

# Technical Advisory for Demolition





# 1. Introduction

Improper handling of demolition of buildings or structures gives rise to many hazards. From August 2007 to February 2008, three workers were fatally injured in demolition-related accidents.

These hazards include falling from elevated work surfaces, exposure to hazardous substances, poor lighting, electrical hazards, falling objects, confined space, etc. In addition, risks incurred during demolition such as overloading, improper removal of bracing members can cause instability to structural members. Dismantling building elements which have already deteriorated or damaged over the building life cycle; weaknesses in building materials, presence of asbestos-containing materials also have to be considered prior to commencement of demolition work.

To ensure that such hazards are properly managed and the potential risks minimised, adequate and practicable measures must be taken before and during demolition work. This is to prevent the accidental collapse of any part of the building or structure, and to ensure that the safety of workers, the public and neighbouring properties are safeguarded.

The purpose of this Technical Advisory is to provide practical guidance on measures to be taken to ensure the safety and health of all persons involved in or exposed to risks arising from demolition work.

## 2. Legislative Requirements in Demolition

The demolition of any building or civil engineering structure must be carried out in accordance with the provisions set out in the Workplace Safety and Health Act. Occupiers and employers have a duty to provide a safe workplace by implementing safety measures which include:

- Planning for demolition work and selecting appropriate method(s) of demolition and equipment to be used;
- Appointing a competent person experienced in demolition work to assess and inspect the structure to be demolished during the course of the demolition work;
- Erecting appropriate hoardings, catch platforms and overhead protection barriers for the protection of the public and personnel on the site; and
- Maintaining the security of the site.

The main contractor or demolition contractor engaged to carry out the demolition works has a duty under the WSH (Risk Management) Regulations to conduct a risk assessment in relation to the safety and health risks posed to any person(s) who may be affected by the demolition work. Safe Work Procedures should be implemented to control risks which are not eliminated (*refer to the section on Risk Assessment on page 7*).

Requirements specific to demolition work are covered under Part X of the WSH (Construction) Regulations. Requirements on permit-to-work for demolition works are covered under Part III of the Regulations. More safety requirements and good practices can be obtained from the Singapore Standard CP11: Code of Practice for Demolition.



1 Clear directional sign.



Well illuminated overhead protection.

# 3. Safety in Demolition

## Preparatory Operations Prior to Commencement of Demolition Work

Preparatory operations including pre-demolition surveys and overall planning of demolition work covering methods to be used to bring the structure down, the equipment necessary to do the job, and the measures to be taken to perform the work safely, must be considered in advance of any demolition work. All planning work must be performed by a competent person who has relevant experience in all stages of demolition work.



1 Hand tools for demolition



1 Cutting of vertical facade wall panel.

## 4. Pre-demolition Surveys

Engineering surveys should be carried out prior to commencement of demolition work. Engineering surveys should include structural stability, existing services and the presence of hazardous substances.

In assessing the structural stability of the building or structure to be demolished, the Safe Working Load (SWL), taking into account debris accumulation, weight of machinery and/or other anticipated dead and live loads, should be determined by a Professional Engineer. Caution should be taken to ensure that floors are not loaded up to a level which exceeds the SWL. Precautionary measures include (but not limited to) the use of steel ramps, limiting the level of accumulation of debris, etc. Where demolition work would render floors, walls and other structural elements unstable, adequate shores and/or braces should be installed.

Effort should be taken to identify, from as-built drawings, if asbestos-containing materials are present in the building(s) /structure(s) to be demolished. If unsure, it should be assumed that asbestos-containing materials are present, or an asbestos survey can be conducted to ascertain that the building/structure to be demolished does not contain asbestos (*refer to the section on Asbestos Management on page 11*).



Steel ramps.

## Case Study

### Roof slab collapses on worker

A worker fell 8m to his death through an uncovered gap in a formwork while erecting the formwork on the second storey.

#### Incident

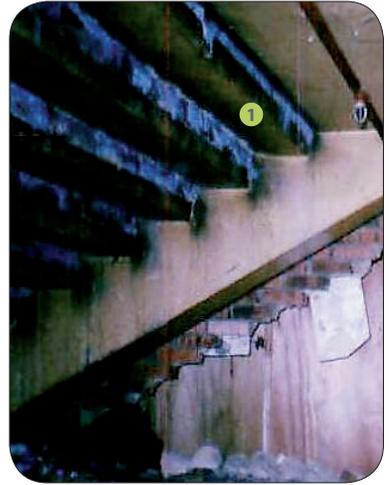
- A roof slab collapsed on the worker after the supporting walls were largely demolished. The roof slab was simply rested on and supported by brick walls.

#### Investigation findings

- No props or supports were provided for the roof slab before demolition of the supporting walls.
- No competent person had been assigned to assess and inspect the roof slab and supporting walls prior to demolition works.

#### Systemic failures

- Lack of pre-demolition surveys and structural investigation to develop a safe method of demolition.
- Lack-of continuous inspections and hazard analysis during demolition.



1 The underside of the staircase when the roof slab collapsed.



1 Collapsed roof slab.

## 5. Risk Assessment

Risk assessment should be carried out to identify hazards associated with the demolition process, assess such hazards and take reasonably practicable steps to eliminate or control the risks arising from those hazards.

For more information on risk assessment, please refer to the Guidelines on Risk Assessment available in MOM's website ([www.mom.gov.sg/wsh/risk\\_management](http://www.mom.gov.sg/wsh/risk_management)).

## 6. Demolition Plan

A demolition plan should include but not be limited to, documentation of the following information:

- The method statement for demolition works should clearly indicate the sequence of demolition, approach to demolition and elements that require specialised methods of removal. Operators and staff involved in the demolition works should be well informed and well versed with how works are to be carried out, the sequence of such works and the safety precautions to be taken prior to the commencement of works.
- A permit to work system should be implemented for the demolition works. The supervisor should conduct a site check to ascertain that safety measures are in place to safeguard the workers entering the site. When all necessary measures are in place, the supervisor should then request for a joint inspection with the safety assessor. The safety assessor should be responsible to check that all safety precautions are in place and highlight any lapses in safety that have not been addressed. Upon confirmation by the safety assessor that all measures are in place, the permit to work should then be reviewed and subsequently endorsed by the Project Manager in charge of the site when safe working conditions are met.

Note: Permit to work for demolition is typically issued at a per floor basis, to ensure that every floor is adequately inspected prior to commencement of demolition.

- A debris management system indicating the method of disposal, movement of debris from floor to floor and to the holding area and transportation of debris should be prepared.

*Implementation of a permit to work system is a requirement under the Workplace Safety and Health (Construction) Regulations 2007.*

## 7. Pre-demolition Work

- Glass and cladding on external walls should be removed prior to commencement of any demolition works.
- Services / utilities should be capped, diverted or protected prior to the commencement of any demolition works.

# 8. Protective Precautions

## Machinery / Equipment

- All demolition equipment should be operated by competent persons with appropriate training. These equipment should be used and maintained as recommended by the equipment's manufacturer or supplier.
- Lifting equipment should be thoroughly examined by an authorised examiner at least once every 12 months for those lifting goods or materials or once every 6 months for those lifting personnel.
- Only excavators that are originally designed and manufactured to also function as a lifting machine can be registered by an Authorised Examiner as a lifting machine and be used for lifting purposes.
- Excavators used for lifting should be equipped with an original hook(s) with a safety catch for hoisting purposes and should have a load capacity chart furnished by the manufacturer or builder. The excavators should also be equipped with an accurate indicator which shows clearly to the operator the working radius and the corresponding safe working load at all times and gives a warning signal when the radius is unsafe.

## Scaffolding

- Scaffolds above 4m in height (excluding tower and trestle scaffolds) should be erected, installed, added, altered or dismantled by an approved scaffold contractor.
- Working platforms should be free from debris.
- Every scaffold should have at least one designated access point.
- Care should be taken to prevent damage to scaffolding components from falling debris.
- All scaffolds should conform to the Factories (Scaffolds) Regulations 2004.



1 Lifting Equipment.



1 Excavator used for lifting.

## Public Safety

- The demolition site should be properly barricaded with appropriate warning signs posted. No unauthorised entry should be permitted in the demolition site.
- Hoardings and covered walkways should be provided in conjunction with catch platforms to guide pedestrian flow and protect pedestrian traffic against falling debris.
- Catch platforms should be provided where exterior walls or roofs are being demolished.



Well lit covered walkways with clear signages.

Excavators that are not manufactured as lifting machines should not be used for lifting operations.

- Movement of machinery from floor to floor should be considered in the demolition procedures. The use of demolition debris to form access ramps for machinery may lead to overloading of floors. Proper ramps of appropriate design (e.g. steel ramps) should be used for floor to floor movement of machinery. Machinery can also be lowered by means of a mobile crane or other methods proposed by a Professional Engineer.

## Worker Safety

- Workers involved in demolition works must be provided with appropriate training and instructions to carry out demolition works safely. Supervision is needed to ensure that only those workers who have received training and instructions are authorised to carry out the work.
- All personnel assessing the demolition site must be provided with safety boots and helmets. Workers should, when necessary, be provided with appropriate personal protective equipment such as goggles, hearing protection devices, safety harness, gloves, appropriate respirators for dust or chemicals, protective clothing, etc.

- All open sides or openings, where persons are liable to fall more than 2 meters, should be guarded by effective guardrails, barriers, etc.
- Safe means of access and egress should be provided from different levels of buildings or structures.
- Sufficient lighting should be provided where persons are at work. Average illuminance at passageways should be a minimum of 50lux.
- Suitable hearing protectors should be provided to all persons exposed to excessive noise.
- Where manual demolition is required, proper working platforms and footholds should be provided.
- Where required, the worksite should be wetted down to control dust.



1 Misting to control dust.

## Asbestos Management

- When a building or structure is ascertained to contain asbestos, all asbestos materials should be properly removed prior to the commencement of demolition.
- Asbestos removal should be carried out and supervised by someone trained in asbestos removal and management.
- Demolition contractors should take reasonably practicable measures to control the release of asbestos fibres by preventing or minimising breakage of asbestos materials.
- MOM should be notified at least 28 days before the commencement of any work involving asbestos.
- For more details on asbestos removal, refer to the MOM's Guidelines on the Removal of Asbestos Materials in Buildings.

## Case Study

### Worker falls through skylight during survey of asbestos roofing prior to demolition

#### Incident

- A worker had gone up to the roof to conduct a survey of the roof before his fellow workers proceeded to take down the asbestos roof sheets. The worker fell through the skylight after the plastic skylight sheets gave way.



1 Opening at the skylight where the deceased fell through.

#### Investigation findings

- No proper work procedures were available for work on the roof where workers are liable to fall a distance of more than 3m.

#### Systemic failures

- Lack of safe work procedures to carry out the survey and asbestos removal works.

## Case Study

### Partition wall collapses on members of public

#### Incident

- A partition wall under demolition collapsed at a public area causing one fatality and four others to be injured. Demolition of the partition wall was carried out in a bottom-up manner.



1 Walls being hacked from bottom up.

#### Investigation findings

- No proper work procedures were available for the demolition works.
- No competent person had been assigned to assess and inspect the structure to be demolished.

#### Systemic failures

- Lack of safe work procedures to carry out the demolition works in a systematic manner.
- Lack of continuous inspections and hazard analysis during demolition.



1 Part of the collapsed roof slab.

# 9. Useful References

- The following legislations are available for download at: [www.mom.gov.sg/oshd](http://www.mom.gov.sg/oshd):
  - Workplace Safety and Health Act
  - Workplace Safety and Health (General Provisions) Regulations
  - Workplace Safety and Health (Construction) Regulations
  - Workplace Safety and Health (Risk Management) Regulations
  - Factories (Asbestos) Regulations
  - Factories (Noise) Regulations
  - Factories (Scaffolds) Regulations
  - Factories (Medical Examinations) Regulations
- More information and guidelines on Risk Assessment are available for download at: [www.mom.gov.sg/managing\\_workplace\\_hazards](http://www.mom.gov.sg/managing_workplace_hazards)

## Code of Practices and Singapore Standards (CPs & SSs)

- CP11: 2002** Code of practice for demolition
- CP14: 1996** Code of practice for scaffolds CP 55 : 1991
- CP49: 1998** Code of practice for noise control on construction and demolition sites

**The CPs and SSs can be obtained from:**  
SNP Corporation (Legal) Ltd  
Legal Publication Retail Outlet  
1 Kim Seng Promenade #18-01/06  
Great World City East Tower S(237994)  
Tel: (65) 6826 9691  
Fax: (65) 6820 3341  
Email: [Singaporestandardseshop@snpcorp.com](mailto:Singaporestandardseshop@snpcorp.com)  
Website: [www.snpcorp.cpm/webshop](http://www.snpcorp.cpm/webshop)

e-Standards are also available for purchase at [www.singaporestandardseshop.sg](http://www.singaporestandardseshop.sg)

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