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Guidelines for the

Prevention of **FALLS**

at Workplaces

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**Amendments issued since publication**

Amd. No.	Date of issue	Text affected

DEPARTMENT OF OCCUPATIONAL SAFETY AND HEALTH  
MALAYSIA (MINISTRY OF HUMAN RESOURCE)  
Level 2, 3 & 4, Block D3, Parcel D  
Federal Government Administrative Centre  
62502 Putrajaya

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## Preface

First and foremost I would like to thank all the technical working committee members who have been actively involved in preparing this guideline - Guidelines for the Prevention of Falls at Workplaces.

This guideline will be most useful to employers or workers who are working at height at workplaces. In many of the accidents that had been reported and investigated by the department, most of the falls from heights can be prevented and avoided by taking the most basic and necessary safety measures. The texts of the guideline provide the relevant and important advice on what steps to be taken, what personal protective equipments to be provided to such workers or on how risk assessment can be carried out to ensure working at height is safe.

It needs to be emphasized here that this guideline has no force of law but the intent of coming out with this guideline is to provide clear written guidance on the recommended safety measure to enable the employers or self-employed persons to discharge their statutory duties to as far as is practicable as stipulated under the Occupational Safety and Health Act 1994 (Act 514).

**Director General  
Department of Occupational Safety and Health  
Malaysia**

**March 2007**

# About these Guidelines

These guidelines apply to work carried out from 2 metres or more in height, in places of work. They will assist those with responsibilities under the Factories and Machinery Act 1967 (Act 139) and Occupational Safety and Health Act 1994 (Act 514) to prevent falls.

These guidelines include relevant sections of the Act and Regulations, namely:

Occupational Safety and Health Act, 1994

- \* Section 15: General duties of employers and self-employed persons to their employer;
- \* Section 15(2)(c): "...Information, instruction, training and supervision..."
- \* Section 17: General duties of employers and self-employed persons to persons other than their employees;
- \* Section 20: General duties of manufacturers, etc. as regards plant for use at work
- \* Section 24: General duties of employees at work ; and

Factories and Machinery Act, 1967

- \* Factories and Machinery (Safety, Health and Welfare) Regulations, 1970, Regulation 12: Working at a height;
- \* Factories and Machinery (Building Operations and Works of Engineering Construction)(Safety) Regulations, 1986

In this document the terms "shall" and "should" are used. "Shall" is used in places where there is a technical requirement to achieve the desired result. It is used to alert the reader to the need for the guard to have that element.

"Should" is used as a way of indicating a preference. It does not indicate a mandatory requirement as other alternatives may achieve an equivalent result.

Practices other than those in this guide may be adopted provided the level of safety is equal to or better than those described.

These guidelines promote good work practices and sets out standards for the prevention of injuries to persons at work due to falls. It can be used as a basis for specific workplace programmes or industrial codes for the control of hazards associated with working at heights.

The Act requires the conscious exercise of judgement and discernment by all parties involved in the workplace. The discharge of persons' duties cannot be equated solely with conformity to a code or guide. Employers and occupiers with control of places of work must actively adopt and promote the principles in the Act.

Safety requirements or methods may be discussed in relation to certain types of work, but could be appropriate in a far wider range of applications. It is important, therefore, that this guideline is used in its entirety. Do not just refer to specific paragraphs in relation to certain types of work.



## Scope

While these guidelines are primarily aimed at the building operation and work of an engineering construction, in relation to the design, building, maintenance and demolition of structures, it also has application to a wide range of work situations where workers are placed in a position from which falls are possible.

Where a fall from any height could result in harm, some sort of fall protection should be used. Fall protection shall be supplied and used in any place where an employee is at risk of a fall of 2 metres or more. The employer can select the fall protection method that is most compatible with the type of work being carried out.

These guidelines apply to all workplaces in Malaysia covered by the Factories and Machinery Act 1967 and Occupational Safety and Health Act 1994. They provide detailed guidance on the safe working at heights. However it is not possible to deal with every situation that may be found in work places where there is a potential for persons/materials to fall from, through or into any place or thing. The reader should refer to the relevant accepted international Standard that will include all practicable steps for the relevant industry standard.

These guidelines should be used by all persons who have a duty to ensure as far as practicable, the safe working at heights including employers, employees, self employed persons, architects, engineers, designers, builders, manufacturers, suppliers, safety and health representatives and safety and health committees.



## **References**

References are made to the Occupational Safety and Health Act 1994 (Act 514), Factories and Machinery Act 1967 (Act 139) and Regulations made thereunder and Guidelines for the Prevention of Falls-Occupational Safety and Health Services, New Zealand.

# Definitions

**Act:** In this guide, the Act refers to the Occupational Safety and Health Act 1994, Factories and Machinery Act 1967 and subsequent regulations.

**Accepted International Standard:** These standards are normally understood to include ISO Standards, IEC Standards, and other international standards having a similar standing, e.g. Commission Internationale de Eclairage (CIE), International Wool Textile Organisation (IWTO), International Telecommunication Union (ITU) and many European Standards produced by European Committee for Standardization (CEN), European Committee for Electrotechnical Standardization (CENELEC), American Society for Mechanical Engineer (ASME), Australian Standard (AS) and New Zealand Standard (NZS). Advice should be sought before accepting any others.

**Anchorage:** A component cast or fixed into a building or structure for the purpose of attaching a scaffold or safety line. It can also mean the holding-down system for cantilevered, hanging or suspended scaffolding and platforms.

**Anchorage Line:** A rigid or flexible line secured to an anchorage point along which a fall arrest device travels, or a flexible line which unreels from a fall arrest device.

**Boatswain's Chair:** A seat to support a workman in sitting position by rope slings attached to a suspension rope.

**Brittle Roofing:** Consists of any flat, trough, or corrugated material such as mineral fiber board, plastic or glass, whether reinforced or otherwise, or any other roofing material that, due to its properties, age or weathering, will not safely support a person at all points on its surface.

**Bump Rail:** A rail or substantial rope barrier suspended at a height of between 0.9 and 1.1 metres to act as a boundary around a work area to prevent access to a hazard. When used as fall protection, it must be at least 2 metres from the fall hazard. Persons shall not cross or work on the wrong side of the barrier without additional protection.

Please note: The barrier must be capable of sustaining, without failure or undue deflection, a force at any point of .69kN (70kg) vertically and .44kN (45kg) horizontally.

**Building Operation:** means the construction, structural alteration, repair or maintenance of a building (including re-pointing, re-decorating, and external cleaning of the structure), the demolition of a building, and the preparation for and the laying of the foundation of an intended building, but does not include any operation which is the work of engineering construction within the meaning of the Act.

**Competent:** capability of identifying existing and predictable hazards in the surroundings or working condition which are unsanitary, hazardous, or dangerous to employees and has authorisation to take prompt corrective measures to eliminate them.

**Confined Space:** A space which-

- is not intended as regular workplace (i.e. continuous employee occupancy);
- has restricted means of entry and exit;
- is large enough and so configured that an employee can bodily enter and perform assigned work; and
- is at atmospheric pressure during occupancy.

In addition, this space has at least one of these characteristics:

- i. it contains or has a potential to contain a hazardous atmosphere;
- ii. it contains material (solid or fluid) that has potential for engulfing an entrant;
- iii. it has an internal configuration such that an entrant could entrap could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- iv. it contains any other recognised serious safety and health hazards, for example exposed rotors blades, noise etc.

**Construction Work:** the carrying out of any building, civil engineering or engineering construction work and includes any of the following-

- a) the construction, alteration, conversion, fitting out, commissioning, renovation, repair, upkeep, redecoration or other maintenance (including cleaning which involves the use of water or an abrasive at high pressure or the use of substances classified as corrosive or toxic for the purpose of Regulation 7 of the Occupational Safety and Health (Classification, Packaging and Labelling of Hazardous Chemical) Regulations 1997, decommissioning, demolition or dismantling of a structure,
- b) the preparation for an intended structure, including site mobilisation, site clearance, exploration, investigation (but not site survey) and excavation, and laying or installing the foundations of the structure,
- c) the manufacturing of articles on-site or the assembly of prefabricated elements to form a structure or the disassembly of prefabricated elements which, immediately before such disassembly, formed a structure,
- d) the removal of a structure or part of a structure or of any product or waste resulting from demolition or dismantling of a structure or from disassembly of prefabricated elements which, immediately before such disassembly, formed a structure,
- e) the removal of any articles resulting from any excavation or blasting or site clearing, and the installation, commissioning, maintenance, repair or removal of mechanical, electrical, gas, compressed air, hydraulic, telecommunications, computer or similar services which are normally fixed within or to a structure,

but does not include the exploration for extraction of mineral resources.

**Crane-Lifted Work Platform:** That portion of equipment from which employees carry out their work which is attached to or suspended from the crane's hook block.

**Edge Protection:** Some form of guardrail or restraint designed to prevent a person reaching or falling over an exposed edge.

**Employee:** a person who is employed for wages under a contract of service on or in connection with the work of an industry to which the Act applies and-

- a) who is directly employed by the principal employer on any work of, or incidental or preliminary to or connected with the work of, the industry, whether such work is done by the employee at the place of work or elsewhere;
- b) who is employed by or through an immediate employer at the place of work of industry or under the supervision of the principal employer or his agent on work which is ordinarily part of the work of the industry or which is preliminary to the work carried on in or incidental to the purpose of the industry;
- c) whose services are temporarily lent or let on hire to the principal employer by the person with whom the person whose services are so lent or let on hire has entered into a contract of service;

**Employer:** the immediate employer or the principal employer or both.

**Enclosed Work Environment:** A work area free from the risk of falls which includes:

- a) A safe means of access and ingress or a bump rail placed 2 metres from the edge of the fall edge;
- b) Edge protection such as guardrails around all perimeters and openings; and
- c) A fall protection barrier, such as safety mesh or a work platform.

**Factor of Safety:** The ratio of the load that would cause failure of a member or structure to the load that is imposed upon it in service, and, unless otherwise prescribed or directed, shall be a minimum of three.

**Fall-Arrest Harness (Safety Harness):** An assembly of interconnected shoulder and leg straps, with or without a body belt, and used where there is likelihood of free or restrained fall.

**Free Fall:** Any fall or part of a fall where the person suffering the fall is under the unrestrained influence of gravity over any fall distance, either vertically or on a slope on which it is not possible to walk without the assistance of a handrail or line.

**Fall-Arrest System:** A system designed to support and hold a person in the event of a fall.

**Fall Protection Barrier:** A barrier other than a work platform that will safely support a person without the risk of falling through.

**Guard-rail:** A railing of metal or wood, supported by stanchions, of sufficient strength and good construction.

**Handrail:** A rail at a height of between 0.9 and 1.1 metres designed to assist a person to retain their balance.

**Hazard:** An activity, arrangement, circumstance, event, occurrence, phenomenon, process, situation, or substance (whether arising or caused within or outside a place of work) that is an actual or potential cause or source of harm and “hazardous” has a corresponding meaning.

**Height:** In relation to a working platform, means the greatest distance from which an article may fall before coming to rest. In determining the distance that an article can fall, no account shall be taken of any obstruction that may delay or stop the fall unless there is no possibility of the fall continuing after the obstruction is reached.

**Hung Scaffold :** A working platform suspended by tubes, fixed ropes, slings or other methods and not intended to be raised or lowered while in use.

**Lanyard:** A line used, usually as part of a lanyard assemble which includes a personal energy absorber, to connect a fall arrest harness to an anchorage point or static line.

**Restrained Fall:** Any fall where the person suffering the fall is under less than the fall influence of gravity due to the action of a restraint device such as a pole strap, or is sliding down a slope less than that described for a free fall.

**Safety Belt:** A belt secured around the waist that may include butt or groin straps and is not suitable to arrest a free fall.

**Safe Working Load (SWL):** The maximum load, calculated in accordance with sound and accepted engineering practice, which can be supported safely under normal working conditions.

**Scaffold:** any temporarily provided structure on or from which persons perform work in connection with operations or works to which this guideline apply, and any temporary provided structure which enables persons to obtain access to or which enables materials to be taken to any gangway, skip, ladder or step-ladder which does not form part of such structure together with any guard-rail, toe-board or other safeguards and all fixing, but does not merely to support such an appliance or such machine as to support other plant or equipment.

**Secure Footing:** means that the combination of the type of shoes worn and the slope and surface friction of the surface being walked on will prevent the possibility of a person slipping or needing a handrail to assist balance.

**Standing Scaffold:** A working platform which is supported wholly or partly from its base.

**Static Line:** In relation to fall protection, means a rope, wire strop, or rail secured between two points and possibly at various points along its length in order to support anchor lines, fall arresters or other fall protection devices. It shall have a minimum breaking strength of 44kN.

**Suspended Scaffold:** A scaffold support from above, the platform of which is supported at more than two points by steel wire cables suspended from overhead outriggers which are anchored to the steel or concrete frame of the building and it may be equipped with a hoisting drum or machine, so that the platform can be raised or lowered.

**Toe Board:** A barrier placed along the edge of a scaffold platform, runway, etc., and secured thereto to guard against the falling materials.

**Travel Restriction System:** A system used to prevent a person reaching a place from where a fall is possible. It can consist of a safety belt and anchorage line.

**Work of Engineering Construction:** means the construction, extension, installation, repair, maintenance, renewal, removal, renovation, alteration, dismantling, or demolition of –

- a) any erection, edifice, structure, caisson, mast, tower, pylon, wall, fence or chimney, whether constructed wholly or partly above or below ground level;
- b) any road works, dock, harbour works, railway, siding, cableway, tramway line, inland navigation, air field or aerodome;
- c) any drainage, sewer, sewage works, irrigation, river control works, sea defence work or earth retaining structure;
- d) any electrical, mechanical, water, gas, petrochemical or telecommunication works; or
- e) any bridge, viaduct, dam, reservoir, lagoon, earthworks, pipeline, sewer, aqueduct, culvert, drive, shaft, tunnel or reclamation works,

and includes-

- aa) any formwork, falsework, scaffold or any works which form an integral part of, or are preparatory to or temporary to, the works described in paragraphs (a) to (e);
- bb) site clearance, soil investigation and improvement, earth-moving, excavation, laying of foundation, site restoration and landscaping; and
- cc) such other works as may be specified by the Minister.'

**Work Positioning System:** A system designed to provide a primary means of support and restraint to allow work to be carried out in reasonable comfort.

# Section 1: Design and Organisational Requirements

## 1.1 Hazard Management

All hazards that any person (including members of the public) could be exposed to as the result of working at heights or falling objects should be identified. Once identified, they should be assessed in terms of their potential to cause harm. To assess this risk, two factors should be considered:

- The likelihood that the situation will develop or the event will occur; and
- The severity of harm that could result.

Once hazards are identified, the hierarchy of control comes into play. These controls are not mutually exclusive but should be used to reduce the risk as far as practicable. They include:

- Elimination: removing the hazard, e.g. organising work so that it is carried out in areas free from falls.
- Isolation: separating the hazard and person, e.g. ensuring that guardrails are in place.
- Minimisation: the least preferred option, involving the use of personnel protection, e.g. fall prevention equipment.

### HEIGHT HAZARD ASSESSMENT

Situations where height hazards assessment is needed include:

- Access to and egress from the work area.
- The ability of work platforms to support the required people, tools and other equipment.
- Size of and changes to the level, friction, slope and environment of work platforms.
- Restraints to stop people accidentally slipping or stepping off work platforms.
- Obstructions caused by materials, rubbish or fixed and protruding objects.
- Position of unprotected work platform edges or penetrations.
- Proximity of energy sources such as electricity and gas, etc.

When deciding on the appropriate fall protection, consider:

- In what situations is fall protection required?
- What are the advantages or disadvantages of each type?
- What is the best specification for the installation of the fall protection?
- What degree of training and supervision is required to ensure the correct use?
- How can the system be safely installed?
- What maintenance schedules or skills are needed to ensure satisfactory performance?
- How will the correct work procedures be implemented?

## 1.2 Engineering and Design

Every principal employer shall take all practicable steps to ensure that no employee of a contractor or subcontractor or, if an individual, no contractor is harmed while doing any work (other than residential work) that the contractor was engaged to do.

Principal employers and their agents such as architects and engineers have a responsibility to ensure that the project is designed to be erected, used and maintained without putting persons at risk of serious harm.

These responsibilities will be discharged by specifying a standard that ensures persons can work safely. It should be noted that while architects' and engineers' functions are primarily to design and engineer work to meet the relevant standards, it is not their duty to oversee the work process in its entirety. However; there will be many occasions when a principal employer has a greater duty to avoid harm, where for instance:

- By agreement or by default, the principal employer has assumed responsibility for safety in the workplace; or
- The principal knows of unsafe practices and allows them to continue, asserting that the employer alone bears the responsibility.

By being reluctant to point out hazards, which training and experience should make them aware of; principals and others are failing to meet the responsibilities of the Occupational Safety and Health Act 1994.

### CHECKLIST FOR CONTRACTORS

To comply with the Act, principal employers and their agents should ensure that the following issues are carefully considered during the designing or planning stages, and the selection and co-ordination of contractors and work schedules:

- Is the contract designed and being carried out in a manner that will reduce hazards to a minimum?
- Can safety be improved by 'building in' features, e.g. guardrails, safety mesh, etc?
- Can future maintenance work be made safer by building in systems, e.g. fall arrest anchors?
- Does the principal employer have supervisory systems in place to monitor contractor safety performance?
- Does the contractor understand the correct sequence of critical operations?
- Does the contractor have enough information to carry out the work safely?
- Do contractors have the expertise and ability to carry out the work safely?
- Do contractors engaged have valid safety systems in place?

- Will the operations of one contractor create a hazard for other contractors?
- Can fall-arrest Systems for future maintenance be built into the structure?

It is often safer and more economical for the principal employer to set up and provide for safety requirements, such as scaffolding, rather than for each contractor to provide their own incompatible systems.

### 1.3 Operational Planning

Operational planning involves developing timetables and systems that include safe work practices during the erection, maintenance, repair and demolition of any plant or building. A co-operative approach between all parties involved is needed. Planning includes:

- Designing building programmes so that walkways, guardrails, and fixing points are installed as work progresses, allowing for safe work methods during construction and future maintenance.
- Planning for work to be carried out at ground level or in areas where falls or hazards are not present.
- Fitting guardrails or brackets to take guardrails and other safety features to formwork and falsework as they are built and before lifting into place.
- Ensuring the structure will take the forces that will be required for the attachment of fall-arrest systems, falsework, scaffold ties, etc.
- Building in safety by using such components as roof safety mesh to provide for the safety of the roofing contractor and future maintenance staff.
- Providing leadership and regular inspections to ensure that safety systems are in place and operating to identify and control hazards.

### 1.4 Maintenance of Existing Buildings and Plant

Those who own, lease or use buildings or plant have a responsibility for the safety of those involved in its maintenance and repair.

Areas that require regular service and maintenance should be provided with permanent safe access and work platforms. In less frequented areas, permanent anchorages for scaffolding or fall-arrest systems may be appropriate.

Principal employers of work should provide training or induction procedures that will make outside contractors aware of the hazards in the area where they are to work. The induction process shall include the hazards in the workplace and emergency systems that the contractor and staff need to know for their protection.

## **1.5 Information, Instruction, Training and Supervision of Employees**

...the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is practicable, the safety and health of his employees.

**(Section 15(2)(c) Occupational Safety and Health Act 1994)**

Supervision includes ensuring that employees receive information, training and instruction in a language or manner they can understand and remember; as well as having the ability to carry out the work. It also includes monitoring the employee's actions to ensure that the agreed safe work practices are being adhered to, including the use of the correct personal protection.

Employers and self-employed persons should have a system for verifying the standard of information and training, either by using a recognised industrial training organisation or by having their own assessment procedures.

### **WHAT EMPLOYEES NEED TO KNOW**

When fully trained, an employee should at least know:

- Safe and practical methods of carrying out the work;
- Correct ways to use tools, plant and equipment safely;
- How tools and equipment should be stored or secured;
- Systems in use to protect employees and others from injury;
- Emergency procedures to be adopted in the event of an accident or mishap; and
- The correct fitting, use and storage of items of personal protection or fall protection.

## **Section 2: General Safety**

### **2.1 Employee Safety**

**General duties of employers and self-employed persons to their employees**-It shall be the duty of every employer and every self-employed person to ensure , so far as is practicable, the safety, health and welfare at work of all his employees.

**(Section 15(1). Occupational Safety and Health Act 1994)**

Working at heights-Where any person is required to work at a place from which he will be liable to fall a distance of more than ten feet, means shall be provided to ensure his safety and such means shall where practicable include the use of safety belt or ropes.

**(Reg. 12. Factories and Machinery (Safety, Health and Welfare) Regulations 1970)**

While most falls occur off high structures, they can also occur when employees enter silos, manholes or excavations from the ground or floor level.

Where there is a possibility of serious harm from a fall of less than 2 metres, fall protection is still needed. Consideration should also be given to situations where a person may slide down an inclined surface before reaching a point at which a fall can occur.

An enclosed work environment should be planned for and set up at the earliest opportunity. This includes a fall protection barrier such as safety mesh, tile battens or work platform, together with guardrails, safe access or a bump placed 2 metres from the edge of the fall.

The employer shall determine that all walking/working surfaces on which employees are to work have the strength and structural integrity to support employees safely. Each employee on a walking/working surface with an unprotected side or edge which is 2 metres or more to a lower level shall be protected from falling by the use of a guardrail system, safety net system, or personal fall-arrest system.

### **2.2 Employee Preplacement Medical Examinations**

Employers shall make arrangements to conduct preplacement examinations in finding the appropriate job fit for employees. Components of the preplacement exam are based on the job requirements. The objective of the examination is to ensure that workers are physically and psychologically fit to work at heights. The recommendation for an employee medical suitability is based on the results of the examination.

The preplacement examinations shall consist of:

- Vital signs: height, weight, blood pressure, pulse
- Vision screening: visual acuity, peripheral and color vision
- Review of history: occupational and general medical
- Physical examination
- Audiograms

## 2.3 Public Safety

General duties of employer and self-employed persons to persons other than their employees-It shall be the duty of every employer and every self-employed person to conduct his undertaking in such a manner as to ensure, so far as is practicable, that he and other persons, not being his employees, who may be affected thereby are not thereby exposed to risks to their safety or health.

**(Section 17(1). Occupational safety and Health Act 1994)**

Other people working on the site and the general public around the site must be protected from site hazards. Activities must be coordinated to provide a safe environment for every person in the area.

Co-ordination could include:

- Providing traffic control or barriers to prevent access under work areas.
- Preventing the employees working or craning of components, over public or access areas.
- Completing floors, decks or work platforms so that there is a fully decked platform protecting people at lower levels.
- Providing safety screens around the work platforms to prevent objects from falling outside building confines.

## 2.4 Protection from Overhead Services

Working at heights often brings employees close to overhead conductors. Minimum clearances from these services must be maintained as set out in the Electricity Supply Act 1990. No person shall, without the lawful authority of the owner, management, licensee or supply authority of the installation, as the case may be, undertake any work or engage in any activity within 4.57 metres of a conductor.

## 2.5 Access and Egress

All persons shall be provided with a safe means of access and egress to their work area. Steps, stairs, ladders, platforms and walkways or suitable mechanical plant shall be provided. Suitable access should take into environmental conditions such as weather and lighting, what people may have to carry, and other relevant factors.

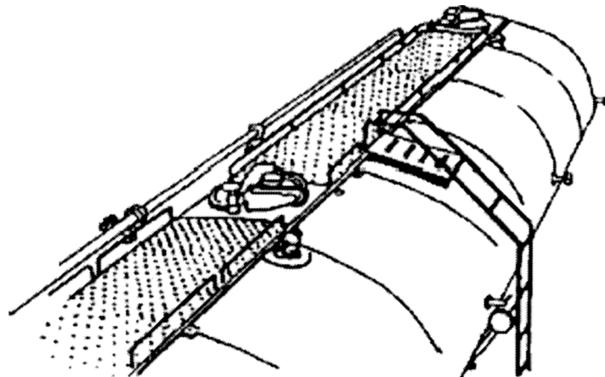


Fig.1 Milk tanker hatch

Where people are required to gain access to high areas of trucks, road transporters, tankers and rail transportation for the purposes of securing, restraining, loading or unloading freight and, where there is a risk of falling, employers must provide a safe system of work for people to get to and from the work area. This could be the provision of steps, permanent access ladders, walkways and guardrails. Wherever practicable, as much work as possible should be carried out at ground level.

Access to and egress from large items of plant, such as large vehicles and earthworks equipment (bulldozers, scrapers, graders, excavators, etc.) and heavy equipment, including during manufacture and maintenance operations, may result in fall injuries.

Employers must give consideration of the equipment and facilities available at both the initial loading point and the unloading destination to ensure safe access and egress is provided to employees involved in the operation.

## 2.6 Access to Confined Spaces

Access to, and working in, confined spaces present a unique series of hazards. These hazards must be carefully assessed and controlled before any person enters such a space.

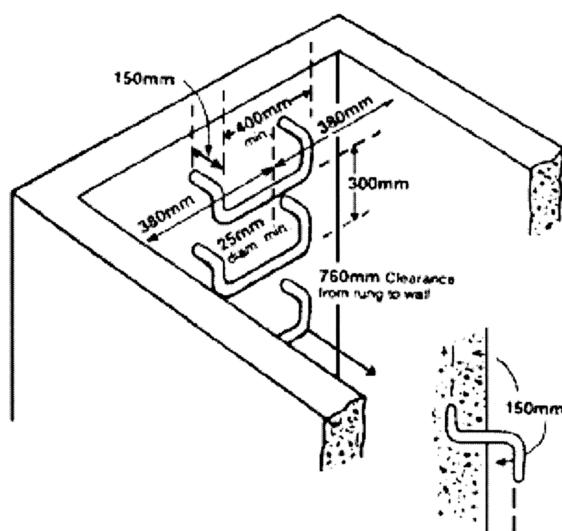


Fig.2 Typical Acceccss to confined space

Employees entering and working in confined spaces often have to wear respiratory protection. This can reduce peripheral vision. It is therefore important that ladders, steps, handrails, etc. are built to a regular pattern and to a high standard. Distances between rungs and steps, and positions of hand holds and guardrails, should be spaced at regular distances and heights. (See Fig 2.)

Before entering such spaces, the possibility of harm must be fully assessed and emergency systems put in place. The wearing of harnesses and life lines should be considered as necessary both to prevent falls and for emergency rescue.

## **2.7 Lighting**

Poor lighting levels and/or the lack of emergency lighting and illuminated signage in times of power failure or in emergency situations can lead to serious workplace incidents which may affect workers and others.

The following workplace issues may be considered non-compliant with the Factories and Machinery Act 1967 and the Factories and Machinery (Safety, Health and Welfare) Regulations 1970:

- inadequate task lighting
- inadequate access and stair lighting
- inadequate emergency lighting.

Lighting system should be considered at the design and installation phases. This is especially significant for workplaces where construction work is performed as the lighting system must be able to accommodate changes in work activities and the progression of construction.

The lighting system should ensure the safety of people to the extent that the lighting makes hazards visible. The facilitation of visible tasks and the creation of an appropriately illuminated environment must also be considered.

The lighting system should, therefore, be designed and installed, so as to reveal the task and provide a safe and comfortable visual environment.

### **Task lighting**

Task lighting enables workers to see clearly so they are more likely to carry out work tasks in a safe way.

Australian / New Zealand Standard 1680.2.4:1997 Interior lighting, Part 2.4: Industrial tasks and processes, gives specific advice in relation to minimum interior lighting levels. Table E1, part 5 – Building Construction Sites (Interior), states 160 lux for general work areas, this level should be considered as a minimum value when designing a lighting system.

### **Access and stair lighting**

Access and stair lighting is necessary so workers can see clearly to move around the workplace in a safe manner.

The minimum interior lighting levels for walkways and access areas shall be 54 lux and this level shall be considered as a minimum value when designing a lighting system.

### **Emergency lighting**

Emergency lighting is important to assist workers to exit the workplace in an emergency situation.

The Factories and Machinery (Safety, Health and Welfare) Regulations 1970 requires that an automatic lighting of the emergency lighting system

which shall be capable of producing and maintaining for at least one hour a minimum intensity of 16 lux for workers to safely exit the site upon failure of the general lighting system. The energy source shall be independent of the installation for the general lighting system.

Emergency evacuation signage may be integrated in an existing emergency lighting system provided that system of lighting incorporates battery back up light fittings capable of illuminating the exit signage and providing clear direction on the safe means of egress from the workplace in the event of power failure.

Emergency escape luminaries should be located within 2 metres of the approach side of each doorway requiring an exit sign and located to emphasise potential hazards to people exiting the workplace.

#### **Natural lighting**

Where natural light is present the workplace should be assessed to ensure sufficient lighting for:

- safe access to and from the workplace
- safe performance of tasks
- exiting the workplace in emergency situations (specific attention should be given to the identification, illumination and signage of emergency exits)
- the size and complexity of the workplace, taking into account all of the above.

## **2.8 Personal Protective Equipment**

Personal protective equipment (PPE) shall be worn where there is the possibility that failure to wear such equipment could result in serious harm. Such equipment should comply with the relevant Malaysian Standard, or an acceptable international Standard.

Specialist PPE will be needed in certain circumstances. Different types of gloves will be needed for handling chemicals and handling steel; respiratory protection will vary for hazardous dusts, fumes and solvents.

Employees shall wear and use PPE when needed or instructed to do so by a person with authority.

Employers shall ensure that the personal protection provided is:

- Suitable for its intended use;
- Correctly sized and fitted to the individual user;
- Used by employees who are trained in its use and understand its performance;
- Correctly stored when not in use;
- Cleaned and checked at regular intervals, usually every time it is used;
- Disinfected and sanitised before use by another person; and
- Used by everyone that needs protection.



*Fig.3 Appropriate personal protective equipment must be provided and used*

## 2.9 Emergency Planning

Emergency planning is required in order to prevent further loss or injury after an accident or natural Planning may involve simply providing first aid facilities and emergency phone numbers, but it could also require specialist rescue equipment, training and evacuation exercises.

Questions that emergency planning should answer include:

- How to reach an injured worker and get them to medical help, remembering that they could be suspended in a harness or trapped in a confined space.
- What first aid and medical equipment is required on site, taking account number of workers, distance to medical services and inherent hazards.
- How to provide the necessary information and protection for emergency personnel.
- How a fire or chemical spill is to be contained.
- How to account for all persons in the event of an emergency evacuation.
- How to secure the site in an emergency to prevent further loss.
- How to disconnect or isolate all energy sources, e.g. gas, steam.

## **Section 3: Permanent Fixed Access and Platforms**

### **3.1 General**

Permanently installed steps, stairs or ramps, etc. shall comply with the Acts and Local Authority requirements. The requirements and standards for access and platforms varies considerably, depending on usage, so this section is for basic guidance only.

All access ways and stairs must have a minimum head clearance of 2.1 metres vertically above the stair nosing.

Doorways should not open directly onto a stair or ramp. A level landing or platform is required.

For open-sided stairs and ramps, the minimum width is 685 mm. When enclosed between walls, etc., the minimum width is increased to 815 mm, and where two persons have to pass, the minimum width is 1 metre.

Guardrails should be fitted to all exposed edges.

### **3.2 Handrails, Guardrails and Toeboards**

Handrails are provided to assist balance; guardrails to prevent falls. The top rail should be at least 1.0 metre above the floor or front of the stair nosing. For guardrails, a midrail shall be fitted. A toeboard should be fitted anywhere there is a danger of tools or materials being lost over the edge.

### **3.3 Stairway and Ramp Landings**

Landings shall be placed so that stairs, ladders or ramps are divided into approximately equal sections. The minimum width and depth of a landing shall be the width of the steps or stairs; this shall be clear of any swinging door or other obstruction. Landings shall be level, with guardrails fitted.

### **3.4 Ramps**

Ramps are safer than stairs or ladders for small changes of level, as people do not have to place their feet so accurately. In addition, ramps can be used by barrows, hand trucks and other means of transport. The slope of the ramp is determined by the type of surface to give a good grip and the type of loads to be carried. For guidance in work place other than factories:

- For reasonably slip-resistant surfaces subject to wetting: 1 vertical to 10 horizontal, under 6 degrees.
- For reasonably slip-resistant surface not subject to wetting: 1 vertical to 8 horizontal, 7 degrees.
- For ramps steeper than 8 degrees, cleats or specialist non-slip surfaces are needed. Such ramps should not be used by trucks and trolleys.

These ramps should only be used for special purposes such as up the side of conveyors. The maximum slope is 1 in 2.7, 20 degrees.



### 3.5 Stairways

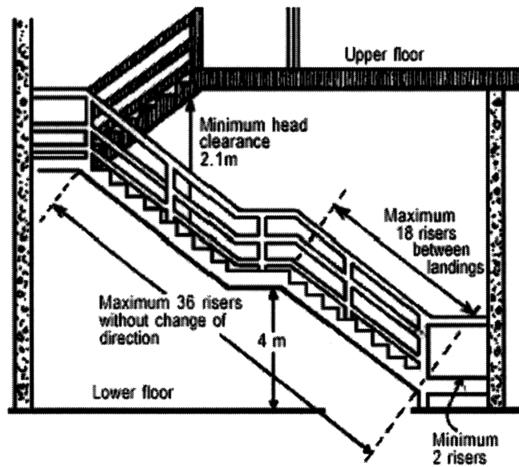


Fig. 4 Stairways

Treads and risers on any stairway must be of uniform dimensions. The rise of each tread and the going (depth) will be governed by available space but should comply with the following criteria:

- The pitch of the stair should be between 20 degrees to 45 degrees from the horizontal.
- The height of the rise and depth of the going of each step should approximate the formula, 'twice the rise plus the going equals 600 mm, e.g. rise of 160 mm, going of 280 mm,  $2 \times 160 + 280 = 600$  mm.'

The maximum number of stairs between landings should be 18, with no more than two flights without a change of direction.

The depth of any landing should be at least equal to the width of the stair.

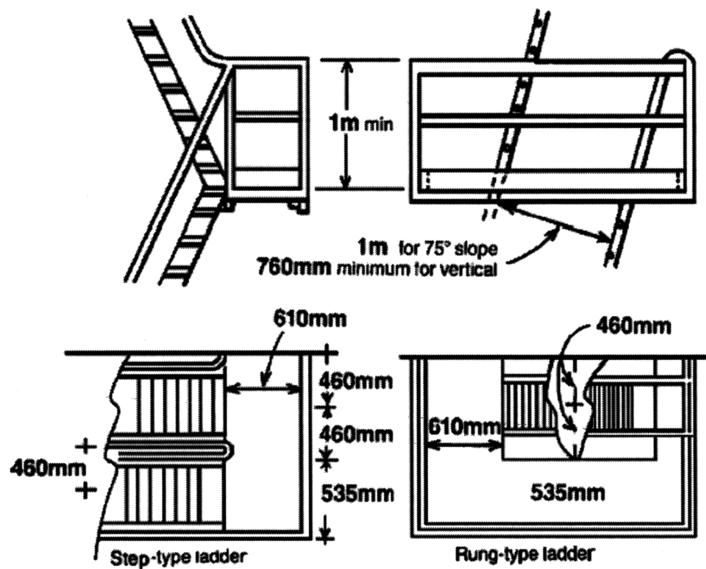


Fig. 5 Intermediate landings

Guardrails shall be provided on the open side of all stairs. Handrails must be provided on one side of all closed stairs. Stairways wider than 1 metre shall have hand or guardrails on each side.

The nosing of each tread should extend 25 mm and be of a non-slip material.

Service stairs around plant or machinery, etc. may not be able to meet these criteria but every effort should be made to do so. Failing this they should be built to the dimensions and pitch of a step or tread ladder. Spiral stairways should be avoided if at all possible.

### 3.6 Fixed Tread or Step Ladders

These ladders should be pitched at an angle of 60 degrees to 70 degrees. Treads should be at least 100 mm wide, with a rise of between 200-250 mm. Guardrails should be fitted at a minimum height of 1.0 metres vertically above the nosing of the treads. Other requirements include:

- Maximum length of 6.1 metres.
- Minimum width of 460 mm with the distance between guardrails of 535-760 mm.

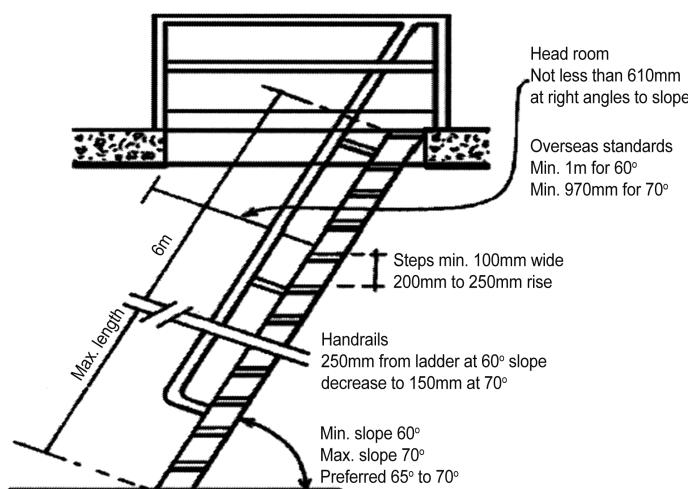


Fig. 6 Steps or tread ladders

- Be so arrange that the distance from the front of the rungs thereof to the nearest fixed structure on the climbing side is not less than thirty inches.
- The maximum length of a vertical fixed ladder between landings should be 9 metres.

Where cage guards or hoops are not possible, a fall-arrest system shall be used. A corrosion-resistant anchor cable or rail, generally stainless, is attached to the ladder or access. The climber wears a harness attached to a type 1 fall arrest device (inertia lock) which is free to slide up or down this rail or cable.

The wearer shall have specialist training in the use of this equipment.

The lanyard between the harness and the inertia lock should not exceed 300mm.

Where a safety rail such as above is not fitted, rung grippers and hooks should be used while a type 1 arrest device is rigged. The grippers are hand-held and attached to a safety harness by short lines. The grippers latch on to the ladder rungs and as the climber ascends, the grips are released and moved from rung to rung. If the hand slips, the gripper stays in position.

Synthetic lines shall not be installed as a permanent anchor line, they will be rigged for each operation. (See Fig. 7)

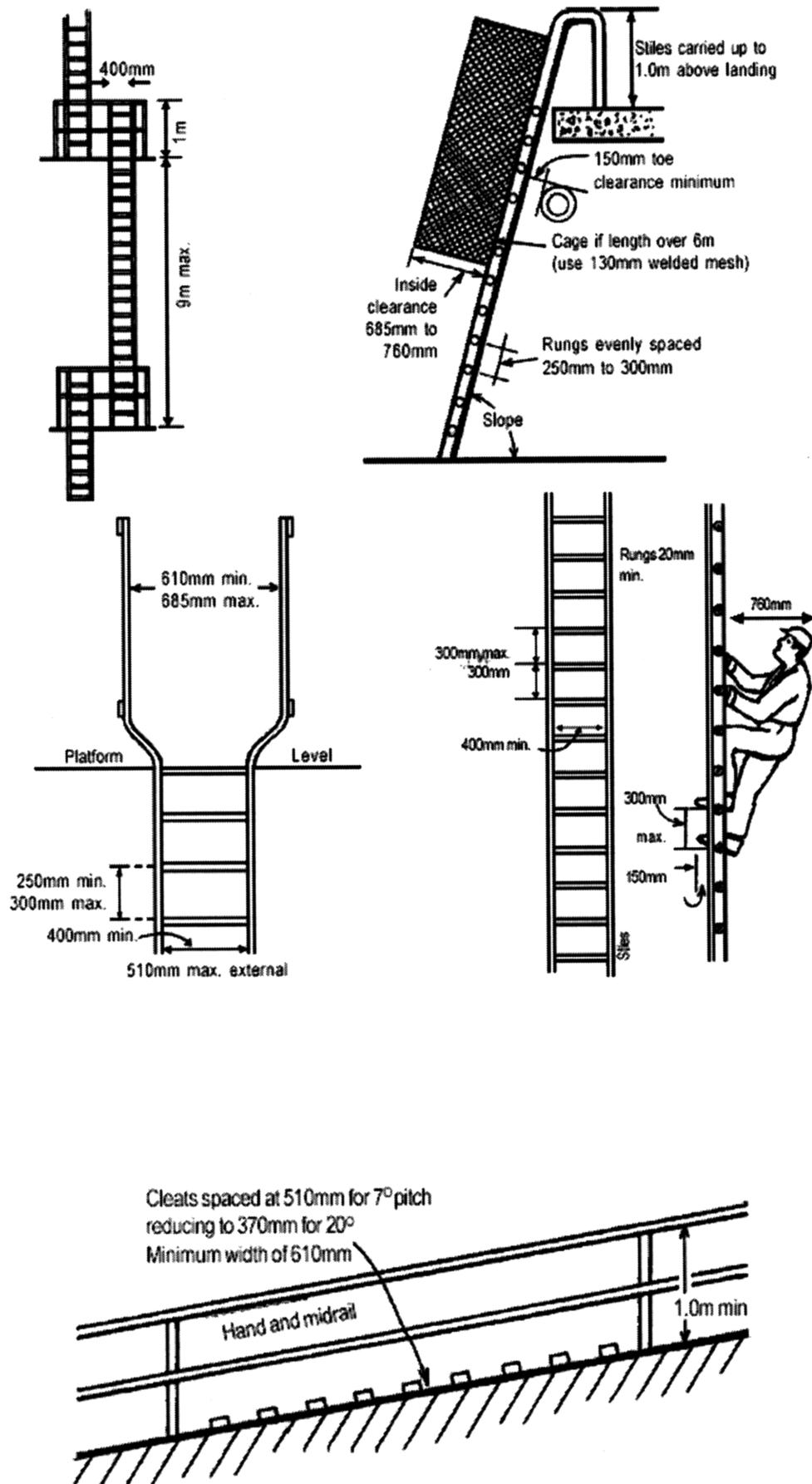


Fig. 7 Fixed rung ladders

### 3.8 Permanent Fixed Roof Ladders and Crawl Boards

Fixed crawl boards and roof ladders may be used to provide access to a work positioning system, or to service plant on pitched or brittle roofs. Crawl boards shall have a minimum width of 450 mm with a hand rails. On brittle roofs, guard rails should be permanently installed. Crawl boards shall have a non-slip surface or cleats, depending on their pitch.

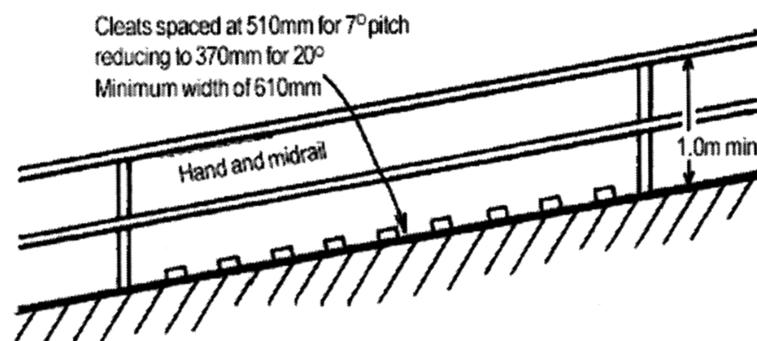


Fig. 8 To climb a roof of 7° to 20°

## **Section 4: Temporary Non-Fixed Access and Platforms**

### **4.1 General**

All ladders, steps, trestles and working platforms shall comply with the relevant Malaysian Standard or other accepted international Standard. Those that do not have a Standards mark are generally of light construction and not suitable for use in a workplace.

- Ladders and steps used to gain access to a step-off point should extend 1 metre past the step-off point unless some other form of adequate handhold is provided.
- The ladder shall be secured against movement sliding at top and bottom while in use.
- The single rung or step of a ladder should not be used to support one end of a plank upon which a person has to work.
- Ladders and steps are designed for the use of one person only at any one time.

Before using any ladder; ask yourself:

- Is using a ladder the safest and best work method for the job?
- Is the ladder in good condition and suitable for the type and height of work?

While using a ladder:

- Do not carry a load that will prevent both hands from being able to hold or grab the rungs.
- Do not over-reach - the waist should always remain within the confines of the stiles.
- Unless there is a secure handhold, do not stand on a rung or step that is closer than 0.9 metres from the top of the ladder or steps while working.
- Always ensure that all loose tools or other items have been removed from the steps or rungs before moving the ladder.
- Where the ladder encroaches onto a passage or roadway, place cones or barricades around the base.

Ladders shall be withdrawn from service immediately on suspicion of any structural damage such as:

- Bent or twisted stiles;
- Loose, bent, worn, or split rungs or steps;
- Loose, bent or disconnected braces between steps and stiles or backframe;
- Damaged or missing locking bars;
- Missing rivets or non-slip feet.

All ladders shall be setup on a firm level surface unless a secure method is used to ensure an even distribution of weight between the stiles. In the case of a step ladder, this includes the back frame.

## 4.2 Perimeter Protection

Perimeter protection shall be provided on the exposed edges of all work areas from which a fall of more than 2 metres is possible. Guardrails, including midrails and toeboards, are the preferred option. However in some situations other systems may be appropriate:

- The height to the top of the guardrail shall be between 0.9 and 1.1 metres.
- The guardrail shall be before or vertically over the edge of the platform except:
- on scaffolds, the guardrail shall be not less than 200 mm horizontal distance of the edges of the platform.
- It must be capable of sustaining, without failure or undue deflection, a force at any point of .69kN (70kg) vertically and .44kN (45kg) horizontally.

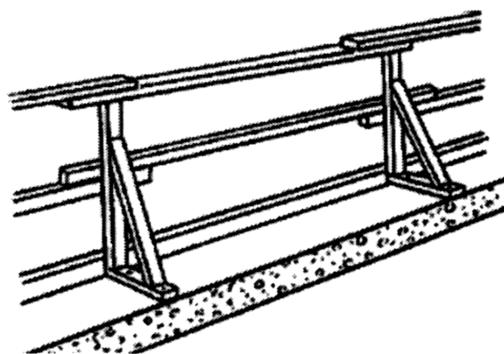


Fig. 9 Wooden guardrail with midrail and toeboard

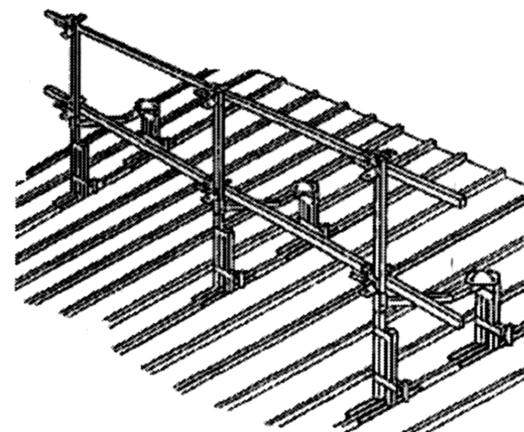


Fig. 10 Proprietary guardrail system

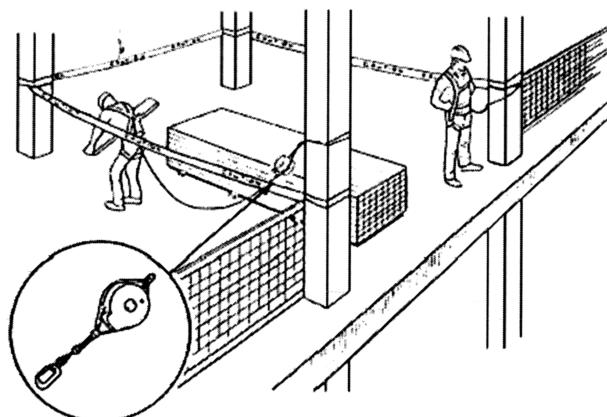


Fig. 11 Fall restraint system

### 4.3 Single and Extension Ladders

The maximum length of a single ladder is 9 metres and the maximum length for an extension ladder is 15 metres.

- Ladders should be setup at an angle of 1 horizontal to 4 vertical, about 14 degrees to the vertical.
- They shall never be used horizontally as a work platform.
- A ladder is to support one person only.

Ladders must be secured against movement at the top and bottom to prevent the possibility of displacement. It may be necessary for one person to hold the ladder until another can climb up and secure the top.

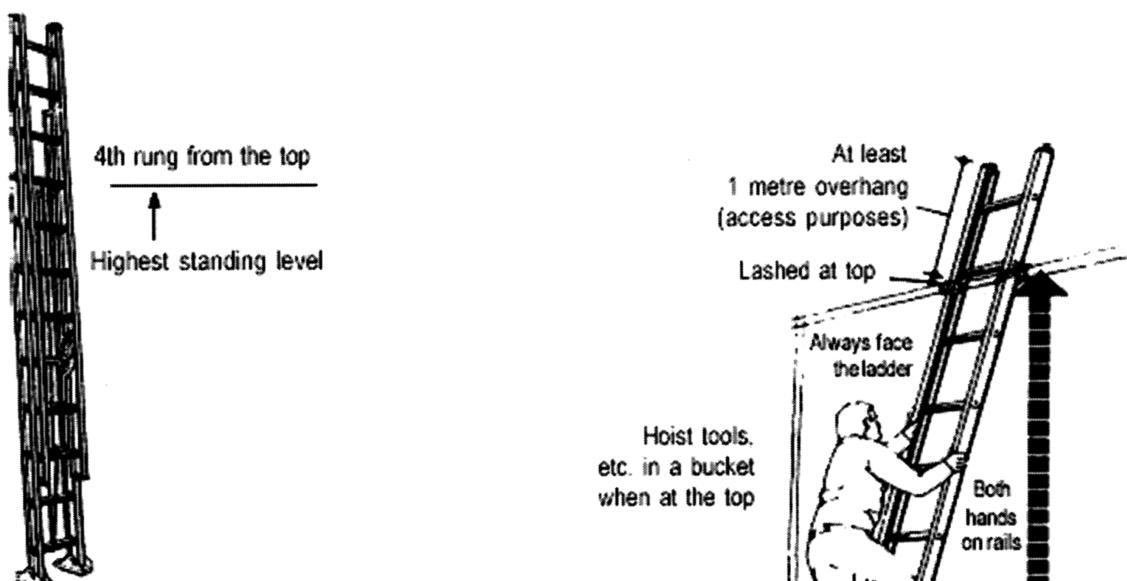


Fig. 12 Extension ladder

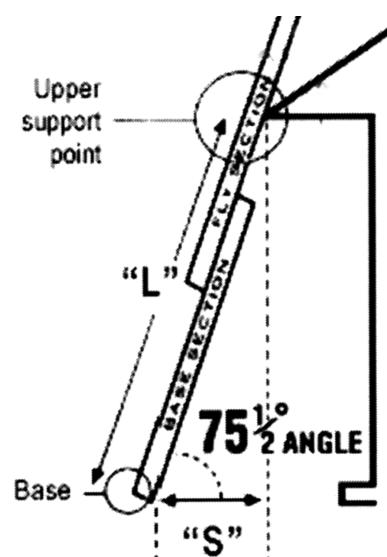


Fig. 13 Extension ladder set-up  
4 to 1 ratio: "S"=1/4 of "L"

Fig. 14 4 up – 1 out gives the right slope

#### 4.4 Foldable/Portable Step Ladders

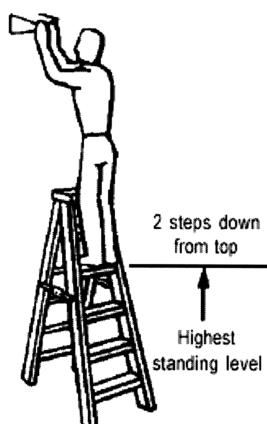


Fig. 15 Step ladder

A foldable/portable step ladder is a self-supporting ladder not adjustable in length, having flat steps and a swinging back stay that is held in place by a secured locking bar.

The maximum height for a step ladder is 6.1 metres. When such ladders are used incorporating a plank, thereby creating a working platform, they shall be fitted with the industry guarding standard and additional bracing to ensure stability where they are used above 2 metres or more in height.

Step ladders must be set up on a firm level area. Sole plates will be needed on soft ground.

#### 4.5 Dual-Purpose Ladders

A dual-purpose ladder is a step ladder where the back frame is fitted with rungs and can be hinged to provide an extension. When the ladder is in use either as a step ladder or extended, the two sections must be securely latched by a locking bar or solid catch.



Fig. 16 Dual-purpose Ladder

#### 4.6 Trestles and Tripods

A trestle is a self-supporting metal or timber stand including horizontal members designed to support one end of a light-duty work platform. It may be folding or telescopic. The design and construction of steel trestles should comply with accepted international Standard.

Fall protection shall be provided if the height of the work platform on trestles exceed 2 metres.

The working platform between the trestles shall comply with a light- working platform (160kg).

Each trestle must be capable of supporting the total live load.

The legs of the trestle or tripod must be set up on firm level ground.

Sole plates shall be used on soft ground.

The planks should be centralized on the trestles.

When timber are used, the material should be of hardwood quality or equivalent.

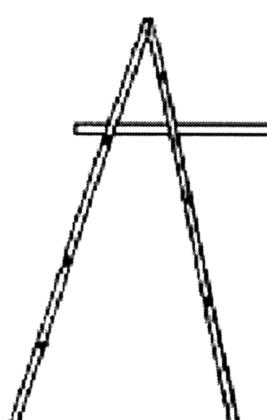


Fig. 17 Light-duty trestle. Maximum Height:3 m; maximum loading: 160 kg

## 4.7 Cantilevered Temporary Work Platforms

This type of structure generally comprises of a structural steel platform supported at one end on a floor slab. The other end is cantilevered out over the edge and used as a support for employees, scaffolding or a loading platform.

A professional engineer's design certificate should be obtained.

Requirements include:

- Fall protection or perimeter edge protection must be provided for persons on the platform.
- The design must be such that the necessary stability is achieved by the use of a through the floor U-bolt or equivalent system providing adequate horizontal and vertical restraint.
- The bearing surface of the floor on which the platform sites must be structurally adequate and with no irregularities that will cause instability.
- A notice clearly stating the safe working load shall be prominently displayed on the platform.

## 4.8 Roof Ladders and Crawl Boards



Fig. 18 Bracket on roof ladder should reach over the ridge

Temporary roof ladders and crawl boards should be of the same standard as for permanent installations. However, other forms of fall protection may be more appropriate. Roof ladders should be used on roof pitches over 30 degrees. The bracket on the top of a crawl board or roof ladder should be sufficiently deep to reach over the ridge and lap the roof framing.

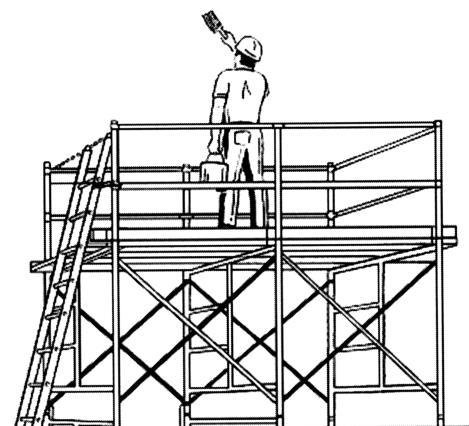
## Section 5: Scaffolding

### 5.1 General

Employers shall ensure that all scaffolding is suitable and safe for employees to use.

### 5.2 Standing Screens

Employers shall ensure that:

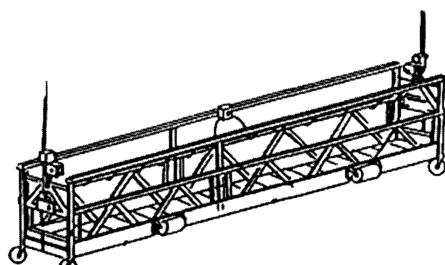


*Fig. 19 Typical standing scaffold with perimeter protection*

- All guardrails and working platforms are in place on all areas in use;
- Safe access is provided to all working platforms;
- Sufficient scaffold ties and braces are in place;
- All load-bearing members are in the correct place and properly secured with the correct fittings;
- Working platforms are fully decked and planks secured against movement; and
- Perimeter protection or guardrails are correctly fitted. Guardrails, and planks may be fitted by a competent person.

If any instability or structural damage is found, the scaffold should not be used until referred to the certificated scaffold for repair.

### 5.3 Suspended Screens and Boatswains' Chairs



*Fig. 20 An example of a light-duty suspended stage with two wire ropes to each winch. A vertical life line should be used.*

Employers must ensure that:

- Workers on the suspended scaffold are fully conversant with all the controls and emergency descent procedures; and
- All employees in the working stage or boatswain's chair must wear a safety harness that is secured to an anchorage independent of the working stage rigged so the arresting force that does not exceed 6kN.

Where the stage has two independent means of support at each support point, the person may use a 2 metre lanyard attached to the stage.

Persons and equipment placed on the platform shall not exceed the SWL of the stage.

Provision shall be made for the safety of those who may be in the vicinity of or under the stage. The use of barriers or gantries under the stage should be considered.

## 5.4 Hung Scaffolds

Hung scaffolds can present a variety of special problems:

- Suspension points from which the scaffold is hung shall have a safety factor of 3.
- Wire ropes or chains used as hangers shall have a safety factor of 5.
- Hangers constructed of scaffold tube shall have check clips fitted.
- While building or dismantling hanging scaffolds, scaffolders shall wear a fall-arrest system.

## 5.5 Tower Scaffold

Tower scaffolds are used by painters and others who need to do lightweight work from a structure than can be readily moved from place to place. When mounted on wheels, they are known as mobile towers.

Towers may be made from normal tube and fittings, but are frequently constructed from proprietary components. The following general matters apply to both types.

- Towers should be erected and used on firm ground. Static towers should have metal base plates and, unless the foundation is concrete or other solid material, the load should be spread by timber sole plates.
- Mobile towers must be used only on hard, level surfaces. Wheels, or castors, should be not less than 125mm in diameter. Castors should be locked into the base of standards and be fitted with brakes which cannot accidentally be released. The maximum permitted load should be stamped on the castors.
- With any type of tower scaffold, its stability, if free standing, depends on the ratio of height to least base ratio. Aluminium towers are much light than steel towers and their centre of gravity is relatively higher. The permissible height to base ratio for aluminium towers is therefore correspondingly less.
- Where a tower is likely to be exposed to appreciable wind loading, or where the maximum recommended height to least base ratio needs to be exceeded, the scaffold should be tied to the structure it is serving, or be designed to ensure stability by means of ground anchors, guys or kentledge.
- Platforms must be fully boarded and be at least 635mm wide, or at least 860mm wide when used for the deposit of materials. They must be protected from tipping or sliding by being properly supported and by the use of cleats or other proprietary fittings. Where 38mm timber scaffold boards are used, they should be supported at least every 1.5m. Loads on the platform should be evenly distributed. Any trap door or hatch on the platform should be closed when the platform is in use.
- Guardrails and toeboards must be fitted on all four sides of the platform. Toeboards must rise at least 200mm above platform level. Guardrails must be 1.0m above the platform with the distance between the top of the toe board and the lowest guardrail not exceeding 690mm.

- The platform must have a safe means of access, always on the narrowest side of the tower. Access should never be by means of a ladder leaning against the outside of a tower.
- A ladder or trestle must never be placed on the top platform to extend the height of the tower as this will cause instability.
- Mobile towers should have their castors turned outwards to provide maximum base dimensions and the brakes locked "on" when the scaffold is in use. Mobile towers should be moved only by pulling or pushing at the base. Working platforms should be clear of persons and materials before towers are moved.

### **Tube and fitting towers**

#### **Structure**

- Where joints in standards are necessary, they should be made with sleeve or parallel couplers.
- Ledgers and transoms, at right angles to the standards, should commence about 150mm from the bottom to provide a firm base clear of the castors. Except at working platform level, ledgers and transoms should be fixed to the standards with right angle couplers. Lifts should not exceed 2.7m.
- Bracing should be fixed to ledgers and transoms with right angle couplers. Bracing is in two forms:
  - plan bracing, i.e. diagonally at the base, and working platform, and also at alternate lifts
  - diagonal bracing in zig zag fashion to the full height of the tower on all four sides.

#### **Height limitations**

The height to least base ratio should be not greater than the following:

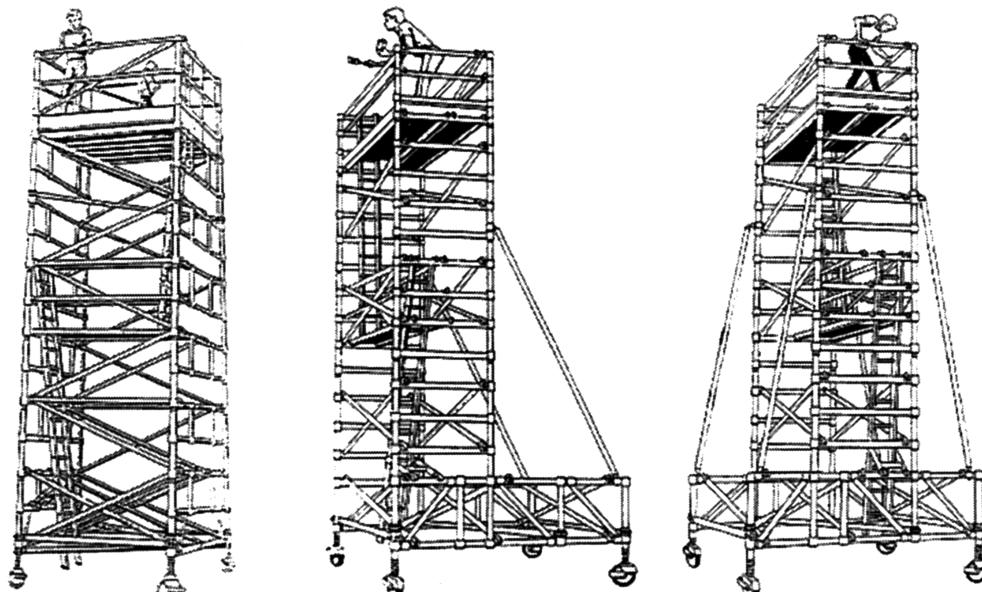
- Static internal tower 4: 1
- Static external tower 3.5:1
- Mobile internal tower 3.5: 1
- Mobile external tower 3: 1

The height to be measured in the above ratios is that to platform level.

The recommended maximum free-standing height for mobile towers is 9.6m and for static towers, 12m.

## Access

A ladder for access purposes can be lashed vertically to one of the narrow sides, preferably inside the base area, with the foot resting on an additional transom. The ladder must extent at least 1.05m above platform level to provide handhold at the stepping off point.



*Fig. 21 Typical examples of light-duty mobile tower-frame scaffolds*

## 5.6 Special Scaffolds

Special scaffolds are those scaffolds that due to their construction, design, expected live loads are not built to match the accepted international Standard. Expert advice from a professional engineer should be sought before such scaffolds are built and used. Every employee using the scaffold shall be informed of its maximum safe live load and any other requirements for its safe use.

## **Section 6: Mechanical Plant for the Support of Personnel**

### **6.1 General**

A wide range of mechanical plant is used for the support of persons at work. All such equipment shall be designed and built to accepted international Standards.

All such equipment must be designed, built and maintained so that if a loss of hydraulic pressure occurs, the machine will remain stable. For mechanically-operated machines, a positive locking system to prevent inadvertent movement shall operate.

Climbing out of platforms at a height should be strongly discouraged. Where it is essential, fall protection must be provided. This may be achieved by stabilising the platform then disconnecting the safety line from inside the bucket and reconnecting it to a point on the structure before the person climbs out.

Care must be taken to ensure that any personnel bucket does not rest or become lodged on any ledge or sill. This can cause the bucket to drop suddenly, resulting in damage or injury.

Mechanical plant must not travel with a person in the bucket or platform unless it is specifically designed to do so.

Work carried on by persons in the platform, such as pulling or pushing on items outside the platform, can have the effect of increasing the live load. This factor must be taken into account when calculating whether the total live load is within the SWL.

All tools and materials lifted onto the platform should be within the confines of the guardrails unless a full engineering and hazard assessment is carried out to ensure safety

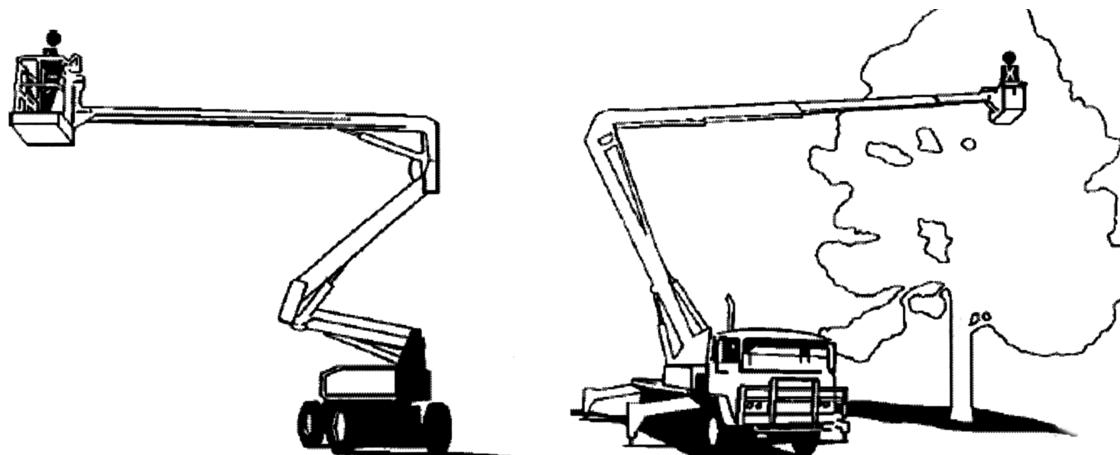
### **6.2 Power-Operated Elevating Work Platforms**

The design, construction, maintenance and use of all types of elevating work platforms must comply with the accepted international Standard.

Power-operated work platforms such as aerial platform, scissors, hoists, etc. are specialised pieces of equipment often designed for particular types of operation. It is essential that the correct type of machine is selected for the intended work. The operator must be trained to operate that particular type of elevating work platform.

Before use the employer should ensure that:

- The machine has been inspected and tested at regular interval in accordance with manufacturer specifications;
- The machine is set up level on firm level ground;
- It is used so that machine or operator will be safe distance from the power lines (see paragraph 2.3);
- The machine's operation will not create a hazard, e.g. the boom will not swing out and block roads; and
- The machine will not be overloaded or used as a crane.



*Fig. 22 Power-operated elevating work platform*

Persons in the bucket of a platform on the end of a boom must wear a safety harness with a lanyard attached to the machine. The line should be just long enough to provide free movement within the confines of the bucket.

### 6.3 Forklift Platforms

Where no other practical and less dangerous method is available, a work platforms may be constructed and secured to the fork of a forklift. It is necessary that such platforms are properly constructed and only used on forklifts that are maintained in accordance with the acceptable international standard.

Requirements include:



*Fig. 23 An example of an engineer-designed mancage, with safety harness and lanyard assembly, correctly positioned on forklift tyres.*

- Platforms shall be fitted with guardrails, intermediate rails and kickboards. Any gates must open in and have a spring-loaded latch.
- A 2.0 metre high guard that is sufficiently wide to prevent any contact with the lifting mechanism shall be fitted to the back of the platform.
- The tilt lever should be locked out or made inoperable or; alternatively, a fall-restraint system introduced using a full harness and short lanyard, allowing free movement only within the platform confines.
- Operating instructions and the SWL of the platform must be attached in a prominent position.
- The platform must be secured to the forks in such a way that it cannot tilt, slide or be displaced.
- The forklift operator must be trained and experienced and remain at the controls at all times while the platform is in use.

## **6.4 Crane-Lifted Work Platform**

Where personnel must work at locations that are inaccessible or unsafe to reach by other practical and less dangerous method, a working platform may be suspended from a crane to perform work. It is essential that the crane operator, signalman, person to be lifted and the person responsible for the task to be performed shall hold to plan and review procedures to be followed.

Minimum safety standards include:

### **1. Job Planning**

- 1.1 Use of crane-lifted working platform to perform work or to transport persons shall be authorized by the client or agent of client. Client's or agent of client's work permit procedure shall be followed, with special notations indicating "CRANE-LIFTED WORKING PLATFORM" and listing any special precautions to be followed. Client's or agent to client's rigging expertise shall be part of all planning and all work execution.
- 1.2 A Job Safety Analysis and Method Statement shall be prepared for every crane-lifted working platform activity.
- 1.3 A lift plan shall be established before using the crane-lifted working platform.
- 1.4 Personnel, including crane operator, riggers and flagman, shall be given specific instructions by the lift supervisor concerning their job responsibilities and the use of safety equipment required for the job.
- 1.5 A trial test shall be done using evenly distributed weight at least 125 % of the intended load. The trial test will involve hoisting the working platform near to the work area with the test weight and use of taglines.
- 1.6 When a person has to work outside the working platform, contingency plans shall be established in the Job Safety Analysis to provide adequate safety personnel should an unexpected hazardous situation develop and emergency rescue of personnel is required.

### **2. Work Platform**

- 2.1 Only work platform design and constructed in accordance to ANSI, BS, AS specifications or accepted international Standard are permitted.
- 2.2 Working Platform drawings and computation figures shall be certified and endorsed by Professional Engineer (P.E.).
- 2.3 The design Load of a work platform shall include its own weight and at least five (5) times the maximum intended load or 1000 kg which ever is more and shall be stamped on the work platform.
- 2.4 Work platform shall not be used for lifting anything other than two (2) workers, their tools and materials necessary to do their job. For performing the calculation for the load weight, each average size person is considered to weigh 90 kilograms. If a person weighs more than 90 kilograms, the person's exact weight shall be used when calculating the load.

- 2.5 Identification data plate or other marking that indicates the weight of the empty work platform and its maximum intended load shall be permanently affixed to the work platform.
- 2.6 The Height shall be between 900 millimeter to 1100 millimeter. It shall be equipped with guardrail system that shall be enclosed at least from mid-rail to the toe board of minimum 200mm height with either solid construction or expanded metal having openings not greater than 12.7 millimeter.
- 2.7 A "grab bar" shall be welded to the inside of the work platform for workers to hold onto during the lift. This bar will prevent hand injuries should the work platform contact objects as the work platform is positioned.
- 2.8 An access gate (where provided) shall swing inward and shall have an automatic restraining device to prevent accidental opening.
- 2.9 Headroom shall be provided to allow employees to stand upright in the work platform.
- 2.10 Overhead protection shall be provided where workers may be exposed to falling objects.
- 2.11 Highly visible painting for basket.
- 2.12 A weight (detachable flat metal plate weighing 125% of the intended load) shall be attached to the bottom of the working platform for the purpose of testing the integrity of the platform and ground conditions.

### **3. Other Work Platform Requirement**

- 3.1 Welded by a qualified welder.
- 3.2 Non-destructive test shall be carried out on all welded part. Test shall be carried out by a qualified NDT company. A copy of the welding inspection report shall be submitted.
- 3.3 The work platform shall be load tested with a uniformly distributed load of 125 % of the design load by holding it in a suspended position. A copy of the load test report from the manufacturer shall be submitted.
- 3.4 Marking on basket
  - Identification number
  - Maximum intended load
  - Work platform occupancy (2 persons)
  - Work platform empty weight
- 3.5 Shall be provided with 2 (two) taglines to control swinging and rotating of basket.

### **4. Crane and Rigging Criteria**

- 4.1 Has a valid certificate of fitness.
- 4.2 Operated by a qualified operator.
- 4.3 Crane and rigging shall comply with the provision of Accepted International Standard.

- 4.4 Minimum capacity shall be 2,000 kg. or twice the combined load and the intended load for the radius and configuration of the crane which ever is more.
- 4.5 Load lines shall be capable of supporting ten (10) times the maximum intended load.
- 4.6 Eyes in wire rope slings shall be fabricated with thimbles. Wire rope, shackles, rings, master links, and other rigging hardware shall be capable of supporting at least five (5) times the maximum intended load applied or transmitted to the component. Where rotation resistant rope is used, the slings shall be capable of withstanding ten (10) times the maximum intended load.
- 4.7 Bridles and associated rigging and attaching the working platform to the hoist line shall be used only for the working platform and not for any other purpose.
- 4.8 The load line on which the work platform is suspended shall have controlled load lowering. The vertical load line speed shall not exceed 23 meters (75 feet) per minute. Free-fall option shall be locked or isolated.
- 4.9 All brakes and locks on the crane shall be set as soon as the platform is positioned and before the works begins.
- 4.10 Provided with dead man switch controls
- 4.11 An anti-two blocking device or a damage prevention feature shall be provide so as it prevents contact between the load block or overhaul (headache) ball and boom tip. Variable angle booms shall be equipped with a boom angle indicator.
- 4.12 Cranes shall be equipped with an operators assistant device to indicate clearly to the operator at all times the boom angle or an accurate determination pf the load radius to be used during the lift operation.
- 4.13 The crane shall be uniformly level. All outriggers shall be fully deployed.
- 4.14 The total weight of the loaded crane-lifted work platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
- 4.15 The crane-lifted working platform shall be attached to the block or hook, and not directly to the load line. The hook must be equipped with a swivel to prevent any rotation of the working platform.
- 4.16 Hooks on overhaul ball assemblies, lower load blocks, or other attachment assemblies shall be of a type that can be closed and locked.
- 4.17 All sling suspension systems shall utilize a master link for attachment to the block or hook. All platform suspension must be provided with positive closure device (e.g. safety type shackle).
- 4.18 No lifts shall be made from another load line while workers are suspended on a working platform.

## **5. Emergency Response Procedure**

Working at height using crane-lifted work platform Emergency Rescue Procedure shall be established when workers have to exit the work platform to perform work.

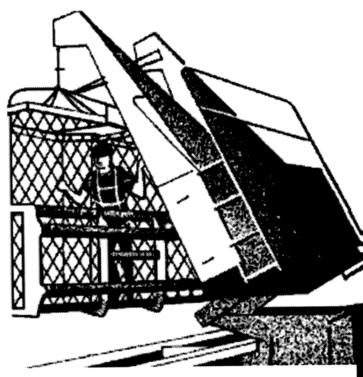
## **6. Pre-Lift Meeting**

A pre-lift meeting attended by the crane operator, rigger/signalman, safety representative, worker to be lifted and the lift supervisor shall be held to review the appropriate requirements of the lift and lift procedures to be followed.

## **7. Operation Requirement**

- 7.1 The Lift Supervisor prior to each lift shall complete the crane-lifted work platform pre-lift checklist as per sub-par. 16.
- 7.2 Lifting operation to be controlled by signal man and supervised by Lift Supervisor and Heavy Equipment Engineer or other Senior Officer of the crane company at all time
- 7.3 Lifted personnel must have continuous sight or communication with crane operator. Communication between the crane operator, slinger and lifted personnel must be maintained. To avoid pinch points, workers shall keep all parts of the body inside the work platform during raising, lowering and positioning (this provision does not apply to employee performing signal person duties).
- 7.4 Only one employee in the work platform shall give signals to the crane operator. The employer or superintendent shall designate the signal person. If visual contact is not possible or when working at elevations above 23 meters, two-way voice communication shall be maintained at all times between the signal person and the crane operator.
- 7.5 While the work platform are lifted or suspended, operator must remain at crane control at all times.
- 7.6 No horizontal movement of the crane is permitted while workers are occupying the work platform. All other crane movement to be minimised when personnel are lifted.
- 7.7 All crane movement must be slow (23 m/min lifting and lowering speed).
- 7.8 The raising and lowering of the work platform is only permitted by powering up and down. Free wheeling down the work platform with workers is not permitted under any circumstances.
- 7.9 Work platform must be attached to the main hook only. Fly jib is not allowed
- 7.10 While working in the work platform, all lifted personnel must wear appropriate safety equipment including safety (full body) harness with shock-absorbing lanyard. The lanyard shall be attached directly to the crane main hook as the work platform.

- 7.11 For those crane equipped with outriggers, the outriggers must be fully extended and set according to manufacturer's recommendations when using crane-lifted work platform. When crawler crane are used to lift the work platform, the crawlers must be in the extended position and on firm uniform ground that is within one percent level.
- 7.12 Work platform is for personnel including necessary equipment to do their job. No other material is allowed in the work platform.
- 7.13 Rotation of the work platform is not permitted. Two tag lines shall be secured to the work platform and two persons shall be holding the other end of the tag lines on the ground. If wind speed exceeds 25 km/h, all lifting operation of personnel must be stopped until the wind speed is below 25 km/h.
- 7.14 Hoisting of workers shall be discontinued upon indication of any dangerous weather conditions or any other impending danger.
- 7.15 When workers are to exit and enter the work platform in the air, two lanyards shall be provided. The one that secured the workers while they are in the work platform shall only be removed once the second lanyard is properly secured to the structure outside the work platform and vice versa. The work platform shall be secured to the structure before entering or leaving.
- 7.16 Workers working over water shall wear life buoyant work vest or life jackets complying with any Acceptable International Standard.
- 7.17 Maximum lifted weight shall not exceed 50% (fifty percent) of the rated load of the crane under the planned condition
- 7.18 A test lift with at least 125 % of the maximum intended load must be performed before every personnel lifting.
- 7.19 Never lift personnel with the test weight attached.
- 7.20 If welding work is required to be done from the basket, all electrode holder must be protected to prevent contact with metal part of basket.
- 7.21 To comply with other requirements of ISO 12480-Part 1: ANNEX C (Safe Use of Crane)



*Fig. 24 Permanently installed access equipment*

## **6.5 Permanently Installed Access Equipment**

A permanently installed access equipment is an item of plant which consists of a structure or trolley installed permanently on a building or structure and designed to raise or lower a cage or swinging stage.

Principals, persons in control of the workplace and employers shall take all practicable steps to ensure that the permanently installed access equipment is only used within its design criteria by competent persons. Manufacturers shall supply maintenance and operating instructions which shall be available to all relevant parties. Safety harnesses and lines shall be worn. (See Fig. 24).

## **Section 7: Safety Nets**

### **7.1 General**

Safety nets must comply with BS 3913:1 982 Industrial safety nets or any acceptable Industrial Standard and shall be of a type tested and approved by a testing body approved by the Director General. Safety nets shall be rigged by a trained personal who can demonstrate specialised training in this field.

Safety nets suspended under work areas may be a satisfactory means of protection in the event of a fall, while also allowing the maximum flexibility

Nets must be inspected daily for signs of wear or damage and rejected if any is found.

Nets must be stored in dry shaded areas with good air circulation.

Nets must be protected from combustible materials, chemicals, welding slag or any damage.

## **Section 8: Safety Lines, Belts and Harnesses**

### **8.1 General**

The construction, selection, checking, rigging, and use of all belts, harnesses, lines and fall arrest devices shall comply with accepted international Standard.

An evaluation of the work method should be carried out in order to select the most appropriate work method and fall-arrest equipment.

All equipment shall be regularly inspected and tested to ensure it complies with MS Standards or other Accepted International Standard.

Equipment must be given a careful visual inspection by a trained personnel every time it is used.

Always ensure that the equipment is being used in conformity with the manufacturer's instructions.

The rigging of static lines, anchorage lines and restraints is a skilled operation that shall be carried out by trained personnel.

People using such equipment must be trained or supervised to ensure that all belts or harnesses are correctly fitted, with lines properly anchored and adjusted.

When a person wearing a safety line moves around, the line may move across the work area and get tangled around obstructions. This could jerk or jam the line and overbalance the wearer. The line may also hook under and dislodge objects such as roofing tiles or loose bolts, causing them to fall and create a hazard.

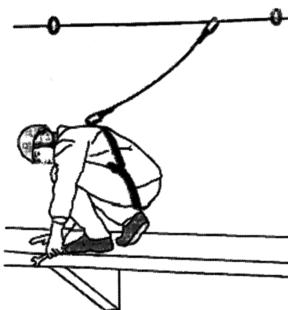
Where work operations such as gas cuffing, grit blasting, or using sharp cuffing tools is being carried out, precautions shall be taken to prevent wear and damage to any of the equipment. Protection could include using short steel wire lanyards, protective covers around lines, or other measures.

Where chain or wire lanyards are used they must be used in conjunction with a personal energy absorber.

### **8.2 Travel-Restriction Systems**

A travel-restriction system generally consists of a safety belt or harness connected by a line to an anchorage. The system shall be rigged in such a way that it will stop a worker reaching a position from which a free fall is possible. If a free fall is possible, a fall-arrest system including a harness must be used, not a travel-restriction system.

Travel-restriction systems may include safety belts fitted with groin or butt straps for greater comfort such as pole straps used by electrical linesmen where they risk a restrained fall.



This equipment must be adjusted to reduce the restrained fall to the absolute minimum. This must be less than 600 mm.

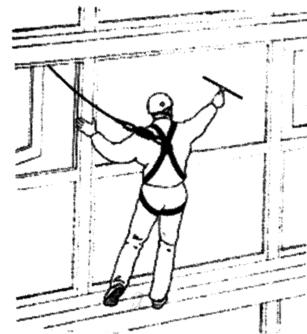


Fig. 25 Restraint system

Fig. 26 Fall arrest

### 8.3 Fall-Arrest Systems

Fall-arrest systems are designed to support and hold a person in the event of a fall. They are not designed to support a person while working. This would be a work-positioning system. An evaluation of the different types of equipment combined with a task assessment is needed to make a practical and safe selection for a particular job.

The arresting force applied to the worker should a fall occur must be less than 6 kN using a 2 metre lanyard with a personal energy absorber (tear web) or a type 2 or 3 fall-arrest device should achieve this.

The lanyard or anchor line must be attached to the top position (at chest height).

Anchorages for a lanyard should be fixed as high as practical but within easy reach. An anchorage at foot level will allow a person to fall the length of the lanyard plus the distance between the anchorage and harness fixing point.

All attachment hardware shall be designed to withstand a load 15kN.

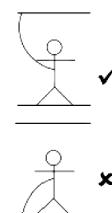
Emergency procedures must be in place so that a person suspended after a fall can be recovered before physiological injuries can occur.

#### **Fall Factor:**

*Is the length of the fall divided by the length of the lanyard assembly, e.g:*

1. *Length of lanyard is 2 metres, length of fall is 2 metres, fall factor equals 1.*
2. *Length of lanyard is 2 metres, length of fall is 4 metres, fall factor equals 2.*

**Maximum fall factor allowed is a fall factor of 1**



A horizontal rail and trolley system fixed to the building or structure can be used as an anchorage. Refer to 109.8 Window Cleaning for further detail.

## 8.4 Static Line and Anchorage Techniques

A static line is a horizontal line that is anchored at both ends and rigged so that a fall-arrest device or lanyard can run along its length. The force on the anchorage points of the static line will be considerably greater than those on an anchor line. This is because the anchor line is in direct tension along its length while the static line is under tension

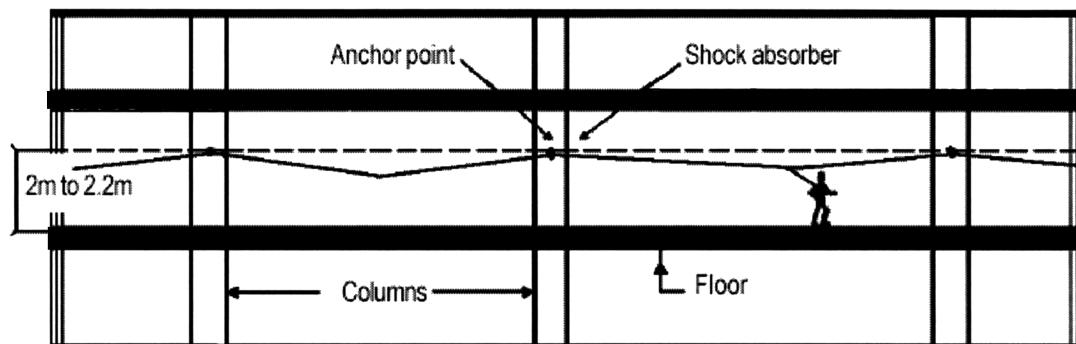


Fig. 27 Fixed static line with a shock absorber for use with safety harnesses and lanyards

at right angles between the anchorages. Special shock-absorbing units that attach to the static line are available to reduce this force to an acceptable level. These are not the same units as used in a lanyard.

Specialist advice and training is needed in the rigging of static lines.

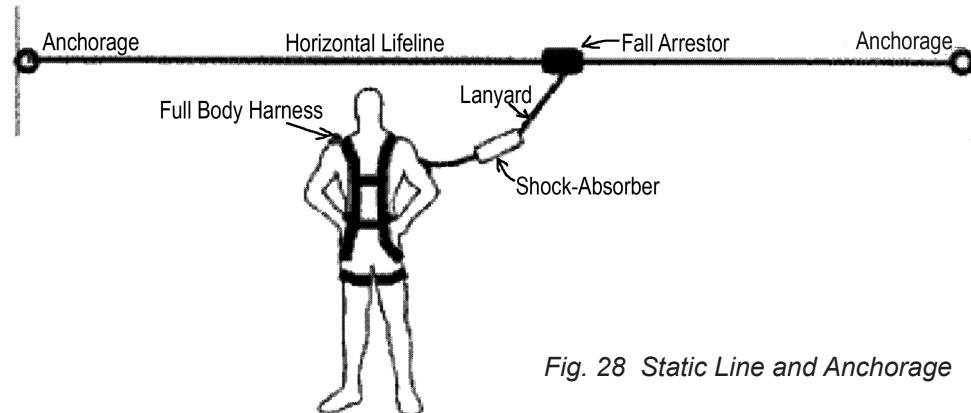


Fig. 28 Static Line and Anchorage

The static line must have a minimum breaking strength of 44 kN unless it is an engineered design.

When planning the site layout and sequence of construction for installing a static safety line system, consideration should be given to the most appropriate fall-arrest system and method of installation.

The correct tensioning of the static line can be achieved by a framed turnbuckle or a removable ratchet and pawl. The static line must be correctly tensioned. Where a slack static line is suddenly pulled by a person slipping, this could jerk others off balance, causing harm. An over-tensioned line will exert too much force on the anchorage points, and reduce the amount available to arrest the fall.

Care must be taken to ensure that loose objects between the anchorage and the worker cannot be dislodged by movement of the lines.

Do not use guardrails as an anchor: they are not designed to take the forces involved in arresting a fall.

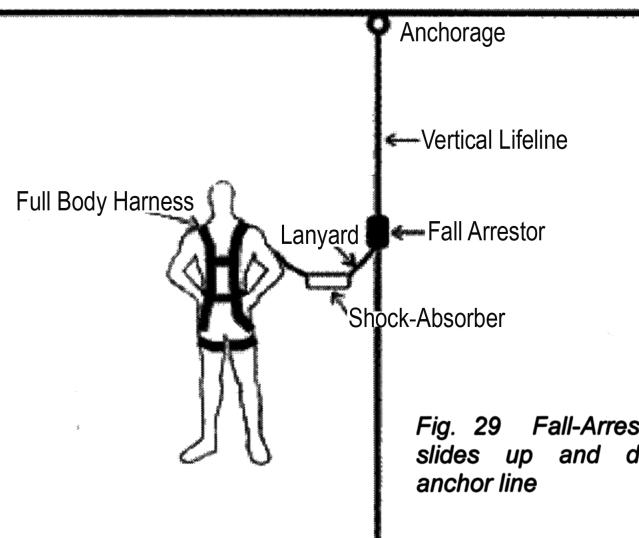


Fig. 29 Fall-Arrest Device slides up and down an anchor line

## 8.5 Type 1 Fall-Arrest Device (Inertia Lock)

This consists of a unit that will slide up and down an anchor line and will lock onto the line in the event of a person falling. In permanent applications, non-corrosive rails and stainless steel lines can be attached to structures such as chimneys, towers or vertical ladders. Other types of anchor lines that may degrade over a short-term period should be rigged each time they are needed.

The maximum length of a lanyard used between the harness and a type 1 fall-arrest device, including the energy absorber, is 2 metres.

All lanyards shall be rigged and used with the least possible slack by keeping the arrest device above head height.

Where a vertical ladder rail or similar system is being used for a restrained

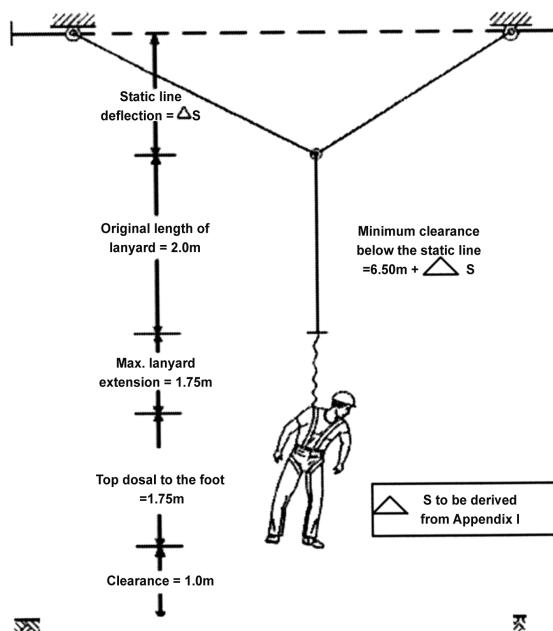


Fig. 30 Required minimum clearance below the level of the line anchorages

## 8.6 Type 2 and Type 3 Fall-Arrest Devices (Inertia Reels)

These are a spring-loaded reels that fix to an anchorage. An anchor line plays out as a person moves away from the reel and is reeled back as the person approaches.

The difference between types 2 and 3 is that type 3 can be used as a winch to allow a person to be wound back after loading the unit. With this equipment, the anchor line is attached directly to the dorsal position on the harness.

Do not use a lanyard in conjunction with a Type 2 or 3 arrest device: the anchorage line attaches directly to the harness.

### PENDULUM EFFECT

This is a potential hazard with the use of individual fall-arrest systems.



## SWING DOWN

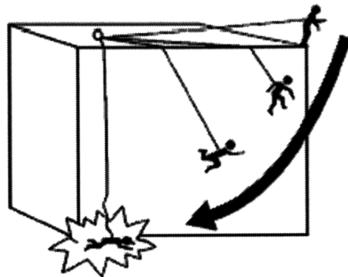


Fig. 31 Swing down

This can occur if an inertia reel or work-positioning device is extended diagonally so that the line makes an extreme angle with the perimeter edge of the structure. In this situation, the forces generated in an arrested fall over the edge will cause the line to rotate back along the perimeter edge until it reaches a position directly in line with the anchorage point of the inertia reel and at right angles with the perimeter edge.

As the line moves back in this way, its unsupported section lengthens, thus dropping the attached worker further than the original (arrested) fall distance. If the length of the unsupported line equals the height of the building, then the worker will hit the ground.

To eliminate the pendulum effect, place the anchorage point perpendicular to the position of the line at the perimeter edge. A mobile anchorage helps here. The use of second anchorages and belay devices is another way of minimising this effect.

## SWING BACK

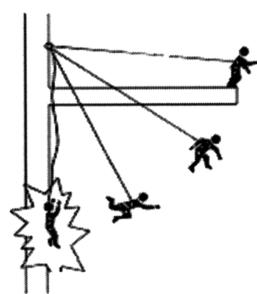


Fig. 32 Swing back

In an arrested fall, particularly from a perpendicular edge, a person will swing back into the building structure and collide with any obstructions in the path of the swing. If this situation can arise, the use of an individual fall-arrest system should be re-assessed.

**The “pendulum effect” requires consideration prior to deciding the location of anchorage points.**

## 8.7 Work-Positioning Systems

Work-positioning Systems are designed to provide the primary means of support and restraint for the user. They shall be design and rigged to allow a person to work safely and in reasonable comfort.

A full harness and safety system shall be used.

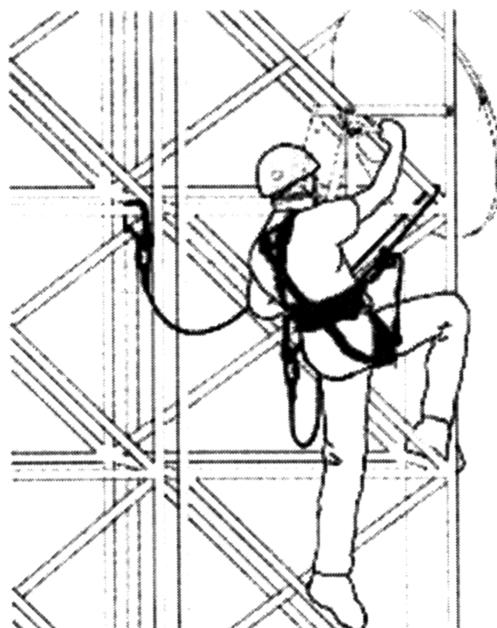


Fig. 33 Work positioning



## Section 9: Roped-Access Systems

### 9.1 General Requirements

This section states some of the most critical requirements but is not comprehensive or a prescription for a safe industrial roped-access site. Industrial roped-access systems are a specialised form of work positioning system used to gain access to a workplace by ascending or descending twin ropes fixed to secured anchorages. A combination of descenders and various types of ascenders and rope grabs are used while the person is supported in a harness.

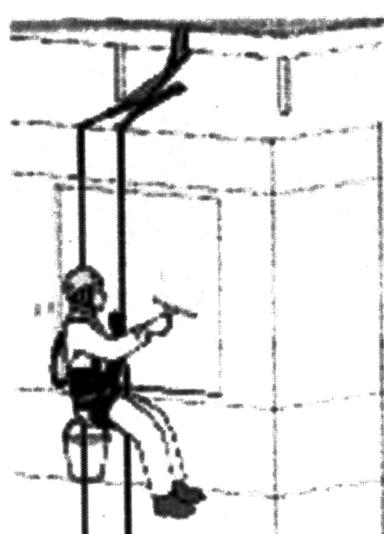


Fig. 34 Roped access

The selection, rigging and checking of all rope access components and assemblies shall comply with industrial rope access systems of accepted International Standard.

Systems should only be used in situations from which workers can be rescued promptly. Whatever the type of harness, motionless suspension is not physiologically safe and can rapidly lead to faintness and serious blood circulation problems. **Brain damage or death can occur in under 10 minutes.**

Employees or self-employed persons carrying out this work need to be physically fit and, to ensure safety, they must have a high standard of training and experienced supervision.

Personnel setting up and using such equipment shall be able to demonstrate their level of expertise and experience. Personnel with training, but without significant experience, should have experienced close supervision.

An operational emergency system and plan, including any necessary (and compatible) rescue recovery equipment, shall be immediately available on site and the required persons shall be trained in its use.

A minimum of two trained industrial roped-access operatives shall be present at the workplace at all times while industrial roped access methods are being used. The second person needs to be present in order to trigger or provide backup and emergency assistance as detailed in the emergency plan. To be effective the workers must be in reasonably distance and constant visual contact with one another.

The anchorage area are closely and constantly monitored at all time by the supervisor who is also trained in the industrial rope-access system to avoid unnecessarily tampering by any unauthorized personnel. Proper signages should be place to inform that there is work in progress.

Work shall not start where high winds and environmental factors will result in a serious hazard.

All operators shall be required to carry at all times while suspended means of both ascent and descent regardless of the anticipated nature of the job.

All tools and other items shall be attached by a cord to the operator employee or the harness, unless another effective method is used to stop presenting a falling hazard. Any item over 8 kg or of a shape that is difficult to handle shall be lowered and supported on a separate line. Care must be taken to ensure that any item dislodged does not fall and create a hazard for those below.

All suspension equipment must be individually identified and should be checked on a daily basis by a competent person. Many equipment items will have specific inspection and maintenance requirements and inspection and service records will need to be kept.

## 9.2 Anchorage

The structural adequacy of anchorages shall be assessed by a competent person. In some cases engineering advice will be needed:

- Anchorages shall be capable of holding a minimum ultimate force of 15kN in all directions in which the anchor might be loaded in use.
- If two person's load might be transferred to one anchorage, it shall be able to hold 21kN.
- Friction or chemical anchors should not be used without being inspected and proof loaded.
- Permanent anchorages specifically installed for industrial rope access (or fall arrest) work shall be clearly labelled as such and marked with their ultimate (failure) load. Annual inspection and proof loading will be required.
- Needles, brackets and parapet hooks shall comply with the same standards as for scaffolding, and must not be subject to any shock loads.

## 9.3 Ropes and Rigging

The industrial roped-access system is based on a twin rope concept with independent primary (working) ropes and secondary (safety, backup) ropes.

- Each rope (working and safety) shall be attached to two independent anchorages, via two independent sets of attachment hardware. If an anchorage is unquestionably adequate, or engineer designed and tested for such purpose, both sets of attachment hardware might be connected to the one anchorage.
- The safety rope shall be attached to separate anchorages to the main rope, unless the anchorages are unquestionably adequate or engineer designed and tested for such purpose. Separate attachment hardware shall be used for both ropes.
- All ropes shall be a minimum of 10.5 mm in diameter and shall have a minimum ultimate strength of 25kN. Ropes should be of kernmantle construction. Users might consult EN 1891:1998 *Personal protective equipment for the prevention of falls at height: Low stretch kernmantle ropes*, or AS 4142.3 *Static rescue lines* as a standard for ropes for industrial roped access

- Working and backup ropes will normally be of static (low stretch) type. Dynamic ropes have specialist purposes within industrial roped access work but should not be used as main support or backup ropes.
- All ropes and equipment should be individually identified and checked on a daily basis by a competent person.
- All ropes shall be protected from fraying or wear. When they come into contact with sharp edges or rough surfaces, sleeves, radius protection or other means of protection should be used.
- Ropes shall not show any significant signs of abrasion or other damage. The kern must never show through the outside mantel or sheath.

Note: Inadequate rigging can create unacceptable and dangerous loadings in industrial roped-access equipment. Correct training and experience is essential.

#### **9.4 Harnesses and Lanyards**

The harnesses used shall be a one-piece full-body harness or a sit harness used in conjunction with a chest harness that is firmly attached to the sit harness.

Constant monitoring of safety standards and equipment is essential.

Lanyards and lanyard assemblies are usually used to connect the user's harness to the backup device on the safety rope. They will also be used for fall arrest purposes.

- All harnesses should be rated for fall arrest and should allow the user to be comfortably supported in a semi-sitting position. Harnesses should conform with accepted international standard.
- If swing chairs (suspended seats) are used, they must not be an integral part of the safety system.
- Lanyards must have a minimum breaking strength of 15kN and should comply with the requirements of accepted international standard.
- The overall length of lanyards in industrial roped-access systems should limit the maximum possible lanyard freefall to 600 mm.

#### **9.5 Descenders**

Descenders shall be designed and constructed to safely and effectively control the speed of descent. This control should be exercised by means of an adjustable rope path through the device using a dead-man-type handle. The descender shall be capable of holding the operator with their hands free. It shall not be able to be removed from the rope while the rope is under tension.

## **9.6 Rope Grabs (Ascenders and Backup Types)**

Ascenders shall have similar safety requirements as descenders. They shall not be removable under tension and be of a dead-man-type that grips the rope in a downward direction.

Ascenders shall be constructed so that it is not possible to move the device down the rope without a deliberate hand action. They shall not damage the rope in normal use.

Backup-type rope grabs, when deployed, must not damage the rope or slip down the rope more than 1.5 m, and must keep the peak-arresting force below 6kN.

## **9.7 Safety System**

A complete safety backup system, independent of the main system, shall be in use. It should be capable of arresting any fall within 600 mm (excluding the effect of any energy absorber deployment) with a maximum arresting force of 6kN.

Normally the safety system will be comprised of a backup-type rope grab connected to a second static rope, independent of the working rope.

This system must be rigged so that it automatically comes into operation if the main system malfunctions.

A person must be securely attached to both ropes before moving off a roof or landing.

All persons should wear a safety helmet with an enhanced chin strap while working in suspension or where a fall situation is possible.

## **9.8 Connectors**

Snap hooks and karabiners shall be of the self-closing type and self- or manual locking to reduce the possibility of involuntary opening. They shall be capable of being opened only by at least two deliberate and concurrent actions.

## **9.9 Public Safety**

An exclusion zone must be established at the base of every worksite open to the public to prevent access. This zone is to be adequate, allowing for the type of work being carried out and the prevailing conditions.

## Section 10: Building Construction and Plant Maintenance

### 10.1 Excavations

When walkways are provided to permit employees to cross excavations deeper than 2 metres, such walkways shall be fitted with guardrails. Bump rails shall be erected 2 metres back from such excavations where guardrails are not in place. When the public have access to the edge of any excavation, barriers or guardrails shall be erected to prevent falls. Where excavations contain water; they shall be effectively fenced to prevent access by children.

### 10.2 Hoisting or Unloading Areas

Every person working in a hoist area or on a load-landing area must be protected from a fall of more than 2 metres by a guardrail or other fall protection. If guardrails or portions of a guardrail are removed to facilitate hoisting operations or landing of lifted materials, and the worker must work close to or lean out over the edge, that person shall use a fall-arrest system.

### 10.3 Holes and Pits in Floor Areas

Any hole in a work area can cause serious injury from falls, regardless of its depth. All holes or penetrations in floors or work areas shall be covered with a secured cover; built to the standard of a light-duty platform or such greater load that could be imposed on it. Where such covers are not practical, guardrails with toe board or barriers shall be erected around all sides. Where persons are working in such pits, fall protection should still be in place.

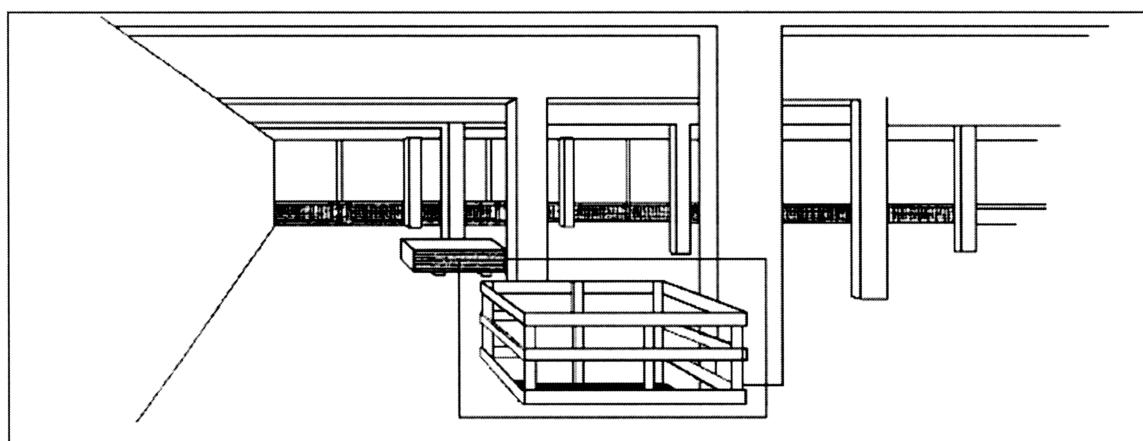


Fig. 35 Guardrails at all openings

## 10.4 Wall Openings

When a wall opening for a door; window or other service leaves an exposed edge from which a person could fall more than 2 metres, such wall openings shall be fitted with a guardrail.

## 10.5 Floor and Work Platform Perimeter Edges

The exposed edges of all floors and work platforms from which a fall of 2 metres is possible shall be fitted with guardrails. Toeboards shall also be fitted if objects can fall from the edge and endanger others below. Where guardrails are impractical, other means of fall protection shall be available and used. While erecting such guardrails, employees shall use other means of fall protection such as harnesses and lines. Bump rails 2 metres back from an exposed edge may be used where the employer can ensure no person will climb over between the bump rail and the edge.

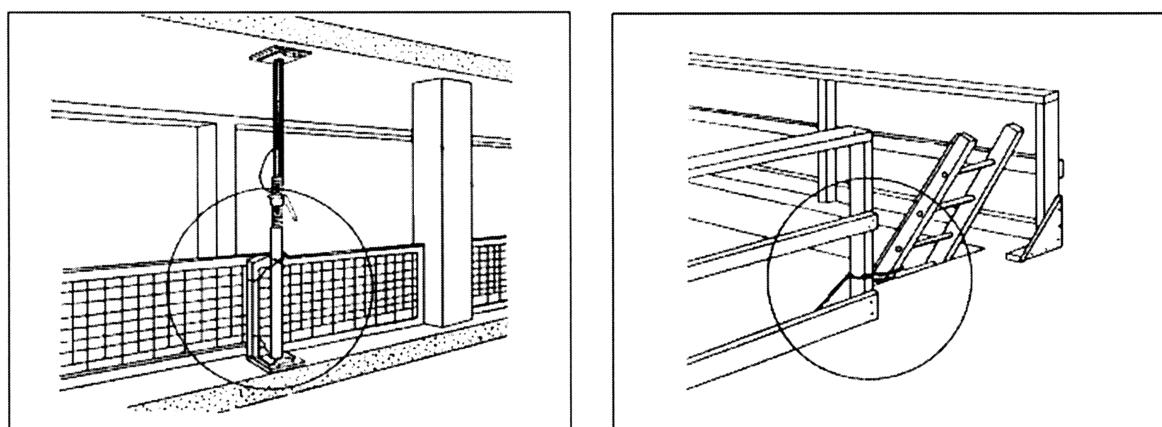


Fig. 36 Tie-off

## 10.6 Shafts and Ducting

Shafts and other similar ducts having wall or floor openings shall have such openings fitted with guardrails and toeboards unless fitted with a cover suitable for use as a fully-decked working platform. Persons who work in shafts shall use a fully-decked working platform, or shall use a fall protection system, to prevent a fall of more than 2 metres.

## 10.7 General Maintenance

Maintenance and cleaning of exterior plant or equipment, such as windows or air-conditioning equipment, on roofs and ledges, etc. requires safe access and fall protection. Employees should be trained in the use of equipment and fall-arrest systems as required.

Individual employees may be sent to do maintenance work where the employer may not be fully aware of all the circumstances until

the employee has found the fault. Under these circumstances, the employee shall have received full training in hazard assessment and control so that the employee, on behalf of the employer, can make the correct choice of fall protection to suit the conditions.

## 10.8 Wall Maintenance and Window Cleaning

All window cleaning systems should comply with accepted international Standard.

Suitable safety harnesses and lines shall be worn by the employee undertaking any window cleaning work. All the window should be within easy reach of the cleaner without the need to overreach or stand on tiptoe.

The design, installation and maintenance of permanent anchorages, rails, trolleys and travelling ladders, etc. shall be approved by a professional engineer.

The engineer shall take into account the effects of age, climatic conditions, impact and wind loading in the design.

All outriggers, stages and boatswains chairs shall comply with the accepted international Standard.

Permanently Installed Access Equipment shall comply with the Building Act and relevant codes.

Rolling ladders and similar equipment must be secure and stable. When secured on ledges or spandrels where persons risk a fall of over 2 metres in height, a fall-arrest system shall be used.

All access equipment should be inspected every monthly interval or before use. Such inspections should be recorded.

## 10.9 Roof and Roof Plant Maintenance

Where regular maintenance of plant or equipment needs to be carried out on roofs, ramps, crawl boards, access ladders should be installed and comply with Section 3: Permanent Fixed Access and Platforms.

Brittle roofing is a major hazard and cause of serious harm:

- Translucent and brittle roofing materials may have weathered to become almost indistinguishable from their surroundings.
- Brittle areas may have been painted to match the rest of the roof.
- Corrosion because of age or chemicals in the building can impair roofing material so it can no longer support the weight of employees.

All roofs should be treated as brittle until a close inspection reveals otherwise.

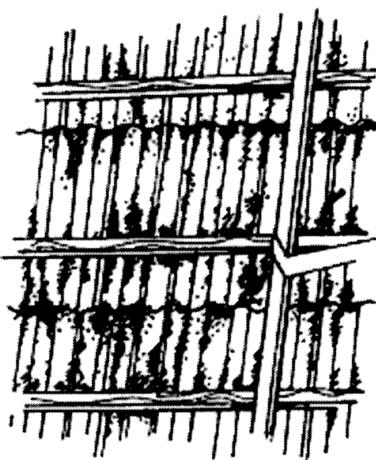


Fig. 37 Severe deterioration of roofing materials may not be readily apparent from the upper surface. Inspect the underside of brittle roofing materials for hazards

Roofs that need regular cleaning or maintenance and that provide secure footing should be fitted with permanent perimeter protection and access ladders. Any skylights or other brittle areas in such roofs should have safety mesh or strong covers fitted under or over them, or guardrails fitted around each side of the suspect area.

A bump rail may be used provided it is successful in keeping all people at least 2.0 metres away from the brittle areas.

Where an employee is required to work closer than 2 metres to the edge of any roof or from where a fall is possible, fall protection or edge protection must be provided.

As a minimum standard on roofs from which a person may fall 2 metres or more:

- On completed roofs that provide a secure footing, edge protection, fall protection or bump rails 2 metres from the edge shall be used.
- On roofs that do not provide secure footing, or are steeper than 30 degrees, fall protection, work positioning systems or permanently installed access and platforms shall be used (see Section 10).



Fig. 38 Danger signs to be fixed at points of access to the roof

## **Section 11: Structural Steel Erection**

### **11.1 General Safety**

Rigging work is a high-hazard occupation requiring a high standard of knowledge and careful planning in order to achieve an adequate level of fall protection. Employers shall assess the work and decide on the methods of fall restraint and the equipment needed. This equipment must be on site before any erection work starts.

All persons involved in steel erection shall be competent at rigging and in the use of work positioning and fall-arrest systems. Plant, equipment and systems used shall comply with the relevant sections of this guide.

Employers should endeavour to provide an enclosed work environment by the use of scaffolds, elevating work platforms or other safe alternative methods.

### **11.2 Workplace Safety**

The erector will check with the principal or main contractor that footing concrete, holding down bolts, etc. have reached the specified strength to allow erection to start.

Each structural component shall be carefully placed and braced in position as work proceeds. Temporary bracing and propping shall allow for wind and seismic loads that may occur during construction.

While climbing around the steel, riggers should not carry equipment in a way that does not leave their hands free. Lines and bolt bags or tool frogs can be used to carry small items, or equipment can be lified with lines. Throwing up bolts, etc. can cause a hazard to the rigger and to other people if the rigger misses a catch.

Safe access equipment and plant could include:

- Work platforms, crane lift platforms or correctly built scaffold and work stages;
- Temporary lightweight work platforms that can be attached or hung to the steel work;
- Temporary work platforms that can be erected and used later for ceiling or pipework erection;
- Safety nets that can be slung under floors;
- Harnesses and anchorage techniques for fall-arrest systems;
- Remote release shackles.

### **11.3 Reducing Work at Heights**

When possible, the need to work at heights should be avoided or reduced to a minimum. Alternative means of erection which may reduce this need could include:

- Connecting as much steel work as possible on the ground or from a working platform;

- Planning for connections to be at points that are safe and easy to reach;
- Using remote-release shackles and systems on lifting gear;
- Fixing anchorage points to steel work for fall-arrest systems before the steel components are in place.

## 11.4 Access to Places of Work

Careful consideration should be given to the hazards involved in climbing on to structural steel. Planning could consider the following:

- The erection sequence should be designed so that permanent stairs, floors, landings and wall panels, etc. are installed as soon as possible as work progresses.
- Fixing temporary ladders to steel components or temporary stairs to sections should be done before erection.
- Access to hazardous areas should be restricted to persons directly involved in the erection process.
- Crane lift platforms, scaffolding or other means of access may be needed. Walking on the top of the steel should be avoided if at all possible. Where it cannot be avoided, a fall restraint shall be used.
- Straddling the beam should be done with great care. It should occur only when a person is able to place each foot on the bottom of the flange and have both hands gripping each side of the top flange. The beam should be sufficiently free of obstructions to allow for safety and easy movement. Where work needs to be carried out from this position, a fall-arrest system shall be in place.

## 11.5 Slinging Loads

Only experienced slinger should sling loads for craneage. The slinger should check the weight and the radius of the load from the crane to ensure the lift is within the crane's capacity.

Dunnage should be used in order to prevent steel chains or wires slipping on steel components.

Tag lines should be used to assist in controlling loads during lifting and positioning. This is particularly important when the load is received by riggers who have little freedom of movement.

The slinger should have continuous communication with the person receiving the load.

The use of remote-release shackles can considerably reduce the need to climb out on the steel.

Multiple lifts of more than one steel member or bundle at a time are not advisable. It should only be allowed when the slinging methods used avoid any chance of entanglement and the lower load is removed first. The slings are hooked up to prevent entanglement and to prevent an overhead danger while the next load is being handled.

## Section 12: Roof Erection and Fixing

### 12.1 General Safety

Employers should liaise among themselves to provide an integrated fall protection method for all persons working on the roof. This should be less hazardous and more economic than every contractor installing their own system. See other sections of this guide for relevant information.

Hazards include:

- Brittle roofing such as skylights or translucent sheets;
- Roof surface, slippery surfaces from roll form dress, paint finishes or dew and rain;
- Roof pitch and projections such as pipework and flashings;
- Any roof opening/penetration larger than 600 mm by 600 mm;
- Any roof edge.

Persons on a roof shall wear the correct type of footwear to grip the roof surface. Natural rubber; flexible-soled shoes are usually best.

As a minimum standard for all roof areas:

- For areas that do not have a fall-protection barrier, a fall-arrest system shall be used;
- For surfaces that have a fall-protection barrier and provide a secure footing, an edge-protection system, travel-restriction system or a fall-protection system shall be used;
- For all roof areas that do not have a fall-protection barrier or secure footing, a fall-protection system shall be used.

A fall-protection barrier can be tile battens or roof framing at less than 500 mm centre to centre, roof safety mesh or a work platform.

On completed roofs or where persons are kept more than 2 metres from any fall hazard by a bump rail, edge protection may be unnecessary. A bump rail consists of a rail or tensioned rope supported on posts at a height of 1.0 metres.

Note: A bump rail shall not be used on a roof of greater than 5 degree pitch.

Where a bump rail is not practical, edge protection, travel restriction systems, or a fall-arrest system shall be used. Edge protection can include scaffolding or a guardrail system.

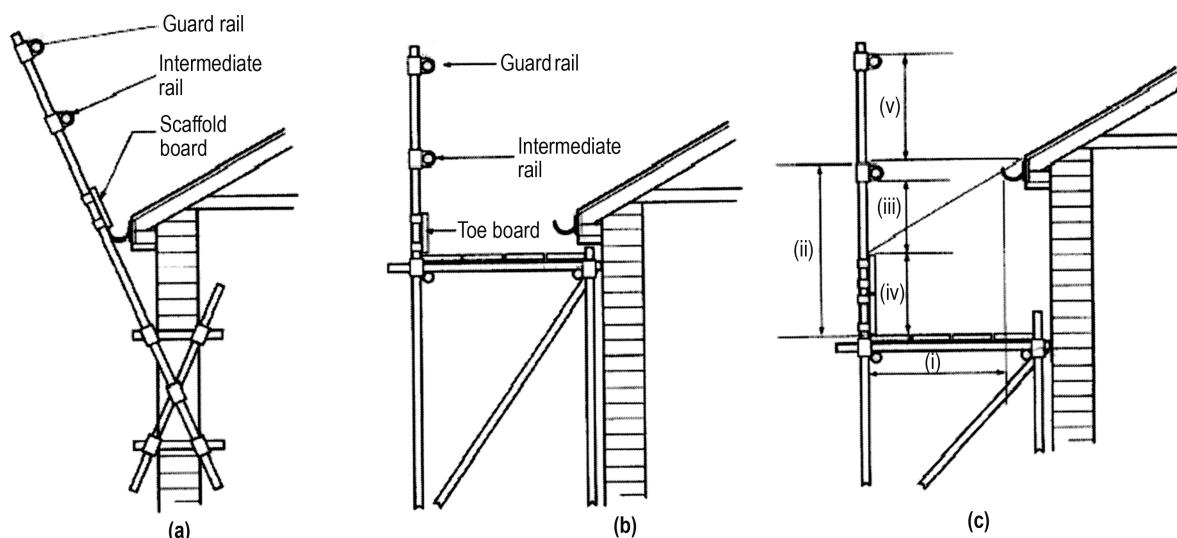
The ability of a surface to provide a secure footing will vary depending on the roofing material, environmental conditions and the type and condition of the roofer's footwear.

## 12.2 Access

Safe access must be provided to all roof areas where work is to be carried out. Such access must take into account the tools or equipment that need to be carried up. Ladder towers are preferable to ladders. Ladders are not sufficient where persons are expected to use their hands to carry materials up onto the roof. Ladders must be secured to prevent displacement sideways and slipping out from the base. All access equipment must comply with the relevant accepted international Standards.

## 12.3 Edge Protection

Full edge protection at eaves level will normally be required for work on sloping roofs. The edge protection needs to be strong enough to withstand a person falling against it. The longer the slope and the steeper the pitch the stronger the edge protection needs to be. A properly designed and installed independent scaffold platform at eaves level will usually be enough. Less substantial scaffolding barriers (rather than platforms) may not be strong enough for work on larger or steeper roofs, especially slopes in excess of 30°.



Sloping roof edge protection; typical arrangement in conventional tube and fittings

- (a) Supported from window opening
- (b) Working platform below the eaves
- (c) Top lift of a scaffold. Dimensions should be as follows:
  - (i) Working platform minimum width 635 mm
  - (ii) Minimum 910 mm
  - (iii) Maximum gap 470 mm
  - (iv) To rise to the line of the roof slope with a minimum height of 200 mm
  - (v) Gap between rails no more than 470 mm

Typical sloping roof edge protection. Barriers shown in (a) can be useful where space is limited, but they are not capable of sustaining loads so large as (b) and (c) which also provide a working platform.

Fig. 39 Edge Protection on slope roof

On some larger roofs, the consequences of sliding down the whole roof and hitting the eaves edge protection may be such that intermediate platforms at the work site are needed to prevent this happening.

If the work requires access within 2 m of gable ends, edge protection will be needed there as well as at the eaves.

Powered access platforms can provide good access as an alternative to fixed edge protection. They can be particularly useful in short-duration work and during demolition when gaps are created in the roof.

#### 12.4 Safety Mesh

Safety mesh shall comply with accepted international Standard in both its manufacture and installation.

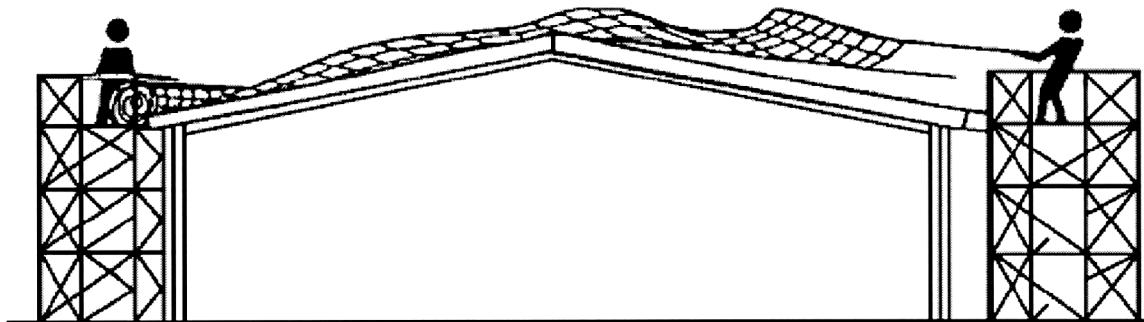


Fig. 40 Means of installing safety mesh across the roof prior to fixing it in position

When correctly installed, safety mesh will provide a fall-protection barrier for roof workers at the time of construction and for future maintenance workers where the roof contains skylights or other brittle roofing. It may be fixed over Roof penetrations to prevent the need for guardrails.

Edge protection and safety mesh provides an enclosed work environment. Mesh should be pulled over the roof by ropes or other methods, otherwise a fall-arrest system will be needed during its installation.

#### 12.5 Hoisting Roofing Materials

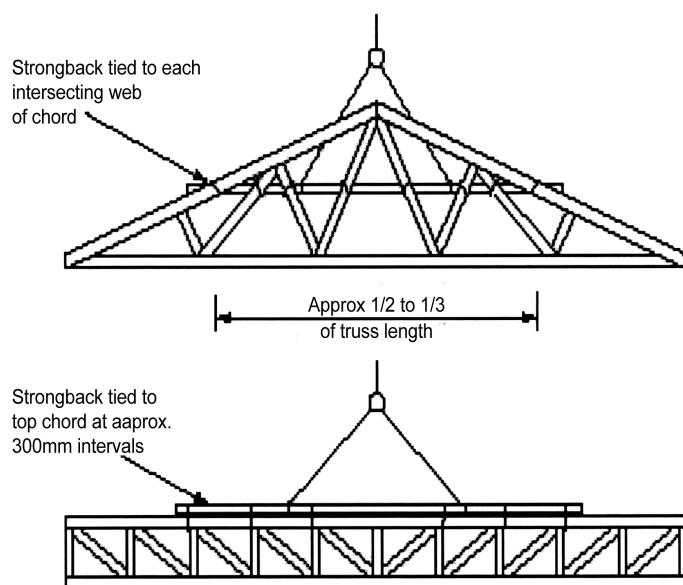
Bundles of roofing materials should be placed evenly along the roof to reduce the need for 'walking' the sheets. When hoisting a bundle of roofing, workers receiving it on the structure must have safe mobility to avoid the load. Short lanyards that restrict movement may not be acceptable.

Where safety mesh is fitted, roofers should keep at least 2 metres from any perimeter edge unless restriction systems or edge protection is in place.

All bundles should be securely banded while being lifted by a crane. Tag lines should be used to control the swinging of the bundles while they are out of reach.



Wearing leather gloves while moving sheets or bundles will reduce cut and slash injuries.



*Fig.41 The use of strongback for lifting roof truss*

Long lengths should be lifted using a strongback, particularly if being lifted by a hoisting machine or crane.

## 12.6 Concrete and Clay Tile Roofing

Tile battens may be used as fall protection barrier provided they are placed in such a manner that the workers may not fall through and of sufficient strength to span roof framing members. Battens may provide a safe platform for the batten fixer provided that work starts at the lowest point and moves up the roof. Care shall be taken to work or walk on the battens over the supporting framework to eliminate the possibility of failure. Where the roofer needs to walk up the roof framing before battens are fixed, fall protection should be provided.

Roofs of under 30 degrees will generally provide secure footing subject to the correct footwear being worn. This allows the tiler to place tiles while standing on a lower row.

On roofs over 30 degrees, it is often possible for the tiles that are not fixed to be slid up under the one above, thus forming a series of penetrations that can be used as footholds for access up the roof. This allows the placing and pointing of ridge tiles, etc. If this is not possible, a work-positioning system will be required.

Where tile battens or tiles provide a fall protection barrier; edge protection is necessary if a fall of more than 2 metres is possible.

## 12.7 Brittle Roofing

Protection from falling through a brittle roof shall be provided. Before working on any roof, employers and self-employed persons need to inspect the roof from its underside for structural soundness. Skylights of matching roof profile are a particular hazard as they may weather or be painted and so match the surrounding roof areas.

A common belief exists that it is safe to walk along the line of nail heads or roof bolts above the purlins. In reality; this is similar to walking a tight rope.

Fall protection shall be provided where roofing material is brittle, corroded, and no fall-protection barrier is installed.

Where only part of the roof area is brittle, i.e. skylights, such areas shall be treated as penetrations with secure covers or guardrails.

Where persons walk along internal gutters, such gutters must be 450 mm wide or fall protection should be provided.

## **Section 13: Broadcast and Telecommunication Structures**

### **13.1 General Safety**

Climbing work is a high-hazard occupation, requiring a high standard of experience and training and careful planning in order to achieve an adequate level of fall protection. Broadcast and telecommunication structures include steel monopoles, steel lattice towers and wooden poles. In all situations where a person may fall 2 metres or more, climbing protection for the employee or contractor is required. All persons involved in a rigging activity shall be adequately trained at rigging and in the use of fall-arrest systems.

### **13.2 Workplace Safety**

- A minimum of two experienced climbers shall be present on site at all times while work is being carried out.
- Work that requires traversing of open steel work is to be carried out by adequately trained climbers.
- Only adequately trained climbers are to undertake work on structures in a free-fall situation.
- All climbers that work in a free-fall situation shall wear a full body harness in compliance with accepted international Standard.
- All climbers will use belayed static lines or be attached to the structure by a lanyard at all times, unless working from platforms or cages.
- All maintenance and construction activities will fall under the scope of this work.
- In a situation where the climber is working alone, there must be a ground support person who is able, in an emergency, to summon assistance.
- Work shall not start where high winds and environmental factors will result in a serious hazard.
- All operators shall be required to carry at all times while suspended means of both ascent and descent regardless of the anticipated nature of the job.
- All tools and other items shall be attached by a cord to the employee or the harness, unless another effective method is used to stop presenting a falling hazards.
- All rigging functions on a broadcast or telecommunications structure shall be undertaken by an experienced climber.

## **Appendix 1: Fall-Arrest Systems Design Guidelines for Static Lines**

For guidance on safe use of fall-arrest systems, the following specifications are based on use by 1 or 2 persons only.

### **SINGLE-SPAN SYSTEM**

The following system specification may be used instead of using an engineer-designed system for single spans of 4 to 6 metres. No more than 2 persons are to be on the static line at any one time, and all persons are using lanyards with personal energy absorbers or another system to reduce deceleration forces to 6kN. The system specifications are:

Static line: 10 mm (minimum) diameter flexible steel wire rope (6 x 19 to 6 x 24 galvanised), minimum breaking load 44 kN, secured with a hard eye and saddles to prevent damaging the wire.

Sag: Approximately 50 mm per metre, i.e. 6 m span =300 mm of sag. This sag is most important as greater tension will increase the forces exerted on the anchor.

Anchorage: Capable of supporting an imposed load of 44 kN.

### **MULTIPLE-SPAN SYSTEM**

The specification for a multi-span system is the same as a single-span system with the following exceptions:

Sag for 2-3 continuous spans: Approximately 30 mm per metre in  $6m=l80mm$ .

Sag for 4 or more spans: No minimum sag required but line should not be over-tensioned, and span not to exceed 6 metres.

## **Appendix 2: Accepted International Standard**

1. NZS 5233:1986 Specification for portable ladders ( other than timber)
2. NZS 3609:1978 Specification for timber ladders
3. NZS 3620: 1985 Specification for scaffold plank
4. NZS 5802: 1978 Window cleaning safety
5. SAA/SNZ HB62.2:1995 Code of practice for safe erection of building steel work . Low rise
6. SAA/SNZ HB62.2:1995 Code of practice for safe erection of building steel work .Multi-story
7. AS/NZS 4576:1995 Guidelines for scaffolding
8. AS/NZS 1576:5:1995 Prefabricated splitheads and trestles
9. AS/NZS 1657:1992 Fixed platforms, walkways, stairways and ladders. Design, construction and installation
10. AS/NZS 1892.1:1996 Portable ladders : Metal
11. AS/NZS 1892.2:1996 Portable ladders : Timber
12. AS/NZS 1892.3:1996 Portable ladders : Reinforced plastic
13. AS/NZS 4387:1996 Safety mesh
14. AS/NZS 1891.1:1995 Safety belts and harnesses
15. AS/NZS 1891.3:1992 Industrial fall-arrest system and devices
16. AS/NZS 4488:1997 Industrial rope access system
17. AS/NZS 4576:1995 Guidelines for scaffolding
18. Australian / New Zealand Standard 1680.2.4:1997 Interior lighting, Part 2.4: Industrial tasks and processes, gives specific advice in relation to minimum interior lighting levels.

Part 1 : Specifications

Part 2 : Selection, use and maintenance



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PERCETAKAN NASIONAL MALAYSIA BERHAD  
KUALA LUMPUR, 2007  
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