ELEMENT 10 WORKING AT HEIGHT – HAZARDS AND RISK CONTROL

Learning outcomes

- 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 control measures necessary to protect other persons not involved in the work at height
- Outline control measures to reduce risk when working over or near to water

Picture: - Work at height has not always been well managed

Picture A more modern example of poor working practices

Work at height (WAH) presents a serious risk within the construction industry. This is responsible for the greatest number of workplace fatalities and major injuries. Some of these are from extreme heights but there are cases of employees being killed or seriously injured even if they have fallen less than 2 metres.

Think firstly about the range of tasks which could be deemed to be work at height; there is no minimum distance now within the legal standards. It is “falling a distance which could cause a personal injury”.

WAH is likely to include:-

- Work on temporary structures such as scaffolding or mobile elevated platforms
- Work next to a trench or pit, into which a person could fall down into it
- Tree surgery
- Unsheeting or unloading a lorry
- Using a ladder as a means of access
- Work from a ladder
- Climbing poles or pylons
- Erecting posters at height, especially large outdoor ones
- Erection and working on falsework.

This is just a taster of the work which could be undertaken at height.

Falling from height is a significant risk, which in the most serious cases could lead to a fatality, and broken bones, head injuries and crushing are common.

10.1 THE WORK AT HEIGHT REGULATIONS 2005

These regulations apply not just to the construction industry but to all workplaces however along with the Construction Design and Management Regulations 2015 these are amongst the most important for all those involved with construction related projects.

OVERVIEW OF MAIN REQUIREMENTS

1. Citation and commencement – 6th April 2005

2. Interpretations

“personal fall protection system" - a fall prevention, work restraint, work positioning, fall arrest or rescue system or rope access and positioning techniques;

"suitable" means suitable in any respect which it is reasonably foreseeable will affect the safety of any person;

"work at height" means - work in any place, including a place at or below ground level; OR obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace, where, if measures required by these Regulations were not taken, a person could fall a distance liable to cause personal injury.

3. Application – In UK but exclude merchant shipping

4. Organisation and planning

The employer and self employed must ensure that work at height is planned, supervised, and carried out in a manner which is so far as is reasonably practicable safe. Planning of work includes planning for emergencies and rescue.

Work at height should only be carried out only when the weather conditions do not jeopardise the health or safety of persons involved in the work.

This requirement excludes members of the police, fire, ambulance or other emergency services acting in an emergency.

5. Competence

Every employer shall ensure that no person engages in any activity, including organisation, planning and supervision, in relation to work at height unless he is competent to do so or, if being trained, is being supervised by a competent person.

6. Avoidance of risks from work at height

The employer has the general obligation to complete a risk assessment under regulation 3 of the Management Regulations.

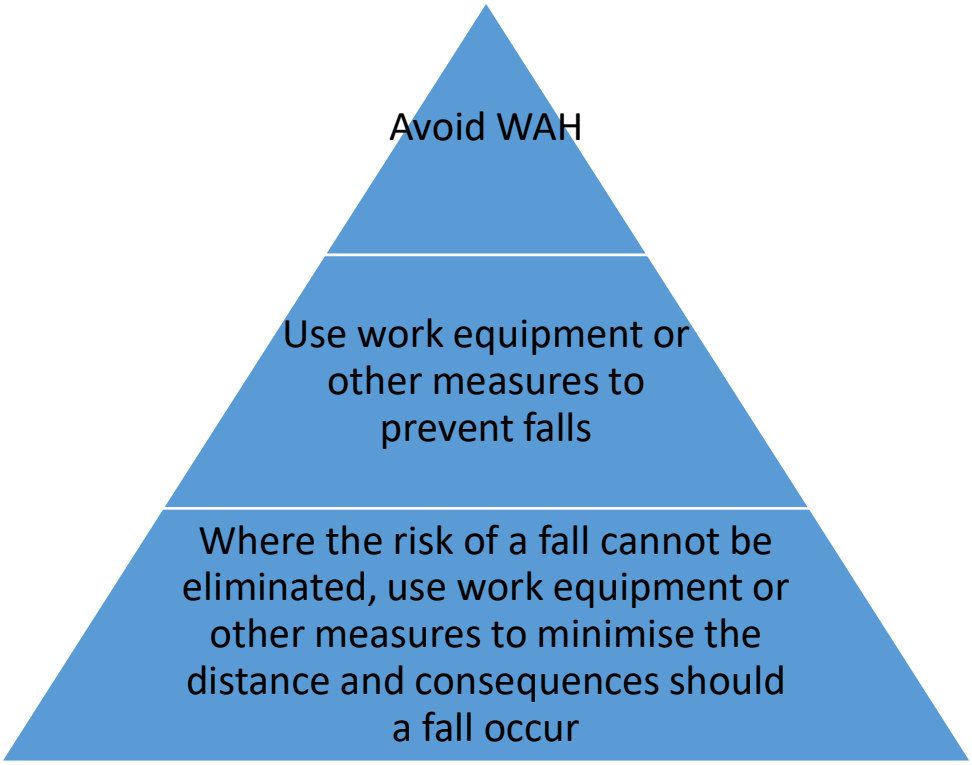
Every employer shall ensure that work is not carried out at height where it is reasonably practicable to carry out the work safely otherwise than at height. This follows the general principle of avoidance or elimination as required by the Management of Health and Safety at Work Regs.

Where work is carried out at height, every employer shall take suitable and sufficient measures to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury.

Where the measures taken do not eliminate the risk of a fall occurring the employer must SFAIRP provide sufficient work equipment to minimise -

(i) the distance and consequences; or
(ii) where it is not reasonably practicable to minimise the distance, the consequences, of a fall

Employees must be provided with training and instruction to prevent, so far as is reasonably practicable, any person falling a distance liable to cause personal injury.



7. Selection of work equipment for work at height

The employer must give collective protection measures priority over personal protection measures; consideration must be given to:-

(i) the working conditions and the risks to the safety of persons at the place where the work equipment is to be used;
(ii) in the case of work equipment for access and egress, the distance to be negotiated;
(iii) the distance and consequences of a potential fall;
(iv) the duration and frequency of use;
(v) the need for easy and timely evacuation and rescue in an emergency;
(vi) any additional risk posed by the use, installation or removal of that work equipment or by evacuation and rescue from it.

An employer shall select work equipment for work at height which is of sufficient size, dimensions, strong enough and allows passage without risk, i.e. is suitable.

There are a variety of different specialist trade associations who deal with a range of different equipment designed to reduce the risk when work at height cannot be avoided. Often these provide some very useful guidance on the different options available, they may also audit and check on the standards of their members. This includes:-

- British Safety Industry Federation
- Edge Protection Federation
- Fall Arrest Safety Equipment Association
- International Powered Access Federation
- Ladder Association
- Prefabricated Access Suppliers and Manufacturers Association

8. Requirements for particular work equipment

See the specific schedules on items such as ladders, scaffolds and platforms. These go a little way back to some of the more prescriptive requirements of the past.

9. Fragile surfaces

The employer shall ensure that no person at work passes across or near, or works on a fragile surface where it is reasonably practicable to carry out work safely and under appropriate ergonomic conditions without his doing so. i.e. if it is possible to do the work away from the fragile surface this must be done.

Where it is not reasonably practicable to work near or on fragile surfaces, suitable and sufficient platforms, coverings, guard rails or similar means of support or protection must be provided. These must be used and able to take the foreseeable loadings required.

Where a risk of a person at work falling remains, suitable and sufficient measures to minimise the distances and consequences of his fall must be taken.

The employer must also display prominent warning notices to warn of the fragile surface.

This regulation does excludes members of the police, fire, ambulance or other emergency services acting in an emergency.

10. Falling objects

Every employer shall, where necessary to prevent injury to any person, take suitable and sufficient steps to prevent, so far as is reasonably practicable, the fall of any material or object.

They also need to prevent people being hit by falling objects. No material or object should be thrown or tipped from height in circumstances where it is liable to cause injury.

Objects to be stored in such a way as to prevent risk to any person arising from the collapse, overturning or unintended movement of such materials or objects.

11. Danger areas – must be highlighted if there is a risk of falling people or falling objects.

12. Inspection of work equipment

Every employer shall ensure that, where the safety of work equipment depends on how it is installed or assembled, it is not used after installation or assembly in any position unless it has been inspected in that position.

Every employer shall ensure that work equipment exposed to conditions causing deterioration which is liable to result in dangerous situations is inspected -

- at suitable intervals
- each time that exceptional circumstances which are liable to jeopardise the safety of the work equipment have occurred

Arrangements must be in place to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

Working platforms used for construction work; and from which a person could fall 2 metres or more should not be used in any position unless it has been inspected in that position or, in the case of a mobile working platform, inspected on the site, within the previous 7 days.

13. Inspection of places of work at height

Every employer shall so far as is reasonably practicable ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used.

14. Duties of persons at work

Employees and others must report any activity or defect relating to work at height which is likely to endanger the safety of himself or another. They must also use any work equipment or safety device provided for work at height in line with any training /instruction received.

SCHEDULE 1 - REQUIREMENTS FOR EXISTING PLACES OF WORK AND MEANS OF ACCESS OR EGRESS AT HEIGHT

(Stable, strong enough, wide enough, no gap where a person could fall, prevent slips & prevent moving parts during work at height)

SCHEDULE 2 - REQUIREMENTS FOR GUARD-RAILS, TOE-BOARDS, BARRIERS AND SIMILAR COLLECTIVE MEANS OF PROTECTION

(Strong enough, secured, prevent fall, falling objects, top guard rail 950mm, toe boards, intermediate guard rail if the gap is over 470mm.)

SCHEDULE 3 - REQUIREMENTS FOR WORKING PLATFORMS & ADDITIONAL REQUIREMENTS FOR SCAFFOLDING

(Supporting structures stable & strong enough, wide enough, no gaps in working platform, erected and maintained in good condition, calculations for structural safety, plans on files, suitable for work & erected and dismantled under supervision of competent person)

SCHEDULE 4 - REQUIREMENTS FOR COLLECTIVE SAFEGUARDS FOR ARRESTING FALLS

(A risk assessment must show work can be completed safely using fall arrest equipment, use of other equipment is not possible, securely anchored & air bags stable)

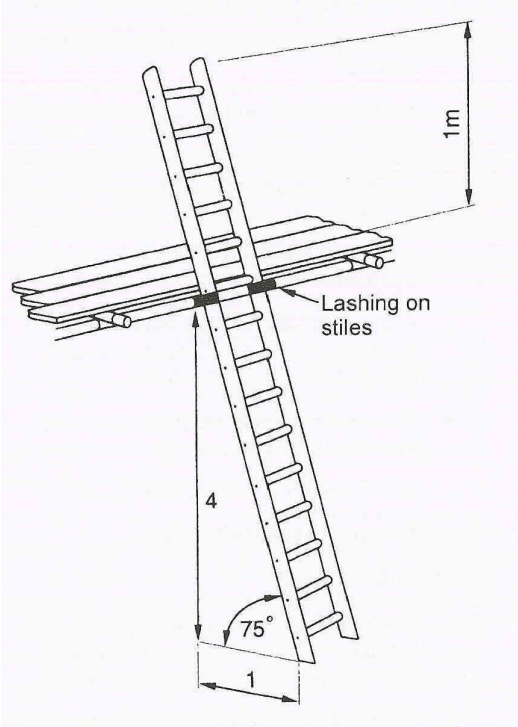
SCHEDULE 5 - REQUIREMENTS FOR PERSONAL FALL PROTECTION SYSTEMS

SCHEDULE 6 - REQUIREMENTS FOR LADDERS

Risk assessment must show use of more suitable work equipment is not possible prior to selecting to work from a ladder. Minimum standards: firm surface, stable, prevented from slipping, long enough, over 9m there must be landings or platforms, users should have a secure handhold available unless step ladder is used and this is not practicable. (Short duration work, low risk etc.)

SCHEDULE 7 - PARTICULARS TO BE INCLUDED IN A REPORT OF INSPECTION

(Name of person completing inspection, location or equipment, description of equipment, date and time, ID no's, hazards identified, action taken, action to be taken, who the inspection is being completed on behalf of)



10.2 THE MAIN HAZARDS OF WORKING ABOVE GROUND

There are a variety of hazards and risks when working above ground. Low risk activities at ground level can become serious issues when the same activity is undertaken at height.

Falsework is one aspect unique to construction and work at height, this is the use of a temporary structure which is used to support another structure which at the time is unable to support itself. The would include the use of scaffolding, wooden boards and props to support walls, arches, fire damaged buildings and even existing structures if the one next to it has been removed. The collapse of falsework (see photo below) can occur when it is not strong enough or it is being removed but then collapses unexpectedly.

WHEN WORKING ABOVE GROUND LEVEL

- Incorrectly erected scaffold - no toe boards or guard rails
- High winds
- Falling objects
- Overhead electric cables
- Unsecured ladders - ladder too short, ladder broken, unsuitable
- Lack of space
- Uneven floor surfaces
- Manual handling of loads
- Fragile roofs
- Unguarded edges

These are a range of hazards but think about what factors might increase the risks associated with work at height. This may increase the severity of the incident or make it more likely to occur.

- Vertical distance / height of building
- Weather
- Fragile materials
- Roof lights
- Deterioration of materials
- Other hazards nearby e.g. moving traffic, metal surfaces which people falling could come into contact with
- Poorly maintained access equipment
- Falling materials
- Age and type of equipment being used
- Nature of task being undertaken
- How long the work at height will take
- Employee health issues
- Employee attitudes

10.3 GENERAL WORK AT HEIGHT CONTROL MEASURES

All work at height must be adequately planned; this may include the design of the project and the design of any temporary structures to be used e.g. scaffolding. Suitable competent employees or contractors need to be selected and the task planned stage by stage, with a risk assessment completed and a safe system or method statement outlining the controls to be taken. This needs to take into account the task to be undertaken and any site specific issues.

Employee Fitness

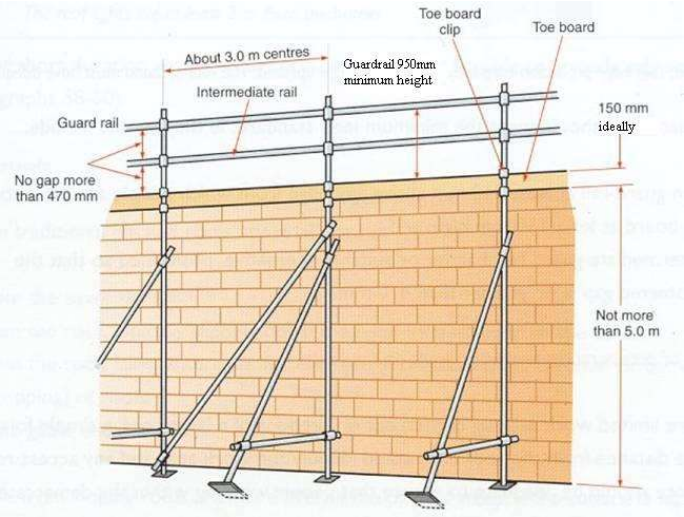
Carrying out work at height outside can be strenuous work and the weather can add to the risk of ill health involved. Some workers could be at greater risk:-

- If they are unfit
- Scared of heights
- Suffer from neurological conditions
- Heart or blood circulation problems – as they may become light-headed
- Breathing problems
- Impaired use of arms or legs could increase the risk of them over-balancing and falling
- Poor eye-sight

Equally individuals who are ill or who are under the influence of drugs or alcohol could be at greater risk if working at height.

The weather can also affect the employees' health with the wind chill factor increasing with higher wind speeds which are felt at higher levels; guard rails and handles become cold and reaction times can suffer. Suitable personal protective clothing will need to be worn but this can cause mobility problems and problems with hand dexterity.

General Controls



- Good security - fencing, passes & gates
- Lock up equipment at the end of the day
- Training – specific and general H&S
- Information and Instruction
- Competent people only – adequate supervision arrangements
- PPE - hard hats, safety shoes, ear defenders and harnesses
- Traffic routes around the site
- Warning signs
- Put out fires at night
- Safe and secure storage of flammables and chemicals
- Support adjacent structures to avoid collapse
- Testing of electrical equipment
- Use of 110V equipment, centre tapped earth.
- Lock ladders away so children cannot climb up them
- Safety nets for falling items
- Guard rails on scaffolding
- Damp down surfaces before cutting into them
- Health Surveillance e.g. for cement dust, lead etc.
- Crawling boards for roof work
- Board over excavations out of hours
- Control access of visitors

Emergency Procedures

There may be a number of reasons which lead to a person needing to leave the workplace at height in an emergency. This could be they are ill and need to be evacuated or it could be that there is a fire or similar which means employees need to leave quickly. Depending on the job and work area it may be that more than one exit is needed. If someone is ill there may be a need for the emergency services to carry out a rescue but just relying on this will not meet the employer's duty under the Work at Height Regulations. Even if employees are wearing harnesses and fall arrest equipment they may also need to be rescued, as serious injuries can occur if they are left suspended.

Head Protection

- Must be worn unless no risk of injury
- Everyone on site
- Unless in designated area
- BS & kite marked
- Change on regular basis

- Instruction to employees
- Report damage
- Replacement if hit or fallen from height
- Affected by solvents, paint etc.

Safe means of access

There are a variety of pieces of equipment which can be used to either provide a workplace for employees to work from, equally some equipment may be used to provide a means of access to and from another place where work is to be undertaken.

Typical equipment in use includes:-

- Ladders
- Independent scaffolding
- Stair towers
- Mobile elevated platforms
- Fixed or mobile towers

Factors to be considered when selecting work equipment for work at height

- Suitable
- Task
- Working conditions
- Distance to be climbed for access/egress
- Duration and frequency of use
- Evacuation
- Additional risks from the work equipment
- Collective protection

10.4 SAFE WORKING PRACTICES FOR ACCESS EQUIPMENT AND ROOF WORK - LADDER SAFETY

Ladders are a simple piece of work equipment yet their use and misuse results in many serious accidents every year, including some fatalities. The following safety precautions can help to prevent these accidents easily and effectively. Staff using ladders whether on site or indoors should be give some practical training to ensure they are aware of the basic steps which they must take to use a ladder safely.

HSE guidance on ladder use

A ladder should only be used as a place of work (not for access) when:-

- The work is of short duration
- Light nature (no carrying of very heavy items)
- Allows one hand to hold the ladder
- Requires nothing to be carried which could destabilise the ladder
- Does not need the top third of the ladder to be used

Ladder Classification

Class 1 - heavy duty e.g. construction work

Class 2 - lighter duty e.g. decorating
Class 3 - light and domestic use

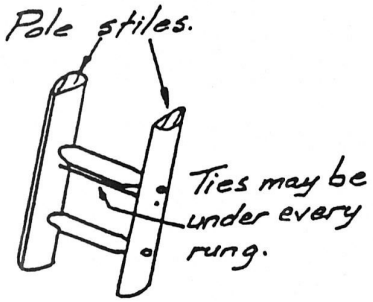
Pole Ladder (Class 1) ⟶

Heavy and robust, the best for frequent use, ideal to provide access to scaffolding. These are constructed from timber stiles and a long wood pole cut down the centre. The rungs reinforced with wires or tie rods.

Single Section (Class 1 & 2)

Timber stiles and rungs can be circular or rectangular, these can also be fitted with aluminium rungs. Ladders of over 5 metres should be reinforced to give extra strength.

Extension Ladders (Class 1 & 2)



Made up double or treble section for easy handling and transportation. Ladders over 4.5 metres should be rope operated, they should never be over-extended. Ladders of 5 metres (double) or 6 metres (treble) must be reinforced by wire.

Aluminium Ladders

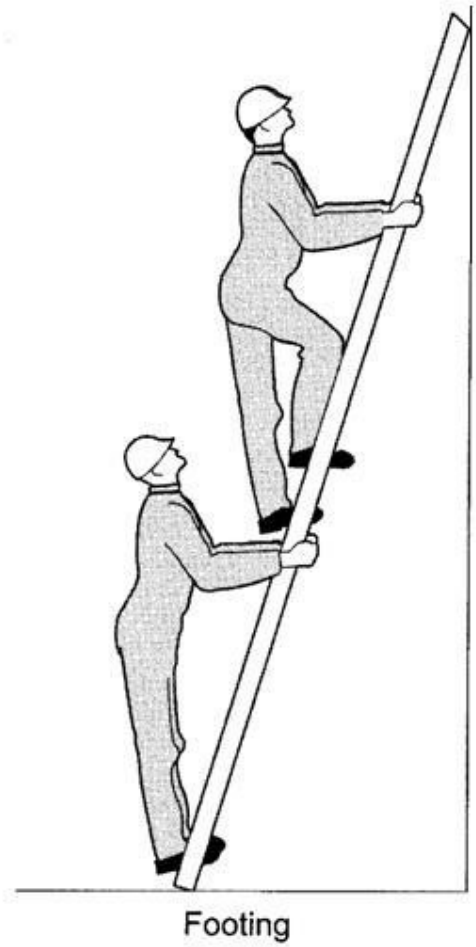
Light weight but will not withstand sudden shock or over-loading. Metal conducts electricity so therefore should never be used near over-head power cables.

Galvanised Ladders are also now in common use.

Step Ladders

These are suitable for low level work, they need to be placed on a flat surface to ensure adequate support is maintained. The rope stays and hinges should all be in good working order. Users must avoid side loading and over-reaching. The small platform on the top of the step ladder is not designed for standing on. It is for light items to be placed such as paint tins.

Class 2 and 3 ladders are not recommended for use on site



Safe Use of Ladders

They should:

- be secured near the top
- be footed if the ladder is under 6 metres (person standing on bottom) but this is now not recommended widely. New recommended method is for there to be two feet on the bottom rung.
- on a flat surface if under 3 metres – without footing
- extend at least 1.05m above landings
- be erected on a 1 in 4 or 75^{o} angle

- be inspected prior to use and on a regular basis be free from defects and not painted
- have rungs which are clean and not greasy
- have a firm level base
- not be used for tasks where both hands are needed
- not have any broken ties, rungs or stiles

Check metal ladders for:-

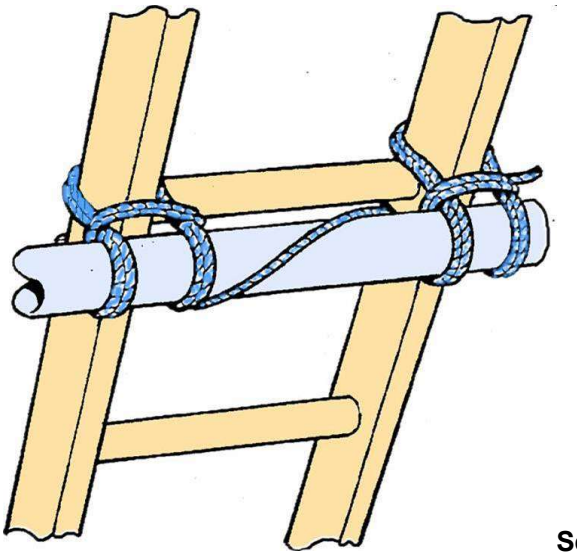
- Cracks on welds or dents
- Twisting or distortion
- Oxidation and corrosion
- Distorted rungs
- Loose ring crimps
- Broken rivets
- Defective fittings
- Are securing hooks and locks in good working order
- Rubber base feet in place
- Any dents greater than 5Gmm renders equipment unsafe for use.

Ladder Check List

- Is ladder suitable for intended use? – Long enough, strong enough
- Is ladder in good condition, is it damaged, warped or split, rungs broken or missing?
- Is ladder clean, free from mud and grease?
- Is help available to carry to place of use?
- Is ladder set on firm level ground?
- Is ladder properly erected and secured? – correct angle, projects 5 rungs above landing place, rung aligned with landing, secured at top and bottom?
- Is there a safe method of raising tools?
- Is your footwear and clothing suitable?
- Can you work safely without over-reaching
- Is ladder properly cleaned and stored after use?

There are a variety of products now on the market which can be used to ensure a ladder is stable. However even when these are in use, the ladder may not be suitable if the employee cannot hold on while carrying a load. Factors increasing the risk include:-

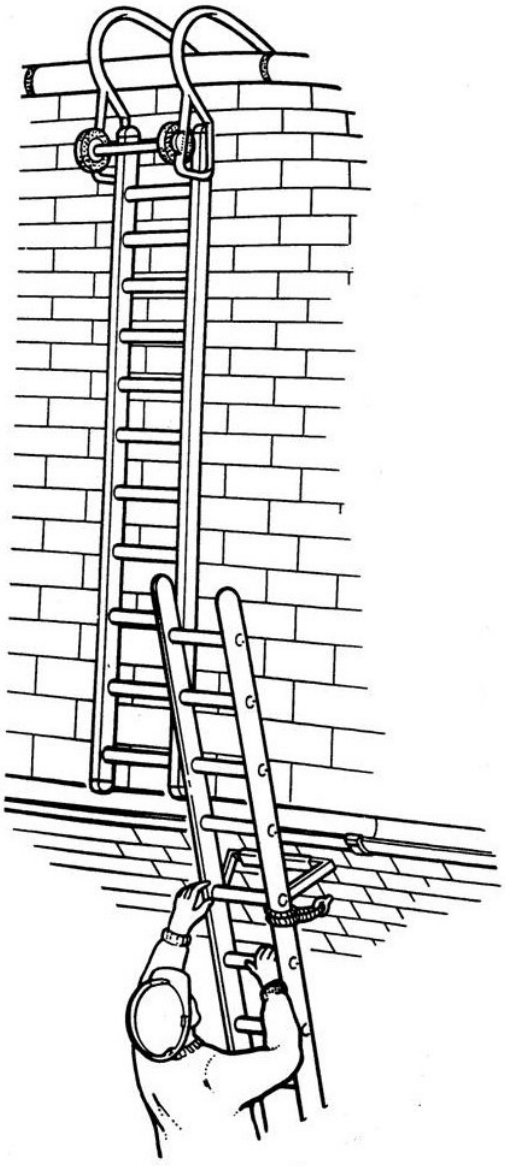
- Lack of handholds
- Adverse weather- windy, wet or cold
- Long duration work
- The loads are large, heavy or bulky.

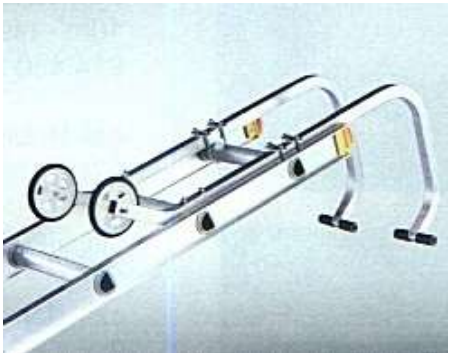


Securing ladders to scaffolding

Ladder Clip

ROOF LADDERS





The roof ladder is erected and hooked over the top ridge tile, it should be secured but not to anything likely to give way such as a plastic guttering. Edge protection is also needed to guard the area below the roof ladder, as in the picture above and below.

10.5 SAFE WORKING PRACTICES FOR ACCESS EQUIPMENT AND ROOF WORK - SAFETY AND SCAFFOLDING

The dictionary definition of scaffolding is an "*ELEVATED PLATFORM TO CARRY OUT HANGINGS*". Modern day scaffolding may not be used for this purpose but it can still result in fatalities. The everyday definition now is "*TEMPORARY STRUCTURE FROM WHICH PERSONS PERFORM WORK OR ENABLES ACCESS TO ENABLE WORK OR MATERIALS TO BE TAKEN TO A PLACE OF WORK"*

The stability of any scaffold will depend on the stability of its foundations which include a steel base plate and a timber sole board. The scaffolding may need to be tied to the building for additional support to prevent movement away from the building. To prevent sideways movement, bracing members or diagonals are used.

Guard rails and toe boards are required at the outside and ends of all working platforms where there is a risk of falling liable to cause personal injury. Guard rails must not be less than 950mm high (approx 1m), nor more than 1.15 m above the working platform.

Guard Rails

- Required at outsides and all ends of platforms
- Should be fitted to the insides of standards
- Toe boards at least 150mm high
- Guardrail at least 910mm above working platform
- No gap more than 470mm
- Needs the use of an intermediate guardrail or SUBSTANTIAL brick guards
- Brick guards are essential for platforms used for material storage

Scaffolding should be inspected:

- prior to use

- after alteration
- after adverse weather
- weekly

Scaffolding must be erected by competent people, with the formal inspection record recording when the inspection was completed, who did the inspection, the location of the scaffolding, the actual area examined, any faults or problems identified. If scaffold is to be erected near the public highway, barriers must be fitted at the base level to protect from impact. The highways authority or local council will need to be contacted where scaffold is to be beside a public thoroughfair.

Main components: Sole board, base plate, standards, ledgers, transoms, couplings and bracing.

Standards

- Vertical tubes
- Independent scaffold has 2 rows.
- Joints should be staggered
- Inner standard 325mm away from building
- Spacing depends on loading
- Lower level standards and components should be marked with red and white stripes to make them clearly visible.

Ledgers

- Horizontal tubes, that keep standards equidistant
- Fixed with right angle couplers (not swivel couplers)
- Jointed with sleeve couplers
- Joints should be staggered

Transoms

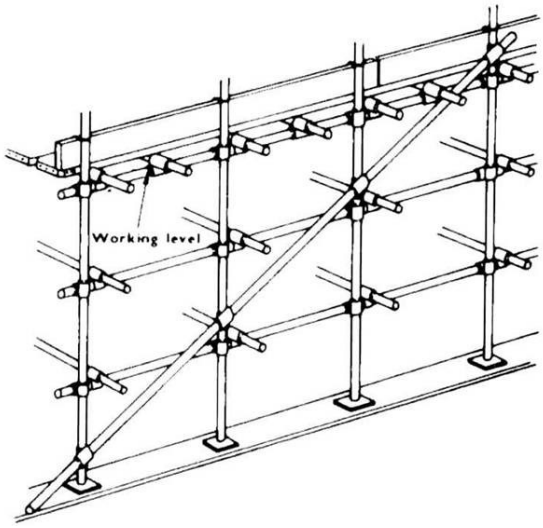
- Keep the inner and outer row of standards equidistant
- Transoms fixed to ledgers or standards with right angle or putlog couplers.
- Should be spaced so no board overhangs by more than 150mm or less than 50mm
- Should not protrude excessively

Rakers

These are angled poles out from the structure that act as stabilisers to minimise the risk of the scaffolding coming away from the structure. They can be used to support cantilevered scaffold rather than standards straight up from ground level.

Bracing

- Essential to stiffen the structure
- Ledger bracing runs diagonally from ledger to ledger or standard to standard in zig zag fashion
- Facade bracing either runs across the face at 45° or zig zag fashion.
- Should be provided at 30m intervals
- Joints should be made with sleeve couplers
- Should not be removed to allow passage of materials



The scaffold working platform should be close boarded and have guard rails and toe boards to prevent the risk of falling people and materials. Safety netting can be fitted to help prevent falling objects and safety chutes give a route for items which need to be lowered from a height.

The platform should be kept as free from obstructions as possible as they may fall or cause an obstruction for those working on the platform.

If ladders are used to access scaffolding they should protrude at least 1m above the work platform height. The worker should be able to climb onto the platform whilst still holding onto the ladder.

Working Platforms

Platforms Width
3 boards (600 mm) - when used as footing
4 boards (800 mm) - for footing or stacking materials
5 boards (1.05 m) - when working with stacked materials to allow 600mm clear for barrows

Maximum span of scaffold boards

Thickness of board mm	Max span between transoms m	Min overhang mm	Max overhang mm
38	1.50	50	150
50	2.6	50	200
63	3.25	50	250

Work Platforms

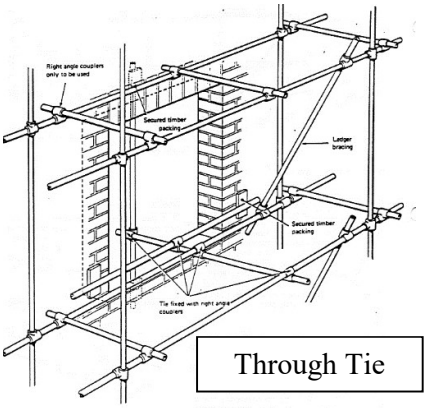
- *Suitable strength*
- *Cannot be accidentally displaced*
- *Prevent fall of person or material*
- *Remain stable during alteration*
- *Any supporting structure strong enough*
- *Prevent from slipping and moving*
- *Not overloaded*
- *If mobile - wheels and castors must lock or similar*

- *The surface of the platform should be even to prevent tripping*
- *Precautions must be taken to prevent boards lifting in high winds using straps or clamps*
- *No board should overhang by more than 4 times its thickness, i.e. 150mm for a 38mm board*

Ties

Ties are a means of resisting inward and outward movement of scaffolds, they must be made using right angle couplers. Strength of structure tied to must be established, they should be considered at the design stage.

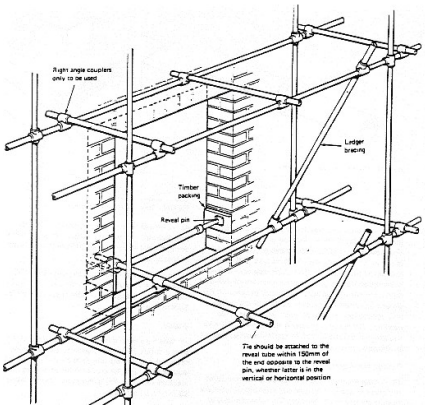
These normally pass through openings in the building to enable the scaffold to be attached to the building for additional stability and support.



Through Tie

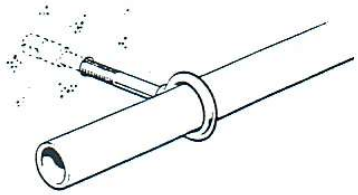
Through tie – this is where a scaffold tube is placed through an opening in the building, such as a window. This is connected to another tube which goes horizontally along the inside of the opening with timber packaging between tube and building. The two tubes are connected at right angles by couplings.

Reveal – when it is not possible to use a through tie because windows cannot be opened or left open, a tube may be wedged into the opposing faces of the opening. The transom is connected to this by a right angled coupling.



Drilled fixing

These are used to attach the various scaffold poles.



TYPES OF SCAFFOLDING

There are many types of scaffold:

- independent (this supports itself)
- putlog (this is supported by the building)
- cantilever
- truss out/ slung
- system
- fan
- suspended (cradles)
- towers (mobile and non mobile)

Independent

This form of scaffolding is the most common, it is free standing but to ensure its stability it should be tied to the building to prevent it from falling away.

Main Components

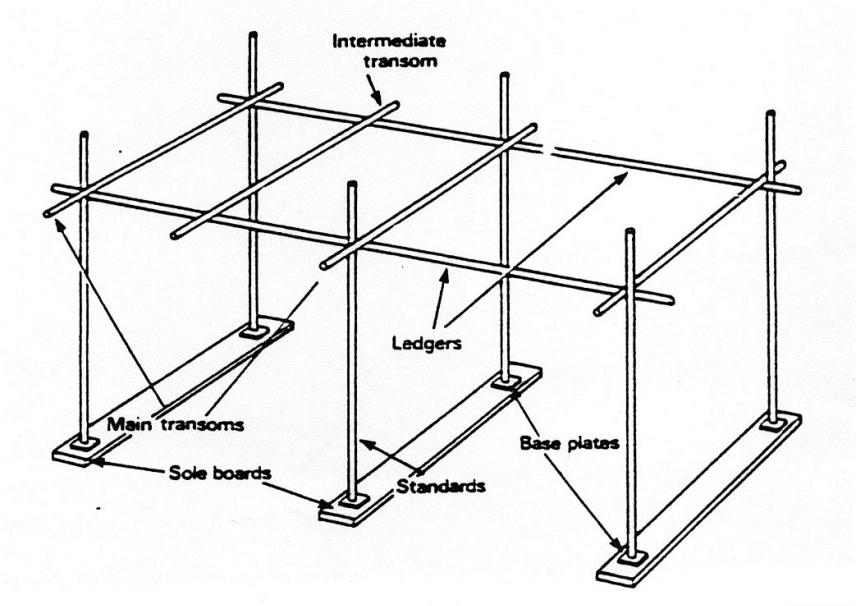
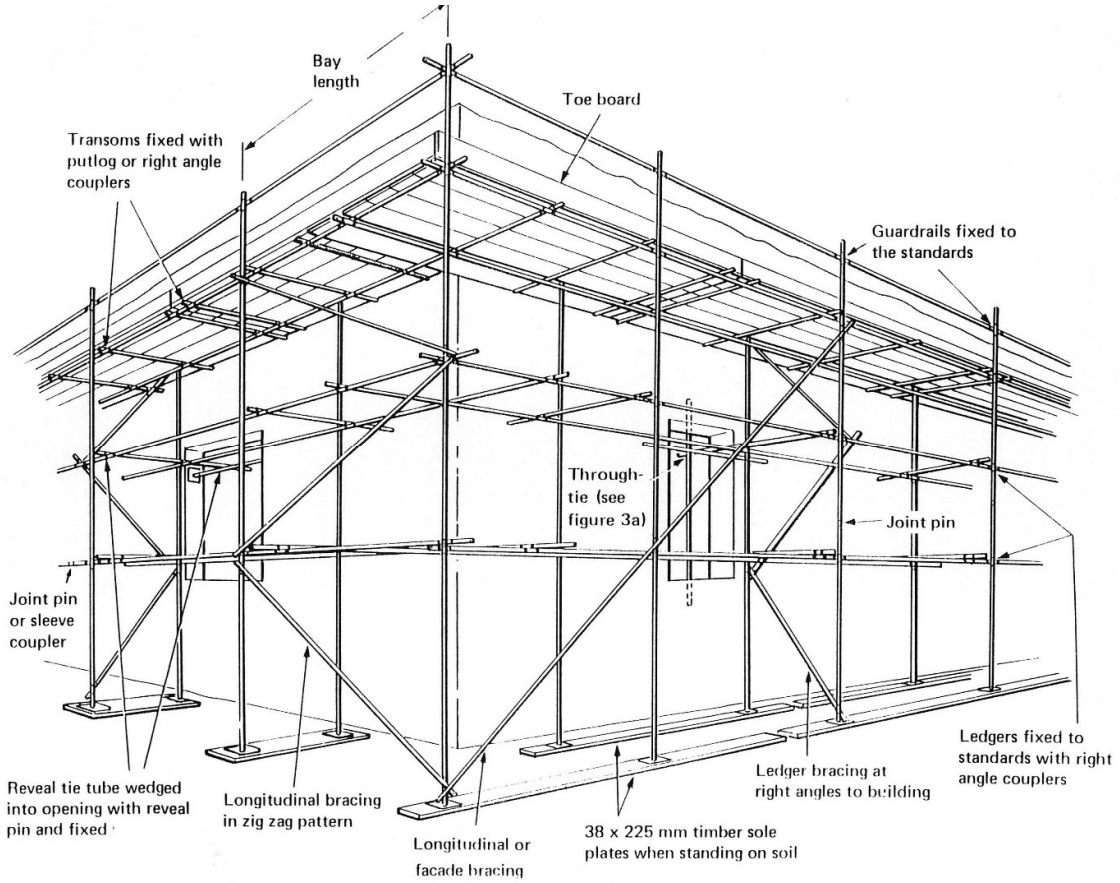
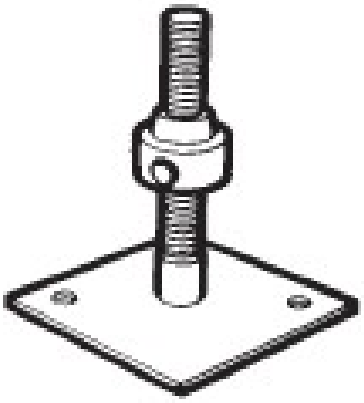


Diagram below showing putlog scaffolding


Bay length
Toe board
Transoms fixed with putlog or right angle couplers
Guardrails fixed to the standards
Through-tie (see figure 3a)
Joint pin
Joint pin or sleeve coupler
Ledgers fixed to standards with right angle couplers
Ledger bracing at right angles to building
Reveal tie tube wedged into opening with reveal pin and fixed
Longitudinal bracing in zig zag pattern
Longitudinal or facade bracing
38 x 225 mm timber sole plates when standing on soil



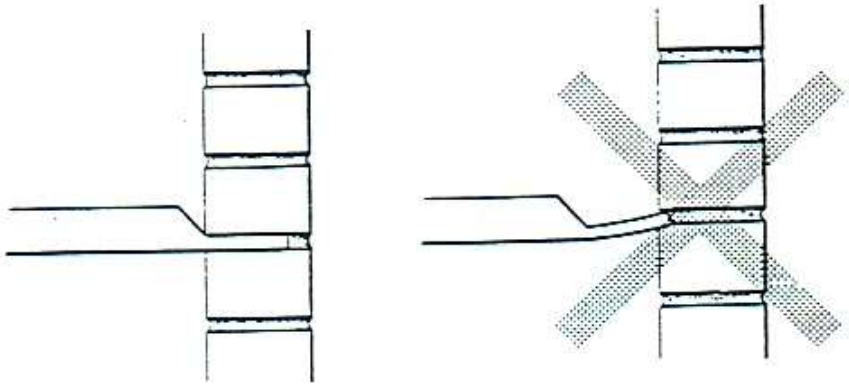
Base Plate for the scaffold to have a stable base

This image shows the standards and base plates on top of the Sole Board. If the floor surface is firm and level, the base plate may be erected straight on top of the floor surface.

Putlog Scaffolding

This form of scaffold relies on the building for its stability and support. It has specially adapted transoms which are inserted into the brick work. This type of scaffolding is normally used for new buildings as they are being erected as it can be raised as the brick work height increases. Bracing members are used to give additional stability. The putlog must be suitably flat, fully inserted and bedded into the brick work. There are limits on the height of put log scaffold and normally this is set at around 45m.

Put log positioning into brick work



Cantilever Scaffolds

This is a form of independent tied scaffold which is erected on a beam which cantilevers out from the building. The structure of the building must be checked to ensure the loads applied by the scaffold can be safely handled. They must be well designed to ensure the load limitations are set and then abided by.

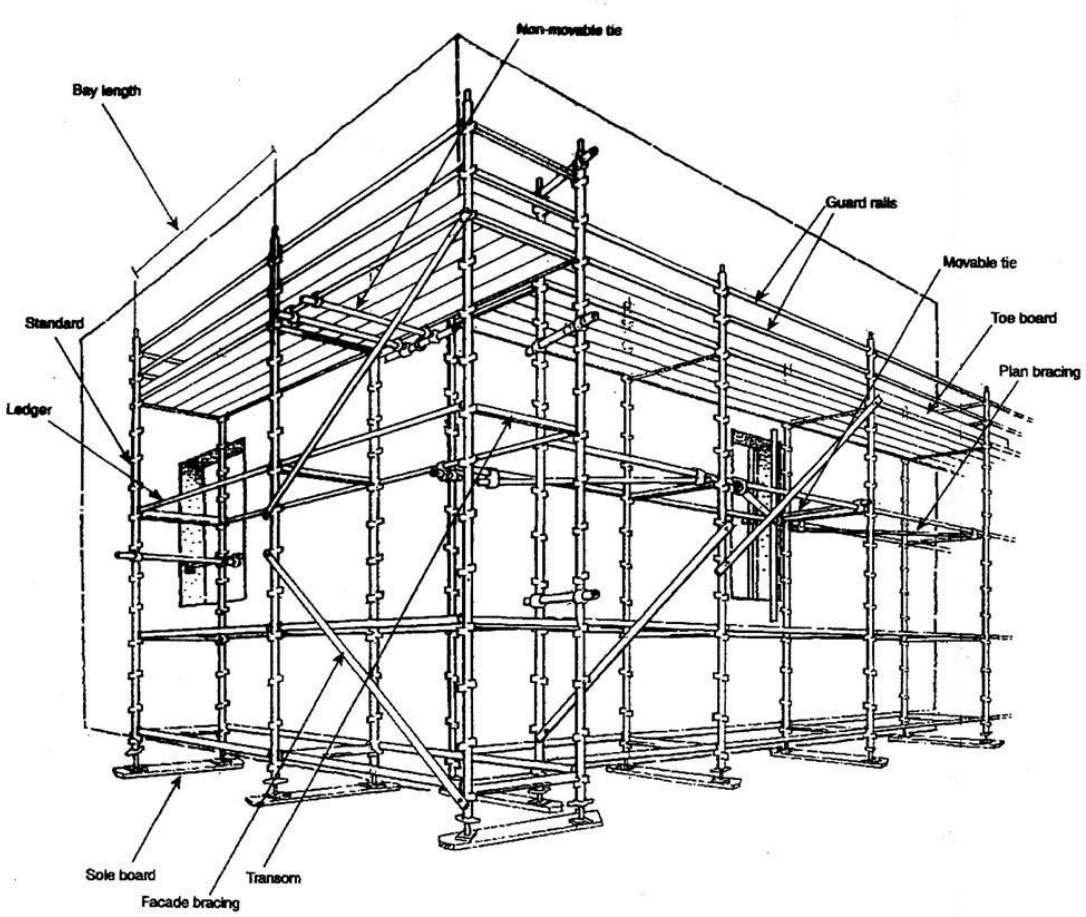
Truss Out/Slung Scaffolds

This is an independent tied scaffold which projects from the building, the supporting structure is known as a truss out.

These are normally used where it is impractical to build up from ground level e.g. upper storey repairs on a tall building on a busy street. It depends entirely on the building for support. It is essential therefore that the building is sound enough to takes the stresses which will be involved.

Slung scaffold is suspended at a fixed height below a beam, structure member of a roof or over-head structure. The suspension can be supplied by either lifting gear, wire ropes or tubular members. The scaffold should not be able to be raised or lowered whilst in use. These types of scaffold are usually designed for a specific purpose; they can be used for ceiling or internal roof work where it is impractical to build up from ground level.

System Scaffolding

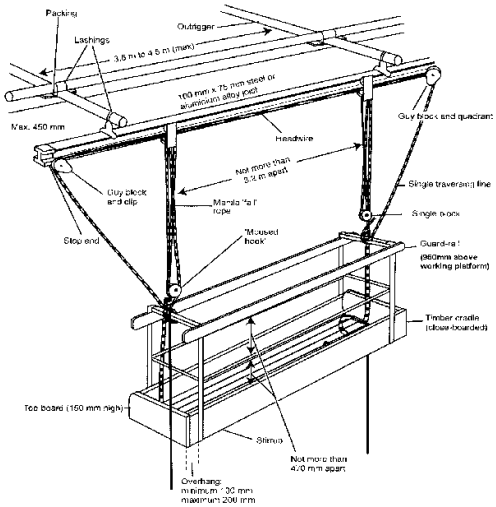


System scaffolding systems are standalone systems but still need to be erected by competent people. It will need to be exactly the right length for building and it will normally still need to be tied to the structure. It is usually easier to carry out alterations to the system with the preformed sections. Working platforms can be a variety of widths; there are no legal limits on size but normally they are at least 600mm wide. Bracing diagonals are not normally used with system scaffolding. The other standard rules for independent or putlog scaffolds apply equally to system scaffolds.

Fan Scaffolding (protection against falls and falling objects)

Suspended Scaffolding

Cradles, which come within the category of suspended access equipment, may be used for window cleaning, painting, exterior maintenance and inspection.



They may be permanently rigged and attached to the roof, or be a temporary installation which can be dismantled.

A suspended access system includes a working platform or cradle, equipped with the means of raising or lowering when suspended from a roof rig.

Cradles can be suspended by pulley blocks with natural or man-made ropes. Cradles over 3.2 m will be suspended on wire ropes which are controlled by a hand or power winch.

Both can be installed as fixed (up and down movement only) or travelling (horizontal and vertical movement) as well.

The main hazards associated with cradles are:-

- total collapse
- over loading
- people falling out of
- equipment falling out of

In most cases accidents occur because working procedures are not followed. Cradles must be at least 430mm wide (2 boards), the platform surface must be non-slip. Toe boards and guard rails as previous standards. (BS 2830 covers suspended safety chains and cradles). Measures must be taken to sop the cradle coming off its runners and the end of the track.

Cradles normally have a counterweight to keep them balanced. This must take into account the length of the outrigger to the fulcrum (pivot) point, the overhang of the cradle from the building and the total weight of a fully loaded cradle.

Counter weight = Safety factor (normally 3) X Overhang of outrigger X Total weight of fully loaded cradle

The counter weight is made of steel and must be sufficient to prevent the whole of the structure from over-turning or collapsing.

Ropes – not less than 18 mm in diameter, strong enough and in good condition.

Pulley blocks or winches- suitable and strong enough, they enable the cradle to be lowered or raised

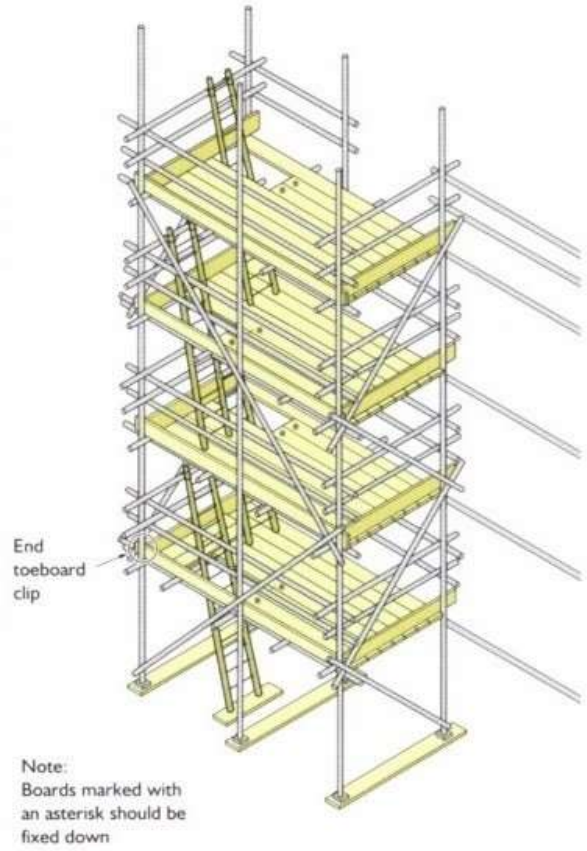
Diagram: cradle in use

Most importantly, employees must be able to access the cradle safely from ground level.

General Controls for Scaffolding

- Ensure it is correctly assembled
- Use outriggers if they are fitted (mobile only)
- Ensure ladders will not overload scaffold
- Regular inspections – prior to use, on erection, after adverse weather & after any alterations
- Stable, flat ground needed
- The height of the base should not exceed the recognised base/height ratio (mobile only)
- Use brakes (mobile)
- Do not use in high winds
- Guard from collisions with vehicles
- Use chutes for waste to be lowered into skips

Tower Scaffolds



These are mobile and have many of the same components as main scaffold but may be on wheels for easy movement. (frame, braces, platforms, outriggers, wheels or castors) To give them additional support they may have outriggers which can be pulled out to widen the base of the tower as shown above.

This type of scaffold is frequently used by painters who need to do lightweight work; when mounted on wheels they are normally known as mobile towers. They can be constructed from normal tubes and fittings but also from fixed components.

Like all scaffolds they must be erected on firm ground and should have base plates unless they are on concrete or another solid material

Usually constructed of aluminium tubes that clip together. Basic requirements for safe use include:-
- good foundations
- braced
- out rigging, bracing or tied to building to give additional stability

Each type of tower has a height to width ratio, these will be set by the manufacturer but will not normally exceed 3.5 :1, the base should not be narrower than 1m.

- Towers need to be on firm level ground
- They need to be constructed by trained individuals only
- Access ladders must not lean on to the scaffold, they should be fitted to the narrowest side of the ladder or inside the tower
- The higher the mobile scaffold the more likely it is to need outriggers
- If brakes are fitted these must be on when the mobile is in use
- It must not be moved with a person or materials on it.

- Do not use on slopes
- Towers may still need to be tied to a structure for additional stability
- No over reaching
- No putting a ladder or step ladder on the top platform
- The platform must be fully boarded

When a tower is being used as a working platform it must be inspected by a competent person:-

- After erection but before first use
- After additions or major changes
- At regular intervals - at least every seven days unless the platform is less than 2 metres

These checks should be recorded. Just moving it to another location does not automatically mean it needs to be examined. A scaf tag alone is not accepted as a written record for scaffolds with working platforms over 2 metres.

Incomplete towers must have labels attached showing clearly “scaffold incomplete do not use”. Aluminium towers are very light and may be affected more than other equipment in high winds; if the wind speed exceeds 17mph, the use of a tower should be restricted, if the wind gets to 25 mph the tower should be secured to a stable structure. If the wind speeds are extreme and over 40mph the tower should be dismantled as it would be at high risk of being blown over.

There are two main ways of erecting tower scaffolds, one is known as the ‘through the trap’ system and the other the ‘advance guard rail’ system. These are the two approved methods for erecting scaffold which have become the industry standard. These were developed by the HSE and the Prefabricated Access Suppliers and Manufacturers Association.

Scaffold erectors

Those erecting scaffold do not have the luxury of having a safe working platform as they are often installing this so that other trades can make use of it. The National Access & Scaffolding Confederation sets a standard for those who are erecting scaffold, this includes a scheme for individuals involved with the installation, design and checking of scaffolding.

- *Construction Industry Scaffolders Record Scheme – this covers the individual workers and employees*
- *BS EN Standard 12811 covers the erection of scaffolding and this is supported by the specific guidance TG20 Good practice for scaffolding & tubes (from NASC)*
- *Competence is not defined specifically for scaffolders but it is usually accepted to be:- practical and theoretical knowledge, together with actual experience of scaffolding and has a recognised qualification in scaffolding*

- *NASC Preventing falls in scaffolding and falsework SG4 – standard to be followed by scaffolders when erecting scaffold, which allows them to install the scaffold and make use of some of its protection as soon as a component or section is completed.*

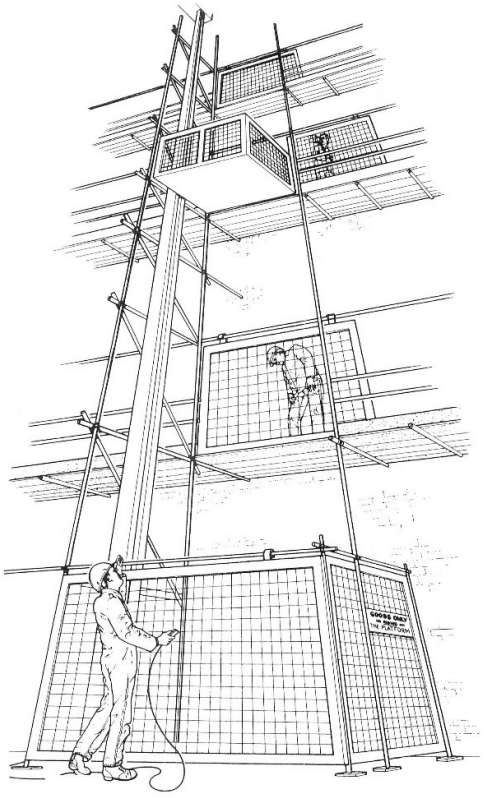
Scaffold hoists

Hoists in this format operate in a similar way to fixed lifts in buildings. They enable loads to be lowered and raised, with gates at each floor or platform to allow and prevent access.

Hazards associated with hoists include:-

- Over loading
- Incorrect loading where materials fall out
- Loading to one side and not maintaining a centre of gravity
- Use of damaged components or those not strong enough
- Incorrect positioning where the hoist may come into contact with other parts of the structure
- Contact with electrical or other cables
- No clear view of the hoist landing positions
- Not locking off at the end of day
- Not adequately fenced
- Large gaps between the hoist and the structure allowing falling objects
- Carrying loose rubble or bricks

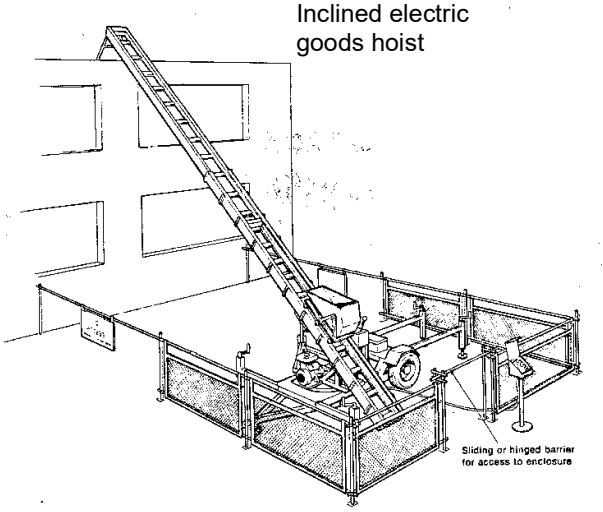
Hoists are normally powered by a winch which raises and lowers the platform. Most systems will have fail safe mechanicals and use deadman's handles to ensure safe operation. Hoists are covered by the Lifting Operations & Lifting Equipment Regulations. They may be goods only hoists, or may be rated to carry people and goods.



The main requirements for safe operation include;

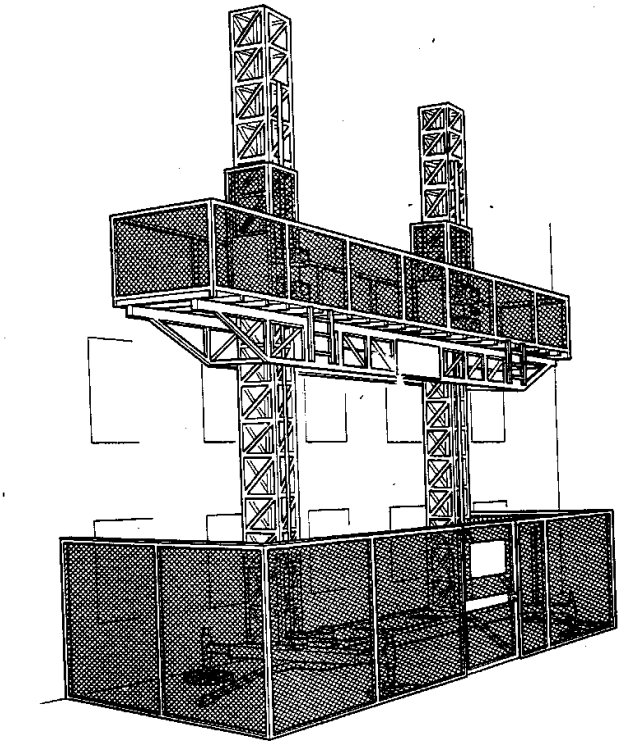
- A firm level base
- The surrounding area at ground level must be kept clear
- Enclosed to prevent falls/falling objects
- Over-run device to prevent hoist coming off rails/track
- Protected at both ends
- A sign showing maximum load must be displayed
- Controls suitably signed and clear
- Must be tested and examined prior to use
- Installed and used by trained and certificated people only
- Formal thorough examinations at least every 6 months
- Weekly recorded inspections
- Even distribution of loads

Hoists can be cantilever as above, where they have a small platform which is fitted to a side mast which the hoist runs up and down or they can be centre slung where they are suspended with guide ropes/lines on either side. Gates at any level must be closed except during loading and unloading operations. Inclined goods hoists are now common on site, and can be quickly set up to lift materials to high level without the need for manual handling.

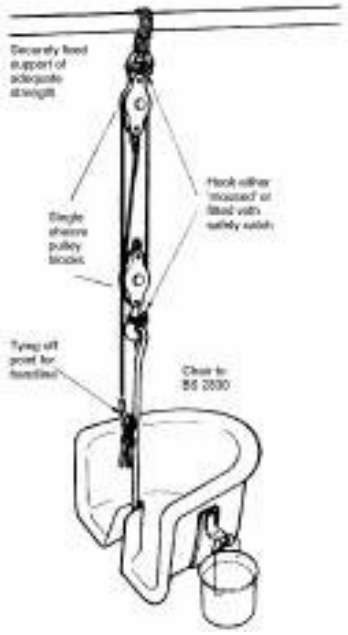


Inclined electric goods hoist

Climb master hoist



Boatswain's chairs can be used for short duration work where suspended scaffold is not practicable. The chair is suspended above the ground and must be fitted and supervised by a competent person. The person must be strapped in to prevent them from falling out. If weights are used to counter balance a factor of four must be used. A minimum SWL of 115kg is required. BS2830 covers the requirements for this equipment.



10.6 ROOF WORK

A roof with a pitch of less than 10^{o} is classed as a flat roof, a sloping roof is therefore a roof with a pitch of over 10^{o}. Safe access to both types of roof must be provided and maintained. Edge protection must take into account those working at or near the roof edge as well as those who may slip down the roof.

General

Where roof work is undertaken, the place of work for employees must still be safe, equally measure must be taken to ensure those working or in the vicinity of the roof work are protected, i.e. from falling objects.

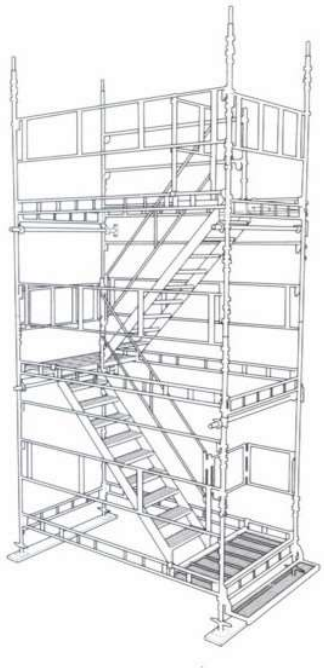
A typical method statement for work at height will need to cover:

- The prevention of falls
- Measures to protect the public
- Specific risks – use of drills, hot bitumen, flammable substances
- What equipment is to be used
- What PPE must be worn
- How the job is to be planned and supervised
- The competence of staff required
- How changes/problems will be dealt with
- Who will be responsible for checking work is being completed safely and how.

A safe place of work can be maintained by the use of physical safe-guards such as guard rails, toe boards and barriers. Fall arrest systems are not a first option as they do not prevent falls but minimise the consequences. Safety nets can be used to protect everyone at height. Harnesses, if used, need to be suitable for the individual and environment, they can also only be used by trained staff who have access to a suitable anchorage point.

Safe Access

This can be via independent scaffold, mobile scaffold, mobile access equipment such as mobile elevated platforms and ladders. If ladders are used they must be long enough and of the right standard. The means of escape from a roof in an emergency must also be considered. Stairs may be used where additional access is required. They also allow materials and equipment to be brought into the workplace more easily.



Materials and Waste

The amount of items manually lifted and moved onto the roof should be minimised as much as possible. Cranes and hoists should be used to move equipment up to roof level where possible. **Chutes** should be used to remove waste to prevent it from falling and injuring those at ground level. The risk of objects such as roof tiles, hot bitumen and roofing sheets must be minimised. Netting can be used to contain debris. Loose fixtures and fitting should not be left at height where they can fall or be blown by the wind.

Weather conditions

The weather is a major factor which can impact on roof work. Rain and ice can make a roof very slippery, wind can lead to loss of balance and falls. An anemometer should be available to assess the wind speed.

Overhead Cables

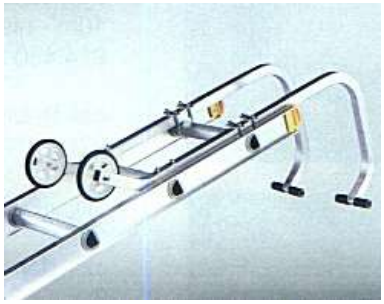
The risk of overhead cables needs to be managed at the design and planning stage. If work must take place, designers must consider if metal components are to be used nearby. Arrangements may need to be made for the power to be switched off or for the cables to be sheathed and protected to control the risk.

Sloping Roofs

Work on a sloping roof with a pitch of more than 30° should be done using roofing ladders or crawling boards, these should be anchored at the top of the roof.

If it is not possible to provide edge protection at eaves level, extra work platforms may be required, if this is not possible harnesses may be required. Netting should be incorporated into edge protection but is no replacement for a physical barrier. Roof workers should not work directly on tiles or slates unless measures have been taken to prevent falls, e.g. safety harness attached at harness point.

Suitable roof ladders (as illustrated) and crawling boards should be used along side edge protection. Home made roof ladders and crawling boards should not be used. They need to be long enough to spread the load adequately. The anchorage of the crawling board or ladder must be secure, it must not



just rely on the roof ridge capping, which may come away from its fixings. Gutters should not be used to secure ladders as they can easily break under pressure

Fragile and Flat Roofs

Falling through fragile roofs is responsible for more fatal accidents in the construction and maintenance industries than any other cause. A roof's fragility does not just depend on the strength of the material it is constructed from, it is also affected by the number and distance between any supporting members. Fewer supports mean less protection. The frailer materials which may fail include roof lights, fibre cement panels, metal sheeting, plastic, glass and wood wool slabs. Materials used in roofing may deteriorate and become more brittle with age, weather, air pollution and sunlight.

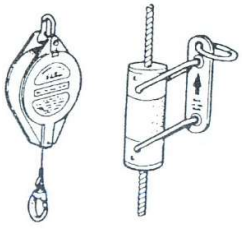
Some roofs are still made of asbestos roofing sheets which can be very brittle. In the long term these problems can be designed out for new structures but this doe not solve the ongoing problem of dealing with existing structures with fragile roofs.

Any fragile parts of the roof should be clearly identified so that appropriate measures are taken - warning notices " FRAGILE ROOF - CRAWLING - BOARDS MUST BE USED " must be fixed to all approaches.

Fragile roofs need to be assessed by a competent person before work commences, even a well-built roof may deteriorate over time, there may be damage from heat and cold, corrosion or fixings, attachments and cladding. Equally if the materials and method of fixing was inadequate in the first place then the deterioration may be even more serious making the roof unstable and a high risk if employees try to walk on the surface.

Other controls include

- Platforms or coverings to support the weight of the person
- Staging with guard rails
- Safety nets
- Bird cage scaffolds
- Harnesses
- Fixed covers
- Highlight, cover or guard sky lights
- Stop unauthorised access to roofs
- Safety signs
- Fall arrest equipment/shock absorbers – attached to harnesses act like seat belts to restrict the fall.

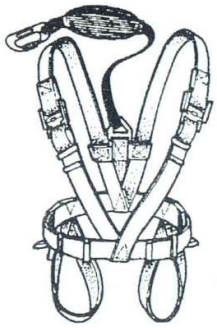


Fall Arrest Equipment

Fall Arrest and Harness Use

What is the difference between fall arrest and fall restraint?

- Arrest – stops a free fall which has already occurred
- Restraint – stops person getting into a situation where they are falling



Harnesses range from body belts to full body harness as shown, they must be worn correctly, tested and examined. Harnesses do not prevent falls but they do minimise the risk of injury from a fall. A shock absorber fitted to the harness lanyard can reduce the risk of impact shock by restricting the distance of fall. Consideration must be given to how a person is to be rescued should they fall.

European and British Standards relevant to harness and fall arrest systems

EN341: Descender devices
EN353: Fall arresters on a rigid or flexible anchorage line
EN354: Lanyards
EN355: Energy absorbers
EN358: Work positioning systems
EN359: Work restraint
EN360: Retractable type fall arresters
EN361: Full body harnesses
EN362: Connectors
EN363: Fall arrest systems
EN364: Test methods
EN365: Instructions and markings
EN795: Anchoring devices
EN1497: Rescue Harnesses

A harness designed to protect can still cause injury or ill health to the individual involved, this is often known as suspension trauma.

Suspension trauma

- Tightening of leg straps
- Cuts blood circulation
- Discomfort
- Can lead to kidney failure
- Loss of consciousness
- Can start within 10 mins
- Once released, lay horizontal, do not stand the person up as this could actually cause them more long term damage
- Fall arrest lanyards are often used with energy absorbing features, to be effective people need to fall at least 2m to enable them to activate effectively.
- Restraint lanyards – are tighter and allow some movement but not enough to enable the person to fall off the leading edge of the building
- Anchorage points of sufficient strength are needed and these need to be checked to ensure they can take the forces which may apply if the harness and fall arrest are activated

Full Body Harness

- Markings on belts/harness show the manufacturer, date of manufacture etc.
- Storage dry and out of sunlight to protect from damage
- Visual inspections prior to use and after use
- Thorough examination every 6 months
- Records to be kept

Crash Decks

Soft landing systems, crash decks and air bags can be used where the risk of falling cannot be prevented this will minimise the risks of injury should an incident occur.

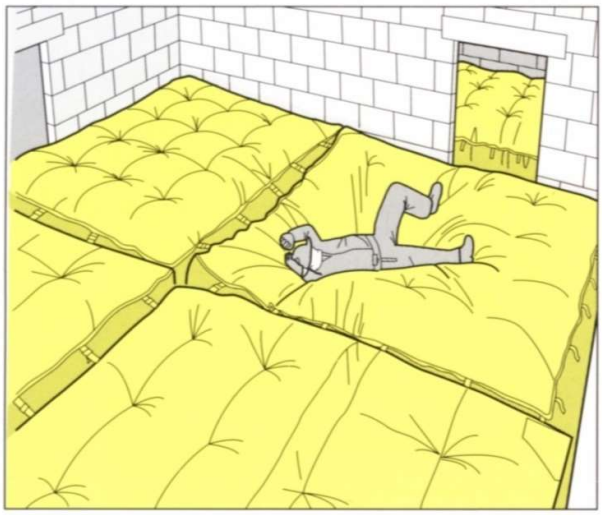


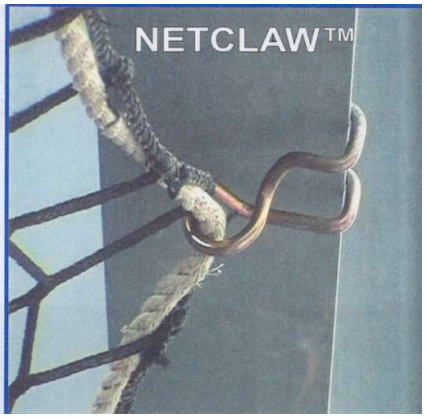
Figure 21 *Examples of other collective fall arrest systems*

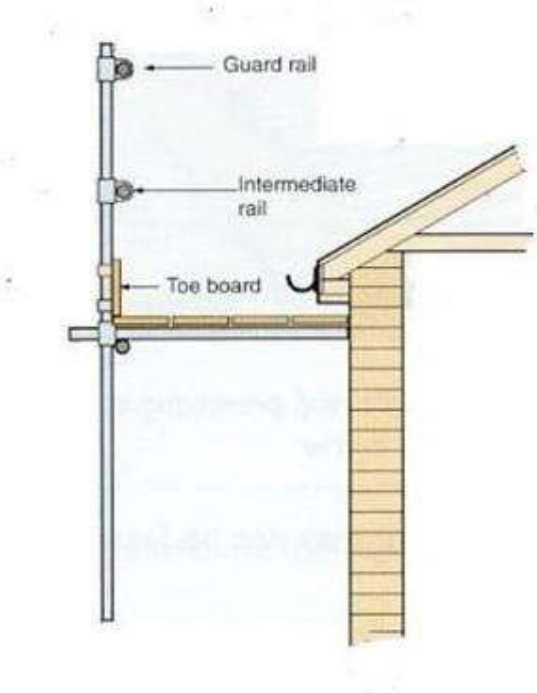
Crash Desk

Fall Arrest Bean Bags

Safety nets can be used as another form of fall arrest. They can be used for people and tools. The net needs to be in good condition and attached suitably with the correct tensioning. If it is too loose, if a person does fall, the shock loading may mean the netting hits surfaces or

objects below. If the net is too taut the person or tool could actually bounce off. The use of safety nets is not common within the construction industry, as they are not suitable for low level work as there needs to be clearance under the netting. If a person does fall, they should not fall more than 2m, as they could hit the ground or obstructions below. Nets must be inspected regularly as they can deteriorate in the sun from the UV light. There must be a record of nets which shows their use and any repairs undertaken. The nets must be located by a trained net rigger and a certificate provided to the site from the rigger. Nets must be manufactured to British Standards and once installed must be inspected on a weekly basis or more often if there is adverse weather.





Scaffold Platforms - may be needed to allow work on the edge of pitched roofs.
With intermediate guide rail.

Walkway for use on virtually any type of roof type and configuration

Crawling Boards – use crawling boards and ladders to spread the weight on flat or minor pitched roofs.

10.7 STEPS WHICH NEED TO BE TAKEN TO PROTECT OTHERS FROM THE RISKS ASSOCIATED WITH WORK AT HEIGHT

- Barriers
- Tunnels
- Signs
- Demarcation
- Lighting
- Sheeting
- Netting
- Fans
- Head protection
- See also NCC1 element 1 & 2

10.8 WORK NEAR WATER

Many accidents and fatal drownings occur in inland shallow rivers as well as in sea water. There are many situations where work must be carried out near water, from swimming pool maintenance to work on the underside of bridges. In any situation where employees have to work near water, a safe system of work must be employed and the employees concerned be fully trained to carry out the specific tasks undertaken.

As well as specific safety legislation such as HASAWA and the Construction Design and Management Regs 2015, additional non-legislative guidance is available to assist employers in ensuring the safety of their employees, who may be at risk because of the work they do near water:

- British Standards
- Water Services Association Guidance
- Water Company Guidance
- ROSPA Water Safety Publications Causes of Entry into Water:

The HSE has shown that it will take stringent action with employers, even if they are fellow government departments, where steps are not taken to minimise the risk of falling into water courses, especially when vehicles are to be used near the edge of the water course.

Although the prosecution below occurred in 2004, the principles it highlighted are still valid today

10.8.1 HSE PROSECUTION

HSE issues warning on construction work near water after Environment Agency is fined over drowning
HSE Press Release E:01504 - 30 January 2004

The Environment Agency was today (January 30, 2004) fined a total of £169,710 by Lincoln Crown Court after admitting a breach of health and safety law in relation to a fatal accident on the banks of the River Witham on 12 September 2001.

After the hearing, the Health and Safety Executive (HSE) warned construction contractors they should ensure proper planning and precautions before undertaking work near water. The Agency pleaded guilty to the charges after the death of their employee Steven Hughes who was working on flood banks on the River Witham. He drowned when the soil-laden dumper truck he was driving overran the edge of the bank and overturned into the river.

The Agency was prosecuted by the Health & Safety Executive (HSE) and faced a single charge of failing to ensure the safety of employees by not taking adequate precautions to prevent vehicles overrunning

the edge of the flood bank, in particular not adequately planning the work, not providing a safe system of work and such information and training as was necessary. The Agency was fined £150,000, and ordered to pay full HSE costs of £19,710.

Before work started the Agency prepared a plan that required all vehicles to be kept a safe distance from the edge of the bank. But the plan did not specify what physical precautions could or should be taken to prevent vehicles overturning into the water and did not adequately consider what equipment was selected for the conditions or set out safe haul routes, passing points and turning areas. Steven Hughes had not been trained to drive the vehicle.

After the hearing, HSE Principal Construction Inspector Samantha Peace, who took the prosecution, said: "Mr Hughes' death was a result of failures in the preparation and execution of the job.
"When planning construction work near water contractors should ensure they have selected the right equipment for the site conditions, particularly where narrow banks and steep slopes leave little margin for error. They should also define haul routes and turning points, mark the edges of the bank and difficult transition points on the routes with 2m poles and tape and ensure the people who work on the job have been trained.

"What really counts is that these precautions then become a reality - that workers are told about them and not left to tackle the work on the hoof. The only way that will happen is with effective supervision and management monitoring."

Notes to editors
1. The HSE brought a charge under the Health & Safety at Work etc. Act 1974 Section 2(1). This states that "It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of his employees

Once the person has entered the water the sudden shock of immersion in cold, sometimes freezing, water can add greatly to the risks involved. The weight of water logged clothes and flow of the water can further endanger the life of the employee. Weils disease or leptospirosis can also be a problem to people who work near water. It is spread via the urine of infected rats and will readily enter the body. Advice to employers and employees is available from EMAS (Employment and Medical Advisory Service).

Drowning can usually be linked to various factors including:

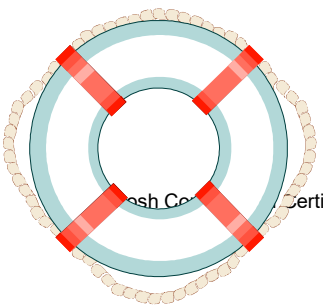
- failure to provide personal buoyancy equipment
- disregard or misjudgement of a hazard
- lack of supervision, especially for the young
- inability to cope once a problem arises
- absence of rescuers and rescue equipment
- failure to take account of weather conditions

10.8.2 PRECAUTIONS

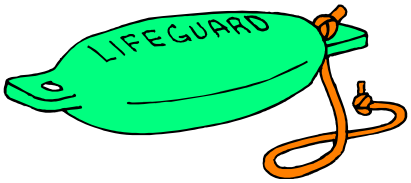
Any boat used to convey people to work must be suitably constructed, maintained and under the control of a competent person.

Where there is a risk of falling into water suitable rescue equipment must be provided along with employees trained to use it. This may include:

Rescue Lines: a line with a small bag at one end which can be thrown out from the shore to the casualty.



Rescue Packs*:* these are packs which contain a life line, this must be taken out to the casualty. The line is used to pull both rescuer

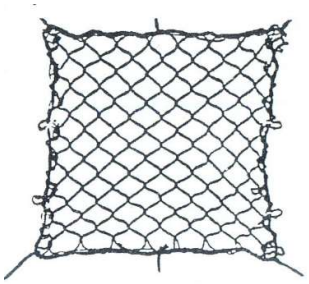


and casualty back to the shore.

***Life Buoys**:* these should have a cord at least 30 metres long attached. They can only be thrown a short distance because of their size and shape and therefore only have a limited use.

Rescue Boats: these should be provided whenever work is being undertaken over or adjacent to tidal water. Those using the vessel must be competent to do so. The boat should be equipped with a two way radio, grab lines and a means of providing adequate lighting.

***Stop Nets**:* these can be suspended just into the water line, they allow a conscious casualty to hold on while awaiting rescue.



Where there is a risk of falling from a structure or scaffolding, edge protection, guard rails or fencing must be provided. Where it is not possible to provide proper scaffold with guard rails and toe boards, safety nets can be provided:

- Should be erected as close as possible to working level.
- Nets can be designed to catch people as well as debris.
- Every 3 months the test cords of netting provided must be tested and recorded.
- Nets should be inspected weekly.

Rescue Equipment And Facilities

Life jackets - These are designed (BS3595) to support an unconscious person face upwards by built-in buoyancy or when inflated by either mouth or $C0_2$ cartridge. The latter automatically inflates, which allows the worker to move far more freely than more bulkier alternatives.

Buoyancy Aids - These will provide a conscious person with the buoyancy to stay afloat; it is normally provided by a closed cell foam pad.

First Aid Facilities - A trained first aider should be present at all work adjacent to water. Consideration should also be given how access can be gained to any potential casualty by the emergency services.

Alarms - Some form of audible alarm should be available, e.g. whistles, horns etc,.

Lighting - Water surfaces and the nearby work areas may need to be illuminated.

Communications - Those working on-site or the site supervisor must have readily available the telephone numbers which may be needed, along with a telephone or other way of summoning help. (i.e. radio)

High visibility vests - should be worn where possible.

Checking Personnel - Regular checks must be made to ensure employees are not missing; people should not work alone when adjacent to water.

Tides - Information should be gathered on current and future weather and tides.

Where there is a significant risk of drowning, contractors must provide a method statement detailing the measures to prevent accidental entry into water, and ensure:-

- All scaffolds and work platforms (including floating platforms), from which a person can slip or fall, are fitted with guard-rails, toe boards and, where appropriate brick guards
- Access adjacent to or above water is similarly guarded
- Where it is not reasonably practicable to provide adequate edge protection, safety harnesses, usually in conjunction with self-inflating life jackets, are worn and secured to a safe anchorage point. It is best practice for safety lines and harnesses to be used in addition to working platforms, in case of failure of the platform. Anchor points must be to the main structure
- Appropriate rescue and emergency equipment and procedures are in place, e.g. rescue boat, safety nets, lifebuoys and lines, lighting, audible alarms, communications etc, as required by the specific risk assessment
- Where rescue boats are used, the vessel should be appropriately maintained and the crew trained
- All personnel working over or near the water and at risk from falling in, must wear an appropriate lifejacket or buoyancy aid. Self-inflating life jackets with lines attached to a secure point are considered to be effective
- Throwing lines can be thrown further than lifebuoys and may be more appropriate in most cases, as a back up to other measures
- Operatives must be trained in the use of their equipment and it must be regularly checked and serviced, with compressed inflation devices being replaced as necessary
- No lone working should take place in areas of significant risk from drowning in water, silt etc. Operatives should work in pairs
- Illumination must be provided for night work, e.g. spotlights on swivels fixed at strategic points to assist in locating a person in the water
- The number of persons at work over water should be checked periodically to ensure no one is missing
- Staff must receive training on emergency procedures.

10.8.3.SAFETY CHECKLIST: WORKING OVER OR NEAR TO WATER

Management and planning

- Risk assessment carried out.
- Safe system of work, usually specified in a method statement.
- Permit to work system implemented where necessary.
- Frequent accounting for all staff.
- Lone working prohibited.
- Regular auditing that safety rules are being adhered to.
- Competence of all staff confirmed.
- Site induction and relevant toolbox talks for all.
- Other training provided where necessary.
- Serviceability and suitability of all rescue equipment periodically checked.
- Lighting available if necessary.
- Weather forecast monitored where the state of the weather could be an issue.
- Preparedness to suspend work, where appropriate.

Keeping out of the water

- Scaffolds: guard-rails, toe-boards fitted; inspections made.
- Safety nets: secure mountings, correct size of net, at the right place.
- Safety harness: right type, properly worn, good anchorage, attached constantly.
- Effective rescue procedures developed, for example, from a safety net.

Keeping afloat

- Life jackets: right size and type, always worn.
- Buoyancy aids: suitable for purpose.
- Prompt response by rescue craft.

Rescue procedures

- Lifebelt: correctly positioned, ready for action.
- Rescue lines: available, personnel trained in use.
- Rescue pack: requires a good swimmer.
- Rescue boat: properly equipped, experienced crew.
- Stop nets or lines, just in or on water.
- Rescue hierarchy:
    - Emergency services
    - Reach out
    - Throw out
    - Wade out
    - Go out
- Avoid becoming a casualty.

Onshore emergency procedure

- Audible alarm
- Good communications: telephone, radio
- Emergency services: phone numbers displayed, clear directions to accident location
- Site access for emergency vehicles.
- Trained first aiders/rescue team.