
Practical tips for façade design

Agnes Koltay

Helsinki
13th JUNE 2023

• Koltay •
FAÇADES

DUBAI

SINGAPORE

SCOPE



FAÇADE ENGINEERING

- Independent technical advice
- Façade consultancy services
- Technical analysis and review
- Material review and selection
- Site supervision and construction services
- Parametric analysis
- Third party engineering and design review
- Value engineering analysis and alternative



FAÇADE ACCESS CONSULTANCY

- Project coordination with structures, MEP
- System design and integration
- Technical analysis and review
- Loading and engineering calculation
- Cleaning cycle calculation
- Specifications for equipment and manual access

Specialist Façade Engineering Consultancy

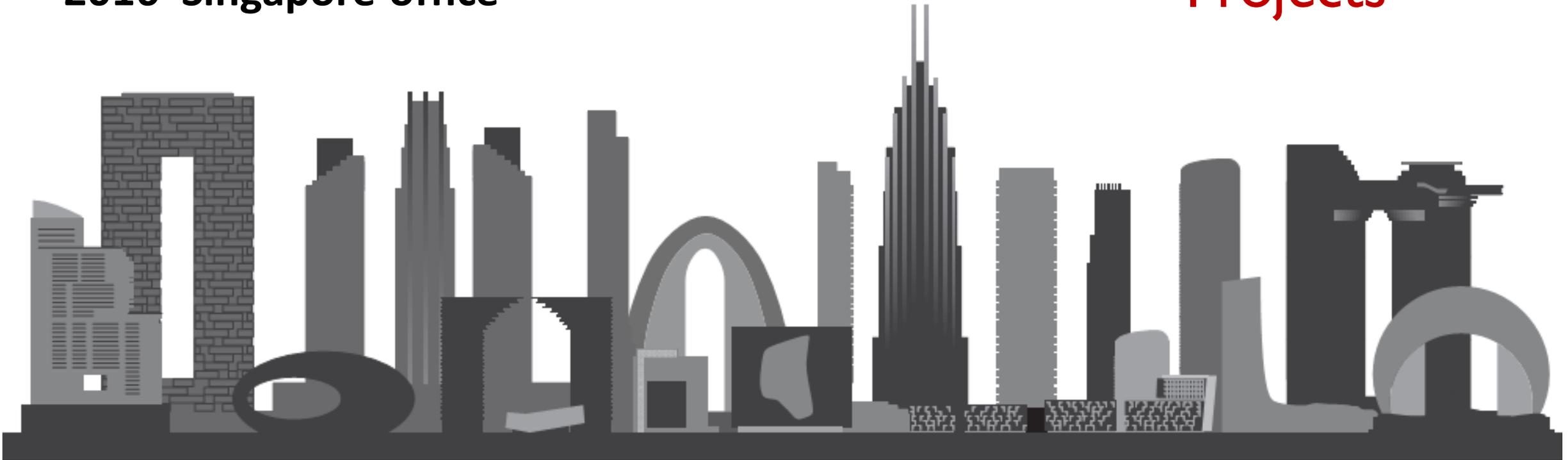


2011 Dubai office

2014 London satellite

2016 Singapore office

**142 +
Projects**

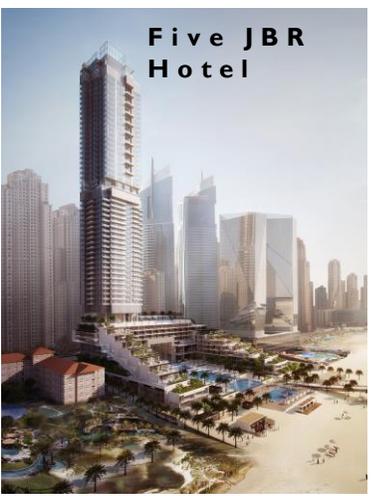




Koltay Façades Project Map



Address Boulevard
KF
High-rise
Projects
Selection



Five JBR
Hotel



A LA CARTE,
Vietnam



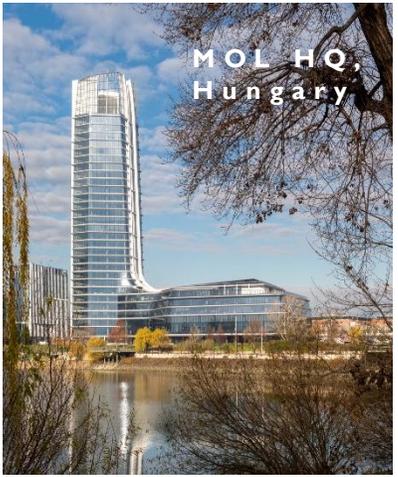
Fountain Views



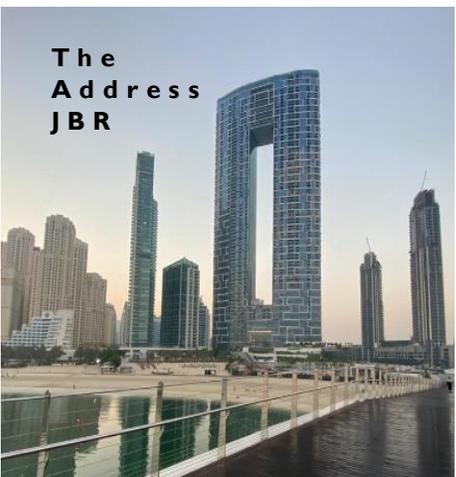
Sky View



St. Regis
Residences



MOL HQ,
Hungary



The
Address
JBR



Vida
Residence



Al Bandar Rotana



The Opus



Vida
Za'abeel



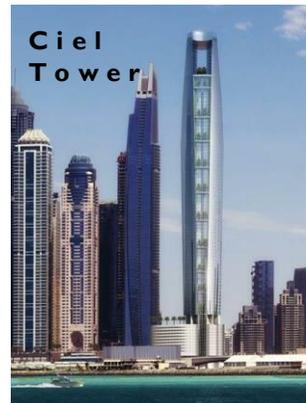
Imperial
Avenue



Snow
Tower



FIVE
JVC



Ciel
Tower



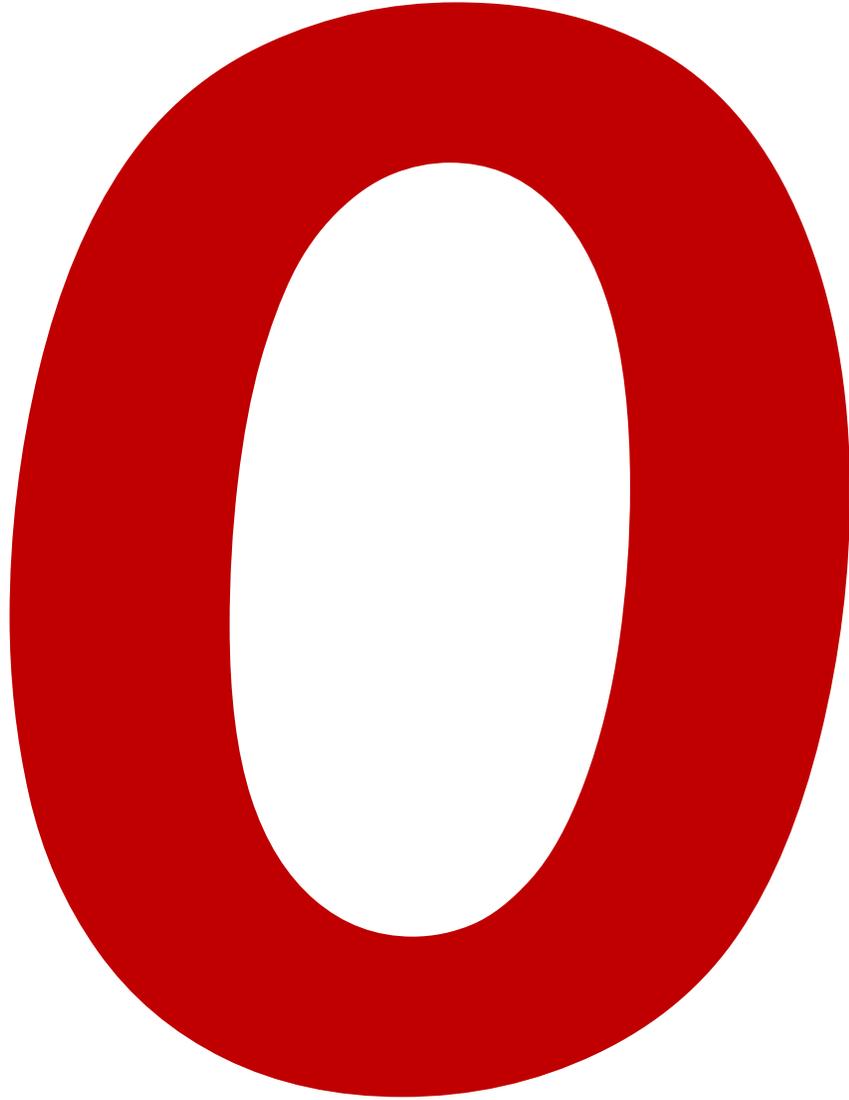
Dubai Creek Residence

SKY SLIDE

DUBAI, UAE



· Koltay ·
FAÇADES



Employ a Façade Consultant

Why to employ a Façade Consultant?

ARCHITECT:

- High-rise buildings tend to be complex, multifunctional buildings
- Short design period, no time for long research

Façade engineer is a concentrated source of related knowledge

SYSTEM SUPPLIER:

- Given product range, interest to sell
- Glass, stone, interfaces are not in scope, only framing
- No interdisciplinary coordination

Façade engineer is independent adviser

FAÇADE CONTRACTOR:

- Interest in low cost
- Interest in fast progress
- Possibility to increase contract value via variation claims

The façade engineer represents the Owner's interest for suitable quality and optimal solutions

- 0 - Why to employ a façade engineer
- 1 – System selection
- 2 – Wind Tunnel Testing
- 3 - Building movements
- 4 – Practicality of bent geometry
- 5 – Technological limits
- 6 - Façade Access Strategy impact
- 7 - Specification hints
- 8 – Façade testing
- 9 – Site inspection tips

1

System Selection

HIGH-RISE CONSIDERATIONS

Design:

- Quantity → Custom designed
- Optimization – laminated safety glazing? , acoustic glazing?, wind load?, mullion size? – cost control
- Quality – prefab advantages, controlled environment, process control, accesability

Manufacturing:

- Quantity → Repetitiveness
- Number of dies, templates, folds, cuts
- Modulation – standard sizes – material wastage - transportation

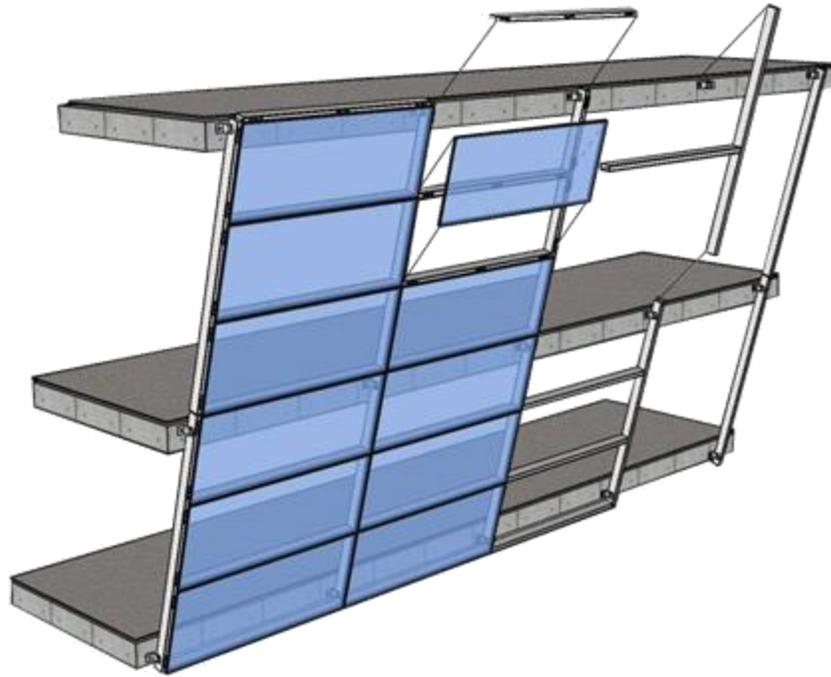
Site:

- External access: no scaffolding
- Hoist restrictions, crane time schedule
- Logistics of custom shapes
- Weight for maneuverability

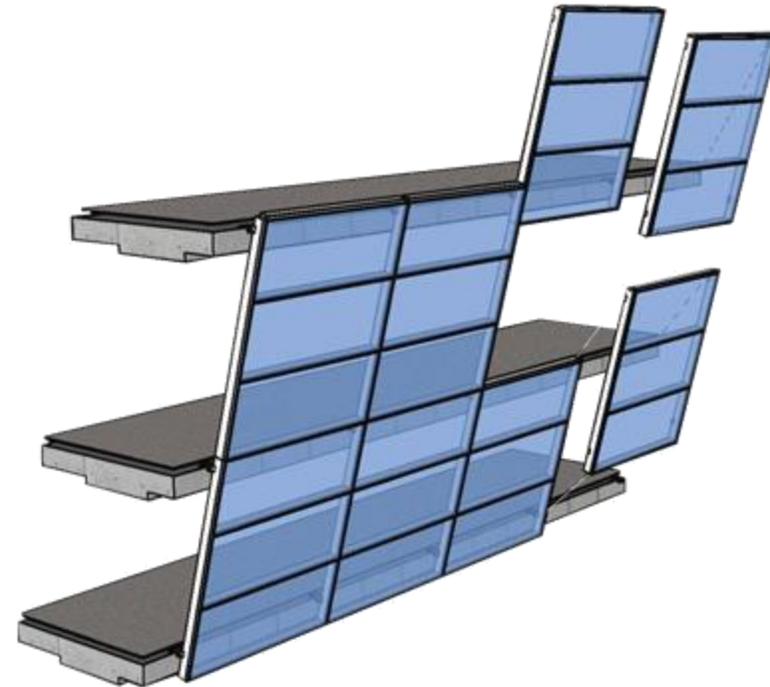


FAÇADE SYSTEMS:

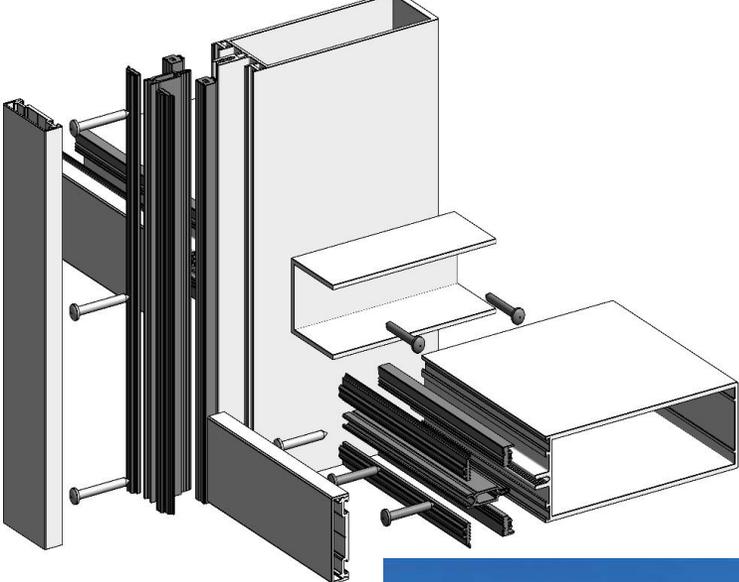
STICK SYSTEM



UNITIZED SYSTEM

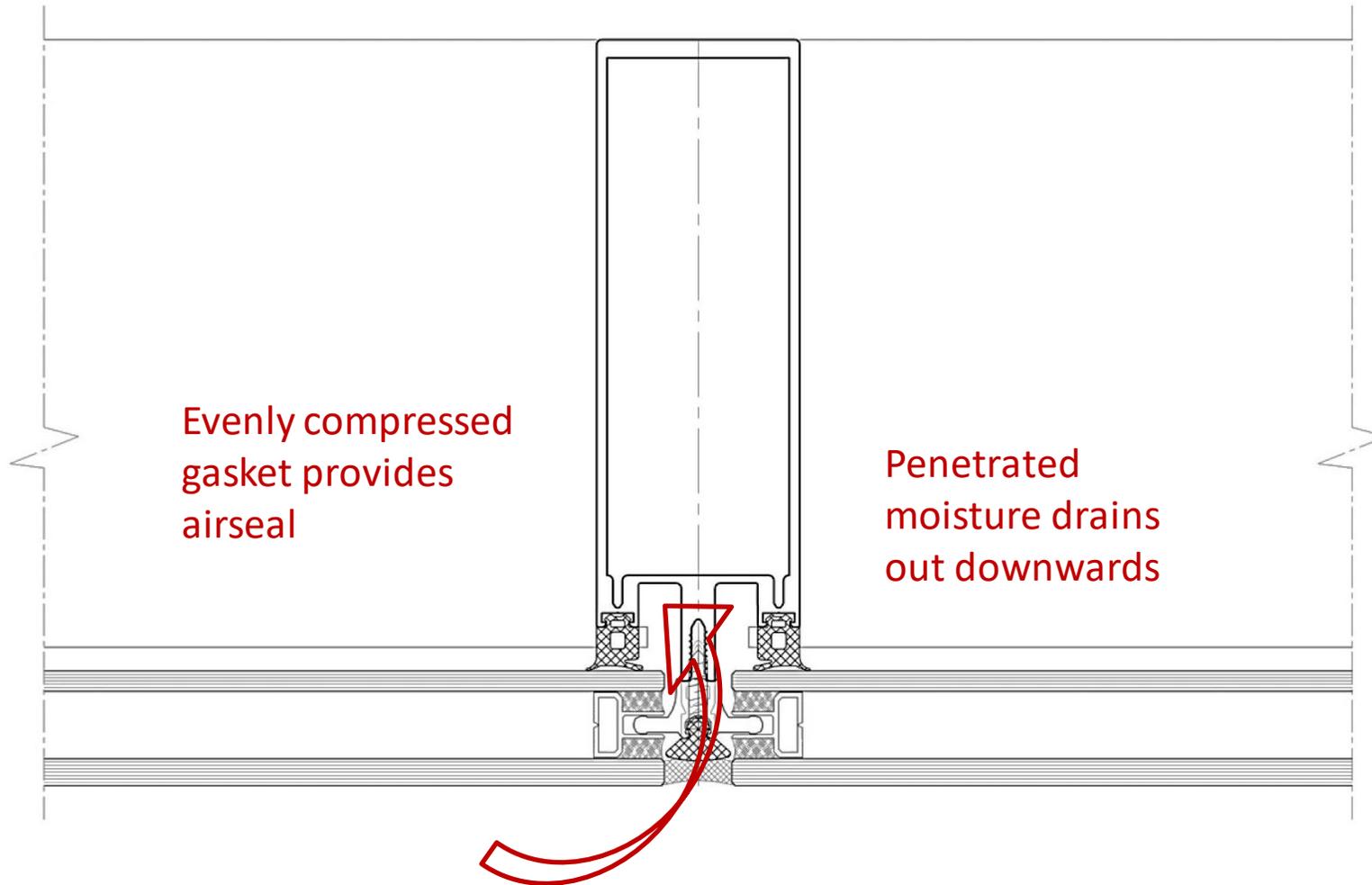


STICK SYSTEM:





STICK SYSTEM CURTAIN WALL

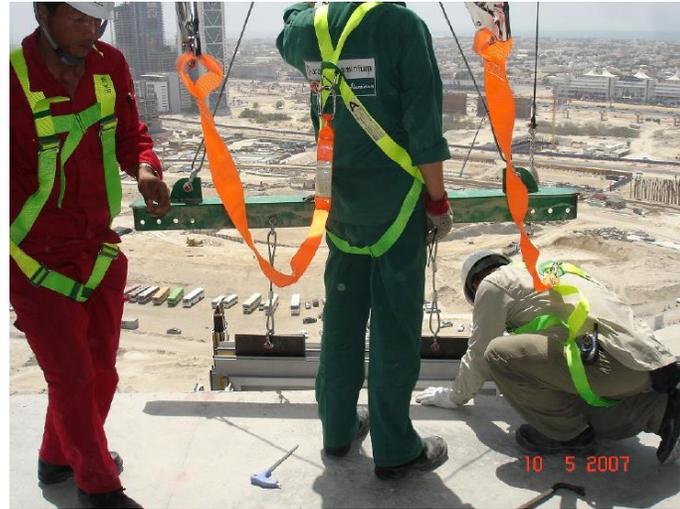


UNITIZED SYSTEM

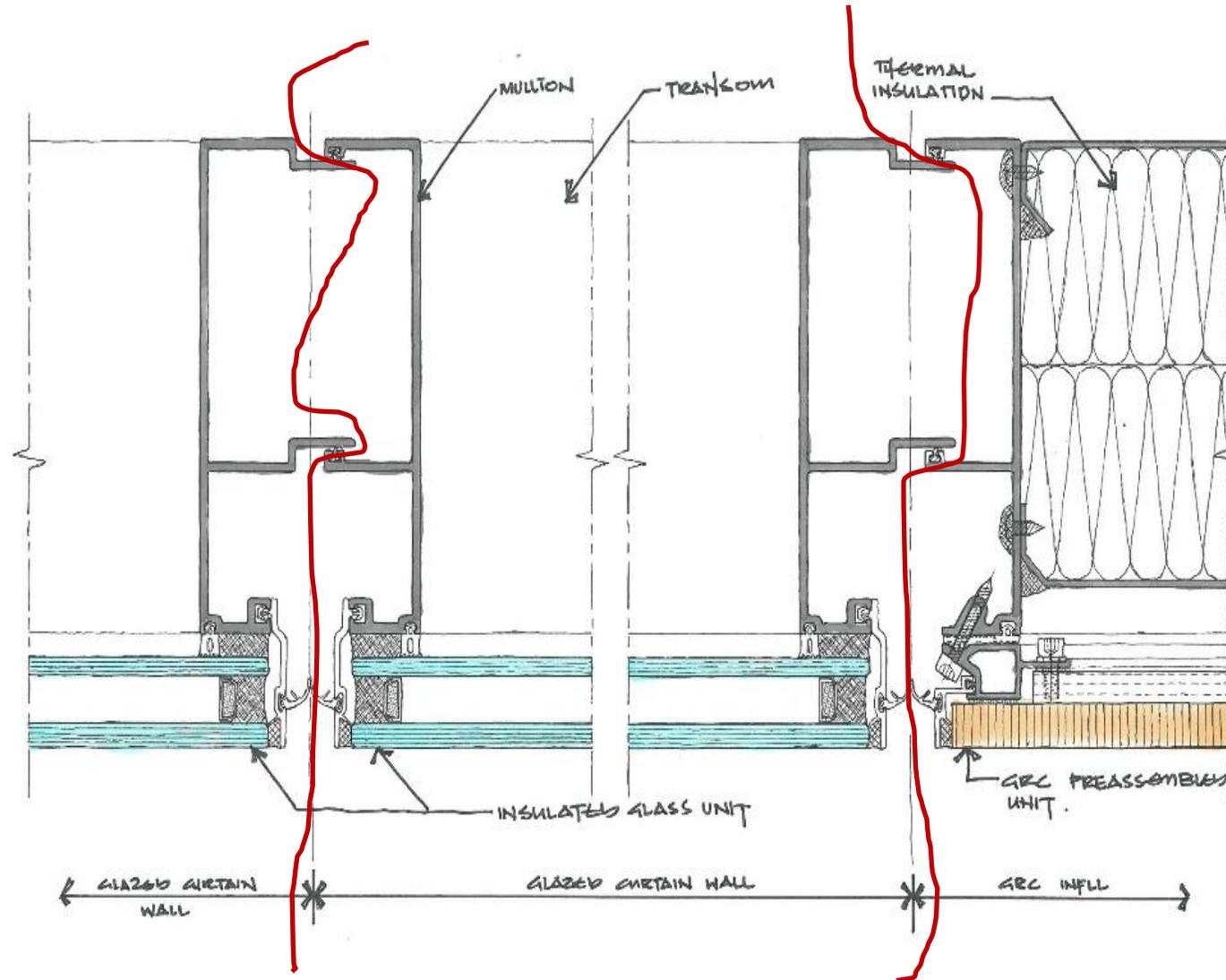


• Koltay •
FAÇADES





UNITIZED CURTAIN WALL – Mullion Detail

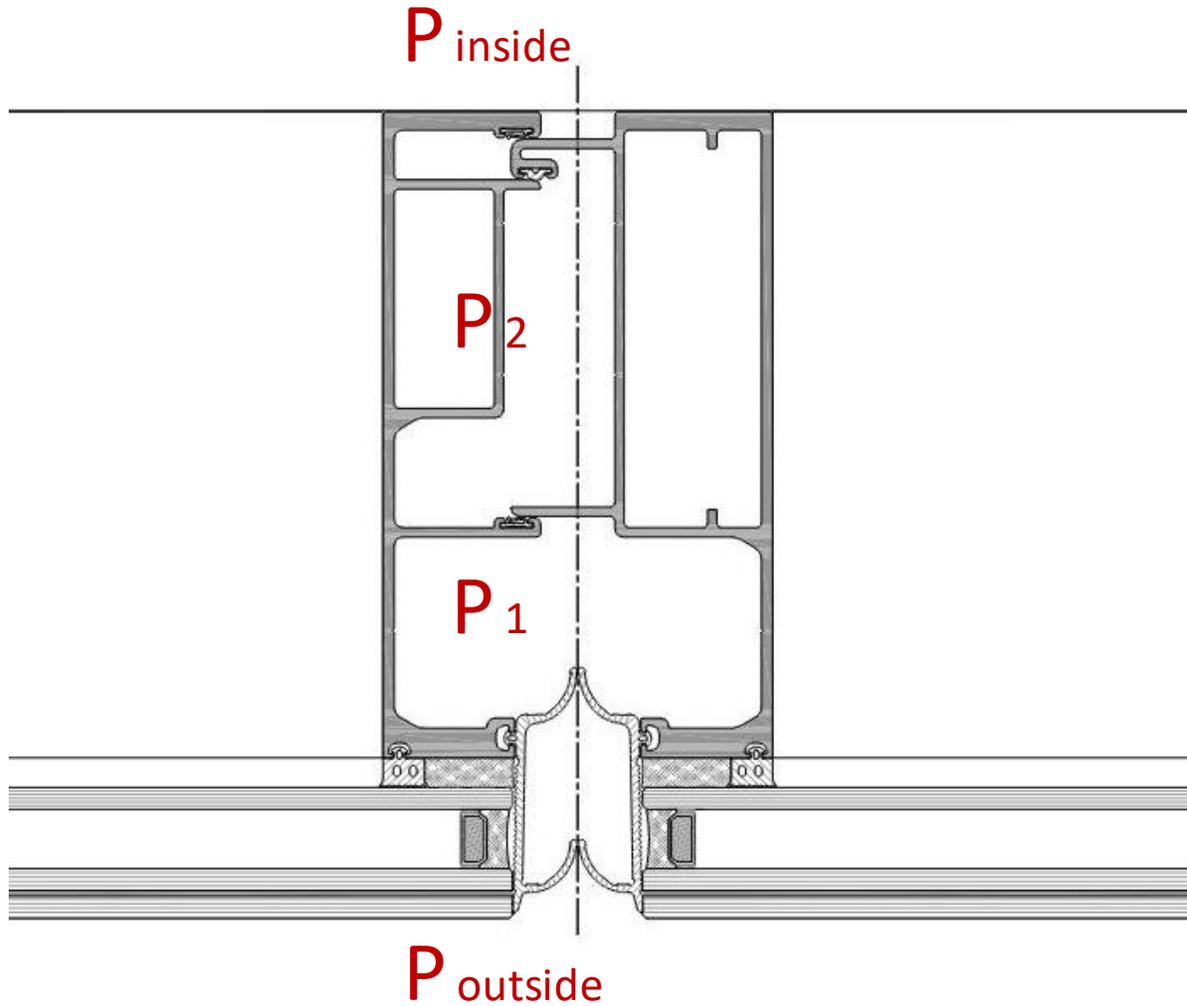


STACK JOINT

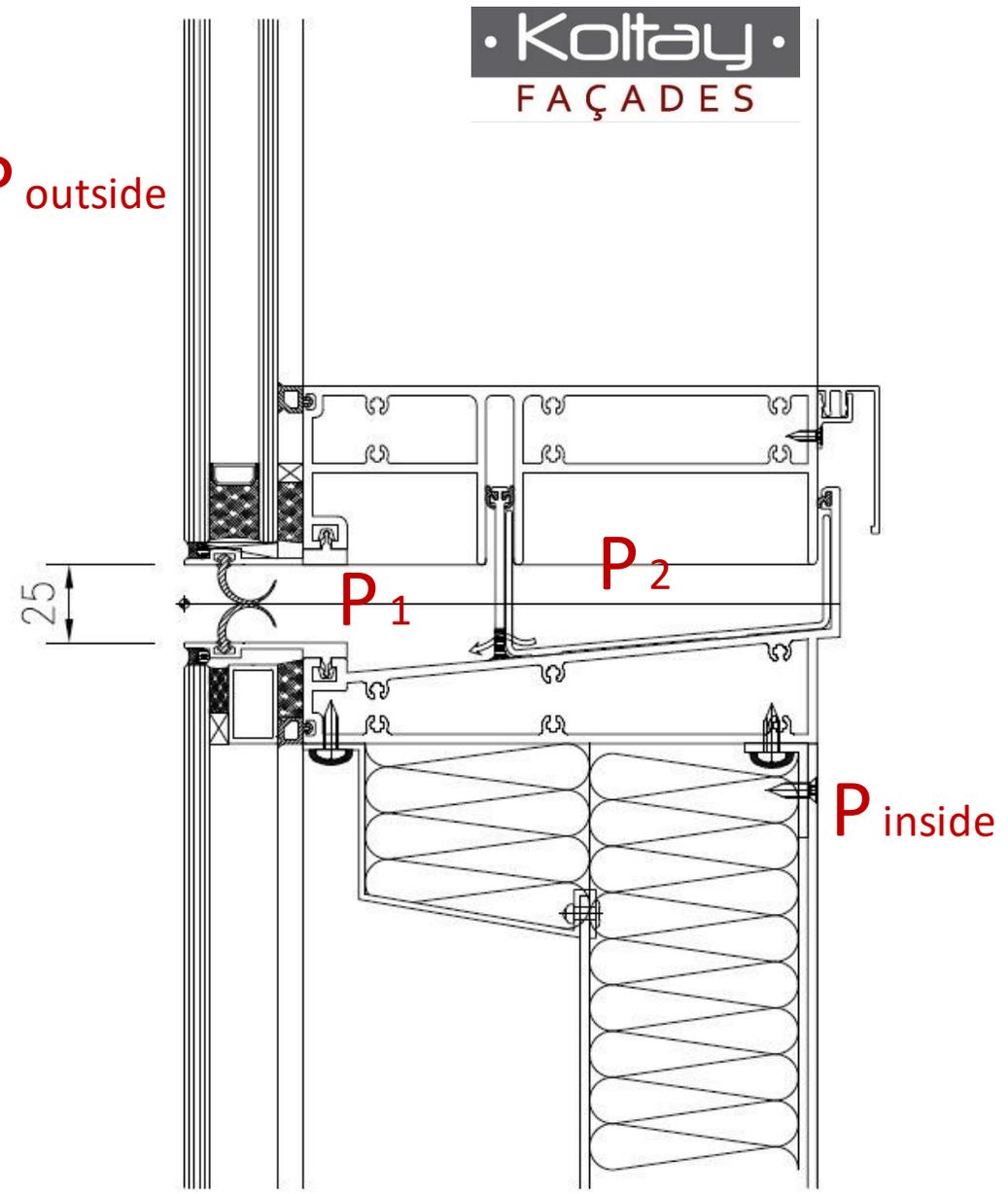


PRESSURE EQUALIZATION

Unitized system

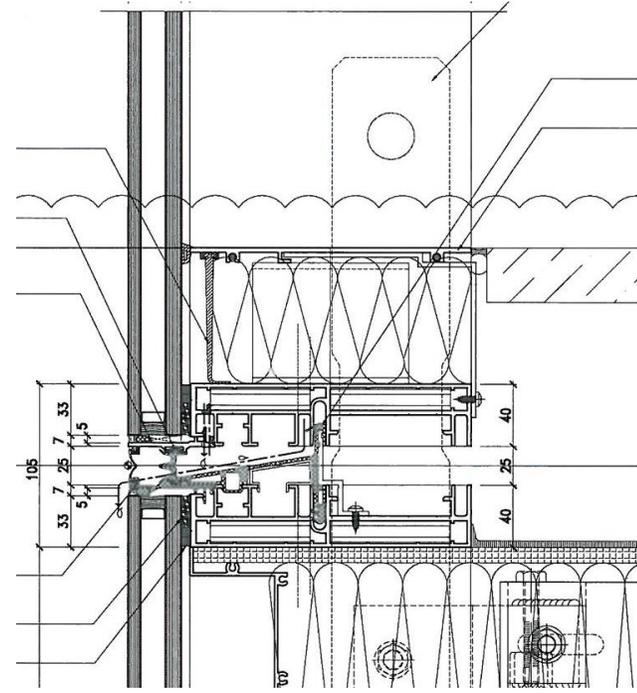
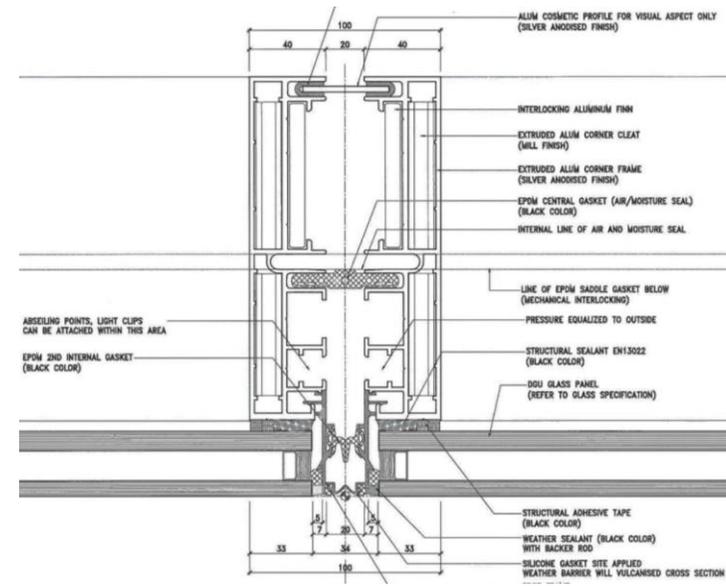


$P_{outside}$



Later: $P_{outside} = P_1$

OTHER TYPES OF UNITIZED SYSTEMS

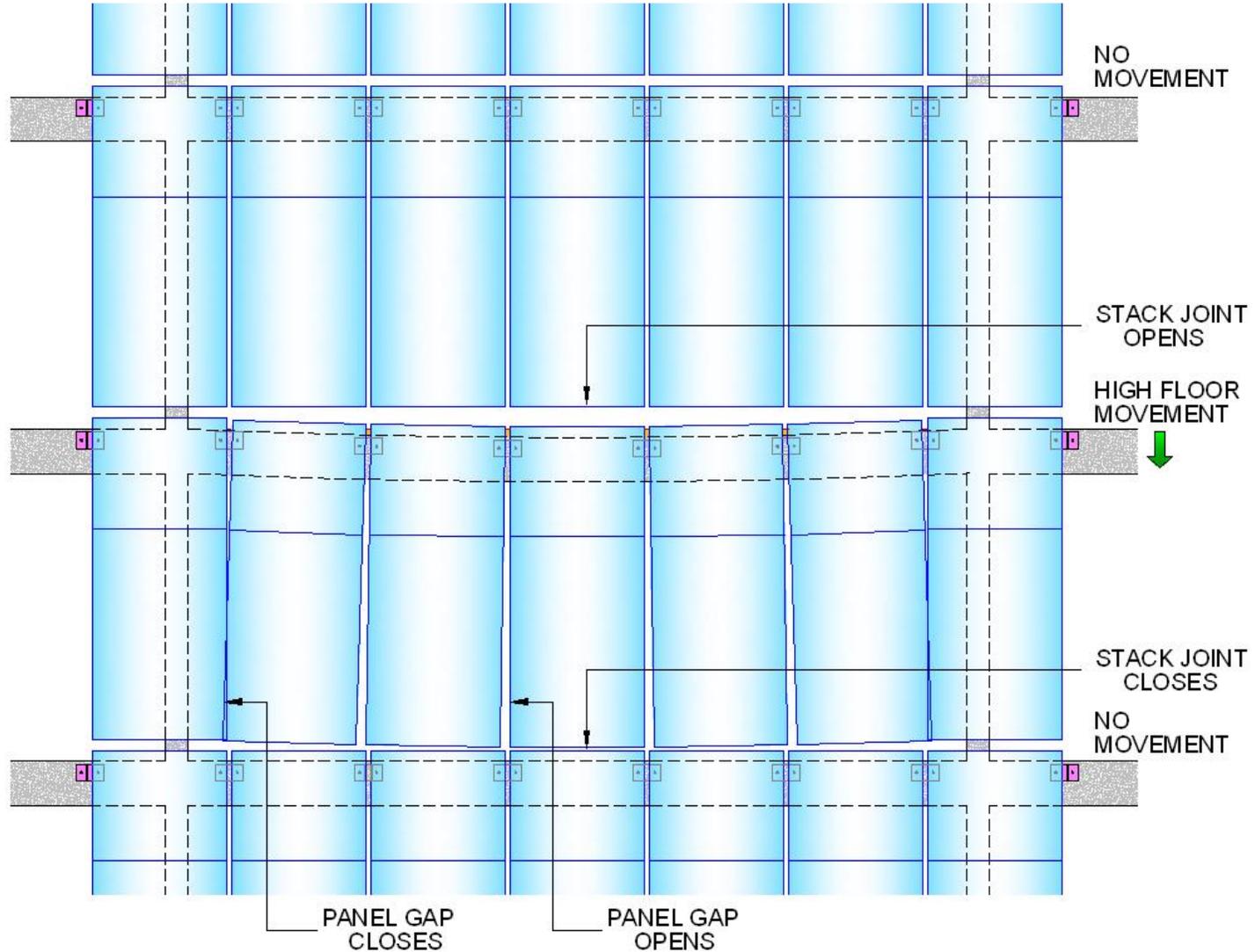




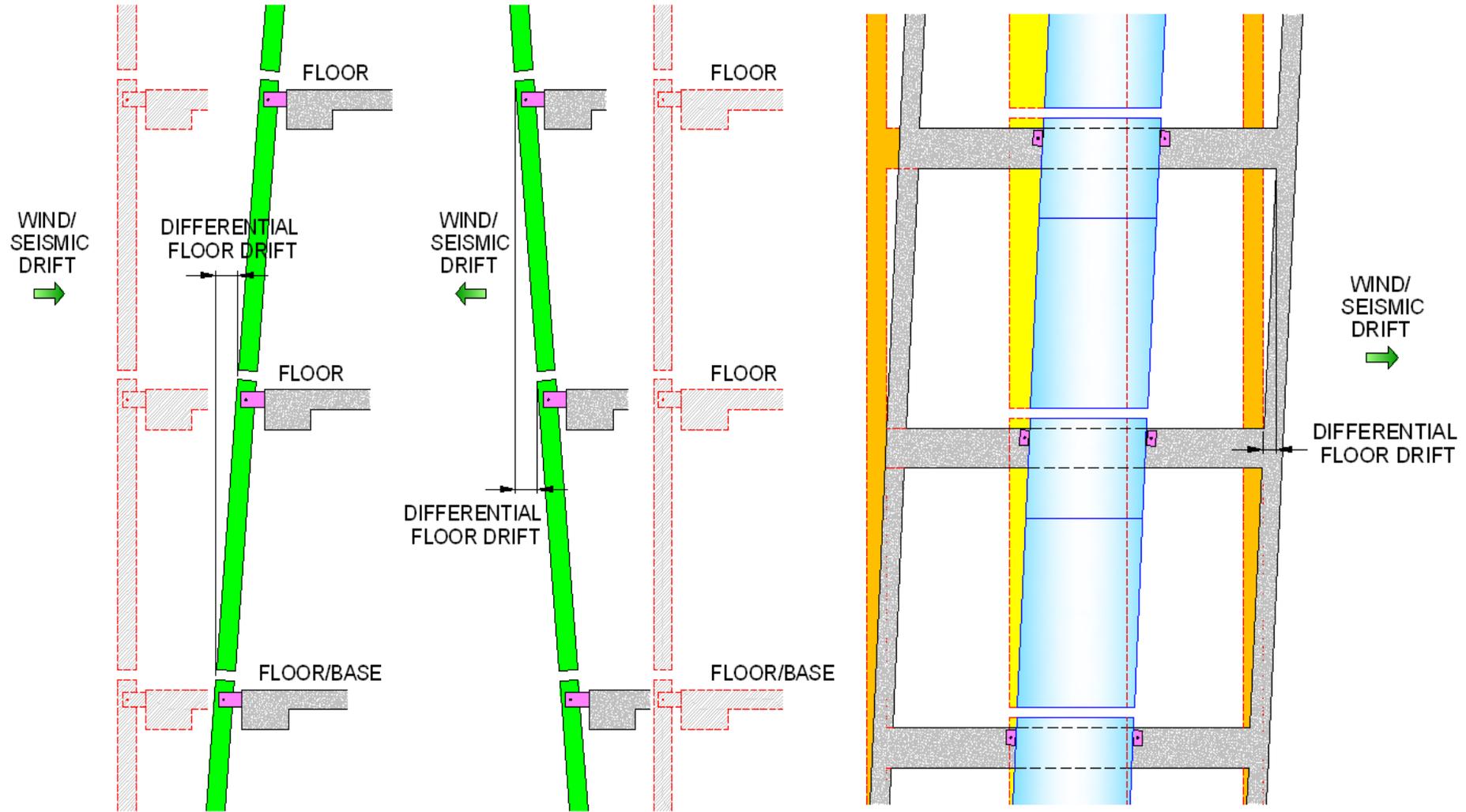
Building Movements

DIFFERENTIAL LIVE LOAD DEFLECTION BETWEEN FLOORS

ON EXPANDED ELEVATION



INTERSTOREY DRIFT DUE TO WIND / SEISMIC LOADING



MOVEMENTS AND TOLERANCES

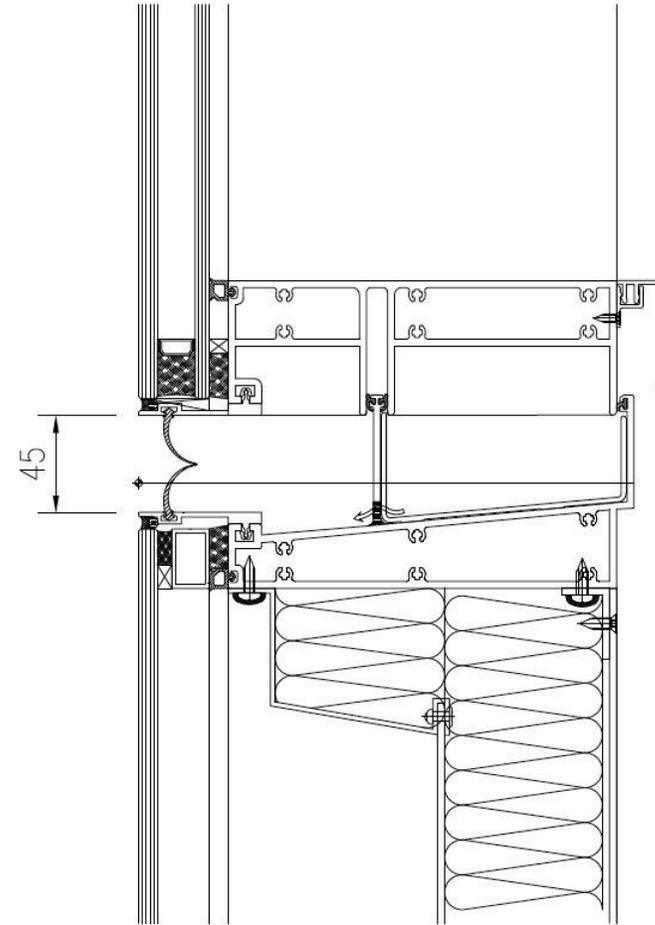
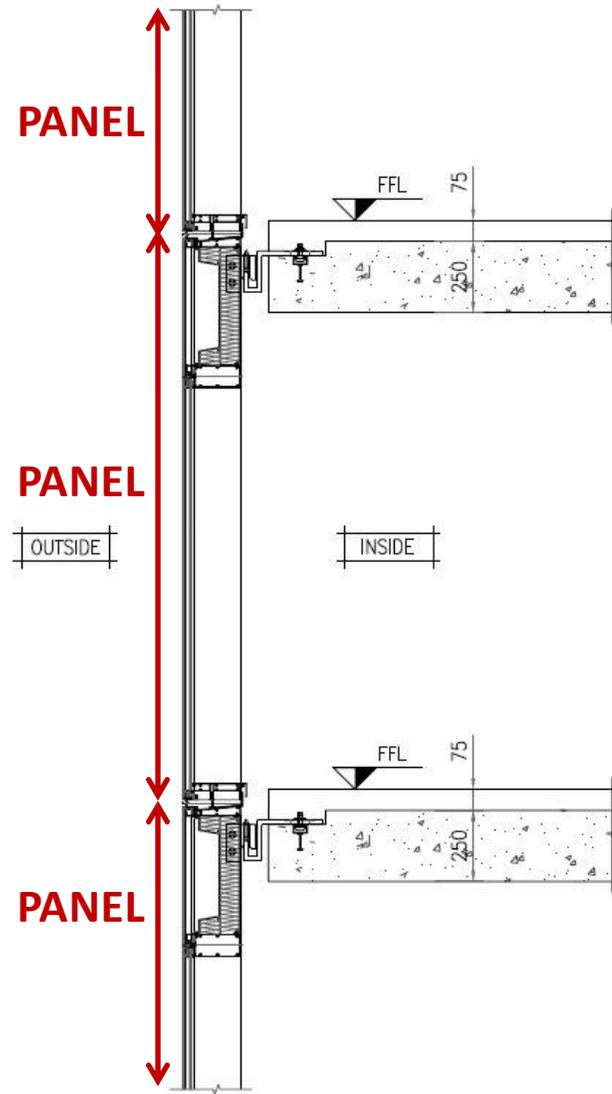
Cladding joints to cater for:

- Differential live load
- Differential drift seismic or wind
- Settlement, shrinkage, shortening
- Thermal movements
- Unit fabrication tolerance
- Unit installation tolerance
- Allow additional for thickness of gaskets, attachments, brackets taking up joint space

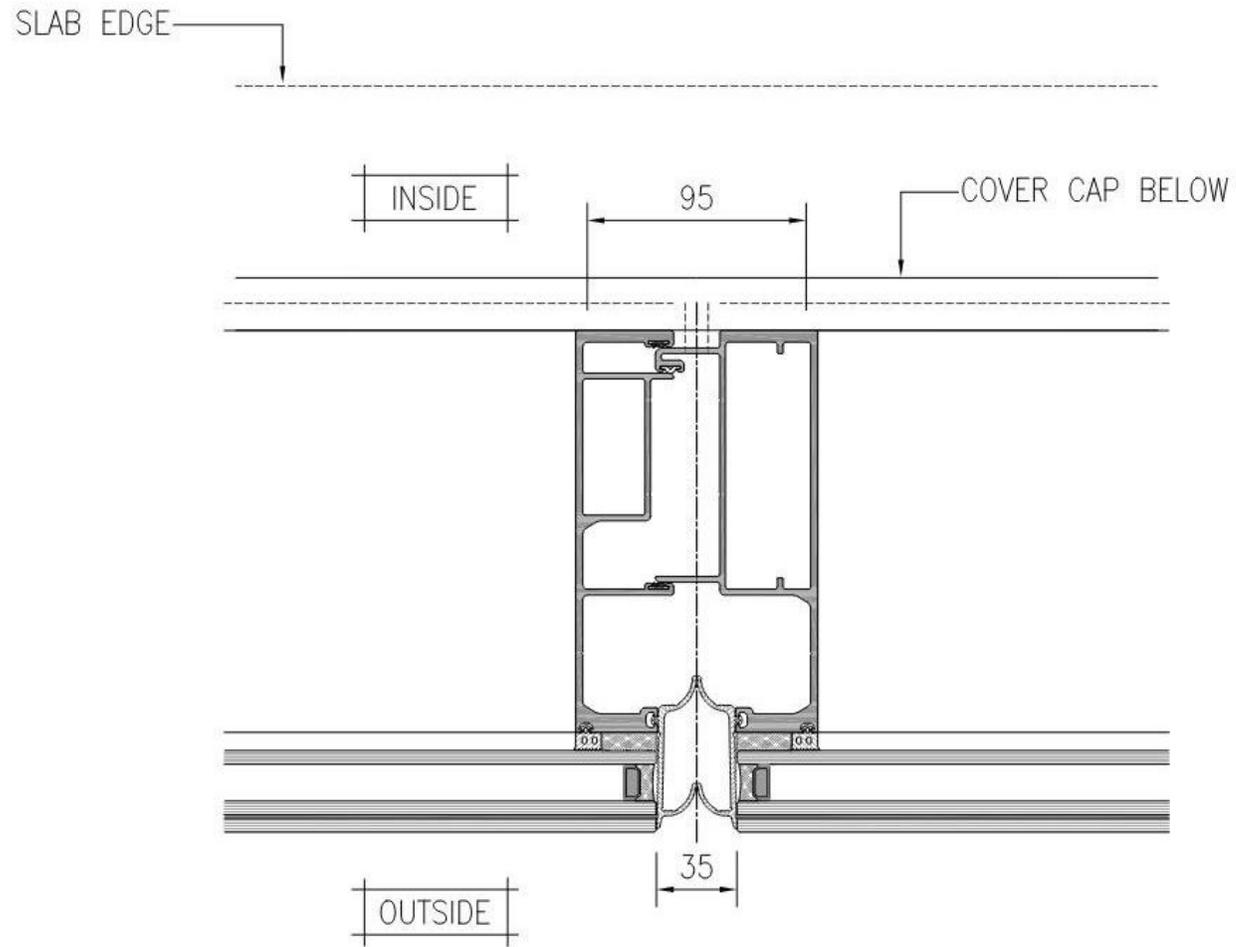
Brackets to cater for:

- 3way tolerance of concrete structure or steel primary structure
- May cater partially for settlement, shrinkage, shortening, if occurs prior to finalizing bracket fixings.

UNITISED CURTAIN WALL – VERTICAL MOVEMENT

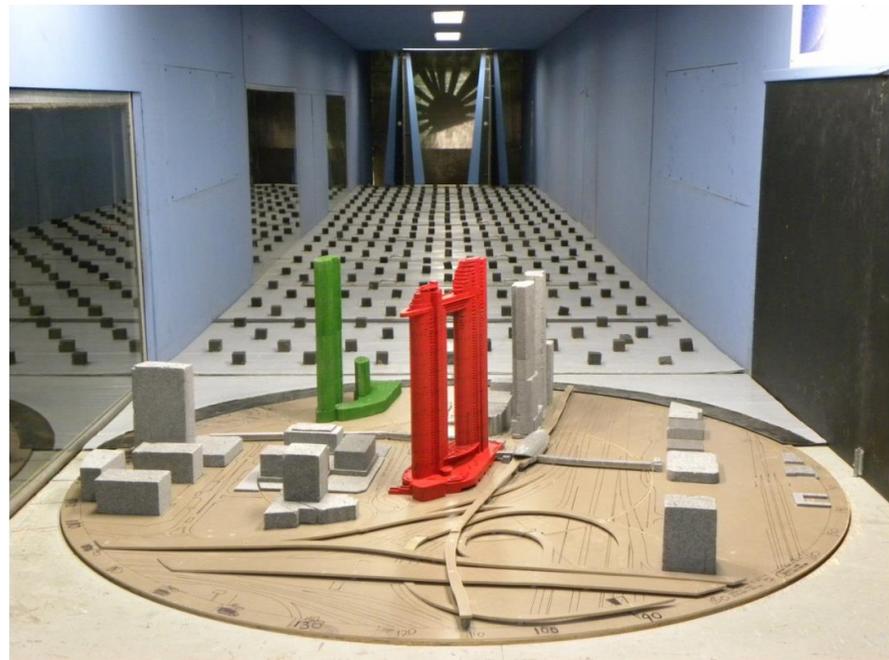
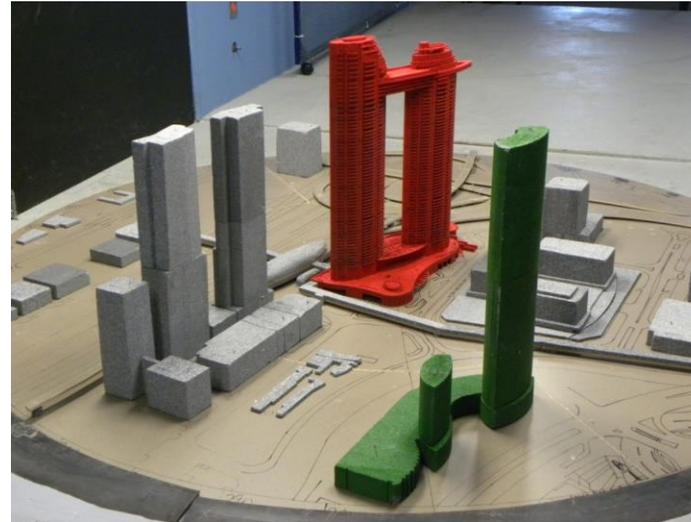
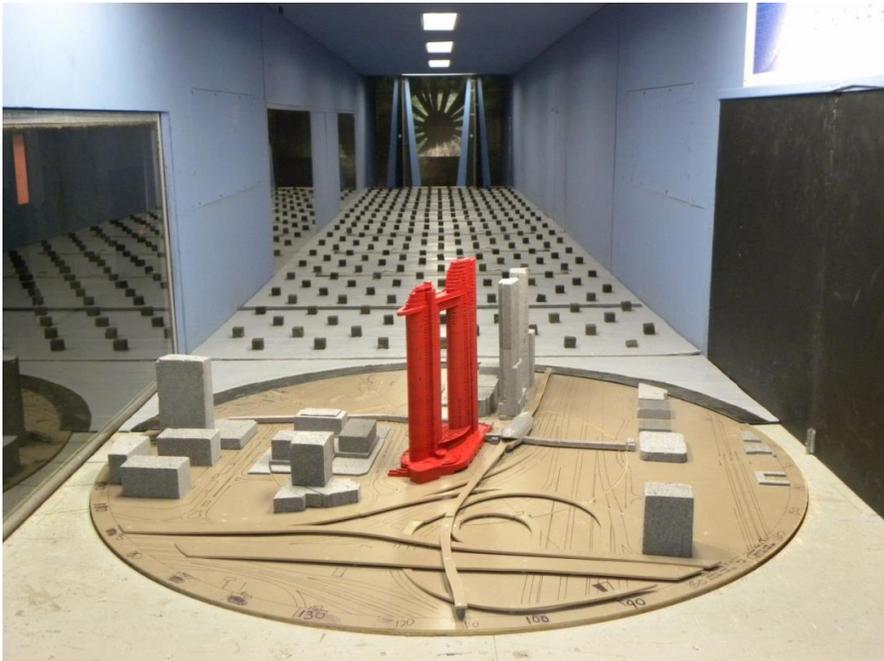


UNITISED CURTAIN WALL – HORIZONTAL MOVEMENT

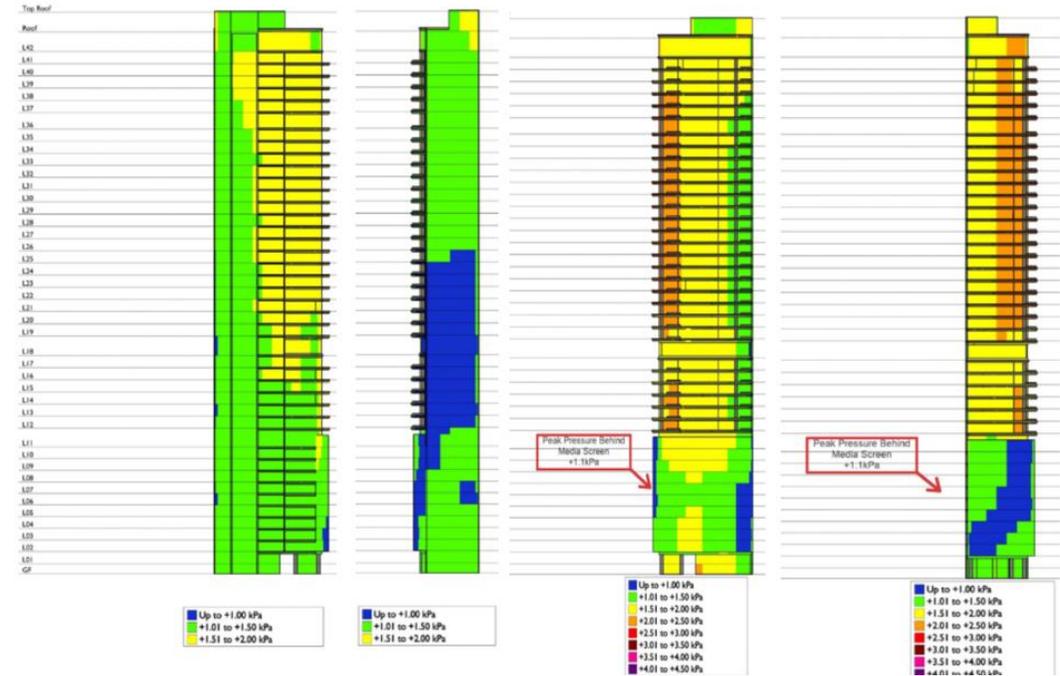


3

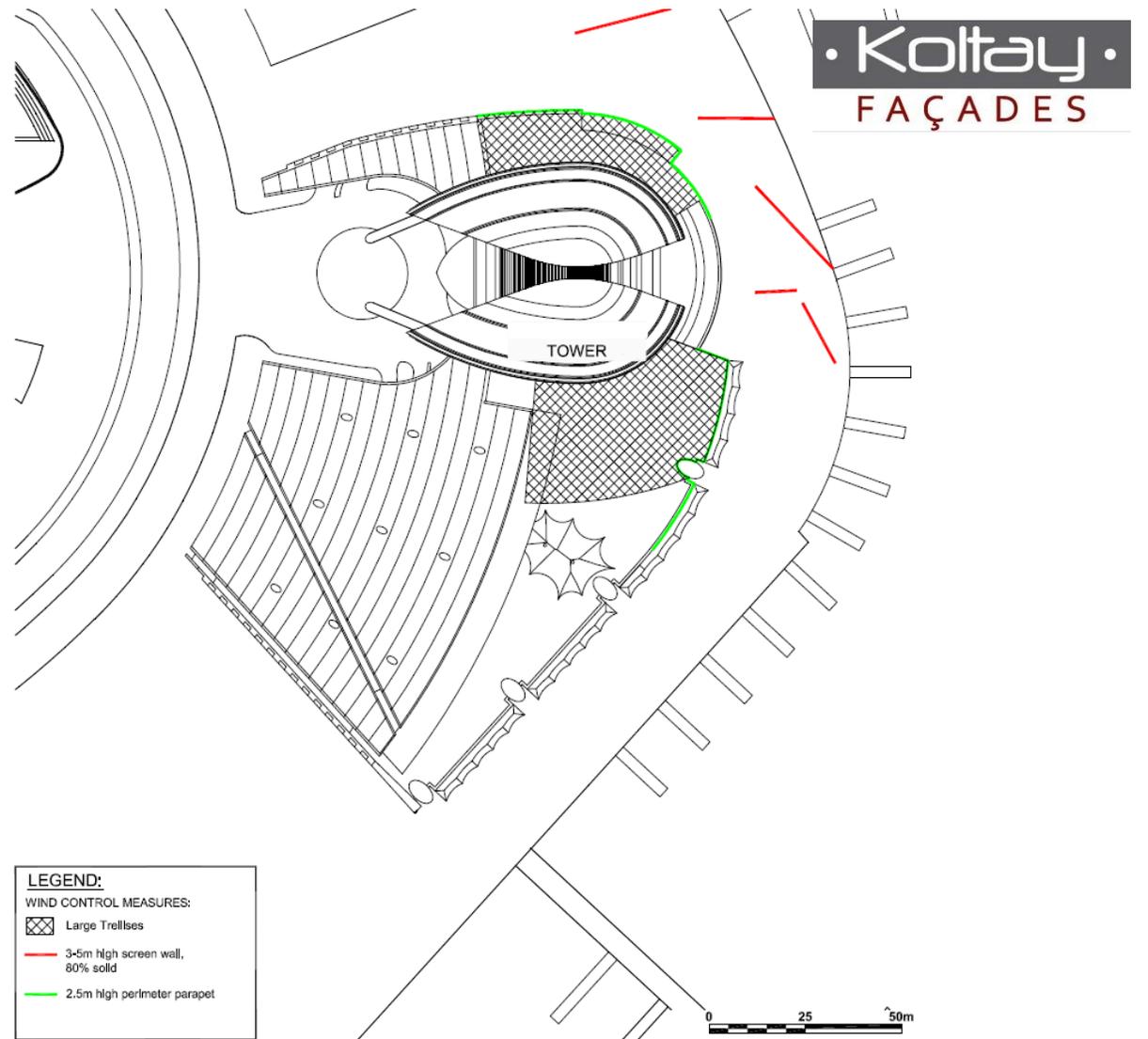
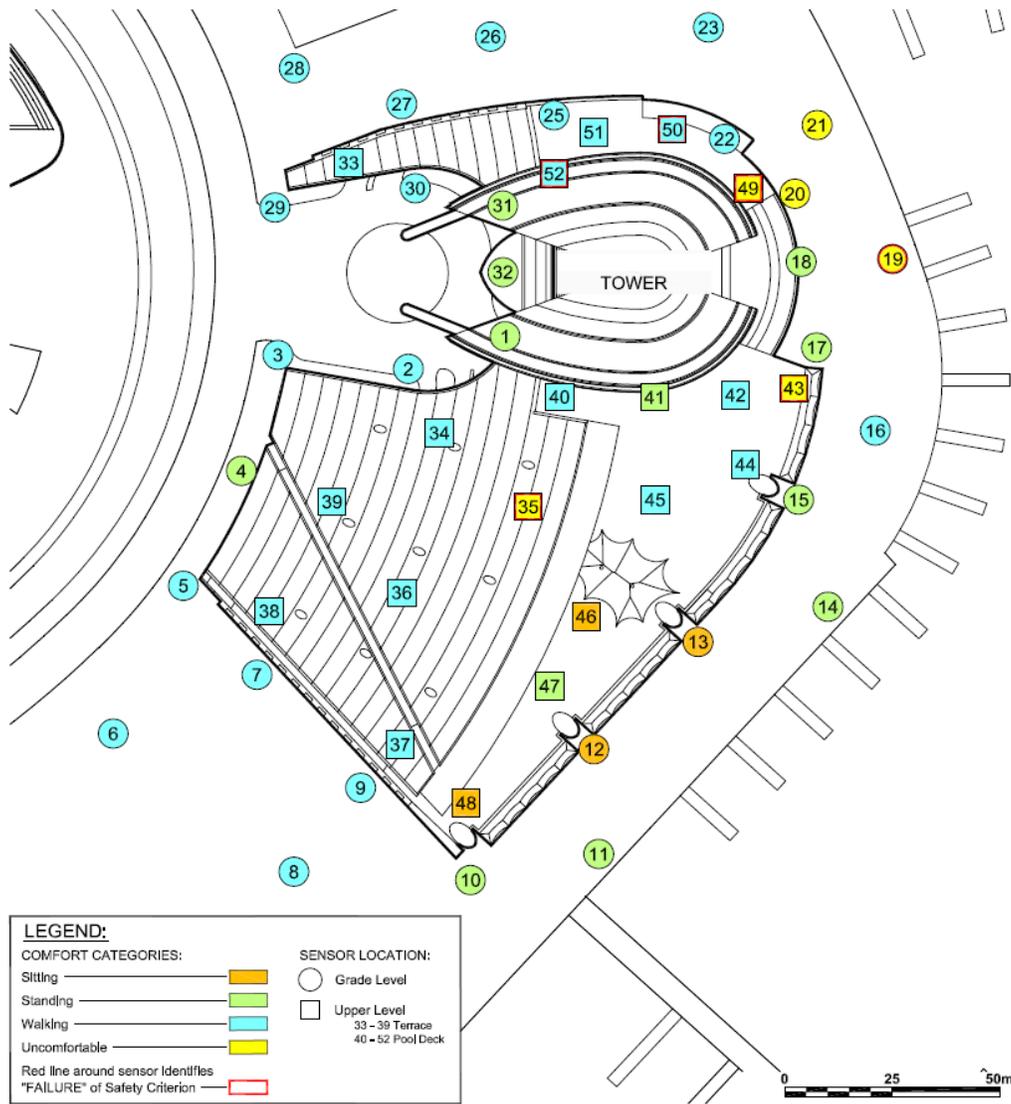
Wind Tunnel Test



WIND TUNNEL TEST CLADDING PRESSURE STUDY

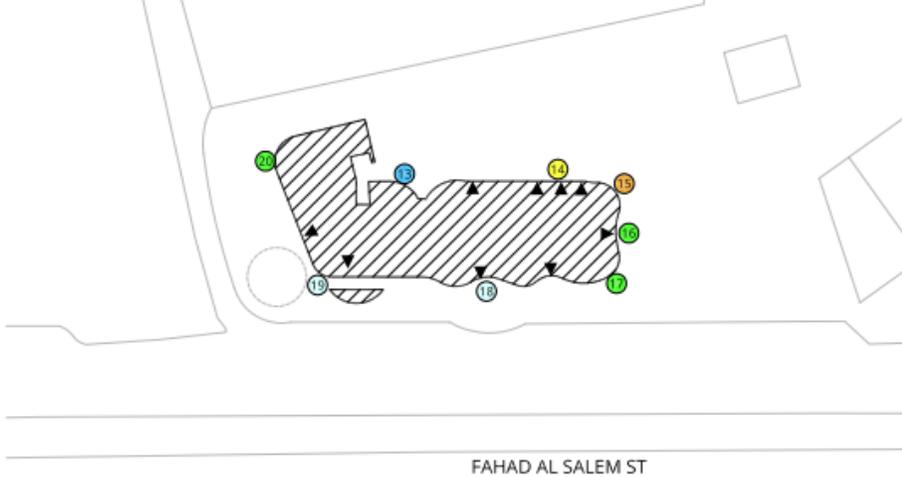
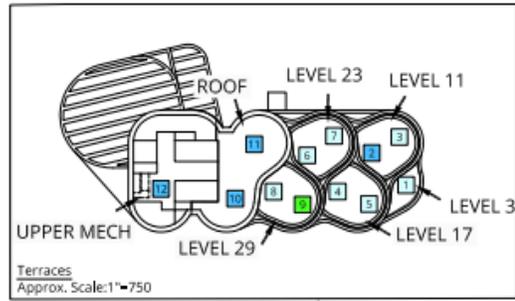
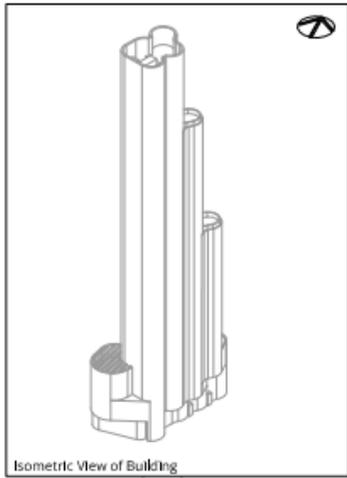


WIND TUNNEL TEST CLADDING PRESSURE STUDY



WIND TUNNEL TEST

MICRO ENVIRONMENT / PEDESTRIAN COMFORT STUDY



LEGEND:

COMFORT CATEGORIES:

- Sitting (Blue circle)
- Standing (Light Blue circle)
- Strolling (Green circle)
- Walking (Yellow circle)
- Uncomfortable (Orange circle)

SENSOR LOCATION:

- Grade Level (White circle)
- Terrace Level (White square)
- Main Entrance Location (Black triangle)



LOCATION

- - Pedestrian location
- - Pedestrian location under overhang

COMFORT RATING

- - Pedestrian sitting
- - Pedestrian standing
- - Pedestrian walking
- - Business walking
- - Uncomfortable

DISTRESS RATING

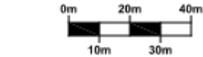
- - Pass
- - Fall

*-5.0m palm trees

- Points 2-39
- Points 2-4 located at el. 3.4m
- Points 5,6 located at el. 4.7m
- Point 7 located at el. 6.1m
- Point 8 located at el. 6,6m
- Point 9 located at el. 7.3m

CONFIGURATION G

- Points 10-15 located at el. 7.8m
- Points 16-18 located at el. 13.8m
- Point 19 located at el. 14.5m
- Point 20 located at el. 17.4m
- Points 21-26 located at el. 19,8m
- Points 27,28 located at el. 20.5m



- Point 29 located at el. 25,8m
- Points 30-33 located at el. 278,9m
- Points 34,35 located at el. 286,9m
- Point 36 located at el. 300,0m
- Point 37 located at el. 301,5m
- Points 38,39 located at el. 301,9m

MICRO ENVIRONMENT / PEDESTRIAN COMFORT STUDY

4

Practicality of Bent Geometry

DESIGN FABRICATION DELIVERY INSTALLATION

BIM tools commonly used

Parametric tools commonly used

Zero wastage, recycling

Energy efficiency with tight joints

New materials with new erection process



DESIGN FABRICATION DELIVERY INSTALLATION

BIM tools
Computer instructed CNC
Adaptive molds and tools

Reality:

Traditional methods
Investment vs. competitive pricing
Still not enough demand
(- When is it enough demand? Too late...)



DESIGN FABRICATION **DELIVERY** INSTALLATION

LOGISTICS

Production sequencing
Item identification



UNIQUE BUILDING SKINS



DESIGN FABRICATION DELIVERY **INSTALLATION**

Calling materials in sequence
Finishing item customization
Installing at correct position
Handling correctly



5

~~Technological limits~~
Financial limits

LIMITS

- The Universe is unlimited.
- Law of Physics, possible materials, manufacturing methods, range of machinery, etc – not all are discovered or invented
- Designers: Awareness of industry:
Keeping standard sizes increases feasibility, reduces cost
- Building contextual cost awareness
- Wait until it goes mainstream – or allow efforts for physical testing in DD phase
- Contractors: Embrace software tools, use up to their potential



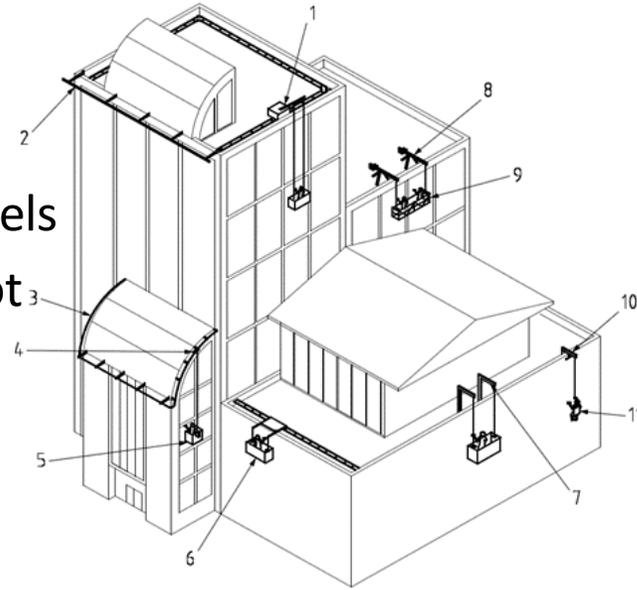
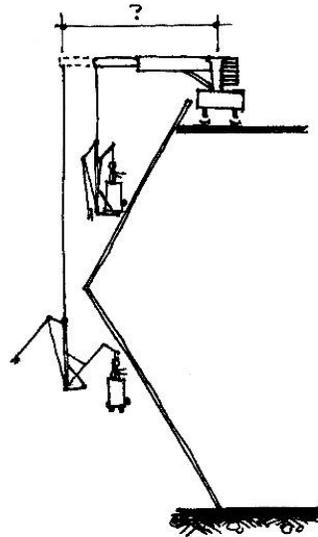


Façade Access Strategy Impact

FAÇADE ACCESS SYSTEMS

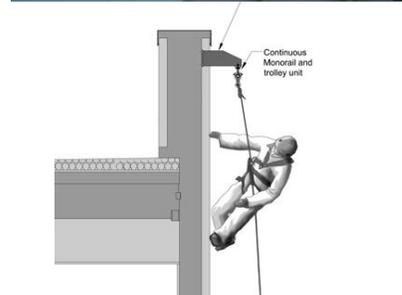
Tower

- BMU (Building Maintenance Unit)
 - Roof machine : fixed, on tracks, on wheels
 - Cradles: self-climbing (motorized) or not
 - Restraints
- Monorail
- Abseiling
- Gantry

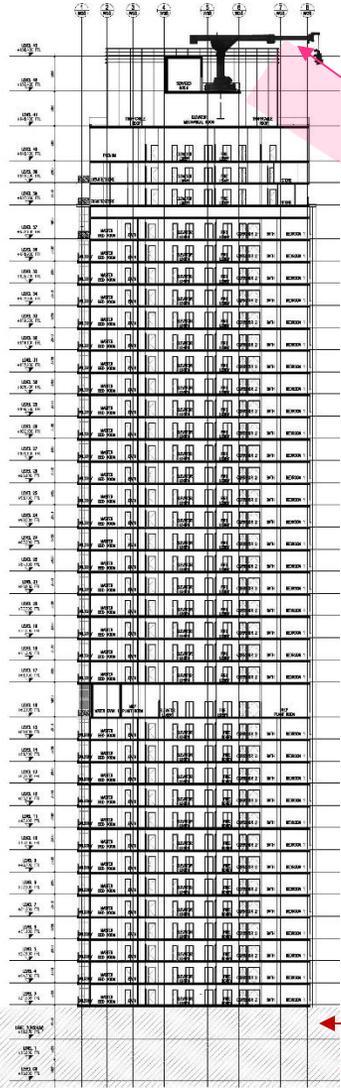


Podium, low-rise

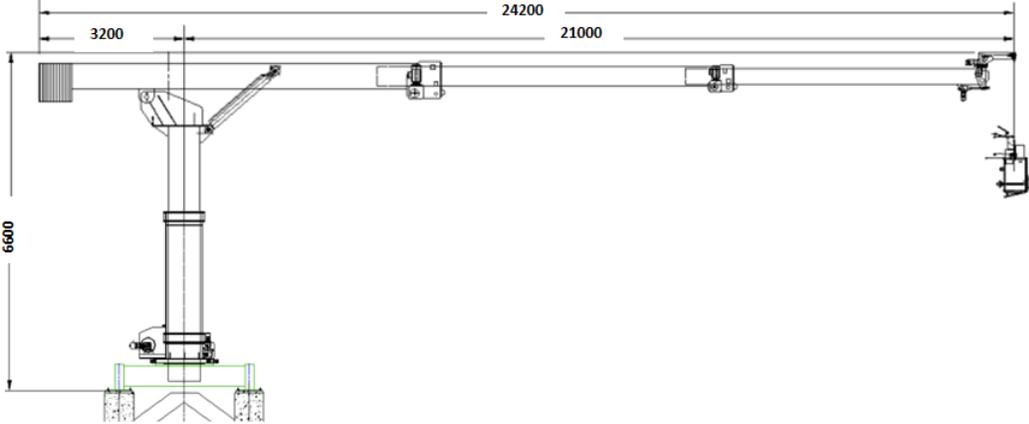
- Davits
- Aerial Working Platforms
- Manual cleaning -Tucker pole-Scaffolding
- Fall arrest system



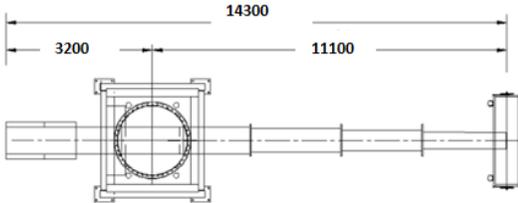
Roof Machine - visibility



MIN 1 KM AWAY FROM THE TOWER



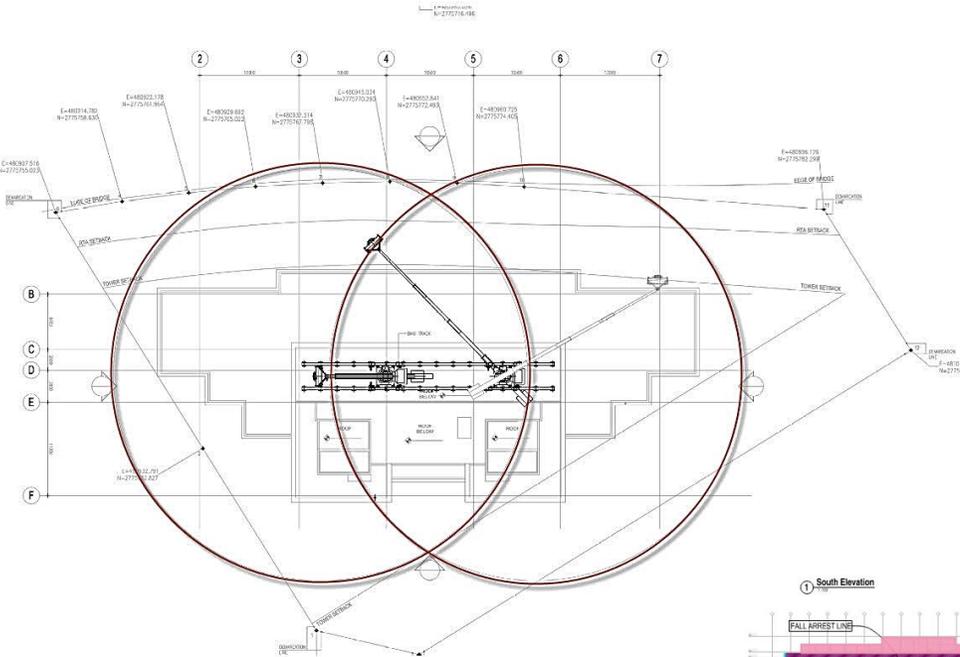
Fixed Machine in operating position, section



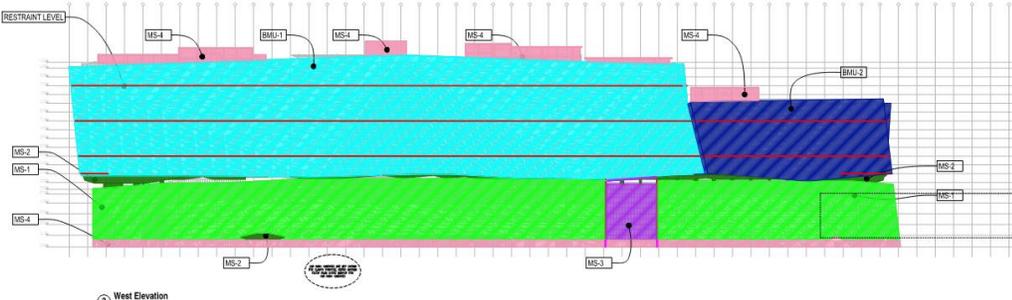
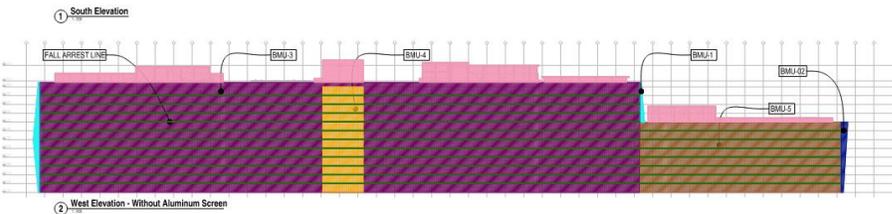
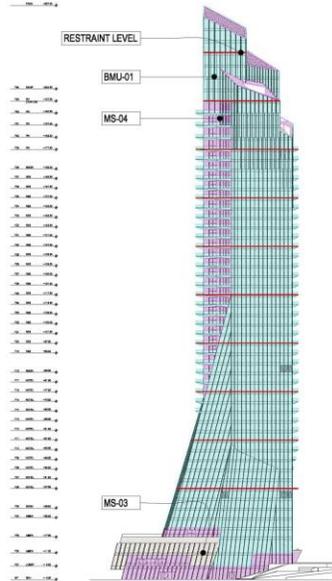
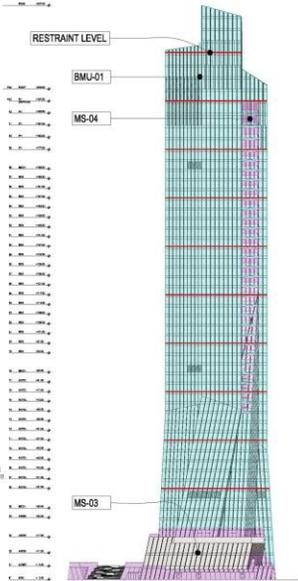
Fixed Machine in parked position, plan

Visual Impact of Fixed Machine.

ACCESS TO ALL AREAS



Telescopic traversing machine.



- External access
 - Internal access
- For:
- Cleaning
 - Glass replacement
 - Maintenance
- Within:
- Cleaning cycle max 40 days

LEGEND: FACADE ACCESS STRATEGY

	BMU-1: BMU-1 (C+M+MR)
	BMU-2: BMU-2 (C+M+MR)
	BMU-3: FALL ARREST (C+M) + BMU-1 (MR)
	BMU-4: FALL ARREST (C+M) + DAVIT (MR)
	BMU-5: FALL ARREST (C+M) + BMU-2 (MR)
	MS-1: AWP (C+M+MR)
	MS-2: FALL ARREST/ ABSEILING RAIL (C,M) + TEMPORARY GANTRY(MR)
	MS-3: SOFFIT ABSEILING RAIL (C,M) + AWP/BMU (MR)
	MS-4: MANUAL (C,M) + MANUAL LIFTING HOIST(MR)
	MS-5: ABSEILING (C,M) + AWP(MR)

FALL ARREST LINE / RAIL
 SOFFIT ABSEILING RAIL
 RESTRAINT LEVEL

(C) - CLEANING
 (M) - MAINTENANCE
 (MR) - MATERIAL REPLACEMENT



Specification hints

SPECIFICATION HINTS

Prescriptive Specification:

- Cost may increase on demand on 1 certain product
- Brand does not consider interfaces or other materials (eg: profile only, not even glass)

Prescriptive Specification:

- Reference to code or industry guide does not always sufficient. Frequently written by suppliers, manufacturers. Add reasonable stricter requirements.
- “Contractors responsibility”, “Contractor to design”, “Contractor’s selection” – use carefully. Still describe all important (and feasible) parameters and aspects.
- Tangible, measurable: what quality is “adequate”, “good”, “best practice”, “high end”, “within tolerance”, “similar”, “reasonable”? Visual expectations: viewing from where? 2 meters or 10? With larger projects, replacements and rectifications are growing large in volume and cost too.
- Copy paste and reuse: still complete 100% reading and customization. “It is there, but not applicable for this project” – how shall it be decided what was intended to be applicable and what not?
- Input from supplier: minimum 3, to avoid exclusivity, update regularly





Façade Testing

PERFORMANCE MOCK-UP TEST

- WATER PENETRATION
- AIR LEAKAGE
- DUST INFILTRATION
- THERMAL PROPERTIES
- NOISE REDUCTION
- FIRE BEHAVIOUR

→ VERIFICATION TESTING

ASTM E283-04	Air in – and exfiltration test
ASTM E331-00	Static water penetration test
AAMA 501.1-05	Dynamic water penetration test
ASTM E330-14	Structural serviceability test / Structural safety test / Failure mode test
AAMA 501.5-07	Thermal cycling test
AAMA 501.4-09	Seismic drift test

SITE TESTS:

HOSE TEST, AIR LOSS TEST



ASTM E331-00

Water leakage test

- Equally spaced spray nozzle grid
- 3.4 L/m²min rate
- 15 min pressurized rain simulation
- Pass criteria: no leakage



ASTM E331-00

Water leakage test

- Equally spaced spray nozzle grid
- 3.4 L/m²min rate
- 15 min pressurized rain simulation
- Pass criteria: no leakage



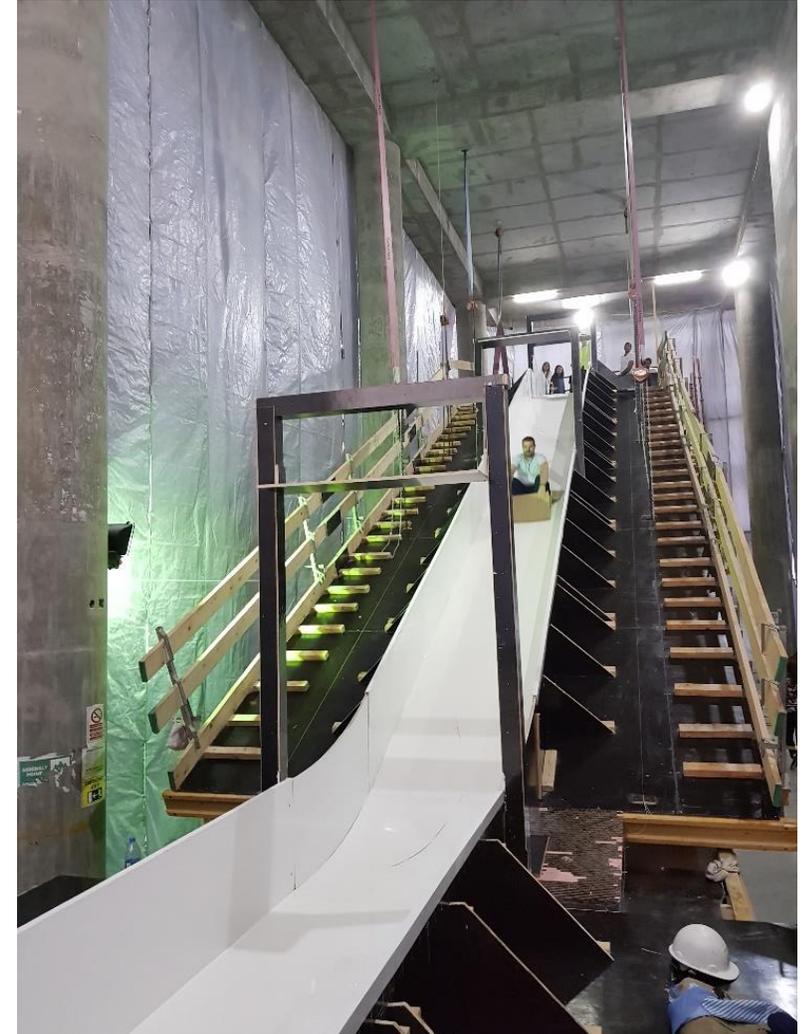
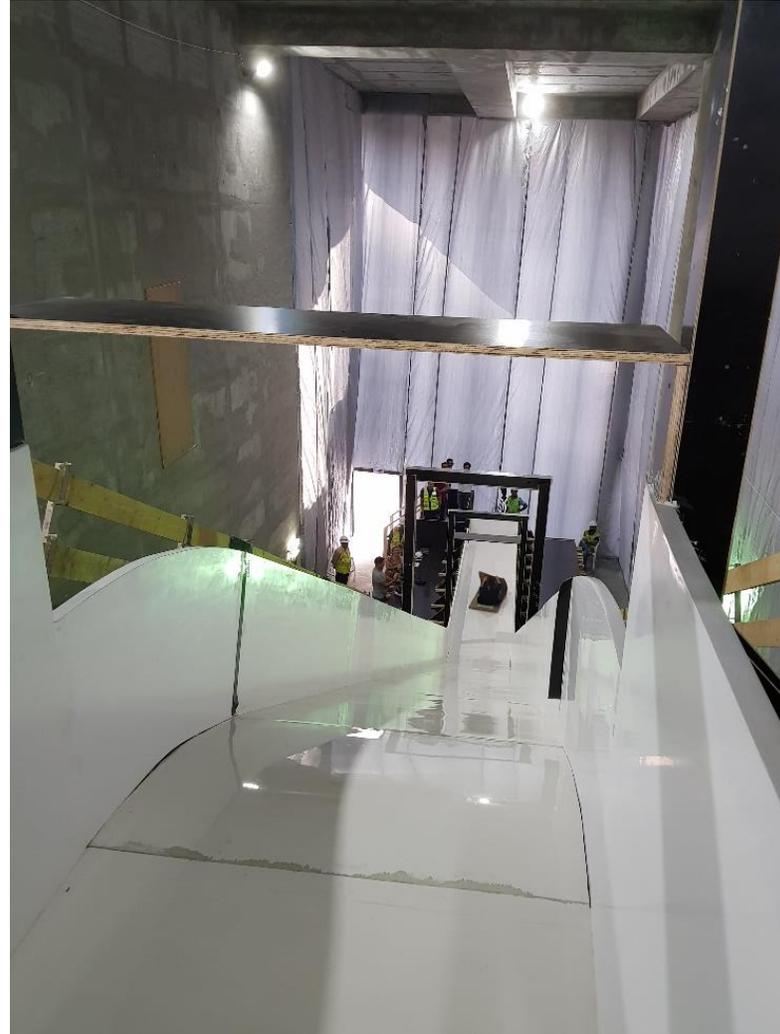
SKY SLIDE

DUBAI, UAE

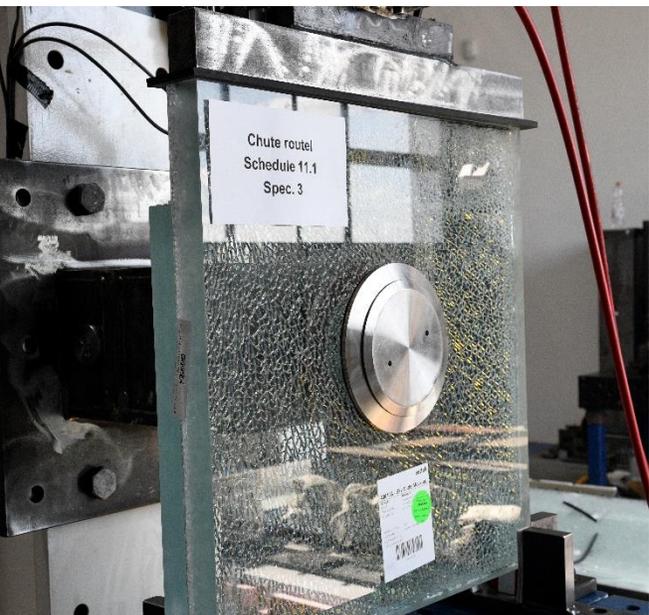
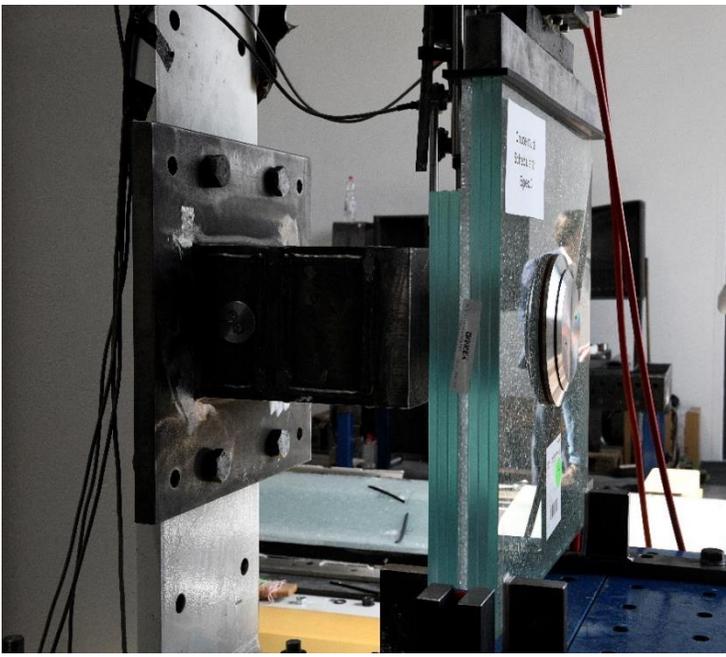
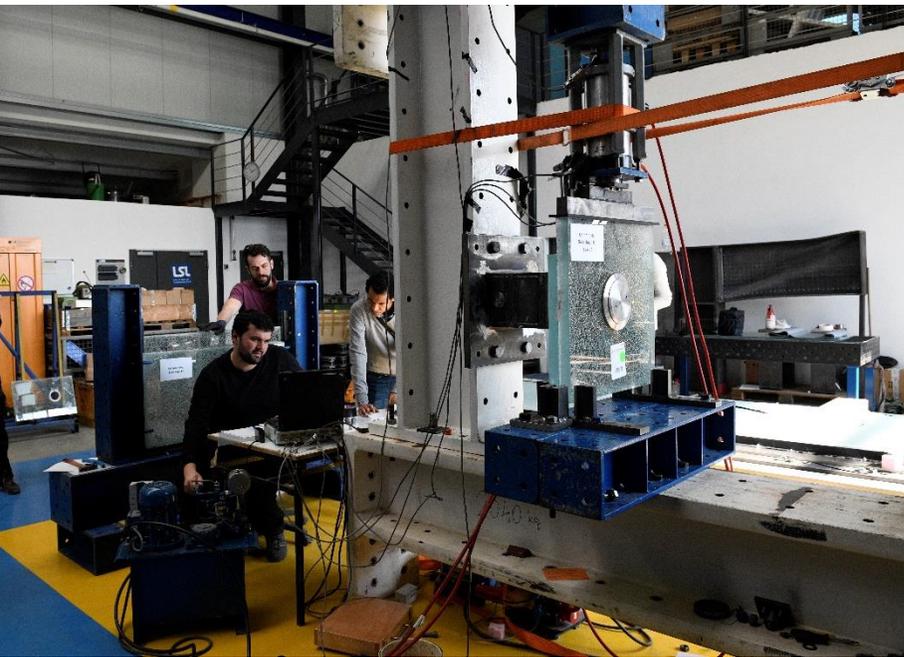


· Koltay ·
FAÇADES

CUSTOM REQUESTED TEST TO ESTABLISH OPTIMAL GEOMETRY



CUSTOM SPECIFIED LOAD TESTS





Site Inspection tips

SITE INSPECTION TIPS

“Contractor to proceed on their own responsibility.” – does it exist?

→ Insist on façade PMU testing

Request for Inspection – shall we wait?

→ Highlighting potential deviations from approved design and malpractices witnessed should be beneficial to both parties

→ Witnessing compliance to design and good practices should be beneficial to both parties

Tools – may come handy

→ Every visit:

→ Mobile phone (photo, magnification, measurement apps, torch light, straight line

→ 10cm metal ruler with 0 on the edge

→ Endoscopic digital camera attachment for mobile phones

→ Advanced tools for known issues:

→ Shore A hardness durometer → Coating thickness gauge

→ Caliper

→ Digital or manual angle measure

→ Rollerwave and edge dip gauge

→ Noise level gauge

→ Air velocity gauge

→ Feeler gauge and true straight measure

→ AI tools to come



THANK YOU



Agnes KOLTAY
agnes.koltay@koltayfacades.com
+971 50 525 3247

