GLASS ● SKIN
HISTORICAL PERSPECTIVE

Tectonics of Glass & Glazing

Anthony M. Catsimatides, AIA
April 22, 2010

A Presentation of Open Atelier Architects

open atelier architects

Ancient agrarian society
House in the Ukraine

A medieval house
Finchingfield, Essex, England

Walls designed for unfavorable environmental conditions such as rain and wind, small openings introduced for small amount of daylight

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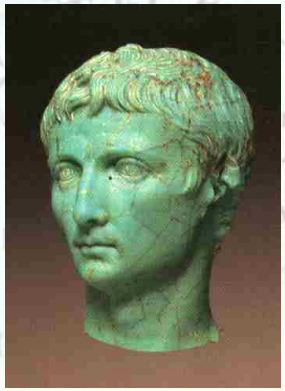
Glazed Wares, around 1250 BC
Piramesses, earliest known glass workshop
19th Dynasty, New Kingdom, Ramesses II



Cast Glass, 31 BC
Octavian (later known as Augustus)
bringing Egypt under his control

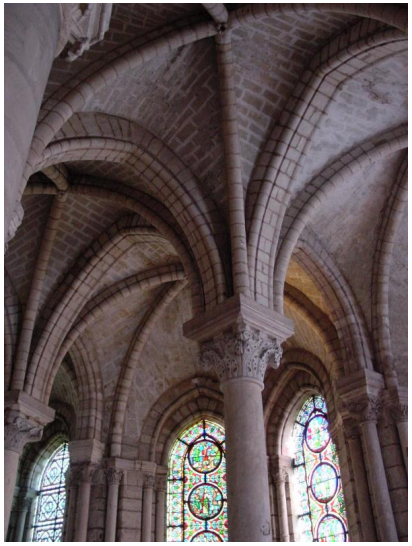
Glass Alabastron
late 8th–6th century B.C.; Archaic
Probably Phoenician; From Cyprus

First use of making glass (artifacts)

- 5th Century BC Mesopotamia
  - Crushed quartz used as a glaze on ceramic vessels
- 1st Century AD Pompeii, 1” to 2” thick glass

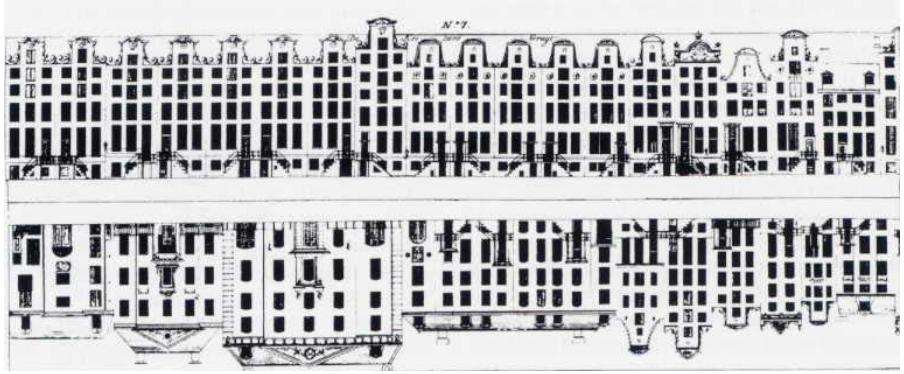
Nave Windows

Transept Window



Ribs

Abbey Church of St. Denis, 1141 AD
Abbot Suger
First Gothic Cathedral



Town House Terraces
Heerengracht Amsterdam
18th century engraving

- 17th C. use of glass reaching more classes
- Bringing more light to the interior
- Open windows for ventilation

Jan Vermeer
Street in Delft 1657/58

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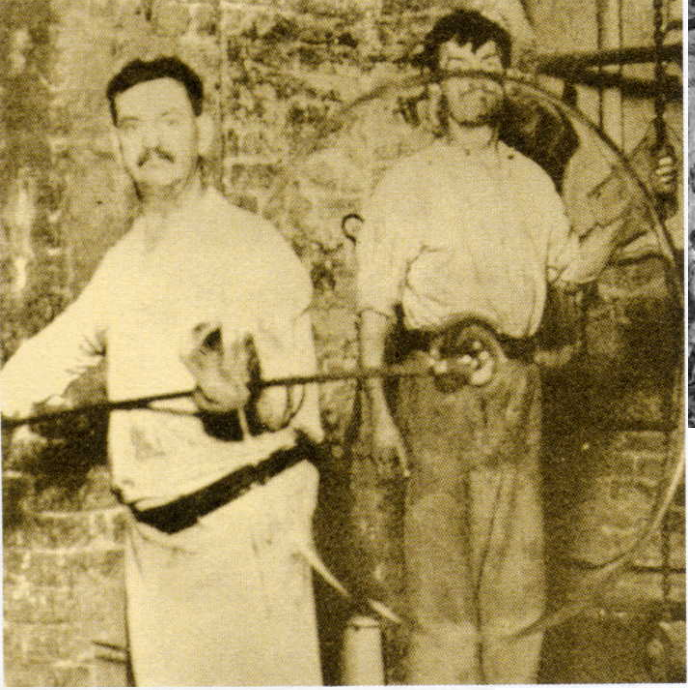
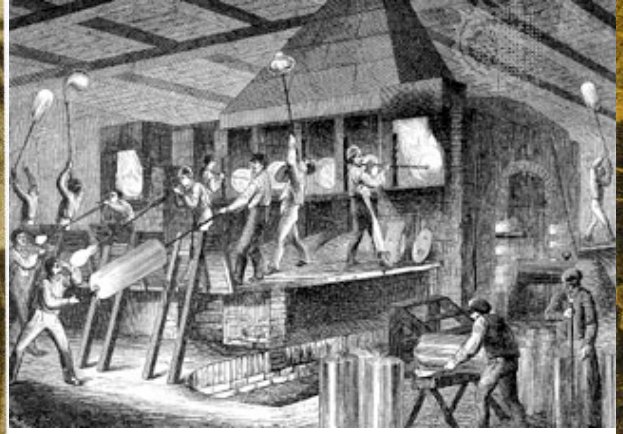
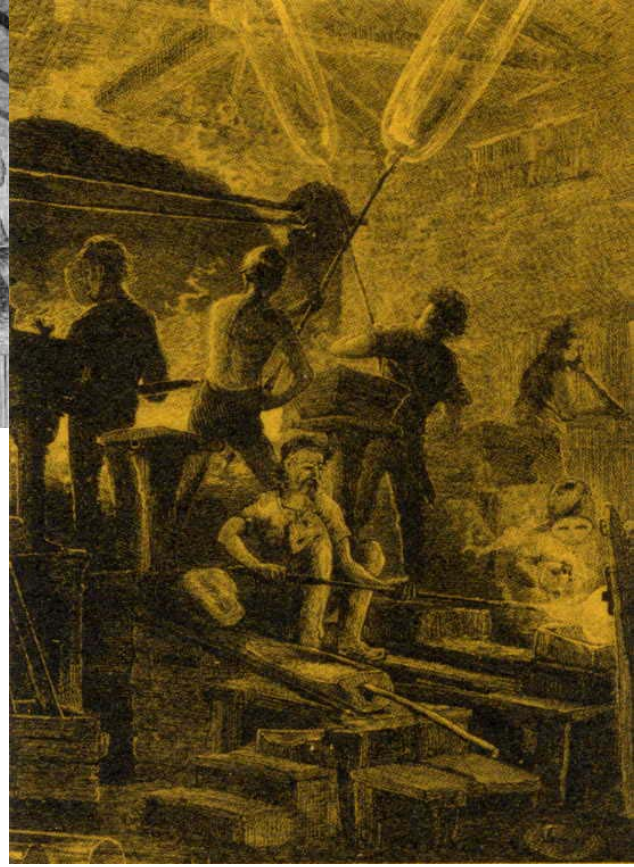
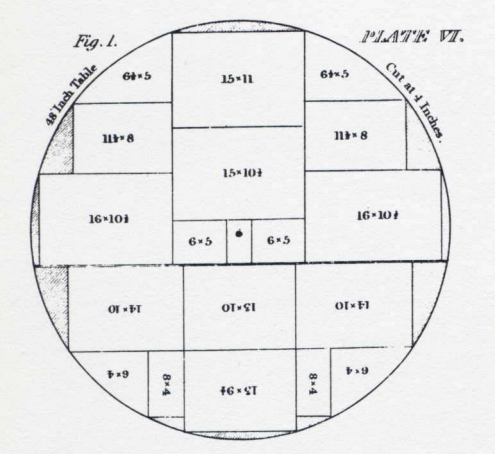




Cylinder method



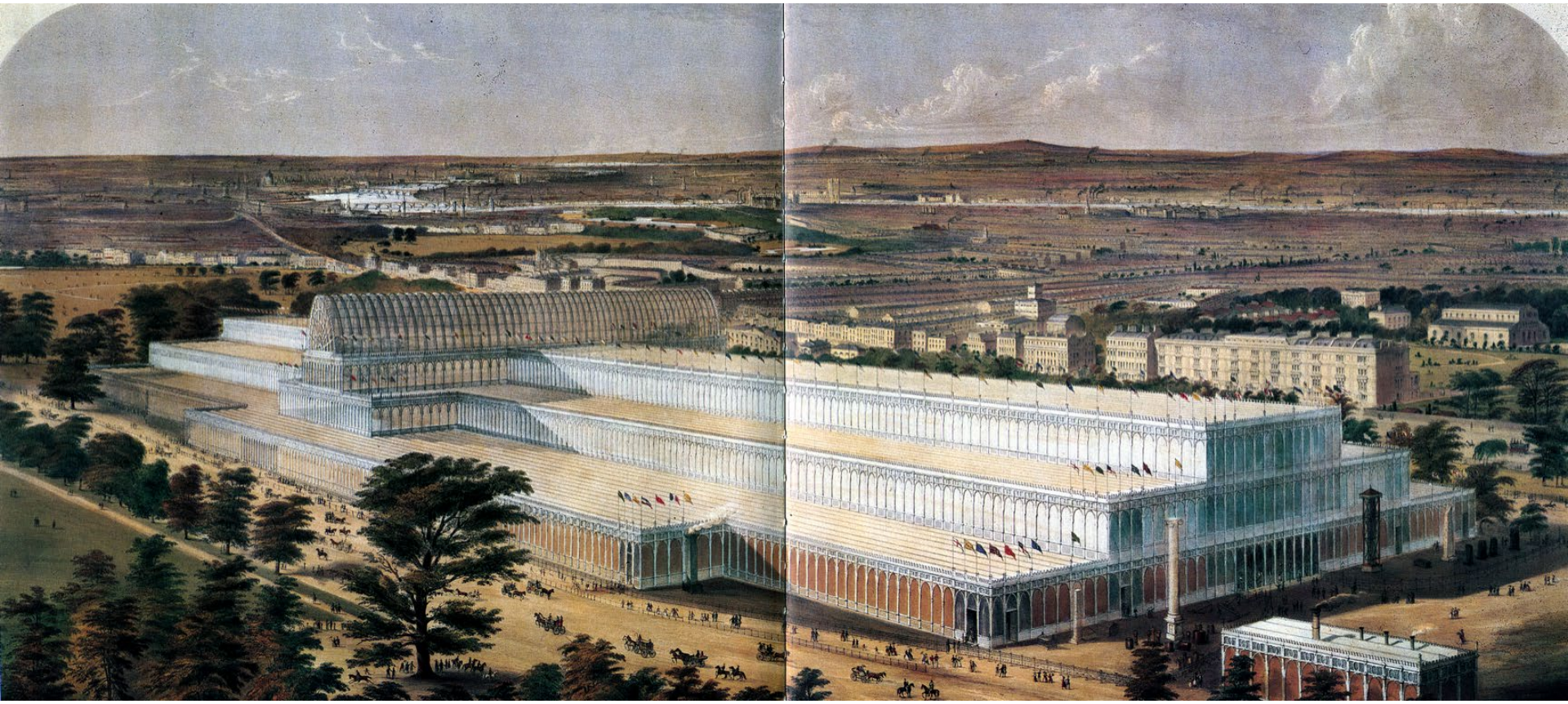


Glass crown marked for cutting

Crown method

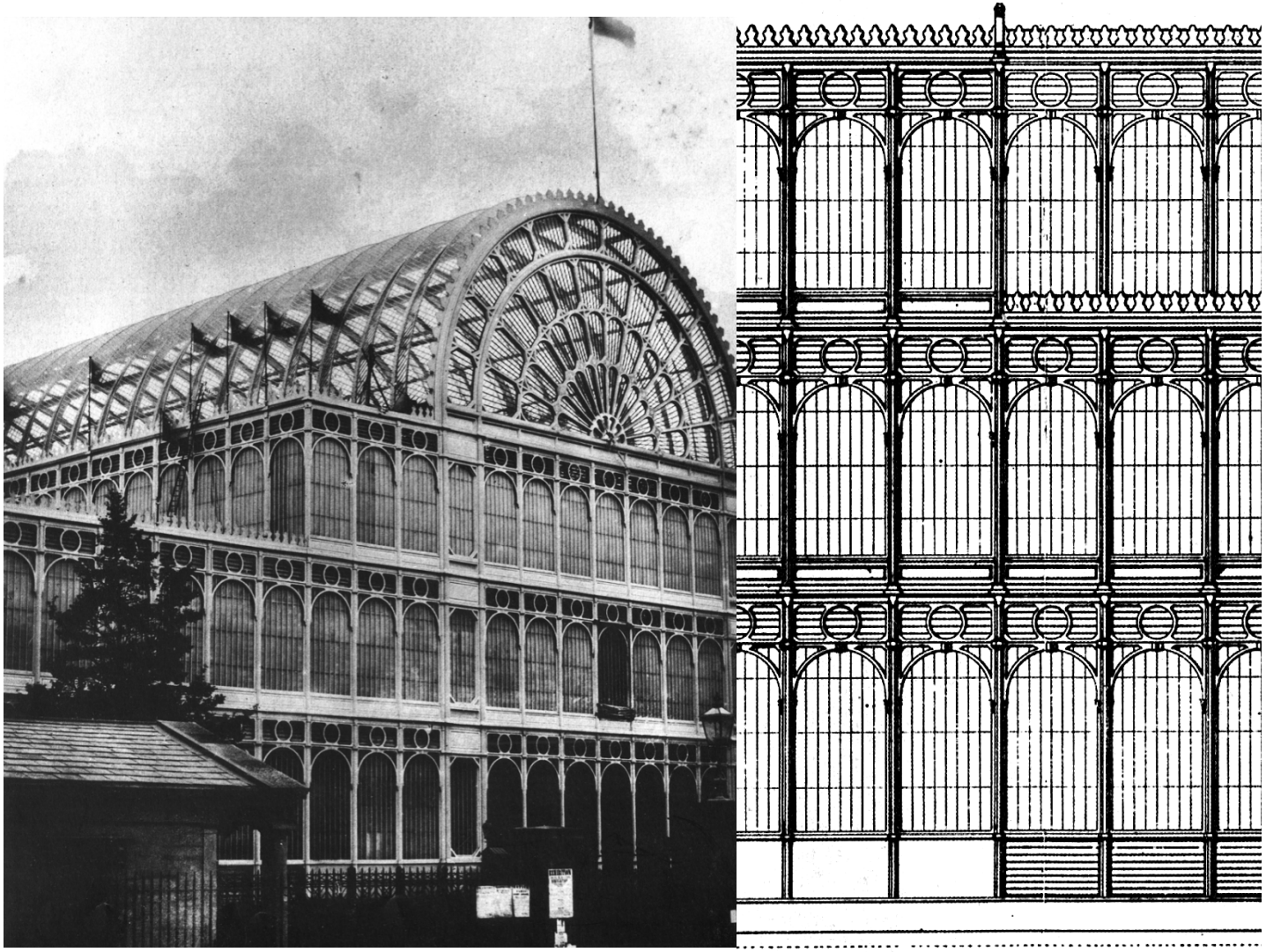
Crown & Cylinder Glass

19th Century



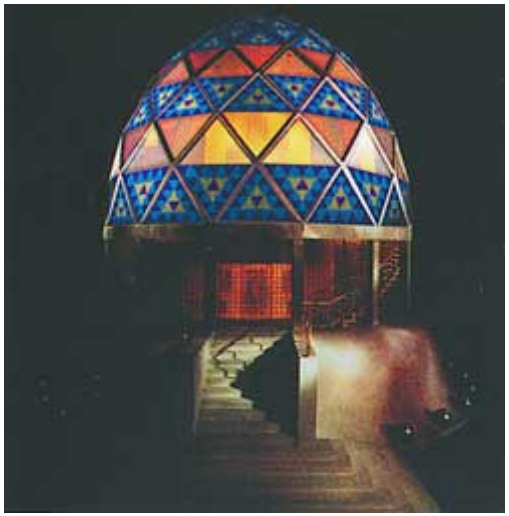
Sir Joseph Paxton 1803 – 1865
Crystal Palace, Hyde Park, London, 1851 – 1852

18 Acre footprint glass enclosed structure

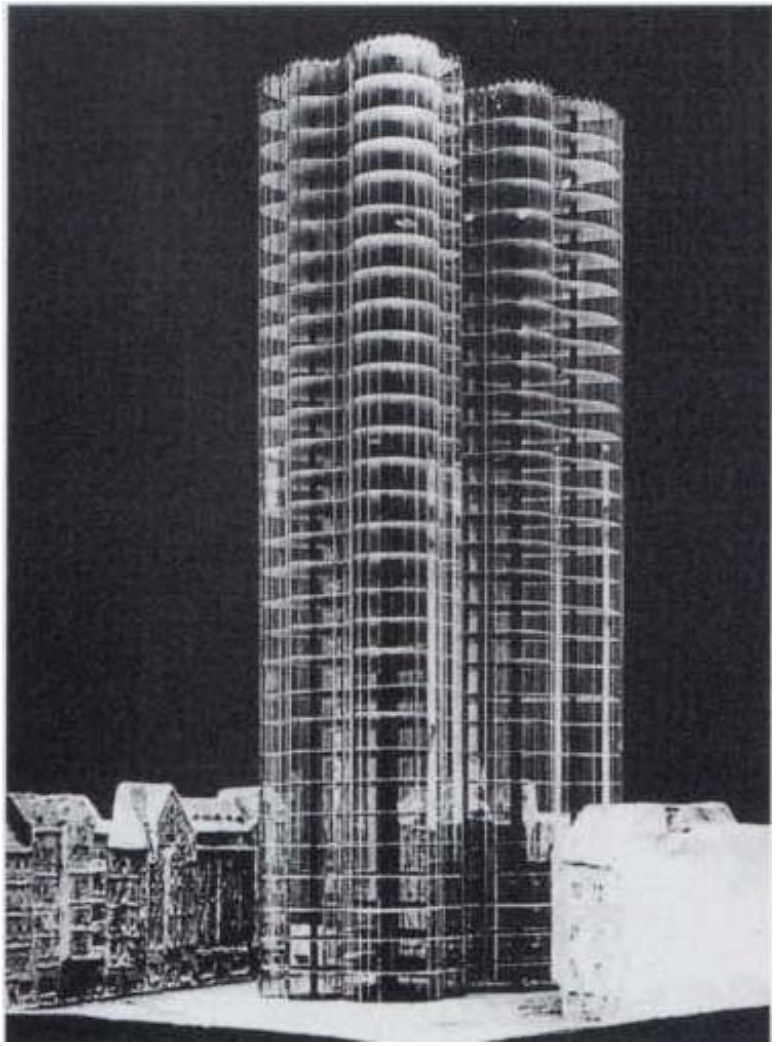


Post & beam steel frame system with infill glass panels

Interior view demonstrating light filled space potential of glass



Bruno Taut
Glass Pavilion for Werkbund Exhibition
Cologne, 1914



Mies van der Rohe
Glass Skyscraper Project
Berlin, 1921

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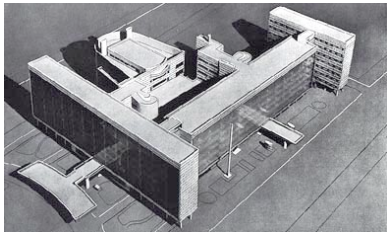
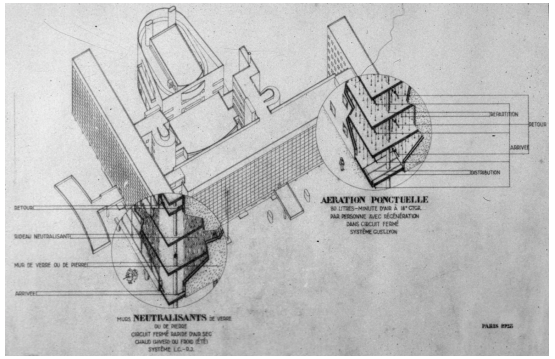
Early Modern Experiments

- Le Corbusier
  - Cite de Refuge, 1930
  - Centrosoyus, 1929 - 1930
- The glass façade was intended as a double walled enclosure with mechanical ventilation within the cavity
- Failure and inability to carry out experiment due to budgets and lack of knowledge base
- St. Gobain tests of system 1931 revealed third glass skin required

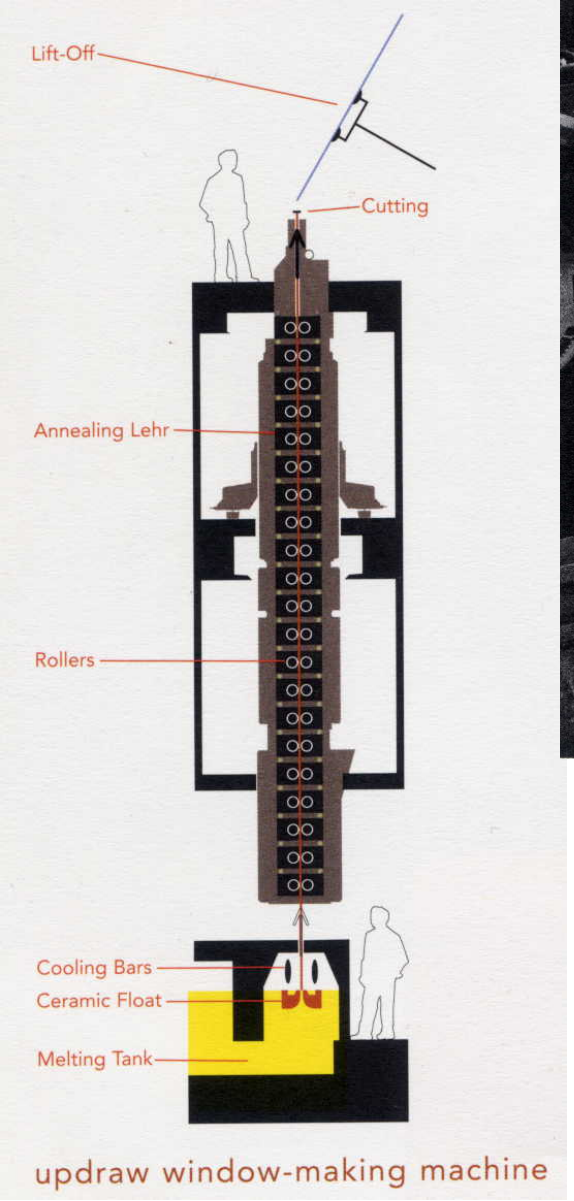


Cite de Refuge, originally constructed façade

Modified with brise soleil added



Centrosoyus 1929 - 1930



updraw machine 1901

Twin Grinding Machine1937
1,400 feet long

EMILE
FOURCAULT
1862–1919

Sheet & Plate Glass

20th Century

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Nanjing Feitian Glass Industry Co., Ltd.

3rd

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Products
- Bending Laminated Glass [1]
- Laminated Glass [1]
- Insulating Glass [1]
- Bulletproof Glass [1]
- Serigraph Glass [1]
- Fireproof Glass [1]
- Tempered Glass [1]
- Arts Glass [1]
- Others [16]

Company Profile

Contact Us

Nanjing Feitian Glass Industry Co., Ltd.
[China]

Address:
199 Tangjiaba, Wengjiaying, Honghua Street, Qinhuan District, Nanjing City, Jiangsu Province. China, Nanjing, Jiangsu, China

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Painted Tempered Laminated Glass

Painted Tempered Laminated Glass

Place of Origin: Nanjing, China

Company info

Date Joined: 2005
Online Postings: Products (24), Selling Leads (30)
Country/Territory: China
Business Type : Manufacturer
No. of Total Employees: 101 - 500 People

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Detailed Product Description

The glass is safe and environment-protected. The max size is 6000X2000.

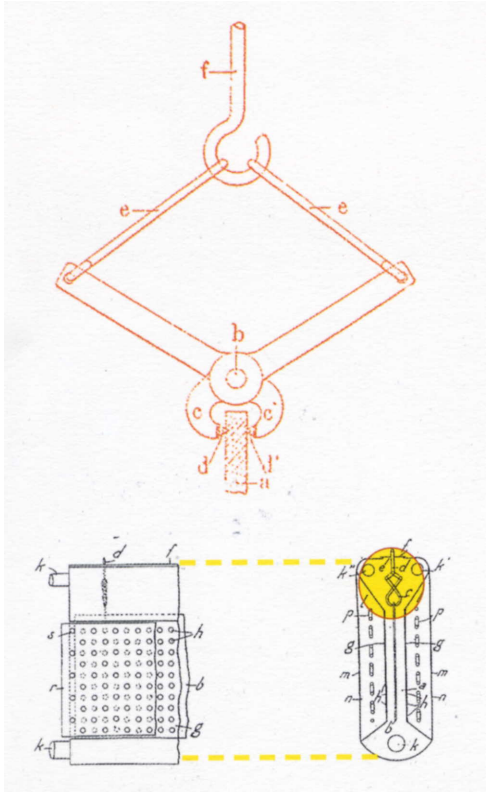
Painted Tempered Laminated Glass

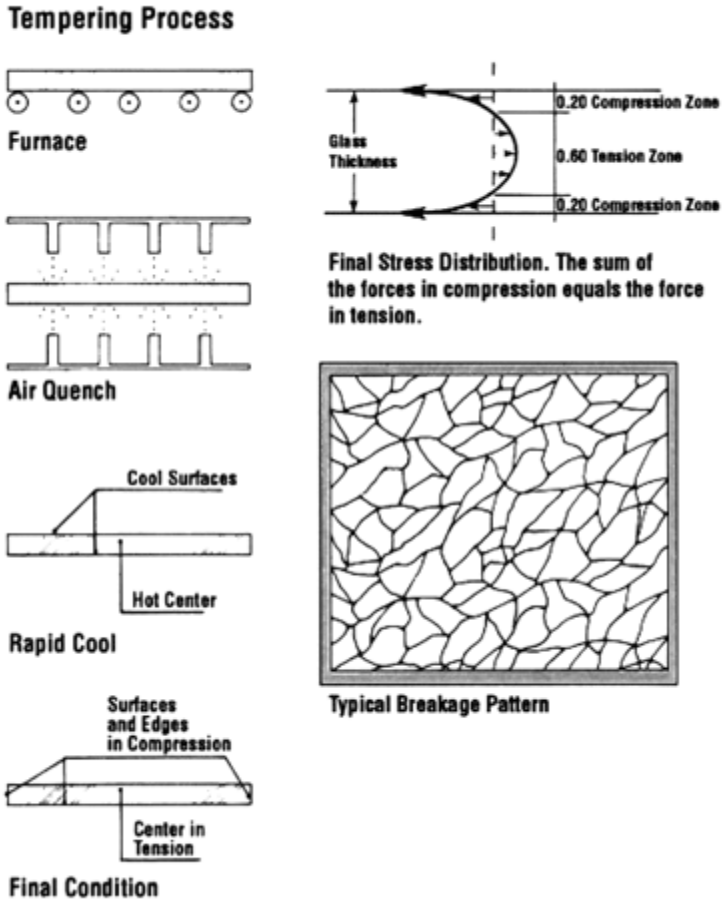
Other products See All

http://ftglass.en.alibaba.com/product/0/50705102/Painted_Tempered_Laminated_Glass.html 10/6/2007

Art Deco Prints by
Edouard Benedictus

Laminated Glass

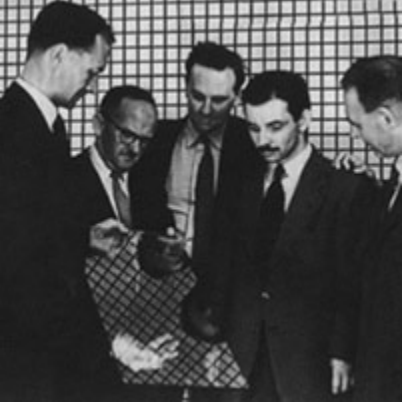




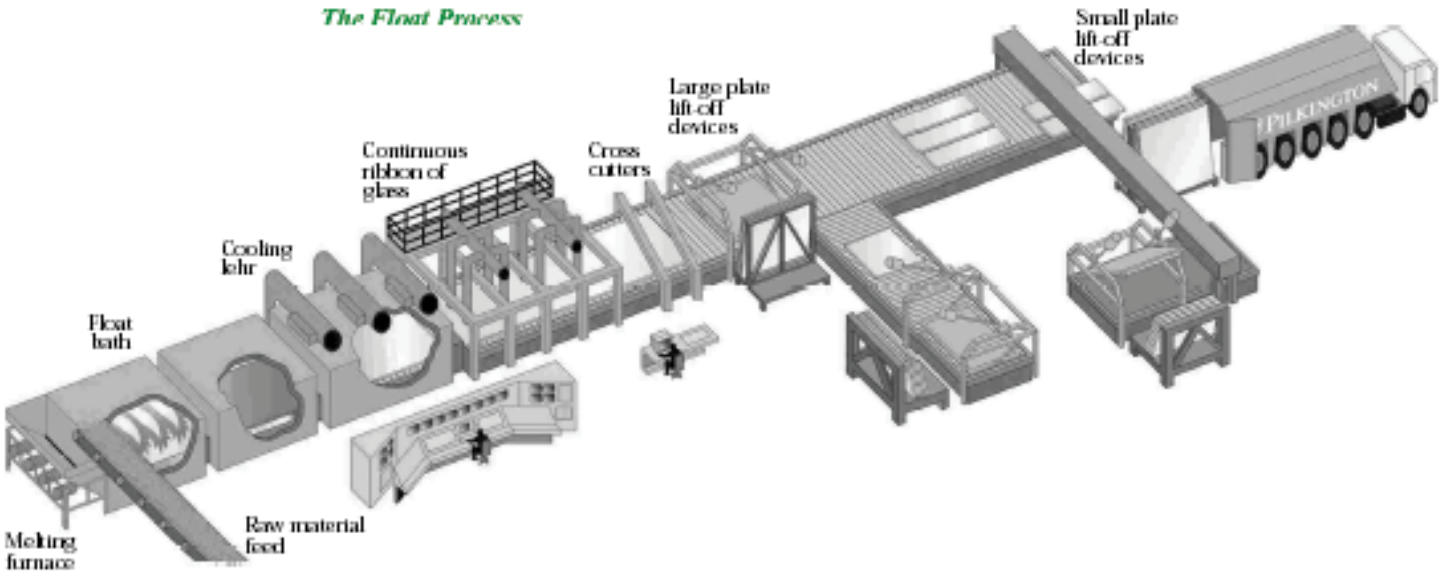
In 1929, Achille Verlay while working at St. Gobain, hung glass sheets in an oven with tungsten steel tipped tongs which glowed at the right temperature signaling the glass was ready for cooling. Jets of air were then blasted uniformly on both sides of the glass

Tempered Glass

1929



Pilkington Family
examining float glass



Float Process

Molten glass, at approximately 1000ºC, is poured continuously from a furnace onto a shallow bath of molten tin. It floats on the tin, spreads out and forms a level surface. Thickness is controlled by the speed at which the solidifying glass ribbon is drawn off from the bath. After annealing (controlled cooling) the glass emerges as a 'fire' polished product with virtually parallel surfaces.

Float Glass

1959

New York City
Sixth Ave. looking north

Glass Box

1950's

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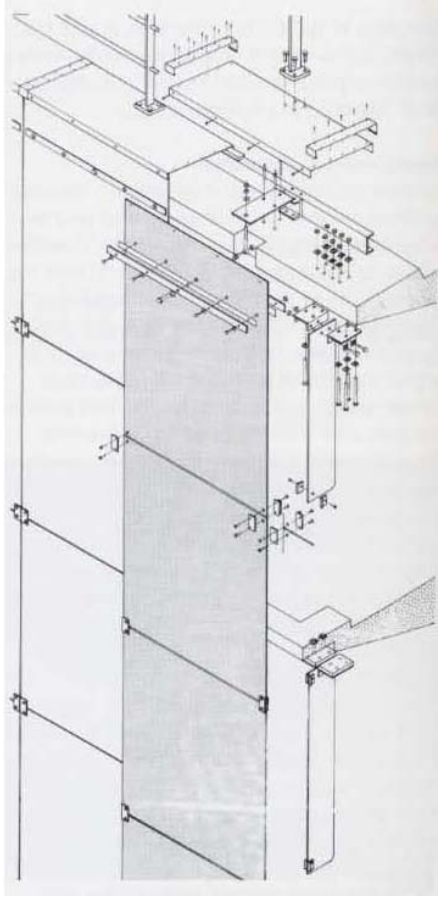
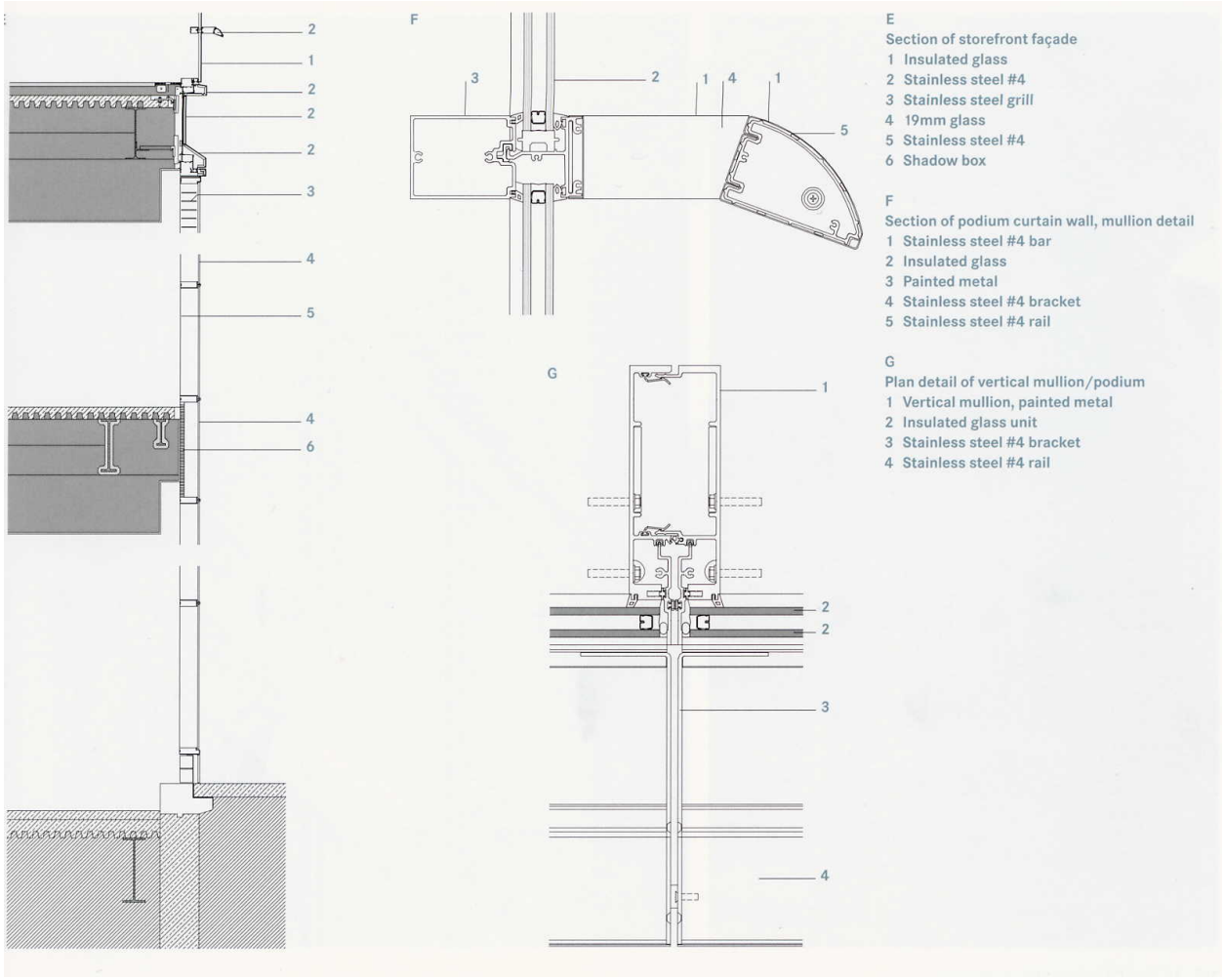


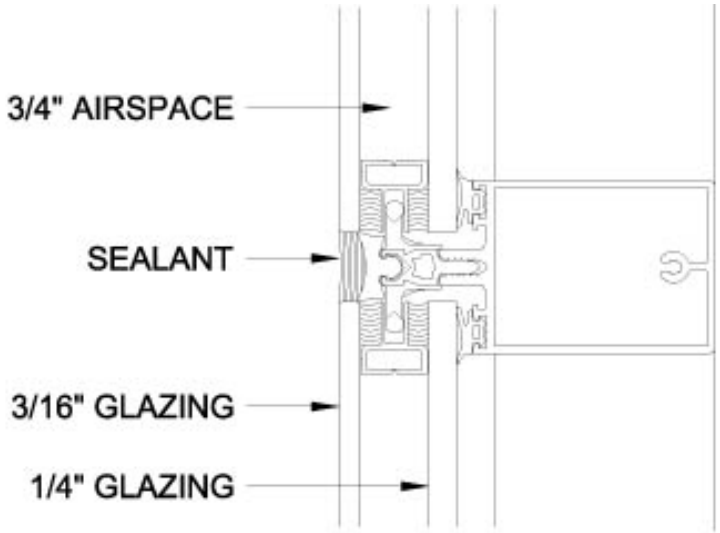
Norman Foster
Office for Willis Faber & Dumas
Ipswich, England, 1971 - 1975

Detail showing structural connection for hanging glass

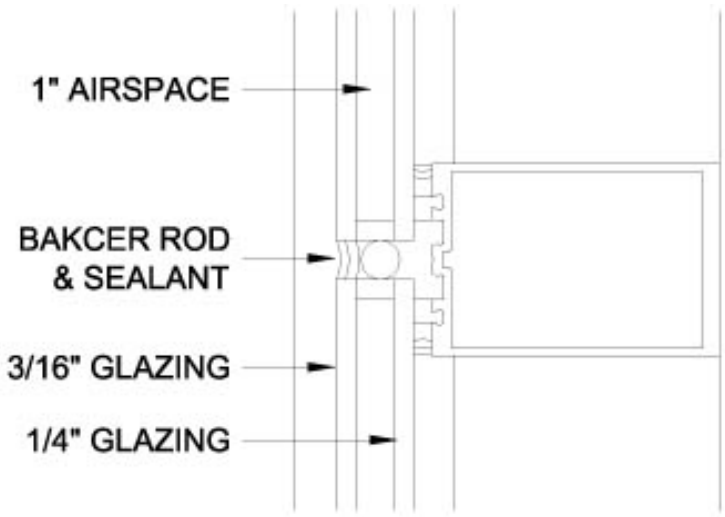
Curtain Wall Details



Curtain Wall Details



SHUCO FW 50 SYSTEM



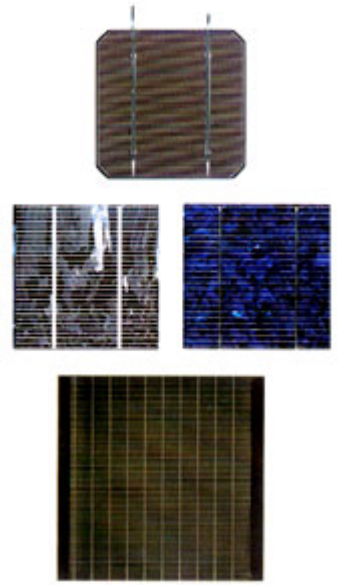
KAWNEER 1600 WALL SYSTEM

Details section of two companies providing standard window wall systems

Photovoltaic glass is integrated with solar cells to convert solar energy into electricity. Power can be produced within the roof and façade areas.

Production:
Solar cells are embedded between two glass panes. Resin seals the edges securely wrapping the solar cells on all sides. Each cell has two electrical connections linked to other cells in the module to form a system which generates a direct electrical current.

Schott Photovoltaic Glass



Photovoltaic Glass

Glass Strength

- Tempered glass & Annealed glass
  - heat strengthened
  - residual surface compression
    - > 3,500 psi & < 10,000 psi (ASTM C 1048)

- Chemically strengthened glass (ion exchange)
  - Samuel Kistler, University of Utah 1962
  - submersed in molten salt bath (at temperature below annealing)
    - potassium ions replace smaller sodium ions
    - not consistent across surface of glass

Glass Composition

- Hybrid between Solid and Liquid state of matter
  - Any material can be transformed into glass
  - Most commonly (sand, lime and soda)
    - Material is melted then rapidly cooled
    - Silica (silicon dioxide) with soda added as a flux
- Natural Formation of Glass
  - Volcanic activity from lava (Obsidian)
  - Sand melted by lighting (Fulgurites)

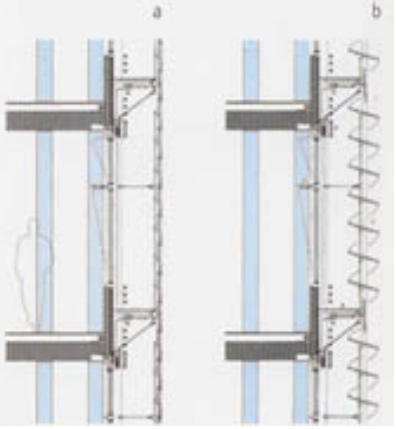
Glass Performance

Table 5.3 Optical and thermal performance of glazing units using low-emittance coatings

Glass type	Gas fill	Visible light transmittance	Infrared transmittance	U-value (W/m*.°C)
Single	–	0.90	0.86	6.4
Double-glazed unit (DGU)	air	0.81	0.76	2.9
DGU, low-e	air	0.74–0.78	0.62–0.71	1.8–2.2
DGU, low-e, porolytic heat mirror	argon	0.75	0.72	1.9
DGU, low-e, sputtered noble metal heat mirror	argon	0.75	0.58	1.1
DGU, low-e, sputtered noble metal heat mirror	xenon	0.76	0.58	0.9
DGU, low-e, sputtered solar control	argon	0.66	0.34	1.2
Triple-glazed unit, 2 low-e	argon	0.62–0.67	0.49–0.58	0.8–1.1
Triple-glazed unit, 2 low-e	krypton	0.63	0.55	0.7

Source: Hutchins 1997
Note: * Low emissivity coating

For the 21-storey high-rise a double-skin façade was developed with an outer skin of frameless, pivoting glass louvres.
In winter it acts a thermal buffer (a), in summer as a single-skin façade with exterior solar protection (b).
debis headquarters, Berlin, 1991–97,
Renzo Piano Building Workshop in cooperation with Christoph Kohlbecker.

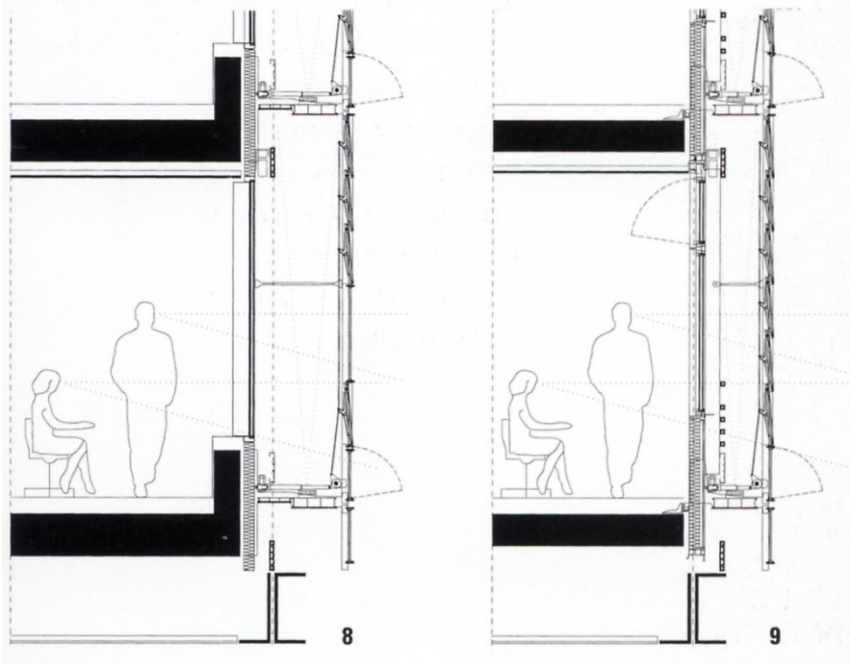


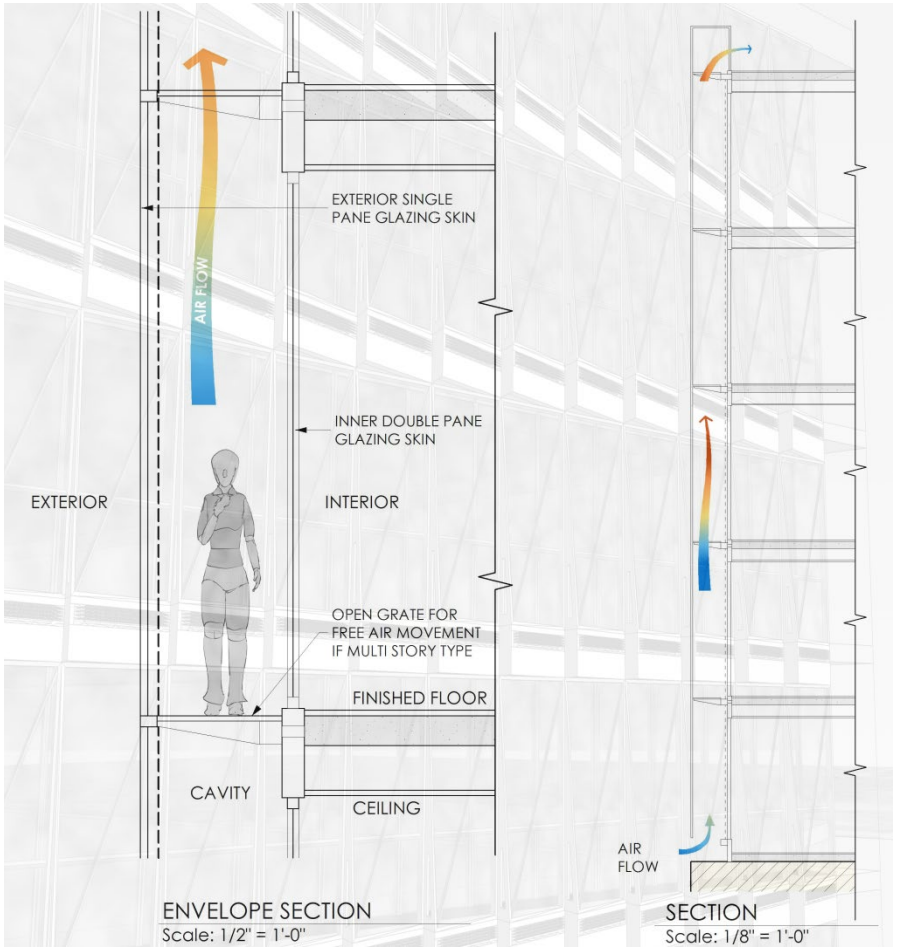
Administration building in Wiesgaden,
Herzog and Partners Light shelves in the shape of scoops re-direct the direct sunlight.

Debis Headquarter, Berlin 1991 – 1997
Renzo Piano
Double Skin Glass Façade with frameless pivoting glass louvers

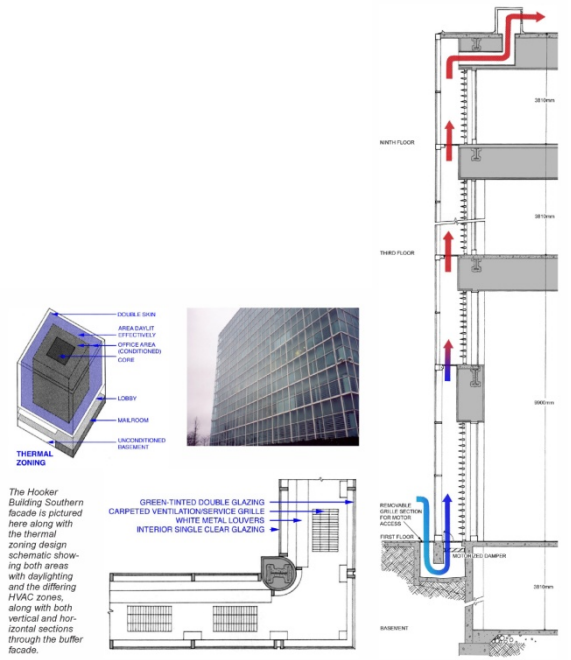
Glass walls integrated
with shading system

Double Skin Glass Facades

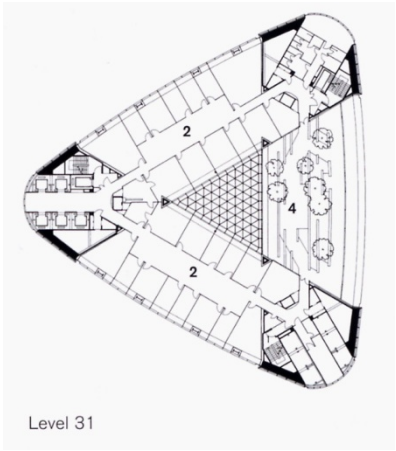




More Recent Examples



Hooker Chemical Company
Niagara NY, 1980
Cannon Design



Commerzbank
Frankfurt am Main, 1997
Foster Associates

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