

0	18/04/2016	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 80 m EL MIARDOR - HUILA</p> </div>						
<div style="text-align: center;"> <p>EVALUACION ESTRUCTURAL</p>  </div>						
ESCALA SIN	FORMATO A4	REFERENCIA BTESA TAC80-EM-HU		REFERENCIA RTVC TORRE 80-EL MIRADOR		HOJA 1/23
						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 TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
**2 / 23**

REV.  
**0**

## TORRE 80 m

### EVALUACION ESTRUCTURAL

#### 1. DESCRIPCIÓN:

A continuación presentamos la verificación estructural de la torre auto-soportada de 80 metros, instalada en la estación El Mirador (Huila), es tipo celosía de sección cuadrada, diseñada con perfiles angulares; El chequeo se hace con las cargas de antenas instaladas actualmente: Doce (12) antenas TV, cuatro (4) antenas yagui, una (1) antena MWØ1.80m, una (1) antena Grid Ø1.80m y una (1) antena MWØ2.4m, se proyecta la instalación de diez (10) antenas panel, 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 TV	71,0 m	2 und
ANTENA TV	68,0 m	2 und
ANTENA TV	64,5 m	2 und
ANTENA TV	55,0 m	2 und
ANTENA TV	52,0 m	2 und
ANTENA TV	49,0 m	2 und
ANTENA YAGUI	29,5 m	2 und
ANTENA YAGUI	16,7 m	2 und
MWØ2,4 m	22,0 m	1 und
GWØ1,8 m (GR)	19,5 m	1 und
MWØ1,8 m	19,5 m	1 und
ANTENAS NUEVAS		
ANTENA PANEL	76,0 m	10 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 TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
3 / 23

REV.  
0

**NOTA:**

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

AZIMUT DE LA CARA A: 78°

AZIMUT DE LA CARA B: 168°

AZIMUT DE LA CARA C: 258°

AZIMUT DE LA CARA D: 348°

**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:

$q_z$  = Presion de viento en daN/m<sup>2</sup>

$C_f$  = Coeficiente de fuerza según capitulo H

$A_f$  = Area expuesta en m<sup>2</sup>

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/m<sup>2</sup>

**3.3. Viento sobre la estructura.**

Se aplican en los nudos que comprenden cada panel analizado.

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

$P(10) = 76.2$

$P(80) = 110.4$

A = área del panel analizado. S / silueta.

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

**EVALUACION ESTRUCTURAL TAC80**



**TORRE 80m-EL MIRADOR**

**TAC80-EM-HU**

HOJA  
**4 / 23**

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 80 m – EL MIRADOR

### EVALUACION ESTRUCTURAL TAC80



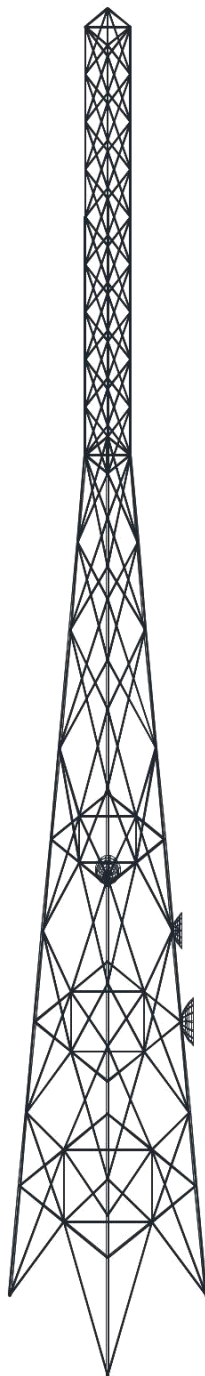
TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
5 / 23

REV.  
0

SILUETA TAC80-ANTENAS



EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
**6 / 23**

REV.  
**0**

## LISTADO TOWER

\*\*\*\*\*  
 \*  
 \* TOWER - Analysis and Design - Copyright Power Line Systems, Inc. 1986-2006 \*  
 \*  
 \*\*\*\*\*

Project Name : TORRE 80 m-EL MIRADOR -ACT.  
 Project Notes: BTESA - RTVC  
 Project File : f:\arch\_2016\eval\_btesa\tac80el\_mirador\tor80m\_mir.tow  
 Date run : 10:23:14 a.m. lunes, 18 de abril de 2016  
 by : Tower Version 10.20

Successfully performed linear analysis



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.
14F	XY-Symmetry	1.162	1.162	80	Free	Free	Free	Free	Free	Free
23F	XY-Symmetry	1.162	1.162	53	Free	Free	Free	Free	Free	Free
25F	XY-Symmetry	1.928	1.928	42	Free	Free	Free	Free	Free	Free
26F	XY-Symmetry	2.486	2.486	34.5	Free	Free	Free	Free	Free	Free
38F	XY-Symmetry	5.05	5.05	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
14X	X-GenXY	1.162	-1.162	80	Free	Free	Free	Free	Free	Free
14XY	XY-GenXY	-1.162	-1.162	80	Free	Free	Free	Free	Free	Free
14Y	Y-GenXY	-1.162	1.162	80	Free	Free	Free	Free	Free	Free
23X	X-GenXY	1.162	-1.162	53	Free	Free	Free	Free	Free	Free
23XY	XY-GenXY	-1.162	-1.162	53	Free	Free	Free	Free	Free	Free
23Y	Y-GenXY	-1.162	1.162	53	Free	Free	Free	Free	Free	Free
25X	X-GenXY	1.928	-1.928	42	Free	Free	Free	Free	Free	Free
25XY	XY-GenXY	-1.928	-1.928	42	Free	Free	Free	Free	Free	Free
25Y	Y-GenXY	-1.928	1.928	42	Free	Free	Free	Free	Free	Free
26X	X-GenXY	2.486	-2.486	34.5	Free	Free	Free	Free	Free	Free
26XY	XY-GenXY	-2.486	-2.486	34.5	Free	Free	Free	Free	Free	Free
26Y	Y-GenXY	-2.486	2.486	34.5	Free	Free	Free	Free	Free	Free
38X	X-GenXY	5.05	-5.05	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
38XY	XY-GenXY	-5.05	-5.05	0	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
38Y	Y-GenXY	-5.05	5.05	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.
15S	XY-Symmetry	14P	23P	0.111	0	Free	Free	Free	Free	Free	Free
16S	XY-Symmetry	14P	23P	0.222	0	Free	Free	Free	Free	Free	Free
17S	XY-Symmetry	14P	23P	0.333	0	Free	Free	Free	Free	Free	Free
18S	XY-Symmetry	14P	23P	0.444	0	Free	Free	Free	Free	Free	Free
19S	XY-Symmetry	14P	23P	0.555	0	Free	Free	Free	Free	Free	Free

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
7 / 23

REV.  
0

20S	XY-Symmetry	14P	23P	0.666	0	Free	Free	Free	Free	Free	Free
21S	XY-Symmetry	14P	23P	0.777	0	Free	Free	Free	Free	Free	Free
22S	XY-Symmetry	14P	23P	0.888	0	Free	Free	Free	Free	Free	Free
24S	XY-Symmetry	23P	25P	0.5	0	Free	Free	Free	Free	Free	Free
30S	XY-Symmetry	26P	38P	0.333	0	Free	Free	Free	Free	Free	Free
27S	XY-Symmetry	26P	30S	0.5	0	Free	Free	Free	Free	Free	Free
28S	Y-Symmetry	27S	27X	0.5	0	Free	Free	Free	Free	Free	Free
29S	X-Symmetry	27S	27Y	0.5	0	Free	Free	Free	Free	Free	Free
34S	XY-Symmetry	26P	38P	0.666	0	Free	Free	Free	Free	Free	Free
31S	XY-Symmetry	30S	34S	0.5	0	Free	Free	Free	Free	Free	Free
32S	Y-Symmetry	31S	31X	0.5	0	Free	Free	Free	Free	Free	Free
33S	X-Symmetry	31S	31Y	0.5	0	Free	Free	Free	Free	Free	Free
35S	XY-Symmetry	34S	38P	0.4	0	Free	Free	Free	Free	Free	Free
36S	Y-Symmetry	35S	35X	0.5	0	Free	Free	Free	Free	Free	Free
37S	X-Symmetry	35S	35Y	0.5	0	Free	Free	Free	Free	Free	Free
15X	X-GenXY	14P	23P	0.111	0	Free	Free	Free	Free	Free	Free
15XY	XY-GenXY	14P	23P	0.111	0	Free	Free	Free	Free	Free	Free
15Y	Y-GenXY	14P	23P	0.111	0	Free	Free	Free	Free	Free	Free
16X	X-GenXY	14P	23P	0.222	0	Free	Free	Free	Free	Free	Free
16XY	XY-GenXY	14P	23P	0.222	0	Free	Free	Free	Free	Free	Free
16Y	Y-GenXY	14P	23P	0.222	0	Free	Free	Free	Free	Free	Free
17X	X-GenXY	14P	23P	0.333	0	Free	Free	Free	Free	Free	Free
17XY	XY-GenXY	14P	23P	0.333	0	Free	Free	Free	Free	Free	Free
17Y	Y-GenXY	14P	23P	0.333	0	Free	Free	Free	Free	Free	Free
18X	X-GenXY	14P	23P	0.444	0	Free	Free	Free	Free	Free	Free
18XY	XY-GenXY	14P	23P	0.444	0	Free	Free	Free	Free	Free	Free
18Y	Y-GenXY	14P	23P	0.444	0	Free	Free	Free	Free	Free	Free
19X	X-GenXY	14P	23P	0.555	0	Free	Free	Free	Free	Free	Free
19XY	XY-GenXY	14P	23P	0.555	0	Free	Free	Free	Free	Free	Free
19Y	Y-GenXY	14P	23P	0.555	0	Free	Free	Free	Free	Free	Free
20X	X-GenXY	14P	23P	0.666	0	Free	Free	Free	Free	Free	Free
20XY	XY-GenXY	14P	23P	0.666	0	Free	Free	Free	Free	Free	Free
20Y	Y-GenXY	14P	23P	0.666	0	Free	Free	Free	Free	Free	Free
21X	X-GenXY	14P	23P	0.777	0	Free	Free	Free	Free	Free	Free
21XY	XY-GenXY	14P	23P	0.777	0	Free	Free	Free	Free	Free	Free
21Y	Y-GenXY	14P	23P	0.777	0	Free	Free	Free	Free	Free	Free
22X	X-GenXY	14P	23P	0.888	0	Free	Free	Free	Free	Free	Free
22XY	XY-GenXY	14P	23P	0.888	0	Free	Free	Free	Free	Free	Free
22Y	Y-GenXY	14P	23P	0.888	0	Free	Free	Free	Free	Free	Free
24X	X-GenXY	23P	25P	0.5	0	Free	Free	Free	Free	Free	Free
24XY	XY-GenXY	23P	25P	0.5	0	Free	Free	Free	Free	Free	Free
24Y	Y-GenXY	23P	25P	0.5	0	Free	Free	Free	Free	Free	Free
30X	X-GenXY	26P	38P	0.333	0	Free	Free	Free	Free	Free	Free
30XY	XY-GenXY	26P	38P	0.333	0	Free	Free	Free	Free	Free	Free
30Y	Y-GenXY	26P	38P	0.333	0	Free	Free	Free	Free	Free	Free
27X	X-GenXY	26P	30S	0.5	0	Free	Free	Free	Free	Free	Free
27XY	XY-GenXY	26P	30S	0.5	0	Free	Free	Free	Free	Free	Free
27Y	Y-GenXY	26P	30S	0.5	0	Free	Free	Free	Free	Free	Free
28Y	Y-Gen	27S	27X	0.5	0	Free	Free	Free	Free	Free	Free
29X	X-Gen	27S	27Y	0.5	0	Free	Free	Free	Free	Free	Free
34X	X-GenXY	26P	38P	0.666	0	Free	Free	Free	Free	Free	Free
34XY	XY-GenXY	26P	38P	0.666	0	Free	Free	Free	Free	Free	Free
34Y	Y-GenXY	26P	38P	0.666	0	Free	Free	Free	Free	Free	Free
31X	X-GenXY	30S	34S	0.5	0	Free	Free	Free	Free	Free	Free
31XY	XY-GenXY	30S	34S	0.5	0	Free	Free	Free	Free	Free	Free
31Y	Y-GenXY	30S	34S	0.5	0	Free	Free	Free	Free	Free	Free
32Y	Y-Gen	31S	31X	0.5	0	Free	Free	Free	Free	Free	Free
33X	X-Gen	31S	31Y	0.5	0	Free	Free	Free	Free	Free	Free
35X	X-GenXY	34S	38P	0.4	0	Free	Free	Free	Free	Free	Free
35XY	XY-GenXY	34S	38P	0.4	0	Free	Free	Free	Free	Free	Free
35Y	Y-GenXY	34S	38P	0.4	0	Free	Free	Free	Free	Free	Free
36Y	Y-Gen	35S	35X	0.5	0	Free	Free	Free	Free	Free	Free
37X	X-Gen	35S	35Y	0.5	0	Free	Free	Free	Free	Free	Free

**Steel Material Properties:**

Steel Material	Modulus of Elasticity	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-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 Capacity Hyp. 1 (kN)	Shear Capacity 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

**Number Bolts Used By Type:**

**EVALUACION ESTRUCTURAL TAC80**



**TORRE 80m-EL MIRADOR**

**TAC80-EM-HU**

**HOJA  
8 / 23**

**REV.  
0**



**Bolt Number  
Type Bolts**

5/8" DC	408
5/8"	384

**Angle Properties:**

Angle Type	Angle Size	Long Leg	Short Leg	Thick.	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 Cost Factor	Section Modulus
		(cm)	(cm)	(cm)	(N/m)	(cm^2)		(cm)	(cm)	(cm)		(cm)	(cm)	(cm)		(cm^3)
DUM	0.1X0.1X1	0.254	0.254	2.54	0	0.06452	2	2.54	2.54	2.54	1	0.254	0	0	1.0000	0
SAE	4X4X0.3125	10.16	10.16	0.7937	119.7	15.48	10.6	3.15	3.15	2.009	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	2.5X2.5X0.1875	6.35	6.35	0.4763	44.8	5.935	10.67	1.976	1.976	1.257	1	6.35	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	5X5X0.5	12.7	12.7	1.27	236.4	30.65	8	3.912	3.912	2.497	1	12.7	0	0	1.0000	0
SAE	5X5X0.375	12.7	12.7	0.9525	179.5	23.29	11	3.962	3.962	2.515	1	12.7	0	0	1.0000	0
DAE	2X2X0.25	5.08	5.08	0.635	93.1	12.13	5	1.547	2.512	1.547	2	5.08	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	Add. Width (cm)
1	M01	SAE	5X5X0.5	A-572	Beam		Size + Type		30.480
2	M02	SAE	5X5X0.5	A-572	Beam		Size + Type		30.480
3	M03	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
4	M04	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
5	M05	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
6	M06	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
7	M07	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
8	M08	SAE	5X5X0.375	A-572	Beam		Size + Type		30.480
9	M09	SAE	4X4X0.3125	A-572	Beam		Size + Type		30.480
10	M10	SAE	4X4X0.25	A-572	Beam		Size + Type		30.480
11	M11	SAE	3X3X0.25	A-572	Beam		Size + Type		30.480
12	M12	SAE	2.5X2.5X0.25	A-572	Beam		Size + Type		30.480
13	D01	DAE	2X2X0.25	A-572	Truss		Size + Type		30.480
14	D02	DAE	2X2X0.25	A-572	Truss		Size + Type		30.480
15	D03	DAE	2X2X0.25	A-572	Truss		Size + Type		30.480
16	D04	SAE	2.5X2.5X0.25	A-572	Truss		Size + Type		30.480
17	D05	SAE	2.5X2.5X0.25	A-572	Truss		Size + Type		30.480
18	D06	SAE	2.5X2.5X0.25	A-572	Truss		Size + Type		30.480
19	D07	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
20	D08	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
21	D09	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
22	D10	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
23	D11	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
24	D12	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
25	H01	SAE	2.5X2.5X0.1875	A-572	Beam		Size + Type		30.480
26	H02	SAE	2.5X2.5X0.25	A-572	Beam		Size + Type		30.480
27	H03	SAE	2.5X2.5X0.25	A-572	Beam		Size + Type		30.480
28	H04	SAE	2X2X0.1875	A-572	Beam		Size + Type		30.480
29	H05	SAE	2X2X0.1875	A-572	Beam		Size + Type		30.480
30	H06	SAE	2X2X0.1875	A-572	Beam		Size + Type		30.480
31	H07	SAE	2X2X0.1875	A-572	Beam		Size + Type		30.480
32	H08	SAE	2X2X0.1875	A-572	Beam		Size + Type		30.480
33	C01	SAE	2.5X2.5X0.1875	A-572	Truss		Size + Type		30.480
34	C02	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
35	C03	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
36	C04	SAE	2X2X0.1875	A-572	Truss		Size + Type		30.480
37	Z22	DUM	0.1X0.1X1	A-572	Truss	Fictitious	None		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	5X5X0.5	A-572	69.45	35.28	16417.50
SAE	5X5X0.375	A-572	143.69	72.99	25790.04
SAE	4X4X0.3125	A-572	12.10	4.92	1447.37
SAE	4X4X0.25	A-572	23.98	9.74	2309.11
SAE	3X3X0.25	A-572	23.98	7.31	1721.34
SAE	2.5X2.5X0.25	A-572	240.96	61.20	14416.46

**EVALUACION ESTRUCTURAL TAC80**



**TORRE 80m-EL MIRADOR**

**TAC80-EM-HU**

**HOJA  
9 / 23**

**REV.  
0**

DAE	2X2X0.25	A-572	175.54	35.67	16342.92
SAE	2X2X0.1875	A-572	545.91	110.93	19437.27
SAE	2.5X2.5X0.1875	A-572	46.97	11.93	2104.10

**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 Bottom	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 Factor EIA Only	Flat Ar Factor For Face EIA Only	Round Ar Factor For Face EIA Only	Transverse Drag x Area Factor For All	Longitudinal Drag x Area Factor For All	SAPS Angle Drag x Area Factor	SAPS Round Drag x Area Factor	Force Solid Face
SECC1	18S	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC2	23P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC3	25P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC4	26P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC5	30S	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC6	34S	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None
SECC7	38P	1.200	0.000	0.000	0.000	0.000	1.000	1.000	0.000	0.000	0.000	0.000	0.000	None

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
10 / 23

REV.  
0

## CARGAS APLICADAS

\*\*\* Loads Data

Loads from file: f:\arch\_2016\eval\_btessa\tac80el\_mirador\tor80m\_mir.eia

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

Structure height above ground 80.00 (m)  
Elevation of structure bottom for wind height adjustment: 0.00 (m)  
Structure height for structure gust response factor: 80.00 (m)  
Structure gust response factor, Gh: 1.0962  
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	1.3300	33.333	0	0.0000	0.0000	20.0	11 loads	
WIN 45-120	1.2500	0.8500	1.0000	1.0000	1.3300	33.333	45	0.0000	0.0000	20.0	11 loads	
WIN 45-60	1.2500	0.8500	1.0000	1.0000	1.3300	16.666	45	0.0000	0.0000	20.0	11 loads	

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	920	920	480	0	0	0	
15S	920	920	480	0	0	0	
16S	920	920	480	0	0	0	
17S	0	1000	400	0	0	0	
18S	0	1000	400	0	0	0	
19S	0	1000	400	0	0	0	
22S	0	1000	400	0	0	0	
23P	0	1000	400	0	0	0	
24S	0	1000	400	0	0	0	
27S	0	300	200	0	0	0	
31S	0	300	200	0	0	0	

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

Equipment Label	Equipment Property Set	Elevation Above Ground (m)	qsGh (Pa)	Ice Thick. (cm)	Total Wind Area (m^2)	Wind Incidence Angle (deg)	222-G CA	222-G CS	222-G CM	Antenna Load (N)	Antenna Axial Load (N)	Antenna Side Load (N)	Antenna Moment (MM)	Long. Load (N)	Trans. Load (N)	Vert. Load (N)
ANT MW1	Ant.MW02.4	17.27	740.56	0.00	0.00	225.00	-0.52150	-0.45705	-0.13905	-1747.18	-1531.26	-1118.06	2318.21	152.68	2875.00	
ANT MW2	Ant.MW01.8Gr	23.01	803.89	0.00	0.00	225.00	-0.37110	-0.24805	-0.04705	-331.74	-221.74	-75.71	391.36	77.78	1000.00	
ANT MW3	Ant.MW01.8	23.01	803.89	0.00	0.00	315.00	1.62895	-0.04880	0.06130	3331.36	-99.80	225.66	2426.19	-2285.05	1750.00	

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

Section Label	Z of Top (m)	Z of Bottom (m)	Ave. Elevation (m)	qsGh (Pa)	Ice Thick. (cm)	Face AF (m^2)	Face AR (m^2)	Face RR (m^2)	Face AG (m^2)	Face e (m)	Face DF (m)	Face DR (m)	Face RR (m)	Face CF (m)	Face AE (m^2)	Face WF (m)	NotF AAF (m^2)	NotF CAF (m)	NotF AAR (m^2)	NotF CAR (m)	NotF AAR*CAR (m^2)	NotF WA (N)	NotF Wind (N)	Total Weight (N)
SECC1	80.00	68.01	74.01	1122.39	0.00	3.18	0.00	0.00	27.9	0.11	1.00	1.00	0.58	3.38	3.2	12065	0.00	2.00	0.00	1.20	0.00	0	12065	11632
SECC2	68.01	53.00	60.51	1059.63	0.00	4.79	2.06	1.21	34.9	0.20	1.00	1.00	0.55	3.00	6.0	19068	0.00	2.00	0.00	1.20	0.00	0	19068	17925
SECC3	53.00	42.00	47.50	988.84	0.00	4.09	4.53	2.73	34.0	0.25	1.00	1.00	0.60	2.76	6.8	18631	0.00	2.00	0.00	1.20	0.00	0	18631	20162
SECC4	42.00	34.50	38.25	929.50	0.00	2.80	3.09	1.81	33.1	0.18	1.00	1.00	0.55	3.08	4.6	13191	0.00	2.00	0.00	1.20	0.00	0	13191	14097
SECC5	34.50	23.01	28.76	856.74	0.00	4.87	4.73	2.75	66.9	0.14	1.00	1.00	0.58	3.24	7.6	21124	0.00	2.00	0.00	1.20	0.00	0	21124	27296
SECC6	23.01	11.52	17.27	740.56	0.00	4.89	4.73	2.73	86.5	0.11	1.00	1.00	0.58	3.39	7.6	19136	0.00	2.00	0.00	1.20	0.00	0	19136	33640
SECC7	11.52	0.00	5.76	634.61	0.00	5.02	4.75	2.73	106.5	0.09	1.00	1.00	0.57	3.49	7.8	17179	0.00	2.00	0.00	1.20	0.00	0	17179	41426

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	920	920	480	0	0	0	
15S	920	920	480	0	0	0	
16S	920	920	480	0	0	0	
17S	707	707	400	0	0	0	
18S	707	707	400	0	0	0	
19S	707	707	400	0	0	0	
22S	707	707	400	0	0	0	
23P	707	707	400	0	0	0	
24S	707	707	400	0	0	0	
27S	212	212	200	0	0	0	
31S	212	212	200	0	0	0	

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
11 / 23

REV.  
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 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.MW02.4	17.27	740.56	0.00	0.00	180.00	-1.05470			-3533.56			2498.61	2498.61	2875.00
ANT_MW2	Ant.MW01.8Gr	23.01	803.89	0.00	0.00	180.00	-0.59380			-530.81			375.34	375.34	1000.00
ANT_MW3	Ant.MW01.8	23.01	803.89	0.00	0.00	270.00	-0.01170	-0.34380	-0.13130	-23.93	-703.10	-483.34	480.25	514.09	1750.00

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

Section Label	Z of Top (m)	Z of Bottom (m)	Elev. Above Gnd. (m)	qzGh (Pa)	Ice Thick. (cm)	Face AF (m²)	Face AR (m²)	Face RR (m²)	Face AR (m²)	Face AG (m²)	e	DF	DR	RR	CF	Face AF (m²)	Face WF (N)	NotF AAF (m²)	NotF CAF (m²)	NotF AAR (m²)	NotF CAR (m²)	NotF AAR*CAR (m²)	WA (N)	Wind (N)	Total Weight (N)
SECC1	80.00	68.01	74.01	1122.39	0.00	3.18	0.00	0.00	27.9	0.11	1.05	1.09	0.58	3.38		3.5	13098	0.00	2.00	0.00	1.20	0.00	0	13098	11632
SECC2	68.01	53.00	60.51	1059.63	0.00	4.79	2.06	1.21	34.9	0.20	1.15	1.15	0.55	3.00		6.9	21877	0.00	2.00	0.00	1.20	0.00	0	21877	17925
SECC3	53.00	42.00	47.50	988.84	0.00	4.09	4.53	2.73	34.0	0.25	1.15	1.19	0.60	2.76		8.1	22177	0.00	2.00	0.00	1.20	0.00	0	22177	20162
SECC4	42.00	34.50	38.25	929.50	0.00	2.80	3.09	1.81	33.1	0.18	1.15	1.13	0.55	3.08		5.2	14952	0.00	2.00	0.00	1.20	0.00	0	14952	14097
SECC5	34.50	23.01	28.76	856.74	0.00	4.87	4.73	2.75	66.9	0.14	1.11	1.11	0.56	3.24		8.4	23397	0.00	2.00	0.00	1.20	0.00	0	23397	27296
SECC6	23.01	11.52	17.27	740.56	0.00	4.89	4.73	2.75	86.5	0.11	1.08	1.08	0.56	3.39		8.2	20731	0.00	2.00	0.00	1.20	0.00	0	20731	33640
SECC7	11.52	0.00	5.76	634.61	0.00	5.02	4.75	2.73	106.5	0.09	1.07	1.07	0.57	3.49		8.3	18361	0.00	2.00	0.00	1.20	0.00	0	18361	41426

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	230	230	480	0	0	0	
15S	230	230	480	0	0	0	
16S	230	230	480	0	0	0	
17S	175	175	400	0	0	0	
18S	175	175	400	0	0	0	
19S	175	175	400	0	0	0	
22S	175	175	400	0	0	0	
23P	175	175	400	0	0	0	
24S	175	175	400	0	0	0	
27S	53	53	200	0	0	0	
31S	53	53	200	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.MW02.4	17.27	185.13	0.00	0.00	180.00	-1.05470			-883.34			624.61	624.61	2875.00
ANT_MW2	Ant.MW01.8Gr	23.01	200.96	0.00	0.00	180.00	-0.59380			-132.70			93.83	93.83	1000.00
ANT_MW3	Ant.MW01.8	23.01	200.96	0.00	0.00	270.00	-0.01170	-0.34380	-0.13130	-5.98	-175.77	-120.83	120.06	128.51	1750.00

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

Section Label	Z of Top (m)	Z of Bottom (m)	Elev. Above Gnd. (m)	qzGh (Pa)	Ice Thick. (cm)	Face AF (m²)	Face AR (m²)	Face RR (m²)	Face AR (m²)	Face AG (m²)	e	DF	DR	RR	CF	Face AF (m²)	Face WF (N)	NotF AAF (m²)	NotF CAF (m²)	NotF AAR (m²)	NotF CAR (m²)	NotF AAR*CAR (m²)	WA (N)	Wind (N)	Total Weight (N)
SECC1	80.00	68.01	74.01	280.58	0.00	3.18	0.00	0.00	27.9	0.11	1.05	1.09	0.58	3.38		3.5	3274	0.00	2.00	0.00	1.20	0.00	0	3274	11632
SECC2	68.01	53.00	60.51	264.89	0.00	4.79	2.06	1.21	34.9	0.20	1.15	1.15	0.55	3.00		6.9	5469	0.00	2.00	0.00	1.20	0.00	0	5469	17925
SECC3	53.00	42.00	47.50	247.19	0.00	4.09	4.53	2.73	34.0	0.25	1.15	1.19	0.60	2.76		8.1	5544	0.00	2.00	0.00	1.20	0.00	0	5544	20162
SECC4	42.00	34.50	38.25	232.36	0.00	2.80	3.09	1.81	33.1	0.18	1.15	1.13	0.55	3.08		5.2	3738	0.00	2.00	0.00	1.20	0.00	0	3738	14097
SECC5	34.50	23.01	28.76	214.17	0.00	4.87	4.73	2.75	66.9	0.14	1.11	1.11	0.56	3.24		8.4	5849	0.00	2.00	0.00	1.20	0.00	0	5849	27296
SECC6	23.01	11.52	17.27	185.13	0.00	4.89	4.73	2.73	86.5	0.11	1.08	1.08	0.58	3.39		8.2	5182	0.00	2.00	0.00	1.20	0.00	0	5182	33640
SECC7	11.52	0.00	5.76	158.64	0.00	5.02	4.75	2.73	106.5	0.09	1.07	1.07	0.57	3.49		8.3	4590	0.00	2.00	0.00	1.20	0.00	0	4590	41426

## EVALUACION ESTRUCTURAL TAC80



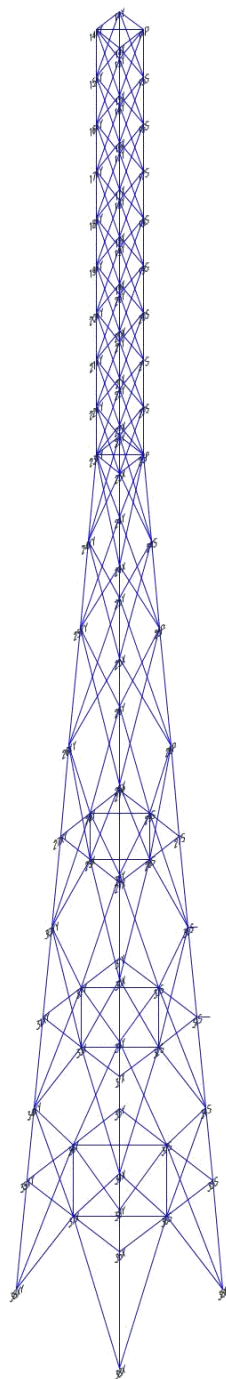
TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
12 / 23

REV.  
0

# SILUETA TAC80-NUDOS



## EVALUACION ESTRUCTURAL TAC80



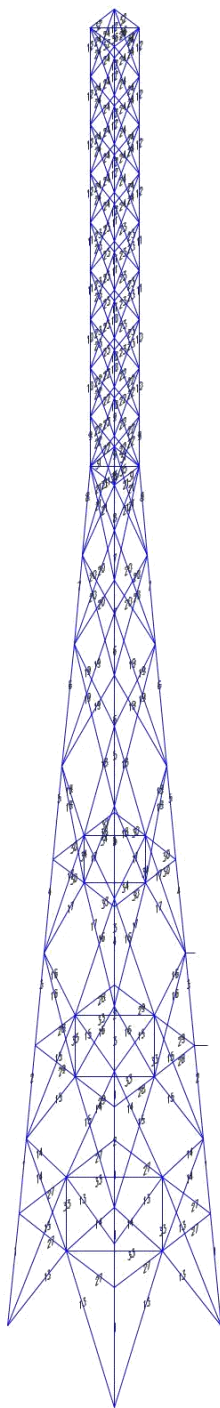
TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
13 / 23

REV.  
0

## SILUETA TAC80-ELEMENTOS



### EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
14 / 23

REV.  
0

## RESUMEN

Project Name : TORRE 80 m-EL MIRADOR -ACT.  
Project Notes: BTESA - RTVC  
Project File : f:\arch\_2016\eval\_btesa\tac80el\_mirador\tor80m\_mir.tow  
Date run : 10:23:14 a.m. lunes, 18 de abril de 2016  
by : Tower Version 10.20

Successfully performed linear analysis

Member check option: TIA/EIA 222-F  
Connection rupture check: Not Checked  
Crossing diagonal check: Fixed  
Loads from file: f:\arch\_2016\eval\_btesa\tac80el\_mirador\tor80m\_mir.eia

\*\*\* Analysis Results:

Maximum element usage is 242.59% for Angle "20X" in load case "WIN 0 -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	38P	-37.45	-23.51	310.75	44.22	-0.35	0.13	0.34	0.38	0.00
WIN 0 -120	38X	-33.90	19.82	253.92	39.27	0.29	0.08	-0.07	0.30	0.00
WIN 0 -120	38XY	-30.09	-16.36	-221.81	34.25	-0.14	-0.01	0.10	0.14	0.00
WIN 0 -120	38Y	-26.83	12.74	-166.81	29.70	0.10	-0.08	-0.13	0.12	0.00
WIN 45-120	38P	-45.74	-45.69	454.53	64.65	-0.31	0.32	-0.02	0.44	0.00
WIN 45-120	38X	-14.95	-7.21	42.98	16.59	0.23	-0.06	0.05	0.24	0.00
WIN 45-120	38XY	-37.74	-37.78	-365.67	53.41	-0.15	0.14	-0.02	0.21	0.00
WIN 45-120	38Y	-7.51	-15.29	44.21	17.04	0.07	-0.24	0.09	0.25	0.00
WIN 45-60	38P	-14.40	-14.38	148.16	20.35	-0.14	0.14	-0.01	0.20	0.00
WIN 45-60	38X	-6.62	1.17	43.22	6.72	0.12	0.05	0.01	0.13	0.00
WIN 45-60	38XY	-6.56	-6.56	-59.74	9.28	0.03	-0.03	-0.01	0.04	0.00
WIN 45-60	38Y	1.10	-6.70	44.40	6.79	-0.05	-0.13	0.02	0.13	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	564.685	4814.090	4847.095
WIN 45-120	4148.278	4135.808	5857.740
WIN 45-60	1055.860	1043.974	1484.831

EIA Sections Information:

Section Label	Top Z (m)	Bottom Z (m)	Joint Count	Member Count	Top Width (m)	Bottom Width (m)	Gross Area (m²)	Face Adjust Factor	Face Ar Adjust Factor	Dead Load
SECC1	80.000	68.012	20	54	2.32	2.32	27.86	1.0000	1.0000	1.200
SECC2	68.012	53.000	24	66	2.32	2.32	34.89	1.0000	1.0000	1.200
SECC3	53.000	42.000	12	24	2.32	3.86	33.99	1.0000	1.0000	1.200
SECC4	42.000	34.500	8	12	3.86	4.97	33.10	1.0000	1.0000	1.200
SECC5	34.500	23.011	16	36	4.97	6.68	66.93	1.0000	1.0000	1.200
SECC6	23.011	11.523	16	36	6.68	8.39	86.55	1.0000	1.0000	1.200
SECC7	11.523	0.000	16	36	8.39	10.10	106.51	1.0000	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	Comp. Capacity (kN)	L/R Comp. Capacity (kN)	Conn. Shear Capacity (kN)	Conn. Bearing Capacity (kN)	RLX	RLY	RLZ	L/R Length Member (m)	Curve No.	No. Of Bolts Comp.
1	M01	SAE	5X5X0.5	344.7	90.83	90.83	2P	-416.74	4WIN 45-120	344.975	700.028	935.315	0.50C 0.500 0.500	92.81	4.635	1	8		
2	M02	SAE	5X5X0.5	344.7	64.88	64.88	3P	-359.80	9WIN 45-120	416.950	700.028	935.315	0.33C 0.330 0.330	76.34	5.776	1	8		
3	M03	SAE	5X5X0.375	344.7	83.71	83.71	4P	-354.68	3WIN 45-120	318.564	700.028	701.486	0.33C 0.330 0.330	75.8C	5.776	1	8		
4	M04	SAE	5X5X0.375	344.7	122.14	122.14	5P	-295.36	1WIN 45-120	181.814	700.028	701.486	0.50C 0.500 0.500	114.85	5.776	1	8		
5	M05	SAE	5X5X0.375	344.7	121.39	121.39	6P	-293.52	7WIN 45-120	181.814	525.021	526.114	0.50C 0.500 0.500	114.85	5.776	1	6		
6	M06	SAE	5X5X0.375	344.7	58.58	58.58	7P	-250.17	7WIN 45-120	321.115	525.021	526.114	0.25C 0.250 0.250	74.96	7.541	1	6		
7	M07	SAE	5X5X0.375	344.7	84.96	84.96	8P	-224.40	1WIN 45-120	198.586	525.021	526.114	0.50C 0.500 0.500	109.85	5.527	1	6		
8	M08	SAE	5X5X0.375	344.7	76.42	76.42	9P	-201.84	9WIN 45-120	198.586	525.021	526.114	0.50C 0.500 0.500	109.85	5.527	1	6		
9	M09	SAE	4X4X0.3125	344.7	59.87	59.87	10P	-169.53	4WIN 45-120	212.907	525.021	438.429	0.50C 0.500 0.500	75.26	3.024	1	6		
10	M10	SAE	4X4X0.25	344.7	65.02	65.02	11P	-136.77	3WIN 45-120	158.171	350.014	233.829	0.50C 0.500 0.500	74.21	2.997	1	4		
11	M11	SAE	3X3X0.25	344.7	57.71	57.71	13P	-73.96	6WIN 45-120	96.361	350.014	233.829	0.50C 0.500 0.500	98.95	2.997	1	4		
12	M12	SAE	2.5X2.5X0.25	344.7	39.16	39.16	15P	-28.51	9WIN 45-120	54.755	350.014	233.829	0.50C 0.500 0.500	120.15	2.997	4	4		
13	D01	DAE	2X2X0.25	344.7	242.59	242.59	20X	-26.87	5WIN 0 -120	8.330	87.538	233.829	1.00C 0.330 0.330	554.45	8.577	6	2		
14	D02	DAE	2X2X0.25	344.7	97.91	97.91	22XY	-18.77	3WIN 0 -120	14.417	87.538	233.829	1.00C 0.500 0.500	403.45	6.241	6	2		
15	D03	DAE	2X2X0.25	344.7	161.65	161.65	24P	-24.73	5WIN 0 -120	11.505	87.538	233.829	1.00C 0.500 0.500	460.61	7.125	6	2		

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
15 / 23

REV.  
0

16	D04	SAE	2.5X2.5X0.25	344.7	131.14	131.14	26Y	-21.065WIN 0	-120	12.077	87.538	116.914	1.000	0.500	0.500	340.88	6.658	6	2	NG
17	D05	SAE	2.5X2.5X0.25	344.7	130.18	130.18	28X	-20.910WIN 0	-120	12.077	87.538	116.914	1.000	0.500	0.500	340.88	6.658	6	2	NG
18	D06	SAE	2.5X2.5X0.25	344.7	98.05	98.05	30XY	-17.354WIN 0	-120	13.307	87.538	116.914	1.000	0.500	0.500	321.19	6.274	6	2	
19	D07	SAE	2X2X0.1875	344.7	84.32	84.32	32XY	-11.202WIN 0	-120	9.988	87.538	87.686	0.500	0.250	0.250	278.22	6.720	6	2	
20	D08	SAE	2X2X0.1875	344.7	76.90	76.90	34XY	-7.945WIN 0	-120	7.768	87.538	87.686	0.750	0.500	0.500	325.55	6.516	6	2	
21	D09	SAE	2X2X0.1875	344.7	71.50	71.50	36XY	-8.127WIN 0	-120	8.546	87.538	87.686	0.750	0.500	0.500	306.87	6.142	6	2	
22	D10	SAE	2X2X0.1875	344.7	58.52	58.52	38Y	-13.751WIN 45-120		17.668	87.538	87.686	0.750	0.500	0.500	190.55	3.814	6	2	
23	D11	SAE	2X2X0.1875	344.7	45.12	45.12	41X	-10.688WIN 45-120		17.811	87.538	87.686	0.750	0.500	0.500	189.48	3.792	6	2	
24	D12	SAE	2X2X0.1875	344.7	20.90	20.90	48XY	-4.951WIN 0	-120	17.811	87.538	87.686	0.750	0.500	0.500	189.48	3.792	6	2	
25	H01	SAE	2.5X2.5X0.1875	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	
26	H02	SAE	2.5X2.5X0.25	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	
27	H03	SAE	2.5X2.5X0.25	344.7	4.44	4.44	58X	-1.306WIN 0	-120	22.124	87.538	116.914	1.000	0.500	0.500	232.24	4.536	6	2	
28	H04	SAE	2X2X0.1875	344.7	8.33	8.33	60Y	-1.388WIN 45-120		12.530	87.538	87.686	1.000	0.500	0.500	240.35	3.767	6	2	
29	H05	SAE	2X2X0.1875	344.7	8.71	8.71	62X	-1.451WIN 0	-120	12.530	87.538	87.686	1.000	0.500	0.500	240.35	3.767	6	2	
30	H06	SAE	2X2X0.1875	344.7	12.53	12.53	66X	-1.545WIN 0	-120	9.299	87.538	87.686	1.000	1.000	1.000	291.07	2.913	6	2	
31	H07	SAE	2X2X0.1875	344.7	19.33	19.33	67P	-3.393WIN 0	-120	13.201	87.538	87.686	1.000	1.000	1.000	232.22	2.324	6	2	
32	H08	SAE	2X2X0.1875	344.7	2.73	0.00	68YR	0.000		13.201	87.538	87.686	1.000	1.000	1.000	232.22	2.324	6	2	
33	C01	SAE	2.5X2.5X0.1875	344.7	12.15	12.15	70XY	-2.197WIN 45-120		13.600	87.538	87.686	1.000	0.500	0.500	269.57	5.327	6	2	
34	C02	SAE	2X2X0.1875	344.7	10.80	10.80	71XY	-1.568WIN 45-120		10.917	87.538	87.686	1.000	0.500	0.500	262.86	4.119	6	2	
35	C03	SAE	2X2X0.1875	344.7	19.46	19.46	72P	-3.977WIN 45-120		15.370	87.538	87.686	1.000	0.500	0.500	209.72	3.287	6	2	
36	C04	SAE	2X2X0.1875	344.7	18.38	18.38	73P	-3.757WIN 45-120		15.370	87.538	87.686	1.000	0.500	0.500	209.72	3.287	6	2	
37	ZZ2	DUM	0.1X0.1X1	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	

Group Summary (Tension Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (MPa)	Max Usage %	Max Tension Use In Control Tens. % Member	Tension Force (kN)	Tension Control Load Case	Net Tens. Section Capacity (kN)	Conn. Shear Capacity (kN)	Tens. Bearing Capacity (kN)	Conn. Rupture Tens. Capacity (kN)	Length Member (m)	No. Of Bolts	No. Of Holes	Hole Diameter (cm)
1	M01	SAE	5X5X0.5	344.7	90.83	40.83	2XY 343.309WIN	45-120	632.122	700.028	935.315	0.000	4.635	8	2.000	1.749
2	M02	SAE	5X5X0.5	344.7	64.88	35.57	3XY 299.074WIN	45-120	632.122	700.028	935.315	0.000	5.776	8	2.000	1.749
3	M03	SAE	5X5X0.375	344.7	83.71	47.04	4XY 301.231WIN	45-120	481.485	700.028	701.486	0.000	5.776	8	2.000	1.749
4	M04	SAE	5X5X0.375	344.7	121.39	40.23	5XY 255.047WIN	45-120	481.485	700.028	701.486	0.000	5.776	8	2.000	1.749 NG
5	M05	SAE	5X5X0.375	344.7	121.39	40.23	6XY 257.610WIN	45-120	481.485	525.021	526.114	0.000	5.776	8	2.000	1.749 NG
6	M06	SAE	5X5X0.375	344.7	58.58	34.35	7XY 219.961WIN	45-120	481.485	525.021	526.114	0.000	7.541	6	2.000	1.749
7	M07	SAE	5X5X0.375	344.7	84.96	30.68	8XY 196.469WIN	45-120	481.485	525.021	526.114	0.000	5.527	6	2.000	1.749
8	M08	SAE	5X5X0.375	344.7	76.42	27.33	9XY 175.017WIN	45-120	481.485	525.021	526.114	0.000	5.527	6	2.000	1.749
9	M09	SAE	4X4X0.3125	344.7	59.87	36.12	10XY 147.250WIN	45-120	306.554	525.021	438.429	0.000	3.024	6	2.000	1.749
10	M10	SAE	4X4X0.25	344.7	65.02	38.14	11XY 118.616WIN	45-120	248.357	350.014	233.829	0.000	2.997	4	2.000	1.749
11	M11	SAE	3X3X0.25	344.7	57.71	29.45	13XY 67.411WIN	45-120	172.093	350.014	233.829	0.000	2.997	4	2.000	1.749
12	M12	SAE	2.5X2.5X0.25	344.7	39.16	18.04	15XY 31.578WIN	45-120	131.627	350.014	233.829	0.000	2.997	4	2.000	1.749
13	D01	DAE	2X2X0.25	344.7	242.59	21.36	20Y 24.869WIN	0 -120	199.359	87.538	233.829	0.000	8.577	2	1.000	1.749 NG
14	D02	DAE	2X2X0.25	344.7	97.91	17.29	22P 20.129WIN	0 -120	199.359	87.538	233.829	0.000	6.241	2	1.000	1.749
15	D03	DAE	2X2X0.25	344.7	161.65	17.99	24XY 20.942WIN	0 -120	199.359	87.538	233.829	0.000	7.125	2	1.000	1.749 NG
16	D04	SAE	2.5X2.5X0.25	344.7	131.14	16.98	26X 19.772WIN	0 -120	118.815	87.538	116.914	0.000	6.658	2	1.000	1.749 NG
17	D05	SAE	2.5X2.5X0.25	344.7	130.18	15.29	28XY 17.802WIN	0 -120	118.815	87.538	116.914	0.000	6.658	2	1.000	1.749 NG
18	D06	SAE	2.5X2.5X0.25	344.7	98.05	14.00	30XY 16.294WIN	0 -120	118.815	87.538	116.914	0.000	6.274	2	1.000	1.749
19	D07	SAE	2X2X0.1875	344.7	84.32	12.18	32X 10.985WIN	0 -120	67.808	87.538	87.686	0.000	8.720	2	1.000	1.749
20	D08	SAE	2X2X0.1875	344.7	76.90	8.39	34X 7.569WIN	0 -120	67.808	87.538	87.686	0.000	6.516	2	1.000	1.749
21	D09	SAE	2X2X0.1875	344.7	71.50	8.83	36X 7.962WIN	0 -120	67.808	87.538	87.686	0.000	6.142	2	1.000	1.749
22	D10	SAE	2X2X0.1875	344.7	58.52	13.83	38X 12.471WIN	0 -120	67.808	87.538	87.686	0.000	3.814	2	1.000	1.749
23	D11	SAE	2X2X0.1875	344.7	45.12	10.91	42X 9.836WIN	0 -120	67.808	87.538	87.686	0.000	3.792	2	1.000	1.749
24	D12	SAE	2X2X0.1875	344.7	20.90	5.96	48X 5.377WIN	0 -120	67.808	87.538	87.686	0.000	3.792	2	1.000	1.749
25	H01	SAE	2.5X2.5X0.1875	344.7	0.00	0.00		0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0
26	H02	SAE	2.5X2.5X0.25	344.7	0.00	0.00		0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0
27	H03	SAE	2.5X2.5X0.25	344.7	4.44	1.03	57P 1.194WIN	0 -120	118.815	87.538	116.914	0.000	4.536	2	1.000	1.749
28	H04	SAE	2X2X0.1875	344.7	8.33	4.21	59P 3.800WIN	45-120	67.808	87.538	87.686	0.000	3.767	2	1.000	1.749
29	H05	SAE	2X2X0.1875	344.7	8.71	4.22	61P 3.806WIN	45-120	67.808	87.538	87.686	0.000	3.767	2	1.000	1.749
30	H06	SAE	2X2X0.1875	344.7	12.53	1.80	65P 1.627WIN	45-120	67.808	87.538	87.686	0.000	2.913	2	1.000	1.749
31	H07	SAE	2X2X0.1875	344.7	19.33	7.98	67R 7.200WIN	0 -120	67.808	87.538	87.686	0.000	2.324	2	1.000	1.749
32	H08	SAE	2X2X0.1875	344.7	2.73	2.73	68YR 2.464WIN	0 -120	67.808	87.538	87.686	0.000	2.324	2	1.000	1.749
33	C01	SAE	2.5X2.5X0.1875	344.7	12.15	1.26	70X 1.468WIN	0 -120	92.321	87.538	87.686	0.000	5.327	2	1.000	1.749
34	C02	SAE	2X2X0.1875	344.7	10.80	1.43	71P 1.286WIN	45-120	67.808	87.538	87.686	0.000	4.119	2	1.000	1.749
35	C03	SAE	2X2X0.1875	344.7	19.46	0.00	72X 0.000		67.808	87.538	87.686	0.000	3.287	2	1.000	1.749
36	C04	SAE	2X2X0.1875	344.7	18.38	0.00	73X 0.000		67.808	87.538	87.686	0.000	3.287	2	1.000	1.749
37	ZZ2	DUM	0.1X0.1X1	344.7	0.00	0.00		0.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0

\*\*\* 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	242.59	20X	Angle NG
WIN 45-120	196.13	20P	Angle NG
WIN 45-60	58.73	20P	Angle

\*\*\* Weight of structure (N):

Weight of Angles*Section DLF:	119983.3
Weight of Equipment:	4500.0
Total:	124483.3

\*\*\* End of Report

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

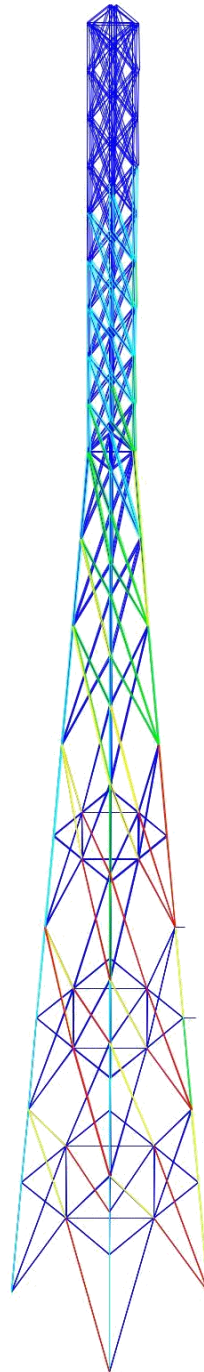
TAC80-EM-HU

HOJA  
16 / 23

REV.  
0



SILUETA ESFUERZOS-DEF.



EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
17 / 23

REV.  
0

TORRE 80 m – EL MIRADOR  
REFORZAMIENTO

EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
**18 / 23**

REV.  
**0**

## RESUMEN DE DISEÑO

Project Name : TORRE 80 m-EL MIRADOR -REF.  
 Project Notes: BTESA - RTVC  
 Project File : f:\arch\_2016\eval\_btesa\tac80el\_mirador\tor80m\_mir\_r.tow  
 Date run : 10:32:49 a.m. martes, 19 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\tac80el\_mirador\tor80m\_mir.eia

\*\*\* Analysis Results:

Maximum element usage is 98.05% for Angle "30XY" in load case "WIN 0 -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	38P	-37.45	-23.51	310.75	44.22	-0.35	0.13	0.34	0.38	0.00
WIN 0 -120	38X	-33.90	19.82	253.92	39.27	0.29	0.08	-0.07	0.30	0.00
WIN 0 -120	38XY	-30.09	-16.36	-221.81	34.25	-0.14	-0.01	0.10	0.14	0.00
WIN 0 -120	38Y	-26.83	12.74	-166.81	29.70	0.10	-0.08	-0.13	0.12	0.00
WIN 45-120	38P	-45.74	-45.69	454.53	64.65	-0.31	0.32	-0.02	0.44	0.00
WIN 45-120	38X	-14.95	-7.21	42.98	16.59	0.23	-0.06	0.05	0.24	0.00
WIN 45-120	38XY	-37.74	-37.78	-365.67	53.41	-0.15	0.14	-0.02	0.21	0.00
WIN 45-120	38Y	-7.51	-15.29	44.21	17.04	0.07	-0.24	0.09	0.25	0.00
WIN 45-60	38P	-14.40	-14.38	148.16	20.35	-0.14	0.14	-0.01	0.20	0.00
WIN 45-60	38X	-6.62	1.17	43.22	6.72	0.12	0.05	0.01	0.13	0.00
WIN 45-60	38XY	-6.56	-6.56	-59.74	9.28	0.03	-0.03	-0.01	0.04	0.00
WIN 45-60	38Y	1.10	-6.70	44.40	6.79	-0.05	-0.13	0.02	0.13	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	564.685	4814.090	4847.095
WIN 45-120	4148.278	4135.808	5857.740
WIN 45-60	1055.860	1043.974	1484.831

EIA Sections Information:

Section Label	Top Z (m)	Bottom Z (m)	Joint Z Count	Member Count	Top Width (m)	Bottom Width (m)	Gross Area (m <sup>2</sup> )	Face Adj Factor	Face Ar Adjust Factor	Dead Load Factor
SECC1	80.000	68.012	20	54	2.32	2.32	27.86	1.0000	1.0000	1.200
SECC2	68.012	53.000	24	66	2.32	2.32	34.89	1.0000	1.0000	1.200
SECC3	53.000	42.000	12	24	2.32	3.86	33.99	1.0000	1.0000	1.200
SECC4	42.000	34.500	8	12	3.86	4.97	33.10	1.0000	1.0000	1.200
SECC5	34.500	23.011	16	36	4.97	6.68	66.93	1.0000	1.0000	1.200
SECC6	23.011	11.523	16	36	6.68	8.39	86.55	1.0000	1.0000	1.200
SECC7	11.523	0.000	16	36	8.39	10.10	106.51	1.0000	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	Size	Steel Strength (MPa)	Max Usage %	Max Use In Control %	Comp. Member	Comp. Force (kN)	Comp. Control Load Case	L/R Capacity (kN)	Conn. Shear Capacity (kN)	Conn. Bearing Capacity (kN)	RIX	RIY	RIZ	L/R Length (m)	Curve No.	Of Comp.	
1	M01	SAE	5X5X0.5	344.7	90.83	90.83	2P	-416.74	44WIN	45-120	344.975	700.028	935.315	0.500	0.500	0.500	92.81	4.635	1
2	M02	SAE	5X5X0.5	344.7	64.88	64.88	3P	-359.80	9WIN	45-120	416.950	700.028	935.315	0.330	0.330	0.330	76.34	5.776	1
3	M03	SAE	5X5X0.375	344.7	83.71	83.71	4P	-354.68	3WIN	45-120	318.564	700.028	701.486	0.330	0.330	0.330	75.80	5.776	1
4	M04	SAE	5X5X0.375	344.7	59.74	59.74	5P	-295.36	1WIN	45-120	371.759	700.028	701.486	0.250	0.250	0.250	57.42	5.776	1
5	M05	SAE	5X5X0.375	344.7	59.37	59.37	6P	-293.52	7WIN	45-120	371.759	525.021	526.114	0.250	0.250	0.250	57.42	5.776	1
6	M06	SAE	5X5X0.375	344.7	58.58	58.58	7P	-250.17	7WIN	45-120	321.115	525.021	526.114	0.250	0.250	0.250	74.98	7.541	1
7	M07	SAE	5X5X0.375	344.7	84.96	84.96	8P	-224.40	1WIN	45-120	198.586	525.021	526.114	0.500	0.500	0.500	109.89	5.527	1
8	M08	SAE	5X5X0.375	344.7	76.42	76.42	9P	-201.84	9WIN	45-120	198.586	525.021	526.114	0.500	0.500	0.500	109.89	5.527	1
9	M09	SAE	4X4X0.3125	344.7	59.87	59.87	10P	-169.53	4WIN	45-120	212.907	525.021	438.429	0.500	0.500	0.500	75.26	3.024	1
10	M10	SAE	4X4X0.25	344.7	65.02	65.02	11P	-136.77	3WIN	45-120	158.171	350.014	233.829	0.500	0.500	0.500	74.21	2.997	1
11	M11	SAE	3X3X0.25	344.7	57.71	57.71	13P	-73.96	0WIN	45-120	96.361	350.014	233.829	0.500	0.500	0.500	98.99	2.997	1
12	M12	SAE	2.5X2.5X0.25	344.7	39.16	39.16	15P	-28.51	9WIN	45-120	54.755	350.014	233.829	0.500	0.500	0.500	120.15	2.997	4
13	D01	DAE	2X2X0.25	344.7	75.98	75.98	20X	-26.87	5WIN	0 -120	26.594	87.538	233.829	0.500	0.330	0.330	277.24	8.577	6

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
19 / 23

REV.  
0

14	D02	DAE	2X2X0.25	344.7	32.77	32.77	22XY	-18.773WIN 0	-120	43.080	87.538	233.829	0.500	0.500	0.500	201.73	6.241	6	2
15	D03	DAE	2X2X0.25	344.7	52.54	52.54	24P	-24.735WIN 0	-120	35.396	87.538	233.829	0.500	0.500	0.500	230.30	7.125	6	2
16	D04	SAE	2.5X2.5X0.25	344.7	88.67	88.67	26Y	-21.065WIN 0	-120	17.862	87.538	116.914	0.500	0.500	0.500	266.94	6.658	6	2
17	D05	SAE	2.5X2.5X0.25	344.7	88.01	88.01	28X	-20.910WIN 0	-120	17.862	87.538	116.914	0.500	0.500	0.500	266.94	6.658	6	2
18	D06	SAE	2.5X2.5X0.25	344.7	98.05	98.05	30XY	-17.354WIN 0	-120	13.307	87.538	116.914	1.000	0.500	0.500	321.19	6.274	6	2
19	D07	SAE	2X2X0.1875	344.7	84.32	84.32	32XY	-11.202WIN 0	-120	9.988	87.538	87.686	0.500	0.250	0.250	278.22	8.720	6	2
20	D08	SAE	2X2X0.1875	344.7	76.90	76.90	34XY	-7.945WIN 0	-120	7.768	87.538	87.686	0.750	0.500	0.500	325.55	6.516	6	2
21	D09	SAE	2X2X0.1875	344.7	71.50	71.50	36XY	-8.127WIN 0	-120	8.546	87.538	87.686	0.750	0.500	0.500	306.87	6.142	6	2
22	D10	SAE	2X2X0.1875	344.7	58.52	58.52	38Y	-13.751WIN 45	-120	17.668	87.538	87.686	0.750	0.500	0.500	190.55	3.814	6	2
23	D11	SAE	2X2X0.1875	344.7	45.12	45.12	41X	-10.688WIN 45	-120	17.811	87.538	87.686	0.750	0.500	0.500	189.48	3.792	6	2
24	D12	SAE	2X2X0.1875	344.7	20.90	20.90	48XY	-4.951WIN 0	-120	17.811	87.538	87.686	0.750	0.500	0.500	189.48	3.792	6	2
25	H01	SAE	2.5X2.5X0.1875	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0	0
26	H02	SAE	2.5X2.5X0.25	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0	0
27	H03	SAE	2.5X2.5X0.25	344.7	4.44	4.44	58X	-1.306WIN 0	-120	22.124	87.538	116.914	1.000	0.500	0.500	232.24	4.536	6	2
28	H04	SAE	2X2X0.1875	344.7	8.33	8.33	60Y	-1.386WIN 45	-120	12.530	87.538	87.686	1.000	0.500	0.500	240.35	3.767	6	2
29	H05	SAE	2X2X0.1875	344.7	8.71	8.71	62X	-1.451WIN 0	-120	12.530	87.538	87.686	1.000	0.500	0.500	240.35	3.767	6	2
30	H06	SAE	2X2X0.1875	344.7	12.53	12.53	66X	-1.549WIN 0	-120	9.299	87.538	87.686	1.000	1.000	1.000	291.07	2.913	6	2
31	H07	SAE	2X2X0.1875	344.7	19.33	19.33	67P	-3.393WIN 0	-120	13.201	87.538	87.686	1.000	1.000	1.000	232.22	2.324	6	2
32	H08	SAE	2X2X0.1875	344.7	2.73	0.00	68YR	0.000		13.201	87.538	87.686	1.000	1.000	1.000	232.22	2.324	6	2
33	C01	SAE	2.5X2.5X0.1875	344.7	12.15	12.15	70XY	-2.197WIN 45	-120	13.600	87.538	87.686	1.000	0.500	0.500	269.57	5.327	6	2
34	C02	SAE	2X2X0.1875	344.7	10.80	10.80	71XY	-1.566WIN 45	-120	10.917	87.538	87.686	1.000	0.500	0.500	262.86	4.119	6	2
35	C03	SAE	2X2X0.1875	344.7	19.46	19.46	72P	-3.977WIN 45	-120	15.370	87.538	87.686	1.000	0.500	0.500	209.72	3.287	6	2
36	C04	SAE	2X2X0.1875	344.7	18.38	18.38	73P	-3.757WIN 45	-120	15.370	87.538	87.686	1.000	0.500	0.500	209.72	3.287	6	2
37	Z22	DUM	0.1X0.1X1	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0	0

Group Summary (Tension Portion):

Group Label	Group Desc.	Angle Type	Angle Size	Steel Strength (MPa)	Max Usage %	Max Tens. Use In 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 (m)	No. Of Bolts	No. Of Holes	Hole Diameter (cm)
1	M01	SAE	5X5X0.5	344.7	90.83	40.83	2XY	343.309WIN	45-120	632.122	700.028	935.315	0.000	4.635	8	2,000	1.749
2	M02	SAE	5X5X0.5	344.7	64.88	35.57	3XY	299.074WIN	45-120	632.122	700.028	935.315	0.000	5.776	8	2,000	1.749
3	M03	SAE	5X5X0.375	344.7	83.71	47.04	4XY	301.231WIN	45-120	481.485	700.028	701.486	0.000	5.776	8	2,000	1.749
4	M04	SAE	5X5X0.375	344.7	59.74	39.95	5XY	255.847WIN	45-120	481.485	700.028	701.486	0.000	5.776	8	2,000	1.749
5	M05	SAE	5X5X0.375	344.7	59.37	40.23	6XY	257.610WIN	45-120	481.485	525.021	526.114	0.000	5.776	6	2,000	1.749
6	M06	SAE	5X5X0.375	344.7	58.58	34.35	7XY	219.961WIN	45-120	481.485	525.021	526.114	0.000	7.541	6	2,000	1.749
7	M07	SAE	5X5X0.375	344.7	84.96	30.68	8XY	196.469WIN	45-120	481.485	525.021	526.114	0.000	5.527	6	2,000	1.749
8	M08	SAE	5X5X0.375	344.7	76.42	27.33	9XY	175.017WIN	45-120	481.485	525.021	526.114	0.000	5.527	6	2,000	1.749
9	M09	SAE	4X4X0.3125	344.7	59.87	36.12	10XY	147.250WIN	45-120	306.554	525.021	438.429	0.000	3.024	6	2,000	1.749
10	M10	SAE	4X4X0.25	344.7	65.02	38.14	11XY	118.616WIN	45-120	248.357	350.014	233.829	0.000	2.997	4	2,000	1.749
11	M11	SAE	3X3X0.25	344.7	57.71	29.45	13XY	67.411WIN	45-120	172.093	350.014	233.829	0.000	2.997	4	2,000	1.749
12	M12	SAE	2.5X2.5X0.25	344.7	39.16	18.04	15XY	31.578WIN	45-120	131.627	350.014	233.829	0.000	2.997	4	2,000	1.749
13	D01	DAE	2X2X0.25	344.7	75.98	21.36	20Y	24.869WIN	0-120	199.359	87.538	233.829	0.000	8.577	2	1,000	1.749
14	D02	DAE	2X2X0.25	344.7	32.77	17.29	22P	20.129WIN	0-120	199.359	87.538	233.829	0.000	6.241	2	1,000	1.749
15	D03	DAE	2X2X0.25	344.7	52.54	17.99	24XY	20.942WIN	0-120	199.359	87.538	233.829	0.000	7.125	2	1,000	1.749
16	D04	SAE	2.5X2.5X0.25	344.7	88.67	16.98	26X	19.772WIN	0-120	118.815	87.538	116.914	0.000	6.658	2	1,000	1.749
17	D05	SAE	2.5X2.5X0.25	344.7	88.01	15.29	28XY	17.802WIN	0-120	118.815	87.538	116.914	0.000	6.658	2	1,000	1.749
18	D06	SAE	2.5X2.5X0.25	344.7	98.05	14.00	30X	16.294WIN	0-120	118.815	87.538	116.914	0.000	6.274	2	1,000	1.749
19	D07	SAE	2X2X0.1875	344.7	84.32	12.18	32X	10.985WIN	0-120	67.808	87.538	87.686	0.000	8.720	2	1,000	1.749
20	D08	SAE	2X2X0.1875	344.7	76.90	8.39	34X	7.569WIN	0-120	67.808	87.538	87.686	0.000	6.516	2	1,000	1.749
21	D09	SAE	2X2X0.1875	344.7	71.50	8.83	36X	7.962WIN	0-120	67.808	87.538	87.686	0.000	6.142	2	1,000	1.749
22	D10	SAE	2X2X0.1875	344.7	58.52	13.83	38X	12.471WIN	0-120	67.808	87.538	87.686	0.000	3.814	2	1,000	1.749
23	D11	SAE	2X2X0.1875	344.7	45.12	10.91	42X	9.836WIN	0-120	67.808	87.538	87.686	0.000	3.792	2	1,000	1.749
24	D12	SAE	2X2X0.1875	344.7	20.90	5.96	48X	5.377WIN	0-120	67.808	87.538	87.686	0.000	3.792	2	1,000	1.749
25	H01	SAE	2.5X2.5X0.1875	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0	0,000	0
26	H02	SAE	2.5X2.5X0.25	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0	0,000	0
27	H03	SAE	2.5X2.5X0.25	344.7	4.44	1.03	57P	1.194WIN	0-120	118.815	87.538	116.914	0.000	4.536	2	1,000	1.749
28	H04	SAE	2X2X0.1875	344.7	8.33	4.21	59P	3.800WIN	45-120	67.808	87.538	87.686	0.000	3.767	2	1,000	1.749
29	H05	SAE	2X2X0.1875	344.7	8.71	4.22	61P	3.806WIN	45-120	67.808	87.538	87.686	0.000	3.767	2	1,000	1.749
30	H06	SAE	2X2X0.1875	344.7	12.53	1.80	65P	1.627WIN	45-120	67.808	87.538	87.686	0.000	2.913	2	1,000	1.749
31	H07	SAE	2X2X0.1875	344.7	19.33	7.98	67R	7.200WIN	0-120	67.808	87.538	87.686	0.000	2.324	2	1,000	1.749
32	H08	SAE	2X2X0.1875	344.7	2.73	2.73	68YR	2.464WIN	0-120	67.808	87.538	87.686	0.000	2.324	2	1,000	1.749
33	C01	SAE	2.5X2.5X0.1875	344.7	12.15	1.26	70X	1.468WIN	0-120	92.321	87.538	87.686	0.000	5.327	2	1,000	1.749
34	C02	SAE	2X2X0.1875	344.7	10.80	1.43	71P	1.286WIN	45-120	67.808	87.538	87.686	0.000	4.119	2	1,000	1.749
35	C03	SAE	2X2X0.1875	344.7	19.46	0.00	72X	0.000		67.808	87.538	87.686	0.000	3.287	2	1,000	1.749
36	C04	SAE	2X2X0.1875	344.7	18.38	0.00	73X	0.000		67.808	87.538	87.686	0.000	3.287	2	1,000	1.749
37	Z22	DUM	0.1X0.1X1	344.7	0.00	0.00		0.000		0.000	0.000	0.000	0.000	0.000	0	0,000	0

\*\*\* 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	98.05	30XY	Angle
WIN 45-120	90.83	2P	Angle
WIN 45-60	29.24	1P	Angle

\*\*\* Weight of structure (N):  
Weight of Angles\*Section DLF: 119983.3  
Weight of Equipment: 4500.0  
Total: 124483.3

\*\*\* End of Report

## EVALUACION ESTRUCTURAL TAC80



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
20 / 23

REV.  
0

TORRE 80 m – EL MIRADOR  
CIMENTACION

EVALUACION ESTRUCTURAL TAC80



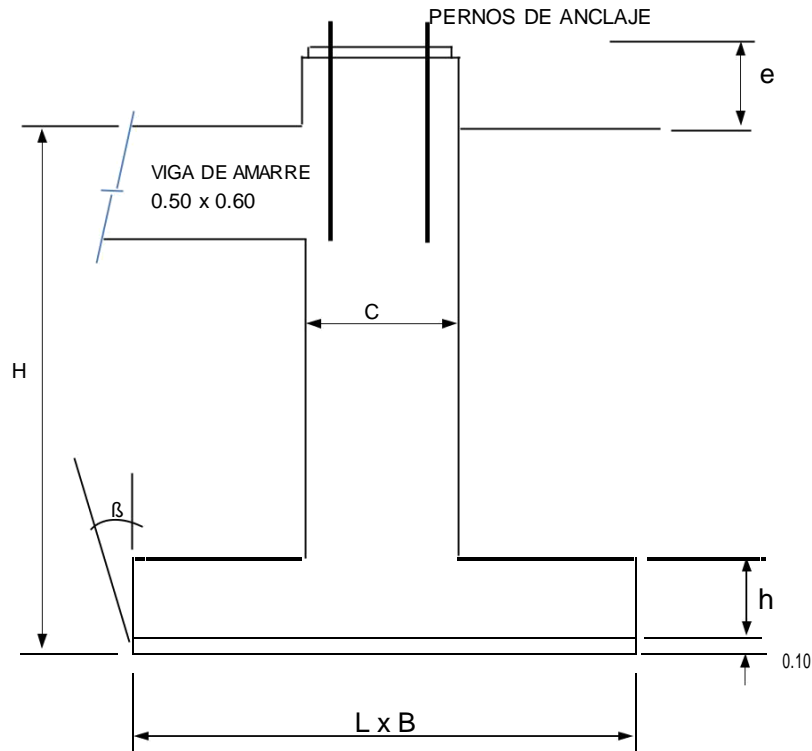
TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
**21 / 23**

REV.  
**0**

**TORRE 80,m - EL MIRADOR**  
**CIMENTACION EN CONCRETO**



MATERIALES: Acero  $f_y = 4,200$  Kg /  $\text{cm}^2$   
 Concr.  $f'_c = 210$  Kg /  $\text{cm}^2$   
 Angulo  $\beta = 20$  grados.  $T_g = 0.364$   
 Suelo  $q_u = 1.00$  Kg /  $\text{cm}^2$   
 Suelo  $C = 0.10$  Kg /  $\text{cm}^2$

PREDIMENSIONAMIENT. CHEQUEO ESTABLD.

Dimensiones ( m.)	H = 2.34	h = 0.50	C = 0.60	L = 2.50	e = 0.25
Volumen de Concreto (m3)	V1 = 0.734	V2 = 3.125	V3 = 0.313	Vc = 4.17	Cortante Vu =
Volumen de Suelo ( m3)	V4 = 14.625	V5 = 9.543	V6 = 1.666	Vs = 21.663	11,954
Peso Específico ( Ton / m3 )	Suelo 1.60	Concreto 2.40	R. Cohesión 11.700	P. Suelo 34.660	P. Concreto 10.013
Peso total Fundación ( Ton.)	56,373	Arrancamiento Fu = 36,567	Factor de seguridad al arranque K = 1.31		
Compresión C =	45,453	Area m2 6.25	0.54	Kg / $\text{cm}^2$	Presión sobre el terreno

**EVALUACION ESTRUCTURAL TAC80**



TORRE 80m-EL MIRADOR

TAC80-EM-HU

HOJA  
**22 / 23**



REV.  
**0**

## CONCLUSIONES:

La torre de 80 metros instalada en sitio El Mirador-Huila, 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 242.59 %, referido al límite fluencia, fallan los elementos M04, M05 de L5"x3/8", D01, D02, D03 de 2L2"x1/4", D04 y D05 de L2-1/2"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 0.475 m, es decir 0.34 ° menor a 0.5°.
  4. Se propone un refuerzo para los elementos M04, M05 con arriostrados adicionales de L2-1/2"x3/16", D01, D02, D03 con L2"x1/4", D04, D05 con L2-1/2"x3/16", además de hacer cierres internos entre estas diagonales para mejorar la esbeltez; El peso aprox. del reforzamiento es 4.500 kg.
- 
1. 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 2.350 metros, con suelo  $q_a=1.0 \text{ kg/cm}^2$  y según la verificación, la cimentación no cumple por esfuerzos para las cargas de la torre con las antenas nuevas; Se propone un reforzamiento, mediante la construcción de una placa superficial en cada pata de 3.5x3.5, espesor de 0.40; Las cantidades de obra son  $19.6 \text{ m}^3$  de concreto de 3000 psi y 1.800 kg de acero de refuerzo.
  2. Según el reglamento NSR-10 de deben construir vigas de amarre entre los pedestales, para este caso se proyectan de 0.50x0.60. Las cantidades de obra son  $12.0 \text{ m}^3$  de concreto de 3000 psi y 1.200 kg de acero de refuerzo.

### EVALUACION ESTRUCTURAL TAC80

		TORRE 80m-EL MIRADOR		
		TAC80-EM-HU	HOJA 23 / 23	REV. 0