

# INNOVATIVE DESIGN APPLICATIONS USING **ADVANCED FIRE RATED GLAZING TECHNOLOGY**

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## LEARNING OBJECTIVES

- 🔥 Review the history of fire rated glass from foreign-made wire glass and ceramics to clear, high performance, USA-made solutions;
- 🔥 Understand the difference between fire protective and fire resistive glazing and how the IBC distinguishes between these two applications;
- 🔥 Examine how the architectural community's demand for large sizes, increased optical clarity, unobstructed views and thermal performance have shaped fire rated glazing product development. Case studies will be highlighted;
- 🔥 Discover the importance of multi-functional fire resistive glazing products providing additional performance features such as hurricane, blast, ballistic, forced entry and more. Case studies will be highlighted.



**LEARNING OBJECTIVE 1:**

# **HISTORY OF FIRE RATED GLASS**

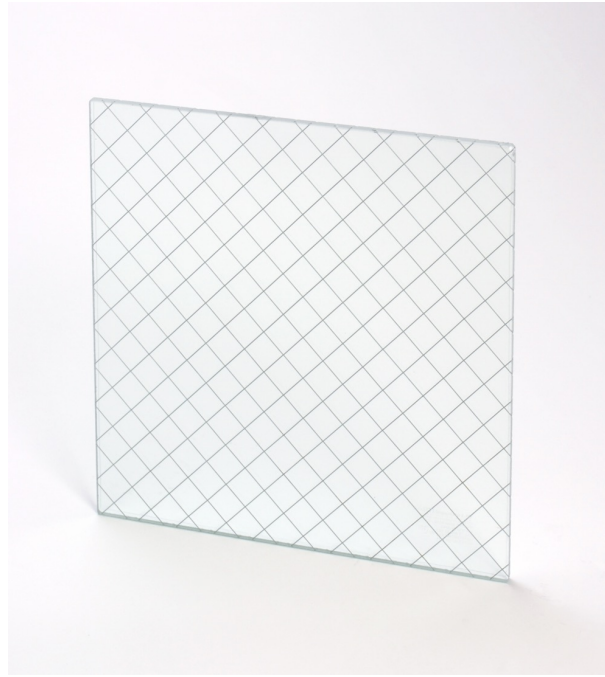
# EVOLUTION OF FIRE RATED GLAZING: OLD SOLUTION AND OLD TECHNOLOGY

*Old solution*



*Opaque - No Views*

*Old Technology*



*Wired Glass and Ceramics in small doorlites and openings*



## **WIRE GLASS AND CERAMICS USED IN DOORS, SIDELITES AND HAZARDOUS LOCATIONS HAVE TO BE FILMED OR LAMINATED TO PASS CURRENT CPSC SAFETY STANDARDS**



A federal safety glazing minimum standard established in 1977 to protect people from injuries due to accidental impact with glazing



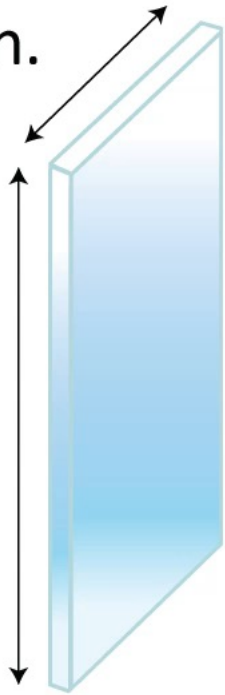
Two categories were established:

- CPSC 16 CFR 1201 Cat. I

- CPSC 16 CFR 1201 Cat. II

# CPSC 16 CFR 1201 CAT. I

**Less than**  
1296 sq. in.



Impact of  
**150 foot  
pounds**  
(small child)

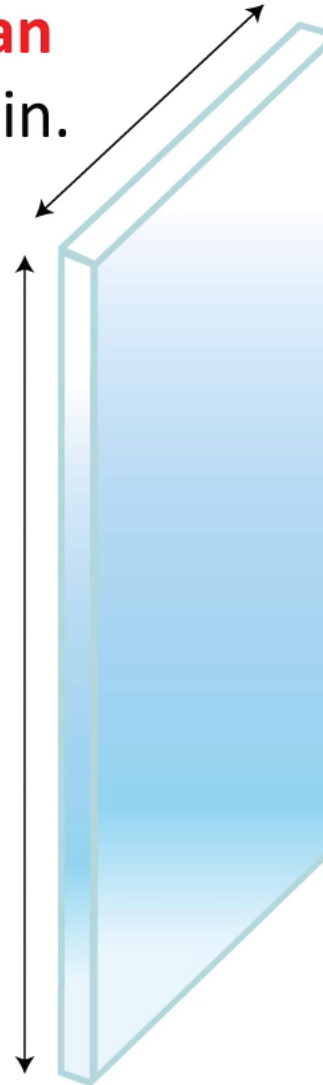
**Cat. I** = for small glazing areas  
*(less than 1296 square inches)*  
to survive impact of 150 foot  
pounds - a small child.



# CPSC 16 CFR 1201 CAT. II

**Cat. II** = for large glazing areas  
*(more than 1296 square inches)*  
to survive impact of 400 foot  
pounds - an adult.

**More than**  
1296 sq. in.



Survives  
impact of  
**400 foot**  
**pounds**  
(an adult)

# EVOLUTION OF FIRE RATED GLAZING: NEW SOLUTION, NEW TECHNOLOGY



*Fire protective glazing  
without wires or amber tints*



*Clear, transparent fire resistive  
glazing in large sizes*

# EVOLUTION OF FIRE RATED GLAZING: MULTI-FUNCTIONAL FIRE RESISTIVE GLAZING



**BALLISTIC**



**BLAST**



**HURRICANE**



**FORCED  
ENTRY**



**UV**



**ACOUSTIC**



**DECORATIVE**

# WHERE CAN **FIRE RATED GLASS** BE FOUND?



## **Fire Doors**

*Vision panels, sidelites & transoms*



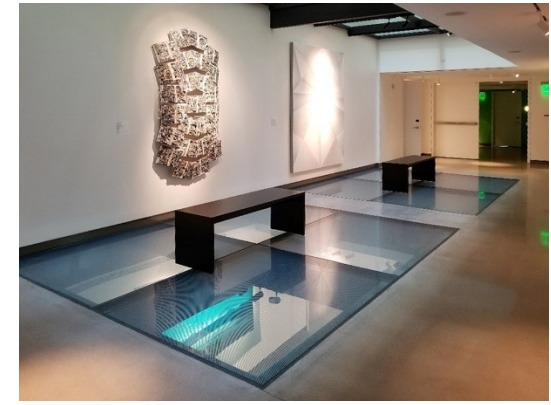
## **Fire Windows**

*Exterior windows & borrowed lites*



## **Fire Resistive Barriers**

*Non load-bearing walls & load-bearing walls*



## **Fire Resistive Floors**

*Non load-bearing & load-bearing*



**LEARNING OBJECTIVE 2:**

**FIRE PROTECTIVE  
VS. FIRE RESISTIVE**



# TWO THINGS YOU SHOULD KNOW BEFORE SELECTING A **FIRE-RATED GLASS** PRODUCT

- 🔥 Glazing fire test standards fall into two basic categories: *fire protective* standards or *fire resistive* standards.
- 🔥 Fire-rated glazing applications such as windows, doors, and walls, are rated to these fire test standards (*fire protective* and *fire resistive*).

## WINDOWS AND DOORS



***FIRE PROTECTIVE***



## WALLS



***FIRE RESISTIVE***

# IBC NOW DISTINGUISHES BETWEEN **FIRE PROTECTIVE** (OR FIRE PROTECTION) AND **FIRE RESISTIVE** (OR FIRE RESISTANCE)

**Doors/Sidelites/  
Transoms/Opening**

**FIRE PROTECTIVE**

NFPA 257/252/  
UL 9/UL 10B/UL 10C



Contains flame and smoke  
**45 minutes and under**

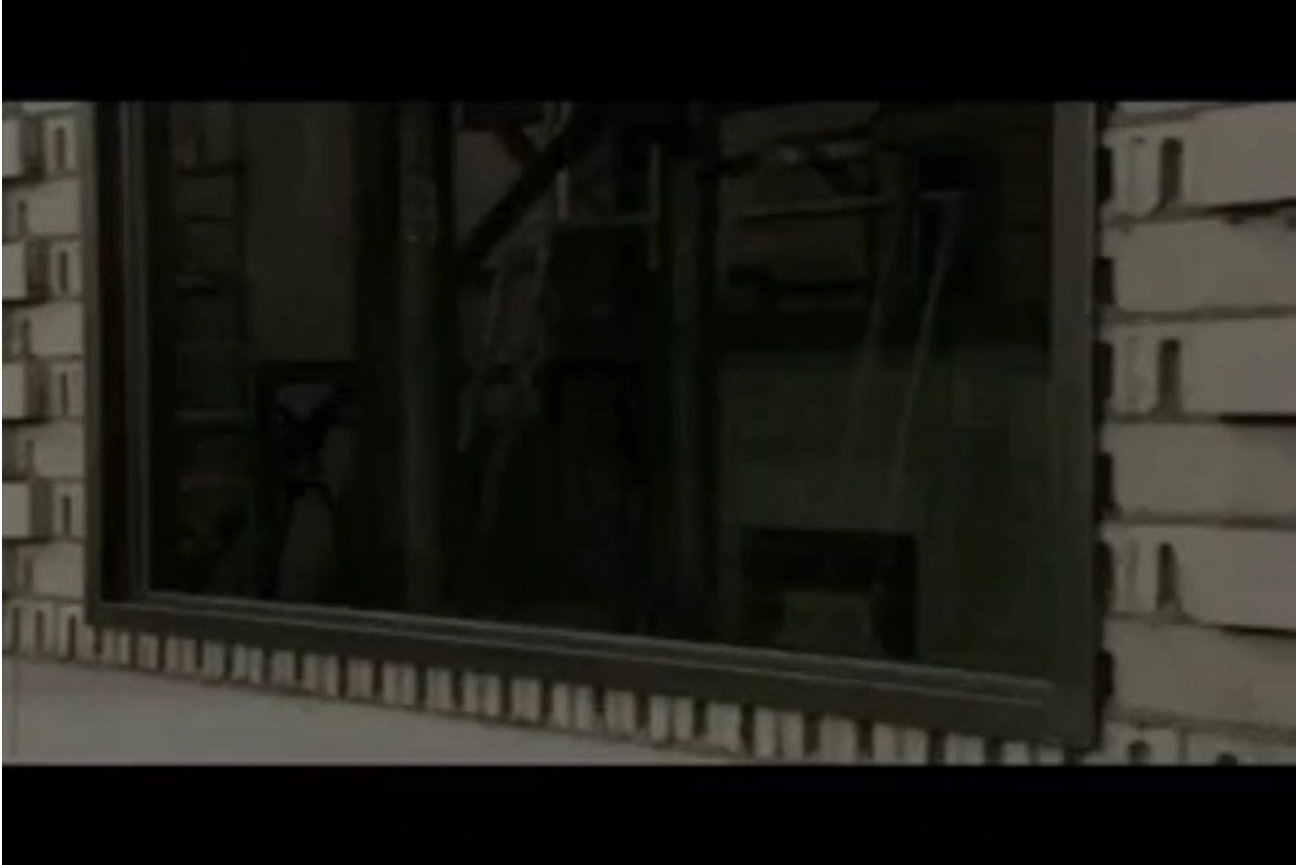
**Wall**

**FIRE RESISTIVE**

ASTM E119/  
NFPA 251/UL 263



Contains flame, smoke AND  
blocks radiant heat  
**over 45 minutes**



## **FIRE ENDURANCE TEST**

Determines the time a glazing product can withstand fire and extreme heat ( up to 1900°F+). If the glass remains in frame with no through openings and limits flame, it is certified for an endurance rating, 20 minutes to 3 hours. Fire resistance rated must also limit temp rise to average of 250F degrees.



## HOSE STREAM TEST

After the fire endurance test, water is delivered via hose stream from 20 feet away at 30 psi. ASTM E119 requires no glazing loss, NFPA 257 allows for 30% loss of glazing around the perimeter and 5% loss at center. Most, not all, fire rated glazing applications require a hose stream test.





# WHAT IS **RADIANT HEAT**?



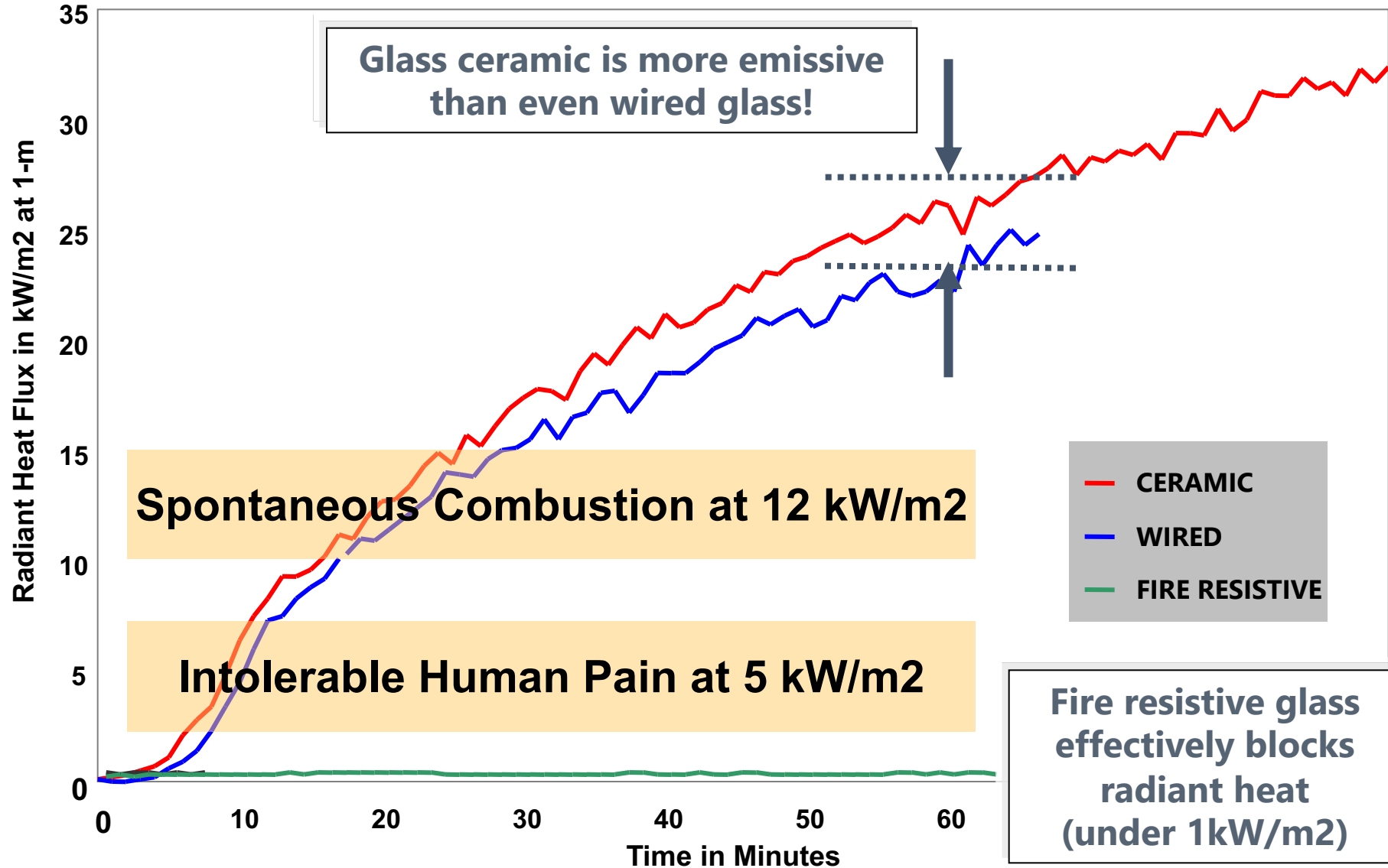
## RADIANT HEAT COMPARATIVE TEST

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The purpose of the test was to monitor the time to failure of these glazing products and to measure the radiation emanating from each specimen. Mannequins were placed in front of each specimen to monitor the time to ignition of clothing as ignited by the radiation under non-piloted conditions.

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# RADIANT HEAT FLUX: COMPARISON AT 60 MINUTES



## **FIRE RESISTIVE GLAZING TYPES IS DEFINED AS:**

Glazing tested as part of a fire resistance-rated assembly in accordance with ASTM E-119 or NFPA 251 (standard method of tests of fire endurance of building construction and materials).

### **ASTM E119**



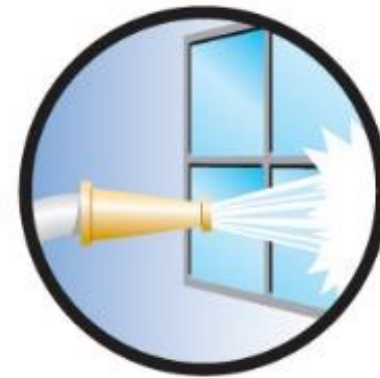
Fire Endurance Test

+



Radiant Heat Test

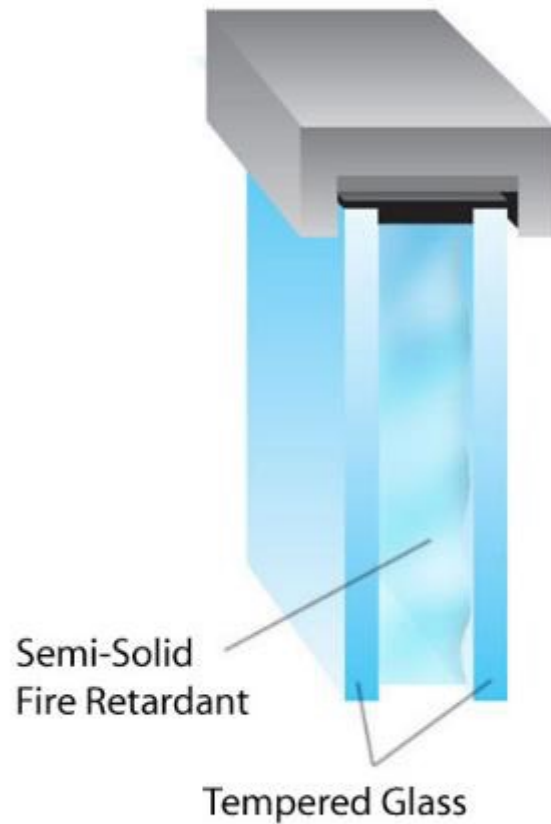
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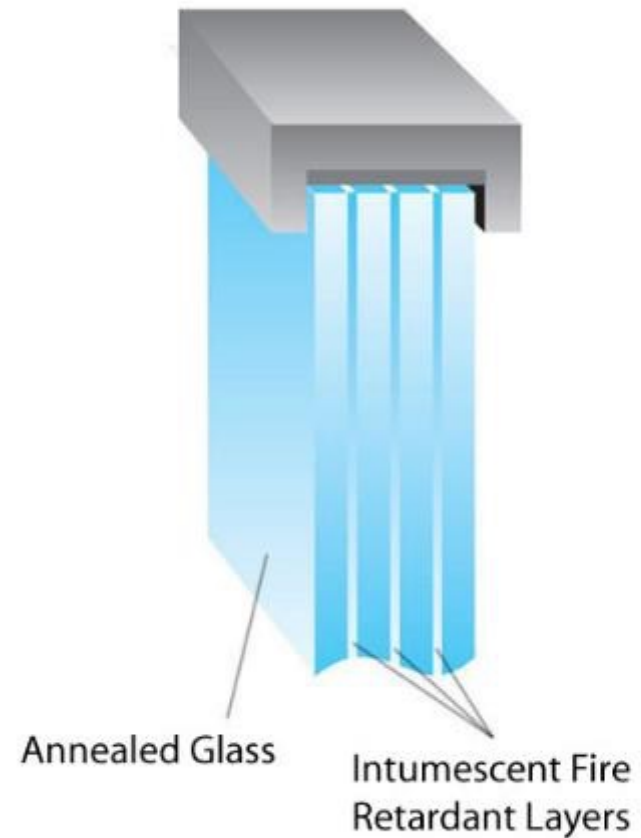
Hose Stream Test

# FIRE-RATED GLASS PRODUCTS THAT MEET FIRE RESISTIVE (WALL) REQUIREMENTS

Fire Retardant Filled Glass



Multi-Laminate Fire Retardant Glass



## **FIRE RESISTIVE GLAZING – TEST EXAMPLE**



**Glass exposed to fire**



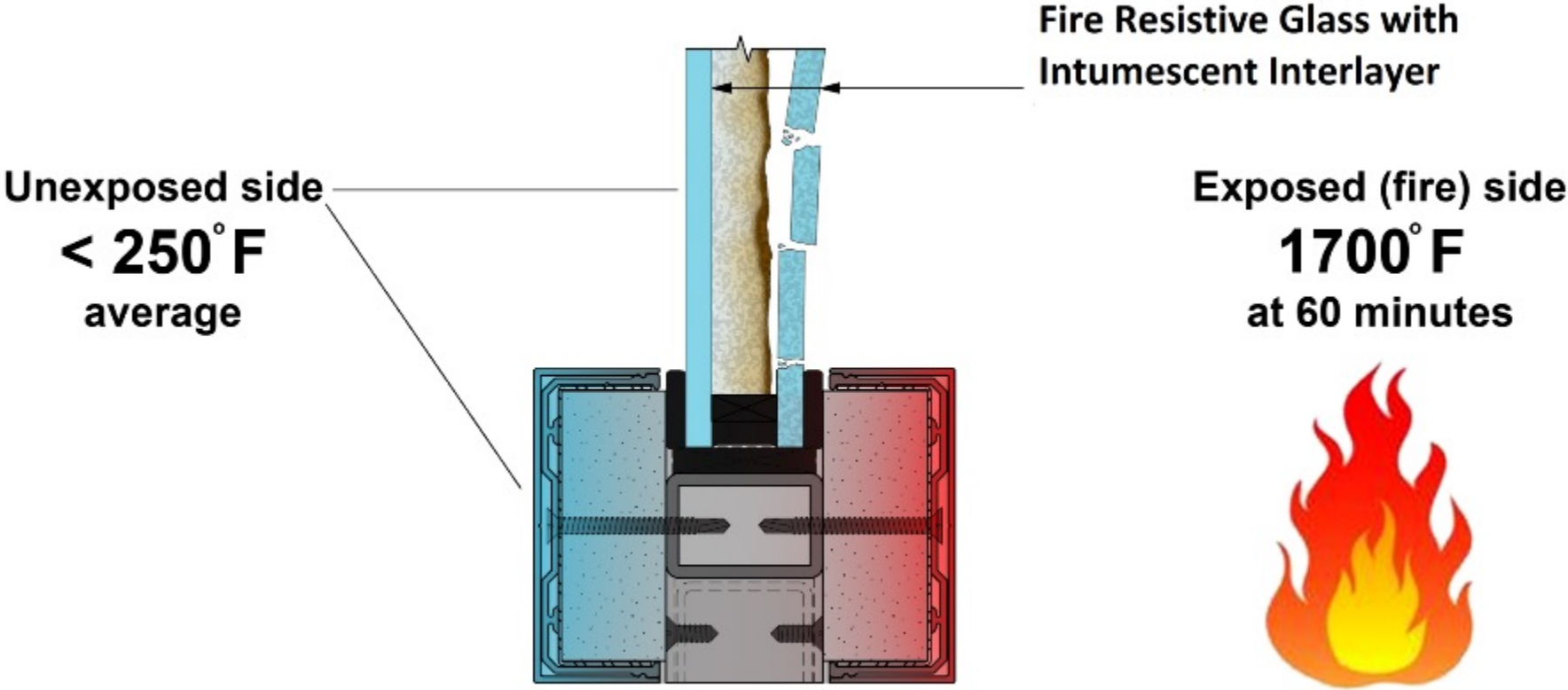
**Fire retardant forms into absorbing char**



**Glass temperature remains low,  
radiant heat is blocked**



# FIRE RESISTIVE FRAMING





## **LEARNING OBJECTIVE 3:**

**DEMAND FOR LARGE SIZES,  
OPTICAL CLARITY,  
UNOBSTRUCTED VIEWS AND  
THERMAL PERFORMANCE**



# LARGE SIZES

- 🔥 Maximum area of **10,000 sq. in.**
- 🔥 Maximum height or width up to **133"**
- 🔥 Temperature Rise Doors up to **10 ft.**

## CASE STUDIES:

- 🔥 *520 West 20<sup>th</sup> Street*
  - 🔥 *Starbucks Reserve Roastery*
- 

# 520 WEST 20<sup>TH</sup> STREET



**LOCATION:** NEW YORK, NY

**ARCHITECT:** MORRIS ADJMI ARCHITECTS

**GLAZIER:** VISION WALLS

- 🔥 *Re-purposing of historic manufacturing building into a mixed-use commercial space in Chelsea*
- 🔥 *3-story glass and steel addition to an existing 4-story brick warehouse.*
- 🔥 *Clear views to landmarks such as the Empire State Building and the Highline*
- 🔥 *Proximity to lot lines mandated 2-hour fire resistive requirements.*
- 🔥 *Each glazing panel is 11 ft. x 5 ft., which was unheard of at the time.*

## 520 WEST 20<sup>TH</sup> STREET (CONTINUED)



**LOCATION:** NEW YORK, NY

**ARCHITECT:** MORRIS ADJMI ARCHITECTS

**GLAZIER:** VISION WALLS

- 🔥 *Largest, individual lite installation of fire resistive glazing tested in the USA.*
- 🔥 *Incorporates low-iron glazing for superior optical clarity*
- 🔥 *Fire resistive glazing make-up includes high performance, energy efficient glazing*

# STARBUCKS RESERVE ROASTERY



**LOCATION:** CHICAGO, IL  
**ARCHITECT:** PERKINS + WILL  
**GLAZIER:** SG METALS & GLASS

- 🔥 *Largest Starbucks in the world.*
- 🔥 *6<sup>th</sup> Starbucks Reserve Globally and 3<sup>rd</sup> in the US.*
- 🔥 *Space used to be Crate & Barrell's flagship store in Chicago's Magnificent Mile, originally designed by Solomon Cordwell Buenz.*

*Photo from Starbucks Reserve website*

# STARBUCKS RESERVE ROASTERY (CONTINUED)



**LOCATION:** CHICAGO, IL  
**ARCHITECT:** PERKINS + WILL  
**GLAZIER:** SG METALS & GLASS

- 🔥 *Features 4-story mural by Chicago artist Euljio Ortega located in 2 hour stairwell.*
- 🔥 *To allow the mural to be visible through multiple floors, 2-hour fire resistive glazing in a butt-glazed wall application was used.*
- 🔥 *Each panel was over 10 ft. high x 4 ft. wide.*
- 🔥 *Incorporates low-iron glass for superior clarity and reduce distortion.*
- 🔥 *10 ft., 90-minute, temperature rise doors were used. No transom needed.*
- 🔥 *To exceed 100 sq. in. in the door vision area, 90 minute fire resistive glazing was used.*



# OPTICAL CLARITY

Incorporates **low-iron** glass for max. visible light transmission and reduced distortion

## CASE STUDY:

 *Harvard Business School Klarman Hall*





# HARVARD BUSINESS SCHOOL KLARMAN HALL

**LOCATION:** BOSTON, MA  
**ARCHITECT:** WILLIAM RAWN & ASSOCIATES  
**GLAZIER:** THE CHEVIOT CORPORATION




- 🔥 *State-of-the-art, 1,000 seat auditorium and gathering space.*
- 🔥 *The 2-hour glass wall separates the lobby from the auditorium while providing a visual connection between them.*
- 🔥 *Since this 2-hour glass wall also serves as the entrance to the auditorium, deciding on a 90-minute door system was of utmost importance.*



# HARVARD BUSINESS SCHOOL KLARMAN HALL (CONTINUED)



**LOCATION:** BOSTON, MA  
**ARCHITECT:** WILLIAM RAWN & ASSOCIATES  
**GLAZIER:** THE CHEVIOT CORPORATION

-  *The 2-hour fire resistive glazing used low-iron glass for superior clarity with a VLT of almost 90% - the highest in the industry for 2-hour fire resistive glass.*
-  *The glass walls were segmented in plan*
-  *The fire resistive framing's slim, 2-1/2" profile with equal sightlines and clean edges mimicked the look of aluminum storefront.*

# HARVARD BUSINESS SCHOOL KLARMAN HALL (CONTINUED)

**LOCATION:** BOSTON, MA  
**ARCHITECT:** WILLIAM RAWN & ASSOCIATES  
**GLAZIER:** THE CHEVIOT CORPORATION

- 🔥 *To ensure safe evacuation of the 1,000 seat auditorium, 6 pairs of 8 ft., 90-minute, full-vision temperature rise aluminum doors were used.*
- 🔥 *The temperature rise, aluminum doors were supplied with panic devices for quick egress.*
- 🔥 *Concealed vertical rods were incorporated in the doors, which was an important design element.*



# UNOBSTRUCTED VIEWS

- 🔥 Direct lines of sight to distilleries, wineries or manufacturing facilities to create an immersive visitor experience
- 🔥 **Butt-glazed** applications
- 🔥 **Unique** Applications

## CASE STUDIES:

- 🔥 *Old Forester Distillery*
- 🔥 *UW School of Business*
- 🔥 *Porsche Design Tower*




# OLD FORESTER DISTILLERY



**LOCATION:** LOUISVILLE, KY

**ARCHITECT:** BRAVURA ARCHITECTS

**GLAZIER:** KENTUCKY MIRROR & PLATE GLASS

-  *70,000 sq. ft. visitor center with a fully operational distillery, cooperage and bottling line on historic Whiskey Row.*
-  *Fire resistive glass walls were used in the Barrel Conveyor so visitors can see where the barrels are filled and brought down the main floor.*
-  *The glazing met the fire rated code requirements of a 3-story shaft while maintaining a visual connection.*

# UNIVERSITY OF WISCONSIN SCHOOL OF BUSINESS LEARNING COMMONS

**LOCATION:** MADISON, WI  
**ARCHITECT:** POTTER LAWSON/MSR  
**GLAZIER:** OMNI GLASS & PAINT




- 🔥 *Typically, stairwells are dark and tucked away in building.*
- 🔥 *This re-imagined, 1 hour stairwell is transparent, centrally located and ideal for everyday use.*
- 🔥 *Clear, butt-glazed fire resistive walls provided ultimate transparency while meeting code requirements.*
- 🔥 *9ft., 60 minute, temperature rise, aluminum doors were used to eliminate transoms.*
- 🔥 *To exceed 100 sq. in. in the door vision area, 60 minute fire resistive glazing was used.*



# PORSCHE DESIGN TOWER



**LOCATION:** SUNNY ISLES, FL  
**ARCHITECT:** SIEGER SUAREZ ARCHITECTS  
**GLAZIER:** CONTINENTAL GLAZING SYSTEMS

-  *Features three fully automated car elevators taking residents from the garage to their units.*
-  *Elevator shaft enclosures are required to meet fire rated requirements. To ensure transparency, an interior, segmented fire resistive curtainwall was used.*
-  *Resident can remain in their car and enjoy ocean front views as they ascend to their units.*

## PORSCHE DESIGN TOWER (CONTINUED)

**LOCATION:** SUNNY ISLES, FL  
**ARCHITECT:** SIEGER SUAREZ ARCHITECTS  
**GLAZIER:** CONTINENTAL GLAZING SYSTEMS

- 🔥 *Residents of this 60-story luxury residential project to park their cars in glass-walled sky garages adjacent to their units.*
- 🔥 *To maintain transparency and meet fire rated requirements between the sky garage and living space, fire resistive glazing and framing was used for the 130 units.*







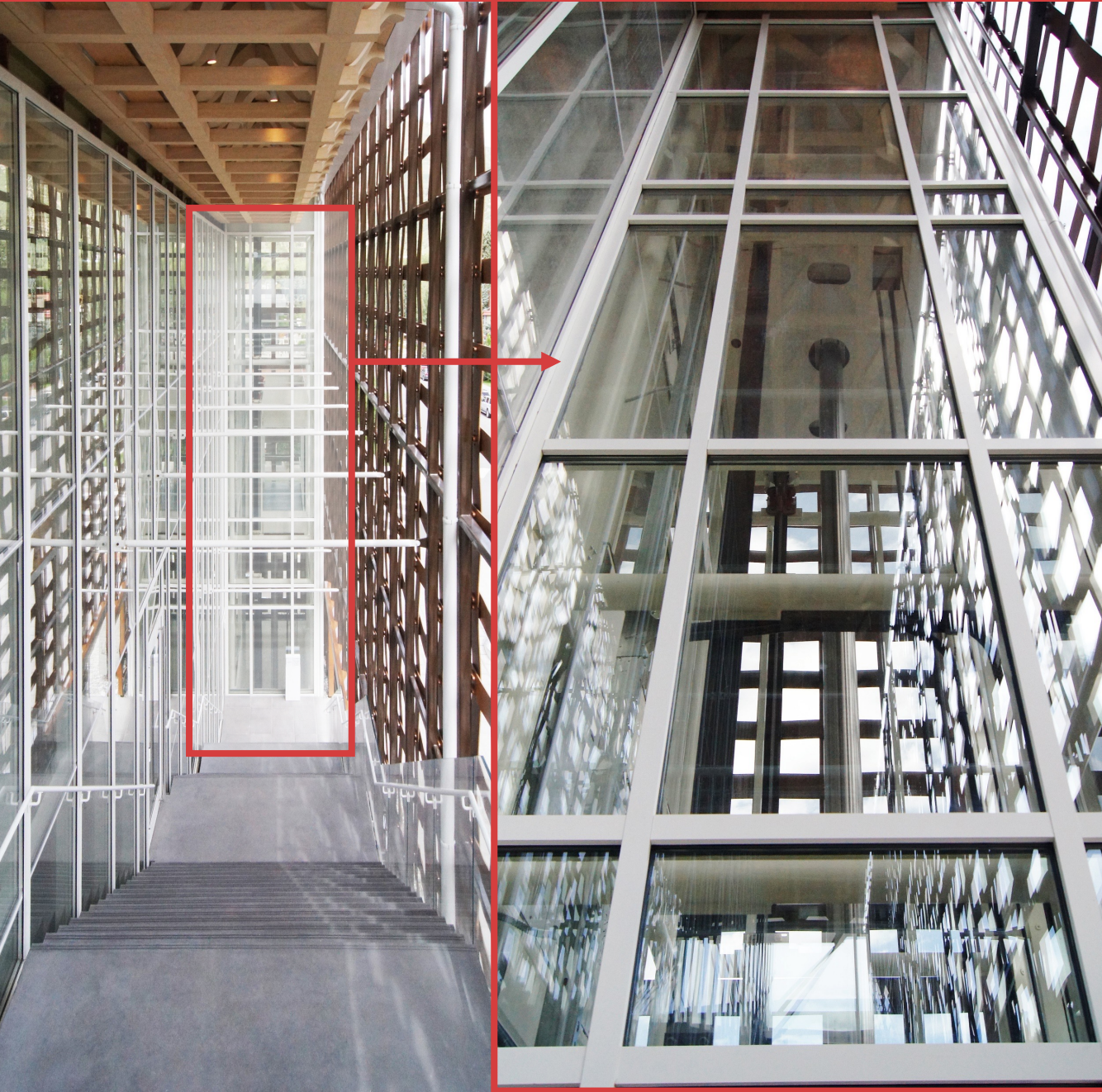
# THERMAL PERFORMANCE

- 🔥 Incorporating high performance glazing for **energy efficiency and occupant comfort**
- 🔥 Approved fire rated glass and framing components in **NFRC CMAST**

## CASE STUDY:

- 🔥 *Aspen Art Museum*
- 

# ASPEN ART MUSEUM



**LOCATION:** ASPEN, CO  
**ARCHITECT:** SHIGERU BAN ARCHITECTS/CCY ARCHITECTS  
**GLAZIER:** HARMON INC.

- 🔥 *One of the most anticipated buildings in 2014*
- 🔥 *Designed by Pritzker prize winning architect Shigeru Ban*
- 🔥 *A woven wooden screen encloses the glass curtain wall.*
- 🔥 *Sections of the glass curtain wall also functions as an elevator enclosure, it had to meet the fire resistive wall criteria ASTM E-119 for 2 hours.*
- 🔥 *Since it is still exposed to the elements, it needed to be able to perform in extreme climates.*




# ASPEN ART MUSEUM (CONTINUED)



**LOCATION:** ASPEN, CO

**ARCHITECT:** SHIGERU BAN ARCHITECTS/CCY ARCHITECTS

**GLAZIER:** HARMON INC.

-  *2-hour fire resistive curtain wall incorporated high-performance, energy efficient glazing.*
-  *Thermal analysis was performed on the 2-hour fire resistive curtain wall to ensure that it insulated as well as the non-rated IGUs.*
-  *In addition, dynamic curtain wall testing, thermal cycling and condensation evaluation were also performed.*



**LEARNING OBJECTIVE 4:**

**DEMAND FOR  
MULTI-FUNCTIONAL  
FIRE RATED GLAZING  
PRODUCTS**



# FIRE AND HURRICANE RATED

- 🔥 Meets **FL Product Approval**
- 🔥 Approved for **HVHZ** (High Velocity Hurricane Zone) Areas
- 🔥 Meets **TX Department of Insurance Approval**





## CASE STUDY:

- 🔥 *VA Orlando Medical Center*
- 

# VA ORLANDO MEDICAL CENTER



**LOCATION:** ORLANDO, FL  
**ARCHITECT:** RLF  
**GLAZIER:** HARMON INC.

-  *2-hour fire resistive, hurricane rated curtain wall.*
-  *Tested to TAS 201 (Large and Small Missile Standards), TAS 202 (Uniform Structural Load Standards) and TAS 203 (Uniform Cyclic Pressure Test Standards).*
-  *Incorporates high performance energy efficient glazing.*
-  *Shipped as factory-glazed, modular units for easy installation.*



# FIRE AND BLAST RATED

- 🔥 Meets **United Facilities Criteria** (UFC 4-010-01)  
Department of Defense Antiterrorism  
Standards for Building

## CASE STUDY:

- 🔥 *Army Hospital in the West Coast*
- 

# ARMY HOSPITAL IN THE WEST COAST

**ARCHITECT:** RLF/US ARMY CORPS OF ENGINEERS

**GLAZIER:** SASHCO

- 🔥 *This hospital was classified as a “critical facility” thus additional hardening requirements for blast hazard mitigation were required per **DoD UFC 4-010-01** Antiterrorism Standards for Buildings and **ASTM F2248**: Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass.*
- 🔥 *Sections of the curtain wall also had to meet 2-hour fire resistive ratings.*
- 🔥 *The design called for a fire and blast rated curtain wall that spanned 45 feet and canted out a few degrees.*







# FIRE, BALLISTIC AND FORCED ENTRY RATED

- 🔥 Used in detention facilities and more recently in educational facilities
- 🔥 Meets up to **UL 752 Level 8 Ballistic**
- 🔥 Meets **ASTM F1915 Grades 1-4**

## CASE STUDY:

- 🔥 *Plaquemines Parish Detention Center*
- 

# PLAQUEMINES PARISH DETENTION CENTER



**LOCATION:** DAVANT, LA  
**ARCHITECT:** L.R. KIMBALL  
**GLAZIER:** GLASS INC.

- 🔥 *Damaged by Hurricane Katrina and Congress allocated funds through FEMA to build a replacement facility.*
- 🔥 *New design called for wire-free, 45-minute fire rated, UL Level 3 ballistic and ASTM F1915 Grade 2 forced entry glazing in the control room and corridors.*
- 🔥 *New design specified glazing for the common areas to give supervisors line of sight while still providing secure separation, physical containment and protection against forced entry and ballistic attack.*

# PLAQUEMINES PARISH DETENTION CENTER (CONTINUED)



**LOCATION:** DAVANT, LA  
**ARCHITECT:** L.R. KIMBALL  
**GLAZIER:** GLASS INC.

- 🔥 *Wire-free, 45-minute fire rated, UL Level 3 ballistic and ASTM F1915 Grade 2 forced entry glazing was provided in the control room and corridors.*
- 🔥 *Fire rated, ballistic rated framing incorporated aluminum caps that covered all the screws, eliminating the potential of tampering with the frames.*

# FIRE RATED DECORATIVE GLAZING

- 🔥 Incorporates pattern glass, stained glass or printed glass

## CASE STUDIES:

- 🔥 *Central Subway Station*
- 🔥 *University of Michigan School of Law*

# CENTRAL SUBWAY STATION IN UNION SQUARE

**LOCATION:** SAN FRANCISCO, CA  
**ARCHITECT:** ROBIN CHIANG & CO.  
**GLAZIER:** ACR GLAZING CO.

- 🔥 *2 hour fire resistive glass floor with decorative glazing by San Francisco visual artist Hughen/Starkweather.*
- 🔥 *Fire resistive glass floor enables natural light to reach the space below.*
- 🔥 *Modular, top-loaded design for easy installation.*
- 🔥 *USA-made fire rated glass floor and structural framing met Buy American requirement of the project.*




*Architectural rendering of Union Square Central Subway Station*



# UNIVERSITY OF MICHIGAN SCHOOL OF LAW HUTCHINS HALL



**LOCATION:** ANN ARBOR, MI  
**ARCHITECT:** HARTMAN-COX AND  
INTEGRATED DESIGN SOLUTIONS  
**GLAZIER:** EDWARDS GLASS

-  *The addition of the new learning commons created a lot line requirement with the University's own property.*
-  *The existing stained glass windows in the adjacent Hutchins Hall now need to meet 2-hour fire resistive requirements.*
-  *Preserving Hutchins Hall's original appearance was of utmost importance.*

# UNIVERSITY OF MICHIGAN SCHOOL OF LAW HUTCHINS HALL (CONTINUED)



**LOCATION:** ANN ARBOR, MI  
**ARCHITECT:** HARTMAN-COX AND  
INTEGRATED DESIGN SOLUTIONS  
**GLAZIER:** EDWARDS GLASS

- 🔥 *To meet code requirements, 2-hour fire resistive glazing were installed in the openings.*
- 🔥 *The existing stained glass and the newly created matching stained glass were installed on both sides of the clear, fire resistive 2-hour glazing.*
- 🔥 *Decorative limestone was added to cover the tube steel framing and complete the look.*

# FIRE RATED PRIVACY GLAZING

- 🔥 Privacy when you need it, transparency when you don't
- 🔥 Typically incorporates integrated blinds or electrified switchable privacy glass
- 🔥 More hygienic and easier to maintain than curtains or external blinds that trap dust and other allergens.

## CASE STUDY:



- 🔥 *University of Chicago Medical Center*



# UNIVERSITY OF CHICAGO MEDICAL CENTER



**LOCATION:** CHICAGO, IL  
**ARCHITECT:** ALBERT KAHN ASSOCIATES  
**GLAZIER:** GLASS SOLUTIONS INC.

-  *The medical and surgical floors had nurse's stations outside the patient rooms. Glazing was used so staff can observe from the outside.*
-  *Most of these rooms required 45 minute glazing.*

45 minute Windows  
in **Clear Mode**

45 minute Windows  
in **Privacy Mode**

# UNIVERSITY OF CHICAGO MEDICAL CENTER (CONTINUED)



45 minute Windows  
in **Clear Mode**

45 minute Windows  
in **Privacy Mode**

**LOCATION:** CHICAGO, IL  
**ARCHITECT:** ALBERT KAHN ASSOCIATES  
**GLAZIER:** GLASS SOLUTIONS INC.

- 🔥 *Electrified switchable privacy glass was incorporated with the 45-minute glazing to enable privacy.*
- 🔥 *Incorporating privacy glass instead of curtains and external blinds kept the rooms hygienic, which was important for patient recovery.*

# QUESTIONS?

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