PROJECT DATA	
Project	Angol Solar I
Project Code	2023112206
Client	PowerTree
Country	Chile
DC Peak Power	3 MWp
Report	Foundation calculation Report - L1
Date	19-12-23
Rev	1
Engineer	F. Pinto
Checked	A. Xu

REFERENCE DOCUMENTS	
PV module	Datasheet_Vertex_DEG21C.20_EN_2022_A_web_DEG21C.20_2022A_EN_20220429
Geotechnical report	Geotechnical report Angol "RWG-101.09.23-POW-087"
Pile Load test Report	Pull out test report Angol "RWP-041.09.23-POW-092"
Location	Angol Solar I v001.007.KMZ
Layout	PT-ANG-GL-PL-001--
Structural drawing	GA-2023112206-CL-POWER TREE-Angol Solar I-2.99MW VER2_45 m+s
Reaction Loads	Reaction Force at Ground Level 2023112206-CL-POWER TREE-Angol Solar I

APPLICABLE STANDARDS	
Load combinations	NCh3171.Of2017
Dead load	NCh1537.Of2009
Snow load	NCh431.Of2010
Seismic action	NCh2369.of2003
Wind load	NCh432.Of2010
Steel	NCh427.Of2016 – AISC360-16 - AISI-16
Soil mechanics	NCh1508 – DS Nº 61
Atmospheric Corrosion	ISO 9223
Soil corrosion	DIN 50929

TRACKING SYSTEM	
Structure type	SLII
Tracking Angle	120º (+60/-60º)
Design Wind speed	35 [m/s]
Stowing Wind speed	18 [m/s]
Stow position	0º
Tracker configuration	1 in portrait
Modules per string	32
Tracker Configuration	2 Strings per Tracker
Tracker A	1V64 EXTERIOR

GEOTECHNICAL ASSESSMENT	
Geotechnical report	Geotechnical report Angol "RWG-101.09.23-POW-087"
Pile Load Testing Report	Pull out test report Angol "RWP-041.09.23-POW-092"

The stratigraphic profile is composed by 2 main layers: The most superficial layer defined as "Top Soil (TS)", with an average thickness of 0,6m, is composed by soft brownish silty clay, also these materials are found with root remains. The walls present instability, it does not present difficulty excavating, and these materials do not present humidity, being dry. The second layer, defined as "Pleistocene Clay (Pc)", with an average thickness higher than 3m, is formed by dark brown clays, the compactions is rigid, and increases with depth. The walls present instability. These materials are found in wet areas and are easy to excavate. Both soil layers have been classified as "Low plasticity silt (ML)" in the USCS.
The following values are adjusted, according to the behavior presented in the POT campaign.

SOIL PARAMETERS

Stratigraphic profile		TS	Pc
Thickness	[m]	0,6	>3
Density	[kN/m3]	19	17,2
Cohesion	[kPa]	0,8	5
Friction angle	[º]	26	28,8

PILE LOAD TESTS

10 Pile Load Tests were performed using W6x9 and C200x80 posts for both Lateral and Tensile loads. The test locations were 5 using 2 sections in each location.

RAMMABILITY

The POT campaign were performed with direct driving and all the tests reached required embedment depth. The average driving time was 1,01min with a maximum of 1,55min and a minimum of 0,23min. The foundation installation method selected is Direct driven piles.

LATERAL PLT PERFORMANCE

All of the tests reached failure displacements for lateral load testing. With the purpose to be on the safe side, the minimum value of the horizontal response has been selected for the design. Based on the results obtained, a p-multiplier of 2.26 from test #W4 has been selected for the geotechnical model.

VERTICAL PLT PERFORMANCE

According to the reported data, 10 Tension tests were performed, and the failure displacement were reached on 7 of 10 tests. No tests for compression were performed. For the design, it was selected a skin friction resistance of 10,5 [kPa] for Tension and 21 [kPa] for Compression, this last value was obtained using the following relation to estimate the skin friction: Compression = Tension/0,5. Test #W2 is not considered, in order to not penalize the design.

CORROSION

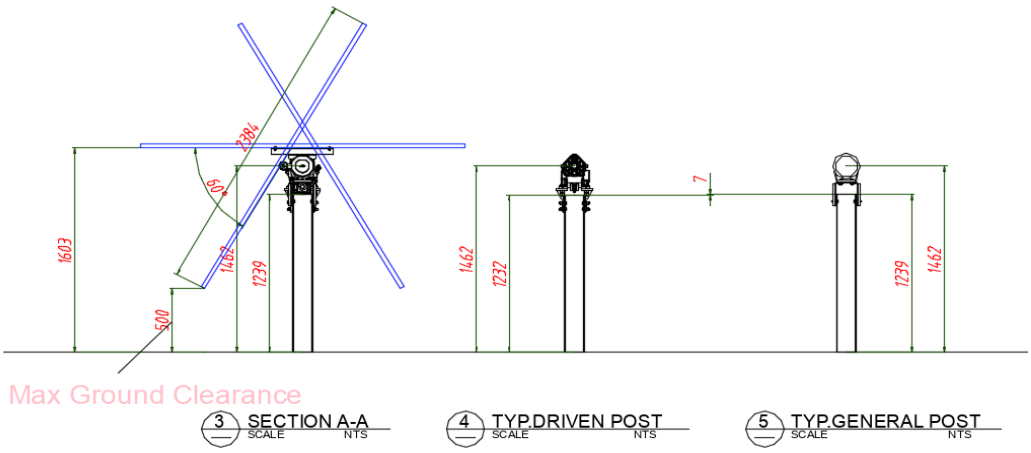
Soil Corrosivity assessment is determined by information available and according standard DIN 50 929. It can be concluded that the soil presents Medium-Low Corrosive soil load, with a rate of 5 µm/year. For design life of 30 years the total loss is 150 µm, is required a minimum 110µm Standard coating thickness. a total steel loss is 0,96mm considering both faces steel removal.

HIDROLOGY

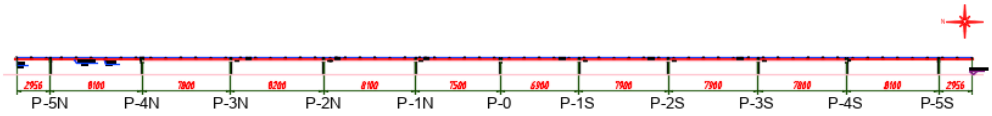
The site has a primarily flat topography, is close to the Huequen River, and close to flood risk, so there is a moderate risk of flooding, in absence of a hydrological/hydraulic study. The design assumes that adequate water management/drainage system will be installed to avoid flooding in the site or permanent water accumulation that could affect the actual soil characteristics.

STRUCTURAL CONFIGURATION - OPTION 1	
Structural Drawing	GA-2023112206-CL-POWER TREE-Angol Solar I-2.99MW VER2_45 m+s

ELEVATION



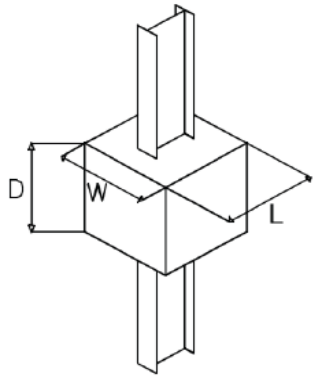
1V64 EXTERIOR

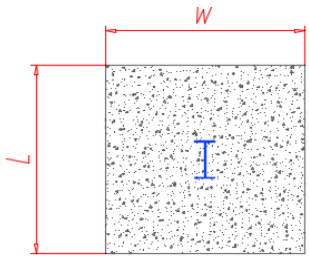


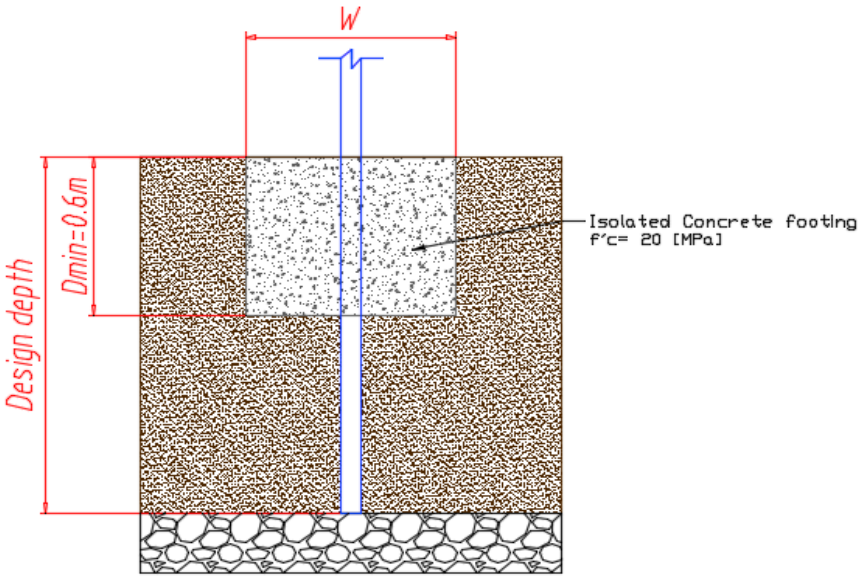
PILES

Post	Type	Steel Section		Material	Pile Length	Embedment
		Metric	Imperial	GB / ASTM	m	Depth [m]
5N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
4N	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
3N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
2N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
1N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
0	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
1S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
2S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
3S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00
4S	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
5S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,239	2,00

FOUNDATION DESIGN - OPTION 1 - CONCRETE REINFORCEMENT



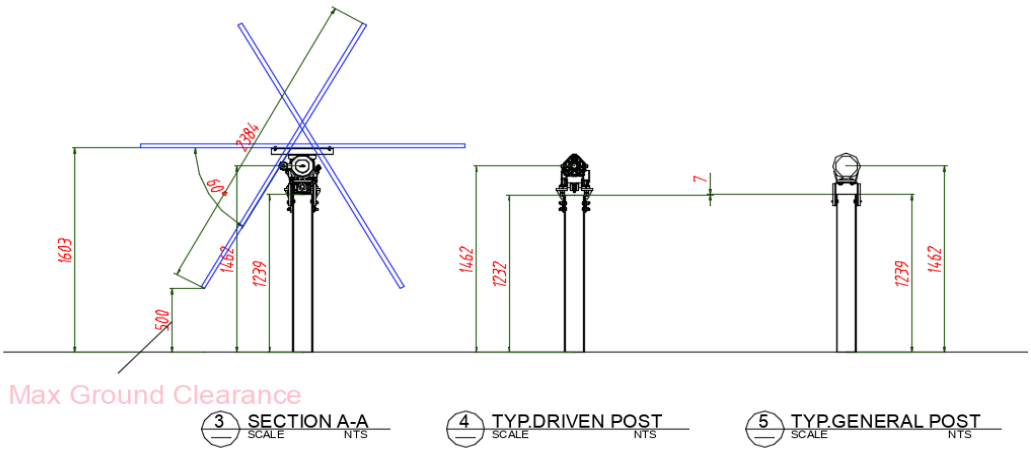




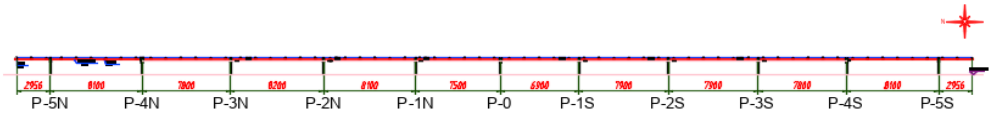
1V64 CORNER				CONCRETE BLOCK DIMENSIONS		
Post	Type	Steel section	Depth m	Depth D [m]	Length - L [m]	Width - W [m]
5N	GP	H148x100x4.3x4.9	2,00	0,80	0,60	0,60
4N	**DP**	**H150x100x4.3x5.5**	**2,00**	**0,80**	**0,60**	**0,60**
3N	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
2N	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
1N	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
0	**DP**	**H150x100x4.3x5.5**	**2,00**	**0,80**	**0,60**	**0,60**
1S	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
2S	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
3S	GP	H148x100x4.3x4.9	2,00	0,80	0,80	0,80
4S	**DP**	**H150x100x4.3x5.5**	**2,00**	**0,80**	**0,60**	**0,60**
5S	GP	H148x100x4.3x4.9	2,00	0,80	0,60	0,60

STRUCTURAL CONFIGURATION - OPTION 2	
Structural Drawing	GA-2023112206-CL-POWER TREE-Angol Solar I-2.99MW VER2_45 m+s

ELEVATION



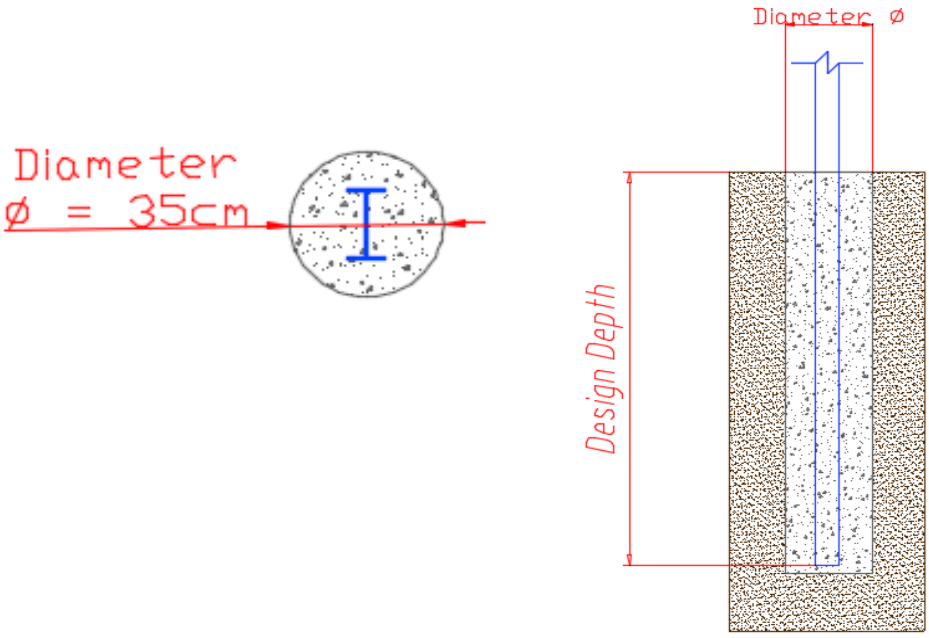
1V64 EXTERIOR



PILES

Post	Type	Steel Section		Material	Pile Length	Embedment
		Metric	Imperial	GB / ASTM	m	Depth [m]
5N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50
4N	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
3N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50
2N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	4,239	3,00
1N	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50
0	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
1S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50
2S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	4,239	3,00
3S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50
4S	**DP**	**H150x100x4.3x5.5**	**W6x9**	**Q355B / A572 Gr. 50**	**3,232**	**2,00**
5S	GP	H148x100x4.3x4.9	W6x8.5	Q355B / A572 Gr. 50	3,739	2,50

FOUNDATION DESIGN - OPTION 2 - CONCRETE ENCASED PILES



1V64 CORNER				CONCRETE ENCASED PILES
Post	Type	Steel section	Depth	Diameter
			m	cm
5N	GP	H148x100x4.3x4.9	2,50	35
4N	**DP**	**H150x100x4.3x5.5**	**2,00**	**35**
3N	GP	H148x100x4.3x4.9	2,50	35
2N	GP	H148x100x4.3x4.9	3,00	35
1N	GP	H148x100x4.3x4.9	2,50	35
0	**DP**	**H150x100x4.3x5.5**	**2,00**	**35**
1S	GP	H148x100x4.3x4.9	2,50	35
2S	GP	H148x100x4.3x4.9	3,00	35
3S	GP	H148x100x4.3x4.9	2,50	35
4S	**DP**	**H150x100x4.3x5.5**	**2,00**	**35**
5S	GP	H148x100x4.3x4.9	2,50	35

MAXIMUM REACTIONS AT GRADE LEVEL													
1V64 CORNER													
Post		Lateral	Moment	Compression	Tension	Lateral	Moment	Compression	Tension	Lateral	Moment	Compression	Tension
ID	Type	[kN]	[kN·m]	[kN]	[kN]	[kN]	[kN·m]	[kN]	[kN]	[kN]	[kN·m]	[kN]	[kN]
		SLS				ULS				FOS=2 => 2xSLS			
1	GP	2,8	2,8	17,4	-10,4	4,4	4,5	28,4	-16,8	5,6	5,7	34,8	-20,7
2	**DP**	1,6	5,6	17,5	-1,5	2,6	9,0	28,6	-2,3	3,2	11,2	35,0	-2,9
3	GP	2,6	3,5	20,0	-11,9	4,1	5,7	32,5	-19,2	5,1	7,1	40,0	-23,8
4	GP	2,6	3,6	20,7	-14,3	4,2	5,8	33,7	-23,1	5,2	7,2	41,4	-28,6
5	GP	2,5	3,5	19,2	-10,8	4,0	5,5	31,3	-17,5	5,0	6,9	38,5	-21,6
6	**DP**	1,4	6,9	15,8	-1,3	2,3	11,0	25,7	-2,1	2,9	13,8	31,6	-2,6
7	GP	2,4	3,2	18,3	-9,7	3,8	5,2	29,8	-15,7	4,8	6,5	36,7	-19,4
8	GP	2,5	3,5	20,0	-12,6	4,1	5,5	32,6	-20,3	5,1	6,9	40,0	-25,1
9	GP	2,5	3,4	19,3	-10,2	4,0	5,5	31,4	-16,6	5,0	6,9	38,5	-20,4
10	**DP**	1,6	5,5	17,5	-1,5	2,6	8,8	28,5	-2,3	3,2	11,0	34,9	-2,9
11	GP	2,8	2,8	15,9	-9,3	4,4	4,5	26,0	-15,1	5,6	5,7	31,8	-18,6