



The Climbing of Tower Cranes



CPA Best Practice Guide



National Construction College

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The Climbing of Tower Cranes

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Working in Partnership

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Foreword

Every year, the construction industry is responsible for causing deaths and serious injury. In recent times the industry has done much to improve its performance which I welcome, but there is always room for more improvement. Tower cranes are an essential part of the construction process and are widely used to move materials around site, which can help resolve some of the safety problems arising from space constraints and workplace transport issues.

In certain circumstances the height of tower cranes is increased using a technique known as 'climbing'. Climbing operations are a specialist area of work and potentially catastrophic unless they are planned meticulously and carried out by suitably trained and experienced personnel working effectively as a team. Tragically, both site workers and members of the public off site have been killed in tower crane accidents. In addition to the terrible cost in human suffering, accidents have a financial cost. There is a very strong business case for improving safety performance.

The law in this area is clear. There are specific legal requirements to ensure that all cranes are installed, inspected, examined and maintained to ensure the risks relating to lifting are adequately controlled. Investigations into recent accidents have shown that enhanced standards of planning, management and execution of the climbing process could have reduced the chance of death and injury.

This guidance has been prepared by industry specialists to provide clarity about the practical elements of tower crane climbing. The guidance is simple but comprehensive and easy to adopt. It represents best practice.

I thank those who have been involved in its preparation and commend the guidance to anyone who owns, supplies or controls the operation of tower cranes. Please read the publication and turn the advice into action.



Philip White

HM Chief Inspector of Construction

Chair of the Health and Safety Executive's Construction Industry Advisory Committee (CONIAC).

1.0 Introduction

The climbing of tower cranes is a specialised technique used in the installation of tower cranes to increase or decrease the height of a crane without the use of a large mobile crane to lift components to the top of the crane. Successful tower crane climbing operations depend on detailed planning and effective teamwork by suitably trained and experienced personnel.

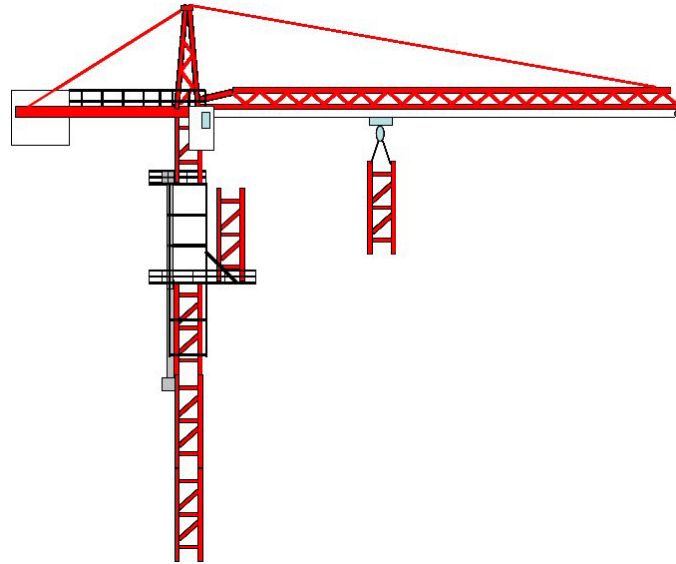


Figure 1 – External Climbing

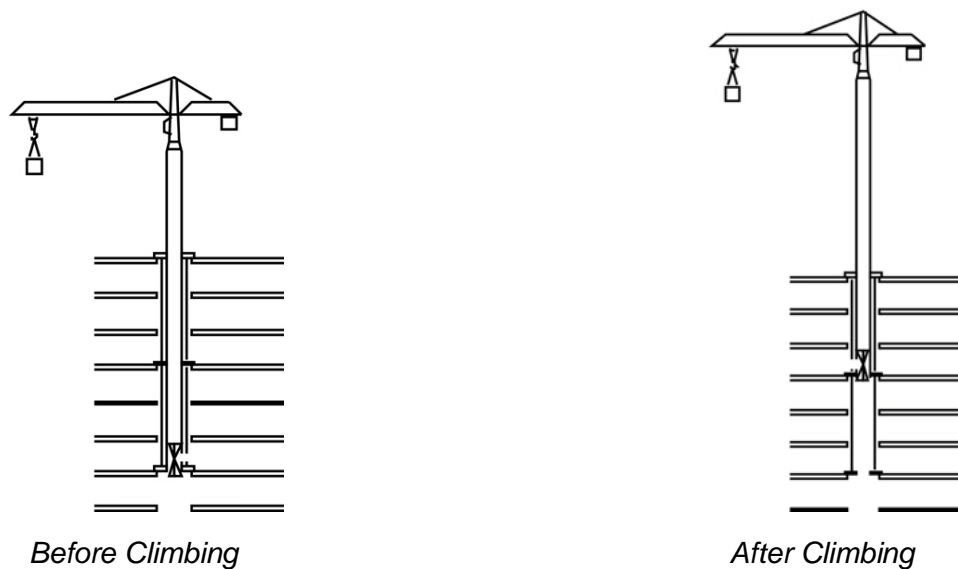


Figure 2 – Internal Climbing

Most tower cranes are erected to their full height using another crane, either a mobile crane or another tower crane. This method is not however always possible as very tall cranes may require tying to an adjacent structure, often the building they are helping to construct, and consequently need erecting in stages. Additionally in congested city centre sites there is often not sufficient room on which to stand the large mobile cranes required to erect tower cranes to great heights. In these cases the height of the tower crane may be extended using climbing techniques. These fall into two main categories, external (where the tower of a crane outside a building is extended with a jacking system to allow additional

tower sections to be inserted), and internal (where the crane tower is supported by the building floors and is jacked up as the building rises). These two methods are illustrated in **Figure B1** and **Figure B2**.

The purpose of this Best Practice Guide is to provide tower crane installers and users (hirers) with guidance on the planning and management of climbing operations, selection and training of climbing personnel and the maintenance, inspection and thorough examination of climbing equipment. The erection, alteration and dismantling of tower cranes is normally carried out by the tower crane owner or supplier, consequently the guide concentrates on information for these people, however the information in this document will also assist tower crane users, in particular Principal Contractors, to fulfil their duties under the Construction Design and Management Regulations 2007 to assess the competence of their tower crane suppliers.

It is essential that Principal Contractors allow sufficient time in the construction programme for the planning and execution of the climbing process. Any pressure for this potentially hazardous operation to be completed hastily will increase the risk of catastrophic failure.

The CPA Tower Crane Interest Group has produced a series of Technical Information Notes (TINs) giving guidance on specific aspects of tower crane operation. These TINs, which are continually being updated and added to, are referenced throughout this document and are available as free downloads on the CPA website at www.cpa.uk.net

***NOTE:** The external climbing process is shown in detail in the DVD on “The Safe External Climbing of Tower Cranes” produced by Lend Lease and Select Tower Cranes in partnership with the Construction Plant-Hire Association and the Health and Safety Executive. Copies of the DVD may be obtained from the CPA.*

Attention is drawn to the following statutory regulations:-

- The Health and Safety at Work etc. Act 1974;
- The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER);
- The Provision and Use of Work Equipment Regulations 1998 (PUWER);
- The Management of Health Safety & Welfare Regulations 1999 (MHSWR);
- The Work at Height Regulations 2005 (WAHR);
- The Supply of Machinery (Safety) Regulations 2008;
- The Construction (Design and Management) Regulations 2007 (CDM);
- Personal Protective Equipment at Work Regulations 1992 (PPE);
- The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR);
- The Air Navigation Order 2000;
- The Notification of Conventional Tower Crane Regulations 2010

2.0 Planning

All climbing operations should be planned to ensure that they are carried out safely and that all foreseeable risks have been taken into account. Poor planning is one of the major causes of accidents arising from climbing operations.

2.1 *The appointed person*

The planning of tower crane climbing operations is the responsibility of the "appointed person" who has been nominated by management of the organisation carrying out the climbing operation (generally the tower crane owner or supplier) to be in overall control of the lifting (climbing) operations and the members of the climbing team (**See 4.2**).

2.2 *Identifying the task to be undertaken*

As the first stage in the planning process, the task to be undertaken should be clearly identified, together with the location and sequence of work. In general there are benefits in considering the need for the climbing of tower cranes early in the construction planning process. It may be possible to avoid the need for climbing altogether.

2.3 *Site surveys*

The planning of a tower crane climbing operation will require a site survey, carried out by a competent person employed by the tower crane owner. This involves visiting the location where the task is to be carried out, preferably with a representative of the user and the Principal Contractor, so that both the task and any hazards involved can be identified. This planning should be undertaken as part of the overall planning before the tower crane is installed on site and should consider the climbing down of the tower crane as well as climbing up.

2.4 *Identifying the hazards associated with the task*

The hazards associated with the task should be identified. These might be associated with the location where the work is to be carried out, the nature of the tower crane and climbing system or the people associated with the task or located in the vicinity. A non-exhaustive list of hazards includes:-

- Collapse due to changing wind loading;
- Collapse due to incorrect balancing of the tower crane top;
- Collapse due to inadvertent slewing during climbing;
- Collapse due to inadequate tie connection arrangements;
- Loss of support for the climbing frame during jacking;
- Falling from walkways, platforms or ladders on the climbing frame;
- Falling objects;
- Incorrect operation of the climbing frame;
- Incorrect connection between the tower crane top and the climbing frame;
- Mechanical/electrical failure of the climbing frame.

NOTE: Under no circumstances should tower crane climbing be undertaken at night or without due consideration of light or weather conditions.

2.5 Carrying out a risk assessment

Having identified the hazards associated with the task, a site specific risk assessment should be carried out to identify who might be harmed, the chance of them being harmed and the consequences of any harm. This assessment should be recorded.

It is essential that the appointed person carrying out the risk assessment has sufficient detailed knowledge of the specific tower crane and specific climbing equipment to be used, in order to identify hazards.

Once the risk assessment has highlighted the risks involved in the task, the procedures and measures required to control them should be identified.

2.6 Developing the method to be used

Having identified the hazards, evaluated the risks and worked out the control measures required to carry out the task safely, they should be developed into a coherent plan. Any contingency measures and rescue procedures should be included in the plan.

2.7 Recording the planning in a Method Statement

Once the plan has been developed it should be recorded in a method statement. The method statement should address all the issues and control measures identified by the risk assessment, including the issues identified in 3.0.

An example of a risk assessment is shown in **Annex C** and an example of a method statement in **Annex D**.

2.8 Liaison during the planning process

Adequate planning by all parties involved in the climbing operation is essential, together with adequate liaison between all parties to ensure that the operation takes place on the day in an efficient safe manner, with the absence of "unforeseen circumstances". As a minimum this will involve the Crane Company and the Principal Contractor, and the Crane Hirer, where they are not the Principal Contractor. It is essential that, wherever possible, planning allows the operation to be undertaken at a time when the potential effect on non-essential personnel on site and the general public in the vicinity, is at a minimum and that sufficient time is allowed to ensure that the operation can be completed safely. Annex J contains a comprehensive checklist to assist with this process. The Method Statement should be formally accepted by the Principal Contractor before climbing operations begin. Annex K gives further information on liaison and approval.

It is essential that the design of tower crane foundations and fixing points for ties are considered early in the planning process (**See 7.0**).

2.9 Communicating the plan to all persons involved

One of the most important aspects of successful planning is to ensure that the contents of the plan are communicated effectively to, and between, all parties involved, taking account of language differences. Arrangements should be made to ensure that copies of any method statements are given, and where necessary explained, to the appropriate people (including the Principal Contractor) and that others involved in or affected by, the job to any extent are fully briefed. Similarly any changes to the plan should be communicated to all parties. (**See 3.8**)

2.10 Reviewing the plan seven days before the start of the climb

Not more than seven days before the climbing operation is due to start a joint inspection and meeting should be held on site between the Crane Company and the Principal Contractor, together with the Crane Hirer where they are not the Principal Contractor, to verify that:-

- There have not been changes to the anticipated site conditions or hazards that affect the risks;

- The method statement remains adequate and details all currently required precautions;
- All temporary works have been completed in accordance with the design and are of adequate strength to take the maximum loads imposed on them at any stage of erection, climbing or operation (**See Annexes F & G**);
- All arrangements for road/footpath closures, exclusion zones etc are in hand.

2.11 Reviewing the plan before starting on the day of the climb

On the day of the climb the Crane Company and the Principal Contractor should carry out checks to ensure that:-

- Arrangements are in place to ensure that advice is available in an emergency;
- Circumstances have not changed, the risk assessment is still valid and that the method statement is still adequate;
- All precautions such as exclusion zones etc are in place;
- All associated with the operation have been inducted and briefed on the safe methods of works;
- The erection crew has the relevant agreed skills training/competence;
- The method statement and manufacturers guidance is on site;
- Emergency procedures are in place.

If any modifications to the plan are required these should be communicated to all those involved, including the Principal Contractor. The appointed person should authorize any amendments to the method statement, following discussions with both the Erection Supervisor and Principal Contractor.

It is recommended that following the above checks that both the Crane Provider's Supervisor and Principal Contractor's Manager sign off a "*Permit to Erect, Climb or Dismantle*", before work commences for the first time and on each subsequent day of the operation. A suggested format for a "*Permit to Erect, Climb or Dismantle*" is shown in **Annex K**.

2.12 Further guidance

Further guidance on planning of lifting, installation and climbing is given in:

- BS 7121 Code of practice for safe use of cranes – Part 1 General and Part 5 Tower Cranes;
- L113 Safe Use of Lifting Equipment - Lifting Operations and Lifting Equipment Regulations 1998 Code of Practice - ISBN 0 7176 1628 2;
- HSE Leaflet INDG218 – Guide to Risk Assessment;
- HSE Leaflet INDG163 – Five Steps to Risk Assessment;
- Tower crane stability, 2006. CIRIA C654. Construction Industry Research and Information Association;
- Crane Stability on Site, 2003. CIRIA C703. Construction Industry Research and Information Association;
- Guidance on The Planning & Liaison Process for the Erection, Climbing & Dismantling of Tower Cranes, Strategic Forum For Construction;
- The Safe External Climbing of Tower Cranes" DVD Lend Lease and Select Tower Cranes
- HS(G)151 Protecting the Public – Your next move. HSE Books.

3.0 Issues to be Addressed in a Method Statement for Climbing Operations

3.1 Issue and revision

The front cover of the method statement should clearly identify the site, tower crane, task to be undertaken, author, date of original issue, issue number, date of any subsequent revisions and distribution list.

Any changes to the method statement following its initial issue should be recorded by a revision to the document and the document reissued for acceptance by all parties.

The appointed person, having authorised the changes, should ensure that all persons on the distribution list are in receipt of the latest version before the start of the operation.

3.2 Tower crane configuration

Details of the tower crane configuration before and after the climbing operation to be undertaken should be recorded.

3.3 Power supply

Power supply arrangements should be specified. The integrity of the power supply should be assessed, as a power failure during climbing may have serious consequences. If mains power is being used, the provision of a standby generator on the climbing frame with sufficient capacity to power the climbing equipment should be considered.

Where a mains supply is not available and a generator is being used, steps should be taken to ensure reliability, including evidence of effective maintenance and the undertaking of a test run before the climbing operation begins. The provision of a standby generator with sufficient capacity to power the climbing equipment should also be considered.

3.4 Programme

A detailed programme should be included indicating the tasks to be achieved each day, with an indicative start time and approximate duration for each task, together with the configuration of the tower crane at the end of each day's work (see Annex D).

3.5 Hold points

Hold points are critical points in the operation where the operation should stop until checks have been carried out by the Erection Supervisor, and the hold point signed off in the method statement. Typical hold points would be:

- On completion of assembling the climbing frame assembly have the bolt torques been checked, the checklist completed and a thorough examination carried out;

NOTE: *Once tightened to the correct torque, all climbing frame and tower bolt heads should be marked to indicate their status*

- The attachment of the crane top to the top of the climbing frame before climbing starts;
- Once a tower section has been installed ensuring that all the tower bolts have been inserted correctly and torqued to the correct preload before climbing restarts or the crane is put back into service.

3.6 Responsibilities

The responsibilities for each part of the preparation and execution of the operation should be clearly stated (e.g. site access (**See 3.11**), exclusion zones (**See 3.17**), base preparation for mobile crane (**See 3.14**), tying points, oversailing tower cranes (**See 3.12**). The appointed person should be clearly identified in the method statement.

3.7 The erection team

The composition and responsibilities of the erection team should be specified (including names and evidence of competence), together with the duties of each member of the team.

3.8 Briefing arrangements

3.8.1 Site induction

On arrival on site the Principal Contractor should ensure that a site induction of the full erection team is carried out

3.8.2 Climbing briefing

The arrangements for a full briefing of the erection team and other parties as necessary should be specified. The briefing should ensure that personnel are familiarised with the contents of the method statement and any sections of the manufacturer's manual to which it refers.

Briefings should take place on site every day during the course of the climbing operation and should be given by either the appointed person, if they are on site, or the Erection Supervisor. The person giving the briefing should confirm that they are in possession of the latest revision of the method statement and manufacturer's manual before the briefing.

The aim of the briefing is to ensure that everyone involved directly or indirectly in the climbing operation is clear on the overall objectives of the task and their role in achieving that objective. Particular emphasis should be placed on contingency arrangements and those being briefed should be encouraged to ask questions and seek clarification on any points on which they are not clear.

All those attending the briefing should sign a declaration confirming that they have attended and understood the briefing.

3.9 Preparation of components and equipment

Arrangements for the off-site preparation of tower crane components together with equipment such as climbing frames, power packs and torque gear should be specified, together with details of any on-site assembly and inspection required before climbing begins. Evidence of inspection and through examination should be available on site.

3.10 Transport of components to and from site

Arrangements for the transport of components and equipment should be specified, taking into account the sequence in which they are required, to ensure that the climbing programme is not delayed. These arrangements should take into account any parking restrictions both on site and in the surrounding area.

3.11 Access

Details of access to the site for both the vehicles involved in transportation of tower crane components and climbing equipment as well as the crane(s) used for erection should be recorded. This should include agreed access routes, taking into account ground conditions and the need for robust traffic management systems, including road closures.

3.12 Proximity hazards

Details of any proximity hazards that might impinge on the operation, such as railways, roads, public access, aircraft or other cranes, should be recorded, together with the measures required to mitigate these hazards. This should also include any restrictions on oversailing adjacent properties which might well prevent the crane top from being put into balance in accordance with the manufacturer's instructions.

3.13 Structural considerations

Tower crane climbing frequently involves tying to an adjacent structure, often the building on which the tower crane is being used for lifting operations. As part of the planning process it is important that the design and fabrication of the ties is taken into account, together with the connection to the structure. The location and structural requirements of internally climbed tower cranes should also be considered at this stage. All design work should be carried out by suitably qualified engineers (**See 7.0**).

3.14 Craneage arrangements

The arrangements for any cranes required to assist with the erection, dismantle or alteration operation should be detailed. These might be either cranes already on site (tower, or mobile) or mobile cranes brought to site specifically for the task to be undertaken. These arrangements should include the assessment of ground conditions, preparation of suitable outrigger foundations and any road closures.

Selection of these cranes should take into account that when removing components from a height the assisting crane is carrying the entire load with no opportunity for safely replacing it once the attachment pins have been removed. In this case it is best practice for the crane to have some excess capacity to allow for any error in the slinging of the component concerned or its sudden release.

NOTE: See BS 7121-3 for guidance on the selection, siting and use of mobile cranes.

3.15 Inspection and Thorough Examination of climbing equipment before and during climbing

Arrangements for the inspection of all equipment (including the climbing frame) before climbing starts should be specified, together with procedures for the reporting of any defects, to ensure that the climbing process is not started with faulty equipment.

Climbing frames require thorough examination before first use after each installation on to the tower crane. (**See 10.0**).

Procedures for the monitoring and reporting of defects such as vibration during the climbing process should also be documented.

NOTE: It is essential that the tower sections, are inspected before being incorporated into the tower crane structure and that the inspection includes the climbing lugs which take the full load of the climbing frame and crane top during climbing.

3.16 Tower verticality

The verticality of the previously erected tower should be checked before climbing is undertaken, as deviations from the vertical can affect the hook radius specified for balance by the manufacturer, ties may be difficult to fit and additional loads may be placed on the climbing frame. Verticality checks should be carried out using accurate surveying instruments operated by experienced personnel.

3.17 Protection from falling objects (exclusion zones)

Arrangements for the protection of persons from falling objects in the area below the climbing operation should be defined. The Principal Contractor should ensure that the primary method of control should be the establishment and enforcement, of appropriate exclusion zones around the base of the tower crane. A drawing should be prepared showing the position and extent of the zone (**See Figure 3**).

Additional control measures may include:-

- The use of a protection fan around the tower (**See Figure 4**).
- Good housekeeping on the crane structure (**See TIN 005**)
- The use of lanyards for small hand tools as appropriate,
- Toeboards and mesh panels on working platforms.

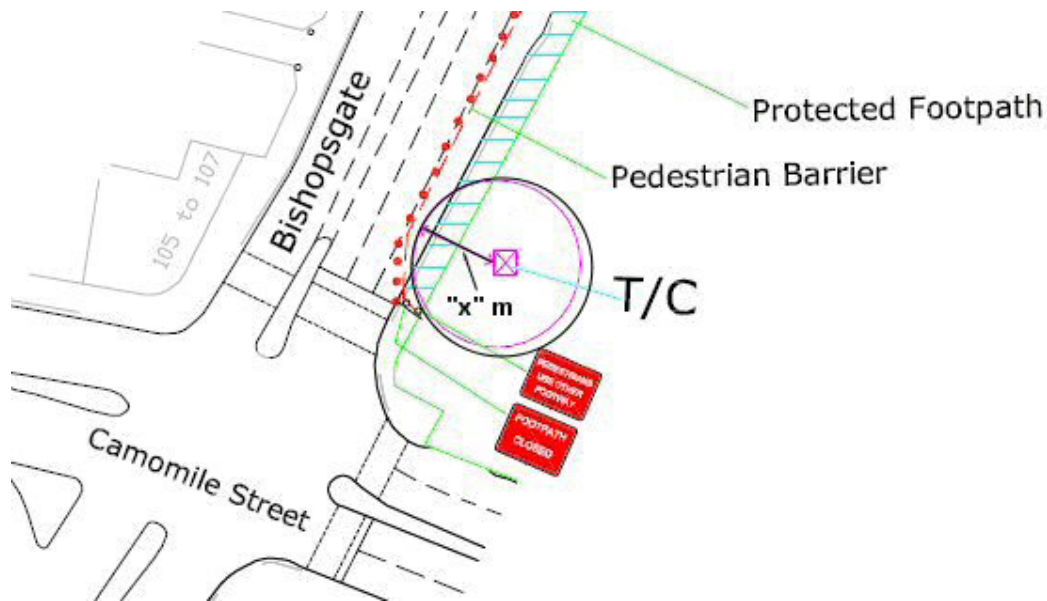


Figure 3 – Example of an Exclusion Zone

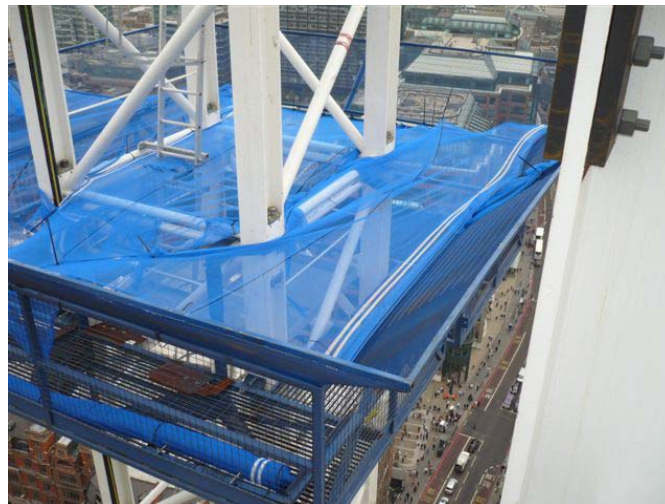


Figure 4 – Falling Object Protection Fan

3.18 Protection from falls from height

Arrangements for the protection of those involved in the climbing operation from falls from height should be specified in accordance with the hierarchy set out in the *Work at Height Regulations 2005* (WAHR). This should include, where possible, adequate edge protection on working platforms. Where collective fall prevention measures are not possible, work restraint PPE should be used to prevent the wearer from falling. If fall arrest equipment is used, arrangements must be in place to ensure that wearers can be rescued in a timely manner in the event of a fall. The arrangements for ensuring that PPE is appropriate and is regularly inspected should be specified.

3.19 Communication

Arrangements for ensuring that all members of the erection team can effectively communicate at all times during the climbing operation should be specified.

Communication is normally required between personnel on the ground, personnel on the tower crane structure, personnel on the climbing frame, the operator in the cab of the tower

crane being climbed and the operators of any other cranes involved. This is normally achieved using verbal communication, where distances permit, or hand held VHF/UHF radios. Arrangements should be made to ensure that good communication is maintained at all times. These might include choosing a unique frequency to avoid interference from other sites, ensuring that batteries are fully charged and that spare handsets are available in case of breakdown. See **Annex H** for further information

3.20 Weather forecasting and monitoring

Tower crane climbing operations may only be carried out in wind speeds below the limit set by the tower crane manufacturer (generally 12.5 m/s, 28 mph). It is good practice to set a limiting wind speed which is 25% below the manufacturer's maximum to allow time for the tower crane to be made secure in a rising wind. Unless specified otherwise this limiting wind speed should be taken as the maximum gust speed. Arrangements should therefore be specified to obtain accurate weather forecasts in the period leading up to the start of climbing. These enable the appointed person and the Erection Supervisor to decide if climbing should go ahead. If the climbing programme is of several days duration, daily forecasts should be obtained to ensure that the tower crane can be secured in a suitable configuration if high winds are indicated. Where a crane is to be climbed down on a completed structure it is likely that the structure will prevent the crane from being able to weather vane in free slew. Consequently a suitable weather window with wind speeds below the maximum climbing wind speed must be identified before the climbing down operation begins.

Arrangements should also be made to monitor wind speed just prior to and during each stage of the climbing operation. This is often achieved by the operator monitoring the tower crane's anemometer and the Erection Supervisor using a calibrated hand held anemometer.

Weather forecasts for climbing operations should be site specific, giving mean and gust wind speeds (at required heights), wind direction and weather for the next five days (to assist forward planning). They should also take account of localised topographic effects such as adjacent high ground which may lead to sudden squalls etc. This information is obtainable from a number of specialist providers (such as the Met Office).

3.21 Specific climbing procedures including balancing

The specific climbing procedures for the make, model and configuration of the tower crane to be climbed should be specified. If this is by reference to the manufacturer's instruction manual the arrangements for ensuring that a copy of the relevant manual is available on site should be given.

Particular attention should be paid to the manufacturer's specified arrangements for ensuring that the tower crane is balanced before climbing.

Balancing is often carried out by carefully increasing or decreasing the hook radius from a nominal balance radius detailed by the manufacturer (together with any balancing mass on the hook). A +/- tolerance on this nominal figure should be specified and the climbing team should not exceed this without reference to the Appointed Person, who will seek specialist advice if necessary.

* The given balancing weights are the weights of the tower element or of a load.

** The Indicated radius refers to the centre of the tower and shall be treated as standard value. Exact balancing will be achieved by travelling of trolley with tower element or load and may be checked by travelling apart free of mismatch at the joints of the tower.

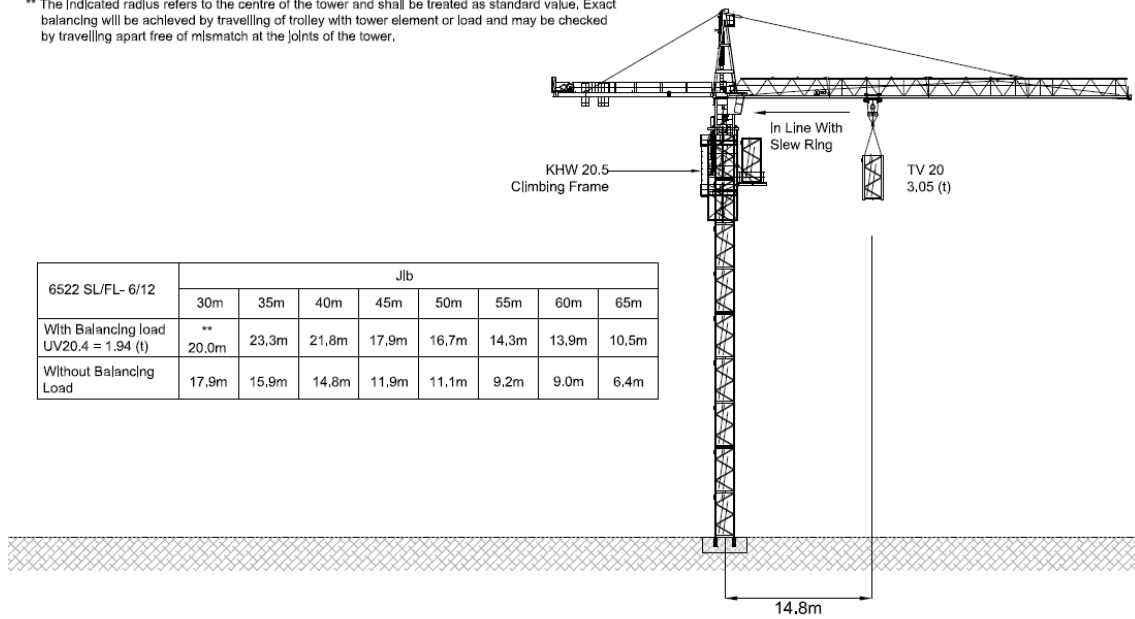


Figure 5 – Typical Balancing Information

3.22 Information

Any information required by the team carrying out the operation in addition to the method statement should be specified. This should include the availability on site of a comprehensive manufacturer’s erection/dismantling/climbing/operation manual. The manual should be specific to the individual tower crane and the information should be readily understood by the erection team.

3.23 Contingency arrangements

Contingency arrangements should be specified for the occurrence of any circumstance that might affect the safety of the climbing operation (e.g. lack of Erection Supervisor, power failure, hydraulic/mechanical equipment failure, increase in wind speed, personnel injury). This should include arrangements for the notification of problems to the appointed person if they are not present on site during the climbing operation.

Reference should also be made to site-specific emergency procedures.

3.24 Inspection and Thorough Examination, including testing

The arrangements for carrying out inspection, thorough examination and any supplementary tests, after the climbing operation has been completed and before the tower crane is returned to service, should be specified.

3.25 Handing over the tower crane

Arrangements for handing over the tower crane to the site following the successful completion of the thorough examination should be specified.

4.0 Duties of Personnel Involved in Climbing Operations

The Health and Safety at Work, etc Act 1974 demands that employers have safe systems of work, so that their employees are protected from any risk, so far as is reasonably practicable. Using or installing tower cranes without a safe system of work is a breach of this Act.

The British Standard Code of Practice for the Safe Use of Cranes, BS 7121 Part 5, gives advice to organisations requiring lifting operations to be carried out with tower cranes and on ways of meeting their legal obligations. It also details who is responsible and what their duties are.

It is a requirement of the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER 98) and BS 7121 Part 5 that one person should be appointed to have overall control of each lifting (climbing) operation to ensure that it is carried out safely.

4.1 Duties of Principal Contractors

The Construction (Design and Management) Regulations 2007 require that designers, coordinators, Principal Contractors, sub-contractors and clients consider health and safety matters throughout all stages of a construction project from conception, design and planning through to carrying out the work, including maintenance, repair and/or demolition.

The installation, use, alteration and dismantling of tower cranes should be included in the Health and Safety Plan required by the Regulations so that factors influencing crane safety can be assessed at a sufficiently early stage.

The Plan should include information to allow all parties involved in the specification, installation or use of cranes to be made aware of the fundamental criteria and planning issues needed to ensure that lifting operations are initiated and proceed in a logical and safe manner.

Good co-operation and co-ordination of work between all of the parties involved in a project is essential if risks are to be identified early on and properly controlled. This is particularly important where tower crane climbing operations are being carried out. The Principal Contractor should take the lead and actively encourage co-operation and co-ordination between all parties from an early stage. A team approach involving the client, designers, contractors and even manufacturers who work closely together will often produce the best results. Even on projects where it is not practical to formally establish an integrated team, the client, designer, contractors and others involved in the project still need to work together.

Designers should obtain and make available to the CDM Coordinator, information relating to the site and type(s) of crane to be used.

4.2 The Duties of the Appointed Person

The appointed person for climbing operations is nominated by management of the organisation carrying out the climbing operation (generally the tower crane owner or supplier) to be in overall control of the lifting (climbing) operations and the members of the climbing team. This person must have had training, experience, and be competent. It is essential that the appointed person carrying out the risk assessment has sufficient detailed knowledge of the specific tower crane and specific climbing equipment to be used, in order to identify hazards.

His duties include ensuring that:-

- The lifting (climbing) operation is properly planned and carried out;
- A suitable and sufficient risk assessment is carried out to evaluate the hazards associated with the lifting operation and identify control measures;
- Planning is recorded in a method statement which is effectively communicated to all members of the climbing team and others affected by the climbing operation;

- Accurate weights, radii, heights, etc are established;
- Suitable mobile/tower cranes, lifting accessories and other equipment are selected ;
- Suitable access is provided to unload and store components within the operating area of the mobile/tower crane;
- Competent, properly trained personnel are provided and that they are fully briefed;
- All mobile/tower cranes, lifting accessories and other equipment are properly maintained, inspected, examined and tested (where necessary);
- Appropriate steps are taken to exclude persons not directly involved with the climbing operation from the lifting zone using barricades etc.

The appointed person needs to appoint a tower crane Erection Supervisor to be present throughout the climbing operation in order to control it and ensure that it is carried out in accordance with the planning. The appointed person may choose to act as the tower crane Erection Supervisor.

The appointed person retains overall responsibility for the climbing operation and has the authority to stop the climbing operation at any time if it is considered that there is a risk to safety. If the appointed person is not present, then this authority passes to the tower crane Erection Supervisor.

4.3 The Duties of the Crane Erection Supervisor

The crane Erection Supervisor should have the responsibilities of a crane erector in addition to the following:-

- The crane erection supervisor should be in control of all senior erectors, erectors and trainee erectors and of any additional craneage and lifting equipment which could be used in the climbing operation, thereby fulfilling the role of the crane supervisor:
- The crane erection supervisor ensures that the operation is carried out in accordance with the method statement;
- Additional craneage and equipment should be in accordance with that specified and properly certified;
- All erectors should be equipped with the necessary tools and personal protective equipment. Where appropriate this must be accompanied by current calibration certificates.

NOTE: *The appointed person retains overall responsibility for the climbing operation, including the planning.*

The appointed person should ensure that if the crane Erection Supervisor has to leave the site of the operation, even for a few minutes, a suitably qualified member of the team is nominated to be in charge during the period of absence, in order to prevent any ambiguity as to the control of the operation.

The crane Erection Supervisor should normally remain on site throughout the whole of the climbing operation.

4.4 The Duties of the Senior Erector

The senior erector should have the responsibilities of an erector in addition to the following:-

- Supervision of erectors as directed by the Erection Supervisor;
- Responsibility for and close monitoring of, any trainee erectors involved with the climbing of the tower crane.

4.5 The Duties of the Erector

The erector should be responsible for working on the climbing of the tower crane in accordance with the manufacturer's instructions and a job specific method statement, working under the guidance of a Senior Erector or Erection Supervisor.

4.6 The Duties of the Trainee Erector

The trainee erector should be responsible for working on the climbing of the tower crane under the direct supervision of a senior erector.

4.7 The Duties of the Tower Crane Electrician/Technician

The tower crane electrician's duties include:-

- Working to the direction of the Erection Supervisor;
- Providing electrical expertise and support to the climbing process;
- Carrying out faultfinding, adjustments and repair as required.

4.8 The Duties of the Tower Crane Operator

The tower crane operator's duties include:-

- Establishing who is in charge of the climbing operation and the other members of the team and their roles;
- Establishing which signalling system is to be used and following instructions from only one nominated signaller at a time;
- Stopping operations if given any instructions that would take the tower crane outside its permitted duties;
- Informing the crane Erection Supervisor if any problems arise which would affect the climbing operation;
- Using the tower crane to lift only the loads that are identified in the method statement.

4.9 The Duties of the Slinger

The slinger's duties include:-

- Attaching and detaching the load to and from the mobile/tower crane;
- Using the correct lifting accessories in accordance with the lifting plan or procedure;
- Visually checking the lifting accessories for damage before use;
- Initiating and directing the movement of the load by giving the appropriate signals;
- Placing the load safely.

4.10 The Duties of the Signaller

The signaller's duties include:-

- Relaying signals from the slinger to the mobile/tower crane operator.

NOTE: The roles of slinger and signaller are generally combined in one person which, in the case of tower crane climbing, is normally one of the erectors.

5.0 Training of Personnel Involved in Climbing Operations

Employers must ensure that their supervisory and operating personnel are competent to work safely during climbing operations. Employers must therefore assess the competence of their staff and, where necessary, provide training to achieve the level of competence required. The training needs to reflect the ability and level of responsibility of the individual, degree of complexity of the task and the risks involved.

The training of personnel for tower crane climbing operations will depend on the extent of previous experience of tower crane erection and climbing. For a Trainee Erector without previous experience, they will require:-

- Training in basic skills;
- Training in climbing techniques;
- Training on the specific cranes and climbing systems they will be working on.

They should then gain three years directly supervised experience of tower crane installation under the guidance of a Senior Erector before becoming an Erector. By this stage they should have at least achieved an NVQ Level 2.

5.1 Basic skills

All tower crane erection personnel should be trained in a set of basic skills to enable them to work safely on site and participate effectively in the climbing process. These basic skills should include the following.

- a) Understanding basic site safety;
- b) Slinging and signalling;
- c) Basic tool skills which includes the selection and use of tools;
- d) Identification, selection and fitting of fasteners;
- e) Use and maintenance of fall protection equipment (working at height);
NOTE: Further information on selection, use and maintenance of personal fall protection systems and equipment is given in BS 8437.
- f) Interpretation of technical information (including drawings), use of manuals;
- g) Basic assessment of ground conditions;
- h) Basic assessment of weather conditions;
- i) Basic principles of tower crane erection and stability, including verticality checks;
- j) Basic practice of erection and dismantle;
- k) Product familiarity limited to the product group on which initial training is being carried out;
- l) Preparing equipment for use;
- m) Effective communication including the use and care of radio equipment;
- n) Assisting with examinations and testing;
- o) Identifying proximity hazards.

NOTE: A suitable programme for the training of tower crane installation personnel is the Tower Crane Installation Training Programme, TWR 01 developed jointly by the Construction Plant-hire Association, Construction Skills and the HSE.

5.2 Additional skills

As tower crane erectors gain experience, their basic set of skills should be augmented with additional skills including the following.

- a) Product familiarity (to be added as part of erectors ongoing training);
- b) First aid;
- c) Wire rope inspection and termination;
- d) Use of specialist tools and equipment;

- e) Foundation checking;
- f) Tying to structures;
- g) Climbing (internal and external);
- h) Setting limits, including RCI/L;
- i) Functional testing;
- j) Carrying out thorough examinations and testing;
- k) Carrying out maintenance;
- l) Carrying out adjustments (complex and not);
- m) Identifying and rectifying faults in equipment;
- n) Operating the tower crane during erection/dismantle/climbing;
- o) Commissioning and handover to operator;
- p) Training to become a Crane Supervisor;
- q) Training to become an Appointed Person;
- r) Loading components onto transport;
- s) Supervision skills.

5.3 Familiarisation with new systems or equipment

All tower crane erection personnel need additional training from time to time before they work on new systems or equipment with which they are not familiar. The nature and extent of this training depends on the complexity of the new equipment and the degree of difference from the equipment with which they are familiar.

5.4 Assessment

It is important that all personnel in the erection team are regularly assessed to ensure that they can carry out their duties safely and effectively. Assessment should form part of any training.

NOTE: Training assessment tools are given in the Tower Crane Installation Training Programme, TWR 01.

5.5 Traceability of product specific training to manufacturers

Product specific training of erection personnel for climbing operations should always be carried out by the equipment manufacturer or their approved agent.

NOTE: The training of erectors and Electricians may be carried out by a suitably qualified Supervisor who holds an appropriate training qualification such as City & Guilds 7300. Training of Erection Supervisors and Senior Erectors must always be carried out by the equipment manufacturer or their approved agent.

5.6 Health and fitness

Tower crane installation operations involve a substantial degree of physical work and those engaged in it should possess a level of physical strength and fitness that enables them to carry out their duties effectively and without endangering the other members of the erection team. A robust drugs and alcohol policy should form part of the health assessment process.

Further advice on the assessment of fitness is given in the forthcoming Strategic Forum for Construction, Plant Safety Group, Best Practice Guide on *Medical Fitness to Operate Construction Plant*.

5.7 Climbing team

A climbing team should consist of a Supervisor, Senior Erector, Electrician and a number of erectors which will depend on the type and model of crane and the circumstances of the climbing operation. Only one Trainee Erector should be permitted within each Climbing Team and the trainee should be additional to the normal team.

Title	Minimum Experience	Minimum Qualification	Product Specific Training
Supervisor	5 years experience in the erection and dismantling of tower cranes Recent verifiable frequent climbing experience	<ul style="list-style-type: none"> • CPCS Crane Supervisor (NVQ) • NVQ Level 3 Plant Installation (Tower Crane) with relevant endorsement • CPCS Slinger Signaller (NVQ) • PMSTS or equivalent (for example SMSTS) 	Practical and theoretical training in climbing techniques by the tower crane manufacturer or their approved agent for the specific model or type of crane to be climbed
Senior Erector	3 years experience in the erection and dismantling of tower cranes Recent verifiable climbing experience	<ul style="list-style-type: none"> • CPCS Crane Supervisor (NVQ) • NVQ Level 3 Plant Installation (Tower Crane) with relevant endorsement • CPCS Slinger Signaller (NVQ) • PMSTS or equivalent (for example SMSTS) 	Practical and theoretical training in climbing techniques by the tower crane manufacturer or their approved agent for the specific model or type of crane to be climbed
Erector	6 months continuous experience in the erection and dismantling of tower cranes	<ul style="list-style-type: none"> • NVQ Level 2 Plant Installation (Tower Crane) through modular training with relevant endorsement • CPCS Slinger Signaller (NVQ) 	Practical and theoretical training in climbing techniques by the tower crane manufacturer or their approved agent for the specific model or type of crane to be climbed NOTE: This training may be carried out by a suitably qualified Supervisor who holds an appropriate training qualification such as City & Guilds 7300.
Electrician	6 months continuous experience in the erection and dismantling of tower cranes	<ul style="list-style-type: none"> • City and Guilds 2391 (Inspection, Testing and Certification) • NVQ level 3. • Electrotechnical Certification Scheme Approved Electrician or equivalent.. • CSCS Blue Card + NVQ Level 2 (If taking part in climbing process as a full erector) 	Training in the electrical aspects of the tower crane by the tower crane manufacturer or their approved agent for the specific model or type of crane to be climbed. NOTE: This training may be carried out by a suitably qualified Supervisor who holds an appropriate training qualification such as City & Guilds 7300. If taking part in the operation as an Erector they will require the same product specific training as an Erector
Trainee	6 months continuous experience in the erection and dismantling of tower cranes	<ul style="list-style-type: none"> • Working towards NVQ Level 2 	General overview of the climbing process and the significant hazards involved. Given by the Erection Supervisor

Table 1 - Minimum Requirements for Climbing Team Personnel

6.0 The Climbing Process

6.1 *Pre-delivery inspection and transport of components to site*

See 3.9 and 3.10

6.2 *Briefing of erection team*

Once the erection team has arrived on site and before the climbing process is started a comprehensive briefing of all those involved with the climbing process, including the Principal Contractor's representative, should be carried out by the Appointed Person or Erection Supervisor using the final edition of the method statement. The briefing should cover the contents of the method statement, any sections of the manufacturer's manual to which it refers, and in particular, those features of the operation that are peculiar to the site (e.g. proximity of other cranes, interface with the public, proximity of other trades, noise restrictions, work hours restrictions). Everyone attending the briefing should sign an attendance record indicating that they were present and have understood the briefing.

The briefing should be repeated at the start of each day during the course of the climbing operation and should include a review of the previous day's operation and the tasks to be undertaken on the day of the briefing.

6.3 *Liaison with site*

The company carrying out the climbing operation should maintain a close liaison with nominated representative of the organization with overall charge of the site (Principal Contractor) to ensure that those matters for which the Principal Contractor is responsible such as monitoring of exclusion zones and liaison with other trades are dealt with effectively (See 2.8).

6.4 *Environmental monitoring*

6.4.1 *Wind*

Tower crane climbing operations may only be carried out in wind speeds below the limit set by the tower crane manufacture (generally 12.5 m/s). Unless specified otherwise this limiting wind speed should be taken as the maximum gust speed. Wind speeds in excess of the manufacturer's limits can affect the balance, and hence the integrity, of the tower crane during climbing, as can gusts and shifts in wind direction. It is good practice to set a limiting wind speed which is 25% below the manufacturer's maximum to allow time for the tower crane to be made secure in a rising wind. Arrangements should therefore be made to obtain accurate site area specific weather forecasts in the period leading up to the start of climbing. These forecasts should indicate wind direction, mean wind speed and maximum gust speed at intervals over a 24 hour period. Wind speed increases with height above the ground and as forecast wind speeds are predicted for a specific height above ground level (often 10 m) these should be corrected for the height at which climbing takes place. TIN 020 gives correction factors for wind speed at various heights above ground level. They should also take account of localised topographic effects such as adjacent high ground which may lead to sudden squalls etc.

These forecasts enable the appointed person and the Erection Supervisor to decide if climbing should go ahead. If the climbing programme is of several days duration, daily forecasts should be obtained to ensure that the tower crane can be secured in a safe configuration if high winds are indicated.

Once on site, wind speed should be monitored by the tower crane operator using the anemometer mounted on the tower crane "A" frame or the highest part of a "flat top" tower crane and by the Erection Supervisor using a calibrated hand held anemometer whilst standing on the back jib. The supervisor should monitor the wind speed for a period of 15 min before starting the climb to assess the degree of gusting and to ensure that the wind speed does not exceed the manufacturer's limit for climbing during the climbing operation. Climbing operations should not be started in conditions where the wind speed is increasing.

6.4.2 Visibility

Adequate visibility is required during tower crane climbing to enable the effective monitoring of the climbing process. The ground and the whole crane structure should be visible at all times from the climbing frame. Climbing should not be carried out when poor visibility poses a significant risk or during the hours of darkness.

6.5 Monitoring of exclusion zones

An important part of the safe system of work for climbing tower cranes is the protection of persons below the tower crane by the establishment and enforcement of exclusion zones. This aims to ensure that all persons not directly concerned with the climbing operation are excluded from the area at risk from falling objects. However once established it is important that these are monitored to ensure that unauthorized persons do not enter the zone. The responsibility for this monitoring should be established at the planning stage (**See 3.17**).

6.6 Craneage arrangements

The climbing of a tower crane is often accomplished by using the crane being climbed to unload and handle all the equipment and components involved in the climbing operation. However site or programme constraints, or requirements for ties or internal climbing frame supports might dictate the use of additional cranes. These may be either existing cranes on the site, tower or mobile, or mobile cranes brought onto site specifically for the climbing operation. In all cases the lifting operations should be planned by the Appointed Person. In the case of mobile cranes particular attention should be paid to positioning the crane and ensuring that the ground has sufficient capacity to safely absorb the loads imposed by the crane's wheels and outriggers.

NOTE: See BS 7121-3 for guidance on the selection, siting and use of mobile cranes.

6.7 Assembly and inspection of climbing equipment

Climbing equipment should be subjected to a pre-delivery inspection before delivery to site.

Once the climbing equipment, either an external climbing frame or internal climbing collars and ladders, has arrived on site it should be inspected to ensure that damage has not occurred during transport and offloading. It should then be assembled in accordance with the manufacturer's instructions, before installation on the tower crane. Once installed around the crane tower the equipment should be inspected again to ensure that it is complete and ready for use. Prior to use, after each installation on the crane it is essential that a thorough examination of the climbing frame is carried out (**See 3.15**).

The tower sections should be checked before use to ensure that they are of the correct type for the particular tower crane.

NOTE: It is advisable to paint the climbing frame in a different colour from the tower to assist with the visualisation of movement between the climbing frame and tower.

NOTE: It is essential that the tower sections are inspected before being incorporated into the tower crane structure and that the inspection includes the climbing lugs which take the full load of the climbing frame and crane top during climbing.

6.8 Positioning of tower sections

Tower sections that are to be incorporated into the tower during the climbing process should be positioned in a line away from the base of the tower, in line with the open side of the climbing frame. This avoids the need for slewing during climbing.

6.9 Following manufacturer's procedures

It is important that the manufacturer's procedures for climbing equipment are understood and adhered to unless additional precautions are deemed necessary (**See 6.4.1**). Whilst most tower crane climbing systems are based on the same principles, the details vary widely between makes and models and it is essential that the specific procedures for the exact climbing equipment type and tower crane configuration are followed. The assumption

that a procedure for a similar looking tower crane can be safely followed should not be made.

It is also important that only components specified by the manufacturer are used in the climbing process.

6.10 Checks before and during climbing

There are a number of checks that should be made before starting and during the climbing process to ensure that the climbing equipment is correctly installed and fully operational, and that the tower cranes systems that are vital to the climbing operation are functioning correctly.

These should include checks that:

- a) The tower crane's hoist brakes and trolley or luffing brakes are functioning correctly. this should be by visual inspection followed by the lifting of a tower section;
- b) The power supply cable has sufficient spare length to accommodate the increase in the tower crane's height;
- c) Hand held radios are in working order with fully charged batteries;
- d) The hydraulic power pack relief valve is set at the correct pressure for the tower crane configuration;
- e) The foot of the hydraulic cylinder(s) reacting on the tower is correctly located on the reaction points;
- f) The foot of any ratchet mechanism used to support the superstructure temporarily between strokes of a multi stage cylinder(s) is correctly located on the reaction points;
- g) The tower crane top and the top of the climbing frame are secured together before climbing starts;
- h) The tower section joints are correctly aligned before a new section is lowered onto the previous section;
- i) Any system to prevent slewing of the superstructure during climbing is functioning correctly and arrangements are in place to ensure that the operator cannot inadvertently slew the tower crane. The operator should leave the cab once the crane is balanced;
- j) The tower crane superstructure is balanced;
- k) the climb can take place within the wind speed limits set by the manufacturer;
- l) After lowering the tower crane top, the foot of the hydraulic cylinder(s) reacting on the tower remains correctly located on the reaction points;
- m) Once a tower section has been installed ensuring that all the tower bolts have been inserted correctly and torqued to the correct preload before climbing restarts or the crane is put back into service.

NOTE: *Once tightened to the correct torque, all climbing frame and tower bolt heads should be marked to indicate their status*

6.11 Balancing the tower crane

Before starting the climbing process the tower crane should be 'balanced' to ensure that the centre of gravity of the tower crane components being supported by the climbing equipment is over the centre of the climbing cylinder(s). This ensures that the climbing equipment is operated within its design criteria. The procedure for balancing varies with the type and model of tower crane, but generally consists of placing the movable components of the tower crane superstructure (luffing jib or trolley) at a specified radius, with or without a weight on the hook, in accordance with the manufacturer's instructions.

The manufacturer's instructions should include a procedure for establishing that the tower crane is in balance. This should be strictly adhered to. The balance of the tower crane should be checked before each extension of the climbing equipment.

A tolerance for the balance radius should be obtained either from the manufacturer or if the manufacturer is no longer available, from a competent engineer. If balance cannot be achieved within this tolerance, climbing should be stopped whilst expert advice is sought.

6.12 Climbing in new tower sections

Once the tower crane has been balanced, the climbing equipment should be extended and new tower sections inserted and secured, in accordance with the manufacturer's instructions. The climbing process should be repeated until the required number of sections has been added to the crane tower.

6.13 Re-commissioning the crane

Once the climbing process has been completed and the thorough examination carried out the tower crane should be returned to its working configuration and handed back to the user. This handover of the climbed tower crane should be recorded in writing so that it is clear to all parties that the tower crane may be used for normal lifting operations.

6.14 Storage and removal of the climbing equipment

Internal climbing equipment is normally left in place between climbs as it forms part of the support arrangements for the tower crane during normal working.

External climbing frames may either be removed after each climbing operation for use on another tower crane or left on the crane tower. Removal of the climbing frame should be planned as part of the climbing operation. If the frame is to be left on the tower between climbing operations this should be done in accordance with the manufacturer's instructions, taking into account of any possible increases in wind loading etc.

6.15 Climbing down

Climbing down is generally the reverse of the climbing process, requiring the same planning and preparation as climbing up. If a tower crane that is tied to an adjacent structure is being climbed down, particular attention should be paid to ensuring that the tower crane is left in a suitable configuration at the end of each day or climbing shift to avoid excessive tie or tower forces in the out-of-service condition. Ties that have been removed as the crane has been climbed will generally need to be reinstated as the crane is climbed down.

6.16 Contingency arrangements

The safety of tower crane climbing operations depends on keeping within a number of set parameters such as tower verticality, wind speed, crane balance and slew orientation throughout the operation. To avoid going outside these parameters arrangements should be put in place to deal with events such as, but not limited to:-

- Increase in wind speed;
- Change of wind direction;
- Wind gusts;
- Electrical power failure;
- Illness;
- Injury;
- Hydraulic and mechanical breakdown.

All possible events should be included in the risk assessment and contingency arrangements drawn up and recorded in the method statement.

6.17 Thorough Examination including testing of the tower crane after climbing

After the climbing operation has been completed, and before the tower crane is returned to service, it should be thoroughly examined and tested in accordance with the relevant clauses of LOLER and BS 7121-2.

On completion of the test any load limits altered to facilitate the test should be reset to the rated load and a thorough examination of the tower crane should be carried out. The competent person should issue a report of thorough examination with an appropriate test certificate appended to it.

On tall cranes the rated capacity may have to be reduced to take account of the weight of the additional hoist rope.

Once the thorough examination has been completed it should be entered on the HSE Tower Crane Register as required by the *Notification of Conventional Tower Cranes Regulations 2010*.

NOTE: *Additional information on the thorough examination and testing of tower cranes can be found in the "Best Practice Guide on the Maintenance and Thorough Examination of Tower Cranes", 2008 – Construction Plant-hire Association.*

7.0 Structural Considerations for Climbing

During the planning of tower crane climbing operations the effect of both the climbing operation and the new crane configuration on the tower crane base and any ties must be considered.

7.1 Tower crane bases

The appointed person planning the climbing operation must ensure that the tower crane base, of whatever type, has been designed taking into account the loads imposed on it during the climbing operation and both in and out of service once the crane has reached its new height.

The design of all tower crane bases should be subject to an independent design check to ensure that the concept, overall design and details of the foundation proposed are adequate and that the foundation designer's intentions have been properly reflected in the drawings to be supplied to site. The check is not intended to take the place of any checking carried out by the foundation designer, who will retain full responsibility for the adequacy of the foundation design.

The appointed person should ensure that a Foundation Completion Form (**See Annex F**) confirming that the base has been correctly designed and installed has been completed before the climbing operation takes place and that the first tower section is vertical.

NOTE: Design checks should be in accordance with Category 2 of Table 1 of BS 5975

7.2 Tower crane ties

Tower cranes that are being climbed are frequently supported by ties attached to an adjacent structure, which is often the building under construction. These ties must be designed by a competent engineer using loadings supplied by the tower crane owner or supplier. The designer of the supporting structure must be consulted at an early stage to ensure that the structure is capable of sustaining the loads imposed by the tower crane in-service, out-of-service and during climbing.

As with tower crane bases, all tie designs should be subject to an independent design check to ensure that the concept, overall design and details of the tie proposed are adequate and that the tie designer's intentions have been properly reflected in the drawings to be supplied to site. The check is not intended to take the place of any checking carried out by the tie designer, who will retain full responsibility for the adequacy of the tie design.

When multiple ties are installed the designer will often require that when additional ties are installed, ties lower down the tower are released to reduce the overall tie forces. The ties must however either be left in place or replaced and reconnected as the crane is climbed down during the dismantling process.

The appointed person should ensure that written approval to use the tie attachment points on the supporting structure has been obtained before the climbing operation takes place.

The appointed person should ensure that a Tower Crane Tie Approval Form (**See Annex G**) confirming that the tie has been correctly designed and manufactured (if applicable) has been completed before the climbing operation takes place.

NOTE: Design checks should be in accordance with Category 2 of Table 1 of BS 5975

7.3 Further guidance

Further guidance on the design and installation of tower crane bases and ties is given in:

- *Tower crane stability*, 2006. CIRIA C654. Construction Industry Research and Information Association.
- BS 5975:2008, *Code of practice for temporary works procedures and the permissible stress design of false work*.

8.0 Lifting Accessories

In preparing the method statement (lift plan) consideration should be given to the selection of lifting accessories such as wire rope slings, chains slings, webbing slings and shackles to ensure that they are sized for the anticipated loads to be handled.

All the lifting accessories used in the climbing process should be accompanied by current reports of thorough examination.

Lifting accessories allocated personally to erectors should be listed in a lifting accessory register (**See Annex E**).

Before use, all lifting accessories should be checked for completeness and any damage that might affect their integrity.

Recorded weekly check (best practice) is desirable

The following points should be considered when selecting lifting accessories:-

- The secure storage of lifting accessories should be considered at the planning stage and suitable arrangements made;
- Lifting accessories should be protected with protective sleeves or suitable packing, where loads with sharp edges are to be lifted. All packing pieces should be secured to prevent them from becoming accidentally dislodged;
- For the lifting of awkward materials or items with a non-central centre of gravity, lifting beams, spreader bars or purpose designed lifting beams may be required;
- All accessories should be marked with a Safe Working Load;
- The type, size, rating and configuration of lifting accessories to be used for each load or generic type of load to be lifted should be recorded in the method statement (lift plan);
- Before each use of lifting accessories pre-use checks should be carried out to ensure that they are in good condition and that a current report of thorough examination is available.
- LOLER requires that lifting accessories are thoroughly examined at intervals not exceeding six months.

9.0 Maintenance Including Checks and Inspections

9.1 General

The effective maintenance of climbing equipment plays a significant part in the safe and efficient completion of tower crane climbing operations.

9.2 Records

A full record of all use and maintenance, including checks and inspections, should be kept to ensure that a full history of the equipment is available. This will enable common faults to be identified and rectified.

9.3 Checks and inspections

Pre-use checks and inspections of the climbing equipment should be carried out in accordance with the manufacturer's instructions, and should include the following as a minimum:

- An inspection of the equipment in the depot before transport to site;
- An inspection of the equipment on arrival at site;
- A recorded inspection of the equipment after assembly;
- A pre-use check of the equipment at the start of each shift;
- Checks during the climbing operation.

Checks and inspections should be recorded and a copy of each record should be available on site during the climbing operation.

9.4 Defect reporting

The Erection Supervisor in charge of the climbing operation should report any defects in the equipment in writing to their manager so that the defects can be rectified before the next use of the equipment.

9.5 Further guidance

Further detailed guidance on the maintenance of tower cranes and associated equipment is given in:-

- *Best Practice Guide on the Maintenance, Inspection and Thorough Examination of Tower Cranes* – Construction Plant-hire Association

10.0 Thorough Examination

The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) require that all lifting equipment is thoroughly examined by a competent person

Climbing frames, whilst not always part of the tower crane's permanent equipment, are devices for lifting persons and should be thoroughly examined each time they are installed on a different crane tower and then at intervals **not exceeding six months (See Annex L)**. Climbing frames require thorough examination before first use after each installation on to the tower crane.

Reports of thorough examination should contain the details required by Schedule 1 of LOLER including details of when testing was last carried out on the tower crane, (this may include: non destructive testing, overload testing, testing of the rated capacity indicator with loads).

Thorough examinations should be carried out by competent persons who have "*such appropriate practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined as will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment*". They must also be sufficiently independent and impartial and separate from the erection team.

Once the thorough examination has been completed it should be entered on the HSE Tower Crane Register as required by the *Notification of Conventional Tower Cranes Regulations 2010*.

10.1 Thorough Examination of lifting accessories

LOLER requires that lifting accessories are thoroughly examined at intervals not exceeding six months.

10.2 Further guidance

Further detailed guidance on the thorough examination of cranes is given in:-

- BS 7121 Code of practice for safe use of cranes, *Part 2: Inspection, testing and examination*.
- *L113 Safe Use of Lifting Equipment - Lifting Operations and Lifting Equipment Regulations 1998 Code of Practice* - ISBN 0 7176 1628 2
- *Best Practice Guide on the Maintenance, Inspection and Thorough Examination of Tower Cranes* – Construction Plant-hire Association

Annex A - Definitions

appointed person

person with the training, practical and theoretical knowledge and experience required to comply with 4.2

carrier

device that supports persons during lifting and lowering

NOTE: This may also be known as a “manrider”.

climbing

increasing or decreasing the tower height of a crane using a means other than another crane

competent engineer

person who has such theoretical knowledge and experience of the design of the lifting equipment as enables them to assess the design of tower crane bases, ties and supporting structure connections, together with the adequacy of supporting structures to take the loads imposed by the crane

competent person

person who has such practical and theoretical knowledge and experience of the crane and the equipment used in the lifting operation as is necessary to carry out the function to which the term relates in each particular context

crane coordinator

person who plans and directs the sequence of operations of cranes to ensure that they do not collide with other cranes, loads and other equipment (e.g. concrete placing booms, telehandlers, piling rigs)

crane operator

person who is operating the crane for the purpose of positioning loads or erection of the crane

NOTE: Sometimes referred to as “crane driver”.

crane supervisor

person who controls the lifting operation, and ensures that it is carried out in accordance with the appointed person’s safe system of work

employing organisation

person or organisation who requires a lifting operation to be carried out and is responsible for safe use of the crane

NOTE: In the case of a hired crane the degree of the employing organisation’s responsibility for the safe use of the crane depends on whether the crane is being supplied under a crane hire contract or as part of a contract lift.

erector

person trained and assessed in tower crane erection, working under the supervision of an erection supervisor

erection supervisor

person in control of a team of tower crane erectors on site, who is a senior erector with sufficient experience and additional skills to enable them to supervise, and take responsibility for, the team

indicator

device which provides warnings and/or data to facilitate the competent control of the crane within its design parameters

installation

group of activities associated with the erection, alteration and dismantling of a tower crane

lifting

any movement of loads or persons that includes a change of height

basic lift

lifting operation where the weight of the load(s) can be simply established, and there are no hazards or obstructions within the area of the operation

intermediate (standard) lift

lifting operation where there are hazards, either within the working area of the crane or on the access route to the working area

complex lift

lifting operation which includes cranes using load enhancement equipment, lifting of persons or when the lifting operation is at a location with exceptional hazards

NOTE: An example of a location with exceptional hazards is a chemical plant.

lifting equipment

work equipment (crane) for lifting or lowering loads, including attachments used for anchoring, fixing or supporting the load

load

weight which is lifted by the crane

NOTE: If cranes are used to lift loads from water, the load could also include forces due to water flow or suction.

lifting accessory

equipment from which the load can be suspended

NOTE: Also known as accessories for lifting.

method statement

document produced by the appointed person to describe how the crane installation or lifting operation is to be carried out

radius

horizontal distance between the point at which the axis of rotation meets the ground and the vertical centreline passing through the hook

NOTE: For non-slewing cranes, the horizontal distance from the centreline of the hook to the centreline of the nearest bogie or axle, bogie or track, measured at ground level, can be assumed to be the radius.

radius indicator

device that shows the radius at which the crane is operating

safe working load

load that the crane or lifting accessory is designed to lift for a given operating condition (e.g. configuration, position of the load)

NOTE: Also known as “rated capacity”.

rated capacity indicator/limiter

RCI/L

device that warns of the approach to overload and prevents the crane from being overloaded as described in BS EN 12077-2

NOTE: This was previously known as an “automatic safe load indicator” (ASLI) and “overload protection”. For information on ASLIs see BS 7262.

senior erector

erector with sufficient experience and additional skills to enable them to work with and directly oversee a trainee erector

service conditions:

in-service

condition where the crane is handling loads not exceeding the rated capacities within permissible wind speeds and other conditions as specified by the manufacturer

out-of-service

condition where the crane is either not required for use or is out of use, without a load on the hook and in conditions as specified by the manufacturer

NOTE: These conditions may include a higher wind speed than that permitted for the in-service conditions.

signaller

person responsible for directing the crane operator to ensure safe movement of the crane and load

slinger

person responsible for attaching and detaching the load to and from the crane, for correct selection and use of lifting accessories in accordance with the specifications of the appointed person and for initiating the movement of the load

thorough examination

examination by a competent person in such depth and detail as the competent person considers necessary to enable them to determine whether the equipment being examined is safe to continue in use

NOTE: The thorough examination is not part of the maintenance regime for the equipment but provides owners with information which could be used to determine the effectiveness of the

regime. The competent person may require supplementary tests as part of thorough examination. See BS 7121-2.

top slew tower crane

slewing jib type crane with jib located at the top of a vertical tower which is assembled on site from components

trainee erector

person undergoing training in the erection of cranes and working at all times under the direct supervision of a senior erector

use

<of work equipment> activity of any kind involving work equipment

NOTE: *This includes starting, stopping, programming, setting, transporting, repairing, modifying, servicing and cleaning.*

user

person or organisation that has control of the lifting operation and the crane operator, and has a responsibility to ensure that cranes are properly maintained and thoroughly examined by a competent person

weight

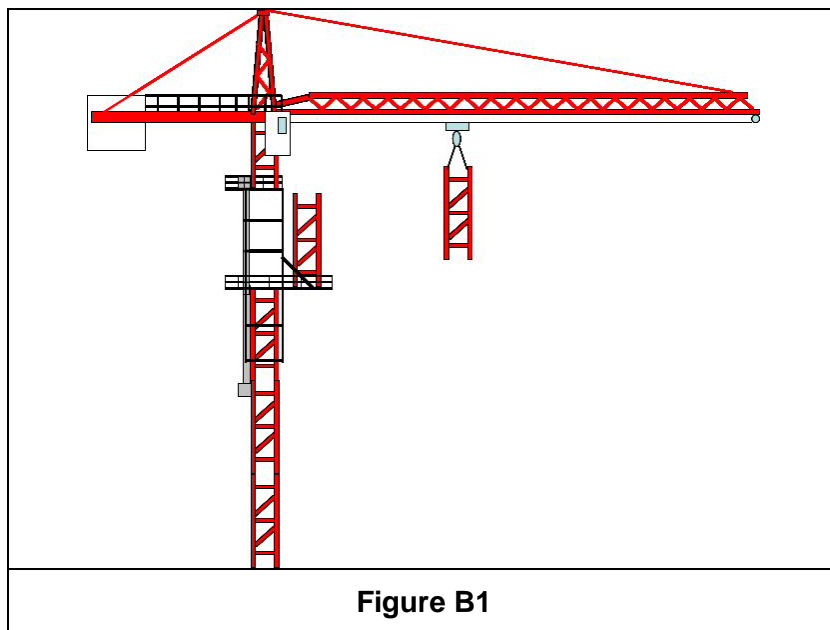
vertical force exerted by a mass as a result of gravity

Annex B – Description of External and Internal Climbing

B.1 General

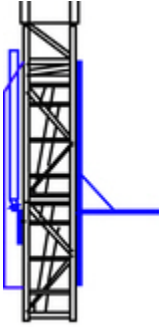
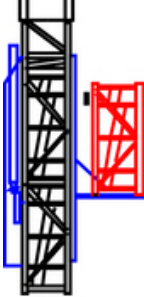
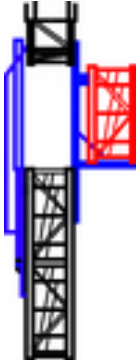
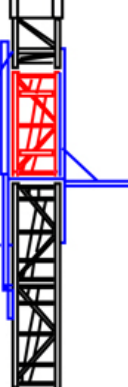
Most tower cranes are erected to their full height using another crane, either a mobile crane or another tower crane. This method is not however always possible as very tall cranes may require tying to an adjacent structure, often the building they are helping to construct, and consequently need erecting in stages. Additionally in congested city centre sites there is often not sufficient room on which to stand the large mobile cranes required to erect tower cranes to great heights. In these cases the height of the tower crane may be extended using climbing techniques. These fall into two main categories, external (where the tower of a crane outside a building is extended with a jacking system to allow additional tower sections to be inserted), and internal (where the crane tower is supported by the building floors and is jacked up as the building rises). These two methods are illustrated in Figures B1, B2 and B3.

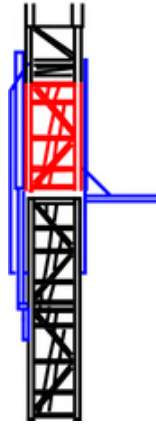
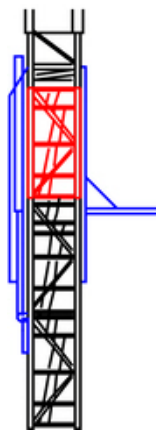
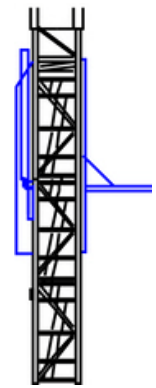
B.2 External climbing



When carrying out external climbing, the most common method of increasing the height of a tower crane is by the use of a climbing frame. This consists of a lattice steel frame surrounding three sides of the crane tower, with an opening on the fourth. A hydraulic cylinder(s) allows the frame to be raised or lowered and guide wheels or rollers are provided to keep the frame aligned on the tower. The open side of the frame incorporates a means of storing a new tower section prior to raising the climbing frame, moving it into the tower after climbing and then lowering it on to the top of the previous section.

The following describes external climbing on a typical tower crane. Climbing systems vary in detail between different tower crane manufacturers, but the principles are substantially the same.

<p>At the start of the climbing process the climbing frame, generally in two parts, is assembled on the crane tower and then lifted to the top of the tower by the tower crane. Once at the top of the tower the frame is secured to the underside of the tower crane slewing section. The foot of the climbing cylinder(s) is then located on reaction (push) points on the tower.</p>	
<p>A tower section is then lifted on the tower crane's hook and transferred to the climbing frame. This may require the inside limits of the crane to be reset to allow the section to be placed on the tray (also fitting climbing frame). The tower crane is then slewed square with the tower to the climbing position, with the jib over the open side of the climbing frame. The crane top is then put in balance to ensure that the overturning moment on the climbing frame is kept to a minimum. Balancing is achieved by lifting a specified weight (normally another tower section) and moving it to a specific radius, or using the self weight of the jib and hook block. This ensures that the superstructure of the tower crane is balancing about the centre of the climbing cylinder(s).</p>	
<p>The climbing cylinder(s) is then pressurized to take the weight of the tower crane superstructure, allowing the fastenings connecting the superstructure of the tower crane to the uppermost tower section to be removed. Once the fastenings have been removed the cylinder(s) is extended to lift the tower crane superstructure a sufficient distance to allow a new tower section to be inserted.</p>	
<p>When the climbing frame has been extended sufficiently, the new tower section is pulled into the frame.</p>	

<p>The frame is then lowered until the joints on the tower crane superstructure engage with the top of the new section. The tower crane superstructure/tower joints are then secured and the new tower section lifted clear of the transfer device to allow it to be pushed out of the climbing frame.</p>	
<p>Once the transfer device is clear of the frame, the tower crane superstructure is lowered to allow the bottom of the new section to engage with the joints of the previous section. When the joints are fully engaged, fastenings are secured to lock them.</p>	
<p>The climbing cylinder(s) is then retracted and its foot located on the tower reaction (push) points, allowing the climbing cycle to be repeated.</p>	
<p>Figure B2 – Typical External Climbing Sequence</p>	

NOTE: This process is shown in detail in the DVD on “The Safe External Climbing of Tower Cranes” produced by Lend Lease and Select Tower Cranes in partnership with the Construction Plant-Hire Association and the Health and Safety Executive

B.3 Internal climbing

On a tall structure placing the tower crane outside the building with a tower extending from foundation level to the top of the building can result in a costly tower configuration. The tower crane may also have to have a high capacity to enable it to place loads in the centre of the building’s footprint. As an alternative the tower crane and its tower can be located inside the building and climbed up inside the structure as construction progresses, using the completed part of the structure to take all the forces generated by the tower crane. This process is known as “internal climbing”.

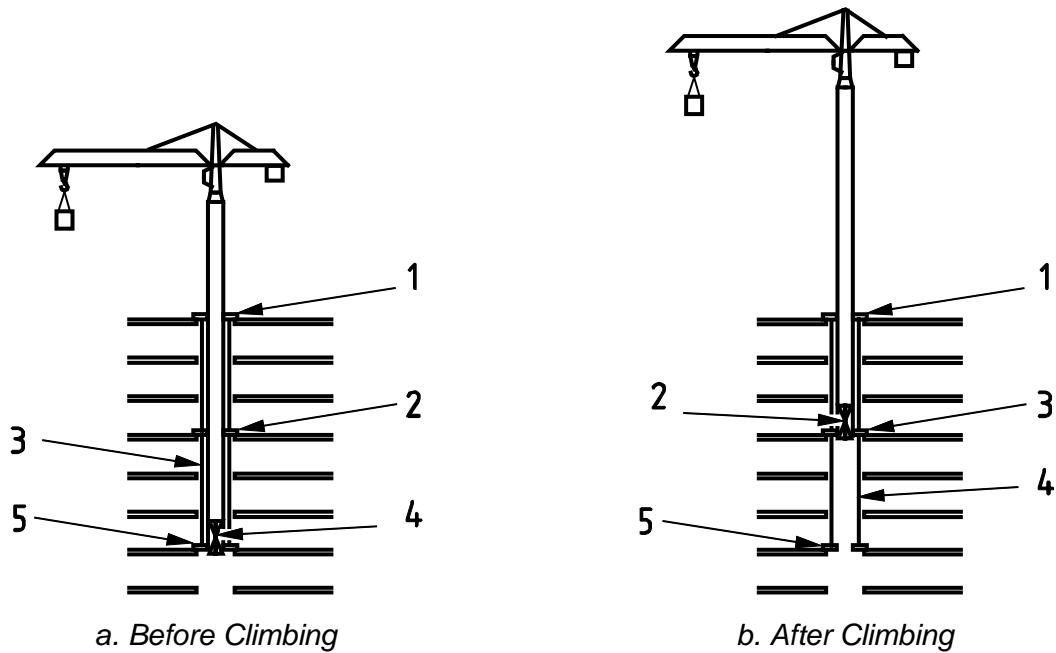
The tower crane is supported in collars which surround the tower at two different floor levels, generally about 12m apart. The lower collar, at the bottom of the tower, takes vertical forces and part of the overturning moment, whilst the top collar takes the horizontal

forces of the remainder of the moment. Whilst the tower crane is working the tower is clamped to both collars allowing the forces generated by the tower crane to be transferred to the collars and into the building structure, usually via a steel grillage.

To climb the tower crane up to the next level an additional collar is assembled around the tower at the prescribed distance above the top collar and the climbing supports, up which the tower crane climbs, are hung from what has now become the top collar.

See Figure B2a. The devices clamping the tower to the collars are released and the tower crane is climbed to the next level using a hydraulic climbing section at the bottom of the tower which reacts on the climbing supports. Once the bottom of the tower has reached the middle collar, the tower is clamped to the middle and top collars, leaving the bottom collar to be removed and available for the next climb. See Figure B2b.

NOTE: Internal climbing systems are infrequently used in the UK and internal climbing should only be carried out by personnel having the required level of competence.



Key

- 1 - New top collar (installed before climbing)
- 2 - Middle (previously top) collar
- 3 - Climbing support
- 4 - Hydraulic climbing section
- 5 - Bottom collar

Key

- 1 - Top collar
- 2 - Hydraulic climbing section
- 3 - Bottom collar
- 4 - Climbing support
- 5 - Old bottom collar (for removal)

Figure B3 – Typical Internal Climbing Sequence

A variation on the system described above uses a hydraulic climbing device situated on the middle collar to push the tower up using the climbing lugs on the tower sections, combined with a system to support the tower whilst the climbing cylinder is being retracted. (See **Figure B4**)

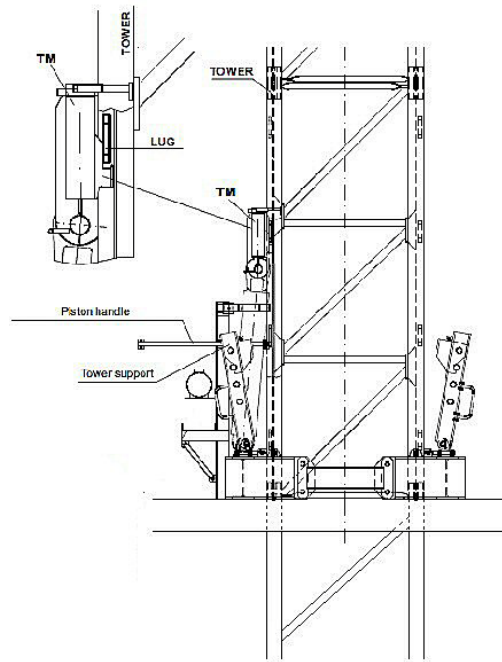


Figure B.4 – Alternative Internal Climbing System

B.4 Climbing systems

Whilst all climbing systems utilize the principles described in **B.2** and **B.3** the details vary between makes, types and models of tower cranes. The manufacturer's instructions for the specific tower crane being climbed should be referred to for both the planning and execution of the climbing operation. Some variations between systems are described below.

B.4.1 External

External climbing frames are all basically a steel lattice frame forming a sleeve around the tower with guide wheels or rollers to transfer any horizontal forces resulting from any overturning moment to the tower. The guide wheels or rollers may bear on either the corners or faces of the tower section corner posts.

Lifting of the climbing frame is carried out by a hydraulic cylinder(s) attached to the frame with the free end located on reaction points on the tower. These reaction points are either tower structure members or lugs welded to the tower. On some designs of climbing frame the cylinder(s) has sufficient stroke to lift the tower crane superstructure the distance required to insert a new tower section. On others a cylinder(s) with a shorter stroke is used in conjunction with a ratchet mechanism requiring the cylinder(s) to be extended and retracted several times to lift the climbing frame the required distance.

On most designs of climbing frame the climbing cylinder(s) is located on one side of the tower but on some it is located centrally, making it easier to balance the tower crane superstructure.

The means of holding the new tower section on the climbing frame and transferring it in to the tower may either be an overhead runway beam projecting from the climbing frame from which the tower section is suspended or a guided platform on which the tower section is placed.

Climbing frames are generally provided with personnel platforms located at the top and bottom of the frame to provide safe access for the erection team, with connecting ladders between the platforms.

A far less common type of external climbing system, occasionally seen on older designs of tower crane, has the tower crane superstructure located on an inner tower which telescopes from an outer tower. Once the inner tower has been extended additional tower sections, in halves, are lifted up and bolted together around the inner tower. The climbing equipment can then be engaged in the new section and the climbing process repeated.

B.4.2 Internal

Internal climbing arrangements generally consist of climbing supports suspended from the top collar and a hydraulic climbing device which lifts the tower crane up the climbing supports in a series of strokes of the cylinder(s), with a ratchet arrangement to support the tower crane during cylinder(s) retraction. Climbing supports can be ladders, rods or tubes.

An alternative arrangement involves a hydraulic climbing device located outside the tower which pushes on climbing lugs incorporated into the tower sections. The tower is raised by extending the climbing cylinder to full stroke, engaging pivoting supports on lugs lower down the tower to support the tower whilst the cylinder is retracted, re-engaging the cylinder with the tower lugs and repeating the process until desired height has been reached. (See **Figure B4**)

B.5 *Tying*

Tower cranes are generally self supporting, with the tower attached to a foundation or base that is capable of absorbing all the forces imposed by the crane, both in-service and out-of-service. In this case the crane is described as “freestanding”. Occasionally it is necessary to provide external support for the tower from an adjacent structure and the crane is “tied” to the structure using specially designed struts or “legs”. The need for a crane to be tied may arise from a number of circumstances, such as:-

- Insufficient tower strength

On a tall crane the tower sections may have insufficient section modulus to resist the moments imposed by the crane and it may be impractical or uneconomical to use a wider tower section. A larger tower section may not be available or space constraints may not permit the use of a larger section.

- Insufficient base capacity

On a tall crane it may not be possible, due to constraints on site, to install a sufficiently large foundation or base to safely absorb the forces from the crane. In this case both the horizontal forces and overturning moments can be taken by ties to an adjacent structure.

B.5.1 Types of Tie

Ties between the crane and adjoining structure generally consist of three pin-jointed struts configured as shown in **Figure B5**, which provides a rigid, statically determinate and economical arrangement. The struts or legs connect onto a collar surrounding the tower forming a stiff “picture frame” which distributes the tie forces concentrically to the tower legs and inhibits racking distortion of the tower. Internal cross bracing may also be added inside the tower at the level of the collar to resist crushing forces. The other ends of the struts connect to lugs attached to suitable points on the supporting structure. When planning the vertical position of ties on the tower it is important to remember that most manufacturers will only allow tie collars to be positioned at certain points on each tower section.

Tie legs normally consist of tubular members with clevises for pin connections at either end. Most crane manufactures supply modular systems which can be used to build up struts of varying length, with some means of fine adjustment for final assembly of the tie (**Figure B6**). In practice most crane owners arrange to have job-specific legs fabricated as this may prove less expensive. It is however important that these fabricated legs also incorporate some means of making fine adjustments to the tie length as this considerably eases the task of fitting the ties and adjusting the plumb of the tower.

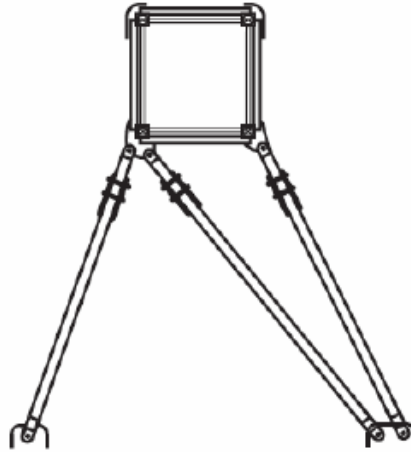


Figure B5 – Typical Tie

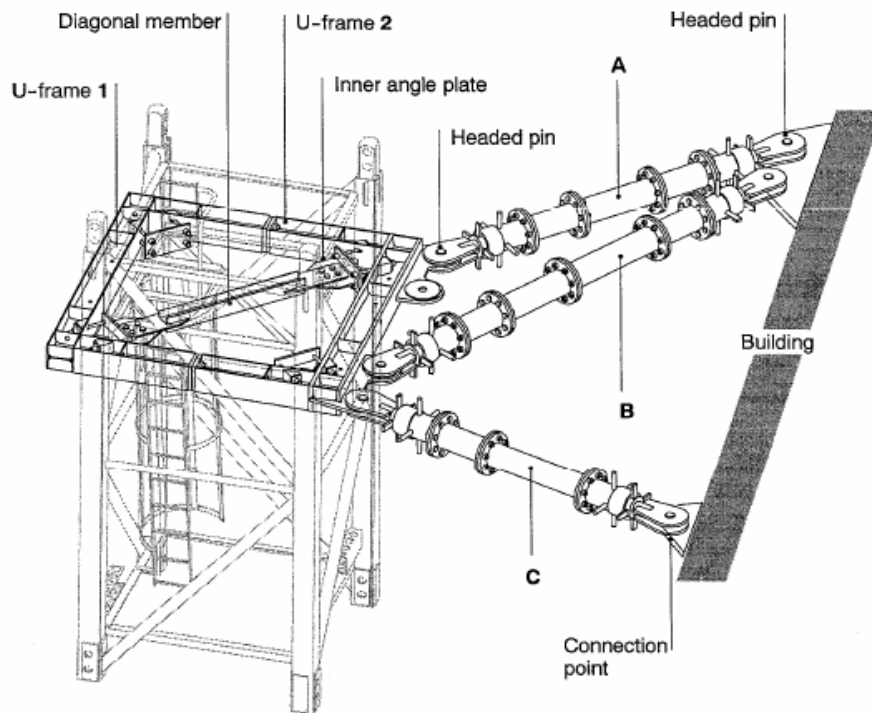


Figure B6 – Proprietary Tie System

Annex C – Example of a Climbing Operation Risk Assessment

SUB ACTIVITY	RISK / HAZARD (i.e. Problems that may or will arise and need controlling)	INITIAL RISK			CONTROL (i.e. How are you going to stop a hazard from becoming an accident)	RESIDUAL RISK			Who ensures?
		S	L	RR		S	L	RR	
Transport of loads	Road traffic accident	5	3	15	Vehicle maintained, MOT'd, Driver competent, within hours	5	1	5	Tower Crane Supplier
	Pedestrians	5	4	20	Driver to remain alert to pedestrians taking risks	5	1	5	Tower Crane Supplier /Site
	Exceeding drivers hours	5	3	15	Driver to check tachograph and log break times. Advise site if return journey critical If necessary leave trailer and d return to base	5	1	5	Tower Crane Supplier
	Reversing	5	4	20	Reversing bleeper to be working and banksman to be in attendance	5	1	5	Tower Crane Supplier
	Late delivery	2	4	8	Deliveries to be planned to arrive in good time deliveries to be coordinated so they arrive in correct order Holding area to be located	2	2	4	Tower Crane Supplier
	Loosening of load	5	3	15	Load to be checked on leaving yard and at each break Good strops / chains to be used	5	1	5	Tower Crane Supplier
	Objects falling off wagon	5	3	15	Large objects to be well secured with good strops and chains, small objects to be put in boxes or secured to large sections	5	1	5	Tower Crane Supplier
	Over width loads	5	4	20	Warning triangles and flashing lights to be fitted, Police escort if required	5	1	5	Tower Crane Supplier
	Over length loads	5	4	20	Warning triangles and flashing lights to be fitted, Police escort if required	5	1	5	Tower Crane Supplier
Mobile crane	Reversing into position	5	4	20	Reversing bleeper to be working and banksman to be in attendance	5	1	5	Tower Crane Supplier
	Capacity	5	3	15	Check crane vs. order. Bigger crane may have access problem	5	1	5	Tower Crane Supplier
	Lifting accessories	5	3	15	Check certificates and condition	5	1	5	Tower Crane Supplier
	Overturning	5	4	20	Set up correctly on good ground, double check on driver's set up	5	1	5	Tower Crane Supplier
	Public interest	5	4	20	Keep public at bay with Herras fencing, hoarding or barriers. Respond politely if questioned	5	1	5	Tower Crane Supplier /Site
	Setting up and basing out	4	4	16	Tell driver where you want him to go. Check this is feasible. Check base pad positions	4	2	8	Tower Crane Supplier
	Ground conditions	5	3	15	Client to advise on sub surface problems	5	1	5	Site
	Positioning	5	3	15	Mark on ground where king pin to be set and orientation	5	1	5	Tower Crane Supplier
	Counterweight swing	4	4	16	Ensure 600mm clearance to hard points or barrier off	4	2	8	Tower Crane Supplier

SUB ACTIVITY	RISK / HAZARD (i.e. Problems that may or will arise and need controlling)	INITIAL RISK			CONTROL (i.e. How are you going to stop a hazard from becoming an accident)	RESIDUAL RISK			Who ensures?
		S	L	RR		S	L	RR	
Unloading & Loading of wagons	Climbing up onto vehicle	4	3	12	Use step and hand holds, clear mud off before climbing. Ladder should/be available	4	2	8	Tower Crane Supplier
	Climbing up crane section	4	3	12	Use ladder if obvious step and hand holds are not valid	4	2	8	Tower Crane Supplier
	Attaching strops	4	3	12	Ensure secure position before releasing hands to work with strops	4	2	8	Tower Crane Supplier
	Manual handling of small loads	3	4	12	Use proper manual handling techniques. Place boxes on benches rather than ground	3	2	6	Tower Crane Supplier
Lifting of sections	Load falling	5	4	20	Use certificated strops. Certified slinger to attach. Lift 6" off ground to check balance. Mark lifting points for disassembly. Ensure strops cannot slip	5	1	5	Tower Crane Supplier
	Public interest	5	4	20	Keep public at bay with Herras fencing, hoarding or barriers. Respond politely if questioned	5	1	5	Tower Crane Supplier /Site
	Load judder on lifting	4	3	12	Check strops cannot slip. Check chains are not twisted or snagged	4	2	8	Tower Crane Supplier
	Pinched fingers	3	4	12	Wear gloves and keep fingers clear as load goes onto crane	3	2	6	Tower Crane Supplier
Assembly & Disassembly of sections on Ground	Pinched fingers	3	4	12	Wear gloves and keep fingers clear as load comes off crane. Set up timbers to rest sections	3	2	6	Tower Crane Supplier
	Tools slipping	3	4	12	Use good correct tools	3	2	6	Tower Crane Supplier
	Misalignment	3	4	12	Check fit and adjust before final tightening	3	2	6	Tower Crane Supplier
	Re-arrangement of strops	4	4	16	Ensure load is stable on ground before altering strops. If held on one strop, ensure restraint against unplanned movement	4	2	8	Tower Crane Supplier
	Sledge hammer work	4	4	16	Check head is secure and use remote drift. Check hands will not hit steel work if drift missed or shifts	4	2	8	Tower Crane Supplier
	Working platforms	5	4	20	Ensure stable base to work off. Use scaffold boards and ladders where practical, adequate guardrails, barriers to prevent falls.	5	1	5	Tower Crane Supplier
Lifting at height	Alignment of base	5	3	15	Check with site for line and level	5	1	5	Tower Crane Supplier
	Concrete strength	5	3	15	Check with site that erection strength attained	5	1	5	Tower Crane Supplier
	Attaching strops	4	3	12	Ensure secure position before releasing hands to work with strops	4	2	8	Tower Crane Supplier
	Releasing strops	4	3	12	Ensure secure position before releasing hands to work with strops	4	2	8	Tower Crane Supplier
	Loose fittings	5	4	20	Minimise loose fittings at height. Keep in sacks or boxes, use catch nets or tie to structure	5	1	5	Tower Crane Supplier

SUB ACTIVITY	RISK / HAZARD (i.e. Problems that may or will arise and need controlling)	INITIAL RISK			CONTROL (i.e. How are you going to stop a hazard from becoming an accident)	RESIDUAL RISK			Who ensures?
		S	L	RR		S	L	RR	
Lifting at height	Sledge hammer work	4	4	16	Check head is secure and use remote drift. Check hands will not hit steel work if drift missed or shifts	4	2	8	Tower Crane Supplier
	Men falling	5	4	20	All men at height to wear full harnesses and clip on when outside handrails	5	1	5	Tower Crane Supplier
	Tools falling	4	4	16	Toe boards provided on all access equipment. Tool belts to be used to store tools when at height. Exclusion zone to be placed around the base of the tower crane.	4	2	8	Tower Crane Supplier
	Public interest	5	4	20	Keep public at bay with Heras fencing, hoarding or barriers. Respond politely if questioned	5	1	5	SITE
	Vertical alignment	4	3	12	Check with site for line and level	4	2	8	SITE
	Load falling	5	4	20	All loads to be well secured with appropriate strops/chains. Certified slinger to attach, lift 6" to check balance, ensure strops cannot slip.	5	1	5	Tower Crane Supplier
	Falling Items	5	4	20	Use certificated strops. Certified slinger to attach. Lift 6" off ground to check balance. Mark lifting points for disassembly. Ensure strops cannot slip	5	1	5	Tower Crane Supplier
Working at height	Fall from height	5	4	20	Edge protection with intermediate guardrail as the preferred control. If this is not possible then harnesses must be worn and clipped on where practicable at all times.	5	1	5	Tower Crane Supplier
	Fall of tools from height	5	4	20	Toe boards provided on all access equipment. Tool belts to be used to store tools when at height. Exclusion zone to be placed around the base of the tower crane.	5	1	5	Tower Crane Supplier
	Fall from ladder	4	4	16	Work on ladder for short duration work only, ladder must be lashed and/or footed. Tool belt to be used to carry tools up or down ladder.	4	2	8	Tower Crane Supplier
	Injury to others	5	4	20	Area below to be secured. No work to be carried out above other operators, to liaise with operators of possible interfaces.	5	1	5	Tower Crane Supplier
	Confined Areas	4	3	12	Operators to be made aware of obstructions that could be in the way, sprinkler heads, or other services. Hardhat to be worn at all times along with any other PPE that may be required.	4	2	8	Tower Crane Supplier
	Use of Hand Tools (cuts bruises abrasions)	3	4	12	Gloves to be worn at all times. Tools to be checked for suitability. Only trained operatives to be used.	3	2	6	Tower Crane Supplier
Assembly & disassembly of sub items	Falling items	5	4	20	Use certificated strops. Certified slinger to attach. Lift 6" off ground to check balance. Mark lifting points for disassembly. Ensure strops cannot slip. Ensure No-Go zone established under work area with sentries.	5	1	5	Tower Crane Supplier
	Falling men	5	4	20	All men at height to wear full harnesses and clip on when outside handrails	5	1	5	Tower Crane Supplier
	Falling tools	5	4	20	Toe boards provided on all access equipment. Tool belts to be used to store tools when at height. Exclusion zone to be placed around the base of the tower crane.	5	1	5	Tower Crane Supplier

SUB ACTIVITY	RISK / HAZARD (i.e. Problems that may or will arise and need controlling)	INITIAL RISK			CONTROL (i.e. How are you going to stop a hazard from becoming an accident)	RESIDUAL RISK			Who ensures?
		S	L	RR		S	L	RR	
	Misalignment	5	3	15	Check fit, and adjust before final tightening. Major errors to be investigated and referred back to crane supplier.	5	1	5	Tower Crane Supplier
	Incompatibility	4	3	12	Site assessment over criticality and ability to continue. Note to be made and reported back to crane supplier to prevent next time	4	2	8	Tower Crane Supplier
	Missing items	4	3	12	Site assessment over criticality and ability to continue. Note to be made and reported back to crane supplier to prevent next time	4	2	8	Tower Crane Supplier
Roping & De-Roping	Sock parting	4	3	12	Ensure free running of ropes and sock in good condition	4	2	8	Tower Crane Supplier
	Wrong rope	4	3	12	Check diameter, configuration, pre use, strength and length before starting	4	2	8	Tower Crane Supplier
	Drum collapsing	4	3	12	Check condition and set up on secure stand	4	2	8	Tower Crane Supplier
	Falling pear	4	3	12	Pull ropes tight and hammer into wedge. Tail to be clipped to drum	4	2	8	Tower Crane Supplier
	Broken wires	4	3	12	Wear gloves and check along length on pre used rope	4	2	8	Tower Crane Supplier
	Working on jib / falling	5	4	20	All men at height to wear full harnesses and clip on when outside handrails	5	1	5	Tower Crane Supplier
	2 fall / 4 fall hook retention	4	3	12	Inner hook to be lashed to jib until reeving complete	4	2	8	Tower Crane Supplier
Commissioning & Decommission	Electric shock	4	3	12	Do not energise until OK'd by electrician	4	2	8	Tower Crane Supplier
	Mis-wiring	4	3	12	Competent electrician to be present	4	2	8	Tower Crane Supplier
	Setting limits	4	3	12	All men at height to wear full harnesses and clip on when outside handrails. Check several times to ensure no creep of pawls. Ensure settings match manual or crane supplier's practice if too fine.	4	2	8	Tower Crane Supplier
	Public Interest	5	4	20	Keep public at bay with Heras fencing, hoarding or barriers. Respond politely if questioned	5	1	5	Tower Crane Supplier
Testing	Crane collapse	5	3	15	Follow procedures for torque and sequence. Check wind strength and completeness of preceding work	5	1	5	Tower Crane Supplier
	Load falling	5	4	20	Use certificated strops. Certified slinger to attach. Lift 6" off ground to check balance. Mark lifting points for disassembly. Ensure strops cannot slip	5	1	5	Tower Crane Supplier
	Setting limits	5	3	15	All men at height to wear full harnesses and clip on when outside handrails. Check several times to ensure no creep of pawls. Ensure settings match manual or crane supplier's practice if too fine.	5	1	5	Tower Crane Supplier

KEY	<i>S = Severity Rating</i>	<i>L = Likelihood of Occurrence</i>	<i>RR = Risk Rating</i>							
	1. Negligible	1. Improbable	Severity	5	5	10	15	20	25	R
2. Minor Injury	2. Remote:	4		4	8	12	16	20	O	Acceptable only if no other method viable and with high level controls in place
3. Major Injury (RIDDOR)	3. Possible:	3		3	6	9	12	15	Y	Acceptable with suitable controls
4. Fatality	4. Probable:	2		2	4	6	8	10	G	Acceptable, no further action required
5. Multiple Fatality	5. Almost Certain:	1		1	2	3	4	5		
				1	2	3	4	5		
			<i>Likelihood</i>							

Example

Annex D – Example of a Method Statement for a Climbing Operation

Tall Tower Cranes Limited

Big Bang Contractors, Project X, Gunpowder Wharf,
Canal Street, Manchester

Method Statement for the External Climbing of TC14 – Climb No. 2

Method Statement No: ENG1001L/M/004

<i>Version</i>	<i>Prepared By Appointed Person</i>	<i>Issue Date</i>	<i>Approved</i>	<i>Date</i>
1	A Pointed	22/06/11	J. Smith	22/06/11

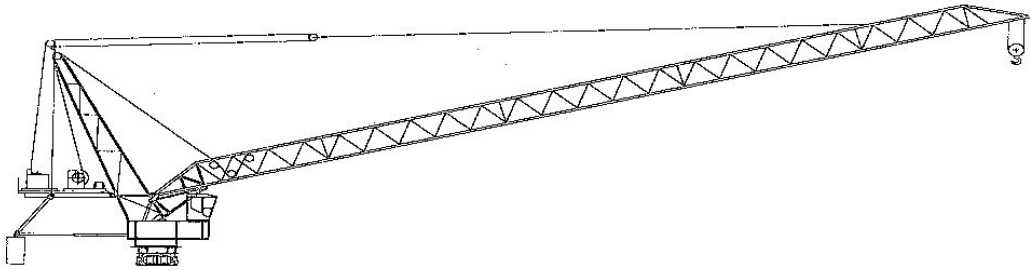
<i>Briefing Register</i>	<i>Print Name</i>	<i>Signature</i>	<i>Date</i>
<i>Name of person contacted on site.</i>	<i>Print Name</i>	<i>Signature</i>	<i>Date</i>

<i>Distribution</i>	<i>Issue Date</i>	<i>Received</i>	<i>Date</i>
Operations Manager			
Erection Supervisor			
Project Manager			
Project Engineer			
Section Manager			
Site Safety Manager			
Site Contact (for day of operation):		Telephone No:	

Method Statement Contents

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1.0 Tower Crane Configuration



Height	Section	
126.4m	HD23 22 6 C tie section	ADDITIONAL
120.4m	HD23 22 6	
114.4m	HD23 22 6	
108.4m	HD23 22 6	
102.4m	HD23 22 6	
96.4m	HD23 22 6 C tie section	EXISTING SECTIONS
90.4m	HD23 22 6	
84.4m	HD23 22 6	
78.4m	HD23 22 6	
72.4m	HD23 22 6 C tie section	
66.4m	HD23 22 6	
60.4m	HD23 22 6	
54.4m	HD23 22 6	
48.4m	HD23 26 6 C tie section	
42.4m	HD23 22.6	
36.4m	HD23 22.6	
30.4m	HD23 26.6	
24.4m	HD23 26.6	
18.4m	HD23 26.6	
12.4m	HD23 26.6	
6.4m	HD23 26.6	

Radius	35M	Radius	60M
SWL	16,000kg	SWL	9,000kg
10%	N/A	10%	9,900kg
Model:	CTL630 TC1		
Plant No:			
Customer:	Project X		
Address:	Gunpowder Wharf Canal Street Manchester		
Base Type:	HD 23-26 F/A		
Base Size:			
Base Ballast:			
Counter Ballast:	9 x 7.5Te blocks Total 67.5Te		

Signed: Alan Pointed

Date: 22/06/11

2.0 Power Supply

The crane is connected to the site mains power supply. Back-up power is available from a 200KVA diesel generator set located on site and connected to the tower crane via a manually operated changeover switch. The Generator will be checked for a full fuel tank (12 hrs running capacity) and run for one hour before the climb starts.

3.0 Sequence of Work and Programme

3.1 Task Outline

- Climb in two tower sections;
- Install third tie collar and tie;
- Climb in two further tower sections to increase tower height from 102.4m to 126.4m.

3.2 Programme of Work: -

3.2.1 Day One

- Start on site. Erection Supervisor to carry out team briefing and ensure tie approval completion form signed off .
- Raise climbing frame from storage position to tower top and connect to P1/P2 beams.
- Test hydraulics and check climbing frame. Erection Supervisor to complete the climbing frame check list and forward to the Tall Tower Cranes office with the signed off cover of the method statement.
- Torque up the tie brackets on the building side (1890Nm using a torque wrench MX5 =2700psi or MX3 = 4300psi) access via man rider.
- Unload tie collar and tie legs ready for fitting + 2 x HD23-22-6 tower sections and place in Canal Street.

3.2.2 Day Two

- Install 1No. HD23 22 6 tower section by self climbing
- Install 1No. HD23 22 6 tower section by self climbing
- Secure the tower crane head to the tower top section.
- Install third tie collar and tie legs at 96.4m level

3.2.3 Day Three

- Unload 2 x HD23-22-6 tower sections and place in Canal Street.
- Install 1No. HD23 22 6 tower section by self climbing
- Install 1No. HD23 22 6 tower section by self climbing
- Secure the tower crane head to the tower top section
- Carry out thorough examination and test
- Handover crane to client.

Note: All timings are approximate and subject to weather conditions.

4.0 Hold Points

- Erection Supervisor to check climbing frame before raising to tower top;
- Erection Supervisor to check balance of crane top before beginning to lift crane top with climbing frame;
- Erection Supervisor to check climbing frame before beginning to lift crane top;
- Erection Supervisor to ensure that operator has isolated crane controls and left the cab before beginning to lift crane top with climbing frame;
- Erection Supervisor to check wind speed before beginning to lift crane top with climbing frame;
- Erection Supervisor to ensure that during climbing only those personnel involved the extension sequence are on the climbing frame, all others members of the erection team are to remain inside the;
- Having completed the tie installation the Erection Supervisor will inspect the tie collar and tie legs to ensure that they are installed correctly and capable of taking load.

5.0 Responsibilities

Big Bang Contractors are responsible for the provision of the following items:-

- Access onto site;
- Lane closure on Canal Street;
- Provision and policing of 10m wide zone excluding all non-essential personnel from the working area to between the transport unloading position & TC base;
- Site management;
- Notification of other contractors on site of proposed works;
- Mains power and standby power for the tower crane;
- Allocation of storage area for tower sections in line with the crane direction when climbing;
- Test area for proof load test at 60m following climbing operation.

6.0 Erection Personnel and Duties

- 6.1** The Erection Supervisor, having participated in climbing operations under the supervision and guidance of a Comedil Supervisor, is certificated and authorised by Tall Tower Cranes to carry out such operations.
- 6.2** The erectors, having also participated in climbing operations under the supervision and guidance of a Comedil Supervisor, are certificated and authorised by Tall Tower Cranes to carry out such operations.
- 6.3** The driver has been trained on this type of crane and holds an appropriate CPCS card.
- 6.4** All erection team members have received theoretical and practical training in the process of climbing with the HD23/A climbing frame from a Comedil Supervisor.
- 6.5** The electrician is responsible for ensuring:-
- That the slew brake is working and in good order.
 - That the power cable to the pump is installed correctly, the motor is rotating in the correct direction and the safety circuit is working i.e. the crane cannot slew whilst the hydraulic pump on the climbing frame is running.
 - That there is ample mains cable lifted up and coiled under the climbing frame before the climb takes place and that the cable is checked for snagging during the climb.

- 6.6** The two erectors on the bottom staging are responsible for ensuring:-
- That during the climbing operation particular attention is paid to the guide rollers for freedom of movement, if the rollers stop or start to bind they must inform the Erection Supervisor who will stop the climb, assess the situation and make any adjustment of balance necessary.
 - That mast sections are correctly landed on the traverse trolley and that the trolley is moved in and out of the climbing frame when it is at full stroke.
 - That the new section is correctly guided and pinned on top of the last section.

- 6.7** The third erector will assist the Erection Supervisor on the top platforms to pin and unpin the sections as they are climbed in, and assist with the balancing operation when lifting the crane off the section.

The third erector is also responsible for ensuring that when the piston traverse (commonly known as the yolk) has been moved down on the top of the section it is correctly located on the push plates.

- 6.8** The Erection Supervisor has overall charge of the operation. If he has concerns about any part of the climbing operation: be it wind, balance, power, stoppages etc. he will stop the climb, place in the permanent pins and then address the problem.

The Erection Supervisor's main duties are to make sure the crane cannot slew whilst climbing; that the crane is perfectly balanced and to monitor both the wind and the other erectors at all times.

7.0 Briefing of Personnel (Tool Box Talk)

Before starting operations on site the Erection Supervisor will give a briefing (tool box talk) to all members of the climbing team, including the crane operator. This briefing will cover all the items in this method statement and will ensure that each member of the team is clear about their specific duties.

On completion of the briefing each member of the team will sign the method statement front cover to acknowledge that they have received the briefing and fully understand their part in the operation.

8.0 Preparation of Components and Equipment

The climbing frame is already installed on the crane. The four tower sections will be prepared in the yard and delivered to site.

9.0 Transport of Components

All tower crane components will be delivered/removed from site as detailed on the attached loading schedule. All loads will be timed to avoid any congestion in or around site.

10.0 Access

Access to the site for loading unloading will be via the west gate from Canal Street.

11.0 Proximity Hazards

There are no proximity hazards that will affect the climbing operation, with the exception of TC2 and TC3. An operator must be present in the cab of each crane throughout the climbing operation.

12.0 Structural Considerations

The tie will be attached to fixing points provided by Big Bang Contractors. Attachment cannot begin until the Erection Supervisor is in possession of a signed Tie Approval/Completion Form. Tie details are given in Drawing No. TT123456 Issue B.

13.0 Craneage Arrangements

All unloading and placing of components will be carried out using TC14, which will need to be switched into erection mode for lifts at minimum radius

14.0 Inspection of Climbing Equipment Before and During Climbing

The Erection Supervisor will ensure that the climbing frame is inspected before raising to the top of the tower and subsequently before each climb takes place. The results of each inspection will be recorded on the Pre-climb Inspection form (See **Annex A**).

15.0 Thorough Examination of Climbing Frame

The climbing frame was thoroughly examined when first installed on TC14 on site. The Erection Supervisor must ensure that he is in possession of a current Report of Thorough Examination before the climbing operation begins.

16.0 Tower Verticality

Checks to ensure that the tower is vertical will be carried out on two faces of the tower by an engineer with theodolite, provided by Big Bang Contractors.

17.0 Protection from Falling Objects

Protection from falling objects will be provided by the establishment of a 10m radius exclusion zone around the tower. This zone will be policed by Big Bang Construction to ensure the exclusion of all personnel not involved in the climbing process.

18.0 Protection from Falls from Height

All erection personnel will wear full body harnesses and fall arrest lanyards at all times when on the crane structure. Lanyards must be clipped to suitable anchor points whenever outside edge protected areas.

19.0 Communication

All communication will be carried out using hand portable radios with a frequency which differs from other radios on the site. The erection team must have at least one spare radio and two spare fully charged batteries. Instructions must be preceded by a call sign, which comprises the name of the Erection Supervisor and the crane number.

20.0 Weather Forecasting and Monitoring

20.1 A weather forecast, with predicted wind speed, will be obtained 24 hours before the climb is to take place. If this is not favourable (6 hour window of winds below 25 mph) the climb will be aborted.

20.2 During the fitting of the climbing frame the Erection Supervisor will ensure that the driver monitors the anemometer (wind speed gauge) in his cab to check for gusting, and report to him if the wind speed exceeds 18 mph.

20.3 The Erection Supervisor will carry a calibrated hand held anemometer to double check the tower crane unit before attempting to climb the tower crane. He will monitor the wind speed for a period of 15 minutes to ensure that the wind speed does not exceed 18 mph.

20.4 The Erection Supervisor will monitor the wind speed periodically throughout the climbing operation. If the wind speed rises above the limit of 20 mph the following action will be taken:-

- If the climbing frame is extended by less than 75%, lower the frame back down so that the slew section engages with the tower top and insert the head bolts and torque to full torque value.

- If the climbing frame is extended by 75% or more continue the climb, insert the new section, lower the frame back down so that the slew section engages with the tower top and insert the head bolts and torque to full torque value.

21.0 Climbing Procedure

NOTE: All figures references are taken from the Comedil top climbing manual

Two tower sections are to be climbed in and then the 3rd tie installed.

1. Check that all pins are retained by R clips, and bolts locked/torqued.
2. Adjust the guide rollers on the climbing frame to match the tower. The maximum permitted gap between the rollers and the tower is 5mm. All work is to be carried out from the walkways or tower platforms with harnesses clipped on as required.
3. Tower sections will be stored at ground level and in line with the climbing frame tray to eliminate slewing.
4. Lift the tower section to be climbed on to the tray and attach the safety chain to the top of section as shown below.



5. Check that the crane counter jib is over the hydraulic cylinder and that the hook with a 1000kg balance weight is at cab height when climbing in a HD23-22-6 @ 450. The crane must be in balance. If it is not in balance, the jib may be luffed slowly in and out until balance is achieved. See table below.

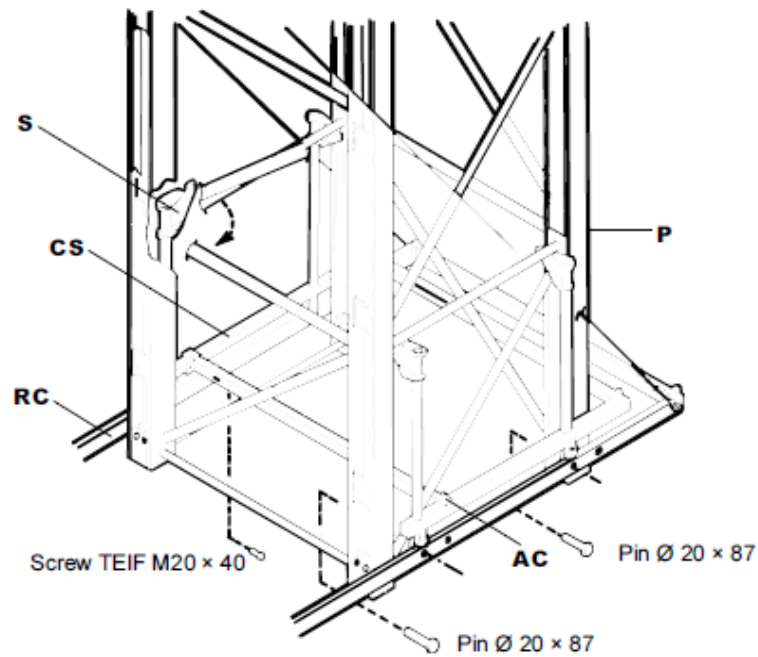


Fig. 1.6.8

- 6) Position the tower section on "CS" service trolley.
Hang "Z" weight to the hook and lift it, thus balancing the crane.
Make sure the jib luffing angle keeps within the limits stated in table 1.6.2.

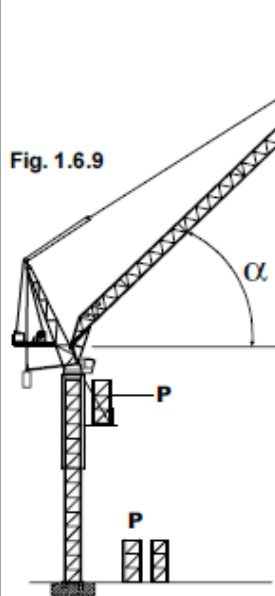


Fig. 1.6.9

Jib		22.6					26.6				
		α	P	Z	α	P	Z				
[m]	[ft]	[°]	[kg]	[lbs]	[kg]	[lbs]	[°]	[kg]	[lbs]	[kg]	[lbs]
60	197	45	4823	10635	1000	2205	45	6473	1427.3	900	1985
50	164	45	4823	10635	3100	6836	45	6473	1427.3	2900	6395
		57	4823	10635	4823	10635	64	6473	1427.3	6473	1427.3
40	131	48	4823	10635	4823	10635	45	6473	1427.3	4100	904.1
30	98	15	4823	10635	4823	10635	15	6473	1427.3	6473	1427.3

Note

α = Theoretical calculation (absence of wind)

Table 1.6.2

- 7) Repeat the operation until all tower sections have been assembled.

6. Lock off the crane cab controls to prevent slew and luffing operations.
7. Check the wind speed – it must be less than 20mph.

8. Double check that the lifting frame bolts and lugs are set correctly. When climbing on HD23-22-6 towers, ensure that the correct spacer is used on the mobile sleeper as in Fig 1.5.5 below.

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1.5.2 Adjusting (1) - (2) spacers of "TR" mobile sleeper, "R1" front-back guide rollers and "R2" side guide rollers

- 1) On positioning "CN" power pack on "B1" platform and connecting it to "MP" hydraulic jack, before "TR" mobile sleeper engages "H" lugs on the tower, adjust spacers (1) and (2) as per following table and figure 1.5.5 and table 1.5.1;
- 2) Adjust the clearance between "R1" front-back guide rollers, "R2" side guide rollers and the tower stanchions by M36 × 200 adjusting screws (fig.1.4.5 and 1.4.6).

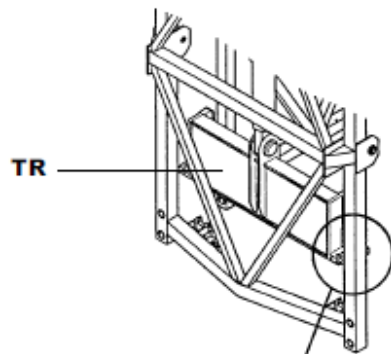
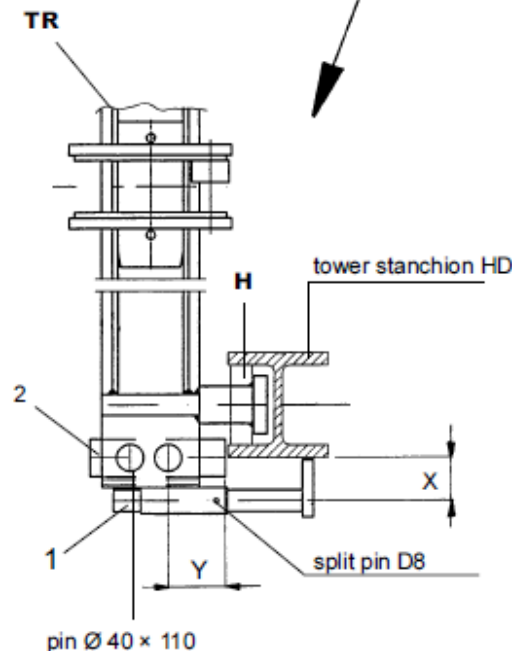


Fig. 1.5.5



		SPACER			
		(1)		(2)	
TOWER HD Type	X	Y			
		[mm]	[inches]	[mm]	[inches]
22.6	55	2	80	3	
26.6	30	1	remove		

Table 1.5.1

ATTENTION!

Failing to get the proper contact between spacer (2) and the tower stanchion, use one of the two extra spacers supplied with the mobile sleeper with "y" measuring 70 mm (3 in.) and 90 mm (4 in.) respectively.

9. Use hydraulic torque gear to loosen, but not remove, the tower head bolts (loosen to 1” of slack), check for balance (if required). If rebalancing is required, the Erection Supervisor will instruct the re-energising of the lift and luffing, but not slew, controls. Then luff in or out to restore balance. Lock off the controls again. Balance is achieved with the same gap under each of the four corners when the slew ring is just lifted clear of the tower. If the crane is balanced, then remove all nuts and plates and store in a safe position on work platform.

AT THIS POINT THE DRIVER MUST LEAVE THE CAB AND WAIT IN THE TOWER SECTIONS BELOW THE CLIMBING FRAME.

10. Use the hydraulic controls on the power pack to jack up the tower head clear of the tower by approximately 1500mm. Then close the pawls onto the upper set of climbing lugs.
11. Slowly transfer the weight from the hydraulic cylinder onto the pawls until all the weight is removed from the hydraulic cylinder. Then remove from the climbing lugs and retract until in line with next set of lugs above.
12. Re-engage the hydraulic cylinder on the lugs and take the weight from the pawls, then retract the pawls and continue to extend the hydraulic cylinder.
13. Continue the above process until there is a 6m opening between the slew ring and tower top.
14. Push the trolley with the tower section to be inserted along the runners so it is in line with tower section below (taking care not to trap the mains cable). Then retract the hydraulic cylinder so that the new tower section joins to the existing tower sections. Then remove the trolley, insert all the bolts and torque.
15. Lower the slew ring onto the new tower section and install 50% of the head bolts and torque them to 50% of full value.
16. Place the next section on the climbing tray and continue the above procedure until 2 tower sections have been climber in.
17. Lower the slew ring onto the new tower section and install all the head bolts and torque to them to full value in preparation for the fitting of the tie collar and legs.
18. On restarting the climbing procedure following the installation of the tie only 50% of the head bolts need to be installed as each section is climbed in. These bolts only need to be torqued to 50% of the full value. On completion of final tower section all the head bolts should be installed and torqued to the full.

22.0 Tie Installation

1. Lift four purpose made chains with shortening clutches onto the tray.
2. Remove the trolley and tray and store at ground level as per drawing TCI-001.
3. Lift up the first half of the tie collar, and working from the tower, suspend the half collar on two chains and pinned turn buckles and connect to tower brace (on HD23-22-6C section adjacent to floor 22/23) so that the centre of collar is in line with centre of wall bracket. Attach holding chains as shown in illustration below.

NOTE: *Wall bracket is the term used for the plates that attach to the building side of the tie.*

4. Lift up the second half of the tie collar, and working from the tower, suspend the half collar on two chains, each with a pinned turn buckle and connect to the tower brace.
5. Join the two halves of the collar using the bolts supplied, with the centre of the collar opposite the wall brackets of the building, then tighten all bolts inclusive of wall brackets fixed to steel work.

The tie has a tolerance on the vertical of +/-100mm. This should be maintained at each tie level, not allowing the tower to go 100mm further in the same direction at the next tie.



6. The Erection Supervisor must then measure the distance between the collar and the bracket attached to the steel work. This should be the same as the previous tie legs.

7. Pre-adjust the tie legs at floor level. Then wide sling leg 1 so that the erectors can reach to disconnect the chain from the safety of the tower. 1 man in the man rider will be lifted up and slewed around into position to insert the pin on the building side. The weight of the tower side leg is then taken by using the chain pull suspended under the climbing frame.
8. Repeat sequence 9 for leg no's 2&3.
9. Once the tie had been completed re-attach the trolley and tray to the climbing frame.
10. **The first tie should now to be re-pinned with 80mm diameter pins. The second tie should then be disconnected at the building end of the tie by removing the 80mm diameter pins and inserting 40mm diameter temporary pins to allow movement without the legs becoming free.**
11. The crane can now continue the climbing procedure, and climb in a further two tower sections, **remembering to fit the HD23 22.6C as the last of these four sections.**

NOTE: If there is insufficient adjustment on the inside turn buckle then use the turn buckle on the building side of the legs.

NOTE: Mark the leg lengths on each leg for future reference.

NOTE: Tower crane lights to isolated and removed from tower section and stored in the slew ring until completion of climb where they will be re-fitted to the top of the last tower section.

23.0 Information

Before starting the operation on site the erection team must be in possession of the following documents:-

- The manufacturer's operation manuals for the specific model of crane and climbing frame.
- Copies of BS712-1:2006 - *Safe Use of Cranes - Part 1: General*, BS 7121-2:2003 – *Safe Use of Cranes - Part 2: Inspection testing and examination* and BS 7121-5:2006: *Safe Use of Cranes - Part 5: Tower Cranes*.
- Tall Tower Cranes Standard Procedures

24.0 Contingency Arrangements

Issue	Action
Wind speed too high at start of climb	Abort operation
Wind speed rises during climb	Make safe and abort operation
Powerpack fails	Inform Tall Tower Crane Management
Trolley jams	Use chain puller to move trolley
Broken roller	Make safe and abort operation
Burst hose	Replace with spare hose
Power cut	Switch to standby generator
Tower sections don't fit	Make safe and abort operation
Misalignment	Adjust rollers, advise site
Out of balance	Adjust luffing jib with specified limit. If balance not achieved make safe and abort operation.
Jib angle changes	Lock off once balanced

25.0 Inspection, Thorough Examination and Testing

Tower crane through examination and testing should be carried out in accordance with BS7121-2:2003.

Any dynamic testing must not subject the crane to an overload in excess of the manufacturer's limit of 110% of rated capacity.

25.1 Erection Supervisor's Responsibilities

The nominated Erection Supervisor is in charge of the test operation.

Prior to commencing the test procedures, the Erection Supervisor will examine the crane to confirm that :

- All structural connections are in order.
- The crane is built to the correct configuration for the contract and conforms to the configuration in the manufacturer's.
- The correct ballast is installed and is correctly marked up.
- All wire ropes are in good condition and correctly reeved.
- All ties are correctly installed and that the tie approval completion form has been completed.

The Erection Supervisor will ensure the area in which the test is to be carried out is clear of any obstacles which might impede the test.

The Erection Supervisor will inform the site management when the test is to start and when the test has been completed.

25.2 Function Testing

The function testing is carried out without load on the hook.

The object of function testing is to determine whether the crane operates smoothly without signs of wear or damage. Every function of the controls should be operated through its full range, including the operation of any brakes and safety devices.

25.3 Performance Testing

Performance testing will be carried out with the rated load applied and after function testing has been successfully completed. The object of the performance testing is to determine if the equipment performs to the manufacturer's specifications. Testing shall include the operation of all controls to determine if the crane operates smoothly and correctly through all motions at the rated speeds, and is free from wear and defects.

25.4 Dynamic Overload Testing

The objective of overload testing is to determine whether the equipment is stable, structurally sound and fit for the use for which it was designed.

During overload testing, all operations must be carried out with extreme care. Every crane motion must be carried out on at a time and at the lowest possible speed.

The dynamic overload test will be carried out with:-

- A load of 110% of the maximum rated capacity of the crane at the permitted maximum radius to prove the integrity of the hoisting, luffing winches, brakes and ropes. The load must be lifted until each tooth in the train of gears has been subject to the overload.

The test load will then be returned to 200mm above solid ground. The load must be suspended for 10 minutes. Check for creep to prove the operation of the hoisting and luffing brakes.

- A load of 110% of the rated capacity at the maximum operating radius, to determine the stability and structural integrity of the crane. The test weight must not be lifted no

more than 200mm above solid ground. The crane must be slewed through 360deg. to test all anchorages. If, because of obstacles, the test weight cannot be slewed through 360° the test weights must be lowered to the ground, dismantled and then re-assembled in the next practicable test position.

If the test at maximum radius is not possible due to site conditions, then a shorter radius can be used with a test load of 110% of the rated capacity at that radius.

On completion of the tests, the Erection Supervisor will examine the crane for any defects.

The crane safe working load limits must then be set to 102% of rated capacity and a test lift carried out to ensure that the hoist cuts out at the correct safe working load.

The test shall be recorded in the site register by the Erection Supervisor. A copy of the test certificate completed by the supervisor must be given to the site management before the supervisor leaves site.

The crane cannot be put to work until a thorough examination has been completed by an independent competent person.

26.0 Handing Over the Tower Crane

Once all operations have been completed, the crane has been tested and a thorough examination has been completed by an independent competent person, the crane may be formally handed back to Big Bang Contractors for lifting operations.

Annex E – Example of an Erector’s Lifting Accessory Register

Lifting Accessory Register							
Site Location	Canal Street Depot	Employing Organisation	A & B Tower Cranes	Appointed Person	F Bloggs	Contact Telephone No	0161 953 8765
	Description	SWL	Weight	Ident. No.	Location	Date of Last Thorough Examination	Date of Next Thorough Examination
1.	Violet web sling 2m long with choker hooks	1400 kg	4 kg	W22228	Van	23.01.06	23.07.06
2.	2 leg 8mm chain sling 2 m leg length	2000 kg	7.5 kg	K26977	Van	19.12.05	19.05.06
3.	4 leg 10mm chain sling 2.5m leg length	4750 kg	31 kg	K17396	Van	19.12.05	19.05.06
4.	Yale Lever Chain Hoist	3000 kg	19.6 kg	Y28963	Van	19.12.05	19.05.06
5.	3 tonne Large Dee Shackle	3000 kg	1.54 kg	D68234	Van	19.12.05	19.05.06
6.	5 tonne Large Dee Shackle	5000 kg	3.11 kg	D68221	Van	19.12.05	19.05.06
7.	4 tonne Small Bow Shackle	4000 kg	2.28 kg	B54382	Van	19.12.05	19.05.06

Annex F – Example of a Foundation Completion Form

Tower Crane Foundation Approval/Completion Certificate			
Site Details :			
Crane Details			
Make:		Model:	
Height under Hook:		Jib Length:	
Base Type:			
Foundation/Grillage Design			
Document and Drawing References:			
Design Carried Out By:			
Company:			
Foundation/Grillage Design Approval			
*Design Checked By:			
* Category 2 check , Table 2 of BS 5975			
Signature:			Date:
NOTE: A separate approval/completion certificate is required for each tower crane			
Permit To Erect			
I confirm the tower crane foundation has been constructed to the specifications detailed above, the foundation anchors/base pads are level and plumb as specified, and that the tower crane may be erected.			
Signature:			Date:
Name:		Position:	
NOTE: The tower crane cannot be erected until the completed form is returned to the Operations Department			

Annex G – Example of a Tower Crane Tie Approval/Completion Form

Tower Crane Tie Approval/Completion Certificate			
Site Details :			
Crane Details			
Make:		Model:	
Height under Hook:		Jib Length:	
Base Type:			
Tie Design			
Document and Drawing References:			
Design Carried Out By:			
Company:			
Tie Design Approval			
*Design Checked By:			
<small>*Category 2 check, Table 2 of BS 5975</small>			
Signature:			Date:
NOTE: A separate approval/completion certificate is required for each tie			
Permit To Erect			
I confirm the tower crane tie attachment point to the supporting structure has been constructed to the specifications detailed above and that the tie may be installed.			
Signature:			Date:
Name:		Position:	
NOTE: The tower crane cannot be erected until the completed form is returned to the Operations Department			

Annex H - Radio Communications for Lifting Operations –TIN 017

Introduction

Tower cranes often work on congested construction sites where the signaller is out of sight of the tower crane operator and the standard hand signals specified in BS 7121 cannot be used. As an alternative, hand held VHF/UHF radios are often used. This however, can lead to a number of problems which may interfere with the clear communication vital for safe lifting operations:-

- Loss of signal and thus communication, leading to loss of control of the lifting operation;
- Interference from radios on adjacent sites, which can lead to loss of communication or directions being given to the wrong crane operator;
- Misunderstanding between the crane operator and the signaller, leading to problems such as a load being lifted before the slinger has his hands clear, loads colliding with the building structure and the load being lowered before people are clear of the landing area.

Radio Specification

The first two issues should be addressed by specification of the correct radio equipment for the application taking into account:-

- Signal strength – if it is too low there is a risk of signal loss - too high and it will cause interference with adjacent sites. When working blind the structure may well cause signal loss and a booster aerial could be required. Signal strength should be checked at the beginning of each shift before lifting operations are started;
- Frequency – choosing a different frequency from other radios on the site or in the area will avoid interference from or to other radios;
- Durability – radio handsets should be sufficiently durable to withstand use on site;
- Charging – adequate charging arrangements to ensure that batteries are charged at the end of a shift and that spare charged batteries are available at all times;
- Battery capacity – sufficient capacity to last for a full shift.

Calls Signs and Standard Commands

The third issue, misunderstandings between the crane operator and signaller, should be addressed as follows:-

- Both parties must have a sufficient command of a common language (normally English) to ensure that clear, unambiguous communication can take place;
- A clear, unique call sign should be allocated to each signaller and crane operator;
- Each message should be preceded by the call sign (e.g. TC1....);
- The crane operator should not respond to any command (other than **Stop**) that is not preceded by the call sign;
- Voice commands must only be given by one person, normally the signaller, at any one time;
- Voice commands should be given using the signals in the following table.

<u>Standard Voice Commands For Lifting Operations</u>		
	<u>Command</u>	<u>Crane Type</u>
1.	“Take the Weight”	All
	“Hoist”	
	“Hoist Slowly” (See Note 1 below)	
2.	“Lower” (See Note 1 below)	All
	“Lower Slowly”	
3.	“Slew Left” (See Note 2 below)	All
	“Slew Right” (See Note 2 below)	
4.	“Trolley In”	Saddle jib tower cranes
	“Trolley Out”	
5.	“Jib Up”	Luffing jib tower cranes, mobile cranes and crawler cranes
	“Jib Down”	
6.	“Extend Jib”	Mobile and some self erecting tower cranes
	“Retract Jib”	
7.	“Travel Forward” (see Note 3 below)	All travelling cranes
	“Travel Backward” (see Note 3 below)	
8.	“Stop”	All
	“Stop Now” (Emergency Stop)	

NOTE 1: When fine positioning control is required, the person giving the signal should repeat the command continuously for as long as motion is required **“Lower slowly, Lower, Lower, Lower, Lower, Lower, Lower, Lower, Stop”**. As long as the crane operator can hear the command he will know that the radio is working. If the commands cease before the final **Stop** he will know that communication has broken down and stop the operation.

NOTE 2: Left and Right are defined from the viewpoint of an operator sitting in a cab looking down at the load. This also applies when a crane is being operated using remote controls.

NOTE 3: In the case of a travelling tower crane **Forwards** and **Backwards** should be clearly designated by signs on the tower crane track that are visible to both the signaller and the operator. If the signaller cannot see the track, he must be provided with a site plan indicating the designated directions.

Annex I – Site Issues for Hirers and Principal Contractors

Tower crane climbing operations on site are generally carried out by the tower crane owner or supplier, who will carry out the planning and execution of the climbing operations. The success of a climbing operation will however depend on effective cooperation between all parties - the crane company, the Principal Contractor and the crane hirer, where they are not the Principal Contractor and a number of items will need to be arranged by the Principal Contractor and/or crane hirer. These include:-

- a. Access onto site;
- b. Parking area for transport:
- c. Establishing and maintaining exclusion zones to exclude all non-essential personnel from transport unloading positions and the area around the tower crane base;
- d. Possessions for railway lines;
- e. Notification to airports or airfields;
- f. Provision of Principal Contractor's representative on site;
- g. Communication of relevant information to other contractors on site of proposed works;
- h. Coordination of other contractors on site;
- i. Power for the tower crane (Generators);
- j. Arrangement of storage for tower sections (preferably in line with the crane direction when climbing);
- k. Arrangement of storage on site for climbing equipment and test weights;
- l. Arrangement of area at tower crane maximum radius to allow assembly of test weights for post climb load test;
- m. Welfare facilities, safety and first aid cover for climbing team;
- n. Arrangement of lane closures and other traffic management:
- o. Mobile crane base (If required).

Adequate liaison must be maintained between all parties during the planning and execution phases of tower crane climbing and a comprehensive check list is shown in **Annex J** to aid this process.

Annex J – Planning/Liason Checklist

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes – No –N/A - Comments	Yes – No –N/A - Comments
		Stage 1 <u>Initial Site Investigation / Meeting</u> Date..... Time..... Those present at meeting	Stage 2 <u>Risk Assessment/ Method Statement Check</u> Have the following where relevant been adequately addressed in the risk assessment and method statement. Completed By Date Completed	Stage 3 <u>Final Pre-erection site inspection / meeting.</u> Items to be checked Date..... Time Those Present
No	Item	Comments / Notes	Yes – No –N/A - Comments	Yes – No –N/A - Comments
Stage 1				
Review the following Items at the initial Site Investigation / Meeting				
A1	Crane Type / design - Crane 1		Confirm the following are still correct and the method statement / risk assessment is for this type of unit	Confirm the following are still correct and the method statement / risk assessment is for this type of unit
1	Max Radius			
2	Max Load at Max. Radius			
3	Max Load at Min. Radius			
4	Max Height Under Hook			
5	Luffing or saddle jib			
6	What are the local wind speeds to be designed to?		Have these been agreed in writing?	Have these been agreed in writing?
A2	Crane Type / design - Crane 2		Confirm the following are still correct and the method statement / risk assessment is for this type of unit	Confirm the following are still correct and the method statement / risk assessment is for this type of unit
1	Max Radius			
2	Max Load at Max. Radius			
3	Max Load at Min. Radius			
4	Max Height Under Hook			
5	Luffing or saddle jib			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes – No –N/A - Comments	Yes – No –N/A - Comments

A3	Crane Type / design - Crane 3		<i>Confirm the following are still correct and the method statement / risk assessment is for this type of unit</i>	<i>Confirm the following are still correct and the method statement / risk assessment is for this type of unit</i>
1	Max Radius			
2	Max Load at Max Radius			
3	Max Load at Min. Radius			
4	Max Height Under Hook			
5	Luffing or saddle jib			
B	Base Type		<i>Are the base type and design criteria still correct?</i>	
1	Tracked If yes length Concrete block / pad			
2	Piles and pile cap			
3	Supported of existing structure			
4	Cruciform and Kentledge			
5	Other			
6	What are the local wind speeds to be designed to?			
7	Who will design		<i>Has the design been agreed?</i>	<i>Has the base(s) been constructed as the agreed design and has it reached sufficient strength – Has the PC signed off the MS to confirm this?</i>
8	Who will approve		<i>Has the design been approved?</i>	

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes – No –N/A - Comments	Yes – No –N/A - Comments

C	Ties Required			
1	Number and levels		<i>Are these clearly identified in the method statement including sequence and hold points?</i>	
2	What are the local wind speeds to be designed to?		<i>Have these been agreed in writing?</i>	
3	Designed by			
4	Approved by		<i>Has the design been approved?</i>	<i>Has the PC signed off the method statement to confirm these have been installed to the agreed design and reached adequate strength?</i>
5	Preparation works by			
6	Installed by			
7	Access	<i>What will access to install be and who will provide access?</i>		
D	Climbing		<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	
1	Number of climbs required			
2	Number of sections each time			
3	Site Conditions and restrictions at time of climb			
4	Exclusion zones required.	<i>Who will make arrangements, who will provide barriers etc who will police?</i>		

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments

E	Adjacent Operations, Owners, undertakings & resultant restrictions.		<i>The requirements changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	<i>Re-confirm actions require, by who and if they are complete / in hand.</i>
1	Railways / Underground Note De rating will probably be required.			
2	Schools			
3	Motorways			
4	Other Construction sites			
5	Other			
F	Air Rights		<i>Any Changes?</i>	
1	Issues			
2	Agreements in place			
3	Who will organise / agree			
G	Structures (above ground)		<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>
1	Details of Existing and New			
2	Drawings issued Plans Elevations			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments
3	Extent of new building works at time of crane operation. (including to adjacent buildings)			
4	Extent of new building works at time of climbing operation. (including to adjacent buildings)			
5	Extent of new building works at time of dismantling operation. (including to adjacent buildings)			
H	Over Head Restrictions		<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>
1	Structures			
2	Services Existing			
3	Services Future			
4	Aircraft			
I	Underground Restrictions		<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>
1	Services			
2	Tunnels			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments

3	Vaults / Basements			
J	Ground Conditions		<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>	<i>Have the following changed since last brief to crane provider and are they adequately reflected where appropriate in the risk assessment and method statement?</i>
1	Acceptable Bearing pressures			
2	Who will design spreaders?			
3	Who will approve design			<i>Have these been agreed with the PC?</i>
K	Hard Standings		<i>Has requirement(s) changed since last brief and is it clear who will provide and to what specification/design?</i>	<i>Has the PC confirmed these have been constructed as the agreed design and have reached adequate strength.</i>
1	Requirement i.e. size and location			
2	Loads to be taken			
3	Designed by			
4	Installed by			
5	Checked by			
L	Road & Footpath Closures	<i>What are requirements and confirm who will arrange</i>	<i>Check if requirements are as last brief to Crane contractor and if all arrangements are in hand. Ensure extent of closures is adequate</i>	<i>Have these been arranged including all diversions, temporary traffic control measures etc and is it clear who takes what actions – is extent / timing of any closure adequate?</i>
1	What is required			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments
2	Who will liaise with LA and obtain			
3	Traffic control required i.e. temporary signs and traffic lights, barriers and marshals. Who to provide/			
4	Dates required/			
M	Liaison with adjacent owners / occupiers / undertakings or transport authorities.		<i>Check if requirements changed and are arrangements in place?</i>	<i>Confirm all arrangements are in place and who does what</i>
1	What is required			
2	Who will liaise and when			
3	Local activities that may affect works			
4	Street Markets			
5	Fairs			
6	Parades/carnivals			
7	Other planned street events			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments

N	Exclusion Zones (on site)		<i>Check these are clearly identified, are they are adequate and who is to provide.</i>	<i>Are these still adequate and are all arrangements to provide and maintain in place?</i>
1	Required size and location			
2	Signs barriers and Marshals required			
3	Who will provide.			
O	Power & Earthing			
1	Power Source, mains / generator?			
2	Who to provides?			
3	If generator – who provides fuel?			
4	Earth requirements for the crane and or generator where applicable. Who specifies? Who provides?			
P	Other items to be provided by crane company			
1	Wind speed indicator requirement on cranes		<i>Confirm to be supplied</i>	<i>Confirm to be supplied</i>
2	Are zoning Controls required? If yes drawings and details to be provided by crane provider.		<i>Are relevant drawings included?</i>	<i>Drawings still relevant?</i>
3	Are anti clash systems required. If yes drawings and details to be provided by crane provider.		<i>Are relevant drawings included?</i>	<i>Drawings still relevant?</i>

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments
4	Driver rescue systems required			
5	Crash Radio Requirements			
6	Slinger Communication Radio requirements			
7	Chains / slings etc			
8	Rescue basket			
9	Operator			
10	Appointed Person			
11	Crane Supervisor			
12	If yes to above, hours of work			
13	Trolley Cameras			
14	Cab air conditioning			
15	Anti climb fence / fan			
16	12 or 6 monthly thorough examination.			
17	Flood Lights required on Crane.			
18	Signage / advertising required on crane. (Wind loading effects and fixing details to be agreed)			
Q	Verticality			
1	Who will carry out survey of base, temporary works and tower?			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments

Stage 2				
Re visit items in Stage 1 and then the following items				
1	Method Statement Review, <u>Additional</u> Questions			<i>In view of any changes is the method statement / risk assessment still appropriate and the following still; correct?</i>
2	Is there a clear step by step/ sequence guide			
3	Does it contain a check list / hold points with key checks identified before next step take place/			
4	Are there adequate plans and elevation drawings indicating, set up, lay down areas, o mobile out rigger locations, exclusion zones, traffic / pedestrian diversions etc.			
5	Are all trades identified with operatives and supervisors names and proof of adequate training and experience (competency)			<i>Confirm Names and training/competency</i>
6	Does the method Statement contain a sign off box for the PC to confirm relevant temporary works / Permanente works are constructed as agreed designs and adequate to take the loads.			<i>Has this been signed off?</i>
8	Are unacceptable weather conditions that will stop / prevent works continuing made clear?			<i>Have expected weather conditions been checked?</i>
9	Is it Clear who will provide 1 st aid cover			<i>Confirm who and name</i>
10	Is bolt torque checking methods clearly identified?			
11	Are fall prevention and rescue methods adequately describe and appropriate.			
12	Does the document contain a list of pre handover checks?			
13	Are crane load testing and thorough examination arrangements explained including documentation and handover for use.			
14	Are emergency arrangements and numbers etc clearly identified / explained?			<i>Are they all in place?</i>
15	Are the manufacturers counter balance weights clearly specified and sequence of installation?			
16	Are details given of contingency arrangements for the occurrence of foreseeable			

Project..... Client..... Operation

		Initial Site Investigation / Meeting	Risk Asses. / Method Statement Check	Pre-erection Visit / Meeting
No	Item	Comments / Notes	Yes - No -N/A - Comments	Yes - No -N/A - Comments

	circumstances that might affect the safety of the operation being undertaken?		
Stage 3			
<u>Revisit the items in Stages 1 and 2 above then the following Items</u>			
1	Additional Pre-erection Site Visit / Meeting Items		
2	Has crane been subject to pre- erection inspection and maintenance?		
3	Has PC signed off the method statement?		
4	Have all temporary works been completed and signed off as being installed as design and reached the required strength?		
5	Have verticality of the base and first tower section (if cast in) been checked? Is it within tolerance?		
6	If climbing has verticality of existing tower been checked? Is it within Tolerance?		
7	Who will be on site on the day to check verticality?		

NOTE: Permit to erect to be completed on day that operations are to commence before work starts.

Annex K – Permit for Tower Crane Erection, Dismantling or Climbing

Project Details			
PROJECT		PRINCIPAL CONTRACTOR MANAGER	
CONTRACTOR		TEL:	LIFTING CO-ORDINATOR
CONTRACTOR'S MANAGER		TEL:	CRANE LOCATION and IDENTIFICATION (number or mark)
DESCRIPTION OF CRANE OPERATION	Installation <input type="checkbox"/> Climbing <input type="checkbox"/> Dismantle <input type="checkbox"/> Tick box <input checked="" type="checkbox"/>		
Checks to be completed prior to commencement on 1 st day of operation			
1	Conditions / restrictions are as expected / planned and allowed for in the method statement.		
2	The Method Statement and Risk Assessment have been signed off by the Principal Contractor and are in the possession of the crane erection team. It contains a detailed sequence of operation with clear hold / check points.		
3	Manufacturers' guidance/operation/ erection manual and crane log book is on site in English and is with the crane erection team.		
4	Erection team including supervisor riggers, electricians and crane operator competency / training checked and in order.		
5	The crane erection team has received a site induction. They and all relevant parties have received a method briefing from the erection team supervisor. The erection team is clear on individual's responsibilities and all hold / check points.		
6	The potential risks to other operations on site and activities adjacent to the site are understood by all relevant parties and precautions are in place.		
7	Weather conditions have been checked and are acceptable for the operation to proceed.		
8	All 3 rd party inspection certificates required for cranes and lifting accessories to be used during the operation are available and valid (check dates and serial numbers).		
9	Mobile crane certification and proof of driver competency checked and OK?		
10	An adequate exclusion zone with where applicable road and foot path closures have been established around area of operations.		
11	Work has been visually inspected to ensure all working platforms are in good condition and protected with guardrails.		
12	Physical observations – Tower crane to be climbed or dismantled have been checked and are free of defects, are stable and bolts tightened etc. Required lifting accessories have been checked – crane hook fitted with safety catch, all chains and slings in good condition etc.		
Who will carry out the pre-use inspections?		Who will be carrying out the Independent Thorough Examination on completion of the works?	

I confirm that all the above arrangements are in place and the operation may proceed

Start Date & Time		Completion Time	
Contractors Manager name	Contractors Manager signature	Date	
Principal Contractor Manager name	Principal Manager signature	Date	

To be completed on subsequent day of operation

Conditions and risks have not substantially changed since yesterday; the method statement requires no amendments. There are no new personnel who require a site induction or instruction in the safe system of work. Weather conditions have been checked and the daily briefing has been carried out.	
Where the tower crane has been partially erected i.e. left over night etc, the structure and installation has been physically checked to ensure it is safe for the next stage to proceed.	

I confirm adequate Safety arrangements are in place and works may proceed

Start Date & Time		Completion Time	
Contractors Manager name	Contractors Manager signature	Date	
Principal Contractor Manager name	Principal Contractor Manager signature	Date	

Annex L – Example of typical procedure for climbing frame thorough examinations and checks

1.0 Procedure for Post Installation Thorough Examination Report

NOTE: The post installation thorough examination may be supplemented by NDT examination at the discretion of the competent person.

- 1.1** Confirm the identification number of the frame and all corresponding sections to confirm all parts are of the same frame;
- 1.2** Carry out a visual check of the frame structure, checking for any damage to structural members or evidence of cracking in welds. Pay particular attention to the suspension brackets and the jointing plates;
- 1.3** Confirm the free movement of all guide rollers and check for damage;
- 1.4** Check the rollers for undue wear and check that all keep plates are in place and secure;
- 1.5** Check the hydraulic ram mounting brackets for security and check the welds for signs of cracking;
- 1.6** Check the lifting yolk at the base of the hydraulic ram for signs of wear and any cracking or deformity;
- 1.7** Check the hydraulic ram joint pin for lift and that it is correctly locked in position;
- 1.8** Check that the rollers, to allow horizontal motion of the ram, are free to rotate;
- 1.9** Carry out a visual inspection to check that the hydraulic system is free from leaks and has no damage to the pipework or the connections;
- 1.10** Check the travelling platform for damage to itself and its supports;
- 1.11** Check the walkways for damage and security of fixing. Close off the walkways;
- 1.12** Record the results of the examination on the appropriate form and retain whilst the frame is installed for use at that location.

2.0 Procedure for Pre-use Check of Frame for Top Climbing of Tower Cranes

- 2.1** Confirm that the frame has current thorough examination and installation reports;
- 2.2** Confirm that the test of the hydraulic system is current;
- 2.3** Confirm that all personnel have been issued with a copy of this procedure or a checklist that relates to it;
- 2.4** Confirm that all personnel are trained in the operation and understand the procedure;
- 2.5** Confirm that communication either by radio or telephone is available;
- 2.6** Examine all connecting pins/bolts prior to erection to determine whether they are the correct type and undamaged;
- 2.7** Check the frame to ensure the jointing bolts are in place and secure;
- 2.8** Check the main guide roller pin keep plates are be in place and secure;
- 2.9** Check the walkways are secure with no missing bolts or guardrails;
- 2.10** Check that the hydraulic system is free from leaks;
- 2.11** Check the apron for the support of the section to be inserted is secure and free to move;
- 2.12** Engage the slew lock or physically lock the slew and inform the operator of the importance of maintaining this action;
- 2.13** Obtain authorization of the checklist and permit to climb from an appointed person at the site.

3.0 Procedure for 6 Monthly Thorough Examination

NOTE: The 6 monthly thorough examination may be supplemented by NDT examination at the discretion of the competent person.

- 3.1** Confirm the identification number of the frame and all corresponding sections, to confirm all parts are of the same frame;
- 3.2** Carry out a visual check of the frame structure, checking for any damage to structural members or evidence of cracking in welds. Pay particular attention to the suspension brackets and the jointing plates;
- 3.3** Confirm the free movement of all guide rollers and check for damage;
- 3.4** Check the rollers for undue wear and check that all keep plates are in place and secure;
- 3.5** Check the hydraulic ram mounting brackets for security and check the welds for signs of cracking;
- 3.6** Check the lifting yoke at the base of the hydraulic ram for signs of wear and any cracking or deformity;
- 3.7** Check the hydraulic ram joint pin for lift and that it is correctly locked in position;
- 3.8** Check that the rollers, to allow horizontal motion of the ram, are free to rotate;
- 3.9** Carry out a visual inspection to check that the hydraulic system is free from leaks and has no damage to the pipework or the connections;
- 3.10** Check the travelling platform for damage to itself and its supports;
- 3.11** Check the walkways for damage and security of fixing. Close off the walkways;
- 3.12** Record the results of the examination on the appropriate form and retain on file.

4.0 Supplementary Tests to Support Thorough Examination at 2 yearly Intervals

NOTE: This work is to be carried out with the frame on the ground at rest.

- 4.1** Carefully examine the main load bearing parts and subject them to NDT examination as necessary. The examination should include the following:
 - the jointing plates and associated supporting structures;
 - the reaction roller supports and associated structures;
 - the main suspension lugs;
 - the corner nodes;
 - the main lifting yoke.
- 4.2** Remove the reaction roller pins and measure them to assess wear. Subject the pins to NDT examination;
- 4.3** Carry out the six monthly thorough examination at this time.

5.0 Supplementary Tests to Support Thorough Examination at 4 yearly Intervals

NOTE: This work is to be carried out with the frame on the ground at rest.

- 5.1** Subject the hydraulic ram and relief valves to a pressure test in accordance with the manufacturer's recommendations for that system;
- 5.2** Remove the ram-jointing pin, measure it for any wear, and subject it to NDT examination;
- 5.3** Carry out the 6 monthly thorough examination at this time.

Annex M- Further Information and Guidance

Technical Information Notes

The CPA Tower Crane Interest Group publishes a series of Technical Information Notes dealing with various aspects of tower crane operation. These can be downloaded free of charge from the CPA website at www.cpa.uk.net and are in the *Special Interest Groups* section under *Tower Crane Interest Group*. At the time of publication the following TINs are available. New TINs are being added and readers should check the website for new additions and revisions.

TIN	Subject	Issue Date	Issue
000	Technical Information Note Index	09.04.09	K
001	Access to Tower Cranes After Commissioning	30.07.07	B
002	Raising and Lowering of Small Material	30.07.07	B
003	Tower Crane Access Procedures	30.07.07	B
004	Installing Wire Ropes on Winch Drums and Storage Reels	30.07.07	B
005	Housekeeping on Tower Cranes	30.07.07	B
006	Tower Crane Access Ladders	30.07.07	B
007	Duty Boards	30.07.07	B
008	Tower Crane Edge Protection	30.07.07	B
009	Security of Access to the Crane Base	30.07.07	B
010	Tower Crane Anti-Collision Systems	30.07.07	B
011	Attachment of Floodlights, Illuminated Signs and Christmas Decorations	27.02.06	A
012	Tower Crane Access Signage	30.07.07	B
013	Rescue of Personnel From Height on Tower Cranes	09.04.09	D
014	Pre-Erection Component Checks	30.07.07	B
015	Risk Assessment – General Access to Tower Cranes (including for maintenance)	30.07.07	B
016	Fall Protection Equipment For Tower Crane Operators	30.07.07	C
017	Radio Communication for Lifting Operations	30.07.07	B
018	Tower Crane Life	30.07.07	B
019	Contract Lifting and Crane Hire When Erecting, Dismantling and Using Tower Cranes on Construction Sites	30.07.07	B
020	The Effect of Wind on Tower Cranes In Service	02.03.09	C
021	Maintenance Principles for Tower Cranes	12.06.07	B
022	The Use of Tag Lines with Tower Cranes	12.06.07	B
023	Luffing Jib Tower Cranes - Information and Actions for Owners/Suppliers	13.10.08	B

TIN	Subject	Issue Date	Issue
024	Luffing Jib Tower Cranes - Precautions For Users	13.10.08	B
025	Luffing Jib Tower Cranes - Precautions for Operators Working at or near Minimum Radius in Strong Winds	13.10.08	B
026	Lifting Loads Using Fabric Bags	09.04.09	A
027	Tower Crane Out-of-Service Wind Speeds	09.04.09	A
028	Lifting of Mechanical Plant on Drip Trays	24.05.10	B
029	Repair and Reprogramming of Inverters	30.04.10	A
030	Tower Crane Erection Team Composition	21.01.11	A

Standards

BS 5975:2008, *Code of practice for temporary works procedures and the permissible stress design of false work.*

BS 6166-3:1998, *Lifting slings — Part 3: Guide to the selection and safe use of lifting slings for multi-purposes.*

BS 6210:1983, *Code of practice for the safe use of wire rope slings for general lifting purposes.*

BS 7121-1:2006, *Code of practice for safe use of cranes — Part 1: General.*

BS 7121-2:2003, *Code of practice for safe use of cranes — Part 2: Inspection, testing and examination.*

BS 7121-3:2000, *Code of practice for safe use of cranes — Part 3: Mobile cranes.*

BS 7121-5:2006, *Code of practice for safe use of cranes — Part 5: Tower cranes.*

BS 7262:1990, *Specification for automatic safe load indicators.*

BS EN 12385-1:2002+A1:2008, *Steel wire ropes — Safety — Part 1: General requirements.*

BS EN 12385-2:2002+A1:2008, *Steel wire ropes — Safety — Part 2: Definitions, designation and classification.*

BS EN 12385-3:2004+A1:2008, *Steel wire ropes — Safety — Part 3: Information for use and maintenance.*

BS EN 12385-4+A1:2008:2002, *Steel wire ropes — Safety — Part 4: Stranded ropes for general lifting applications.*

BS EN 13557:2003+A2:2008, *Cranes — Controls and control stations.*

BS EN 13586:2004+A1:2008, *Cranes — Access.*

BS EN 14502-1:2010, *Cranes — Equipment for the lifting of persons — Part 1: Suspended baskets.*

Legislation and Other Publications

Health and Safety at Work etc. Act 1974. London: The Stationery Office.

The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER).

Provision and Use of Work Equipment Regulations 1998 (PUWER).

L113 *Safe use of lifting equipment*, HSE Books.

L22 *Safe use of work equipment*, HSE Books.

The Notification of Conventional Tower Crane Regulations 2010

The Management of Health and Safety at Work Regulations 1999 as amended (MHSWR).

Work at Height Regulations 2005 (WAHR).

The Supply of Machinery (Safety) Regulations 2008 (SM(S)R).

The Construction (Design and Management) Regulations 2007 (CDM).

Personal Protective Equipment at Work Regulations 1992.

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR);

The Air Navigation Order 2000.

HSE Leaflet INDG218 – Guide to Risk Assessment;

HSE Leaflet INDG163 – Five Steps to Risk Assessment.

HSE publication L73 - *A guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995*, HSE Books.

HS(G)151 *Protecting the Public – Your next move*. HSE Books.

Best Practice Guide on the Maintenance, Inspection and Thorough Examination of Tower Cranes, 2008 – Construction Plant-hire Association.

Tower Crane Operator's Handbook – Construction Plant-hire Association.

Safe Use of Self Erecting Tower Cranes – CPA Best Practice Guide – Construction Plant-hire Association.

Medical Fitness to Operate Construction Plant - Strategic Forum for Construction, Plant Safety Group Best Practice Guide - Construction Plant-hire Association (Available November 2011).

Tower crane stability, 2006. CIRIA C654. Construction Industry Research and Information Association.

Crane Stability on Site, 2003. CIRIA C703. Construction Industry Research and Information Association.

Guidance on The Planning & Liaison Process for the Erection, Climbing & Dismantling of Tower Cranes, Strategic Forum For Construction.

The Safe External Climbing of Tower Cranes" DVD Lend Lease and Select Tower Cranes.

Tower Crane Installation Training Programme, TWR 01. Construction Skills.

Cranes and planes - A guide to procedures for operation of cranes in the vicinity of aerodromes. Airport Operators Association (AOA).

A voluntary code of practice for the safe use of cranes in and around airports. Off-highway Plant and Equipment Research Centre.

Code of practice for the safe use of lifting equipment. Lifting Equipment Engineers' Association.

Useful Websites

Construction Plant-hire Association	www.cpa.uk.net
Construction Skills	www.constructionskills.net
Health and Safety Executive	www.hse.gov.uk
Lifting Equipment Engineers Association	www.leea.co.uk
Safety Assessment Federation	www.safed.co.uk
Strategic Forum for Construction	www.strategicforum.org.uk
UK Contractors Group	www.ukcg.org.uk

Annex N - Working Group Membership

CPA Tower Crane Interest Group –

Climbing of Tower Cranes – Best Practice Guide Working Group

Chairman:

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Members:

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M O'Connor HSE Inspector of Health and Safety
T Hewitt HSE Specialist Inspector
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D O'Neil Liebherr Great Britain Ltd
A Walker HTC Plant Ltd
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