

0	02/05/2016	A. B.	M. I. A.	BTESA	PRIMERA EMISIÓN	PE
Rev.	Fecha	Elaborado por nombre/firma	Revisado por nombre/firma	Aprobado por nombre/firma	Descripción	Estado
<div style="text-align: center;">  <p>TORRE 25 m + EXTENSION 10 m CERRO AZUL - YARUMAL</p> </div>						
<div style="text-align: center;"> <p>EVALUACION ESTRUCTURAL</p>  </div>						
ESCALA SIN	FORMATO A4	REFERENCIA BTESA TAC25-E10-CA-YA	REFERENCIA RTVC TORRE 25-CERRO AZUL	HOJA 1/24	REV 0	

TABLA DE CONTENIDO

1.	DESCRIPCION.....	3
2.	ESPECIFICACIONES.....	3
3.	CARGAS.....	4
4.	MATERIALES.....	4
5.	ANALISIS Y DISEÑO.....	5
6.	ANEXOS – EVALUACION ESTRUCTURAL.....	5

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
2 / 24

REV.
0

TORRE 25 m + EXTENSION 10 m

EVALUACION ESTRUCTURAL

1. DESCRIPCIÓN:

A continuación presentamos la verificación estructural de la torre auto-soportada de 25 metros, instalada en la estación Cerro Azul (Yarumal-Antioquia), es tipo celosía de sección cuadrada, diseñada con perfiles angulares; El chequeo se hace con las cargas de antenas instaladas actualmente: Tres (3) antenas TV, siete (7) antenas de radio, dos (2) antenas omni, una (1) antena MWØ3.7 y dos (2) antenas MWØ4.7m; Se proyecta la instalación de dieciocho (18) antenas panel, en una extensión de 10m, según cuadro y luego se verifican los elementos que requieren refuerzo.

2. ESPECIFICACIONES:

Carga de diseño:

TIPO / DIAMETRO	ALTURA EN TORRE	CANTIDAD
ANTENAS EXISTENTES		
ANTENA RADIO	25,0 m	2 und
MWØ4,7 m	23,5 m	1 und
ANTENA OMNI	23,0 m	2 und
MWØ3,7 m	20,5 m	1 und
ANTENA TV	15,0 m	3 und
ANTENA RADIO	15,0 m	5 und
MWØ4,7 m	13,0 m	2 und
ANTENAS NUEVAS		
ANTENA PANEL	33,0 m	14 und
ANTENA PANEL	28,7 m	4 und

Carga viva: 3 Operarios de 80 kg. c/u.

Velocidad del viento: 120. Km / h

Materiales :- Ángulos, canales y platinas: ASTM A36 y ASTM A572

- Tornillos : ASTM A325 –G5

Galvanizado: Según norma ASTM A153 y ASTM A123

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
3 / 24

REV.
0

NOTA:

A CONTINUACION SE MUESTRAN LOS AZIMUT DE LAS CARAS DE LA TORRE:

AZIMUT DE LA CARA A: 90°

AZIMUT DE LA CARA B: 180°

AZIMUT DE LA CARA C: 270°

AZIMUT DE LA CARA D: 0°

3. CARGAS:

Las cargas de diseño corresponden a acciones de gravedad y viento sobre la torre, antenas y demás accesorios, afectadas por un factor de seguridad.

3.1. Cargas de gravedad.

El peso propio de la estructura es evaluado por el programa de análisis estructural y es afectado por un factor de 1.2 para tener en cuenta los elementos redundantes, platinas, tornillos, uniones y galvanizado. El peso de las antenas y sus soportes se obtienen directamente del catálogo del fabricante.

3.2. Carga de viento:

V = Velocidad del viento: 120 Km. / hora.

Para el cálculo de las cargas viento se utiliza el NSR-10, con la siguiente expresión:

Fuerza debida al viento $F = q_z * C_f * A_f$

En donde:

q_z = Presión de viento en daN/m²

C_f = Coeficiente de fuerza según capítulo H

A_f = Área expuesta en m²

La presión del viento q_z , está dada por:

$$q_z = Q \times (Z_V \times V)^2 \times G$$

En donde,

Q Factor de densidad del aire = 0.0048

ZV Factor de terreno.

V Velocidad de viento básica = 120 km/h

G Factor de ráfaga de viento.

Presión de viento básica 76.2 kg/m²

3.3. Viento sobre la estructura.

Se aplican en los nudos que comprenden cada panel analizado.

Para $P(0) = 76.2 \text{ kg / m}^2$

$P(10) = 76.2$

$P(35) = 88.4$

A = área del panel analizado. S / silueta.

Se plantean tres (3) hipótesis de carga de acuerdo con las especificaciones:

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
4 / 24

REV.
0

3.3.1.Viento Transversal:(Hipótesis C1)

Esta dada por la siguiente expresión: $F_t = C_f * P * A$

3.3.2.Viento a 45° : (Hipótesis C2)

Esta dada por la expresión: $F_{45^\circ} = 1.15 * F_t$

Se debe aplicar en cada dirección principal simultáneamente.

Adicionalmente para verificar deformaciones se tiene una hipótesis (C3) con viento de 60.Km/h

4. MATERIALES:

Acero: ASTM A36, A572

Tornillos: ASTM A394 To

Galvanización: ASTM A153 y ASTM A123

5. ANÁLISIS Y DISEÑO.

Se llevó a cabo según lo especificado en las normas EIA-222F, NSR-10 y se ejecutó mediante el programa tower.

6. ANEXOS-EVALUACION ESTRUCTURAL

TORRE 25m+EXT.10m – CERRO AZUL - YARUMAL

EVALUACION ESTRUCTURAL TAC25



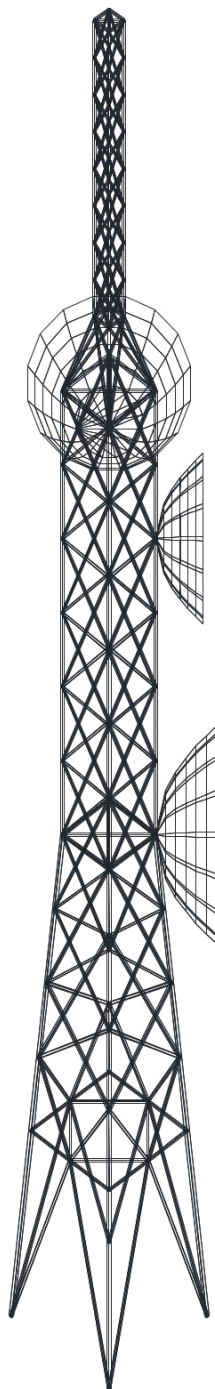
TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
5 / 24

REV.
0

SILUETA TAC25-ANTENAS



EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
6 / 24

REV.
0

LISTADO TOWER

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*****
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* TOWER - Analysis and Design - Copyright Power Line Systems, Inc. 1986-2006 *
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Project Name : TORRE 25.m+EXT.10m-CERRO AZUL-YARUMAL -ACT.
 Project Notes: BTESA - RTVC
 Project File : f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az.tow
 Date run : 10:32:19 a.m. miércoles, 27 de abril de 2016
 by : Tower Version 10.20
 Successfully performed linear analysis

The model has 0 warnings.



Member check option: TIA/EIA 222-F
 Connection rupture check: Not Checked
 Crossing diagonal check: Fixed

Joints Geometry:

Joint Label	Symmetry Code	X Coord (m)	Y Coord (m)	Z Coord (m)	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.
14P	XY-Symmetry	0.3	0.3	35	Free	Free	Free	Free	Free	Free
22P	XY-Symmetry	0.3	0.3	27	Free	Free	Free	Free	Free	Free
23P	XY-Symmetry	0.95	0.95	25	Free	Free	Free	Free	Free	Free
29P	XY-Symmetry	0.95	0.95	13	Free	Free	Free	Free	Free	Free
33P	XY-Symmetry	1.597	1.597	5	Free	Free	Free	Free	Free	Free
36P	XY-Symmetry	2	2	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
14X	X-GenXY	0.3	-0.3	35	Free	Free	Free	Free	Free	Free
14XY	XY-GenXY	-0.3	-0.3	35	Free	Free	Free	Free	Free	Free
14Y	Y-GenXY	-0.3	0.3	35	Free	Free	Free	Free	Free	Free
22X	X-GenXY	0.3	-0.3	27	Free	Free	Free	Free	Free	Free
22XY	XY-GenXY	-0.3	-0.3	27	Free	Free	Free	Free	Free	Free
22Y	Y-GenXY	-0.3	0.3	27	Free	Free	Free	Free	Free	Free
23X	X-GenXY	0.95	-0.95	25	Free	Free	Free	Free	Free	Free
23XY	XY-GenXY	-0.95	-0.95	25	Free	Free	Free	Free	Free	Free
23Y	Y-GenXY	-0.95	0.95	25	Free	Free	Free	Free	Free	Free
29X	X-GenXY	0.95	-0.95	13	Free	Free	Free	Free	Free	Free
29XY	XY-GenXY	-0.95	-0.95	13	Free	Free	Free	Free	Free	Free
29Y	Y-GenXY	-0.95	0.95	13	Free	Free	Free	Free	Free	Free
33X	X-GenXY	1.597	-1.597	5	Free	Free	Free	Free	Free	Free
33XY	XY-GenXY	-1.597	-1.597	5	Free	Free	Free	Free	Free	Free
33Y	Y-GenXY	-1.597	1.597	5	Free	Free	Free	Free	Free	Free
36X	X-GenXY	2	-2	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
36XY	XY-GenXY	-2	-2	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
36Y	Y-GenXY	-2	2	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed

Secondary Joints:

Joint Label	Symmetry Code	Origin Joint	End Joint	Fraction	Elevation (m)	X Disp. Rest.	Y Disp. Rest.	Z Disp. Rest.	X Rot. Rest.	Y Rot. Rest.	Z Rot. Rest.

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
7 / 24

REV.
0

15S	XY-Symmetry	14P	22P	0.125	0	Free	Free	Free	Free	Free	Free
16S	XY-Symmetry	14P	22P	0.25	0	Free	Free	Free	Free	Free	Free
17S	XY-Symmetry	14P	22P	0.375	0	Free	Free	Free	Free	Free	Free
18S	XY-Symmetry	14P	22P	0.5	0	Free	Free	Free	Free	Free	Free
19S	XY-Symmetry	14P	22P	0.625	0	Free	Free	Free	Free	Free	Free
20S	XY-Symmetry	14P	22P	0.75	0	Free	Free	Free	Free	Free	Free
21S	XY-Symmetry	14P	22P	0.875	0	Free	Free	Free	Free	Free	Free
24S	XY-Symmetry	23P	29P	0.166	0	Free	Free	Free	Free	Free	Free
25S	XY-Symmetry	23P	29P	0.333	0	Free	Free	Free	Free	Free	Free
26S	XY-Symmetry	23P	29P	0.5	0	Free	Free	Free	Free	Free	Free
27S	XY-Symmetry	23P	29P	0.666	0	Free	Free	Free	Free	Free	Free
28S	XY-Symmetry	23P	29P	0.833	0	Free	Free	Free	Free	Free	Free
30S	XY-Symmetry	29P	33P	0.25	0	Free	Free	Free	Free	Free	Free
31S	XY-Symmetry	29P	33P	0.5	0	Free	Free	Free	Free	Free	Free
32S	XY-Symmetry	29P	33P	0.75	0	Free	Free	Free	Free	Free	Free
34S	Y-Symmetry	33P	33X	0.5	0	Free	Free	Free	Free	Free	Free
35S	X-Symmetry	33P	33Y	0.5	0	Free	Free	Free	Free	Free	Free
15X	X-GenXY	14P	22P	0.125	0	Free	Free	Free	Free	Free	Free
15XY	XY-GenXY	14P	22P	0.125	0	Free	Free	Free	Free	Free	Free
15Y	Y-GenXY	14P	22P	0.125	0	Free	Free	Free	Free	Free	Free
16X	X-GenXY	14P	22P	0.25	0	Free	Free	Free	Free	Free	Free
16XY	XY-GenXY	14P	22P	0.25	0	Free	Free	Free	Free	Free	Free
16Y	Y-GenXY	14P	22P	0.25	0	Free	Free	Free	Free	Free	Free
17X	X-GenXY	14P	22P	0.375	0	Free	Free	Free	Free	Free	Free
17XY	XY-GenXY	14P	22P	0.375	0	Free	Free	Free	Free	Free	Free
17Y	Y-GenXY	14P	22P	0.375	0	Free	Free	Free	Free	Free	Free
18X	X-GenXY	14P	22P	0.5	0	Free	Free	Free	Free	Free	Free
18XY	XY-GenXY	14P	22P	0.5	0	Free	Free	Free	Free	Free	Free
18Y	Y-GenXY	14P	22P	0.5	0	Free	Free	Free	Free	Free	Free
19X	X-GenXY	14P	22P	0.625	0	Free	Free	Free	Free	Free	Free
19XY	XY-GenXY	14P	22P	0.625	0	Free	Free	Free	Free	Free	Free
19Y	Y-GenXY	14P	22P	0.625	0	Free	Free	Free	Free	Free	Free
20X	X-GenXY	14P	22P	0.75	0	Free	Free	Free	Free	Free	Free
20XY	XY-GenXY	14P	22P	0.75	0	Free	Free	Free	Free	Free	Free
20Y	Y-GenXY	14P	22P	0.75	0	Free	Free	Free	Free	Free	Free
21X	X-GenXY	14P	22P	0.875	0	Free	Free	Free	Free	Free	Free
21XY	XY-GenXY	14P	22P	0.875	0	Free	Free	Free	Free	Free	Free
21Y	Y-GenXY	14P	22P	0.875	0	Free	Free	Free	Free	Free	Free
24X	X-GenXY	23P	29P	0.166	0	Free	Free	Free	Free	Free	Free
24XY	XY-GenXY	23P	29P	0.166	0	Free	Free	Free	Free	Free	Free
24Y	Y-GenXY	23P	29P	0.166	0	Free	Free	Free	Free	Free	Free
25X	X-GenXY	23P	29P	0.333	0	Free	Free	Free	Free	Free	Free
25XY	XY-GenXY	23P	29P	0.333	0	Free	Free	Free	Free	Free	Free
25Y	Y-GenXY	23P	29P	0.333	0	Free	Free	Free	Free	Free	Free
26X	X-GenXY	23P	29P	0.5	0	Free	Free	Free	Free	Free	Free
26XY	XY-GenXY	23P	29P	0.5	0	Free	Free	Free	Free	Free	Free
26Y	Y-GenXY	23P	29P	0.5	0	Free	Free	Free	Free	Free	Free
27X	X-GenXY	23P	29P	0.666	0	Free	Free	Free	Free	Free	Free
27XY	XY-GenXY	23P	29P	0.666	0	Free	Free	Free	Free	Free	Free
27Y	Y-GenXY	23P	29P	0.666	0	Free	Free	Free	Free	Free	Free
28X	X-GenXY	23P	29P	0.833	0	Free	Free	Free	Free	Free	Free
28XY	XY-GenXY	23P	29P	0.833	0	Free	Free	Free	Free	Free	Free
28Y	Y-GenXY	23P	29P	0.833	0	Free	Free	Free	Free	Free	Free
30X	X-GenXY	29P	33P	0.25	0	Free	Free	Free	Free	Free	Free
30XY	XY-GenXY	29P	33P	0.25	0	Free	Free	Free	Free	Free	Free
30Y	Y-GenXY	29P	33P	0.25	0	Free	Free	Free	Free	Free	Free
31X	X-GenXY	29P	33P	0.5	0	Free	Free	Free	Free	Free	Free
31XY	XY-GenXY	29P	33P	0.5	0	Free	Free	Free	Free	Free	Free
31Y	Y-GenXY	29P	33P	0.5	0	Free	Free	Free	Free	Free	Free
32X	X-GenXY	29P	33P	0.75	0	Free	Free	Free	Free	Free	Free
32XY	XY-GenXY	29P	33P	0.75	0	Free	Free	Free	Free	Free	Free
32Y	Y-GenXY	29P	33P	0.75	0	Free	Free	Free	Free	Free	Free
34Y	Y-Gen	33P	33X	0.5	0	Free	Free	Free	Free	Free	Free
35X	X-Gen	33P	33Y	0.5	0	Free	Free	Free	Free	Free	Free

Steel Material Properties:

Steel Material Label	Modulus of Elasticity (MPa)	Yield Stress Fy (MPa)	Ultimate Stress Fu (MPa)	Member Stress All. Hyp. 1 (MPa)	Member Stress All. Hyp. 2 (MPa)	Member Rupture Hyp. 1 (MPa)	Member Rupture Hyp. 2 (MPa)	Member Bearing Hyp. 1 (MPa)	Member Bearing Hyp. 2 (MPa)
A-36	2e+005	248.1	399.9	0	0	0	0	0	0
A-572	2e+005	344.7	482.5	0	0	0	0	0	0

Bolt Properties:

Bolt Label	Bolt Diameter (cm)	Hole Diameter (cm)	Ultimate Shear Capacity (kN)	Default End Distance (cm)	Default Bolt Spacing (cm)	Shear Hyp. 1 (kN)	Shear Hyp. 2 (kN)
5/8"	1.59	1.749	62.53	2.5	0	0	0
5/8" DC	1.59	1.749	125	2.5	0	0	0

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

**HOJA
8 / 24**

**REV.
0**

Number Bolts Used By Type:

Bolt Number Type Bolts	
5/8" DC	472
5/8"	388

Angle Properties:

Angle Type	Angle Size	Long Leg	Short Leg	Thick. Leg	Unit Weight	Gross Area	w/t Ratio	Radius of Gyration Rx	Radius of Gyration Ry	Radius of Gyration Rz	Number of Angles	Wind Width	Short Edge Dist.	Long Edge Dist.	Optimize Factor	Section Cost Modulus
	(cm)	(cm)	(cm)	(cm)	(N/m)	(cm ²)		(cm)	(cm)	(cm)		(cm)	(cm)	(cm)		(cm ³)
SAE	4X4X0.375	10.16	10.16	0.9525	143	18.52	8.67	3.132	3.132	2.004	1	10.16	0	0	1.0000	0
SAE	4X4X0.25	10.16	10.16	0.635	96.31	12.52	13.5	3.175	3.175	2.019	1	10.16	0	0	1.0000	0
SAE	3X3X0.25	7.62	7.62	0.635	71.79	9.355	9.75	2.375	2.375	1.514	1	7.62	0	0	1.0000	0
SAE	2.5X2.5X0.25	6.35	6.35	0.635	59.83	7.677	7.75	1.953	1.953	1.247	1	6.35	0	0	1.0000	0
SAE	2X2X0.25	5.08	5.08	0.635	46.55	6.065	5	1.547	1.547	0.9931	1	5.08	0	0	1.0000	0
SAE	2X2X0.1875	5.08	5.08	0.4763	35.61	4.581	7	1.567	1.567	1.001	1	5.08	0	0	1.0000	0
SAE	1.5X1.5X0.1875	3.81	3.81	0.4763	26.27	3.419	5	1.161	1.161	0.7442	1	3.81	0	0	1.0000	0

Angle Groups:

Group Label	Group Description	Angle Type	Angle Size	Material Type	Element Type	Group Type	Optimize Group	Allow. Angle Width For Optimize (cm)	Add. Width
5	M01	SAE	4X4X0.375	A-572	Beam		Size + Type	30.480	
6	M02	SAE	4X4X0.375	A-572	Beam		Size + Type	30.480	
7	M03	SAE	4X4X0.25	A-572	Beam		Size + Type	30.480	
8	M04	SAE	3X3X0.25	A-572	Beam		Size + Type	30.480	
9	M05	SAE	3X3X0.25	A-572	Beam		Size + Type	30.480	
10	M06	SAE	2.5X2.5X0.25	A-572	Beam		Size + Type	30.480	
11	M07	SAE	2.5X2.5X0.25	A-572	Beam		Size + Type	30.480	
17	D01	SAE	2.5X2.5X0.25	A-36	Truss		Size + Type	30.480	
18	D02	SAE	2.5X2.5X0.25	A-36	Truss		Size + Type	30.480	
19	D03	SAE	2X2X0.25	A-36	Truss		Size + Type	30.480	
20	D04	SAE	2X2X0.25	A-36	Truss		Size + Type	30.480	
21	D05	SAE	2X2X0.25	A-36	Truss		Size + Type	30.480	
22	D06	SAE	2X2X0.1875	A-36	Truss		Size + Type	30.480	
23	D07	SAE	1.5X1.5X0.1875	A-36	Truss		Size + Type	30.480	
25	H01	SAE	2X2X0.1875	A-36	Beam		Size + Type	30.480	
26	H02	SAE	2X2X0.1875	A-36	Beam		Size + Type	30.480	
27	H03	SAE	2.5X2.5X0.25	A-36	Beam		Size + Type	30.480	
28	H04	SAE	2X2X0.1875	A-36	Beam		Size + Type	30.480	
33	C01	SAE	2X2X0.1875	A-36	Truss		Size + Type	30.480	
34	C02	SAE	2X2X0.1875	A-36	Truss		Size + Type	30.480	
35	C03	SAE	2X2X0.1875	A-36	Truss		Size + Type	30.480	
36	C04	SAE	2X2X0.1875	A-36	Truss		Size + Type	30.480	

Aggregate Angle Information:

Note: Estimate of surface area reported for painting purposes, not wind loading.

Angle Type	Angle Size	Material Type	Total Length (m)	Total Surface Area (m ²)	Total Weight (N)
SAE	4X4X0.375	A-572	36.23	14.73	5181.58
SAE	4X4X0.25	A-572	16.10	6.54	1550.99
SAE	3X3X0.25	A-572	48.00	14.63	3446.12
SAE	2.5X2.5X0.25	A-572	40.80	10.36	2441.27
SAE	2.5X2.5X0.25	A-36	97.51	24.77	5833.61
SAE	2X2X0.25	A-36	180.37	36.65	8395.91
SAE	2X2X0.1875	A-36	75.56	15.35	2690.19
SAE	1.5X1.5X0.1875	A-36	65.31	9.95	1715.35

Sections:

The adjustment factors below only apply to dead load and wind areas that are calculated for members in the model. They do not apply to equipment or to manually input dead load and drag areas.

Section Label	Joint Defining Section	Dead Load Adjust. Factor	Transverse Drag x Area Factor For Face	Longitudinal Drag x Area Factor For Face	Transverse Area Factor (CD From Code)	Longitudinal Area Factor (CD From Code)	Af Flat Face EIA Only	Ar Round Face EIA Only	Transverse Drag x Area Factor For All	Longitudinal Drag x Area Factor For All	SAPS Angle Factor	SAPS Round Face Factor	Force Solid Face
EXT10	22P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	None
SECC1	23P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	None
SECC2	26S	1.200	0.000	0.000	0.000	0.000	1.100	1.000	0.000	0.000	0.000	0.000	None
SECC3	29P	1.200	0.000	0.000	0.000	0.000	1.100	1.000	0.000	0.000	0.000	0.000	None
SECC4	32S	1.200	0.000	0.000	0.000	0.000	1.150	1.000	0.000	0.000	0.000	0.000	None
SECC5	36P	1.200	0.000	0.000	0.000	0.000	1.150	1.000	0.000	0.000	0.000	0.000	None

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
9 / 24

REV.
0

CARGAS APLICADAS

*** Loads Data

Loads from file: f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az.eia

Structure Height Summary (used for calculating wind/ice adjust with height):

Structure height above ground 35.00 (m)
Elevation of structure bottom for wind height adjustment: 0.00 (m)
Structure height for structure gust response factor: 35.00 (m)
Structure gust response factor, Gh: 1.1521
Guy installation temperature: 15.56 (deg C)
Tower Type: Rectangular Latticed

EIA Rev. F Load Cases:

Load Case Description	Dead Load Factor	Wind Load Factor	Ice Load Factor	Strength Factor	Allowable Stress Increase Factor	Basic Wind Speed (m/s) (Deg)	Wind Dir. (Deg)	Ice Thick. (cm)	Ice Density (N/m ³)	Ice Temperature (deg C)	Point Loads	Joint Displ.
WIN 0 -120	1.2500	0.8500	1.0000	1.0000	1.0000	33.333	0	0.0000	0.0000	20.0	8loads	
WIN 45-120	1.2500	0.8500	1.0000	1.0000	1.0000	33.333	45	0.0000	0.0000	20.0	8loads	
WIN 45-60	1.2500	0.8500	1.0000	1.0000	1.0000	16.666	45	0.0000	0.0000	20.0	8loads	

Concentrated Loads for Load Case "WIN 0 -120":

Joint Label	Force X-Dir (N)	Force Y-Dir (N)	Force Vertical (N)	Moment X-Axis (N-m)	Moment Y-Axis (N-m)	Moment Z-Axis (N-m)	Load Comment
14P	1650	1650	860	0	0	0	
17S	1650	1650	860	0	0	0	
20S	1650	1650	860	0	0	0	
23P	0	1000	400	0	0	0	
24S	0	1000	400	0	0	0	
25S	0	1500	600	0	0	0	
27S	0	1500	600	0	0	0	
29P	0	1500	600	0	0	0	

Equipment Load Case Information for "WIN 0 -120":

Equipment Label	Equipment Property Set	Elevation Above Ground (m)	qzGh (Pa)	Ice Thick. (cm)	Total Wind Incidence Area (m ²)	Wind Angle (deg)	222-G CA	222-G CS	222-G CM	Antenna Axial Load (N)	Antenna Side Load (N)	Antenna Moment (N-m)	Long. Load (N)	Trans. Load (N)	Vert. Load (N)
ANT MW1	Ant.MW04.7	13.00	717.71	0.00	0.00	225.00	-0.52150	-0.45705	-0.13905	-6493.50	-5691.00	-8137.55	8615.74	567.46	7250.00
ANT MW2	Ant.MW03.7	21.00	823.15	0.00	0.00	225.00	-0.52150	-0.45705	-0.13905	-4615.57	-4045.15	-4553.48	6124.05	403.35	4750.00
ANT MW3	Ant.MW04.7	23.01	844.87	0.00	0.00	315.00	1.62895	-0.04880	0.06130	23876.53	-715.29	4223.01	17389.05	-16377.47	7250.00

EIA Section Load Case Information for "WIN 0 -120":

Section Label	Z of Top (m)	Z of Ave. Bottom (m)	Elev. Above Gnd. (m)	qzGh (Pa)	Ice Thick. (cm)	Face AF (m ²)	Face AR (m ²)	Face RR*AR (m ²)	Face AG (m ²)	Face e (m)	Face DF	Face DR	Face RR	Face CF	Face AE (m ²)	Face WF (N)	NotF AAF (m ²)	NotF CAF (N)	NotF AAR (m ²)	NotF CAR (N)	NotF AAR*CAR (m ²)	NotF WA (N)	Total Wind (N)	Total Weight (N)
EXT10	35.00	27.00	31.00	919.99	0.00	1.82	0.00	0.00	4.8	0.38	1.00	1.00	0.64	2.34	1.8	3912	0.00	2.00	0.00	1.20	0.00	0	3912	6290
SECC1	27.00	25.00	26.00	874.90	0.00	0.65	0.00	0.00	2.5	0.26	1.00	1.00	0.60	2.74	0.6	1554	0.00	2.00	0.00	1.20	0.00	0	1554	2804
SECC2	25.00	19.00	22.00	834.12	0.00	1.93	3.46	2.37	11.4	0.47	1.00	1.00	0.68	2.10	4.3	7545	0.00	2.00	0.00	1.20	0.00	0	7545	9367
SECC3	19.00	13.00	16.00	761.58	0.00	2.04	3.46	2.38	11.4	0.48	1.00	1.00	0.69	2.08	4.4	7019	0.00	2.00	0.00	1.20	0.00	0	7019	10060
SECC4	13.00	7.00	10.00	666.99	0.00	2.60	3.46	2.29	14.3	0.42	1.00	1.00	0.66	2.22	4.9	7240	0.00	2.00	0.00	1.20	0.00	0	7240	11982
SECC5	7.00	0.00	3.50	666.99	0.00	2.98	4.04	2.48	24.0	0.29	1.00	1.00	0.61	2.62	5.5	9534	0.00	2.00	0.00	1.20	0.00	0	9534	15378

Concentrated Loads for Load Case "WIN 45-120":

Joint Label	Force X-Dir (N)	Force Y-Dir (N)	Force Vertical (N)	Moment X-Axis (N-m)	Moment Y-Axis (N-m)	Moment Z-Axis (N-m)	Load Comment
14P	1650	1650	860	0	0	0	
17S	1650	1650	860	0	0	0	
20S	1650	1650	860	0	0	0	
23P	707	707	400	0	0	0	
24S	707	707	400	0	0	0	
25S	1060	1060	600	0	0	0	
27S	1060	1060	600	0	0	0	
29P	1060	1060	600	0	0	0	

Equipment Load Case Information for "WIN 45-120":

Equipment Label	Equipment Property Set	Elevation Above Ground (m)	qzGh (Pa)	Ice Thick. (cm)	Total Wind Incidence Area (m ²)	Wind Angle (deg)	222-G CA	222-G CS	222-G CM	Antenna Axial Load (N)	Antenna Side Load (N)	Antenna Moment (N-m)	Long. Load (N)	Trans. Load (N)	Vert. Load (N)
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10 / 24

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Label	Property Set	Above Ground (m)	Thick. (Pa)	Thick. (cm)	Wind Area (m²)	Incidence Angle (deg)	CA	CS	CM	Axial Load FAM (N)	Side Load FSM (N)	Moment MM (N-m)	Load (N)	Load (N)	Load (N)
ANT_MW1	Ant.MW04.7	13.00	717.71	0.00	0.00	180.00	-1.05470			-13132.69			9286.21	9286.21	7250.00
ANT_MW2	Ant.MW03.7	21.00	823.15	0.00	0.00	180.00	-1.05470			-9334.68			6600.62	6600.62	4750.00
ANT_MW3	Ant.MW04.7	23.01	844.87	0.00	0.00	270.00	-0.01170	-0.34380	-0.13130	-171.49	-5039.29	-9045.36	3442.05	3684.58	7250.00

EIA Section Load Case Information for "WIN 45-120":

Section Label	Z of Top (m)	Z of Bottom (m)	Ave. Above Gnd. (m)	Elev. (m)	qzGh (Pa)	Ice Thick. (cm)	Face AF (m ²)	Face AR (m ²)	Face RR*AR (m ²)	Face AG (m ²)	Face e (m)	Face DF (m ²)	Face DR (m ²)	Face RR (m ²)	Face CF (m ²)	Face AE (m ²)	Face WF (N)	NotF AAF (m ²)	NotF CAF (m ²)	NotF AAR (m ²)	NotF CAR (m ²)	NotF AAR*CAR (m ²)	NotF WA (N)	Total Wind Weight (N)	
EXT10	35.00	27.00	31.00	919.99	0.00	1.82	0.00	0.00	0.00	4.8	0.38	1.20	1.20	0.64	2.34	2.2	4694	0.00	2.00	0.00	1.20	0.00	0	4694	6290
SECC1	27.00	25.00	26.00	874.90	0.00	0.65	0.00	0.00	0.00	2.5	0.26	1.19	1.19	0.60	2.74	0.8	1857	0.00	2.00	0.00	1.20	0.00	0	1857	2804
SECC2	25.00	19.00	22.00	834.12	0.00	1.93	3.46	2.37	11.4	0.47	1.20	1.20	0.68	2.10	5.2	9053	0.00	2.00	0.00	1.20	0.00	0	9053	9367	
SECC3	19.00	13.00	16.00	761.58	0.00	2.04	3.46	2.38	11.4	0.48	1.20	1.20	0.69	2.08	5.3	8422	0.00	2.00	0.00	1.20	0.00	0	8422	10060	
SECC4	13.00	7.00	10.00	666.99	0.00	2.60	3.46	2.29	14.3	0.42	1.20	1.20	0.66	2.22	5.9	8688	0.00	2.00	0.00	1.20	0.00	0	8688	11982	
SECC5	7.00	0.00	3.50	666.99	0.00	2.98	4.04	2.48	24.0	0.29	1.20	1.20	0.61	2.62	6.6	11441	0.00	2.00	0.00	1.20	0.00	0	11441	15378	

Concentrated Loads for Load Case "WIN 45-60":

Joint Label	Force X-Dir (N)	Force Y-Dir (N)	Force Vertical (N)	Moment X-Axis (N-m)	Moment Y-Axis (N-m)	Moment Z-Axis (N-m)	Load Comment
14P	410	410	860	0	0	0	
17S	410	410	860	0	0	0	
20S	410	410	860	0	0	0	
24S	176	176	400	0	0	0	
26S	176	176	400	0	0	0	
25S	265	265	600	0	0	0	
27S	265	265	600	0	0	0	
29P	265	265	600	0	0	0	

Equipment Load Case Information for "WIN 45-60":

Equipment Label	Equipment Property Set	Elevation Above Ground (m)	qzGh (Pa)	Ice Thick. (cm)	Total Wind Area (m²)	Wind Incidence Angle (deg)	222-G CA	222-G CS	222-G CM	Antenna Axial Load FAM (N)	Antenna Side Load FSM (N)	Antenna Moment MM (N-m)	Long. Load (N)	Trans. Load (N)	Vert. Load (N)
ANT_MW1	Ant.MW04.7	13.00	179.42	0.00	0.00	180.00	-1.05470			-3282.98			2321.41	2321.41	7250.00
ANT_MW2	Ant.MW03.7	21.00	205.78	0.00	0.00	180.00	-1.05470			-2333.53			1650.06	1650.06	4750.00
ANT_MW3	Ant.MW04.7	23.01	211.20	0.00	0.00	270.00	-0.01170	-0.34380	-0.13130	-42.87	-1259.75	-2261.21	860.46	921.09	7250.00

EIA Section Load Case Information for "WIN 45-60":

Section Label	Z of Top (m)	Z of Bottom (m)	Z of Ave. Above Gnd. (m)	Elev. (m)	qzGh (Pa)	Ice Thick. (cm)	Face AF	Face AR	Face AG	Face e	Face DF	Face DR	Face RR	Face CF	Face AE	Face WF	NotF AAF	NotF CAF	NotF AAR	NotF CAR	NotF AAR*CAR	NotF WA	Total Wind Weight	Total
							(m²)	(m²)	(m²)	(m)	(m²)	(m²)	(m²)	(m²)	(m²)	(N)	(m²)	(m²)	(m²)	(m²)	(N)	(N)	(N)	(N)
EXT10	35.00	27.00	31.00	229.98	0.00	1.82	0.00	0.00	4.8	0.38	1.20	1.20	0.64	2.34	2.2	1173	0.00	2.00	0.00	1.20	0.00	0	1173	6290
SECC1	27.00	25.00	26.00	218.71	0.00	0.65	0.00	0.00	2.5	0.26	1.19	1.19	0.60	2.74	0.8	464	0.00	2.00	0.00	1.20	0.00	0	464	2804
SECC2	25.00	19.00	22.00	208.52	0.00	1.93	3.46	2.37	11.4	0.47	1.20	1.20	0.68	2.10	5.2	2263	0.00	2.00	0.00	1.20	0.00	0	2263	9367
SECC3	19.00	13.00	16.00	190.38	0.00	2.04	3.46	2.38	11.4	0.48	1.20	1.20	0.69	2.08	5.3	2105	0.00	2.00	0.00	1.20	0.00	0	2105	10060
SECC4	13.00	7.00	10.00	166.74	0.00	2.60	3.46	2.29	14.3	0.42	1.20	1.20	0.66	2.22	5.9	2172	0.00	2.00	0.00	1.20	0.00	0	2172	11982
SECC5	7.00	0.00	3.50	166.74	0.00	2.98	4.04	2.48	24.0	0.29	1.20	1.20	0.61	2.62	6.6	2860	0.00	2.00	0.00	1.20	0.00	0	2860	15378

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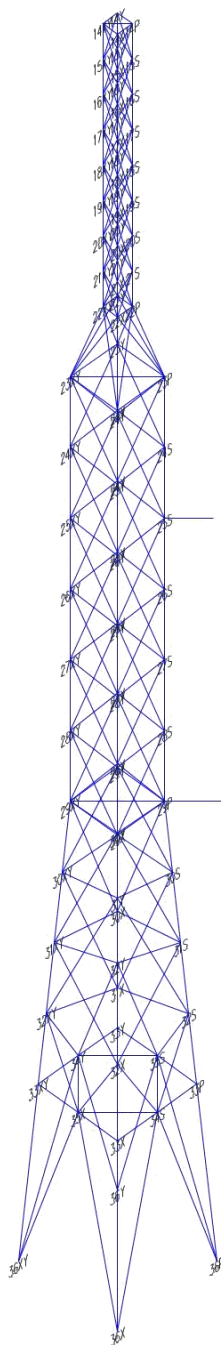
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TAC25-E10-CA-YA

HOJA
11 / 24

REV.
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SILUETA TAC25-NUDOS



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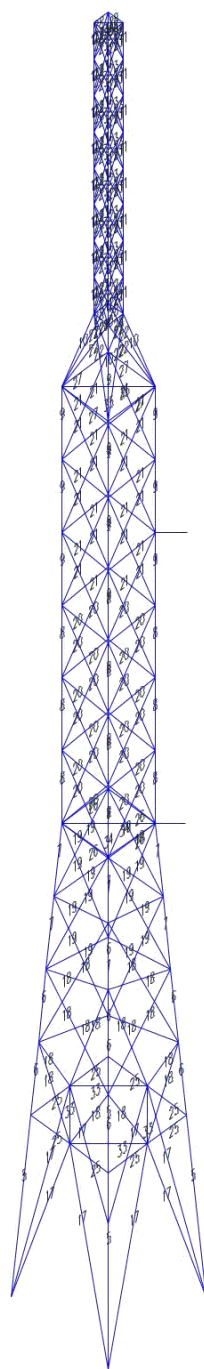
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TAC25-E10-CA-YA

HOJA
12 / 24

REV.
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SILUETA TAC25-ELEMENTOS



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TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
13 / 24

REV.
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RESUMEN

Project Name : TORRE 25.m+EXT.10m-CERRO AZUL-YARUMAL -ACT.
 Project Notes: BTESA - RTVC
 Project File : f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az.tow
 Date run : 10:32:19 a.m. miércoles, 27 de abril de 2016
 by : Tower Version 10.20

Successfully performed linear analysis

The model has 0 warnings.

Member check option: TIA/EIA 222-F
 Connection rupture check: Not Checked
 Crossing diagonal check: Fixed
 Loads from file: f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az.eia

*** Analysis Results:

Maximum element usage is 130.05% for Angle "13P" in load case "WIN 45-120" NG

Summary of Joint Support Reactions For All Load Cases:

Load Case	Joint Label	Long. Force (kN)	Tran. Force (kN)	Vert. Force (kN)	Shear Force (kN)	Tran. Moment (kN-m)	Long. Moment (kN-m)	Vert. Moment (kN-m)	Bending Moment (kN-m)	Found. Usage %
WIN 0 -120	36P	-21.15	-18.19	182.32	27.90	-0.37	0.03	0.93	0.38	0.00
WIN 0 -120	36X	-20.80	22.33	197.79	30.52	0.28	0.14	-0.32	0.31	0.00
WIN 0 -120	36XY	-14.35	-15.11	-143.52	20.84	-0.13	0.06	0.29	0.14	0.00
WIN 0 -120	36Y	-17.58	14.92	-156.28	23.06	0.16	0.04	-0.40	0.16	0.00
WIN 45-120	36P	-32.58	-30.39	287.65	44.55	-0.29	0.26	-0.06	0.39	0.00
WIN 45-120	36X	-2.63	2.29	17.94	3.49	0.15	-0.05	0.07	0.16	0.00
WIN 45-120	36XY	-25.55	-27.34	-248.06	37.42	-0.15	0.18	-0.06	0.24	0.00
WIN 45-120	36Y	0.67	-4.89	22.78	4.93	0.10	-0.22	0.15	0.24	0.00
WIN 45-60	36P	-10.23	-9.55	89.25	14.00	-0.12	0.11	-0.01	0.16	0.00
WIN 45-60	36X	-2.39	2.56	18.38	3.50	0.07	0.03	0.02	0.08	0.00
WIN 45-60	36XY	-4.68	-4.99	-49.50	6.85	-0.00	0.01	-0.01	0.01	0.00
WIN 45-60	36Y	2.29	-3.09	22.18	3.85	-0.02	-0.10	0.04	0.10	0.00

Note: Summary of Joint Support Reactions For All Load Cases in Direction of Leg not printed because none of the angle members attached to foundation joints have a group type of 'Leg'.

Overturning Moment Summary For All Load Cases:

Load Case	Transverse Moment (kN-m)	Longitudinal Moment (kN-m)	Resultant Moment (kN-m)
WIN 0 -120	-56.450	1359.817	1360.988
WIN 45-120	1081.099	1061.727	1515.269
WIN 45-60	285.098	269.912	392.598

EIA Sections Information:

Section Label	Top Z (m)	Bottom Z (m)	Joint Count	Member Count	Top Width (m)	Bottom Width (m)	Gross Area (m^2)	Face Adjust Factor	Face Ar Adjust Factor	Dead Load Factor
EXT10	35.000	27.000	36	106	0.60	0.60	4.80	1.0000	1.0000	1.200
SECC1	27.000	25.000	8	18	0.60	1.90	2.50	1.0000	1.0000	1.200
SECC2	25.000	19.000	16	36	1.90	1.90	11.40	1.1000	1.0000	1.200
SECC3	19.000	13.000	16	42	1.90	1.90	11.40	1.1000	1.0000	1.200
SECC4	13.000	7.000	16	36	1.90	2.87	14.31	1.1500	1.0000	1.200
SECC5	7.000	0.000	16	36	2.87	4.00	24.05	1.1500	1.0000	1.200

*** Overall summary for all load cases - Usage = Maximum Stress / Allowable Stress
 Printed capacities do not include EIA allowable stress increase for wind load cases.
 Printed capacities do not include the strength factor entered for each loadcase.

Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (MPa)	Max Usage %	Max Use In Control %	Comp. Member	Comp. Force (kN)	Comp. Control Load Case	L/R Capacity (kN)	Comp. Shear Capacity (kN)	Conn. Bearing Capacity (kN)	RLX	RLY	RLZ	L/R Length Member (m)	Curve No.	No. Bolts	Of Comp.
5	M01	SAE	4X4X0.375	344.7	83.75	83.75	8P	-237.757	WIN 45-120	283.879	700.028	701.486	0.250	0.250	0.250	62.78	5.032	1	8
6	M02	SAE	4X4X0.375	344.7	83.86	83.86	10P	-260.300	WIN 45-120	310.401	700.028	701.486	0.500	0.500	0.500	50.22	2.013	1	8
7	M03	SAE	4X4X0.25	344.7	128.09	128.09	12P	-239.136	WIN 45-120	186.692	700.028	467.657	0.500	0.500	0.500	49.84	2.013	1	8 NG
8	M04	SAE	3X3X0.25	344.7	130.05	130.05	13P	-181.449	WIN 45-120	139.524	700.028	467.657	0.500	0.500	0.500	66.19	2.004	1	8 NG
9	M05	SAE	3X3X0.25	344.7	60.53	60.53	16P	-84.454	WIN 45-120	139.524	525.021	350.743	0.500	0.500	0.500	66.19	2.004	1	6
10	M06	SAE	2.5X2.5X0.25	344.7	40.56	40.56	19P	-37.165	WIN 45-120	91.640	525.021	350.743	0.500	0.500	0.500	88.25	2.201	1	6

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TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
14 / 24

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11	M07	SAE	2.5X2.5X0.25	344.7	56.87	56.87	20P	-57.123WIN	45-120	100.442	350.014	233.829	1.000	1.000	1.000	80.18	1.000	1	4
17	D01	SAE	2.5X2.5X0.25	248.1	70.28	70.28	43P	-30.903WIN	45-120	43.973	87.538	96.906	0.500	0.330	0.330	142.89	5.400	6	2
18	D02	SAE	2.5X2.5X0.25	248.1	46.25	46.25	45Y	-23.799WIN	45-120	51.454	87.538	96.906	1.000	0.500	0.500	126.30	2.467	6	2
19	D03	SAE	2X2X0.25	248.1	51.69	51.69	49Y	-15.850WIN	45-120	30.661	87.538	96.906	0.750	0.500	0.500	156.93	3.117	6	2
20	D04	SAE	2X2X0.25	248.1	62.52	62.52	53Y	-22.508WIN	45-120	35.999	87.538	96.906	0.750	0.500	0.500	139.03	2.762	6	2
21	D05	SAE	2X2X0.25	248.1	54.30	54.30	62XY	-19.630WIN	0 -120	36.147	87.538	96.906	0.750	0.500	0.500	138.59	2.753	6	2
22	D06	SAE	2X2X0.1875	248.1	71.57	71.57	62aP	-22.794WIN	45-120	31.851	87.538	72.679	0.750	0.500	0.500	122.23	2.446	6	2
23	D07	SAE	1.5X1.5X0.1875	248.1	17.59	11.28	67XY	-3.479WIN	45-120	30.835	87.538	72.679	0.750	0.500	0.500	78.35	1.166	3	2
25	H01	SAE	2X2X0.1875	248.1	3.29	3.29	83X	-1.351WIN	45-120	41.021	87.538	72.679	1.000	0.500	0.500	79.79	1.597	3	2
26	H02	SAE	2X2X0.1875	248.1	66.51	66.51	96P	-11.812WIN	0 -120	17.760	87.538	72.679	1.000	1.000	1.000	189.86	1.900	6	2
27	H03	SAE	2.5X2.5X0.25	248.1	19.46	8.04	100XR	-3.248WIN	0 -120	40.393	87.538	96.906	1.000	1.000	1.000	152.35	1.900	6	2
28	H04	SAE	2X2X0.1875	248.1	9.06	2.45	101P	-1.100WIN	45-120	44.860	87.538	72.679	1.000	1.000	1.000	59.95	0.600	3	2
33	C01	SAE	2X2X0.1875	248.1	3.19	3.19	103X	-0.828WIN	0 -120	25.945	87.538	72.679	1.000	0.500	0.500	144.11	2.258	6	2
34	C02	SAE	2X2X0.1875	248.1	35.26	35.26	104P	-7.233WIN	45-120	20.510	87.538	72.679	1.000	0.500	0.500	171.45	2.687	6	2
35	C03	SAE	2X2X0.1875	248.1	44.95	44.95	105P	-9.220WIN	0 -120	20.510	87.538	72.679	1.000	0.500	0.500	171.45	2.687	6	2
36	C04	SAE	2X2X0.1875	248.1	7.56	7.56	106P	-3.473WIN	0 -120	45.939	87.538	72.679	1.000	0.500	0.500	54.14	0.849	3	2

Group Summary (Tension Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength	Max Usage	Max Use In Tens.	Tension Control Member	Tension Force	Tension Control Load Case	Net Section Capacity	Tens. Shear Capacity	Conn. Bearing Capacity	Conn. Rupture Capacity	Length Member	No. Of Bolts	No. Of Holes	Hole Diameter
				(MPa)	%	%		(kN)		(kN)	(kN)	(kN)	(kN)	(m)			(cm)
5	M01	SAE	4X4X0.375	344.7	83.75	58.12	8XY	212.889WIN	45-120	366.310	700.028	701.486	0.000	5.032	8	2.000	1.749
6	M02	SAE	4X4X0.375	344.7	83.86	60.26	10XY	220.725WIN	45-120	366.310	700.028	701.486	0.000	2.013	8	2.000	1.749
7	M03	SAE	4X4X0.25	344.7	128.09	78.69	12XY	195.439WIN	45-120	248.357	700.028	467.657	0.000	2.013	8	2.000	1.749 NG
8	M04	SAE	3X3X0.25	344.7	130.05	92.50	13XY	159.191WIN	45-120	172.093	700.028	467.657	0.000	2.004	8	2.000	1.749 NG
9	M05	SAE	3X3X0.25	344.7	60.53	46.96	16XY	80.807WIN	45-120	172.093	525.021	350.743	0.000	2.004	6	2.000	1.749
10	M06	SAE	2.5X2.5X0.25	344.7	40.56	26.88	19XY	35.383WIN	45-120	131.627	525.021	350.743	0.000	2.201	6	2.000	1.749
11	M07	SAE	2.5X2.5X0.25	344.7	56.87	39.00	20XY	51.333WIN	45-120	131.627	350.014	233.829	0.000	1.000	4	2.000	1.749
17	D01	SAE	2.5X2.5X0.25	248.1	70.28	26.56	42XY	23.249WIN	45-120	98.481	87.538	96.906	0.000	5.400	2	1.000	1.749
18	D02	SAE	2.5X2.5X0.25	248.1	46.25	20.08	44Y	17.576WIN	45-120	98.481	87.538	96.906	0.000	2.467	2	1.000	1.749
19	D03	SAE	2X2X0.25	248.1	51.69	21.84	51P	16.226WIN	45-120	74.292	87.538	96.906	0.000	2.877	2	1.000	1.749
20	D04	SAE	2X2X0.25	248.1	62.52	29.24	55P	21.721WIN	0 -120	74.292	87.538	96.906	0.000	2.762	2	1.000	1.749
21	D05	SAE	2X2X0.25	248.1	54.30	27.50	59P	20.434WIN	0 -120	74.292	87.538	96.906	0.000	2.762	2	1.000	1.749
22	D06	SAE	2X2X0.1875	248.1	71.57	28.60	63aXY	16.073WIN	45-120	56.203	87.538	72.679	0.000	2.446	2	1.000	1.749
23	D07	SAE	1.5X1.5X0.1875	248.1	17.59	17.59	66P	6.824WIN	45-120	38.788	87.538	72.679	0.000	1.166	2	1.000	1.749
25	H01	SAE	2X2X0.1875	248.1	3.29	2.96	80P	1.662WIN	45-120	56.203	87.538	72.679	0.000	1.597	2	1.000	1.749
26	H02	SAE	2X2X0.1875	248.1	66.51	28.95	96Y	16.270WIN	0 -120	56.203	87.538	72.679	0.000	1.900	2	1.000	1.749
27	H03	SAE	2.5X2.5X0.25	248.1	19.46	19.46	100YR	17.038WIN	0 -120	98.481	87.538	96.906	0.000	1.900	2	1.000	1.749
28	H04	SAE	2X2X0.1875	248.1	9.06	9.06	101R	5.090WIN	0 -120	56.203	87.538	72.679	0.000	0.600	2	1.000	1.749
33	C01	SAE	2X2X0.1875	248.1	3.19	2.02	103P	1.137WIN	0 -120	56.203	87.538	72.679	0.000	2.258	2	1.000	1.749
34	C02	SAE	2X2X0.1875	248.1	35.26	5.38	104X	3.024WIN	45-120	56.203	87.538	72.679	0.000	2.687	2	1.000	1.749
35	C03	SAE	2X2X0.1875	248.1	44.95	12.75	105X	7.163WIN	0 -120	56.203	87.538	72.679	0.000	2.687	2	1.000	1.749
36	C04	SAE	2X2X0.1875	248.1	7.56	0.00	106X	0.000	0 -120	56.203	87.538	72.679	0.000	0.849	2	1.000	1.749

*** Maximum Stress Summary for Each Load Case

Summary of Maximum Usages by Load Case:

Load Case	Maximum Usage %	Element Label	Element Type
WIN 0 -120	89.76	13P	Angle
WIN 45-120	130.05	13P	Angle NG
WIN 45-60	41.72	12P	Angle

*** Weight of structure (N):
Weight of Angles*Section DLF: 37506.0
Weight of Equipment: 15400.0
Total: 52906.0

*** End of Report

EVALUACION ESTRUCTURAL TAC25



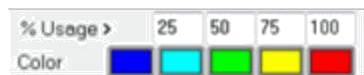
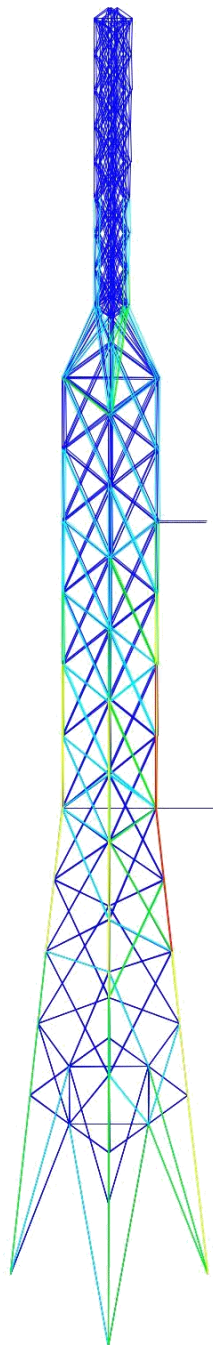
TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
15 / 24

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SILUETA ESFUERZOS-DEF.



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TORRE 25m+EXT.10m



TAC25-E10-CA-YA

HOJA
16 / 24

REV.
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TORRE 25 m – CERRO AZUL-YARUMAL
REFORZAMIENTO

EVALUACION ESTRUCTURAL TAC25

 BTESA BROADTELECOM	 RTVC Sistema de Medios Públicos	TORRE 25m+EXT.10m		
		TAC25-E10-CA-YA	HOJA 17 / 24	REV. 0

RESUMEN DE DISEÑO

Project Name : TORRE 25m+EXT.10m-CERRO AZUL-YARUMAL -REF.
 Project Notes: BTESA - RTVC
 Project File : f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az_r.tow
 Date run : 02:41:29 p.m. jueves, 28 de abril de 2016
 by : Tower Version 10.20

Successfully performed linear analysis

The model has 0 warnings.

Member check option: TIA/EIA 222-F
 Connection rupture check: Not Checked
 Crossing diagonal check: Fixed
 Loads from file: f:\arch_2016\eval_btesa\tac25_cero azul\tor25e10c_az.eia

*** Analysis Results:

Maximum element usage is 86.05% for Angle "12P" in load case "WIN 45-120"

Summary of Joint Support Reactions For All Load Cases:

Load Case	Joint Label	Long. Force (kN)	Tran. Force (kN)	Vert. Force (kN)	Shear Force (kN)	Tran. Moment (kN-m)	Long. Moment (kN-m)	Vert. Moment (kN-m)	Bending Moment (kN-m)	Found. Usage %
WIN 0 -120	36P	-21.73	-19.39	187.21	29.12	-0.39	0.01	1.22	0.39	0.00
WIN 0 -120	36X	-21.47	23.46	201.86	31.80	0.28	0.13	-0.39	0.31	0.00
WIN 0 -120	36XY	-14.62	-15.64	-145.36	21.41	-0.12	0.06	0.35	0.14	0.00
WIN 0 -120	36Y	-18.01	15.53	-158.92	23.78	0.15	0.04	-0.52	0.16	0.00
WIN 45-120	36P	-33.92	-31.69	294.78	46.42	-0.29	0.25	-0.10	0.38	0.00
WIN 45-120	36X	-2.60	2.70	18.75	3.75	0.15	-0.05	0.10	0.15	0.00
WIN 45-120	36XY	-26.37	-28.19	-252.33	38.61	-0.15	0.18	-0.09	0.23	0.00
WIN 45-120	36Y	1.15	-4.81	23.59	4.94	0.11	-0.23	0.28	0.25	0.00
WIN 45-60	36P	-10.75	-10.05	91.94	14.72	-0.12	0.11	-0.02	0.16	0.00
WIN 45-60	36X	-2.53	2.83	19.36	3.79	0.07	0.03	0.03	0.08	0.00
WIN 45-60	36XY	-4.73	-5.04	-49.67	6.91	-0.00	0.01	-0.02	0.01	0.00
WIN 45-60	36Y	2.58	-3.23	23.16	4.13	-0.02	-0.10	0.07	0.10	0.00

Note: Summary of Joint Support Reactions For All Load Cases in Direction of Leg not printed because none of the angle members attached to foundation joints have a group type of 'Leg'.

Overturning Moment Summary For All Load Cases:

Load Case	Transverse Moment (kN-m)	Longitudinal Moment (kN-m)	Resultant Moment (kN-m)
WIN 0 -120	-56.428	1386.696	1387.843
WIN 45-120	1103.907	1084.532	1547.521
WIN 45-60	290.801	275.613	400.659

EIA Sections Information:

Section Label	Top Z (m)	Bottom Z (m)	Joint Count	Member Count	Top Width (m)	Bottom Width (m)	Gross Area (m^2)	Face Adjust Factor	Face Ar Adjust Factor	Dead Load
EXT10	35.000	27.000	36	106	0.60	0.60	4.80	1.0000	1.0000	1.200
SECC1	27.000	25.000	8	18	0.60	1.90	2.50	1.0000	1.0000	1.200
SECC2	25.000	19.000	16	36	1.90	1.90	11.40	1.1000	1.0000	1.200
SECC3	19.000	13.000	16	42	1.90	1.90	11.40	1.1000	1.0000	1.200
SECC4	13.000	7.000	16	36	1.90	2.87	14.31	1.1500	1.0000	1.200
SECC5	7.000	0.000	16	36	2.87	4.00	24.05	1.1500	1.0000	1.200

*** Overall summary for all load cases - Usage = Maximum Stress / Allowable Stress
 Printed capacities do not include EIA allowable stress increase for wind load cases.
 Printed capacities do not include the strength factor entered for each loadcase.

Group Summary (Compression Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (MPa)	Max Usage %	Max Use In Comp. %	Comp. Member	Comp. Force (kN)	Comp. Control Load Case	L/R Comp. Capacity (kN)	Conn. Shear Capacity (kN)	Conn. Bearing Capacity (kN)	RLX	RLY	RLZ	L/R Length (m)	Comp. Member	No. Bolts	Of Comp.
5	M01	SAE	4X4X0.375	344.7	84.63	84.63	8P	-240.249	WIN 45-120	283.879	700.028	701.486	0.250	0.250	0.250	62.78	5.032	1	8
6	M02	SAE	4X4X0.375	344.7	86.04	86.04	10P	-267.062	WIN 45-120	310.401	700.028	701.486	0.500	0.500	0.500	50.22	2.013	1	8
7	M03	DAI	4X1/4+3X1/4	344.7	86.05	86.05	12P	-241.760	WIN 45-120	280.950	700.028	584.572	0.500	0.500	0.500	29.79	2.013	1	8
8	M04	DAI	3X3X0.25	344.7	54.36	54.36	13P	-184.992	WIN 45-120	340.306	700.028	935.462	0.500	0.500	0.500	34.60	2.004	1	8
9	M05	SAE	3X3X0.25	344.7	58.80	58.80	16P	-82.036	WIN 45-120	139.524	525.021	350.743	0.500	0.500	0.500	66.19	2.004	1	6
10	M06	SAE	2.5X2.5X0.25	344.7	40.55	40.55	19P	-37.162	WIN 45-120	91.640	525.021	350.743	0.500	0.500	0.500	88.25	2.201	1	6
11	M07	SAE	2.5X2.5X0.25	344.7	56.96	56.96	20P	-57.207	WIN 45-120	100.442	350.014	233.829	1.000	1.000	1.000	80.18	1.000	1	4

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
18 / 24

REV.
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17	D01	SAE	2.5X2.5X0.25	248.1	76.16	76.16	43P	-33.490WIN	45-120	43.973	87.538	96.906	0.500	0.330	0.330	142.89	5.400	6	2
18	D02	SAE	2.5X2.5X0.25	248.1	51.46	51.46	44P	-26.477WIN	0 -120	51.454	87.538	96.906	1.000	0.500	0.500	126.30	2.467	6	2
19	D03	SAE	2X2X0.25	248.1	55.86	55.86	48P	-17.128WIN	0 -120	30.661	87.538	96.906	0.750	0.500	0.500	156.93	3.117	6	2
20	D04	SAE	2X2X0.25	248.1	61.18	61.18	53Y	-22.024WIN	45-120	35.999	87.538	96.906	0.750	0.500	0.500	139.03	2.762	6	2
21	D05	SAE	2X2X0.25	248.1	48.25	48.25	62XY	-17.442WIN	0 -120	36.147	87.538	96.906	0.750	0.500	0.500	138.59	2.753	6	2
22	D06	SAE	2X2X0.1875	248.1	71.58	71.58	62aP	-22.800WIN	45-120	31.851	87.538	72.679	0.750	0.500	0.500	122.23	2.446	6	2
23	D07	SAE	1.5X1.5X0.1875	248.1	17.60	11.28	67XY	-3.478WIN	45-120	30.835	87.538	72.679	0.750	0.500	0.500	78.35	1.166	3	2
25	H01	SAE	2X2X0.1875	248.1	3.33	3.33	83X	-1.367WIN	45-120	41.021	87.538	72.679	0.500	0.500	0.500	79.79	1.597	3	2
26	H02	SAE	2X2X0.1875	248.1	51.12	51.12	96P	-9.078WIN	0 -120	37.760	87.538	72.679	1.000	1.000	1.000	189.86	1.900	6	2
27	H03	SAE	2.5X2.5X0.25	248.1	18.81	8.38	100R	-3.384WIN	45-120	40.393	87.538	96.906	1.000	1.000	1.000	152.35	1.900	6	2
28	H04	SAE	2X2X0.1875	248.1	9.00	2.39	101P	-1.073WIN	45-120	44.860	87.538	72.679	1.000	1.000	1.000	59.95	0.600	3	2
33	C01	SAE	2X2X0.1875	248.1	4.10	4.10	103X	-1.064WIN	0 -120	25.945	87.538	72.679	1.000	0.500	0.500	144.11	2.258	6	2
34	C02	SAE	2X2X0.1875	248.1	34.55	34.55	104P	-7.086WIN	45-120	20.510	87.538	72.679	1.000	0.500	0.500	171.45	2.687	6	2
35	C03	SAE	2X2X0.1875	248.1	43.53	43.53	105P	-8.928WIN	0 -120	20.510	87.538	72.679	1.000	0.500	0.500	171.45	2.687	6	2
36	C04	SAE	2X2X0.1875	248.1	7.55	7.55	106P	-3.470WIN	0 -120	45.939	87.538	72.679	1.000	0.500	0.500	54.14	0.849	3	2

Group Summary (Tension Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (MPa)	Max Usage %	Max Tens. %	Tension Control Member	Tension Force (kN)	Tension Control Load Case	Net Tens. Section Capacity (kN)	Tens. Conn. Shear Capacity (kN)	Tens. Conn. Bearing Capacity (kN)	Tens. Conn. Rupture Capacity (kN)	Length Tens. Member (m)	No. Of Bolts	No. Of Holes	Hole Diameter (cm)
5	M01	SAE	4X4X0.375	344.7	84.63	58.44	8XY	214.087WIN	45-120	366.310	700.028	701.486	0.000	5.032	8	2,000	1.749
6	M02	SAE	4X4X0.375	344.7	86.04	61.11	10XY	223.865WIN	45-120	366.310	700.028	701.486	0.000	2.013	8	2,000	1.749
7	M03	DAI	4X1/4+3X1/4	344.7	86.05	43.41	12XY	195.814WIN	45-120	451.082	700.028	584.572	0.000	2.013	8	2,000	1.749
8	M04	DAI	3X3X0.25	344.7	54.36	41.80	13XY	160.643WIN	45-120	384.299	700.028	935.462	0.000	2.004	8	2,000	1.749
9	M05	SAE	3X3X0.25	344.7	58.80	45.58	16XY	78.434WIN	45-120	172.093	525.021	350.743	0.000	2.004	6	2,000	1.749
10	M06	SAE	2.5X2.5X0.25	344.7	40.55	26.98	19XY	35.514WIN	45-120	131.627	525.021	350.743	0.000	2.201	6	2,000	1.749
11	M07	SAE	2.5X2.5X0.25	344.7	56.96	38.96	20XY	51.284WIN	45-120	131.627	350.014	233.829	0.000	1.000	4	2,000	1.749
17	D01	SAE	2.5X2.5X0.25	248.1	76.16	28.50	42XY	24.951WIN	45-120	98.481	87.538	96.906	0.000	5.400	2	1,000	1.749
18	D02	SAE	2.5X2.5X0.25	248.1	51.46	21.96	44Y	19.223WIN	45-120	98.481	87.538	96.906	0.000	2.467	2	1,000	1.749
19	D03	SAE	2X2X0.25	248.1	55.86	21.12	51P	15.692WIN	45-120	74.292	87.538	96.906	0.000	2.877	2	1,000	1.749
20	D04	SAE	2X2X0.25	248.1	61.18	29.41	55P	21.846WIN	0 -120	74.292	87.538	96.906	0.000	2.762	2	1,000	1.749
21	D05	SAE	2X2X0.25	248.1	48.25	28.17	59P	20.927WIN	0 -120	74.292	87.538	96.906	0.000	2.762	2	1,000	1.749
22	D06	SAE	2X2X0.1875	248.1	71.58	28.30	63aXY	15.904WIN	45-120	56.203	87.538	72.679	0.000	2.446	2	1,000	1.749
23	D07	SAE	1.5X1.5X0.1875	248.1	17.60	17.60	66P	6.827WIN	45-120	38.788	87.538	72.679	0.000	1.166	2	1,000	1.749
25	H01	SAE	2X2X0.1875	248.1	3.33	3.04	82P	1.707WIN	0 -120	56.203	87.538	72.679	0.000	1.597	2	1,000	1.749
26	H02	SAE	2X2X0.1875	248.1	51.12	29.92	96Y	16.817WIN	0 -120	56.203	87.538	72.679	0.000	1.900	2	1,000	1.749
27	H03	SAE	2.5X2.5X0.25	248.1	18.81	18.81	100YR	16.465WIN	0 -120	98.481	87.538	96.906	0.000	1.900	2	1,000	1.749
28	H04	SAE	2X2X0.1875	248.1	9.00	9.00	101R	5.060WIN	0 -120	56.203	87.538	72.679	0.000	0.600	2	1,000	1.749
33	C01	SAE	2X2X0.1875	248.1	4.10	2.23	103P	1.256WIN	0 -120	56.203	87.538	72.679	0.000	2.258	2	1,000	1.749
34	C02	SAE	2X2X0.1875	248.1	34.55	5.73	104X	3.222WIN	45-120	56.203	87.538	72.679	0.000	2.687	2	1,000	1.749
35	C03	SAE	2X2X0.1875	248.1	43.53	12.26	105X	6.889WIN	0 -120	56.203	87.538	72.679	0.000	2.687	2	1,000	1.749
36	C04	SAE	2X2X0.1875	248.1	7.55	0.00	106X	0.000	0 -120	56.203	87.538	72.679	0.000	0.849	2	1,000	1.749

*** Maximum Stress Summary for Each Load Case

Summary of Maximum Usages by Load Case:

Load Case	Maximum Usage %	Element Label	Element Type
WIN 0 -120	60.55	57Y	Angle
WIN 45-120	86.05	12P	Angle
WIN 45-60	28.09	12P	Angle

*** Weight of structure (N):
Weight of Angles*Section DLF: 41085.1
Weight of Equipment: 15400.0
Total: 56485.1

*** End of Report

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

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19 / 24

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TORRE 25 m – CERRO AZUL - YARUMAL
CIMENTACION

EVALUACION ESTRUCTURAL TAC25



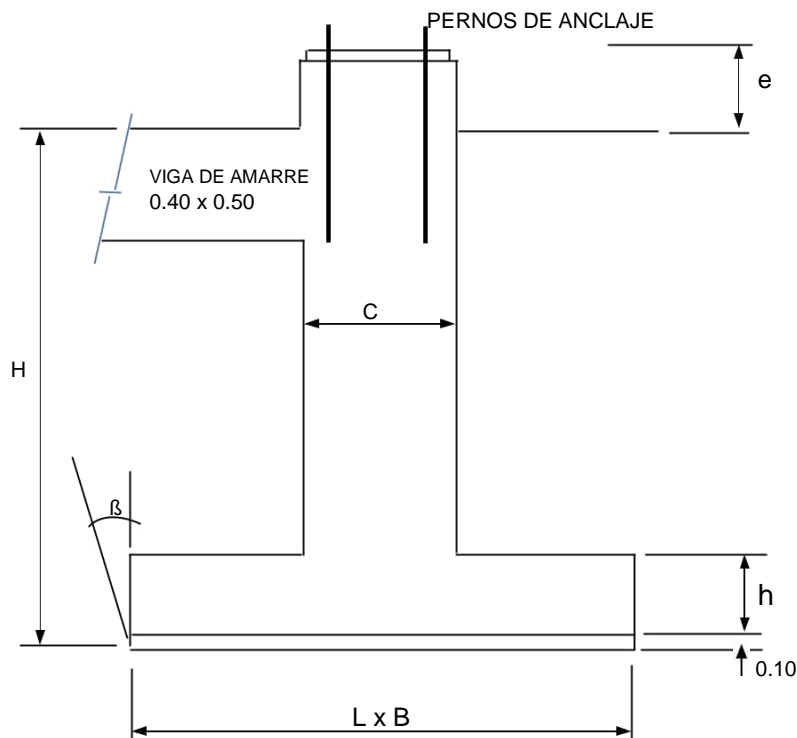
TORRE 25m+EXT.10m

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20 / 24

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TORRE 25,m - CERRO AZUL
CIMENTACION EN CONCRETO



MATERIALES: Acero $f_y = 4,200$ Kg / cm²
 Concr. $f'_c = 210$ Kg / cm²
 Angulo $\beta = 20$ grados. $T_g = 0.364$
 Suelo $q_u = 1.00$ Kg / cm²
 Suelo $C = 0.05$ Kg / cm²

PREDIMENSIONAMIENTO. CHEQUEO ESTABLD.

Dimensiones (m.)	H = 2.50	h = 0.50	C = 0.60	L = 2.50	e = 0.25
Volumen de Concreto (m3)	V1 = 0.792	V2 = 3.125	V3 = 0.313	Vc = 4.23	Cortante Vu=
Volumen de Suelo (m3)	V4 = 15.625	V5 = 10.924	V6 = 2.040	Vs = 24.359	4,642
Peso Específico (Ton / m3)	Suelo 1.60	Concreto 2.40	R. Cohesión 6.250	P. Suelo 38.975	P. Concreto 10.151
Peso total Fundación (Ton.)	55,376	Arrancamiento	Fu = 25,233	Factor de seguridad al arranque K=	1.87
Compresión C =	29,478	Area m2 6.25	0.37	Kg / cm2	Presión sobre el terreno

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
21 / 24



REV.
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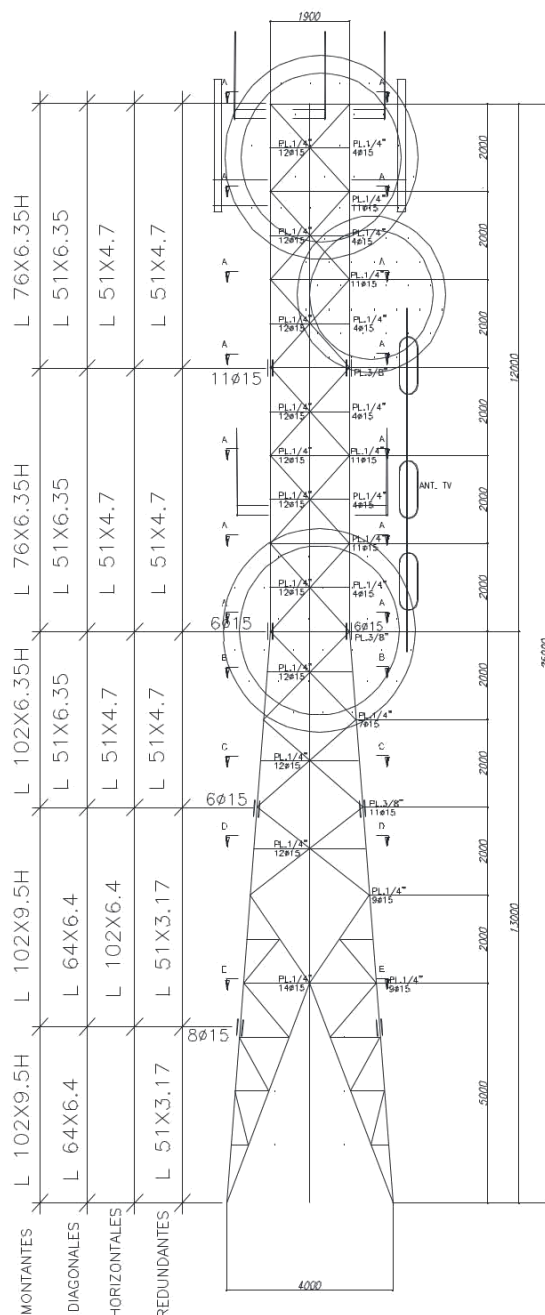
CONCLUSIONES:

La torre de 25 metros instalada en sitio Cerro Azul-Yarumal, en el estado actual y después del análisis con las antenas instaladas:

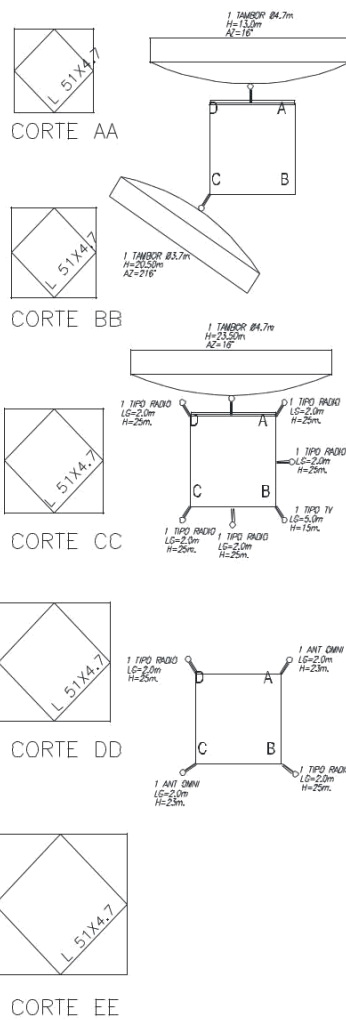
1. La estructura metálica en las condiciones de trabajo con las cargas actuales mas las antenas nuevas, no cumple por esfuerzos y deformaciones; El elemento más esforzado está trabajando al 130.05 %, referido al límite fluencia, fallan los elementos M03 de L4"x1/4" y M04 de L3"x1/4", marcados en rojo en la silueta.
2. El análisis estructural se hace considerando que los elementos que conforman la estructura están en buen estado.
3. La deflexión máxima en el extremo superior de las torre, para cargas de trabajo, con viento de 60.km/h es 0.24 m, es decir 0.39 ° menor a 0.5°.
4. Se propone un refuerzo para los elementos M03, M04 con perfiles adicionales de L3"x1/4", además de hacer cierre interno entre estas diagonales de la pata para mejorar la esbeltez; El peso aprox. de la extensión de 10 metros mas el reforzamiento es 2.500 kg.
5. La cimentación, según el informe de campo, está compuesta por zapatas cuadradas de 2.5m, con pedestales de 0.60x0.60 a una profundidad de 2.50 metros, unidos mediante vigas de amarre de 0.40x0.50m, con suelo $q_a=1.0 \text{ kg/cm}^2$ y según la verificación, la cimentación cumple por esfuerzos para las cargas de la torre con las antenas nuevas.

EVALUACION ESTRUCTURAL TAC25

		TORRE 25m+EXT.10m	
		TAC25-E10-CA-YA	HOJA 22 / 24 REV. 0



SILUETA DE LEVANTAMIENTO.
TC25m YARUMAL



EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
23 / 24

REV.
0

EVALUACION ESTRUCTURAL TAC25



TORRE 25m+EXT.10m

TAC25-E10-CA-YA

HOJA
24 / 24

REV.
0