

BUILDING MAINTENANCE UNITS
(a.k.a. Façade Access Equipment)
Introduction & Planning considerations

Presented by:
Samson Rajan Babu MCIBSE
Façade Access Consultant & Project Manager
Dubai, UAE

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Description:

Permanently installed on a specific building or structure for the inspection, cleaning and maintenance of the façades.

Other Names:

Façade Access Equipment

Window Washing Equipment

Permanent Access Suspended Platform

Cleaning cradle system

Other possible use:

Glass panel replacement

TYPES OF BMU:

- Manual (removable & relocatable) Roof Systems
- External Monorail Systems – Manual & Motorised
- Motorised Roof systems
- Specially designed BMUs.



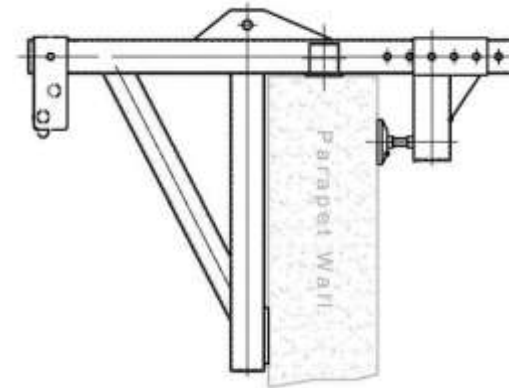
Davit systems



Counterweighted Beams



Internal Monorail



Parapet Clamps



STANDARD EXTERNAL MONORAIL



CLIMBING TYPE EXTERNAL MONORAIL

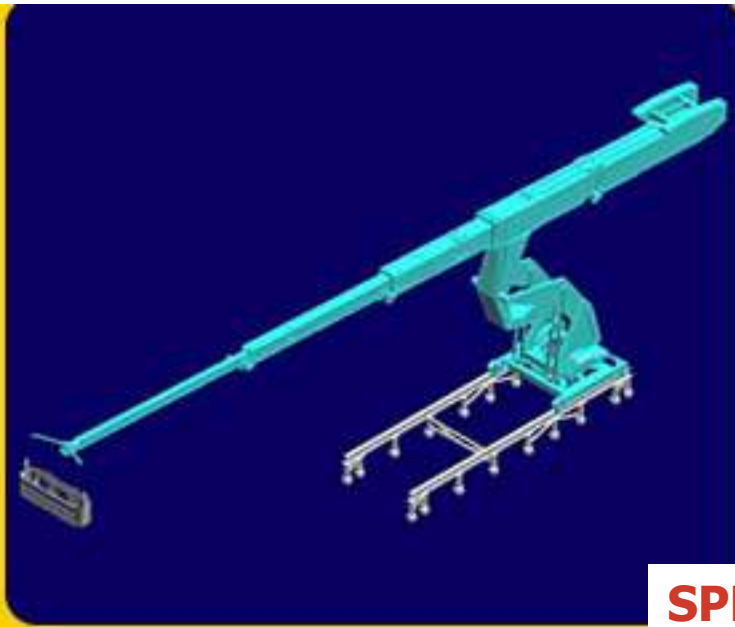
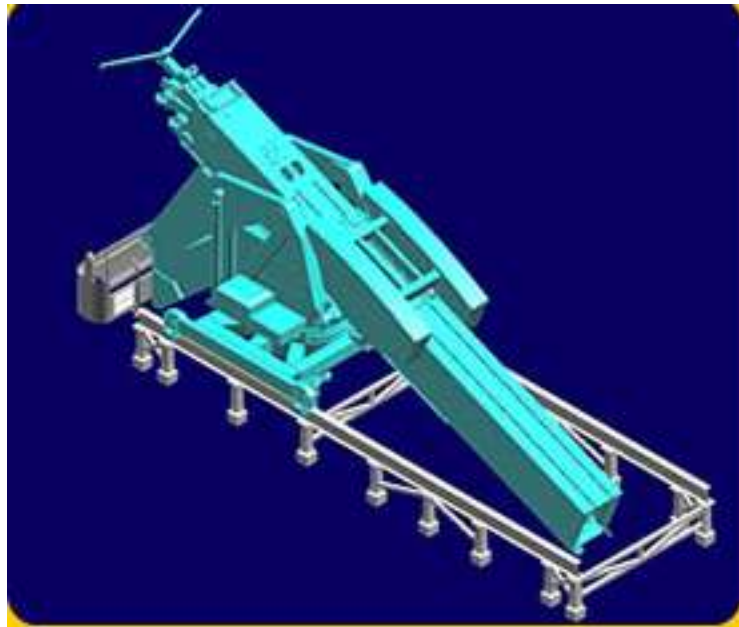


**ROOF MOUNTED
MOTORISED MACHINES**





**SPECIALLY DESIGNED
ACCESS SYSTEMS**



**SPECIALLY DESIGNED
ACCESS SYSTEMS**





A basic BMU!



And, The Most Complex BMU!

MANUFACTURERS (International with Worldwide projects):

- **SECALT – LUXEMBOURG**
- **MANNTECH – GERMANY**
- **COX GOMYL – AUSTRALIA, SPAIN**
- **FARRA ENGINEERING – NEW ZEALAND**
- **FAÇADE HOISTS – UK**
- **SKYGONDOLA – SPAIN**
- **AESA – SPAIN**
- **GEDA – GERMANY**

Governing Codes:
BSEN 1808, AS 1418
BS 6037

CSI Specification Division:
11 - Equipment

ESSENTIALS OF A BMU MANUFACTURER:

- **Compliance to governing codes**
- **CE Certified Prototype Designs, Lifting and Safety components**
- **Years of experience, Design versatility & Capability**
- **Qualified structural design engineers & local certification of design calculations.**
- **Type tested & proven components from reputed sub-contractors**
- **High-tech fabrication facility**
- **Special consideration for surface treatment and protection**
- **QA/QC procedures**
- **Trained installers**
- **Spare parts availability**

While designing BMU systems:

Reduce the level of risk in the final design to **"As Low As Reasonably Practicable" (A.L.A.R.P)**

Façade Design should allow for a BMU design that is:

- Installed safely
- Accessed safely
- Used, inspected and maintained safely

Problem façades include:

- Stepped façades, Ribbed façades
- Curved elevations – Concave/Convex
- Localised steps in the façade, eg. sun shading, ledges, canopies, fins
Projecting balcony / Mashrabiya
- Sloped façade (inwards/outwards)
- Local attachments to the façade, which protrude: CCTV cameras, signage
- Recessed windows.

Typical information required for planning a BMU:

- Perspectives / 3D sketches / Model pictures
- Roof plan both architectural and structural.
- Elevations.
- Floor plans – Ground, each typical floor type
- Roof equipment layout: Clear spaces on roof
- Exterior wall sections of the façade: Show recess/projection

Data to be reviewed:

- Multiple roofs/terraces
- Façade types
- Roof layout: Clear space for moving around & parking area
- Parapet line Vs Façade line: Walk through
- Parapet heights
- Roof/Parapet structural detail
- Ground conditions: Clear space for moving around

Solution depends on:

- Combination of Roof / Parapet / Ground conditions
- Budget
- Frequency of cleaning (cleaning cycle analysis)
- Aesthetics: While working & when parked
- Parking requirements
- Availability of structural support for the solution

Solutions can be:

- Single/multiple manual systems with common/dedicated platforms.
- Single/multiple monorail systems with common/dedicated platforms.
- Single/multiple roof trolleys with common/dedicated platforms.

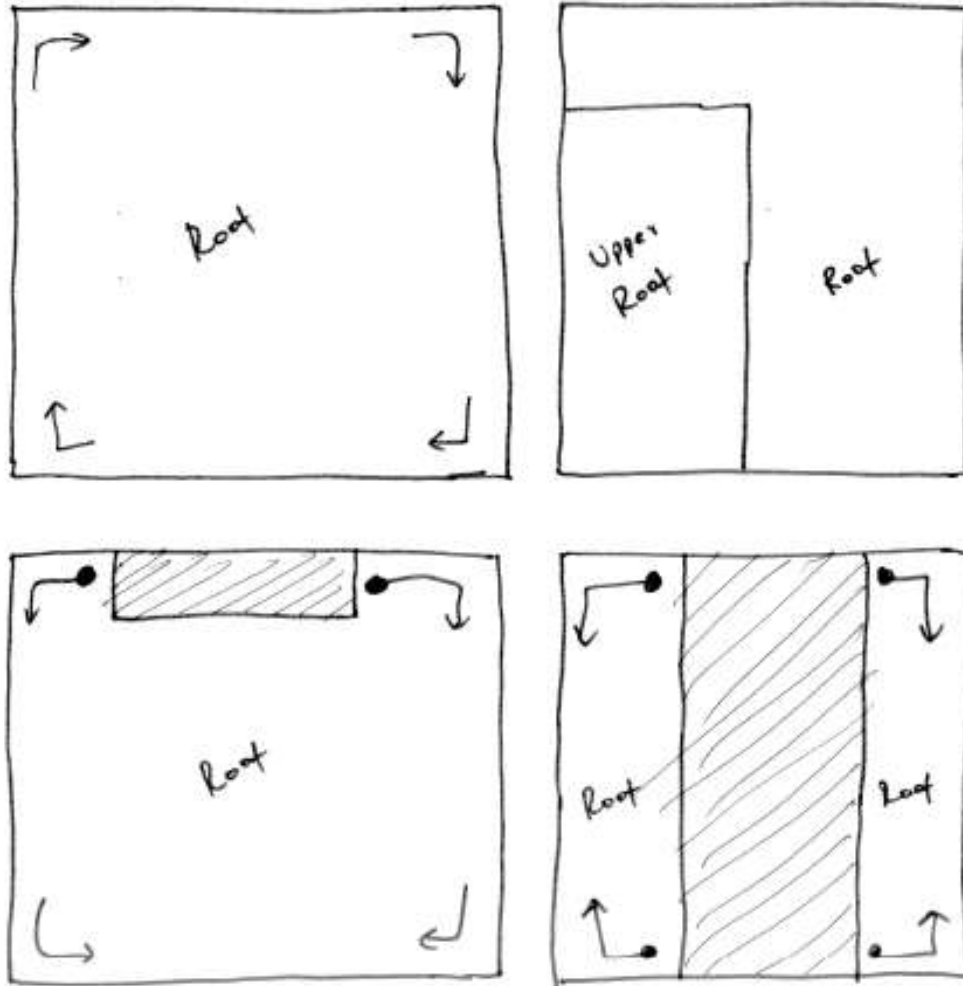


FAÇADE TYPES



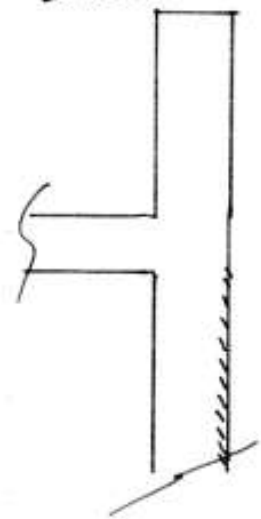
CHALLENGING FAÇADE TYPES

Various roof conditions

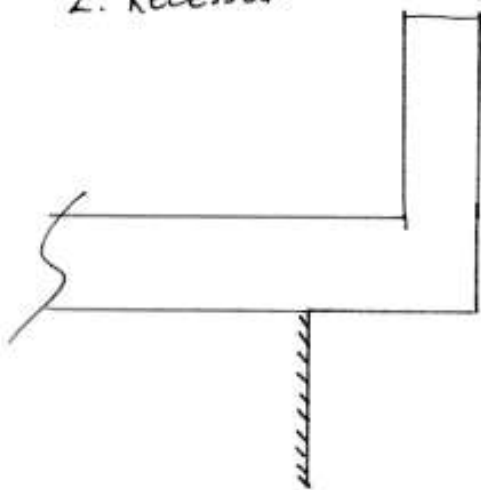


Sloped roof

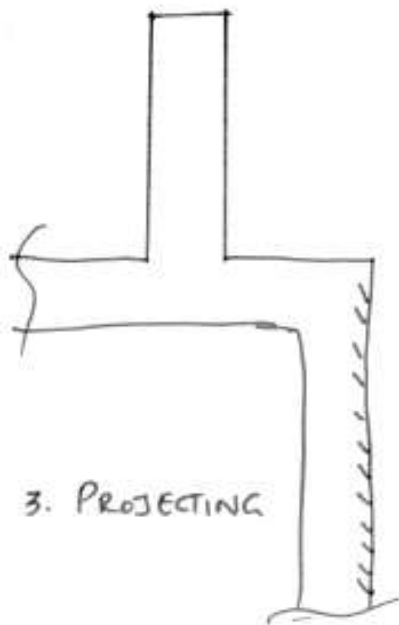
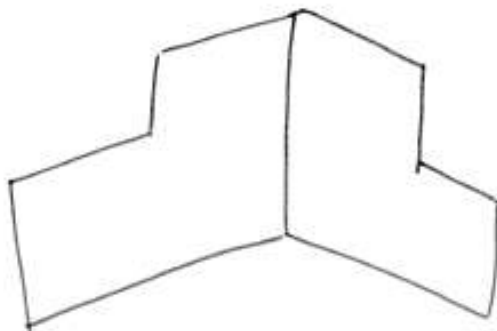
1. REGULAR



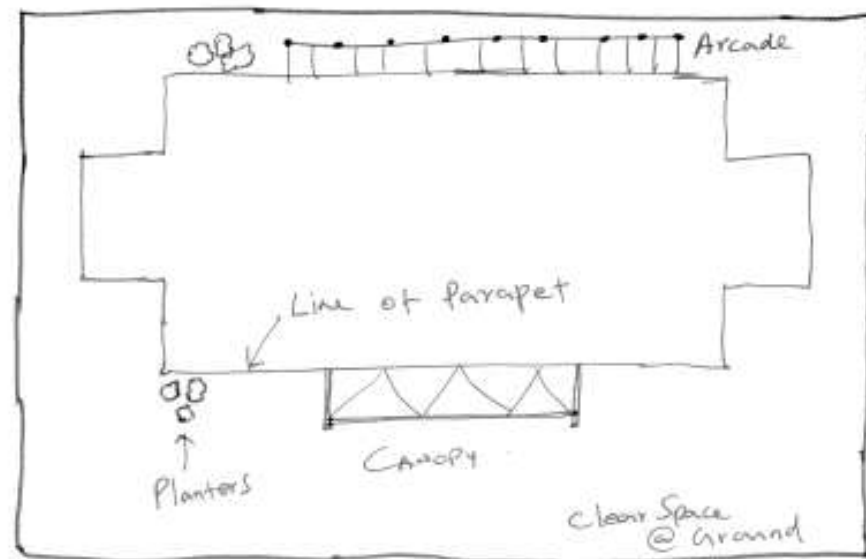
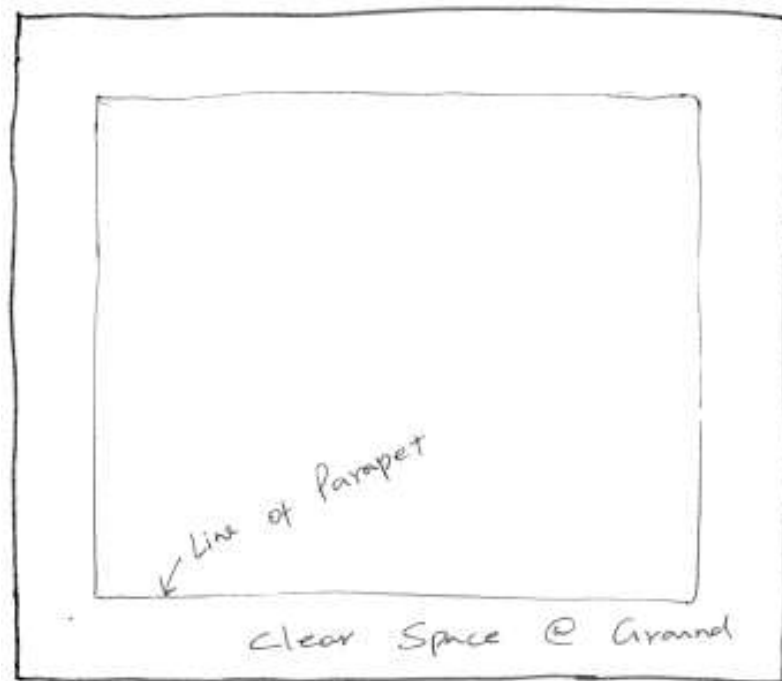
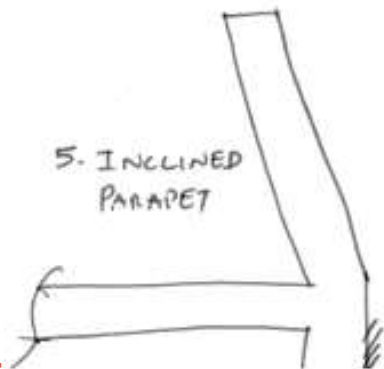
2. RECESSED



4. CHANGING PARAPET HEIGHT

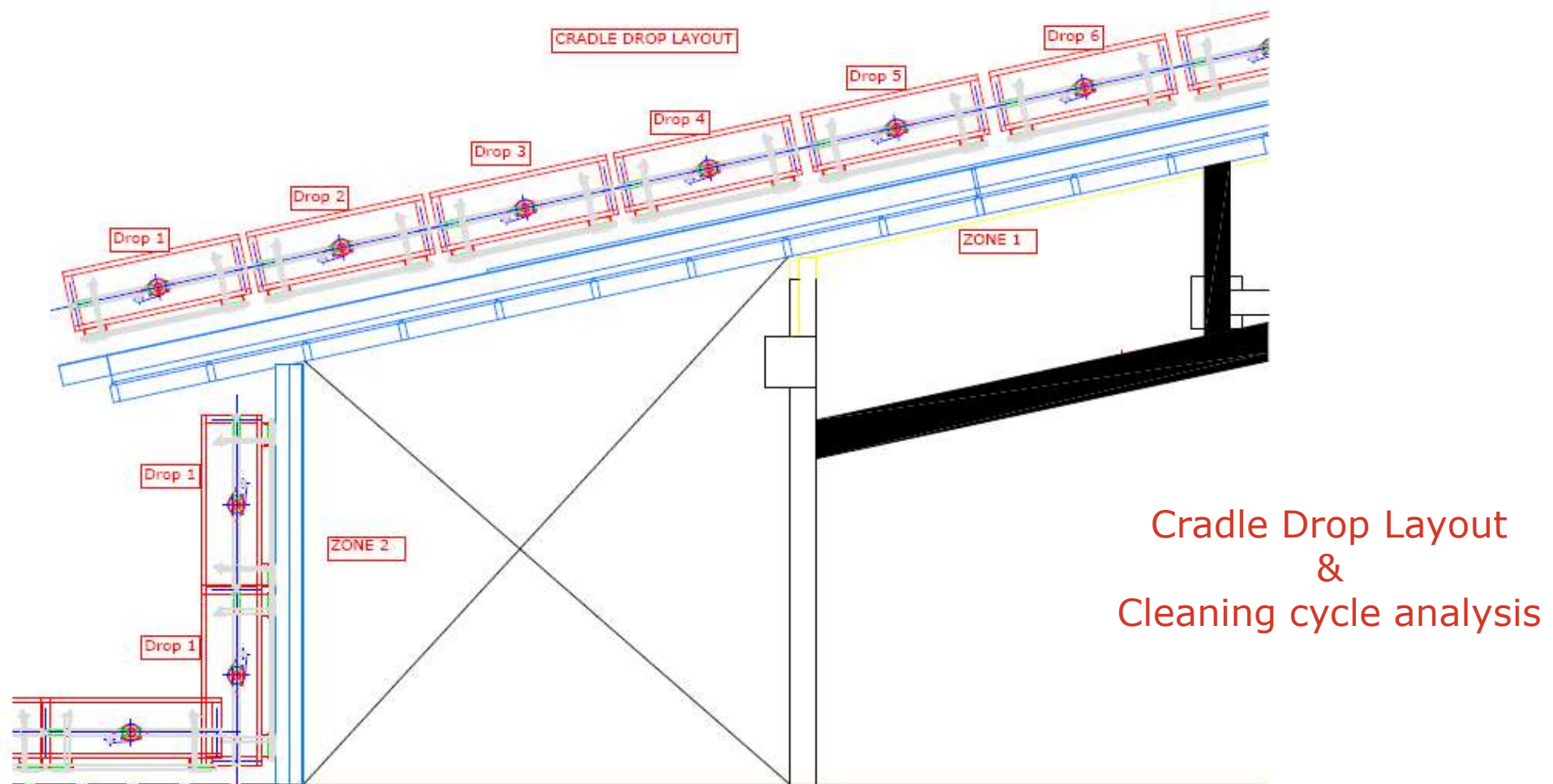


5. INCLINED PARAPET



Parapet conditions

Ground conditions

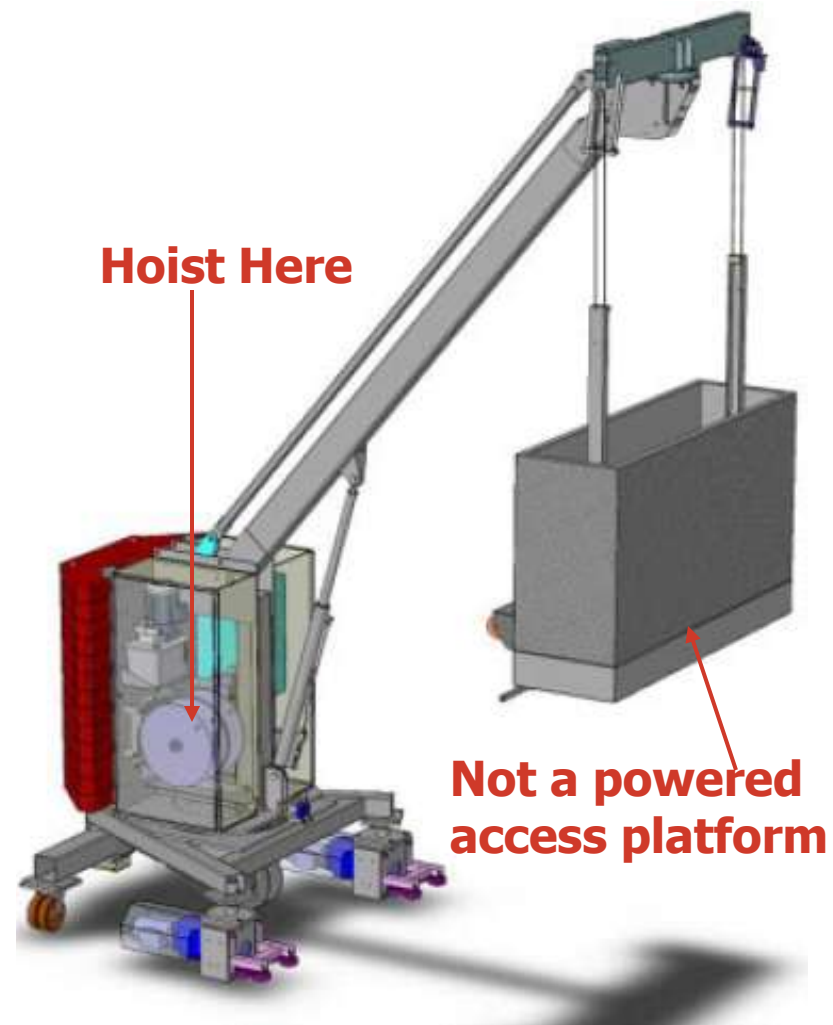


Hoisting: 8mtrs./min Cleaning: 3 sq.mtr./min (by 2 persons)

Elevation	Drop #	Vertical rise (mtrs.)	Cleaning height (mtrs.)	Cleaning width (mtrs.)	Cleaning time (min)	Up/down time (min)	Restraint time (min)	Forward luff time (min)	Initial set up time (min)	Change work position time (min)	Total time/drop (min)	Total time / elevation (min)	Total days (6.5hrs per day)	Total span (days)
West	1	60	56	2.5	47	14	3	10	30	10	114	830	2.1	3
	2				47	14	3	10		10	84			
	3				47	14	3	10		10	84			
	4				47	14	3	10		6	80			
	5				47	14	3	10		6	80			
	6				47	14	3	10		6	80			
	7				47	14	3	10		6	80			
	8				47	14	3	10		6	80			
	9				47	14	3	10		10	84			
	10				47	14	3	0			64			

2 Basic types of BMUs:

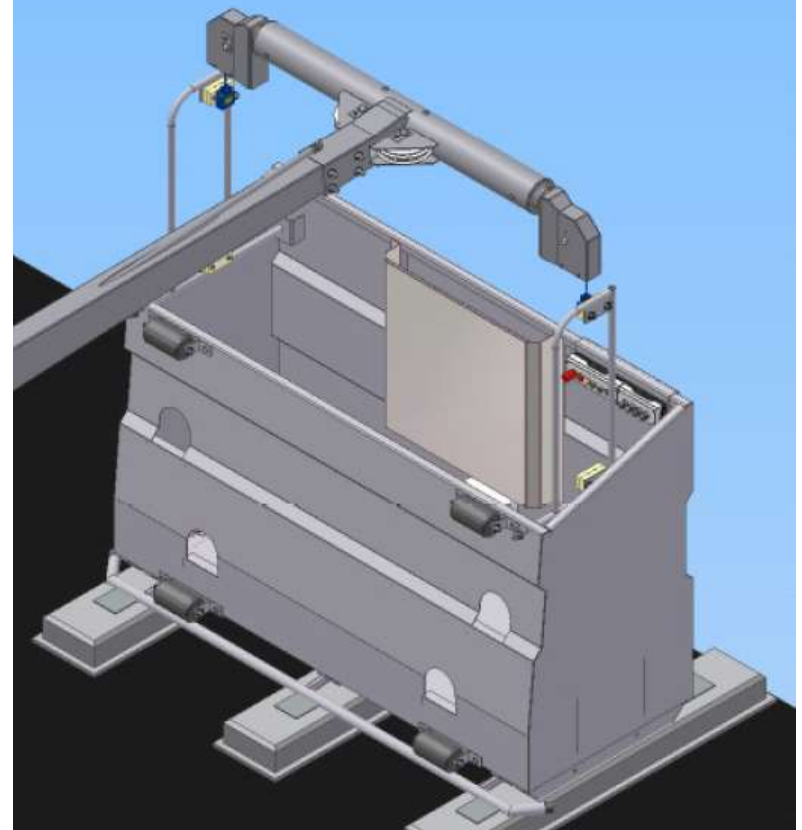
- **Hoisting mechanism within carriage at roof level**
- **Hoisting mechanism within suspended platform**





Motorised platform:

- Heavy – difficult to handle
- Platform space not roomy.
- Cleaner must check proper operation of various devices
- Use if lifting below 40mtrs.
- Can be shared with other roof systems.



Non-motorised platform:

- Light weight – easy to handle
- Platform is spacious
- Cleaner can concentrate in cleaning
- Use if lifting more than 40mtrs.
- Cannot be shared – used only on roof trolleys

Components of Davit systems

Fixed boom

- cannot bring cradle onto roof

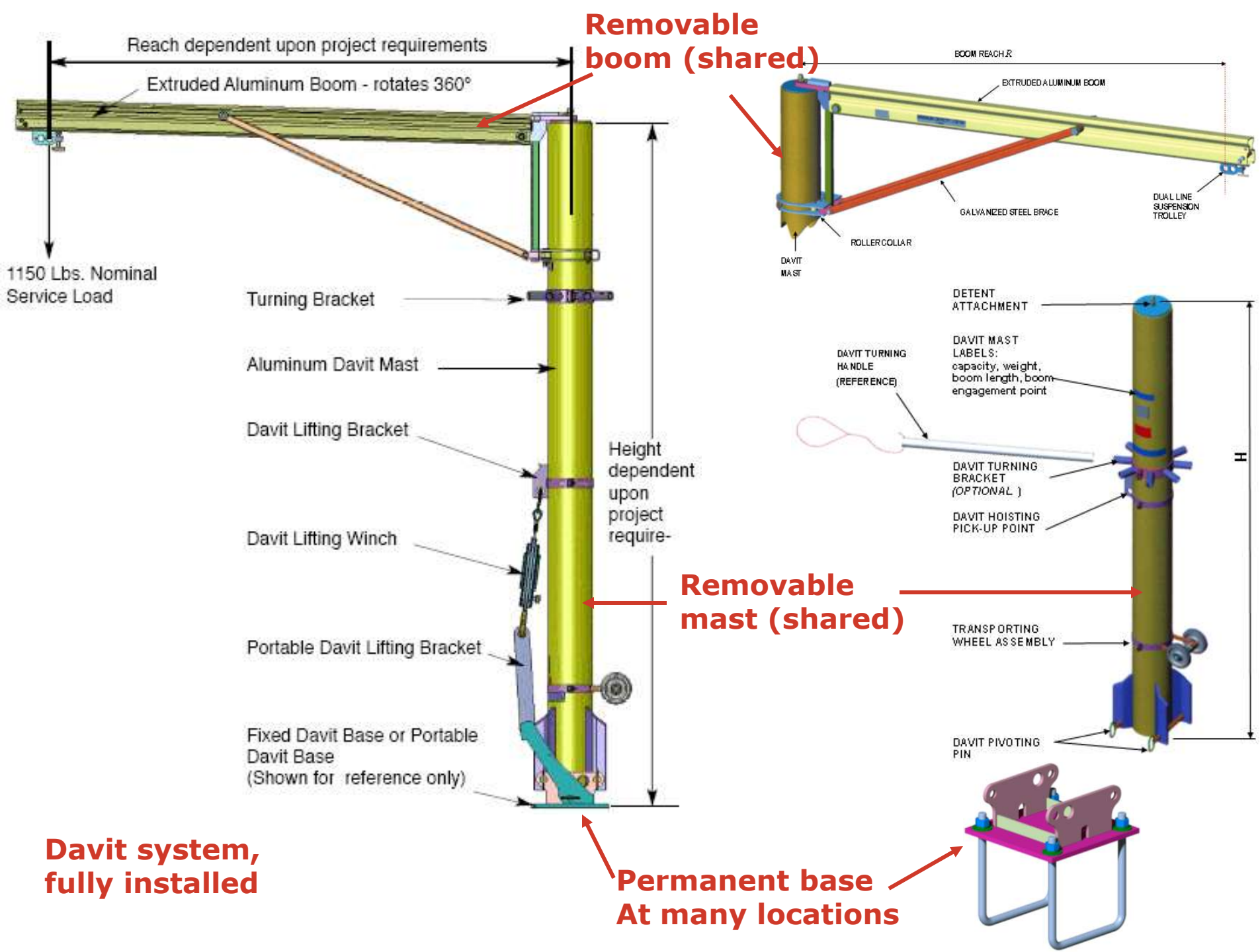


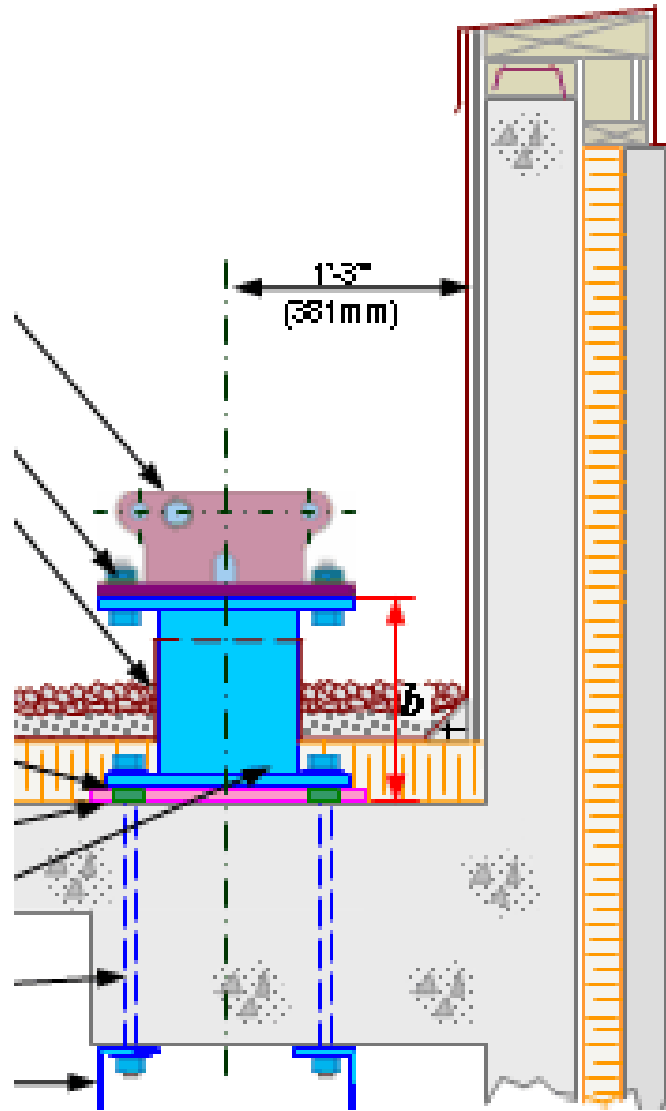
- Davit bases are laid out on the roof slab
- Along the parapet
- At typical spacing suitable for platform length

Rotating boom

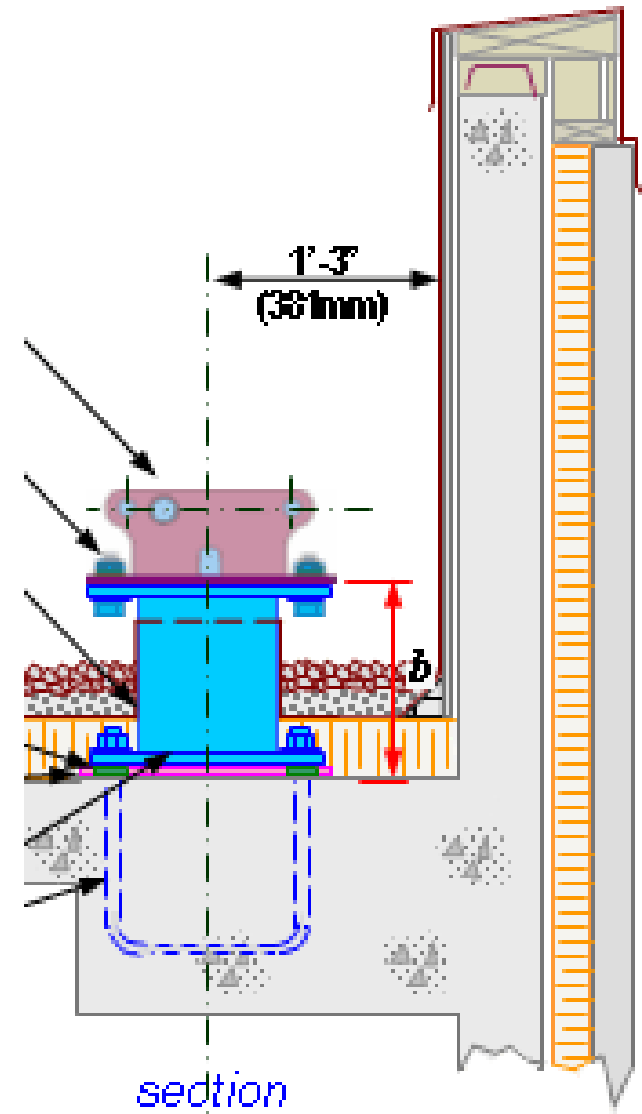
- can bring cradle onto roof







Through bolt fixing



Cast-in U bolt fixing

REQUIREMENTS OF BMU SYSTEMS:

Manual systems: (Davits, Roof anchors, Roof beams, Clamps)

- Floor mount (or) parapet mount
- Structurally sound roof slab & parapets (RCC or steel) – Verify loads!
- RCC pedestals – Verify height & waterproofing
- Advisable to use through-bolting or cast-in bolts inside concrete. (Drill in place or chemical bolts not recommended due to high pullout loads.)
- When relocating, the suspended load must be removed (need landing space directly below suspension point.) Keep ground floor clear!
- Usually in natural aluminium or galvanised steel finish

Disadvantages:

- Heavy, laborious & time-consuming to use.
- Platform stays at ground floor most of the time.
- Hooking & unhooking of ropes need extra care.
- Important components/fasteners are lost & replaced with local means.

Components of Monorail:

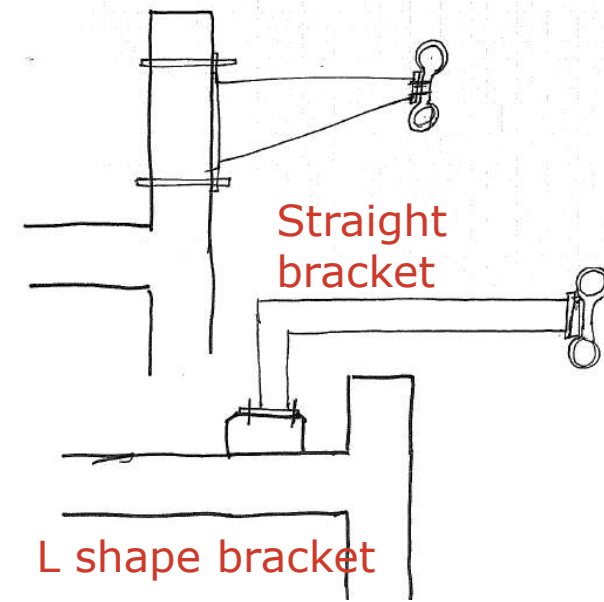


Monorail Track

Support bracket

Traversing trolley

- Manual pull
- Rope driven
- Motorised



Straight
bracket

L shape bracket

- Monorail brackets are anchored on parapet wall (straight brackets) or on floor slab (L-shape brackets)
- At typical spacing of 2000mm
- Typical overhang is 700mm for smooth façade types.

REQUIREMENTS OF BMU SYSTEMS:

Monorail systems:

- Floor mount (or) parapet mount
- Structurally sound roof slab & parapets (RCC or steel) – Verify loads!
- RCC pedestals – Verify height & waterproofing
- Advisable to use through-bolting or cast-in bolts inside concrete. (Drill in place or chemical bolts not recommended due to high pullout loads.)
- When sharing cradle with another monorail, need landing space directly below suspension point. Keep ground floor clear at the point of cradle transfer.
- Park at the rear of building (with ropes hanging) Not recommended.
- Provide access door at monorail level to remove ropes for clean storage & sharing cradle.
- In variety of finishes: natural aluminium, anodized, powdercoated to RAL color

Disadvantages:

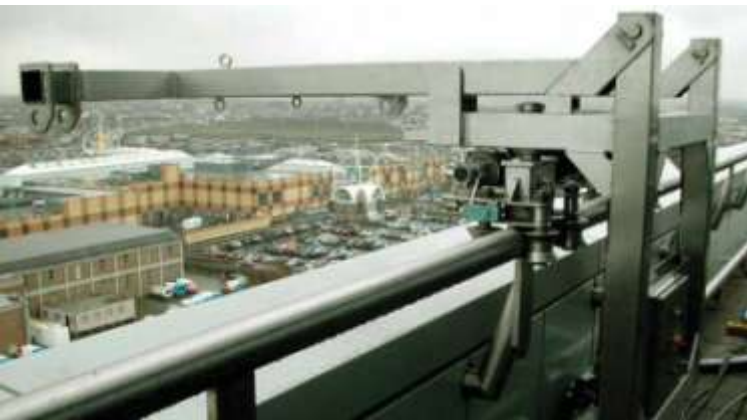
- Cradle sharing is laborious & time-consuming.
- Platform stays at ground floor most of the time.
- Hooking & unhooking of ropes need extra care & access doors.

Types of roof trolleys:

- * With motorised platform
- * With non-motorised platform

Design variations:

- Trolleys running on RCC runway / Steel plate runway (with tiller)
- Trolleys running on RCC runway / Steel plate runway with continuous guide angle track.
- Trolleys running on Steel beam tracks on floor slab
- Trolleys running on Steel beam tracks on parapet wall
- Pedestal type (do not run around the roof.)
- Trolleys climbing on a sloped roof / parapet



Machine with rail tracks on parapet wall



**Climbing slopes-
Self powered**



**Climbing slopes-
Remote powered**

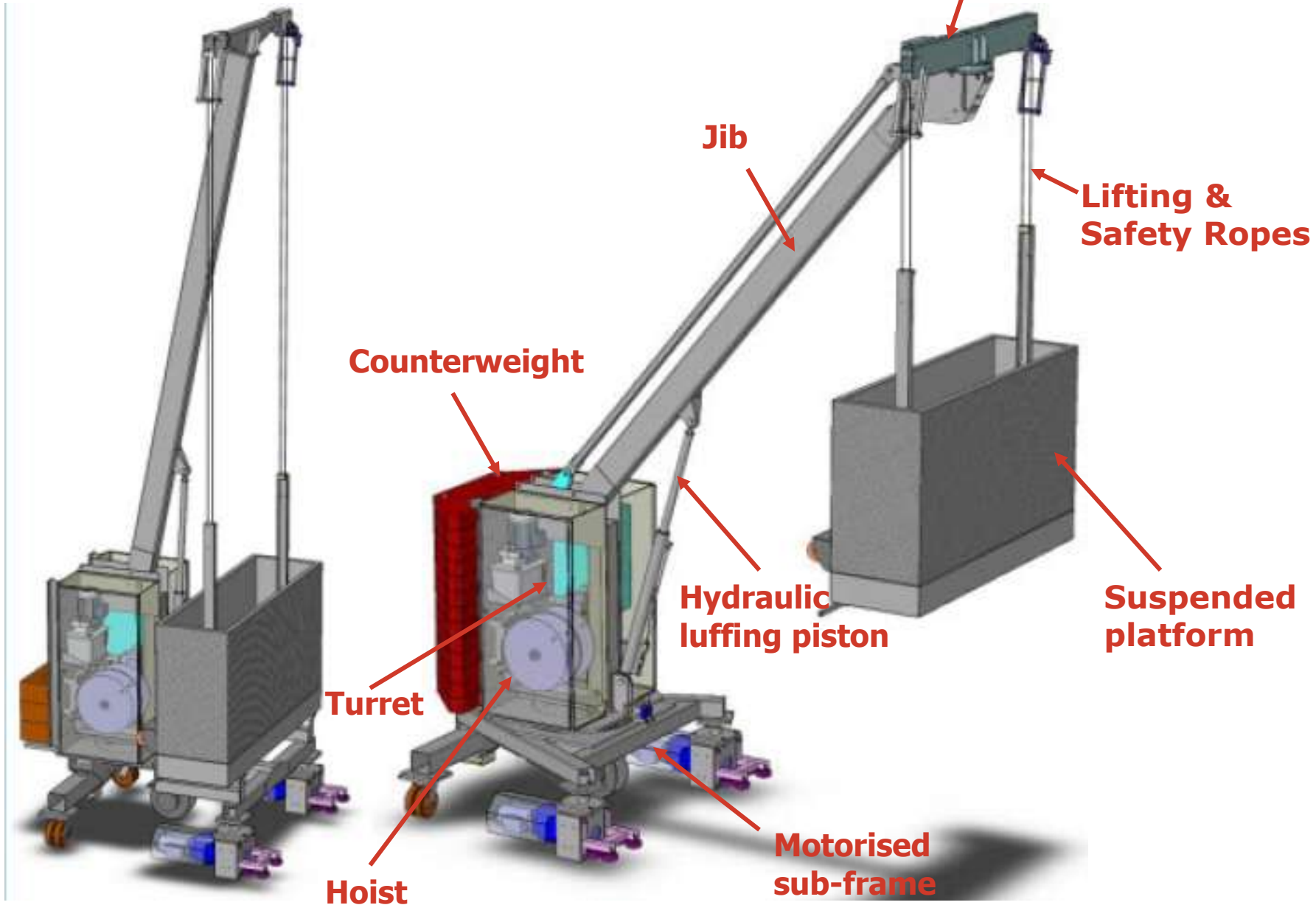


**Standard machine
on I beam tracks**



**Standard machine
on RCC runway**

Basic components of a roof trolley BMU:

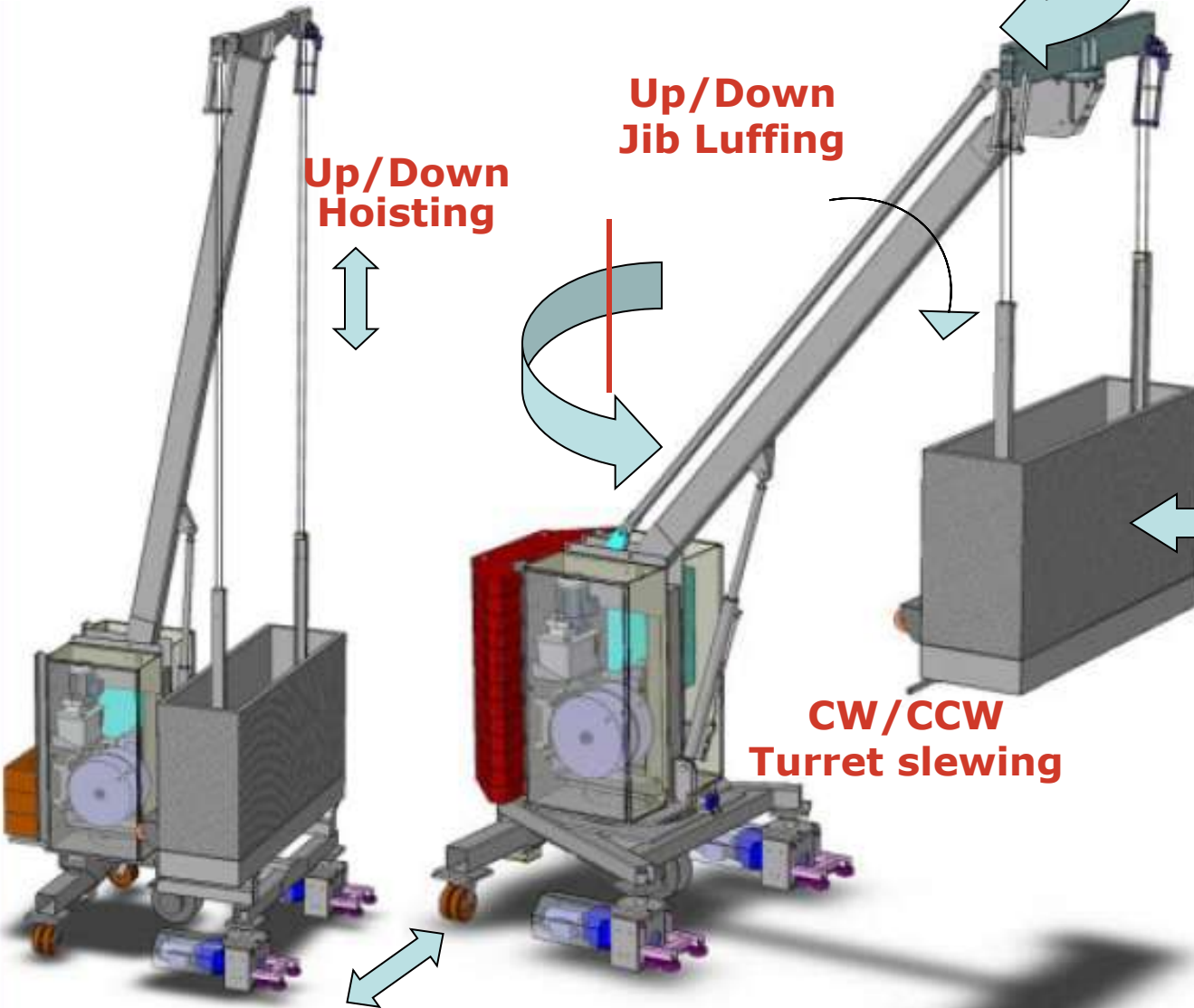


MOVEMENTS OF A BMU

**CW/CCW
Cross bar
slewing**

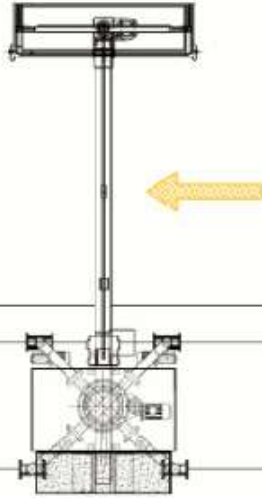
**Up/Down
Jib Luffing**

**Up/Down
Hoisting**

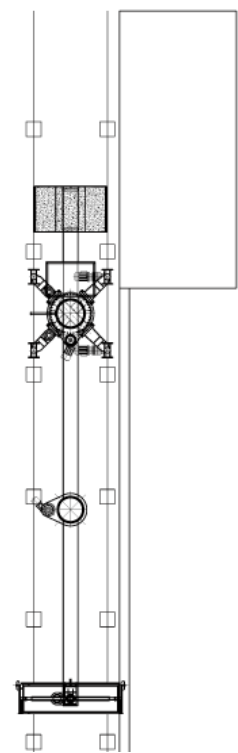
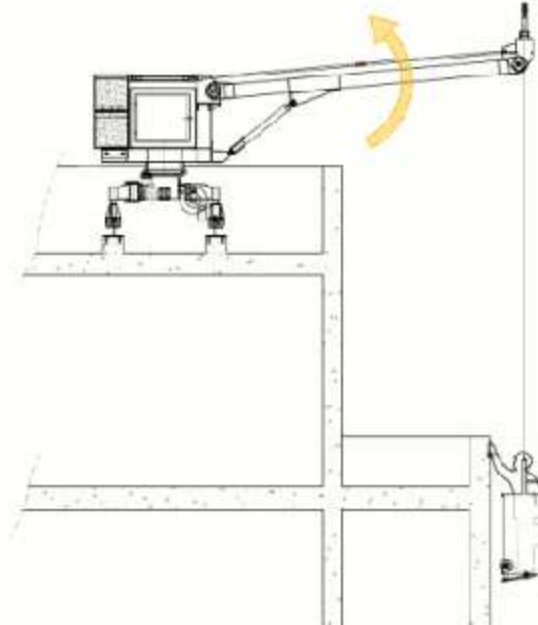


Left/Right Traversing

Traversing



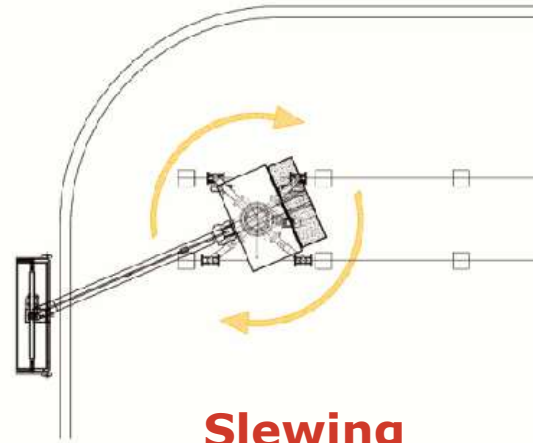
Luffing



Horizontal elbow



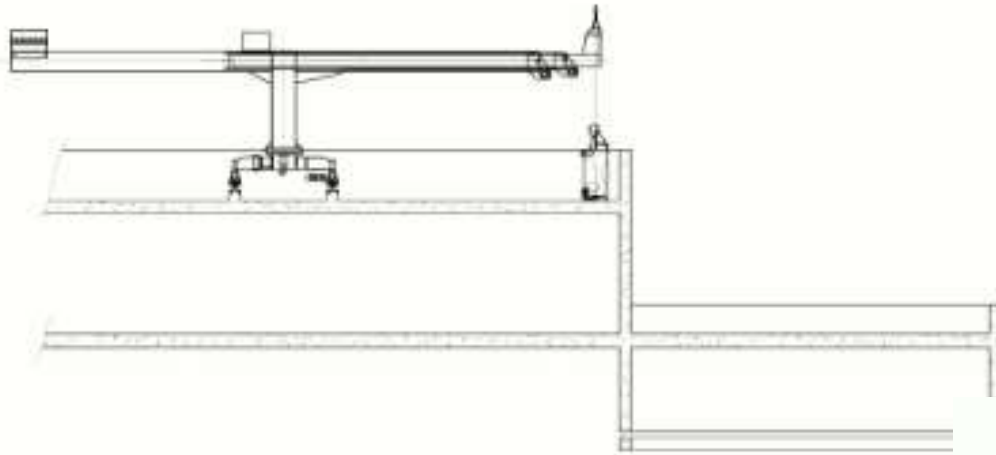
**Spreader bar
slewing**



Slewing

**Movements of
BMU components**

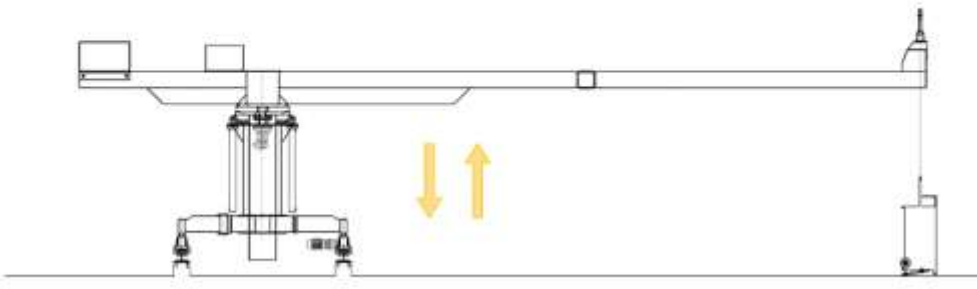
Jib telescoping



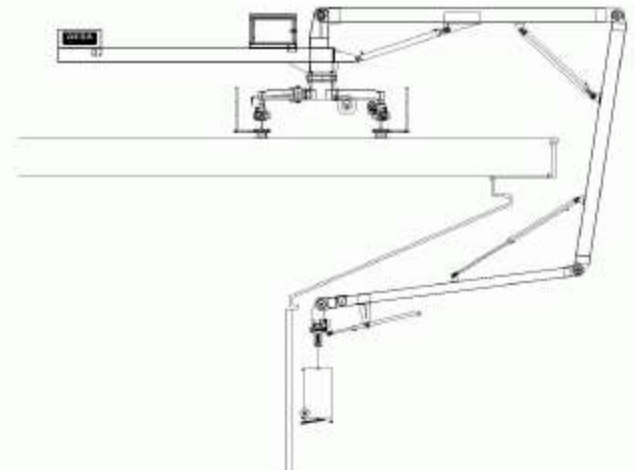
Movements of BMU components

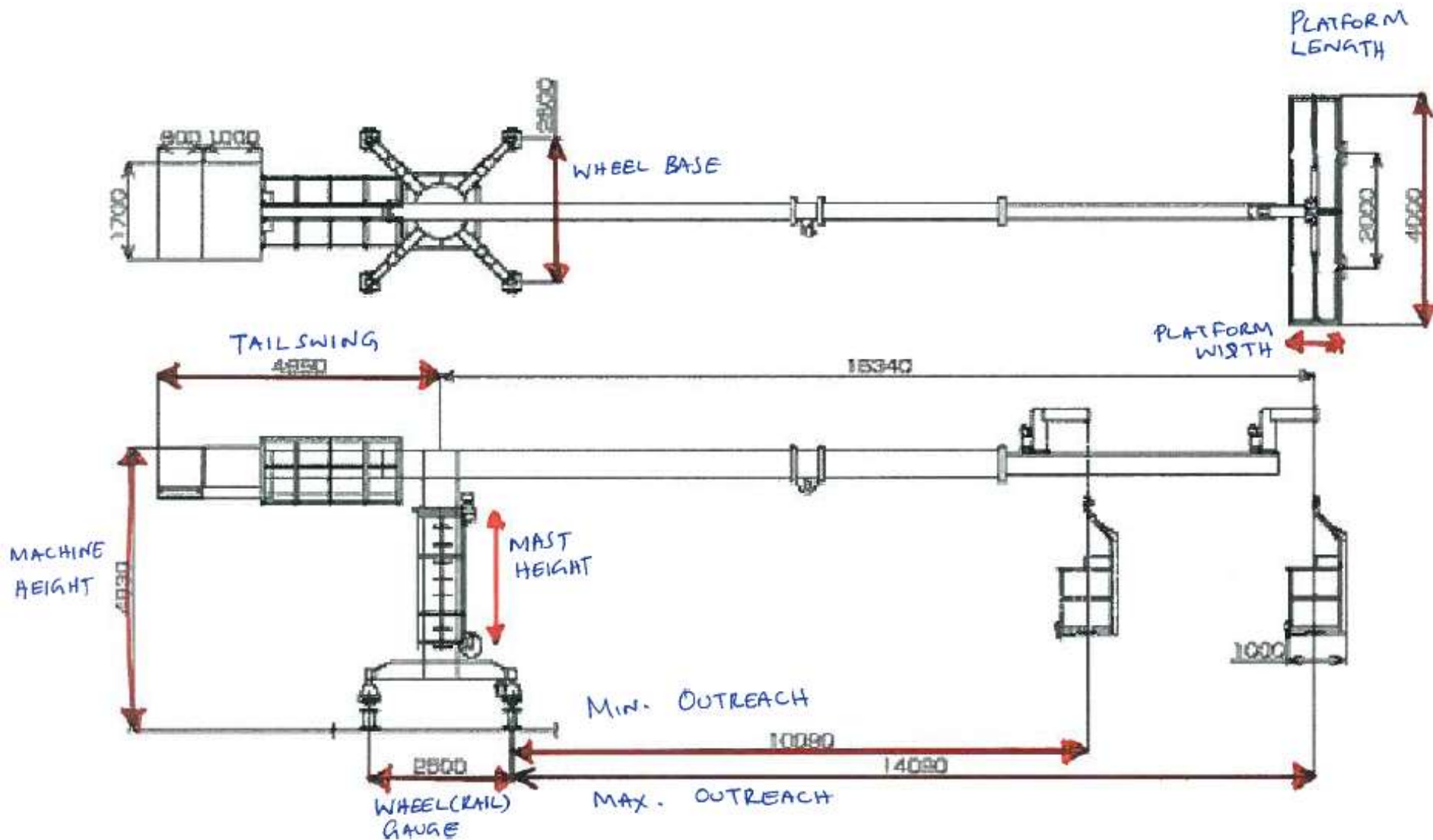
Mast rise/lower

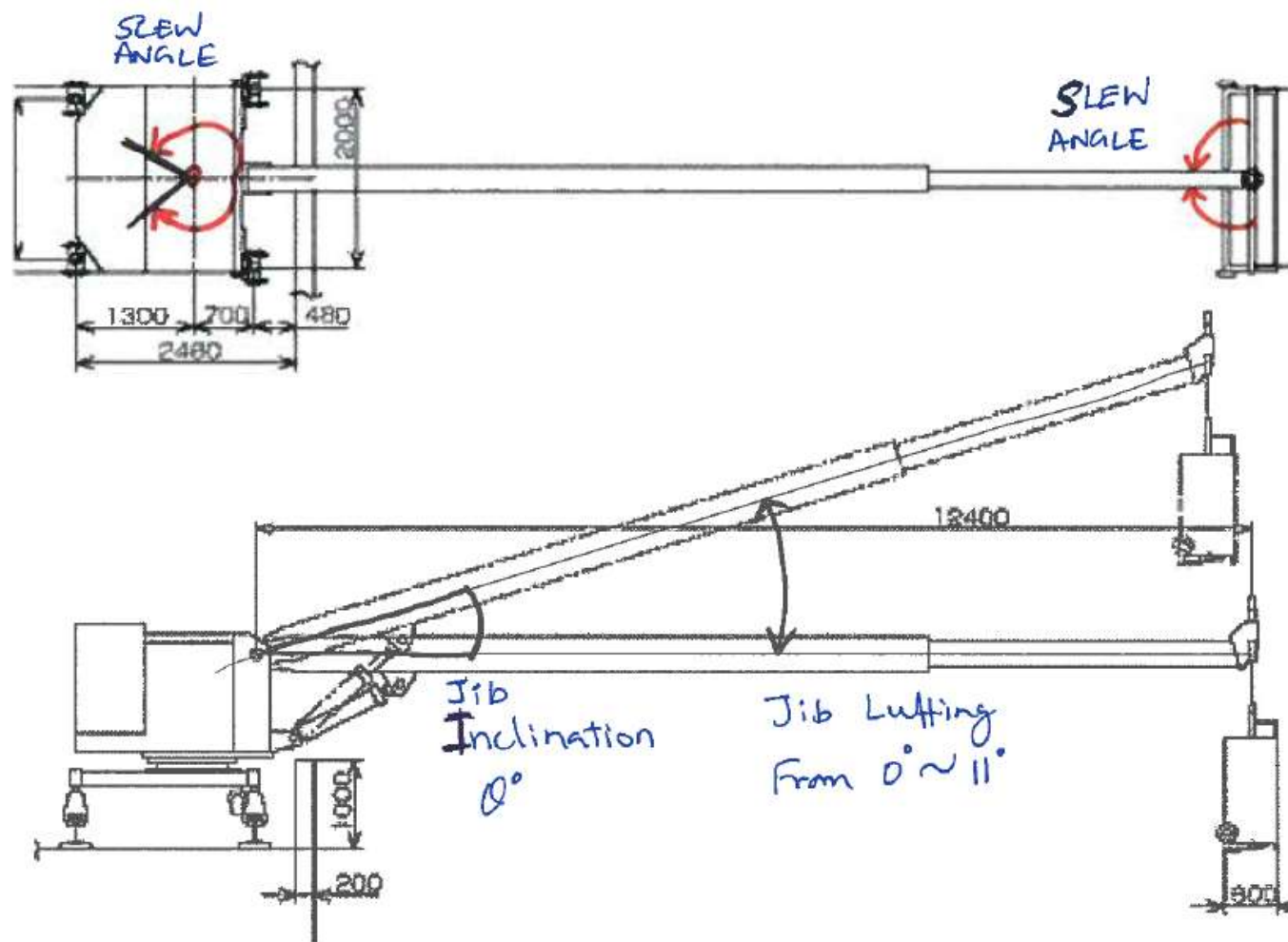
AESA
EUROGONDOLAS



Vertical elbow







Important terminologies relating to the BMU:

- Wheel gauge, Wheel base
- Outreach, Tail swing
- Jib inclination
- Jib luffing angle (From... to...)
- Machine Height

Jib length (Extended / Retracted)
 Slew (rotation) angles
 Mast Height
 Platform width
 Platform length

REQUIREMENTS OF BMU SYSTEMS:

Roof trolley systems:

- Structurally sound roof slab & parapets (RCC or steel) – Verify wheel loads!
- RCC pedestals – Verify height & waterproofing
- Dead weight of machine
- Parked at the rear of building or at designated parking garage on roof.
- Can be hidden inside the building when façade doors are provided for moving out.
- In variety of finishes: Galvanised steel / powder coated to RAL color
- Safest solution to access complicated façades

Disadvantages:

- Expensive
- Requires considerable amount of free space at roof for movement.
- Heavy & puts considerable load on structure.

MEP REQUIREMENTS OF BMU SYSTEMS:

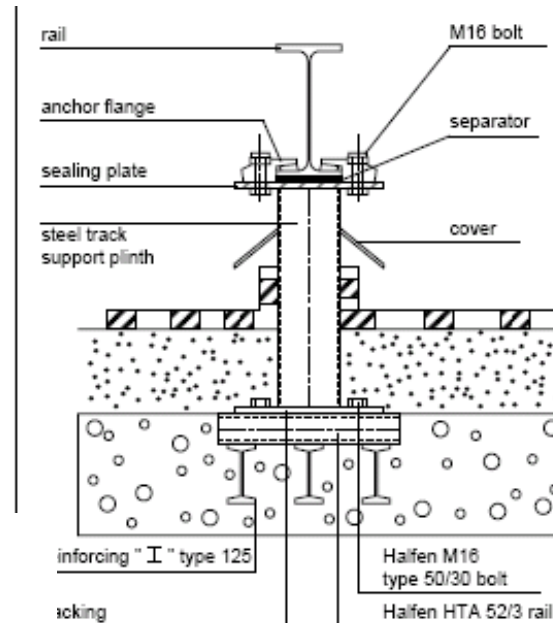
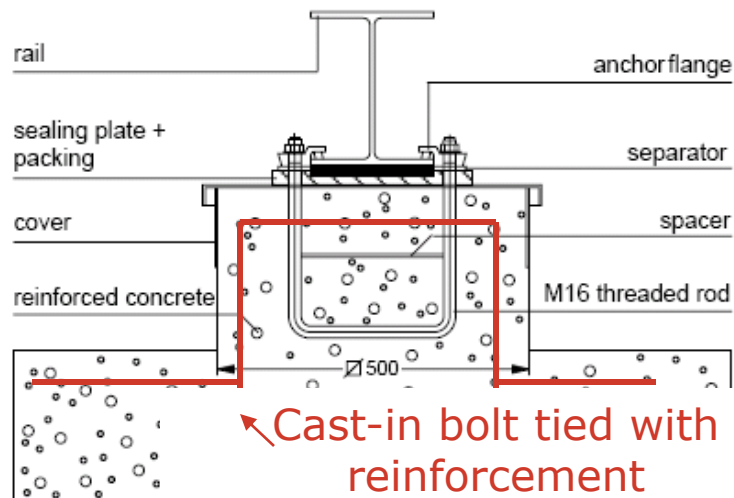
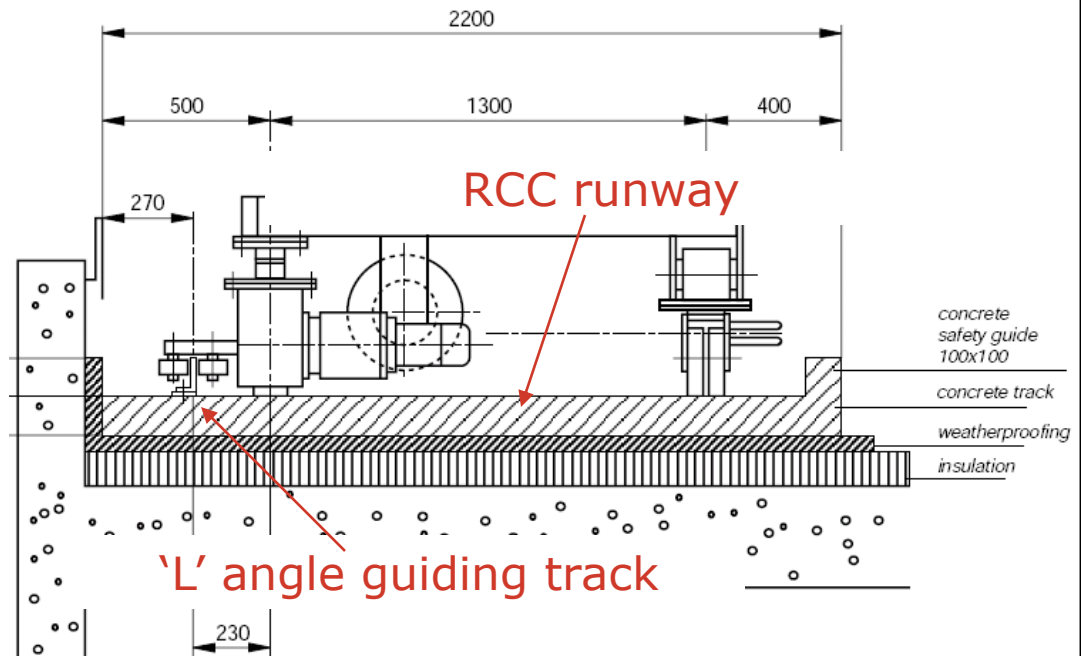
- 3-Phase, Neutral, Earth – 5 pin AC power supply
- Sockets at many locations on roof level for roof trolleys – spaced @15mtrs.
- Sockets at many locations on ground level for monorail / manual systems – spaced @15mtrs.
- Usually 32Amps. Weatherproof sockets on the building (socket type to match with plug on BMU.)
- Provide 1 No. 1-Phase, Neutral, Earth – 3 pin AC power supply for use of maintenance tools.
- Usually 16Amps. Weatherproof sockets on the building. (Most common type in the local market.)
- Provide water supply mains – for cleaners to carry water inside the cradle. Provide at platform storage level.



Weatherproof
Power socket

Track systems for Roof Trolley BMU

- To spread machine load evenly on the supporting structure.
- Provide means to climb over sloped roofs
- To facilitate parking
- To change movement direction without turning radius
- To hide machine from general view



RCC Plinths

Baseplate with isolation



I beam tracks on elevated steel structure



RCC runway with guiding rail

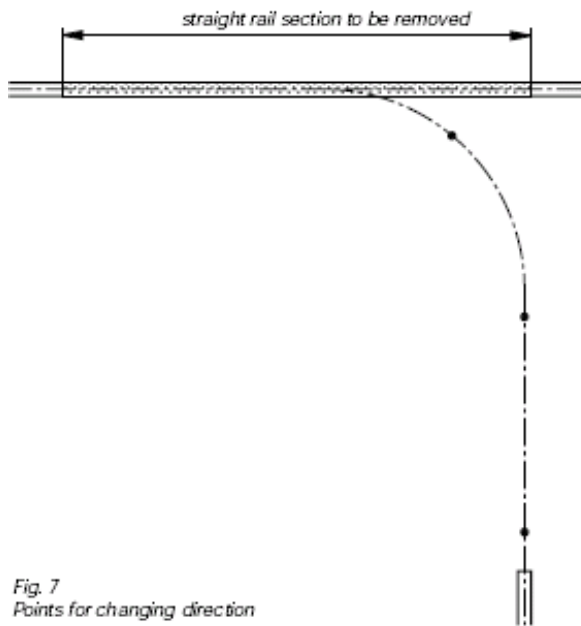


Gear rack track for climbing slopes

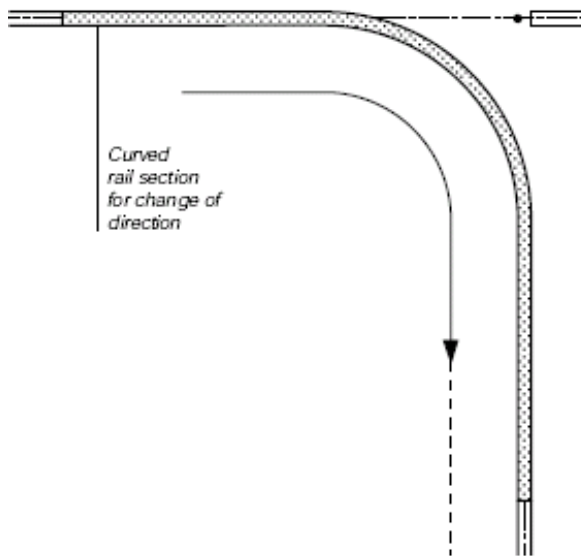


I beam tracks on sloped roof

Track systems for Roof Trolley BMU



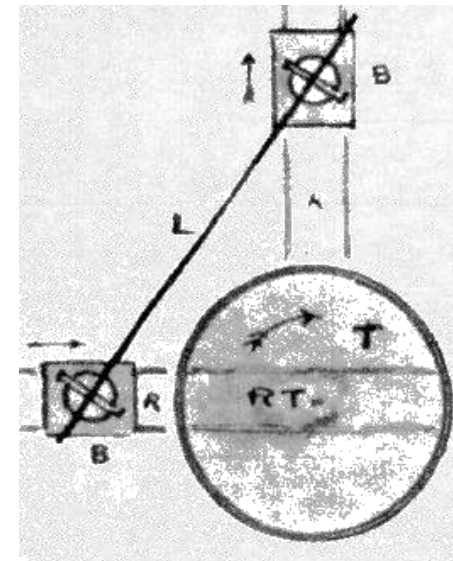
I Beam Track transfer system
90° branch



'L' Angle Track transfer system
90° branch



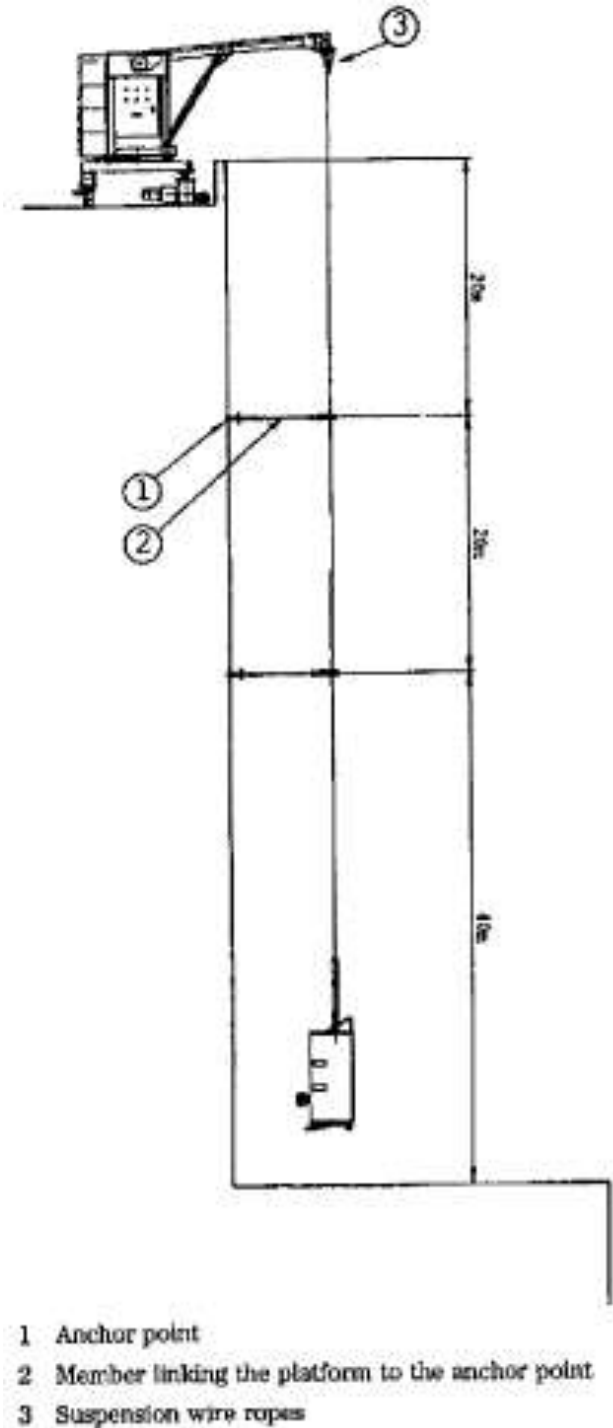
Scissor platform to hide
machine from view



Rotating
turn table

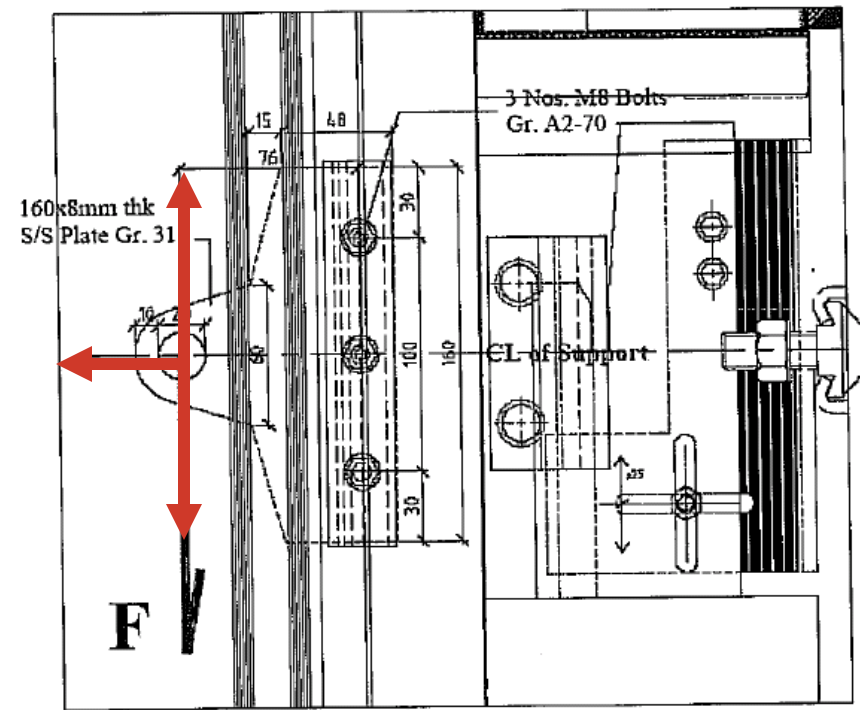
BMU: Platform stabilisation

- Applicable when lifting height is more than 40mtrs.
- Rope with cradle is tied to façade at 20mtr. on elevation – to prevent cradle swaying with wind
- Horizontal spacing depends on cradle width (W+300mm)
- Restraint sockets built into façade – flush mount or projecting bracket type.
- Lashing on structural fins
- Min. 100kgs. Pull out load on façade at any direction (for standard equipment)

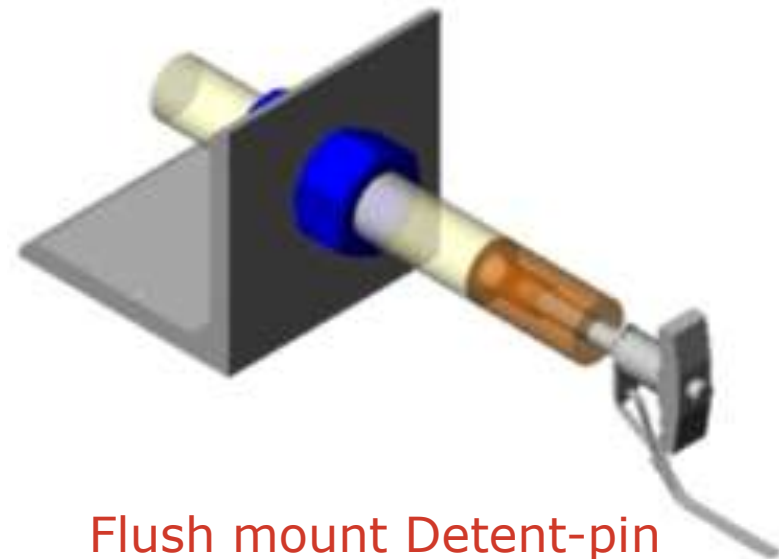


BMU: Platform stabilisation

- Coordination required with façade supplier – At early stage
- To finalise locations of sockets on façade, quantity required, dimensions and fixing details
- 2 components:
 - 1) Restraint socket (built-inside façade) - usually at mullion joints
 - 2) Restraint plug with lanyard (on the cradle)
- Ask for Restraint layout drawing (per elevation), Restraint details drawing – From BMU supplier.
- BMU supplier supplies the sockets & Façade supplier installs them on his façade.
- Sockets quantity: Large depending on area of façade
- Lanyards quantity: (1 on left, 1 on right) X Elevation levels

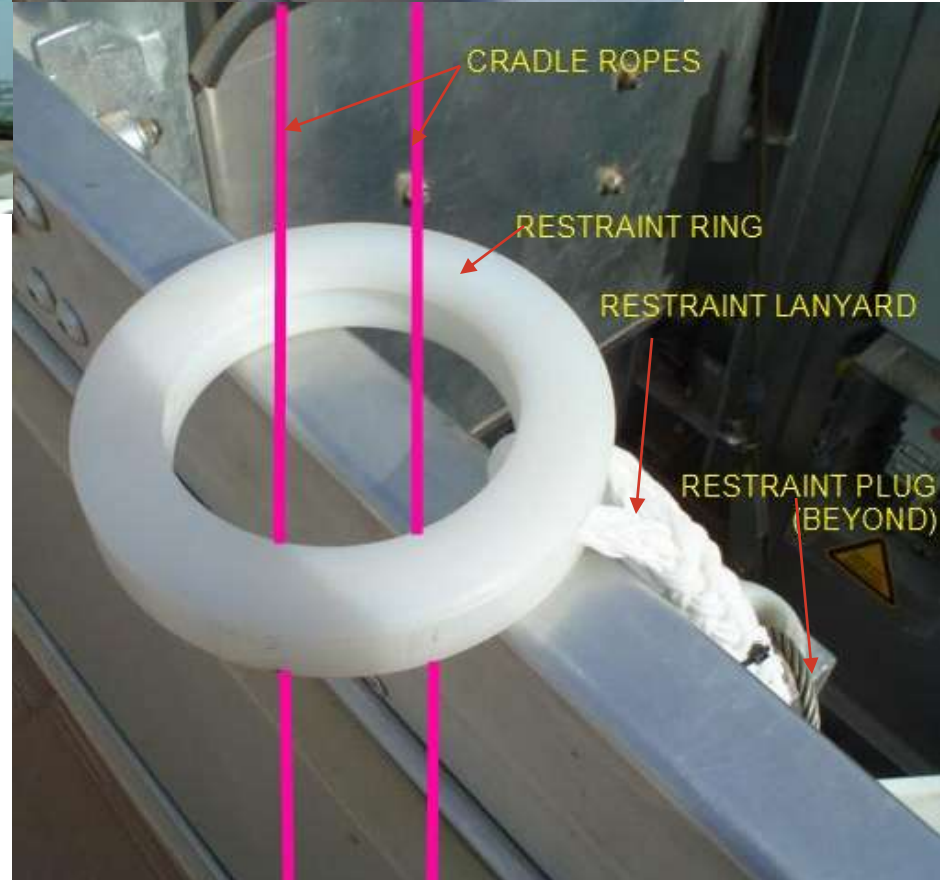
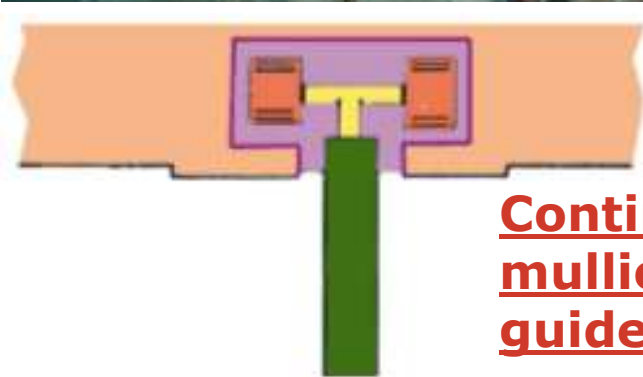
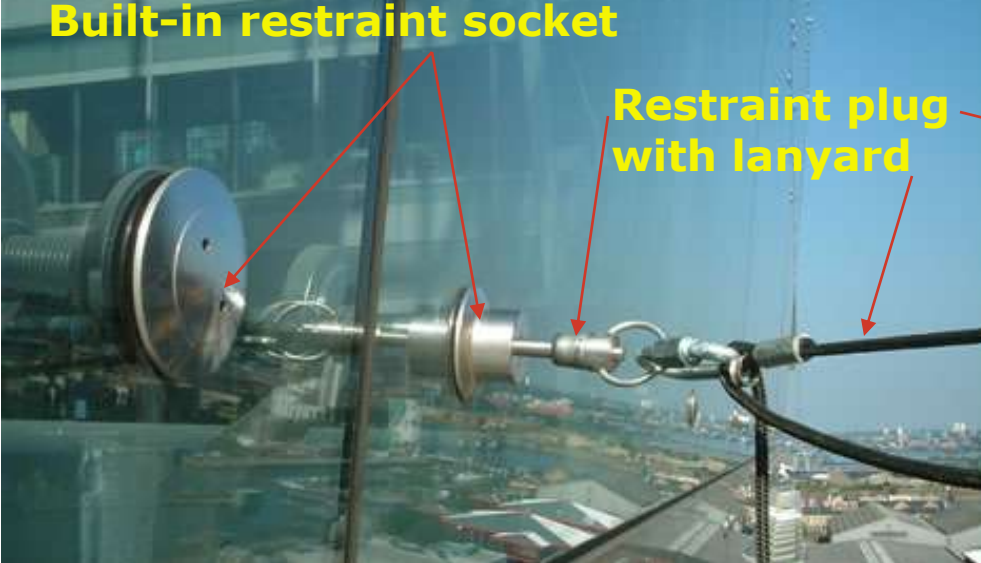


Projecting bracket



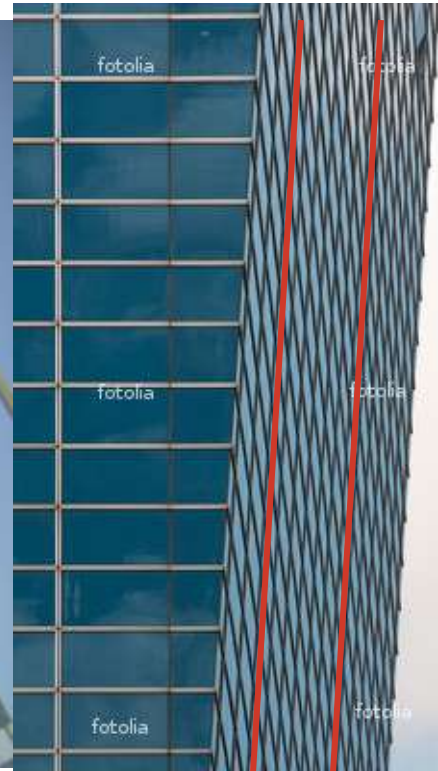
Flush mount Detent-pin

Built-in restraint socket



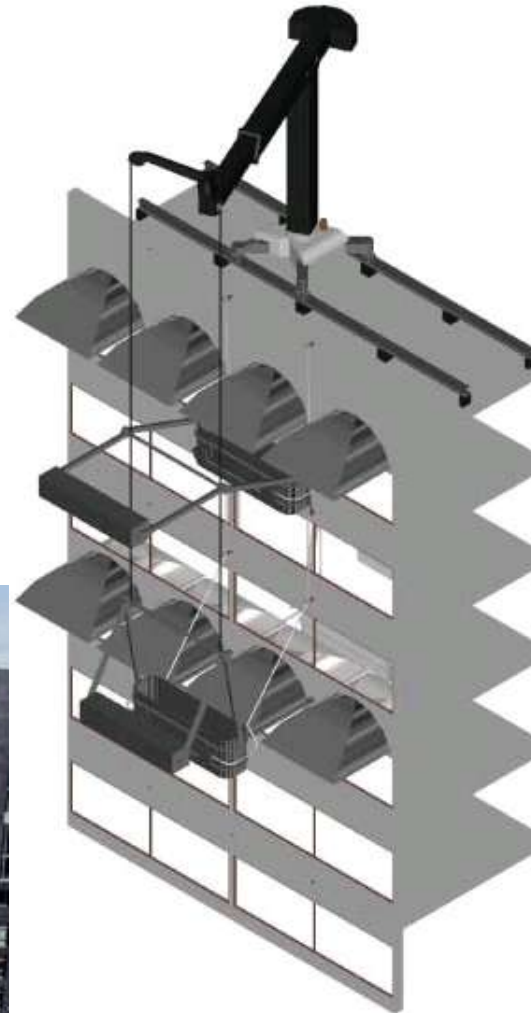
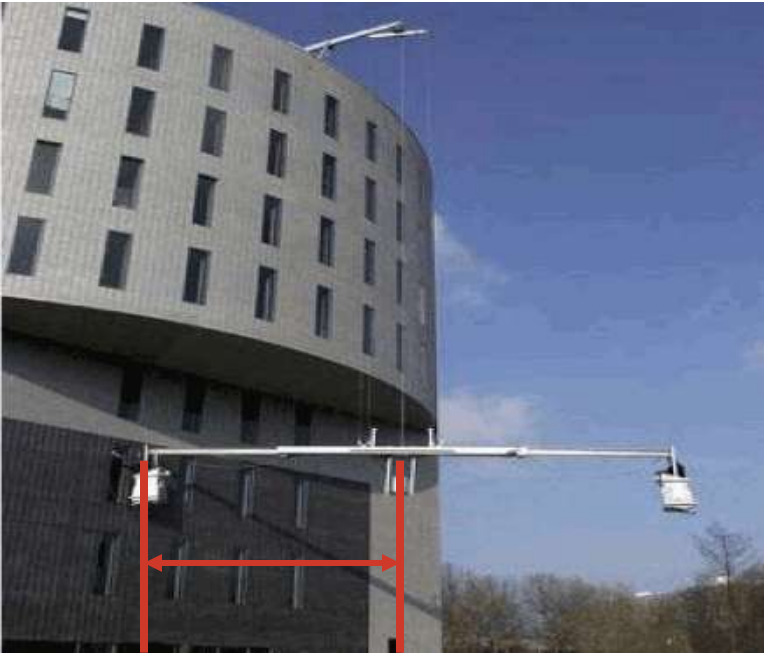
- Sockets on façade preferred.
- Sockets on structure (behind façade) not recommended – trouble with dimensions.

BMU: Platform stabilisation Mullion Guides



- Mullion guides are used on continuously changing facades.
- Continuous guiding track built inside the mullions.
- Cradle simply follows façade mullion's path: outward slopes, inward slopes, projections, twists/ribs

BMU: Special Accessories: FORWARD LUFF/PANTOGRAPH



- Access recessed façades
- Pantograph mechanism
- Manual or motorised
- Standard designs up to 2.5mtrs.
- Special designs up to 5.5mtrs.
- Suspended load is 3-5 times more!
- Roof machine becomes very heavy!

BMU: Special Accessories: Single suspension platforms

- Advantageous with less suspended load.
- Easy to handle & carry around
- Use only for lowrise applications (up to 40mtrs.)
- Single suspension at centre:
Tendency to swivel
- Less stable
- Manual / Motorised versions

Bosun chair (Flying seat)



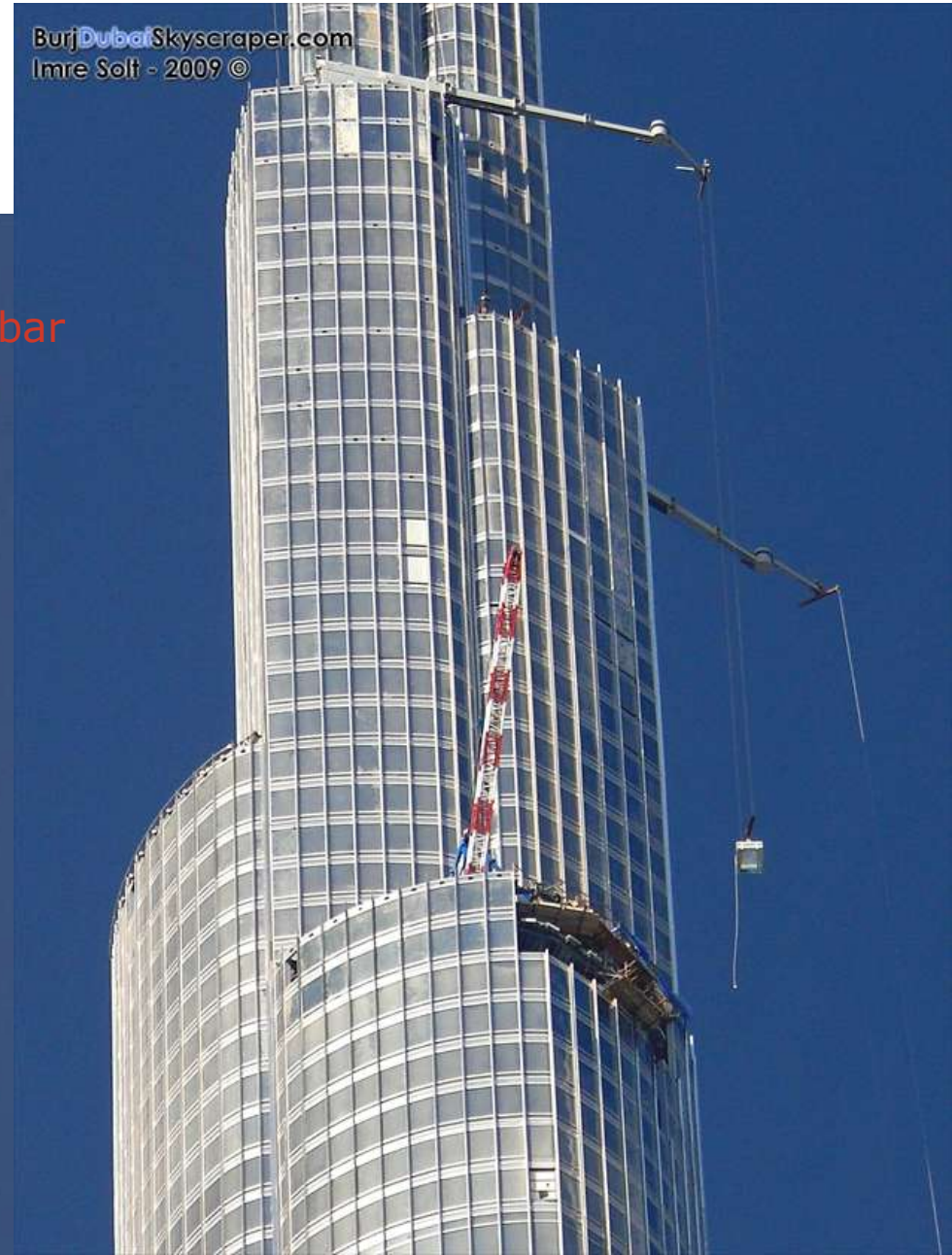
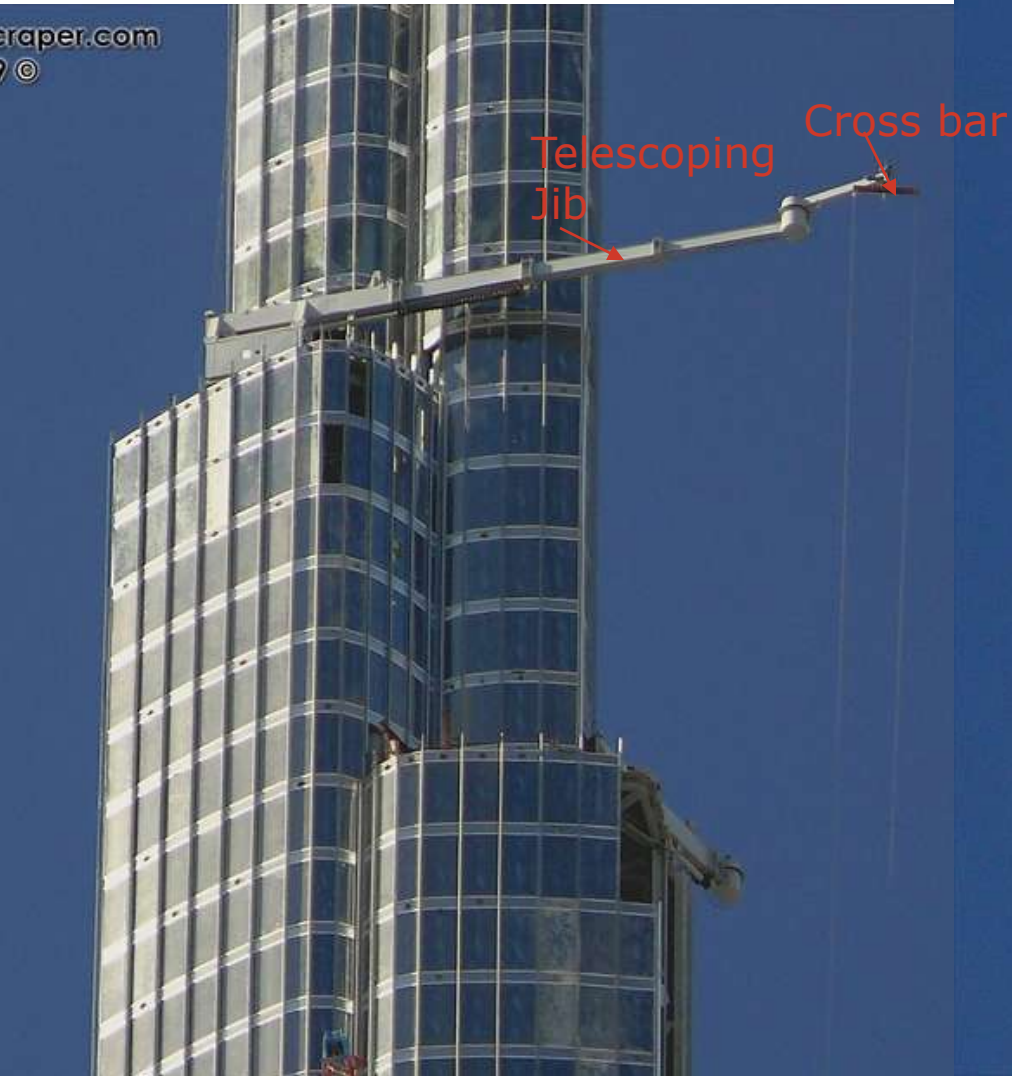
1-Man cradle



BMU on world's tallest building – BURJ KHALIFA, DUBAI

Upper levels:

- Roof trolleys on roof slab
- Telescopic jib with elbow end

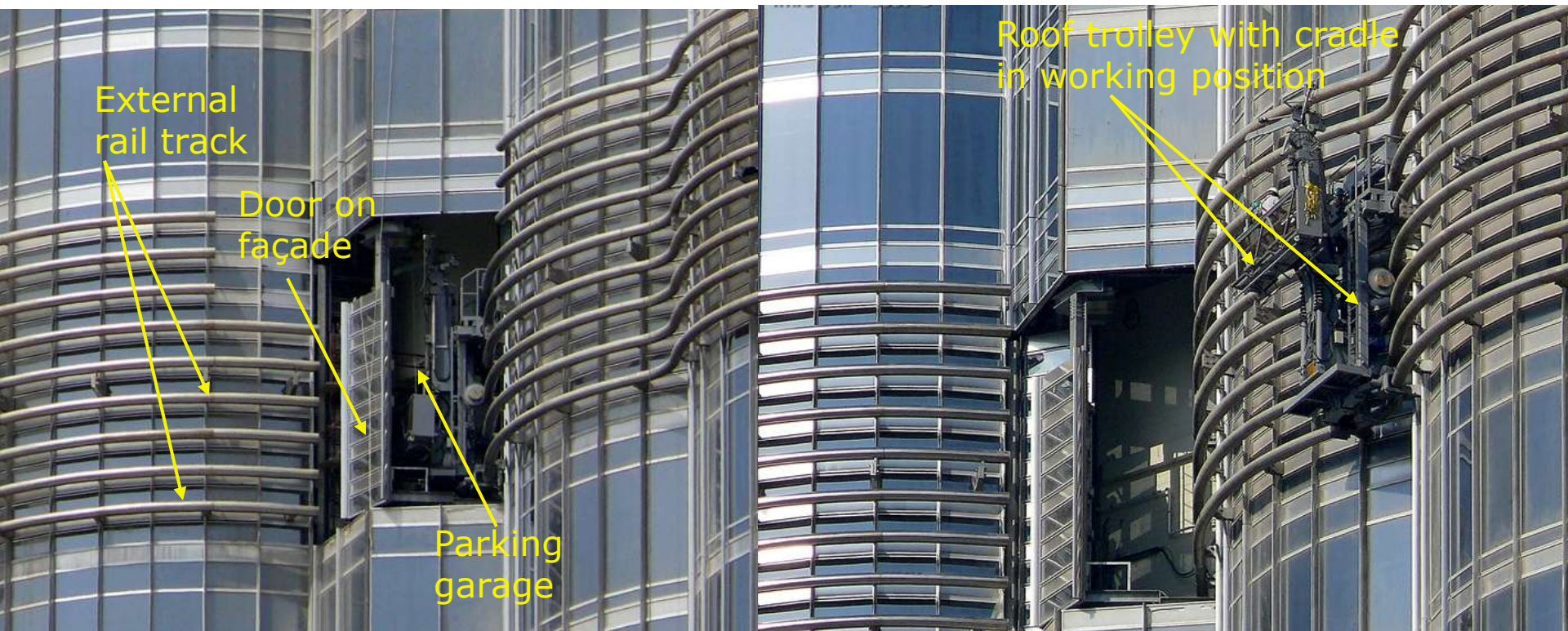


BMU on world's tallest building – BURJ KHALIFA, DUBAI

Lower levels:

- **Roof trolleys running on wall mounted rail tracks: Externally to façade.**
- **Roof trolley with cradle is parked inside the building façade when not in use. A façade door hides roof trolley from view.**

Cross bar



QUESTIONS?

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