DESIGN FOR MAINTAINABILITY

FACADE ACCESS DESIGN GUIDE

Version 1.1

BCA

History of amendments

S/N	Brief description of changes	Revision date
1	Ver 1.0 – First issue	Dec 2017
2	Ver 1.1 – First revision a) Revision made to Fig. 4-37	May 2019

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01
INTRODUCTION

1.1

Principles of Design for Maintainability

The maintenance of buildings can be made easy and efficient by integrating maintainability concept in their designs, with the provision of adequate access often an important consideration.

With super high-rise buildings and complex façade designs becoming more common, safe and efficient façade access are becoming increasingly important. Designers should understand how their designs can affect maintenance work and consider how the building envelope can be accessed for inspection, cleaning, and repair and replacement throughout the building's lifetime.

The cost of including or installing access provision as an after-thought during construction or post-construction is significantly more expensive than when done as an integral part of design. Designers should consider façade access early in the design stage of a building so that the most practical access systems that are in keeping with the architectural intent can be developed and incorporated in the building design.

Fig. 1-1 The Star
Complex building shape with high-volume internal spaces

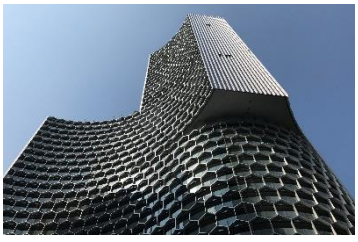


Image by M+S

Fig. 1-2 DUO
Complex building form and façade features

Image by Edward Hendricks

Fig. 1-5 Sky Habitat
Stepped form and bridging sky gardens

Image by Iwan Baan

Fig. 1-3 The Interlace
Stacking blocks of structures

Fig. 1-4 Reflections at Keppel Bay
Curved façade and stepped roof structure

Note:
'Maintainability' is a measure of the ease and ability with which maintenance activities can be carried out.

Image by Diamond Glass Enterprise Pte Ltd

Fig. 1-6 Façade access design should use the most productive means instead of labour-intensive methods

Fig. 1-7 Façade access provisions should be integrated with the building design and not an afterthought

Note:
Other than routine cleaning, safe and efficient façade access is also needed for façade inspection and repair activities such as cladding and glazing replacement.

Adequate access provision will allow façade maintenance to be carried out in a safe, efficient and user-friendly manner. By not doing so, this will affect:

SAFETY

Increased risk for those carrying out façade maintenance works and higher long-term costs incurred from the shortfall in adequate safety provision

PRODUCTIVITY

Additional time and/or manpower needed to undertake inspection and maintenance tasks

BUILDING PERFORMANCE

Omission or delayed maintenance activities that can affect building performance

FACADE

Unsightly, obtrusive façade access solutions

AESTHETICS

A poorly maintained façade adversely affects the architecture as well as the appeal to prospective tenants and the community

VALUE

Loss of value and function due to the above

1.2

Purpose of this guide

Often, the design for maintainability-related needs are based on the experience of designers and lessons learnt from previous projects. There is no local guide on the façade access design from the designers' perspective.

This guide highlights the importance of façade access, and allows designers to understand access considerations. It also provides a benchmark for future improvement to safe and efficient façade access provisions for buildings. A set of recommended standards are provided for designers to consider. The recommendations in this publication are not intended to override or replace any legal rights, responsibilities or regulatory requirements.

This guide is primarily targeted at building designers, but will be of interest to building developers, managers and other industry professionals who are involved in the design decision process.

02
DESIGN PROCESS AND FACTORS

2.1

Design brief and workflow

The principles of maintainability and access provisions have to be considered by the client and the design team in the early stages of a building development.

Façade access design and challenges should be co-ordinated and resolved in an integrated manner throughout the project. In the process, it is important for designers to engage the relevant stakeholders such as regulators, suppliers, specialist contractors, facility managers and end-users.

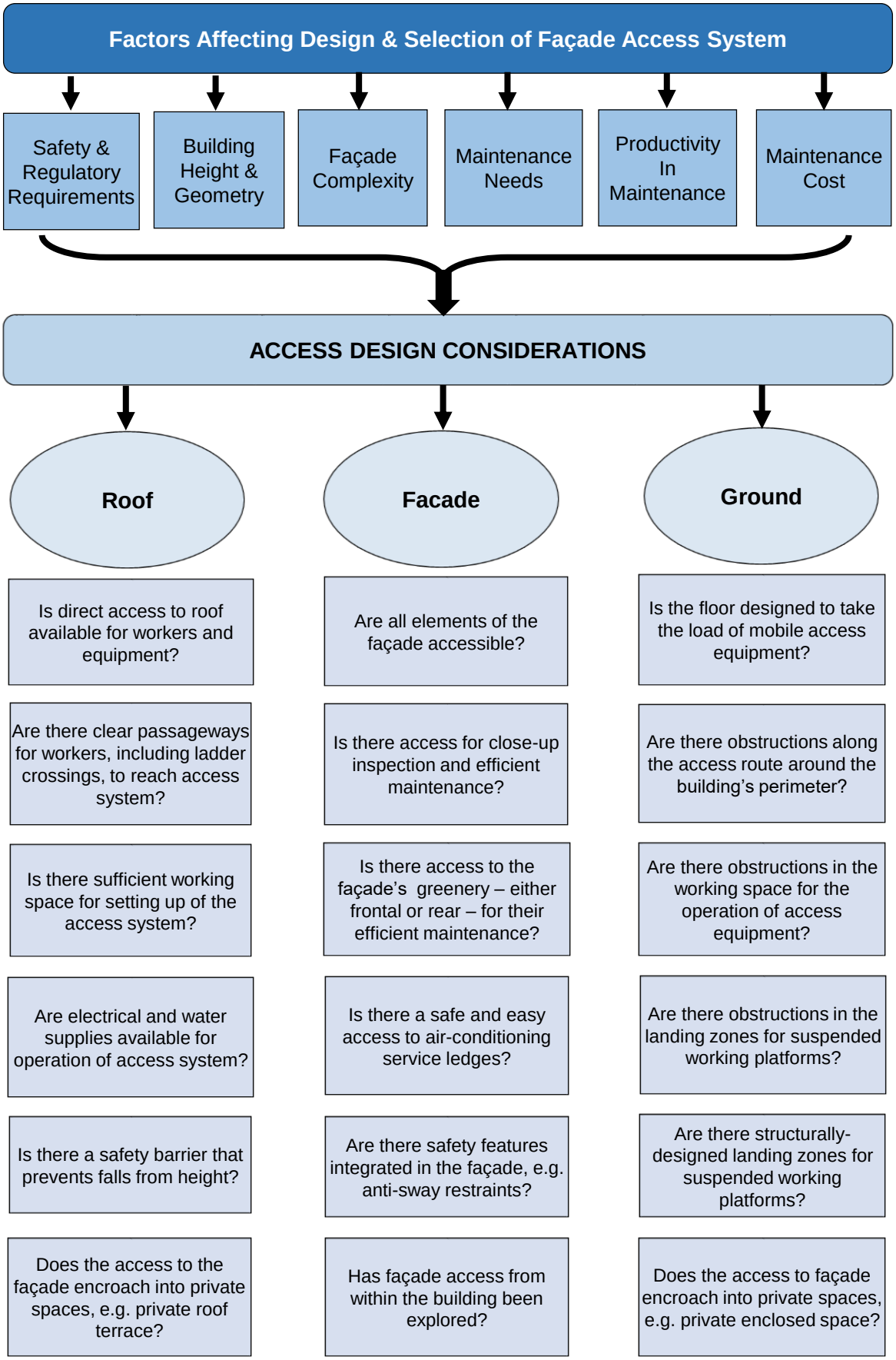
The design team must ensure that the final details of the façade access strategy and design provisions are put in placed during construction. Following a project's completion, the as-built records should capture the provisions that are implemented for the benefit of those carrying out façade maintenance tasks.

A workflow diagram and a design decision-making flowchart in respect to façade access provisions are given in Fig 2.1 and Fig 2.2 respectively.

Fig. 2-1 Façade access considerations at various stages of a development

Stages / Tasks	Planning & concept design	Detailed design	Tender & construction	Hand over & occupation
Brief/ Documentation	Site and climatic considerations	Detailed façade design – co-ordinated architectural, structural and building services proposals	Tender/contract documentation	
	Façade design concept	Maintainability requirements, including safety considerations (e.g. provisions for tie-back restraints or lifelines)	Commitment of contractors to specifications and maintainability requirements	
	Anticipated maintenance requirements (e.g. compute cleaning cycle duration)	Devise maintenance regime		Maintenance regime in place
Access Strategy	Façade access and maintenance strategy, including material hoist requirements for glass or façade lighting replacement	Finalise façade access and maintenance options, with consideration for parking/storage location for maintenance equipment	Construction and installation as per specialist contractors'/ manufacturers' details	As-built records, including façade access and maintenance strategies information
Access System	Types of access system and equipment available with consideration of maximum operating height	Detailed design and specifications of access systems and equipment	Testing and commissioning of access systems and equipment	
	Reliability and availability of parts	Specialist contractors'/ manufacturers' requirements	Preparation of operation and maintenance (O&M)	Updated O&M documents and Design for Safety register
Operations	Building lifespan/ lifecycle cost considerations	Anticipated business costs and inconvenience to building users	As-built records, including façade access and maintenance strategies information	Operational procedures and training for maintenance personnel
	Feedback to/from developer and building managers	Review and validate with developer and building managers	Review and validate with developer and building managers	Feedback from occupants/building managers for benefit of future projects
Pertinent statutory requirements	Urban design (building mass, façade treatments, lighting, signage, etc) and landscaping requirements	• Buildability • Environmental sustainability • Daylight reflectance • Design for Safety • Fire safety	Workplace Safety and Health (WSH)	• Safety certification by Professional Engineer • Workplace Safety and Health (WSH)

Fig. 2-2 Decision-making flowchart for façade access design



2.2

Design factors

There are six important factors that can affect the design and selection of façade access systems.

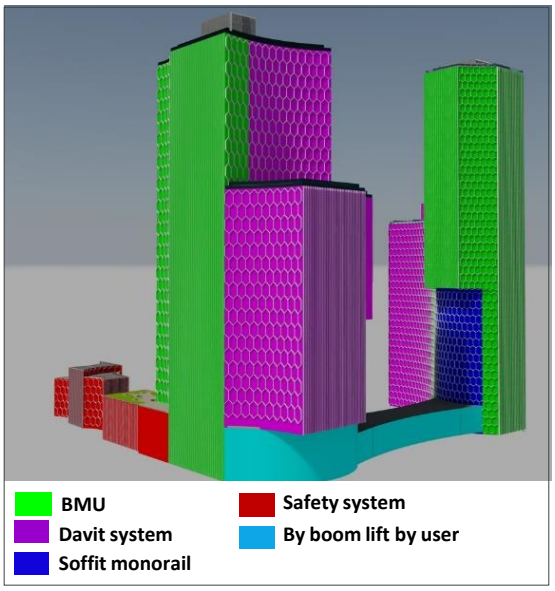


Image by M+S

Fig. 2-3 Access should be provided to every part of the building elevation

Fig. 2-4 Buildings with irregular shapes may require customised access solutions

Factor 1
Safety and regulatory requirements

Compliance with Workplace Safety and Health (WSH) Act and its subsidiary legislations as well as other **applicable building codes and standards**

Loading conditions and need for additional strengthening of building base structure for façade access system

Design of the access system should be **reviewed by Professional Engineer and/or competent person**

Consideration for **rescue and emergency circumstances** related to façade access operations

Factor 2
Building height and geometry

Access should be provided to **every part of the elevation**

Building **height, width and geometry will determine the access system/s** to be adopted

Irregular building shapes will usually need customised or multiple access solutions

Consideration for appropriate **location and storage of rooftop access equipment** to minimise its visibility and keep within permissible height limits

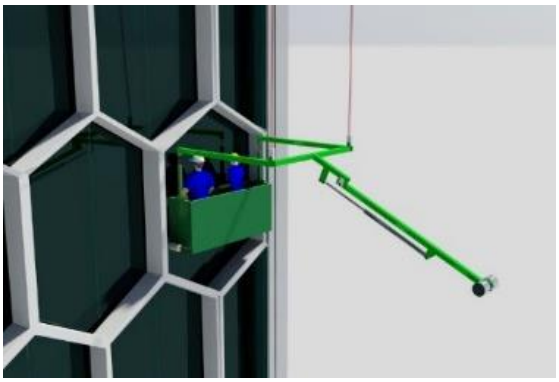


Image by M+S

Fig. 2-5 All elements of the façade should be accessible for inspection and maintenance

Image by M+S

Fig. 2-6 Façade lighting fixtures should be easy to access for maintenance

Factor 3
Façade complexity

Designers should understand the **inherent constraints and restrictions imposed by building envelope** in respect to access requirements

Ensure **all elements of the façade including its appendages** (sunshades, canopies, claddings, lighting features, etc.) are easy to access for inspection, cleaning and maintenance

An access solution should allow easy **inspection of the connections between façade features and the building's main structure**

Note:
Designers should consider easy maintenance access for façade lighting fixtures, which may require higher frequency of maintenance as compared to façade cleaning or cladding/glass replacement.


Fig. 2-7 The façade access system of Lucasfilm Singapore's Sandcrawler Building is designed as an integral part of the inclined roof structure

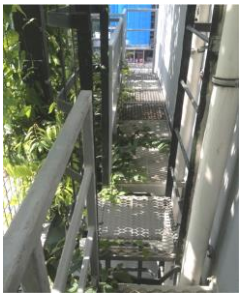



Fig. 2-8 Access ladders and passageways are incorporated in the façade design of Treehouse condominium to facilitate regular maintenance of the façade greenery

Factor 4
Maintenance needs

Consider the **façade access frequency for cleaning and extent of maintenance work** required

An access system should be designed such that the **cycle time for cleaning the entire external envelope** of the building is within the stipulated timeframe

Other **unscheduled tasks** such as repair and replacement of glazing, cladding, sunshades, etc. should be considered

A **glass replacement strategy** should be devised to facilitate rectification and periodic replacement /refurbishment

Rope access techniques cannot fully support façade inspection activities as well as repair and replacement works which require hoisting or other powered access equipment

Note:
Glazing panels installed on high-rise buildings or skyscrapers tend to be very heavy especially if they are prefabricated and installed in large modules. Replacing a damaged or defective panel will often require heavy duty equipment. A glass replacement strategy should be developed at the design to address this.

Factor 5 Productivity
Façade access design should be **optimised to a minimal number of access systems**
Design of access system should consider the **simplicity and efficiency of operation** with minimal manpower
An access system should have the **ability and effectiveness to access and maintain a wide range of façade surfaces**
A fully permanent access solution should be designed
Facilitate **the efficient movement of workers and equipment** through planning of the roof space, access for landing at ground level as well as the access route between equipment storage and work areas
Temporary means may only be considered where safer and more productive methods of access are not practicable
An access solution should have **minimal impact to building occupants and work activities** during maintenance operations
Consult facility managers on the façade maintenance workflow and needs

Fig. 2-9 Consider the simplicity and efficiency of façade access operation with minimal manpower

Factor 6 Cost
The cost of initial materials and installation of facade access system **varies depending on the type of systems**
The cost of regular servicing and maintenance of access systems/ equipment installed should be considered
The **required support from the facility managers** should be discussed and ascertained. The facility management budget should account for the costs of : i. Equipment inspections to comply with prevailing regulations ii. Servicing and maintenance of the equipment iii. Equipment replacement iv. Training for maintenance operatives

Note:
All façade access systems require regular inspection by competent persons to ensure the safe operation of these systems.

03
TYPES OF FACADE ACCESS SYSTEM

3.1 Building Maintenance Unit

3.2 Monorail

3.3 Temporary Suspended Working Platform

3.4 Rope Access

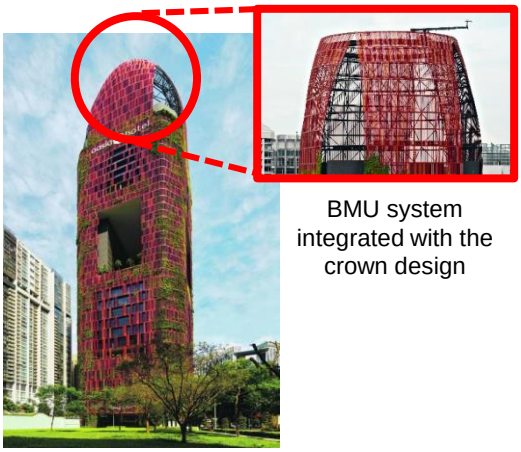
3.5 Ground-based Access Equipment

3.6 Ladders and Gantries

3.1

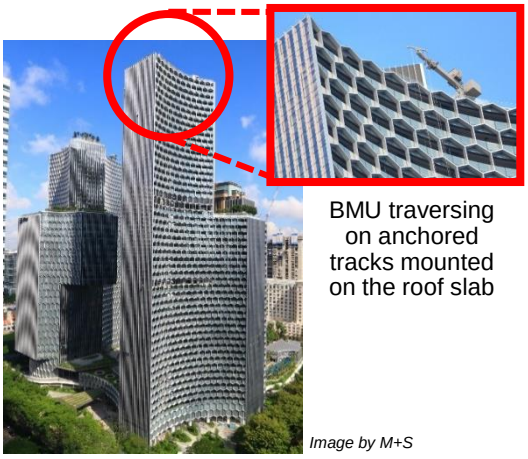
Building Maintenance Unit

A building maintenance unit (BMU) is a suspended access equipment that is permanently installed onto the building or structure. It typically comprises mechanised cradles and roof trolleys. BMUs are most suited for maintaining buildings with tall and wide facades because the cradle can move vertically and horizontally while it is suspended. The suspension systems can be on the rooftop, ceiling or façade. BMUs are recommended for buildings exceeding 100m in height and/or with a façade area over 3,000 sqm.



BMU system integrated with the crown design

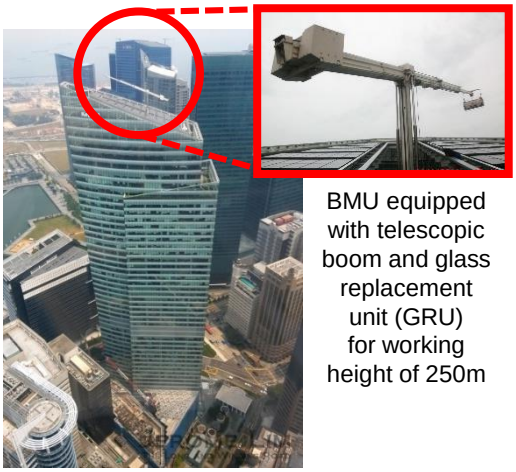
Fig. 3-1 Oasia Hotel Downtown



BMU traversing on anchored tracks mounted on the roof slab

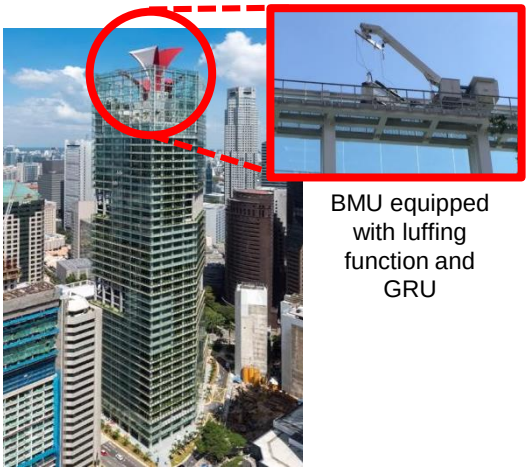
Image by M+S

Fig. 3-2 DUO



BMU equipped with telescopic boom and glass replacement unit (GRU) for working height of 250m

Fig. 3-3 Ocean Financial Centre



BMU equipped with luffing function and GRU

Fig. 3-4 CapitaGreen

Note:
BMU with telescopic jib has further reach and is suitable for buildings with large balconies and articulating façades.

Fig. 3-5 BMU traversing on roof-mounted tracks. Some systems allow the cradle to be detached and use with other rigging system

Fig. 3-6 A pantograph cradle can enable access to facades beneath projections or in recesses

Note:
The design of the cradle shall consider the maximum load comprising the maintenance tool/s, material load and the maximum weight of the personnel which may be placed thereon. As most BMU cradles are provided with a working load for two operatives with hand tools (approx. 250 kg), additional loads has to be designed into the system to facilitate cladding or glazing replacement, where a single glass panel could weigh 500kg.

Pros
Suitable for tall buildings with wide façades
Able to provide full lateral, horizontal and vertical movement for the working platform
Customisable to meet specific demands of complex building shapes and façade features
Permanently designed and installed system require less set-up time
No rigging or de-rigging procedures
Reach radius up to 50m from central point; large coverage area
Able to hoist building material/façade parts
Relatively easy process for external glazing or cladding panel replacement

Cons
Relatively higher initial equipment and installation costs
Design needs to take into account the placement and storage of roof-powered BMU to minimise their silhouette and keep within permissible height limits
Comparatively higher structural loading requirements

Relevant code and standards
SS 598: 2014, Code of Practice for Suspended Scaffolds
BS EN 1808: 2015 - Safety requirements for suspended access equipment.
BS 6037-1:2017 Planning, design, installation and use of permanently installed access equipment.

3.2

Monorail

A monorail system consists of an aluminium track, a trolley or a cradle. The aluminium track is typically designed to follow the building profile. The tracks can be located on the face, soffit or the parapet of a building. The trolley travelling along the monorail can be either manual or motorised. This access solution is suitable for unconventional façade designs involving sloped roof, cantilevered or recessed profiles.

Fig. 3-7 Face mounted monorail

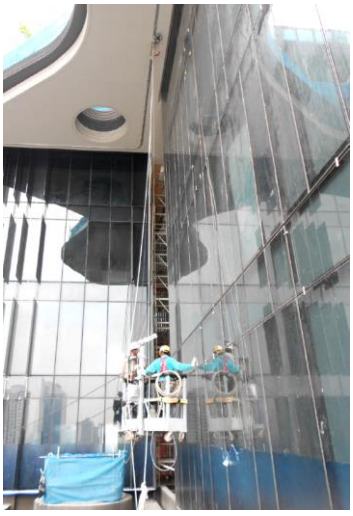


Fig. 3-8 Soffit mounted monorail system

Pros
Cradle and tracks can be designed to blend with the architecture
Does not require roof space
Does not increase the height of the building
Permanently designed and installed system requires lesser set-up time

Cons
Comparatively higher initial equipment and installation costs
More complexity involving rigging and de-rigging procedures
Require landing space at ground level

Relevant code and standards
SS 598: 2014, Code of Practice for Suspended Scaffolds
BS EN 1808: 2015 - Safety requirements for suspended access equipment.
BS 6037-1:2017 Planning, design, installation and use of permanently installed access equipment.

3.3

Temporary Suspended Working Platform

Temporary suspended working platform ('gondola') is a common type of rigging system that uses outriggers or overhead supports. It is temporarily assembled on a building and dismantled when façade access is no longer required.

The davit system is commonly used in Singapore. It consists of portable davit arms and a series of sockets or pedestals that are installed permanently on the roof slab or onto the parapet wall of the building. The working platform is suspended from the davit arms, and can be raised and lowered into position using powered winches. To move horizontally, the platform needs to be detached and manually moved which can be time-consuming.

Modular working platforms can be used on both the external and internal sides of buildings and structures. The relatively longer platform makes this system efficient especially for buildings with simple and straight façades.

Fig. 3-9 Temporary suspended working platform is a common access system used in various building types

Note:
For temporary suspended working platform supported by wire ropes, the outriggers and overhead supports for the working platform should constructed in accordance with the drawings and design prepared by a Professional Engineer.

There are four main types of overhead supports for suspended working platforms :

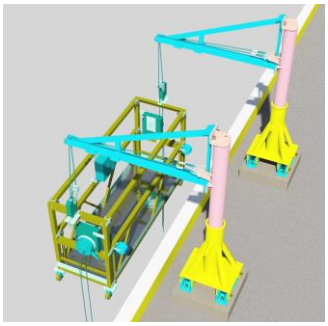



Fig. 3-10 Slab mounted outrigger

Image by M+S

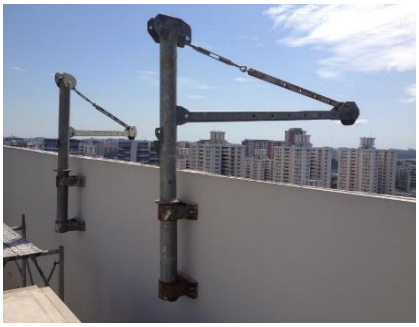



Fig. 3-11 Wall mounted outrigger

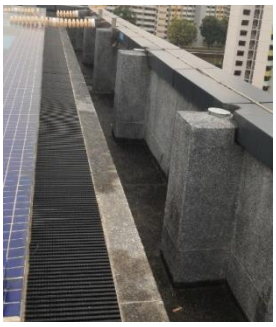



Fig. 3-12 Cast-in outrigger


Fig. 3-13 Wall clamp outrigger

Fig. 3-14 High-profile davits allow the working platform to be launched from the roof top or the ground level

Fig. 3-15 Low-profile davits only allow the working platform to be launched from the ground level. Clear passage around the ground level of the building is needed for rigging and de-rigging procedures

Pros
Suitable for simple, straight façades
Requires comparatively less roof space
Relatively lower cost
Corner and other customised platform available
Relatively easy operation by trained worker

Cons
Not suitable for recessed or outward sloping facades
No traversing – rigging and de-rigging required for each drop
Slower cleaning cycle
More complexity involving rigging and de-rigging procedures
Require landing space at ground level

Relevant code and standards
SS 598: 2014, Code of Practice for Suspended Scaffolds
BS 5974: 2017 Planning, design, setting up and use of temporary suspended access equipment.

Note:
For the anchorage of the temporary suspended working platform, the bolt and nut sets should be permanently installed without the need of fixing and removing the nut and bolt during the setting up and dismantling of the temporary suspended working platform. This is to prevent damage to the bolt and nut sets that are permanently installed into the building structure. All nuts and bolts should be regularly maintained to prevent them from rust.

3.4

Rope Access

Rope access is a relatively quick façade access method requiring low upfront investment. However, rope access needs well-trained operatives who are more costly than workers using the temporary suspended access platforms or building maintenance units. It is comparatively more labour-intensive and inefficient for major repair and cladding replacement work. As the manual reach of the worker is limited, rope access is not suitable for a façade which is wide and requires regular maintenance.

Fig. 3-16 Rope access requires trained rope access operatives

Fig. 3-17 Rope access may not be ideal for more complex tasks such as glass replacement

Pros
Comparatively lower equipment and installation cost

Cons
Labour intensive, requires skilled rope access operatives
Generally limited to simple tasks such as cleaning
Additional hoisting facility needed for material hoist and external glazing or cladding panel replacement
Relatively higher operation cost with each cleaning cycle

Relevant code and standards
Code of Practice for Working Safely at Heights
SS 588: 2013 Personnel equipment for protection against fall – Rope access systems

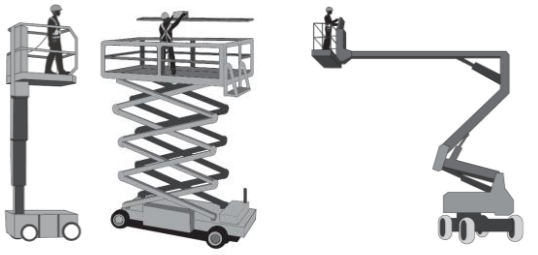
Note:
The building façade should provide sufficient anchorages for rope access work, in particular at the roof level.

3.5

Ground-based Access Equipment

A prevalent form of ground-based access equipment is the mobile elevating work platform (MEWP), which comprises mobile machines providing temporary access for workers and their tools to high working positions. There are generally two basic types of access platforms – vertical lift (e.g. scissor lifts) and boom lift (e.g. cherry pickers). Vertical lift moves primarily vertical, whereas a boom lift has lateral outreach, to work above areas not accessible from directly below.

MEWP are suitable for both indoor and outdoor operations. These mobile platforms typically provide a reach of between 3m and 50m working height. During operation, MEWP require unobstructed access routes and stable floor surfaces. For rental options, unloading area must be planned to cater for large vehicles such as trailer trucks that transport the MEWP to the worksite.



Vertical Personnel Platform **Boom lift**

Image by Workplace Safety and Health Council

Fig. 3-18 Examples of MEWPs

Fig. 3-19 Examples of scissor lifts

Vertical Lifts
Pros
Suitable for both indoor and outdoor use
Platform extensions allow for extra room when walking on the platform
Easy to manoeuvre into tight spaces

Cons
Vertical movement only, short lateral range

Relevant code and standards
SS 616: 2016 Code of practice for safe use of mobile elevating work platforms

Fig. 3-20 MEWP such as boom lift can complement BMU and cover those areas which cannot be accessed by suspended platform

Fig. 3-21 An example of a truck-mounted boom lift

Boom Lifts
Pros
Able to work above areas that are not directly accessible from below
Able to reach much higher than a scissor lift
Cons
Harder to manoeuvre in tight spaces
May need large work area due to the risk of boom arms colliding with surrounding objects
Relevant code and standards
SS 616: 2016 Code of practice for safe use of mobile elevating work platforms

3.6

Ladders and Gantries

Ladders and gantries allow internal or external parts of various inclined or vertical glazed facades, glass roofs, domes, atriums or skylights to be accessed. Usually made of profiled metal, both ladders and gantries can be designed to fit the building profile and blend in with the architecture. There are also travelling gantries which can traverse through manual, hand-cranked or electrical means along the tracks affixed onto the building structure.

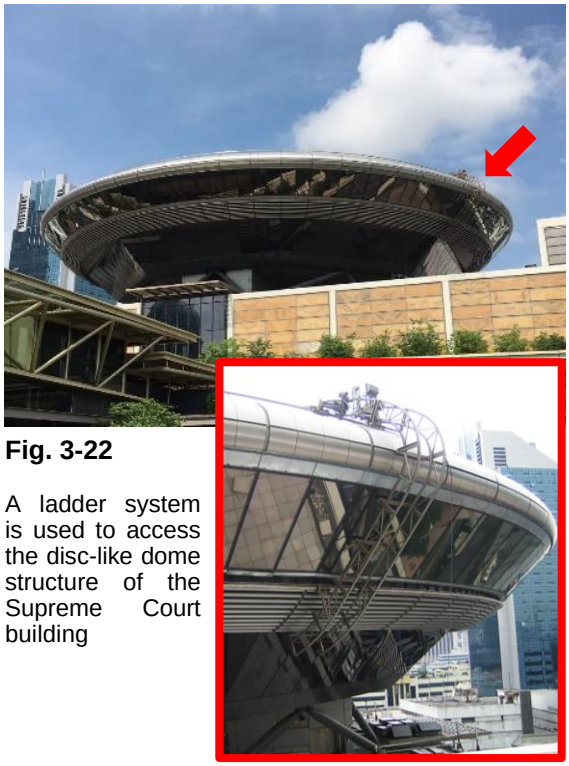


Fig. 3-22

A ladder system is used to access the disc-like dome structure of the Supreme Court building

Pros
Profile can be designed to blend with the architecture
Permanently designed and installed system requires no setup time

Cons
Single dimensional access
Commonly designed for human load only, i.e. replacement of heavy glass panels will require an alternative method

Relevant code and standards
Code of Practice for Working Safely at Heights
BS 6037 -2:2004 Code of practice for the planning, design, installation and use of permanently installed access equipment – Part 2 Travelling ladders and gantries

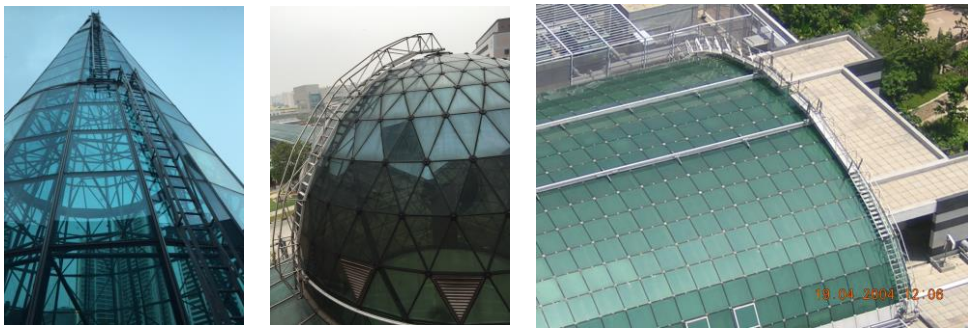


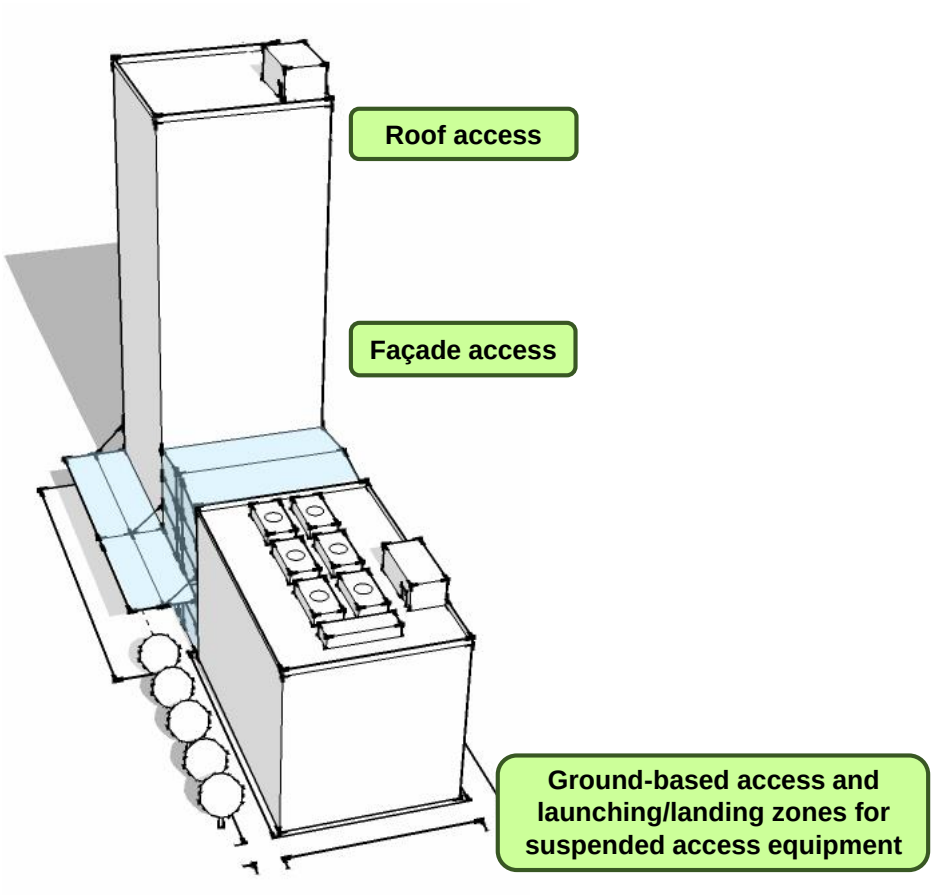
Fig. 3-23 Examples of ladders and gantries used on glass roofs

04
BUILDING DESIGN PROVISIONS

Design Provisions for Façade Access

While different façade access methods may be adopted to meet the particular circumstances and maintenance needs during a building's operational life, the upfront design should incorporate necessary inbuilt provisions for the intended access strategies and solutions. These provisions must enable safe and efficient access to façades for cleaning, inspection, and repair. It is preferable to access façades from a safe working platform such as a cradle or mobile elevating platform.

This chapter covers the guidelines for inbuilt design provisions in buildings for the common access systems - building maintenance unit, temporary suspended working platforms and ground-based access equipment. Such design provisions are usually required on the roof, façade and ground level of the development.



Note:
Under WSH (Design for Safety) Regulations, the designer must provide all the information relevant to the design, construction, and maintenance of the building or structure to the person who has appointed the designer.

4.1
Roof Access

4.1.1 Vertical access to roof

a. Buildings should have at least one direct staircase or lift access to the main roof for maintenance operations. Where a service lift is provided to roofs/sky terrace floors, it should be designed with adequate spatial and loading capacity to facilitate transport of access equipment and other materials or parts needed for façade maintenance.

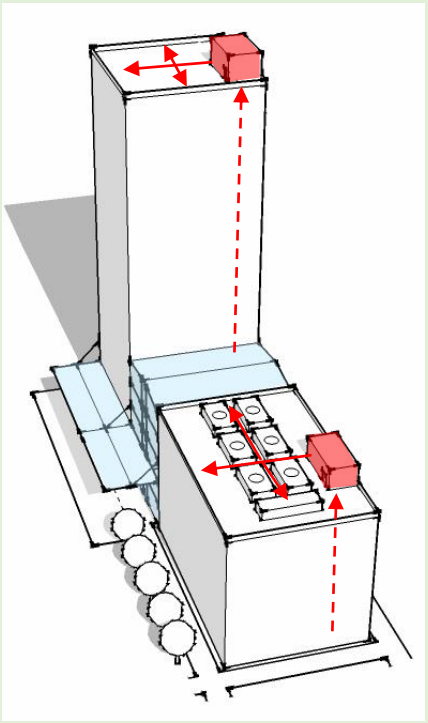


Fig. 4-1 Provision of vertical access to the roof facilitates the transport of façade access equipment and parts

Fig. 4-2 Direct staircase access to the roof

Fig. 4-3 : As more designers opt for landscaping, solar photovoltaic panels installations and other activities on the rooftop, it is crucial that rooftop access are carefully planned at the design stage

4.1.2 Unobstructed passageways and working spaces within the rooftop

a. Unobstructed passageways of at least 1m width should be provided for maintenance personnel carrying tools and equipment.

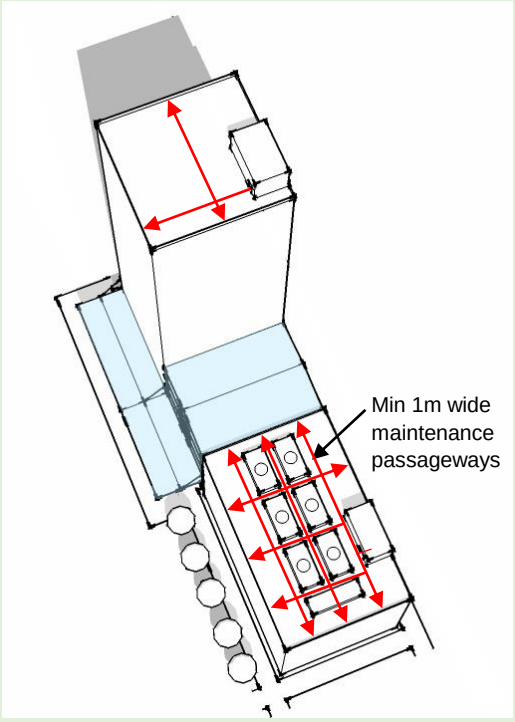


Fig. 4-4 Provide 1m wide unobstructed maintenance passageway

b. Self-supporting ladder crossings or walk platforms with safety barrier should be provided along passageways to avoid stepping onto rooftop services such as MEP pipes and conduits.

Fig. 4-5 Provision of walk platform over rooftop services

4.1.3 Rooftop working space for operation / launch of access equipment

a. Working space of at least 1.5m (or more as may be required for the operational needs of access equipment) from the building edge or parapet wall should be provided for the setting up and dismantling of temporary access equipment.

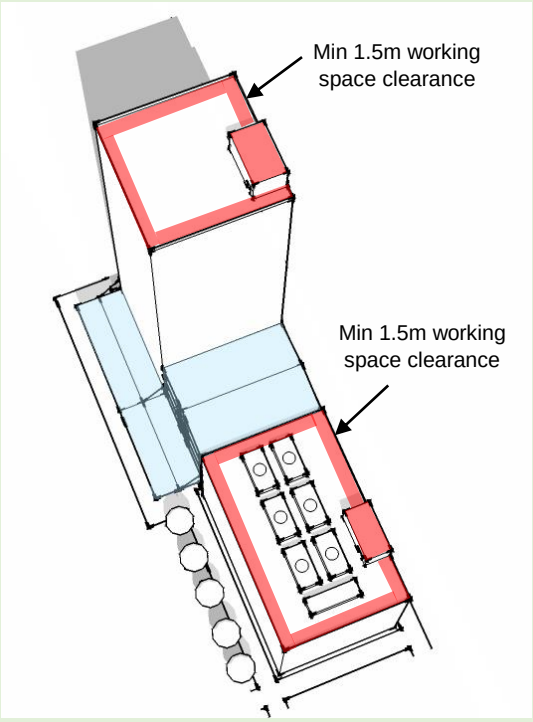


Fig. 4-6 Provide at least 1.5m clear working space along the building's edge. The designer should note that certain access equipment may require larger setback from the building edge e.g. high-profile davits require at least 2.5m

b. Spacing of hoisting facilities and anchorage points for suspended working platforms should have sufficient drop locations so that the entire façade is covered.

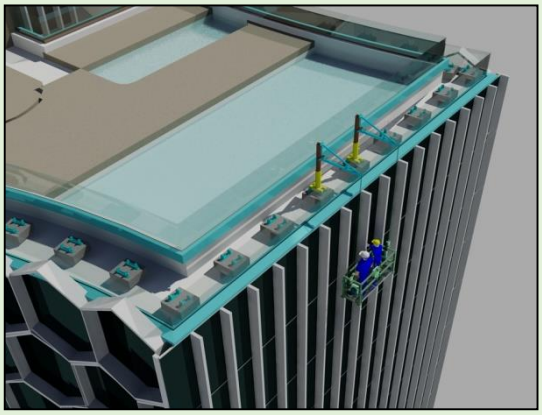


Fig. 4-7 Maximum façade coverage through sufficient spacing of hoisting facilities and anchorage points for suspended platforms

4.1.4 Other design considerations

a. Door openings to the rooftop/sky terrace floor should allow portable or mobile access equipment to pass through. The service lift used for transporting the mobile equipment should have adequate size and capacity.

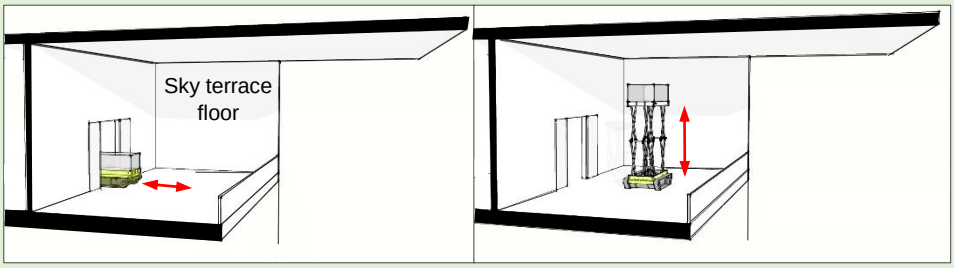


Fig. 4-8 Design of door openings should allow access equipment to pass through

b. Parapets, pedestals and roof slabs should be structurally designed for the access equipment.

c. Storage spaces for davits, cradles and other temporary equipment should be provided nearby for ease of access.

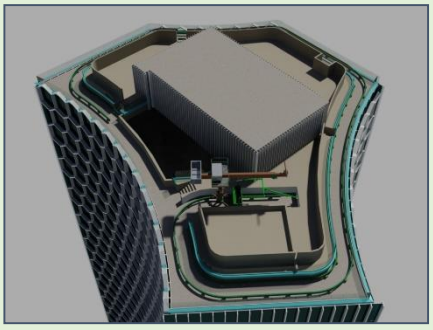


Image by M+S

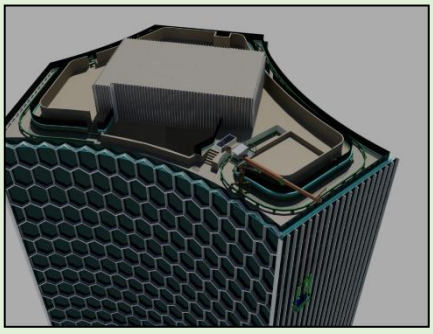


Image by M+S

Fig. 4-9 The use of BIM for 3D simulations to study the operating and parked positions of the BMU

Note:
Where BMU are used, safety measures shall be taken to ensure adequate clearance between the BMU and adjacent parts of the building to prevent personnel from being trapped.

4.1.4 Other design considerations

d. Access passageway should not be located within private spaces such as private roof terraces and balconies.

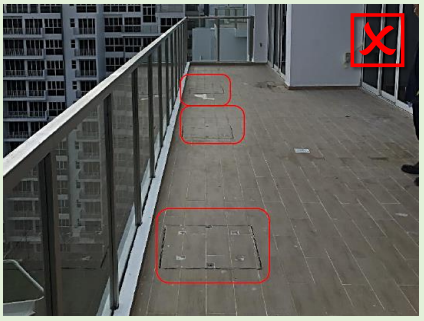


Fig. 4-10 Anchorage for suspended access equipment should not be located within private balconies or roof spaces

e. Electrical and water supplies should be provided at regular intervals for operation of access equipment and maintenance activities.

Fig. 4-11 Provision of electrical and water points

f. MEP services should not obstruct passageways for the operation of access equipment.

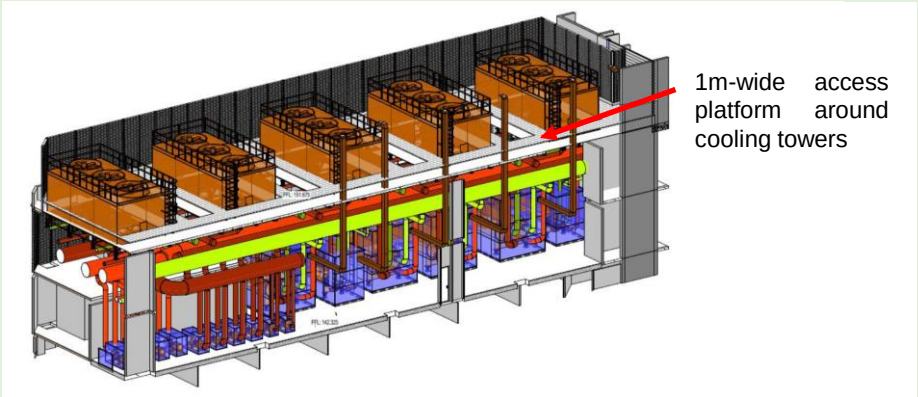


Fig. 4-12 Passageways must be considered when MEP services are being planned

4.1.5 Safety

a. Safety barriers and fall arrestors should be provided to minimise risks from falls.

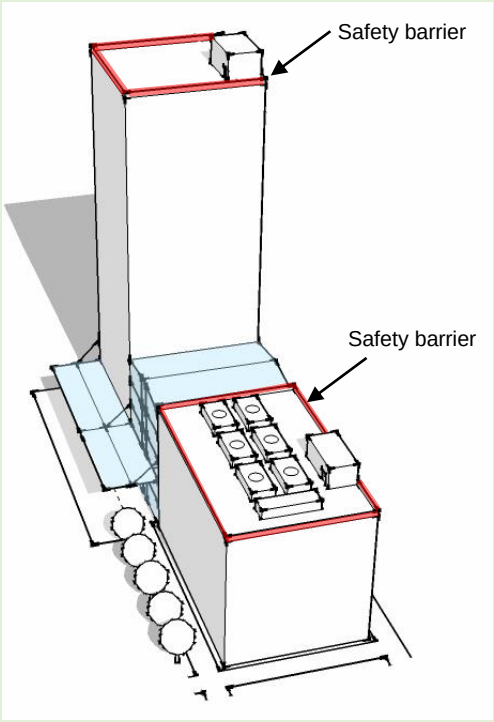


Fig. 4-13 Provision of safety barriers on rooftops

Image by M+S

Fig. 4-14 An example of safety barriers

Fig. 4-15 An example of horizontal lifeline

Note:
Anchorage provision should be designed and installed to support independent lifeline for access equipment.

4.1.6

Typical drawings and information required

Maintenance requirements of rooftop features	
a.	Information on rooftop features requiring access for frequent inspection, including frequency of inspection, cleaning, or maintenance and weight of replaceable items replaced e.g. roof lights, trellis, atria, skylight, fixed plant or equipment
Maintenance equipment, passageway and working space within roof	
b.	List of access equipment/provisions and their specific operational requirements
c.	Details of safe access routes to built-in access equipment/provisions on the roof, including safety barriers, walkways and lifelines anchors
Façade Access Strategy	
d.	Details of façade access systems for inspection, cleaning or repair and replacement
e.	Information about loading onto structure, location of tie-back restraints, anchorage, etc.

4.2
Ground-based Access & Launching/Landing Zones

4.2.1 Ensuring suitable ground conditions

a. The floor supporting the mobile elevating work platform (MEWP) must be structurally designed for stability and loadings.

Fig. 4-16 Examples of MEWP in operation

Note:
The load on the platform, ground conditions (e.g. slope), and lifting height can affect the stability of the MEWP. For better stability, various MEWP use outriggers to provide larger supporting surface on the ground.

4.2.2 Provision of unobstructed access route and working spaces at ground level

a. Sufficiently wide access route with adequate working space should be provided around the building's perimeter where façade access is via the mobile elevating work platform (MEWP). The access route should be level and designed to take the equipment's loading.

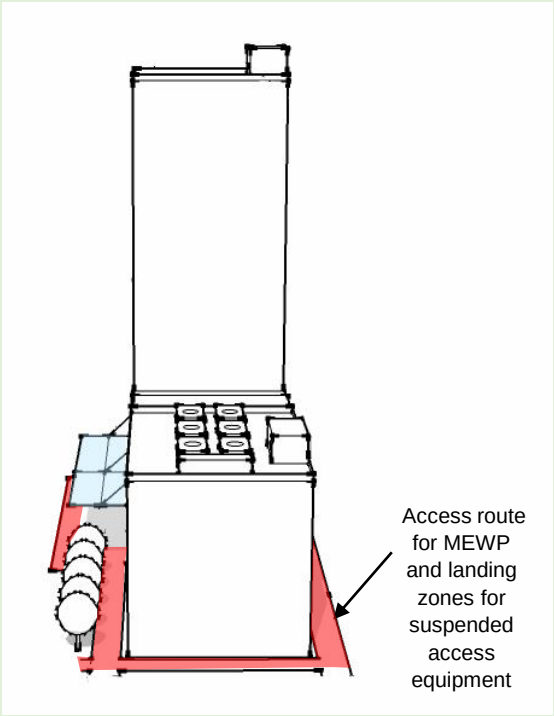


Fig. 4-17 Access route and landing zones should be planned and designed for around the building

Fig. 4-18 Access and working space for scissor lifts

b. Designers should note that:

i. Trees, lamp posts, gantries and other overhead objects may hinder the reach and operation of mobile elevating work platform (MEWP).

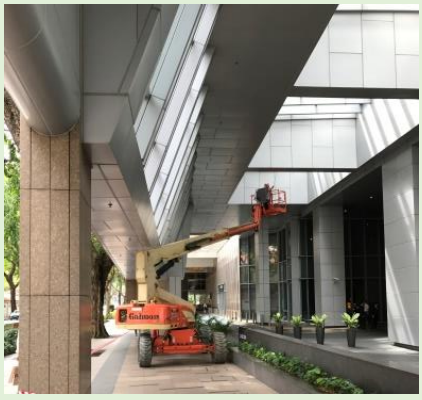


Fig. 4-19 Reach of a MEWP may be affected by overhead structures

ii. MEWP may need more ground space when using outriggers and jack-legs for levelling and stabilisation.

4.2.2 Provision of unobstructed access route and working spaces at ground level

c. Landing and rigging zones for suspended working platforms should not be over landscaped areas, water features, uneven ground surfaces, or private spaces such as private enclosed spaces (PES). The landing zone should be designed to take the load of the equipment.

Fig. 4-20 The suspended working platform should not land on PES, landscaped areas or other places that are not suited for landing and rigging operations

Fig. 4-21
Landing zones should be planned on an unobstructed hard surface

Fig. 4-22 Direct access can be hindered by water bodies

4.2.3

Typical drawings and information required

Maintenance requirements of external façade features	
a.	Information on the external elements requiring inspection, maintenance or repair and replacement (e.g. cladding, windows, entrance canopies, signage, feature lighting).
Maintenance equipment, access routes and working space	
b.	List of ground-based access equipment/provisions and its operational requirements.
c.	Drawings indicating the designated maintenance access/egress routes.
Launching/landing zones for temporary suspended working platform strategy	
d.	Drawings outlining working routes and zones for temporary suspended working platform that is clear from obstruction or landscaping
e.	Loading check requirements; suitability of working space which is stable and incline-free.

4.3
Façade Access

4.3.1 Integration of façade designs for ease of access to carry out inspection, cleaning, and repair & replacement

a. Façade access system should be well-integrated with the building design:

i. Addition of necessary safety features, e.g. anti-sway restraints, stabilisation mullions/tracks, fall arrestors, and anchor points for safety ropes.

Fig. 4-23 Provision of anti-sway restraints prevent swaying of suspended working platform during windy conditions

ii. Ensuring additional strengthening to the base building structure due to the imposed loads of façade access equipment.

iii. Provision of façade door or garage to conceal bulky access equipment.

Fig. 4-24 Consider how bulky access equipment can be stowed away when not in operation

4.3.1 Integration of façade designs for ease of access to carry out inspection, cleaning, and repair & replacement

b. Façade access for routine inspection, cleaning and maintenance should not rely on inefficient methods such as the use of extensive scaffolding.

Fig. 4-25 Use of extensive external scaffolding as the primary means of façade access should be avoided

c. Façade design and access method should allow for the close-up inspection and efficient maintenance of façade surfaces and features.

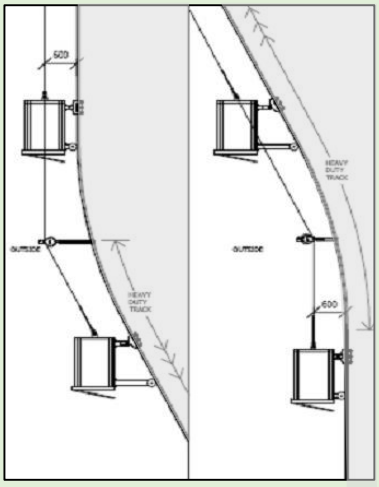


Fig. 4-26 A guidance system comprising guide wires, rollers, etc. could be incorporated to enable the working platform to access irregular and curvilinear facades at required proximity

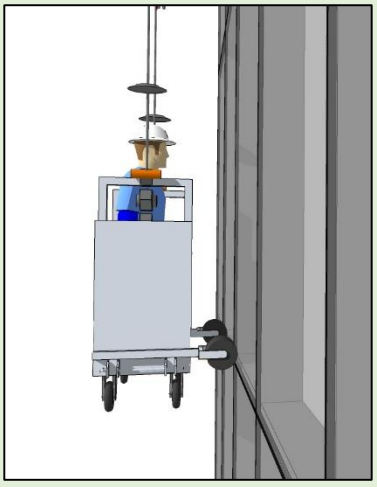


Fig. 4-27 In its working position, the cradle or working platform should be as close as practicable to the face of the building

4.3.2 Access and maintenance for façade greenery

a. Maintenance access should be designed to allow workers carrying tools and equipment to reach and manoeuvre around the work areas to effectively inspect and maintain the verdure.

Image by WOHA

Fig. 4-28 The extent and frequency of maintenance tasks as well as the need for safety features – such as maintenance access, anchorage points and safety lines – should be considered in the façade greenery design

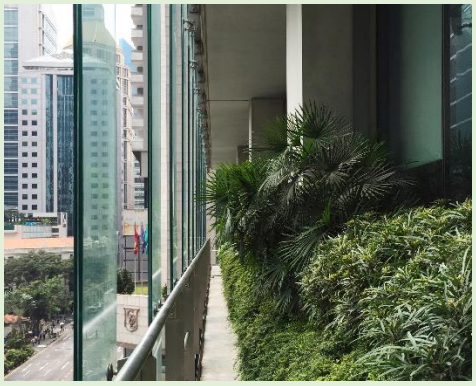


Image by Patrick Bingham-Hall

Fig. 4-29 Maintenance access can be designed either in front or behind the verdure

Note:
Where the facade greenery systems span a few storeys, maintenance access should be provided at every level.

4.3.2 Access and maintenance for façade greenery

b. For maintenance activities involving MEWP, it is important to provide clear access routes and landing spaces that are free of obstructions

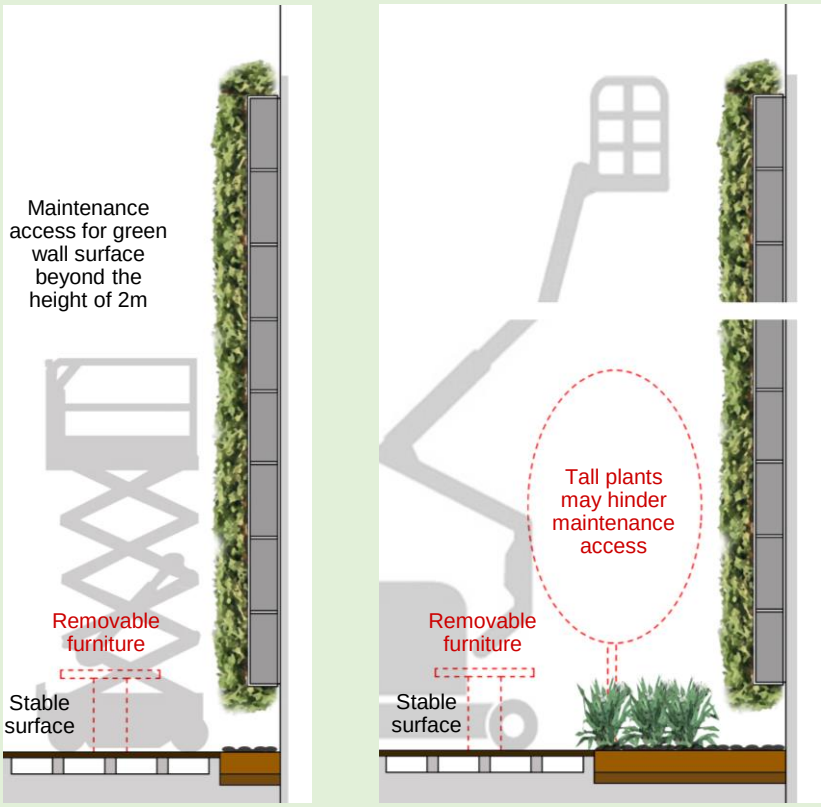


Fig. 4-30 Using MEWP for maintenance of façade greenery

Note

The supporting structures of the facade greenery, such as the connections to walls/panels, should be inspected regularly for signs of corrosion, loosening, or defects which may affect the structural integrity of these supports.

4.3.3 Access to façade from within the building

a. Façade design should allow access from within the building for inspection, cleaning, and minor repair works, wherever possible.

Provide windows of a size and design that allow cleaning from within the building.

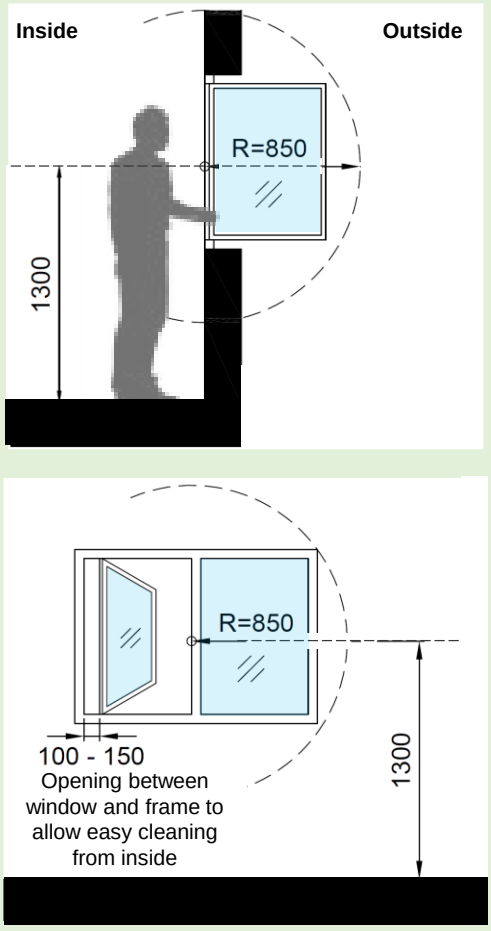


Fig. 4-31 Safe reach for cleaning casement window

Note:
Replacing a damaged or defective panel beneath the building / facade projections or recesses using a separate material hoist may not be possible in some situations. Alternative methods like replacing the panel from inside the building is preferable, e.g. using a floor crane to handle the glass panel from inside of the building and complete the installation with the gondola from external.

4.3.4

Typical drawings and information required

Maintenance requirements of facade features	
a.	Information on the external elements requiring inspection, cleaning, or maintenance (e.g. curtain walling, windows, sun-shading devices, balconies, signage, feature lighting, downpipes).
Maintenance equipment, passageway and working space for facade	
b.	List of inbuilt access equipment/provisions and their specific operational requirements, including loadings on the building, and clear path for travelling and operation.
c.	Details of safe access routes to inbuilt access equipment/provisions on the façade including safety barriers, restraints, anchors, etc.
d.	Drawings indicating the designated maintenance access/egress route for temporary access equipment.

4.4

Access to Air Conditioning Unit Service Ledge

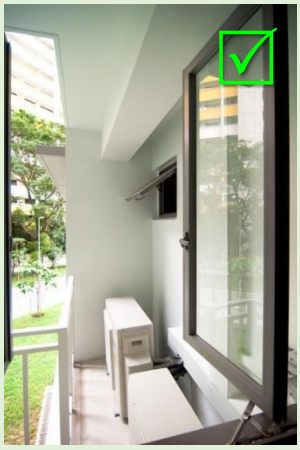
4.4.1 Safe and easy access for routine maintenance and replacement of air conditioning unit (AC)	
a.	Service ledges should not be located in building recesses or enclosed areas that makes access difficult. Furthermore, AC equipment in confined spaces increases the chance of rejected heat being recirculated into the equipment intake, thereby affecting its proper function.
b.	A maintenance worker should have access to the AC equipment serving common areas without having to intrude into private spaces.

Fig. 4-32 Insufficient working space affects the safety and efficiency of maintenance activities

Note:
Designers should assess the risk of fall and consider incorporating anchorage points onto AC service ledge structure.

4.4.1 Safe and easy access for routine maintenance and replacement of air conditioning unit (AC)

c. Maintenance access to service ledges through windows/openings* – preferably 900 min (H) x 600 min (W) and located at no higher than 1m from the finished floor level – should allow safe and easy access for maintenance personnel carrying tools, equipment and spare parts.



**Note: Provide larger dimensions as may be required to meet AC manufacturer's specifications.*

Fig. 4-33 Sufficiently large window opening for access to service ledge

d. Access to AC ledges should not require dismantling of building elements (e.g. window parts) and services.

Fig. 4-34 Restricted access openings to AC ledge

e. Kitchen counters, water closets and other fixtures that may pose obstructions should not be located near access openings to AC ledges.

Fig. 4-35 The access opening is poorly located behind the kitchen countertop

4.4.1 Safe and easy access for routine maintenance and replacement of air conditioning unit (AC)

f. Safety barriers should be provided around the service ledge to mitigate the risk of fall from height.

Fig. 4-36 Safety barrier is provided for the AC ledge

g. Provide adequate working space for service and maintenance.

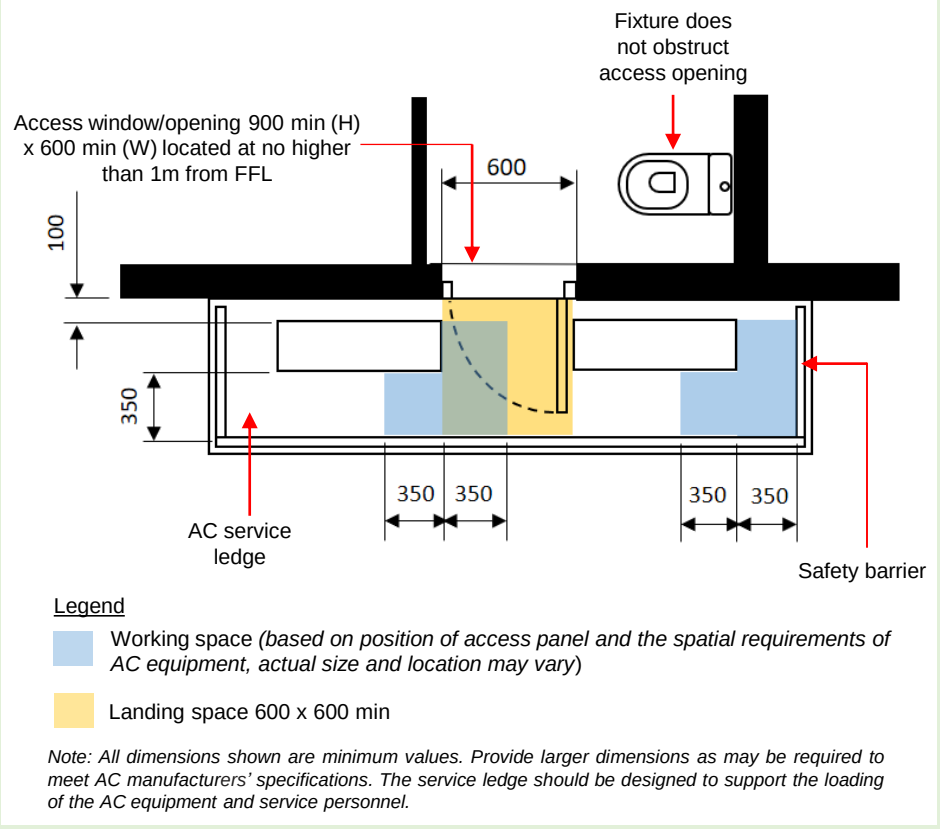


Fig. 4-37 Working space required for AC servicing and maintenance

REFERENCES

- Design for Maintainability Checklist, BCA
- Approved Document – Acceptable Solutions, BCA
- A Concise Guide to Safe Practices for Rooftop Greenery, NParks
- A Concise Guide to Safe Practices for Vertical Greenery, NParks
- CS E11:2014 Guidelines on Design for Safety of Skyrise Greenery, NParks CUGE
- Code of Practice for Working Safely at Heights
- Workplace Safety and Health (Scaffold) Regulations, 2011
- Workplace Safety and health (Work at height) Regulations, 2013
- Workplace Safety and Health Guidelines – Personal Protective Equipment for work at heights
- Workplace Safety and Health Guidelines - Anchorages, Lifelines and Temporary Edge Protection Systems
- Workplace Safety and Health Guidelines - Working Safely on Roofs
- SS 588: 2013 Personnel equipment for protection against fall – Rope access systems
- SS 598: 2014, Code of practice for suspended scaffolds
- SS 616: 2016 Code of practice for safe use of mobile elevating work platforms
-
- BS EN 1808: 2015 - Safety requirements for suspended access equipment. Design calculations, stability criteria, construction. Examinations and tests.
- BS 5974: 2017 Planning, design, setting up and use of temporary suspended access equipment. Code of practice.
- BS 6037-1:2017 Planning, design, installation and use of permanently installed access equipment. Code of practice. Suspended access equipment
- BS 6037 -2:2004 Code of practice for the planning, design, installation and use of permanently installed access equipment – Part 2 Travelling ladders and gantries
- Approved Document K - Protection from falling, collision and impact

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- Singapore Contractors Association Ltd
- Singapore Institute of Architects

Industry stakeholders/practitioners
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- BMS Group Singapore
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