Dated 4 December 2023

SALE OF SITE
FOR RESIDENTIAL DEVELOPMENT
LAND PARCEL
AT UPPER THOMSON ROAD (PARCEL B)

TECHNICAL CONDITIONS OF TENDER

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PART I

1.0 GENERAL

1.1 The Urban Redevelopment Authority ("the Authority"), acting as agent for and on behalf of the Government of the Republic of Singapore ("the Government"), is inviting offers for lease by tender for the Land Parcel at Upper Thomson Road (Parcel B) ("the Land Parcel"). The lease of the Land Parcel is subject to these Technical Conditions of Tender and the Conditions of Tender for the Land Parcel. In these Technical Conditions of Tender, where the context so admits, the expression "the Authority" includes the Government.

1.2 The Successful Tenderer shall in addition to the Conditions of Tender observe, and comply with, these Technical Conditions of Tender. The Conditions of Tender and these Technical Conditions of Tender shall be read in conjunction with the Control Plans provided in the eDeveloper's Packet.

PART II

2.0 PLANNING CONCEPT

Site Context

2.1 The Land Parcel, which is located within Yishun Planning Area and bounded by Upper Thomson Road and Seletar Expressway (SLE), is designated for Residential development. It is located within an established residential area that comprises low-density private housing and is adjacent to Springleaf Forest, characterised by lush vegetation and home to a rich variety of flora and fauna, including threatened and endangered plant and animal species.

2.2 The Land Parcel comprises a former school and was surrounded by plantations. It was in close proximity to the former Nee Soon Village, which served as the commercial centre for the North until the early 1980s. The Land Parcel is now part of the tranquil, lush and historically significant Springleaf Identity Node, which includes shophouses across Upper Thomson Road, that provide amenities for the neighbourhood.

2.3 The Land Parcel is currently well-served by rail by the Springleaf MRT Station on the Thomson-East Coast Line (TEL), and well-connected to major roads and expressways such as the SLE, Sembawang Road and Upper Thomson Road.

Vision

2.4 The Land Parcel is envisaged as a well-connected and distinctive node for future and existing residents, adding to the existing retail amenities of the area without compromising the tranquillity, biodiversity and lushness of the Springleaf Identity Node.

2.5 The development of the Land Parcel shall leverage its proximity to the existing Springleaf MRT Station and the historic Upper Thomson Road corridor to create a distinctive and lively streetscape; with seamless pedestrian-friendly connectivity to nearby amenities and neighbourhoods.

Ecological Strategies

2.6 The larger Springleaf precinct is located between the Central Catchment Nature Reserve (CCNR) and Upper Seletar Reservoir to the west, and Springleaf Nature Park and Lower Seletar Reservoir to the east. The forested portion of the site, also known as Springleaf Forest, is characterised by lush vegetation and is home to a rich variety of native flora

and fauna, including threatened and endangered plant and animal species. It is ecologically connected to the CCNR and Nee Soon Swamp Forest (NSSF), with Sungei Seletar as the sole hydrological outlet from both the Upper Seletar Reservoir and the Nee Soon Swamp Forest into the Lower Seletar Reservoir downstream. It is also along the Khatib Nature Corridor, an identified pathway under NParks' Ecological Profiling Exercise (EPE).

2.7 The plans for the precinct, including the retention of core biodiversity areas within Springleaf Forest, were informed by findings from a baseline study and Environmental Impact Assessment (EIA). The Successful Tenderer may wish to refer to the EIA report, which is available on URA's EIA webpage[1].

2.8 Given its proximity to ecological and hydrological assets such as the CCNR and Nee Soon Swamp Forest, the Land Parcel is envisioned to be an environmentally sensitive development that prioritises biodiversity protection and ecological connectivity - one that safeguards nature while encouraging residents to connect with nature.

2.9 The development of the Land Parcel will need to incorporate Biodiversity Sensitive Urban Design (BSUD) strategies. The proposed development will be reviewed by a Design Advisory (DAP) which is chaired by URA as part of the formal development control submission process for the grant of Planning Permission. There will also be an additional pre-submission requirement in the DAP workflow to facilitate upstream design discussions with the DAP. The Successful Tenderer will be required to submit an ecological report outlining the development's overall greening and biodiversity-sensitive strategies.

2.10 The Successful Tenderer will be required to develop an appropriate Environmental Management and Monitoring Plan (EMMP) to ensure that impact from developments within the Land Parcel are adequately minimised.

2.11 The Successful Tenderer is to alert MND/URA and Technical Agencies if any unexpected negative environmental impacts are detected at any stage and to cease all works until the necessary assessment and/or mitigating measures are put in place.

Innovative Building Typologies

2.12 The Land Parcel's proximity to natural assets and its role in ecological connectivity, presents an opportunity to develop a seminal development

[1] https://www.ura.gov.sg/Corporate/Planning/Our-Planning-Process/Bringing-plans-to-Reality/Environmental-Impact-Assessment

with BSUD strategies both within and outside the development boundary, through innovative building typologies.

2.13 Given the proximity to an ecologically-sensitive area, the Successful Tenderer of the Land Parcel is encouraged to develop new green building typologies that can respond sensitively to the surrounding ecology (e.g. bird-safe façade and massing utilising NParks' Bird-Safe Building Guidelines), encourage biodiversity in high-rise areas (e.g. vertical and skyrise greenery techniques with diverse landscaping), leverage passive design strategies and not detract from the sense of rustic charm and greenery of the Springleaf area (e.g. sensitive form and scale with lush facades as viewed from street level along Upper Thomson Road).

Conserved Building

2.14 The Land Parcel includes a former classroom building of the former Upper Thomson Secondary School (later used by the former Seletar Institute) which is conserved ("the Conserved Building"). The Conserved Building is located within a conservation area as shown in the Control plan. It is located prominently along Upper Thomson Road, near the junction with Springleaf Road and is a familiar landmark of the area. It was also the backdrop for the old assembly area of the school which was a key focal point and gathering space.

2.15 The Conserved Building shall be restored and integrated into the overall residential development, together with an open communal gathering space in front of the Conserved Building to recall the former assembly area of the school. The sensitive integration of the Conserved Building and assembly area provides the opportunity to create a distinctive sense of place and delightful setting within the development.

PART III

3.0 SUMMARY OF PLANNING, URBAN DESIGN AND CONSERVATION REQUIREMENTS

3.1 A summary of the planning, urban design and conservation requirements is set out in Table 1. The detailed planning and urban design requirements and conservation guidelines are set out in Part IV and Part V respectively.

Table 1 – Summary of Planning, Urban Design and Conservation Requirements for the Land Parcel

PARAMETERS	**PROVISIONS/REQUIREMENTS**
Site Area[2]	32,023.7 m^2
Land Use/Zoning	Residential
Type of Proposed Housing Development	The proposed residential development shall be for: a. Condominium; or b. Flats; or c. With prior written approval, a combination of flats and strata landed houses. Serviced Apartments and Serviced Apartments II (SA2) will not be allowed.
Permissible Gross Floor Area (GFA)	Maximum GFA[3]: 80,060 m^2 Minimum GFA: 72,054 m^2
Building Height	a. <u>No-build Zone</u> The no-build zone includes the conservation area and the setback area from Upper Thomson Road. b. <u>Low-Rise Zone</u> Up to a maximum of 5 storeys high in front of the Conserved Building c. <u>High-Rise Zone</u> Up to the technical height control of 90 – 100 m SHD

[2] Subject to final cadastral survey

[3] This shall include the existing GFA of the Conserved Building. The estimated GFA of the Conserved Building is 3,447.4 m^2.

	The details are set out in Part IV (Condition 4.5) and as shown in the Control Plans.
Pedestrian Network	The Successful Tenderer is to provide a minimum 2.4m wide (1.8m wide clear) covered linkway, minimum 1.5m wide permanent footpath connecting the main entrance of the proposed development to Parcel A, along Upper Thomson Road. The details are set out in Part VI (Condition 6.3) and as shown in the Control Plans.
Building Setback	The details are set out in Part IV (Condition 4.6) and as shown in the Control Plans.
Allowed Uses in the Conserved Building	The Land Parcel includes a Conserved Building which is to be retained and restored. The details of the conservation guidelines are set out in Part V and as shown in the Control Plans. The Conserved Building shall be adapted for residential and/ or indoor recreation spaces, such as private clubhouse or communal facilities use only.
Landscape Replacement Area (LRA)	The Successful Tenderer is to respond sensitively to the biodiversity and ecology of the Central Catchment Area, and to portray a visually lush development by incorporating Landscape Replacement Areas (LRAs) equivalent to the site area of the Land Parcel. The development shall provide a minimum softscape requirement of 60% of Site Area. The details are set out in Part IV (Condition 4.9).
Design Advisory Panel	The development proposal will be reviewed by a Design Advisory Panel (DAP) prior to formal submission and as part of the formal Development Control submission process in relation to the application and grant of Planning Permission. The details are set out in Part VII (Condition 7.4-7.6).

PART IV

4.0 PLANNING, URBAN DESIGN AND CONSERVATION REQUIREMENTS

4.1 General Guidelines

4.1.1 The Planning and Urban Design Requirements as set out in Part IV are to be read in conjunction with the Control Plans and the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees provided in the eDeveloper's Packet.

Development Control

4.1.2 The Successful Tenderer shall comply with the Development Control (DC) Guidelines issued by, that may be issued by the Competent Authority under the Planning Act 1998, unless otherwise stated in the Technical Conditions of Tender.

4.1.3 Where applicable, the Successful Tenderer's Qualified Person shall submit a Development Statement of Intent (DSI), together with their development proposal, to the Competent Authority under the Planning Act 1998 at the formal submission stage in compliance with prevailing guidelines and circulars issued by the Competent Authority.

Access into State Land

4.1.4 For the purpose of entering State Land to carry out any works for the purpose of or in relation to the proposed development as may be required under these present Technical Conditions of Tender or Conditions of Tender, the Successful Tenderer shall obtain a Temporary Occupation License (TOL) from the Singapore Land Authority (SLA) for use of the State Land. The TOL may be granted on such terms and conditions and subject to the payment of such charges and fees as the SLA may determine.

Existing Underground Structures

4.1.5 The Successful Tenderer shall be responsible, at their own cost and expense, to carry out their own site investigation to verify whether there is any sub-structure or other obstructions (e.g. footings, piles, tree roots) in the ground of the Land Parcel, and ascertain their effect on the proposed development, including the removal of such sub-structure or obstructions, if necessary. The Successful Tenderer shall be deemed to have notice of any sub-structure or other obstructions in the ground of the Land Parcel and shall not raise any objection or requisition whatsoever in respect of any sub-structure or other obstructions.

Deviations from Planning Requirements

4.1.6 The Planning and Urban Design requirements, asset out in this Part relating to location, height, size, area or extent of uses, etc., are specified with a view to achieving the relevant planning objectives as outlined or indicated in the provisions in this Part. The Successful Tenderer may submit an alternative proposal to any such requirements for the Authority's consideration. Where the Authority is satisfied that the alternative proposal will serve to achieve the planning objective relevant to the requirement, the Successful Tenderer may be allowed to adopt such alternative proposal instead; in which event, the relevant provisions in this Part shall be deemed to have been complied with. The Authority however reserves the absolute discretion to decide whether to allow any alternative proposal to be adopted.

4.2 Land Use and Quantum

4.2.1 The Land Parcel is to be developed for a Residential development. The maximum permissible Gross Floor Area (GFA) for the proposed development is 80,060 m^2 and the total GFA to be built is not to be less than 72,054 m^2.

4.2.2 The GFA of the Conserved Building shall be computed as part of the maximum permissible GFA.

4.2.3 Any additional GFA over and above the maximum permissible GFA specified for the proposed development accrued from incentive GFA schemes will be subject to the prevailing Development Control Guidelines and the approval of the Competent Authority under the Planning Act. This additional GFA may be subject to the payment of Differential Premium, if applicable.

4.2.4 All tenderers are advised to carry out their own simulation studies to ascertain the achievable GFA for the proposed development, particularly if any additional bonus GFA allowable under the prevailing Development Control Guidelines can be included in the proposed development. Such simulation studies should account for all relevant considerations including the building height controls and existing ground conditions of the Land Parcel as well as the possible need to provide basements.

Allowable Uses within the Conserved Building

4.2.5 The Land Parcel includes a Conserved Building which shall be retained and restored.

4.2.6 The Conserved Building shall be adapted for residential and/ or indoor recreation uses only, such as a private clubhouse or communal facilities.

Open Space within Conservation Area

4.2.7 The conservation area surrounding the Conserved Building, is to be used as an open communal gathering space to recall the former assembly area on site, as shown on the Control Plans. The open communal gathering space may be used as an outdoor recreational space or as landscaped areas for communal activities, events and community interactions. Sports and communal facilities, such as swimming pools or barbeque pits may be included.

4.2.8 Pedestrian access shall be provided from a side gate (along Upper Thomson Road) leading to the open space and allow appreciation of the Conserved Building from a key pedestrian approach.

4.3 Land / Strata Sub-division

4.3.1 The Successful Tenderer is not allowed to sub-divide the Land Parcel. The proposed development (including the Conserved Building) may be strata sub-divided, subject to the prevailing Development Control Guidelines issued by the Competent Authority under the Planning Act.

4.3.2 The share values applicable to each strata lot is subject to the approval of the Commissioner of Buildings under the Building Maintenance and Strata Management Act.

4.4 Building Form and Massing

4.4.1 The overall building form and massing of the proposed development shall be designed to respond, and relate sensitively, to the natural topography of the site and the surrounding context. It shall also be designed to relate sensitively to the Conserved Building and its foreground space within the site.

4.4.2 The overall form of the development is to be well-articulated to maintain visual porosity and allow birds to fly between Upper Thomson Road and Springleaf Forest in the west. Hence, the development shall not create a wall-like effect when viewed from all elevations. Please refer to URA's circular "Sensitive Design and Development: An Industry Guide of Good Practices to Minimise Wall-Like Developments" dated 4 March 2010[4].

[4] https://www.ura.gov.sg/Corporate/Guidelines/Circulars/dc10-02

Building Facades

4.4.3 The facades of the parts of the proposed development that front onto Upper Thomson Road as well as the new open communal gathering space within the Land Parcel shall be treated as main building elevations.

4.4.4 The buildings within the Land Parcel are to be designed taking into consideration the need to reduce bird strikes. The facades are to be well articulated with a good proportion of solid (walls) and void (fenestration). Full glass facades will not be supported, and any external glazed areas are encouraged to be suitably and aesthetically treated to enhance their visibility to birds (e.g. through the inclusion of window mullions). For more information on strategies to mitigate bird strikes, please refer to Clause 8.2.9 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees as well as NParks' Bird-Safe Building Guidelines[5].

4.4.5 The design of the development shall incorporate elements of tropical architecture, such as sky terraces, balconies, sun shading and anti-bird strike louvres / fins, deep recesses, window ledges, roof terraces, communal planter boxes and vertical green walls as part of the development's overall building form and architectural treatment. The design of the new buildings shall adopt an architectural language that references or take inspiration from that of the Conserved Building to achieve a cohesive holistic design for the entire development.

4.5 Building Height

4.5.1 The proposed development is subject to specific building height controls which are established to guide the proposed development to relate sensitively to the surrounding developments and site context. These building height controls are as set out below and as shown in the Control Plans:

a. No-build Zone
The no build zone, which includes the conservation area and the setback area from Upper Thomson Road, is as shown in the Control Plans;

b. Low-Rise Zone
This part of the proposed development may be built up to a maximum of 5 storeys high in front of the Conserved Building; and

[5] https://www.nparks.gov.sg/biodiversity/urban-biodiversity/bird-safe-building-guidelines

c. High-Rise Zone
This part of the proposed development (including sky terrace(s) and all structures / fixtures on the roof top such as water tanks and lift motor rooms) may be built up to technical height constraint of 90-100m Singapore height Datum (SHD).

4.5.2 All construction equipment and temporary structures, such as cranes, piling rigs, etc., as well as permanent structures, such as water tanks, mechanical and electrical (M&E) equipment, lift motor rooms, TV antennae, etc., are subject to the maximum allowable technical height control of 90m SHD and are to comply with the requirements of the relevant Competent Authorities. The Successful Tenderer shall obtain written approval from Republic of Singapore Air Force's (RSAF) for clearance on the use of construction equipment and temporary structures above 60m SHD (email: height_control@defence.gov.sg) and Civil Aviation Authority Singapore (CAAS) prior to mobilising and/ or installing any construction equipment.

4.5.3 There is a need for visual controls for the proposed development to shield views into the facilities at the adjacent Nee Soon Camp. This can only be determined when design details, such as the number of storeys of the proposed development, location of openings (e.g windows), etc., are known. The Successful Tenderer shall comply with the details of the visual controls as follows:

a. The views from windows, corridors, staircases or any openings, or any surveillance cameras, devise or equipment (e.g CCTVs) on the Land Parcel exceeding the height of 95m SHD onwards (indicative) must be directed away from MINDEF's premises; and

b. If (a) becomes impracticable to implement, the Successful Tenderer can propose visual screening measures in the form of permanent fixtures which are impossible or difficult to remove. They can include but are not limited to the following:

i. Window openings are to be recessed or have fixed frosted glass panels;

ii. Corridors, staircases, fixtures and other openings are to be provided with louvres; and

iii. Access to rooftop areas is to be restricted. If the development includes a roof garden, measures to screen off the view from it are required to comply with the requirements stated above.

4.5.4 The Successful Tenderer shall liaise with the Defence Science and Technology Agency (DSTA) and obtain clearance from MINDEF through DSTA on the relevant visual screening measures at the detailed building design stage.

4.6 Building Setback

4.6.1 The proposed development shall comply with the setback requirements in accordance with the prevailing Development Control Guidelines and the setback requirements from the Conserved Building, as shown on the Control Plans.

4.6.2 The green buffer and planting strip areas within the proposed development are to be well-planted with predominantly native trees and shrubs species to create a lush and verdant environment. The detailed landscaping proposal will be subject to the approval of the Authority and the relevant Competent Authorities at the formal submission stage.

4.6.3 Submerged basement structures can be built up to the lines of Road Reserve along all perimeters of the site subject to the prevailing DC Guidelines issued by the Competent Authority under the Planning Act. A minimum 2.5 m soil depth for tree planting is to be provided above the parts of the basement structures located within the building setback areas.

4.6.4 Minor ancillary structures, e.g. guardhouses, may be allowed within the building setback areas and green buffer, subject to the Objective-Based Guidelines for Ancillary Structures in the URA Development Control Handbook. Minor ancillary structures, if provided are to be well designed and integrated with landscaping.

4.7 Building Platform Level

4.7.1 The minimum platform level for the proposed development shall comply with the requirements of the relevant Competent Authority.

4.7.2 The main communal ground level of the proposed development shall be designed to be seamless with the platform level of the Conserved Building. Where steps are required to mitigate any level differences, appropriate barrier-free vertical circulation facilities, such as lifts and/or ramps, shall be provided to comply with the relevant codes on barrier-free access.

4.8 Basement and Subterranean Developments

4.8.1 Basement and permanent subterranean structures, including service and car parking areas, are allowed within the Land Parcel and may extend up to the site boundary, subject to the prevailing Development Control

Guidelines issued by the Competent Authority under the Planning Act and the technical requirements of the relevant Competent Authorities, and subject to the following requirements:

a. All excavation works are to comply with the requirements of the relevant Competent Authorities and the Public Utility Licensees; and

b. A minimum 6.0m set back distance shall be observed between the basement levels and the Conserved Building. No basement or permanent subterranean structures may be built under the Conserved Building.

4.9 Greenery Replacement and Landscaping

Landscape Replacement Area (LRA)

4.9.1 Given its proximity to the CCNR, the design of the development is to respond sensitively to the biodiversity and ecology of CCNR and achieve the vision of a lushly landscaped development when viewed from street level along Upper Thomson Road, as well as from existing and future surrounding developments.

4.9.2 The design of the development is to incorporate Landscape Replacement Areas (LRAs) equivalent in size to the site area of the Land Parcel.

4.9.3 Within these LRAs, at least 60% of the area is to be used for softscape (permanent planting). The remaining areas can be used for hardscape, as outlined in the prevailing guidelines for Landscaping for Urban Spaces and High-Rises (LUSH)[6] and will be subject to detailed evaluation and approval at the formal submission stage.

Landscaping

4.9.4 Each residential building within the High-Rise Zone is to incorporate at least one double volume Predominant Sky Terrace.

4.9.5 The design of the development shall feature pervasive greenery in the form of balconies, roof terraces, roof gardens, communal planters that are lushly landscaped, and vertical greenery. These areas are to be integrated as part of the overall form and architectural treatment of the individual buildings; and shall contribute to the enhancement of biodiversity in the development. The vertical greenery needs to be visible from the street level, especially for the façade of the proposed development fronting Upper Thomson Road. For more information, please refer to NParks' Bird-Safe Building Guidelinesas well as NParks' skyrise greenery guidelines[7].

[6] https://www.ura.gov.sg/Corporate/Guidelines/Circulars/dc17-06
[7] https://www.nparks.gov.sg/skyrisegreenery/resources/guidelines

4.9.6 The Successful Tenderer is strongly encouraged to provide vertical greenery which shall be visible from the street level, especially on the façade of the proposed development fronting Upper Thomson Road.

4.9.7 The prevailing Development Control Guidelines issued by the Competent Authority under the Planning Act on the GFA exemption for sky terraces and roof gardens as well as the provision of additional GFA for balconies will apply.

4.9.8 Landscaping should also be provided to help frame and enhance the appreciation of the Conserved Building.

4.10 Roofscape and Screening

4.10.1 The roof areas of the proposed development are to be considered as the 'fifth' elevation and designed to be fully integrated with the overall building form, massing and architectural treatment of the proposed development.

4.10.2 To contribute to the sense of pervasive greenery within the Springleaf Identity Node, and to enhance biodiversity of the site, the roof areas within the Low-Rise Zone of the proposed development are to be designed as landscaped roof gardens or accessible communal gardens.

4.10.3 To ensure that the roof areas are well-designed and attractive when viewed from the surrounding developments, all service areas, mechanical and electrical (M&E) equipment, water tanks, etc., are to be located within. and fully integrated into, the building envelope and be visually well-screened from the top and all sides of the proposed development, subject to the prevailing screening guidelines for M&E services.

4.11 Vehicular and Servicing Access

Vehicular Access

4.11.1 The detailed proposal for the vehicular access point to the proposed development will be subject to the requirements and approval of the Authority, LTA and the relevant Competent Authorities at the formal submission stage and as set out in Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

Service Areas

4.11.2 Sufficient service areas, including the bin centre, loading/ unloading areas, etc., are to be provided within the Land Parcel to meet the needs of the proposed development.

4.11.3 The Successful Tenderer shall ensure that access to all the service areas (e.g. bin centre, electrical substation, loading / unloading areas) shall be taken from within the proposed development. Service access taken directly from the public roads will not be allowed.

4.11.4 All ventilation shafts to the basement levels are to be fully integrated within the overall building envelope of the proposed development and visually well-screened, subject to the prevailing screening guidelines for M&E services.

4.11.5 All loading/ unloading areas are to be designed as sheltered and enclosed to minimise noise generated from the loading / unloading activities and to ensure that there is no conflict between collection of refuse with loading / unloading activities. Loading bay barriers are to be located within the proposed development to prevent queuing traffic from spilling onto the adjacent road.

4.11.6 The design of the development is to include spaces (e.g. temporary parking lots) for food delivery riders using motorcycles or active mobility devices (e.g. bicycles, power-assisted bicycles).

4.11.7 All service areas will be subject to the requirements and approval of the Authority and the relevant Competent Authorities at the formal submission stage.

Bin Centre

4.11.8 The bin centre shall be sensitively located within the Land Parcel such that it is not a disamenity to residents in the surrounding developments. The bin centre shall be sited away from the forest perimeter and should have a wildlife-proof design.

4.11.9 The service driveway for the bin centre is to be fully located within the Land Parcel and its dimensions (e.g. length and width) will need to accommodate all types of service vehicles.

4.11.10 Service areas and bin centre are to be sensitively designed and site away from the key frontages of the Conserved Building.

Construction Access

4.11.11 The Successful Tenderer shall refer to Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees for details of the Vehicular Access location(s).

4.12 Car, Motorcycle and Bicycle Parking Provision

4.12.1 The development shall be designed to comply fully with LTA's requirements for car, motorcycle and bicycle parking provisions as set out in Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees and shall be subject to the evaluation and approval of the Authority and other relevant Competent Authorities.

4.12.2 The development is to be designed to comply with the full physical parking requirement under the prevailing Parking Places (Provision of Parking Places and Parking Lots) Rules or any statutory modification and re-enactment thereto.

4.12.3 The motorcycle parking lots and associated parking facilities shall be located within the proposed car parking areas of the proposed development.

4.13 Electric Vehicles (EV) Charging Infrastructure Provision

4.13.1 To future-proof new development sites in Singapore, the Successful Tenderer is required to have active and passive provision of EV charging points for the proposed development as set out in Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees.

4.14 Protection of Existing Retaining Walls, Slopes / Embankments

4.14.1 There are existing slopes / embankments along and within the boundaries of the Land Parcel, as shown indicatively in the planimetric survey plan. The Successful Tenderer shall comply with all requirements from the relevant Authorities, if any, if the development works affect any slopes/ embankments.

4.14.2 Upon being granted possession of the Land Parcel, the Successful Tenderer shall take all necessary measures to ensure the stability of existing slopes / embankments.

4.14.3 The Successful Tenderer shall indemnify the State against all claims and/or damages which may arise either directly or indirectly from any instability rendered to the existing slopes / embankments by any cause whatsoever

or by any works carried out by the Successful Tenderer or by his servants and/or agents.

4.14.4 Any retaining walls shall be stepped in section and built within the Land Parcel according to the prevailing Development Control guidelines. The stepped sections should be lushly planted to contribute to the lush planting in this area.

4.14.5 The Successful Tenderer is to ensure any retaining walls do not conflict with NParks' green buffer requirements as set out in Clause 8.1.3c of the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees.

PART V

5.0 CONSERVATION GUIDELINES

5.1 General Guidelines

5.1.1 The Conservation Guidelines, as set out in Part V, are to be read in conjunction with the accompanying Control Plans Nos. 5 to 9. The Conservation Guidelines set out the general principles for the restoration of the Conserved Building within the Land Parcel. As the objective of these guidelines is to enhance or restore the character or appearance of the Conserved Building, the Successful Tenderer may submit alternative proposals to any of such guidelines for the Authority's consideration. Where the Authority is satisfied that the alternative proposal will also serve to achieve the conservation objective, the Successful Tenderer may be allowed to adopt such alternative proposal, in which event the relevant provisions in this Part shall be deemed to be complied with. The Authority, however, reserves the absolute discretion to decide whether or not to allow any alternative proposals to be adopted. Detailed evaluation of the proposals will be carried out at the formal plan submission stage. All proposals are subject to the approval of the Authority and all relevant Competent Authorities.

5.1.2 The Successful Tenderer is not to commence any work on the Conserved Building or any part or parts thereof without first obtaining the approval of the Authority and all relevant Competent Authorities which shall be granted at their absolute discretion and subject to such terms and conditions as they deem fit.

Heritage Interpretation Strategy

5.1.3 The Conserved Building on the Land Parcel was the former classroom block of the former Upper Thomson Secondary School built in 1965 and later used by the former Seletar Institute. It was a landmark for the area and served the communities in the Northern region, being located as part of a key regional node at the former Nee Soon village. The building is a physical reminder of the pursuit for progress for local communities during Singapore's early independence years and Nee Soon Village as the focus of activities and amenities for the population in the North. The prototypical school building by the post-independence Public Works Department also embodies the educational institution evolution from colonial period to post-independent Singapore.

5.1.4 The Successful Tenderer is to implement a heritage interpretation strategy to recall and share the history and heritage of the site and the Conserved

Building in prominent, accessible areas and within communal areas of the development.

5.1.5 The heritage interpretation elements could consist of, but not limited to the following:

a. Architectural, public space, landscaping design or common furniture and installations that recalls the sense of place. For example, the distinctive use of fair-faced bricks can be reinterpreted in new ways in façade design, wayfinding, playgrounds, tiling, etc.
b. Designated heritage corner (may include conserved artifacts, storyboards or photo gallery)
c. Murals
d. Use of historic names of the area in naming various buildings or spaces in the development

5.1.6 All heritage interpretation element(s) should be presented in a visually engaging and delightful manner that will appeal to residents and visitors alike and be accompanied by suitable signs or signboards that clearly communicates the heritage significance of the site.

5.1.7 The content of the heritage interpretation proposal shall be submitted to URA for approval. The physical heritage interpretation measures shall also be included in submission drawings and to be maintained as common property for the whole of the development and are not to be removed without prior consent from the Competent Authority.

5.2 Conservation Guidelines

5.2.1 In restoring the Conserved Building, the Successful Tenderer is to retain the character and architectural features of the building in accordance with the following guidelines and those shown in the accompanying Control Plans. The fundamental 3Rs principle of maximum Retention, sensitive Restoration and careful Repair, and the “Top-Down” approach are to be applied.

Conservation Best Practice

5.2.2 The Successful Tenderer is to engage a restoration / conservation specialist who will carry out research and investigation on the building (including their historical, architectural, constructional, technological and material attributes). The consultant shall be engaged early prior to the demolition of the other non-conserved former school buildings and be part of the project team to ensure that site planning for the development is sensitive to the Conserved Building, and that the Conserved Building is restored and refurbished according to conservation best practice,

preserving the special qualities of the building as it takes on a new lease of life.

5.2.3 As part of the Development Application, the restoration / conservation specialist is to submit a conservation report consisting of:

a. Documentation and Research
b. Conservation & Heritage Interpretation Strategy
c. Conservation Maintenance Guidelines

The following shall be addressed:

a. Documentation and Research
- Detailed research into the site, building typology, architecture, structure, materials and building history which includes physical alterations carried out over time. Sources used in the research are to be cited.
- Detailed documentation of the Conserved Building's physical condition, including aerial photographs of the building and setting. This includes materials investigation e.g. paint analysis.
- Research and documentation of the non-Conserved Building that made up the original cluster of school buildings to provide an understanding and appreciation of the original terrain, layout, form and function of the Conserved Building and its foregrounds and context setting in the design of the residential development.

b. Conservation & Heritage Interpretation Strategy
- Conservation approach taking into consideration the documentation and research and 3R principles.
- Adaptive reuse and design strategy for the Conserved Building and its foreground that respects and enhances the inherent historic physical, spatial, and environmental qualities of the Conserved Building and its surroundings.
- Promotion of the history and significance of the Conserved Building and the surrounding area.

c. Conservation Maintenance Guidelines
- Strategies for proper maintenance for extending the lifespan of the building.
- A maintenance guide is to be produced and handed over to the strata owners of the Conserved Building and sub-Management Committee maintaining the common property.

Building Profile and Height

5.2.4 The Conserved Building on the Land Parcel is a 4-storey former school classroom block designed in simple, utilitarian, modern style. The building consists of a main slab block with a perpendicular service block and a projected staircore. The original external building profile, facade and height of the building is to be retained.

Roof

5.2.5 The main slab block's original pitched roof profile, height, structure, eaves projection, material and finish are to be retained and restored. The service wing and projected staircore's flat roof profile, height, structure, material and finish are to be retained and restored.

5.2.6 Addition of small skylights on the roof will be subject to evaluation. Any proposed skylights which require a change in the roof structure is not allowed. Jackroof is not allowed to be added on the roof of the Conserved Building.

5.2.7 If services are required to be located on the flat roof, they should be sensitively located, least visually obtrusive, neatly placed and set back from the edge and screened.

5.2.8 Any railings to comply with technical agencies' requirements on the flat roof for service maintenance shall be set back from the edge, be simple and sensitively designed.

External Façade

5.2.9 The external façade features and elements are to be restored in accordance with the Control Plans Nos. 5 to 9.

Front and Side Façade – Main Slab Block

5.2.10 The main slab block has fair-faced brick chamfered end walls and continuous naturally ventilated corridors with concrete canopies facing the former assembly area on every storey. The corridors are framed by regularly spaced concrete columns and with solid concrete parapet wall with metal railings. The layout is adapted to the tropical climate with the corridors allowing access and air movements.

5.2.11 The corridors are to be kept open and naturally ventilated without enclosures of any kind. Additional safety features or shades (e.g. "invisible" steel wires and blinds), if required, may be installed subject to evaluation of the design. Conversion of the corridors to private balconies is subject to

evaluation and any additions are to be designed sensitively such that it does not negatively impact the architectural reading of the building.

5.2.12 The original inner leaf façade, which is the partition wall along the corridors within the building envelope (see Control Plan No. 9), must be retained to maintain the spatial quality of the corridors but can be rebuilt or replaced. Flexibility can be given for the design and material of the inner leaf façade but it must complement the building's architectural character and must be consistent across all storeys.

Front and Side Façade – Service Block

5.2.13 The service block has fair-faced brick end walls and concrete columns and beam structure with fair-faced brick parapet walls. The inner leaf within the building envelope of the service block consisting of distinctive fair-faced brick walls with lattice-design for ventilation is to be retained and restored across all storeys as they provide a delightful aesthetic counterpoint for the building (see Control Plan No. 9).

5.2.14 New localised openings in the solid portion of the fair-faced brick inner leaf can be considered, subject to evaluation of the design and provided the structural integrity of the lattice ventilation screen is not compromised.

5.2.15 The corridors are to be kept open and naturally ventilated without enclosures of any kind. Additional safety features or shades (e.g. "invisible" steel wires and blinds), if required, may be installed subject to evaluation of the design. Conversion of the corridors to private balconies is subject to evaluation and the additions are to be designed sensitively such that it does not negatively impact the architectural reading of the building.

Rear Façade

5.2.16 The rear of the slab block has continuous concrete canopies, half height solid parapet walls and large openings framed by regularly spaced columns lined with adjustable glass louvred windows, to be retained and restored. Localised openings in the rear façade to facilitate addition of new external lifts or staircases are subject to evaluation. Openings should be sensitively located, respect the structural grid and complement the building's architectural character.

Windows and Transoms

5.2.17 All windows and transoms within the Conserved Building were originally adjustable glass louvre windows with timber frame. The Successful Tenderer is encouraged to retain and restore the original design, proportion and material of the original windows and transoms in accordance with the

Control Plans. Flexibility can be given for the replacement of the original windows and transoms to casement or sliding windows with clear or light-tinted glass of the same proportion as the original modules indicated in the Control Plans.

5.2.18 New internal secondary windows, if required, can be added subject to the design being compatible with those of the main windows. The frame of the secondary windows can be of any material. If metal is used, it is to be anodized or colour coated.

5.2.19 Additional security features may be installed, subject to evaluation of the design. As far as possible, they must be unobtrusive to keep the openness or porosity of the opening.

Internal Architectural Elements

5.2.20 All original structural elements, such as columns and beams, are to be retained. In the event that their replacement is necessary, the Successful Tenderer is to reinstate the architectural features of these elements to their original design and materials.

5.2.21 Internal non-load bearing walls may be removed for the purposes of reconfiguring the spaces for new uses.

5.2.22 New partitions are to respect the architectural character of the building. They shall not abut any original window openings or transoms.

5.2.23 The original metal downpipes with the embossed year of completion of the building at the columns of the main slab block corridor are encouraged to be retained and restored as historical markers of the building.

5.2.24 The original fair-faced brick lattice ventilation screen walls of the staircores are to be retained and restored (see Control Plan No. 9).

Floors and Structure

5.2.25 The existing structural system, including structural elements such as columns and beams, are to be retained and restored. The original structural grid is to be retained. New columns, if required to be added, are to align with and respect the original grids. Provided that the structural integrity of the building is not compromised, flexibility to relocate some of the existing columns to meet the specific operational and functional requirements may be considered on a need-to-basis.

5.2.26 The original floor levels are to be retained.

5.2.27 Localised openings in the upper storey floors to create double-volume spaces and visual connectivity between floors may be allowed. This is subject to the merits of the design and provided that it is no more than 25% of the floor area of each floor and respects the structural grid system of the building. The detailed proposal shall be subject to evaluation at the formal submission stage.

5.2.28 Addition of attic or mezzanine floor within the original building envelop may be considered, subject to evaluation. The insertion of these floors should not affect the roof structure of the Conserved Building.

5.2.29 No new basement is allowed below the Conserved Building. Any proposed new basement within the site shall be set back 6m from the Conserved Building to protect its structural integrity.

5.2.30 New staircase, if required, whether on the interior or exterior, should respect the architectural character of the building and its internal spatial quality. It should not abut any original window openings or transoms.

Addition of Lift

5.2.31 Lifts can be added within the building envelop or along the front or rear façade of the main slab block, subject to the merits of the design.

5.2.32 For lifts located along the front and rear façade of the main slab block, the lift shafts should be sensitively located, respect the structural grid and complement the building's architectural character. They shall not abut any original window openings or transoms. The detailed proposal shall be subject to evaluation at the formal submission stage.

Paint scheme and finishes

5.2.33 The paint scheme and colours are to complement the architecture of the building. Non-gloss paint shall be used.

5.2.34 Fair-faced bricks are not to be painted over.

Signage

5.2.35 Sensitively-located and well-designed signs may be considered at the facades of the Conserved Building. The architectural features of the Conserved Building should not be obscured or affected.

Air-conditioning (A/C) Units

5.2.36 A/C units are to be sensitively located. They may be located at the flat roof or neatly aligned with existing window openings on the external wall of the rear façade, and properly screened. Alternatively they may be sensitively located outside the Conserved Building at the rear of the building, integrated with the new development and be visually well-screened.

Mechanical and Electrical Equipment

5.2.37 External exhaust flue is not allowed. Vents and other mechanical equipment are to be installed at locations least obtrusive from public view. As far as possible, all mechanical and electrical equipment should be of the most compact design available, located outside the Conserved Building and integrated with the new development and be visually well-screened.

5.2.38 Installation of all metering equipment and junction boxes is not to affect the front and side façades of the building.

Former Assembly Area and Covered Walkways

5.2.39 The Conserved Building was the backdrop for the old assembly area of the school which was a key focal point and gathering space for the school. This open foreground and setting of the Conserved Building shall be retained and used as an open communal gathering space, outdoors recreational space or as landscaped areas for communal activities, events and community interaction. Sports and communal facilities such as swimming pools or barbeque pits may be introduced.

5.2.40 The design and orientation of new buildings in the low-rise zone facing the former assembly area and Conserved Building should sensitively recall and respond to the Conserved Building, the former school layout (e.g. the former school buildings framing the former assembly area) and the spatial quality of the assembly area.

5.2.41 Pedestrian access shall be provided from a side gate along Upper Thomson Road and from the low-rise zone to this open space to allow appreciation of the Conserved Building from a key pedestrian approach.

5.2.42 Any covered link ways, if required for connection to the Conserved Building, shall be sensitively planned and designed so as to be least visually obtrusive. They must not detract from the architecture of the building or adversely impact the spatial quality of the former assembly area. Sensitively designed covered walkway within the building envelop of the Conserved Building can be considered provided it is minimally invasive and respectful of the architecture of the building.

5.3 Protection of Conserved Building Against Deterioration and Collapse

5.3.1 The Successful Tenderer is required to carry out all necessary measures and works to protect and prevent the on served building against deterioration and or collapse, upon site procurement. For this purpose, the Successful Tenderer is to engage his own Professional Engineers to:

a. Prepare and submit within 3 months from the date of the possession of the Land Parcel, to the Authority plans for the measures and works that are assessed and determined by the Professional Engineer as being necessary for the protection and prevention of the Conserved Building against deterioration and / or collapse. Prior to the submission of the plans to the Authority, the Architect appointed by the Successful Tenderer for the proposed conservation on the site is to also declare and certify on the plans that the measures and works to be taken and carried out will not affect the architectural features of the building;

b. Ensure that the measures and works for the Conserved Building as shown on the plans are carried out and completed according to the plans either within six (6) months from the date of the possession of the Land Parcel or before the commencement of the repair works on the building whichever is earlier; and

c. Confirm and certify to the Authority in writing within fourteen (14) days upon the completion of the measures and works as shown on the plans and that such measures and works have been taken and carried out in accordance with the plans and to the satisfaction of the Professional Engineer.

5.3.2 The submission of the plans to the Authority is to be solely for the purpose of the record of the Authority and such submission to and receipt by the Authority of the plans are not deemed to be approval or confirmation by the Authority of the adequacy of the measures and works as shown on the plans for the building.

5.4 Structural Alterations to the Conserved Building

5.4.1 The Successful Tenderer is required to engage a Professional Engineer to determine the structural loading adequacy of the structure of the existing Conserved Building to support the new use and to design and make the required submission for the proposed conservation and repair of the building.

5.4.2 The Successful Tenderer's Professional Engineer is to adopt strengthening and repair as the basic approach towards the proposed conservation of the building. Any recommendation of the Professional Engineer involving

partial reconstruction of the Conserved Building is to be submitted to the Authority for approval. Such recommendation must be justified by detailed calculation and sound engineering judgment.

5.4.3 In the event that the Authority and the Successful Tenderer's Professional Engineer is unable to reach an agreement as to whether this part of the Conserved Building can be restored and repaired, the BCA will be requested to give its assessment. If the BCA concurs with the recommendation of the Successful Tenderer's Professional Engineer for partial demolition and reconstruction, the request of the Successful Tenderer for the same will be allowed by the Authority.

PART VI

6.0 OTHER REQUIRED WORKS

6.1 Demolition of Existing Buildings

6.1.1 There are buildings located within the Land Parcel, adjoining land parcel (Land Parcel A) and State Land as shown in the Control Plans. The Land Parcel will be sold with the buildings in its current conditions.

6.1.2 The Successful Tenderer is required, at his own cost and expense, to demolish all the buildings (except the Conserved Building) and remove all abandoned services. The demolition works shall be completed within 12 months from the date of acceptance of tender by the Authority.

6.1.3 For the demolition of the existing buildings that are within Land Parcel A, the Successful Tenderer and his contractor(s) shall occupy the area within Land Parcel A (as marked indicatively on the Control Plans) for up to 12 months from the date of acceptance of tender by the Authority. The Successful Tenderer shall also obtain a Temporary Occupation License (TOL) from the Singapore Land Authority (SLA) for the demolition of existing buildings on State Land.

6.1.4 The Successful Tenderer shall ensure that the Conserved Building, other buildings and services within the vicinity of the works, are not damaged or in any way affected by the demolition works. The Successful Tenderer and his contractor(s) shall reinstate all affected turfing in accordance to Nparks' guidelines on Greenery Provision and Tree Conservation for Developments prior to handing over the area to the Successful Tenderer. The Successful Tenderer shall liaise and coordinate directly with the Successful Tenderer of Land Parcel A and their contractor(s) on the handover of the affected area.

6.2 Presence of Asbestos in Existing Buildings

6.2.1 The presence of asbestos has been detected in some of the existing buildings within the Land Parcel. The locations of asbestos in these buildings have been identified in the 'Asbestos Identification Assessment Report for the Buildings' contained in the eDeveloper's Packet. The said 'Asbestos Identification Assessment Report for the Buildings' is for information of tenderers only. The Authority does not warrant the accuracy of information contained in the 'Asbestos Identification Assessment Report for the Buildings' and shall not be responsible in any way for any error or omission whatsoever in respect of the same.

6.2.2 The handling of asbestos materials within the Land Parcel shall conform with the Workplace Safety and Health (WSH) (Asbestos) Regulations 2014 (see Annex G).

6.2.3 The Successful Tenderer shall, at its own cost and expense, engage an asbestos surveyor to update the "Asbestos Identification Assessment Report for the Buildings" and provide the latest site survey information with photos, including the taking of asbestos samples for testing where required, submission of the reports to the relevant Authorities (e.g. Ministry of Manpower (MOM) and any other relevant agencies that the Contractor and the appointed asbestos surveyor have to liaise with, in relation to asbestos removal works prior to building demolition works.

6.2.4 In the event that asbestos containing materials (ACMs) are detected on site, the Successful Tenderer shall engage an Approved Asbestos Removal Contractor (hereafter known as AARCs) to remove the material at his own cost, including the proper disposal of ACMs to NEA's approved dumping grounds off site.

6.2.5 The Successful Tenderer shall also refer to the NEA website on "Guidelines on The Disposal of Asbestos Waste" and strictly conform to the guidelines listed for removal and disposal of asbestos materials.

6.3 Pedestrian and Cycling Network

Covered Linkways and Pedestrian Footpaths

6.3.1 The Successful Tenderer shall at his own cost and expense, provide covered linkways and pedestrian footpaths within the road reserve of Upper Thomson Road.as shown indicatively on the Control Plans and set out below:

a. A minimum 2.4m wide (1.8m wide clear) covered linkway along Upper Thomson Road and 5.0m wide (minimum 4.4m wide clear path) high covered linkways across the proposed vehicular access (including the existing access point)

b. A minimum 1.5m wide permanent footpath

6.3.2 The location, design and technical details of the covered linkway shall comply with the technical requirements of LTA as set out in Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities and Public Utility Licensees, be subject to the evaluation and approval of the Authority and the relevant Competent Authorities at the formal submission stage. The Successful Tenderer shall take into account the site context such as topography and consider measures to mitigate potential issues

(such as surface runoff during heavy rainfall) in the design of the sidetable, subject to relevant agencies' approvals.

6.3.3 Upon completion, the Successful Tenderer shall handover the portion of the covered linkways within the Road Reserve to LTA for ownership and maintenance. Until such time when they are taken over by LTA, the Successful Tenderer is to maintain the portion of the covered linkways within the Road Reserve to the satisfaction of the relevant Competent Authorities. The Successful Tenderer is to maintain the portion of the covered linkways within the development to the satisfaction of the relevant Competent Authorities. They are to be kept open and unobstructed for public use at all times.

Cycling Path

6.3.4 The Successful Tenderer shall at his own cost and expense, construct a cycling path adjacent to the footpath and covered linkway abutting the development, along Upper Thomson Road within the road reserve in accordance with the Control Plans.

6.3.5 The scope and details of the cycling path treatment are to be determined in consultation with LTA during the Development Control submission stage.

6.3.6 The pedestrian and cycling connection shall comply with LTA's requirements and be handed over to LTA for maintenance upon completion to the satisfaction of LTA. The Successful Tenderer shall at his own cost and expense, maintain the pedestrian and cycling connection until such a time when it is handed over to LTA for ownership and structural maintenance.

6.4 **Road Works**

6.4.1 To facilitate northbound traffic movement along Upper Thomson towards SLE, the Successful Tenderer shall at his own cost and expense construct a mid-block U-turn facility with 40m storage lane and 30m taper along Upper Thomson, at least 150m from the junction of Upper Thomson Road/Springleaf Road as shown indicatively on Control Plan. The detailed location and requirements shall be determined in consultation with LTA at the plan submission stage. For information of tenderers, the detailed requirements of the proposed road are set out in Clause 7.0 of the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees.

PART VII

7.0 OTHER REQUIREMENTS

7.1 Public Communications Plan

7.1.1 The Successful Tenderer is required to carry out a public communications plan as part of the efforts to keep the local community informed of the development plans for the Land Parcel.

7.1.2 The Successful Tenderer is required to carry out a public communications plan as part of the efforts to keep the local community informed of the development plans for the Land Parcel.

7.1.3 The local community is defined as:

a) all residents of HDB flats, private condominiums / flats and landed houses;
b) Management Corporation Strata Title (MCST) Committee of private residential developments and Neighbourhood Committees; and
c) administration of schools and other institutions

that fall within a 100m (approximate) radius of the Land Parcel.

In addition, it shall include the local Member of Parliament (MP), Constituency Director of the Constituency and General Manager of Town Council.

<u>Stage 1: Prior to submission of application for Written Permission</u>

7.1.4 Prior to the erection of any hoarding or commencement of any clearance and / or tree-felling on the Land Parcel, the Successful Tenderer shall distribute flyers to the local community containing the following information and ensure this information are accurately presented:

a) Project information (e.g. type of development, number of units, storey height, vehicular access);
b) Location map showing hoarding, construction access etc.;
c) Key milestones in the construction programme [e.g. site clearance, hoarding works, commencement and duration of piling works, expected date of issuance of Temporary Occupation Permit (TOP)];
d) Details of proposed measures to mitigate the impact of development to the surrounding environment and users;
e) Contact details of the Successful Tenderer for the community to highlight issues such as noise and dust arising from the construction activities, and to provide feedback on the proposal; and

f) The hotline numbers of the relevant departments in BCA, National Environment Agency (NEA), Ministry of Manpower (MOM) and URA.

7.1.5 Prior to the distribution of the flyer, the Successful Tenderer shall ensure that information as outlined in Condition 7.1.4 are included in the flyer and inform the Authority on the distribution date with a copy of Form A (as shown in Annex A) and flyer.

7.1.6 After the distribution of the flyers, the Successful Tenderer shall submit to the Authority a duly completed Form B (as shown in Annex B) verifying that the requirements set out in Condition 7.1.4 have been complied with. Upon confirming that the declaration provided by the Successful Tenderer is in order, the Authority will give written consent for the Successful Tenderer to proceed with the submission of an application to the Competent Authority under the Planning Act (Cap. 232) for Written Permission ("development application") for the proposed development on the Land Parcel. The Successful Tenderer shall not submit any development application for the proposed development on the Land Parcel without the prior written consent of the Authority as mentioned above.

7.1.7 Upon receiving the Authority's written consent, the Successful Tenderer may proceed with the erection of hoarding, on which the contact details of the Successful Tenderer and the hotline numbers of the relevant departments in BCA, NEA and MOM shall be prominently displayed.

<u>Stage 2: Prior to resubmission of application for Written Permission</u>

7.1.8 After the grant of Provisional Permission by the Competent Authority under the Planning Act (Cap. 232), the Successful Tenderer shall distribute additional flyers to the local community containing detailed information on the proposed development. The information to be provided shall include those stated in Condition 7.1.4 as well as (but not limited to) the following:

a) Schematic site layout showing the location of building blocks and facilities such as the bin centre, electrical substation, BBQ pits etc.; and

b) Indicative timeframe for the community to respond to the proposal, which shall be at least 2 weeks from the date the flyers are distributed.

The Successful Tenderer is required to submit a copy of the flyer for the Authority's approval before the distribution to the local community.

7.1.9 At least 2 weeks after the date of distribution of flyers, the Successful Tenderer shall submit to the Authority a duly completed Form C (as shown in Annex C) verifying that the requirements set out in Condition 7.1.8 have been complied with and detailing the preliminary feedback received from the local community for the Authority's information, if any. Upon confirming that the declaration provided by the Successful Tenderer is in order, the Authority will give written consent for the Successful Tenderer to proceed

with the resubmission for Written Permission, which shall be made no earlier than 3 weeks from the date the flyers are distributed. The Successful Tenderer shall not resubmit any application without the prior written consent of the Authority as mentioned above.

7.1.10 The Successful Tenderer shall include a duly completed Form D (as shown in Annex D), which is a final collation of the feedback received on the proposed development, if any, as part of the resubmission application. The developer shall explain how the development proposal seeks to sensitively address the concerns raised by the local community, if any.

7.1.11 The Successful Tenderer shall not commence structural works until the Authority has given written consent for the Successful Tenderer to proceed to apply to BCA for the permit to commence structural works or has granted Written Permission under the Planning Act (Cap. 232).

7.2 Design Advisory Panel (DAP)

7.2.1 To ensure that the development meets the planning and urban design objectives described in Part IV, the development proposal for the Land Parcel will be subject to review by a Design Advisory Panel (DAP) at pre submission and submission stages and approval from the Authority as part of the formal Development Application process.

7.2.2 The DAP will be appointed by the Authority and will comprise members from the building and real estate industries as well as representatives from related fields, as and when necessary. The DAP will convene necessary meetings to provide input and comments on the overall building layout, typology, form massing and architectural design, including the appropriate use of building materials, finishes and external lighting.

7.3 Pre-submission DAP

7.3.1 Prior to DAP, a Pre-submission DAP will be convened to allow exploration of different options in response to the site context and have an early dialogue with the panel.

7.3.2 With the site's proximity to the Central Catchment Nature Reserve area, it presents an opportunity for the Successful Tenderer to develop a seminal residential development that incorporates biodiversity-sensitive urban design strategies and explores innovative building typologies. The pre-submission DAP facilitates upstream review and opportunities for the Successful Tenderer to clarify or propose options, encouraging innovative building typologies of appropriate form and scale and responds sensitively to the biodiversity in the area.

7.3.3 The pre-submission DAP should be convened no later than 6 months after the GLS tender. After comments from the pre-submission DAP panel have been conveyed, the typical DAP evaluation process applies.

7.3.4 Please see Annex E for details on the scheduling of pre-submission DAP meetings and submission requirements.

7.4 DAP Evaluation Process

7.4.1 The DAP evaluation process will be a two-stage process with Stage 1 addressing the broader urban design aspects of the development proposal in relation to the form, massing, adaptive reuse of the Conserved Building, pedestrian connectivity, vehicular circulation, view corridors, landscaping concepts; as well as the conceptual proposal in relation to the environmentally-friendly design practices and features to meet BCA's Green Mark requirements. This is to ensure that major issues affecting the layout of the proposal are addressed by the time Provisional Permission (PP) is issued for the development. After establishing the broad parameters such as building height, form and massing, the external lighting design concept should also be submitted for evaluation as part of Stage 1 to ensure that the external building lighting installation is considered as an integral part of the development's design.

7.4.2 Stage 2 DAP commences after the grant of the PP and will focus on the building layout and architectural design aspects of the proposal including the appropriate use of building materials, finishes, detailed landscaping design, detailed external lighting design, and detailed works to the Conserved Building.

7.4.3 Please refer to the DAP Advisory Notes in Annex F for details on the scheduling of DAP meetings and submission requirements.

7.5 Site Works

7.5.1 Clearance from SLA, URA, LTA, NParks and the relevant Competent Authorities shall be obtained prior to commencement of any construction works affecting State Land. All State Land affected by the construction works associated with the proposed development on the Land Parcel shall be reinstated to the requirements and satisfaction of SLA, LTA, NParks and the relevant Competent Authorities upon completion of the works.

7.5.2 During the construction period, all construction works are to be always hoarded up and visually screened. Any inconvenience and disturbance to

the adjacent developments shall be minimised and pedestrian access along all existing sidetables outside the site boundary shall be always maintained.

7.6 Productivity

7.6.1 The Successful Tenderer is required to adopt the minimum level of use of prefabricated systems as stipulated under the Building Control (Buildability and Productivity) Regulations 2011 and conform to the corresponding requirements set out in the Code of Practice on Buildability for the proposed development on the Land Parcel as set out in Clause 10.3 of the Conditions and Requirements of Relevant Competent Authorities & Public Utility Licensees.

7.6.2 If PPVC method of construction is adopted, the Successful Tenderer is required to set aside some space within the Land Parcel for storage and/or holding area for PPVC modules. No additional space/land outside the Land Parcel will be granted TOL basis for this purpose.

URBAN REDEVELOPMENT AUTHORITY

ANNEX A

FORM A

PUBLIC COMMUNICATIONS PLAN

Parcel Reference Number: _____

Proposed Development: _____

_____

Lot/Parcel Reference: _____ TS/MK: _____

	Key milestones **(Refer to Condition 7.1 of the Technical Conditions of Tender)**	**Proposed date of commencement***
1.	Send Stage 1 flyer to local (MP)	(dd/mm/yy)
2.	Distribution of Stage 1 flyer containing brief project information and contact details of parties specified	
3.	Submission of Form B	
4.	First submission of development proposal	
5.	Erection of hoarding and site clearance	
6.	Obtain grant of Provisional Permission	
7.	Send Stage 2 flyer to local (MP)	
8.	Distribution of flyers containing detailed project information	
9.	Submission of Form C	
10.	Submission of Form D	
11.	Construction schedule a) Piling b) Sub-structure c) Superstructure d) M&E works e) Finishes	

Name, Designation & Signature of Developer's representative

* *The Authority shall be kept informed of any changes to the public communications plan.*

The Successful Tenderer shall ensure the minimum periods stated below are adhered to:

NO	KEY MILESTONES	MINIMUM PERIOD
1	a) Item 1 (Send Stage 1 flyer to local MP) and Item 2 (Distribution of Stage 1 flyer); and b) Item 7 (Send Stage 2 flyer to local MP) and Item 8 (Distribution of Stage 2 flyer)	1 week
2	Item 2 (Distribution of Stage 1 flyer) and Item 3 (Submission of Form B)	1 week
3	Item 4 (First submission of development proposal) and Item 8 (Distribution of Stage 2 flyer)	6 weeks
4	Item 8 (Distribution of Stage 2 flyer) and Item 9 (Submission of Form C)	2 weeks
5	Item 8 (Distribution of 2nd flyer) and Item 10 (Submission of Form D)	3 weeks
6	Item 10 (Submission of Form D) and item 11(a) (Commencement of piling)	4 weeks

ANNEX B

FORM B

DECLARATION BY THE DEVELOPER (PRIOR TO APPLICATION FOR WRITTEN PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Authority prior to submission of an application to the Competent Authority under the Planning Act (Cap. 232) for Written Permission.

If the written consent of the Authority is not submitted together with the development application to the Competent Authority, the development application will be returned.

Details of Developer	**To:**
Company Name:	Group Director Land Sales & Administration
Address:	Urban Redevelopment Authority 45 Maxwell Road
Tel no:	The URA Centre
Email:	Singapore 069118

Parcel Reference Number: _____

Proposed Development: _____

_____

Lot/Parcel Reference: _____ TS/MK: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 7.1.4 of the Technical Conditions of Tender, flyers containing brief information on the project and the contact details of the parties specified in the said Condition have been distributed to the local community* on _____ (Date).

We have enclosed supporting documents to show that the flyers have been distributed.

Signature: Date:

* *Local community is defined and includes the parties specified in Condition 7.1.3 of the Technical Conditions of Tender.*

ANNEX C

URBAN REDEVELOPMENT AUTHORITY

FORM C

DECLARATION BY THE DEVELOPER

(FOR RESUBMISSION OF APPLICATION SUBSEQUENT TO THE PROVISIONAL PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Authority prior to resubmission of development application and no later than 2 months after the grant of Provisional Permission. Upon confirming that the form is in order, the Authority will give written consent for you to proceed with the resubmission of the development application, which shall be made no earlier than 3 weeks from the date the flyers were distributed. If the written consent of the Authority is not submitted together with the resubmission of the development application, the development application will be returned.

Details of Developer	**To:**
Company Name:	Group Director Land Sales & Administration
Address:	Urban Redevelopment Authority 45 Maxwell Road
Tel no:	The URA Centre
Email:	Singapore 069118

Parcel Reference Number: _____

Proposed Development: _____

_____

Lot/Parcel Reference: _____ TS/MK: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 7.1.8 of the Technical Conditions of Tender, flyers containing detailed information on the development project and the contact details of the parties specified in the said Condition have been distributed to the local community* on _____ (Date).

We have enclosed supporting documents to show that the flyers have been distributed.
Details of preliminary feedback received from the local community (if any):** 1) 2) 3) 4)
Signature: Date:

* *Local community is defined and includes the parties specified under Condition 7.1.3 of the Technical Conditions of Tender.*

** *This should include all feedback received up to the point of the submission of this form. If this space is insufficient, additional information should be provided on a separate page and submitted as part of Form C.*

ANNEX D

URBAN REDEVELOPMENT AUTHORITY

FORM D

CONSOLIDATED FEEDBACK ON PROPOSED DEVELOPMENT

(FOR RESUBMISSION OF APPLICATION SUBSEQUENT TO THE PROVISIONAL PERMISSION)

INSTRUCTION:

This form is to be duly completed and submitted to the Competent Authority as part of the resubmission of the development application subsequent to the grant of the Provisional Permission.

Details of Developer	**To:**
Company Name: Address: Tel no: Email:	Group Director Development Control Urban Redevelopment Authority 45 Maxwell Road The URA Centre Singapore 069118

DC Reference: _____

Submission Number: _____

Proposed Development: _____

_____

Lot Number: _____

I, _____ (Name), _____ (Designation), hereby declare on behalf of the developer that in accordance with Condition 7.2.10 of the Technical Conditions of Tender, the table below has included all feedback that has been received from the local community, up to the date of this resubmission of the development application.

Feedback received from the local community and how the development proposal has sensitively addressed the feedback raised**:	
Feedback Received from Local Community	**Proposed Measures to Address the Feedback**
1)	1)
2)	2)
3)	3)
4)	4)
Signature:	Date:

* *Local community is defined and includes the parties specified under Condition 7.1.3 of the Technical Conditions of Tender.*

** *This must include all feedback received up to the point of this resubmission of the development application. If this space is insufficient, additional information should be provided on a separate page and submitted as part of Form D.*

ANNEX E

Pre-submission DAP Advisory Notes

Scheduling of pre-submission DAP Meetings

1. The pre-submission DAP process will convene no later than 6 months after the GLS tender is awarded.

2. The Applicant is to inform the Authority by way of email 4 weeks in advance, of submitting the concept proposal.

3. The pre-submission DAP session will take place approximately 3 to 4 weeks after receiving the Applicant's concept proposal with a complete set of pre-submission DAP materials as detailed below.

4. Conveyance of minutes will generally be issued approximately 2 weeks after the pre-submission DAP session. This is not meant as an endorsement of the proposal, but to provide clearer directions for the Successful Tenderer to continue developing the scheme with design strategies that respond positively to the site.

Guidelines for Preparing the Submission/Presentation Materials

5. The following aspects are to be included in the submission materials:

   a) Design Philosophy/Concept demonstrating how:

      - A distinctive heritage and identity is created (e.g. Conservation and heritage interpretation report, building massing, integration of Conserved Building and proposed adaptive reuse)

      - Greenery and biodiversity features are integrated in the design (e.g. planters; sky terraces; façade which prevents bird strike; ABC features; boundary fence treatment; planting palette)

   b) A sensitive and well-considered architectural design language for the new buildings that references that of the Conserved Building to achieve a cohesive holistic design for the entire development

   c) Form and Massing

   d) Pedestrian Network and Vehicular Access

   e) Public Spaces and Landscape Replacement Areas / landscaping concepts

6. The submission should include the following:

a) Schematic plans, sections, elevations and renders

b) A pre-submission DAP presentation deck that is brief and succinct, not exceeding 30 slides. 2 hardcopies of the slides should be provided in A3 print format. The applicant should elaborate on their approach to design and propose topics for discussion at pre-submission DAP. If alternative options are proposed, diagrams should be provided to describe the different options.

c) Schematic physical massing model(s) – scale of the model(s) can be proposed by the Successful Tenderer, with the consideration that the models shall be of a suitable scale to facilitate a discussion with the DAP.

d) Digital massing models. The digital model is to be accurately geo-referenced (i.e. to SVY21). The files for the 3D digital model should be in any of the following formats: .3dm .max, .3ds, .skp, .dwg, .dxf, .fbx, or BIM format.

e) Ecologist report, focusing on the how greenery and biodiversity features are conceptually integrated in the design. The report should explain how greenery and biodiversity features are conceptually integrated in the design, and should include recommendations in the Springleaf EIA report on URA's EIA webpage[8].

[8] https://www.ura.gov.sg/Corporate/Planning/Our-Planning-Process/Bringing-plans-to-Reality/Environmental-Impact-Assessment

ANNEX F

DAP Advisory Notes

Scheduling of DAP Meetings

a) The DAP process is initiated as part of the formal development application process.

b) The Applicant is to inform the Authority by way of email, at least 4 weeks in advance, on the submission date of the formal development application, to secure the availability of the various DAP members in the scheduling of the DAP session.

c) The DAP session will take place approximately 3 to 4 weeks after the formal development application is made together with a complete set of DAP materials as detailed below.

d) Please note that all submissions must be accompanied by the requisite materials and information (refer to *Guidelines for Preparing the Submission/Presentation Materials* below) before a DAP session can convened.

e) The formal submission is to reflect the design proposal accurately. If major design revisions to the proposal or parts of it are made after the formal submission, the DAP session might have to be rescheduled to a later date to allow more time for the new information and design changes to be evaluated before the DAP session convenes.

f) Decisions for the formal applications will generally be issued approximately 2 weeks after the DAP session. The processing time of the development application will be approximately 6 weeks.

g) Deviations from the guidelines or waiver requests will be evaluated in relation to the overall design concept/scheme and against the objectives of the guidelines, in order to determine if there are merits to allow the deviations/waivers. Applicants are advised to factor in additional time for the evaluation of deviations/waivers.

h) Depending on the level of resolution by the Applicant, there may be more than 1 DAP session for each stage. Applicants are advised to factor in the necessary time for the DAP submissions.

Guidelines for Preparing the Submission/Presentation Materials

1. In addition to the technical drawings (plans, elevations and sections) submitted as part of the formal development application, DAP materials consisting of digital A3 booklets, presentation slides and digital models [where necessary, a physical model of the proposed development will be required, at scale of 1:400 or smaller (to be advised by the officer in charge), showing context of site] will have to be submitted. Additional reports, such as Conservation Reports, are to be included as Appendices to the A3 booklets.

Stage 1

2. For Stage 1, only the following aspects are to be included in the submission materials:

   - Design Philosophy/Concept
   - Form and Massing
   - General architectural treatment (roofscape, façades in relation to context)
   - Pedestrian Network and Vehicular Access
   - Public Spaces and Landscape Replacement Areas / landscaping concepts

3. Aspects such as detailed planting palette, materials etc. will be addressed at Stage 2 and are not required to be submitted for Stage 1.

4. The DAP booklet and presentation slides are to be presented in the format shown in *Submission Templates* below. The digital DAP booklet (including 2 hard copies in A3) should not exceed 50 pages, including appendices, attached drawings and plans, with a minimum font size of 12. The number of presentation slides should be comfortable for a 20-minute presentation without lengthy text, highlighting the key points with further elaboration provided in the DAP booklet.

Stage 2

5. The DAP materials submitted at this stage will include:

   - Detailed building layout
   - Detailed architectural treatment including appropriate use of building materials and finishes
   - Detailed landscaping design including planting palette
   - Detailed Design of Public Spaces

6. Scaled elevations and sections of the relevant details (preferably 1:50 in hardcopy), digital architectural model of part(s) of the building (if necessary), as well as material samples of the façade and roof materials are required to be submitted to show the architectural design of the development.

7. The DAP booklet (including 2 hard copies in A3) should not exceed 50 pages, including appendices, attached drawings and plans, with a minimum font size of 12. As with Stage 1, the DAP presentation slides are to be kept salient and presented in the format shown in Submission Templates.

All Submissions

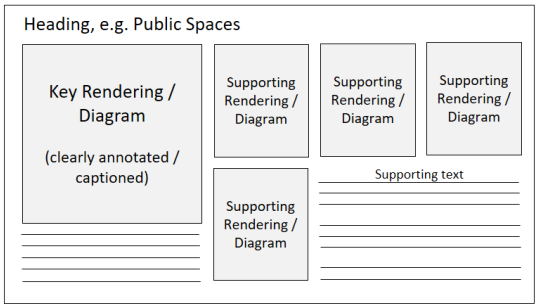
8. All submissions are to include a digital massing model, in any of the formats as stated below to show the proposed development in relation to the adjacent sites and surrounding context. The digital model is to be accurately geo-referenced (i.e. to SVY21). The files for the 3D digital model should be in any of the following formats: .3dm .max, .3ds, .skp, .dwg, .dxf, .fbx, or BIM format.

9. Physical models may be required, depending on the scale and complexity of the proposal. Where required, physical models are to adopt a 1:400 scale (or smaller, depending on the scale and location of the project, which would be advised by the officer in charge).

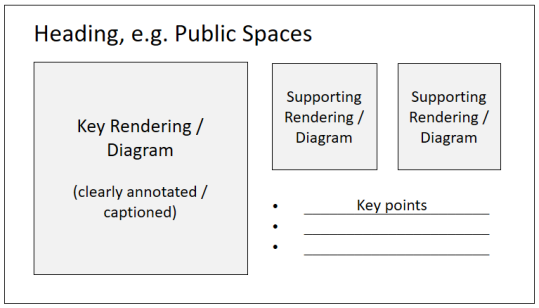
10. Resubmissions should be kept succinct. The A3 DAP booklet and presentation slides should highlight only outstanding issues with a comparison between the previous and current proposal (see Submission Templates). There is no need to highlight issues which have already been resolved.

Submission Templates

For First DAP Submission

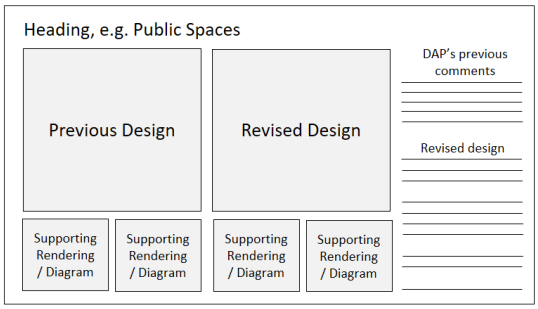


A3 Booklet

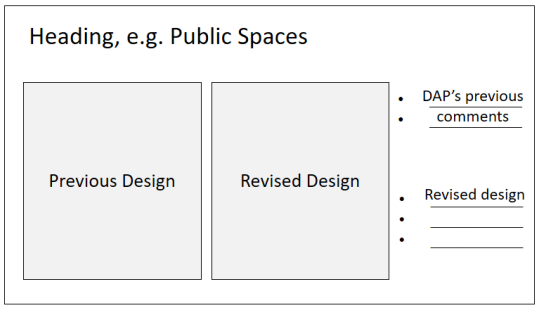


Powerpoint Slides

For Subsequent DAP Submissions



A3 Booklet



Powerpoint Slides

ANNEX G

Workplace Safety and Health Guidelines

Management and Removal of Asbestos

WSHCOUNCIL

Year of issue: 2014

Contents

1. Introduction

Asbestos had been widely used in buildings, plants and ships due to its excellent fire, heat and chemical resistance properties. However, exposure to asbestos, such as through inhalation of asbestos fibres, can lead to serious diseases. In response to these health risks, the use of asbestos in buildings was banned in Singapore in 1988 by the Building Control Division (now the Building and Construction Authority [BCA]).

Many old buildings in Singapore still contain asbestos or asbestos-containing materials (ACMs). These asbestos and ACMs can be released into the air when disturbed, affecting building occupants. It is therefore important to manage asbestos in buildings and workplaces to prevent harmful exposure. Precaution and care must be taken when conducting work activities involving ACMs. These activities include building structural works (e.g., repair, dismantling, demolition, renovation, maintenance and alteration) and other related operations (e.g., handling, sawing, cutting, grinding, drilling, lagging and delagging).

This set of guidelines was developed to provide guidance on the proper management of ACMs and how to work with them safely. It is primarily aimed at contractors, occupiers and building owners, especially those in the construction sector, shipyards and petrochemical facilities.

The guidelines will first discuss some health effects of asbestos exposure and list examples of ACMs. It will then elaborate on the management of ACMs and good industry practices. This is followed by a description of the various aspects of asbestos-removal work. Salient points on air monitoring, training and medical surveillance will also be covered.

After reading this guide, contractors, occupiers and building owners should be able to:

- identify ACMs in workplaces;
- understand the health risks of work involving asbestos; and
- manage the risk of ACMs through appropriate controls.

2. Asbestos and Asbestos-containing Materials

Asbestos
Asbestos is a naturally-occurring mineral. Asbestos fibres have excellent physical and chemical properties which made them popular as construction materials and useful for fireproofing, thermal, electrical or sound insulation and heat or chemical resistance.

There are six types of asbestos fibre and they are classified into two groups: amphibole and serpentine (see Table 1). Amphibole is generally more brittle and tends to be straighter, whereas serpentine, that is, chrysotile is more flexible and less likely to be friable. Crocidolite, amosite and chrysotile are the three most common types of asbestos. Crocidolite and amosite are known to be more hazardous than chrysotile.

Types of asbestos	
Amphibole	Serpentine
• Crocidolite (blue asbestos) • Amosite (brown asbestos) • Anthophyllite • Tremolite • Actinolite	• Chrysotile (white asbestos)

Table 1: Types of asbestos.

Asbestos-containing Materials
ACMs are any material, substance, product or article containing asbestos. ACMs are either friable or non-friable. The degree of friability of an ACM determines its classification and the potential that it will release respirable fibres. To classify whether the ACMs are friable or non-friable, the densities of the materials need to be determined. Established methods to determine density can be found in the *British Standards BS 4624: 1981* and *BS 3536 Part 2: 1974*.

A list of materials that may contain asbestos is provided in **Annex A**.

2.1 Non-friable Asbestos Materials

Generally, non-friable ACMs are less hazardous than friable ACMs. Non-friable asbestos materials are cementitious, resinated, plastic or bituminous. In their dry form, they cannot be crumbled, pulverised or reduced to fine particles by hand, thus it is harder for them to produce the asbestos fibres that constitute a serious health risk. In these materials, asbestos fibres are generally locked or embedded in the base material matrix. Therefore under normal usage conditions or in the course of normal handling, they usually do not release enough asbestos fibres to constitute a health risk.

In a dry state, non-friable asbestos materials usually have a density greater than 1 tonne per cubic metre (1000 kg/m^3). They are hard, light grey and generally contain 10% to 15% asbestos fibres, but occasionally they can contain up to 40% asbestos fibres.

Examples of non-friable asbestos materials include:

- corrugated asbestos roof sheets;
- asbestos wall cladding;
- asbestos floor tiles;
- asbestos vinyl sheets;
- asbestos cement piping; and
- asbestos friction products.

2.2 Friable Asbestos Materials

Friable asbestos materials can be crumbled by hand, and their fibres are readily released into the air when disturbed. To completely contain airborne asbestos fibres, total enclosure for the work area and other strict control measures are necessary.

Any non-friable material in poor condition that has a high probability of being crumbled or pulverised during removal operations should be considered friable (e.g., roof sheets that are damaged or have been infested by mold or algae, and old gaskets that require scraping off during removal).

Examples of friable asbestos materials include:

- asbestos fibrous sprayed-on materials used for fire protection, anti-condensation and acoustic control purposes;
- asbestos thermal insulation on boilers and pipes;
- asbestos ceiling boards or wall panels; and
- cable penetrations.

3. Health Risks of Asbestos Exposure

Asbestos is a confirmed human carcinogen and all types of asbestos can cause cancer. Asbestos fibres can enter a body when inhaled as airborne dust or when contaminated materials are ingested. These fibres are retained in respiratory or digestive tissues, leading to diseases such as asbestosis, mesothelioma and lung cancer. These diseases often have a long latency period, and symptoms generally do not appear until 15 to 50 years after initial exposure.

Asbestosis
Asbestosis is a scarring of the lung tissue which leads to decreased lung volume and increased resistance in the airways. It is normally associated with high levels of exposure for many years. Symptoms include shortness of breath, persistent coughing, tiredness and nausea.

Mesothelioma
Mesothelioma is a cancer of the lining of the lungs (pleura) and abdominal organs (peritoneum). Persons diagnosed with this disease usually have a short survival span. It does not normally require a threshold of exposure before ill effects occur, however the risk of contracting mesothelioma generally increases with the frequency, duration and level of exposure to asbestos. Symptoms include weight loss, fever, night sweats, chest pain and breathlessness on exertion.

Lung Cancer
Lung cancer, which can be caused by a number of inhaled carcinogens, including asbestos, is a malignant tumour in the lungs' air passages. Like mesothelioma, lung cancer does not require a threshold of exposure before ill effects occur. The synergistic effect of asbestos exposure and smoking can increase the risk of lung cancer by at least 50 times. Symptoms include a chronic cough, breathlessness, chest pain, haemoptysis (coughing up blood), hoarseness of the voice and wheezing.

4. Risk Management of Asbestos-containing Materials

Proper risk management of ACMs in buildings and workplaces can protect the safety and health of both occupants and workers. Putting in place a proper asbestos management plan can help prevent exposure to airborne asbestos fibres (see Figure 1) for a flow chart for the managing of ACMs.)

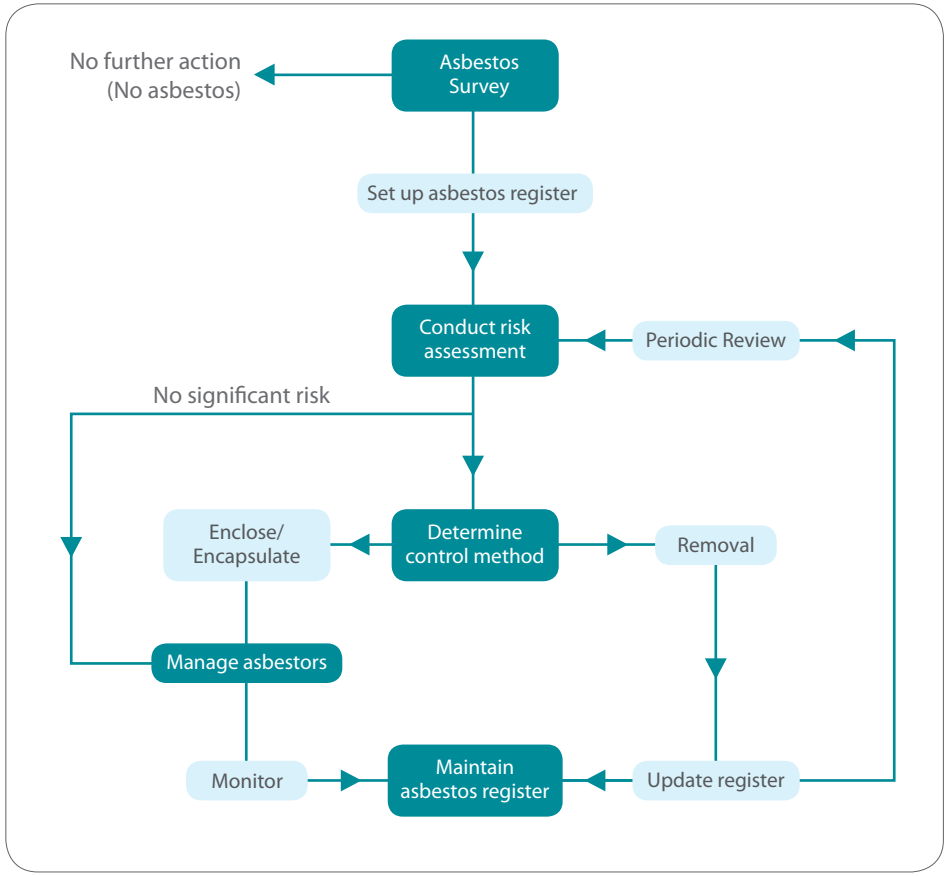


Figure 1: Flow chart for managing ACMs.

4.1 Identification of Asbestos-containing Materials

The first step in managing the risk of asbestos exposure is to determine the presence and location of all ACMs at the workplace, as well as the types and conditions of these ACMs.

Asbestos may be found in numerous building materials, typically for the purposes of fire protection, heat and sound insulation, such as partition walls, refuse chutes, roofing sheets and ceiling boards (see Figure 2).

The type of ACMs which may be found in a typical building include:

- corrugated roof sheets (e.g., roofing, wall cladding);
- insulation boards or tiles (e.g., wall partitions, ceiling boards, fire protection boards);
- flooring materials (e.g., vinyl floor tiles or sheets);
- insulation materials (e.g., fire doors, rubbish chute columns, brake linings); and
- asbestos cement products (e.g., gutters, water tanks, underground pipelines).

ACMs may also be found in ships and plant facilities. They include:

- asbestos sheets, ropes and cloths (e.g., gaskets, insulation, seals, fire blankets);
- spray-on thermal insulation (e.g., fire protection in ducts and structural steelwork, ceilings);
- lagging (e.g., thermal insulation of pipes and boilers; see Figure 3);
- insulation boards or tiles (e.g., wall panels, ceiling boards, fire protection boards, refractory linings); and
- electrical circuits (e.g., panels, wiring insulation, seals, cable penetrations; see Figure 4).

An asbestos survey can be carried out by a competent person to identify all the ACMs in the workplace. (See **Annex B** on how to conduct an asbestos survey.) The competent person must exercise care and diligence in conducting the survey to ascertain the presence of asbestos or ACMs. See below for general steps on how to identify asbestos in buildings.

Figure 2: Asbestos used in building roof sheets and ceiling boards.

1. Roof sheets.
2. Celling panels.

Figure 3: Asbestos cloth wrapping with asbestos lagging of exhaust pipe.

Figure 4: Asbestos-containing cable penetrations used on ships.

Step 1: Check the age of the building.

If the building was constructed before 1991, it is likely to contain asbestos since the use of asbestos in building materials was banned in Singapore in 1988.

Step 2: Check building plans.

Some building plans may indicate the use of ACMs. However, it should not be assumed that the buildings do not contain asbestos just because the building plans do not indicate the presence of ACMs.

Details of any extension, adaptation, renovation or refurbishment to the building in the building plans must be examined.

Step 3: Conduct an asbestos survey.

There are two types of asbestos survey, Asbestos Management Survey and Building Refurbishment or Demolition Survey.

- An Asbestos Management Survey is conducted to locate, as far as reasonably practicable, any materials suspected of containing asbestos and assess their condition. It enables proper management of ACMs by preventing ACMs from being disturbed during building maintenance. Any inaccessible structure or material which may contain asbestos should be clearly indicated in the report.
- A Building Refurbishment or Demolition Survey is required if major renovation (alteration, addition or repair work) or demolition of the building needs to be carried out. This may involve destructive inspections to ensure that all areas are accessed and thoroughly checked. Condition assessment of the ACMs may be unnecessary if ACMs are soon to be removed. The report may indicate areas of damage or locations where asbestos debris may be present.

An asbestos survey must be carried out for buildings due for demolition or renovation if the building was built before 1 Jan 1991 (based on its temporary occupation permit date). A competent person must be appointed to carry out the survey to ascertain the presence of asbestos or ACMs before commencement of the work.

See **Annex A** for examples of materials that may contain asbestos.

All identified ACMs must be removed by an Approved Asbestos-Removal Contractor (AARC) before demolition work is carried out (see Chapter 6 on Removal of Asbestos-containing Materials).

Step 4: Take samples for analysis where appropriate.

Samples of materials suspected to contain asbestos should be sent to an accredited laboratory for analysis. Sample taking must be performed by a competent person and necessary precautionary measures should be taken. Samples should be analysed using the NIOSH 9002 Polarised Light Microscopy (PLM) Method of asbestos fibre identification. The analysis result should report the type of asbestos present in the sample. If any asbestos fibres are found in the sample, the material is taken to contain asbestos.

4.2 Exposure and Risk Evaluation

After ACMs in the building are identified, the risk of exposure to the ACMs is evaluated. The risk of exposure is determined by the potential of release and likelihood of disturbance of the ACMs. Factors to consider when evaluating the exposure risk are illustrated in Figure 5 and further elaborated in the paragraphs that follow.

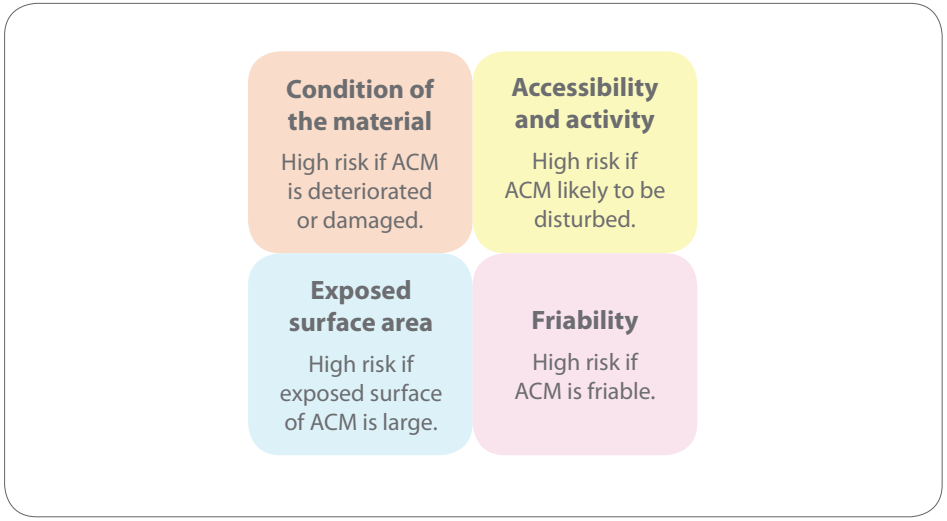


Figure 5: Factors affecting the risk of exposure to ACMs.

Condition of Material
The condition, extent of damage or deterioration of the ACM can influence how fast and how easily it releases asbestos fibres into the immediate environment. This factor is usually associated with the quality of the installation work, the adhesion of the friable material to the underlying surface, and the integrity of the material. Water can also affect the condition of the ACM by dislodging and disturbing the asbestos in the material. Asbestos fibres can be dislodged by water and deposited elsewhere after the water has evaporated.

Exposed Surface Area
The greater the exposed surface area of the friable material, the higher the potential for fibres to be dislodged or released. The release potential and risk of exposure are further increased if the friable material is exposed.

Accessibility and Activity
If a material can be accessed or reached easily, it may be subject to increased contact and hence possible damage. The amount and/ or type of activity or work happening in the vicinity of the ACM, such as vibration and air movement, can also result in potential damage and fibre release.

Friability and Content
Different ACMs have varying degrees of friability – the more friable the material, the greater the potential for asbestos fibres to be released. In addition, a higher asbestos content in a material also increases the likelihood of fibres being released.

4.3 Control Methods

Having evaluated the risk of exposure of ACMs, appropriate control measures need to be put in place. There are four methods of control.

Removal
Removal of ACMs should be considered if ACM damage is extensive and repair is not justifiable. Major changes or remodelling made to the building may also disturb ACMs present and warrant their removal. Asbestos-removal work poses a great risk of fibre release and should only be carried out by an AARC (see Chapter 6 on Removal of Asbestos-containing Materials).

Encapsulation
Encapsulation involves treating the ACM with a sealant that either binds the asbestos fibres together or coats the ACM so that fibres are not released. Encapsulation should be limited to areas where damage due to contact will not occur, so that the ACM will retain its bonding integrity. This method is usually used as an interim measure. It is necessary to ensure that the person carrying out the encapsulation work is adequately protected from exposure to asbestos fibres.

Enclosure
For the enclosure method, a barrier such as a suspended ceiling is usually constructed between the ACM and the building's environment. As the ACMs still remain, asbestos fibres and fallout can accumulate behind the enclosure. However, the accumulated fibres can be released into the building's environment if the enclosure is damaged. It is therefore important to include provision for access to the ACMs during the design and installation of enclosures so they can be inspected regularly.

Leave-in-place
ACMs that are in a good condition should be left undisturbed as they are less likely to release asbestos fibres into the surrounding air. The risk of exposure is normally low or negligible in such instances, and remedial action and assessment can be deferred to a later time when necessary.

The conditions of existing ACMs can change with time, making it necessary to periodically inspect and monitor ACMs. An inspection regime can be established to ensure that the risk of asbestos exposure does not endanger the health of building occupants. It can also indicate the need for further corrective actions such as ACM removal.

5. Good Practices in Managing Exposure to Asbestos-containing Materials

Asbestos Register
Based on the findings of the asbestos survey, an asbestos register can be maintained to keep a record of identified ACMs or those likely to be present.

The asbestos register should indicate the location, type and condition of the ACMs. It should also include inaccessible locations where materials may contain asbestos. The asbestos register has to be maintained, kept up to date, and made available to occupants and any other persons who may be exposed to ACM. The following should be done regularly to help maintain the asbestos register.

Information and Labelling
Wherever possible, ACMs in the workplace should be labelled with warning signs to warn workers or occupants of asbestos hazards. These help prevent people from disturbing the ACMs unknowingly and exposing themselves unnecessarily.

Training and Awareness
Training can be provided for workers or occupants to heighten their awareness of hazards caused by asbestos when working with or near ACMs. Persons who conduct activities in areas with ACMs or who are likely to be exposed to the asbestos in the building must also be informed and educated about the presence of ACMs and their potential hazards.

Isolate or Restrict Access
Restrict and control access to areas where ACMs may pose a risk. Only authorised persons wearing proper personal protective equipment (PPE) should be allowed access to these areas.

Asbestos Monitoring Programme
A programme can be implemented to inspect ACMs periodically (e.g., every six or 12 months depending on the condition of the ACMs) and monitor the concentration of asbestos in the air when necessary.

Reporting Procedures
Procedures can be established for workers or occupants to report any damage or deterioration of the ACMs so that timely and appropriate corrective actions can be implemented to minimise the risk of exposure.

Some Do's and Don'ts

- In areas with damaged ACMs, do keep activities to a minimum if unable to avoid the areas completely.
- Do wear appropriate PPE when working in areas where ACMs may be disturbed.
- Don't dust, sweep, or vacuum debris that may contain asbestos.
- Don't saw, sand, scrape, or drill holes in ACMs.

6. Removal of Asbestos-containing Materials

The Workplace Safety and Health (WSH) (Asbestos) Regulations define asbestos-removal work as any work that entails the removal of asbestos or ACMs that are fixed or installed in a building, plant, ship, machine, equipment or workplace, so that the asbestos or ACMs are no longer fixed or installed in that building, plant, ship, machine, equipment or workplace.

Asbestos-removal work is a high risk activity, and should only be carried out by AARCs. It is important to properly plan, effectively communicate and adequately prepare the site before starting asbestos-removal work.

Asbestos-removal work includes total or partial removal of any type of ACM. Examples of asbestos-removal work include:

- removing asbestos corrugated roof sheets or ceiling boards from buildings or factories;
- removing asbestos insulation or laggings from pipelines or boilers;
- removing asbestos gaskets from piping, flanges, boilers or heat exchangers;
- removing part of damaged asbestos roof sheets, ceiling boards or pipe insulations;
- cutting an opening in asbestos roof sheets or ceiling boards for installation of exhaust fans or pipelines; and
- cleaning up asbestos debris, including decontamination of the worksite or workplace.

6.1 Roles and Responsibilities

The occupier of a workplace should ensure that asbestos-removal work is carried out by an AARC.

An AARC should:

- Submit a notification of asbestos-removal work at least seven calendar days before commencement of the work;
- Appoint a competent person to supervise the asbestos-removal work;
- Ensure that the work is carried out under the immediate supervision of the competent person;
- Ensure that the asbestos-removal plan of work prepared by the competent person is implemented; and
- Ensure that asbestos-removal work is carried out in accordance with the requirements in the WSH (Asbestos) Regulations.

The competent person for asbestos-removal work should:

- Prepare an asbestos-removal plan of work and ensure that it is adequate, suitable and effective;
- Advise on all methods and measures related to asbestos-removal work;
- Ensure that the asbestos-removal work is carried out in accordance with the asbestos-removal plan of work;

- Coordinate or manage asbestos-removal work activities;
- Supervise the entire asbestos-removal work; and
- Ensure that only trained persons carry out asbestos-removal work.

6.2 Notification of Asbestos-removal Work

Under the WSH (Asbestos) Regulations, AARCs carrying out asbestos-removal work must notify the Commissioner for Workplace Safety and Health (WSH) at least seven calendar days prior to the commencement of work. This notification should be submitted through the e-service portal available on MOM's website.

AARCs have to update any change to the notification submitted. A copy of the notification should also be made available at the workplace and must be produced upon request by MOM inspectors.

6.3 WSH Risk Assessment

A proper and thorough WSH risk assessment (RA) must be conducted prior to the start of asbestos-removal work. The RA should identify all potential hazards, establish all the risks associated with asbestos-removal work (e.g., working at height, working in confined spaces), and propose measures to prevent or minimise these risks. Available asbestos registers and survey reports should be referred to when conducting the RA.

For more information about WSH risk assessment, see *Approved Code of Practice for WSH Risk Management*.

6.3.1 Other Hazards Associated with Asbestos-removal Work

Working at Heights

Contractors should avoid working on top of asbestos roofs or ceiling boards. As much as possible, asbestos-removal should be carried out from underneath the roof using suitable work platforms such as mobile elevated work platforms and scaffold platforms. Work platforms must be of safe design, sound material, good construction and adequate strength.

If working on a roof cannot be avoided, safety harnesses, lifelines and anchorage points have to be adequately provided to ensure that the work can be carried out safely. A proper fall prevention plan has to be developed and implemented for working at heights.

For more information on working at height, refer to the following:

- *WSH (Work at Heights) Regulations;*
- *Code of Practice for Working Safely at Heights;*
- *WSH guidelines: Working safely on roofs;*
- *WSH guidelines: Anchorage, lifelines and temporary edge protection*; and
- *Technical advisory for scaffolds*.

Working in Confined Spaces

For asbestos-removal work carried out in confined spaces, entry permits must be obtained prior to entry into the confined space(s). All requirements for work in confined spaces apply.

For more information on work in confined space, refer to the following:

- *WSH (Confined Spaces) Regulations;*
- *SS 568:2011 Code of Practice for confined spaces; and*
- *Technical advisory on working safely in confined spaces.*

Working in a Hot Environment

Outdoor asbestos work causes heat exhaustion due to the hot and humid environment, heavy physical work and non-breathable protective clothing. Heat-related hazards also result from working in enclosures and confined spaces.

However, heat-related disorders can be prevented by:

- ensuring workers are acclimatised;
- ensuring that workers drink plenty of water;
- ventilating the work area; and
- implementing a work-rest schedule.

Removal of asbestos from hot pipelines or machinery should be scheduled to take place during shutdowns, thus allowing sufficient time for the pipelines or machinery to cool. If this cannot be avoided, the plan of work has to take into consideration additional heat stress hazards arising from the pipelines or machinery. Appropriate PPE and control measures have to be put in place to ensure that the work can be carried out safely.

For more information on working in hot environment, refer to *WSH guidelines: Managing heat stress at the workplace*.

6.4 Plan of Work

Before undertaking any asbestos-removal work, it is important to develop a proper plan of work. A written plan of work will guide and establish details on how asbestos-removal work is to be carried out. The plan will vary according to the nature of the task, and the type, location, quantity and condition of the ACM to be removed. Other work activities in the vicinity should also be considered when developing the plan.

The plan of work must be readily available on site. A copy should be made available upon request by MOM inspectors and to others who may be affected by the work. Any change to the plan of work should be documented and updated.

The plan of work shall include, but should not be limited to, the following:

a) Scope of work:
   - nature of work;
   - estimated duration of work;

- date of work commencement;
- type(s) of asbestos fibres involved;
- type of ACM(s) involved (attach photos if possible);
- quantity of ACM(s) involved (estimated amount); and
- the condition of the ACM(s).

b) Location and address of asbestos-removal work.

c) Particulars of person(s) involved in the work:
- stakeholders involved in the project (e.g., developer, main contractor, sub-contractors, consultants, AARCs);
- competent person(s):
  - who advises on the establishment of the plan of work; and
  - who supervises the asbestos-removal work.
- workers:
  - total number of workers involved in the project;
  - workers register;
  - summary reports for medical examinations;
  - fit testing records of respiratory protection devices; and
  - safety orientation course certificates of workers (in the relevant industries).

d) Method(s) of removal and measures to minimise the release or spread of asbestos:
- method statement (see Chapter 6.6 on Removal Methods);
- details of enclosures (see Chapter 6.5.3 on Enclosure):
  - size and dimensions;
  - structure and materials used for construction; and
  - calculations of air extraction flow rate requirements.
- tools and equipment (including PPE) used:
  - specifications of equipment; and
  - checking and maintenance records of equipment.

e) Decontamination facilities (see Chapter 6.5.4 on Decontamination Facilities):
- size, structure and material used (if it is to be constructed); and
- manufacturer specifications (if the facility is a purchased unit).

f) Site layout:
- demarcation of asbestos work area;
- location of air extraction units;
- location of the hygiene facility;
- location of the asbestos waste storage area;
- transit route; and
- waste route.

g) Decontamination procedures (where applicable, see Chapter 6.5.4 on Decontamination Facilities for more information) for:
- the workplace;
- tools and equipment;
- personnel; and
- soil.

h) Disposal arrangement (see Chapter 6.9 on Waste Disposal):
- procedures for waste handling;
- National Environment Agency (NEA) approved asbestos disposal contractor; and
- certificate of waste disposal receipt.

i) Monitoring of asbestos levels (where applicable; see Chapter 6.10 on Air Monitoring):
- background level (before starting work);
- workers' exposure level (during work);
- check for spread of asbestos outside work area;
- air clearance check (after completion of work); and
- monitoring or test reports (where applicable).

j) Emergency procedures (where applicable):
- breaches in integrity of enclosure during removal work;
- unplanned ACM disturbance;
- fire emergencies; and
- rescue of personnel.

k) Other hazards (where present, see Chapter 6.3 on WSH Risk Assessment).

6.5 Site Preparation

A visual inspection should be carried out to verify that the area is not contaminated before setting up the site for asbestos-removal work. If necessary, air monitoring can be conducted to establish the level of asbestos concentration in the air to determine if respiratory protection is necessary during site preparation.

Prior to covering the asbestos work area with a polyethylene sheet, the area should be pre-cleaned using a high efficiency particulate air (HEPA)-filtered vacuum cleaner or wet wiped. Dry sweeping must never be used to collect asbestos debris under any circumstances. All movable objects such as furniture should be removed from the work area to prevent them from being

contaminated with asbestos. Non-movable objects which are to remain within the work area such as circuit boxes and switch gears should be pre-cleaned thoroughly with an industrial vacuum cleaner equipped with a HEPA filter, or wet-wiped. They should then be sealed with two layers of polyethylene sheets and securely taped down to protect them from contamination. Any ventilation system serving or connected to the asbestos work area should be disabled and the ventilation ducts leading to and from the work area should be sealed for the whole duration of the asbestos-removal work.

6.5.1 Site Control and Arrangement

No person is allowed to enter the asbestos work area, except for those involved in the asbestos-removal work or authorised to enter the work area. The owner, occupants and employees in the workplace and anyone who may be affected by the asbestos-removal work should be advised to stay away from the asbestos work area during the period of work. Barriers or barricades should be erected to control the entry and exit of persons in the asbestos work area. Arrangement for alternate walking path is necessary to prevent unauthorised people or the public from going through or near the asbestos work area.

Signs should be put up at all entry and exit points of the work area to warn the occupants and public of the hazards of asbestos work (see Figure 6). The warning or hazard statements on the signs must be in languages that any person who may be exposed to the hazard can understand. The signs should also be weatherproof and secured in place until the asbestos-removal work is completed. Other signs should enforce site disciplinary rules such as mandatory PPE and no eating, drinking or smoking in the work area.

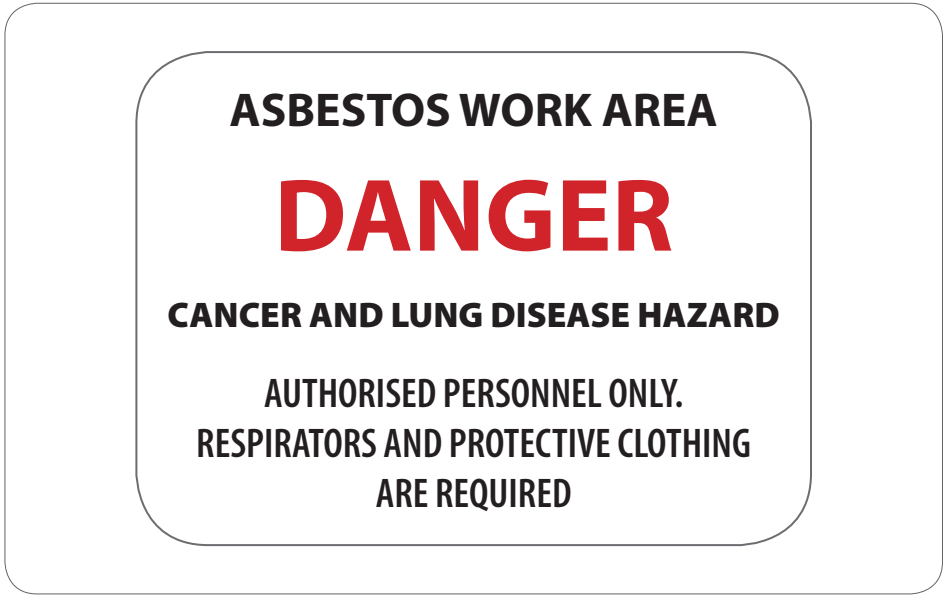


Figure 6: Example of a warning sign.

Scaffolds, lifelines and other work equipment required for asbestos-removal work have to be arranged and set up. During equipment installations, the ACMs should not be disturbed, to prevent unnecessary asbestos exposure. Workers performing the installations must wear appropriate PPE and be able to recognise work hazards such as falling through asbestos roofs or ceilings.

Arrangements should be made for other operations or work to stop during asbestos-removal work. Where possible, avoid work activity in the vicinity of the asbestos work area.

6.5.2 Tools, Materials and Equipment

The following are some tools, materials and equipment that may be required for asbestos-removal work:

- Polyethylene Sheets

  Polyethylene sheets of 0.20 mm (or 8 mils) thickness should be used to enclose and seal the asbestos work area. These sheets are impermeable and impervious and can prevent asbestos dust and waste from spreading to the surrounding environment.

- Wetting Agent

  ACMs need to be properly wetted with a suitable wetting agent to suppress asbestos fibres. Water can be used as the wetting agent for ACMs that contain hydrophilic chrysotile fibres, but is less effective for hydrophobic asbestos fibres such as amosite or crocidolite. For the latter, surfactants (e.g., detergent) will be a more effective wetting agent. Whenever possible, surfactants should be used for all types of asbestos-removal work. Surfactants used should be diluted to a specific concentration based on the manufacturer's instructions. For example, a wetting solution can be applied by an airless type portable water spray.

- Water-based Polyvinyl Acetate Adhesives

  Water-based polyvinyl acetate (PVA) adhesives may be sprayed onto exposed surfaces to bind traces of asbestos that may still be around during the clean-up of the work area. The adhesives should be dyed to indicate where (and whether) they have been applied to facilitate cross-checking at a later stage. Such adhesives can also be used during decontamination work, by spraying them onto asbestos debris to minimise the release of asbestos fibres.

- Industrial Vacuum Cleaner

  An industrial vacuum cleaner can collect asbestos dust and debris during the clean-up of the asbestos work area. The vacuum cleaner used should be of Type H or equivalent, fitted with a HEPA filter. Unless the vacuum cleaner is designed for wet application, it should not be used to vacuum wet materials as this will damage the HEPA filter. Domestic or general purpose vacuum cleaners should not be used as they do not meet the requirements needed to remove asbestos dust which is hazardous to health.

6.5.3 Enclosure

Depending on the type of ACMs to be removed, a partial or total enclosure needs to be provided.

Non-friable ACM Removal

Partial enclosures are required for non-friable ACMs removal. If the precautionary measures to suppress dust release during the removal work are found to be inadequate after assessment, total enclosures may be necessary. It is advisable to use polyethylene sheets to cover all openings to the asbestos work area as the sheets act as a barrier to prevent the spread of asbestos fibres to other areas in the workplace.

At the asbestos work area, the floor should be covered with polyethylene sheets extending up to at least 1.5m away from the work activity area. The edges of the polyethylene sheets should extend at least 30cm upwards, and should be sealed to the wall with adhesive tapes (see Figure 7). All wall openings such as windows should be covered and sealed with two layers of polyethylene sheets.

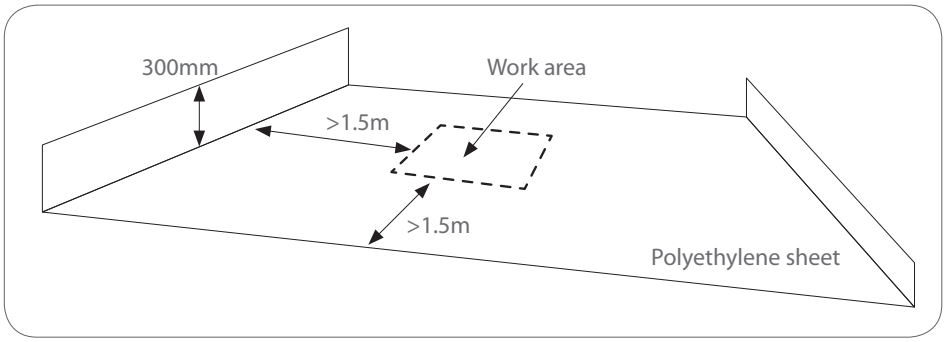


Figure 7: **Flooring to be covered with polyethylene sheets at the asbestos work area.**

For asbestos-removal work on roofs, a barricade at least 2m high should be erected 5m around the work area to prevent unauthorised entry (see Figure 8). If the minimal distance of 5m is not possible, the barricade should be high enough to prevent any ACMs or debris from falling out.

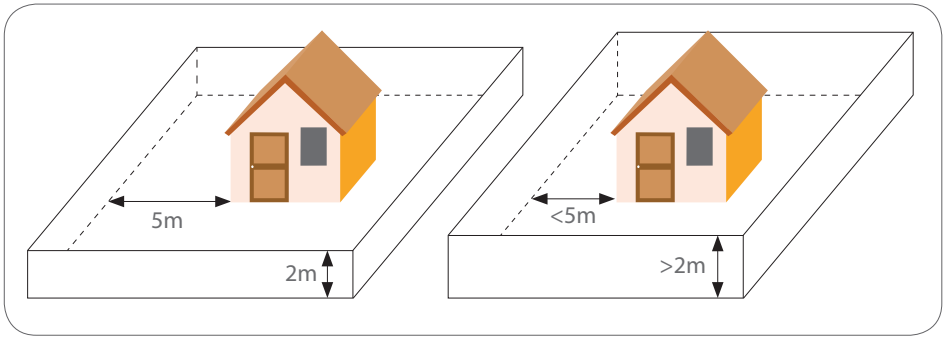


Figure 8: **Example of how barricades for non-friable ACM removal work can be set up.**

Friable ACM Removal

For removal of friable ACMs, the concentration of airborne asbestos fibres is expected to be high and total enclosure is necessary to prevent the spread of asbestos beyond the asbestos work area. Some factors to consider when designing the enclosure include location, size and shape of the work area, number of workers involved and the use of an air extraction unit to maintain sufficient negative pressure.

Enclosure Design

The enclosure should be of a suitable size based on the work requirements. (An oversized enclosure may not be practical as it increases the amount of ventilation required.) A common type of enclosure used is a self-supporting temporary unit built to accommodate the work area (see Figure 9). It consists of a frame to which polyethylene sheets are securely fixed.

Figure 9: **Example of a self-supporting temporary enclosure.**

The choice of materials for the construction of the enclosure is determined by a number of factors, including duration and location of the work. The sheets used must be thick enough to withstand wear and tear. In situations where fire hazards are a concern, fire-retardant polyethylene sheets must be used. Wherever possible, operating processes should not be enclosed as this may introduce additional hazards such as plant overheating, heat stress and fire hazards.

The construction of an enclosure may either make use of parts of the existing building structure or self-supporting temporary structures built around the asbestos working area. Where existing walls, ceilings and floors are used to form part of an enclosure, they should have smooth impervious surfaces that can be thoroughly cleaned after the asbestos-removal work. If any part of the surface is rough, damaged or friable, it should be lined with polyethylene sheets, after pre-cleaning has been done. Any openings (e.g., doors, vents, windows, holes) should be sealed using tape or proprietary sealing compounds and/or covered with two layers of polyethylene sheets. Care should also be taken to ensure that openings through which pipes or ducts pass are properly sealed. All the joints in the polyethylene sheeting need to be adequately sealed using adhesive tape.

The enclosure should be provided with a negative pressure unit (NPU) to prevent asbestos fibres from escaping. Airlocks should be constructed to allow a one-directional air flow between compartments (see Figure 10).

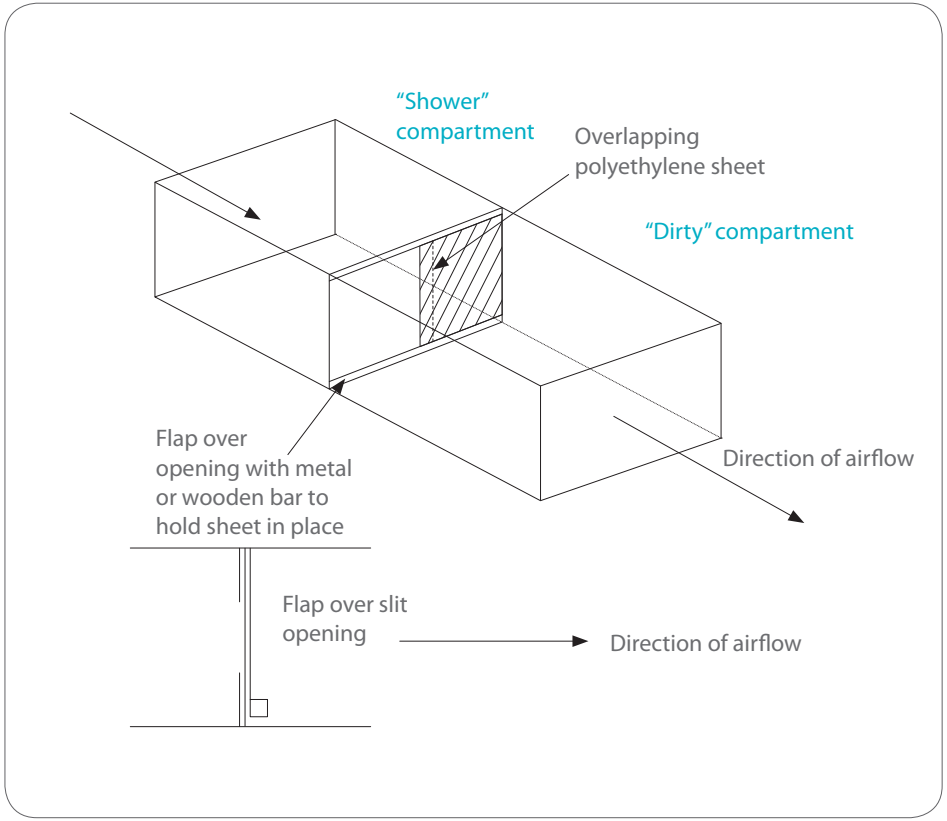


Figure 10: **Air locks between compartments allow one-directional air flow.**

Where a large plant such as a power station is to be stripped of asbestos, it is recommended that the whole area be compartmentalised into multiple smaller enclosed work areas for easier management of the asbestos-removal work. Suitable clear plastic "viewing panels" can be provided so that work activities can be supervised from outside the enclosure.

The enclosure must not obstruct any fire exits. (Where this is unavoidable, alternative arrangements should be made and clearly communicated to the occupants and workers in the premises.)

Air extraction equipment

Air extraction equipment such as an NPU is used to ensure that any asbestos released during the removal work is contained within the enclosure by maintaining the enclosure at negative pressure relative to the surrounding air (5 pascals or 0.5 mm water gauge). The integrity of the negative pressure system can be gauged from the effect of pressure on the plastic sheet. Negative pressure will pull the plastic sheet inwards. This indicates that air flow through any leaks is inwards rather than outwards, preventing asbestos fibres from spreading to the outside of the enclosure. This allows a supply of clean air to the enclosure.

The type of job, layout of the building, and enclosure size and volume need to be considered when determining ventilation requirements. The air extraction unit should be located where it can provide an effective airflow throughout the enclosure. The unit should be placed opposite of or furthest from the entrance to the enclosure so that air can be purged through the entire enclosure (see Figure 11). For large enclosures or those with complex shapes, more than one air extraction unit may be needed to achieve effective airflow.

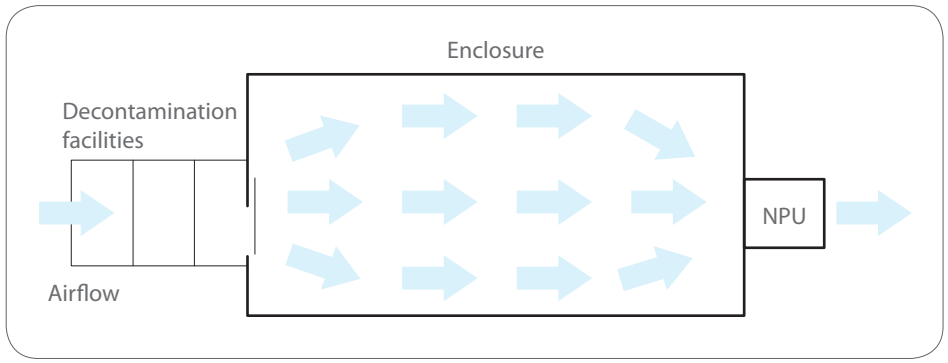


Figure 11: **Illustration of an enclosure with an NPU.**

It is recommended that the extraction flow rates should result in eight air changes per hour in the enclosure. The air extraction unit must be fitted with a HEPA filter of at least 99.97% efficiency. The air extraction unit should be located outside the enclosure where possible.

The following formula is used to determine the capacity of the NPU required:

(Required NPU capacity (m^3/hr) = Volume of enclosure (m^3) x no. of air changes per hour)

Example: For an enclosure that is 10m x 5m x 3m; the
NPU capacity required = 10m x 5m x 3m x 8 air changes per hour
= 1200 m^3/hr

The air extraction unit must be correctly installed and checked by a competent person before use. Safe work procedures for changing of filters should be put in place where there is potential for exposure to asbestos. The air extraction unit should be examined and maintained at least once every six months to ensure that it is in good working condition and operating at its specified efficiency. The maintenance record must be kept updated and available for inspection.

- Inspection and Testing of Enclosure
  A thorough visual inspection of the enclosure is required to check for any leakage prior to the start of each shift. Smoke testing by releasing smoke from a smoke generator inside the enclosure can be done to detect leakages. All air extraction units should be switched off during the smoke testing. Leakages can be detected by observing the smoke flow patterns from outside the enclosure. Any leakage detected must be rectified before work starts.

Additional testing can be performed externally using smoke tubes with the air extraction units running. Smoke tube testing should be carried out at around particular seals and joints to ensure they are effective. Smoke should be drawn into the enclosure during smoke tube testing.

The enclosure must also be maintained in negative pressure during work. Differential pressure monitors can be used to provide a continuous indication of whether or not the enclosure is in negative pressure. A pressure difference of about 5 pascals (0.5 mm water gauge) or above should be maintained. The pressure gauge on the air extraction unit should also be checked to ensure that sufficient airflow is maintained at all times during the work.

6.5.4 Decontamination Facilities

Decontamination or hygiene facilities should be provided to enable workers to:

- change into protective clothing and wear safety equipment such as respirators before entering the asbestos work area; and
- decontaminate themselves before leaving the work area.

The decontamination facility should be positioned adjacent to the work area as shown in Figure 12. Where it is not possible to provide the facilities adjacent to the work area, an alternative known as "transit facilities" should be provided. These transit facilities allow workers to decontaminate themselves partially before moving to the main decontamination facilities for complete decontamination. The route that connects the transit facilities to the decontamination facilities should not pass through occupied areas and allow public access.

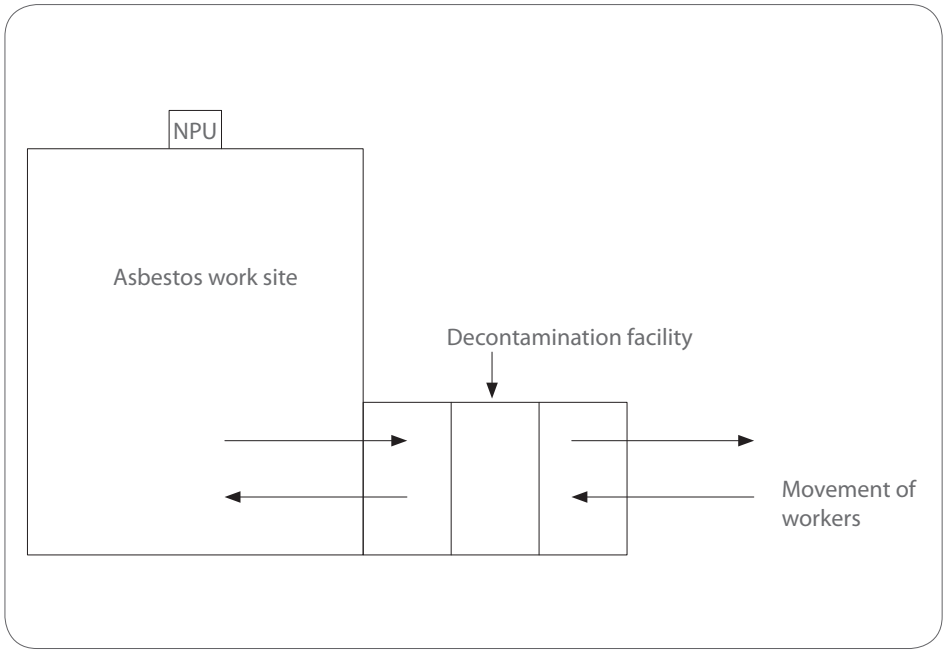


Figure 12: Illustration of a decontamination facility.

The size of the facilities is dependent on the number of workers who will be using them. These facilities should only be used by workers involved in asbestos work.

Design and Construction

Decontamination facilities consist of three separate compartments. They are clean, shower and dirty areas (see Figure 13). At minimum, each compartment should be 1m x 1m x 2m in dimension.

- Clean Area

  There should be provisions for hanging workers' clothing and safe keeping their personal belongings. Decontaminated PPE are to be stored in the clean area. Battery charging points can also be provided in this area.

- Shower Area

  Proper showers should be provided for friable asbestos-removal. The shower area should be between the clean and dirty areas.

- Dirty Area

  There should be storage and disposal bags available in the dirty area for contaminated clothing and asbestos waste respectively. The disposal bags should be labelled to indicate that they contain asbestos waste.

Figure 13: A decontamination facility consisting of three separate compartments (clean, shower and dirty areas).

Decontamination facilities should be constructed such that the facilities can be easily cleaned and no accumulation of asbestos dust in inaccessible areas is possible. Some features and considerations for the facilities include:

- impervious surfaces for all internal walls and ceilings;
- floors completely covered with impervious floor coverings;
- avoiding ledges and grooves;
- covering all corners for easy cleaning;
- providing drainage holes on the floor; and
- capping all poles or tubing used for structure construction.

Two or more overlapping polyethylene sheets between the compartments should be used to ensure that an airlock is maintained as the worker passes through the decontamination facility or unit.

An air extraction unit is needed in the dirty compartment to ensure proper airflow and supply replacement air. Waste water from the decontamination facility should pass through a high efficiency particulate filter (less than 5 microns) before the water can be discharged into the sewer mains (see Figure 14).

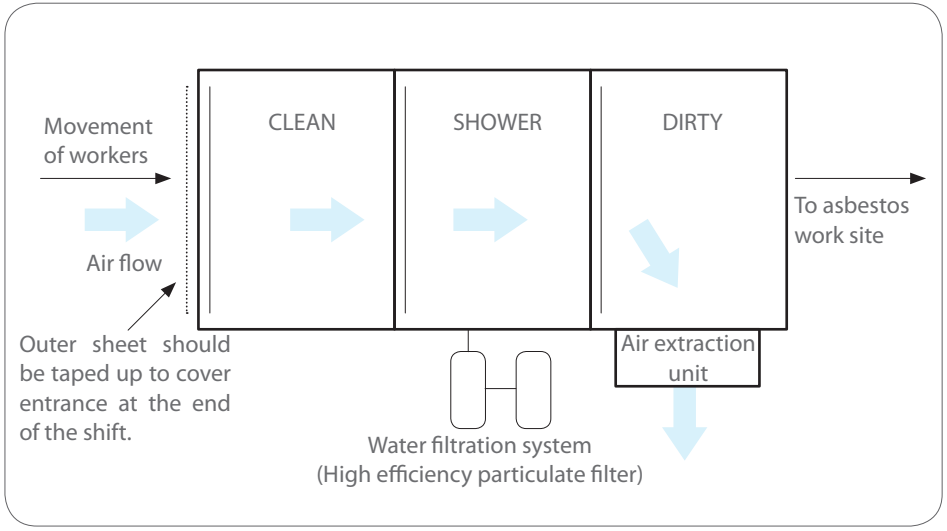


Figure 14: **Illustration of a decontamination facility equipped with a high efficiency particulate filter and air extraction unit.**

Cleaning and Maintenance

Decontamination facilities should be cleaned at the end of each working day. The daily cleaning regime should include the vacuuming of the entire facility followed by a thorough washing down of any exposed surfaces. The water filtration system should also be drained, and debris traps in the shower area emptied. Debris and asbestos waste collected should be put in labelled disposal bags for subsequent disposal. Maintenance workers cleaning the decontamination facilities should wear the appropriate respirator and PPE.

6.6 Removal Methods

The removal technique chosen for asbestos-removal work is usually determined by the nature of the ACMs and their location. Regardless of the technique chosen, the release of asbestos fibres during removal must always be kept to a minimum. Care must be exercised when handling ACMs to minimise breakage. Only non-powered hand tools should be used during the removal process, as the vibration from powered tools will cause more asbestos fibres to be released. Local exhaust ventilation or shadow vacuuming[1] may be used to control asbestos release.

The removal procedures for the different types of ACMs are provided in **Annex C**.

To select the appropriate asbestos-removal method, the following factors should be considered:

- the need to minimise the amount of asbestos fibres generated at the point where ACM is being stripped;
- the type of ACM present (e.g., impervious cement layer on pipe lagging resists wetting whereas lagging such as blankets is better wetted using sprays rather than injection);

[1] Shadow vacuuming applies local exhaust by placing the hose opening of a vacuum cleaner close to the task. The hose opening may be held by a second worker or directly attached to a tool.

- the presence of live electrical equipment that will prevent or restrict the use of controlled wet stripping (wet method);
- the presence of chemicals may present a direct risk to workers or prevent the use of controlled wet stripping methods; and
- the use of wetting agents can result in slips and falls. This is especially important when workers are working at heights.

6.6.1 Wet Method

The wet method refers to water or another wetting agent being used to minimise the release of asbestos. This method is suitable for ACMs that are not covered with other materials (e.g., metal cladding, coated with paint). The wetting agent is sprayed onto the ACM, and sufficient time is given to allow the agent to be absorbed into the material. Over-wetting would result in excess agent seeping out, causing a slip hazard and creating a runoff that may be difficult to handle. The wet ACMs should be removed and placed in a disposal bag, labelled and sealed.

6.6.2 Glove Bag Method

The glove bag is made of strong clear plastic material and can be used in the removal of asbestos-containing gaskets. Generally, the top of the glove bag fits around the material to be removed while the bottom keeps tools and asbestos waste (see Figure 15). The glove bag should have an entry port to allow a spray nozzle to wet the ACM before removal. The bag must not be reused. Procedures to remove the tools and asbestos waste from the glove bag after the removal work have to be established.

Figure 15: **Glove bag containing asbestos waste.**

6.6.3 Injection

Injection methods can be used when the outer surface of the ACM is sealed, covered or coated with impervious material. Where lagging is covered by a cement-like layer, holes can be drilled to allow access for injection heads. The holes should be 10 to 15 cm apart so that the wetting agent is able to reach all areas.

6.6.4 Other Methods

Asbestos can be found in vinyl floor tiles or mastic used to glue tiles to the floor. Hand tools such as scrapers should be used to remove such ACMs. Power tools or abrasive methods such as sanding must not be used during the removal process.

6.7 Personal Protective Equipment

Workers whose work involves asbestos should always put on the appropriate PPE such as disposable protective clothing and respirators.

6.7.1 Disposable Protective Clothing

Workers carrying out asbestos-removal work should use disposable protective clothing. The protective clothing should not have pockets, to prevent asbestos fibres from collecting in them. Also, it should not readily retain or allow the penetration of asbestos fibres. Clothing made of wool or other materials can attract fibrous dusts and must not be worn in the asbestos work area. A Type 5 (BS EN ISO 13982-121) disposable coverall is the appropriate clothing for asbestos work.

The disposable protective clothing must be removed upon leaving the work area (e.g., when the worker goes for meal breaks). It has to be stored in sealed labelled containers to prevent asbestos fibres from getting into the surrounding environment. The worker should refrain from blowing or shaking dust and debris off the clothing as this can dislodge the asbestos fibres. At the end of each shift, the clothing must be disposed of in sealed impermeable bags that are properly labelled.

6.7.2 Respirator

For friable ACM removal work where the exposure is likely to exceed the Permissible Exposure Level (PEL) of 0.1fibre/cc, workers should be provided with powered air-purifying respirators or other high performance equipment (self-contained breathing apparatus or airline respirators). Full-facepiece air-purifying respirators may be used if the exposure is not likely to be above the PEL. On the other hand, for non-friable ACMs removal work and low risk ancillary tasks (e.g., scaffold erection, site set-up, enclosure dismantling, waste handling outside enclosure), provisions should be made for half-facepiece air-purifying respirators equipped with HEPA filters.

Workers should be issued with personal respirators, and they have to ensure that their respirators are regularly cleaned and properly maintained. Fit tests for respirators must be conducted for all users to determine their suitability. Users should also be advised to have their faces clean-shaven to ensure a good fit.

The filter cartridges of the respirators should be replaced when damaged or clogged with dust (e.g., when breathing resistance increases). Workers are reminded to wash their faces and respirators when they leave the work area. The selection, use and maintenance of respiratory protective devices (RPDs), should be in accordance with *SS 548:2009*.

See **Annex D** for the selection and use of RPDs and filter cartridges, and fit test requirements.

6.8 Decontamination

Decontamination is an important step in minimising workers' exposure to residual asbestos fibres during asbestos-removal work processes. The asbestos work area, tools, equipment and PPE need to be decontaminated. Workers should carry out personal decontamination.

Work Area

Decontamination of the work area should be carried out after the asbestos-removal work. The wet-wiping method (e.g., using damp rags to clean the contaminated area[s]) can be used. This is followed by vacuuming to remove asbestos dust. The rags used must be disposed of properly after cleaning. Where wet-wiping is not feasible, sealing agents such as PVA may be used to bind asbestos fibres or dust. After decontamination, a visual inspection should be carried out to ensure that the area has been thoroughly cleaned.

Areas to be decontaminated should include the following, as asbestos debris or residue can be deposited in these areas:

- window sills, ledges, shelves;
- any rough or porous surface;
- support brackets, clamps and pipe hangers;
- nuts and bolts of flanges and hatches of vessels;
- backs of pipes and vessels;
- round conduits and inside cable trays, especially when they are made of metal mesh;
- holes in walls or partitions where pipes, cables or ducts pass through;
- undersides of boilers and tanks;
- folds or overlaps in the polyethylene sheets used to construct the enclosure; and
- electrical installations such as fuse and switch boxes and the inside of light-fitting enclosures.

After decontamination of the work area, an air clearance test should be carried out (see Section 6.10 Air Monitoring for details). The enclosure at the asbestos work area can be dismantled once satisfactory air sampling results are obtained. The sheeting materials used should be taken down, folded inwards, placed and sealed in appropriate disposal bags. The materials used in the construction of the enclosure may be contaminated and they may have to be disposed of as asbestos waste unless they can be effectively cleaned or sealed. All contaminated materials, including cleaning rags, plastic sheeting, timber scaffolds, and PPE must be disposed of properly as asbestos waste.

Tools and Equipment

All tools and equipment used during asbestos-removal work should be properly cleaned and decontaminated before they are removed from the asbestos work area. Otherwise, they would have to be disposed of as asbestos waste depending on the level of decontamination and ease of replacement. Tools and equipment can be cleaned by wet-wiping followed by vacuuming (where practicable) to ensure that all asbestos dust has been removed. Tools that cannot be completely decontaminated or are to be reused should be put in appropriate containers or bags, sealed and labelled.

Personnel

Workers have to carry out personal decontamination in the decontamination facilities at the asbestos work area. They must be trained in decontamination procedures, and adhere to the procedures for using the facilities to avoid contaminating the facilities and creating a health risk to themselves and others.

See **Annex E** for procedures for entering and leaving the asbestos work area.

Soil
In situations where the soil is contaminated with asbestos, for example, due to accidental breakage of ACMs or improper removal of ACMs, the contaminated area should be cordoned off and appropriate steps taken to mitigate the situation.

Decontamination can take the following steps:

- Wet the top layer of soil to minimise generating dust;
- Pick up all visible pieces of ACM debris;
- Remove contaminated topsoil to a depth that has no contamination or asbestos debris (a depth of 10cm is usually sufficient for most cases); and
- Dispose of the contaminated soil as asbestos waste.

6.9 Waste Disposal

Asbestos-containing waste, debris and contaminated clothing should be collected in sealed and impermeable bags or closed containers. The outer surface of these bags or containers should be wet-wiped or vacuumed before they are transported out of the asbestos work area. Bulky asbestos waste such as cement sheets, pipes or insulating boards should be wrapped twice in heavy duty plastic. All asbestos waste should be double-bagged, preferably using a coloured bag on the inside and a clear transparent bag outside. Asbestos waste must be sealed and affixed with labels that clearly indicate the presence of asbestos wastes.

All bags or containers used for asbestos-containing waste should be stored in a designated asbestos waste area. This area should be distinguished from other areas with warning signs. If waste bins or skips are used, wastes must be packed and sealed so that when bins and skips are emptied, there is no residual asbestos contamination.

All asbestos waste should be removed and disposed of accordingly by an approved asbestos disposal contractor regulated by NEA. An application for written permission to dispose of the asbestos waste should be made to NEA. A copy of the receipt issued by the NEA when asbestos waste is disposed off at a landfill should also be kept.

For more information on disposal of asbestos waste, visit www.nea.gov.sg

6.10 Air Monitoring

Air monitoring is conducted to ascertain:

- the airborne concentrations of asbestos fibres so that the correct choice of respirators has been made;
- that there is no measurable spread of airborne fibres to areas adjacent to the asbestos work area; and
- that the work area was adequately cleaned before it was returned to normal use.

Air monitoring is important when:

- large quantities of ACMs have been handled;
- work involves the use of abrasive power or pneumatic tools, and/ or breaking ACMs; and
- significant contamination has occurred.

Air samples collected should only be sent to accredited laboratories for analysis. See **Annex F** for information on air sampling.

6.10.1 Initial Exposure Assessment

To ascertain initial air exposure concentration, air monitoring can be done for friable asbestos before asbestos-removal work starts. The initial exposure assessment can help establish the condition of the work site and ensure that adequate preventive measures have been put in place to protect workers.

6.10.2 Exposure Assessment During Operation

For friable asbestos-removal work, contractors or employers must carry out exposure assessment for workers working in the asbestos work area unless there is:

- reliable data showing that the removal activity will not release airborne fibres in excess of the PEL; and
- historical data from prior monitoring for similar asbestos jobs conducted under similar conditions.

For non-friable asbestos-removal work conducted indoors, contractors or employers must carry out exposure assessment for workers working in the asbestos work area unless the contractor is using the control methods and removal methods recommended in the guidelines. If the contractor uses other control methods, the assessment must be carried out even when workers use supplied-air respirators.

The assessment can be terminated if the results show that the exposure is less than the PEL and there is no change in the conditions, for example, in the work method or equipment used.

6.10.3 Post-operation Assessment

Air or clearance monitoring is necessary after asbestos-removal work is completed for friable ACMs and non-friable ACMs indoors. The monitoring should only be carried out when the area has been cleaned and dried after a visual inspection of the work area.

When the results from the monitoring and visual inspection are satisfactory, the enclosure can then be removed. If any contamination is found during the dismantling of the enclosure, further cleaning must be carried out and the process of visual inspection and air monitoring repeated. For clearance monitoring, the concentration of airborne asbestos fibres in the air should not exceed 0.01 fibres/cc.

7. Training of Workers

Workers involved in asbestos work must be adequately trained not earlier than 12 months before they start any asbestos work and retrained once every 12 months after the completion of the last training.

The training programme must include instructions on the following:

- the harmful properties of asbestos and their hazardous effects on health;
- materials, substances, products and articles which contain or are likely to contain asbestos;
- work, processes or operations which may result in exposure to asbestos and preventive measures to minimise such exposure;
- safe work procedures and use of PPE;
- proper use, maintenance and limitations of respiratory protective equipment;
- asbestos decontamination procedures;
- asbestos waste handling procedures; and
- purpose and requirements of medical examinations as specified in the WSH (Medical Examinations) Regulations.

Training programmes must be reviewed periodically to take into account any significant changes in the type of work and/ or work methods used. The training record shall include information on the syllabus and content of the training programme and the start and end dates of the training programme. The training record must be updated, made readily available and kept for at least two years.

8. Medical Surveillance

Under the WSH (Medical Examinations) Regulations, workers involved in asbestos work must be sent for a pre-placement medical examination not later than three months after their employment commences, and every three years thereafter for regular medical examinations.

The medical examination includes a clinical examination and a large-size chest X-ray, and must be conducted by a designated workplace doctor, The contractor or employer is required to submit a register of all workers involved in asbestos work together with their medical summary reports to MOM. The contractor or employer is also required to update MOM if any asbestos worker has resigned or left employment.

The medical examination reports should be kept by the contractor or employer for at least five years, and should be made available upon request by MOM inspectors. It is recommended that these medical records should be retained as long as possible due to the long latency period of asbestos-related illnesses. Employees could also be given a copy of their medical report.

9. Annexes

Annex A – Materials That May Contain Asbestos

The following are materials that may contain asbestos. The list is not exhaustive.

- Bituminous adhesive or sealant
- Boiler insulation
- Brake disc pad
- Brake or clutch lining
- Caulking or putty
- Ceiling board or panel
- Cement board or panel
- Cement pipe
- Corrugated roof sheet
- Corrugated wall cladding
- Electric wiring insulation
- Electrical cloth
- Electrical panel partition
- Elevator brake shoes
- Fire blanket
- Fire curtain
- Fire door insulation
- Fire proofing cloth
- Fire proofing gloves
- Fire-rated wall
- Fire-resistant board
- Floor vinyl sheet
- Floor vinyl tile
- Gasket
- Gland packing
- Insulation block
- Joint sheet or compound
- Mastic
- Millboard
- Pipe cladding
- Pipe insulation
- Plaster (acoustical or decorative)
- Refractory lining or tile
- Roof gutter
- Roofing felt
- Rubbish or refute chute
- Sprayed insulation
- Textured paint or coating
- Thermal insulation lining
- Thermal paper product
- Ventilation panel or pigeon hole ventilation block

Annex B – How to Conduct an Asbestos Survey

Below are general guidelines on asbestos surveys.

a. Survey Planning

Information you need before conducting an asbestos survey:

- number of buildings to be surveyed;
- description and use of building(s);
- age, type and construction details of building(s);
- details on any extension or refurbishment carried out after the building(s) was completed;
- building plans, floor layout or drawings of the site (to record location of samples taken and indications of ACM presence);
- safety and health hazards on site; and
- the location of heating and ventilation ducts, plant rooms, riser shafts, lift shafts, and so on.

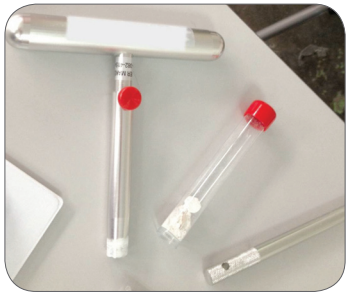


Figure 17: A core sampler.

A list of equipment for asbestos survey work:

Equipment for taking samples	Other ancillary/ auxiliary items	PPE
• Pliers • Screwdrivers • Hammer • Core samplers (see Figure 17) • Tapes • Penknife • Fillers • Hand-spray containing PVA or surfactant • Sampling bags	• Site plan • Step ladder • Camera • Torch • Sampling labels • Type H vacuum cleaner • Asbestos waste bags • Wet wipes • Polythene sheeting	• Disposable clothing • Disposable shoe covers • Disposable gloves • Respirators (where appropriate)

b. Bulk Sampling

Surveys should be carried out systematically to ensure that all areas are inspected and no ACMs are missed out. Each area and room should be thoroughly examined to identify the materials and locations to be selected for sampling.

Below are some good sampling practices:

- Materials should be inspected for apparent differences and variation in appearance;
- Samples of approximately 3 to 5 cm^2 surface area and covering the entire depth of the ACM should be taken;
- For homogenous materials, one or two samples will normally be sufficient. For non-homogenous materials, more samples may be required;
- Repaired or patched materials should be sampled in addition to the original material;
- Materials should be wetted with suitable wetting agent to control any release of airborne asbestos during sampling, and if necessary, shadow vacuuming[2] should be adopted;
- Sampling points, or locations where samples are taken, should be sealed with tapes or fillers to prevent the release of asbestos fibres after sampling; and
- The sampling area should be thoroughly clean, leaving no evidence of debris from the sampling operation.

c. Survey Report

The asbestos survey report should follow the format below:

- Executive summary:
  - brief description of scope and type of survey; and
  - summary of findings and conclusion.

- Introduction:
  - scope, purpose and objectives of survey;
  - type of survey (e.g., management, refurbishment or demolition survey);
  - number of buildings involved in survey; and
  - type and age of building(s).

- Site information:
  - details of surveyor (name of survey company, address, name of surveyor, contact email or number, etc.);
  - details of client (name of company, address, contact person, contact email or number, etc.);
  - name and address of premises surveyed;
  - date of survey;

[2] Shadow vacuuming applies local exhaust by placing the hose opening of a vacuum cleaner close to the task. The hose opening may be held by a second worker or directly attached to a tool.

- date of report;
- areas accessed/ included in the survey;
- inaccessible areas and the reasons why access is not permitted; and
- survey method used.

- Survey results:
  - sample number;
  - location description;
  - product type;
  - photographs of ACM;
  - quantity;
  - test result (asbestos type);
  - condition[3];
  - surface treatment[4]; and
  - building plans indicating the location of ACMs.

- Conclusions and recommendations:
  - summary of findings (list samples that contain asbestos and type of asbestos found); and
  - recommendations and actions to be taken.

- Appendix:
  - bulk analysis results of the samples tested (provided by the laboratory);
  - building plans or floor layout indicating sample locations and areas that contain ACMs; and
  - photographs of the site.

[3] not needed for Demolishment Survey.

[4] not needed for Demolishment Survey.

Examples of ACMs and their locations that could be provided in the survey report:

Sample no	Location	Product type	Quantity	Photo	Test result (asbestos type)
1.	Living room	Ceiling board	Whole ceiling		Amosite
2.	Roof	Corrugated roof sheets	Entire roof		Chrysotile
3.	Backyard roof	Corrugated roof sheets	50m^2		Chrysotile

Annex C – Removal Procedures for Asbestos-containing Materials

Removal Procedures of Non-friable ACMs

- **Manual Dismantling Method**

  If asbestos cement sheets are in a good condition and it is reasonably practicable to provide safe access, they should be taken down in their entirety without breakage. It is best to:

  – Remove them intact;
  – Use wet methods where possible;
  – Immediately vacuum all loose dust along the cut;
  – Lower the roof sheets to the ground as soon as possible or by the end of the work shift;
  – Wrap or bag the removed material before hoisting;
  – Transfer unwrapped materials to a closed receptacle to prevent dispersion of the dust when lowered; and
  – Isolate roof-level ventilation air intakes or shut down the ventilation system.

  Roof sheets should preferably be removed from underneath with mobile elevating work platforms such as scissor lifts or cherry pickers. When using this method, the sheets should not be dropped or damaged. The equipment used should be thoroughly cleaned.

- **Remote Dismantling Method**

  If the sheets are disintegrating or the risk of falls is too great, remote dismantling or demolition methods such as deliberate controlled collapse should be used. Remote demolition could expose equipment operators or waste disposal workers to asbestos fibres.

  When the remote method is used, the work area must be continually sprayed with water to suppress the release of asbestos fibres. The roof sheets should be dismantled in a controlled manner, for example, using excavators fitted with suitable demolition attachments. The area should be cleared of other materials before work commences. The work should be designed to minimise breakage of sheets. Before and while loading the broken sheets onto lorries, keep the sheets damp by spraying them with water. Lorries should be securely covered to prevent the asbestos waste from drying out and dispersing during transportation.

  In some cases, the public may be alarmed by the remote method of demolition as it can be noisy, dusty, or appear uncontrolled, and potentially spread dangerous fibres from asbestos roofing and/ or roof sheets. To alleviate these concerns, contractors can keep members of the public informed about the work and carry out background air sampling at the perimeters of the site.

- **Removal of Floor Tiles**

  To remove asbestos-containing floor tiles, such as vinyl floor tiles, individual tiles should be lifted by scraping manually at their bases. As underlying mastic adhesives may also contain asbestos, any adhering remnant of tiles should be completely removed from the floor slab by manual scraping and wetting.

  To remove asbestos floor coverings, a continuous 1 m high dust barrier sealed to the floor around the work area is required, and mechanical chipping should not be carried out unless in a negative pressure enclosure. Dry sweeping and sand flooring are not allowed.

- **Removal of Gaskets**

  When removing asbestos-containing gaskets, contractors or employers must ensure the following are carried out:

  – Enclose gaskets in glove bags before removal if they are visibly deteriorated and unlikely to be removed intact;
  – Thoroughly wet the gaskets with wetting solutions or water prior to removal;
  – Immediately place the wet gaskets in a disposal container; and
  – Scrape using wet methods to remove residue.

- **Removal of Cement Pipes**

  In most cases, asbestos-containing pipes are considered non-friable. They should not be shattered, crumbled, and/ or pulverised as they will release asbestos fibers. Asbestos-containing pipes should not be sanded, sawed, ground and/ or chipped under any circumstances, such as when using power tools.

  When removing the asbestos containing pipes, contractors or employers must ensure the following are carried out:

  – Excavate the soil to expose the pipes;
  – Use manual tools to clear away the soil surrounding the pipes;
  – Wet the material during removal using a water hose, garden sprayer, spray bottles, or any method that keeps the material wet;
  – Cut the pipe using hand-operated blade cutters or snap cutters and pull the pipe up out of the ground in easy to handle lengths (1 to 1.5 m or 3 to 5 feet); and
  – Do not use compressed air, dry sweep, or vacuum with a non-HEPA rated vacuum cleaner.

Removal Procedures for Friable Asbestos-containing Materials

- **Removal of Lagging and Sprayed Coating**

  If the material is thick (greater than 1 cm), and covered with a coating which can be punctured by injection heads, low-pressure injection can be used.

  If the material is unsealed and relatively thin (less than 1 cm), controlled low-pressure sprays can be used to wet the materials. If there is an impermeable layer which cannot be punctured by injection heads, such as a pipe lagging with a hard cement coating, injection holes can be made by drilling.

  When pipework is redundant, wrap and cut can be applied.

- **Removal of Boards**

  For surfaces which are painted and accessible, shadow vacuuming must be applied while unscrewing the board. Controlled low-pressure sprays should be used on unpainted surfaces, followed by surface vacuuming while unscrewing the boards.

- **Soaking Method (Controlled Wetting Using Injections)**

  If the ACM is so thick that the spray method will not suppress the dust significantly, the soaking method should be used to ensure the material is completely saturated. First, the insulation is soaked in water or another wetting agent through an appropriate applicator which feeds the wetting agent to the insulation via numerous side holes or outlets. To facilitate rapid wetting of the insulation material, holes or cuts should be made in the outer covering to enable water or wetting agents to be injected. It is important to note that the ACM should be saturated with the wetting agent, not just washed out through a liquid passage.

  Where access to ACM is obstructed by coating or cladding, the coating or cladding should be removed carefully to avoid dust generation. Before removal, the surfaces should be vacuum cleaned or where practicable, sprayed with water. The quantity of water or wetting agent and soaking time will depend on the thickness of material, access and location of holes. Water or wetting agent application should be controlled to prevent slurries and/ or surface run off. The saturated ACM should be removed in sections and placed in properly labelled and sealed containers before it is disposed of as asbestos waste.

  The most useful technique for achieving good control of asbestos fibres at the point of removal is multi-point injections, using injection heads which penetrate the outer layer of ACM such as sprayed coatings or lagging. Injection heads with holes only at the tip allow thin layers (1 cm or less) of sealed sprayed coatings to be injected. Alternatively, angled injection heads which help the lateral movement of the wetting agent can be used. However, injection methods may not be appropriate for unsealed sprayed coatings where the injection heads can dislodge asbestos during application.

- **Spray Method**

  The spray method should be used on ACM which is not covered or coated by other materials such as paint and/ or cladding which requires prior removal. The water spray should be applied so that the entire surface of ACM is wet while also minimising runoff. A manually controlled low-pressure water spray could be used. The spray should be both copious and fine so that the water droplets do not generate dust on the surface of the insulation material upon impact. The ACM should be wet through the entire cross section of the ACM.

  The spray should be directed at the cutting-up operation in progress and the wet material removed. The wet ACM should be removed in sections and placed in labelled containers, then suitably sealed. All removed ACM should be properly wet and small sections which may be dislodged should be properly disposed of. Suitable respiratory protection is still necessary when using a water spray method because asbestos dust may not be fully suppressed or eliminated.

Annex D – Selection and Use of Respiratory Protective Devices

Respiratory Protective Devices must be adequate (i.e., provide the level of protection required) and suitable (i.e., matched to the user, job and working environment).

- **Selection**

  The selection of RPD for asbestos work should take into consideration:

  – Expected Level of Exposure

    The expected level of exposure should be established during risk assessment. Results from pre-job or previous air monitoring may be used as a guide in determining expected exposure levels.

  – Protection Factor

    Protective factor determines the effectiveness of the respirator in reducing the concentration of asbestos particles in breathing air.

    See *SS 548: 2009 Code of practice for selection, use and maintenance of respiratory protective devices* for more information on the protection factor of the different RPDs available.

- **Fitting**

  Users must undergo fit testing to ensure they have been outfitted with the right respirator in the right size for their job. A good facial seal is important to ensure optimal respirator performance. Fit testing should be conducted by the manufacturer or manufacturer-accredited representatives.

  A qualitative or quantitative fit test method may be employed to determine if a satisfactory fit has been achieved. A fit test shall not be conducted if there is any hair growth between the face and sealing surface of the respirator, such as a beard or moustache.

  See *SS 548: 2009 Code of practice for selection, use and maintenance of respiratory protective devices* for more information on the fit test procedures.

  A fit test must be conducted before the first use of a respirator and subsequently at least once every 12 months, or whenever there is a change in the user's facial characteristics. Records of fit testing must be kept for at least two years.

- **Maintenance and Storage**

  All respirators must be inspected for defects before each use. Fit checks must be done every time a respirator is used to ensure that the respirator is in good condition and that it is a good fit. Both a negative and positive pressure check should be performed. Respirators must be placed in a clean, sealable plastic bag when not in use.

- **Filter Cartridge**

  For asbestos-removal work, a HEPA filter should be used.

  Under the AS/NZS 1715:2009 and BS EN 143:2000 classification, the Type P3 particulate filter should be selected as it has a 99.95% efficiency.

  Under National Institute of Occupational Safety and Health (NIOSH) classification, a P100 particulate filter should be used where 99.97% filtering efficiency is expected.

Annex E – Procedures for Entering and Leaving Asbestos Work Area

i. Procedure for entering the work area with decontamination facility:

- Enter the "clean area" of the decontamination facility.

- Inspect the respirator to ensure that it is in good working condition.
- Replace filter if/ when necessary.
- For positive pressure powered respirators, ensure that a fully charged battery has been fitted.

- Remove all personal clothing.
- Put on clean protective clothing if provided[5].
- Put on the respirator and carry out a fit check.

- Pass through the "shower area" (without showering) into the "dirty area".

- Enter work area.

[5] If protective clothing was left in the "dirty area" from a previous shift, put it on there.

ii. Procedure for leaving the work area with a decontamination facility:

- Before entering the decontamination facility, while still in the work area, remove all visible dust and fibres from protective clothing, respirator and footwear using vacuum cleaning equipment fitted with a HEPA filter.
- A shoe bath can be provided where there is contamination by wet materials.

- Enter the "dirty area" of the decontamination facility.
- Remove protective clothing and place them in the storage region orplastic bags for disposal.
- Do not remove the respirator.

- Enter the "shower area".
- Shower thoroughly while wearing the respirator.
- Remove the respirator and continue showering.

- Remove filter from respirator and place it into a plastic bag, then leave the bag in the "shower area" for disposal later.
- Ensure that the inside and outside of the respirator is clean.

- Enter the "clean area".
- Dry and change into personal clothing.

- Leave the respirator in the "clean area".
- Charge the battery (if necessary).

- Exit the decontamination facility.

iii. Procedure for entering a work area that uses a transit facility:

- Put on protective clothing and respirator in the "clean area" of the decontamination facility.

- Pass through the "shower area" (without showering) into the "dirty area".
- Wear transit coveralls and foot covers.

- Exit the "dirty area" and walk to the transit facility via designated route.

- Enter the transit facility.
- Remove transit coveralls and foot covers.
- Containers or hooks can be provided in the transit facility for coveralls and foot covers.

- Enter work area.

iv. Procedure for leaving the work area that uses a transit facility:

- While still in the work area, remove all visible dust and fibres from protective clothing, respirator and footwear using vacuum cleaning equipment fitted with a HEPA filter before entering the transit facility.
- A shoe bath can be provided where there is contamination by wet materials.

- Enter the transit facility.
- Remove protective clothing and place them in the storage region or plastic bags for disposal.
- Do not remove the respirator.

- Put on transit overalls and foot covers.

- Exit the transit facility and walk to the decontamination facility via designated route.

- Enter the "dirty area" of the decontamination facility.
- Remove transit overalls and foot covers and place them in plastic bags for disposal.
- Do not remove the respirator.
- Follow **Annex E**: Procedure for leaving work area (main decontamination facility) from showering onwards.

Annex F – Air Sampling

Air sampling involves collecting airborne particles, including asbestos fibers and other fibres by drawing air though a filter using a sampling pump operating at a known flow rate for a measured period of time.

Static sampling is undertaken with the filter holder positioned between one to two meters above ground. The points of measurement should cover likely sources of fibres and places where many people gather.

For personal sampling, the sampling pump should be light and portable so that the worker can wear it on his/ her belt. The filter holder should be positioned within the breathing zone. If the worker is wearing a respirator, he/ she should take care to position the filter holder facing away from the filtered air exhaust outlet of the respirator.

Application	Sampling flow rates (litres/min)	Sample volume (litres)	Graticule areas examined	Limit of quantification (fibres/cm^3)
Compliance sampling	1 – 4	240	100	0.04
Assessment of respiratory protection	1 – 4	240	100	0.04
Clearance sampling	2 – 16	480	200	0.01
Background	2 – 16	480	200	0.01
Leak and reassurance	2 – 16	480	200	0.01

Figure 18: **Recommended flow rates, volumes and limits of quantification.**

The sampling flow rate should be adjusted to produce a fibre density of 100 to 1300 f/mm^2 on the filter. For clearance or background leak sampling, the number of graticule areas inspected may be reduced if the collected air volume is increased. In relatively clean atmosphere where targeted fibre concentrations are much lower than 0.1fibre/cc, larger sample volumes are needed to achieve quantifiable loadings. A minimum sample volume of 1200 litres is recommended for air clearance sampling.

Details of the sampling should include the:

- date of sampling;
- type of sampling carried out (e.g., personal, leak, background);
- sampling location;
- details of the worker and type of work he/ she undertook at the time (only applicable for personal sampling);
- identification numbers of equipment used (e.g., sampling pumps, flow measurement devices, filters and sampling heads);
- individual sample details of each sample in the form of:
  - unique identifier;
  - specific sample position; and
  - start and finish time for each sample.

Analytical Methods

NIOSH 7400 Phase Contrast Microscopy Method

The air sample should be analysed using Phase Contrast Microscopy (PCM) to determine the asbestos fibre concentration in the air. However, PCM does not differentiate between asbestos and other types of fibres. All fibres are counted and assumed to be asbestos. Results are expressed in fibres per cubic centimeter (f/cc).

NIOSH 7402 Transmission Electron Microscopy Method

The air sample can be analysed using Transmission Electron Microscopy (TEM). TEM is able to distinguish asbestos from other fibres, expressing results as an asbestos fibre count with the type of asbestos present also reported. The air sample can be analysed using TEM if the analysis result using PCM method exceeds PEL. This method is intended to complement the results obtained by PCM.

10. Further Information

Workplace Safety and Health (WSH) Act

WSH (Asbestos) Regulations

WSH (General Provisions) Regulations

WSH (Risk Management) Regulations

WSH (Medical Examinations) Regulations

WSH Council Code of Practice for WSH Risk Management

WSH Council Code of Practice for Working Safely at Heights

Singapore Standard SS 548: 2009 – Code of Practice for selection, use and maintenance of respiratory protective devices

UK Health and Safety Executive (HSE). Asbestos health and safety.

Published in July 2014 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.

This publication is available on the
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Website: www.wshc.sg
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