Safety, Health and Environment National Authority

INDUSTRY GUIDANCE NOTE

TOPIC: **Guidelines For The Safe Use Of Scaffolding**			Reference Number: **IGN 01/2020**
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PURPOSE

To provide practical guidance on the safe use of scaffolding throughout its life cycle from design to dismantling.

These Guidelines provide information and details on the various types of scaffolding available in Brunei Darussalam and the expectations placed on designers, constructors, inspectors and users of scaffolding to ensure scaffolding is safe for use throughout its life cycle. These Guidelines also make references to applicable laws in Brunei Darussalam including practical interpretation of those laws.

BACKGROUND

Scaffolding is a universal method of providing :

- A safe access and egress to a worksite
- A safe platform on which work is performed whilst working at height, for example during the construction of a tall building
- A safe platform on which to work is performed where there is a potential to fall and cause injury, for example working over a pit

Once constructed and certified, the scaffolding is fit for purpose and ready to for use.

However, during the construction, alteration or dismantling of a scaffold, particular precautions have to be taken since this type of work in itself may create a potential to fall and cause injury.

DEFINITIONS

Client – means a person who requests the scaffolding work;

Contractor – means an individual or business in charge of carrying out construction work (e.g. building, altering, maintaining or demolishing;

Occupier – is defined in the Workplace Safety and Health (Construction) Regulations, 2014;

Principal contractor – means a contractor appointed by the client to manage the construction phase on projects with more than one contractor;

Professional Engineer – is defined in the Workplace Safety and Health (Construction) Regulations, 2014;

Scaffold is defined in the Workplace Safety and Health (Construction) Regulations, 2014;

Scaffolds are commonly used so that workers may have a safe, stable platform on which to work from when work cannot be done at ground level or on a finished floor;

Scaffolds, once properly erected, are a control measure to prevent the risk of persons and objects falling when working at height;

Scaffolding – refers to the plant components and scaffold materials that, when assembled, form a scaffold;

Scaffolding contractor – means the person or occupier who has management and control of the scaffolding work;

Scaffolding work – means any activity associated with construction or removal of a scaffold;

USE "use of scaffolding" – includes any activity required to design, construct, alter, operate, inspect, and dismantle a scaffold and is intended to cover the life cycle of a scaffold;

Work at height – There is no legal definition in Brunei legislation of work at height. However, this is a common term used throughout industry to indicate that additional precautions should be taken due to the potential for someone or an object to fall and cause injury. Brunei legislation does however, refer to working above the 2m height where particular legal requirements are to be met; These are discussed in this document where appropriate.

Worker – means an individual who actually carries out the work. Workers include but not limited to: plumbers, electricians, scaffolders, civil workers, electrical workers, mechanical workers, painters, blasters, welders, steel erectors and labourers, as well as supervisors, foremen and charge hands.

RELEVANT LEGISLATION

The Workplace Safety and Health Order, 2009, referred to as WHSO, 2009, provides the overarching legal requirements on workplace safety and health in Brunei Darussalam. It places a duty on principals, employers, employees and self-employed persons to provide a safe place work and prevent harm to persons (including the public).

This general duty is further developed with respect to the safe use of scaffolding, by the Workplace Safety and Health (Construction) Regulations, 2014. These Regulations are referenced where as required in this document.

The Workplace Safety and Health (Risk Management) Regulations, 2014, require a risk assessment to be conducted by the employer in relation to any

safety and health risks posed to any person who may affected by his undertaking.

The Workplace Safety and Health (Incident Reporting) Regulations, 2014, places a duty on the employer, where any accident occurs at a worksite which leads to the death of any employee and where there is any dangerous occurrence, to notify the authorities. Collapse of scaffolding structures including form work is a specific dangerous occurrence.

STATUS OF GUIDANCE

Guidelines are not a legal requirement, however if followed a person will usually be doing enough to demonstrate compliance with the law. If a person does not follow the Guidelines, he will have to demonstrate that his chosen approach is sufficient to achieve the same level of compliance as if he had followed the guidelines.

HOW TO USE THESE GUIDELINES

These Guidelines should be read in conjunction with the referenced legislation to ensure the correct understanding and context is maintained.

References to sections of the Workplace Safety and Health Order, 2009, are made by (**S**).

References to regulations in the Workplace Safety and Health (Construction) Regulations, 2014, are made by (**R**).

1. WORKING AT HEIGHT

1.1. Definition

There is no legal definition in Brunei legislation of work at height. However, this is a common term used throughout industry to indicate that additional precautions should be taken due to the potential for someone or an object to fall and cause injury.

Throughout this document the term "working at height" is used to indicate there is a potential to fall and cause personal injury or there is a potential for falling objects to cause personal injury or asset damage.

1.2. Working above 2m

Under the Workplace Safety and Health (Construction) Regulations, 2014, scaffolding work that involves scaffold from which a person or object could potentially free fall more than 2m is classified as 'high risk construction work', for which a permit to work is required.

1.3. Examples of working at height

Typical examples of working at height are if you:

- are working on a ladder or on a flat roof
- could fall through a fragile surface or structure
- could fall into an opening in a floor or a hole in the ground or over /above water

There is a common misconception that ladders and stepladders are not allowed. There are many situations where a ladder is the most suitable equipment for working at height.

Take a sensible approach when considering precautions for work at height.

2. DUTIES ON PERSONS

An employer has the primary duty under the WHSO, 2009 to ensure, so as far as reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from his activity or undertaking. This includes the use of scaffolding.

An occupier of a worksite also has specific duties under the Workplace Safety and Health (Construction) Regulations, 2014 for the management and control of scaffolding activities at a worksite.

For clarity, the person or occupier who has management and control of the scaffolding work is sometimes referred to in these Guidelines as the scaffolding contractor.

Installers or Erectors (of scaffold) – under the WHSO, 2009, (**S.17**) must ensure, as far as is reasonably practicable, that the way the scaffold is installed is without risks to the safety and health of persons who uses the scaffold and others who are at or in the vicinity of the worksite.

Manufacturers, importers and suppliers (of scaffold) – under the WHSO, 2009 (**S.16**) must ensure, so far as is reasonably practicable, that scaffold material they manufacture, import or supply are without risks to safety and health; and meets recognized, good industry standards.

Officers – under the WHSO, 2009, (**S.47**), such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the WSHO Order, 2009 and the Regulations made thereunder. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to eliminate or minimize risks that arise from the construction work.

Scaffold Inspector in these Guidelines – is a competent person with relevant knowledge and experience to be able to inspect and find any faults with the basic access and complex/designed scaffold structure, signing certificates and registers and provide recommendations in accordance with industry best practice and legislative requirements.

He would attain an understanding of scaffolding components, forms of construction and inspection procedures of basic access scaffolds to comply with relevant current legislation, these Guidelines and an understanding of the appropriate safety regulations and the ability to interpret design specifications and statutory regulations when inspecting complex/designed scaffolding structures for faults.

Scaffold Supervisor in these Guidelines – is a competent person who has the knowledge and experience to be able to allocate, coordinate, be responsible for the safety of his teams and any other worker on site, be able to notice career advancement of members of his team, be a good listener and communicator with his team and management.

3. WHAT IS RISK MANAGEMENT?

Effectively controlling safety and health risks involves following a systematic process known as risk assessment as referred to under the Workplace Safety and Health (Risk Management) Regulations, 2014.

A risk assessment is the process of identifying hazards and evaluating the probability of injury or illness if exposed to that hazard, and determining the appropriate measures required to control the risk of injury or illness.

This can be summarized as :

- Identifying the hazards
- Assessing the risks and implement controls
- Communicating the findings
- Reviewing the effectiveness of control measures.

4. MANAGING RISKS ASSOCIATED WITH THE USE OF SCAFFOLDING

4.1. Identifying the hazards

Some examples of the hazards associated with the use of scaffolding include -

- fall from height
- falling objects
- scaffolding collapse (before, during and after placement of the scaffold)
- work near overhead electric lines (within 4m)
- mobile plant and other worksite traffic
- mixing components from different scaffold systems (for example, do not mix aluminium tubing with steel tubing)
- working over water
- collision with lifting object or tackles
- manual tasks.

4.2. Assessing the risks

When assessing risks relating to the use of scaffold you should consider the following:

- the type of scaffold to be used
- the height of the scaffold to be erected
- the scheduling of the scaffolding work
- the layout of the worksite, including proximity to public areas

- the surface on which the scaffold will be erected (ground conditions, the structural integrity of the surface to support the scaffold and its load)
- the number of people involved
- plant and equipment that will be used on or near the scaffold
- ongoing adjacent concurrent activities
- damage to adjacent equipment or structures
- materials and safety equipment in use are certified
- plan for rescue
- the skill and competencies required to erect, use, maintain, alter and dismantle the scaffold
- exposures that might occur, such as noise or ultraviolet (UV) radiation
- local weather conditions, particularly wind forces.

It should then be possible to:

- select the most suitable type of scaffold for the work
- minimize the working heights for persons erecting and dismantling scaffolds
- barricade the scaffolding erection area
- ensure that edge protection (including guardrails, mid-rails and toe boards), containment sheeting or other fall risk controls are able to be installed when working at height

R. 20: *It shall be the duty of the occupier of a worksite with a supporting structure to take, so far as is reasonably practicable, such measures as are necessary to ensure that the supporting structure complies with the regulations*.

4.3. Implementing risk controls

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of control measures*. The duty holder must always aim to eliminate a hazard first. If this is not reasonably practicable, the risk must be minimized by using one or more of the following:

R.4: *A person or occupier of a worksite shall implement and maintain at all times a safety and health management system for the purpose of ensuring the safety and health of every person within the worksite, whether or not the person is at work or is an employee of the occupier*.

Before working at height, you must work through these simple steps:

- avoid working at height where it is reasonably practicable to do so
- where working at height cannot be avoided, prevent falls using an existing fully boarded platform with guard rails and toe boards and safe access
- minimize the distance and consequences of a fall, by using the right type of fall arrest equipment where the risk cannot be eliminated.

You should:

- do as much work as possible from the ground
- ensure workers can get safely to and from where they work at height
- ensure fall arrest system is in place where necessary
- ensure equipment is used according to its design and manufacturer's recommended purpose
- ensure equipment is suitable, stable and strong enough for the job, maintained and checked regularly
- ensure you do not overload the scaffold or overreach when working at height
- take precautions when working on or near fragile surfaces
- provide protection from falling objects
- consider your emergency evacuation and rescue procedures.
- *Substitution* – for example:
  - ❖ Do use mechanical aids such as cranes, hoists, pallet jacks or trolleys to move equipment and materials wherever possible instead of manual lifting
  - ❖ Do use scaffold systems which are made of lighter weight materials and use modern technologies, for example, modular systems which have shorter standard lengths or systems that are made of aluminum rather than steel or timber.
- *Isolation* – for example, do use concrete barriers to separate pedestrians and powered mobile plant to reduce the risk of collision.
- *Engineering controls* – for example, do provide a catch platform to prevent falling objects hitting workers or other persons below the work area.

If risk remains, it must be minimized by implementing administrative controls, so far as is reasonably practicable. For example, store scaffolding components as close as practical to the work area in order to minimize the distance over which loads are manually moved. Clear access ways should also be ensured so that materials and equipment can be easily accessed.

Any remaining risk must be minimized with suitable personal protective equipment *(PPE),* such as providing workers with suitable hard hats, personal fall-arrest equipment, hearing protectors and high visibility vests.

Administrative control measures and PPE rely on human behaviour and supervision, and used on their own, tend to be least effective in minimizing risks.

4.3.1. High risk construction permit to work

Under the Workplace Safety and Health (Construction) Regulations, 2014, scaffolding work that involves scaffold from which a person or object could potentially free fall more than 2m is classified as 'high risk construction work', for which a permit to work is required.

R.10: *Work on a scaffold where a person could fall more than 2m requires a permit to work system to be in place*.

The permit to work is issued by the Project Manager or an authorised person.

R.13: *A permit to work is prepared by the supervisor of a person who is to carry out any high-risk construction work in a worksite and approved by the Project Manager and then submitted to the safety assessor for the worksite*.

Refer to *Appendix B* for further information on types of scaffolding works.

Where a permit to work is not required

A person or occupier of a worksite is not required to prepare a scaffolding work permit if a person or thing may potentially free fall 2m or less. However, any person performing scaffolding work should be competent and must be provided with relevant information, instruction, training and supervision in the

safe erection, dismantling, maintenance and alteration of the scaffold. Refer to *Appendix G*

Other key terms used in this publication are defined in *Appendix A*.

S.12: *It shall be the duty of every employer to take, so far as is reasonably practicable, such measures as are necessary to ensure the safety and health of his employees at work and persons not his employees at the workplace.*

4.3.2. Combinations of control measures

In many cases, a combination of control measures provides the best solution. For example, using fall protection devices to protect workers from falls, such as guard rails (engineering), and safe systems of work (administrative), and other workers from falling objects by establishing an exclusion zone for the work area (isolation), netting and providing hard hats (PPE). These control measures shall be mentioned in the site's permit to work processes that take into account relevant information as provided in the *Appendix D* and the Planning Checklists.

R.33: *A person, employer or principal for any work undertaken on a worksite must ensure that any person who carries out any work in a worksite is provided with appropriate personal protective equipment and that this equipment is maintained and suitable for use*.

4.4. Communicating the findings

4.4.1. Informing and consulting your workers

Consultation with workers and their workplace safety and health representatives is required at every step of the risk management process. In many cases, decisions about construction work and projects are made prior to engaging workers, therefore, it may not be possible to consult with workers or inform them in these early stages. However, it is important to consult with them as the scaffolding work progresses. A briefing should be conducted prior to commencement of any works and include operational requirements and safety measures to be taken.

S.12: *As an employer you must, so far as is reasonably practicable, provide workers who carry out work for you with adequate instruction, information, training and supervision*.

S.28: *If the workers are represented by a health and safety representative, the consultation must involve that representative*.

R.7: *The WSH Coordinator would recommend reasonably practicable measures to remedy any unsafe condition or unsafe work practices on the site*.

4.4.2. Consulting, cooperating and coordinating activities with other occupiers of the site

A construction worksite will often be shared by various persons conducting a business or undertaking, such as engineers, contractors and mobile plant operators. Persons with overlapping duties should exchange information about the risks associated with the scaffolding work including any traffic and plant movements near the scaffold area. They should work together in a cooperative and coordinated way so that all risks are eliminated or minimised so far as is reasonably practicable. This shall be undertaken by convening a routine site co-ordination meeting.

R. 5: *An occupier of a worksite conducting a business or undertaking must consult, cooperate and coordinate activities with all other persons who have a work safety or health duty in relation to the same matter, so far as is reasonably practicable*.

4.4.3. Information, Instruction, training and supervision.

S. 12: *Any employer must provide any information, instruction, training and supervision necessary to protect all persons from risks to their safety and health arising from the work carried out at the worksite and having due regard to*:

- the nature of the work carried out by the worker
- the nature of the risks associated with the work
- the control measures implemented.

The training provided must be readily understood by any person to whom it is provided. The Authority recommends that

all workers involved in any scaffolding activities are trained and suitably qualified. Training shall be based on Government recognized and approved standards and guidelines or similar. Refer *Appendix G* for training and experience required.

R. 9: *Any employer must not direct or allow a worker to carry out any manual work in a worksite unless the worker has successfully completed general construction safety and health training for the purpose of familiarizing the worker with the hazards associated with such work and the precautions to be observed.*

A person supervising or providing oversight in a worksite for any work or any process involved at the worksite, must receive and have successfully completed general construction safety and health training to ensure the safety of the persons being overseen. Refer to *Appendix G*

Training specific to the scaffold and/or scaffolding work and to the worksite should also be provided to workers. Workers in a supervisory role (for example, leading hand or foreman) should be experienced and trained in scaffolds and scaffolding work. Refer to *Appendix G*

4.5. Reviewing risk control measures

The control measures that are implemented to protect health and safety must be regularly reviewed to ensure they are effective and that no new hazards have been introduced by the control measures.

It may be necessary to revise control measures:

- when the control measure is not effective in controlling the risk
- before a change at the worksite that is likely to give rise to a new or different safety and health risk that the control measure may not effectively control
- if a new hazard or risk is identified
- if the results of consultation indicate that a review is necessary
- if a health and safety representative requests a review

Common review methods include worksite inspection, consultation, testing and analysing records and data.

When reviewing control measures, a Safe Work Method Statement (SWMS) which includes scaffold designs must also be reviewed and revised where necessary.

5. PRACTICAL EXAMPLES OF RISK CONTROL IN SCAFFOLDING WORK

The following general requirements apply to the use any scaffold and section 6 of this publication describes more specific types of scaffold.

R. 14: *The person or occupier with management or control of a scaffold at a worksite must ensure that:*

- *the scaffold and its supporting structure are inspected by a competent person i.e. scaffolding inspector*
- *the scaffold is not used unless the person receives written confirmation from a competent scaffolding inspector, who has inspected the scaffold, that construction of the scaffold has been completed*
- *if an inspection indicates that a scaffold or its supporting structure is unsafe that appropriate repairs, alterations and additions are made or carried out and the scaffold and its supporting structure are inspected again by a competent scaffolding inspector before use of the scaffold is resumed*
- *unauthorised access to the scaffold is prevented while the scaffold is incomplete or unattended.*

R.14: *The competent scaffolding inspector shall inspect the site and structure where the high-risk construction work is to be carried out together with the supervisor of the worker who is to carry out the work ensure it is safe to do so; when satisfied, he shall endorse the permit to work and forward the application to the project manager of the worksite*.

These requirements apply to all high-risk scaffolding activities where a person could fall more than 2m including suspended, cantilevered, spur or hung scaffolds.

5.1. Safe erection of scaffold

The following work method should be complied when erecting scaffold:

- after enough components of the scaffold have been erected to support it, immediately install:
  - ❖ a platform at least 450mm wide along the full length of the section of scaffold (see Figure 1)

- ❖ edge protection across the space between the uprights forming the outer frame of the scaffold at the level the scaffold has reached (see Figure 2)
- ❖ a means of access (for example, temporary stairs or a ladder) to the level the scaffold has reached

- before the next level of the scaffold is erected, a platform should be installed below the level at a distance of not more than 2m (see Figure 3)
- a section of the platform may be left open to allow the passing of planks or other scaffolding components between levels
- a platform does not need to be installed on the bottom level of the scaffold
- a platform may be removed after work has started two levels above the level from which the platform is to be removed

The following additional safe work practices should be followed when erecting scaffold:

- Scaffold '*fittings*' and other connections should be securely tightened. Where 'safety fittings' are used, they should be fitted in accordance with the scaffolding plan
- All scaffolding components should be installed as the scaffold is erected. For example, the installation of:
  - ❖ all bracing and ties
  - ❖ guy ropes or buttresses
- Using specifically designed loading platforms and/or back propping to prevent overloading the building floor or the scaffold
- Obtaining approval from a competent person before erecting scaffold on awnings
- Limiting the number of workers on a scaffold at any one time
- Developing a methodical work sequence if more than one worker will be on the scaffold at the one time for example, allocate specific tasks to each scaffolder
- Working from a full deck of planks whenever possible
- Do not climb on guardrails to gain extra height
- It is not permitted for persons to carry or transfer material to and from a scaffold platform at any height by hand while ascending or descending any ladder or using any ladder
- Implement measures to control the risk of a fall if the internal gap (the gap between the inner edge of the length of the platform and the face of the building or structure immediately beside the

platform) on scaffolds (includes hanging bracket scaffolds) is greater than 225mm. For example, install:

- ❖ edge protection
- ❖ additional scaffold planks to minimize the size of the internal gap

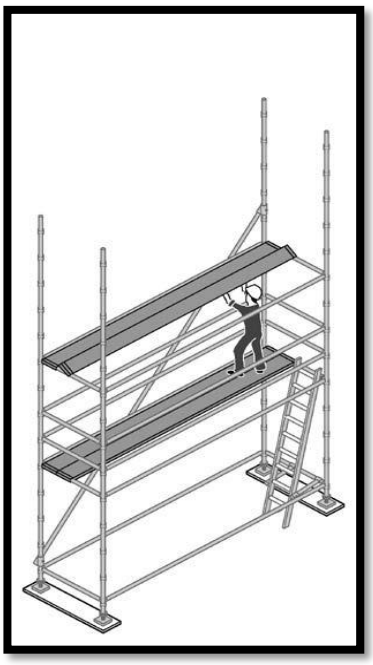


Figure 1.

Work from a platform at least 450mm wide to install planks overhead. Platform does not need to be installed on the bottom level of the scaffold.

Figure 2.

Immediately install edge protection after enough scaffolding components have been erected. A section of the platform may be left open to allow scaffolding components to be passed between lifts.

Figure 3.

Worker on two planks should have a fully decked platform positioned beneath them at a distance of no more than 2m

5.2. Safe dismantling of scaffold

Edge protection and any means of access can be removed as the scaffold is dismantled, provided it is removed at the last possible stage. The sequence of dismantling must be complied with, that is, to commence the dismantling from the top down.

- A platform of at least 450mm wide, at the level the dismantling has reached, is in place, where practicable
- Ensure that when dismantling scaffold, the platform immediately below the level the worker is standing on, has a full set of planks across its width and is no lower than 2m
- A section of the scaffold may be left open (for example no platform in place) to allow the lowering of planks or other scaffolding components between levels
- Scaffolding components should never be dropped in an uncontrolled manner when dismantling scaffold.

5.3. Scaffold modification and maintenance

Control measures to eliminate or minimize health and safety risks include:

- consulting the scaffold designer before making any alterations
- scaffold alterations are in accordance with the scaffolding plan
- alterations do not compromise the structural integrity of the scaffold
- systems are in place (for example, regular inspections every 7 days) to identify unauthorised interference with the scaffold
- scaffolds that are not in use for a period of over 7 days should be re-inspected by a competent scaffolding inspector
- all unused scaffolds over a duration of one month should be dismantled as soon as reasonably practicable and not be used as erected
- records of modifications, alterations and inspections shall be maintained by the scaffold contractor

R.49: *It is the duty of a person or occupier of a worksite to ensure that every cantilevered platform or material platform is inspected by a designated person at least once every 7 days, the inspection is registered and records maintained.*

5.4. Fall from height and falling objects

R. 22: *A person or occupier of a worksite shall take, so far as is reasonably practicable, such measures as are necessary to prevent any person from falling on a worksite, especially in areas where there is potential of persons or loose material falling more than 2 m.*

R.25: *It shall be the duty of any person or occupier of a worksite to ensure that adequate overhead protection is provided in the worksite against objects that could fall on or otherwise hit persons*.

Control measures to eliminate or minimize the risk of a falling object can include catch platforms, perimeter screening, netting and exclusion zones.

Hazards which may increase the risk from a fall while erecting, altering or dismantling scaffold include:

- poor environmental conditions, for example:
  - ❖ strong winds that may cause workers to lose balance
  - ❖ rain that can cause a slippery work surface
  - ❖ glare emitted from work surfaces and/or poor lighting that can affect visibility
- materials, equipment or protruding objects below, or in adjoining work area for example,
  - ❖ pallets of construction materials
  - ❖ vertical reinforcing steel
  - ❖ a rubbish skip
  - ❖ exposed starter bars
  - ❖ picket fences
- void areas not identified or protected, for example, ladder access voids
- incomplete scaffolds or loose scaffolding components where work is being done, or is likely to be done, including inadequate training, instruction and supervision of scaffold workers.

S.12: *It shall be the duty of every employer to take, so far as is reasonably practicable, such measures as are necessary to ensure the safety and health of his employees at work*.

5.5. Fall arresting platforms

A fall arresting platform can be used as a risk control measure to arrest a person's fall during work at height, especially on a sloping roof.

If the slope of the surface where work is being done is:

- not over 26° – then install the platform no more than 1m lower than the surface (see Figure 4a), or

- over 26° – then install the platform no more than 300mm lower than the surface (see Figure 4b).

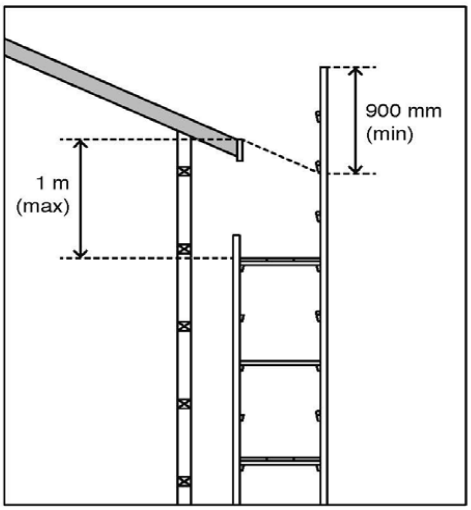


Figure 4a: Fall arrest platform ≤ 26°

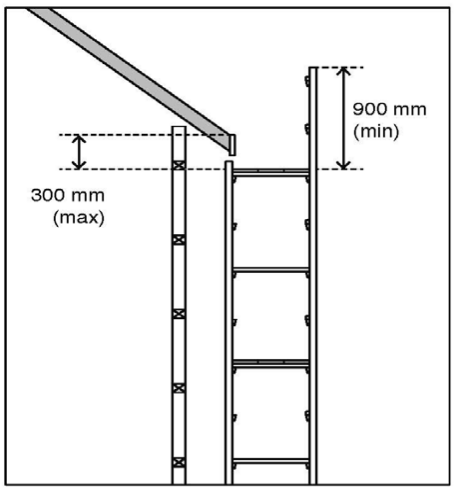


Figure 4b: Fall arresting platform > 26°

The fall arresting platform should:

- be unobstructed and at least 675mm wide for the length of the platform
- be able to withstand the impact of a fall onto it
- have edge protection erected along the outer edge of the length of the platform and along the edges of each end of the fall arresting platform

If the internal gap (the gap between the inner edge of the length of the platform and the face of the building or structure immediately beside the platform) exceeds 225mm, do implement a control measure to control the risk of a fall.

This platform is recommended for use when working on roof tops to prevent persons falling off or materials dropping off the edge and hitting persons in the vicinity. If used as an access route to the roof top, it shall be inspected by a competent scaffold inspector. No persons shall use it for working from or for storing materials on it without a proper inspection.

5.6. Fall-arrest systems

Fall-arrest systems can be used as a risk control measure to arrest a person's fall when working on a scaffold.

Fall arrest systems that meet industry standard [e.g. EN361] consisting of full body harness, shock absorbing lanyard, double hooked lanyard and suitable anchor point should be used. Operator shall be

appropriately trained in the use and application of the fall arrest system.

For any scaffold work above the height of 2m, scaffolders and any other persons working at height with a potential for a fall from height, shall use fall arrest system suitably secured to a strong point.

R.33: *It shall be the duty of an employer or principal of a worksite to ensure that all his employees or persons who carry out work on the worksite, are provided with appropriate personal protective equipment, where there is any potential for a fall from height*.

5.7. Edge protection

Edge protection may be used as a risk control measure to prevent the risk of death or injury from a fall during work at height.

Do obtain written approval from a competent person before installing edge protection on a scaffold system which was not originally designed, supplied or manufactured with edge protection. Approval should include specifications on how to install and maintain edge protection.

Toe boards and end toe boards should be suitably fixed to all working platforms where there is a risk of falling material, and are always required where a person may fall more than 2m. They should be of such a height that the gap between the top of the toe board and the guardrail does not exceed 470mm and have a minimum height of 150mm. They should be placed inside the standards. Toe boards may be dispensed with on stairways.

Toe boards shall be designed to resist a horizontal point load of 0.15kn.

A person conducting a business or undertaking must, so far as is reasonably practicable, identify all fall hazards associated with the installation and dismantling processes of edge protection and implement control measures. Controls for falling objects such as toe boards should also be considered when installing edge protection.

5.8. Access and egress

Workers must be provided with safe access to and egress from scaffold during the erection, use and dismantling of scaffold. Common means of access and egress include:

- temporary stairs or portable ladder access systems installed at the start of erection, progressed with the scaffold, and used by the scaffolder whenever possible
- permanently installed platforms or ramps
- personnel hoists (non-mechanical forms of egress, such as a ladder or stair tower should be provided in case of emergency)
- using the existing floor level of a building, provided such access is safe

Scaffolders should not climb standards externally. Use of external ladders up to the first lift of 2m and shall be followed by internal ladders for all higher access. Any climbing above 2m should utilise the 100% tie-off to contact point method.

Stairs should be secured to the scaffold bay. If not secured, the supplier should provide documentation illustrating the maximum amount of clearance allowed between the transom and the top and bottom of the stair module. Ensure the gap between the end of a stair module and a transom is as small as practicable. Large gaps can lead to stairs dislodging and falling when a load is placed onto it.

5.9. Ladders

Extensions or single ladders should only be used as a means of access to or egress from a work area, not as a working platform. Homemade ladders are not recommended under these Guidelines. All ladders should be to specification and inspected by a competent person prior to use. The following are additional safe work practices which should be complied when working on ladders:

- Ladders may be used where access to the working platform is needed by only a few persons, and where tools and equipment can be delivered separately to the working platform (for example, by materials hoist, crane or a rope and certified gin wheel or pulley system)
- Ladders should be within a separate ladder access bay of the scaffold, wherever space permits

- If the access bay is part of the working platform, a trap door is to be provided. Strict controls should be implemented to ensure the trap door remains closed while working from the platform
- Ladders should be set up on a firm, level surface and not used on scaffold bays to gain extra height

R.43: *It shall be the duty of a person or occupier of a worksite to ensure that any person who carries out work which requires the use of a ladder on the worksite, to ensure that the ladder is of good construction, sound material and adequate strength for the purpose for which it is used*.

Guidelines for use of Ladders

- Ladders should be at an ideal angle of 75 degrees (ratio of 4m up to 1m out) from the side of a building or structure
- Ladders should extend above the platform by as a minimum 1m or 5 rungs, to allow ease of access or transfer to and from a platform.
- Ladders should be adequately secured at all times prior to use
- If a ladder is over 4m in height, it must be adequately braced or supported
- Ladders should not be more than 6m in height. If there is a consideration to access further heights, then intermediate landing platforms must be constructed

5.10. Perimeter containment screening

Perimeter containment screening may be used to protect persons from falling objects. Perimeter containment screens can be made of mesh, netting, a good quality shade cloth, timber, plywood, metal sheeting or other material suitable for the purpose.

Perimeter containment screens should be located inside the standards on working platforms. Where used, the lining should be attached to the inside of the mesh. The lining can be attached using non-structural locating product which keeps the lining in place while minimizing damage to the lining. However, the additional wind loading represented by the use of linings must be considered in the selection of an appropriate lining material.

The framework supporting a screen must be able to bear the load of the screen.

5.11. Electricity

Any construction work that is carried out on or near energised electrical installations or services is high risk construction work and a SWMS must be prepared before this work commences. Contact with overhead electric lines has the potential to cause serious life-threatening injuries or death.

Electrical power sources, whether overhead or underground can be a major hazard. In addition to direct electric shock and possible electrocution, contact with overhead electric lines can lead to a variety of hazards including arcing, explosion or fire causing burns, unpredictable cable whiplash and the electrifying of other objects (for example, signs, poles, trees or branches).

Specific control measures must be implemented when work is done in the vicinity of electric lines. The local electricity supply authority should be consulted and appropriate risk controls implemented.

Any scaffolds are erected in the proximity to any electrical power sources (e.g. live electrical power lines), a minimum distance of 4m shall be maintained to prevent exposure to electrical arching. Risk assessments by the scaffold contractor should assess the risk to any persons in the vicinity of electrical power sources.

R.34: *It shall be the duty of an employer or a principal of a worksite, where a person carries out work on the worksite and who may come in contact with any part of an electrical power circuit, to ensure the worksite is inspected for any electrical power circuits on the site and tools that may be connected to electrical power circuit and to provide warning signage, advice to all persons on the worksite and protective measures to maintain a safe place of work*.

5.12. Powered mobile plant and traffic

Mobile plant and vehicular traffic are hazards which can potentially affect worker safety and the safe use and structural integrity of a scaffold.

Control measures that can be used to prevent or minimize exposure to the risk of death or injury from moving plant and traffic include:

- Re-route motor vehicles and mobile plant away from the location of the scaffold, for example, by using traffic controllers to redirect traffic

- Use barricades, signs, posts, buffer rails, guards, or concrete or timber kerbs to prevent mobile plant and traffic from coming into contact with a scaffold
- Ensure the scaffold does not have any unnecessary protrusions, such as over-length transoms, putlogs, tie tubes or over-height standards

R.28: *It shall be the duty of a person or occupier, employer or principal of a worksite to ensure the site is barricaded, suitable warning signs and lights are posted and traffic is controlled by designated persons. That any vehicles on the worksite are of good construction and roadworthy with persons driving such vehicles to be authorized and trained to operate or drive the vehicle*.

5.13. Mixing components from different scaffold systems

Components from different manufacturers or suppliers, while appearing compatible, are often of different dimensions and tolerances (see Figure 5).

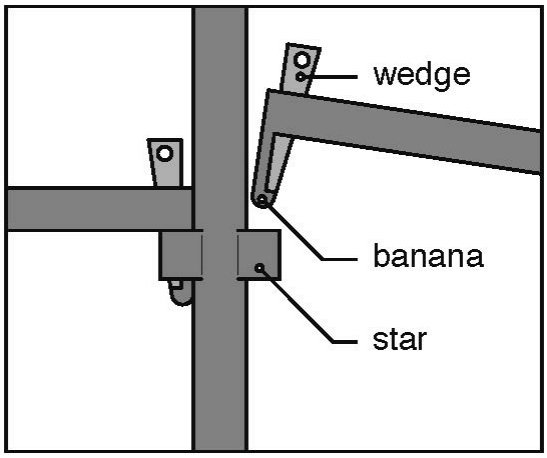


Figure 5: Mixing components.

Different modular systems should not be mixed. Often connection points known as the 'star' and 'banana' used on these systems are of a different shape and tolerance and are not compatible.

Mixing incompatible scaffolding components can significantly affect the structural integrity of the scaffold and could lead to the possible collapse of the scaffold. Mixing incompatible components can also lead to increased wear on the components and difficulties in disassembly, which in turn may increase the risk of musculoskeletal injury to workers.

The following controls can be used to prevent or minimise the risk of injury and scaffold collapse due to the incorrect mixing of components:

- Do not mix scaffolding components from different manufacturers unless a competent person approves that the:
  - components are of compatible size and strength
  - components have compatible deflection characteristics
  - fixing devices are compatible
  - mixing does not lessen the strength, stability, rigidity or suitability of the scaffold
- Do not mix scaffolding couplers and tubing of different outer diameters and strengths unless designed specifically for the task by a competent person or the coupler manufacturer has designed the couplers for this purpose. For example, do not mix aluminium and steel components as steel clamps may cause aluminium tubing to be crushed thus reducing the strength of the tube
- 'Beam clamps' or 'flange clamps' should be provided with information about safe use, including adequate tightening where required and when to use different types of couplers. If no information is provided, contact the supplier, manufacturer or designer of the scaffold

Material records shall be maintained by the scaffold contractor at an appropriate location for ease of access and reference, when required.

5.14. Scaffolding in vicinity of open excavation or trench

As a rule of thumb, it is recommended that no scaffolding should be built in the vicinity of open drains, trenches or excavations. However, if there is need for such structures to be built, they should be placed at a safe distance from the edge of the open drains, trenches or excavations with a minimum ratio of 1m deep to 1m distance away consideration.

When open trenches are built after a scaffold structure is built, a competent person shall reassess the suitability and load bearing capacity of the scaffold, prior to permitting access to the scaffold for any activities.

6. TYPES OF SCAFFOLD

The design, shape and location of the building or other structure should be considered when selecting the type of scaffold to be used. Choose a scaffold system that is most adaptable to the contour of the building or other structure, particularly if a modular scaffold is being considered. Also consider the purpose for which the scaffold is to be used, for example, bricklaying, plastering or demolition. Refer to *Appendix H* for pictures of scaffolding structures.

Scaffolds should be erected in accordance with the designer's instructions and the scaffolding plan.

6.1. Special note for the use of A or H frame scaffolding in Brunei

6.1.1. Frame scaffold

Frame scaffold is a scaffold assembled from prefabricated frames, braces and accessories. Frame scaffolds such as 'A' and 'H' frame trestle scaffolds are commonly used by bricklayers, plasterers and painters, and for general fit-out and finishing work. Refer Figure 6.

A and H frame scaffolds are also extensively used in Brunei to support formwork during the curing period of poured concrete. Formwork and supports is regulated under the Workplace Safety and Health (Construction) Regulations, 2014. Duties are placed on Occupiers, Employers, Formwork Supervisors and Professional Engineers to ensure all formwork, including support structures are safe to use.

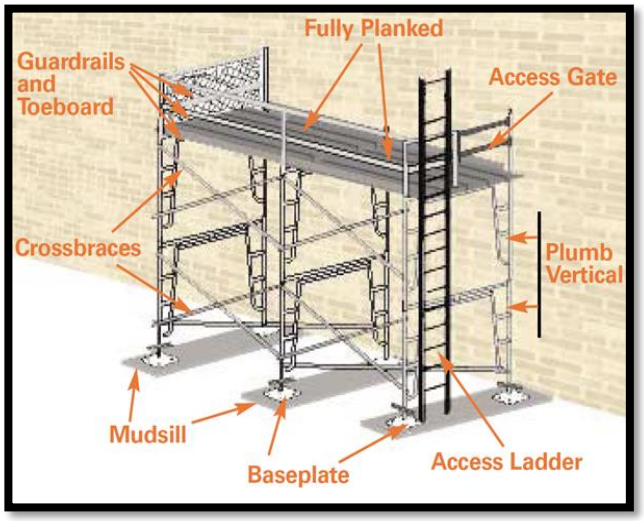


Figure 6: Standard A Frame

***NOTE**: Frame scaffold is not recommended as an access scaffold for use above a single frame height without additional precautions.*

Frame scaffold should be erected and dismantled by a competent person in a progressive manner to ensure both the installers safety and the stability of the overall structure and braces should be attached to the frames in accordance with the manufacturer's or supplier's instructions. As the height of frames increase, there is a greater need to provide lateral stability to the frames.

Frame scaffold should be stable and erected on a suitable foundation to ensure it can adequately carry and distribute the loads such as materials and workers evenly to each frame. Measures to control instability and prevent possible toppling can include the use of ties to a permanent structure or using outriggers.

Frame scaffold should:

- install barriers (or edge protection) where the potential fall exceeds 2 meters or the fall area contains hazards such as sharp objects – e.g. steel reinforcing bars
- support the relevant live load or duty rating – not exceeding load limit. Note: The full width of a frame trestle must be fully planked or boarded, irrespective of the duty rating and loading
- use scaffold planks that are uniform and in good condition (no splits, cracks, knots, bends etc.), overhang their end supports between 150–250 millimeters and are secured against uplift
- establish a horizontal work platform. If on sloping or uneven ground, use a frame trestle that incorporates height adjustment. Do not use bricks or blocks as soleplates
- have a safe means of access and egress – e.g. by secured ladders or from the building if approximately level with the platform
- have a safe means to load material onto the working platform – e.g. use mechanical means or, if this is not practicable, pass (do not throw) material up to the working platform

- movements of multiple persons e.g. walking around others on 2 plank platforms should be controlled

Guardrails must be provided at 1m from scaffold work floor. For any working platform, toe boards and two handrails must be provided, at a maximum gap of 400 millimeters to 450 millimeters between the handrails.

Most bracing systems for tubular frame scaffolds are manufactured from light materials and are easily damaged by misuse or abuse so care should be taken during installation and dismantling. Under no circumstances should any person be allowed to climb the braces or frames.

6.2. Birdcage scaffold

A birdcage scaffold is an independent scaffold that consists of more than two rows of standards in both directions and is connected by ledgers and transoms. It is mainly used for work that is to be carried out on a single level, such as ceilings.

Refer to the designer's specifications when erecting and dismantling birdcage scaffolds made from modular scaffolding.

The following risk control measures should be implemented for birdcage scaffolds made from tube and coupler scaffolding:

- provide untied birdcage scaffolds with lengthwise bracing at each outer longitudinal row of standards
- only use birdcage scaffold to support formwork that has been specifically designed for this purpose
- provide longitudinal bracing or a tied face at every third longitudinal row of standards
- brace the outside row of standards on each face and each third row internally with longitudinal bracing
- provide transverse bracing at every fourth bay on the ends of the scaffold
- A fall arrest system is generally not an appropriate risk control measure for the erection or dismantling of perimeter and birdcage scaffolds (see Section 4.4 for further information on fall arrest systems).

Guardrails must be provided at 1m from scaffold work floor. For any working platform, toe boards and two handrails must be provided, at a maximum gap of 400 to 450 millimeters between the handrails.

Load Class	Duty	Max Loading (KN/m2)	Typical Use	Max bay length	Max bay width	Transom target spans
1	Very light duty	0.75 kN/m2	Inspection, access, very light-duty work	2.1m	2.1m (9 boards)	1.2m
2	Light Duty	1.5 kN/m2	Light duty work, plastering, stone, cleaning, glazing	1.9m	1.9m (8 boards)	0.9m
3	General purpose	2.0 kN/m2	General building work, rendering, plastering	1.7m	1.7m (7 boards)	0.9m
Maximum first lift height 2.5m			Subsequent lifts at no more than 2.0m			

6.3. Static Tower scaffold

A static tower scaffold consists of 4 vertical members connected longitudinally and transversely.

The following control measures should be implemented for tower scaffolds:

- construct the tower with modular, frame, or tube and coupler scaffolding
- ensure the tower is resting on firm level ground with the feet properly supported. Do not use bricks or building blocks to take the weight of any part of the tower
- ensure the height of a tower scaffold, from the bottom of the scaffold to the working surface, is no greater than the multiple of the minimum base dimension as specified in the manufacturer, supplier or designer information
- use alternative height to base ratios or extra support if the scaffold is used for specific designed purpose such as:
  - ❖ sheeted or likely to be exposed to strong winds
  - ❖ loaded with heavy equipment or materials
  - ❖ to hoist heavy materials or support rubbish chutes

- ❖ for operations involving heavy or awkward equipment (for example, grit blasting or water-jetting)

- Guardrails must be provided at 1m from scaffold work floor. For any working platform, toe boards and two handrails must be provided, at a maximum gap of 400 to 450 millimeters between the handrails.

Maximum base lengths, widths and load classes

Maximum heights are determined by base dimensions

Internal tower 4 x SBD, External tower 3 x SBD. (SBD = smallest base dimension)

Height is measured from the base or foundation of the tower to the top of the topmost guardrail of the tower structure.

Examples –

i. For an internal tower which has a dimension of SBD of 2.4 meters. This would be multiplied by 4 to give a maximum height of 9.6 meters for the tower.
ii. For an external tower which has a dimension of SBD of 2.4 meters. This would be multiplied by 3 to give a maximum height of 7.2 meters for the tower.

Load Class	Duty	Maximum loading	Maximum base dimension	Maximum height	
				Internal tower	External tower
1	Very light duty	0.75 kN/m2	2.7m x 2.7m	10.8m	8.0m
2	Light Duty	1.5k N/m2	2.1m x 2.1m	8.4m	6.3m
3	Heavy Duty	2.0k N/m2	1.8m x 1.8m	7.2m	5.4m

Towers required supporting greater loads, or greater dimensions are subject to design.

6.4. Mobile scaffold

A mobile scaffold is a tower scaffold that is mounted on castors (see Figure 7).

Figure 7: Mobile scaffold

Manufacturers and suppliers must provide information regarding the safe use and erection of mobile scaffolds. If a scaffold is to be altered, contact the manufacturer or supplier for additional guidance. All modular mobile scaffolds are to be erected in accordance with manufacturer's specifications.

The following control measures should be implemented for mobile scaffolds:

- The height of a mobile scaffold, from the bottom of the scaffold to the working surface, should be no greater the multiple of the minimum base dimension as specified in the manufacturer, supplier or designer information
- As a rule of thumb, the base or bottom of mobile tower shall not be less than 1/3 of the mobile tower height
- Where adjustable castors are used, the slope of the surface should not exceed 5 degrees
- Use a secure internal ladder with a protected opening (for example, a hinged trap door) for access and egress to and from the scaffold
- Select the appropriate size and capacity castors to support the total mass of the dead and live loads of the scaffold. Castors must be lockable type
- Use castors that have the safe working load limit clearly marked

- Castors fitted to standards should be locked before erection continues
- Castors with adjustable legs should be used and adjusted to keep the platform level when the supporting structure is at different heights
- Incorporate plan bracing at the base of mobile scaffolds to provide greater stability
- Before moving any form of mobile scaffolds, ensure that:
  - ❖ there are no power lines or other overhead obstructions
  - ❖ the ground is firm and level
  - ❖ no person is on the scaffold
  - ❖ no scaffold is built on the back of a truck or movable vehicle
  - ❖ no equipment and material can be dislodged from the platform
  - ❖ the supporting surface is free of obstructions (a small obstruction may cause a mobile scaffold to overturn)
  - ❖ electrical equipment and leads are not tangled
- Brakes on castors are to be locked at all times unless you are moving the scaffold
- Scaffold is not moved during windy conditions
- Mobile scaffold is pushed or pulled from the base – never use powered vehicles to move the scaffold
- Guardrails, mid-rails and toe boards are installed on all working platforms

Guardrails must be provided at 1m from scaffold work floor. For any working platform, toe boards and two handrails must be provided at a maximum gap of 400mm to 450mm between the handrails.

6.5. Tube and coupler scaffold

Tube and coupler scaffolds are so-named because they are built from tubing connected by coupling devices. Due to their strength, they are frequently used where heavy loads need to be carried, or on structures with unusual design, shape and locations. The versatility of tube and coupler scaffolds enables them to be assembled in multiple directions in a variety of settings.

When using tube and coupler scaffolding consideration should be given to the diameters and strength of the tube and components being used to form the scaffold. Steel tubes and aluminium tubes should not be mixed in the one scaffold, except for guardrails, mid-

rail or other members that are not structural members. Refer to *Appendix I* for fittings used.

For a scaffold incorporating plain steel tube, the analysis and design should consider the most adverse combination of tubes by wall thickness, strength of the tube material or both.

Except where used as standards, tubes of different wall thicknesses must not be interconnected by spigots or joint pins or internal-type end-to-end couplers, unless additional measures are taken to positively secure the joint, such as by fixing a short tube with swivel couplers over and parallel to the joint (scarfing), or by fixing a bridle with right-angle couplers to the adjacent members. All such joints shall be inspected by a competent person prior to use.

Metal tube and coupler components should be regularly inspected for damage and particular attention given to crushing, deformation, cracks, corrosion and splitting.

Guardrails must be provided at 1m from scaffold work floor. For any working platform, toe boards and two handrails must be provided, at a maximum gap of 400mm to 450mm between the handrails.

6.6. Hanging scaffold

A hanging scaffold is an independent scaffold that hangs from another permanent structure~~,~~ but is not capable of being raised or lowered when in use.

The following control measures should be implemented for a hung scaffold:

- a competent person shall approve the use of the hanging scaffold when it is hung from a structure to verify its capability to bear the load of the hanging scaffold
- the hanging scaffolding plan shall include information about the position of the beam clamp
- if a cantilevered suspension rig is to be used, information should be included on how the rig is to be constructed and secured
- all vertical hanging tubes are to be provided with beam clamp couplers at the suspension points and underneath the platform
- any hung scaffold should be risk assessed by a competent person prior to its installation and use.

6.7. Special scaffolds

Cantilever scaffold

A cantilever scaffold is a scaffold which is supported by cantilevered load-bearing members.

The following risk control measures should be implemented for a cantilevered scaffold:

- the design and position cantilever beams are in accordance with the engineer's requirements and the scaffolding plan
- ensure a competent person certifies that the supporting structure can support the cantilevered scaffold
- use the following preferred methods for fixing the inboard length of the cantilevered beam to the structure:
  - ❖ fix the beam to the floor below using a positive fixing (for example, a U-bolt fitted over the beam and through the concrete floor slab)
  - ❖ use counterweights on the beam
  - ❖ install props to the top of the beam and to the underside of the floor above. Ensure the props are fixed to prevent dislodgement
- any cantilever scaffold should be risk assessed by a competent person prior to its installation and use.

6.8. Scaffold for demolition including shoring work

At a minimum, heavy or special duty scaffold should be used during demolition work to contain dislodged materials or to provide a safe working platform and edge protection for workers.

Factors which affect the stability of scaffold for demolition work include:

- the load imposed by demolished material dislodged onto the scaffold
- wind forces acting on containment sheeting on the scaffold face
- water retention in containment sheeting by capillary attraction
- progressive removal of building elements affecting the lateral stability of the upper portion of the scaffold
- progressive removal of ties and dismantling of scaffold

The following risk control measures should be implemented for scaffold for demolition work:

- the vertical spacing of scaffold ties may have to be reduced to facilitate the demolition cycle
- containment sheeting on the internal face of the scaffold should be installed to deflect any material into the building. This reduces the potential for overloading the scaffold
- ensure the scaffold is dismantled progressively and in line with the demolition work
- scaffold planks should be secured to prevent dislodgement from falling debris
- specific design criteria shall be considered by the competent person when using scaffold for this activity
- any scaffold for demolition including shoring work shall be risk assessed prior to construction and its use.

6.9. Safety Net and Peripheral Net

Every safety net shall be attached to sufficient anchorages or supports outside and beyond the area of possible fall and supported at a height sufficient to prevent dropping to any surface or object. Every safety net shall comply with any relevant international standard.

Where a scaffold is erected in an area where the construction activities may pose hazards to pedestrian or vehicular traffic in the form of falling objects, peripheral nets should be used to envelope the scaffold.

Every safety net or combination of safety nets shall be of sufficient size, strength and must be provided to the area of possible fall. No damaged safety net and peripheral net should be installed. Safety net and peripheral net shall be inspected by a designated person before each installation.

Safety net, peripheral net and their supports shall be inspected daily after each installation.

Figure 8: Use of safety net around scaffold

6.10. Catch Platform

Catch platforms should be erected along the exterior faces of the exterior walls to prevent injury to the public below. Catch platforms may be constructed of material other than wood provided such material is of equal strength and does not otherwise lessen the security against falling material.

All loose materials at elevated areas should be secured so as to prevent them from being blown off the structure by strong gusts of wind.

7. PLANNING SCAFFOLDING WORK

Scaffolding work should be carefully planned before work commences so that it can be carried out safely. Planning involves identifying the hazards, assessing the risks and determining appropriate control measures in consultation with all relevant persons involved in the work, including the Client, principal contractor, scaffolding contractor, designers and mobile plant operators.

Consultation should include discussions on the:

- nature and/or condition of the ground and/or working environment
- weather conditions
- nature of the work and other activities that may affect health and safety
- interaction with other trades
- duration of work
- access and egress from scaffold

- public safety and interaction with public
- ongoing adjacent concurrent activities
- safe work method statement
- management of mobile plant and surrounding vehicular traffic
- provision of adequate amenities and welfare of the workers (e.g. rest areas)
- provisions for rescue from height including adequately competent persons for rescue.

7.1. Scaffolding plan

An effective plan will help identify ways to protect persons who are:

- erecting, using, maintaining, altering and dismantling the scaffold
- near the scaffolding work (for example, other workers and members of the public)

A scaffolding plan should be prepared by a competent person as identified under Section 1.2 on behalf of the person conducting business or undertaking. In preparing the scaffold plan, the person should consult with:

- the scaffold designer, for example, to discuss the design loads and the capability of the structure to support any additional loadings
- the builder or principal contractor, for example, to assess the location of underground drains or pits. The work should be planned so as to avoid excavating service trenches under, through or adjacent to scaffolds
- workers, health and safety committees, and health and safety representatives regarding erecting, maintaining, altering and dismantling the scaffold
- other competent persons (for example, an engineer or architect) familiar with such structures
- the electricity supply authority if the scaffold is being erected with in the vicinity of overhead electric lines

The scaffolding plan should include a site layout plan and detail the elevations and sections of the scaffold. It is to be made available for inspection at the worksite. The scaffolding plan should address the following issues:

- basis of design

- foundations (including ground conditions)
- the weight bearing capacity of the surface where the scaffold is to be erected.
- size and weight of the scaffold (for example, dead, live and environmental loads)
- supporting structure
- access and egress
- tying and anchors (that is, where anchors will be placed on the supporting structure; and types of anchors to be used)
- bracing
- type of scaffold and application
- edge protection
- protection from falling objects

7.2. Safe work method statements

In some situations, scaffolding work may involve activities that are defined as '*high risk construction work*' under the Workplace Safety and Health (Construction) Regulations, 2014. High risk construction work includes work that:

- involves a risk of a person falling more than 2m
- involves a person being stranded at height or suspended from fall-arrest equipment
- involves structural alterations, design or repairs that require temporary support to prevent collapse
- is carried out on or near energised electrical installations or services
- is carried out for overboard offshore platform activities
- is carried out at a worksite in which there is any movement of powered mobile plant

R11: *It shall be the duty of the occupier of a worksite to take, so far as reasonably practicable, such measures as are necessary to ensure that a permit to work system is implemented for that worksite*.

A safe work method statement (SWMS) must be prepared as part of the permit to work system for any high risk construction work before the work starts. The SWMS must:

- identify the type of construction work being done
- specify the safety and health hazards and risks arising from that work
- describe how the risks will be controlled

- describe how the control measures will be implemented, monitored and reviewed
- be developed in consultation with workers, and their workplace safety and health representatives, who are carrying out the high risk construction work

A SWMS is required, for example if the scaffold is erected near energised electrical lines (within 4m) or if there is a risk of a person falling more than 2m during the erection or dismantling process.

Prior to start of work involving scaffold erecting, work on or dismantling of scaffolding a pre-job meeting or tool box talk shall be held at the work site. This should include details of the day's activities, roles and responsibilities, hazards and controls and any other relevant information.

7.3. Designers

Scaffold designers may be involved in:

- the design of the structure (that is, the finished scaffold structure)
- the design of the plant (that is, the scaffolding components that will be manufactured)

S.16: *Designers must ensure, so far is reasonably practicable, that the structure is designed to be without risks to the health and safety of persons in relation to the manufacture, assembly, construction or use of the structure or the proper demolition or disposal of the structure*.

The scaffold or plant must be designed to be without risks to the safety of persons who carry out any reasonably foreseeable activity at a worksite in relation to the assembly or use of the plant for a purpose for which it was designed, or the proper storage, decommissioning, dismantling or disposal of the scaffold or plant.

Designers of plant, scaffold or structures must:

- carry out, or arrange the carrying out of, any calculations, analysis, testing or examination that may be necessary to ensure, so far is reasonably practicable, that the plant or scaffold is designed to be without risks to safety and health
- provide adequate information to each person who is provided with the design of the scaffold, plant or structure and transient conditions (weather, proximity of traffic or public)

Anything that is constructed to support a load can be referred to as a structure, including a scaffold.

An experienced scaffold designer should be consulted during the design of any scaffold structure to provide input on ways to minimize the risk of injury.

The term designer includes anyone who modifies the design. For example, if the capacity of the scaffold is to be increased by adding additional components, a designer will need to complete additional calculations to ensure the modified structure is capable of supporting the additional load. The person designing the addition has designer duties and, if they are not the original designer, they should consult the original designer to ensure the new configuration does not compromise the existing design specifications or safety factors.

7.4. Safety report

The written safety report should specify the hazards associated with the design of the structure that, so far as the designer is reasonably aware:

- may create a risk to the safety or health of persons who are to carry out construction work on the scaffold or structure or part; and
- are associated only with the particular design and not with other designs of the same type of structure

The information requirements under the WSHO, 2009 may be incorporated into the safety report prepared under the Workplace Safety and Health (Construction) Regulations, 2014. The written safety report may include proprietary documentation that sets out the safe use of scaffolding components or component system, the type of scaffold and safety and health risk control measures to be used.

S.16: *The person who designs or designer, of a permanent structure or any part of a structure, that is to be constructed must take specified steps, including providing a written report which he gives to the occupier of a worksite, who commissioned the design*.

A person or occupier of a worksite, commissioning the construction work must consult, so far as is reasonably practicable, with the designer of the whole or any part of the structure about eliminating

and controlling risks. If the person commissioning the construction work did not commission the design of the construction project, they must take all reasonable steps to obtain the designer's safety report.

Where there is a principal contractor, the person conducting a business or undertaking who commissioned the scaffold work must give a copy of any safety report provided by the designer to the principal contractor.

The design process may be simple or complex depending on the size and complexity of the scaffold. However, a scaffold must be designed by a competent person, for example an engineer experienced in structural design, to ensure that it is capable of carrying the loads that will be applied to it.

R.20: *The professional engineer who designed the structure shall take, so far as it is reasonably practicable, such measures as are necessary to ensure that the design of the supporting structure or its foundation is safe for its intended use and endorse the design*.

Scaffold designers should consider the work practices necessary to carry out the erection and dismantling of the scaffold as designed and identify safety and health risks and controls at the design stage. Design matters to be considered include:

- the method and sequence of erecting and dismantling the scaffold and the related risks, particularly relating to manual handling
- the provision of safe access to and egress from the work areas on and around the scaffold
- minimizing the working heights for persons erecting and dismantling scaffold
- that edge protection (including guardrails, mid-rails and toe boards), containment sheeting, fall arrest systems including horizontal life lines or other fall risk controls are able to be installed when working at height
- advice and information (such as drawings, scope of work instructions and bills of quantity) to be provided to the scaffolding contractor and the principal contractor regarding the use of the scaffold
- minimizing any sloping surfaces on a scaffold that may cause slip hazards and ensure appropriate risk control measures are identified and included in the design

- advice on limitations against transient conditions (weather, public or traffic interfaces)

7.5. Technical Guidance

A designer may use any technical standard or combination of standards and engineering principles that are relevant to the design requirements as long as the outcome is a design that meets all regulatory requirements, including for workplace safety and health. Engineering principles would include, for example, mathematical or scientific procedures outlined in an engineering reference manual or standard.

A list of relevant industry published technical guidance is provided in *Appendix C*. The list is not exhaustive; scaffold designers, contractors and end users may wish to consider other technical standards when developing a design and deciding on risk control measures.

7.6. Prefabricated design authentication

Persons or occupiers of a worksite must not use prefabricated scaffolding where its design has not been endorsed by the relevant professional engineer.

If you are hiring prefabricated scaffolding, the supplier must provide the design information which should be verified and endorsed for its suitability by the professional engineer, usually on the supply docket or agreement. This record must be kept at the worksite.

Duties are also placed on manufactures, importers and suppliers of prefabricated scaffolding structures.

S.16: *It shall be the duty of any person who manufactures or supplies any machinery or equipment for use at work to ensure, so far as reasonably practicable, precautions, health hazards, test examination information is provided, and the equipment is safe and without risk to health, when properly used*.

7.7. Scaffold design

The design of the scaffold should as a minimum take into account:

- the strength (loads, duty, capacity), stability and rigidity of the supporting structure
- the type and material used
- the intended use and application of the scaffold

- the safety of persons engaged in the erection, maintenance, alteration and dismantling of the scaffold
- the safety of persons using the scaffold
- the safety of persons in the vicinity of the scaffold

7.7.1. Foundations

Scaffold foundations should be designed and constructed to carry and distribute all the weight of the scaffold, including any dead and live loads, for example, perimeter containment screens, placed on the scaffold.

Ground conditions and loadings should be considered when designing the foundation of the scaffold. For suspended scaffolding, the condition and loading capacity of the supporting structure e.g. beam should be determined.

7.7.2. Ground conditions

The principal contractor (for a construction project) and scaffolding contractor should ensure ground conditions are stable and inform scaffold erectors of any factors which may affect ground stability, before the scaffold is erected.

When a scaffold is erected on a surface other than soil it is important the surface is sufficiently stable to bear the most adverse combination of dead, live and environmental loads that can reasonably be expected during the period that the scaffold is in use.

Water and nearby excavations may lead to soil subsidence and the collapse of scaffold. Any likely watercourse, such as a recently filled trench, which has the potential to create a wash out under the scaffold base, should be diverted away from the scaffold.

7.7.3. Loadings

A scaffold should be designed for the most adverse combination of dead, live and environmental loads that can reasonably be expected during the period that the scaffold is in use.

The specifications of the designer, manufacturer or supplier should be followed for the maximum loads of the scaffold. The dead loads, live loads and environmental loads need to be

calculated during the design stage to ensure the supporting structure and the lower standards are capable of supporting the loads.

7.7.4. Environmental loads

Consider environmental loads, particularly the effects of wind and rain on the scaffold. For example, environmental loads imposed by wind and rain may be heightened if perimeter containment screens, shade cloth or signs are attached to the scaffold. Staggering the joints in standards (uprights or vertical tubes) may help control the risk of scaffold collapse from environmental loads. If the vertical tubes or standards are not in a staggered position, tensions splices shall be applied (see Figure 9)

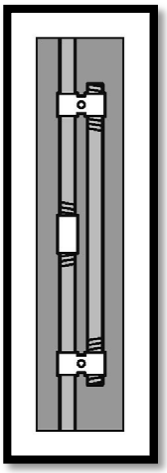


Figure 9: 'Tension splices' or 'through bolts' may be required to secure scaffolding components together to accommodate any environmental loads.

7.7.5. Dead loads

Dead loads relate to the self-weight of the scaffold structure and components including any working, catch or access platforms, stairways, ladders, screens, sheeting, platform brackets, suspension ropes, secondary ropes, traversing ropes, tie assemblies, scaffolding hoists or electrical cables.

7.7.6. Live loads

Live loads include:

- the weight of persons
- the weight of materials and debris
- the weight of tools and equipment
- impact forces

Scaffolds should not be used to support formwork and plant, such as hoist towers and concrete pumping equipment, unless the scaffold is specifically designed for this purpose.

R.20: *Every supporting structure in a worksite, including its foundation, shall be of sound design, good construction in accordance with the design, and of adequate strength for its intended purpose*.

7.7.7. Supporting structures

The capability of the supporting structure to bear the most adverse combination of loads possible during the use of the scaffold must be considered. Advice from a competent person must be obtained before erecting scaffolds on verandas, suspended flooring systems, compacted soil, parapets and awnings or other similar sites.

Propping may be required where the supporting structure is not capable of bearing the most adverse combination of loads.

7.7.8. Sole boards and baseplates

Sole boards and baseplates must be used to evenly distribute the load from the scaffold to the supporting surface (see Figure 10). Both sole boards and baseplates are required for use on less stable surfaces, such as soil, gravel, fill or other product which creates a system of beams and flat slabs.

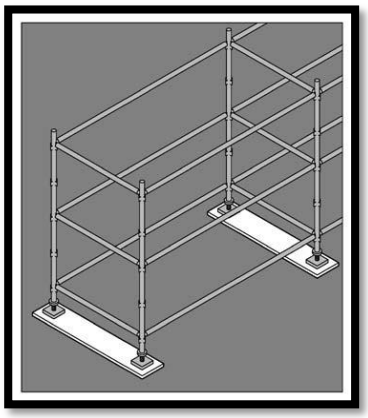


Figure 10: Sole boards and baseplates

The size of the sole board will vary depending on the supporting surface. Where necessary a competent person should determine the bearing capacity of the ground or other supporting structure.

Sole boards should be level and some digging may be required to obtain a level surface. Adjustable bases can be used on uneven surfaces for modular scaffold systems. No part of the baseplate or adjustable base should protrude over the side of the sole board to ensure the loads are imposed evenly on the sole board.

Needles and spurs should be considered where ground conditions are very unstable.

Stability

Scaffold stability may be achieved by:

- tying the scaffold to a supporting structure
- guying to a supporting structure
- increasing the dead load by securely attaching counterweights near the base
- adding bays (buttresses) to increase the base dimension

R.21: *The occupier of a worksite shall ensure that no wall, chimney, other structure or part of a structure (or scaffold) in the worksite shall be left unsecured or unshored in such condition that it may fall, collapse or weaken due to wind pressure, vibration or any work being carried out in the worksite or in the vicinity of the worksite*.

7.7.9. Tying and anchoring scaffold

Tie methods and spacing need to be in accordance with the instructions of the manufacturer, designer or supplier.

Control measures for tying scaffold include the following:

- consultation with the scaffold designer, manufacturer, supplier or a professional engineer if it is not practical to position the ties in accordance with the instructions
- requirement of more ties if:
  - ❖ the scaffold is sheeted or netted due to increased wind loadings
  - ❖ it is used as a loading platform for materials or equipment
  - ❖ attaching lifting appliances or rubbish chutes
- the person conducting business or undertaking should have a competent person regularly inspect the existence

and effectiveness of scaffold ties to ensure they are not modified or altered by unauthorised persons (for example, finishing trades who may loosen, relocate or remove ties to obtain access to walls and openings)

- additional loads should not to be attached on the scaffold - for example, signs and perimeter containment screen – without first consulting with a competent person, who could possibly be the scaffold design engineer or the supplier
- cast-in anchors or '*through bolts*' (that is, pass through a wall) are preferred to drill-in expansion or chemical anchors for securing scaffold ties because of possible failure due to faulty tensioning or epoxies
- drill-in expansion anchors should be limited to the load (torque) controlled type. The working load limit should be assessed by a competent person, who could possibly be the scaffold design engineer or the supplier
- deformation-controlled anchors, including self-drilling anchors and drop-in (setting) impact anchors, should not be used
- where chemical anchors are used, all anchors should be tested and proof loaded to the working load, and should be proof tested by a competent person
- all drill-in expansion anchors should be installed using a torque wrench set to the appropriate torque, unless the anchor has an in-built torque indicator. Documented verification is to be kept on site, stating the anchor setting torque, date of installation, location of installation and name of competent person installing the anchors
- drill-in expansion or chemical anchors should have a safety factor of 3 to 1 on their failure load. If any anchors fail, the remaining anchors on the same level should be tested
- ties should not obstruct access along the working and access platforms
- ties should interconnect with both the inner and outer scaffold standards (unless otherwise specified by an engineer) to increase the rigidity of the scaffold

7.7.10. Working platforms

Working platforms, except suspended scaffolds should have duty classifications and dimensions complying with the manufacturers' information on loadings.

Each scaffold should be designed to carry the required number of working platforms and to support its live loads. Scaffold planks on working platforms should:

- have a slip-resistant surface
- not be cracked or split
- be of uniform thickness
- be captive (that is, cannot be kicked off) and not be capable of uplift or displacement during normal use
- be positioned so that no single gap between planks exceeds 10 millimeters
- not be lapped on straight runs of modular and tube and coupler scaffolding but may be lapped on hanging bracket scaffolds where butting of planks at a pair of brackets cannot be achieved.

Lapped scaffold planks may sometimes be used to cover gaps around corners of scaffold bays (see Figure 11). These planks generally may not need to be secured, provided the followings are met:

- timber is lapped over metal planks
- planks are 1.2 meters long or greater
- plank overlap, past the edge of the plank underneath, is 300 millimeters or greater
- standards prevent planks from moving sideways on the scaffold

If using plywood sheets to cover gaps between scaffold bays, the plywood sheets should:

- be a minimum of 17 millimeters thick
- cover gaps less than 500 millimeters wide (unless approved by a professional engineer)
- secured

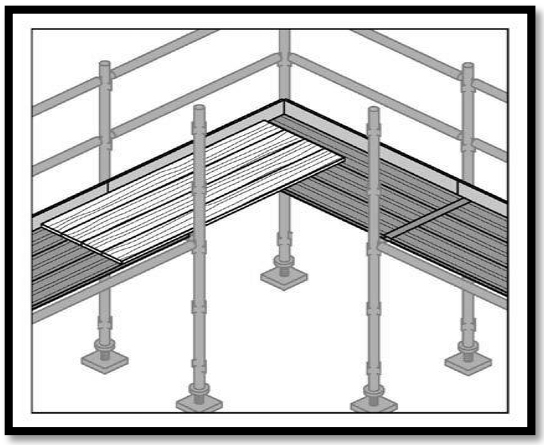


Figure 11:
Overlapping planks.

Metal planks lapped on other metal planks should be secured using fixings such as a double tie wire or strapping. Tie wire or any other system that is not structurally rated should not be used to secure planks on hop-up brackets (securing brackets).

More generally:

- planks should be secured
- all hop-up brackets should be provided with tie bars to stop brackets from spreading apart, causing planks to dislodge, unless otherwise specified by the scaffold designer
- the overhang of planks which are supported by putlogs should be greater than 150 millimeters but less than 250 millimeters – otherwise uplift might occur
- avoid nailing or screwing laminated planks into position, unless otherwise specified by the manufacturer. Moisture penetrating the planks can cause damage and may not be easily detected
- avoid tripping hazards on platforms

7.7.11. Duty

Scaffold working platforms are generally categorized as light, medium or heavy duty.

- **Light Duty** – can receive load up to 225 kg per bay. Examples include painting, electrical work, many carpentry tasks and other light tasks. Minimum 4 boards wide. (approximately 900 millimeters)

- **Medium Duty** – can receive load up to 450 kg per bay. This is suitable for general trades work. Minimum 4 boards wide. (approximately 900 millimeters)
- **Heavy Duty** – can receive load up to 675 kg per bay. This is what is needed for bricklaying, concreting, demolition work and most other work tasks involving heavy loads or heavy impact forces. Minimum 5 boards wide. (approximately 1000 millimeters)
- **Special Duty** – has a designated allowable load as designed by a scaffolding designer

Independent Load Class					
Load Class	**Duty**	**Uniformly distributed load on platform**	**Maximum number of loaded platforms**	**Max bay length**	**Max spacing of board transoms**
1	Very light duty	0.75 kN/m^2	One full (0.75 kN/m^2)	2.7m	1.2m
2	Light duty	1.50 kN/m^2	One full (1.50 kN/m^2)	2.4m	1.2m
3	General Purpose	2.00 kN/m^2	One full (2.00 kN/m^2) and one 50% (1.00 kN/m^2)	2.0m	1.2m
4	Heavy Duty	3.00 kN/m^2	One full (3.00 kN/m^2) and one 50% (1.50 kN/m^2)	1.8m	900mm

Duty Classification as specified in AS/NZS 1576.1	**Approximate maximum total load for persons and materials Kg per platform per bay**	**Approximate maximum mass of any single concentrated load of materials or equipment (as part of total load) Kg**	**Minimum length and width of platform mm**
Light duty*	225	100	450
Medium duty	450	150	900
Heavy duty	675	200	1000
* Materials must not be stored on light duty working platforms that have the minimum allowable width.			

7.8. Adjacent buildings or structures

No part of the scaffolding activities should adversely affect the structural integrity of any other building. Ensure risks are controlled to prevent injury to persons or damage to adjacent buildings or structures from the:

- collapse of the scaffold onto the adjacent building or structure
- collapse of the adjacent building or structure, or a part of the building or structure

7.9. Unauthorised access

This requirement applies to suspended, cantilevered, spur or hung scaffolds, as well as any scaffold from which a person or thing could fall more than 2 meters.

Access to the scaffold area should be restricted to those carrying out the scaffolding work while the scaffold is being erected, altered, repaired or dismantled. Control measures, such as physical barriers and warning signs, must be used to prevent unauthorised access when it is left unattended.

S.11: *The occupier of a worksite with management or control of a scaffold at a worksite must ensure that unauthorised access to the scaffold is prevented while the scaffold is incomplete or unattended. He must ensure that the access to or egress from the workplace is safe and without risks to health of every person within that premises*.

7.10. Emergency plan

To ensure a coordinated approach to responding in an emergency, the scaffold contractor should consult with the principal contractor to ensure any unexpected incidents, such as scaffold collapse, people falling from height or rescue from height, are included in the broader emergency plan for the construction site prepared by the principal contractor.

First aid equipment to be made available on site with a qualified first aider readily available.

S.19: *The occupier with control over a workplace or undertaking must ensure that an emergency plan is prepared for the worksite that provides procedures to respond effectively in an emergency and that these plans are maintained in a common area*.

7.10.1. Tiered Emergency Response

As a general industry guide, the following should be considered:

- **Tier Zero** Immediate response, person knows to raise the alarm onsite
- **Tier One** First Aider should be onsite within 4 minutes to assist the casualty
- **Tier Two** Paramedics/Ambulance should be onsite within 20 minutes
- **Tier Three** Casualty should be at the nearest hospital within one hour
- **Tier Four** Specialist medical treatment as required

Individuals and companies should follow recognized industry capability to manage a relevant tiered response, especially when considering offshore locations. As a general guideline, a rescue from height should be capable to rescue the casualty to a safe place within 10 minutes, especially for trauma cases.

8. INSPECTION AND MAINTENANCE

8.1. Hand over inspections

Procedures must be developed for the inspection and maintenance of the scaffold and scaffolding components to ensure that the scaffold is safe to use and remains in a safe condition. The inspection of scaffolds and scaffolding components at a worksite is particularly important when the scaffold is in place for a prolonged period of time. An example scaffold inspection checklist is included at *Appendix D*. Records of hand over inspections and material shall be maintained by the scaffold contractor for reference.

The person responsible for the erection of the scaffold from which a person or object could fall more than 2 meters must provide the principal contractor or the person conducting a business or undertaking with a scaffold handover certificate which should be kept at the worksite until the scaffold has been dismantled (see *Appendix E*).

The following requirements apply to any types of scaffold from which a person or object could fall more than 2m:

R. 11: *An occupier of a worksite must ensure that prior to any high risk activity being carried out, a permit to work system is implemented for that worksite*.

R.14: *The competent scaffold inspector shall inspect the site and surroundings where the high-risk activity is to be carried out together with the supervisor of the person who is to engage in the high-risk activity on the worksite, and ensure the site is safe in all respects, for the work to be undertaken*.

R.49: *It is the duty of the occupier of a worksite to ensure that every cantilevered platform or material platform is inspected by a designated person at least once every 7 days, the inspection is registered and records maintained*.

8.2. Frequency of inspection

The person with the management or control of a scaffold at a worksite must ensure that the scaffold and its supporting structure are inspected by a competent person:

- before use of the scaffold is resumed after an incident occurs that may reasonably be expected to affect the stability of the scaffold (for example, strong winds or storms)
- immediately following installation and before first use
- before use after adverse weather conditions
- before use of the scaffold is resumed after any repairs or modifications
- at least once in every 7 days.

All scaffolding inspection should be carried out by a competent person whose combination of knowledge, training and experience is appropriate for the type and complexity of the scaffold.

The frequency of inspections may vary depending on weather and worksite conditions, the type and size of the scaffold and the risks associated with scaffold collapse. This includes provision of a safe tag, placed at ground level at the access point.

The supplier of the scaffold should also be consulted on the appropriate intervals for inspection when the scaffold is first installed.

Inspection records should be kept on site and they should include the location, comments, date and time of inspections, relevant design or specification reference and the person who conducted

the inspection. It is recommended that inspection records are maintained for at least 3 months after the scaffold is dismantled and removed from site. However, this does not include incident related inspection records.

R.49: *It is the duty of the occupier of a worksite to ensure that every cantilevered platform or material platform is inspected by a designated person at least once every 7 days, the inspection is registered and records maintained.*

8.3. Scaffolds and scaffolding components

If an inspection indicates that a scaffold at a worksite or its supporting structure creates a risk to safety or health, the person with the management or control of the scaffold must ensure that:

- any necessary repairs, alterations, modifications and additions are made or carried out
- the scaffold and its supporting structure are re-inspected by a competent person before use of the scaffold is resumed.

Suppliers and owners of plant must ensure that the plant is without risk to health and safety when properly used. Procedures for the regular inspection of new and re-used scaffolding components should be developed and implemented to ensure scaffold defects are detected and any affected components are identified, repaired or disposed of and replaced as appropriate.

The scaffold must also be structurally sound and safe to use. Where issues are identified and repairs, alterations and/or additions are made, the scaffold must be re-inspected and confirmed as safe to use.

APPENDIX A – DEFINITIONS

Access platform	A platform that is only used or intended to be used to provide access for persons, or for persons and materials to or from places of work
Anchors in relation to scaffolds	Need to consult technical experts for definition
Baseplate	A plate to distribute the load from a load-bearing member to the supporting structure
Bay	The space enclosed by four adjacent standards, or the equivalent space in a single pole scaffold
Brace	A member, usually a diagonal, which resists lateral loads and/or movements of a structure
Castor wheel	A swivel wheel attached to the lower end of a standard for the purpose of supporting and moving a scaffold
Catch platform (Fan protection)	A temporary platform attached to a scaffold to contain debris falling from a work platform
Chute	An inclined or vertical trough or tube through which articles are passed from a higher to a lower level
Competent person	A person who has acquired through training, qualification or experience the knowledge and skills to carry out the task
Counterweight	A weight or series of weights that counterbalance a scaffold from overturning
Cradle (Sky-cradle)	The portion of a suspended scaffold that incorporates a suspended platform
Dead Load	A permanent inert load on a building or other structure due to the weight of its structural members and the fixed loads they carry,

	which impose definite stresses and strains upon the structure
Edge protection	A barrier to prevent a person or thing falling from the edge of: • a building or other structure~~;~~ • an opening in a surface of a building or other structure~~;~~ • a fall arresting platform~~; or~~ • the surface from which work is to be done e.g. a scaffold
Fall arresting platform	A platform installed to arrest the fall of a person who falls from a building or other structure
Frame scaffold	A scaffold assembled from prefabricated frames, braces and accessories
Guardrail	A fixed structural member to prevent persons from falling from a height, such as roof, work platform, walkway, stairway or landing
Guy rope	A rope used to help stabilize a vertical member
Hazard	A situation or thing that has the potential to harm a person
Landing	A level area used to provide access to a stairway or ladder, or located at an intermediate level in a system of stairways or ladders
Ledger	A horizontal structural member longitudinally spanning a scaffold
Lift	The vertical distance from the supporting surface to the lowest ledger or level at which a platform can be constructed, or the vertical distance between adjacent ledgers or levels at which platforms can be constructed

Loading bay	A platform on a scaffold for the storage of materials and equipment
Member	Anything that forms part of the scaffold assembly
Needle	A cantilevered structural member that forms part of the scaffold assembly
Outrigger	A framed component that increases the effectiveness of base dimensions of a tower and is attached to the vertical load-bearing members
Parapets	A vertical element usually located at the edge of a balcony, roof, bridge or similar structure
Perimeter containment screening	A screen which is — • designed to stop objects falling on persons from a level of a building • to redirect a falling object onto a catch platform (e.g. net protection)
Platform	An elevated surface
Platform bracket	A bracket attached to the scaffold to enable a platform to be placed between the scaffold and the building or structure
Permit to Work	A formal written document process that allows work related to scaffolding to commence and is signed off by a Project Manager or authorized person
Safe Working Load (SWL)	The maximum working load that may be safely applied to any component or system
Scaffold plank	A decking component, other than a prefabricated platform, that is used or intended to be used in construction of any platform supported by a scaffold
Sole board	A board that is able to distribute the load from a load-bearing member to a supporting

	surface and is intended for use underneath baseplates
Spur	An inclined load-bearing member that transmits a load to the supporting structure
Safe Tag	A documented record of inspection by a competent person, placed at the access point to the scaffold structure, to indicate that the scaffolding is safe for use. E.g. '*Scafftag*'
Standard	A vertical structural member that transmits a load to the supporting structure
Supporting structure	Any structure, structural member or foundation that supports a scaffold
Suspension rig	A supporting structure (including the trolley rack) from which a cradle is suspended
Suspension rope	A rope carrying the weight of a cradle and supporting an imposed load
Tie	A member or assembly of members used to tie a scaffold to a supporting structure
Toe board	A board that is able to restrict objects falling off the edge of a scaffold platform. It must be fixed inside the standard and as a minimum it must be to a height of 150mm without any gap
Transom	A horizontal structural member transversely spanning an independent scaffold at the standards
Travel restraint system	A system which— • consists of a harness or belt, attached to 1 or more lanyards, each of which is attached to a static line or anchorage point; and • is designed to restrict the travelling range of a person wearing the harness or belt so that the person cannot get

	into a position where the person could fall off an edge of a surface or through a surface
Tube and coupler	Scaffolding which consists of steel tubing (tube) and joining or fixing components (couplers) that are fixed together to form a required scaffold design
Working platform	A platform from which persons perform work and may also be used to support materials and equipment

APPENDIX B – SCAFFOLDING WORKS

Scaffolding Works	Description of work activity
Basic scaffolding	Scaffolding work involving: • modular or pre-fabricated scaffolds • cantilevered materials hoists with a maximum working load of 500kg • ropes • gin wheels • fall arrest systems, including safety nets and horizontal lifelines • bracket scaffolds (tank and formwork)
Intermediate scaffolding	Scaffolding work included in the class of Basic scaffolding Scaffolding work involving: • cantilevered crane loading platforms • cantilevered scaffolds • spur scaffolds • barrow ramps and sloping platforms • scaffolding associated with perimeter safety screens and shutters • mast climbing work platforms • tube and coupler scaffolds (including tube and coupler covered ways and gantries)
Advanced scaffolding	Scaffolding work included in the class of Intermediate scaffolding Scaffolding work involving: • cantilevered hoists • hung scaffolds, including scaffolds hung from tubes, wire ropes or chains • suspended scaffolds

APPENDIX C – GENERAL AND TECHNICAL GUIDANCE

General Guidance

- Scaffolding Code of Practice (2009); Workplace Health and Safety Queensland, Australia
- Health, Safety and Environment Manual, (2012); Ed.1. *Ministry of Development, Brunei Darussalam*

Technical Guidance

- Code of Practice for Access and Working Scaffolds (2009); *Health and Safety Authority, United Kingdom*
- BS EN 12811-1:2003; Temporary works Equipment "Part 1 – Scaffolds – Performance Requirements & General Design (2004); *British Standard*
- BS EN 361:2002; Personal Protective Equipment against fall from Height. Full Body Harness

APPENDIX D – SCAFFOLD INSPECTION CHECKLIST

1. Scaffold vicinity

- Has public protection been provided?
- Have sufficient safeguards against overhead electric lines been provided?
- Is there sufficient control over vehicle movement?
- Is there sufficient control over crane operation?
- Are there sufficient controls for the storage, handling and use of hazardous substances?
- Are scaffolds erected a safe distance away from trenches or excavations?

2. Supporting structure

- Is the supporting structure in good condition?
- Does the supporting structure have adequate strength?
- Are there sufficient controls to prevent deterioration of the supporting structure?
- Are all measures to strengthen the supporting structure adequate?
- Is the risk of the supporting structure being overloaded from other sources adequately controlled?
- Is the scaffold built on solid ground? If built on soft ground, are sole boards used to properly distribute the load?

3. Sole boards and baseplates

- Are there sufficient sole boards?
- Are the sole boards of suitable material and in a serviceable condition?
- Are the sole boards secure?
- Are there sufficient baseplates?
- Are the baseplates of the appropriate type?
- Are the baseplates serviceable and of suitable dimensions?
- Are the baseplates secure?

4. Scaffold structure

- Are the standards bearing firmly?
- Are the standards plumb (or as designed)?
- Are the longitudinal standard spacings correct?
- Are the transverse standard spacings correct?
- Are the joints in standards correctly positioned?

- Are the joints in standards correctly secured (special duty or hung scaffold)?
- Are the ledgers level (or as designed)?
- Are the ledgers continuous (or as designed)?
- Are the lift heights correct?
- Are the horizontal ledger spacings correct?
- Are the ledgers correctly secured?
- Are ledger joints correctly positioned (tube and coupler scaffold)?
- Are the joints in ledgers correctly secured (tube and coupler scaffold)?
- Are there sufficient transoms?
- Are the transoms correctly positioned and secured?
- Is the bracing adequate?
- Is the scaffold sufficiently stable?
- Are the ties correctly positioned and correctly fixed?
- Are all scaffold equipment and components in good condition and free from external damage or surface rust?

5. Platforms

- Does the scaffold have the required number of working platforms?
- Are the working platforms at the required locations?
- Are catch platforms correctly positioned?
- Are the platforms and supporting scaffold constructed for the appropriate duty live loads?
- Are the platform dimensions suitable for the intended work?
- Is there adequate edge protection (guardrails, toe boards)?
- Are the platforms correctly constructed?
- Are planks secured against wind?

6. Access and egress

- Is there safe access and egress to every scaffold platform?
- Are temporary stairways correctly installed?
- Are portable ladders of an industrial grade, serviceable and correctly installed?
- Are access ways and access platforms correctly installed?
- Are portable ladders adequately secured and correct angle?
- Is there an appropriate system in place for transferring material to and from the platform?

7. Containment sheeting

- Has the scaffold been designed for wind loading on any containment sheeting?
- Are the fixing ties secure?
- Are there any rips or tears?
- Are the overlap joints satisfactory?

8. General fitness for purpose

- Is there adequate provision for material handling?
- Are the clearances between the scaffold and adjacent structures correct?
- Is there adequate protection from falling debris?
- Has the scaffold been adequately designed to support all attachments?
- Are all approaches and platforms effectively lit?
- Are securing materials of adequate strength, suitability and condition (e.g. nylon rope)?

9. Mobile scaffolds

- Is the supporting surface hard and flat?
- Is the area of operation free of floor penetrations, power lines and other hazards?
- Are the castor wheel locks in working order? They should be locked at all times, except during movement of the scaffold.

10. Planning Checklists

The scaffold should be suitably designed for use and purpose, by a competent person, to ensure it has adequate strength, rigidity and stability while it is erected, used and dismantled.

At the start of the planning process, the user should supply relevant information to the scaffold contractor to ensure an accurate and proper design process is followed. Typically, this information should include:

- site location
- period of time the scaffold is required to be in place
- intended use
- height and length and any critical dimensions which may affect the scaffold
- number of boarded lifts
- maximum working loads to be imposed and maximum number of people using the scaffold at any one time
- type of access onto the scaffold e.g. staircase, ladder bay, external ladders

- whether there is a requirement for sheeting, netting or brick guards
- any specific requirements or provisions e.g. pedestrian walkway, restriction on tie locations, inclusion/provision for mechanical handling plant e.g. hoist)
- nature of the ground conditions or supporting structure
- information on the structure/building the scaffold will be erected against together with any relevant dimensions and drawings
- any restrictions that may affect the erection, alteration or dismantling process
- environmental conditions
- conflicting activities considered

Prior to installation, the scaffold contractor or scaffold designer can then provide relevant information about the scaffold. This should include:

- type of scaffold required (tube & fitting or system)
- maximum bay lengths
- maximum lift heights
- platform boarding arrangement (i.e. 5 + 2) and the number of boarded lifts that can be used at any one time
- safe working load / load class
- maximum leg loads
- maximum tie spacing both horizontal and vertical and tie duty
- details of additional elements such as beamed bridges, fans, loading bays etc., which may be a standard configuration or specifically designed
- information can be included in relevant drawings if appropriate
- any other information relevant to the design, installation or use of the scaffold
- reference number, date etc. to enable recording, referencing and checking

All scaffolding must be erected, dismantled and altered in a safe manner.

For scaffolds that fall outside the scope of a generally recognized standard configuration, the design must be such that safe erection and dismantling techniques can also be employed throughout the duration of the works. To ensure stability for more complex scaffolds, drawings should be produced and, where necessary, these may need to be supplemented with specific instructions.

Any proposed modification or alteration that takes a scaffold outside the scope of a generally recognized standard configuration should be designed by a competent person and proven by calculation.

APPENDIX E – SCAFFOLD HANDOVER CERTIFICATE: SCAFFOLD OVER 2M

Scaffold supplier/erector			Client		
Certificate No:			Client Name:		
Company Name:					
Address:			Address:		
Site Address:					
Contact Phone:			Contact Phone:		
Fax:			Fax:		
Project Details					
Project/Reference Number:					
Description of area handed over:					
Drawings attached:					
Intended use of scaffold:					
Scaffold Duty (light, medium or heavy):					
Number of working platforms:					
Top working platform height:					
2.7m Bays		2.4m Bays		1.8m Bays	
1.3m Bays		0.8m Bays		Access Bays	
Scaffold Design Reference Number: (if applicable)			Additional Details:		
Handover of scaffold					
The scaffold detailed above has been erected in accordance with the attached drawings and the Workplace Safety and Health(Construction)					

Regulations, 2014 and Scaffolding Safety Guidelines relevant technical standards; and is suitable for its intended purpose			
Name:		Signature:	
Position:			
Time:		Date:	
Acceptance – on behalf of the client			
Name:		Signature:	
Date:			
Arrange for scaffold to be inspected at intervals not exceeding 7 days or immediately following any incident which may affect the adequacy of the scaffold. Scaffold Design Reference number to be displayed at access points.			

APPENDIX F – SCAFFOLD DETAILS

1.0 Contents

2.1 Erecting and Dismantling

Approximately 15 to 20% of scaffold-related injuries involve erecting and dismantling. The most common problem is the failure to provide an adequate working platform for a worker to use when installing the next lift of scaffold. Working from one or two planks is not an acceptable practice.

The next important consideration involves components, such as tie-ins, which you should install as the assembly progresses. Failure to do so makes the scaffold less stable and, while it may not topple, it may sway or move enough to knock someone off the platform. This happens more often when platforms are only one or two planks wide and guardrails are missing, as is frequently the case during erection and dismantling.

2.2 Climbing Up and Down

Approximately 15% of scaffold-related injuries occur when workers are climbing up and down. Climbing up and down frames is a common but unacceptable practice that has resulted in numerous injuries and fatalities. Climbing up and down braces is also a frequent cause of accidents. You must provide adequate ladders to overcome this problem. In addition, workers must use proper climbing techniques (three-point contact).

2.3 Planks Sliding Off or Breaking

Many scaffold injuries involve problems with planks. If scaffold planks are un-cleated or otherwise unsecured, they can easily slide off – this causes a surprising number of injuries. Scaffold planks can also break if they are in poor condition or overloaded. It is therefore important to use proper

grades of lumber and to inspect planks before erection to ensure that there are no weak areas, deterioration, or cracks. Another common problem is insufficient or excessive overhang of planks at their support. Excessive overhang can cause a plank to tip up when a worker stands on the overhanging portion. Insufficient overhang is a leading cause of planks slipping off.

2.4 Improper Loading or Overloading

Overloading causes excessive deflection in planks and can lead to deterioration and breaking. Overloading occurs most often in the masonry trade where skids of material can exceed 1,500kg (3,000 lb.). If material is left overhanging the scaffold platform it can cause an imbalance leading to the scaffold overturning.

2.5 Platforms Not Fully Decked

This situation is related to injuries not only during erection and dismantling but in general scaffold use. Industry practice requires that all scaffold platforms must be at least 450 millimeters (18 inches) wide. All platforms above 2 meters must be fully decked.

2.6 Platforms without Guardrails

Platforms without guardrails are a serious safety problem in construction. Guardrails are an important fall prevention measure for both high and low platform.

Over one-third of the falls from scaffolds are from platforms less than 3 meters in height.

Therefore, guardrails are recommended and must be used during normal use for all scaffold platforms over 2 meters high. Guardrails for all working platforms should consist of a top rail, a mid-rail and a toe board.

2.7 Failure to Install All Required Components

Failure to use all of the proper scaffold components is a serious safety problem. Workers are more likely to cut corners when scaffolds are only a few frames in height. All too frequently they fail to install base plates, braces, proper securing devices such as “banana” clips or “pigtails” at the pins of frame scaffolds, and adequate tie-ins.

Those erecting the scaffold must have all the necessary components, and must use them to ensure that the scaffold is safe. These components should be installed as the scaffold erection progresses.

2.8 Electrical Contact with Overhead Wires

Scaffolds seldom make contact with overhead electrical lines, but when it does happen it almost always results in a fatality. Failure to maintain safe distances from overhead electrical power lines while moving scaffolds is a major problem. Before attempting to move rolling scaffolds in outdoor open areas, check the route carefully to ensure that no overhead wires are in the immediate vicinity.

Partial dismantling may be necessary in some situations to ensure that the scaffold will make the required safe clearances from overhead electrical power lines. The required minimum safe distances are listed in Table 1. Hoisting scaffold material by forklift or other mechanical means requires careful planning and should be avoided in the vicinity of power lines. Transporting already-erected scaffolds by forklift, particularly in residential construction, has been the cause of many electrical contacts and is a dangerous practice. Workers handling materials or equipment while working on the platform must also take care to avoid electrical contact.

Table 1: Minimum distance from power lines

Voltage Rating of Power line Minimum Distance	Voltage Rating of Power line Minimum Distance
750 to 150,000 volts 4 m (12 ft)	750 to 150,000 volts 4m (12 ft)
150,001 to 250,000 volts 4.5 m (15 ft)	150,001 to 250,000 volts 4.5m (15 ft)
over 250,000 volts 6 m (20 ft)	over 250,000 volts 6m (20 ft)

2.9 Moving Rolling Scaffolds with Workers on the Platform

Moving rolling scaffolds with workers or materials on the platform can be dangerous and is not permitted.

3.0 SELECTION

The safe and efficient use of scaffolding depends first on choosing the right system for the job. If the scaffold's basic characteristics are unsuited to the task, or if all the necessary components are not available, personnel are forced to make do and improvise. These conditions lead to accidents. Proper selection of scaffolding and related components requires basic knowledge about site conditions and the work to be done.

Considerations include:

- weight of workers, tools, materials, and equipment to be carried by the scaffold
- site conditions (e.g., interior, exterior, backfill, concrete floors, type and condition of walls, access for the equipment, variations in elevation, anchorage points)
- height or heights to which the scaffold may be erected
- type of work that will be done from the scaffold (e.g., masonry work, sandblasting, painting, metal siding, mechanical installation, suspended ceiling installation)
- duration of work
- experience of the supervisor and crew with the types of scaffolds available
- requirements for pedestrian traffic through and under the scaffold
- anticipated weather conditions
- ladders or other access to the platform
- obstructions
- configuration of the building or structure being worked on
- special erection or dismantling problems including providing practical fall protection for the erector
- the use of mechanical equipment to aid in erecting the scaffold

4.0 BASIC TYPES OF SCAFFOLDS

4.1 Standard Tubular Frame Scaffolds

This is the most frequently used scaffold in construction. Historically it has been made of steel tubing, but aluminum is gaining popularity. The scaffold is manufactured in various configurations and spans. On some systems, ladder rungs are built into the end frames (Figure 12). These ladders are not suitable for tall scaffold towers unless rest platforms are installed at regular intervals and trapdoors are provided in the platforms. Other models are equipped with ladders that attach to the end frames (Figure 14). The ladder shown in Figure

4.3 is continuous and workers gain access via gates at the platform level. Again, this ladder is not suitable for high scaffolds. Scaffolds in excess of 6m should have built-in stairs with rest platforms. Vertical ladders can reach up to 6m, but if above 2m, they require a safety cage.

The advantages of the frame scaffold are that it is simple to assemble, many construction trades are familiar with its use, and the components can be lifted manually by workers. However, as with other systems, all components must be used. Failure to install any of the components, such as bracing and base plates, may lead to accidents.

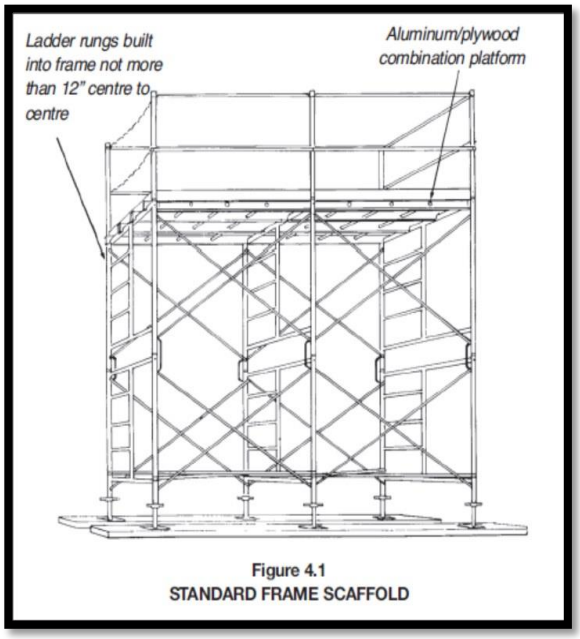


Figure 12: Standard Frame Scaffold

4.2 Standard Walk-through Frame Scaffolds

This is a variation of the standard tubular frame scaffold. An example is shown in Figure 13. Although primarily designed to accommodate pedestrian traffic at the ground or street level, the walk-through scaffold is frequently used by the masonry trade to provide greater height per tier and easier distribution of materials on platforms at intermediate levels.

4.2.1 Spans of Tower Base

Span lengths are varied using different lengths of vertical bracing. Most manufacturers have braces providing spans between 1.5 and 3 meters in length, with 1.8 meter spans being the most common. The use of 1.8 meter spans is ideal

when using 3.9 meter planks as this allows a maximum of 150 millimeters overhang at each end. When using spans in excess of 1.8 meters the load bearing capacity of the platforms is reduced and must be accounted for in the design.

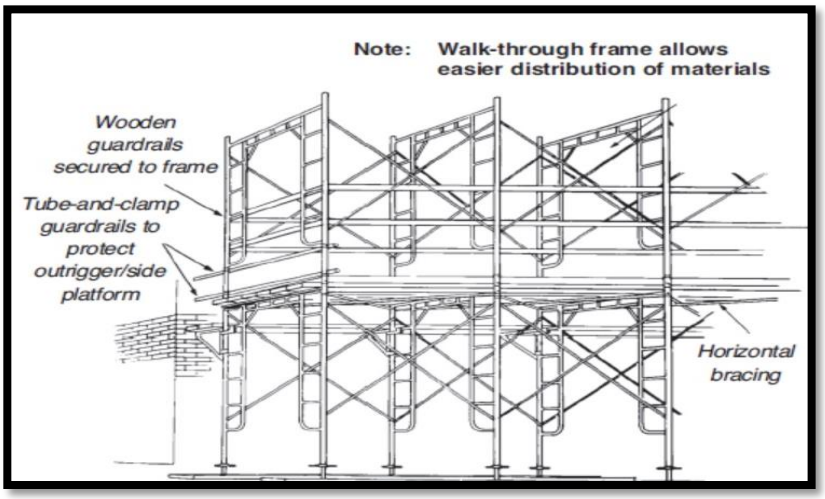


Figure 13: Walk-Through Scaffold

4.3 Rolling Scaffolds

Rolling scaffolds are best suited where short-duration work must be carried out at multiple locations. They are used mainly by mechanical and electrical trades. There are two main types of rolling scaffold.

• **Castor Wheel Type**. This type of scaffold is best suited for work on smooth floors and is typically used inside buildings. All castors should be equipped with braking devices (Figure 14). This kind of scaffold should be erected so that its height-to-width ratio is no greater than 3 to 1. This limits the height of platforms with standard outrigger stabilizers and single span towers to approximately 9 meters.

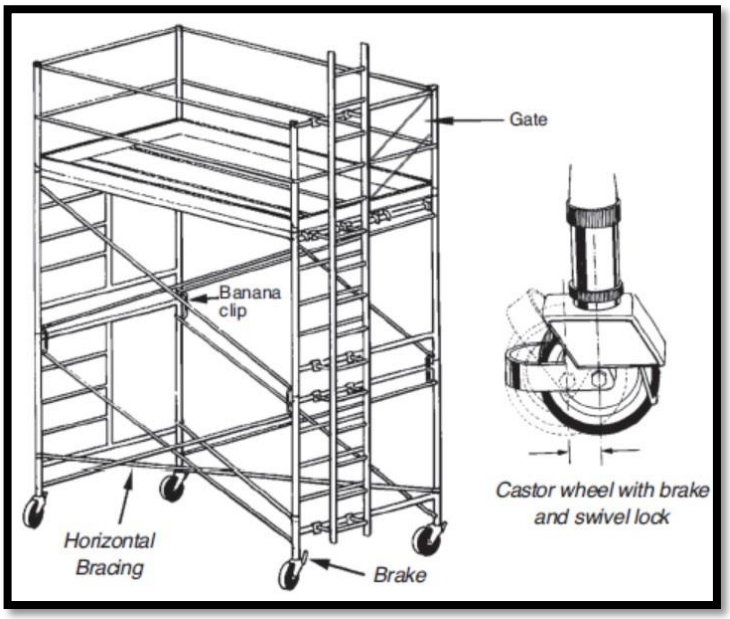


Figure 14: Rolling Scaffold

It is not permitted to move rolling scaffolds while a worker is on the platform. The area through which the scaffold is to be moved should be free of bumps or depressions and cleared of all debris. Overhead hazards, especially power lines, should be identified. Rolling scaffolds should always have guardrails. They should also be securely pinned together and be fitted with horizontal bracing as recommended by the manufacturer.

Scaffolds that are not securely pinned together can separate if they drop into a hole or depression or run into an obstacle at ground level. Horizontal bracing is necessary on a rolling tower scaffold to keep it from folding up because the connections between frames and braces are essentially pinned joints.

Castor wheels should be secured to the frame. A castor wheel dropping off in a hole or depression in floors has been the cause of serious accidents and injuries. Each castor wheel should have a brake and swivel lock which are in good working order, safe working load and can be applied easily. The castors or wheels should be suitable for the surface on which the scaffold is being used. Small wheels are suitable for pavement or concrete floors. You need larger pneumatic wheels when soils are the working surface. Before using rolling scaffolds, the surface must be smooth, free of depressions and reasonably level.

4.3.1 Electrical Contact

One of the biggest concerns with rolling scaffolds is the possibility of contact with overhead electrical wires. Scaffolds making accidental contact with power lines have caused many deaths. Before moving a rolling scaffold, check the intended path of travel and maintain the required minimum clearances as set out in Table 1.

4.4 Fold-up Scaffold Frames

Fold-up scaffold frames (Figure 15) are frequently used by trades such as electricians, painters and suspended ceiling erectors. Widths range from dimensions that will pass through a 750 millimeters (30 inches) opening to the standard width of about 1.5 meters. Frequently made of aluminum, this type of scaffold is easily and quickly transported, erected, and moved about construction sites and from job to job. It should be used only on a smooth and hard surface. This type of scaffold should only be used where basic information on safe working load, use and methodology is controlled.

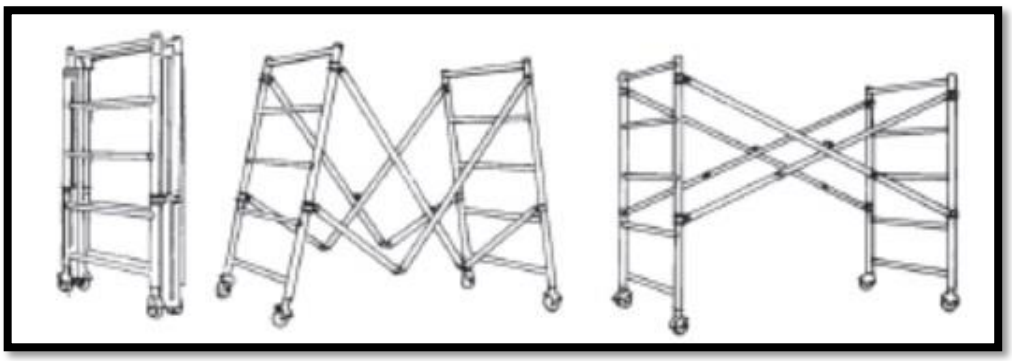


Figure 15: Fold-up Scaffold Frames

4.5 Adjustable Scaffolds

Figure 16 illustrates another type of scaffold with uses similar to the fold-up model. Although it is not so easily erected, the system is light and very easily adjusted for height. It breaks down into a minimum of components and can be readily transported from job to job. These devices should also be used only on smooth and hard surfaces. They are not intended to carry heavy loads.

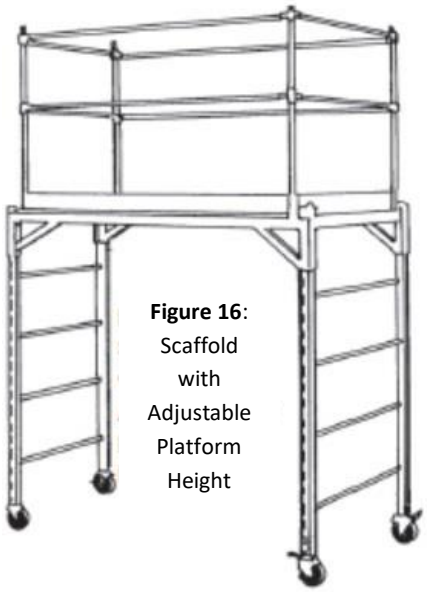


Figure 16: Scaffold with Adjustable Platform Height

This type of scaffold should only be used where basic information on safe working load, use and methodology is controlled.

4.6 Tube-and-Clamp Scaffolds

Tube-and-clamp scaffolds (Figure 17) are frequently used where obstructions or non-rectangular structures are encountered. The scaffolds are infinitely adjustable in height and width. They can also be used for irregular and circular vertical configurations.

Personnel erecting tube-and-clamp scaffolds must be experienced. It is strongly recommended that, for each application, a sketch or drawing be prepared by someone who understands general structural design and the need for diagonal and cross bracing. In general, this type of scaffold takes longer to erect than the standard tubular frame type. Tube-and-clamp scaffolds above 10m must be designed by a professional engineer.

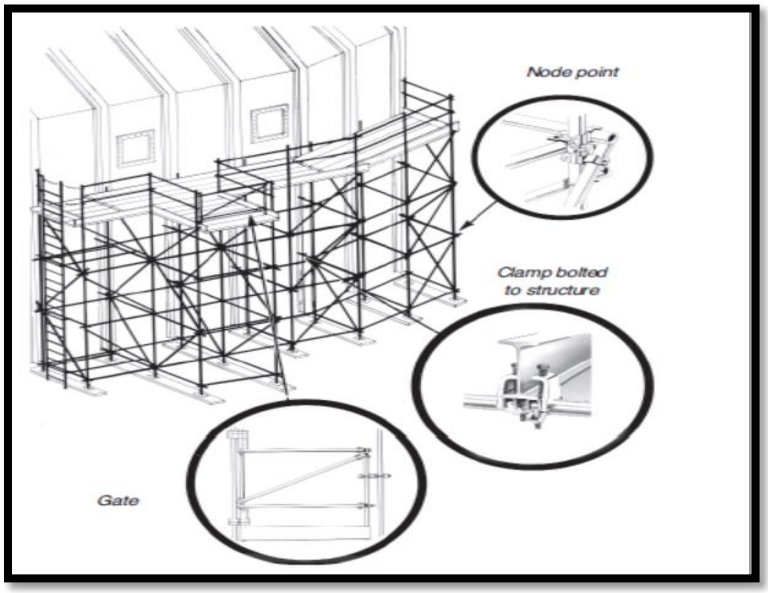


Figure 17: Tube and Clamp Scaffold

4.7 Systems Scaffolds

European scaffold systems have become very popular in applications that were traditionally suited to tube-and-clamp. Although they are not as adjustable as tube-and-clamp scaffolds, they can be applied to a wide variety of non-rectangular, circular or dome-shaped structures. A typical example is shown in Figure 18. As with tube-and-clamp scaffolds, personnel carrying out the erection should be experienced with that type of system and a sketch or drawing of the scaffold to be erected is recommended for each application. Systems scaffolds above 10m in height must be designed by a professional engineer and is dependent on manufacturer's instructions and specifications.

There are a great many systems available, ranging from light-duty aluminum to heavy-duty steel support structures. They all employ different patented locking devices (wedges, locking pins etc.) which are not intended to be interchanged with other systems.

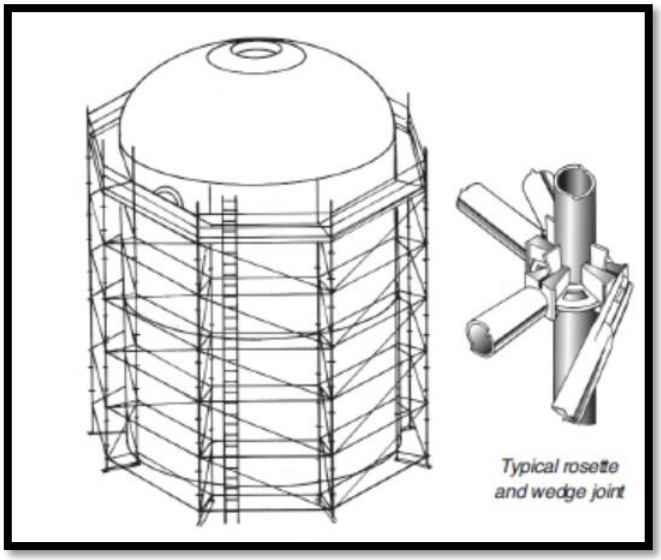
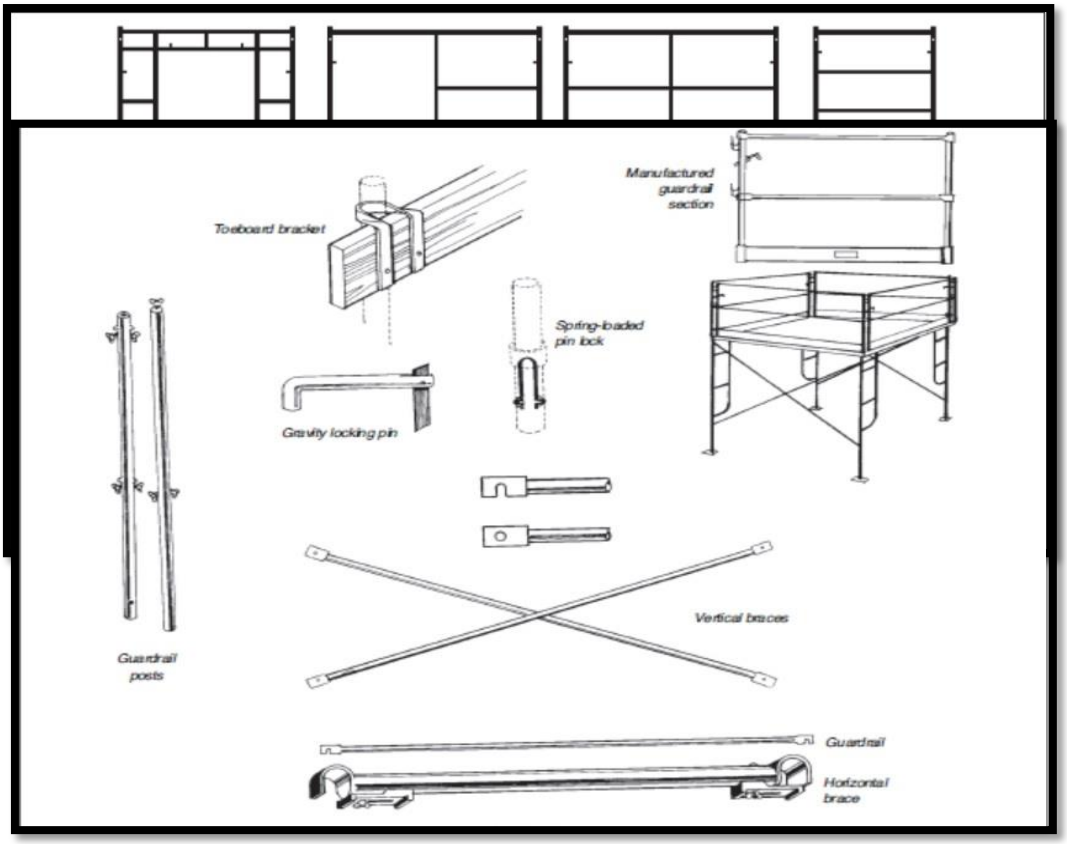


Figure 18: Systems Scaffold

5.0 SCAFFOLD COMPONENTS

Tubular Frame Scaffolds: There are many tubular frame scaffold components available (Figures 19 and 20). Some components are necessary in almost all situations; others are optional depending on use and manufacturer's instructions. In addition to scaffold end frames, the minimum components required are:

- base plates or castors
- mudsills or sole boards
- adjustable screw jacks
- vertical braces on both sides of frames unless
  - frames are designed with "non-pinned" joints
  - additional bracing is provided by a designed system using tube-and-clamp accessories
    - horizontal braces on every third tier of frames
    - platform materials to fully deck in the intended working level
    - guardrails complete with toe boards
    - guardrail posts where working platforms will be at the top level
    - ladders or stairs for access
    - intermediate platforms where required—not more than 9m (30 ft) apart and adjacent to vertical ladders



Figures 19 & 20: Frame Scaffold Components

Tube-and-Clamp Scaffolds and Systems Scaffolds have individual components unique to each type. These components are identified and discussed in detail in Section 6.

5.1 Platforms

Platforms for frame scaffolds are normally either aluminum/plywood platforms or wood planks. Planks normally come in 1.5 meters or 3.9 meters to cover one or two 2 meter bays with adequate overhang. Platforms are discussed in detail in Section 8.

5.2 Outrigger/Side Brackets

The use of outrigger brackets, also known as side brackets (Figure 21) is very popular in the masonry industry. They are attached to the inside of the frame and accommodate a platform approximately 20 inches (two planks) wide. They provide a work platform for the mason at an ergonomically convenient location—lower than the material platform. Intended as a work platform only, they are not to be used for material storage.

Instances have been reported of brackets installed on the "wrong" side of the scaffold—facing the forklift, for example–to provide a landing area for skids of material.

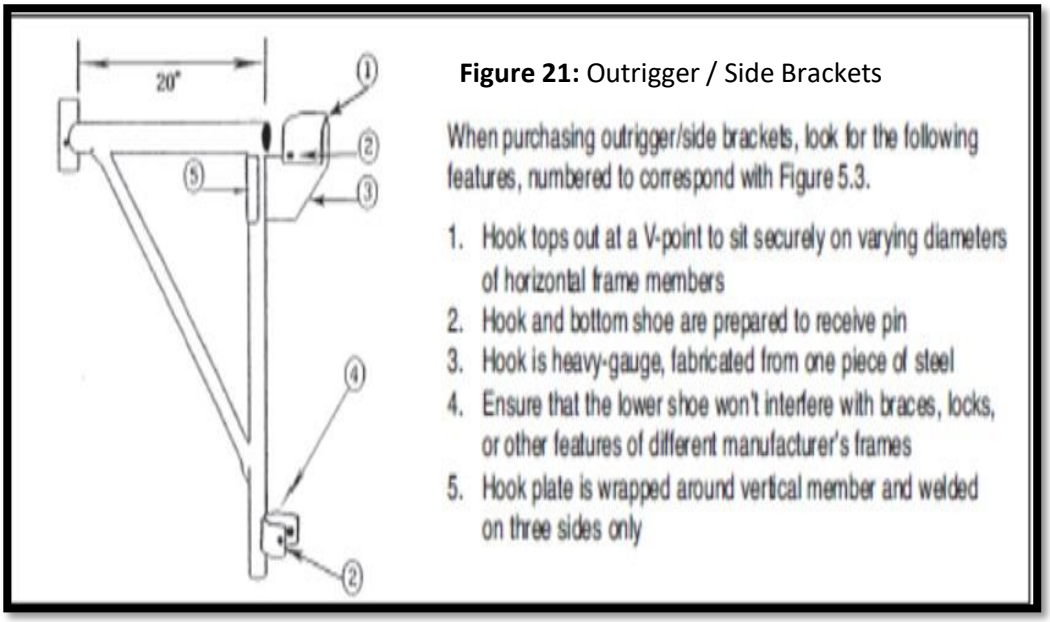


Figure 21: Outrigger / Side Brackets

When purchasing outrigger/side brackets, look for the following features, numbered to correspond with Figure 5.3.

1. Hook tops out at a V-point to sit securely on varying diameters of horizontal frame members
2. Hook and bottom shoe are prepared to receive pin
3. Hook is heavy-gauge, fabricated from one piece of steel
4. Ensure that the lower shoe won't interfere with braces, locks, or other features of different manufacturer's frames
5. Hook plate is wrapped around vertical member and welded on three sides only

This is not acceptable because outrigger brackets are not designed for supporting material and the practice may lead to unbalanced loading of the scaffold, causing tip-over.

Figure 22 illustrates typical outrigger/side brackets attached to the scaffold for masonry use. For efficient, comfortable work, the brackets should be adjustable in lifts of no more than 600 millimeters (24 inches). A space no greater than 150 millimeters (6 inches) should be maintained between the bracket platform and the wall. Although the outrigger brackets illustrated are side brackets, end brackets are also available from most manufacturers.

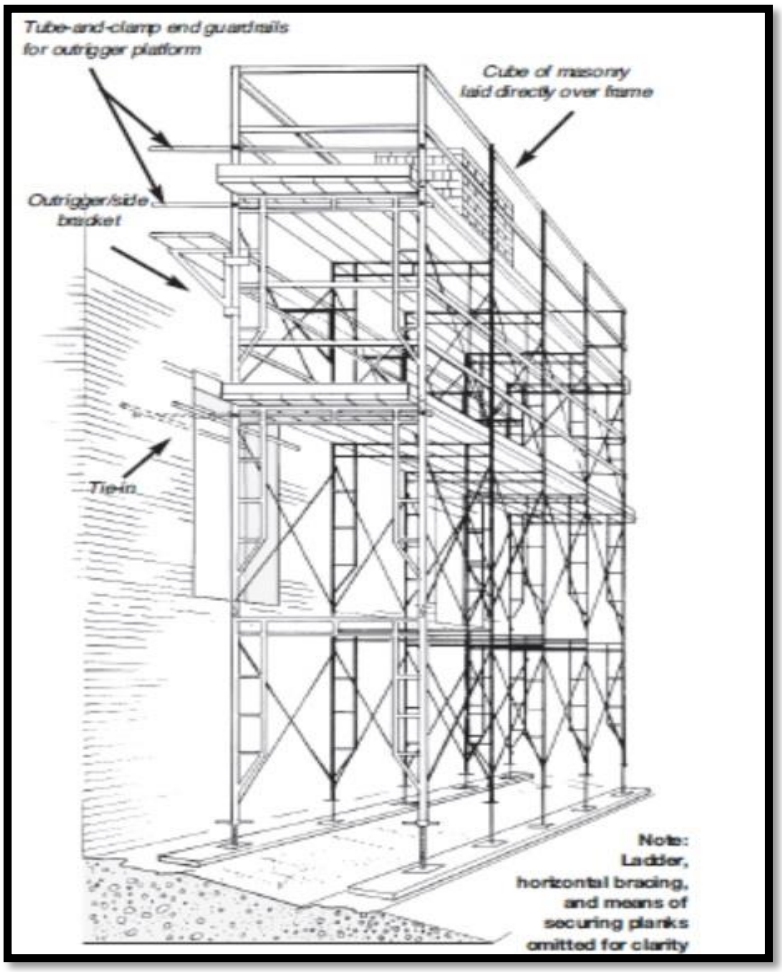


Figure 22: Masonry Scaffold with Outrigger/Side Brackets

Use the following good work practices:

- Do not drop or roughly handle outrigger/side brackets during erection or dismantling as this can bend or damage hooks
- Use planks that are double-cleated at one end to ensure that the cleats are engaged over a bracket to prevent the bracket from pivoting
- Inspect brackets installed on the scaffold to ensure that only sound brackets with no defects are used
- Tag for repair any brackets that have deformed or cracked hooks, cracked welds, or other defects
- Ensure that brackets are mounted securely on the frame all the way down
- Never stock material on the bracket working platform. The working platform is for the worker only
- Make sure that planks laid on the brackets extend at least 150 millimeters (6 inches) beyond the frames at either end

- Place brackets so the level where the worker stands is no more than 1 meter (40 inches) below the level where the material is stored

Beware of common hazards with outrigger/side brackets:

- hooks bent or deformed to the extent that they will roll off the frame under load
- hooks bent back into place, thereby causing cracks in the metal or welds which then break under load
- home-made brackets that are poorly designed and fabricated, too flimsy to bear the load or not sized properly to hold two planks. These are not permitted for use in Brunei Darussalam
- failure to inspect brackets during erection to ensure that they are not damaged
- failure to use planks that have double cleats on one end

Other features to look for are:

- manufacturer's plate showing name and model number
- brackets that are hot-dipped galvanized
- manufacturer's literature stating that the bracket has been designed and fabricated to meet loading requirements as specified by the component

5.3 Ladders

Whether built into frames, attached as a separate component or portable, ladders are an important means of access to scaffold platforms. The number of falls connected with climbing up and down scaffolds will substantially be reduced if workers always used adequate and properly erected ladders. Unfortunately, suitable ladders are not often provided or used.

A major problem with ladders built into the frame is that planks sometimes stick out so far that it is difficult to get from the ladder to the platform. This situation can result in injuries but can be overcome in one of three ways:

- use manufactured platform components which do not project beyond the support
- use a portable ladder where platform elevations are less than 9 meters in height (Figure 23)
- use a stand-off vertical ladder with a safety cage if the scaffold is above 2 meters

Ladder rails should extend at least 1 meter above the platform level to facilitate getting on and off. Injuries are often connected with stepping on and stepping off the ladder at the platform level. Rest stations should be decked in on scaffold towers at intervals no greater than every 6 meters. Climbing is strenuous work and accidents happen more frequently when climbers suffer from overexertion.

5.4 Guardrails

Failing to use guardrails is one of the main reasons for falls from scaffold platforms. Manufacturers of frame scaffolds have guardrail components that can be attached to the scaffold frames. These have posts that sit directly onto the connector pins and to which the rails are attached using wing nuts. Where manufactured guardrails are not available, guardrails can be constructed from lumber (Figure 24) or tube-and-clamp components.

Tube-and-clamp guardrails may be constructed from standard aluminum scaffold tubing using parallel clamps to attach the vertical posts to each frame leg (Figure 24). Top rails and mid-rails should be attached to the vertical posts using right-angle clamps. Connections in these rails should be made with end-to-end clamps.
Most manufacturers have toe board clips to fasten toe boards quickly and easily to standard tubular posts on either frames or guardrail posts.

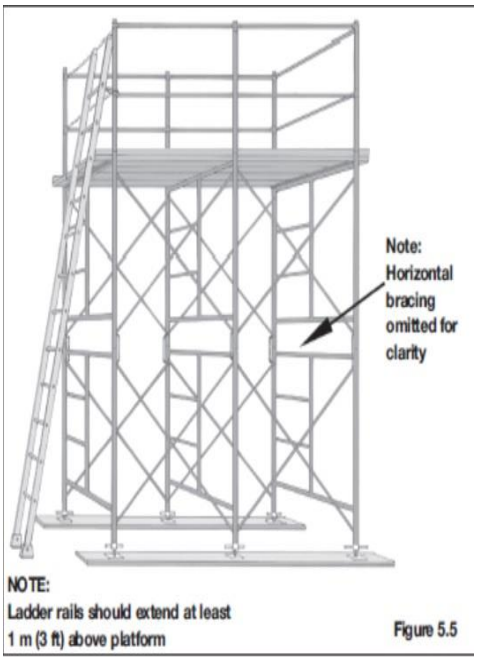


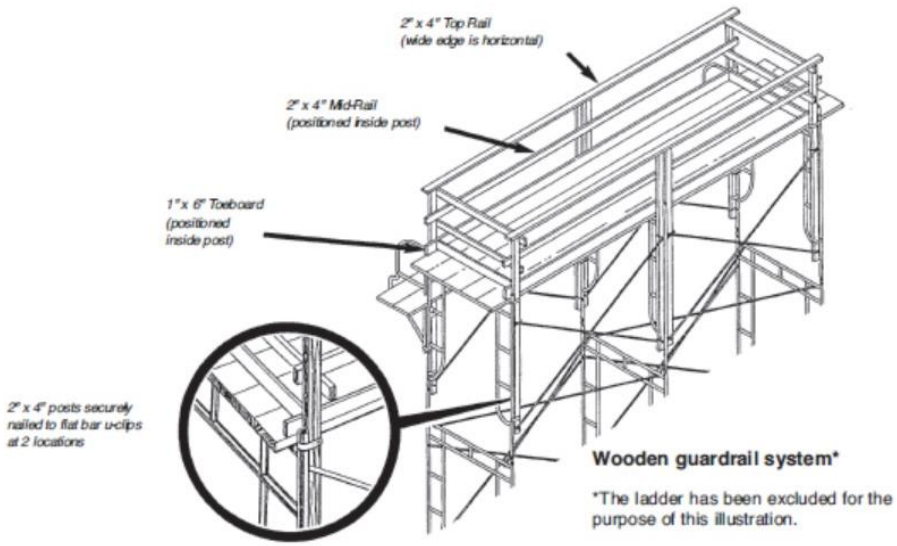
Figure 23: Guardrails

A guardrail should consist of:

- a top rail about 1 meter (40 inches) above the
- platform
- a mid-rail about halfway between the platform and the
- top rail
- a toe board at least 150 millimeters (6 inches) high at the platform level if made from wood
- posts no more than 2.4 meters apart if made from wood. Guardrail posts can be farther apart if the materials used are adequate to support the loads specified

Guardrails should be designed to resist the forces as specified for by the design. Frequently, guardrails must be removed to allow material to be placed on the scaffold platform. Workers must protect themselves from falling by using a fall-arrest system properly worn, used and tied off. The fall-arrest system should be worn while the worker is removing the guardrail, receiving the material, and replacing the guardrail. Too often, guardrails are removed to receive materials and then not replaced.

Many workers fall because other workers have left unguarded openings on scaffold platforms.



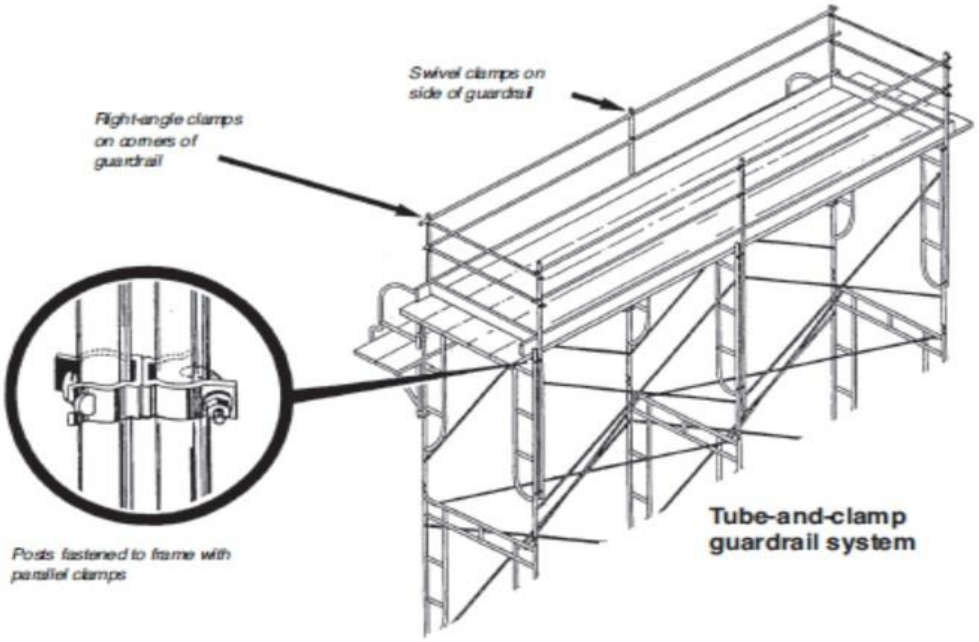


Figure 24: Guardrails

6.0 ERECTING AND DISMANTLING SCAFFOLDS

6.1 General

Scaffolds should always be erected under the supervision of a qualified supervisor or scaffolder. Although scaffold systems vary between manufacturers, certain fundamental requirements are common to all scaffold systems. Tube-and-clamp and systems scaffolds over 15 meters, must be designed by a professional engineer. Supervisors must ensure that the system scaffolds are adequately constructed in accordance with manufacturer's specifications.

6.1.1 Foundations and Support Surfaces

Scaffolds must be erected on surfaces that can adequately support all loads applied by the scaffold. To support scaffolds, backfilled soils must be well compacted and levelled. Mud and soft soil should be replaced with compacted gravel or crushed stone. Embankments that appear unstable or susceptible to erosion by rain must be contained. Otherwise, the scaffold must be set far enough back to avoid settlement or failure of the embankment.

Where sole boards or mudsills must be placed on sloping ground, levelling the area should be done, wherever possible, by excavating rather than backfilling (Figure 25).

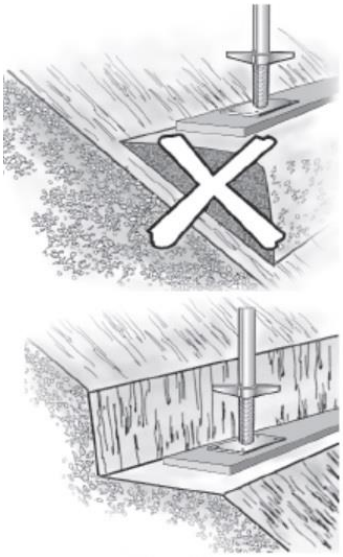


Figure 25: Mudsill on Sloping

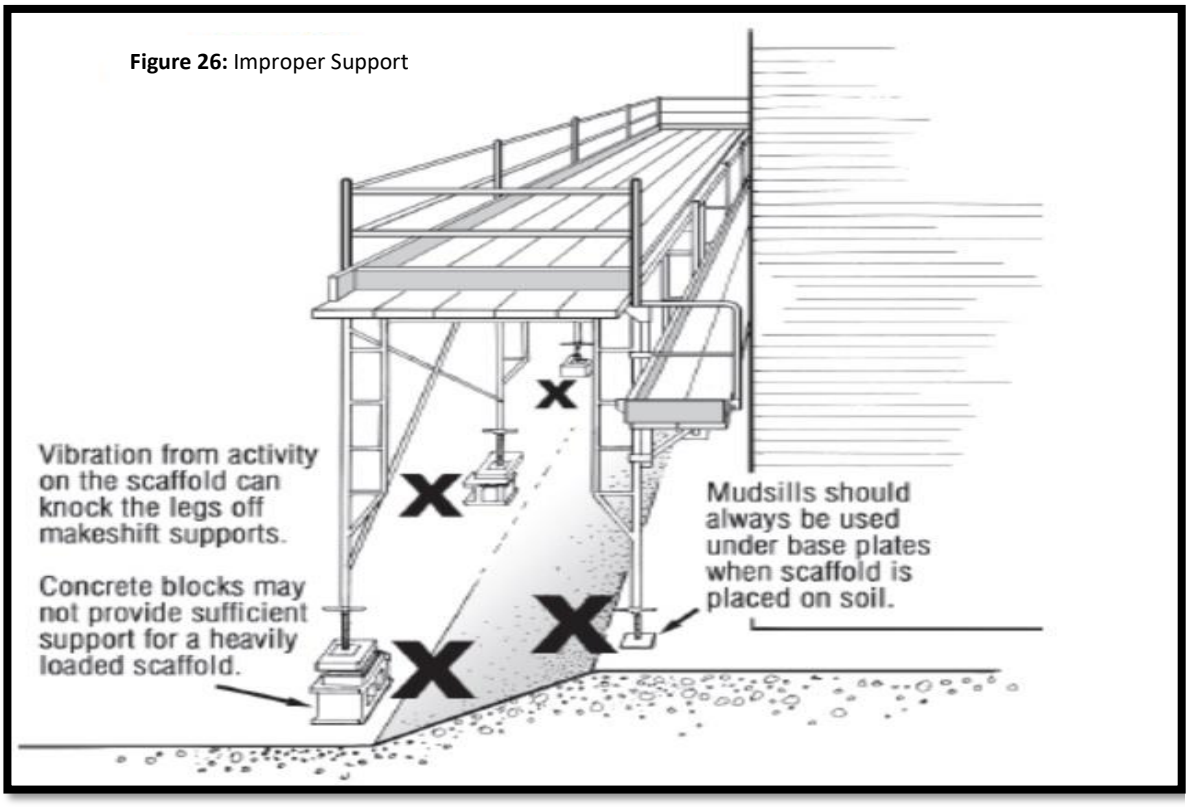
In some cases, it may be necessary to use half-frames to accommodate grade changes. For these situations, the side bracing is usually provided by using tube-and-clamp components. Floors are usually adequate to support scaffold loads of workers, tools, and light materials. As loads become greater, floors, especially the older wooden types, should be examined to ensure that they will support the anticipated loads. In some cases, shoring below the floor and directly under the scaffold legs may be necessary. In other situations, you may need sills that span the floor support structure.

Scaffolds erected on any type of soil should have a sole board or mudsill. At minimum the sole board or mudsill should be a 35 mm x 220mm plank (full size) and should be continuous under at least two consecutive supports. Where there is soft ground, one standard using one sole board should be as a minimum of 760 millimeters in length and where there is hard ground, one standard using one sole board should be as a minimum 450 millimeters in length. If two standards are sharing one sole board, it should be as a minimum 1500 millimeters in length.

The scaffold feet should rest centrally on the sole board or mudsill and the sill should, where possible, project at least 300 millimeters (1 foot) beyond the scaffold foot at the ends. Sole boards or mudsills may be placed either along the length or across the width of the frames.

Do not use blocking or packing such as bricks, short pieces of lumber, or other scrap materials under scaffold feet or under mudsills (Figure 26). If the scaffold is subjected to heavy loading, bricks or blocks, it can break. Vibration can cause blocking to move or shift, leaving a scaffold leg unsupported. In such conditions, the scaffold can topple when heavy loads are applied.

Figure 26: Improper Support



If the scaffold is inside a building, preparing the foundation may mean –

- clearing away debris or construction materials and equipment stored in the way
- using sills or placing shoring under old wooden floors

If a scaffold is on the outside of a building, preparing the foundation may include –

- replacing mud and soft ground with gravel or crushed stone
- levelling and compacting loose backfill
- stabilizing or protecting embankments
- providing protection against erosion from rain
- using mudsills or sole boards

Foundation preparation is important with any scaffold. It is especially important when scaffolds will be heavily loaded, as in masonry work. Differential settlement may damage scaffold components even if no serious incident or collapse occurs.

6.1.2 Inspection

Scaffold materials should be inspected before use for -

- damage to structural components
- damage to hooks on manufactured platforms
- splits, knots, and dry rot in planks
- delamination in laminated veneer lumber planks
- painted planks that may hide defects
- presence of all necessary components for the job
- compatibility of components

Structural components which are bent, damaged or severely rusted should not be used. Similarly, platforms with damaged hooks should not be used until properly repaired. Planks showing damage should be discarded and removed from the site so that they cannot be used for platform material.

6.1.3 Location

Before erecting a scaffold, check the location for -

- ground conditions
- overhead wires
- obstructions
- variation in surface elevation
- tie-in locations and methods
- public access
- conflicting activities

Checking the location thoroughly beforehand can eliminate many problems that develop during erection and will allow erection to proceed smoothly, efficiently and safely.

6.1.4 Base Plates

Base plates and adjustable screw jacks should be used whether the scaffold is outside on rough ground or indoors on a smooth level surface. Base plates should be centered on the width of the sill and nailed securely after the first tier has been erected. Sills may run either across the width or along the length of the scaffold depending on grade conditions and other factors. Generally, bearing capacity will be increased by running sills longitudinally because the sill has more contact with the ground. Minimum dimension being 150mm x 155mm and thickness of minimum 5 millimeters and must have a shank of 50mm at the centre. (see *Appendix I*)

6.1.5 Plumb

When the first tier of scaffold has been erected it should be checked for plumb, alignment, and level. Where necessary, adjustments can be made using the screw jacks.

Settlement or slight variations in the fit of the components may require additional adjustments as tiers are added to the scaffold tower. Braces should fit easily if the scaffold tower is level. If braces do not fit easily it is an indication that the scaffold is out of plumb or out of alignment. When constructing a scaffold, a standard or ledger up to a height or length of 2 meters should not have more than 20 millimeters slant from the vertical or horizontal and not more than 50 millimeters if the height or length is more than 2 meters.

6.1.6 Hoisting Materials

Where scaffolds will be more than 3 frames high, a well wheel or "gin" wheel and a hoist arm or davit will make the hoisting of materials easier during erection (Figure 27). Use of a certified gin wheel is recommended. Safe working load of a gin wheel is 250kg. While materials can be pulled up by rope without these devices, the well wheel and hoist arm allow the hoisting to be done by workers on the ground. This is much safer and eliminates the risk of workers falling from the

scaffold platform as they pull materials up by rope. Loads lifted by a well wheel should normally be no more than 50kg (100lb) unless special structural provisions are made.

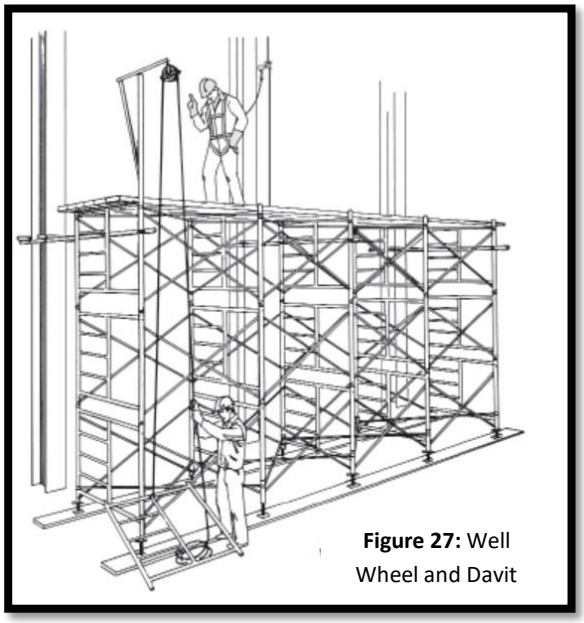


Figure 27: Well Wheel and Davit

The use of forklifts or other mechanical means of hoisting scaffold materials has become more common particularly in masonry applications. The use of this type of equipment greatly reduces the potential for overexertion injuries due to lifting and pulling. However, extra precaution must be taken to prevent power line contact and other potential hazards such as overloading.

It is recommended to use mechanical means for lifting rather than manual handling of loads.

6.1.7 Tie-ins

Scaffolds must be tied in to a structure or otherwise stabilized in accordance with manufacturer's instructions as erection progresses. Leaving such items as tie-ins or positive connections until the scaffold is completely erected will not save time if it results in an accident or injury.

In most jurisdictions, it is prohibited. For further information on tie-in requirements, see Section 7.6.

6.1.8 Fall Protection in Scaffold Erection

Providing practical fall protection for workers erecting and dismantling scaffold and shoring has been challenging for the construction industry.

In Brunei Darussalam, the Workplace Safety and Health (Construction) Regulations, 2014 requires that workers erecting, using or dismantling scaffolds must be protected from falling by using guardrails, travel restraint, fall-restricting systems or fall arrest systems.

For fall protection while workers are using a scaffold as a work platform, the safest solution is guardrails, provided they are erected safely. Workers involved in erecting or dismantling scaffolds face a different challenge.
Erecting guardrails and using fall-arrest equipment requires specialized procedures since normally there is nothing above the erector on which to anchor the fall protection system.

In all cases, do ensure that procedures comply with the regulations. You must use engineered design and procedures when required, and competent workers must review the installed scaffold before use. Do pay special care and attention to anchorages.

A competent person must give adequate oral and written instructions to all workers using fall protection systems. Like all scaffolds, this equipment must be used under the supervision of a competent person.

6.2 ERECTING FRAME SCAFFOLDS

Too often they are erected by people who are inexperienced and do not know or recognize the potential hazards. Erectors must be aware of the potential dangers not only to themselves but also to the end user of the scaffold. Do pay strict attention to manufacturer's recommendations and specifications.

6.2.1 Fittings and Accessories

People are sometimes reluctant to install all the parts, fittings, and accessories required for a properly built frame scaffold. This poor practice continues because parts are frequently lost

or otherwise not available at the site. Other times, it is due to haste, lack of training or carelessness. Always use base plates with adjustable screw jacks. They allow for minor adjustments to keep the scaffold plumb and level. Base plates usually have holes so you can nail them to sole boards or mudsills. This is good practice and should be done as soon as the first tier is erected and plumbed with base plates centered on the sills. (Refer to *Appendix I*)

You must brace in the vertical plane on both sides of every frame. Bracing in the horizontal plane should be done at the joint of every third tier of frames starting with the first tier. Horizontal bracing should coincide with the point at which the scaffold is tied to the building.

Horizontal bracing is needed to maintain scaffold stability and full load-carrying capacity. The use of horizontal bracing on the first tier helps to square up the scaffold before nailing base plates to mudsills.

Every scaffold manufacturer provides coupling devices to connect scaffold frames together vertically. Figure 28 illustrates various types of coupling devices. Erectors often ignore these devices, believing that the bearing weight of the scaffold and its load will keep the frame above firmly connected to the frame below. This will probably hold true until the scaffold moves or sways. Then the joint may pull apart, causing the scaffold to collapse. Coupling devices should always be used and installed properly on every leg of the scaffold and at every joint, as assembly proceeds.

If wheels or castors are used, they should be securely attached to the scaffold and be equipped with brakes. Failure to attach wheels or castors properly to the frame has been the cause of many serious accidents and fatalities involving rolling scaffolds. Wheels or castors must have brakes which are well maintained and easily applied.

Scaffolds should always have guardrails. Unfortunately, workers frequently leave them out, especially on scaffolds of

low to moderate height with the result they sustain serious injury.

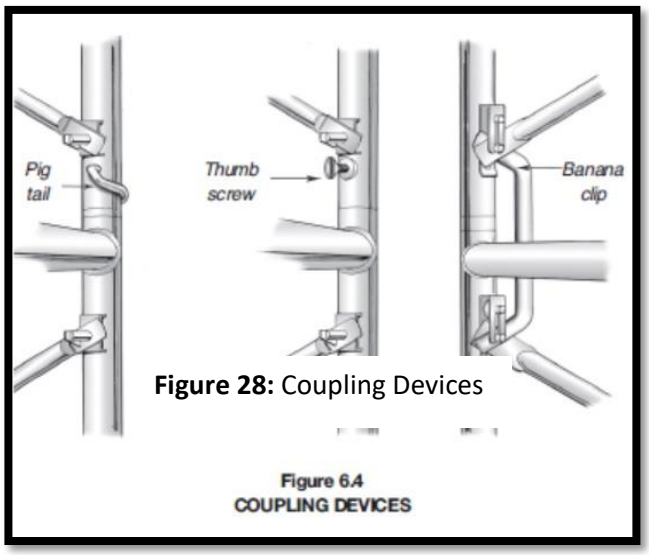


Figure 28: Coupling Devices

6.2.2 Braces

Once you have fitted the adjustable base plates on the frames, you must then attach the braces for each tower span. The braces should slide into place easily. If force is required, it means either the braces are bent, damaged or the frames are out of plumb or alignment.

Secure braces at each end. The erection crew must ensure that self-locking devices move freely and have fallen into place. Rust or slight damage can prevent some of these devices from working properly and they then require force to secure them in position. Maintain moving parts in good condition to prevent this situation from developing.

6.2.3 Platform Erection

Ensure that parts and fittings are in place and secure before placing platform components on a scaffold tier. When proceeding with the next tier, workers should use platform sections or planks from the previous tier, leaving behind either one platform section or two planks. While this requires more material, it speeds up erection because workers have platforms to stand on when erecting or dismantling the platform above. At heights above 2 meters, all workers involved in the erection or dismantling of scaffolds must be protected by a guardrail or by other means of fall protection.

Frequently, low scaffolds one or two frames in height are not fully decked in. This can lead to accidents and serious injury.

6.2.4 Ladders

See Section 5.3 for more details on ladders.

6.2.5 Guardrails

Guardrails must be installed at each working level as the scaffold is erected and also at the top level of the scaffold. This is recommended for all scaffolds regardless of height.

Although you do not require guardrails until scaffolds are 2 meters high, a considerable number of severe injuries and even fatalities are due to falls from lower scaffolds.

Some manufacturers have recently introduced temporary guardrails for workers to use when erecting scaffolds. A guardrail can be set in position from the previous level and can provide a protected work platform for the worker to install the next level of components. Each type of guardrail has a unique design and system of attachment to the scaffold.

Figure 29 shows one example of an 'advanced guardrail' with the platform fully enclosed. The guardrail is positioned on a bracket which is mounted from below on the outside of the scaffold, and does not interfere with the placement of subsequent frames and braces. As the scaffold goes up the guardrail may be raised as well, or left in position to form the permanent guardrail. The erector must use another fall protection method that is, permanent guardrails or a full body harness with a lanyard attached to the scaffold while moving either the platforms or the temporary guardrail.

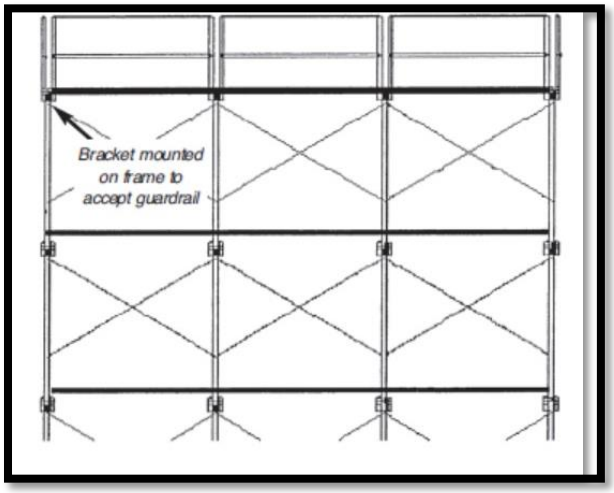


Figure 29: Advanced Temporary Guardrail

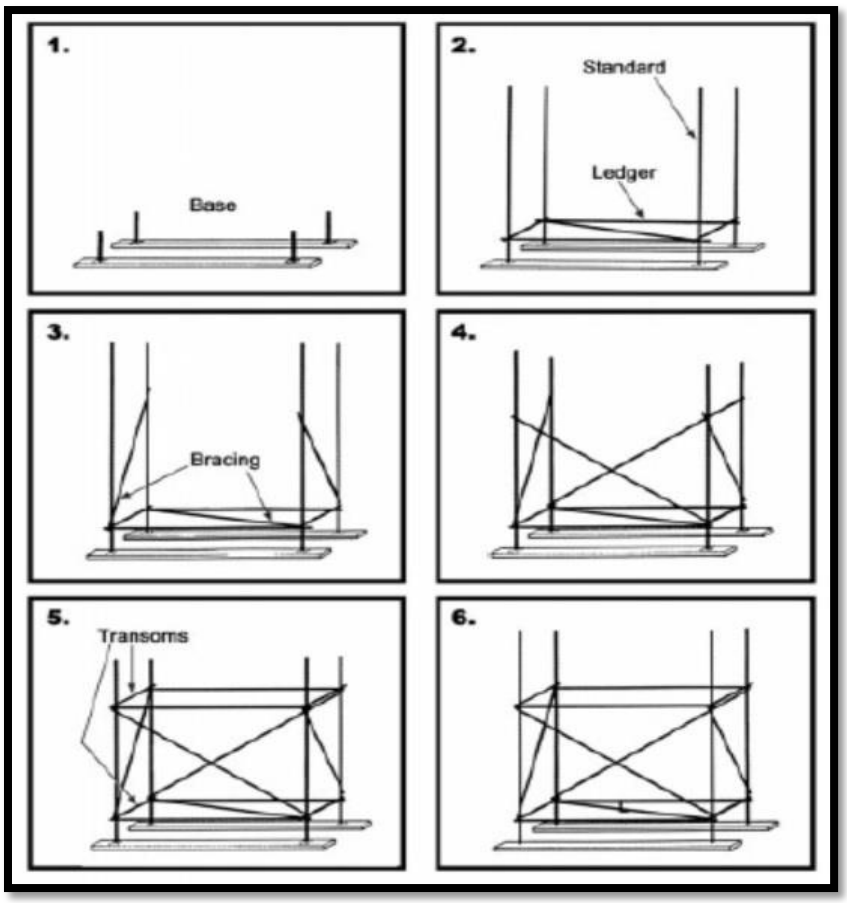
6.3 ERECTING TUBE-and-CLAMP SCAFFOLDS

Most of the general rules that apply to frame scaffolding also apply to tube-and-clamp scaffolding. The requirements for mudsills, platforms and guardrails are exactly the same for both types.

The most important difference between the two is the additional degree of skill and knowledge necessary to erect tube-and-clamp scaffolds safely and efficiently. Tube-and-clamp scaffolds should not be erected by an unskilled or inexperienced worker. Basic terms are identified in Figure 6.6.

6.3.1 General Requirements

Tube-and-clamp scaffolds are erected plumb and level like frame scaffolds but the erection system is quite different. The scaffold must start with a set of ledgers and transoms immediately above the base plates. This is necessary to hold the base plates in their proper position. The typical erection sequence for a simple tower is shown in Figure 30. Each vertical and horizontal member should be checked with a spirit level as erection proceeds.



6.3.2 Materials and Components

The tubing normally used for tube-and-clamp scaffolding is to BS 1139. Refer to *Appendix C*. Clamps are usually made of steel and have a variety of configurations. Depending on the manufacturer, clamps can be fastened using wedges, bolts or other methods.

The following types are used.

- **Right-Angle or 'Double' clamp**—a clamp used for connecting tubes at right angles. They maintain the right-angled orientation providing rigidity to the structure
- **End-to-End or 'Sleeve' Clamp**—an externally applied clamp to connect two tubes end-to-end
- **Swivel Clamp**—a clamp used to connect two tubes when right-angle clamps cannot be used. They usually connect bracing
- **Concrete Tie Clamp**—a clamp used to connect a tube to concrete or other surfaces using a bolt or concrete anchor

- **Single or Putlog Clamp** – a clamp used for securing intermediate transom to the ledger for supporting the board

These and other devices are shown in Figure 6.8 depicting a typical tube-and-clamp scaffold. Before using clamps, check them carefully for damage to wedges or threads on bolts and distortion of the clamp body.

6.3.3 Spacing of Standards

The spacing of standards depends on the load-carrying requirements of the scaffold. Wherever possible, tube-and-clamp scaffolding should have bay and elevation spacing of about 2 meters (6 feet 6 inches) longitudinally and vertically. This allows for the front sway bracing to be located at approximately 45° to the horizontal. It also facilitates the use of 3.9 meter planks with adequate overhang. The width of these platforms can vary but is usually approximately 1 meter (3 feet). This spacing allows the tubing specified earlier to carry normal construction loads adequately. An advantage of tube-and-clamp scaffolding is that the platform height can be easily adjusted to the most appropriate level for the work being done. Spacing of standard is determined by the duty of the scaffold, refer to tables provided above for Independent, birdcage and tower scaffolds.

6.3.4 Ledgers and Transoms

Ledgers should be connected to standards using right angle clamps. These clamps maintain a rigid 90° angle between members.

Transoms should be placed above the ledgers and both should be maintained in a horizontal position by levelling with a spirit level. Transoms may be connected to either standards or ledgers by using right-angle clamps.

6.3.5 Joints in Standards and Ledgers

Joints in standards and ledgers should be made with end-to-end clamps. These joints should be as close to the node points as the clamp arrangements will allow. Joints in vertically-

adjacent ledgers should not occur in the same bay but should be staggered to provide rigidity.

A node point is the point at which the ledger-to-standard, transom-to-standard, and bracing-to-standard connections come together. An example of a node point is shown in Figures 17 and 31, if the standard or ledger joint occurs on the same bay or lift and cannot be avoided, one of them should be spliced.

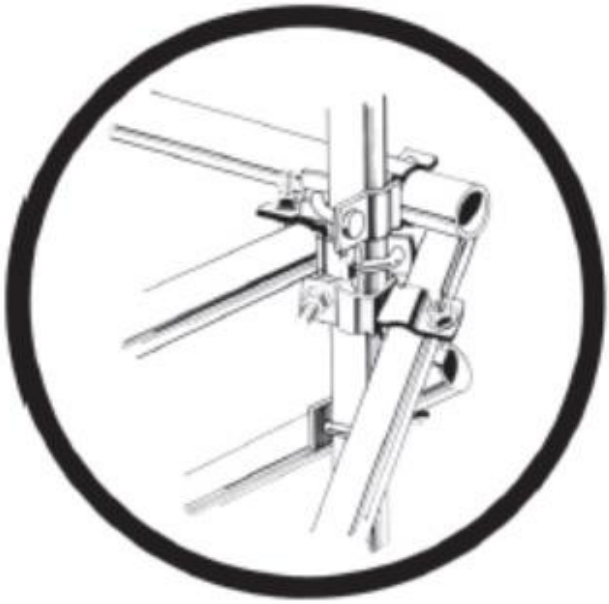


Figure 31: Node Point

6.3.6 Intermediate Transoms

You should install intermediate transoms when the scaffold is supporting heavy loads. You can also use them to avoid lapping planks and the tripping hazard that comes with it.

6.3.7 Tie-ins

Tie-ins are required with tube-and-clamp scaffolding. They should be placed at every 4 meter location vertically and horizontally. The tie-in tube should be connected to both standards or to both ledgers. It is recommended that they are placed at a location not exceeding 300 millimeters from the node point at a pair of brace standard, and near the standard to provide rigidity. Connections should be made with right-angle clamps. Tie-ins should be capable of

withstanding both tension (pull) and compression (push) forces (Figure 6.8).

6.3.8 Bracing

Internal or ledger bracing (Figure 32) is connected standard-to-standard using swivel clamps or ledger-to-ledger using right angled clamps. It should be clamped as close to the node as possible and not more than 300mm from the node point. Internal or ledger bracing should normally be placed at both ends and alternate pair of standard. The location should coincide with tie-in points. You should also install bracing for tube-and-clamp scaffolding as erection progresses.

Facade or sway bracing should be installed to the full height of the scaffold. It may be located in a single bay or extend across several bays (Figure 33). Where the bracing is located in single bays it should be in the end bays and at least in every fourth bay longitudinally. In practice, it becomes difficult to get bracing close enough to the node points if it extends more than four bays in width (see ends of bracing in Figure 33).

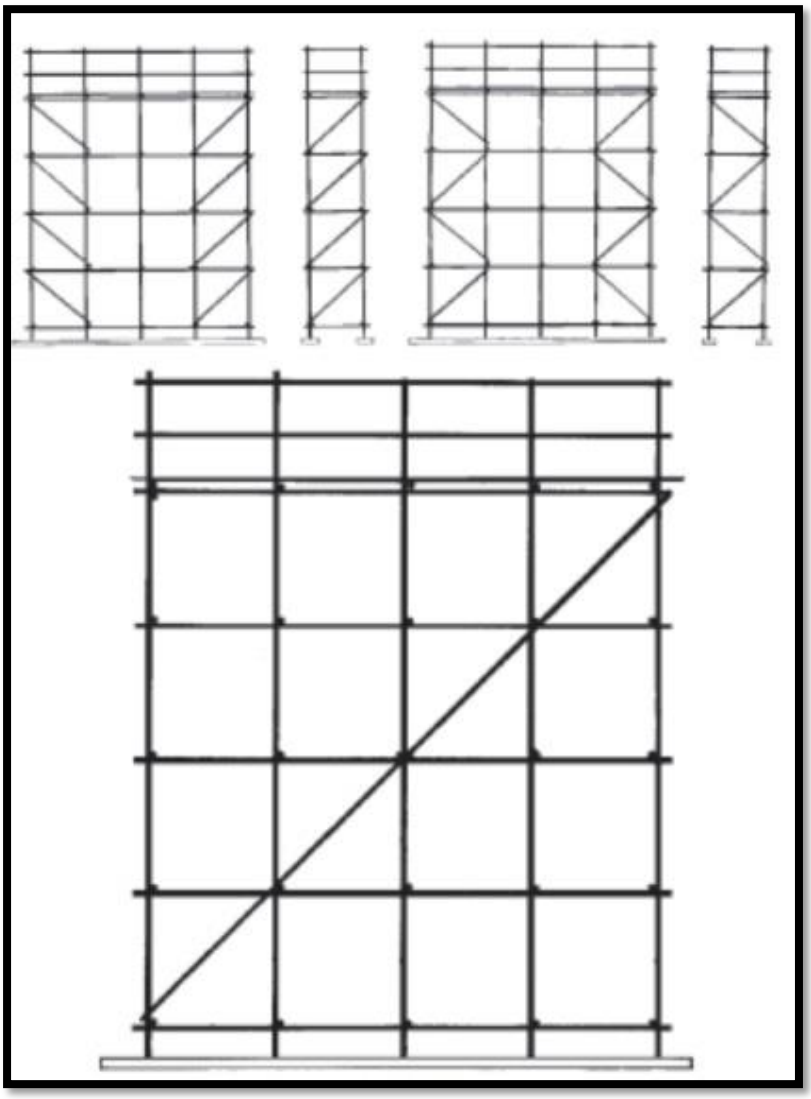


Figure 32: Tube-and-Clamp Bracing

6.3.9 Drawings and Inspections

A sketch or drawing is strongly recommended to be prepared before erecting tube-and-clamp scaffolding. It is important that you place the standard to accommodate the anticipated loads adequately. Bracing must also be designed to provide stability and to transfer horizontal loads to tie-in points.

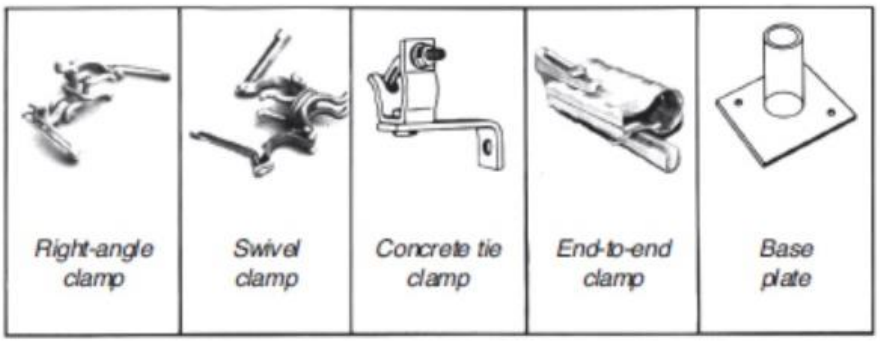
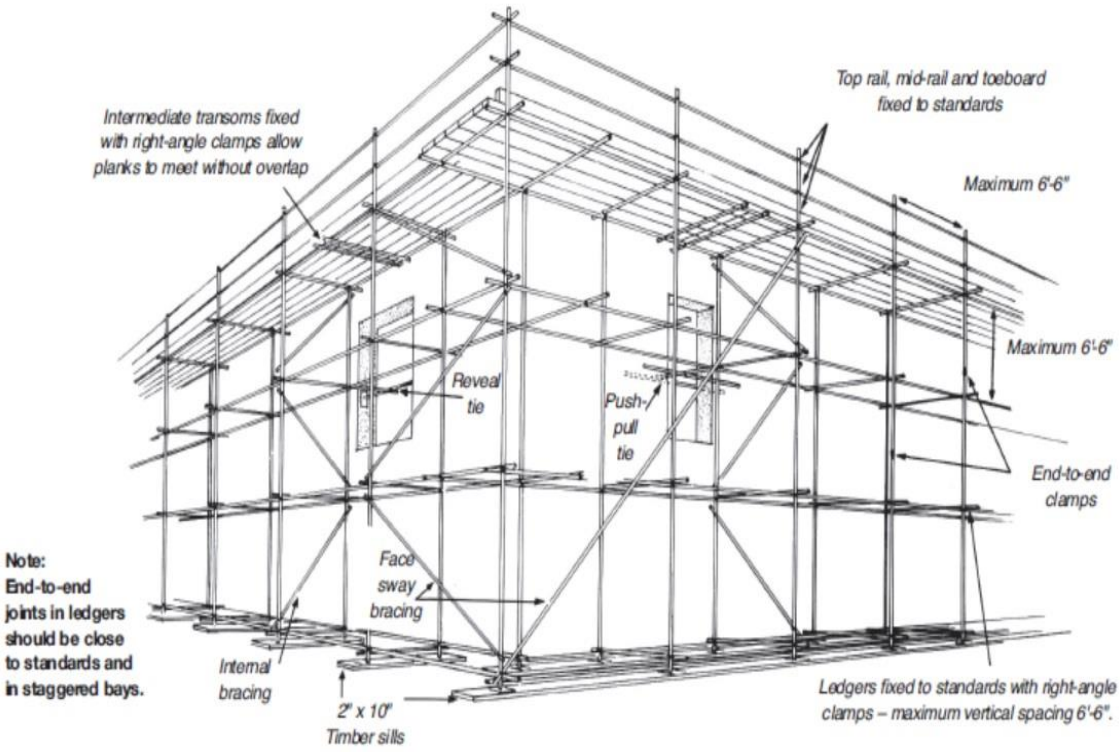


Figure 33: Completed Tube-and-Clamp Scaffold



Where the height of the structure is more than 15 meters high or where unusual structures such as cantilevered platforms are involved, a professional engineer must design the scaffold. A professional engineer or a competent worker must inspect the scaffold before it is used to ensure that it is erected in accordance with the design drawings.

6.4 ERECTION of SYSTEMS SCAFFOLDS

Erection of systems scaffold is very similar to that of tube-and-clamp scaffold. The requirements for mudsills, platforms and guardrails are the same as is the requirement for being built level and plumb. The main differences are the method of connecting individual members together and the fact that all the members are of a fixed length. As with tube-and-clamp scaffolds, all systems scaffolds above 15 meters must be designed by a professional engineer and in line with manufacturer's specifications.

6.4.1 Components

Standards come in a variety of lengths and have a variety of built-in connection points at equal distances along their length. These connectors are normally between 450 and 500 millimeters (18 and 21 inches) apart depending on the manufacturer. Typical connections are shown in Figure 33, although others are available. An end-to-end connection, normally a spigot, is formed at one end to facilitate extension of the standard.

Starter Collars are short standards with one set of system rings or rosettes attached. They are convenient to use because they allow one person to put the first set of transoms and ledgers in place easily (See Figure 34).

Ledgers or Runners for each system are available in varying lengths and have built-in connection devices for connecting to the standards. The connection is secured by wedging, bolting or by other methods.

Transoms or Bearers are made wide enough for four or five planks. They normally have end connections similar to those of ledgers and connect directly to the standard. Normally transoms have a lip or groove which is particular to the individual manufacturer and is so designed to accommodate the platform.

Braces are made in set lengths to fit the scaffold being constructed, with connections at both ends to fit directly onto the connection point on the standard.

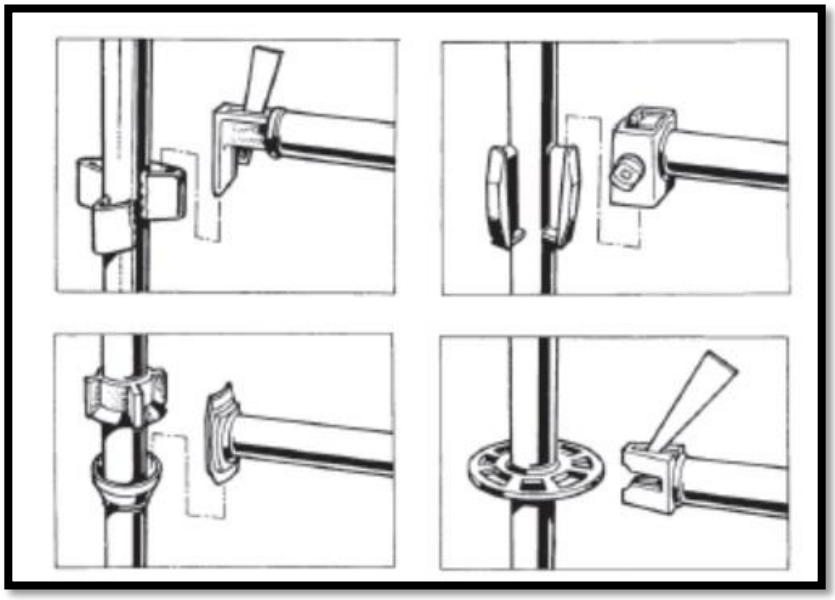


Figure 34: Typical Systems Scaffold Connectors

Platform boards (also called staging) come in a variety of lengths and widths. They fit directly into the transoms and can be secured to prevent wind uplift. To facilitate climbing, some platforms have trap doors with built-in drop-down ladders.

6.4.2 Erection Procedure

The foundation for systems scaffolds should be prepared in the same way as other types of scaffolding, ensuring a firm level base, and using sole boards or mudsills, base plates and adjustable screw jacks.

The base plates should be laid out in what you estimate is the correct location. We recommend starter collars since they allow scaffolds to be laid out level and square.

The first level of transoms and ledgers should be placed on the starter collars and be levelled using the screw jacks. When the scaffold is square and level, you should tighten the connections and place the base plates to the center of the sole boards or mudsills. At this point set up an erection platform for installing the standards for the next lift. You now install the second level ledgers and transoms as well as the deck. You must install ledger bracing at the ends of all system scaffolds and at intervals according to the manufacturers' recommendations. Each brace will be the correct length for

the span being braced and should be connected to the attachment point on the standard.

You must install facade or sway bracing according to manufacturers' instructions. Again, attachment points are set on the standards, and the braces come in specific lengths for the span of the scaffold being constructed. Normally, every third bay is braced for sway. Figure 6.10 outlines the typical erection procedure for systems scaffold.

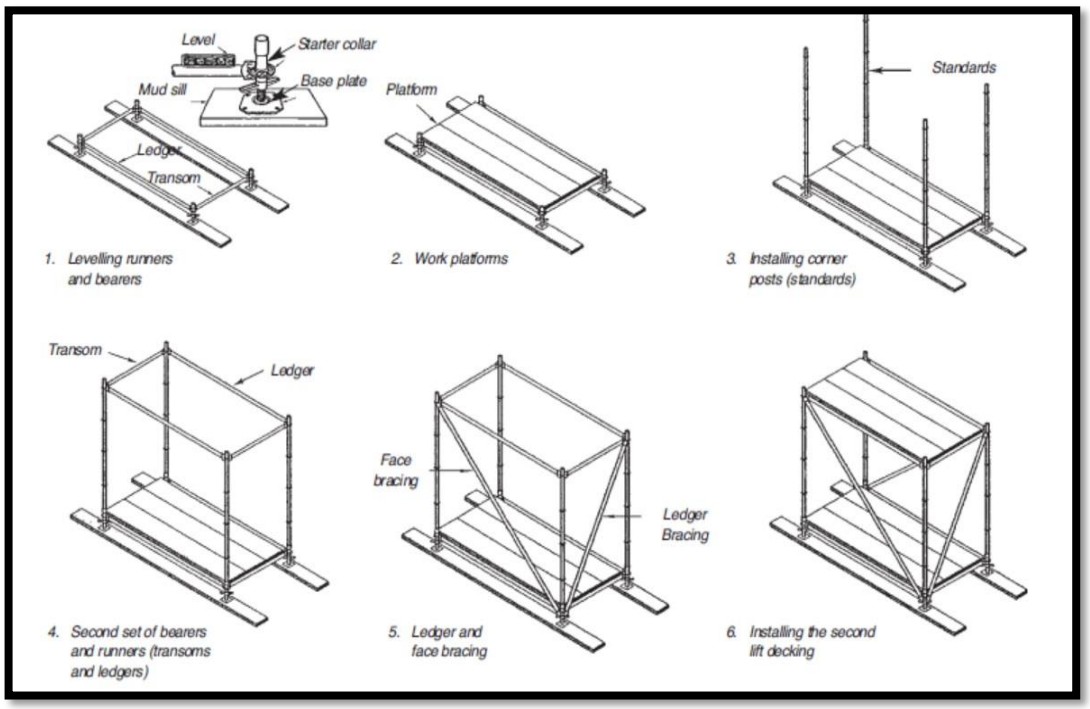


Figure 35: Erection Sequence of Typical Systems Scaffold

6.4.3 Tie-ins

See section 6.3.7.

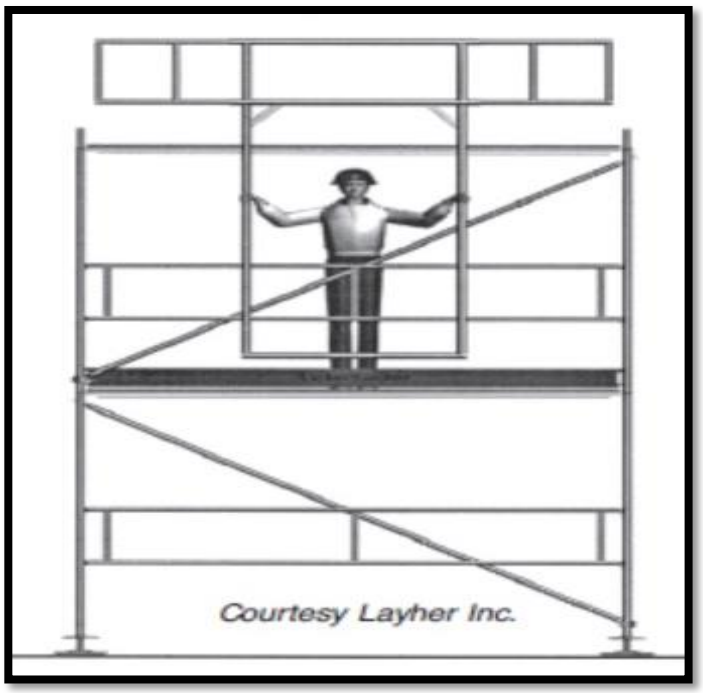
6.4.4 Guardrails

Generally, guardrails are installed at all working levels. These guardrail components come in modular lengths and are made from lighter materials than the ledgers. They attach directly to the connection points on the standards.

Certain manufacturers have developed advanced guardrail systems that can be installed for a level above the erector,

providing fall protection for the worker accessing the next level.

The example shown in Figure 36 consists of a "T" shaped temporary guardrail which is attached to the permanent guardrails on the level underneath. When mounted, it extends the required distance past the deck above to form a guardrail. The erector can then work safely without being tied off and install the next level of standards, ledgers and transoms.



6.5 DISMANTLING

Dismantling frame scaffolds is essentially erection in reverse. Each tier should be completely dismantled and the material lowered to the ground before beginning to dismantle the next tier.

If platform sections or planks have been left at each level during erection, as suggested above, it should be relatively easy to lower platform materials from above and deck in the current working platform completely. Extra platform material can be lowered to the ground. Using this procedure, workers will be operating most of the time from a fully decked-in platform. This makes for easier removal of braces and frames.

Dismantled materials could be lowered using a gin wheel and hoist arm or by mechanical means. Manual handling is not recommended. Dropping materials not only causes damage and waste, but also endangers workers below. When scaffolds have been in the same location for a long time, pins and other components frequently rust, braces become bent and materials such as mortar or paint often build up on the scaffold parts. These factors can prevent components from separating easily. Removing jammed or rusted scaffold components can be very hazardous.

Tugging or pulling on stuck components can cause you to lose your balance and fall. Workers should wear a full body harness and lanyard tied off to a suitable anchor point or lifeline before attempting to loosen stuck or jammed parts.

Dismantling tube-and-clamp and systems scaffolding must proceed in reverse order to erection. Each tier should be completely dismantled as far as connections will allow before you begin dismantling the lower tier. You must dismantle them this way because the bracing for tube-and-clamp scaffold is not located in each bay as it is for frame scaffolding. The span or spans with front sway bracing should be the last to be dismantled on each tier.

7.0 SCAFFOLD STABILITY

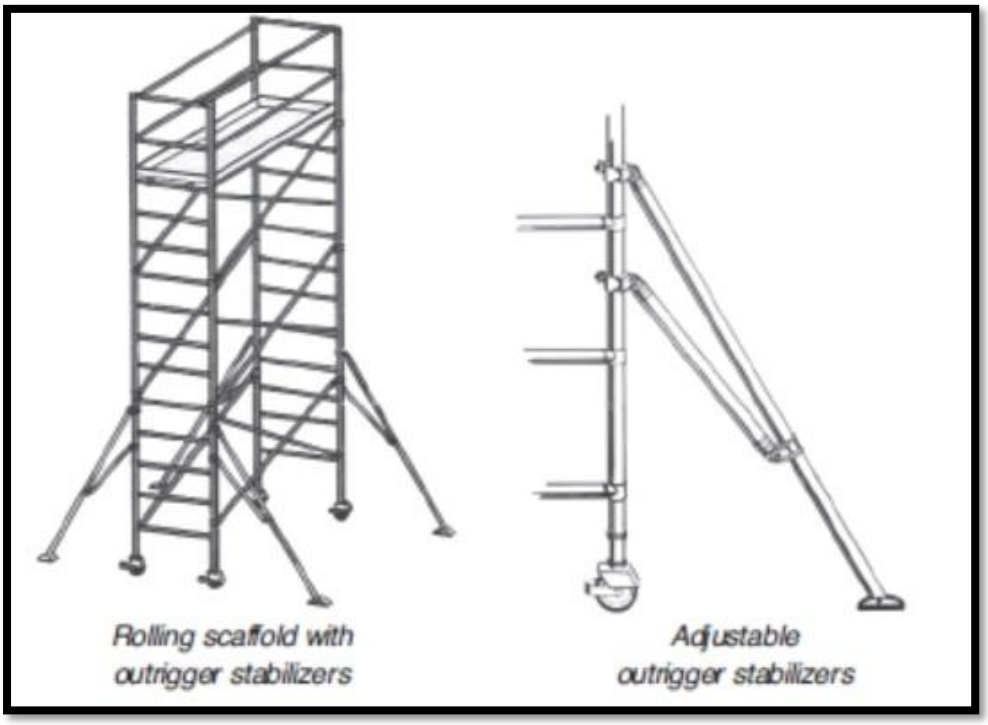
7.1 Three-to-One Rule

The ratio of height to least lateral dimension must not exceed 3 to 1 unless the scaffold is -

- tied to a structure, as discussed in Section 7.6
- equipped with outrigger stabilizers (Figure 37) to maintain the ratio of 3 to 1
- equipped with suitable guy wires. Wooden planks are not recommended

7.2 Outrigger Stabilizers

Scaffold manufacturers usually make outrigger stabilizers that can be attached to their equipment (Figure 37).



With devices of this type, do ensure that the outrigger is adjusted so that vibration or dynamic loads on the platform will not move the stabilizer.

Where stabilizers with castors are used, the castors must rest firmly on a solid surface, with the brakes applied and with the stabilizer secured in the extended position before workers use the platform (Figure 38). Many of these stabilizers fold up to allow movement through smaller openings and around obstructions (Figure 38).

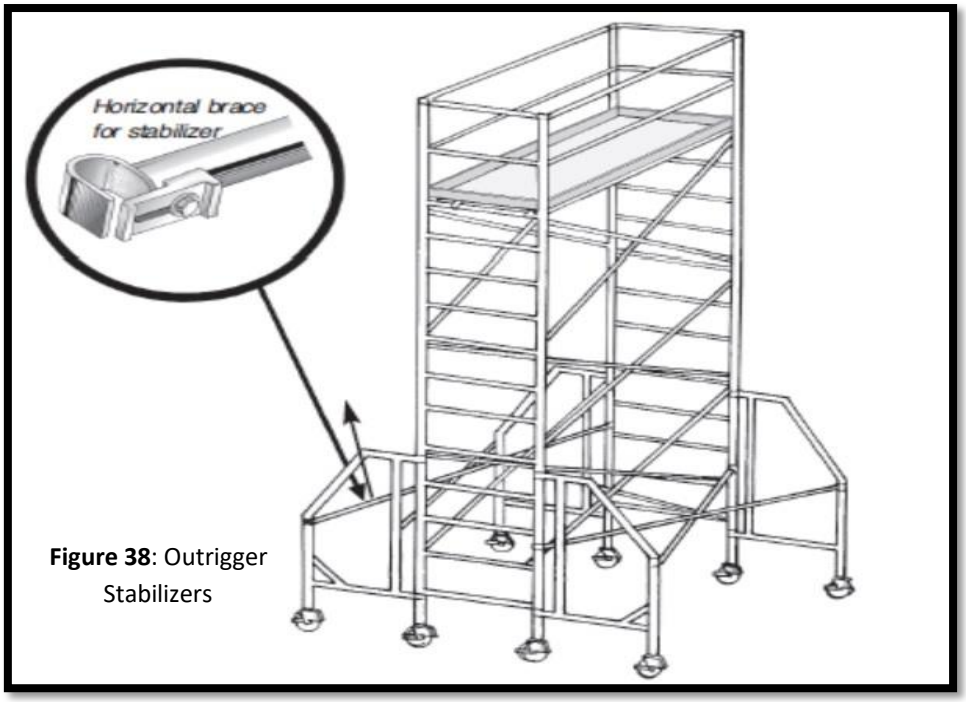


Figure 38: Outrigger Stabilizers

7.3 Limitations to the Three-to-One Rule

The 3-to-1 rule applies only to the extent that outriggers are extended symmetrically about the scaffold tower. If the outriggers are extended only on one side, you will only prevent toppling in that direction.

7.4 Damage

Most bracing systems for tubular frame scaffolds are manufactured from light materials and are easily damaged. Braces with kinks, bends or deformations should not be used. Such damage can weaken them significantly. The ends of braces are frequently damaged by dropping them on concrete or other hard surfaces during dismantling. Ends of braces are also frequently bent by forcing them onto the locking pin during erection. Constant bending can cause the ends to crack. You should inspect them before use and discard braces with cracked ends. You should maintain the locking device onto which the brace fits in good condition. It should move freely to accept and release the brace. Common securing devices are shown in Figure 39.

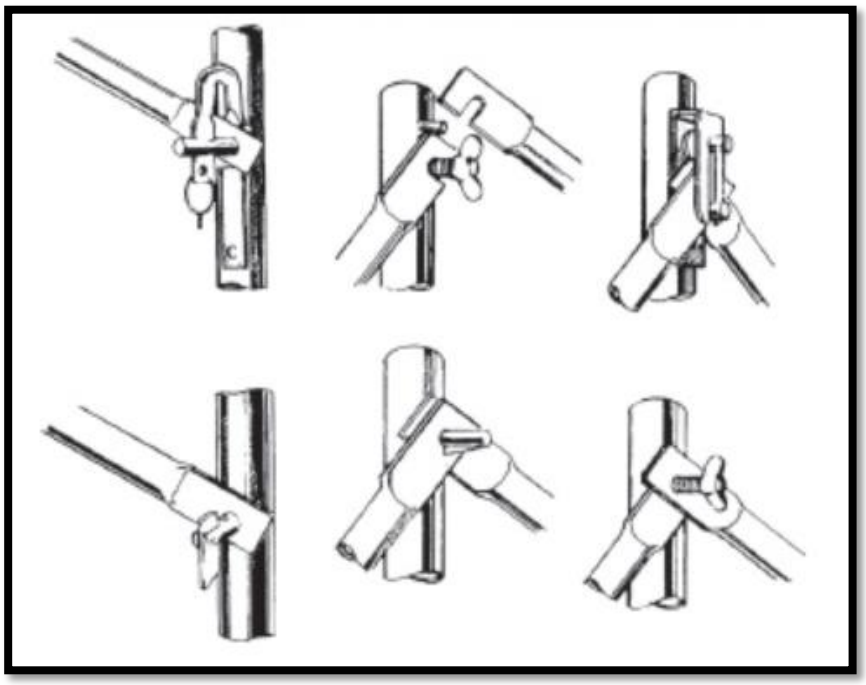


Figure 39: Securing Devices for Frame Scaffold Brace

7.5 Installation Problems and Symptoms

Ensure that bracing is secured in place. Otherwise, scaffold movement can dislodge the braces and reduce the stability of the scaffold. These devices must secure the braces in place but they must operate freely so that it is easy to erect and dismantle the scaffold. Frequently, a worker has lost balance and fallen when trying to release a jammed or rusted drop hook while dismantling a scaffold.

You should completely deck platforms used to install bracing. Trying to work from a platform one or two planks wide often results in a fall. In addition, it leads to greater damage to the ends of scaffold braces because they bend when they are not kept close to proper alignment during installation and removal.

If a brace does not easily drop onto pins, it means the brace may simply be bent and should be discarded.

Often, however, it also means the scaffold is twisted and out of plumb. Braces should not be forced or hammered onto the pin. The condition causing this difficulty should be corrected so that the brace slides onto the pin easily. Adjusting screw jacks slightly often

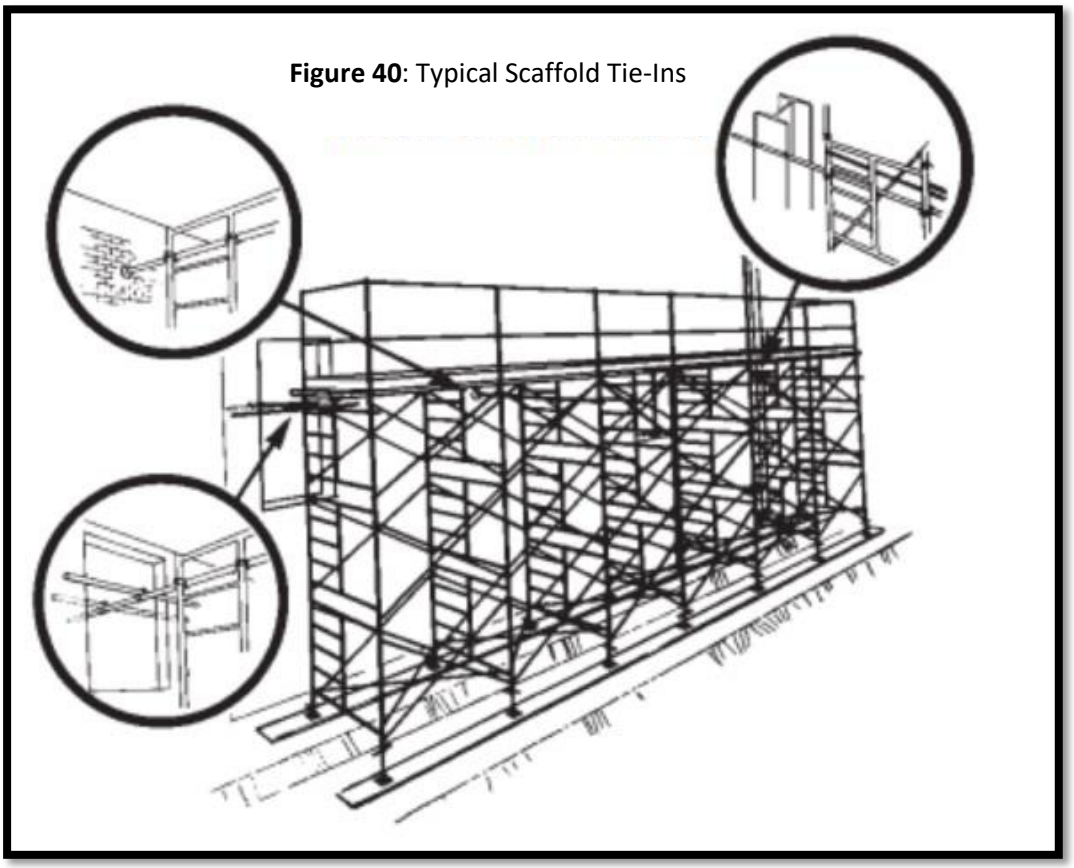
solves this problem. However, you need to take care to ensure the scaffold is not adjusted out of plumb.

7.6 Tie-in Requirements

Scaffolds which exceed the 3-to-1 rule of height to least lateral dimension must be tied in to a building or structure. Refer to section 6.3.7.

These tie-ins must be capable of sustaining lateral loads in both tension (pull) and compression (push). See Figure 40.

Figure 40: Typical Scaffold Tie-Ins



Wind loads can affect tie-ins and bracing. These loads vary not only with speed but also with the exposure of the location and the height and shape of structures where the scaffold is erected. In addition, scaffolds which are going to be enclosed for sandblasting will be subjected to significantly greater wind loads. If severe winds are expected, it is recommended that a professional engineer be consulted for tie-in requirements. It is recommended that all netted and sheeted scaffold are subject to design requirements.

8.0 PLATFORMS

Before you select the platform material, you need to assess the weight of the workers, tools and materials to be supported. You must also take into consideration the spans being used in the scaffold.

8.1 Typical Loads and Requirements

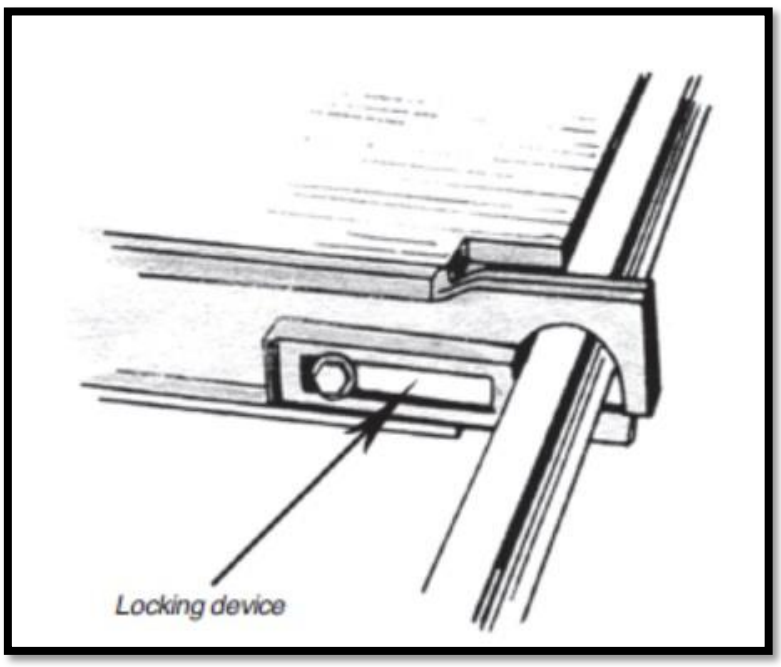
Refer to tables for independent, bird cage and tower scaffolds for load requirements.

For weights of construction materials and allowable load carrying capacities of planks at various spans, see Table 9.1.

8.2 Aluminum/Plywood Platform Panels

Most manufacturers make their heavy-duty platforms capable of supporting a uniformly distributed load of 3.6 kn/m2 (75 lb./sq. ft.) together with a concentrated load of 227kg (500lb) spread over an area near the centre of the span. The load-carrying capacity of these platforms varies to some extent.

It is recommended that the rated load-carrying capacity be obtained from the supplier and marked on the platform panel if the manufacturer has not provided such information on the equipment already. The light-duty platforms with less capacity are not suitable for construction.



The advantage of aluminum/plywood platform panels is that they are light and durable. Worn-out plywood can easily be replaced. However, they are expensive and the hooks on most models can be damaged if dropped from the scaffold repeatedly during dismantling. Check the platform hooks and fastening hardware regularly for looseness, cracks and distortion. When used outdoors, these platforms should be secured to the scaffold frames using wind locks. Otherwise, when left unloaded, they can be blown off the scaffold by strong winds.

8.3 Laminated Veneer Lumber for Aluminium scaffold

This material is really a special type of exterior plywood with laminations oriented longitudinally rather than in two directions. The material is manufactured in large sheets of various thicknesses that can be sawn to the sizes required.

The strength varies from manufacturer to manufacturer depending on method of fabrication and species of wood used. Users of the material should ask suppliers to furnish rated working loads for the scaffold spans on which the lumber will be used. In general, the material will be stronger than sawn lumber scaffold planks of similar size and species. The strength is also more uniform than sawn lumber.

Like all lumber and plywood, laminated veneer lumber is subject to deterioration from weathering and rot. It must therefore be inspected periodically. Sections showing delamination, cracks, serious damage to several layers of lamination, fungi or blisters should be discarded. It is only recommended for internal use in buildings.

8.4 Sawn Lumber Planks

Rough sawn planks 38mm x 225mm or larger have been the standard scaffold platform material for many years. They are also the least expensive of the common platform materials. Dressed lumber should never be used for scaffold platforms.

Industry practice specifies that wooden planks used on a scaffold must -

- be at least 38mm x 225mm
- be arranged so their span does not exceed 1.2 meters
- overhang their supports by no less than 50 millimeters and no more than 150 millimeters

- be laid tightly side by side across the full width of the scaffold at the working level
- be cleated or otherwise secured against slipping

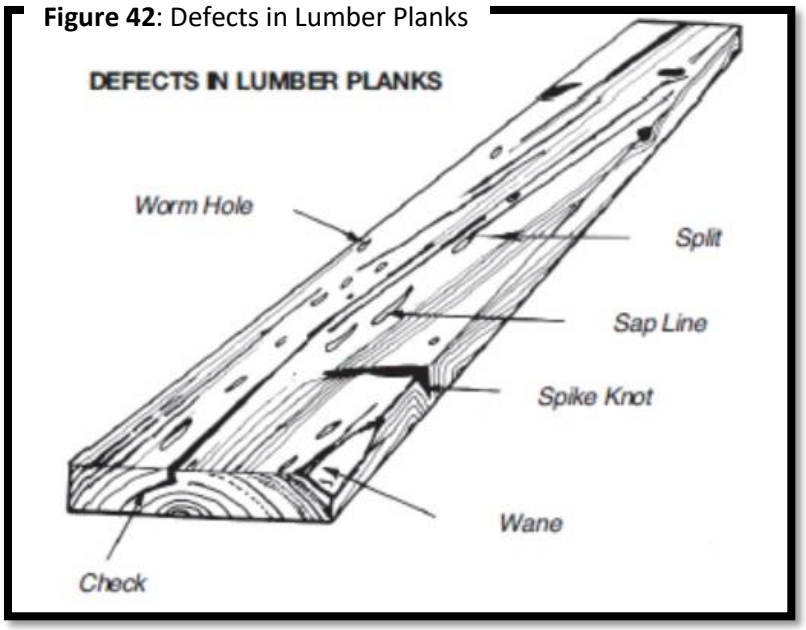
It should meet BS2482, refer Appendix C.

As a good practice, sawn lumber planks must be stamped by the manufacturer identifying them as scaffold planks.

Since wood planks deteriorate, they must be re-graded and culled periodically. For most situations, visual grading is recommended. Scaffold planks must be inspected regularly because they deteriorate with use and age, and are subject to damage. Figure 42 illustrates defects to look for when inspecting planks. Remove planks with large knots in the edge, spike knots, checks, wanes, worm holes and steeply sloping grain patterns. Planks with these defects should not be used as scaffold material and should be destroyed. Scaffold planks can also be weakened by dry rot. It is not easy to spot this condition in its early stages, especially if the exterior of the planks is weathered.

Planks substantially infected with dry rot are usually lighter than sound planks of similar size and species. For this reason, do not use planks which feel lighter than normal.

Figure 42: Defects in Lumber Planks



8.5 Reinforcing Wood Planks

Reinforcing wood planks is not recommended.

8.6 Securing Platforms to the Frame

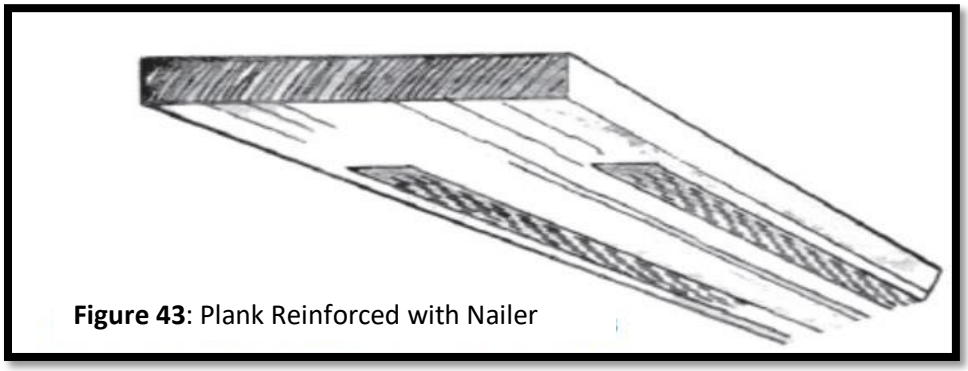
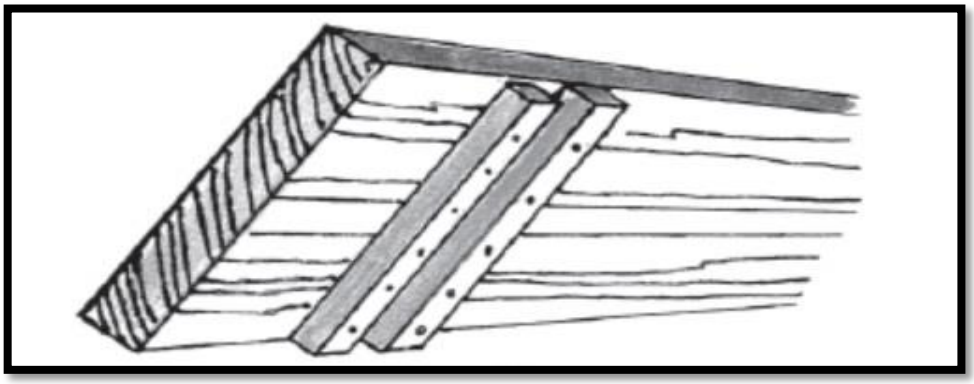


Figure 43: Plank Reinforced with Nailer



Reinforcing wood planks is not recommended.

If you have overlapping planks, the cleated end should be resting on the scaffold support. Be aware that the overlapped section presents a tripping hazard (Figure 45).

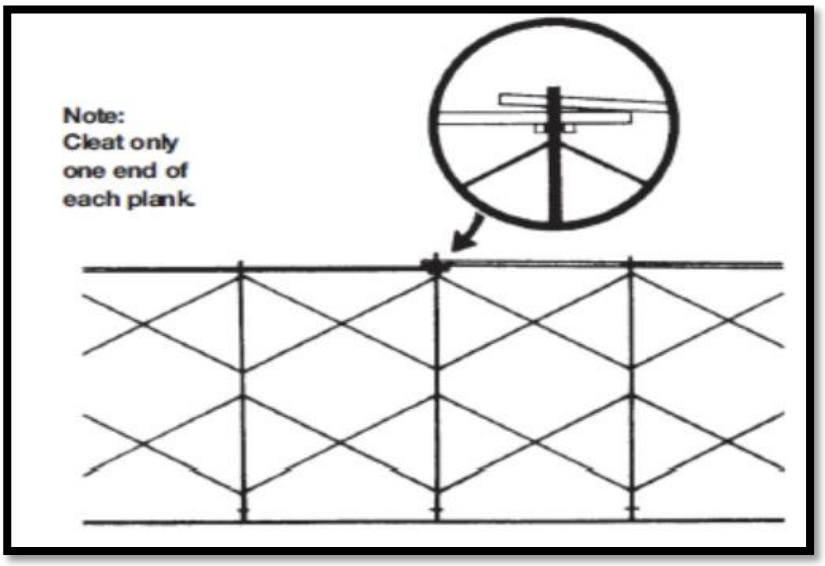
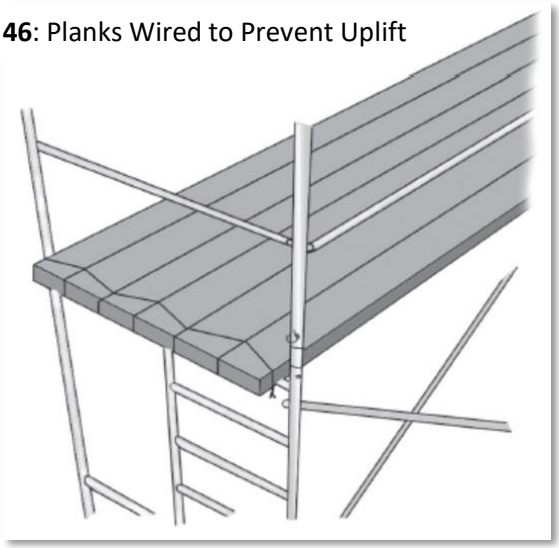


Figure 45: Overlapping Planks for Multi-Span Towers

8.7 Wind Uplift

Wind can lift light platform materials from the scaffold if they are not secured. When you anticipate severe wind conditions or when you are using high scaffolds, you should secure platform materials such as aluminum or plywood panels to the scaffold. With some types of platform panels, you can do this with wire or nails. Others have a sliding locking device (see Figure 41). These locking devices, however, can be easily damaged and are often difficult to apply and release.

Figure 46: Planks Wired to Prevent Uplift



9.0 PROPER USE OF SCAFFOLDS

Much of this chapter deals with the erection and dismantling of various types of scaffolds. Frequently, the end user of the scaffold is not the person who erects it. In order for scaffolds to provide efficient access to work areas they must be used properly by all workers.

9.1 Ladders and Climbing

Ladder access is discussed in Section 5.3.

9.2 Guardrails Missing or Removed

There may be situations where scaffolds must be used without guardrails. If the scaffold is more than one frame or tier in height and there are no guardrails, the worker on the platform must tie off with a full body harness and lanyard (Figure 48). Many falls and serious injuries occur when workers use platforms without guardrails. Any worker who removes a guardrail for any reason must replace it when the task is completed.

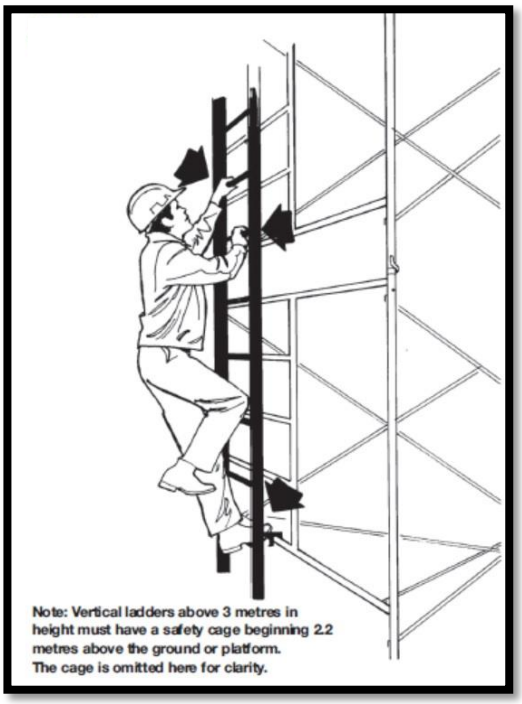


Figure 47: Three-Point Contact

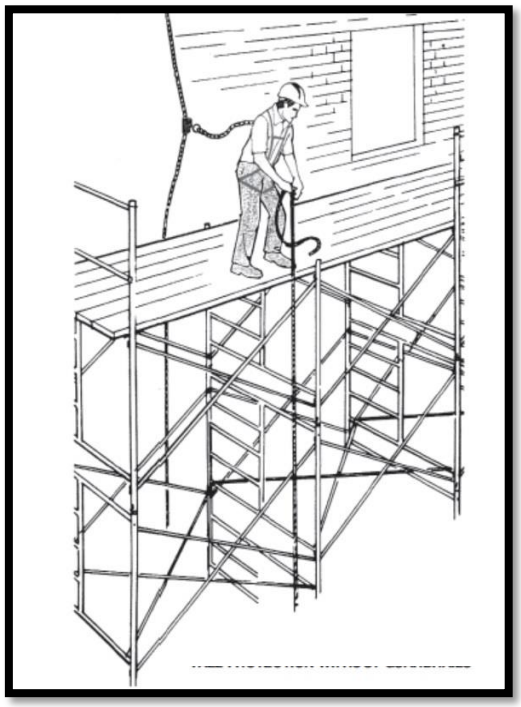


Figure 48: Fall Protection Without Guardrails

9.3 Standing on Objects above Platform

Any person performing work from the platform should have both feet on the platform. Standing on a barrel, box, stepladder, guardrail or other object to gain extra height is extremely dangerous. You should know the required height of the scaffold before erecting it, so you

can obtain all the required material, including half frames when necessary.

9.4 Overloading

Overloading scaffold platforms in the masonry trades is one of the most frequent violations of good scaffold practice. Placing full pallets of bricks or concrete blocks on a single layer of 38mm x 225mm scaffold planks is considered, overloading the platform and is not recommended. In addition, inspect planks used to support masonry materials for damage or for deterioration regularly and often. Table 9.1 lists the approximate weights of common building materials. Bear in mind that overloading may affect stability as well as load-carrying capacity.

Table 9.1

APPROXIMATE WEIGHTS OF BUILDING MATERIALS

Material	Metric Unit Weight	Imperial Unit Weight
Aluminum	2643 kg/cu m	165 lb/cu ft
Iron (Wrought)	7769 kg/cu m	485 lb/cu ft
Steel	7849 kg/cu m	490 lb/cu ft
Nickel	8730 kg/cu m	545 lb/cu ft
Glass (plate)	2563 kg/cu m	160 lb/cu ft
Lumber (dry)		
Cedar (white)	352 kg/cu m	22 lb/cu ft
Douglas Fir	513 kg/cu m	32 lb/cu ft
Maple	689 kg/cu m	43 lb/cu ft
Red Oak	657 kg/cu m	41 lb/cu ft
Spruce	433 kg/cu m	27 lb/cu ft
Concrete	2403 kg/cu m	150 lb/cu ft
Granite	2803 kg/cu m	175 lb/cu ft
Brick	1922 – 2243 kg/cu m	120 – 140 lb/cu ft
Limestone, Marble	2643 kg/cu m	165 lb/cu ft
Sandstone	2082 kg/cu m	130 lb/cu ft
Steel Pipe (standard)		
1" I.D.	2.49 kg/m	1.68 lb/ft
2" I.D.	5.43 kg/m	3.65 lb/ft
3" I.D.	11.27 kg/m	7.58 lb/ft
4" I.D.	16.05 kg/m	10.79 lb/ft
Copper Pipe		
1" I.D.	2.71 kg/m	1.82 lb/ft
2" I.D.	6.28 kg/m	4.22 lb/ft
3" I.D.	13.02 kg/m	8.75 lb/ft
4" I.D.	19.20 kg/m	12.90 lb/ft
Aluminum Pipe (standard)		
1" I.D.	0.86 kg/m	0.58 lb/ft
1-1/2" I.D.	2.40 kg/m	1.61 lb/ft
2" I.D.	3.08 kg/m	2.07 lb/ft
3" I.D.	4.57 kg/m	3.07 lb/ft
Drywall (1/2" thick)	10.25 kg/m^2	2.10 lb/ft^2

Differential settlement is often a problem when you apply heavy loads to scaffolds resting on un-compacted soils. A scaffold tower 9 meters high that settles 25 millimeters (1 inch) on one side can move 150 millimeters (6 inches) at the top. Settlement puts stress on braces, tie-ins, and frame joints. Place heavy loads symmetrically on the platform to ensure that soil settlement is uniform.

Finally, the scaffold structure must be capable of carrying the load that you will apply. Both light-duty and heavy-duty frames are

available on the market. Do not use light duty frames where you have heavy loads. If you do not know the load-carrying capacity of the frames, consult the manufacturer or supplier. The load-carrying capacity of frames usually varies with the height of the towers.

9.5 Debris on Scaffold Decks

Scaffold decks are small, narrow, and confined. Store tools and materials in an orderly fashion. Do not allow debris and waste materials to collect on the platform. Put them in a container or remove them from the platform immediately. Set up a plan for dealing with waste materials. Simply throwing garbage off the scaffold is extremely dangerous and is not allowed. If work on the scaffold is likely to result in debris falling, such as in masonry work, cordon off the scaffold to prevent workers from entering the area. Waste pieces of lumber, pipe, wire, miscellaneous metal, and small tools are tripping hazards which can cause serious falls from scaffolds.

You need an orderly work area to work safely on scaffolds.

9.6 Exposure to Hazardous Material

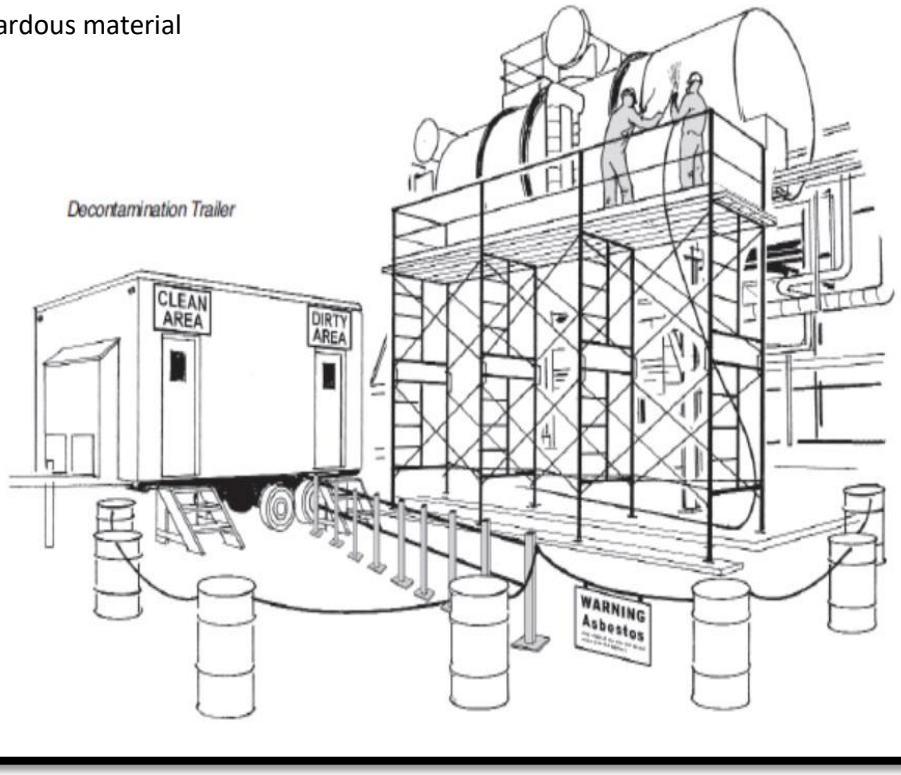
Frequently, scaffolds are erected for work involving hazardous substances: e.g., refurbishing structures painted with lead-based paint or removing asbestos. If you are sandblasting painted surfaces for instance, lead can accumulate on planks and other components. Workers carrying out these activities must use appropriate personal protective equipment (PPE). The scaffold worker who has to dismantle the scaffold can also be at risk from the lead residue. Under these conditions you should do the following:

1. Clean components that are likely to be contaminated by lead dust, preferably by washing with a hose before dismantling begins
2. Cap scaffolding frames and standards as the scaffold is being erected to prevent lead dust from accumulating inside and being subsequently released during the dismantling process
3. If it is not possible to wash down the scaffolding before dismantling, then scaffold workers should wear properly fitting appropriate filtering face piece respirators while dismantling. The scaffold should be kept clean
4. Proper attention to personal hygiene is critical when dealing with hazardous substances e.g. lead. Workers must be

instructed not to eat, drink, or smoke without washing their hands. A sign or notice indicating this should be conspicuous

5. Workers should be provided with separate clean and dirty areas. The dirty area can be used for changing out of contaminated clothing and the clean area for changing into uncontaminated clothing and eating (Figure 49). Washing facilities with clean water, soap, and individual towels should be separated between the two areas
6. Scaffold workers should have routine medical checks and especially when exposed to hazardous materials (e.g. asbestos, lead, hydrocarbon)

Figure 49: Using scaffold around hazardous material



APPENDIX G – SCAFFOLD TRAINING AND COMPENTENCY

COMPETENCY OF SCAFFOLDER

1. Trainee Scaffolder (Assistant)

Trainee Scaffolder is an unskilled or semi-skilled scaffolder who assists a scaffolding team to perform following tasks:

- Erects and dismantles basic type of scaffold such as independents, birdcage and tower under the supervision of basic or advanced scaffolder
- Carries out material handling and housekeeping onsite
- Carries out scaffold material servicing works

A trainee scaffolder must not perform any scaffolding tasks without supervision of basic or advanced scaffolders. In sequence of erecting and dismantling, a trainee scaffolder is only allowed to work on scaffold not exceeding 2 meters in height.

2. Part A Scaffolder (Basic level 1)

- Assists an Advanced Scaffolder in erecting, dismantling and alteration of scaffold
- Assists in supervising a trainee scaffolder in erecting, dismantling and alteration of scaffold
- Erects and dismantles basic type of scaffold such as independents, birdcage and tower
- Assists in material handling and housekeeping onsite

Be able to understand:

The correct and safe methods of erecting, modifying and dismantling independent scaffolds, scaffolds with returns and tower scaffolds in tube and fitting

The regulations governing the safe erecting, alteration and dismantling of scaffolds and the work methods to be adopted

To determine the material requirements for independent scaffolds, independents with returns and tower scaffolds in tube and fitting

To lay out materials, set out scaffolds and overcome obstacles to erect scaffold safely

To ensure that scaffolds are constructed following safe systems of work

As a member of a team to erect, alter and dismantle a range of basic scaffold structures safely and in the correct sequence

3. Part B Scaffolder (Intermediate level 2)

- Assists an Advanced Scaffolder in erecting, dismantling and alteration of scaffold
- Assists in supervising trainee and Part A scaffolder in erection, dismantle and alteration of scaffold
- Erects and dismantles basic type of scaffold such as independents, birdcage, tower, loading bay, Protection fan, Truss out, Bridge scaffold and Beam scaffold
- Assists in material handling and housekeeping onsite

Be able to understand:

- The correct and safe methods of erecting, altering and dismantling independent scaffolds incorporating prefabricated beams, loading bays, splays/radials, protection fans and cantilever sections
- To determine the material requirements for independent scaffolds incorporating prefabricated beams, loading bays, splays/radials, protection fans and cantilever sections
- To lay out materials, interpret simple drawings, set out the scaffolds and overcome obstacles to erect the scaffold safely
- To construct scaffolds following safe systems of work
- To rescue from height and have impact from suspension trauma awareness

Basic scaffolder shall not erect, dismantle and alteration complex and special purpose scaffold unless under supervision of a Complex or an Advanced Scaffolder.

4. Complex Scaffolder (Advanced).

The main role of a Complex or Advanced Scaffolder is to supervise the basic scaffolders to carry out the erection, alteration or dismantling of scaffolds. As an Advanced scaffolder, he must be capable to perform the scaffolding activities as listed below:

Be able :

- To use correct and safe methods of erecting, altering and dismantling false work scaffolds, shoring scaffolds, cantilever drop, staircases, ramps and truss out scaffolds in tube and fitting

- To demonstrate skills to progress towards competence for the safe erection, alteration and dismantling of complex scaffold structures
- To use Procedures for producing, interpreting and using risk assessments and methods statements.
- To determine the material requirements for false work scaffolds, shoring scaffolds, cantilever drop, staircases, ramps and truss out scaffolds in tube and fitting
- To lay out materials, interpret design drawings, set out scaffolds and overcome obstacles to erect the scaffold safely
- To construct scaffolds to statutory regulations following the safe systems of work set out in safety guidance note 4
- To rescue from height and have impact from suspension trauma awareness

5. Scaffold Supervisor

- He is responsible for the supervision of multiple scaffolding crews in performing the erection, alteration, modifications and dismantling of scaffold
- He is responsible for pre-planning work schedule and material movement of tasks and must be capable of carrying out the work scope of a Complex or an Advanced Scaffolder
- He must have good supervisory ability and able to lead and arrange groups of scaffolders for scaffolding activities onsite
- He must adopt construction industry best practice to supervise the day to day process of managing the scaffold phase of construction projects
- Safe Systems – understanding and implementing safe systems of working
- Risk Assessments – producing, interpreting and using
- Method Statements – producing, interpreting and using
- Tool Box Talks - Delivering safety briefings and identifying promoting the key elements
- Estimating – how to estimate the materials required for each individual scaffold project
- Scaffold Drawings – reading and understand scaffold related drawings
- Rescue from height and have impact from suspension trauma awareness

6. Scaffold Inspector

- The responsibility of a scaffold inspector is to inspect the erected and modified scaffold to ensure the scaffold is safe to be used and meet with all the requirements
- Inspector will inspect the scaffold based on the scaffold checklist to ensure the scaffold have been inspected accordingly
- State the current specifications and limitations relating to scaffold materials
- Identify and explain the various types and uses of scaffold fittings
- Inspect and identify the most common defects which may occur in scaffold materials

6a. Basic Scaffold Inspector

He must have the knowledge and an understanding of scaffolding components, forms of construction and inspection procedures of basic access scaffolds to comply with relevant current legislation and industry guidance

He must be able to demonstrate a thorough understanding of:

- Industry Best Practice
- Scaffolding Components
- Scaffolding terminology
- Access Requirements
- Scaffold ties
- Construction regulations and recommendations of basic scaffolds to include:
  - independent
  - birdcage
  - towers
  - system scaffolds
  - fans
- Practical inspection
- Reports

6b. Complex Scaffold Inspector

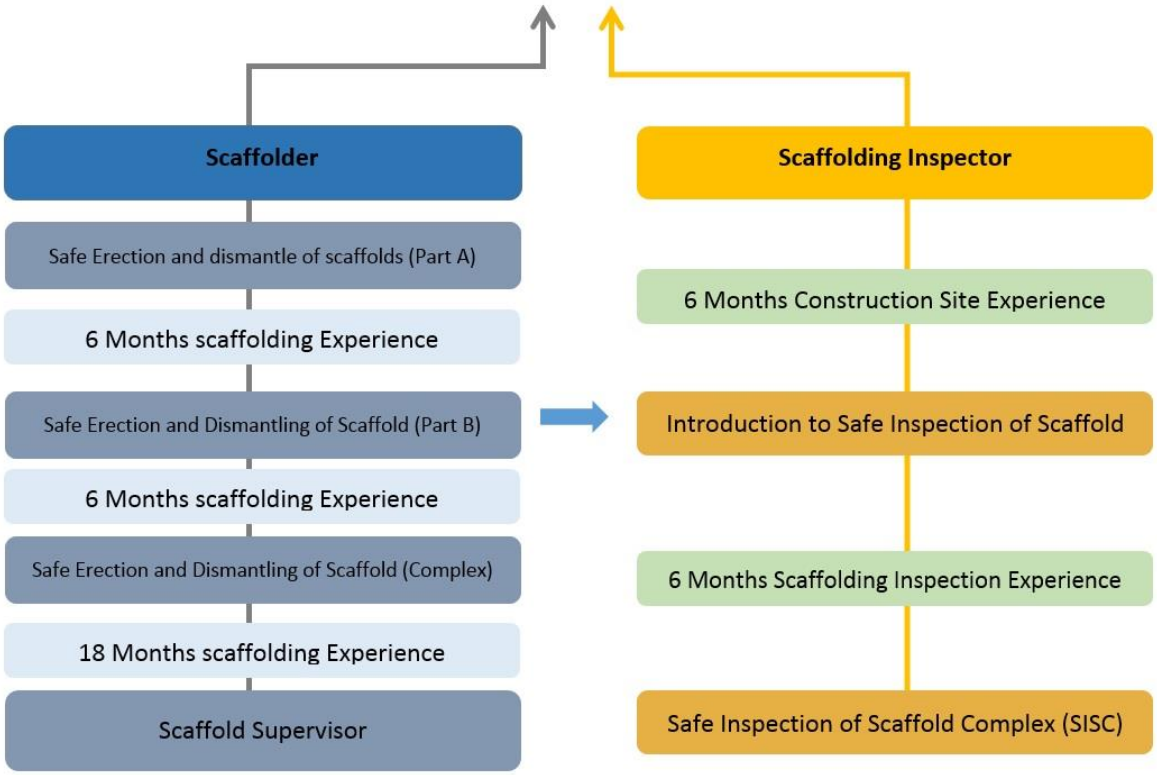
He must have the knowledge and an understanding of the appropriate safety regulations and the ability to interpret design

specifications and statutory regulations when inspecting complex/designed scaffolding structures for faults

He must be able to demonstrate a thorough understanding of:

- Industry Best Practice
- Scaffolding components and terminology
- Basic inspection
- Construction of complex/designed scaffolds including:
  - Interpretation of design drawings
  - Staircase scaffolds
  - Cantilever drop/truss out scaffolds
  - Slung scaffolds
  - Shoring
  - Temporary building protection scaffolds
- Inspection
- Reports

TRAINING & COMPETENCY PROCESS MAPPING



Basic 1 Scaffolder

To become a Basic 1 Scaffolder, a trainee shall have at least 6 months onsite scaffold experience. Assessment will be made, based on the competency of the workers to become a Basic 1 Scaffolder. Upon the confirmation of the competency, the trainee shall undergo and pass Basic Part A course.

Basic 2 Scaffolder

To become a Basic 2 Scaffolder, a Basic 1 Scaffolder shall need at least 6 months onsite scaffold experience. Assessment again is required to determine the potential of the Scaffolder's competency to become Basic 2 Scaffolder and shall undergo and pass Basic Part B course.

Advanced Scaffolder

An Advanced Scaffolder shall have at least 6 months of onsite scaffold experience as Basic 2 Scaffolder and has been assessed on the competency to become Advanced Scaffolder. He shall attend Complex/advance course and passed both theory and the practical part of the course before he becomes a competent Advanced Scaffolder.

Scaffold Supervisor

Scaffold Supervisor should have at least 18 months of onsite experience as an Advanced Scaffolder. Before being upgraded to Scaffold Supervisor, he shall attend and pass the Scaffold Supervisory course.

APPENDIX H – SCAFFOLD TYPES GENERALLY FOUND IN BRUNEI

Below are some pictures of scaffold structures generally found in Brunei, courtesy of *Mashhor Scaffolding:-*

Figure 1 (a) - Static Tower Scaffold using Tubes and Clamp for Pipe Support

Figure 1 (b) - Static Tower Scaffold for General Purpose

Figure 2 - Mobile Scaffold using Tubes and Clamps

Figure 3 (a) – Independent Scaffold using Tubes and Clamps for Piping and Structure Construction

Figure 3 (b) – Independent Scaffold using Tubes and Clamps for Building Construction

Figure 4 – Bird Cage Scaffold using Tubes and Clamps

Figure 5 - Sheathed Scaffold

Figure 6 (a) – Independent Scaffold using Tubes and Clamps for Tank

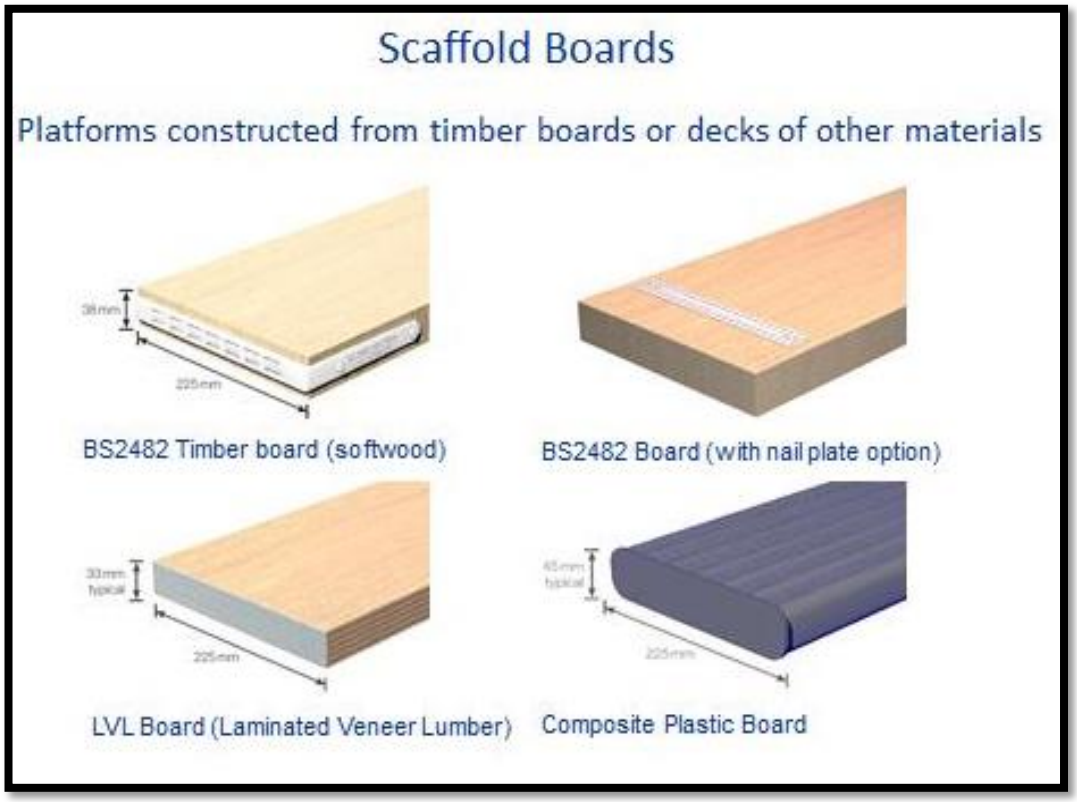
Figure 6 (b) – Independent Scaffold using Tubes and Clamps for Tank

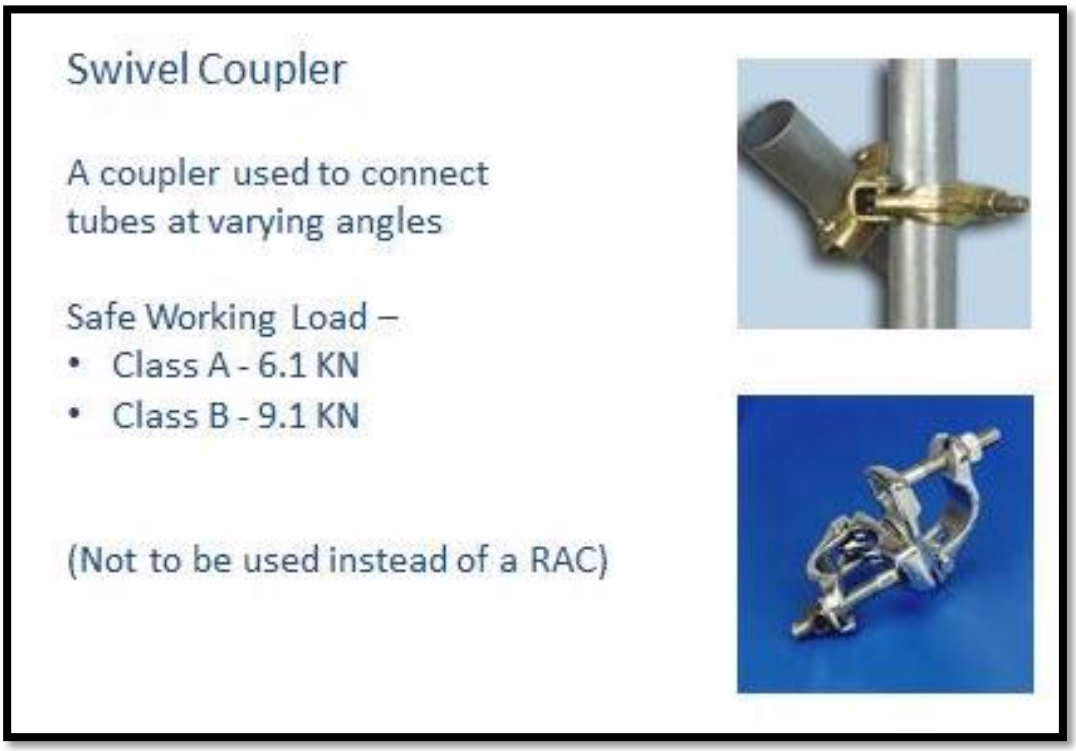
Figure 7 – Cantilever Scaffold using Tubes and Clamps

Figure 8 – Combination of Bird Cage, Cantilever and Circular Scaffolding using Tubes and Clamps

APPENDIX I – SCAFFOLDING FITTINGS AND ANCILLARY EQUIPMENT

Below are some pictures of scaffold fittings and equipment, courtesy of Megamas Training Company Sdn. Bhd.:-





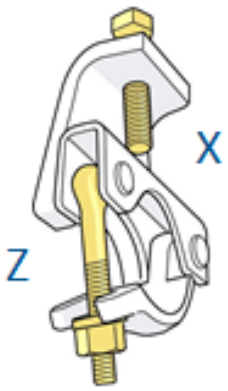
Girder Couplers

Girder Coupler

Must be used in opposing pairs.

Safe working slip load varies depending upon application:

- Axis X = 10kN
- Axis Z = 6.5kN



Scaffold couplers/fittings

Base Plate

- Minimum Dimension - 150mm x 150mm x 5mm
- Shank - 50mm

Right Angle Coupler

A coupler used to connect tubes at right angles to each other.

Safe Working Load –

- Class A - 6.1 KN
- Class B - 9.1 KN

Putlog Coupler (Single)

A coupler used to connect transoms or putlog tubes to the ledgers.

Safe Working Load - 0.63 KN

A putlog coupler is NOT a load bearing fitting.

Sleeve Coupler

An external coupler used to connect tubes end to end.

Safe Working Load

- Class A - 3.6 KN in tension
- Class B - 5.5 KN in tension

Ancillary Equipment

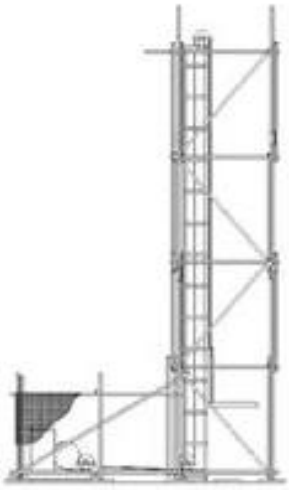
All lifting equipment should be used, examined and inspected in accordance with ACoP.

All gin wheels, ropes and accessories for lifting, including bags and buckets, must be identifiable and regularly inspected.

Ancillary Equipment

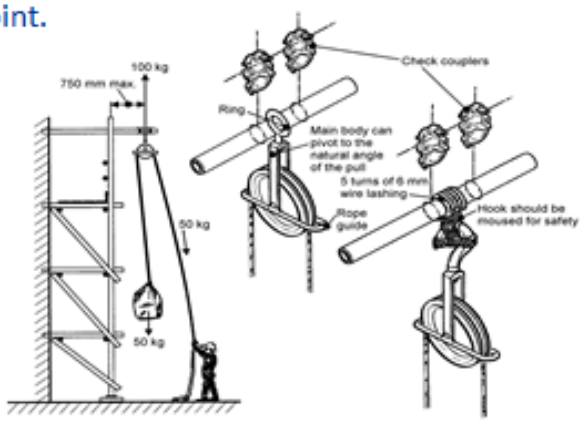
Gin Wheel & Rope

Goods Hoist (including Saga Hoists)



Gin Wheel Installation

- The suspension point of a gin wheel should be no more than 750mm beyond the outer standard.
- Ring type gin wheels should be secured with right angle couplers either side of the suspension point.
- Ideally the suspension tube should be supported on two standards extending above the working lift.
- If a joint occurs on the inner standard a sleeve coupler should be used.



Acknowledgements

We would like to extend our gratitude to the Minister of Energy, the Permanent Secretary (Energy) and industry experts for their cooperation and contribution in the publication of these Guidelines for the Safe Use of Scaffolding.

Last but not least, we also wish to thank those who have contributed directly or indirectly in the publication of these Guidelines for the Safe Use of Scaffolding.

Website: www.shena.gov.bn

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