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ATTACHMENT OF MOBILE PHONE ANTENNAS TO OVERHEAD LINES

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PURPOSE AND SCOPE

This TGN gives guidance on the structural capacity of overhead line towers to accept mobile phone antenna installations without encroaching upon the minimum structural reliability required of such towers.

Mobile phone installations comprise of cellular antennae, microwave dishes, wave-guides, feeders and the steelwork associated for attachment to the tower, which add appreciably to the tower wind loading especially where multiple installations are involved.

This TGN is applicable to towers of types L66, L2, L3, L6, and L8. No other towers are suitable for installation.

This TGN assumes that tower foundations have been upgraded to be compatible in strength with their tower superstructures. If there is no record or written proof of this, increase site wind speed, V_B , by 8% when determining the suitability of the proposals. This is explained further in Appendix A.

The TGN also assumes that all towers are modified in accordance with TDC 161 and TGN(E) 863. Un-modified towers shall not be considered for cellular installations unless modifications are carried out. However, this shall be agreed with Asset Strategy

The calculations taken from BS 8100 assume the feeders are installed inside the tower leg. To install the feeders on the outside of the tower leg, or on the structure itself, would increase the wind loading. For guidance on installing the feeder in a position that is not covered in this document, refer to Asset Strategy - Asset Policy.

PART 1 - GUIDANCE

1 GENERAL REQUIREMENTS

1.1 Locations of Antenna Installations on Towers

It has been assumed that the location of a single antenna installation will be at the maximum practicable height for the particular tower under consideration.

This document considers up to three different installations and in this case the second and third installations have been located at the second and third highest practicable locations for the tower.

Details of antenna locations for each tower type shall be in accordance with G3-ES-0703.

1.2 Antenna Installation

For the purpose of this guide the calculations have been carried out on a typical cellular installation, each one comprising of the following:

- a) Maximum of 6 cellular antennae, each having maximum dimensions of 2.5 m x 0.25 m.
- b) Maximum of 2 microwave dishes each with a diameter no greater than 600 mm.
- c) Maximum of 12 feeders with a maximum of 50 mm diameter for each feeder.
- d) 2 wave-guides with a maximum of 15 mm diameter each.
- e) The number and size of the cellular antennae and microwave dishes may vary as long as the overall wind loading is equivalent to a typical cellular installation which is stated above, and is compliant to G3-ES-0703.

If the equipment needed exceeds a typical cellular installation as listed above, then a site-specific study shall be required.

2 GRAPHICAL ANALYSIS

The Appendix contains charts relevant to each tower type and shows the conductor system, which is the maximum standard conductor size, defined in NGT specifications for that tower design. It also shows lengths of adjacent spans together with numbers of antenna installations carried. Each chart shows limitations of suitability in respect of values for V_B , γ_v , A and T

An example of the use of the charts is given in Appendix B.

If a proposed installation scheme does not fall within the “zone of acceptability” of the relevant chart, a site-specific study shall be undertaken.

The charts are prepared for suspension towers, which are the critical designs. They may also be used for angle/tension towers when at their maximum designed deviation but note clause 2.4.

These charts are based on a maximum value for sum of adjacent spans. If the actual sum of the spans is significantly lower than the chart value then this can be allowed for as shown in clause 2.4.

2.1 Failure Containment Loads

In accordance with IEC 60826, longitudinal loads shall be included in the tower design as indicated below using the concept of ‘broken wire loads’.

A ‘broken wire’ condition shall be defined as the static tension of two broken phase bundles or one bundle and the earthwire in the same span (worst combination on the tower). This shall be applied for both suspension and tension towers.

Suspension towers:	Design everyday tension at 15 °C, no wind or ice load.
	An alleviation factor of 0.7 for phase conductor to allow for insulator swing, no alleviation for earthwires.
Tension Towers:	1 As above but no alleviation factor shall be allowed.
	2 Additional requirement assuming only one phase conductor bundle or earthwire broken. The conductor loads shall be determined on the 3 year return period wind on iced conductors, (equivalent to $\gamma_v = 0.75$). No alleviation factor shall be used on this load.

2.2 Site Specific Conditions

In order to check the suitability of any particular tower to carry one or more antenna installations, the following site-specific conditions must be known:

- V_B , basic mean hourly wind speed for the site, in metres per second, taken from the wind map, Figure 1 in Appendix A to this document.
- The relevant values of the parameters in BS 8100 are as follows.
- For suspension towers designed for use in open country a value of 1.1 shall be chosen for the partial safety factor γ_v , and terrain category 2 shall be assumed.
- For suspension towers constructed in areas adjacent to habitation, motorway and rail crossings, for deviation and terminal towers and for towers used for high-level river crossings, a value of 1.2 shall be adopted for γ_v .
- A, altitude of the tower site in metres.
- T, terrain category taken from Figure 2 in Appendix A to this document. (Note: This document provides guidance for the most common terrain categories II and III. If guidance is required for categories significantly different to these refer to Asset Strategy - Asset Policy).

In order to carry out tower suitability checks, and permit audit of the assessment process the above details shall be recorded in site survey reports by those responsible for assessing overall suitability of the sites.

2.3 Adjustment for a Lesser Sum of Adjacent Spans

Using the same charts, a lesser sum of adjacent spans may be taken into account by reducing the basic mean hourly wind speed for the site, V_B . The effective reduced basic wind speed, V_{Beff} , is calculated as follows.

$$V_{Beff} = V_B (0.52 + 0.48 S/S_{max})^{0.5}$$

Where, S_{max} = Maximum sum of adjacent spans (from chart)

and, S = Actual sum of adjacent spans

An example of this is given in Appendix A

2.4 Angle/Tension Towers

Angle/tension towers are designed to cope with a range of angles of line deviation and therefore they may be used for actual line deviations which are significantly less than the maximum for which they are designed.

If a line deviation is not within 2.5 degrees of the maximum for which the tower is designed the tower may be presumed to be suitable for mounting one antenna installation without any further check.

If a line deviation is not within 5 degrees of the maximum for which the tower is designed, the tower may be presumed to be suitable for mounting up to three antenna installations without any further check.

The above presumes that the maximum sums of adjacent spans are not exceeded.

An example is given in Appendix B.

3 SITE SPECIFIC TOWER ANALYSIS

At the initial feasibility stage a procedure shall be put in place to check the capability of a tower to carry antenna installations.

This process should be initiated by the commencement of the TGN(E) 179 graphical analysis. If the analysis shows the tower to be compliant with TGN(E) 179 then the installation can proceed.

However, if the analysis shows the tower to be non-compliant, a full site-specific tower study shall be undertaken in accordance with EN 50341 Part 3-9 (NNA). If at this point the site-specific study shows the tower to be un-suitable to carry antenna installations, then the tower shall be withdrawn and no further consideration taken.

If the site specific study shows the tower to be compliant to EN 50341 Part 3-9 (NNA), a foundation study based on foundation loads calculated in accordance with the NNA, and foundation strengths calculated according to NGT TS 2.10 in conjunction with results from site investigations shall be carried out. If the tower and foundations site specific studies are deemed suitable then the antenna installation can proceed. If the site-specific study shows the foundations to be un-suitable to carry antenna installations, then the tower shall be withdrawn and no further consideration taken.

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

4 REFERENCES

This Technical Guidance Note makes reference to, or should be read in conjunction with, the following documentation.

BS 8100	Lattice Towers and Masts. Part 1: Code of Practice for loading Part 2: Guide to Background and use of part 1
BS 7733	Loading and Strength of Overhead Transmission Lines.
BS EN 50341	Overhead Line Exceeding 45Kv
G3-ES-0703	Work on Cellular Installations.
PS(T) 011	Alternative use of Overhead line Towers.