Subject: BUILDING MATERIALS AND PROCESSES – II

Topic: Glass and Glazing

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Glass & Glazing
part -1

Glass & Glazing

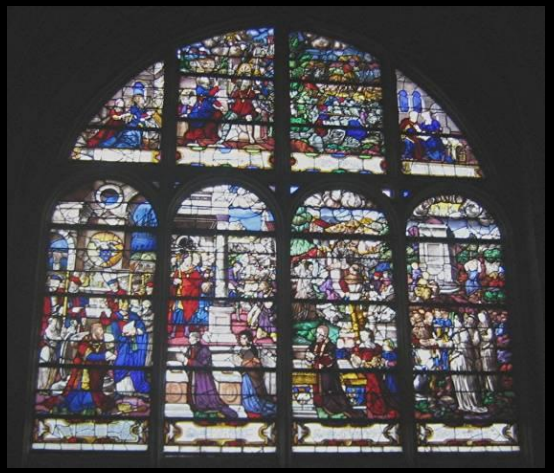
- Glass Ingredients
- Glass types
  - blown
  - plate
  - float
- Heat Treated Glass
  - tempered glass
  - heat strengthened glass
- Laminated Glass
- Fire Rated Glass
- Fritted Glass
- Spandrel Glass
- Insulating Glass
- Low Emissivity Glass
- Tinted & Reflective Coated Glass
  - mirrors

Glass Ingredients

- sand

  approx. 70% by weight
- soda ash
- lime

Flat Glass History

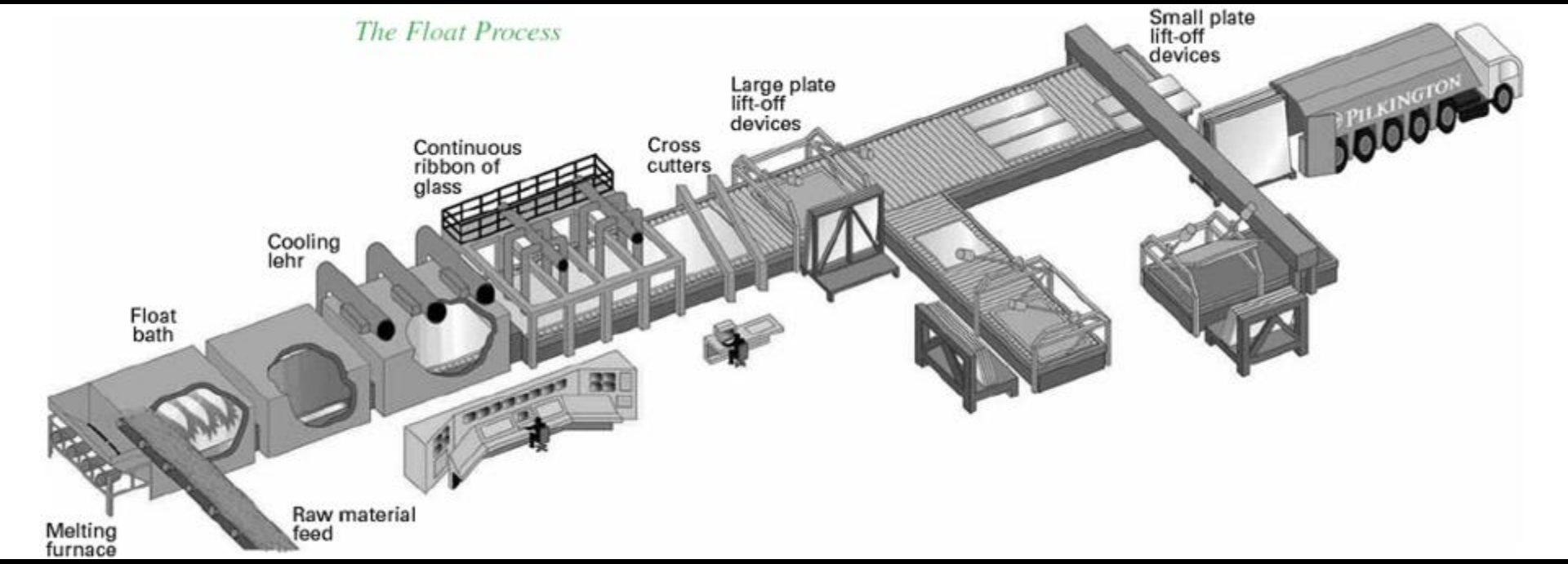


- Blown
  - cylinder glass blown, reheated and flattened.
- Plate
  - late 17th century, high enough in quality for mirrors
- Float
  - invented in 1959 by Pilkington Brothers
  - now the standard for glassmaking

Float glass

- Process introduced in 1959 by Pilkington Brothers
- Float Glass Manufacturing Process video

  http://www.glasswebsite.com/video/fgmd.asp



Annealing Glass

Annealing: cooling glass at a slow controlled rate to counteract internal stresses. This is done in a kiln known as a Lehr.

http://www.youtube.com/watch?v=qBlsNNPRseQ

Glass Thickness

- For window/building glass: 1/8” to 1 inch

Glass Treatment

- Heat Treated

Prince Rupert's Drop

1.www.youtube.com/watch?v=6V2eCFsDkK0&eurl=http%3A%2F%2Fvideo.google.com%2Fvideosearch%3Fq%3Dprince%2520ruperts%2520drop%26rls%3Dcom.microsoft%3Aen-us%26oe%3DUTF-8%26startIndex%3D%26startPage%3D1%26um%3D1%26ie%3DU&feature=player_embedded

2. Showing the release of tension forces
http://www.youtube.com/watch?v=8-GOwtikSO0&NR=1

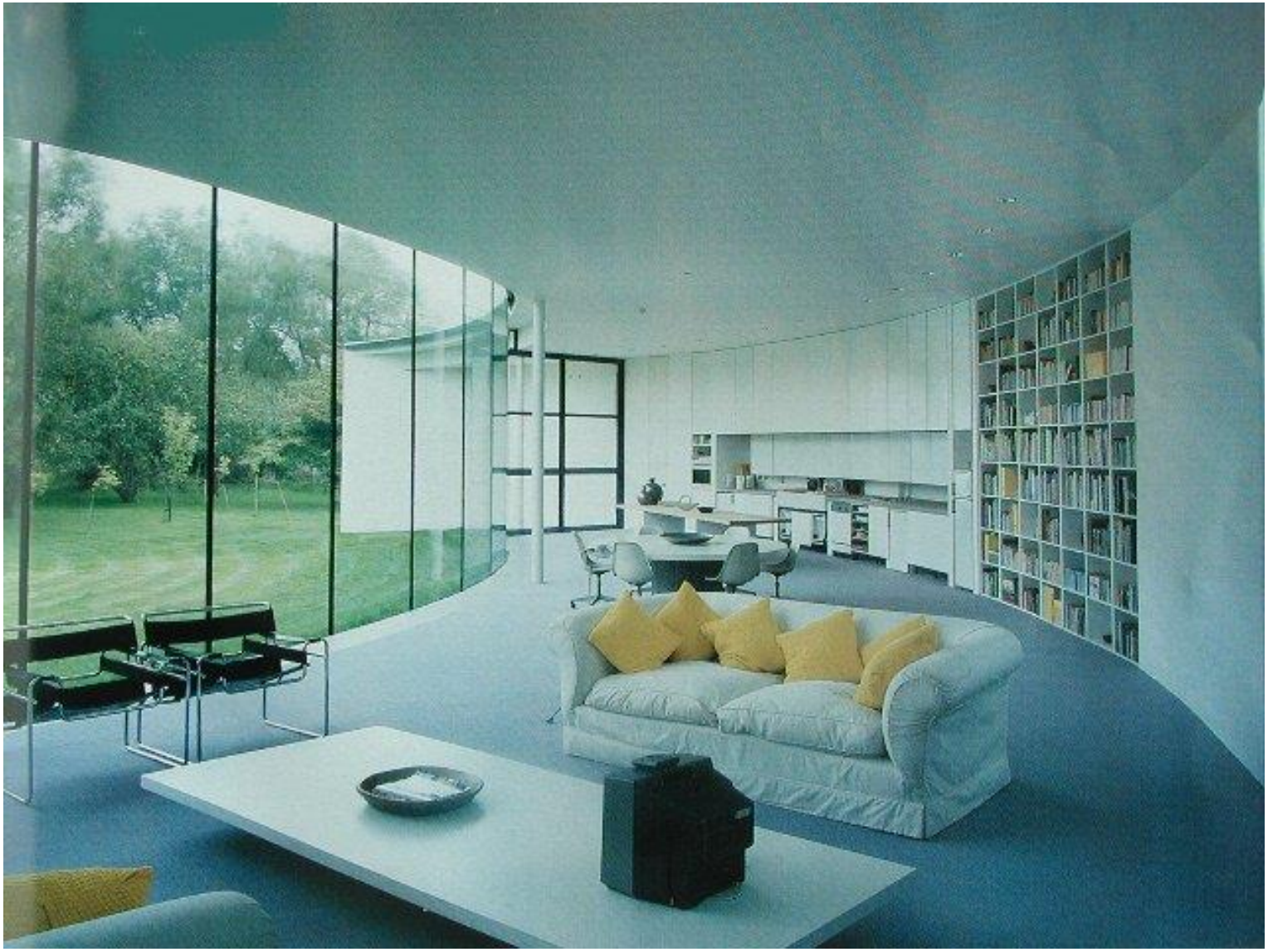
Glass Treatments for Strength

- Three methods to strengthen Annealed Glass

  - **heat strengthened**
    - 2x times stronger than annealed
    - less distortion than tempered
    - breaks like annealed glass into long sharp edge shards

  - **tempered**
    - 4x times stronger than annealed
    - some noticeable distortion
    - cannot be drilled or cut
    - breaks into small square edge granules
    - since 1977 Federal law has required glass located within 18 in of a floor or doorway to be tempered.

  - **laminated**

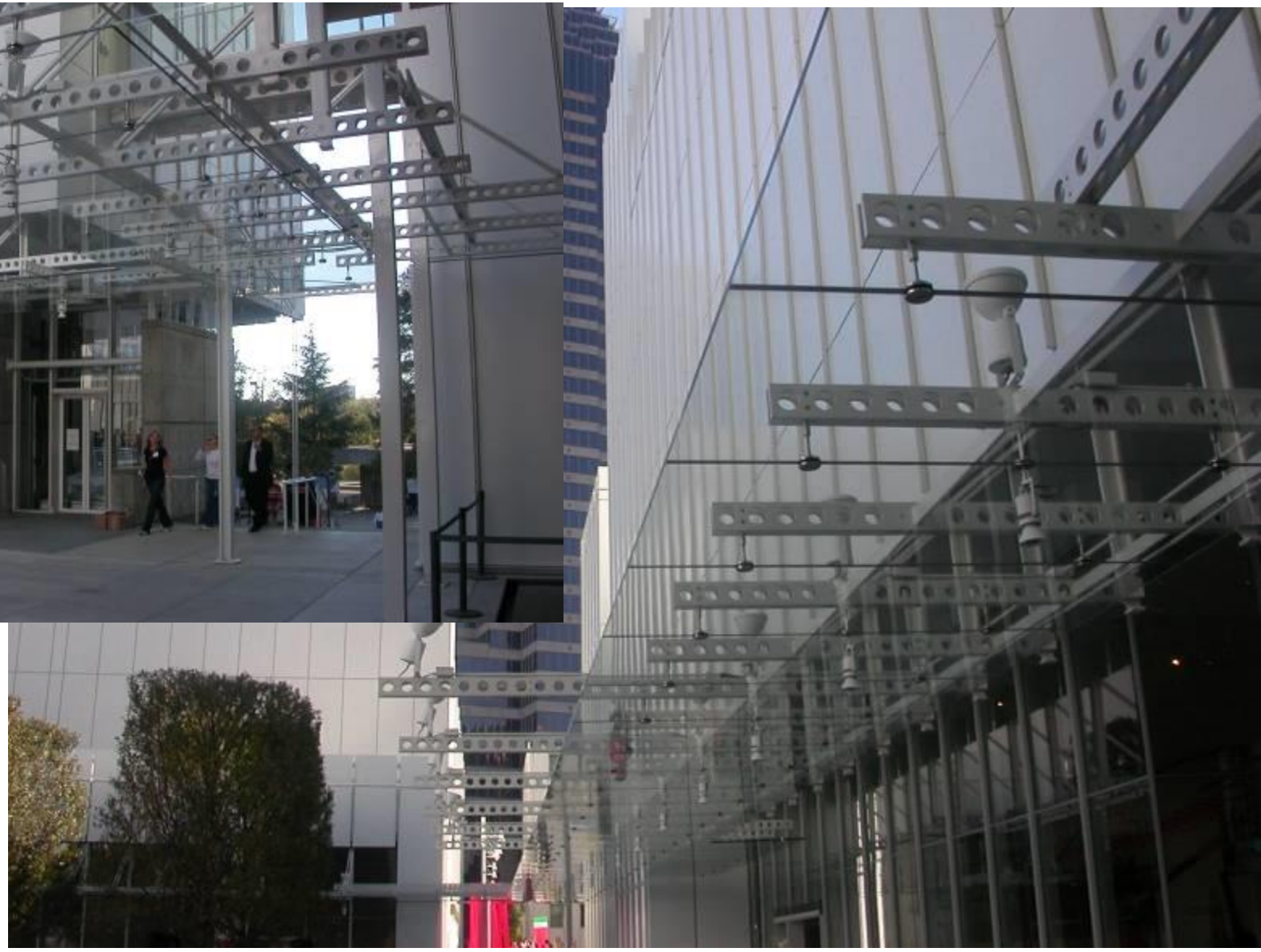


Tempered Glass is annealed glass that is reheated and rapidly cooled, which strengthens the glass and causes it to break into pea-sized pellets if subject to impact.

Laminated Glass

- ***Laminated Glass*** is made by sandwiching a transparent polyvinyl butyric (PVB) interlayer between sheets of glass bonding the three layers together under heat and pressure.
- When laminated glass breaks, the plastic sheet holds the broken glass in place, thus reducing the risk of injury in case of breakage.

The Entry canopy at the High Museum is made of laminated glass supported by stainless steel spider fittings that transmit the weight of the roof to cantilevered steel beams.



How laminated glass is made: http://www.glasswebsite.com/video/laminating.asp

Wire Glass

- Glass that remains intact and restricts the expansion of fire.

- Its made by placing wire mesh in the middle of glass during the manufacturing process.

Fire Rated Glass

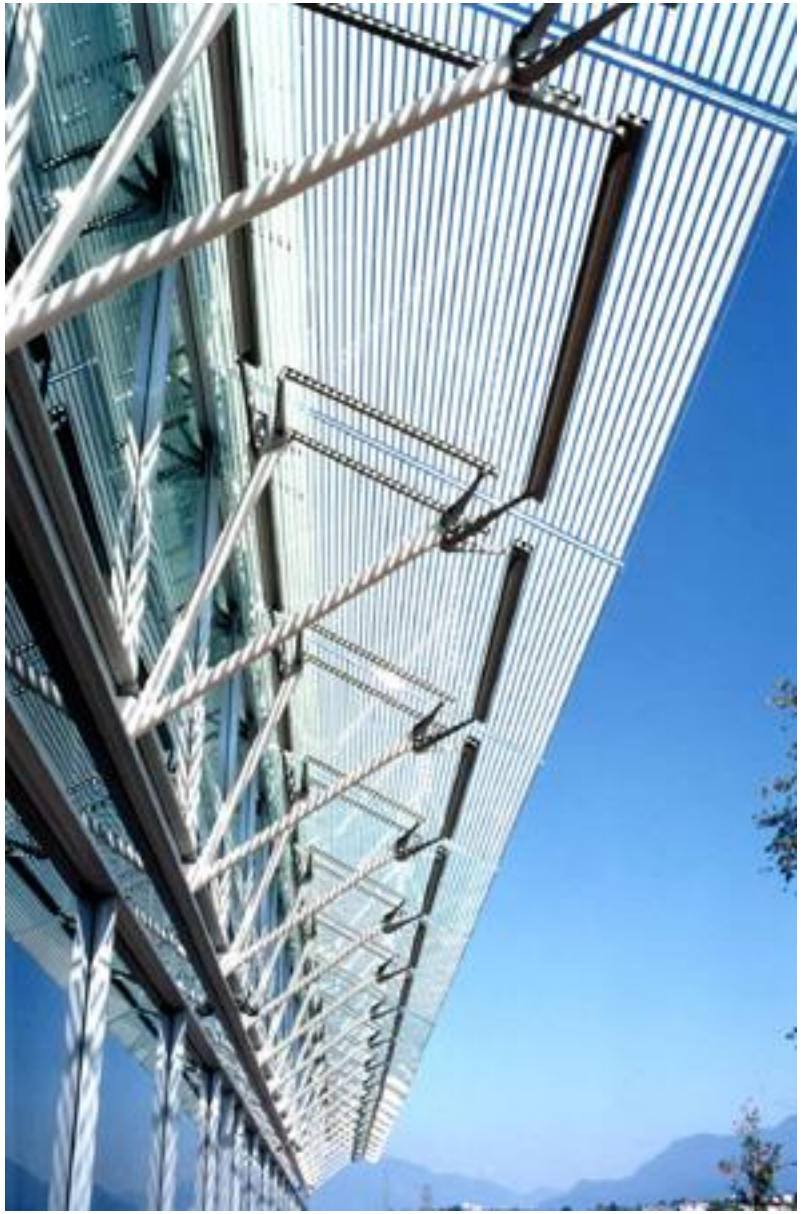
- Wire Glass
  - inserting wire mesh in the glass producing process
  - in fire glass remains intact under thermal stress and acts as a fire barrier
  - 45 minute fire rating
- Ceramic Glass
  - optically clear
  - 20 minute to 3 hour ratings

Fire Rated Glass Video (21 minutes)
http://www.fireglass.com/offer-kit/video/

TABLE 601
FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS (hours)

BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A[d]	B	A[d]	B	HT	A[d]	B
Structural frame[a] Including columns, girders, trusses	3[b]	2[b]	1	0	1	0	HT	1	0
Bearing walls Exterior[f]	3	2	1	0	2	2	2	1	0
Interior	3[b]	2[b]	1	0	1	0	1/HT	1	0
Nonbearing walls and partitions Exterior	See Table 602								
Nonbearing walls and partitions Interior[e]	0	0	0	0	0	0	See Section 602.4.6	0	0
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	1 1/2[c]	1[c]	1[c]	0[c]	1[c]	0	HT	1[c]	0

Fritted Glass

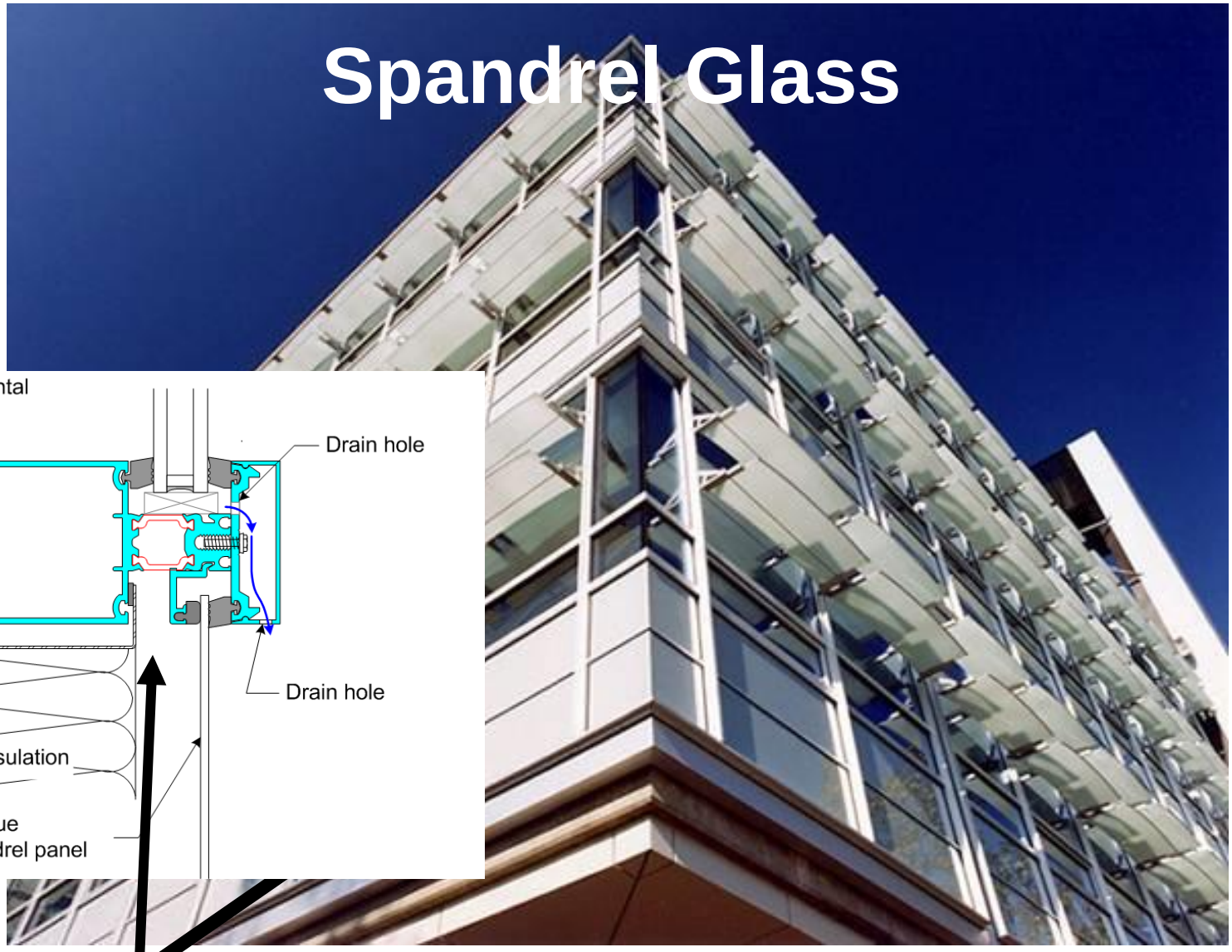


Glass that has an imprint on the surface with silk screened patterns of ceramic based paint. Paint is fired in a glass furnace to transform into a hard ceramic permanent coating.

The paint consist primarily of pigmented glass particles that are called ***frits***.

Typical patterns are stripes or dots, but custom designs are easily reproduced.

Spandrel Glass

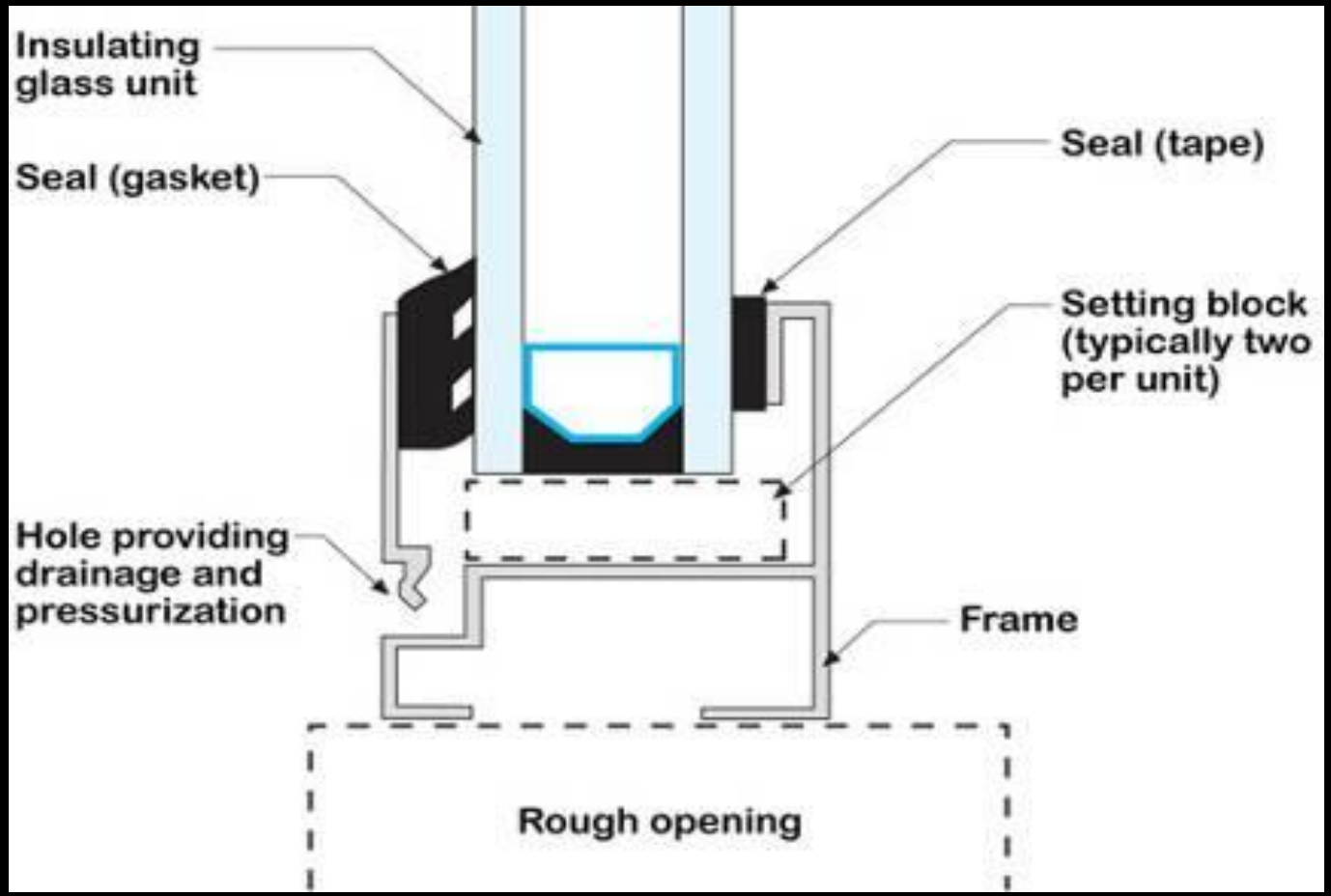


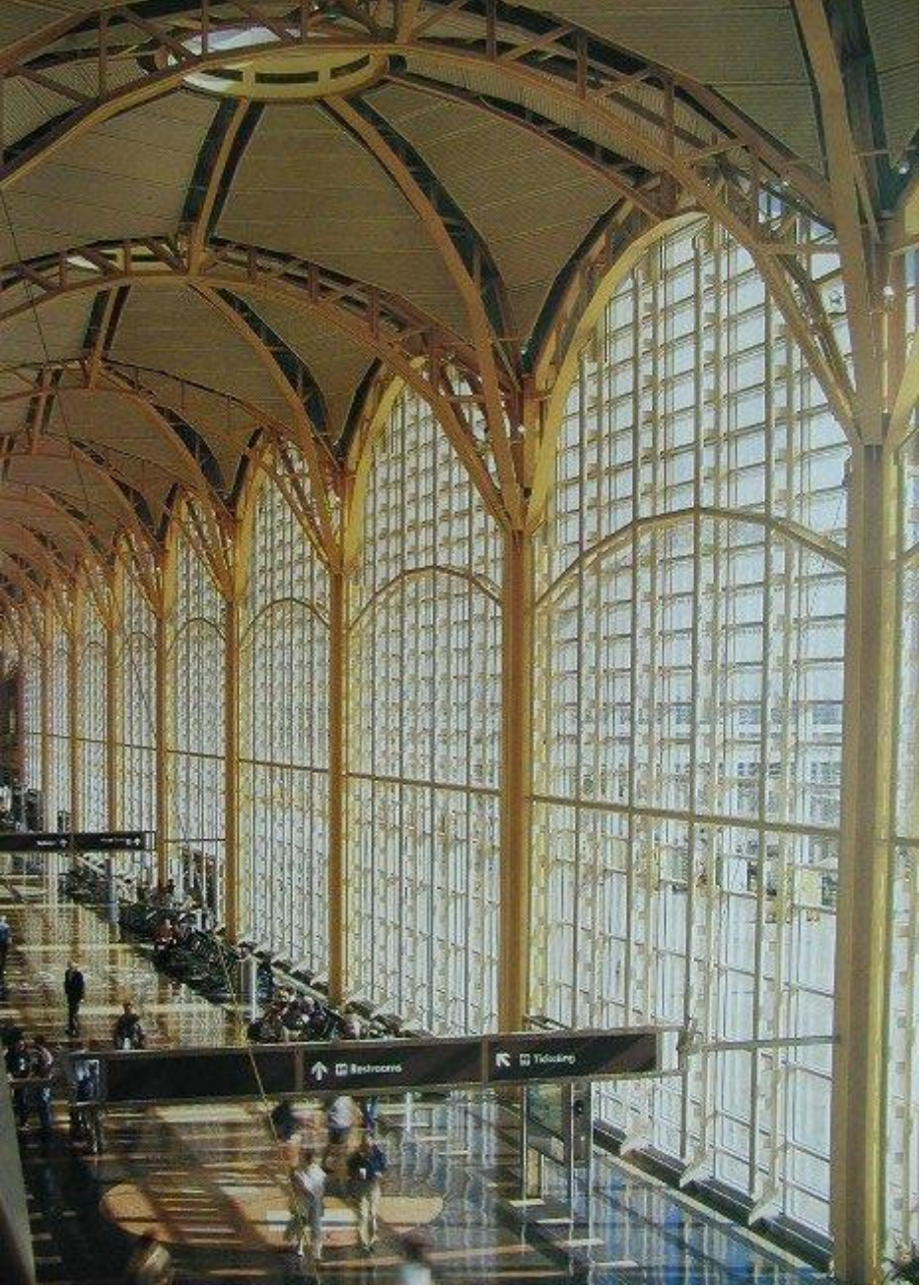
Opaque glass used for covering the bands of wall around the edges of floors

DGU:Insulating glass consists of two or more sheets of glass separated by a hermetically sealed air space.

Argon Gas is most commonly used in the airspace

Most types of glass can be used.

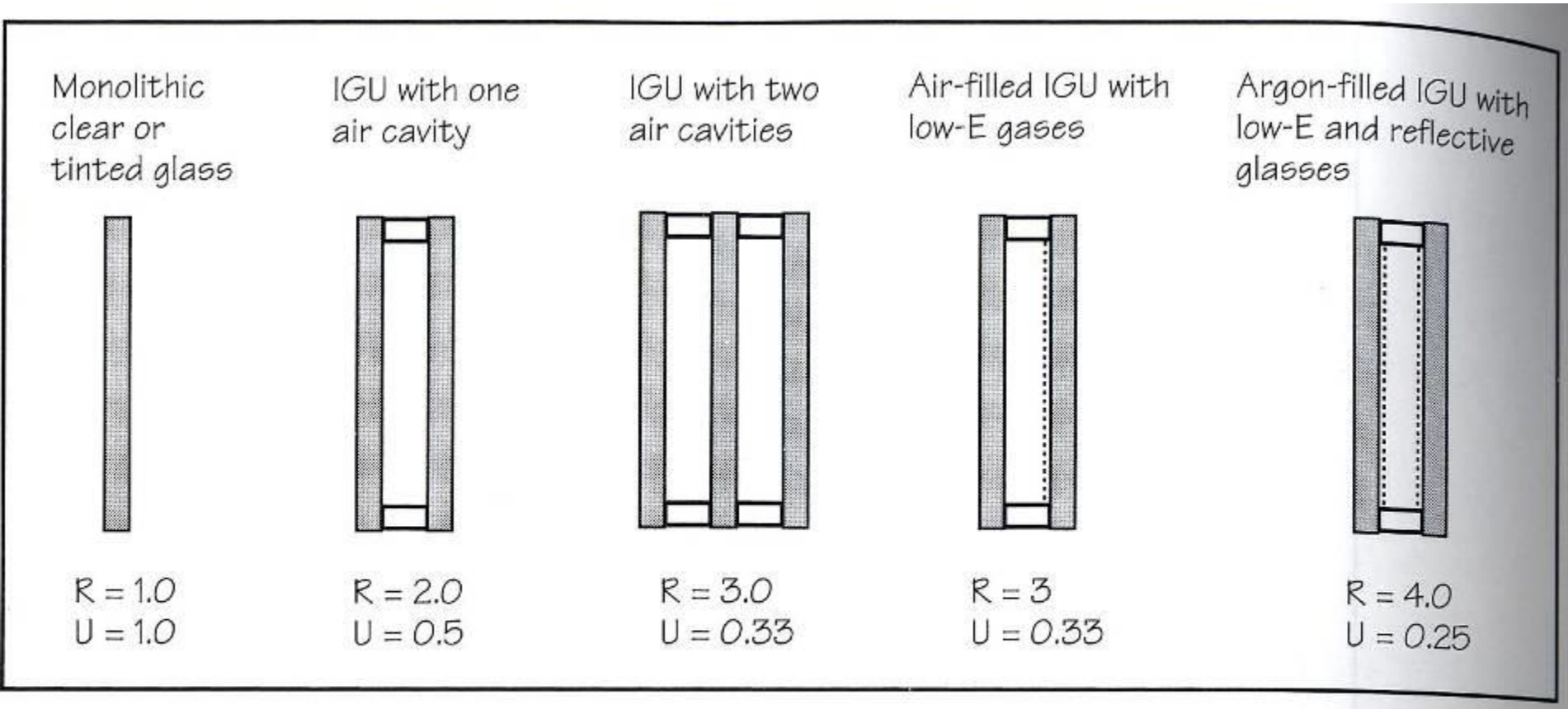




Insulated Glass

3 benefits

1. provides better **insulating value** (higher R-value)
2. **prevents condensation** from forming on the glass surface.
3. provides **acoustical** control



28.7 R-VALUE (OR U-VALUE) OF GLASS

U value is reciprocal of the R value

IGU = Insulated Glass Unit

Sunlight transmission thru glass

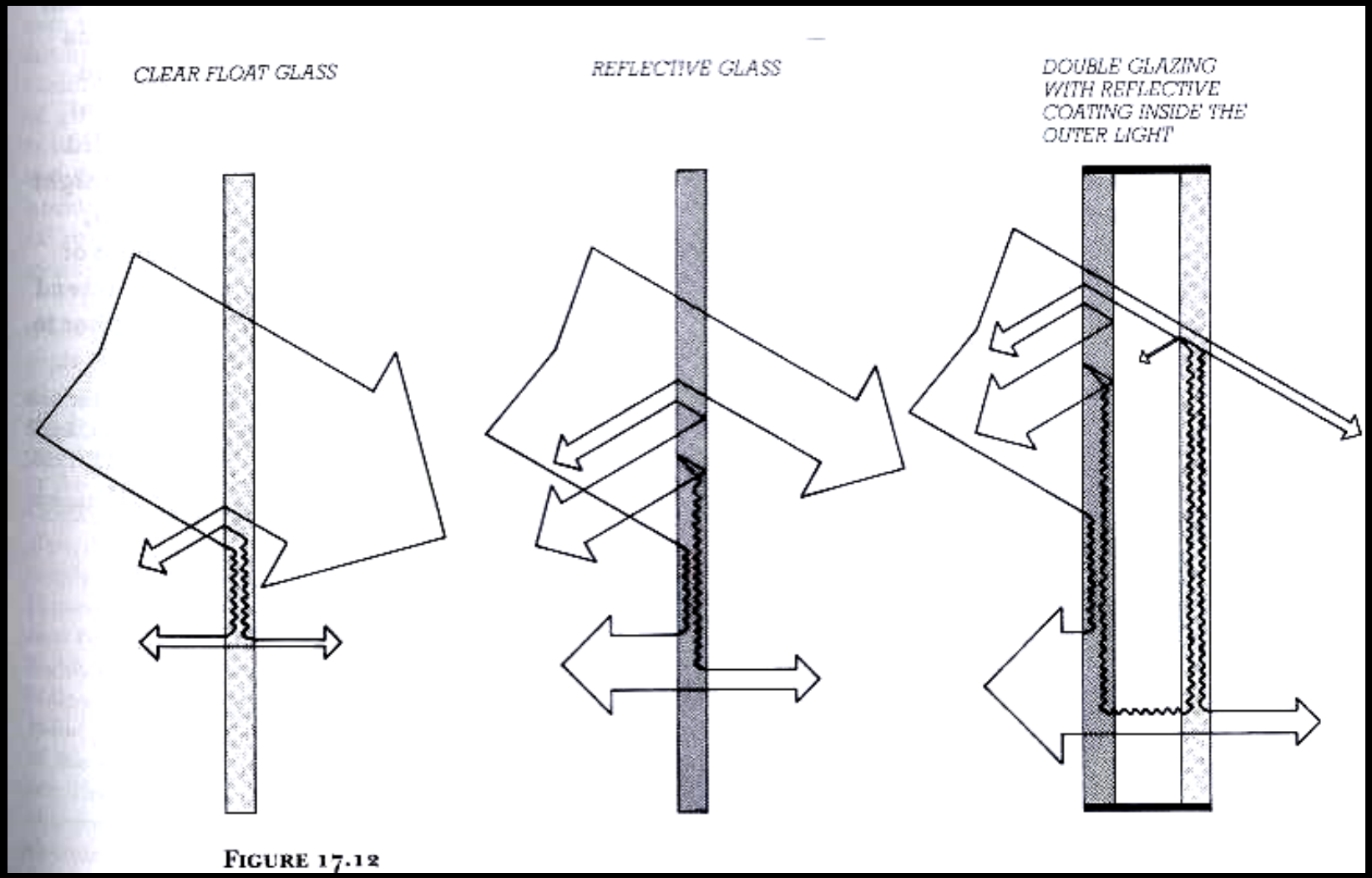
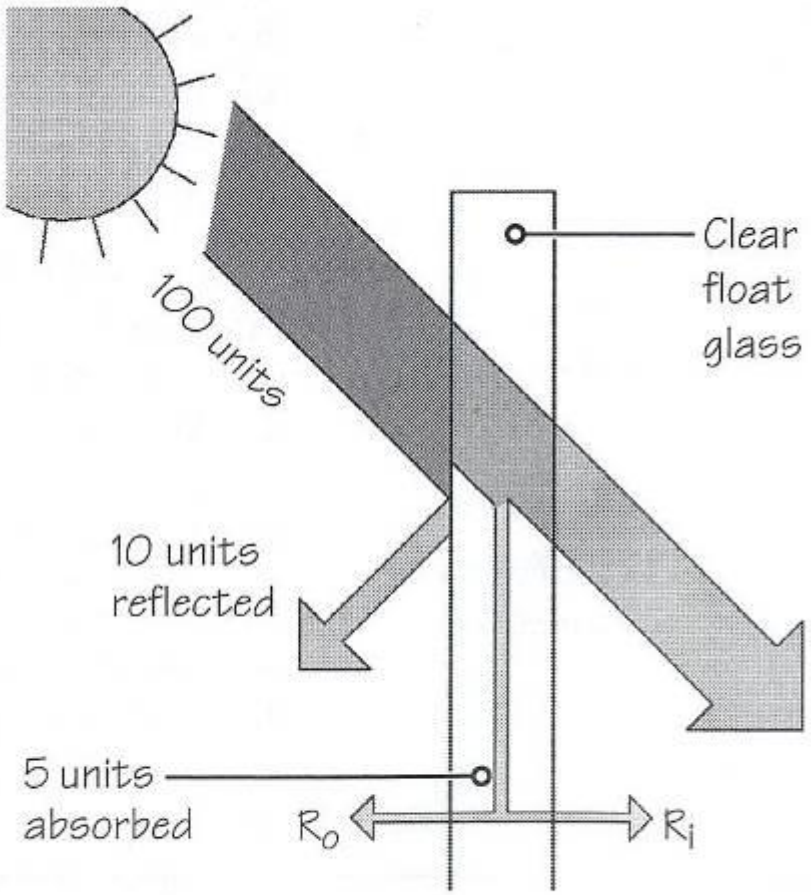


FIGURE 17.12



Solar heat gain through a 1/8 in. thick clear glass = 85 units + R_i

If we assume that 50% of heat absorbed by glass is transmitted to the inside, R_i = 2.5 units. Thus, the total solar heat gain of a 1/8 in. thick clear glass is approximately = 87.5 out of the 100 units, i.e., SHGC = 0.875.

FIGURE 28.13 Properties of a $\frac{1}{8}$-in.-thick clear glass with respect to solar radiation.

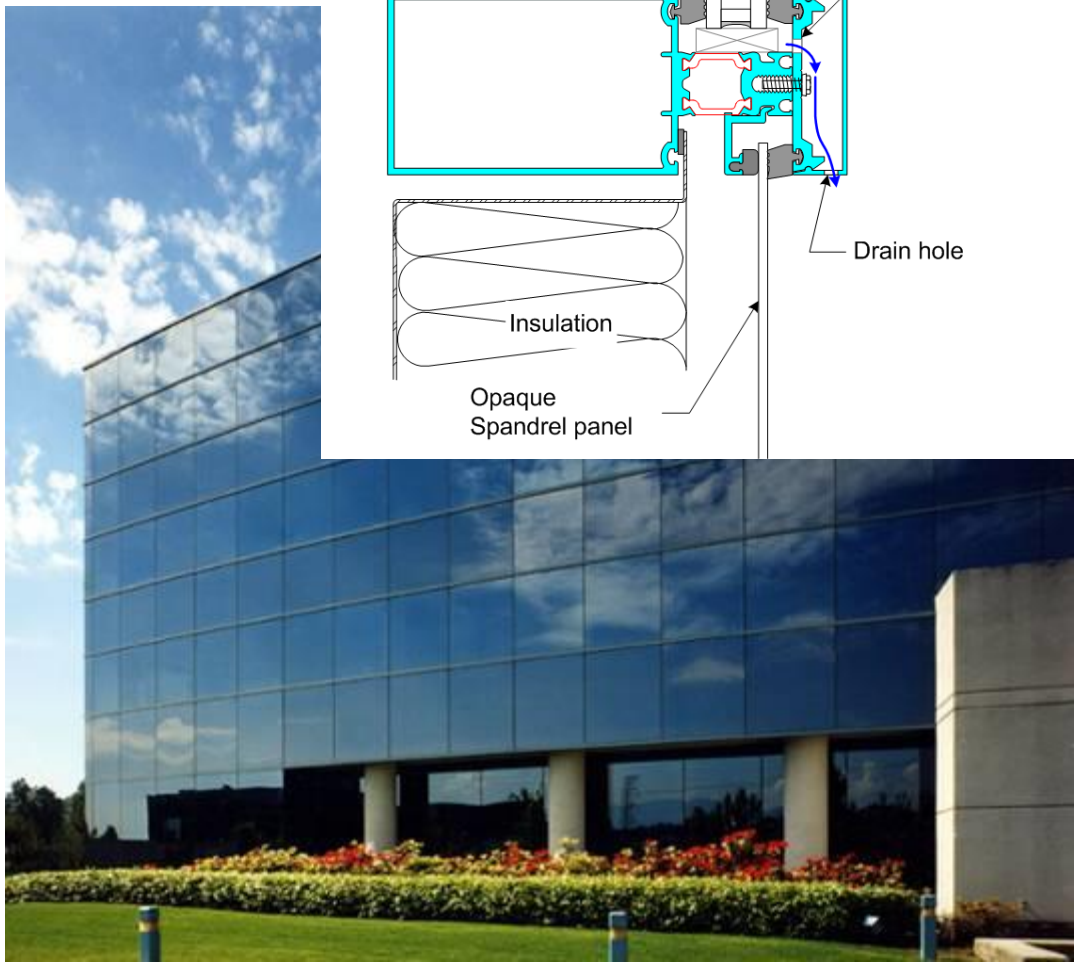
SHGC : Solar Heat Gain Coefficient

the lower the number the better for HOT climates

the higher the number the better for COLD climates

Low-E Glass
(low emmitance)

Coating or film applied on the inside face of insulating glass that restricts radiant energy (heat) flow. Keeps radiant heat on the same size of glass where it originates depending on coating placement. In this case heat from the sun is kept outside.



INSIDE

OUTSIDE

Low E-Glass

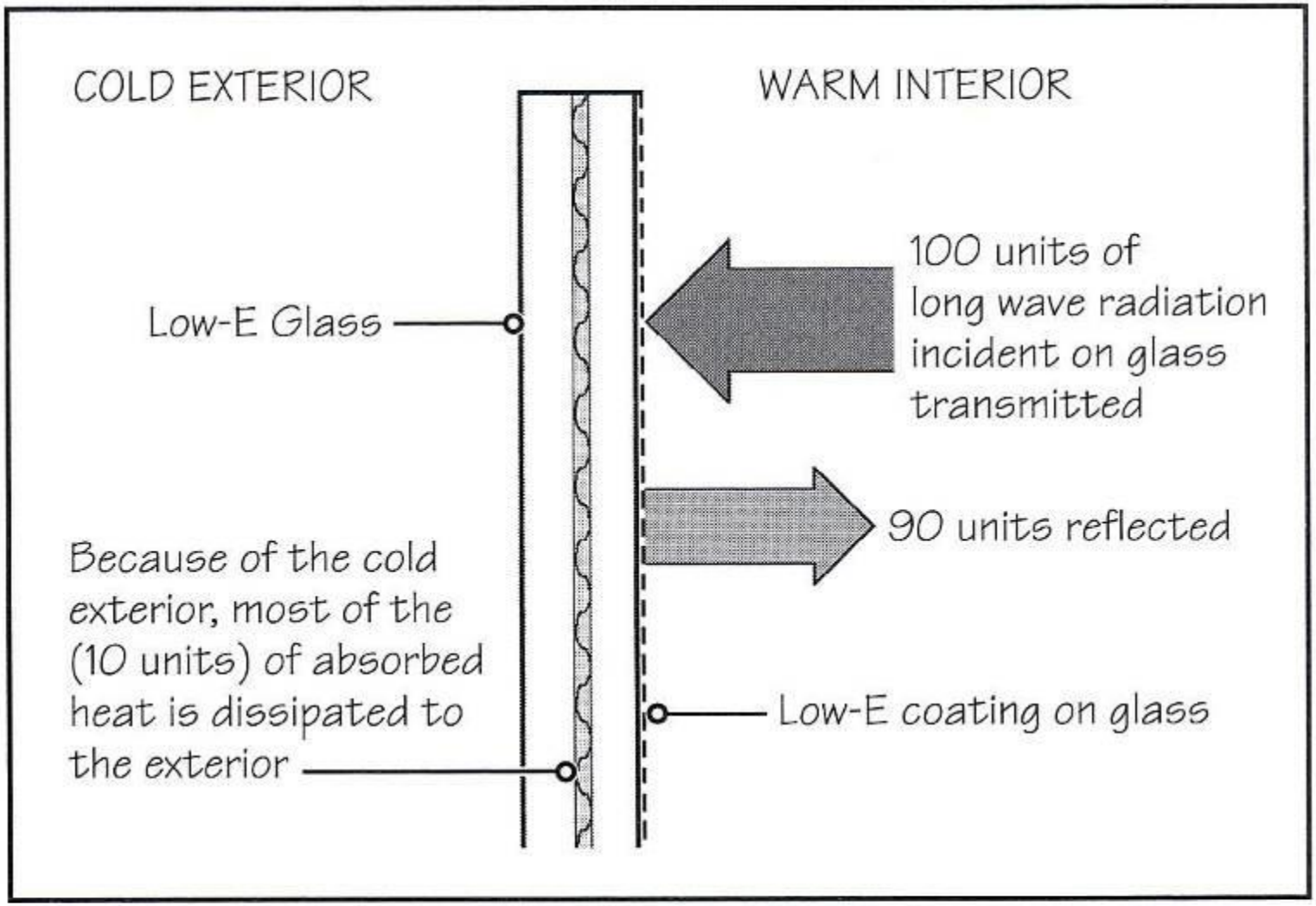


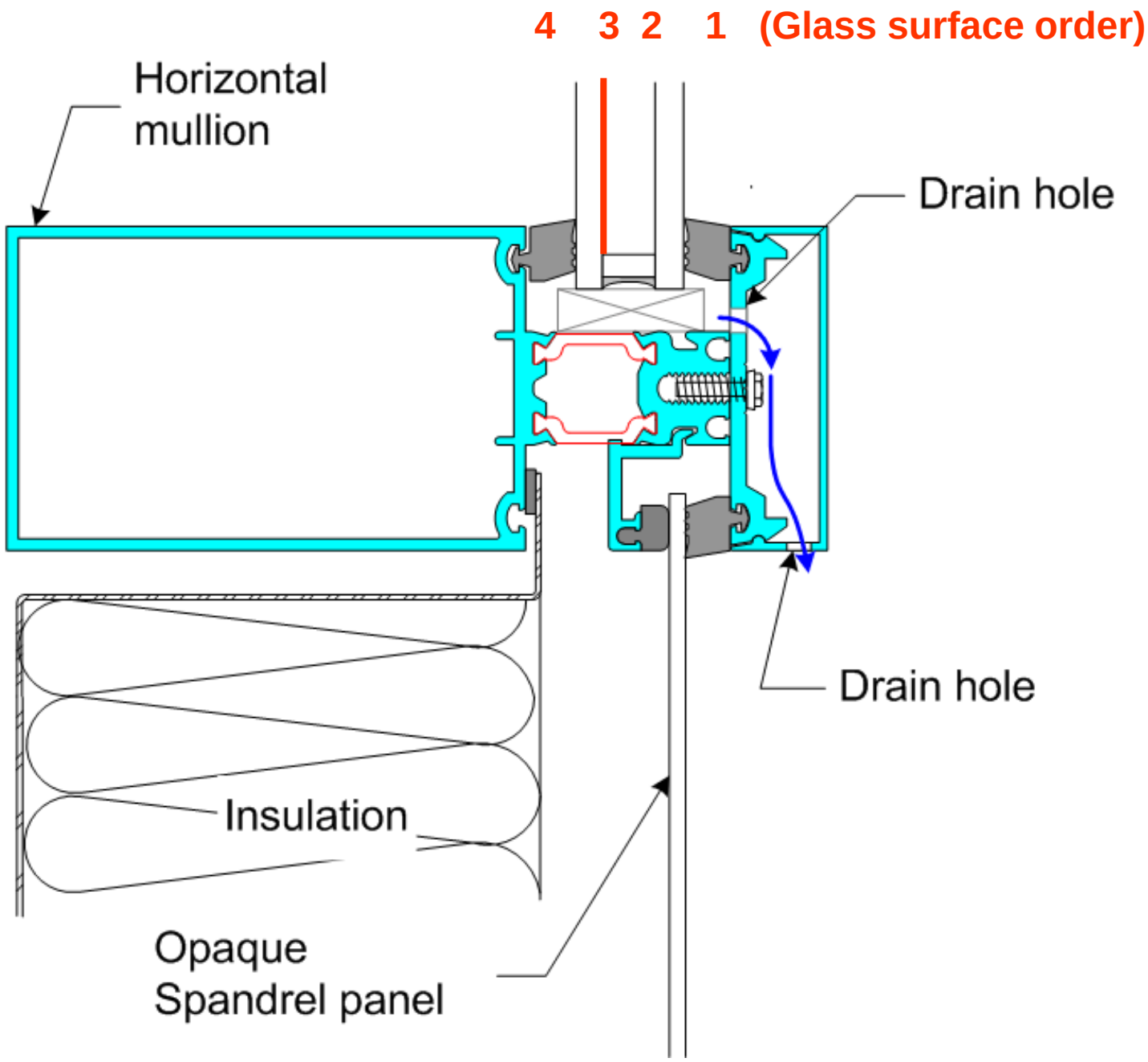
FIGURE 28.18 Long-wave radiation absorbed by low-E glass from a warm interior Observe that the bulk of interior heat returns to the interior.

Low E Solar Control Glass

- **SOLARBAN®70XL**
  Video (5 minutes)

http://www.ppg.com/corporate/ideascapes/glass/products/solarcontrol/Pages/SOLARBAN70XLDemoVideo.aspx

Tinted & Reflective Coating Glass


4 3 2 1 (Glass surface order)
Horizontal mullion
Drain hole
Drain hole
Insulation
Opaque Spandrel panel