Façades in Architecture: History and Development

Arch 173: Building Construction 2

Façade – definition

Noun:
The face of a building, especially the principal front that looks onto a street or open space

Your choice of skin/ façade will be CLIMATE DEPENDENT

The type of building – commercial, institutional, residential matters

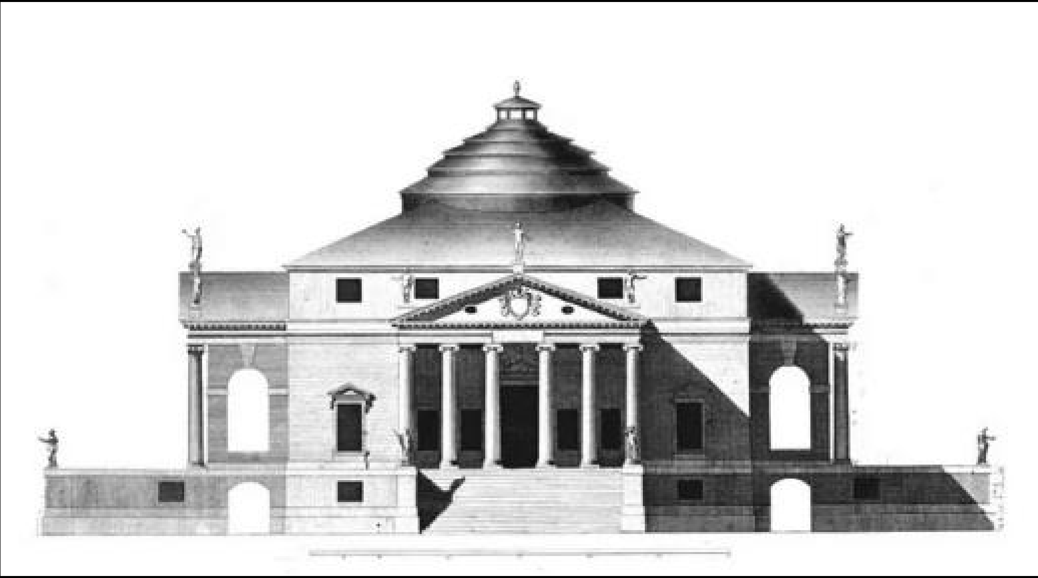
The amount of insulation needed responds to both climate and building use

The façade or skin is a huge part of the budget

Every façade we will look at, think about:

1. Composition
2. Performance
3. Light

Composition



More formal to less formal

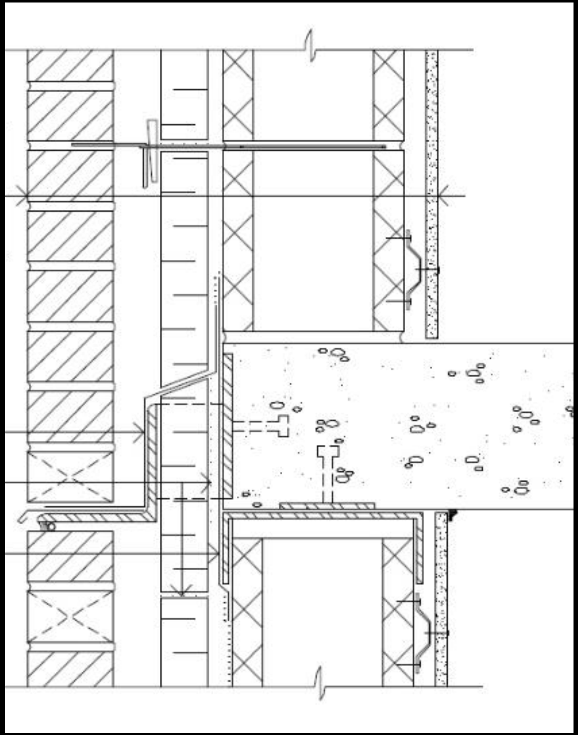
Performance

From defence to energy

Light

More light a function of separation of structure and envelope
Cost of glass goes down dramatically over time

Façade vs. Enclosure??



Appearance vs. Performance

Questions to ask:

1. What does your building want to say (human)?
2. What does your building need to DO (technical)?
3. Where do you want light & views, solid, privacy"
4. What existing technologies will fit these needs"

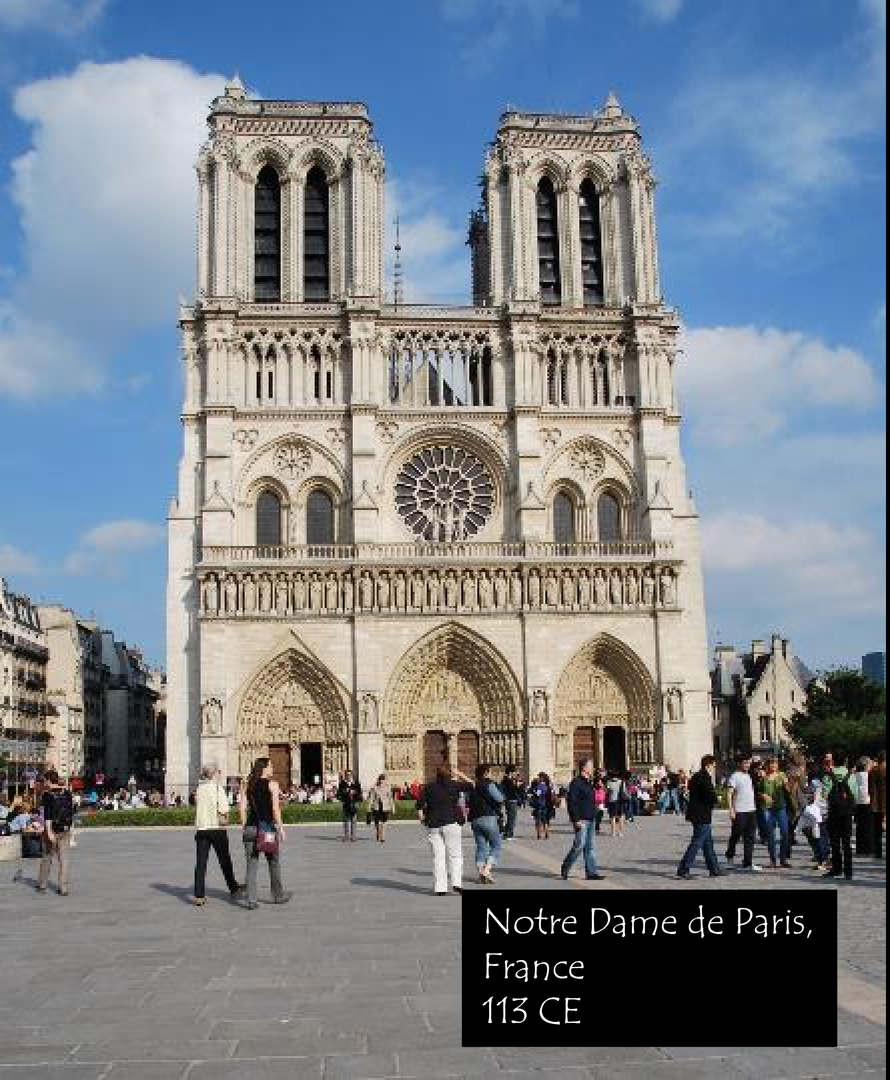
In Architecture and Engineering

PERFORMANCE is the goal!

- Climate responsive
- Energy efficient
- Durable
- Low carbon
- And yes, aesthetically pleasing

For early stone and masonry buildings the load bearing, solid walls of the building also presented the appearance or façade of the building.

The style and the structural system were joined.



Notre Dame de Paris,
France
113 CE

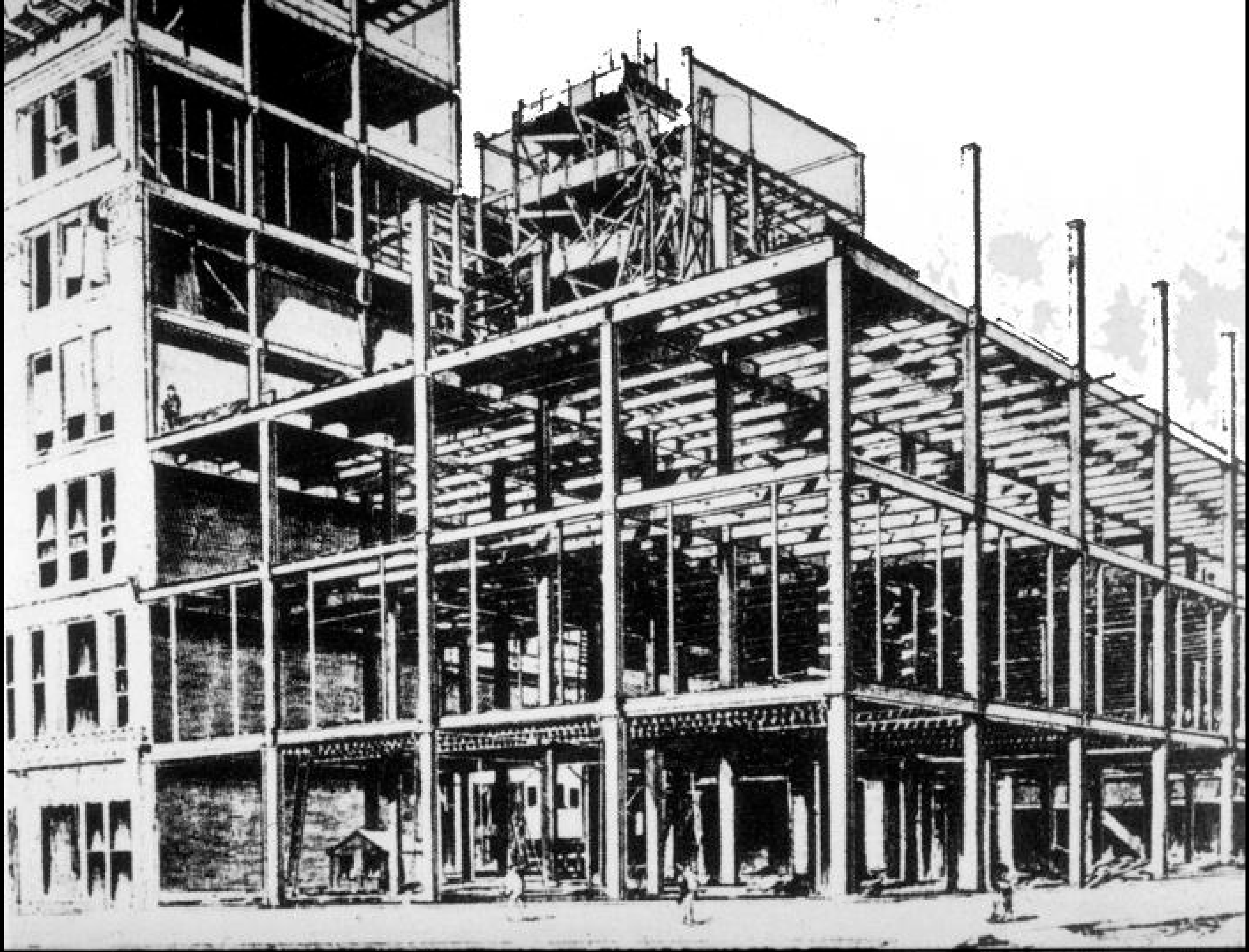


Biblioteque Sainte-Genevieve
Paris, France
Henri Labrouste
1835-1851

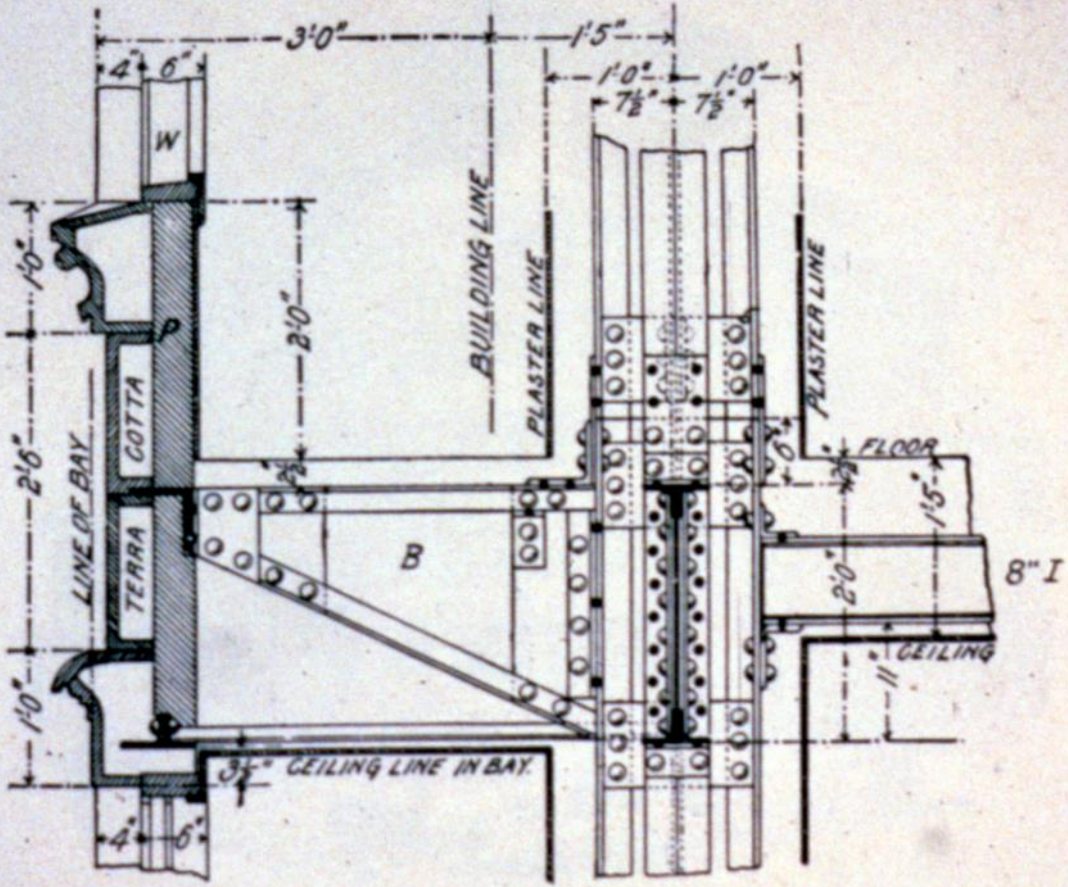
Monadnock Buildling (north half)
Chicago, Illinois
Burnham and Root
1891

The invention of the skeleton steel frame at the end of the 1800s separated the roles of the structure and enclosure system.

The enclosure system took on the role of façade and had much more freedom of expression as it did not have to also support the loads of the building.



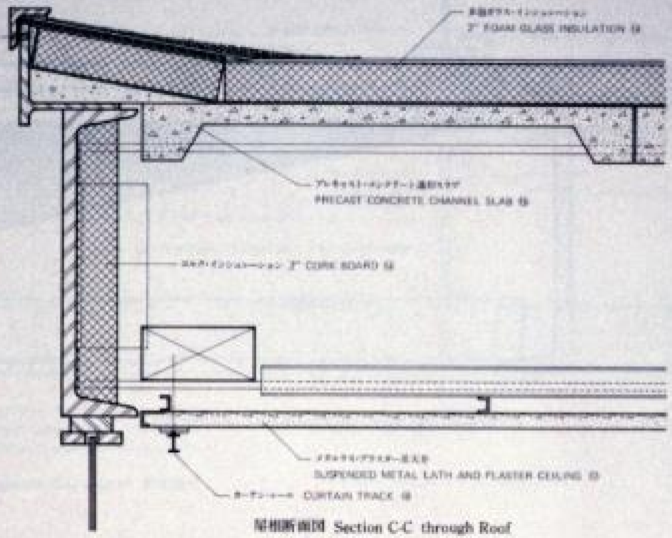
Reliance Building
Chicago, Illinois
Burnham, Root and Atwood
1895
First real skyscraper



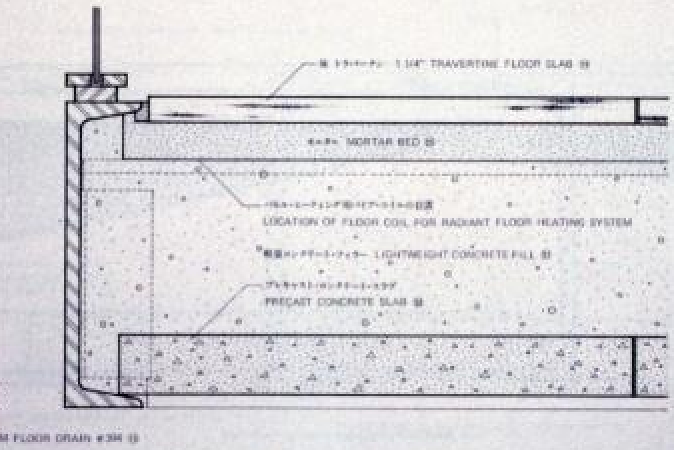
27 Atwood and Burnham, Reliance Building, Chicago, 1890/94-95. Cross section of window bay.

Enclosure systems for Early Skyscrapers

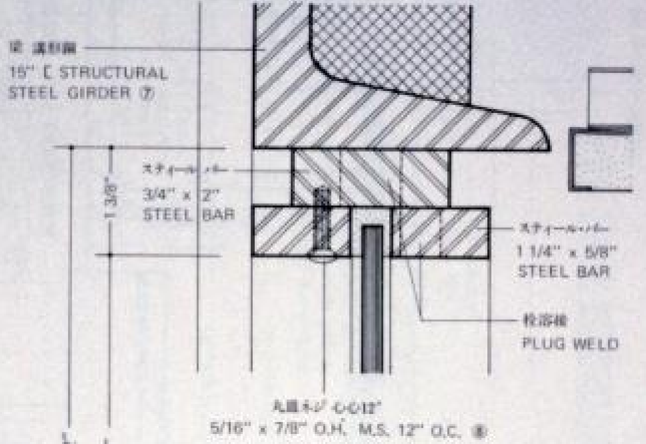
Farnsworth House
Ludwig Mies van der Rohe
Plano, Illinois
1951



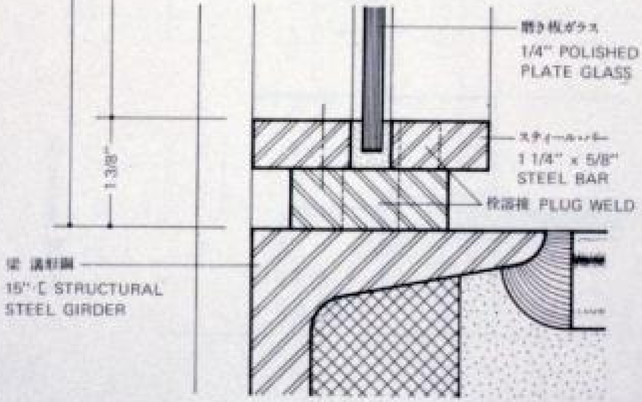
屋根断面図 Section C-C through Roof



床断面図 Section C-C through Floor



断面図 Section 109



断面図 Section 110


SOUTHWEST AIRLINES

Mies van der Rohe
Lakeshore Drive Apartments, Chicago

Tall Buildings and Curtainwall:

In the 1950s a new curtainwall enclosure system was developed based on a modular system of aluminum components that allowed large expanses of glazing.

Lever House, NYC

Different approaches to the construction of the enclosures for tall vs mid-rise vs low-rise *commercial* buildings

Tall = curtain wall

Mid-rise = less use of aluminum curtain wall and more composite layered systems with insulation

Low-rise = composite layered systems with more insulation requirements

Low-rise (mostly residential)

- Load bearing framed walls
- Insulation contained between the studs
- Glazed openings punched in the wall

Exterior cladding is a "veneer" that keeps out the weather but does not support the floors and roof

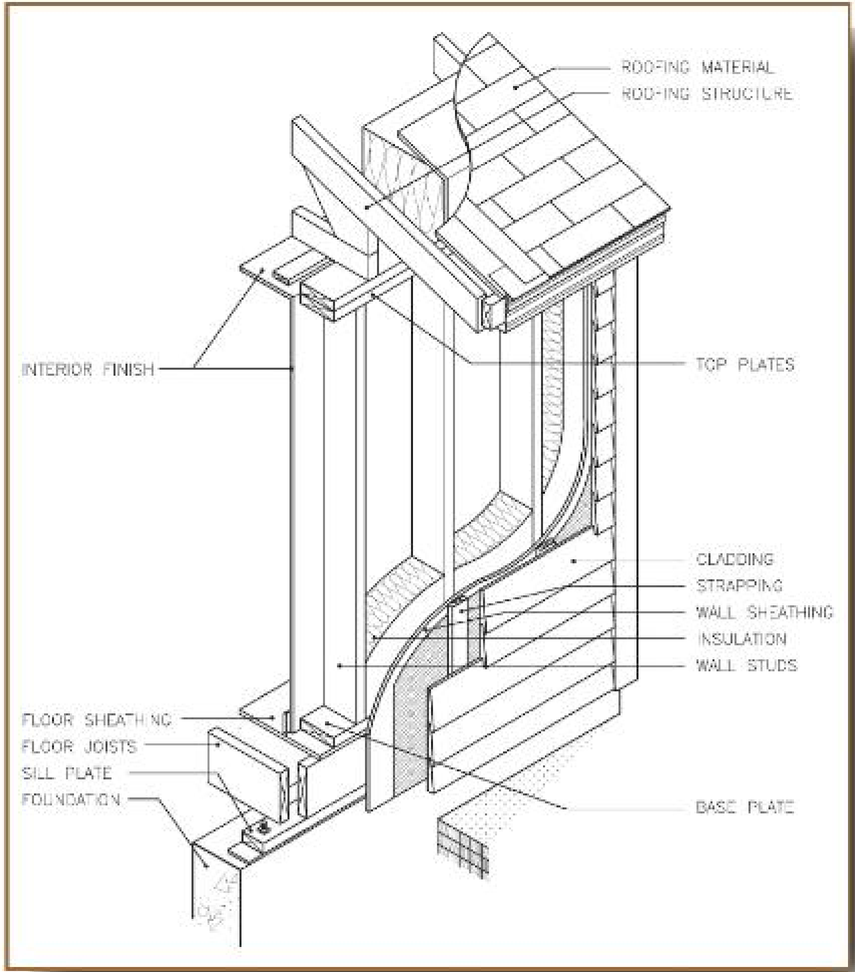
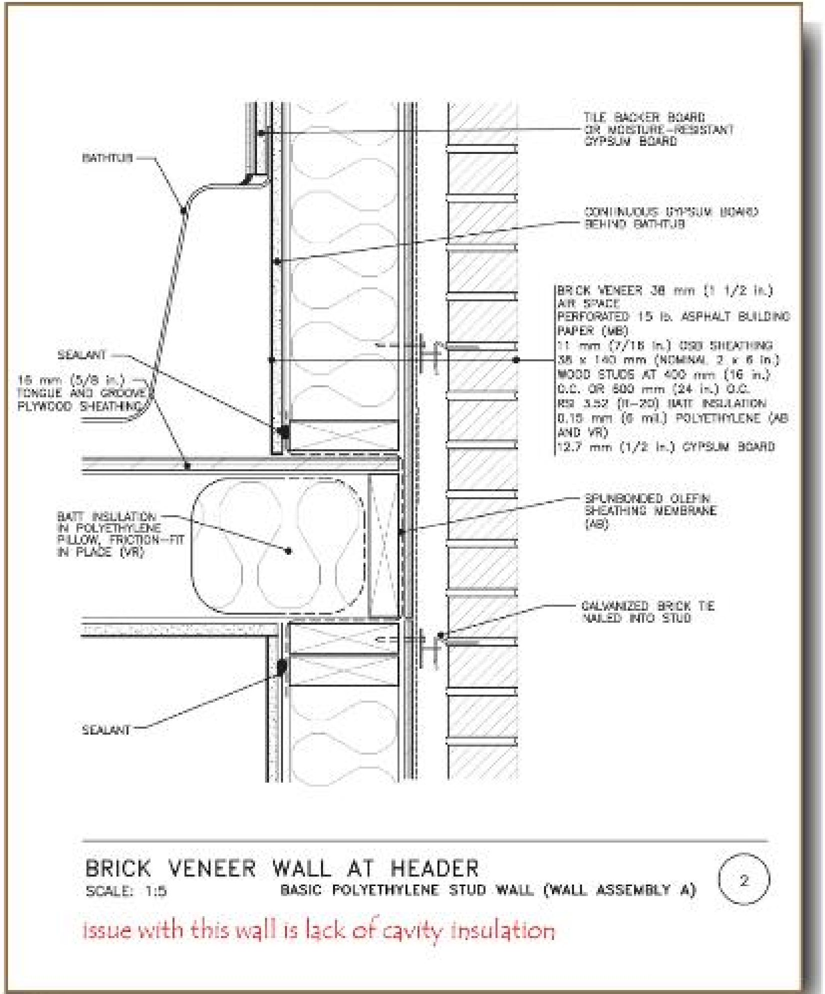


Figure 2.6: Components of a wood frame structure



Detail 2: Brick Veneer Wall at Header

Rain Screen:

In the 1960s an improved wall system was developed that placed an air space behind the outermost layer of the envelope system.

This equalized the pressure on either side of this "veneer" and prevented rain from penetrating to the interior part of the wall.


Boots

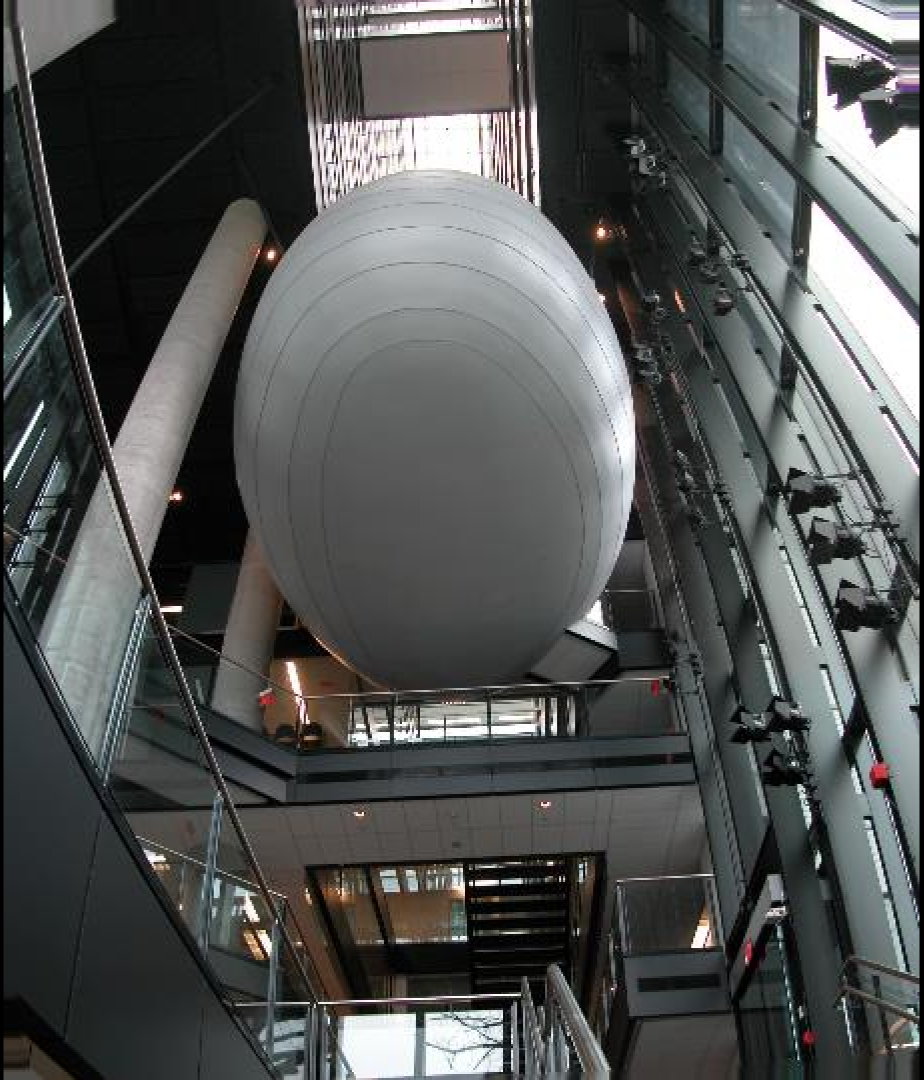

For column and beam type structures (non load bearing walls) it doesn't matter if the material is steel, concrete or heavy timber, the structure gets erected first, then the curtain wall/window wall is installed.



VANBOTS
Genie S-125


PCL


RTNERSHIPS
EATE GREAT
ACES
University of Toronto
what it takes to be great
CONSTRUCTION
ENTRANCE




ONE HUDSON Y


ENTRANCE
ENTRANCE

The curtain wall connects to the slab edge NOT the columns

Residential Tower
Melbourne, Australia


E35
DECK

Swiss Re (The Gherkini)
London, England
Foster and Partners
2004

CCTV Tower
Beijing, China
OMA/Rem Koolhaas
2013

Pearl River Tower
Guanzhou, China
SOM
2013

20 Fenchurch Street
Aka The Walkie Talkie Building
London, England
Rafael Vinoly Architects
2014

CNOOC Headquarters
Beijing, China
Kohn Pederson Fox Architects

Typical curtain wall systems for commercial buildings were always sealed – no operable windows

Due to interest in sustainability, now looking for ways to include access to fresh air into the envelope design, while maintaining safety from falling.

Bahn Tower
Berlin, Germany
Murphy Jahn
2000

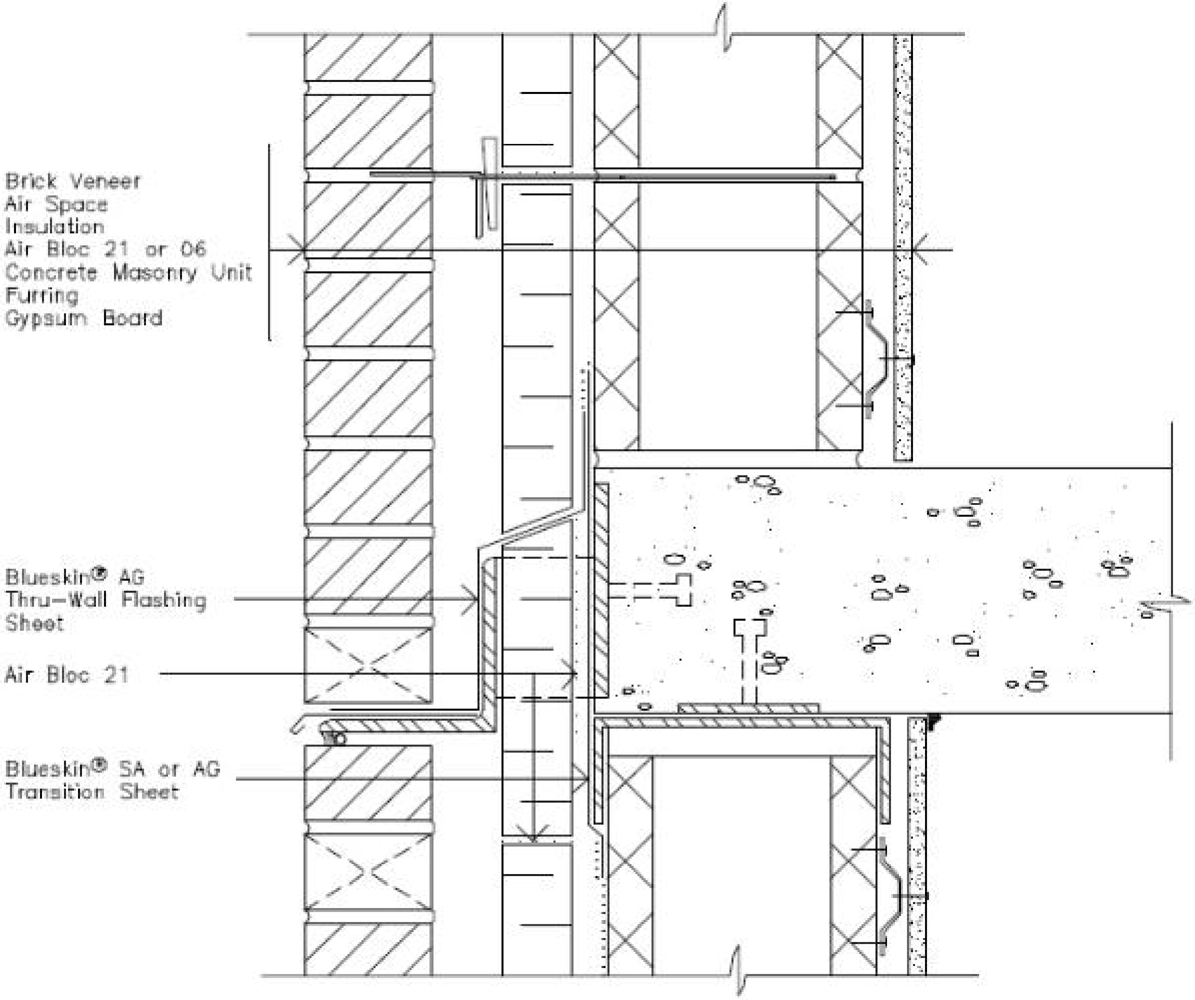
Window Wall:

This type of enclosure for high rise buildings does not use an expansive grid of aluminum frames.

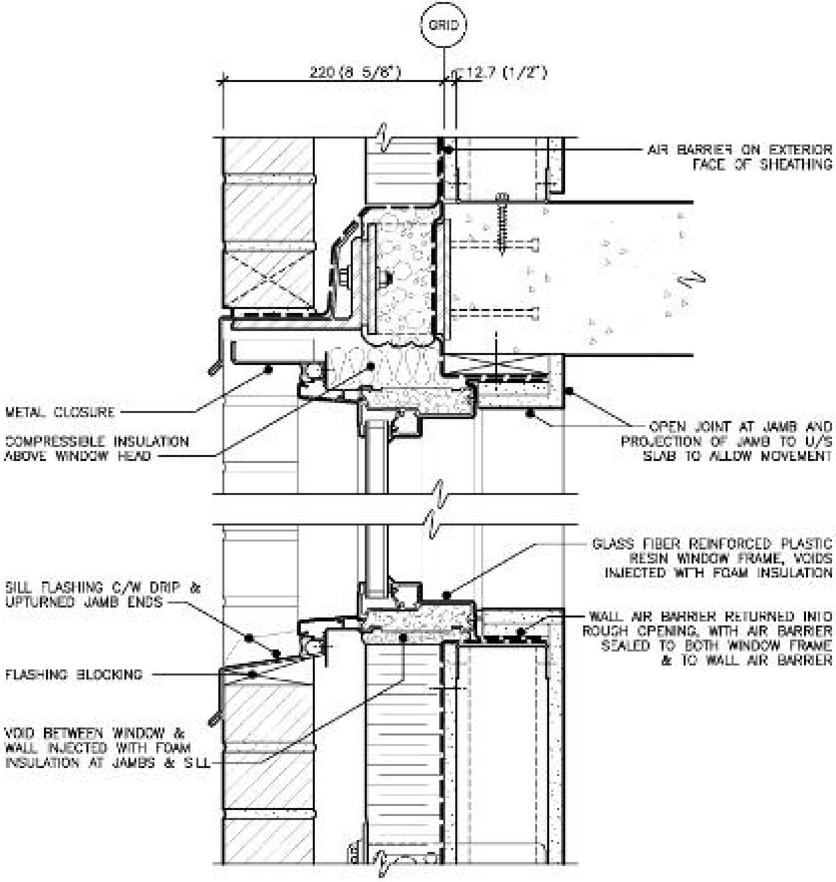
Typically has horizontal bands of windows supported by bands of precast concrete, stone, masonry or metal cladding panels.

In window wall construction the infill opaque wall sits (bears) on the edge of the concrete floor slab

It extends to the underside of the next floor, with a small space to allow for slab edge deflections.



Brick Veneer
Air Space
Insulation
Air Bloc 21 or 06
Concrete Masonry Unit
Furring
Gypsum Board
Blueskin® AG
Thru-Wall Flashing
Sheet
Air Bloc 21
Blueskin® SA or AG
Transition Sheet



4 WINDOW AT U/S SLAB DETAIL

1" 0 4" 8"

50mm 0 100 200mm

Which to use?

CURTAIN WALL

- Regular geometry
- Large expanses of glazing
- Limited use of opaque elements
- Typical aluminum frame systems spanning one to two floors height
- Lower insulation values achieved

WINDOW WALL

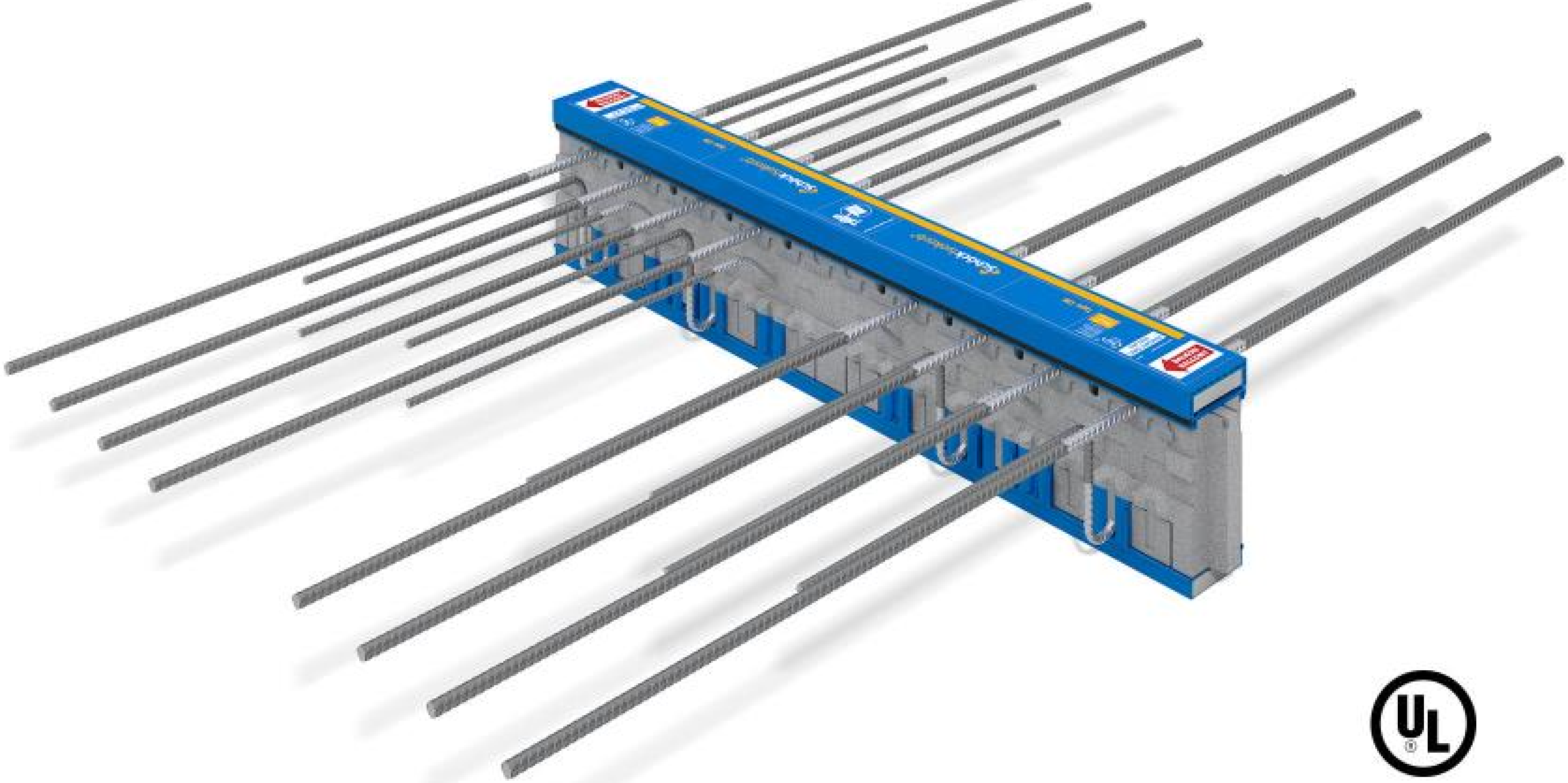
- Any kind of geometry
- Limited glazing
- Glazing often as punched or strip windows
- Large opaque portions
- Better insulation levels required

Thermal Bridge

A VERY BAD place in the building envelope that allows HEAT to ESCAPE

No insulation layer preventing heat flow

Usually happens at concrete slab edges



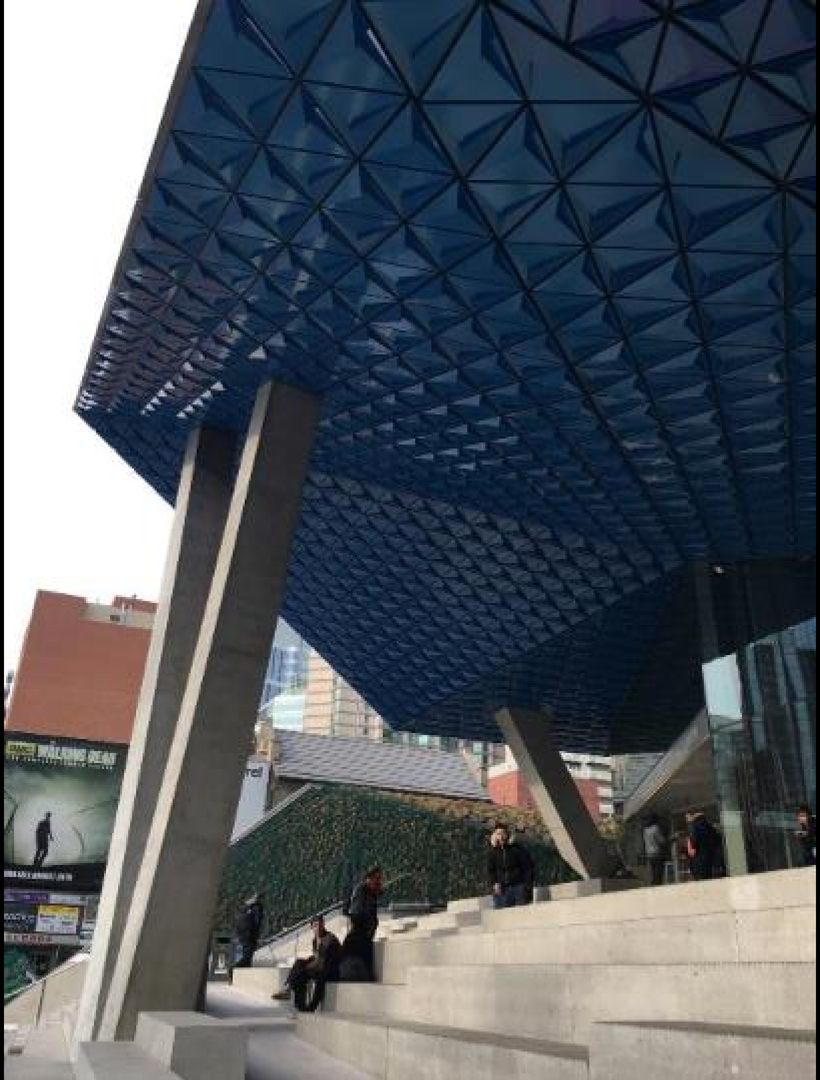
56 Leonard Street
New York City
Herzog & deMeuron




Vancouver House
Vancouver, BC
Bjarke Ingles Group


Toronto Metropolitan University
Student Learning Centre
Toronto, Ontario
Snohetta
2015


GP
DensGlass
Sheathing




STARBUCKS COFFEE

Office Building
Potsdamer Platz
Berlin, Germany
Richard Rogers

DB


Dutch Embassy
Berlin, Germany
OMA


reel

Thin Metal Cladding / Veneer

Chrysler Building
NYC 1930

Frank Gehry…

Residential Building
Berlin, Germany
Zaha Hadid


degewo

Linked Hybrid
Beijing, China
Steven Holl Associates
2009

Galaxy Soho
Beijing, China
Zaha Hadid


入口


地产
商铺

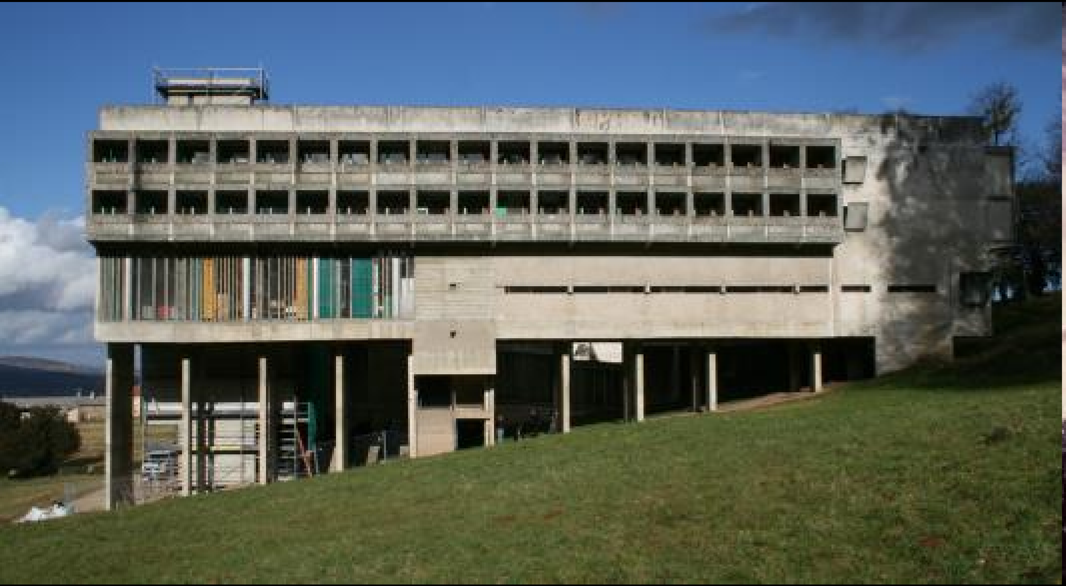
Conrad Hotel
MAD Architects
Beijing, China

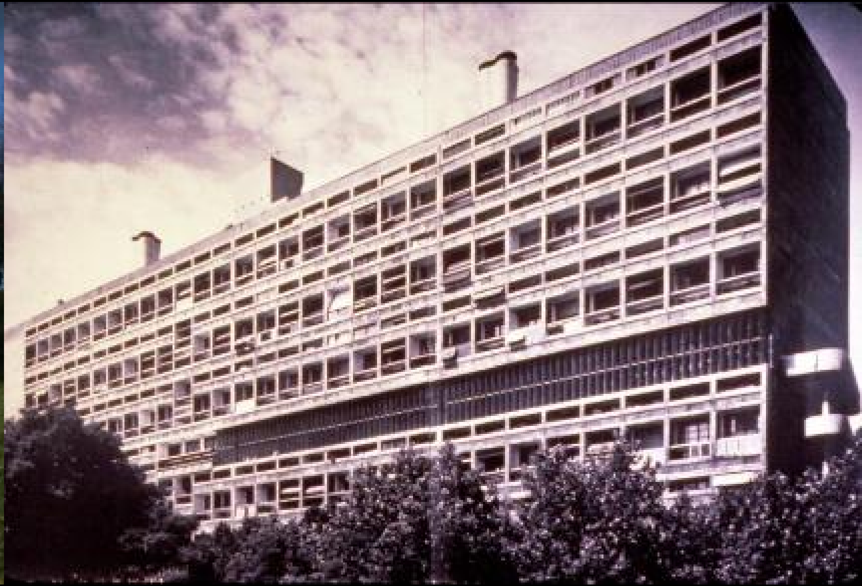
Royal Ontario Museum, Toronto
Studio Libeskind

Residence
Roger Williams University
Bristol, Rhode Island
Perkins + Will Architects

School of Architecture
Penn State University
WTW Architects

Shading Motivated Systems





Le Corbusier and the Brise Soliel

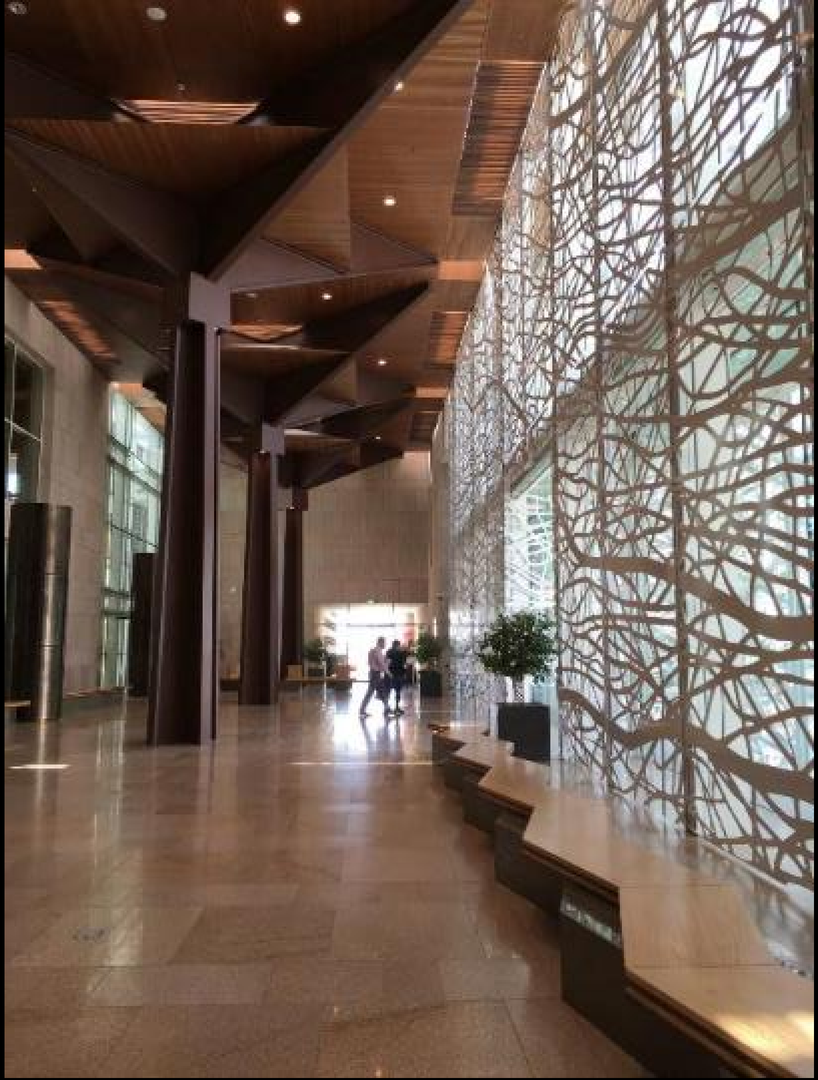
Veer Towers
Las Vegas, Nevada
Murphy Jahn Architects
2010


TESCO
express



101

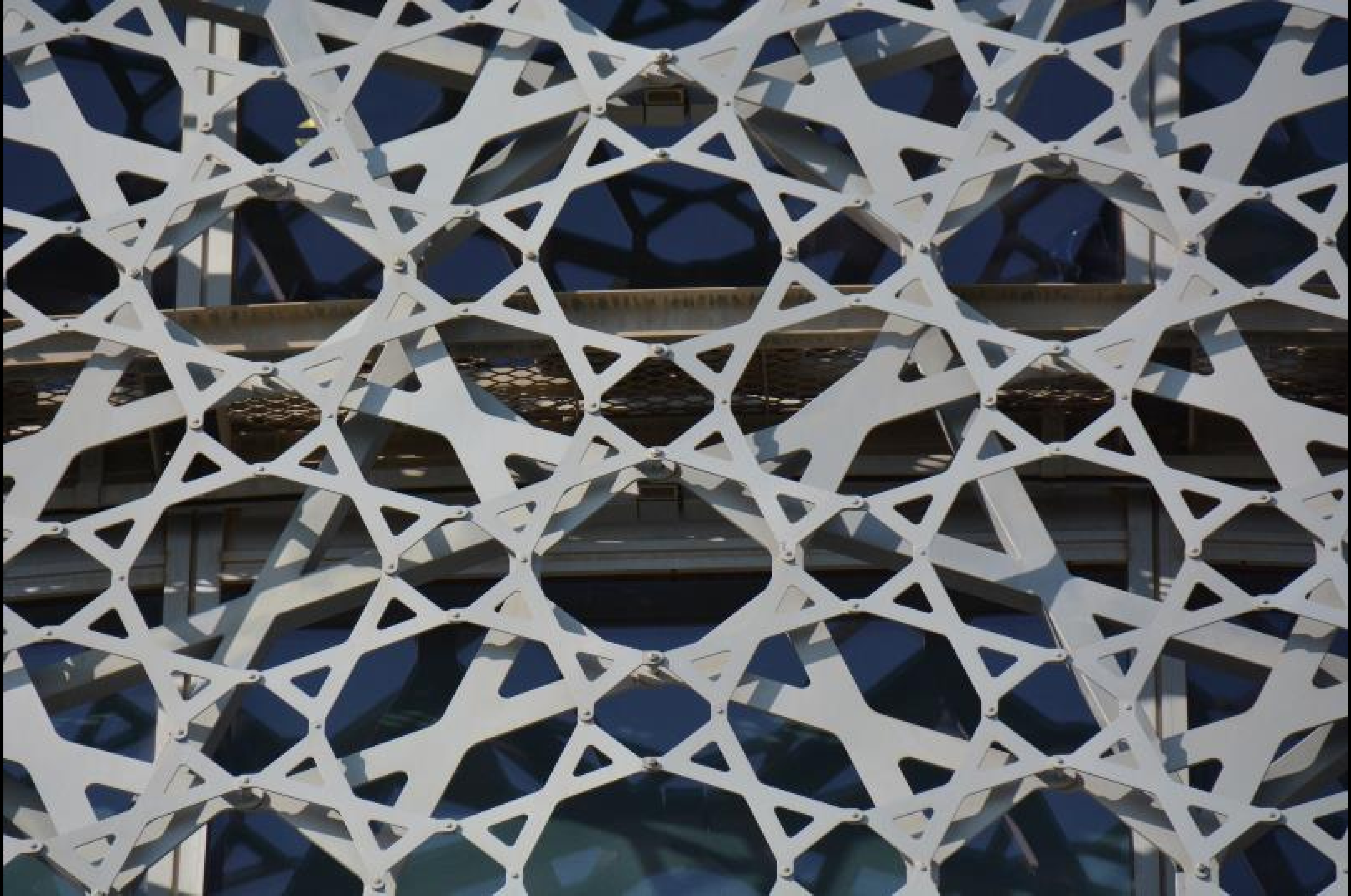
Al Bahar Towers
Abu Dhabi, UAE
Aedas Architects
2012

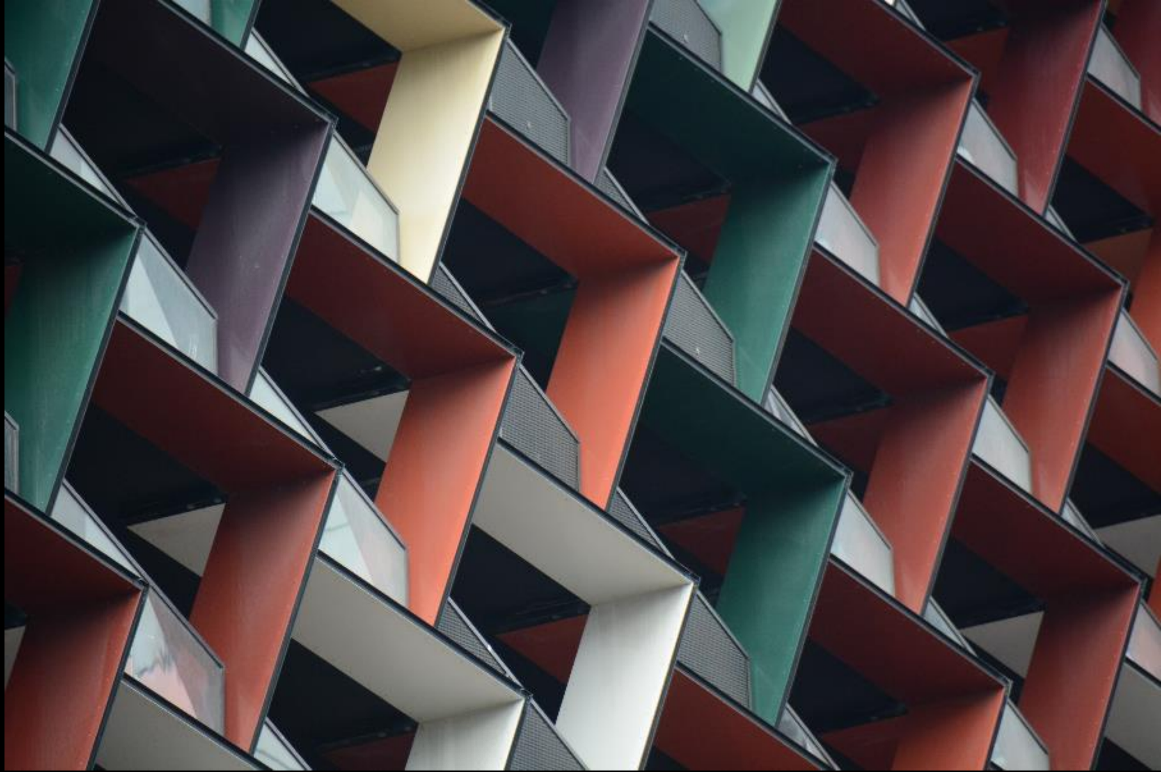


Education City
Doha, Qatar

Al Noor Butterfly Pavilion
Sharjah, UAE
3deluxe Architects
2015

Doha Tower
Doha, Qatar
Jean Nouvel
2012





The Index
Dubai, UAE
Foster and Partners
2010

People's Daily New Headquarters
Beijing, China
Southeast University School of Architecture
2015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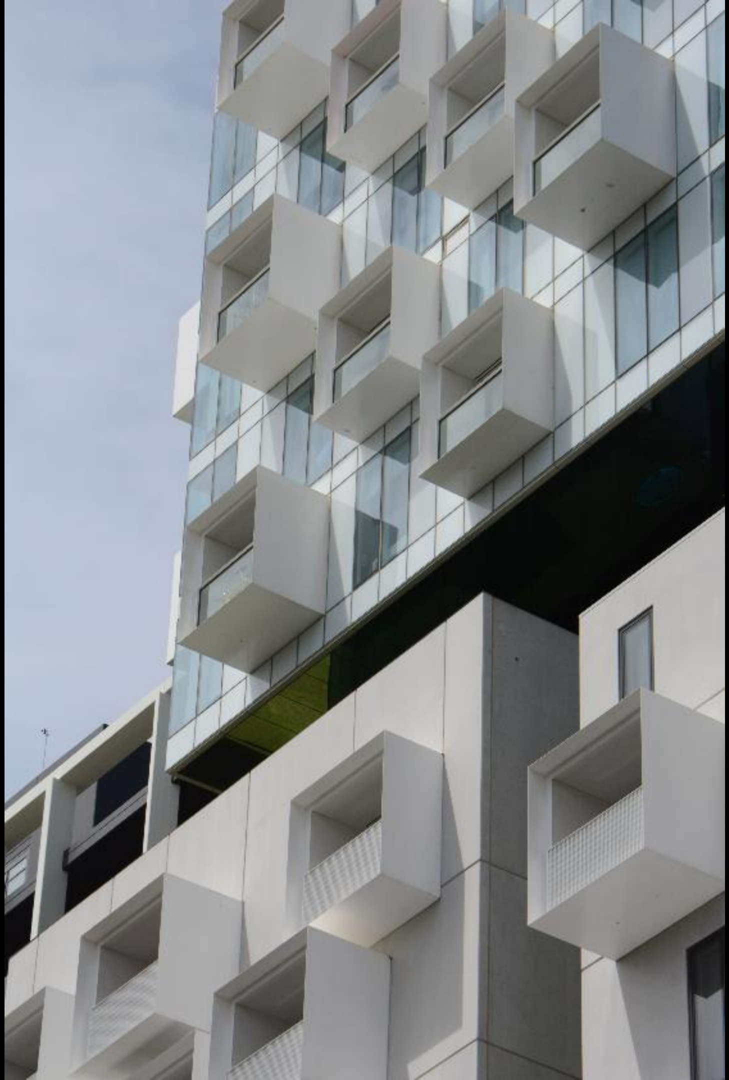
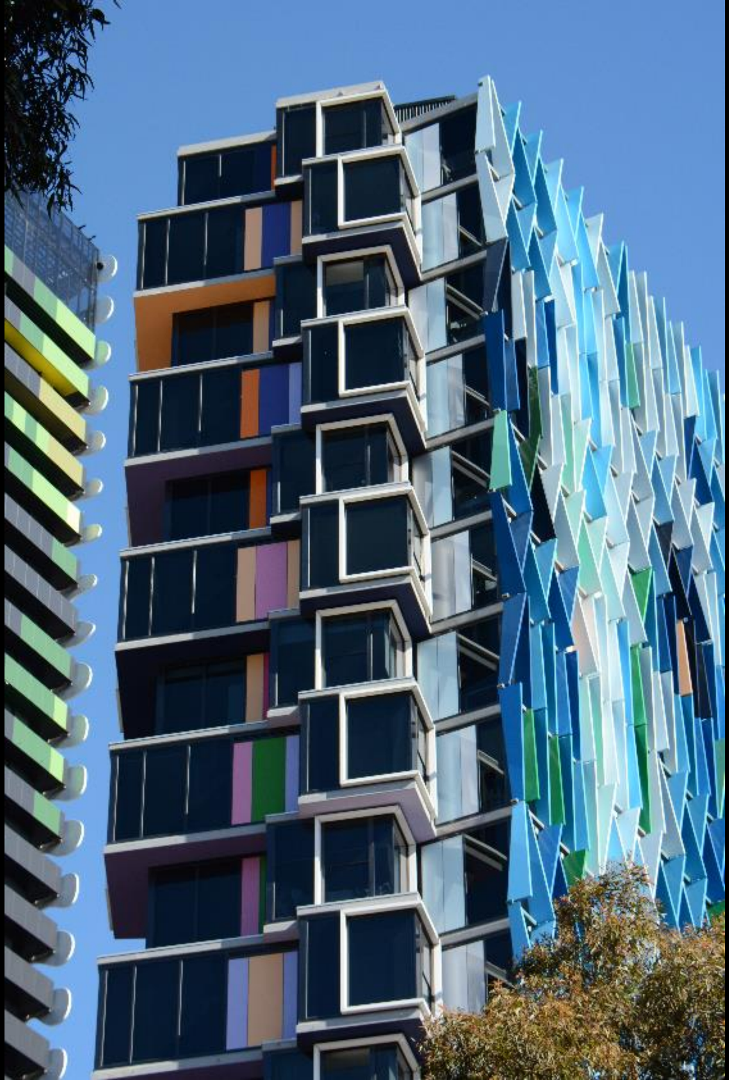
-19

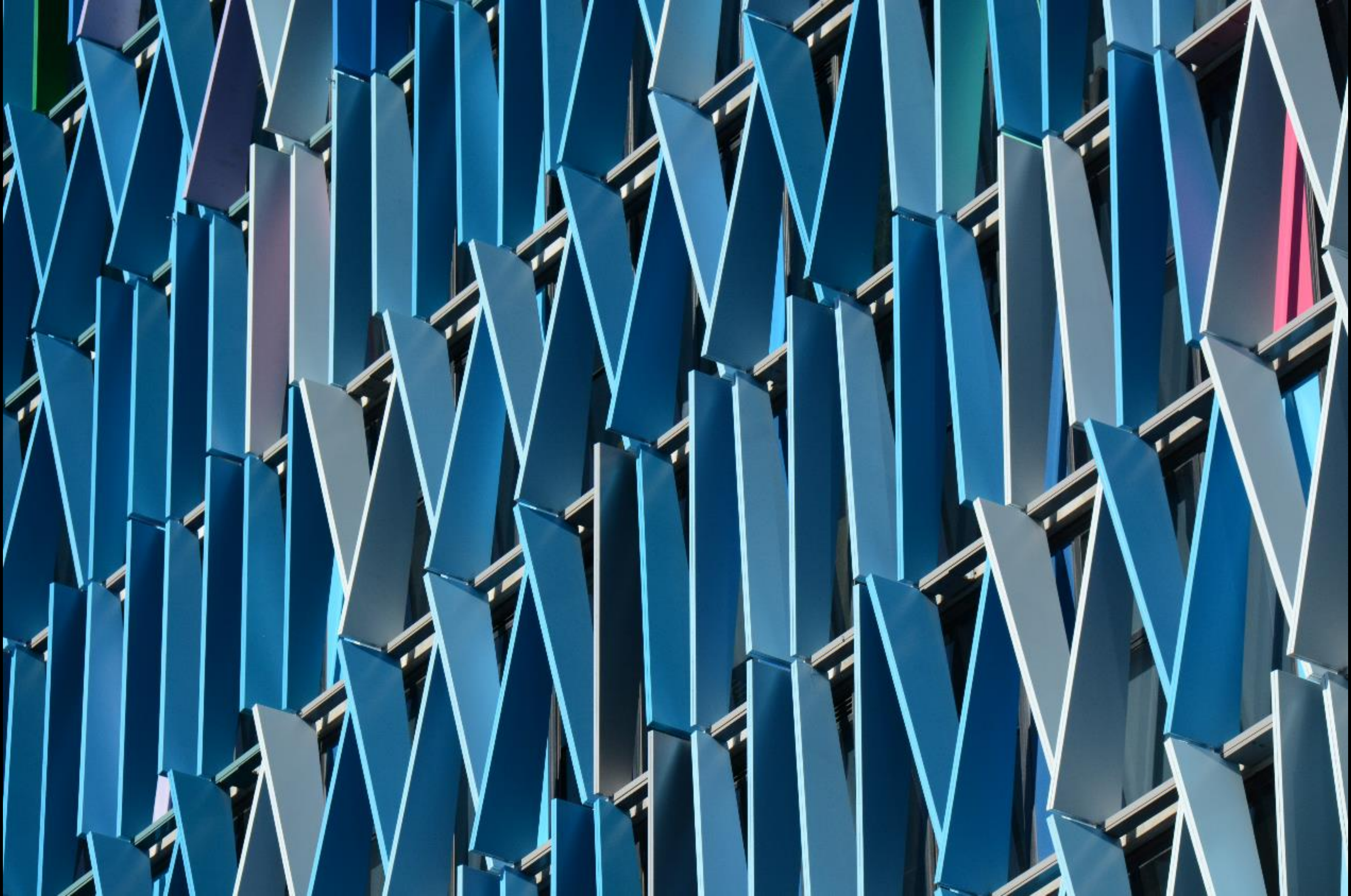
Various
Melbourne, Australia

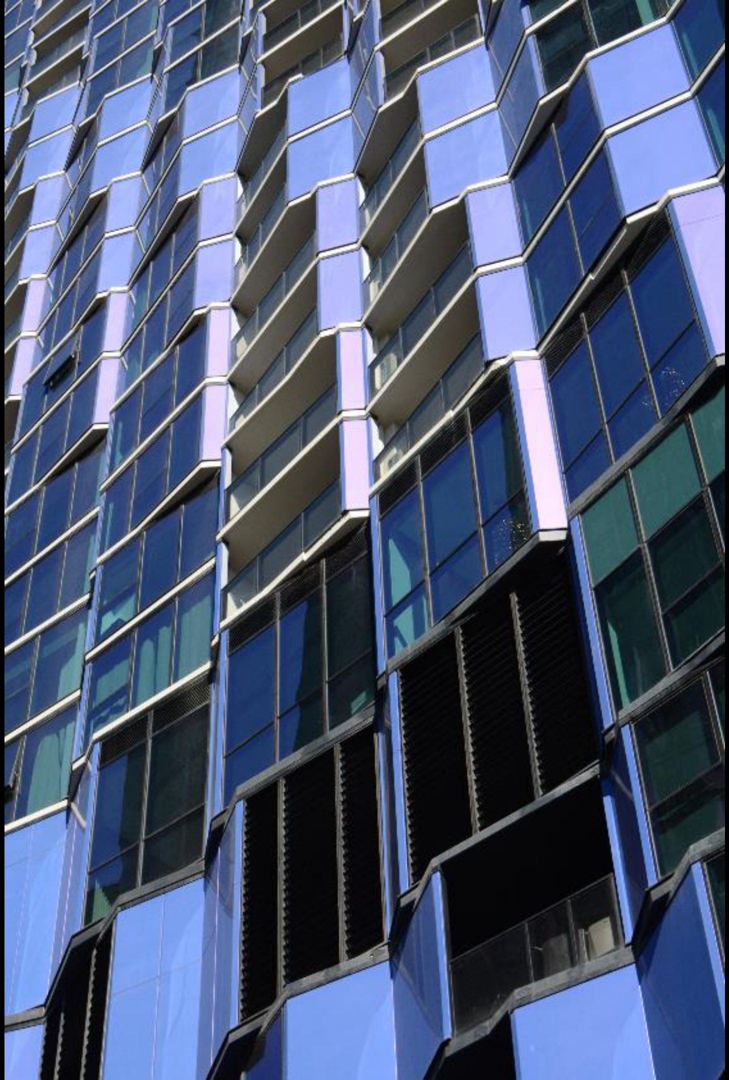



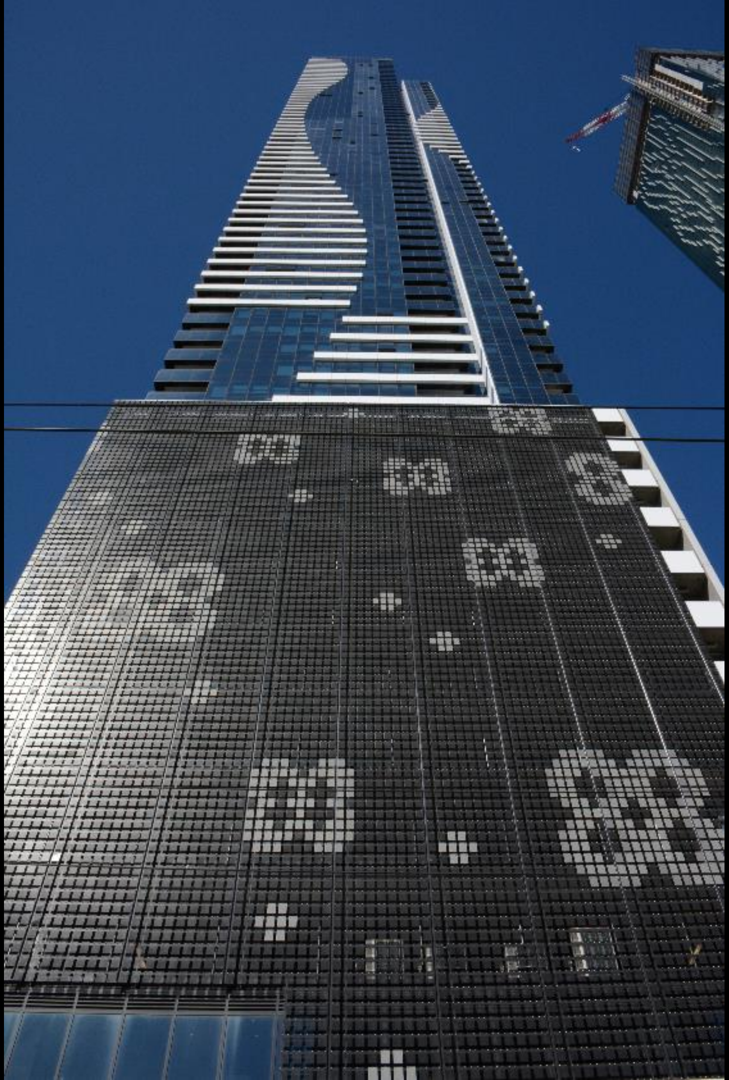


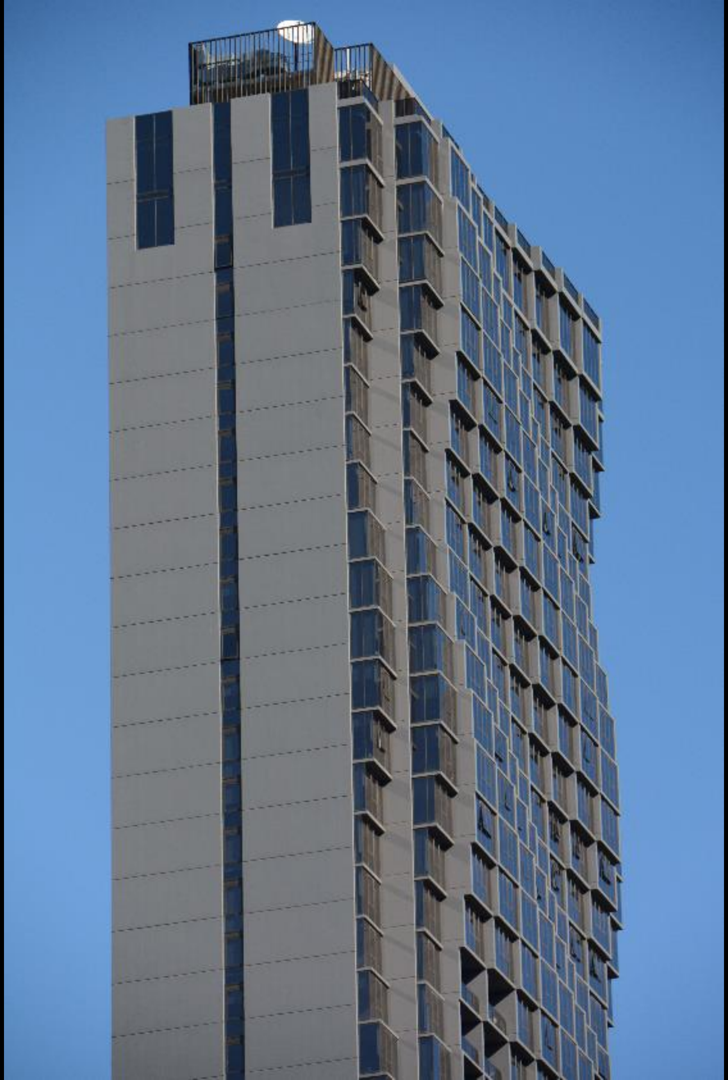
THE MELBOURNE





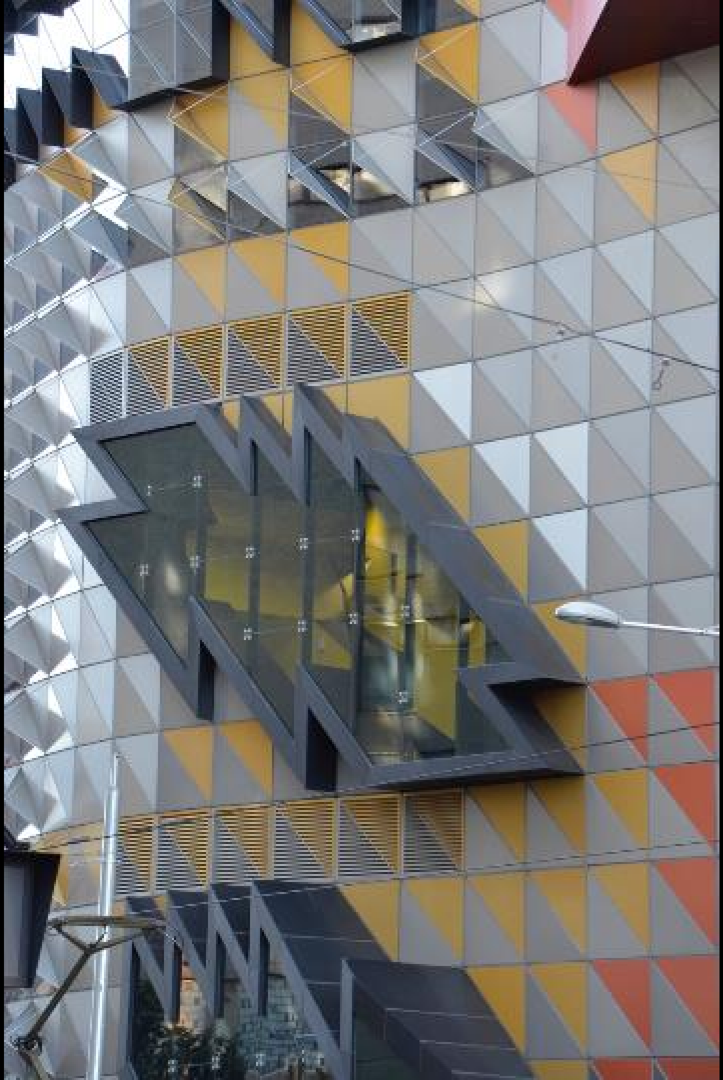










Royal Melbourne Institute of Technology
Accounting Building
Melbourne, Australia
Lyons Architects





RMIT

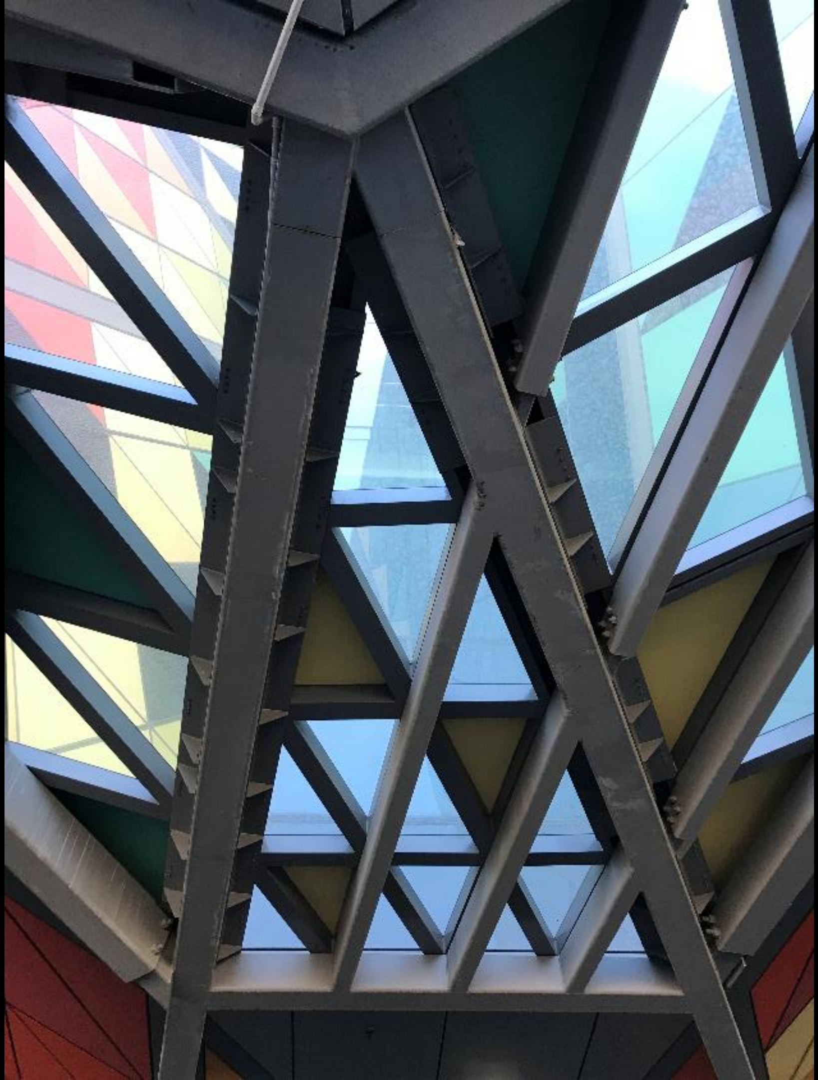
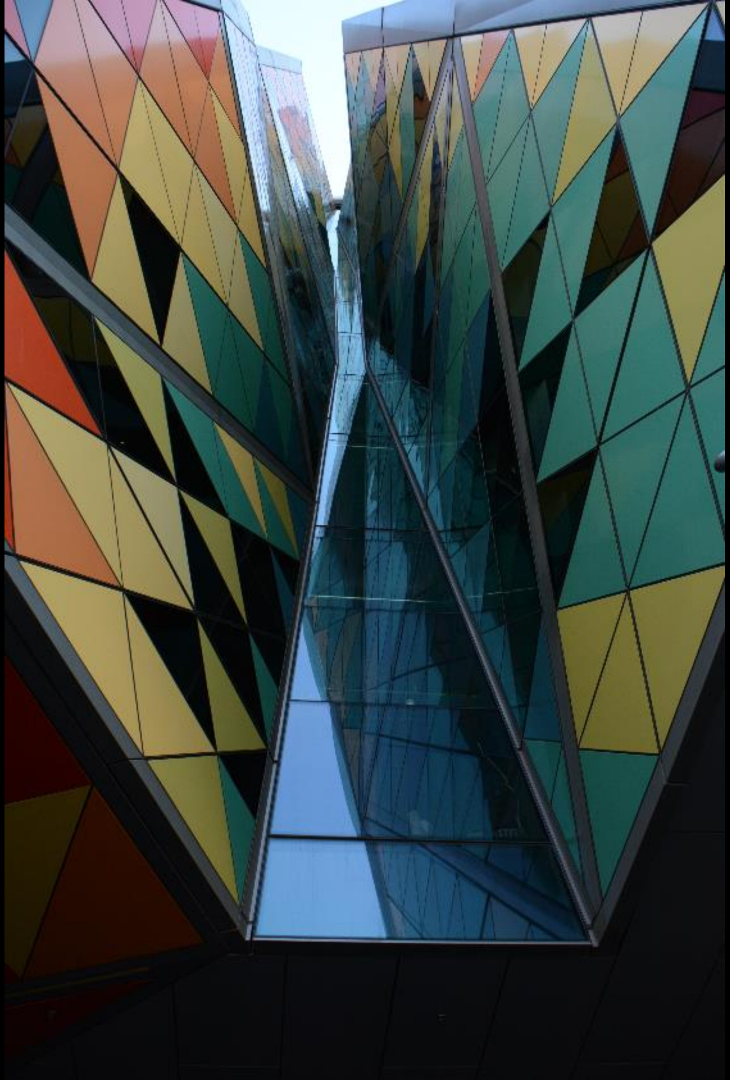

16


330 Swanston Street
330 Swanston Street

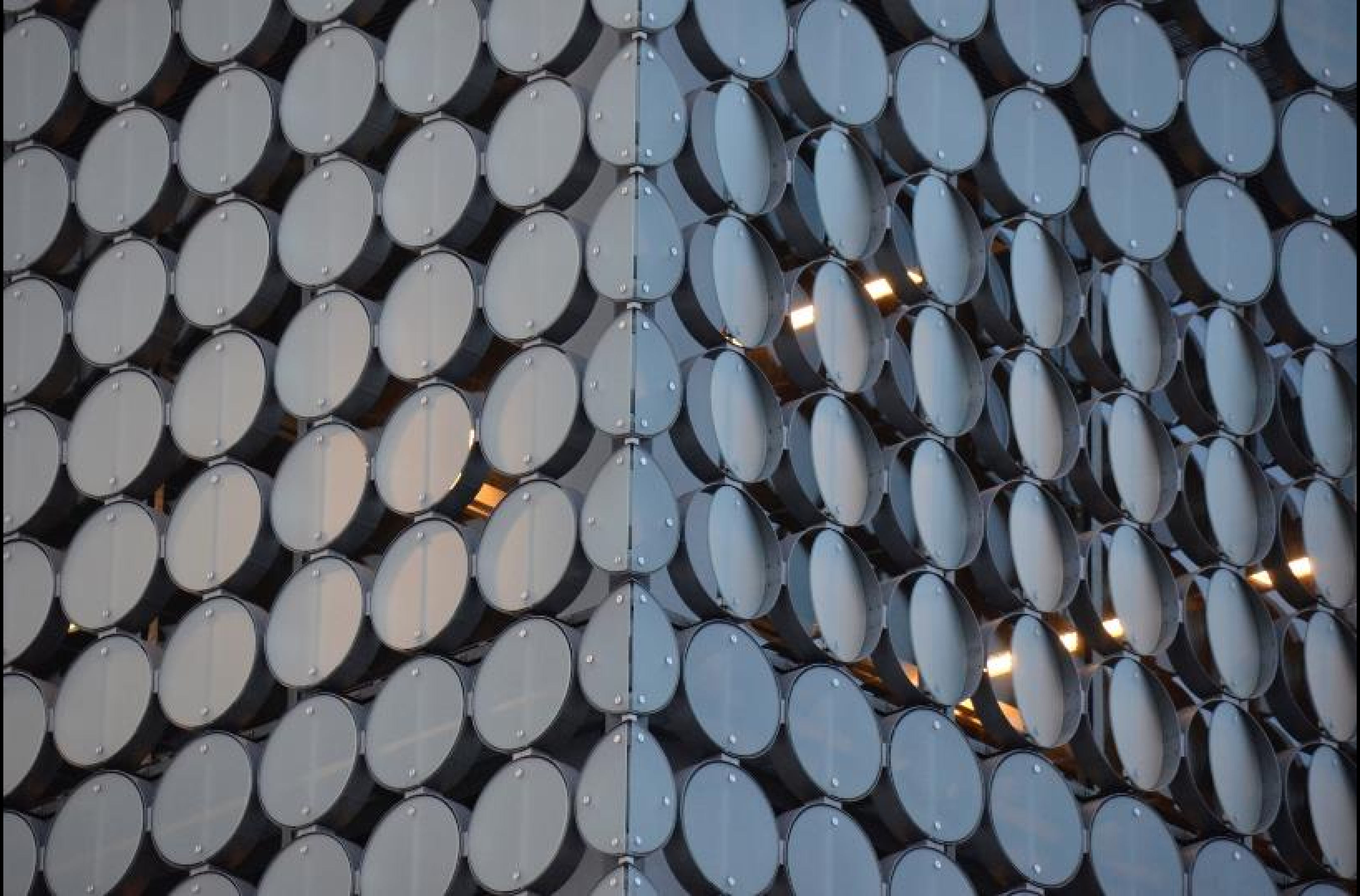

16

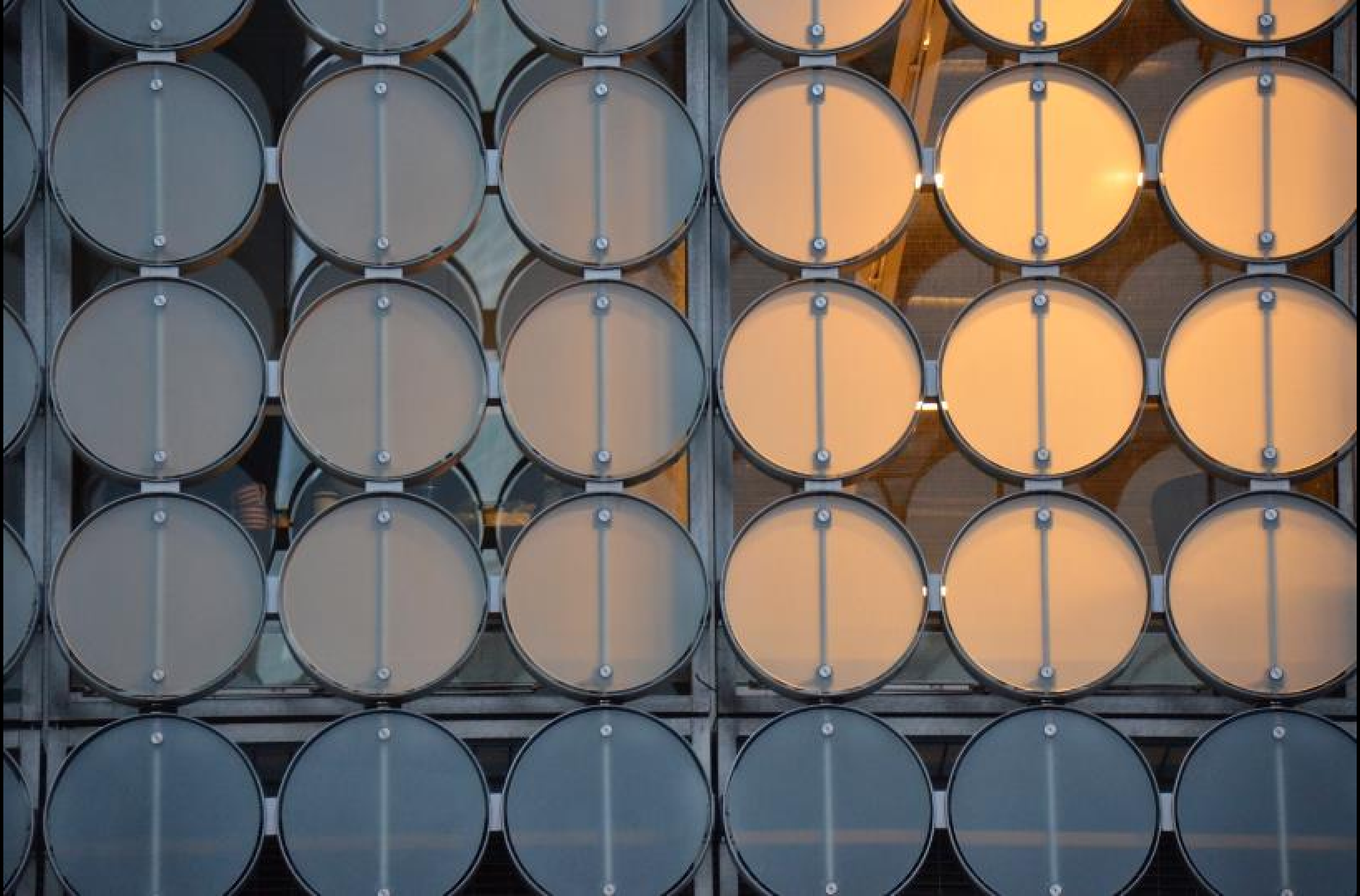
Pixel Building
Melbourne, Australia
Studio 505


CENTRAL
Cleaning Supplies
347 7044
OATES
CLEAN
4P

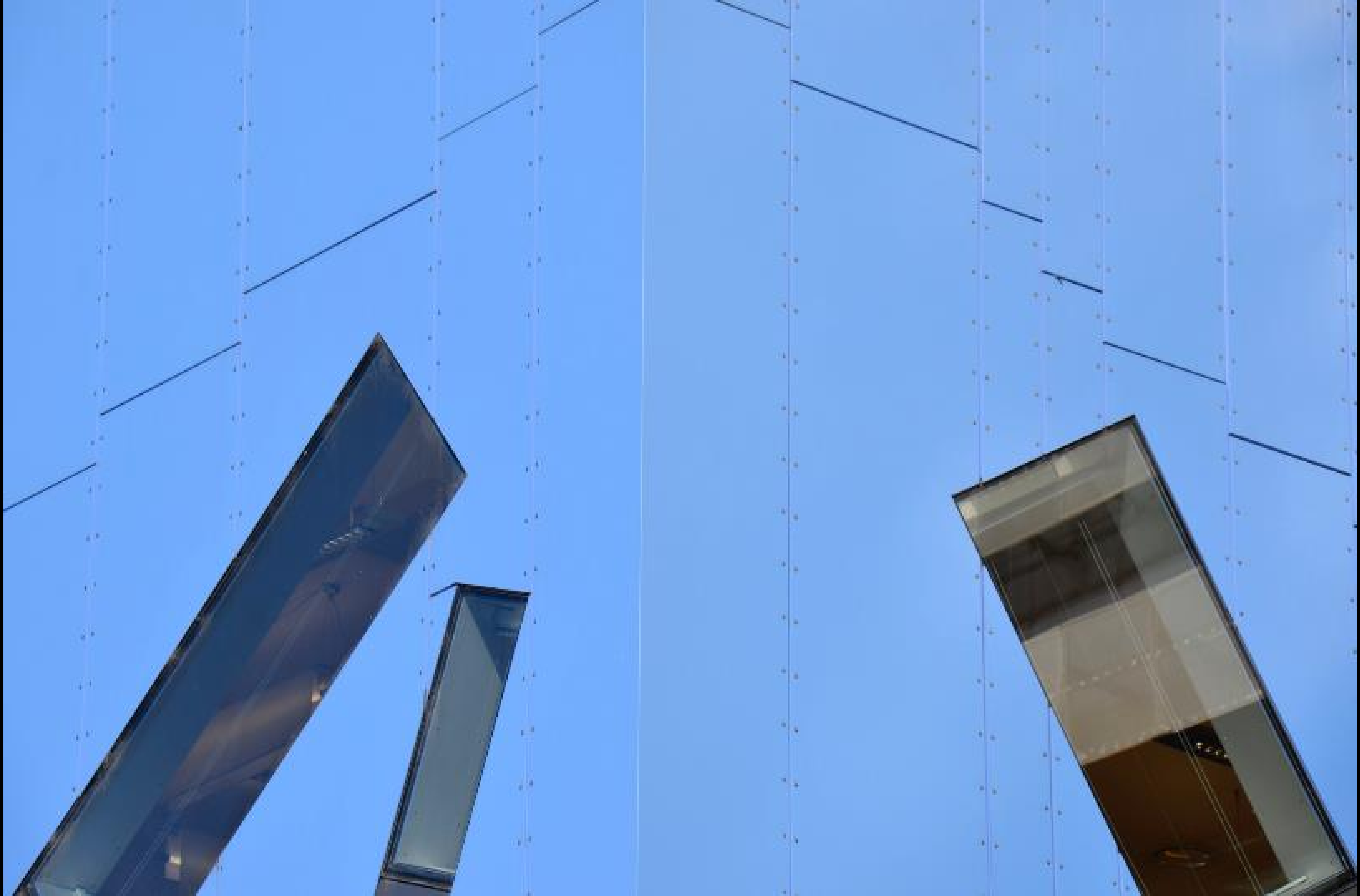
RMIT Design Hub
Melbourne, Australia
Peddle Thorp Architects





Various Projects
Brisbane, Australia


MAS SIVE
STO CK
CLEAR ANCE

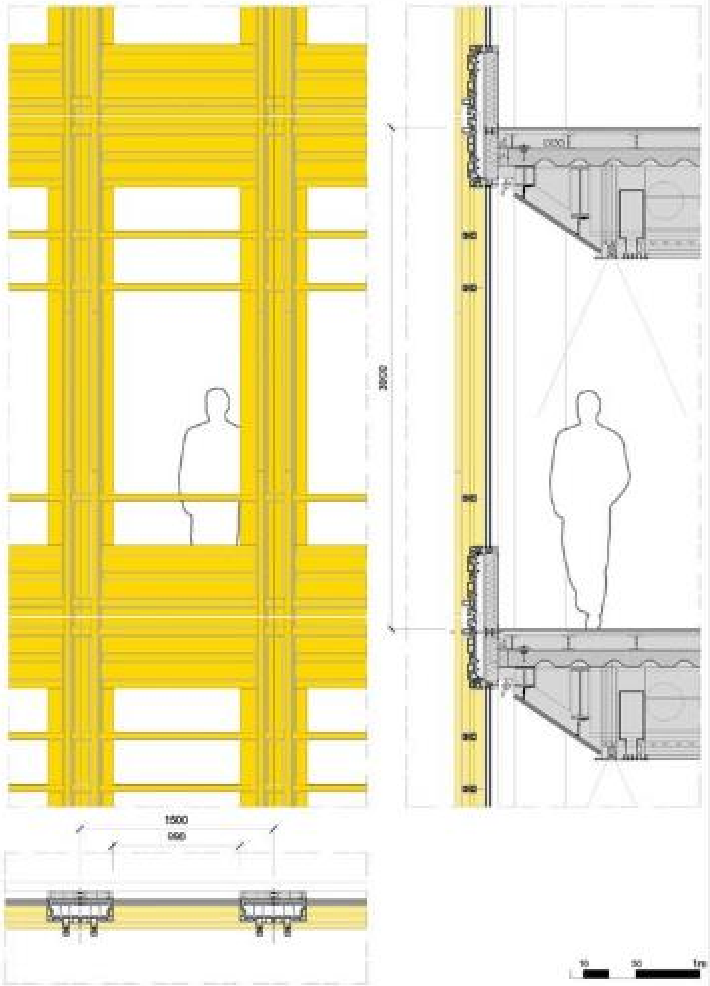


Stone Veneer Systems

Guangzhou Opera House
Guangzhou, China
Zaha Hadid Architects
2010


法国西餐厅

St. Giles Complex
London, England
Renzo Piano



St Giles - London
Type01 - Office Ceramic Facade

RPBW

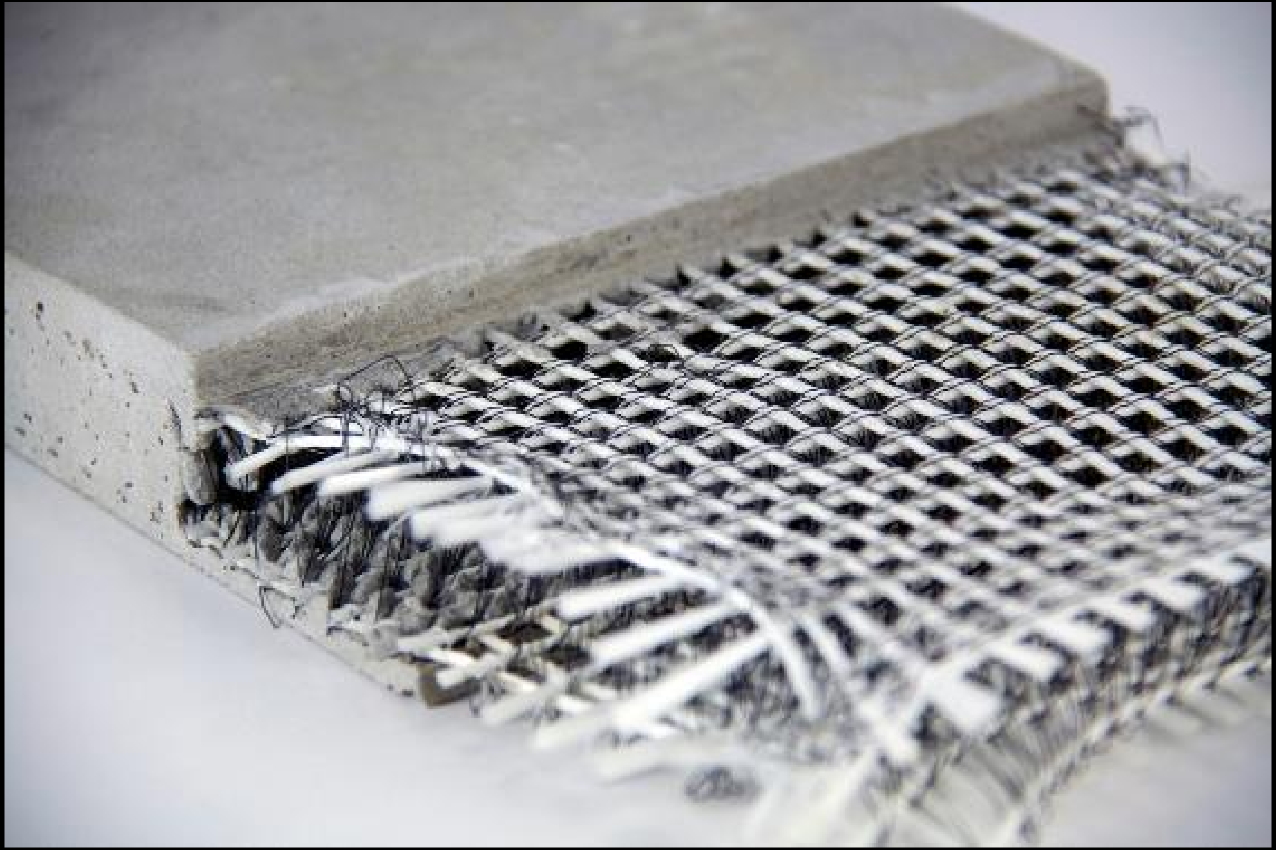
Fibre Reinforced Concrete

Fibre reinforced concrete is a type of concrete that includes fibrous substances that increase its structural strength and cohesion.

Fibre reinforced concrete has small distinct fibers that are homogeneously dispersed and oriented haphazardly.

Fibres used are steel fibers, synthetic fibres, glass fibres and natural fibres.


1 in. Crack
Opening



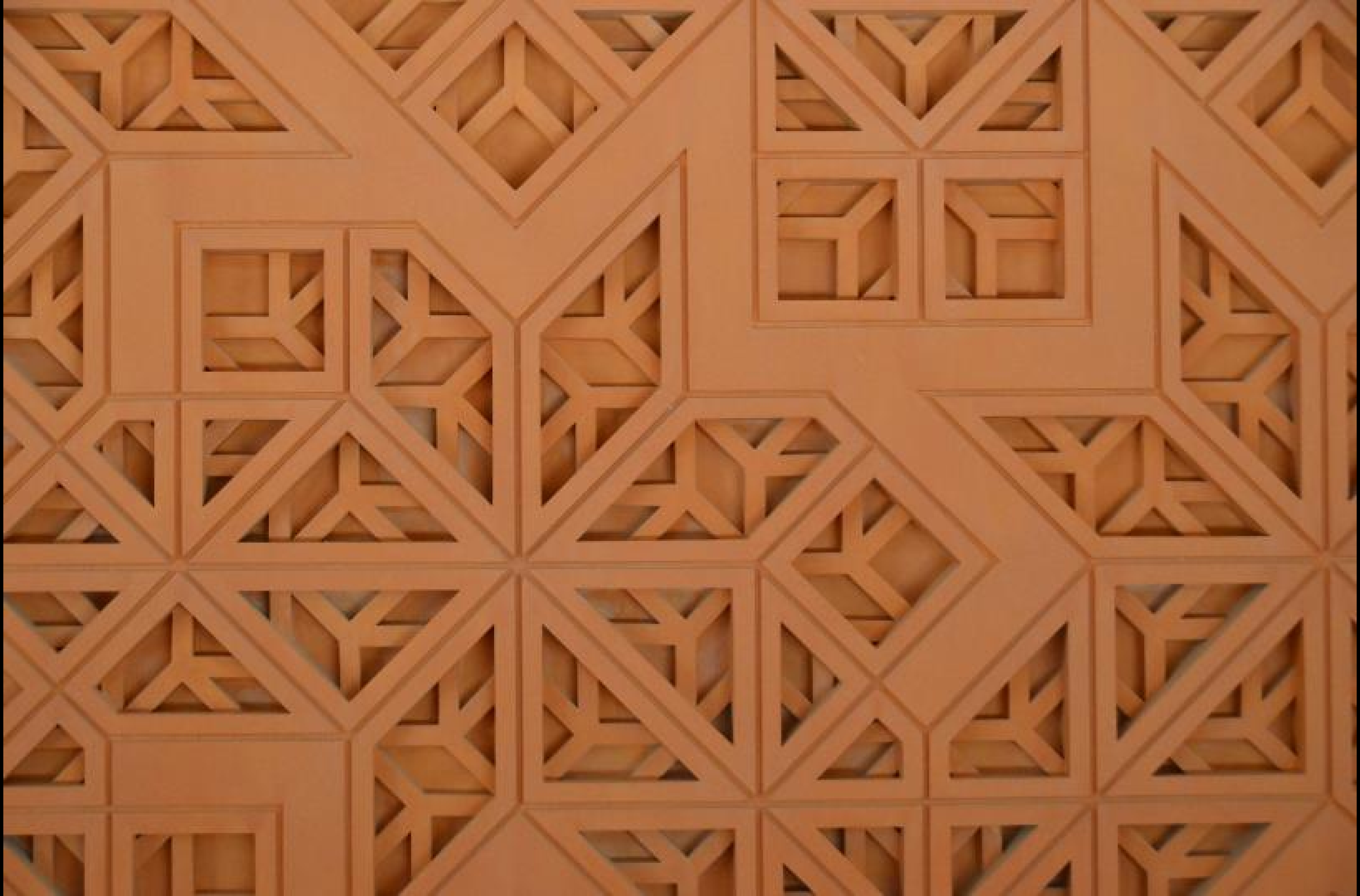

ROYAL ROSE


ROYAL ROSE

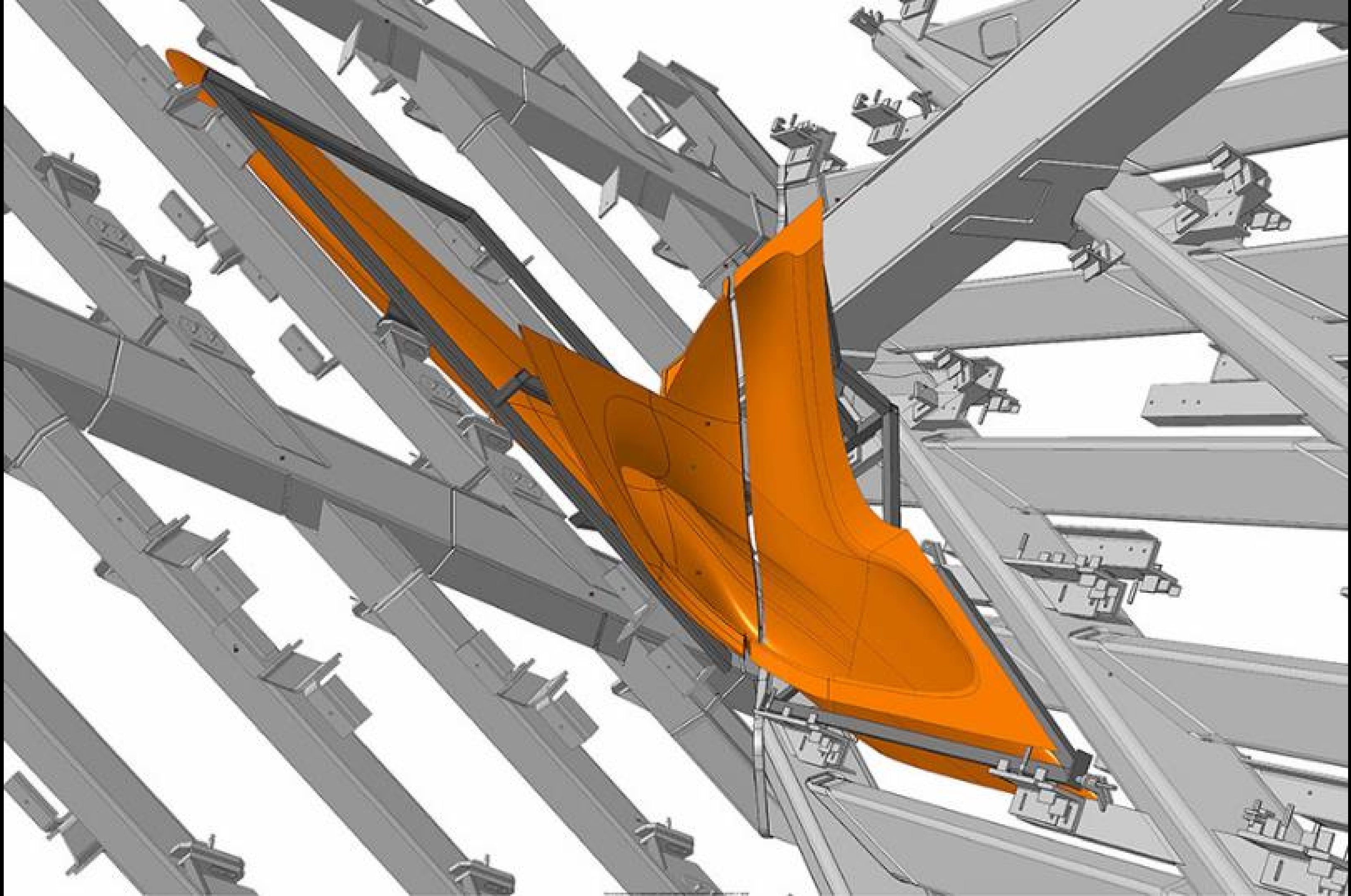
The FRP (fibre reinforced panels) are pretty thin, unlike precast concrete, and are often supported behind by a steel frame which is then attached to the building structure behind.


Academic Bridge Program
Education City
Doha, Qatar


Masdar Institute
Foster and Partners
Abu Dhabi, UAE
2010



The Broad Museum
Los Angeles, California
Diller Scofidi + Renfro
2015

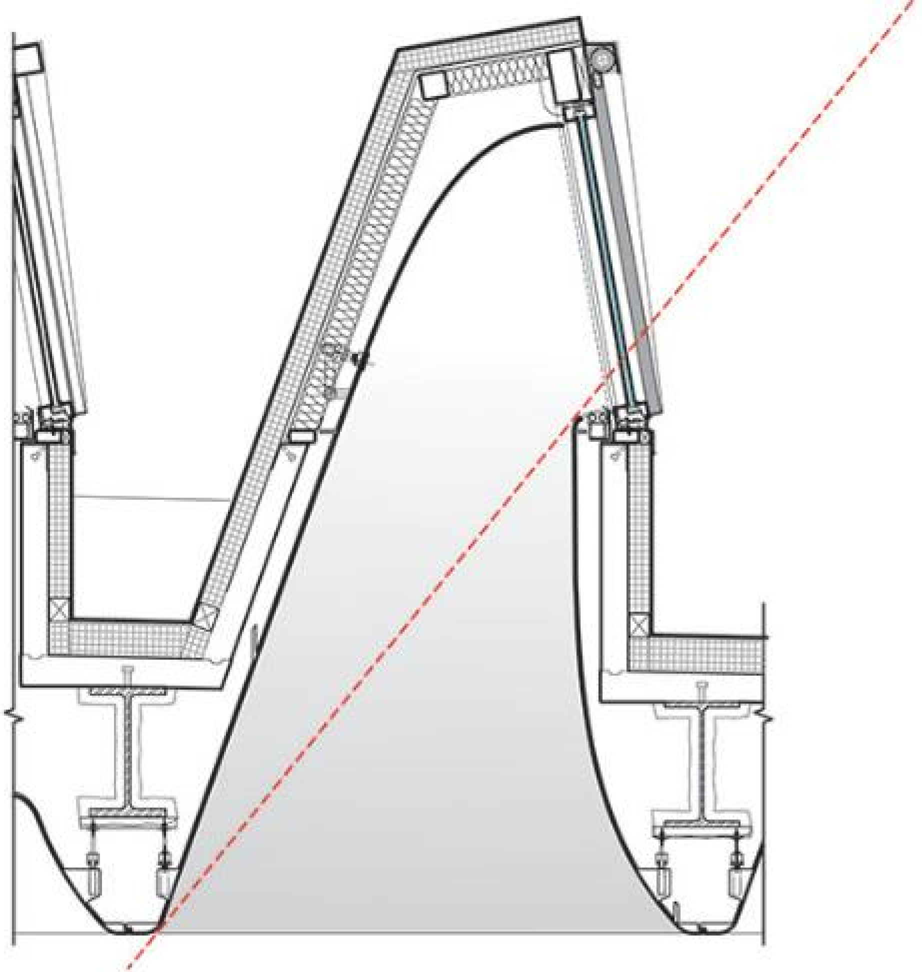



2012.10.08

Mr. Crane
THE BROAD

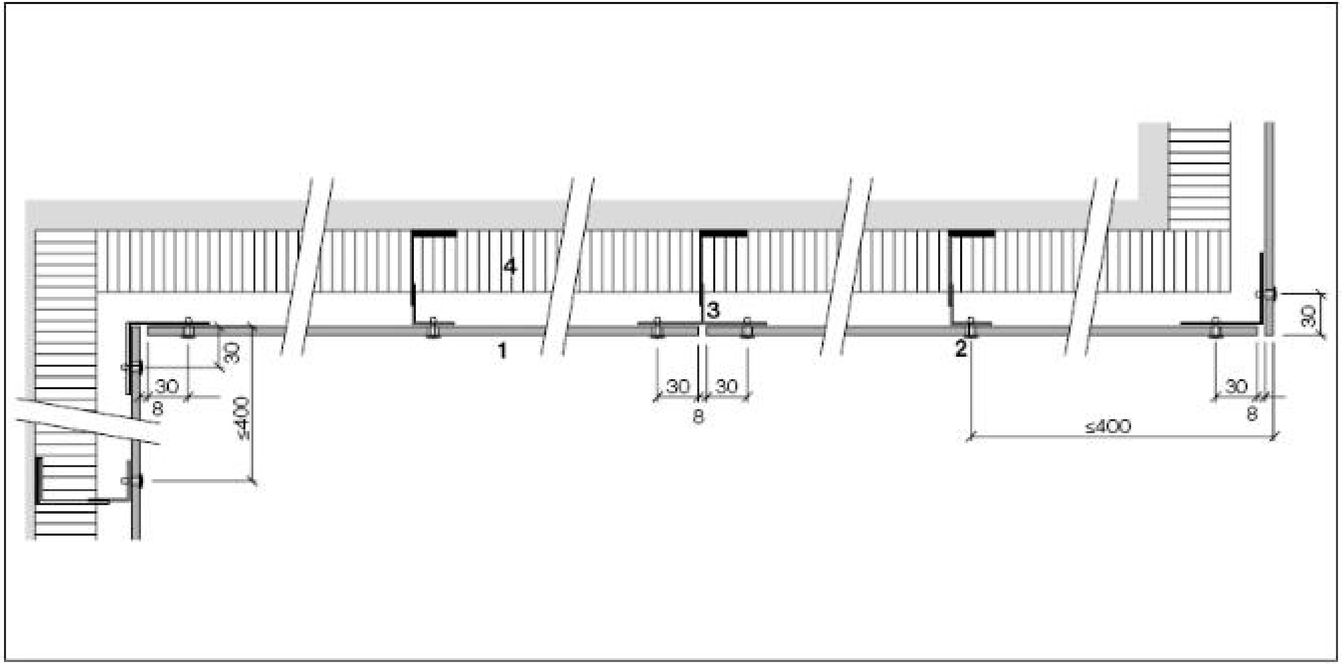

CalARTS
REDCAT


REDCAT
THE BROAD
Takashi Murakami
Mark Bradford
Cindy Sherman



Very thin FRP manufactured under
the name "Swiss Pearl"

Horizontal section

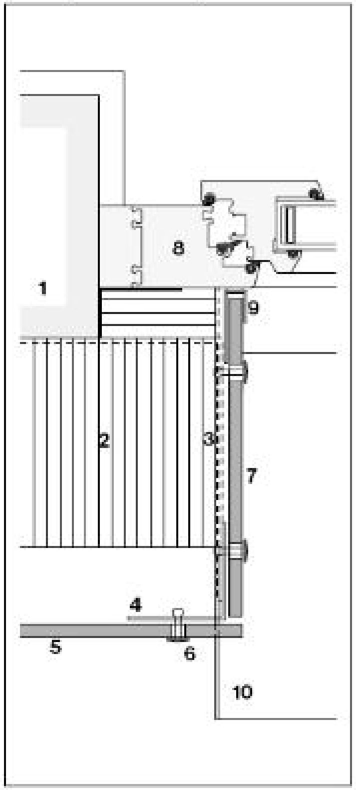


Panel may be cantilevered max. 400 mm.

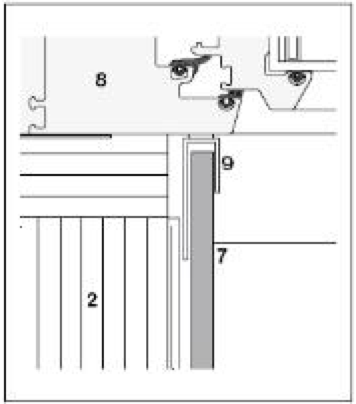
1 Swisspearl panel 8 mm
2 Rivet
3 Aluminum profile
4 Thermal insulation

Design | **Metal supports**

Example window jamb



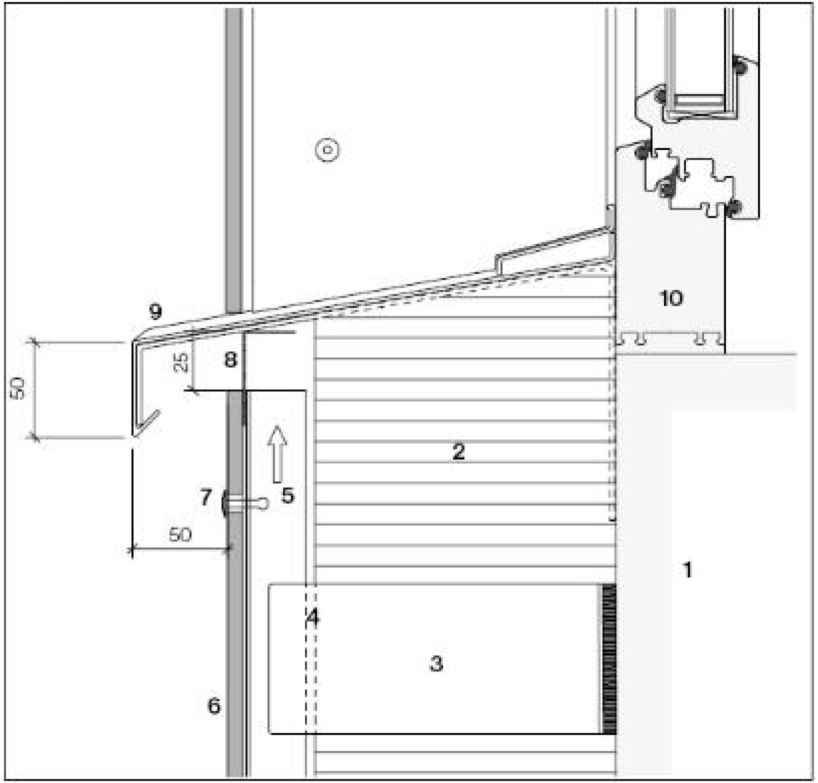
Jamb with 8 mm panel



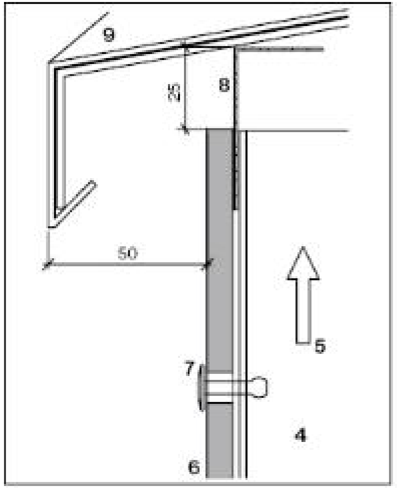
Window jamb with metal frame

1 Exterior wall
2 Thermal insulation
3 Horizontal support
4 Vertical support
5 Swisspearl panel 8 mm
6 Rivet 4.5x18 K15
7 Swisspearl jamb board 8 mm
8 Window frame
9 U or F-profile with sealant
10 Window sill

Example window sill



Window sill made of metal



Sill detail

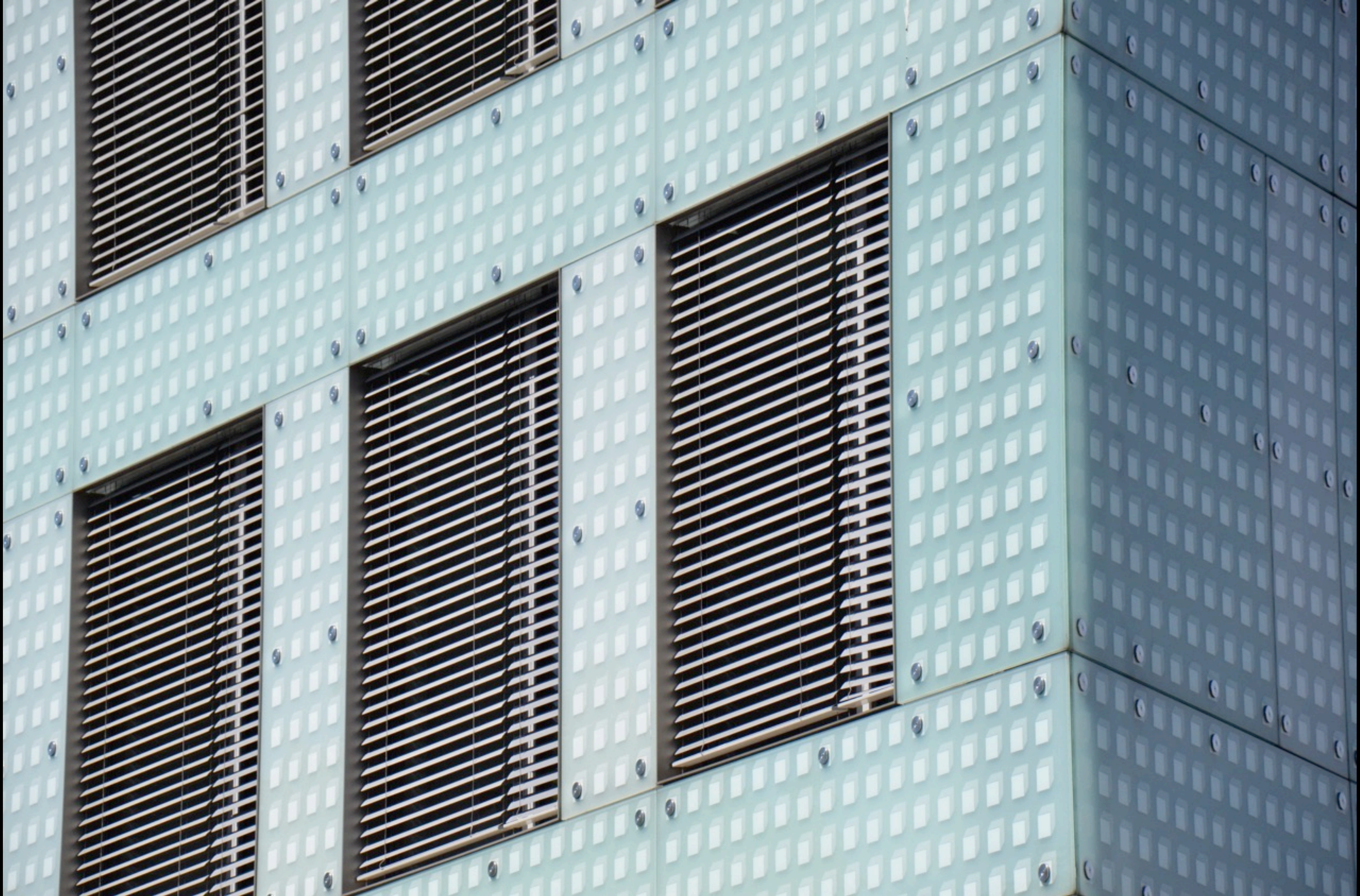
1 Exterior wall
2 Thermal insulation
3 Bracket
4 Vertical support
5 Ventilation cavity
6 Swisspearl panel 8 mm
7 Rivet 4.0×18-K15
8 Perforated angle
9 Window sill
10 Window frame

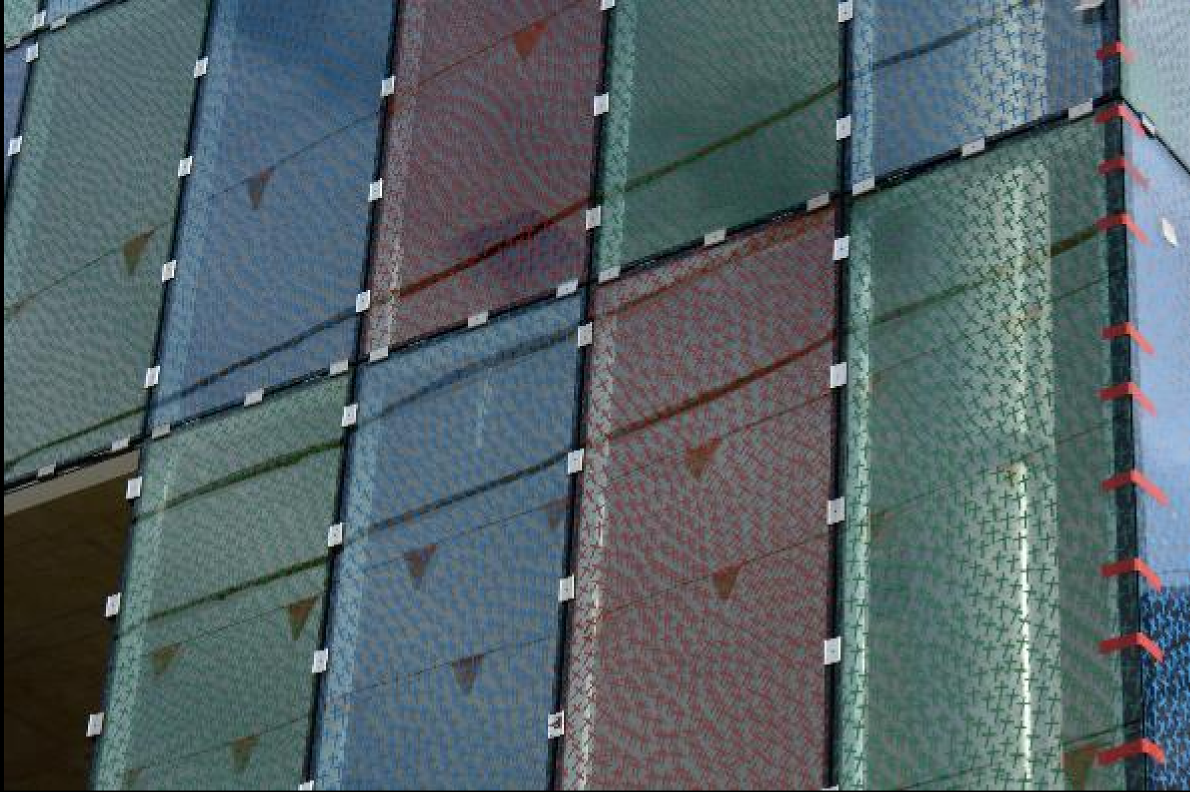
Ceramic Fritted Glass

Ceramic Fritted Glass:

- Silk screening onto glass improves solar control performance
- Can be combined with clear or tinted substrates
- Reduces glare
- Can be any pattern (cost dependent)

Chicago O'Hare International Airport





One New Change Shopping Centre
London, England
Ateliers Jean Nouvel


London Bridge
beauty
next

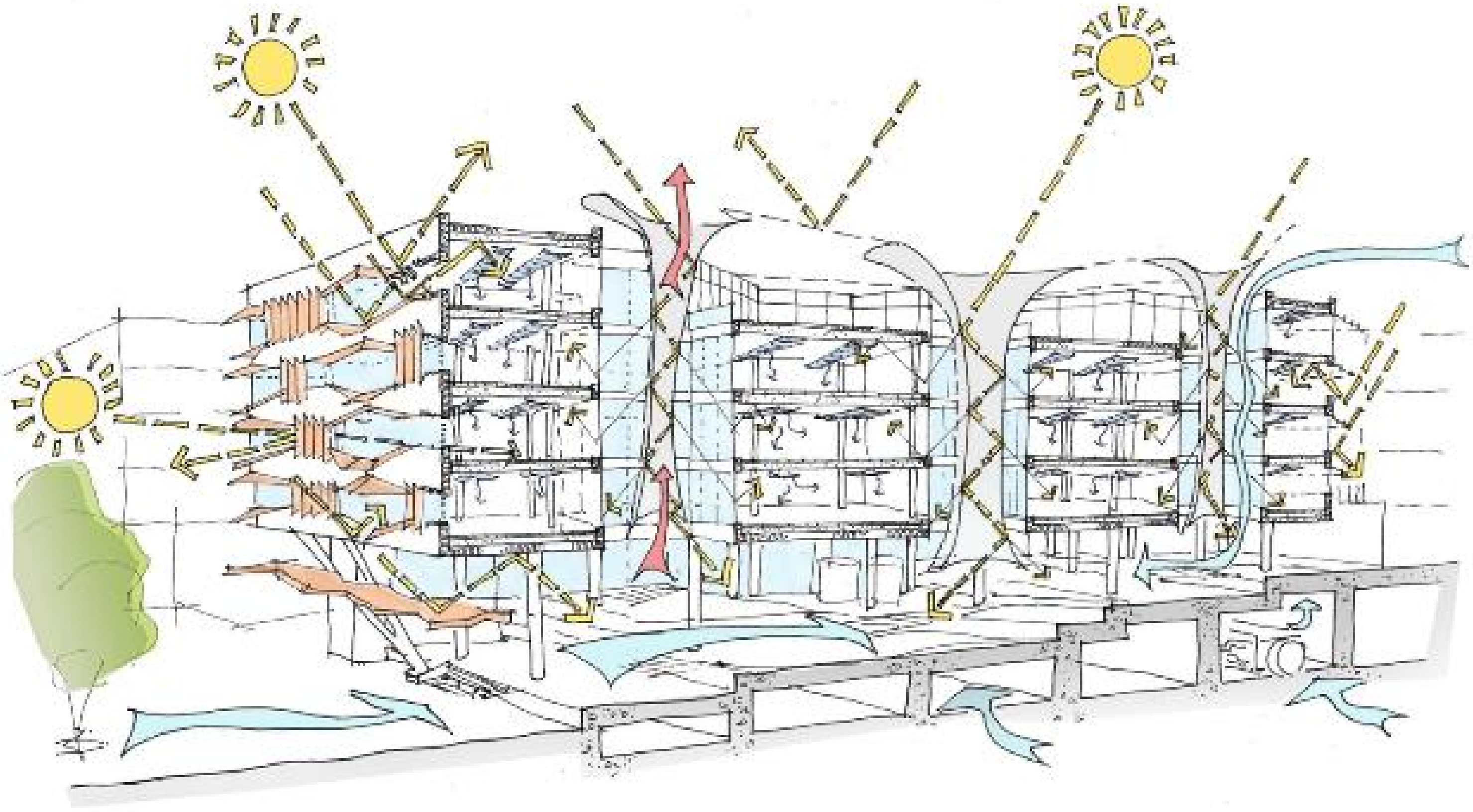

K&L GATES

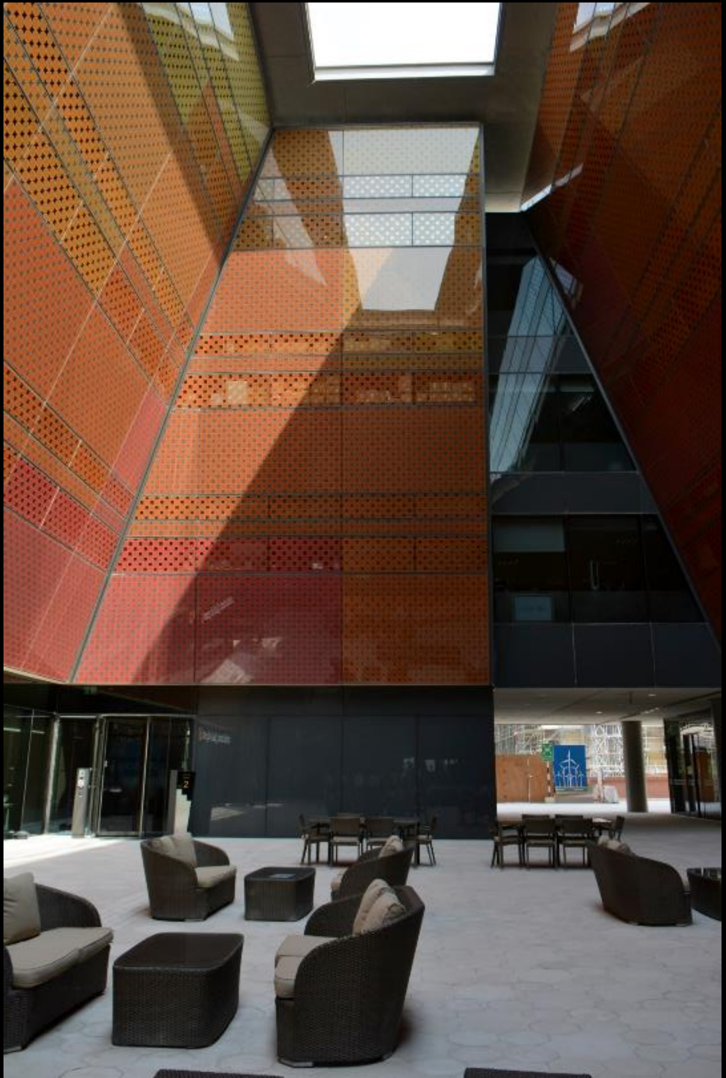

WATLING
STREET EC4
K&L GATES


WATLING
STREET EC4

Office Building
Brisbane, Australia

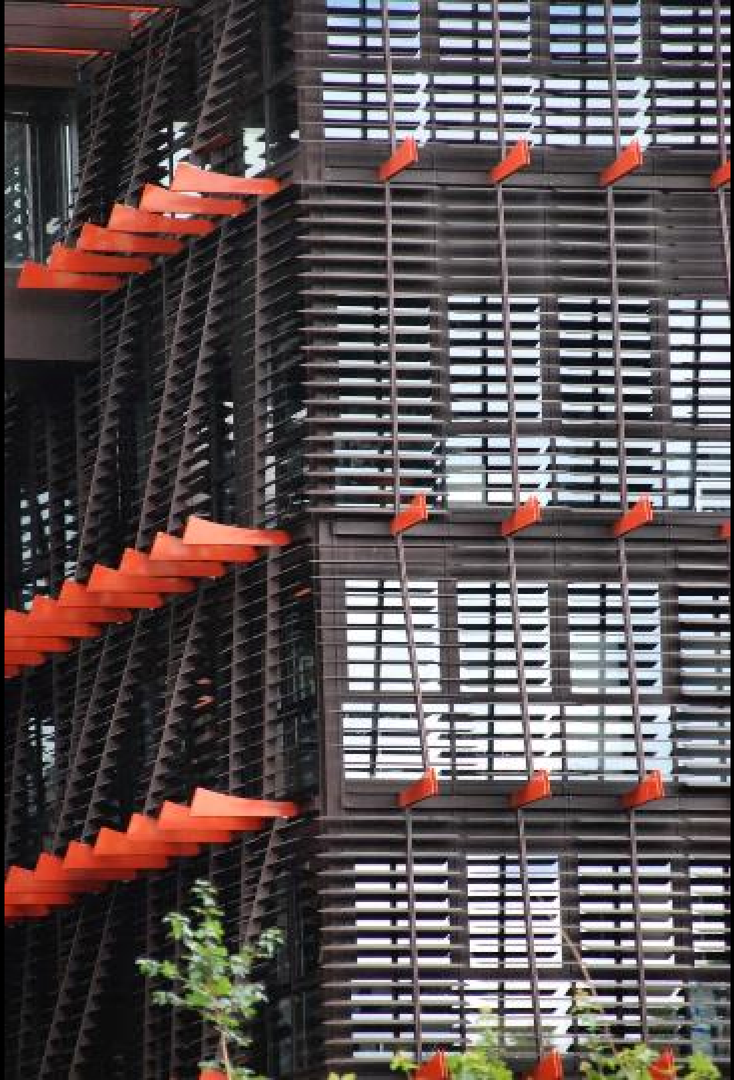
Siemens HQ
Masdar City, Abu Dhabi, UAE
Sheppard Robson Architects
2013

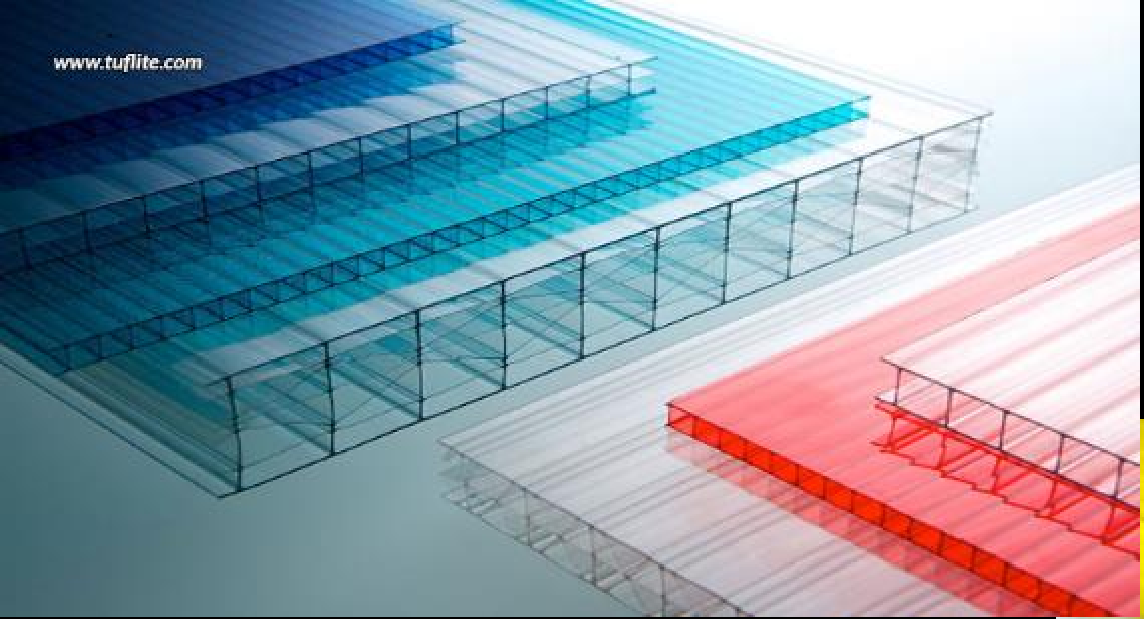




The Branley Museum
Paris, France
Ateliers Jean Nouvel

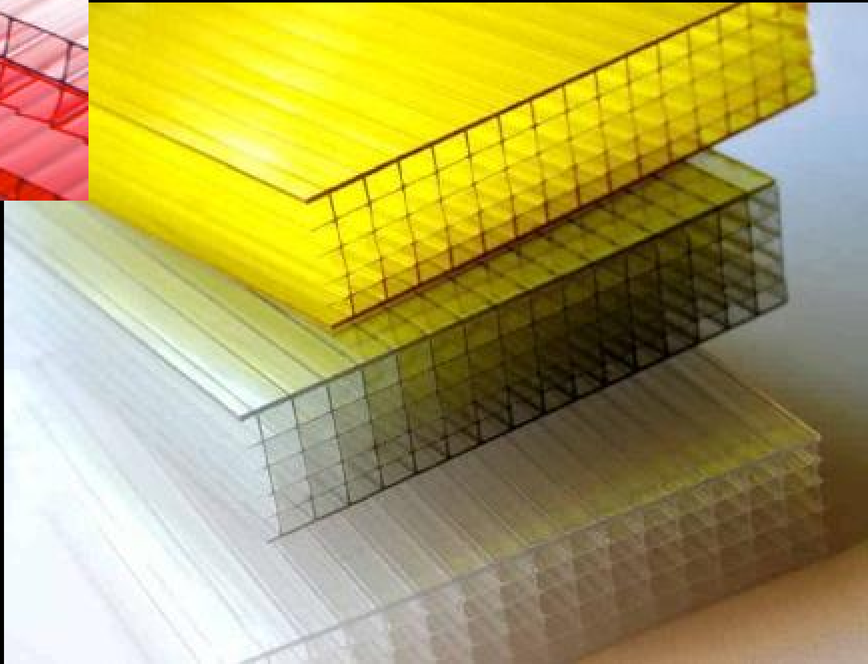

Billetterie

Polycarbonate Panels

https://danpal.com/polycarbonate-panels/



Trinity Laban Dance Centre
London, England
Herzog & deMeuron

ETFE

Ethylene tetrafluoroethylene (ETFE) is a fluorine-based plastic. It was designed to have high corrosion resistance and strength over a wide temperature range. ... ETFE has a relatively high melting temperature and excellent chemical, electrical and high-energy radiation resistance properties.

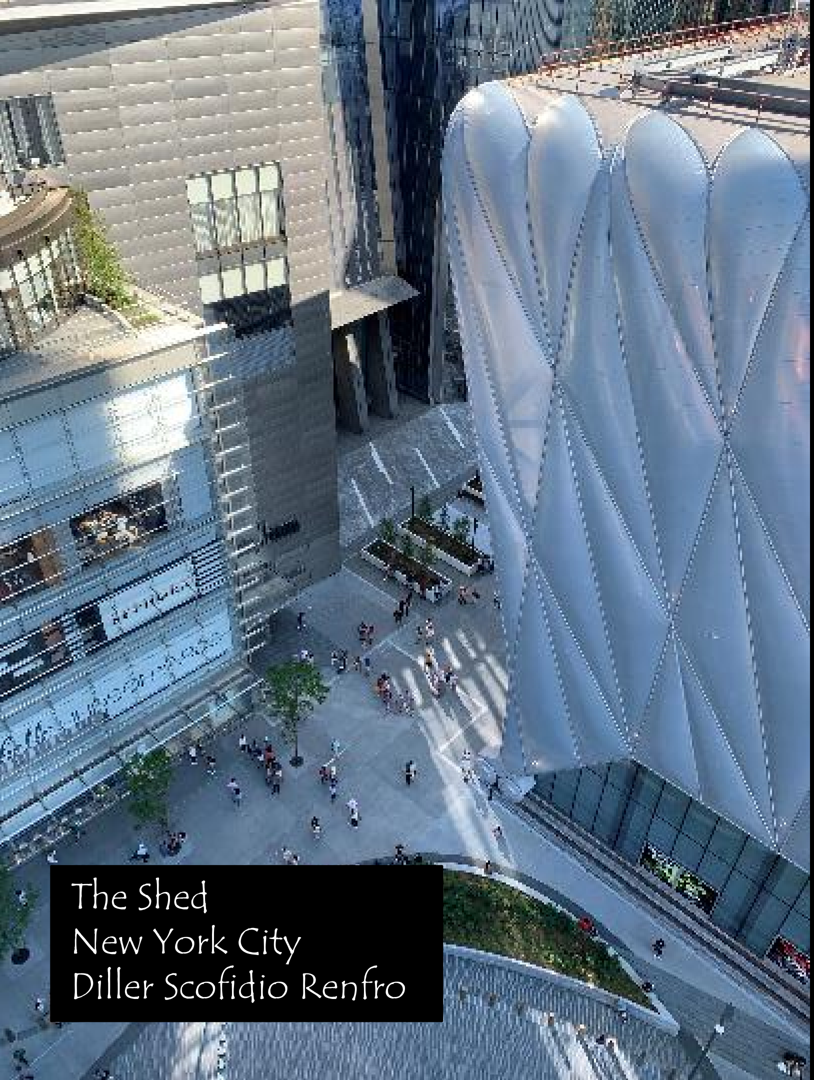
The Water Cube
2008 Beijing Olympics


Eden Project
St. Austell,England
Nicholas Grimshaw

Japan National Pavilion
Shanghai Expo 2010

Parkview Green
Beijing, China

Allianz Arena
Munich, Germany

The Shed
New York City
Diller Scofidio Renfro

Generally the façade has evolved towards systems that are:

- Durable
- Lighter – so less mass, weight on foundations, carbon
- Higher R-values
- Made of multiple layers
- Using a rain screen/drainage plane
- External to the structural system to keep the structure at a constant temperature