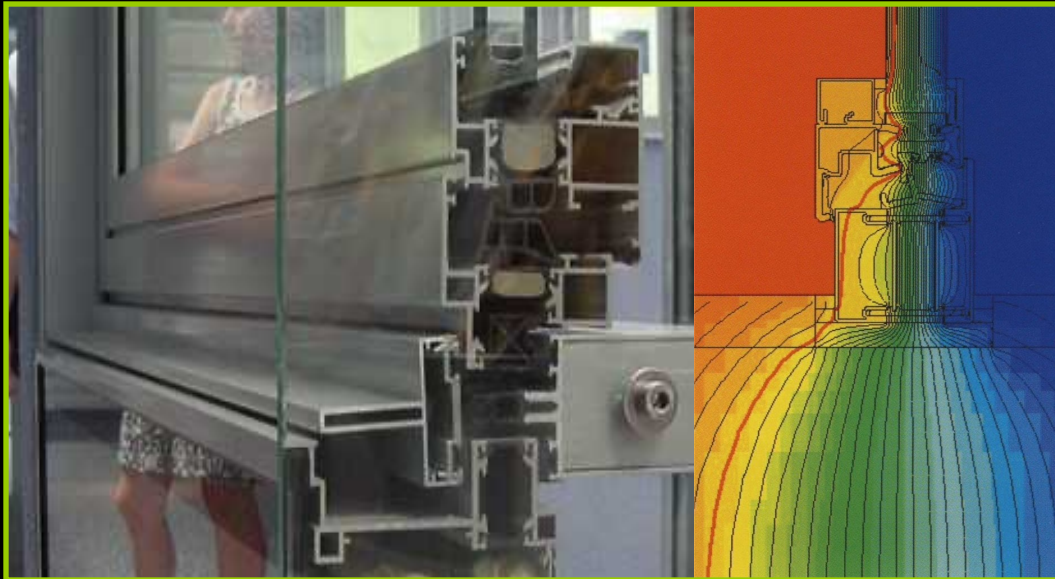
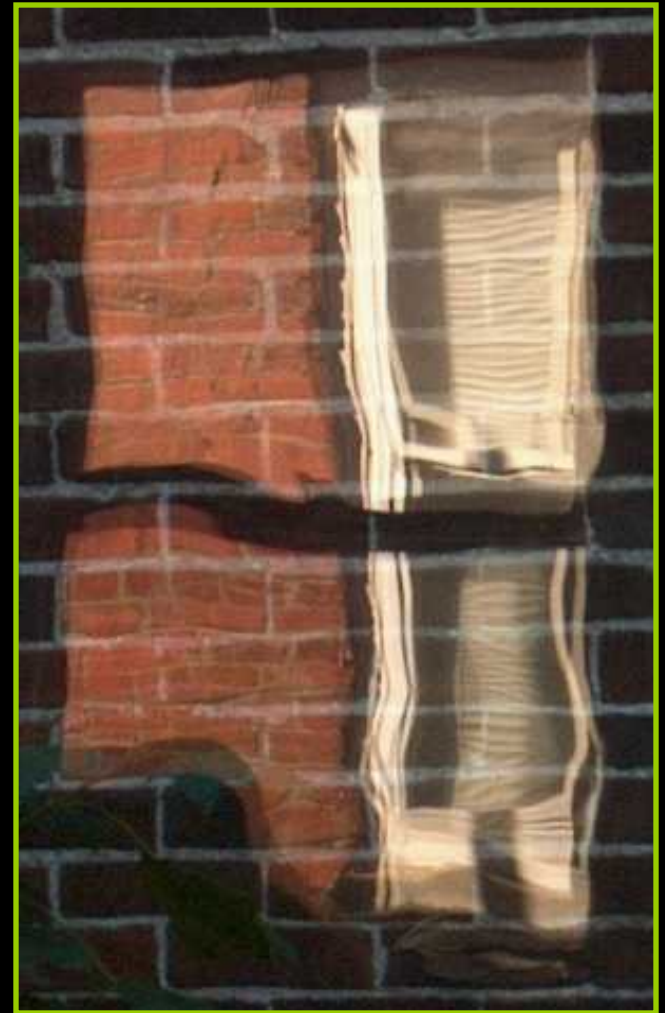


# Construction Technology 1 (ARCH 24501)

## *Intro to Basic Materials:*



GLASS, GLAZING, WINDOWS



- 'GLASS' BUILDINGS



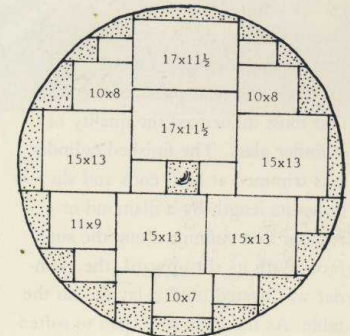
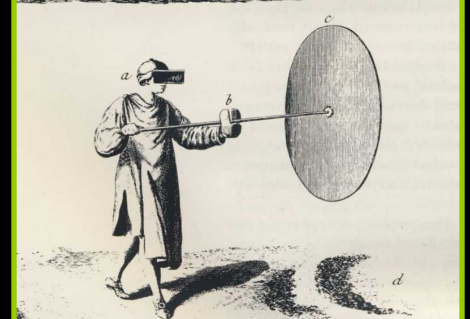
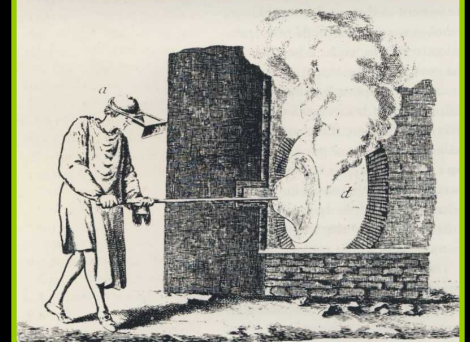
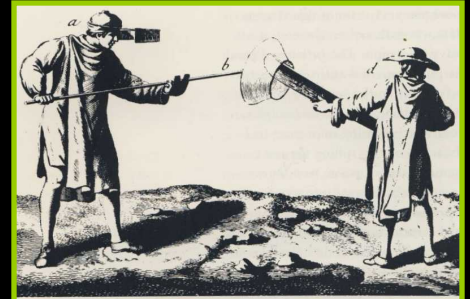


- GLASS: A 'COMPOSITE' MATERIAL



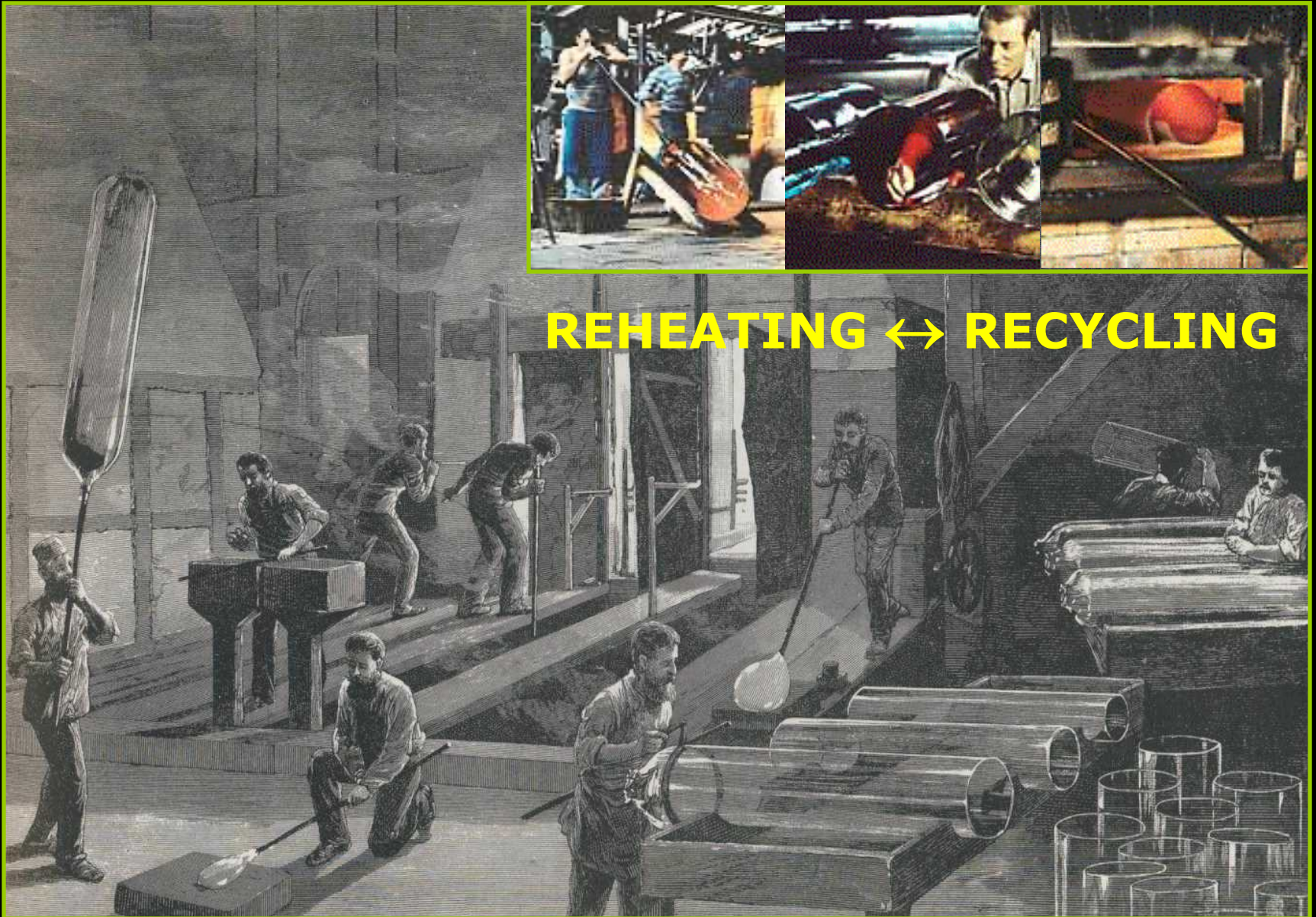


# • FOR WINDOWS CROWN GLASS





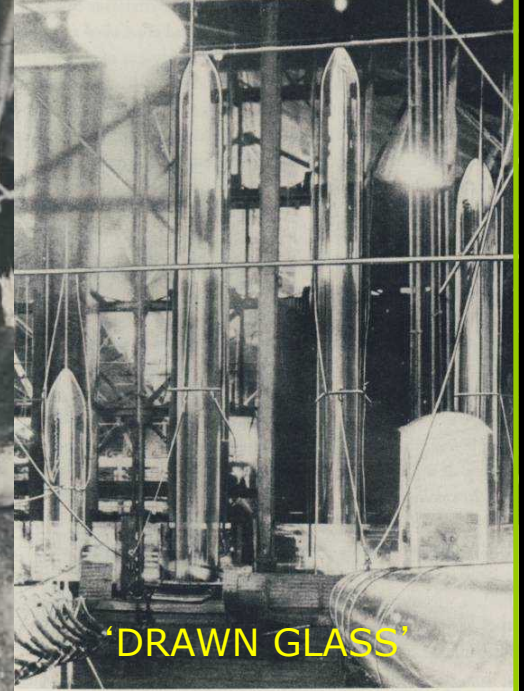
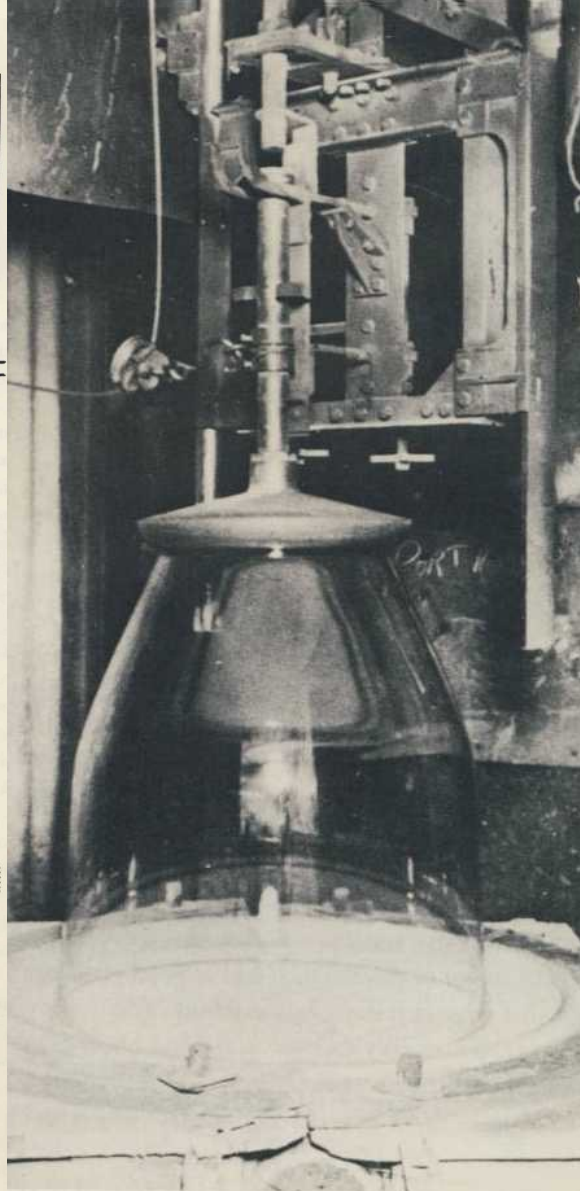
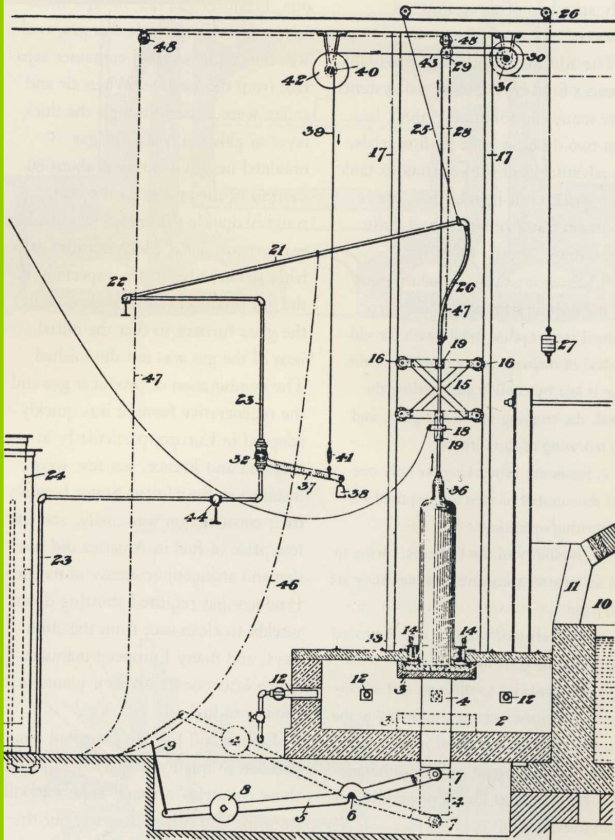
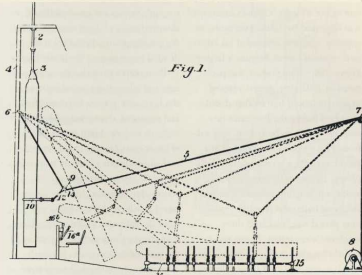
- **FOR WINDOWS** CYLINDER GLASS (8.-19. CENTURY)





# • FOR WINDOWS 'LUBBERS CYLINDER GLASS (1920)

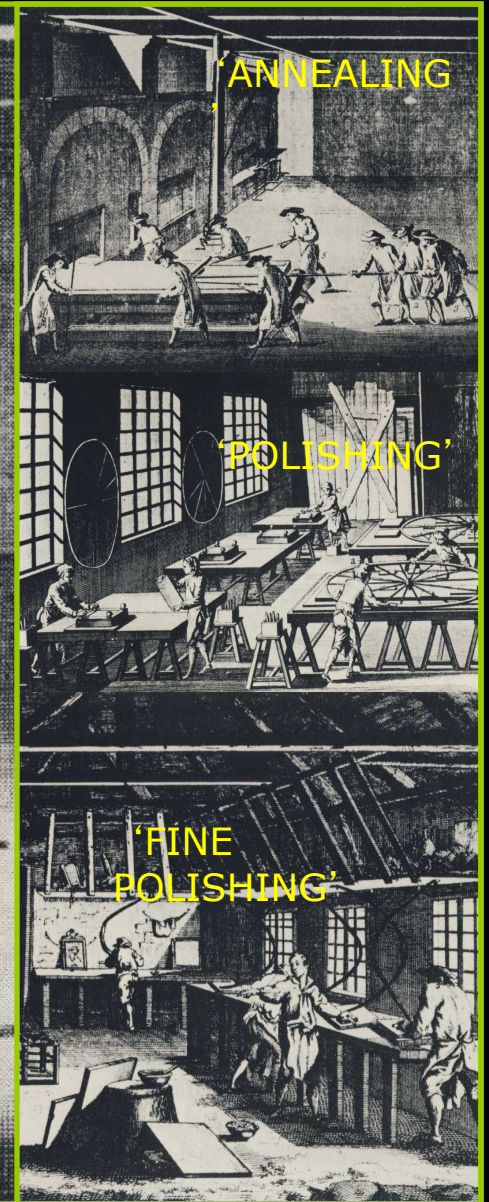
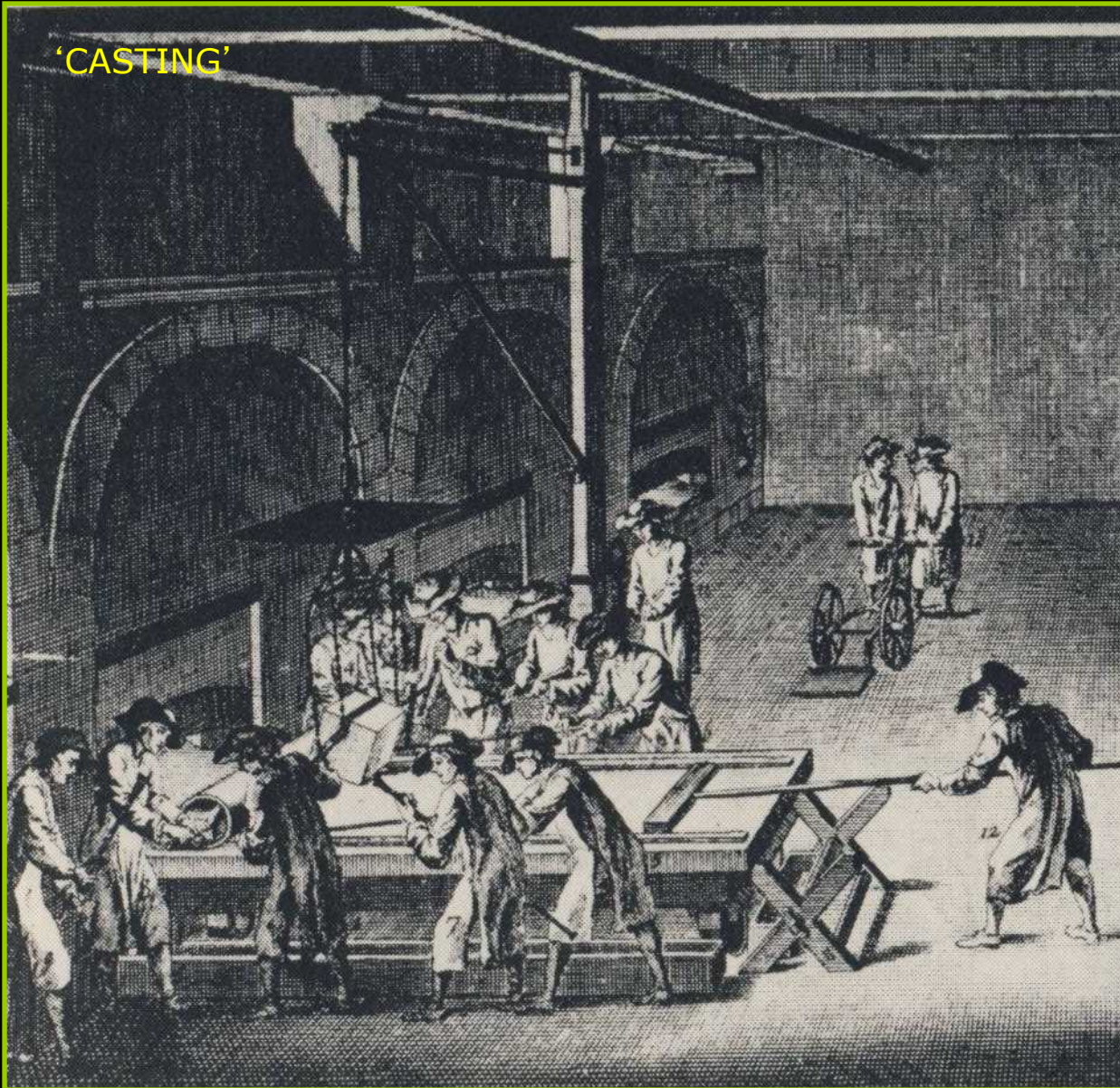
5.17 In the Lubbers glass-blowing machine, air was fed through a blowpipe that moved vertically (21), drawing with it a measured quantity of glass that had been ladled into a heated vessel (3). Success of the process depended largely on regulating even movement of the blowpipe and stable air pressure. (U.S. Patent no. 702,013.)





- FOR WINDOWS

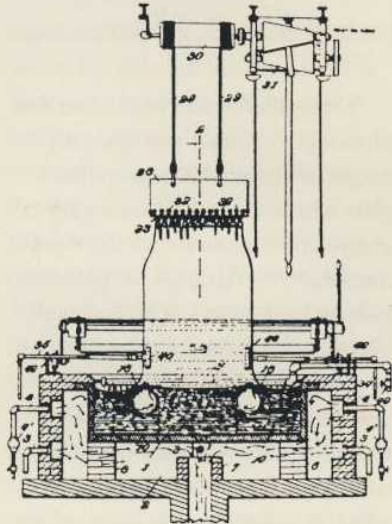
## PLATE GLASS (17.-19. CENTURY)



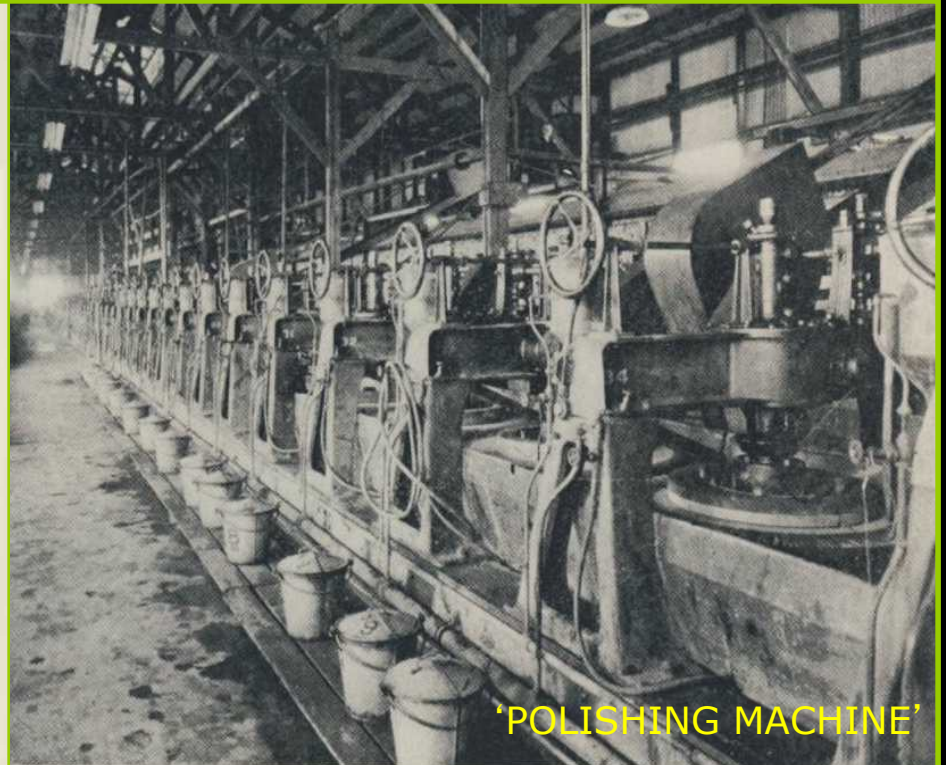
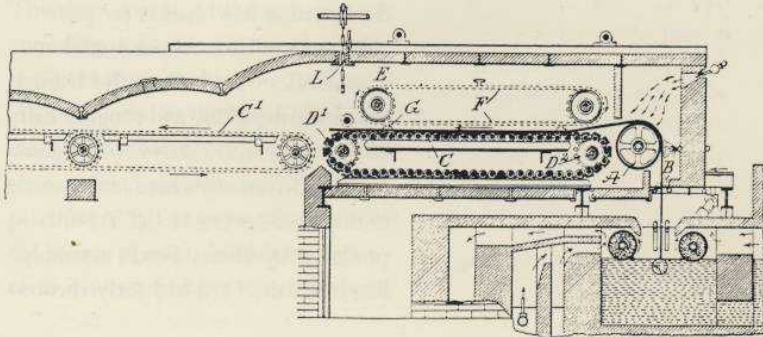


# • FOR WINDOWS

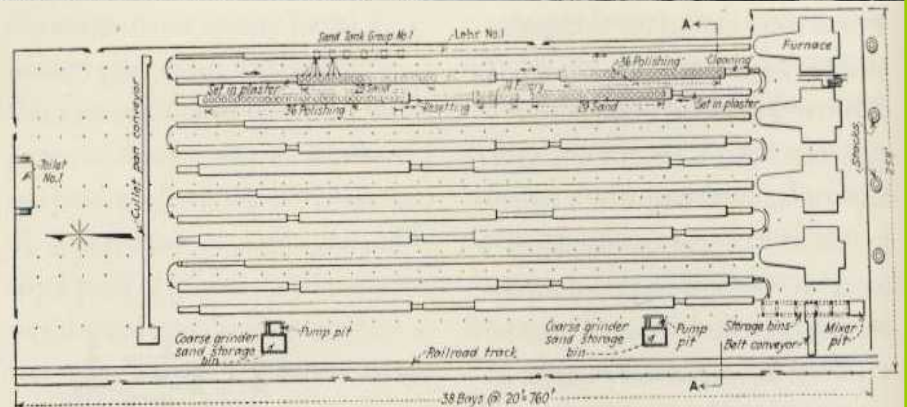
## DRAWN PLATE GLASS (1920's)



**5.22** The Colburn patents for drawing sheet glass, like others, used a bait to start drawing the glass upward. The more difficult task was preventing the sheet of glass narrowing as it was drawn. This patent included the claim of "imparting movement to the surface portion of the molten mass away from the medial line of the sheet." For that purpose, two revolving elements are placed below the drawing level to pull the glass outward. (U.S. Patent no. 821,780.)



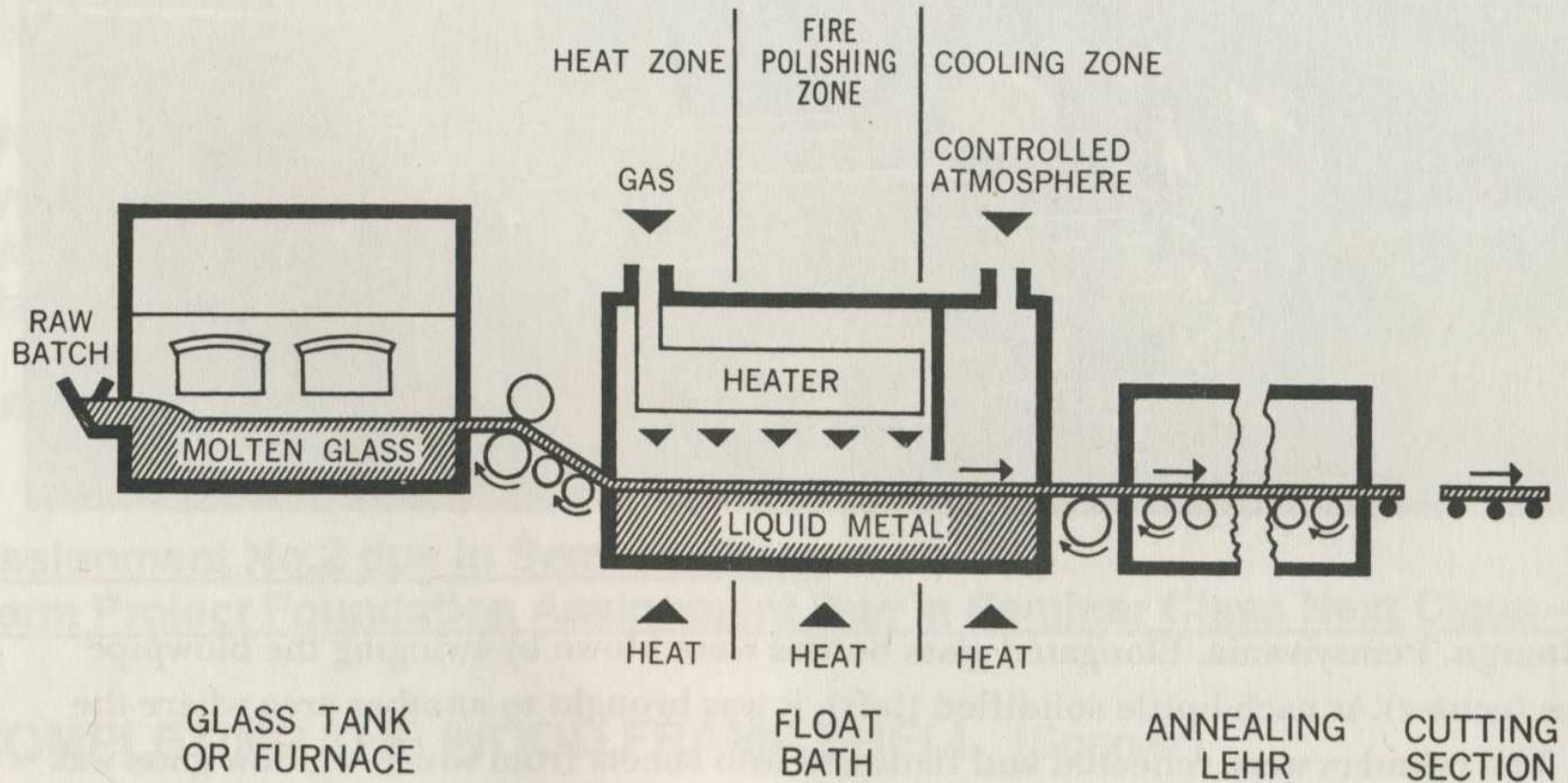
'POLISHING MACHINE'





# • THE PROCESS

## FLOAT GLASS





- MODERN FABRICATION

## FLOAT GLASS (SINCE 1959)



















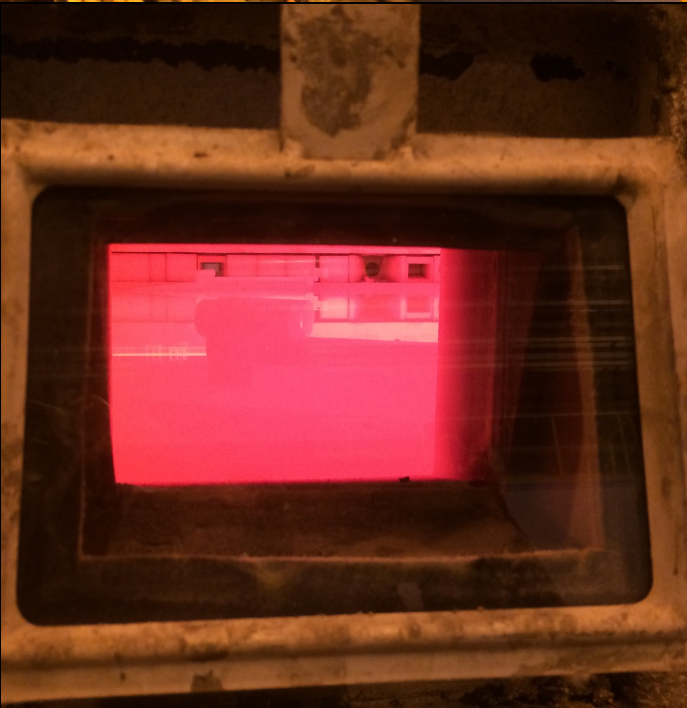












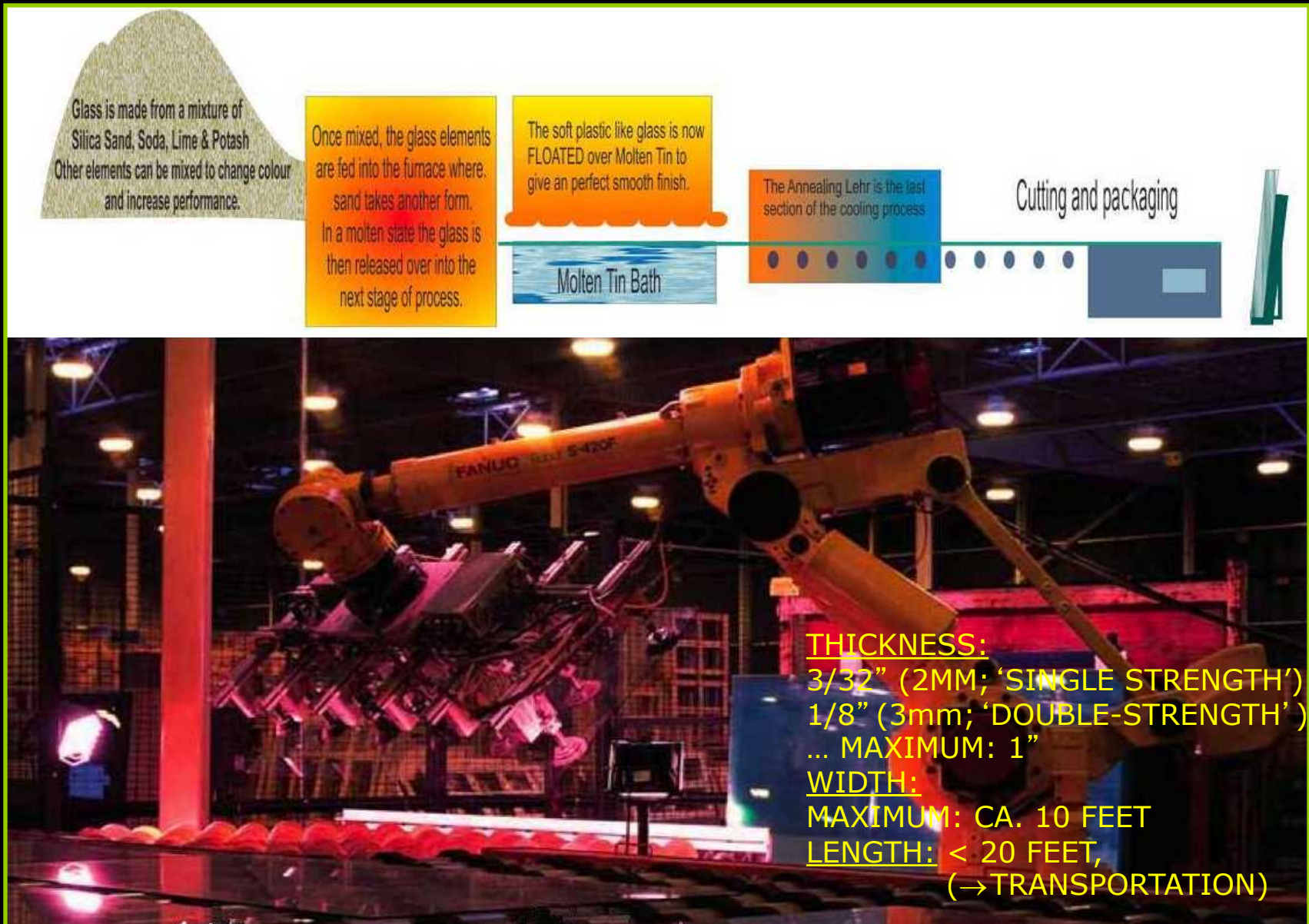




EGS 82



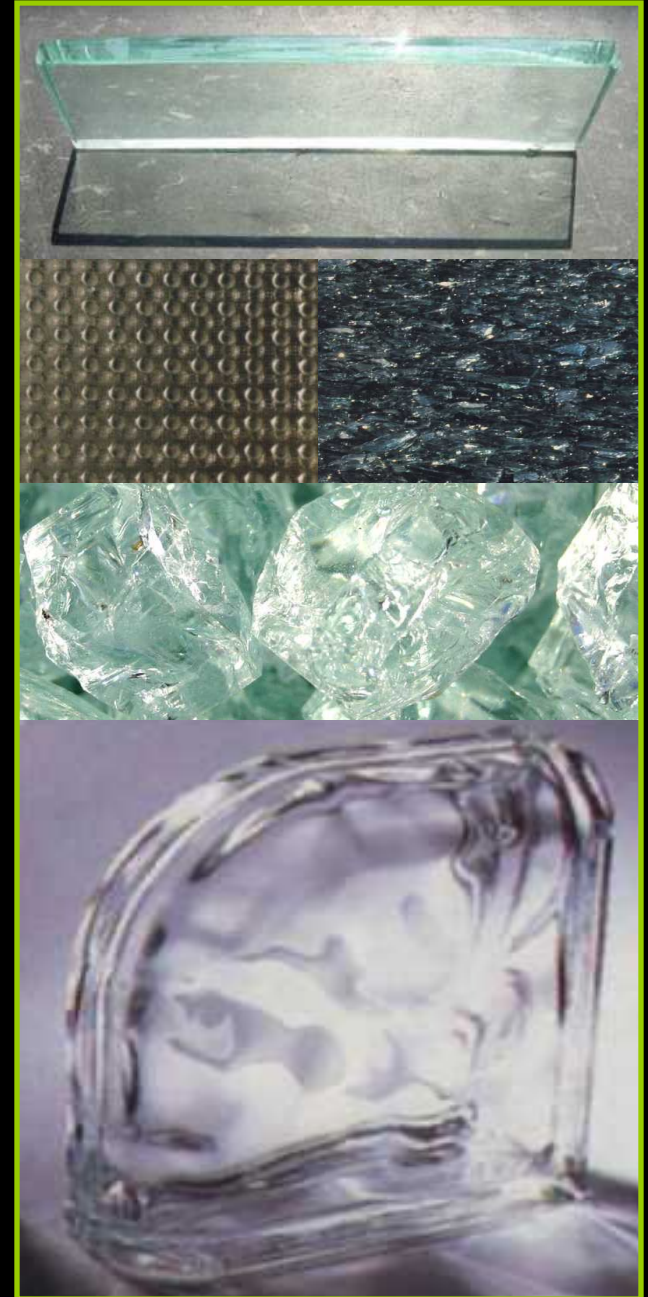
# • THE MATERIAL GLASS: A COMPOSITE





## MATERIAL SPECIFICS *FLOAT GLASS:*

|                          |                                                                      |
|--------------------------|----------------------------------------------------------------------|
| WEIGHT:                  | 158 <sup>LB.</sup> / <sub>CU.FT.</sub>                               |
| COMPRESSIVE STRENGTH:    | 5,000 - 7,000 PSI                                                    |
| TENSILE STRENGTH:        | NEGLIGIBLE                                                           |
| FIRE RESISTANCE:         | NON-COMBUSTIBLE                                                      |
| WATER RESISTANCE:        | GOOD                                                                 |
| THERMAL EXPANSION COEF.: | $\sim 13 \times 10^{-6} \text{ }^{\circ}\text{F}^{-1}$               |
| THERMAL CONDUCTIVITY:    | $\sim 0.4 \text{ BTU/hr.ft.}^{\circ}\text{F}$                        |
| SPECIFIC HEAT CAPACITY:  | $0.2 \text{ BTU/LB.}^{\circ}\text{F}$                                |
| AESTHETICS:              | TRANSPARENT, REFLECTIVE, POLISHED,<br>INDUSTRIAL, (...SUBJECTIVE...) |
| RELATIVE ECONOMICS:      | ...FAIRLY EXPENSIVE...                                               |
| LONGEVITY:               | LONG LIFE CYCLE (...IF IT DOESN'T<br>BREAK...)                       |





- DISADVANTAGES - ADVANTAGES

- DRAWN GLASS FIBER CAN BE STRONGER THAN STEEL, BUT MICROSCOPIC IMPERFECTIONS REDUCE STRENGTH, ESPECIALLY IN TENSION. → **SHATTERING**
- RELATIVELY HIGH CONDUCTIVITY
- HIGH EMBODIED ENERGY
- GLASS CAN BE REUSED / REMOLTEN INDEFINITELY.
- MULTI-PURPOSE MATERIAL (I.E. FIBERS)
- VERY LONG LIFE CYCLE
- WATER RESISTIVE
- LAMINATION 'REINFORCEMENT'
- COATINGS MANIPULATION
- CAPTURES LONGWAVE RADIATION.



SHATTERED LAMINATED GLASS

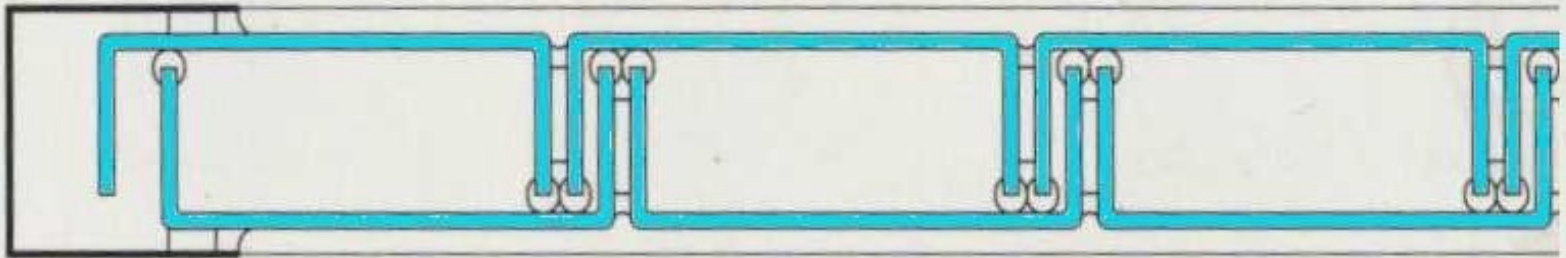


FIBER GLASS



- **PRESSED/MOLDED GLASS**

## **CHANNEL GLASS**



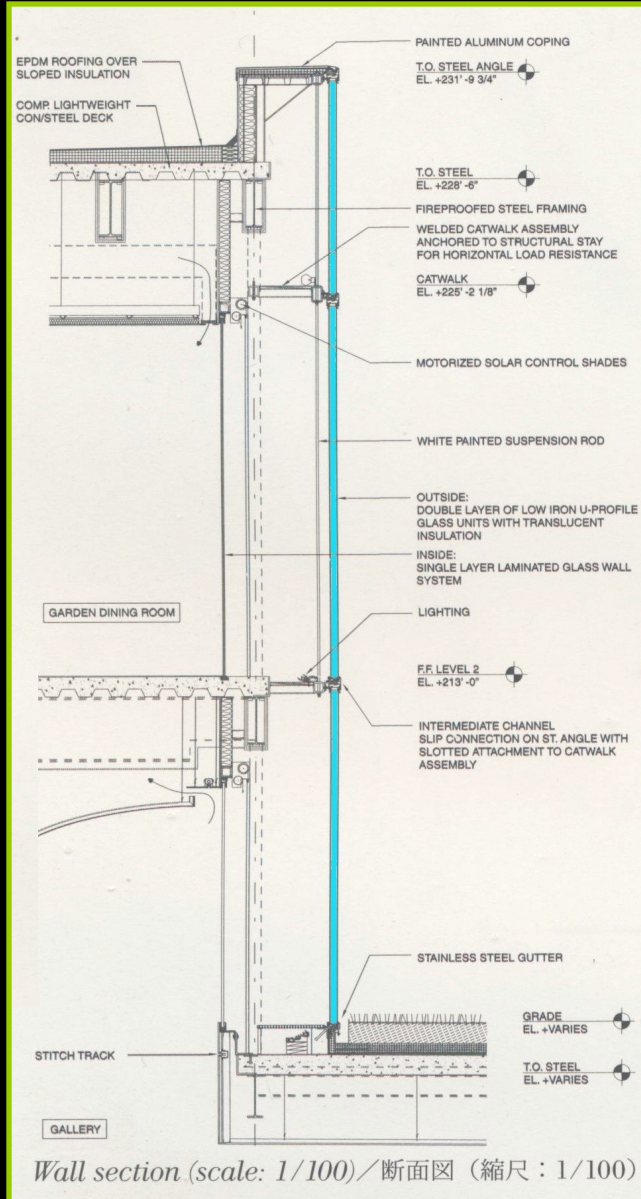
The depth of construction depends on the type of profiled glass selected.

“PROFILIT”



# ● PRESSED/MOLDED GLASS

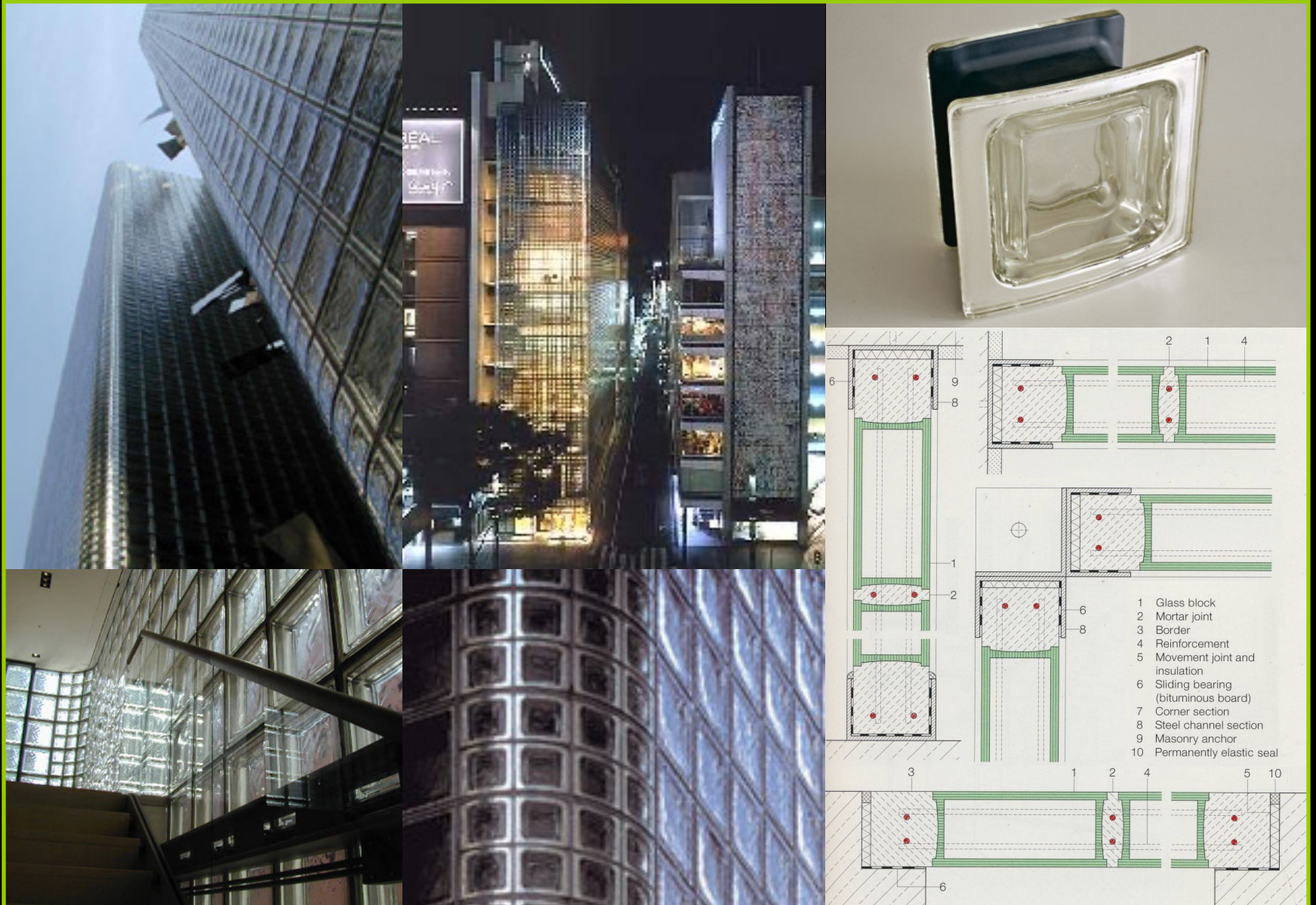
# CHANNEL GLASS





# ● PRESSED/MOLDED GLASS

## GLASS BLOCK

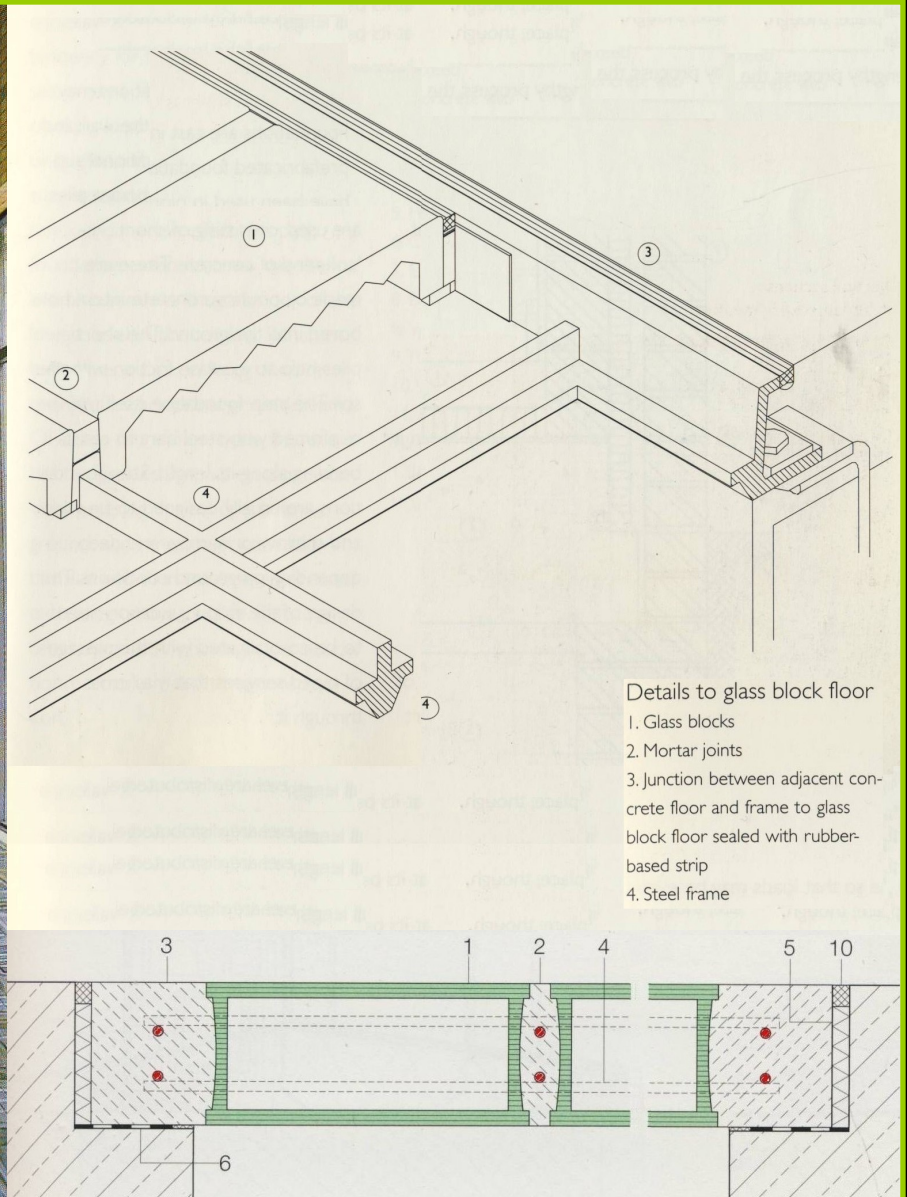


RENZO PIANO ARCH.: 'HERMES' DEPARTMENT STORE, TOKYO 2001



# ● PRESSED/MOULDED GLASS

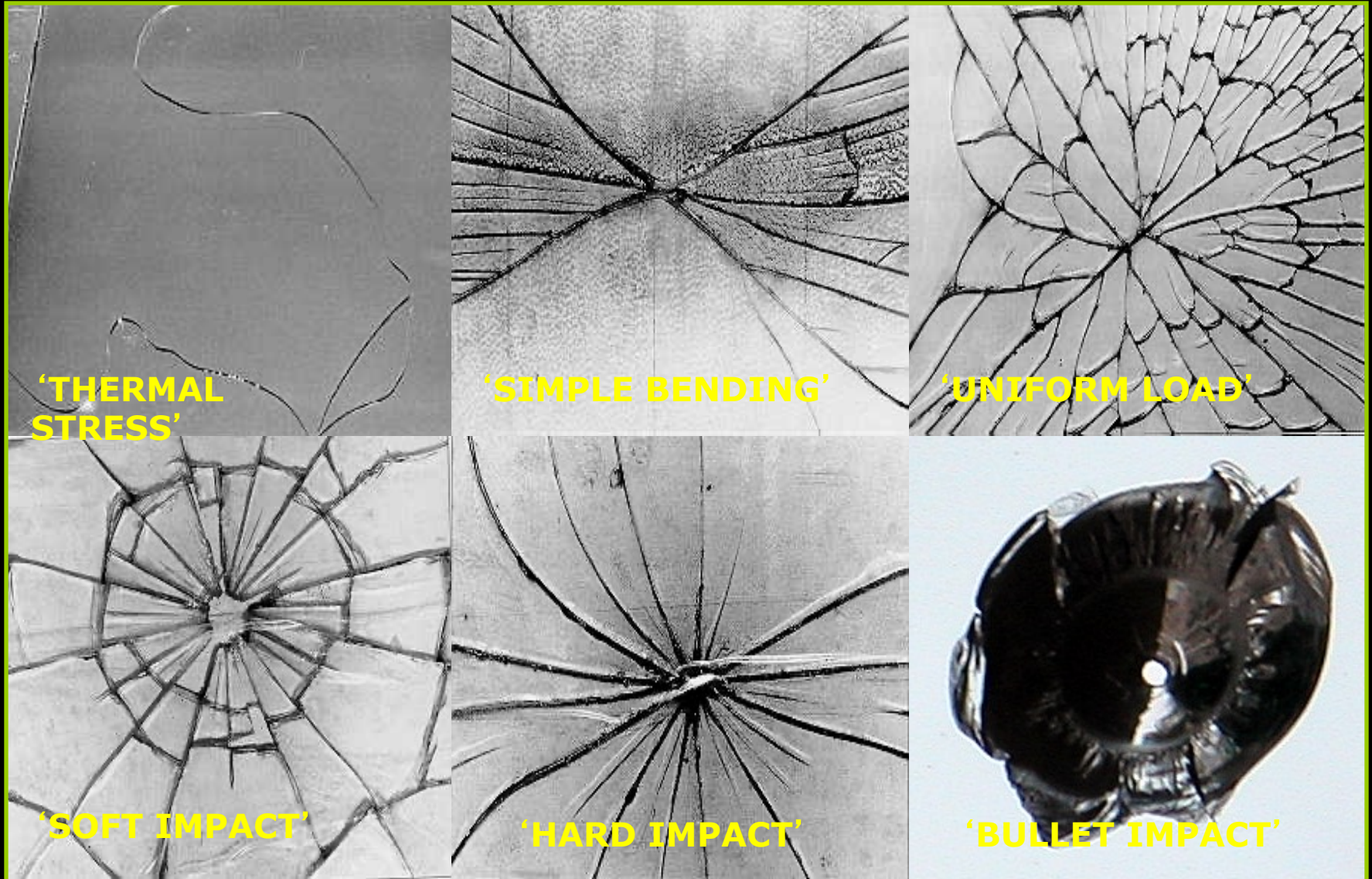
## GLASS BLOCK





- **BREAKAGE**

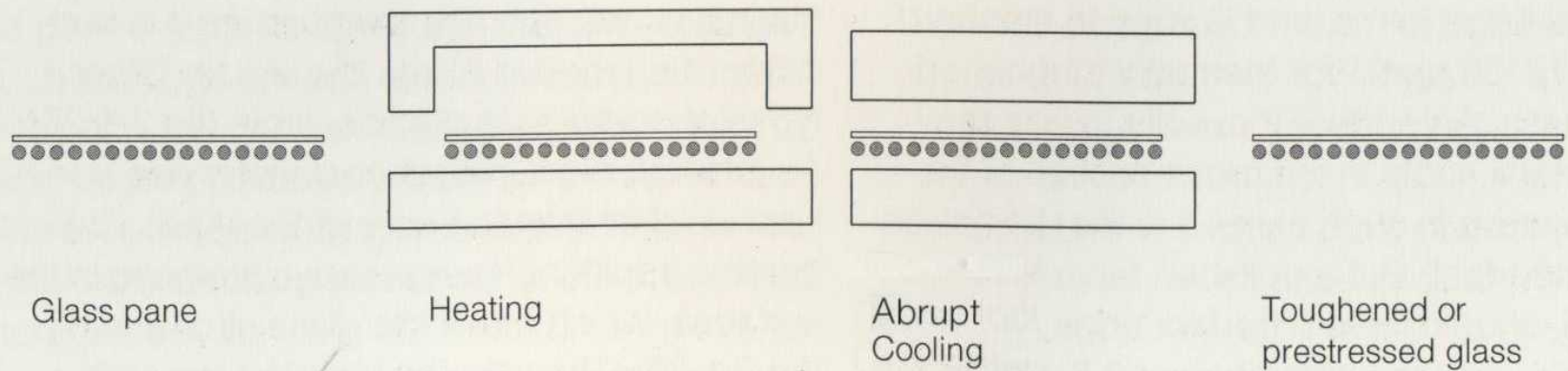
## 'STRESS DIAGRAMS'





- MANIPULATION: 'TEMPERED GLASS'

## PROCESS





- ‘TEMPERED GLASS’ (~3x AS STRONG AS FLOAT GLASS)

- 2 STEP PROCESS:

- 1) CUTTING OF ‘ANNEALED’ GLASS

- 2) REHEATING / TEMPERING:

- EVEN COOLING W/ BLASTS OF AIR → SURFACE IN COMPRESSION*

- 15,000 PSI INSTEAD OF ~4,000 PSI

- SHATTERING IN SQUARE-EDGED GRANULES INSTEAD OF SHARDS.

- USE AS SAFETY GLASS:

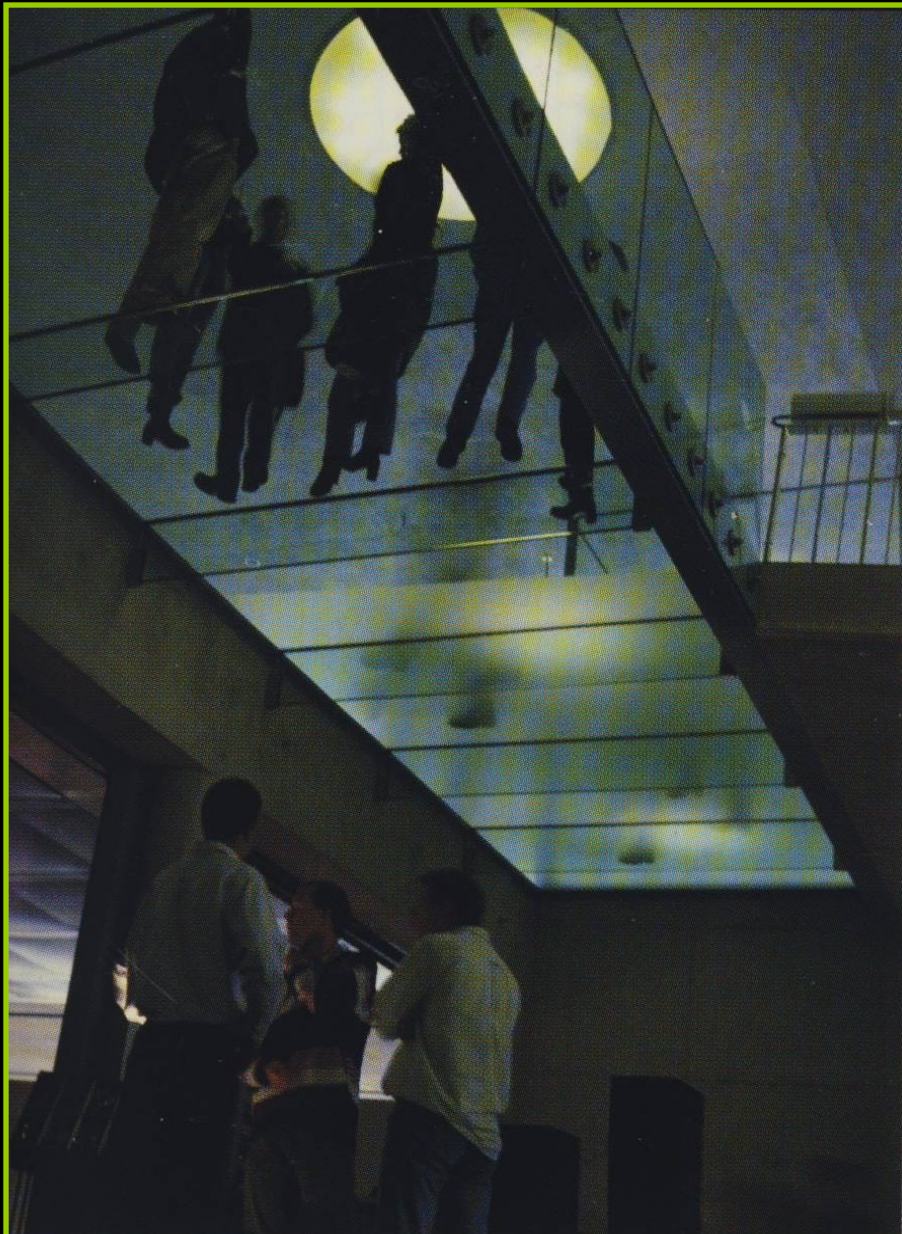
- AUTO GLASS, STOREFRONTS,  
GLASS-, SHOWERDOORS, ...

- NO ADJUSTMENTS POSSIBLE  
AFTER TEMPERING (CAREFUL!)

- 2x AS EXPENSIVE AS FLOAT GLASS



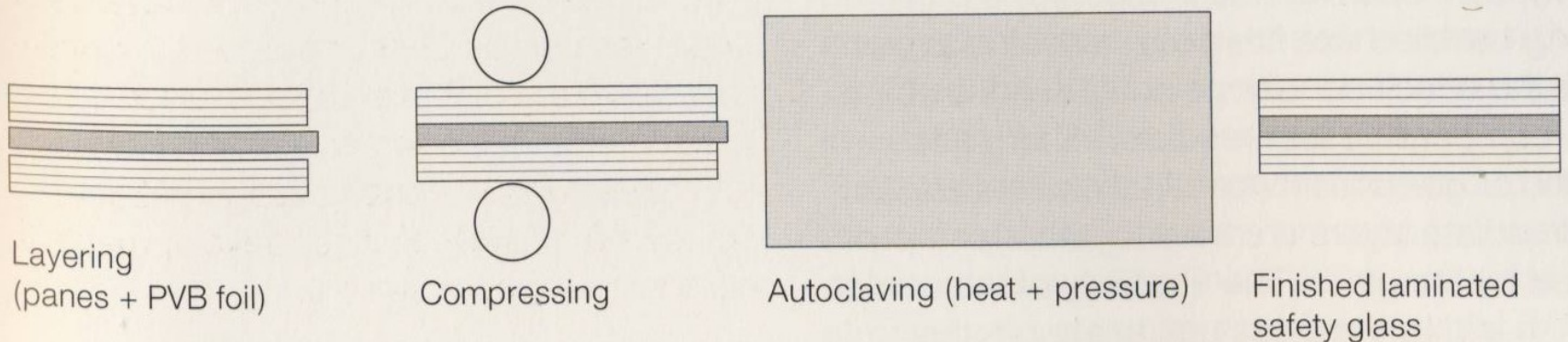






- MANIPULATION: 'LAMINATED GLASS'

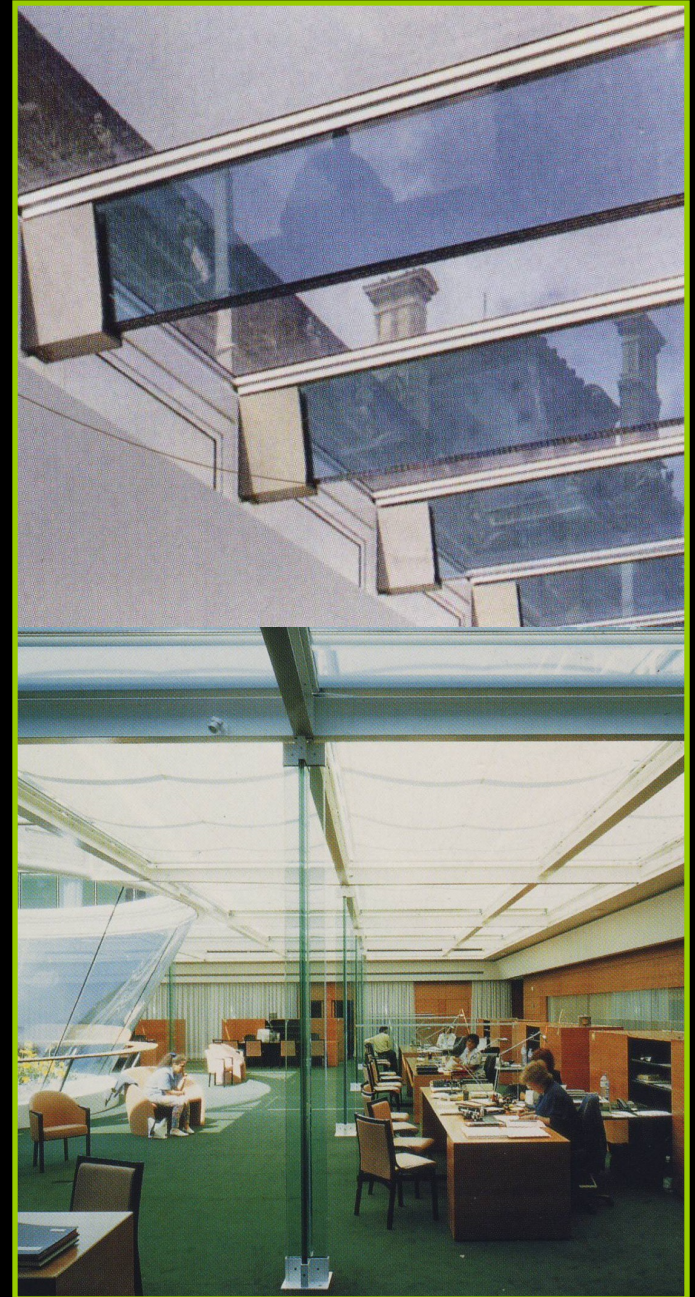
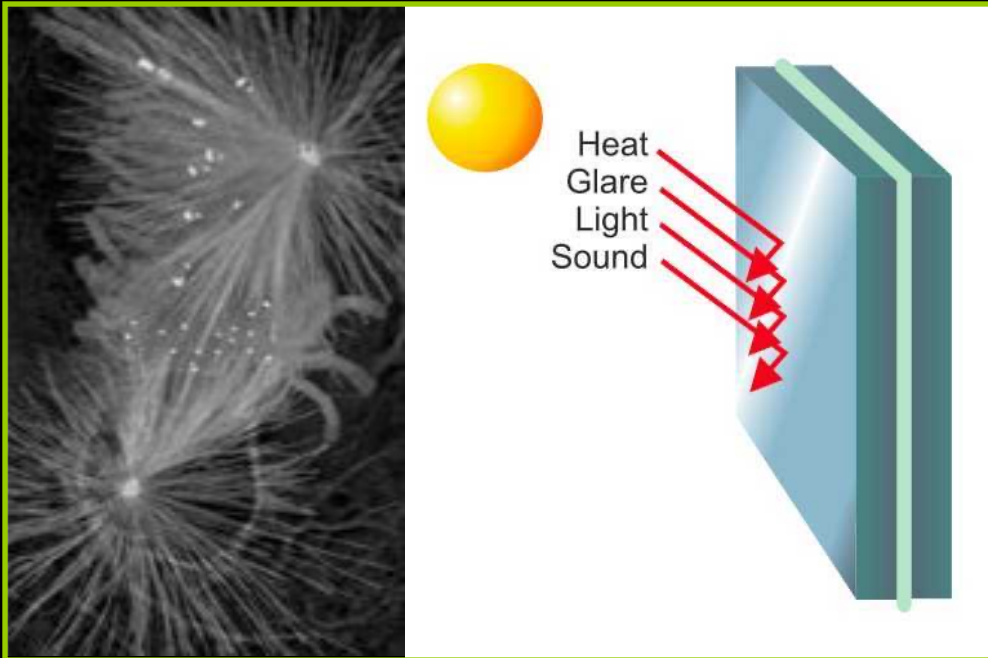
## PROCESS



**POLYVINYL BUTYRAL = PVB**



- 'LAMINATED GLASS'
- POLYVINYL BUTYRAL INTERLAYER
- POLYCARBONATE INTERLAYER
- CASTING RESINS
- USE: SKYLIGHTS, BANK TELLER WINDOWS, SMALL STRUCTURAL MEMBERS, HORIZ. LOAD FINS ...

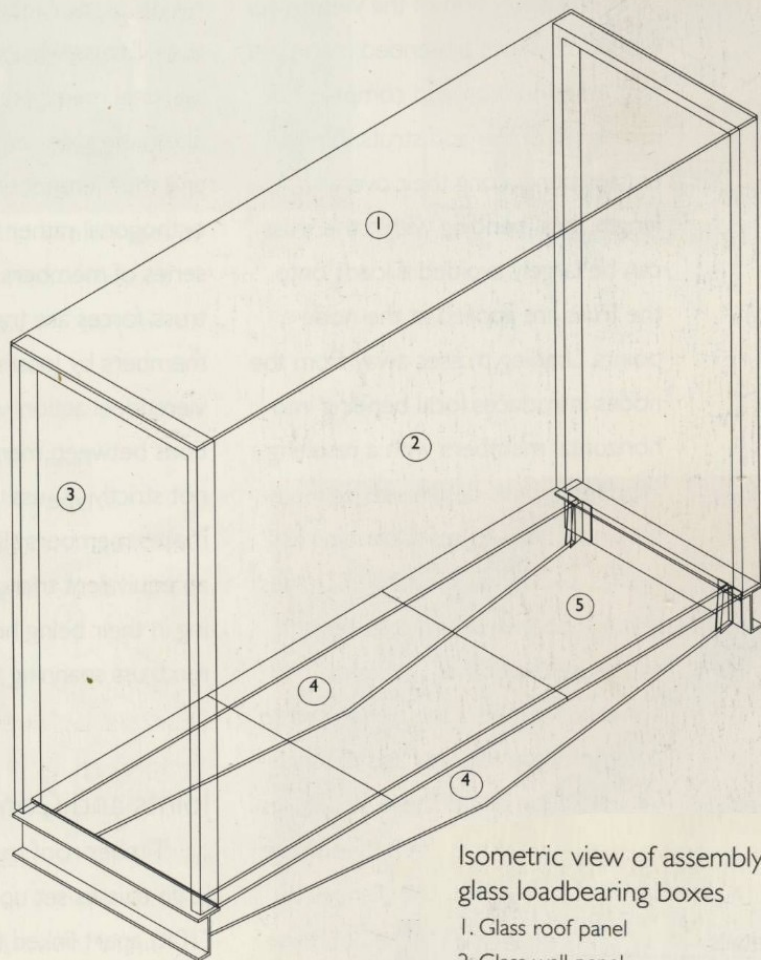






Bohlin Cywinski Jackson Arch., Apple Stores New York City (59th Street / SoHo)





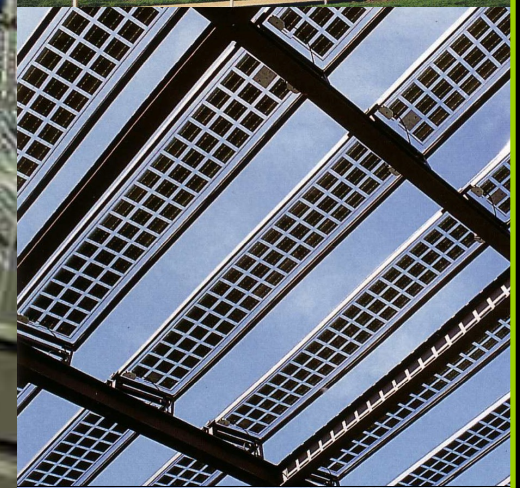
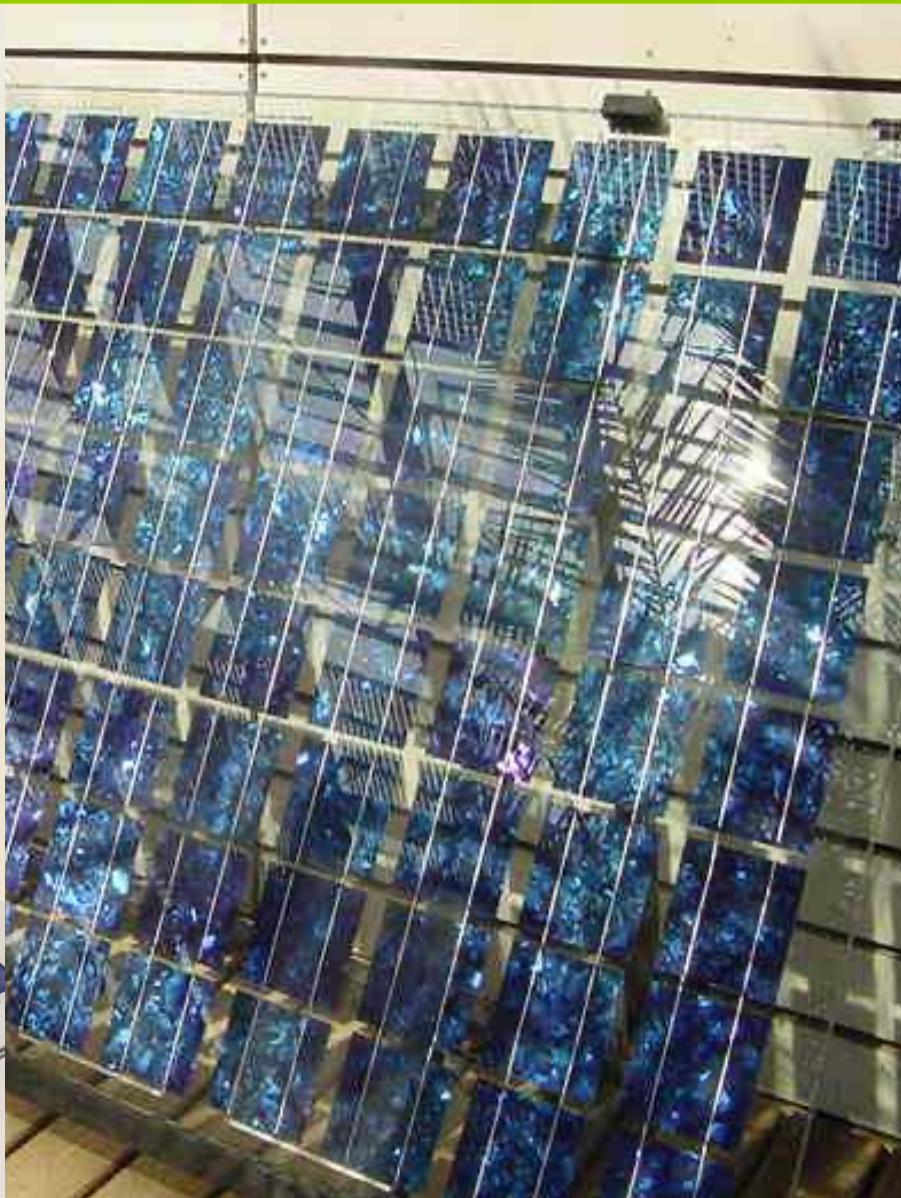
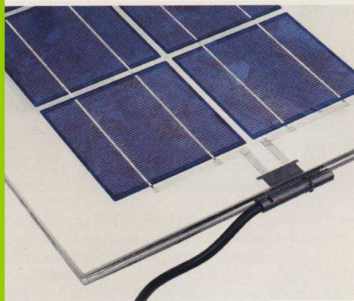
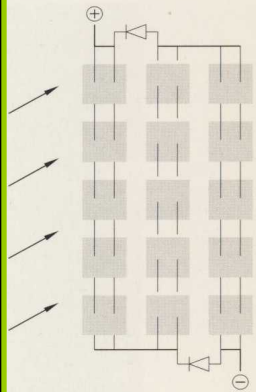
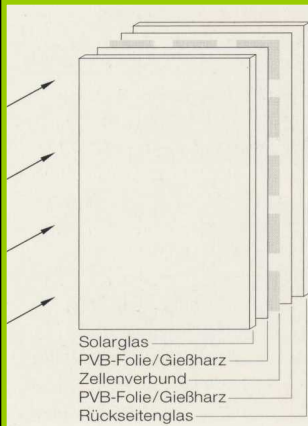
Isometric view of assembly  
glass loadbearing boxes

- 1. Glass roof panel
- 2. Glass wall panel
- 3. Steel frame at each end of bridge
- 4. Laminated glass beam
- 5. Glass sheet as floor deck





# ● LAMINATION: PV-ELEMENTS POLYCRYSTALLINE CELLS



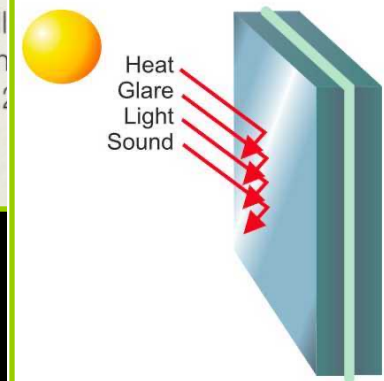


- ‘SAFETY GLASS’ FIBER-REINFORCEMENT / NANO-TECHNOLOGY



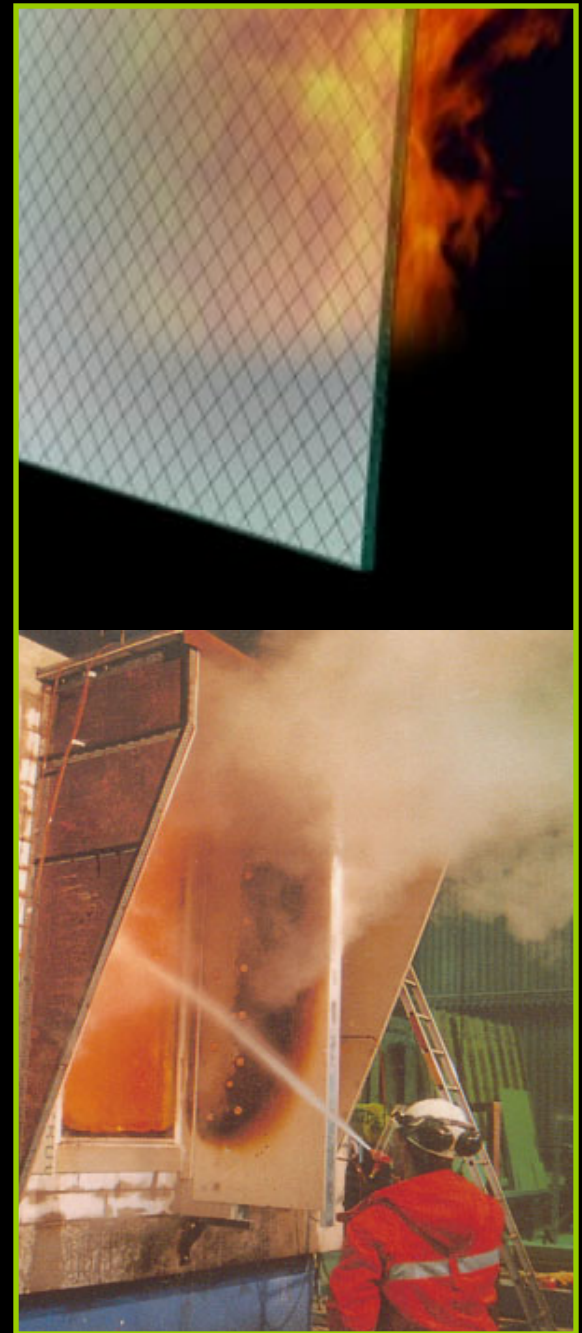
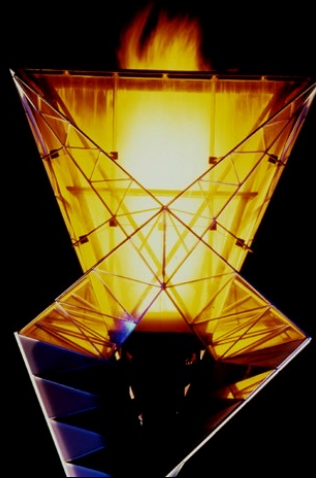
2.2.34

Increasing the residual load-bearing capacity involves improving the strain stiffness and tensile strength of the intermediate layer, which in most applications up to now has been made from a homogeneous PVB sheet. The solution is either to incorporate some kind of reinforcement in the intermediate layer or to enhance the strain stiffness and tensile strength of the intermediate layer itself, as with the Sentry Glas® Plus product. Possible reinforcing materials are textiles made from high-strength synthetic fibres or stainless steel wires or even thin, perforated sheet metal. Glass fibre and carbon fibre products can also be used as reinforcement in the intermediate layer. Such interwoven structures are not visible to the naked eye from a normal viewing distance. Indeed, by selecting suitable fibre/wire thicknesses and mesh pitches, both the strength of the can be controll also act as sun feature (figs 2.2



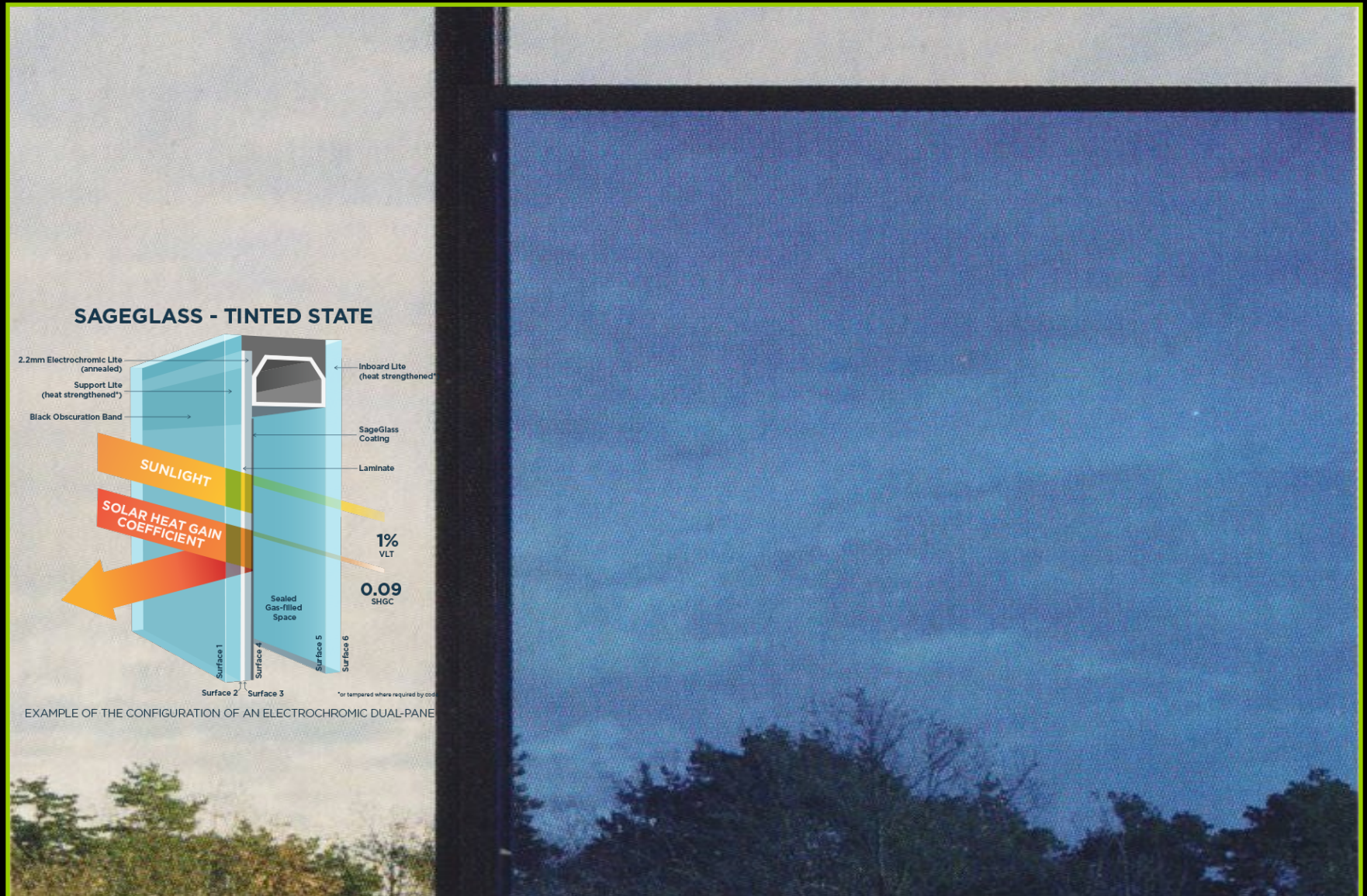


- MANIPULATION: FIRE RESISTANCE
  - FIRE RATED GLASS: BARRIER TO PASSAGE OF SMOKE, HEAT, FLAMES
  - WIRED GLASS: 45 MIN. RATED
  - CERAMIC-BASED:  $\frac{1}{2}$  - 3 HRS.,...  
VERY EXPENSIVE: \$100-150/S.F.,  
CA. \$2,000 PER WINDOW





- ‘PHOTOTROPIC’ or ‘THERMOTROPIC’ GLASS **ACTIVE**





- 'ELECTROCHROMIC' or 'STEREOGENIC' GLASS ACTIVE





- **COATINGS** (MANIPULATION)

- **ONLINE COATING**

(PYROLYTIC COATING):

ONE-SIDED METAL OXIDE  
SPREAD DURING FLOAT  
GLASS PRODUCTION WHILE  
GLASS IS STILL HOT.

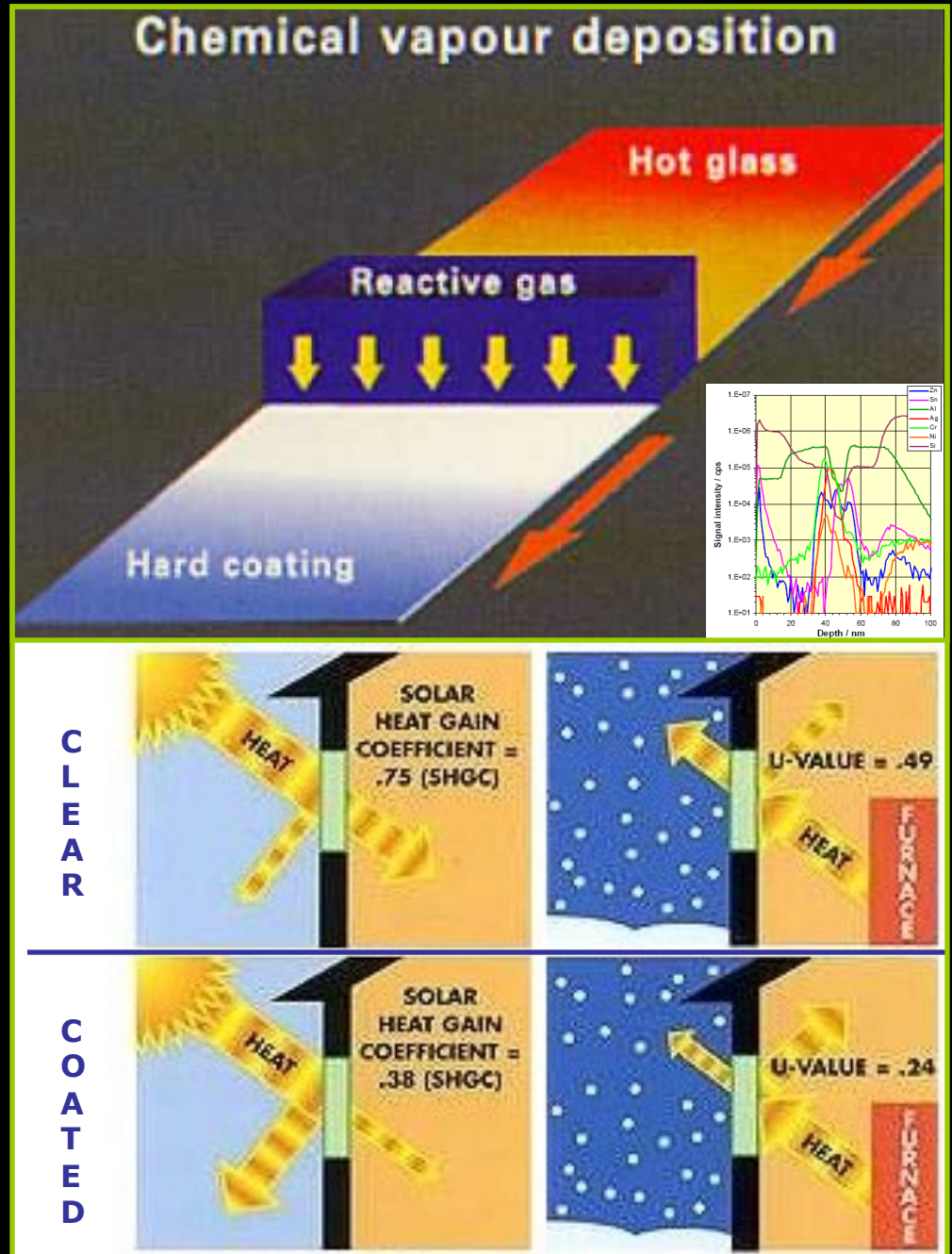
(VISIBLE SPECTRUM TRANSPARENT)

- **SOLAR CONTROL:**

- ENHANCE REFLECTIVITY OR
- ENHANCE 'EMISSION' (13% INSTEAD OF 90%)

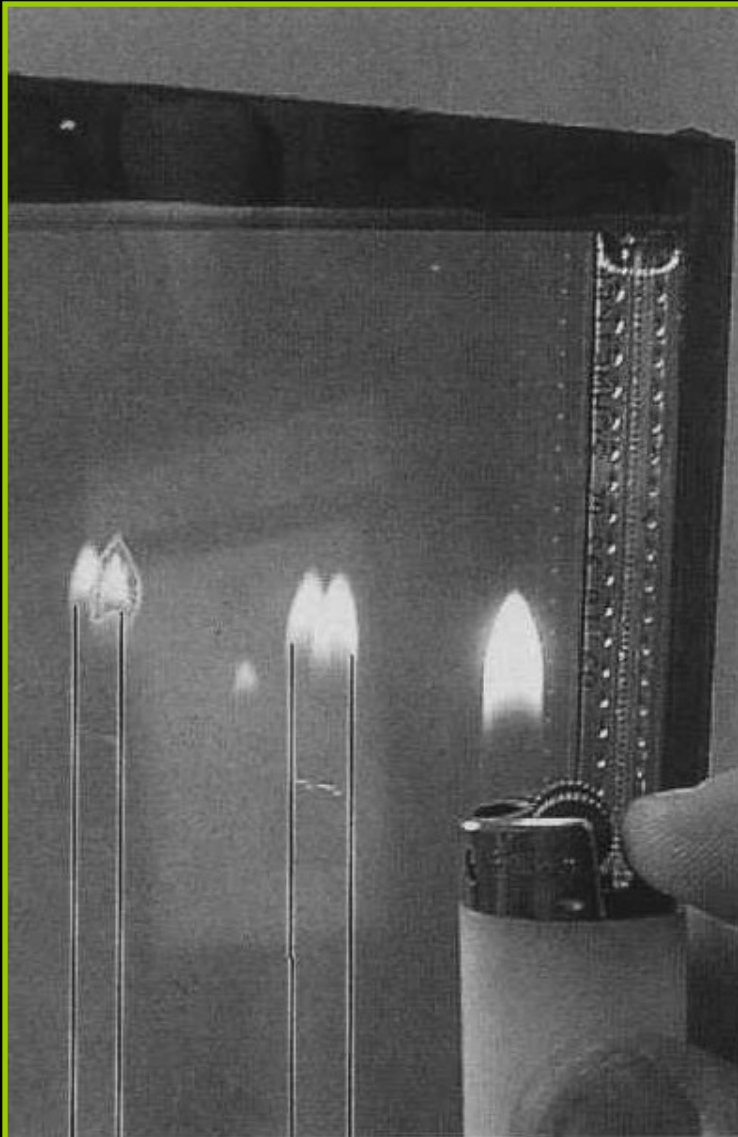
- **EMISSION: ( $\epsilon$ -VALUE)**

THE ABILITY OF A SURFACE  
TO ABSORB HEAT AND TO  
REFLECT IT. THE LOWER THE  
EMISSION, THE LESS ROOM  
HEAT IS ABSORBED - THE  
MORE HEAT IS EMITTED  
BACK INTO THE ROOM.





- MANIPULATION: COATINGS



*Coated insulating units for better thermal insulation*

Surface coatings with thicknesses of  $0.01\text{--}1\text{ }\mu\text{m}$  can improve the physical radiation properties of glass. The radiation transmission is reflected or absorbed, i.e. the emissivity is reduced, depending on the thickness and composition of the coating. The position of the coating is also important because it can bring about various refractive effects or release the absorption gains into the room or to the outside, depending on the direction of the radiation. Coatings include magnetron-sputtered inert metals, e.g. copper, silver, gold, or semiconductor coatings, e.g. tin oxide, applied in a pyrolytic process. The silver- and gold-coloured low E glasses of the 1970s have now been superseded by invisible coatings whose position is disclosed only by the lighter test (fig. 2.3.12). The reflection with a different colour – compared to the other three – reveals the coating.



# ● MANIPULATION: THERMAL CONDUCTIVITY LAYERS

## THERMAL CONDUCTIVITY:

THE ABILITY OF A MATERIAL TO CONDUCT HEAT. (BTU/hrft<sup>°</sup>F)

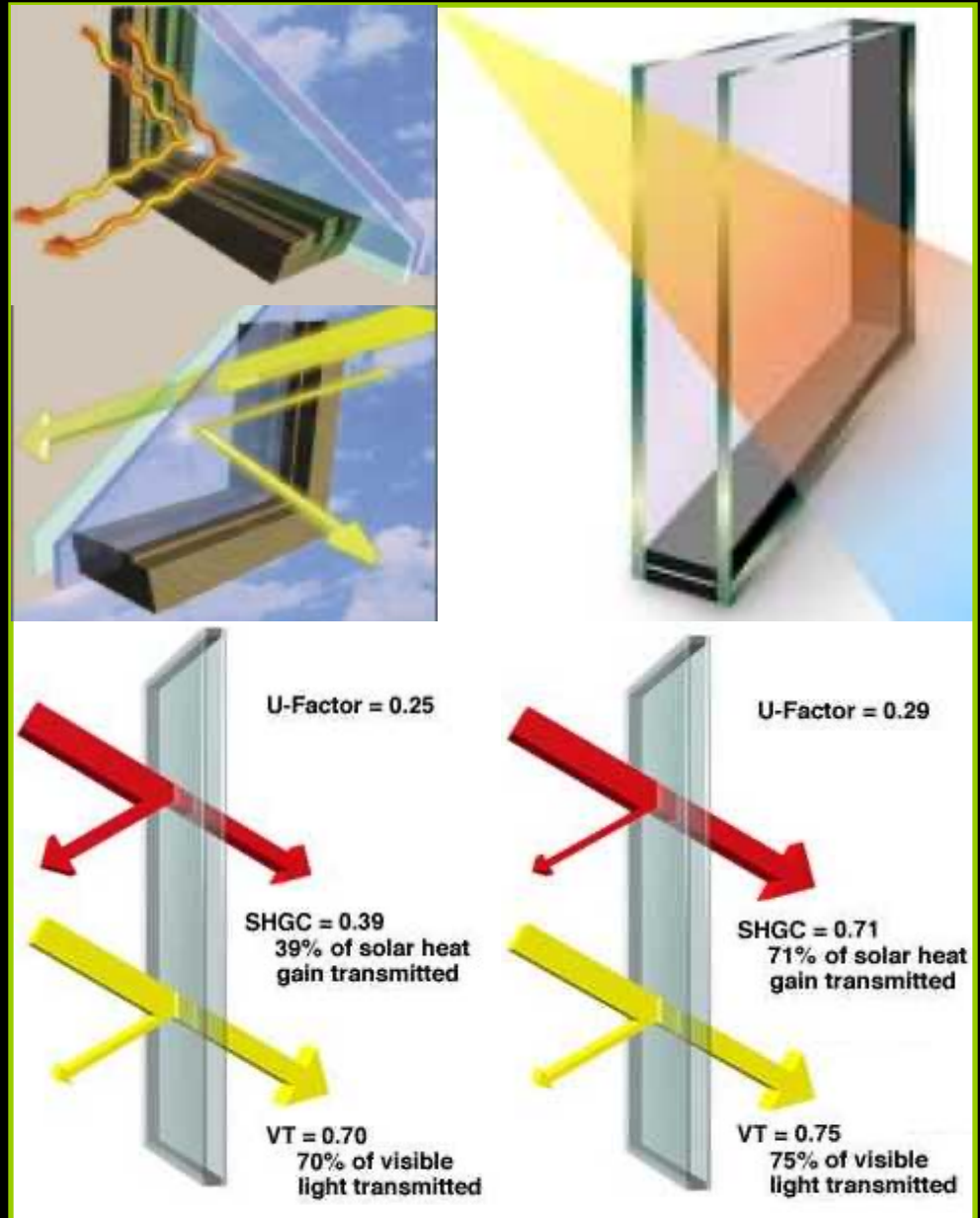
|              |      |
|--------------|------|
| AIR:         | 0.01 |
| FLOAT GLASS: | 0.4  |
| WOOD:        | 0.1  |
| PLASTIC:     | 0.2  |
| STEEL:       | 26   |
| ALUMINUM:    | 135  |

EXPRESSED AS 'U-VALUE' FOR ASSEMBLIES. (BTU/hrft<sup>2</sup>°F)  
(... -THE LOWER THE BETTER-...)

## THERMAL RESISTANCE:

THE RECIPROCAL OF THERMAL CONDUCTIVITY. (hrft<sup>°</sup>F/BTU)

EXPRESSED AS 'R-VALUE' FOR ASSEMBLIES. (hrft<sup>2</sup>°F/BTU)  
(...-THE HIGHER THE BETTER-...)





# ● MANIPULATION

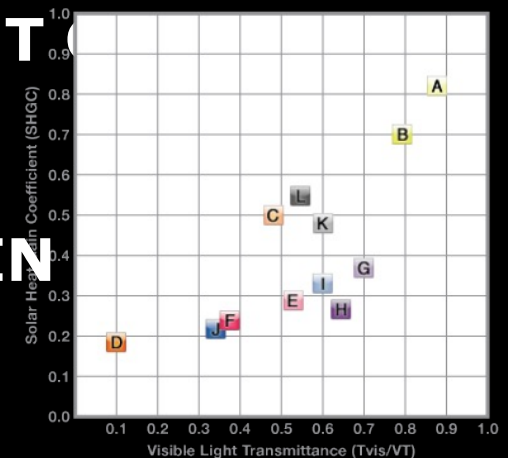
## - 3 FACTORS FOR PERFORMANCE OF WINDOW GLASS:

‘U-VALUE’ ( $\text{BTU/hrft}^2\text{°F}$ ) → **THERMAL TRANSMISSION**  
(... -THE LOWER THE BETTER-...)

‘SHGC’ - SOLAR HEAT GAIN COEFFICIENT (%) → **HEAT GAIN**  
(... -THE ? THE BETTER-...)

‘VT’ - VISIBLE TRANSMITTANCE (%) → **LIGHT**  
(... -THE HIGHER THE BETTER- ...)

‘LSG’ RATIO → **LIGHT-TO-SOLAR GAIN**  
( $\text{VT}/\text{SHGC}$ ) (... -THE HIGHER THE BETTER-...)





# ● MANIPULATION: THERMAL CONDUCTIVITY GASES

## THERMAL CONDUCTIVITY:

THE ABILITY OF A MATERIAL TO CONDUCT HEAT. (BTU/hrft<sup>2</sup>°F)

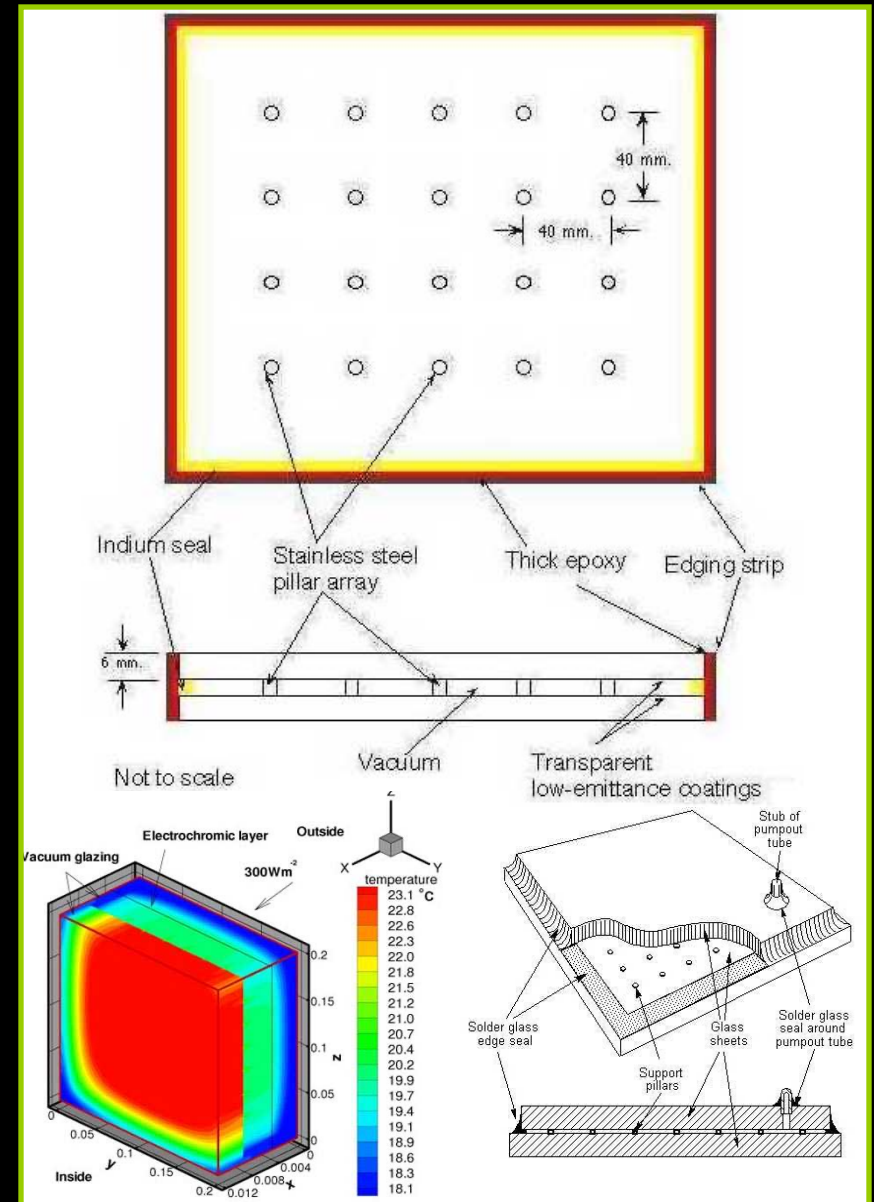
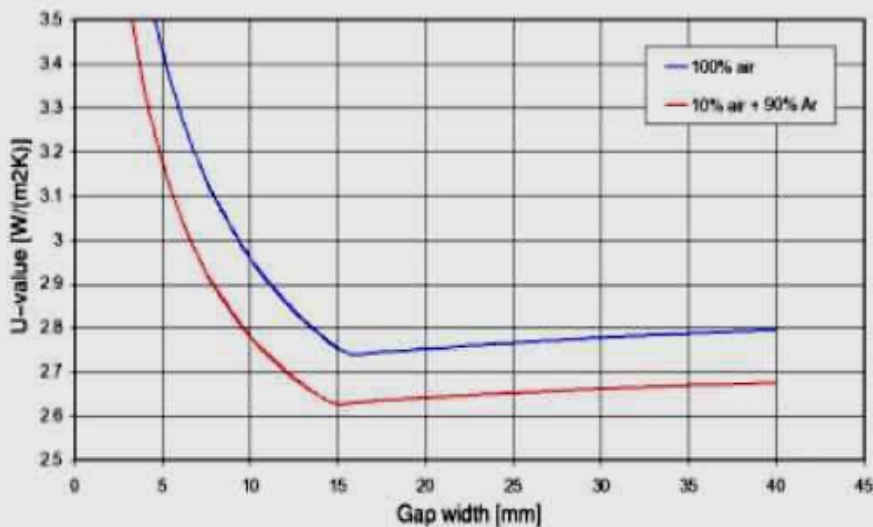
AIR 'FILM': 0.01

ARGON: ...BETTER

VACUUM: ...BEST !

Gas thermal conductivities as percent of the conductivity of air at 1ata, 300 K

| GAS                               | H <sub>2</sub> | He   | Ar  | CO <sub>2</sub> | CF <sub>4</sub> |
|-----------------------------------|----------------|------|-----|-----------------|-----------------|
| $K_{\text{GAS}} / K_{\text{AIR}}$ | 695%           | 563% | 67% | 62%             | 62%             |



VACUUM GLASS



# • U-VALUES/R-VALUES WINDOWS + EXT. WALLS

|                   | U <sub>w</sub> -Wert<br>in W/m <sup>2</sup> K |                                                                                    | U-value<br>BTU/ft <sup>2</sup> h°F | R-value<br>ft <sup>2</sup> h°F/BTU | U-value<br>BTU/ft <sup>2</sup> h°F | R-value<br>ft <sup>2</sup> h°F/BTU |
|-------------------|-----------------------------------------------|------------------------------------------------------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| <u>FUTURE:</u>    | 0,3                                           |  | 0.09                               | 11.1                               | 0.01                               | 100                                |
| VACUUM            | 0,4                                           |                                                                                    |                                    |                                    |                                    |                                    |
| INSULATION        | 0,5                                           |                                                                                    |                                    |                                    |                                    |                                    |
| TRIPLE+ GLAZING,  | 0,6                                           |                                                                                    |                                    |                                    |                                    |                                    |
| COATINGS          | 0,7                                           |                                                                                    |                                    |                                    |                                    |                                    |
|                   | 0,8                                           |                                                                                    |                                    |                                    |                                    |                                    |
| <u>PRESENT:</u>   | 0,9                                           |                                                                                    |                                    |                                    |                                    |                                    |
| ADVANCED:         | 1,0                                           |                                                                                    |                                    |                                    |                                    |                                    |
| TRIPLE GLAZING    | 1,1                                           |                                                                                    |                                    |                                    |                                    |                                    |
| GAS FILL, COATING | 1,2                                           |                                                                                    |                                    |                                    |                                    |                                    |
|                   | 1,3                                           |  | 0.17                               | 5.9                                | 0.04                               | 25                                 |
| <u>PRESENT:</u>   | 1,4                                           |                                                                                    |                                    |                                    |                                    |                                    |
| STANDARD:         | 1,5                                           |                                                                                    |                                    |                                    |                                    |                                    |
| DOUBLE GLAZING    | 1,6                                           |                                                                                    |                                    |                                    |                                    |                                    |
| GAS FILL          | 1,7                                           |                                                                                    |                                    |                                    |                                    |                                    |
|                   | 1,8                                           |                                                                                    |                                    |                                    |                                    |                                    |
| <u>PAST:</u>      | 1,9                                           |                                                                                    |                                    |                                    |                                    |                                    |
| INFERIOR:         | 2,0                                           |                                                                                    |                                    |                                    |                                    |                                    |
| SINGLE GLAZING    | 2,1                                           |                                                                                    |                                    |                                    |                                    |                                    |
| w/ STORM WINDOW   |                                               |                                                                                    |                                    |                                    |                                    |                                    |
|                   |                                               |                                                                                    |                                    |                                    |                                    |                                    |

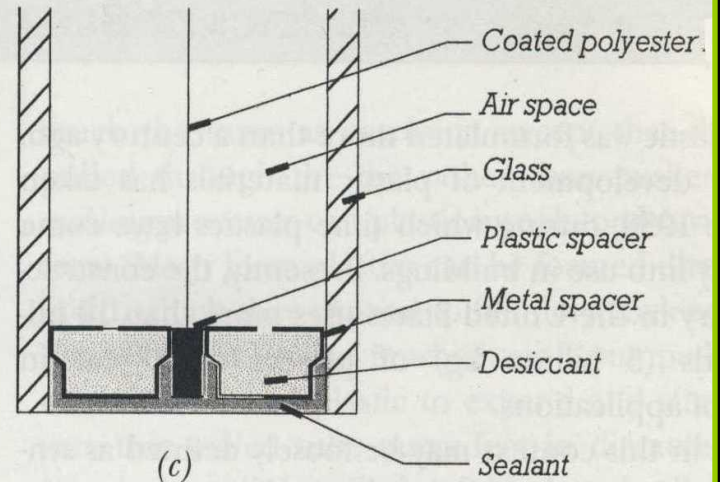
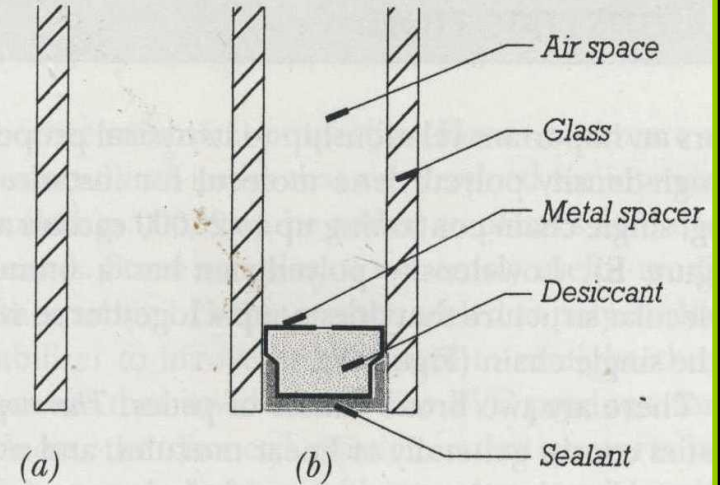


# • U-VALUES, R-VALUES

(BTU/ft<sup>2</sup>h° F, ft<sup>2</sup>h° F/BTU)

**Thermal Insulating Values, Center of Glass**

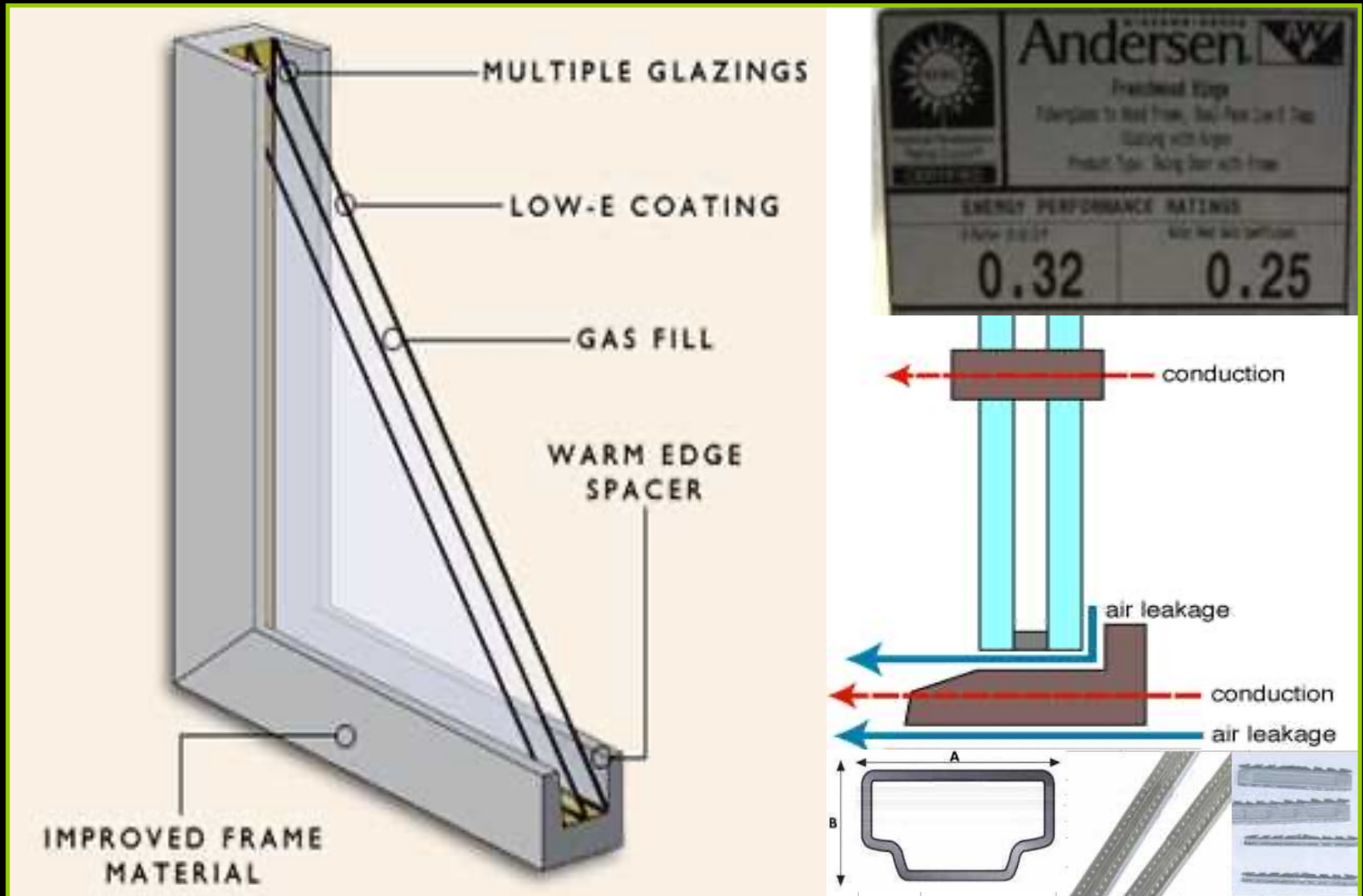
|                                                                                                                 | U    |      | R    |      |
|-----------------------------------------------------------------------------------------------------------------|------|------|------|------|
|                                                                                                                 | U.S. | S.I. | U.S. | S.I. |
| Single glass                                                                                                    | 1.11 | 6.29 | 0.90 | 0.16 |
| Double glass or<br>Single glass plus<br>storm window                                                            | 0.50 | 2.84 | 2.00 | 0.35 |
| Double glass with<br>argon fill                                                                                 | 0.46 | 2.61 | 2.17 | 0.38 |
| Double glass with<br>low-e coating on<br>one surface                                                            | 0.34 | 1.93 | 2.94 | 0.52 |
| Double glass with<br>argon fill and low-e<br>coating on one surface                                             | 0.28 | 1.59 | 3.57 | 0.62 |
| Triple glass                                                                                                    | 0.34 | 1.93 | 2.94 | 0.52 |
| Double glass, polyester<br>film in middle of airspace,<br>argon fill, low-e coating on<br>two interior surfaces | 0.17 | 0.96 | 5.88 | 1.03 |



R-VALUE, S.I. UNIT CONVERSION: **5.678** x m<sup>2</sup>hK/W = ft<sup>2</sup>h° F/BTU

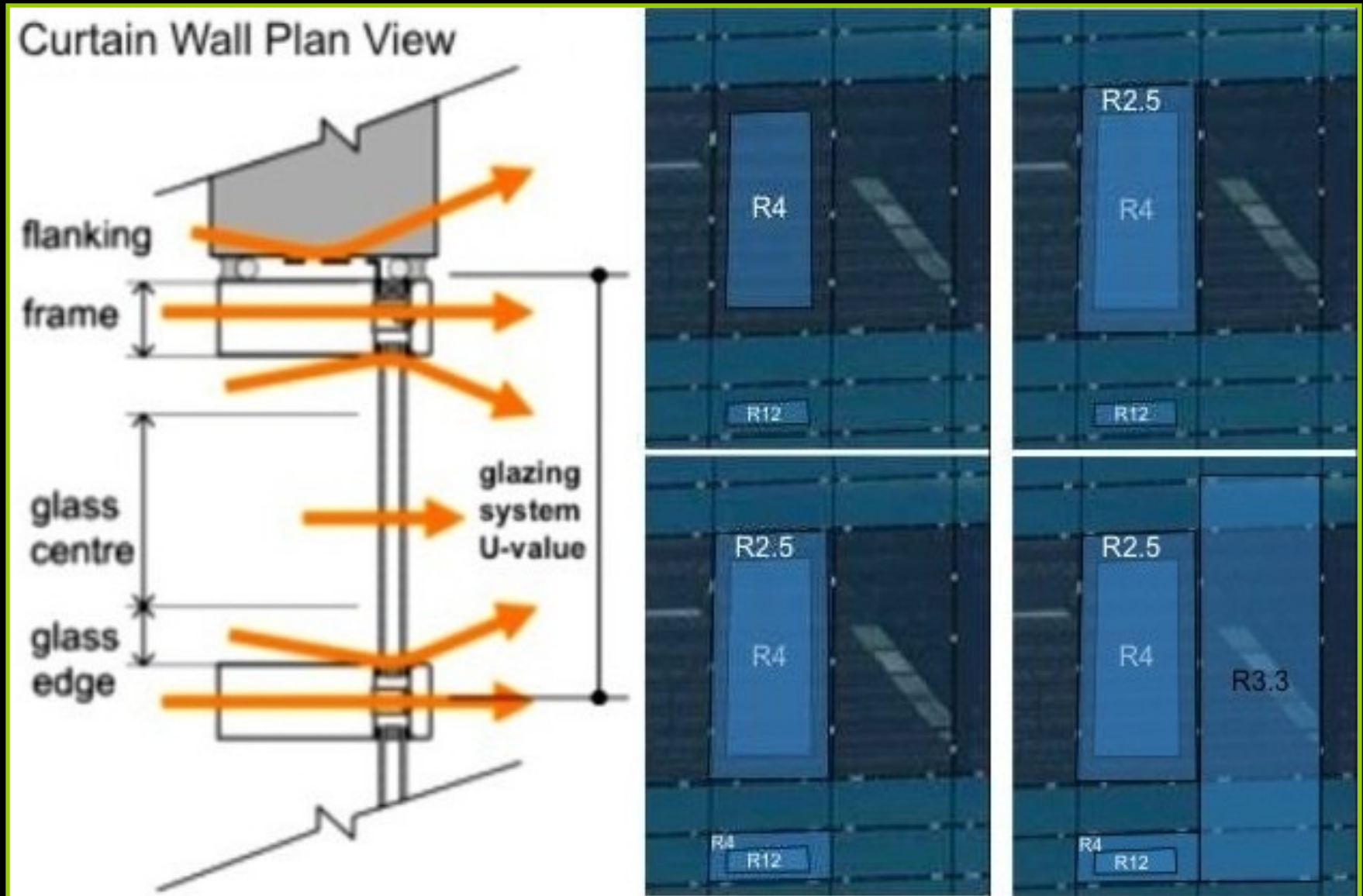


- LAYERS / 'WEAK POINTS'



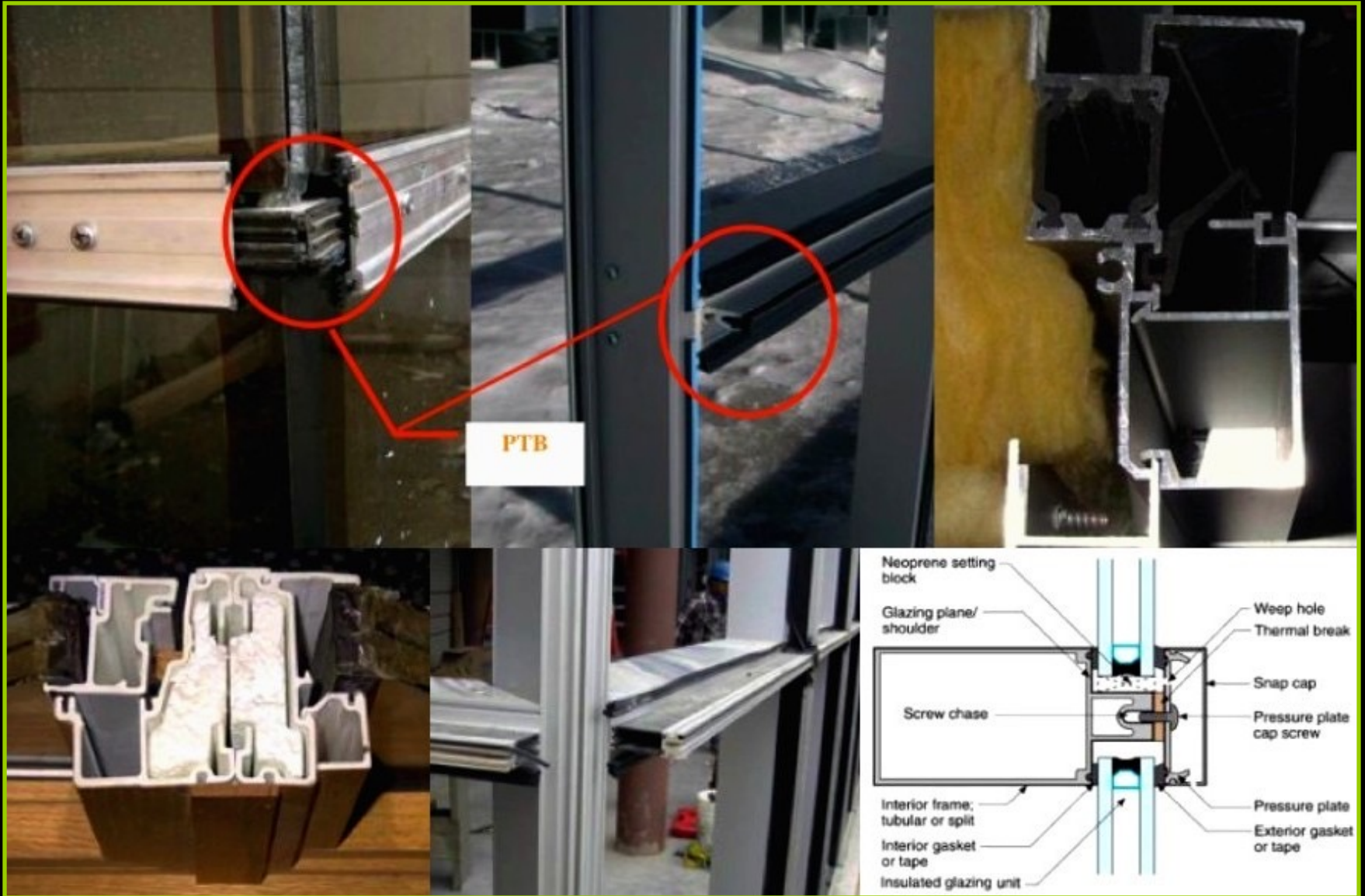


- LAYERS / 'WEAK POINTS'





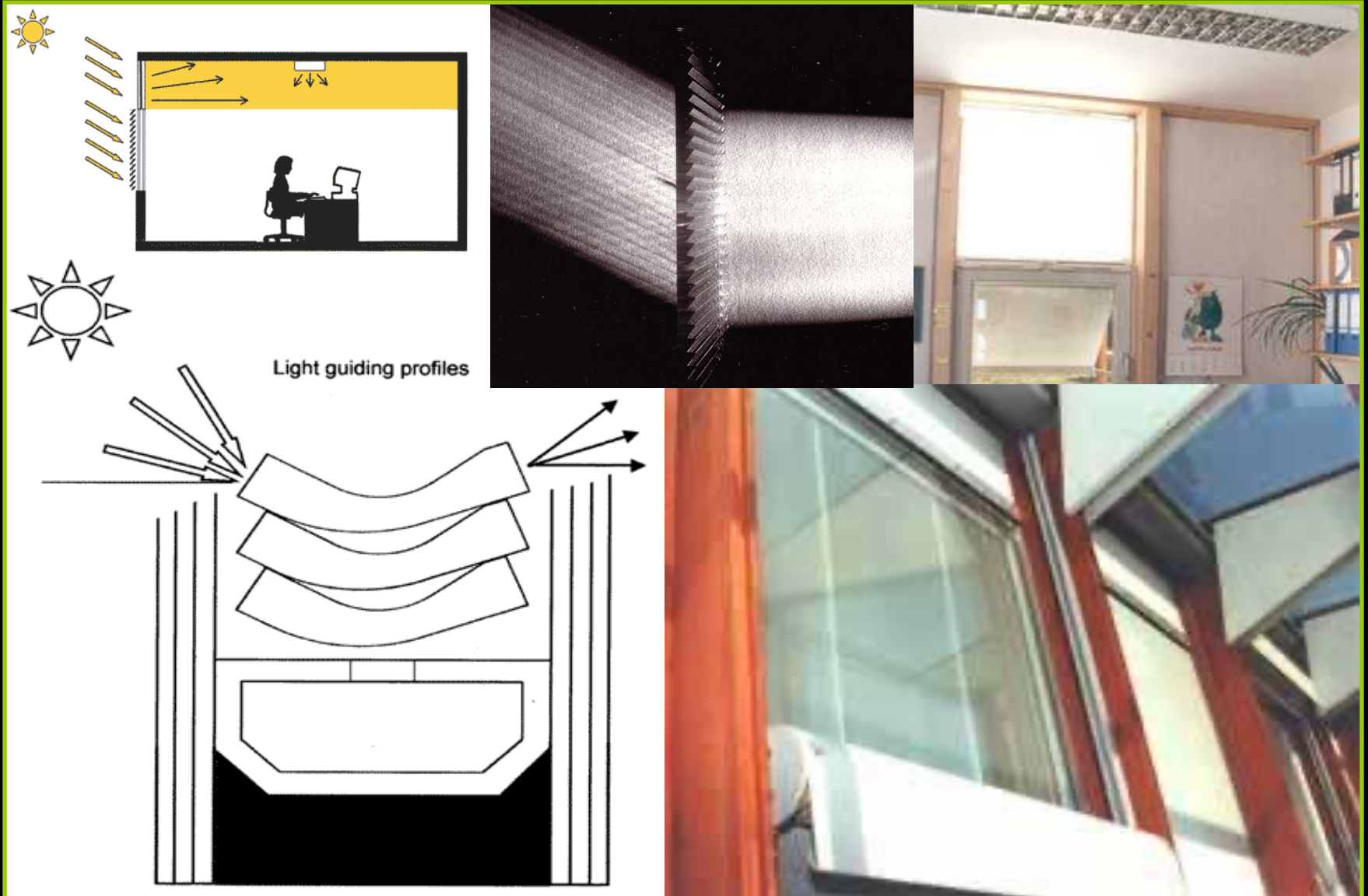
- LAYERS / 'WEAK POINTS'





- ‘LIGHT REDIRECTING GLASS’

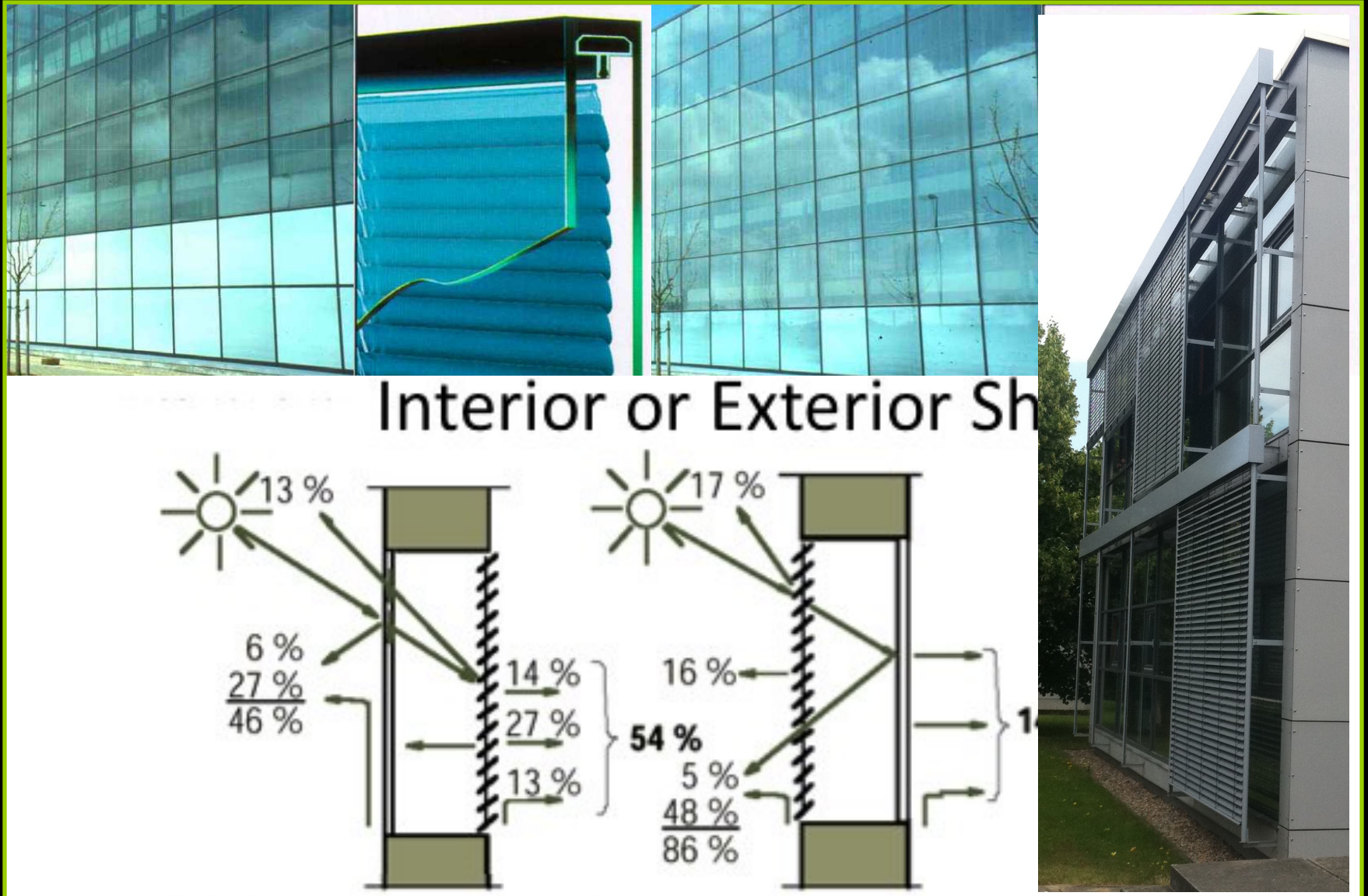
# LAYERS





- INTEGRATED SHADES GLASS

OPERABLE



FINK + JOCHER ARCH.: INNOVATION CENTER, INGOLSTADT GERMANY

- EXTERIOR SHADING

OPERABLE

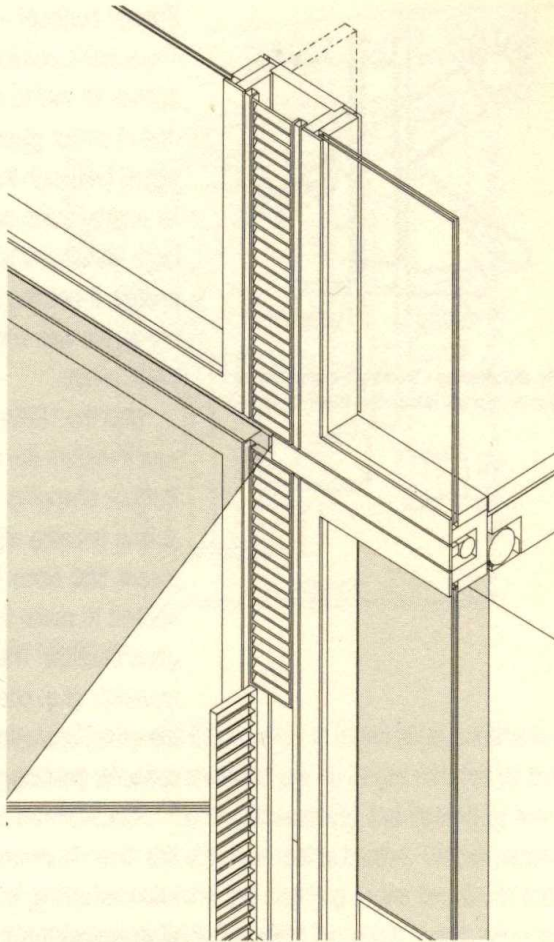
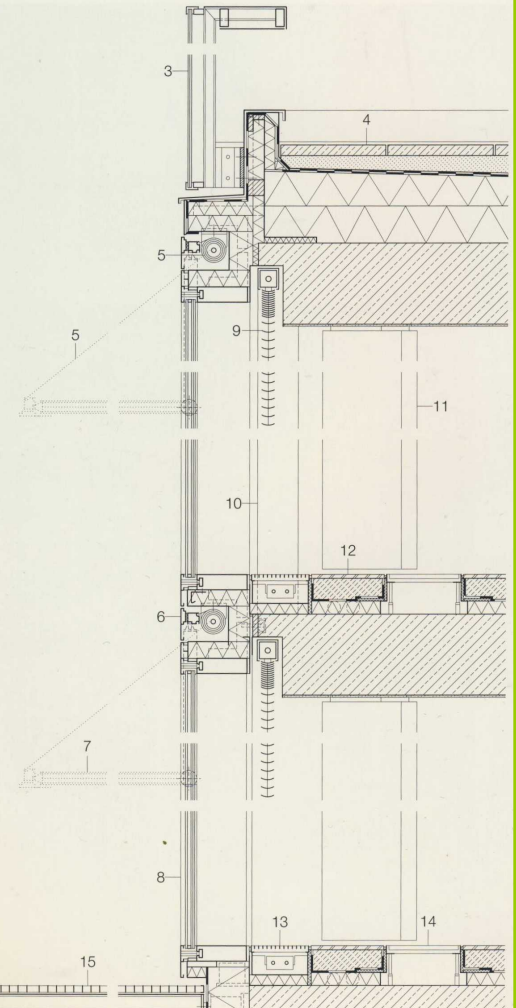


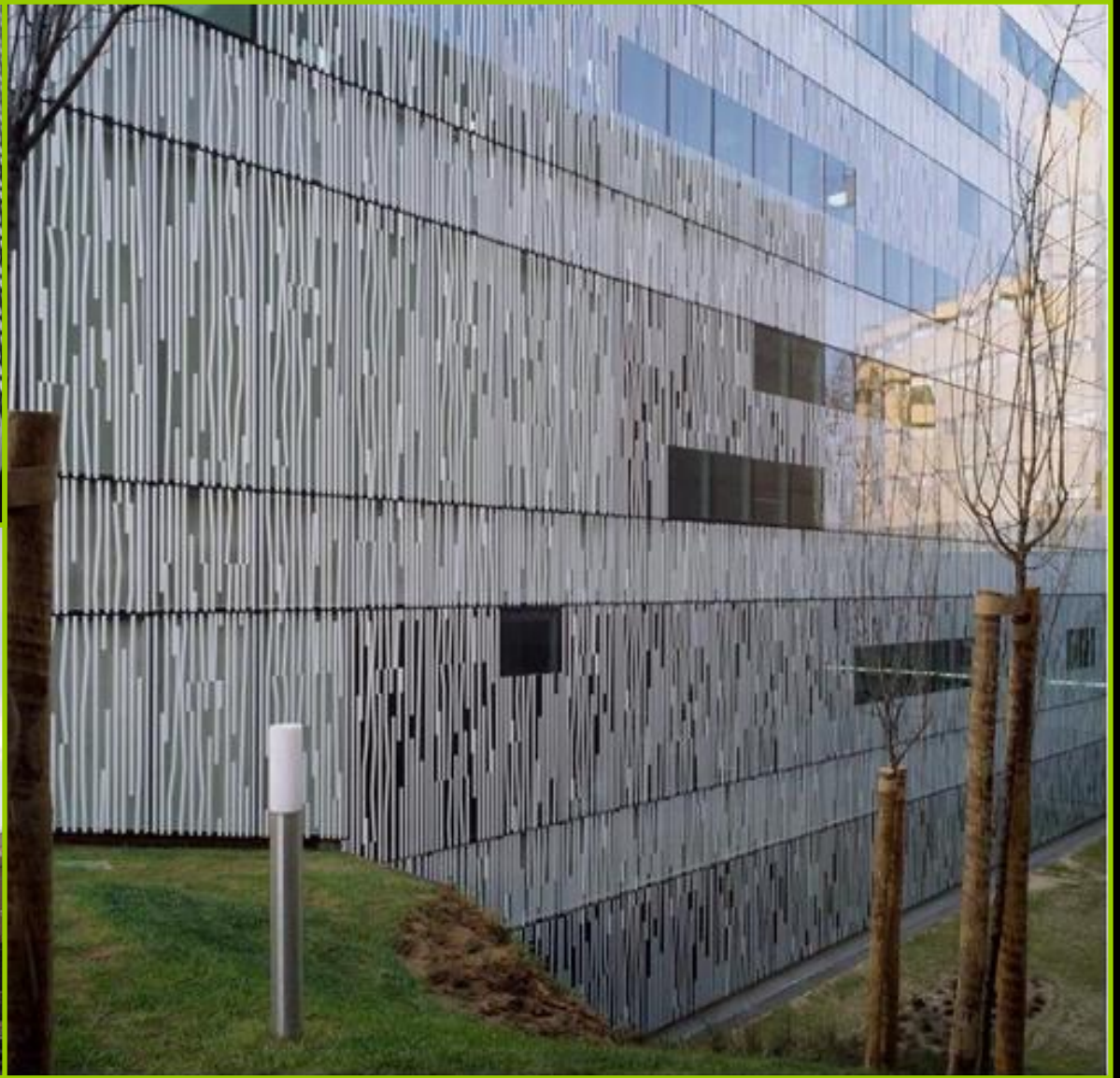
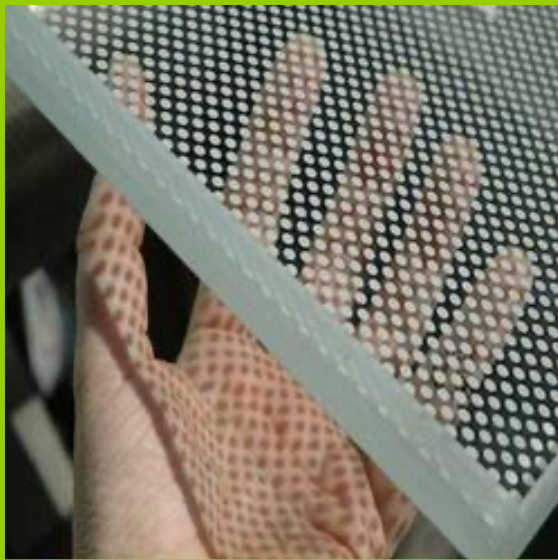
Fig. 252: South facade with awning extended  
Maximum extension of straight arm = horizontal





- FRITTED GLASS SHADING

NOT OPERABLE

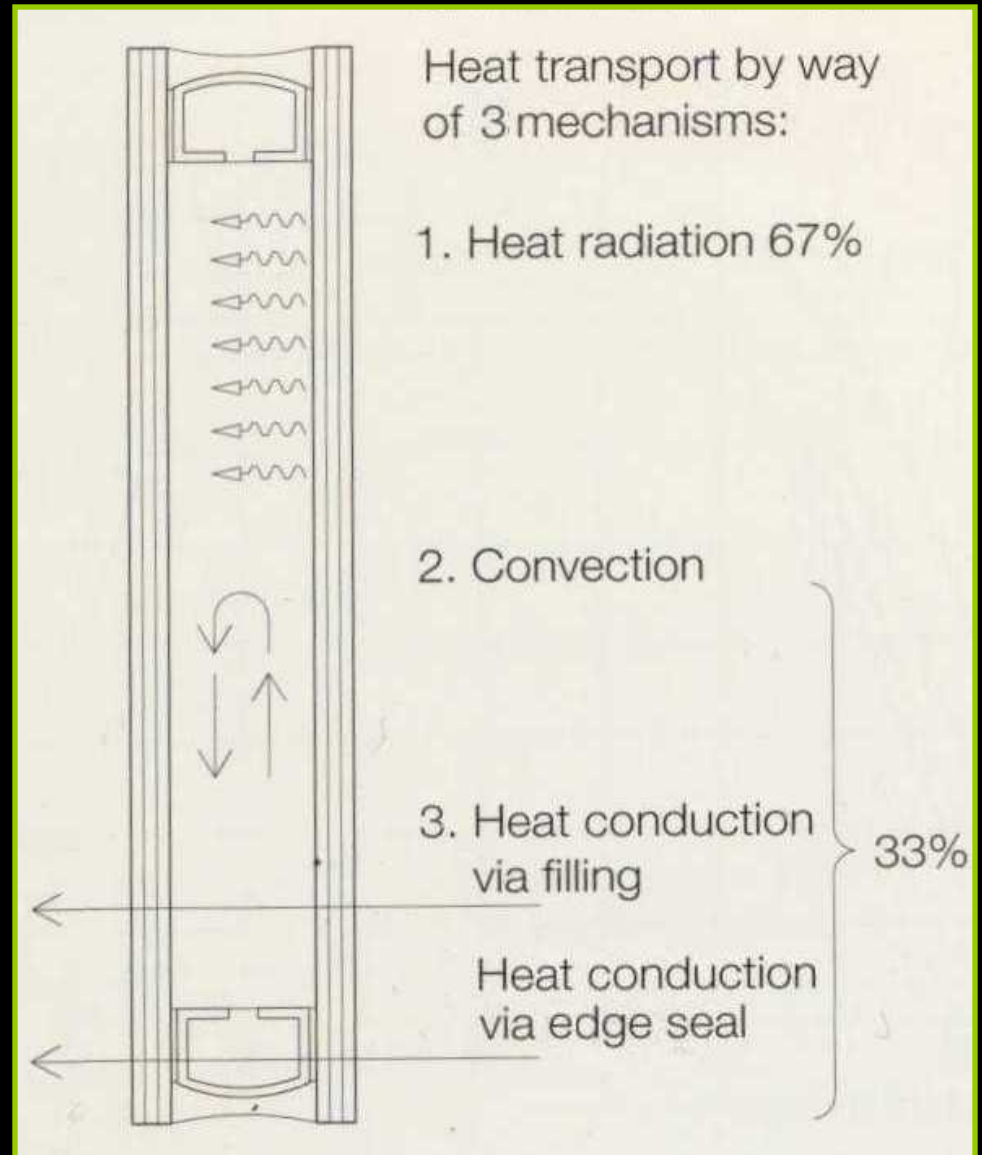
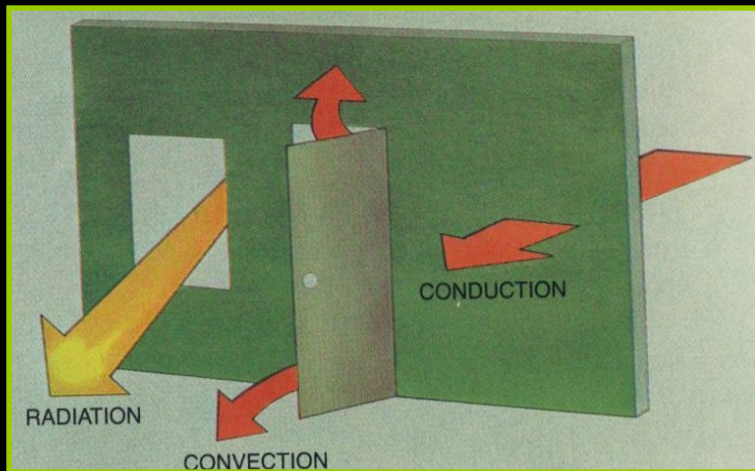


# • HEAT TRANSFER: RADIATION, CONDUCTION, CONVECTION

RADIATION... IS THE PROCESS BY WHICH HEAT IS TRANSFERRED BETWEEN OBJECTS NOT IN CONTACT AND NOT SHIELDED FROM EACH OTHER.

CONDUCTION... IS HEAT TRANSFER WHICH OCCURS WHEN OBJECTS ARE IN DIRECT CONTACT WITH EACH OTHER.

CONVECTION... IS HEAT EXCHANGE WHICH OCCURS ONLY IN A FLUID MEDIUM, LIKE AIR OR A LIQUID.



**COMPROMISE** CONDUCTION/CONVECTION: OPTIMUM DISTANCE  $5/8$ " BETWEEN PANES



- **EXCHANGE:** TRANSMISSION, REFLECTION, ABSORPTION

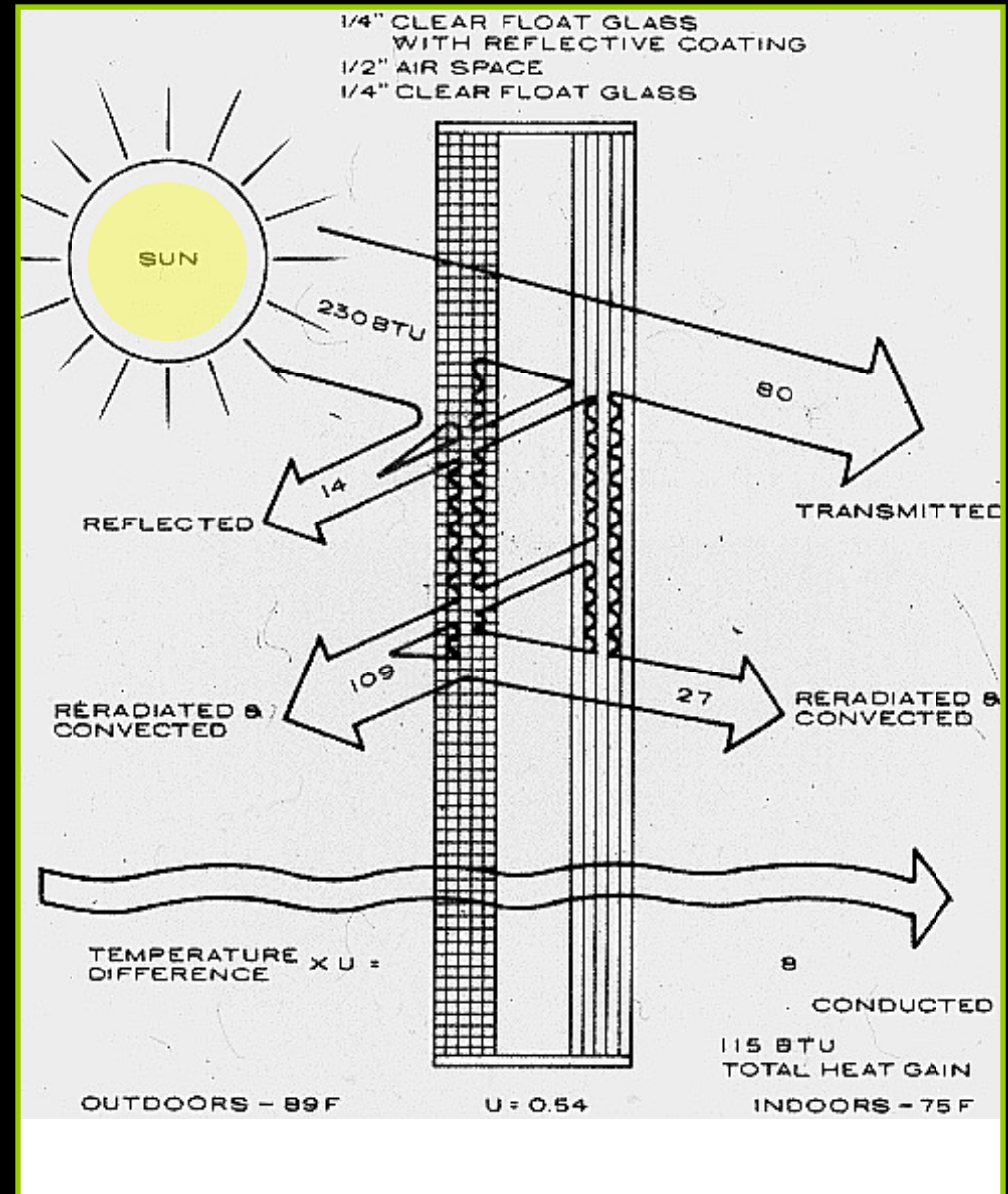
'TRANSPARENCY':

**THE PROPERTIES OF:**

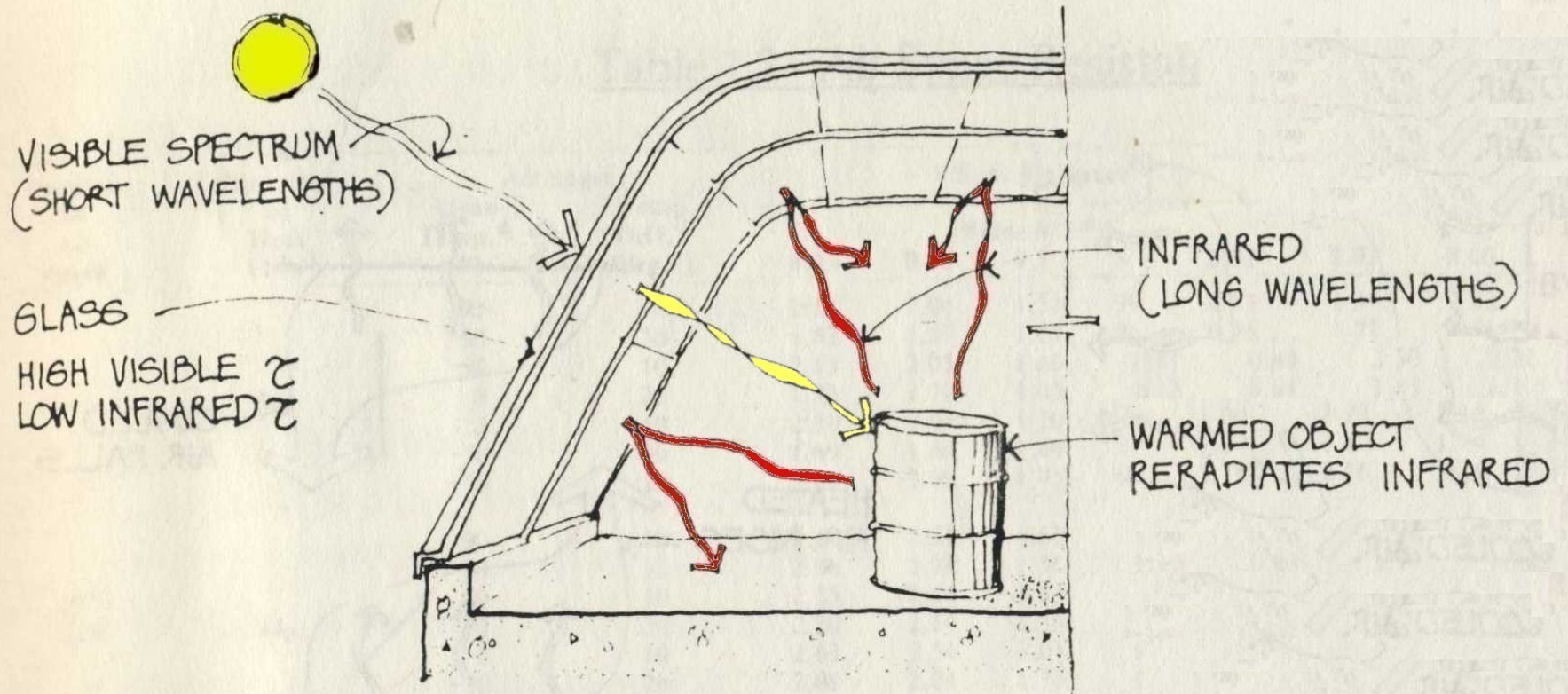
- 1) TRANSMISSION,
- 2) REFLECTION

[ 3) ABSORPTION ] (SEC. GAIN)

- **U -VALUE (CONDUCTION)**
- **SHGC (HEAT GAIN)**
- **VT -VALUE (TRANSPARENCY)**  
(DAYLIGHT TRANSMISSION)



- TRANSMISSION, REFLECTION, ABSORPTION SPECTRUM



GREENHOUSE EFFECT

THE HEAT IS TRAPPED  
INSIDE THE GREENHOUSE  
BY THE GLASS.



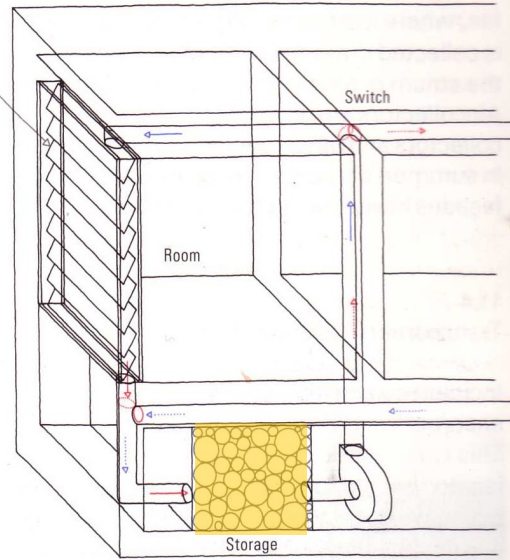
# ● DOUBLE-LEAF FAÇADE PRINCIPLE

## LAYERING

### Window Collector Panels

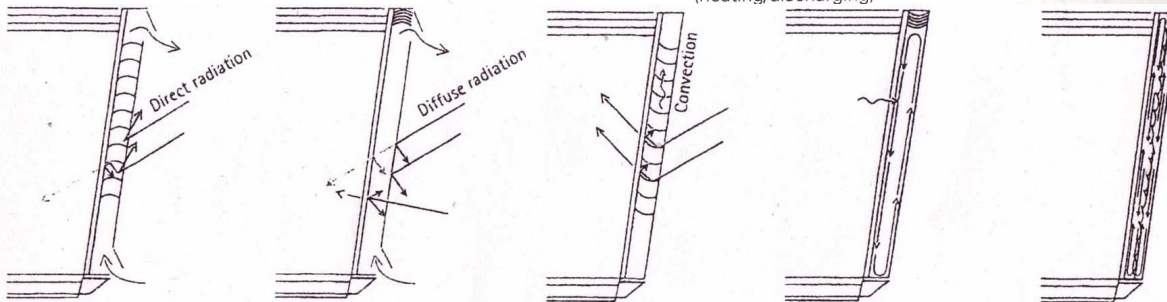
Window collector panels are glazed box elements in which solar energy is transformed into heat and transmitted as heated air to a storage unit inside the building. Between collector (box element) and storage unit, the heated air is completely separate from the room air. Window collectors are south-oriented façade units where air is heated to 30–70°C by absorption when radiation is intense. The air heated in the box element is conducted to a storage unit through air pipes (fan-driven).

The south-facing window collector is generally equipped with interior and exterior high-insulating glazing, to avoid losing the thermal energy absorbed through the slats directly to the outside or to prevent too high a heat radiation toward the interior. When the thermal process is not wanted, the heat-absorbing slats are raised and insulation is used as direct (heat) gain. During the night the slats are lowered again and closed, to reduce heat loss from the interior toward the outside. In summer, it is advisable to install additional outside shading in the form of slats or awnings.



Working principle,  
window collector

— Daytime operation  
(charging)  
..... Nighttime operation  
(heating/discharging)



Summer -  
sunny day

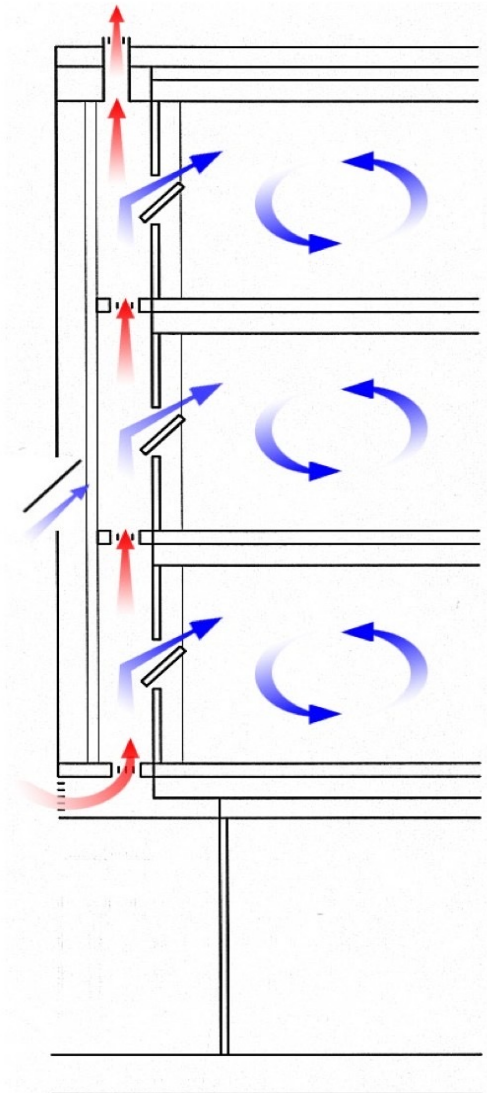
Summer -  
overcast day

Winter -  
sunny day

Winter -  
overcast day

Winter -  
night

The Twin-Face Facade with Divided Air Space





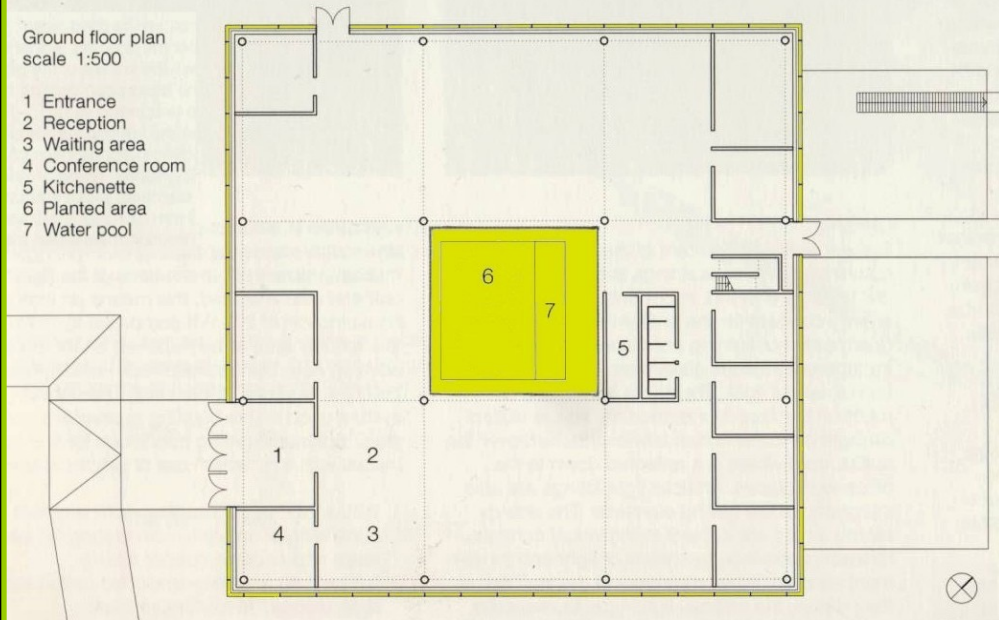
# ● DOUBLE-LEAF FAÇADE PRINCIPLE

## LAYERING



Ground floor plan  
scale 1:500

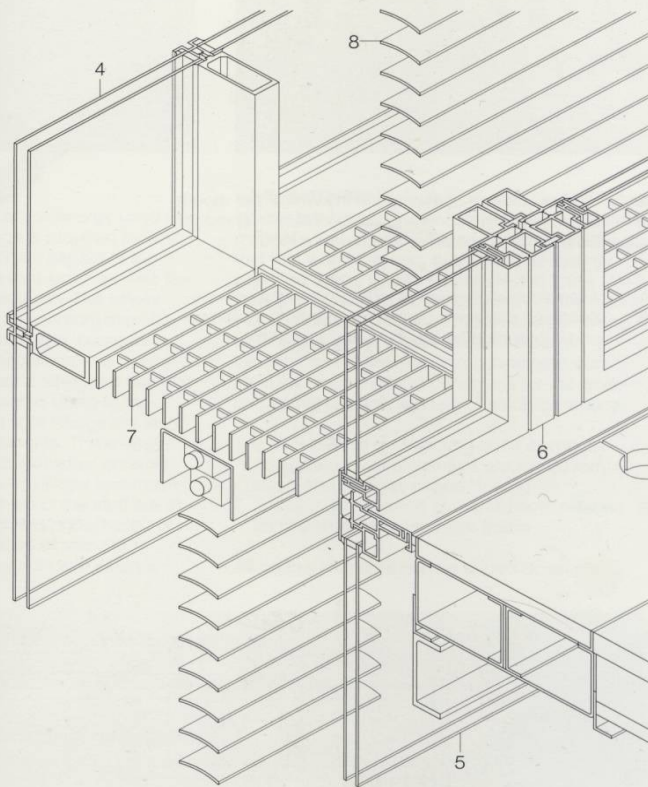
- 1 Entrance
- 2 Reception
- 3 Waiting area
- 4 Conference room
- 5 Kitchenette
- 6 Planted area
- 7 Water pool





# ● DOUBLE-LEAF FAÇADE PRINCIPLE

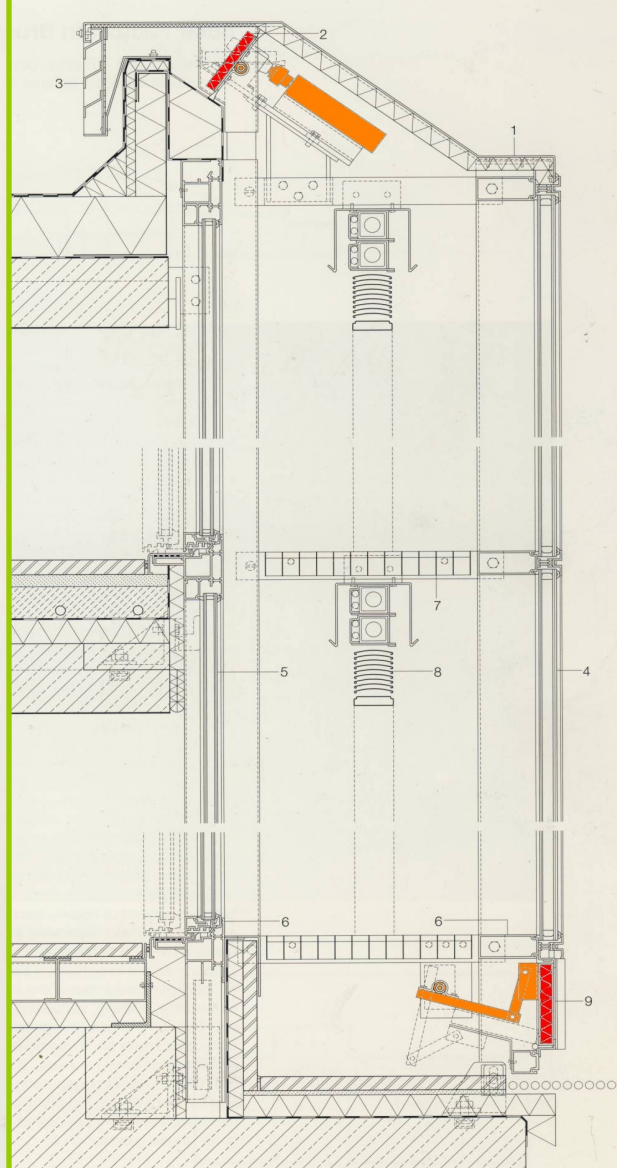
## LAYERING



Axonometric facade detail  
Sectional details of  
facade scale 1:10

- 1 sheet aluminium covering with anti-drumming coating
- 2 upper ventilation flap with brush seal at sides
- 3 aluminium ventilation louvers with fly screen
- 4 outer glazing skin:  
8 mm toughened glass (externally)  
22 mm cavity with inert-gas filling  
6 mm float glass with low-E coating
- 5 inner glazing skin:  
6 mm toughened glass (externally)

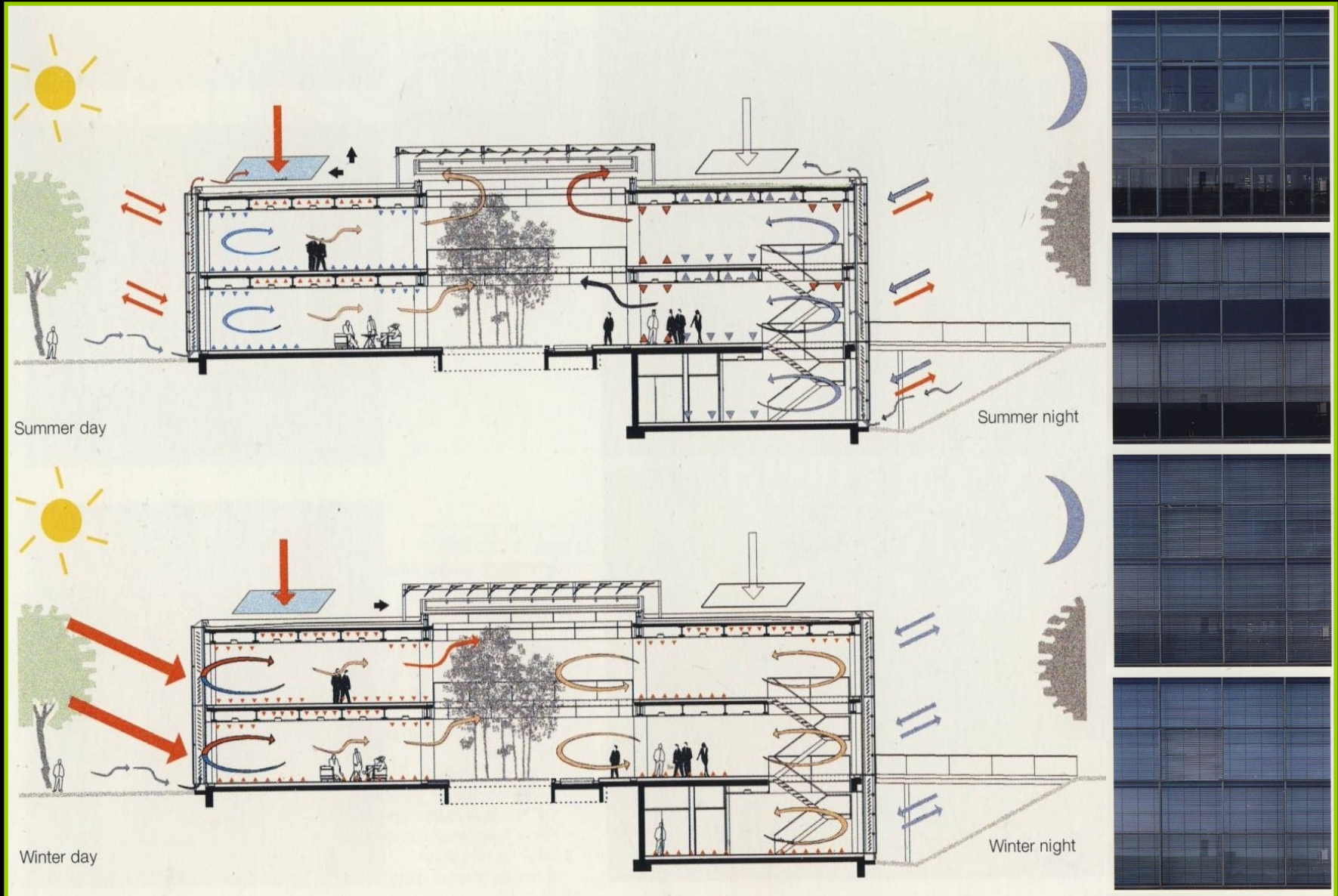
- 6 aluminium frame, thermally divided
- 7 aluminium grating
- 8 perforated lightweight metal louvre blind:  
upper section with white coating on both faces;  
lower section with dark coating on one face;  
both sections independently operable
- 9 lower ventilation flap





# • DOUBLE-LEAF FAÇADE PRINCIPLE

## PASSIVE COLLECTOR





- SPANDREL 'FLAT PLATE' COLLECTOR ACTIVE COLLECTOR

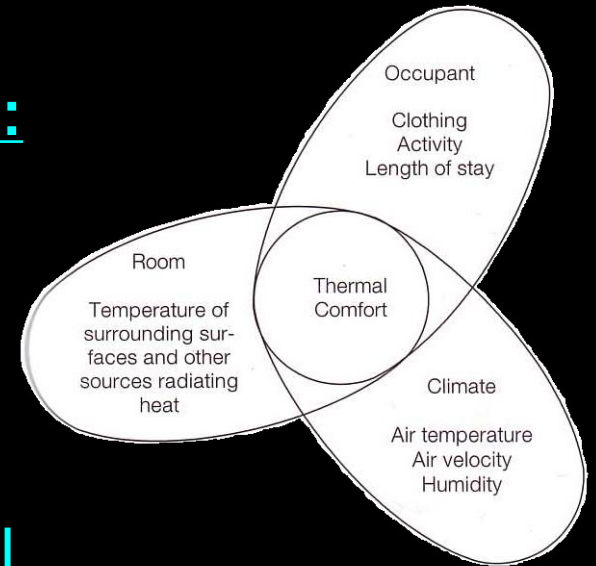


# • VISUAL COMFORT + PASSIVE GAINS

## MEMBRANE

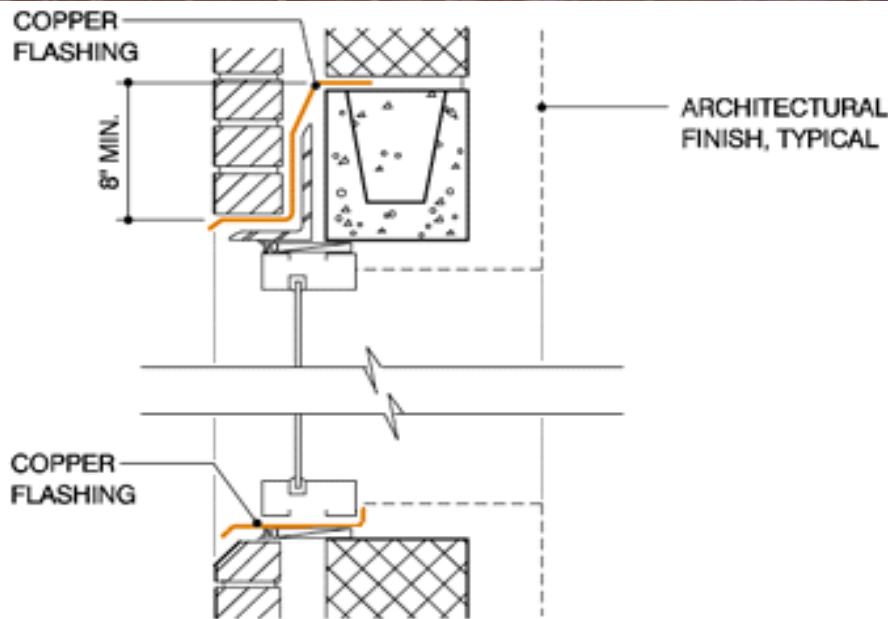
### OPERATION / FUNCTIONS:

- DAYLIGHT
- GLARE/SHADING
- TEMPERATURE CONTROL
- SUN RAYS; RADIATION; HEAT GAIN
- VENTILATION / AIR CHANGE
- TRANSPARENCY; CONTACT TO OUTSIDE
- VIEW PROTECTION FROM OUTSIDE
- ...





# ● FAÇADE INTEGRATION



## FLASHING WINDOW OPENINGS:

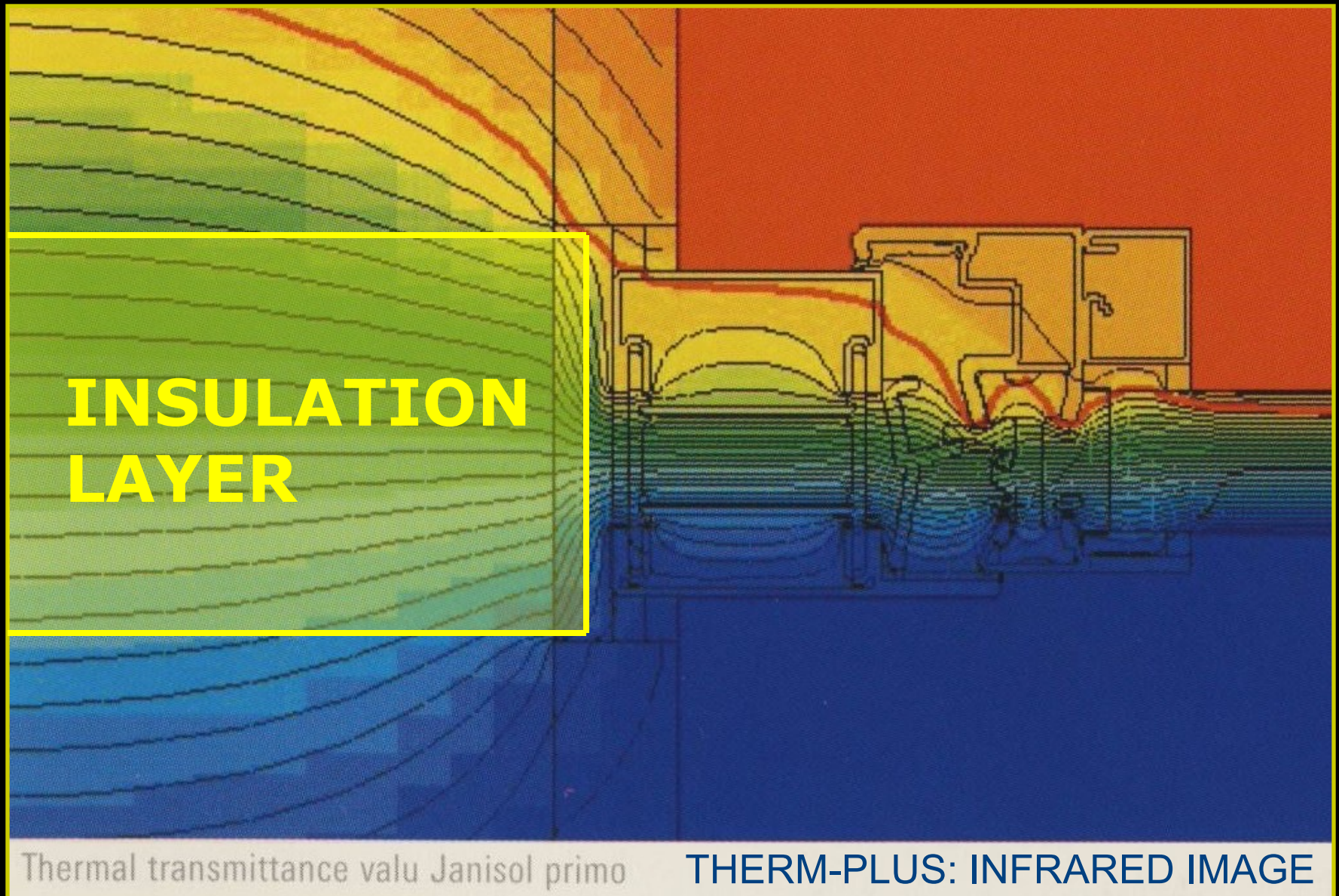
SILL: EXTENSION (6"-8")  
BEYOND JAMB LINES;  
BOTH ENDS NEED AN  
'END DAM'.  
CHECK JAMB TO  
FRAME DETAIL !

HEADER: EXTEND FLASHING  
SO THAT WATER  
CANNOT GET BEHIND  
LINTEL: DRIP EDGE !

INSTALLATION W/ CONTINUOUS  
MASTIC BED, OR SELF-ADHERING;  
CONTINUOUS SLOPE TO OUTSIDE

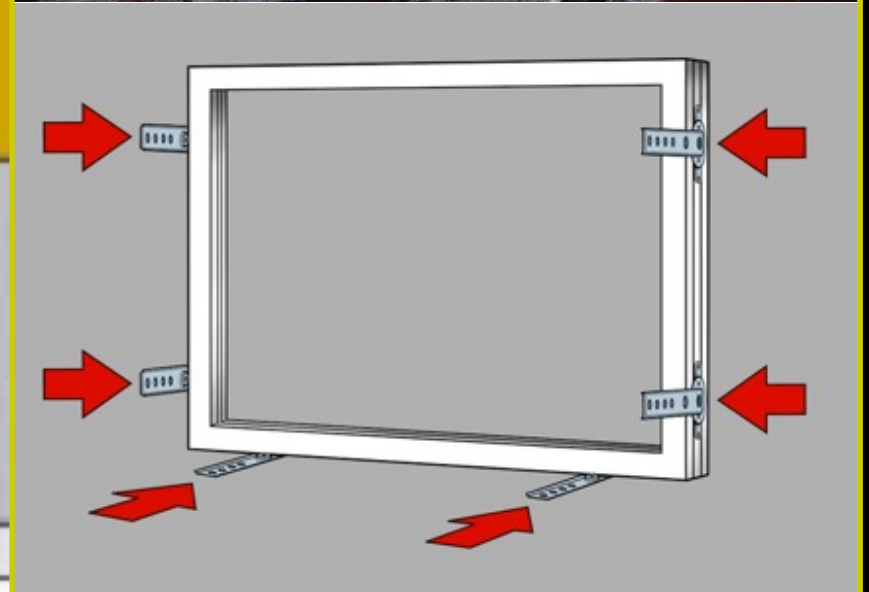
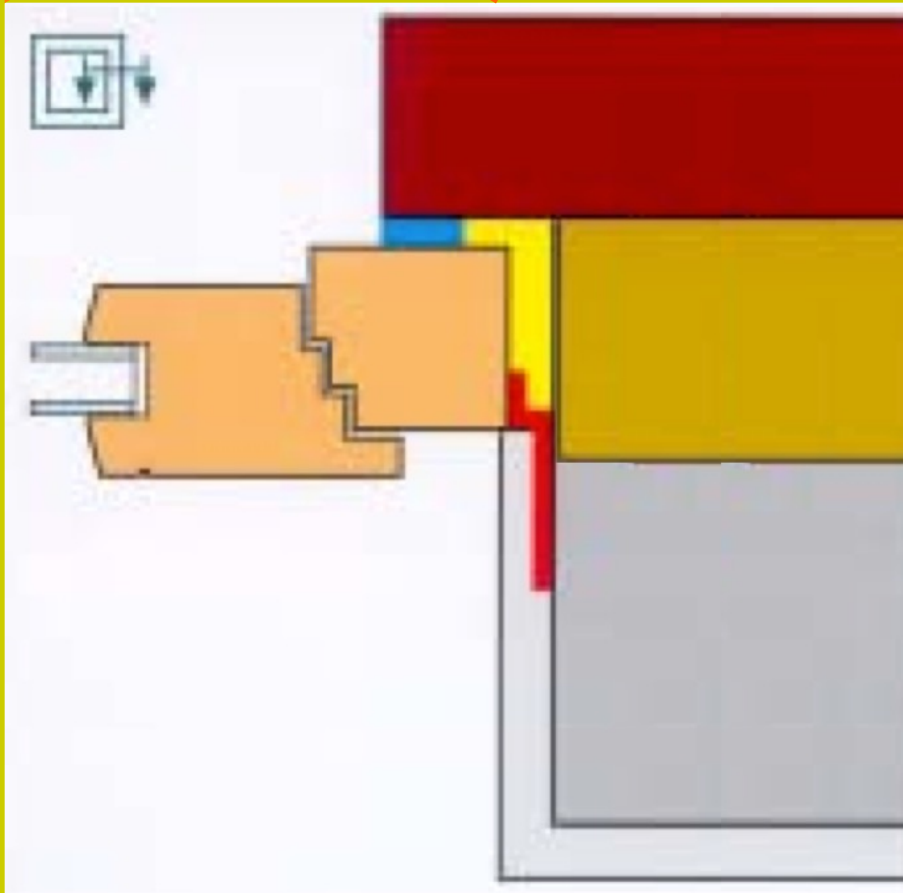
RULE OF THUMB: FLASHING IS  
NECESSARY: OVER OPENINGS,  
UNDER OPENINGS, @ ANY BASE  
OF WALL, @ ANY TOP OF WALL;  
CHANGE IN PROJECTION; SHELF  
ANGLES; WEEP HOLES: SAME!

- THERMAL INSULATION: LAYERING





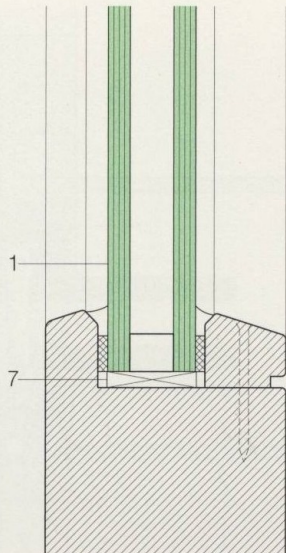
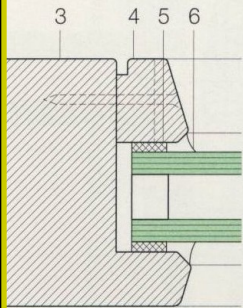
- MOUNTING A WINDOW



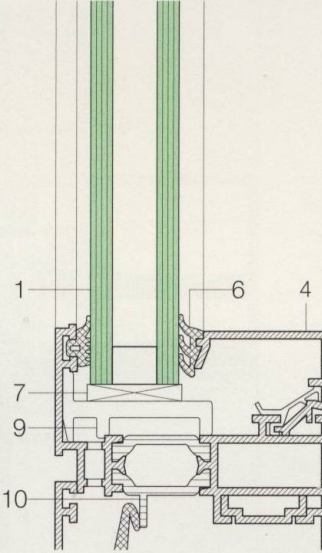
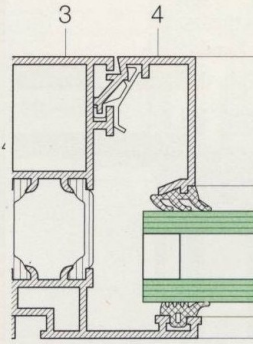
# ● FRAMES: FIXING THE GLASS

## Linear support

- 3.1.1 Wood
- 3.1.2 Aluminium
- 3.1.3 Steel
- 3.1.4 Plastic
- 3.1.5 Wood/aluminium

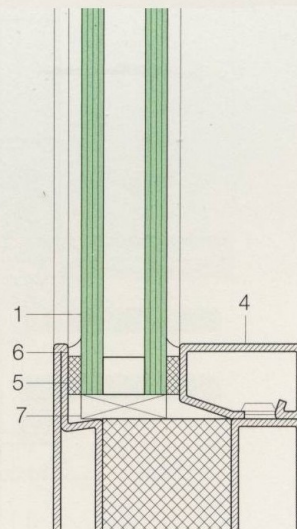
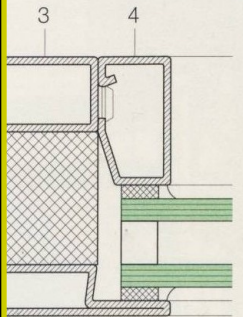


3.1.1

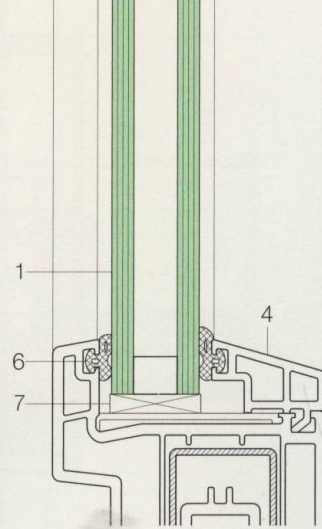
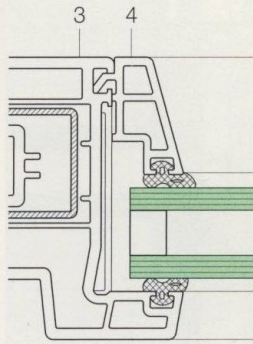


3.1.2

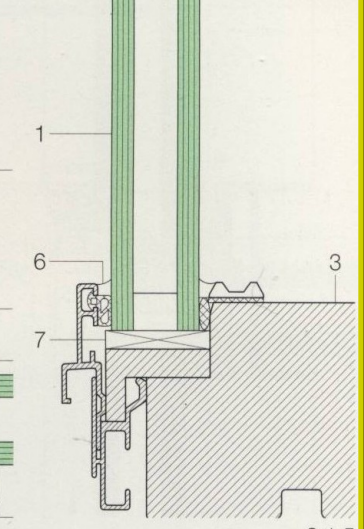
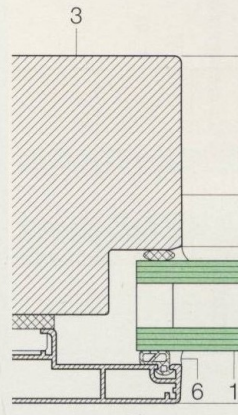
- 1 Double glazing
- 2 Single glazing
- 3 Window frame
- 4 Glazing bead
- 5 Edge tape
- 6 Weatherstripping
- 7 Setting block
- 8 Glass fixing/sealing gasket
- 9 Raised setting block
- 10 Thermal break
- 11 Wedge insert



3.1.3



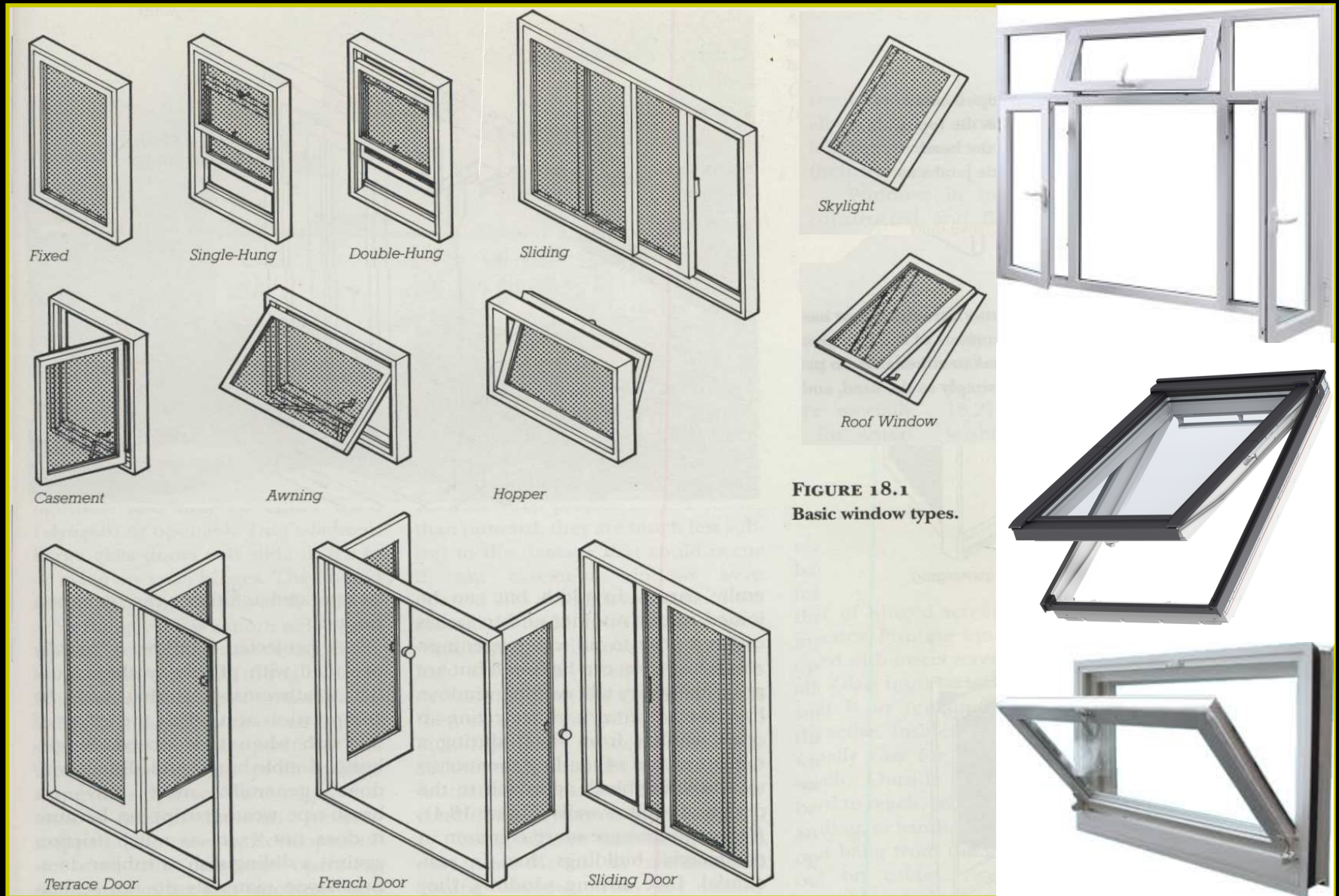
3.1.4



3.1.5



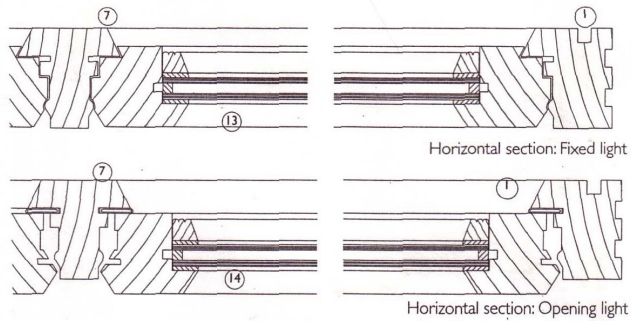
# ● OPERATION



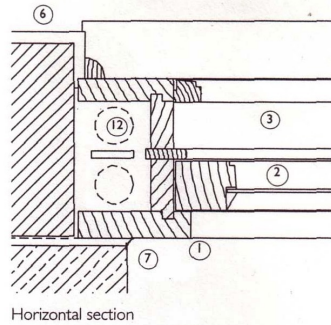
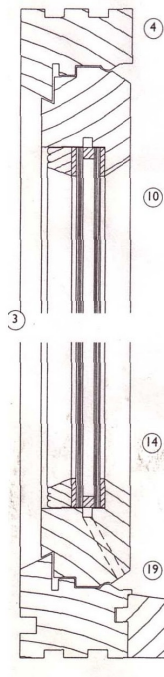




# WOOD WINDOWS

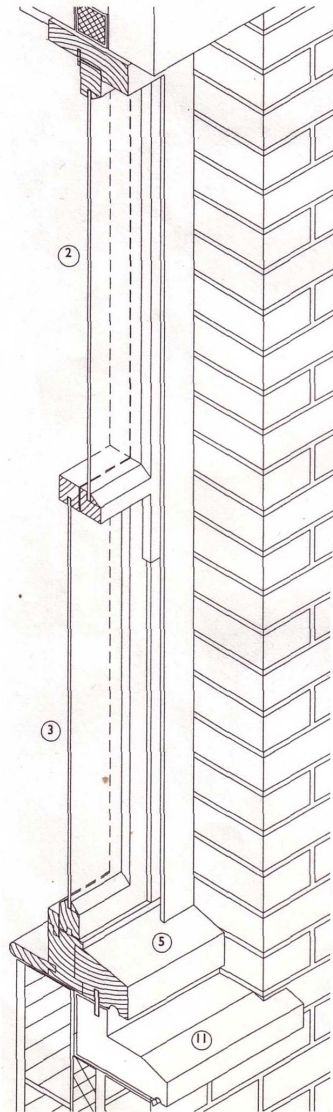


Vertical section  
Fixed light

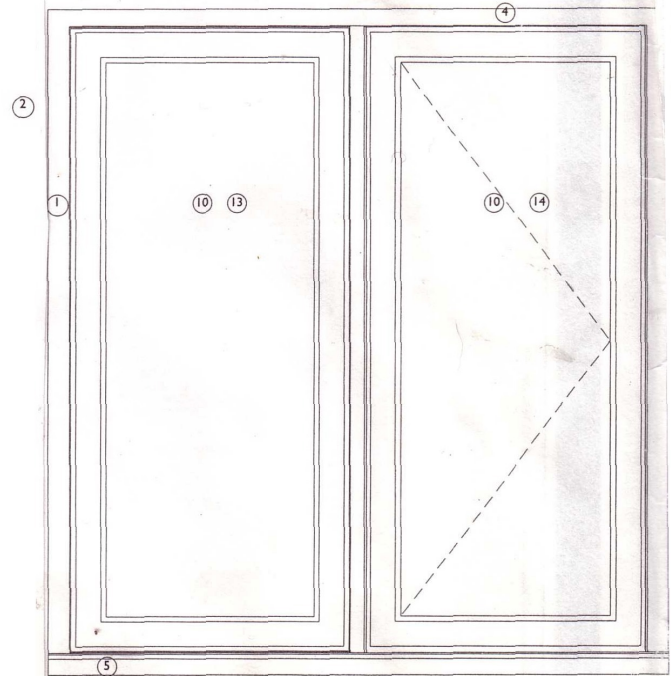


## Details

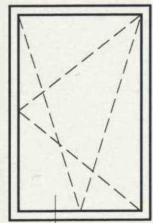
1. Window frame
2. Outer sash
3. Inner sash
4. Heads
5. Cill
6. Internal finish
7. Outer wall facing
8. Damp proof course (DPC)
9. Weather bar
10. Drip
11. Sub-cill
12. Counterweights



Elevation



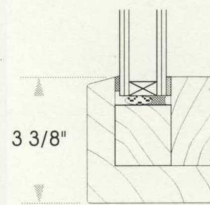
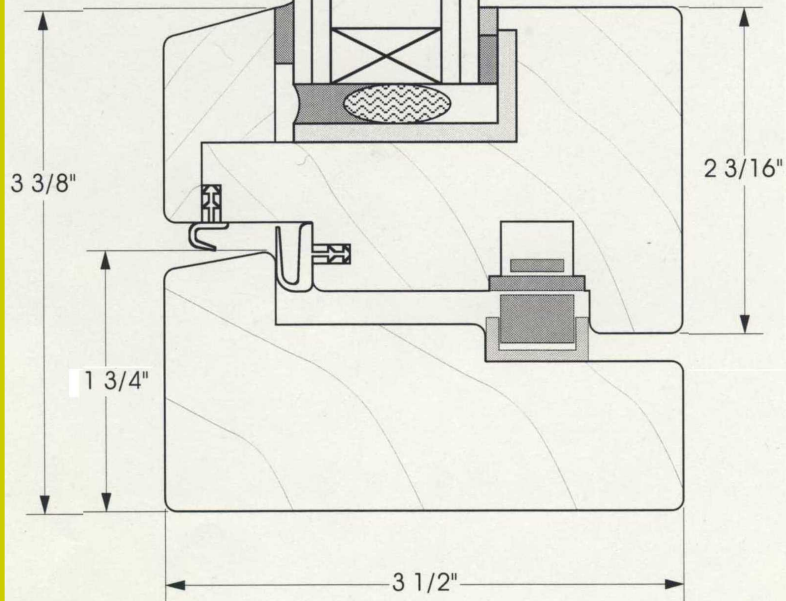
# ● WOOD WINDOWS



2060

outside

inside



4050

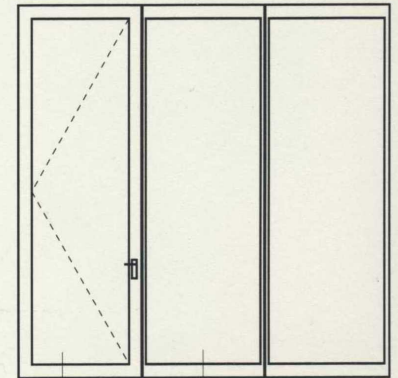
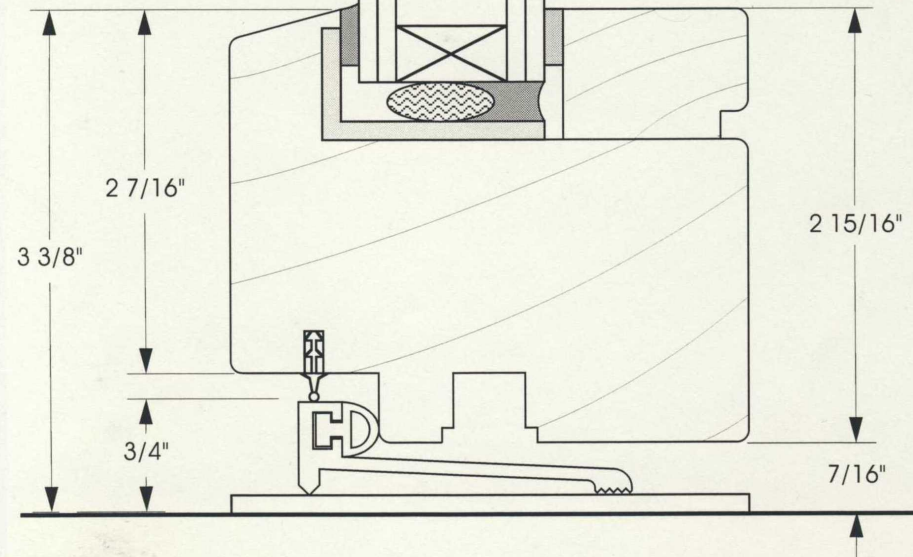
Matching Fixed Sill

Fixed Sill with matching  
sightlines to match 4170  
Operable Sill.

3 3/8"

outside

inside

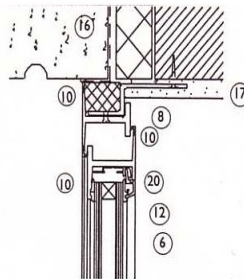
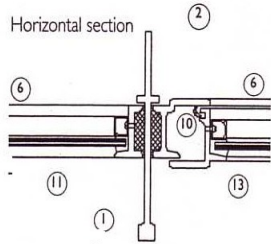
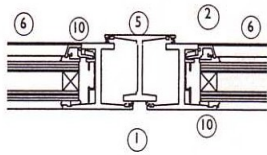


4170

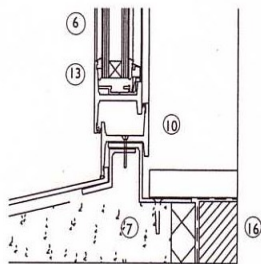
4050



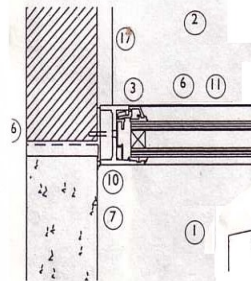
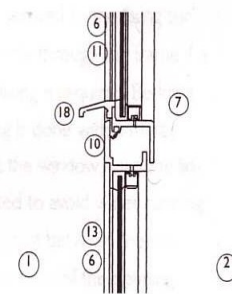
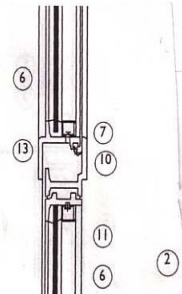
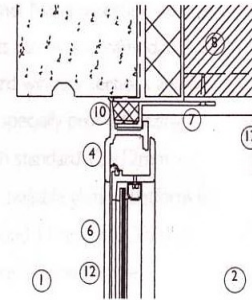
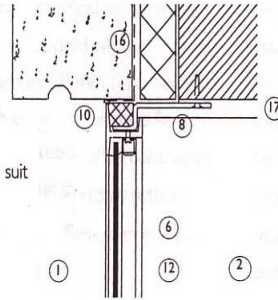
# ● STEEL WINDOWS



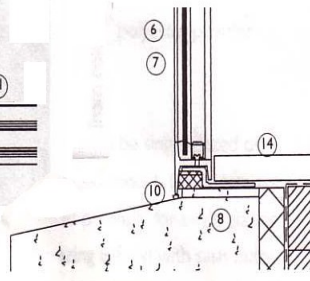
Vertical section with double glazed unit



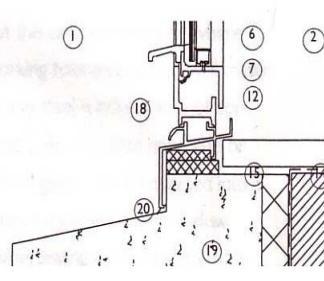
1. Outside
2. Inside
3. Rolled steel glazing section
4. Transom
5. Mullion
6. Single glazed or double glazed unit to suit application
7. Fixing bead
8. Fixing lug
9. Projecting transom
10. Rubber-based seal
11. Fixed light
12. Inward opening light
13. Outward opening light
14. Window cill
15. Condensation tray
16. Damp proof course (DPC)
17. Internal finish
18. Drip
19. Packing
20. Aluminium clip to secure double glazed unit
21. Steel cill



Horizontal section  
Double glazed fixed light



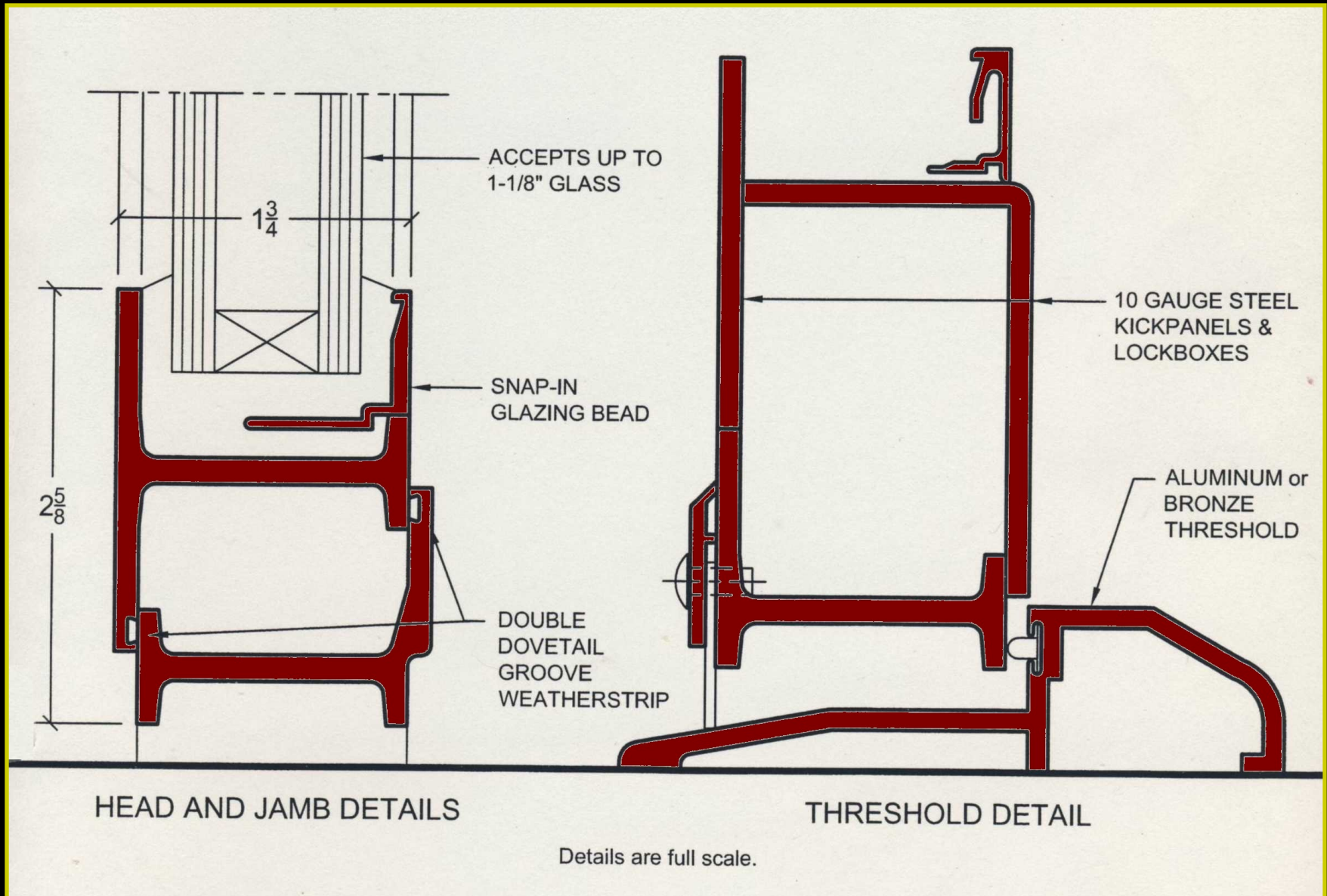
Vertical section  
Outward opening window (single glazed)



Vertical section  
Inward opening window (single glazed)

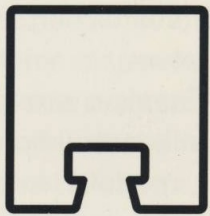
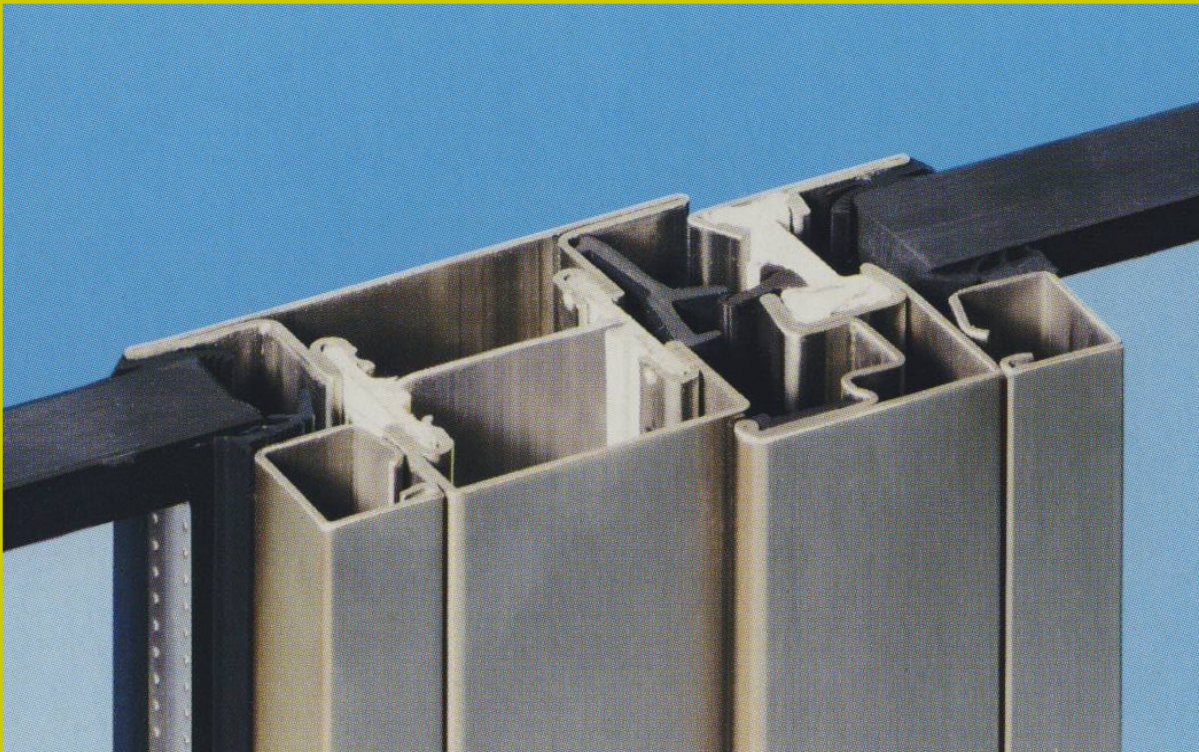


# • STEEL WINDOWS

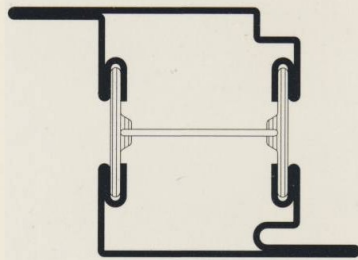




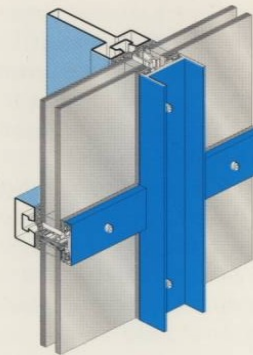
# • STEEL WINDOWS



Jansen-VISS Fassadensysteme  
Jansen-VISS façade systems



Janisol Türen und Fenster  
Janisol doors and windows



VISS Linea

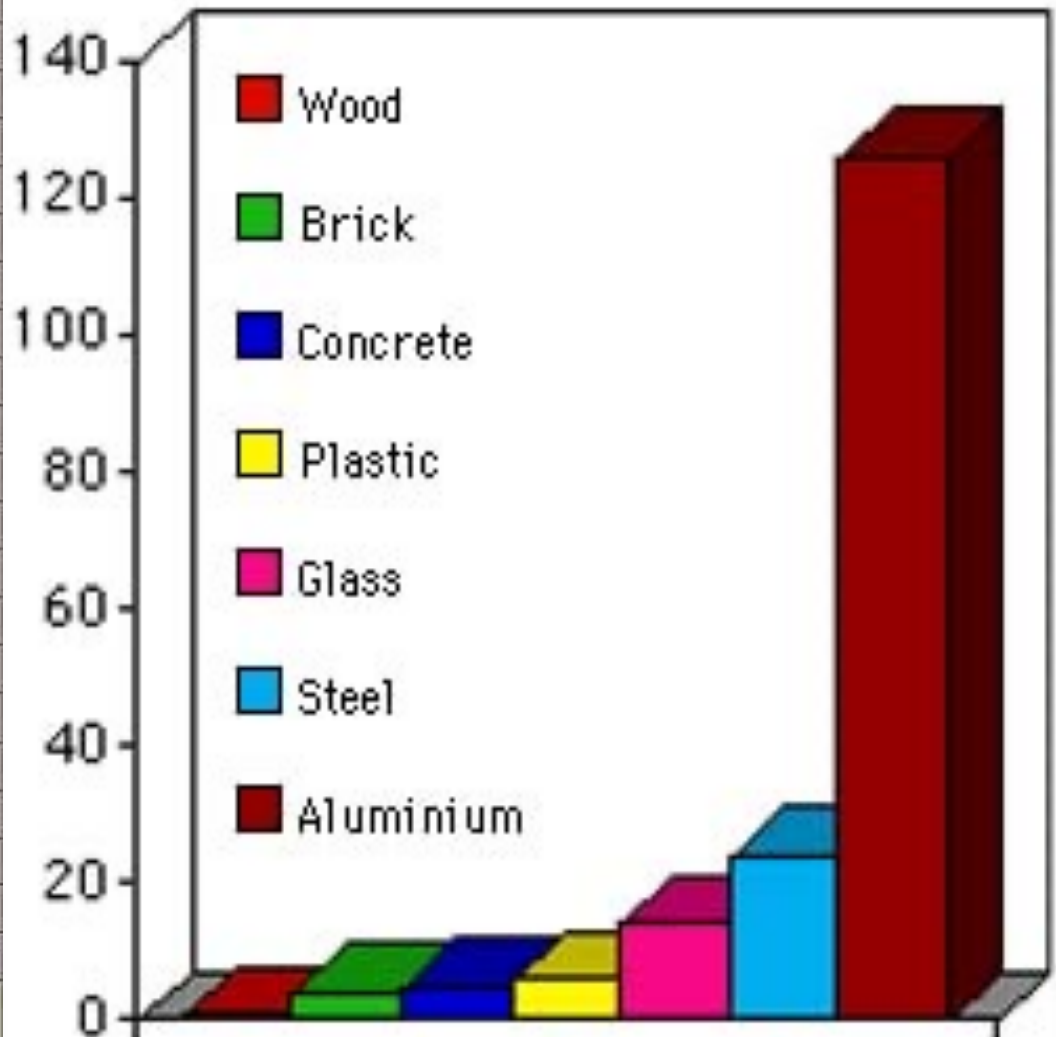


# • EMBODIED ENERGY

| MATERIAL                | EMBODIED ENERGY |        |
|-------------------------|-----------------|--------|
|                         | MJ/kg           | MJ/m3  |
| Stone (local)           | 0.79            | 2030   |
| Concrete block          | 0.94            | 2350   |
| Concrete (30 Mpa)       | 1.3             | 3180   |
| Lumber                  | 2.5             | 1380   |
| Brick                   | 2.5             | 5170   |
| Cellulose insulation    | 3.3             | 112    |
| Gypsum wallboard        | 6.1             | 5890   |
| Particle board          | 8.0             | 4400   |
| Aluminum (recycled)     | 8.1             | 21870  |
| Steel (recycled)        | 8.9             | 37210  |
| Shingles (asphalt)      | 9.0             | 4930   |
| Plywood                 | 10.4            | 5720   |
| Mineral wool insulation | 14.6            | 139    |
| Glass                   | 15.9            | 37550  |
| Fiberglass insulation   | 30.3            | 970    |
| Steel                   | 32.0            | 251200 |
| PVC                     | 70.0            | 93620  |
| Copper                  | 70.6            | 631164 |
| Paint                   | 93.3            | 117500 |
| Polystyrene Insulation  | 117             | 3770   |
| Aluminum                | 227             | 515700 |

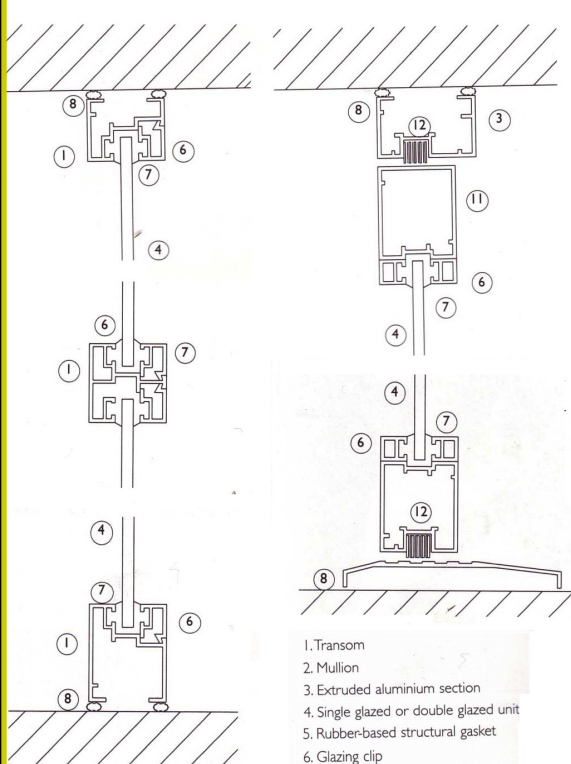
**NOTE:** Embodied energy values based on several international sources - local values may vary.

## Embodied Energy





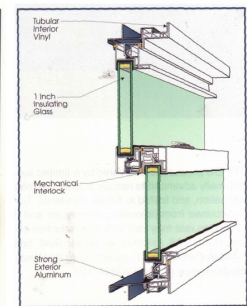
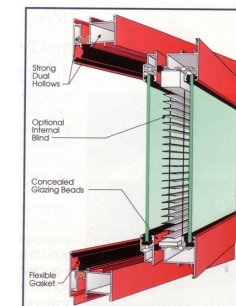
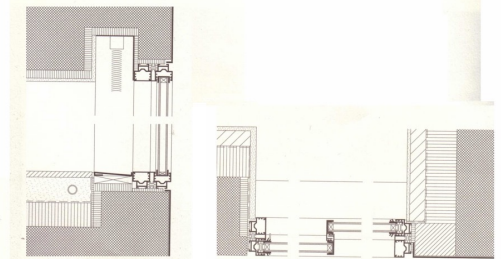
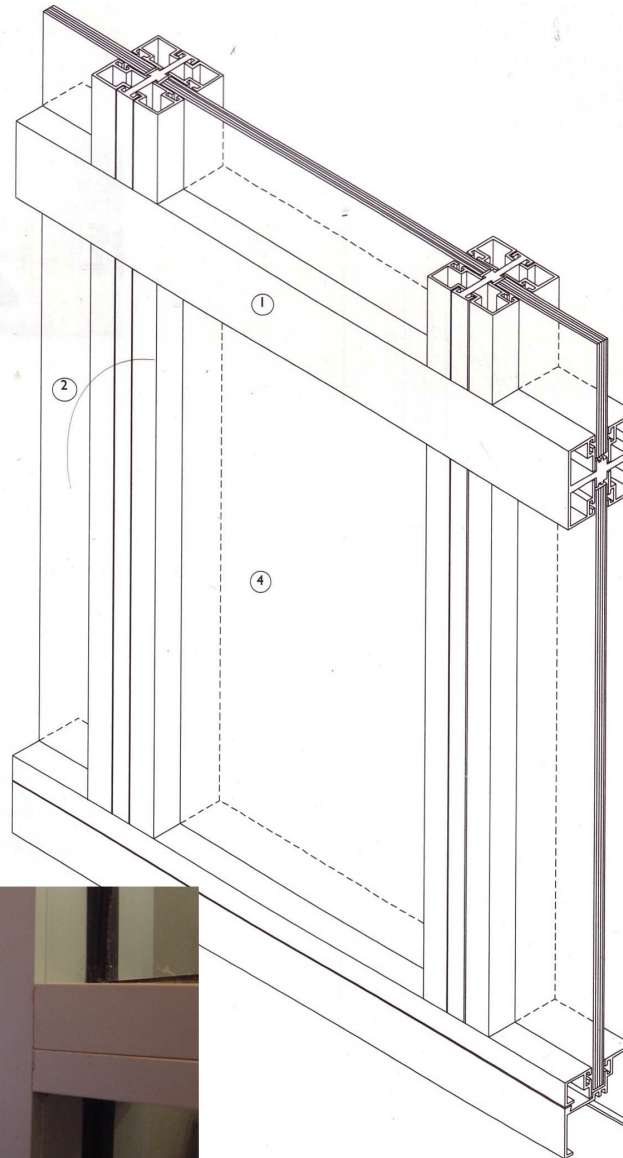
# ● ALUMINUM WINDOWS



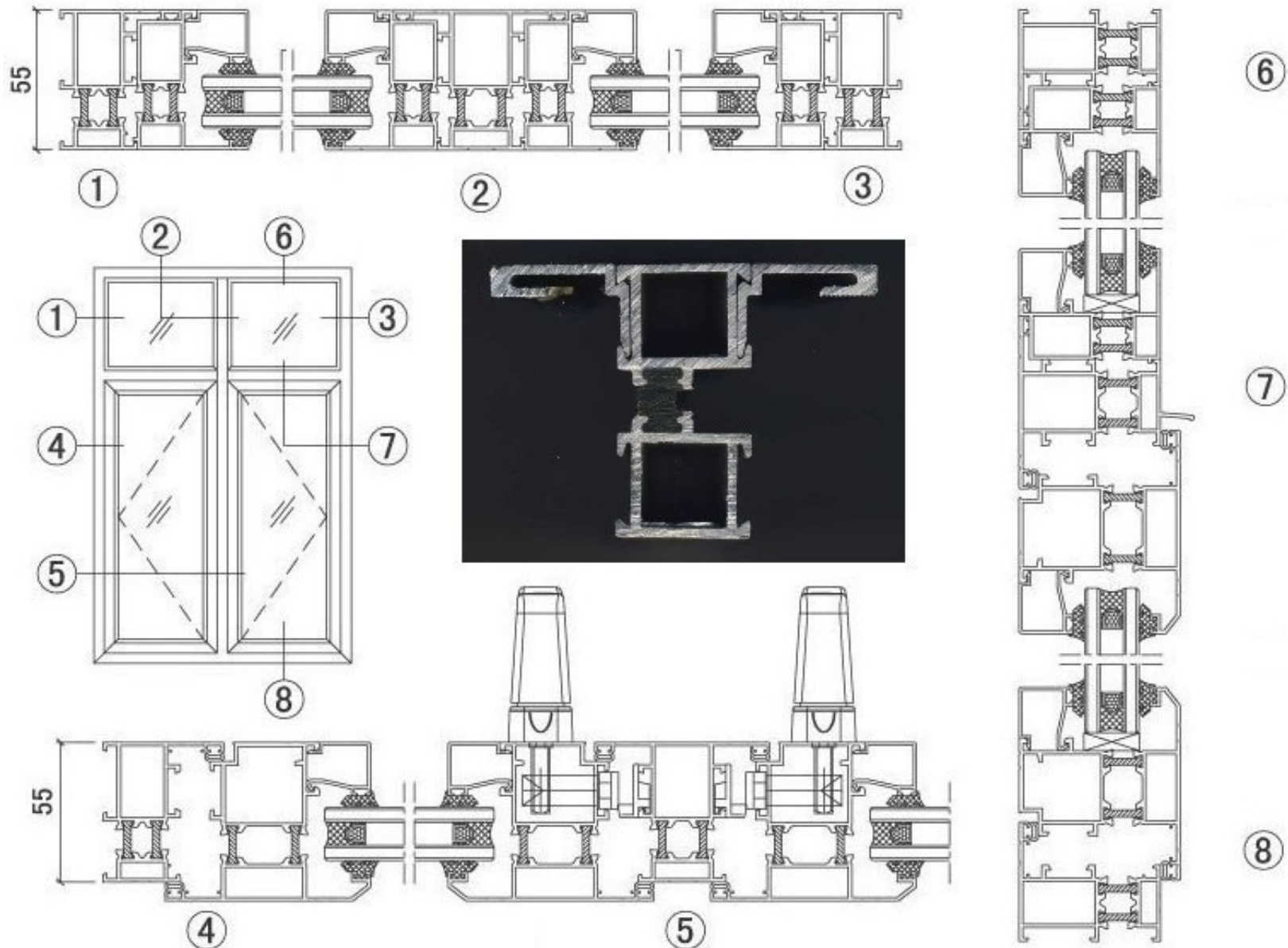
Vertical section

Horizontal section

1. Transom
2. Mullion
3. Extruded aluminium section
4. Single glazed or double glazed unit
5. Rubber-based structural gasket
6. Glazing clip
7. Rubber-based seal
8. Silicone-based seal
9. Fixing screws at 300mm centres
10. Mild steel structural member
11. Door section
12. Nylon brush

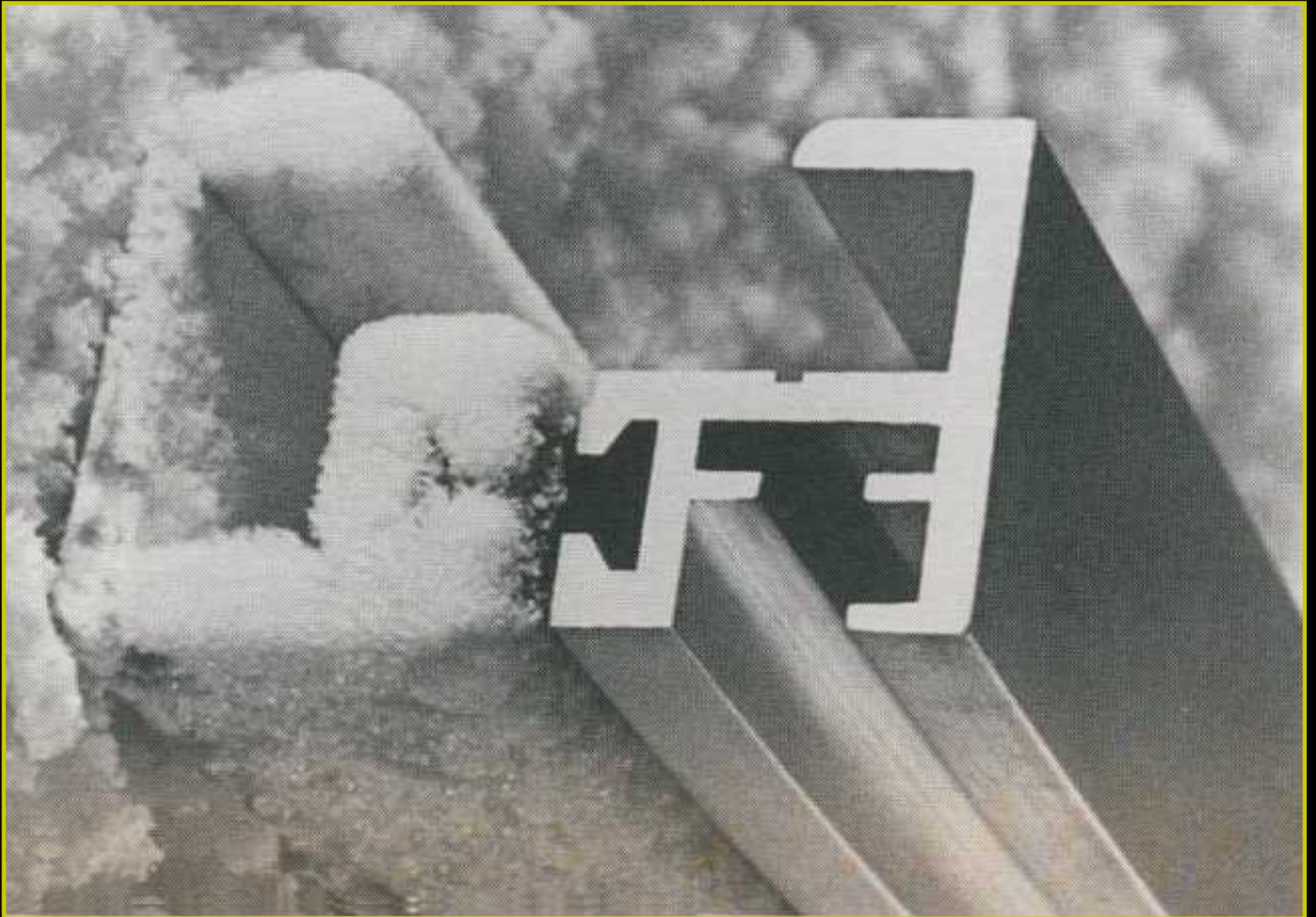


# • ALUMINUM WINDOWS

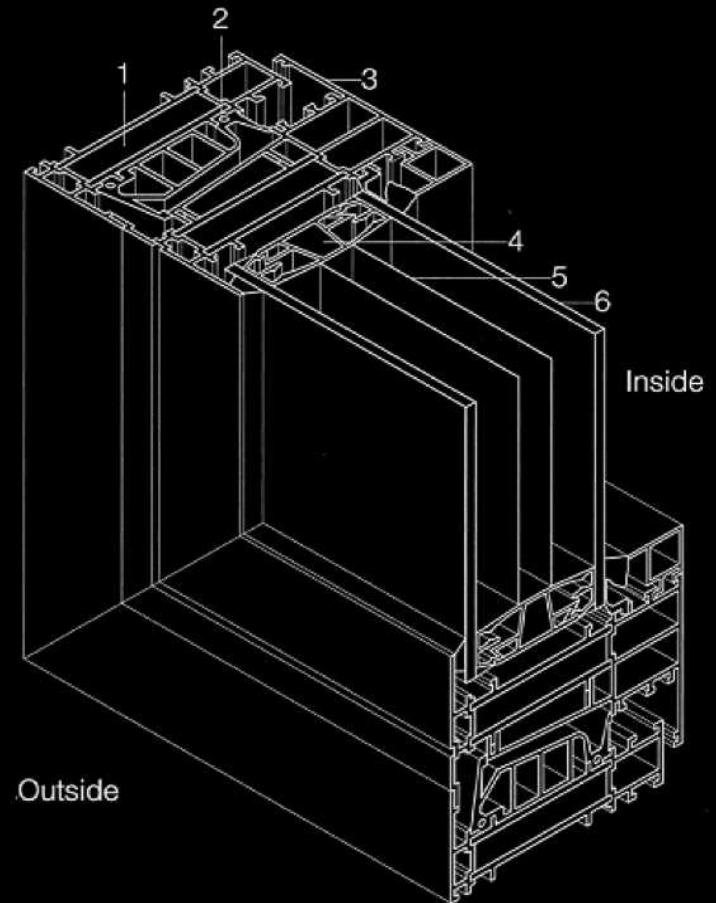
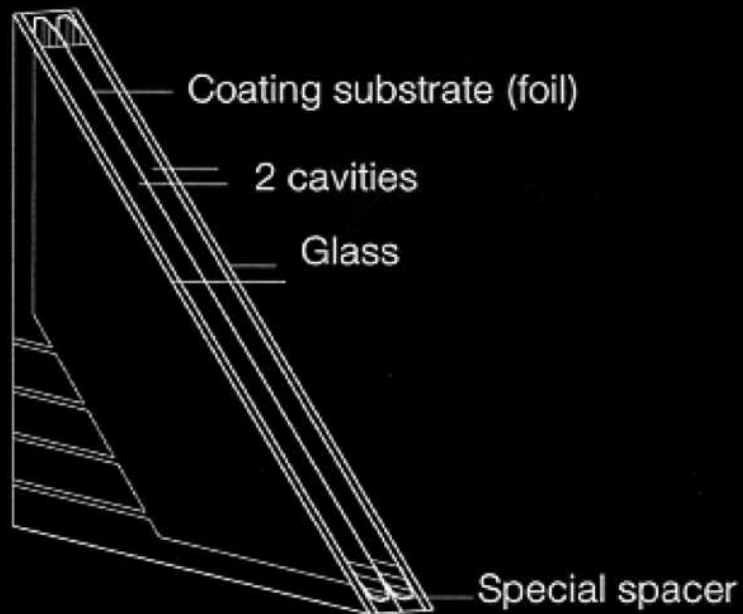




- ALUMINUM WINDOWS



# ● HIGH PERFORMANCE WINDOWS FRAME THICKNESS

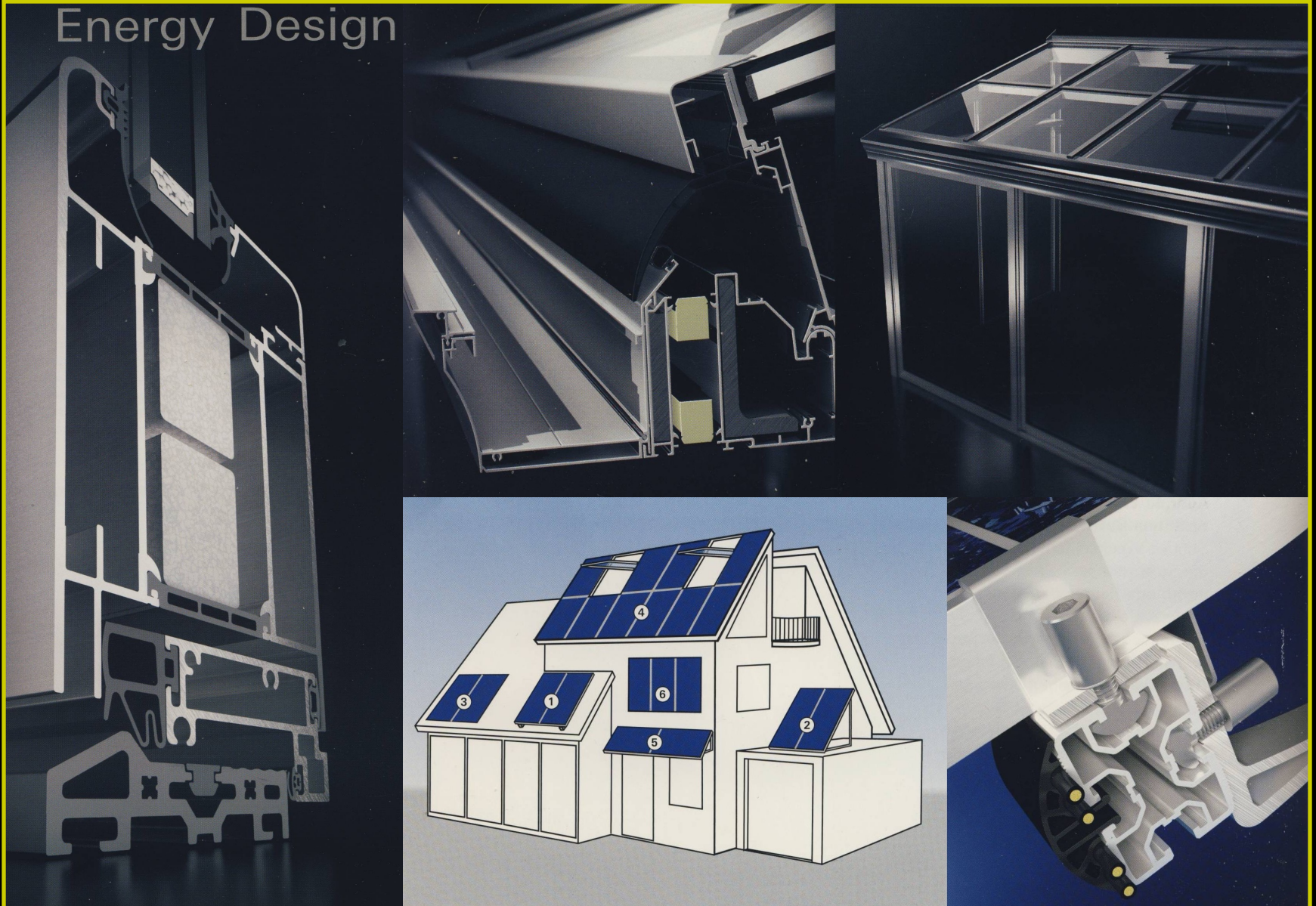


High-performance insulated glazing



- ALUMINUM WINDOWS: SYSTEMS

Energy Design





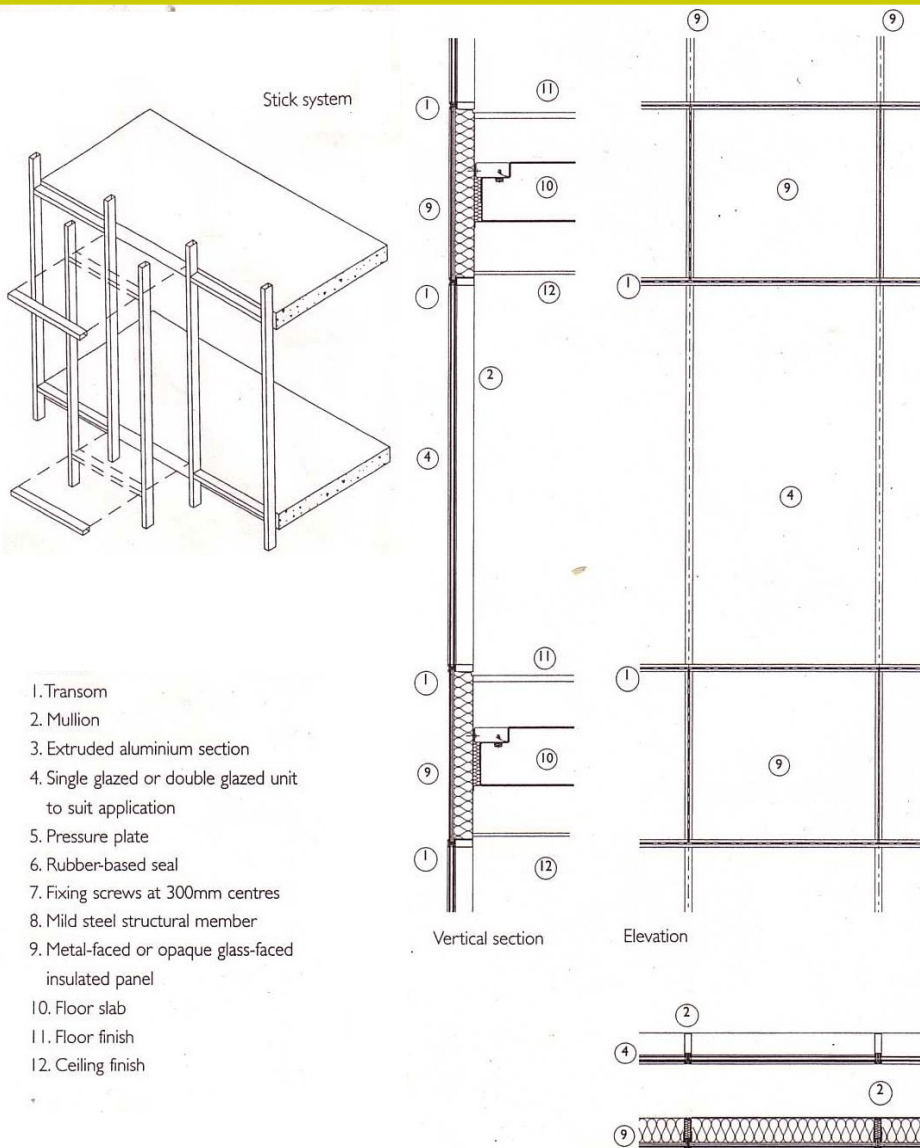
- ALUMINUM WINDOWS: SYSTEMS



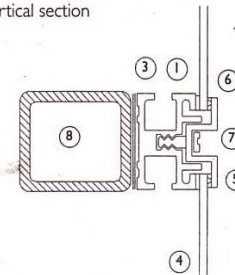
REM KOOLHAS + OMA ARCH.: DUTCH EMBASSY, BERLIN GERMANY 2004



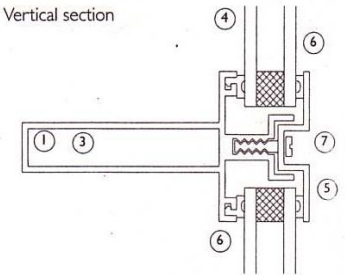
# ● CURTAIN WALL SYSTEMS: 'STICK SYSTEM'



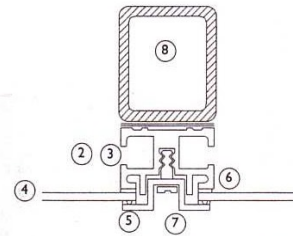
Vertical section



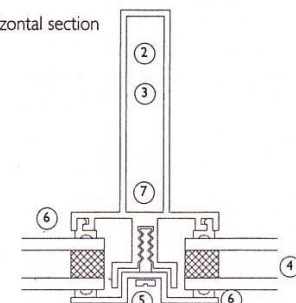
Vertical section



Horizontal section

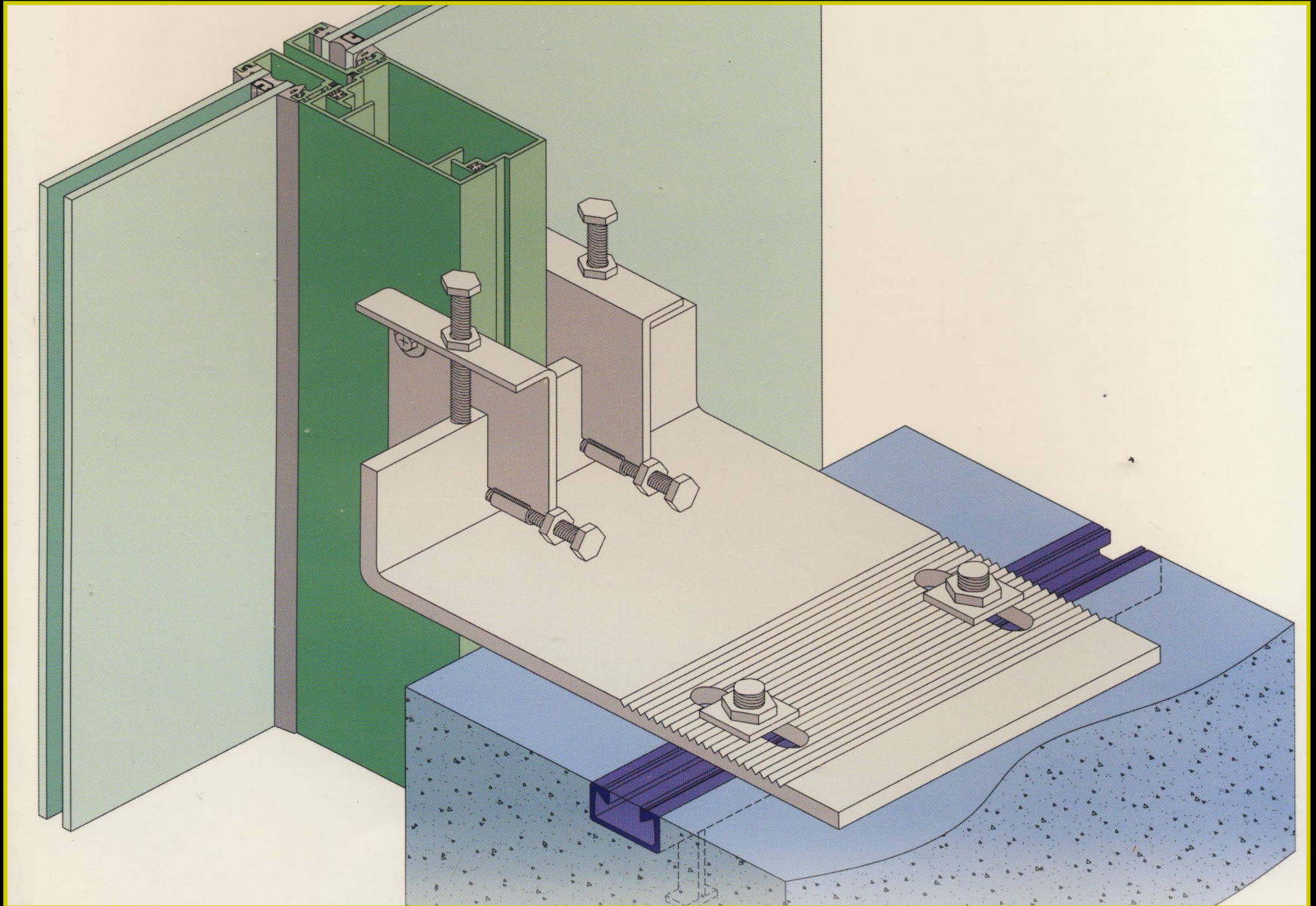


Horizontal section



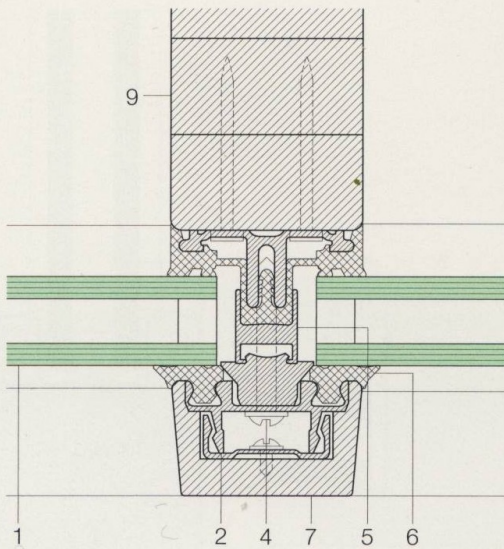


- CURTAIN WALL SYSTEMS: 'STICK SYSTEM'

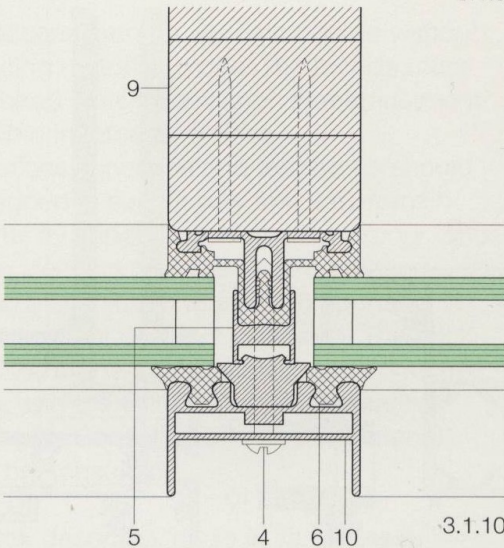




# ● CURTAIN WALL SYSTEMS: 'STICK SYSTEM'



3.1.9

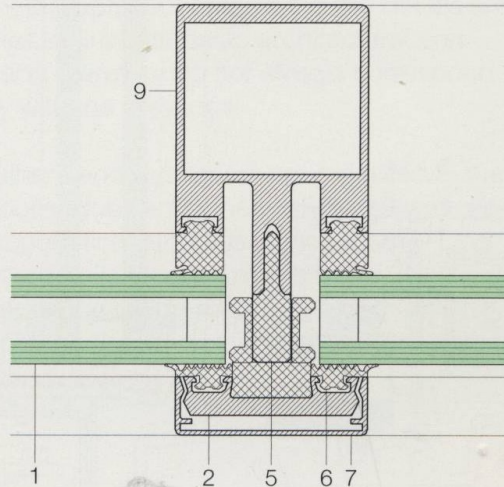


3.1.10

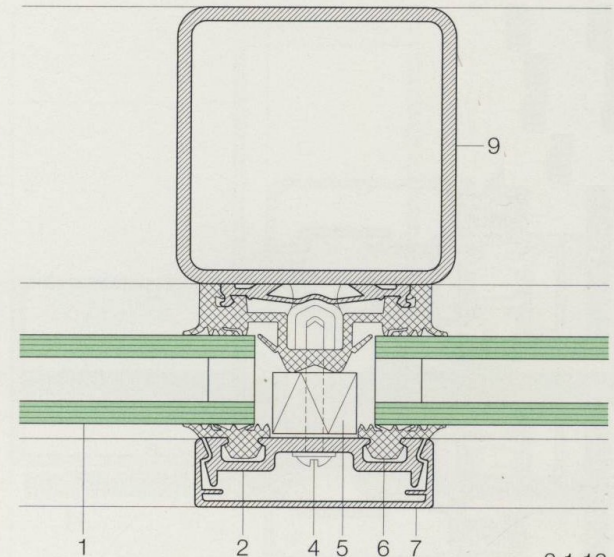
## Glazing bar Linear support

- 3.1.9 Wood
- 3.1.10 Aluminium/wood
- 3.1.11 Aluminium/wood
- 3.1.12 Aluminium with cover strip
- 3.1.13 Steel with cover strip
- 3.1.14 Steel without cover strip
- 3.1.15 Aluminium with thermal insulation
- 3.1.16 EPDM gasket

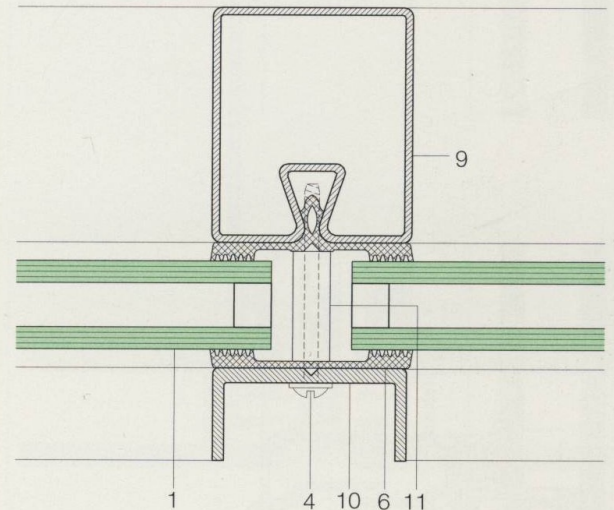
Horizontal and vertical sections  
scale 1:2.5



3.1.12

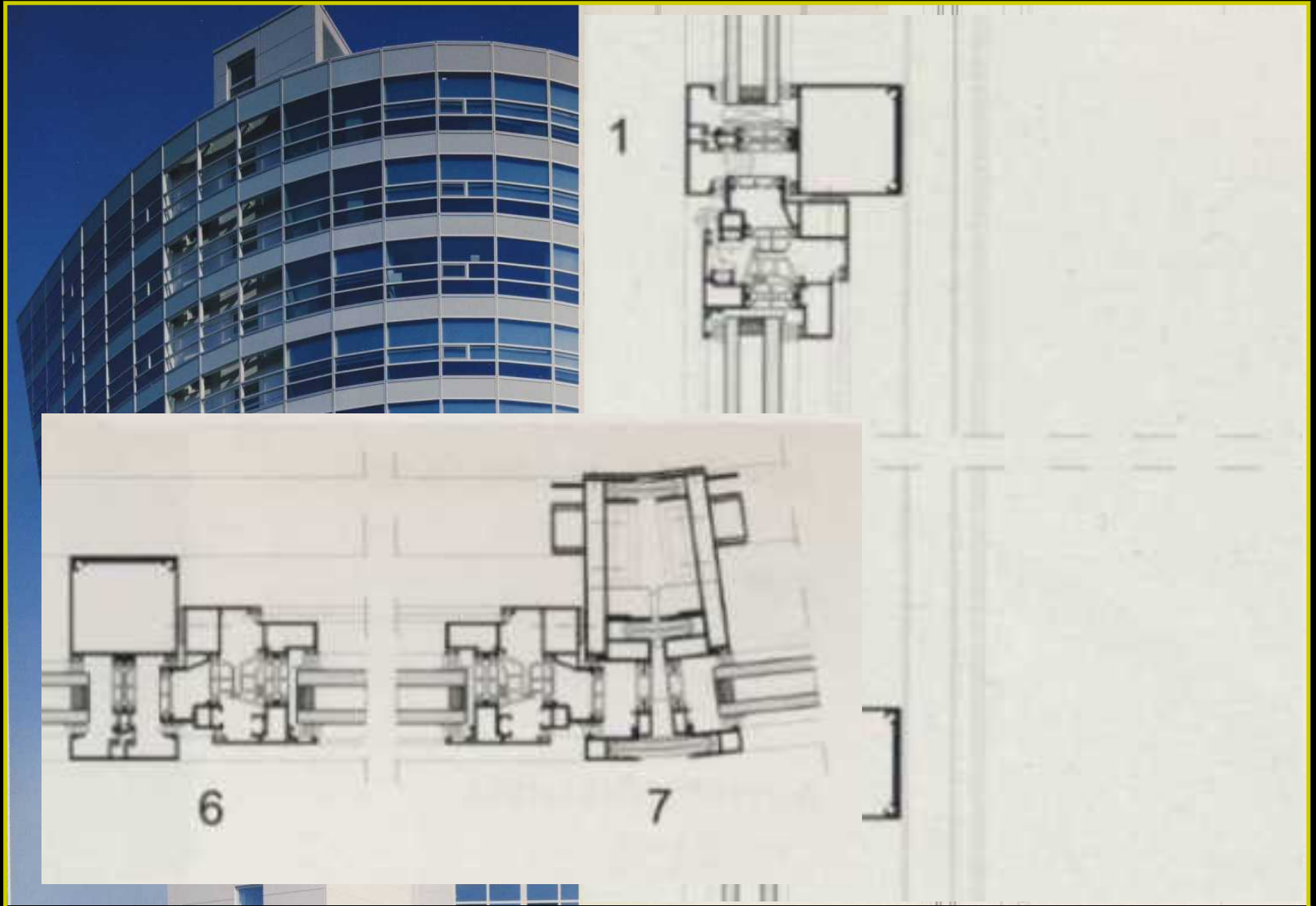


3.1.13



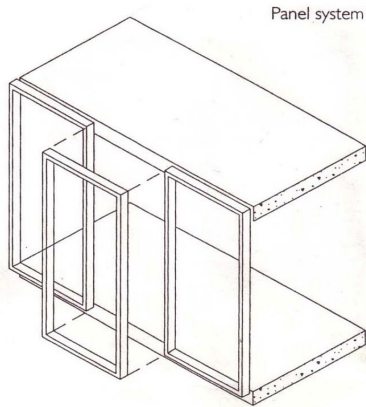
3.1.14

- CURTAIN WALL SYSTEMS: 'STICK SYSTEM'

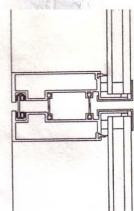
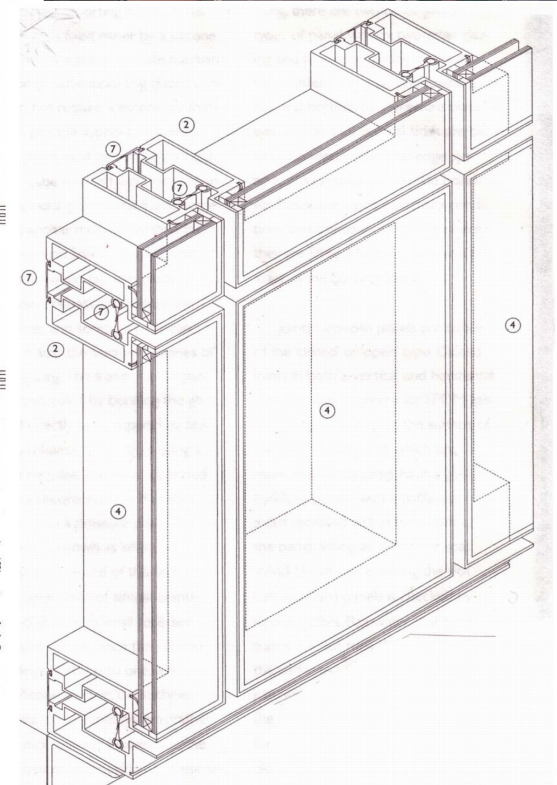
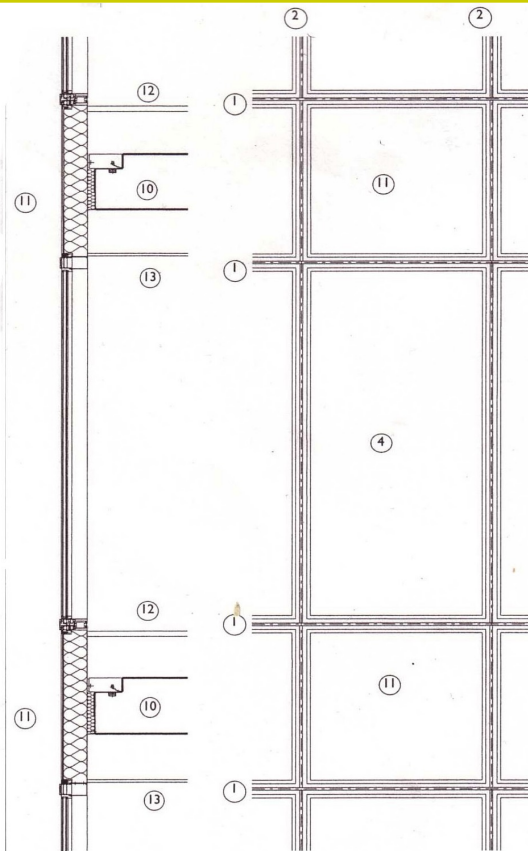




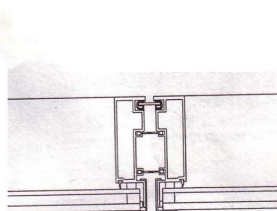
# ● CURTAIN WALL SYSTEMS: 'PANEL SYSTEM'



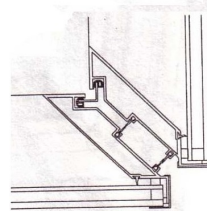
1. Transom
2. Mullion
3. Extruded aluminium section
4. Single glazed or double glazed unit
5. Silicone bond
6. Optional securing clips
7. Rubber-based baffles
8. Rubber-based seal
9. Fixing screws at 300mm centres
10. Floor slab
11. Metal-faced insulated panel
12. Floor finish
13. Ceiling finish



Vertical section

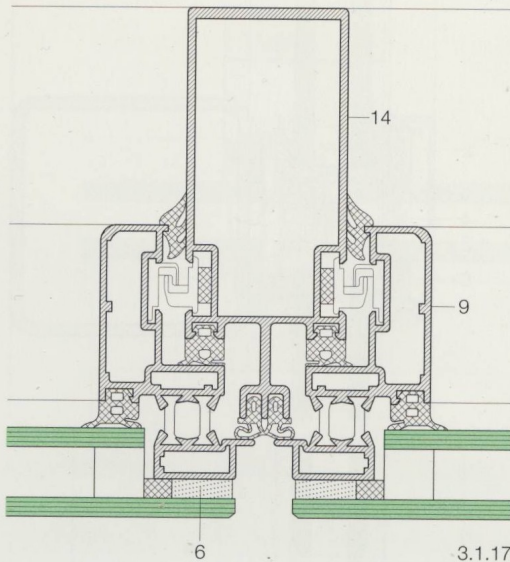


Horizontal section

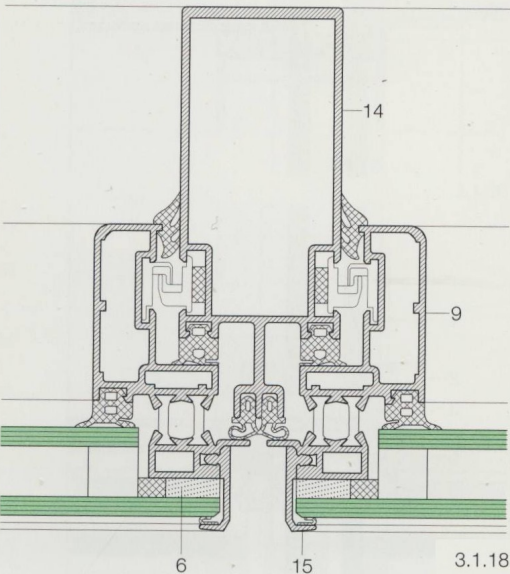


Horizontal section

# • CURTAIN WALL SYSTEMS: 'PANEL SYSTEM'



3.1.17



3.1.18

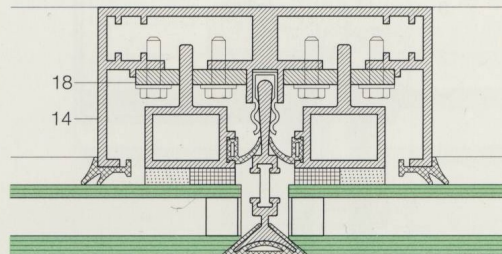
## Structural sealant glazing (SSG)

Linear support

- 3.1.17 Without mechanical fixing
- 3.1.18 Mechanical fixing, peripheral
- 3.1.19 Mechanical fixing and sealing in one section
- 3.1.20 Mechanical fixing of inner panes
  - a dry sealing
  - b wet sealing

Vertical and horizontal sections  
scale 1:2.5

- |                                        |                                  |
|----------------------------------------|----------------------------------|
| 1 Outer pane                           | 11 Rail section                  |
| 2 Inner pane                           | 12 Cover section                 |
| 3 Hermetic edge seal of double glazing | 13 Baffle                        |
| 4 Setting block                        | 14 Post section                  |
| 5 Edge tape                            | 15 Mechanical fixing, continuous |
| 6 Silicone/adhesive                    | 16 Mechanical fixing, discrete   |
| 7 Steel or aluminium spacer            | 17 Glass fixing/sealing gasket   |
| 8 Thermal break                        | 18 Retaining plate               |
| 9 Modular frame system                 |                                  |
| 10 Edge seal                           |                                  |

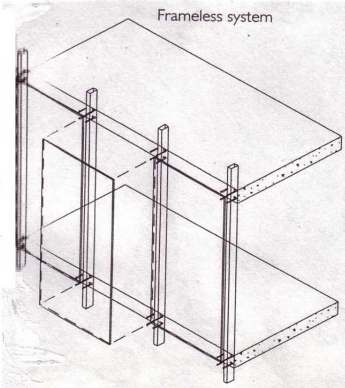


3.1.19

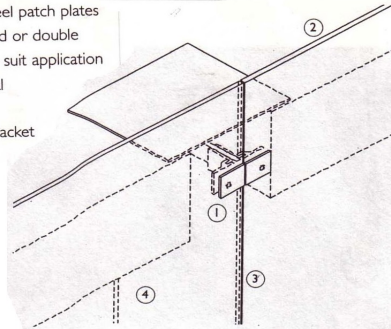




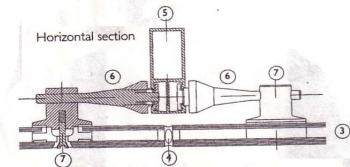
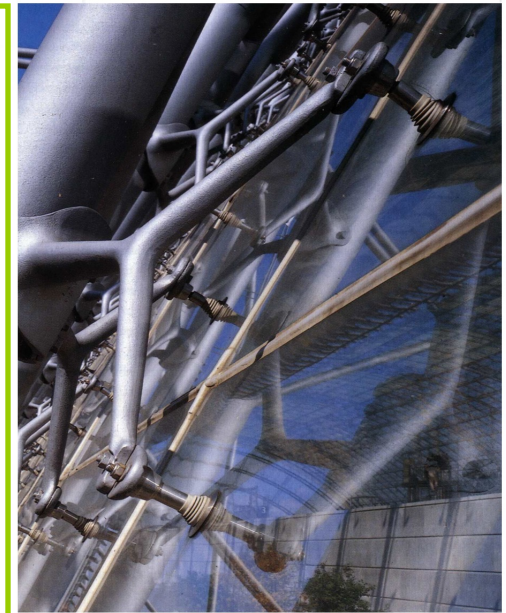
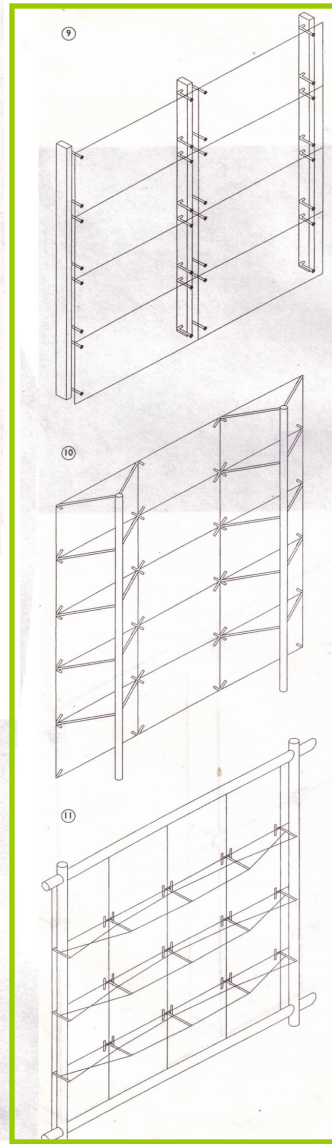
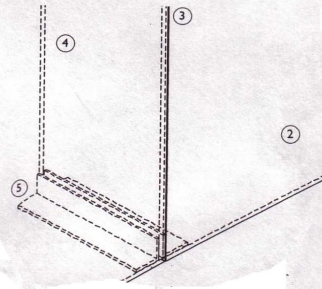
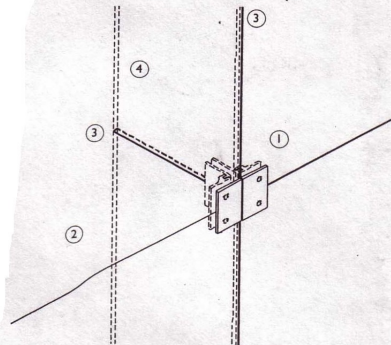
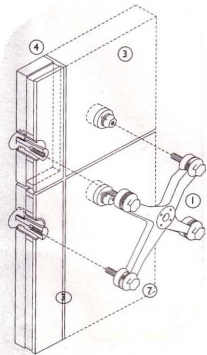
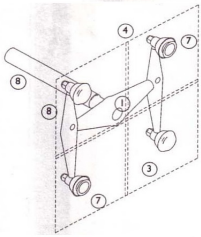
# ● CURTAIN WALL SYSTEMS: 'FRAMELESS SYSTEM'



1. Stainless steel patch plates
2. Single glazed or double glazed unit to suit application
3. Silicone seal
4. Glass fin
5. Support bracket
6. Bolt



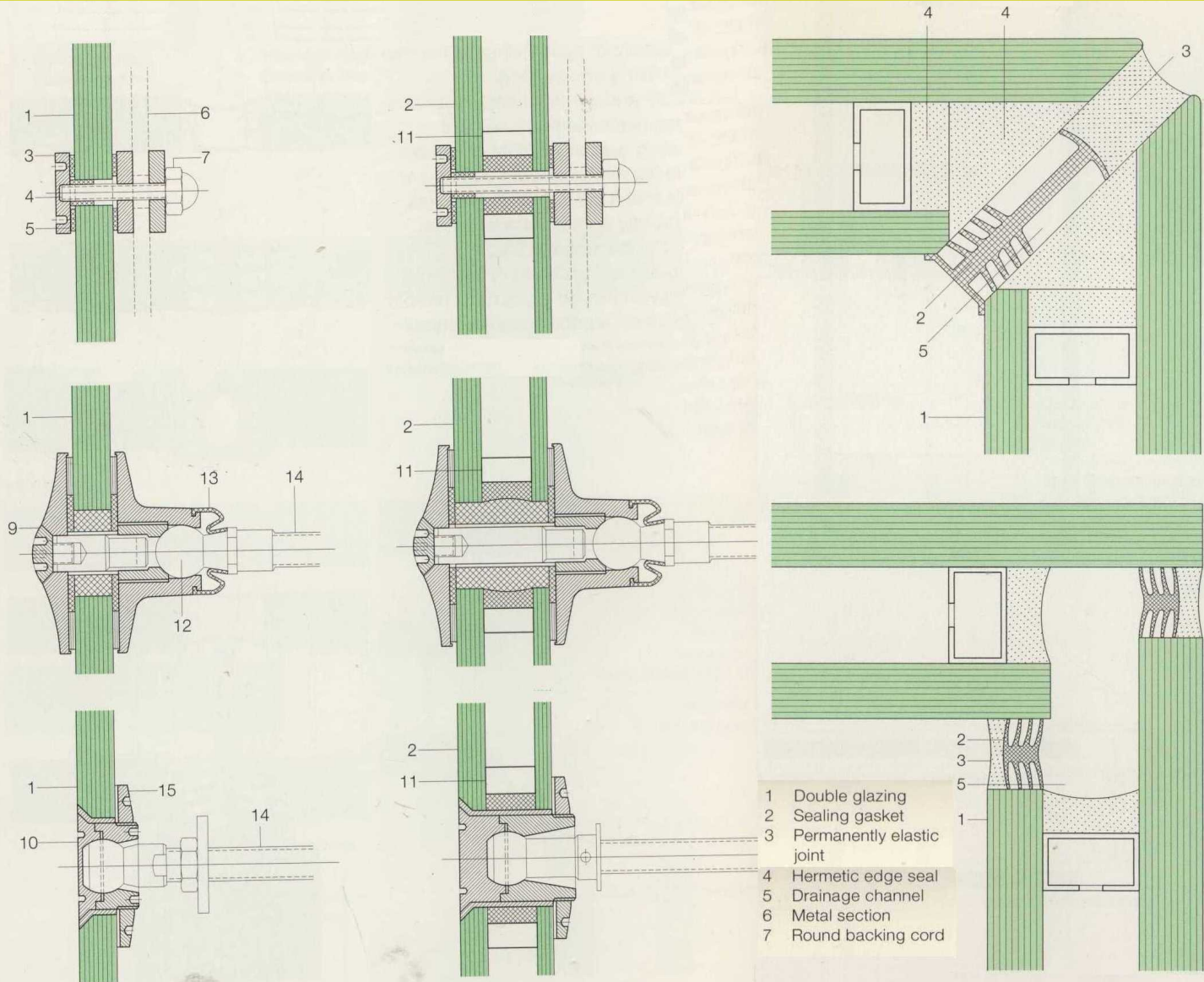
1. Cast steel connector
2. Mild steel or stainless steel angle bracket
3. Single glazed or double glazed unit to suit application
4. Silicone seal
5. Mullion
6. Support bracket
7. Bolt fixing
8. Steel connector rod secured to primary structure



“STRUCTURAL GLAZING”

# ● CURTAIN WALL SYSTEMS: 'FRAMELESS SYSTEM'

- 1 Single glazing or laminated safety glass
- 2 Double glazing
- 3 Clamping disc
- 4 Bolt
- 5 Intermediate pad/seal
- 6 Supporting construction
- 7 Nut
- 8 Cap
- 9 Screw
- 10 Countersunk head
- 11 Hermetic edge seal
- 12 Ball joint
- 13 Sealing gaiter
- 14 Threaded bar
- 15 Threaded disc
- 16 Injected synthetic resin





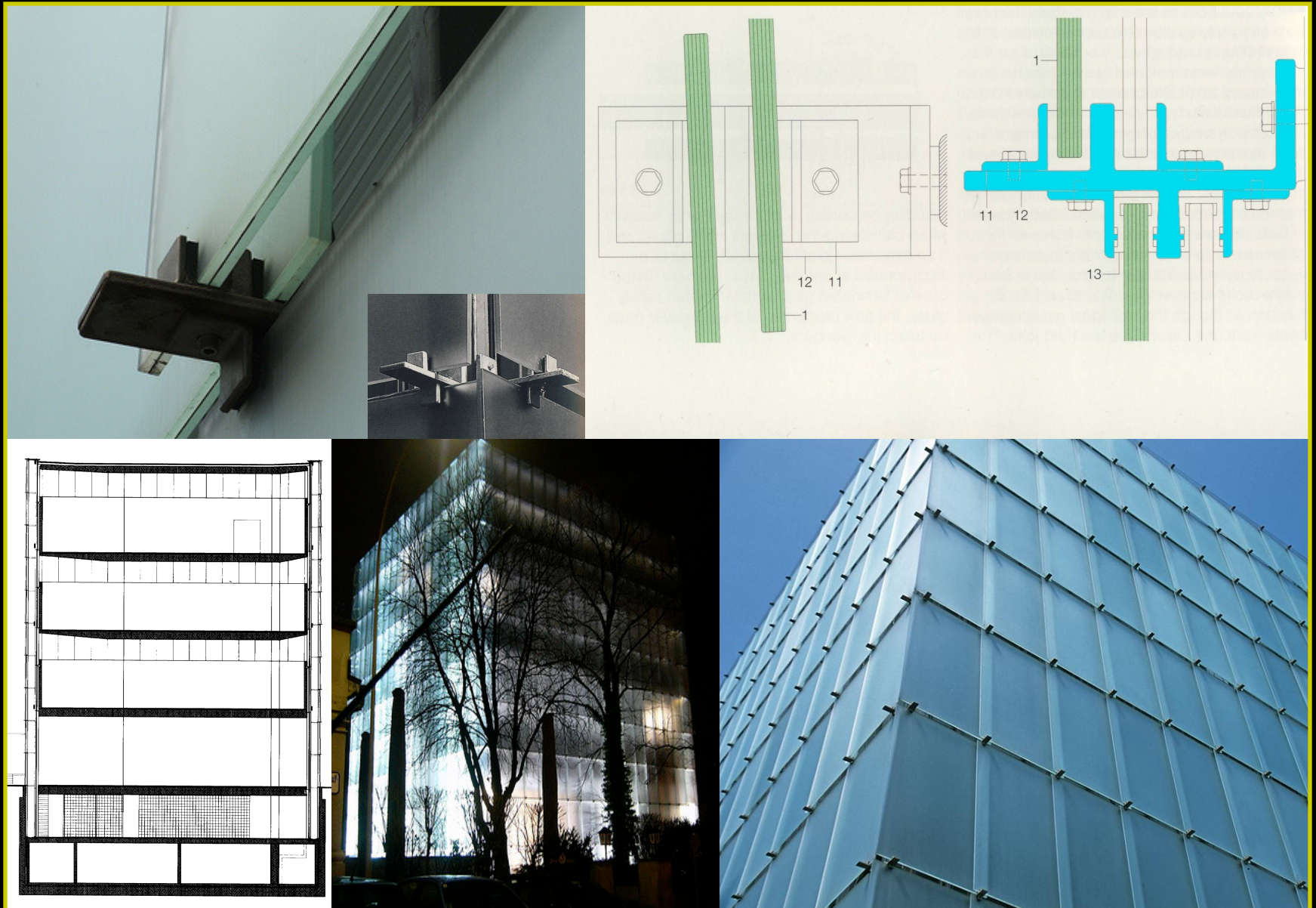
- CURTAIN WALL SYSTEMS: 'FRAMELESS SYSTEM'



BOHLIN CYWINSKI JACKSON ARCH., APPLE STORE NEW YORK (59th St.) 2005



- CURTAIN WALL SYSTEMS: 'FRAMELESS SYSTEM'



PETER ZUMTHOR ARCH.: KUNSTHAUS BREGENZ, AUSTRIA 2001

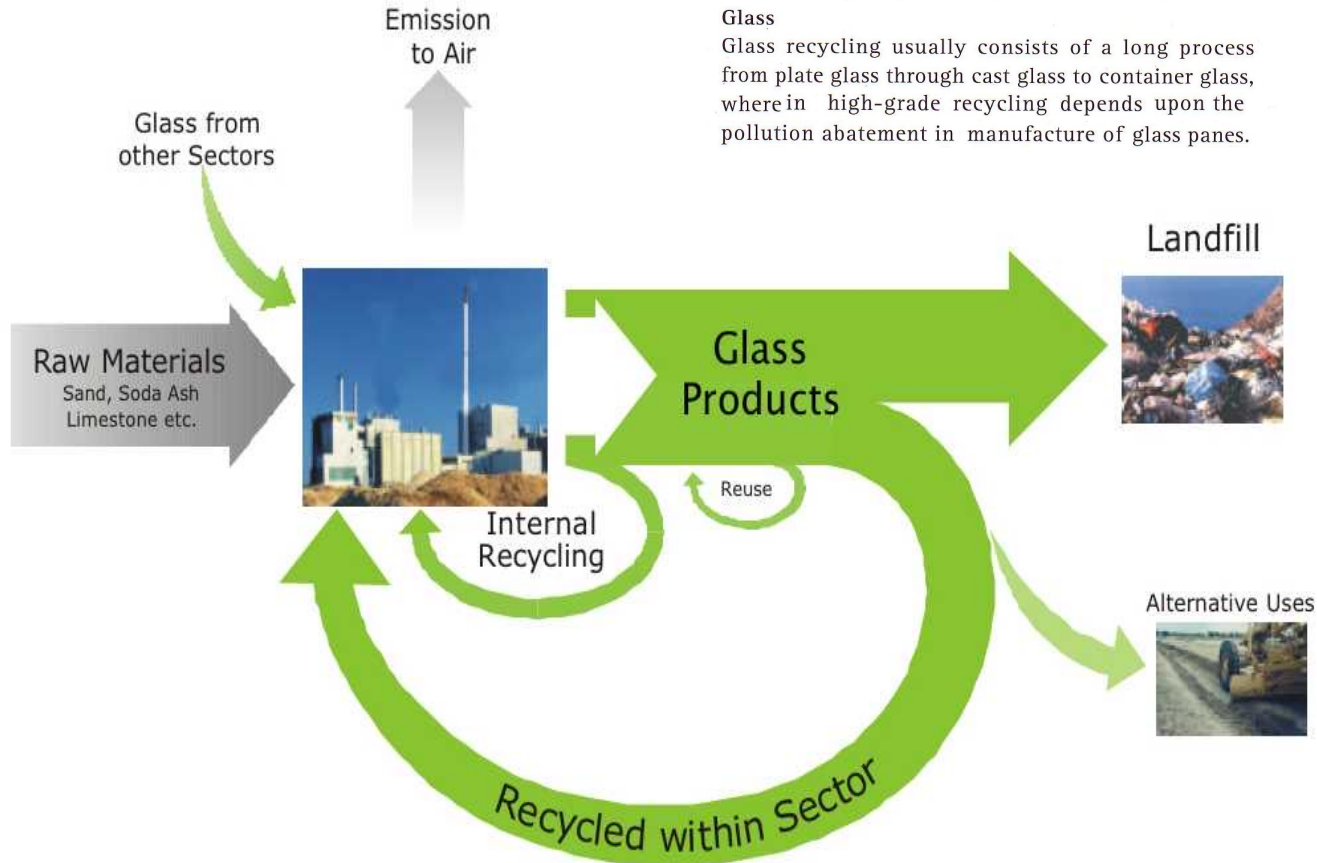


# ● RECYCLING

Metals can usually be treated and re-used without any loss in quality. Coatings limit recycling options.

Glass

Glass recycling usually consists of a long process from plate glass through cast glass to container glass, wherein high-grade recycling depends upon the pollution abatement in manufacture of glass panes.



Simplified representation of the various recycling loops operating within the industry.



Recycled Glass

