

# HOUSTON TOWER COMMISSION

## Draft Agenda

Monday  
February 24, 2020

City of Houston City Hall  
Annex Council Chamber  
3:30 p.m.

**Members:**

Rob Todd, Chair  
John R. Melcher  
Kerrick Henry  
Teresa Lynn Flores  
Christy B. Smidt  
Linda Smith  
Asim Tufail

**Secretary:**

Margaret Wallace-  
Brown

# **TOWER COMMISSION MEETING POLICIES AND REGULATIONS**

## **Public Participation**

The public is encouraged to take an active interest in matters that come before the Tower Commission. Anyone wishing to speak before the Commission may do so. The Commission has adopted the following procedural rules on public participation:

1. Anyone wishing to speak before the Commission must sign-up on a designated form located at the entrance to the Council Chamber.
2. If the speaker wishes to discuss a specific item on the agenda of the Commission, it should be noted on the sign-up form.
3. If the speaker wishes to discuss any subject not otherwise on the agenda of the Commission, time will be allowed after all agenda items have been completed and "public comments" are taken.
4. An applicant is given first opportunity to speak and is allowed five minutes for an opening presentation. The applicant is also allowed a rebuttal after all speakers have been heard; three additional minutes will be allowed.
5. All other speakers will be given three minutes.
6. No speaker is permitted to accumulate speaking time from another person.
7. Time devoted to answering any questions from the Commission is not charged against allotted speaking time.
8. The Commission reserves the right to limit speakers if it is the Commission's judgement that an issue has been sufficiently discussed and additional speakers are repetitive.
9. The Commission reserves the right to stop speakers who are unruly or abusive.

**NOTE:** The Tower Commission may only act to approve or disapprove the placement of a tower under Chapter 28, Article XVI, City of Houston Code of Ordinances.

This online document is preliminary and not official. It may not contain all the relevant materials and information that the Tower Commission will consider at its meeting. The official agenda is posted at City Hall 72 hours prior to the Tower Commission meeting. Final detailed packets are available at the Tower Commission meeting.

## **HOUSTON TOWER COMMISSION Agenda February 24, 2020**

Meeting to be held in the  
Council Chamber, City Hall Annex  
900 Bagby  
3:30 p.m.

### **Call to order**

### **Secretary's Report**

- I. Approve the January 27, 2019 Tower Commission Meeting minutes
- II. Public hearing and consideration of a waiver request
  - A. 19-T-0741 3206 2/3 Webster Street
- III. Public Comment
- IV. Adjournment

**Minutes of the Houston Tower Commission**

(A CD of the full proceedings is on file in the Planning and Development Department)

**January 27, 2020**

Meeting held in

Council Chambers, Public Level, City Hall Annex  
3:30 p.m.

**CALL TO ORDER**

Chair Rob Todd called the meeting to order at 3:31 p.m., with a quorum present.

Rob Todd, Chair

Teresa Lynn Flores

Kerrick Henny

Absent

John R. Melcher

Christy B. Smidt

Linda Smith

Asim Tufail

**SECRETARY'S REPORT**

**NONE**

**I. APPROVAL OF THE NOVEMBER 25, 2019 TOWER COMMISSION MEETING MINUTES**

Motion was made by Commissioner Flores, seconded by Commissioner Tufail, to approve the November 25, 2019 Tower Commission meeting minutes. Motion carried unanimously.

Ill was taken out of order at this time.

**III. PUBLIC HEARING AND CONSIDERATION OF WAIVER REQUEST**

**A. 19-T-0741 3206 2/3 Webster Street**

Speakers: Jared Ledet, applicant -supportive; Lori Cral, Joseph Zenner and Derick Broze - opposed.

Commission took a brief recess at 4:20 p.m.

Commission reconvened at 4:31 p.m.

Motion was made by Commissioner Tufail, seconded by Commissioner Smith, to defer the application, for item III A to give the applicant time to provide additional information. Motion carried unanimously.

**II. APPROVAL OF THE 2020 TOWER COMMISSION MEETING DATES**

Motion was made by Commissioner Flores, seconded by Commissioner Smidt, to approve the Tower Commission meeting dates for 2020. Motion carried unanimously.

Chair Rob Todd showed pictures of the cell tower still standing located in the area of the Watson Grinding and Manufacturing explosion.

**IV. PUBLIC COMMENT**

**NONE**

**V. ADJOURNMENT**

There being no further business before the Commission, Chairman Rob Todd adjourned the meeting at 4:39 p.m. Motion was made by Commissioner Melcher and seconded by Commissioner Flores. Motion carried unanimously.

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**Rob Todd**  
Chair

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**Hector Rodriguez**  
Secretary

# AGENDA ITEM: II - A

## TOWER APPLICATION AND WAIVER REQUEST - STAFF REPORT

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| Location:               | File No.  | Zip   | Lamb. No. | Key Map |
|-------------------------|-----------|-------|-----------|---------|
| 3206 2/3 Webster Street | 19-T-0741 | 77004 | 5456      |         |

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Applicant: Jared Ledet, Branch Towers III, LLC  
Application Date: 10/14/2019  
Location: South of I-45 and west of Oliver & Dreyling  
Existing Use: Religious - Vacant  
Proposed Use: 100' Monopole tower  
Proposed Tower Users: Branch

**Waivers Request:**

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28-524 (g): Fall zone

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### **Relevant Tower Ordinance Waiver Provisions:**

28-524 (g): A tower permit shall not be approved for the construction or alteration of a tower structure unless the distance between the center of the base of a tower and the nearest residential lot is at least one and one-half times the height of the tower or tower structure.

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### **BASIS OF REQUEST:**

**Reason for waiver:** At the request of the anchor tenant, Branch as the proposed tower owner/operator has designed a monopole structure that will accommodate potential needs for the proposed anchor tenant and future tenants as well. The structure will meet all federal, state, and local building codes and standards, and it will be engineered to local wind speed requirements. The new cell site location will help us provide coverage to our customers. Daily business commuters and residents will find improved network coverage as coverage surrounding the area location will be enhanced. The proposed tower location meets all requirements of the code except the 150' setback to residential. The Residential Test ratio for this location is 61% NON-Residential, 39% Residential. Branch asks that the request for a waiver be granted, so that the wireless infrastructure in Houston may be improved.

**STAFF COMMENTS:**

**Approval Criteria**

**Staff Findings**

|   |  |
|---|--|
| Tower is not prohibited by deed restrictions  | The proposed tower will not violate deed restrictions.   |
| Tower is not located in a residential area<br>Residential test area is a 375' radius measured from the base of the tower.<br><br>More than 50% of the tracts or parcels are used or restricted for residential purposes | Tower is not located in a residential area<br><br><b>39.31% of the properties within the residential test area are single family.</b>  |
| Tower is not within a scenic area, in a park or on a tract of land surrounded by a park   | The tower is not within a scenic area, park or in a tract of land surrounded by a park as defined by the ordinance.                    |
| Tower must setback 1-1/2 times the height of the tower from a residential lot (150')  | <b>Nearest residential lot is less than 150' away. The nearest residential structure is approximately 35' from the proposed tower.</b> |
| Must not be within 1,000' of an approved tower structure  | There is no approved tower structure within 1000'  |

**CRITERIA FOR CONSIDERATION OF A TOWER APPLICATION WAIVER REQUEST:**

Per 28-532 (d) (formerly 41-59): The commission is authorized to consider and grant a waiver from the provisions of this article, following a public hearing, when the commission finds that each of these conditions exist:

- 1.) That a literal application of this article will result in undue and unnecessary hardship to the applicant, taking into account any federal or state licenses the applicant may have received to conduct its business;
- 2.) The waiver, if granted, will not be contrary to the public interest as implemented in this article;
- 3.) Consistent with the city's police power authority over towers, the waiver, if granted, will not be detrimental to the public health, safety or welfare;
- 4.) The waiver, if granted, will not result in a violation of any other applicable ordinance, regulation or statute enforceable by the city; and
- 5.) The waiver, if granted, will not result in the violation of any applicable deed restriction or zoning regulation or the location of the tower in a park.

# Houston Tower Commission ITEM:II - A

Planning and Development Department

Meeting Date:2/24/2020



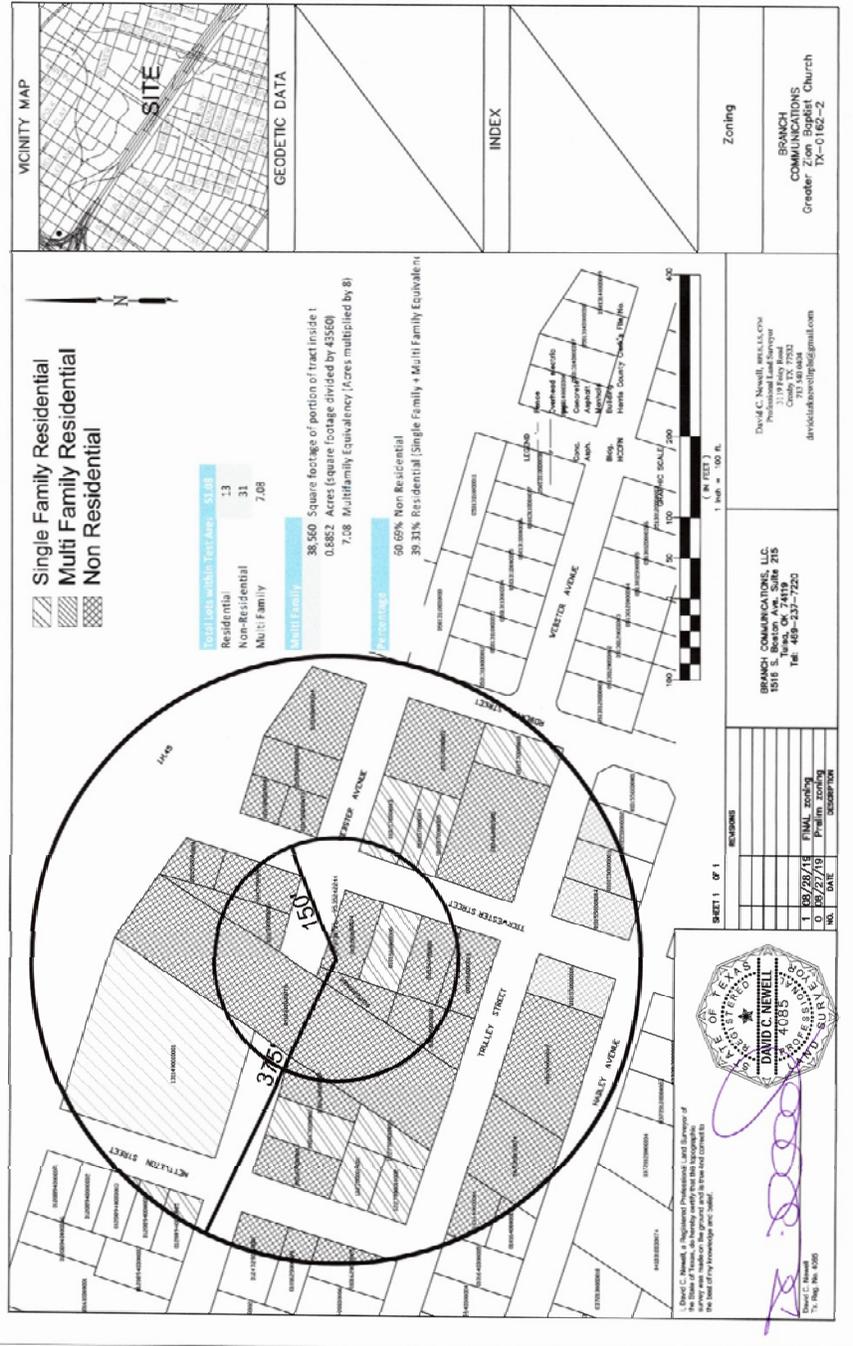
**Exhibit 1**

**Area Map**

# Houston Tower Commission ITEM:II - A

Planning and Development Department

Meeting Date:2/24/2020



Exhibit

Residential Test Map

|                                    |              |
|------------------------------------|--------------|
| <b>Total Lots within Test Area</b> | <b>51.08</b> |
| Residential                        | 13           |
| Non-Residential                    | 31           |
| Multi Family                       | 7.08         |

**Multi Family**

38,560 Square footage of portion of tract inside test ;  
0.8852 Acres (square footage divided by 43560)  
7.08 Multifamily Equivalency (Acres multiplied by 8)

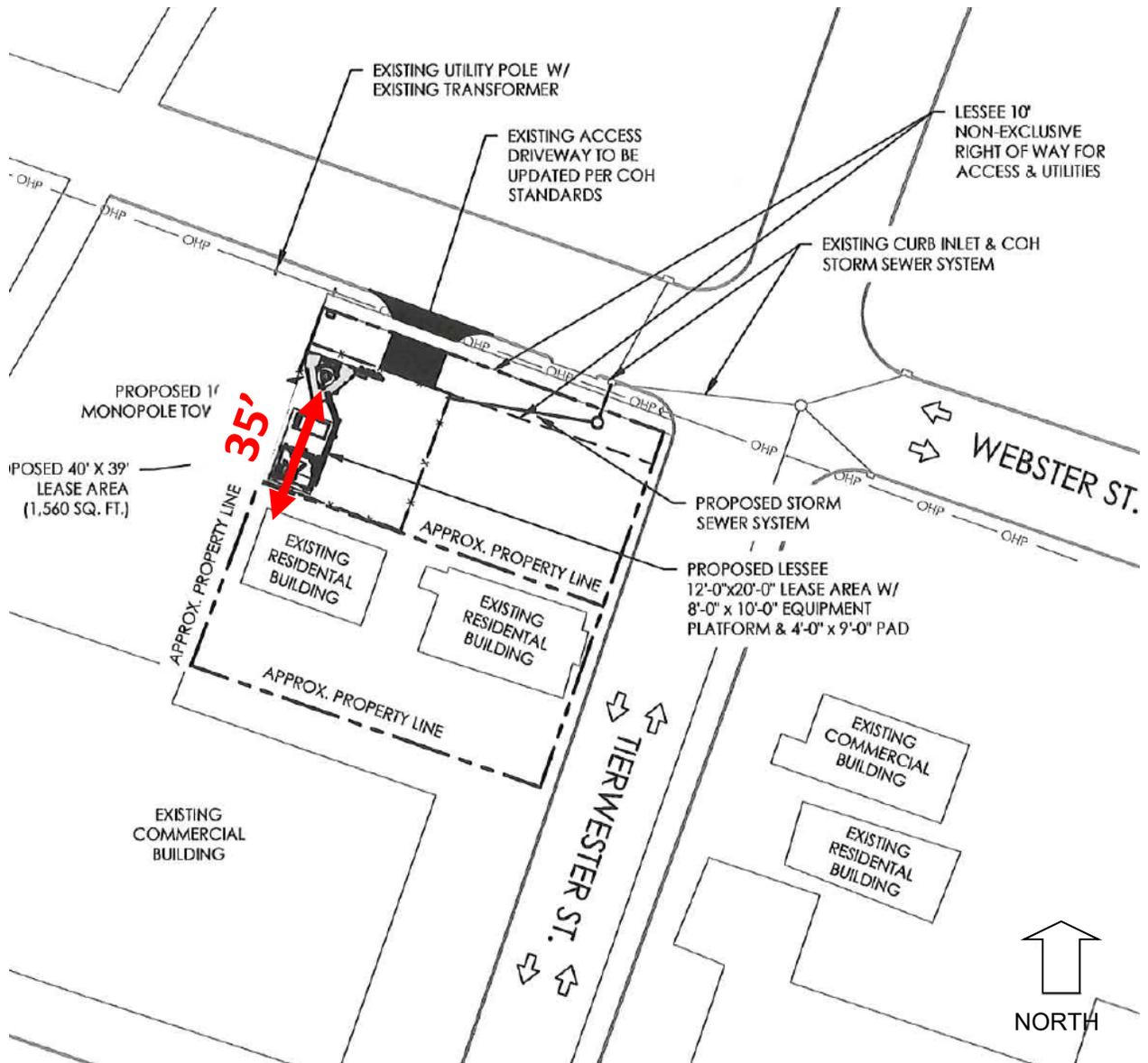
**Percentage**

60.69% Non Residential  
39.31% Residential (Single Family + Multi Family Equivalency)

# Houston Tower Commission ITEM:II - A

Planning and Development Department

Meeting Date:2/24/2020



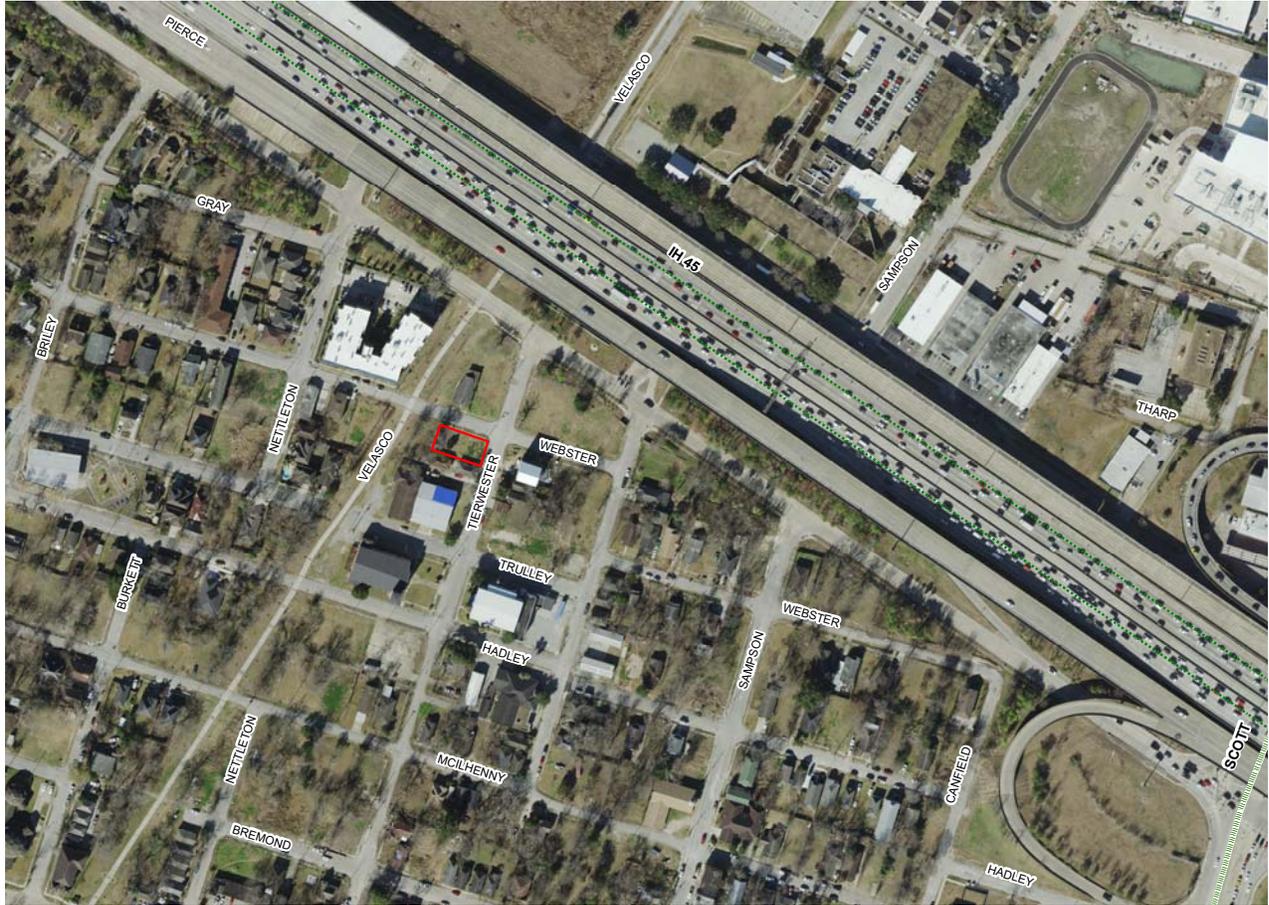
Exhibit

Site Map

# Houston Tower Commission    ITEM:II - A

Planning and Development Department    Meeting Date:2/24/2020

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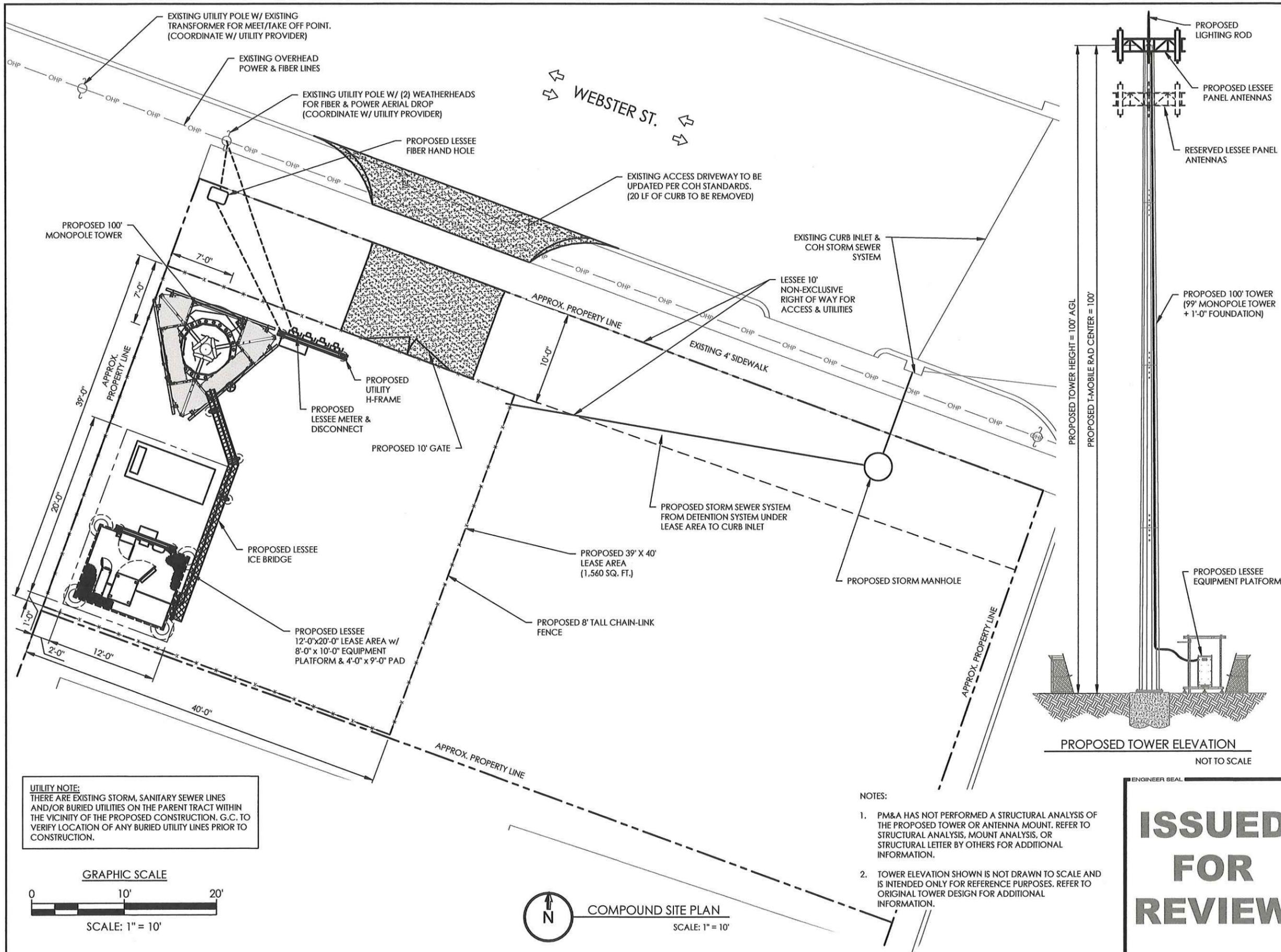


**Exhibit**

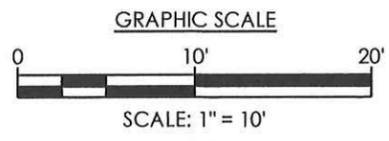
**Aerial Map**

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**UTILITY NOTE:**  
 THERE ARE EXISTING STORM, SANITARY SEWER LINES AND/OR BURIED UTILITIES ON THE PARENT TRACT WITHIN THE VICINITY OF THE PROPOSED CONSTRUCTION. G.C. TO VERIFY LOCATION OF ANY BURIED UTILITY LINES PRIOR TO CONSTRUCTION.



**COMPOUND SITE PLAN**  
 SCALE: 1" = 10'

- NOTES:**
1. PM&A HAS NOT PERFORMED A STRUCTURAL ANALYSIS OF THE PROPOSED TOWER OR ANTENNA MOUNT. REFER TO STRUCTURAL ANALYSIS, MOUNT ANALYSIS, OR STRUCTURAL LETTER BY OTHERS FOR ADDITIONAL INFORMATION.
  2. TOWER ELEVATION SHOWN IS NOT DRAWN TO SCALE AND IS INTENDED ONLY FOR REFERENCE PURPOSES. REFER TO ORIGINAL TOWER DESIGN FOR ADDITIONAL INFORMATION.

**ISSUED FOR REVIEW**

PREPARED FOR:

**Branch**  
 A SOLUTIONS PROVIDER

PREPARED BY:

**PM&A**  
 P. MARSHALL & ASSOCIATES

DESIGN REVISIONS:

| NO. | DATE | REVISIONS | BY |
|-----|------|-----------|----|
|     |      |           |    |
|     |      |           |    |
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|     |      |           |    |

LE 09/16/19 LEASE EXHIBIT SBE

NO. DATE REVISIONS BY

NOT VALID WITHOUT SIGNATURE AND DATE

PREPARED FOR:

**T-Mobile**

4126 SOUTHWEST FWY.  
 SUITE 1400  
 HOUSTON, TX 77027

MARKET: HOUSTON

BRANCH SITE NUMBER: TX-0162

BRANCH SITE NAME: ZION BAPTIST CHURCH

SITE ADDRESS: 3210 WEBSTER ST. HOUSTON, TX 77004

SITE COORDINATES:  
 LAT: 29.737164°  
 LONG: -95.352403°

SITE TYPE: MONOPOLE

APPROVED BY: P. MARSHALL  
 DESIGNED BY: B. WILSON  
 PROJECT NO: 18TN19-037  
 DATE: 9/4/19

SHEET NAME: COMPOUND SITE PLAN

SHEET NUMBER: LE-2

# Tower Permit Waiver Application

## APPLICANT INFORMATION:

Site address: 3206 2/3 Webster Street, Houston, TX 77004

Tower Company: Branch Towers III LLC ("Branch")

Contact person: Jared Ledet Title: COO & Executive Vice President

Phone: 469-237-7220 FAX: / Email: Jared.ledet@branchcomm.net

*The waiver application request must be completed in full and include the appropriate studies, investigations, and colored coded maps. Applicants must provide 12 copies minimum of supporting documentation with the waiver application. A separate application is required for each waiver. Attach no more than 2 pages of waiver request details.*

## WAIVER REQUEST:

Specify City Code reference and standard subject to waiver: 28-524b Residential Test Ratio

Reason for waiver: Residential Setback does not achieve 150'. Of the 45 parcels within the 375' Residential Test Ratio area, 4 are less than 150'.

## WAIVER JUSTIFICATION:

Following a public hearing, the Tower Commission is authorized to consider and grant a waiver according to the five provisions delineated in Chapter 41, Article III, Section 41-59. Provide an attachment to this form repeating the following conditions with a response for justification of the waiver for each of the by showing that:

1. *a literal application of this article will result in undue and unnecessary hardship to the applicant, taking into account any federal or state licenses the applicant may have received to conduct its business because...;*
2. *the waiver, if granted, will not be contrary to the public interest as implemented in this article because...;*
3. *consistent with the city's police power authority over towers, the waiver, if granted, will not be detrimental to the public health, safety, or welfare because...;*
4. *the waiver, if granted, will not result in a violation of any other applicable ordinance, regulation or statute enforceable by the city because...; and*
5. *the waiver, if granted, will not result in the violation of any applicable deed restriction or zoning regulation or the location of a tower in a park because...*

Tower permit applications that do not comply with Section 41-53(h) regarding the 1,000-foot tower separation standard must also complete **Tower Permit Waiver Application – Page 2**.

## WAIVER APPLICATION CERTIFICATION

I certify that all the information on this application is true and correct.

Signature of applicant or agent: \_\_\_\_\_

Print Name: Jared Ledet

OWER WAIVER REQUEST: 8405 2/3 Brookwulf Drive  
Statement of Support  
Tower Ordinance Sec 41-59 (d)

1. *a literal application of this article will result in undue and unnecessary hardship to the applicant, taking into account any federal or state licenses the applicant may have received to conduct its business because...;*

This location was selected as the preferred location with the least residential impact. Branch attempted to locate the tower on a lot that would afford the fewest variances required while minimizing views of the tower from the residences while balancing the need for service in this area.

The following would be considered a hardship if this application is not granted:

- Coverage Parity – without the specific location that has been selected, customer experience and call/data quality will continue to degrade. In addition, the surround sites will continue to have capacity issues that will only increase drop calls and latency in data consumption by the wireless customers
- Residential Test Ratio – any other parcel within the immediate area would require an additional variance for this proposal. This is the only parcel in the area that is less than fifty percent residential ratio. If we move to an alternative location, it will require two variances (test ratio and distance to residential).
- Multiple sites – with the proposal of a 100' structure, this would afford the coverage objective to be met with a single tower solution. If denied, the carriers would look to split the solution into a two tower solution at a slightly lower height

2. *the waiver, if granted, will not be contrary to the public interest as implemented in this article because...;*

The proposed site offers multiple benefits from a providing increased coverage capacity and enhanced high speed cellular signal to residents and businesses alike. The location of this tower will provide enhanced E911 coverage for users of the system. Moreover, the proposal furthers the City's policy of collocation by being designed to accommodate up to three additional carriers' antennas.

3. *consistent with the city's police power authority over towers, the waiver, if granted, will not be detrimental to the public health, safety, or welfare because...;*

The Branch anchor tenant for the proposed location is expanding their infrastructure to accommodate system traffic which has been produced by LTE Technology. The technology is similar to the older cellular services introduced more than 20 years ago, but with additional enhanced features. An extension of the land-line telephone system, LTE & GSM technology utilizes radio waves in place of wires to transmit and receive calls. It is similar to radio and TV broadcasts, but the signals utilized by wireless telephones are much weaker, as they utilize two-way communication (handset to base station and vice-versa) and provide signal to a smaller service area. The proposed anchor tenant and any other incoming carrier will operate within their FCC issued and /or granted licenses. Their antenna will operate well within the Federally mandated requirements with an ERP range of 100-1000 watts maximum which are similar power levels for a remote-control car, heating blanket, or hair dryer. The proposed communications facility will not interfere with either television or radio reception, as all carriers are licensed by the FCC to operate in a very specific frequency at a different location on the spectrum.

4. *the waiver, if granted, will not result in a violation of any other applicable ordinance, regulation or statute enforceable by the city because...; and*

The proposed facility will be privacy fenced and locked. The proposed facility will have a landscape design. The facility will emit no noise, glare or odor, and will have no signage other than those required by the FCC for identification. The facility will comply with the strict guidelines of the FCC and FAA, which are designed to protect public safety. To ensure structural integrity of the tower, Branch Communications will construct and maintain it in compliance with all federal, state, and local building codes and standards, and it will be engineered to local wind speed requirements.

5. *the waiver, if granted, will not result in the violation of any applicable deed restriction or zoning regulation or the location of a tower in a park because....*

There are no known applicable Deed Restrictions governing the location of this proposed tower. The proposed facility is not near any parks, and does not violate any zoning regulations.

### *Conclusion*

At the request of the anchor tenant, Branch as the proposed tower owner/operator has designed a monopole structure that will accommodate potential needs for the proposed anchor tenant and future tenants as well. The structure will meet all federal, state, and local building codes and standards, and it will be engineered to local wind speed requirements. The new cell site location will help us provide coverage to our customers. Daily business commuters and residents will find improved network coverage as coverage surrounding the area location will be enhanced. The proposed tower location meets all requirements of the code except the 150' setback to residential. The Residential Test ratio for this location is 61% NON-Residential, 39% Residential. Branch asks that the request for a waiver be granted, so that the wireless infrastructure in Houston may be improved.

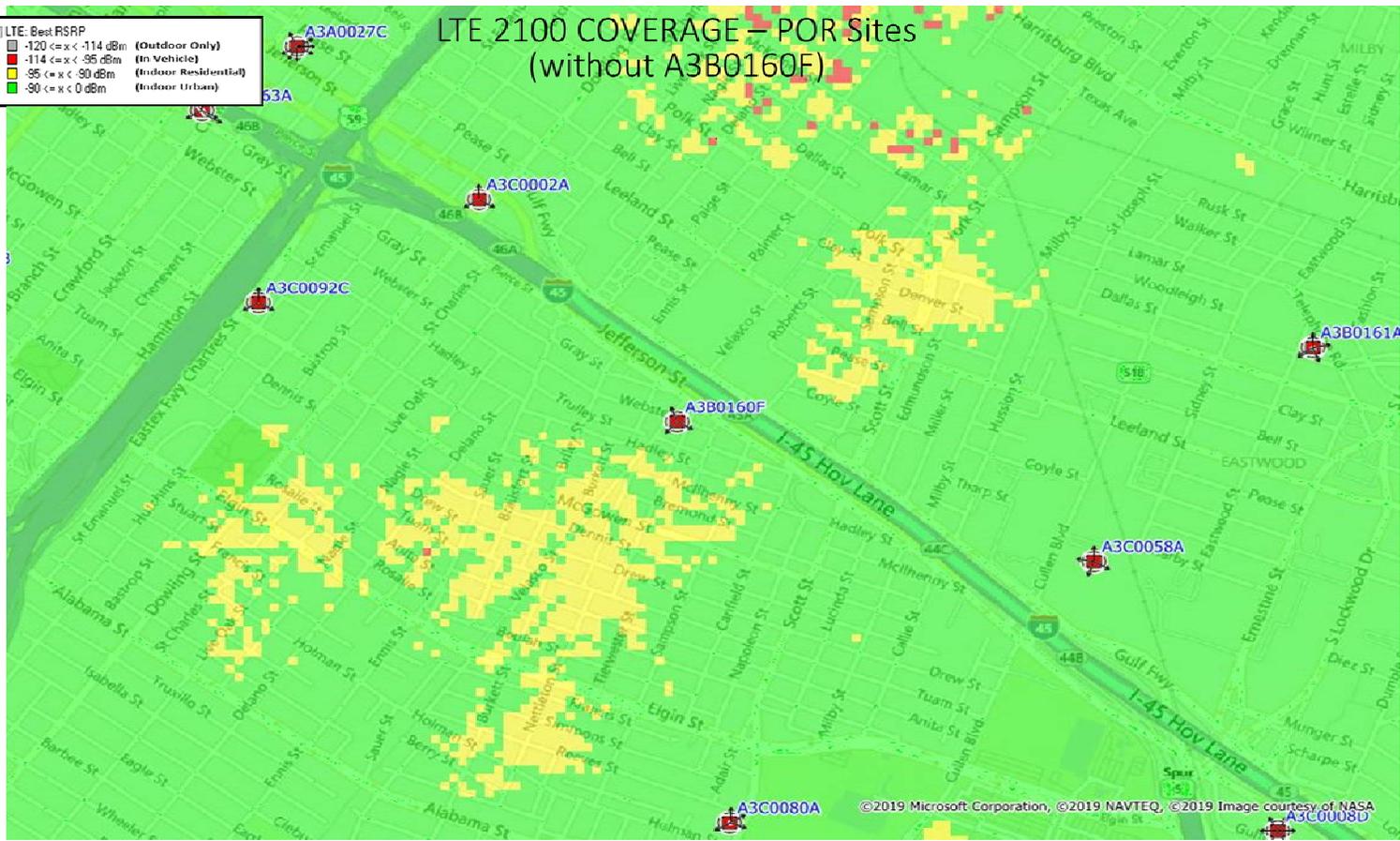
3206 2/3 Webster Street



INSERT COPY OF RESIDENTIAL TEST RATIO FIRST

- LTE: Best RSRP
- 120 <= x < -114 dBm (Outdoor Only)
- 114 <= x < -95 dBm (In Vehicle)
- 95 <= x < -80 dBm (Indoor Residential)
- 80 <= x < 0 dBm (Indoor Urban)

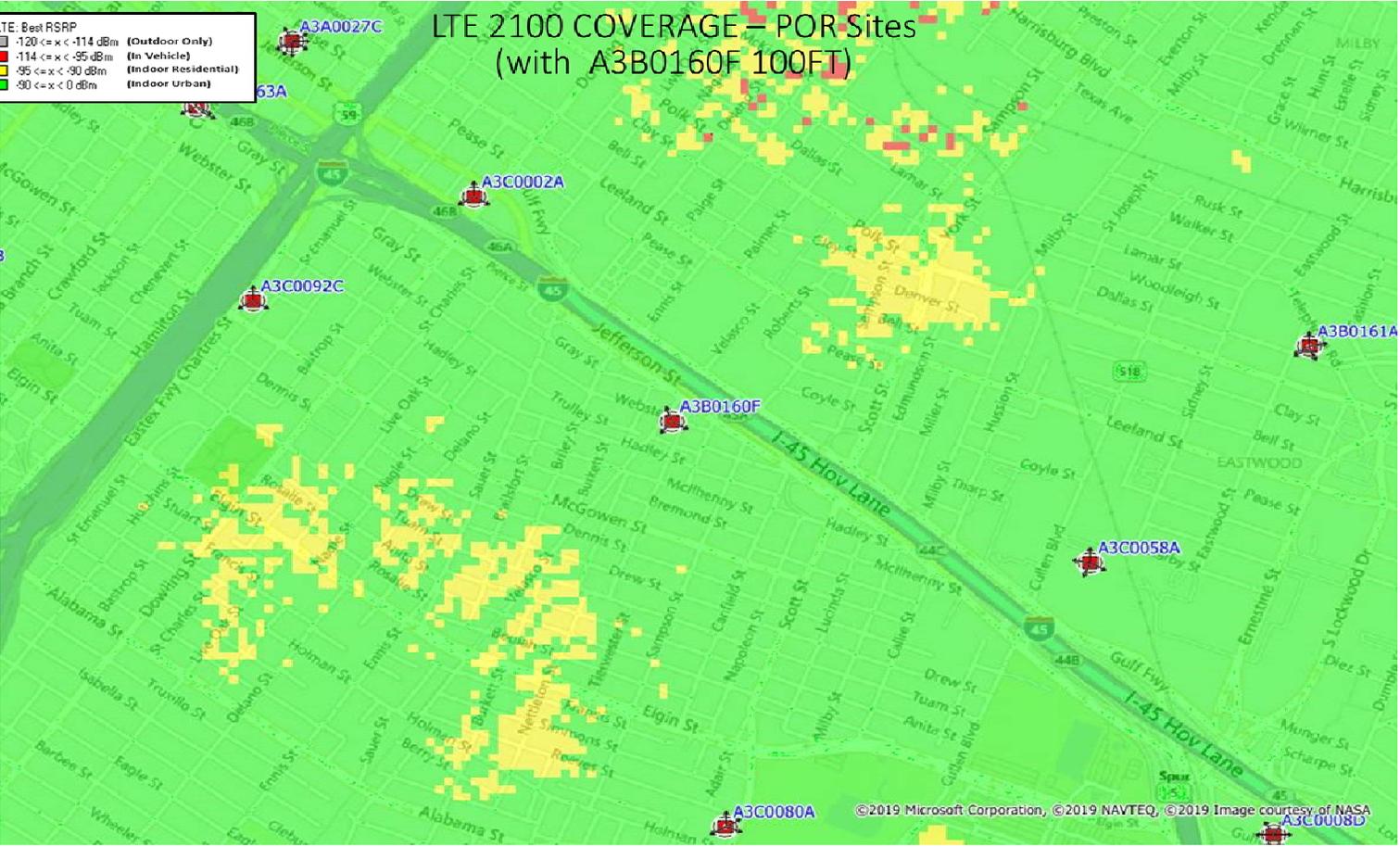
### LTE 2100 COVERAGE – POR Sites (without A3B0160F)



©2019 Microsoft Corporation, ©2019 NAVTEQ, ©2019 Image courtesy of NASA

# LTE 2100 COVERAGE – POR Sites (with A3B0160F 100FT)

LTE Best RSRP  
 -120 <= x < -114 dBm (Outdoor Only)  
 -114 <= x < -95 dBm (In Vehicle)  
 -95 <= x < -90 dBm (Indoor Residential)  
 -90 <= x < 0 dBm (Indoor Urban)

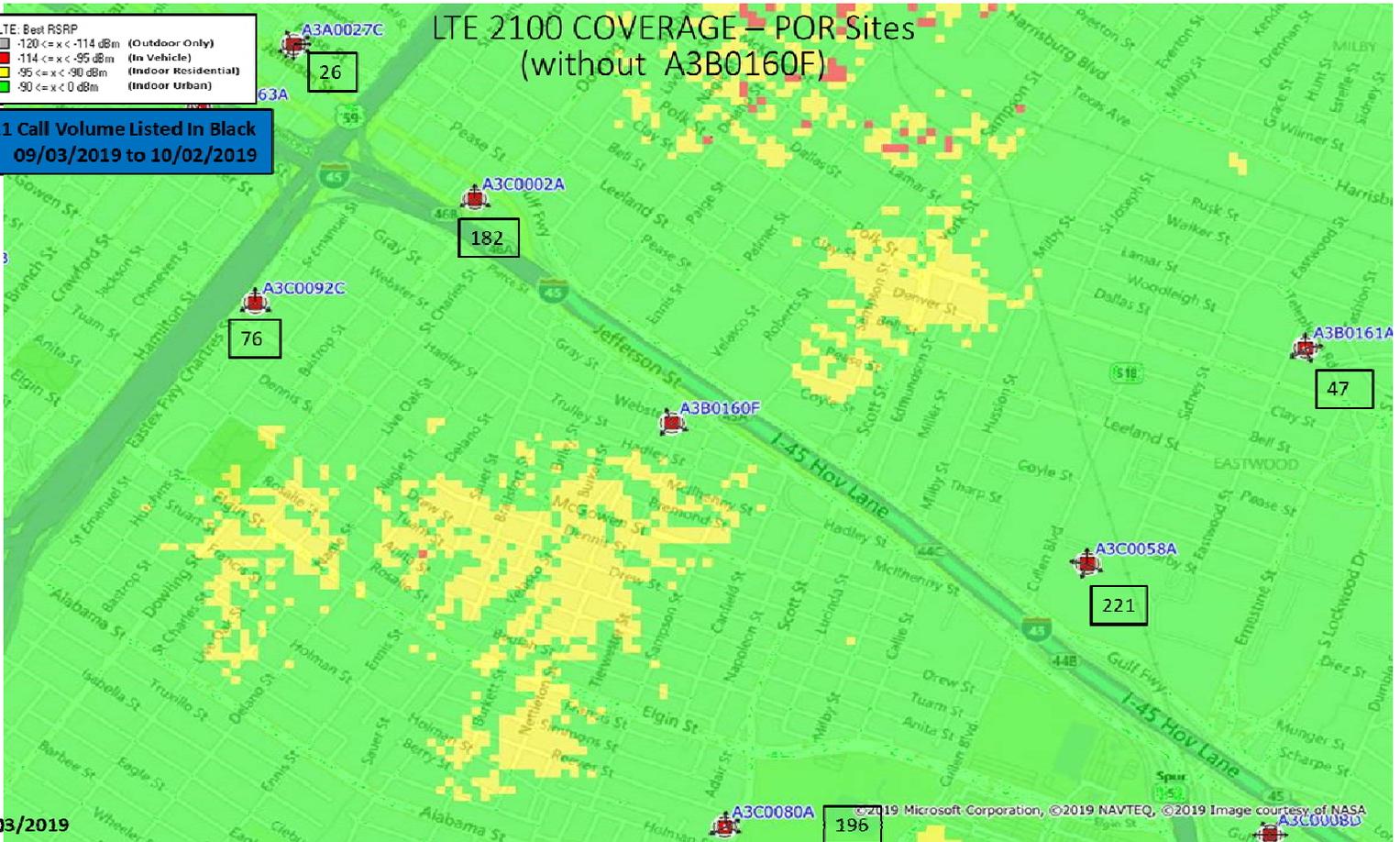


# E911 Call Volume

## LTE 2100 COVERAGE – POR Sites (without A3B0160F)

LTE: Best RSRP  
 -120 <= x < -114 dBm (Outdoor Only)  
 -114 <= x < -95 dBm (In Vehicle)  
 -95 <= x < -80 dBm (Indoor Residential)  
 -80 <= x < -65 dBm (Indoor Urban)

**911 Call Volume Listed In Black**  
 • 09/03/2019 to 10/02/2019



10/03/2019

Petition to Oppose Tower Application # 19-T-0741

3206 2/3 Webster Street

Houston, TX 77004

The Planning and Development Department of the City of Houston has received an application to construct a tower on a tract of land being approximately 0.358 acres, out of the north 1/2 of lot 6 and 7, in block 2, of Coli Harris County, Texas.

| Name              | Signature   | Address                  |
|-------------------|-------------|--------------------------|
| Lot 6 Coal        | [Signature] | 3135 Trulley 77004       |
| Carmine Coal      | [Signature] | 3135 Trulley St 77004    |
| Maria Carrasco    | [Signature] | 3126 Webster St. Houston |
| Raquel Hernandez  | [Signature] | 3122 Webster St 77004    |
| Marces Hernandez  | [Signature] | 3122 Webster St 77004    |
| Esteban Gonzalez  | [Signature] | 3122 Webster St 77004    |
| Della Buford      | [Signature] | 3205 Webster St 77004    |
| Willie Buford     | [Signature] | 3205 Webster St 77004    |
| Lizeth Martinez   | [Signature] | 3305 Tierce St 77004     |
| Christine Mendez  | [Signature] | 3205 Tierce St 77004     |
| Harold Sanchez    | [Signature] | 2205 Tierce St 77004     |
| Marina Yano       | [Signature] | 2206 Tierce St           |
| Rosemaria Morales | [Signature] | 2206 Tierce St           |
| Paula Henry       | [Signature] | 2223 Webster 77004       |
| Amrit L. Kaur     | [Signature] | 223 Webster St.          |
| Misela Kandle     | [Signature] | 3201 Webster St.         |
| Motervand Mendez  | [Signature] | 3117 Webster St.         |
| Sonny Allen       | [Signature] | 309 2114 Gray 77004      |
| Jessie Allen      | [Signature] | 2714 Gray                |
| Carleen Hernandez | [Signature] | 3154 Gray 77004          |
| Adriana Soto      | [Signature] | 3100 Hadley St 77004     |
| Denise J. Johnson | [Signature] | 3135 Trulley St 77004    |
| Dorinda Mae       | [Signature] | 3046 Webster St 77004    |
| Tong Tong         | [Signature] | 3132 Trulley Street      |



## **Supporting material**



**Structural Design Report**

100' Monopole

Site: JR Richard, TX

Site Number: TX-0158

Address: 1691 2/3 S Highway 6, Houston, TX 77077

Prepared for: BRANCH COMMUNICATIONS

by: Sabre Towers & Poles™

Job Number: 434718

Revision A

May 29, 2019

**Monopole Profile**..... 1

**Foundation Design Summary**..... 2

**Pole Calculations**..... 3-11

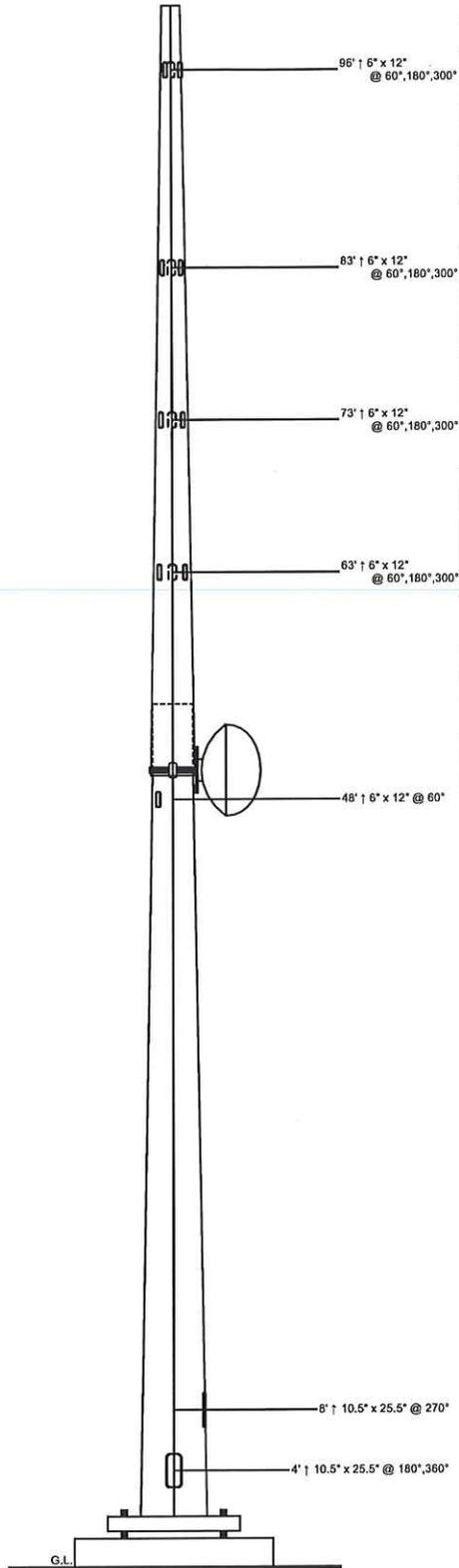
**Foundation Calculations**..... 12-18



*[Handwritten Signature]*  
5/29/19

Sabre Communications Corporation  
Texas Registration Number F-4365

|                           |         |        |
|---------------------------|---------|--------|
| Length (ft)               | 53'-3"  | 50'-6" |
| Number Of Sides           | 18      |        |
| Thickness (in)            | 3/8"    | 5/16"  |
| Lap Splice (ft)           | 4'-9"   | 14"    |
| Top Diameter (in)         | 31.13"  | 33.59" |
| Bottom Diameter (in)      | 51.79"  |        |
| Taper (in/ft)             | 0.388   |        |
| Grade                     | A572-55 | A581   |
| Weight (lbs)              | 10818   |        |
| Overall Steel Height (ft) | 99      |        |



### Designed Appurtenance Loading

| Elev | Description   | Tx-Line     |
|------|---|-------------|
| 100  | (1) 210 sq. ft. EPA 4000# (no ice)                          | (12) 1 5/8" |
| 85   | (1) 180 sq. ft. EPA (no ice) 200 sq. ft. EPA (ice)          | (12) 1 5/8" |
| 75   | (1) 180 sq. ft. EPA (no ice) 200 sq. ft. EPA (ice)          | (12) 1 5/8" |
| 65   | (1) 180 sq. ft. EPA (no ice) 200 sq. ft. EPA (ice)          | (12) 1 5/8" |
| 50   | (1) Dish Mount (Monopole Only) - Pipe Mount (up to 6' Dish) |             |
| 50   | (1) 6' Solid Dish W/ Radome                                 | (1) 1 5/8"  |

### Design Criteria - ANSI/TIA-222-G

|  |         |
|--|---------|
| ASCE 7-16 Ultimate Wind Speed (No Ice) | 139 mph |
| Wind Speed (Ice)                       | 30 mph  |
| Design Ice Thickness                   | 1.00 in |
| Structure Class                        | II      |
| Risk Category                          | II      |
| Exposure Category                      | C       |
| Topographic Category                   | 1       |

### Load Case Reactions

| Description             | Axial (kips) | Shear (kips) | Moment (ft-k) | Deflection (ft) | Sway (deg) |
|-------------------------|--------------|--------------|---------------|-----------------|------------|
| 3s Gusted Wind          | 39.83        | 56.16        | 4294.36       | 6.59            | 7.56       |
| 3s Gusted Wind 0.9 Dead | 29.88        | 56.18        | 4263.03       | 6.52            | 7.48       |
| 3s Gusted Wind&Ice      | 67.04        | 4.24         | 340.7         | 0.56            | 0.67       |
| Service Loads           | 33.22        | 9.69         | 740.5         | 1.15            | 1.31       |

### Base Plate Dimensions

| Shape | Diameter | Thickness | Bolt Circle | Bolt Qty | Bolt Diameter |
|-------|----------|-----------|-------------|----------|---------------|
| Round | 64.25"   | 2"        | 58.5"       | 16       | 2.25"         |

### Anchor Bolt Dimensions

| Length | Diameter | Hole Diameter | Weight | Type    | Finish |
|--------|----------|---------------|--------|---------|--------|
| 84"    | 2.25"    | 2.625"        | 1937.6 | A615-75 | Galv   |

### Notes

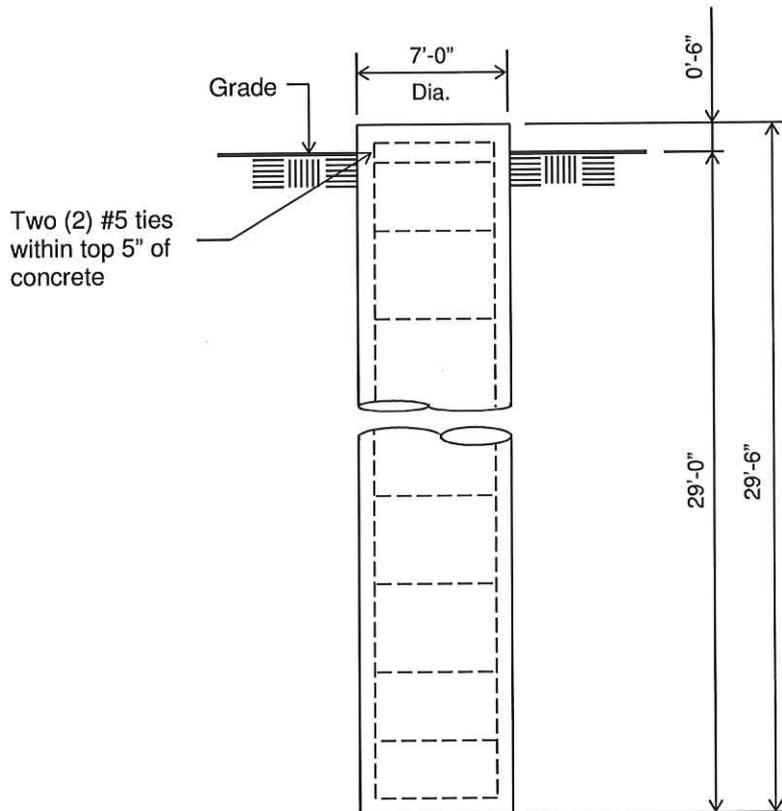
- 1) Antenna Feed Lines Run Inside Pole
- 2) All dimensions are above ground level, unless otherwise specified.
- 3) Weights shown are estimates. Final weights may vary.
- 4) Full Height Step Bolts
- 5) This tower design and, if applicable, the foundation design(s) shown on the following page(s) also meet or exceed the requirements of the 2012 International Building Code.
- 6) Tower Rating: 99.7%

|  |   |   |
|--|---|---|
|  | <b>Sabre Communications Corporation</b><br>7101 Southbridge Drive<br>P.O. Box 658<br>Slouss City, IA 51102-0658<br>Phone: (712) 258-6699<br>Fax: (712) 279-0314   | Job: <b>434718A</b><br>Customer: <b>BRANCH COMMUNICATIONS</b><br>Site Name: <b>JR Richard, TX TX-0158</b><br>Description: <b>100' Monopole</b><br>Date: <b>5/29/2019</b> By: <b>ARH</b> |
|  | <small>Information contained herein is the sole property of Sabre Communications Corporation, constitutes a trade secret as defined by Iowa Code Ch. 550 and shall not be reproduced, copied or used in whole or part for any purpose whatsoever without the prior written consent of Sabre Communications Corporation.</small> |   |

**Customer: BRANCH COMMUNICATIONS**

**Site: JR Richard, TX TX-0158**

100' Monopole



**Notes:**

- 1) Concrete shall have a minimum 28-day compressive strength of 4,500 psi, in accordance with ACI 318-11.
- 2) Rebar to conform to ASTM specification A615 Grade 60.
- 3) All rebar to have a minimum of 3" concrete cover.
- 4) All exposed concrete corners to be chamfered 3/4".
- 5) The foundation design is based on the geotechnical report by Geotel Engineering, Inc., project no. E19-170, dated May 19, 2019.
- 6) See the geotechnical report for drilled pier installation requirements, if specified.
- 7) The foundation is based on the following factored loads:  
 Moment = 4,294.36 k-ft  
 Axial = 39.83 k  
 Shear = 56.16 k

**ELEVATION VIEW**

(42.05 Cu. Yds.)

(1 REQUIRED; NOT TO SCALE)

| Rebar Schedule for Pier |  |
|-------------------------|--|
| Pier                    | (28) #10 vertical rebar w/ #5 ties, two within top 5" of pier, then 8" C/C |

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100' Monopole / JR Richard, TX

\* All pole diameters shown on the following pages are across corners.  
 See profile drawing for widths across flats.

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POLE GEOMETRY

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| ELEV<br>ft | SECTION<br>NAME | No.<br>SIDE | OUTSIDE<br>DIAM<br>in | THICK<br>-NESS<br>in | RESISTANCES<br>φ*Pn φ*Mn<br>kip ft-kip | SPLICE<br>TYPE | ...OVERLAP...<br>LENGTH<br>ft | RATIO | w/t  |
|------------|-----------------|-------------|-----------------------|----------------------|--|----------------|-------------------------------|-------|------|
| 99.0       | A               | 18          | 14.22                 | 0.312                | 1008.6 279.9                           |                |                               |       | 6.1  |
| 53.2       | A/B             | 18          | 32.23                 | 0.312                | 2312.1 1491.6                          | SLIP           | 4.75                          | 1.73  |      |
| 48.5       | B               | 18          | 33.49                 | 0.375                | 2883.1 1926.6                          |                |                               |       | 13.7 |
| 0.0        |                 |             | 52.59                 | 0.375                | 4121.3 4360.7                          |                |                               |       |      |

=====

POLE ASSEMBLY

=====

| SECTION<br>NAME | BASE<br>ELEV<br>ft | BOLTS<br>NUMBER | AT BASE<br>OF SECTION<br>DIAM<br>in | STRENGTH<br>ksi | THREADS IN<br>SHEAR PLANE | CALC<br>BASE<br>ELEV<br>ft |
|-----------------|--------------------|-----------------|-------------------------------------|-----------------|---------------------------|----------------------------|
| A               | 48.500             | 0               | A325                                | 0.00            | 92.0                      | 48.500                     |
| B               | 0.000              | 0               | A325                                | 0.00            | 92.0                      | 0.000                      |

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POLE SECTIONS

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| SECTION<br>NAME | No. of<br>SIDES | LENGTH<br>ft | OUTSIDE<br>DIAMETER<br>BOT<br>*<br>in | DIAMETER<br>TOP<br>*<br>in | BEND<br>RAD<br>in | MAT-<br>ERIAL<br>ID | FLANGE, ID<br>BOT TOP | FLANGE, WELD<br>..GROUP.ID..<br>BOT TOP |
|-----------------|-----------------|--------------|---------------------------------------|----------------------------|-------------------|---------------------|-----------------------|---|
| A               | 18              | 50.50        | 34.11                                 | 14.22                      | 0.000             | 1                   | 0 0                   | 0 0                                     |
| B               | 18              | 53.25        | 52.59                                 | 31.61                      | 0.000             | 2                   | 0 0                   | 0 0                                     |

\* - Diameter of circumscribed circle

=====

MATERIAL TYPES

=====

| TYPE OF<br>SHAPE | TYPE<br>NO | NO OF<br>ELEM. | ORIENT<br>& deg | HEIGHT<br>in | WIDTH<br>in | THICKNESS,<br>WEB FLANGE<br>in in | IRREGULARITY<br>PROJECTION,<br>% OF ORIENT<br>AREA<br>deg |
|------------------|------------|----------------|-----------------|--------------|-------------|-----------------------------------|---|
| PL               | 1          | 1              | 0.0             | 34.11        | 0.31        | 0.312 0.312                       | 0.00 0.0  |
| PL               | 2          | 1              | 0.0             | 52.59        | 0.38        | 0.375 0.375                       | 0.00 0.0  |

& - with respect to vertical

=====

MATERIAL PROPERTIES

=====

| MATERIAL<br>TYPE NO. | ELASTIC<br>MODULUS<br>ksi | UNIT<br>WEIGHT<br>pcf | .. STRENGTH ..<br>Fu ksi Fy ksi | THERMAL<br>COEFFICIENT<br>/deg |
|----------------------|---------------------------|-----------------------|---------------------------------|--------------------------------|
|----------------------|---------------------------|-----------------------|---------------------------------|--------------------------------|

|   |         |       |      |      |            |
|---|---------|-------|------|------|------------|
| 1 | 29000.0 | 490.0 | 80.0 | 65.0 | 0.00001170 |
| 2 | 29000.0 | 490.0 | 80.0 | 65.0 | 0.00001170 |

\* Only 3 condition(s) shown in full  
 \* Some concentrated wind loads may have been derived from full-scale wind tunnel testing

LOADING CONDITION A

139 mph Ultimate wind with no ice. Wind Azimuth: 0°

LOADS ON POLE

| LOAD TYPE | ELEV<br>ft | APPLY.<br>RADIUS<br>ft | LOAD.<br>AT<br>AZI | LOAD<br>AZI | FORCES       |             | MOMENTS            |                   |
|-----------|------------|------------------------|--------------------|-------------|--------------|-------------|--------------------|-------------------|
|           |            |                        |                    |             | HORIZ<br>kip | DOWN<br>kip | VERTICAL<br>ft-kip | TORSNAL<br>ft-kip |
| C         | 99.000     | 0.00                   | 0.0                | 0.0         | 13.3443      | 4.8366      | 0.0000             | 0.0000            |
| C         | 97.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 1.4527      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 1.2580      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0                | 0.0         | 11.0636      | 4.8366      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 1.1082      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0                | 0.0         | 10.7759      | 4.8366      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.9585      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0                | 0.0         | 10.4561      | 4.8366      | 0.0000             | 0.0000            |
| C         | 49.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.0612      | 0.0000             | 0.0000            |
| D         | 99.000     | 0.00                   | 180.0              | 0.0         | 0.0580       | 0.0678      | 0.0000             | 0.0000            |
| D         | 83.750     | 0.00                   | 180.0              | 0.0         | 0.0580       | 0.0678      | 0.0000             | 0.0000            |
| D         | 83.750     | 0.00                   | 180.0              | 0.0         | 0.0753       | 0.0914      | 0.0000             | 0.0000            |
| D         | 68.500     | 0.00                   | 180.0              | 0.0         | 0.0753       | 0.0914      | 0.0000             | 0.0000            |
| D         | 68.500     | 0.00                   | 180.0              | 0.0         | 0.0904       | 0.1151      | 0.0000             | 0.0000            |
| D         | 53.250     | 0.00                   | 180.0              | 0.0         | 0.0904       | 0.1151      | 0.0000             | 0.0000            |
| D         | 53.250     | 0.00                   | 180.0              | 0.0         | 0.0989       | 0.2850      | 0.0000             | 0.0000            |
| D         | 48.500     | 0.00                   | 180.0              | 0.0         | 0.0989       | 0.2850      | 0.0000             | 0.0000            |
| D         | 48.500     | 0.00                   | 180.0              | 0.0         | 0.1030       | 0.1701      | 0.0000             | 0.0000            |
| D         | 36.375     | 0.00                   | 180.0              | 0.0         | 0.1030       | 0.1701      | 0.0000             | 0.0000            |
| D         | 36.375     | 0.00                   | 180.0              | 0.0         | 0.1089       | 0.1928      | 0.0000             | 0.0000            |
| D         | 24.250     | 0.00                   | 180.0              | 0.0         | 0.1089       | 0.1928      | 0.0000             | 0.0000            |
| D         | 24.250     | 0.00                   | 180.0              | 0.0         | 0.1098       | 0.2155      | 0.0000             | 0.0000            |
| D         | 12.125     | 0.00                   | 180.0              | 0.0         | 0.1098       | 0.2155      | 0.0000             | 0.0000            |
| D         | 12.125     | 0.00                   | 180.0              | 0.0         | 0.1154       | 0.2381      | 0.0000             | 0.0000            |
| D         | 0.000      | 0.00                   | 180.0              | 0.0         | 0.1154       | 0.2381      | 0.0000             | 0.0000            |

ANTENNA LOADING

| ANTENNA<br>TYPE | ELEV<br>ft | AZI | ATTACHMENT |     | ANTENNA FORCES |              |                |                   |
|-----------------|------------|-----|------------|-----|----------------|--------------|----------------|-------------------|
|                 |            |     | RAD<br>ft  | AZI | AXIAL<br>kip   | SHEAR<br>kip | GRAVITY<br>kip | TORSION<br>ft-kip |
| STD+R           | 49.0       | 0.0 | 2.1        | 0.0 | 1.33           | 0.00         | 0.24           | 0.00              |

LOADING CONDITION M

139 mph Ultimate wind with no ice. Wind Azimuth: 0°

LOADS ON POLE

| LOAD TYPE | ELEV<br>ft | APPLY.<br>RADIUS<br>ft | LOAD.<br>AT<br>AZI | LOAD<br>AZI | FORCES       |             | MOMENTS            |                   |
|-----------|------------|------------------------|--------------------|-------------|--------------|-------------|--------------------|-------------------|
|           |            |                        |                    |             | HORIZ<br>kip | DOWN<br>kip | VERTICAL<br>ft-kip | TORSNAL<br>ft-kip |
| C         | 99.000     | 0.00                   | 0.0                | 0.0         | 13.3443      | 3.6274      | 0.0000             | 0.0000            |
| C         | 97.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 1.0895      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.9435      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0                | 0.0         | 11.0636      | 3.6274      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.8312      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0                | 0.0         | 10.7759      | 3.6274      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.7188      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0                | 0.0         | 10.4561      | 3.6274      | 0.0000             | 0.0000            |
| C         | 49.000     | 0.00                   | 0.0                | 0.0         | 0.0000       | 0.0459      | 0.0000             | 0.0000            |
| D         | 99.000     | 0.00                   | 180.0              | 0.0         | 0.0580       | 0.0508      | 0.0000             | 0.0000            |
| D         | 83.750     | 0.00                   | 180.0              | 0.0         | 0.0580       | 0.0508      | 0.0000             | 0.0000            |

|   |        |      |       |     |        |        |        |        |
|---|--------|------|-------|-----|--------|--------|--------|--------|
| D | 83.750 | 0.00 | 180.0 | 0.0 | 0.0753 | 0.0686 | 0.0000 | 0.0000 |
| D | 68.500 | 0.00 | 180.0 | 0.0 | 0.0753 | 0.0686 | 0.0000 | 0.0000 |
| D | 68.500 | 0.00 | 180.0 | 0.0 | 0.0904 | 0.0863 | 0.0000 | 0.0000 |
| D | 53.250 | 0.00 | 180.0 | 0.0 | 0.0904 | 0.0863 | 0.0000 | 0.0000 |
| D | 53.250 | 0.00 | 180.0 | 0.0 | 0.0989 | 0.2137 | 0.0000 | 0.0000 |
| D | 48.500 | 0.00 | 180.0 | 0.0 | 0.0989 | 0.2137 | 0.0000 | 0.0000 |
| D | 48.500 | 0.00 | 180.0 | 0.0 | 0.1030 | 0.1276 | 0.0000 | 0.0000 |
| D | 36.375 | 0.00 | 180.0 | 0.0 | 0.1030 | 0.1276 | 0.0000 | 0.0000 |
| D | 36.375 | 0.00 | 180.0 | 0.0 | 0.1089 | 0.1446 | 0.0000 | 0.0000 |
| D | 24.250 | 0.00 | 180.0 | 0.0 | 0.1089 | 0.1446 | 0.0000 | 0.0000 |
| D | 24.250 | 0.00 | 180.0 | 0.0 | 0.1098 | 0.1616 | 0.0000 | 0.0000 |
| D | 12.125 | 0.00 | 180.0 | 0.0 | 0.1098 | 0.1616 | 0.0000 | 0.0000 |
| D | 12.125 | 0.00 | 180.0 | 0.0 | 0.1154 | 0.1786 | 0.0000 | 0.0000 |
| D | 0.000  | 0.00 | 180.0 | 0.0 | 0.1154 | 0.1786 | 0.0000 | 0.0000 |

ANTENNA LOADING

| .....ANTENNA..... | ATTACHMENT |     | .....ANTENNA FORCES..... |     |       |       |         |         |
|-------------------|------------|-----|--------------------------|-----|-------|-------|---------|---------|
| TYPE              | ELEV       | AZI | RAD                      | AZI | AXIAL | SHEAR | GRAVITY | TORSION |
|                   | ft         |     | ft                       |     | kip   | kip   | kip     | ft-kip  |
| STD+R             | 49.0       | 0.0 | 2.1                      | 0.0 | 1.33  | 0.00  | 0.18    | 0.00    |

LOADING CONDITION Y

30 mph wind with 1 ice. Wind Azimuth: 0

LOADS ON POLE

| LOAD TYPE | ELEV   | APPLY.. | LOAD.. | AT  | LOAD   | .....FORCES..... |        | .....MOMENTS..... |         |
|-----------|--------|---------|--------|-----|--------|------------------|--------|-------------------|---------|
|           |        |         |        |     |        | HORIZ            | DOWN   | VERTICAL          | TORSNAL |
|           | ft     | RADIUS  | AZI    | AZI | kip    | kip              | ft-kip | ft-kip            |         |
| C         | 99.000 | 0.00    | 0.0    | 0.0 | 1.3620 | 9.3056           | 0.0000 | 0.0000            |         |
| C         | 97.000 | 0.00    | 0.0    | 0.0 | 0.0000 | 1.4527           | 0.0000 | 0.0000            |         |
| C         | 84.000 | 0.00    | 0.0    | 0.0 | 0.0000 | 1.2580           | 0.0000 | 0.0000            |         |
| C         | 84.000 | 0.00    | 0.0    | 0.0 | 0.6664 | 10.9923          | 0.0000 | 0.0000            |         |
| C         | 74.000 | 0.00    | 0.0    | 0.0 | 0.0000 | 1.1082           | 0.0000 | 0.0000            |         |
| C         | 74.000 | 0.00    | 0.0    | 0.0 | 0.6474 | 10.9157          | 0.0000 | 0.0000            |         |
| C         | 64.000 | 0.00    | 0.0    | 0.0 | 0.0000 | 0.9585           | 0.0000 | 0.0000            |         |
| C         | 64.000 | 0.00    | 0.0    | 0.0 | 0.6265 | 10.8294          | 0.0000 | 0.0000            |         |
| C         | 49.000 | 0.00    | 0.0    | 0.0 | 0.0000 | 0.0612           | 0.0000 | 0.0000            |         |
| D         | 99.000 | 0.00    | 180.0  | 0.0 | 0.0058 | 0.0926           | 0.0000 | 0.0000            |         |
| D         | 83.750 | 0.00    | 180.0  | 0.0 | 0.0058 | 0.0926           | 0.0000 | 0.0000            |         |
| D         | 83.750 | 0.00    | 180.0  | 0.0 | 0.0073 | 0.1238           | 0.0000 | 0.0000            |         |
| D         | 68.500 | 0.00    | 180.0  | 0.0 | 0.0073 | 0.1238           | 0.0000 | 0.0000            |         |
| D         | 68.500 | 0.00    | 180.0  | 0.0 | 0.0086 | 0.1545           | 0.0000 | 0.0000            |         |
| D         | 53.250 | 0.00    | 180.0  | 0.0 | 0.0086 | 0.1545           | 0.0000 | 0.0000            |         |
| D         | 53.250 | 0.00    | 180.0  | 0.0 | 0.0094 | 0.3287           | 0.0000 | 0.0000            |         |
| D         | 48.500 | 0.00    | 180.0  | 0.0 | 0.0094 | 0.3287           | 0.0000 | 0.0000            |         |
| D         | 48.500 | 0.00    | 180.0  | 0.0 | 0.0097 | 0.2165           | 0.0000 | 0.0000            |         |
| D         | 36.375 | 0.00    | 180.0  | 0.0 | 0.0097 | 0.2165           | 0.0000 | 0.0000            |         |
| D         | 36.375 | 0.00    | 180.0  | 0.0 | 0.0102 | 0.2434           | 0.0000 | 0.0000            |         |
| D         | 24.250 | 0.00    | 180.0  | 0.0 | 0.0102 | 0.2434           | 0.0000 | 0.0000            |         |
| D         | 24.250 | 0.00    | 180.0  | 0.0 | 0.0102 | 0.2691           | 0.0000 | 0.0000            |         |
| D         | 12.125 | 0.00    | 180.0  | 0.0 | 0.0102 | 0.2691           | 0.0000 | 0.0000            |         |
| D         | 12.125 | 0.00    | 180.0  | 0.0 | 0.0106 | 0.2916           | 0.0000 | 0.0000            |         |
| D         | 0.000  | 0.00    | 180.0  | 0.0 | 0.0106 | 0.2916           | 0.0000 | 0.0000            |         |

ANTENNA LOADING

| .....ANTENNA..... | ATTACHMENT |     | .....ANTENNA FORCES..... |     |       |       |         |         |
|-------------------|------------|-----|--------------------------|-----|-------|-------|---------|---------|
| TYPE              | ELEV       | AZI | RAD                      | AZI | AXIAL | SHEAR | GRAVITY | TORSION |
|                   | ft         |     | ft                       |     | kip   | kip   | kip     | ft-kip  |
| STD+R             | 49.0       | 0.0 | 2.1                      | 0.0 | 0.07  | 0.00  | 0.57    | 0.00    |

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on: 29 may 2019 at: 9:10:38

100' Monopole / JR Richard, TX

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)

| MAST<br>ELEV<br>ft | DEFLECTIONS (ft)    |        |       | ROTATIONS (deg) |        |       |
|--------------------|---------------------|--------|-------|-----------------|--------|-------|
|                    | HORIZONTAL<br>ALONG | ACROSS | DOWN  | TILT<br>ALONG   | ACROSS | TWIST |
| 99.0               | 6.59A               | 0.01P  | 0.61A | 7.56A           | 0.01P  | 0.00E |
| 83.7               | 4.68A               | 0.01P  | 0.37A | 6.86A           | 0.01P  | 0.00E |
| 68.5               | 3.03A               | 0.00P  | 0.19A | 5.59A           | 0.01P  | 0.00E |
| 53.2               | 1.75A               | 0.00V  | 0.08A | 4.07A           | 0.01P  | 0.00J |
| 48.5               | 1.44A               | 0.00V  | 0.06A | 3.66A           | 0.01P  | 0.00J |
| 36.4               | 0.78A               | 0.00V  | 0.02A | 2.60A           | 0.00V  | 0.00J |
| 24.2               | 0.33A               | 0.00V  | 0.01A | 1.63A           | 0.00V  | 0.00J |
| 12.1               | 0.08A               | 0.00V  | 0.00A | 0.77A           | 0.00V  | 0.00J |
| 0.0                | 0.00A               | 0.00A  | 0.00A | 0.00A           | 0.00A  | 0.00A |

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS

| ELEV<br>ft | ANT<br>AZI<br>deg | ANT<br>TYPE | BEAM DEFLECTIONS (deg) |         |         |         |
|------------|-------------------|-------------|------------------------|---------|---------|---------|
|            |                   |             | ROLL                   | YAW     | PITCH   | TOTAL   |
| 49.0       | 0.0               | STD+R       | 3.682 D                | 0.106 C | 3.701 A | 3.701 A |

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)

| MAST<br>ELEV<br>ft | TOTAL<br>AXIAL<br>kip | SHEAR.w.r.t.WIND.DIR |               | MOMENT.w.r.t.WIND.DIR |                  | TORSION<br>ft-kip |
|--------------------|-----------------------|----------------------|---------------|-----------------------|------------------|-------------------|
|                    |                       | ALONG<br>kip         | ACROSS<br>kip | ALONG<br>ft-kip       | ACROSS<br>ft-kip |                   |
| 99.0               | 9.31 AH               | 13.35 R              | 0.00 R        | 0.00 N                | 0.00 R           | 0.00 N            |
| 83.7               | 24.42 AG              | 25.29 R              | 0.00 R        | -222.36 A             | -0.01 D          | -0.02 P           |
| 68.5               | 38.33 AC              | 37.21 F              | 0.00 C        | -697.29 L             | -0.03 D          | 0.06 V            |
| 53.2               | 52.48 AC              | 49.03 S              | 0.00 O        | -1415.46 A            | -0.07 D          | -0.13 P           |
| 48.5               | 54.67 AB              | 50.85 M              | 0.21 D        | -1658.67 G            | 1.23 AB          | 2.58 D            |
| 36.4               | 57.29 AH              | 52.13 X              | -0.20 J       | -2300.59 A            | -2.30 P          | -2.66 J           |
| 24.2               | 60.25 AB              | 53.46 X              | -0.21 V       | -2954.27 A            | -4.80 P          | -2.71 J           |
| 12.1               | 63.51 AB              | 54.79 X              | -0.20 V       | -3618.87 A            | 7.30 V           | -2.73 J           |
| base               | 67.04 AB              | 56.18 X              | -0.20 V       | -4294.36 A            | 9.79 V           | -2.74 J           |

base

reaction 67.04 AB -56.18 X 0.20 V 4294.36 A -9.79 V 2.74 J

COMPLIANCE WITH 4.8.2 & 4.5.4

| ELEV<br>ft | AXIAL  | BENDING | SHEAR +<br>TORSIONAL | TOTAL | SATISFIED | D/t(w/t) | MAX<br>ALLOWED |
|------------|--------|---------|----------------------|-------|-----------|----------|----------------|
| 99.00      | 0.01AH | 0.00R   | 0.03R                | 0.01Y | YES       | 6.14A    | 45.2           |
|            | 0.02Y  | 0.38A   | 0.04R                | 0.40A | YES       | 9.47A    | 45.2           |
| 83.75      | 0.02AC | 0.38A   | 0.04F                | 0.40A | YES       | 9.47A    | 45.2           |
|            | 0.02AC | 0.71L   | 0.04F                | 0.72L | YES       | 12.81A   | 45.2           |
| 68.50      | 0.02AC | 0.71A   | 0.04S                | 0.72A | YES       | 12.81A   | 45.2           |
|            | 0.02AC | 0.95A   | 0.04S                | 0.96A | YES       | 16.15A   | 45.2           |
| 53.25      | 0.02AB | 0.79A   | 0.04V                | 0.81A | YES       | 13.17A   | 45.2           |
|            | 0.02AB | 0.83G   | 0.03M                | 0.84G | YES       | 14.03A   | 45.2           |
| 48.50      | 0.02AH | 0.86G   | 0.04X                | 0.87G | YES       | 13.74A   | 45.2           |
|            | 0.02AH | 0.91A   | 0.03X                | 0.92A | YES       | 15.95A   | 45.2           |
| 36.37      | 0.02AB | 0.91A   | 0.03X                | 0.92A | YES       | 15.95A   | 45.2           |
|            | 0.02AB | 0.95A   | 0.03X                | 0.96A | YES       | 18.16A   | 45.2           |
| 24.25      | 0.02AB | 0.95A   | 0.03X                | 0.96A | YES       | 18.16A   | 45.2           |
|            | 0.02AB | 0.97A   | 0.03X                | 0.98A | YES       | 20.38A   | 45.2           |
| 12.12      | 0.02AB | 0.97A   | 0.03X                | 0.98A | YES       | 20.38A   | 45.2           |
|            | 0.02AB | 0.98A   | 0.03X                | 1.00A | YES       | 22.59A   | 45.2           |
| 0.00       |        |         |                      |       |           |          |                |

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

| DOWN<br>kip | SHEAR.w.r.t.WIND.DIR<br>ALONG<br>kip | WIND.DIR<br>ACROSS<br>kip | MOMENT.w.r.t.WIND.DIR<br>ALONG<br>ft-kip | WIND.DIR<br>ACROSS<br>ft-kip | TORSION<br>ft-kip |
|-------------|--------------------------------------|---------------------------|--|------------------------------|-------------------|
| 67.04<br>AB | 56.18<br>X                           | -0.20<br>V                | -4294.36<br>A                            | 9.79<br>V                    | -2.74<br>J        |

(USA 222-G) - Monopole Spatial Analysis (c)2015 Guymast Inc.  
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Sabre Towers and Poles on: 29 may 2019 at: 9:10:45

100' Monopole / JR Richard, TX

\*\*\*\*\*  
\*\*\*\*\* Service Load Condition \*\*\*\*\*  
\*\*\*\*\*

\* Only 1 condition(s) shown in full  
\* Some concentrated wind loads may have been derived from full-scale wind tunnel testing

LOADING CONDITION A

60 mph wind with no ice. wind Azimuth: 0°

LOADS ON POLE  
=====

| LOAD TYPE | ELEV<br>ft | APPLY.<br>RADIUS<br>ft | LOAD..AT<br>AZI | LOAD<br>AZI | .....FORCES..... |             | .....MOMENTS.....  |                   |
|-----------|------------|------------------------|-----------------|-------------|------------------|-------------|--------------------|-------------------|
|           |            |                        |                 |             | HORIZ<br>kip     | DOWN<br>kip | VERTICAL<br>ft-kip | TORSNAL<br>ft-kip |
| C         | 99.000     | 0.00                   | 0.0             | 0.0         | 2.3032           | 4.0305      | 0.0000             | 0.0000            |
| C         | 97.000     | 0.00                   | 0.0             | 0.0         | 0.0000           | 1.2106      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0             | 0.0         | 0.0000           | 1.0483      | 0.0000             | 0.0000            |
| C         | 84.000     | 0.00                   | 0.0             | 0.0         | 1.9095           | 4.0305      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0             | 0.0         | 0.0000           | 0.9235      | 0.0000             | 0.0000            |
| C         | 74.000     | 0.00                   | 0.0             | 0.0         | 1.8599           | 4.0305      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0             | 0.0         | 0.0000           | 0.7987      | 0.0000             | 0.0000            |
| C         | 64.000     | 0.00                   | 0.0             | 0.0         | 1.8047           | 4.0305      | 0.0000             | 0.0000            |
| C         | 49.000     | 0.00                   | 0.0             | 0.0         | 0.0000           | 0.0510      | 0.0000             | 0.0000            |
| D         | 99.000     | 0.00                   | 180.0           | 0.0         | 0.0100           | 0.0565      | 0.0000             | 0.0000            |
| D         | 83.750     | 0.00                   | 180.0           | 0.0         | 0.0100           | 0.0565      | 0.0000             | 0.0000            |
| D         | 83.750     | 0.00                   | 180.0           | 0.0         | 0.0130           | 0.0762      | 0.0000             | 0.0000            |
| D         | 68.500     | 0.00                   | 180.0           | 0.0         | 0.0130           | 0.0762      | 0.0000             | 0.0000            |
| D         | 68.500     | 0.00                   | 180.0           | 0.0         | 0.0156           | 0.0959      | 0.0000             | 0.0000            |
| D         | 53.250     | 0.00                   | 180.0           | 0.0         | 0.0156           | 0.0959      | 0.0000             | 0.0000            |
| D         | 53.250     | 0.00                   | 180.0           | 0.0         | 0.0171           | 0.2375      | 0.0000             | 0.0000            |
| D         | 48.500     | 0.00                   | 180.0           | 0.0         | 0.0171           | 0.2375      | 0.0000             | 0.0000            |
| D         | 48.500     | 0.00                   | 180.0           | 0.0         | 0.0178           | 0.1418      | 0.0000             | 0.0000            |
| D         | 36.375     | 0.00                   | 180.0           | 0.0         | 0.0178           | 0.1418      | 0.0000             | 0.0000            |
| D         | 36.375     | 0.00                   | 180.0           | 0.0         | 0.0188           | 0.1607      | 0.0000             | 0.0000            |
| D         | 24.250     | 0.00                   | 180.0           | 0.0         | 0.0188           | 0.1607      | 0.0000             | 0.0000            |
| D         | 24.250     | 0.00                   | 180.0           | 0.0         | 0.0190           | 0.1795      | 0.0000             | 0.0000            |
| D         | 12.125     | 0.00                   | 180.0           | 0.0         | 0.0190           | 0.1795      | 0.0000             | 0.0000            |
| D         | 12.125     | 0.00                   | 180.0           | 0.0         | 0.0199           | 0.1984      | 0.0000             | 0.0000            |
| D         | 0.000      | 0.00                   | 180.0           | 0.0         | 0.0199           | 0.1984      | 0.0000             | 0.0000            |

ANTENNA LOADING  
=====

| .....ANTENNA..... | ELEV | AZI | ATTACHMENT | .....ANTENNA FORCES..... | AXIAL | SHEAR | GRAVITY | TORSION |
|-------------------|------|-----|------------|--------------------------|-------|-------|---------|---------|
| TYPE              | ft   |     | RAD ft AZI | AXIAL kip                | kip   | kip   | kip     | ft-kip  |
| STD+R             | 49.0 | 0.0 | 2.1 0.0    | 0.23                     | 0.00  | 0.20  | 0.00    |         |

MAXIMUM POLE DEFORMATIONS CALCULATED(w.r.t. wind direction)  
=====

| MAST<br>ELEV<br>ft | .....DEFLECTIONS (ft)..... |                 |       | .....ROTATIONS (deg)..... |                 |       |
|--------------------|----------------------------|-----------------|-------|---------------------------|-----------------|-------|
|                    | HORIZONTAL<br>ALONG        | .....<br>ACROSS | DOWN  | .....TILT.....<br>ALONG   | .....<br>ACROSS | TWIST |
| 99.0               | 1.15L                      | 0.00D           | 0.02A | 1.31L                     | 0.00H           | 0.00D |
| 83.7               | 0.81L                      | 0.00D           | 0.01A | 1.19L                     | 0.00H           | 0.00J |
| 68.5               | 0.53L                      | 0.00D           | 0.01A | 0.97L                     | 0.00H           | 0.00J |
| 53.2               | 0.30L                      | 0.00D           | 0.00A | 0.70L                     | 0.00H           | 0.00J |
| 48.5               | 0.25L                      | 0.00D           | 0.00A | 0.63L                     | 0.00H           | 0.00J |
| 36.4               | 0.13L                      | 0.00D           | 0.00A | 0.45L                     | 0.00D           | 0.00J |
| 24.2               | 0.06L                      | 0.00D           | 0.00A | 0.28L                     | 0.00D           | 0.00J |
| 12.1               | 0.01L                      | 0.00D           | 0.00A | 0.13L                     | 0.00D           | 0.00D |
| 0.0                | 0.00A                      | 0.00A           | 0.00A | 0.00A                     | 0.00A           | 0.00A |

MAXIMUM ANTENNA AND REFLECTOR ROTATIONS  
=====

| ELEV<br>ft | ANT<br>AZI<br>deg | ANT<br>TYPE | ..... BEAM DEFLECTIONS (deg) ..... |         |          |         |
|------------|-------------------|-------------|------------------------------------|---------|----------|---------|
|            |                   |             | ROLL                               | YAW     | PITCH    | TOTAL   |
| 49.0       | 0.0               | STD+R       | 0.636 D                            | 0.004 C | -0.639 G | 0.639 G |

MAXIMUM POLE FORCES CALCULATED(w.r.t. to wind direction)

| MAST<br>ELEV<br>ft | TOTAL<br>AXIAL<br>kip | SHEAR.w.r.t.<br>ALONG<br>kip | WIND.DIR<br>ACROSS<br>kip | MOMENT.w.r.t.<br>ALONG<br>ft-kip | WIND.DIR<br>ACROSS<br>ft-kip | TORSION<br>ft-kip |
|--------------------|-----------------------|------------------------------|---------------------------|----------------------------------|------------------------------|-------------------|
| 99.0               | 4.03 E                | 2.30 F                       | 0.00 L                    | 0.00 D                           | 0.00 L                       | 0.00 I            |
| 83.7               | 11.18 E               | 4.37 F                       | 0.00 L                    | -38.63 G                         | 0.00 F                       | 0.00 F            |
| 68.5               | 17.30 G               | 6.42 E                       | 0.00 I                    | -120.81 G                        | 0.00 F                       | 0.00 F            |
| 53.2               | 23.59 G               | 8.47 H                       | 0.00 I                    | -244.72 G                        | 0.01 F                       | 0.00 F            |
| 48.5               | 24.97 G               | 8.78 L                       | -0.03 J                   | -286.95 G                        | -0.39 J                      | -0.47 J           |
| 36.4               | 26.69 B               | 8.99 L                       | 0.04 D                    | -397.10 G                        | -0.29 H                      | -0.47 J           |
| 24.2               | 28.63 B               | 9.22 L                       | 0.04 D                    | -509.48 L                        | -0.46 D                      | 0.47 D            |
| 12.1               | 30.81 B               | 9.45 L                       | -0.04 J                   | -623.98 L                        | -0.89 D                      | -0.47 J           |
| base<br>reaction   | 33.22 B               | -9.69 L                      | -0.04 D                   | 740.50 L                         | 1.31 D                       | -0.47 D           |

COMPLIANCE WITH 4.8.2 & 4.5.4

| ELEV<br>ft | AXIAL | BENDING | SHEAR +<br>TORSIONAL | TOTAL SATISFIED | D/t(w/t) | MAX<br>ALLOWED |      |
|------------|-------|---------|----------------------|-----------------|----------|----------------|------|
| 99.00      | 0.00E | 0.00D   | 0.00F                | 0.00D           | YES      | 6.14A          | 45.2 |
| 83.75      | 0.01E | 0.07G   | 0.01F                | 0.07G           | YES      | 9.47A          | 45.2 |
| 68.50      | 0.01G | 0.12G   | 0.01E                | 0.13G           | YES      | 12.81A         | 45.2 |
| 53.25      | 0.01G | 0.16G   | 0.01H                | 0.17G           | YES      | 16.15A         | 45.2 |
| 48.50      | 0.01G | 0.14G   | 0.01L                | 0.15G           | YES      | 13.17A         | 45.2 |
| 36.37      | 0.01B | 0.16G   | 0.01L                | 0.17G           | YES      | 15.95A         | 45.2 |
| 24.25      | 0.01B | 0.16L   | 0.01L                | 0.17L           | YES      | 18.16A         | 45.2 |
| 12.12      | 0.01B | 0.17L   | 0.00L                | 0.18L           | YES      | 20.38A         | 45.2 |
| 0.00       | 0.01B | 0.17L   | 0.00L                | 0.18L           | YES      | 22.59A         | 45.2 |

MAXIMUM LOADS ONTO FOUNDATION(w.r.t. wind direction)

=====

| DOWN  | SHEAR.w.r.t.WIND.DIR |        | MOMENT.w.r.t.WIND.DIR |        | TORSION |
|-------|----------------------|--------|-----------------------|--------|---------|
| kip   | ALONG                | ACROSS | ALONG                 | ACROSS | ft-kip  |
|       | kip                  | kip    | ft-kip                | ft-kip |         |
| 33.22 | 9.69                 | 0.04   | -740.50               | -1.31  | 0.47    |
| B     | L                    | D      | L                     | D      | D       |

=====

## Round Base Plate and Anchor Rods, per ANSI/TIA 222-G

### Pole Data

Diameter: 51.790 in (flat to flat)  
Thickness: 0.375 in  
Yield (Fy): 65 ksi  
# of Sides: 18 "0" IF Round  
Strength (Fu): 80 ksi

### Reactions

Moment, Mu: 4294.36 ft-kips  
Axial, Pu: 39.83 kips  
Shear, Vu: 56.16 kips

### Anchor Rod Data

Quantity: 16  
Diameter: 2.25 in  
Rod Material: A615  
Strength (Fu): 100 ksi  
Yield (Fy): 75 ksi  
BC Diam. (in): 58.5 BC Override:

### Anchor Rod Results

Maximum Rod (Pu+ Vu/η): 229.7 Kips  
Allowable  $\Phi^*R_{nt}$ : 260.0 Kips (per 4.9.9)  
Anchor Rod Interaction Ratio: **88.4% Pass**

### Plate Data

Diameter (in): 64.25 Dia. Override:  
Thickness: 2 in  
Yield (Fy): 50 ksi  
Eff Width/Rod: 10.27 in  
Drain Hole: 2.625 in. diameter  
Drain Location: 23.75 in. center of pole to center of drain hole  
Center Hole: 39.5 in. diameter

### Base Plate Results

Base Plate (Mu/Z): 44.9 ksi  
Allowable  $\Phi^*F_y$ : 45.0 ksi (per AISC)  
Base Plate Interaction Ratio: **99.7% Pass**

=====  
Lpile for windows(Beta), Version 2018-10.009  
Analysis of Individual Piles and Drilled Shafts  
Subjected to Lateral Loading Using the p-y Method  
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=====

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-----  
Files Used for Analysis  
-----

Path to file locations:  
\Program Files (x86)\Ensoft\Lpile2018\files\

Name of input data file:  
434718A.lp10

Name of output report file:  
434718A.lp10

Name of plot output file:  
434718A.lp10

Name of runtime message file:  
434718A.lp10

-----  
Date and Time of Analysis  
-----

Date: May 29, 2019

Time: 9:11:56

-----  
Problem Title  
-----

Site : JR Richard, TX

Tower : 100' Monopole

Prepared for : BRANCH COMMUNICATIONS

Job Number : 434718 Revision A

Engineer : ARH

-----  
Program Options and Settings  
-----

Computational Options:  
- Use unfactored loads in computations (conventional analysis)  
Engineering Units Used for Data Input and Computations:  
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 999  
 - Deflection tolerance for convergence = 1.0000E-05 in  
 - Maximum allowable deflection = 100.0000 in  
 - Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

-----  
 Pile Structural Properties and Geometry  
 -----

Number of pile sections defined = 1  
 Total length of pile = 29.500 ft  
 Depth of ground surface below top of pile = 0.5000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|-----------|----------------------------|----------------------|
| 1         | 0.000                      | 84.0000              |
| 2         | 29.500                     | 84.0000              |

Input Structural Properties for Pile Sections:  
 -----

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile  
 Length of section = 29.500000 ft  
 Shaft Diameter = 84.000000 in  
 Shear capacity of section = 0.0000 lbs

-----  
 Ground Slope and Pile Batter Angles  
 -----

Ground Slope Angle = 0.000 degrees  
 = 0.000 radians  
 Pile Batter Angle = 0.000 degrees  
 = 0.000 radians

-----  
 Soil and Rock Layering Information  
 -----

The soil profile is modelled using 6 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer = 0.500000 ft  
 Distance from top of pile to bottom of layer = 2.500000 ft  
 Effective unit weight at top of layer = 110.000000 pcf  
 Effective unit weight at bottom of layer = 110.000000 pcf  
 Undrained cohesion at top of layer = 14.400000 psf

Undrained cohesion at bottom of layer = 14.400000 psf  
 Epsilon-50 at top of layer = 0.100000  
 Epsilon-50 at bottom of layer = 0.100000

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer = 2.500000 ft  
 Distance from top of pile to bottom of layer = 6.500000 ft  
 Effective unit weight at top of layer = 122.000000 pcf  
 Effective unit weight at bottom of layer = 122.000000 pcf  
 Undrained cohesion at top of layer = 750.000000 psf  
 Undrained cohesion at bottom of layer = 750.000000 psf  
 Epsilon-50 at top of layer = 0.010000  
 Epsilon-50 at bottom of layer = 0.010000

Layer 3 is stiff clay without free water

Distance from top of pile to top of layer = 6.500000 ft  
 Distance from top of pile to bottom of layer = 14.500000 ft  
 Effective unit weight at top of layer = 122.000000 pcf  
 Effective unit weight at bottom of layer = 122.000000 pcf  
 Undrained cohesion at top of layer = 750.000000 psf  
 Undrained cohesion at bottom of layer = 750.000000 psf  
 Epsilon-50 at top of layer = 0.010000  
 Epsilon-50 at bottom of layer = 0.010000

Layer 4 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 14.500000 ft  
 Distance from top of pile to bottom of layer = 20.500000 ft  
 Effective unit weight at top of layer = 6.000000 pcf  
 Effective unit weight at bottom of layer = 6.000000 pcf  
 Friction angle at top of layer = 30.000000 deg.  
 Friction angle at bottom of layer = 30.000000 deg.  
 Subgrade k at top of layer = 60.000000 pci  
 Subgrade k at bottom of layer = 60.000000 pci

Layer 5 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 20.500000 ft  
 Distance from top of pile to bottom of layer = 32.500000 ft  
 Effective unit weight at top of layer = 60.000000 pcf  
 Effective unit weight at bottom of layer = 60.000000 pcf  
 Friction angle at top of layer = 30.000000 deg.  
 Friction angle at bottom of layer = 30.000000 deg.  
 Subgrade k at top of layer = 60.000000 pci  
 Subgrade k at bottom of layer = 60.000000 pci

Layer 6 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 32.500000 ft  
 Distance from top of pile to bottom of layer = 40.500000 ft  
 Effective unit weight at top of layer = 60.000000 pcf  
 Effective unit weight at bottom of layer = 60.000000 pcf  
 Friction angle at top of layer = 30.000000 deg.  
 Friction angle at bottom of layer = 30.000000 deg.  
 Subgrade k at top of layer = 60.000000 pci  
 Subgrade k at bottom of layer = 60.000000 pci

(Depth of the lowest soil layer extends 11.000 ft below the pile tip)

\*\*\*\* Warning - Possible Input Data Error \*\*\*\*

Values entered for effective unit weights of soil were outside the limits of 20 pcf to 140 pcf.

The minimum input value, in layer 4, for effective unit weight = 6.00 pcf

This data may be erroneous. Please check your data.

-----  
 Summary of Input Soil Properties  
 -----

| Layer | Soil Type | Layer | Effective | Undrained | Angle of | E50 |     |
|-------|-----------|-------|-----------|-----------|----------|-----|-----|
| Layer | Name      | Depth | Unit Wt.  | Cohesion  | Friction | or  | kpy |

| Num. | (p-y Curve Type)             | ft                 | pcf                  | psf                  | deg.               | krm                | pci                |
|------|------------------------------|--------------------|----------------------|----------------------|--------------------|--------------------|--------------------|
| 1    | Soft<br>Clay                 | 0.5000<br>2.5000   | 110.0000<br>110.0000 | 14.4000<br>14.4000   | --<br>--           | 0.10000<br>0.10000 | --<br>--           |
| 2    | stiff clay<br>w/o Free Water | 2.5000<br>6.5000   | 122.0000<br>122.0000 | 750.0000<br>750.0000 | --<br>--           | 0.01000<br>0.01000 | --<br>--           |
| 3    | Stiff Clay<br>w/o Free Water | 6.5000<br>14.5000  | 122.0000<br>122.0000 | 750.0000<br>750.0000 | --<br>--           | 0.01000<br>0.01000 | --<br>--           |
| 4    | Sand<br>(Reese, et al.)      | 14.5000<br>20.5000 | 6.0000<br>6.0000     | --<br>--             | 30.0000<br>30.0000 | --<br>--           | 60.0000<br>60.0000 |
| 5    | Sand<br>(Reese, et al.)      | 20.5000<br>32.5000 | 60.0000<br>60.0000   | --<br>--             | 30.0000<br>30.0000 | --<br>--           | 60.0000<br>60.0000 |
| 6    | Sand<br>(Reese, et al.)      | 32.5000<br>40.5000 | 60.0000<br>60.0000   | --<br>--             | 30.0000<br>30.0000 | --<br>--           | 60.0000<br>60.0000 |

-----  
 Static Loading Type  
 -----

Static loading criteria were used when computing p-y curves for all analyses.

-----  
 Pile-head Loading and Pile-head Fixity Conditions  
 -----

Number of loads specified = 2

| Load No. | Load Type | Condition 1    | Condition 2          | Axial Thrust Force, lbs | Compute Top y vs. Pile Length |
|----------|-----------|----------------|----------------------|-------------------------|-------------------------------|
| 1        | 1         | V = 74880. lbs | M = 68709760. in-lbs | 53107.                  | No                            |
| 2        | 1         | V = 9690. lbs  | M = 8886000. in-lbs  | 33220.                  | No                            |

V = shear force applied normal to pile axis  
 M = bending moment applied to pile head  
 y = lateral deflection normal to pile axis  
 S = pile slope relative to original pile batter angle  
 R = rotational stiffness applied to pile head  
 Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).  
 Thrust force is assumed to be acting axially for all pile batter angles.

-----  
 Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness  
 -----

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:  
 -----

Dimensions and Properties of Drilled Shaft (Bored Pile):  
 -----

|   |   |                   |
|---|---|-------------------|
| Length of Section                                 | = | 29.500000 ft      |
| Shaft Diameter                                    | = | 84.000000 in      |
| Concrete Cover Thickness (to edge of long. rebar) | = | 3.625000 in       |
| Number of Reinforcing Bars                        | = | 28 bars           |
| Yield Stress of Reinforcing Bars                  | = | 60000. psi        |
| Modulus of Elasticity of Reinforcing Bars         | = | 290000000. psi    |
| Gross Area of Shaft                               | = | 5542. sq. in.     |
| Total Area of Reinforcing Steel                   | = | 35.469524 sq. in. |
| Area Ratio of Steel Reinforcement                 | = | 0.64 percent      |
| Edge-to-Edge Bar Spacing                          | = | 7.181079 in       |

Maximum Concrete Aggregate Size = 0.750000 in  
 Ratio of Bar Spacing to Aggregate Size = 9.57  
 Offset of Center of Rebar Cage from Center of Pile = 0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity =  $0.85 F_c A_c + F_y A_s$  = 23189.769 kips  
 Tensile Load for Cracking of Concrete = -2542.986 kips  
 Nominal Axial Tensile Capacity = -2128.171 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

| Bar Number | Bar Diam. inches | Bar Area sq. in. | X inches   | Y inches   |
|------------|------------------|------------------|------------|------------|
| 1          | 1.270000         | 1.266769         | 37.740000  | 0.000000   |
| 2          | 1.270000         | 1.266769         | 36.793779  | 8.397940   |
| 3          | 1.270000         | 1.266769         | 34.002565  | 16.374772  |
| 4          | 1.270000         | 1.266769         | 29.506320  | 23.530505  |
| 5          | 1.270000         | 1.266769         | 23.530505  | 29.506320  |
| 6          | 1.270000         | 1.266769         | 16.374772  | 34.002565  |
| 7          | 1.270000         | 1.266769         | 8.397940   | 36.793779  |
| 8          | 1.270000         | 1.266769         | 0.000000   | 37.740000  |
| 9          | 1.270000         | 1.266769         | -8.397940  | 36.793779  |
| 10         | 1.270000         | 1.266769         | -16.374772 | 34.002565  |
| 11         | 1.270000         | 1.266769         | -23.530505 | 29.506320  |
| 12         | 1.270000         | 1.266769         | -29.506320 | 23.530505  |
| 13         | 1.270000         | 1.266769         | -34.002565 | 16.374772  |
| 14         | 1.270000         | 1.266769         | -36.793779 | 8.397940   |
| 15         | 1.270000         | 1.266769         | -37.740000 | 0.000000   |
| 16         | 1.270000         | 1.266769         | -36.793779 | -8.397940  |
| 17         | 1.270000         | 1.266769         | -34.002565 | -16.374772 |
| 18         | 1.270000         | 1.266769         | -29.506320 | -23.530505 |
| 19         | 1.270000         | 1.266769         | -23.530505 | -29.506320 |
| 20         | 1.270000         | 1.266769         | -16.374772 | -34.002565 |
| 21         | 1.270000         | 1.266769         | -8.397940  | -36.793779 |
| 22         | 1.270000         | 1.266769         | 0.000000   | -37.740000 |
| 23         | 1.270000         | 1.266769         | 8.397940   | -36.793779 |
| 24         | 1.270000         | 1.266769         | 16.374772  | -34.002565 |
| 25         | 1.270000         | 1.266769         | 23.530505  | -29.506320 |
| 26         | 1.270000         | 1.266769         | 29.506320  | -23.530505 |
| 27         | 1.270000         | 1.266769         | 34.002565  | -16.374772 |
| 28         | 1.270000         | 1.266769         | 36.793779  | -8.397940  |

NOTE: The positions of the above rebars were computed by LPILE

Minimum spacing between any two bars not equal to zero = 7.181 inches  
 between bars 24 and 25.

Ratio of bar spacing to maximum aggregate size = 9.57

Concrete Properties:

Compressive Strength of Concrete = 4500. psi  
 Modulus of Elasticity of Concrete = 3823676. psi  
 Modulus of Rupture of Concrete = -503.115295 psi  
 Compression Strain at Peak Stress = 0.002001  
 Tensile Strain at Fracture of Concrete = -0.0001152  
 Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

| Number | Axial Thrust Force kips |
|--------|-------------------------|
| 1      | 33.220                  |
| 2      | 53.107                  |

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003  
 or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|----------|-------------------|--------------------------|-------------------|
| 1        | 33.220            | 77387.068                | 0.00300000        |

2                      53.107                      78011.986                      0.00300000

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in <sup>2</sup> |
|----------------|---------------------------|----------------------------|----------------------------|-------------------------------|---|
| 1              | 0.65                      | 77387.                     | 21.593000                  | 50302.                        | 1.6186E+09                                  |
| 2              | 0.65                      | 78012.                     | 34.519333                  | 50708.                        | 1.6339E+09                                  |
| 1              | 0.70                      | 77387.                     | 23.254000                  | 54171.                        | 1.6134E+09                                  |
| 2              | 0.70                      | 78012.                     | 37.174667                  | 54608.                        | 1.6278E+09                                  |
| 1              | 0.75                      | 77387.                     | 24.915000                  | 58040.                        | 1.5589E+09                                  |
| 2              | 0.75                      | 78012.                     | 39.830000                  | 58509.                        | 1.5742E+09                                  |

-----  
 Layering Correction Equivalent Depths of Soil & Rock Layers  
 -----

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|-----------|---------------------------------|---|--------------------------------|--------------------------------------|---------------------------|---------------------------|
| 1         | 0.5000                          | 0.00                                    | N.A.                           | No                                   | 0.00                      | 1639.                     |
| 2         | 2.5000                          | 0.1037                                  | No                             | No                                   | 1639.                     | 72917.                    |
| 3         | 6.5000                          | 4.0945                                  | Yes                            | No                                   | 74556.                    | 204512.                   |
| 4         | 14.5000                         | 8.4754                                  | No                             | No                                   | 279068.                   | 460394.                   |
| 5         | 20.5000                         | 16.1310                                 | Yes                            | No                                   | 739462.                   | 938687.                   |
| 6         | 32.5000                         | 32.0000                                 | No                             | No                                   | 1678150.                  | N.A.                      |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

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 Summary of Pile-head Responses for Conventional Analyses  
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Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs  
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians  
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.  
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs  
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Load 1 | Load Type 2 | Pile-head Load 2 | Axial Loading lbs | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---------------|-----------|------------------|-------------|------------------|-------------------|-----------------------------|----------------------------|-----------------------|---------------------------|
| 1             | V, lb     | 74880.           | M, in-lb    | 6.87E+07         | 53107.            | 15.9703                     | -0.07004                   | -622590.              | 7.36E+07                  |
| 2             | V, lb     | 9690.            | M, in-lb    | 8886000.         | 33220.            | 0.09890                     | -5.18E-04                  | -49988.               | 9325398.                  |

Maximum pile-head deflection = 15.9703059769 inches  
 Maximum pile-head rotation = -0.0700379178 radians = -4.012877 deg.

The analysis ended normally.

1807.3.2.1 (2009 IBC, 2012 IBC, & 2015 IBC)

|   |          |   |
|---|----------|---|
| Moment (ft·k)   | 4,294.36 |   |
| Shear (k)   | 56.16    |   |
| Caisson diameter (ft)                                 | 7        |   |
| Caisson height above ground (ft)                      | 0.5      |   |
| Caisson height below ground (ft)                      | 27       |   |
| Lateral soil pressure (lb/ft <sup>2</sup> )           | 350.00   |   |
| Ground to application of force, h (ft)                | 76.97    |   |
| Applied lateral force, P (lb)                         | 56,160   |   |
| Lateral soil bearing pressure, S <sub>1</sub> (lb/ft) | 3,150.00 |   |
| Diameter, b (ft)                                      | 7        |   |
| A   | 5.96     | $= (2.34P)/(S_1 b)$                         |
| Minimum depth of embedment, d (ft)                    | 25.54    | $= 0.5A[ 1 + ( 1 + ( 4.36h / A ) )^{1/2} ]$ |



## BUILDING CODE DESIGN CRITERIA

### CONSTRUCTION CODES

#### Commercial

2012 International Building Code  
2012 International Fire Code  
2012 Uniform Mechanical Code  
2012 Uniform Plumbing Code  
2017 National Electrical Code (State Mandated)  
2015 International Energy Conservation Code, or  
ASHRAE 90.1-2013

#### Residential

2012 International Residential Code  
2015 International Energy Conservation Code

**Note:** All construction codes on this list have been amended by the City of Houston. To access the amendments, visit: <http://www.houstonpermittingcenter.org/code-enforcement/publications.html>

### STRUCTURAL REQUIREMENTS

#### Basic Wind Speed:

- IRC** - 110 mph (3-second gust)
- IBC** - Risk Category I:  $V_{ult}$  130 mph  
Risk Category II:  $V_{ult}$  139 mph  
Risk Category III & IV:  $V_{ult}$  150 mph

Seismic Design Category: A

Weathering Probability: Negligible (IRC)

#### Roof Design Load:

- IRC** - Varies (Refer to Table R301.6)
- IBC** - Varies (Refer to Table 1607.1 and Section 1607.12.2)

Soil Class: Expansive\*

Wind Exposure Category: B\*

Ground Snow Load: 0

Frost Line Depth: 6 inches

Maximum rainfall rate: 8 inches/hour

\* These are general requirements for Houston and certain conditions may vary depending on the location.

### PLAN REVIEW REQUIREMENTS

- 2 sets of plans
- Applicable Energy Software Report, or prescriptive compliance shown on the plans
- TDLR numbers for accessibility: <http://www.license.state.tx.us/ab/ab.htm#techinfo>
- Asbestos Survey for existing building(s) – (TDH Toxic Substances Control Division • (800) 572-5548)

**Note:** This information is general in nature; for minimum submittal requirements, you may obtain a copy of the prerequisite checklist online or at the CACD office. For specific questions, consult with a Senior Plan Analyst at (832) 394-8810 or Senior Inspector (832) 394-8840.

### WEBSITE INFORMATION

Check plan review status and schedule inspections - [www.houstonpermittingcenter.org/city-of-houston-permits/online-permits.html](http://www.houstonpermittingcenter.org/city-of-houston-permits/online-permits.html)

Building Code Enforcement Home Page - [www.houstonpermittingcenter.org/building-code-enforcement.html](http://www.houstonpermittingcenter.org/building-code-enforcement.html)

Public Works and Engineering website - [www.publicworks.houstontx.gov](http://www.publicworks.houstontx.gov)

Planning and Development website - [www.houstontx.gov/planning](http://www.houstontx.gov/planning)

Fire Department website - [www.houstontx.gov/fire/](http://www.houstontx.gov/fire/)

City Website - [www.houstontx.gov](http://www.houstontx.gov)

For questions please contact the Plan Review Section at 832-394-8810 or email at [rmcacd@houstontx.gov](mailto:rmcacd@houstontx.gov).

## CHAPTER 16

# STRUCTURAL DESIGN

**1603.1.7 Flood design data.** ~~See Chapter 19 of the *City Code*. For buildings located in whole or in part in *flood hazard areas* as established in Section 1612.3, the documentation pertaining to design, if required in Section 1612.5, shall be included and the following information, referenced to the datum on the community's Flood Insurance Rate Map (FIRM), shall be shown, regardless of whether flood loads govern the design of the building:~~

- ~~1. In *flood hazard areas* not subject to high-velocity wave action, the elevation of the proposed lowest floor, including the basement.~~
- ~~2. In *flood hazard areas* not subject to high-velocity wave action, the elevation to which any nonresidential building will be dry flood proofed.~~
- ~~3. In *flood hazard areas* subject to high-velocity wave action, the proposed elevation of the bottom of the lowest horizontal structural member of the lowest floor, including the basement.~~

**1609.3 Basic wind speed.** The ultimate design wind speed,  $V_{ult}$ , in mph, for the determination of the wind loads shall be determined by Figures 1609A, 1609B and 1609C. The ultimate design wind speed,  $V_{ult}$  for use in the design of Risk Category II buildings and structures shall be 139 mph obtained from Figure 1609A. The ultimate design wind speed,  $V_{ult}$ , for use in the design of Risk Category III and IV buildings and structures shall be 150 mph obtained from Figure 1609B. The ultimate design wind speed,  $V_{ult}$ , for use in the design of Risk Category I buildings and structures shall be 130 mph obtained from Figure 1609C. ~~The ultimate design wind speed,  $V_{ult}$ , for the special wind regions indicated near mountainous terrain and near gorges shall be in accordance with local jurisdiction requirements. The ultimate design wind speeds,  $V_{ult}$ , determined by the local jurisdiction shall be in accordance with Section 26.5.1 of ASCE 7.~~

~~In nonhurricane-prone regions, when the ultimate design wind speed,  $V_{ult}$ , is estimated from regional climatic data, the ultimate design wind speed,  $V_{ult}$ , shall be determined in accordance with Section 26.5.3 of ASCE 7.~~

### SECTION 1612 FLOOD LOADS

{EDITORIAL NOTE: DELETE SECTION 1612 TEXT IN ITS ENTIRETY AND REPLACE WITH THE FOLLOWING.}

#### **1612.1 General. (See Chapter 19 of the *City Code*).**

**1613.3.5 Determination of seismic design category.** This jurisdiction is classified as Seismic Design Category A. ~~Structures classified as *Risk Category I, II or III* that are located where the mapped spectral response acceleration parameter at 1-second period,  $S_{4.7}$ , is greater than or equal to 0.75 shall be assigned to *Seismic Design Category E*. Structures classified as *Risk Category IV* that are located where the mapped spectral response acceleration parameter at 1-second period,  $S_{4.7}$ , is greater than or equal to 0.75~~

~~shall be assigned to Seismic Design Category F. All other structures shall be assigned to a seismic design category based on their risk category and the design spectral response acceleration parameters,  $S_{DS}$  and  $S_{D1}$ , determined in accordance with Section 1613.3.4 or the site-specific procedures of ASCE 7. Each building and structure shall be assigned to the more severe seismic design category in accordance with Table 1613.3.5(1) or 1613.5.5(2), irrespective of the fundamental period of vibration of the structure,  $T$ .~~

## **Example of insurance policy**



**Engineering fall letter**

December 12, 2019

Mr. John Kesner  
Branch Communications  
7335 South Lewis Ave Suite 300  
Tulsa, OK 74136

RE: 100' Monopole for TX-0162 Greater Zion Church at 3206 2/3 Webster Street, Houston, TX

Dear Mr. Kesner,

Upon receipt of order, we propose to design and supply the above referenced Sabre monopole for an Ultimate Wind Speed of 139 mph with no ice and 30 mph with 1" ice, Structure Class II, Exposure Category C, and Topographic Category 1, in accordance with the Telecommunications Industry Association Standard ANSI/TIA-222-G, "Structural Standard for Antenna Supporting Structures and Antennas".

When designed according to this standard, the wind pressures and steel strength capacities include several safety factors, resulting in an overall minimum safety factor of 25%. Therefore, it is highly unlikely that the monopole will fail structurally in a wind event where the design wind speed is exceeded within the range of the built-in safety factors.

Should the wind speed increase beyond the capacity of the built-in safety factors, to the point of failure of one or more structural elements, the most likely location of the failure would be within the monopole shaft, above the base plate. Assuming that the wind pressure profile is similar to that used to design the monopole, the monopole will buckle at the location of the highest combined stress ratio within the monopole shaft. This is likely to result in the portion of the monopole above leaning over and remaining in a permanently deformed condition. **Please note that this letter only applies to the above referenced monopole designed and manufactured by Sabre Towers & Poles.** This would effectively result in a fall radius within a 35' x 40' compound.

Sincerely,

Amy R. Herbst, P.E.  
Senior Design Engineer

