Department of Justice and Attorney-General

Workplace Health and Safety Queensland

Steel construction

Code of Practice 2004

This Queensland code of practice was preserved as a code of practice under section 284 of the *Work Health and Safety Act 2011*.

This code was varied by the Minister for Education and Industrial Relations on 27 November 2011 and published in the Queensland Government Gazette on 2 December 2011.

This preserved code commences on 1 January 2012.

PN11187

Contents

1. Introduction

This *Steel Construction Code of Practice* 2004 is an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the Act and the Work Health and Safety Regulation 2011 (the Regulation).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the Act and Regulation. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the Act and Regulation may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

How is the code organised
In providing guidance, the word ‘should’ is used in this Code to indicate a recommended course of action, while ‘may’ is used to indicate an optional course of action.

This Code also includes various references to provisions of the Act and Regulation which set out the legal requirements. These references are not exhaustive. The words ‘must’, ‘requires’ or ‘mandatory’ indicate that a legal requirement exists and must be complied with.

Who has duties?
A **person conducting a business or undertaking** has the primary duty under the Act to ensure, as far as reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

Officers, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the Act and Regulation. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to provide and maintain a safe work environment.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace.

Consulting workers

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

The Act requires that you consult, so far as is reasonably practicable, with workers who carry out work for you who are (or are likely to be) directly affected by a work health and safety matter.

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

You must consult your workers when proposing any changes to the work that may affect their health and safety.

Consulting, cooperating and coordinating activities with other duty holders

The Act requires that you consult, cooperate and coordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

Sometimes you may share responsibility for a health and safety matter with other business operators who are involved in the same activities or who share the same workplace. In these situations, you should exchange information to find out who is doing what and work together in a cooperative and coordinated way so that all risks are eliminated or minimised as far as reasonably practicable.

Further guidance on consultation is available in the *Work Health and Safety Consultation, Coordination and Cooperation Code of Practice.*

1.1 Risk and steel construction

This code of practice provides advice aimed at preventing the risk of injury or death to persons undertaking steel construction and other persons at the workplace.

1.2 What is steel construction work?

Steel construction is any work to erect assembled portions and single components of structural steel, such as:

- columns
- beams
- bracing
- rafters
- purlins
- girts
- bridging and fly bracing
- trusses

- other related steelwork, for example, free standing structures.

2. Control of risk through planning

2.1 Planning to control risk

Planning is an effective control measure for preventing the risk of injury or death arising from steel construction. Designers, principal contractors, erectors and fabricators have an important role in planning the work.

2.2 **Work Health and Safety (WHS) management** plans and safe work method statements

Chapter 6 of the Regulation sets out the requirements for preparing WHS management plans and safe work method statements. The contents of a WHS management plan are listed in Chapter 6 of the Regulation. A WHS management plan must be prepared before any construction work starts. The contents of a safe work method statement are listed in Chapter 6 of the Regulation. A safe work method statement must be prepared before any high risk construction activity starts. Chapter 6 of the Regulation describes what is meant by 'high risk construction activity'. The term 'construction work' is defined in Chapter 6 of the Regulation and is included in Appendix 5 of this code.

2.3 Who must prepare WHS management plans and safe work method statements?

Chapter 6 of the Regulation prescribes the requirements for who must prepare WHS management plans and safe work method statements. A principal contractor must ensure that a WHS management plan is prepared before construction work starts. A PCBU must prepare or direct the preparation of a safe work method statement for a high risk construction activity.

This code of practice may be used to help persons identify what control measures need to be written into the WHS management plan or safe work method statement when a risk of injury arising from steel construction has been identified.

2.4 Factors to be considered in planning

The designer, principal contractor, fabricator and the erector must hold discussions about the structure to be erected. The discussions should address the hazards, associated risks and control measures that will be implemented during the steel construction work and cover all phases of the project. In addition to the risks of falls from heights, falling objects and the stability of structure, the discussion should consider other factors such as the sequence and the method of erection, in particular:

(a) access to work areas where erection is taking place
(b) location of other trades relative to the erection work
(c) restricted areas and the need for barricades
(d) criteria for safety e.g. sequential erection.

Further details, available in **'Appendix 1 - Example of risk management in steel construction - Falls from heights'**.

2.5 Designers

It is critical that the designer considers the safe erection of the steel structure and provides guidance to the steel erector. This is particularly important with modern designs where 'limit state' design techniques are used by the designer. In this system the design engineer considers the structure in its completed form with all the members and bracing installed. The structure can then withstand much higher loads, e.g. wind and other live loads, than when the structure is in the construction stage. With this in mind it is necessary for the designer to provide guidance to the steel erector on how the structure will remain standing as it is built.

An effective planning process enables a designer to eliminate risks at the design stage before steel construction work starts. Designers should, for example, take into account the safe work methods to be used during erection. Areas that should be considered at each design stage include:

(a) The stability at all stages of erection of the assembled portions and single components.
(b) Maximum permissible wind speed for erecting the steel structure.
(c) The effect of the erection sequence on stability.
(d) An assessment of loadings at all stages of construction.
(e) The safe access and working environment.
(f) The ease of connecting components, for example the provision of landing cleats.
(g) Clear instructions for the requirement of temporary bracing. Where it is recognised by the design engineer that temporary bracing will be required, it should be detailed on the drawings so that the erector can make provision for such bracing and riggers do not have to access an unstable structure.
(h) The handling, lifting, storing, stacking and transportation of components depending on their size, shape and weight. Identifiable lifting points and component weights should be specified. For sub-assemblies, it is critical that overall weight and lifting points are identified on all drawings for example, design drawings and as-built drawings.
(i) The requirement for specific lifting arrangements to be detailed on structural member drawings to facilitate safe lifting.
(j) The information required for safe erection of the structure. This information should include any special conditions. Special conditions relating to the safe erection of the structure should be highlighted on all documentation at the pre-contract stage, for example, the need for temporary bracing/guying or the use of mobile access platforms.
(k) If the erection technique involves the use of a 'rigger's post system', verification that the structure can withstand the loadings that may be applied by these.
(l) The grades of steel including bolts and means for fabrication of components such as welding, are in accordance with relevant 'Standards', and
(m) Consider the option of assembling the unit on the ground to reduce the number of fixings or connections made when working at heights.

2.6 Principal contractors

Factors that should be considered by the principal contractor when planning the project include:

(a) The number of contractors. Where a number of contractors are to be employed on the project and there is a likelihood of injury because of the actions of any one

contractor, planning should provide for sufficient physical or time separation to ensure the work by each contractor can be carried out safely.

(b) The scheduled time frames for steel construction. The scheduled time frames should provide enough time for the steel to be constructed in a safe manner.

(c) The frequency of site meetings to discuss health and safety issues on site. The timing of site meetings should ensure safe working practices are developed, implemented and maintained by all contractors as the various phases of the project are reached.

(d) How any modifications to the structural building layout, or any other additions, substitutions or remedial work considered necessary, will affect the WHS management plan, and

(e) How the accuracy of each PCBU's work will be reviewed to determine if it complies with the required level of safety specified in the WHS management plan. Where the accuracy is not specifically detailed, the tolerances to the relevant code should be used. Failure to ensure the integrity of each PCBU's work could lead to unsafe working conditions by other contractors working on the project and may compromise the stability of the building or its component parts especially during erection.

2.7 Fabricators

A fabricator is a PCBU who fabricates structural steel components for buildings and other structures. When planning the work the fabricator should take into account:

(a) The sequence for delivery of each stage of the structural steel

(b) The need for locating numbers to be clearly marked on steel components. This will allow the components to be easily identified for the sequence of erection. Consideration should also be given to identifying the lifting points on steel components to allow loads to be lifted in a safe manner

(c) How members will be supported and their ends tied and held to prevent uncontrolled movement of the steel while it is being loaded, transported, unloaded, moved and located, and

(d) Marking of steel members with their mass - steel to be marked should be determined after consultation between the steel erector and the steel fabricator.

2.8 Erectors

An erector is a PCBU who erects structural steel components for buildings, and employs a person experienced in the erection of structural steel, licensed as a 'rigger'. When planning the work, the erector should take into account:

(a) The method to be used when erecting the structure. The method should be developed in accordance with the drawings, specification following discussions with the designer and the principal contractor.

(b) How the structure will be erected paying particular attention to bracing bays and temporary bracing.

(c) Plant to be used for the work. Consideration should be given to indicating the size, type, position and coverage of the proposed erection crane(s) on a site plan. In addition, locations such as unloading points and storage areas (if any) should be shown. Consideration should be given to the required crane usage in the overall plan including access, working radii and boom clearances.

(d) The stability requirements for all components of the structure.

(e) The proposed methods for handling components.

(f) The possibility for pre-assembly, on the ground, of members prior to installation and the movement and location of heavy members, and
(g) That ground conditions are suitable to allow plant to be moved and used in a safe manner at the workplace. For example, in muddy conditions an operator may lose control of a mobile crane when driving to a new location at the site.

3. Work systems

3.1 Prioritise control measures

The primary risks to the health and safety of persons involved in steel construction work are falls from heights, falling objects, collapse of the structure and plant engaged in the steel construction work. Risk management plays an important role in the management of workplace health and safety. It is a logical and systematic approach which can result in a reduction in the incidence of injury and illness. **Appendix 1 – 'Risk management in steel construction – falls from heights'**, provides detailed information on this issue.

The control measures implemented to address these risks should be implemented in priority order. This is called the 'hierarchy of control'.

The primary task is to determine whether the risk can be eliminated. Where this is not possible, substitution for a less hazardous method should be considered. If this is not possible, consideration should be given to each of the other controls, isolation/engineering controls, administrative controls and as a last resort; the use of personal protective equipment (PPE). These should be considered in turn, starting with substitution and working down to the use of PPE. This should occur until a control or combination of controls are identified which can then achieve the required reduction in risk.

3.2 Working at heights

The Regulation prescribes the requirements for controls to be in place where a person can fall from one level to another that is reasonably likely to cause injury to the person or to any other person (see part 4.4 and chapter 6 of the Regulation).

3.3 Risk of a person falling from one level to another

A person may be exposed to the risk of injury and death from a fall of any height and principal contractors, PCBUs, and workers all have duties under the Act where a person can fall from one level to another (see part 2 of the Act).

3.4 Controls to prevent falls from heights

The control measures to prevent death or injury from a fall should be in place before work commences. Persons carrying out steel construction at a height may be exposed to the risk of death or injury from falling. Several control measures are available in these circumstances, and more than one control measure may be necessary. Ground level prefabrication should be considered as a fall prevention strategy. To reduce the need to work at heights, some alternative means of erection are:

(a) Construct as much of the steelwork as possible at ground level or from erected floor slabs or decks in the structure. This should be taken into consideration when planning the work
(b) Where possible, the lifting sling or device should be released from floor level by the use of long slings, remote release shackles or other suitable devices (refer to ***Figure 5*** in section 4.3.5, ***'Erecting steel components – Columns'***), and
(c) The use of fall-arrest harnesses is not the preferred control measure for persons working on steel construction as these do not actually prevent a fall from occurring. Wherever possible and practicable the use of a method which reduces the risk of a person falling, e.g. perimeter guardrail, elevating work platforms (EWPs), should be selected.

Control measures that may prevent the risk of death or injury from falls from heights include:
(a) work platforms
(b) fall prevention systems
(c) fall arrest system
(d) edge protection systems
(e) fall protection covers.

3.5 Work platforms

3.5.1 Fabricated working platforms

These platforms can be used in many locations as they can be designed to fit a variety of beam and column configurations.

A work platform should be secured against uplift or displacement to a structure and installed with edge protection systems. The area of the platform should be of a size and strength to carry the tools, materials and persons required to work from it.

Working platforms should be designed by an engineer and should not be less than 450 mm in width or length.

3.5.2 Elevating work platforms (EWPs)

An elevating work platform means a telescoping, scissor or articulating device or any combination thereof used to position personnel, equipment and materials at work locations, and to provide a working area for persons elevated by and working from the platform.

EWPs include scissor lifts, boom lifts and truck mounted EWPs (travel towers). EWPs are primarily designed so that a person may work at an elevated position, on a structure from within the confines of the EWP platform or basket.

EWPs are regularly used for steel construction. They provide an efficient access system and are preferable to other methods that involve the use of fall-arrest systems, because they reduce the risk of a fall occurring. Both boom lifts and scissor lifts are used in steel erection.

EWPs are used as access for workers to help position steelwork as it is being lifted by a crane. They are also used by workers when installing and tightening bolts.

EWPs are not specifically designed for a person to move from the platform to gain access onto another elevated surface, although they are sometimes used in this application instead of other more conventional forms of access, such as scaffold stair access towers.

In some situations EWPs may not be suitable for providing access/egress onto a roof or structure due to factors such as the following:

- The number of workers required to access the roof/structure may be in excess of what an EWP could safely transport in the event of having to provide emergency evacuation from the roof/structure.
- The platform on the EWP can move as the person gets in and out with the potential for the person to fall through the gap – when the platform is beside the roof/structure.
- There is a possibility that the EWP can be removed from the access area while persons are located at height.
- The stability of the unit relies on firm and level ground. This is not the case on some construction sites, and
- In comparison with stair access, an EWP is not available for access at all times because it takes time to raise and lower persons. This issue becomes a greater problem when more workers are required to work on the roof or structure.

Where an EWP has been selected to provide access for workers onto a roof/structure the system of access should be safe. Factors that should be ensured include the following:

- The EWP should not be used for any other purpose and should not be driven away from the building.
- The area around the EWP should be free of vehicular traffic.
- The ground condition should be suitable for the use of the EWP.
- The EWP should not be used near live electrical power lines.
- Boom-type EWPs with a boom length of 11 metres or more require a licensed operator to operate the unit, or the operator should be directly supervised by the holder of a licence.
- All operators of EWPs should be competent and adequately trained.
- A competent person should be available at ground level to lower the platform in case of malfunction.
- Where the EWP platform is raised so that it is next to the roof/structure edge, the gap between the landing and the platform should not exceed 100 mm.
- The platform should be secured against sideways movement as necessary (i.e. the platform should not move as workers get on and off – this may be more of an issue with smaller EWPs). Where the platform is secured, it is preferable to use a restraint system that does not snag on the building when the platform is lowered, and
- Safe access and egress should be provided by either one of the following:
  (a) A guardrail system at roof/structure level that extends at least 1.5 metres either side of the gate on the platform of the EWP. The gate on the EWP should be inward opening so that workers are not required to climb over the top of the guardrail.
  (b) The use of a safety harness by workers, or a system that will prevent a worker, who is entering or leaving the EWP, from falling off or through the structure.

This may require the use of a ‘double lanyard’ system. On a steep roof workers should be provided with a means to prevent them sliding down and/or off the roof.

All persons in boom-type EWPs should wear a full body harness and energy absorber type lanyard attached to an anchorage point in the basket of the EWP.

In some situations EWPs may be used to lift lighter steelwork, e.g. purlins, girts and bridging, where the EWP manufacturer states that this is an acceptable practice.

The following points should be noted when lifting steelwork with an EWP.

- Total load on the EWP including workers and materials must not exceed the ‘rated capacity’, sometimes referred to as ‘safe working load’ (SWL), of the platform.
- Steelwork must not be loaded so that it will damage the EWP in any way or become imbalanced.
- Where an EWP is used to lift steel components, the steelwork should not be loaded onto the EWP guardrails, as this may damage the guardrails or allow the steelwork to roll off the platform. A ‘purpose built’ cradle to hold the steelwork should be used. Cradles should be designed by a competent person and not make the operation of the EWP unsafe in any way.
- A ‘purpose built’ cradle, used in conjunction with a crane, should be considered to install steelwork.
- The EWP must never be used to force the steelwork into place, this places excessive load on the unit.
- The working surface for the EWP must be level, firm, have clear access and no step up or step down on the floor slab.
- EWPs used for steel erection must be rated for outdoor use and the effects of wind loading must be considered.
- Workers in boom type EWPs must use full-body harness with an energy absorber type lanyard attached to an anchorage point in the basket of the EWP.

3.5.3 Temporary working platforms

These platforms can be fitted to members at ground level before erection or lifted into position following the erection of steelwork.

3.5.4 Work boxes

A work box is a personnel-carrying device designed to be suspended from a crane, which provides an elevated working area for persons working from the box. Persons using a workbox should be attached, at all times, by a full body safety harness, lanyard and energy absorber to a suitable anchorage point located within the workbox or to the main sling ring above the workers heads. Fall arrest attachments must not be placed in the throat of the lift hook. Where a workbox is used, at least one person in the workbox must be competent in crane signals, for example a dogger.

3.5.5 Design

Workboxes should be specifically designed for that purpose and:

(a) have slings permanently attached by locked shackles or a hammer lock device

(b) have a factor of safety of each suspension sling of at least 8 for chains and 10 for wire rope
(c) be marked with the 'rated capacity', tare mass of the workbox and identification reference
(d) have sides with a height of at least one metre in height
(e) if provided with a door, should be inward opening only, self closing and be provided with a latch to prevent accidental opening
(f) should only be used to lift persons and their equipment.

3.5.6 Lifting of work box

Where a crane is used to lift work boxes, the crane should:
(a) be fitted with a hook that has a spring loaded operable latch to prevent inadvertent release of the load
(b) be fitted with a functioning over hoisting device such as an anti-two-block
(c) be equipped with a dead-man control on power lowering to produce self-centring and automatic brake engagement
(d) be equipped with a lockout control on the crane free fall function to prevent free fall of the lift box and its contents
(e) at the maximum radius of the task to be performed, have a minimum 'rated capacity' of 1000kg, and
(f) have a minimum 'rated capacity' of at least twice the total load of the workbox and its contents, at the maximum radius for the task to be performed.

3.5.7 Crane operator

Where a crane is used to lift work boxes, the crane operator should:
(a) remain at the controls of the crane at all times while the work box is occupied by a person
(b) ensure that the work box and its contents are moved under powered conditions, at all times.

Guidance on the design and safe use of workboxes and cranes is also provided in *AS 1418.17 Cranes (including hoists and winches) – Design and construction of workboxes* and *AS 2550.1 Cranes, hoists and winches – Safe use – General requirements.*

3.6 Fall-prevention systems

Personal fall-prevention systems that do not allow a person to get into a falling situation are preferred over those that arrest a person once the person has fallen. These are travel restraint devices where a person is tethered to an anchorage point to restrain the person from reaching an unprotected edge. The anchorage points should be capable of supporting the load.

Figure 1. Fall arrest harness

3.7 Fall-arrest systems

A fall-arrest system is designed to arrest the fall of a person. It consists of a full fall-arrest harness connected to a lanyard assembly and attached to a fall-arrest static line or an anchorage point where there is a risk of free fall.

The use of fall-arrest harnesses is not the preferred control measure for persons working on steel construction as these do not actually prevent a fall from occurring. Where ever possible and practicable select a method which reduces the risk of a person falling, e.g. perimeter guardrail, EWPs.

The *How to Prevent Falls at Workplaces Code of Practice* states the requirements for construction work where there is a risk a person could fall, including the requirements for the use of 'travel restraint' and 'fall-arrest harness' systems.

Australian/New Zealand Standard series *AS/NZS 1891 Industrial fall-arrest systems and devices* provides guidance on all aspects of fall-arrest systems and should be consulted before installing or using any fall-arrest system.

The use of a fall-arrest harness system has limitations.

- There can be difficulties finding or designing anchorage points that will have adequate capacity to resist fall-arrest loads. Individual fall-arrest anchorages require a capacity of at least 15 kN (i.e. suspending a load of 1.5 tonne), and static lines require anchorages with higher strengths.
- Locating fall-arrest anchorages points on frames is not ideal because the frame is usually the highest part of the building. As anchorage points generally cannot be located directly above head height, the distance a person falls will be greater.
- Most manufacturers of fall-arrest inertia reels state that the reel is to be located directly above head height, with the user working in a small arc below the device – this can rarely be achieved on steelwork.

- In the event of a fall, the fall-arrest line can sometimes come in contact with an edge, and may fail in some situations.
- The system requires substantial clearance distances below the working surface to ensure that the worker does not hit the ground or other obstruction prior to the fall being arrested.
- The system requires high levels of training and supervision to ensure its safe use. It will also require the active participation and co-operation of users to operate effectively.
- Ropes and lanyards can become entangled and snagged on obstructions. This can be a particular problem when a number of workers are on the work area.
- It can be difficult to have an effective rescue procedure to ensure users are rescued before injury occurs, without putting others at risk. Persons suspended in harnesses after falling can lose consciousness or suffer modified cardiac rhythm if not rescued promptly.
- Even when a system is set up correctly, a person using it may be injured. The system does not prevent a fall from occurring – rather, it prevents the user from colliding with the ground or an obstruction underneath. The user may still receive some injury as a result of the fall due to factors such as:
    (a) swinging into an obstruction prior to the fall being arrested
    (b) falling in an unusual manner (e.g. sideways) so that the fall-arrest force is not transmitted to the body in the best possible manner, and
    (c) the harness not operating as designed because the user is in an irregular shape (e.g. obese).

Fall protection may be provided by the use of fall-arrest harnesses where other control measures cannot be used. Fall-arrest harnesses, lanyards and static lines provide a degree of fall protection, provided the following points are taken into account:

(a) All persons who may be exposed to the risk of falling, e.g. riggers, should be properly trained and supervised in the use of the equipment.
(b) All persons who may be exposed to the risk of falling, e.g. riggers using fall protection such as a fall-arrest harness, should not work in isolation.
(c) A lanyard assembly should be as short as possible and the working slack length not more than 2 metres, to minimise the pendulum effect.
(d) The fall-arrest anchorage point should be located so that the lanyard can be attached before the user moves into a position where they would be at risk from a fall. Anchorage points should have a force capacity of 15kN for a single person. Static line anchorages require greater capacities.
(e) Travelling anchorages should also be located so that the lanyard can be attached to a travelling anchorage before the user moves into position, and
(f) The components of a fall-arrest system should be compatible. The use of non-compatible components could lead to ineffective equipment that presents a risk of the user being injured from a fall.

3.7.1 ‘Rigger’s post’ systems

‘Rigger’s post’ is a term used to describe posts that are used as anchorages for a horizontal fall arrest line (static line). These are often set up along the top of portal frame steel structures and are intended to arrest any potential falls from the steelwork. There has been an increase in the use of riggers posts with some systems being fabricated by steel erection companies. These systems should be verified as ‘fit for

purpose' as there may be a risk of failure of such systems or the supporting structure in the event of a fall occurring.

Fall arrest loadings on end anchorages can be extremely high due to shock loading that can result when a user has a 'free fall' and due to other factors such as triangulation of the load.

In addition to high loadings a fall arrest line must stop a person's fall before hitting the ground or another obstruction. Although systems that use synthetic rope or webbing reduce end anchorage loadings, they require greater vertical clearances underneath the line because of extra stretch and can cause additional bounce. In some situations more than 8 metres may be required underneath the line.

Prior to using a rigger's post fall arrest system on a building under construction the building designer should be consulted to determine if the structure is strong enough to support the system, while the building is being erected. The designer should be made aware of the proposed locations of the rigger's posts and at what stages of construction these are to be installed.

If the designer states the structure cannot safely support the rigger's post system, alternative methods of construction such as the use of elevating work platforms should be considered.

Static line systems should be verified by a competent person to be safe and without risk to health when used properly. Any verification should include all parts of the fall arrest system, as used on site, and not parts in isolation. For instance, a rigger's post may be very strong in itself, but if the supporting framework or method of attachment is structurally inadequate the system may fail when a person falls.

Verification should include:

- the design of the rigger's post and the method of attaching the static line to the post
- the method of attaching posts to the supporting structure
- the minimum strength of the supporting structure (the designer may wish to specify a minimum steel section size for attaching the posts – support provided to the steel section would also need to be considered)
- the specification of the static line – material type, size, pre-tension etc
- the maximum span of the line between posts
- the minimum amount of vertical clearance required underneath the line
- the maximum number of persons to be using the line at any one time.

Australian/New Zealand Standard *AS/NZS 1891.2 Industrial fall-arrest systems and devices – Horizontal lifeline and rail systems*, provides guidance on the design and testing of static lines. One means of verification would be for a suitably qualified engineer to verify the design of the rigger's post and static line system complies with the requirements of the Australian Standard.

Where testing is selected to verify the system, it should reflect the way the static line is set up and used on site and be severe enough to demonstrate that the system will not

cause injury to the user. It is advisable for testing to be undertaken by an independent testing organisation that has experience in fall arrest equipment.

Any testing should demonstrate that the system does not fail in such a manner that a user will hit the ground or an obstruction.

Workplace health and safety inspectors may require verification for rigger's post or static line systems when visiting workplaces. It is advisable that documentation verifying the safe design of these systems is available on site.

When working with an extended line such as a fall-arrest system, there is a concern that if a worker fell and was suspended, injuries may result because the 'pendulum effect'. Where it can be anticipated that the work may have to be undertaken with the use of a fall-arrest system, planned anchorage points should be in place to help reduce the length of line that is to be connected to the rigger.

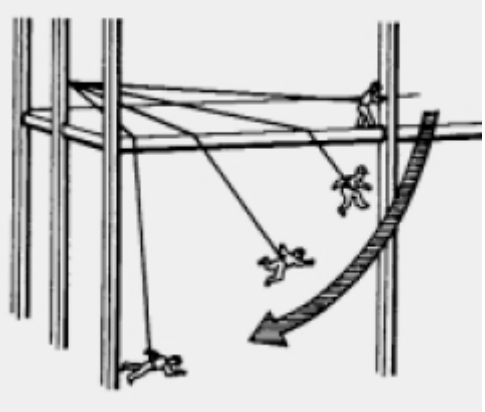

Figure 2. Pendulum effect

Figure 2 also shows the fall arrest line contacting an edge and in some situations the line may also fail.

3.8 Emergency recovery

A system must be in place to quickly retrieve fallen workers whenever a fall-arrest harness is used. Persons with responsibilities should ensure that adequate training and supervision are provided to allow effective recovery when required.

Research indicates that persons can lose consciousness or suffer modified cardiac rhythm in 2-12 minutes.

3.9 Edge protection systems

Edge protection consists of a system of rails, mesh, sheeting or other material used to prevent persons falling off a platform or other surface. Edge protection should consist of components designed to withstand the forces imposed upon them if a person fell against it, it should have a top rail or edge at least 900 mm above the platform or other surface.

Where mid-rails are used they should be placed between the top rail and the platform or other surface so that no more than 450mm exists between adjacent rails and must have either:

- a bottom rail fitted no more than 250mm or less than 150mm above the platform, or
- a toeboard for the platform that is at least 150mm high.

3.10 Fall protection covers

All holes and openings, other than lift shafts and stairwells should be protected to prevent persons falling. A fall protection cover is a protective structure placed over a hole or opening to prevent a person from falling through the hole or opening. A fall protection cover should be capable of supporting the impact of a person falling onto it.

Where a fall protection cover is used on an opening, it should be secured against movement and should not be used as a working platform. An example is metal mesh spread on top of purlins or battens to prevent persons from falling between the purlins or battens, the metal mesh should not be used as a working platform.

4. Falling objects

Work activities, such as working at heights and lifting loads over work areas are likely to produce falling objects. Work should not commence until controls are put in place to prevent the risk of injury to workers and other persons from falling objects. Refer to part 3.2 of the Regulation for the requirements for protection of the public from falling objects.

Control measures that should be used to prevent falling objects, and resultant injuries, in steel construction are:

(a) tool lanyards
(b) lift boxes
(c) securing the load
(d) containment sheeting
(e) toeboards
(f) exclusion zones.

4.1 Tool lanyards

A tool lanyard is a short rope or webbing used to secure tools and equipment to an anchorage point to reduce the risk of injury from a falling object. The tool lanyard may be attached to an anchorage point such as the person using the tool (see **Figure 3**), or around a column or beam.

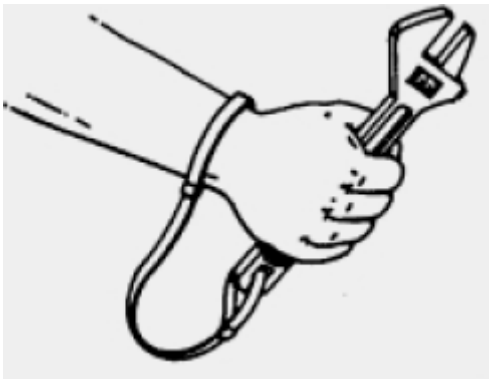

Figure 3. Tool attached by lanyard to wrist.

A lanyard should be made from material such as synthetic fibre, natural fibre or steel rope or webbing which will maintain the required strength and resistance to abrasion under harsh conditions. Consideration should be given to the length of rope or webbing used to secure a tool, especially if the tool is to be used near the edge of a working platform and other persons are working below. For example, a tool lanyard attached at the wrist should have a length no longer than 300 mm. This will ensure that if the tool is dropped, the lanyard would not allow the tool to hit a person working below. The length of the lanyard should also be kept to a minimum to reduce the risk of the line snagging as the worker moves about.

For example, a rigger who is erecting steel may secure working tools to his or her body by a lanyard to prevent a person below from being hit by a dropped tool.

4.2 Lift boxes

A lift box is a container suspended from a crane or hoist to transport plant and/or materials. It should be fully sheeted and enclose the load.

4.3 Securing the load

4.3.1 Wire ropes, chains and lifting slings

Chains and auxiliary fittings should be thoroughly cleaned and periodically inspected to determine whether any defects exist. Guidance on inspection criteria and intervals between inspections is provided in Australian Standards. A chain, ring, shackle, swivel, wire rope or similar gear should not be used for lifting any load if:

(a) the wear on any part exceeds an amount specified by the manufacturer, or
(b) any part is deformed, nicked, cracked, split or otherwise damaged.

Wire ropes should not be exposed to high temperatures because of the potential for heat to adversely affect the core. All lifting equipment should be stored according to the manufacturer's instructions. Further guidance may be obtained from Workplace Health and Safety Queensland publication – '*Guide for Doggers'*.

4.3.2 Safe storage and handling of steelwork

Steelwork should be stored on site in such a way that it cannot fall on workers or cause damage to buildings or plant. Where steelwork is stacked, the stacks should be stable and safe access should be available when workers are required to sling a load.

The effect of wind and the potential for mobile plant to come into contact with the stored steelwork should also be considered when deciding how and where steelwork is to be stored.

Where steelwork is strapped together caution should be exercised when releasing the strapping. The strapping may whip back and cause an injury or the bundle can fall apart and injure workers.

4.3.3 Lifting steelwork

Consideration should be given to the marking of the mass of steel members together with their protective coatings, if any, by the fabricator. This is particularly important where it is difficult to estimate the mass of the steel member and will enable the erector to select correctly designed lifting gear of appropriate capacity as well as the selection of a crane with adequate capacity. In situations where the material thickness cannot be easily determined, e.g. pipe that has its ends covered, the weight should be marked on by the fabricator.

Before lifting any steelwork, the rigger/dogger should sling the load to be lifted and, where appropriate, fix tag lines (see **figure 4**) to the ends of the load. When transferring lifts from a horizontal to a vertical position, care should be taken to avoid unrestrained movement of the lower end. The use of lifting beams may be necessary during lifting and positioning of some members to ensure member stability.

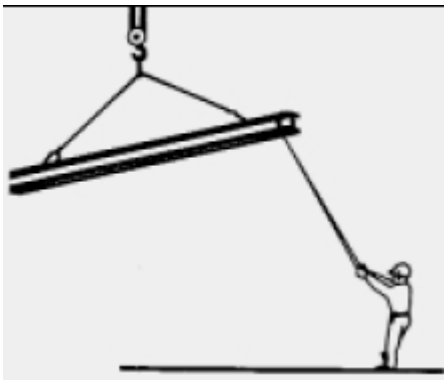

Figure 4. Tag line.

4.3.4 Lifting bundles of steelwork

The lifting of more than one steel member or bundles of steel at the same time, to one or more levels should only be undertaken where:

(a) lifting slings are designed to avoid steel members becoming entangled or dislodged from a bundle, or
(b) cradles for bundles of steel or decking are used.

4.3.5 Erecting steel components – columns

Free standing single columns or column assemblies should be secured by bolting the column base plate onto the column footing. Once the column has been securely anchored and is in as close to perpendicular position as possible and stabilised against overturning, the column lifting gear can be released.

Where possible, the lifting sling or device should be released from floor level by the use of long slings, remote release shackles or other suitable devices (see **Figure 5**). The use of an EWP may also be considered.

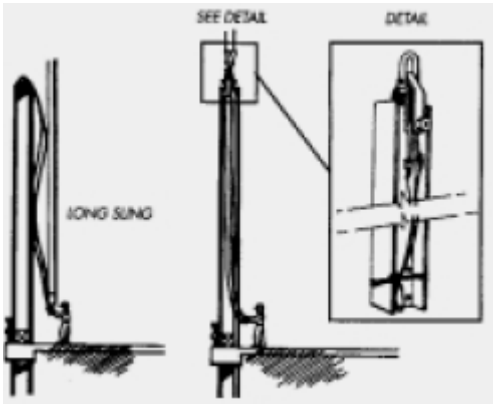

Figure 5. Remote release shackles

4.3.6 Erecting steel components – rafters

To minimise the potential for collapse, a rafter spanning between adjacent columns should ideally be erected in one length involving one crane and a single lift. However, where this is not possible, the rafter will need to be erected by using two or more cranes. The erector should consider the lifting stresses imposed on steelwork during erection. Where it is proposed to erect a rafter in a:

(a) 'single lift' - the rafter should be first bolted together on the ground at the ridge joint or possibly an intermediate joint. The rafter should then be fitted into position and bolted to the portal columns and end wall columns by riggers working from an elevating work platform, or

(b) 'multiple lift'- where the rafter needs to be joined while in position at its apex or an intermediate rafter position then the rafter to column connections can be made by the rigger working from an elevating work platform.

When lifting rafters consideration should be given to the use of lifting brackets (designed and certified by an engineer) attached to rafters, in preference to the use of chains or slings around the steel.

4.3.7 Erecting steel components – purlins

The preferred method for erecting purlins is by the use of riggers working from EWPs. Where this is not practicable and the method chosen requires riggers to work from the rafter steelwork this could be carried out with the use of a recognised, correctly installed and tested fall-arrest system, e.g. a rigger's post system (see section Fall-arrest system). Where it is chosen to work from the rafter steelwork (normally on buildings with a short frame spacing), individual purlins can be carried into position from the purlin bundle previously deposited at the base of the rafter slope. Purlins should always be carried up the rafter slope rather than down, as this is both easier and safer. Carrying purlins into position will normally involve two riggers, each attached to a fall-arrest system, working from adjacent rafters. Alternatively, where purlins cannot be safely carried into position, individual purlins may be lifted into position using mechanical equipment.

Where purlins cannot be erected directly from the rafter steelwork, an alternate method such as a crane can be used to raise and place them on the rafter beams. With this method, there is no need to unsling the bundle; each purlin can be lifted off individually at each cleat location so that there is no need to carry individual purlins along the rafter tops, riggers can then locate and attach the purlins working from an EWP or purlin cradle (see **Figure 6**).

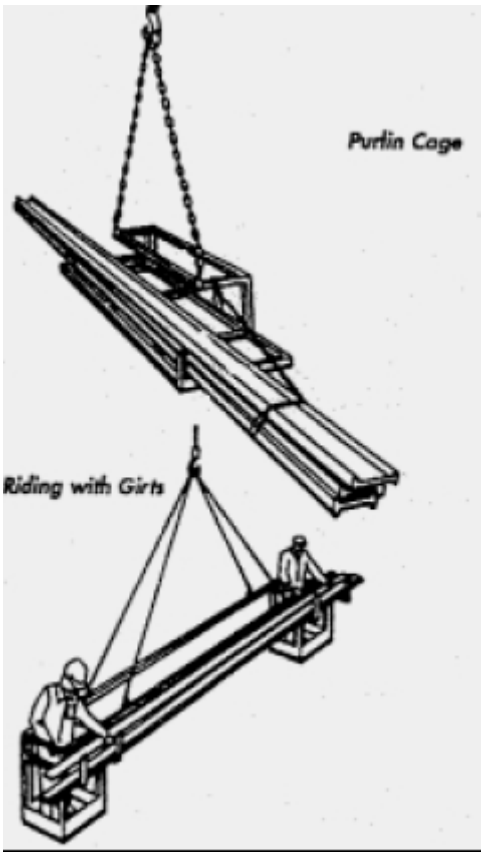

Figure 6. Example of purlin and girt cage/cradle

4.3.8 Erecting steel components – girts

Girts should be erected by a rigger working from within an EWP or combined access and lifting cradle (see **Figure 6**). Individual girts should not be carried by hand; rather they should be lifted into position by mechanical equipment.

To prevent girts falling from the structure, mobile scaffold towers or a combined access and lifting cradle should be used. With the latter, the crane or hoist will need to have a cradle designed for the intended load and be suitable for a person to ride. A crane or hoist used in this manner should be:

(a) fitted with a hook that has a spring loaded operable latch to prevent inadvertent release of the load
(b) fitted with a functioning over hoisting device that stops the relevant crane motions e.g. motion cut-out anti-two-block. The *AS 1418 Cranes, hoists and winches* set provides guidance on over hoisting devices. Note: This standard consists of a number of parts
(c) equipped with a **'dead-man'** control on power lowering to produce self-centring and automatic brake engagement, and

(d) be equipped with a lockout control on the crane free fall function to prevent free fall of the lift box and its contents.

Clearly marked working load limits should be displayed at each end of the cradle, preferably in terms of the number of workers and the total mass of girts allowed, as well as the total working load limit in kilograms.

4.3.9 Erecting steel components – bridging

Girt and purlin bridging and any associated sag rods may be erected from an elevating work platform. Bridging should be lifted from the ground by the rigger using mechanical equipment. Care should be taken to ensure it does not get tangled while being lifted.

4.3.10 Erecting steel components - roof and wall bracing

A crane should be used to lift bracing members. Bracing should be assembled on the ground when this is possible. The weight of a bracing member may permit it to be safely lifted by hand. The rigger should do this:

(a) while working from an elevating work platform, preferably, or the steelwork, with suitable controls in place to prevent falls from heights
(b) using a hand line to lift the bracing from the ground.

In the case of wall bracing, where it can be safely lifted by hand, this should be done by the rigger working from an elevating work platform and using a hand line to lift the bracing member from the ground.

4.4 Containment sheeting

Containment sheeting is fixed to the perimeter of the structure or working surface to prevent a person or objects, such as building materials from falling into an area accessed by persons at or near the workplace. The working surface/structure is usually sheeted with:

(a) timber or plywood
(b) metal or synthetic sheets, or
(c) metal or synthetic mesh.

Where containment sheeting is used the sheeting should extend to a height that will prevent falling objects. When selecting containment sheeting, consider:

(a) whether the sheeting capable of supporting the loads likely to be imposed on it
(b) whether the sheeting capable of containing materials and equipment
(c) the pattern and frequency of fixing points
(d) the degree of protection required from rain
(e) the likely forces that will be imposed on the structure from wind effects.

4.5 Toeboards

A toeboard is a vertical barrier to prevent the fall of tools or materials. Toeboards may be used to prevent objects falling into an area accessed by persons at or near a workplace. Toeboards may be fully sheeted with timber or metal or made from mesh. They should be securely fixed adjacent to the work surface and extended a minimum of 150 mm above the work surface. The height of the toeboard should increase as the

size and height of the materials or equipment stored near the edge increases. The gap between the toeboard and the work surface should not be greater than 10 mm.

4.6 Exclusion zones

Bunting or barricades and suitable signage may be erected around the perimeter of an exclusion zone to exclude personnel from the area under which the riggers are erecting steelwork, reducing the risk of being hit by falling objects.

5. Structure integrity

In order to prevent the risk of death or injury from collapse of a structure, the need for stability at all stages of steel construction work should be understood by all those undertaking the work. See an example of an erection procedure for a typical frame building at Appendix 2.

Control measures to prevent the risk of death or injury from the collapse of structures during construction are:

(a) ensuring inherent designed stability of the structure
(b) temporary bracing
(c) maintenance of column stability during erection
(d) maintenance of beam stability during erection
(e) ensuring proper installation of chemical and mechanical anchorages.

5.1 Building stability

The erection of any component or subassembly should start only when the necessary equipment to ensure stability of the structure is available and stability of the structure can be maintained at all times. This would include temporary guys or bracing to ensure the stability of all parts of the structure as well as the structure as a whole. All temporary guys or bracing should be securely anchored. Anchor points should be constructed so that they are able to resist any force likely to be imposed on them. The movement of an anchor should be reported to the erector and action taken immediately.

Guys should be clearly identified by coloured bunting or similar to avoid accidents. In areas of plant and vehicle movement adequate visual barriers should be located between guys, plant and vehicle movement areas.

During erection, the stability of the structure should be verified by the person identified in the WHS management plan as the verifier, in the following circumstances:

(a) at the end of the workday or during temporary cessations of work. The effectiveness of temporary guys, bracing and supports should also be inspected at the beginning of each shift
(b) when fastenings may be incomplete, for example, during lining up and adjustment of level procedures
(c) during high winds or when high winds are forecast
(d) when the structure or parts of it may be subject to construction loads. For example, the stacking of parts and lifting or freeing of components which may have become inadvertently wedged in position.

5.2 Bracing

Where required by design, erection should start in a nominated braced bay in order that the structure can be plumbed and made self-supporting. This stable and self-supporting bay can then be used to support the erection of further steelwork.

If it is not possible to commence erection at a braced bay, consideration of, and a decision on, the extent of temporary support should be made prior to any work being carried out. This should be considered when preparing the WHS management plan, see section 2.

5.3 Column stability

Footings for support of columns during erection should be checked to ensure adequate structural capacity for the erection conditions, such as wind loadings on columns to prevent rotation of column in the footing.

Column splices should be capable of supporting the standing column until it is tied together, or the column should have temporary guys attached to ensure its stability at height. The erector should use tightly fitted steel packers or steel wedges driven under the edges of the column base plate to provide added stability.

A common form of ‘setting’ the height for the fixings of columns is by the use of ‘jacking nuts’ that are levelled on the threads of the cast-in fixings. The column is placed on these and the top nuts, washers etc. installed to secure the column.

5.4 Beam stability

The erector should ensure that all beams are secured before releasing the slings.

5.5 Alignment of bolts

The stability of the steel structure relies upon effective bolted connections both from the concrete slab to the columns and between the columns and all the individual steel components. If the bolts are bent to line up with holes or the holes in the steelwork are enlarged to align with the bolts, the integrity of the structure can be adversely affected and this can increase the risk of collapse. Bent bolts are more likely to fail and also cause uneven load distribution to the steelwork. Enlarged holes in the steelwork reduce the ability of the steelwork to effectively transfer loads and can also result in tearing of the steelwork.

Wherever holes do not line up with bolts or other holes, the building design engineer is to be consulted and should provide technical guidance to the steel erector. Written verification from the engineer is to be provided that details any changes or alterations that can be made to bolts or holes in the steelwork. The engineer should ensure this certification complies with safe structural design and bolting principals.

5.6 Chemical and mechanical anchorages

An in-situ connection, for instance cast-in bolts/threaded studs, for a bolted connection or cast-in steel plate, for a welded connection, is the preferred method for anchorage.

In some cases chemical, expansion or other ‘drill-in’ type anchors are sometimes used to secure structural steel to a concrete slab. With the use of these anchors a hole is initially drilled in the concrete slab and the anchor inserted in the hole. The strength of fixing of the anchor is achieved through a variety of means including mechanical action or chemical reaction.

Drill-in type anchors are sometimes used where a cast-in anchor e.g. a cast-in bolt or steel plate has been placed in the wrong position. However in some situations all anchors have been of the ‘drill-in’ type.

This is strongly discouraged for the following reasons:

- difficulty experienced in drilling holes to the correct depth and location due to the presence of re-enforcing steel in the slab
- potential problems in ensuring the correct setting torque is applied
- reliance on friction or bonding strength to maintain the anchors’ integrity
- difficulty in verifying the chemical reaction is complete and the correct bonding strength has been reached.

Where chemical (epoxy resin) and mechanical (expansion shell) type anchorage connections are to be used, they should be installed in accordance with manufacturer’s recommendations. The erector should ensure that the concrete in both walls and floors has reached the specified strength into which the chemical or mechanical type anchorage is to be installed.

5.7 Paint touch up when erecting steel components

When assembling components of structural steel the protective coating may be damaged and require touch up. The more common paint types for this purpose are ‘alkyd primers’ or ‘ethyl silicate zinc packs’.

When handling any paint materials, personal contact with paint materials should be avoided and a high degree of personal hygiene encouraged. Full details of health and safety precautions can be found on the paint container or in the material safety data sheet.

6. Cranes

There are a number of administrative control measures relating to work practices that require persons to observe certain safe work practices. These control measures, to prevent the collapse of cranes should be in place before steel construction work commences. In some circumstances, more than one control measure will be necessary. Control measures which should be considered include:

(a) ensuring outriggers are properly set up
(b) correct positioning of boom to ensure loads are lifted vertically
(c) Precautions when manoeuvring e.g. avoidance of overhead power lines
(d) ensuring accurate load distribution when using multiple crane lifts
(e) preventing lateral loadings being applied to the boom
(f) preventing over-loading of cranes by accurate determination of the mass to be lifted
(g) providing the appropriate load rating charts and correctly calibrated moment limiters

(h) ensuring the correct counterweight has been fitted for the load chart being used
(i) ensuring the bolting of boom sections have been correctly tensioned.

6.1 Outriggers - crane set up

Where ground conditions are suspect regarding bearing capacity, the following should be considered:

(a) The principal contractor should supply to the erector all necessary information on the location of trenches and backfilled trenches/services, to enable the crane to be positioned and erected safely.
(b) Before ‘setting up’ the crane, carry out a full evaluation of potential overhead, underground and jobsite hazards. Visually inspect ground conditions to determine the type and amount of packing required under the crane's outriggers to support the proposed loads.
(c) When placed in position the outrigger extensions should be locked or pinned in position as recommended by the manufacturer, and
(d) Footpads or hydraulic pads which form part of the outriggers should be placed upon adequate footing and the crane levelled. Check the footing frequently during the crane's operation to make sure it is always in place. All packing used should be of a substantial nature. Hardwood timber should be at least 200 x 75 mm and the length determined by calculating the required area.

Packing should always be laid in a ‘pigsty’ configuration (see **Figure 7**). It should not be laid in a parallel manner. Beware of underground services (cable tunnels, drains, cellars, etc.). Before setting up on structures or suspended floors, find out if the structure is capable of supporting the imposed loading and will retain a sufficient margin of strength in service.

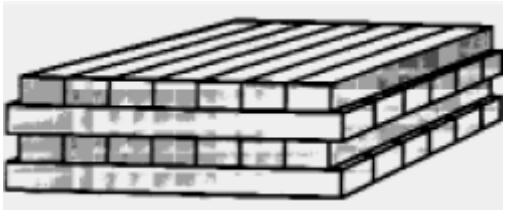

Figure 7. ‘Pigsty’ configuration

6.2 Operating signals

Only one person should give visual and/or audible signals at any one time. If there is a loss of contact using 2-way radio control, stop work immediately. If there are 2-way radios operational in close proximity but located on different work sites, the ‘Spectrum Management Agency of the Commonwealth Department of Communications, Information Technology and the Arts’ should be consulted to allocate correct radio frequencies.

6.3 Lifting loads

Before starting to hoist a free load, the crane operator or dogger should make sure that the hoist rope hangs vertically over the load (see **Figure 8**). Avoid swinging the load when the lift is taken. When lowering loads or when the load is suspended, make sure

the load is under control. When handling maximum or near maximum loads, the following precautions should be taken after the load has been lifted a few centimetres:

- test the hoist brakes
- check the weight recorded on the load weight indicator
- recheck the load chart.

Except in the case of an emergency, do not leave the cabin or control room while a load is suspended from the crane.

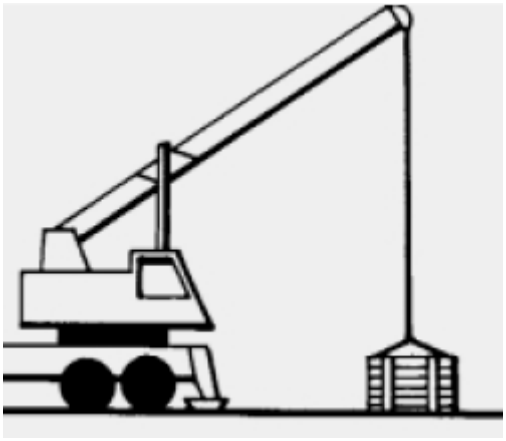

Figure 8. Correct slinging

6.4 Lifting loads near persons

Avoid carrying loads over persons. This should never be done when using devices that function by friction, fluid pressure, partial vacuum, and magnets or local indentation of surfaces. Crane operators should give audible warning before lifting loads near persons.

6.5 Crane types

The placement of steelwork is a process that can utilise any of the available crane types. A tractor type crane can be used to transport steel around the workplace. Positioning the smaller or lighter pieces can be carried out with an articulating truck type crane. Larger mobile cranes such as truck mounted lattice boom or hydraulic boom cranes can be used to position heavier components that require a much further reach. On high rise steel construction the use of tower cranes would also be a consideration.

6.6 Precautions when travelling and manoeuvring with a load

When operating in congested areas post a ‘safety observer’ to warn of potential for collision with adjacent structures and overhead electrical power cables. Always use a dogger when travelling and keep loads close to the ground. In some cases swinging loads can be roped off to control the swing. Always travel with the load facing up the slope.

When moving a load in the ‘pick and carry’ mode the dogger should remain in sight of the crane operator and not walk in the path of the crane.

The operator of a mobile crane should ensure that:
(a) the slew brake is applied at all times other than when the slew motion is being used
(b) when travelling a mobile crane, be aware of uneven road surfaces when loaded or unloaded, as an undulation in the road surface may move the crane into a zone of instability
(c) the slewing brake or lock is applied when travelling with a load
(d) a rope luffed mobile crane is not moved up hill with an unloaded boom in the near vertical position.

6.7 Multiple crane lifts

If possible, avoid hoisting a load with more than one crane. However, where it is necessary to lift a load using more than one crane, the following steps should be taken:
(a) one person should be designated to be in overall control of the lift
(b) an accurate assessment should be made of:
    (i) the share of the load which is to be carried by each crane
    (ii) how the load sharing is to be proportioned, and
    (iii) how the proportioning is to be maintained
(c) the instructions to each crane driver and other persons involved should be clear and the operation should be rehearsed wherever possible
(d) cranes of equal capacity and similar characteristics should be used
(e) when using tractor type cranes in the 'pick and carry' mode, make sure that both cranes are aligned in the same direction
(f) luffing up should be used in preference to luffing down.

6.7.1 Calculated share of the load

Where multiple hoisting operations are not designed by an engineer, the following minimum capacity requirements for each crane shall apply:
(a) For two cranes……20% greater than the calculated share of the load.
(b) For three cranes……33% greater than the calculated share of the load.
(c) For four cranes……50% greater than the calculated share of the load.

6.8 Precautions with lattice boom cranes

The top of the extended boom should not be lowered to a point below the horizontal plane that passes through its base pivot pin. If the boom tips below this plane, the angle of pull of the boom luffing ropes could cause the boom to buckle before the boom begins to lift.

When changing boom sections on lattice boom cranes, the crane operator should take special care to prevent collapse of the boom, adequate support should be provided under each section before removing the joint pins or bolts. When joint pins or bolts are replaced they should be provided with properly fitted split pins or a locking device. Joint pins should be fitted so that they can be removed while the operator is standing on the ground on the outside of the boom or jib.

The crane should not be operated:
(a) with the boom at an angle greater than that shown on the load chart, or

(b) with the boom hard against the boom backstop. In this position serious damage could be caused to structural members of the boom. Regard the boom backstop as a safety device only.

6.9 Precautions with hydraulic boom cranes

When extending the boom on hydraulically operated cranes, ensure that the boom sections are extended or retracted in accordance with the manufacturer's recommendations. Boom sections have failed through being extended contrary to recommendations.

The crane should not be operated with the boom at an angle greater than that shown in the load chart.

6.10 Loading of cranes

A crane should not be subjected to a greater load or manner of loading than is marked on the crane load chart. Where the mass of the load is cause for concern, the rigger should verify if the stamped mass on the load is correct.

Cranes should not be operated in wind speeds exceeding those specified for safe use by the manufacturer. When lifting loads with a large surface area the wind speed can be further reduced. The decision to lift a load rests with the crane operator; however, if the operator believes it is unsafe to lift the load guidance should be obtained from the crane manufacturer or a suitably qualified engineer. Where the wind speed reaches this figure, either retract the boom (hydraulic boom) or lower the boom to a safe position (lattice boom).

6.11 Load rating charts and indicators

Each crane should have attached a permanent notice indicating its working load limit. An additional notice should also list the condition, incidence and manner of application of the load or use of the crane. This notice should be placed in a position where it can be easily read by the crane operator and where possible, the dogger.

All cranes should be provided with a load chart and be equipped with a radius indicator. This will enable the driver to determine the working load limit for any given working radius. Load indicators to be fitted to all mobile cranes with a rated capacity of 15 tonnes and greater. This requirement should also apply to mobile cranes manufactured since 1996 with a ‘rated capacity’ equal to or greater than 5 tonnes.

‘Rated capacity’ means the maximum load that may be attached and handled by the crane, and may not include the weight of the hook block, falls of rope, slings and rigging hardware. The load to be raised must include the weight of all lifting appliances that are not permanently attached to the crane. The crane’s load chart will provide guidance on any deductions that may need to be made. In the case of mobile cranes, the load ratings shown on the load chart referring to pick up and carry operations apply only when the crane is standing on level or firm ground with the tyres inflated to the manufacturer's recommendations and where applicable, outriggers correctly placed.

The manufacturers load chart of a mobile crane should be divided into two sections by a heavy horizontal line at various locations on the load chart. The load ratings indicated above this line are based on structural strength of the boom while the load ratings indicated below the line are based on crane stability.

Appendix 1: Risk management in steel construction – Falls from heights

A1.1 The process of risk management

Risk management is the process of **identifying** what can cause an injury (falls from heights), making an **assessment** of what could happen as a result (injury to persons at or near the workplace), and **controlling those risks**.

A1.2 Hazard identification

Prior to commencing the steel construction work, all hazards related to falls from heights should be identified. There are a number of ways of identifying potential sources of injury including:

(a) using consultation - this is one of the easiest and most effective means of identifying hazards. Designers, fabricators, erectors and workers are usually aware of what can go wrong and why, based on their experience
(b) contacting specialist practitioners, representatives of industry associations, trade unions and government bodies who may be of assistance in gathering health and safety information relevant to falls from heights.

Factors which can cause a person to fall include:

(a) moving from one surface to another
(b) capability of a surface to support a load
(c) openings or holes not identified or protected
(d) open edges that are not protected
(e) slippery surfaces
(f) equipment, tools or rubbish obstructing work areas
(g) incorrect or inappropriate use of ladders
(h) struck by a moving or falling object
(i) fall-arrest systems and devices not being provided or not used correctly.

A1.3 Risk assessment

A risk assessment allows appropriate control measures to be developed. Once hazards have been identified, they should be assessed in terms of their potential to do harm. To assess risk, consideration should be given to:

(a) the likelihood that harm will occur
(b) the severity of the harm, should it occur.

Factors to consider when assessing the likelihood and severity of risk include:

(a) potential sources of injury and illness
(b) number of people who may be exposed
(c) location of the work area
(d) location of access routes
(e) type of steel construction work to be carried out
(f) work practices to be used
(g) scheduling of work
(h) type of plant and equipment to be used
(i) training and experience of persons carrying out the work.

A1.4 Risk control

Risk control is the process of preventing or minimising risk. The control or prevention of risk is undertaken by implementing the control measures identified in the assessment. A hierarchy of control measures is a list of control measures, in priority order, that can be used to prevent or minimise exposure to a risk.

Application of the hierarchy of control measures involves:

(a) firstly assessing whether the risk can be eliminated
(b) where this is not possible, substitution should be considered
(c) if this is not possible, consideration should be given to each of the other control measures (e.g. isolation, engineering controls, safe work practices and the use of personal protective equipment).

A1.5 Monitor and review control measures

The risk identification, assessment and control process requires regular monitoring to ensure that any control measure implemented performs as originally intended. One of the ways to undertake the review is to re-do the first 2 steps of the risk management process. This involves identifying the hazards and assessing the risks. Methods that can be used to review the control measures in place include:

(a) consulting with workers
(b) referring to specialist practitioners and representatives of industry associations, unions and government bodies.

A written record, detailing when control measures were reviewed, should be kept.

Appendix 2: Erection procedure for portal frame buildings

A2.1 General

A2.1.1 Portal frame buildings

This erection procedure is for portal frame buildings with conventional bracing in the buildings longitudinal direction. The bracing will usually be located near the ends of the building at the end bay or the bay adjacent to the end bay. The end wall of the building may be either a portal frame or of braced construction. Bracing locations covered are indicated in Figures A1 to A4. Long buildings may have additional braced bays along their length. This procedure is based on, braced bays being no more than seven bays apart and the portal frames being lifted in one piece.

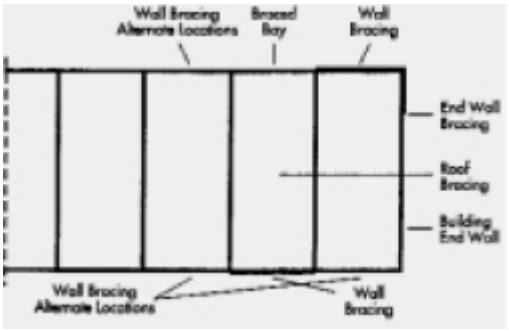

Figure A1. Building bracing location – internal bay

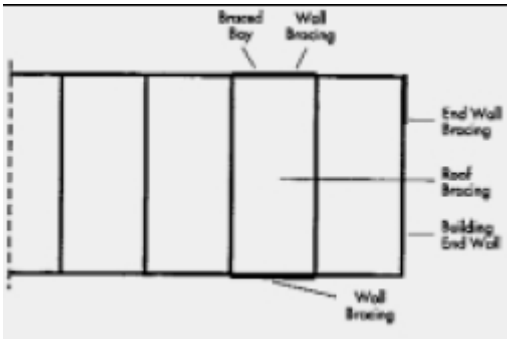

Figure A2. Alternative wall bracing location

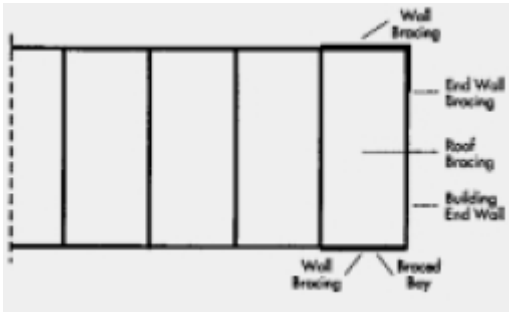

Figure A3. Building bracing location – end bay

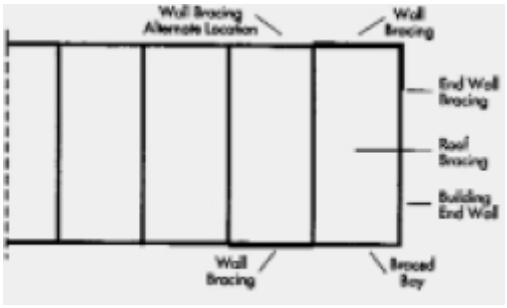

Figure A3. Building wall bracing location

A2.1.2 Bracing systems

The bracing systems may be of the following types:

(a) cross bracing roof and walls. See Figures A5 and A6

(b) rigid frame (or moment frame) bracing walls. See Figure A7, or

(c) tension bracing roof and walls. See Figures A8 and A9.

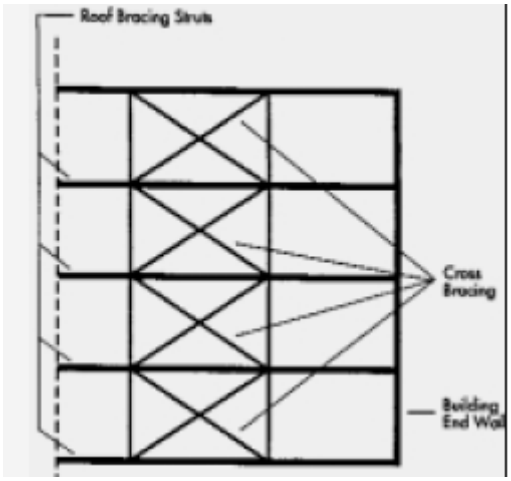

Figure A5. Roof cross bracing

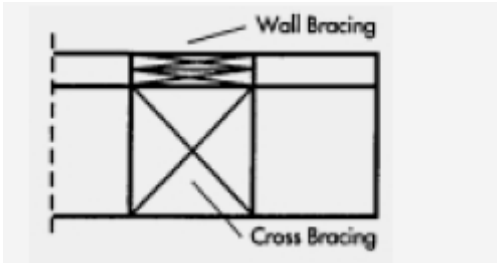

Figure A6. Wall cross bracing

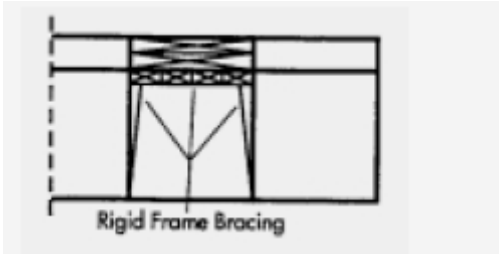

Figure A7. Wall right frame bracing

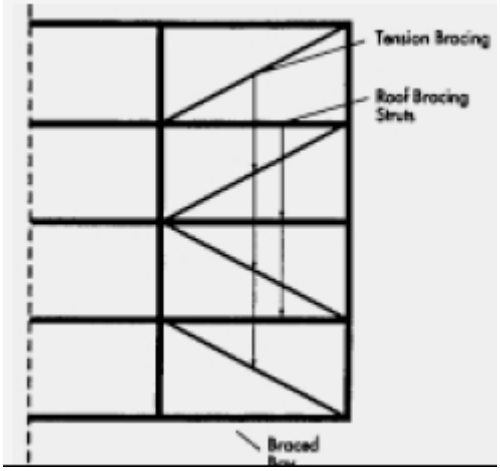

Figure A8. Roof tension bracing

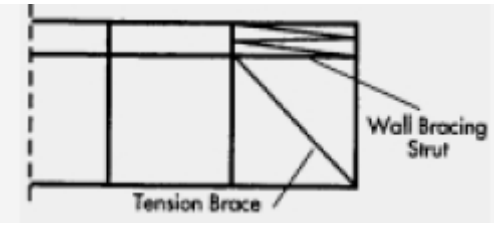

Figure A9. Wall tension bracing

A2.2 Type of main frame

The erection procedure described covers main frames of the following types:

(a) The braced bay is located within the building (see Figures A1 and A2). These contain cross bracing and the walls have either cross bracing or rigid frame bracing. Section A2.4 details the erection procedure, and

(b) The braced bay is located in the end bay (see Figures A3 and A4). The roof contains cross bracing or single acting tension bracing. The walls have either cross bracing, rigid frame bracing or single action tension bracing. Section 5 details the erection procedure.

Preferred sequence A2.3.1, A2.3.2, A2.3.4, A2.3.5 and A2.3.6

A2.3 Erection procedure for main frame with the braced located within the building

A2.3.1 Erection of first braced bay

The braced bay will usually be located adjacent to the end bay in this case as shown in Figures A1 and A2. However this section applies if the braced bay is towards the centre of the building.

The procedure is as follows:

(a) Erect a pair of braced bay columns on one side of the building. If the wall bracing is offset from the braced bay, as in Figure A4, erect the third main wall column. Complete with wall bracing and horizontal strut(s) between them including strut in unbraced bay if required. Level and plumb, tighten holding down bolts, bracing and strut(s) end bolts or tie rods.

(b) Repeat (a) for the columns on the other side of the building.

(c) Position and bolt up the two parts of the two portal rafters on the ground to enable easy lifting. This operation may be done before (a) and (b) if there is sufficient access to the outside walls of the building. If the portal rafter is fabricated in one piece this step will not be required.
(d) Erect the first rafter and bolt to the columns. If the span of the portal is such that the free standing frame could be unstable then the portal is to be guyed from the apex in opposite directions before detaching the crane hook(s). It would be expected that this would certainly be the case for frame spans of 30 metres and over.
(e) Erect the second rafter and bolt to the columns. Again if the span of the portal is such that the free standing portal frame could be unstable, then the portal frame is to be stabilised at the apex by connecting a purlin to the previously erected frame, before detaching the crane hook(s).
(f) Erect the entire roof bracing in the bay including the struts. See Figures A5 and A6. The erection of this roof bracing should proceed from each outside wall towards the apex.
(g) Re-plumb the structure erected so far if necessary, tension all tie rods and/or tighten all bolts. There will now be a stable frame from which to attach the remaining building structure, and
(h) The guys attached to the apex can now be removed.

A.2.3.2 Erection of end bay

If the end wall is a portal frame:
(a) Erect the columns and eave struts or top wall girts, at each side of the building.
(b) Erect the previously bolted up portal and connect with a purlin at the apex before releasing the crane hook(s).
(c) Erect one stabilising purlin at each roof bracing strut position. See Figure A10
(d) Erect remaining end wall columns.

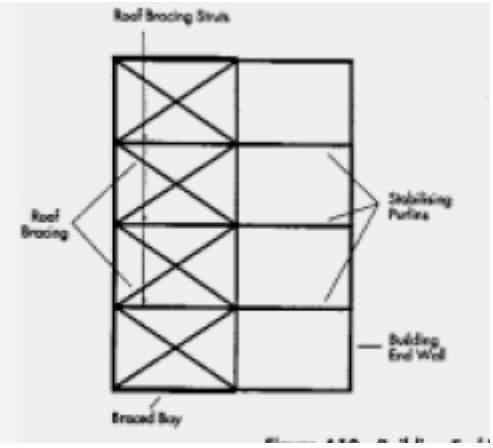

Figure A10. Building end wall

If the end wall is a braced frame:
(e) Starting erection from the corner nearest the end wall bracing, erect and bolt the corner column and the eaves strut or top wall girt.
(f) Continue erection and bolting of the remaining end wall columns, rafters and bracing from the corner column. As the erection proceeds across the end wall the completed bolted frame must be secured back to the previously erected portal frames with roof purlins at bracing strut members. See Figure A10, and

(g) Erect the remaining eaves strut or top wall girt at the other side of the building.

Proceed to A2.3.4

Alternate sequence if end bay needs or has to be erected first A2.3.3, A2.3.4, A2.3.5, and A2.3.6 (This will generally be required where access is limited or to improve working area on site.)

A2.3.3 Erection of end frame with first braced

If the end frame is a portal frame:

(a) follow the procedure as described in Paragraph A2.3.1 (a) to (d), and
(b) erect the remaining end wall columns.

Proceed to (g) below

If the end frame is a braced frame:

(c) Start erection from the corner nearest the end wall bracing.
(d) Erect this corner column and the next two main wall columns next to it. Complete with wall bracing and horizontal strut(s) between them including strut in unbraced bay. Level and plumb, tighten holding down bolts, bracing and strut(s) end bolts or tie rods.
(e) Continue erection and bolting of the remaining end wall columns, rafters and bracing from the corner column. As the erection proceeds across the end wall the completed bolted frame must be guyed from the apex in opposite directions. If there is the potential for the end wall to be unstable before the apex is reached addition guys in opposite directions will be progressively required.
(f) Erect main wall columns etc. on the other side of the building as in (d).
(g) Position and bolt up the two parts of the portal rafters on the ground to enable easy lifting. This operation may be done before (c) to (f) above if there is sufficient access to the outside walls of the building. If the portal rafters are fabricated in one piece this step will not be required.
(h) Erect the first rafter and bolt to the columns. If the span of the portal is such that the free standing portal frame could be unstable then erect a purlin between the apexes of the portals before detaching the crane hook(s). It would be expected that this would certainly be the case for frame spans of 30 metres and over.
(i) Erect one stabilising at each roof-bracing strut position (See Figure A10) to provide stability for the truss.
(j) Erect the next rafter as in (h) above. Erect the entire roof bracing in the bay including the struts. (See Figures A5 and A6). The erection of this roof bracing should proceed from each outside wall towards the apex.
(k) Re-plumb the structure erected so far if necessary, tension tie rods and/or tighten all bolts. There now exists a stable frame from which to attach the remaining building structure, and
(l) The guys attached to the apex can now be removed.

A2.3.4 Erection of additional portals

(a) Erect wall columns and tie back to the stable frame with the eaves strut or top wall girt. Erect wall bracing in bays required. Level, plumb and tighten holding down and other bolts.

(b) Position and bolt up both parts of the portal rafters on the ground to enable easy lifting. This operation may be done before (a) above if there is sufficient access to the outside walls of the building. If the portal rafter is fabricated in one piece this step will not be required.

(c) Erect the first rafter and bolt to the columns. If the span of the portal is such that the free standing portal frame could be unstable then erect a purlin between the apexes of the portals before detaching the crane hook(s). It would be expected that this would certainly be the case for frame spans of 30 metres or over.

(d) Erect sufficient stabilising purlins at the roof bracing struts located at the ends of the roof cross bracing to provide stability for the truss (See Figure A11). The number of purlins required at each location is shown in Table 1. The purlins closest to the node points are to be used.

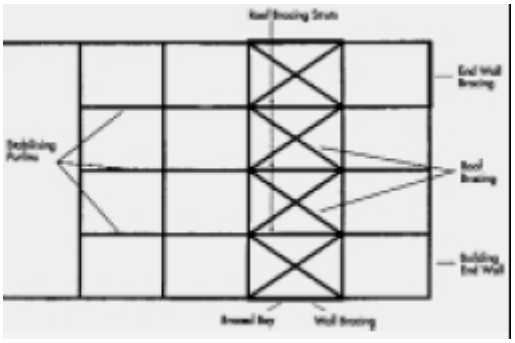

Figure A11. Erection of additional portals

(e) Erect purlin fly braces to each side of each portal. This may require additional purlins to be erected. The fly bracing erection can lag one portal behind to allow easy installation of lapped purlins. Ensure that all bolts are installed and tightened, and

(f) Proceed to erect additional portal rafters by following steps (b) to (e) in sequence. Continue to erect down the building in the same manner to the next braced bay.

Table 1

Stabilising requirements (See Figures A5 and A8)

Number of purlins required

Bracing strut spacing (mm)	**At eaves**	**At strut locations within buildings**
Up to 6000	One	One
6000 – 9000	One	Two
9000 – 12000	Two	Three

A2.3.5 Erection of next braced bay

(a) When the portals each side of the braced bay have been erected. Erect the entire roof bracing in the bay including the struts (See Figures A5 and A6). The erection of the roof bracing should proceed from each outside wall to the apex, and
(b) Tension all tie rods and/or tighten all bolts.

A2.3.6 Erection of last end bay

The erection of this bay is identical to section 3.2.

Follow Paragraphs A2.3.2(b) to A2.3.2(d) or A2.3.2(e) to A2.3.2(g).

Proceed to section 5

A2.4 Erection procedure for main frame with braced bay located in the end bay

A2.4.1 Erection of first braced

(a) follow the procedures as described in Section A2.3.1, and
(b) erect the remaining end wall columns.

If the end frame is a portal frame:

(c) Start the erection from the corner nearest the end wall bracing.
(d) Erect this corner column and main wall column next to it. If the wall bracing is offset from the braced bay as in Figure A4 erect the next main wall column. Complete with wall bracing and horizontal strut(s) between them including strut in unbraced bay if required. If building has single action tension bracing, supply and erect a temporary brace or guy from the top of the corner column to the bottom of the next main wall column. This will form cross bracing in this bay (See Figure A12.). Level and plumb, tighten holding down bolts, bracing and strut(s) end bolts or tie rods.

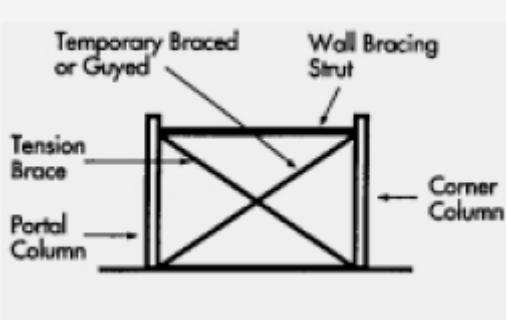

Figure A12. Wall temporary tension brace.

(e) Continue erection and bolting of the remaining end wall columns, rafters and bracing from the corner column. As the erection proceeds across the end wall the completed bolted frame shall be guyed from the apex in opposite directions. If end wall could be unstable before the apex is reached additional guys in opposite direction will be progressively required.
(f) Erect main wall column etc. on the other side of the building as in (d) above.
(g) Position and bolt up two ports of the portal rafter on the ground in a position to enable easy lifting. This operation may be done before (c) to (f) if there is

sufficient access to the outside walls of the building. If the portal rafter is fabricated in one piece this step will not be required.

(h) Erect the rafter and bolt to the columns. If the span of the portal is such that the free standing portal frame could be unstable then the portal is to be guyed from the apex in opposite directions before detaching the crane hook(s). It would be expected that this would certainly be the case for frame spans of 30 metres and over.

(i) Erect the entire roof bracing in the bay including the struts (See Figures A5 and A8). The erection of this roof bracing should proceed from each outside wall towards the apex. (If building has single action tension bracing proceed to Step (j) below).

(j) Re-plum the structure as necessary, tension tie rods and/or tighten all bolts. A stable frame now exists from which to attach the remaining building structure.

(k) The guys attached to the apex can now be removed. (The following Steps (I) and (m) are only for buildings with single action tension bracing).

(l) Erect temporary roof cross bracing or a guy has been installed from the apex at the end of the building to a secure ground anchor within the building (see Figure A13). This bracing or guy is to be tightened with the roof bracing and left in place until the bracing at the other end of the building is complete, and

(m) Re-plumb the structure erected as necessary, tension tie rods and/or tighten all bits. A stable frame now exists from which to attach the remaining building structure. Remove temporary guys other than the one identified in step (1).

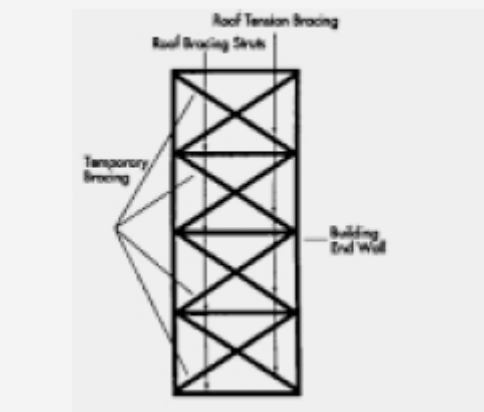

Figure A13. Temporary roof tension bracing.

A2.4.2 Erection of additional portals

(a) Erect wall columns and tie back to the stable frame with the eaves strut or top wall girt. Erect wall bracing in bays as required. Tighten holding down and other bolts.

(b) Position and bolt up the two parts of the portal rafters on the ground to enable easy lifting. This operation may be done before (a) if there is sufficient access to the outside walls of the building. If the portal rafter is fabricated in one piece this step will not be required.

(c) Erect the first rafter and bolt to the columns. If the span of the portal is such that the free standing portal frame could be unstable then erect a purlin between the apexes of the portals before detaching the crane hook(s). It would be expected that this would be the case for frame spans of 30 metres and over.

(d) Erect sufficient stabilising purlins at the roof bracing struts (see Figure A11). The number of purlins required at each location is shown in Table 1. The purlins closest to the node points are to be used.

(e) Erect purlin fly braces to each side of each portal. This may require additional purlins to be erected. The fly bracing erection can lag one portal behind to allow easy installation of lapped purlins. Ensure that all bolts are installed and tightened, and
(f) Proceed to erect additional portal rafters by following Steps (b) to (e) in sequence. Continue to erect down the building in the same manner to the next braced bay.

A2.4.3 Erection of next braced bay

Ensure all portal frames up to and including the braced bay have been erected. If the braced bay is an internal bay, or if the end frame is a portal frame, follow steps in Section A2.3.5.

If an end bay is a braced frame follow the steps below:
(a) starting erection from the corner nearest the end wall bracing, erect and bolt the corner column and the eaves strut or top wall girt.
(b) Continue erection and bolting of the remaining end wall columns, rafters and bracing from the corner column. As the erection proceeds across the end wall the completed bolted frame shall be secured back to the previously erected frames with the bracing strut members (see Figure A13).
(c) Erect the eaves strut or top wall girt to the top of this column.
(d) Erect the entire roof bracing in the bay including the struts (see Figures A5 and A8). The erection of this roof bracing should proceed from each outside wall towards the apex. Tension all tie rods and/or tighten all bolts, and

(Following step (e) is only for buildings with single acting tension bracing)

(e) Remove the temporary wall and apex guys and/or temporary wall and roof bracing from the other end of the building.

Proceed to section A2.5

A2.5 Erection of remaining building components

A2.5.1 Purlins

The remaining purlins can be loaded onto the erected structure provided the following conditions are satisfied:
(a) the initial braced bay has been completed
(b) purlin packs are limited to purlins for the remaining half-bay
(c) packs must be located on the roof bay near the sidewall (see Figure A4), and
(d) packs can be loaded onto the various bays as follows:
    (i) braced bay, when completed as described in section A2.3.1, A2.3.3, A2.3.5, A2.4.1, or A2.4.3
    (ii) end wall bay, when completed as described in section A2.3.2, A2.3.3 or A2.3.6, and
    (iii) intermediate bay, after stabilising purlins have been finally bolted and will not be unbolted for attachment of continuing lapped stabilising purlins.

Erection of the remaining purlins may proceed at any time after they have been loaded on the roof.

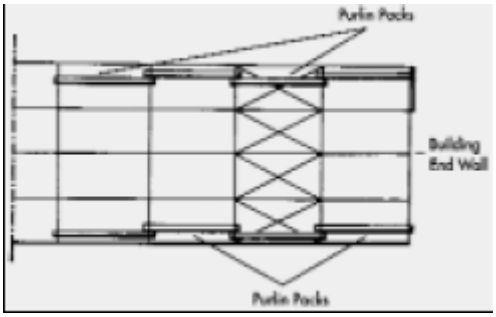

Figure A14. Location of purlin packs.

A2.5.2 Girts

Long wall girts may be erected with columns or in bays as for purlins (i.e. condition as stated in section A2.5.1).

End wall girts may be erected after the end wall structure erection has been completed.

A2.5.3 Roof sheeting

Packs of roof sheeting may only be loaded on to the structure when purlins and their bridging have been completed to the end of the building or up to the second braced bay when purlins and their bridging have been completed to that bay.

Roof sheeting packs must be loaded near portal rafter or end frame. Roof sheet pack sizes should not be greater than a bay coverage. The sheet packs should be placed at each portal or end frame (see Figure A15).

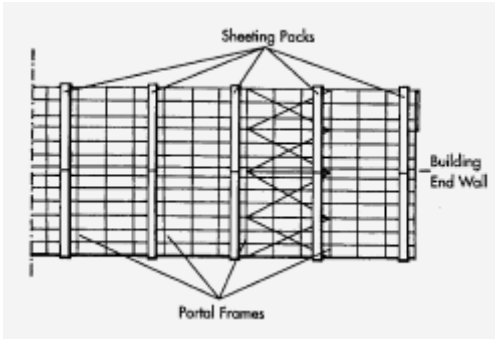

Figure A15. Location of sheeting packs.

A2.5.4 Wall sheeting or tilt-up panels

Wall sheeting and tilt up panels can only be attached to the frame after the whole structure or a section containing two braced bays, has been completed including roof purlins, purlin fly bracing and bridging.

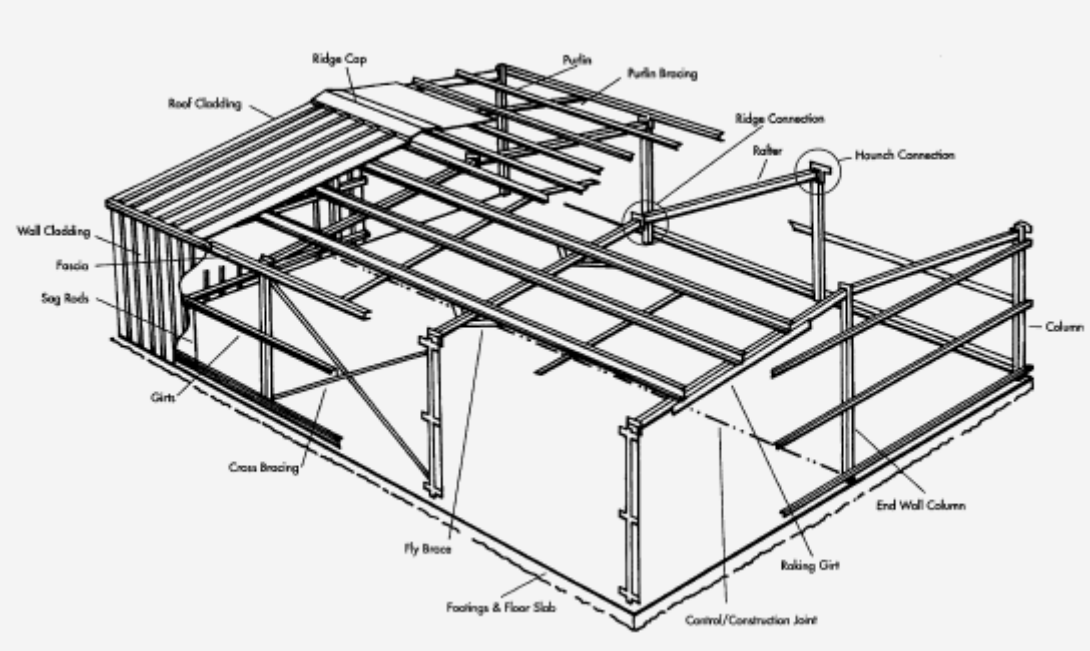

Figure A16. View of typical building showing arrangement of components.

Appendix 3: Published technical standards

Standards

AS 1418 Set	Cranes, hoists and winches set
AS / NZS 1554 Set	Structural steel welding set
AS / NZS 1576.1	Scaffolding – General requirements
AS 1657	Fixed platforms, walkways, stairways, and ladders - Design, construction and installation
AS / NZS 1891 Series	Industrial fall-arrest systems and devices
AS / NZS 1892 Series	Portable ladders
AS 2550 Set	Cranes, hoists and winches - Safe use set
AS 2759	Steel wire rope – Use, operation and maintenance
AS 3828	Guidelines for the erection of building steelwork
AS 3990	Mechanical equipment - Steelwork
AS 4100	Steel structures

Appendix 4: Duties

Work health and safety duties

(Part 2 – the Act, Division 2 and Division 3)

Duties of persons conducting business or undertaking (PCBUs)

Section 19 of the Act

1. A PCBU must ensure, so far as is reasonably practicable, the health and safety of:
   (a) workers engaged, or caused to be engaged by the person; and
   (b) workers whose activities in carrying out work are influenced or directed by the person

while the workers are at work in the business or undertaking.

2. A PCBU must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.

Example of duties under this section-
A PCBU contracts with a supplier of labour to obtain the services of the supplier's employees to perform a work activity for the purposes of the business or undertaking. As well as any duty the person may have under section 19 to ensure the health and safety of the PCBU's own employees, if any, the PCBU also has, under this section, a duty to ensure the health and safety of labour hire employees while they are performing the work activity.

Duties of principal contractors

Section 314 of the Regulations

This section specifies that the principal contractor for a construction project must put in place arrangements for ensuring compliance at the workplace with the provisions in the Regulation about:

- the general working environment (division 2 of part 3.2)
- first aid (division 3 of part 3.2)
- emergency plans (division 4 of part 3.2)
- personal protective equipment (division 5 of part 3.2)
- managing risks from airborne contaminants (division 7 of part 3.2)
- hazardous atmospheres (division 8 of part 3.2)
- storage of flammable or combustible substances (division 9 of part 2.2)
- falling objects (division 10 of part 3.2)
- falls (part 4.4)

A note to this section states that all PCBUs at the construction project workplace have these same duties (see part 3.2 of this regulation and section 19(3)(e) of the Act). Section 16 of the Act provides for situations in which more than one person has the same duty.

Section 315 of the Regulations

This section provides that the principal contractor for a construction project must manage risks to health and safety in relation to the matters stated in this clause.

The principal contractor for a construction project must in accordance with part 3.1 manage risks to health and safety associated with the following:

(a) the storage, movement and disposal of construction materials and waste at the workplace
(b) the storage at the workplace of plant that is not in use
(c) traffic in the vicinity of the workplace that may be affected by construction work carried out in connection with the construction project
(d) essential services at the workplace.

Duties of designers of plant

Section 22 of the Act

1. This section applies to a person (the ***designer***) who is a PCBU that designs:
   (a) plant that is to be used, or could reasonably be expected to be used, as, or at, a workplace; or
   (b) a substance that is to be used, or could reasonably be expected to be used, at a workplace; or
   (c) a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace.
2. The designer must ensure, so far as is reasonably practicable, that the plant, substance or structure is designed to be without risks to the health and safety of person in relation to 2(a) to (f), (3), (4) and (5) of this section.

Duties of manufacturers of plant

Section 23 of the Act

1. This section applies to a person (the ***manufacturer***) who conducts a PCBU that manufactures:
   (a) plant that is to be used, or could reasonably be expected to be used, as, or at, a workplace; or
   (b) a substance that is to be used, or could reasonably be expected to be used, at a workplace; or
   (c) a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace.
2. The manufacturer must ensure, so far as is reasonably practicable, that the plant, substance or structure is manufactured to be without risks to the health and safety of persons in relation to 2(a) to (f), (3), (4) and (5).

Duties of suppliers of plant

Section 25 of the Act

This section applies to a PCBU (the ***supplier***) who supplies:

(a) plant that is to be used, or could reasonably be expected to be used, as, or at, a workplace; or
(b) a substance that is to be used, or could reasonably be expected to be used, at a workplace; or
(c) a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace.

2. The supplier must ensure, so far as is reasonably practicable, that the plant, substance or structure is without risks to the health and safety of persons in relation to 2(a) to (f), 93), (4) and (5).

Duties of erectors and installers of plant

Section 26 of the Act

This section applies to a PCBU that installs, constructs or commissions plant or a structure that is to be used, or could reasonably be expected to be used, as, or at, a workplace.

2. The person must ensure, so far as is reasonably practicable, that the way in which the plant or structure is installed, constructed or commissioned ensures that the plant or structure is without risks to the health and safety of persons:
    (a) who install or construct the plant or structure at a workplace; or
    (b) who use the plant or structure at a workplace for a purpose for which it was installed, constructed or commissioned; or
    (c) who carry out any reasonably foreseeable activity at a workplace in relation to the proper use, decommissioning or dismantling of the plant or demolition or disposal of the structure; or
    (d) who are at or in the vicinity of a workplace and whose health or safety may be affected by a use or activity mentioned in paragraph (a), (b) or (c).

Duties of owners of plant

Section 21 of Act

In this section, ***person with management or control of fixtures, fittings or plant at a workplace*** means a PCBU to the extent that the business or undertaking involves the management or control of fixtures, fittings or plant, in whole or in part, at a workplace, but does not include:

(a) the occupier of a residence, unless the residence is occupied for the purposes of, or as part of, the conduct of a business or undertaking; or
(b) a prescribed person.

The person with management or control of fixtures, fittings or plant at a workplace must ensure, so far as is reasonably practicable, that the fixtures, fittings and plant are without risks to the health and safety of any person.

Duties of workers

Section 28 of the Act

While at work, a worker must:

(a) take reasonable care for his or her own health and safety; and
(b) take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons; and
(c) comply, so far as the worker is reasonably able, with any reasonable instruction that is given by the PCBU to allow the person to comply with this Act; and
(d) cooperate with any reasonable policy or procedure of PCBU relating to health or safety at the workplace that has been notified to workers.

Duties of other persons at the workplace

Section 29 of the Act

A person at a workplace, whether or not the person has another duty under this part, must:

(a) take reasonable care for his or her own health and safety; and
(b) take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons; and

(c) comply, so far as the person is reasonably able, with any reasonable instruction that is given by the PCBU to allow the PCBU to comply with this Act.

Appendix 5: Dictionary

For the purpose of this advisory standard the following definitions apply.

'access platform' means 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.

'civil construction work' means work to:

(a) construct a road or highway or erect associated works
(b) construct a railway or erect associated works
(c) construct or erect a harbour or associated works
(d) construct or erect a water storage or supply system or associated works
(e) construct a sewerage or drainage system or associated works
(f) construct or erect an electricity or gas generation, transmission or distribution structure or associated works
(g) construct a park or recreation ground, including, for example, a golf course, playing field, racecourse or swimming pool or associated works
(h) erect a telecommunications structure or associated works
(i) construct production, storage and distribution facilities for heavy industry, refineries, pumping stations, or mines or associated works, or
(j) construct or structurally alter a bridge or associated works.

'**construction work**' is defined in the *Work Health and Safety Regulation 2011*.

'**person conducting a business or undertaking'** is defined in the *Work Health and Safety Act 2011*.

'principal contractor' for construction work is defined in the *Work Health and Safety Regulation 2011*.

'structure' is defined in the *Work Health and Safety Regulation 2011*.

'worker' is defined in the *Work Health and Safety Act 2011.*

'working load limit' means the maximum working load that may be applied to any component or system.

'working platform' means a platform that is intended to support persons, materials and equipment.

Appendix 6: Safety checklist – Steel erection

Project:	Rigging Contractor	Fabrication Contractor:	Date:
Principal Contractor:	Steel Const. Foreman:	Engineer:	

It is the subcontractor's responsibility to have all sections checked off as the item is completed. The checklist is to be completed each day when portal steel members are being installed. The completed form must be given to the principal contractor when all items are completed.

The crossed areas in the 'Inspection By' column identify who is responsible for each item. The responsible party initials this section as each item is inspected/actioned.

Item No. and Description	Acceptance Criteria	Checked	Inspection by Principal Contractor, Subcontractor, Engineer		
			PC.	SC.	En.
1. Drawings Required	Certified engineer's drawings exist for all of the following: Steelwork design – position of members, braces and bracing points, steel content. Permanent and temporary bracing design – types of braces required (primary, knee, lateral, end), brace angles. Workmanship and materials in accordance with AS 4100, AS 3828, AS 1554 Set, AS 3678. Steel layout and erection sequence. Design engineer specification on bolt torque. Sign off by engineer on erection method prior to erection. Lifting point on large items. Drawings to note any special conditions.				

2. Subcontractors' safety documentation	The following documentation has been provided prior to work commencing: Rigging/erection contractors safe work method statement (SWMS). (PC's WMS where tower crane is used) Crane/rigging contractors' SWMS/lift plan showing crane set-up. Locations, location of obstacles, hazards and existing structures in proximity to the crane (especially temporary braces), rigging procedures and equipment, spotters duties, method of communication between crane operator and dogger, references to erection sequence, procedure for release of steel after securing and bolting off.				
3. Other safety documentation	Other documentation provides evidence of the following: Safe work method statements (SWMS) approved and discussed with and signed off by workers. Risk assessments/SWMS completed for all tasks to be undertaken. Unloading procedures and safe storage areas. Layout and erection sequence. Rescue procedure for work at heights including falls from heights in safety harness equipment. Access to work at height arrangements. Inspection requirements for steel structure (engineer consultation). Proof of training in safe use of safety harness and lanyard.				

	Record of EWP and other plant training. Wind loads permissible on structure during erection.				
4. Licensing issues	Steel erection supervised by a person with a minimum of basic rigger's qualification. Crane operator and riggers/doggers have appropriate licences. Dual lifts to be supervised by a person with intermediate rigger qualification. Licences for work platforms or training evidence for EWPs. Visual verification for all occupational licences. Photocopy of all licences to be kept on file. Qualified welder to perform welding. Qualified engineer to sign off documentation. Crane use complies with AS 2550.1. Elevating work platform use complies with AS 2550.10. Fall-arrest harnesses comply with AS 1891 Series.				
5. Pre-erection checks	Weight of steel members to be known/marked on steel. (Where it is difficult to estimate the weight of steel members it should be marked). Crane is capable of lifting weights, all checks and servicing done. Field bolted beams bolted together, during storage, to prevent rolling on ground, e.g. diagonal brace bolted to main member to prevent main member				

	rolling. Rigging configuration used meets load requirements of code (dual lifts). All slings have SWL and current inspection tags displayed. Ground conditions suitable for supporting crane (level and compacted surface, outriggers used – slewing cranes only, no penetrations or pits in proximity). 47 Site access is adequate. Proximity to overhead powerlines considered and appropriate action taken (safety observer where required). Exclusion zone installed. Exclusion zones have been barricaded and signed to keep non-essential personnel away during erection and rigging. Wind conditions are not detrimental to lifting. Chains and slings checked. Crane radius checked. Tag lines supplied. Crane fitted with safety hook, over-hoisting device, dead-man control on power lowering and lock-out control to prevent free-fall.				
6. Erection checklist	Double wrap chains where applicable. No ‘suicide lifting’ i.e. lifting in such a way that if the rigging fails, the steel will strike the crane and/or the operator. Bolts and washers of the correct size,				

	type and number. Welds as per engineering drawings and AS 1554 Set. Hand flame cutting prohibited as per AS 4100, check detail if task is required to be performed. Bolts pitched at least one thread clear of nut connection. Connections using high-strength bolts identified as either – bearing type or the preferred friction type. Check type of washers to be used. Use of steel packers only for column. Check tensioning sequence and pattern. It may be necessary to re-tension bolts after installation. Tolerances correct for column base. Work area isolated for safety. Grout to baseplate prior to installing cladding. Contractor to sign-off in accordance with drawing. Guys clearly identified with bunting.				
7. Permanent structure capable of supporting imposed loads prior to final loading	All bracing or supporting structure fixing points have been installed and fixed as per shop drawings and engineer's requirements. The supporting is adequately braced and structurally sound (engineer to inspect and confirm that the structure can adequately support loads imposed upon it). Introduce extra temporary wind bracing if required.				

8. Ongoing monitoring of steel and support systems	Daily inspections and documented weekly checklist to be undertaken on steel and temporary support systems. Competent person to sign-off at days end, at completion of each day's erection sequence.				
9. Training and communication	A toolbox talk to be undertaken with all relevant parties prior to work commencing each day.				
10. Additional items as required					
Note: (Acceptance Criteria) always include the relevant approved drawings, Australian Standards, engineers instructions, client specifications or manufacturers instructions.					

Appendix 7: Sample of engineer's certification letter for the use of rigger's posts

19 June 2004

Hector Smith
21 Concrete Drive
Urbanville Qld

Dear Mr Smith

Pineapple Industrial Estate Project – Spiky Road, Golden Beach

Structural adequacy of steel during erection and use of rigger's post fall-arrest system.

I certify that the steel structure: (*insert type of structure, i.e. portal frame structure*) will support the rigger's post system detailed below.

I reach this conclusion based upon the loadings and information supplied to me in regard to the rigger's post system by: (*name of the steel erector*).*

* *Steel erector to provide rigger's post loadings that are engineer verified.*

Conditions

(*examples of conditions that maybe applied by the engineer*)

1. Monitor wind speed during steel erection, wind speed not to exceed _____ km/h.

2. Maximum number of workers to be attached to static line at any one time.

3. Minimum number and type of anchors per column.

Yours faithfully

Signature

Engineer's Name
RPEQ No.