

Discover the WHYs and HOWs of BIG GLASS in Architecture

AG-0001

WHO WE ARE:

AGNORA is an award-winning glass fabricator providing the largest, high-quality architectural glass in North America.

Known as an industry leading, team-based customer service company, AGNORA employs innovative production processes and invests in leading-edge machinery to push the boundaries of what is possible in architectural glass fabrication and meet challenging design objectives brought by their customers.



Louis Moreau

Head of Technology and Innovation, AGNORA

Louis brings a unique mix of international experiences in float manufacturing, high-performance vacuum coatings, large building glazing, and high-end glass fabrication.

Louis considers architecture as the purest form of art and loves glass. He explores the limits of materials and processes to create innovative solutions that can be easily built.



Adam Mitchell

Marketing Manager, AGNORA

Adam is a marketing professional focused on the manufacturing sector for over 10 years. He has a strong focus on building relationships and delivering value added content that support evolving partnerships.

LEARNING OBJECTIVES



WHY LARGER GLASS BRING MORE BENEFITS TO A BUILDING

- a) Application
- b) Aesthetics
- c) Efficiency

SOME TRADE PRACTICES THAT YOU SHOULD KNOW

- a) Digital Templating
- b) Logistics

DEALING WITH A FABRICATOR – KNOW THE LIMITS

- a) Glass Thickness and Weight
- b) Raw Material Availability
- c) Design Choices in Large Glass

FABRICATION TOOLS AND THE APPLICATIONS (SPREAD THROUGH DOCUMENT IN VIDEO FORMAT)

- a) Edgework
- b) Logistics
- c) HST
- d) Interlayer
- e) QC



WHY LARGER GLASS BRINGS
MORE TO A BUILDING

APPLICATION



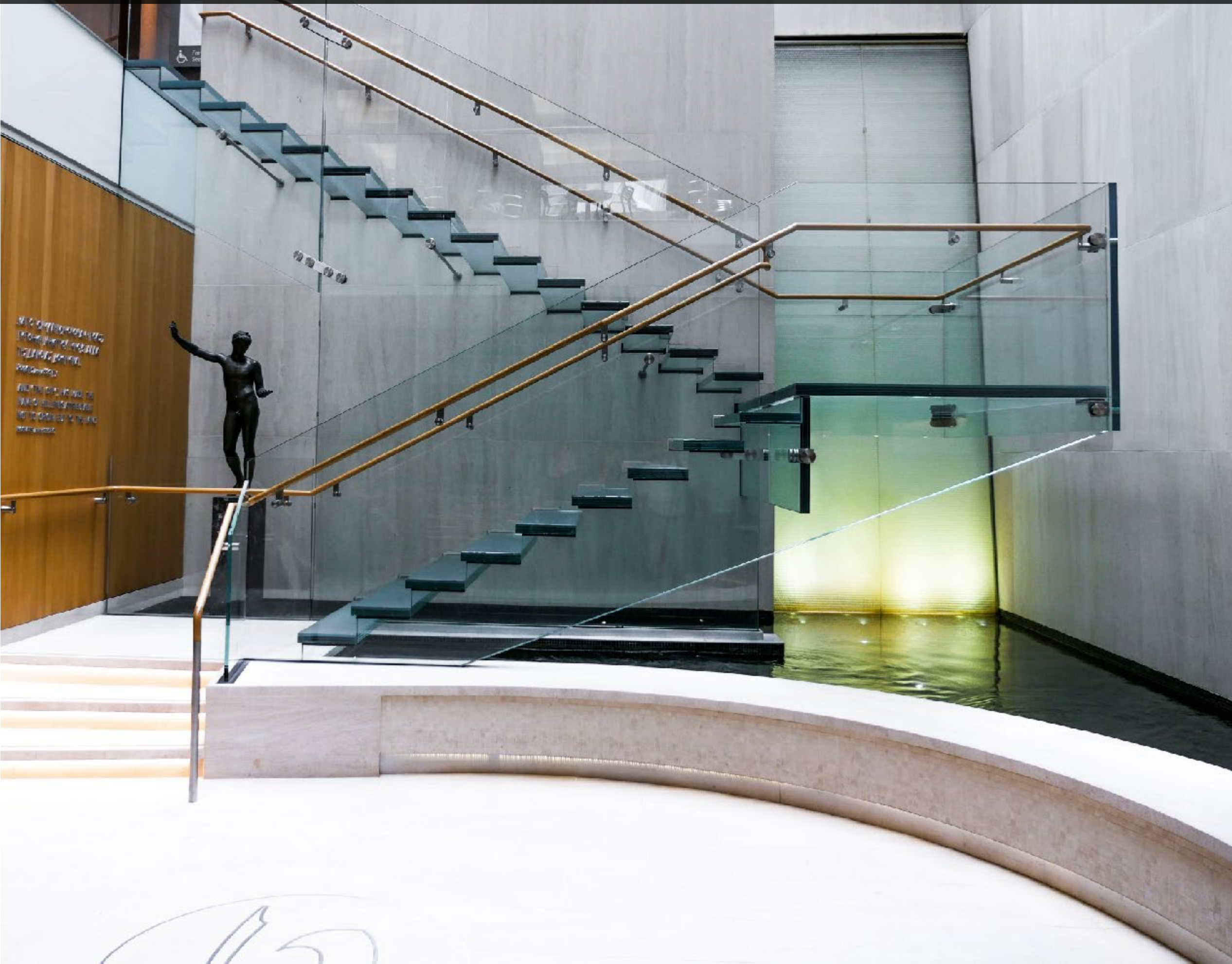
SEDAK Cutting table



SOLARIS



ONASSIS CULTURAL CENTER



APPLE – SAN FRANCISCO



CHICAGO O'HARE AIRPORT ATCT



HANGZHOU APPLE STORE



SECTION SUMMARY

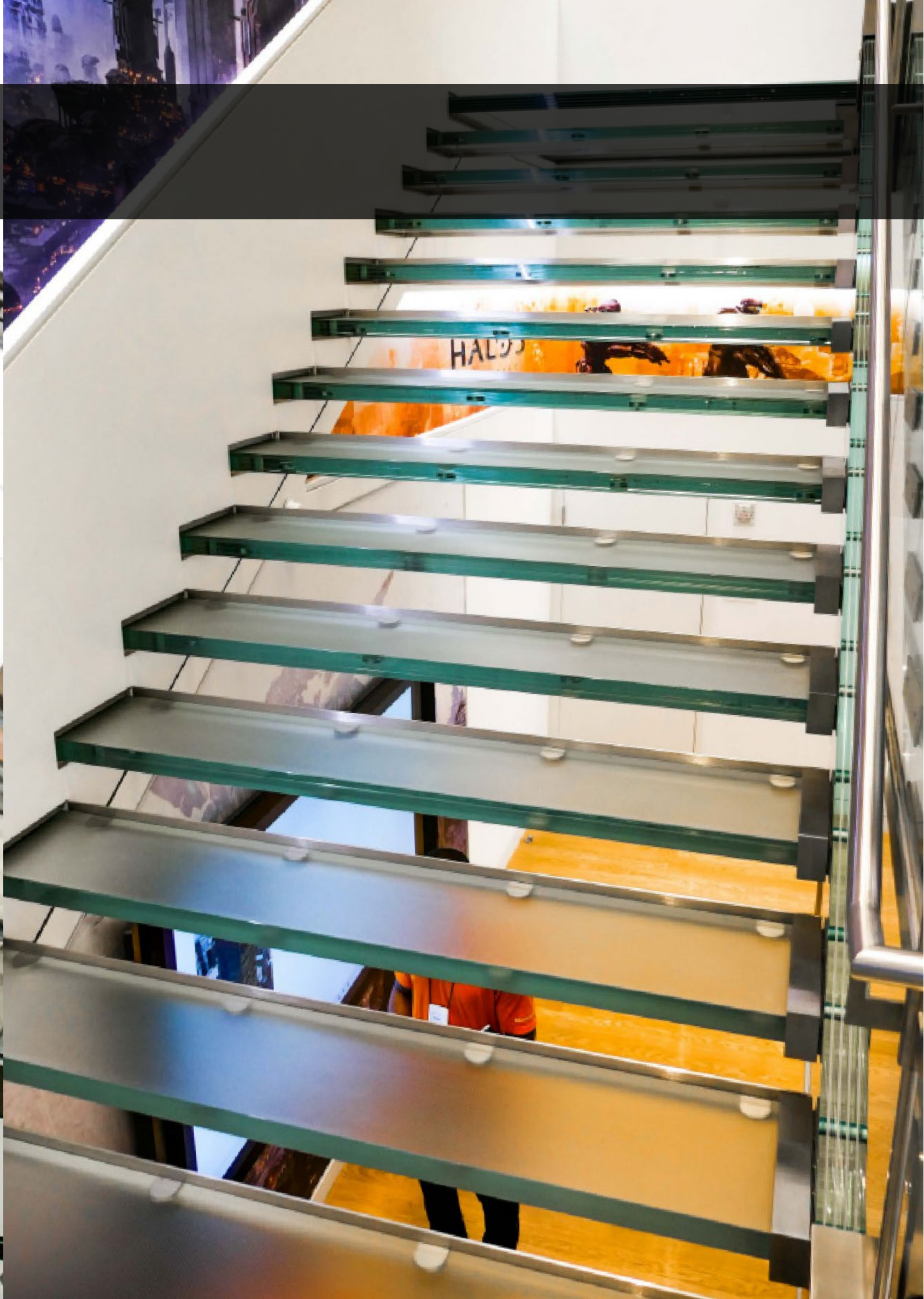
APPLICATION

- You need maximum visibility. I.e. Planes and runways
- The staircase needs to reach the second floor
- High ceiling / building resulting in need for oversized glass cladding

AESTHETICS



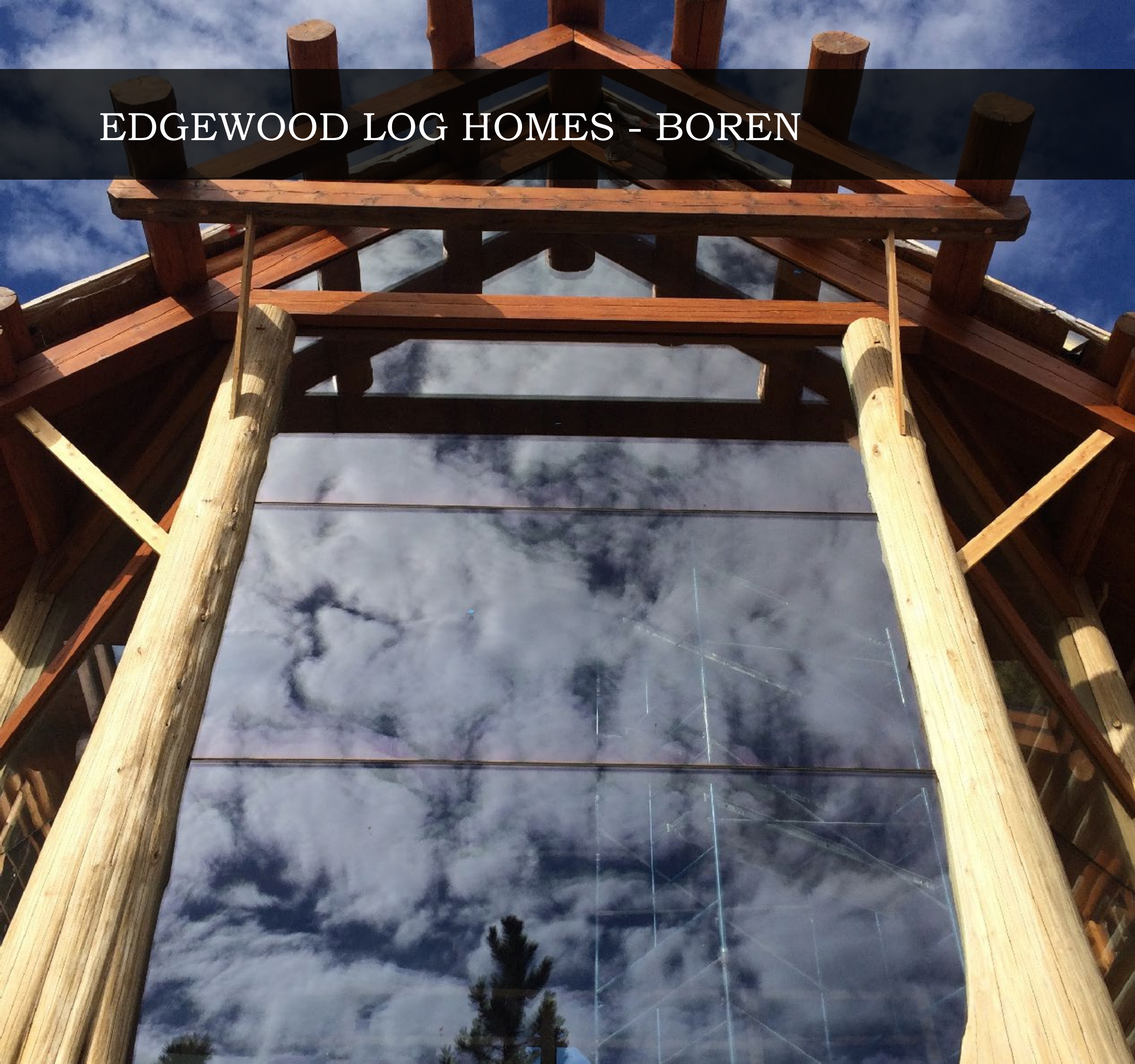
MICROSOFT 5th AVE



OCULUS



EDGEWOOD LOG HOMES - BOREN



SECTION SUMMARY

APPLICATION

- You need maximum visibility. I.e. Planes and runways
- The staircase needs to reach the second floor
- High ceiling / building resulting in need for oversized glass cladding

AESTHETICS

Natural light improves behavior, increase purchases, deliver impressive vistas for residences, and create landmarks in high-profile buildings.

Examples include:

- Pool blends in the forest
- Maintained historic landmarks and settings
- Create enhanced storefront visibility
- Expose and accentuate wood beams and glass

EFFICIENCY



H&M 5th Avenue New York



MNBAQ



SECTION SUMMARY

APPLICATION

- You need maximum visibility. I.e. Planes and runways
- The staircase needs to reach the second floor
- High ceiling / building resulting in need for oversized glass cladding

AESTHETICS

Natural light improves behavior, increase purchases, deliver impressive vistas for residences, and create landmarks in high-profile buildings.

Examples include:

- Pool blends in the forest
- Maintained historic landmarks and settings
- Create enhanced storefront visibility
- Expose and accentuate wood beams and glass

EFFICIENCY

Oversized architectural glass (large) can be extremely efficient.

While Building

Each crane movement, each large panel can lay more area, resulting in less parts to the “puzzle.” Less caulking, less hardware.

For the Building

Glass is the only cladding material that brings energy into the building.

Control that energy with proper coatings and insulating.



DESIGN CONSIDERATIONS

FIXING VINTAGE

FARNSWORTH HOUSE

Ludwig Mies van der Rohe

THE BROKEN GLASS CONUNDRUM

Physics has not change, but glass technology has.

Consider...Super flat tempered

Don't fear the new glass. We can make it fit.



FIXING VINTAGE

GLASS HOUSE

Philip Johnson





GLASS THICKNESS & WEIGHT



GLASS THICKNESS & WEIGHT

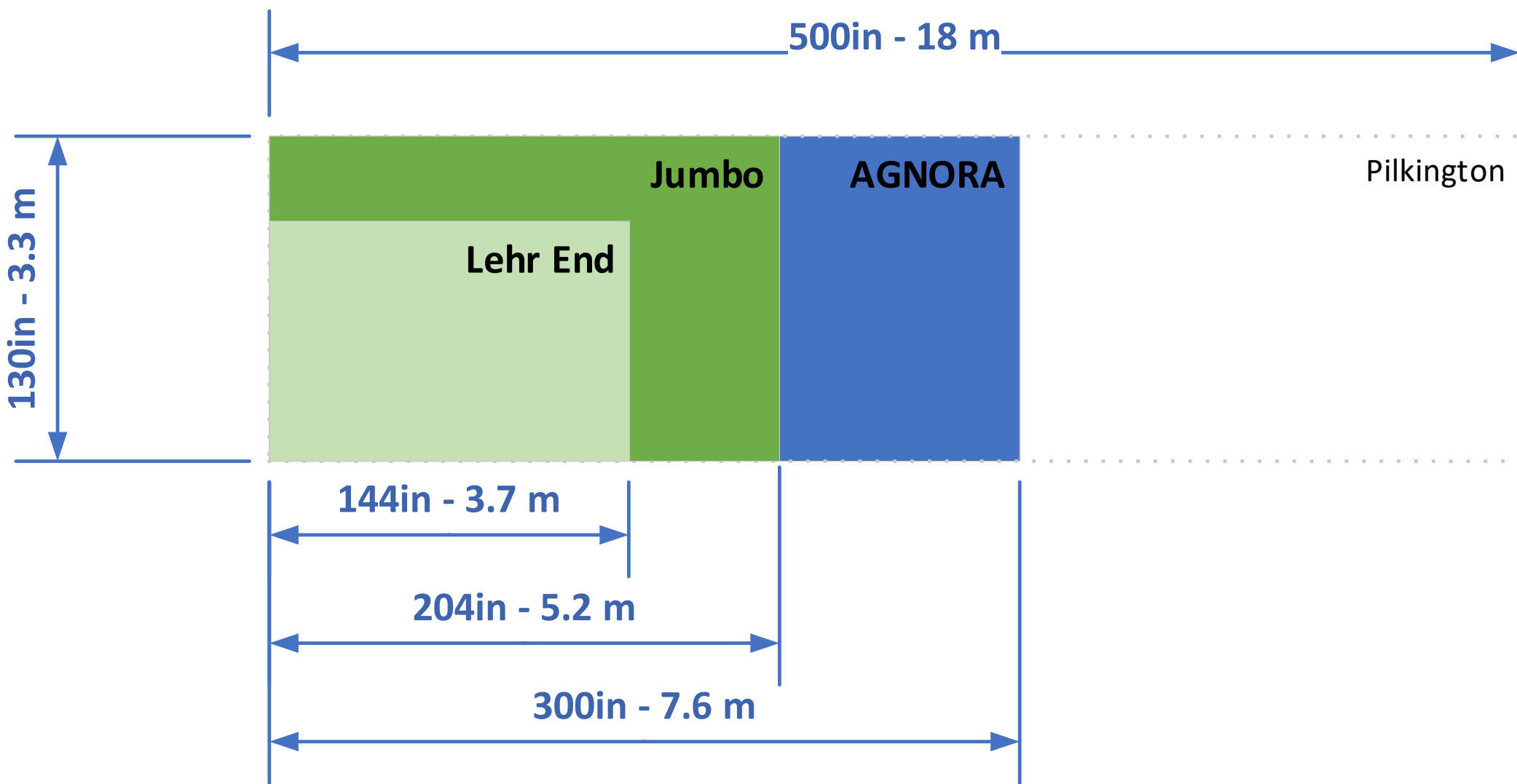
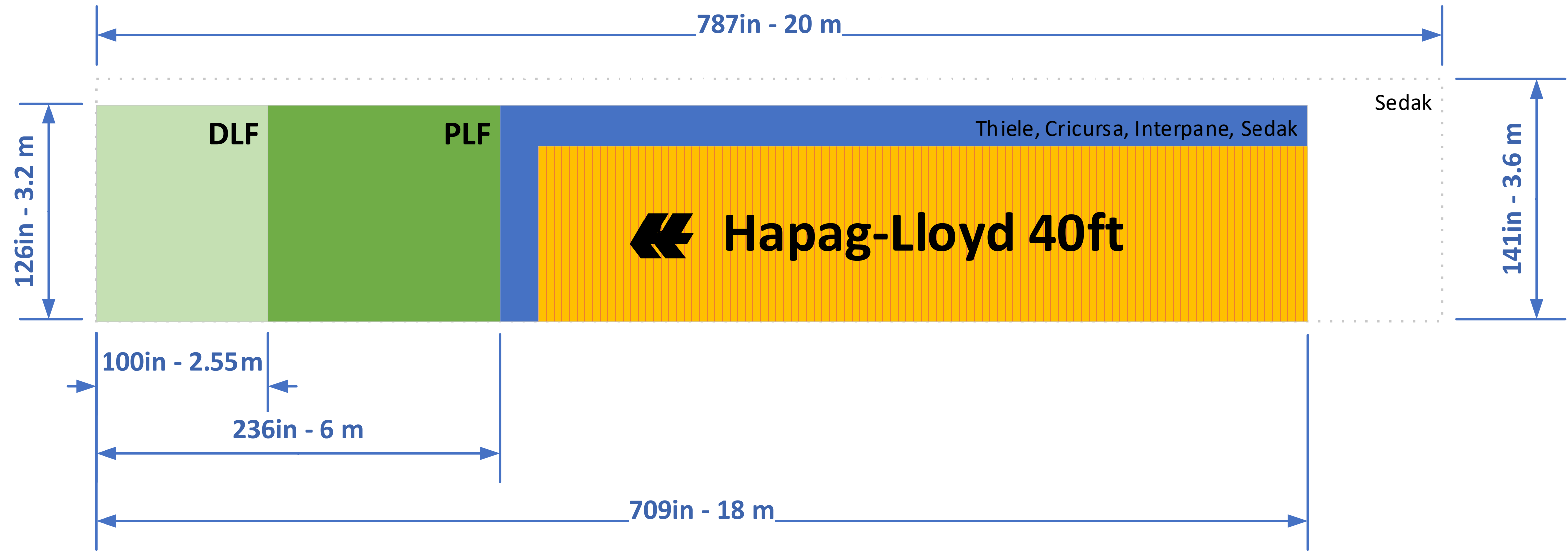
300"	7500 mm	A	B	C	E	F	G	I	J
288"	7200 mm	A	B	C	E	F	G	I	J
276"	6900 mm	A	B	C	E	F	G	I	J
264"	6600 mm	A	B	C	E	F	G	I	J
252"	6300 mm	A	B	C	E	F	G	I	J
240"	6000 mm	A	B	C	E	F	G	H	I
228"	5700 mm	A	B	C	E	F	G	H	I
216"	5400 mm	A	B	C	E	F	G	H	I
204"	5100 mm	A	B	C	D	E	G	H	I
192"	4800 mm	A	B	C	D	E	G	G	I
180"	4500 mm	A	B	C	D	E	G	G	H
168"	4200 mm	A	B	C	D	E	G	G	H
156"	3900 mm	A	B	C	D	E	F	G	G
144"	3600 mm	A	B	C	D	E	E	G	G
132"	3300 mm	A	B	B	C	E	E	F	G
120"	3000 mm	A	B	B	C	D	E	E	F
108"	2700 mm	A	B	B	C	D	D	E	E
96"	2400 mm	A	B	B	C	C	D	D	E
84"	2100 mm	A	A	B	B	C	C	C	C
72"	1800 mm	A	A	B	B	B	B	B	B
60"	1500 mm	A	A	A	A	B	B	B	B
48"	1200 mm	A	A	A	A	A	A	A	A
		1200 mm	1500 mm	1800 mm	2100 mm	2400 mm	2700 mm	3000 mm	3300 mm
		48"	60"	72"	84"	96"	108"	120"	130"

	COMPOSITION	OVERALL THICKNESS	WEIGHT per m ²	WEIGHT per ft ²
A	6 mm (1/4") 12 mm (1/2") spacer 6 mm (1/4")	24 mm (1")	30 Kg	6.1 Lbs
B	6 mm (1/4") 12 mm (1/2") spacer 10 mm (3/8")	28 mm (1 1/8")	40 Kg	8.2 Lbs
C	10 mm (3/8") 12 mm (1/2") spacer 10 mm (3/8")	32 mm (1 1/4")	50 Kg	10.2 Lbs
D	10 mm (3/8") 15 mm (5/8") spacer 12 mm (1/2")	37 mm (1 1/2")	55 Kg	11.3 Lbs
E	10 mm (3/8") 15 mm (5/8") spacer 15 mm (5/8")	40 mm (1 9/16")	63 Kg	12.8 Lbs
F	12 mm (1/2") 15 mm (5/8") spacer 15 mm (5/8")	42 mm (1 5/8")	68 Kg	13.8 Lbs
G	12 mm (1/2") 15 mm (5/8") spacer 19 mm (3/4")	46 mm (1 13/16")	78 Kg	15.9 Lbs
H	15 mm (5/8") 15 mm (5/8") spacer 19 mm (3/4")	50 mm (1 15/16")	85 Kg	17.4 Lbs
I	19 mm (3/4") 15 mm (5/8") spacer 19 mm (3/4")	53 mm (2 1/16")	95 kg	19.5 Lbs
J	19 mm (3/4") 15 mm (5/8") spacer 25 mm (1")	59 mm (2 5/16")	110 Kg	22.5 Lbs

SECTION SUMMARY

LOADS

- Annealed thin plate glass was traditionally used in iconic houses
- Failure mode of annealed can simply be a strong wind gust
- Larger glass means more efforts, and requires heavier structures
- Deflection needs to be controlled
- 1" Overall will work up to 50 or even 65 SQF but beyond, will require thicker glass
- ASTM E1300 is the North American reference for calculation
- Table driven, and is being reworked to accommodate larger sizes



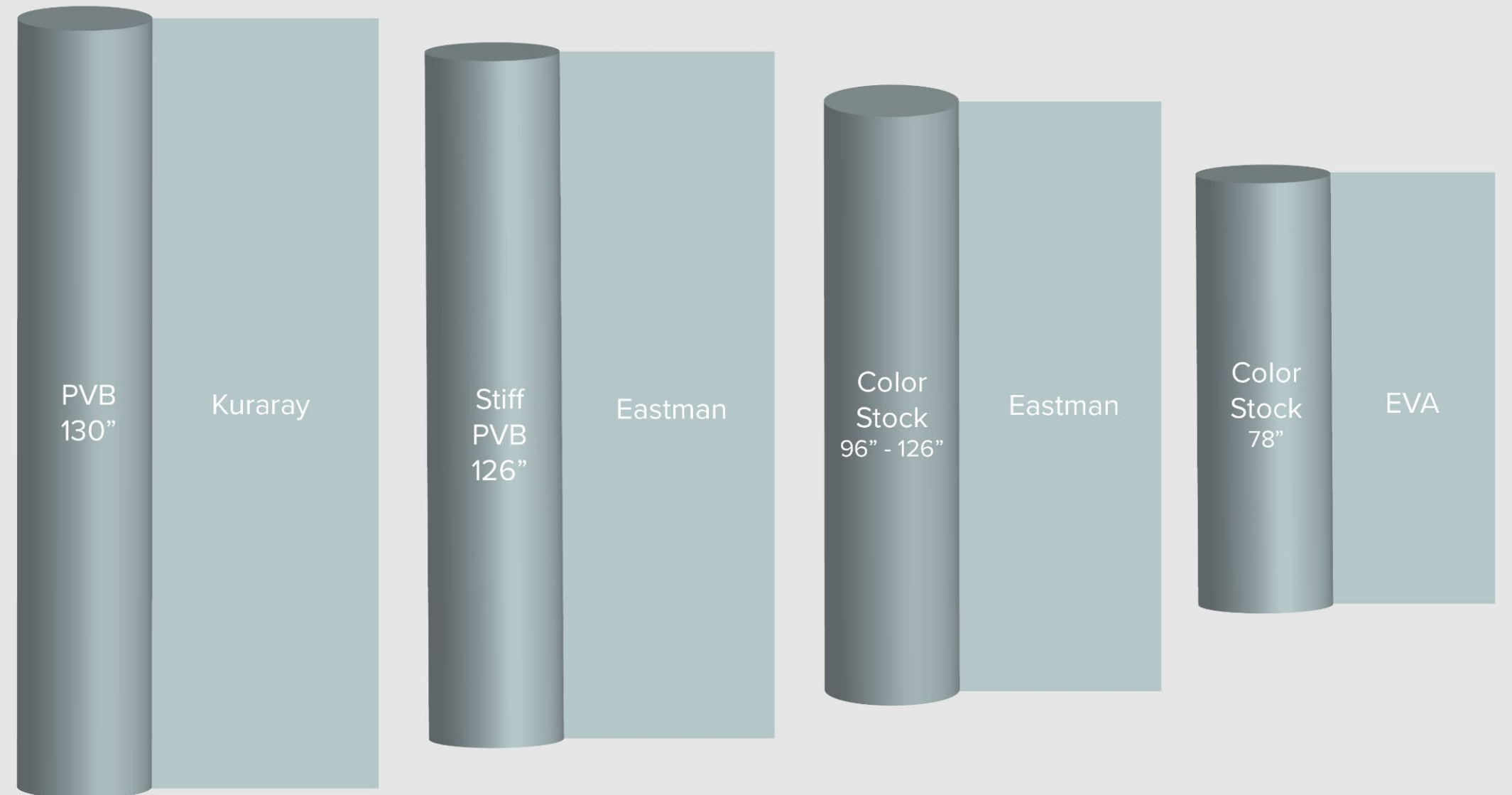
KNOW YOUR LIMITS

KNOW YOUR SIZES



IT'S NOT JUST THE GLASS

Laminates and IGUs must be taken into consideration. After all, laminates are products that must match the size of the glass.



SUMMARY OF SECTION

LOADS

- Annealed thin plate glass was traditionally used in iconic houses
- Failure mode of annealed can simply be a strong wind gust
- Larger glass means more efforts, and requires heavier structures
- Deflection needs to be controlled
- 1" Overall will work up to 50 or even 65 SQF but beyond, will require thicker glass
- ASTM E1300 is the North American reference for calculation
- Table driven, and is being reworked to accommodate larger sizes

RAW MATERIALS

- Glass ribbon width is 130" – 3.3 m
- Glass ribbon length is 200 m
- Glass is cut into pieces that can be manipulated and transported
- 18 m X 3 m is current maximum for a heat treated, coated, laminated IGU
- 11.5 m X 2.5 m is the inside dimensions of a 40' container if glass is coming overseas
- Think how it will be manipulated

INTERLAYER

- Required most of the time to thicken glass
- 10 mm | 0.030" | 10 mm annealed laminate is cheaper than 19 mm tempered
- Laminate comes in a roll, and may have variable sizes
- PVB available in glass width
- SentryGlas rolls are 106" wide (but clever person seamed 130" roll)





DESIGN CONSIDERATIONS

BEST - ANNEALED LAMINATE

- Protects you in your car (Windshield). Protects you in your store!
- Breaks in large portions, allowing the form to be maintained by the laminate

BETTER - HEAT STRENGTHENED LAMINATE

- Provide adequate protection in most application and resists most thermal stresses
- Breaks in large chunks

GOOD - TEMPERED LAMINATES

- For high stress lites only and fails in a non-structural manner

BAD - TEMPERED

- Break & Grab

CRIMINAL

- Annealed



SUMMARY OF SECTION

LOADS

- Annealed thin plate glass was traditionally used in iconic houses
- Failure mode of annealed can simply be a strong wind gust
- Larger glass means more efforts, and requires heavier structures
- Deflection needs to be controlled
- 1" Overall will work up to 50 or even 65 SQF but beyond, will require thicker glass
- ASTM E1300 is the North American reference for calculation
- Table driven, and is being reworked to accommodate larger sizes

RAW MATERIALS

- Glass ribbon width is 130" – 3.3 m
- Glass ribbon length is 200 m
- Glass is cut into pieces that can be manipulated and transported
- 18 m X 3 m is current maximum for a heat treated, coated, laminated IGU
- 11.5 m X 2.5 m is the inside dimensions of a 40' container if glass is coming overseas
- Think how it will be manipulated

INTERLAYER

- Required most of the time to thicken glass
- 10 mm | 0.030" | 10 mm annealed laminate is cheaper than 19 mm tempered
- Laminate comes in a roll, and may have variable sizes
- PVB available in glass width
- SentryGlas rolls are 106" wide (but clever person seamed 130" roll)

WHAT TO USE ON A STOREFRONT

BEST - ANNEALED LAMINATE

- Protects you in your car (Windshield). Protects you in your store!
- Breaks in large portions, allowing the form to be maintained by the laminate

BETTER - HEAT STRENGTHENED LAMINATE

- Provide adequate protection in most application, and resists most thermal stresses
- Breaks in large chunks

GOOD - TEMPERED LAMINATES


- For high stress lites only and fails in a non-structural manner

BAD - TEMPERED

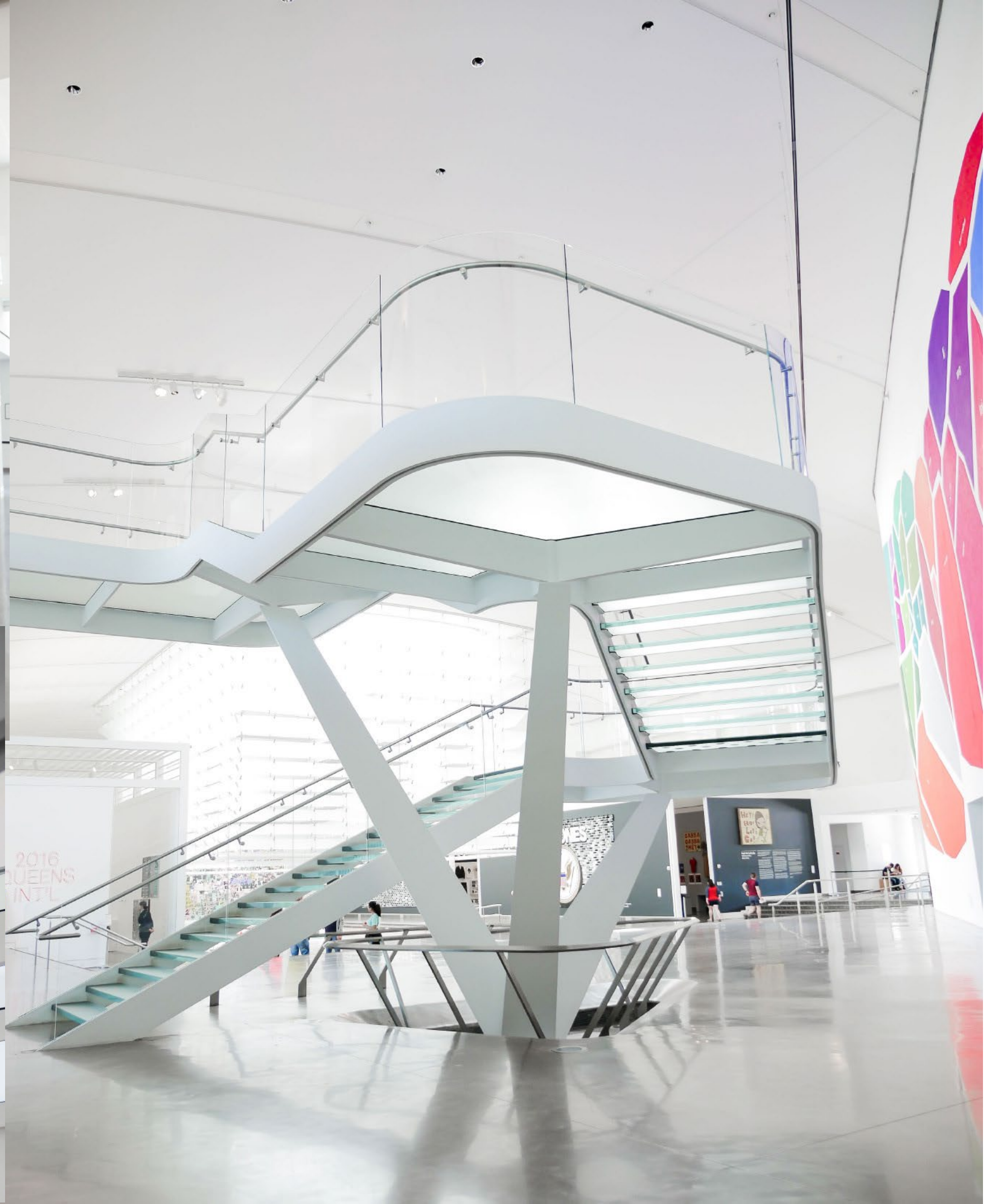
- Break & Grab

CRIMINAL

- Annealed



TRADE PRACTICES
YOU SHOULD KNOW



LOGISTICS



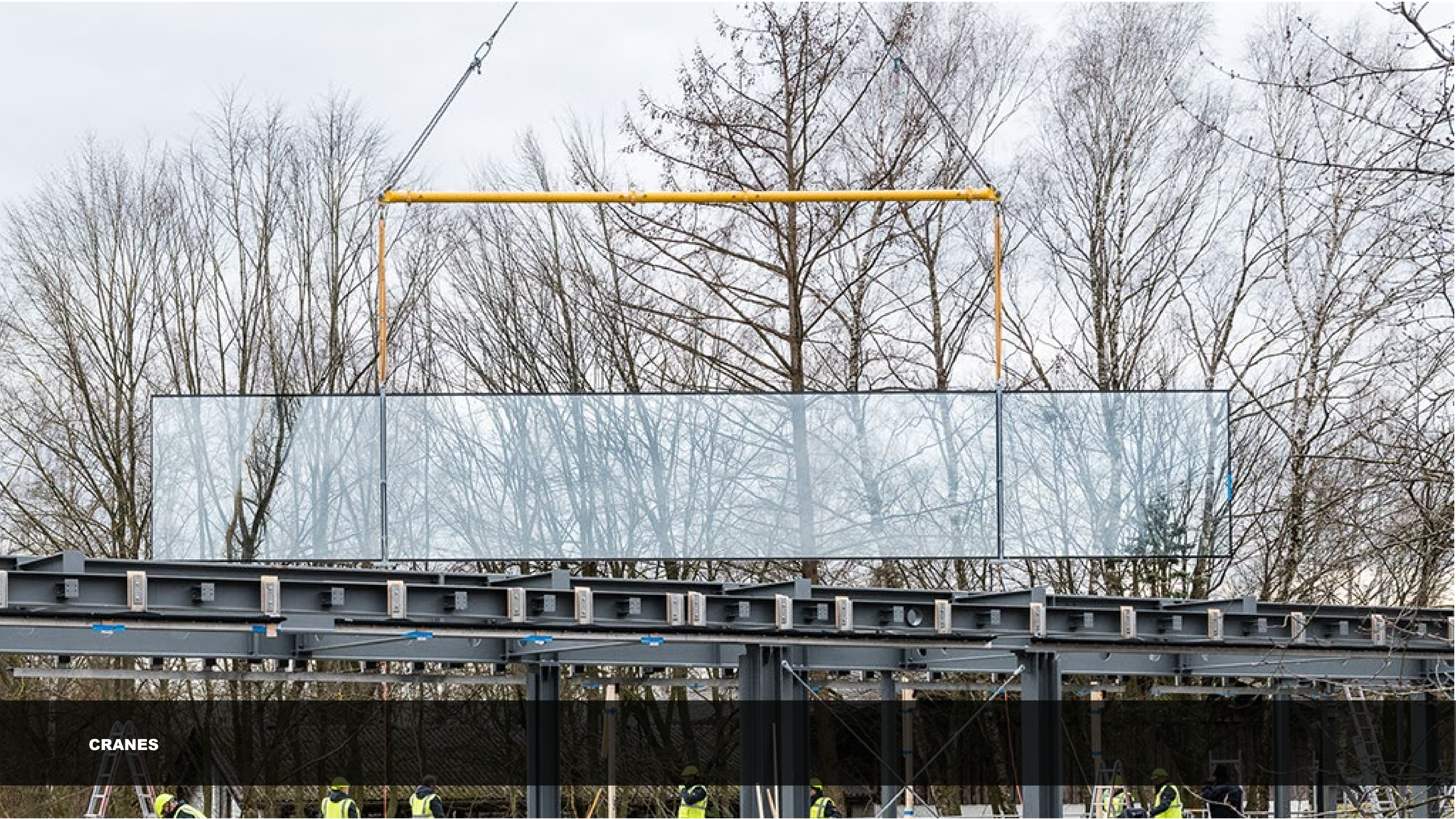
300" Double Drop Trailer >



GROUND BASED

HIGH CAPACITY - ROTATION





CRANES



MANIPULATORS

A NUGGET OF TRUTH:

INSTALL COST > GLASS COST

CHOOSE YOUR PARTNERS CAREFULLY.
DO IT RIGHT, THE FIRST TIME.



CN Tower walkable glass IGU
Suction Device holding oversized glass



SUMMARY OF SECTION

HEAT SOAK TEST

Cheap insurance: Buy it!

ON-SITE DIGITAL TEMPLATING

- Recreate “As Built” model
- No expensive wood templates
- 3D modelling
- 1/32” precision

LOGISTICS

- Safety First
- Figure out how you going to deploy before hand
- Work with your fabricator on packaging, labeling, sequencing
- Buy or rent the best equipment

Thank you!

