



**Mast and Tower Safety Group**

*promoting safety and best practice*

**Guidance Note**

**GN-014**

# Structural Inspections of Masts and Towers



# MATS Group Guidance Note

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### 1 Introduction

The purpose of this document is to provide guidance on structural inspections for tower and mast owners (transmission and radio). It will describe the principles of inspections and provide general guidance for their completion.

The tower or mast owner should manage the estate in such a manner that the risk of injury to employees, subcontractors and the general public is minimised as far as is reasonably practicable.

There is no single document that specifies what constitutes an acceptable through-life estate management practice to minimise risk levels as far as is reasonably practicable. It is recognised that some tower and mast owners have stringent in-house processes and procedures for the inspection of their towers, built up over a number of years' experience and assessment of risks within their estates.

This document does not detail these in-depth company policies and procedures but provides guidance on the minimum recommended requirements to other companies which may not have similar regimes in place. It also clarifies areas of ambiguity relating to responsibilities for inspection on sites that are shared with third parties.

The guidance draws on what is accepted as the minimum requirements by recognised tower and mast owners and by British Standards where they exist.

Note that individual companies/infrastructure owners may choose to operate more stringent or more frequent inspection regimes than are recommended in this Guidance Note.

### 2 Scope

This document provides guidance on the requirements for inspecting masts and towers (transmission and radio) within the UK. It also identifies responsibilities for inspections where equipment is installed on a third party site.

It assumes that the structure was originally built to the required standards and that the design of new structures and appraisal of existing structures, concerning both the derivation of environmental loading conditions and the determination of structural response, are undertaken in accordance with current British Standards and Euronorms and in line with industry best practice.

Relevant standards for design and appraisal are listed below:

- Guyed masts – BS EN 1993-3-1.
- Towers – BS EN 1993-3-1 in conjunction with Annex B to PD6688-1-4, which is due for publication in December 2015.
- Monopoles – BS EN 40 or PLG07 (Professional Lighting Guide 07 published by the Institution of Lighting Professionals).

This guidance also assumes that further structural review, potentially including full analysis of the structure, will have been undertaken in the following circumstances:

- prior to use of the structure or a proposed change of use of the structure, i.e. incorporating additional apparatus or equipment on the structure.
- following an incident in which significant damage or structural distress has occurred.
- by recommendation following a previous technical inspection.

This document does not provide details of how to climb the structure safely to undertake the inspection, and assumes that the persons undertaking the inspection are competent to complete the inspection safely.

### 3 Competent persons

A technical inspection should be carried out by, and certificates signed by, a competent person. A competent person should:

- have a minimum of three years' collective relevant experience in the inspection and construction of the type of structure involved, or have attended a structural inspection course to obtain relevant information on the specific structures in order to conduct an inspection adequately. If only the latter is the case, there must be robust internal procedures and additional expertise in place as a back-up to provide further advice and experience as required.
- have the appropriate level of climber competency to operate safely on the structures involved. (See MATS Guidance Notes GN-001 – Work at Height Training and GN-012 – Climbing Masts and Towers.)

Each tower and mast owner will have a person/team in place to oversee the inspection regime and assess its effectiveness in identifying issues and ensuring that these issues are resolved in a satisfactory manner. This person/team will either have the following competency or access to following competency:

- a suitably qualified structural engineer.

### 4 Structural Inspections

The objectives of the technical inspection are to undertake a safety audit and to determine whether the structure is in a satisfactory condition and to ensure that the form of access and places of work are fit for purpose and comply with statutory requirements.

If possible/available, obtain a copy of the previous structural condition report or safe to climb certificate prior to inspection. This may prove to be a valuable source of information or reference basis for comparison while conducting the structural inspection.

### 5 Inspection Frequency

Fundamentally the frequency with which a structure is inspected is determined within Standard BS8100, which states that Class A & B towers inspection periods should not exceed 2 and 5 years respectively, or that inspection should take place if the conditions laid out in the scope of this Guidance Note regarding change of use or structural damage apply.

Although BS8100 has been withdrawn, and there is no similar reference to inspection frequency in its successor BS EN 1993-3-1, it is anticipated that similar inspection guidance may be provided in the yet to be released NCCI document PD 6695-3-1.

Owners of all structures should ultimately seek advice from the manufacturer on the frequency of inspections. However the manufacturer's opinion may be regarded as 'guidance only' if owners can provide sufficient records and risk assessments to demonstrate that alternative frequencies can be used, and still provide adequate safe integrity of the structure factors including:

- Previous maintenance records – if consistently no issues have been raised over various inspections this may extend the inspection frequency.
- Age – as the structure gets older the inspection frequency may need to increase.
- Loadings – structures where there is little or no information on their loading status or which are known to be highly loaded, e.g. 95% of its design criteria, may need more frequent inspections.
- Location – structures in populated areas may need to be inspected more frequently than those in very rural areas; also structures in very exposed conditions (wind, rain, sea) may need inspecting more frequently than those in sheltered areas.
- Areas where there are high levels of vibration from external sources.

Whatever decision is made, the frequency inspection should not exceed BS8100 guidelines and the decision should be made by persons with the competence to assess all the required information and determine a suitable inspection frequency.

Owners may determine that a fixed inspection regime is required across their portfolio, e.g. all sites inspected 2 yearly. If this approach is taken the frequency should be based on manufacturers' data together with knowledge of the structures being inspected, including age, use and locations to ensure a suitable assessment has been made.

It is recommended that the frequency of inspection for the following types of structures does not exceed an annual inspection:

- Sites with previous structural issues identified and/or stated in any structural analysis reports.
- Sites loaded over 100% design criteria – these should also have internal procedures in place to manage the overload to minimise any associated risks and a remedial action plan in place to resolve issues.
- Guyed masts.
- Temporary structures.
- Fall arrest systems.
- Structures with person-riding access systems.
- Lowerable structures requiring partial dismantlement before lowering.
- Linked structures, e.g. forming part of a complex antenna arrangement.
- Structures using innovative structural form, techniques or materials as identified by the Professional Appraisal.
- Major masts/towers and broadcast sites.
- Structures prone to wind induced vibrations, e.g. with top antennas prone to vortex shedding, or otherwise subject to abnormal dynamic behaviour.
- Sites where it has been assessed that structural failure may cause a catastrophic incident.
- Structures in areas where there are high levels of ground vibration from external sources.

## **6 Third Party Equipment**

It is the responsibility of the owner of any equipment (cables, bracketry, antennas etc) installed on a tower or mast owner's site to be inspected, to ensure the equipment is structurally sound. It is recommended that inspection of such equipment is conducted at a similar frequency to that detailed above for structures.

There may be agreements in place with tower and mast owners to inspect this additional equipment when they conduct their inspection of the tower or mast; this is acceptable provided that the frequency of inspection meets the requirements explained in this document.

If the tower or mast owner completes the inspection of the additional equipment, agreements or records should be kept to demonstrate compliance. There should also be a robust system in place to ensure any issues raised are resolved.

Where tower or mast owners are not inspecting the additional third party equipment it is for the equipment owner to arrange with the tower or mast owner to gain access in order to undertake the inspection. The tower or mast owner may ask for evidence of inspection at any time.

It is the responsibility of anyone conducting an inspection on a tower and identifying an issue with any third party equipment or equipment outside their original scope of work to report it to the specific owner as soon as possible.

The owner of any equipment on a third party tower or mast owner's site should ensure that the equipment is inspected within the frequency periods described in this document; this may be completed internally or by third party agreements. A process should be in place to ensure:

- Adequate documentation is available to demonstrate the inspection taking place.
- Robust procedures in place to fix and repair any issues identified within suitable timescales based on the element of risk.
- There is an audit trail demonstrating compliance for all equipment on third party sites.

## **7 Completing the Inspection**

A condition report should be completed for all inspections, which is sufficiently detailed to demonstrate that the site is structurally sound at the time of the inspection. Ideally it should include photographs to provide evidence of any issues raised.

The person undertaking the inspection will use their competency to determine if the site passes its inspection and/or what issues are to be raised that need resolution. If there is any doubt then the issue will be escalated within the company, utilising the expertise of the overseeing or supervising person. If necessary a fully qualified structural engineer will be used for more detailed analysis.

All tower and mast owners should have a robust system in place for dealing with any issues or recommendations raised at the time of inspection, and an audit trail to demonstrate rectification.

## **8 Records**

All tower and mast owners should also have a robust system in place for raising any significant issues identified at the inspection to any persons that may be affected by the finding, including third parties.

The primary records that should be kept include:

- Evidence of adherence to CDM requirements covering design, checking 'as built' drawings and hazards, and demonstrating due diligence checking that design and 'as built' comply with applicable standards and associated loadings.
- Details of inspections, audits and reviews to demonstrate sound management.
- A fault history of the structure and remedial action taken.
- Identification of similar structures to assist in identifying fault trends.
- Other information will need to be kept, for example to enable more cost effective management of the site.
- Photographs of inspections.

## **9 Audit and Review**

It is good practice, and a way to demonstrate that the duty of care is being fulfilled, for all tower and mast owners to:

- Audit work for adherence to process.
- Audit work for thoroughness (i.e. comparative inspections).
- Review results, assess the effectiveness of the process, and implement improvements.
- Review changes in statutory legislation for impact on the project.

## 10 Related MATS documents

- MATS Group Guidance Note GN-001 – Work at Height Training
- MATS Group Guidance Note GN-005 – Medical requirements for climbing masts and towers
- MATS Group Guidance Note GN-008 – Mast and Tower Rescue

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*The information in this document does not absolve contractors or suppliers from their responsibility to identify and comply with all relevant legislation, regulations and legal standards nor does it take precedence over laws, regulations and external standards*

# Appendix – Basic Inspection Guide

## Lattice Towers

Not all lattice towers are the same but they will all require the same fundamental inspection. Plus as it is a more complicated structure it can be broken into two parts – the Base and the Structure.

### Base

- Remove the weather protection on the bolts at the base of the legs.
- Check all nuts and bolts are present.
- Check they are all tight and at that bolts extend at least ONE entire thread past the face of the nut.
- If known torque the bolts to the correct setting.
- Replace weather protection on the bolts.
- Check integrity of anti-climb device.

### Structure

Before commencing the tower inspection plan your route up the tower, sample 10% of the nuts and bolts on the structure. This should be done equally around the structure as the engineer climbs – so to complete this the climb will spiral around the structure and cannot be completed solely from the ladder.

- One engineer climbs the tower checking integrity of the tower and climbing system during the ascent to the top.
- Minimum 10% check of all nuts and bolts on the structure. This can be a visual check ensuring spring washers are fully compressed and/or whether there is any cracking of the paint around the nut. Check all boom arms, all nuts and washers present and assembled correctly.
- Check any other attachments on the structure – for example microwave dishes, GPS.

**In summary – spiral climb the structure, minimum 10% check of nuts and bolts and if any are found to be loose then the structure will require a 100% check.**

Note: records should be kept of what nuts and bolts were checked so a different 10% can be checked at the next inspection; some companies colour them in paint and use different colours for each inspection.

## Monopoles

Not all monopoles are the same but they will all require the same fundamental inspection:

- Remove the weather protection on the bolts at the base of the monopole.
- Check all nuts and bolts are present.
- Check all nuts are tight and at that bolts extend at least ONE entire thread past the face of the nut.
- If known torque the bolts to the correct setting.
- Check grouting is present at base and drain holes are clear.
- Replace weather protection on the bolts.
- Check weld at base of tower using the penetrative dye kit (unless there is a known problem and/or high risk sites then dye penetration can be done at alternate inspections).
- Check integrity of anti-climb device.

- Check step attachments and bolts as climbing.
- One engineer climbs the tower checking integrity of the tower and climbing system during the ascent to the top.
- Check boom arms, all nuts and washers present and assembled correctly.
- Check boom arm welds using penetrative dye kit (unless there is a known problem and/or high risk sites then dye penetration can be done at alternate inspections).
- If the structure is hinged, check splice pins hinges and attachments.
- Check any other attachments on the structure – microwave dishes, GPS.

**In summary – check 100% of nuts and bolts and all welds on a monopole**

## Guyed Masts

Not all guyed masts are the same but they will all require the same fundamental inspection:

- Remove the weather protection on the bolts at the base of mast.
- Check all nuts and bolts are present.
- Check they are all nuts are tight and at that bolts extend at least ONE entire thread past the face of the nut.
- Check structure for verticality over its full height and where necessary for any twist. Check guys are secure, measure and record tensions, ideally in still air, but noting temperature and weather conditions at the time. Replace weather protection on the bolts.
- Check all stays and anchor points for excessive corrosion.
- Check all stays for adequate articulation.



**Non-climbable masts still require an annual inspection to ensure guys are tight.**

## Ancillary Equipment on Third Party Tower or Mast

### Antennas and bracketry (own antennas and bracketry only)

- Inspect the antennas for signs of mechanical damage or wear and tear.
- Check the antenna mounting clamps for tightness.
- Check feeders and cable management system.
- Check the tightness of all equi-potential bonds and supplementary bonding terminations.

- Inspect the antenna support steelwork for tightness and connection to the support structure.
- Check RF Hazard signage is in place.
- Check for rust, any signs of rust, wire brush and treat with galvanising spray.

#### Additional for dishes

- Inspect the fixed link dishes including Grid pack / Yagi for signs of mechanical damage or wear and tear.
- Check the fixed link dish mounting brackets for tightness. Inspect the fixed link dish support steelwork and connection to the support structure.
- Inspect the fixed link dish including Grid pack / Yagi support steelwork and connection to the support structure.

#### Feeder checks (own feeders only)

- Inspect the feeder for signs of mechanical damage or wear and tear.
- Inspect feeder terminations at antennas and radio equipment for condition of weather proofing.
- Check feeder grounding kits are secure.
- Check for presence of feeder identification tags.
- Check feeder clamps / brackets for tightness.

#### Lightning protection

- Visually check to ensure the presence of a connection between third party owned lightning protection ring and your equipment cabin / cabinet (if applicable).
- Check electrical continuity and mechanical condition of all conductors, fixings, joints, bonds and air terminations, from your equipment to the third parties lightning protection main system.

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