BCSA Code of Practice for Erection of Low Rise Buildings

BCSA Publication No 36/04

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BCSA is the national organisation for the Steel Construction Industry: its Member companies undertake the design, fabrication and erection of steelwork for all forms of construction in building and civil engineering. Associate Members are those principal companies involved in the purchase, design or supply of components, materials, services etc., related to the industry. The principal objectives of the Association are to promote the use of structural steelwork: to assist specifiers and clients: to ensure that the capabilities and activities of the industry are widely understood and to provide members with professional services in technical, commercial, contractual and quality assurance matters.

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SUMMARY

This document is a code of practice for Steelwork Contractors erecting low rise steel-framed buildings. It also provides guidance to Clients, Planning Supervisors, Principal Contractors and Designers. It describes the management procedures and methods to be adopted and is intended to serve as a standard reference when drafting site- and project-specific Erection Method Statements.

Low rise buildings are defined as those single storey and other structures that can be erected using mobile cranes and accessed using mobile elevating work platforms [MEWPs]. Generally these structures do not require columns to be spliced.

The document contains advice on the safety aspects of site management; site preparation; delivery, stacking and storage of materials; structural stability; holding down and locating arrangements for columns; lifting and handling; and interconnection of components.

The document is intended to aid compliance with the *Health and Safety at Work etc Act*, and with the relevant specific requirements of applicable regulations and approved codes of practice issued by the Health & Safety Executive.

If the Steelwork Contractor appoints a specialist erection subcontractor, then some obligations defined in the code of practice may inevitably devolve to the erection subcontractor (eg where these relate to the direct employer of the erectors), but the Steelwork Contractor should still ensure that the code of practice is being followed properly by agreeing the allocation of responsibilities in advance.

ENDORSEMENT

The Health & Safety Executive welcomes this BCSA Code of Practice for Erection of Low Rise Buildings and considers it as an important document in supporting the effective management of health and safety risk. It is a clear example of industry "self regulation", as the direct involvement of experienced and professional practitioners ensures that such guidance will be both relevant and authoritative.

The British Constructional Steelwork Association understands the importance of self regulation and over the years has been proactive and not simply reactive in reducing risks and accidents. The HSE welcomes working in partnership with BCSA because its positive approach has enabled steelwork erection to be undertaken both imaginatively and with increased safety.

This code can also serve, in part, to replace the withdrawn HSE publication entitled GS 28 *Safe erection of structures.*

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1 INTRODUCTION

1.1 SAFETY OBJECTIVES

The principal safety objectives when erecting steelwork are:

- Stability of the part-erected structure;
- Safe lifting and placing of steel components;
- Safe access and working positions.

The most serious accidents that occur during the erection of structures are generally caused by falls from height, either from working positions or while gaining access to them. Other serious accidents can occur because of structural instability during erection and while handling, lifting and transporting materials. Failure to establish safe erection procedures and to implement them through effective site management can create unnecessary hazards, leading to risks being taken and hence to accidents.

1.2 COMPETENCE AND SUPERVISION

The single most important step that contributes towards safe practice is to ensure that competent persons are mobilised. This is because such persons will observe the following precautions concerning the work in general and tasks in particular:

PRECAUTIONS

Do not commence work until it is clear what needs to be done.
Do not undertake work outside the limits of your competence.
Do not undertake tasks without the necessary tools and equipment.
Be clear about the arrangements for supervision in terms of the chain of command.
Do not deviate from what has been planned without checking with those in the chain of command.
Ensure that the area around the worksite is kept clear of hazards.
Watch out for hazardous activities being undertaken by other operatives, including others in your own gang.
Ensure that others not involved in the task do not encroach into an exclusion zone around the worksite.

Selection of a competent Steelwork Contractor is a necessary precondition towards ensuring that competent persons are mobilised to undertake the steel erection – whether these be employed by the Steelwork Contractor directly or by a specialist steel erection subcontractor. The Steelwork Contractor must observe the following preconditions:

PRECONDITIONS

Ensure that the scope of work is within the limits of competence of the firm.
Develop suitable method statements for the erection work in general and for specific tasks as necessary.
Agree the chain of command for site work with the Principal Contractor.
Provide appropriate supervision to manage the work on site.
Provide the necessary resources of manpower, plant and equipment.
Agree how exclusion zones should be operated to keep others away from hazards arising from steel erection.

The BCSA's *Guidance Notes on the Safer Erection of Steel-Framed Buildings* define activities that Steelwork Contractors should be able to undertake within their Scope of Competence (see the Appendix to this code of practice).

Work should be supervised by persons who are suitably trained and experienced in the type and size of structure being erected and their authority should be made known to all concerned, possibly by means of an organisation chart. The arrangements for supervision of work on site during erection can vary as follows:

- The Steelwork Contractor must identify a manager in overall charge of the work being undertaken, and the personnel and resources mobilised. Often this person, such as a contracts manager, will be in charge of work on more than one site and will thus not be on site continuously.
- Individuals sent to site to work alone must be assessed as capable of self-supervision, and they must report regularly to the Principal Contractor's site manager.
- When work is in gangs, each gang requires a chargehand to be identified.
- A site foreman, often being the most senior chargehand, would often be in continuous charge of day-to-day site operations on smaller sites.
- If several gangs are working on site simultaneously with more than one foreman, it may be necessary for the Steelwork Contractor to maintain the continuous on-site presence of an overall site supervisor.

At all times whilst erection activity is taking place, it must be made clear to both the erectors and to the Principal Contractor's management who is in direct supervisory control of those activities. The identity of the responsible erection supervisor may change over the period of a contract.

1.3 TRAINING AND QUALIFICATIONS

The Steelwork Contractor should be satisfied that those employed are fit enough to carry out the work required, have the necessary experience and have received the necessary training to carry out the work safely and without risk to health.

Experienced operatives may generally be assessed as being competent to undertake steel erection based on their record of work. New entrants will require a more detailed record of training and assessment in a suitable National Vocational Qualification at Level 2 as a minimum.

All persons employed on site need to produce evidence of having passed an appropriate Health & Safety Test. Advice on the specific NVQs and H&S Tests that are appropriate is available from the BCSA.

The Steelwork Contractor should ensure that training and qualifications meet that required by the Principal Contractor (eg those of the Major Contractors Group [MCG]). Minimum training and qualification requirements are as follows:

Managers and Supervisors	CSCS Manager or Supervisor Cards
Erectors	CSCS Erector Card Health & Safety awareness training Work at height awareness training Certificated slinger/signaller training CPCS Card for operation of MEWP
Welders	CSCS Fabricator Card Welder qualification suited to task in hand

1.4 BRIEFING AND INDUCTION

All erectors should be issued with a copy of the BCSA *Erectors' Manual* and be familiar with its contents. Erectors should also be properly briefed about the tasks in hand using on-the-job instruction.

Before beginning work on site, all operatives should attend a site induction which should include making operatives aware of special site restrictions or any specific hazards on site. Site inductions should be organised by the Steelwork Contractor in accordance with the Principal Contractor's arrangements for site inductions. If operatives are involved in the main work of steel erection, their induction should include a briefing conducted by the Steelwork Contractor based on the Erection Method Statement for the work. Operatives should countersign a document that confirms that they have received and understood the site induction.

Erectors should continue to be briefed on the safe method of work to be employed on each particular job as the work progresses using regular toolbox talks that:

- Familiarise erectors with the development of the work in accordance with the Erection Method Statement;
- Brief them on changes to methods and Addendum Method Statements as necessary;
- Explain the content of any *Task Specific Method Statements*;
- Discuss other topics relevant to site conditions (eg developing weather conditions);
- Focus on problems identified from "walk round" risk assessments;
- Ensure that their equipment, training and certification are up-to-date.

1.5 PLANNING, PROGRAMMING AND COORDINATION

Safe working methods and practices on site require:

- Appreciation of the implications of design risk assessments;
- The preparation and use of detailed method statements;
- Thorough and active contract co-ordination both on and off site;
- The implementation and maintenance of effective communications;
- Realistic and effective methods of programming and progressing;

- The organisation of work, which takes into account adverse weather conditions;
- The provision of competent staff, as noted above;
- The provision of the necessary resources including protective equipment appropriate for the work.

Co-ordination and liaison should be planned before the job starts. Depending upon the size and complexity of the job, the Steelwork Contractor should identify a line manager responsible for erection and/or a manager with overall responsibility for the contract. The role of the person, or persons, responsible for co-ordination and liaison should be clearly defined and their authority made known to others involved.

Before implementing any procedures or changes in previously agreed procedures, the procedures must be verified as being safe by the person responsible for co-ordination. Safety must be assessed in terms of the safety objectives defined above – stability, lifting and access.

If procedures or changes affect structural stability, they should be checked with the Designers or by a suitably qualified person who has knowledge of the structural scheme and of design risk assessments provided by the Designers, who would include the designer of the structural frame, and may also include those who have detailed the structural connections. Occasionally it could include other designers, such as those with responsibility for the design of specialist components such as light gauge members or precast elements.

The coordination necessary for safe erection includes ensuring:

- That liaison has taken place on the sequence of operations, the arrangements for stacking and storage on site, and the provision of suitable access and hard standings.
- The availability of the necessary information including sufficient detailed drawings available in time to allow effective forward planning for safe construction: these drawings may be from the frame designer, the detailer or the manufacturer.
- The manufacturer has adequate information (including any dimensions which can only be obtained from site once construction has started) and is manufacturing to specification and according to programme.
- That the supply of materials/components is as specified: generally all steel components should comply with the BCSA "Black Book" *National Structural Steelwork Specification for Building Construction* [NSSS]. A copy of the NSSS should be made available on site.
- That the correct components are delivered to site in the required order: if incorrect or insufficient or non-conforming components are delivered to site, the consequences should be reviewed and the effect on the erection sequence taken into account in any subsequent action.
- The availability of resources of manpower, plant and equipment.

Irrespective of the employment status of the site erectors, arrangements should be made to ensure that erectors know who to contact if the work cannot proceed as planned. When erecting, communications should be clear and unambiguous and use of on-site radio contact may be appropriate in some cases.

Erection progress should be recorded to help ensure that the correct components are available when required to enable the job to proceed according to the agreed sequence in the erection method statement. This may be by means of an easily read system of graphical representation to record progress. The system chosen should reflect the magnitude and type of job, and could be illustrated by bar charts, marked-up drawings or by more sophisticated computerised reviewing techniques.

1.6 WEATHER CONDITIONS

As weather conditions can change from hour to hour, and as not all erection activities are similarly affected by weather changes, persons in charge of supervising erection work on site should regularly monitor weather conditions, and take appropriate decisions. Weather conditions that could have an adverse effect on erection work include:

- Rain or dew that leaves the steel wet;
- High winds that may cause light components to blow about, suspended loads to swing or part-erected structures to become unstable;
- Frost, ice or snow that can result in slippery surfaces and endanger personal health;
- Fog, mist or glare that may impair visibility.

Even for low rise structures, on exposed sites it may be necessary to undertake a particular assessment of how wind might affect the proposed erection method in terms of stability, craneage and access equipment. BCSA guidance on *Steel Erection in Windy Conditions* and any guidance given by the manufacture or supplier of the plant in use should be followed.

If a decision is made to stop work, then measures should be taken to ensure the maintenance of stability of the remaining part-erected structure. If the wind is increasing sharply, it may be necessary to guy columns or even to dismantle them as a precaution. If the wind increases in strength more quickly than anticipated, such that it is no longer possible to operate safely but components have been left in a potentially dangerous condition, the designation and strict operation of an absolute exclusion zone will be necessary. Later, the stability of the previously erected components must be reassessed before work is restarted.

1.7 METHOD STATEMENTS

Employers must ensure, as far as is reasonably practicable, the provision of a safe system of work. The preparation of an erection method statement setting out the proposed erection scheme is an important part of planning for such a safe system of work. The extent of detail in a method statement will depend upon the size and/or complexity of the work. Simple jobs may only require a simple method statement and repetitive tasks may be covered by standard sheets. With this in mind, the BCSA has published a proforma suitable for use in preparing *Task Specific Method Statements* [see the Appendix to this code of practice].

For all but the most straightforward of structures, it is preferable that the frame designer identifies how the stability of the structure is to be developed by defining a safe design erection sequence. For complex structures it is essential that a more detailed design-basis method of erection is provided. It can also be the case that stability during erection is affected by the nature of the connections selected by the detailer. The BCSA's *Guidance Notes on the Safer Erection of Steel-Framed Buildings* give additional guidance on:

- How erection method statements should be prepared;
- Items to be considered in developing the erection method statement;
- How the design of connections can affect safe erection;
- Stability and temporary bracing.

Note that in this document terms are used in the following way:

- **Erection sequence.** The order in which components are lifted and placed into position; often this will be provided by a suitably qualified person who clearly understands design implications, and it does not need to be presented graphically.
- **Erection scheme.** The erection sequence presented graphically in the form of drawings.
- **Erection procedure.** An extension of the erection scheme or sequence that includes information about the location and movement of plant such as cranes; often this will be initially defined in the tender by a specialist in erection techniques.
- **Erection method statement.** This comprises what is needed for planning and control of the site operations; this document will add more detail to the erection procedure to ensure that it is comprehensive in coverage. Often this is based on a *generic method statement* but should always be developed into a s*ite specific method statement* by or with the collaboration of the person with primary line responsibility for supervising the work on the site. It is a "live document" that should be reviewed and updated if site circumstances dictate. It should then be distributed to all those concerned with the supervision of erection.
- **Addendum method statements.** These are often needed if a change takes place that affects the previously agreed method significantly.

1.8 REGULATIONS AND DOCUMENTATION

There are many regulations that affect site erection of steelwork, and it is the responsibility of management to be both familiar with the regulatory requirements and to ensure that relevant requirements are observed. Generally, the most practical way of doing this is to follow the approved codes of practice and guidance notes that have been prepared for this purpose by the Health & Safety Executive [HSE]. The person named in the Company's H&S Policy as having primary responsibility for health and safety is responsible for ensuring that line managers have copies of the latest relevant HSE documents.

Where directly relevant, copies of useful documents (such as the HSE's Construction Information Sheets [CISs]) should be issued to those directly responsible for the supervision of site operations. Site supervisors can then use the codes and guidance issued to brief site erectors as necessary. Supervisors should not rely solely on issuing paperwork to those undertaking the actual work on site; instead key abstracts should be used to brief the site team.

The BCSA *Guidance Notes on the Safer Erection of Steel-Framed Buildings* incorporate many of the most important points flowing from the regulations. The Steelwork Contractor should ensure that those with overall responsibility for steel erection are familiar with this document.

Currently the regulations of most importance to steel erection are:

- *Construction (Design & Management) Regulations* [CDM Regs]
- *Construction (Head Protection) Regulations*
- *Construction (Health, Safety & Welfare) Regulations* [CHSW Regs]
- *Control of Substances Hazardous to Health Regulations* [COSHH Regs]

- *Electricity at Work Regulations*
- *Health and Safety (First Aid) Regulations*
- *Health and Safety at Work, etc Act* [HSW Act]
- *Highly Flammable Liquids and Liquefied Petroleum Gases Regulations*
- *Lifting Operations and Lifting Equipment Regulations* [LOLER]
- *Management of Health & Safety at Work Regulations* [MHSW Regs]
- *Manual Handling Operations Regulations*
- *Noise at Work Regulations*
- *Personal Protective Equipment at Work Regulations* [PPE Regs]
- *Provision and Use of Work Equipment Regulations* [PUWER]
- *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations* [RIDDOR]
- *Workplace (Health, Safety & Welfare) Regulations*

New *Work at Height Regulations* are in the course of preparation.

BS 5531 *Safety in erecting structural frames* is a code of practice that is still current in terms of all its technical advice including especially that concerning how to ensure stability during erection.

Note that for many years steel erectors relied on the guidance given in a general series guidance note issued by the HSE in four parts entitled GS 28 *Safe erection of structures.* This guidance note was withdrawn by the HSE and has not been replaced as some of its advice has been outdated by more recent regulatory changes. Part 3 *Working places and access* and Part 4 *Legislation and training* of GS 28 were most affected by the subsequent changes, whereas most of the guidance in GS 28 Part 1 *Initial planning and design* and Part 2 *Site management and procedures* remains sound background advice. The Steelwork Contractor should ensure that those with overall responsibility for steel erection are familiar with BS 5531 and have reviewed for themselves what was in GS 28 Parts 1 and 2.

1.9 RISK ASSESSMENT

Employers must identify and assess hazards and risks that apply to their undertakings, and state the measures to be taken to eliminate, reduce or control those hazards. Such assessments should be in writing. The following steps should be followed:

- Operations or tasks that are or could be performed on site should be identified. Hazards that might arise from those activities are then listed. As these steps are generally common to steel erection operations on most construction sites irrespective of size and complexity, generic lists of activities and hazards may be prepared.
- The risk assessment then consists of evaluating the extent or degree of risk that could arise from each hazard. The ability to avoid, reduce or control risks arising from these hazards can be taken into account in order to reduce risks arising to an acceptable level, provided that the controls etc are managed. For instance, the risk of laceration from sharp edged steel components can be managed by the supply and enforced use of suitable gloves as personal protection equipment appropriate to the job in hand.

- Importantly, there is always the possibility that each new project may give rise to new hazards as each project is different. For this reason, the generic risk assessments associated with generic methods should always be reviewed alongside the implications of the site-specific method statement. If the design of the structure gives rise to special hazards, these should be identified in a design risk assessment issued as part of the *Pre-Tender Health & Safety Plan* and carried forward for action in the *Construction Health & Safety Plan.* The opportunity should be taken to consider whether some risks could be avoided by re-design.
- During the progress of the work on site situations may arise that require a review of methods and/or a re-assessment of risks. There may be the necessity to alter the sequence of work, to undertake variations to the work content, or a "walk round" the site may identify unanticipated or poorly controlled hazards. In all these circumstances, the BCSA's *Task Specific Method Statement* provides a proforma for additional hazard identification and risk assessment associated with specific situations.

2 DESIGN ISSUES

2.1 GENERAL

There is an obligation on Designers to have adequate regard to:

- Avoiding risks to health and safety
- Tackling the causes of risks at source;
- Reducing and controlling the effects of risks by means aimed at protecting anyone at work (ie general protection is preferable to providing personal protection for individuals);
- Providing information to contractors about significant residual risks occasioned by the design.

When providing information about erection to others, Designers should concentrate on items whose importance for safety would not be evident to persons without a detailed knowledge of the design and design practice. Generally, these residual risks will be identified in the *Pre-Tender Health & Safety Plan* or on the drawings. However, as the distinctive role of the Designer may be less clear if the work is being undertaken on a design-and-build basis, the Steelwork Contractor should ensure that in-house Designers are aware that they carry the same obligations defined above.

With respect to the erection of the steel structures of low rise buildings, the most important design considerations arise from the need to ensure stability of the part-erected structure. The design erection sequence will generally require an understanding of structural concepts that a Designer would have but which those responsible for supervising erection may well not have. This places a special obligation on the Designer to ensure that others without specialist knowledge are clearly informed about what might otherwise be latent hazards arising from the design concept. On more complex structures it may be necessary for the person drafting the Erection Method Statement to enter into a dialogue with the Designer. The NSSS requires that erection shall not commence until the method statement is accepted by the person responsible for the structural design.

2.2 STRUCTURAL LAYOUT

With low rise structures, the most important design issues affecting stability are:

- **Securing of single columns against toppling.** Before they are tied into other structural members, they may require guying if stability cannot be ensured by using suitable holding down [HD] bolt arrangements combined with wedging. Often the base details will be decided by the connection designer, and the wind speed used to review the stability of a single column (with wedges as appropriate) should be clearly communicated.
- **The condition of the foundations.** Erection is often started as soon as the foundations are complete and before they achieve their full design strength. The forces arising in the holding down bolts from, say, single erected columns may place significant loads on the part-cured foundation.
- **Pin bases.** Often column bases, such as those along valley lines in multi-bay buildings are designed as pinned connections. In such cases, the erectors need to be warned that it would not be safe to leave the columns un-guyed unless an assessment showed that the "pin" base does nevertheless provide sufficient rigidity.
- **The location of the permanent bracing.** The issue is whether it is suitably positioned to be erected early on and thus form part of a "stable box" for stabilising the equilibrium of the subsequently erected structure.

- **Stability of long slender members.** Quite large spans are achievable with slender rafters and such members require restraint to stabilise them against collapse by buckling. Usually this necessitates that the number and location of connecting purlin lines be identified such that craneage can be released. It may also require the use of two cranes for a single lift.
- **Valley beams.** It is quite common for alternate columns to be omitted on valley lines and for valley beams to span over two bays. If portal rafters or relatively slender trusses are connected to mid-span of the valley beams, the beams may lack the torsional rigidity needed to secure the end moment connection required by the rafter/truss. In such cases, temporary support may be needed to provide stability.
- **Precast units.** Being relatively heavy, both planks and staircases made of precast concrete can impose significant local loads that can de-stabilise the steel frame before the work is completed (eg by the use of in situ topping or grout). This may require a sequence of erection to be defined that has been evaluated for its design implications. The guidance issued by the Precast Flooring Federation on the safe erection of precast elements should be followed.
- **Bracing.** Even if the erection sequence has been arranged to utilise the permanent bracing, it is not uncommon that the execution of other construction work may require the temporary removal of bracing elements. If bracing is to be removed temporarily or if temporary bracing is required at any time, it will be necessary to ensure that this is approved by a suitably qualified person.

2.3 HANDOVER CRITERIA

With low rise structures, there are also design issues that affect the safe handover of the structure to following trades:

- **Grouting.** Until the bases are grouted, the structure does not possess the full stiffness and stability intended by design. It may be necessary to ensure that the grout is sufficiently cured before the structure is ready to receive other construction loads.
- **Decking and sheeting.** The locations where packs of decking or roof sheeting panels may be safely positioned may need to be determined by the frame designer. Fixing of decking or sheeting should not commence until the structure has been aligned.
- **Purlins.** The use of purlins to secure rafters has been noted above, but purlins are generally relatively slender members that require care to ensure that they are not damaged during installation. If sag rail systems and knee braces are utilised, these will need to have been installed before the sheeting is fixed to the purlin system or loaded out onto it.
- **Handrails and netting.** It is common for handrail edge protection and netting to be fixed to the steel structure to ensure safe access for following trades such as deckers and cladders. However, over-tensioned netting can distort steel members and fixing handrails to cold-formed purlins or edge beams requires care to ensure the members are not distorted.

- **Concreting.** Usually concreting is not undertaken by the steelwork contractor. Hence, the use of decking prior to concreting and the conditions necessary to ensure stability during concreting will need to be discussed between the relevant contractor, the Principal Contractor and the Designer.

3 MANUFACTURE AND DELIVERY

3.1 FABRICATION

Fabrication of steel components for the most common form of low rise structures is generally semi-automated nowadays, such that errors are few and trial assembly is unnecessary. Trial assembly would only generally be used where three-dimensional trusses are broken down for site delivery.

3.2 DELIVERY

Except in the rare case that there are large three-dimensional trusses, it is generally the case that steel components used in low rise structures can be delivered without the need of an escort. The Steelwork Contractor's primary concerns during delivery are thus to load the components so that they are not distorted or any surface coatings are not damaged. Surface coatings applied to internal steelwork are generally more for reasons of visual appearance than corrosion protection.

It is also necessary to ensure that they arrive in due time and in a manner that permits them to be easily unloaded to meet the requirements for site progress. On large open sites a lay-down area is generally needed to enable the components to be stored prior to erection. On restricted sites where components cannot be stored before erection, it will be necessary to erect "straight from the trailer", which means that loads need very careful stacking and that the trailer will be on site longer.

4 SITE ACCEPTANCE

4.1 PRINCIPAL CONTRACTOR'S RESPONSIBILITY

It is the responsibility of the Principal Contractor to provide a site that is suitable for erection to proceed safely. Prior to commencement of work on site, the Steelwork Contractor needs to clarify that site conditions provided by the Principal Contractor are safe for erection. The BCSA's *Safe Site Handover Certificate* [SSHC] should be used to ensure that the key issues affecting safety are addressed.

In completing the SSHC, the Principal Contractor also has the opportunity to identify any special conditions that may exist, such as shared use of access, fall protection or other provisions.

Often the Steelwork Contractor will have based the preliminary scheme for steel erection on the *Pre-Tender Health & Safety Plan.* The Principal Contractor is responsible for developing the *Construction Health & Safety Plan.* In developing this, the Principal Contractor should clarify any special requirements that may affect steel erection, such as special restrictions on hours of work, noise levels and timing of deliveries to site.

4.2 SAFE SITE HANDOVER CERTIFICATE

The *Safe Site Handover Certificate* has been developed to:

- Facilitate the safe erection of steelwork, with the risks arising from poor site conditions removed, avoided or reduced.
- Assist Clients, Principal Contractors and Steelwork Contractors alike to meet their respective responsibilities under health and safety regulations eg CDM Regulations.
- Provide criteria stipulating safe site conditions as an inherent part of the steelwork tender offer, and as an agreed basis for the commencement of steelwork delivery and erection on site.
- Provide a consistent approach to safe site conditions.

The SSHC provides a checklist approach to key areas of safety related to site conditions. In some cases, brief descriptions of the checklist items are given to maintain consistency of interpretation of terms and of specific requirements.

Commencement of site delivery and erection shall be contingent upon the completed and signed certificate being received by the Steelwork Contractor SEVEN DAYS before an agreed commencement date. Subject to agreement with the Steelwork Contractor, survey of the position and condition of column foundations may proceed prior to the acceptance of the site as safe for the main erection activities.

This seven-day period should allow the Steelwork Contractor to ascertain whether adequate conditions have been provided and, subject to that provision, to sign and return a copy of the SSHC to the Principal Contractor signifying that the steelwork delivery/erection can commence on the agreed date.

It is assumed that the site conditions will be maintained at a proper level, and the SSHC checklist provides the means for monitoring conditions throughout the programme of steel erection.

Similarly, where the contract involves phasing, the SSHC can be used as a means of either:

- Providing a single certificate with a condition that subsequent areas/phases will be provided to the same standards, or
- Providing multiple certificates, one for each phase.

When assessing site conditions and completing the SSHC, the following issues will need to be given due consideration: access for delivery; hardstanding; craneage; electric power lines; delivery, loading and off-loading on site; and attendances.

4.2.1 Access for delivery

The Principal Contractor should provide satisfactory means of access to the site so that delivery vehicles can reach the correct unloading point. Suitable unloading facilities should be available and the ground should be capable of withstanding the wheel loads of the delivery vehicles as well as any mobile plant used for unloading. Sufficient storage area should be designated and made available before deliveries of components take place.

The Principal Contractor should ensure that there are clear points of access, free of all obstructions, to allow passage of vehicles carrying the steelwork on to the site. No obstructions should prevent the access of vehicles with high loads, or the movement of cranes and lifting gear in the erection area. If there are obstructions, the Principal Contractor should provide sufficient and adequate warning that such hazards or restrictions exist prior to commencement of work on site.

When any vehicle is reversed, a banksman must be in attendance.

4.2.2 Hardstanding

The Principal Contractor should ensure that rolled and consolidated hardstanding is provided to the complete building footprint and for a distance of 5 metres around the complete perimeter.

4.2.3 Craneage and powered plant

The most common types of plant used for steel erection are mobile telescopic cranes, all-terrain telehandlers, crawler cranes and boom-type mobile elevating work platforms [MEWPs].

The Steelwork Contractor should ensure that only trained and competent persons operate powered plant except when persons are being trained under the direct supervision of a competent person.

Care must be taken to ensure that plant (for lifting, handling or access) is located on properly prepared ground. Outriggers should be well supported with no possibility of ground slippage. The Principal Contractor is responsible for notifying the Steelwork Contractor of the allowable ground bearing pressure of the made-up sub-base. The Steelwork Contractor should then calculate the requirements for outrigger pads, wheels or tracks as appropriate based on data from the plant manufacturer or supplier.

4.2.4 Electric power lines

Overhead power lines pose particular hazards to the use of cranes and MEWPs. Before any work is commenced full consultation should be sought with the Electricity Authorities. If possible the Principal Contractor should arrange for the power to be disconnected or the power lines diverted. If neither is possible the authority must signify, in writing, what the safe working distances from the power lines should be – based on a minimum of 6 metres.

Under no circumstances must any operation be carried out within the danger zone. The Steelwork Contractor and the Principal Contractor must collaborate to ensure that cranes and other plant capable of entering any danger zone is either kept away from the area by physical barriers, goal posts, or mechanical/electronic restrictions applied to limit the reach of appliances.

The Steelwork Contractor should ensure that erectors are briefed that, if at any time a machine makes electrical contact with a live overhead electric line, the following precautions should be observed:

- All persons should be kept away from the machine and they should not to touch any part of the crane, rope or load.
- The driver should remain inside the cab if possible.
- If it is essential to leave the cab through fire or other reason, the driver should be instructed to jump clear as far away as possible to avoid touching the machine and the ground at the same time.

4.2.5 Delivery, loading and off-loading on site

Special care is necessary in the delivery, storage and handling of components on site as unloading facilities may be less satisfactory than when loading at the fabrication works. The general means of unloading on open sites is by means of a telehandler or fork-lift that releases the primary craneage to continue erection and reduces the requirement for manual handling to a minimum. The Steelwork Contractor should ensure that:

- Deliveries are planned to coincide with the availability on site of personnel and plant adequate to deal with the work.
- Drivers and/or passengers are in possession of safety helmets for use when delivering to site and they do not remain in the cab of the vehicle during any loading/off loading operation.
- Special care is taken in loading the components at the fabrication works. They should be loaded in such a way (eg using timbers) so the slings may be placed easily for off-loading.
- Guidance issued by the BCSA on safe access onto trailers to sling components for unloading is followed.
- If part-loads are to be moved on site, the load is secure and that the vehicle has stability while it is being moved, and that the driver has checked the position of the load and its fastenings before taking a vehicle onto the public highway.
- As far as possible, components that are of such a shape or weight as to involve difficulty in handling should be in a position from which they can be lifted directly without adjustment of their position before slinging.
- Steelwork that is to be stacked and stored should be laid on suitable timber packers, not directly onto the ground. It should be stacked in a manner and position that will avoid any risk of stack collapse or component distortion. To minimise undue re-handling of the material, stacks should be in an area which will provide convenient proximity to the point of erection and which should avoid soil contamination from passing traffic.

4.2.6 Attendances

Unless agreed otherwise, the Principal Contractor should provide:

- Off-loading and hoisting for items other than steelwork components;
- Access to working levels;
- Perimeter edge protection;
- Skips for waste;
- Welfare facilities;
- 110V power as required;
- First aid facilities.

4.3 FINALISATION OF ERECTION METHODS

Before work is commenced on site, the Steelwork Contractor should ensure that agreement has been reached with the Principal Contractor:

- That the erection sequence included in the method statement has been accepted as safe by the Designers, and is in accordance with the *Construction Health & Safety Plan;*
- That adequate resources have been committed to the tasks;
- That competent personnel are available to undertake the tasks;
- That a chain of command has been established from the site erectors through to the Principal Contractor's senior agent on site.

Often it is necessary to change the method of working because of change orders/variations, or changed circumstances that arise. In such cases, it is the responsibility of the Steelwork Contractor to decide any changes to the sequence of work, to notify the Principal Contractor accordingly, and to brief the erection personnel about changes. For significant alterations, an addendum to the method statement should be produced.

4.4 BEARINGS AND FOUNDATION SUPPORTS

To permit safe and speedy erection of columns, tolerances are required between the prescribed level of concrete and the level of the underside of the column baseplates to allow for discrepancies in the level of the concrete. The permitted deviations for foundations, walls and foundation bolts are specified in the NSSS.

The common method of adjusting the level is attained by the use of packing plates. Generally these are placed in a single central pile. For larger columns it may be necessary to use four piles of packs or to use pairs of folding wedges instead, as illustrated in BS 5531.

The method to be used should be stated in the erection method statement so that the location where the packs will be positioned is known in advance. This is important as the concrete surface around that location needs to be generally level and smooth. Otherwise this would jeopardise the ability to provide a stable surface on top of the packing plates for the safe positioning of the column.

The Principal Contractor should ensure that foundations meet the requirements explained above and that the HD bolts are clean with free running nuts to permit proper tightening without overloading.

Occasionally, conventional cast-in adjustable holding-down bolts are not provided (eg for smaller columns or side posts). Then, it may be necessary to use resin anchors pre- or post-drilled. If pre-drilled anchors are to be relied upon to stabilise columns during erection, it is important that their capacity is properly evaluated. If post-drilled anchors are to be used, the method of stabilising the column without foundation bolts needs to address the hazards of toppling and lateral movement of the column base.

5 SITE PRACTICE

5.1 ACCESS AND WORKING PLACES

5.1.1 Temporary access during construction

The Steelwork Contractor must ensure that method statements and their associated risk assessments address the need to provide safe access and working positions. In general these can be provided as follows:

- Using telescopic boom MEWPs: this is the preferred method for steel erection of low rise buildings;
- Using crane-mounted cradles or "man baskets": this is the preferred alternative method for locations where boom MEWPS cannot reach;
- Using scissor-lift MEWPs: this is sometimes a practicable method for later operations such as bolting-up or site painting;
- Using mobile access towers: this is another method sometimes suitable for later operations if sporadic tasks need to be undertaken;
- Using scaffolding with suitable edge protection: this is rarely practicable except where very large steelwork items such as three-dimensional trusses need to be "dressed" with access equipment prior to lifting;
- Using ladders: these are often used for access but can only be justified for working positions involving easily-completed tasks of very short duration (eg replacing a bolt).

Note that, in principle, collective fall arrest for everyone is preferable to the provision of individual fall arrest equipment. However, the common systems of providing such fall arrest – netting, air mats and air cushions – do not provide suitable means of providing fall arrest during steel erection. They are suited to other activities associated with steelwork, and guidance on their use may be found in the BCSA *Code of Practice for Metal Decking and Stud Welding*.

The Steelwork Contractor should generally ensure that erectors working from mobile platforms or baskets use harnesses and fall restraint lanyards and are instructed not to climb out.

If access to the work is not reasonably practicable using any of the above methods, the Steelwork Contractor and the Principal Contractor should agree a suitable alternative. Methods that rely on exit from a mobile platform or basket at height or access over the steel itself may sometimes be justified, but the following considerations must be addressed:

- A *Task Specific Method Statement* should be developed, using a circumstance-specific risk assessment of the method.
- The controls and briefing needed to reduce the risk as far as possible (eg instruction on the need for double lanyards to provide fall arrest at all times and how these should be attached and re-located).
- The training and experience of the specific persons being asked to undertake the task.
- Recovery of persons should a fall occur.

The same principles may be followed if circumstances dictate that erectors need to gain height by standing on the rail of the basket/cradle as, with careful planning and control, this may sometimes result in less risk than alternatives. Fall restraint would still be needed. Employers are responsible for ensuring that scaffold is safe to use and complies with the regulations. Only competent persons may erect, alter or dismantle scaffolding, and a competent person must also inspect the work.

Mobile access towers [MATs] must be constructed with due regard to stability and may be used only on a firm base. The wheels must be secured against movement when a person is working on the tower and movement of the tower must be only from the base.

5.1.2 Exclusion zones

The Steelwork Contractor should try to ensure that others do not enter a hazardous area where steel erection work is taking place. Where reasonably practicable, the hazardous area should be established by the Principal Contractor as an exclusion zone within which only steel erection activity should be allowed. As a general guide the exclusion zone should extend to an area below all uncompleted steelwork and around columns to a distance 1.5 times their height.

Removal of the exclusion provisions should only be permitted to self-contained portions of the steel structure that have been completed and handed over in a condition ready for grouting.

If unauthorised entry is made to an exclusion zone, hazardous work should cease and a report should be made immediately to the Principal Contractor. Work should not be restarted until the situation has been resolved.

Objects falling from above are a hazard on construction sites; therefore, it is important that warning signs indicating overhead work should be posted by the Principal Contractor. Where possible, the area underneath overhead work should be cordoned off by the Principal Contractor with tape, bunting or barriers and, where necessary, moved with the work as it progresses.

The Principal Contractor should warn the Steelwork Contractor about exclusions zones operated on behalf of other contractors (eg around trenches). In addition, the Steelwork Contractor needs to ensure that all erection personnel remain alert to the possibility of hazards arising on site that are outside of their control. If these arise, they should be reported to the Principal Contractor and personnel should not enter the hazardous areas until the danger has been eliminated.

5.2 FALL PREVENTION AND ARREST

5.2.1 Fall protection

The Steelwork Contractor should ensure that work is not being conducted in areas where personnel are exposed to risk of injury – for example: on unsafe scaffolding, near exposed and unprotected edges or openings, under others working above, adjacent to others carrying out dangerous operations or in dark areas.

All holes, voids and edges should be protected wherever people work or pass nearby and there is a danger of falling more than two metres. The Principal Contractor should provide suitable barrier edge protection to the perimeter edge of floors and round all voids in accordance with of the CHSW Regulations. Edge protection barriers may sometimes need to be temporarily removed to aid the access of persons or materials, but they must be replaced as soon as practicable.

5.2.2 Fall restraint

During steel erection, fall restraint is generally only used when erectors are working in a MEWP or man basket.

5.2.3 Fall arrest

Where it is not reasonably practicable to provide fixed barriers and/or fall restraint, the Steelwork Contractor must consider how to provide fall arrest. During steel erection the only practicable method relies on harnesses attached with shock-absorbing lanyards to a suitable anchorage or running line.

Where fall arrest equipment is used, its safe use should be clearly defined by the Steelwork Contractor in a method statement that also includes a plan for the safe recovery of those who might fall, including ensuring that they do not strike the surrounding structure during the fall or when swinging afterwards.

5.2.4 Harnesses and attachments

The Steelwork Contractor should ensure that, where harnesses and lanyards are in use, erectors are instructed on how to check their equipment and what attachment anchorages are suitable.

For fall restraint purposes the loads are relatively low, and attachment points are provided on MEWPs etc. If it is necessary to use harnesses with fall arrest lanyards attached to running lines or directly to the steelwork, the shock load can be significant. The Steelwork Contractor should ensure that the advice of a suitably qualified person has been sought concerning the suitability of attachment points.

5.3 SPECIAL SITUATIONS

If work is to take place in confined spaces, over/alongside water or in other special situations, the Steelwork Contractor should develop a *Task Specific Method Statement* that addresses the specific measures necessary.

5.4 HEALTH HAZARDS

5.4.1 Housekeeping and waste

Unwanted materials should be kept to a minimum on site. The Steelwork Contractor should ensure that waste materials are disposed of as soon as possible and do not accumulate on the ground. The Principal Contractor should provide skips or other waste disposal facilities with the type of waste permitted designated on each skip.

When not required for immediate use, the Steelwork Contractor should ensure that loose materials arising from steel erection activities should be placed where they will not restrict unduly the passage of any person, and that the working area is cleared daily of any hazardous waste materials.

5.4.2 Manual handling

The Steelwork Contractor should provide lifting equipment on site, such as telehandlers or fork-lifts for off-loading and distribution, to minimise the amount of manual handling that is needed.

The Steelwork Contractor should use the BCSA's *Task Specific Method Statement* to define procedures for any remaining tasks that require manual handling of significantly heavy pieces.

5.4.3 Noise and hand-arm vibration

Pneumatic nut runners and other equipment used for erection can be the source of noise and vibration. In such cases, the Steelwork Contractor should use the BCSA's *Task Specific Method Statement* to develop safe procedures for using such equipment that meet the regulatory requirements for noise limitation and reduction of risk of hand-arm vibration syndrome [HAVS] (also known as "vibration white finger" [VWF]).

5.4.4 Hazardous substances

Under the *Control of Substances Hazardous to Health* [COSHH] *Regulations*, no substance should be permitted to be used unless a suitable assessment of the risks involved has been made and the steps needed to eliminate or minimise the risk have been taken. Examples of substances used during steel construction that may come under COSHH are gases, most liquids other than water and the residues from consumable products used in welding, painting etc.

If such substances are to be used, the Steelwork Contractor should use the BCSA's *Task Specific Method Statement* to develop safe procedures. In all cases, data sheets on the materials and antidotes should be provided on site, records of use must be kept, and such records should be available on site.

5.4.5 Fire precautions

Rubbish fires should not be allowed on site unless specifically permitted by the Principal Contractor. Where burning operations are to take place, an extinguisher should be provided.

Site accommodation should be sited in a safe place by agreement with the Principal Contractor. The Steelwork Contractor should provide each unit with at least one extinguisher appropriate to the fire risk involved and for the size of unit.

The Steelwork Contractor should ensure that:

- The relevant recommendations of HSE publication HSG 168 *Fire safety in construction work* are followed.
- Gas bottles, flammable liquids, paint and fuel are stored in accordance with regulations.
- *Task Specific Method Statements* are developed for welding and burning operations that could create fire hazards that include the consideration of whether a fire watcher needs to be appointed during these operations.
- Only sufficient gas bottles for the operation in progress are kept at the place of work: all others should be kept in a secure safe place.

6 TOOLS AND EQUIPMENT

6.1 LIFTING EQUIPMENT

The Steelwork Contractor must ensure that cranes are appropriate to the maximum weight they will be expected to lift and the 'reach' they will be expected to need. This should be done by identifying the necessary craneage in the erection method statement, which should also state the locations where cranes will need to operate. It is a sound precaution for the Steelwork Contractor to check these items even if craneage is provided by others (eg the Principal Contractor or an erection subcontractor).

The Steelwork Contractor must ensure that all lifting equipment being used is in accordance with the *Lifting Operations and Lifting Equipment Regulations* [LOLER]. The regulatory requirements for the provision and use of lifting equipment require that:

- Valid test certificates for cranes must be available at all times.
- Lifting equipment is thoroughly examined every six months in the case of equipment used for lifting people, or every 12 months in the case of other lifting equipment - but in either case in accordance with an examination scheme as where there is significant risk weekly or daily inspection may be necessary.
- All chains, slings, shackles and other lifting tackle must be tested and certificated before being brought into use.
- Six monthly examinations of chains etc must be undertaken and the records kept.
- All lifting equipment must be marked with its lifting capacity [eg SWL] and identification reference.

Note that the requirement for testing and certification of lifting tackle also applies to special rigging devices manufactured by the Steelwork Contractor for use on a one-off basis. It does not apply to temporary cleats attached to the permanent steelwork for attaching lifting equipment, which should, however, be designed by a suitably qualified person.

The Steelwork Contractor should also ensure that:

- All crane hooks are of an approved design.
- Damaged equipment is discarded or replaced to prevent it remaining in use.

6.2 SAFETY EQUIPMENT

The Steelwork Contractor must ensure that personal protective equipment PPE is provided in accordance with the needs of the task and as defined in the associated method statement and/or risk assessment. If individuals assume the responsibility for providing PPE for their own use (eg abseilers) this must be specifically agreed in advance and in writing.

The Steelwork Contractor should manage the provision and proper use of PPE by ensuring that:

- Users check the adequacy of their PPE daily, and are instructed to bring any possible deficiencies to the attention of their supervisor.
- The issue of specialist equipment, such as harnesses/lanyards, is recorded so that it can be replaced or inspected by a competent person at the necessary time.
- Where equipment is issued for the first time, the user is instructed on its proper use and care.
- As the *Construction (Head Protection) Regulations* require that safety helmets are used on all sites, everyone is instructed that safety helmets MUST BE WORN AT ALL TIMES IN ALL AREAS, except where management have agreed dispensation (eg mess rooms).

- Safety harnesses are worn and used as required by the safe system of work.
- Safety harnesses and with fall restraint lanyards are worn and suitably clipped on whenever MEWPS are being operated.
- If used as fall arrest protection, safety harnesses are used with suitable shock absorbing devices and users are instructed on what attachment methods and locations are suitable. Consideration should be given to providing suitably located holes in steel components for this purpose.
- A competent person regularly inspects safety harnesses for suitability/damage.
- If work is carried out involving risk of eye injury, appropriate eye protection is made available and the wearing of it enforced.
- If noise above permitted levels is likely to be produced by any erection activities or adjacent activities, appropriate ear defenders are provided.
- All those working on or visiting construction sites wear high visibility vests or jackets.
- Erectors are issued with suitable safety footwear and gloves.

The Steelwork Contractor should ensure that clothing used does not have flaps that could get trapped and is suitable for the weather conditions. Warm, water-proof outer garments will generally be needed in winter. In sunny weather, shirts should be worn and sun-screen cream used to protect skin from UV radiation. Foul weather clothing should be issued and used when necessary.

6.3 ERECTION EQUIPMENT

6.3.1 Mobile plant

In addition to the craneage used for lifting and placing the steelwork into position, other lifting equipment may be needed on site for off-loading, storage and distribution of the steel components. Fork lifts, side loaders and telehandlers are the most common. The Steelwork Contractor should ensure that the use of such equipment is limited to those erectors with appropriate training.

The Steelwork Contractor should ensure that MEWPs are appropriate for the job in hand. The relevant test certificates and inspection records must be available at all times.

6.3.2 Handtools

Three types of handtool are in common use for bolting:

- The podger spanner which has a tapered end to assist with aligning bolt holes in different plies;
- Club hammers to assist with aligning the steel locally taking care to avoid distortion;
- Socket spanners and ratchets to then tighten up the bolt assembly.

The Steelwork Contractor should ensure that:

- All erectors are fully familiar with how to use these tools.
- Tool belts are provided to reduce the risk that these tools are dropped.
- The tool belts are also suitable for carrying bags of the bolts needed for the connection being assembled.

Occasionally it is necessary to install proprietary fasteners (such as torque-controlled bolts [TCBs]), or to use torque wrenches or other devices to ensure that bolts are preloaded. In such cases, the BCSA's *Task Specific Method Statement* should be used to define methods of use. Erectors should be briefed on such special methods and may need to undertake trials under supervision before being allowed to work alone.

6.3.3 Survey and alignment

Survey equipment, such as laser sights, may require special care in use.

Alignment of the permanent works is generally undertaken by applying forces using *Tirfor* wires or pull-lifts. The Steelwork Contractor should ensure that the use of such equipment is properly supervised and that the supervisor is aware of precautions to take to avoid overloading the tackle and to avoid distorting or over-stressing the permanent works when using such equipment.

6.4 SPECIAL WORK EQUIPMENT

Where the work requires the use of special equipment – such as portable power tools, grinders, burning equipment, welding equipment, drills or reamers – the BCSA's *Task Specific Method Statement* should be used to develop safe methods of operation.

6.4.1 Portable power tools

Nut-runners and other portable power tools are in common use by steel erectors. The Steelwork Contractor should ensure that:

- All tools and equipment are suitable for the job or process in hand and are in good condition. Use of the "wrong tool for the job" is to be avoided.
- Low Voltage (110V) or rechargeable battery powered tools are used wherever possible. Such tools and any associated equipment need to comply with current standards for electrical equipment.
- If a portable generator or mobile compressor is used to provide power for small tools or welding, it is kept in good condition.

6.4.2 Grinders

If abrasive wheels and cutting discs are used, the Steelwork Contractor must ensure that users are competent and the equipment provided meets the requirements of the *Provision and Use of Work Equipment Regulations* [PUWER]. Wheels should only be mounted by a competent person.

6.4.3 Burning equipment

If burning is to be undertaken, the Steelwork Contractor should ensure that:

- The gas bottles are safely handled and stored.
- Gas valves and nozzles are in good condition.
- Burning operations can be damaging to the eyes; not only for those carrying out the operation, but also to others working nearby; hence, if such a risk exists, screens should be used or an exclusion zone operated.
- Suitable fire precautions are taken and "hot work" procedures operated if necessary.

6.4.4 Welding equipment

If electric arc welding is to be undertaken, the Steelwork Contractor should ensure that:

- The voltage should be as low as possible and consistent with requirements.
- Leads and return cables should be of equal length and in good condition.
- Welding operations can be damaging to the eyes; not only for those carrying out the operation, but also to others working nearby; hence, if such a risk exists, screens should be used or an exclusion zone operated. Weather protection may also be needed.
- Suitable fire precautions are taken and "hot work" procedures operated if necessary.

During welding, the provision of temporary means of support and stability may be needed to secure the joint in the correct position for welding.

6.4.5 Drills and reamers

Site drilling is generally undertaken using a *Rotabroach* bit in a drill with a magnetic stand. Precautions are needed to ensure that, if the power supply to the magnet is lost during use, the drill is restrained by a chain from falling too far. Reaming may be undertaken using a hand reamer or a mechanical reamer for larger holes.

7 ERECTION

7.1 PRE-ASSEMBLY

In developing the erection method statement, the Steelwork Contractor should give consideration as to whether it is reasonably practicable to undertake some pre-assembly of steelwork at a lower level, bearing in mind that even lower level work may present fall hazards. For low rise single storey buildings, often the greatest gains can be from "dressing" larger components with smaller ones before lifting, such as adding knee braces, wind stays and purlin sleeves to rafters. Other examples are the possibility of lifting rafters as pairs joined at their apex, and sections of pre-assembled parapet.

7.2 MAINTAINING STABILITY

In developing the erection method statement, the Steelwork Contractor should observe the following:

- The safety of the structure during erection is paramount. Wherever possible the structure should be erected as self-stable modules complete with the necessary bracings. If necessary, temporary support should be provided.
- Columns should normally be erected commencing from a brace bay. The bracing should be fixed as soon as practicable thereafter. Work should continue progressively down the length of the building placing columns, rafters, side rails, eaves rails and purlins, thus completing steelwork as building progresses.
- Columns should not be erected if they cannot be tied in with the rafters/rails etc by the end of the working shift. Unless specifically designed to do so, single columns must not be left unsupported for extended periods eg overnight (see the BCSA's guide to *Steel Erection in Windy Conditions*).

7.3 LIFTING AND POSITIONING

7.3.1 Lifting

In all cases each lift should be controlled by a competent person. In most cases this will be the gang chargehand acting in the role of slinger/banksman whilst the other erectors in the gang are guiding the steel component into position (on the ground or aloft) and then securing it in position with bolts. As a slinger the chargehand attaches the load to the crane, as a banksman (or signaller) the chargehand dictates the movement of the crane hook.

Immediately after any component is lifted clear of the round, and whilst it is still close to the ground, its trim should be checked by the slinger to ensure that it is still safely secured and it is taking the right attitude to enable it to be place in position as safely and easily as possible.

In those cases where special or complex lifts are required, a specific lifting plan will be required and the conduct of the lift will need to be under the control of an appointed person, such as the site supervisor or the Steelwork Contractor's erection manager. It may be necessary to draft a *Task Specific Method Statement* in such cases.

7.3.2 Slinging

The Steelwork Contractor should ensure that erectors know that during slinging:

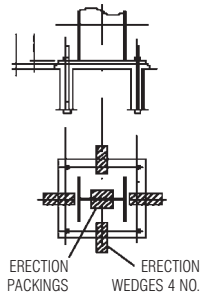
- Chains are generally preferable to fabric slings for steel erection.
- Slings, chains, clamps and shackles should be checked that they are properly and safely fitted.
- Multi-legged slings/chains, beam clamps, lifting beams or cradles, etc should be used to keep components in a horizontal attitude.
- Slings/chains should not be allowed to be trapped by steel loads. Trapping can either cut or damage the sling to a point where it would no longer be safe to use
- Chain slings should not be wrapped under load round the crane hook; the rings at the ends of the sling should be used instead.
- The load should be fully supported in the bowl of the hook and not on the tip.
- Snatch or sudden loads should be avoided.
- Where practicable, sections that are lifted horizontally should be controlled by a tail-line fixed to one end and held by a man on the ground.

In those circumstances where it is necessary to use two cranes to lift wide span portal rafters etc the Steelwork Contractor should select cranes of similar specification, and then arrange that they are under the single control of a competent slinger/banksman.

7.3.3 Columns

In order to erect steelwork it is necessary at some stage that single columns are stood upright. Ensuring that single columns do not topple before they can be tied in to form a stable module is sufficiently important that it is recommended that the Steelwork Contractor describes this in a *Task Specific Method Statement*. The principles are as follows:

- Before works starts, ensure that all the necessary equipment for erection of steelwork is on site.
- Place separate items (columns and the rafters or beams to be used to tie in) close to where they are to be finally erected.
- Ensure that the holding down bolts are cleaned and nuts free running.
- Packs are placed prior to erection of the columns, recording the amount placed at each base for checking when the column is erected on the base.
- The most common arrangement is as shown in the figure with the baseplate supported on a single central pile of packs and four wedges inserted around the perimeter of the plate.



- The packs are set at the required level or 3mm high to allow for any compression or to assist in beam level surveys at a later date, as steelwork tends to ‘sit down’ on bolt groups.
- The column is lifted onto the foundation and the pile of packs, and aligned to position on the centre lines as closely as possible, using position points and marks previously scribed on the concrete base.

- The HD bolts are tightened.
- The column is checked for plumb – with a spirit level.
- With part of the column weight on the central packs (say 1 tonne of a 3 tonne column), the column is plumbed using the HD bolts.
- When the column is 'near-enough' (bubble within the lines) all HD bolts are tightened.
- Then the wedges are driven in. This assumes that access is readily available around the baseplate, and special considerations might apply if the column base is set in a pocket or positioned on top of a narrow wall.
- The bolts are rechecked again for tightness.
- The column is released from the crane. Wherever possible, holes should be provided in columns to facilitate the use of "Quick Release Shackles". If not provided, suitably secured chain slings may be used.
- Progressive adjustment of the wedges and HD bolt tensions may be required to enable the other steel components to be installed that tie the column in initially – although this needs careful control.
- When the column is fully tied in with other steelwork, the wedges will be removed to allow alignment of the structure. The column can rock on the central pack to permit alignment of the structure and to achieve the tolerances stated in NSSS.

For larger columns (eg short, heavy columns with large baseplates) it may be necessary to use four piles of packs (or to use pairs of folding wedges instead), as illustrated in BS 5531. In this method the following procedure is followed:

- Four sets of laminated packs are set to exactly the same level and rechecked.
- The column is landed and aligned against the centre lines.
- The HD bolts are fully tightened.
- The column is checked for plumb with a spirit level.
- Plumbing of the column can only be achieved by adding or removing packs (or selectively driving in one of the folding wedges) but this requires lifting of the column, and probably means that the baseplate has not been welded perpendicular to the column shaft. HD bolts would then be retightened.
- The column is released from the crane.

This method is rarely used as to align the column and plumb [to NSSS] is very hard work. The column is not plumbed to NSSS when on the crane as it would be too time-consuming, so alignment is done using wedges and a heavy hammer. This introduces an additional risk from injury whilst swinging the hammer. Also, it is difficult to install further pieces, as the column is rigid. This may also introduce additional hazards and hold up progress.

Another method is to use two nuts on each HD bolt, with the lower one used for levelling.

If conventional cast-in adjustable holding-down bolts are not provided, it may be necessary to use resin anchors pre- or post-drilled. If pre-drilled anchors are to be relied upon to stabilise columns during erection, it is important that their capacity is properly tested.

In some circumstances it may be necessary to hold the column in one crane whilst it is being tied in with other members installed by a second crane. This could include tall, slender columns above, say, 10m in length, top heavy columns or asymmetric columns with a centre of gravity away from the column shaft centre line.

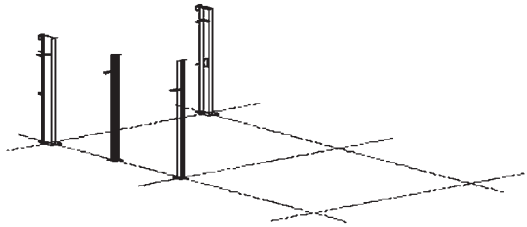
7.3.4 Rafters

The Steelwork Contractor should generally observe the following practice:

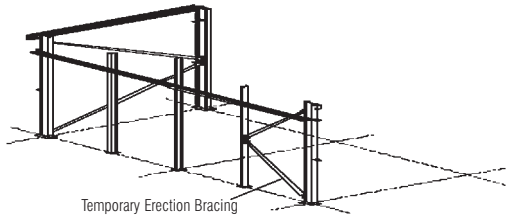
- Prior to actually lifting the rafters, wind stays etc should be loosely bolted to their respective cleats. Purlin bolts may also be loosely positioned in the cleats at this stage.
- For a shallow pitch roof, a single rafter section should normally be lifted at its point of balance. In the case of steep pitch, 10^0 or more, it should be lifted so that when suspended it will assume an angle from the horizontal as close as possible to that of the roof pitch. To ensure an appropriate angle, wherever practicable, the two halves of a rafter should be bolted together at ground level and lifted into position as a complete unit, the apex bolts being fully tightened prior to lifting.
- Once the rafter has been lifted to the desired position the haunch connections can be made using the bolts and necessary washers specified in the bolt list.
- It may be found necessary to slightly adjust the position of the column to enable the haunch connection to be made. If this is the case, tightening and loosening the HD bolts will usually provide sufficient adjustment. With rafters forming a span of more than 35m it is usual to use two or more lifting appliances – ie lifting the whole span as one unit, but as if it were still two separate rafters. Two cranes would not normally be considered for light rafters less than 30m span.
- When using two cranes, there is a possibility for a large span to topple at the apex. In this situation temporary restraint wires/ropes should be considered.
- The use of a hand line attached to the rafter is also recommended generally as it prevents the rafter spinning in the wind.

7.3.5 Stable box

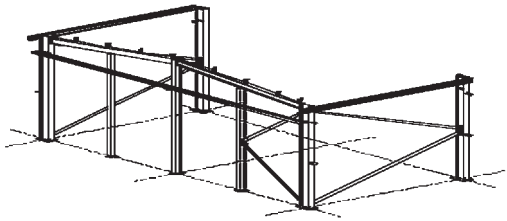
Illustration of a typical sequence to erect enough steelwork to form a stable box is as follows:



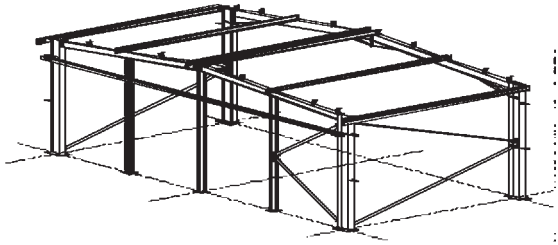
Stage 1: Set the first columns in position, keeping the number of unsecured free-standing columns to as few as reasonably practicable especially in windy weather.



Stage 2: Install the vertical bracing and eaves beam; extend the gable steelwork, tying in the posts with rails. Note that some gable frames do not have full rafters to serve as sway bracing, so temporary bracing may be needed as illustrated.



Stage 3: Install the gable rafters and bolt up the gable posts; install the column, vertical bracing and eaves beam on the other elevation.



Stage 4: Install the first set of main rafters and tie in with single-spanning purlins.

7.3.6 Beams

The Steelwork Contractor should generally observe the following practice:

- Beams should normally be lifted at the point of balance as most beams are finally fixed horizontally. If, for a particular beam, the angle with the vertical is different from 90º, then an adjustment in the slinging leg lengths by a proprietary-shortening device should be made.
- A tail line should always be attached to prevent the beam spinning in the wind. Special care may be needed when erecting on a site surrounded by other buildings as beams may leave the lee of a sheltered zone and suddenly enter a zone exposed to much higher wind speeds.
- For lifting a canopy or lean-to rafter, the same procedure should apply at ground level and then the item lifted as a beam or rafter. As far as possible maintain the component as close to its erected attitude as possible.
- Crane beams require special attention, as they are generally erected to a more exacting tolerance for line and level. As a general rule they should be positioned as close to the column as possible when first erected (they are usually connected with a slotted connection). It is much easier to move a crane beam away from the column than it is to move it towards it. A small jack may be employed for this purpose; landing should be on pre-set packs, where applicable.

7.4 BOLTING-UP

7.4.1 General

The Steelwork Contractor should ensure that the maximum number of joints is made at ground level.

The erector should be instructed to always:

- Use a MEWP for access to make connections on the structure, where practicable.
- Take sufficient bolts, nuts and washers to the connection by bag in the basket of the MEWP.
- Ensure that the spanners required to secure the bolts are of the correct size and of adequate length to achieve the required tightness of the bolts.
- Ensure that the ground below is clear of persons who may be injured by falling bolts or spanners.

7.4.2 Secondary steelwork

The Steelwork Contractor should generally observe the following practice:

- Secondary steelwork should be positioned and fixed as the building progresses. Positioning of components should be carried out during the period when the crane is on site.
- Access to install and bolt up should be by MEWP wherever reasonably practicable. Purlin sag bars should be fixed starting from apex.
- All bracing should be fitted strictly in accordance with the erection drawings and all bolts installed immediately and tightened as soon as possible.
- Temporary bracing may be necessary where the permanent sidewall bracing is not suitably located to allow erection to proceed as described earlier. This must be suitably designed to resist normal construction and wind loads on the frame. It should also be designed is such a way as to facilitate safe removal (eg using bolted cleats).

8 COMPLETION

8.1 ALIGNMENT

Unless specifically forbidden in the Steelwork Contractor's erection method statement, installation and removal of temporary ties (eg *Tirfor* wires or pull-lifts) used to assist with the alignment of the structure may be added and removed at the discretion of the erection supervisor.

8.2 HANDOVER

Prior to withdrawing labour, plant and equipment from site, the Steelwork Contractor should ensure that the steelwork is handed over to the Principal Contractor in accordance with the specification and in a safe condition, and that this handover is recorded. The assessment of whether the structure is complete and stable as a "bare" steel frame is the responsibility of the Steelwork Contractor. It is the Principal Contractor's responsibility to assess whether the structure is safe for the use of following trades. The column bases should be fully grouted before other trades are permitted to have access to work on the structure unless authorised by the Designer or a suitably qualified person.

If the Steelwork Contractor is asked to omit or remove components of the permanent works to permit access for others, this request should be referred to the Designer or a suitably qualified person for agreement to check whether the action could endanger structural stability.

8.3 SITE CLEARANCE

The Steelwork Contractor is responsible for ensuring that all his equipment brought on to site has been safely removed.

Temporary bracing and other temporary works should only be removed with the consent of the person who has specified what temporary works shall be used. Generally, the timing for removal will be specified in the erection method statement that the Designer has reviewed.

9 ACCIDENTS

9.1 LOG/DIARY

In addition to any arrangements made by the Principal Contractor, the Steelwork Contractor should ensure that the person on site identified as being in direct control of erection maintains a personal log/diary and keeps it with them at all times in case an accident or emergency arises. It should record the significant events concerning:

- Weather and site conditions.
- Drawings and amendments issued.
- Plant resources and manpower on site.
- Toolbox briefings given.
- Deliveries received.
- Progress with erection, alignment and handovers.
- Health and safety issues.
- Problems encountered.
- Liaison with the Principal Contractor, daywork and site instructions received.

Entries in the log should be summarised in the form of a short daily report for issue to the Steelwork Contractor's manager in charge.

9.2 RESCUE AND RECOVERY

The Steelwork Contractor should review with the Principal Contractor what emergency rescue equipment should be available in case of accidents at heights.

As MEWPs will normally be used to access an erector from heights, at least two (or one and a man basket) should be available on site. A man basket can also provide access to any part of the structure that is inaccessible by MEWP, provided there is a crane on site with a suitable capacity to lift and recover the manned basket.

9.3 FIRST AID

Provision of first aid should be coordinated by the Principal Contractor. This includes identification of who are the designated first-aiders and where the first aid facilities and resources are located.

The Steelwork Contractor has a special responsibility to ensure that specific situations that might possibly occur during steel erection are adequately covered. These include: trauma from falls in harnesses, trapping of limbs by heavy components and exposure of eyes to dust and grit.

9.4 ACCIDENT REPORTING

The Steelwork Contractor must make arrangements to ensure that ALL accidents are recorded in the accident book kept on site.

The Steelwork Contractor should also ensure that any accidents are reported to the Principal Contractor and that the Company Safety Officer is informed so that follow-up investigations and reporting can be undertaken.

It should be noted that:

- It is the responsibility of the employer of any injured person to report all major injuries, reportable diseases and dangerous occurrences (see RIDDOR for definitions) to the enforcing authority (usually the local HSE office) by the quickest means available (ie telephone). Generally the employer would be the Steelwork Contractor or their specialist erection subcontractor.
- It is the responsibility of the employer of any injured person to report all injuries involving absence of more than three days to the enforcing authority within ten days.
- In such cases, a copy of the report should also be forwarded to the Principal Contractor.

REFERENCES

Publications produced by the BCSA:

Code of Practice for Metal Decking and Stud Welding

Erectors' Manual

Guidance Notes on the Safer Erection of Steel-Framed Buildings

Health & Safety Guide for Sites

National Structural Steelwork Specification for Building Construction

Safe Site Handover Certificate

Steel Erection in Windy Conditions

Task Specific Method Statement

Other publications:

BS 5531 *Code of practice for safety in erecting structural frames*

ACKNOWLEDGMENTS

This code of practice has been produced with the special assistance of:

Andrew Kilby	Atlas Ward Structures Limited
Tony Power	Barrett Steel Buildings Limited
Mike Rowe	Billington Structures Limited

APPENDIX: Task Specific Method Statements

For ease of reference, this code recommends that a *Task Specific Method Statement* may be needed for the following tasks or situations:

TASK OR SITUATION	TYPE
Issue of variations or site instructions	Site specific
Alterations to the erection sequence to cope with circumstances arising	Site specific
Coping with unanticipated hazards arising on site	Site specific
Work in confined spaces	Generic
Work over or alongside water	Generic
Manual handling of heavy pieces	Generic
Using equipment that causes noise or vibration	Generic
Coping with substances hazardous to health	Generic
Site welding	Generic
Burning	Generic
Use of equipment for tightening preloaded fasteners	Generic
Site drilling steelwork	Generic
Reaming	Generic
Erection and stabilisation of a single column including packing, wedging and tightening of HD bolts	Generic
Special or complex lifts requiring an appointed person to control	Site specific

Based on the activities defined in the Scope of Competence listed in BCSA's *Guidance Notes on the Safer Erection of Steel-Framed Buildings,* the following tasks or situations may also demand the preparation of a *Task Specific Method Statement:*

TASK OR SITUATION	TYPE
Normal Scope of Competence	
Jacking	Site specific
Hot work	Generic
Site painting or "touch up"	Generic
Fixing of metalwork items (railings, balustrades, stairs, walkways, ladders, catwalks, steel flooring)	Generic
Placing precast flooring	Generic
Drilling concrete	Generic
Installing expanding/chemical anchors	Generic
Work on a contoured site	Site specific
Work on a confined city centre site	Site specific
Work over or in close proximity to publicly accessible areas	Site specific
Connection to an existing structure	Site specific
Special Scope of Competence	
Grouting bases	Generic
Placing movement bearings	Generic
Installing a scaffold platform	Generic
Assisting external inspectors	Generic
Use of special fasteners of fixing proprietary items	Site specific
Work in artificial light	Generic
Lateral movement of heavy loads (eg using winches)	Site specific
Work over a railway or airside at an airport	Site specific
Work alongside a trafficked road or during a possession	Site specific
Work on tall structures outside the reach of a MEWP	Site specific
Other activities	
Arrangements for radiographic inspection	Site specific
Site blasting	Generic
Fixing pre-glazed frameworks	Site specific
Using bonded adhesives	Generic
Proof testing to commission runway beams etc	Site specific

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