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|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |

1.0 Introduction

The stability and safety of a tower crane is reliant on the safe design, construction and installation of temporary works including bases, grillages, and mast ties. Tower cranes are often in use on construction sites in urban areas and, although rare, any collapse of the crane is likely to result in injury to members of the public outside the boundaries of the site as well as personnel working inside the site. Collapse of tower cranes also presents a risk to adjacent railways and roads. This document is intended to promote the safe design and construction of tower crane bases, grillages and ties through an improved understanding and management of temporary works design, construction, and installation process.

2.0 Regulatory Requirements and Guidance

CDM, The Construction (Design and Management) Regulations 2015

LOLER, Lifting Operations and Lifting Equipment Regulations 1998 - The Approved Code of Practice to the Lifting Operations and Lifting Equipment Regulations 1998

CIRIA – C761, Guide to tower crane foundations and tie design – January 2019. Available for purchase from <https://www.ciria.org/ItemDetail?iProductcode=C761&Category=BOOK>

BSI Standards Publication BS 7121-1:2016, Code of practice for the safe use of cranes - Part 1; General

BSI Standards Publication BS 7121-5:2019, Code of practice for the safe use of cranes - Part 5; Tower cranes.

BSI Standards Publication BS7121-2-5:2012, Code of practice for the safe use of cranes Part 2-5: Inspection, maintenance, and thorough examination – Tower cranes

BSI Standards Publication BS5975:2019, Code of practice for temporary works procedures and permissible stress design of falsework provides guidance on the design and construction of temporary works

British Standard Publications are available to purchase from <http://shop.bis.com>

CPA Publication TCIG 0801, Maintenance, Inspection and Thorough Examination of Tower Cranes


CPA Publication Tower Crane Technical Information Note TIN027, Tower Crane Out-of-Service Wind Speeds

CPA Publication Tower Crane Technical Information Note TIN042, Selection of Tower Cranes – Anticipated Utilization

CPA Publication Tower Crane Technical Information Note TIN048, The use of high tensile fasteners on tower cranes

CPA Publications are available for free download from <https://www.cpa.uk.net/tower-crane-interest-group-tcig-publications/>

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3.0 Terms and Definitions

Appointed Person - In-service (AP-IS)

Person nominated to plan and to have overall control of, the in-service lifting operations with the tower crane

Appointed Person - Tower Crane Erection (AP-TE)

Person nominated to plan and to have overall control of, the erection of the tower crane

Crane Supplier

The organisation that provides the crane

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

Permanent Works Designer (PWD)

Competent person with responsibility for the design of permanent works

Principal Contractor (PC)

A contractor appointed by the client to control the construction phase of any project involving more than one contractor

Principal Contractor's Temporary Works Coordinator (PC's-TWC)

Competent person with responsibility for the coordination of all activities related to the temporary works on the construction project

Sub-Contractor's Temporary Works Coordinator (TWC-SC)

Competent person with responsibility for the coordination of temporary works of a sub-contracted element of the temporary works where the sub-contractor manages their own temporary works

Temporary Works Designer (TWD)

Competent person with responsibility for the design of temporary works

Temporary Works Design Checker (TWDC)


Competent person with responsibility for checking the design of temporary works

Temporary Works Design Brief

A document provided to the Temporary Works Designer containing all pertinent information for the design

Temporary Works Design Package

A document prepared by the Temporary Works Designer containing all pertinent information for the installation and construction of the temporary works

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Temporary Works File

The storage location for all information, communications and documents related to the tower crane temporary works

Temporary Works Register

A record of all temporary works on a construction site

Temporary Works Supervisor (TWS)

A competent person who is responsible to and assists the PC's-TWC or TWC-SC.

4.0 Temporary Works Stages

BS5975 sets out good practice (and industry consensus) recommendations for the procedures required to ensure the safe management of the temporary works.

For a tower crane installation to be safe, it must be properly managed at all stages of its procurement and use, from initial planning during the pre-construction phase to removal from site. The temporary works stages involved are generally:


- Appointment of personnel;
- Risk assessment;
- Planning;
- Ground investigation and assessment;
- Temporary Works Design and integration with permanent works;
- Temporary Works Design checking;
- Procurement;
- Construction/installation;
- Inspection and testing;
- Tower Crane erection;
- Tower Crane Thorough Examination;
- Inservice maintenance and inspection of Temporary Works;
- Removal of the tower crane and temporary works on completion.

On a construction project, all these stages are covered by CDM. These regulations require all those involved to consider health and safety matters throughout all stages of the project from conception, design, and planning through to carrying out the work, including maintenance, repair, and alteration.

5.0 Appointment of Personnel

The appointment of personnel at an early stage in the Temporary Works process is essential. All appointments should be in writing and accepted by the appointee. A record of all appointments should be retained.

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The Principal Contractor should appoint a Temporary Work Coordinator (PC’s-TWC) to have oversight and control of all temporary works completed on the construction project.

Where a sub-contractor is to manage the temporary works associated with a tower crane, the sub-contractor should also appoint a Temporary Works Coordinator (TWC-SC). The appointment should be approved by the PC. The PC’s TWC retains have the ultimate control of all temporary works activities.

The Principal Contractor should nominate an Appointed Person (AP-IS) to plan and to have overall control of, the in-service lifting operations to be undertaken by tower crane.

It is essential that the Principal Contractor, PC’s-TWC, TWC-SC and AP-IS work together to plan the installation and use of the crane.

The Principal Contractor should appoint a Temporary Works Designer (TWD) for temporary works they will be directly managing. The Principal Contractor should approve the nomination of any Temporary Works Designers made by a sub-contractor who may be managing their own temporary works. It is essential that the experience and capability of the Temporary Works Designer is assessed prior to any appointment.

NOTE: On large projects there may be more than one Temporary Works Designer. For example, a TWD maybe nominated by a sub-contractor. The sub-contractor’s nominated TWD should still be approved by the Principal Contractor.

A Temporary Works Supervisor(s) (TWS) may be appointed by the PC’s-TWC or TWC-SC to oversee the on-site construction and installation process.

An illustrative example of a Temporary Works Structure is shown in Figure 1.

NOTE: Figure 1 represents one possible structure. With differing contractual arrangements, alternative structures will be required.

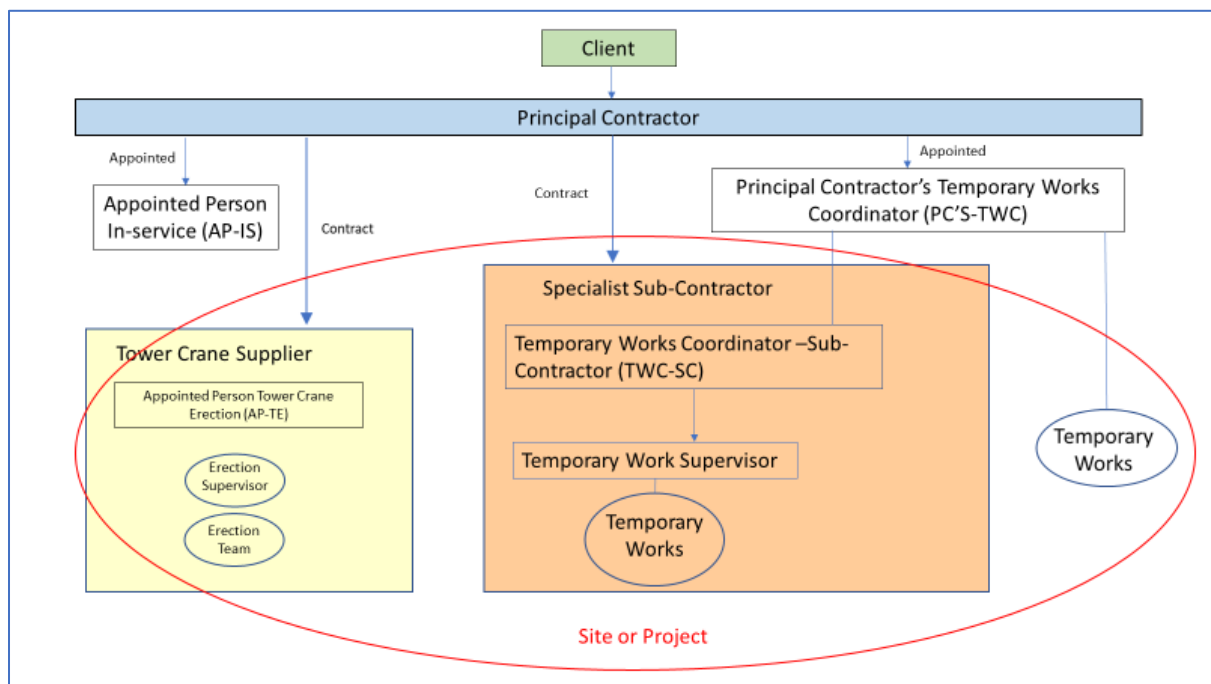



Figure 1: Illustrative Example of a Temporary Works Structure

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6.0 Planning

Planning for the use of a tower crane should start at the pre-construction phase of the project.

The Principal Contractor is accountable for the planning process during the construction phase although the responsibility for different activities may be assigned to different parties, e.g. the PC's-TWC, TWC-SC and AP-IS for individual activities.

The planning activities for the tower crane should include:

- a) Identifying the operational requirements of the crane including the weight, dimensions, operational radii, and frequency of items to be lifted;
- b) Selecting a suitable crane based on:
 - radius/capacity and utilization;
 - site constraints;
 - operational requirements.

NOTE: *Guidance on the selection of tower cranes is provided in CPA TIN042 – Selection of Tower Cranes– Anticipated Utilization*

- c) Obtaining and reviewing information pack from the crane supplier for the crane selected. The pack should include:
 - Drawings of the crane showing the configuration and key components. This should include the orientation of the mast;

NOTE: *The orientation of the mast is critical as it could prevent the crane being dismantled at the end of the project*

- Drawings of any mast connections, foundation anchors, foot plates, wall brackets, mast collars and mast ties to be supplied by the crane supplier;
- Loads imposed by the crane both in and out of service;


NOTE: *For certain cranes and configurations, the greatest loads may occur when the crane is being erected or dismantled*

- Tolerances for verticality of the base;
- Proposed installation and removal methodology of the tower crane;
- Climbing sequences and tie configurations.

- d) Entering details of the tower crane temporary works on the “Temporary Works Register” for the site in accordance with the requirements of *BS5975 Clause 6.2*.

NOTE: *Where a sub-contractor will be managing their own temporary works, the TWC-SC should also prepare and maintain a local temporary works register. The TWC-SC should provide relevant information to the PC's-TWC to enable the master temporary works register to be maintained*

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The planning activities for the temporary works should include:

- i. Assessment of the risks associated with the temporary works and determining the Implementation Risk Class in accordance with *BS5975 Table 1*. This provides guidance on implementation risk classes for temporary works and examples of mitigation measures. The implementation risk class selected for the temporary works associated with the installation of a tower crane should be at least “Medium”. The outcome of the assessment should include who is authorised to sign off inspection and permits (**see Forms A to F**).

NOTE: *BS5975 Table 1 relates to implementation risk and is not to be confused with the category of design check as outlined in BS5975 Table 2. For example, the implementation risk for the same tower crane erected in two different locations can vary significantly, depending on proximity to local assets such as an adjacent railway line, thus justifying different levels of risk and changing the risk classification – in contrast the temporary works design, might be unchanged, requiring the same category of independent design check*

- ii. Liaison with the Principal Designer and Permanent Works Designer;
- iii. Reviewing the findings of a site investigation undertaken by the Permanent Works Designer (*This should identify any underground or over ground hazards and or restrictions*);
- iv. Reviewing the findings of a Geotechnical Survey for the area where the base is to be constructed;

NOTE: *It is essential that the ground conditions are ascertained for the planned location of the tower crane base*
- v. Identifying the wind exposure of the site. Guidance on out of service wind speeds is provided in CPA TIN027 – Tower Crane Out of Service Wind Speeds;
- vi. Formulating and recording an implementation plan for all temporary works. The plan should cover the erection/assembly, use, and dismantling of the temporary works including what inspections, checks, hold points, permits and certification are required and who will undertake the work;
- vii. The Principal Contractor formulating a protocol for document and communication retention that identifies which documents will be retained, where and how they will be stored and who is responsible for retention.

NOTE: *Within this document, the term “Temporary Works File” is used to describe the storage location for all information, communications and documents related to the tower crane selection, tower crane installation and temporary works design, temporary works inspection and permits*


NOTE: *It may be expedient for the Principal Contractor to set up a “shared drive” or “cloud” location, with a predetermined structure, where all documents are retained*

7.0 Temporary Works Design

The PC’s-TWC (or TWC-SC if the work is sub-contracted) should issue a Design Brief to the TWD that includes all data relevant to the design of the temporary works.

NOTE: *Guidance as to the content of a Design Brief is provided in BS5975 Clause 13.2.4*

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The design brief should include details of the loads that will be applied by the crane to the temporary works. This should include all of the loading cases – for example at each stage of a crane that is climbed as there may be a number of ‘worst cases’ that are not immediately evident. It should also include the loads from any part of the permanent structure that loads the foundation

Any requests for clarification or provision of additional information should be made via the relevant TWC. A record of any requests, responses and documents should be retained by the TWC within the Temporary Works File for the crane.

Tower crane bases, grillages and ties should be designed by the TWD in accordance with *CIRIA Guide to tower crane foundation and tie design (C761)*.

Where the detailed design of piles, grillages or ties is to be undertaken by a TWD working for a specialist contractor, copies of all communications with the specialist contractor’s TWD should be copied to the PC’s-TWC for retention in the Temporary Works File for the crane. The TWD should provide details of the loads that will be applied to the piles, grillages or ties.


The TWC should seek confirmation from the Permanent Works Designer (PWD) that any loads that may be imposed by the crane on the permanent works can be safely sustained. A record of the outcome of this consultation should be provided to the TWD and a copy retained by the PC’s-TWC with the Temporary Works File for the crane.

The temporary works design package issued by TWD should include, where applicable:

- Confirmation of the crane (make and model) for which the Temporary Works have been designed. This should include:
 - Tower crane type and model;
 - Jib length;
 - Hook height or tower height;
 - Type of base – stating the type of expendable anchor or the cruciform base that is to be used;
 - Either the foundation loads specified by crane supplier, or the reference to the document that states the crane loads supplied by the crane supplier. This should include details of the wind zone the loads were based upon;
- Detailed drawings and associated specifications;
- Tension/torque requirements for any bolted connections (including bolt types, grades, coatings, lubricants, etc.);

NOTE: *It is important that the grade of fasteners selected takes account of the potential for hydrogen embrittlement that may occur. Guidance on the selection of high tensile fasteners is provided in CPA TIN048 – The use of high tensile fasteners on tower cranes.*

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- Welding procedures and inspections for welded joints;
- Stress relieving procedures where specified;
- Pile drawings and specifications;
- Details of the connection between the pile and base;
- Rebar drawings and material specifications;
- Pile testing requirements;
- Blinding materials laid under bases – material type, minimum depths, and minimum compaction pressures. This should include details of tests required on formations for ground bearing bases;
- Specification for the concrete used to form the base together with inspection and testing requirements. This should include the minimum concrete strength to be achieved prior to erection commencing;
- Arrangements for an electrical power supply to crane and lightning protection;
- In-service maintenance and inspection regime including indicating the critical areas of the design which require inspection. Details of any Non-Destructive Testing (NDT) examinations and frequency;
- Arrangements for safe access to undertake in service inspections of the completed temporary works. For items to be inspected at height this may require access platforms, walkways and ladders. For foundations this may include drainage pipes, and or pumped systems, to remove any surface water that may accumulate.

A copy of the Temporary Works Design should be retained in the Temporary Works File for the crane.

It is recommended that the Tower Crane Supplier is provided, for information purposes, with a copy of the Temporary Works Design. The provision of this information should not be regarded as a part of a Temporary Works Design Check.


8.0 Temporary Works Design Checking

The design of tower crane bases, piles, grillages and ties should be subject to an independent design check, in accordance with at least Category 2 of Table 2 of BS 5975:2019 to ensure that the concept, overall design and details of the design proposed are adequate and that the 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 designer, who will retain full responsibility for the adequacy of the design.

NOTE: *On complex or novel designs, it is recommended that the design check is undertaken to Cat 3.*

The appointment of the Temporary Works Design Checker (TWDC) who will undertake the independent design check should be confirmed by the PC's-TWC and a record made in the Temporary Works Implementation Plan for the site.

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On completion, the person undertaking the design check should sign and issue a “Temporary Works Design Check Certificate”. A copy of the certificate should be retained in the Temporary Works File for the crane.

9.0 Procurement

The PC’s-TWC should ensure that the suppliers and specialist contractors are provided with relevant information from the Temporary Works Design Package for the work to be completed.

At the tender stage suppliers should provide to the PC’s-TWC details of the quality control procedures and plans they will be following to ensure that construction and installation is undertaken in accordance with the Temporary Works Design Package.

Grillages, Rail Tracks, Foundation Anchors and Ties will generally be manufactured at the supplier’s workshops. Copies of manufacturing drawings and quality assurance documents should be provided by the supplier to the PC’s-TWC for retention in the crane Temporary Works File. A copy of the drawings should be forwarded, for information purposes, to the crane supplier.

It is recommended that a trial assembly is undertaken prior to delivery, as it is easier and more economic to resolve any issues before the components are delivered to site. It is good practice to take photographs of individual components and the trial assembly and provide copies to the PC’s-TWC for retention in the Temporary Works File for the crane. Generally, the supplier will produce their own set of fabrication shop drawings from the design drawings. A copy of the fabrication drawings should be provided to the PC’s-TWC before fabrication commences and a copy kept with the Temporary Works File for the crane. A copy of the drawings should be forwarded, for information purposes, to the crane supplier.

10.0 Tower Crane Base & Grillage – On-site Construction/Installation


The on-site construction and installation of bases, grillages should be undertaken in accordance with the Temporary Works Design Package.

Prior to construction commencing, an inspection should be undertaken to check that the ground conditions have not changed since the initial survey. For example, periods of prolonged rain may have waterlogged the ground, other construction activities may have disturbed the ground, or the permanent works may have impinged into the area reserved for the base. If any issues are found, the TWC should consult with the TWD before construction commences to determine whether the construction should proceed, or be put on hold pending further investigations or changes to the temporary works design.

A “Temporary Works Supervisor(s)” should be appointed to oversee all construction and installation work.

It is recommended that a dummy mast section or templates are used during the construction of the base and grillage.

Photographs should be taken during the construction and installation process at each build step and retained in the Temporary Works File for the crane.

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Variations from the design should not be undertaken without prior consultation with the PC's-TWC and written approval of the TWD. The TWD should provide a copy of any additional calculations, drawings to the PC's-TWC. This should include any supplementary checks that should be made.

The PC's-TWC should ensure that a record of the outcome is retained in the Temporary Works File for the crane.

11.0 Tower Crane Base & Grillage - Inspection


Inspection and tests should be undertaken to verify that the base and grillage has been constructed to the Temporary Works Design Package. The PC's-TWC or TWC-SC should appoint the person(s) responsible for undertaking the inspections taking account of the implementation risk class.

With cast bases, a pre-pour inspection should be completed.

With complex and novel designs, it is recommended that the TWD is involved in the inspection process.

The inspection and test plan should include the following items where applicable:

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| All Foundations | <ul style="list-style-type: none"> • Details in accordance with foundation designer's drawings and details and the inspection and test plan. |
| Cast-in Items (foundation anchors etc.) | <ul style="list-style-type: none"> • Cast-in items supplied by crane manufacturer or approved source • Level, vertical and to tolerance. |
| Reinforced Concrete | <ul style="list-style-type: none"> • Concrete of correct grade and sufficient maturity • Rebar grade, diameter, quantity, tie patterns and location. |
| Piles | <ul style="list-style-type: none"> • Results of pile tests • Sufficient reinforcement bond length into pile cap and pile to take tension where applicable • As built location to enable eccentricity checks to be closed out. |
| Steelwork | <ul style="list-style-type: none"> • Steel - correct grade • Fasteners – correct grade, size, type, grade and tightened in accordance with design schedule • Bolts and nuts paint marked after tightening (for ease of checking) <p>NOTE: Marking is also recommended for Tension Controlled Bolts (TCB) and Direct Tension Indication (DTI) High Strength Friction Grip (HSFG) bolts.</p> <ul style="list-style-type: none"> • Welds completed to specification. |
| Rail Tracks | <ul style="list-style-type: none"> • Bedding properly compacted • Rail centres and levels to correct tolerance • Rail clips secure • Limit ramps and end stops correctly positioned and firmly fixed • Rails earthed • Fasteners – Correct size, type, grade and tightened in accordance with design schedule. |

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All inspection records should be signed by the person undertaking the inspection. The results of the inspection should be recorded on a Tower Crane Foundation Pre-erection Inspection Record (**See Form A**) and kept in the Temporary Works File for the crane. On completion, the record should be signed by either the PC's-TWC or TWC-SC.

NOTE: BS5975 Table 1 provides guidance on implementation risk classes for temporary works and examples of mitigation measures. The implementation risk class selected for the temporary works associated with the installation of a tower crane should be at least "Medium"

12.0 Tower Crane Erection

Prior to the erection commencing, the PC's-TWC or TWC-SC should confirm that that the temporary works have been completed and inspected by signing the Tower Crane Foundation Inspection Report (**see Form A**) and Approval/Completion Certificate (**see Form B**).

A "Permit to Erect" should be completed and signed by the PC's-TWC or TWC-SC (**see Form C**). The permit should confirm that:

- a) the temporary works have been constructed in accordance with the certified design (design and design check certificates have been issued and the drawings and specification used are the ones referenced on the certificates);
- b) any modifications to the temporary works have been approved by the designer; and
- c) the water, ground and environmental conditions and use are as envisaged by the design.


NOTE: Within BS5975 the term "Permit to Load" is used rather than "Permit to Erect".

A copy of the "Tower Crane Foundation Inspection Report", "Tower Crane Foundation Approval/Completion Certificate" and the "Permit to Erect" should be retained in the Temporary Works File for the crane.

The Tower Crane Supplier should be provided, or given access to, a copy of the Temporary Works File for the crane prior to the erection proceeding.

Prior to erection the Appointed Person- Tower Crane Erection (AP-TE) should attend site to:

- Review access arrangements for delivery vehicles for the tower crane;
- Visually inspect the berthing position for the erection crane;
- Visually inspect the structure of the base for any significant defects;
- Visually inspect any bolted connections to check they are formed correctly (no air gaps, all bolts are installed correctly, perpendicular and have been marked to show that they have been tightened). If the appointed person has any concerns as to whether the bolts have been tightened correctly, they should request random torque tests to be undertaken;
- Visually inspect any connections between the grillage and foundations;
- Inspect the connection points for the first mast section on the grillage. This should include dimension checks, level checks and that sufficient clearance is available to both install and tighten fasteners during erection.

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The AP-TE should be provided with the following documents from the Temporary Works File:

- Tower Crane Foundation Inspection Report, Tower Crane Foundation Approval/Completion Form and Permit to Erect have been completed and signed by the PC's-TWC or TWC-SC; **(See Forms A, B & C)**
- That the base has been designed for the make, model and configuration of crane that will be erected.

If the AP-TE is unable to inspect, check and verify all the above, the erection should not commence.

The AP-TE should receive training and instruction to undertake the above inspections and checks. This should include training and instruction on the temporary works process and the role of the AP-TE as described within this document.

NOTE: *Guidance on the selection and general training of the appointed persons is provided in BS7121-1:2016. The standard does not include guidance on the supplementary training and instruction necessary to for a person to successfully undertake the role as an AP-TE.*




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Tower Crane Technical Information Note**

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Form A: Example of a Tower Crane Foundation Inspection Report to be signed by PC's-TWC or TWC-SC on completion

| Tower Crane Foundation Inspection Report | | | | | |
|--|---|--------------------------|--------------------------|--------------|------|
| Site Details: | | | | | |
| Tower Crane Number | | Make: | | Model: | |
| Location: | | Jib length: | | Base Type: | |
| Height under Hook: | | | | | |
| Items Checked (delete where not applicable) | | As Specified | | Inspected by | Date |
| | | Yes | No | | |
| All Foundations | Compliance with design drawings/specification | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Cast-in Items | Supplied by tower crane manufacture or approved source | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Level check | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Verticality check | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Concrete | Within tolerance | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Correct grade | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Sufficient maturity | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Piles | Rebar-grade, diameter, quantity and position prior to pour | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Satisfactory pile tests | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Steelwork | Reinforced bond length | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Steel grade | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Dimensional check, Level check | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Weld completed to specification | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Rail Tracks | Bolts- grade, quantity, correct assembly, torque/tension | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Bedding properly compacted | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Rail and sleeper quality | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Levels and gauge to tolerance | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Limit ramps and end stops correctly positioned and fixed firmly | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Rails correctly fixed and earthed | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Temporary Works Design Package: Documents against which foundation has been checked (drawing nos./document references etc) | | | | | |
| I confirm the tower crane foundation has been constructed to the temporary works design package drawings and specifications and that a satisfactory post construction inspection has been carried out. | | | | | |
| Name: | | Signed: | | Date: | |
| Position: | | Company: | | | |

| | | |
|--|---|--|
|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |


Form B: Example of a Tower Crane Foundation/Grillage Approval Certificate to be completed and signed by PC's-TWC or TWC-SC

| Tower Crane Foundation/Grillage Approval/Completion Certificate | | | | | |
|--|--|--------------------|---|---------------|--|
| <i>Site Details :</i> | | | | | |
| <i>Tower Crane No/Location:</i> | | <i>Make:</i> | | <i>Model:</i> | |
| <i>Height under Hook:</i> | | <i>Jib Length:</i> | | | |
| <i>Base Type:</i> | | | | | |
| Foundation/Grillage Design | | | | | |
| <i>Design Criteria and References:</i> | | | | | |
| <i>Temporary Works Design Package Documents Issued:</i> | | | | | |
| <i>Limitations or Restrictions:</i> | | | | | |
| <i>NOTE: If the foundation design relies on the use of permanent works, confirmation from that the works have been analysed should obtained from the Permanent Works Designer.</i> | | | | | |
| <i>Independent Design Check:</i> Category of Independent Design Check Completed (BS5975 Table 2): | | | <i>Independent Design Check Completed by:</i> | | |
| <i>Implementation Risk Category from BS5975 Table 1:</i> | | | | | |
| Foundation/Grillage Sign Off | | | | | |
| <i>Name:</i> | | <i>Signed:</i> | | <i>Date:</i> | |
| <i>Position:</i> | | <i>Company:</i> | | | |

| | | |
|--|---|--|
|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
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Form C: Example of a Tower Crane Permit to Erect to be completed and signed by PC's-TWC or TWC-SC

| | | | | | |
|---|--|--------------------|--|---------------|--|
| Permit to Erect | | | | | |
| <i>Site Details:</i> | | | | | |
| | | | | | |
| Tower Crane No/Location: | | Make: | | Model: | |
| Height under Hook: | | Jib Length: | | | |
| Base Type: | | | | | |
| <p><i>I confirm that: -</i></p> <ul style="list-style-type: none"> a) <i>the tower crane foundation/grillage has been constructed and installed to the temporary works design package;</i> b) <i>a post construction and installation inspection has been carried out (recorded on the attached report);</i> d) <i>any modifications to the temporary works have been approved by the temporary works designer and a record made in the Temporary Works File for the crane; and</i> e) <i>the water, ground and environmental conditions and use are as envisaged by the design.</i> <p><i>I confirm that the tower crane may be erected.</i></p> | | | | | |
| Name: | | Signed: | | Date: | |
| Position: | | Company: | | | |
| NOTE: <i>The Permit to Erect only should be signed by the PC's-TWC or TWC-SC.</i> | | | | | |

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|--|---|--|
|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |

13.0 Tower Crane Tie – Inspection prior to installation

Prior to the installation of a tie, an inspection should be carried out to ensure that the tie has been fabricated to the design specification. A further inspection should be carried out following installation to ensure that the tie has been installed to the design specification.


The results of the inspections should be recorded on a Tower Crane Tie Fabrication and Pre-installation Inspection Record (**See Form D**) and retained in the Temporary Works File for the crane. The record should be signed by the PC's-TWC or TWC-SC.

These inspections should include the following items, where applicable: -

| | |
|-------------------------------------|---|
| All Ties | <ul style="list-style-type: none"> • Details in accordance with tie designer's drawings and details. |
| Steelwork | <ul style="list-style-type: none"> • Steel correct grade • Dimensional check • Bolts tight (check if particular torque is required) • Bolts and nuts paint marked after tightening (for ease of checking) This is also recommended for Tension Control Bolts (TCB) and Direct Tension Indication (DTI) equipped High Strength Friction Grip (HSFG) bolts • Weld quality. |
| Structural Attachment Points | <ul style="list-style-type: none"> • Confirmation that the tie attachment points on the supporting structure will take the design loads. |
| Tower Crane Mast | <ul style="list-style-type: none"> • Vertical and to tolerance. |
| Access | <ul style="list-style-type: none"> • Safe access has been provided to undertake tie installation and in-service inspection. |


Prior to a tie being installed the AP-TE should ensure that:

- a Tower Crane Tie Approval/Completion Form (**See Form E**) confirming that the tie has been correctly designed, manufactured (if applicable) and installed, has been completed;
- A "Permit to Install a Tie" (**see Form F**) has been completed and signed by the PC's-TWC or TWC-SC.

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|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | Tower Crane Technical Information Note | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |


Form D: Example of a Tower Crane Tie Fabrication and Pre-installation Inspection Report signed by PC's-TWC or TWC-SC

| Tower Crane Tie Fabrication and Pre-installation Inspection Report | | | | | |
|--|--|--------------------------|--------------------------|---------------------|-------------|
| <i>Site Details:</i> | | | | | |
| <i>Tower Crane No/Location:</i> | | <i>Make:</i> | | <i>Model:</i> | |
| <i>Height under Hook:</i> | | <i>Jib Length:</i> | | | |
| <i>Tie Type:</i> | <i>Tie Position (from base):</i> | | | | |
| <i>Items Checked</i> (delete where not applicable) | | <i>As Specified?</i> | | <i>Inspected By</i> | <i>Date</i> |
| | | <i>Yes</i> | <i>No</i> | | |
| All Ties | Compliance with design drawings/specification | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Steelwork | Steel grade | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Dimensional check | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Weld quality | <input type="checkbox"/> | <input type="checkbox"/> | | |
| | Bolts – grade, torque, tightness, quantity | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Structure Attachment Points | Confirmation that the tie attachment points on the supporting structure will take the design tie loads | <input type="checkbox"/> | <input type="checkbox"/> | | |
| Tower Crane Mast | Vertical and to tolerance | <input type="checkbox"/> | <input type="checkbox"/> | | |
| <i>Temporary Works Design Package Documents against which tie has been checked (drawing nos./document references):</i> | | | | | |
| <i>Notes and Observations:</i> | | | | | |
| <i>I confirm the tower crane tie has been manufactured to the design specifications and that a satisfactory pre-installation construction inspection has been carried out.</i> | | | | | |
| <i>Name:</i> | | <i>Signed:</i> | | <i>Date:</i> | |
| <i>Position:</i> | | <i>Company:</i> | | | |
| NOTE: On completion the report should be signed by the PC's-TWC or TWC-SC. | | | | | |

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|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | Tower Crane Technical Information Note | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |


Form E: Example of a Tower Crane Tie Approval/Completion Form

| | | | | | |
|--|--|--------------------|----------------------------------|---------------|--|
| Tower Crane Tie Approval/Completion Certificate | | | | | |
| <i>Site Details:</i> | | | | | |
| <i>Tower Crane No/Location:</i> | | <i>Make:</i> | | <i>Model:</i> | |
| <i>Height under Hook:</i> | | <i>Jib Length:</i> | | | |
| <i>Tie Type:</i> | | | <i>Tie Position (from base):</i> | | |
| Tie Design | | | | | |
| <i>Design Criteria and References:</i> | | | | | |
| <i>Drawings and Documents Issued:</i> | | | | | |
| <i>Limitations or Restrictions:</i> | | | | | |
| <p>NOTE: Where the tie design relies on the use of permanent works for support, the designer should state whether the permanent works have been analysed</p> | | | | | |
| <p><i>I certify that reasonable professional skill and care has been used in the preparation of this design, that the details have been checked for compliance with the relevant standards listed above and that the design has been accurately translated into drawings and other documents issued to site.</i></p> | | | | | |
| <i>Name:</i> | | <i>Signed:</i> | | <i>Date:</i> | |
| <i>Position:</i> | | <i>Company:</i> | | | |

| | | |
|--|---|--|
|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |

Form F: Example of a Permit to Install a Tie to be completed and signed by PC's-TWC or TWC-SC

| | | | | | |
|--|--|-----------------|--|--------------|--|
| Permit to Install a Tie | | | | | |
| <p><i>I confirm that:</i></p> <p>a) <i>the tower crane tie and tie attachment point to the supporting structure has been constructed to the temporary works design package</i></p> <p>b) <i>a pre installation inspection has been carried out (recorded on the attached report),</i></p> <p>c) <i>any modifications to the temporary works have been approved by the temporary works designer and a record made in the Temporary Works File for the crane; and</i></p> <p>d) <i>I confirm that that the tie may be installed.</i></p> | | | | | |
| Name: | | Signed: | | Date: | |
| Position: | | Company: | | | |
| NOTE: <i>The Permit to Install a Tie should only be signed by the PC's-TWC or TWC-SC.</i> | | | | | |

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|  | Construction Plant-hire Association Tower Crane Interest Group | |
| | <i>Tower Crane Technical Information Note</i> | |
| TIN 031 | Managing the design, construction and inspection of tower crane bases, grillages, and ties | |

14.0 Tower Crane Thorough Examination following installation or alteration

The thorough examination of a tower crane required by Regulation 9 of LOLER is aimed at ensuring that the crane has been installed correctly and at periodic intervals, remains in a safe condition for continued use. While this examination is primarily aimed at the crane, it is important that the condition of the foundation and ties (if applicable) is examined.

Following installation or alteration, the tower crane should be thoroughly examined by a competent person.

The competent person undertaking the examination should have appropriate practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined. This will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the crane. It is essential that that the competent person is sufficiently independent and impartial to allow objective decisions to be made.

As part of the thorough examination, the competent person should review all information for base and tie construction contained in the Temporary Works File.


The following information should be reviewed (where applicable):

- a) information on in and out of service wind conditions;
- b) force and moment data supplied to the base designer, pile designer, grillage designer and tie designer;
- c) copy of the base design drawing;
- d) copy of the grillage design drawing;
- e) copy of the rail track design drawing;
- f) copy of pile drawing including vertical reactions;
- g) photographs of the base prior to pouring, showing the anchors and reinforcement;
- h) test cube results;
- i) copy of the Tower Crane Foundation Inspection Report (**See Form A**);
- j) copy of the Tower Crane Foundation/Grillage Approval Certificate and Permit to Erect (**See Forms B & C**);
- k) force and moment data supplied to the tie designer;
- l) copy of the tie design drawing;
- m) copy of the Tower Crane Tie Fabrication and Pre-installation Inspection Report (**See Form D**);
- n) copy of the Tower Crane Tie Approval/Completion Certificate (**See Form E**).

During the thorough examination, the competent person should inspect the base and ties and check them for consistency with the information listed in the Temporary Works File.

On completion the report of thorough examination should be retained in the Lifting File for the crane.

| | | | | | | | | |
|---------|--------|------------|----------|---------------|----------|-------|---|---------------|
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NOTE: Guidance on the Thorough Examination of Tower Cranes is provided in BS7121-2-5:2012 Code of practice for the safe use of cranes Part 2-5: Inspection, maintenance, and thorough examination – Tower cranes. Additional guidance is also provided in CPA Publication TCIG 0801 – Maintenance, Inspection and Thorough Examination of Tower Cranes – CPA Best Practice Guide.

15.0 Inservice Maintenance and Inspection of Temporary Works

The PC's-TWC should ensure that the temporary works associated with the installation of the tower crane are inspected at suitable intervals whilst the crane remains in-service to ensure that the condition of the works has not deteriorated, and that remedial action can be taken. The PC's-TWC should prepare a schedule for the inspection that should include a description of the items that are to be inspected, the frequency that they should be inspected and who should undertake the inspection. This should be based on the information supplied by the TWD at the design stage and guidance provided in C761 - *Tower crane foundation and tie design*. A copy of the inspection schedule and records of the inspection undertaken should be retained in the Temporary Works File for the crane.


15.1 Foundation Inspection

The inspections should include the following items, where applicable:

| Item | Check Required |
|----------------------------|--|
| All foundations | <ul style="list-style-type: none"> • Level check. |
| Reinforced concrete | <ul style="list-style-type: none"> • Inspection for cracking, especially around cast in items. |
| Steelwork | <ul style="list-style-type: none"> • Bolts tight • Inspection for cracks in welds. |
| Rail | <ul style="list-style-type: none"> • Rail centres and level (particular need for frequent checks for rails on sleepers or ballast • Limit ramps and end stops correctly positioned and firmly fixed. |
| Groundwater level | <ul style="list-style-type: none"> • Base clear of accumulated groundwater • Level check if foundation stability would be impaired by water rise. |

The PC's-TWC should ensure that safe access is provided to all the items within the inspection schedules.

Monitoring tower crane foundations can be difficult if surface water can accumulate at the tower crane base area. Accumulation can be avoided by ensuring there is good drainage. It may be necessary to install pumped drainage.

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|  | Construction Plant-hire Association Tower Crane Interest Group | |
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15.2 Tie Inspection

The inspections should include where applicable:

| <i>Item</i> | <i>Check Required</i> |
|---|---|
| Ties | <ul style="list-style-type: none"> • Inspection for cracking especially around welds • Fasteners tight • Pins secure and in place. |
| Mast collars | <ul style="list-style-type: none"> • Bolts tight. |
| Anchor plates, anchor points and fixings | <ul style="list-style-type: none"> • Bolts tight • Inspection for cracks in welds • No cracking in concrete around mounting plate fasteners. |

The PC-TWC should ensure that safe access is provided to inspect mast ties and anchor plates.

15.3 Frequency of Inspection

During the first week of crane operation, it is recommended that inspections are carried out daily. Visual inspection should then be carried out weekly with more detailed examination of critical items such as bolts and welds at three monthly intervals by a competent person.

Level checks for rail-mounted cranes should continue at weekly intervals. For such cranes mounted on concrete foundations, the frequency of level checks may be reduced to monthly for the first three months and then three-monthly thereafter, so long as the settlement is within projected limits.

16.0 Inservice Inspection of the Crane (PUWER and LOLER)


The AP-IS should ensure that daily and weekly inspections undertaken by the crane operator of the crane. Records of the inspection should be retained within the Lifting File for the crane. Any faults that are found should be reported to the maintenance provider so that they may be rectified.

NOTE: *Guidance on the inspection of Tower Cranes is provided in BS7121-2-5:2012 Code of practice for the safe use of cranes Part 2-5: Inspection, maintenance, and thorough examination – Tower cranes. Additional guidance is also provided in CPA Publication TCIG 0801 – Maintenance, Inspection and Thorough Examination of Tower Cranes – CPA Best Practice Guide.*

17.0 Removal of the Tower Crane and Temporary Works on completion

The Principal Contractor in conjunction with the PC's-TWC and TWC-SC should develop a plan for the removal of temporary works associated with the tower crane. The plan should identify the temporary works items that will be removed or dismantled. The plan should identify who will be completing each activity and the sequence they will be undertaken.

The AP-TE should visit the site prior to inspect the crane and site prior to the dismantling commencing. The AP-TE should submit a plan for the dismantling of the tower crane to the Principal Contractor.

| | | |
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Dismantling activities should not commence until a permit has been issued and signed by the PC's-TWC or TWC-SC.

Dismantling activities should be supervised by a Temporary Works Supervisor, or for the crane a Tower Crane Erection Supervisor.

A copy of the dismantling plan(s) and permit(s) should be retained in the Temporary Works File for the crane.