

***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.



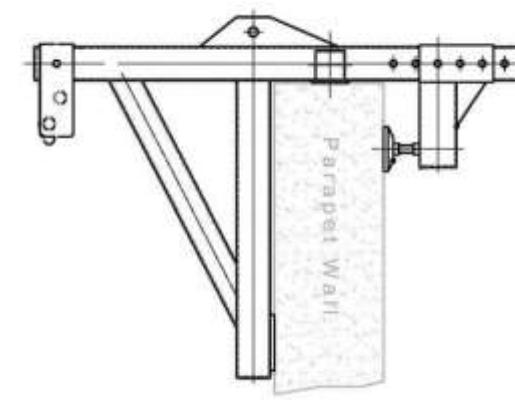
Davit systems



Counterweighted Beams



Internal Monorail



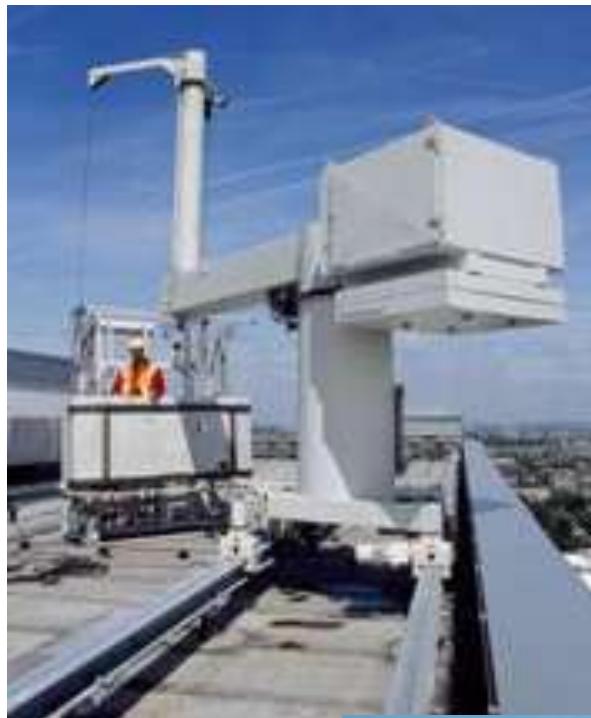
Parapet Clamps



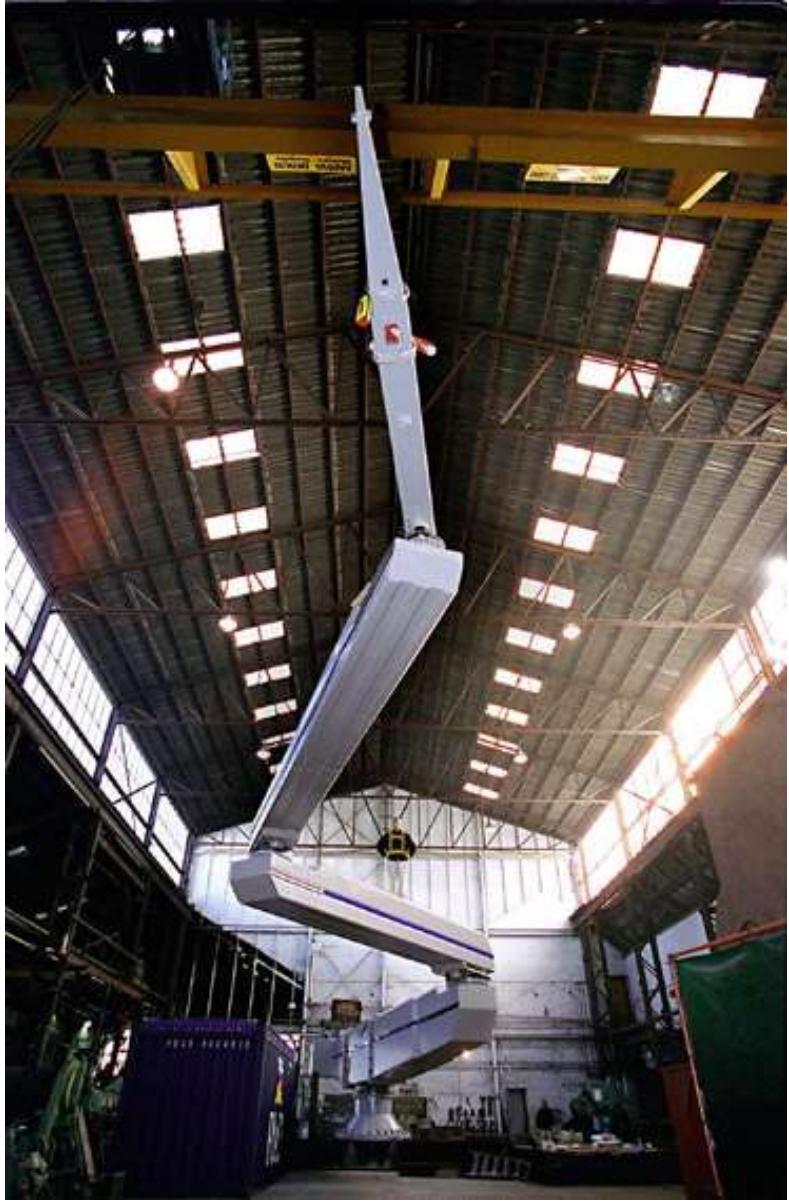
STANDARD EXTERNAL MONORAIL



CLIMBING TYPE EXTERNAL MONORAIL

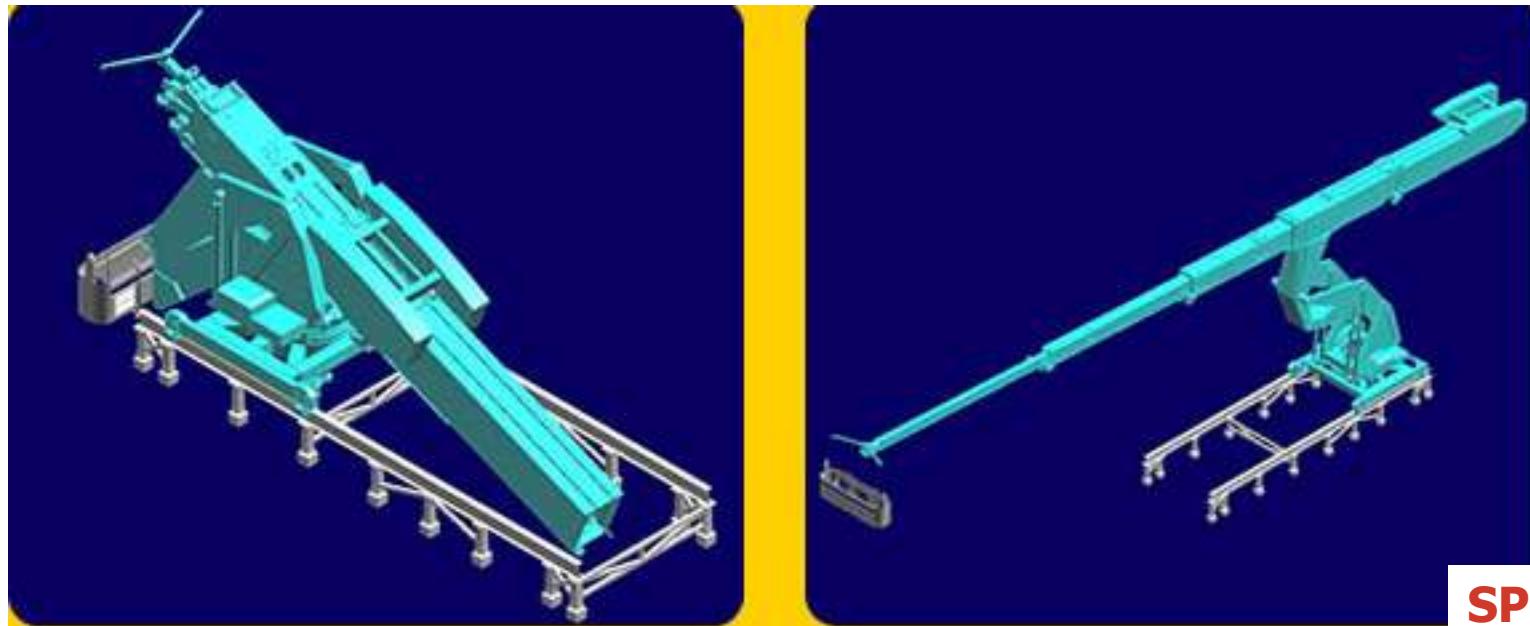


ROOF MOUNTED MOTORISED MACHINES



**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:

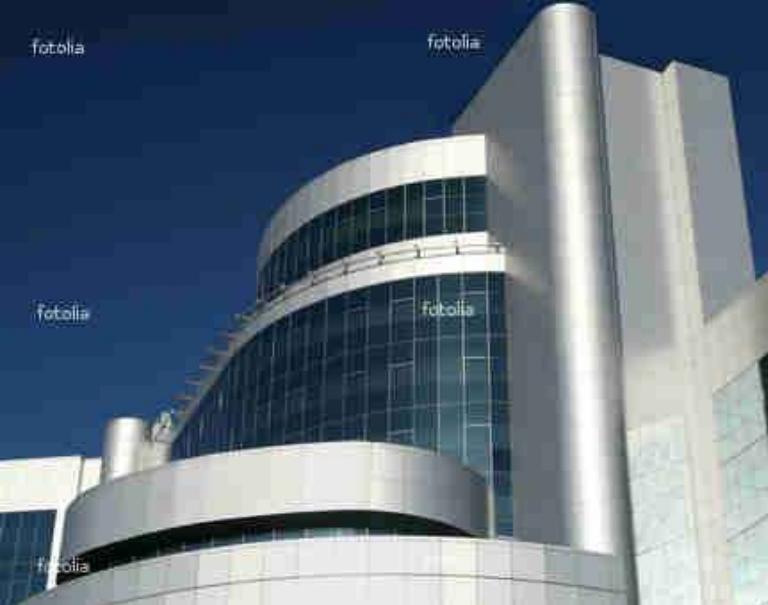
- Multiple roofs/terraces
- Façade types
- Roof layout: Clear space for moving around & parking area
- Parapet line Vs Façade line: Walk through
- Parapet heights
- Roof/Parapet structural detail
- Ground conditions: Clear space for moving around

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.

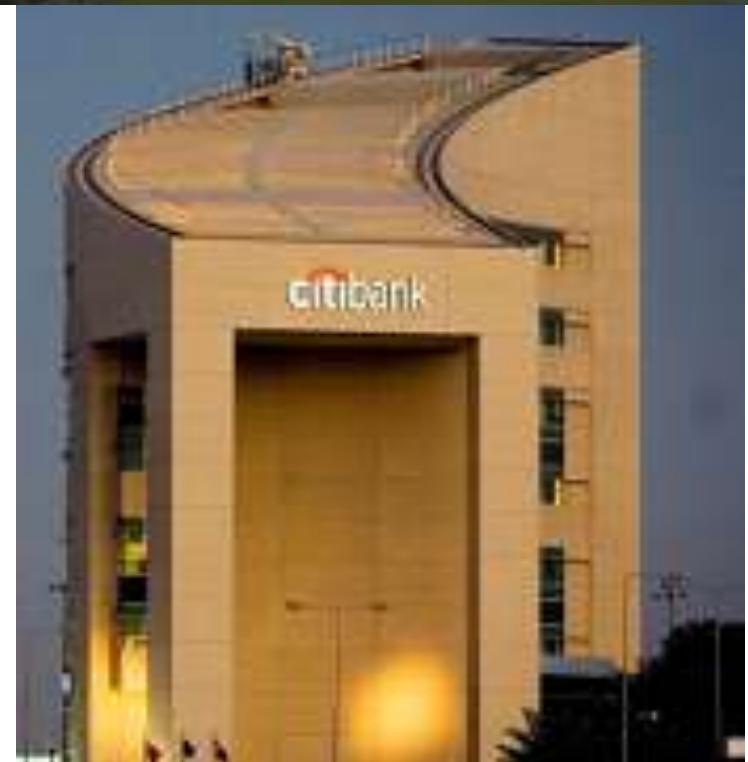
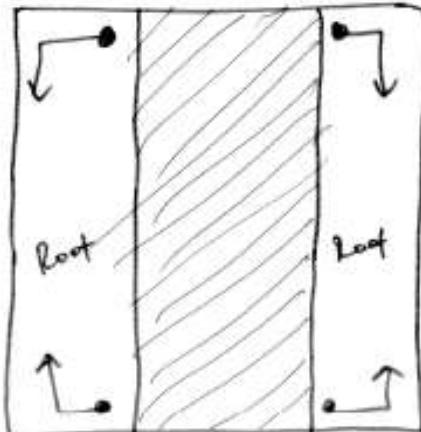
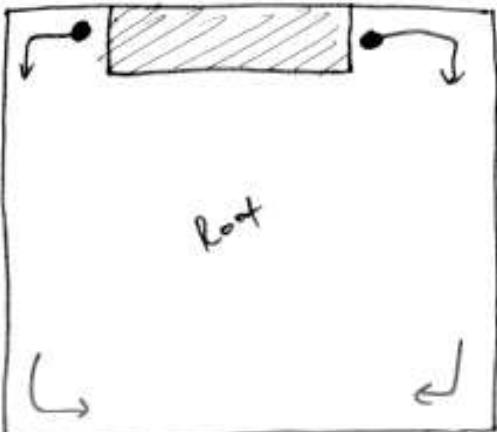
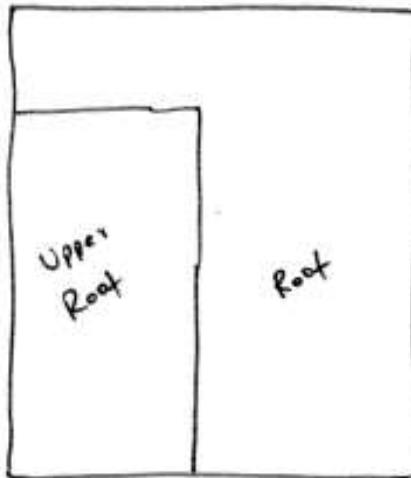
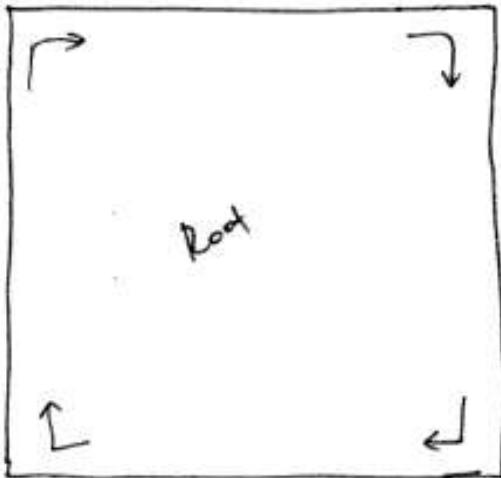


FAÇADE TYPES



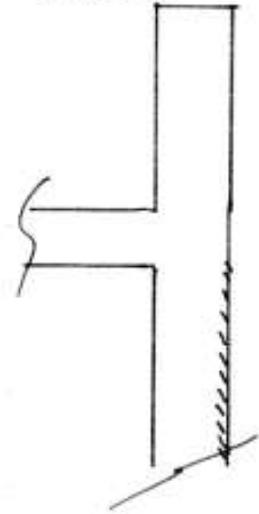
CHALLENGING FAÇADE TYPES

Various roof conditions

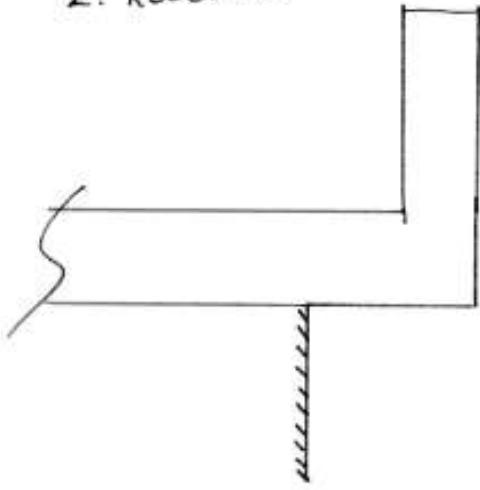


Sloped roof

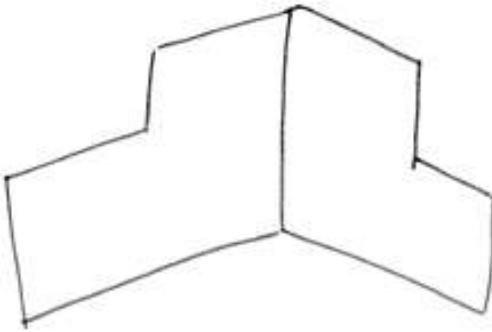
1. REGULAR



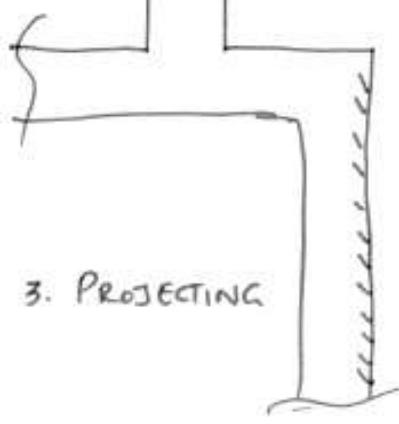
2. RECESSED



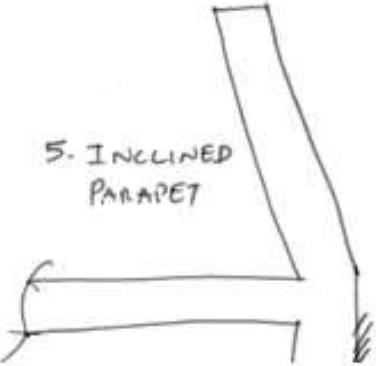
4. CHANGING PARAPET HEIGHT



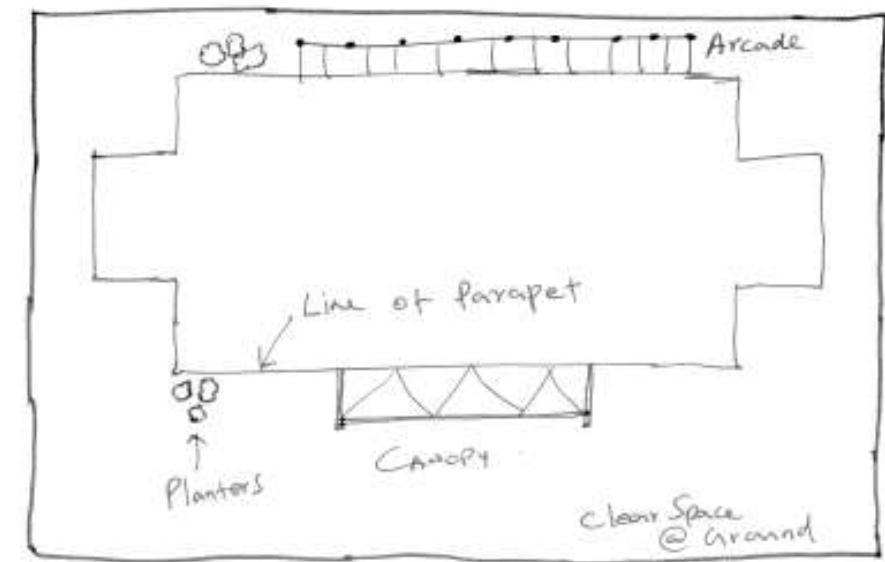
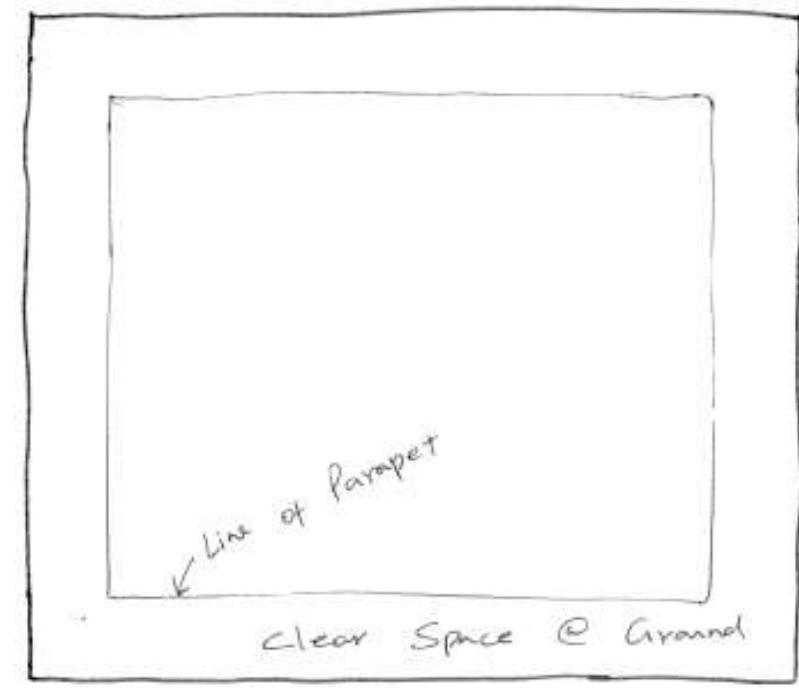
3. PROJECTIONS



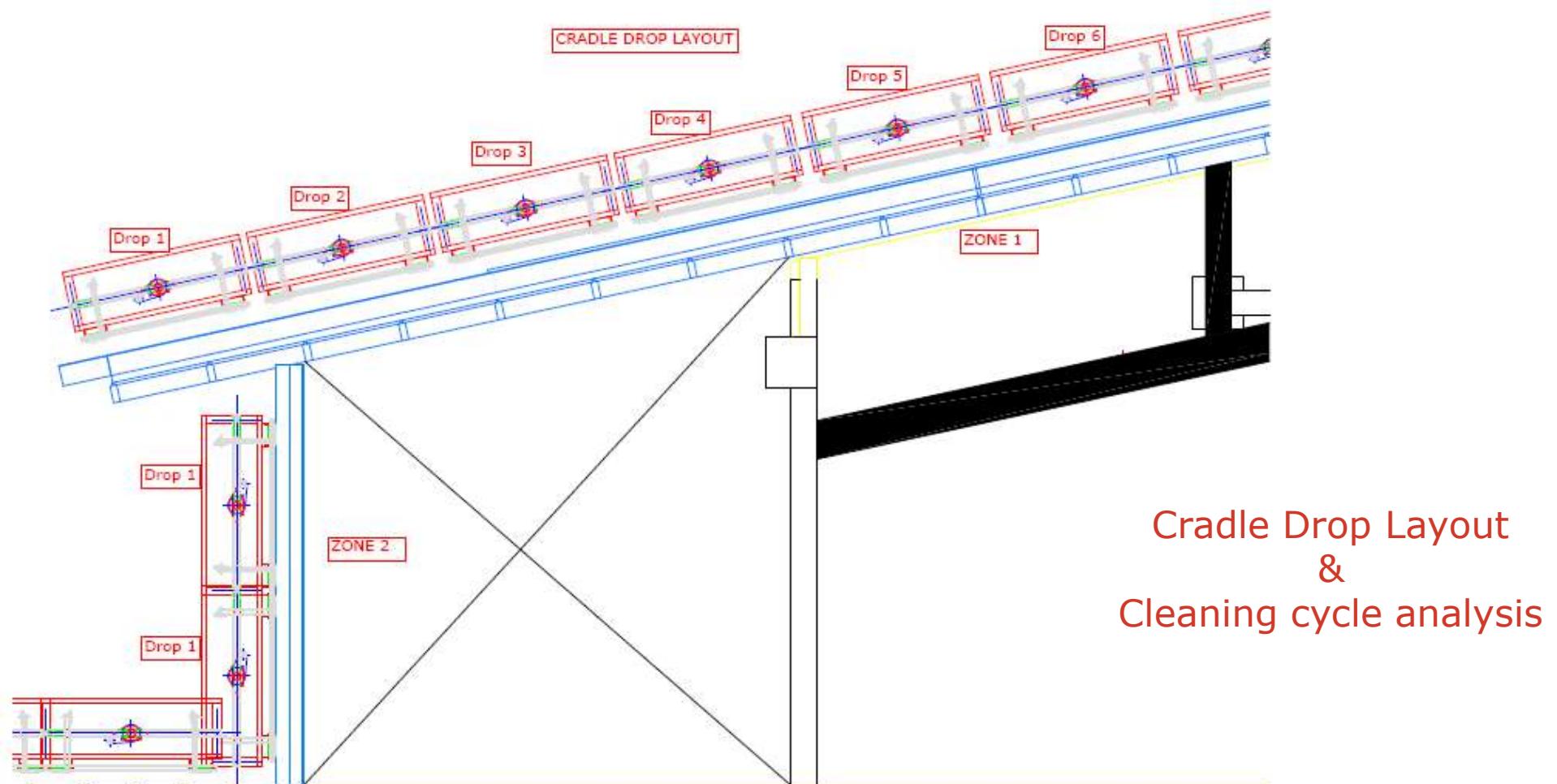
5. INCLINED PARAPET



Parapet conditions



Ground conditions

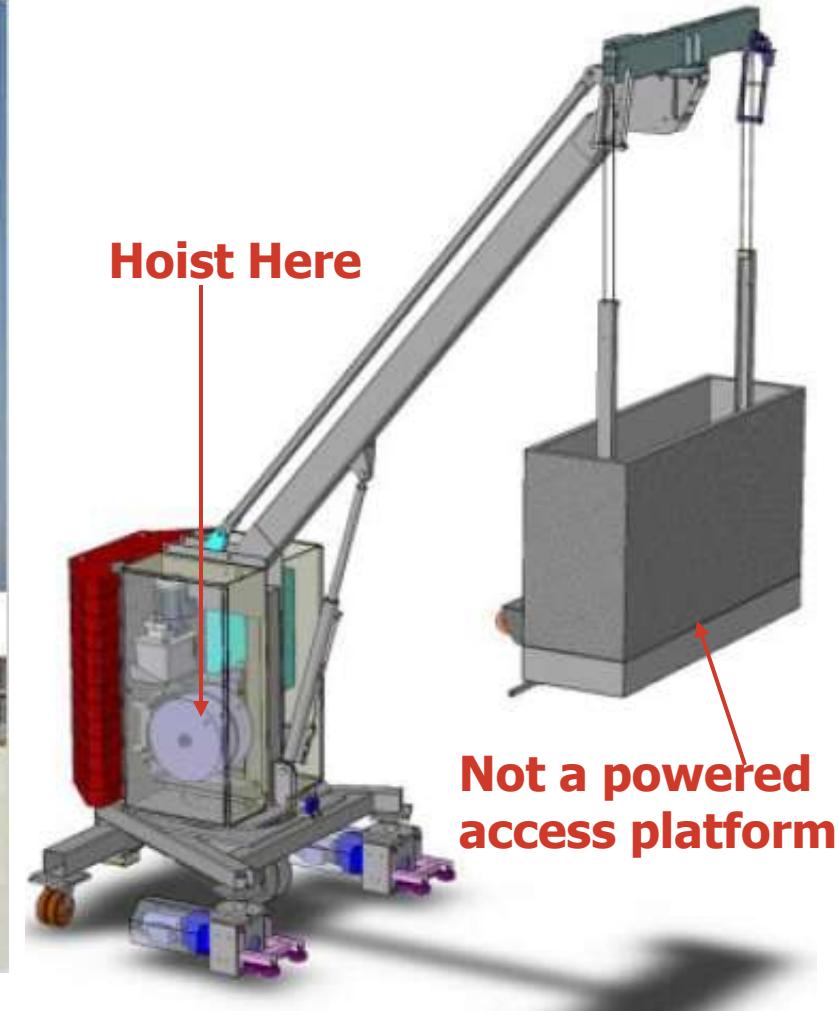


Hoisting: 8mtrs./min Cleaning: 3 sq.mtr./min (by 2 persons)

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:

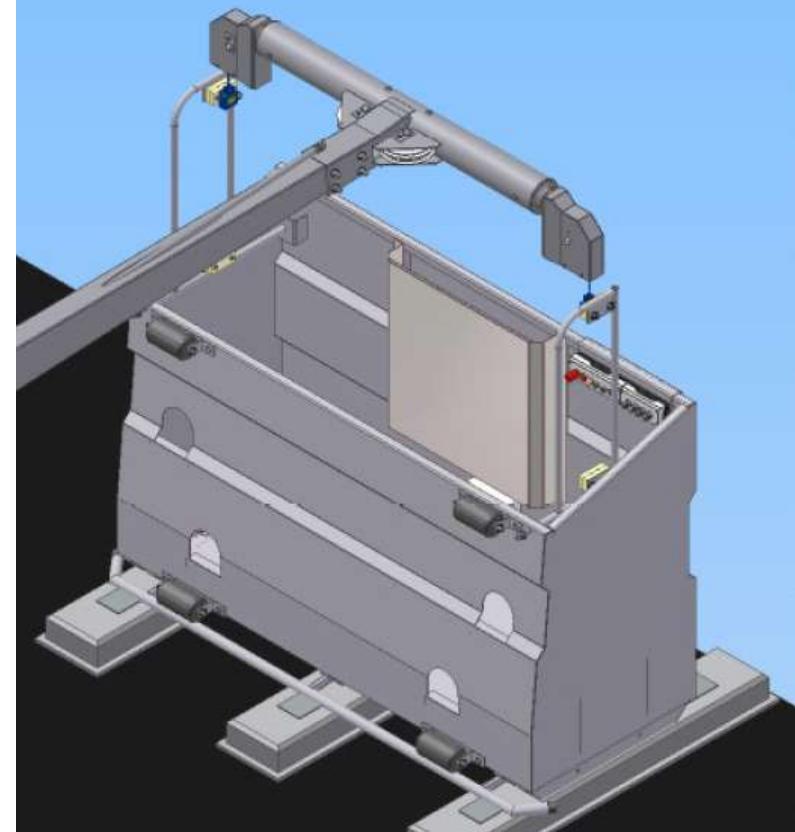
- Hoisting mechanism within carriage at roof level
- Hoisting mechanism within suspended platform





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



Reach dependent upon project requirements

Extruded Aluminum Boom - rotates 360°

1150 Lbs. Nominal
Service Load

Turning Bracket

Aluminum Davit Mast

Davit Lifting Bracket

Davit Lifting Winch

Portable Davit Lifting Bracket

Fixed Davit Base or Portable
Davit Base
(Shown for reference only)

Removable boom (shared)

BOOM REACH

EXTRUDED ALUMINUM BOOM

VANIZED STEEL BRAC

DAVIT
MATE

DETENT
ATTACHMENT

DAVIT TURNING
HANDLE
(REFERENCE)

DAVIT MAST
LABELS:
capacity, weight,
boom length, boom
engagement point

DAVIT TURNING
BRACKET
(OPTIONAL 1)

**DAVIT HOISTING
PICK-UP POINT**

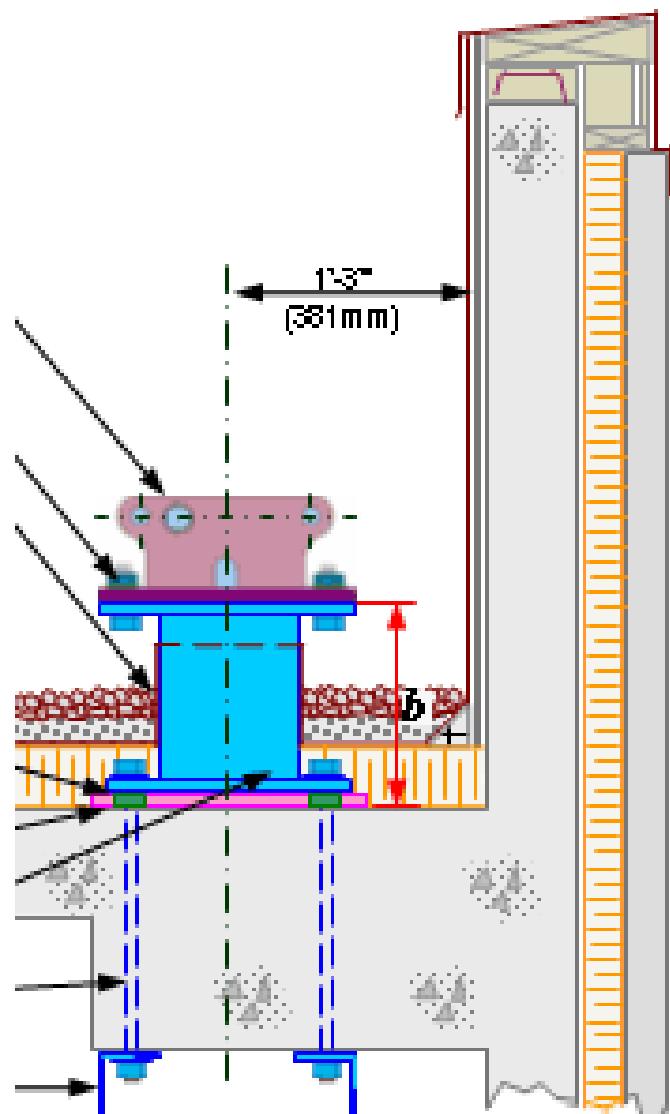
TRANSPORTING
WHEEL ASSEMBLY

DAVIT PIVOTI
PIN

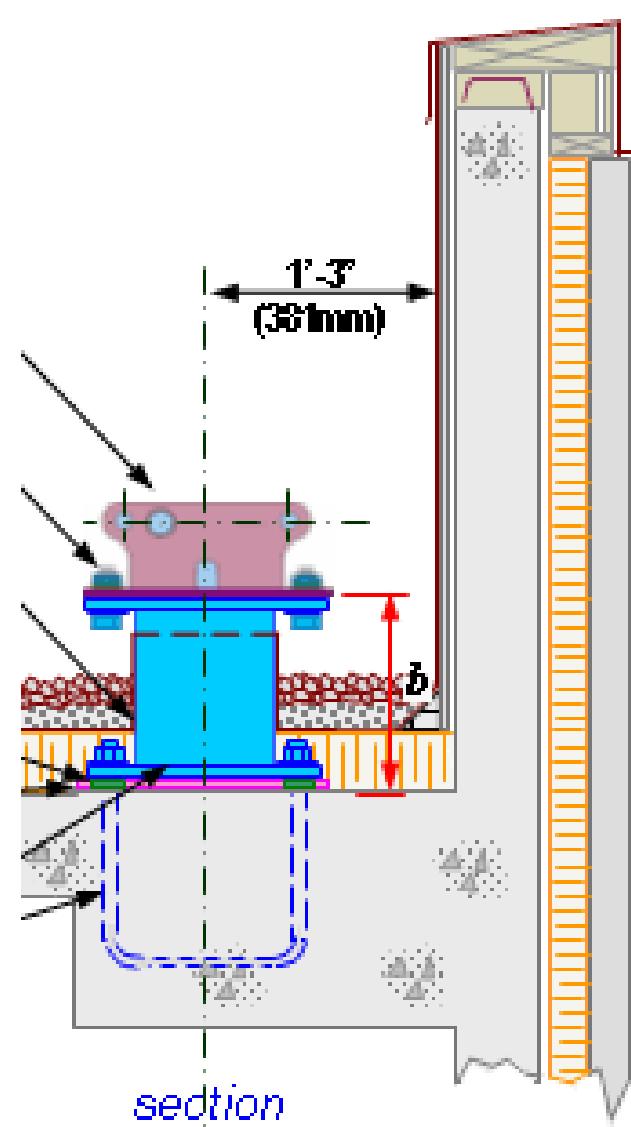
Removable mast (shared)

Davit system, fully installed

Permanent base At many locations



Through bolt fixing



Cast-in U bolt fixing

REQUIREMENTS OF BMU SYSTEMS:

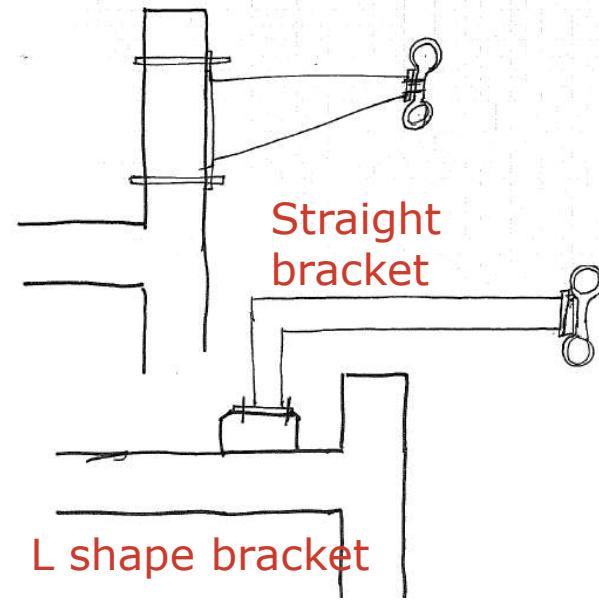
Manual systems: (Davits, Roof anchors, Roof beams, Clamps)

- 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:



Traversing trolley

- Manual pull
- Rope driven
- Motorised

- 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**

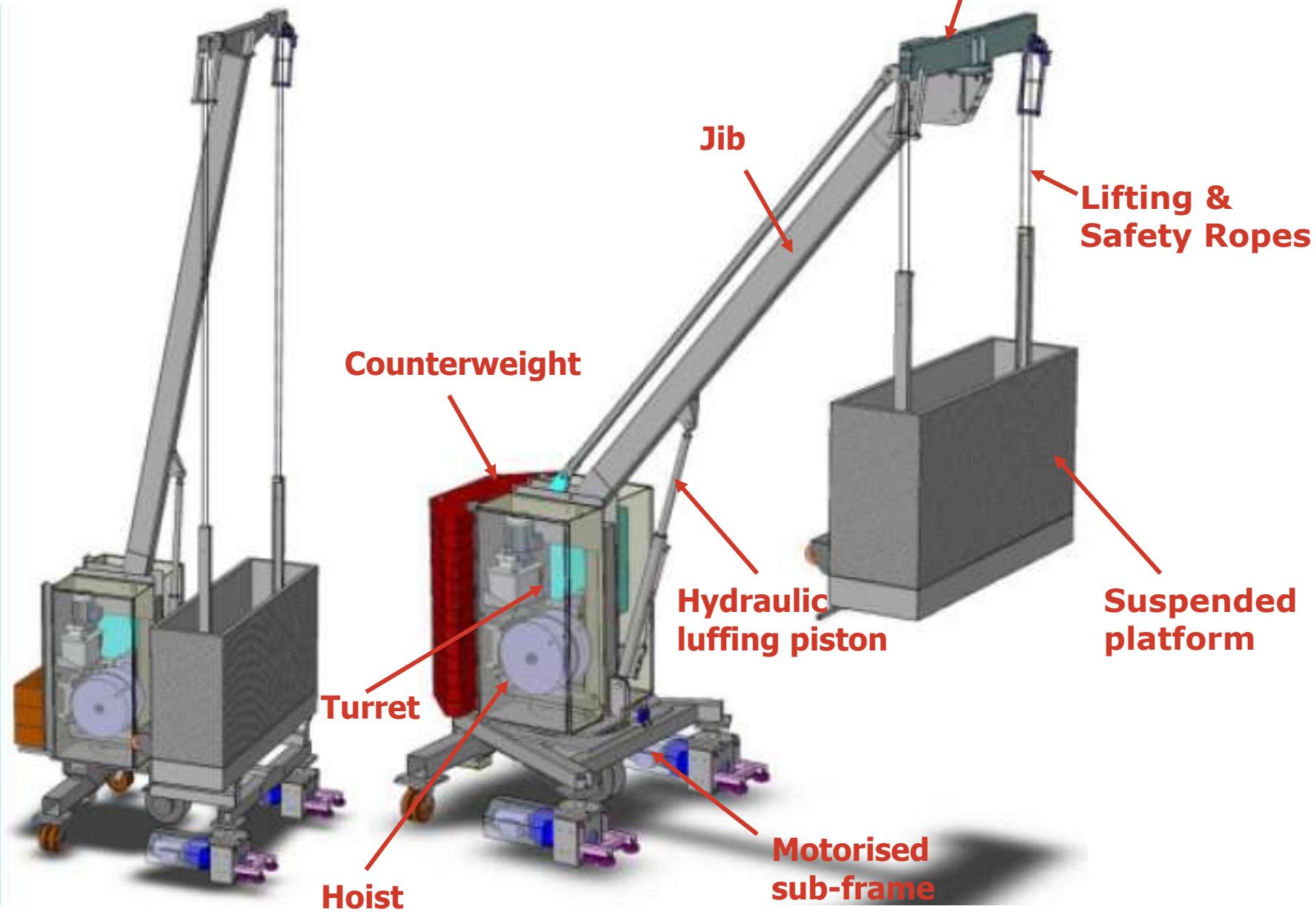


**Standard machine
on I beam tracks**

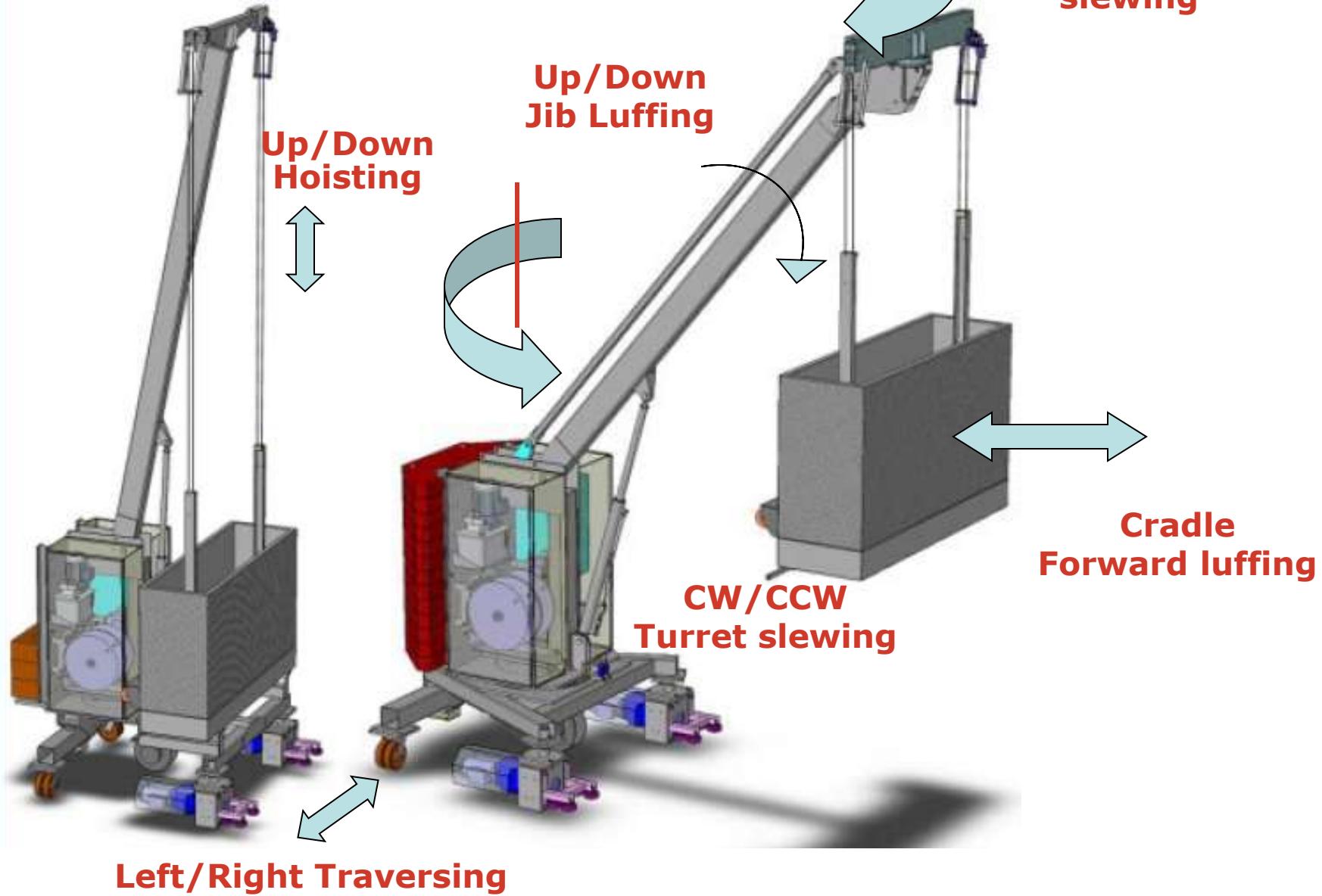


**Standard machine
on RCC runway**

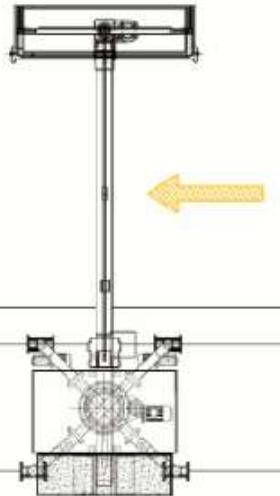
Basic components of a roof trolley BMU:



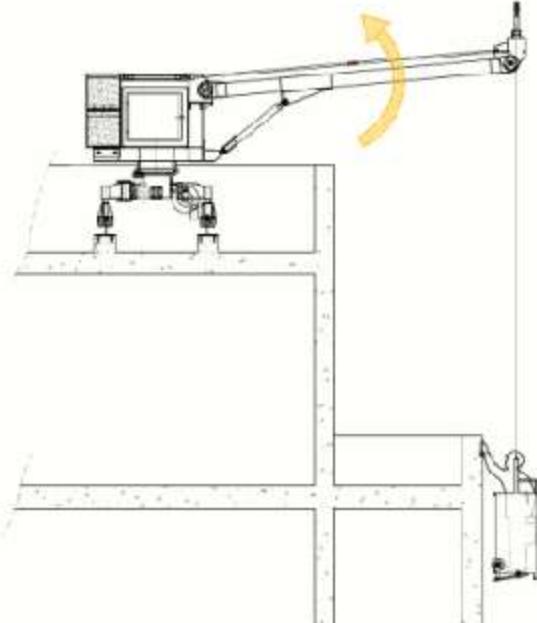
MOVEMENTS OF A BMU



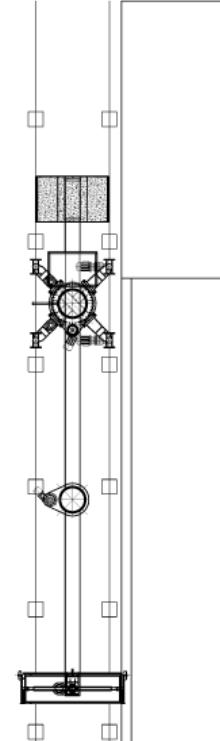
Traversing



Luffing



Horizontal elbow



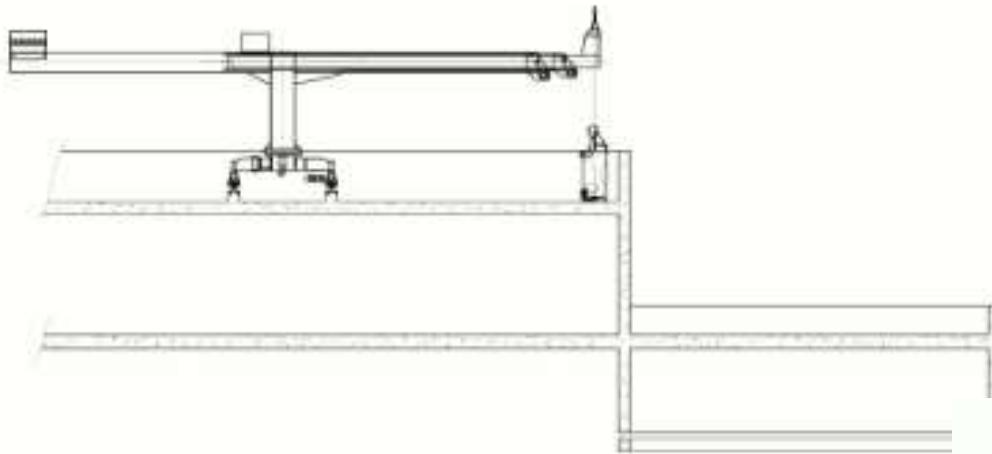
Spreader bar slewing



Slewing

Movements of BMU components

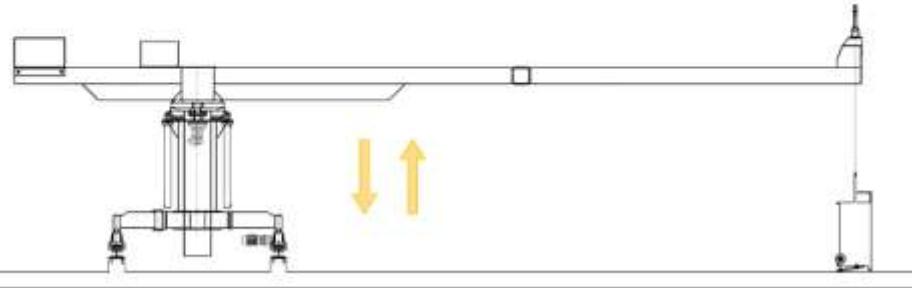
Jib telescoping



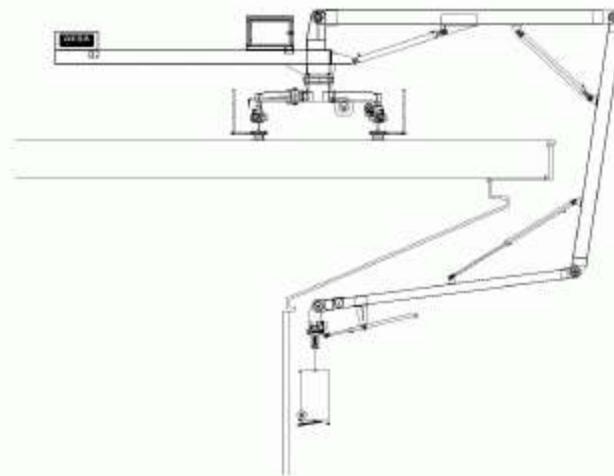
**Movements of
BMU components**

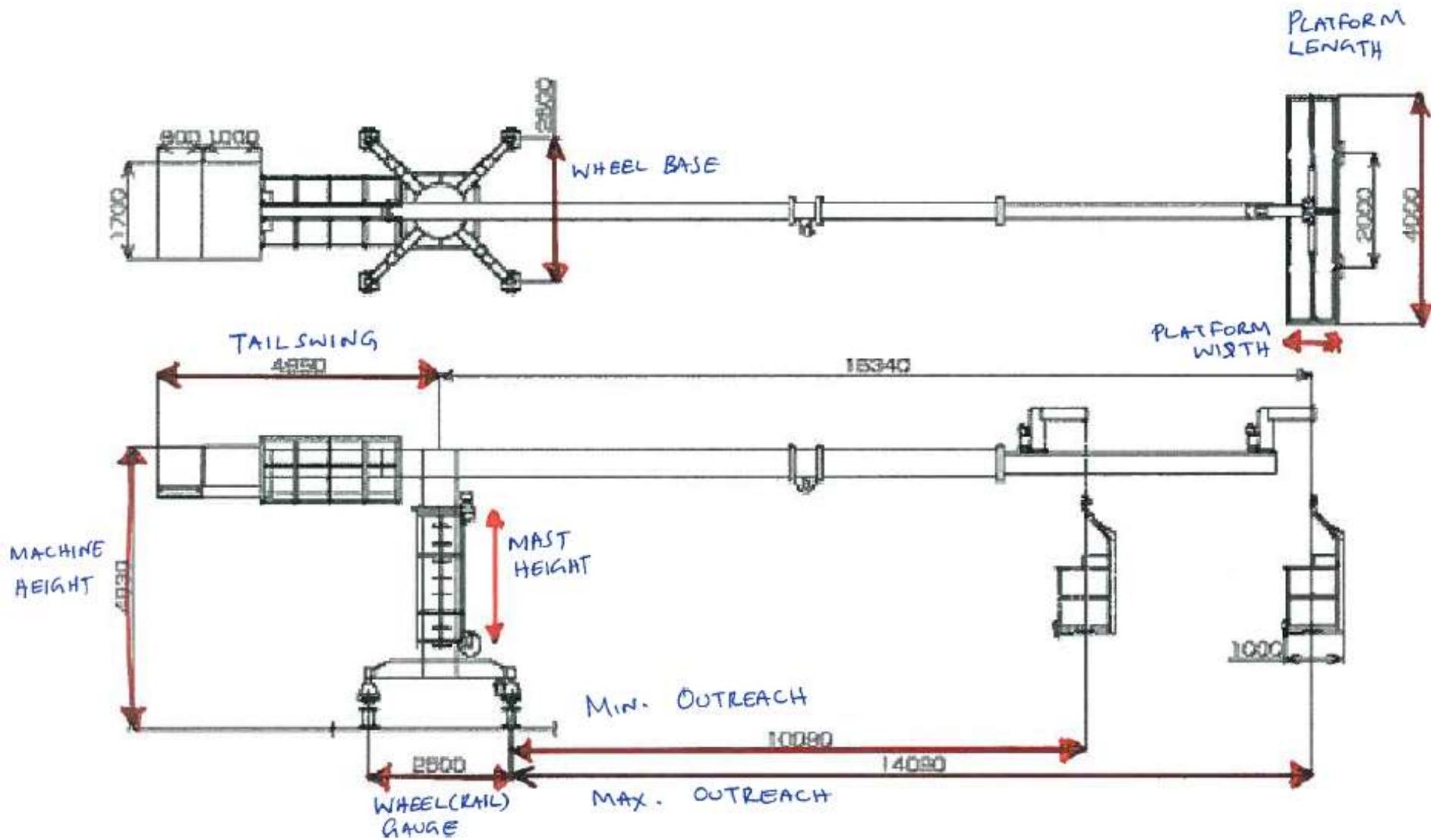
Mast rise/lower

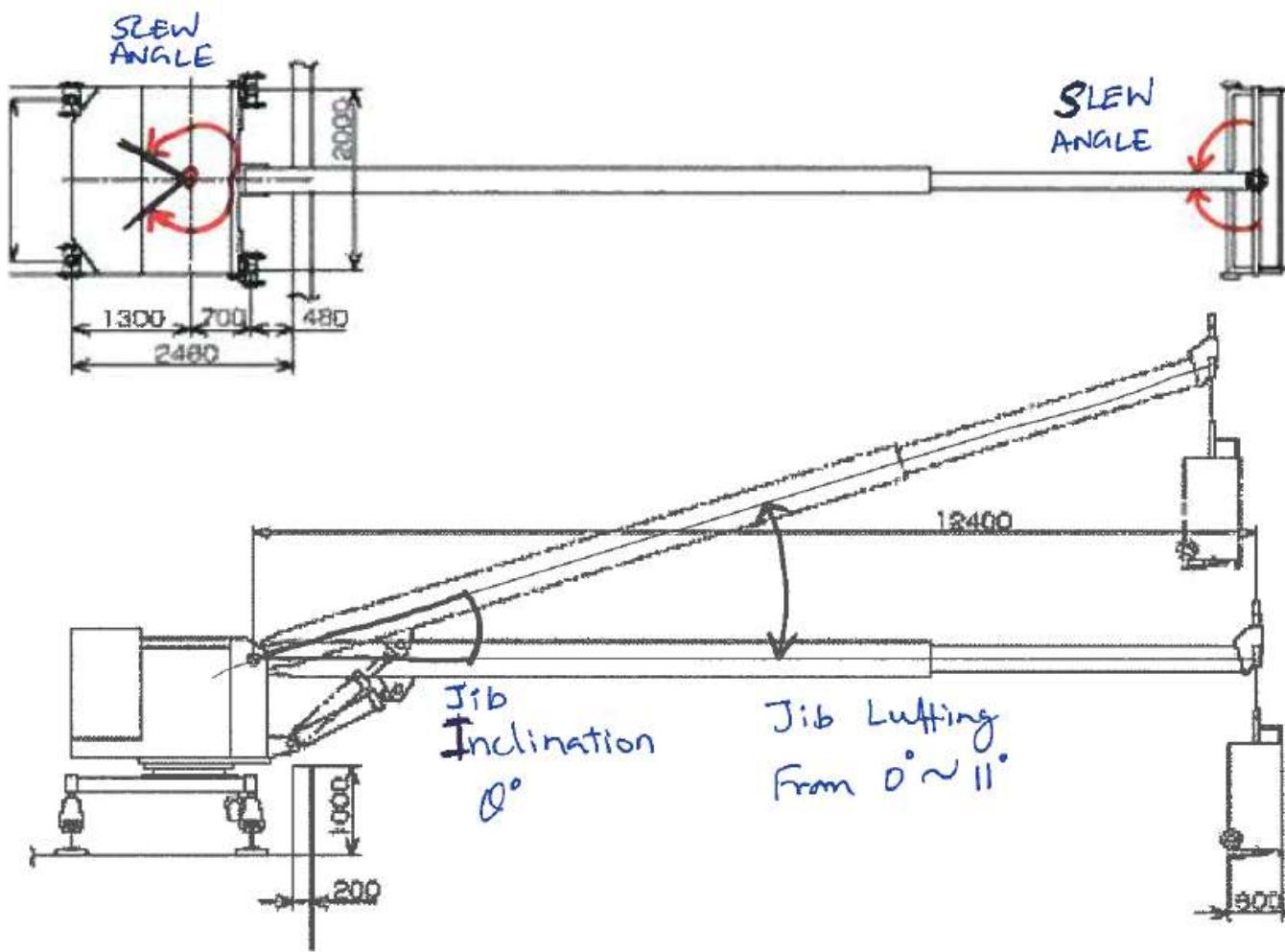
AESA
EUROGONDOLAS



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.)

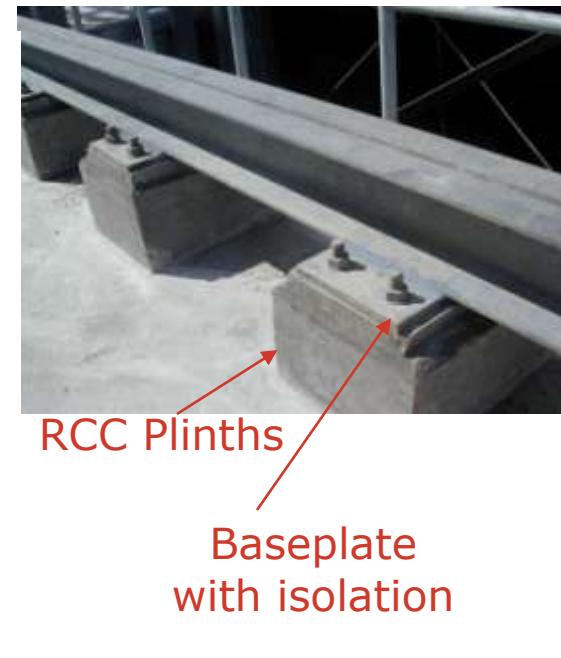
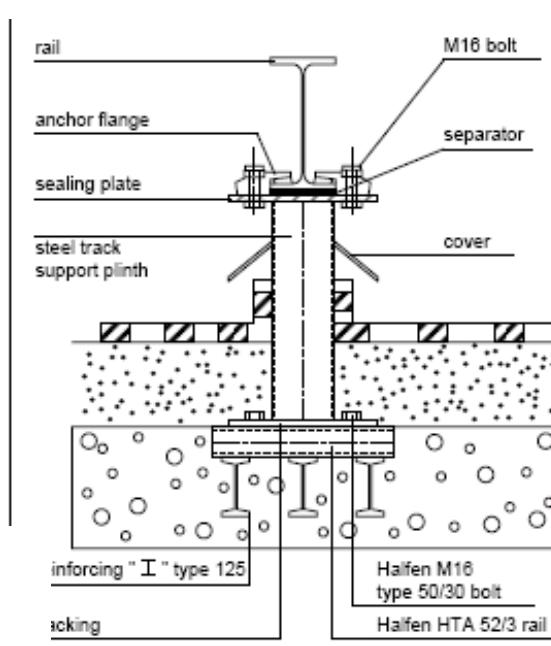
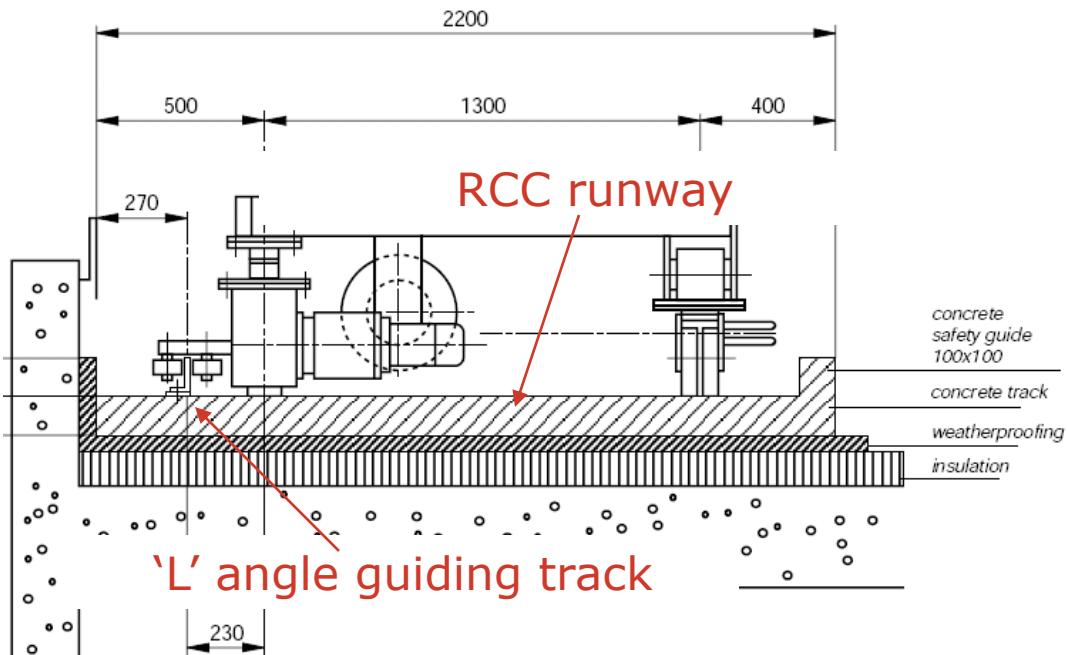
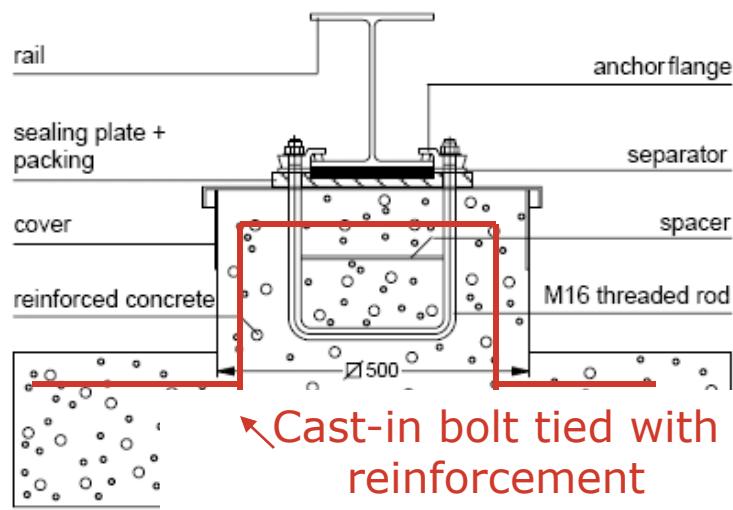
- Provide water supply mains – for cleaners to carry water inside the cradle. Provide at platform storage level.



**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





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

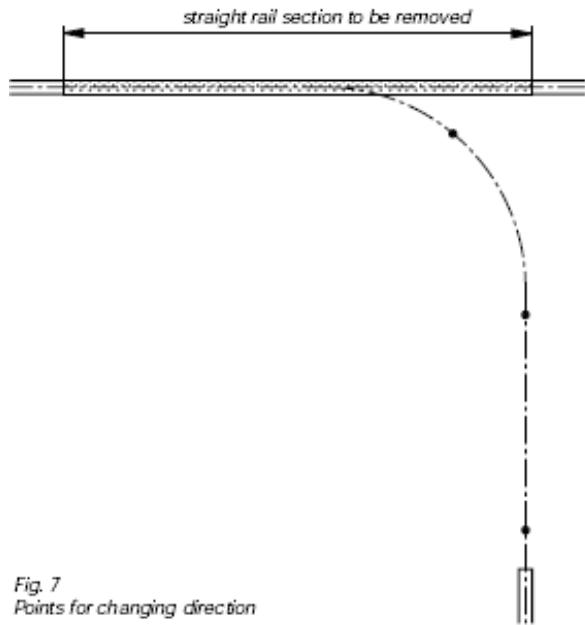
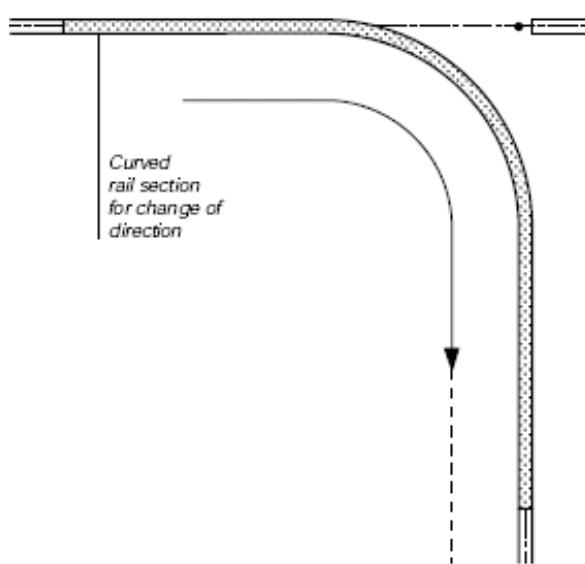


Fig. 7
Points for changing direction



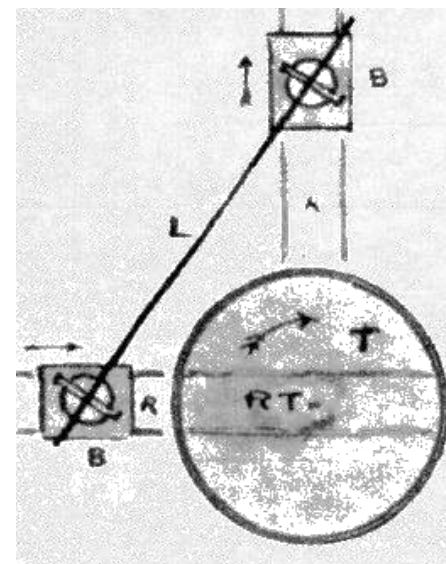
'L' Angle Track transfer system
90° branch



I Beam Track transfer system
90° branch



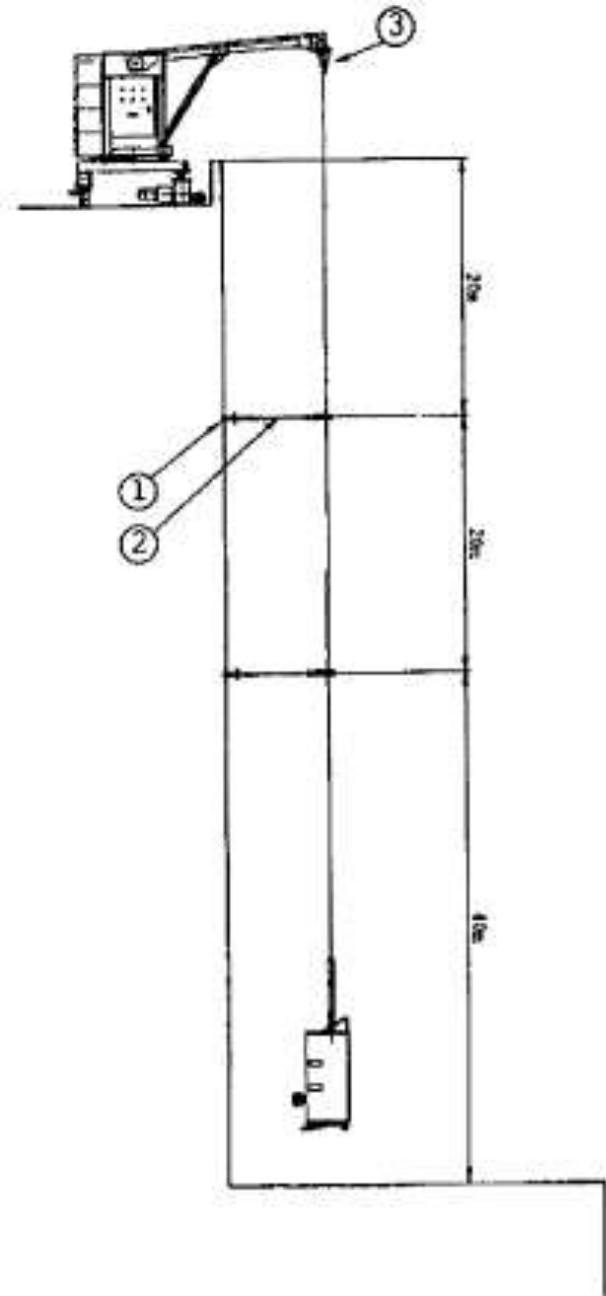
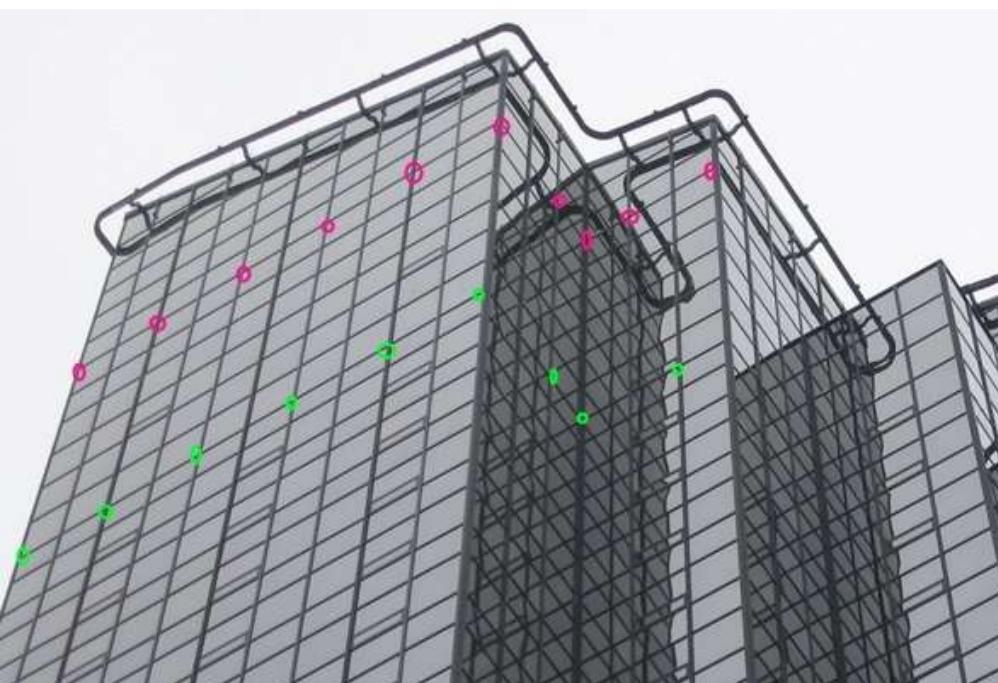
Scissor platform to hide
machine from view



Rotating
turn table

BMU: Platform stabilisation

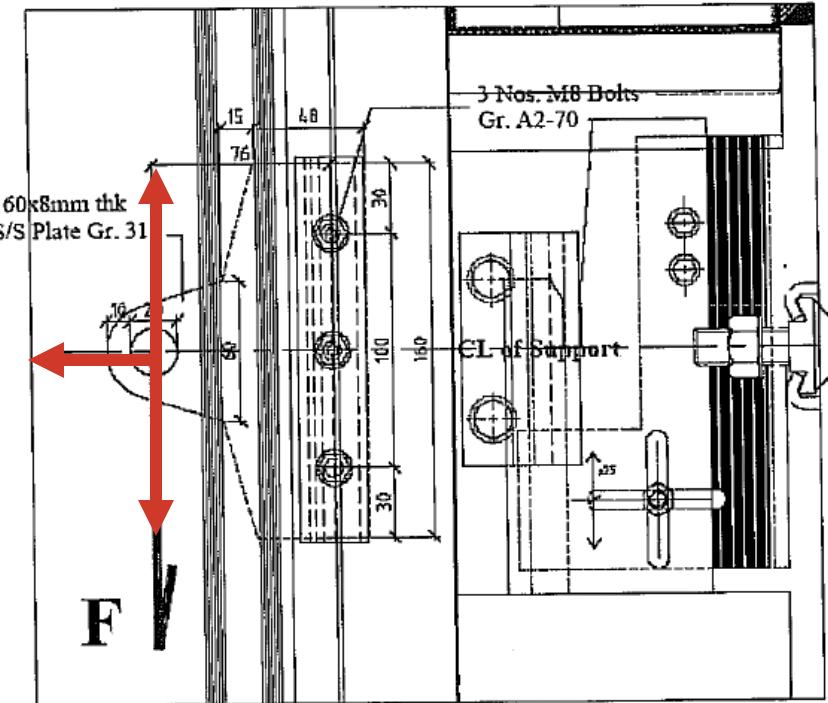
- Applicable when lifting height is more than 40mtrs.
- Rope with cradle is tied to façade at 20mtr. on elevation – to prevent cradle swaying with wind
- Horizontal spacing depends on cradle width (W+300mm)
- Restraint sockets built into façade – flush mount or projecting bracket type.
- Lashing on structural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



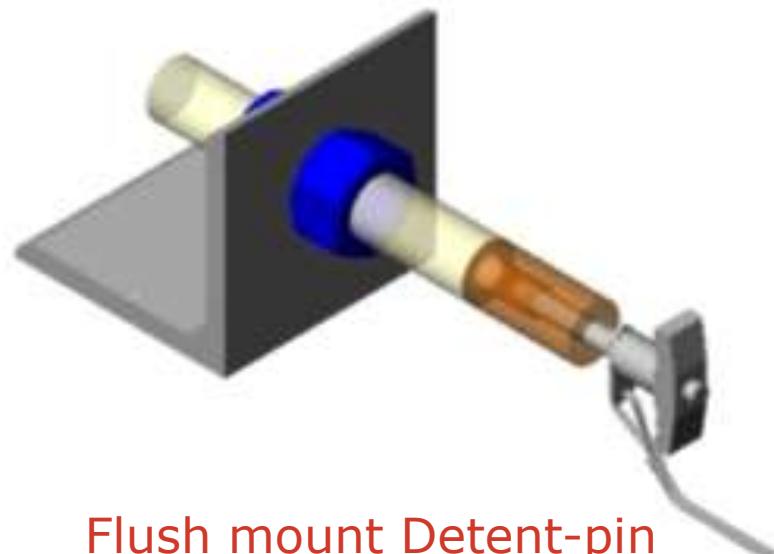
- 1 Anchor point
- 2 Member linking the platform to the anchor point
- 3 Suspension wire ropes

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

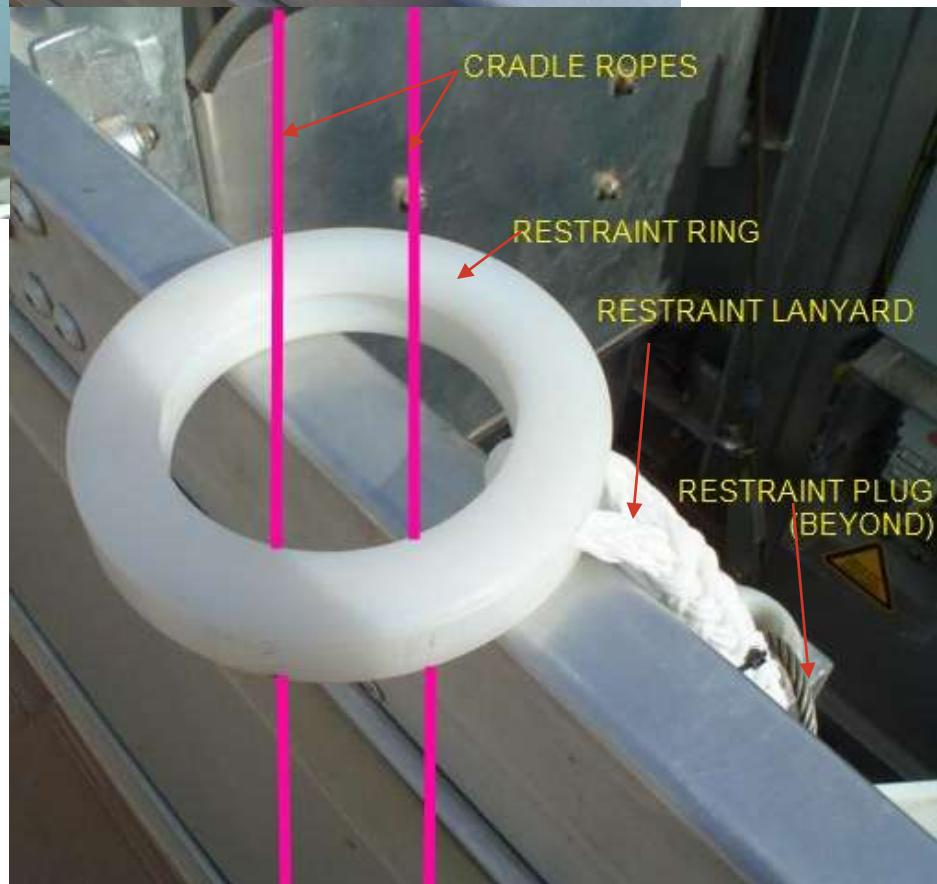
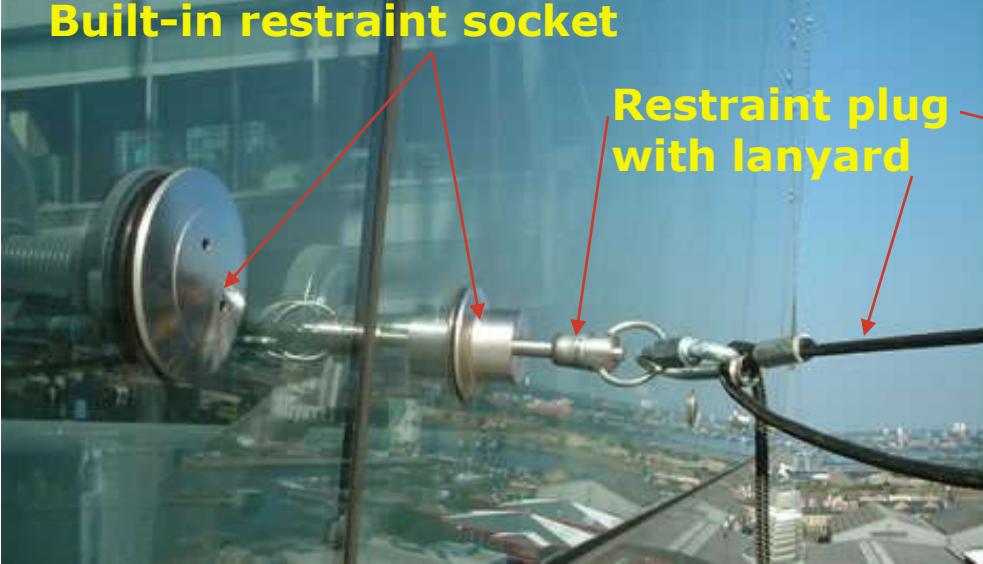


Projecting bracket



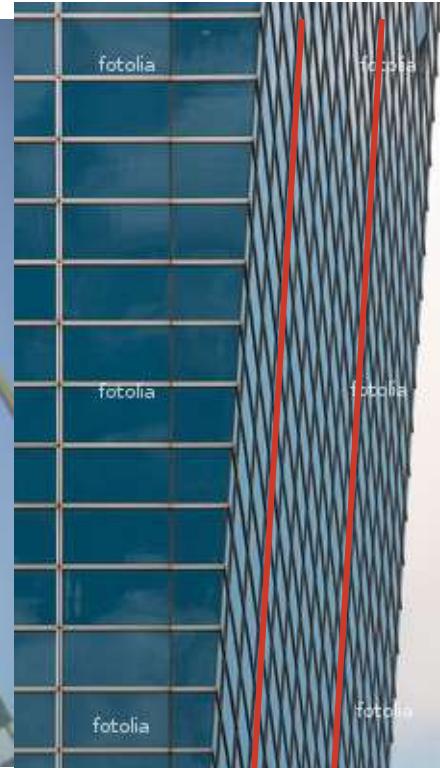
Flush mount Detent-pin

Built-in restraint socket



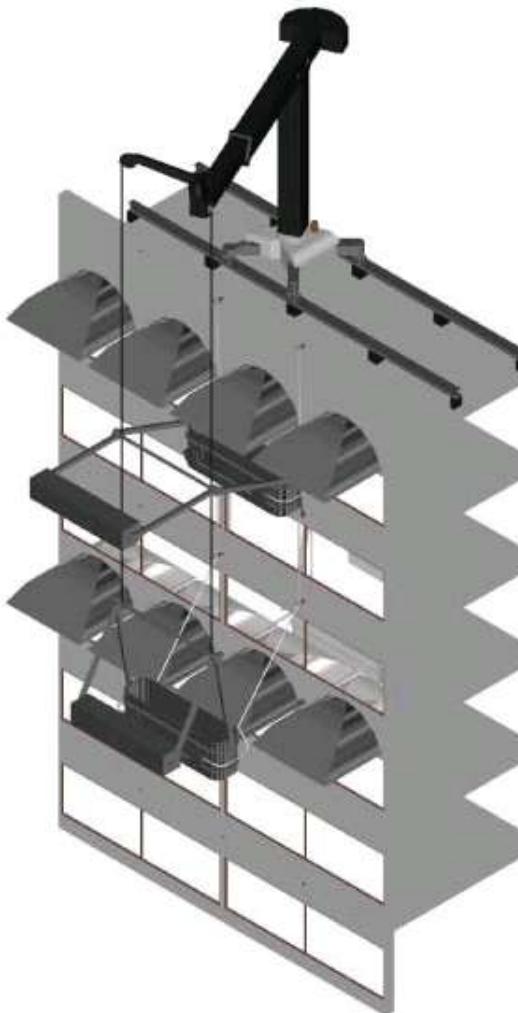
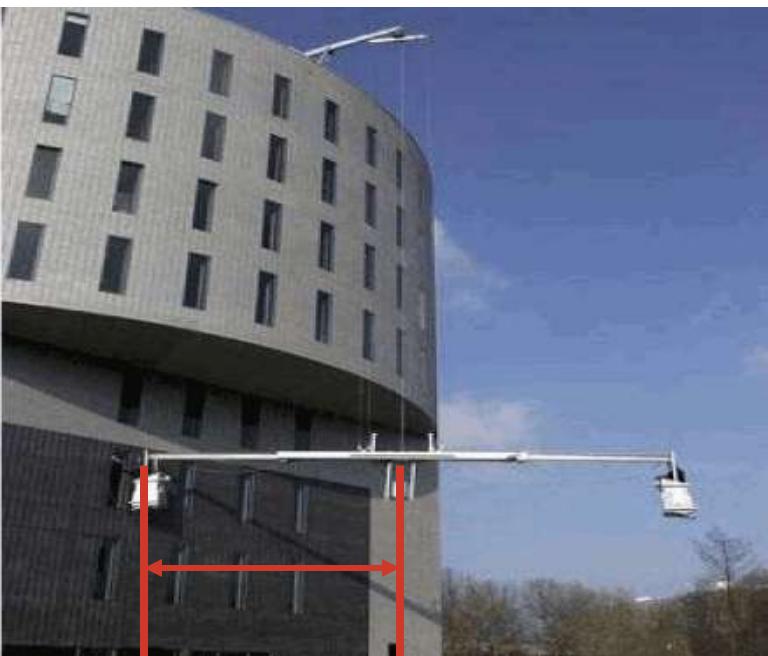
- Sockets on façade preferred.
- Sockets on structure (behind façade) not recommended – trouble with dimensions.

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 LUFT/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

Bosun chair (Flying seat)



1-Man cradle



- 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

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Upper levels:

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

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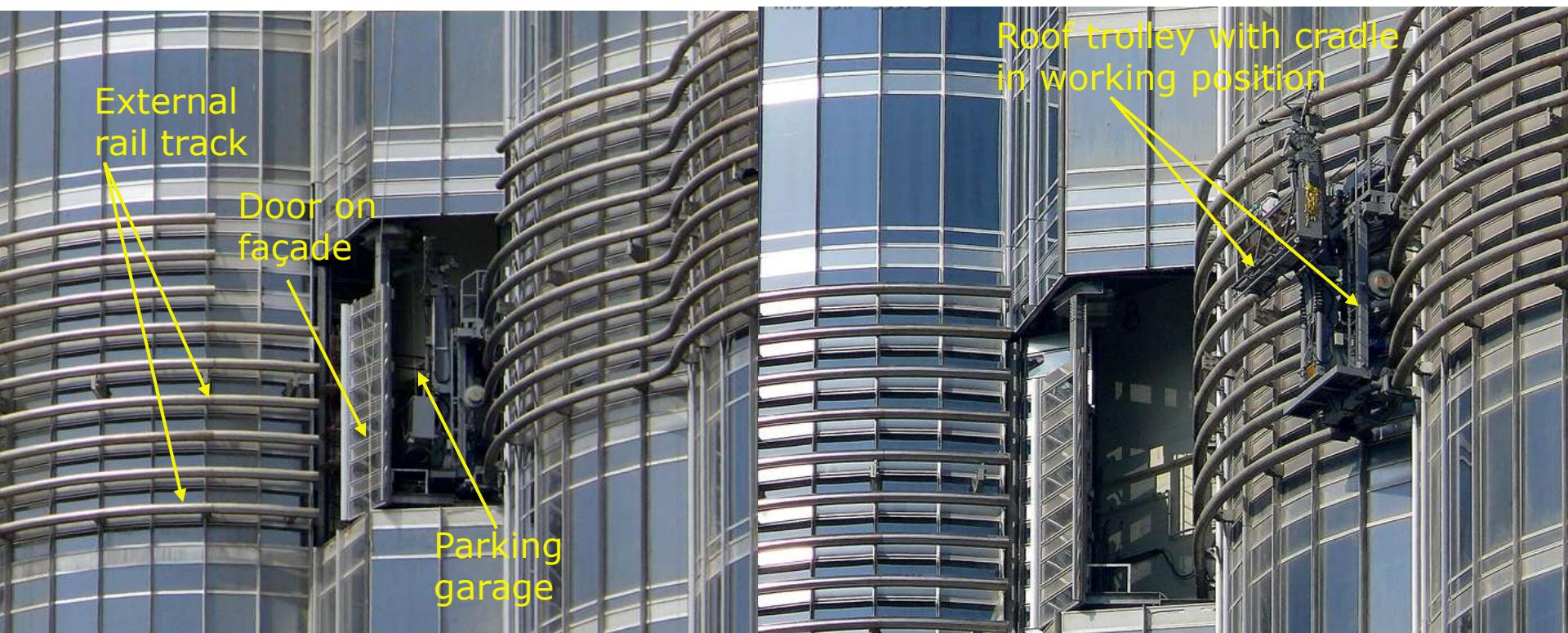
BurjKhalifaSkyscraper.com
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Lower levels:

- **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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