

# Construction Hazard and Risk Control

**Lecture Title: Working at heights**

**Lecturer: Josette Cutajar**

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**Undergraduate Diploma in  
Occupational Health and Safety**

# This lecture covers the following learning objectives:

- Explain the hazards of working at height and outline the precautions necessary to control them
- Explain safe working practices for access equipment and roof work
- Outline the control measures necessary to protect other persons not involved in the work at height



# Work at Height Regulations

The Regulations have no minimum height requirement for work at height. They cover many activities, including:

- working on a scaffold or from a mobile elevating work platform (MEWP);
- sheeting a lorry;
- tree surgery;
- using cradles or rope for access to a building or other structure;
- working near an excavation area or cellar opening;
- working on staging or trestles;
- using a ladder/stepladder or kick stool for shelf filling, window cleaning and the like; and
- working in a shaft



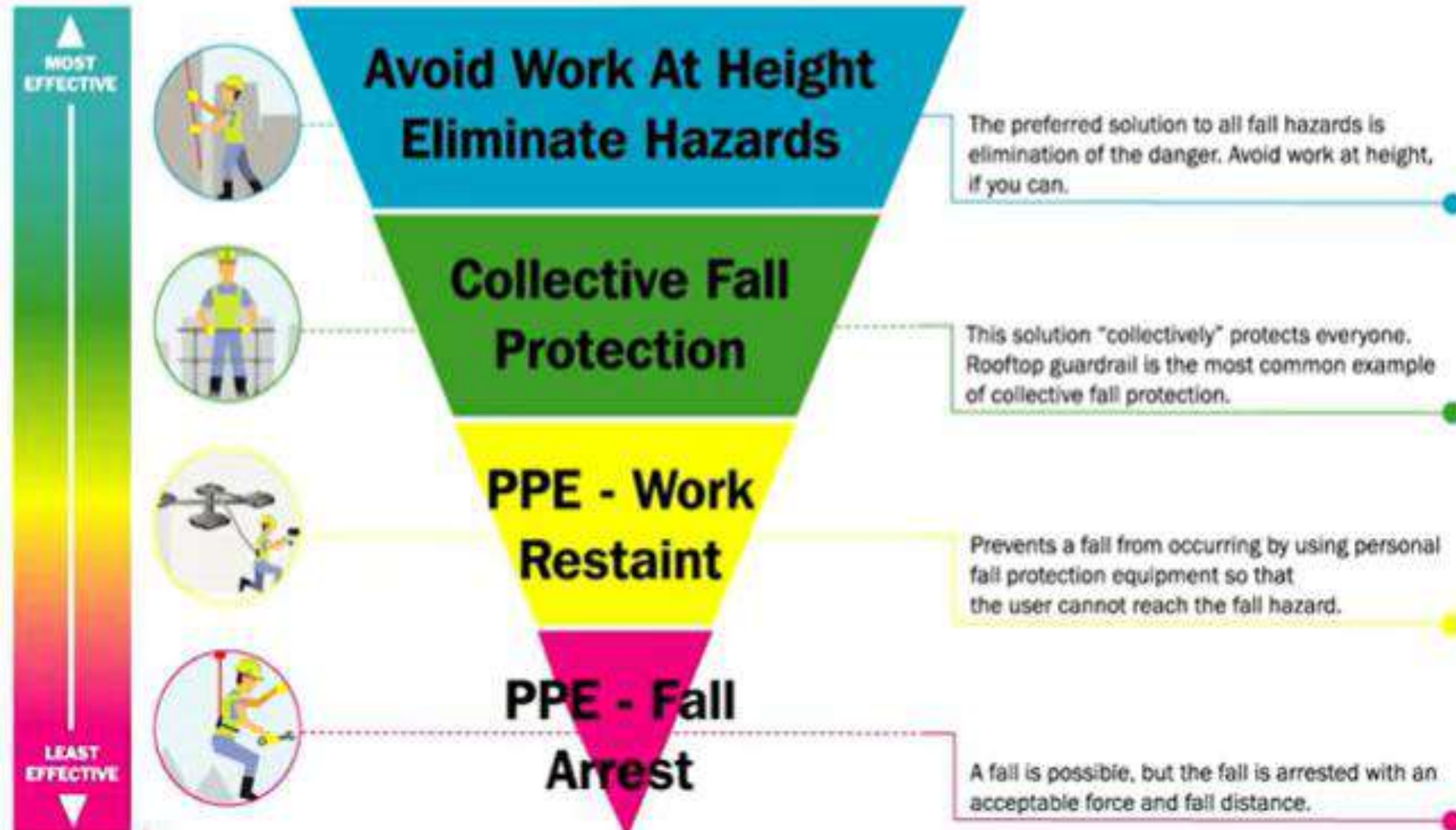
# The Regulations give the following hierarchy of control:

- The Regulations give the following hierarchy of control:
  1. Avoid working at height if possible
  2. Use an existing safe place of work
  3. Provide work equipment to prevent falls (e.g. guard rails)
  4. Mitigate distance and consequences of a fall (e.g. air bags, safety nets and, as a last resort, safety harnesses)
  5. Instruction, training and supervision.

Work at height can be reduced by completing some of the work at ground level



# HIERARCHY OF FALL PROTECTION



[https://youtu.be/F\\_Df5oh6wl4?t=133](https://youtu.be/F_Df5oh6wl4?t=133)



# A risk assessment for working at height

A risk assessment for working at height should consider the following issues:

- the nature and duration of the work;
- the competence level of all those involved with the work and any additional training requirements;
- the required level of supervision;
- use of guard rails, toe boards, working platforms and means of access and egress;
- required personal protective equipment, such as helmets and harnesses;
- the presence of fall arrest systems, such as netting or soft landing systems;
- the health status of the workers;
- the possible weather conditions; and
- compliance with the relevant legislation, in particular the Work at Height regulations



# Method Statement

A method statement for working at height should include:

- methods used to prevent falls;
- detailed breakdown of the job and any equipment to be used; and
- the name of the immediate supervisor



# Protection against falls

When working at height the following hierarchy of measures should be considered to prevent falls:

- avoid working at height, if possible;
- the provision of a properly constructed working platform, complete with toe boards and guard rails;
- if this is not practicable or where the work is of short duration, suspension equipment should be used; and only when this is impracticable,
- collective fall arrest equipment (air bags or safety nets) may be used;
- where this is not practicable, individual fall restrainers (safety harnesses) should be used; and
- only when none of the above measures are practicable, should ladders or step ladders be considered





# Protection from falling objects

Protection from falling objects could be provided by:

- the use of covered walkways or suitable netting to catch falling debris
- waste material brought to ground level by the use of chutes or hoists
- minimal quantities of building materials stored on working platforms
- hard hats worn by all employees, contractors and visitors



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# The effect of deteriorating materials and weather

- ageing materials become brittle, weaker and less stable
- high winds can affect the stability of scaffolding and ladders
- high winds can displace tools and materials and cause injuries to persons working at or below the workings
- lightning is another weather hazard to those working at height
- increased risk of skin cancer due to excessive exposure to sunlight
- cold weather can also present hazards when working at height. Guard rails become colder and the reactions of workers much slower.

# Emergency Rescue Plans

- simple and straightforward rescue method;
- proprietary schemes available for complex rescues;
- any rescue system selected needs to be proportionate to the risk;
- there should not be undue reliance on the emergency services. However, arrangements should be in place to inform the emergency services of any serious incident;
- instruction and training are essential for the teams, preferably by simulated rescue exercises;
- trained rescue teams available at all times with a designated leader; and
- awareness of suspension trauma



# Requirements for head protection

The Construction (Head Protection) Regulations virtually mandated employers to supply head protection (hard hats) to employees whenever there is a risk of head injury from falling objects. Other requirements:

- the employer must ensure that hard hats are properly maintained and replaced when they are damaged;
- self-employed workers must supply and maintain their own head protection;
- visitors to construction sites should always be supplied with head protection; and
- mandatory head protection signs displayed around the site.
- Head protection is now included in the PPE Regulations



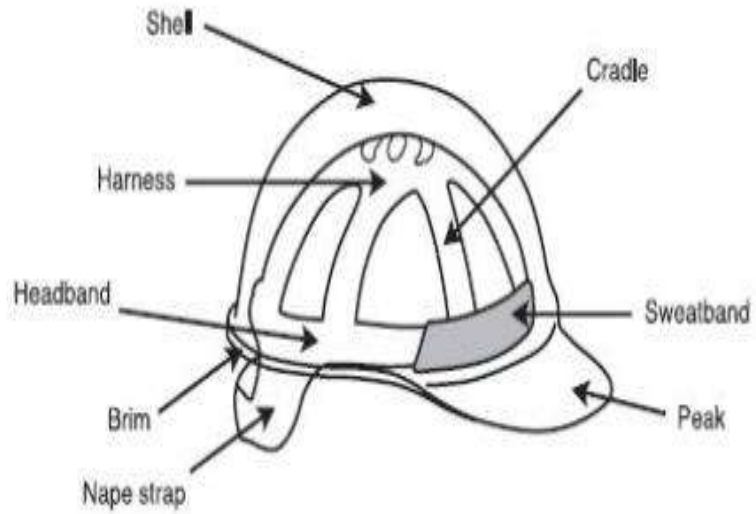


Figure D: Chin strap



Figure E: Faceshield



Figure F: Earmuffs



Figure G: Headlamp

# Inspection requirements for work equipment

The reporting requirements for work equipment inspections are:

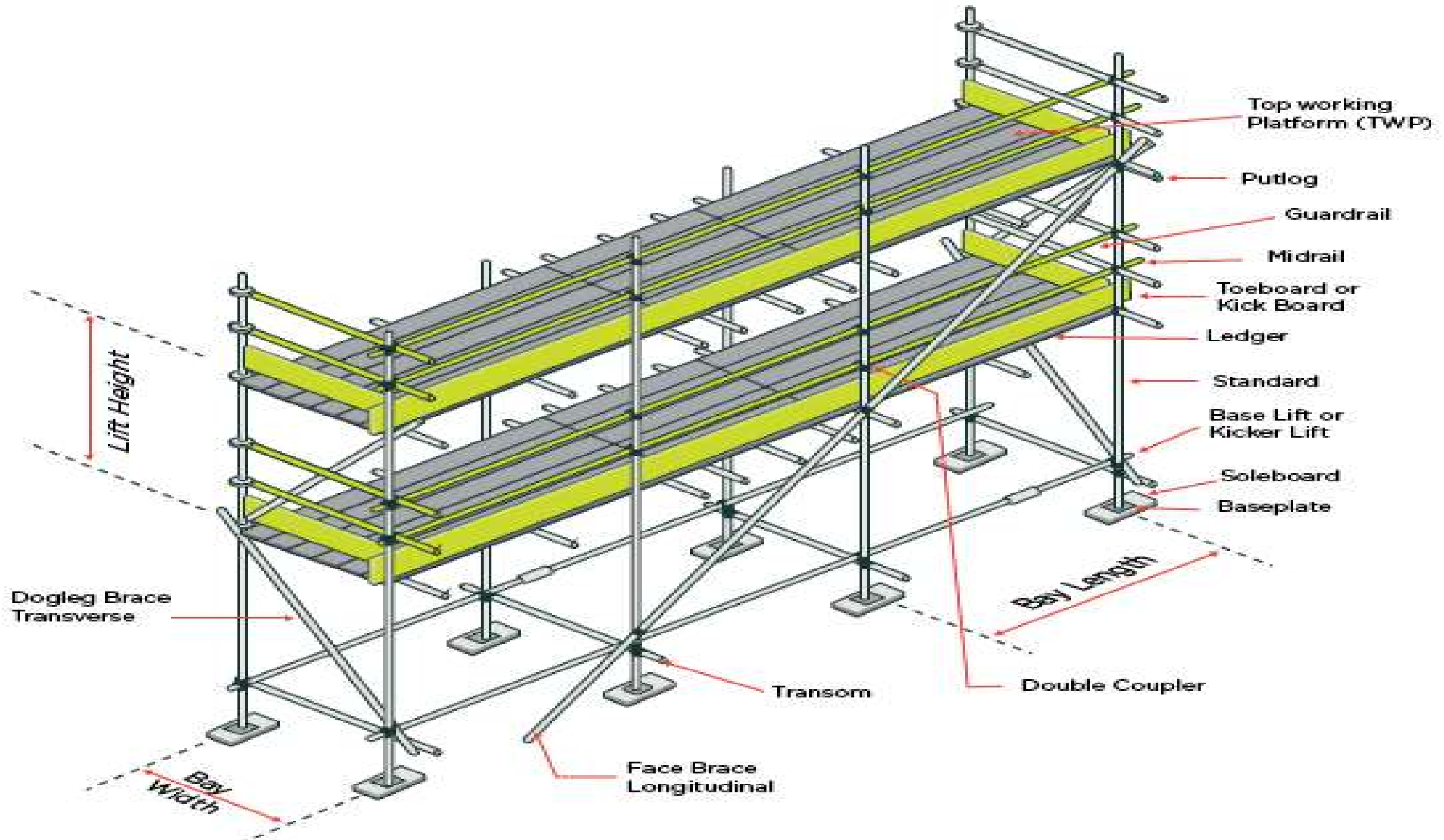
- name and address of the person for whom the inspection was undertaken;
- date and time of the inspection;
- location of the work equipment inspected;
- description of the work equipment inspected;
- date and time of the inspection;
- details of any matter identified that could give rise to a risk to the health or safety of any person;
- details of any action taken as a result of any matter identified in the previous paragraph;
- details of any further action considered necessary; and
- name and position of the person making the report



# Safe working practices for access equipment and roof work- Fixed Scaffolding

Fixed scaffolds are usually independently tied and important considerations are:

- scaffolding must only be erected and dismantled by competent people – any changes to the scaffold must be made by a competent person;
- busy town centres, the erection and dismantling of the scaffold should take place during quiet times;
- the scaffold must be designed to carry all the required loads and use only sound fittings and materials;
- adequate toe boards, guard rails and intermediate rails must be fitted to prevent people or materials from falling;
- the use of appropriate bay lengths and widths, bracing and tie-in arrangements together with edge and stop-end protection;
- the scaffold must rest on a stable surface; uprights should have base plates and timber sole plates if necessary;
- the scaffold must have safe access and egress;



# Safe working practices for access equipment and roof work- Fixed Scaffolding

- work platforms should be fully boarded with no tipping or tripping hazards;
- the scaffold must be maintained and cleaned and have proper arrangements for waste disposal;
- the scaffold should be sited away from or protected from traffic routes so that it is not damaged by vehicles;
- lower level uprights should be prominently marked in red and white stripes;
- if the scaffold must be erected near to vehicle roadways then barriers or fenders should be fitted around its base;
- the scaffold should be properly braced and secured to the building or structure;
- overloading of the scaffold must be avoided;
- the public must be protected at all stages of the work; and
- regular inspections of the scaffold must be made and recorded

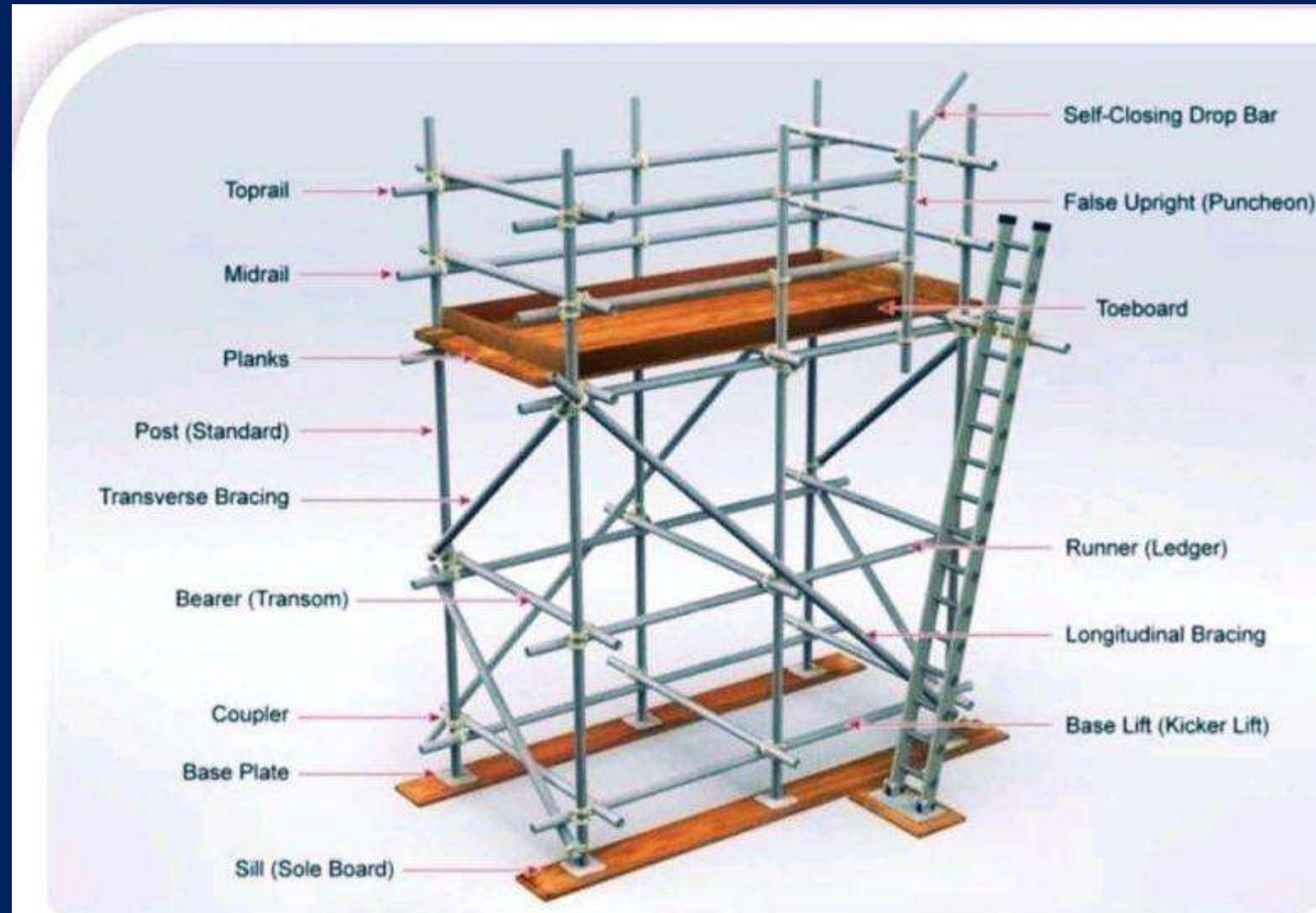


# There are two basic types of external scaffold

- ► independent tied
- ► putlog

# Components of a scaffold:

- ► Standard
- ► Ledger
- ► Guard rail
- ► Toe boards
- ► Bracing
- ► Transom
- ► Base plate
- ► Sole board
- ► Ties
- ► Working platform



# Factors affecting the stability of an independently tied scaffold include:

- poor, incompetent erection and/or a lack of regular inspections;
- the strength of the supporting ground or foundation;
- the proximity to the scaffold of any excavation work;
- the effect of excessive surface water in weakening the scaffold foundation;
- unauthorised alteration by incompetent persons (perhaps by vandals)



# Factors affecting the stability of an independently tied scaffold include:

- the use of incorrect or damaged fittings during the erection or extension of the scaffold;
- the overloading of the scaffold;
- adverse weather conditions;
- the sheeting in of the scaffold without the use of extra ties; and
- vehicular impact

# Other points on scaffolds include:

- Brick guards and debris netting should be used to prevent materials and equipment falling to the ground. Brick guards are the best means of preventing materials from falling over the toe board on a scaffold.
- The maximum permitted gap between guard rails on a working platform is 470 mm.
- For putlog scaffolds, the putlog ends should be fully inserted and securely bedded into well-constructed brickwork.
- A putlog scaffold should not exceed 45 m in height.



## Other points on scaffolds include:

- All scaffolds should have an assembly, use and dismantling plan.
- Only an authorised and competent person should erect, dismantle or alter a scaffold.
- Before accepting for use a scaffold erected by a specialist scaffolding sub-contractor, the site supervisor must check the scaffold and obtain a handing-over certificate.
- A scaffold must be inspected by a competent person after it is erected and at intervals not exceeding 7 days.
- The site supervisor, at the beginning of each week, should inspect the scaffold and ensure that any defect is rectified.

[illegible]

# Other points on scaffolds include:

- A report of the inspection and action taken should be entered in the site inspection register.
- A similar inspection should also be carried out after high winds or other adverse weather conditions.
- Any scaffold that is being erected, altered or dismantled, or otherwise not suitable for use by workers, must have a warning notice erected stating that it must not be used.
- All scaffolds must be checked at the end of each working day to ensure that access to the scaffold by children has been prevented



# The requirements of scaffold erectors:

- be competent and experienced scaffolders;
- have a good reputation and accident record for scaffolding work;
- be supervised throughout the erection of the scaffold;
- be capable of inspecting scaffolding materials and equipment before they are used;
- be equipped with personal lifelines which must be attached at all times while working at height; and
- have attended a specialist scaffolding course and be able to provide documentary evidence that they have successfully completed the course.



# Design of loading platforms involves the following features:

- the platform is built by laying scaffold boards across the transoms and, normally, at least three support points are required for each board;
- there must be a slight overhang (50 to 150 mm) across a support at each end of the board;
- boards are normally butt jointed;
- toe boards and guard rails, at least 950 mm above the working platform, must be fitted inside the standards along the edge of the working platform;



# Design of loading platforms involves the following features:

- ladders used to access the loading platform must extend at least 1 m above the level of the platform;
- all stacking of materials and equipment, such as bricks, must be as close to standards as possible to enable the added weight to be more evenly distributed throughout the scaffold;
- the boards need some additional fixing to the structure so that they are protected from lifting during high winds; and
- the width of the platform varies with the type of work being undertaken, from a minimum of three boards to a maximum of seven (when trestles are to be used on the platform)



# Relevant points for the design of all working platforms, whether loading or not, are:

- they must be wide enough (at least 600 mm) to allow people to pass each other and for any required equipment or materials to be carried and stored;
- they must be free of openings and trip hazards;
- if members of the public are able to pass beneath, a double-boarded platform with a sheet of polythene placed between the boards may be necessary to prevent debris or tools falling on them



# Relevant points for the design of all working platforms, whether loading or not, are:

- the principal hazards associated with working platforms are overloading, the fall of materials, tools and equipment, and slips, trips and falls of people working on the platform; and
- good housekeeping and supervision are essential on all working platforms

# If materials are stored on a working platform, then

- the platform must be strong enough;
- the platform must not become unsafe for other workers; and
- the materials must be secure and not be moved by strong winds.
- A working platform must be inspected before its first use and after every 7 days

# Scaffold Hoist

- well maintained, inspected regularly and in good working order;
- positioned on firm and stable ground;
- erected by trained and experienced people who will follow the manufacturer's instructions and ensure that the hoist is properly secured to the supporting structure;
- operated by a driver who is properly trained and competent;
- properly protected at either end; and
- marked with safe working load and control functions



# The main hazards associated with hoist operations are:

- failure of equipment due to lack of maintenance;
- incorrect positioning of lifting appliance;
- insecure attachment of load and falls from the platform;
- unstable slinging of loads (hook not over centre of gravity);
- contact with overhead electricity cables;
- lack of operator training;
- no banksman used when driver's view is obscured; and
- incorrect signals used

# The following additional precautions may be needed:

- the controls set so that the hoist is operated from one position only (normally ground level)
- all the landing levels must be clearly visible by the operator from the operating position
- the hoist way must be enclosed at working platforms or window openings
- gates must be provided at all landings and at ground level

# The following additional precautions may be needed:

- the gates at landings are kept closed except during loading and unloading
- there must be no significant gap between the hoist platform and the landing
- loads, such as wheelbarrows, should be securely chocked and not overfilled
- loose loads, such as bricks, should be carried in proper containers or a hoist with an enclosed platform should be used



# The following additional precautions may be needed:

- loads, such as wheelbarrows, should be securely chocked and not overfilled
- loose loads, such as bricks, should be carried in proper containers or a hoist with an enclosed platform should be used
- the platform must not be overloaded and should be clearly marked with its safe working load
- loads must be evenly distributed on the hoist platform
- the hoist must be thoroughly examined and tested after erection, substantial alteration or repair and at 6-month intervals
- regular inspections should be carried out at least on a weekly basis and the results recorded



# Pre- fabricated mobile scaffold towers

The following points must be considered when mobile scaffold towers are to be used:

- towers should only be used on level, firm and stable ground;
- the selection, erection, dismantling and inspection of mobile scaffold towers must be undertaken by competent and trained persons with maximum height to base ratios not being exceeded;
- no person must be permitted to erect, alter or dismantle any mobile tower scaffold unless authorised by the site supervisor;
- diagonal bracing and stabilisers should always be used

# Pre-fabricated mobile scaffold towers



- access ladders must be fitted to (not leaning on) the narrowest side of the tower or inside the tower and persons should not climb up the frame of the tower;

# Pre- fabricated mobile scaffold towers

- all wheels must be locked whilst work is in progress and all persons must vacate the tower before it is moved;
- all operatives who are required to use mobile tower scaffolds will be instructed in their safe use and movement;
- outriggers or stabilisers must be extended where applicable;
- tower scaffolds must not be used or moved on sloping, uneven or obstructed surfaces;



# Pre- fabricated mobile scaffold towers

- the tower working platform must be fully boarded, fitted with guard rails and toe boards and not overloaded;
- towers must be tied to a rigid structure if exposed to windy weather or to be used for work such as jet blasting;
- persons working from a tower must not over-reach or use ladders from the work platform;
- safe distances must be maintained between the tower and overhead power lines both during working operations and when the tower is moved; and
- the tower should be inspected on a regular basis and a report made



# The main reasons why a mobile tower scaffold may become unstable are:

- the brakes are defective;
- it was not erected by a competent person or unauthorised adjustments were made;
- it was erected on ground that was neither firm nor level;
- the height of the tower exceeded the recommended base to height ratio;
- the failure to fit and/or use outriggers when they were required;
- the safe working load was exceeded;
- the movement of the tower with either persons and/or materials on the working platform or under windy conditions; and
- collision with vehicles or other plant



# Mobile Elevating Work Platforms (MEWPs)



[https://www.youtube.com/watch?v=GkZM\\_tpESx8](https://www.youtube.com/watch?v=GkZM_tpESx8)

# Mobile Elevating Work Platforms (MEWPs)

- the MEWP must only be operated by trained and competent persons;
- safety harnesses should be worn;
- it should be inspected before use;
- the working platform should not be overloaded;
- it must never be moved in the elevated position;
- it must be operated on level and stable ground with consideration being given to the stability and loading of floors

# Mobile Elevating Work Platforms (MEWPs)

- the tyres must be properly inflated and the wheels normally immobilised when the platform is in use;
- outriggers, if fitted, should be fully extended and locked in position;
- warning signs should be displayed and barriers erected to avoid collisions;
- due care must be exercised with overhead power supplies and obstructions and adverse weather conditions;
- it should be maintained regularly, and procedures should be in place in the event of machine failure; and
- drivers of MEWPs must be instructed in emergency procedures, particularly to cover instances of power failure and overhead obstructions



# Ladders: Factors to consider



- <https://www.youtube.com/watch?v=s4UEGkXNcsw>

# Ladders: Factors to consider

- aluminium ladders are light but should not be used in high winds or near live electricity;
- timber ladders need regular inspection for damage and should not be painted as this could hide cracks;
- ensure that the use of a ladder is the safest means of access for the work to be done and the height to be climbed;
- the ladder needs to be stable in use with a safe inclination (1 in 4);
- the best way to prevent a ladder from slipping is to tie it at the top;
- if possible, the foot of the ladder should also be tied to a rigid support

# Ladders: Factors to consider

- weather conditions must be suitable;
- the proximity of live electricity should be checked;
- the ladder should be fitted with non-slip feet;
- there should be at least 1 metre of ladder above the stepping off point;
- over-reaching must be eliminated;
- workers who are to use ladders must be trained in the correct method of use and selection; and
- ladders should be inspected (particularly for damaged or missing rungs) and maintained on a regular basis, and they should only be repaired by competent persons

# Certain work should not be attempted using ladders such as:

- two hands are required;
- the work is at an excessive height;
- the ladder cannot be secured or made stable;
- the work is of long duration;
- the work area is very large;
- the equipment or materials to be used are heavy or bulky;
- the weather conditions are adverse; and
- there is no protection from vehicles

# Causes of accidents with any access equipment:

- Design faults
- Over-reaching
- Falls and slips
- Collision with vehicles
- Unsound base support
- Untrained personnel
- Climbing with loads
- Poor maintenance and/or inspection
- Instability
- Adverse wind effects

# Other access techniques:

## Boatswain's chair:

- used for light work of a short-term nature
- the worker should be protected by a harness and lanyard



# Other access techniques: Cradles

Suspended access cradles or platforms are used for maintenance operations on bridges or similar inaccessible structures. The reasons for accidents involving cradles include:

- poor equipment selection procedures – cradle is not fit for purpose
- unsafe access to the cradle
- overloading of the cradle or non-uniform loading across the platform
- holes or cracks in the platform floor allowing material to fall below
- inadequate guard rails and toe boards
- the structure supporting the cradle is not capable of carrying the additional load
- insecure counterweights and/or braking system
- the failure of essential components of the cradle structure
- the failure of the winching and climbing devices
- poor erection, maintenance and dismantling by incompetent and untrained personnel
- inadequate emergency procedures



# Other access techniques: Cradles

- The safest access to a cradle is at ground level.
- If access at height is unavoidable, then the cradle must be secured to prevent it swinging away from the structure.
- Suitable anchorage points must be available for safety harnesses and a secondary rope fitted.
- Regular visual inspections must be made before each time it is used.
- A weekly detailed inspection must be made by a competent person

# Other access techniques: Rope Access

- Abseiling or rope access techniques are used for inspection work when a properly constructed working platform is not practicable.
- Rope access must be erected by a competent person and the worker must be properly trained in the use of the technique.
- The main rope and safety access rope must always be attached to separate anchorage points.
- Any tools or equipment used must be secured to the worker to prevent them falling.
- The area beneath the work should be fenced off



# Fall arrest equipment

- <https://youtu.be/3DI8UywHjRk>



# Fall arrest equipment: Safety Harnesses

- The last resort for workers when conventional protection, using guard rails, is no longer practicable.
- Safety harness and lanyard is a fall arrest system.
- Only the length of fall is reduced, and the worker may still be injured due to the shock load applied to him/her when the fall is arrested.
- The lanyard should always be attached above the worker, whenever possible.
- The worker must be attached to a secure anchorage point before he/she moves into an unsafe position.
- Only trained and competent workers should attach lanyards to anchorage points and work in safety harnesses.
- Those who wear safety harnesses must be able to undertake safety checks and adjust the harness before it is used



# Fall arrest equipment: Safety Nets

- Safety nets arrest falls of people, tools and materials from height.
- Competent installation is essential.
- The correct tensioning of the net is important.
- Specialist companies normally fit nets.
- Nets are not suitable for use in low-level construction as there is insufficient clearance below the net.
- Nets should be positioned so that workers will not fall more than 2 m or hit the ground or other obstructions

# Fall arrest equipment: Air bags

## Air bags

- Air bags are used when it is not practical to use safety nets.
- The bags must be of sufficient strength and air pressure.
- The inflation pump must run while work is in progress.

If it is not possible to install edge protection or a soft landing system, then a harness and lanyard should be worn and anchored to a fixed point

# Fall arrest equipment: Roof Work

The main hazards are:

- fragile roofing materials – more brittle with age and exposure to sunlight
- exposed edges
- unsafe access equipment
- fragile roof lights and voids
- falls from girders, ridges or purlins
- overhead services and obstructions
- the use of equipment such as gas cylinders and bitumen boilers
- manual handling hazards.



# The controls include:

- a risk assessment and a method statement must be completed before any roof work takes place;
- suitable means of access such as scaffolding, ladders and crawling boards;
- suitable barriers, guard rails or covers where people work near to fragile materials and roof lights;
- edge protection on a flat roof is best provided by double guard rails and toe board

# The controls include:

- suitable warning signs indicating that a roof is fragile, at ground level;
- access to the area immediately below the work should be restricted using suitable barriers, netting, safety signs and safety helmets;
- the safe transportation of materials to and from the working area, involving lifts, hoists, manual handling and/or using chutes and covered waste skips; and
- good housekeeping procedures.

# A risk assessment for roof work should include:

- an assessment of the structural integrity of the roof;
- the methods to be used to repair the roof; and
- a COSHH assessment of any hazardous substances to be used.



# Protection of others

Members of the public must be protected during construction work. The protection methods include:

- the painting of scaffold standards with red and white stripes;
- masking couplers;
- adequate warning signs;
- good illumination at night;
- the provision of barriers and other means of safe passage;
- sheeting, netting and fans;
- the provision of head protection for visitors; and
- the boarding of ladders when the site is unoccupied



# Protection of others:

When construction work is being undertaken on occupied premises, the following issues may arise:

- the location and isolation of the construction working areas;
- supervision of the work;
- procedures for the emergency evacuation of the premises;
- the use of welfare and canteen facilities;
- the protection of the occupier's employees;
- procedures for handing back areas of the store when the work has been completed; and
- the safe removal of all waste materials



# Working over water Hazards

- falling from a height
- scaffold stability
- falling material
- pedestrian safety
- possible collision with the scaffolding by boats
- leptospirosis and tetanus



# Working over water Hazards- Possible Controls

Include those for working at height and:

- the provision of rescue equipment such as life belts and grab lines;
- the availability of a rescue boat under the control of a competent person, should someone fall into the water;
- harnesses must be worn by those working on the scaffold in addition to the use of appropriate personal protective equipment;
- there should be a current register of workers and nobody should work alone on the scaffold;



# Working over water Hazards- Possible Controls

Include those for working at height and:

- for pedestrians, using perhaps a towpath, a protected access or safe diversion route must be provided;
- signs, lighting and protective barriers will also be required to minimise the risk of boats colliding with the scaffold; and
- disinfection, good standards of personal hygiene, the use of appropriate personal protective equipment, adequate washing and first-aid facilities.



# At the planning stage the following points need to be considered

- the provision of barriers or fences with toe boards;
- the provision of life jackets, buoyancy aids and grab lines;
- the provision of rescue equipment, lifebelts, harnesses, safety lines and, in some cases, a rescue boat;
- if transport by water is required, arrangements must be made for safe landing stages and life jackets

# At the planning stage the following points need to be considered

- any boats that are used should be of suitable construction; under the control of a competent person; not overloaded and properly maintained;
- the provision of rescue teams and procedures;
- training for boat operatives, rescue teams and supervisors; and
- Precautions to protect the safety of the public, especially children.

The personal protective equipment for working over water is a life jacket, harness and lanyard.



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