132kV Steel Pole Transmission Lines:

Preliminary Test Specification for NeSTS 132 kV Single Circuit

Issue 1.0

March 2020

REVISION HISTORY

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MDL TS			0.1	27/11/2018	First draft for comment
TS			0.2	26/02/2019	Loads updated
TS			0.3	12/03/2019	Loads updated
TS			0.4	14/03/2019	Formatting tidied and prepared for PDF
TS			0.5	15/03/2019	S30 load case 7 corrected
TS			0.6	10/05/2019	Weld testing added, programme dates modified
TS			0.7	17/09/2019	S30 Load case 3 title corrected
TS			0.8	30/09/2019	Missing S30 direct loads added
MHS	MDL	TS	0.9	02/03/2020	Direct loads updated
TS	MDL	TS	1.0	20/03/2020	Load case section numbers clarified.

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Foreword

This test specification is published by the New Suite of Transmission Structures (NeSTS) Project. It sets out the testing requirements specified by Scottish Hydro Electric Transmission plc (SHE Transmission) for the purposes of type approving the NeSTS 132kV Single Circuit (SC) supports for use on its electricity network.

1. Scope

This test specification is applicable to NeSTS 132kV SC supports, as specified in Preliminary Technical Specification for NeSTS 132kV SC supports.

2. Normative references

The following referenced documents, in whole or part, are indispensable for the application of this testing specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1. Standards publications

BS EN 60652:2004
Loading tests on overhead line structures

BS EN 61773:1997
Overhead lines – Testing of foundations for structures

BS EN 50341-1:2012
Overhead electrical lines exceeding AC 1 kV.
General requirements. Common specifications

BS EN 50341-2-9:2017
Overhead electrical lines exceeding AC 1 kV.
National Normative Aspects (NNA) for Great Britain and Northern Ireland

2.2. Other publications

Preliminary Technical Specification for NeSTS 132kV Single Circuit Supports

ENA TS 43-125: Issue 2:2017
Design guide and technical specification for overhead lines above 45kV[1]

[1] The foreword to ENA TS 43-125 Issue 2 implies that it applies to lattice steel supports in particular, and not to pole supports, however, useful guidance is given for overhead lines in general, and to supports for double circuit configurations. Reference has been made to ENA TS 43-125 for certain aspects of the design.

3. Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1. Client

Organization which contracts with the testing station and provides the test specification.

3.2. Design load

Load for which the support has been designed.

3.3. Failure load

Point at which the support cannot carry any additional load.

NOTE: It is also known as the limit state failure load and is determined during a destruction test on the support.

3.4. Test report

Document summarizing all the relevant aspects of the tests.

4. Historical background

4.1. General

The NeSTS 132kV Single Circuit suite of supports has been developed as part of the Network Innovation Competition (NIC) to provide a steel pole solution to support overhead lines.

It is specified by Preliminary Technical Specification for NeSTS 132kV Single Circuit

4.2. Testing basis

This document specifies the requirements for full scale design testing of two support types from the suite. These have been selected by SHE Transmission to represent all design elements used in the suite and to provide a basis for its type approval.

5. General Description and Notes

5.1. Testing in accordance with BS EN 60652:2004

The testing is to be undertaken in accordance with BS EN 60652:2004, but subject to the amendments stated herein, or by written agreement with the Client.

5.2. Foundation testing and BS EN 61773:1997

Where foundation elements are included in the test programme, testing should meet the requirements of BS EN 61773:1997, subject to the amendments stated herein, or by written agreement with the Client. Where a structure and foundation are to be tested in the same programme, the load levels specified in BS EN 60652:2004 should be used instead of those specified in the loading schedule of BS EN 61773:1997.

5.3. Test Supports

Two NeSTS 132kV SC support types will be subjected to the design tests specified in this document; a S2 STD and a S30 STD.

5.4. Design Loads

The design loads given herein have been calculated in accordance with EN BS 50341-2-9, corresponding to the design parameters stated in the Preliminary Technical Specification for NeSTS 132kV Single Circuit Supports.

Vector loads correspond to loads imposed by the conductor system on the supports for a number of loadcase scenarios.

Loads that simulate direct wind loading on the pole are presented as a series of transverse loads and longitudinal loads at a number of loading points on the pole. The transverse and longitudinal loads have been calculated to correspond to the projected area of the pole and to representative climatic loading that has been calculated in accordance with BS EN 50341-2-9:2017.

Foundation reactions are presented for each of the test loadcases. These foundation reactions correspond to the vector loads and direct loading discussed above.

5.5. Key Design Aspects

The key aspects of the support designs that were considered in the identification of critical loadcases were:

- Earth wire peak utilisation.
- Pole utilisation.
- Crossarm utilisation.
- Stay utilisation.
- Maximal base moment.
- Maximal vertical moment at pole/cross arm connection.
- Maximal horizontal moment at pole/cross arm connection.

5.6. Acceptance Criteria

Permanent local deformations, ovalisation of holes and permanent deformation of bolts may be accepted at the discretion of the Client.

6. Test Support and Foundation Drawings

6.1. NeSTS 132kV SC S2 STD Support General Arrangement

This drawing is presented in Appendix 1.

6.2. Spigot foundation for NeSTS 132kV SC S2 STD support

This drawing is presented in Appendix 2.

6.3. NeSTS 132kV SC S30 STD Support General Arrangement

This drawing is presented in Appendix 3.

6.4. Flange foundation for NeSTS 132kV SC S30 STD support

This drawing is presented in Appendix 4.

7. Test Programme

7.1. Expected Test Date

Design testing is planned for January 2020. Sample testing has not yet been specified.

7.2. Foundations for the Test Supports

Construction of reinforced concrete spigot and flange foundations is planned in Autumn 2019. Should a contracted Test Facility be unable to accommodate reinforced concrete spigot foundations, steel spigot fabrications with adapter plates to suit Test Facility foundations will be supplied.

7.3. Method of load application

< test contractor information >

7.4. Test rigging and attachment details

< test contractor information >

7.5. The position of the dynamometers and/or load cells and the position of angle transducers in the case of resultant load applications.

< test contractor information >

7.6. Strain Gauging

The use of strain gauges to monitor the performance of cross arm and foundation connections is required. Suitably configured and positioned tri axial strain gauge rosettes shall be used to monitor some of the key design aspects, and to allow computation of Von Mises stress. Strain gauges should be deployed in the locations listed in Table 1.

Key design aspect	Location of strain gauge(s)	Comments
Cross arm vang plates	50mm inside stiffener plates on side of vang adjacent to bolted joint.	Tri axial gauge rosettes in two locations
Pole walls adjacent to vang plates	50mm spaced laterally from top and bottom extent of vang on the tube wall.	Tri axial gauge rosettes in two locations
Foundation connection	100mm above spigot top, on tube under, and in line with, single cross arm connection. OR 100mm above flange gussets on tube under, and in line with single cross arm connection.	Tri axial gauge rosette.

Table 1: Locations of Strain Gauges

7.7. Deflection Monitoring

Monitoring of deflection is required. Deflection monitoring points are shown in Table 2

Element	Monitoring points	Comments
Principal pole	P-1	Pole top (end)
Crossarm	X-1	End of middle crossarm

Table 2: Deflection Monitoring Points

7.8. Weld Testing

Welds shall be tested in accordance with the National Structural Steelwork Specification. Testing shall include visual inspection to BS EN 17637:2016, and may include non-destructive magnetic particle testing to BS EN 17638:2016 and/or ultrasonic testing to BS EN 17640:2018 by prior agreement with the Client.

All welds shall be visually inspected by an appropriately qualified, capable and experienced person before testing and after completion.

Magnetic particle or ultrasonic testing of all structural welds shall be carried out prior to testing and on completion of testing. Welds that are considered to be structural in this context include those at these junctions;

- Crossarm box to crossarm end plate
- Crossarm end plate to end plate returns (unless returns are bend formed)

- Stay attachment plate to crossarm box
- Stay attachment vang to pole
- Crossarm vang to pole
- Crossarm vang to circumferential stiffener
- Seam welds to tubes (bottom 500 mm only)

7.9. Test Loads

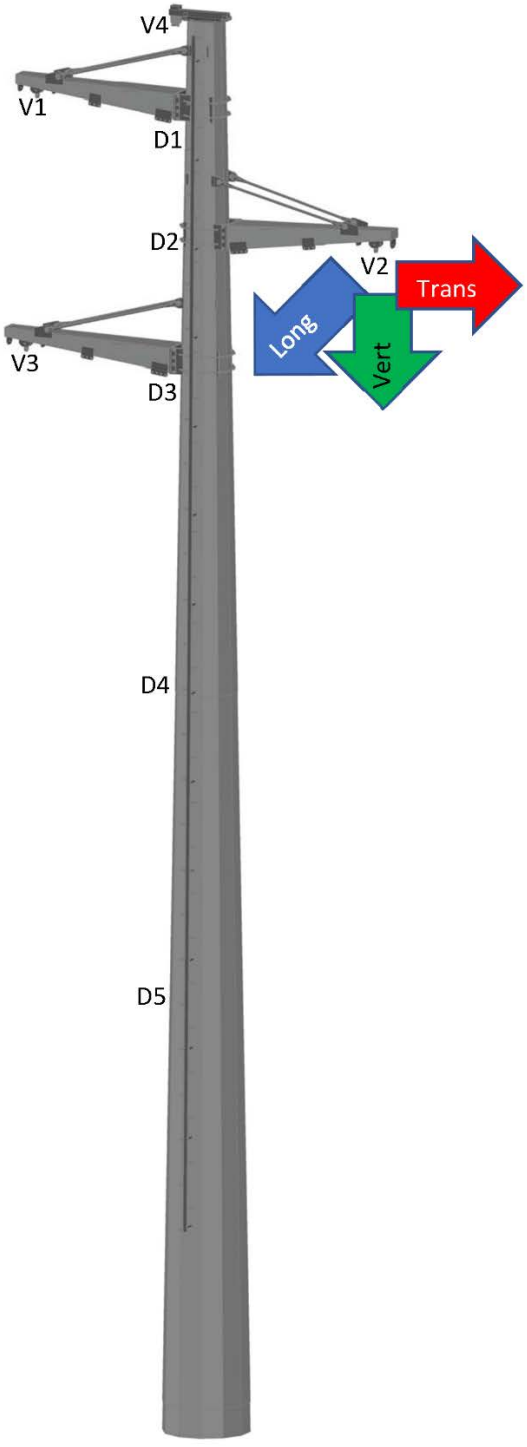
The design loads for the NeSTS 132kV SC S2 STD structure are presented in Appendix 5: NeSTS 132kV SC S2 STD Design Load Schedule & Foundation Reactions.

The design loads for the NeSTS 132kV SC S30 STD structure are presented in Appendix 6: NeSTS 132kV SC S30 STD Design Load Schedule & Foundation Reactions.

Test loads are to be the Design Loads, but increased by a factor of 1.0

Vertical test loads are to be applied in 5 equal increments, followed by application of the transverse and longitudinal components, again in 5 equal increments. Loading shall be maintained for a minimum of 5 minutes or until all monitoring activities have been completed for the loading stage.

7.9.1 NeSTS 132kV SC S2 STD Load Cases – all loads presented in kN



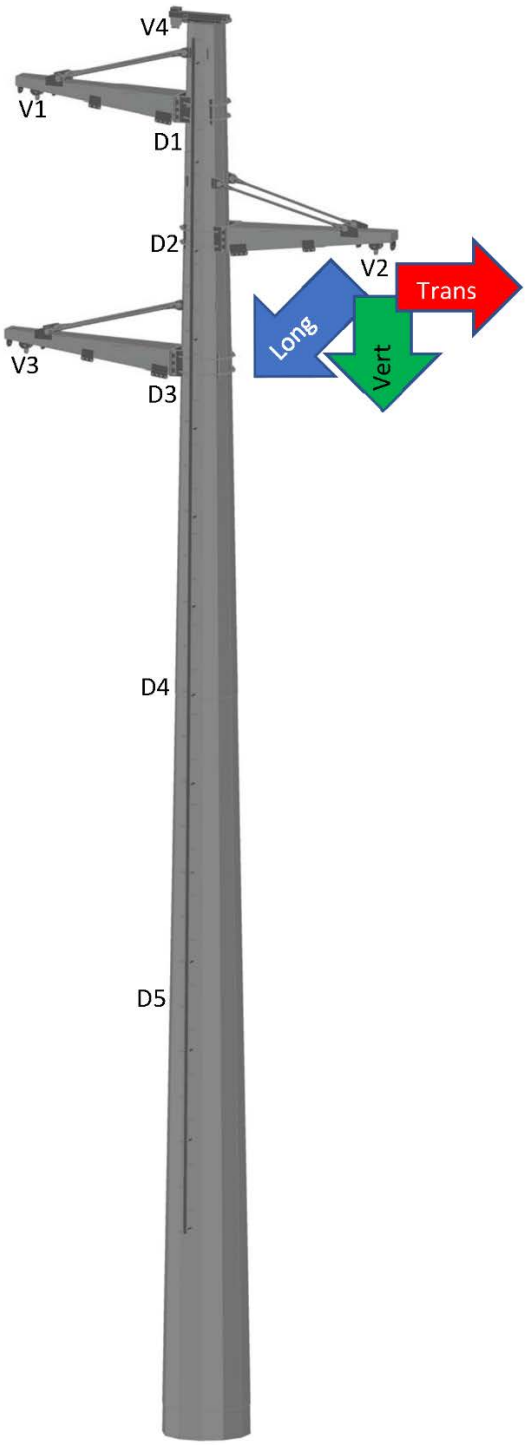
7.9.1.1	1#25-500-1 2a,C Global		
Attach Point	Long Load	Vert Load	Trans Load
V1	-0.1	47.9	3.5
V2	-0.1	47.8	3.5
V3	-0.1	47.8	3.5
V4	0	48.8	3.4
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-1	-317	-15	15	-6	0	514	514



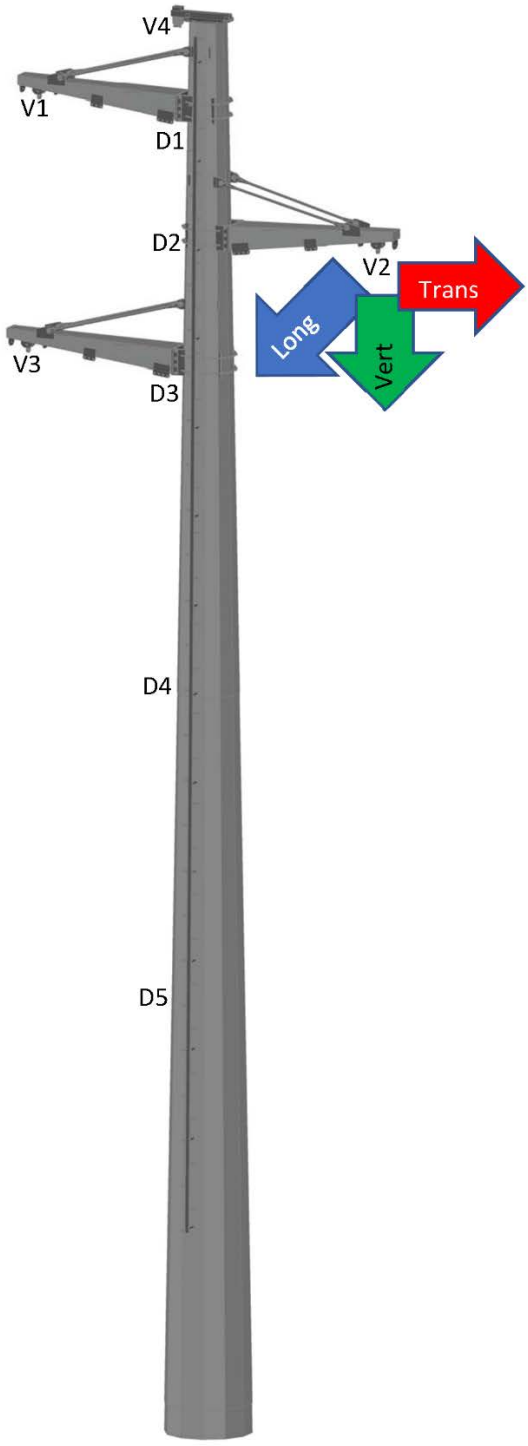
7.9.1.2	2#38-750-1 3a 180,C Global		
Attach Point	Long Load	Vert Load	Trans Load
V1	-2.3	25.3	35.7
V2	-3.7	25.3	34.9
V3	-4.0	25.2	34.0
V4	-2.7	24.7	33.6
D1	0.0	0.0	5.7
D2	0.0	0.0	4.5
D3	0.0	0.0	7.9
D4	0.0	0.0	12.1
D5	0.0	0.0	22.5

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
13	-225	-193	193	-269	-10	3709	3719



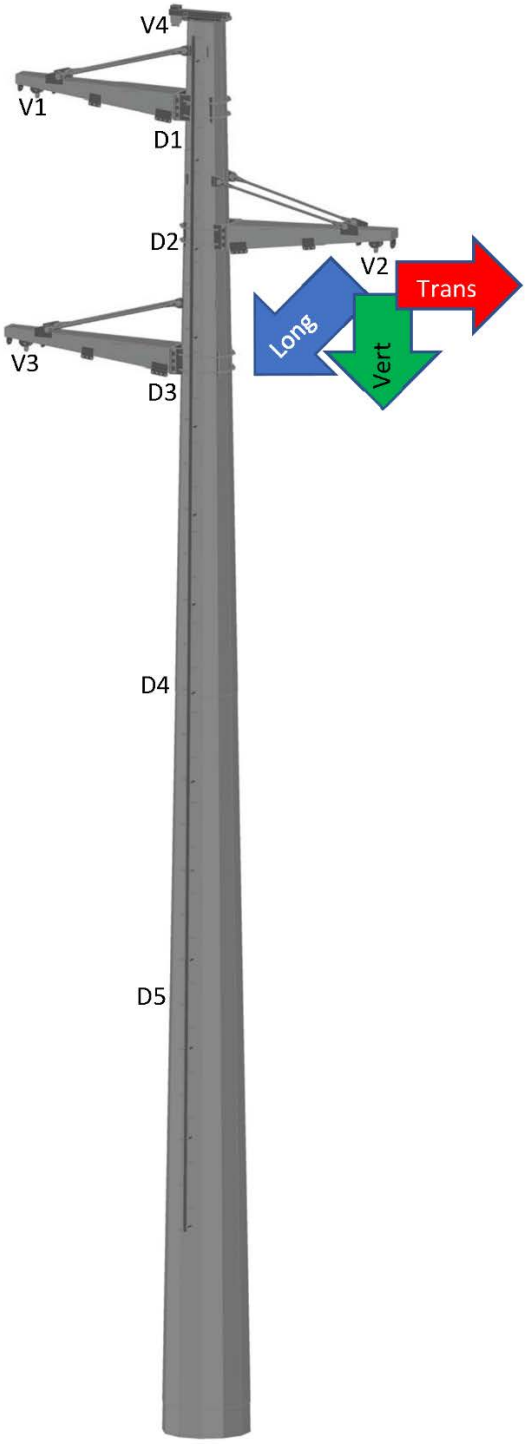
7.9.1.3	8#4-750-4 5a1 T A 1,C NA+		
Attach Point	Long Load	Vert Load	Trans Load
V1	21.2	1.7	0
V2	0	2.8	0
V3	0	2.8	0
V4	0	2.0	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-22	-100	-1	22	-495	65	25	496



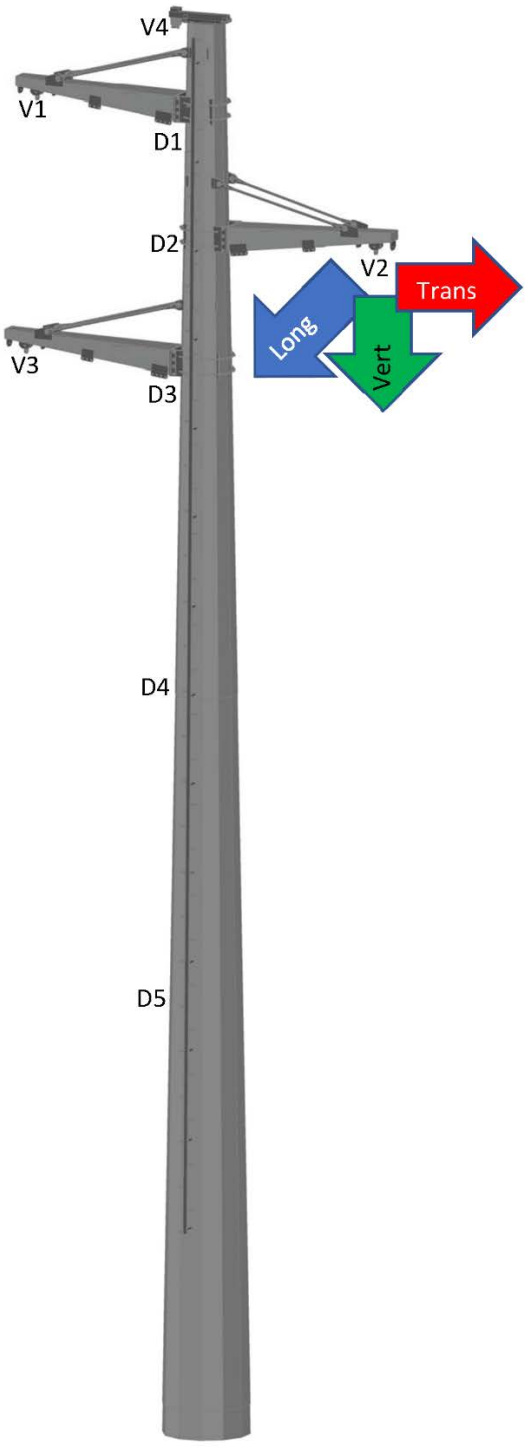
7.9.1.4	8#5-750-4 5a1 M A 1,C NA+		
Attach Point	Long Load	Vert Load	Trans Load
V1	0	2.8	0
V2	21.2	1.7	0
V3	0	2.8	0
V4	0	2.0	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-22	-100	-1	22	-449	-64	32	450



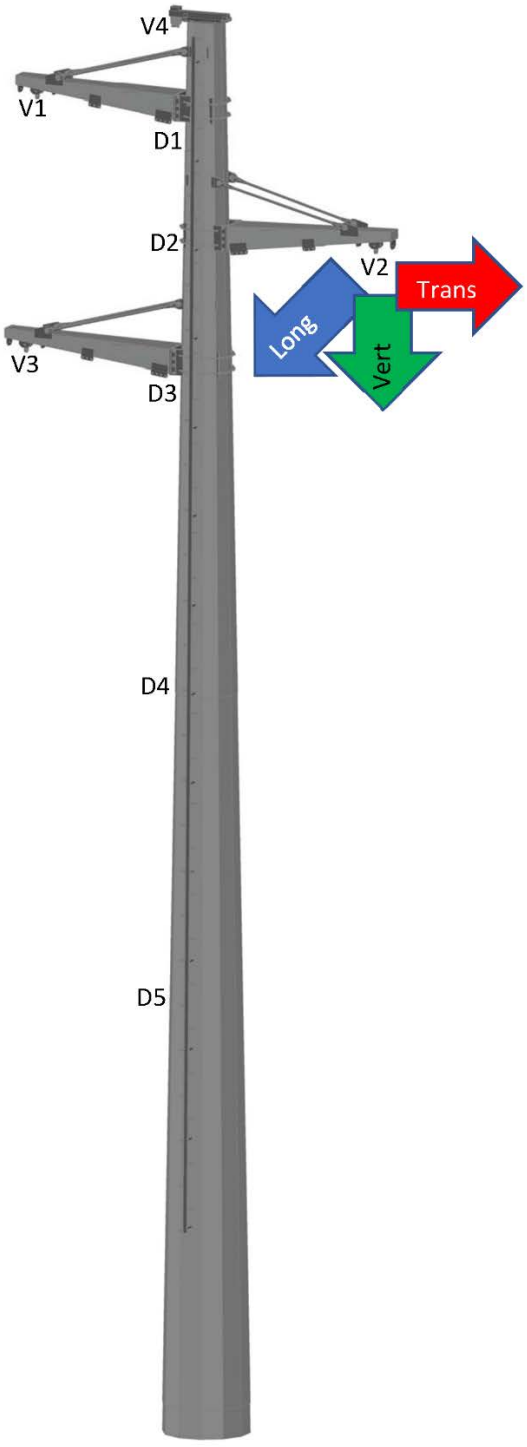
7.9.1.5	8#6-750-4 5a1 B A 1,C NA+		
Attach Point	Long Load	Vert Load	Trans Load
V1	0	2.8	0
V2	0	2.8	0
V3	21.2	1.7	0
V4	0	2.0	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-22	-100	-1	22	-403	-64	25	404



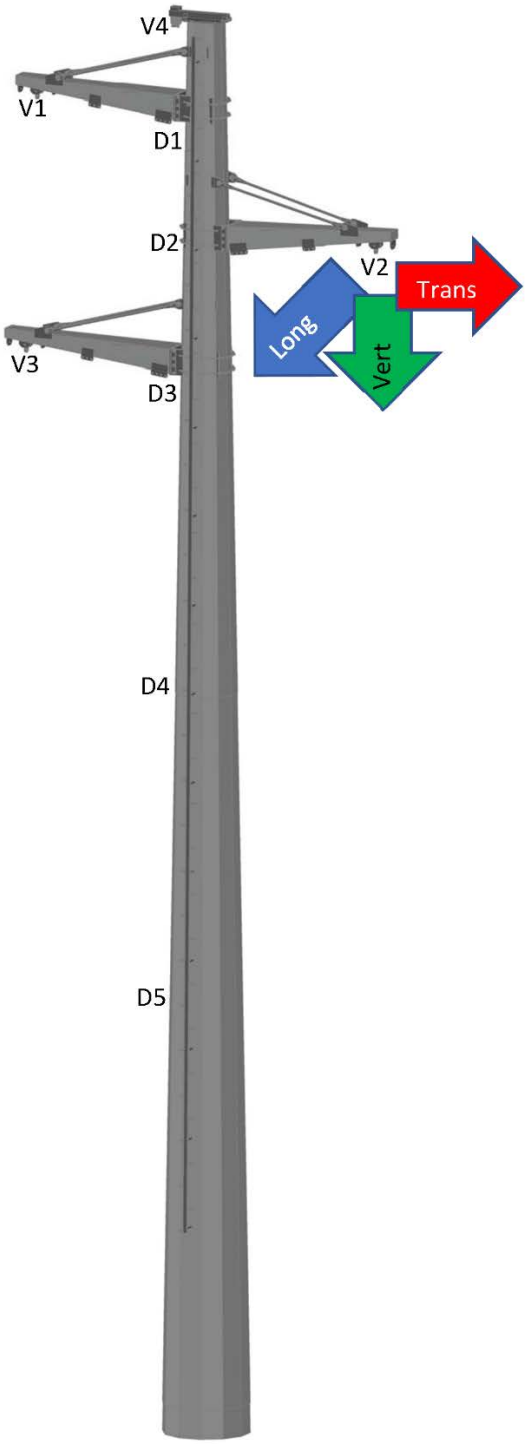
7.9.1.6	8#6-750-4 5a1 B A 1,C NA+		
Attach Point	Long Load	Vert Load	Trans Load
V1	0	2.8	0
V2	0	2.8	0
V3	21.2	1.7	0
V4	0	2.0	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-10	-165	0	10	-221	30	198	296



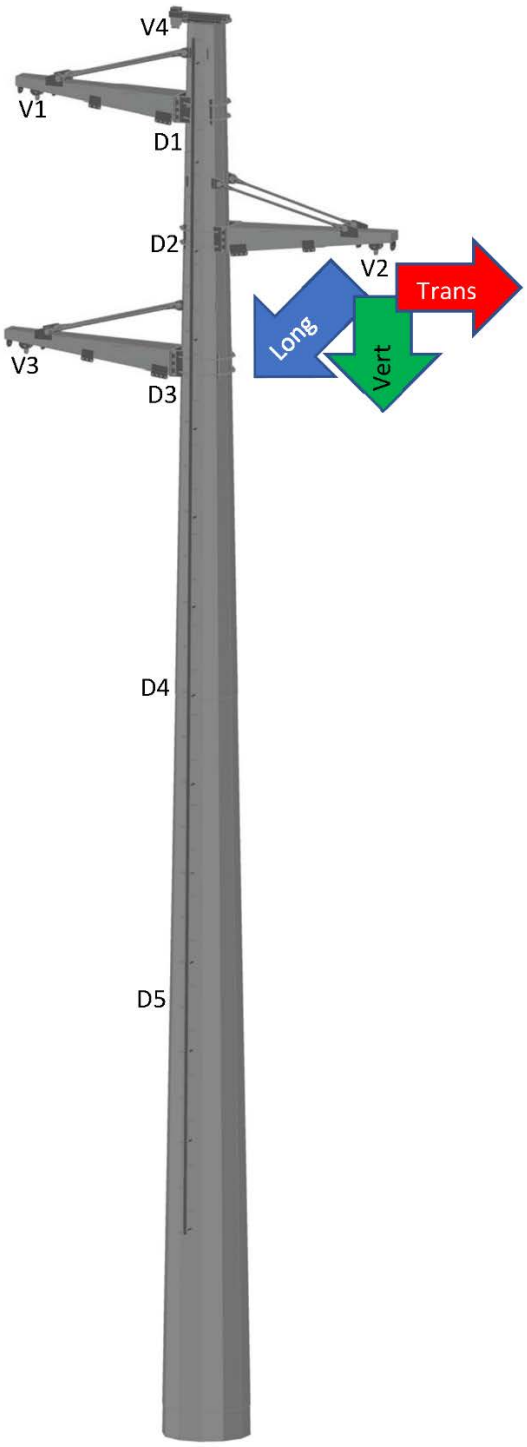
7.9.1.7	9#5- -5 4a C&M loads MXarm BS		
Attach Point	Long Load	Vert Load	Trans Load
V1	0	8.1	0
V2	9.6	58.7	0
V3	0	8.1	0
V4	0	7.4	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-10	-165	0	10	-199	-29	-118	232



7.9.1.8	9#6- -5 4a C&M loads BXarm BS		
Attach Point	Long Load	Vert Load	Trans Load
V1	0	8.1	0
V2	0	8.1	0
V3	9.6	58.7	0
V4	0	7.4	0
D1	0	0	0
D2	0	0	0
D3	0	0	0
D4	0	0	0
D5	0	0	0

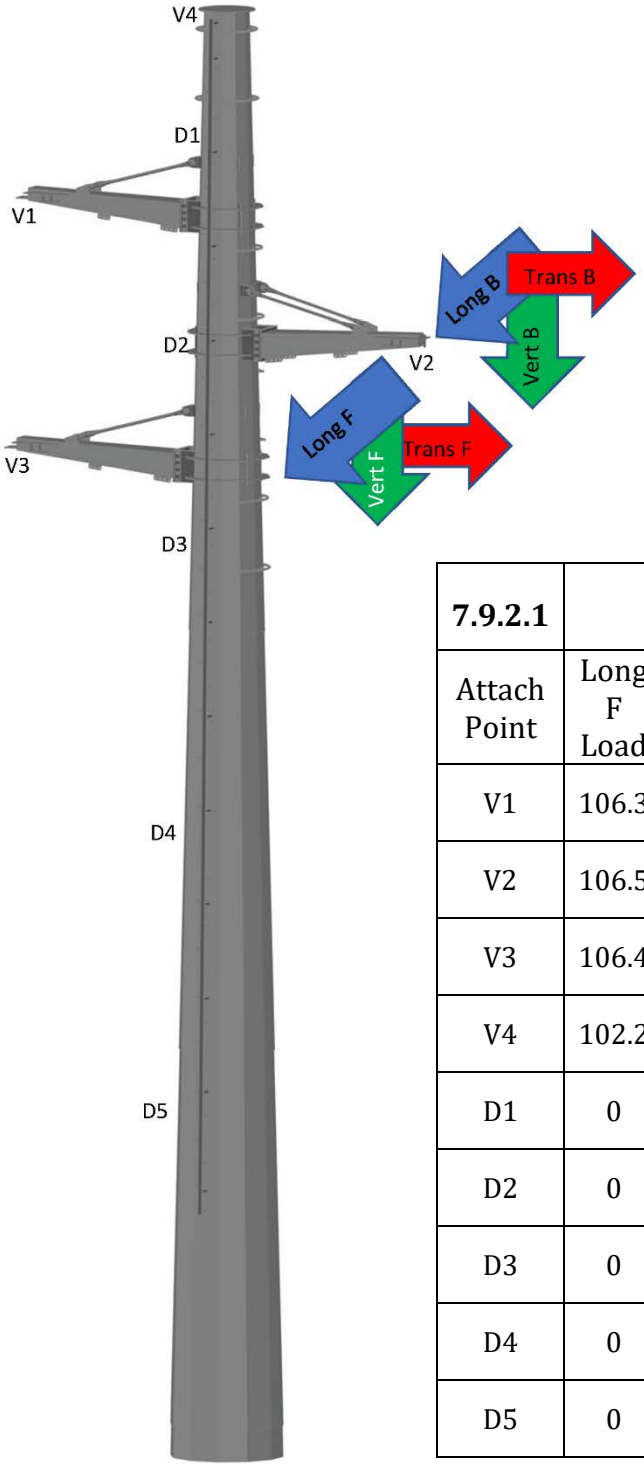
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2.3m
D2 = pole top – 4.3m
D3 = pole top – 7m
D4 = pole top – 12m
D5 = pole top – 18m

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-10	-165	0	10	-178	32	208	274

7.9.2 NeSTS 132kV SC S30 STD Load Cases – all loads presented in kN



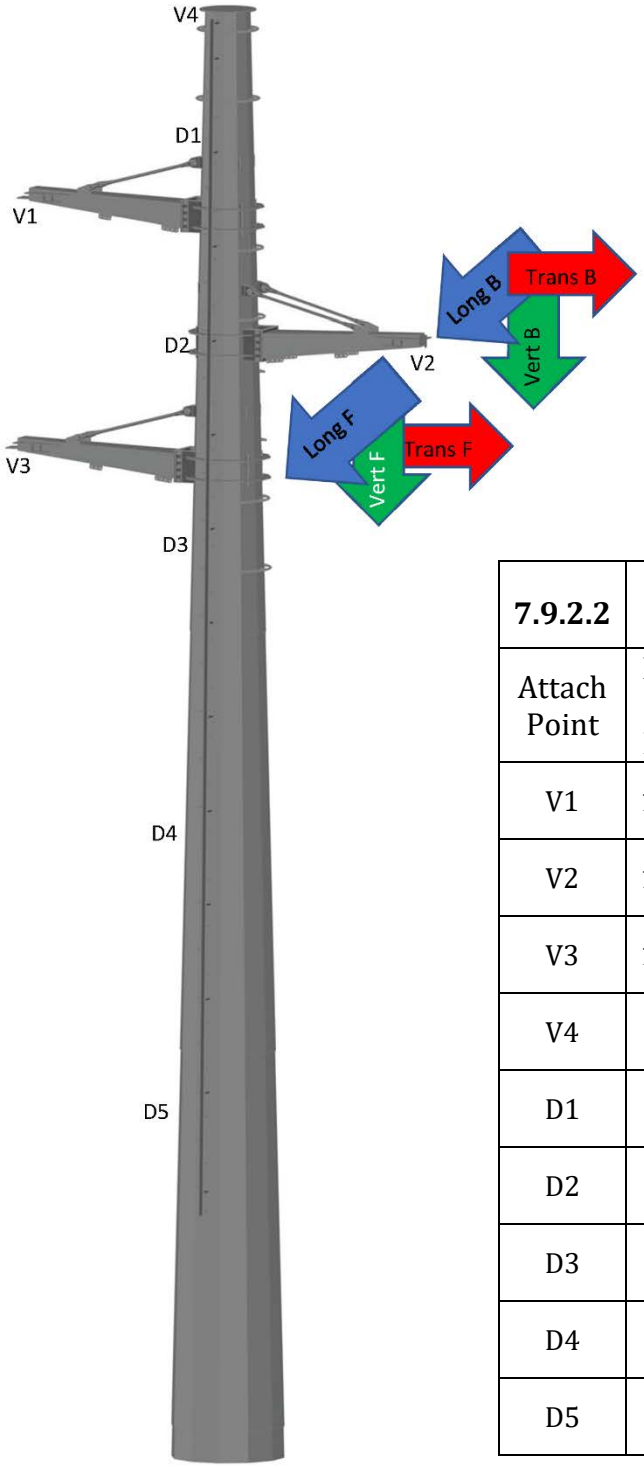
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.1	02#25-500-1R 2a,C Global					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	106.3	-104.4	35.6	20	28.5	28
V2	106.5	-105.6	35.6	19.9	28.5	28.3
V3	106.4	-106.5	35.5	19.9	28.5	28.5
V4	102.2	-100.8	36.9	20.7	27.4	27.0
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-5	-409	-225	225	-105	3	4560	4561



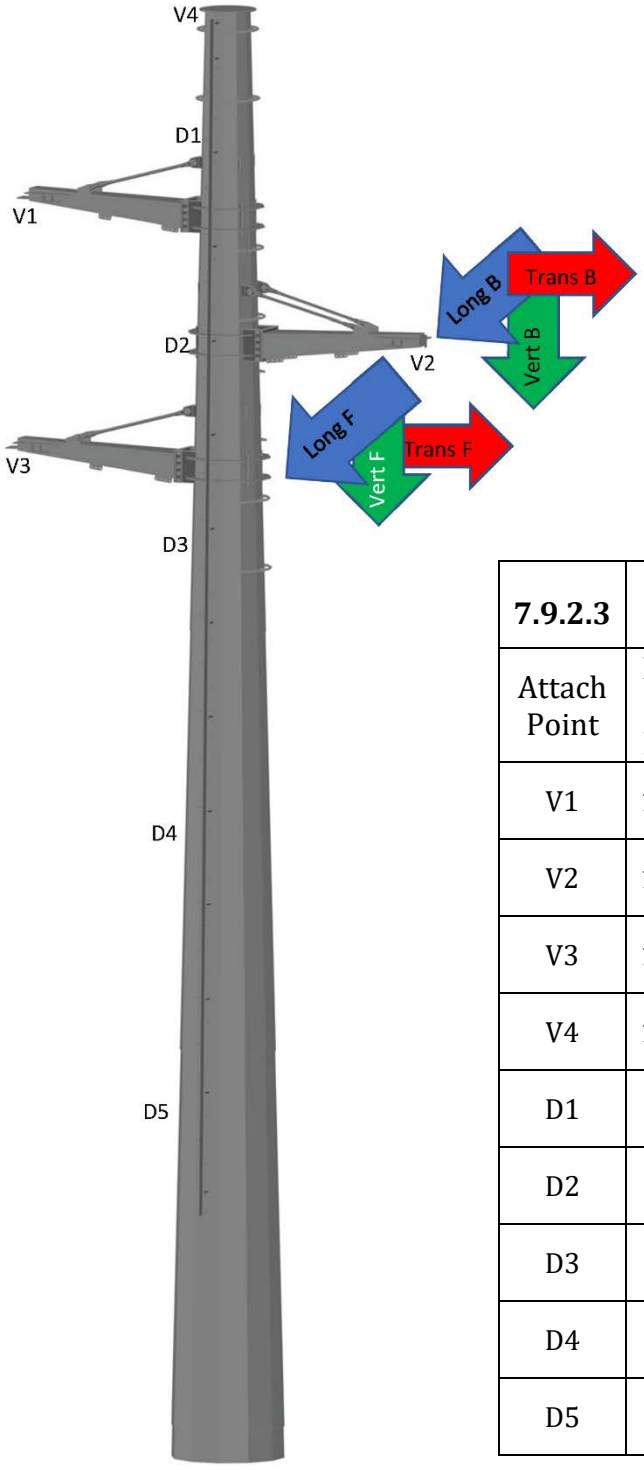
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.2	**04#38-750-1R 3a 180,C Global**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	101.6	-107.0	18.4	10.7	57.0	46.9
V2	101.9	-107.1	18.4	10.7	56.6	46.6
V3	102.3	-107.3	18.3	10.7	56.0	46.3
V4	95.8	-101.5	18.4	10.8	56.4	46.0
D1	0		0		9.7	
D2	0		0		11.1	
D3	0		0		12.0	
D4	0		0		14.7	
D5	0		0		22.7	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
21	-302	-489	490	411	-24	8914	8924



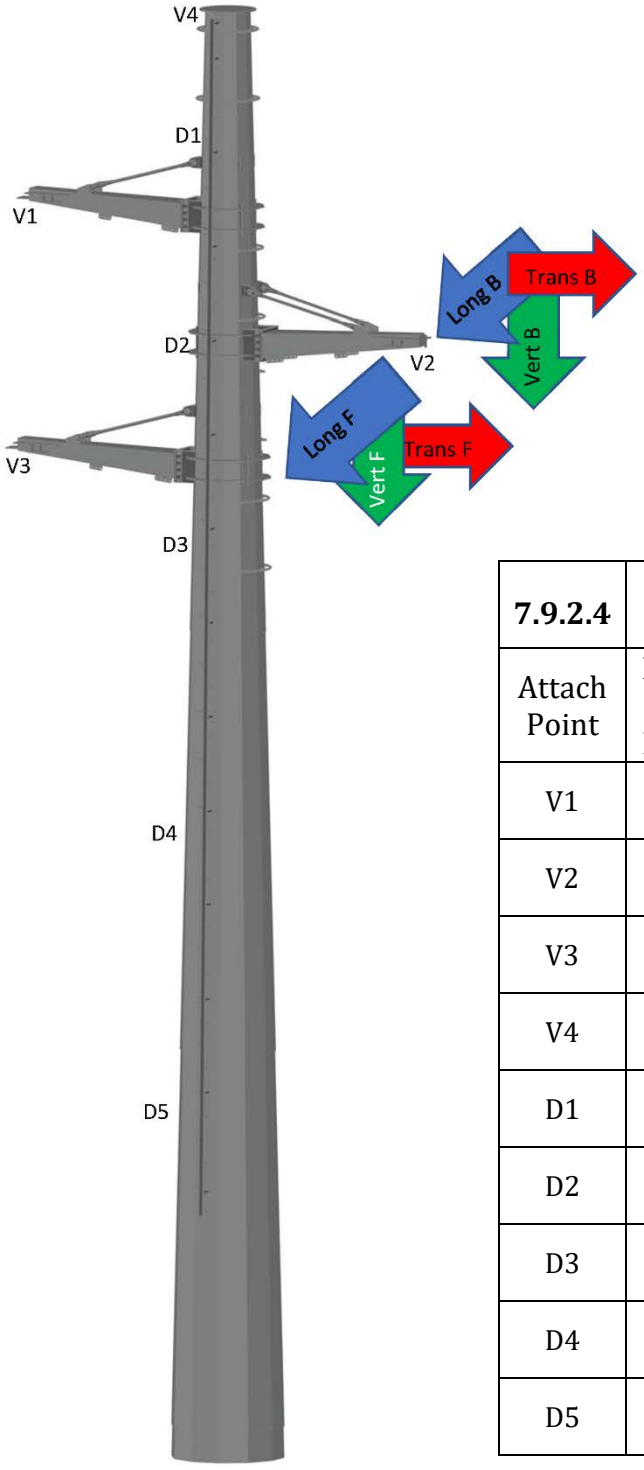
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.3	**10#1-500-3R 2a,C Global**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	106.1	-103.2	38.1	17.4	28.4	27.7
V2	106.5	-104.4	38.1	17.4	28.5	28.0
V3	106.4	-105.7	38.0	17.4	28.5	28.3
V4	102.2	-99.7	39.5	18.1	27.4	26.7
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-9	-409	-224	224	-187	4	4536	4540



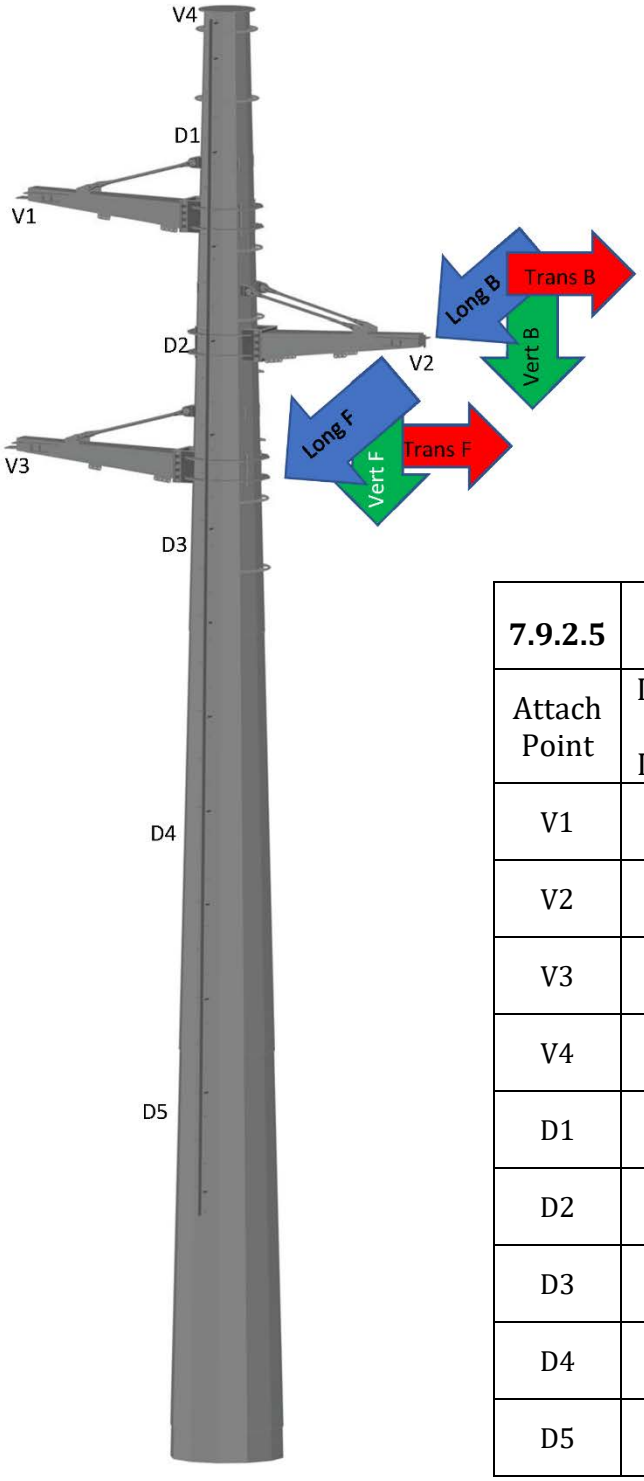
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.4	**15#14-750-4L 5b+ T A,C NA+**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	62.2	0	6.6	0.5	-8.0	1.4
V2	63.0	-63.0	6.6	6.6	-8.4	-8.4
V3	63.9	-63.9	6.6	6.6	-8.8	-8.8
V4	57.6	-57.6	6.5	6.5	-6.6	-6.6
D1	0		0		3.7	
D2	0		0		4.2	
D3	0		0		4.6	
D4	0		0		5.7	
D5	0		0		8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-63	-220	25	68	-1257	191	-681	1429



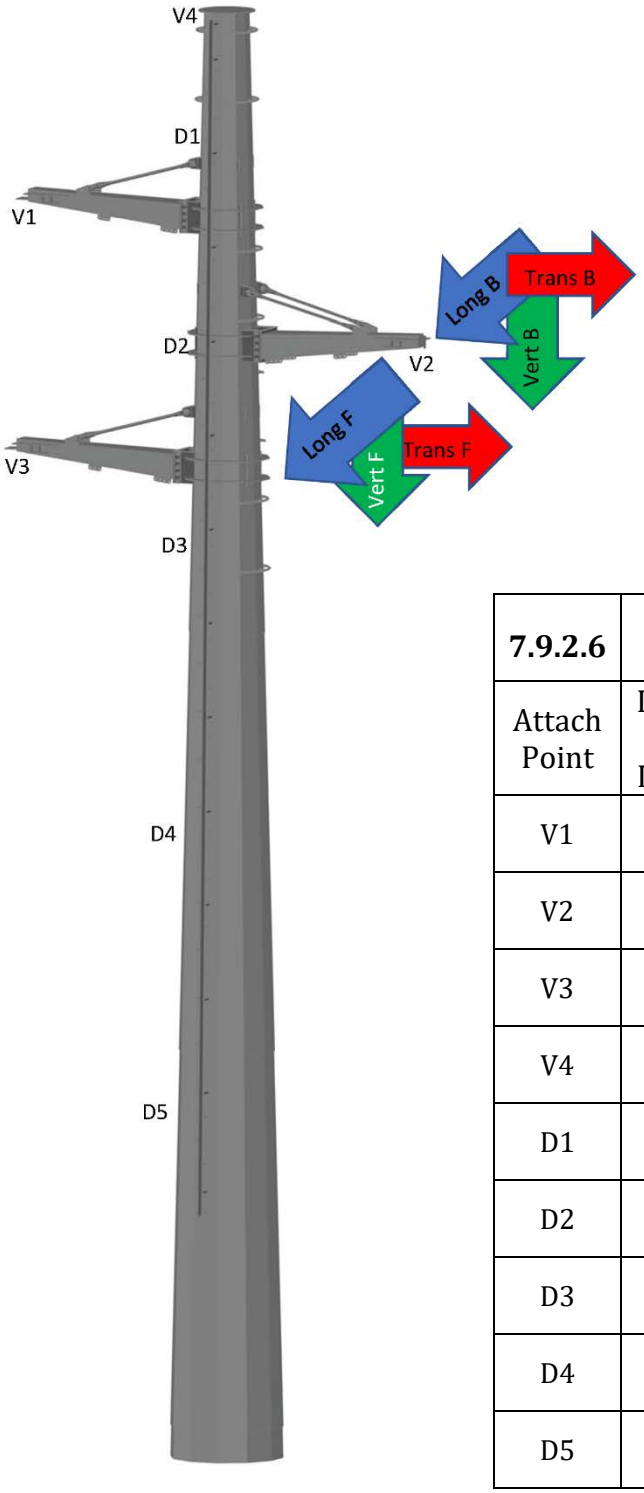
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.5	**15#16-750-4L 5b+ B A,C NA+**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	62.2	-62.2	6.6	6.6	-8.0	-8.0
V2	63.0	-63.0	6.6	6.6	-8.4	-8.4
V3	63.9	0	6.6	0.5	-8.8	1.3
V4	57.6	-57.6	6.5	6.5	-6.6	-6.6
D1	0		0		3.7	
D2	0		0		4.2	
D3	0		0		4.6	
D4	0		0		5.7	
D5	0		0		8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-64	-220	24	69	-1033	211	-708	1252



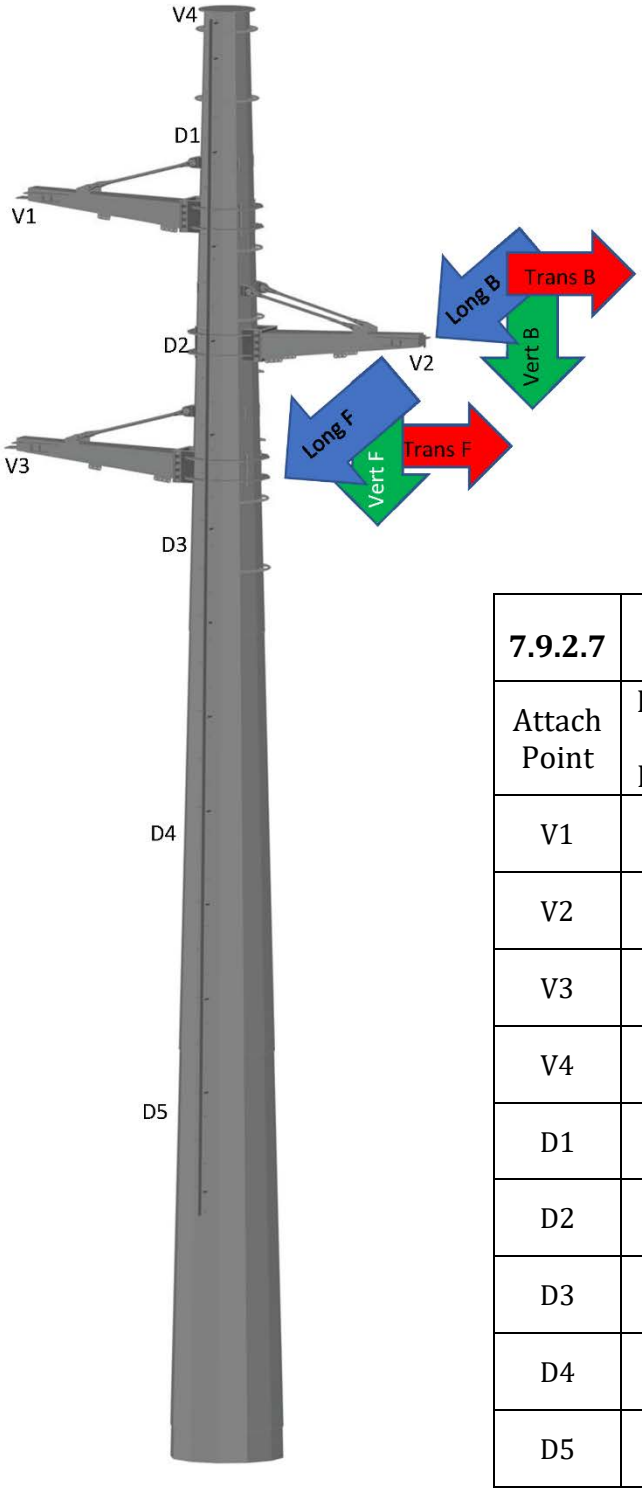
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.6	**15#18-750-4L 5b- T B,C NA-**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	0	-58.5	0.5	6.6	-1.4	-24.3
V2	59.5	-59.5	6.6	6.6	-24.4	-24.4
V3	60.4	-60.4	6.6	6.6	-24.5	-24.5
V4	53.9	-53.9	6.5	6.5	-23.3	-23.3
D1	0		0		-3.7	
D2	0		0		-4.2	
D3	0		0		-4.6	
D4	0		0		-5.7	
D5	0		0		-8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
58	-220	200	208	1172	-182	-3554	3742



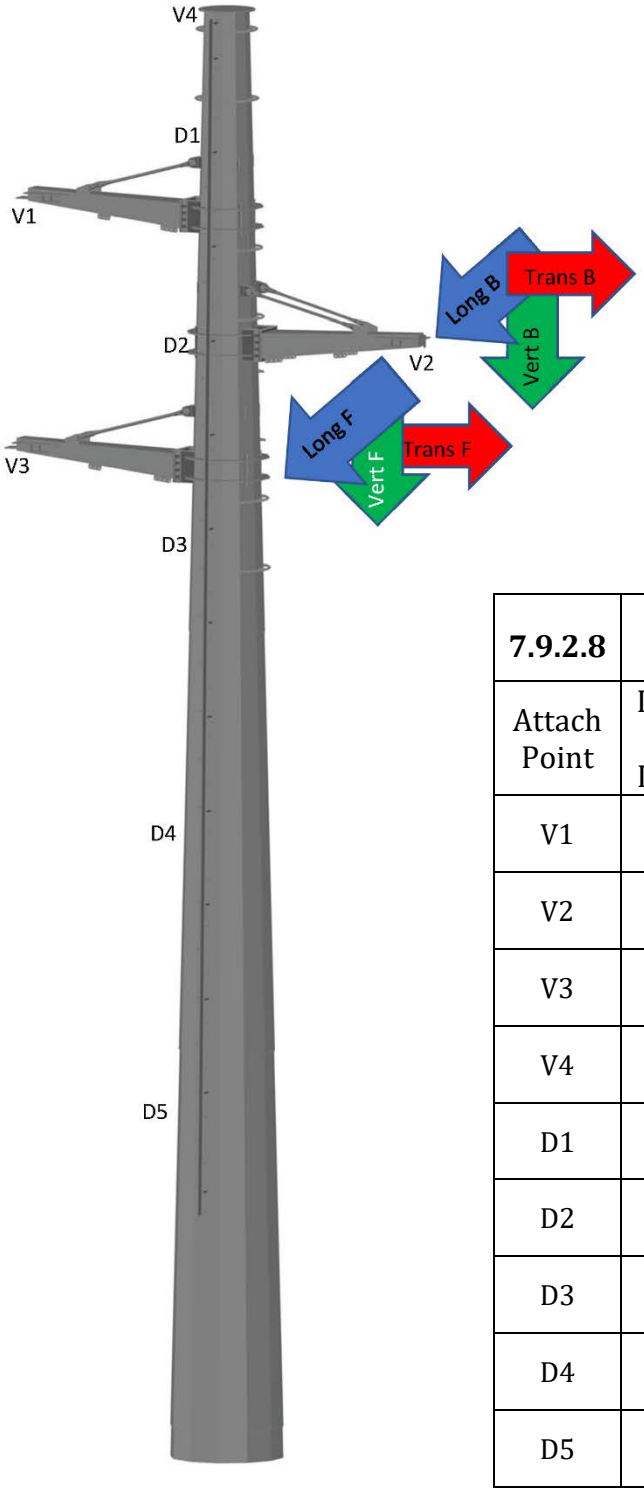
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.7	**16#15-500-1R 5b+ M A,C NA+**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	58.6	-58.6	6.6	6.6	-24.3	-24.3
V2	59.5	-59.5	6.6	6.6	-24.4	-24.4
V3	0.0	-60.4	0.5	6.6	-1.3	-24.5
V4	53.9	-53.9	6.5	6.5	-23.3	-23.3
D1	0		0		-3.7	
D2	0		0		-4.2	
D3	0		0		-4.6	
D4	0		0		-5.7	
D5	0		0		-8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
60	-220	199	208	966	-201	-3645	3771



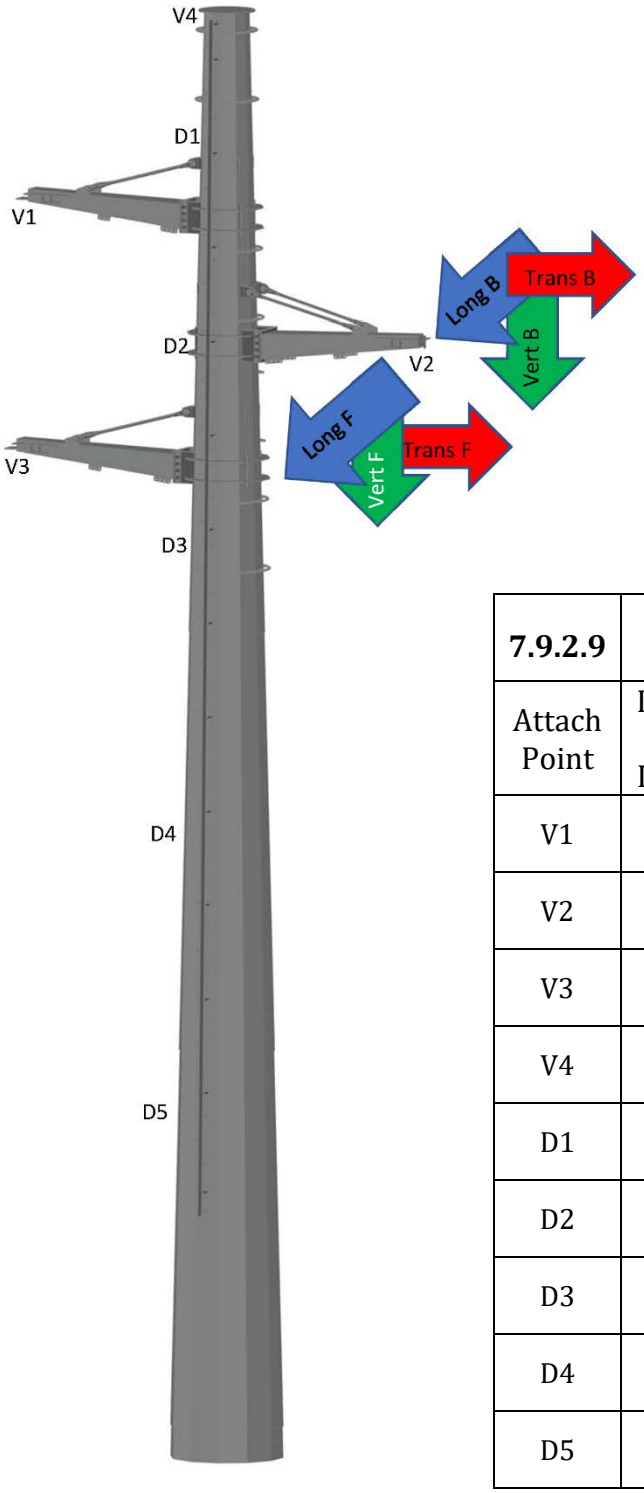
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.8	**16#15-500-1R 5b+ M A,C NA+**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	58.6	-58.6	6.6	6.6	24.3	24.3
V2	59.5	0	6.6	0.5	24.4	1.4
V3	60.4	-60.4	6.6	6.6	24.5	24.5
V4	53.9	-53.9	6.5	6.5	23.3	23.3
D1	0		0		3.7	
D2	0		0		4.2	
D3	0		0		4.6	
D4	0		0		5.7	
D5	0		0		8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-60	-220	-200	208	-1083	-184	3693	3848



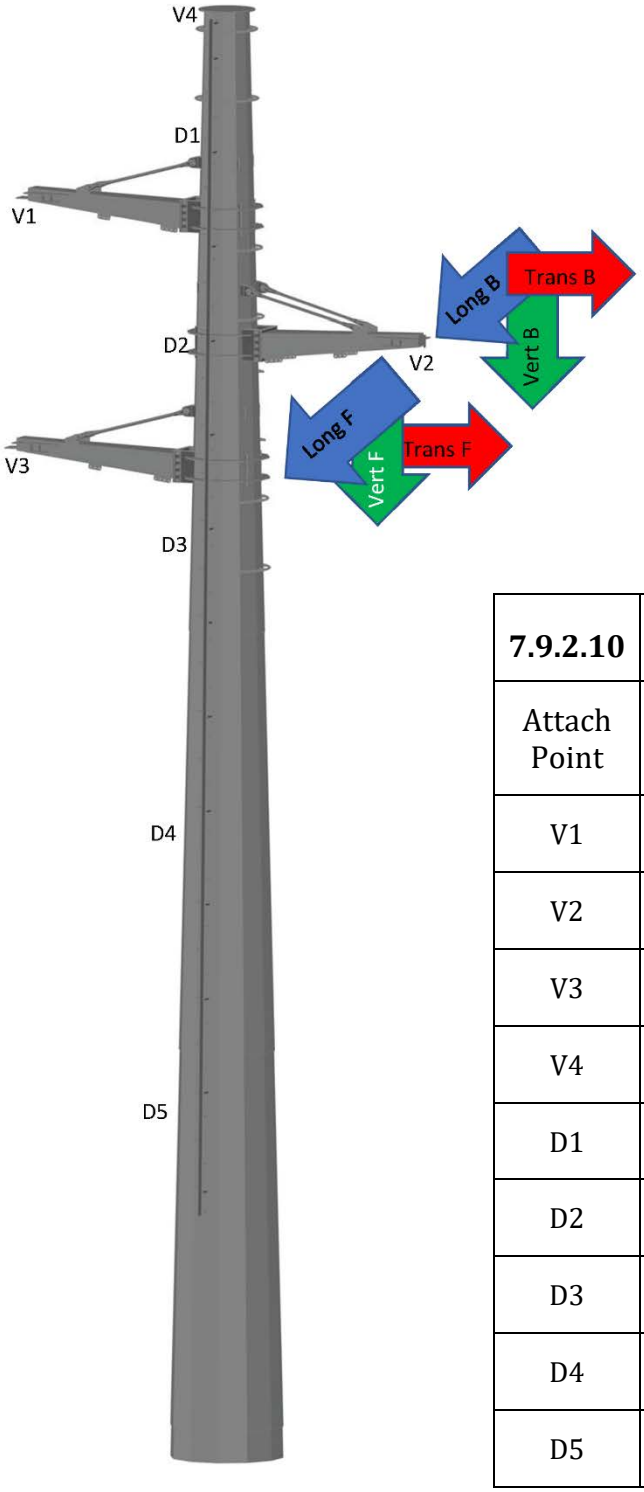
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.9	**16#23-500-1R 5b- M A,C NA-**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	62.2	-62.2	6.6	6.6	8.0	8.0
V2	63.0	0.0	6.6	0.5	8.4	-1.4
V3	63.9	-63.9	6.6	6.6	8.8	8.8
V4	57.6	-57.6	6.5	6.5	6.6	6.6
D1	0		0		-3.7	
D2	0		0		-4.2	
D3	0		0		-4.6	
D4	0		0		-5.7	
D5	0		0		-8.8	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-64	-220	-24	68	-1146	-193	791	1392



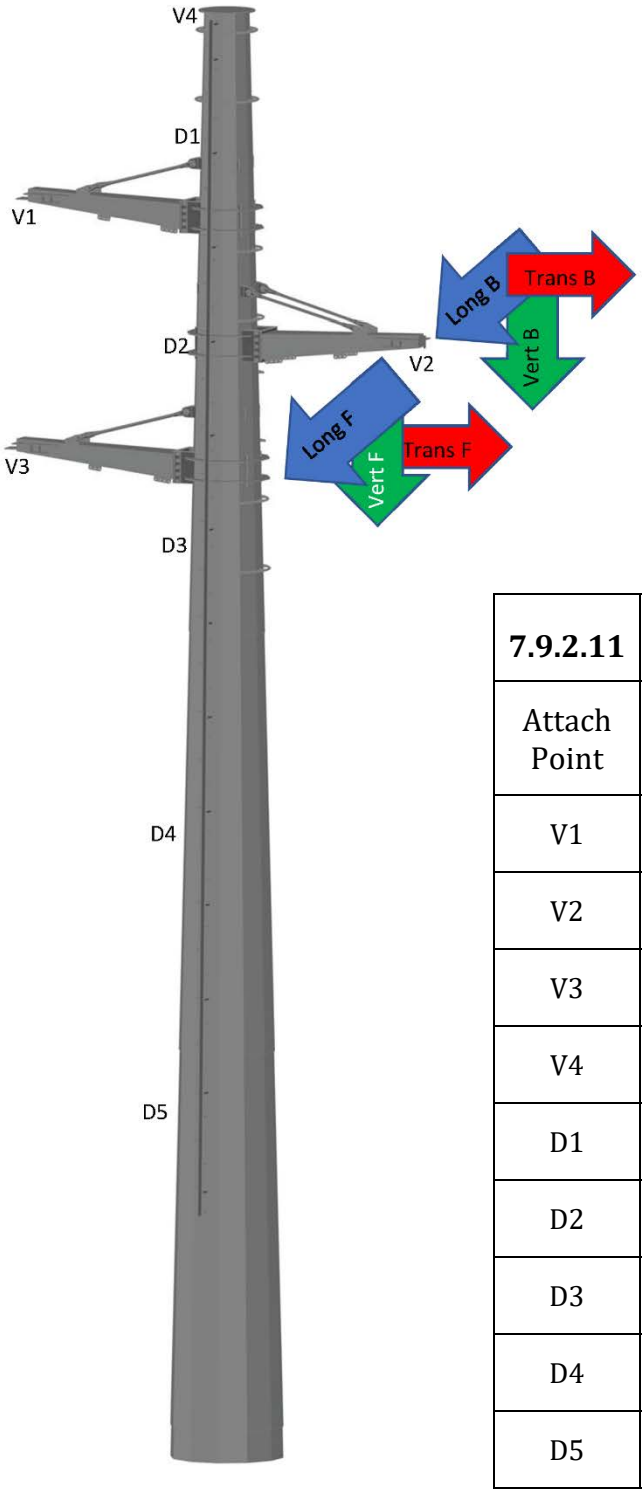
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.10	**17#1- -5R 4b C&M loads TXarm FS L**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	-9.3	0.0	57.9	0.0	44.5	0.0
V2	65.7	-65.7	4.9	3.3	17.6	17.6
V3	65.7	-65.7	4.9	3.3	17.6	17.6
V4	69.6	-69.6	3.0	4.5	18.7	18.7
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
9	-213	-152	153	178	-33	3150	3155



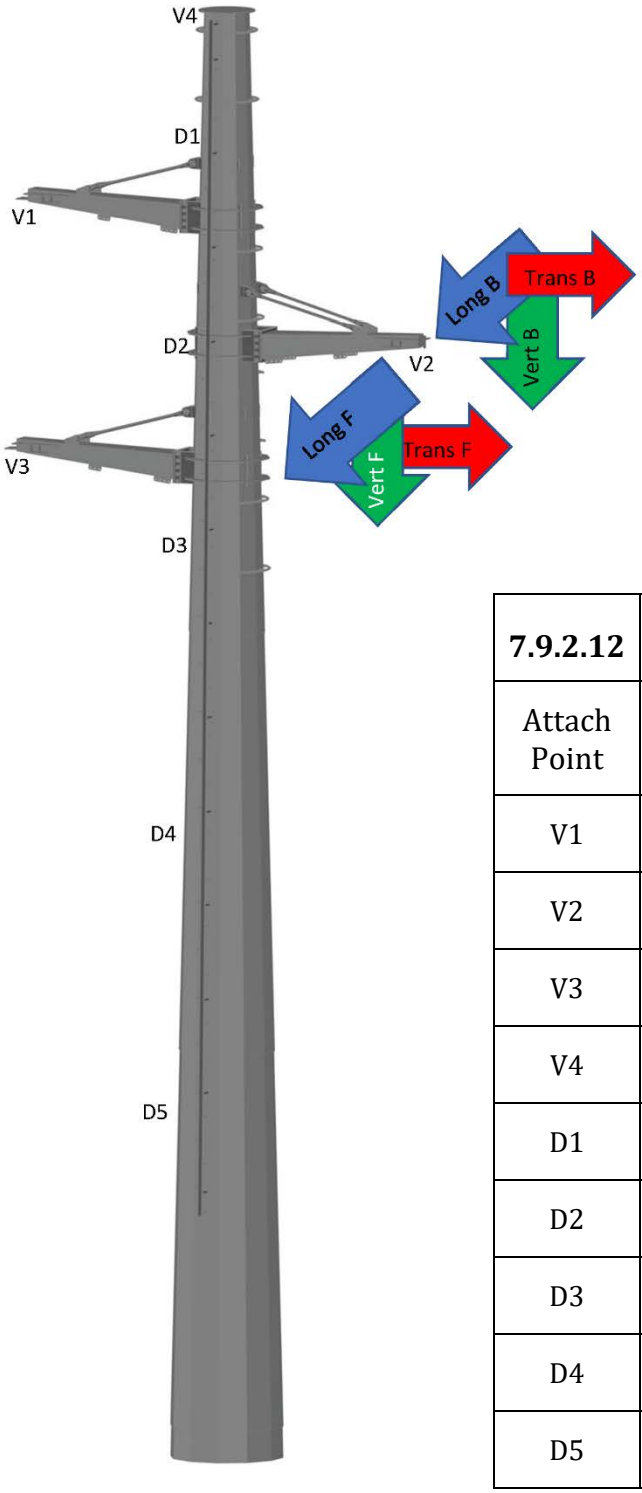
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.11	**17#7- -5R 4b C&M loads TXarm BS L**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	9.3	0.0	58.7	0.0	44.5	0.0
V2	65.7	-65.7	4.9	3.3	17.6	17.6
V3	65.7	-65.7	4.9	3.3	17.6	17.6
V4	69.6	-69.6	3.0	4.5	18.7	18.7
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-9	-214	-152	153	-193	24	3153	3159



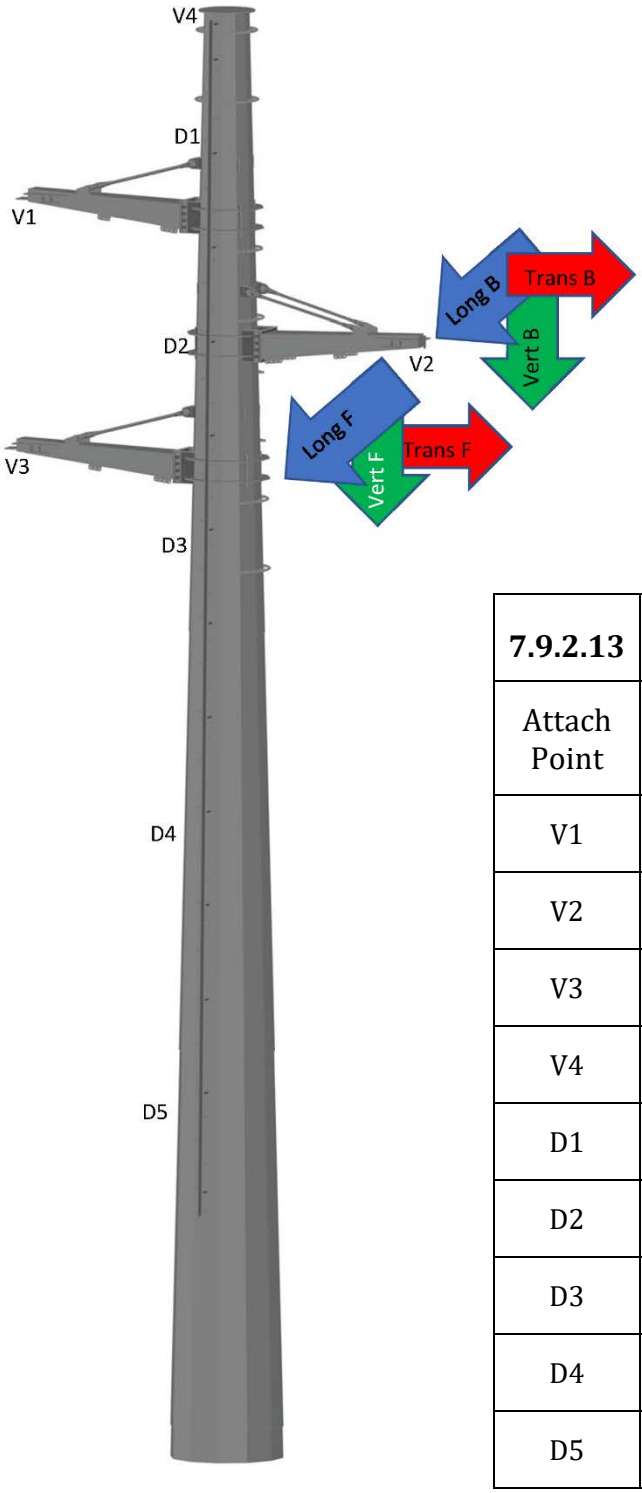
Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.12	**17#11- -5R 4b C&M loads MXarm BS R**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	65.7	-65.7	4.9	3.3	-17.6	-17.6
V2	9.3	0	58.7	0.0	-44.5	0.0
V3	65.7	-65.7	4.9	3.3	-17.6	-17.6
V4	69.6	-69.6	3.0	4.5	-18.7	-18.7
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-9	-214	152	152	-175	-24	-3066	3071



Vector load attachment points shown at wire fitting attachment points.

Direct load attachment points defined at distances below pole top as follows;

D1 = pole top – 2m
D2 = pole top – 6m
D3 = pole top – 10m
D4 = pole top – 14m
D5 = pole top – 19m

7.9.2.13	**17#12- -5R 4b C&M loads BXarm BS R**					
Attach Point	Long F Load	Long B Load	Vert F Load	Vert B Load	Trans F Load	Trans B Load
V1	65.7	-65.7	4.9	3.3	-17.6	-17.6
V2	65.7	-65.7	4.9	3.3	-17.6	-17.6
V3	9.3	0.0	58.7	0.0	-44.5	0.0
V4	69.6	-69.6	3.0	4.5	-18.7	-18.7
D1	0		0		0	
D2	0		0		0	
D3	0		0		0	
D4	0		0		0	
D5	0		0		0	

Foundation Reactions – all forces in kN, all moments in KN-m							
Long Force	Vert Force	Trans Force	Shear Force	Long Moment	Vert Moment	Trans Moment	Bending Moment
-9	-214	152	152	-157	35	-2724	2729

8. Test Report

8.1. Video recording

Continual video recording is required of the test supports during loading and unloading cycles. A minimum of two UHD cameras is required, giving both a longitudinal perspective and a transverse perspective of the complete length of each test support.

Appendix 1: NeSTS 132kV SC S2 STD Support General Arrangement

Appendix 2: Spigot foundation for NeSTS 132kV SC S2 STD support

Appendix 3: NeSTS 132kV SC S30 STD Support General Arrangement

Appendix 4: Flange foundation for NeSTS 132kV SC S30 STD support

Appendix 5: NeSTS 132kV SC S2 Design Load Schedule

Appendix 6: NeSTS 132kV SC S30 Design Load Schedule