Engineering Drawing and Computer Graphics
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Lecture – 62
Assembly Drawing (Contd.)

Hello everyone, I am Gaurav Singh. I am the teaching assistant to the course instructor Professor Rajaram in this course. I am a research scholar in the Mechanical Department in IIT, Kharagpur. I shall introduce you with the assembling process of the parts that we have already learned to design in the previous series of lectures.

The assembly process consists of combing the individual parts that are usually used in mechanical designs and product assembly.

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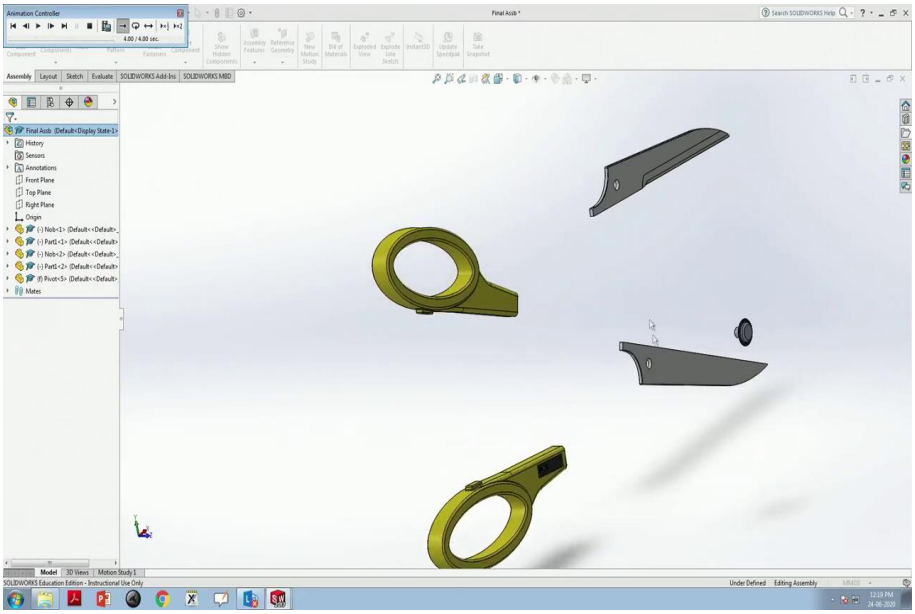

For example, we will see let us see this scissor. This scissor consists of five fundamental parts that we can see here consists of two handgrips, the blades and the pivot that makes it easier to use.

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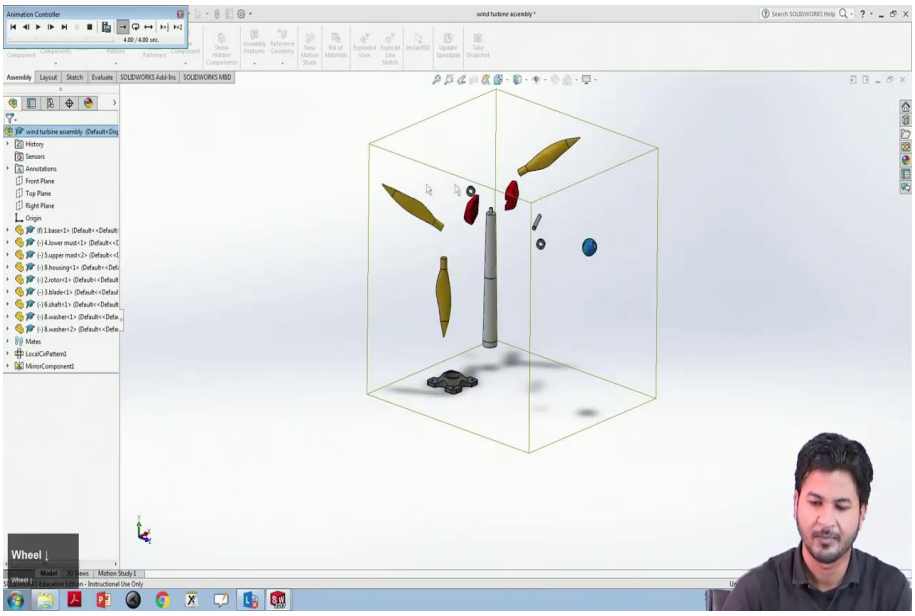

Another assembled model is this windmill. This is a very popular source of renewable energy. This model is built out of 12 design parts in this SolidWorks that we can see it like this; the blades, the rotor in the stator, the casing, the pedestal and the stand.

You can see the blades. The whole set up moving along the direction of the wind and also we can see the motor rotating as per the speed of the wind that will be coming. There are multiple such methods of assembly that which depend on the component being related to one another.

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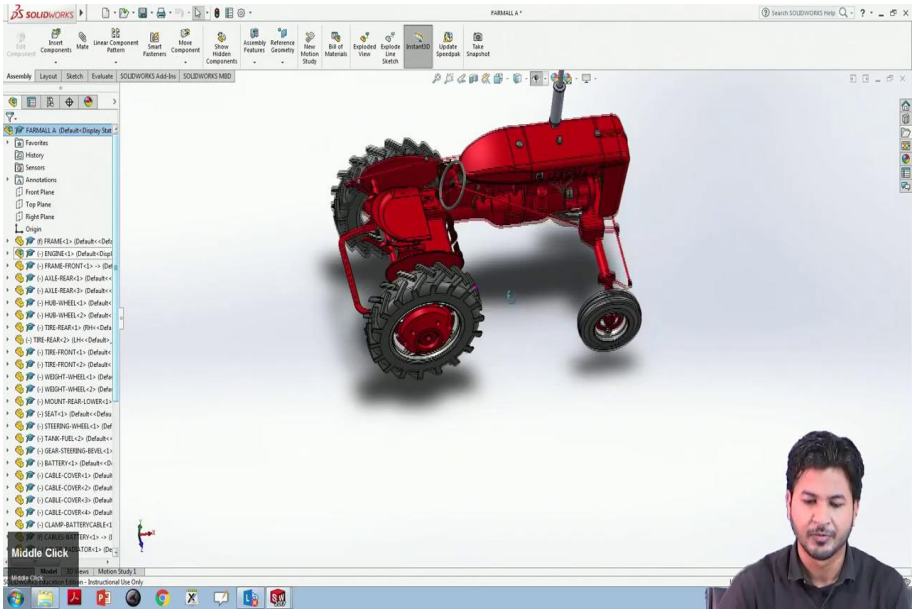

Another, take a look at this tractor. Assembling this tractor requires multiple components to be gathered each other each of which shall have a particular relationship with each other.

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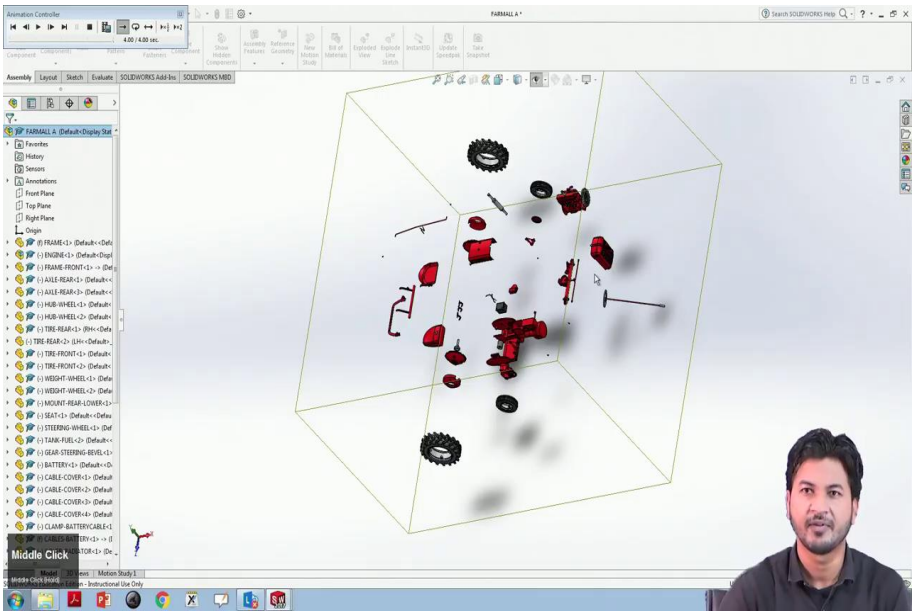

So, there are a huge number of parts included in this you can see here. This number of parts and each parts having a particular relationship with each other forms a complete tractor here in this SolidWorks model.

So, the relations that we are talking about the SolidWorks features all such assembly relations under a tool called mate. We will learn some elementary mating methods in this session. So, let us begin with this SolidWorks window. We now will open up a new document.

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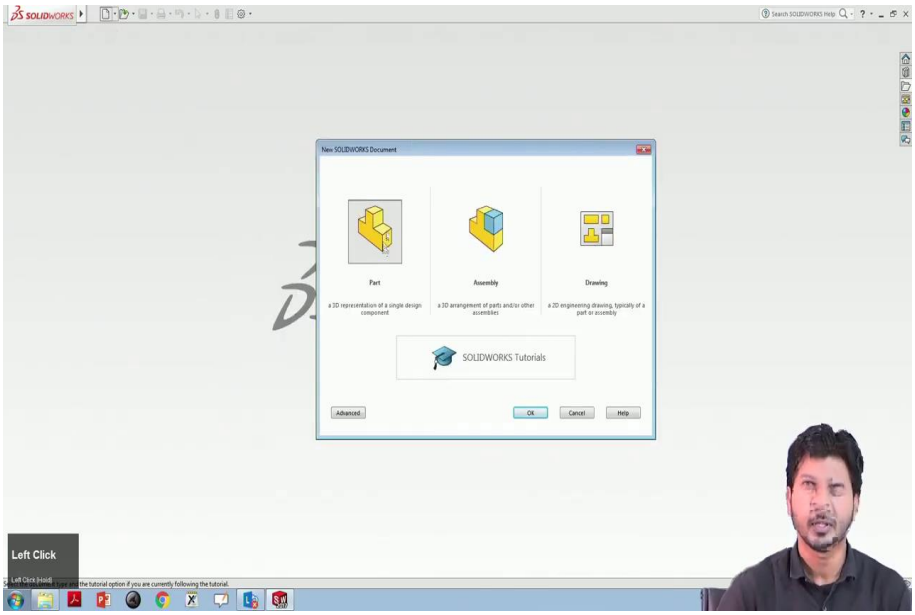

Earlier we used to work in this part section, now we will be selecting assembly. we will click ok.

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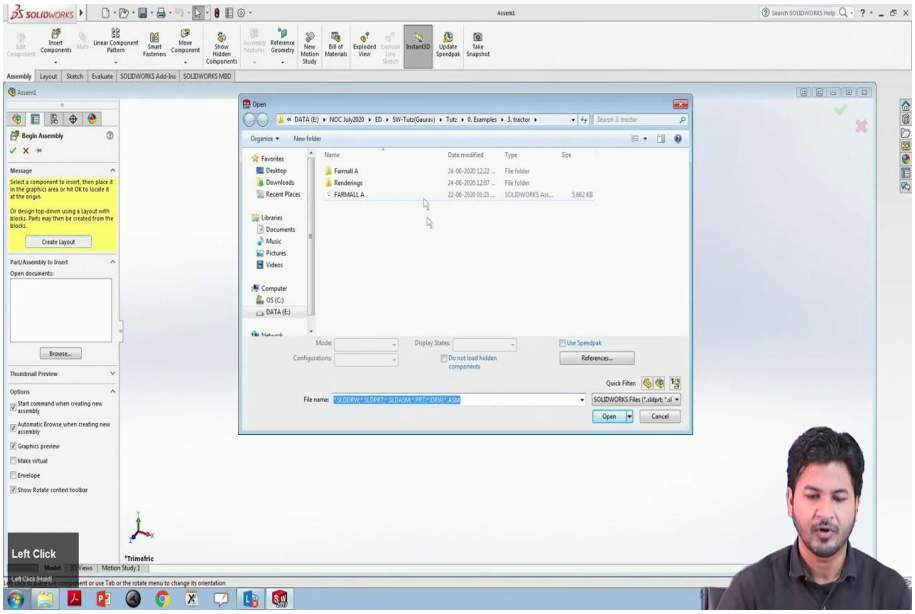

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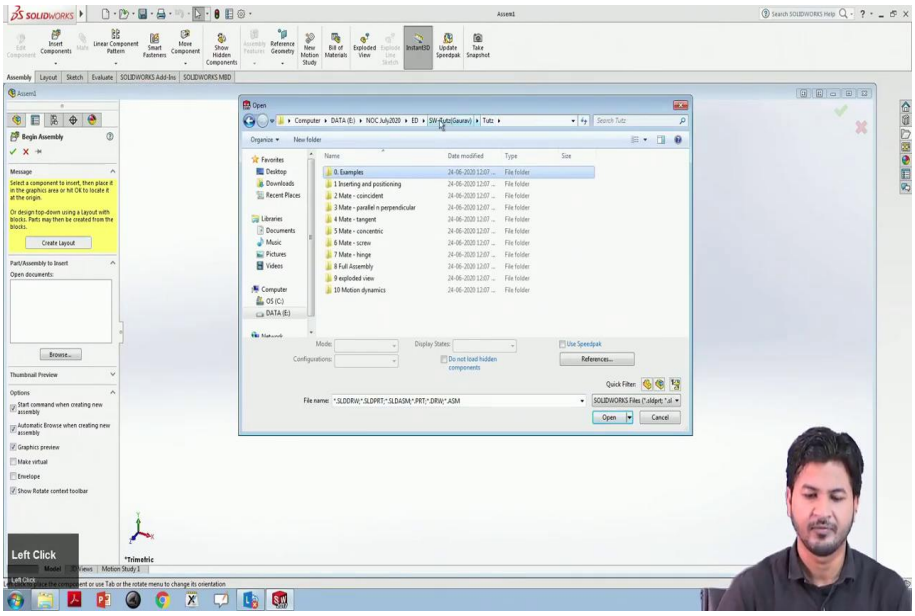

And this assembly window will automatically ask us to select the parts that have that we wish to be assembled.

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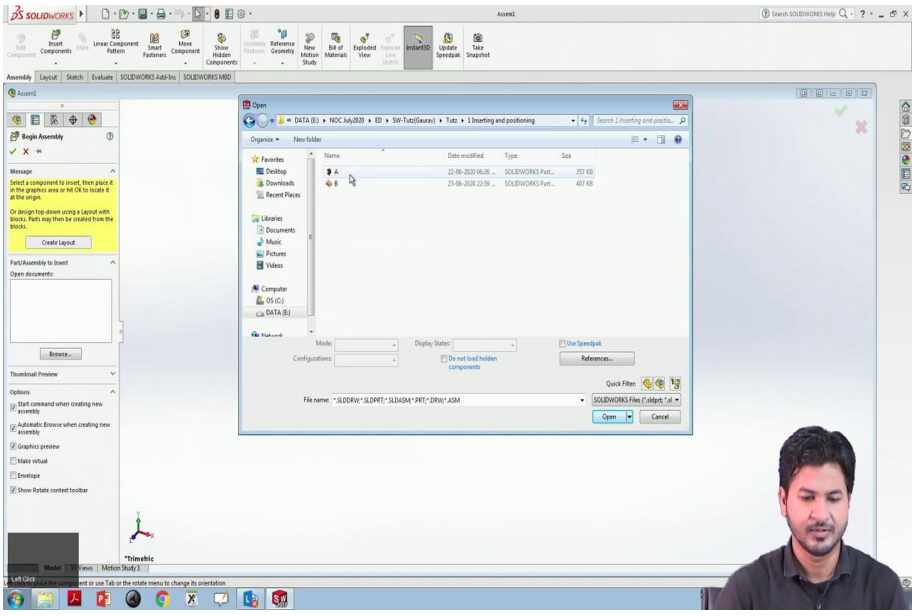

Suppose we are selecting a part.

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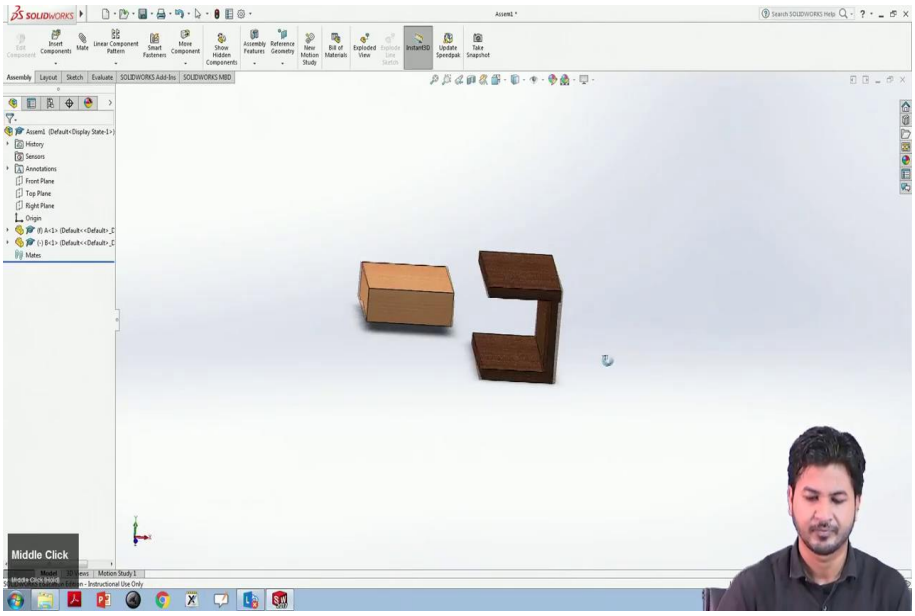

This is a block, this is now selected and clicking anywhere on the screen we will place this block as a permanent position. For the demonstration purpose of assembly, we need another part. So, to include another part in this assembly we will go to insert component right there in the right top corner. We will ask for another part to be opened. We will select another part, we will click open.

And this is the second part that can be placed anywhere in relation to the previous block. Let us suppose we will place it here. Note that there is an option called hide or show here and we can see the origins of each of the items being present here.

So, this is the origin for this block B this is the origin for block A and this is the origin of the complete assembly. One thing we can check here that selecting this block allows us to move this anywhere in the plane; however, this block cannot be moved and it is fixed.

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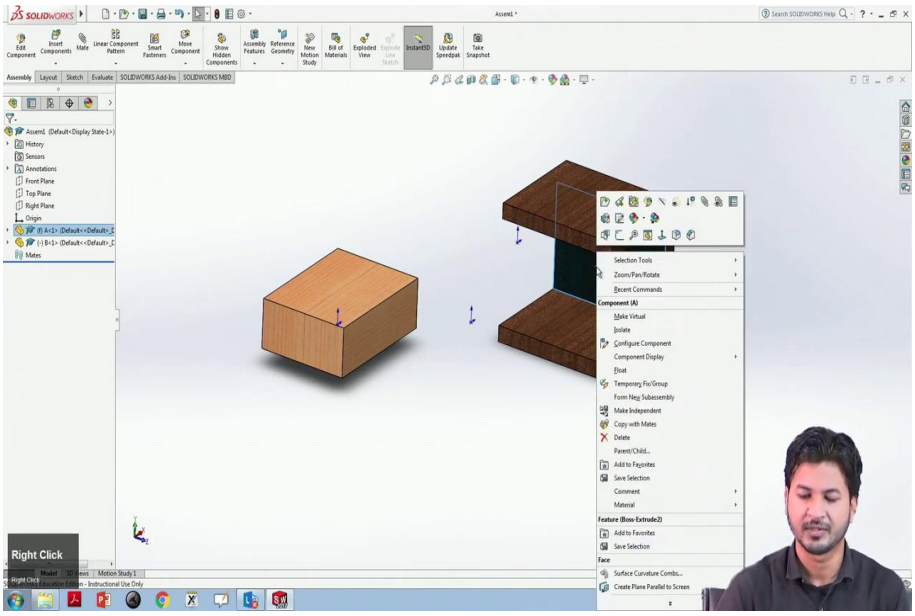

This is because we have imported this block in the very first time and this makes us this makes this block fixed in the position. So, this other assembly part may have a reference. So, we can change this; however, we will have to right-click this and select float. So, it will also be moving and in case if it is floating we can fix this. So, this will be fixed in its position and this can be made floating.

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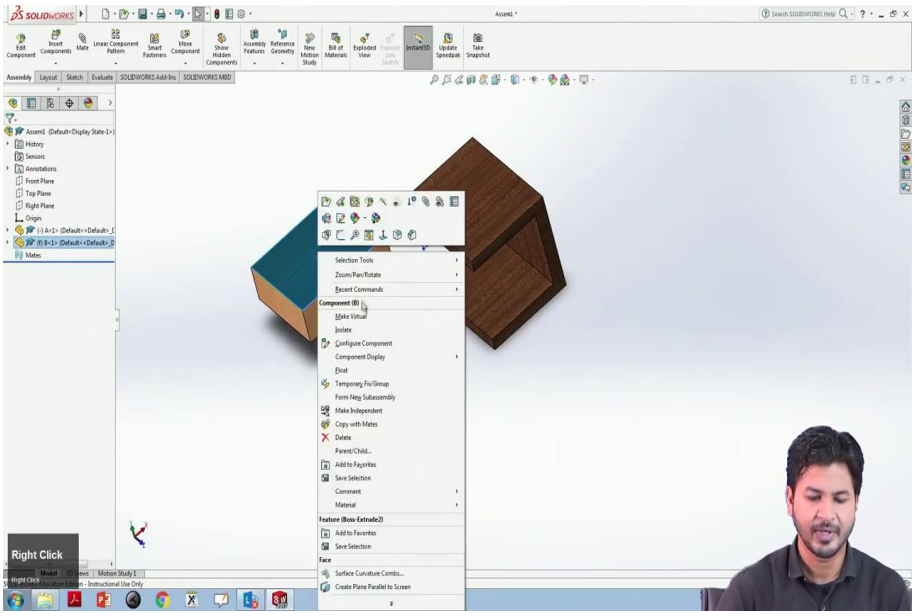

So, now, we will have to see many different mating methods that are available in SolidWorks. First is to to do such relations with there is an option called mate here.

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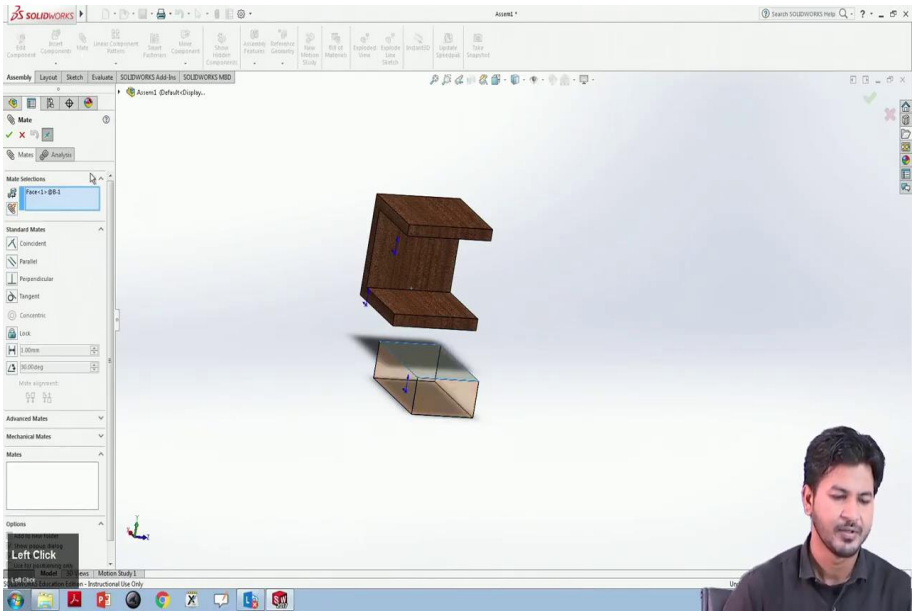

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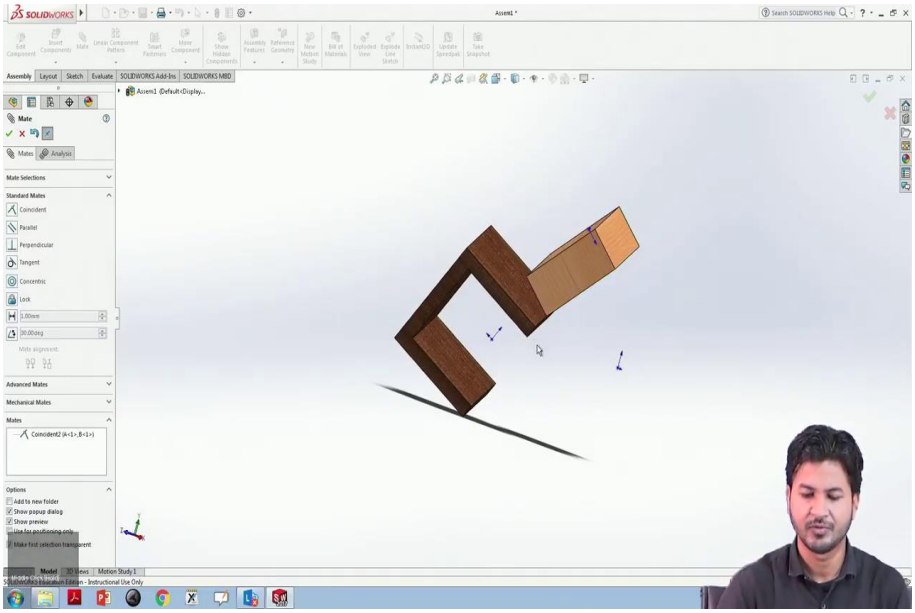

If you click on mate we can see standard mates advanced mates and mechanical mates. So, let us check the standard mates first. First of this is the coincident mate. Coincidence mate is if we in case we need any two planes any two edges or any two faces or vertices to coincide over each other we can do that.

For instance, we will select this edge and this edge, this coincides with each other and if we click tick ok, this tick mark it fixes this position as and aligns edges with each other. You can see this moving. This can also rotate, but we can see always that this the edges of these two are always fixed.

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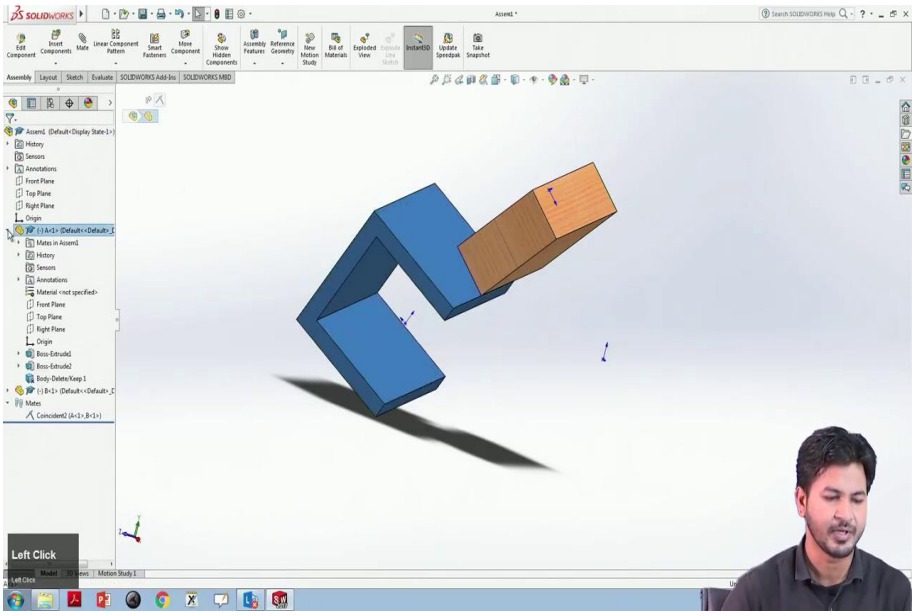

So, this is a coincident mate. If you click the mating the recent mate that we have done it can be is listed here in this mate section. This is our assembly. This blocks A details of block A, this is details of block B and this is the mating history of these the two assemblies. So, in case we need to edit it we can select right click and this first option edit feature we can edit here. Also, we can delete this mate as delete.

Once again we can see it will go to mate, this little blue tab select this and if you want to mate this say this face to this face and we will click ok, we can see these two are aligned with each other. So, let us move onto the next kind of mate that is we will see here on the list that is parallel mate.

With a parallel mate, I need two planes or vertex can be made parallel in relation to each other such as we will select this particular face and say this particular face and we will click we can click ok in the mini toolbar here as well. You can see these two faces are always parallel to each other.

Similarly, we can work on the perpendicular mate as well. So, there is another shortcut method for doing this kind of mate is we can select directly select the two options the two faces or the vertices that we want to mate. You can select these two and say this face.

Now, we have control selected both of these as 1 and now we can go to mate, this will give us the option to select any one of these. We will go to perpendicular and click ok. So, the two faces that we selected are now perpendicular to each other. So, anywhere we move in this coordinate plane they will remain perpendicular in relation.

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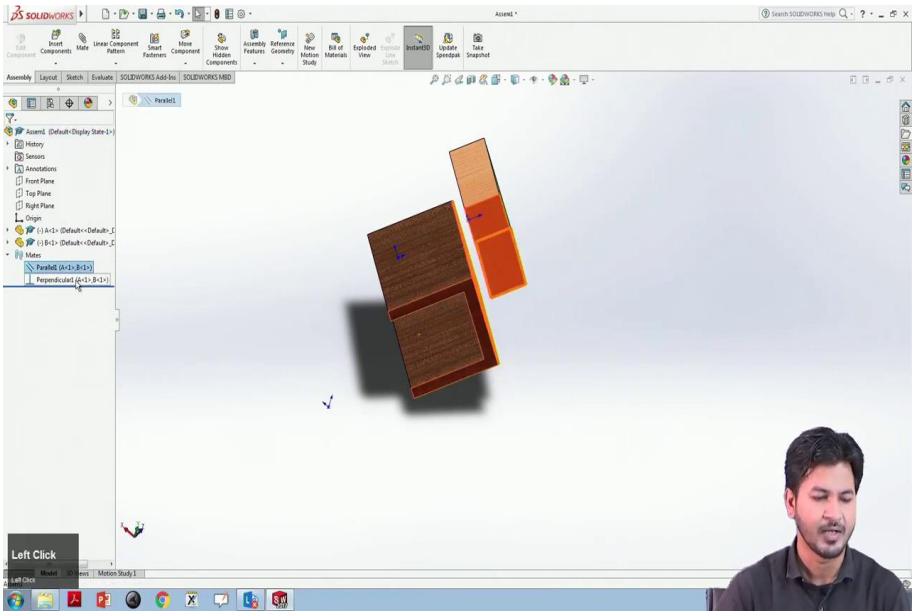

So, in the mating history, we can see these two planes are parallel with each other and these two planes are perpendicular with each other. We can delete each of them one by one.

Now, we will see the next one that is tangent mate. So, for a tangent mate, we need some curved geometry. So, we have to remove these already these parts.

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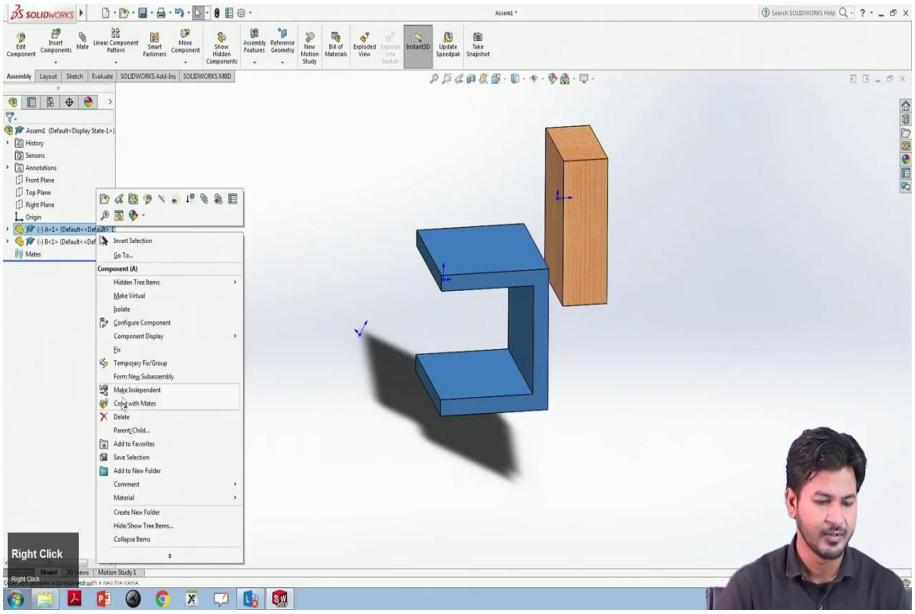

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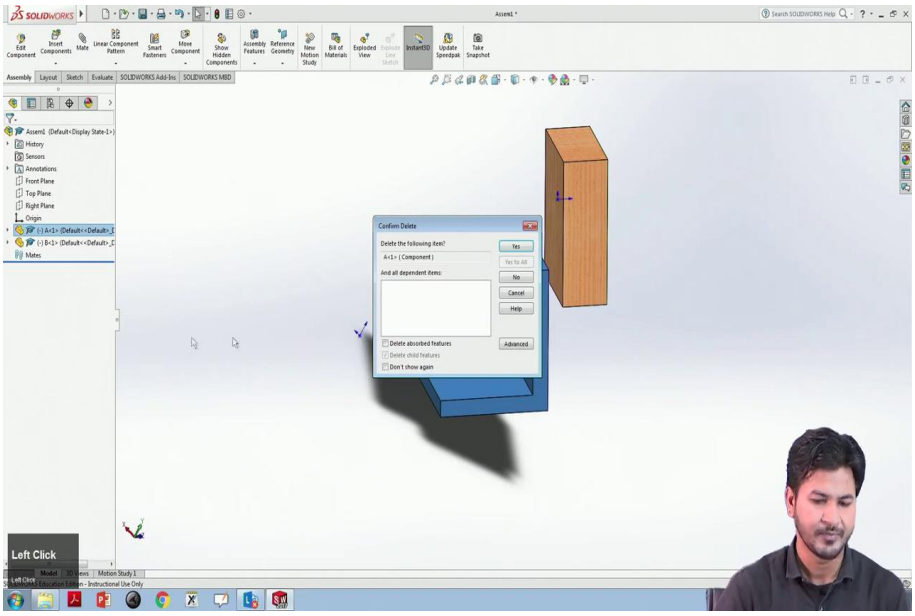

And we need to import some curved geometry. To remove these parts we can directly select the part this A that will select the complete block and we can right-click, delete and we will select ok and for block B we will select B and we can directly press delete or yes. So, now, to import a fresh geometry we will go to insert component. We will select some geometrical circular geometry or geometry with curve.

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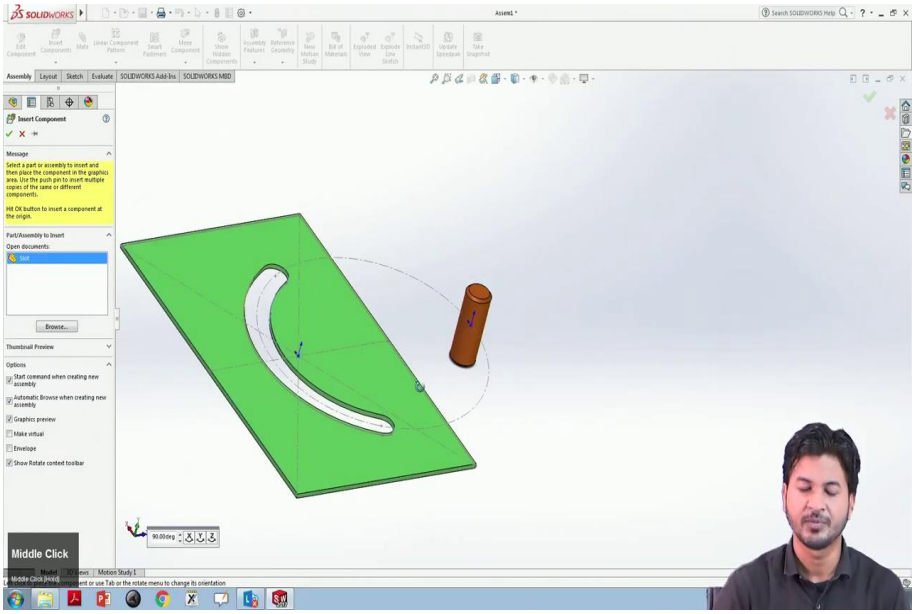

We will work here with pin and slot kind of example. One thing we can note here while importing the geometry while we have activated this view origins we can directly if we wish to import in the plane geometry plane origin we can directly import the part to have the plane origin.

So, now, we will go to insert components. Now, we will see a pin and slot kind of example. One thing we can note is that while importing the geometry we can move anywhere in the plane and while we have activated this feature of a view origins we can see the origins of both the parts and the assembly.

And we can coincide both of them each at each to each other while coming in proximity to each other. So, the part this is part 2, this is the slot.

You can see here this pin is supposed to be within this slot that can be moved within this slotted the slot path. So, if you take a close analysis we can see that this surface is geometrical this is a cylindrical surface that has a circle in cross-section and this is a path.

So, to make allow this to move into this slot, this particular slot path is supposed to be tangent on this circular cylinder. So, if we want to demonstrate this tangent mate we will select this surface and this slot path holding the control and click on mate.

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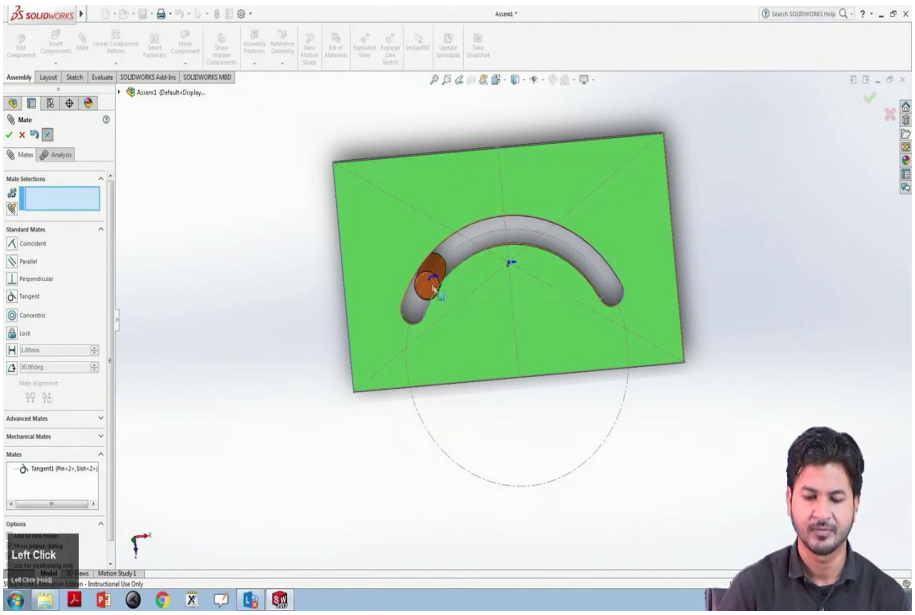

So, we will select tangent over here and click ok. Now, you can see the two components assembled in a way that does this slot surface is tangent to this cylindrical surface. You can see this. You can see this moving. As I have already told you the first item that we bring in remains fixed and the second item can be moved.

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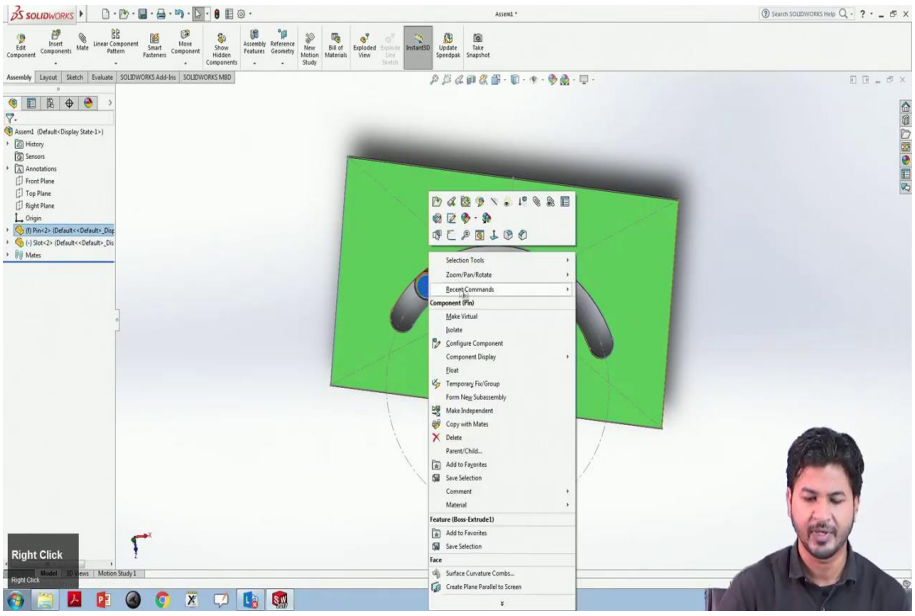

So, this green slot is moving however this pin is fixed. We can do it otherwise. We can right-click on this pin, we will make it float and we will right-click over the slot and we will make it fixed.

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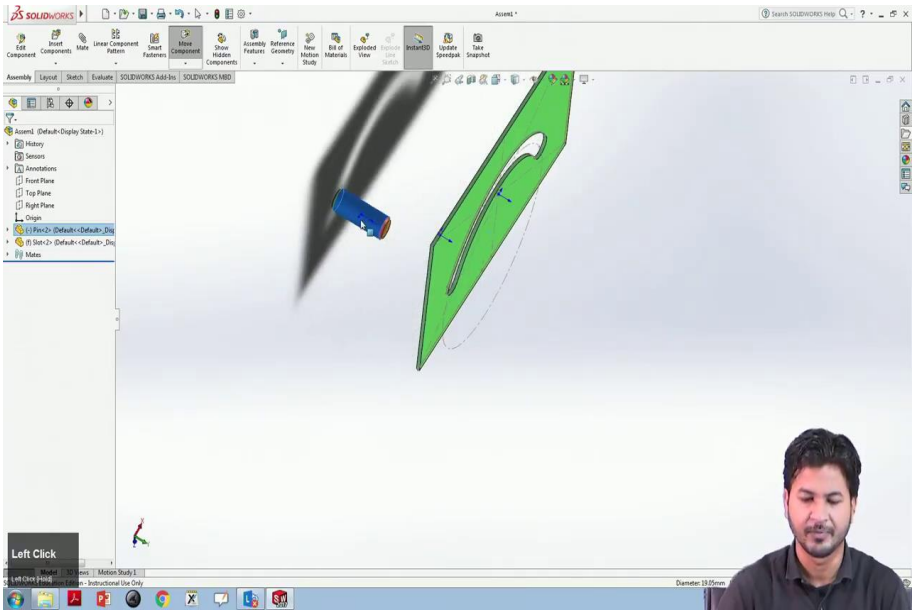

So, now we can see you can see this pin to be moving while this slot remains fixed. Note that the only relation we have made between these two is the tangent relation. So, this plane is free to move in other degrees of freedom. To make sure this plane remains in this slot we need to make some other relationships as well.

To do this what if we select coincide the plane of the slot and the plane of this pin to each other? Then it will ensure the pin to remain in the slot only.

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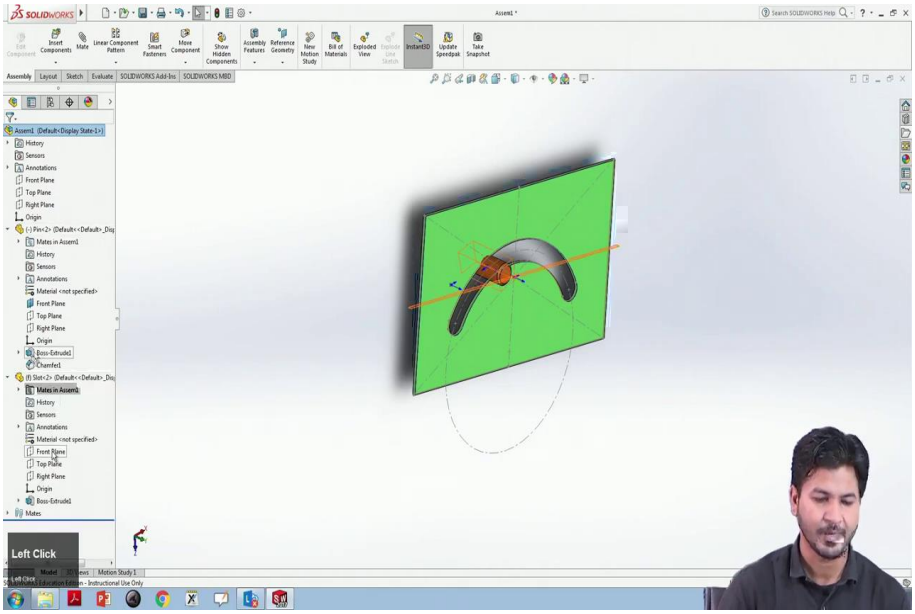

So, we will here we can see we have the details of the pin and here we have the details of the slot.

So, if you select the top plane for this pin here we can see. And if we select the top plane of the slot and we control to select the top planes of both of them and we will click on mate and select coincident mate ok.

So, now, it remains in the centre and it is free to move within the slot and it the other degrees of freedom have now been constrained and it this cannot move to each other. So, now, this is good and fine moves within the slot. So, this was the demonstration for this tangent mate. The next kind of mate we can see here is concentric mate.

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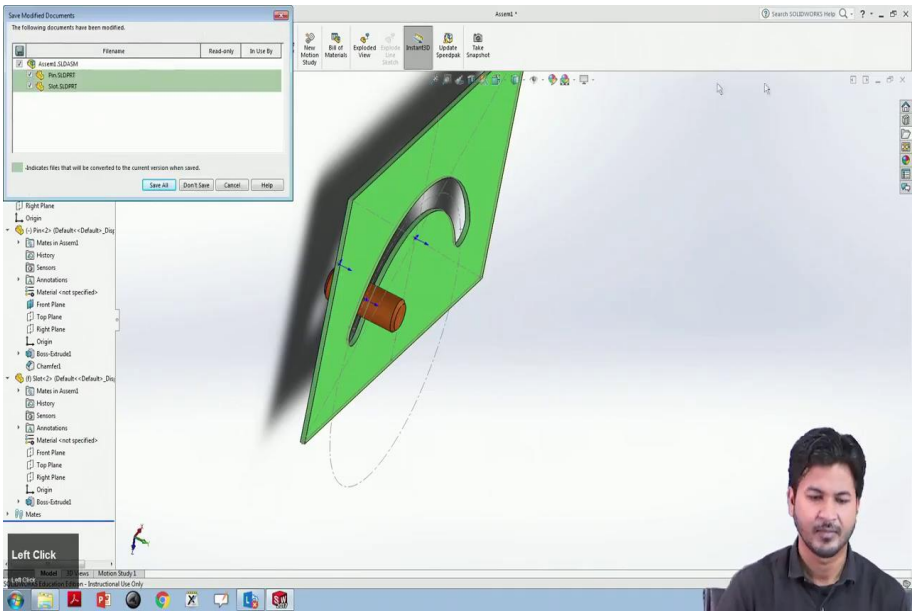

So, for a concentric mate, I would like to import some other geometry. Open new document assembly.

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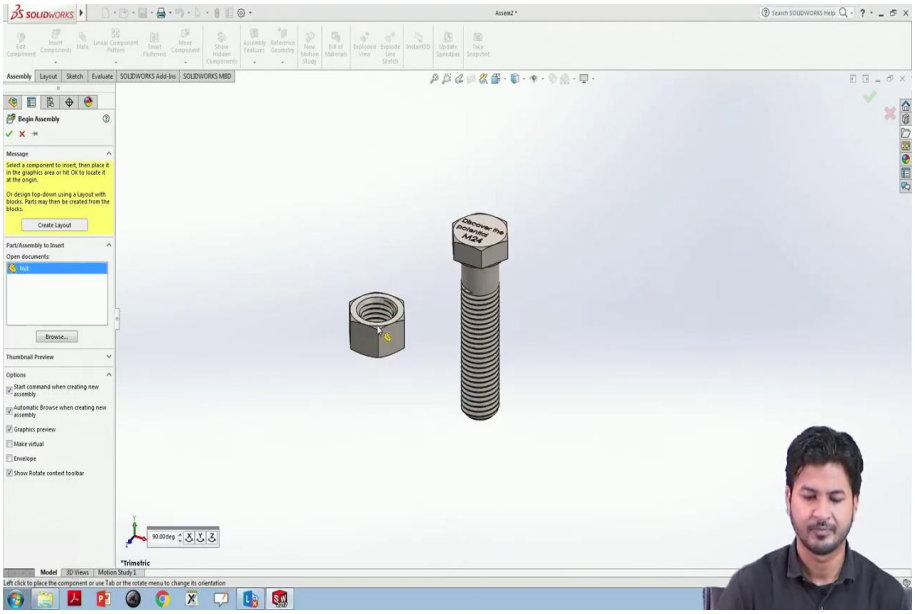

I will be importing one a bolt and a nut.

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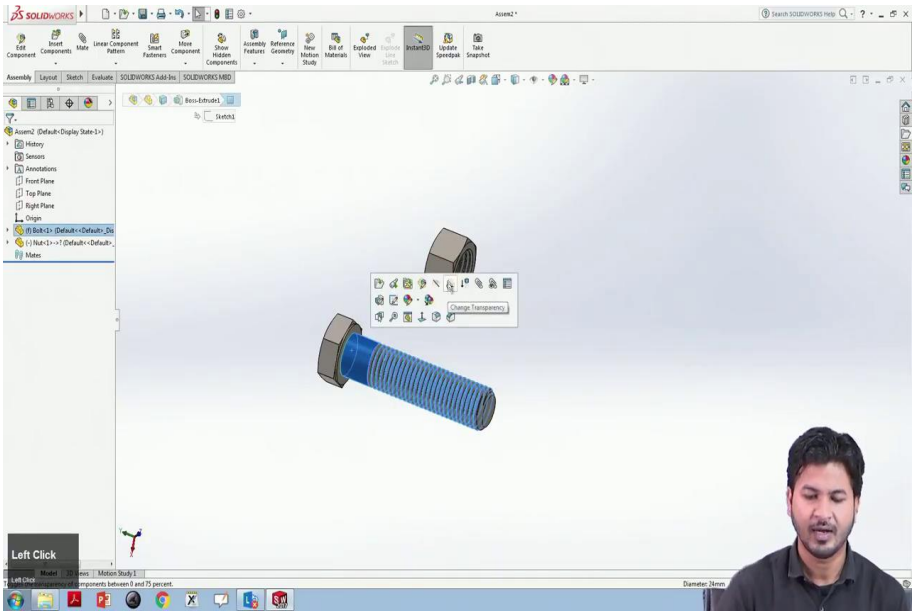

o, by intuition, we can see the relation between the bolt and the nut is supposed to be concentric over one another.

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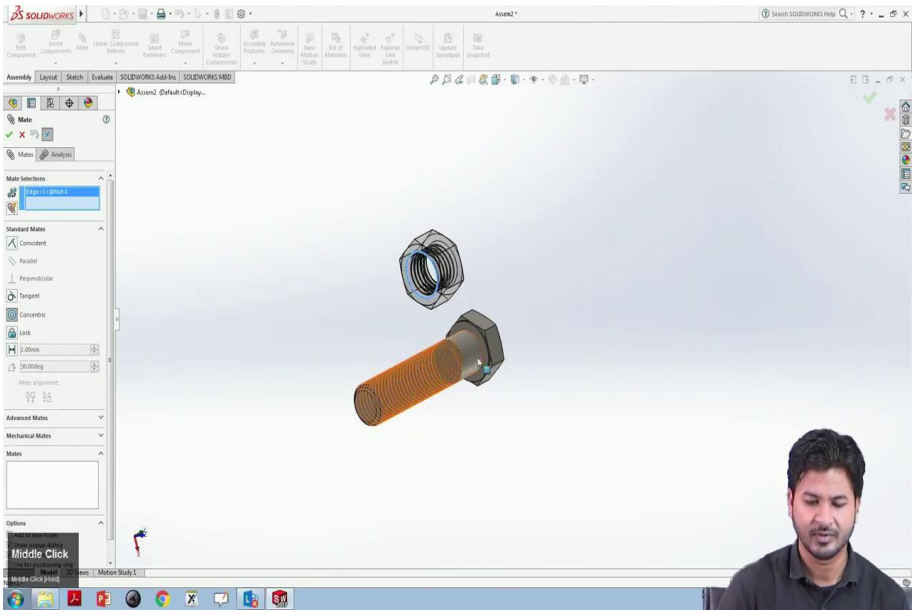

So, we will go to mate and select concentrically. So, the two we need to pick up two circles that need to be concentric over each other. We will select this particular edge and this edge and we will click ok in this mini toolbar. Now, we can see this is concentric to each other. So, this is this kind of mating is called concentric mating. We can see here.

In continuation with this we can we need we should assemble these two nut and bolt in a relation that it should because it had threads it should roll over each other and uncover this thread one by one. So, could do this kind of mates these are these come under mechanical mates. We will go to mate.

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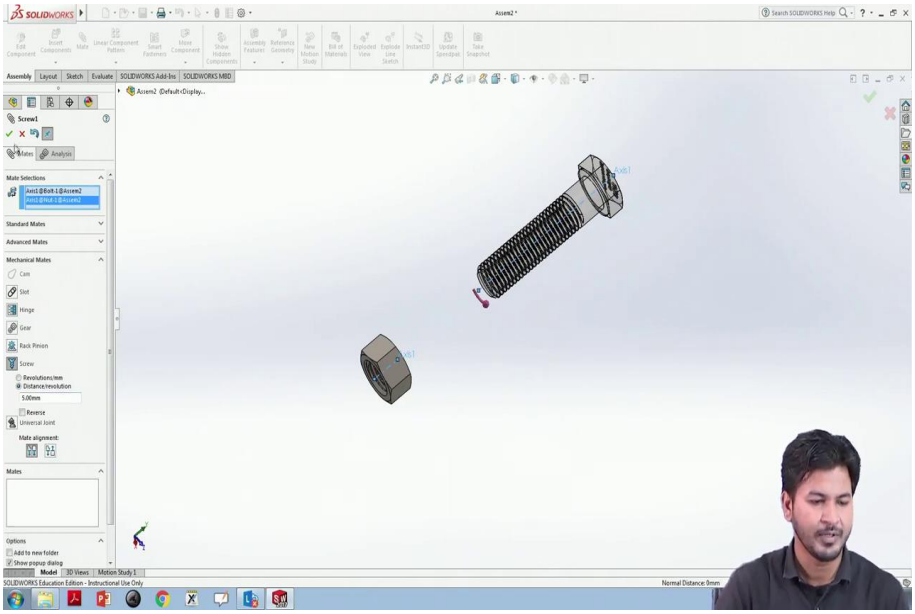

We have just finished this standard mates we have now these mechanical mates we will select this screw. This mates selection for this the screw needs the access of this the two nuts and the bolt to be aligned. For that, we will go to this visibility hiding and show. We will select this view axis. You can see the axis of both of these.

Now in the screw mate dialogue box, we will see we have to select this axis of the bolt and also the axis of this nut to be aligned. Now, this other option that it demands is we can set the revolution per minute for this screw this nut to be tightened or also we can enter this distance per revolution. So, let us enter 10 say 5 mm per revolution. We click ok.

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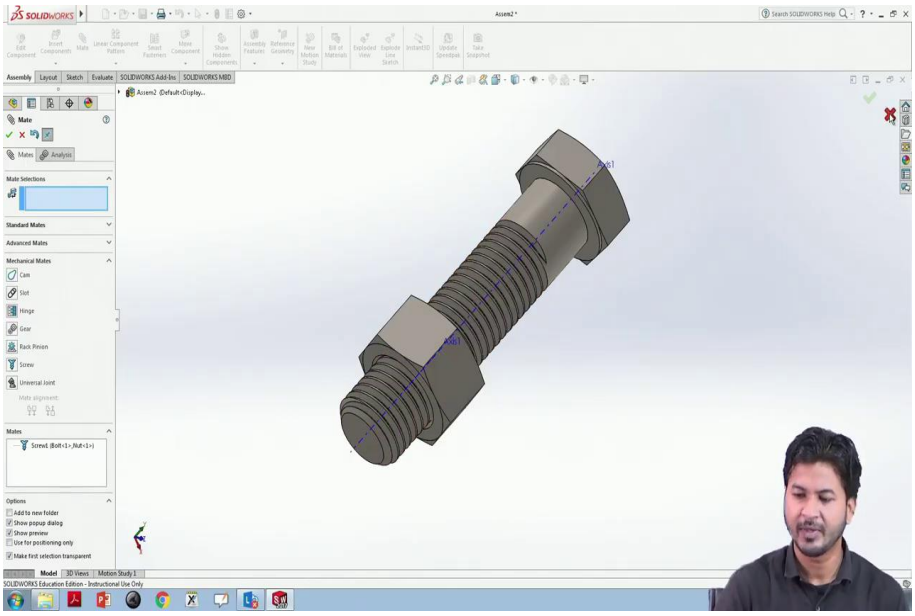

So, as we move this we as we evolve this nut we can see this moving forward or opening it outward. So, we will revolve it like this per revolution it moves 5 mm forward. So, now, it enters the bolt and we can see this see the threads uncovering one by one as the nut revolves into the bolt.

This is a very important kind of mechanical mate very frequently used in assemblies. You can also see on reversing this direction this opens the nut out of this bolt. So, this was the screw mate that we have worked.

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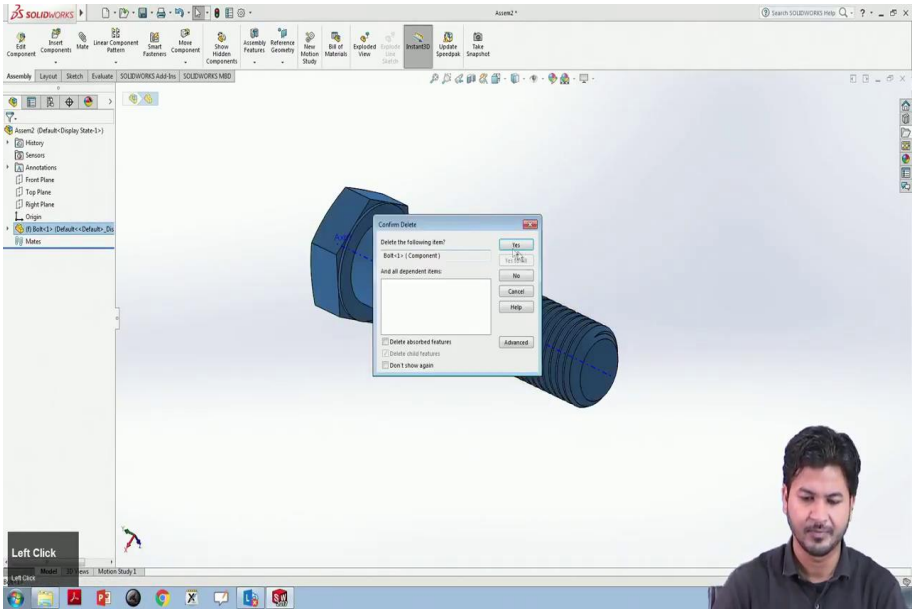

Another mechanical mate we will work on is hinge mate. For this, we need some other geometry. We will delete this nut and the bolt as well. We will insert components.

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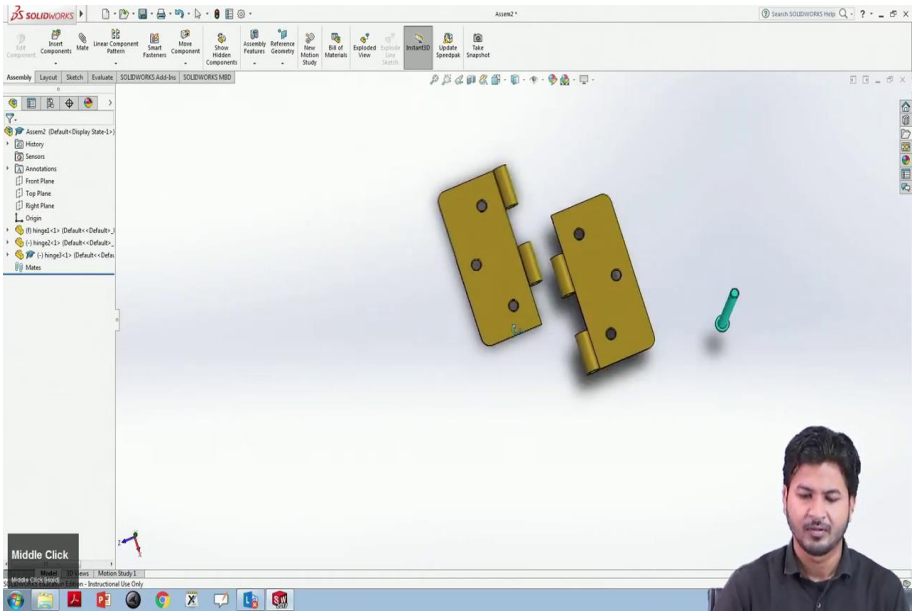

This is a very typical hinge example that is used in general in windows and doors. You can see it here. So, by the first prima facie we can easily guess that these two-part has to be fixed over here and this nut would ensure their fixation.

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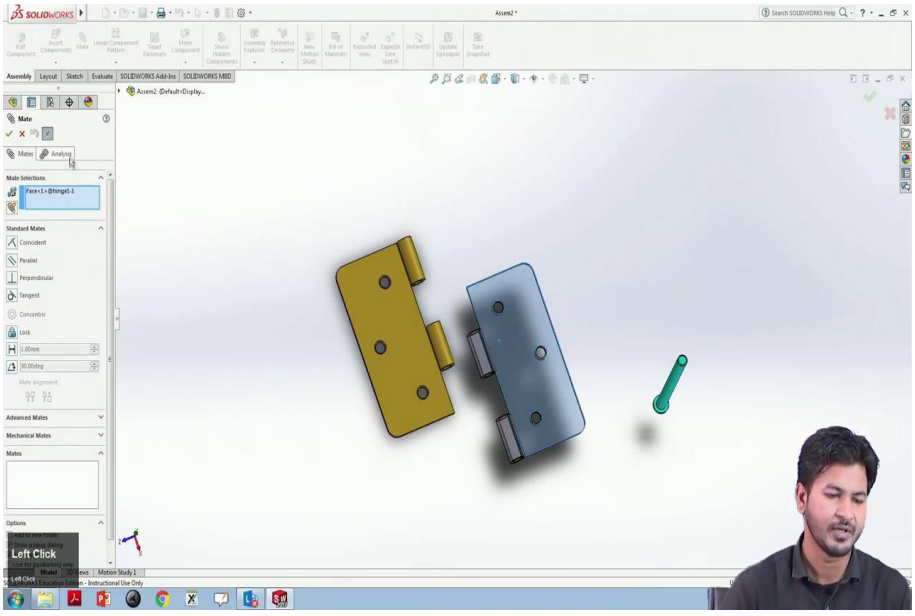

To do this kind of mate, we need this because these are supposed to be hinged to each other. We will go we will select hinge mate that is available under mate and mechanical mate. We will select hinge.

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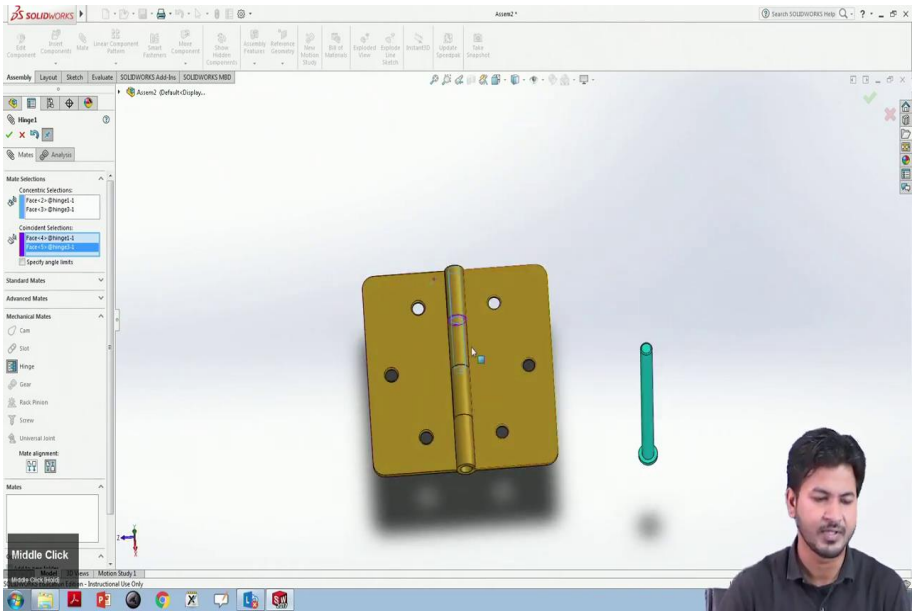

So, now under hinge, it gives us to select two a small little windows that are concentric selection and coincident selections. For concentric selection we wish to have this particular face to align with this face as concentric and the faces to be coincident are this face and this face.

So, now, we can see it has automatically detected the faces and the concentric inner surfaces and it has aligned the two. This hinge mate also allows us to specify angle limits.

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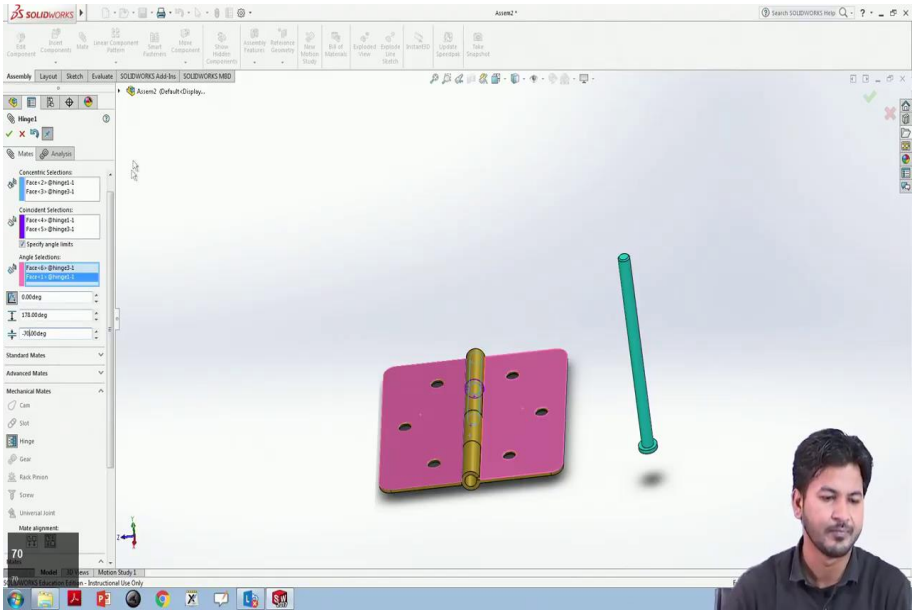

Then we can check a tick mark here to open this dialogue box.

So, the first window asks the two planes that are to be for which the angles are to be specified. We will select this and the two planes that we need angle between with is this and this plane. So, if we increase this current angle this is the present angle. If we say this is 70, you can see this moving by 70 degrees. So, we will keep it at 0 for now. This is the maximum value that the maximum limit, that this angle can go. Let us make it 100 say 78. And for this minimum value, this could go to minus 70. We will click ok. So, now, this hinge mate is complete and we can check for the angle limits. This is moving this completes 170 degrees, 178 degrees and in the negative direction, this is minus 70 degree; maximum value and this minimum value.

So, to complete this we can you can just guess what a mate is supposed to be done or this nut and this hinge selection. So, we can easily guess this is supposed to be concentric mate. To do this we will select this face and we will select control select this face and we will mark.

We will go to mate, it has already detected this concentric relation. We will click on ok.

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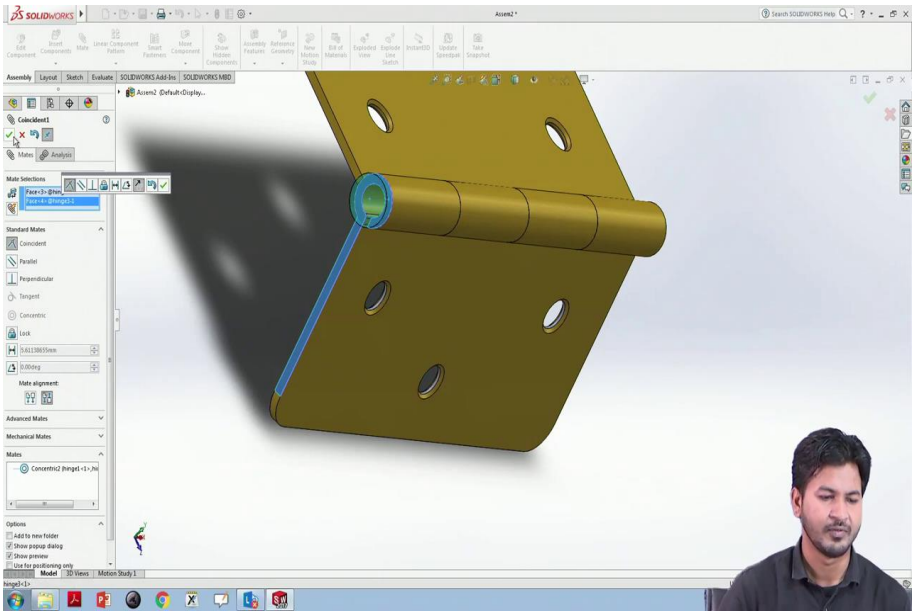

However, this is free to move in this direction. We can fix this by mating coinciding the two faces this and this with each other. We will click ok. So, now, this is the complete model for this hinge.

So, we have seen here this hinge mate. So, we have seen different kinds of elementary mating methods for that generally used in assembly. In the next lecture I will go with the I will use all of these assemblies to make one full assembly that is single cylinder piston assembly and we will see all of those examples and we will apply those in the full assembly.

Thank you.