

Far North Solar 'The Point'

Solutions Study Report

18-Oct-2024

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Executive Summary

A new solar farm is proposed to be installed 10km southeast of the Twizel township. This solar farm will require a Grid Injection Point (GIP) to link the solar farm to circuit 1 of the Benmore to Islington line (BEN-ISL-A). A new cut-in structure will be installed in-line at the mid-span of structures BEN-ISL-A0083 and A0084 to form a line-in-line-out (LILO) configuration. The proposed structure will be a standard 2DD-HSTC tower with no body extension (BE) and 3m leg extension (LE). The existing Goat ACSR/GZ conductors in the relevant span will be cut to size to form the new spans either side of the new structure T83A.

This report has determined all the internal and external clearances that will be associated with the implementation of the new structure. All external clearances were concluded to be maintained or increased from the existing configuration of the circuit. Internal clearances all meet the requirements as per TP.DL 12.02.

The blowout corridor was found to decrease in all effected spans, therefore no new easement allocation will only be required except for the slack spans as they run perpendicular to the existing alignment.

A geotechnical assessment has been excluded from this report as at the time of submission the Geotechnical data had not yet been collected.

Structural assessments concluded that the existing structures BEN-ISL-A T83 and T84 were overloaded in both the existing and proposed configuration of the line. The overutilisation of the proposed configuration was less than that of the existing, however, further investigation of this is recommended to ensure the structural integrity of these towers. The proposed tower T83A reported a structure usage of 40% in the new configuration.

2 foundation types (pile and Slab & Pedestal) have been considered for the proposed tower T83A.

The construction sequencing for the line concluded that an outage will be required during construction of the new tower. The construction of the foundation for the new tower will also require an outage if the height of equipment exceeds 5m.

The cost of the proposed GIP has been estimated from the Transpower TEES spreadsheet to be \$753,932. The existing and proposed structure were assessed under construction and maintenance loading conditions and found to have a structural utilisation of under 95%. This will however be required to be further investigated depending on the contractor's construction methodology.

1.0 Background & Scope

1.1 Background

This solution study report (SSR) investigates the design of a new cut-in structure proposed to be installed on the Benmore-Islington-A (BEN-ISL-A) line. The new cut-in structure will be installed to serve as a Grid Injection Point (GIP) from the proposed Greenfield substation and 300MW solar farm to be installed 10km southeast of the Twizel township. The new GIP will be installed between structure T83 and T84 of the BEN-ISL line in a line-in line-out (LILO) configuration.

The scope of the project calls for the investigation of 3.5km of the BEN-ISL-A line from T79 to T88. The existing line is a 220kV single circuit with a double overhead earth wire (OHEW) configuration. The tap off structure will be a double circuit structure to accommodate for the LILO configuration while either side of the tap-off remains a single circuit line. The scope includes the creation of PLS TOWER models for the existing structures as well as the investigation of the loadings associated with the proposed and existing structures upon the installation of the GIP. The line will also be checked to ensure all spans within the scope meet the relevant clearance requirements outlined in Transpower standards. Analysis was also completed to ensure the new structure layout falls within the existing blowout corridor.

EPR assessments have been excluded from the scope of this project. It is expected that Transpower will engage a separate engineering consultant (EC) to complete these assessments.

1.2 Line overview

A summary of the BEN-ISL-A line has been included in Table 1 and a single line diagram (SLD) of the circuit as Figure 1.

Table 1 : BEN-ISL-A Line Summary

Line Name	BEN-ISL-A
Model Name	BEN-ISL-A
Circuit Name	BEN-TWL Circuit 1
Length	127.0km (3.5km in scope)
Structure Quantity	333 (9 in scope)
Conductor Type	Duplex Goat ACSR GZ (Existing and Proposed) Duplex Goat ACSR AC (Proposed slack spans)
Operating Voltage	220kV
Max Operating Temperature (MOT)	50°C (Existing and Proposed)
Earth wire	2 x GHSS 7/3.71
Snow/ Ice Zone	S
Wind Zone	A7
Elevation range	0-900m 350-450m (in scope)

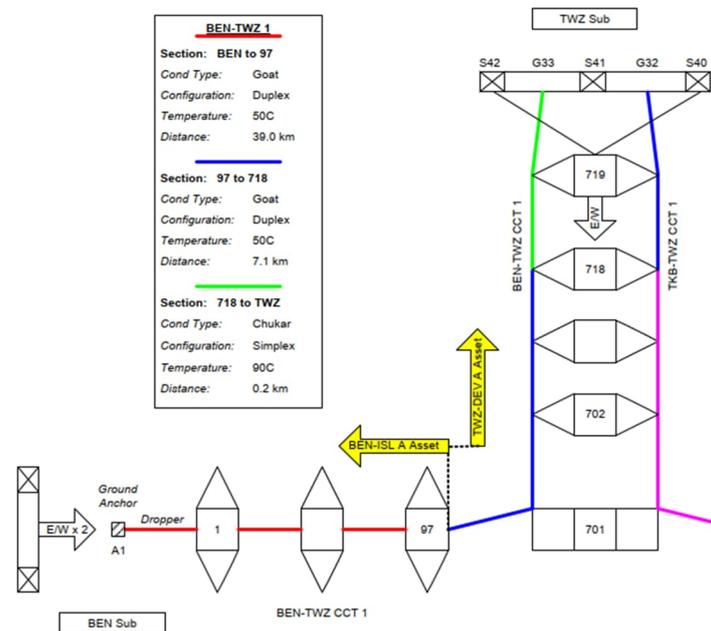


Figure 1: BEN-TWL Circuit 1 SLD

2.0 Inputs & data validation

2.1 Inputs

The following technical inputs were received from Transpower to form the basis for the SSR design models:

- BEN-ISL-A(BEN-T333) als opten 20190123.bak
- 2DD-HSTC Tower Data Input Rev A.xlsx
- 220kV A-FRAME Gantry.bak as per TP65059
- 512a_BEN-ISL-A(BEN-T333)_Temperature 2019.xls
- BEN-ISL-A_T80-T88_RP300yr_Rev0 Loading Criteria.xlsx
- Transpower Database - Insulator sets Rev D6.xlsx

2.2 Design Criteria Document (DCD)

The DCD was compiled to encapsulate the input data for the project using the data specified in section 1.2. This document also details the relevant clearances and loading criteria outlined in TP.DL 12.01 & 12.02. The DCD has been included in Appendix A.

3.0 PLS-CADD & PLS TOWER modelling

3.1 PLS TOWER Modelling

To accurately model the section of line in which the GIP will be installed, the Tower models were required to be created. The section of line within the scope of this project includes 2, C357-D strain structures and 8, C327-A suspension structures. It was assumed that the model could be accurately analysed through insertion of only the neighbouring structures to the new cut-in structure (T83 and T84).

All unaffected spans within the scope of this project remained clipped to keep an accurate representation of these spans in the proposed configuration.

T83 and T84 are both C327-A type structures and thus this M4 structure type was modelled within PLS TOWER software based on drawings extracted from Redeye. The Redeye drawings used to model the Tower are included in Appendix H.

Upon insertion of the PLS TOWER models, the as-built PLS CADD model was checked for consistency with the lidar data for any discrepancies that may be present.

3.2 Weather & Structure load cases

Weather cases and load cases were generated based on the Weather and Load case generator spreadsheet. The Snow Zones were modified to match the zones required by TP.DL. 12.02.

3.3 Generic Wind Speed

After discussion with Transpower, it was determined that site specific wind speeds were not available for the towers within the scope of this report. The wind speeds were ascertained using the standard TP.DL 12.01 WCLC generator spreadsheet. Generic wind speeds were calculated from this spreadsheet by inputting each tower and conductors', centroid height, wind topographical factors, and the average span length. The generic wind speeds were only calculated for existing and proposed Tower's 82, 83A, 83, and 84. This was done as all other towers within the scope would have minimal changes in loading and therefore would not require analysis. The generic structure and conductor wind speeds is summarised in Table 2 and further detailed in Appendix G.

Table 2: Generic Wind Speeds

Structure Number	Centroid of Structure Height (m)	Centroid of Conductor Height (m)	Structure Wind Speed (m/s)	Conductor Wind Speed (m/s)
82	30.04	16.30	57.00	48.84
83	30.04	20.20	57.00	53.16
83A	33.70	20.20	58.00	53.16
84	30.04	16.39	57.00	48.87

***All Structures use a topographical factor of 1.18**

4.0 Design Ideology

After discussion with Transpower it was determined that the proposed tower T83A would be a 2DD-HSTC. The height of the tower was selected based on the clearance requirements of the new spans. It was ascertained that all clearance requirements of the new spans could be satisfied with the lowest variant of the tower. The smallest variant of the 2DD-HSTC tower includes a 0-meter body extension (BE) and 3-meter leg extension (LE). Therefore, a 2DD-HSTC BE0 LE3 was selected.

The new tower T83A will be positioned in line with the existing alignment between structure T83 and T84. Figure 2 and Figure 3 display the plan view of the proposed structures position and a 3D representation of the proposed configuration respectively. This design aligns with the configuration of Arrangement 1 suggested in AECOM's initial proposal.

The gantry structures were proposed to be standard 220kV A-Frames as per reference drawings TP65059. The new gantry structures have been labelled Gantry 1 and Gantry 2 for the purposes of this report as they are yet to be assigned with appropriate asset IDs.

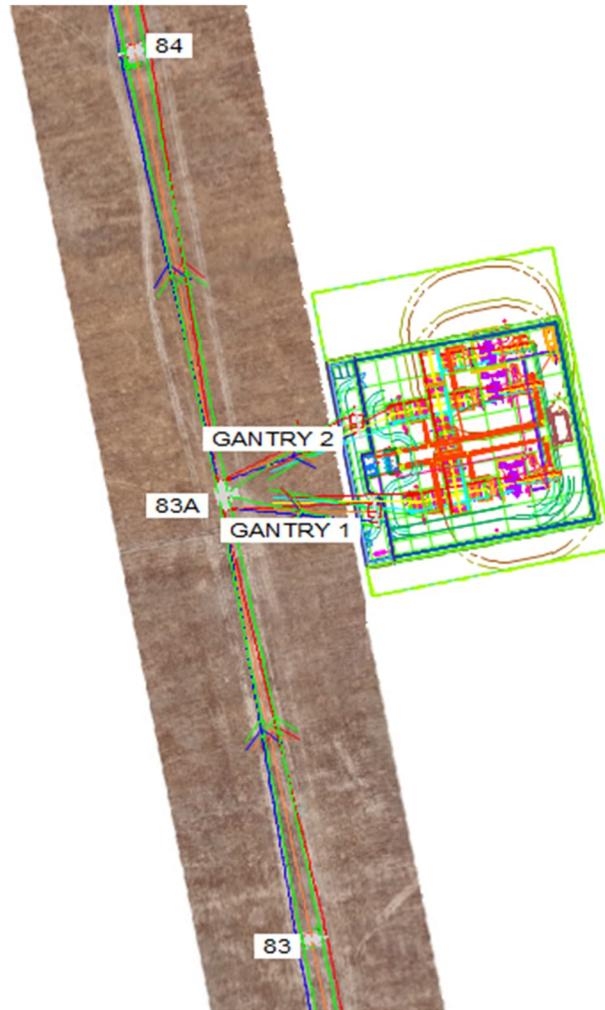


Figure 2: Plan View of New Structure 83A Position.

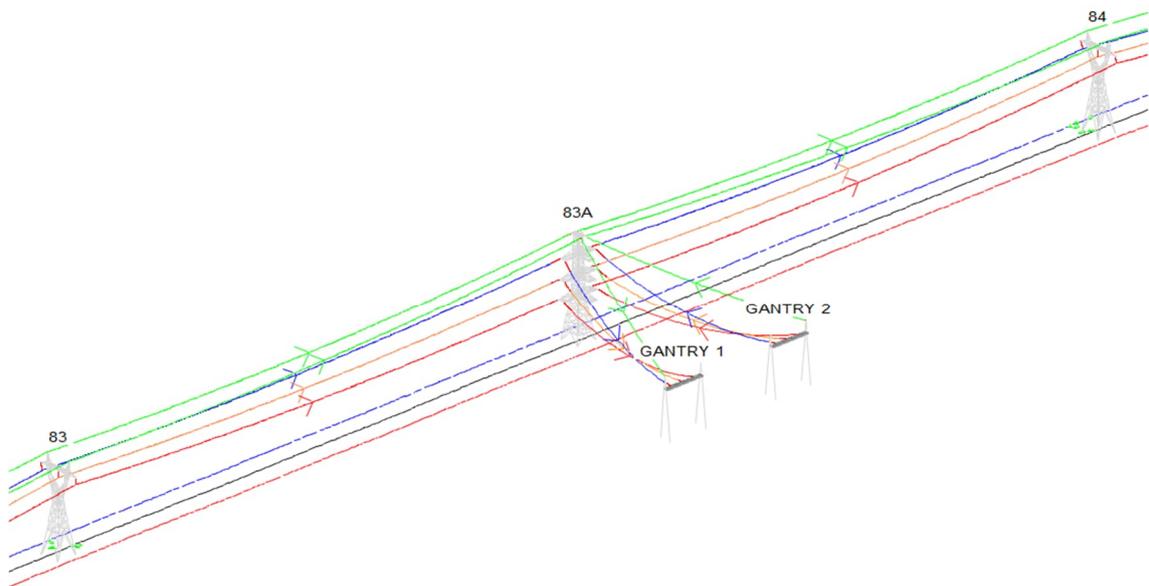


Figure 3: 3D View of Proposed Configuration

4.1 Outage

The decision to keep the structure in the current alignment will result in a longer outage time as the BEN-TWL circuit 1 will need to be de-energised to build the proposed structure. This was deemed acceptable as circuit 1 of Tekapo B to Twizel (TKB-TWZ) line can supply a supplementary feed to the Twizel substation at the time of works as evident in Figure 1. There is another parallel path due to the BEN-TWZ-A line running through Ohau B and C, providing more redundancy.

4.2 Structure Placement/Loading

The placement of the structure being in line with the existing lines is preferred as it means the neighbouring structures will not be required to support the deviation angle that would otherwise be present. Neighbouring structures T83 and T84 will therefore maintain similar transverse loading to the existing configuration. The longitudinal loading was expected to remain similar in the new configuration. The length of the conductor was designed so that horizontal tensions on these structures will remain balanced and therefore keeping the longitudinal load much the same. The length of conductors in the proposed configuration is summarised in Table 18.

4.3 Cut-in Spans

Two slack spans will form the LILO configuration. These spans will be strung with new Goat ASCR AC conductors with single overhead earth wire (OHEW) to connect cut-in structure T83A to the station gantry. The characteristics of these spans have been summarised in

Table 3: Slack span design

Back Structure ID	Ahead Structure ID	Span Length (m)	Conductor Type	Conductor Tension (%UTS)	Earthwire Type	Earthwire Tension (%UTS)
83A	Gantry 1	63	Goat ASCR AC	5	SC/GZ 7 3.71	2.5
Gantry 2	83A					

5.0 External Clearances Assessment

Within the scope of this project the line has no undercrossing lines or structures and therefore no such analysis was necessary.

All required external clearance values include the standard Transpower 0.5m buffer to account for variability in the ground and allow construction tolerances.

5.1 Ground Clearances

The proposed cut-in structure T83A will be placed centrally along the existing alignment. This allows existing conductors in span T83 to T84 to be cut to the required length that ensures clearances are met in the new spans. The conductor length was also designed so clearances were increased in the neighbouring spans. All ground was assumed to be traversable and therefore TP.DL 12.02 specifies a required clearance to ground to be 8m. Tactical thermal uprating (TTU) was also considered. Ground clearances were simulated at 75°C operating temperature to check if the proposed configuration will allow for future uprating.

All clearances at a MOT of 50°C and still air snow loads (SDS) were found to satisfy the required values. When simulated with a MOT of 75°C, slight clearance violations were identified in spans 81 to 82 and 82 to 83. These violations should be further investigated in the instance the line is proposed to be uprated.

A table specifying the additional margin over the required clearances to ground were summarised in Table 4 and fully detailed in Appendix B.

Table 4: Summary of Ground Clearances

Span ID	Clearance Margin Above Required (m)		
	Existing Configuration (50°C)	Proposed Configuration (50°C)	Proposed Configuration (75°C)
79-80	1.56	1.43	0.65
80-81	2.19	2.2	1.45
81-82	0.67	0.69	-0.35
82-83	1.02	0.98	-0.06
83-84	1.3	-	-
83-83A	-	5.93	5.79
83A-GANTRY 1	-	1.63	1.86
GANTRY 2-83A	-	1.69	5.62
83A-84	-	1.92	5.43
84-85	1.32	1.25	0.26
85-86	1.62	1.53	0.61
86-87	1.03	0.98	0.07
87-88	1.03	0.96	0.04

5.2 Roads & tracks

Within the scope of works the line crosses over 3 tracks.

Figure 4 displays a plan view of the identified tracks. These tracks have unsealed road surfaces and therefore were assumed to have a low crossing importance classification. TP.DL 12.02 requires vertical clearance of 8m to a track of this classification. All track crossings have sufficient clearances from the line. A summary of the additional margin above the required clearance to these tracks is outlined in Table 5 and Appendix B.

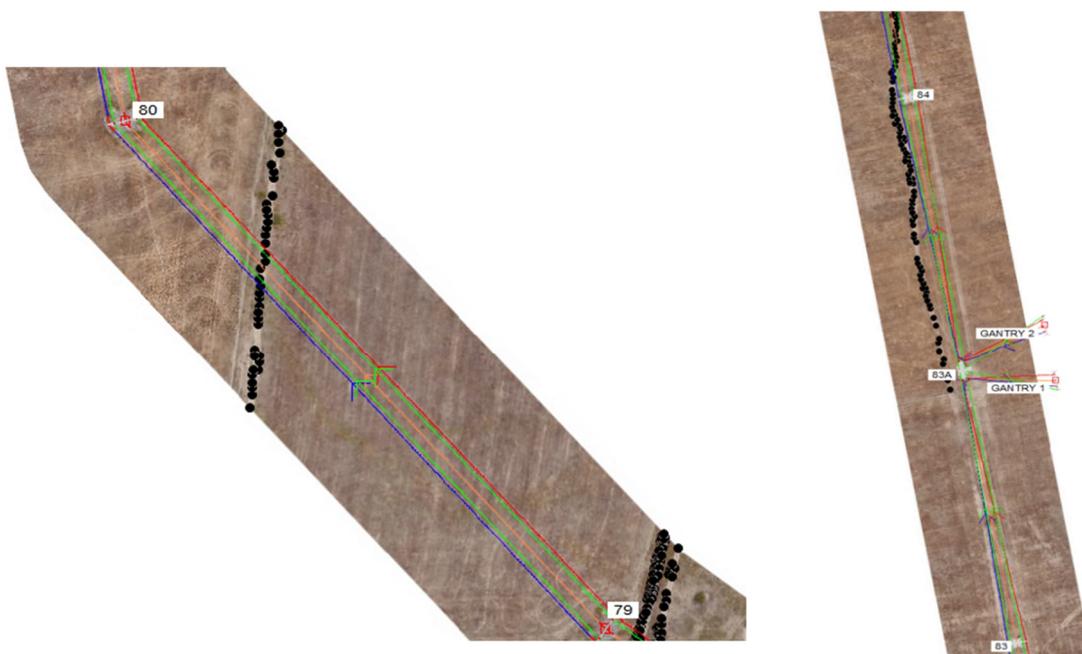


Figure 4: Plan View of Tracks within Scope

Table 5: Clearances to Road Crossings

Span ID	Clearance Margin Above Required (m)	
	Existing Configuration	Proposed Configuration
79-80	2.87	2.82
83-83A	-	6.15
83-84	2.07	-
83A-84	-	6.16
84-85	6.11	6.16

5.3 Vegetation

All clearances to vegetation were considered based on the Lidar data provided. All clearance requirements were met. The presence of any vegetation that may have grown since the lidar data of this area was taken should be confirmed at detailed design stage. This needs to be done to ensure clearance values are maintained upon the construction phase of the project. The available clearance values at each span are published in Table 6 and Appendix B.

Table 6: Clearance to Vegetation

Structure ID	Available Clearance (m)	
	Existing Configuration	Proposed Configuration
79-80	4.07	4.07
80-81	4.44	4.45
81-82	16.03	16.03
82-83	15.55	15.55
83-84	15.46	-
83-83A	-	15.7
83A-84	-	15.65
84	15.5	15.5
85	15.74	15.74
86	13.28	13.28
87	15.63	15.63

6.0 Internal Clearances assessment

The internal clearance assessment was simulated with Jumpers installed between the proposed spans T83 to T83A and T83A to T84 to the terminal spans. These clearances were sufficient however this will be further assessed at the detailed design stage of this project.

6.1 Internal Wire Clearances

Internal wire clearances for phase-to-earth and phase-to-phase were conducted to ensure all requirements as per TP.DL 12.02 are met. The clearance checks yielded no violations. A summary of the clearances achieved has been included in Appendix C.

6.2 Structure Clearances

The clearance of the conductors to each tower was reviewed under everyday deflection (EDD) and High wind (HWD) conditions. Structure clearances were only specified for Tower 83, 83A, and 84 as all other towers in the scope are unchanged from the existing configuration. All clearances met the required values as set by TP.DL 12.02. The structure clearances have been summarised in Table 7 and fully detailed in Appendix C.

Table 7: Wire Clearances to structure

Structure ID	Required Clearance at HWD (m)	Clearance at HWD (m)	Required Clearance at EDD (m)	Clearance at EDD (m)
83	0.75	1.21	1.9	2.16
83A	0.75	1.65	1.9	2.42
84	0.75	1.21	1.9	2.16

7.0 Geotechnical Desktop Analysis

Geotechnically analysis is yet to be completed at the time of submission of this report and therefore summary of the geotechnical parameters present at the site of works will be supplied as an addendum to this report.

8.0 Structural Assessment

Structural assessment was only carried out on the proposed tower and its neighbouring towers (T83 and T84) as the change in loading on all other towers within the scope was assumed to be negligible.

8.1 TOWER assessment

The proposed tower T83A and the neighbouring towers were assessed to the standard load cases generated by the approved Transpower WCLC spreadsheet. SAPS analysis level L3 was used to determine structure utilisations.

The utilisations of each tower are summarised in Table 8. Full tower utilisations and further outputs from PLS-CADD are included in Appendix F.

Table 8: Structural utilisations by tower

Struc. ID	Tower type	Existing Line			Proposed Line		
		Max Usage (%)	Load Case	Tower Member ID	Max Usage (%)	Load Case	Tower Member ID
83	C327-A	148.7	MW0300_A5+E BI++00,T BI+	33-135/XY	125.0	MW0300_A5+E BI-+15,T BI-	60-403/P
83A	2DD-HSTC	-			40.0	ES0050_5+E NA-,T NA-	510-510Y/X
84	C327-A	167.2	MW0300_A5+DA BI++00,T BI+	60-69C/P	130.1	MW0300_A5+E BI-+00,T BI-	60-253/Y

The structure utilisations illustrated in Table 8 indicate that the existing structures in both the existing and proposed configuration are over utilised. The structures have been modelled in the strengthened configuration as per Transpower drawing TZ10823 which is included as Appendix H. Though the tower utilisations will be decreased in the proposed configuration, it is Transpower practise to only address the strengthening required within the project scope. Therefore, only towers T83 and T84 are considered at this instance.

The overutilisation of structures T83 and T84 can be solved by adding 50x50x5mm bracing members to the lower common body. A high-level sketch of the approximate strengthening required is included as Figure 5.

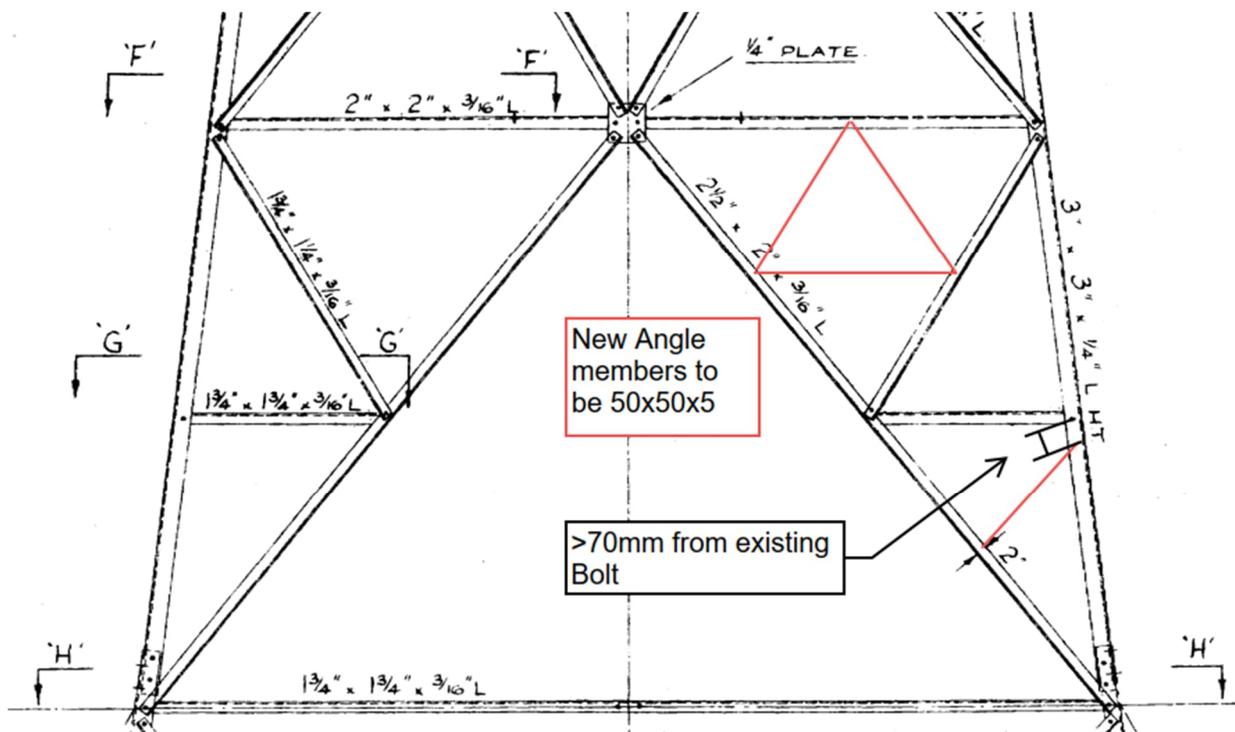


Figure 5: Strengthening proposed for existing structures.

8.1.1 Snow Loading

The elevation of the line varies from the Benmore substation through to the proposed works. Over this section the elevation peaks at T26 at 942m, however, the average elevation across the spans within the scope (T79 to T88) is 407m. As per Transpower standard weather and Load case generator spreadsheet snow loading is required at all altitudes in the South Island Ice Zone. Snow load cases have been simulated on the existing adjacent structures T83 and T84 at an elevation of 900m for a conservative assessment.

The structures usage of the adjacent structures T83 and T84 were tested under exclusively the snow loads discussed in this section to identify any overloads. The structure usage of the adjacent structures under snow loads was found to be less severe than the overloads identified under high wind summarised in Table 8. A summary of the overloads identified due to snow loads is included as Table 9.

Table 9: Adjacent Structure Loadings under Snow and Ice Conditions

Struc. ID	Group Label	Max Usage before Strengthening (%)	Usage Control Member	Load Case	Type Strengthening
83	20-33	74.29	Comp	ES0050_9+E NA-,T NA-	None
84	20-33	69.56	Comp	ES0050_9+E NA-,T NA-	None

8.2 Gantry Assessment

Two A-Frame gantries were selected as per drawing TP65059. The loadings on the line side of these gantries were compared with line loading parameters specified in note 2 of TP65059 sheet 1. The gantries were found to be within all required parameters. The required and proposed conditions of the gantries are specified in Table 10 and TP65059 is included as Appendix L.

Table 10: Maximum Gantry Line Side Conditions

Gantry Name	Conductor Type	Maximum Conditions			Conditions In Proposed Configuration		
		Installed Final Tension (UTS%)	Turnoff Angle (°)	Span Length (m)	Installed Final Tension (UTS%)	Turnoff Angle (°)	Span Length (m)
Gantry 1	Duplex Goat	5.0	30	110	1.2	12	65
Gantry 2	Duplex Goat				1.2	12	65

8.2.1 Inverted Gantry Design

Industry accepted practise suggests that insulators with vertical departure angles greater than 5° should be inverted to avoid pooling in a rain event. Pooling that will shorten the creepage distance and therefore decrease the electrical capacity of the insulator. Both slack spans in the proposed configuration have departure angles exceed 5° and therefore it is suggested that the insulators be inverted for attachment to both Gantry 1 and Gantry 2 in the proposed configuration. The vertical departure angle of each wire connecting to the gantries has been summarised in Table 11.

Table 11: Vertical Departure Angle of Gantry Attachments

Gantry ID	Vertical Departure Angle (°) (-ve value indicates above Horizontal axis)			
	Phase Number			EW
	1	2	3	
Gantry 1	3.5	-2.1	-7.5	-7.6
Gantry 2	3.6	-2	-7.8	-7.6

8.3 Foundation assessment

The foundations of the existing structures within the scope of this project were identified as grillage foundations. Initial high-level calculations of the utilisation of these foundations were conducted to identify any required strengthening. After discussion with Transpower engineers it was confirmed, the loads should be simulated in the proposed configuration and tension of the line as no future reconducting is planned. The geotechnical parameters were ascertained based on a geotechnical desktop review (GDR) of the site completed on 08/12/2023. A table of the geotechnical parameters used to calculate the foundation capacities and utilisations is summarised in Table 12.

Table 12: Geotechnical Parameters

Soil Description		Bulk Density (Dry) [kN/m ³]	Internal Friction angle, ϕ [°]	Undrained Soil Shear Strength, S_u [kPa]	Bulk Density (Wet) [kN/m ³]
General	Specific				
Non-Cohesive	GRAVEL	18	30	0	8

8.3.1 Existing Foundation Assessment

The calculations indicated that both structure 83 and 84 will require strengthening. Table 13 summarises the high-level capacity of the existing structures. The foundation calculation and reference drawing are fully detailed in Appendix J.

Table 13: Foundation Capacities of Existing Structures

Structure ID	Design Uplift Load (kN)	Calculated Capacity (kN)	Utilisation
83	160	112	142.9%
84	179	112	159.8%

8.3.2 Proposed Pile Foundation Design

A high-level assessment of the proposed pile dimensions for the new structure 83A has been provided. The pile diameter has been assumed to be 900mm and the soil parameters as per Table 12. The foundation has been designed to accommodate the site-specific loads of T83A. A summary of the site-specific foundation loads is detailed in Table 14 and the proposed pile dimensions for T83A is included in Table 15. The full MATHCAD calculation details are included as Appendix K.

Table 14: Site-Specific Foundation Loads

Tower ID	Foundations Loads					
	Compression (kN)			Uplift (kN)		
	Longitudinal	Transverse	Vertical	Longitudinal	Transverse	Vertical
83A	88.2	106.2	396.2	80.4	83.5	535.3

Table 15: Initial Proposed Tower 83A Pile Dimensions

Tower Number	Pile Diameter (mm)	Pile Depth (m)
83A	900	9

A detailed foundation assessment/design of the new tower and further analysis of existing towers will be submitted as an addendum pending the Geotechnical analysis of the site. The assessment will include the design of a bored foundation for the proposed structure and further calculation/checks of the capacities of the existing foundations.

8.3.3 Pad and Pedestal

A pad and pedestal type foundation was also considered for proposed structure 83A. The pad and pedestal foundation was designed for all load cases including the snow and ice loads discussed in Section 8.1.1 of this report. A drawing of the pad and pedestal foundation design and the loads considered have been included in Appendix J.

9.0 Property & Environmental Assessment

9.1 Blowout

The structures within the scope of works lie on land owned by the developer of the new solar farm and therefore the blowout corridor will remain over an interested party's land regardless of the arrangement adopted for the cut-in structure. This excludes the new slack spans that will require a new easement and thus, approval according to NESETA. Nevertheless, the blowout corridor in the new configuration will remain within the existing corridor. A summary of the calculated blowout of the structures within the scope was illustrated in Table 16 and a full summary is included in Appendix D.

Table 16: Summary of Blowout

Proposed or Existing	Span	Existing Maximum Blowout (m)	Proposed Maximum Blowout (m)	Comparison of Blowout (-ve indicates Decrease)
Both	79 - 80	12.7	12.7	0.0
Both	80 - 81	12.8	12.8	0.0
Both	81 - 82	13.1	13.1	0.0
Both	82 - 83	24.8	24.7	-0.1
Proposed	83 - 83A	-	13.9	-
Proposed	83A - 84	-	14.1	-
Existing	83 - 84	25.7	-	-
Both	84 - 85	24.9	25.5	-0.6
Both	85 - 86	13.1	13.1	0.0
Both	86 - 87	12.0	12.0	0.0
Both	87 - 88	12.0	12.0	0.0

9.2 Condition assessment.

A review of the existing Condition Assessment (CA) data held in MAXIMO / OBIEE was carried out. The lowest insulator CA was a value of 60 at tower T82, T84, and T86. As per Table 1 of TP.SS 02.40 a condition assessment of 50 suggests a work order should be planned for corrective maintenance, therefore AECOM suggests these insulators should be monitored and a work order placed if the condition worsens to a rating of 50. A summary of the insulator CA's is summarised in Table 17 and Appendix E.

Table 17: Condition Assessment of Insulators.

Tower Number	Lowest Insulator CA	Date of Assessment	Comment
T79	80	24/07/2019	
T80	85	24/07/2019	
T81	70	24/07/2019	
T82	60	25/07/2019	Wear cold end shackles
T83	65	25/07/2019	
T84	60	25/07/2019	Wear cold end shackles
T85	75	25/07/2019	
T86	60	25/07/2019	Wear cold end shackles
T87	85	03/09/2018	
T88	70	03/09/2018	

The condition of the steel of each of the tower within the scope was also assessed. All structures within the scope maintain a steel condition of over 60%. As stated above, TP.SS 02.40 suggests a CA rating of 50 requires the planning of corrective maintenance, thus the tower steel should also be monitored for any further deterioration. The collated CA's of each tower have been summarised in Appendix E.

9.3 Electro-magnetic Field (EMF)

The MATHCAD sheet used to calculate EMF is currently being updated and therefore a full EMF assessment as per ADEGL 02.13 is not possible at the time of the submission of this report. To gain a preliminary understanding of the EMF present in the proposed configuration, the PLS CADD tool "3D EMF Along Line" was used. Assessments were run on the cross section of the lines at the mid-span of T83 to T83A and T83A to Gantry 1. The current load was simulated at 60% and 110% of the current rating as per ADEGL 02.13. The results of the EMF reports are published in Appendix M.

The AN and RI cannot be simulated in PLS CADD and therefore these will be submitted as an addendum once the Transpower MATHCAD spreadsheets are available.

9.4 Lightning Protection (Rolling Sphere Test)

A rolling sphere test was carried out within PLS CADD to compare the lightning protection of the proposed configuration to the existing line. This was done by specifying a strike distance that yields a length of wire that is exposed in the existing configuration. This length of exposed wire was then compared to the length of exposed wire yielded from the proposed configuration with the same strike distance input. This allowed comparison of how the change in configuration will affect the vulnerability of the line to lightning strike. The strike distance is proportional to stroke current as per TP.DL 01.04 Section 3.1.16.

A stroke current of 8kA which corresponds to a strike distance of 30m was found to result in the existing configuration having a total of 246m of conductor outside the protection envelope provided by the OHEWs. The 246m exposed length of conductor is made of 4 instances of the outside conductors, adjacent to the structures being exposed as seen in Figure 6.

When simulating the proposed configuration with a strike distance of 30m, 231m of wire was exposed including the gantry spans. This indicates that the proposed configuration will improve lightning protection. This is likely due to the transposition of the conductors as they attach to T83A. The transposition creates less exposed wire as the conductor's transition to a vertical configuration under the OHEWs as illustrated in Figure 7.

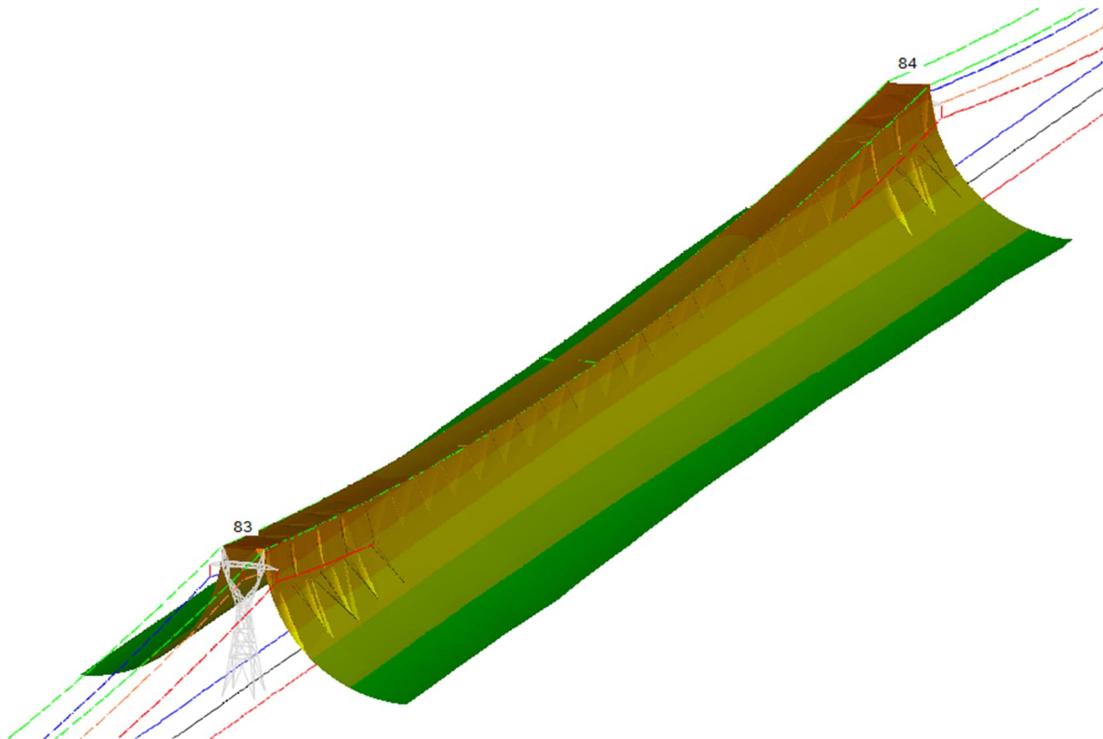


Figure 6: Existing Configuration Rolling Sphere Test

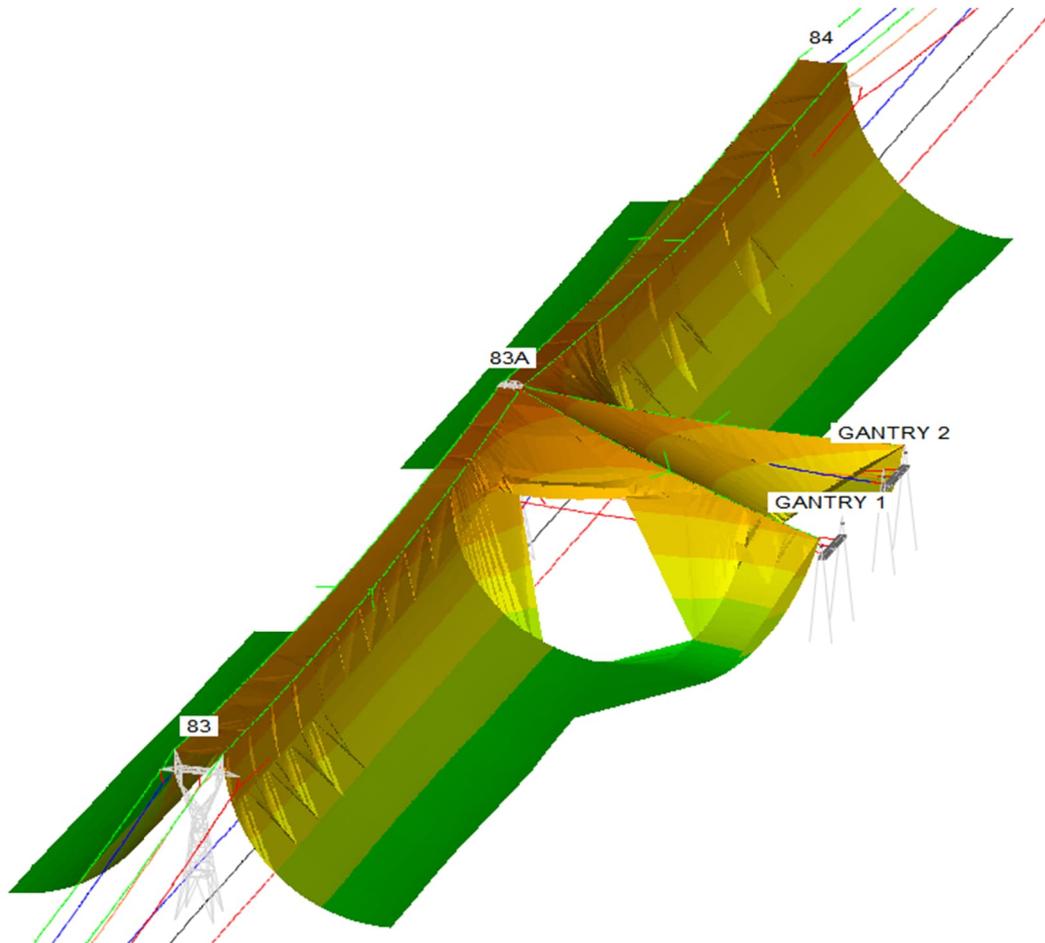


Figure 7: Proposed Configuration Rolling Sphere Test

10.0 Constructability

10.1 Construction Sequencing

A high-level construction sequencing of the project is outlined as follows.

1. Bored Pile foundations to be constructed for proposed Tower T83A.
2. Tower Strengthening to take place on existing structures.
3. Concrete over grillage for existing foundations (Requirement for this is subject to the Geotechnical data)
4. Outage to be taken.
5. Span T83 to T84 shall be cut to and conductors shall be anchored to ground to maintain tension balance at structure T83 and T84.
6. Tower T83A constructed.
7. Conductors can be attached to new Tower T83A.
8. Pending the commissioning of the substation either landing spans can be strung and the line reenergised or a bypass configuration can be adopted utilising the third crossarm installed on the 2DD-HSTC structure as illustrated in Figure 8.

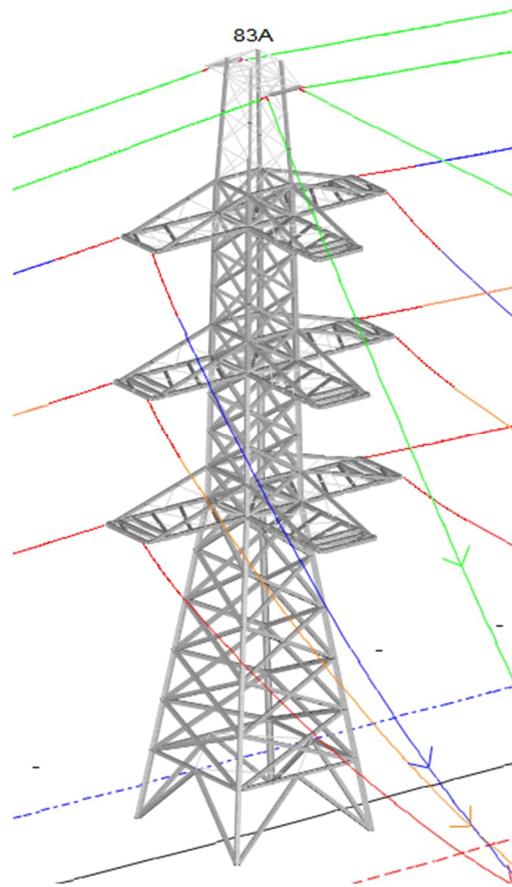


Figure 8: 2DD-HTSC Tower Illustration

The construction of the foundation of proposed tower T83A before an outage is taken is contingent on the assumption the equipment required to construct the piles does not exceed a height of 5m. TP.DL 12.02 Table 22 specifies a distance of 4m to mobile plants under live conductors. The clearance to ground under span T83-T84 is 9.3m at MOT of 50 degrees and 10.9m at EDS. Assuming Transpower would like to design to MOT wire conditions, the mobile plant equipment must be less than 5m in height to meet requirements.

10.2 Conductor Lengths

As specified in item 2 of the construction sequencing above, the existing conductors from span T83-T84 will be cut to size for attachment to the new structure. Lengths of the conductor in the proposed configuration were calculated to keep existing and proposed clearance requirements met while also maintaining balance in the existing structures. The presence of the new crossarms and insulators installed within the new spans were considered as these will affect the final length of the conductor. The lengths of the existing conductors have been specified in Table 18.

Table 18: Existing and Proposed Conductor Lengths

Phase Location	Existing Conductor Length (m)	Insulator +Crossarm Length (m)	83-83A Proposed Conductor Length (m)	83A-84 Proposed Conductor Length (m)	Amount of Conductor Length removed from Existing Length(m)
Top Phase	396.677	9.12	197.47	199.21	18.58
Middle Phase	396.665	9.42	197.73	198.93	20.10
Bottom Phase	396.665	9.72	198.06	198.61	19.33

10.3 Insulation Design

The arc distance and creepage distance of the new strain insulators were compared to the existing insulators. The proposed insulators were confirmed to have larger creepage distance however the arc length of the proposed insulators is shorter than that of the existing. The arc length is controlled by the spacing distance and number of discs. Table 1 of the reference tab of "Transpower Power -Insulator set rev D6" states that the ideal number of discs for 220kV is 14 that equates to an effective set length of 2044mm and therefore this is the configuration that was adopted for this design. A summary of the creepage and arc distance of both the existing and proposed insulators has been included as Table 19.

Table 19: Arc and Creepage length of Insulators

Existing or Proposed	Insulator Set	Creepage Distance (mm)	Arc Length (mm)	Insulator Drawing Reference	Disc Drawing Reference
Existing	11B	4940	2210	TF25006	N/A
Proposed	860B	5600	2044	TP62036	ENG377CED22
Proposed	865C	5600	2044	TP62036	ENG377CED22

10.3.1 Earth Wire Dead-Ending

The earth wire that initially spanned from T83 to T84 will now be dead ended to the proposed structure T83A and then turn-off to the gantries. The earth wire is proposed to be dead ended at the tower end using set 22 and at the station end using set 26C as per TF25009.

10.4 Construction Loading

During the construction phase of the project the conductors will be anchored to ground to allow assembly of the new structure. This scenario was modelled in PLS CADD using the strengthened configuration of C327-A as is present on site. This TOWER model was used as it will produce a more conservative utilisations until the re-strengthened configuration of T83 and T84 is confirmed by Transpower. The utilisations of the existing structures T83 and T84 were confirmed under construction and maintenance loading (CM) criteria. Analysis was considered for the works taking up to one week (CM1) and up to 6 months (CM2). A summary of the utilisations of the existing towers during the anchoring of conductors was included as Table 20 and an illustration of the PLS CADD modelling as Figure 9.

Table 20: C&M Tower utilisations

Structure Number	Tower type	CM1 Utilisation (%)	CM2 Utilisation (%)
83	C327-A	69.97	91.51
84	C327-A	71.33	93.31



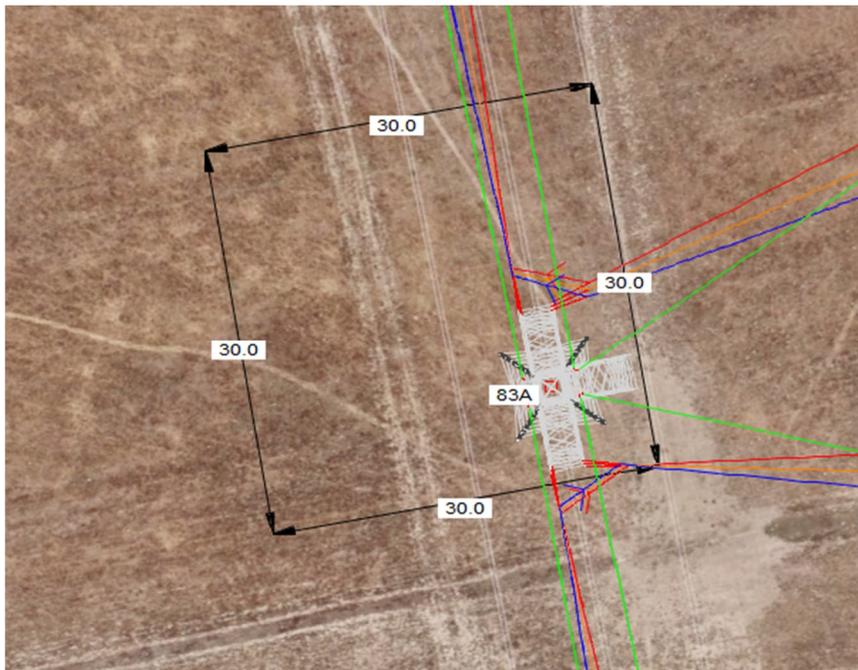
Figure 9: PLS CADD Modelling of Conductors anchored to Ground

10.5 Access roads and Construction Pads

Access to the site is assumed to be included as part of the larger substation works.

A 30m x 30m constructability pad for the proposed structure T83A will be required for construction. Figure 10 displays a high-level illustration of the location of the constructability pad, however, a constructability site visit by the contractor to confirm all indicative set up dimensions is recommended.

Figure 10: High-level Constructability Pad Location



11.0 Costing

11.1 TEES Costing Estimate

A TEE's costing assessment was completed to estimate a high level of the procurement required for the project. This assessment excluded costing of items such as the anchor blocks as these were considered be included in the contractor methodology. A table summarising the items contained in TEES estimate was included as Table 21 and a full description in Appendix I.

Table 21: TEES estimate

Item	Description	Quantity	Unit	Cost
Intermediate structure - strain tower -220kV - Double Circuit	2DD-HSTC	1	Per Tower	\$298,788.4
Minor tower strengthening	-	2	Per Tower	\$21,984.70
New foundation - tower - pile	Bored Pile	1	Per Tower	\$239,633.9
Terminal Span Conductor - cct/km	Goat ACSR AC	0.43	CCT/km	\$9,793.0
Earthwire - cct/km	7 3-71 GHSS	0.14	CCT/km	\$504.5
Insulator sets = 220kV - strain	2 x Set 860B 2 x Set 865C 2 x Set 865E	6	CCT Set	\$93,229.50
Crane Pad	-	1	Per Pad	\$8,854.7
Existing Foundation Strengthening	COG	2	Per Tower	\$81,143.0
Total	-	-	-	\$753,931.63

Costing of the new station Gantry's and Geotechnical analysis required for the new tower has been excluded as this is assumed to be included in the overall substation works cost. Erection costs of new tower will be specified by the contractor.

12.0 Directives at the DIR stage

A few observations were made at the SCORED workshop that would need consideration during the DIR stage.

- Groundwire peak strengthening on the 2DDHST towers carried out on similar projects.

Appendix A

Design Criteria Document

DESIGN CRITERIA DOCUMENT

FNS 'The Point' 330MW Solar Farm

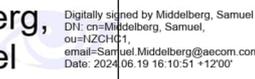
Version History

Version	Date	Nature of Amendment
Revision 0	11/04/2024	Issued for Comment
Revision 1	19/06/2024	Updated as per TP Comments

Distribution List

Person	Position	Copy #
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Checked:	Ashok Bhat	AECOM Principal Transmission Lines Engineer	 Bhat, Ashok 2024.06.19 16:14:30 +12'00'	19/06/24
Verified:	Iqbal Kalsi	AECOM Principal Transmission Lines Engineer	 Kalsi, Iqbal 2024.06.19 16:42:06 +12'00'	19/06/24

**FNS 'The Point' 330MW Solar Farm SS
ENGINEERING DATA AND DESIGN PARAMETERS**

GENERAL LINE INFORMATION AND DESIGN PARAMETERS

ITEM	DESCRIPTION		VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE
Affected Section Length	BEN-ISL-A (BEN-TWZ CCT1) - T80-T88		3.67km	Transpower Asset Map
Affected Tower Configuration	BEN-ISL-A - T80-T88		Steel lattice single circuit flat top	As per Transpower Database - _Lines_Assets_TWR V1.xlsx
Maximum Operating Temperature	BEN-ISL-A	ACSR/GZ GOAT	50°C (Existing)	Existing: Transpower Asset Map
Line Thermal Rating	Duplex Goat ACSR/GZ - 50°C		1103A (Proposed)	Transpower Conductor Current and Temperature Rating Utility Ver3.11 (Latta)
Electrical Design Parameters	Nominal System Voltage		220kV	
Terrain Parameters	Terrain Category		2	AS_NZS 1170.2 Sec 4.2.1
Structural Design Parameters	Wind Return Period		300yrs	TP.DL 12.01:2021 Sec 7.3.2, Appendix B Wind region A6
	M _{RP} Factor		0.953	TP.DL 12.01:2021 Appendix B
	M _{lee} Factor		1.18 – Interpolated from outer lee zone	AS_NZS 1170.2 Sec 4.4.3 Image of Interpolated Lee Factor included as Appendix A
	Structure Loadings		Reliability, Security, and Safety Loading Conditions	TP.DL 12.01:2021 Sec 7 & 8
	Construction Loads		CM1, CM2 and CM3 load cases considered 2kN man standing load assessed in PLS-Tower Capacity reduction factor = 0.5	TP.DL 12.01:2021 Sec 5.4 TP.DL 12.01:2021 Sec 6.3.5 Table 5

GENERAL LINE INFORMATION AND DESIGN PARAMETERS (CONTINUED)			
ITEM	DESCRIPTION	VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE
Structural Design Parameters	Broken Wire Loads	One broken phases	Existing Suspension Structure
	Broken Wire Loads	All Wire Broken	Stop structures only. Refer to Attachment 1.
	Structural Design/Verification	Towers: Designed to ASCE-10 and checked with PLS-Tower	

PLS MODELING PARAMETERS				
ITEM	DESCRIPTION	VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE	
PLS-CADD Modeling	Source	BEN-ISL-A(BEN-T333) als opten 20190123.xyz		
	Coordinate System	New Zealand Transverse Mercator (NZTM)	Standard Transpower PLS-CADD coordinate system	
	Levels	New Zealand Geodetic Datum 2000, Meters above Ellipsoid Datum	Standard Transpower PLS-CADD datum	
Conductor System	Configuration (Existing)	BEN-ISL-A	Duplex Goat ACSR/GZ	Tower 0082, 0083, 0083A, and 0084
	Configuration (New Section)	BEN-ISL-A	Duplex Goat ACSR/AC	From 0083A to Station Gentries
TOWER Modeling	Configuration (Existing)	BEN-ISL-A 83 – C327-A Strengthened BEN-ISL-A 84 – C327-A Strengthened		C327-A-ew2-sus1-strg0-BE0-le22-22-22-22{Validation}[rA1].TOW Tower C327 Joint Diagram Rev 002.dwg C327-A TOWER Data Input Master - Rev 002.xlsx Redeye Dwg Number: T1421, TZ10823, XM3298
	Configuration (New Structure)	New Structure Tower 83A <ul style="list-style-type: none"> • 2DD-HSTC 		2DD-HSTC3-ew2-leftarms(2x)+jx(ah&bk)-be05-le3.0-3.0-3.0-3.0 {Master} [rA].tow 2DD-HSTC Tower Data Input Rev A Joint Diagram.pdf 2DD-HSTC Tower Data Input Rev A.xlsx

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PLS MODELING PARAMETERS (CONTINUED)				
Conductor System	Cable File	Existing: goat_acsr_gz_ungreased_pre1964_tp-wir-566-rev-A_l.wir		Goat ACSR GZ: $\varnothing = 25.96\text{mm}$, CBL = 135.137kN "TP-WIR-566"
		Proposed to be same as existing apart from Terminal Spans Terminal Spans: goat_acsr_ac_greased_tp-wir-549B_l.wir		Goat ACSR AC: $\varnothing = 25.97\text{mm}$, CBL = 134.129kN "TP-WIR-549" Goat ACSR GZ: $\varnothing = 25.96\text{mm}$, CBL = 135.137kN "TP-WIR-566"
Earthwire System	Configuration (Existing)	BEN-TWZ-A	7 3-71 GHSS	
	Configuration (New Section)	BEN-TWZ-A		
	Cable File	7_3-71_ghss_ungreased_pre1964		7_3-71 GHSS: $\varnothing = 11.13\text{mm}$, CBL = 93.857kN "TP-WIR-567"

VIBRATION/TENSION LIMITS			
ITEM	DESCRIPTION	VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE
Vibration/tension Limits	Under 30Pa wind air, everyday temperature (10°C) Conductor should not exceed	30Pa wind, Ted: values between 18% & 22% preferred.	TP.DL 12.01:2021 Sec 7.7.1
	Earthwire Sag	Not to exceed 95% of phase conductor sag	TP.DL 12.01:2021 Section 7.6.1:
	Ultimate Tension Limit	A capacity reduction factor (CRF) of 70% CBL to be applied to conductor tensions	TP.DL 12.01:2021 Sec 6.3 Table 6

INSULATORS				
ITEM	DESCRIPTION	VALUE/SOURCE		REFERENCE/COMMENTS/ WEATHER CASE
Insulation	Coastal or Inland	Inland		
	Material	Porcelain		
	Wind Area	<ul style="list-style-type: none"> • NGK Porcelain post-1970 Set 11B – 0.4m² • NGK Porcelain post-1970 Set 13A – 0.63m² • 220_TEN_860B_DI38 – 0.79m² • 220_TEN_865C_DI38 – 0.40m² 		As per Transpower Database – Insulator sets Rev D6.xlsx
	Weight	<ul style="list-style-type: none"> • NGK Porcelain post-1970 Set 11B – 0.95kN • NGK Porcelain post-1970 Set 13A – 1.49kN • 220_TEN_860B_DI38 – 1.27kN • 220_TEN_865C_DI38 – 0.64kN 		As per Transpower Database – Insulator sets Rev D6.xlsx
	Existing Insulator Set	BEN-ISL-A0080-0088	Suspension Insulators <ul style="list-style-type: none"> • NGK porcelain post-1970 (Std) – 11B • NGK porcelain post-1970 (Antifog) – 11B Strain Insulators <ul style="list-style-type: none"> • NGK porcelain post-1970 (Std) – 13A, 11B 	As per Transpower Database – _Lines_Assets_INS V1.xlsx
	New Insulator Set	BEN-ISL-A0083A	Full tension Strain Insulators: <ul style="list-style-type: none"> • 220_TEN_860B_DI38 • Length - 3.302m • Glass Cap and Pin insulator • Weight – 1270N Terminal Span Strain Insulators: <ul style="list-style-type: none"> • 220_TER_865C_DI38 • Length – 3.5075m • Glass Cap and Pin insulator • Weight – 640N 	TP62036_3_0.dwg TP62036_5_0.dwg See Appendix B for reference drawings. As per Transpower Database – Insulator sets Rev D6.xlsx

Insulation (cont.)	New Insulator Set	Gantries	Terminal Span Strain Insulators (Gantry Side): <ul style="list-style-type: none"> • 220_TER_865E_14 • Length – 3.33m • Glass Cap and Pin insulator • Weight – 853N 	TP62036_5_0.dwg
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FOUNDATION/GEOTECHNICAL PARAMETERS			
ITEM	DESCRIPTION	VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE
Foundation	Structure Loadings	As per TP.DL 12.01:2021	TP.DL 12.01:2021 Sec 7 & 8
	Geotechnical design soil strength parameters and groundwater levels	TBC - once detail investigations are completed	TBC
	Capacity Reduction Factors Failure Sequence Factor:	Weight of Concrete and Steel $\Phi_c = 0.95$ Weight of Soil $\Phi_G = 0.9$ Soil Strength $\Phi_S = 0.65$ to 0.85 $\Phi_T = 0.95$ (for suspension foundations) $= 0.85$ (for strain foundations)	TP.DL 01.01:2023 TP.DL 12.01:2021 Sec 6.3 Table 6
	Foundation type	Existing foundation types: Grillage	_Lines_Assets_FNDT V1.xlsx Reference Drawing "T1421_3" has been included in Appendix C

CLEARANCES – 220kV			
ITEM	DESCRIPTION	VALUE/SOURCE	REFERENCE/COMMENTS/ WEATHER CASE
Internal Electrical Clearances	Design Assumption	Construction tolerance of 0.5m not included unless noted	
	Conductor to Structure Clearance	0.75m – High Wind (HWD) 1.90m – EDS & EDD	TP.DL. 12.02:2020: Table 1
	Minimum Approach Distance (MAD)	2.2m – Maintenance	TP.DL. 12.02:2020: Table 2
	Live Line Minimum Approach Distance	1.6m – Phase to Earth	NZECP46 Part 2, Sect 2.3 EDS and EDW to live-line climbing corridor

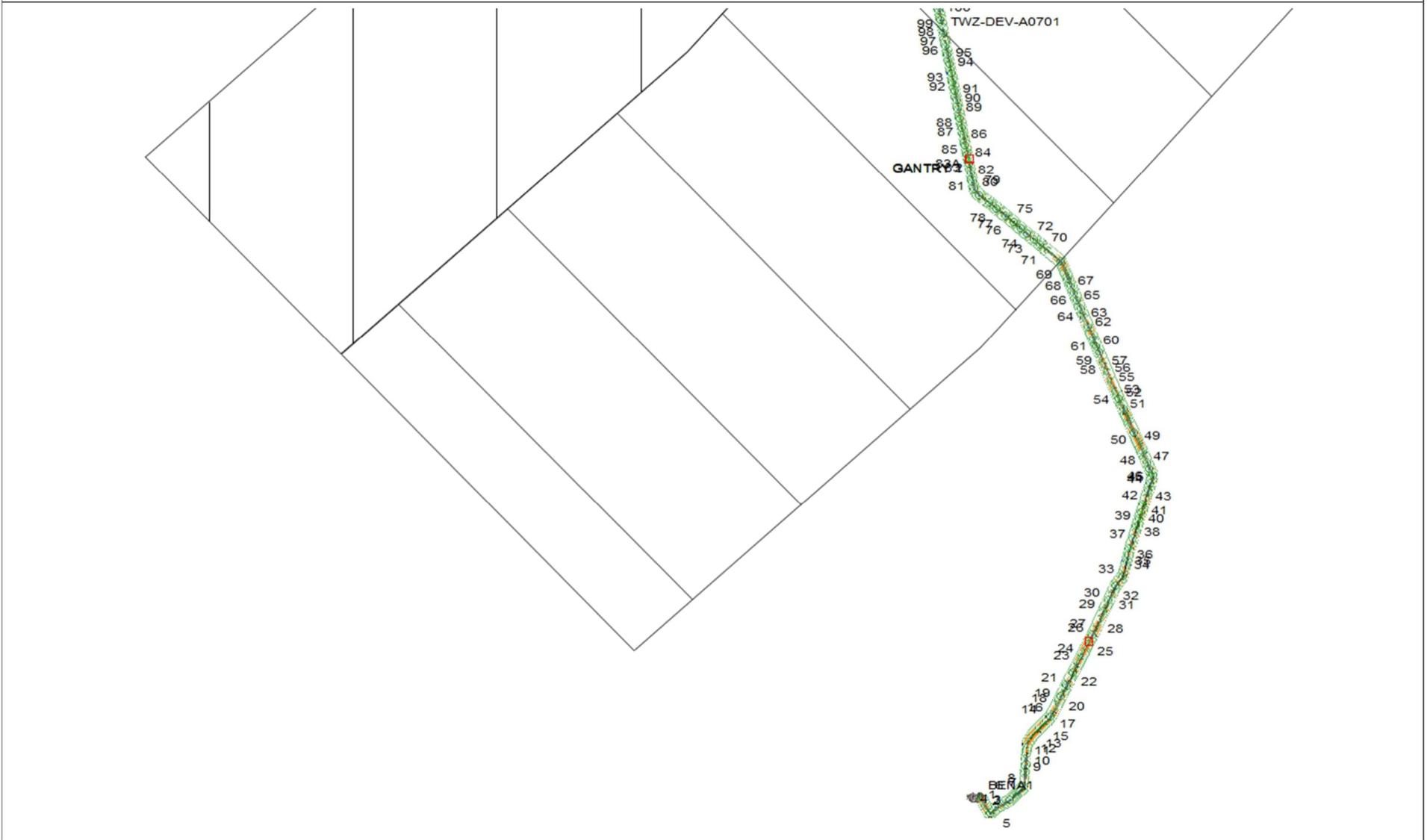
CLEARANCES – 220kV (continued)					
ITEM	DESCRIPTION	VALUE/SOURCE			REFERENCE/COMMENTS/ WEATHER CASE
Internal Electrical Clearances (continued)	Climbing Corridor Distances	Tower	1.0m from tower face 1.0m above crossarm bottom chord 0.3m above crossarm top chord		TP.DL. 12.02:2020 Table 3
		Pole	0.5m either side of centre of pole climbing side 1.0m from pole face climbing side 0.4m from all other pole faces		
	Phase to Phase Clearance	0.75m – High Wind (HWD) 1.90m – EDS & EDW			TP.DL 12.02, Table 4:
External Clearance Requirements	Design Assumption	0.5m buffer is included for all minimum distances to ground, buildings and other structures, under crossings, water crossings and when checking clearance to vegetation. Refer TP.DL 12.02, section 6.2.			
	Distance to Ground	Vertical	8.0m Traversable 6.5m Non-Traversable	Still air (e.g., MOT) and Continuous range of wind up to HWD	TP.DL. 12.02:2020 Table 7 NZECP 34:2001 Table 4
		Radial	5.0m	HWD	TP.DL. 12.02:2020 Table 7, Figure 4 Horizontal clearance used in PLS- CADD when calculating vertical clearances only. Radial clearances used otherwise
	8.0m Traversable 6.5m Non-Traversable		EDD		
	EWP Clearance	Vertical	4.0m 7.5m	HWD MOT&EDD	TP.DL. 12.02:2020 Se8.4.1 Table 11
	Distance to vegetation	Radial	4.5m	Still air (e.g., MOT) and Continuous range of wind up to HWD	TP.DL. 12.02:2020 Se8.3.3 Table 9
	Growth Limit Zone	Vertical	Tree Height + 4.5m	Maximum sag condition	
Horizontal		150m-300m: 4.5m	End 15% span		
Horizontal		150m-300m: 8.5m	Centre 70% span		

CLEARANCES – 220kV (continued)					
ITEM	DESCRIPTION	VALUE/SOURCE			REFERENCE/COMMENTS/ WEATHER CASE
External Clearance Requirements (continued)	Growth Limit Zone (Continued)	Horizontal	300m-500m: 8.0m	End 15% span	TP.DL. 12.02:2020 Se8.3.3 Table 9 TP.SS. 02.18
		Horizontal	300m-500m: 15.5m	Centre 70% span	
	Buildings or other structures	Vertical accessible	7.0m	All weather conditions.	TP.DL. 12.02:2020 Se8.4.1 Table 10 A _{NSS}
		Vertical not accessible	6.5m		TP.DL. 12.02:2020 Se8.4.1 Table 10 B _{NSS}
		Radial accessible	5.0m		TP.DL. 12.02:2020 Se8.4.1 Table 10 C _{NSS}
		Radial not accessible	4.0m		TP.DL. 12.02:2020 Se8.4.1 Table 10 D _{NSS}
	Undercrossing Structure (not normally accessible)	Radial	4.0m	TP.DL. 12.02:2020 Se8.4.1 Table 10, D _{NSS} .	
	Undercrossing Conductor	Radial	3.3m (Still Air)	TP.DL. 12.02:2020 Se8.5.3.1 Table 18	
		Radial	2.7m (with wind on either circuit up to HWD)		
	Distance to Road	Vertical	8.0m	TP.DL. 12.02:2020 Se8.3.1 Table 7	
Blowout Criteria (For Easements)	Horizontal Electrical Clearance, HWD Load Case	$W_{HWD(3yrs RP)}$	Blowout + 5.0m	TP.DL. 12.02:2020 Sec 8.8. TP.DL. 12.02:2020 Table 10 C _{NSS} TP.DL. 12.01:2021 Table 21	
	Containment Within the Easement	$W_{MW(300yrs RP)}$	Blowout + 0.5m		

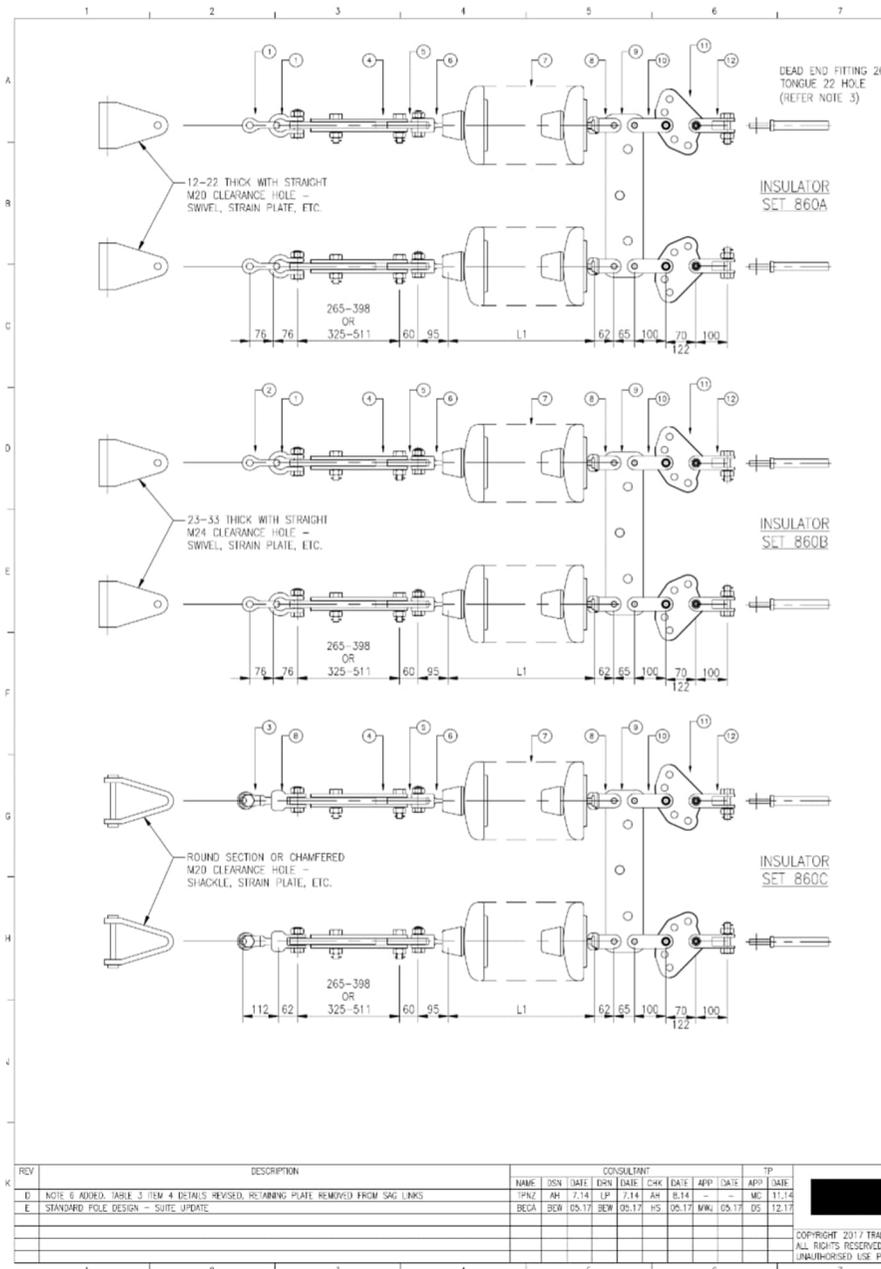
REFERENCES			
<ol style="list-style-type: none"> 1. TP DL 12.01 (Issue 6.1 Feb 2020) 2. TP DL 12.02 (Issue 2.1 Oct 2020) 3. TP.DL 01.01 (Issue 2.1 Apr 2024) 4. TP.ML 04.02 (Issue 1, March 2003) 5. AS/NZS 7000:2016 6. AS/NZS 1170.2:2011 7. NZECP 34:2001 8. NZECP 46:2003 9. TP.DG 01.01 (Issue 3.3, Jan 2024) 10. TP.DG 30.01 (Issue 4.1, Jul 2022) 11. NZS 6869:2004 12. NZS 6802:2008 13. AS 1824-1995 14. _Lines_Assets_INS V1.xlsx 15. _Lines_Assets_FNDT V1.xlsx 16. _Lines_Assets_TOW V1.xlsx 17. BEN-ISL-A_T80-T88_RP300yr_Rev0 Loading Criteria.xlsx 			
ATTACHMENTS			
Attachments		Attachment 1	BEN-ISL-A_T80-T88_RP300yr_Rev0 Loading Criteria.xlsx BEN-ISL-A_T80-T88_Transpower Conductor Current and Temperature Rating Utility Ver3.11(WORKING).xlsm

APPENDICES

APPENDIX A – M_{lee} Factor Interpolation



Appendix B – Insulator 860B and 865C Reference Drawings



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LENGTHS SHOWN ARE NOMINAL. ACTUAL LENGTHS FROM THE NOMINAL LENGTHS.
2. REFER TO SERVICE SPECIFICATION TP.SS 02.15 TO DETERMINE THE CORRECT TYPE OF INSULATOR SET.
3. REFER TO SERVICE SPECIFICATION TP.SS 04.16 TO DETERMINE THE CORRECT DEAD-END AND TERMINAL FITTINGS TO USE.
4. ITEM 4 LENGTH IN EACH STRING SHALL BE ADJUSTED SO THAT BOTH INSULATOR STRINGS LINE UP AS SHOWN. THE MAXIMUM ACCEPTABLE MISALIGNMENT IS 30mm. DRAWING TP76629 PROVIDES EXAMPLES OF WHICH SAG LINKS TO USE AND HOW TO ADJUST THEM TO KEEP THE ENDS OF THE INSULATOR SETS ALIGNED.
5. WHEN THE SAG LINK LENGTH ADJUSTMENTS HAVE BEEN COMPLETED, ADJUST THE SUBCONDUCTOR LENGTHS USING ITEMS 11 SO THAT BOTH SUBCONDUCTORS HAVE THE SAME SAG.
6. ITEM 4 SAG LINK MFL IS 160 kN POST 2012 AND 145 kN PRE 2013.

REFERENCE DRAWING:

TP76629 – DUPLEX CONDUCTOR, DOUBLE ATTACHMENT, SAG LINK LENGTH SETTINGS

PRIOR TO 2011, DIFFERENT INSULATOR SETS WERE USED. REFER TO DRAWINGS TP25006, TP29990, TP30000, TP30006

TABLE 1: NOMINAL INSULATOR STRING LENGTHS (REFER NOTE 2)

VOLTAGE (kV)	DISC INSULATOR STRING			COMPOSITE INSULATOR STRING			
	NO OF DISCS	L1	USCD (mm/kV)	TP ITEM CODE	L1 (MAX)	USCD (mm/kV)	GRADING RING REQUIREMENTS
66	5	730	45	L011747	918	43.3	NONE
				L011748	990	53.7	NONE
110	7	1022	38	L011770	1355	43.3	LIVE END ONLY
				L011771	1355	53.7	LIVE END ONLY
220	14	2044	38	L011772	2220	43.3	BOTH ENDS
				L011773	2350	53.7	BOTH ENDS

TABLE 2: CONDUCTOR AND MMS ASSEMBLY CODE DATA

CONDUCTOR		INSULATOR SET	
TYPICAL CODE NAME	NOMINAL COND. DIA.	MMS ASSEMBLY CODES	MAX. LOAD CAPACITY (kN)
GOAT ACSR	25.97	860A, 860B & 860C	252
PHOSPHORUS AAAC	26.25		
ZEBRA ACSR	28.62		
SELENIUM AAAC	29.25		
SULFUR AAAC	33.75		

TABLE 3: MATERIAL LIST

ITEM NO.	DESCRIPTION	MFL (kN)	SET A QUANTITY	SET B QUANTITY	SET C QUANTITY	REMARKS	TP/ITEM CODE
1	SHACKLE, M20 BOLT, 24 CLEVIS	160	4	2	--		L022541
2	SHACKLE, M24 BOLT, 36 CLEVIS	320	--	2	--		L022544
3	BALL Y-CLEVIS, IEC 20 BALL, M20 CURVED BOLT	160	--	--	2		L022516
4	SAG LINK, 24 CLEVIS, M20 BOLT, 20 TONGUE, 22 HOLE, 265-398 LONG	160	2	2	2	NOTES 4,6	L022555
4	SAG LINK, 24 CLEVIS, M20 BOLT, 20 TONGUE, 22 HOLE, 325-511 LONG	160	2	2	2	NOTES 4,6	L022556
5	LINK PLATE, TRIANGULAR, 20 THK, 22 HOLE, 60 LONG	160	2	2	2		L022550
6	BALL CLEVIS, IEC 20 BALL, M20 BOLT, 24 CLEVIS	160	2	2	2		L022512
7	DISC INSUL, STD, IEC 20 BALL & SOCKET, 146 SPACING	160	TABLE 1	TABLE 1	TABLE 1		L011002
7	COMPOSITE SUSP INSULATOR, IEC 20 BALL & SOCKET	210	2	2	2		TABLE 1
8	SOCKET CLEVIS, IEC 20 SOCKET, M20 BOLT, 24 CLEVIS	160	2	2	4		L022521
9	RECTANGULAR YOKE PLATE, 20 THK X 65 HIGH X 460 SPACING, 22 HOLE	160	1	1	1		L022597
10	PARALLEL LINKS, M20 BOLTS, 24 CLEVISES, 100 LONG	210	2	2	2		L022610
11	SAG ADJ PLATE, 20 THK, 22 HOLE, 70-122 ADJUST	160	2	2	2	NOTE 5	L022551
12	TWISTED CLEVIS CLEVIS, M20 BOLTS, 24 CLEVISES	160	2	2	2		L022539

submit your markups to TranspowerProduction@redpeaks.com

REV	DESCRIPTION	NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	TP
D	NOTE E ADDED, TABLE 3 ITEM 4 DETAILS REVISED, RETAINING PLATE REMOVED FROM SAG LINKS	TPN/	AH	7.14	TP	7.14	AH	8.14	--	MC	11.14
E	STANDARD ROLE DESIGN - SUITE UPDATE	BECA	BEH	05.17	BEW	05.17	HS	05.17	MW	05.17	05.17.17

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GENERAL TL DESIGN

INSULATOR SETS

DUPLEX ACSR & AAAC DIA. RANGE 25 TO 35mm

FULL TENSION - DOUBLE ATTACHMENT

DRG SIZE: A2

SCALE: 1:10

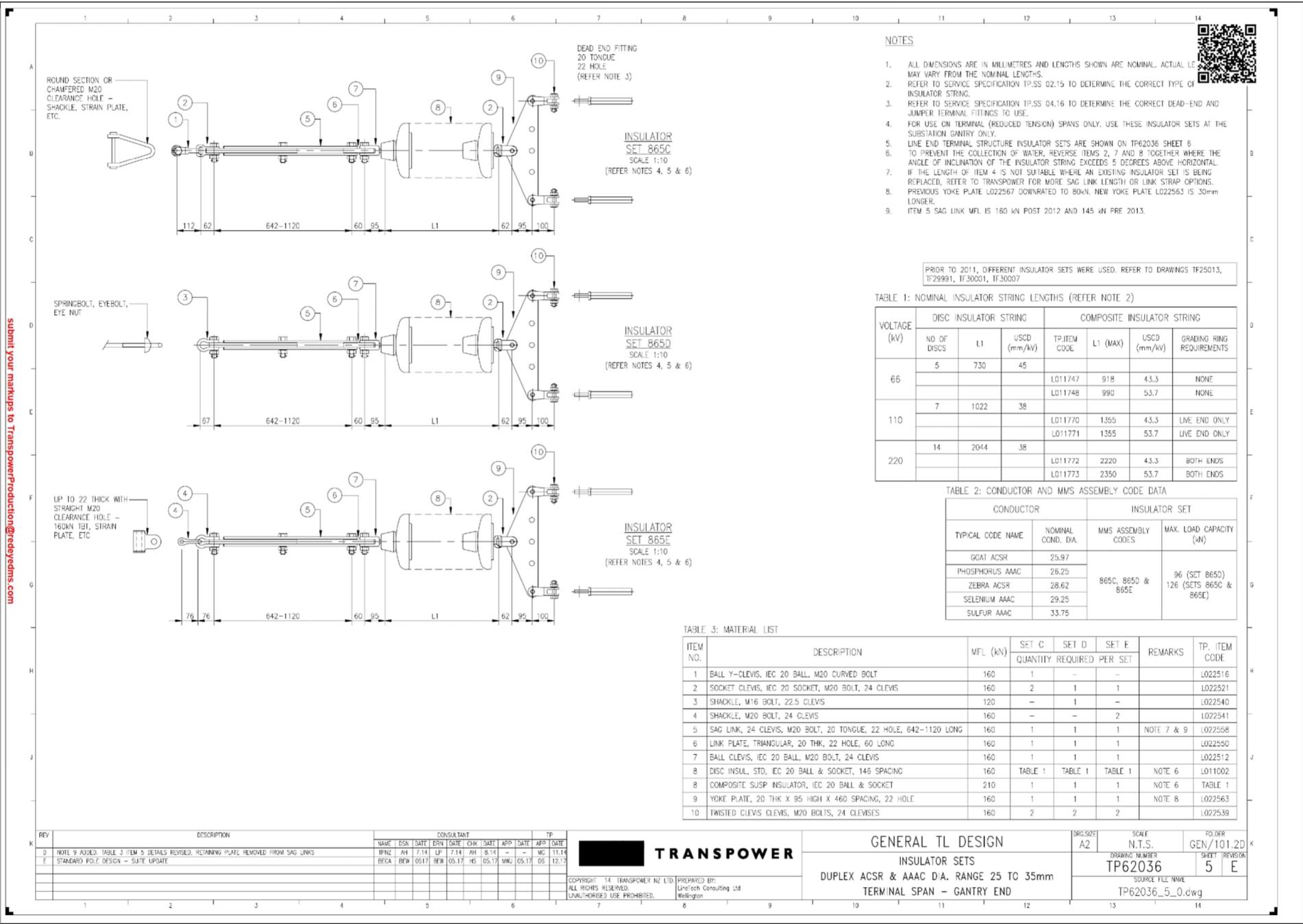
FOLDER: GEN/101.2D

DRAWING NUMBER: TP62036

SHEET: 3

REVISION: E

SOURCE FILE NAME: TP62036_3_0.dwg



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LENGTHS SHOWN ARE NOMINAL. ACTUAL LENGTHS MAY VARY FROM THE NOMINAL LENGTHS.
2. REFER TO SERVICE SPECIFICATION TP.SS 02.15 TO DETERMINE THE CORRECT TYPE OF INSULATOR STRING.
3. REFER TO SERVICE SPECIFICATION TP.SS 04.16 TO DETERMINE THE CORRECT DEAD-END AND JUMPER TERMINAL FITTINGS TO USE.
4. FOR USE ON TERMINAL (REDUCED TENSION) SPANS ONLY. USE THESE INSULATOR SETS AT THE SUBSTATION GANTRY ONLY.
5. LINE END TERMINAL STRUCTURE INSULATOR SETS ARE SHOWN ON TP62036 SHEET 6 TO PREVENT THE COLLECTION OF WATER, REVERSE ITEMS 2, 7 AND 8 TOGETHER WHERE THE ANGLE OF INCLINATION OF THE INSULATOR STRING EXCEEDS 5 DEGREES ABOVE HORIZONTAL.
6. IF THE LENGTH OF ITEM 4 IS NOT SUITABLE WHERE AN EXISTING INSULATOR SET IS BEING REPLACED, REFER TO TRANSPOWER FOR MORE SAG LINK LENGTH OR LINK STRAP OPTIONS.
7. PREVIOUS YOKE PLATE L022567 DOWNGRATED TO 80KN. NEW YOKE PLATE L022563 IS 30mm LONGER.
8. ITEM 5 SAG LINK MFL IS 160 kN POST 2012 AND 145 kN PRE 2013.

PRIOR TO 2011, DIFFERENT INSULATOR SETS WERE USED. REFER TO DRAWINGS TP25013, TP29991, TP30001, TP30007

TABLE 1: NOMINAL INSULATOR STRING LENGTHS (REFER NOTE 2)

VOLTAGE (kV)	DISC INSULATOR STRING			COMPOSITE INSULATOR STRING			
	NO OF DISCS	L1	USCD (mm/kV)	TP ITEM CODE	L1 (MAX)	USCD (mm/kV)	GRADING RING REQUIREMENTS
66	5	730	45	L011747	918	43.3	NONE
				L011748	990	53.7	NONE
	7	1022	38				
110				L011770	1355	43.3	LIVE END ONLY
				L011771	1355	53.7	LIVE END ONLY
220	14	2044	38				
				L011772	2220	43.3	BOTH ENDS
				L011773	2350	53.7	BOTH ENDS

TABLE 2: CONDUCTOR AND MMS ASSEMBLY CODE DATA

CONDUCTOR		INSULATOR SET	
TYPICAL CODE NAME	NOMINAL COND. DIA.	MMS ASSEMBLY CODES	MAX. LOAD CAPACITY (kN)
GOAT ACSR	25.97	865C, 865D & 865E	96 (SET 865D) 126 (SETS 865C & 865E)
PHOSPHORUS AAAC	26.25		
ZEBRA ACSR	28.62		
SELENIUM AAAC	29.25		
SULFUR AAAC	33.75		

TABLE 3: MATERIAL LIST

ITEM NO.	DESCRIPTION	MFL (kN)	SET C	SET D	SET E	REMARKS	TP ITEM CODE
			QUANTITY	REQUIRED	PER SET		
1	BALL Y-CLEVIS, IEC 20 BALL, M20 CURVED BOLT	160	1	-	-		L022516
2	SOCKET CLEVIS, IEC 20 SOCKET, M20 BOLT, 24 CLEVIS	160	2	1	1		L022521
3	SHACKLE, M16 BOLT, 22.5 CLEVIS	120	-	1	-		L022540
4	SHACKLE, M20 BOLT, 24 CLEVIS	160	-	-	2		L022541
5	SAG LINK, 24 CLEVIS, M20 BOLT, 20 TONGUE, 22 HOLE, 642-1120 LONG	160	1	1	1	NOTE 7 & 9	L022558
6	LINK PLATE, TRIANGULAR, 20 THK, 22 HOLE, 60 LONG	160	1	1	1		L022550
7	BALL CLEVIS, IEC 20 BALL, M20 BOLT, 24 CLEVIS	160	1	1	1		L022512
8	DISC INSUL, STD, IEC 20 BALL & SOCKET, 145 SPACING	160	TABLE 1	TABLE 1	TABLE 1	NOTE 6	L011002
8	COMPOSITE SUSP INSULATOR, IEC 20 BALL & SOCKET	210	1	1	1	NOTE 6	TABLE 1
9	YOKE PLATE, 20 THK X 95 HIGH X 460 SPACING, 22 HOLE	160	1	1	1	NOTE 8	L022563
10	TWISTED CLEVIS CLEVIS, M20 BOLTS, 24 CLEVIS	160	2	2	2		L022539

REV	DESCRIPTION	CONSULTANT	TP
D	NOTE 9 ADDED. TABLE 3 ITEM 5 DETAILS REVISED. RETAINING PLATE REMOVED FROM SAG LINKS	NAME: [REDACTED] DATE: [REDACTED] APP: [REDACTED]	DATE: [REDACTED]
E	STANDARD P.O.F. DESIGN - SUITE UPDATE	NAME: [REDACTED] DATE: [REDACTED] APP: [REDACTED]	DATE: [REDACTED]

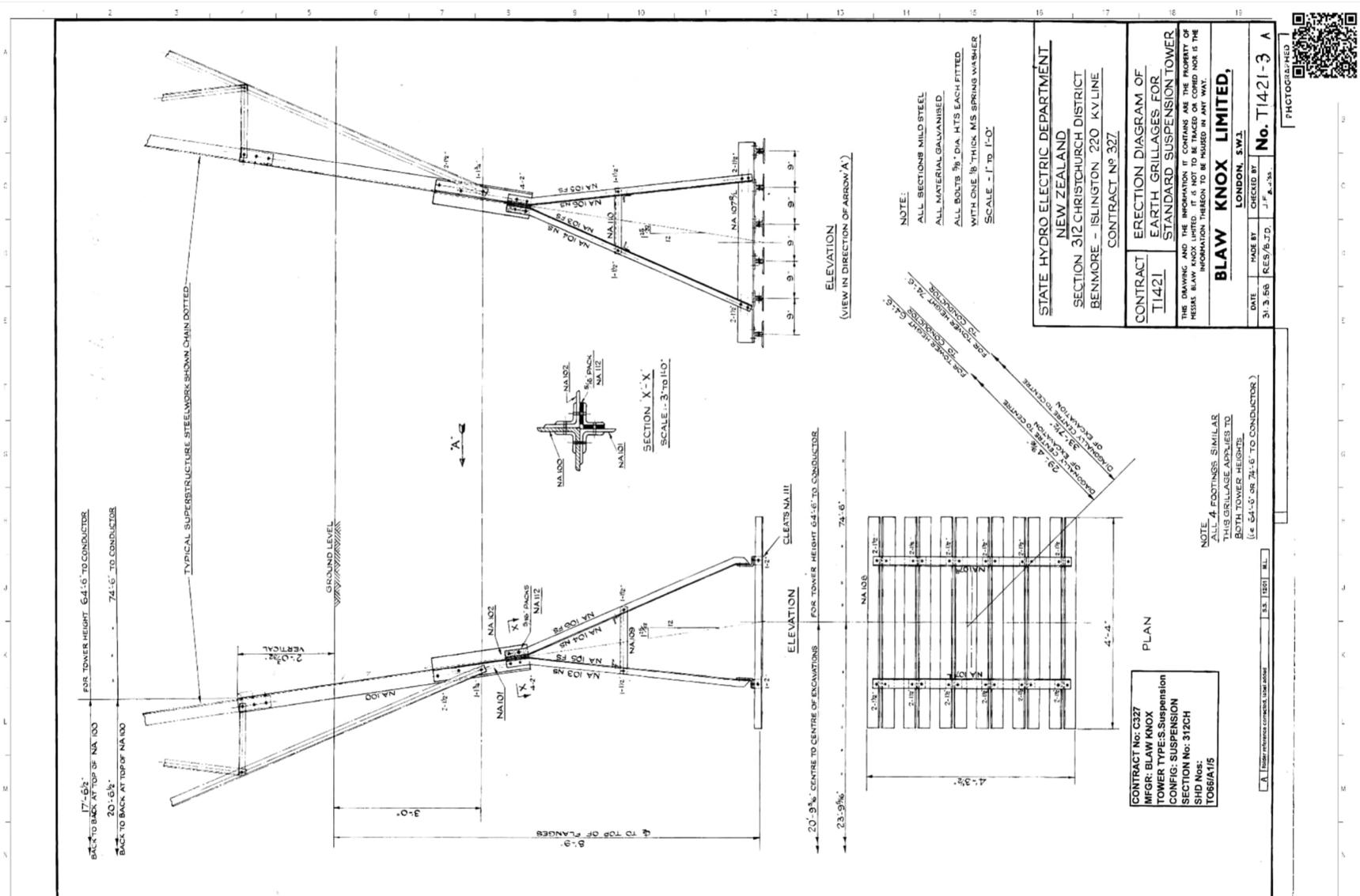


GENERAL TL DESIGN
INSULATOR SETS
DUPLX ACSR & AAAC D.I.A. RANGE 25 TO 35mm
TERMINAL SPAN - GANTRY END

ORG/SIZE A2	SCALE N.T.S.	PO.DWG GEN/101.2D
DRAWING NUMBER TP62036		SHEET REVISION 5 E
SOURCE FILE NAME TP62036_5_0.dwg		

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Appendix C – C327-A Grillage



STATE HYDRO ELECTRIC DEPARTMENT
 NEW ZEALAND
 SECTION 312 CHRISTCHURCH DISTRICT
 BENMORE - ISLINGTON 220 KV LINE
 CONTRACT NO. 327

ERECTOR DIAGRAM OF
 T1421
 EARTH GRILLAGES FOR
 STANDARD SUSPENSION TOWER

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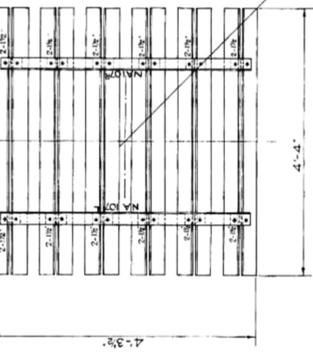
BLAW KNOX LIMITED,
 LONDON, S.W.1

DATE: 31.3.58 MADE BY: J.F.A. CHECKED BY: J.F.A. No. T1421-3 A

PHOTOGRAPHED

CONTRACT No: C327
 MFR: BLAW KNOX
 TOWER TYPE: S Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD No: T066/A15

NOTE: 4 FOOTINGS SIMILAR
 TO THIS GRILLAGE APPLIES TO
 BOTH TOWER HEIGHTS
 (i.e. 64'-6" OR 74'-6" TO CONDUCTOR)



REV	REVISION DESCRIPTION	DATE	BY	CHKD
1	AS BUILT MASTER (SHRDED & SOWER ADDED) IN DOLBY C404 (PREVIOUS VERSION)	05/20/20	MR	MR

TP.DL 12.01 WEATHER AND LOAD CASE GENERATOR FOR PLS-CADD

PLS-CADD WC & LC Generator Master Rev H.xlsx

 SITE NAME **BEN-ISL-A** SECTION **T80-T88** Revision **A**

VULNERABILITY ANALYSIS?

N

Line Reliability (return period, years)

300

Years (default 300 for Towers; 150 for standard poles)

Use this filename for this Spreadsheet

BEN-ISL-A_T80-T88_RP300yr_RevA Loading Criteria.xlsx

For PLS-CADD CRITERIA FILE NAME employ

BEN-ISL-A_T80-T88_RevA Reliability Loading 300 yrRP.cri

Select Conductor & Earthwire types & utilisation limits

(select *None* if not applicable)

VDC %UTS

MWT %UTS

MOT

Cable Filename

Conductor (Required)

1
Goat_ACSR_GZ_Pre1994
22%
70%
50°C
r_gz_greased_pre1968_tp-wir-5

Conductor

2
None

Conductor

3
None

Conductor

4
None

Earthwire

1
7_3.71_SCGZ
22%
70%
7_3-05_scac_greased_l.wir

Earthwire

2
None

Earthwire

3
None

Earthwire

4
None
LINE SECTION LOCATION INFORMATION

Wind Loading Site Specific (SS) or Generic (GL)

GL

Provide additional data below & employ generic wind speeds given in Tab Staking table

North or South Island

S

(N or S)

Portion of Line <5km from Coast?

N

 for t_{min}

Max GROUND LEVEL Altitude along line section

500

m (NZGD2000 - refer ADEGL.02.25)

Wind Zone (Ref TP.DL 12.01 Appendix B. Figure B-1)

A7

(If more than one wind zone refer to Transpower)

TP.DL 12.01 Ice Zone

S

Ref Appendix B. Figure B-2

SECURITY Level (for RSL loading) Default = 1

1

RSL Loading based on 100Pa Wind

Failure Containment (FC) on all structures ?

N

In Staking table identify which structures are 'STOP' Structures

Identify deflection & cracking specification, if applicable

N

"N" = Not applicable (towers), "SP" = Standard Steel / Concrete Pole to TP.PL 01.15

"XP" = Standard steel pole to TP.PL 01.20; "WP" = Standard Wood pole to TP.PL 01.11

This ADDITIONAL data required when Generic loading selected

The following regional wind speed has been selected

 $V_{1000,Z=10,Cat=2}$
46

with

0.953

Mrp for 300 years return period

Select Min Terrain Category

2.5

Ref AS/NZS 1170.2 4.2.1 & Amdt 2

Structures

15
30

Select Average Height area centroid >GL (m)

 Terrain Height Multiplier $M_{z,CAT}$
0.97
1.05

Wind speed Topographic factors

1
1

 Effects of M_v , M_s , M_{lee} ($M_d = 1$)

Average span (m)

350

Span to be representative (small spans result in higher loading)

Span Reduction Factor

0.75

 Employ the following generic wind speeds for $V(rp1000,z=15,cat=2.5)$
45.00
42.51

m/s [Enter in Staking Table]

COMMENTS:

1

2

PLS-CADD STRUCTURE GROUPS
BEN-ISL-A T80-T88 Rev A

PLS-CADD WC & LC Generator Master Rev H.xlsx

500 Max height (from Staking Table); **ROUND UP** to nearest 100m
3 Enter number of height intervals (max 3)

These are the structure groups to be included; Grey indicates the CADD default group "All";
 the others are line specific but may be included as defaults

IF REQUIRED THE HEIGHT BANDS MAY BE ADJUSTED MANUALLY Filter to remove blank rows and copy orange columns to PLS-CADD

Height Bands		PLS-CADD INPUT [CRITERIA \ STRUCTURE LOADS (METHODS 3, 4)... \ STRUCTURE GROUPS]				PURPOSE
Min	Max	Group Name	Group Description	Rule For Group Membership		
	-	All	Built in group that all structures belong to	Automatic: all structures		Default - Automatic - all structures
	DEFAULT	PLS-POLE	PLS-POLE created structure	Automatic: PLS-POLE created		TP for pole serviceability cases
0	200	GL Max 200m	GL not more than 200m	Automatic: str. base elevation inside 0.00 to 200.00 (m)		For elevation dependent load cases
200	400	GL Max 400m	GL not more than 400m	Automatic: str. base elevation inside 200.00 to 400.00 (m)		For elevation dependent load cases
400	500	GL Max 500m	GL not more than 500m	Automatic: str. base elevation inside 400.00 to 500.00 (m)		For elevation dependent load cases
	DEFAULT	Stop	Designated Stop Structure	Manually assigned by user		For Failure containment cases restricted to "stop" structures
0	200	Stop GL Max 200m	Stop with GL up to 200m	Automatic: str. base elevation inside 0.00 to 200.00 (m) and inside all following groups 'Stop'		For height dependent FC cases restricted to stop structures
200	400	Stop GL Max 400m	Stop with GL up to 400m	Automatic: str. base elevation inside 200.00 to 400.00 (m) and inside all following groups 'Stop'		For height dependent FC cases restricted to stop structures
400	500	Stop GL Max 500m	Stop with GL up to 500m	Automatic: str. base elevation inside 400.00 to 500.00 (m) and inside all following groups 'Stop'		For height dependent FC cases restricted to stop structures
						Line specific - as required
						Line specific - as required
						Line specific - as required
						Line specific - as required
						Line specific - as required
						Line specific - as required
						Line specific - as required

PLS-CADD WEATHER CASES BEN-ISL-A T80-T88 Rev A

FOLLOWING WEATHER CASES APPLICABLE TO SITES WITH GROUND ELEVATIONS < 500 m FOR DEFAULT TP.DL 12.01 ANALYSES

PLS-CADD WC & LC Generator Master Rev H.xlsx

- 1) Select Weather Case "1" (checks to see if the case is "loaded") - These also include the default weather cases for Safety, Serviceability, etc.
- 2) Cases with "1" are those that are Lines with more than one wind region. Select "W" (=Wind) after resetting previous columns
- 3) "Repeat" Cases for Lines with more than one height range. Select "H" (=Height) after resetting previous columns

CONTROL COLUMNS				CASE SELECTION			PLS-CADD DATA INPUT [Criteria \ Weather]												
WEATHER CASE	Weather Case ID	Weather Case Return Period (Years)	Coincident Wind Return Period (years)	Weather case reqd [Select 1]	Wind Region [Select A, W]	Height Dependent Case [Select H]	Description	Air Density Factor (Q) (kg/m ³) (Pa/(m/s) ²)	Wind Velocity (m/s)	Wind Pressure (Pa)	Wire Ice Thickness (cm)	Wire Ice Density (N/m ³)	Wire Ice Load (N/m)	Wire Temp. (deg C)	Ambient Temp. (deg C)	Weather Load Factor	NESC Constant (N/m)	Wire Wind Height Adjust Model	Wire Gust Response Factor
Maximum Wind conditions	MW	300	300	1	A	H	MW0300_A5	0.6	0.953	0.545	0.0	0	0	7		1		Apply Span Specific Wind & Ice Adj.	1
Minimum Temperature with wind	MT	300	300	1	A	H	MT0300_A5	0.6	0.572	0.196	0.0	0	0	-11		1		Apply Span Specific Wind & Ice Adj.	1
Extreme Snow	ES	50	-	1	-	H	ES0050_5	0.6	5.774	20	3.0	3900	0	-5		1		None	1.2
Cascade & RSL Wind	RW	1	-	1	-	H	RW0001_5	0.6	12.910	100	0.0	0	0	5		1		None	1
Cascade & RSL Snow	RS	1	-	1	-	H	RS0001_5	0.6	0	0	1.0	3900	0	-5		1		None	1.2
Default C&M	CM1	-	-	1	-	-	CM1	0.6	12.910	100	0.0	0	0	5		1		None	1
Extended C&M Works (Summer)	CM2	-	1	1	A	-	CM2_A	0.6	0.565	0.192	0.0	0	0	5		1		Apply Span Specific Wind & Ice Adj.	1
Extended C&M Works (with snow)	CM2S	-	-	1	-	H	CM2S_5	0.6	5.774	20	1.0	3900	0	-5		1		None	1.2
Delayed Strengthening (Summer)	CM3	-	4	1	A	H	CM3_A5	0.6	0.681	0.278	0.0	0	0	-11		1		Apply Span Specific Wind & Ice Adj.	1
Delayed Strengthening (Snow)	CM3S	-	-	1	-	H	CM3S_5	0.6	5.774	20	1.0	3900	0	-5		1		None	1.2
Vibration Damage Control	VDC	-	-	1	-	-	VDC	0.6	7.071	30	0.0	0	0	5		1		None	1
Everyday still air	EDS	-	-	1	-	-	EDS	0.6	0	0	0.0	0	0	5		1		None	1
Everyday Wind (Structural)	EDW	-	-	1	-	-	EDW	0.6	12.910	100	0.0	0	0	5		1		None	1
Falling Tree Deflection TP.SS 02.18	FTD	-	-	1	-	-	FTD	0.6	18.257	200	0.0	0	0	35		1		None	1
Maximum Operating Temperature Condr 1	MOT	50	-	1	-	-	MOT_50	0.6	0	0	0.0	0	0	50		1		None	1
Everyday wind deflection Condr 1	EDD	50	-	1	-	-	EDD_50	0.6	12.910	100	0.0	0	0	35		1		None	1
High Wind Deflection Condr 1	HWD	50	3	1	A	-	HWD_A50	0.6	0.658	0.260	0.0	0	0	32		1		Apply Span Specific Wind & Ice Adj.	1
Maximum Wind deflection Condr 1	MWD	50	50	1	A	-	MWD_A50	0.6	0.854	0.438	0.0	0	0	32		1		Apply Span Specific Wind & Ice Adj.	1
Snow Deflection – Still air	SDS	-	-	1	-	H	SDS_5	0.6	0	0	3.0	3900	0	-5		1		None	1.2
Snow Deflection – Wind 50%P _{des}	SDD	-	-	1	-	H	SDD_5	0.6	4.082	10	3.0	3900	0	-5		1		None	1.2
Snow Deflection – No snow	SDO	-	-	1	-	-	SDO	0.6	0	0	0.0	0	0	-5		1		None	1
Thin (and thick) Ice – No Ice	TIO	-	-	1	-	-	TIO	0.6	0	0	0.0	0	0	-11		1		None	1
Minimum Temp Still air	MTS	-	-	1	-	H	MTS_5	0.6	0	0	0.0	0	0	-11		1		None	1
Support replace criteria 10 year for wind	RCW	15	15	1	A	H	RCW_A5	0.6	0.777	0.362	0.0	0	0	7		1		Apply Span Specific Wind & Ice Adj.	1
CA criteria wind 6 year	CA6	10	10	1	A	H	CA6_A5	0.6	0.749	0.337	0.0	0	0	7		1		Apply Span Specific Wind & Ice Adj.	1
CA criteria Wind Orange Tag	CA1	4	4	1	A	H	CA1_A5	0.6	0.681	0.278	0.0	0	0	7		1		Apply Span Specific Wind & Ice Adj.	1
CA criteria Wind Red Tag	CA0	2	2	1	A	H	CA0_A5	0.6	0.625	0.234	0.0	0	0	7		1		Apply Span Specific Wind & Ice Adj.	1
Support Replacement criteria snow	RCS	-	-	1	-	H	RCS_5	0.6	0	0	1.0	3900	0	-5		1		None	1.2



BEN-ISL-A T80-T88 Rev A

PLS-CADD WC & LC Generator Master Rev H.xlsx

Criteria / Cable Tensions

Cable *.wir file must be saved in directory **BEN-ISL-A_T80-T88\PLS\Cables**

This tab does not require any input - merely select the appropriate rows and copy to PLS-CADD

FIRST Case Applicable ? [Select 1]	SECOND Height Dependent?	Weather Case	Cable Condition	% of Ultimate	Maximum Tension (N)	Maximum Catenary (m)	Applicable Cable (blank=all cables)
1		VDC	Creep FE	22%			goat_acsr_gz
1		VDC	Creep FE	22%			7 3-
1	YES	MW0300_A5	Creep FE	70%			goat_acsr_gz_greased_pre1968
1	YES	MW0300_A5	Creep FE	70%			7 3-05_scac_grease
1	YES	MT0300_A5	Creep FE	70%			goat_acsr_gz_greased_pre1968
1	YES	MT0300_A5	Creep FE	70%			7 3-05_scac_grease
1	YES	ES0050_5	Creep FE	70%			goat_acsr_gz_greased_pre1968

BEN-ISL-A T80-T88 Rev A
PLS-CADD STRUCTURE LOAD CRITERIA

PLS-CADD WC & LC Generator Master Rev H.xlsx

INSTRUCTIONS
STAKING TABLE
CONTROL INPUT

STRUCTURE GROUPS
WEATHER CASES
PLS-CADD

Failure Containment on all structures? N [Data input]

Table with columns: Description, Weather case, Cable condition, Wind Direction, Bleasor, Wind Dir (deg), Wire Vert. Load Factor, Wire and Struct. Wind Load Factor, Wire Tension Load Factor, Struct. Weight Load Factor, Struct. Wind Area Factor, Struct. Wind Load Model, Struct. Ice Thickness (cm), Struct. Ice Density (N/m^3), Strength Factor Steel Poles Tubular, Strength Factor Wood Poles, Strength Factor Concrete Poles Ultimate, Strength Factor Concrete Poles First Crack, Strength Factor Concrete Poles Zero Tension, Strength Factor Guy, Strength Factor Non-Tubular Arms, Strength Factor Bases, Strength Factor Insulators, Strength Factor Hardware, Strength Factor Foundation, Structures Groups On Which To Apply, Pole Tip Deflection Check (PLS-POLE only), Pole Tip Deflect. Limit % or (in), Adjust Cable Loads, #1 Wire(s) Set Phase Span, #1 Command, #2 Wire(s) Set Phase Span, #2 Command, #3 Wire(s) Set Phase Span, #3 Command, #4 Wire(s) Set Phase Span, #4 Command, #5 Wire(s) Set Phase Span, #5 Command, #6 Wire(s) Set Phase Span, #6 Command, #7 Wire(s) Set Phase Span, #7 Command.

PLS-CADD INPUT - COPY AND PASTE TO [CRITERIA \ STRUCTURE LOADS (METHODS 3, 4...)]

Table with columns: Description, Weather case, Cable condition, Wind Direction, and various structural load criteria (e.g., Strength Factor, Pole Tip Deflection, Adjust Cable Loads, #1 Wire(s) Set Phase Span, #2 Wire(s) Set Phase Span, #3 Wire(s) Set Phase Span, #4 Wire(s) Set Phase Span, #5 Wire(s) Set Phase Span, #6 Wire(s) Set Phase Span, #7 Wire(s) Set Phase Span).

PLS-CADD INPUT - COPY AI

Description	Weather case	#7 Value [%] (# subcond.) [N] (deg)	#8 Wire(s) Set Phase Span	#8 Command	#8 Value [%] (# subcond.) [N] (deg)	#9 Wire(s) Set Phase Span	#9 Command	#9 Value [%] (# subcond.) [N] (deg)	#10 Wire(s) Set Phase Span	#10 Command	#10 Value [%] (# subcond.) [N] (deg)	#11 Wire(s) Set Phase Span	#11 Command	#11 Value [%] (# subcond.) [N] (deg)	#12 Wire(s) Set Phase Span	#12 Command	#12 Value [%] (# subcond.) [N] (deg)	#13 Wire(s) Set Phase Span	#13 Command	#13 Value [%] (# subcond.) [N] (deg)	#14 Wire(s) Set Phase Span	#14 Command	#14 Value [%] (# subcond.) [N] (deg)	#15 Wire(s) Set Phase Span	#15 Command	#15 Value [%] (# subcond.) [N] (deg)	#16 Wire(s) Set Phase Span	#16 Command	#16 Value [%] (# subcond.) [N] (deg)	#17 Wire(s) Set Phase Span	#17 Command	#17 Value [%] (# subcond.) [N] (deg)	#18 Wire(s) Set Phase Span	#18 Command	#18 Value [%] (# subcond.) [N] (deg)	#19 Wire(s) Set Phase Span	#19 Command	#19 Value [%] (# subcond.) [N] (deg)	
CM1+E NA+	CM1																																						
CM1+DA NA+	CM1																																						
CM1+DB NA+	CM1																																						
CM1+E NA-	CM1																																						
CM1+DA NA-	CM1																																						
CM1+DB NA-	CM1																																						
CM2 A+E NA+	CM2 A																																						
CM2 A+DA NA+	CM2 A																																						
CM2 A+DB NA+	CM2 A																																						
CM2 A+E NA-	CM2 A																																						
CM2 A+DA NA-	CM2 A																																						
CM2 A+DB NA-	CM2 A																																						
CM25 S+E NA-	CM25 S																																						
CM25 S+DA NA-	CM25 S																																						
CM25 S+DB NA-	CM25 S																																						
CM3 AS+E NA+	CM3 AS																																						
CM3 AS+DA NA+	CM3 AS																																						
CM3 AS+DB NA+	CM3 AS																																						
CM3 AS+E NA-	CM3 AS																																						
CM3 AS+DA NA-	CM3 AS																																						
CM3 AS+DB NA-	CM3 AS																																						
CM3 S+E NA-	CM3 S																																						
CM35 S+DA NA-	CM35 S																																						
CM35 S+DB NA-	CM35 S																																						
RCW AS+ NA+	RCW AS																																						
RCW AS+ NA-	RCW AS																																						
RCS S+ NA+	RCS S																																						
RCS S+ NA-	RCS S																																						
CA6 AS+ NA+	CA6 AS																																						
CA6 AS+ NA-	CA6 AS																																						
CA1 AS+ NA+	CA1 AS																																						
CA1 AS+ NA-	CA1 AS																																						
CA0 AS+ NA+	CA0 AS																																						
CA0 AS+ NA-	CA0 AS																																						
EDS+ NA+	EDS																																						
EDW+ NA+	EDW																																						
EDW+ NA-	EDW																																						
HWD AS0+ NA+	HWD AS0																																						
HWD AS0+ NA-	HWD AS0																																						
MWD AS0+ NA+	MWD AS0																																						
MWD AS0+ NA-	MWD AS0																																						
MOT 50+ NA+	MOT 50																																						

Conductor Type	Goat ACSR/GZ
a.c. or d.c.	a.c.
Voltage (kV _{rms})	220
Configuration	Duplex
Line Rating Methodology	Latta
Maximum Conductor Temperature (°C)	50.0

Conductor: Goat ACSR/GZ Diameter: 25.97mm DC Resistance 20°C: 0.089 Ω/km α: 0.00403 Ω/°C
 Core: 7/3.71mm 593kg/km St Outer Layers: 30/3.71mm 895kg/km Al

Basic Parameters	
Solar Absorptivity	0.7
Emissivity	0.7
Mean Height Above Sea Level (m)	500
Wind Direction on Conductor (°)	90.0
Albedo (Reflectance of Earth) F	0.15
Azimuth of Conductor (°)	45.0
Day of the year	1
Time of Day (24 hrs)	12.0
Latitude (°)	-44.0

Historically, ratings have been calculated with values of:
 Solar Absorptivity = 0.5, Emissivity = 0.5.
 ACI Ratings are still based on these historic parameters.

1 January

Static Conductor Rating	
Ambient Temperature (°C)	30.0
Wind Speed (m/s)	0.61
Solar Radiation (W/m ²)	0
Static Conductor Rating (A)	1103
Apparent Power (MVA)	420

Manually Entered Solar Radiation = 1381

Static Conductor Temperature	
Static Conductor Rating (A)	1103
Ambient Temperature (°C)	1.0
Wind Speed (m/s)	0.61
Solar Radiation (W/m ²)	-
Static Conductor Temperature (°C)	

RUN MACRO AGAIN

Calculated Solar Radiation = -

Transient Current Limit	
Ambient Temperature (°C)	30.0
Wind Speed (m/s)	0.61
Solar Radiation (W/m ²)	-
Initial Condition	Manually Enter Conductor Current
Initial Conductor Current (A)	100
Transient Time Period (s)	900
Transient Current Limit - Quick (A)	
Transient Current Limit - Solver (A)	

RUN MACRO AGAIN

Calculated Solar Radiation = -

Appendix B

External Clearances

Far North Solar External Clearance

Structure Number	Clearance Above required Margin (m)						
	Ground			Vegetation		Roads	
	Existing Configuration	Proposed Configuration	Ground @ 75°C MOT in Proposed Configuration°	Existing Configuration	Proposed Configuration	Existing Configuration	Proposed Configuration
79-80	1.56	1.43	0.65	4.07	4.07	2.87	2.82
80-81	2.19	2.2	1.45	4.44	4.45	-	-
81-82	0.67	0.69	-0.35	16.03	16.03	-	-
82-83	1.02	0.98	-0.06	15.55	15.55	-	-
83-84	1.3	-	-	15.46	-	2.07	-
83-83A	-	5.93	5.79	-	15.7	-	6.15
83A-GANTRY 1	-	1.63	1.86	-	-	-	-
GANTRY 2-83A	-	1.69	1.62	-	-	-	-
83A-84	-	1.92	5.43	-	15.65	-	6.16
84-85	1.32	1.25	0.26	15.5	15.5	6.11	6.16
85-86	1.62	1.53	0.61	15.74	15.74	-	-
86-87	1.03	0.98	0.07	13.28	13.28	-	-
87-88	1.03	0.96	0.04	15.63	15.63	-	-

Appendix C

Internal Clearance

FNS 'The Point' GIP Structure Clearance



DESIGN	SM	9/04/2024
CHK'D		
DRAWN		
APP		

Revision	Description	Date
1	Issued For Review	20/03/2024
2		
3		

Structure ID	Proposed Structure Clearance (m)							
	Required HWD Clearance (m)	HWD Actual Clearance (m)	Margin Above Required (m)	OK	Required EDD Clearance (m)	EDD Actual Clearance (m)	Margin Above Required (m)	OK
83	0.75	1.214	0.464	OK	1.90	2.156	0.256	OK
83A	0.75	1.654	0.904	OK	1.90	2.420	0.520	OK
84	0.75	1.210	0.460	OK	1.90	2.160	0.260	OK

Appendix D

Blowout

Far North Solar 'The Point' Blowout Report



Notes:

- 1 Blowouts are calculated in accordance with Section 8.8 of TP.DL 12.02, Issue 2.1, Sept 2020.
- 2 Blowout values are maximum blowout from centre line of all conductors in each span
- 3 Positive comparison number indicates increase in maximum conductor blowout from centre line

SI	Span	Existing - Duplex Goat GZ			Proposed - Duplex Goat GZ @ 50°C (m)			Comparison : Rectified 50°C - Existing (m)			Easement check (OK/NG?)		
		No.	FROM -TO	HWD	MWD	MAX	HWD +4.5m + 0.5m	MWD	Max	HWD + 4.5m + 0.5m		Max. Wind + 0.5m	Max
79	79 - 80			12.7	8.2	12.7	12.7	8.2	12.7	0.00	0.00	0.00	OK
80	80 - 81			12.8	8.3	12.8	12.8	8.3	12.8	0.00	0.00	0.00	OK
81	81 - 82			13.1	9.0	13.1	13.1	9.0	13.1	0.00	0.01	0.00	OK
82	82 - 83			24.8	24.6	24.8	24.7	24.7	24.7	-0.18	0.09	-0.12	OK
83	83 - 83A			-	-	-	13.9	10.4	13.9	-	-	-	-
83A	83A - 84			-	-	-	14.1	10.8	14.1	-	-	-	-
83	83 - 84			25.7	25.3	25.7	-	-	-	-	-	-	-
84	84 - 85			24.9	24.9	24.9	25.0	25.5	25.5	0.10	0.52	0.52	NG
85	85 - 86			13.1	8.8	13.1	13.1	8.9	13.1	0.00	0.04	0.00	OK
86	86 - 87			12.0	7.5	12.0	12.0	7.5	12.0	0.00	0.00	0.00	OK
87	87 - 88			12.0	7.5	12.0	12.0	7.5	12.0	0.00	0.00	0.00	OK

Appendix E

Condition Assessment

FNS 'The Point' GIP Condition Assessment



Tower Condition Assessment										
Structure ID	Crossarm Steel			Lower Body Steel			Upper Body Steel			Date of Assessment
	Condition Assessment %									
	60%	70%	80%	60%	70%	80%	60%	70%	80%	
79	0	50	50	0	50	50	5	50	45	24/07/2019
80	40	60	0	35	65	0	35	65	0	24/07/2019
81	0	50	50	0	50	50	10	50	40	24/07/2019
82	10	90	0	10	90	0	10	90	0	25/07/2019
83	0	20	80	0	20	80	5	20	75	25/07/2019
84	0	80	20	0	80	20	0	80	20	25/07/2019
85	0	20	80	0	20	80	10	10	80	25/07/2019
86	0	40	60	0	40	60	0	50	50	25/07/2019
87	0	20	80	0	20	80	0	20	80	3/09/2018
88	0	15	85	0	10	90	0	15	85	3/09/2018

Insulator Condition Assessment			
Structure ID	Insulator CA	Date of Assessment	Comment
79	80	24/07/2019	Jumper cold end minor wear hotend ZCP
80	85	24/07/2019	Armour rods on jumper hardware weathering main and jumper components
81	70	24/07/2019	Cold end minor wear .hotend ZCP
82	60	25/07/2019	Wear cold end shackles
83	65	25/07/2019	Rust stain and 2mm wear on cold endZCP hotend minor
84	60	25/07/2019	Wear cold end shackles
85	75	25/07/2019	ZCP hot end and minor wear from rubbing at shackle
86	60	25/07/2019	Wear cold end shackles weathering of components
87	85	3/09/2018	<Not Specified>
88	70	3/09/2018	Minor wear cold end

Appendix F

Structure Utilisations

FNS 'The Point' GIP Structure Utilisations

Structure ID	Structure Utilisation			
	Existing (%)	Load Case	Proposed (%)	Load Case
83	148.7	MW0300_A5+DB BI-+00,T BI-	125.02	MW0300_A5+E BI-+15,T BI-
83A	-	-	40.00	ES0050_5+TA23 NA+,T NA+
84	167.2	MW0300_A5+DA BI++00,T BI+	130.14	MW0300_A5+E BI-+00,T BI-

Structure ID	CM1	CM2
83	69.97	91.51
83A	0	0
84	71.33	93.31

Appendix G

Generic Wind Speeds

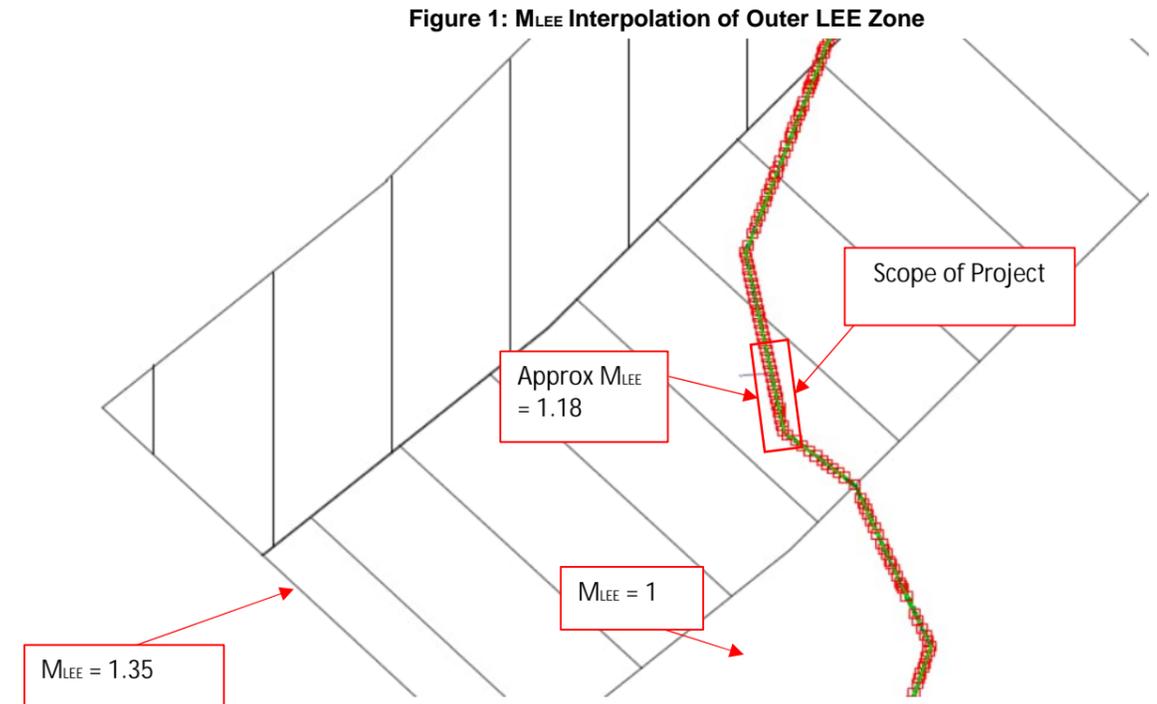
FNS 'The Point' Generic Wind Speed Calculation



Structure Number	Span Length (m)	Structure Height (m)	Centroid of Structure (0.5 * Struc Height) (m)	Conductor Centroid (From table below)	Structure Output from Loading Criteria Spreadsheet (m/s)	Conductor Output from Loading Criteria Spreadsheet (m/s)
82	398.3	30.04	15.0	16.3	57.00	48.84
83	198.0	30.04	15.0	20.2	57.00	53.16
83A	198.0	33.7	16.9	20.2	58.00	53.16
84	396.1	30.04	15.0	16.4	57.00	48.87

- Input
- Input to TP Load Case Generator Spreadsheet
- Calculation
- Output from TP Load Case Generator (Input to to PLS CADD)

Input Calculations for TP Loading Criteria Spreadsheet (Figure 2)	
Min Terrain Category = 2 As per AS_NZS 1170.2 Sec 4.2.1	
Average Structure Height area centroid = Height of Tower x 0.5 (TP.DL 12.01 Fig 5)	
Average Conductor Height area centroid = Average Conductor Attachment Height (TP.DL 12.01 Fig 5)	
Wind speed Topographic Factors = 1.18	
- Mt = 1	
- Ms = 1	
- M _{LEE} = 1.18 (Linear Interpolation from Figure 1)	
- Mt = 1	
Average Span Length	



Wind height of Conductors									
Back Span Struc ID	n (Conductor Att. Height [m])							\bar{Z}_c	Notes
	1 (Back Span)	2 (1/6 of span)	3 (2/6 of span)	4 (Mid Span)	5 (4/6 of Span)	6 (5/6 of Span)	7 (Ahead Span)		
82	22.6	16.3	12.5	11.3	12.5	16.3	22.6	16.30	
83	22.6	21	19.5	19.1	19	19.6	20.6	20.20	Conductor Height take from middle phase
83A	20.6	19.6	19	19.1	19.5	21	22.6	20.20	Conductor Height take from middle phase
84	22.6	16.5	12.6	11.3	12.6	16.5	22.6	16.39	

Wind Height of Conductors as per Fig 5 TP.DL 12.01 = $\bar{Z}_c = \sum_1^n \frac{Z_c}{n}$

Figure 2 - TP Loading Criteria Speasheet used to Produce Generic Wind speeds
This ADDITIONAL data required when Generic loading selected The following regional wind speed has been selected

$V_{1000,z=10,cat=2}$	46	with	0.953	Mrp for 300 years return period
Select Min Terrain Category	2			Ref AS/NZS 1170.2 4.2.1 & Amdt 2
	Structures		Condrs	
Select Average Height area centroid >GL (m)	19.3		14.9	
Terrain Height Multiplier $M_{z,CAT}$	1.07		1.04	
Wind speed Topographic factors	1.18		1.18	Effects of M_t, M_s, M_{lee} ($M_d = 1$)
Average span (m)	398			Span to be representative (small spans result in higher load)
Span Reduction Factor			0.73	
Employ the following generic wind speeds for $V(rp1000,z=19.3,cat=2)$	59.00		48.65	m/s [Enter in Staking Table]

Appendix H

C327-A Tower Drawings



Print Transcript

Generated By: Eisuke Morioka (eisuke.morioka@aecom.com)
Date Requested: 06/12/2023 5:38pm (NZDT)
Source: Transpower Production
Artefacts Total: 52



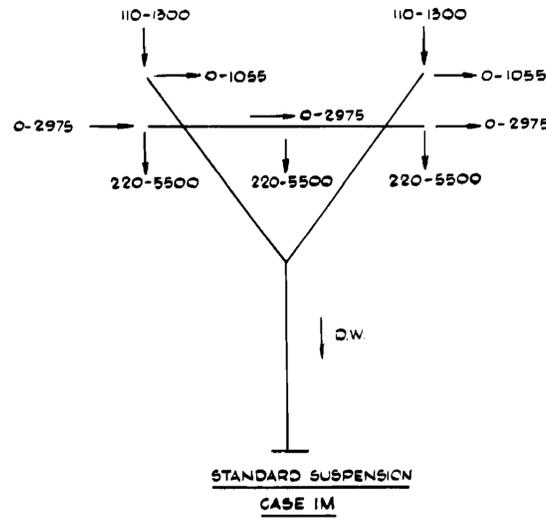
Printed Artefacts

Artefact Number Artefact Title

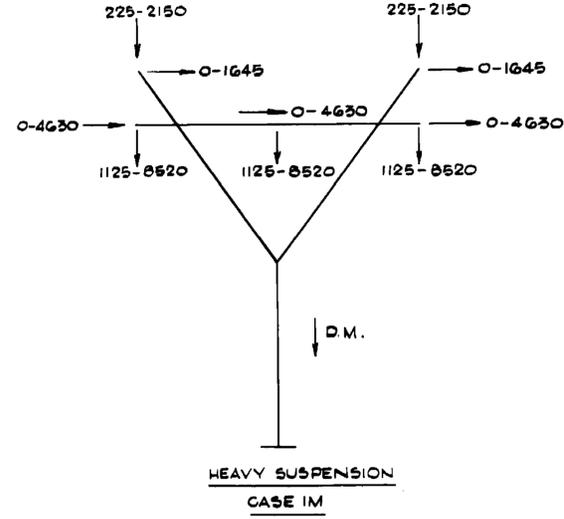
E7673	BENMORE-ISLINGTON 220KV LINE TOWER CONTRACT FOR C327 DISTRIBUTION OF LOADS FOR MODIFIED TOWERS
F4631	BENMORE-ISLINGTON 220KV LINE STANDARD SUSPENSION TOWER
F4631_1	BENMORE-ISLINGTON 220KV LINE LIGHT SUSPENSION TOWER
T1421-P_101	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_102	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_111	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_112	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_113	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_114	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_115	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_116	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_117	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_118	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_119	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_120	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST

T1421-P_121	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_122	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_123	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_124	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_125	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_126	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_127	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_128	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421-P_129	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER PACKING LIST
T1421_1	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER DETAIL OF SHACKLE
T1421_2	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER STRINGING ARRANGEMENT
T1421_3	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER ERECTION DIAGRAM EARTH GRILLAGES
T1421_9	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER ERECTION DIAGRAM SHEET 1 OF 2
T1421_10	BENMORE-ISLINGTON 220KV LINE TOWER CONTRACT 327 STANDARD SUSPENSION TOWER ERECTION DIAGRAM
TE38857_1	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_2	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_3	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_4	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_5	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_6	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_7	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TE38857_8	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATIONS FABRICATION DETAILS
TP103684	PLACEHOLDER - C327 TYPE A TOWER;SHOP DETAILS;MEMBER ##;{Optional}
TP107869	PLACEHOLDER;TOWER TYPE C327-A;ELECTRICAL CLEARANCE DIAGRAM;SET UTILISATION LIMITS;{Optional}
TZ10823_1	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION MODIFIED TOWER
TZ10823_2	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION TOP OF CROSSARM
TZ10823_3	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION SIDE OF CROSSARM
TZ10823_4	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION TOWER BODY
TZ10823_5	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION LEG DETAIL
TZ10823_6	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION TOWER WAIST
TZ10823_7	BENMORE-ISLINGTON A C327/S.SUS - TOWER MODIFICATION 4A, 4B, 4C FIT
XM3298_10	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER DESIGN OF SHEET 1 OF 4

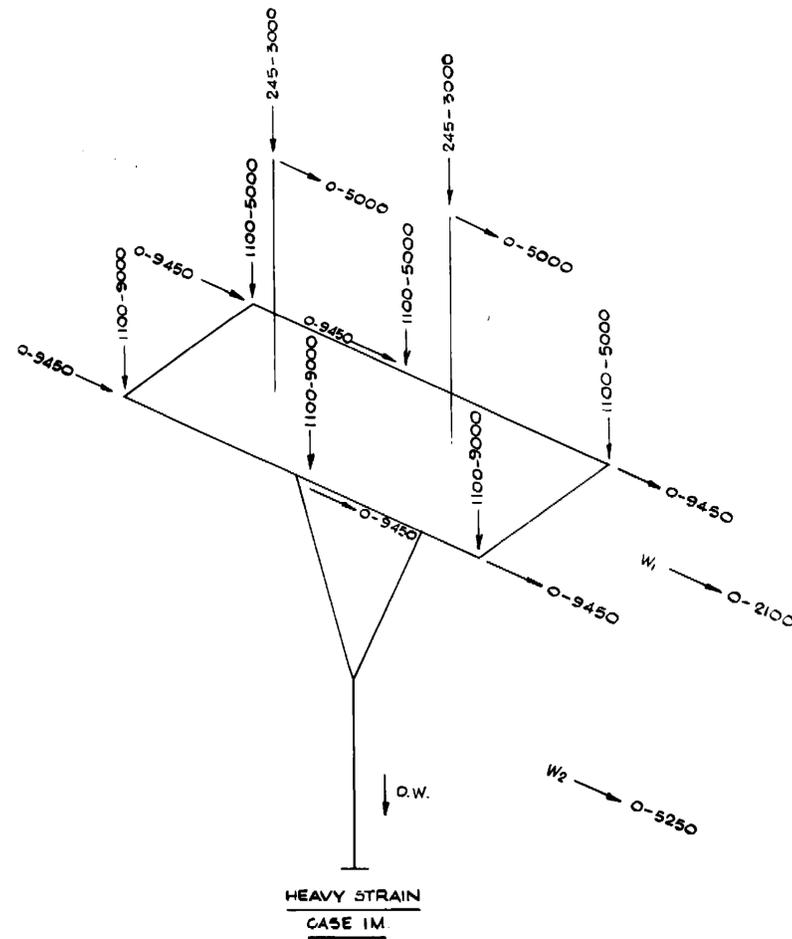
XM3298_11	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER DESIGN OF SHEET 2 OF 4
XM3298_12	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER DESIGN OF SHEET 3 OF 4
XM3298_13	TOWER CONTRACT C327 HEAVY SUSPENSION TOWER ERECTION DIAGRAM
XM3298_15	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER GENERAL ARRANGEMENT SHEET 1 OF 2
XM3298_16	TOWER CONTRACT C327 STANDARD SUSPENSION TOWER GENERAL ARRANGEMENT SHEET 2 OF 2



W₁ → O-990
W₂ → O-4435



W₁ → O-1075
W₂ → O-4435
W₃ → O-4900



NOTES
FOR ALL TOWERS, FACTOR OF SAFETY TO BE MINIMUM OF 1.65.
ALL LOADS ARE EXPRESSED IN LB.

COMBINE WORST T WITH WORST V PLUS D.W.
WORST T WITH LEAST V PLUS D.W.
LEAST T WITH WORST V PLUS D.W.

DESIGN EACH MEMBER ON WORST LOADING FROM ABOVE COMBINATIONS.
STRESS TABULATION X3857.

C327
MFGR: BLAW KNOX
TOWER TYPE: S.SUS, H.SUS, H.STR
CONFIG:
SECTION No: 312CH
SHD Nos:
T066/A1/1, T066/A2/1, T066/A3/1

CONTRACT 327

GRAPHIC SCALE			AMENDMENTS			AMENDMENTS			AMENDMENTS			DRAWN TRACED COMPTNS CHECKED RECOMM'D APPROVED			N.Z. ELECTRICITY DEPARTMENT E. B. MACKENZIE GENERAL MANAGER			BENMORE-ISLINGTON 220KV LINE			SCALE N.T.S.			FILE 29/5/11			FOLDER		
NO DEF COLLECTED												C. MONAGHAN S. Macdonald W. J. Strong B. F. THOMP T. J. Dickson			E. B. MACKENZIE GENERAL MANAGER			DISTRIBUTION OF LOADS FOR MODIFIED TOWERS			E7673			ISSUE			A		

REV	REVISION DESCRIPTION	CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	TP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP

TRANSPOWER
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BENMORE-ISLINGTON 220KV LINE
TOWER CONTRACT FOR C327
DISTRIBUTION OF LOADS FOR MODIFIED TOWERS

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER T066/A1/1, T066/A2/1, T066/A3/1	
DRAWING NUMBER E7673		SHEET REVISION - B	
DRAWING CREATED BY: NZED Border Replaced at Revision B		SCALE N.T.S.	

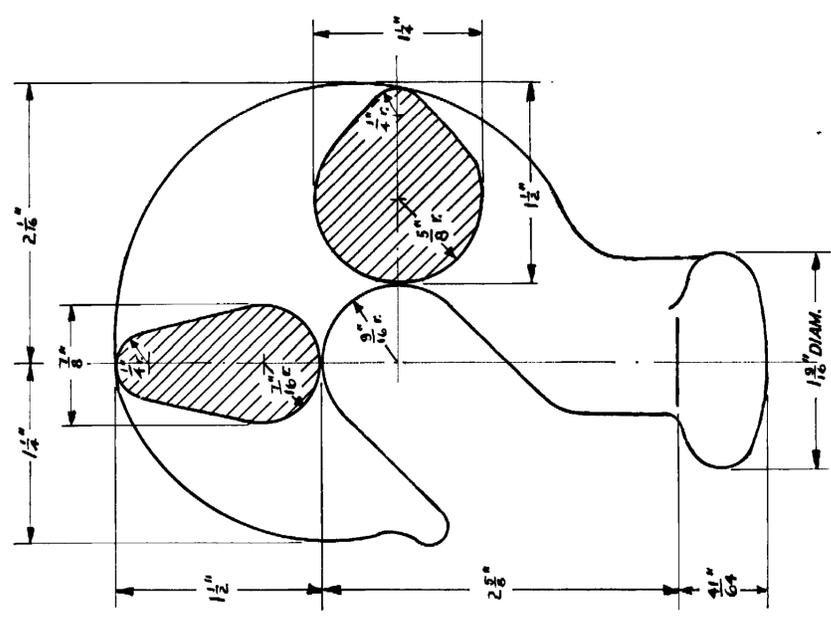
submit your markups to TranspowerProduction@redyedms.com

b40



A1

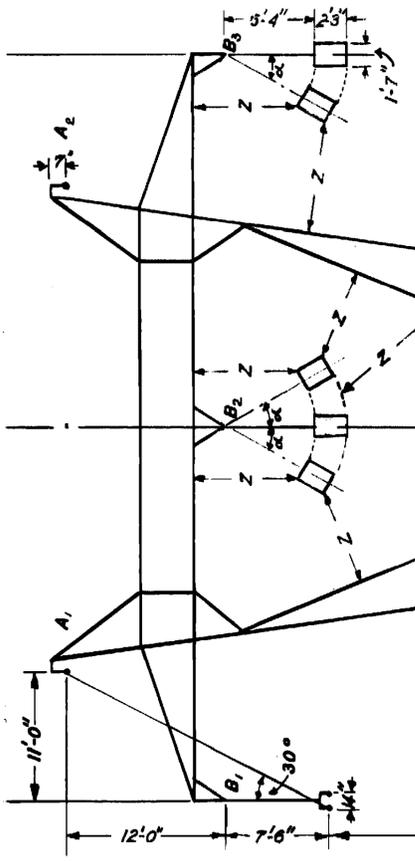
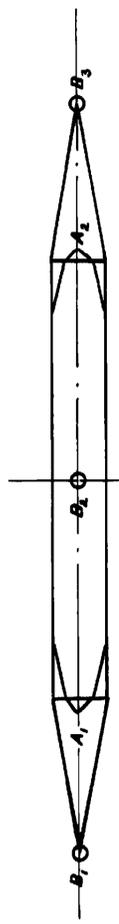
F 4631



HEAVY SUSPENSION INSULATOR HOOK

CLEARANCE TO ANY STEEL Z-50" OR 72" TWIN 37/146 A.C.S.R. 14" SPACING.
 12° SWING 72" CLEARANCE, α = 12°
 44° SWING 50" CLEARANCE, α = 44°
 7/146 G.H.S.S. EARTH WIRE.

HANGER BRACKET IS NOT ESSENTIAL.
 HOOK FOR SUSPENSION INSULATOR IS APPROXIMATELY 1 1/2" THICK.



WORKING LOADS

TRANSVERSE		LONGITUDINAL	
1. A ₁ AND A ₂	600 LBS EACH	7. A ₁ OR A ₂	4000 LBS
2. B ₁ , B ₂ AND B ₃	1900 LBS EACH	8. THE ONE B CONDUCTOR	7100 LBS
3. A ₁ & A ₂	280 LBS	VERTICAL	
4. ANY ONE B CONDUCTOR	900 LBS		
5. THE OTHER TWO B CONDUCTORS	1300 LBS EACH		
6. WIND LOAD ON TOWER AT 30 LBS/SQ-FT ON 1/5 TIMES THE PROJECTED AREA OF THE TOWER NORMAL TO THE LINE.			
9. A ₁ AND A ₂	1300 LBS EACH	9. A ₁ AND A ₂	1300 LBS EACH
10. B ₁ , B ₂ AND B ₃	5800 LBS EACH	10. B ₁ , B ₂ AND B ₃	900 LBS
11. A ₁ & A ₂	400 LBS	11. THE ONE B CONDUCTOR	5500 LBS EACH
12. THE OTHER TWO B CONDUCTORS	2600 LBS EACH	12. THE OTHER TWO B CONDUCTORS	11000 LBS EACH
13. A ₁ AND A ₂		13. A ₁ AND A ₂	
14. B ₁ , B ₂ AND B ₃		14. B ₁ , B ₂ AND B ₃	
15. THE OTHER TWO B CONDUCTORS		15. THE OTHER TWO B CONDUCTORS	
16. WEIGHT OF TOWER		16. WEIGHT OF TOWER	

SIMULTANEOUS APPLICATION OF LOADS.

CASE	LOADS	CONDITION
I.	1, 2, 6, 9, 10, 16.	ALL WIRES INTACT.
II.	2, 3, 6, 7, 10, 11, 16.	BROKEN EARTH WIRE.
III.	1, 4, 5, 8, 9, 12, 13, 16.	BROKEN CONDUCTOR.
IIIa	AS ABOVE	ALTERNATIVES OF III.
IV.	14, 15, 16.	HEAVY VERTICAL.

NUTS, BOLTS, WASHERS, SMALL PLATES AND CLIMBING STEPS TO BE PACKED IN BOXES OR KEYS FOR INDIVIDUAL TOWERS.
 SEE CLAUSE OF SPECIFICATION.

A SET OF SPECIAL FITTINGS EACH SUITABLE FOR HOLDING A SHACKLE FOR MOUNTING A BLOCK AND TACKLE SHALL BE SUPPLIED FOR CLAMPING OR BOLTING TO THE CROSS-ARM NEAR B₁, B₂ AND B₃ TO TAKE THE LOADING IV TO ENABLE THE CONDUCTORS TO BE TRANSFERRED FROM THE INSULATOR TO THE FITTING AND VICE VERSA.

TEST LOADS: CASE I LOADS TO BE MULTIPLIED BY 1.65.
 CASE II & III LOADS TO BE MULTIPLIED BY 1.2.
 CASE IV. LOADS TO BE MULTIPLIED BY 1.65.

C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/1

Contract 327

GRAPHIC SCALE:

AMENDMENTS	By	Date	App'd
1. Raster corrected, TPR label added	ES	12/01/11	ML

AMENDMENTS	By	Date	App'd

AMENDMENTS	By	Date	App'd

DRAWN	A. J. FREED	7.2.57
TRACED		
COMPT'NS		
CHECKED	B. J. T. DAVENPORT	7.2.57
RECOMM'D		
APPROVED	A. E. DAVENPORT	7.2.57



BENMORE-ISLINGTON 220KV LINE
STANDARD SUSPENSION TOWER

SCALE	FILE	FOLDER
1/8" TO 1'-0"	23/8/11	
F 4631		
ISSUE	A	

REV	REVISION DESCRIPTION	CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	TP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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BENMORE-ISLINGTON 220KV LINE
STANDARD SUSPENSION TOWER

TRANSPOWER PROJECT CODE	FOLDER	
IP_1920_244_11	T066/A1/1	
DRAWING NUMBER	SHEET	REVISION
F4631	-	B
DRAWING CREATED BY:	SCALE	
STATE HYDRO DEPARTMENT Border Replaced at Revision B	N.T.S.	



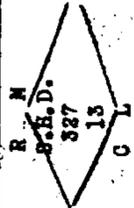
MATURE

BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT. No. T.1421 SHEET No. 101

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.



**210. GRILLAGE FOUNDATIONS
for STANDARD SUSPENSION
TOWERS. (746)**

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES BY BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1	210 Bundles	B1	4	L	3 1/2 x 3 1/2	6 1.5/16	100	8530	8530	
2	210 Bags	B2	4	L	3 1/2 x 1 1/2	0	101	22890	23730	
3			4	L	8 x 5	2 0	102			
4			8	L	1 1/2 x 1 1/2	1 8.3/16	109			
5	210 Bundles	B3	4	L	1 1/2 x 1 1/2	5 7.3/4	103	13020	13020	
6	210 Bundles	B4	4	L	1 1/2 x 1 1/2	6 0.5/16	104	14070	14070	
7	210 Bundles	B5	4	L	1 1/2 x 1 1/2	5 2.15/16	108	12180	12180	
8	210 Bundles	B6	4	L	1 1/2 x 1 1/2	5 7.7/8	106	13020	13020	
9	210 Bundles	B7	4	L	4 x 2 1/2	4 1	107B	44940	44940	
10			4	L	4 x 2 1/2	4 1	107L			
11	880 Bundles	B8	16	L	3 x 2	4 4	108	176400	176400	
12	210 Bags	B9	8	L	1 1/2 x 1 1/2	1 5.15/16	110	18480	19320	
13			96	L	2 1/2 x 2	1.5/4	111			
14			8	Pack	1 1/2 x 5/16	7.3/4	112			
15	210 Bags	B10	176	1 1/2 x 5/8	KOX SCD 1 1/2/16			20370	21210	
16			8	1 1/2 x 1/2	KOX SCD 1 1/2/16					
17			80	2 x 5/8	KOX SCD 1 1/2/16					
18			264	Spring Washers	1/8" th 1.3/16 o/d for 5/8" dia. bolts					
19										
20										
21								371700	374320	
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										

CONSIGN TO: *McAlister*

AT: *FOR DELIVERY*

VIA: *FOR DELIVERY*

MAILING ADDRESS:

ORDER No. *71421* OUR CONTRACT No. *71421* SHEET No. *101*

SHIPMENT No. *1890* SUMMARY FOR SHEET: *1890* PIECES: *620* BUNDLES: *620* CRATES: *620*

Gross Weight: -1677. 16.19.0lbs. Nett 1667.180.39.0lbs.

Check 3293. Standard

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/101
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP		DATE	APP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER T066/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 101 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



submit your markups to Transpower@redyedims.com

BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CLIFTON HOUSE,
EUSTON ROAD,
LONDON, N.W.1.

CONT. NO. T.1421 SHEET NO. 102

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

210 - SMTS OF EXTER. WITH TLD
TOP STD. SUSPENSION COVER

NO.	NUMBER OF BUNDLES OR PACKAGES.	SERIAL NUMBERS OF PACKAGES.	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE.	LENGTH OF EACH PIECE	ERECTOR MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CHATE OR BOX
1	210 Bundles	B11	(1	L	3 x 3	21 11 1/2	1	55860	55860	
2			(1	L	3 x 3	21 11 1/2	2			
3	210 Bundles	B12	(2	L	3 x 3	21 11 1/2	2	55860	55860	
4	210 Bundles	B13	(4	L	2 1/2 x 2	27 7 1/2	118R	83790	83790	
5	210 Bundles	B14	(4	L	2 1/2 x 2	27 7 1/2	118L	83790	83790	
6	210 Bags	B15	(4	P	5 5/8 x 4 1/2	6	119	9660	10500	
7			(4	L	1 1/2 x 1 1/2	15-15/16	112R			
8			(4	L	1 1/2 x 1 1/2	15-15/16	121L			
9			(4	L	1 1/2 x 1 1/2	0	122			
10	210 Bundles	B16	(4	L	1 1/2 x 1 1/2	14 4-3/16	120	25410	25410	
11	210 Bundles	B17	(4	L	1 1/2 x 1 1/2	5-2 1/4	123R	47460	47460	
12			(4	L	1 1/2 x 1 1/2	5-2 1/4	123L			
13			(4	L	1 1/2 x 1 1/2	10 7-15/16	131			
14			(4	L	1 1/2 x 1 1/2	10 7-15/16	131A			
15	210 Bundles	B18	(4	L	1 1/2 x 1 1/2	2 10 5/16	124R	25620	25620	
16			(4	L	1 1/2 x 1 1/2	2 10 5/16	124L			
17			(4	L	1 1/2 x 1 1/2	5 6-11/16	125R			
18			(4	L	1 1/2 x 1 1/2	5 6-11/16	125L			
19	210 Bundles	B19	(4	L	1 1/2 x 1 1/2	4 3-3/8	126R	25620	25620	
20			(4	L	1 1/2 x 1 1/2	4 3-3/8	126L			
21			(4	L	1 1/2 x 1 1/2	8 11-1/8	127			
22	210 Bundles	B20	(4	L	1 1/2 x 1 1/2	6 2 1/2	126R	42000	42000	
23			(4	L	1 1/2 x 1 1/2	6 2 1/2	128L			
24			(4	L	1 1/2 x 1 1/2	6 8-1/16	129R			
25			(4	L	1 1/2 x 1 1/2	6 8-1/16	129L			
26	210 Bundles	B21	(4	L	2 x 2	7 -1	130R	26980	26980	
27			(4	L	2 x 2	7 -1	130L			
28	210 Bags	B22	(48	Bolts	1 1/2 x 5/8	XXX STD. 15/16		12600	13400	
29			(64	Bolts	1 1/2 x 5/8	XXX STD. 15/16				
30			(40	Bolts	1 1/2 x 5/8	XXX STD. 15/16				
31			(2	BOLTS	7 x 5/8"	XXX STD. WITH TWO FULL THRES				
32			(170	SINGLE COIL SPLITTING WAGERS	1/8"	75X10-3/16 S/D 10		496650	496650	
33										

CONSIGN TO **0803336**
AT **London**

FOR DELIVERY
MAPPING ADDRESS **London**

SHIPMENT NO. _____ DATE SHIPPED _____

GROSS WT. 222T. 90WT. 10R. 1311Lb. Net. 221140Lb. 144

SUMMARY FOR SHEET
PIECES 2,100
BUNDLES 220
CRATES 220
BOXES 220

SHEET NO. 102

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/102
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
PACKING LIST

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
DRAWING NUMBER T1421-P	SHEET REVISION 102 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

23001

CONT. No. T.1421 SHEET No. 111

100 Sets STANDARD
SUSPENSION TOWERS
74'6"
(Common Portion).



MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1	110 Bundles	B.35	1	L	3 x 3	18 1/2	5	40810	40810	
2			3	L	3 x 3	18 1/2	6			
3	110 Bundles	B.36	1	L	3 x 3	16 1/2	7	34650	34650	
4			3	L	3 x 3	16 1/2	8			
5			1	L	3 x 3	16 1/2	9			
6	110 Bundles	B.37	4	L	3 1/2 x 3 1/2	9 10 1/2	10R	23980	23980	
7			4	L	3 1/2 x 3 1/2	9 10 1/2	10L			
8	110 Bundles	B.38	4	L	3 1/2 x 3 1/2	9 7 1/2	11R	30680	30680	
9			4	L	3 1/2 x 3 1/2	9 7 1/2	11L			
10	110 Bags	B.39	4	P	2 1/2 x 1/4	5	12	9850	9790	
11			2	P	7 1/2 x 1/4	9 7 1/2	16			
12			4	P	10 1/2 x 1/4	1 8 1/2	38			
13			2	P	2 1/2 x 3/16	- 10 1/2	39R			
14			2	P	2 1/2 x 3/16	- 10 1/2	39L			
15			2	P	2 1/2 x 3/16	- 11 1/2	40			
16			2	P	4 1/2 x 3/16	- 10 1/2	41R			
17			2	P	4 1/2 x 3/16	- 10 1/2	41L			
18	110 Bundles	B.40	2	L	1 1/2 x 1 1/2	7 10 1/2	13	13980	13980	
19			2	L	1 1/2 x 1 1/2	7 10 1/2	14			
20			4	L	1 1/2 x 1 1/2	6 2-1/16	17			
21	110 Bundles	B.41	4	L	2 1/2 x 2 1/2	5 4 1/2	15	6490	6490	
22	110 Bundles	B.42	2	L	3 x 3	29 5 1/2	18	31680	31680	
23	110 Bundles	B.43	2	L	3 x 3	29 5 1/2	19	31680	31680	
24	110 Bundles	B.44	2	L	3 x 2	8 10-5/16	20	6270	6270	
25	110 Bundles	B.45	2	L	2 x 2	8 10-5/16	21	6270	6270	
26	110 Bundles	B.46	2	L	2 x 2	12 7 1/2	22	6710	6710	
27	110 Bundles	B.47	2	L	2 x 2	12 7-5/16	23	6710	6710	
28	110 Bundles	B.48	2	L	2 1/2 x 2 1/2	9 5 1/2	25R	12540	12540	
29			2	L	2 1/2 x 2 1/2	9 5-5/16	25L			
30	110 Bundles	B.49	2	L	2 1/2 x 2 1/2	28 5 1/2	26	22660	22660	
31										
32										
33										

CONSIGN TO AT
VIA FOR DELIVERY
MAILING ADDRESS
ORDER No.

SHIPMENT No. DATE SHIPPED

SUMMARY FOR SHEET
PIECES BUNDLES CRATES
1,640 110 BAGS

OUR CONTRACT No. T.1421 SHEET No. 111

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/111
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 111 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

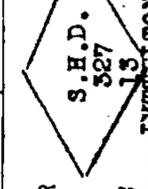


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BLAW KNOX LTD.
(TOWER DEPARTMENT)
90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT. No. T-1241 SHEET No. 112

MARK EACH PIECE, BUNDLE, OR PACKAGE AS FOLLOWS ALSO WITH SERIAL NUMBERS GIVEN BELOW.



100 sets Standard Suspension Towers 74'6" (Common Portion).

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTOR MARK	NET WEIGHT IN 100'S	GROSS WEIGHT IN 100'S	SIZE OF EACH CRATE ON BOX
1	110 Bundles.	B.50	2	L	2 x 2	9'3 1/2"	27B	20900	20900	
2			2	L	2 x 2	9'3 1/2"	27L			
3			2	L	2 1/2 x 2	9'0 1/2"	28B			
4			2	L	2 1/2 x 2	9'0 1/2"	28L			
5	"	B.51	2	L	2 x 2	10'1 1/2"	29	29590	29590	
6			4	L	2 x 2	12'1.15/16"	142			
7			4	L	2 x 2	10'0 3/4"	145			
8	"	B.52	2	L	1 1/2" x 1 1/2"	2'7.5/16"	30	10570	10570	
9			2	L	1 1/2" x 1 1/2"	3'10.15/16"	31B			
10			2	L	1 1/2" x 1 1/2"	3'10.25/16"	31L			
11			4	L	1 1/2" x 1 1/2"	3'0.11/16"	140B			
12			4	L	1 1/2" x 1 1/2"	3'0.11/16"	140L			
13	"	B.53	2	L	2 x 2	2'11 1/8"	32B	10340	10340	
14			2	L	2 x 2	2'11 1/8"	32L			
15			2	L	2 x 2	5'0.3/16"	35B			
16			2	L	2 x 2	5'0.3/16"	35L			
17			2	L	2 1/2 x 2 1/2	2'11.11/16"	36			
18			1	L	2 1/2 x 2 1/2	2'11.11/16"	36A			
19	"	B.54	2	L	2 1/2 x 2	7'11.7/16"	33B	12540	12540	
20			2	L	2 1/2 x 2	7'11.7/16"	33L			
21	"	B.55	2	L	2 x 2	17'8.5/16"	34B	18920	18920	
22			2	L	2 x 2	17'9.5/16"	34L			
23	"	B.56	2	L	1 1/2" x 1 1/2"	2'7.3/16"	37	12760	12760	
24			2	L	1 1/2" x 1 1/2"	2'7.3/16"	37A			
25			4	L	1 1/2" x 1 1/2"	3'1.7/16"	143B			
26			4	L	1 1/2" x 1 1/2"	3'1.7/16"	143L			
27			4	L	1 1/2" x 1 1/2"	2'6 1/8"	147B			
28			4	L	1 1/2" x 1 1/2"	2'6 1/8"	147L			
29	"	B.57	2	P	8 x 1/2	1'0 1/2"	42B	10560	11000	
30			2	P	8 x 1/2	1'0 1/2"	42L			
31			2	P	4 1/2 x 1/2	1'0 1/2"	43L			
32			2	P	4 1/2 x 1/2	1'0 1/2"	43B			
33						Cont'd...				

CONSIGN TO AT *Chol3675*

VIA FOR DELIVERY MAILING ADDRESS

ORDER No. OUR CONTRACT No. T-1241.

SHIPMENT No. DATE SHIPPED

SUMMARY FOR SHEET: 770 PIECES, 770 BUNDLES, 110 CRATES, 110 BOXES. SHEET No. 112.

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/112
Issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPower

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 112 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

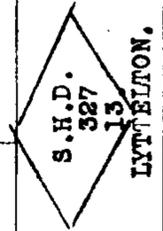


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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT. No. T.1421. SHEET No. 113



100 sets - Standard
Suspension Towers
74'6" (Common
Portion).

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1	(Bags Cont'd.)									
2			2	P	5 1/2 x 3/16	7 1/2	44R			
3			2	P	5 1/2 x 3/16	7 1/2	44L			
4			2	P	5 1/2 x 3/16	7 1/2	45			
5			2	P	4 1/2 x 5/8	7 1/2	46			
6			2	P	4 1/2 x 3/16	9 1/2	47			
7			4	P	5 1/2 x 1/4	6 1/2	148			
8			4	L	1 1/2 x 1 1/2	2'0.15/16	150			
9	110 Bundles	B.58	4	L	2 1/2 x 1 1/2	11'2.3/4	139R	27280	27280	
10			4	L	2 1/2 x 2	11'2 1/2"	139L			
11	110	B.59	4	L	1 1/2 x 1 1/2	5'1"	141R	17090	17090	
12			4	L	1 1/2 x 1 1/2	5'1"	141L			
13			4	L	1 1/2 x 1 1/2	5'0 1/2"	143R			
14			4	L	1 1/2 x 1 1/2	5'0 1/2"	143L			
15	"	B.60	8	L	1 1/2 x 1 1/2	8'4 1/2"	146	16280	16280	
16			2	L	1 1/2 x 1 1/2	4'5.15/16	149R			
17			2	L	1 1/2 x 1 1/2	4'5.15/16	149L			
18			4	L	1 1/2 x 1 1/2	5'5.11/16	151			
19	"	B.61	1	L	1 1/2 x 1 1/2	7'10 1/2"	152	27940	27940	
20			1	L	1 1/2 x 1 1/2	7'10 1/2"	153			
21			4	L	1 1/2 x 1 1/2	7'9.9/16	189			
22			2	L	1 1/2 x 1 1/2	8'0.3/16	196			
23			2	L	1 1/2 x 1 1/2	8'0.3/16	196A			
24			2	L	1 1/2 x 1 1/2	7'9.9/16	197			
25			2	L	1 1/2 x 1 1/2	7'9.9/16	197A			
26			2	L	1 1/2 x 1 1/2	7'10.3/8	198			
27			2	L	1 1/2 x 1 1/2	7'10.3/8	198A			
28	"	B.62	2	L	1 1/2 x 1 1/2	9'10.7/8	155	3960	3960	
29										
30										
31										
32										
33										

CA08 3675

CONSIGN TO AT: _____

VIA _____ FOR DELIVERY MAILING ADDRESS _____

ORDER No. _____ OUR CONTRACT No. **T.1421.**

SHIPMENT No. _____ DATE SHIPPED _____

SUMMARY FOR SHEET: 590 PIECES, 5 BUNDLES, 3 CRATES, 1 BOXES

SHEET No. **113.**

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/113
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER PACKING LIST	DRAWING NUMBER T1421-P	SHEET REVISION 113 B
	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



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90-94 BROMPTON ROAD,
LONDON, S.W.3.

BLAW KNOX LTD.
(TOWER DEPARTMENT)

SHIPPING SPECIFICATION
AND PACKING PARTICULARS

100 Sets Standard Suspension
Towers 74'6"
(COMMON PORTION).

S.H.D.
327
13
LYTTELTON.

CONT. No. T.1421. SHEET No. 114

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN	GROSS WEIGHT IN	SIZE OF EACH CRATE OR BOX
1	110 Bundles	B63	2	L	1 1/2" x 1 1/2"	4' 1 1/2"	MA	124.30	124.30	124.30
2			2	L	1 1/2" x 1 1/4"	4' 10 1/2"	154			
3			2	L	1 1/2" x 1 1/4"	4' 10 1/2"	156L			
4			4	L	1 1/2" x 1 1/2"	3' 7.5/16"	157			
5			2	L	1 1/2" x 1 1/2"	4' 11.1/8"	158R			
6			2	L	1 1/2" x 1 1/2"	4' 11 1/8"	158L			
7	" B64	B64	4	L	1 1/2" x 1 1/2"	1' 10"	159		8.10	
8			2	L	1 1/2" x 1 1/2"	1' 9.3/16"	160R			
9			2	L	1 1/2" x 1 1/2"	1' 9.3/16"	160L			
10			4	L	1 1/2" x 1 1/2"	1' 8.7/16"	162			
11			4	L	1 1/2" x 1 1/2"	1' 8 1/2"	170			
12			2	L	1 1/2" x 1 1/2"	2' 0", 9' 1/8"	174			
13			2	L	1 1/2" x 1 1/2"	1' 2 1/2"	176			
14			2	L	1 1/2" x 1 1/2"	1' 0 3/4"	177			
15			2	L	1 1/2" x 1 1/2"	1' 11 1/4"	184			
16			1	L	1 1/2" x 1 1/2"	1' 11 1/4"	19AA			
17			1	L	1 1/2" x 1 1/2"	9 1/2"	200R			
18			1	L	1 1/2" x 1 1/2"	9 1/2"	200L			
19	" Bundles	B65	2	L	1 1/2" x 1 1/2"	4' 3.11/16"	161R	134.20	134.20	
20			2	L	1 1/2" x 1 1/2"	4' 3.11/16"	161L			
21			2	L	1 1/2" x 1 1/2"	4' 18 1/2"	165R			
22			2	L	1 1/2" x 1 1/2"	4' 8 1/2"	165L			
23			2	L	1 1/2" x 1 1/2"	4' 3.5/8"	164R			
24			2	L	1 1/2" x 1 1/2"	4' 3 3/8"	164L			
25			2	L	1 1/2" x 1 1/2"	1' 10 1/4"	166R			
26			2	L	1 1/2" x 1 1/2"	1' 10 1/4"	166L			
27	"	B66	4	L	1 1/2" x 1 1/2"	1' 10.1/16"	165	12650	12650	
28			4	L	1 1/2" x 1 1/2"	4' 1 1/2"	167			
29			2	L	1 1/2" x 1 1/2"	4' 0.15/16"	171			
30			2	L	1 1/2" x 1 1/2"	1' 11.5/16"	173			
31			2	L	1 1/2" x 1 1/2"	4' 1 1/2"	185			
32										
33										

CONSIGN TO AT: *Chas 8675*

VIA FOR DELIVERY MAILING ADDRESS

ORDER No. T.1421. OUR CONTRACT No. T.1421. SHEET No. 114

SUMMARY FOR SHEET
PIECES 330
BUNDLES 110
CRATES 114
BOXES 114

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/114
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP		DATE	APP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 114 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



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90-94 BROMPTON ROAD,
LONDON, S.W.3.

BLAW KNOX LTD.
(TOWER DEPARTMENT)

SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CONT. No. T.1421 SHEET No. 115

100 Sets - Standard
Suspension Towers 74'6"
(Common Portion).

S.H.D.
327
13
LYTTLETON.

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK NO.	NET WEIGHT IN lbs.	GROSS WEIGHT IN lbs.	SIZE OF EACH CRATE OR BOX
1	110 Bundles	B.67	2.	L.	2 x 2	10'2.7/16"	168R	5500	5500	
2	"	B.68	2.	L.	2 x 2	10'2.7/16"	168L	5500	5500	
3	"	B.69	2.	L.	1 1/2 x 1 1/2	5'1.3/16"	169R	13420	13420	
4			2.	L.	1 1/2 x 1 1/2	5'1.3/16"	169L			
5			2.	L.	1 1/2" x 1 1/2"	6'6 1/2"	193			
6			2.	L.	1 1/2" x 1 1/2"	6'6 1/2"	193A			
7			2.	L.	1 1/2" x 1 1/2"	5'7.9/16"	195			
8			2.	L.	1 1/2" x 1 1/2"	5'7.9/16"	195A			
9	110	B.70	2.	L.	1 1/2" x 1 1/2"	2'10 1/2"	172	10560	10560	
10			2.	L.	1 1/2" x 1 1/2"	3'5 1/2"	173			
11			2.	L.	1 1/2" x 1 1/2"	2'7.5/16"	178			
12			2.	L.	1 1/2" x 1 1/2"	2'11 1/2"	179			
13			2.	L.	1 1/2" x 1 1/2"	2'3 1/2"	180			
14			2.	L.	1 1/2" x 1 1/2"	3'4 1/2"	181			
15			2.	L.	1 1/2" x 1 1/2"	3'5"	182			
16			2.	L.	1 1/2" x 1 1/2"	3'1.3/16"	184R			
17			2.	L.	1 1/2" x 1 1/2"	3'1.3/16"	184L			
18	110	B.71	8.	L.	1 1/2" x 1 1/2"	2'10 1/2"	183	5720	5720	
19			2.	L.	1 1/2" x 1 1/2"	2'11 1/2"	199			
20	110	B.72	4.	L.	1 1/2" x 1 1/2"	4'5 1/2"	186	14190	14190	
21			2.	L.	1 1/2" x 1 1/2"	4'3 1/2"	187			
22			2.	L.	1 1/2" x 1 1/2"	4'3 1/2"	187A			
23			4.	L.	1 1/2" x 1 1/2"	4'2.11/16"	216			
24			4.	L.	1 1/2" x 1 1/2"	4'3.7/16"	217			
25	110	B.73	4.	L.	1 1/2" x 1 1/2"	8'6.7/16"	188	24310	24310	
26			4.	L.	1 1/2" x 1 1/2"	7'9"	190			
27			4.	L.	1 1/2" x 1 1/2"	7'5.11/16"	191			
28			4.	L.	1 1/2" x 1 1/2"	7'6 1/2"	192			
29										
30										
31										
32										
33										

CONSIGN TO AT *CHS 3675*

SHIPMENT No. DATE SHIPPED

VIA MAILING ADDRESS FOR DELIVERY

OUR CONTRACT No. T.1421

SUMMARY FOR SHEET
PIECES BUNDLES CRATES BOXES
770

SHEET No. 115

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/115
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP		DATE	APP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 115 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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90-94 BROMPTON ROAD,
LONDON, S.W.3.

BLAW KNOX LTD.

(TOWER DEPARTMENT)

SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CONT. No. T.1421 SHEET No. 116

100 SETS SUSPENSION TOWERS
74'6" (COMMON PORTION).

S.H.D.
327
13
LYPELTON.

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	SECTION MARK	NET WEIGHT IN Lbs.	GROSS WEIGHT IN Lbs.	SIZE OF EACH CRATE OR BOX
1	110 Bags	B.74	2	L	3 1/2" x 2 1/2"	8'-3/4"	201R	10870	11110	
2			2	L	3 1/2" x 2 1/2"	8'-3/4"	201L			
3			4	L	2 1/2" x 2 1/2"	4'-1/8"	205			
4			2	Ch	8 x 3	4'-7/8"	204			
5			2	Ch	8 x 3	6'-1/8"	206			
6			4	P	5 1/2" x 1 1/2"	10"	208			
7			1	L	1 1/2" x 1 1/2"	8'-1 1/2"	207			
8			1	P	5 1/2" x 3/8"	8"	208			
9			4	Pa	2 1/2" x 1/4"	3'-5/8"	209			
10			2	F	3 x 1/4"	2'-11"	210			
11			1	L	1 1/2" x 1 1/2"	1'-11 1/2"	194R			
12			1	L	1 1/2" x 1 1/2"	1'-11 1/2"	194L			
13			1	Unit comprising:						
14			2	3/4" dia. Rods.		5"	213			
15			2	1/2"	4 x 1/2"	6'-5/16"	213A			
16			4	1/4" dia. Check Plate			C.P.			
17	110 Bundles	B.75	1	Ch	4" x 2"	2'-10-15/16"	202R	4610	4610	
18			1	Ch	4" x 2"	2'-10-15/16"	202L			
19	110 Bundles	B.76	1	L	Ladder comprising:			13090	15090	
20			2	F	8" x 3/16"	18'-6"	211			
21			16	1/8" dia. Rod		1'-0-3/8"				
22			1	Ladder comprising:						
23			2	F	2" x 3/16"	18'-5-3/8"	212			
24			16	1/8" dia. Rods		1'-0-3/8"				
25	110 Bundles	B.77	4	L	1 1/2" x 1 1/2"	4'-10-7/8"	214	13320	13320	
26			4	L	1 1/2" x 1 1/2"	3'-4-9/16"	218			
27			4	L	1 1/2" x 1 1/2"	6'-3-15/16"	215			
28										
29										
30										
31										
32										
33										

CONSIGN TO AT *0608 3675*

SHIPMENT No. DATE SHIPPED

VIA MAILING ADDRESS FOR DELIVERY

ORDER No. OUR CONTRACT No. T.1421

SUMMARY FOR SHEET
PIECES 330
BUNDLES 110 BAGS
CRATES 20000

SHEET No. 116

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/116
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP		DATE	APP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 116 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



submit your markups to Transpower@redyedims.com

90-94 BROMPTON ROAD,
LONDON, S.W.3.

BLAW KNOX LTD.
(TOWER DEPARTMENT)

SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CONT. No. **T.1481** SHEET No. **117**

100 SETS STANDARD SUSPENSION
TOWERS 74'6"
(COMMON PORTION).

S.H.D.
327
13
LYTELTON.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
SETS OF BOLTS MCD. 333/ST.										
2	110 Bags	B.78	500	Bolts	1 1/2 x 5/8"	XOX SCD	15/16"	10890	11350	
3	110 Bags	B.79	3	Bolts	2 x 5/8"	XOX SOD	15/16"	11000	11440	
4			16	Bolts	1 1/2 x 5/8"	XOIX SCD	1-5/16"	with Nut & Locknut		
5			34	Bolts	1 1/2 x 5/8"	XOX SCD	15/16"			
6			245	Bolts	1 1/2 x 5/8"	XOX SCD	15/16"			
7	110 Bags	B.80	232	Bolts	1 1/4 x 5/8"	XOX SCD	15/16"	14190	14630	
8			3	Bolts	2 1/2 x 5/8"	XOIX SCD	1-5/16"	with Nut & Locknut		
9			28	Bolts	7" x 5/8"	XOIX SCD	2-1/2"	with 2 full nuts		
10			4	Bevel washers for 5/8" dia. bolts.						
11			2	Flat Washers 3/16" x 1-7/8" o/d for 7/8" dia. bolts.						
12			2	Flat Washers 3/16" x 1-3/4" o/d for 5/8" dia. bolts.						
13			280	Single coil spring washers 1/8" x 1-5/16" o/d for 5/8" dia. bolts.						
14										
15			3	Shackles to Stk. 4621 Mtd. 935/TS.						
16										
17										
18										
19										
20										
21								4890		
22								770		
23	TOTAL SHIPMENT SHEETS 103 - 109 Incls.									
24								Gross Weight	3167.42	Ogr. 2-lbs.
25								Nett Weight	3147.150	2-lbs.
26										
27										
28										
29										
30										
31										
32										
33										

CONSIGN TO
AT

VIA FOR DELIVERY
MAILING ADDRESS

ORDER No.

OUR CONTRACT No. **T.1481**

SHIPMENT No.
DATE SHIPPED

SUMMARY FOR SHEET
PIECES
BUNDLES
CRATES
350 BAGS

SHEET No. **117**

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/117
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPOWER

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TOWER CONTRACT C327
 STANDARD SUSPENSION TOWER
 PACKING LIST

TRANSPOWER PROJECT CODE
IP_1920_244_11

FOLDER
TO66/A1/6

DRAWING NUMBER
T1421-P

SHEET REVISION
117 B

DRAWING CREATED BY:
BLAW KNOX
Border Replaced at Revision B

SCALE
N.T.S.



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90-94 BROMPTON ROAD,
LONDON, S.W.3.

BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CONT. No. **T.1421**, SHEET No. **118**

MARK EACH PIECE, BUNDLE, OR PACKAGE AS FOLLOWS ALSO WITH SERIAL NUMBERS GIVEN BELOW.

M
S.H.D. 327
13
L
LITTLETON.

100 Sets of Spare Bolts for Standard Suspension Tower (74'6")

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN lbs.	GROSS WEIGHT IN lbs.	SIZE OF EACH CRATE OR BOX
1	36 Bags	B-81		1 Sets of Bolts Mod. 933/STB, each				SET comprising:-		
2			14	Bolts	1 1/2"	XOX SOD	15/16	3000		
3			40	"	1 1/2"	XOX SOD	15/16			
4			5	"	1 1/2"	XOX SOD	15/16			
5			4	"	2 x 1/2"	XOX SOD	15/16			
6			1	"	1 1/2 x 1/2"	XOX SOD	1-5/16 with locknut.			
7			1	"	2 1/2 x 1/2"	XOX SOD	1-5/16 with locknut.			
8			2	Step Bolts 7 x 5/8	XOX SOD	2 1/2 with 2 hex nuts.				
9			1	Bevel Washer 5°	XOX SOD	5/16" dia. bolts.				
10			1	Flat Washer 3/16" th.	XOX SOD	1 1/2" o/a for 5/8" dia. bolts.				
11			1	Flat Washer 3/16" th.	XOX SOD	1 1/2" o/a for 7/8" dia. bolts.				
12			69	Spring Washers 1" th.	XOX SOD	1-5/16" o/a for 5/8" dia. bolts.				
13										
14	1 Bag	B-82		2 Sets of Bolts Mod. 933/STB, each				SET comprising:-		
15			14	Bolts	1 1/2 x 1/2"	XOX SOD	15/16	52		
16			40	"	1 1/2 x 1/2"	XOX SOD	15/16			
17			5	"	1 1/2 x 1/2"	XOX SOD	15/16			
18			4	"	2 x 5/8"	XOX SOD	15/16			
19			1	"	1 1/2 x 5/8"	XOX SOD	1-5/16 with locknut.			
20			1	"	2 1/2 x 5/8"	XOX SOD	1-5/16 with locknut.			
21			2	Step Bolts 7" x 5/8	XOX SOD	2-1/2 with 2 hex nuts.				
22			1	Bevel Washer 5°	XOX SOD	for 5/8" dia. bolts.				
23			1	Flat Washer 3/16" th.	XOX SOD	1-5/16" o/a for 5/8" dia. bolts.				
24			1	Flat Washer 3/16" th.	XOX SOD	1-7/8" o/a for 7/8" dia. bolts.				
25			69	Spring Washers 1/8" th.	XOX SOD	1-5/16" o/a for 5/8" dia. bolts.				
26										
27								2860	3006	
28										
29										
30										
31										
32										
33										

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ORDER No.

OUR CONTRACT No. **T.1421**

SHIPMENT No.

DATE SHIPPED

SUMMARY FOR SHEET

PIECES

BUNDLES

CRATES

BOXES

37 Bags

SHEET No. **118**

A: title, folder reference corrected SS 12/01 ML LDS

TOWER CONTRACT C327		T1421-P/118
TYPE TOWER - S. SUSPENSION		
PACKING LIST		
		issue A

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327		TRANSPower PROJECT CODE		FOLDER	
STANDARD SUSPENSION TOWER		IP_1920_244_11		TO66/A1/6	
PACKING LIST		DRAWING NUMBER		SHEET REVISION	
		T1421-P		118 B	
		DRAWING CREATED BY:		SCALE	
		BLAW KNOX		N.T.S.	
		Border Replaced at Revision B			

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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CO. No. T.1421 SHEET No. 119

34 Grillage Foundations for
Standard Suspension Towers
(84' 6")



S.H.D.
327
219

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK H.A.	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1	34 Bundles	B.1	L.	3 1/2 x 3 1/2	6 1/2	100	5882	5882	
2	34 Bags	B.2	L.	3 x 3 x 1/4	2 0	101	3706	3842	
3			L.	3 x 3	2 0	102			
4			L.	1 3/4 x 1 1/4	8 3/16	109			
5	34 Bundles	B.3	L.	1 1/2 x 1 1/2	5 7/8	103	2108	2108	
6	34 Bundles	B.4	L.	1 1/2 x 1 1/2	6 0 5/16	104	2278	2278	
7	34 Bundles	B.5	L.	1 1/2 x 1 1/2	5 2 1/2 1/16	105	1972	1972	
8	34 Bundles	B.6	L.	1 1/2 x 1 1/2	5 7 7/8	106	2108	2108	
9	34 Bundles	B.7	L.	4 x 2 1/8	4 1	107R	7276	7276	
10			L.	4 x 2 1/8	4 1	107L			
11	102 Bundles	B.8	L.	3 x 2	4 4	108	28560	28560	
12	34 Bags	B.9	L.	1 1/2 x 1 1/2	5 3 3/16	110	2992	3128	
13			L.	2 1/2 x 2	1 1/2	111			
14			B.	1 1/2 x 1/16	7 1/2	112			
15	34 Bags	B.10	L.	1 1/2 x 1 1/2	5 15/16	109	3298	3434	
16			B.	1 1/2 x 5/8	15/16				
17			B.	2 x 5/8	15/16				
18			B.	264 Spring washers	1/8" th.	1 1 3/16 o.d.			
19									
20									
21							60180	60588	
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									

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MAILING ADDRESS

ORDER No.

OUR CONTRACT No. T.1421.

SHEET No. 119

SUMMARY FOR SHEET

PIECES BUNDLES CRATES

306

102 BAGS, 119

Apr 26 75

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/119
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
PACKING LIST

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
DRAWING NUMBER T1421-P	SHEET REVISION 119 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



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90-94 BROMPTON ROAD,
LONDON S.W.3.
38106

BLAW KNOX LTD.
(LIMITED COMPANY)
SHIPPING SPECIFICATION
PARTICULARS

COY No. T.1421. SHEET No. 120

34 Sets STANDARD
SUSPENSION TOWERS 64'6"
(Common Portion).

S.H.D. 327
L
LITERATURE.

ITEM No.	NUMBER OF PIECES, BUNDLE, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	SECTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1	34 Bundles	B35.	1	L	3 x 3	18 11	5	12614	12614	
2	"	"	3	L	3 x 3	18 11	6			
3	"	B36.	1	L	3 x 3	16 1	7	10710	10710	
4	"	"	2	L	3 x 3	16 1	8			
5	"	"	1	L	3 x 3	16 1	9			
6	"	B37.	4	L	2 1/2 x 2	9 10 1/2	10R	7412	7412	
7	"	"	4	L	2 1/2 x 2	9 10 1/2	10L			
8	"	B38.	4	L	2 1/2 x 2	9 7 1/2	11R	9452	9452	
9	"	"	4	L	2 1/2 x 2	9 7 1/2	11L			
10	"	B39.	4	P	3 1/2 x 1 1/2	5	12	2890	3026	
11	"	"	2	P	7 1/2 x 1 1/2	9 1/2	16			
12	"	"	4	P	10 1/2 x 1 1/2	1 2 1/2	38			
13	"	"	2	P	2 1/2 x 3/16	- 10 1/2	39R			
14	"	"	2	P	2 1/2 x 3/16	- 10 1/2	39L			
15	"	"	2	P	9 1/2 x 3/16	- 11 1/2	40			
16	"	"	2	P	4 1/2 x 3/16	- 10 1/2	41R			
17	"	"	2	P	4 1/2 x 3/16	- 10 1/2	41L			
18	"	Bundles B40.	2	L	1 1/2 x 1 1/2	7 10 1/2	13	4012	4012	
19	"	"	2	L	1 1/2 x 1 1/2	7 10 1/2	14			
20	"	"	4	L	1 1/2 x 1 1/2	6 2.1/16 17				
21	"	"	4	L	2 1/2 x 2 1/2	5 4 1/2	15	2006	2006	
22	"	B42.	2	L	3 x 3	29 5 1/2	18	9792	9792	
23	"	B43.	2	L	3 x 3	29 5 1/2	19	9792	9792	
24	"	B44.	2	L	2 x 2	8 10.5/16 20	20	1938	1938	
25	"	B45.	2	L	2 x 2	8 10.5/16 21	21	1938	1938	
26	"	B46.	2	L	2 x 2	12 7 1/2	22	2074	2074	
27	"	B47.	2	L	2 x 2	12 7.5/16 23	23	2074	2074	
28	"	B48.	2	L	2 1/2 x 2 1/2	9 5 1/2	25R	3876	3876	
29	"	"	2	L	2 1/2 x 2 1/2	9 5.3/16 25L				
30	"	B49.	2	L	2 1/2 x 2 1/2	28 5 1/2	26	7004	7004	
31	"	"								
32	"	"								
33	"	"						87584	87720	

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MAILING ADDRESS
ORDER No.

SHIPMENT No.
DATE SHIPPED

SUMMARY FOR SHEET
PIECES
BUNDLES
CRATES
BOXES BA08,
SHEET No. 120

OUR CONTRACT No. T1421.
SH/9

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/120
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 120 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

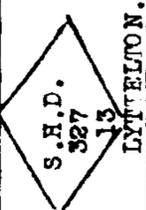


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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3

CON No. **T.1241.** SHEET No. **121**



MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

M 34 SETS STANDARD SUSPENSION
TOWERS 64'6"
L (COMMON PORTION).

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS	GROSS WEIGHT IN LBS	SIZE OF EACH CRATE OR BOX
1	34 Bundles	B50	2	L	2 x 2	9' 3 1/2"	27L	8120	8160	
2			2	L	2 x 2	9' 3 1/2"	27L			
3			2	L	2 1/2 x 2	9' 0 1/2"	28R			
4			2	L	2 1/2 x 2	9' 0 1/2"	28L			
5	"	B51	2	L	2 x 2	10' 1 1/2"	29	9146	9146	
6			4	L	2 x 2	12' 1.15/16	30	3298	3298	
7			4	L	2 x 2	10' 0 1/2"	145			
8	"	B52	2	L	2 1/2 x 1 1/2"	2' 7.5/16	30	3298	3298	
9			2	L	2 1/2 x 1 1/2"	3' 10.15/16	31R			
10			2	L	2 1/2 x 1 1/2"	3' 10.15/16	31L			
11			4	L	2 1/2 x 1 1/2"	3' 0.11/16	140R			
12			4	L	2 1/2 x 1 1/2"	3' 0.11/16	140L			
13	"	B53	2	L	2 x 2	2' 11 1/8"	32R	3196	3196	
14			2	L	2 x 2	2' 11 1/8"	32L			
15			2	L	2 x 2	5' 0.3/16	35R			
16			2	L	2 x 2	5' 0.3/16	35L			
17			1	L	2 1/2 x 2 1/2"	2' 11.11/16	36			
18			1	L	2 1/2 x 2 1/2"	2' 11.11/16	36A			
19	"	B54	2	L	2 1/2 x 2	7' 11.7/16	33R	3876	3876	
20			2	L	2 1/2 x 2	7' 11.7/16	33L			
21	"	B55	2	L	2 x 2	17' 9.5/16	34R	5848	5848	
22			2	L	2 x 2	17' 9.5/16	34L			
23	"	B56	2	L	2 1/2 x 1 1/2"	2' 7.3/16	37	3944	3944	
24			2	L	2 1/2 x 1 1/2"	2' 7.3/16	37A			
25			4	L	2 1/2 x 1 1/2"	3' 1.7/16	144R			
26			4	L	2 1/2 x 1 1/2"	3' 1.7/16	144L			
27			4	L	2 1/2 x 1 1/2"	2' 6.1/8	147R			
28			4	L	2 1/2 x 1 1/2"	2' 6.1/8	147L			
29	"	B57	2	P	8 x 4	1' 0.7/8	42R	3264	3400	
30			2	P	8 x 4	1' 0.7/8	42L			
31			2	P	4 1/2 x 3/16	1' 0.3/4	43L			
32			2	P	4 1/2 x 3/16	1' 0.3/4	43R			
33						(CONT'D)	C/TWd.126616	126888		

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ORDER No. T.1421.

OUR CONTRACT No. T.1421.

SHIPMENT No. DATE SHIPPED

SUMMARY FOR SHEET
PIECES 238.
BUNDLES 34.
CRATES 121.
SHEET No. 121.

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/121
issue A

REV	REVISION DESCRIPTION	CONSULTANT				TP				
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20

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TOWER CONTRACT C327	TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 121 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT. No. **T.1421** SHEET No. **122**

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

S.H.D. 327

LYTTELTON.

34 Sets - Standard Suspension
Towers **64'6"**
(Common Portion).

ITEM No.	NUMBER OF PIECES, BUNDLES OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN Lbs.	GROSS WEIGHT IN Lbs.	SIZE OF EACH CRATE OR BOX
1		(Bags cont'd).					b/twd.	180616		
2			2	P.	5 1/2 x 3/16	8 7-5/8	44R.			
3			2	P.	5 1/2 x 3/16	7-5/8	44L.			
4			2	P.	5 1/2 x 3/16	7-3/4	45			
5			2	P.	4 1/2 x 5/8	7-1/8	46			
6			2	P.	4 1/2 x 3/16	9-1/8	47			
7			4	P.	5 1/2 x 1/4	6-1/8	148			
8			4	L.	1 1/2 x 1 1/2	2'0-15/16	150			
9	154 Bundles	B.58	4	L.	2 1/2 x 2	11'2-3/4"	139R	8432	8432	
10			4	L.	2 1/2 x 2	11'2-3/4"	139L			
11	54 Bundles	B.59	4	L.	1 1/2 x 1 1/2	5'1"	141R	5270	5270	
12			4	L.	1 1/2 x 1 1/2	5'1"	141L			
13			4	L.	1 1/2 x 1 1/2	5'8-1/2"	143R			
14			4	L.	1 1/2 x 1 1/2	5'8-1/2"	143L			
15	"	B.60	8	L.	1 1/2 x 1 1/2	8'4-1/4"	146	5032	5032	
16			2	L.	1 1/2 x 1 1/2	4'5-15/16	149R			
17			2	L.	1 1/2 x 1 1/2	4'5-15/16	149L			
18			4	L.	1 1/2 x 1 1/2	5'8-1/2"	151			
19	"	B.61	1	L.	1 1/2 x 1 1/2	7'10-1/2"	152	8636	8636	
20			1	L.	1 1/2 x 1 1/2	7'10-1/2"	153			
21			4	L.	1 1/2 x 1 1/2	7'9-9/16"	189			
22			2	L.	1 1/2 x 1 1/2	8'0-5/16"	196			
23			2	L.	1 1/2 x 1 1/2	8'0-5/16"	196A			
24			2	L.	1 1/2 x 1 1/2	7'9-9/16"	197			
25			2	L.	1 1/2 x 1 1/2	7'9-9/16"	197A			
26			2	L.	1 1/2 x 1 1/2	7'10-3/8"	198			
27			2	L.	1 1/2 x 1 1/2	7'10-3/8"	198A			
28	"	B.62	2	L.	1 1/2 x 1 1/2	9'10-7/8"	156	1224	1224	
29										
30										
31										
32										
33							g/twd.	155210	135482	

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ORDER No.

SHIPMENT No.
DATE SHIPPED

SUMMARY FOR SHEET
PIECES
BUNDLES
CRATES
BOXES

170

OUR CONTRACT No. **T.1421**

SHEET No. **122**

C327
MFGR: **BLAW KNOX**
TOWER TYPE: **S. SUSPENSION**
CONFIG: **SUSPENSION**
SECTION No: **312CH**
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/122
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP				
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20

TRANSPower

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER PACKING LIST	DRAWING NUMBER T1421-P	SHEET REVISION 122 B
	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

submit your markups to TranspowerProduction@redyeds.com



BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT. No. T.1421 SHEET No. 123

34 Sets Standard Suspension
Tower 64'6"
(Common Portion).

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

S.B.D.
327
13
LYTTELTON.

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS	GROSS WEIGHT IN LBS	SIZE OF EACH CRATE OR BOX
1	184 Bundles	B.63	2	L ₁	12" x 12"	4'11-1/8"	154	155210	155482	
2			2	L ₂	12" x 1/4"	4'10"	156R			
3			2	L ₃	12" x 12"	4'10"	156L			
4			4	L ₄	12" x 12"	3'7-5/16"	157			
5			2	L ₅	12" x 12"	4'11-1/8"	158R			
6			2	L ₆	12" x 12"	4'11-1/8"	158L			
7	184 Bags	B.64	4	L ₇	12" x 12"	1'10"	159	2686	2822	
8			2	L ₈	12" x 12"	1'9-3/16"	160R			
9			2	L ₉	12" x 12"	1'9-3/16"	160L			
10			4	L ₁₀	12" x 12"	1'5-7/16"	162			
11			4	L ₁₁	12" x 12"	1'8-7/8"	170			
12			2	L ₁₂	12" x 12"	2'0-9/16"	174			
13			2	L ₁₃	12" x 12"	1'2-1/8"	176			
14			2	L ₁₄	12" x 12"	1'0-3/8"	177			
15			1	L ₁₅	12" x 12"	1'11-1/2"	194			
16			1	L ₁₆	12" x 12"	1'11-1/2"	194A			
17			2	L ₁₇	5 1/2" x 2 1/2"	9-1/4"	200R			
18			1	L ₁₈	5 1/2" x 2 1/2"	9-1/4"	200L			
19	184 Bundles	B.65	2	L ₁₉	12" x 12"	4'3-11/16"	161R	4148	4148	
20			2	L ₂₀	12" x 12"	4'3-11/16"	161L			
21			2	L ₂₁	12" x 12"	4'8-7/8"	163R			
22			2	L ₂₂	12" x 12"	4'8-7/8"	163L			
23			2	L ₂₃	12" x 12"	4'5-5/8"	164R			
24			2	L ₂₄	12" x 12"	4'3-5/8"	164L			
25			2	L ₂₅	12" x 12"	3'10-1/8"	166R			
26	184 Bundles	B.66	4	L ₂₆	12" x 12"	3'10-1/8"	166L	3910	3910	
27			4	L ₂₇	12" x 12"	4'1-3/8"	167			
28			2	L ₂₈	12" x 12"	4'0-15/16"	171			
29			2	L ₂₉	12" x 12"	3'11-15/16"	173			
30			2	L ₃₀	12" x 12"	4'1-3/4"	185			
31										
32										
33										

CONSIGN TO
AT
Apel 3875

VIA FOR DELIVERY
MAILING ADDRESS

OUR CONTRACT No. T.1421

SHIPMENT No.
DATE SHIPPED

SUMMARY FOI SHEET
PIECES
BUNDLES
CRATES
102
34 Bags
340000

SHEET No. 123

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/123
issue A

REV	REVISION DESCRIPTION	CONSULTANT				TP				
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20

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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
PACKING LIST

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
DRAWING NUMBER T1421-P	SHEET REVISION 123 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-4 BROMPTON ROAD,
LONDON, S.W.3.

CON'T No. **T.1421** SHEET No. **100**

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

S.H.D. 327

34 Sets - Standard Suspension Towers 64'6" (COMMON PORTION).

ITEM No.	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN lbs.	GROSS WEIGHT IN lbs.	SIZE OF EACH CRATE OR BOX
1										
2	34 Bundles	B.67.	2.	L.	2 x 2	10'2.7/16"	168R	1700	1700	
3	"	B.68.	2.	L.	2 x 2	10'2.7/16"	168L	1700	1700	
4	"	B.69.	2.	L.	1.3/4x1.43/16"	1.3/16"	169R	4148	4148	
5			2.	L.	1.3/4x1.43/16"	1.3/16"	169L			
6			2.	L.	1 1/2" x 1 1/2"	6'6 1/2"	193			
7			2.	L.	1 1/2" x 1 1/2"	6'6 1/2"	193A			
8			2.	L.	1 1/2" x 1 1/2"	5'7.9/16"	195			
9			2.	L.	1 1/2" x 1 1/2"	5'7.9/16"	195A			
10	34 Bundles	B.70.	2.	L.	1 1/2" x 1 1/2"	2'10.7/8"	172	3264	3264	
11			2.	L.	1 1/2" x 1 1/2"	3'5 1/2"	175			
12			2.	L.	1 1/2" x 1 1/2"	2'7.5/16"	178			
13			2.	L.	1 1/2" x 1 1/2"	2'11.5/8"	179			
14			2.	L.	1 1/2" x 1 1/2"	2'3.3/8"	180			
15			2.	L.	1 1/2" x 1 1/2"	3'4.7/8"	181			
16			2.	L.	1 1/2" x 1 1/2"	3'5"	182			
17			2.	L.	1 1/2" x 1 1/2"	3'1.3/16"	184R			
18			2.	L.	1 1/2" x 1 1/2"	3'1.3/16"	184L			
19	34 Bundles	B.71.	8.	L.	1 1/2" x 1 1/2"	2'10.3/8"	183	1768	1768	
20			2.	L.	1 1/2" x 1 1/2"	2'11.1/4"	199			
21			4.	L.	1 1/2" x 1 1/2"	4'5.1/2"	186	4386	4386	
22			2.	L.	1 1/2" x 1 1/2"	4'2.1/2"	187			
23			2.	L.	1 1/2" x 1 1/2"	4'3.1/4"	187A			
24			4.	L.	1 1/2" x 1 1/2"	4'2.11/16"	216			
25			4.	L.	1 1/2" x 1 1/2"	4'3.7/16"	217			
26	34 Bundles	B.73	4.	L.	1 1/2" x 1 1/2"	8'6.7/16"	188	7514	7514	
27			4.	L.	1 1/2" x 1 1/2"	7'9"	190			
28			4.	L.	1 1/2" x 1 1/2"	7'5.11/16"	191			
29			4.	L.	1 1/2" x 1 1/2"	7'10 1/2"	192			
30										
31										
32										
33										

CONSIGN TO
AT
VIA FOR DELIVERY
MAILING ADDRESS

SHIPMENT No.
DATE SHIPPED

SUMMARY FOR SHEET
PIECES
BUNDLES
CRATES
BOXES

OUR CONTRACT No. **T.1421**

SHEET No. **100**

C327
MFGR: **BLAW KNOX**
TOWER TYPE: **S. SUSPENSION**
CONFIG: **SUSPENSION**
SECTION No: **312CH**
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/124
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER PACKING LIST	DRAWING NUMBER T1421-P	SHEET REVISION 124 B
	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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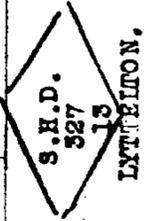


BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CO. T. No. **T.1421** SHEET No. **125**

34 SETS SUSPENSION TOWERS
24 1/2"
(COMMON PORTION).



MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN LBS	GROSS WEIGHT IN LBS	SIZE OF EACH CRATE OR BOX
1	184 Bags	B74	(2)	L _o	3 1/2 x 2 1/2	8 1/2"	B/forward 102276	102276	34.34	
2			(2)	L _o	3 1/2 x 2 1/2	8 1/2"	201L			
3			(4)	L _o	2 1/2 x 2 1/2	4 1/2"	203			
4			(2)	Ch _o	8 x 3	4 1/2"	204			
5			(2)	Ch _o	8 x 3	6 1/2"	205			
6			(4)	P _o	5 1/2 x 1 1/4	10"	206			
7			(1)	L _o	1 1/2 x 1 1/2	2 1/2"	207			
8			(1)	P _o	5 1/2 x 3/16"	8"	208			
9			(4)	P _o	2 1/2 x 1/4"	3 1/2"	209			
10			(2)	P _o	2 1/4"	2 1/4"	210			
11			(1)	L _o	1 1/2 x 1 1/2	1 1/2"	194B			
12			(1)	L _o	1 1/2 x 1 1/2	1 1/2"	194L			
13			(1)	Units, compri:-						
14			(2)	3/4" dia. rods.	5"		213			
15			(2)	P _o	4 1/2 x 2"	6-5/16"	213A			
16			(4)	1/4" dia. check pins.			OR.			
17	" Bundles	B75	(1)	Ch _o	4 x 2"	2'10-15/16"	202B, 202C	1398		
18	" "	B76	(1)	Ch _o	4 x 2"	2'10-15/16"	202L	1398		
19	" "		(1)	L _o	Ladder compri:-		212	2046	4046	
20	" "		(2)	P _o	2x3/16"	18'8"	211	4046	4046	
21	" "		(18)	1/2" dia. rods.	1'9-3/8"					
22	" "		(1)	Ladder compri:-						
23	" "		(2)	P _o	2x3/16"	18'3/8"	212			
24	" "		(18)	1/2" dia. rods.	1'0 1/8"					
25	" "	B77	(4)	L _o	1 1/2 x 1 1/2	4'10"	214	3808	3808	
26	" "		(4)	L _o	1 1/2 x 1 1/2	3'4-9/16"	218			
27	" "		(4)	L _o	1 1/2 x 1 1/2	4'3-1/4"	215			
28	" "		(2)	L _o						
29										
30										
31										
32										
33										

CONSIGN TO
AT **CM3875**

VIA **FOR** DELIVERY
MAILING ADDRESS

OUR CONTRACT No. **T.1421**

SUMMARY FOR SHEET
PIECES **102**
BUNDLES
CRATES **34** BAGS
SHEET No. **125**

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/125
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
PACKING LIST

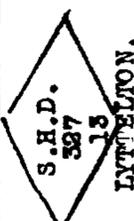
TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
DRAWING NUMBER T1421-P	SHEET REVISION 125 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

BLAW KNOX LTD.
(TOWER DEPARTMENT)

90-94 BROMPTON ROAD,
LONDON, S.W.1.

SHIPPING SPECIFICATION
AND PACKING PARTICULARS

CONT. No. T.1421. SHEET No. 126



34 Sets Standard Suspension
Towers 24'6" (COMMON PORTION).

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLE, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	FRACTION MARK	NET WEIGHT IN LBS.	GROSS WEIGHT IN LBS.	SIZE OF EACH CRATE OR BOX
1				SETS OF BOLTS NO. 933/ST.	b/forward: 206822					
2	134 Bags.	B 78.	300	Bolts.	1 1/4 x 5/8"	XOX SCD	15/16"	3366.	3502	
3	"	B 79.	3	"	2 x 5/8"	XOX SCD	15/16"	3400.	3536	
4	"		16	"	1 1/4 x 5/8" XOX SCD		1.5/16"			with nut and locknut.
5	"		34	"	1 1/4 x 5/8"	XOX SCD	15/16"			
6	"		245	"	1 1/4 x 5/8"	XOX SCD	15/16"			
7	"	B 80.	232	"	1 1/4 x 5/8"	XOX SCD	15/16"	4386	4522	
8	"		3	"	2 1/4 x 5/8" XOX SCD		1.5/16"			with nut and locknut.
9	"		28	"	7" x 5/8" XOX SCD		2"			with 2 full nuts.
10			4	Bevel washers for 5/8" dia. bolts.						
11			2	Flat washers 3/16" x 1.7/8" o/d for 7/8" dia. bolts.						
12			2	Flat washers 3/16" x 1 1/4" o/d for 5/8" dia. bolts.						
13			889	Single coil spring washers 1/8" x 1.3/16" o/d for 5/8" dia. bolts.						
14			3	Shackles to 38-4642. Mod. 913/1S.						
17				TOTAL:				21774	218926	
23									1326	Bundles.
24									238	Bags.
26				Gross:					97.14.2.22	Gross.
27				Nett:					97.6.0.22	Nett.

CONSIGN TO AT *CH883875*

VIA FOR DELIVERY

MAILING ADDRESS

ORDER No. OUR CONTRACT No. T.1421

SHIPMENT No. DATE SHIPPED

SUMMARY FOR SHEET
PIECES
BUNDLES
CRATES
102 BAGS. 30XXX

SHEET No. 126

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/126
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT	TP
REV	DESCRIPTION	CONSULTANT	TP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	TP

TRANSPOWER

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TOWER CONTRACT C327	TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 126 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



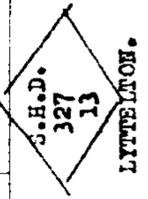
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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CONT No. **T1421.** SHEET No. **127.**

**34 SETS OF EXTENSION
MATERIAL TO COMPLETE
STANDARD SUSPENSION TOWER
54' 9".**



MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

ITEM No.	NUMBER OF PIECES, BUNDLES OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	EJECTION MARK	NET WEIGHT IN	GROSS WEIGHT IN	SIZE OF EACH CRATE OR BOX
1	34 Bundles	B86.	1.	L.	3 x 3	11'8.7/8"	NAA.	4828.	4828.	
2			1.	L.	3 x 3	11'8.7/8"	NAA.			
3	34 "	B87.	2.	L.	3 x 3	11'8.7/8"	NAA.	4828.	4828.	
4	34 "	B88.	4.	L.	1 1/2 x 1 1/2	14'24.3/16"	NAA120.	4114.	4114.	
5	34 "	B89.	4.	L.	1 1/2 x 1 1/2	10'7.15/16"	NAA138.	2584.	2584.	
6	34 "	B90.	4.	L.	1 1/2 x 1 1/2	10'7.15/16"	NAA131A.	2584.	2584.	
7	34 "	B91.	4.	L.	2 1/2 x 2	17'.11.10"	NAA138R.	8805.	8805.	
8	34 "	B92.	4.	L.	2 1/2 x 2	17'.11.1/16"	NAA138L.	8805.	8805.	
9	34 "	B93.	4.	L.	1 1/2 x 1 1/2	2'4.3/4"	NAA134F.	580.	580.	
10	34 "	B94.	4.	L.	1 1/2 x 1 1/2	2'4.3/4"	NAA134L.	580.	580.	
11	34 "	B95.	4.	L.	1 1/2 x 1 1/2	3'3.1/2"	NAA135.	815.	815.	
12	34 "	B96.	4.	L.	1 1/2 x 1 1/2	5'4.7/16"	NAA136R.	1292.	1292.	
13	34 "	B97.	4.	L.	1 1/2 x 1 1/2	5'4.7/16"	NAA136L.	1292.	1292.	
14	34 "	B98.	4.	L.	1 1/2 x 1 1/2	4'8.1/4"	NAA137B.	1155.	1155.	
15	34 "	B99.	4.	L.	1 1/2 x 1 1/2	4'8.1/4"	NAA137L.	1155.	1155.	
16	34 "	B100.	4.	L.	1 1/2 x 1 1/2	6'5.5/16"	NAA138R.	1836.	1836.	
17	34 "	B101.	4.	L.	1 1/2 x 1 1/2	6'5.5/16"	NAA138L.	1836.	1836.	
18	34 Bags	B102.	4.	P.	3 1/2 x 1 1/2	6 1/2"	NAA132.	1666.	1802.	
19			32.	BOLTS.	1 1/2 x 5/8" XOX SCD.	15/16"				
20			48.	"	1 1/2 x 5/8" "	15/16"				
21			32.	"	1 1/2 x 5/8" "	15/16"				
22				3. Step Bolts.	7 x 5/8" XOX "	2 1/2"				
23				118. Spring Washers	1/8" Thick x 1.3/16" o/d for 5/8" Bolt.					
24								48860..	49086	
25										
26										
27				NETT	WEIGHT	21 T. 17.			00rs.	16 It.
28				GROSS		21 T. 18.			10rs.	18 It.
29										
30										
31										
32										
33										

CONSIGN TO
AT

VIA MAILING ADDRESS FOR DELIVERY

SHIPMENT No. DATE SHIPPED

OUR CONTRACT No. **T.1421.** SHEET No. **127.**

SUMMARY FOR SHEET
PIECES BUNDLES CRATES BAGS.
544. 34. 127.

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/127
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPOWER

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TOWER CONTRACT C327	TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 127 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.



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CONT No. T.1421. SHEET No.128.		BLAW KNOX LTD. (TOWER DEPARTMENT) SHIPPING SPECIFICATION AND PACKING PARTICULARS		90-94 BROMPTON ROAD, LONDON, S.W.3.						
MARK EACH PIECE, BUNDLE, OR PACKAGE AS FOLLOWS ALSO WITH SERIAL NUMBERS GIVEN BELOW.		M S.H.D. 327 13 LITTELTON		L 34 SETS OF SPARE BOLTS, NUTS AND WASHERS FOR STANDARD SUSPENSION TOWER, INCLUDING GRILLAGE. 64'6".						
ITEM No	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN	GROSS WEIGHT IN	SIZE OF EACH CRATE OR BOX
1	34 Bage.	B.103.	13	BOLTS	1 1/4 x 5/8"	XOX 3CD	15/16"	816	952	
2			38	"	1 1/4 x 5/8"	"	"			
3			4	"	1 1/4 x 5/8"	"	"			
4			4	"	2 x 5/8"	"	"			
5			1	"	1 1/4 x 5/8" XOX	1/5.16"	with locknut.			
6			1	"	2 1/4 x 5/8"	"	"			
7			2	STEP BOLTS	7 x 5/8"	"	2 1/4"	"	2 nuts.	
8			1	BEVEL WASHER	5°	for 5/8"	bolt.			
9			1	FLAT WASHER	3/16"	thick x 1 1/2"	o/d for 5/8"	bolt.		
10			1	"	"	"	x 1-7/8"	o/d for 7/8"	bolt,	
11			65	SPRING	1/8"	"	x 1.3/16"	"	5/8"	
12										
13										
14										
15										
16										
17										
18										
19										
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21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										

NET WEIGHT 70.1d: 4 lbs.
GROSS WEIGHT 80.1d: 29.0 lbs.

CONSIGN TO AT	SHIPMENT No. DATE SHIPPED	SUMMARY FOR SHEET PIECES BUNDLES CRATES
VIA MAILING ADDRESS	OUR CONTRACT No. T.1421.	34 BLOW B.C.
ORDER No.	SHEET No. 128.	

C4083875

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/128
issue A

A: title, folder reference corrected SS 12/01 ML LDS

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER PACKING LIST	DRAWING NUMBER T1421-P	SHEET REVISION 128 B
	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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BLAW KNOX LTD.
(TOWER DEPARTMENT)
SHIPPING SPECIFICATION
AND PACKING PARTICULARS

90-94 BROMPTON ROAD,
LONDON, S.W.3.

CC T. No. T1421. SHEET No. 129

MARK EACH PIECE, BUNDLE,
OR PACKAGE AS FOLLOWS
ALSO WITH SERIAL
NUMBERS GIVEN BELOW.

M. S.H.D. 327.
R. 13
C. LYTTLETON.

ITEM OMITTED FROM
SHEET 108.
100 SETS SUSPENSION TOWERS
74"6" COMMON PORTION.

ITEM No	NUMBER OF PIECES, BUNDLES, OR PACKAGES	SERIAL NUMBERS OF PACKAGES	PIECES IN EACH BUNDLE OR PACKAGE	DESCRIPTION	SIZE OF EACH PIECE	LENGTH OF EACH PIECE	ERECTION MARK	NET WEIGHT IN lbs.	GROSS WEIGHT IN lbs.	SIZE OF EACH CRATE OR BOX
1	4 BAGS	B74	25	3/4 DIA	RODS	5"	NA.213	336	344	
2		(PART ONLY)	25	P	4"x1/2"	6 5/16	NA.213A			
3				(AS ONE UNIT)						
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
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28										
29										
30										
31										
32										
33										

Bags marked with Red flash - loaded finally so to be easily available if urgently required, omitted from the "ROM/NIC" shipment.

INVOICES TO FOLLOW.

CA08 3675

CONSIGN TO AT	SHIPMENT No. DATE SHIPPED	SUMMARY FOR SHEET PIECES BUNDLES CRATES
VIA MAILING ADDRESS	OUR CONTRACT No. T1421.	4 BAGS. SHEET No. 129
FOR DELIVERY		
ORDER No.		

C327
MFGR: BLAW KNOX
TOWER TYPE: S. SUSPENSION
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
TO66/A1/6

TOWER CONTRACT C327
TYPE TOWER - S. SUSPENSION
PACKING LIST

T1421-P/129
issue A

A: title, folder reference corrected SS 12/01 ML LDS

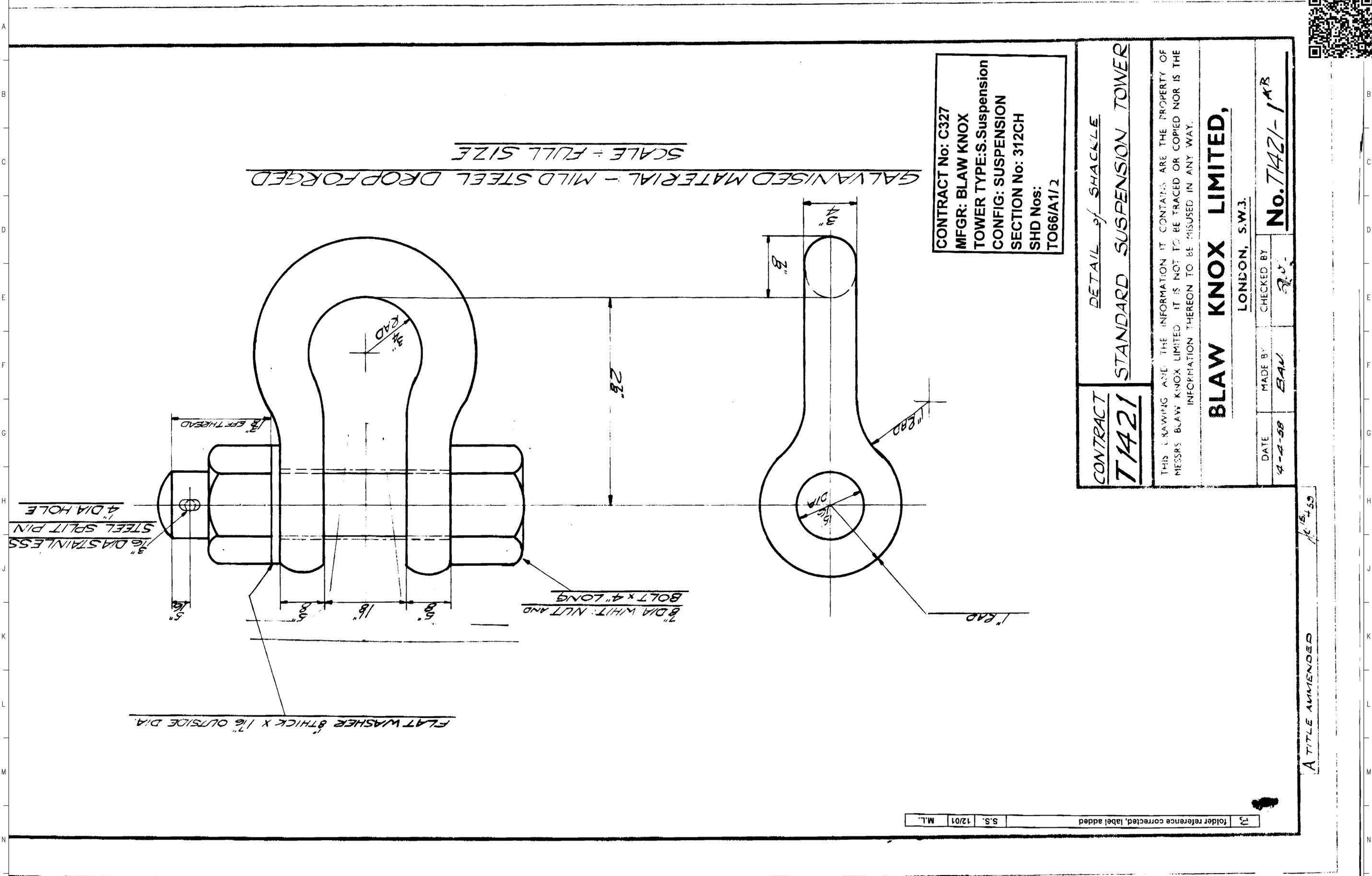
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		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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TOWER CONTRACT C327	TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/6
STANDARD SUSPENSION TOWER	DRAWING NUMBER T1421-P	SHEET REVISION 129 B
PACKING LIST	DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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submit your markups to TranspowerProduction@redyedms.com

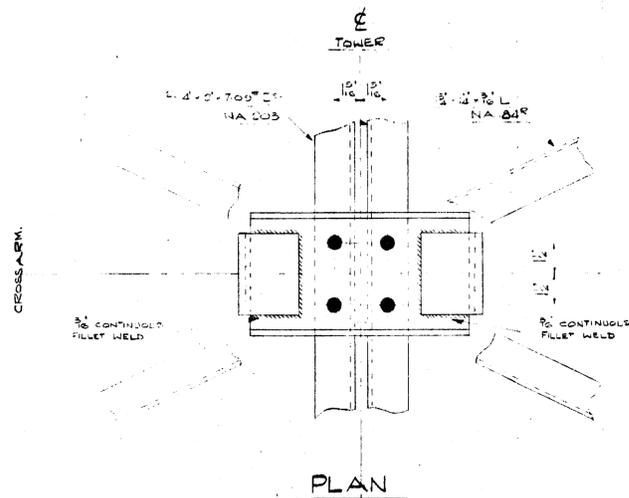
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		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
C	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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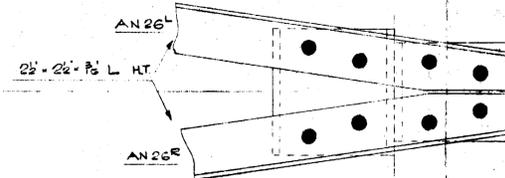
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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
DETAIL OF SHACKLE

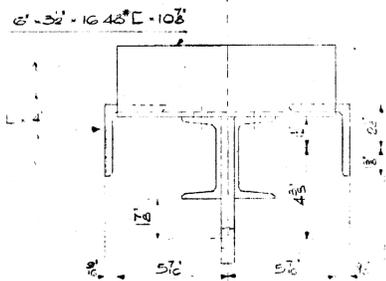
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DRAWING NUMBER T1421	SHEET REVISION 1 C
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision C	SCALE N.T.S.



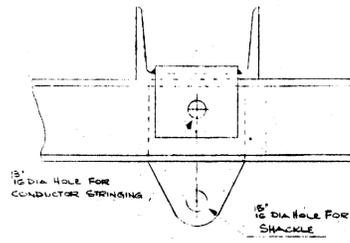
PLAN



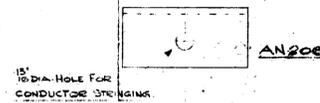
PLAN



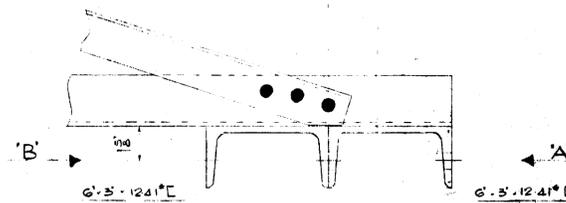
ELEVATION



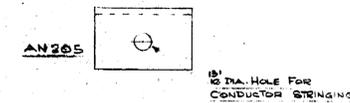
END ELEVATION



VIEW ON ARROW 'B'



ELEVATION



VIEW ON ARROW 'A'

CENTRE OF CROSSARM

END OF CROSSARM

CONTRACT No: C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 TO66/A1/5

NOTE:
 FOR GENERAL ARRANGEMENT
 OF TOWER, REFER TO DRWG.
 No. XM.3228-15 & 16
 SCALE: 3" = 140'

STATE HYDRO ELECTRIC DEPARTMENT
 NEW ZEALAND
 SECTION 312 CHRISTCHURCH DISTRICT
 BENMORE - ISLINGTON 220KV LINE
 CONTRACT No. 327

CONTRACT T1421
 STRINGING ARRANGEMENT
 FOR STANDARD SUSPENSION
 TOWER

BLAW KNOX LTD.
 LONDON S.W.3.

A folder reference corrected, label added S.S. 1201 M.L.

DATE 28.3.58 MADE BY J.F. CHECKED BY [Signature] No. T1421-2 A

REV	REVISION DESCRIPTION	CONSULTANT										TP
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

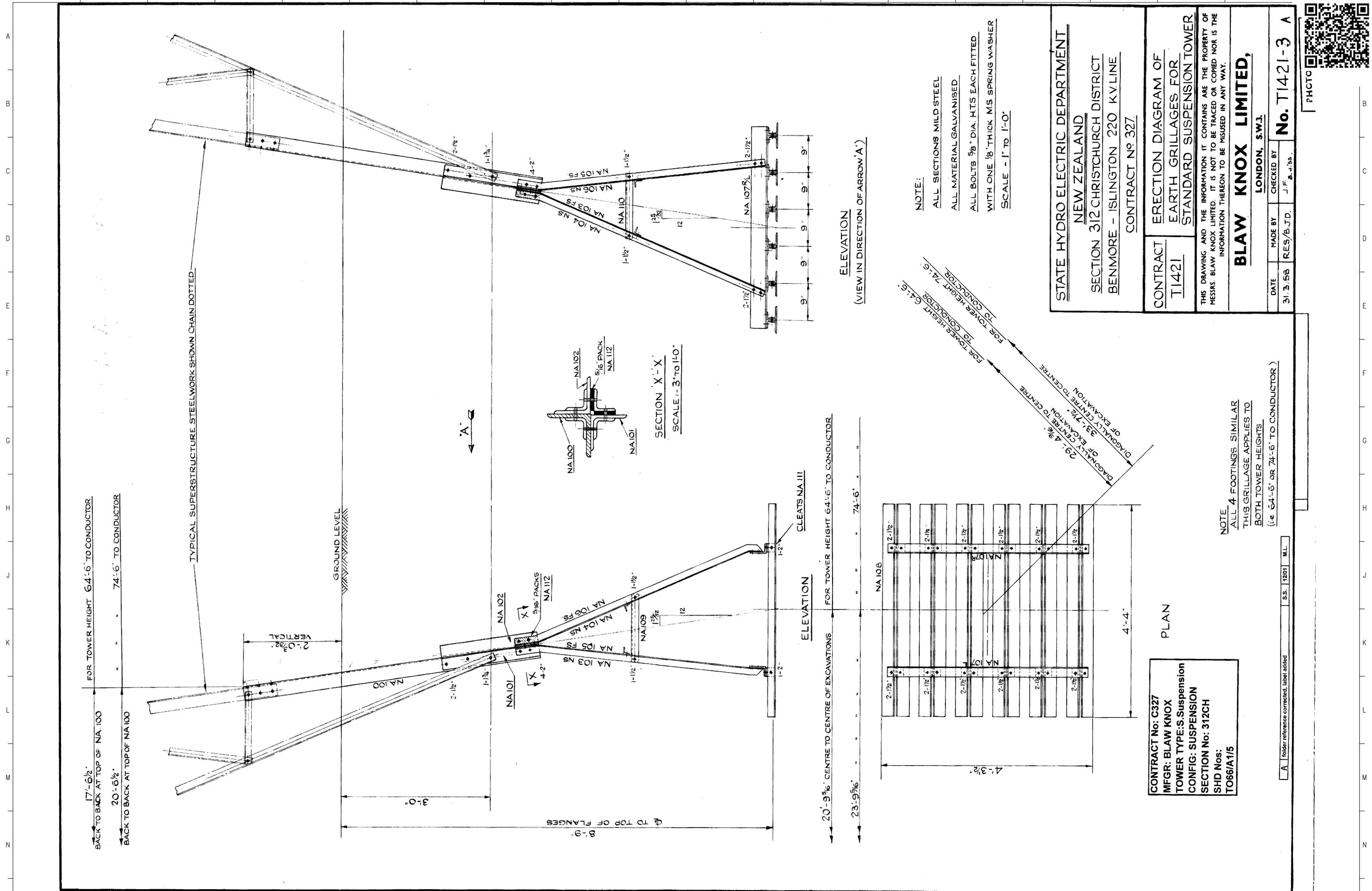


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TOWER CONTRACT C327
 STANDARD SUSPENSION TOWER
 STRINGING ARRANGEMENT

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/5
DRAWING NUMBER T1421	SHEET REVISION 2 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

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ELEVATION
(VIEW IN DIRECTION OF ARROW 'A')

SECTION 'X' - 'X'
SCALE: 1/8" TO 1'-0"

ELEVATION

CONTRACT No: C327
MFR: BLAW KNOX
TOWER TYPE: S. Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos: TO66/A1/5

NOTE:
ALL SECTIONS MILD STEEL
ALL MATERIAL GALVANISED
ALL BOLTS 5/8" DIA. HTS EACH FITTED
WITH ONE 1/8" THICK M.S. SPRING WASHER
SCALE - 1" TO 1'-0"

NOTE
ALL 4 FOOTINGS SIMILAR
THIS GRILLAGE APPLIES TO BOTH TOWER HEIGHTS (i.e. 64'-6" OR 74'-6" TO CONDUCTOR)

STATE HYDRO ELECTRIC DEPARTMENT NEW ZEALAND SECTION 312 CHRISTCHURCH DISTRICT BENMORE - ISLINGTON 220 KV LINE CONTRACT No 327	
CONTRACT T1421	ERECTION DIAGRAM OF EARTH GRILLAGES FOR STANDARD SUSPENSION TOWER
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BLAW KNOX LIMITED, LONDON, S.W.3.	
DATE 31.3.58	MADE BY RES/B.J.D.
DATE 31.3.58	CHECKED BY J.F. g.-1'ss.
No. T1421-3 A	



REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

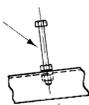
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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
ERECTION DIAGRAM
EARTH GRILLAGES

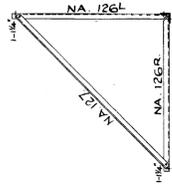
TRANSPower PROJECT CODE IP_1920_244_11		FOLDER TO66/A1/5	
DRAWING NUMBER T1421		SHEET 3	REVISION B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B		SCALE N.T.S.	

STEP BOLTS 5/8" DIA. x 7" LONG
(HEX HEAD, 2 HEX NUTS & 2 1/8" THICK SPRING WASHERS) ON ONE CORNER LEG FROM 9'-0" ABOVE GROUND LEVEL TO HORIZONTAL MEMBER AT PLAN 'B-B'.

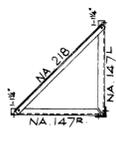


DETAIL OF STEP BOLT
SCALE: 1/8" TO 1'-0"

PLAN ON 'M-M'



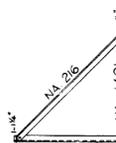
PLAN ON 'C-C'



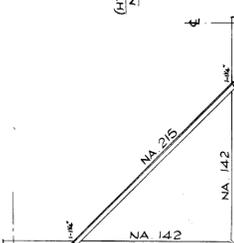
PLAN ON 'E-E'



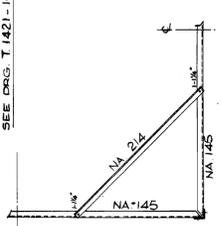
PLAN ON 'G-G'



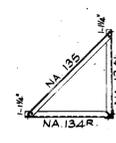
PLAN ON 'F-F'



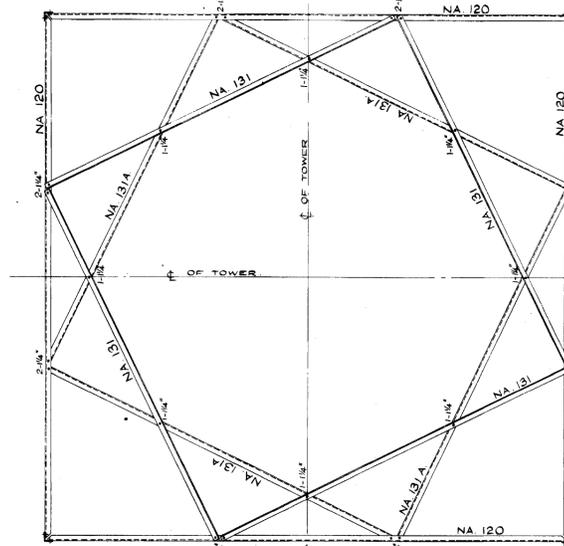
PLAN ON 'D-D'



PLAN ON 'K-K'



PLAN ON 'H-H'



PLAN ON 'H-H'

PLAN ON 'N-N'



GENERAL NOTES:
BOLTS 5/8" DIA. HT. (1/16" DIA. HOLES) EACH FITTED WITH ONE 1/8" THICK SPRING WASHER
MATERIAL GALVANISED TO WITHSTAND TESTS OF BS729 FOR UPPER PORTION OF TOWER SEE DRG. FOR ERECTION DIAGRAM OF EARTH GRILLAGE
SEE DRG. T.1421-3

SCALE: 1/2" TO 1'-0" TOWER OUTLINE

CONTRACT No: C327
MFR: BLAW KNOX
TOWER TYPE: S.Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
T066/A1/5

STATE HYDRO ELECTRIC DEPARTMENT
NEW ZEALAND
SECTION 312 CHRISTCHURCH DISTRICT
BENMORE - ISLINGTON 220 KV LINE
CONTRACT No 327.

CONTRACT T.1421 ERECTION DIAGRAM OF STANDARD SUSPENSION TOWER

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BLAW KNOX LIMITED,
LONDON, S.W.3.

DATE	MADE BY	CHECKED BY	No. T.1421-9A
31. 3. 58.	R.L.C./M.D.B.		

PHOTOGRAPHED

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
P	C	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPower

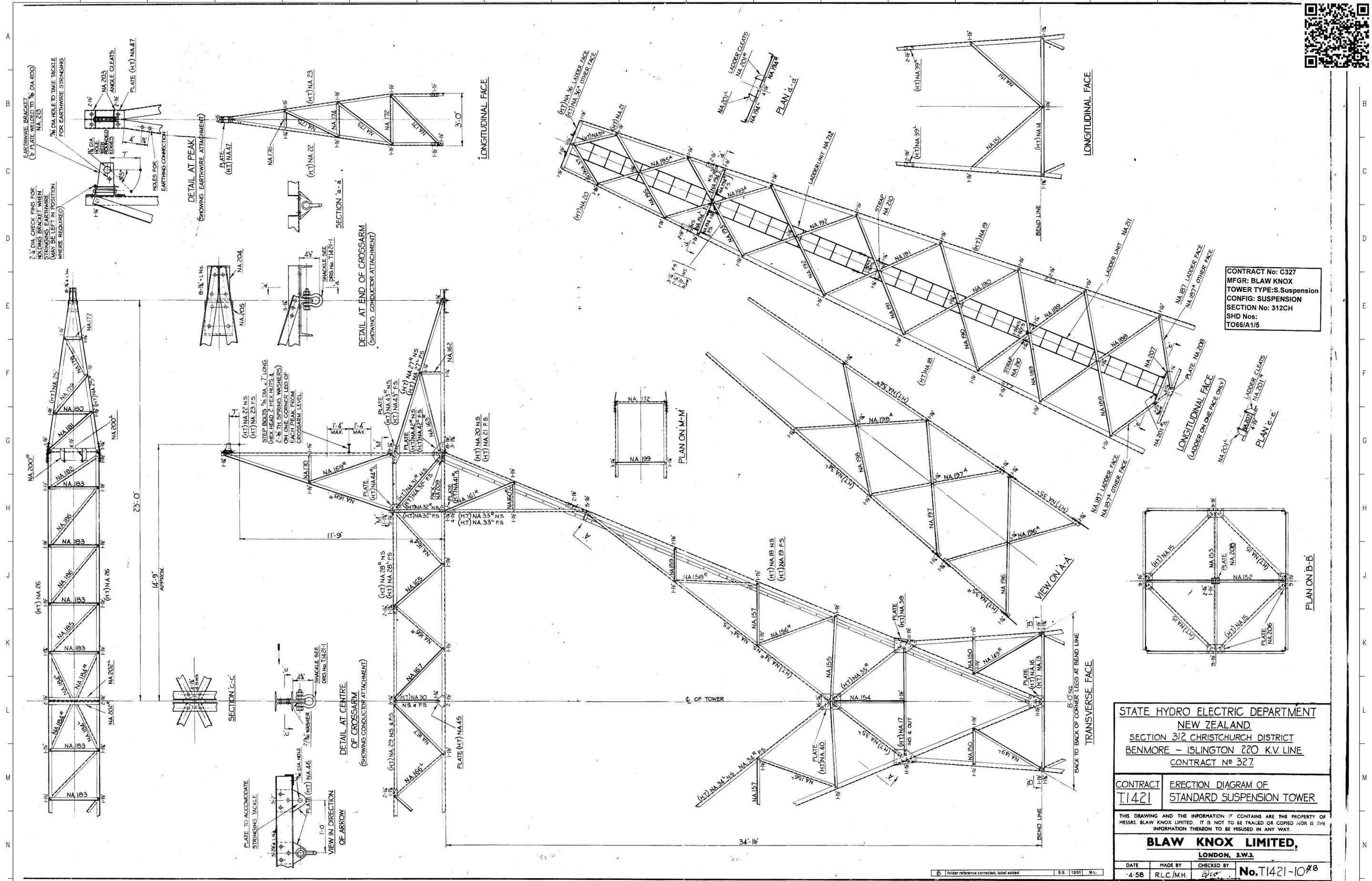
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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
ERECTION DIAGRAM
SHEET 1 OF 2

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER T066/A1/5
DRAWING NUMBER T1421	SHEET REVISION 9 C
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision C	SCALE N.T.S.



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CONTRACT No: C327
 MFRG: BLAW KNOX
 TOWER TYPE: S Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/5

STATE HYDRO ELECTRIC DEPARTMENT
 NEW ZEALAND
 SECTION 312 CHRISTCHURCH DISTRICT
 BENMORE - ISLINGTON 220 K.V. LINE
 CONTRACT No 327.

CONTRACT T1421
 ERECTION DIAGRAM OF
 STANDARD SUSPENSION TOWER

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BLAW KNOX LIMITED,
 LONDON, S.W.3.

DATE: 4-58 MADE BY: R.L.C./M.H. CHECKED BY: [Signature] No. T1421-10#B

REV	REVISION DESCRIPTION
C	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION

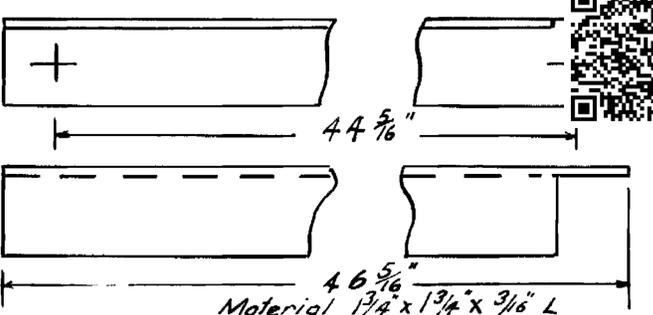
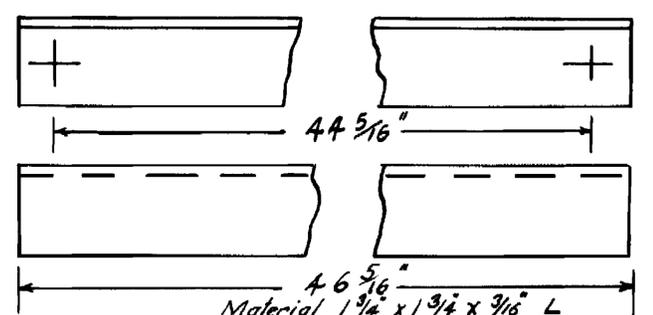
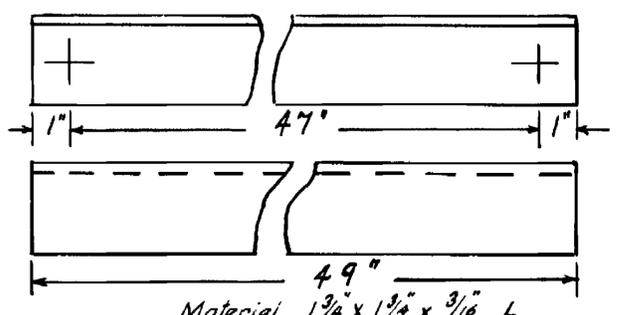
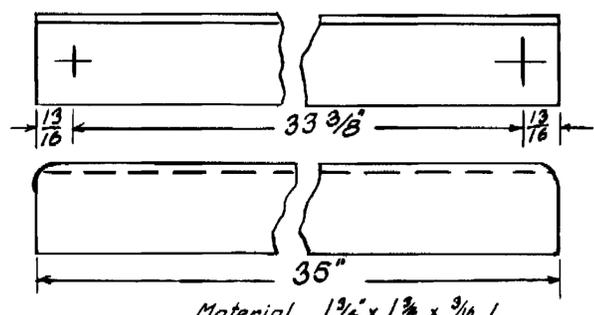
CONSULTANT		APP		TP						
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



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BENMORE-ISLINGTON 220KV LINE
 TOWER CONTRACT 327
 STANDARD SUSPENSION TOWER
 ERECTION DIAGRAM

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER T066/A1/5
DRAWING NUMBER T1421	SHEET REVISION 10 C
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision C	SCALE N.T.S.

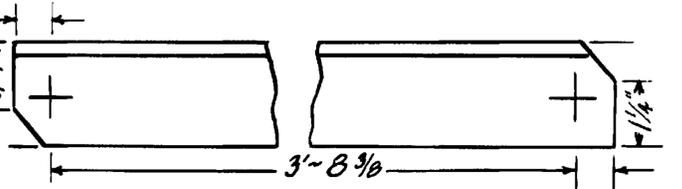
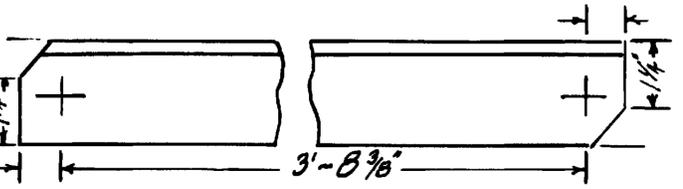
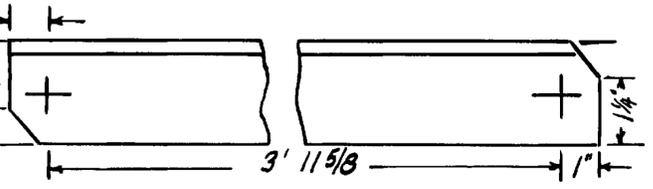
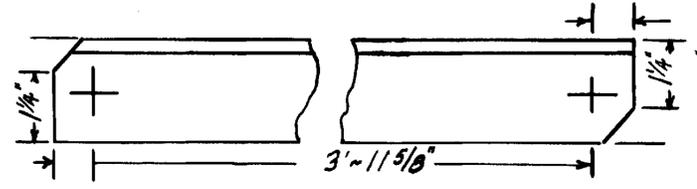


Note:-
Corners to be rounded as shown.
8 Req
N° NAA. 1.

4 Req
N° NAA. 2.

2 Per Tower
N° NAA 3(a)

2 Per Tower
N° NAA 3(b).

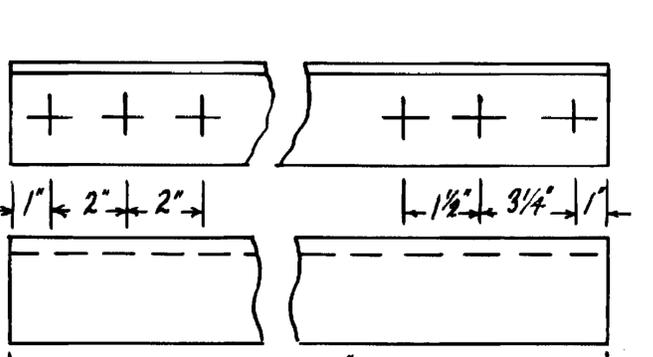
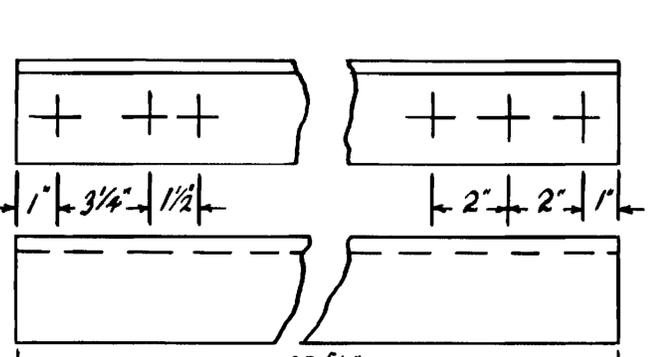
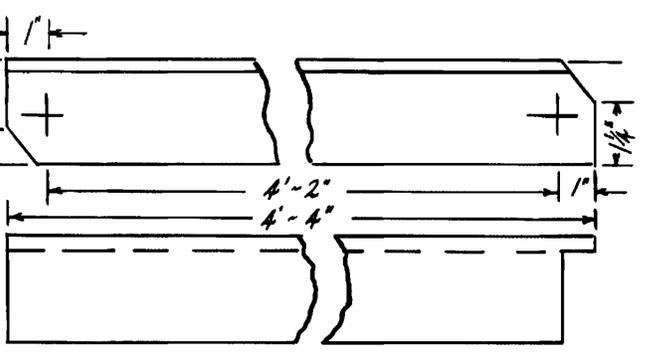
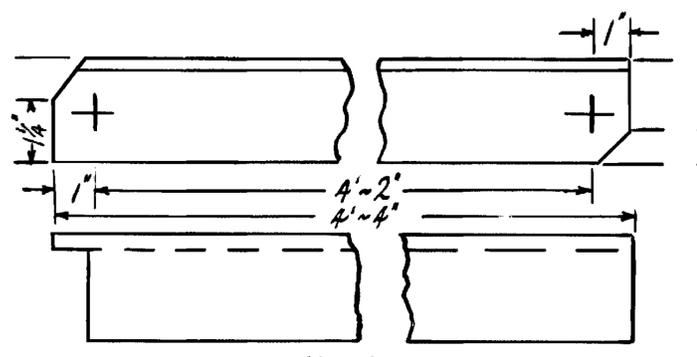


2 Req
N° NAA R. 4 (a).

2 Req
N° NAA L. 4 (a)

4 Req
N° NAA R 4 (b)

4 Req
N° NAA L 4 (b)



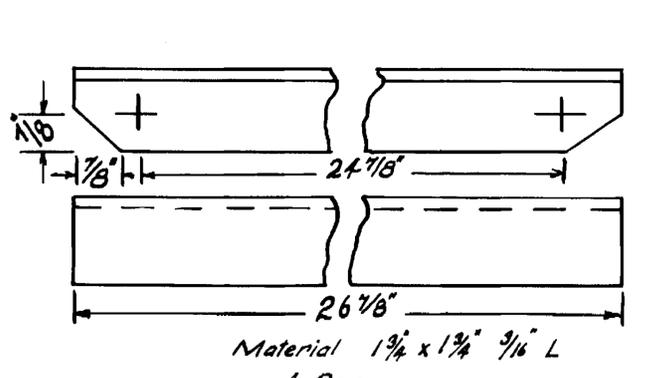
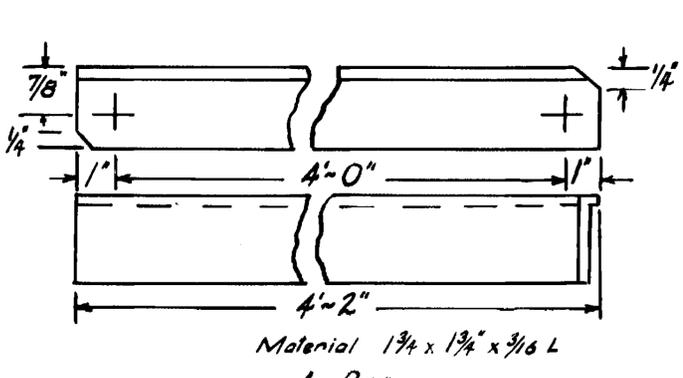
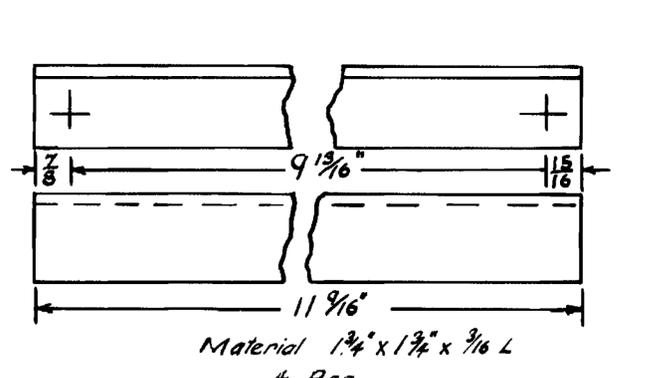
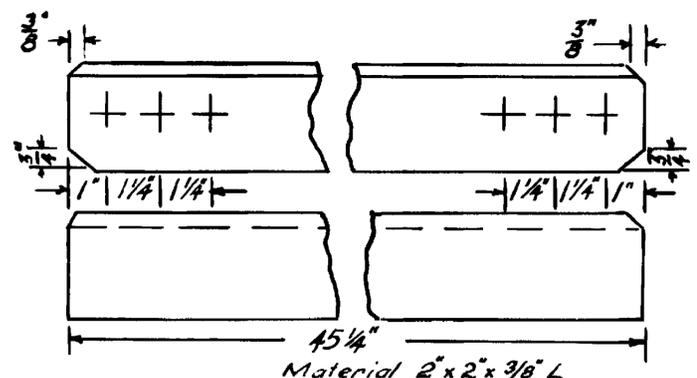
2 Req
N° NAA R 4 (c)

2 Req
N° NAA L 4 (c)

2 Req
N° NAA. R 5.

2 Req
N° NAA. L. 5.

N°s 4 (a)(b) & (c) are all 2" x 2" x 3/8" M.S. L



4 Req
N° NAA 6.

4 Req
N° NAA. 7.

4 Req
N° NAA 7(a).

4 Req
N° NAA 8.

Note:-
Corners to be ground as shown.

MATERIAL - MILD STEEL. NOTES. All holes to be 1/16" Dia & 7/8" from outside of web. All material to be galvanised.

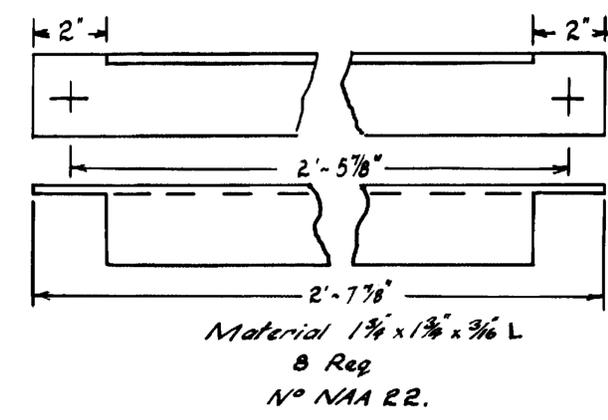
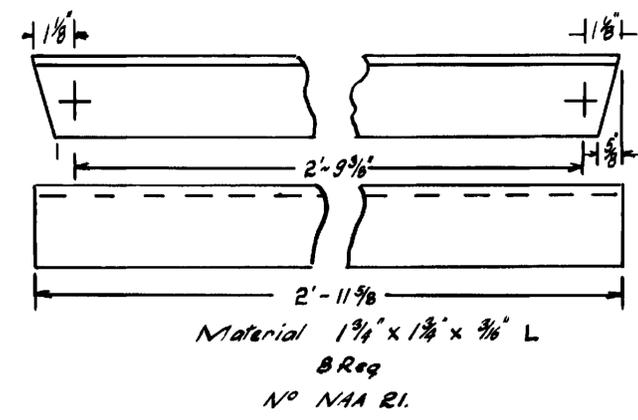
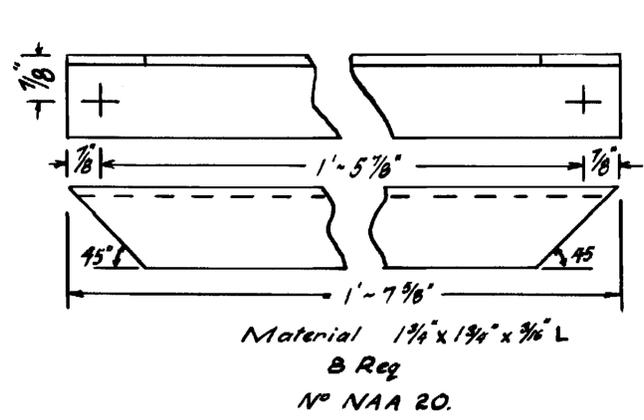
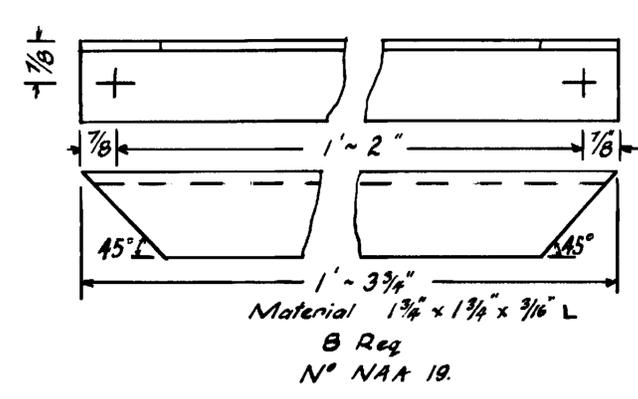
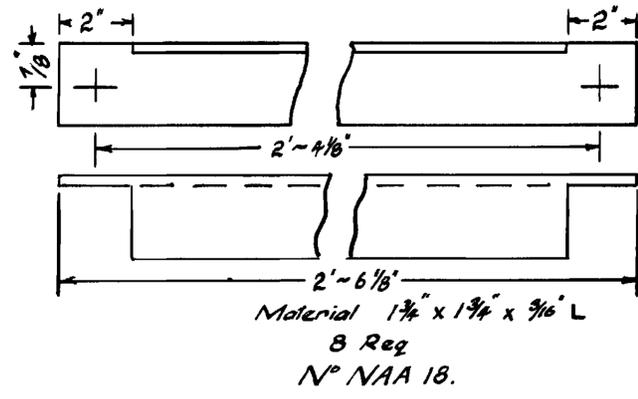
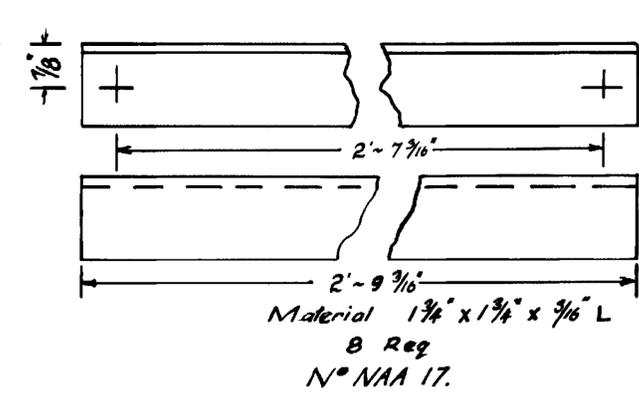
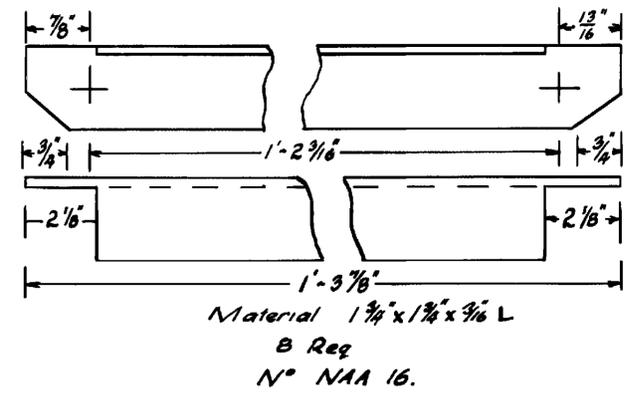
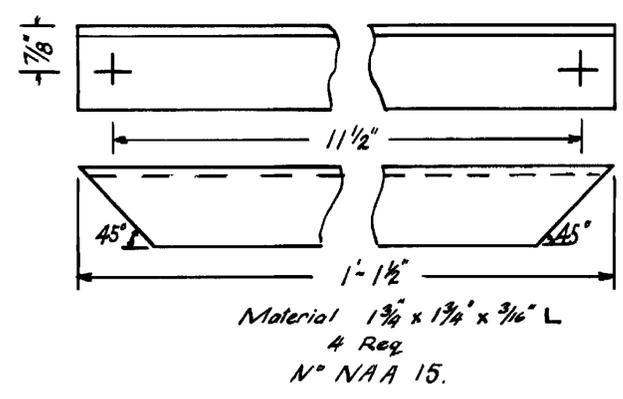
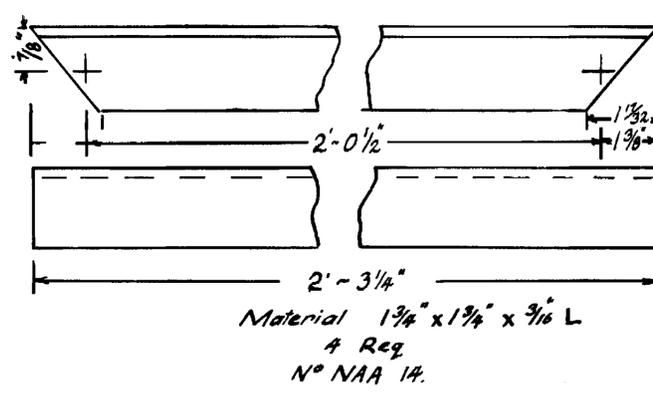
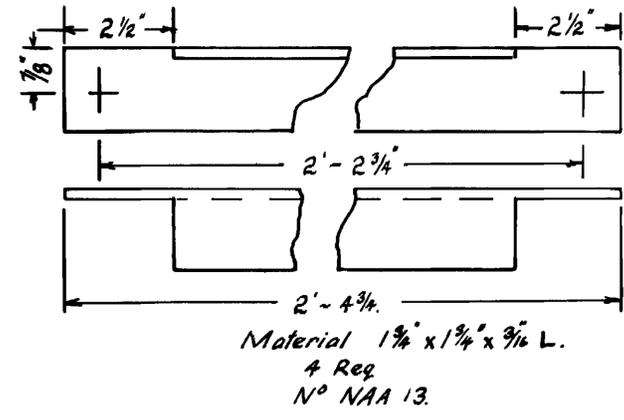
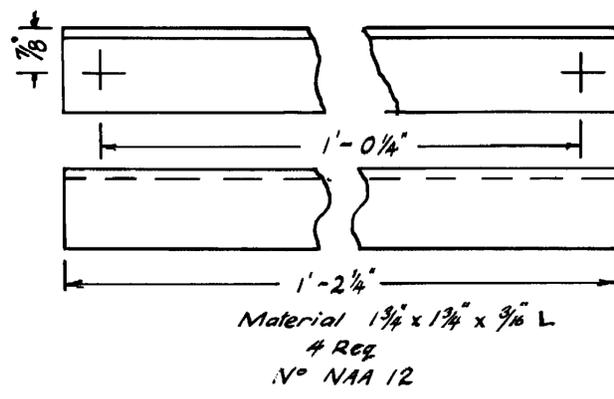
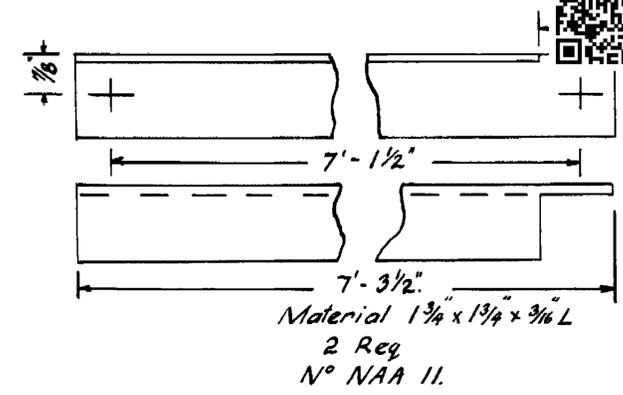
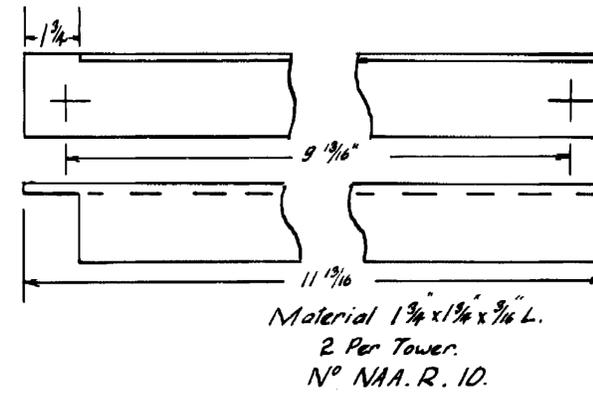
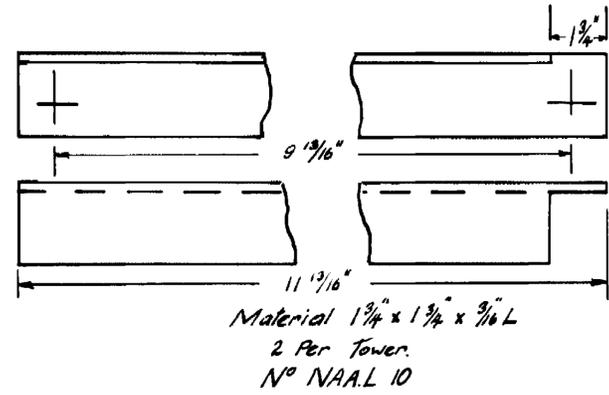
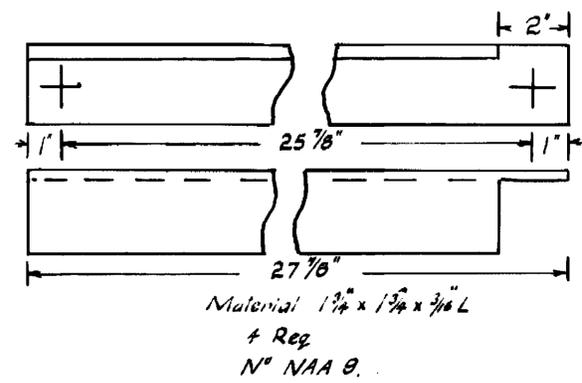
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		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20

TRANSPower

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BENMORE-ISLINGTON A
C327/S.SUS - TOWER MODIFICATIONS
FABRICATION DETAILS

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/2
DRAWING NUMBER TE38857	SHEET REVISION 1 B
DRAWING CREATED BY: TRANSPower Border Replaced at Revision B	SCALE N.T.S.



MATERIAL-MILD STEEL
Note:-
All holes to be $\frac{1}{16}$ Dia.
All materials to be galvanised.

Supersedes sch1116/2

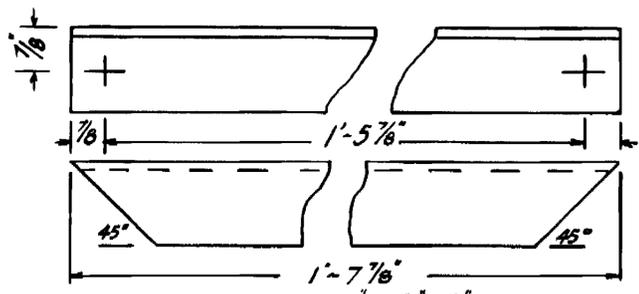
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B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPOWER

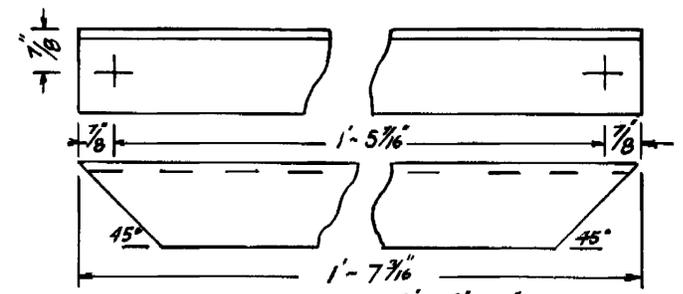
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BENMORE-ISLINGTON A
C327/S.SUS - TOWER MODIFICATIONS
FABRICATION DETAILS

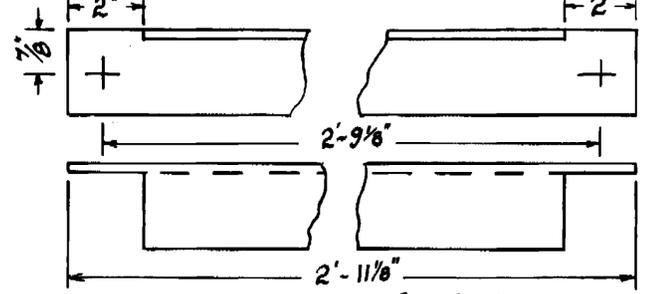
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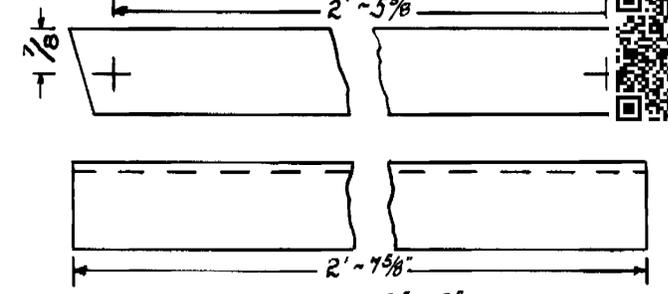
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B Req
N° NAA 23.



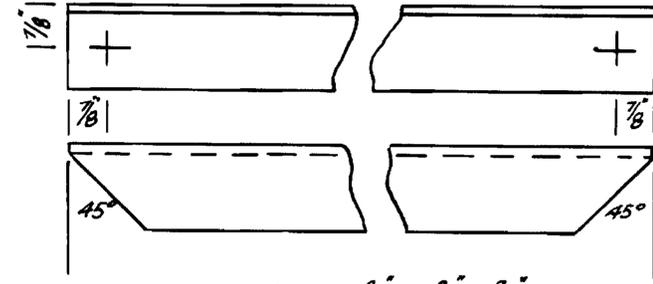
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B Req
N° NAA 24.



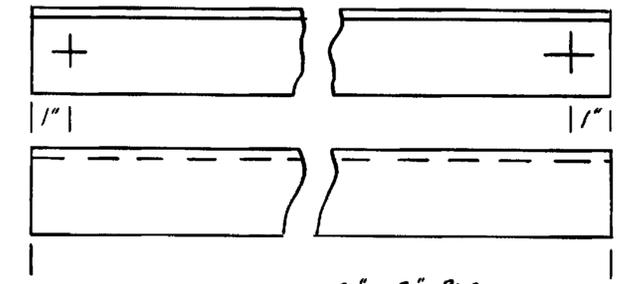
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
B Req
N° NAA 25.



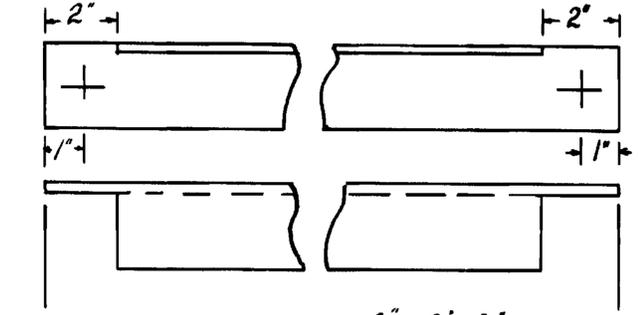
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B Req
N° NAA 26.



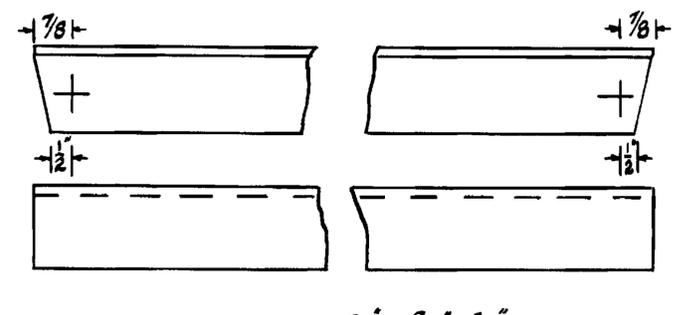
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
B Req
N° NAA 27.



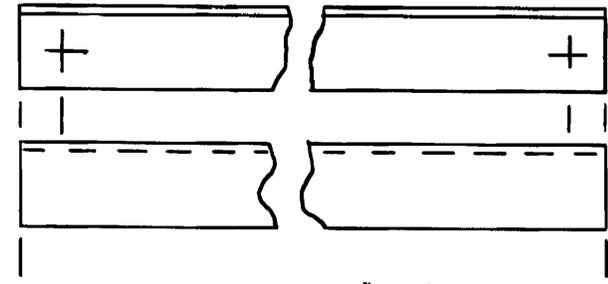
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 10ft leg Req.
N° NAA 28.



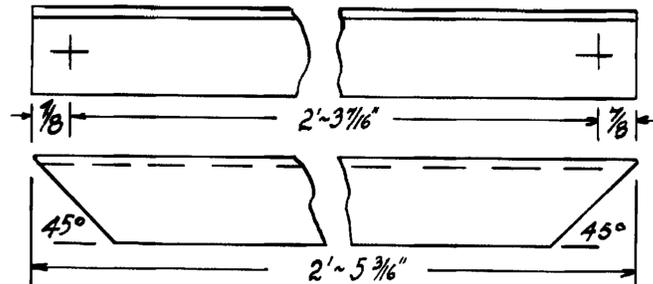
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 10ft leg Req.
N° NAA 29.



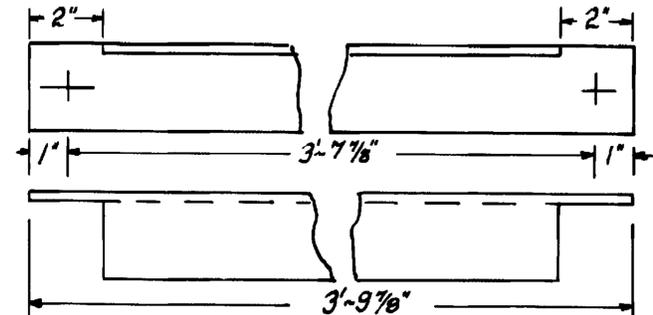
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 10ft leg Req.
N° NAA 30.



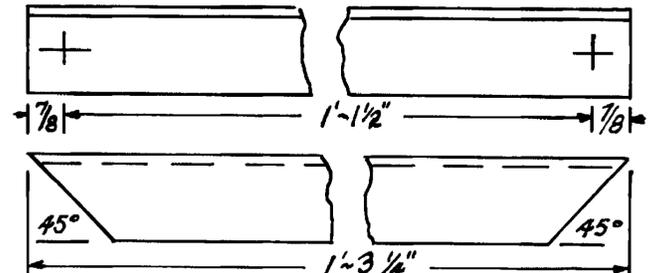
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2 Per 10ft Leg Req.
N° NAA 31.



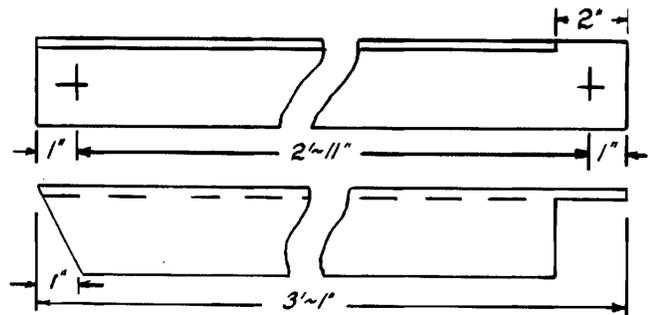
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 15ft leg Req.
N° NAA 32.



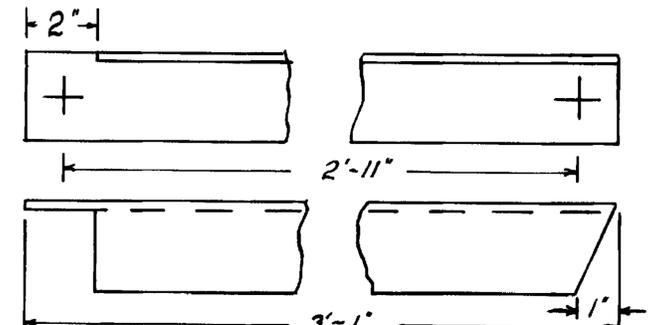
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 15ft leg Req.
N° NAA 33.



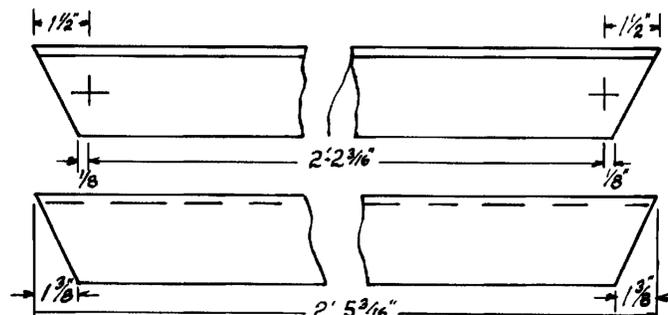
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 15ft leg Req.
N° NAA 34.



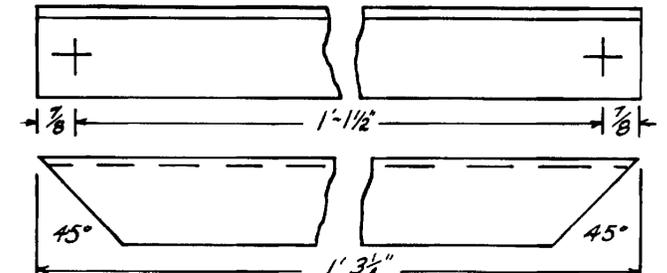
Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
1 Per 15ft leg Req.
N° NAA.L. 35.



Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
1 Per 15 Ft leg Req.
N° NAA.R. 35.



Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 15 ft leg Req.
N° NAA.36.



Material $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ L.
2 Per 15 ft leg Req.
N° NAA 37.

MATERIAL - MILD STEEL. NOTE :- All holes to be 1/16" Dia. All material to be galvanised.

Supersedes SCH116/3

REV		REVISION DESCRIPTION		CONSULTANT		TP		DRAWN		SCALE		FILE		FOLDER	
NO.	DATE	BY	DESCRIPTION	DATE	CHK	DATE	APP	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE
B			AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	05.20	JWB	05.20	JBF	05.20	TP	05.20					

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BENMORE-ISLINGTON A

C327/S.SUS - TOWER MODIFICATIONS

FABRICATION DETAILS

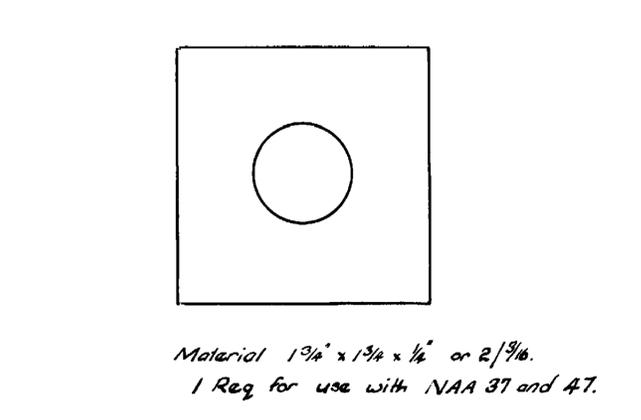
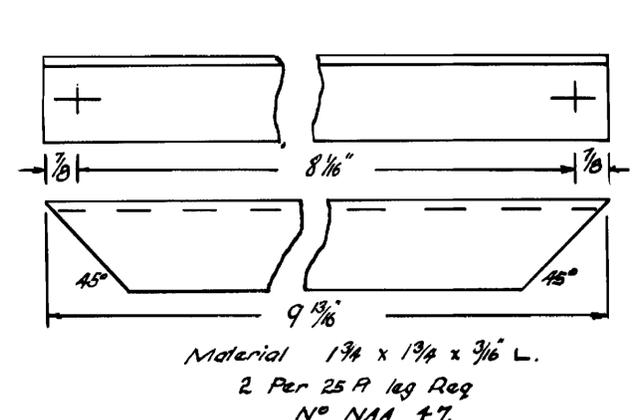
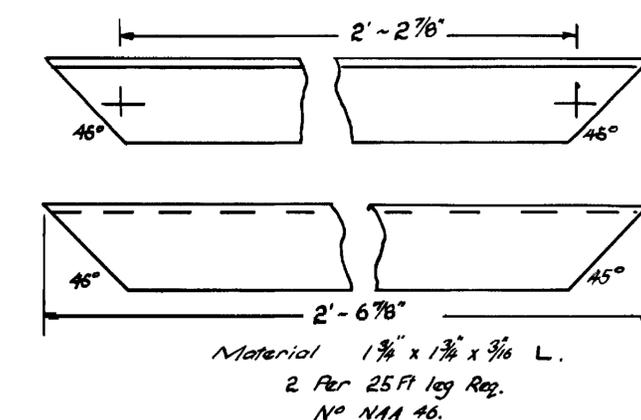
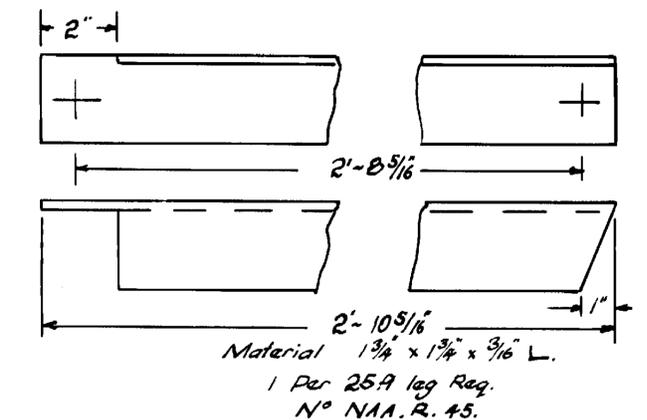
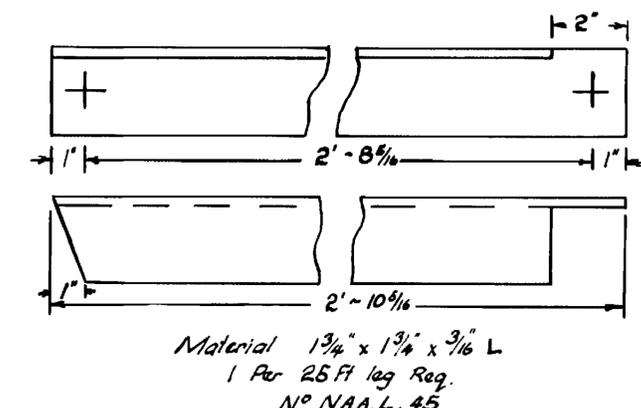
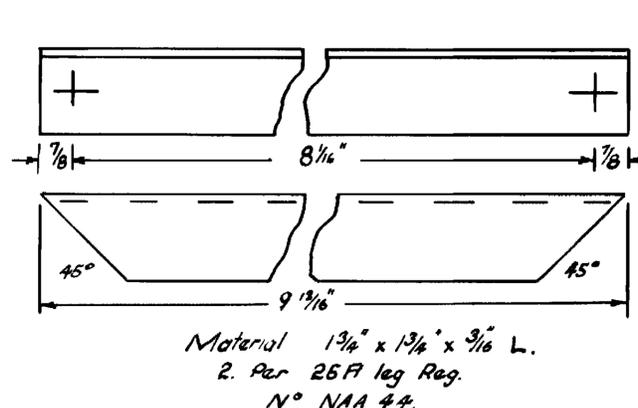
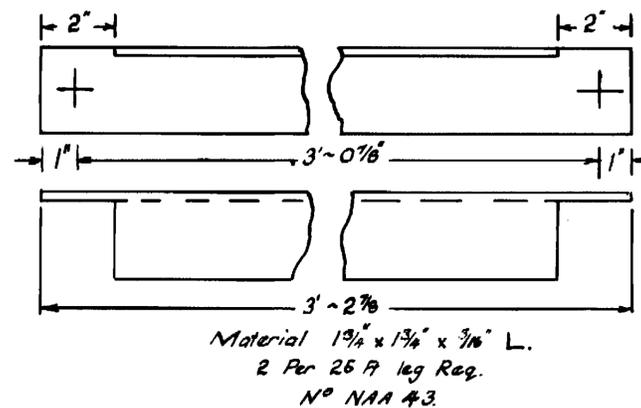
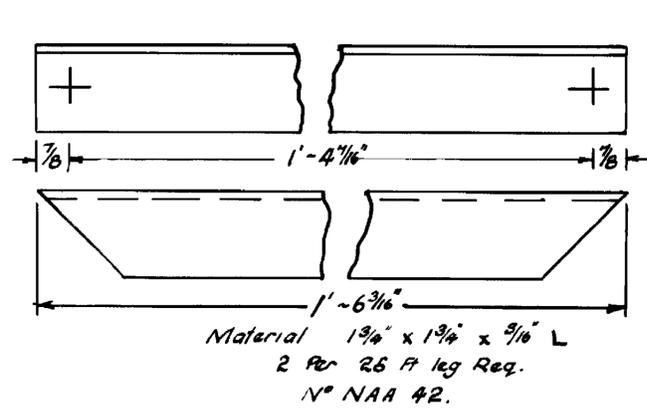
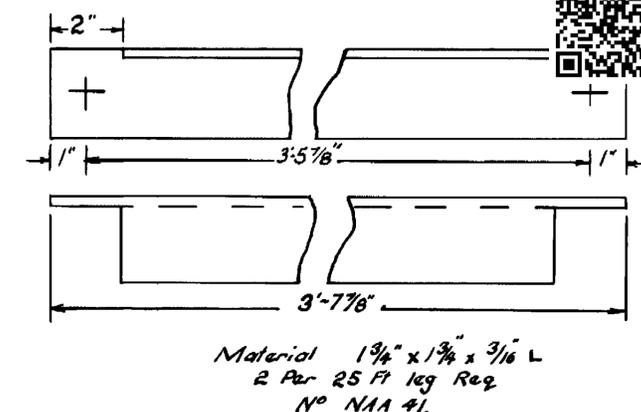
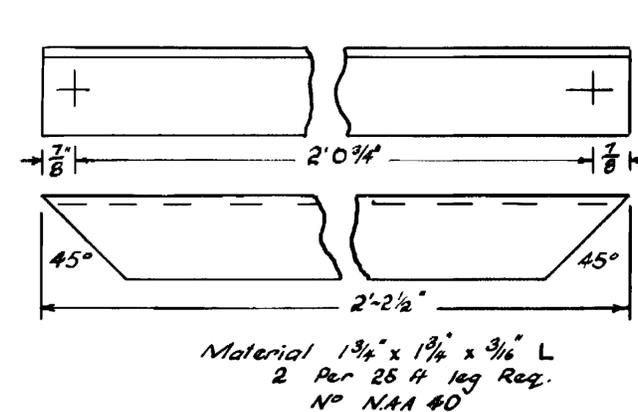
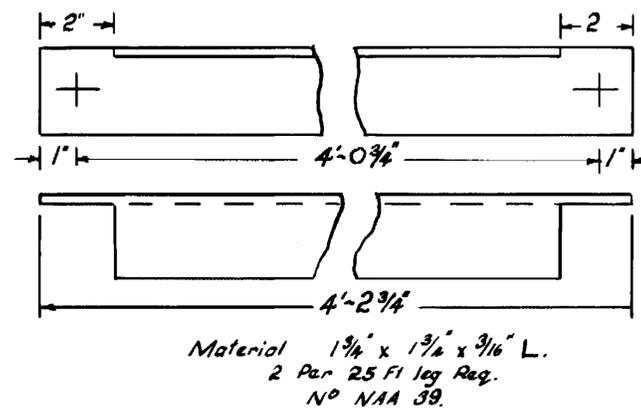
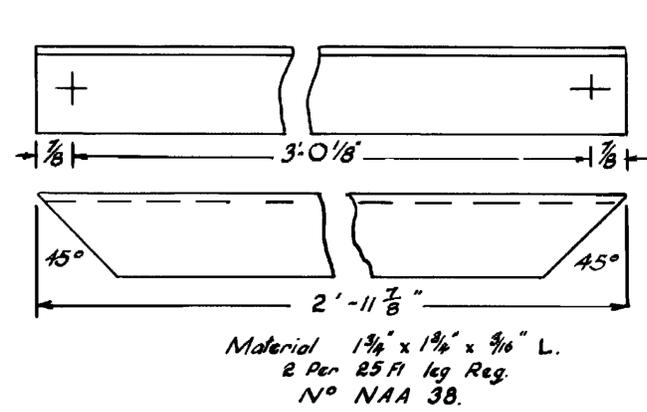
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IP_1920_244_11

DRAWING NUMBER
TE38857

DRAWING CREATED BY:
TRANSPower
Border Replaced at Revision B

SHEET REVISION
3 B

SCALE
N.T.S.



MATERIAL - MILD STEEL.

NOTES. All holes to be 1/16 Dia. All material to be galvanised.

Supersedes SCH1116/A

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

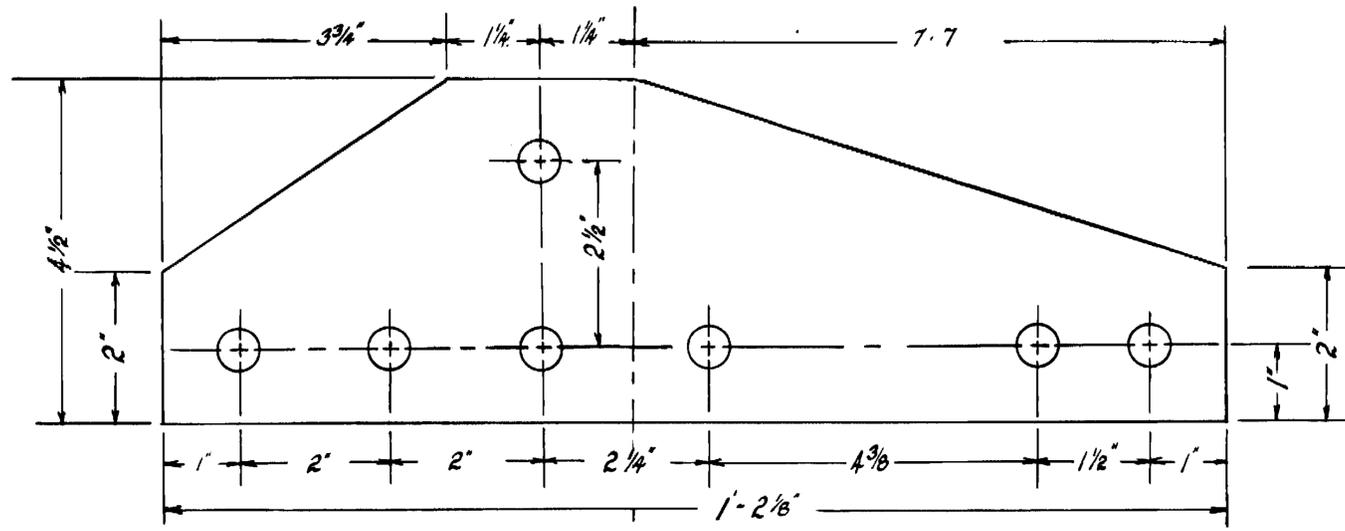
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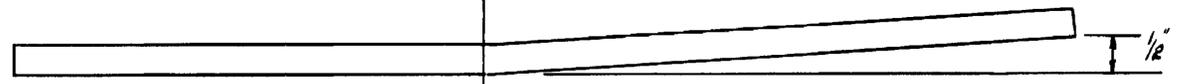
BENMORE-ISLINGTON A
C327/S.SUS - TOWER MODIFICATIONS
FABRICATION DETAILS

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER TO66/A1/2	
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DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B		SCALE N.T.S.	

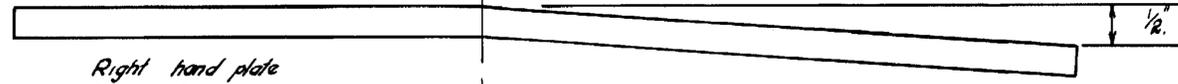
A1



Bend Line.

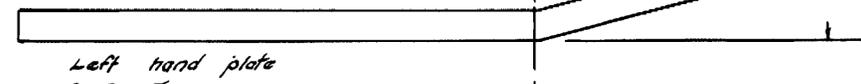
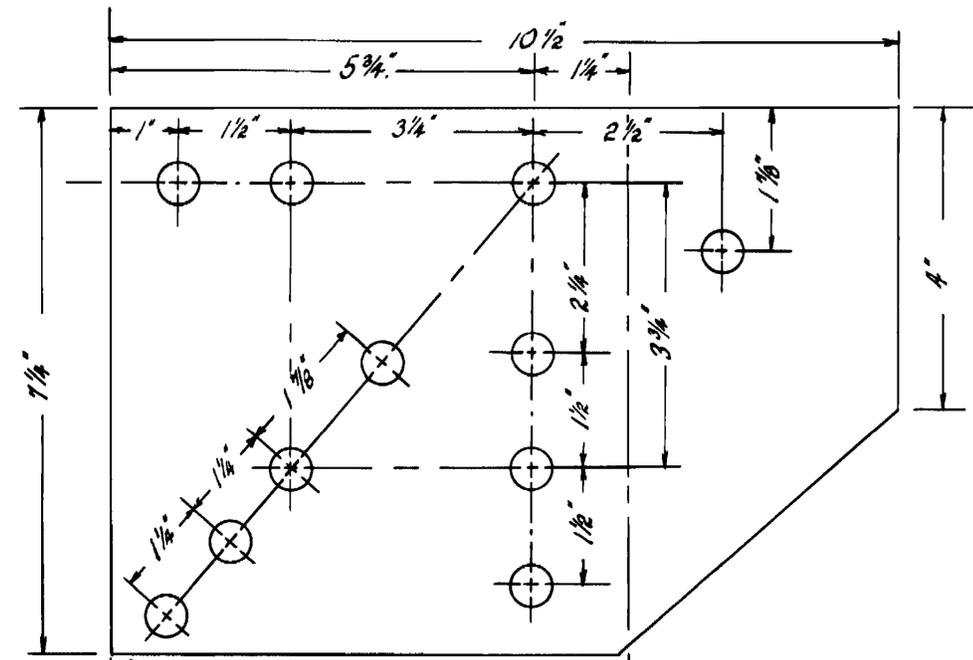


Left hand plate.
2 Per Tower.

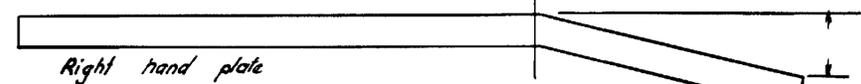


Right hand plate
2 Per Tower.

Material 3/8 M.S. PLATE.
N° N.A.A. G 41.



Left hand plate
2 Per Tower.



Right hand plate
2 Per Tower.

Material 3/8 M.S. PLATE.
N° N.A.A.G 41.

MATERIAL - MILD STEEL.

NOTE. All holes to be 1/16" Dia. All material to be galvanised.

Supersedes SCH 1116/5

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



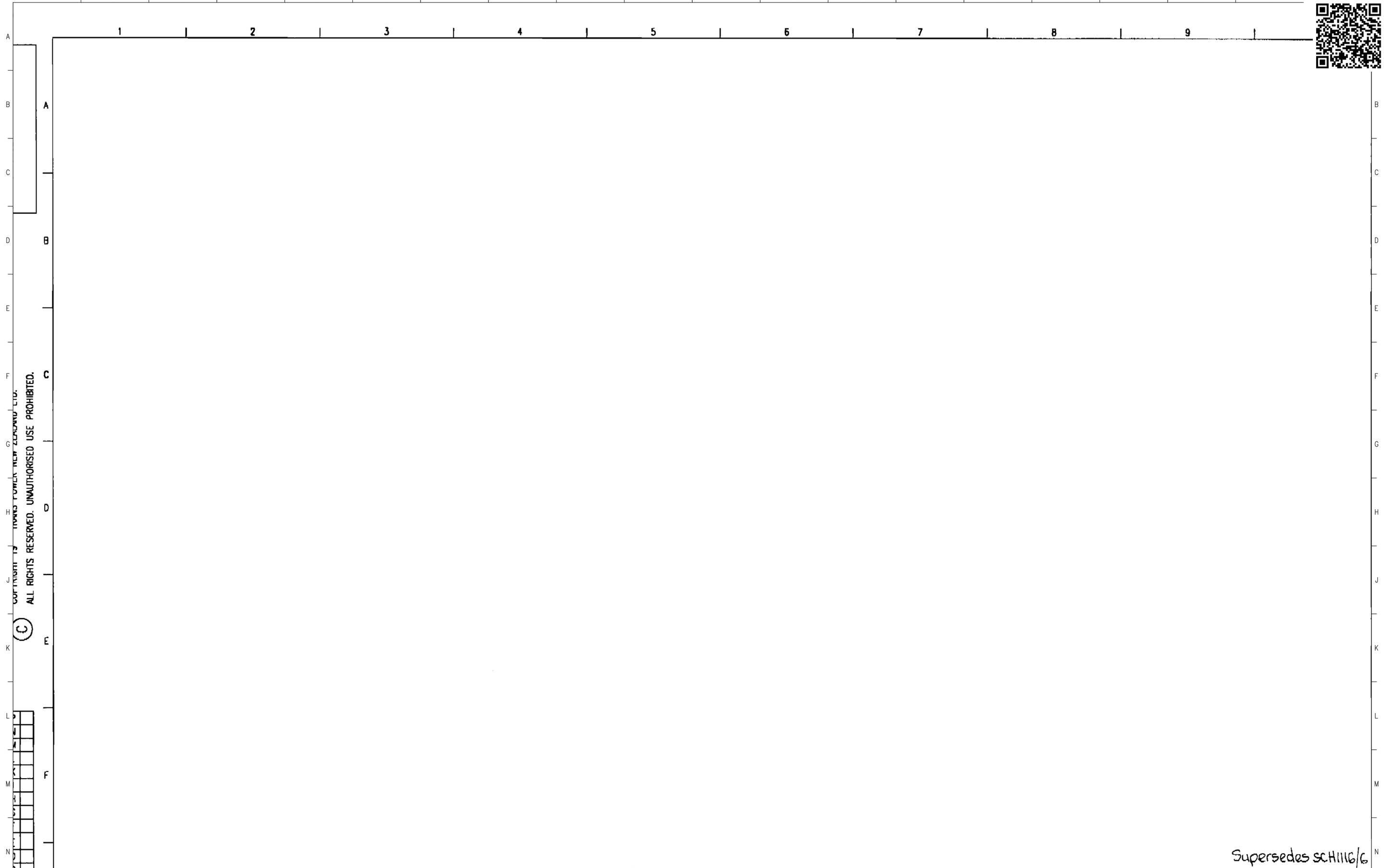
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BENMORE-ISLINGTON A
C327/S.SUS - TOWER MODIFICATIONS
FABRICATION DETAILS

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/2
DRAWING NUMBER TE38857	SHEET REVISION 5 B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B	SCALE N.T.S.



submit your markups to TranspowerProduction@redyedms.com



Supersedes sc.H116/6

REV	DESCRIPTION	CONSULTANT										TP	DESIGNED	BENMORE - ISLINGTON A			SCALE	FOLDER		
REV	DESCRIPTION	CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	TP	DESIGNED	BENMORE - ISLINGTON A			SCALE	FOLDER	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20			BENMORE - ISLINGTON A			IP_1920_244_11	T066/A1/2	
															C327/S.SUS - TOWER MODIFICATIONS			DRAWING NUMBER	SHEET	REVISION
															FABRICATION DETAILS			TE38857	6	B
																		DRAWING CREATED BY:	SCALE	
																		TRANSPOWER	N.T.S.	
																		Border Replaced at Revision B		

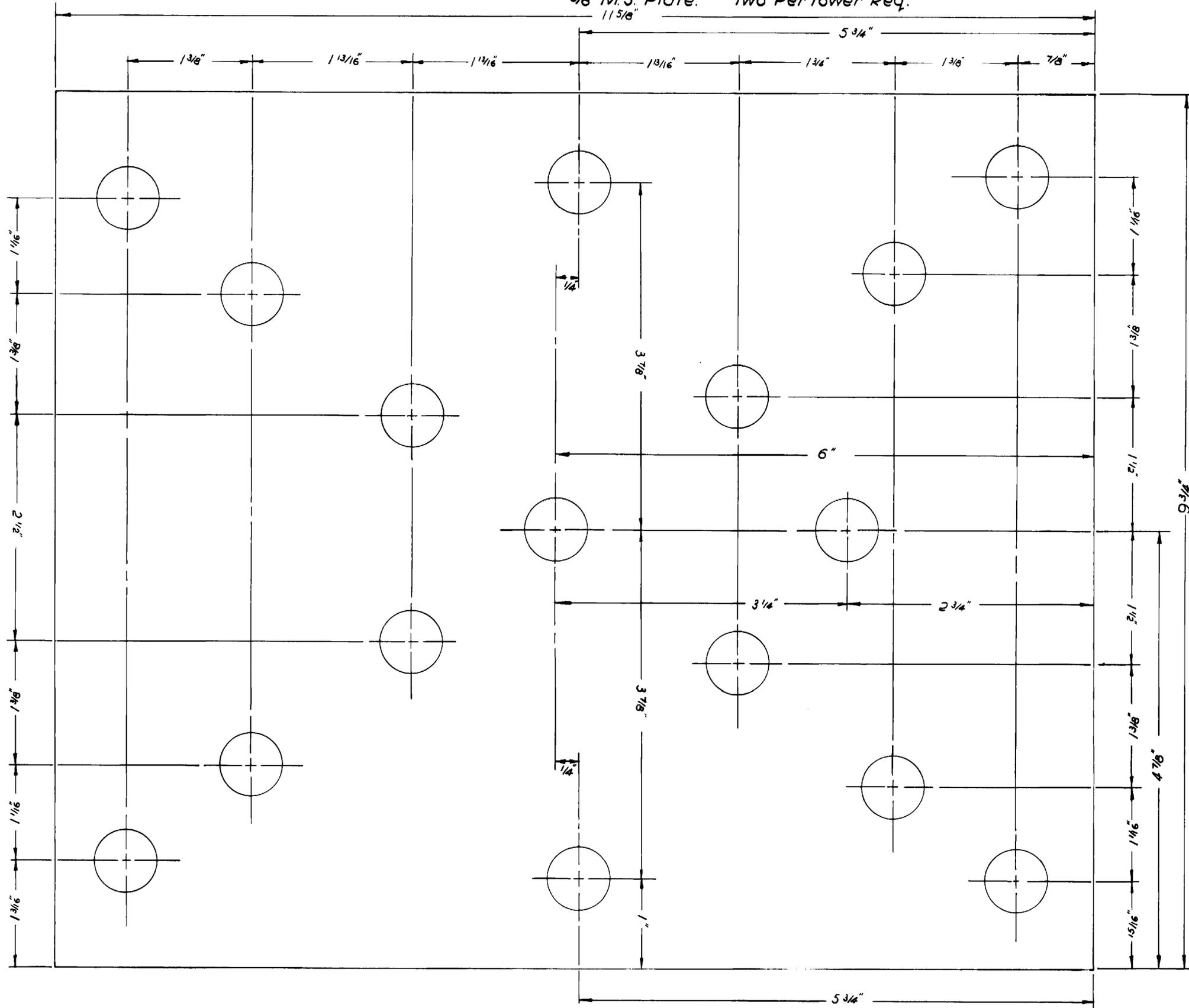


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A1

Nº NAAG 40
 3/8" M.S. Plate. Two Per Tower Req.
 11 5/8"



NOTE
 All holes to be 1/16" Dia.
 All material to be galvanized.

Supersedes 6CH1116/T

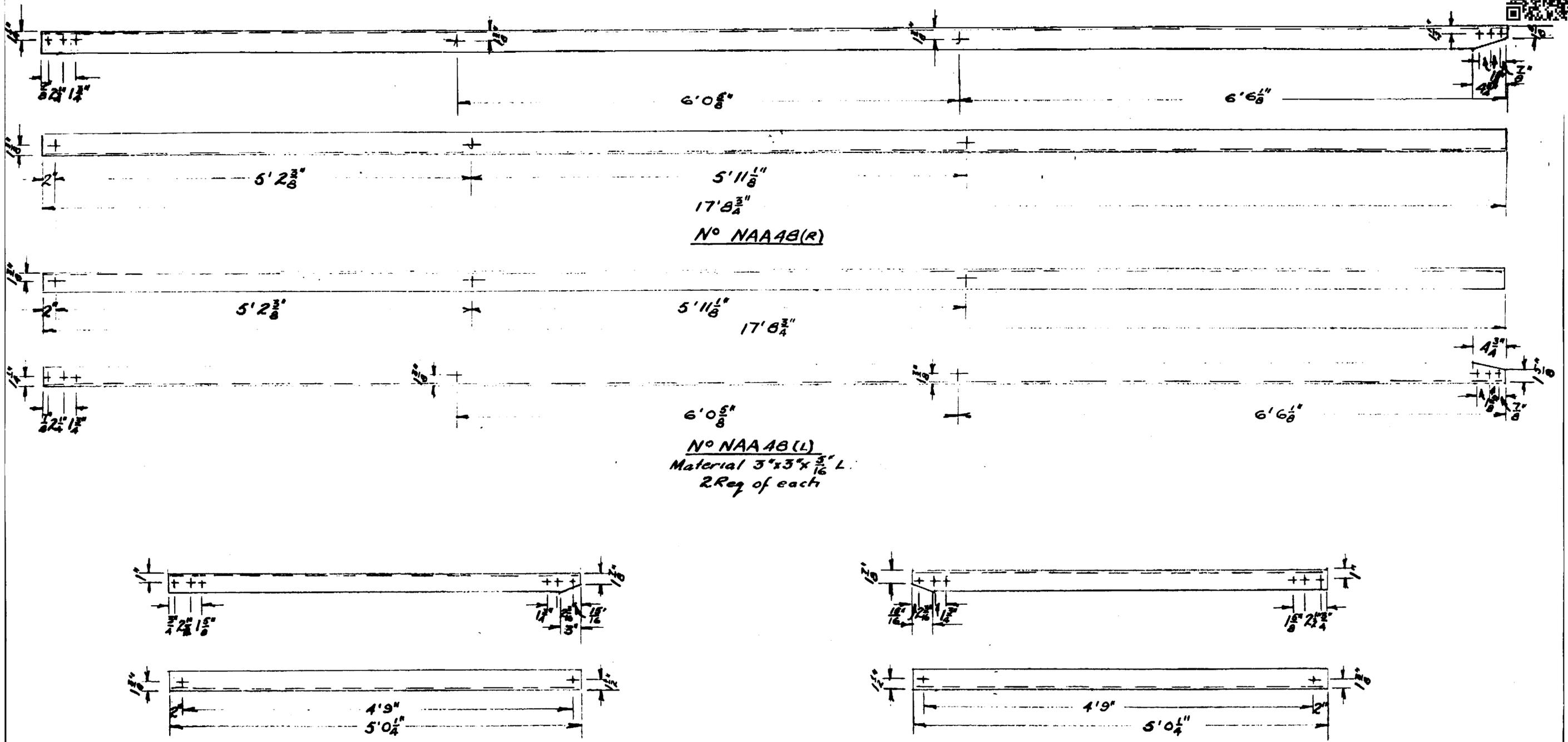
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		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATIONS
 FABRICATION DETAILS

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER TO66/A1/2	
DRAWING NUMBER TE38857		SHEET REVISION 7 B	
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B		SCALE N.T.S.	



N° NAA48(L)
 Material 3"x3"x 5/16" L
 2 Req of each

N° NAA49(L)
 Material 3"x3"x 5/16" L
 2 Req of each

MATERIAL-MILD STEEL

- NOTES**
 All holes to be 1/16" Dia
 All material to be galvanised

Supersedes SCH111G/3

REV	REVISION DESCRIPTION	CONSULTANT							TP			
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATIONS
 FABRICATION DETAILS

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/2
DRAWING NUMBER TE38857	SHEET REVISION 8 B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B	SCALE N.T.S.

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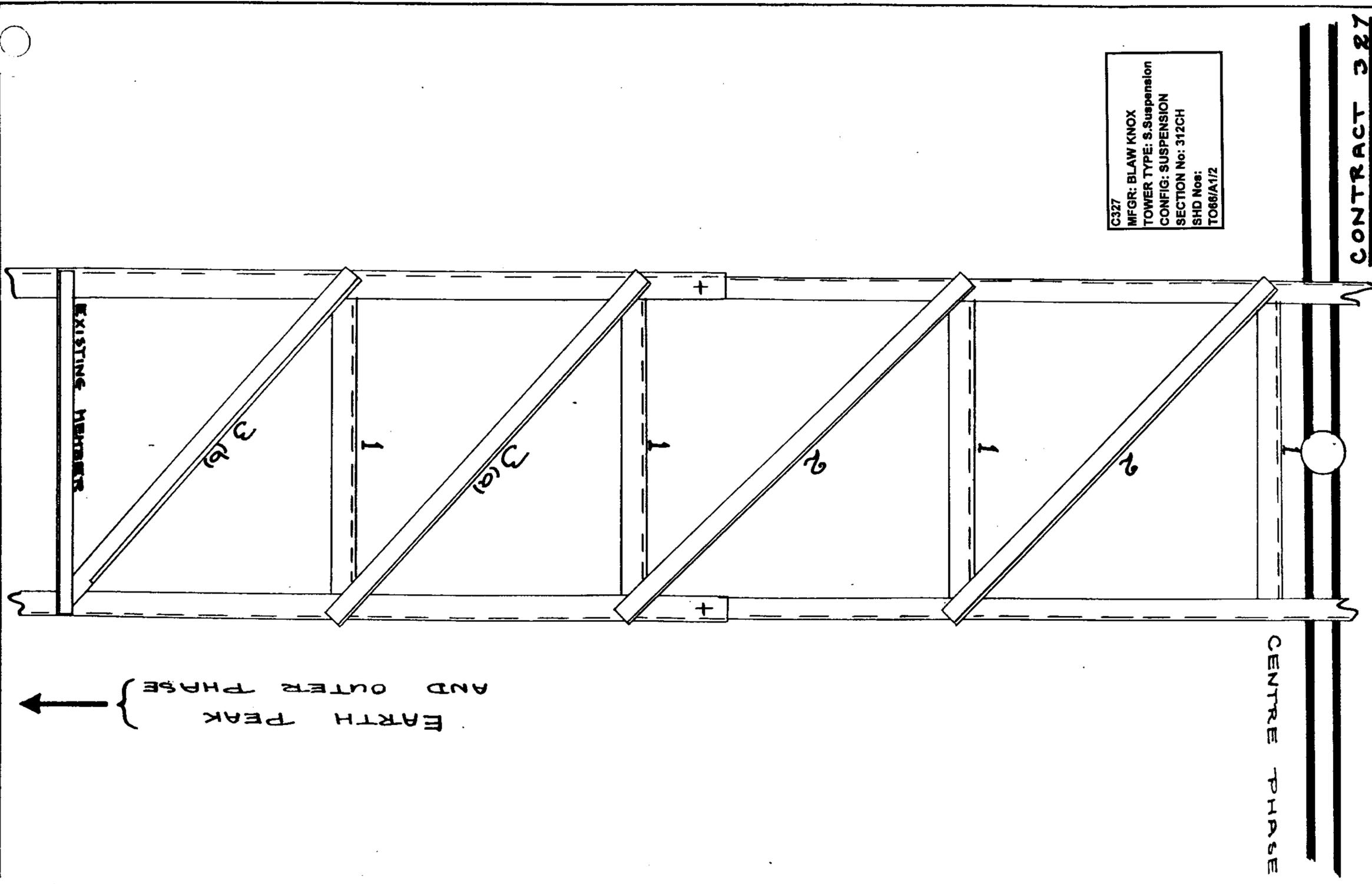
PLACEHOLDER

1.3. As-Built - DRAFTING & APPROVAL



PLACEHOLDER

1.3. As-Built - DRAFTING & APPROVAL



C327
 MFR: BLAW KNOX
 TOWER TYPE: S. Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 TO66/A1/2

CONTRACT 387

CHECKED RECOMM'D APPROVED	SCALE	FILE	FOLDER
	TZ10823/2		
ISSUE A			
AMENDMENTS Folder Ref. Corrected.	Date 12/01	By P.C.	App'd M.L.
DRAWN TRACED COMPT'NS		20/1/85	
BENMORE - ISLINGTON A			
C327/S.SUS - TOWER MODIFICATIONS TOP OF CROSSARM			
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, B.E., M.I.E.E., GENERAL MANAGER			

REV	REVISION DESCRIPTION	CONSULTANT										TP
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPower

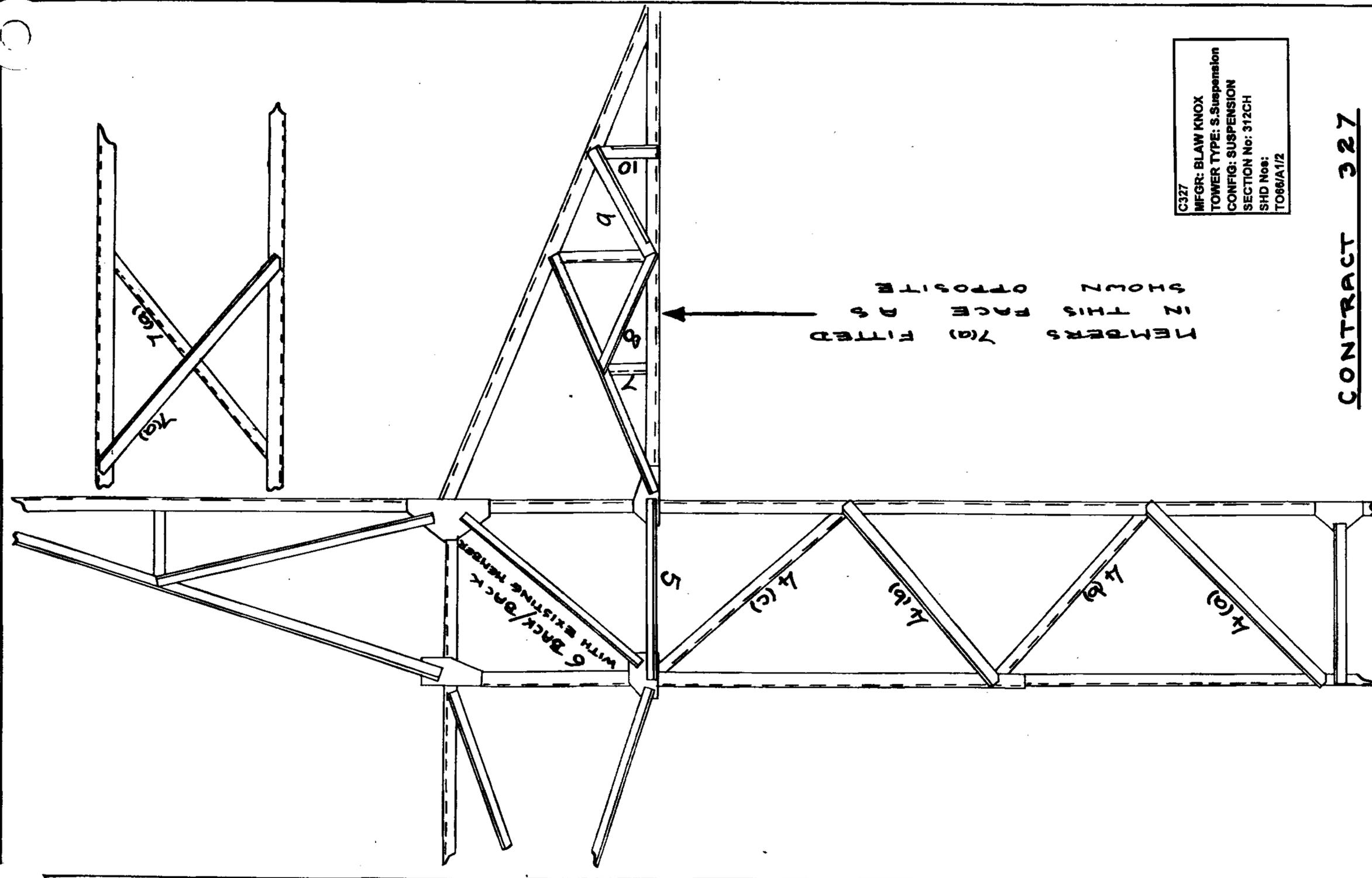
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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATION
 TOP OF CROSSARM

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/2
DRAWING NUMBER TZ10823	SHEET REVISION 2 B
DRAWING CREATED BY: TRANSPower Border Replaced at Revision B	SCALE N.T.S.

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C327
 MFGR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD No: TO66/A1/2

CONTRACT 327

AMENDMENTS Folder Ref. Corrected.	Date 12/01	By P.L.	App'd M.L.	DRAWN A.A.	TRACED 20/1/65	COMPTNS A.A.	CHECKED RECOMM'D APPROVED	SCALE	FILE	FOLDER	
BENMORE - ISLINGTON A							TZ10823/3		ISSUE A		
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, B.E., M.I.E.E., GENERAL MANAGER											
C327/S.SUS - TOWER MODIFICATIONS SIDE OF CROSSARM											

REV	REVISION DESCRIPTION	CONSULTANT										TP
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

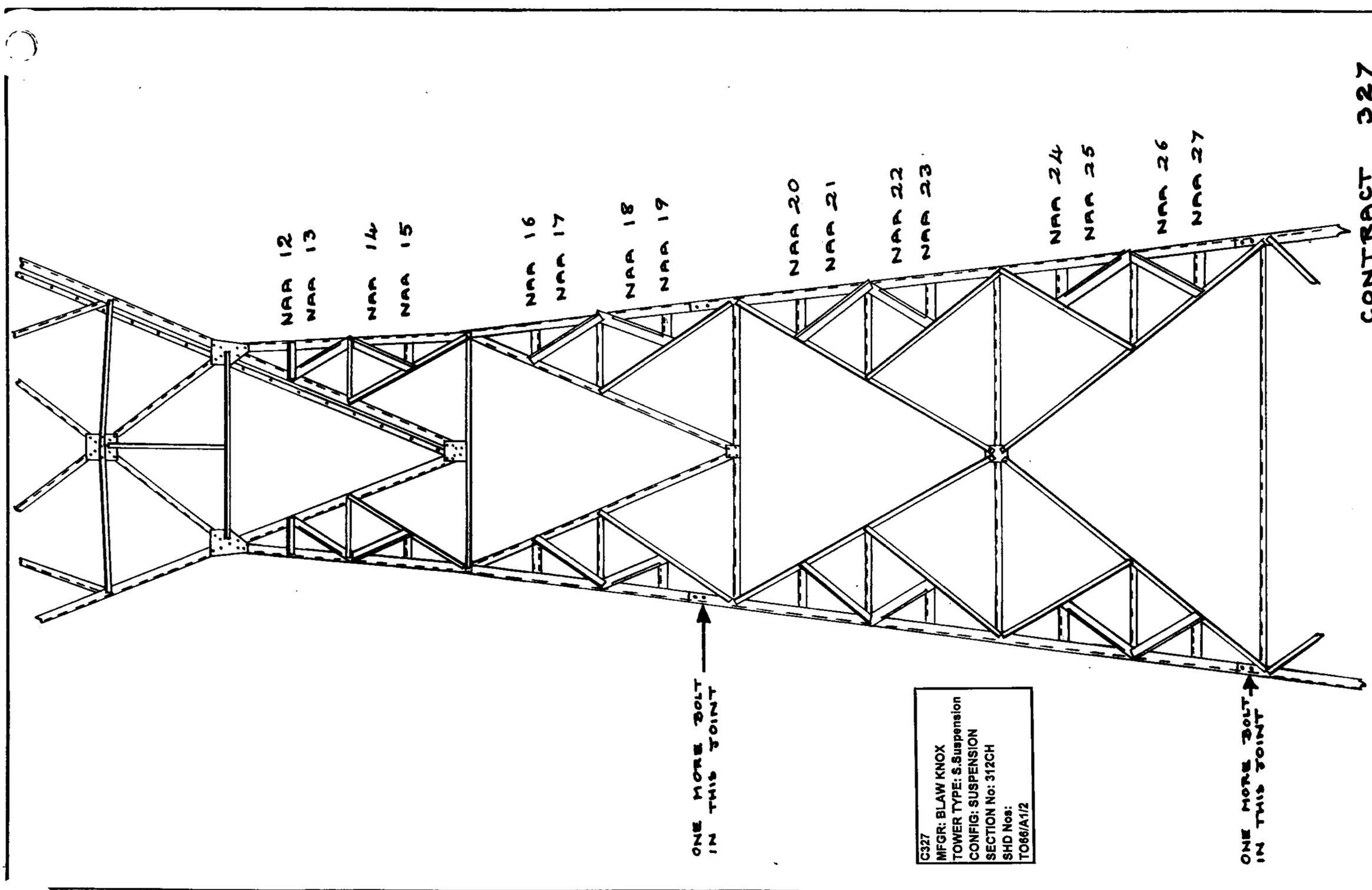
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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATION
 SIDE OF CROSSARM

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER TO66/A1/2
DRAWING NUMBER TZ10823	SHEET REVISION 3 B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B	SCALE N.T.S.

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CONTRACT 327

AMENDMENTS Folder Ret. Corrected.	Date 12/01	By P.L.	App'd M.L.	DRAWN TRACED 29/1/65 COMPT'NS	CHECKED RECOMM'D APPROVED	SCALE FILE FOLDER	
BENMORE - ISLINGTON A				TZ10823/4			ISSUE A
C327/S.SUS - TOWER MODIFICATIONS TOWER BODY				TZ10823/4			ISSUE A
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, S.E., M.I.E.E., GENERAL MANAGER							

ONE MORE BOLT
IN THIS JOINT

C327
 MFGR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T086/A1/2

ONE MORE BOLT
IN THIS JOINT

REV	REVISION DESCRIPTION	CONSULTANT										TP
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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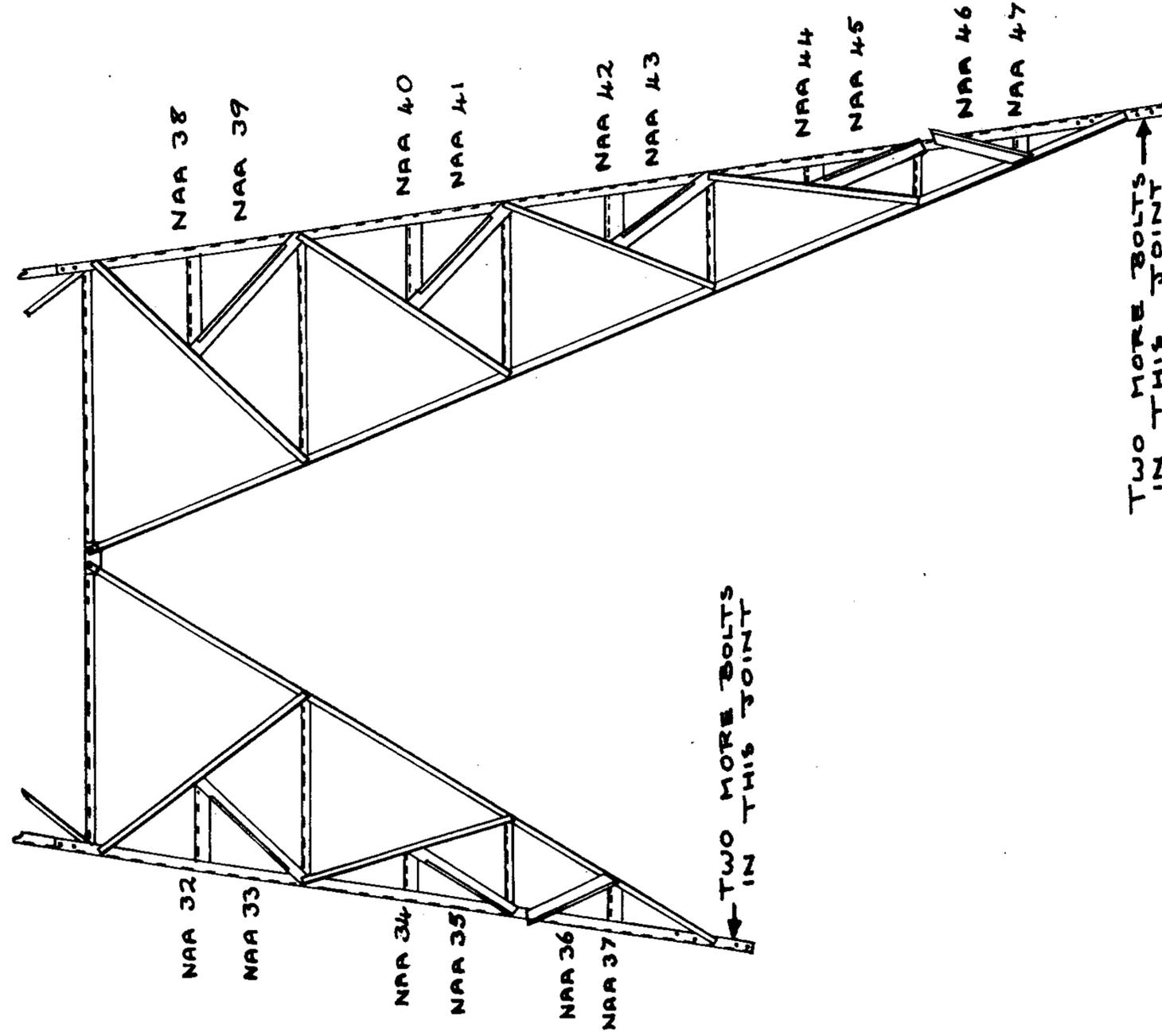
BENMORE-ISLINGTON A

C327/S.SUS - TOWER MODIFICATION

TOWER BODY

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER T066/A1/2	
DRAWING NUMBER TZ10823		SHEET 4	REVISION B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B		SCALE N.T.S.	

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C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/2

CONTRACT 327

AMENDMENTS Folder Rev. Corrected	Date 12/01	By P.L.	App'd M.L.	DRAWN K.A.	CHECKED RECOMM'D APPROVED	SCALE	FILE	FOLDER	
	TRACED 20/11/65			COMPTNS K.A.					
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, B.E., M.I.E.E., GENERAL MANAGER				BENMORE - ISLINGTON A				ISSUE	A
				C327/S.SUS - TOWER MODIFICATIONS LEG DETAIL				TZ10823/5	

REV	REVISION DESCRIPTION	CONSULTANT						TP				
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

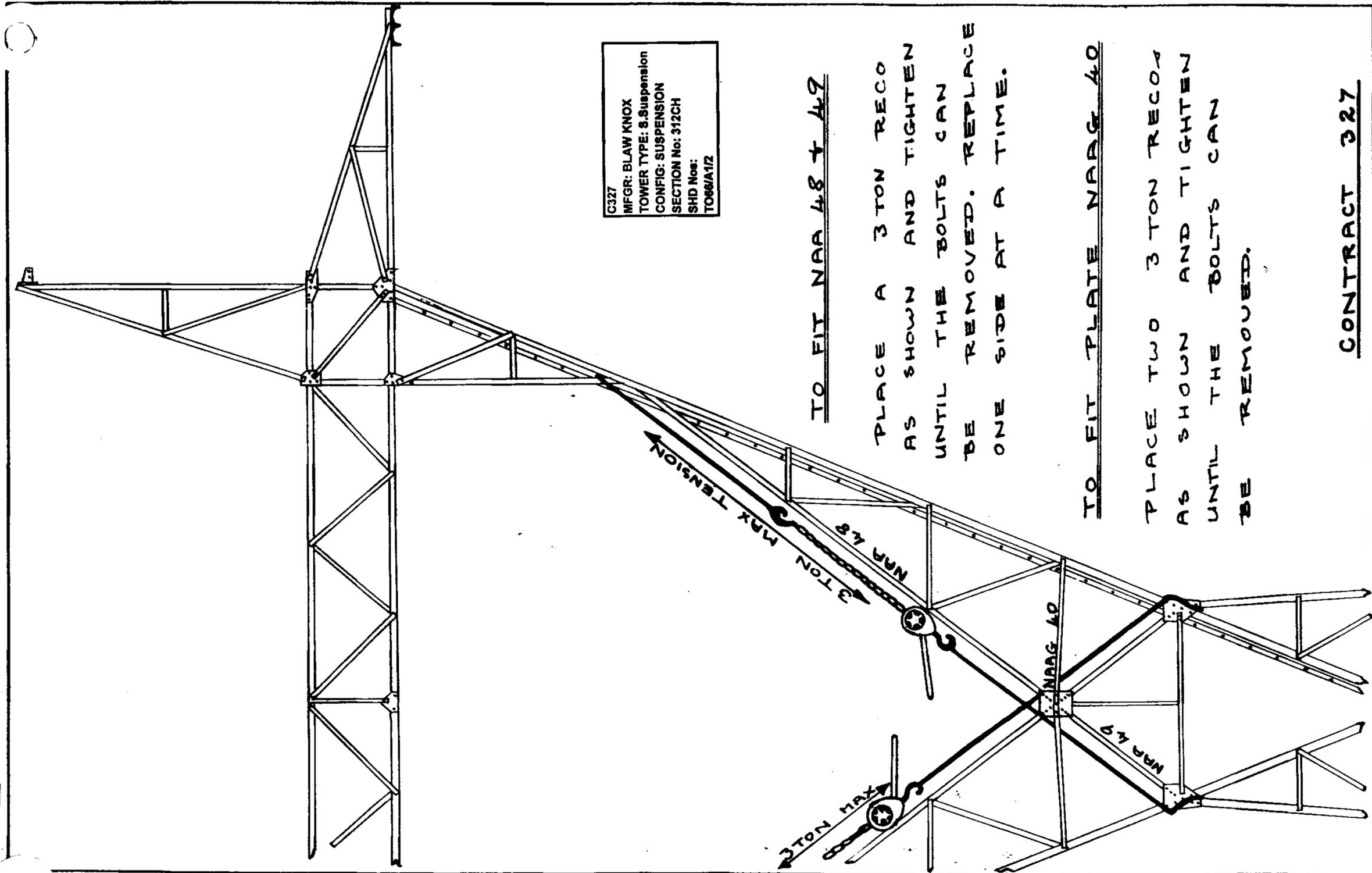
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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATION
 LEG DETAIL

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER T066/A1/2	
DRAWING NUMBER TZ10823		SHEET 5	REVISION B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B		SCALE N.T.S.	

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C327
MFR: BLAW KNOX
TOWER TYPE: S.Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
T066/A1/2

TO FIT NAA 48 + 49
PLACE A 3 TON RECO
AS SHOWN AND TIGHTEN
UNTIL THE BOLTS CAN
BE REMOVED. REPLACE
ONE SIDE AT A TIME.

TO FIT PLATE NAA 40
PLACE TWO 3 TON RECO
AS SHOWN AND TIGHTEN
UNTIL THE BOLTS CAN
BE REMOVED.

CONTRACT 327

AMENDMENTS Folder Ret. Corrected.	Date 12/01	By P.L.	App'd M.L.	CHECKED RECOMM'D APPROVED	SCALE	FILE	FOLDER
DRAWN <i>AAA</i> TRACED 20/1/65 COMPTNS <i>AAA</i>							
BENMORE - ISLINGTON A				TZ10823/6			
C327/S.SUS - TOWER MODIFICATIONS TOWER WAIST				ISSUE A			
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, B.E., M.I.E.E., GENERAL MANAGER							

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP		DATE	APP
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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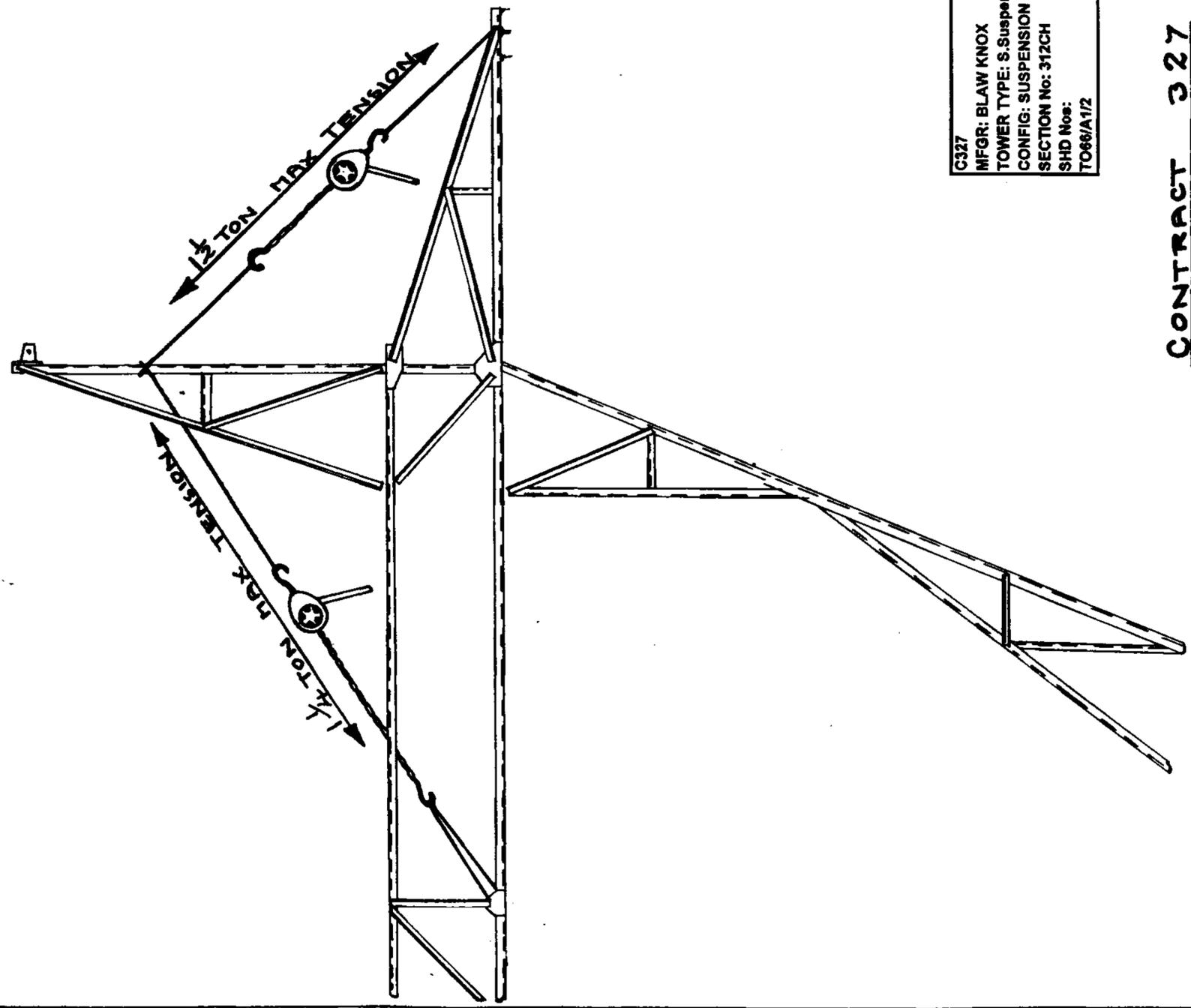
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BENMORE-ISLINGTON A
C327/S.SUS - TOWER MODIFICATION
TOWER WAIST

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER T066/A1/2
DRAWING NUMBER TZ10823	SHEET REVISION 6 B
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B	SCALE N.T.S.

TO FIT MEMBERS 4(a) 4(b) 4(c) AND 4

- 1/ PLACE 1 1/2 TON RECOX AS SHOWN; HARD AGAINST ONE SIDE. **DO NOT** TRY TO DO BOTH FACES OF THE CROSSARM AT ONCE BY PLACING RECOX IN THE MIDDLE.
- 2/ TIGHTEN THE RECOX TOGETHER TO KEEP THE HORIZONTAL FORCE ON THE EARTH PEAK ZERO.
- 3/ REMOVE A MEMBER AND FIT THE NEW ONE BEFORE MOVING ON TO THE OTHERS.



C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/2

CONTRACT 327

AMENDMENTS Folder Rep. Corrected	Date 12/01	By P.L.	App'd M.L.	DRAWN 20/1/65	CHECKED RECOMM'D
				TRACED 20/1/65	APPROVED
				COMPT'NS A B	SCALE
BENMORE - ISLINGTON A				FILE	FOLDER
C327/S.SUS - TOWER MODIFICATIONS MODIFIED TOWER - 4A,4B,4C FIT				TZ10823/7	
N.Z. ELECTRICITY DEPARTMENT A. E. DAVENPORT, B.E., M.I.E.E. GENERAL MANAGER				ISSUE	A

REV	REVISION DESCRIPTION	CONSULTANT								TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPOWER

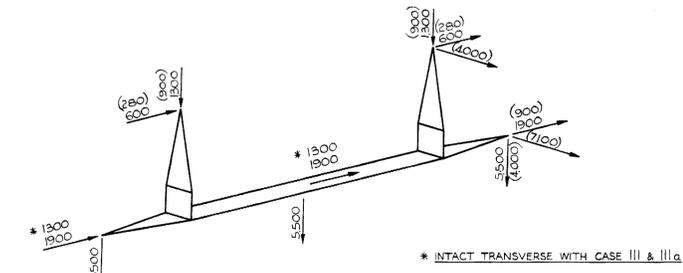
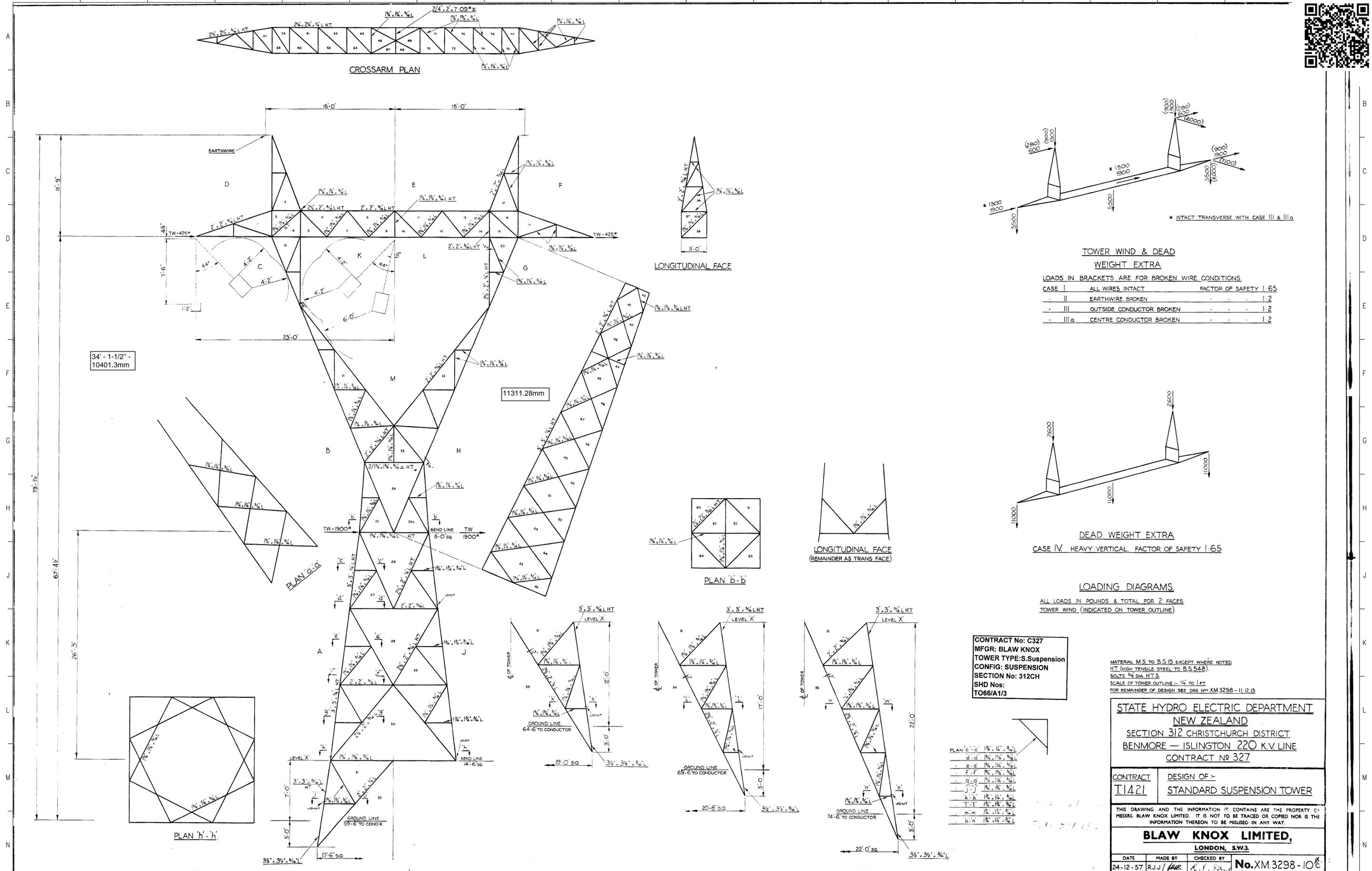
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BENMORE-ISLINGTON A
 C327/S.SUS - TOWER MODIFICATION
 4A, 4B, 4C FIT

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER T066/A1/2
DRAWING NUMBER TZ10823	SHEET 7
DRAWING CREATED BY: TRANSPOWER Border Replaced at Revision B	REVISION B
SCALE N.T.S.	



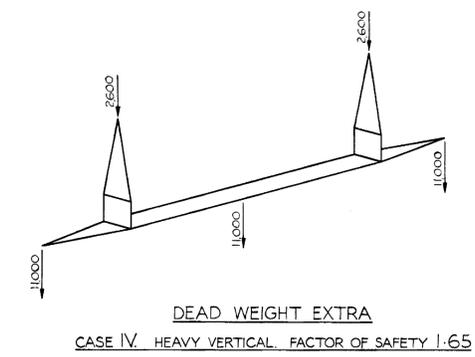
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TOWER WIND & DEAD WEIGHT EXTRA

LOADS IN BRACKETS ARE FOR BROKEN WIRE CONDITIONS

CASE	DESCRIPTION	FACTOR OF SAFETY
I	ALL WIRES INTACT	1.65
II	EARTHWIRE BROKEN	1.2
III	OUTSIDE CONDUCTOR BROKEN	1.2
IIIa	CENTRE CONDUCTOR BROKEN	1.2



LOADING DIAGRAMS
ALL LOADS IN POUNDS & TOTAL FOR 2 FACES
TOWER WIND (INDICATED ON TOWER OUTLINE)

CONTRACT No: C327
MFR: BLAW KNOX
TOWER TYPE: S. Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
T066/A1/3

MATERIAL M.S TO B.S.15 EXCEPT WHERE NOTED
H.T. (HIGH TENSILE STEEL TO B.S.548)
BOLTS 3/8" DIA. H.T.S.
SCALE OF TOWER OUTLINE 1/4" TO 1 FT.
FOR REMAINDER OF DESIGN SEE DRG NO. XM 3298 - 11, 12, 13

**STATE HYDRO ELECTRIC DEPARTMENT
NEW ZEALAND**
SECTION 312 CHRISTCHURCH DISTRICT
BENMORE - ISLINGTON 220 K.V. LINE
CONTRACT No 327

CONTRACT T.1421
DESIGN OF -
STANDARD SUSPENSION TOWER

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**BLAW KNOX LIMITED,
LONDON, S.W.3.**

DATE	MADE BY	CHECKED BY	No. XM.3298 - 10E
24-12-57	R.J.J./M.E.	K.L./K.A.	

REV	REVISION DESCRIPTION	CONSULTANT	TP								
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
D	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

TRANSPower

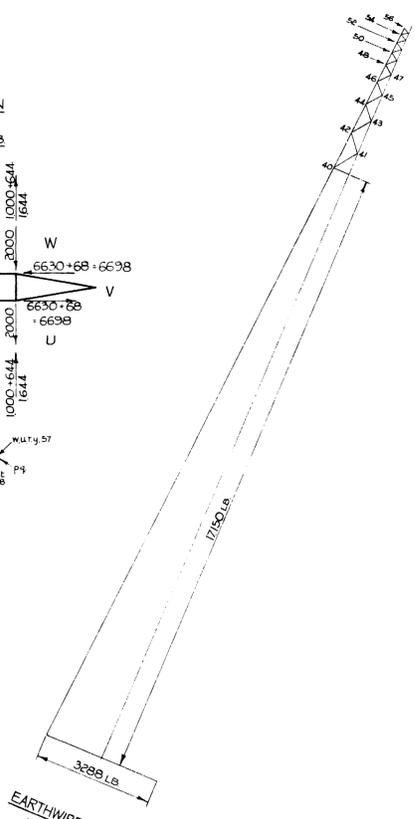
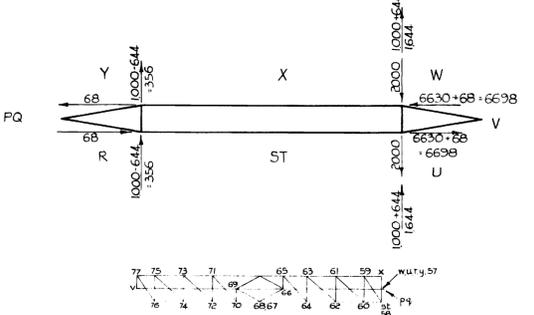
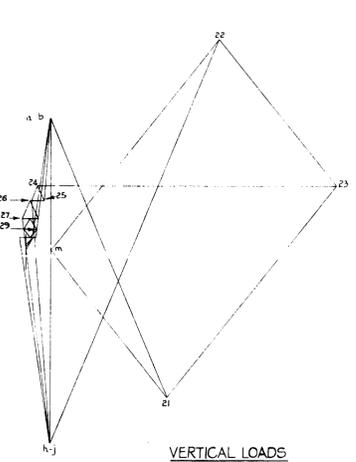
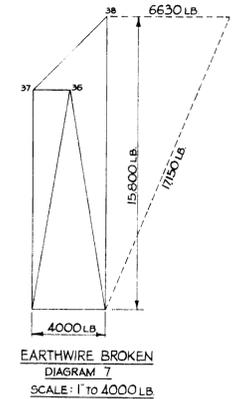
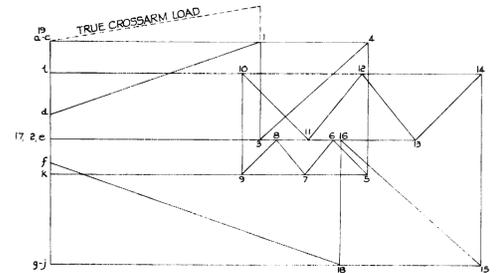
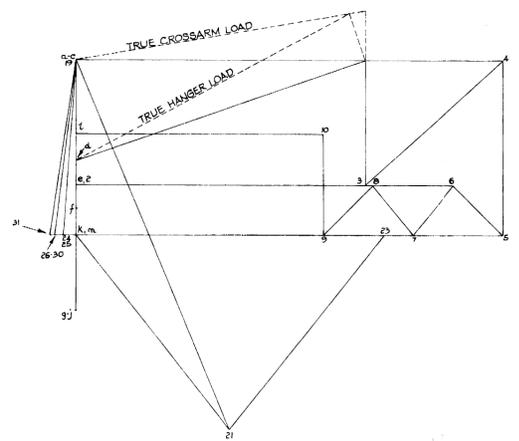
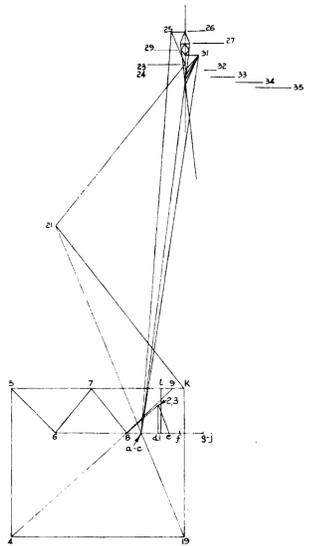
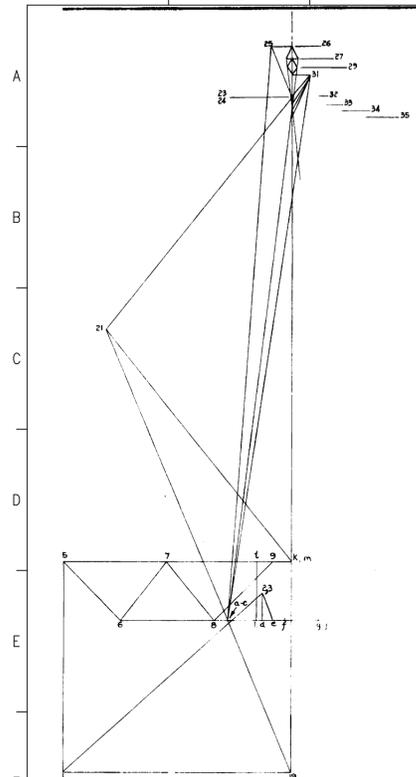
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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
DESIGN OF
SHEET 1 OF 4

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER T066/A1/3
DRAWING NUMBER XM3298	SHEET REVISION 10 D
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision D	SCALE N.T.S.



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TRANSVERSE LOADS
NORMAL CONDITIONS
DIAGRAM 1
SCALE: 1" TO 2000 LB.

TRANSVERSE LOADS
OUTSIDE CONDUCTOR BROKEN
DIAGRAM 2
SCALE: 1" TO 2000 LB.

VERTICAL LOADS
NORMAL CONDITIONS
DIAGRAM 3
SCALE: 1" TO 2000 LB.
SCALE: 1" TO 4000 LB. FOR CASE IV ONLY

VERTICAL LOADS
OUTSIDE CONDUCTOR BROKEN
DIAGRAM 4
SCALE: 1" TO 2000 LB.

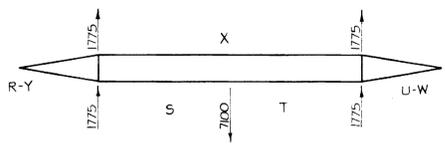
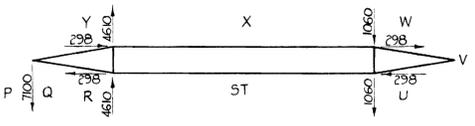
EARTHWIRE BROKEN
DIAGRAM 5
SCALE: 1" TO 4000 LB.

EARTHWIRE BROKEN
DIAGRAM 6
SCALE: 1" TO 2000 LB.

TRANSVERSE TORSION
OUTSIDE CONDUCTOR BROKEN
DIAGRAM 10
SCALE: 1" TO 1000 LB.

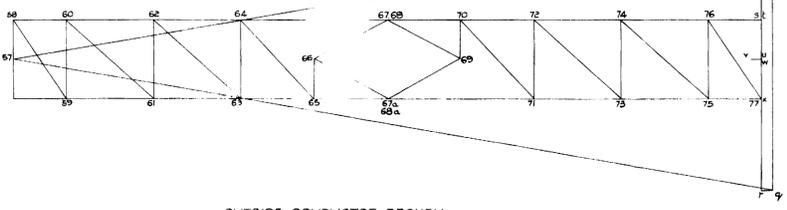
FOR EARTHWIRE BROKEN MULTIPLY
ABOVE LOADS BY $\frac{68}{298} = 0.228$

VERTICAL LOADS
CENTRE CONDUCTOR BROKEN
DIAGRAM 5
SCALE: 1" TO 2000 LB.



EARTHWIRE BROKEN
DIAGRAM 8
SCALE: 1" TO 2000 LB.

TOWER WIND
DIAGRAM 6
SCALE: 1" TO 1000 LB.



OUTSIDE CONDUCTOR BROKEN
DIAGRAM 14
SCALE: 1" TO 2000 LB.

CENTRE CONDUCTOR BROKEN
DIAGRAM 15
SCALE: 1" TO 2000 LB.

CONTRACT No: C327
MFR: BLAW KNOX
TOWER TYPE: S.Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
T066/A1/3

STATE HYDRO ELECTRIC DEPARTMENT
NEW ZEALAND
SECTION 312 CHRISTCHURCH DISTRICT
BENMORE - ISLINGTON 220 K.V. LINE
CONTRACT No 327

CONTRACT T1421 DESIGN OF: STANDARD SUSPENSION TOWER

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BLAW KNOX LIMITED,
LONDON, SW3

DATE 24.12.57 MADE BY R.J.J./M.H. CHECKED BY A.H./R.R.Y. No. XM 3298-11 A B

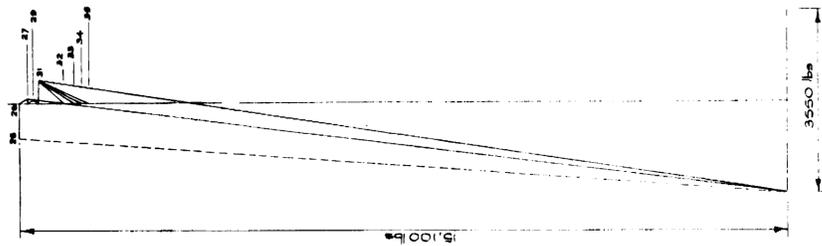
REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE		
P	C	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20

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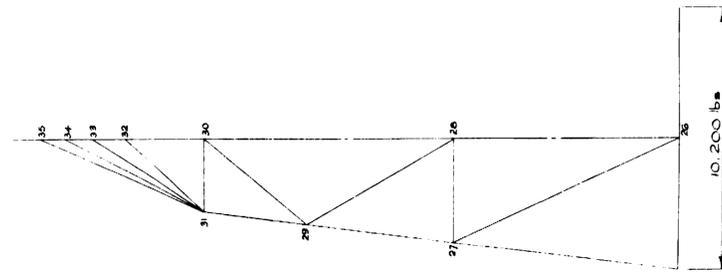
TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
DESIGN OF
SHEET 2 OF 4

TRANSPower PROJECT CODE IP_1920_244_11	FOLDER T066/A1/3
DRAWING NUMBER XM3298	SHEET REVISION 11 C
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision C	SCALE N.T.S.

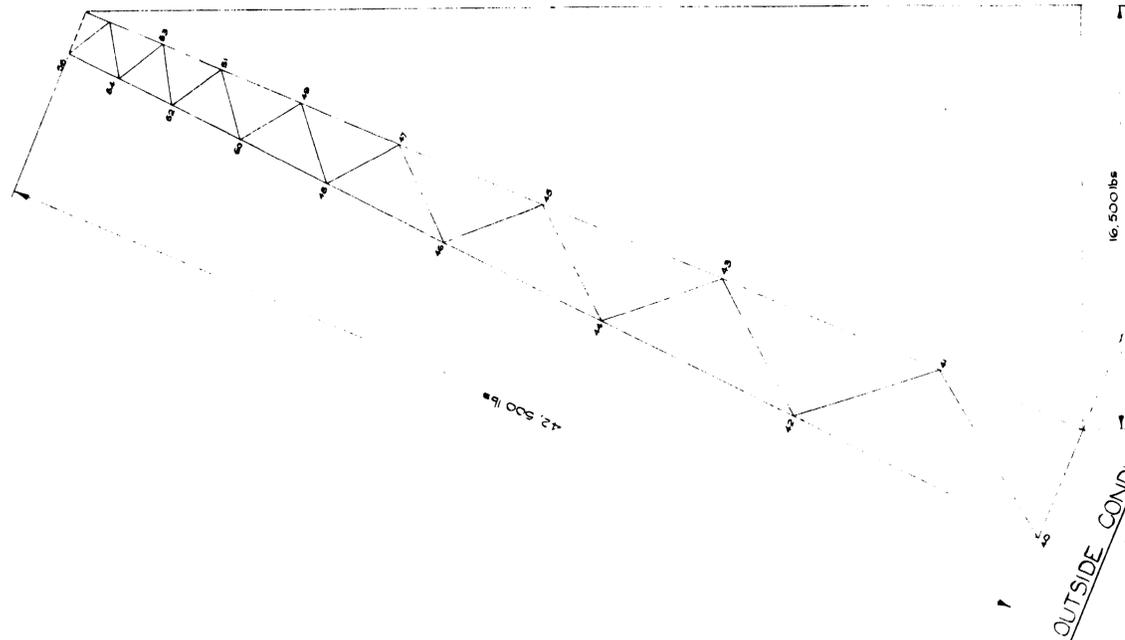
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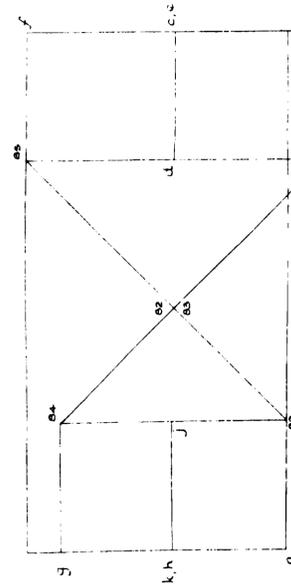
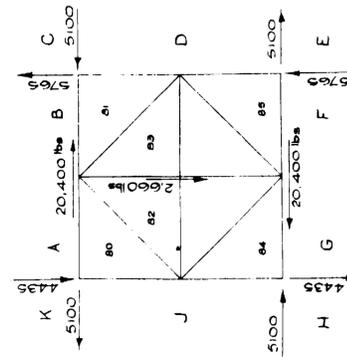
LONGITUDINAL LOADS DUE TO BROKEN CONDUCTOR
FOR MEMBERS BELOW TORSION BRACING
DIAGRAM 12
SCALE: 1" TO 2000 lbs



TORSION DUE TO OUTSIDE CONDUCTOR
BROKEN
DIAGRAM 13
SCALE: 1" TO 4000 lbs



OUTSIDE CONDUCTOR BROKEN
DIAGRAM 14
SCALE: 1" TO 4000 lbs



TORSION DISTRIBUTION
DUE TO OUTSIDE CONDUCTOR BROKEN
DIAGRAM 16
SCALE: 1" TO 4000 lbs

CONTRACT No: C327
MFRG: BLAW KNOX
TOWER TYPE: S.Suspension
CONFIG: SUSPENSION
SECTION No: 312CH
SHD Nos:
T066/A1/3

STATE HYDRO ELECTRIC DEPARTMENT
NEW ZEALAND
SECTION 312 CHRISTCHURCH DISTRICT
BENMORE - ISLINGTON 220 K.V LINE
CONTRACT No 327

CONTRACT T 1421
DESIGN OF:-
STANDARD SUSPENSION TOWER.

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DATE 20-12-57
MADE BY R.J.J./M.D.B.
CHECKED BY A.J.G.
No. XM.3298-12 AS

SHEET 3 OF 4



REV	REVISION DESCRIPTION	CONSULTANT								TP			
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TRANSPOWER

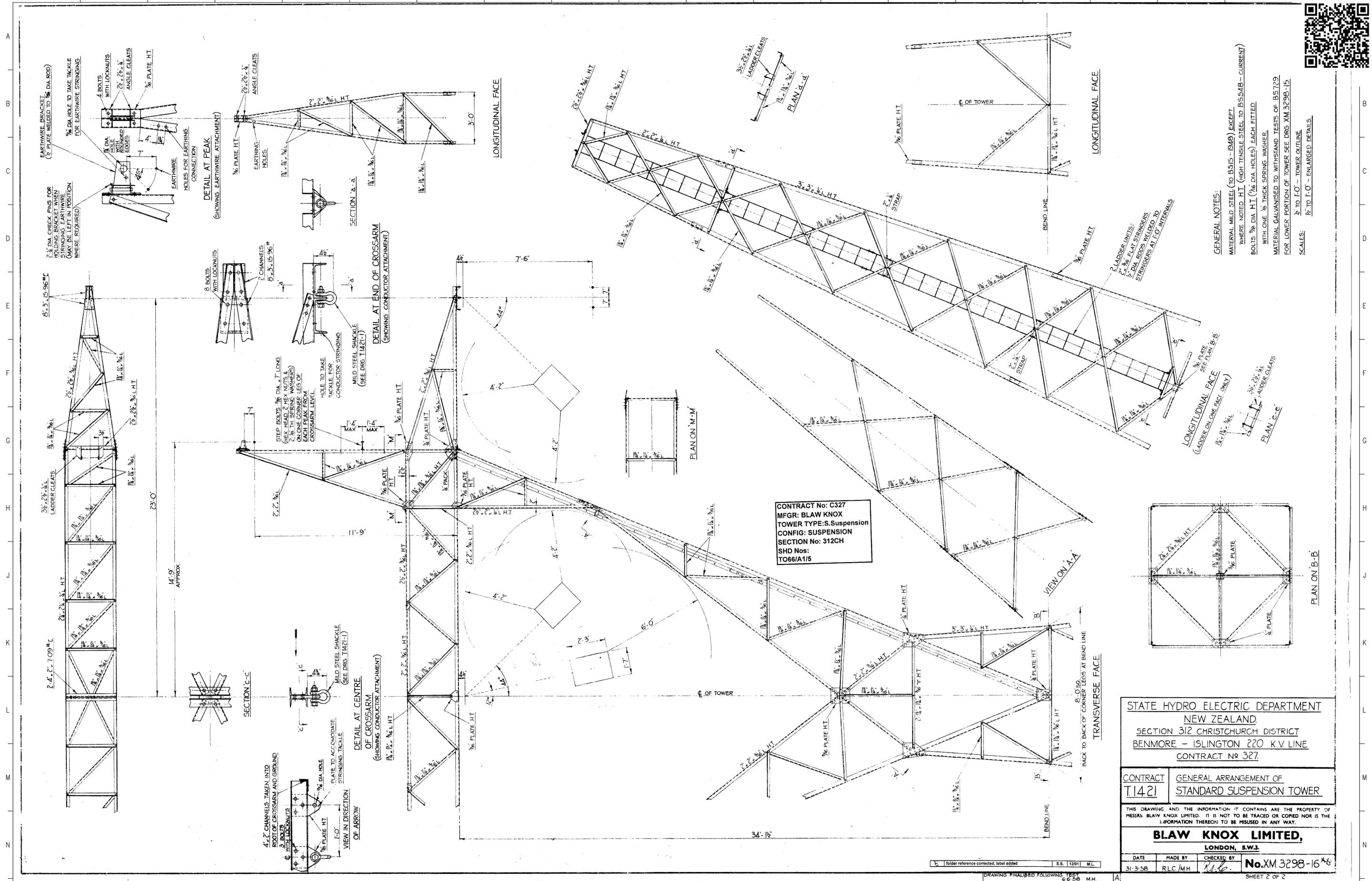
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TOWER CONTRACT C327
STANDARD SUSPENSION TOWER
DESIGN OF
SHEET 3 OF 4

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER T066/A1/3	
DRAWING NUMBER XM3298		SHEET 12	REVISION C
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A1

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CONTRACT No: C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/5

STATE HYDRO ELECTRIC DEPARTMENT
 NEW ZEALAND
 SECTION 312 CHRISTCHURCH DISTRICT
 BENMORE - ISLINGTON 220 K.V. LINE
 CONTRACT No 327

CONTRACT T1421 GENERAL ARRANGEMENT OF STANDARD SUSPENSION TOWER

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DATE: 31-3-58 MADE BY: RLC/M.H. CHECKED BY: *K.G.* No.XM.3298-16*6

SHEET 2 OF 2

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
P	C	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



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TOWER CONTRACT C327
 STANDARD SUSPENSION TOWER
 GENERAL ARRANGEMENT
 SHEET 2 OF 2

TRANSPOWER PROJECT CODE IP_1920_244_11		FOLDER T066/A1/5	
DRAWING NUMBER XM3298		SHEET REVISION 16 C	
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision C		SCALE N.T.S.	

A1

Appendix I

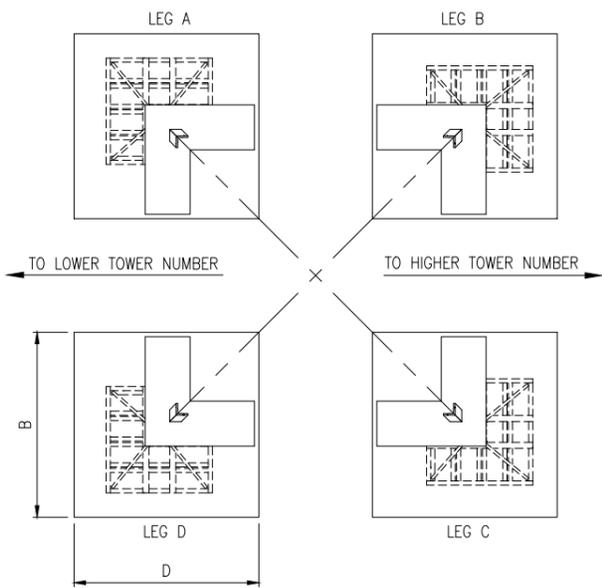
TEES Estimate

FNS 'The Point' TEES Estimate

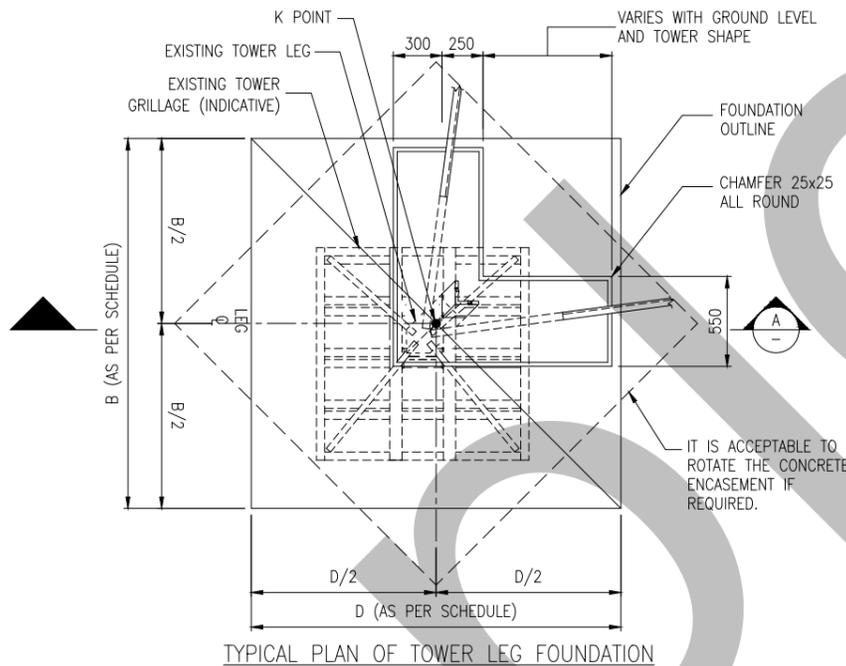
Project name:		FNS 'The Point'		Engineering Consultant:		AECOM		Date final estimate		Link to TEES estimate	
Project code:		60720998		Project Engineer:		Dayan Hewa Buhege		TEES Estimate Completed by:			
Project description:		GIP		Link to SSR:		SSR_FNS_The Point_rev01		Estimate accuracy class:			
Project start date:				Date initial estimate:		7/03/2024		Date Risk workshop (if applicable):			
Project end date:				Risk workshop required (Y/N):				Link to final Risk spreadsheet:			
DESCRIPTION	SSR Qty (Initial)	TEES Qty (Final DBC)	Unit Of Measure	RATE 1	ADJUSTMENT FACTOR	REASON	FINAL RATE	COMMENTS PROJECT ENGINEER	COMMENTS ESTIMATION	TOTAL	SOURCE
Clearance Rectifications										\$298,788.42	
Intermediate structure - strain tower -220kV - Double Circuit	1	1	Per Struc	\$ 199,192.3	1.5		\$ 298,788.4			\$ 298,788.4	
Tower strengthening enabling works										\$ 21,984.7	
Minor tower strengthening	2	2	Each	\$ 10,992.3	1		\$ 10,992.3			\$ 21,984.7	
Foundation strengthening										\$320,776.89	
COG	2	2	Per Twr	\$ 40,571.5	1		\$ 40,571.5			\$ 81,143.0	
New foundation - tower - pile	1	1	Per Twr	\$ 171,167.1	1.4		\$ 239,633.9			\$ 239,633.9	
Access										\$ 8,854.7	
Crane pad - easy	1	1	Each	\$ 8,854.7	1		\$ 8,854.7			\$ 8,854.7	
Materials										\$103,527.01	
Conductor - cct/km	0.43	0.43	CCT/km	\$ 22,774.5	1		\$ 22,774.5			\$ 9,793.0	
Earthwire - cct/km	0.143	0.143	CCT/km	\$ 3,528.0	1		\$ 3,528.0			\$ 504.5	
Insulator sets = 220kV - strain	6	6	CCT Set	\$ 15,538.2	1		\$ 15,538.2			\$ 93,229.5	
TOTAL										\$ 753,931.63	

Appendix J

Foundation
Strengthening Drawing
and Summary



PLAN



TYPICAL PLAN OF TOWER LEG FOUNDATION

NOTES:

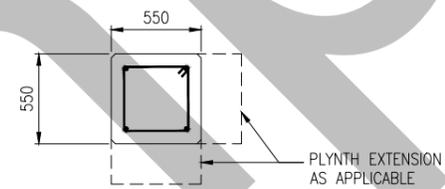
- ALL DIMENSIONS ARE IN MILLIMETRES
- ENSURE THE TOWER BASE IS SQUARE AND LEVEL IN ACCORDANCE WITH THE "GRILLAGE FOUNDATIONS - CONCRETE ENCASEMENT TECHNICAL SPECIFICATION" (HEREAFTER CALLED THE SPECIFICATION) PRIOR TO POURING CONCRETE.
- CONCRETE TO COMPLY WITH NZS 3104 & 3109 WITH A 28 DAY COMPRESSION STRENGTH OF 25MPa. CONCRETE TO BE PLACED IN ONE CONTINUOUS POUR. ALL CONCRETE SHALL INCLUDE ANY ONE OF THE FOLLOWING STEEL FIBRE PRODUCTS AT THE STATED DOSAGE RATE:

STEEL FIBRE	MIN CE DOSAGE [kg/m³]
DRAMIX 3D 65/60BG	15
DRAMIX 3D 80/60BG	10
WIRAND FF1	25
- CONTRACTOR SHALL ASSESS THE CONDITION OF EXISTING FOUNDATION STEEL ABOVE THE GRILLAGE, PREPARE AND PAINT OR REPLACE AS REQUIRED IN ACCORDANCE WITH THE SPECIFICATION.
- UNDER NO CIRCUMSTANCES SHALL FOUNDATIONS BE LEFT EXCAVATED OVERNIGHT, OR AT ANY OTHER TIME WHEN THE WIND SPEED EXCEEDS 13.0m/s (46km/hr).
- CLEAT BOLTS TO BE TOWER BOLTS TO AS/NZS 1559:1997 AND SHALL BE SUPPLIED FREE ISSUE BY TRANSPOWER (UN-GALVANISED ARE ACCEPTABLE).
- ACTUAL GRILLAGE DEPTH MAY VARY FROM THAT SHOWN ON DRAWINGS. PLEASE NOTIFY ENGINEER BEFORE PROCEEDING WITH THE CONCRETE PLACEMENT IF DIMENSION "t" CANNOT BE ACHIEVED DUE TO SHALLOW GRILLAGE.
- WATER TO BE PUMPED FROM EXCAVATION PRIOR TO CONCRETE POUR. RECORD WATER TABLE DEPTH IMMEDIATELY PRIOR TO PUMPING.
- ALLOW TO REMOVE FROM SITE ALL EXCAVATED MATERIAL AND REINSTATE GROUND SURFACE, GRASS SEED OR OTHERWISE TO BE CONFIRMED WITH LANDOWNER AND TRANSPOWER. BACKFILL TO BE COMPACTED AS PER TP STANDARDS.
- CONDUCT SCALA PENETROMETER TEST AT BASE OF EXCAVATION. TEST TO MEET OR EXCEED 3 BLOWS PER 100mm FOR A DEPTH OF 2.5m. RECORD TEST AND ATTACH TO QA DOCUMENTS. IF SOFT SOIL IS ENCOUNTERED, REFER SPECIFICATION FOR REMEDIAL MEASURES.
- IDENTIFY AND LOCATE ALL SERVICES BESIDE TOWERS BEFORE EXCAVATING.
- REFER TO ASSOCIATED SCHEDULE DRAWING FOR DESIGN CRITERIA FOUNDATION LOADS AND DIMENSIONS.
- REINFORCEMENT TO BE TO AS/NZS 4671:2001. D500E20 DESIGNATES A DEFORMED BAR, GRADE 500, SEISMIC DUCTILITY WITH NOMINAL 20mm DIAMETER.

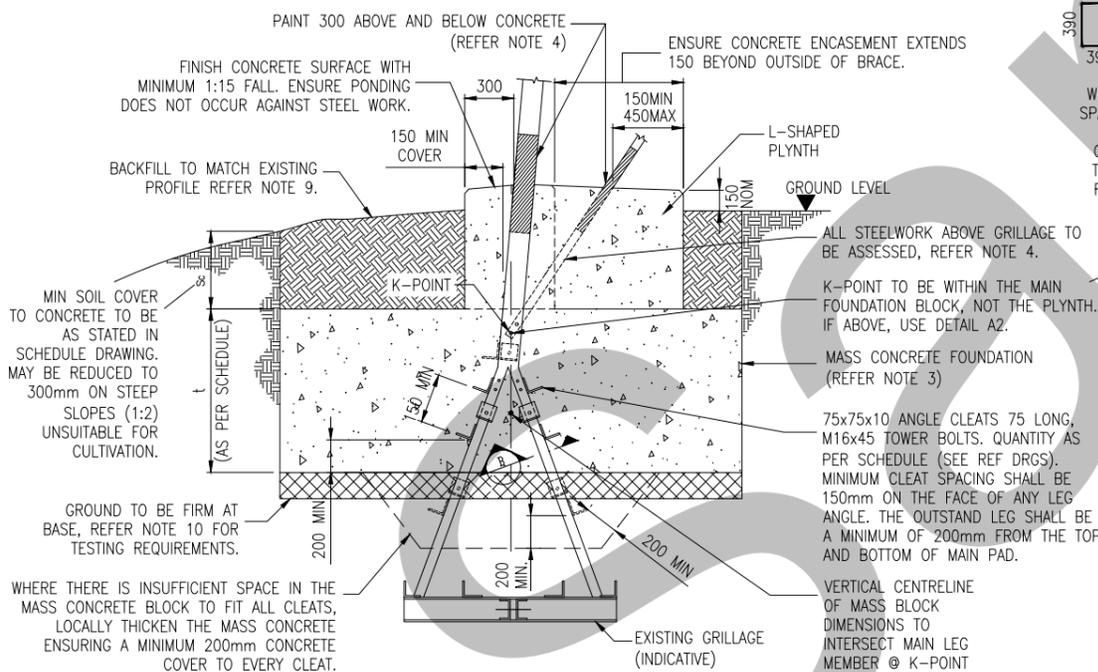
REFERENCE DRAWINGS:

- TP100452 BPE-WRK A 220kV LINE, CONCRETE ENCASED GRILLAGE FOUNDATION, SITE SPECIFIC DATA SCHEDULE
- TP102128 BPE-WRK A 220kV LINE, CONCRETE ENCASED GRILLAGE FOUNDATION, SITE SPECIFIC DATA SCHEDULE
- FPN973 BPRE-WRK A 220kV TRANSMISSION LINE, STUB SETTING DATA
- 0T6819 TOWER CONTRACT C354 TYPE A, B, C, & D STUB SETTING DETAILS
- P11865 C354 TYPE A TOWER, 10' & 15' LEG EXTENSIONS, GRILLAGE FOUNDATION
- P11869 C354 TYPE B TOWER, 10' & 15' LEG EXTENSIONS, GRILLAGE FOUNDATION
- P11873 C354 TYPE C TOWER, 10' & 15' LEG EXTENSIONS, GRILLAGE FOUNDATION

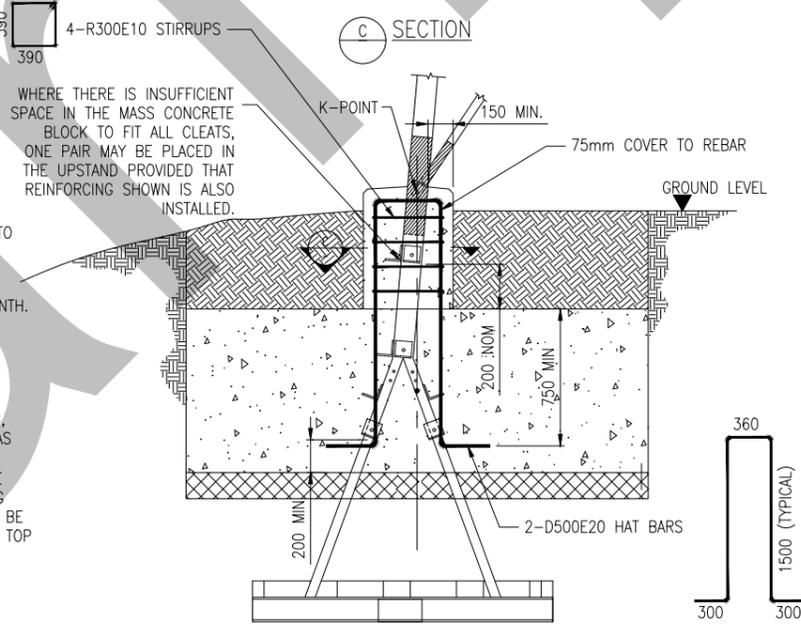
ALL NOTES IN SECTION A1 ARE ALSO APPLICABLE FOR SECTION A2



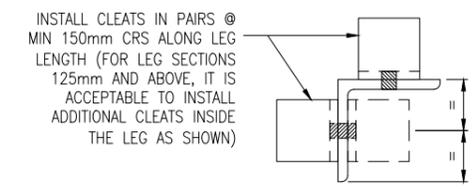
SECTION C



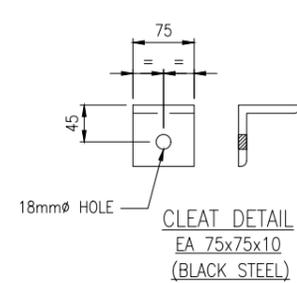
TYPICAL SECTION FOR K-POINT WITHIN MASS CONCRETE BLOCK (NO REBAR REQUIRED)



TYPICAL SECTION FOR K-POINT ABOVE MASS CONCRETE BLOCK (WITHIN OR ABOVE PLYNTH)



TYPICAL SECTION



CLEAT DETAIL
EA 75x75x10
(BLACK STEEL)

REV	DESCRIPTION	NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	TP	
A	AS BUILT	LineTech	RO	02.19	RO	02.19	PG	02.19	ID	02.19	DM	02.19

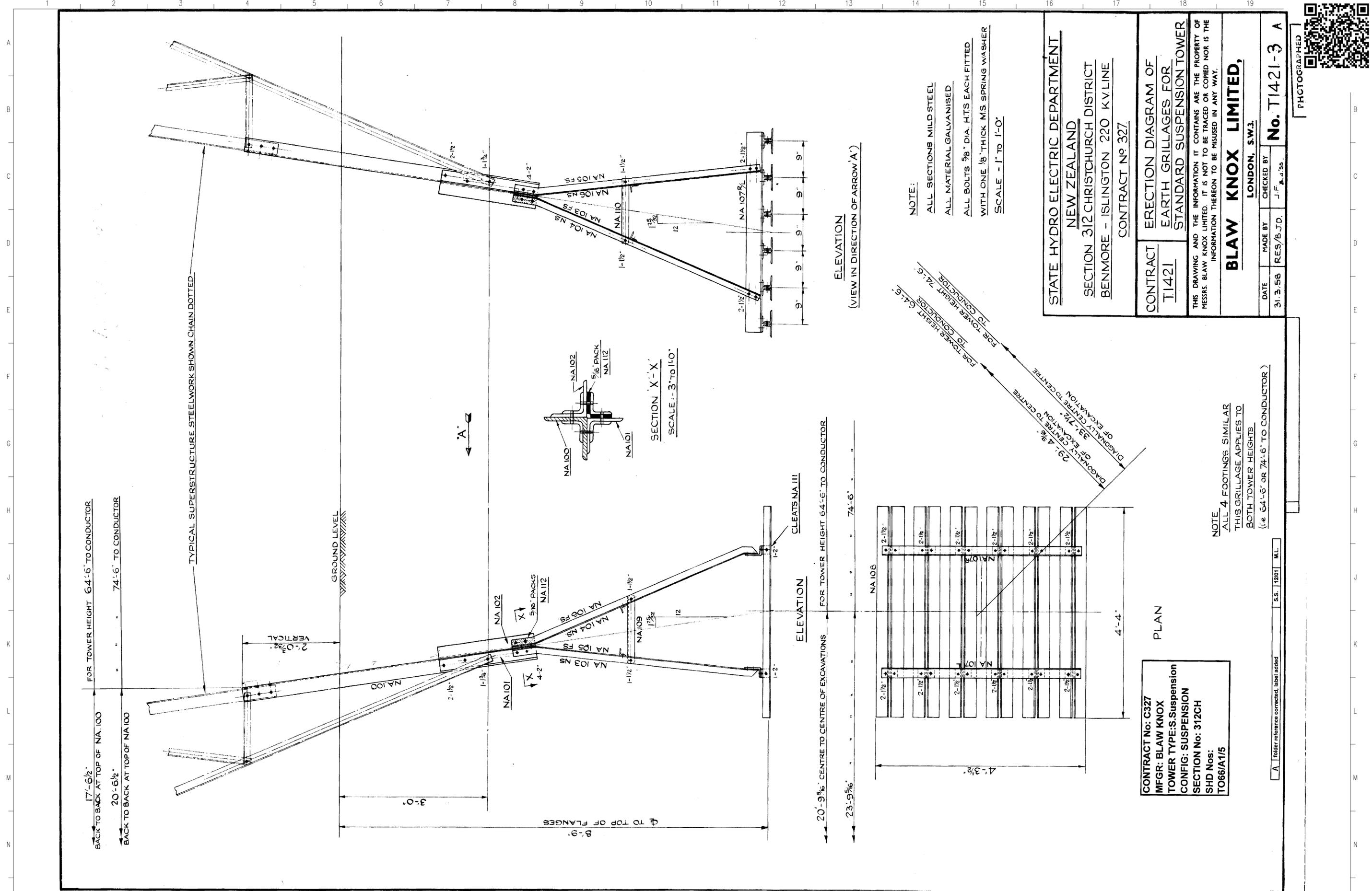


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ASY-DEV A 66kV LINE
C136-B8 TOWERS
GRILLAGE FOUNDATION ENCASEMENT
STRENGTHENING WORK

DRG. SIZE A1	SCALE N.T.S.	FOLDER
DRAWING NUMBER	SHEET	REVISION
SOURCE FILE NAME		A

submit your markups to TranspowerProduction@redyedms.com



NOTE:
 ALL SECTIONS MILD STEEL
 ALL MATERIAL GALVANISED
 ALL BOLTS 5/8" DIA. HTS EACH FITTED
 WITH ONE 1/8" THICK MS SPRING WASHER
 SCALE - 1" TO 1'-0"

STATE HYDRO ELECTRIC DEPARTMENT
 NEW ZEALAND
 SECTION 312 CHRISTCHURCH DISTRICT
 BENMORE - ISLINGTON 220 KV/LINE
 CONTRACT No 327

CONTRACT
 T1421
 ERECTION DIAGRAM OF
 EARTH GRILLAGES FOR
 STANDARD SUSPENSION TOWER

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 LONDON, S.W.3.

DATE 31.3.58 MADE BY RES/B.J.D. CHECKED BY J.F. B.4.55. No. T1421-3 A



SECTION 'X-X'
 SCALE: - 3" TO 1'-0"

NOTE:
 ALL 4 FOOTINGS SIMILAR
 THIS GRILLAGE APPLIES TO
 BOTH TOWER HEIGHTS
 (i.e. 64'-6" OR 74'-6" TO CONDUCTOR)

CONTRACT No: C327
 MFR: BLAW KNOX
 TOWER TYPE: S.Suspension
 CONFIG: SUSPENSION
 SECTION No: 312CH
 SHD Nos:
 T066/A1/5

A folder reference corrected, label added S.S. 1201 M.L.

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
B	AS BUILT - RASTER EMBEDDED & BORDER ADDED - IF IN DOUBT CHECK PREVIOUS VERSION	BECA	-	-	-	05.20	JWB	05.20	JBF	05.20	TP	05.20



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TOWER CONTRACT C327
 STANDARD SUSPENSION TOWER
 ERECTION DIAGRAM
 EARTH GRILLAGES

TRANSPOWER PROJECT CODE IP_1920_244_11	FOLDER T066/A1/5
DRAWING NUMBER T1421	SHEET REVISION 3 B
DRAWING CREATED BY: BLAW KNOX Border Replaced at Revision B	SCALE N.T.S.

ULTIMATE FOUNDATION LOADS FROM PLS TOWER in KN					
		Max Comp	Max Uplift	Max Trans. Shear	Max Long Shear
		1	2	3	4
Maximum Compression	[C]=	612	612	500	500
Maximum Uplift	[U]=	-450	-450	-450	-450
Shear Force in X - direction	[Sx]=	12	7	18	18
Shear Force in Y - direction	[Sy]=	12	7	18	18

ULTIMATE FOUNDATION LOADS FOR OVERTURNING AND UPLIFT in KN					
Load case		Max Comp	Max Uplift	Max Trans. Shear	Max Long Shear
strength factor		1	2	3	4
Maximum Compression	[C]=	795.60	795.60	650.00	650.00
Maximum Uplift	[U]=	585.00	585.00	585.00	585.00
Shear Force in X - direction	[Sx]=	15.60	9.10	23.40	23.40
Shear Force in Y - direction	[Sy]=	15.60	9.10	23.40	23.40

TOWER SLOPE AND MATERIAL PROPERTIES			
Tower Slope in Plane (β1)		8.24	8.24
Tower Slope in long Plane (β2)		8.24	8.24
Transverse Face Shift (tanβ1) for tower		0.144840	
Longitudinal Face Shift (tanβ2) for tower		0.144840	
Slope for true length of tower leg member		1.020979	
Density of Reinforced Concrete	[Wcd]=		24 KN/cum
Density of Soil	[Wsd]=		17 KN/cum
Ultimate Bearing stress of Soil (KN/m ²)=	[fc]=		300 KN/sqm
Angle of frustum	[θ1]=		30 Deg
Angle of internal friction	[f1]=		45 Deg
Density of backfilled Soil	[Wsd1]=		17 KN/cum
Cover to main reinforcement =	[Co]=		70 mm
Allowable Tensile stress of Steel Reinf. Bars	[fy]=		420 N/sqmm
Partial safety factor for Steel			1.15
Allowable Compression stress of Conc.	[fck]=	C20/25	20 N/sqmm
Partial safety factor for concrete			1.50

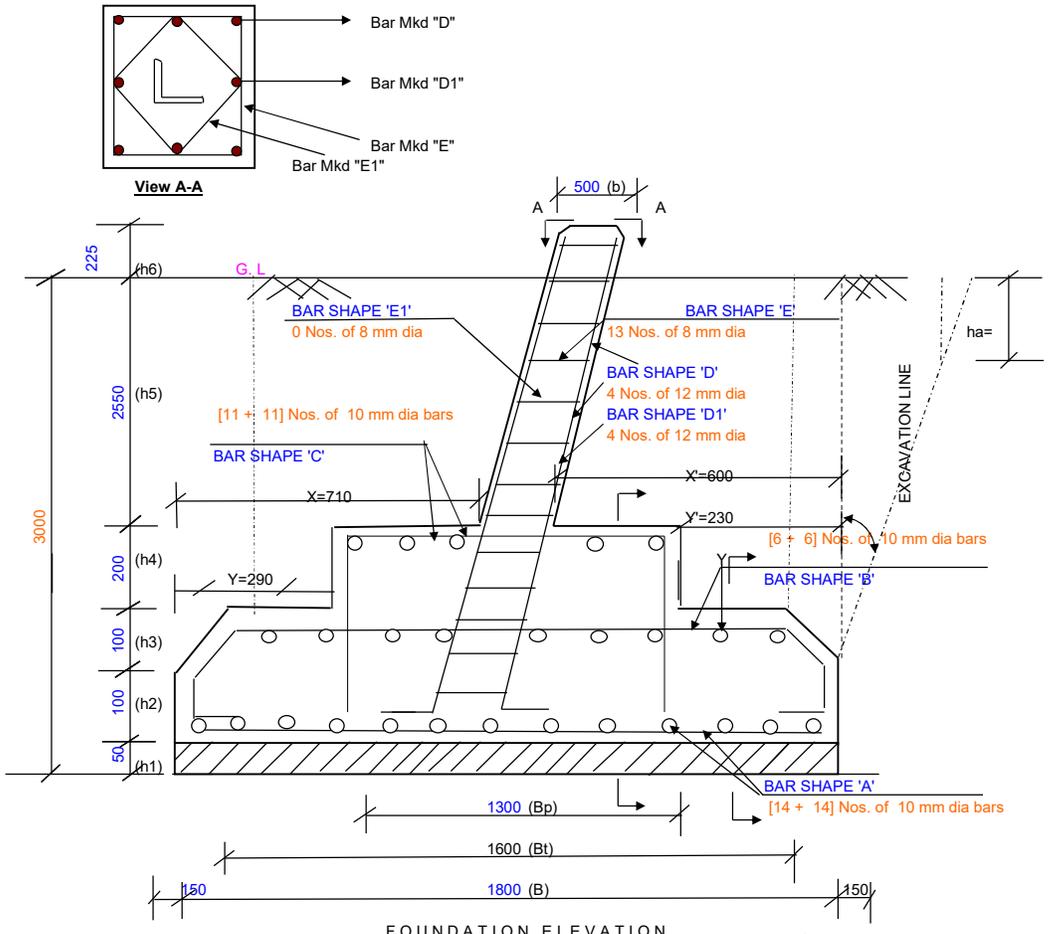
FOUNDATION DESIGN PARAMETERS			
Base Width of R.C.C. Slab (B)		1.800	1.800
Width of Chimney (b)		0.500	0.500
Width of Second Slab (Bp)		1.300	1.300
Top width of bottom slab (Bt)		1.600	1.600
Depth of Foundation below G. L. (H)		3.000	3.000
Lean Concrete Thickness (h1)		0.050	0.050
Depth of First Slab (Vertical) (h2)		0.100	0.100
Depth of First Slab (Inclined) (h3)		0.100	0.290
Depth of Second Slab (h4)		0.200	0.290
Height of Chimney below Ground Level (h5)		2.550	
Height of Chimney above Ground Level (h6)		0.225	0.23
Dist. Between Chimney Top & Last Lattice Bolt (HC)		0.050	0.05
	H/B =	1.667	
	H/b =	5.650	SHORT COLUMN
Water table upto G.L. (submerged)		No	

Quantity Schedule		Rates			
Concrete Volume (m ³)		6.58	34.42	1	19%
Lean Concrete Volume (m ³)		0.650	3.29	1	20%
Excavation Volume (Under-Cut) (m ³)		31.26	119.36	1	26%
Excavation Volume (Neat) (m ³)		38.88			
Excavation Volume (150 mm Clear) (m ³)		52.92			
Reinforcement Steel (kgs)	Ratio = Steel / Concrete	59.119	389.00	2978.00	1 13%
			0		

FOUNDATION DESIGN CHECKS				
Critical factor of safety	1.051	one way shear		
Factor of safety in Uplift	1.0887			
Factor of safety in compression	1.1619	Vrd,c	Actual	
One way shear Check	1.0507	0.41	0.39	
Punching shear @2d _{eff}	2.8443	0.41	0.14	
Punching shear @face of chimney	3.0065	2.94	0.98	
Factor of safety in sliding	21.0580			
Factor of safety in overturning	1.2985			
Minimum Pressure on soil check	240.21	KN/sqm		
Reinforcement Design				
Bottom Steel (Bar MKD A)				
Diameter of Bars	10	10		Extra bar
Number of Bars		14	14	
Area of Bars Provided (Ast Prov.)		1099.557		106%
Spacing of Bars	70	128	400	
Area of Bars Reqd (Ast Reqd.)		1035		
Top Steel (Second Slab) (Bar MKD C)				
Diameter of Bars	10	10.0		
Number of Bars		11	11	0
Area of Bars Provided (Ast Prov.)		864		106%
Spacing of Bars	70	116.0	400	
Area of Bars Reqd (Ast Reqd.)		812.2		
Top Steel (Bottom Slab) (Bar MKD B)				
Diameter of Bars	10	10.0		
Number of Bars		6	6	127%
Area of Bars Provided (Ast Prov.)		471		
Spacing of Bars	70	292.0	400	
Area of Bars Reqd (Ast Reqd.)		371.2		
BM, MR & Ratio				
Details of Chimney Reinforcement				
Stub Area to be consider	NO	d/b =	0.168	
Diameter of Corner Bars	12			
No of Corner Bars	4			
Diameter of Intermediate Bars	12			
No of Intermediate Bars	4			
Diameter of Chimney Stirrups	8			
$(M_{ux}/M_{ux1})^{1.5} + (M_{uy}/M_{uy1})^{1.5} =$	0.769	SAFE	1	
Minimum Percentage of Steel in the Chimney =	0.3619	%		

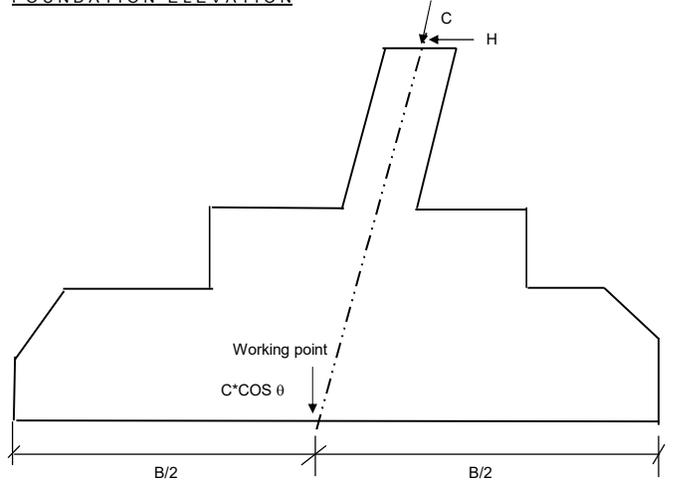
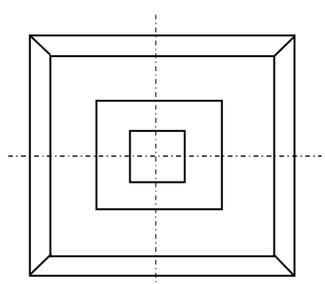
Project		DESIGN OF RCC FOUNDATION										TT	
												Soil Type	

H	B	b	Bt	Bp	h1	h2	h3	h4	h5	X	X'	Y	Y'
3000	1800	500	1600	1300	50	100	100	200	2550	710	600	290	230



FOUNDATION ELEVATION

ESTIMATED VOLUME OF WORK / TOWER	
VOLUME OF CONCRETE	
LEAN CONC (M10)	= 0.65 m ³
GRADE-M20	= 6.58 m ³
TOTAL	= 7.23 m ³
EXAVATION VOL.	= 38.88 m ³
REINFORCEMENT	= 389.00 kg



Appendix K

Initial Tower 83A Pile Calculations

Description

This worksheet is used to determine the capacity of existing bored pile foundation of a Tower structure. The following failure mechanisms are evaluated based on existing bored pile foundation configuration and estimated Geotechnical design properties (derived in a separate Geotechnical desktop study).

I. Uplift Capacity as the minimum between the following failure mechanisms:

1. Pull-out Cone Failure Model (Note A)
2. Shear Surface Failure Model (Note B)
3. Uplift Bearing Failure Model (Note B)

II. Ultimate Bearing Capacity

Notes:

A. This failure mode is provided for comparison, but is not used in TP.DL 01.01 2023 for piles in soils, and does not govern uplift capacity in these calculations. Cone angle is in accordance with TP.DL 01.01 2013.

B. Includes wedge breakout reduction when applicable.

Calculation Process

The calculation process is based on TP.DL 01.01 (Issue 2, Dec 2023) and is summarised as follows.

- I. Summary of Geotechnical Parameters
- II. Existing foundation parameters.
- III. Calculation of Uplift Capacity
- IV. Calculation of Ultimate Bearing Capacity
- V. Compare capacity required and iterate pile depth

References:

1. TP.DL 01.01 Transpower Transmission Line Foundation Design Standard (Issue 2, Dec 2023)
2. TP.DL 12.01 Transpower Transmission Line Loading Code (Issue 6.1, Feb 2021)

I. Summary of Geotechnical Parameters

Below are the Geotech Design parameters as specified in the **Geotechnical Desktop Assessment** and/or **TP.DL 01.01**.

Geotech Model: Gravel Groundwater depth; $d_w := 0 \text{ m}$

Layer thickness;	Layer 1: Silty Sand	Layer 2: Silty Clay
	$D_{L1} := 20 \text{ m}$	$D_{L2} := 30 \text{ m}$
Effective soil unit weight;	$\gamma_{s1} := 18 \frac{\text{kN}}{\text{m}^3}$	$\gamma_{s2} := 18 \frac{\text{kN}}{\text{m}^3}$
Angle of internal friction;	$\phi_{s1} := 30 \text{ deg}$	$\phi_{s2} := 30 \text{ deg}$
Undrained Shear Strength;	$S_{u1} := 0 \text{ kPa}$	$S_{u2} := 0 \text{ kPa}$
Cohesion;	$c'_1 := 0 \text{ kPa}$	$c'_2 := 0 \text{ kPa}$
Soil to soil interface friction angle (Table 18 of TP.DL 01.01);	$\delta_{ss1} := \phi_{s1}$	$\delta_{ss2} := \phi_{s2}$
Adhesion Factor: Soil to Concrete (Table 18 of TP.DL 01.01);	$\alpha_{sc1} := 0$	$\alpha_{sc2} := 0$
Adhesion Factor: Soil to Soil (Table 18 of TP.DL 01.01);	$\alpha_{ss1} := 0$	$\alpha_{ss2} := 0$
Flotation below groundwater level	$\gamma_w := 9.81 \frac{\text{kN}}{\text{m}^3}$	
Coefficient of Friction; $\beta_{1_{ss}} := 0.4$		
Capacity reduction factor for Soil Shear Friction and/or Bearing;	$\Phi_S := 0.65$	(Table 2 of TP.DL 01.01)
Capacity reduction factor for Soil Weight;	$\Phi_{GS} := 0.9$	(Table 2 of TP.DL 01.01)
Capacity reduction factor for Concrete Weight;	$\Phi_{GC} := 0.95$	(Table 2 of TP.DL 01.01)
Failure Sequence factor for Suspension;	$\Phi_{TS} := 1.0$	(Table 5 of TP.DL 12.01)
Failure Sequence factor for Strain;	$\Phi_{TSt} := 1.0$	(Table 5 of TP.DL 12.01)

II. Proposed Pile Foundation for 2DD-HSTC

Refer to Drawing **E930** for details of Existing foundation.

Pile diameter;	$D_S := 2.95276 \text{ ft} = 900 \text{ mm}$
Pile radius;	$r_S := 0.5 \cdot D_S = 450 \text{ mm}$
Bell diameter;	$D_B := 2.95276 \text{ ft} = 900 \text{ mm}$
Bell radius;	$r_B := 0.5 \cdot D_B = 450 \text{ mm}$
Overall depth below ground;	$L := 29.52756 \text{ ft} = 9000 \text{ mm}$
Unit weight of concrete;	$\gamma_c := 2 \frac{\text{kN}}{\text{m}^3}$

III. Wedge Breakout Reduction Factor

Non-cohesive soils in drained, short or long term loading state:

$$R_{s_d_reduced} := 1$$

Applies when $\frac{L}{D_B} < 6$ and, the average $\frac{\beta_{1_ss} \cdot L}{L}$ over the foundation depth is > 1

If $R_{s_d_reduced} = 1$, then NO BREAKOUT occurs. i.e. No Reduction

$$\frac{L}{D_B} = 10 \quad \frac{\beta_{1_ss} \cdot L}{L} = 0.4$$

Cohesive soils in undrained, short term loading state:

Soil to backfill Adhesion; $f_{ss1} := \alpha_{sc1} \cdot S_{u1} = 0 \text{ kPa}$

Side resistance along soil to backfill interface; $Q_{ss_ud1} := f_{ss1} \cdot (\pi \cdot D_B \cdot D_{L1}) = 0 \text{ kN}$

$$f_{ss} := \frac{Q_{ss_ud1}}{\pi \cdot D_B \cdot L} = 0 \text{ kPa}$$

$$R_{s_ud_reduced} := 1$$

Applies when $\frac{L}{D_B} < 6$ and, the average $\frac{f_{ss}}{(\gamma_{s1} \cdot L)}$ over the foundation depth is > 1

If $R_{s_ud_reduced} = 1$, then NO BREAKOUT occurs. i.e. No Reduction

$$\frac{L}{D_B} = 10 \quad \frac{f_{ss}}{(\gamma_{s1} \cdot L)} = 0$$

IV. Uplift Capacity

4.1 Pull-out Cone Failure Model

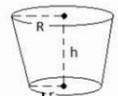
The cone pull-out capacity is basically the weight of the truncated inverted cone formed by the soil and pile foundation.

Cone angle; $\theta_s := 0.55 \cdot \phi_{s1} = 16.5 \text{ deg}$ (Table 18 of TP.DL 01.01)

Truncated inverted cone base radius; $r := r_B = 450 \text{ mm}$

Truncated inverted cone top radius; $R := r + L \cdot \tan(\theta_s) = 3116 \text{ mm}$

$$\text{Volume} = \frac{\pi}{3} h (R^2 + Rr + r^2)$$



Truncated Cone Volume Formula

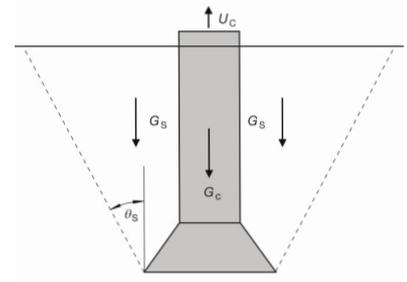
Total Volume of concrete pile ; $V_c := \pi \cdot r_s^2 \cdot L = 5.73 \text{ m}^3$

Weight of concrete pile; $G_c := \gamma_c \cdot V_c = 11 \text{ kN}$

Total Volume of Soil above GW above Bell; $V_{s1} := \left(\frac{\pi}{3} \cdot D_{L1} \cdot (R^2 + R \cdot r + r^2) \right) - V_c = 231.23 \text{ m}^3$

Weight of Soil above GW above Bell; $G_s := \gamma_{s1} \cdot V_{s1} = 4162 \text{ kN}$

The pull-out capacity is then calculated as; $Q_{u1} := \Phi_{TS} \cdot (\Phi_{G_s} \cdot G_s + \Phi_{G_c} \cdot G_c)$



$Q_{u1} = 3757 \text{ kN}$

4.2 Shear Surface Failure Model with Wedge Breakout Reduction

Under SLS conditions (i.e., long term loading), side resistance is based on Friction (drained) for both Cohesive and Non-cohesive soils, thus;

Total Volume of Soil above bell; $V_{ss1} := (\pi \cdot r_B^2 \cdot L) - V_c = 0 \text{ m}^3$

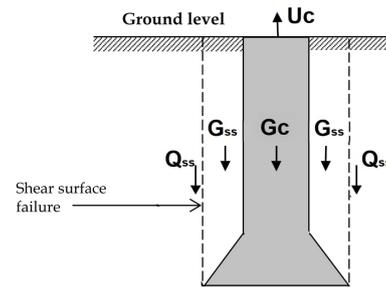
Total Weight of Soil above bell; $G_{ss} := \gamma_{s1} \cdot V_{ss1} = 0 \text{ kN}$

Side resistance along soil to soil interface;

$Q_{ss,d} := R_{s,d_reduced} \cdot \beta_{1,ss} \cdot \frac{(\gamma_{s1} \cdot L)}{2} \cdot (\pi \cdot D_B \cdot L) = 824 \text{ kN}$

$Q_{u2,1} := \Phi_{TS} \cdot (\Phi_{G_s} \cdot G_{ss} + \Phi_{G_c} \cdot G_c + \Phi_S \cdot Q_{ss,d})$

$Q_{u2,1_final} := Q_{u2,1} = 547 \text{ kN}$



Under ULS conditions (i.e., short term loading), side resistance is based on Adhesion (undrained) for Cohesive soils and Friction (drained) for Non-cohesive soils, thus;

$Q_{ss,ud} := R_{s,ud_reduced} \cdot Q_{ss,ud1} = 0 \text{ kN}$

$Q_{u2,2} := \Phi_{TS} \cdot (\Phi_{G_s} \cdot G_{ss} + \Phi_{G_c} \cdot G_c + \Phi_S \cdot Q_{ss,ud})$

$Q_{u2,2_final} := Q_{u2,2} = 11 \text{ kN}$

Case not applicable as $S_u = 0$ for all layers. ULS value will be the same as the SLS value i.e, 341 kN

4.3 Uplift Bearing Failure Model

The Uplift capacity under the Uplift Bearing failure model is calculated by assuming failure of shaft friction along the depth of the shaft plus the bearing on the effective area of the undercut (see figure to the right).

Under SLS conditions (i.e., long term loading), side resistance is based on Friction (drained) for both Cohesive and Non-cohesive soils, thus;

Coefficient of Friction; $\beta_{1,ss} = 0.4$

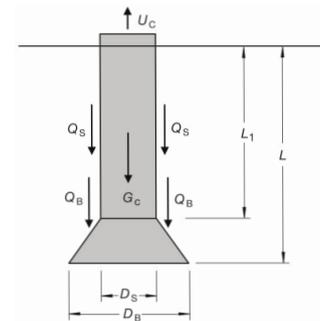
Width of the Foundation; $B := r_B - r_s = 0 \text{ m}$

Effective Overburden pressure on top of bell; $\sigma'_v := \gamma_{s1} \cdot L = 162 \text{ kPa}$

Calculated at top of bell - could take midheight

Side resistance along soil to concrete interface;

$Q_{s,d} := R_{s,d_reduced} \cdot \left(\beta_{1,ss} \cdot \frac{\gamma_{s1} \cdot 1 \text{ m} + \gamma_{s1} \cdot L}{2} \cdot (L - 1 \text{ m}) \right) \cdot (\pi \cdot D_s) = 814 \text{ kN}$



Bearing Capacity Factor; $N_q := 23$ (Layer 1, Angle of internal friction $\phi_{s1} = 30$ deg as per Table 14 of TP.DL 01.01)

Bearing Capacity Factor; $N_\gamma := 2 \cdot (N_q - 1) \cdot \tan(\phi_{s1}) = 25.4$

Bearing on top of bell (Table 18 of TP.DL 01.01 Issue 2, Nov 2023); $Q_{b,d} := \min((50 \cdot N_q \cdot \tan(\phi_{s1}) \text{ kPa}), (\sigma'_v \cdot N_q + 0.3 \cdot B \cdot (\gamma_{s1}) \cdot N_\gamma)) = 664 \text{ kPa}$

$Q_{b,d} := Q_{b,d} \cdot \pi \cdot (r_B^2 - r_S^2) = 0 \text{ kN}$

The pull-out capacity is then calculated as; $Q_{u3.1} := \Phi_{TS} \cdot (\Phi_S \cdot (Q_{s,d} + Q_{b,d}) + \Phi_{Gc} \cdot G_c)$

$Q_{u3.1} = 540 \text{ kN}$

Under ULS conditions (i.e., short term loading), side resistance is based on Adhesion (undrained) for Cohesive soils and Friction (drained) for Non-cohesive soils, thus;

Shaft Adhesion; $f_{s1} := \alpha_{sc1} \cdot S_{u1} = 0 \text{ kPa}$ $f_{s2} := \alpha_{sc2} \cdot S_{u2} = 0 \text{ kPa}$

Side resistance along soil to concrete interface; $Q_{s,ud} := \left\| R_{s,ud, \text{reduced}} \cdot f_{s1} \cdot (\pi \cdot D_S \cdot (L - 1 \text{ m})) \right\| = 0 \text{ kN}$

Bearing Capacity factor; $N_{c1} := \begin{cases} \text{if } L < 2 \text{ m} \\ \left\| 5.14 \right\| \\ \text{else if } \frac{L}{D_B} > 4 \\ \left\| 9 \right\| \\ \text{else} \\ \left\| -0.0135 \left(\frac{L}{D_B}\right)^4 + 0.1616 \left(\frac{L}{D_B}\right)^3 - 0.8028 \left(\frac{L}{D_B}\right)^2 + 2.1922 \left(\frac{L}{D_B}\right) + 6.197 \right\| \end{cases} = 9$
(Interpolated value per Table 18 of TP.DL 01.01)
Calculated at the base of the bell.

Bearing on top of bell; $Q_{b,ud} := \begin{cases} \text{if } D_{L1} < L \\ \left\| (N_{c1} \cdot S_{u2} + \sigma'_v) \cdot (\pi \cdot (r_B^2 - r_S^2)) \right\| \\ \text{else} \\ \left\| (N_{c1} \cdot S_{u1} + \sigma'_v) \cdot (\pi \cdot (r_B^2 - r_S^2)) \right\| \end{cases} = 0 \text{ kN}$

The pull-out capacity is then calculated as; $Q_{u3.2} := \Phi_{TS} \cdot (\Phi_S \cdot (Q_{s,ud} + Q_{b,ud}) + \Phi_{Gc} \cdot G_c)$

$Q_{u3.2} = 11 \text{ kN}$

Case not applicable as $S_u = 0$ for all layers. ULS value will be the same as the SLS value i.e., 662 kN

4.4 The Effective UPLIFT Capacity of the Bored Pile Foundation is then given by;
 $U_{C,SLS} := \min(Q_{u2.1}, Q_{u3.1})$
 $U_{C,ULS} := \min(Q_{u2.1}, Q_{u3.1})$

$U_{C,SLS} = 540 \text{ kN}$

$U_{C,ULS} = 540 \text{ kN}$

V. Ultimate Bearing Capacity

The Ultimate bearing capacity is calculated as the sum of shaft friction along the depth of the shaft and bearing under the base of the pile, minus the effective weight of pile and soil above bell.

Under **SLS conditions** (i.e., long term loading), side resistance is based on **Friction (drained) for both Cohesive and Non-cohesive soils**, thus;

Coefficient of Friction; $\beta_{1,ss} = 0.4$ (See 4.3 of this calc sheet)

Side resistance along soil to concrete interface; $Q_{s,db} := R_{s,d, \text{reduced}} \cdot \left(\beta_{1,ss} \cdot \frac{\gamma_{s1} \cdot 1 \text{ m} + \gamma_{s1} \cdot (L - D_B)}{2} \cdot ((L - D_B) - 1 \text{ m}) \right) \cdot (\pi \cdot D_S) = 658 \text{ kN}$

REMOVE FRICTION IN TOP 1.0. REMOVE FROM BOTTOM 1DB HEADINGS.

$\sigma'_v := \gamma_{s1} \cdot L = 162 \text{ kPa}$ **To be fixed. Does not affect current results. Depth limit of 20xD to be included later.**

Bearing under base of pile; $Q_{bb,d} := \min((50 \cdot N_q \cdot \tan(\phi_{s1}) \text{ kPa}), (N_q \cdot \sigma'_v + 0.3 \cdot (\gamma_{s1}) \cdot D_B \cdot N_\gamma)) = 664 \text{ kPa}$

$Q_{bb,d} := Q_{bb,d} \cdot \pi \cdot r_B^2 = 422 \text{ kN}$

The effective bearing capacity is then calculated as; $Q_{c1} := \Phi_{TS} \cdot (\Phi_S \cdot (Q_{s,db} + Q_{bb,d}) - (\Phi_{Gc} \cdot G_c))$

$Q_{c1} = 691 \text{ kN}$

Under ULS conditions (i.e., short term loading), side resistance is based on Adhesion (undrained) for Cohesive and Friction (drained) for Non-cohesive soils, thus;

Shaft Adhesion; $f_{s1} = 0 \text{ kPa}$ (See 4.3 of this calc sheet)

Side resistance along soil to concrete interface; $Q_{s_udb} := R_{s_ud_reduced} \cdot f_{s1} \cdot (\pi \cdot D_S \cdot ((L - D_B) - 1 \text{ m})) = 0 \text{ kN}$

Bearing under base of pile; $Q_{bb_ud} := (N_{c1} \cdot S_{u2} + (\gamma_{s1} \cdot L)) \cdot (\pi \cdot r_B^2) = 103 \text{ kN}$

The effective bearing capacity $Q_{c2} := \Phi_{TS} \cdot (\Phi_S \cdot (Q_{s_udb} + Q_{bb_ud}) - (\Phi_{Gc} \cdot G_c + \Phi_{Gs} \cdot G_{ss}))$
is then calculated as;

$Q_{c2} = 56 \text{ kN}$

Case not applicable as $S_u = 0$ for all layers. ULS value will be the same as the SLS value i.e, 824 kN

5.1 The Ultimate BEARING Capacity of the Bored Pile Foundation is then given by;

$C_{C_SLS} := Q_{c1}$

$C_{C_SLS} = 691 \text{ kN}$

$C_{C_ULS} := Q_{c1}$

$C_{C_ULS} = 691 \text{ kN}$

Appendix L

Gantry Reference Drawing



Print Transcript

Generated By: Tim Klingenberg (tim.klingenberg@aecom.com)

Date Requested: 10/06/2024 1:38pm (NZST)

Source: Transpower Production

Artefacts Total: 17



Printed Artefacts

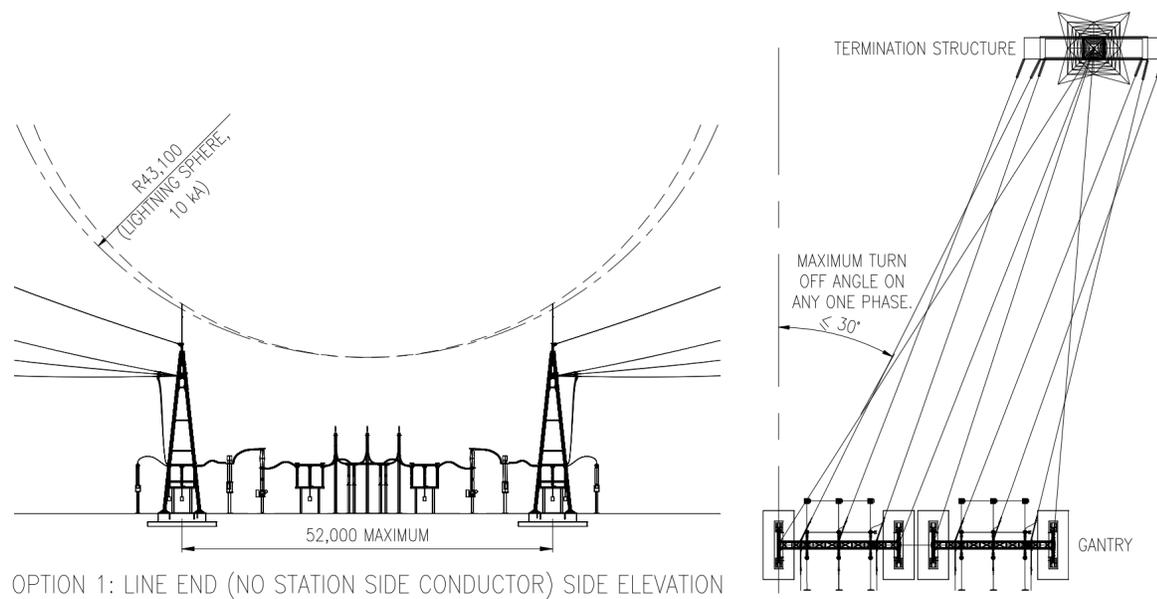
Artefact Number	Artefact Title
TP65059_1	STANDARD DRAWING 220 kV GANTRY A-FRAME APPLICATION NOTES
TP65059_2	STANDARD DRAWING 220 kV GANTRY A-FRAME GENERAL ARRANGEMENT
TP65059_3	STANDARD DRAWING 220 kV GANTRY A-FRAME FOUNDATION DETAILS
TP65059_4	STANDARD DRAWING 220 kV GANTRY A-FRAME LEG DETAILS
TP65059_5	STANDARD DRAWING 220 kV GANTRY A-FRAME BEAM & BRACE DETAILS

TP65059_6	STANDARD DRAWING 220 kV GANTRY A-FRAME TIE AND LIGHTNING DETAILS
TP65059_7	STANDARD DRAWING 220 kV GANTRY CONCRETE POLE APPLICATION NOTES
TP65059_8	STANDARD DRAWING 220 kV GANTRY CONCRETE POLE GENERAL ARRANGEMENT
TP65059_9	STANDARD DRAWING 220 kV GANTRY CONCRETE POLE FOUNDATION & LIGHTNING DETAILS
TP65059_10	STANDARD DRAWING 220 kV GANTRY CONCRETE POLE BEAM DETAILS
TP65059_12	STANDARD DRAWING 220kV GANTRY STATION SIDE FITTINGS AND HARDWARE
TP65059_13	STANDARD DRAWING 220 kV GANTRY A-FRAME AND CONCRETE POLE EARTHING CONNECTIONS
TP65059_14	STANDARD DRAWING 220 kV GANTRY A-FRAME & CONCRETE POLE SEISMIC SELECTION CRITERIA
TP65059_15	STANDARD DRAWING 220 kV GANTRY A-FRAME AND CONCRETE POLE LIGHT MOUNTING BRACKET DETAILS - SINGLE LAMP

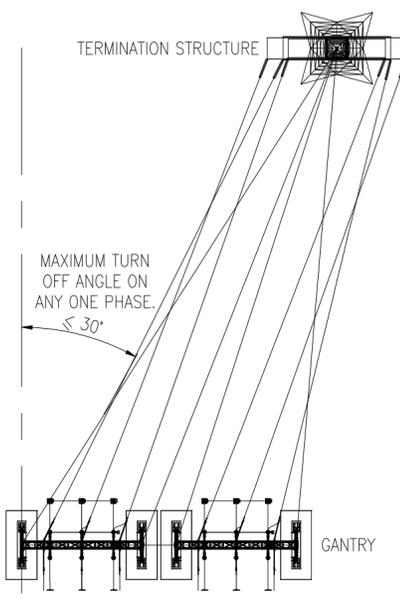
TP65059_16 STANDARD DRAWING 220
kV GANTRY A-FRAME AND
CONCRETE POLE LIGHT
MOUNTING BRACKET
DETAILS - TWIN LAMPS

TP65059_17 STANDARD DRAWING 220
kV GANTRY A-FRAME AND
CONCRETE POLE LIGHTING
ASSEMBLY AND LAYOUT

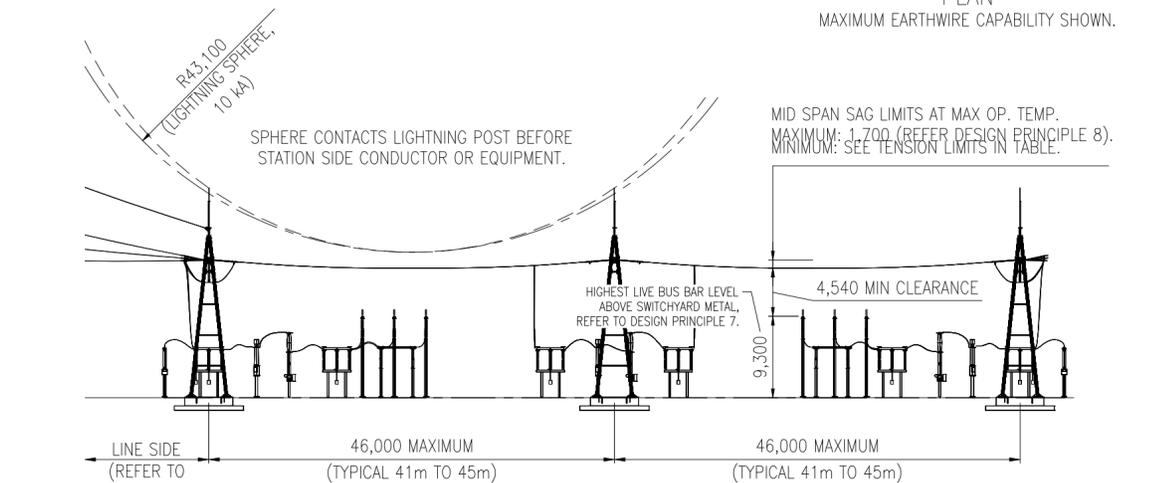
TP65059_XREFS STANDARD DRAWING
220KV GANTRY



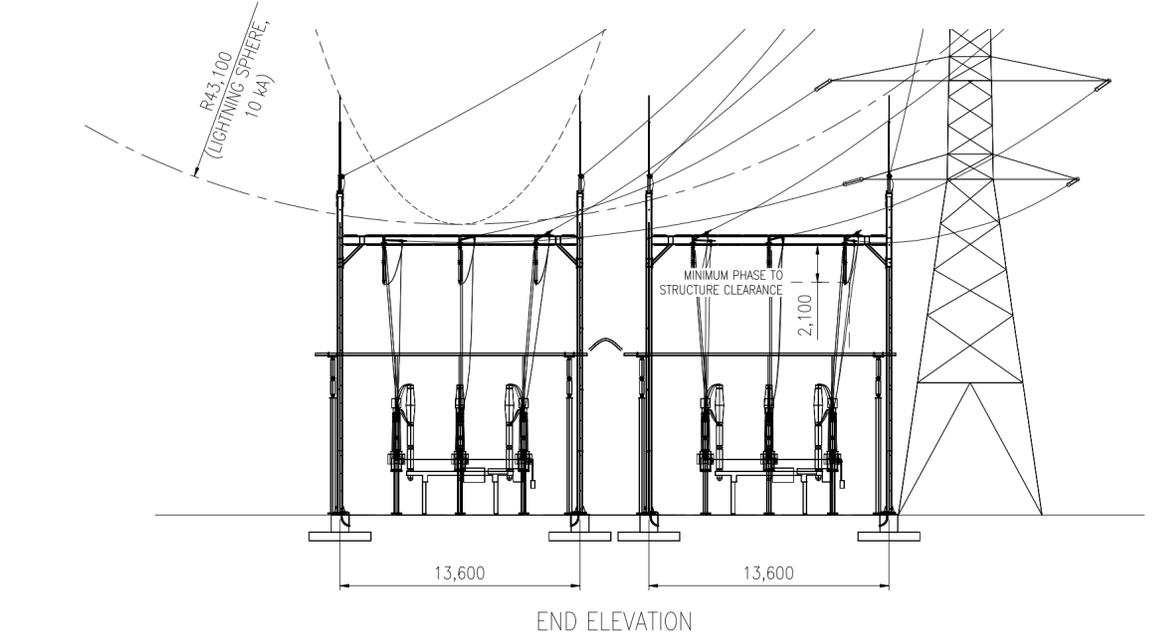
OPTION 1: LINE END (NO STATION SIDE CONDUCTOR) SIDE ELEVATION



PLAN
MAXIMUM EARTHWIRE CAPABILITY SHOWN.



OPTION 2: BREAKER & HALF, SIDE ELEVATION



END ELEVATION

APPLICATION NOTES

- THE 220 kV GANTRY, A-FRAME OPTION, IS SUITABLE FOR USE IN APPLICATIONS AS DESCRIBED BELOW. IF THE PROPOSED APPLICATION FALLS OUTSIDE THE PARAMETERS LISTED BELOW, A SPECIFIC DESIGN CHECK SHOULD BE CARRIED OUT TO CONFIRM SUITABILITY. ALTERNATIVELY THE CONCRETE POLE OPTION CAN BE USED IF A LESSER CAPABILITY IS REQUIRED, REFER TP65059/7-10. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
- LINE LOADING PARAMETERS
CONDUCTOR TYPES AND SPANS – THE GANTRY WILL ACCOMMODATE TWO 7/3.18 SC/AC EARTHWIRES, (ONE PER SIDE) STRUNG TO ACHIEVE 95% OF THE LINE SIDE CONDUCTOR SAG AT EVERYDAY TEMPERATURE. THE STATION SIDE CONDUCTOR SHOULD BE TENSIONED TO ENSURE SAG IS WITHIN THE LIMITS SHOWN IN THE SIDE ELEVATION. THE ALLOWABLE CONDUCTOR TYPES, SPANS, TENSIONS AND TURN OFF ANGLES ARE OUTLINED BELOW:

CONDUCTOR TYPE	LINE SIDE CONDUCTOR			STATION SIDE CONDUCTOR (OPTIONAL)				SUMMER CURRENT RATING OF LINE SIDE/STATION SIDE CONDUCTOR (A)
	MAXIMUM INSTALLED FINAL TENSION (% UTS @ EDT)	MAXIMUM TURN OFF ANGLE (°)	MAXIMUM SPAN LENGTH (M)	CONDUCTOR TYPE	MAXIMUM INSTALLED FINAL TENSION (% UTS @ EDT)	MAXIMUM TURN OFF ANGLE (°)	MAXIMUM SPAN LENGTH (m)	
DUPLEX GOAT	5.0	30	110	DUPLEX BUTTERFLY	10.0	0	46	1600/1800
DUPLEX ZEBRA	5.0	30	110	DUPLEX BUTTERFLY	10.0	0	46	1860/1800
DUPLEX PHEASANT	4.0	30	95	DUPLEX CICADA	7.5	0	46	2430/2600
DUPLEX MOA	4.0	30	95	DUPLEX CICADA	7.5	0	46	2770/2600
DUPLEX CHUKAR	3.5	30	90	DUPLEX CICADA	7.5	0	46	3000/2600
QUAD GOAT	2.5	30	85	QUAD BUTTERFLY	5.5	0	46	3200/3600
QUAD ZEBRA	2.5	30	85	QUAD BUTTERFLY	5.5	0	46	3720/3600
QUAD PHEASANT	2.0	30	70	QUAD CICADA	3.7	0	46	4860/5200
QUAD MOA	2.0	30	70	QUAD CICADA	3.7	0	46	5540/5200
TRIPLEX SULFUR	2.9	30	90					~4000

THE GANTRY IS ALSO CAPABLE OF TERMINATING A STATION SIDE CONDUCTOR (STRUNG BUS) WITH NO LINE SIDE CONDUCTOR PROVIDED THE SPAN AND TENSION LIMITS IN THE TABLE ABOVE ARE MET.

WIND LOADS – THE GANTRY WILL WITHSTAND WINDS OF 1000 YEAR RETURN PERIOD IN WIND REGIONS A1 TO A7 (FIGURE 3.1 AS/NZS 1170.2), AT SITES THAT HAVE SOME TOPOGRAPHIC EFFECTS. THE SPECIFIC PARAMETERS AND RESULTING PRESSURES ARE OUTLINED BELOW:

PARAMETER	VALUE	ASSUMED SITE DETAILS
V_R	46 m/s	1000 YEAR RETURN PERIOD, ZONE A1 TO A7 (ALL EXCEPT W)
M_t	1.10	SOME TOPOGRAPHIC EFFECTS
$M_{(z,cat)}$	0.97	HEIGHT ABOVE GROUND OF 15m AND TERRAIN CATEGORY 2.5
V_z	49.1 m/s	
P_z	1445 Pa	WIND PRESSURE ON STRUCTURE (EXCLUDING DRAG COEFFICIENT)
SRF	0.90	WIND SPAN LENGTH 50m, AVERAGE COND. HEIGHT A.G.L 15m AND TC 2.5
$P_{(z,cond)}$	1300 Pa	WIND PRESSURE ON CONDUCTORS

SNOW LOADS – THE GANTRY WILL BE SUITABLE FOR INSTALLATION AT SITES UP TO AN ALTITUDE OF 600m ABOVE SEA LEVEL AS IT HAS BEEN DESIGNED FOR WET SNOW WITH NO COINCIDENT WIND, REFER TO APPENDIX 1 TP.DL 12.01 ISSUE 2 DRAFT 2 JULY 2005. THE SPECIFIC PARAMETERS USED ARE: SNOW RADIAL THICKNESS OF 30mm & SNOW/ICE DENSITY OF 400 kg/m³.

- LINE LOADING ULTIMATE DESIGN LOADS – IF THE LINE LOADING PARAMETERS ABOVE ARE NOT MET, A DESIGN CHECK CAN BE MADE AGAINST THE FOLLOWING SIX LOAD CASES. THE PROPOSED APPLICATION MUST ALSO COMPLY WITH THE SEISMIC LOADING PARAMETERS BELOW.

LOAD CASE	Description	LINE SIDE CONDUCTOR LOADS (kN)			STATION SIDE CONDUCTOR LOADS (kN)			EARTHWIRE LOADS (kN)			WIND ON STRUCTURE (Pa)
		L	T	V	L	T	V	L	T	V	
1	MAXIMUM LONGITUDINAL LINE SIDE CONDUCTOR LOAD	42.0	6.4	11.0	0.0	0.0	0.0	2.8	0.4	0.5	1445
2	MAXIMUM TRANSVERSE LINE SIDE CONDUCTOR LOAD	33.2	26.5	11.0	44.7	3.9	3.0	2.2	1.8	0.5	1445
3	MAXIMUM RESULTANT OTM	33.4	25.9	11.0	0.0	0.0	0.0	3.1	2.4	0.5	1445
4	MAXIMUM LONGITUDINAL EARTHWIRE LOAD	40.1	0.0	4.0	0.0	0.0	0.0	9.9	0.0	0.5	0
5	MAXIMUM TRANSVERSE EARTHWIRE LOAD	32.6	23.1	4.0	27.7	1.4	3.0	5.8	4.1	0.5	1445
6	MAXIMUM LONGITUDINAL STATION SIDE CONDUCTOR LOAD	0.0	0.0	0.0	44.7	3.9	3.0	0.0	0.0	0.0	1445

- SEISMIC LOADS – REFER TO TP65059/14 FOR ZONES WHERE THIS STANDARD GANTRY DESIGN IS SUITABLE.

DESIGN PRINCIPLES

- THE DIMENSIONS AND LAYOUT OF THE 220 kV GANTRY, A-FRAME OPTION, ARE DETERMINED BY CLEARANCES (TP.DS 62.01, ISSUE 3) VEHICLE ACCESS AND LIGHTNING PROTECTION REQUIREMENTS FOR BREAKER AND A HALF AND LINE END SUBSTATION LAYOUTS. REFER TO THE PLAN AND ELEVATIONS FOR FURTHER DETAILS.
- THE GANTRY HAS BEEN DESIGNED TO WITHSTAND THE LINE LOADINGS FROM THE CONDUCTOR CONFIGURATIONS OUTLINED IN THE APPLICATION NOTES AND AS PER TP.DL 12.01 ISSUE 2 DRAFT 2 JULY 2005. THE LOADINGS CONSIDERED INCLUDE BOTH LINE AND STATION SIDE CONDUCTORS, LINE SIDE ONLY, STATION SIDE ONLY, AND LINE SIDE TURN OFF ANGLES OF 0° AND 30°.
- SEISMIC LOADING IS BASED ON NZS 1170.5 AND TP.GG 61.02. REFER TO TP65059/14 FOR SPECIFIC PARAMETERS USED.
- THE GANTRY HAS BEEN DESIGNED TO WITHSTAND THE ULS LINE AND SEISMIC LOADINGS. STEEL DESIGN TO NZS 3404.
- THE GANTRY HAS BEEN DESIGNED TO LIMIT THE COMBINED HORIZONTAL DEFLECTIONS ON ANY PART OF THE STRUCTURE TO 2% OF THE HEIGHT UNDER ULS LOADINGS. THE EVERYDAY LOADS WHERE CONDUCTORS ARE STRUNG ON ONE SIDE OF THE GANTRY ONLY, ARE APPROXIMATELY 30% OF THE ULS LOADS. HENCE THE STRUCTURE DEFLECTION AT THE CROSSARM LEVEL (15.5m) UNDER EVERYDAY LOADING MAY BE UP TO 100mm.
- THE GANTRY IS THE RESULT OF A PROJECT TO DESIGN A COST EFFECTIVE GANTRY FOR TRANSPower. FOR MORE INFORMATION REFER TO AECOM LTD REPORT TITLED "STANDARD 220 kV GANTRY".
- HIGHEST LIVE BUS BAR LEVEL IS DERIVED FROM: SWITCHYARD LEVEL TO TOP OF PAD 50, HIGH LEVEL BUS HEIGHT ABOVE CONCRETE PAD 9100, ALLOWANCE FOR VARIATION OF CLAMP HEIGHT 25, HALF MAXIMUM BUS BAR DIA. 100 = HIGHEST LIVE BUS BAR LEVEL 9275, ADOPTED HIGHEST LIVE BUS BAR LEVEL 9300.
- SAG LIMIT CALCULATED FOR FLAT SUB CONDUCTOR CONFIGURATION ONLY.
- ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.

THIS DRAWING SUPERSEDES TP62590/1

REV	REVISION DESCRIPTION	CONSULTANT										TP	
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	APP
A	Bus height increased, line side conductor tensions and loadings revised, seismic capability revised.	AECOM	ST	8.09	LC	8.09	HZ/MM	8.09	DW	8.09	AR	8.09	
B	Seismic details moved to sht 14. Deflections discussed in more detail. Tripex Sulphur added. Title revised	AECOM	ST	3.10	PS	3.10	DH	8.10	DW	8.10	AR	8.10	
C	Elevations and Plan updated to show revised lighting mount arm	AECOM	CTB	7.12	TC	7.12	ST	7.12	DW	7.12	AR	7.12	
D	MAIN TITLE REVISED TO STANDARD DRAWINGS;TEXT CONVERTED TO UPPERCASE.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	
E1	STANDARD REFERENCES UPDATED, MINOR REVISIONS	AECOM	RL	9.19	KMo	9.19	AB	1.20	ST	1.20			
E	NOTES MODIFIED	AECOM	RL	2.20	KMo	2.20	RL	2.20	AB	2.20	AH	8.20	

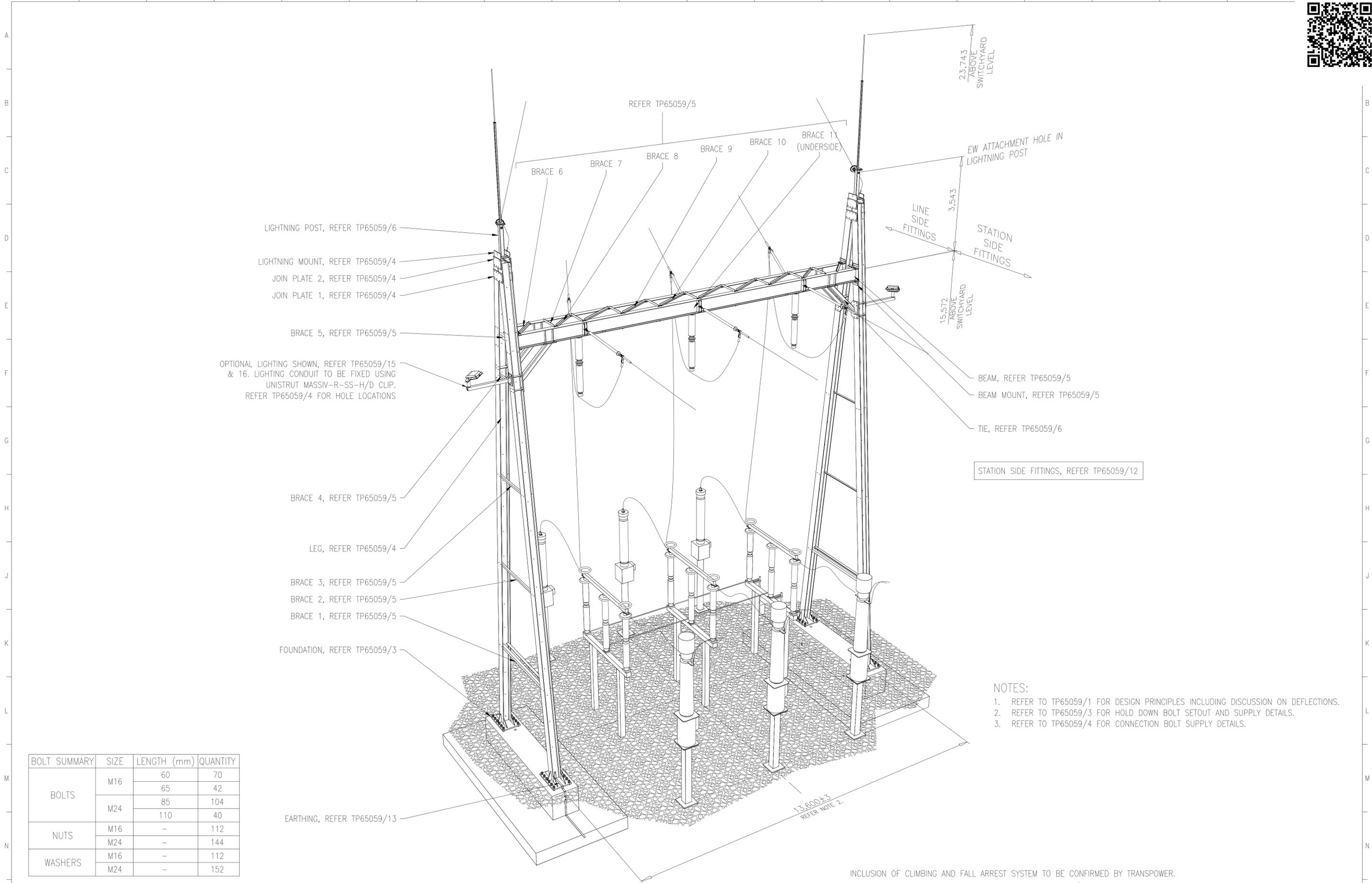
TRANSPower

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STANDARD DRAWING
220 kV GANTRY
A-FRAME
APPLICATION NOTES

TRANSPower PROJECT CODE IP_1920_242_01		FOLDER STD/3D1	
DRAWING NUMBER TP65059		SHEET REVISION 1 E	
DRAWING CREATED BY: MAUNSELL (WPT TPPE 007) PO Box 27-277 Wellington		SCALE N.T.S.	

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- NOTES:
- REFER TO TP65059/1 FOR DESIGN PRINCIPLES INCLUDING DISCUSSION ON DEFLECTIONS.
 - REFER TO TP65059/3 FOR HOLD DOWN BOLT SETOUT AND SUPPLY DETAILS.
 - REFER TO TP65059/4 FOR CONNECTION BOLT SUPPLY DETAILS.

BOLT SUMMARY	SIZE	LENGTH (mm)	QUANTITY
BOLTS	M16	60	70
		65	42
	M24	85	104
		110	40
NUTS	M16	-	112
	M24	-	144
WASHERS	M16	-	112
	M24	-	152

INCLUSION OF CLIMBING AND FALL ARREST SYSTEM TO BE CONFIRMED BY TRANSPOWER.
THIS DRAWING SUPERSEDES TP62590/2

REV	REVISION DESCRIPTION	CONSULTANT										TP	
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
G	Optional light fitting appearance updated	AECOM	-	-	LC	3.18	ARB	3.18	ARB	3.18	QH	3.18	
H	EARTHING REFERENCE UPDATED	AECOM	TC	9.19	KMo	9.19	AB	1.20	ST	1.20	AH	3.20	
C	Note 3 added	AECOM	ST	12.11	TC	12.11	DRH	12.11	DW	12.11	DH	12.11	
D	Brace 11 added, M16 bolt quantities amended to suit new brace	AECOM	ST	12.11	TC	12.11	DRH	12.11	DW	12.11	DH	12.11	
E	Lighting Mounting arm added, bolts updated to suit.	AECOM	TC	2.12	TC	2.12	ST	2.12	DW	2.12	AR	7.12	
F	LINE SIDE FITTINGS REMOVED AS THESE ARE CUSTOM DESIGN FOR EACH SITE.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	

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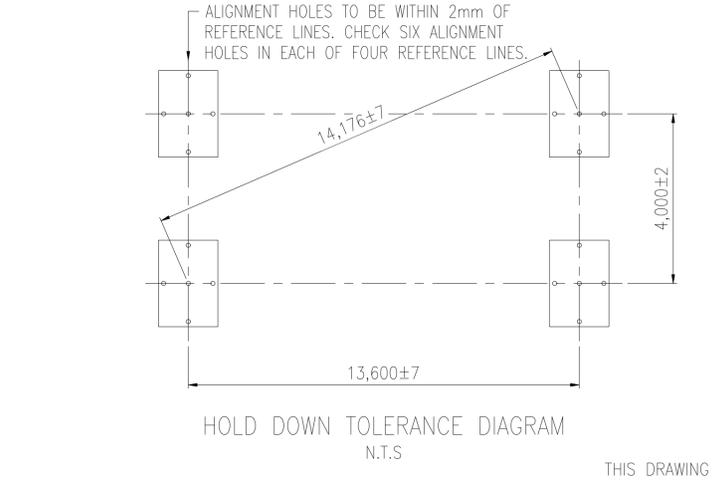
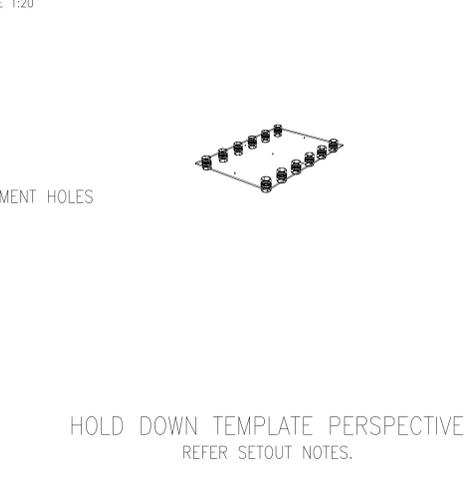
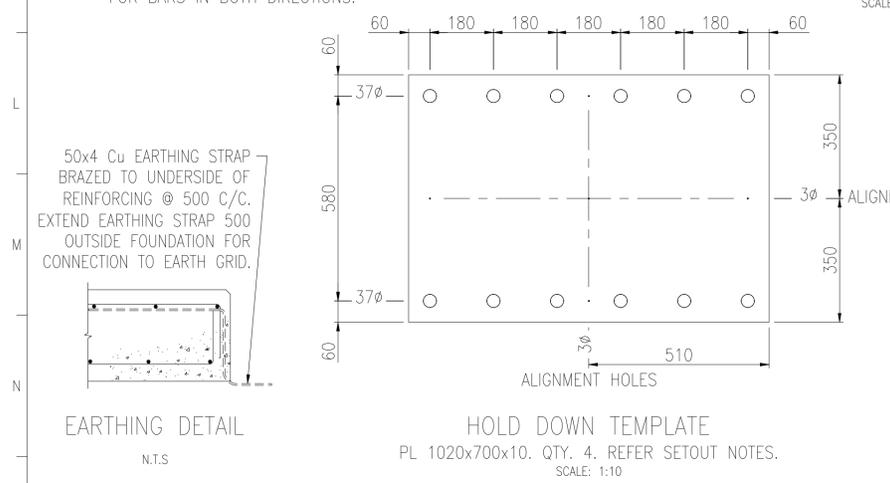
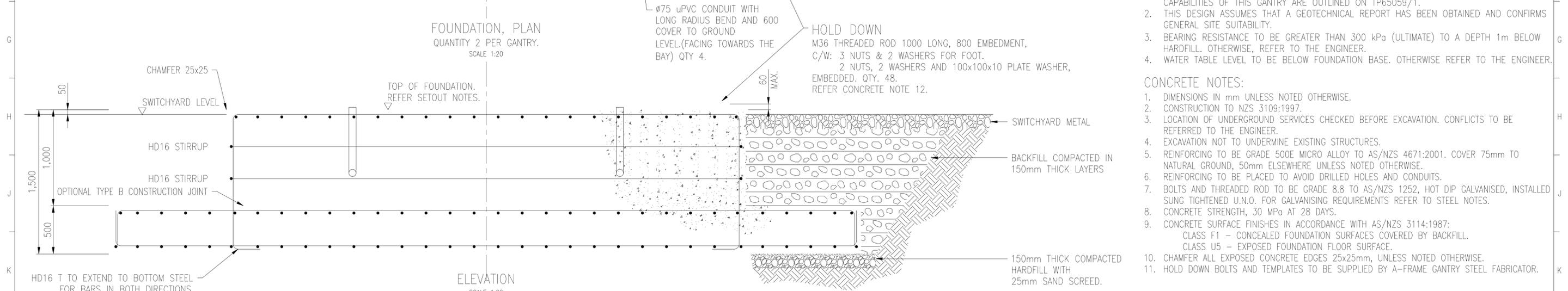
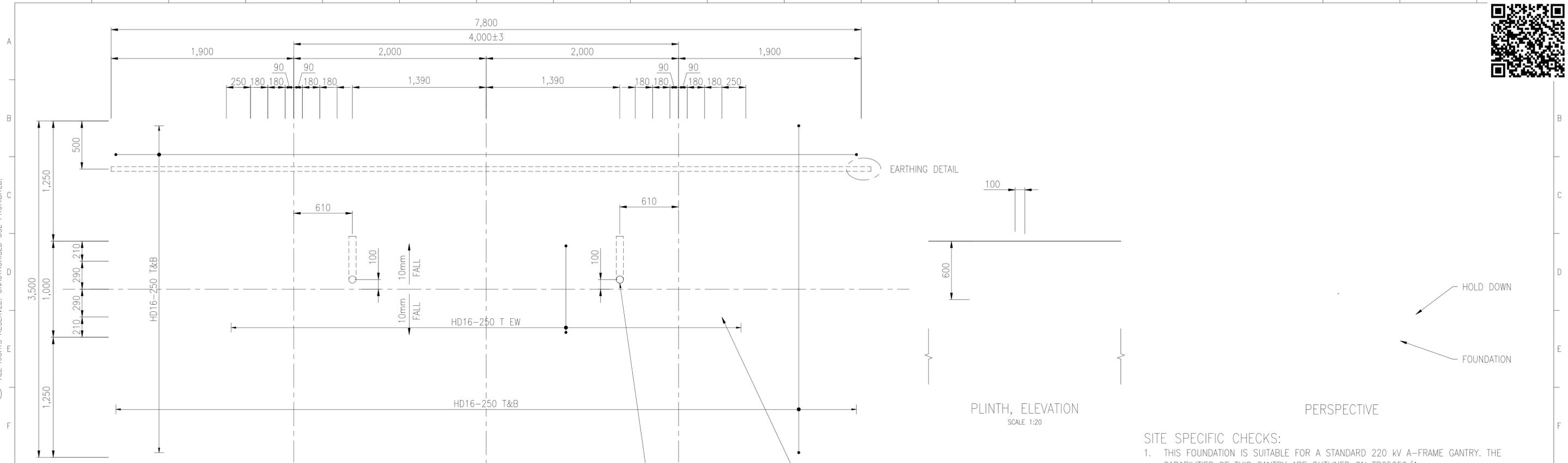
STANDARD DRAWING
220 kV GANTRY
A-FRAME
GENERAL ARRANGEMENT

TRANSPOWER PROJECT CODE IP_1920_242_01		FOLDER STD/3D1	
DRAWING NUMBER TP65059		SHEET 2	REVISION H
DRAWING CREATED BY: MAUNSELL (WPT TP RE 007) PO Box 27-277 Wellington		SCALE N.T.S	



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- SITE SPECIFIC CHECKS:**
- THIS FOUNDATION IS SUITABLE FOR A STANDARD 220 kV A-FRAME GANTRY. THE CAPABILITIES OF THIS GANTRY ARE OUTLINED ON TP65059/1.
 - THIS DESIGN ASSUMES THAT A GEOTECHNICAL REPORT HAS BEEN OBTAINED AND CONFIRMS GENERAL SITE SUITABILITY.
 - BEARING RESISTANCE TO BE GREATER THAN 300 kPa (ULTIMATE) TO A DEPTH 1m BELOW HARDFILL. OTHERWISE, REFER TO THE ENGINEER.
 - WATER TABLE LEVEL TO BE BELOW FOUNDATION BASE. OTHERWISE REFER TO THE ENGINEER.

- CONCRETE NOTES:**
- DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
 - CONSTRUCTION TO NZS 3109:1997.
 - LOCATION OF UNDERGROUND SERVICES CHECKED BEFORE EXCAVATION. CONFLICTS TO BE REFERRED TO THE ENGINEER.
 - EXCAVATION NOT TO UNDERMINE EXISTING STRUCTURES.
 - REINFORCING TO BE GRADE 500E MICRO ALLOY TO AS/NZS 4671:2001. COVER 75mm TO NATURAL GROUND, 50mm ELSEWHERE UNLESS NOTED OTHERWISE.
 - REINFORCING TO BE PLACED TO AVOID DRILLED HOLES AND CONDUITS.
 - BOLTS AND THREADED ROD TO BE GRADE 8.8 TO AS/NZS 1252, HOT DIP GALVANISED, INSTALLED SUNG TIGHTENED U.N.O. FOR GALVANISING REQUIREMENTS REFER TO STEEL NOTES.
 - CONCRETE STRENGTH, 30 MPa AT 28 DAYS.
 - CONCRETE SURFACE FINISHES IN ACCORDANCE WITH AS/NZS 3114:1987:
CLASS F1 - CONCEALED FOUNDATION SURFACES COVERED BY BACKFILL.
CLASS U5 - EXPOSED FOUNDATION FLOOR SURFACE.
 - CHAMFER ALL EXPOSED CONCRETE EDGES 25x25mm, UNLESS NOTED OTHERWISE.
 - HOLD DOWN BOLTS AND TEMPLATES TO BE SUPPLIED BY A-FRAME GANTRY STEEL FABRICATOR.

- SETOUT NOTES:**
- INSTALLATION CONTRACTOR TO PROVIDE MEANS TO FIX HOLD DOWN TEMPLATE DURING FOUNDATION CONSTRUCTION TO ACHIEVE THE TOLERANCES SPECIFIED. THE SETTING OUT METHODOLOGY (AND QA/AS-BUILT RECORD KEEPING) IS TO BE APPROVED PRIOR TO WORK COMMENCING.
 - SETOUT OF THE BOLT GROUPS IS TO THE CENTRE ALIGNMENT HOLE ON EACH OF THE HOLD DOWN TEMPLATES. THE DIMENSIONS SHOWN IN HOLD DOWN TOLERANCE DIAGRAM AND BASEPLATE ROTATION SHOULD BE CHECKED PRIOR AND AFTER CONCRETE POUR.
 - TOP OF CONCRETE AT HOLD DOWN TEMPLATE LOCATIONS TO BE LESS THAN 3mm LEVEL DIFFERENCE.

- STEEL NOTES:**
- FOR STEEL NOTES REFER TP65059/4.

REFERENCE DRAWING
TP65059/1 STD/3D1 220 kV GANTRY A-FRAME APPLICATION NOTES

THIS DRAWING SUPERSEDES TP62590/3

REV	DESCRIPTION	CONSULTANT										TP		DESIGNED	S Thomas	7.08
		NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE				
A	Title revised, Ref drawing & site specific checks added & minor changes	AECOM	ST	7.10	TC	7.10	DH	8.10	DW	8.10	AR	8.10	CHECKED	D Parker	7.08	
1B	Hold Down revised and tolerances added.	AECOM	ST	9.11	LC	9.11	DH	9.11	DW	9.11	DH	12.11	APPROVED	D Wills	7.08	
B	Conduits, Hold Down template details, steel and setout notes added, concrete notes revised	AECOM	ST	10.11	TC	10.11	DRH	10.11	DW	10.11	DH	12.11	TP APPROVED	A Renton	7.08	
C	Plinth elevation, 2 extra conduits and hold down tolerance detail added, hold down and setout notes amended	AECOM	ST	11.11	TC	11.11	DRH	11.11	DW	11.11	DH	12.11	PREPARED BY:			
D	CONCRETE FINISH WAS U2 NOW U5; EARTHING AND CONDUIT DETAILS AND TITLE BLOCK REVISED.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	MAUNSELL (WPT TPRE 007) PO Box 27-277, Wellington			

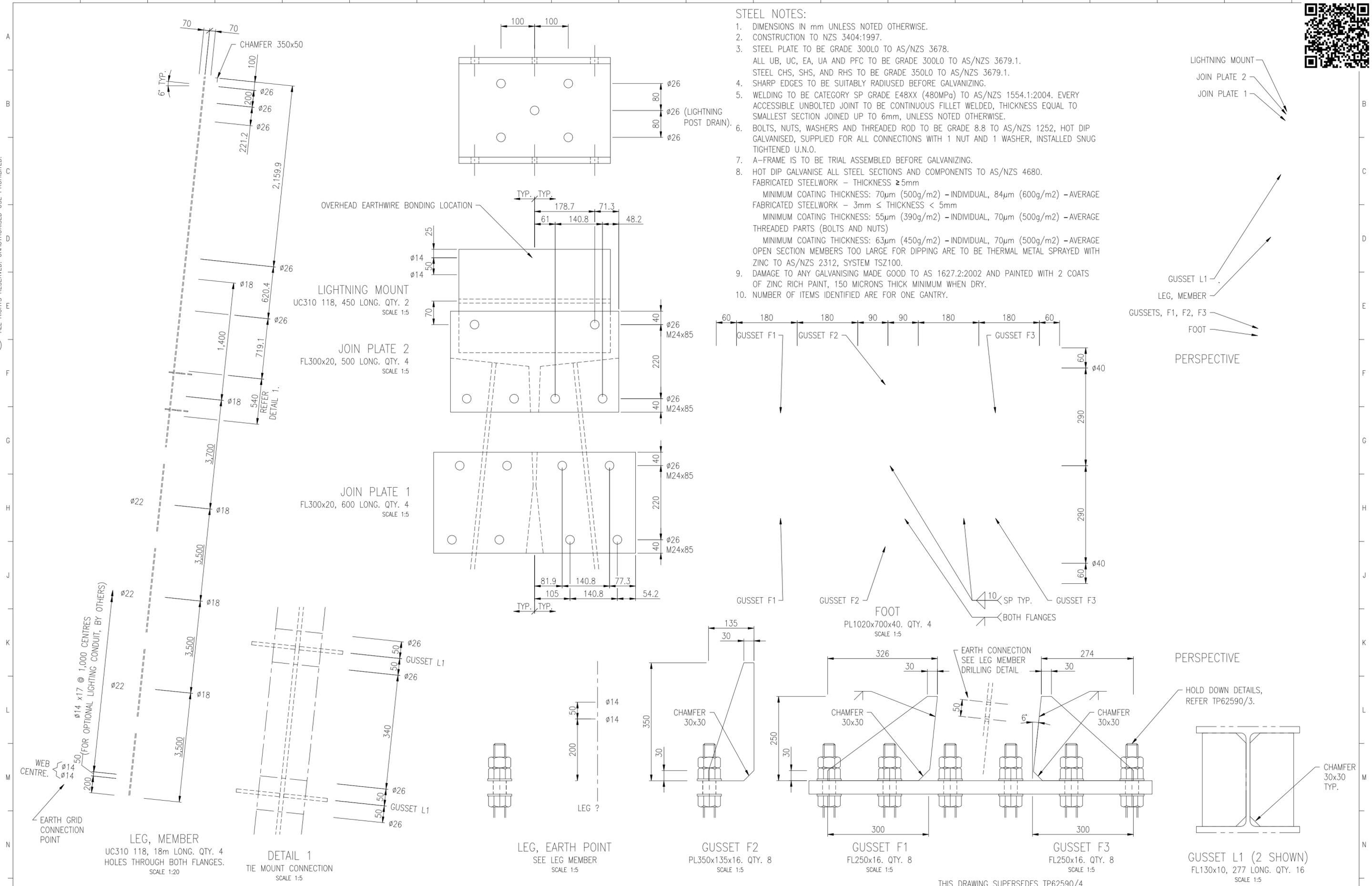


STANDARD DRAWING

220 kV GANTRY
A-FRAME
FOUNDATION DETAILS

DRG.SIZE A1	SCALE As Shown	FOLDER STD/3D1
DRAWING NUMBER TP65059		SHEET / REVISION 3 / D
CAD FILE NAME TP65059_3_0.DWG		

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STEEL NOTES:

- DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
- CONSTRUCTION TO NZS 3404:1997.
- STEEL PLATE TO BE GRADE 300L0 TO AS/NZS 3678.
ALL UB, UC, EA, UA AND PFC TO BE GRADE 300L0 TO AS/NZS 3679.1.
STEEL CHS, SHS, AND RHS TO BE GRADE 350L0 TO AS/NZS 3679.1.
- SHARP EDGES TO BE SUITABLY RADIUSSED BEFORE GALVANIZING.
- WELDING TO BE CATEGORY SP GRADE E48XX (480MPa) TO AS/NZS 1554.1:2004. EVERY ACCESSIBLE UNBOLTED JOINT TO BE CONTINUOUS FILLET WELDED, THICKNESS EQUAL TO SMALLEST SECTION JOINED UP TO 6mm, UNLESS NOTED OTHERWISE.
- BOLTS, NUTS, WASHERS AND THREADED ROD TO BE GRADE 8.8 TO AS/NZS 1252, HOT DIP GALVANISED, SUPPLIED FOR ALL CONNECTIONS WITH 1 NUT AND 1 WASHER, INSTALLED SNUG TIGHTENED U.N.O.
- A-FRAME IS TO BE TRIAL ASSEMBLED BEFORE GALVANIZING.
- HOT DIP GALVANISE ALL STEEL SECTIONS AND COMPONENTS TO AS/NZS 4680.
FABRICATED STEELWORK - THICKNESS ≥ 5mm
MINIMUM COATING THICKNESS: 70µm (500g/m²) - INDIVIDUAL, 84µm (600g/m²) - AVERAGE FABRICATED STEELWORK - 3mm ≤ THICKNESS < 5mm
MINIMUM COATING THICKNESS: 55µm (390g/m²) - INDIVIDUAL, 70µm (500g/m²) - AVERAGE THREADED PARTS (BOLTS AND NUTS)
MINIMUM COATING THICKNESS: 63µm (450g/m²) - INDIVIDUAL, 70µm (500g/m²) - AVERAGE OPEN SECTION MEMBERS TOO LARGE FOR DIPPING ARE TO BE THERMAL METAL SPRAYED WITH ZINC TO AS/NZS 2312, SYSTEM TSZ100.
- DAMAGE TO ANY GALVANISING MADE GOOD TO AS 1627.2:2002 AND PAINTED WITH 2 COATS OF ZINC RICH PAINT, 150 MICRONS THICK MINIMUM WHEN DRY.
- NUMBER OF ITEMS IDENTIFIED ARE FOR ONE GANTRY.

LIGHTNING MOUNT
 JOIN PLATE 2
 JOIN PLATE 1

GUSSET L1
 LEG, MEMBER
 GUSSETS, F1, F2, F3
 FOOT

PERSPECTIVE

PERSPECTIVE

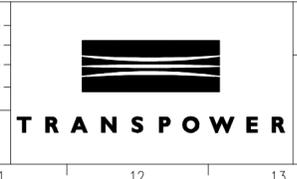
HOLD DOWN DETAILS, REFER TP62590/3.

CHAMFER 30x30 TYP.

THIS DRAWING SUPERSEDES TP62590/4

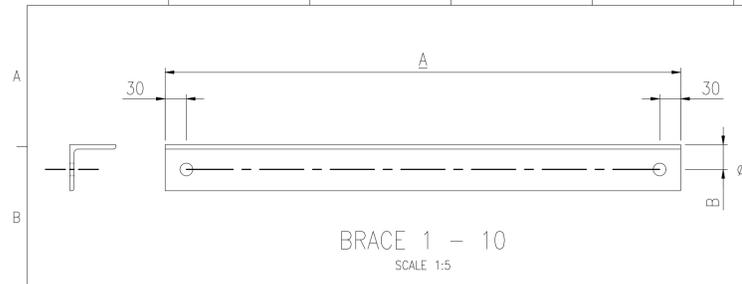
REV	DESCRIPTION
F	Presentation of gusset F1 corrected
1B	Bolt details revised. Hold Down Template added
B	Hold Down Template details moved to sheet 3, Notes 3, 6 & 8 revised
C	Note 6 amended
D	Optional lighting by others note removed
E	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE

CONSULTANT										TP		DESIGNED	S Thomas	7.08
NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE				
AECOM	LC	3.18	LC	3.18	ARB	3.18	ARB	3.18	QH	3.18	DRAWN	B Parker	7.08	
AECOM	ST	9.11	LC	9.11	DH	9.11	DW	9.11	DH	12.11	CHECKED	D Wills	7.08	
AECOM	ST	10.11	TC	10.11	DRH	10.11	DW	10.11	DH	12.11	APPROVED	D Wills	7.08	
AECOM	ST	11.11	TC	11.11	DRH	11.11	DW	11.11	DH	12.11	TP APPROVED	A Renton	7.08	
AECOM	TC	2.12	TC	2.12	ST	2.12	DW	2.12	AR	7.12	PREPARED BY:	MAUNSELL (WPT TPRE 007)		
TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	PO	Box 27-277, Wellington		



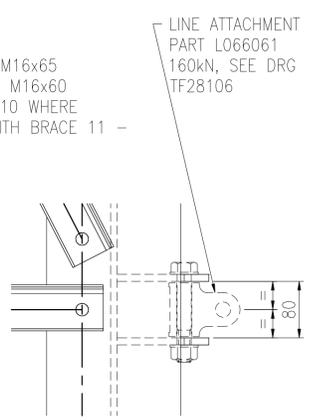
STANDARD DRAWING
 220 kV GANTRY
 A-FRAME
 LEG DETAILS

DRG. SIZE	SCALE	FOLDER
A1	As Shown	STD/3D1
DRAWING NUMBER		SHEET
TP65059		4
CAD FILE NAME		REVISION
TP65059_4_0.DWG		F

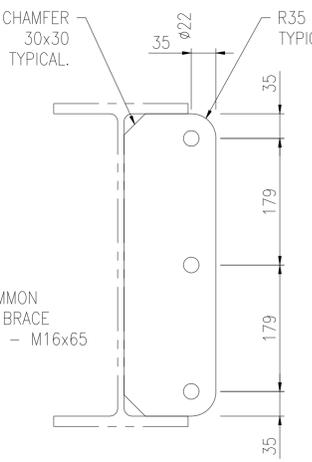


BRACE NO.	MEMBER SIZE	A (LENGTH)	B (GAUGE DISTANCE)	QUANTITY (REFER NOTE 10)
1	100x10	3,192.4	55	4
2	65x6	2,460.7	35	2
3	65x6	1,729	35	2
4	65x6	955.5	35	2
5	100x10	662.8	55	4
6	65x6	995.2	35	4
7	65x6	730	35	18
8	65x6	1,103.5	35	4
9	65x6	1,434.4	35	8
10	65x6	1,522.5	35	4

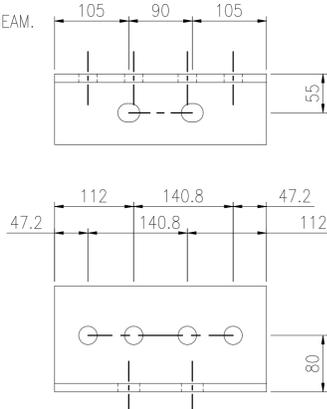
BRACES 1 TO 5 M16x65
BRACES 6 TO 10 M16x60
BRACES 8, 9 & 10 WHERE COMMON BOLT WITH BRACE 11 - M16x65



PLAN, TYPICAL

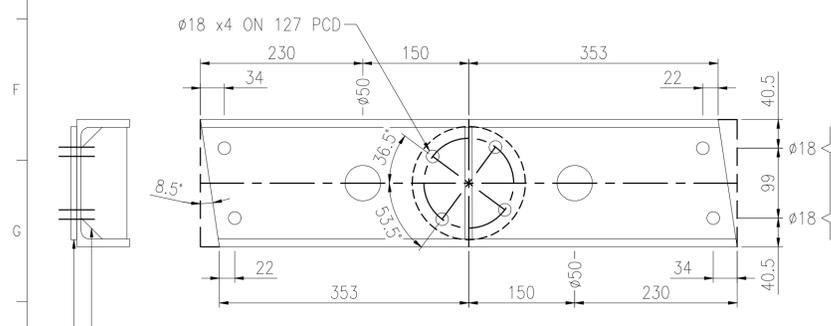
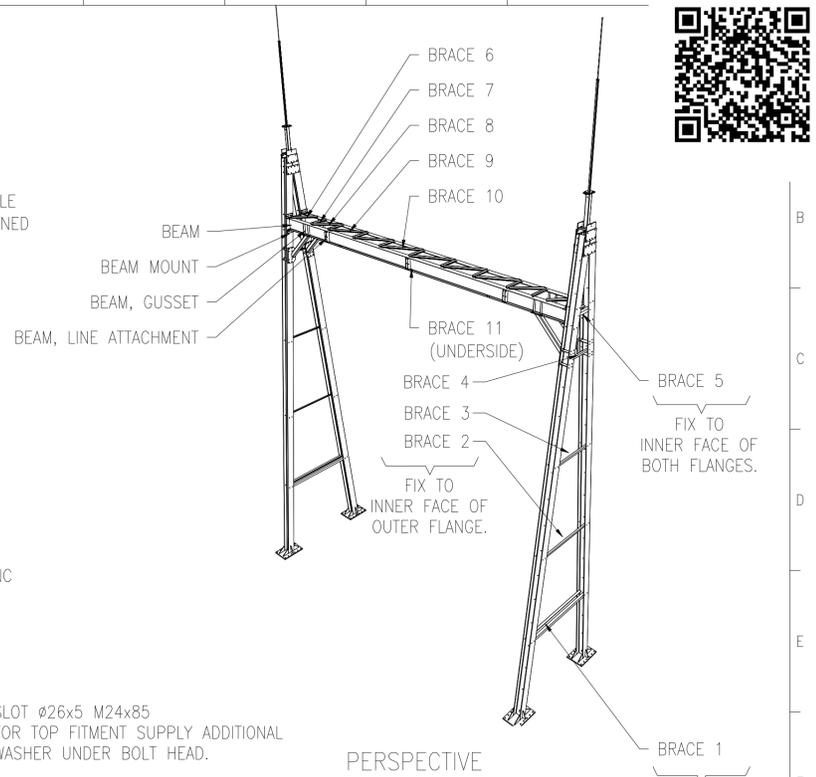


BEAM, GUSSET (2 SHOWN)
FL80x10, 428 LONG. QTY. 16
SCALE 1:5

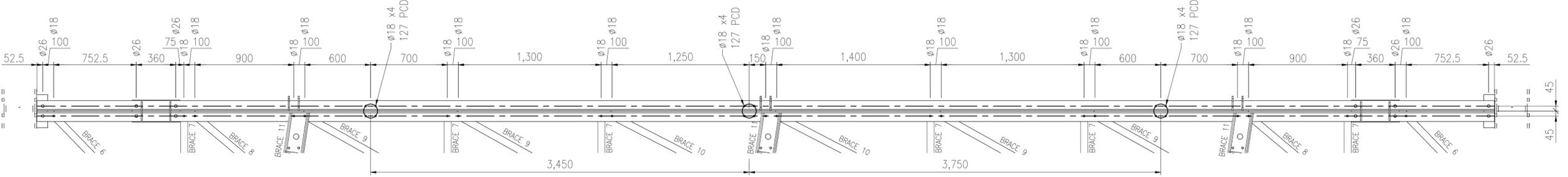
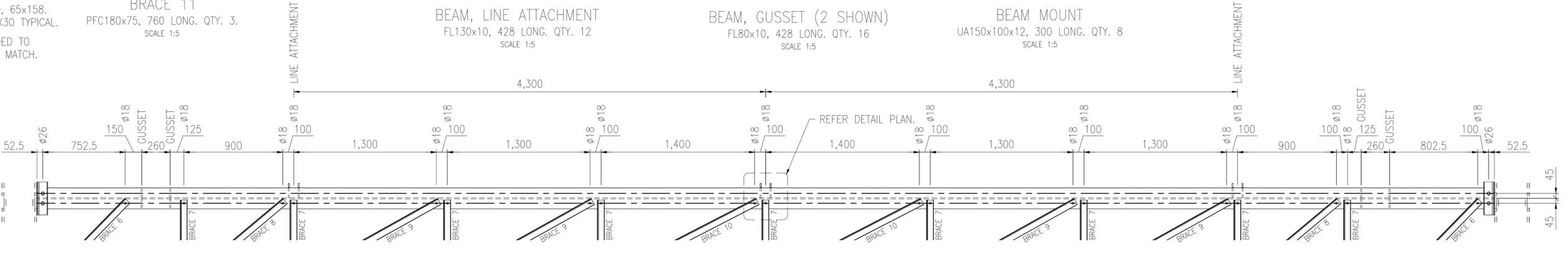


STEEL NOTES:

- DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
- CONSTRUCTION TO AS/NZS 5313.
- STEEL PLATE TO BE GRADE 300LO TO AS/NZS 3678. ALL UB, UC, EA, UA AND PFC TO BE GRADE 300LO TO AS/NZS 3679.1. STEEL CHS, SHS, AND RHS TO BE GRADE 350LO TO AS/NZS 3679.1.
- SHARP EDGES TO BE SUITABLY RADIUSED BEFORE GALVANIZING.
- WELDING TO BE CATEGORY SP GRADE E48XX (480MPa) TO AS/NZS 1554.1:2004. EVERY ACCESSIBLE UNBOLTED JOINT TO BE CONTINUOUS FILLET WELDED, THICKNESS EQUAL TO SMALLEST SECTION JOINED UP TO 6mm, UNLESS NOTED OTHERWISE.
- BOLTS, NUTS, WASHERS AND THREADED ROD TO BE GRADE 8.8 TO AS/NZS 1252, HOT DIP GALVANISED, SUPPLIED FOR ALL CONNECTIONS WITH 1 NUT AND 1 WASHER, INSTALLED SNUG TIGHTENED U.N.O.
- A-FRAME IS TO BE TRIAL ASSEMBLED BEFORE GALVANIZING.
- HOT DIP GALVANISE ALL STEEL SECTIONS AND COMPONENTS TO AS/NZS 4680. FABRICATED STEELWORK - THICKNESS ≥ 5mm
MINIMUM COATING THICKNESS: 70µm (500g/m²) - INDIVIDUAL, 84µm (600g/m²) - AVERAGE
FABRICATED STEELWORK - 3mm ≤ THICKNESS < 5mm
MINIMUM COATING THICKNESS: 55µm (390g/m²) - INDIVIDUAL, 70µm (500g/m²) - AVERAGE
THREADED PARTS (BOLTS AND NUTS)
MINIMUM COATING THICKNESS: 63µm (450g/m²) - INDIVIDUAL, 70µm (500g/m²) - AVERAGE
OPEN SECTION MEMBERS TOO LARGE FOR DIPPING ARE TO BE THERMAL METAL SPRAYED WITH ZINC TO AS/NZS 2312, SYSTEM TS2100.
- DAMAGE TO ANY GALVANIZING MADE GOOD TO AS 1627.2:2002 AND PAINTED WITH 2 COATS OF ZINC RICH PAINT, 150 MICRONS THICK MINIMUM WHEN DRY.
- NUMBER OF ITEMS IDENTIFIED ARE FOR ONE GANTRY BEAM.



GUSSET PL10, 65x158. CHAMFER 30X30 TYPICAL.
PLØ160x8 WELDED TO PFC, HOLES TO MATCH.



REV	REVISION DESCRIPTION
G	Bottom flange centre underhung insulator mouting hole dimensions added
B	Bolt details revised. Brace No.7 quantity revised and No.11 deleted, notes 3, 6 & 8 revised.
C	Note 6 amended.
D	Brace 11 added.
E	LINE TERMINATION PART NUMBER L066061 ADDED; TITLE CHANGED TO STANDARD DRAWING; ALL TEXT NOW UPPER CASE. GFB
F	Brace 1-10 bewteen dimensions removed. Brace 11 revised

CONSULTANT										TP	
CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	DATE
AECOM	TC	10.19	KMc	10.19	AB	1.20	ST	1.20	QH	8.20	
AECOM	ST	10.11	TC	10.11	DRH	10.11	DW	10.11	DH	12.11	
AECOM	ST	11.11	TC	11.11	DRH	11.11	DW	11.11	DH	12.11	
AECOM	ST	12.11	TC	12.11	DRH	12.11	DW	12.11	DH	12.11	
UPPER CASE	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	
AECOM	LC	3.18	LC	3.18	CT	3.18	ST	3.18	AH	3.18	



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THIS DRAWING SUPERSEDES TP65059/5

STANDARD DRAWING
220 kV GANTRY
A-FRAME
BEAM & BRACE DETAILS

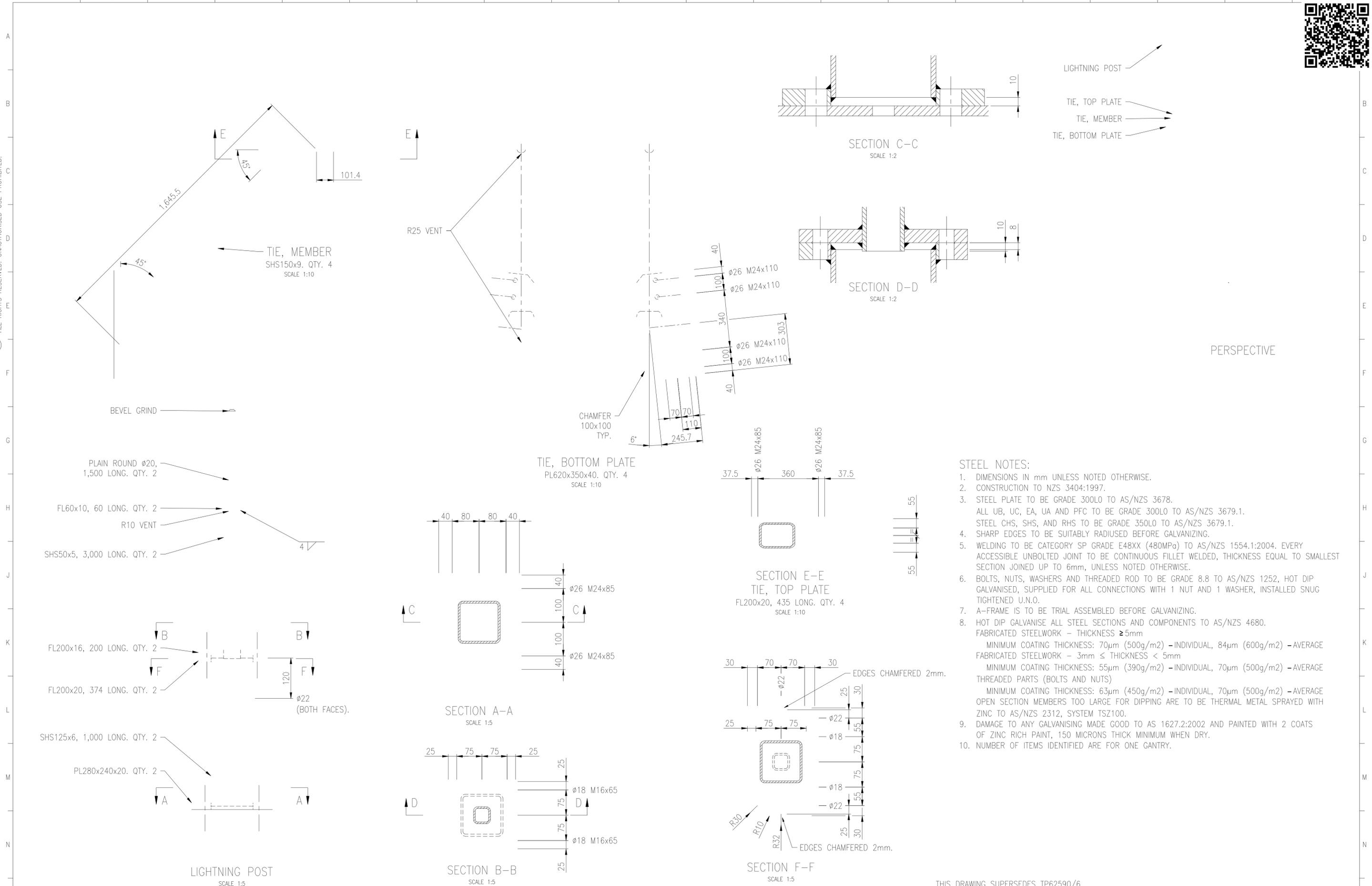
TRANSPOWER PROJECT CODE IP_1920_242_01		FOLDER STD/3D1	
DRAWING NUMBER TP65059		SHEET REVISION 5 G	
DRAWING CREATED BY: MAUNSELL (WPT TPRE 007) PO Box 27-277 Wellington		SCALE As Shown	



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REV	DESCRIPTION	NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
A	Title revised	AECOM	ST	7.10	TC	7.10	DH	8.10	DW	8.10	AR	8.10
1B	Bolt details revised	AECOM	ST	9.11	LC	9.11	DH	9.11	DW	9.11	DH	12.11
B	H	AECOM	ST	10.11	TC	10.11	DRH	10.11	DW	10.11	DH	12.11
C	Note 6 amended	AECOM	ST	11.11	TC	11.11	DRH	11.11	DW	11.11	DH	12.11
D	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14

CONSULTANT												TP		
DESIGNED	S Thomas	7.08										DESIGNED	S Thomas	7.08
DRAWN	B Parker	7.08										DRAWN	B Parker	7.08
CHECKED	D Wills	7.08										CHECKED	D Wills	7.08
APPROVED	D Wills	7.08										APPROVED	D Wills	7.08
TP APPROVED	A Renton	7.08										TP APPROVED	A Renton	7.08
PREPARED BY:	MAUNSELL (WPT TPRE 007)											PREPARED BY:	MAUNSELL (WPT TPRE 007)	
	PO Box 27-277, Wellington												PO Box 27-277, Wellington	

THIS DRAWING SUPERSEDES TP62590/6

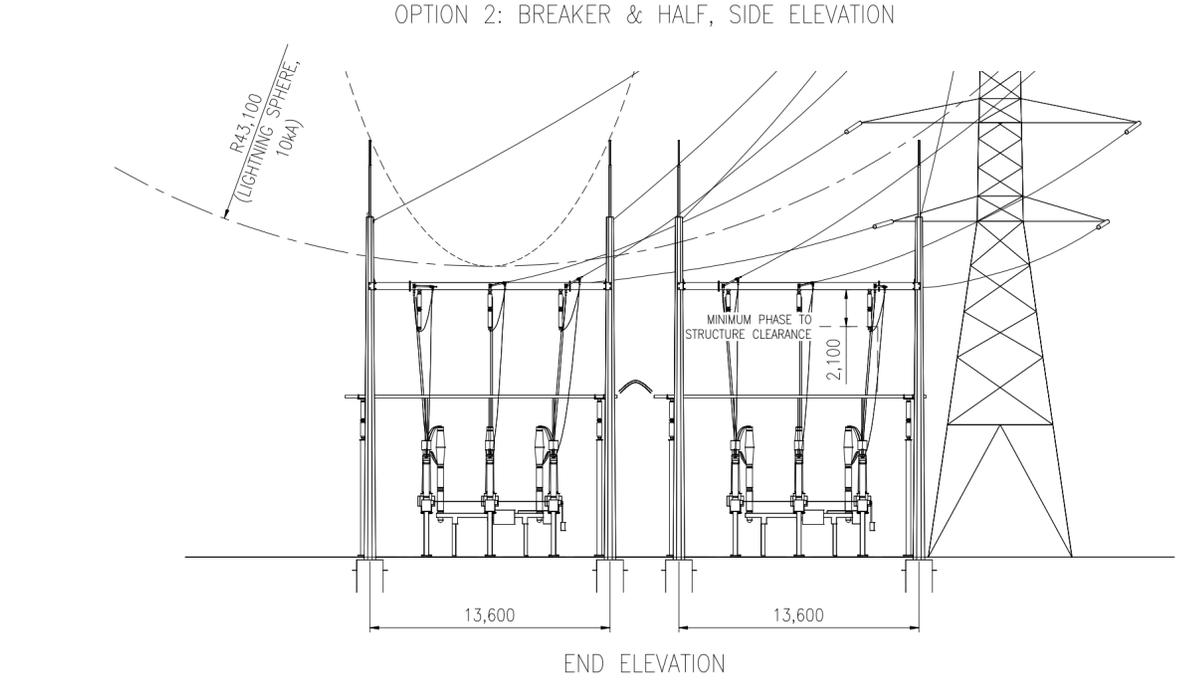
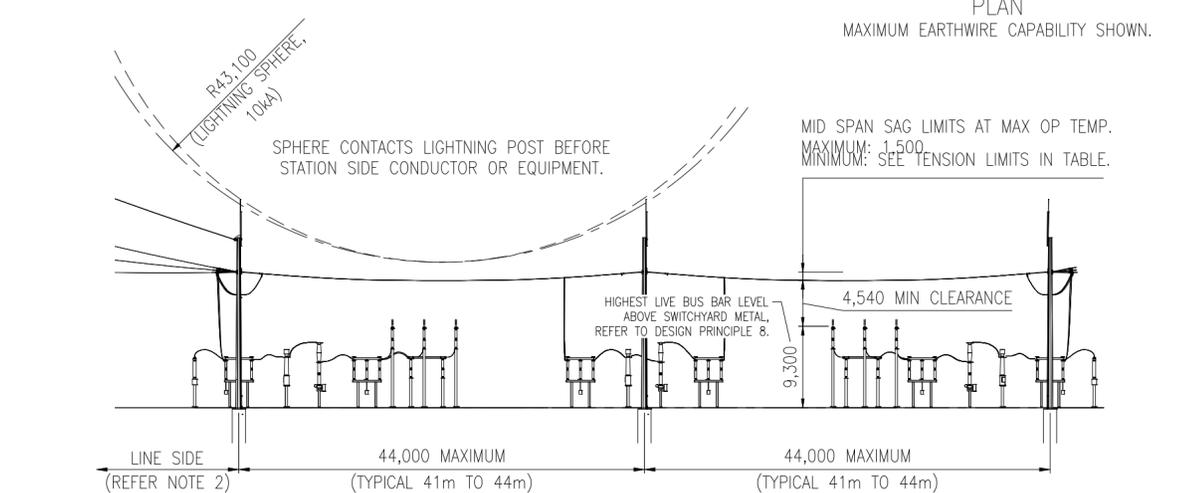
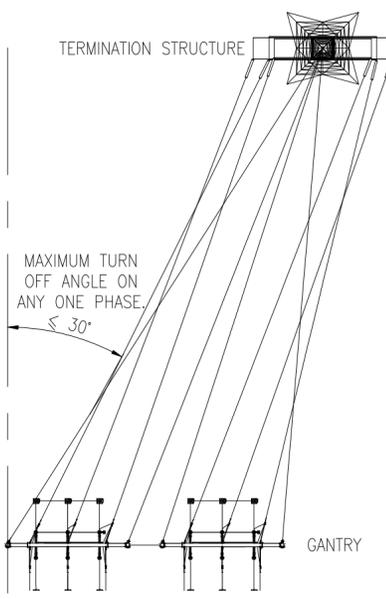
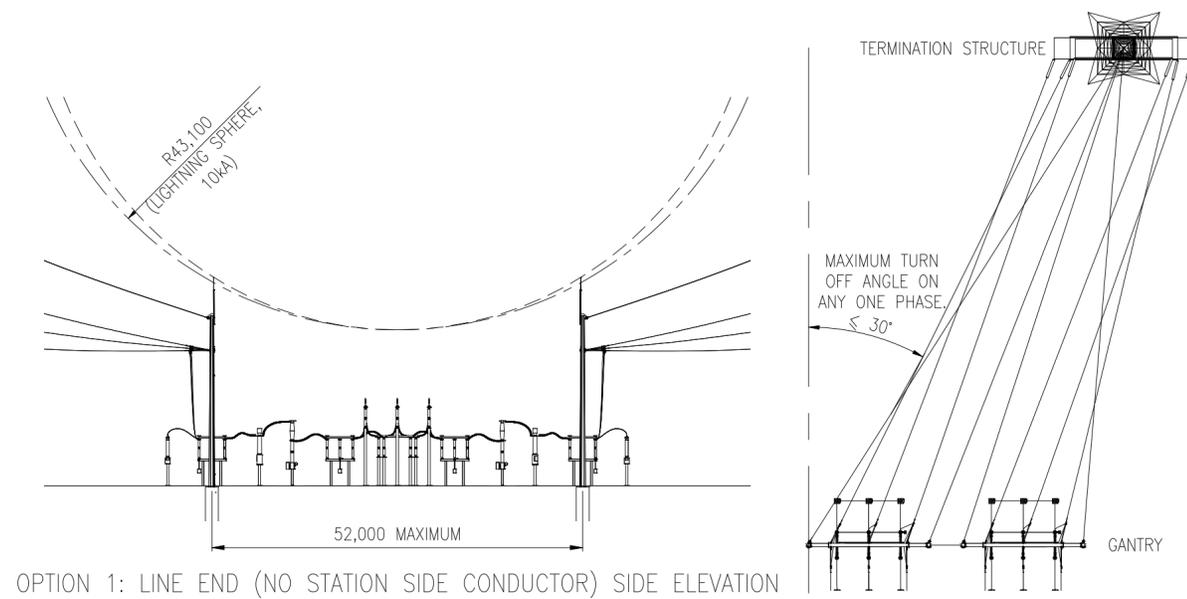
STANDARD DRAWING

220 kV GANTRY
A-FRAME
TIE AND LIGHTNING DETAILS

TRANSPower

DRG.SIZE	SCALE	FOLDER
A1	As Shown	STD/3D1
DRAWING NUMBER		SHEET
TP65059		6
CAD FILE NAME		REVISION
TP65059_6_0.DWG		D

REV	DESCRIPTION
A	Title revised
1B	Bolt details revised
B	H
C	Note 6 amended
D	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE



APPLICATION NOTES

- THE 220 kV GANTRY, CONCRETE POLE OPTION, IS SUITABLE FOR USE IN APPLICATIONS AS DESCRIBED BELOW. IF THE PROPOSED APPLICATION FALLS OUTSIDE THE PARAMETERS LISTED BELOW, A SPECIFIC DESIGN CHECK SHOULD BE CARRIED OUT TO CONFIRM SUITABILITY. ALTERNATIVELY THE STEEL A-FRAME OPTION COULD BE USED. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.
- LINE LOADING PARAMETERS
CONDUCTOR TYPES AND SPANS – THE GANTRY WILL ACCOMMODATE TWO 7/3.18 SC/AC EARTHWIRES, (ONE PER POLE) STRUNG TO ACHIEVE 95% OF THE LINE SIDE CONDUCTOR SAG AT EVERYDAY TEMPERATURE. THE STATION SIDE CONDUCTOR SHOULD BE TENSIONED TO ENSURE SAG IS WITHIN THE LIMITS SHOWN IN THE SIDE ELEVATION. THE ALLOWABLE CONDUCTOR TYPES, SPANS, TENSIONS AND TURN OFF ANGLES ARE OUTLINED BELOW:

Conductor Type	LINE SIDE CONDUCTOR			STATION SIDE CONDUCTOR (OPTIONAL)			SUMMER CURRENT RATING OF LINE SIDE/STATION SIDE CONDUCTOR (A)	
	MAXIMUM INSTALLED FINAL TENSION (% UTS @ EDT)	MAXIMUM TURN OFF ANGLE (°)	MAXIMUM SPAN LENGTH (m)	CONDUCTOR TYPE	MAXIMUM INSTALLED FINAL TENSION (% UTS @ EDT)	MAXIMUM TURN OFF ANGLE (°)		MAXIMUM SPAN LENGTH (m)
SIMPLEX GOAT	3.9	30	110	SIMPLEX BUTTERFLY	10.0	0	44	800/900
SIMPLEX ZEBRA	4.3	30	110	SIMPLEX BUTTERFLY	10.0	0	44	930/900
SIMPLEX PHEASANT	3.6	30	100	SIMPLEX CICADA	6.0	0	44	1215/1300
SIMPLEX MOA	3.8	30	95	SIMPLEX CICADA	6.0	0	44	1385/1300
SIMPLEX CHUKAR	3.4	30	90	SIMPLEX CICADA	6.0	0	44	1500/1300
DUPLEX GOAT	2.2	30	85	DUPLEX BUTTERFLY	5.0	0	44	1600/1800
DUPLEX ZEBRA	2.4	30	85	DUPLEX BUTTERFLY	5.0	0	44	1860/1800
DUPLEX PHEASANT	2.0	30	55	DUPLEX CICADA	4.2	0	44	2430/2600
DUPLEX MOA	2.0	30	55	DUPLEX CICADA	4.2	0	44	2770/2600

THE GANTRY IS ALSO CAPABLE OF TERMINATING A STATION SIDE CONDUCTOR (STRUNG BUS) WITH NO LINE SIDE CONDUCTOR PROVIDED THE SPAN AND TENSION LIMITS IN THE TABLE ABOVE ARE MET.

WIND LOADS – THE GANTRY WILL WITHSTAND WINDS OF 1000 YEAR RETURN PERIOD IN WIND REGIONS A1 TO A7 (FIGURE 3.1 AS/NZS 1170.2), AT SITES THAT ARE FAIRLY FLAT AND NOT ELEVATED. THE SPECIFIC PARAMETERS AND RESULTING PRESSURES ARE OUTLINED BELOW:

PARAMETER	VALUE	ASSUMED SITE DETAILS
V_R	46 m/s	1000 YEAR RETURN PERIOD, ZONE A1 TO A7 (ALL EXCEPT W)
M_t	1.00	NO TOPOGRAPHIC EFFECTS
$M_{(z,cat)}$	0.97	HEIGHT ABOVE GROUND OF 15m AND TERRAIN CATEGORY 2.5
V_z	44.6 m/s	
P_z	1195 Pa	WIND PRESSURE ON STRUCTURE (EXCLUDING DRAG COEFFICIENT)
SRF	0.90	WIND SPAN LENGTH 50m, AVERAGE COND. HEIGHT A.G.L 15m AND TC 2.5
$P_{(z,cond)}$	1075 Pa	WIND PRESSURE ON CONDUCTORS

SNOW LOADS – THE GANTRY WILL BE SUITABLE FOR INSTALLATION AT SITES UP TO AN ALTITUDE OF 600m ABOVE SEA LEVEL AS IT HAS BEEN DESIGNED FOR WET SNOW WITH NO COINCIDENT WIND, REFER TO APPENDIX 1 TP.DL 12.01 ISSUE 2 DRAFT 2 JULY 2005. THE SPECIFIC PARAMETERS USED ARE: SNOW RADIAL THICKNESS OF 30mm & SNOW/ICE DENSITY OF 400kg/m³.

- LINE LOADING ULTIMATE DESIGN LOADS – IF THE LINE LOADING PARAMETERS ABOVE ARE NOT MET, A DESIGN CHECK CAN BE MADE AGAINST THE FOLLOWING SIX LOAD CASES. THE PROPOSED APPLICATION MUST ALSO COMPLY WITH THE SEISMIC LOADING PARAMETERS BELOW.

LOAD CASE	DESCRIPTION	LINE SIDE CONDUCTOR LOADS (kN)			STATION SIDE CONDUCTOR LOADS (kN)			EARTHWIRE LOADS (kN)			WIND ON STRUCTURE (Pa)
		L	T	V	L	T	V	L	T	V	
1	MAXIMUM LONGITUDINAL LINE SIDE CONDUCTOR LOAD	20.0	0.0	3.0	0.0	0.0	0.0	3.9	0.0	1.5	0
2	MAXIMUM TRANSVERSE LINE SIDE CONDUCTOR LOAD	14.7	10.9	3.0	0.0	0.0	3.0	1.9	1.4	1.5	1195
3	MAXIMUM RESULTANT OTM	13.9	10.3	3.0	0.0	0.0	0.0	2.9	2.2	1.5	1195
4	MAXIMUM LONGITUDINAL EARTHWIRE LOAD	15.9	0.0	3.0	0.0	0.0	0.0	8.2	0.0	1.5	0
5	MAXIMUM TRANSVERSE EARTHWIRE LOAD	11.2	8.2	3.0	12.1	0.6	3.0	4.0	3.0	1.5	1195
6	MAXIMUM LONGITUDINAL STATION SIDE CONDUCTOR LOAD	0.0	0.0	0.0	24.2	0.0	3.0	0.0	0.0	0.0	0

- SEISMIC LOADS – REFER TO TP65059/14 FOR ZONES WHERE THIS STANDARD GANTRY DESIGN IS SUITABLE.

DESIGN PRINCIPLES

- THE DIMENSIONS AND LAYOUT OF THE 220 kV GANTRY, CONCRETE POLE OPTION, ARE DETERMINED BY CLEARANCES (TP.DS 62.01 ISSUE 3), VEHICLE ACCESS AND LIGHTNING PROTECTION REQUIREMENTS FOR BREAKER AND A HALF AND LINE END SUBSTATION LAYOUTS. REFER TO THE PLAN AND ELEVATIONS FOR FURTHER DETAILS.
- THE GANTRY HAS BEEN DESIGNED TO WITHSTAND THE LINE LOADINGS FROM THE CONDUCTOR CONFIGURATIONS OUTLINED IN THE APPLICATION NOTES AND AS PER TP.DL 12.01 ISSUE 2 DRAFT 2 JULY 2005. THE LOADINGS CONSIDERED INCLUDE BOTH WITH AND WITHOUT THE STATION SIDE SPAN INSTALLED, AND LINE SIDE TURN OFF ANGLES OF 0° AND 30°.
- SEISMIC LOADING IS BASED ON NZS 1170.5 AND TP.GG 61.02. REFER TO TP65059/14 FOR SPECIFIC PARAMETERS USED.
- THE GANTRY HAS BEEN DESIGNED TO WITHSTAND THE ULS LINE AND SEISMIC LOADINGS. THE STRENGTH REDUCTION FACTOR USED FOR THE PRESTRESSED CONCRETE POLES IS 0.8 FOR STRAIN STRUCTURES AS PER TP.DL 12.01 ISSUE 2 DRAFT 2 JULY 2005, TABLE 3.
- THE GANTRY HAS BEEN DESIGNED TO LIMIT THE COMBINED HORIZONTAL DEFLECTIONS ON ANY PART OF THE STRUCTURE TO 2% OF THE HEIGHT UNDER ULS LOADINGS. THE EVERYDAY LOADS WHERE CONDUCTORS ARE STRUNG ON ONE SIDE OF THE GANTRY ONLY, ARE APPROXIMATELY 30% OF THE ULS LOADS. HENCE THE STRUCTURE DEFLECTION AT THE CROSSARM LEVEL (15.5m) UNDER EVERYDAY LOADING MAY BE UP TO 100mm.
- THE GANTRY IS THE RESULT OF A PROJECT TO DESIGN A COST EFFECTIVE GANTRY FOR TRANSPower. FOR MORE INFORMATION REFER TO AECOM LTD REPORT TITLED "STANDARD 220 kV GANTRY".
- THE GANTRY USES TWO 23m, HIGH STRENGTH CONCRETE POLES. THESE POLES HAVE AN UNGUYED SPECIFICATION TIP LOAD CAPACITY OF 32 kN.
- HIGHEST LIVE BUS BAR LEVEL IS DERIVED FROM: SWITCHYARD LEVEL TO TOP OF PAD 50, HIGH LEVEL BUS HEIGHT ABOVE CONCRETE PAD 9100, ALLOWANCE FOR VARIATION OF CLAMP HEIGHT 25, HALF MAXIMUM BUS BAR DIA. 100 = HIGHEST LIVE BUS BAR LEVEL 9275, ADOPTED HIGHEST LIVE BUS BAR LEVEL 9300.
- ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.

THIS DRAWING SUPERSEDES TP62588/1

REV	REVISION DESCRIPTION	CONSULTANT										TP
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	
A	Bus height increased, line side conductor tensions and loadings revised, seismic capability revised.	AECOM	PS	8.09	PS	8.09	ST	8.09	DW	8.09	AR	8.09
B	Seismic details moved to sht 14. Deflections discussed in more detail. Title revised.	AECOM	ST	3.10	PS	3.10	DH	8.10	DW	8.10	AR	8.10
C	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14
D	STANDARD REFERENCES UPDATED. MINOR REVISIONS.	AECOM	RL	9.19	KoM	9.19	AB	1.20	ST	1.20	AH	8.20

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STANDARD DRAWING

220 kV GANTRY
CONCRETE POLE
APPLICATION NOTES

TRANSPower PROJECT CODE
IP_1920_242_01

DRAWING NUMBER
TP65059

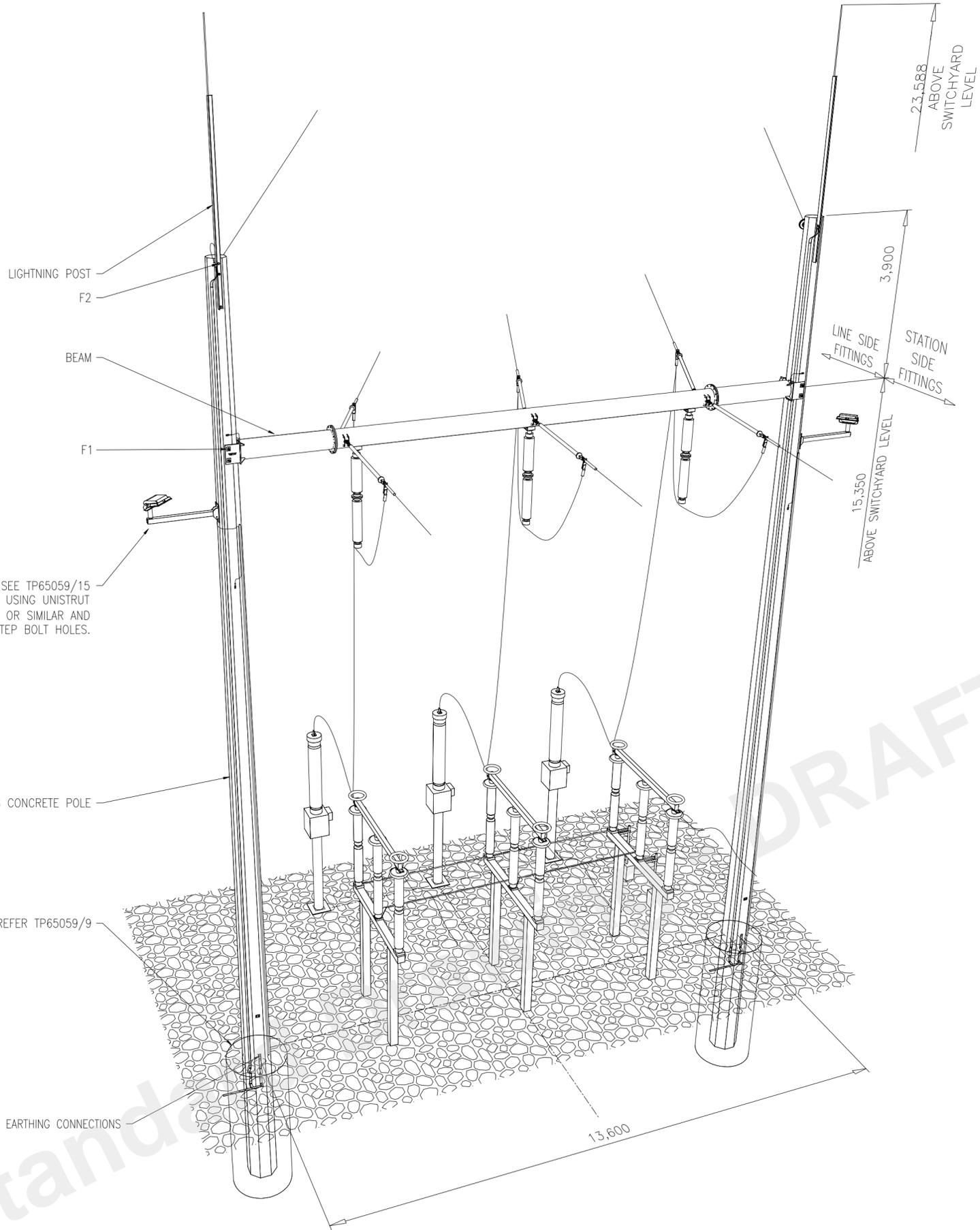
DRAWING CREATED BY:
MAUNSELL (WPT TP65059)
PO Box 27-277 Wellington

FOLDER
STD/3D1

SHEET REVISION
7 D

SCALE
N.T.S.

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OPTIONAL LIGHTING SHOWN, SEE TP65059/15 LIGHTING CONDUIT TO BE FIXED USING UNISTRUT MASSIV-R-SS-H/D CLIP OR SIMILAR AND SUITABLE ADAPTOR FOR STEP BOLT HOLES.

PARTS LIST					
ITEM	QUANTITY PER GANTRY	DESCRIPTION	STOCK/MANUFACTURES CODE/No.	DRAWING REFERENCE	SUPPLIER
POLE	2	CONCRETE OCTAGONAL HS 23m	L055105	P23H	TP
BEAM	1	-	S011500	TP65059/10	CONTRACTOR
LIGHTNING POST	2	-	-	TP65059/9	CONTRACTOR
F1	4	BOLT, M24, 550 LONG, G8.8 AND NUT	L066167	TF29591	TP
	4	M24 LOCKNUT (DOUBLE CHAMFERED NUT)	-	TF29591	CONTRACTOR
	8	WASHER, SQUARE, M24, 80x80x10	L066172	TF28116	TP
F2	4	BOLT, M20, 450 LONG, G4.6 AND NUT	L066190	TF28117	TP
	4	WASHER, SQUARE, M20, 60x60x10	L066171	TF28116	TP
LINE SIDE FITTINGS, REFER TO SPECIFIC LINE/4A DRAWING.					
STATION SIDE FITTINGS, REFER TP65059/12 OR SPECIFIC SUBSTATION/3C3 DRAWING.					
EARTHING CONNECTIONS, REFER TP65059/13 OR SPECIFIC SUBSTATION/3A5 DRAWING.					
INCLUSION OF CLIMBING AND FALL ARREST SYSTEM TO BE CONFIRMED BY TRANSPOWER.					

NOTES:
1. REFER TO TP65059/7 FOR DESIGN PRINCIPLES INCLUDING DISCUSSION ON DEFLECTIONS

THIS DRAWING SUPERSEDES TP62588/2

REV	REVISION DESCRIPTION	CONSULTANT				TP						
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
A	Title & Lighting connection revised. Note 1 added.	AECOM	DH	2.10	RP	2.10	ST	8.10	DW	8.10	AR	8.10
B	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE. REFERENCE TO LINE SIDE FITTINGS (REFERENCE TO TP65059/11) REMOVED.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14
C	Optional light fitting appearance updated	AECOM	-	-	LC	3.18	ARB	3.18	ARB	3.18	QH	3.18
D	23m HS CONCRETE POLE DRG REF. ADDED	AECOM	RL	9.19	KaM	9.19	AB	1.20	ST	1.20	AH	8.20

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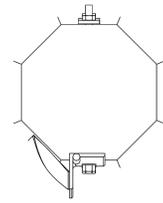
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STANDARD DRAWING		TRANSPOWER PROJECT CODE	FOLDER
220 kV GANTRY		IP_1920_242_01	STD/3D1
CONCRETE POLE		DRAWING NUMBER	SHEET REVISION
GENERAL ARRANGEMENT		TP65059	8 D
		DRAWING CREATED BY:	SCALE
		MAUNSELL (WPT TPRE 007)	35mm
		PO Box 27-277 Wellington	

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DRAFTING & APPROVAL

A1

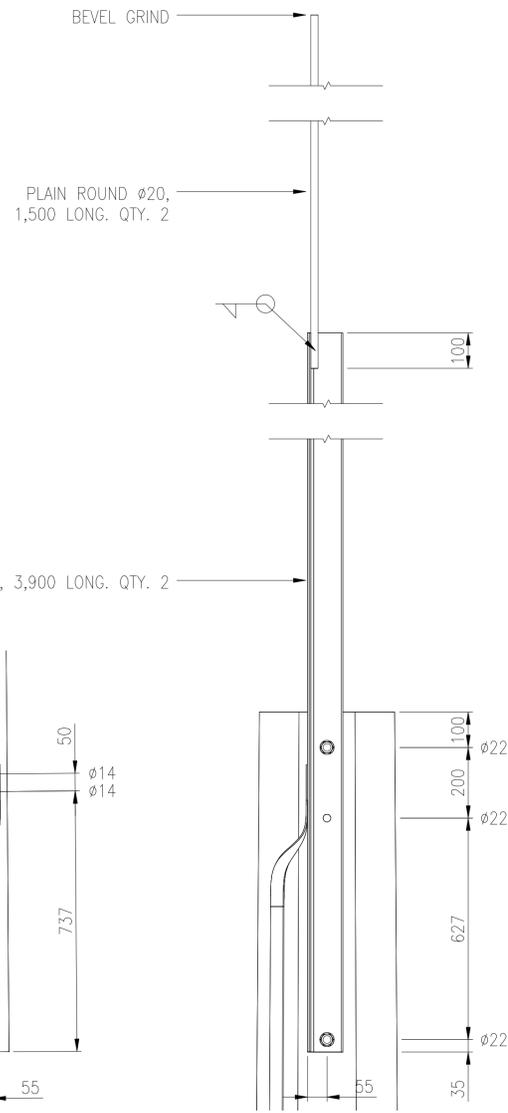


PLAN
SCALE 1:10

FOUNDATION, REFER DETAIL

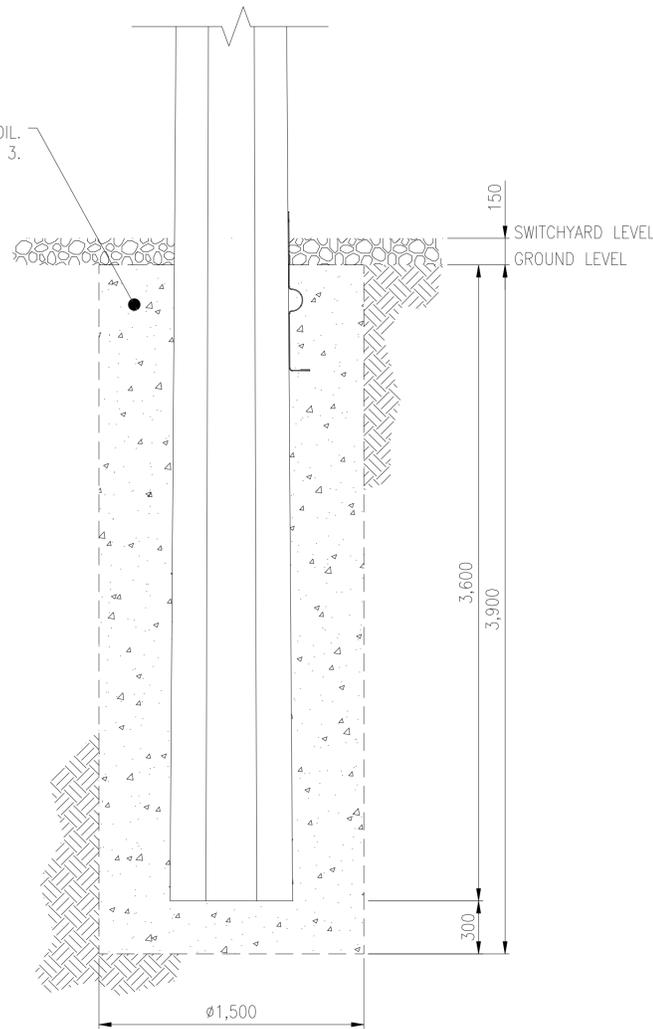
LIGHTNING POST

PERSPECTIVE



LIGHTNING POST
SCALE 1:10

CEMENT/LIME STABILISED SOIL.
REFER NOTE 3.



FOUNDATION DETAIL
SCALE 1:20

FOUNDATION NOTES:

1. THE POLE FOUNDATIONS SHOWN HAVE BEEN DERIVED ASSUMING DRY/MOIST, MEDIUM (FIRM), NON-COHESIVE OR COHESIVE SOILS. IF WEAK OR SATURATED SOILS ARE FOUND, THE MATTER SHOULD BE REFERRED TO THE ENGINEER. REFER TO TE38422 FOR FURTHER DETAILS AND SOIL DEFINITIONS.
2. BREAST BLOCKS TO BE CONSIDERED IN SOILS WHICH MAY BE SUSCEPTIBLE TO LONG TERM CREEP.
3. EXCAVATED MATERIAL IS TO BE MIXED THOROUGHLY WITH 30kg OF CEMENT PER m³ OF FOUNDATION AND COMPACTED AS PER BELOW.
4. PRIOR TO PLACEMENT AND COMPACTION OF SOIL, THE EXCAVATION SHALL BE CLEARED OF ALL LOOSE MATERIAL. BASE OF EXCAVATION IF LOOSENED MUST BE TAMPED TO A FIRM CONSISTENCY OR IF COHESIVE SOIL IS ENCOUNTERED, PLACE A MINIMUM OF 100mm OF SAND OR CRUSHED ROCK AS A BEARING LAYER.
5. PLACE SOIL IN 150mm MAXIMUM LAYERS. COMPACT EACH LAYER BY HAND OR MACHINE TO ACHIEVE A RELATIVE DENSITY EQUIVALENT TO SCALA PENETROMETER VALUES > 10 BLOWS/300mm.

STEEL NOTES:

1. DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
2. CONSTRUCTION TO AS/NZS 5313.
3. STEEL EA TO BE GRADE 300.
4. SHARP EDGES TO BE SUITABLY RADIUSSED BEFORE GALVANIZING.
5. BOLTS AND THREADED RODS TO BE GRADE 8.8, 2mm SMALLER THAN HOLES. SUPPLIED FOR ALL CONNECTIONS WITH 1 NUT AND 2 WASHERS UNLESS NOTED OTHERWISE. BOLT LENGTH TO BE SELECTED TO ENSURE THAT THREADS ARE EXCLUDED FROM SHEAR PLANES.
6. HOT DIP GALVANIZE ALL STEEL SECTIONS AND COMPONENTS INCLUDING BOLTS, NUTS AND WASHERS TO AS/NZS 4680, MINIMUM AVERAGE MASS OF 600g/m².
7. DAMAGE TO ANY GALVANIZING MADE GOOD TO AS 1627.2 AND PAINTED WITH 2 COATS OF ZINC RICH PAINT, 150 MICRONS THICK MINIMUM WHEN DRY.

GENERAL NOTES:

1. QUANTITIES ARE FOR ONE GANTRY.
2. ORIENTATE POLE SO THAT THE A-TYPE HOLES ARE PERPENDICULAR TO THE BEAM. REFER P23H/1 AND TP28930.

REFERENCES:

P23H/1 GEN/101 STAHLTON 23m HIGH STRENGTH OCTAGONAL POLE
 TP28930 GEN/101.7A HOLE DETAILS FOR CONCRETE POLES

THIS DRAWING SUPERSEDES TP62588/3

REV	REVISION DESCRIPTION	CONSULTANT										TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	APP	DATE
A	Title revised	AECOM	ST	7.10	TC	7.10	DH	8.10	DW	8.10	AR	8.10		
B	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE AND UNNECESSARY NOTES REMOVED.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14		
C1	MINOR UPDATE TO STANDARD REFERENCES & NOTES	AECOM	RL	9.19	KMa	9.19	AB	1.20	ST	1.20				
C	NOTES MODIFIED & REFERENCE ADDED	AECOM	RL	3/20	KMa	3/20	AB	3/20	AB	3/20	AH	8/20		



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STANDARD DRAWING

220 kV GANTRY

CONCRETE POLE

FOUNDATION & LIGHTNING DETAILS

TRANSPOWER PROJECT CODE

IP_1920_242_01

FOLDER

STD/3D1

DRAWING NUMBER

TP65059

SHEET

9

REVISION

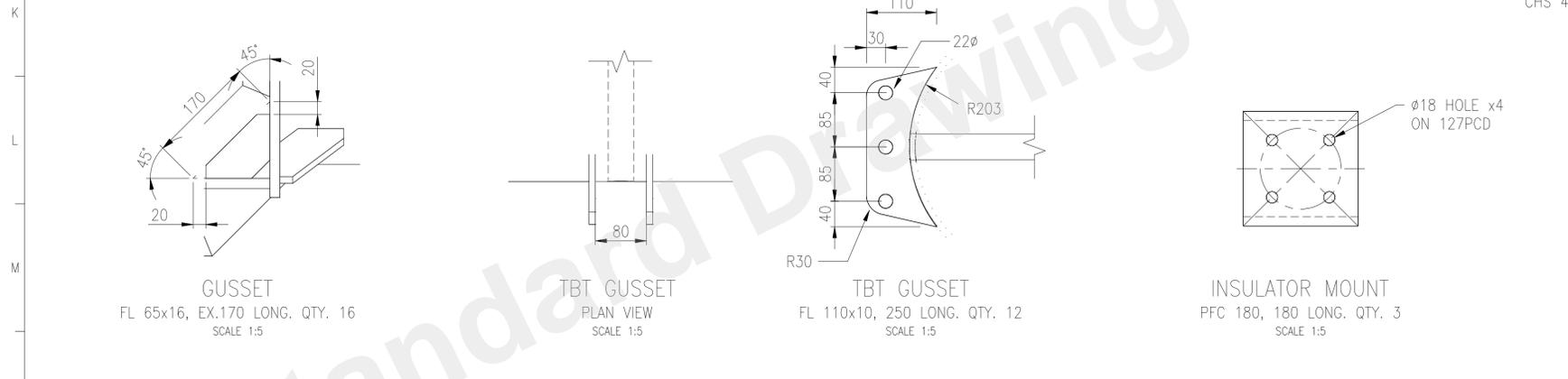
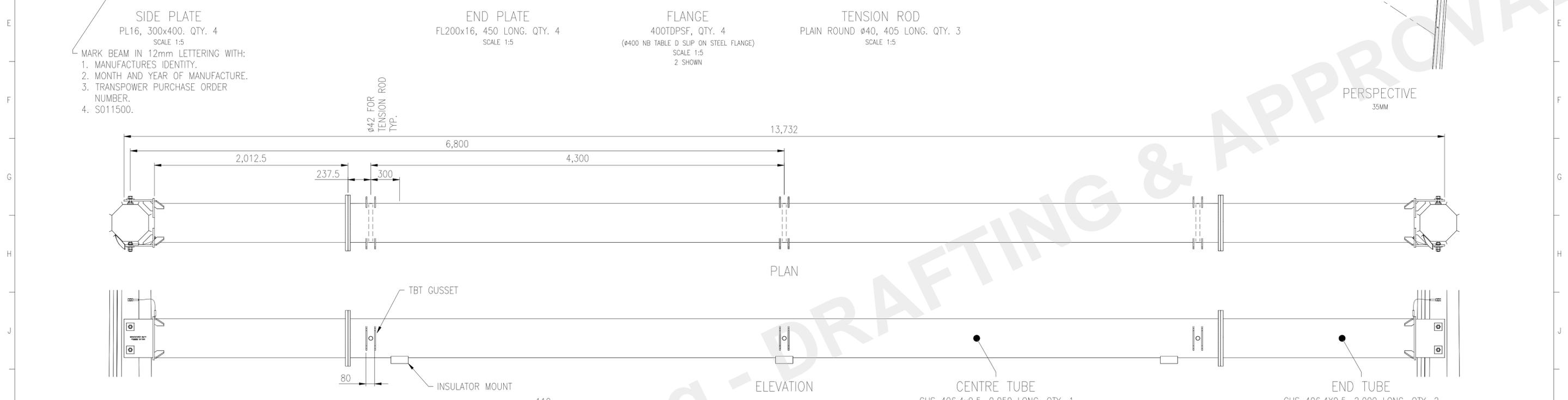
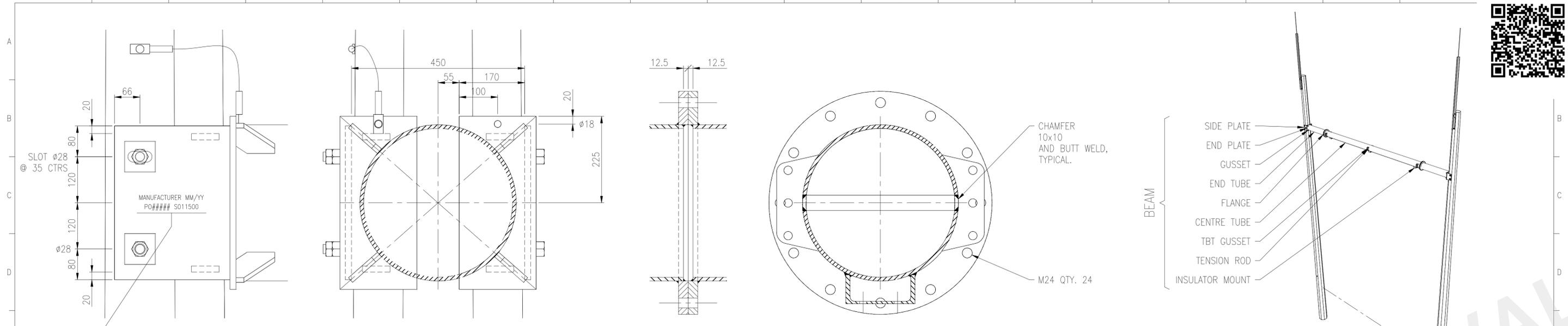
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PO Box 27-277 Wellington

SCALE

As Shown

A1



- STEEL NOTES:**
- DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
 - CONSTRUCTION TO AS/NZS 5131.
 - STEEL PLATE TO BE GRADE 300LO TO AS/NZS 3678. PFC TO BE GRADE 300LO TO AS/NZS 3679.1. CHS TO BE GRADE 350LO TO AS/NZS 3679.1.
 - SHARP EDGES TO BE SUITABLY RADIUSSED BEFORE GALVANIZING.
 - WELDING TO BE CATEGORY SP GRADE E48XX (480 MPa) TO AS/NZS 1554.1:2004. EVERY ACCESSIBLE UNBOLTED JOINT TO BE CONTINUOUS FILLET WELDED, THICKNESS EQUAL TO SMALLEST SECTION JOINED UP TO 6 mm, UNLESS NOTED OTHERWISE.
 - BOLTS AND THREADED RODS TO BE GRADE 8.8, 2 mm SMALLER THAN HOLES. SUPPLIED FOR ALL CONNECTIONS WITH 1 NUT AND 2 WASHERS UNLESS NOTED OTHERWISE. BOLT LENGTH TO BE SELECTED TO ENSURE THAT THREADS ARE EXCLUDED FROM SHEAR PLANES.
 - HOT DIP GALVANIZE ALL STEEL SECTIONS AND COMPONENTS INCLUDING BOLTS, NUTS AND WASHERS TO AS/NZS 4680:2006.
 - DAMAGE TO ANY GALVANIZING MADE GOOD TO AS 1627.2:2002 AND PAINTED WITH 2 COATS OF ZINC RICH PAINT, 150 MICRONS THICK MINIMUM WHEN DRY.
 - QUANTITIES ARE FOR ONE BEAM.

REV		REVISION DESCRIPTION	CONSULTANT				TP						
REV	DATE	DESCRIPTION	CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
A		TBT Gusset & orientation changed	Maunsell	ST	2.09	TC	2.09	DW	2.09	DW	2.09		
B		Title revised	AECOM	ST	7.10	TC	7.10	DH	8.10	DW	8.10	AR	8.10
C		TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE AND NOTE 3 REVISED.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14
D		GUSSET DIMS MODIFIED, NOTES MODIFIED	AECOM	RL	3/20	KMo	3/20	AB	3/20	AB	3/20	AH	8/20

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THIS DRAWING SUPERSEDES TP62588/4

STANDARD DRAWING

220 kV GANTRY
CONCRETE POLE
BEAM DETAILS

TRANSPOWER PROJECT CODE
IP_1920_242_01

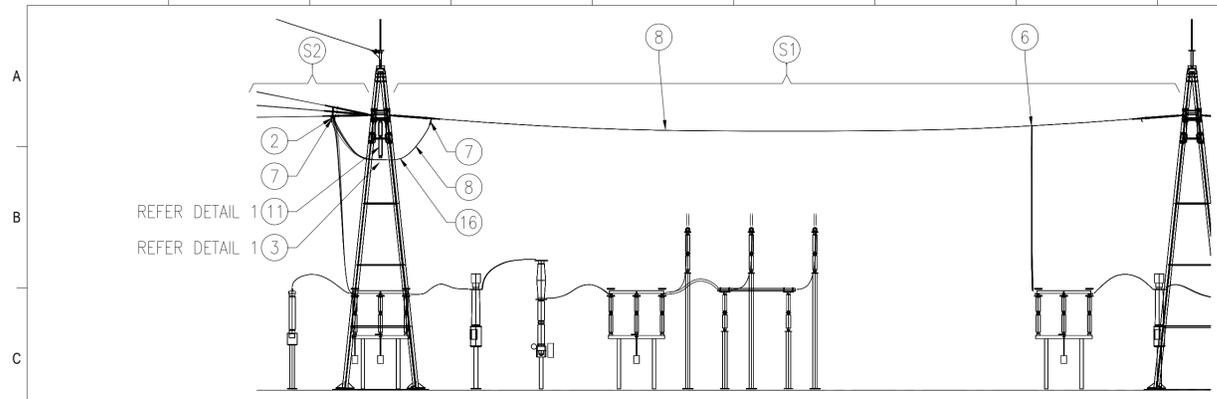
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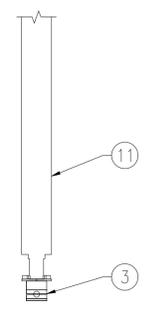
DRAWING CREATED BY:
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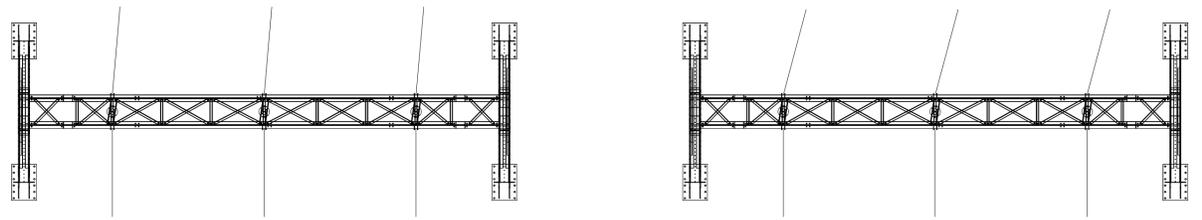
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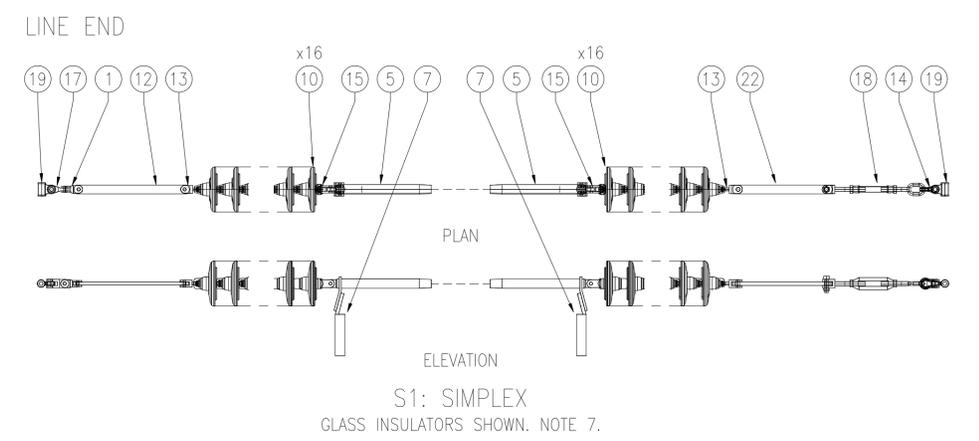
BREAKER & HALF
ONE HALF OF DIAMETER SHOWN. FITTINGS MIRRORED ABOUT GANTRY.



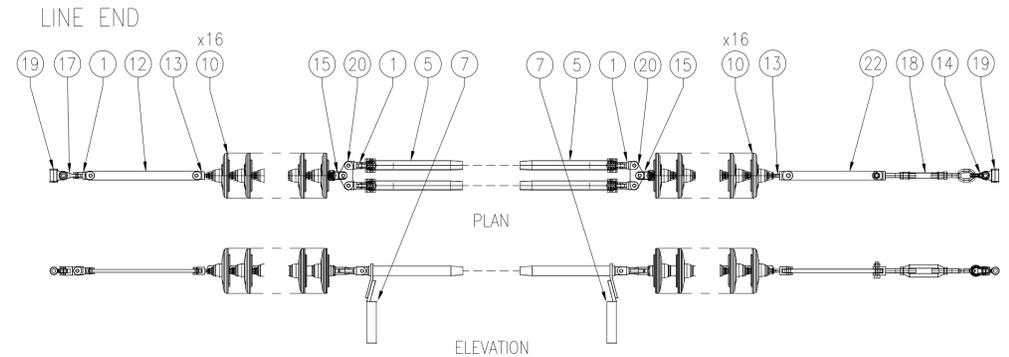
DETAIL 1
SIMPLEX SHOWN AS EXAMPLE.



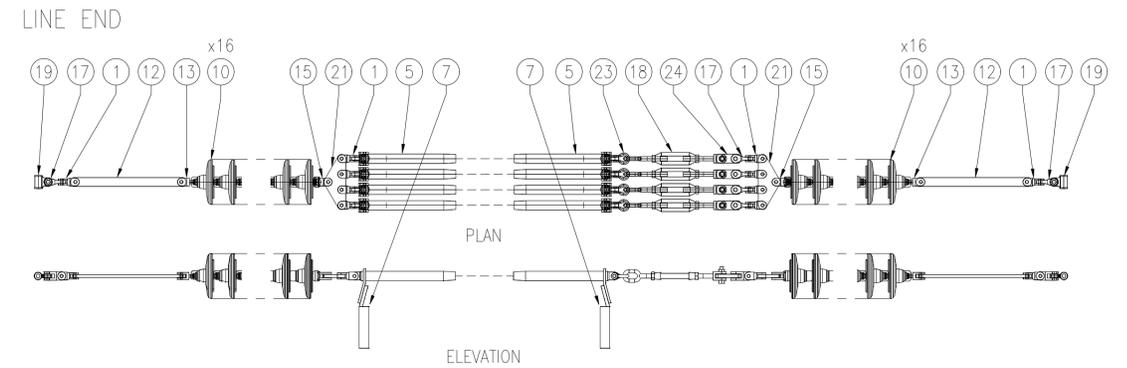
0° TO 10° TURN-OFF ANGLE S2 LOCATION PLAN 10° TO 30° TURN-OFF ANGLE



S1: SIMPLEX
GLASS INSULATORS SHOWN. NOTE 7.



S1: DUPLEX
GLASS INSULATORS SHOWN. NOTE 7.



S1: QUAD
GLASS INSULATORS SHOWN. NOTE 7.

NOTES

- FITTINGS ITEMISED ARE FOR A-FRAME AND CONCRETE POLE GANTRIES. WHEN USED WITH OTHER GANTRY STRUCTURES, COMPATIBILITY OF ATTACHMENT POINTS TO BE CHECKED.
- QUANTITIES ARE FOR ONE DIAMETER OF 220 kV BREAKER AND A HALF (2 SPANS AND 3 GANTRIES). QUANTITIES FOR OTHER CONFIGURATIONS TO BE AMENDED AS APPROPRIATE.
- THIS DRAWING ASSUMES THE USE OF A TRANSITION PLATE (TP69249) FOR ALL LINE SIDE/CICADA CONNECTIONS I.E. ONLY 58 x 35mm CICADA COMPRESSION TERMINALS ARE LISTED.
- SAG LIMITS IDENTIFIED ON TP65059/1 AND TP65059/7.
- THE SCHEDULE OF FITTINGS ASSUMES THAT BUTTERFLY WILL BE USED ON THE STATION SIDE WITH GOAT OR ZEBRA ON THE LINE SIDE, OR CICADA WILL BE USED ON THE STATION SIDE WITH PHEASANT, MOA AND CHUKAR ON THE LINE SIDE.
- TRANSITION PLATE REQUIRED FOR DUPLEX LINE TERMINATION TO QUAD STATION JUMPER ARRANGEMENT. OTHERWISE IT IS ASSUMED THAT THE NUMBER OF SUBCONDUCTORS ON THE LINE AND STATION SIDE IS EQUAL.
- POLYMER INSULATOR L011763 (ITEM 9) REPLACES GLASS INSULATOR STRING AS REQUIRED. DESIGNER TO ENSURE POLYMER INSULATORS DO NOT EXCEED 80% OF SPECIFIED MECHANICAL LOAD.
- POLYMER INSULATORS TO BE CONSIDERED IN PLACE OF GLASS INSULATOR STRINGS FOR SUBSTATION SITES WITHIN VERY HIGH CORROSION/POLLUTION CLASSIFICATIONS. REFER TP.DS 01.05, APPENDIX A, FOR LIST OF APPLICABLE SITES.

REFERENCE DRAWINGS

TF27505	101B9	LINE TERMINATIONS, ANCHORING DEVICE TO STATION STRUCTURE
TP65059/1-6	STD/3D1	220KV GANTRY A-FRAME
TP65059/7-10	STD/3D1	220KV GANTRY CONCRETE POLE

Item	S1 (and jumpers)						S2						Conductor Configuration	Conductor Name	Insulator Type			
	Simplex		Duplex		Quad		Simplex		Duplex		Quad							
	Butterfly	Cicada	Butterfly	Cicada	Butterfly	Cicada	Butterfly	Cicada	Butterfly	Cicada	Butterfly	Cicada						
	Composite	Glass	Composite	Glass	Composite	Glass	Composite	Glass	Composite	Glass	Composite	Glass	Butterfly	Cicada	Butterfly	Cicada	Butterfly	Cicada

Item	Quantity (Refer NOTE 2)												Description	Stock Code or Manufactures No.	Drawing Reference	Supplier	Comment
1	6	6	6	6	30	30	30	30	60	60	60	60	Twisted clevis clevis, 18mm M16 clevis, 18mm M16 clevis, 70kN	L022636	TF25534	TP	
2													Transition Plate	L044350/L044351/L044352/AR	TP69249	TP	Note 6
3													Support clamp, Butterfly, Simplex, 127 PCD	EPCSC-BUTTERFLY-P1-127-AL	9984	TP	
3													Support clamp, Cicada, Simplex, 127 PCD	EPCSC-CICADA-P1-127-AL	5539	TP	
3													Support clamp, Butterfly, Duplex 114mm, 127 PCD	EPCSC-BUTTERFLY-P2-127-114-AL	4085	TP	
3													Support clamp, Cicada, Duplex 114mm, 127 PCD	EPCSC-CICADA-P2-127-114-AL	6447	TP	
3													Support clamp, Butterfly, Quad, Flat, 88mm, 127 PCD	EPCSC-BUTTERFLY-P4F-127-88	30777	TP	
3													Support clamp, Cicada, Quad, Flat, 88mm, 127 PCD	EPCSC-CICADA-P4F-127-88	9808	TP	
5	12	12			24	24			48	48			Compression deadend tongue, Butterfly, with lug, 2 x Ø18 @ 50mm	E092533	29711	TP	
5			12	12							48	48	Compression deadend tongue, Cicada, with lug, 4 x Ø18 @ 58 x 35mm	E092531	29711	TP	
6	6	6			12	12			24	24			Compression tee, Butterfly, 2 x Ø18 @ 50mm	E092527	32100	TP	
6			6	6							24	24	Compression tee, Cicada, 4 x Ø18 @ 58 x 35mm	E092525	32100	TP	
7	6	6			12	12			24	24			Compression terminal, Butterfly, 15°, 2 x Ø18 @ 50mm	E092512	29731	TP	
7			6	6							24	24	Compression terminal, Cicada, straight, 4 x Ø18 @ 58 x 35mm	E092513	3162	TP	Note 3
8													Conductor, Butterfly	E092401	NA	TP	
8													Conductor, Cicada	E092403	NA	TP	
9	12				12				12				Insulator, Polymer, Suspension, 220kV, 120kN, socket ball + Corona rings	L011763	E12A-SE590-SB-41	TP	
10	192				192				192				Insulator, Glass disc, 127mm centres, 120kN	E092004S	ENG70126	TP	
11													Insulator, Composite, Line post, 220kV	L011726	2012-NZ-00269-6-3E	TP	
12	6	6	6	6	6	6	6	6	12	12	12	12	Link strap, 2 x Ø18, 16mm thk, 600mm long, 120kN	L022603	TP64500	TP	
13	12	12	12	12	12	12	12	12	12	12	12	12	Ball clevis, 16 ball, 24mm clevis, M20, 120kN	L022511	TP64488	TP	
14	6	6	6	6	6	6	6	6	6	6	6	6	Shackle, 24mm clevis, 20mm shank, M20, 160kN	L022541	TP64484	TP	
15	12	12	12	12	12	12	12	12	12	12	12	12	Socket clevis, 16A socket, 20mm clevis, M16, 120kN	L022520	TP64491	TP	
16					AR	AR	AR	AR	AR	AR	AR	AR	Spacer, Butterfly, Quad, 88mm, Flat	EPCSC-BUTTERFLY-4-88	30799	TP	
16					AR	AR	AR	AR	AR	AR	AR	AR	Spacer, Cicada, Quad, 88mm, Flat	EPCSC-CICADA-M-4F-88	27299	TP	
16					AR	AR	AR	AR	AR	AR	AR	AR	Spacer, Butterfly, Duplex, 114mm	EPCSC-BUTTERFLY-M-2-114	27303	TP	
16					AR	AR	AR	AR	AR	AR	AR	AR	Spacer, Cicada, Duplex, 114mm	EPCSC-CICADA-M-2-114	27305	TP	
17	6	6	6	6	6	6	6	6	6	6	6	6	Twisted clevis tongue, 24mm M20 clevis, 16mm M16 tongue, 70kN	L022538	TP78575	TP	
18	6	6	6	6	6	6	6	6	6	6	6	6	Turnbuckle, clevis-eye, 24mm M20 clevis, 64 x 32mm (R16) eye, 160kN	L022144	TP63618	TP	
19	12	12	12	12	12	12	12	12	12	12	12	12	Twisted barrel tongue, 22mm M20 tongue, 160kN, c/w M20 bolt	L066061	TP28106	TP	
20					12	12	12	12	12	12	12	12	Yoke plate, 16mm thk, 1 x M16 to 2 x M16 @ 114mm, 120kN	EP17237	17237	TP	
21													Yoke plate, 16mm thk, 1 x M16 to 4 x M16 @ 88mm, 120kN	EP11748	11748	TP	
22	6	6	6	6	6	6	6	6	6	6	6	6	Link strap, 2 x Ø22, 20mm thk, 500mm long, 160kN	EP12254	12254	TP	
23									24	24	24	24	Shackle, 22mm clevis 16mm shank, M16, 120kN	L022540	TP64167	TP	
24									24	24	24	24	Link strap, 2 x Ø22, 20mm thk, 75mm long, 160kN	EP12254	12254	TP	

REV	REVISION DESCRIPTION	CONSULTANT						TP				
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE
A	Turnbuckles to centre gantry. Duplex spacing reduced. Triplex Sulphur added.	AECOM	LC	3.10	LC	3.10	PS	8.10	ST	8.10	AR	8.10
B	Quad Square removed. Quad Cicada palms in line. Fittings amended. Title revised.	TP/AES	GFB	3.14	GFB	3.14	CTB	5.14	CTB	5.14	RD	7.14
C	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGES TO UPPER CASE											
D	Items 1, 3, 5, 6, 7, 9-15, 16, 17 & 20-21 updated. S1 Simplex, Duplex and Quad diagrams modified. Items 22-24 added, Triplex Sulphur removed. Drawing title modified. Note 8 added.	AECOM	KMa	12/19	KMa	12/19	TC	12/19	AB	1/20	AH	8/20
	Item 20 updated	AECOM	KMa	4/21	KMa	4/21	AB	4/21	AB	4/21	QH	4/21

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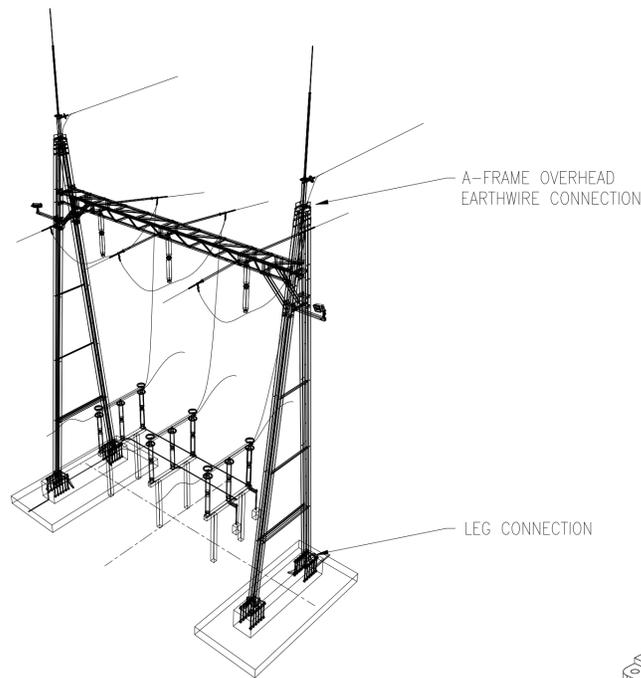
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STANDARD DRAWING
220KV GANTRY
STATION SIDE
FITTINGS AND HARDWARE

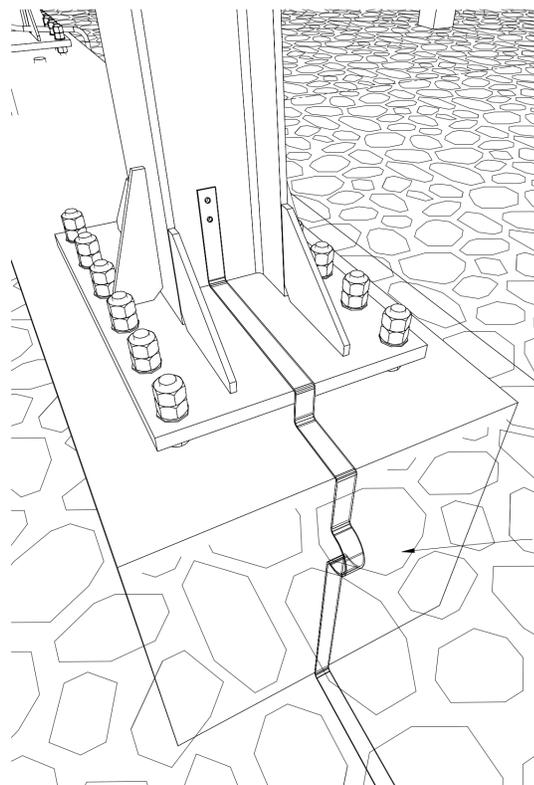
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DRAWING NUMBER TP65059	SHEET REVISION 12 D
DRAWING CREATED BY: MAUNSELL (WPT TPRE 007) PO Box 27-277 Wellington	SCALE N.T.S



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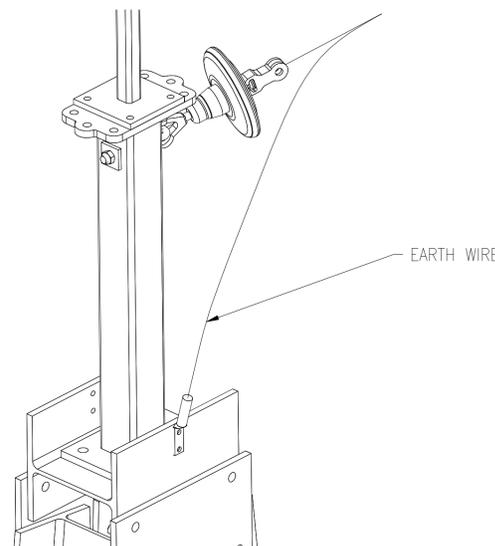
A-FRAME GANTRY



A-FRAME LEG CONNECTION
2 DIAGONALLY OPPOSITE CONNECTIONS TO GANTRY LEGS.
50x4 Cu STRAP, LENGTH TO SUIT.
CADWELD CONNECTION TO STATION EARTHGRID, QTY. 2
M12 BOLT, NUT & WASHER, QTY.

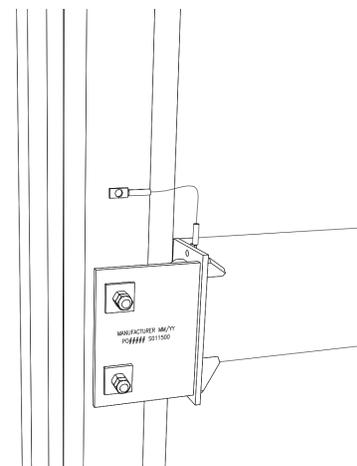
R60 LOOP TO ALLOW MOVEMENT
IN EARTHQUAKE, TYPICAL.

POLE OVERHEAD EARTHWIRE CONNECTION



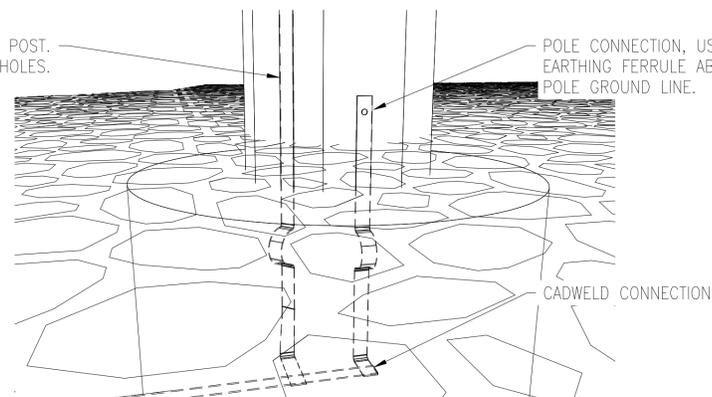
A-FRAME OVERHEAD EARTHWIRE CONNECTION

LIGHTNING POST CONNECTION
50x4 Cu STRAP, LENGTH TO SUIT.
M12 BOLT, NUT & WASHER, QTY.

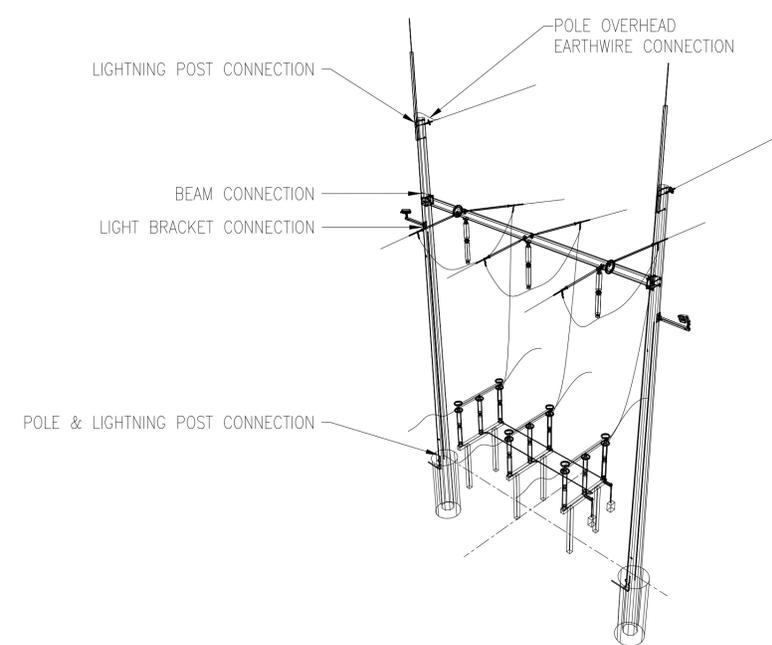


BEAM CONNECTION
CONNECT EACH END OF BEAM.
XLPE L033080, LENGTH TO SUIT.
TERMINAL L044456, QTY. 4
M16 SET SCREW L066114 & LARGE WASHER L066174, QTY. 2
M16 BOLT, NUT & WASHER L066402, QTY. 2

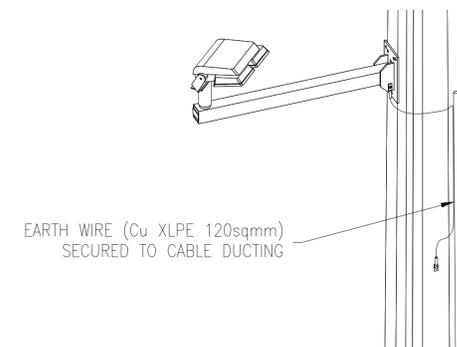
CONNECTION TO LIGHTNING POST.
SECURE TO POLE USING STEP BOLT HOLES.



POLE & LIGHTNING POST CONNECTION
CONNECTIONS TO EACH GANTRY POLE.
50x4 Cu STRAP, LENGTH TO SUIT.
CADWELD CONNECTION TO STATION EARTHGRID, QTY. 4
M16 SET SCREW L066114 & LARGE WASHER L066174, QTY. 2



CONCRETE POLE GANTRY



LIGHT BRACKET CONNECTION
CONNECT EACH BRACKET WITH XLPE L033080, LENGTH TO SUIT.
TERMINAL L044456, QTY. 2
M16 SET SCREW L066114 & LARGE WASHER L066174, QTY. 1
M16 BOLT, NUT & WASHER L066402, QTY. 1
(QUANTITIES ABOVE ARE BASED ON ONE LIGHT BRACKET)

NOTES:

1. QUANTITIES ARE FOR ONE GANTRY.
2. CONNECT STATION EARTHGRID TO GANTRIES WITH 50x4 mm COPPER STRAP.
3. CADWELD ALL UNDERGROUND COPPER JOINTS.
4. FASTEN EARTHS TO GANTRIES AT 1 m INTERVALS OR LESS.
5. CONTACT SURFACES ABOVE GROUND TO BE THOROUGHLY CLEANED AND COATED WITH NON-DRYING, WATER REPELLENT, LOW RESISTANCE, CORROSION INHIBITING GREASE PRIOR TO FASTENING. TIN COPPER CONTACT AREA WHERE CONNECTION IS MADE TO GALVANIZED STEEL.

REFERENCE DRAWINGS:

TF25438	GEN/101.5E	ELECTRICAL BONDING DETAILS FOR CONCRETE POLES.
TP65059/7-10	STD/3D1	220 kV GANTRY CONCRETE POLE
TP65059/1-6	STD/3D1	220 kV GANTRY A-FRAME

THIS DRAWING SUPERSEDES TP62814

REV	REVISION DESCRIPTION	CONSULTANT										TP		
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	APP	DATE
A	Title revised	AECOM	ST	7.10	TC	7.10	DH	8.10	DW	8.10	AR	8.10		
B	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14		
C	Optional light fitting appearance updated	AECOM	-	-	LC	3.18	ARB	3.18	ARB	3.18	QH	3.18		
D	TEXT MODIFICATIONS	AECOM	RL	3/20	KMo	3/20	PS	3/20	AB	3/20	AH	8/20		



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STANDARD DRAWING

220 kV GANTRY
A-FRAME AND CONCRETE POLE
EARTHING CONNECTIONS

TRANSPOWER PROJECT CODE
IP_1920_242_01

FOLDER
STD/3D1

DRAWING NUMBER
TP65059

SHEET REVISION
13 D

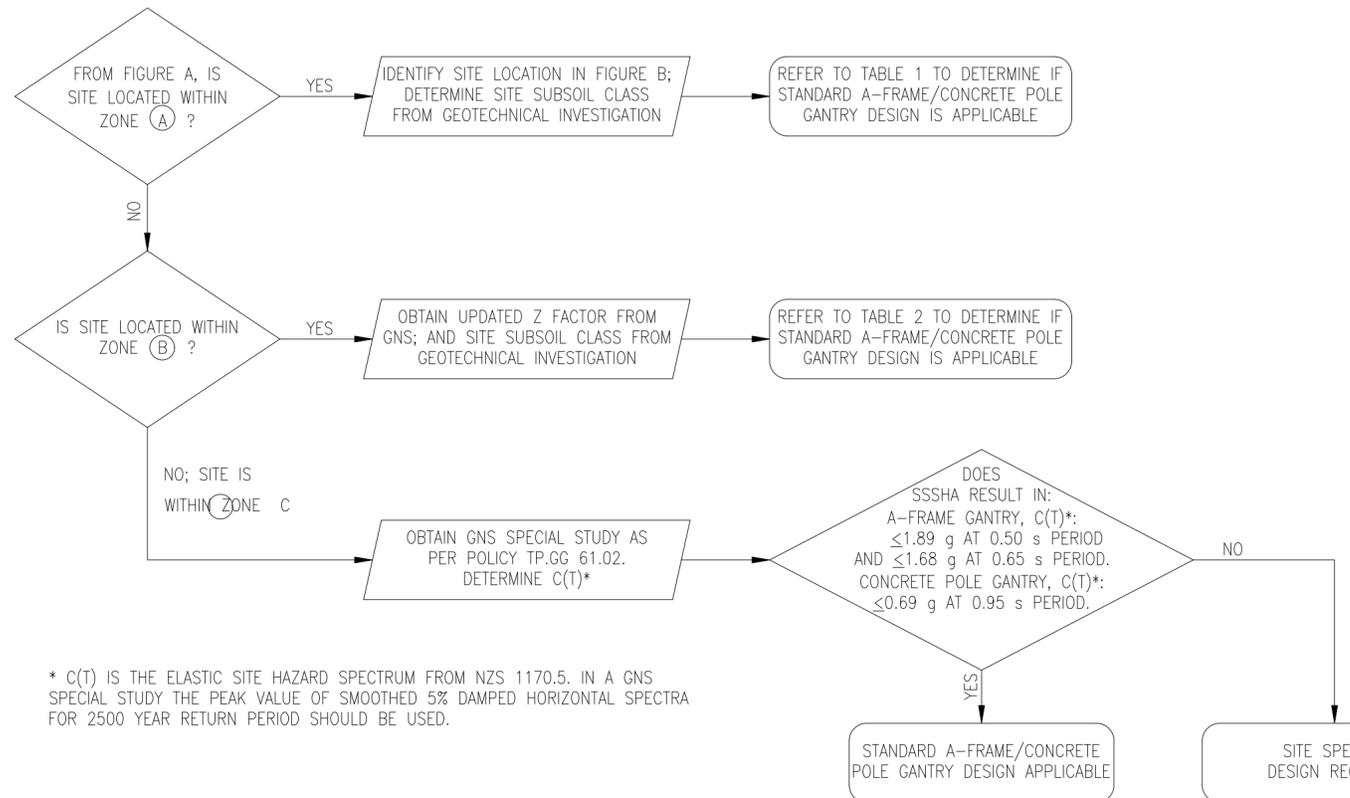
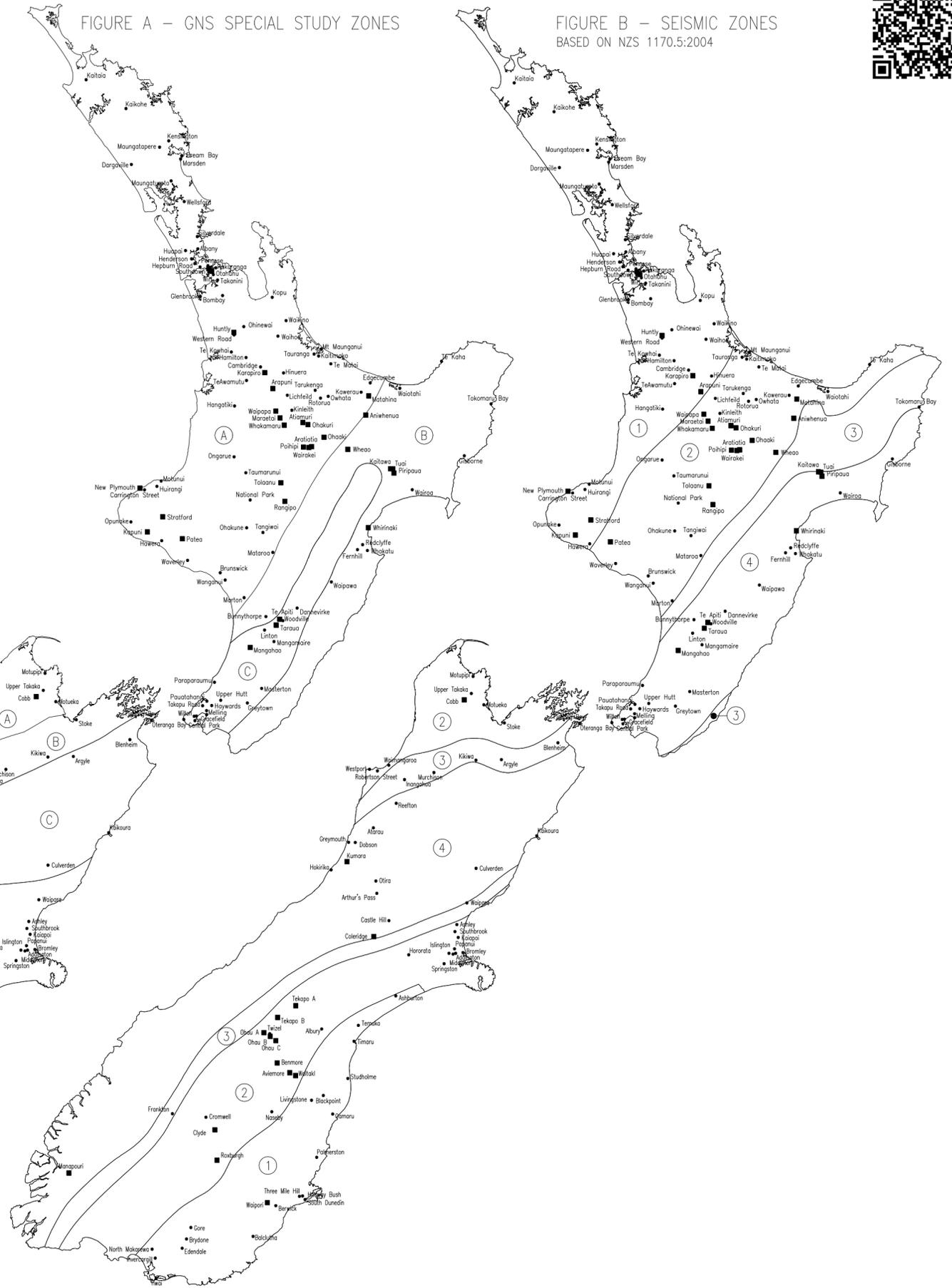
DRAWING CREATED BY:
MAUNSELL (WPT TP65059)
PO Box 27-277 Wellington

SCALE
As Shown



FIGURE A – GNS SPECIAL STUDY ZONES

FIGURE B – SEISMIC ZONES
BASED ON NZS 1170.5:2004



* C(T) IS THE ELASTIC SITE HAZARD SPECTRUM FROM NZS 1170.5. IN A GNS SPECIAL STUDY THE PEAK VALUE OF SMOOTHED 5% DAMPED HORIZONTAL SPECTRA FOR 2500 YEAR RETURN PERIOD SHOULD BE USED.

TABLE 1 – SELECTION ZONES BASED ON FIGURE B

SEISMIC ZONE	SITE SUBSOIL CLASS							
	A-FRAME				CONCRETE POLE			
	B	C	D	E	B	C	D	E
1	✓	✓	✓	✓	✓	✓	✓	X
2	✓	✓	✓	✓	✓	✓	X	X
3	✓	✓	✓	X	✓	X	X	X
4	✓	✓	X	X	✓	X	X	X

TABLE 2 – SELECTION ZONES BASED ON UPDATED Z

UPDATED Z	SITE SUBSOIL CLASS							
	A-FRAME				CONCRETE POLE			
	B	C	D	E	B	C	D	E
≤0.19	✓	✓	✓	✓	✓	✓	✓	X
0.20–0.31	✓	✓	✓	✓	✓	✓	X	X
0.32–0.35	✓	✓	✓	X	✓	X	X	X
0.36–0.60	✓	✓	X	X	✓	X	X	X

TABLES 1 & 2 SHOWS THE DESIGN IS SUITABLE (✓) OR IF SITE SPECIFIC DESIGN IS REQUIRED (X) BASED ON SEISMIC REQUIREMENTS.

TABLE 3 – SEISMIC DESIGN PARAMETERS

PARAMETER	A-FRAME								CONCRETE POLE			
	TRANSVERSE				LONGITUDINAL							
STRUCTURE PERIOD, T	0.65				0.50				0.95			
HAZARD FACTOR, Z	0.60	0.60	0.35	0.32	0.60	0.60	0.35	0.32	0.60	0.31	0.19	0.12
RETURN PERIOD FACTOR, R	1.8				1.8				1.8			
SITE SUBSOIL CLASS	B	C	D	E	B	C	D	E	B	C	D	E
SPECTRAL SHAPE FACTOR, C _s (T)	1.31	1.64	2.67	3.00	1.60	2.00	3.00	3.00	0.99	1.24	2.01	3.00
ELASTIC SITE HAZARD SPECTRUM, C(T)	0.92	1.15	1.68	1.73	1.12	1.40	1.89	1.73	0.69	0.69	0.69	0.65
DUCTILITY FACTOR, μ	1.25				1.25				1.25			
HORIZONTAL DESIGN ACTION COEFFICIENT, C _a (T)	0.69	0.86	1.26	1.28	0.88	1.10	1.48	1.28	0.51	0.51	0.51	0.48

TABLE 3 IDENTIFIES THE NZS 1170.5 PARAMETERS USED TO DERIVE THE HORIZONTAL DESIGN ACTION COEFFICIENT FOR THE DESIGN OF THE GANTRIES. THE COMBINATION THAT GOVERNS THE DESIGN IS PRESENTED IN BOLD. TABLE 3 ALSO IDENTIFIES OTHER COMBINATIONS OF HAZARD FACTOR AND SITE SUBSOIL CLASS THAT WILL RESULT IN THE SAME OR LESSER HORIZONTAL DESIGN ACTION COEFFICIENT.

BACKGROUND INFORMATION REGARDING GNS SPECIAL STUDY ZONES

TRANSPOWER'S SEISMIC POLICY TP.GG 61.02 ISSUE 2 APR 2009 REQUIRES THAT ALL TRANSPOWER SITES HAVE A SPECIAL STUDY TO DETERMINE THE SEISMIC HAZARD SPECTRA. TP.GG 61.02 ISSUE 3 DELETED THIS REQUIREMENT.

HOWEVER, AS PART OF THE 33 kV BUILDING STANDARD SUBSTATION SEISMIC ZONE STUDY, 30 JULY 2009, TRANSPOWER, AECOM AND GNS HAVE AGREED AN APPROACH TO REDUCE THE AREAS WHERE GNS SPECIAL STUDY ARE REQUIRED TO BE COMPLETED. REFER TO FIGURE A. ZONES CAN GENERALLY BE DESCRIBED AS FOLLOWS:

- (B) UPDATED Z FACTOR ZONE – <50 km FROM ALL MAJOR FAULT LINE AND NOT IN GNS SPECIAL STUDY ZONE.
- (C) GNS SPECIAL STUDY ZONE – <10 km FROM THE MOST ACTIVE FAULTS.

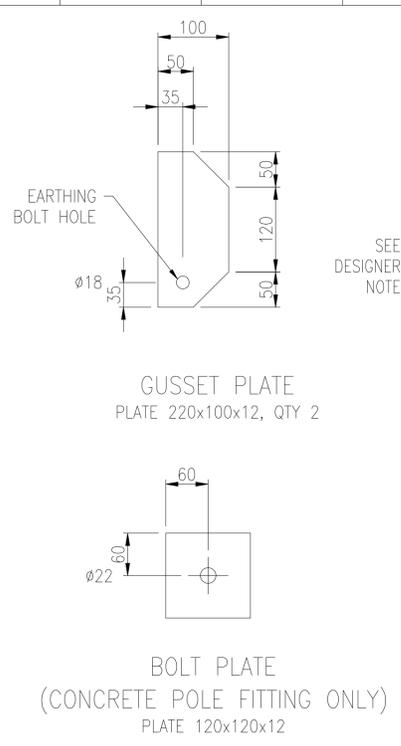
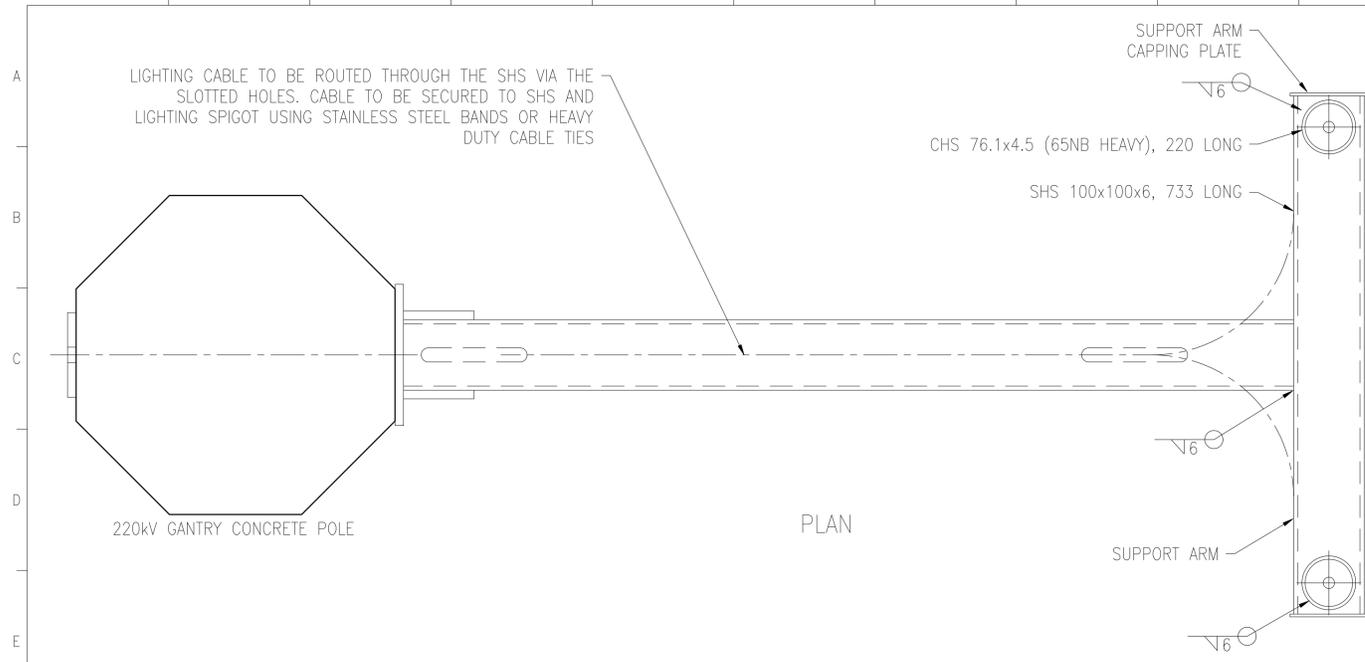
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		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	
A	TITLE REVISED TO STANDARD DRAWING; TEXT CHANGED TO UPPER CASE.	TP/AES	GFB	11.13	GFB	11.13	CTB	5.14	CTB	5.14	RD	7.14	
B	ALL ZONING FOR CHRISTCHURCH REVISED.	TP/AES	GFB	07.15	GFB	7.15	CTB	9.15	CTB	9.15	RD	9.15	
C	ZONE C DECISION TEXT MODIFIED. SSSHA REQUIREMENT UPDATED.	AECOM	TC	10.19	KMa	10.19	AB	1.20	ST	1.20	AH	8/20	

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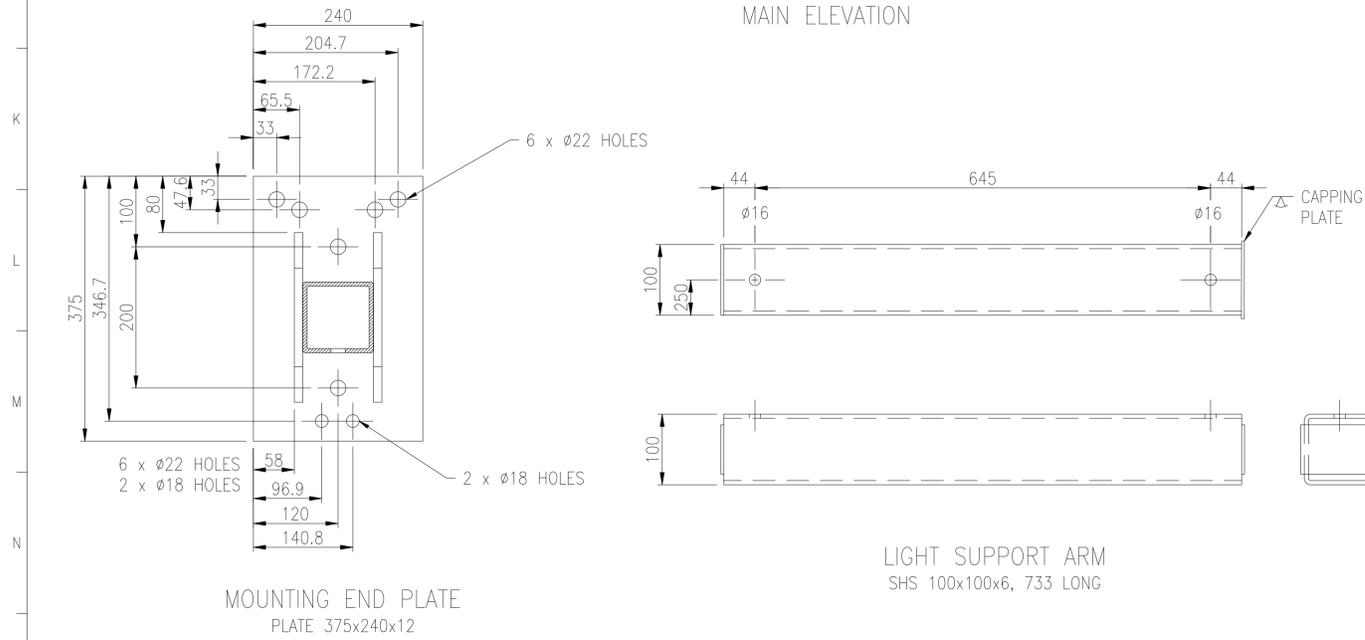
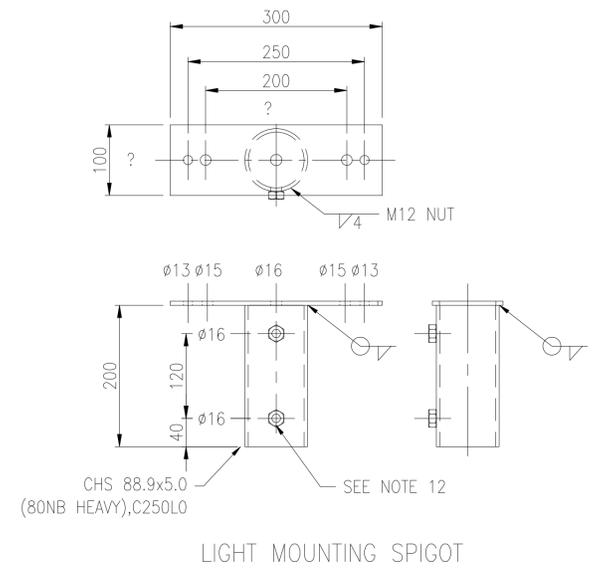
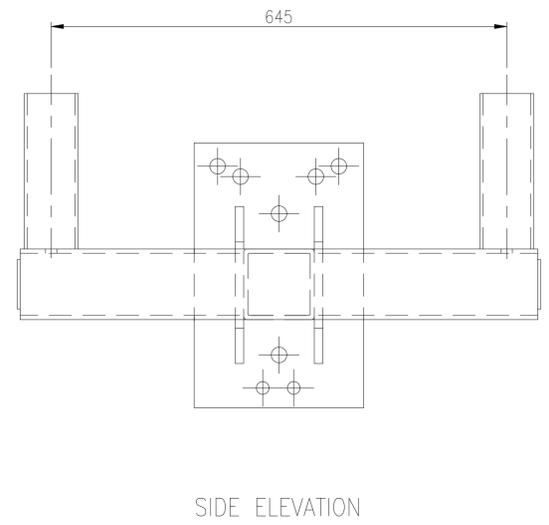
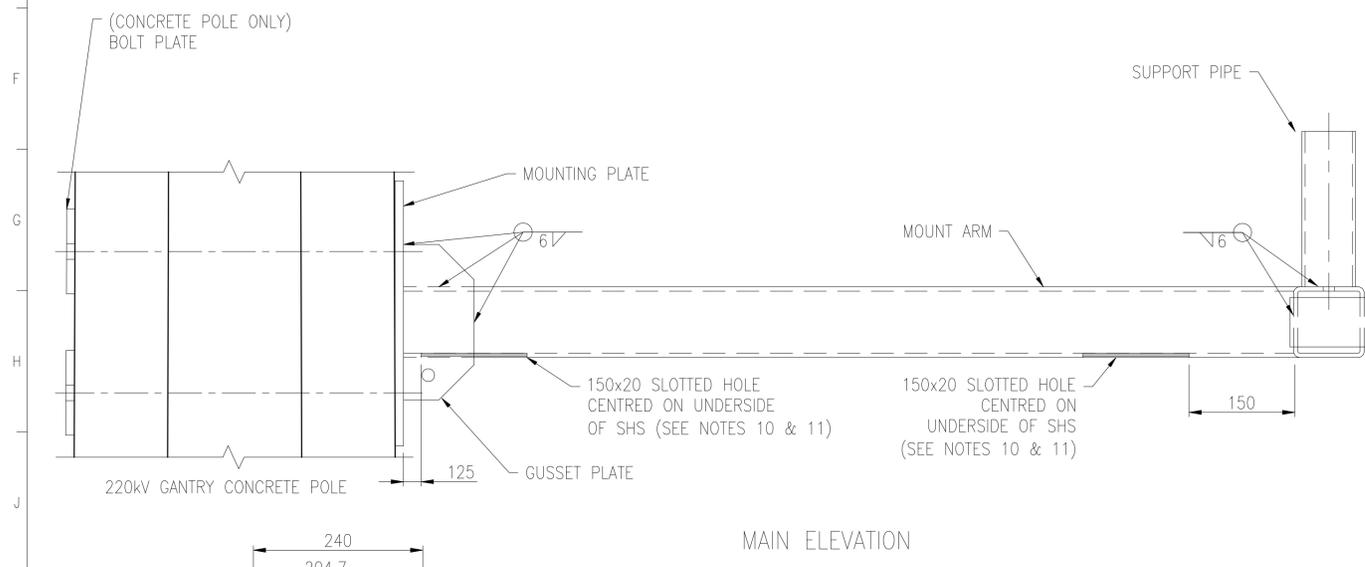
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STANDARD DRAWING
220 kV GANTRY
A-FRAME & CONCRETE POLE
SEISMIC SELECTION CRITERIA

TRANSPOWER PROJECT CODE IP_1920_242_01	FOLDER STD/3D1
DRAWING NUMBER TP65059	SHEET REVISION 14 C
DRAWING CREATED BY: MAUNSELL (WPT TPRE 007) PO Box 27-277 Wellington	SCALE N.T.S.



MATERIAL LIST (Quantities for one bracket)		
DESCRIPTION	MATERIAL	QUANTITY
MOUNTING END PLATE	PLATE, 375x240x12, GRADE 300L0	1
BOLT PLATE - CONCRETE POLE ONLY	PLATE, 120x120x12, GRADE 300L0	2
MOUNTING BOLTS - CONCRETE POLE ONLY	M20x525mm WITH NUT, LOCKING NUT, WASHER, GRADE 8.8	2
EARTHING CONNECTION - CONCRETE POLE ONLY	LO33080 EARTH CABLE CUT TO SUIT LENGTH (1), L044456 COMPRESSION JOINT (2), L066114 M16 SET SCREW (1), L066274 WASHER (1), L066402 M16 BOLT, NUT & WASHER (1)	SEE MATERIAL COLUMN (QTY)
MOUNTING BOLTS - A-FRAME	M20x75mm WITH NUT, LOCKING NUT, SQUARE PLATE WASHER, GRADE 8.8	2
MOUNT ARM	SHS, 100x100x6, 1260 LONG, GRADE 350L0	1
SUPPORT ARM	SHS, 100x100x6, 733 LONG, GRADE 350L0	1
SUPPORT ARM CAPPING PLATE	PLATE, 110x70x4, GRADE 300L0	2
SUPPORT PIPE	CHS, 76.1x4.5 (65NB HEAVY), 220 LONG, GRADE C250L0	2
LIGHT SPIGOT - FLAT	FLAT, 100x6, 300 LONG, GRADE 300L0	2
LIGHT SPIGOT - CHS	CHS, 88.9x5.0 (80NB HEAVY), 200 LONG, GRADE C250L0	2
LIGHT SPIGOT - LOCKING BOLT/NUT	M12 NUTS (4) SUPPLIED WITH M12x40 (2) LOCKING BOLTS	2
GUSSET PLATE	PLATE, 220x100x12, GRADE 300L0	2



DESIGNER NOTES (TO BE REMOVED BEFORE ISSUING FOR CONSTRUCTION)

- a. DESIGNER TO CONFIRM A-FRAME OR CONCRETE POLE MOUNTING. REMOVE UNWANTED ITEMS FROM THE MATERIAL LIST WHICH ARE NOT REQUIRED.
- NOTES:
- THIS LIGHTING BRACKET IS A UNIVERSAL FIT. IT CAN BE MOUNTED ON EITHER THE 220kV CONCRETE POLE (2 BOLTS) OR ANY OF THE 220kV A-FRAME LEG MEMBERS (3 BOLTS). SEE TP65059/17 FOR MOUNTING LAYOUT DETAILS.
 - DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
 - STEEL CONSTRUCTION IN ACCORDANCE WITH NZS 5131.
 - STEEL FLAT, PLATE TO BE GRADE 300L0 TO AS/NZS 3678. STEEL SHS SHALL BE GRADE 350L0 TO AS/NZS 3679.1. CHS SHALL BE GRADE C250L0 TO AS/NZS 1163.
 - BOLTS AND THREADED RODS SHALL BE GRADE 8.8, TO AS/NZS 1252:1996 (EACH SUPPLIED WITH A NUT, LOCK NUT AND WASHER). HOT DIP GALVANIZE TO AS/NZS 1214:1983
 - WELDING SHALL BE CATEGORY SP GRADE 48XX/W50X (480 MPa) TO AS/NZS 1554.1:2004. CONTINUOUS FILLET WELDS, THICKNESS EQUAL TO SMALLEST SECTION JOINED UP TO 6 mm UNLESS NOTED OTHERWISE.
 - HOT DIP GALVANIZE ALL STEEL SECTIONS TO AS/NZS 4680:2006.
 - DAMAGE TO GALVANIZING MUST BE REPAIRED AS SPECIFIED IN TP.PS 01.02
 - MAXIMUM DESIGN WIND SPEED FOR THE LIGHTING BRACKET IS 76 m/s.
 - ALL EDGES TO BE ROUNDED.
 - CABLE TO BE ROUTED INTERNALLY VIA THE SHS AND THEN TIED TO THE CHS (SPIGOT) WITH STAINLESS STEEL BANDS OR APPROPRIATE HEAVY DUTY CABLE TIES.
 - SPIGOT M12 NUT TO BE WELDED OVER Ø16 HOLE. M12x40 BOLT AND LOCKING NUT TO BE INSTALLED ON WELDED NUT BEFORE SHIPPING.

REFERENCE DRAWINGS:

- TP65059/15 STD/3D3 220kV GANTRY A-FRAME AND CONCRETE POLE LIGHT MOUNTING BRACKET DETAILS - SINGLE LAMP.
- TP65059/17 STD/3D3 220kV GANTRY A-FRAME AND CONCRETE POLE LIGHTING ASSEMBLY AND LAYOUT.

REV	REVISION DESCRIPTION	CONSULTANT										TP	
		CONSLT	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE	APP
A	LIGHTING MOUNT ARM ADDED. TITTLE AND STEEL NOTES REVISED, NOTE 11 AND REF TO SHHET 16 ADDED	AECOM	TC	2.12	TC	2.12	ST	2.12	DW	2.12	AR	7.12	
B	SHEET 16 RENAMED SHEET 17; NEW LIGHTING BRACKET DESIGN.	TP/AES	GFB	3.14	GFB	3.14	CTB	5.14	CTB	5.14	RD	7.14	
C	SEE GRID A2, LIGHTING CABLE TO BE ROUTED..., WAS 4C CABLE TO BE ROUTED...	TP/AES	GFB	1.15	GFB	1.15	CTB	1.15	CTB	1.15	RD	1.15	
D	SHS CABLE SLOT REDUCED FROM 40mm TO 20mm. OTHER MINOR AMMENDMENTS	TP/AES	GFB	6.15	GFB	6.15	CTB	7.15	CTB	7.15	RD	7.15	
E	GUSSET PLATE ADDED TO MATERIAL LIST, CAPPING PLATE & SPIGOT FLAT MODIFIED	AECOM	PS	9.19	KMo	9.19	AB	1.20	ST	1.20	AH	8/20	

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STANDARD DRAWING

220 kV GANTRY

A-FRAME AND CONCRETE POLE

LIGHT MOUNTING BRACKET DETAILS - TWIN LAMPS

TRANSPOWER PROJECT CODE
IP_1920_242_01

FOLDER
STD/3D3

DRAWING NUMBER
TP65059

SHEET
16

REVISION
E

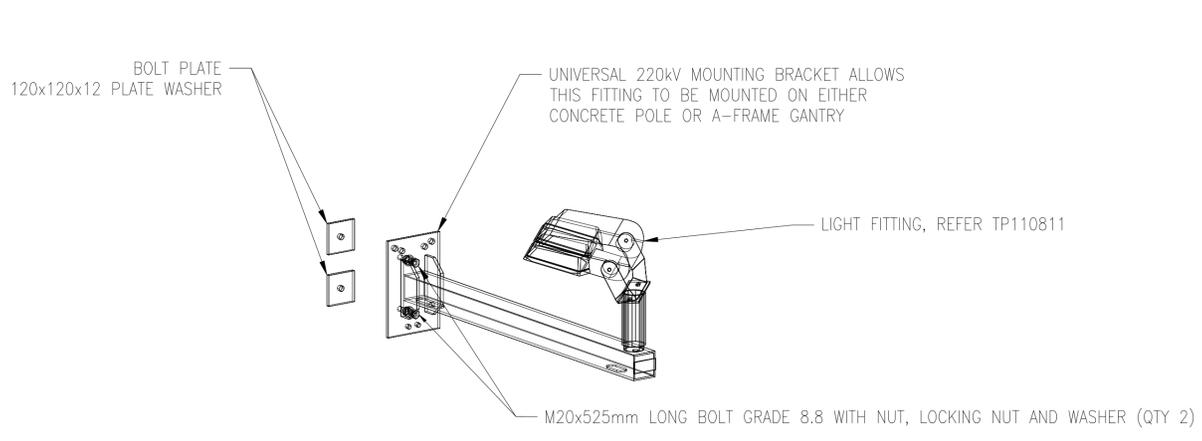
DRAWING CREATED BY:
MAUNSELL (WPT TP6 007)
PO Box 27-277 Wellington

SCALE
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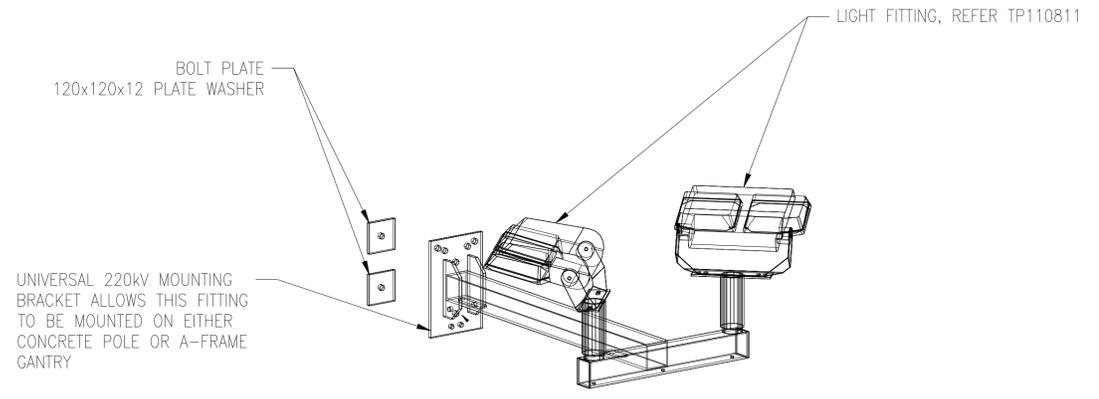
submit your markups to Transpower@redyedms.com

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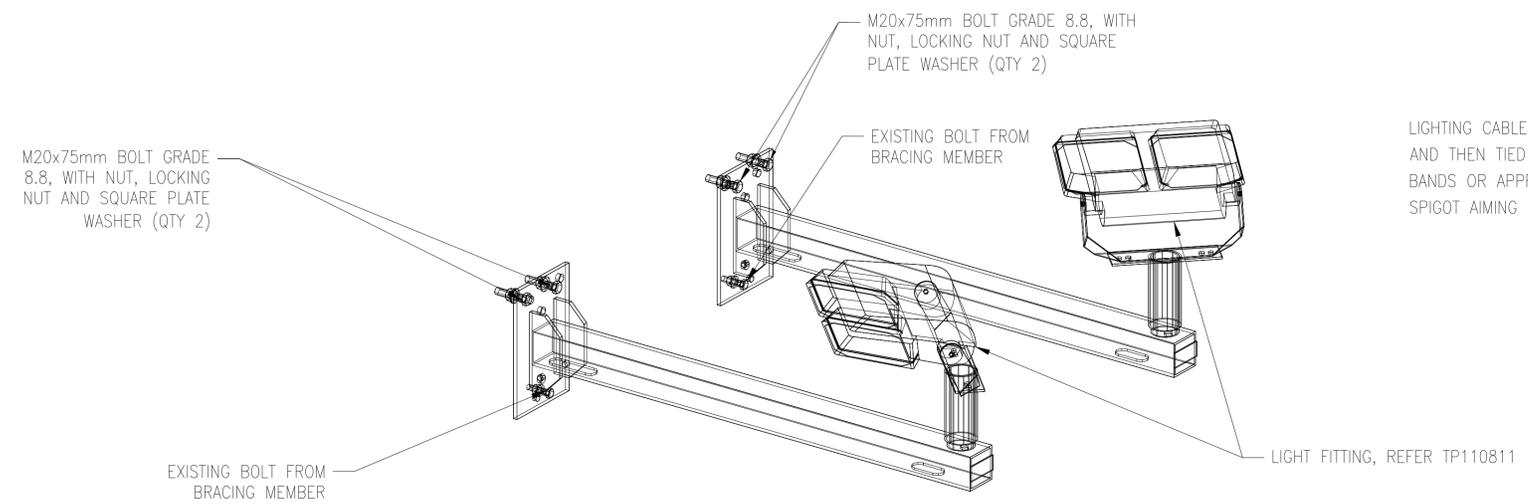


LIGHTING MOUNT INSTALLED ON POLE GANTRY (SINGLE LAMP)
AXONOMETRIC
N.T.S.

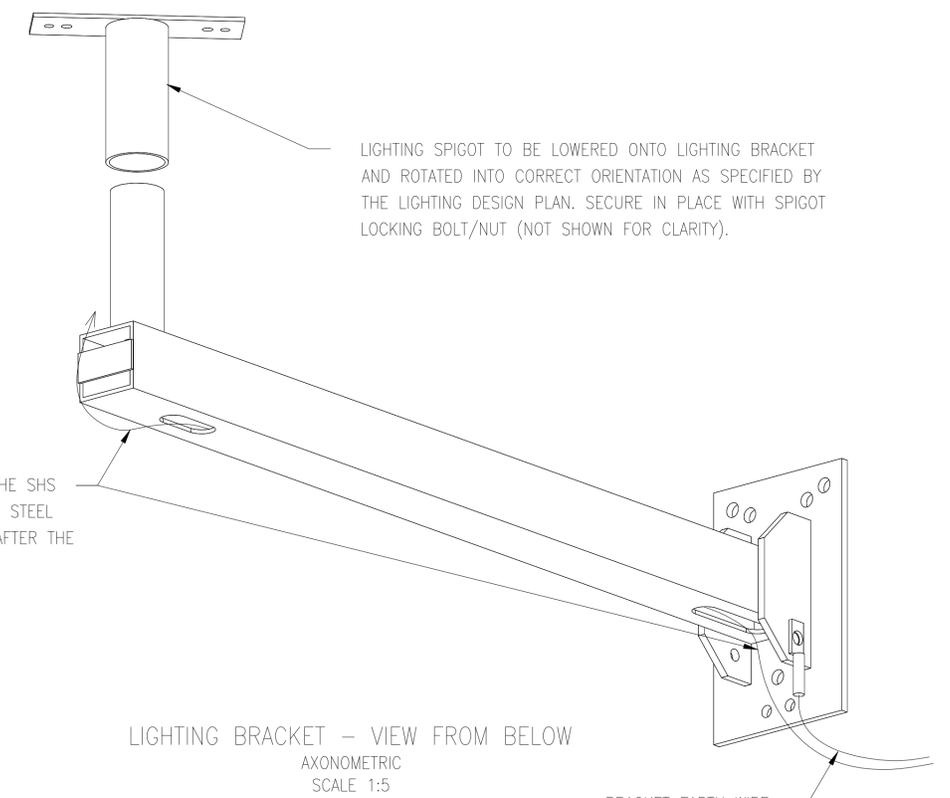


LIGHTING MOUNT INSTALLED ON POLE GANTRY (TWIN LAMP)
AXONOMETRIC
N.T.S.

THE A-FRAME GANTRY LIGHT BRACKET IS A UNIVERSAL FIT. IT CAN BE MOUNTED ON EITHER OF THE LEGS AND IS SECURED IN PLACE BY 3 BOLTS. (2 x M20 AT THE TOP AND AN EXISTING BRACING BOLT AT THE BOTTOM OF THE BRACKET)



LIGHTING MOUNT INSTALLED ON A-FRAME GANTRY
AXONOMETRIC
N.T.S.



LIGHTING BRACKET - VIEW FROM BELOW
AXONOMETRIC
SCALE 1:5

REFERENCE DRAWINGS:

TP65059/1-6	STD/3D1	220 kV GANTRY A-FRAME
TP65059/7-10	STD/3D1	220 kV GANTRY CONCRETE POLE
TP65059/15	STD/3D3	220 kV LIGHTING MOUNTING BRACKET DETAILS - SINGLE LAMP
TP65059/16	STD/3D3	220 kV LIGHTING MOUNTING BRACKET DETAILS - TWIN LAMP
TP110811	STD/3A6, 3D3	220 kV AIR INSULATED SUBSTATION SINGLE BUS - DISCONNECTING CIRCUIT BREAKERS (DCB) LIGHTING LAYOUT AND DESIGN DATA

REV	DESCRIPTION	CONSULTANT										TP		DESIGNED	DRAWN	CHECKED	APPROVED	TP APPROVED
		NAME	DSN	DATE	DRN	DATE	CHK	DATE	APP	DATE	APP	DATE						
-	Lighting Tilt table revised, note 2 added	AECOM	SM	4.12	TC	4.12	ST	4.12	DW	4.12	AR	7.12	S	Masters				02.2012
A	WAS SHEET 16 - LIGHT BRACKET REPLACED WITH NEW DESIGN.	TP/AES	GFB	3.14	GFB	3.14	CTB	5.14	CTB	5.14	RD	7.14	I	Costigan				02.2012
B	Light fitting revised and reference added	AECOM	-	-	LC	3.18	ARB	3.18	ARB	3.18	QH	3.18	D	Wills				02.2012
													A	Renton				07.2012

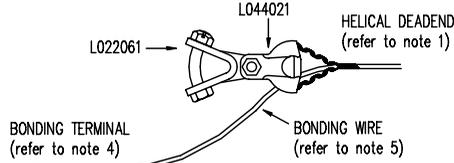
PREPARED BY:
AECOM (WPS TPR 060)
PO Box 27-277, Wellington



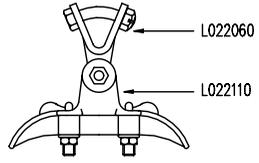
STANDARD DRAWING

220 kV GANTRY
A-FRAME AND CONCRETE POLE
LIGHTING ASSEMBLY AND LAYOUT

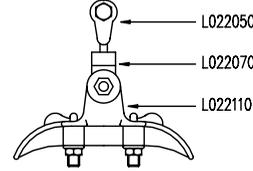
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DRAWING NUMBER		SHEET
TP65059		17
CAD FILE NAME		REVISION
TP65059_17_0.DWG		B



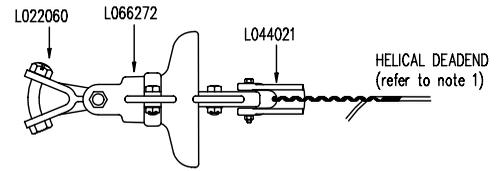
70 kN TENSION EARTHWIRE SET No. 22 (with bond-as shown)
70 kN TENSION EARTHWIRE SET No. 22D (without bond)
 (LOAD CAPACITY 56kN)
 (REFER TO NOTE 6)



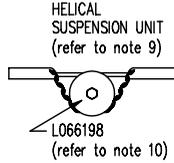
70 kN SUSPENSION EARTHWIRE SET No. 23
 (LOAD CAPACITY 56kN)



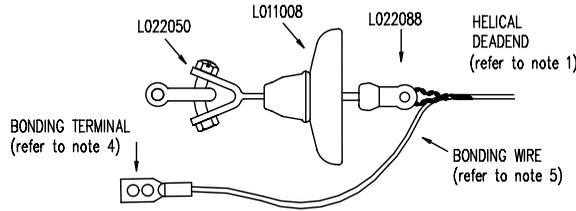
70 kN SUSPENSION EARTHWIRE SET No. 23A
 (LOAD CAPACITY 56kN)



70 kN TENSION EARTHWIRE SET No. 26
 (LOAD CAPACITY 56kN)
 (REFER TO NOTE 8)

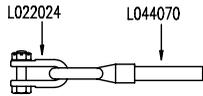


POLE STRUCTURE SUSPENSION EARTHWIRE SET No. 23B
 (LOAD CAPACITY 56kN)
 (REFER TO NOTE 7)

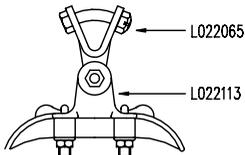


70 kN TENSION EARTHWIRE SET No. 26C
 (LOAD CAPACITY 56kN)
 (REFER TO NOTE 6)

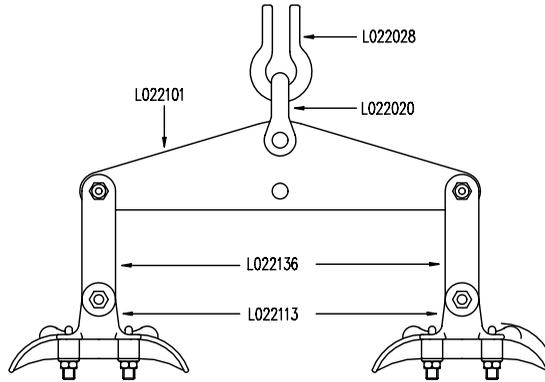
EARTHWIRE SETS FOR 7/2.59 TO 7/3.71mm SC/GZ



190 kN TENSION EARTHWIRE SET No. 24
 (LOAD CAPACITY 152kN)



120 kN SUSPENSION EARTHWIRE SET No. 25
 (LOAD CAPACITY 96kN)



210 kN SUSPENSION EARTHWIRE SET No. 25A
 (LOAD CAPACITY 168kN)

EARTHWIRE SETS FOR 19/2.87mm SC/GZ

NOTES

- Use helical dead end fittings with galvanized steel (except 19/2.87) tension sets. Refer to Service Specification TP.SS 04.16 for stock code of helical dead end required.
- Armour Rods
Helical armour rods are to be fitted to all suspension earthwire sets. Refer to Service Specification TP.SS 04.16 for stock code of helical fitting required.
- Earthwire sets for ASCR up to Wolf on drawing TP60984
Earthwire sets for SC/AC on drawing TF25187
Earthwire sets for Copper on drawing TP60985
- Bonding wires shall be installed at the station structure and at the terminal tower.
Bonding terminal to suit earthwire size. Use compression fitting with two bolt holes on each terminal.
Refer to Service Specification TP.SS 04.16 for stock code of terminal required.
- Earth bond jumper assemblies are depicted on drawing TP61154
- Use earthwire set No. 26C at the station structure end of the terminal spans.
Use earthwire set No. 22 at the tower end of the terminal span.
- The earthwire set is only to be used on standard suspension structures where the turnoff angle is between 0° and 10°.
- The earthwire set is only to be used with the approval of Transpower NZ Ltd.
- Refer to Service Specification TP.SS 04.16 for stock code of helical suspension unit required.
- Refer to drawing TF25484 for details on attachment of this earthwire set to pole earthwire bracket.
- The stated load capacity includes a strength reduction factor of 0.8.
Ensure the set load capacity is not exceeded under any relevant load case in TP.DL 12.01.

E	Assembly #25A Component Modified	RCB	K.McC	WDM	6/95
F	Redrawn	RCB	K.McC	WDM	8/96
G	Title and stock codes amended,idents added.	TN	K.McC	TEJ	7.98
H	Stock codes, folder reference and notes amended.	TN	K.McC	TEJ	10.98
J	Insulator set 22A amended.	TN	K.McC	TEJ	12.01
M	Minor errors corrected	ML	RB	GI	11.06
N	Copper sets removed to TP60985, title amended	DRN	CHFD	TP APP	DATE
REV	DESCRIPTION				

PREPARED	AC POWER GROUP LTD
DRAWN	RICHARD. J. LOCK. 02/91
CHECKED	PHILIP. A. HOBY. 02/91
APPROVED	JOHN. A. CRABTREE. 02/91
RECORD'D	KEITH. I. McCALLUM. 02/91
T.P. APP.	WALLY. D. MARSHALL. 02/91



STANDARD T. L. DRAWINGS

EARTHWIRE SETS:
 22, 22D, 23, 23A, 23B, 24, 25, 25A, 26, 26C
 FOR 7/2.59 TO 19/2.87mm SC/GZ

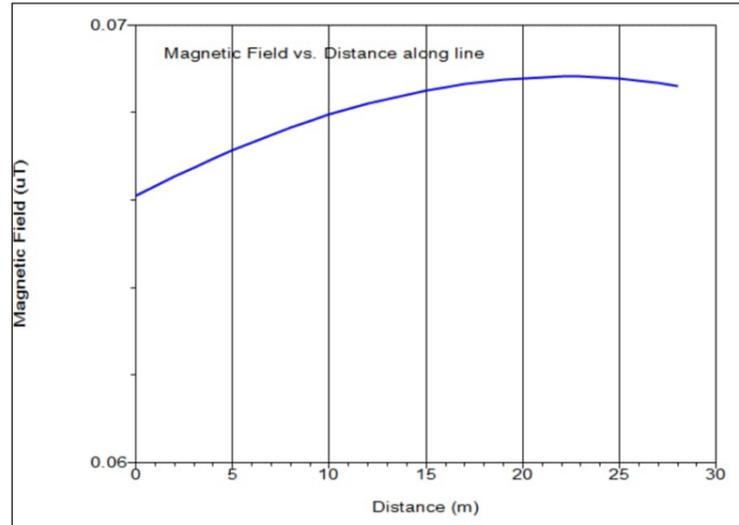
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			N
CADD FILE NAME.		TF25009	

Appendix M

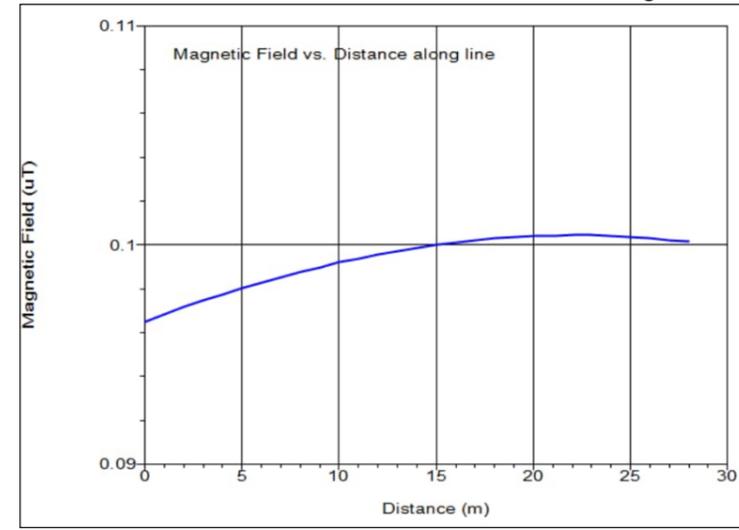
EMF Ratings

PLS CADD EMF Rating Calculation

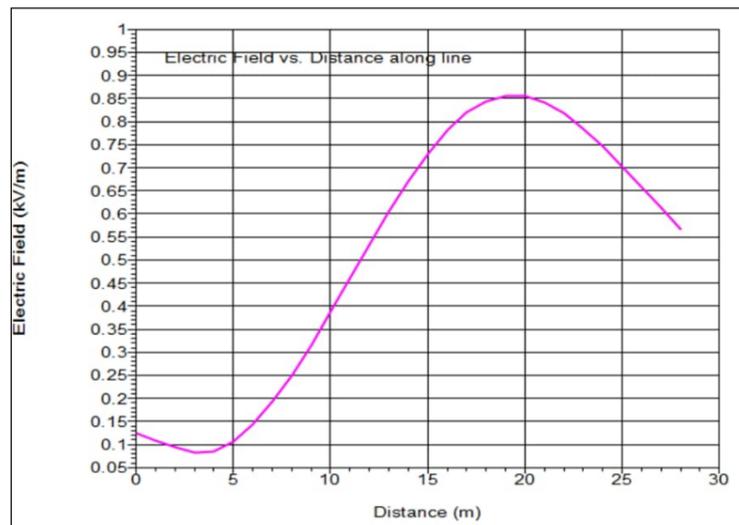
Magnetic Field vs. Time
T80-T83A 75% of Latta Conductor Rating



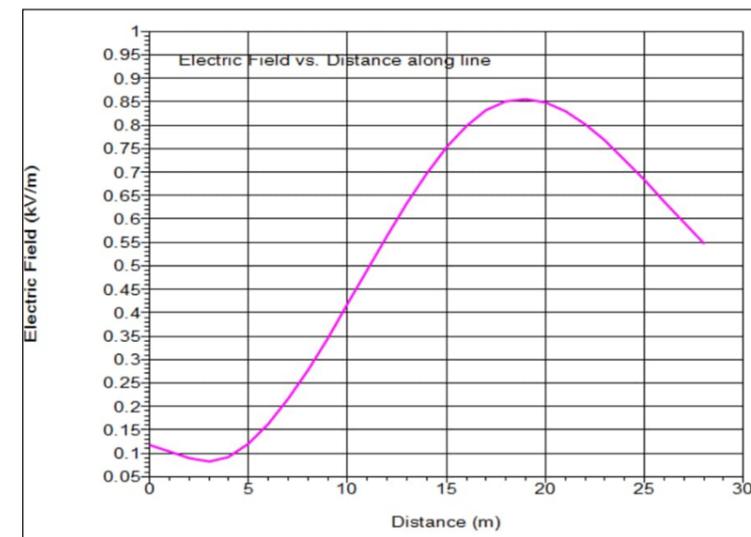
Magnetic Field vs. Time
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Electric Field vs. Distance along Line
T80-T83A 75% of Latta Conductor Rating

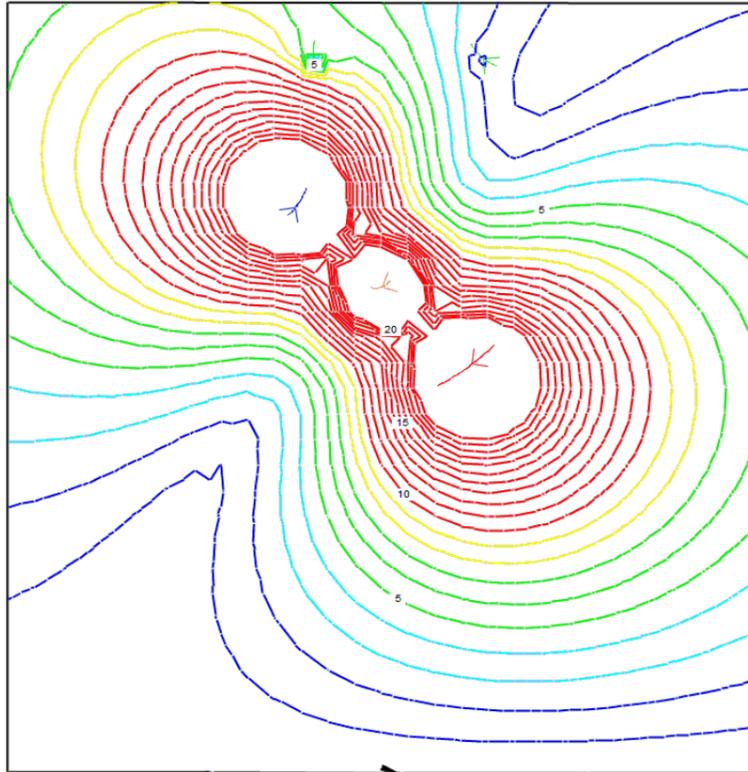


Electric Field vs. Distance along Line
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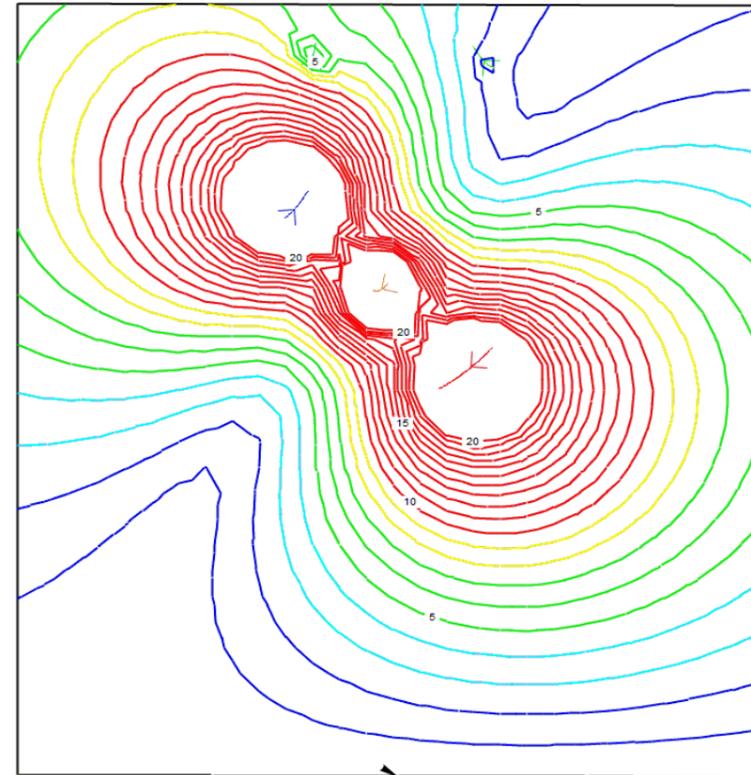


PLS CADD EMF Rating Calculation

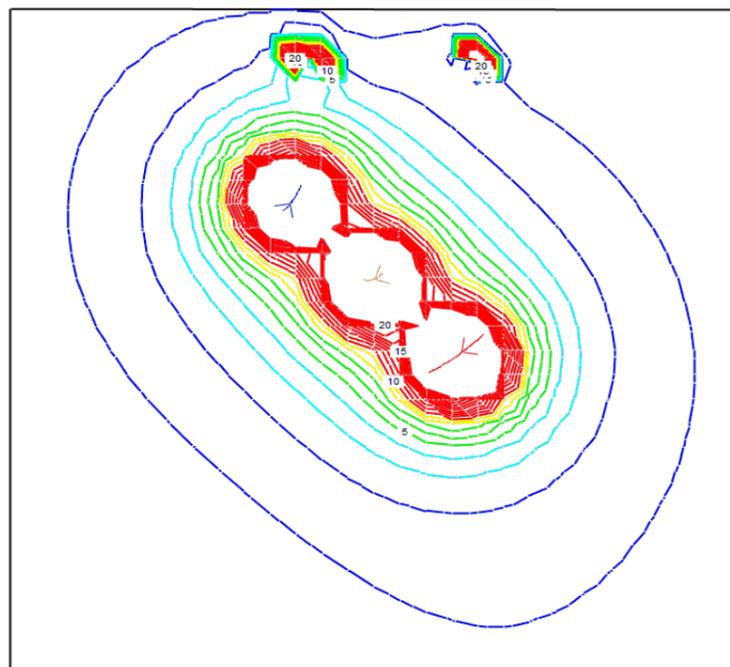
Space Potential Contours (kV)
T80-T83A 75% of Latta Conductor Rating



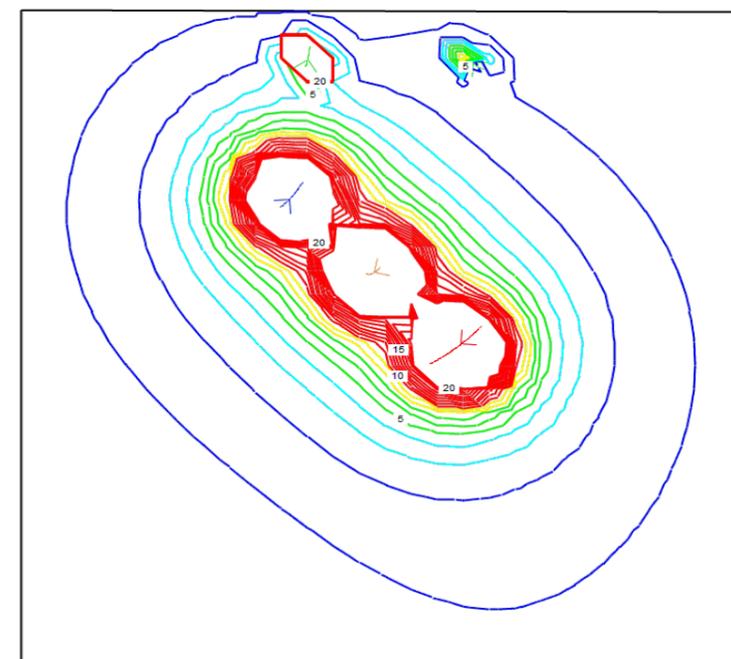
Space Potential Contours (kV)
T80-T83A 75% of Latta Conductor Rating



Electric Field Contours (kV/m)
T80-T83A 75% of Latta Conductor Rating

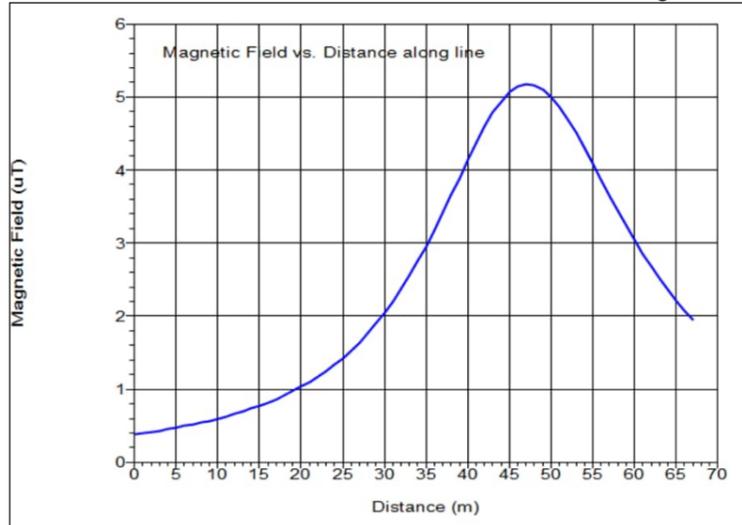


Electric Field Contours (kV/m)
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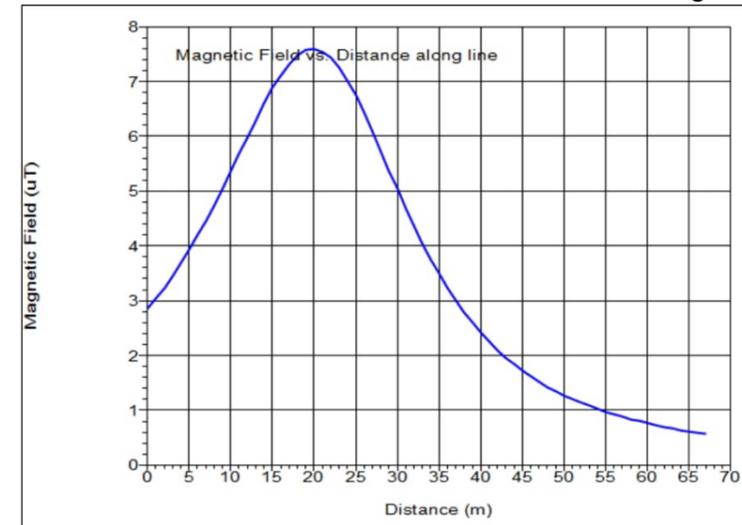


PLS CADD EMF Rating Calculation

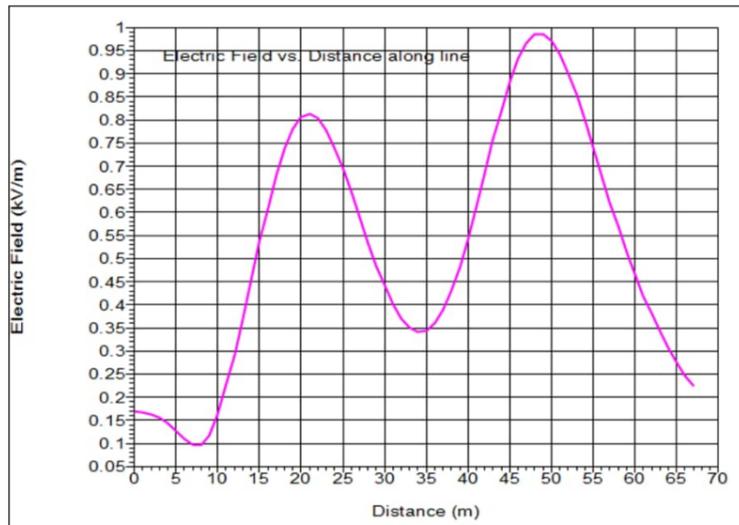
Magnetic Field vs. Time
T83A-GANTRY 1 75% of Latta Conductor Rating



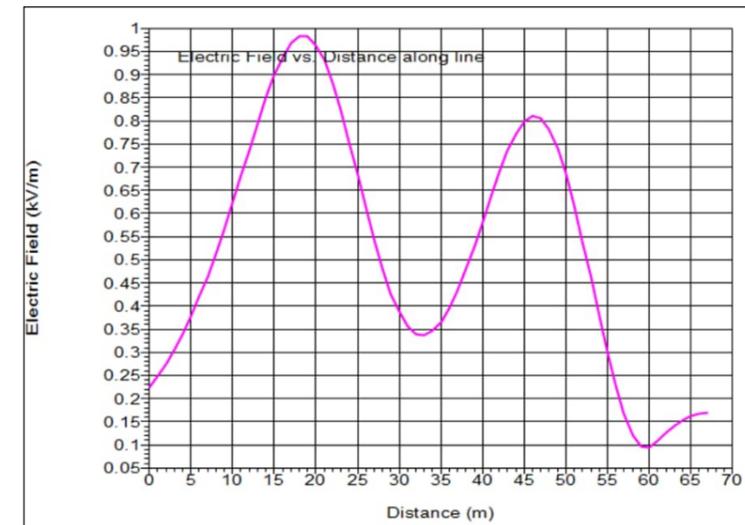
Magnetic Field vs. Time
T83A-GANTRY 1 110% of Latta Conductor Rating



Electric Field vs. Distance along Line
T83A-GANTRY 1 75% of Latta Conductor Rating

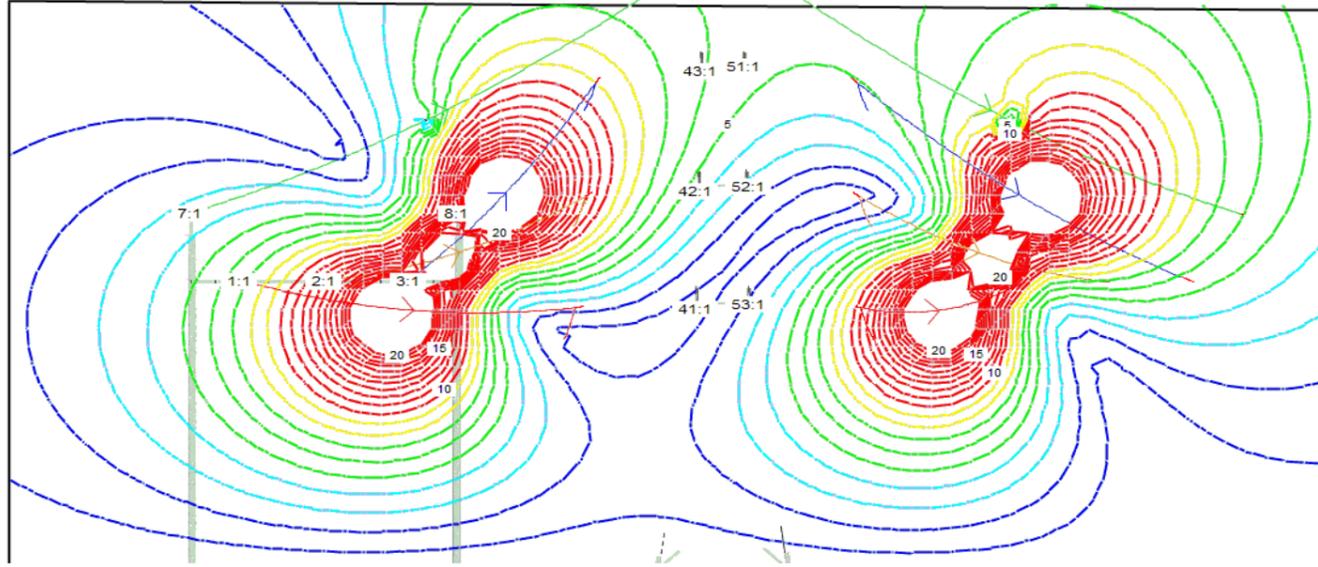


Electric Field vs. Distance along Line
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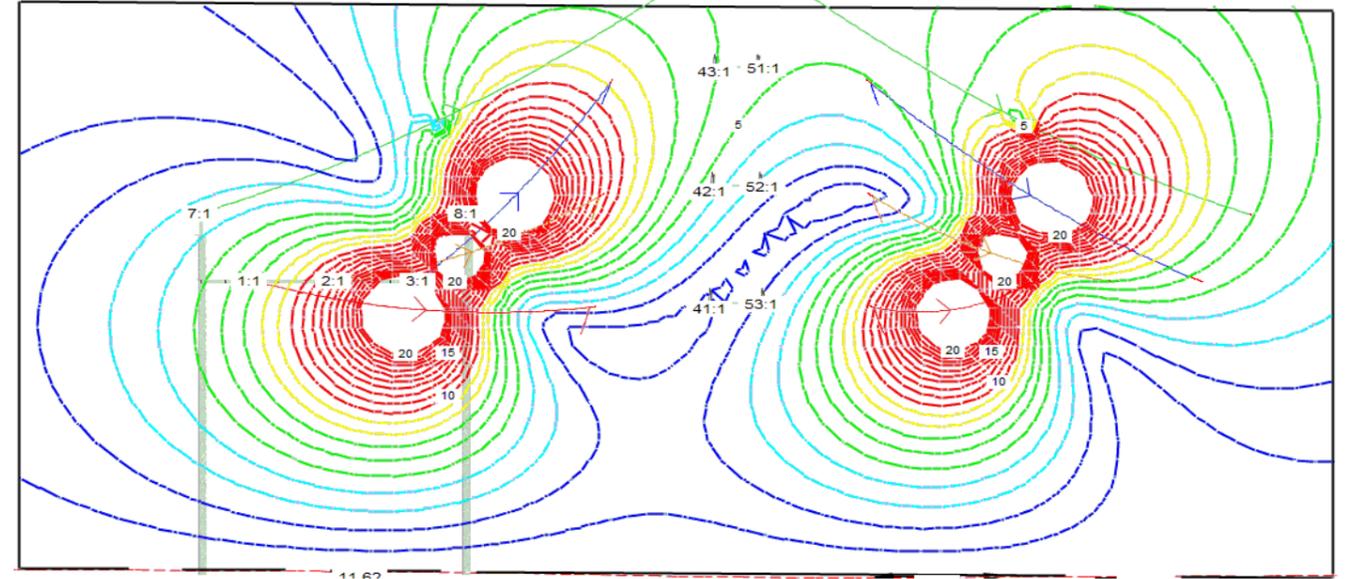


PLS CADD EMF Rating Calculation

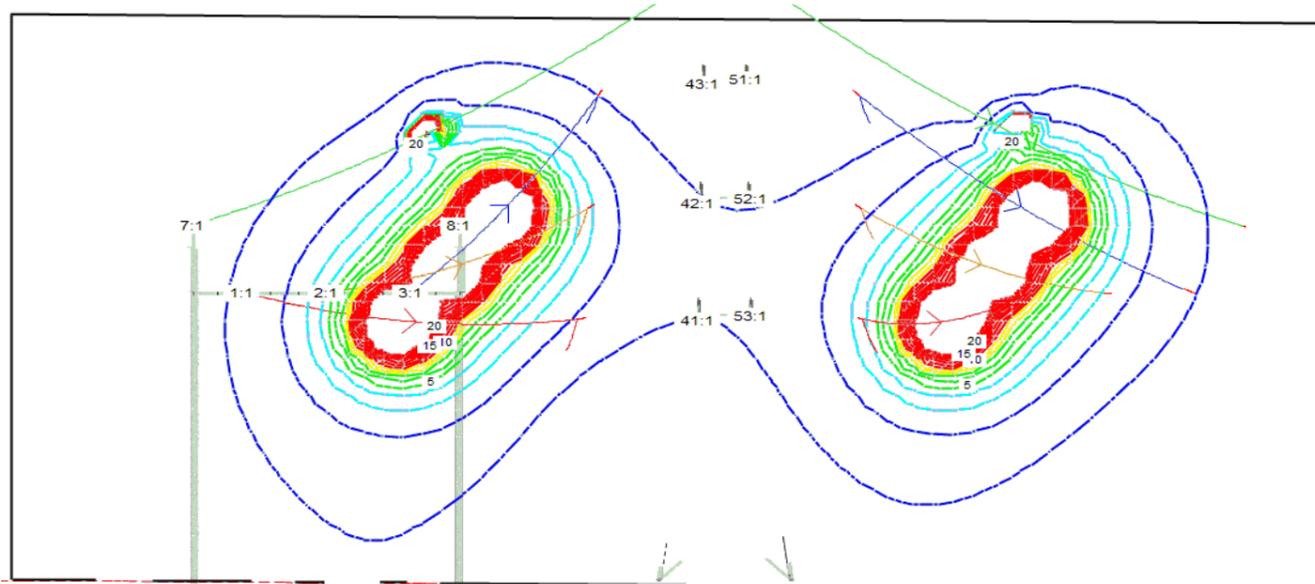
Space Potential Contours (kV)
T83A-GANTRY 1 75% of Latta Conductor Rating



Space Potential Contours (kV)
T83A-GANTRY 1 110% of Latta Conductor Rating



Electric Field Contours (kV/m)
T83A-GANTRY 1 75% of Latta Conductor Rating



Electric Field Contours (kV/m)
T83A-GANTRY 1 110% of Latta Conductor Rating

