

TOWER ANALYSIS - 260'- 24" GUYED TOWER
BRIGHTON, COLORADO
ADAMS COUNTY

08-09-10



Leo Roberts
8-10-10

LEO L. ROBERTS, P.E.
8809 N. 145th E. AVE. OWASSO, OK 74055
918-272-8680

**Tower Analysis- Brighton, Colorado- 260' Guyed Tower
Adams County**

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Authorization:

This structural analysis was authorized by Mr. Cris Alexander of Crawford Broadcasting on 7-25-10.

Description of Tower:

The structure is a 260' AM guyed tower. The tower manufacturer is not known or the tower manufacturer.

The tower is welded construction and has a face width of 24" center to center of leg members.

The design is triangular lattice type with single laced diagonal bracing, 12 bays per 20ft. section.

The tower has a tapered base.

There are six guy wire elevations and a two anchor system at 110' and 185' average radius at 120 degree intervals.

Materials of Fabrication:

Leg Members:

| <u>Elevation</u> | <u>Size</u> | <u>Material</u> |
|------------------|------------------|-----------------|
| 0' – 260' | 7/8" Solid Round | 50 ksi |

Diagonal Members:

| <u>Elevation</u> | <u>Size</u> | <u>Material</u> |
|------------------|------------------|-----------------|
| 0' – 260' | 5/8" Solid Round | 36 ksi |

Horizontal Members:

| <u>Elevation</u> | <u>Size</u> | <u>Material</u> |
|------------------|------------------|-----------------|
| 0' – 260' | 5/8" Solid Round | 36 ksi |

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Materials of Fabrication-continued:

Existing Guy Wire System:

| <u>Elevation</u> | <u>Size & Type</u> | <u>Ultimate Strength</u> |
|------------------|------------------------|--------------------------|
| 40' | 3/16" EHS | 3.99 k |
| 80' | 3/16" EHS | 3.99 k |
| 120' | 3/16" EHS | 3.99 k |
| 165' | 3/16" EHS | 3.99 k |
| 205' | 3/16" EHS | 3.99 k |
| 250' | 3/16" EHS | 3.99 k |

Method of Analysis:

The tower was analyzed using "Risa Tower" computer program for lattice type guyed structures. This program is well recognized for its accuracy.

The tower was examined for conformance with ANSI/TIA-222-G for 90 MPH wind with no ice. The tower was also examined for 50 MPH wind and 1/4" radial ice. The wind is applied to structure and tower appurtenances in accordance to TIA standards.

Existing & Proposed Loading:

| <u>Load</u> | <u>Qty</u> | <u>Elev.</u> | <u>Waveguide</u> | <u>Mount</u> |
|-------------|------------|--------------|------------------|--------------|
| * 4' Dish | 1 | 260' | 7/8" | Std. Leg Mt. |

*Proposed antenna.

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Results of Analysis:

Guy Wires:

| <u>Elevation</u> | <u>Safety Factor</u> | <u>Allowable (kip)</u> |
|------------------|----------------------|------------------------|
| 40' | 2.3 | 1.0 |
| 80' | 1.7 | 1.0 |
| 120' | 1.5 | 1.0 |
| 165' | 1.1 | 1.0 |
| 205' | ** .8 | 1.0 |
| 250' | ** .6 | 1.0 |

** Over stressed guy wires.

Leg Members:

| <u>Elevation</u> | <u>Load (kip)</u> | <u>Allowable (kip)</u> |
|------------------|-------------------|------------------------|
| 0' – 260' | * 16.9 | 12.0 |

* Over stressed leg members.

Diagonal Members:

| <u>Elevation</u> | <u>Load (kip)</u> | <u>Allowable (kip)</u> |
|------------------|-------------------|------------------------|
| 0' – 260' | 1.0 kips | 3.7 kips |

Horizontal Members:

Not loaded.

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Summary and Recommendations:

There are two guy wires over stressed. This is causing the tower shaft to bend and over stressing the leg members.

The top guy wire will be upgraded.

Results of Analysis:

Guy Wires:

| <u>Elevation</u> | <u>Safety Factor</u> | <u>Allowable (kip)</u> |
|-----------------------|----------------------|------------------------|
| 40' | 3.0 | 1.0 |
| 80' | 2.2 | 1.0 |
| 120' | 1.6 | 1.0 |
| 165' | 1.4 | 1.0 |
| 205' | 1.4 | 1.0 |
| 250' (Upgraded-5/16") | 1.6 | 1.0 |

Leg Members:

| <u>Elevation</u> | <u>Load (kip)</u> | <u>Allowable (kip)</u> |
|------------------|-------------------|------------------------|
| 0' – 260' | 10.8 | 12.0 |

Diagonal Members:

| <u>Elevation</u> | <u>Load (kip)</u> | <u>Allowable (kip)</u> |
|------------------|-------------------|------------------------|
| 0' – 260' | .98 kips | 3.7 kips |

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Foundations:

There was not any foundation information provided.

As a minimum, we recommend the anchor shafts be measured and checked for capacity.

Tower Reactions:

| | | | | | |
|--------------|----------|-----------|--------------|---------|----------|
| Base- | Down- | 22.0 kips | | | |
| | Horiz. | .06 kips | | | |
| Anchor-Inner | Uplift- | 2.5 kips | Anchor-Outer | Uplift- | 6.6 kips |
| | Horiz.- | 3.3 kips | | Horiz. | 5.9 kips |
| | Result.- | 4.1 kips | | Result. | 8.9 kips |

Assumptions made for this analysis include the following:

1. The tower guy wires have an initial tension of 10% of their breaking strength.
2. All leg steel is 50 KSI, all bracing is 36 KSI.
3. The guy wires are standard EHS type.
4. The tower has no damage.
5. Tower site is relatively level.

The general condition of the tower must be considered anytime additional loading is being considered. Rust, corrosion, damage, etc. could cause problems.

It is the responsibility of the tower owners and representatives to verify the tower loading.

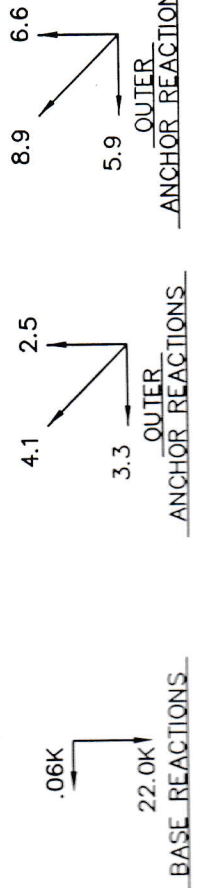
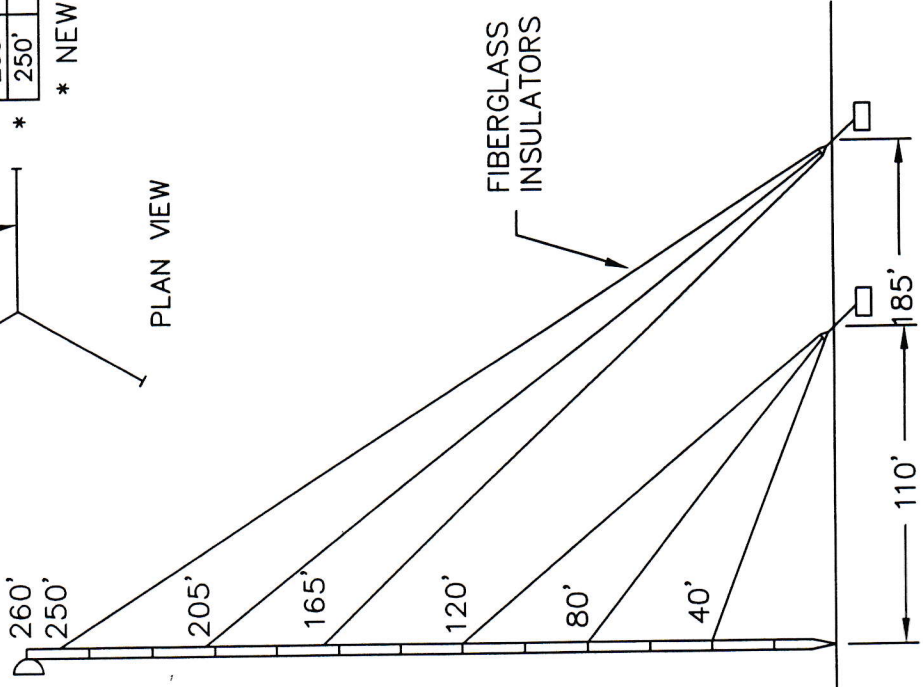
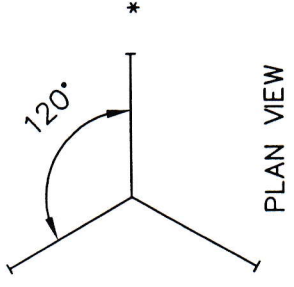
The tower information to perform this analysis was provided by Mr. Chris Alexander who supplied the tower material sizes and proposed antenna loads.

GUYWIRES

ANTENNAS

| ELEV. | QTY. | SIZE | CORD LENGTH | CUT LENGTH | INITIAL TENSION | TYPE ANTENNA | QTY. | ELEV. | LINE |
|-------|------|-----------|-------------|------------|-----------------|--------------|------|-------|------|
| 40' | 3 | 3/16" EHS | | | .399 | BEACON | 1 | 260' | 3/4" |
| 80' | 3 | 3/16" EHS | | | .399 | 4' DISH | 1 | 260' | 7/8" |
| 120' | 3 | 3/16" EHS | | | .399 | | | | |
| 165' | 3 | 3/16" EHS | | | .399 | | | | |
| 205' | 3 | 3/16" EHS | | | .399 | | | | |
| 250' | 3 | 5/16" EHS | | | 1.1 | | | | |

* NEW GUY WIRE



GENERAL NOTES:

1. TOWER IS LOCATED IN ADAMS COUNTY, COLORADO.
2. TOWER WAS ANALYZED FOR 90 MPH IN ACCORDANCE WITH THE TIA-222-G STANDARD.

| | |
|-------|-----------------------------|
| TOWER | 24" - SINGLE LACED - 12 BAY |
| HORIZ | SOLID ROD-1/2" Ø |
| GIRTS | SOLID ROD-1/2" Ø |
| DIAGS | SOLID ROD-5/8" Ø |
| LEGS | SOLID ROD-7/8" Ø |

LEO L. ROBERTS, P.E.
 (918) 272-8680 - 8809 N. 145TH E. AVE. - OWASSO, OK 74055

TOWER ANALYSIS - 260' - 24" GUYED TOWER
 SITE: BRIGHTON, COLORADO
 ADAMS COUNTY

DRAWN BY LLR
 DATE 08-09-10
 JOB#

DRAWING NO. BC00810M

| NO | DATE | REVISION | BY |
|----|------|----------|----|
| | | | |

| | | | | |
|---|---------|-----------------------|-------------|---------------------|
| RISA Tower LEO L ROBERTS PE 8809 N. 145TH E. AVE OWASSO, OK. 74055 Phone: 918-272-8680 FAX: 918-272-2508 | Job | 260 ft. 24" GT | Page | 44 of 46 |
| | Project | BRIGHTON COLORADO | Date | 15:18:32 08/09/10 |
| | Client | CRAWFORD BROADCASTING | Designed by | LEO L ROBERTS PE |

Section Capacity Table

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | ϕP_{allow} lb | % Capacity | Pass Fail |
|-------------|--------------|--------------------------|------|------------------|----------|---------------------|------------|-----------|
| T1 | 260 - 240 | Leg | 7/8 | 3 | -5837.05 | 12035.30 | 48.5 | Pass |
| | | Diagonal | 5/8 | 76 | -980.97 | 3709.48 | 26.4 | Pass |
| | | Horizontal | 1/2 | 74 | -108.04 | 2485.02 | 4.3 | Pass |
| | | Top Girt | 1/2 | 6 | -440.40 | 2485.02 | 17.7 | Pass |
| | | Bottom Girt | 1/2 | 9 | -245.01 | 2485.02 | 9.9 | Pass |
| | | Guy A@250 | 5/16 | 1017 | 4959.62 | 6720.00 | 73.8 | Pass |
| | | Guy B@250 | 5/16 | 1016 | 4163.21 | 6720.00 | 62.0 | Pass |
| | | Guy C@250 | 5/16 | 1015 | 4886.44 | 6720.00 | 72.7 | Pass |
| | | Top Guy Pull-Off@250 | 1/2 | 44 | 1633.30 | 8835.73 | 18.5 | Pass |
| T2 | 240 - 220 | Leg | 7/8 | 81 | -5167.10 | 12035.30 | 42.9 | Pass |
| | | Diagonal | 5/8 | 155 | -488.32 | 3709.48 | 13.2 | Pass |
| | | Horizontal | 1/2 | 152 | -88.56 | 2485.02 | 3.6 | Pass |
| | | Top Girt | 1/2 | 82 | -220.66 | 2485.02 | 8.9 | Pass |
| | | Bottom Girt | 1/2 | 86 | -16.52 | 2485.02 | 0.7 | Pass |
| T3 | 220 - 200 | Leg | 7/8 | 159 | -6588.01 | 12035.30 | 54.7 | Pass |
| | | Diagonal | 5/8 | 166 | -472.66 | 3709.48 | 12.7 | Pass |
| | | Horizontal | 1/2 | 170 | -23.70 | 2485.02 | 1.0 | Pass |
| | | Top Girt | 1/2 | 162 | -41.78 | 2485.02 | 1.7 | Pass |
| | | Bottom Girt | 1/2 | 165 | -165.51 | 2485.02 | 6.7 | Pass |
| | | Guy A@205.188 | 3/16 | 1020 | 2029.83 | 2394.00 | 84.8 | Pass |
| | | Guy B@205.188 | 3/16 | 1019 | 1692.63 | 2394.00 | 70.7 | Pass |
| | | Guy C@205.188 | 3/16 | 1018 | 1991.36 | 2394.00 | 83.2 | Pass |
| T4 | 200 - 180 | Top Guy Pull-Off@205.188 | 3/8 | 183 | 749.03 | 4970.10 | 15.1 | Pass |
| | | Leg | 7/8 | 237 | -6950.84 | 12035.30 | 57.8 | Pass |
| | | Diagonal | 5/8 | 245 | -251.51 | 3709.48 | 6.8 | Pass |
| | | Horizontal | 1/2 | 308 | -57.29 | 2485.02 | 2.3 | Pass |
| | | Top Girt | 1/2 | 238 | -126.24 | 2485.02 | 5.1 | Pass |
| | | Bottom Girt | 1/2 | 243 | -129.14 | 2485.02 | 5.2 | Pass |
| | | Leg | 7/8 | 315 | -6325.04 | 12035.30 | 52.6 | Pass |
| | | Diagonal | 5/8 | 340 | -508.99 | 3709.48 | 13.7 | Pass |
| T5 | 180 - 160 | Horizontal | 1/2 | 326 | -24.92 | 2485.02 | 1.0 | Pass |
| | | Top Girt | 1/2 | 318 | -125.45 | 2485.02 | 5.0 | Pass |
| | | Bottom Girt | 1/2 | 321 | -147.12 | 2485.02 | 5.9 | Pass |
| | | Guy A@165.188 | 3/16 | 1023 | 2031.76 | 2394.00 | 84.9 | Pass |
| | | Guy B@165.188 | 3/16 | 1022 | 1681.46 | 2394.00 | 70.2 | Pass |
| | | Guy C@165.188 | 3/16 | 1021 | 1994.82 | 2394.00 | 83.3 | Pass |
| | | Top Guy Pull-Off@165.188 | 3/8 | 339 | 841.90 | 4970.10 | 16.9 | Pass |
| | | Leg | 7/8 | 391 | -6364.45 | 12035.30 | 52.9 | Pass |
| T6 | 160 - 140 | Diagonal | 5/8 | 467 | -305.04 | 3709.48 | 8.2 | Pass |
| | | Horizontal | 1/2 | 464 | -56.03 | 2485.02 | 2.3 | Pass |
| | | Top Girt | 1/2 | 394 | -140.75 | 2485.02 | 5.7 | Pass |
| | | Bottom Girt | 1/2 | 399 | -76.57 | 2485.02 | 3.1 | Pass |
| | | Leg | 7/8 | 471 | -6956.89 | 12035.30 | 57.8 | Pass |
| T7 | 140 - 120 | Diagonal | 5/8 | 484 | -508.80 | 3709.48 | 13.7 | Pass |
| | | Horizontal | 1/2 | 482 | -24.97 | 2485.02 | 1.0 | Pass |
| | | Top Girt | 1/2 | 474 | -88.06 | 2485.02 | 3.5 | Pass |
| | | Guy A@120.375 | 3/16 | 1026 | 1811.04 | 2394.00 | 75.6 | Pass |
| | | Guy B@120.375 | 3/16 | 1025 | 1493.28 | 2394.00 | 62.4 | Pass |
| | | Guy C@120.375 | 3/16 | 1024 | 1784.75 | 2394.00 | 74.6 | Pass |
| | | Top Guy Pull-Off@120.375 | 3/8 | 477 | 668.01 | 4970.10 | 13.4 | Pass |
| | | Leg | 7/8 | 549 | -6956.88 | 12035.30 | 57.8 | Pass |
| T8 | 120 - 100 | Diagonal | 5/8 | 623 | -308.18 | 3709.48 | 8.3 | Pass |
| | | Horizontal | 1/2 | 619 | -37.43 | 2485.02 | 1.5 | Pass |
| | | Top Girt | 1/2 | 552 | -125.05 | 2485.02 | 5.0 | Pass |

| | | | | |
|--|---------|-----------------------|-------------|---------------------|
| RISATower LEO L ROBERTS PE 8809 N. 145TH E. AVE OWASSO, OK. 74055 Phone: 918-272-8680 FAX: 918-272-2508 | Job | 260 ft. 24" GT | Page | 45 of 46 |
| | Project | BRIGHTON COLORADO | Date | 15:18:32 08/09/10 |
| | Client | CRAWFORD BROADCASTING | Designed by | LEO L ROBERTS PE |

| Section No. | Elevation ft | Component Type | Size | Critical Element | P lb | θP_{allow} lb | % Capacity | Pass Fail |
|-------------|--------------|-------------------------|------|------------------|-----------|-----------------------|-------------|-------------|
| T9 | 100 - 80 | Bottom Girt | 1/2 | 555 | -40.36 | 2485.02 | 1.6 | Pass |
| | | Leg | 7/8 | 627 | -10855.70 | 12035.30 | 90.2 | Pass |
| | | Diagonal | 5/8 | 640 | -457.32 | 3709.48 | 12.3 | Pass |
| | | Horizontal | 1/2 | 638 | -46.79 | 2485.02 | 1.9 | Pass |
| | | Top Girt | 1/2 | 630 | -92.96 | 2485.02 | 3.7 | Pass |
| | | Guy A@80.375 | 3/16 | 1029 | 1448.72 | 2394.00 | 60.5 | Pass |
| | | Guy B@80.375 | 3/16 | 1028 | 1181.50 | 2394.00 | 49.4 | Pass |
| | | Guy C@80.375 | 3/16 | 1027 | 1417.60 | 2394.00 | 59.2 | Pass |
| | | Top Guy Pull-Off@80.375 | 3/8 | 631 | 657.78 | 4970.10 | 13.2 | Pass |
| T10 | 80 - 60 | Leg | 7/8 | 705 | -10855.70 | 12035.30 | 90.2 | Pass |
| | | Diagonal | 5/8 | 779 | -416.79 | 3709.48 | 11.2 | Pass |
| | | Horizontal | 1/2 | 776 | -51.71 | 2485.02 | 2.1 | Pass |
| | | Top Girt | 1/2 | 708 | -173.59 | 2485.02 | 7.0 | Pass |
| | | Bottom Girt | 1/2 | 711 | 38.78 | 6361.73 | 0.6 | Pass |
| T11 | 60 - 40 | Leg | 7/8 | 783 | -10489.00 | 12035.30 | 87.2 | Pass |
| | | Diagonal | 5/8 | 796 | -284.46 | 3709.48 | 7.7 | Pass |
| | | Horizontal | 1/2 | 794 | -42.32 | 2485.02 | 1.7 | Pass |
| | | Top Girt | 1/2 | 786 | -13.59 | 2485.02 | 0.5 | Pass |
| | | Guy A@40.375 | 3/16 | 1032 | 1026.09 | 2394.00 | 42.9 | Pass |
| | | Guy B@40.375 | 3/16 | 1031 | 792.22 | 2394.00 | 33.1 | Pass |
| T12 | 40 - 20 | Guy C@40.375 | 3/16 | 1030 | 968.93 | 2394.00 | 40.5 | Pass |
| | | Top Guy Pull-Off@40.375 | 3/8 | 787 | 561.00 | 4970.10 | 11.3 | Pass |
| | | Leg | 7/8 | 861 | -10489.00 | 12035.30 | 87.2 | Pass |
| | | Diagonal | 5/8 | 936 | -445.13 | 3709.48 | 12.0 | Pass |
| | | Horizontal | 1/2 | 932 | -69.60 | 2485.02 | 2.8 | Pass |
| T13 | 20 - 10 | Top Girt | 1/2 | 864 | -167.37 | 2485.02 | 6.7 | Pass |
| | | Bottom Girt | 1/2 | 867 | -76.29 | 2485.02 | 3.1 | Pass |
| | | Leg | 7/8 | 939 | -7502.02 | 12405.40 | 60.5 | Pass |
| | | Diagonal | 5/8 | 978 | -168.93 | 3813.95 | 4.4 | Pass |
| T14 | 10 - 0 | Horizontal | 1/2 | 949 | -17.55 | 2485.02 | 0.7 | Pass |
| | | Top Girt | 1/2 | 942 | 83.62 | 6361.73 | 1.3 | Pass |
| | | Bottom Girt | 1/2 | 944 | 274.50 | 6361.73 | 4.3 | Pass |
| | | Leg | 7/8 | 981 | -7689.53 | 10082.90 | 76.3 | Pass |
| | | Diagonal | 5/8 | 989 | -317.95 | 6400.53 | 5.0 | Pass |
| | | Horizontal | 1/2 | 987 | 69.93 | 6361.73 | 1.1 | Pass |
| | | Top Girt | 1/2 | 983 | 280.10 | 6361.73 | 4.4 | Pass |
| | | Summary | | | | | | |
| | | | | | | Leg (T9) | 90.2 | Pass |
| | | | | | | Diagonal (T1) | 26.4 | Pass |
| | | | | | | Horizontal (T1) | 4.3 | Pass |
| | | | | | | Top Girt (T1) | 17.7 | Pass |
| | | | | | | Bottom Girt (T1) | 9.9 | Pass |
| | | | | | | Guy A (T5) | 84.9 | Pass |
| | | | | | | Guy B (T3) | 70.7 | Pass |
| | | | | | | Guy C (T5) | 83.3 | Pass |
| | | | | | | Top Guy Pull-Off (T1) | 18.5 | Pass |
| | | | | | | RATING = | 90.2 | Pass |