Glass Processing Technology
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Lecture - 26
Tempering Part III

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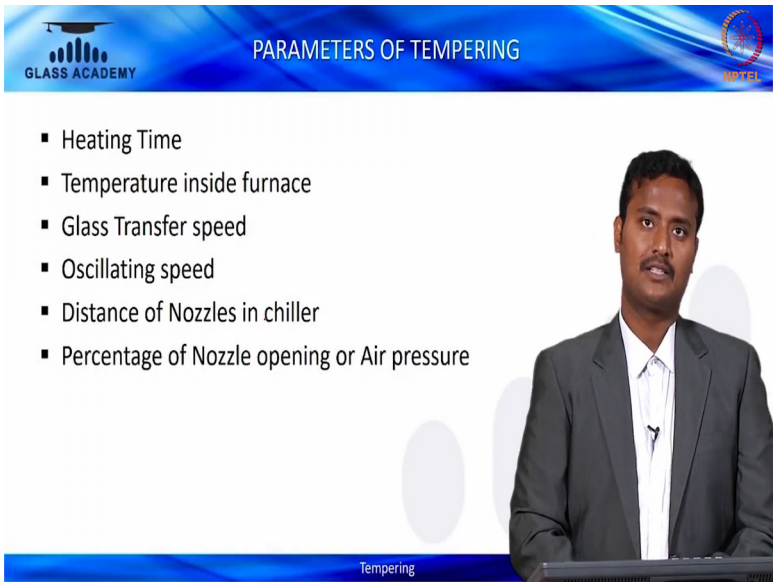

Yes, let us move on parameters of the tempering. This is the most important part in this tempering process. If somebody is understood: what is exact parameters of tempering for example, if it is you are the operator for tempering furnace, you should know first these are the basic six steps to be you know studied first, what recipe has to be made for particular glasses. The one recipe would not be used for all the glasses because all the glasses would be vary. So, let us look at it in a different aspects let us see.

So, parameters of tempering let us start with the heating time temperature inside the furnace, glass transfer speed, oscillation speed, distance nozzle in chiller, percentage of nozzle opening on the air pressure which talking about. So, these are the main parameters of the tempering.

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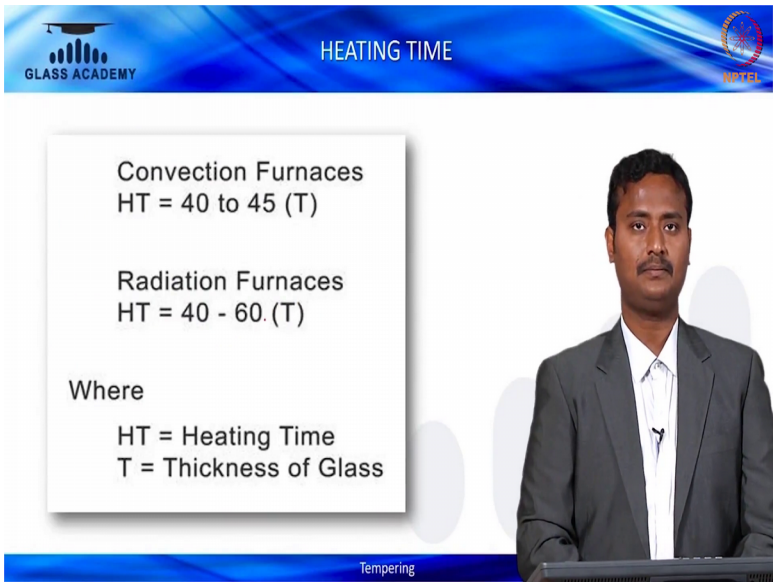

Let us move on heating time, if you are using the convection furnace heating time would be 40 to 45 times multiple of thickness of your glass. Radiation types if you use it, 40 to 60 time which is T nothing, but the thickness of the glass HT which is nothing, but heating time. So, this is the thumb rule basic principle, but accordingly if depends upon the glass output.

You have to change the recipe the heating time accordingly, but when you enter when you start testing, it you should know how much normal heating time can be fed as a 6 mm, 8 mm, 9 mm. So, basically you have to multiply in to the thickness by heating time. So, that is a first simple process we should understand about this heating time.

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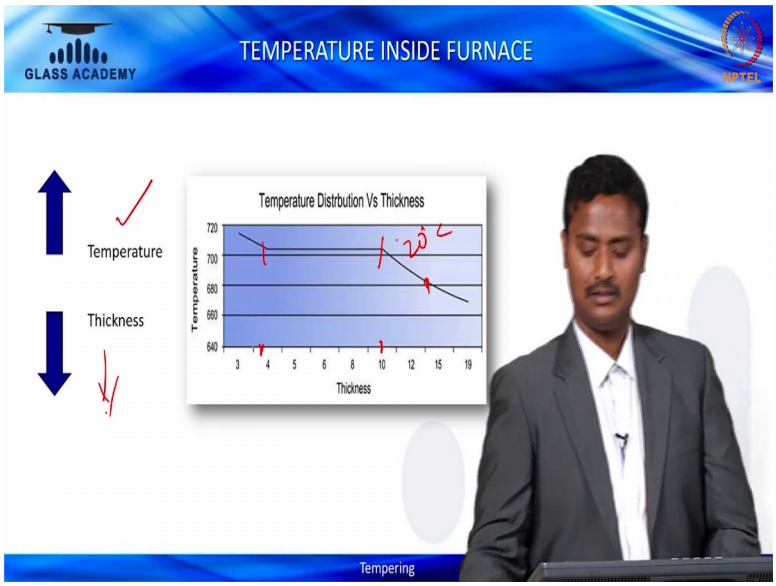

And temperature inside the furnaces, when the temperature goes is up thickness is down. You see this carefully you see that which the graphs the 4, this is the I mean 4 and 40 will have a range of 700 to 700 degree centigrade means move on 12th thickness of 12mm glass is basically 60, 80. There will be a reduction of 20 degree centigrade. So, basically when the thickness increases sorry in the temperature increases, thickness will decreases. So, that is the schematic diagram which helps us to understand further about this.

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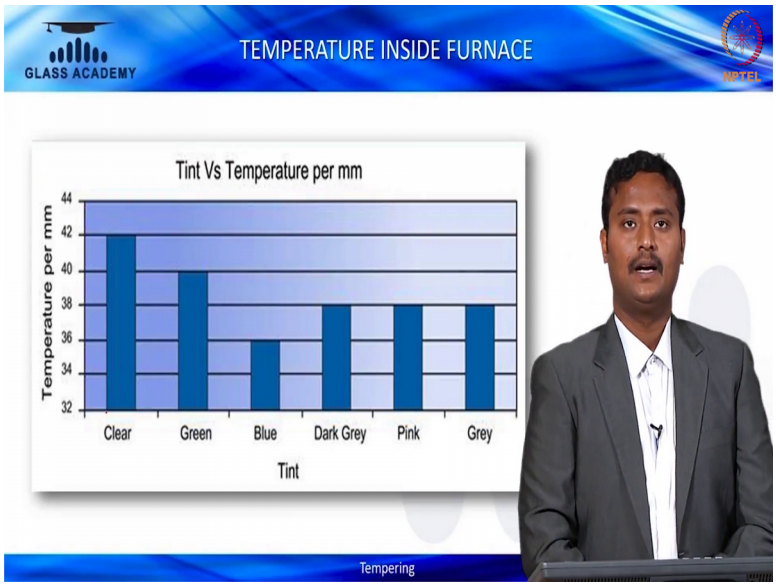

And again tint vs temperature per mm. Clear glass will be a temperature per mm at 42

whereas, the less is to blue. So, again these also furnace to furnace vary, but this is the basic principle which we can apply for glass. Basically, what why we have to understand this? If you use a clear glass what kind of temperature per mm you have to put. If use a green base as a substrate is a different, clear glass will be substrate green glass green base is substrate blue is again there will be a difference surface I mean substrate. And dark grey is then again other substrate and grey the other substrate pink as well. So, basically that the different colours would behave differently; so, basically if use the proper recipe will thereby you will get a proper result.

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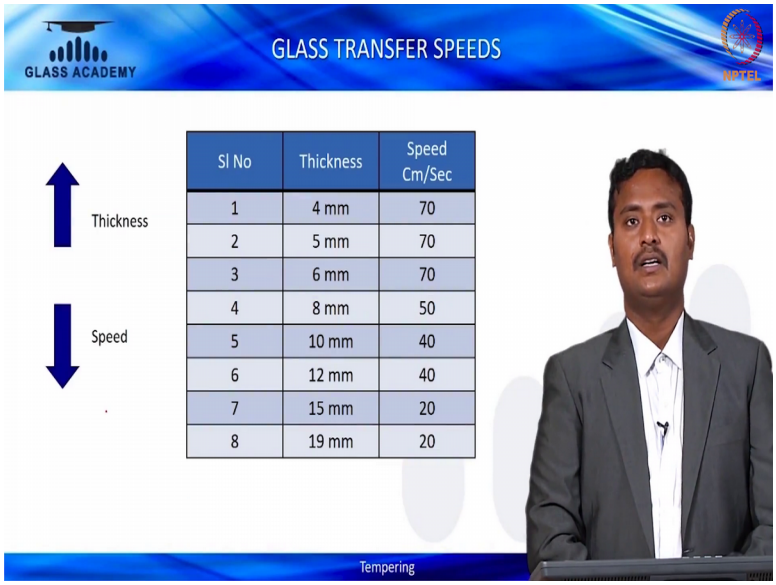

So, glass transfer speed when the thickness goes I mean increases, the speed is decreases. For example, 19 mm of thick glass you have to transfer the speed from one place to other which means loading table to this furnace, 90 19 mm we are using it. So, which means you are speed is 20 centimetre per second which you have to use whereas, 4 mm will be 70 centimetre per second. That is what you have to understand.

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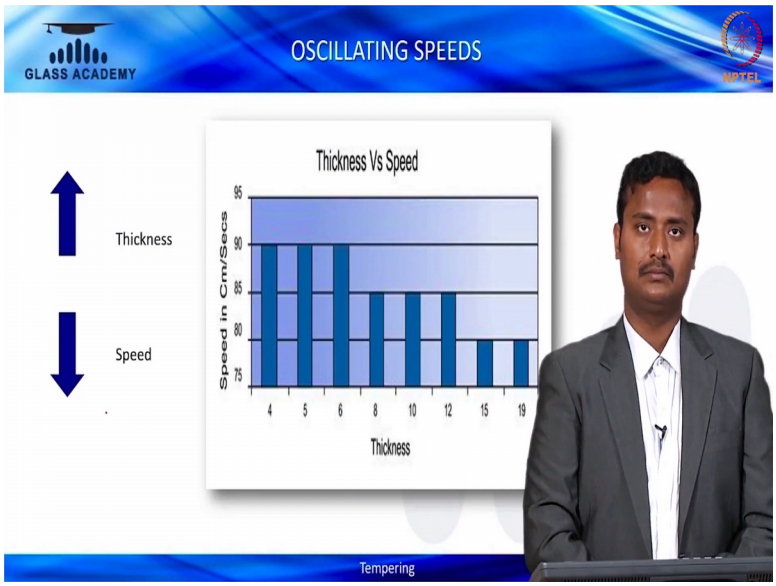

Oscillation speed which is inside as well as inside the furnace when the thickness increases; the speed is decreases. For example, 4 mm speed in centimetre per second is 19 centimetre per seconds whereas, 12 mm 85. So, there will be a 5 centimetre per second is varies the speed.

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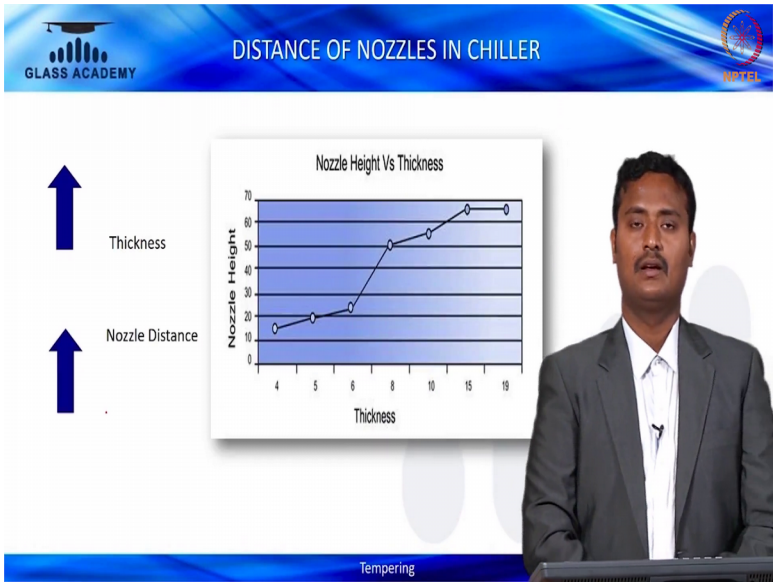

And again nozzle distance of chiller when the thickness is increases the nozzle distance as well increases. You can able to understand from the graph; from the left hand side nozzle height, the bottom side the thickness x axis. You can see that.

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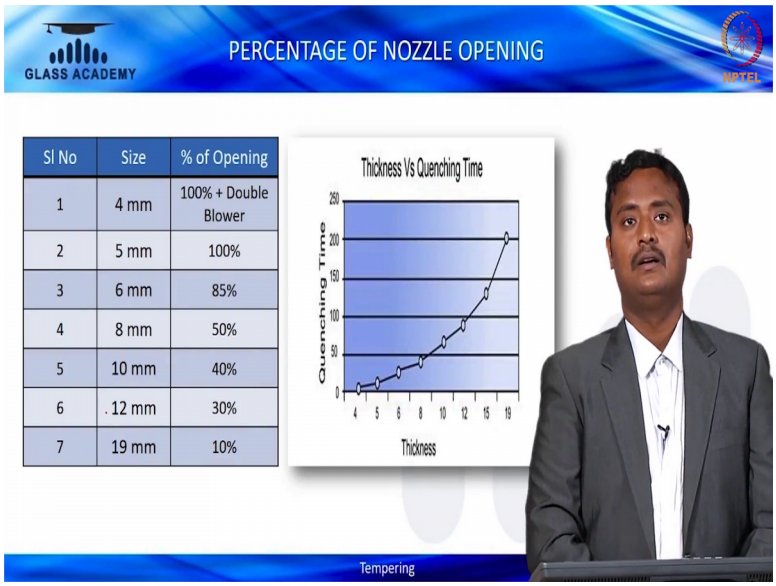

Percentage of the nozzle opening the 4 mm, it is 100 percentage double blower. We have to use it because the lesser thicknesses would absorb the more heat faster. So, we required percentage of opening will be higher whereas, 19 mm 10 percentage, but the durability of quenching area time is increased whereas, the percentage of the opening will be less.

The thickness 19 mm thickness 10 percentage of nozzle opening is sufficient whereas, if you use 6 mm normally, if you use the 6 mm, we have to use 85 percentage of nozzle opening in if you want to have a tempered glass. Whereas, if you want have a heat strengthened glasses, you have to reduce further. Let us move on bending and tempering process.

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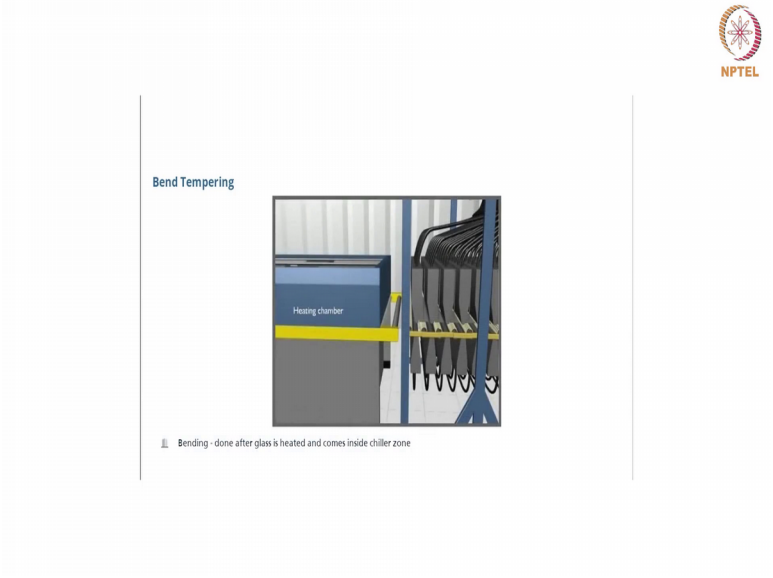

Now, so, far we have look at the flat tempering process. Now we will move on to bend tempering process. So, this is all together different, this cannot be done on the flat tempering process where this quenching session chiller portions will be completely different than the horizontal tempering.

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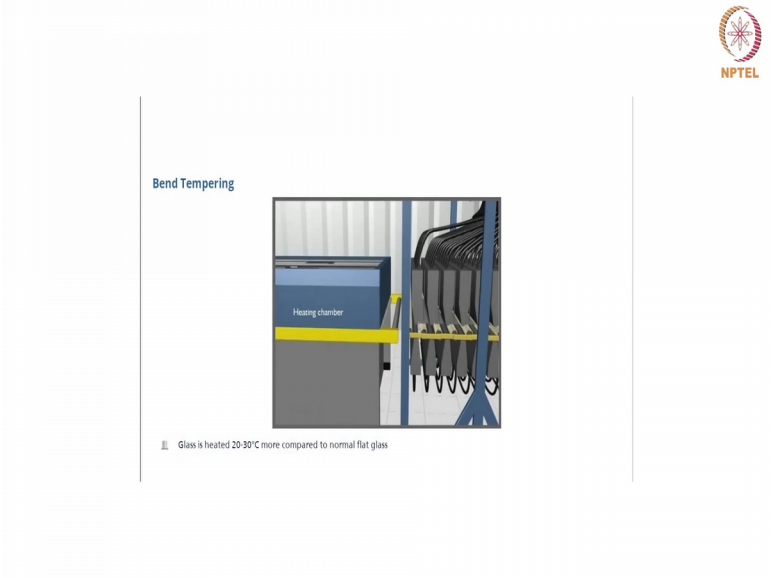

So, heating chamber the heating is uniform process which is will be nothing there is no changes at all in the heating process, only changes in the quenching cooling session alone.

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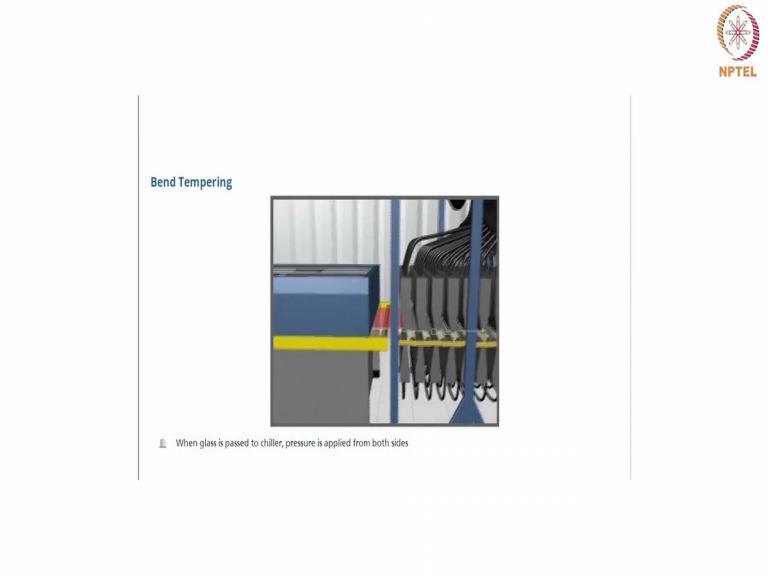

So, let us move on this. You see would have seen that there is a chiller portion which having lot of fixes.

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Like it is a movable, flexible fixes over there.

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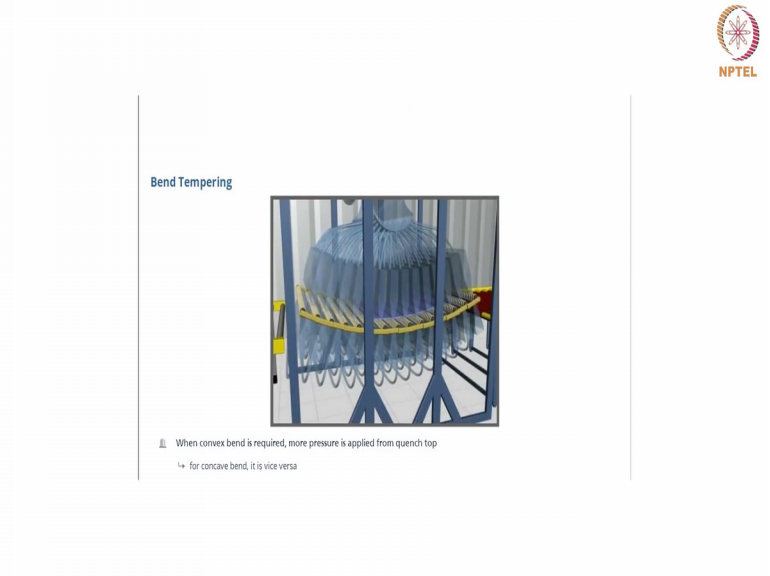

Where this is the glass has been you know comes into from heating chamber to this chilling chamber, I mean quenching chamber where this there will be air pressure has been applied with the help of the air nozzles over there and depends upon the bend dimensions.

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You have to do you know lift it accordingly; the machine can be altered based on the setting. So, basically this is not a flat that the heated up in the glass. Then once comes here, then based on the size of the pent whatever you wanted accordingly you have to

change. Basically this is without tool you have to change like this and you have to put the more temperature I mean put the more air on the top and bottom thereby getting the tempered bend glass. You see the bend glasses happening process happening like this. This is type of convex which taking place here, it's comes out after tempering will be unloading table.

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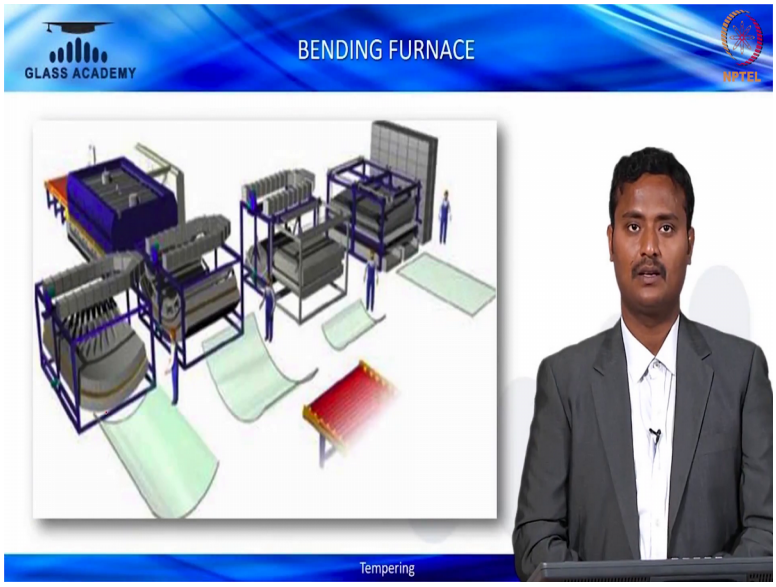

So, the flat tempering flat tempering as you saw the second picture is bend again further, then this way also. So, different types of bending furnaces are there earlier. So, this is the tempering furnace you know, schematic diagram which is help us to understand the bending process.

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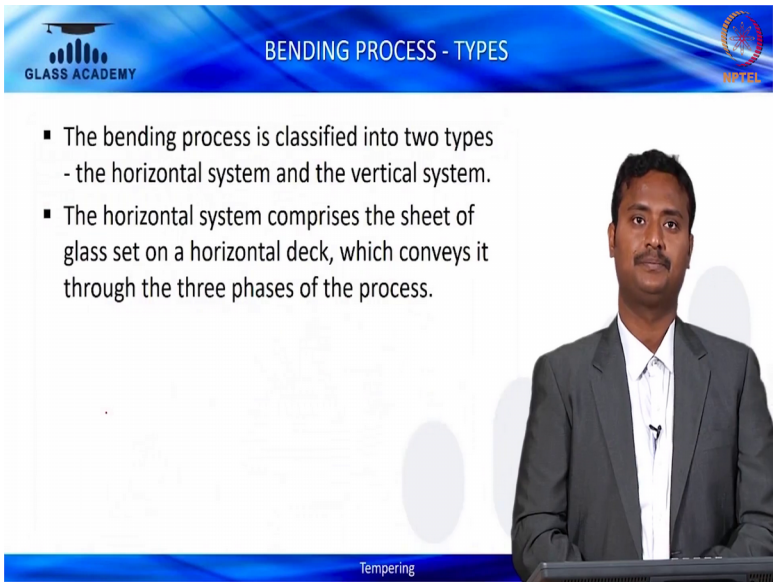

Bending process types bending process is classified into two types: horizontal system and vertical system. Horizontal system comprises the sheets of the glass sets on the horizontal deck which conveys it through this three phase of the process which means loading, heating and quenching cooling; that is a three phases.

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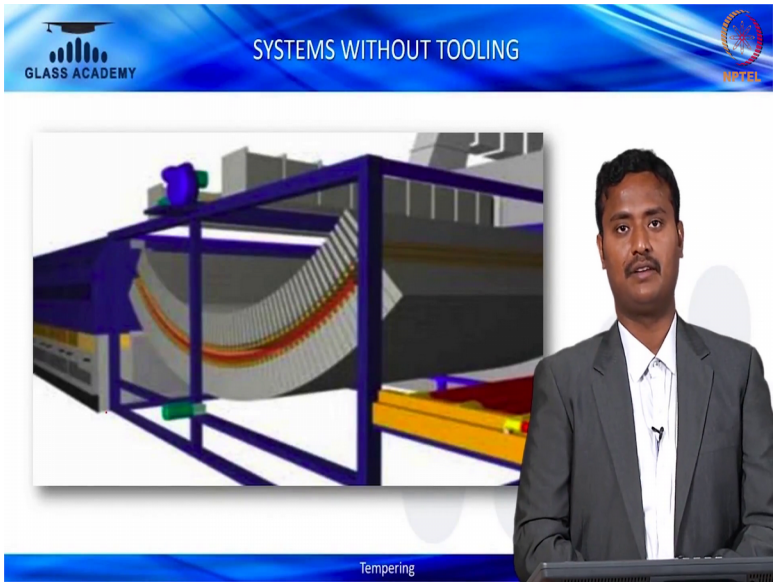

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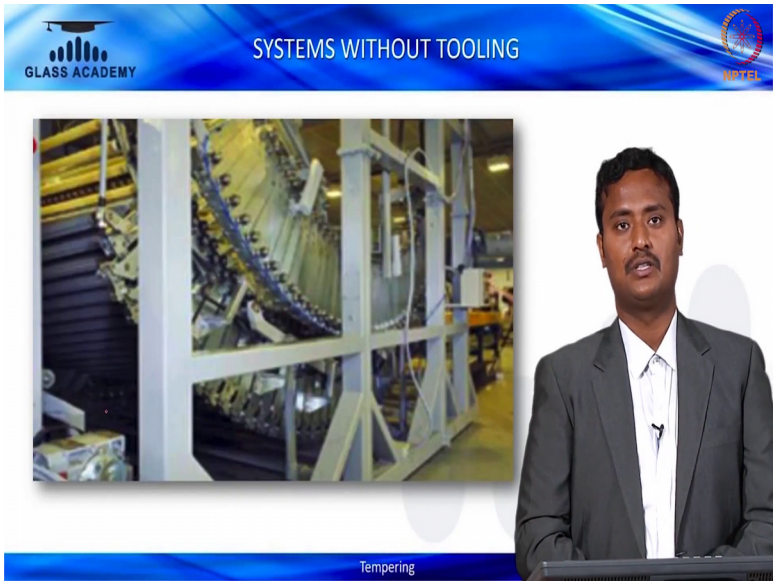

So, these are the fixes you see the fixes completely you know, it is not flat you can depends upon the radius the complete portion of your chiller would be changes. This is system which is without rolling and this is the vertical press.

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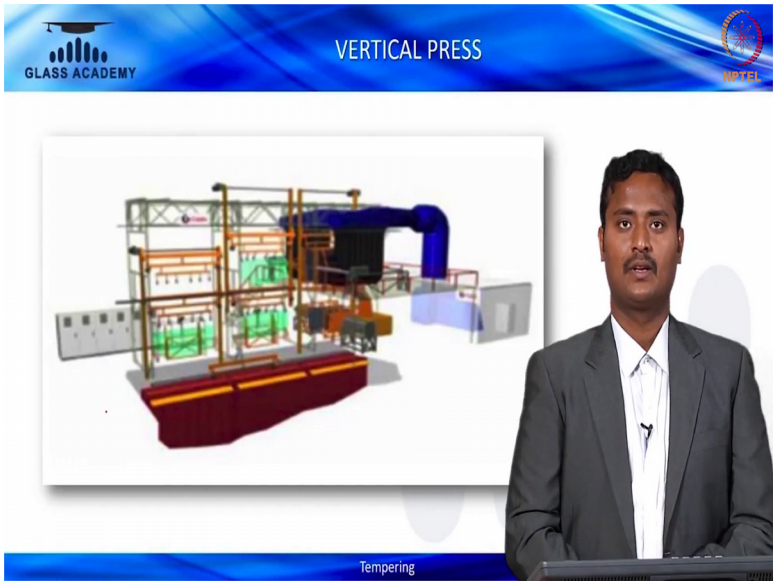

So, this is vertically bending. This is taking place instead of doing this horizontal wise, this is a vertically it will be the can be done as well this is the schematic diagram.

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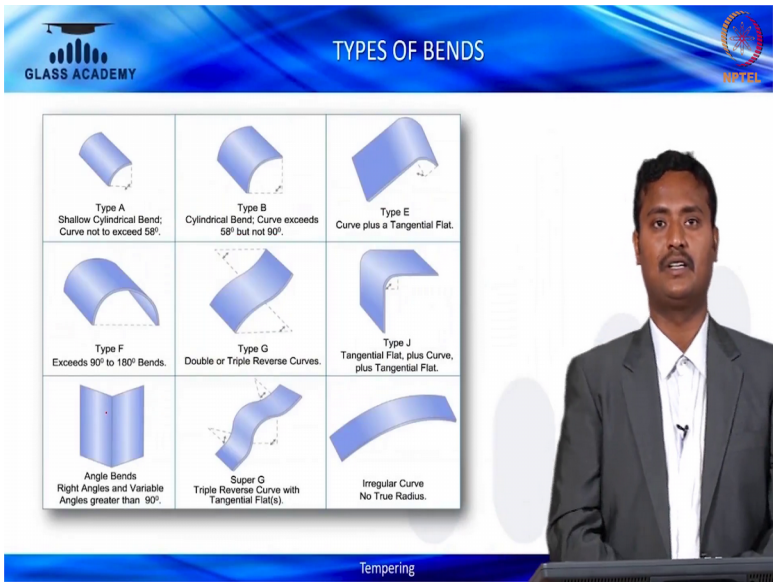

So, these are the types of bend which you can do it. Type one, the shallow cylindrical bend curve not exceeds of 58 degree centigrade sorry 58 degree and Type B cylindrical bend curves exceeds 58, but not 90. Type E curve plus tangential flat and see the one side is flat one side is the curve which you can do it. And Type F exceeds 90 degree to 180 bends. It is possible and Type G double and triple reverse curves which you can be then.

And Type J tangential flat plus curve mostly its widely used for like table tops kind of this and angle bends which is again will be used for bakeries small stores will be used for this angle bends right angles and variable angles greater than ninety degree as well. And super G and followed by regular curves based on your radiations I mean radius curve which you can get it out.

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