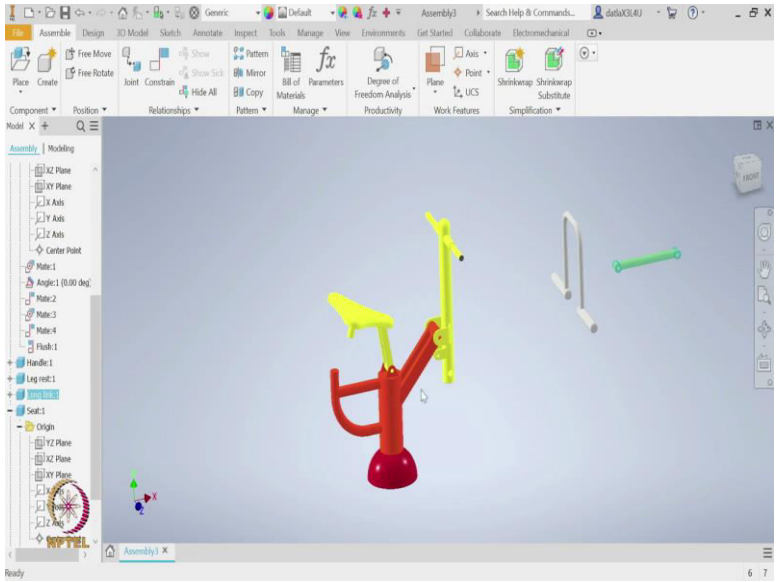

And currently it can move away from the base or close to the base, we need to make sure they are aligned. Now to make sure that the seat is symmetric with the base, we can apply a mate constraint between both those planes. So I will choose one plane from the base which is this XY plane and one plane from the C which is again this XY plane and apply. So now we see that both of them are in the symmetric about this XY plane of the model.

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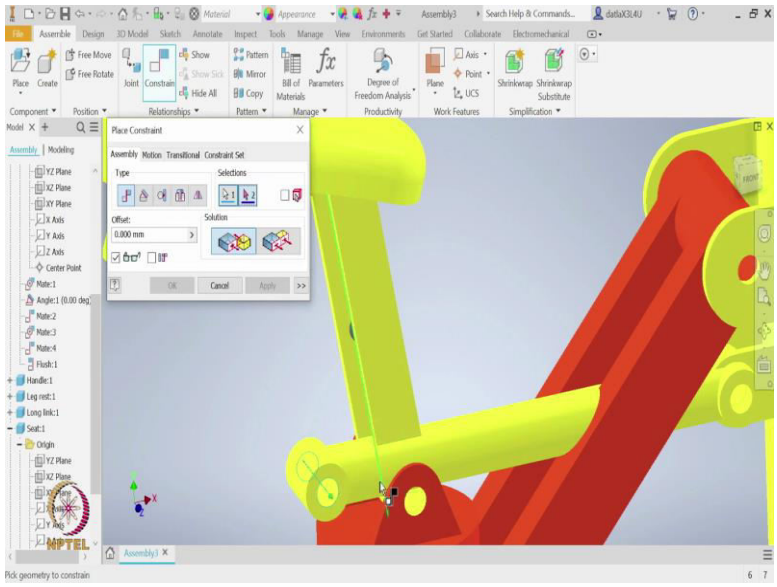

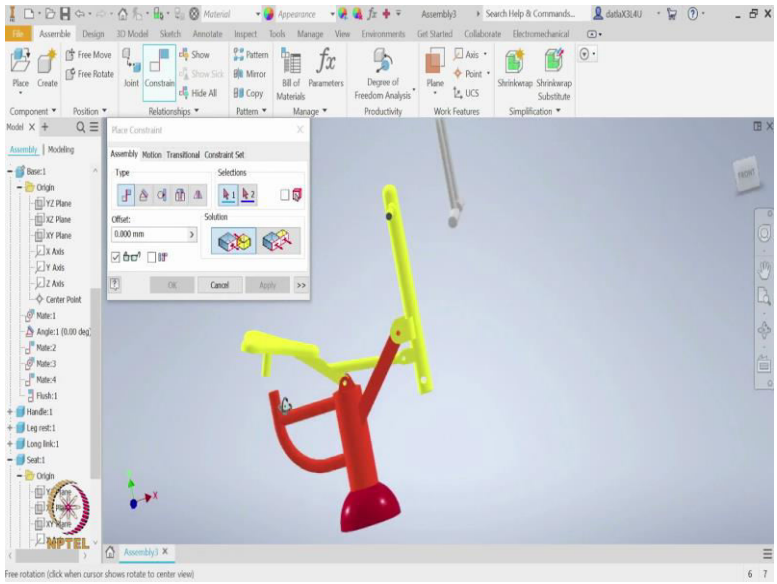

Now what we achieved is we are able to connect the seat to the smaller link before we go ahead and constraint the seat we need to apply this longer link so let us first see how we constrain this longer link. So let us bring it close we see both ends of the longer link there are holes.

So we can mate with the corresponding axis. So we will first start with the right end of it. Let us zoom in. So this should match with this pair of holes. Let us apply that. And we also know that this end of this longer link should match with the this component at the middle of the shorter link, and apply.

So now let us see that this longer link is free to translate. So to restrict that, we can simply use the mate constraint, let us say between this face of the link and the inner face of this shorter

link and apply. So now we have the both the short link and the longer link are connected to each other.

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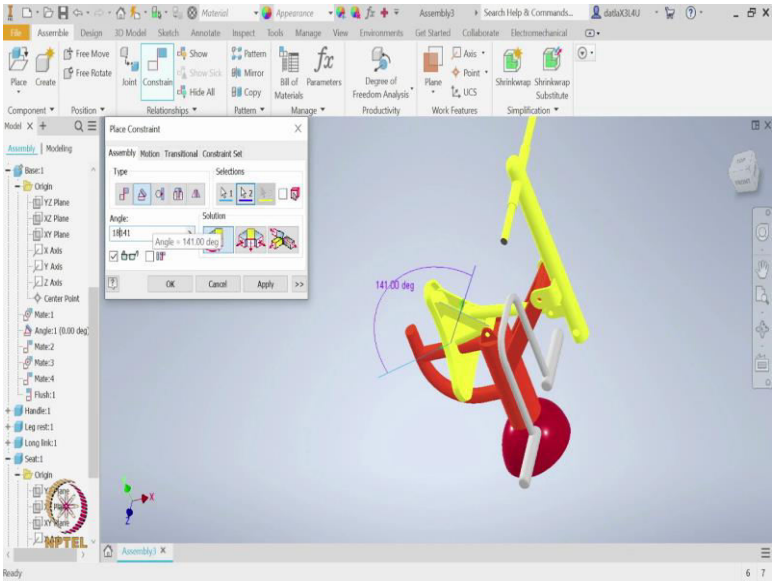

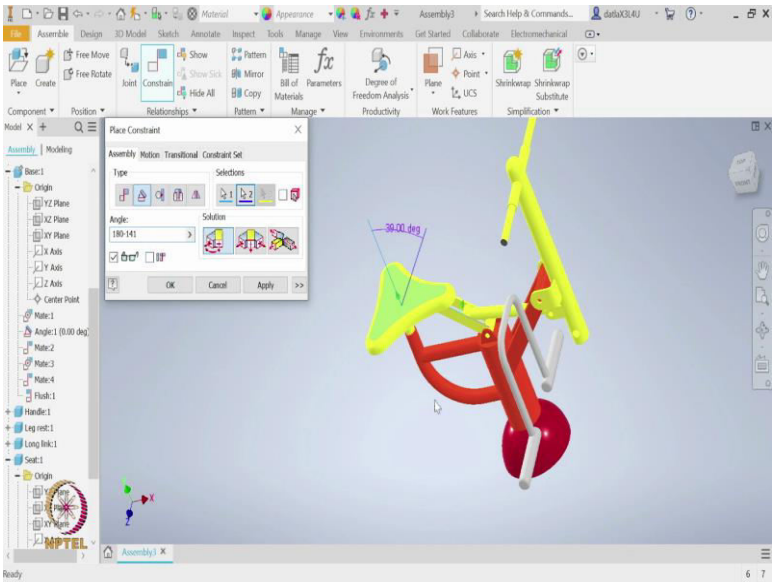

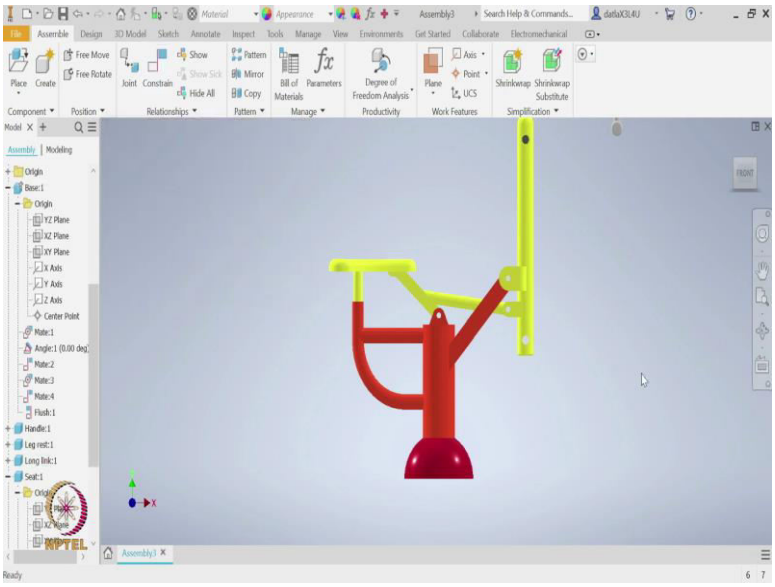

Lastly, what we need to do is if we go back to the assembly, we see this angle of 141. Let us now try to apply this angle between the shorter link and the top face of the seat. So for that, I can go to constraint angle by two directions. First, let us choose the top face of the seat and then this face of the shorter link. So let us zoom in.

And now let us specify an angle of 141. So maybe this is a little more, so we will say 180 - 141. Now if we look from the side angle and zoom in, we see that the seat is properly aligned with the shorter link. So currently, this is 39 degrees, but if you look at the question will say the remaining angle is 180 -141, which is 39 degree. So let us apply.

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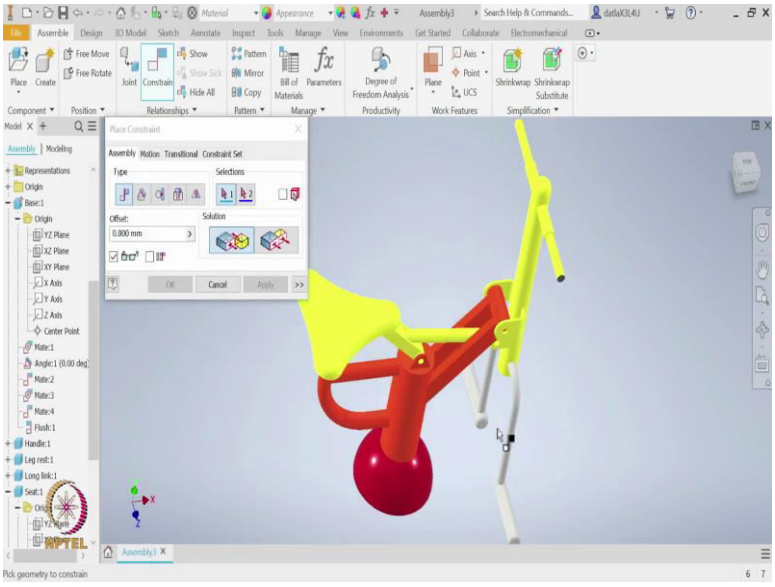

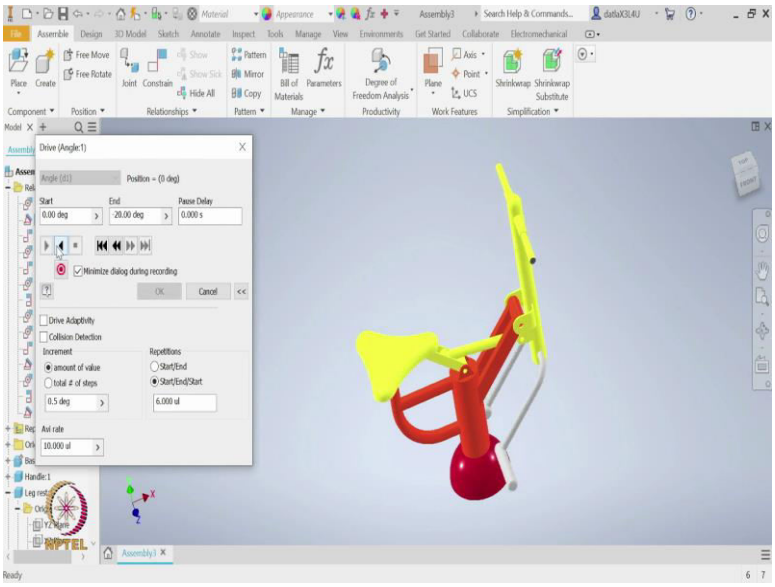

And lastly, what is remaining is we need to apply this leg rest. Again, we notice that the way to do that is the axis of this leg rest should be matching with this holes here. Apply the constraint. And lastly, make sure that this leg rest is symmetric about this base. For that again, we will do the mate but select the planes. So first we will start with the base XY plane and then the leg rest go to origin and let us choose the xy plane.

So now we are almost done with the assembly because this looks close to what we have. I now notice that there is an angle which is specified for the leg rest as well we say that this angle is 130 degrees, essentially with the vertical it should make an angle of 45 degrees this leg rest.

So how do we specify that we see that it is free to rotate, so let us apply angle constraint. Let us say between this axis and the vertical axis, we will say that angle is 45 degree. So let us apply that angle as 45. We see it is going in the opposite direction. So let us add 180 now it is close to what we need.

So now as you can see, this leg rest is in the same orientation as shown in the question. This angle of 135 is imposed. So now that we are done with the assembly, let us go to animate. Further, what we will do is we will go in go and have a look at these relationships. We noticed that we apply an Angle 1 between this handlebar and base.

So we will go there to animate, we will go to the drive. And this angle will change from 0 to 180. And let us see how it looks like. I can go to more options where I can do use this relationship or start and start so that it will complete one full cycle and here I will make it two

steps. And probably it is being too fast. So let me slow it down by instead of one degree in each step let us say 0.5.

Let us play it and see. I can always increase the number of loops so let us say it is six so that it does it three times. So now we can see that how this device works so if someone is pulling it closer the seat raise up in effectively he is lifting his own weight and then relatively the hand wrist or the leg rest also moves so you can apply the force by pushing the leg rest or by pulling with the handles.

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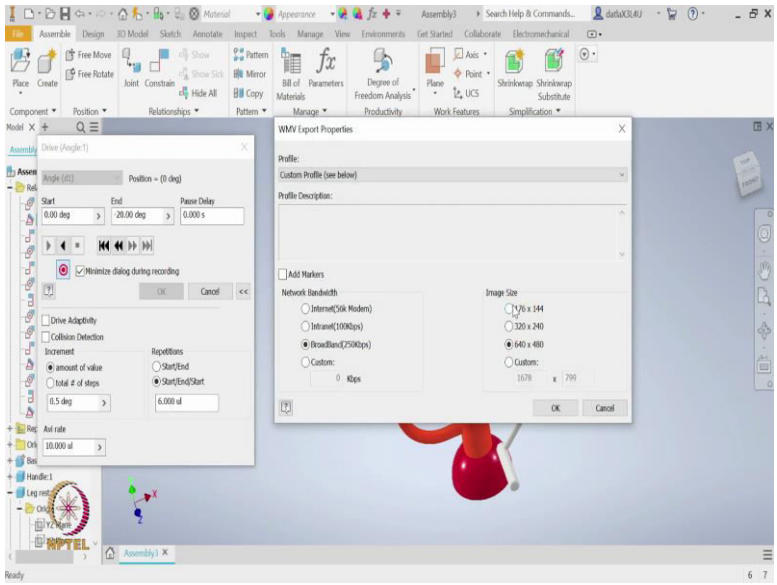

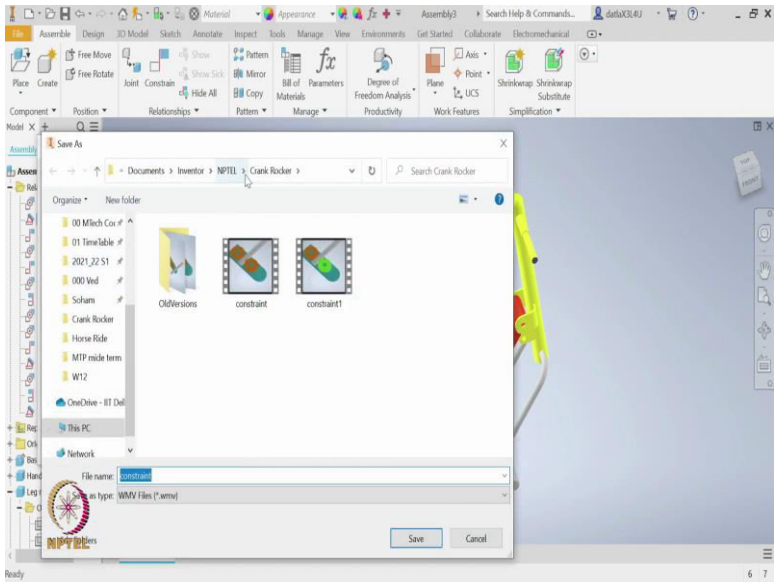

So for recording the animation, we need to select this red record button. So then go into the proper place where you want to save it. Let us name it as constraint one and choose the file

type as WMV for now, otherwise, we can also choose the AVI file for high quality videos. And then save.

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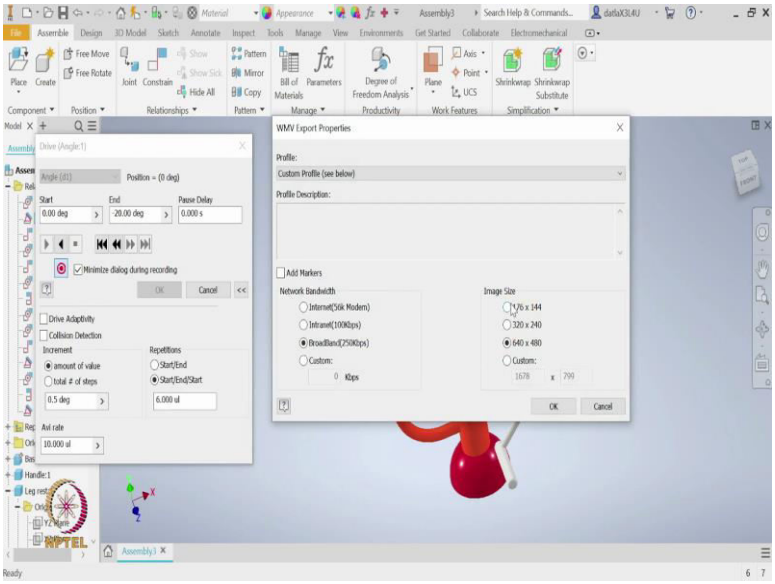

So we can choose again there's network bandwidth and image size but let us go with the default ones and click Ok. So now when I click play, it will start recording. So whatever is in the screen, it starts recording in the video. So after this animation is done, the dialog box again comes back. The file is already saved, we can go back and have a look at it.

So in summary, what we are looked in this lecture is to assemble all these six parts together to make this assembly of a horse rider thing, which is more common these days in these outdoor gyms. After assembly we will also show you how to animate it and show how it works. And in that process, you can also record it because it has that option. So thank you for your attention.