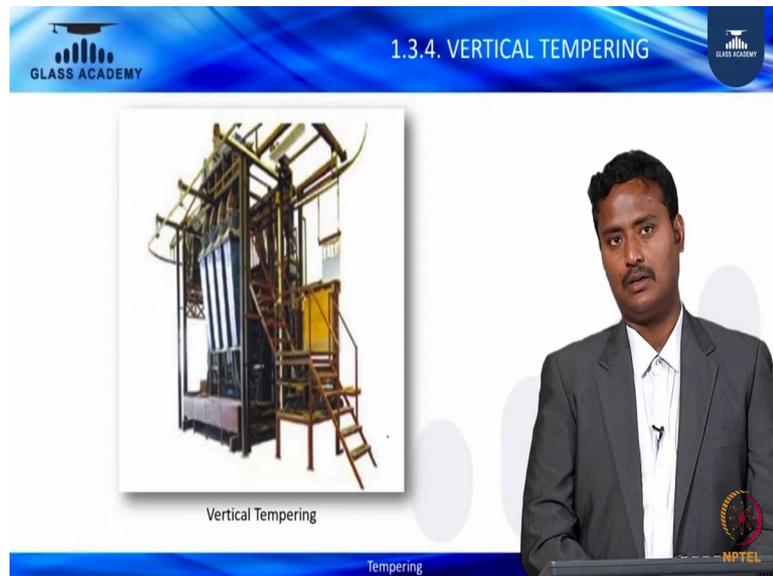


Glass Processing Technology
Mr. John Peter
Department of Civil Engineering
Indian Institute of Technology, Madras

Lecture - 25
Tempering

So, Vertical Tempering as of now it is completely obsolete.

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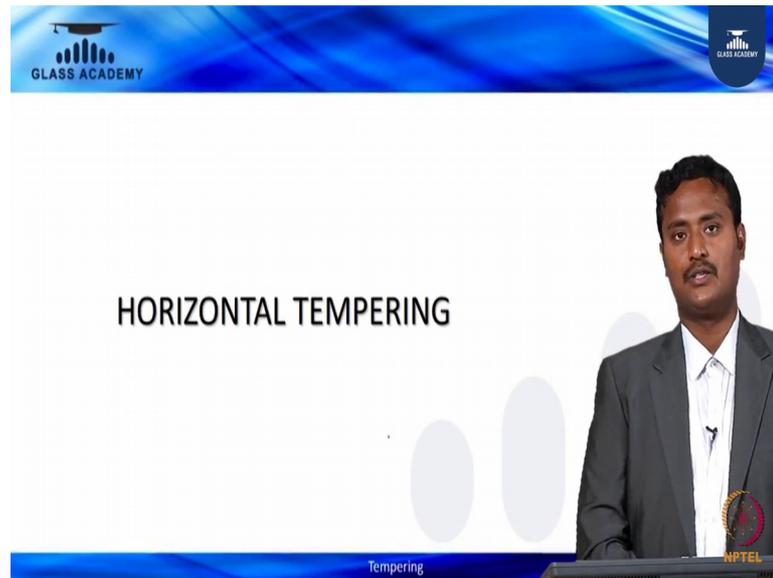


It this is widely used for Automotive applications the earlier and this disadvantage is we will have a tong box because you have to the you have to drop glass like vertically, will be a chamber we have to. There will be holding tong which is you have to drop it and you have to take it back and you have to give a pressure to the glass.

Thereby, you attaining the tempering process vertical which is each glass if you do it is takes longer time and we cannot do it as a mass productions. So, this completely obsolete presently; so, it is widely used for automotive sector say earlier.

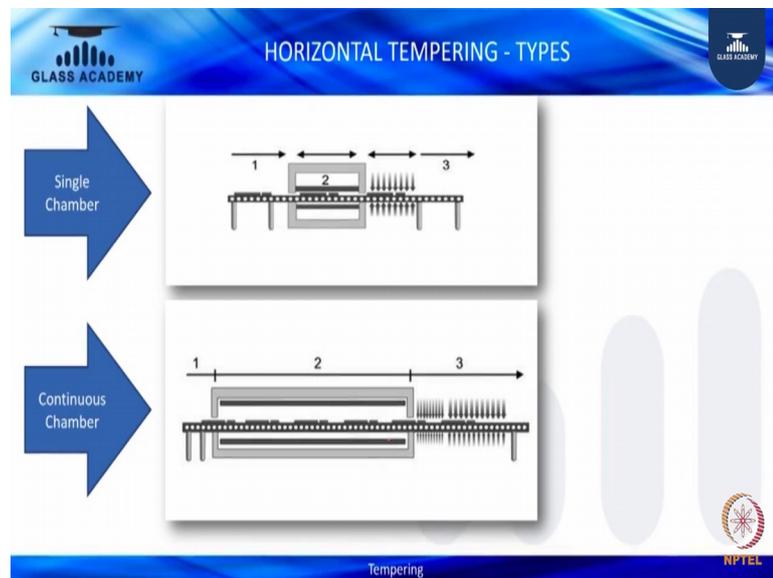
So, this is not commonly used for what you have seen the architectural glasses which is not being process through help of vertical tempering or so, whatever the architecture glasses you have seen that is completely from horizontal tempering process not for the vertical tempering. Just to.

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So, let us move on Horizontal Tempering. This is vital and widely used in glass industry. All the glass processor has Horizontal Tempering machine.

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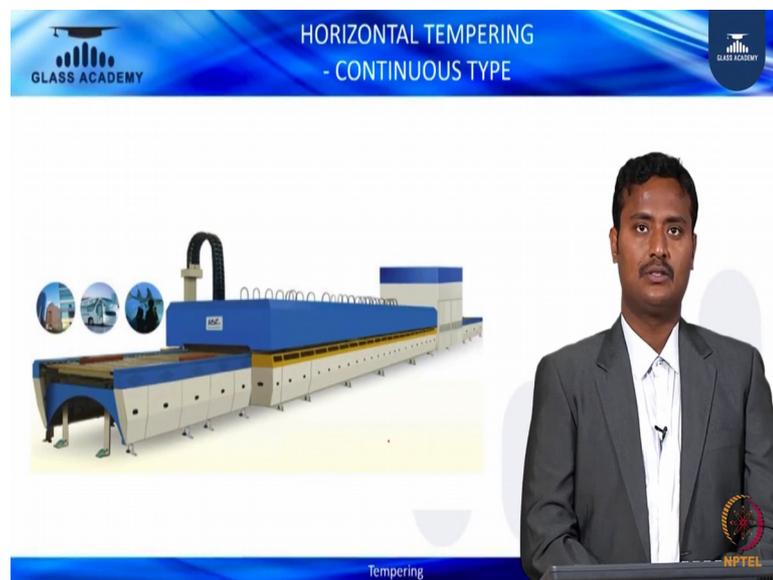


Let us look at the 2 difference between this horizontal tempering types; one is Single Chamber, other one is Continuous Chamber. You can see that single chamber measure the pot number 2, we can see here there is one chamber the heating portion changes I mean its tiny when compared with the below the continuous chamber, the same 2 which has a larger area. So, which means it is a continuous chamber or the loading, the loading

is similar.

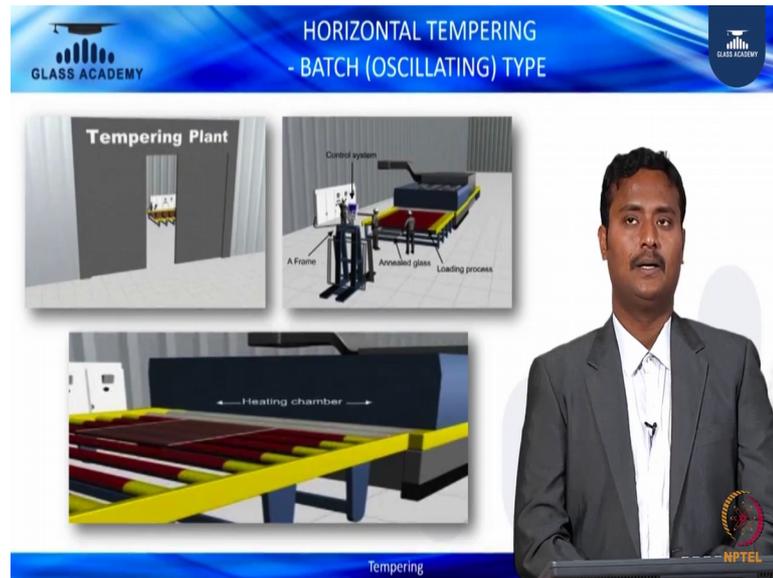
Only the difference between here is the heating zone and the quenching zone because you need the space for such a larger glass to be tempered for the small sizes you can use single chamber, which widely used and continuous chambers are used for the jumbo glass processing at present. And the main advantages of continuous chamber is, you will have a less optical distortions other defects like (Refer Time: 02:52) which will be completely eliminated. Not the complete eliminate may be when compared to the single chamber, you will have a more advantages for with respect to optical quality and this distortion qualities as well.

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So, this is the machines which see the long heating zone and as well as the long quenchings chamber, which will used to temper a glass of jumbo glass.

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For example, 6100 by 310; it s presently it s a massive size which if you want to do it that the tempering, if you need a such kind of continuous chamber to temperate and.

Next move on this Horizontal Tempering-Batch Oscillation type furnace you see this tempering plant and thereby, there will be a glass a frame stacked; annealed glass which is getting loaded on the process this stacked oscillation type. Just loading on this and next is the heating chamber, where the glass is about to enter into chamber.

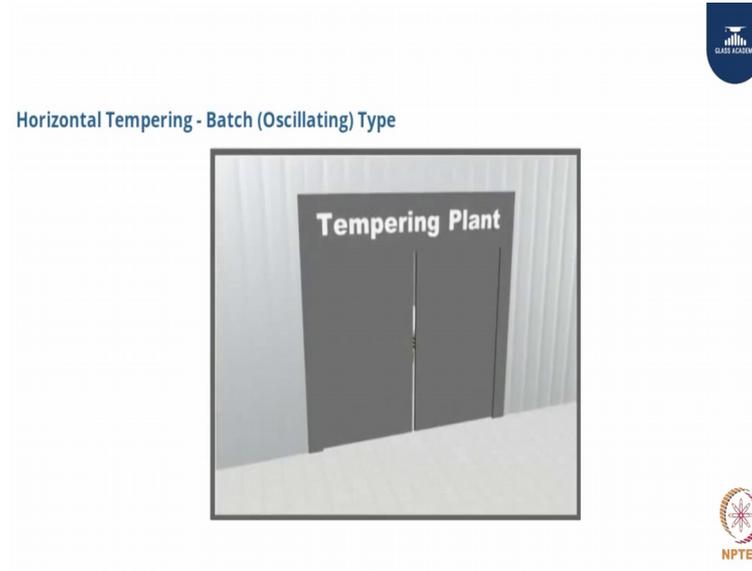
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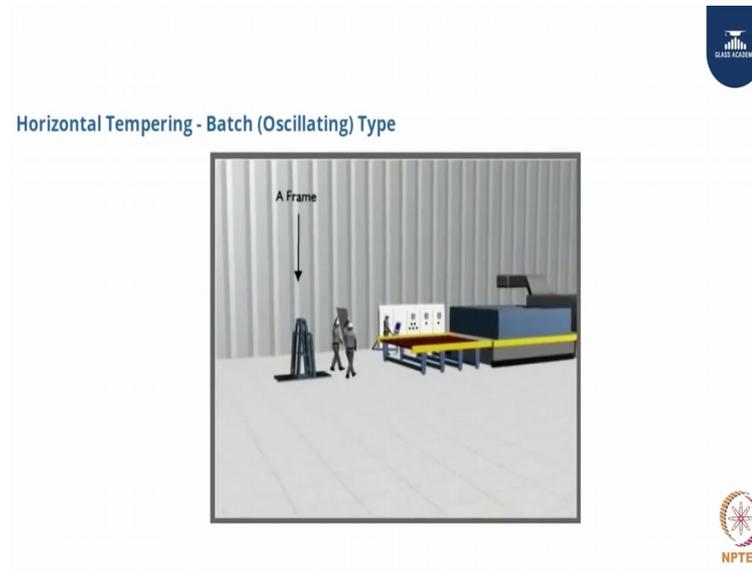
So, after that oscillations is have been taking place at the heating zone. If it is not

oscillation the glass would sack or the glass would became like concave and convex depends upon the heating profile, which has kept inside. So, in order to avoid such defective circumference, we have to oscillate the glass inside the furnace. Thereby you will get the required flatness from the glass.

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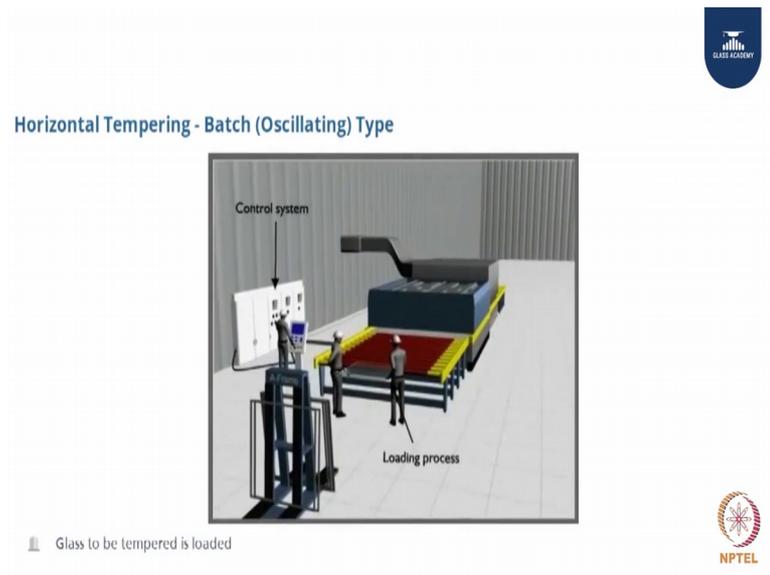
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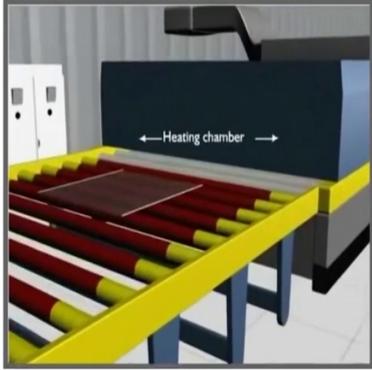


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Horizontal Tempering - Batch (Oscillating) Type

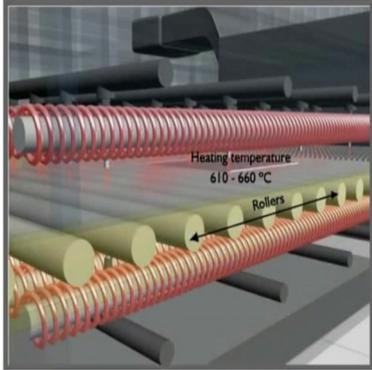


Then glass moves over to heating chamber



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Horizontal Tempering - Batch (Oscillating) Type

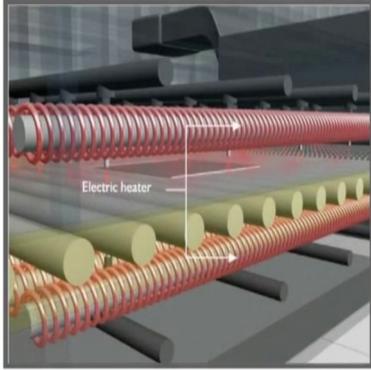


It is heated up to 610 - 660°C in this chamber



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Horizontal Tempering - Batch (Oscillating) Type



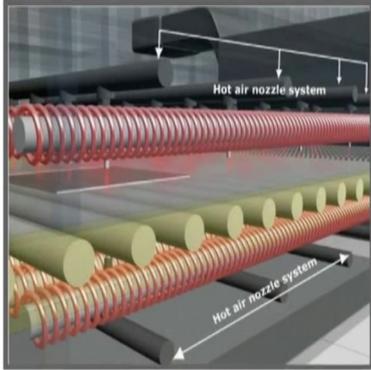
Electric heater

Air is heated up with electric or gas heaters



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Horizontal Tempering - Batch (Oscillating) Type



Hot air nozzle system

Hot air nozzle system

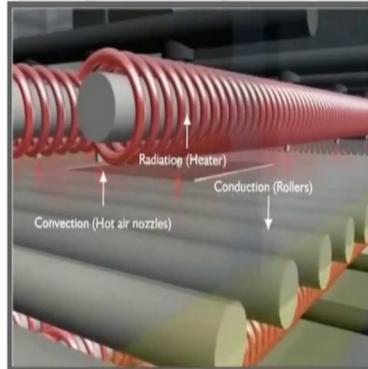
Air is heated up with electric or gas heaters

Then blown across glass by blowers and air nozzle system



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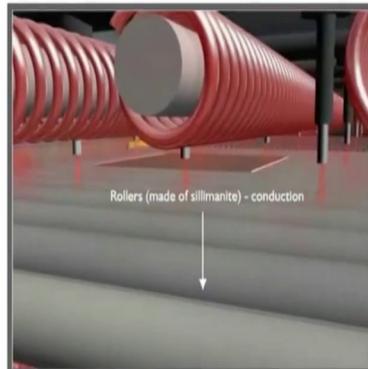
Horizontal Tempering - Batch (Oscillating) Type



📌 Glass is heated by means of conduction, radiation, and convection

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Horizontal Tempering - Batch (Oscillating) Type

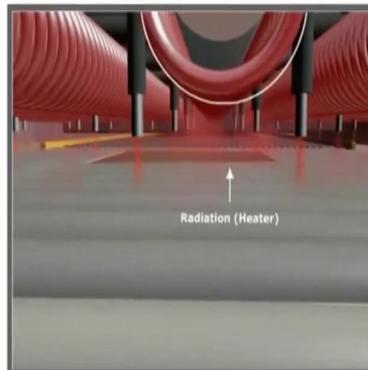


📌 Rollers - made of Sillimanite - conduct heat, coils help in radiation

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Horizontal Tempering - Batch (Oscillating) Type



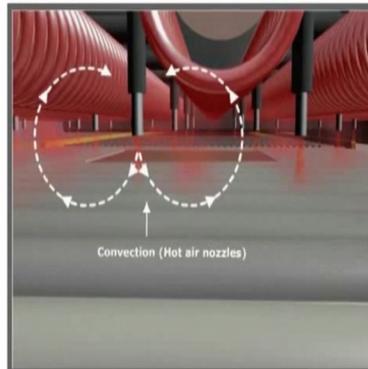
Rollers - made of Sillimanite - conduct heat, coils help in radiation



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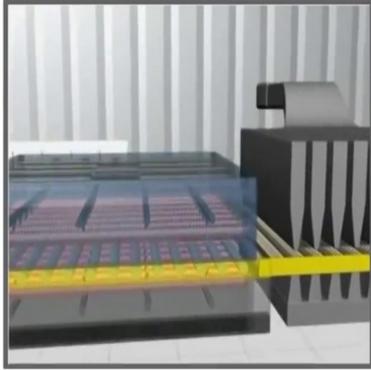
Horizontal Tempering - Batch (Oscillating) Type



Convection effect - brought about by hot air blowing through nozzles



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Horizontal Tempering - Batch (Oscillating) Type

Convection effect - brought about by hot air blowing through nozzles

Circulating heat incite furnace and making sure glass is heated evenly

GLASS ACADEMY

NPTEL

(Refer Slide Time: 06:15)

CHARACTERISTICS OF THERMALLY TEMPERED GLASS

Characteristics	Annealed float	Toughened float
Bending Strength - 40 N/mm ² - 120 ~200 N/mm ²	40 N/mm ²	120 ~200 N/mm ²
Thermal stress	50°C	200°C
Breakage Pattern	Big sharp	Small dulled edges
Hard steel ball (230 Gms) IS-2553	50 cm	350 cm
Soft (Bag 5 Kg) IS-2553	115 cm	250 cm

Tempering

GLASS ACADEMY

NPTEL

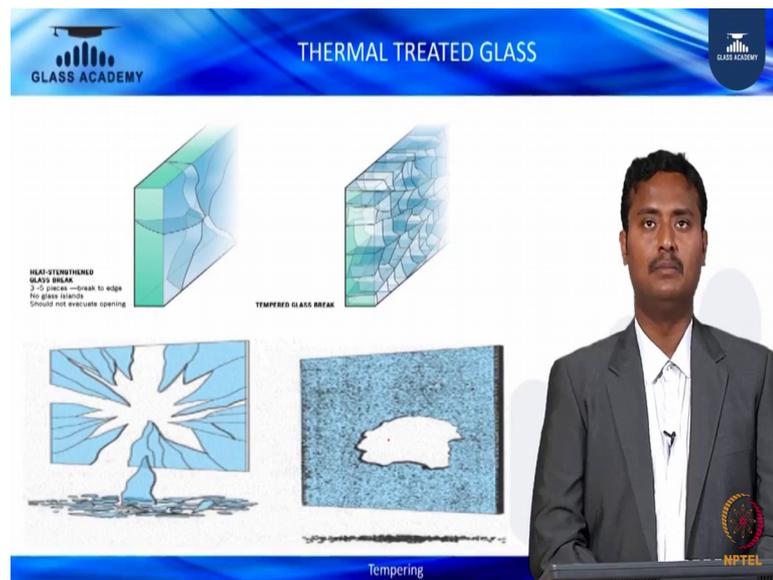
Characteristics of thermally tempered glasses: Bending strength 40 neutron per mm square; whereas, Annealed glass you have 40 neutron thermal square; toughened glass 120 to 200 neutron per mm square. Thermal stress, it can resist up to 50 degree centigrade; whereas, tempered glass 200 degree centigrade, it can resist.

Breakage pattern which is big and sharp it will hurt people; whereas, this is a small which is very dulled edges, it will not hurt anybody and in with respect to the hard steel ball when you drop from this 50 centimeter which you have to do; whereas, here is 350

centimeter you see the difference of the same ball to 230 grams. How much it has been fall? So, it breaks.

So, 50 centimetres 350 falls. So, there will be have a characteristic of thermally tempered glass, you have different types and soft bag. If the 5 kg soft bag, as per the IS-2553 standard, 115 centimeter away we have to pull it and drop it and this is 250 centimetre.

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This is thermal treated glass fragmentations between Annealed glass and Tempered glass. You can see heat strengthened glass as well. Heat strengthened glass is nothing but the same fragmentation as good as annealed glass; whereas, tempered glass you see the fragmentations very very tiny this one. So, in the event of breakages, it will not hurt anybody.

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Summary:

By the end of this module, you have learnt about the:

- Types of thermal tempering
 - Vertical tempering
 - Horizontal tempering
 - i) Single chamber
 - ii) Continuous chamber
- Characteristics of thermally tempered glass
- Thermal treated glass