

Critical Loading States for XL-TTC Structures

(033677-BHP-DN-XL-TTC-001)

Project GW Electrification - Innovation in OLE Structures

Subject Critical Loading States for XL-TTC Structures

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1 Introduction

Analysis of the Series 1 OLE Extra Large Twin Track Cantilever (XL-TTC or Long TTC) has been carried out using hand calculations which have been proven to corroborate with LUSAS modelling software. This design note presents the characteristic reactions at the base of the mast. All loading has been derived using ULS combinations of actions in accordance with:

- NR/L3/CIV/072 Wind Loading of OLE Structures
- NR/L3/CIV/073 Design of Overhead Line Structures

2 Loading

2.1 Ultimate Limit State (ULS)

The outputs of this design note are the worst case reactions at the base of the masts in response to characteristic loading. ULS load combinations have been applied but with partial factors set to 1.0, or in the case of load combination D, wind has a combination factor of 0.5.

The worst case load effects for the structure occur at the following track conditions. Track spacing = 65m, Track Radius = 1651m (versine of 320mm) when all across track loads are away from the mast towards the tracks which generates the highest overturning moment at the mast baseplate. All reactions provided in this note are derived from these parameters.

3 XL-TTC Structure

3.1 Arrangement

Figure 1 shows the arrangement of a XL-TTC to A8100.010.006. This is known to be the arrangement which provides the largest moments at the foundation.

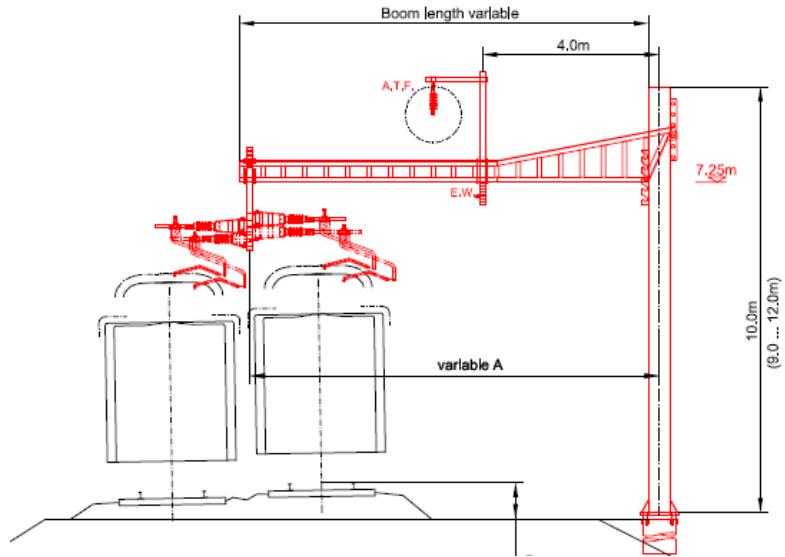


Figure 1: Arrangement of XL TTC (as extracted from C&S Engineering Manual drawing A8100.010.006)

3.2 Model Parameters

Figure 2 shows the arrangement used to model the XL-TTC in LUSAS and in hand calculations. Note the assumed values of offset between the two back to back Single Insulated Cantilevers (SIC). The vertical offset (0.3m) was informed by assuming the same offset as the Twin Cantilever SIC and the horizontal (0.4m) was informed by drawing B.02.02.05.

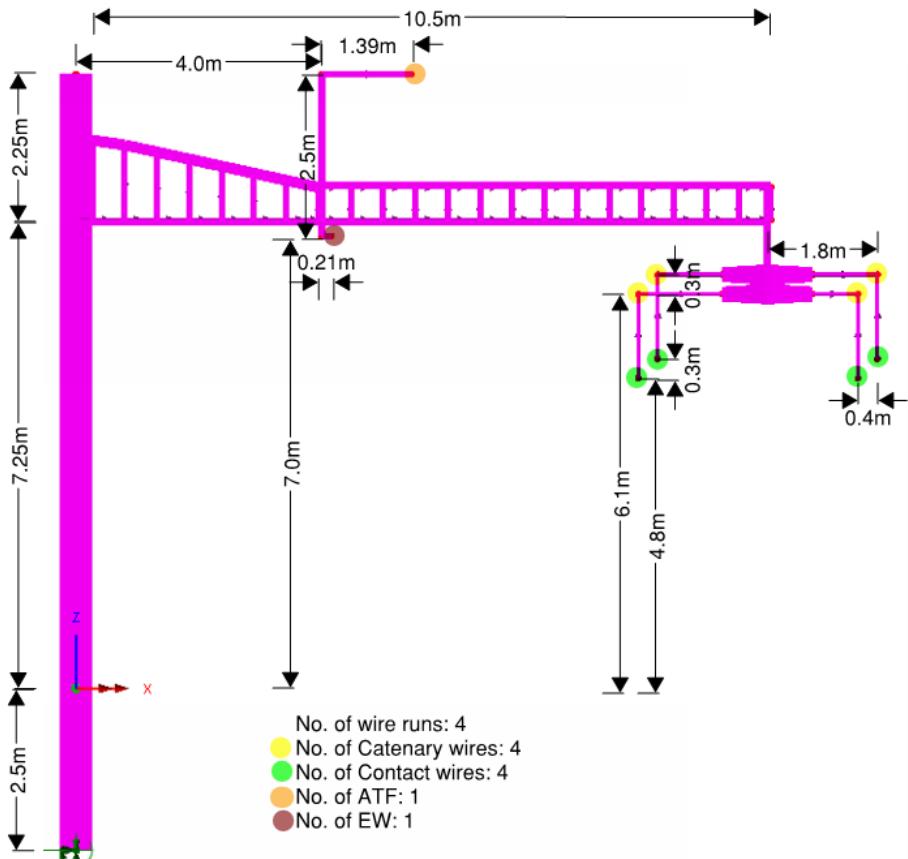


Figure 2: Geometry of the LUSAS model for the XL-TTC. The Y axis is positive into the page.

3.3 Results

The worst case for the mast foundation load effects is load combination D with across track (X) wind although it is to be noted load combination B with across track wind (X) produces a very similar value of maximum moment.

The along track (Y) and across track wind loads were applied in the positive direction. The values of forces and moments in the following tables are absolute values.

3.3.1 Load Combination A

Wind Direction: N/A, Temperature= -18°C, no ice.

	Description	Unit	Action			Σ (Total)
			Permanent	Wind*	Other variable	
Fx	Across track shear	kN	-	-	5.5	5.5
Fy	Along track shear	kN	0.0	-	0.5	0.5
Fz	Axial compression	kN	47.6	-	-	47.6
Mx	Along track moment	kN	4.3	-	5.7	10.0
My	Across track moment	kN	180.7	-	47.1	227.8
Mz	Torsion	kN	-	-	3.1	3.1

3.3.2 Load Combination B

Wind Direction: Along track (Y), Temperature= 10°C, no ice

	Description	Unit	Action			Σ (Total)
			Permanent	Wind*	Other variable	
Fx	Across track shear	kN	-	-	5.5	5.5
Fy	Along track shear	kN	-	33.8	0.5	34.3
Fz	Axial compression	kN	47.6	-	-	47.6
Mx	Along track moment	kN	2.7	277.5	5.7	285.9
My	Across track moment	kN	180.7	-	47.0	227.6
Mz	Torsion	kN	-	99.8	1.3	101.1

3.3.3 Load Combination B

Wind Direction: Across track (X), Temperature= 10°C, no ice.

	Description	Unit	Action			Σ (Total)
			Permanent	Wind*	Other variable	
Fx	Across track shear	kN	-	23.9	5.5	29.5
Fy	Along track shear	kN	-	-	0.5	0.5
Fz	Axial compression	kN	47.6	-	-	47.6
Mx	Along track moment	kN	2.7	-	5.7	8.4
My	Across track moment	kN	180.7	188.8	47.0	416.4
Mz	Torsion	kN	-	3.5	1.3	4.9

3.3.4 Load Combination D

Wind Direction: Along track (Y), Temperature= -5°C, with 9.5mm radial ice.

	Description	Unit	Action				Σ (Total)
			Permanent	Wind*	Other variable		
Fx	Across track shear	kN	-	-	5.6		5.6
Fy	Along track shear	kN	-	18.5	0.6		19.1
Fz	Axial compression	kN	47.6	-	7.5		55.1
Mx	Along track moment	kN	3.6	154.0	7.9		165.5
My	Across track moment	kN	180.7	-	85.1		265.8
Mz	Torsion	kN	-	60.3	2.4		62.7

3.3.5 Load Combination D

Wind Direction: Across track (X), Temperature= -5°C, with 9.5mm radial ice.

	Description	Unit	Action				Σ (Total)
			Permanent	Wind*	Other variable		
Fx	Across track shear	kN	-	18.0	5.6		23.6
Fy	Along track shear	kN	-	-	0.6		0.6
Fz	Axial compression	kN	47.6	-	7.5		55.1
Mx	Along track moment	kN	3.6	-	7.9		11.5
My	Across track moment	kN	180.7	150.8	85.1		416.6
Mz	Torsion	kN	-	4.9	2.4		7.2

*To convert to SLS multiply Wind values by 0.66.