History of amendments

<table>
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<th>S/N</th>
<th>Brief description of changes</th>
<th>Revision date</th>
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<tr>
<td>1</td>
<td>Ver 1.0 – First issue</td>
<td>Dec 2017</td>
</tr>
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<td>Ver 1.1 – First revision</td>
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<tr>
<td></td>
<td>a) Revision made to Fig. 4-37</td>
<td>May 2019</td>
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1.1 Principles of Design for Maintainability

1.2 Purpose of this guide
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.

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

<table>
<thead>
<tr>
<th>SAFETY</th>
<th>Increased risk for those carrying out façade maintenance works and higher long-term costs incurred from the shortfall in adequate safety provision</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTIVITY</td>
<td>Additional time and/or manpower needed to undertake inspection and maintenance tasks</td>
</tr>
<tr>
<td>BUILDING PERFORMANCE</td>
<td>Omission or delayed maintenance activities that can affect building performance</td>
</tr>
<tr>
<td>FACADE</td>
<td>Unsightly, obtrusive façade access solutions</td>
</tr>
<tr>
<td>AESTHETICS</td>
<td>A poorly maintained façade adversely affects the architecture as well as the appeal to prospective tenants and the community</td>
</tr>
<tr>
<td>VALUE</td>
<td>Loss of value and function due to the above</td>
</tr>
</tbody>
</table>

**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.
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

2.2 Design 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 place 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

<table>
<thead>
<tr>
<th>Stages</th>
<th>Planning &amp; concept design</th>
<th>Detailed design</th>
<th>Tender &amp; construction</th>
<th>Hand over &amp; occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site and climatic considerations</td>
<td>Detailed façade design – co-ordinated architectural, structural and building services proposals</td>
<td>Tender/contract documentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Façade design concept</td>
<td>Maintainability requirements, including safety considerations (e.g. provisions for tie-back restraints or lifelines)</td>
<td>Commitment of contractors to specifications and maintainability requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated maintenance requirements (e.g. compute cleaning cycle duration)</td>
<td>Devises maintenance regime</td>
<td>Maintenance regime in place</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Façade access and maintenance strategy, including material hoist requirements for glass or façade lighting replacement</td>
<td>Finalise façade access and maintenance options, with consideration for parking/storage location for maintenance equipment</td>
<td>Construction and installation as per specialist contractors’/manufacturers’ details</td>
<td>As-built records, including façade access and maintenance strategies information</td>
<td></td>
</tr>
<tr>
<td>Types of access system and equipment available with consideration of maximum operating height</td>
<td>Detailed design and specifications of access systems and equipment</td>
<td>Testing and commissioning of access systems and equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability and availability of parts</td>
<td>Specialist contractors’/manufacturers’ requirements</td>
<td>Preparation of operation and maintenance (O&amp;M)</td>
<td>Updated O&amp;M documents and Design for Safety register</td>
<td></td>
</tr>
<tr>
<td>Building lifespan/lifecycle cost considerations</td>
<td>Anticipated business costs and inconvenience to building users</td>
<td>As-built records, including façade access and maintenance strategies information</td>
<td>Operational procedures and training for maintenance personnel</td>
<td></td>
</tr>
<tr>
<td>Feedback to/from developer and building managers</td>
<td>Review and validate with developer and building managers</td>
<td>Review and validate with developer and building managers</td>
<td>Feedback from occupants/building managers for benefit of future projects</td>
<td></td>
</tr>
<tr>
<td>Urban design (building mass, façade treatments, lighting, signage, etc) and landscaping requirements</td>
<td>• Buildability</td>
<td>Workplace Safety and Health (WSH)</td>
<td>• Safety certification by Professional Engineer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Environmental sustainability</td>
<td></td>
<td>• Workplace Safety and Health (WSH)</td>
<td></td>
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<td></td>
<td>• Daylight reflectance</td>
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<tr>
<td></td>
<td>• Design for Safety</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Fire safety</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 2-2 Decision-making flowchart for façade access design

Factors Affecting Design & Selection of Façade Access System

- Safety & Regulatory Requirements
- Building Height & Geometry
- Façade Complexity
- Maintenance Needs
- Productivity in Maintenance
- Maintenance Cost

ACCESS DESIGN CONSIDERATIONS

**Roof**
- Is direct access to roof available for workers and equipment?
- Are there clear passageways for workers, including ladder crossings, to reach access system?
- Is there sufficient working space for setting up of the access system?
- Are electrical and water supplies available for operation of access system?
- Is there a safety barrier that prevents falls from height?
- Does the access to the façade encroach into private spaces, e.g. private roof terrace?

**Facade**
- Are all elements of the façade accessible?
- Is there access for close-up inspection and efficient maintenance?
- Is there access to the façade’s greenery – either frontal or rear – for their efficient maintenance?
- Is there a safe and easy access to air-conditioning service ledges?
- Are there safety features integrated in the façade, e.g. anti-sway restraints?
- Has façade access from within the building been explored?

**Ground**
- Is the floor designed to take the load of mobile access equipment?
- Are there obstructions along the access route around the building’s perimeter?
- Are there obstructions in the working space for the operation of access equipment?
- Are there obstructions in the landing zones for suspended working platforms?
- Are there structurally-designed landing zones for suspended working platforms?
- Does the access to façade encroach into private spaces, e.g. private enclosed space?
2.2 Design factors

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

**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.

---

**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
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.
### 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.

---

**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.

---

**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.

---

### Factor 6
Cost

The cost of initial materials and installation of façade 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:

1. Equipment inspections to comply with prevailing regulations
2. Servicing and maintenance of the equipment
3. Equipment replacement
4. 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.

![Fig. 3-1 Oasia Hotel Downtown](image1)
BMU system integrated with the crown design

![Fig. 3-2 DUO](image2)
BMU traversing on anchored tracks mounted on the roof slab

![Fig. 3-3 Ocean Financial Centre](image3)
BMU equipped with telescopic boom and glass replacement unit (GRU) for working height of 250m

![Fig. 3-4 CapitaGreen](image4)
BMU equipped with luffing function and GRU

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

**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.

**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.

<table>
<thead>
<tr>
<th>Pros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cradle and tracks can be designed to blend with the architecture</td>
</tr>
<tr>
<td>Does not require roof space</td>
</tr>
<tr>
<td>Does not increase the height of the building</td>
</tr>
<tr>
<td>Permanently designed and installed system requires lesser set-up time</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparatively higher initial equipment and installation costs</td>
</tr>
<tr>
<td>More complexity involving rigging and de-rigging procedures</td>
</tr>
<tr>
<td>Require landing space at ground level</td>
</tr>
</tbody>
</table>

 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

**Fig. 3-11** Wall mounted outrigger

**Fig. 3-12** Cast-in outrigger

**Fig. 3-13** Wall clamp outrigger
**Façade Access Design Guide**

**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.

![Rope Access](image)

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

<table>
<thead>
<tr>
<th>Pros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparatively lower equipment and installation cost</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Relevant code and standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code of Practice for Working Safely at Heights</td>
</tr>
<tr>
<td>SS 588: 2013 Personnel equipment for protection against fall – Rope access systems</td>
</tr>
</tbody>
</table>

**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 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. 3-18** Examples of MEWPs

**Fig. 3-19** Examples of scissor lifts
### 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

---

**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
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.

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. 3-22

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

Fig. 3-23

Examples of ladders and gantries used on glass roofs
4.1 Roof Access

4.2 Ground-based Access & Launching/Landing Zones

4.3 Façade Access

4.4 Access to Air Conditioning Unit Service Ledge
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.

![Diagram of min 1.5m working space clearance]

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.

![Diagram of maximum façade coverage through sufficient spacing of hoisting facilities and anchorage points for suspended platforms]

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](image) 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.

![Fig. 4-9](image) 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](image)

| 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](image)

| 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](image)
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

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

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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.

![MEWP in operation](image)

**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

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**

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### 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](image) 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](image) 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](image1)

![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](image2)

![Fig. 4-27 In its working position, the cradle or working platform should be as close as practicable to the face of the building](image3)

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

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.

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

**Note:**
Where the façade 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 façade 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**

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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.

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

b. A maintenance worker should have access to the AC equipment serving common areas without having to intrude into private spaces.

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](image)

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](image)

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

Legend
- Working space (based on position of access panel and the spatial requirements of AC equipment, actual size and location may vary)
- Landing space 600 x 600 min

Note: All dimensions shown are minimum values. Provide larger dimensions as may be required to meet AC manufacturers’ specifications. The service ledge should be designed to support the loading of the AC equipment and service personnel.
REFERENCES

- Design for Maintainability Checklist, BCA
- Approved Document – Acceptable Solutions, BCA
- 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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