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Tempered glass quality measurement & development

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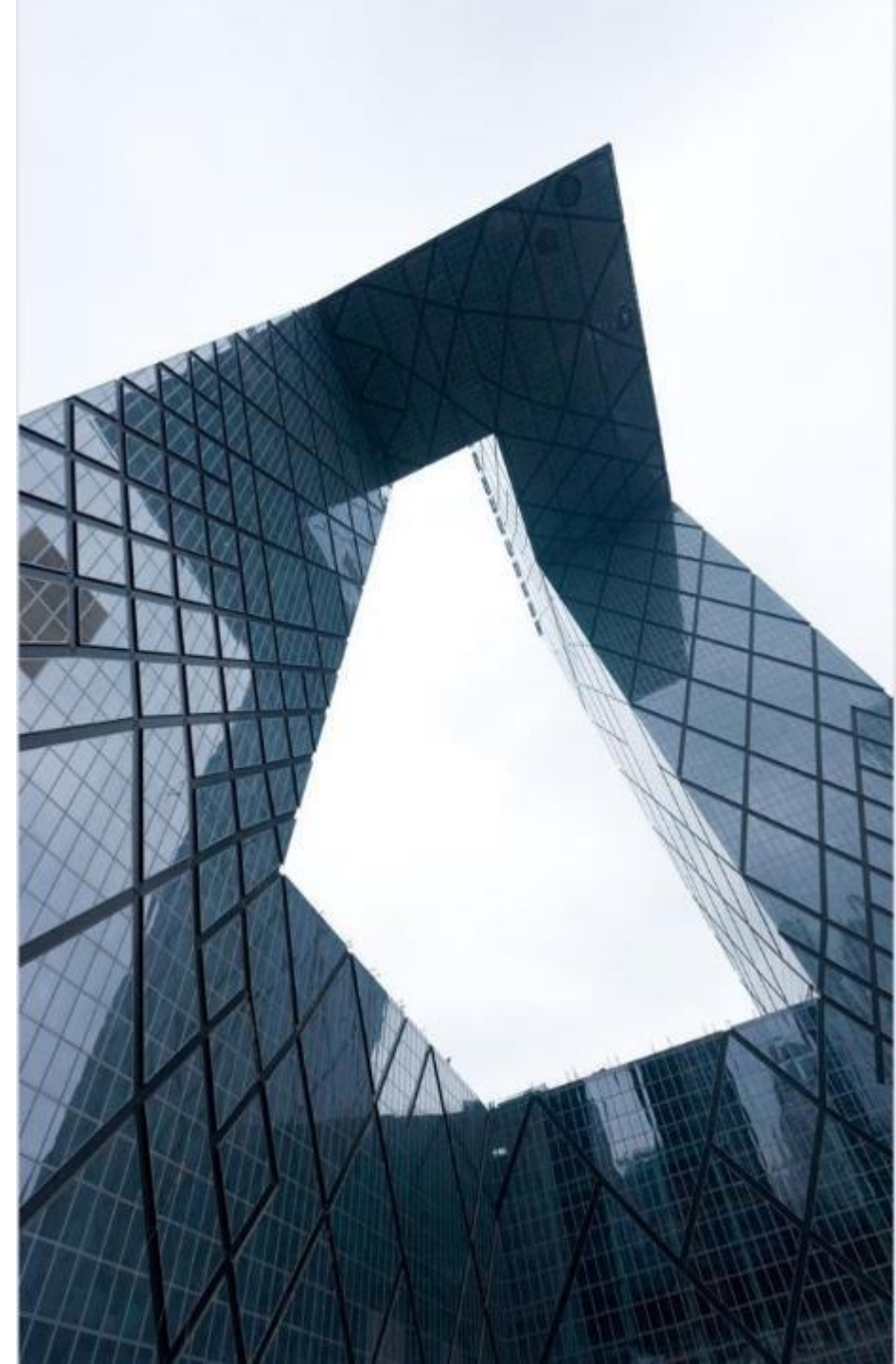
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Do we want our buildings to look like they were designed to , or?



Content

- Glazing examples: current/future challenges
- Measurement
 - How to measure
 - Online distortion measurement
 - Online anisotropy measurement
- Technology solutions to increase facade quality
- Your checklist



Quality challenges



Picture source: www.gpd.fi © M. Elstner, Interpane Glasgesellschaft GmbH

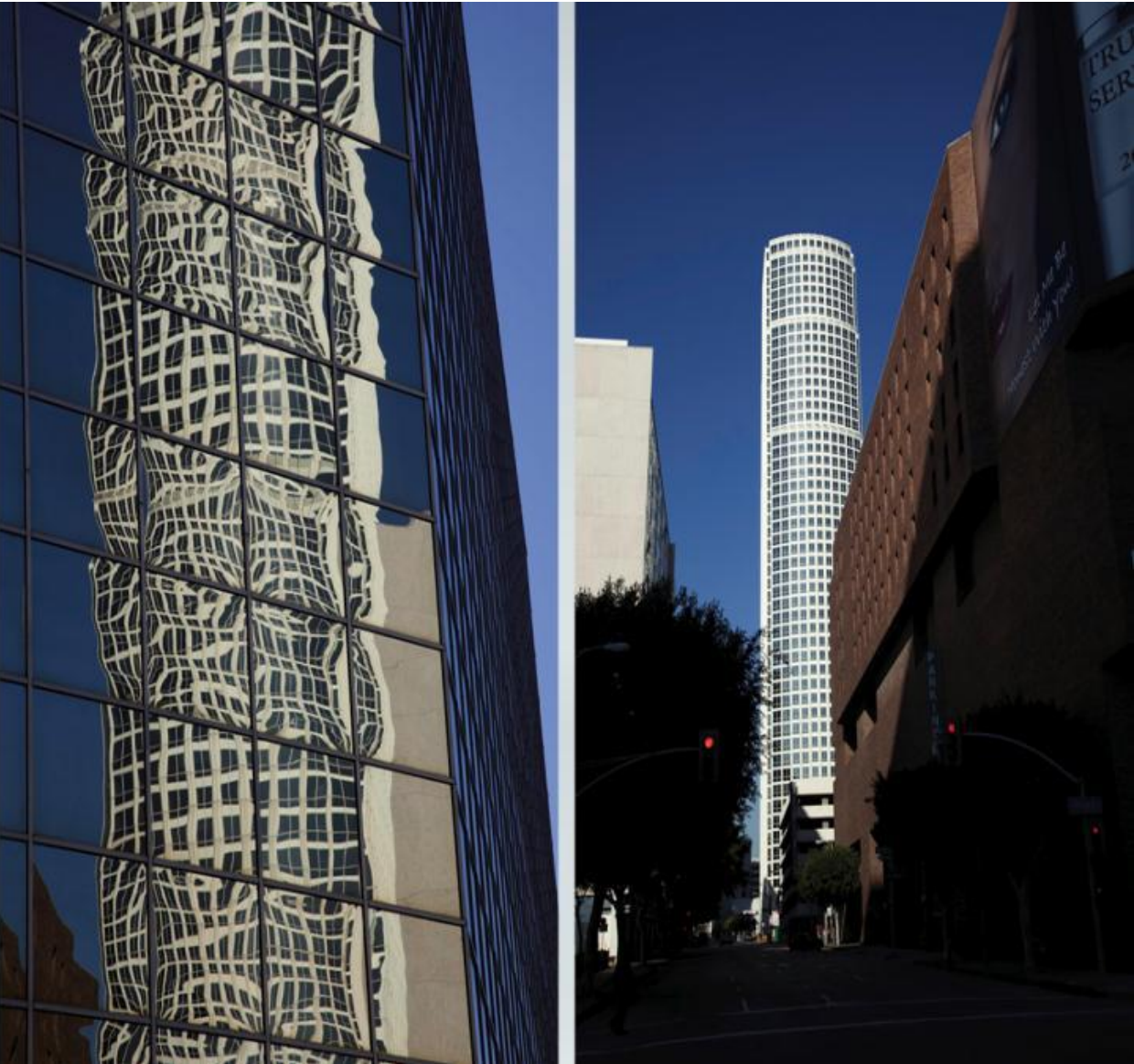
Quality challenges



Quality challenges



Intent or Accident?



SOURCE: www.gpd.fi © M. Patterson, Enclos



Causes for quality defects

Sources for distortion

(for tempered, bent and laminated)



**Heat treatment /
tempering** can
cause distortion

Distortion can be
multiplied in
lamination

**Thickness
variation** along
the glass

**IG unit pressure
level** and
**environment
condition**

**Reflective coating
quality** can add the
visibility of
distortion

**Pressure on the
glazing** will cause
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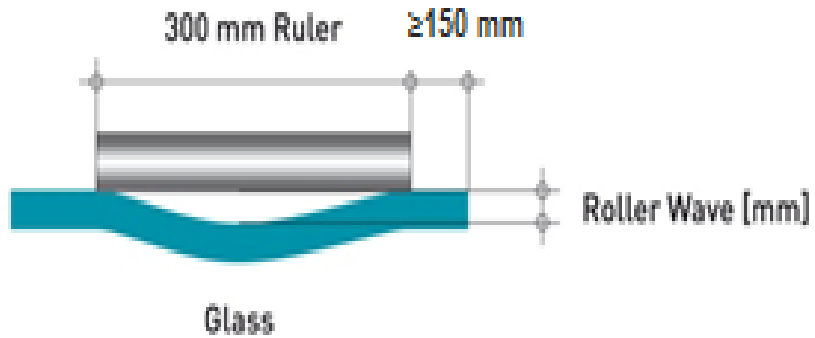
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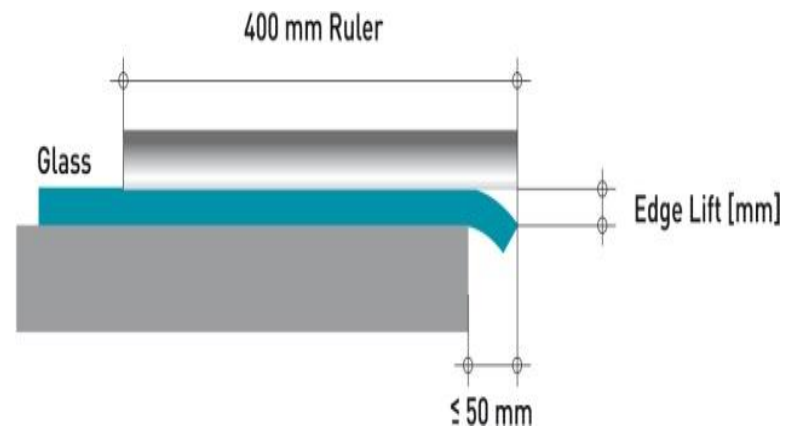
Manual measurement – how to measure



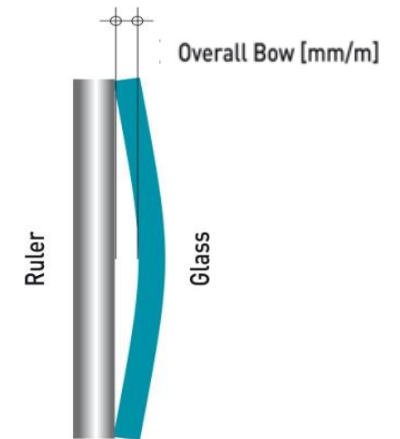
Roller wave



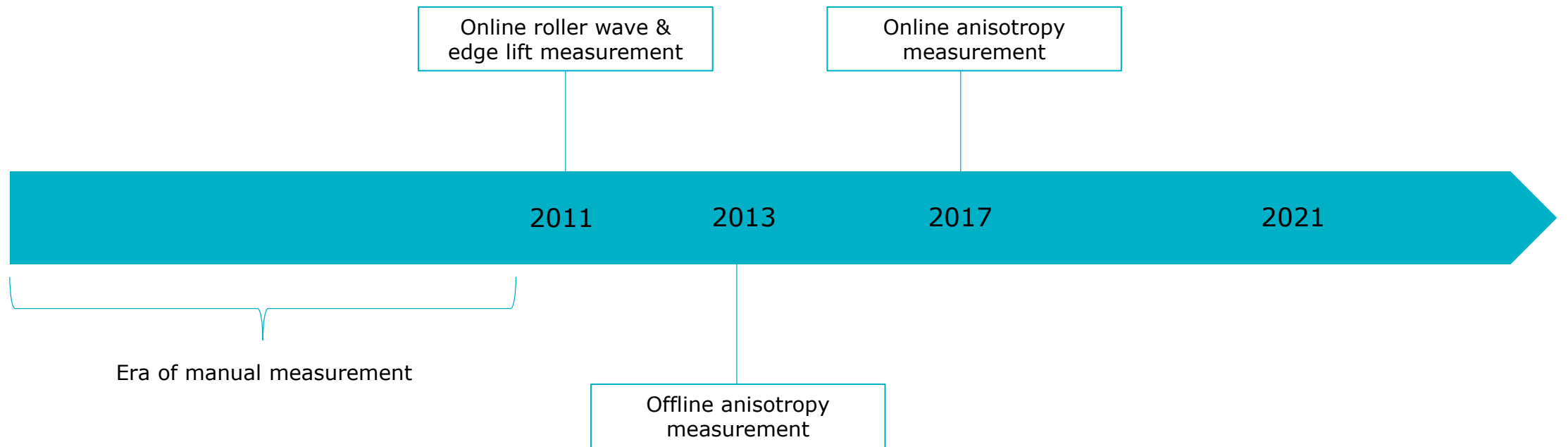
Edge lift



Overall bow



Towards online measurement



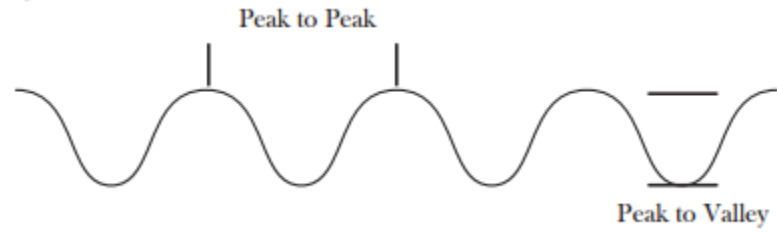
Online measurement advantages



- All glasses are measured
 - Immediate feedback, minimized remakes after installation
 - Fewer problems with lamination
- Proven quality
- All glasses are traceable
- No human error



Measuring distortion: Millidiopter vs mm



The impact on optical quality
from short roller waves



The impact on optical quality
from long roller waves



Rollerwaver 0,2
Mpdt ~300



Rollerwave 0,1
Mpdt ~130



Rollerwave 0,07
Mpdt ~100

Anisotropy



Source: Vehmas, J., GLASTON

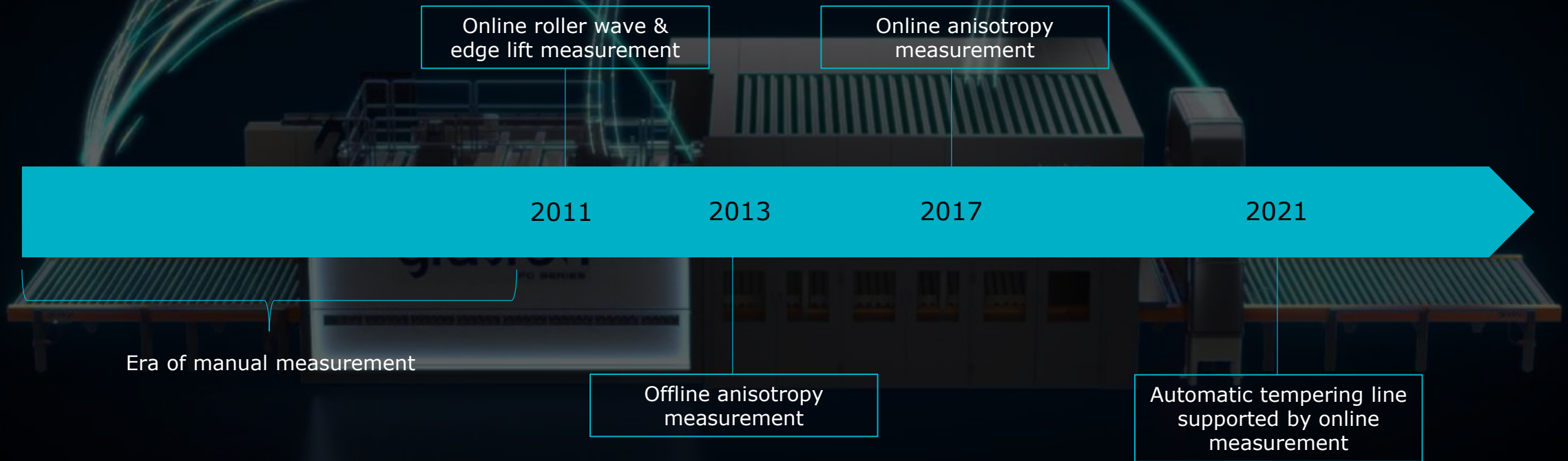
No standards for anisotropy

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Building owners
have created their
own standards for
anisotropy

Measurement development





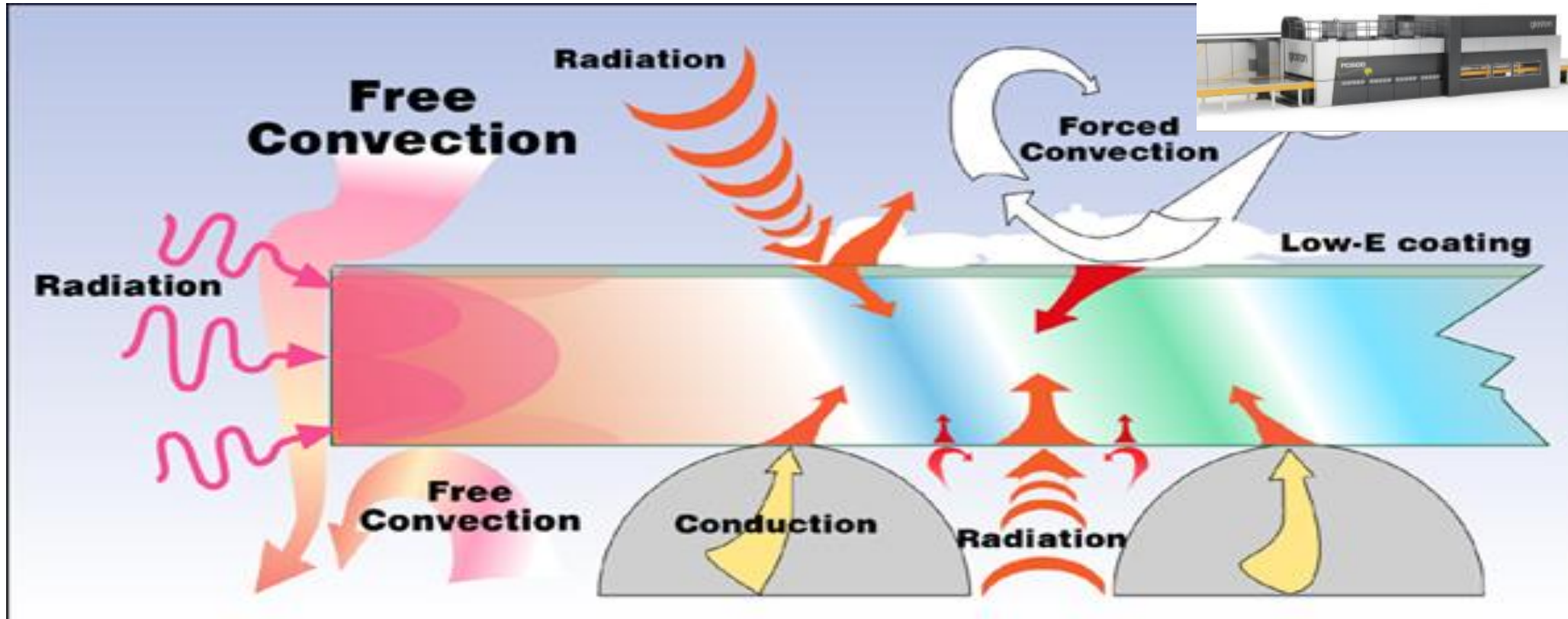
Solutions

Solutions provided by new technology

Tempering line has a huge effect on final façade outlook



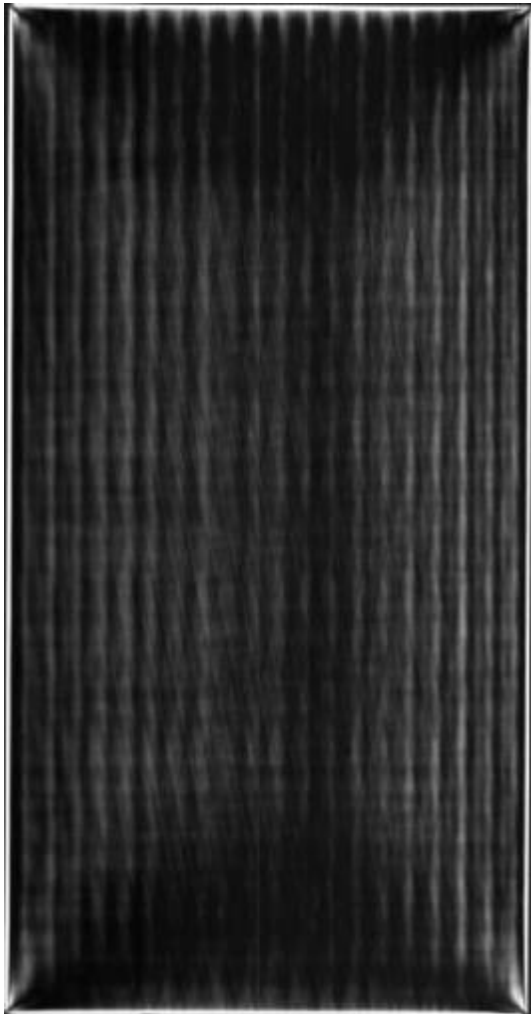
Heat treatment / tempering can cause distortion	Distortion can be multiplied in lamination	Thickness variation along the glass
IG unit pressure level and environment condition	Reflective coating quality add the visibility of distortion	Pressure on the glazing will cause distortion



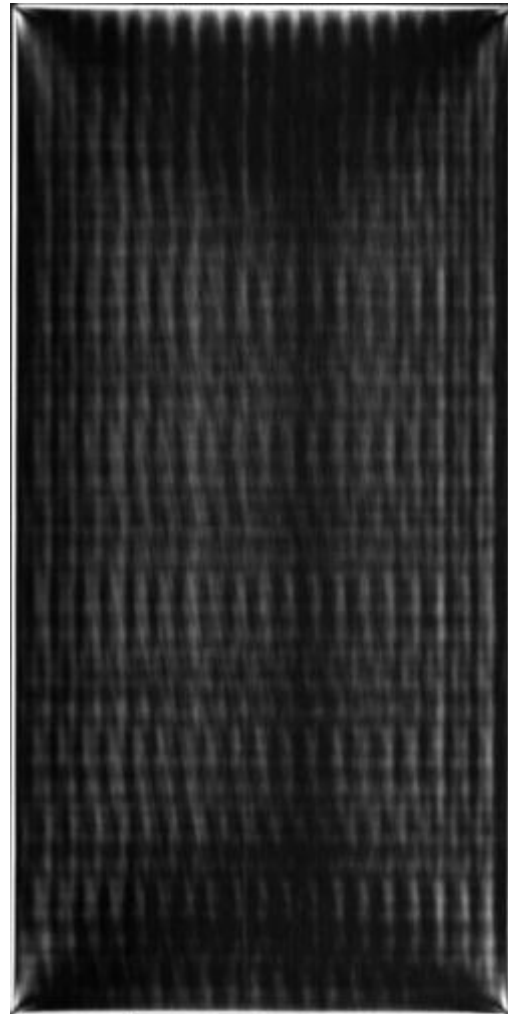
Process development: transfer speed

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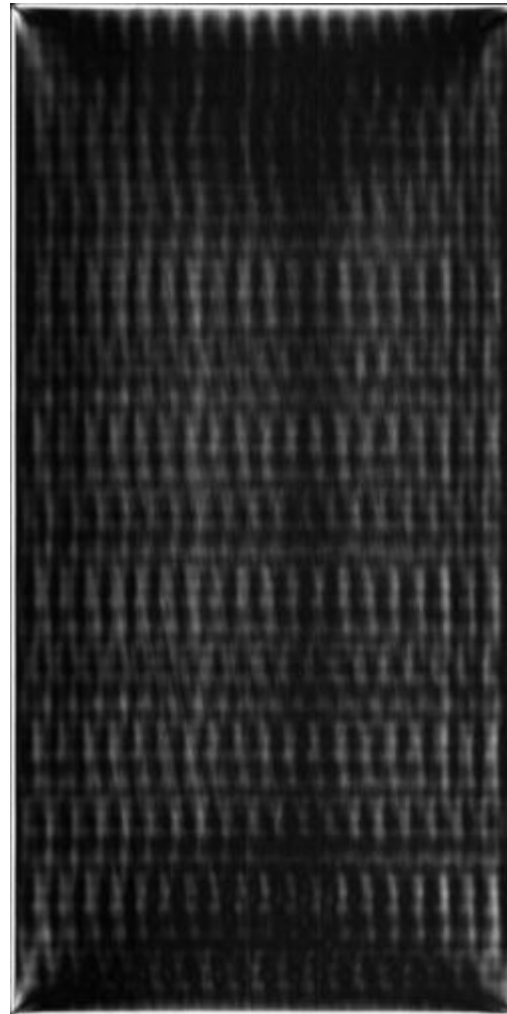
200mm/s



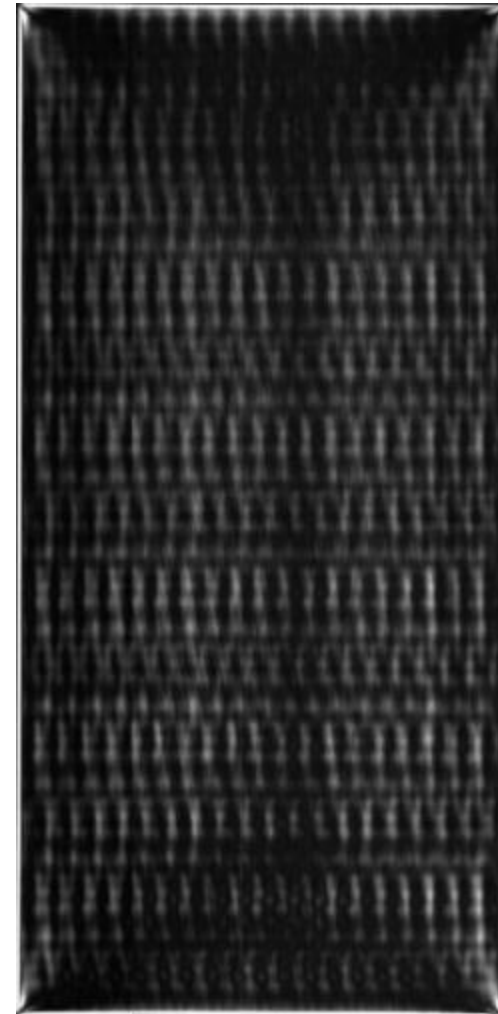
300mm/s



400mm/s



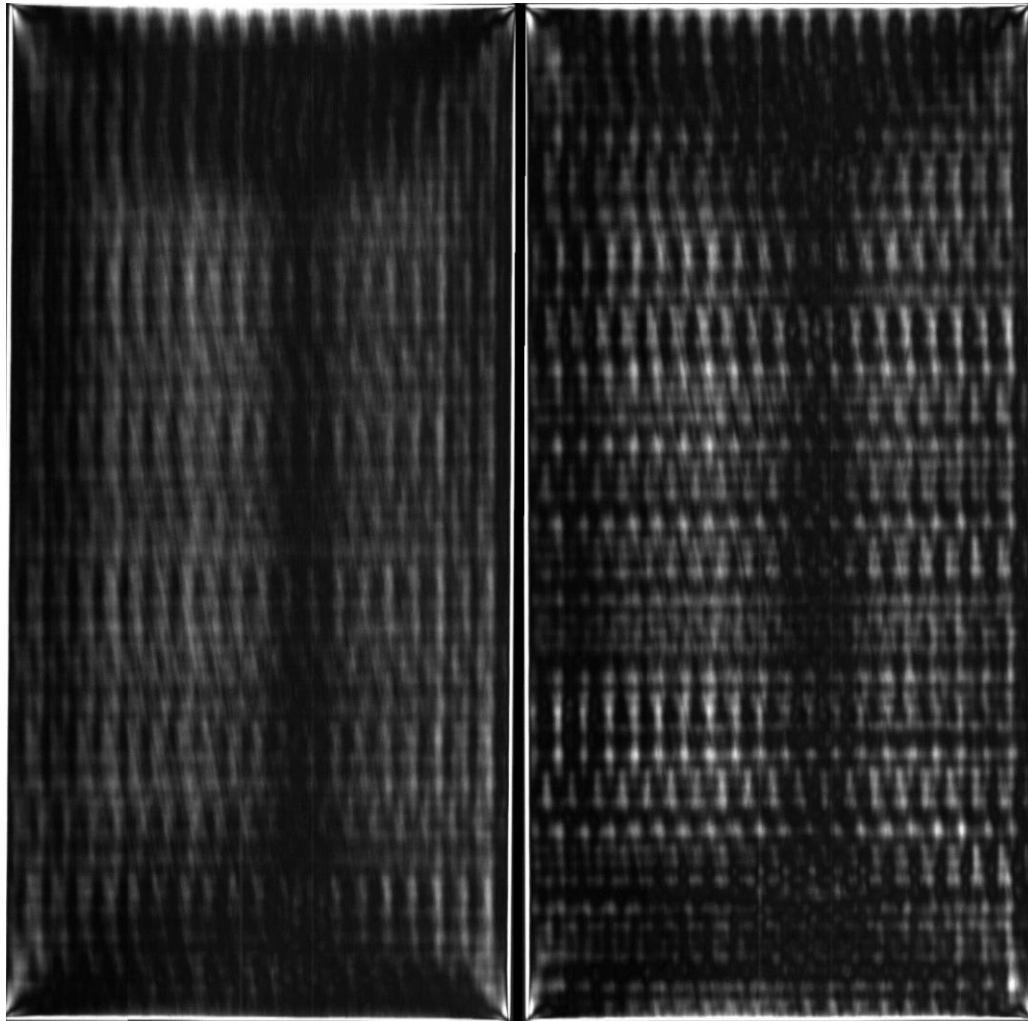
500mm/s



Process development: oscillation

The first glass

The second glass (trailing)





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Summary and your checklist



How to ensure your project glazing does not end up in the beginning of my presentation

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- Demand a mock-up
- Right specification for the application
- Is the heat treatment technology up-to-date for today's requirements?
- How is the quality control arranged?
- See reference projects





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Thank you!

