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Main Category:	General Engineering
Sub Category:	Safety & Failures
Course #:	SAF-117
Course Content:	63 pgs
PDH/CE Hours:	6

OFFICIAL COURSE/EXAM

(SEE INSTRUCTIONS ON NEXT PAGE)

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SAF-117 EXAM PREVIEW

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Exam Preview:

1. On April 19, 2018, an incident during the reinforcement of the KOZK 1,891-foot-tall guyed communication tower. The tower was initially designed and erected in ___.
    a. 1965
    b. 1971
    c. 2009
    d. 2018

2. The legs of the tower consisted of 63 sections of solid round steel ranging in diameter from 4½" to 3¼" that were approximately 30 feet long. The lower 34 leg sections were constructed from high strength alloy steel with a design yield strength of 95 ksi. The design yield strength of the remaining leg sections was ___ ksi.
    a. 35
    b. 46
    c. 47
    d. 50

3. Structural modifications to the tower were being made at the time of the collapse. The contractor was replacing diagonals at the 105-foot level of the 1891-foot tall communication tower when the tower started to collapse.
    a. True
    b. False

4. After the investigation showed that during the replacing of the diagonals, a total of ___ bolted connections were missing.
    a. 2
    b. 3
    c. 4
    d. 6
5. One of the characteristics of a structural member that affects its compressive strength is the unbraced length of the member. The compressive capacity of a structural member is proportional to the unbraced length. Typically, as the unbraced length of a member is decreased, the compressive capacity of the member is reduced.
    a. True
    b. False
6. In order to replace a diagonal, the two bolts on each end of the diagonal and the two bolts at the diagonal's mid-span must be removed. The removal of the bolts at the mid-span, however, resulted in increasing the unbraced length of the tower legs and redundant from five to ___ feet.
    a. 6
    b. 10
    c. 15
    d. 20
7. The ANSI/TIA-222-G design strength of the tower legs was reduced by 68% due to the increasing of the unbraced length. The tower legs require a minimum bracing resistance of approximately 13 kips. However, the horizontal redundant member during the modification would only capable of providing 8 kips.
    a. True
    b. False
8. One of the conclusions was that a single diagonal brace could not be removed without affecting the integrity of the redundant brace because the braces share two common bolts at the diagonal/redundant connection.
    a. True
    b. False
9. It was determined that the come-a-long used by Lemay during the modifications was more than adequate for the project.
    a. True
    b. False

10. Tower Consultants, INC (TCI) failed to confirm the use/design of a ____as TCI is required to approve the adequacy of the ____ prior to diagonal replacement according to TCI's construction documentation.
    a. Come-a-long
    b. Diagonal brace
    c. Lateral brace
    d. Temporary frame

Investigation of the April 19, 2018, Communication Tower Collapse in Fordland, Missouri.

U.S. Department of Labor
Occupational Safety and Health Administration
Directorate of Construction

October 2018

Report

Investigation of the April 19, 2018, Communication Tower Collapse in Fordland, Missouri.

October 2018

Report Prepared by
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Mohammad Ayub, P.E., S.E.
Office of Engineering Services
Directorate of Construction

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Executive Summary

On April 19, 2018, an incident occurred in Fordland, Missouri where one employee was killed. The project involved the reinforcement of the KOZK 1,891-foot-tall guyed communication tower along Highway FF just north of Fordland, Missouri. The location of the tower is shown in Figure 1 (905 State Highway FF Fordland, MO 65602). The tower was initially designed and erected by Kline in 1971. Currently, Missouri State University (MSU) contracted Tower Consultants, Inc. (TCI) to design the required structural modifications necessary to support the transmission line replacement. TCI's scope of work involved creating construction documents, reviewing submittal drawings, observing the construction process including producing progress reports and assisting MSU in the bidding and contractor selection process. MSU selected Steve Lemay, LLC (Lemay) to serve as the contractor.

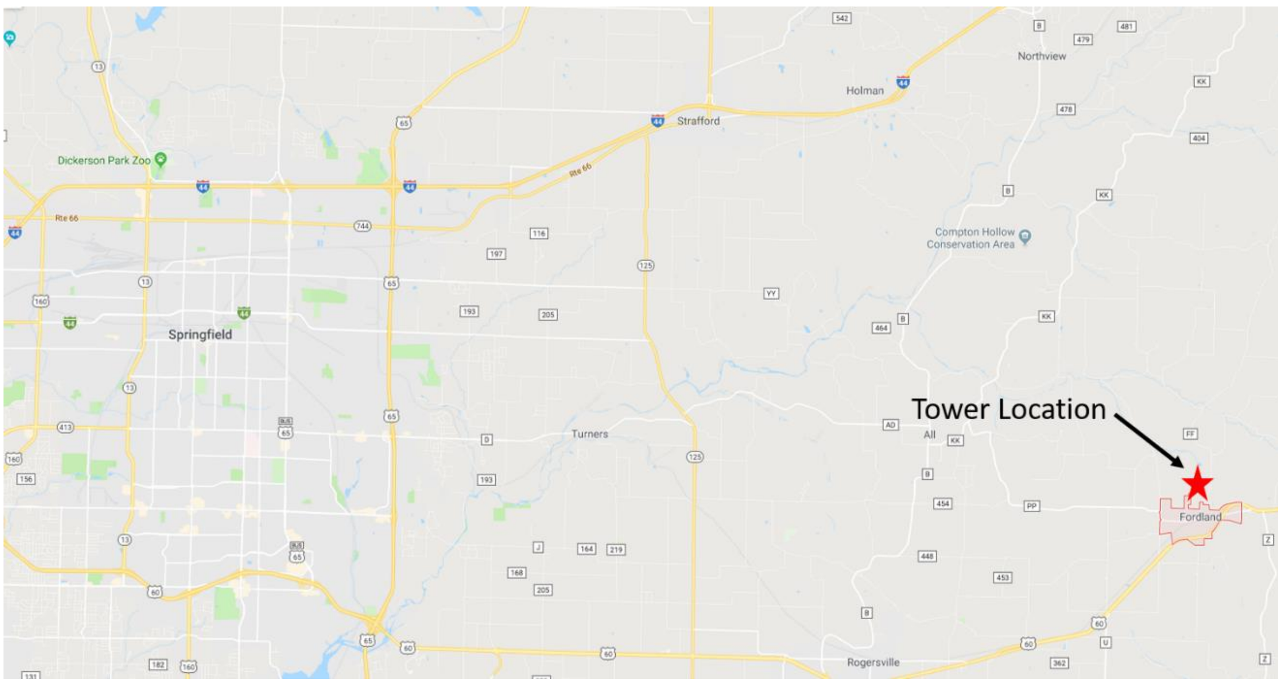


Figure 1. Project Location

The Occupational Safety and Health Administration's (OSHA) Regional Administrator, Region VII, asked the Directorate of Construction (DOC) in OSHA's National Office in Washington, D.C., to provide technical and engineering assistance to the OSHA Kansas City Area Office in its investigation of the tower collapse in Fordland, MO. At your request an engineer from DOC, Dr. Bryan Ewing, P.E., accompanied by Chester Ray, visited the incident site on April 23, 2018 and August 1, 2018. We also reviewed photographic evidence, witness interviews, construction documents, industry standards and engineering reports in preparation of this report. Attached is our report. After reviewing the documents and conducting independent structural analysis, we conclude the following:

1) TCI's suggested diagonal replacement procedure was flawed in that it compromised the effectiveness of the integrated surrounding braces and the load bearing capacity of the

tower legs. A single diagonal brace could not be removed without affecting the integrity of the redundant brace because the braces share two common bolts at the diagonal/redundant connection.

2) The cause of the communication tower collapse was the weakening of the compressive strength of the tower legs by removing the bolts at the connection of the diagonals to the horizontal redundant. The compromised redundant effectively doubled the unbraced length of the tower leg which reduced the compressive capacity of the tower leg.
3) Lemay used an undersized come-a-long while removing the diagonal braces.
4) Lemay failed to provide the design of the required temporary frame for diagonal replacement above or below a guy level. TCI failed to confirm the use/design of a temporary frame as TCI is required to approve the adequacy of the temporary frame prior to diagonal replacement according to TCI's construction documentation.

Introduction

The 1,891-foot-tall guyed communication tower is constructed of 10-foot wide triangular sections. The legs of the tower consisted of 63 sections of solid round steel ranging in diameter from 4½" to 3¼" that were approximately 30 feet long. The lower 34 leg sections were constructed from high strength alloy steel with a design yield strength of 95 ksi. The design yield strength of the remaining leg sections was 47 ksi. The legs are connected by numerous angle struts, solid rod diagonals and horizontal redundants as shown in Figure 2. Although Figure 2 only shows one side, all three sides of the tower are similar. The angle struts consisted of double back-to-back A36 grade steel angles. The sizes of the angles vary and were either L3x2x¼ or L2½x2x¼. The solid rod diagonals were fabricated from A36 grade steel and vary in diameter from ¾" to 1¼". The horizontal redundants were 1¾" diameter solid A36 steel rods. The horizontal redundants were narrowed at its mid-span to accommodate the splice plates of the crossing diagonals. Both diagonals and the redundant were secured to each other with two through bolts. Note that Figure 2 shows the recommended split pipe reinforcement of the tower legs, but these split pipe reinforcements were not in place at the time of the incident. The 30-foot tower leg sections were field spliced together with six A325 bolts through factory fabricated flange plates at each end of the leg. The tower was stabilized by nine levels of guy wires. Each level had three guy lines (1 for each of the principal triangular directions of the tower). The diameter of the guy lines varied from 1–1/16" to 1–9/16" with a range of initial tensile forces between ±15 kips to ±33 kips depending on the temperature. A typical cross section of the tower and tower elevation are shown in Figures 3 and 4, respectively.

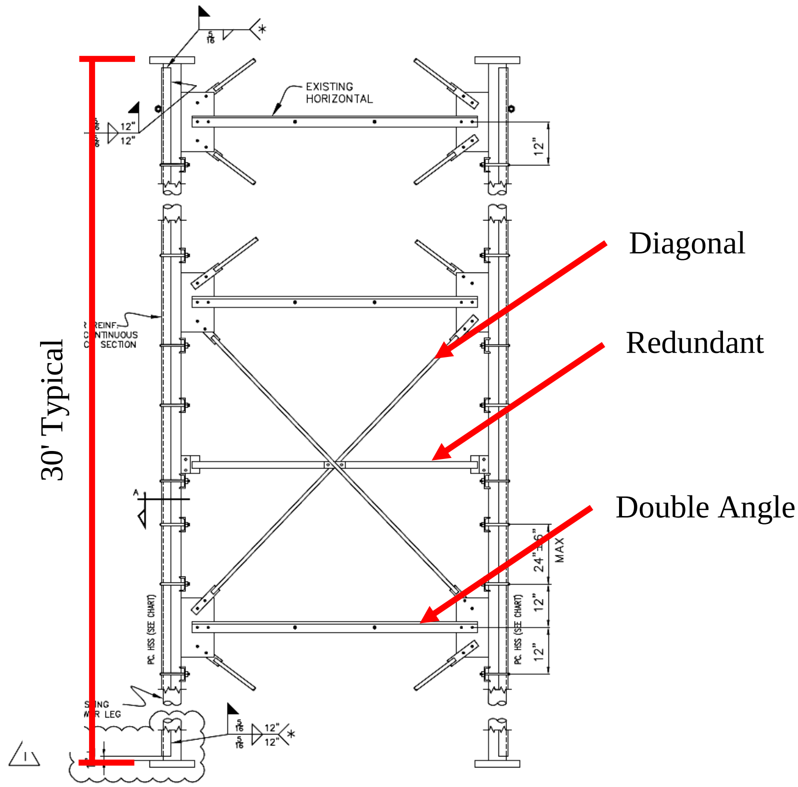


Figure 2. Typical Bracing Elevation of Tower Legs

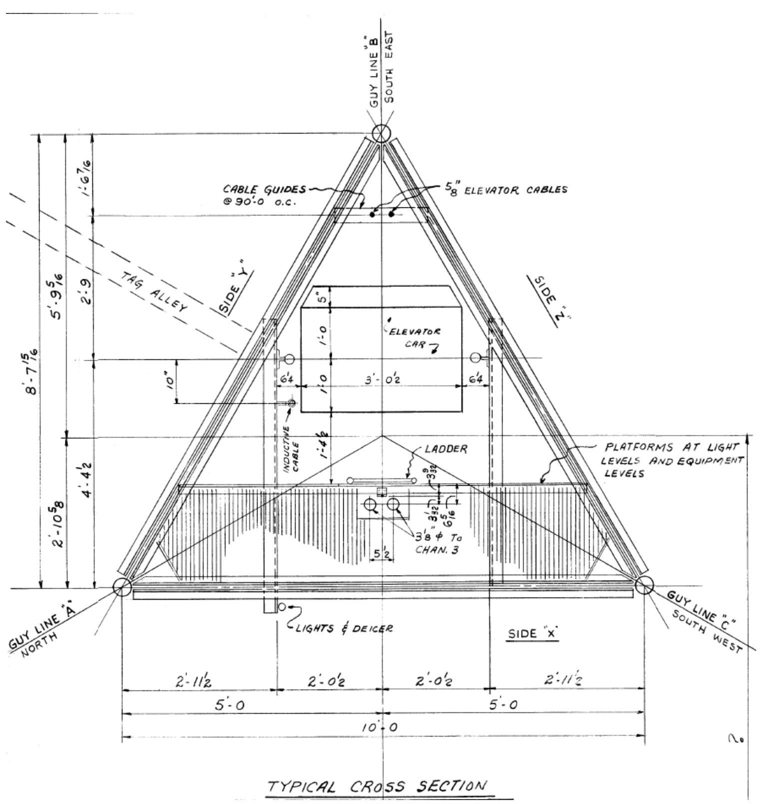
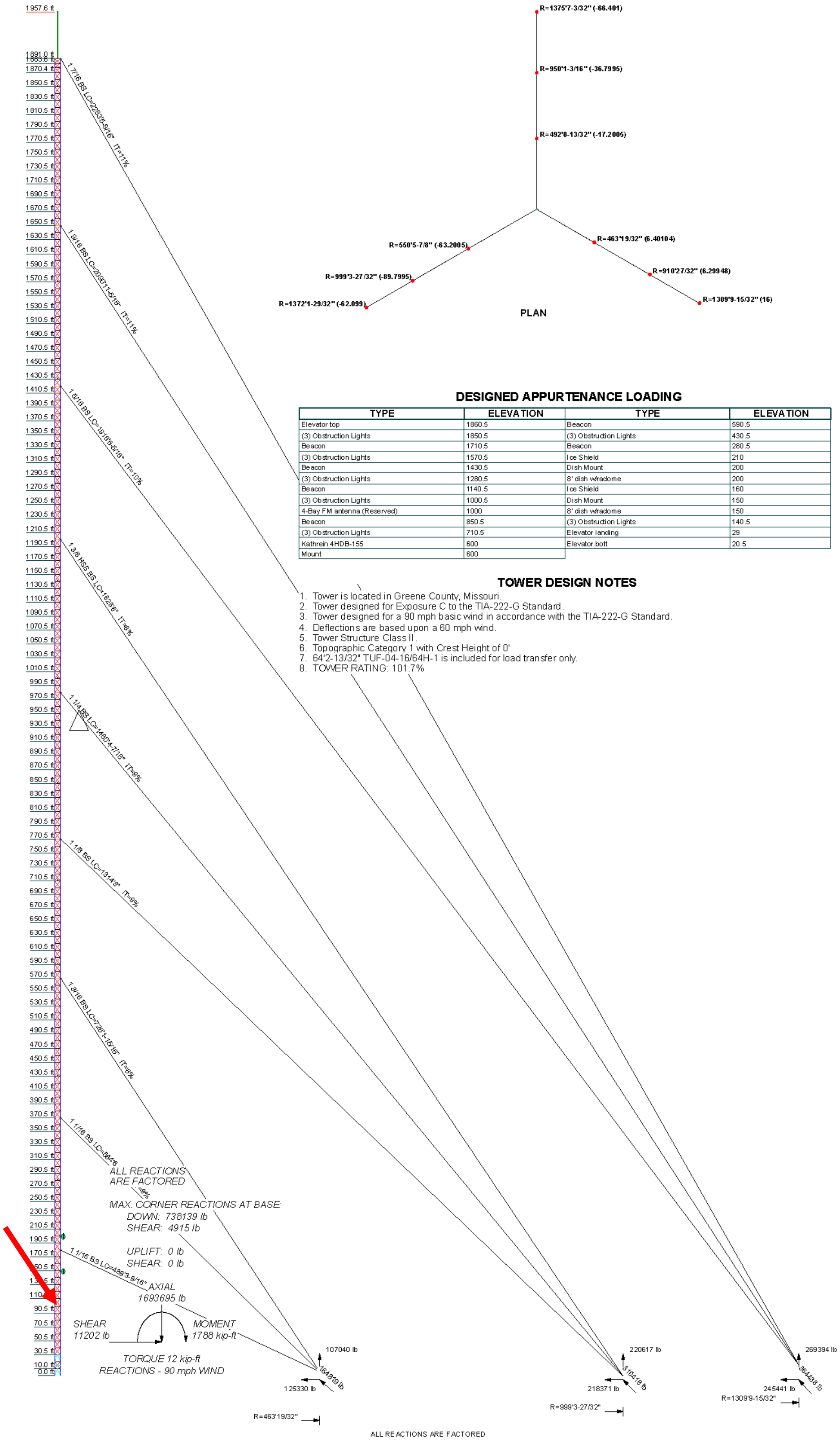


Figure 3. Typical Tower Cross Section



DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
Elevator top	1860.5	Beacon	590.5
(3) Obstruction Lights	1850.5	(3) Obstruction Lights	430.5
Beacon	1710.5	Beacon	280.5
(3) Obstruction Lights	1570.5	Ice Shield	210
Beacon	1430.5	Dish Mount	200
(3) Obstruction Lights	1280.5	8' dish w/radome	200
Beacon	1140.5	Ice Shield	160
(3) Obstruction Lights	1000.5	Dish Mount	150
4-Bay FM antenna (Reserved)	1000	8' dish w/radome	150
Beacon	850.5	(3) Obstruction Lights	140.5
(3) Obstruction Lights	710.5	Elevator landing	29
Kathrein 4HDB-155	600	Elevator bott	20.5
Mount	600		

TOWER DESIGN NOTES

1. Tower is located in Greene County, Missouri.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 90 mph basic wind in accordance with the TIA-222-G Standard.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0'
7. 64'2-13/32" TUF-04-16/64H-1 is included for load transfer only.
8. TOWER RATING: 101.7%

Diagonal Replacement at Time of Failure
(105' Elevation)

Figure 4. Tower Elevation (TCI Structural Analysis Report Appendix E-1)

TCI's May 19, 2017 structural analysis of the communication tower concluded that structural modifications were necessary for the tower to comply with the wind and ice loading requirements of ANSI/TIA-222-G. TCI recommended to replace one level of guy wires, reinforce 34 tower leg sections, replace 25 bays of diagonals and reinforce one level of horizontal struts. Lemay was contracted to perform the recommended structural modifications.

Incident Description

On April 19, 2018 at 9:33 AM, according to security camera surveillance footage, the KOZK communication tower collapsed resulting in the fatality of one worker and non-life-threatening injuries to four others. Lemay was performing structural modifications to the tower at the time of the collapse. An image of the resulting debris is shown in Figure 5. The contractor was replacing diagonals at the 105-foot level of the 1891-foot tall communication tower when the tower started to collapse. According to witness statements, the foreman of the five-man crew instructed the other employees on the tower to descend when audible structural distresses indicated the loss of structural integrity of the tower. The other employees on the tower managed to reach the ground and retreat from the falling debris. The foreman, however, decided to remain on the tower to discern and rectify the cause of the audible structural distresses and was struck and killed by the falling structure.

Figure 5. Collapsed Communication Tower (Google Image Search)

Figure 6 Top Section of Collapsed Communication Tower

Lemay arrived on-site on Monday, April 16, 2018 to begin working on the structural modifications to the communication tower the next day. The first two days involved preparation of the materials and tools and laying down and painting diagonals. Work on the tower was originally going to take place on Wednesday, but high winds caused the crew to delay work on the tower for another day. The crew began replacing diagonals on Thursday, April 19, 2018. They began replacing the diagonals at the 105' elevation. According to witness statements, the six replacement diagonals, the necessary equipment and the foreman were raised in a man-basket. One employee remained on the ground and the remaining employees went to assist with the replacement of diagonals. Two of the diagonals did not fit and were returned to the staging area on the ground so that the bolt holes could be bored out to facilitate their installation. The crew completed the diagonal replacement on two of the three sides and started work on the third. Witnesses stated they began hearing unusual sounds above them and the foreman instructed the other crew members to descend the tower as quickly as possible. The crew members made it off the tower before the collapse. However, the foreman did not, resulting in the lone fatality of the incident.

Observations of Collapsed Tower

As shown in Figure 5, it appears that as the tower began to collapse onto itself, the tower initially fell in the southern direction. Then the tower tilted and fell over itself back in a northern direction. As the top tiers of the tower fell, they remained essentially intact. As shown in Figure

6, all the guy wires disengaged from their anchor points and whipped about slashing through tree limbs and fencing. The man-basket, original and new diagonals and tools, including two come-a-longs were buried under the wreckage. The tower section from 90' to 120' was recovered and stored on-site for further observation. This tower section is shown in Figures 7 to 10. The slings and diagonals were found at the 105' tower elevation as shown in Figure 11. Several wires of the sling used for the come-a-long attachment to the tower panel point was severed and others were bird-nesting. A total of six bolted connections were missing. Two bolts were missing at the connection point between the two diagonals and the redundant horizontal bar. Two more bolts were missing from each gusset plate at the connection between the tower legs at the 100' elevation of the diagonals (see Figure 11). This was consistent with witness statements that the crew was working on the final third bay of diagonals at the 105' elevation at the time of the incident. The redundant bar and the tower leg appeared to have buckled.

Figure 7. Recovered Section of the Tower 90'–120'

Figure 9. Bent Redundant Member at 105' Tower Elevation

Figure 8. Bent Tower Leg from the Recovered Section

Figure 10. New bolts Installed on Two Diagonals at 100' Tower Elevation

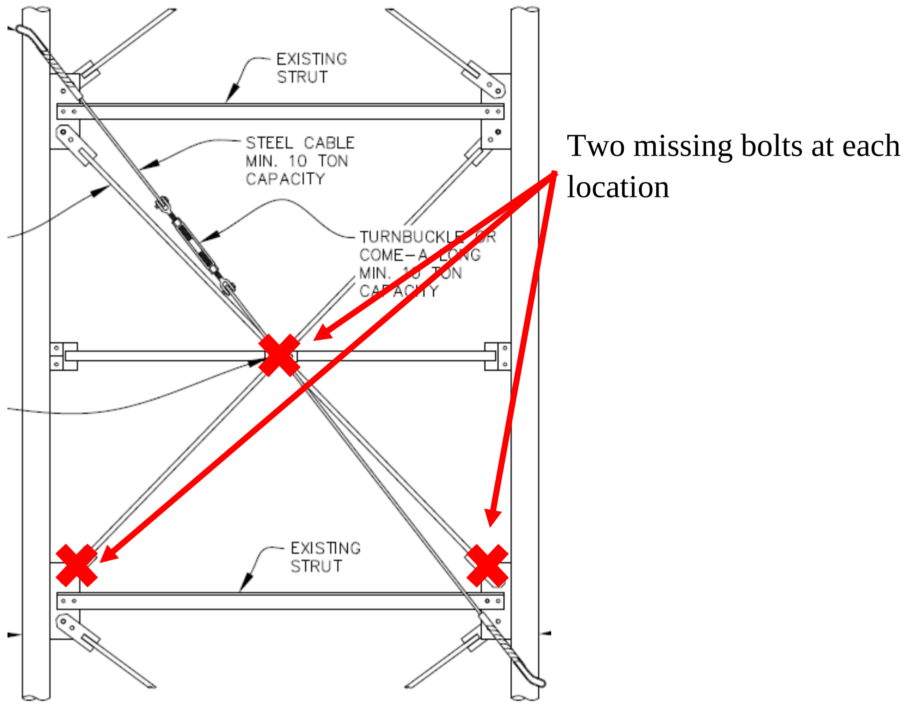


Figure 11. Missing bolts at the 105' Tower Elevation

Structural Analysis and Discussion

A guyed communication tower is a slender structure that relies on the guy wires to minimize flexural stresses generated by lateral loads, including wind, earthquake, etc. The tensioned guy wires were attached to the structure at various locations along the height of the tower. The compressive gravity loads, arising from its own weight, weight of the antennas and other equipment and resultant vertical loads of the guy wires, are supported by the axial strength of the tower. One of the characteristics of a structural member that affects its compressive strength is the unbraced length of the member. Therefore, it is critical that the tower legs are adequately braced while renovations or structural modifications are underway. Bracing must be in place to ensure the compressive stability of the tower legs and the lateral stability of the tower itself. The compressive capacity of a structural member is inversely proportional to the unbraced length. Typically, as the unbraced length of a member is increased, the compressive capacity of the member is reduced.

A representative section of the 105' tower elevation is shown in Figure 12. Figure 12 is a photograph of one of the tower bays of the top section of the tower that remained essentially intact after the collapse. The tower legs are braced by the diagonal rod members and the horizontal (appears vertical in the photograph as the tower is on its side) redundant. The typical tower bay is 10' wide by 10' tall. Therefore, this configuration of the bracing members creates unbraced lengths of five feet for the tower legs and redundant. The diagonals and the redundant were connected with two bolts at their mid-span as shown in Figure 13.

Figure 12. Representative Section from the Top of the Tower

Figure 13. Bolted Connection between Diagonals and Redundant Horizontal

TCI's erection drawings states that the diagonals must be replaced one at a time. However, in order to replace a diagonal, the two bolts on each end of the diagonal and the two bolts at the diagonal's mid-span must be removed. The removal of the bolts at the mid-span, however, results in doubling the unbraced length of the tower legs and redundant from five to ten feet.

This doubling of the unbraced length creates three problems for the redundant member. First, the redundant member exceeds the allowable slenderness ratio for main compression members other than leg members and for secondary members (200 and 250 respectively) as outlined in ANSI/TIA-222-G. The resultant slenderness ratio of the redundant member without the bolted connection at its mid-span is 274. Second, the unfactored compressive resistance is reduced from 32 kips to 8 kips. This 75% reduction of compressive strength created the third problem for the redundant member. The redundant no longer satisfied the ANSI/TIA-222-G requirement for minimum bracing resistance for the tower legs. ANSI/TIA-222-G requires that the strength of the brace is at least 1.5% of the axial design compressive force of the supported member. Therefore, the unbraced length of the tower legs has doubled to ten feet.

The ANSI/TIA-222-G design strength of the tower legs was reduced by 68% due to the doubling of the unbraced length. The tower legs require a minimum bracing resistance of approximately 13 kips. However, the horizontal redundant member is only capable of providing 8 kips. The resultant unfactored design strength of the tower legs reduces from 865 kips to 279 kips. The total dead load from the guy wires and the weight of the tower above the 105-foot elevation is 316 kips. Furthermore, any incidental wind load would increase the compressive load on some of the tower legs. The overstressing of the tower legs could have been a reason for why some of the diagonals did not fit and required re-boring of the bolt holes.

The diagonal replacement procedure is described on sheet E-5 of TCI's erection drawings document and is partially shown in Figure 14. The diagonal replacement procedure requires the use of a come-a-long to eliminate the tensile forces in the diagonal to facilitate the removal of the diagonal. TCI requires the use of a come-a-long with a ten-ton capacity. However, Lemay used a come-a-long device (Griphoist/Tirfor® T-532D) with a rated working load of 8,000 pounds (4 tons). An identical model come-a-long used on-site is shown in Figure 15. The come-a-long used on the tower is shown in Figure 16 while in the debris field and which was recovered later is shown in Figure 17.

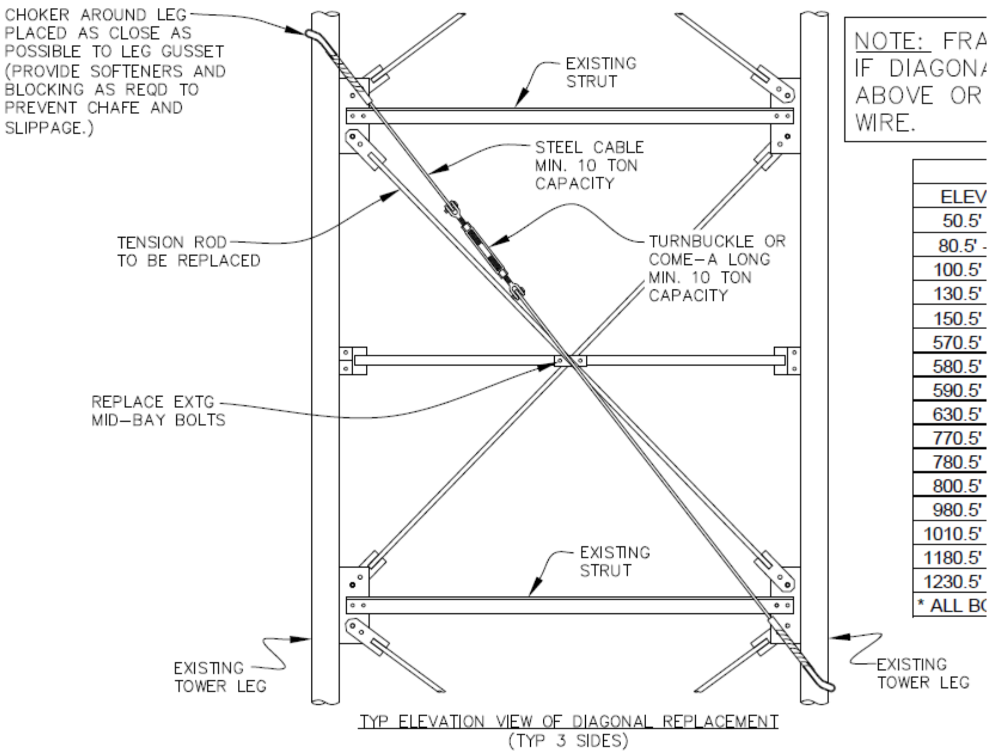


Figure 14. TCI Diagonal Replacement (E-5)

Figure 15. Lemay Come-a-long Used On-site

Figure 16. T-532D Come-a-long in Debris

Figure 17. T-532D Come-a-long Salvage from Debris

TCI's erection drawings document requires the use of a temporary frame when a diagonal is replaced above or below a guy wire location. Furthermore, TCI requires that the frame, provided by Lemay, be approved by TCI. During an interview with TCI engineering staff, TCI stated that they had no communications with Lemay about the use or design of a temporary frame. Lemay should have submitted a temporary frame design to TCI since diagonals required replacement above guy wire levels 3, 4 and 5. Reciprocally, TCI should have requested a temporary frame design from Lemay since TCI's diagonal replacement procedure requires them to approve the frame. The notes from sheet E-5 of TCI's erection documents is shown in Figure 18. The lack of the temporary frame design did not contribute to the collapse of the communication tower, because at the time of the incident Lemay was not working on a bay that required a temporary frame.

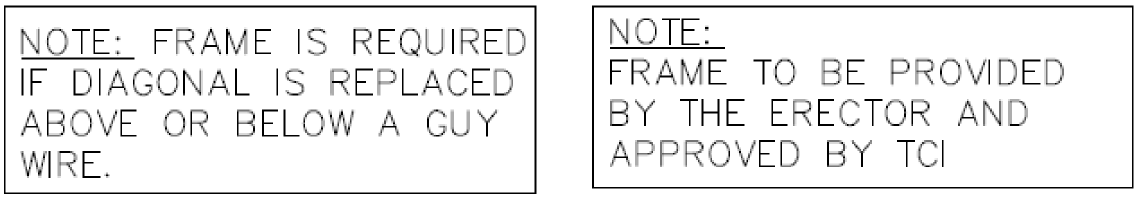


Figure 18. TCI Temporary Frame Requirements (E-5)

Conclusion

Based upon the above, we conclude that:

1) TCI's suggested diagonal replacement procedure was flawed in that it compromised the effectiveness of the integrated surrounding braces and the load bearing capacity of the tower legs. A single diagonal brace could not be removed without affecting the integrity of the redundant brace because the braces share two common bolts at the diagonal/redundant connection.
2) The cause of the communication tower collapse was the weakening of the compressive strength of the tower legs by removing the bolts at the connection of the diagonals to the horizontal redundant. The compromised redundant effectively doubled the unbraced length of the tower leg which reduced the compressive capacity of the tower leg.
3) Lemay used an undersized come-a-long while removing the diagonal braces.
4) Lemay failed to provide the design of the required temporary frame for diagonal replacement above or below a guy level. TCI failed to confirm the use/design of a temporary frame as TCI is required to approve the adequacy of the temporary frame prior to diagonal replacement according to TCI's construction documentation.

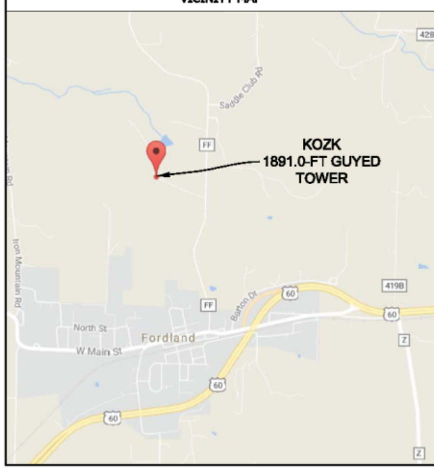
Appendix A

Erection Drawings
(prepared by TCI)

REINFORCE TOWER, KOZK

PROJECT NO.: 180830-027
MISSOURI STATE UNIVERSITY
1891.0-FT GUYED TOWER
KOZK FORDLAND
905 STATE HIGHWAY FF
FORDLAND, MISSOURI 65602
(37°10'11.0"N, 92°56'31.0"W)
(WEBSTER COUNTY)

VICINITY MAP



TOWER DESIGNED FOR A WIND SPEED OF 90-MPH WITH NO ICE & 30-MPH WITH 1" OF RADIAL ICE PER EIA/TIA-222-G STANDARD.

PROJECT INFORMATION

APPLICANT:
MISSOURI STATE UNIVERSITY
901 S NATIONAL AVENUE
FORDLAND, MO 65897
PH: 417-836-5101

LAND OWNER:
MISSOURI STATE UNIVERSITY

EMERGENCY CONTACT:
BRENT MOORE
MISSOURI STATE UNIVERSITY
PH: 417-836-3504

JURISDICTION:
WEBSTER COUNTY, MISSOURI

CONTRACTOR LIST

TOWER CONTRACTOR:
Tower Consultants, Inc.
15 Surrey Ct.
Columbia, SC 29212
(803) 407-8489

PROJECT DESCRIPTION

MISSOURI STATE UNIVERSITY IS PROPOSING TO PERFORM A TOWER MODIFICATION IN ORDER TO COMPLY WITH ANSI/TIA-222-G STANDARD WITH PROPOSED LOADING ON THE EXISTING 1891.0-FT GUYED TOWER.

SHEET INDEX

T-1 = TITLE SHEET
G-1 = GENERAL NOTES
G-2 = MODIFICATION DESCRIPTION
E-1 = TOWER ELEVATION DRAWING
E-2 = TOWER ELEVATION DRAWING
E-3 = TOWER ELEVATION DRAWING
E-4 = CROSS SECTION
E-5 = DIAGONAL REPLACEMENT
E-6 (REV 01) = SPLIT PIPE REINFORCING
E-7 = HORIZONTAL REINFORCEMENT
E-8 = GUY WIRE REPLACEMENT
E-9 = TENSION CHART
E-10 = POST MODIFICATION CHECKLIST

LEGEND

A = DETAIL
= SECTION
℄ OR CL = CENTERLINE
PL = PLATE
= PROPERTY LINE
= REVISION

TOWER CONSULTANTS, INC.
15 Surrey Ct.
Columbia, SC 29212
ph: 803-407-8489
fx: 803-407-8681

4208 198th St. SW., Suite 208
Seattle, WA 98036
ph: 425-778-5169
fx: 425-778-5103
www.tower-tci.com

KOZK
SPRINGFIELD, MO
1891'-0 GUYED TOWER
ERECTION DRAWINGS

INDEX

T-1

Date: 11-3-17

GENERAL NOTES

GENERAL

1. ALL METHODS, MATERIALS, AND WORKMANSHIP SHALL FOLLOW THE DICTATES OF GOOD CONSTRUCTION PRACTICE.

2. ALL WORK INDICATED ON THESE DRAWINGS SHALL BE PERFORMED BY QUALIFIED CONTRACTORS WITH A MINIMUM OF 10 YEARS EXPERIENCE IN TOWER AND FOUNDATION CONSTRUCTION.

3. ALL DIMENSIONS, MATERIALS, AND DETAILS OF THE EXISTING STRUCTURES ARE INCLUDED FOR INFORMATION ONLY. CONTRACTOR SHALL FIELD VERIFY ALL RELEVANT INFORMATION PRIOR TO CONSTRUCTION OR FABRICATION AND NOTIFY THE ENGINEER OF RECORD IMMEDIATELY OF ANY VARIANCE OR DISCREPANCIES. ALL NEW WORK SHALL ACCOMMODATE EXISTING CONDITIONS. DETAILS NOT SPECIFICALLY SHOWN ON THE DRAWINGS SHALL FOLLOW SIMILAR DETAILS FOR THIS JOB.

4. DIMENSIONS AND ELEVATIONS GIVEN FOR THE NEW CONSTRUCTION MUST ALSO BE VERIFIED BY THE CONTRACTOR PRIOR TO FABRICATION AND ERECTION TO ASSURE PROPER FIT AND ALIGNMENT OF THE STRUCTURAL COMPONENTS IN ACCORDANCE WITH THE INTENT OF THE CONTRACT DOCUMENTS.

5. ANY SUBSTITUTIONS MUST CONFORM TO THE REQUIREMENTS OF THESE NOTES AND SPECIFICATIONS AND SHOULD BE SIMILAR TO THOSE SHOWN. ALL SUBSTITUTIONS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR REVIEW AND APPROVAL PRIOR TO FABRICATION.

6. ANY MANUFACTURED DESIGN ELEMENTS MUST CONFORM TO THE REQUIREMENTS OF THESE NOTES AND SPECIFICATIONS AND SHOULD BE SIMILAR TO THOSE SHOWN. THESE DESIGN ELEMENTS MUST BE STAMPED BY A REGISTERED PROFESSIONAL ENGINEER IN THE STATE THE WORK IS BEING PERFORMED. IF REQUIRED CONTRACTOR TO PREPARE PERMIT DRAWING SET SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE WHERE THE WORK IS BEING PERFORMED. ALL PERMITS, LICENSES, APPROVALS AND OTHER REQUIREMENTS FOR CONSTRUCTION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

7. ALL WORK SHALL BE DONE IN ACCORDANCE WITH LOCAL CODES AND SAFETY REGULATIONS.

8. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND EXECUTION OF ALL MISCELLANEOUS SHORING, BRACING, TEMPORARY SUPPORTS, ETC. NECESSARY TO PROVIDE A COMPLETE AND STABLE STRUCTURE AS SHOWN ON THESE DRAWINGS. ALL INSTALLATION PROCEDURES, SAFEGUARDS AND MEANS AND METHODS OF CONSTRUCTION ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

9. A DETAILED RIGGING PLAN SHALL BE PREPARED BY THE CONTRACTOR AND SUBMITTED TO THE OWNER FOR APPROVAL. THE RIGGING PLAN SHALL INCLUDE AS A MINIMUM: BRIEF TOWER DESCRIPTION, HOIST MODEL AND CAPACITY, DATA, WIRE ROPE SIZE AND CONSTRUCTION, SHEAVE/BLOCK DIAMETER AND CAPACITY, CHOKER SIZE AND CAPACITY, RIGGING DETAILS TO THE TOWER, PLANNED LIFT WEIGHTS, GIN POLE SIZE AND CAPACITY AND A DIAGRAM LOCATING KEY RIGGING COMPONENTS.

APPLICABLE CODES AND STANDARDS

1. ANSI/TIA/EIA: STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND ANTENNA SUPPORTING STRUCTURES.

2. IBC: INTERNATIONAL BUILDING CODE, LATEST EDITION.

3. ASTM: STANDARDS FOR BUILDING CODES, LATEST EDITION.

4. ACI 318: AMERICAN CONCRETE INSTITUTE, BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, LATEST EDITION.

5. ACI 315: AMERICAN CONCRETE INSTITUTE, DETAILS AND DETAILING OF CONCRETE REINFORCEMENT, LATEST EDITION.

6. CSRI: CONCRETE STEEL REINFORCING INSTITUTE, MANUAL OF STANDARD PRACTICE, LATEST EDITION.

7. AISC: AMERICAN INSTITUTE OF STEEL CONSTRUCTION, MANUAL OF STEEL CONSTRUCTION, LATEST EDITION.

8. AWS: AMERICAN WELDING SOCIETY, STRUCTURAL WELDING CODE, LATEST EDITION.

STEEL AND FABRICATION

1. ALL STEEL FABRICATION TO BE DONE BY AN AISC CERTIFIED FABRICATION FACILITY IN ACCORDANCE WITH THE LATEST EDITION OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION.

2. ALL STEEL TO BE ASTM A572 GR.50 (50KSI MIN YIELD STRENGTH) U.N.O.; BOLTS TO BE ASTM A325 WITH ANCO LOCKNUTS U.N.O.

3. ALL MATERIAL TO BE HOT DIPPED GALVANIZED PER ASTM A123 OR ASTM A153.

4. BOLT HOLE DIAMETER SHALL NOT BE MORE THAN $\frac{1}{16}$" LARGER THAN NOMINAL BOLT DIAMETER AND SHALL BE PUNCHED OR DRILLED U.N.O.

WELDING

1. ALL WELDING TO BE PERFORMED BY AWS CERTIFIED WELDERS AND CONDUCTED IN ACCORDANCE WITH THE LATEST EDITION OF THE AWS WELDING CODE. ALL WELDS TO BE INSPECTED FOR STRUCTURAL SOUNDNESS AND DOCUMENTED.

2. ALL ELECTRODES TO BE E70 LOW HYDROGEN TYPE.

3. MINIMUM WELD SIZE TO BE 0.3125 INCH FILLET WELDS UNLESS NOTED OTHERWISE ON THE DRAWINGS.

4. ALL WELDED CONNECTIONS TO BE SEAL WELDED FOR GALVANIZING.

FIELD INSTALLATION

1. ALL GALVANIZED SURFACE THAT ARE SCRATCHED OR DAMAGED SHALL BE REPAIRED USING A ZINC RICH TWO PART EPOXY SUCH AS CARBOLINE 15 OR EQUIVALENT.

2. A490 BOLTS SHALL BE SPRAY PAINTED WITH A COAT OF COLD GALVANIZING PRIOR TO INSTALLATION FOLLOWED BY A COAT OF A ZINC RICH TWO PART EPOXY SUCH AS CARBOLINE 15 OR EQUIVALENT AFTER INSTALLATION.

3. HARDWARE INTERFERING WITH THE INSTALLATION OF REINFORCING MATERIAL SHALL BE TEMPORARILY MOVED AND REINSTALLED AFTER THE COMPLETION OF THE WORK.

4. WHEN FIELD WELDING IS REQUIRED THE STEEL SHALL BE CLEANED OF ALL PAINT AND GALVANIZING TO A BARE METAL. AS SPECIFIED PER AWS D1.1. PREHEATING AND POST HEATING MAY BE REQUIRED.

5. WELDED AREAS ARE TO BE TOUCHED UP USING A ZINC RICH TWO PART EPOXY SUCH AS CARBOLINE 15 OR EQUIVALENT.

TIGHTENING OF BOLTS AND NUTS

1. ALL HIGH STRENGTH BOLTS TO BE TIGHTENED TO THE SNUG TIGHT CONDITION AS SPECIFIED IN THE CURRENT EDITION OF THE AISC "SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS". BOLTS REQUIRING FULL PRETENSION TO BE TIGHTENED BY "THE TURN OF THE NUT METHOD" U.N.O.

FOUNDATIONS

1. CONTRACTOR SHALL VERIFY THE LOCATION OF UNDERGROUND UTILITIES IN THE AREA WHERE THE WORK IS TO BE PERFORMED.

2. DRILLED SHAFT INSTALLED IN ACCORDANCE WITH ACI-336 (LATEST EDITION).

CONCRETE

1. ALL CONCRETE FOR FOUNDATIONS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI. AFTER 28 DAYS.

2. THE CONCRETE MIX SHALL NOT CONTAIN LESS THAN 5$\frac{1}{2}$ SACKS OF CEMENT (ASTM C 150 TYPE II) PER CUBIC YARD.

3. THE CONCRETE SHALL HAVE A MAXIMUM AGGREGATE SIZE OF $\frac{7}{8}$".

4. THE CONCRETE MIX SHALL PRODUCE A MAXIMUM SLUMP OF 5" ±1".

5. THE CONCRETE MIX SHALL HAVE A TOTAL AIR CONTENT OF 5%, WITH A TOLERANCE OF PLUS OR MINUS 1.5%. AIR-ENTRAINING ADMIXTURES SHALL CONFORM TO ASTM C 260.

6. THE CONCRETE MIX SHALL HAVE A MAXIMUM WATER-CEMENT RATIO OF 0.45. WATER REDUCING OR ACCELERATING ADMIXTURES SHALL CONFORM TO ASTM C 494.

7. THE CONCRETE SHALL NOT CONTAIN CALCIUM CHLORIDE OR ANY OTHER ADMIXTURE CONTAINING CHLORIDE OTHER THAN NATURAL IMPURITIES.

8. FORM WORK SHALL CONFORM TO ACI 318 (LATEST EDITION) SPECIFICATIONS.

9. ALL CONCRETE SHALL BE PLACED IN A MONOLITHIC POUR UNLESS SHOWN OTHERWISE ON THE DRAWINGS.

10. PROVIDE CHAMFERS AT ALL EXPOSED CORNERS OF CONCRETE.

11. CONCRETE WORK UNDER EXTREME WEATHER CONDITIONS SHALL CONFORM TO ACI 318 (LATEST EDITION) SPECIFICATIONS.

STEEL REINFORCEMENT (REBAR)

1. ALL REINFORCING STEEL TO BE GRADE 60 DEFORMED BILLET STEEL PER ASTM A615.

2. REINFORCEMENT SHALL BE FABRICATED AND PLACED IN ACCORDANCE WITH THE ACI 315 AND CSRI. SUPPORT REINFORCING AS REQUIRED BY CSRI TO PREVENT DISPLACEMENT UPON CONCRETE POURING.

3. MAINTAIN ALL CLEARANCES NOTED ON THE DRAWINGS. WHERE NO DIMENSIONS ARE NOTED, USE THE ACI RECOMMENDED CLEARANCES.

4. FOR CONCRETE POURED AGAINST SOIL, THE MINIMUM COVER FOR ALL REINFORCING BARS SHALL BE 3".

5. TIE BARS SECURELY WITH #16 ANNEALED WIRE AND SUPPORT AS REQUIRED.

6. ALL WELDED WIRE FABRIC TO BE PER ASTM A185. ALL BARS AND WIRE SHALL BE FREE OF RUST, MILL SCALE, DIRT, OR OTHER FOREIGN MATERIAL PRIOR TO CASTING CONCRETE.

7. PROVIDE MINIMUM LAP SPLICES OF 36 BAR DIAMETERS UNLESS NOTED OTHERWISE.

8. FIELD BENDING OF REINFORCEMENT BARS IS NOT PERMITTED. DO NOT WELD REINFORCING BARS.

No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

TOWER CONSULTANTS, INC.
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Columbia, SC 29212
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KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
GENERAL NOTES

Sheet No.: G-1
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17

MODIFICATION DESCRIPTION:

1. THIS DRAWING IS FOR JOB USE.

2. UPGRADES APPLY TO ALL THREE FACES OF THE TOWER.

3. A TEMPORARY BRACE MUST BE INSTALLED THAT IS OF EQUIVALENT OR GREATER CAPACITY THAN THE MEMBER BEING REPLACED. THE TEMPORARY BRACE SHALL BE PLACED ADJACENT TO THE MEMBER BEING REPLACED SUCH THAT IT WILL TAKE THE LOAD AFTER THE EXISTING MEMBER IS REMOVED.
A TEMPORARY FRAME IS REQUIRED ABOVE AND BELOW GUY LEVELS DURING DIAGONAL REPLACEMENT.

4. REPLACE THE EXISTING SOLID ROD DIAGONAL MEMBERS WITH A NEW HIGHER CAPACITY MEMBER AT THE FOLLOWING LOCATIONS (SEE E-5):

50.5' - 60.5'	(1 BAY)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
80.5' - 100.5'	(2 BAYS)	1"φ S.R., ASTM A572-50, 5/8"φ A490X BOLTS
100.5' - 110.5'	(1 BAY)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
130.5' - 160.5'	(3 BAYS)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
570.5' - 590.5'	(2 BAYS)	1¼"φ S.R., ASTM A572-50, 3/4"φ A490X BOLTS
590.5' - 630.5'	(4 BAYS)	1"φ S.R., ASTM A572-50, 5/8"φ A490X BOLTS
630.5' - 650.5'	(2 BAYS)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
770.5' - 800.5'	(3 BAYS)	1"φ S.R., ASTM A572-50, 3/4"φ A325X BOLTS
800.5' - 830.5'	(3 BAYS)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
980.5' - 990.5'	(1 BAY)	1"φ S.R., ASTM A572-50, 3/4"φ A325X BOLTS
1010.5' - 1020.5'	(1 BAY)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS
1180.5' - 1190.5'	(1 BAY)	1"φ S.R., ASTM A572-50, 3/4"φ A325X BOLTS
1230.5' - 1240.5'	(1 BAY)	7/8"φ S.R., ASTM A572-50, 5/8"φ A325X BOLTS

5. REINFORCE THE EXISTING LEGS BY ADDING SPLIT PIPE REINFORCING AT THE FOLLOWING LOCATIONS (SEE E-6)

0.0' - 60.5'	(2 SECTIONS)	HALF HSS 5.5" O.D. x 0.5" WALL, FY=50KSI MIN.
60.5' - 150.5'	(3 SECTIONS)	HALF HSS 5.25" O.D. x 0.5" WALL, FY=50KSI MIN.
150.5' - 210.5'	(2 SECTIONS)	HALF HSS 5.5" O.D. x 0.5" WALL, FY=50KSI MIN.
210.5' - 390.5'	(6 SECTIONS)	HALF HSS 5.25" O.D. x 0.5" WALL, FY=50KSI MIN.
390.5' - 420.5'	(1 SECTION)	HALF HSS 5.125" O.D. x 0.5" WALL, FY=50KSI MIN.
420.5' - 450.5'	(1 SECTION)	HALF HSS 5.25" O.D. x 0.5" WALL, FY=50KSI MIN.
450.5' - 600.5'	(5 SECTIONS)	HALF HSS 5.125" O.D. x 0.5" WALL, FY=50KSI MIN.
600.5' - 810.5'	(7 SECTIONS)	HALF HSS 4.875" O.D. x 0.5" WALL, FY=50KSI MIN.
810.5' - 1020.5'	(7 SECTIONS)	HALF HSS 4.75" O.D. x 0.5" WALL, FY=50KSI MIN.

6. REINFORCE THE EXISTING DOUBLE ANGLE HORIZONTAL MEMBERS BY ADDING A SINGLE ANGLE MEMBER BETWEEN THE DOUBLE ANGLES AT THE FOLLOWING LOCATIONS (SEE E-7):

590.5'	(1 LEVEL)	L3½x2½x3/8, 5/8"φ A325X BOLTS

7. REPLACE GUY LEVEL 6 AND ADJUST THE GUY WIRE INITIAL TENSION USING THE TANGENT INTERCEPT METHOD TO THE VALUES LISTED IN THE CHART BELOW. REUSE EXISTING GROUNDING AND HFD (SEE E-8 & E-9):

GUY LEVEL	EXISTING GUY PROPERTIES			RECOMMENDED GUY PROPERTIES		
	GUY ANCHOR	GUY SIZES	% OF ULT. TENSION	GUY ANCHOR	GUY SIZES	% OF ULT. TENSION
9th (top)	Outer Anchor	1-7/16"Ø BS	7.82%	Outer Anchor	1-7/16"Ø BS	**11.0%**
8th		1-9/16"Ø BS	8.44%		1-9/16"Ø BS	**11.0%**
7th		1-5/16"Ø BS	10.22%		1-5/16"Ø BS	**10.0%**
6th	Middle Anchor	1-3/8"Ø BS	9.67%	Middle Anchor	**1-3/8"Ø HSS**	**8.0%**
5th		1-1/4"Ø BS	10.52%		1-1/4"Ø BS	**9.0%**
4th		1-1/8"Ø BS	12.08%		1-1/8"Ø BS	**9.0%**
3rd	Inner Anchor	1-3/16"Ø BS	9.34%	Inner Anchor	1-3/16"Ø BS	**8.0%**
2nd		1-1/16"Ø BS	12.30%		1-1/16"Ø BS	**9.0%**
1st (bot)		1-1/16"Ø BS	12.62%		1-1/16"Ø BS	**12.0%**

NOTE: VALUES SHOWN ABOVE ARE VALID AT 60 DEGREES FAHRENHEIT; A P&T CHART WITH TEMPERATURE CORRECTIONS WILL BE REQUIRED FOR FIELD ADJUSTMENTS

8. ALL MATERIAL SHALL BE HOT DIP GALVANIZED IN ACCORDANCE TO ASTM SPECIFICATIONS.

9. ALL REINFORCING MATERIAL SHALL BE PAINTED IN THE FIELD TO MATCH THE EXISTING COLOR SCHEME OF THE TOWER.

10. THE MODIFICATION MATERIAL AND INSTALLATION DRAWINGS CONTAINED HEREIN ARE BASED ON THE ASSUMPTION THAT THE TOWER HAS BEEN PROPERLY INSTALLED AND MAINTAINED, INCLUDING BUT NOT LIMITED TO THE FOLLOWING:

A. PROPER ALIGNMENT AND PLUMBNESS.
B. CORRECT GUY TENSIONS.
C. CORRECT BOLT TIGHTNESS.
D. NO SIGNIFICANT DETERIORATION OR DAMAGE TO ANY COMPONENT.

11. ALL MATERIAL REQUIRED BY SHEETS E-1 THROUGH E-8 FURNISHED TO CONTRACTOR BY TCI. FOR PRICING PLEASE CONTACT:

RON DOZSA
425-778-5169

DESIGN INFORMATION:

1. THIS DRAWING PACKAGE IS BASED ON TOWER CONSULTANTS ANALYSIS REPORT 17.289.001, DATED MAY 19, 2017.

2. THE TOWER IS DESIGNED FOR THE EXISTING AND PROPOSED LOADING AS LISTED IN THE REPORT REFERENCED ABOVE.

ANTENNA WORK:

1. REMOVE THE FOLLOWING LINES (SEE CROSS SECTION ON E-4):

0' - TOP 6⅛" RIGID LINE

2. INSTALL THE FOLLOWING LINES (SEE CROSS SECTION ON E-4):

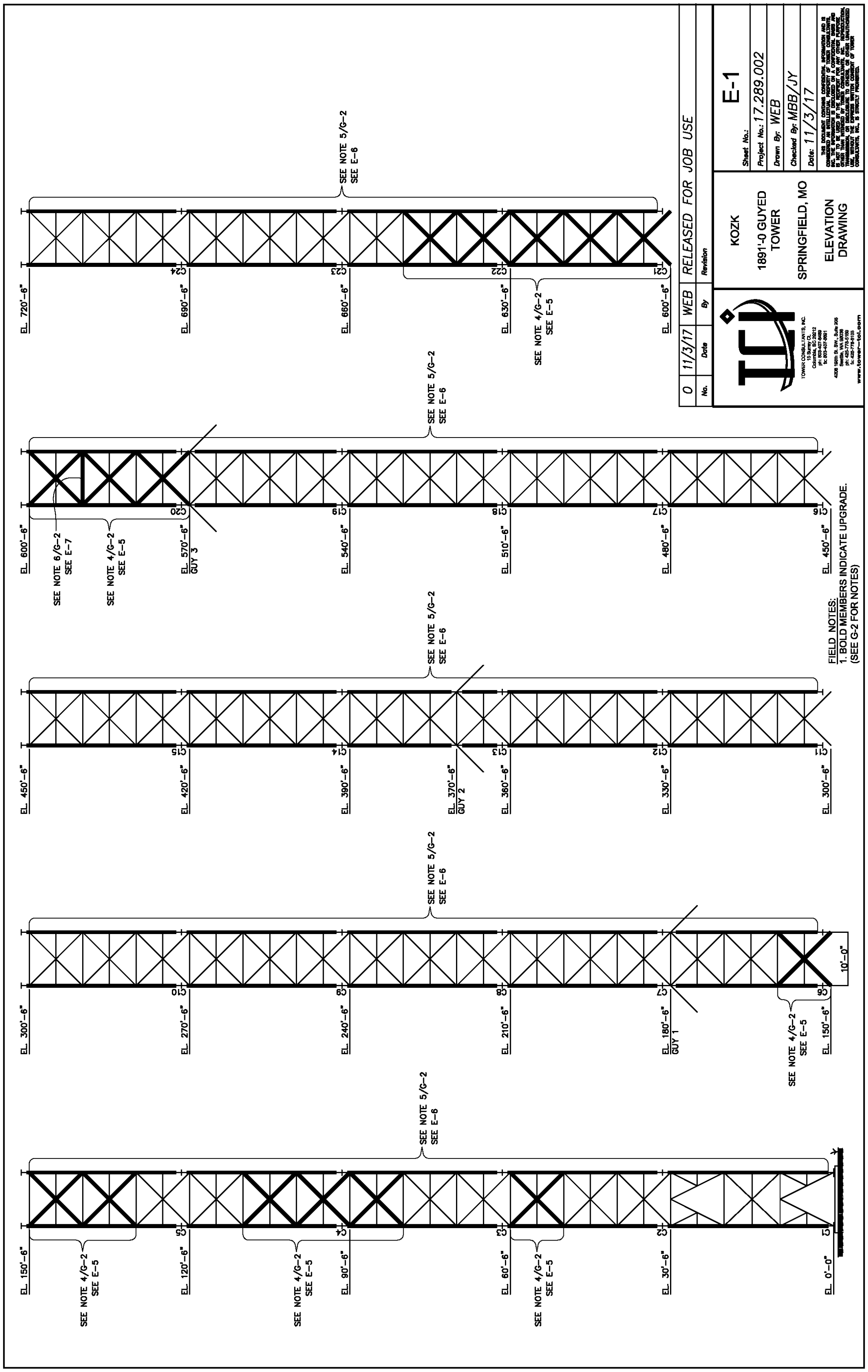
0' - TOP 6⅛" RIGID LINE

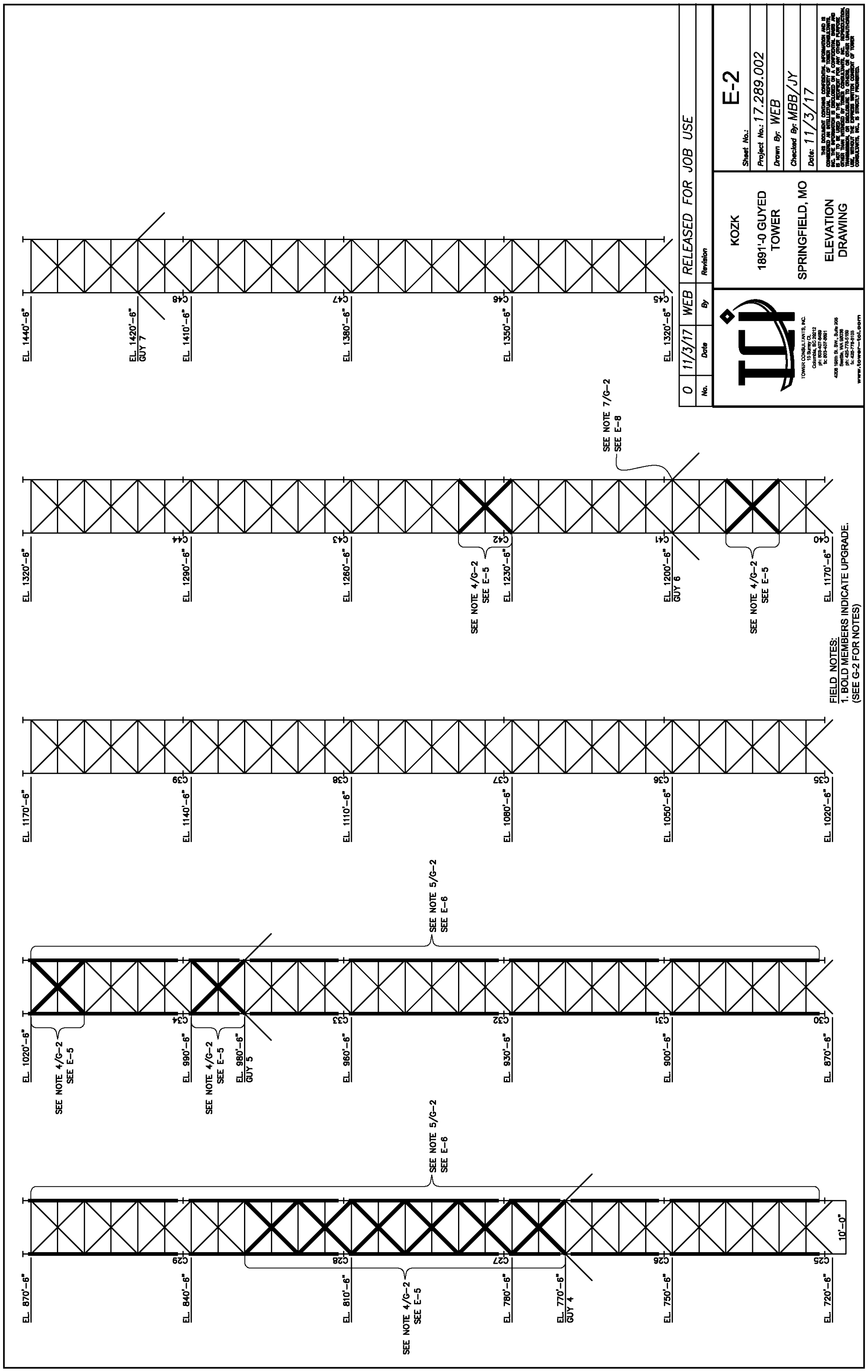
No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

TOWER CONSULTANTS, INC. www.tower-tci.com

KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
MODIFICATION DESCRIPTION

Sheet No.: G-2
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17


RELEASED FOR JOB USE
0 11/3/17 WEB
No. Date By Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
ELEVATION DRAWING
Sheet No.: E-1
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
FIELD NOTES:
1. BOLD MEMBERS INDICATE UPGRADE.
(SEE G-2 FOR NOTES)


EL. 1440'-6"
EL. 1420'-6"
GUY 7
EL. 1410'-6"
EL. 1380'-6"
EL. 1350'-6"
EL. 1320'-6"
C48
C47
C46
C45
EL. 1290'-6"
EL. 1260'-6"
EL. 1230'-6"
EL. 1200'-6"
GUY 6
EL. 1170'-6"
C44
C43
C42
C41
C40
SEE NOTE 4/G-2
SEE E-5
SEE NOTE 7/G-2
SEE E-8
FIELD NOTES:
1. BOLD MEMBERS INDICATE UPGRADE.
(SEE G-2 FOR NOTES)
EL. 1140'-6"
EL. 1110'-6"
EL. 1080'-6"
EL. 1050'-6"
EL. 1020'-6"
C39
C38
C37
C36
C35
EL. 990'-6"
EL. 980'-6"
GUY 5
EL. 960'-6"
EL. 930'-6"
EL. 900'-6"
EL. 870'-6"
C34
C33
C32
C31
C30
SEE NOTE 5/G-2
SEE E-6
EL. 840'-6"
EL. 810'-6"
EL. 780'-6"
EL. 770'-6"
GUY 4
EL. 750'-6"
EL. 720'-6"
C29
C28
C27
C26
C25
10'-0"
0
11/3/17
WEB
RELEASED FOR JOB USE
No.
Date
By
Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
ELEVATION DRAWING
Sheet No.: E-2
Project No.: 17.289.002
Drawn By: WEB
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Date: 11/3/17
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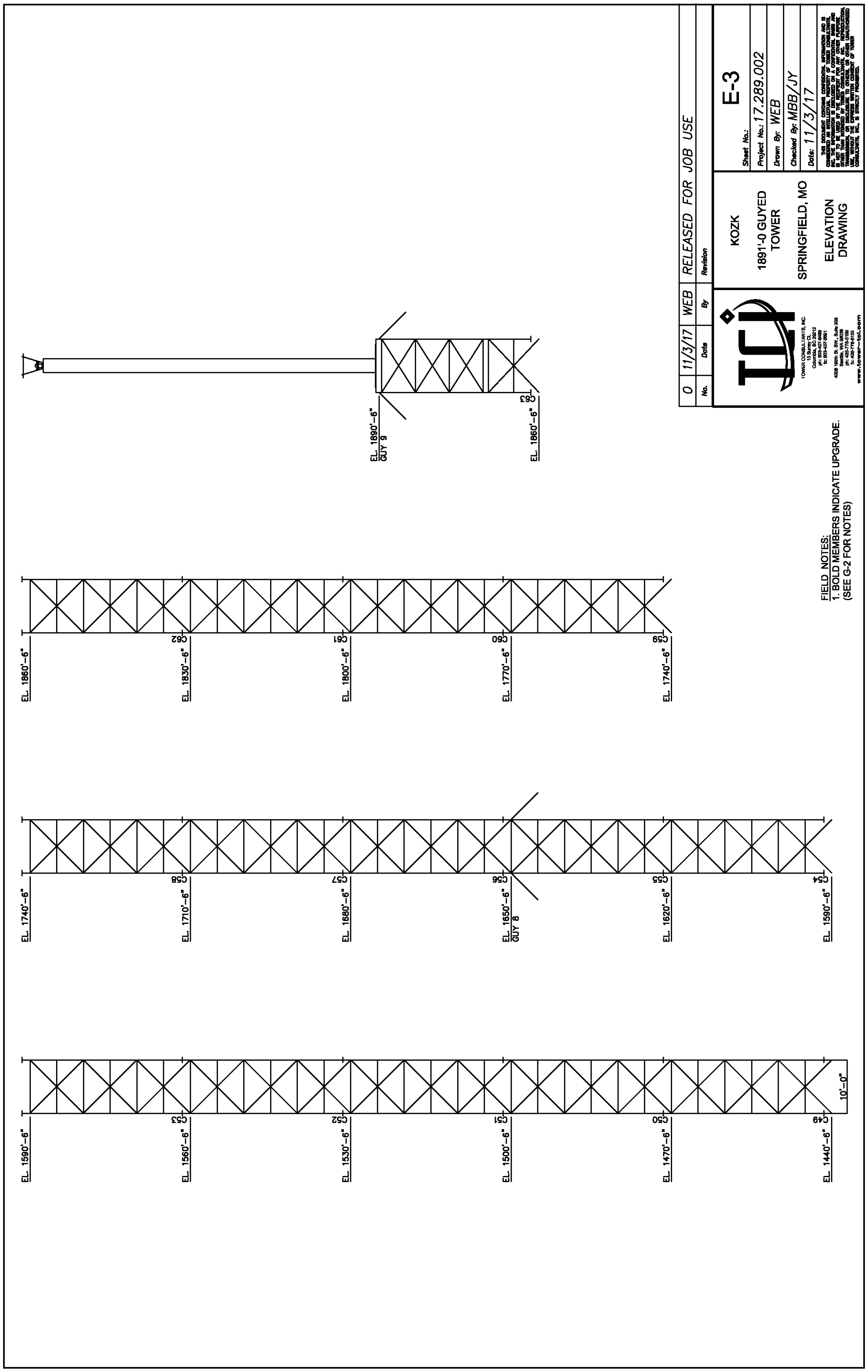
RELEASED FOR JOB USE
0
11/3/17
WEB
No.
Date
By
Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
ELEVATION DRAWING
Sheet No.: E-3
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
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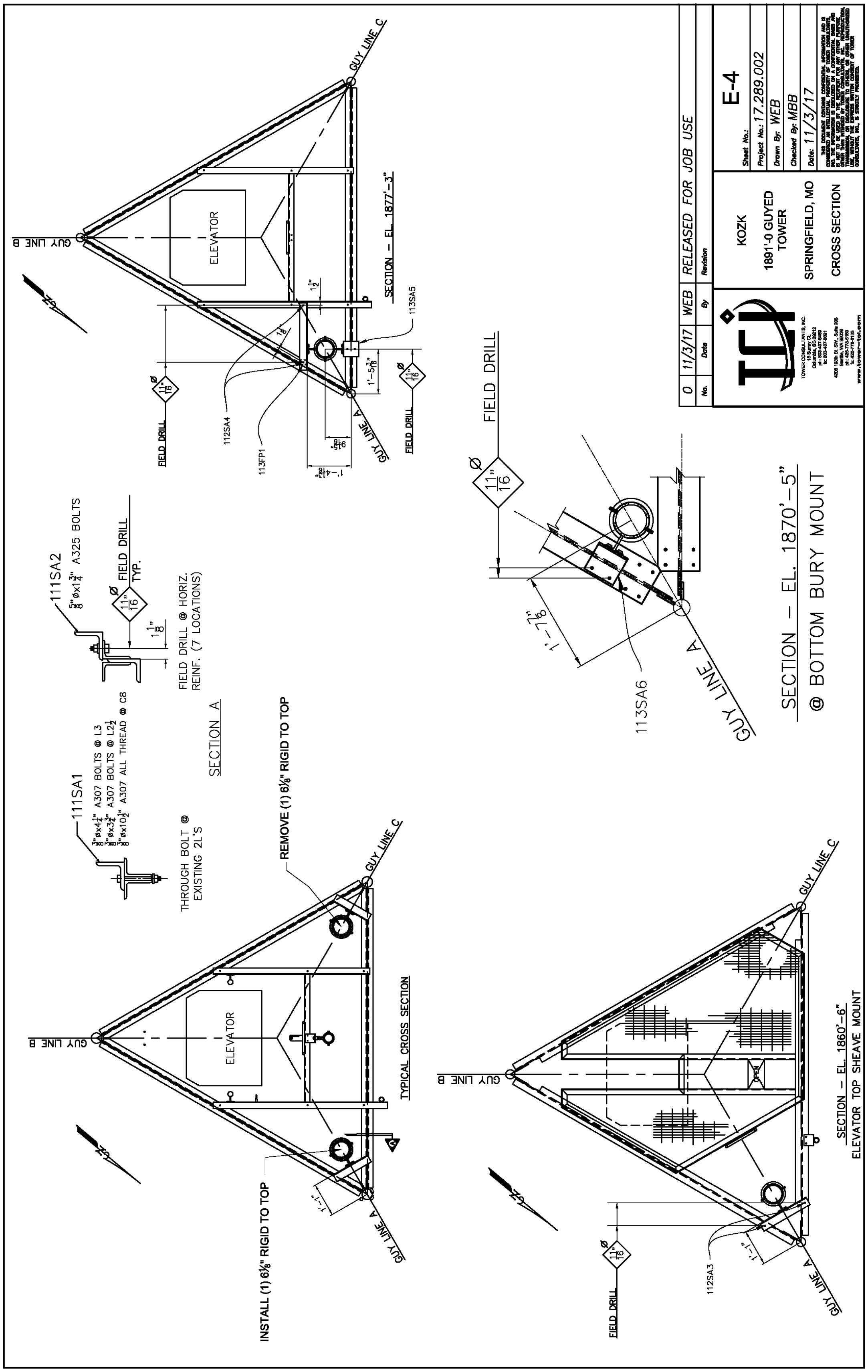
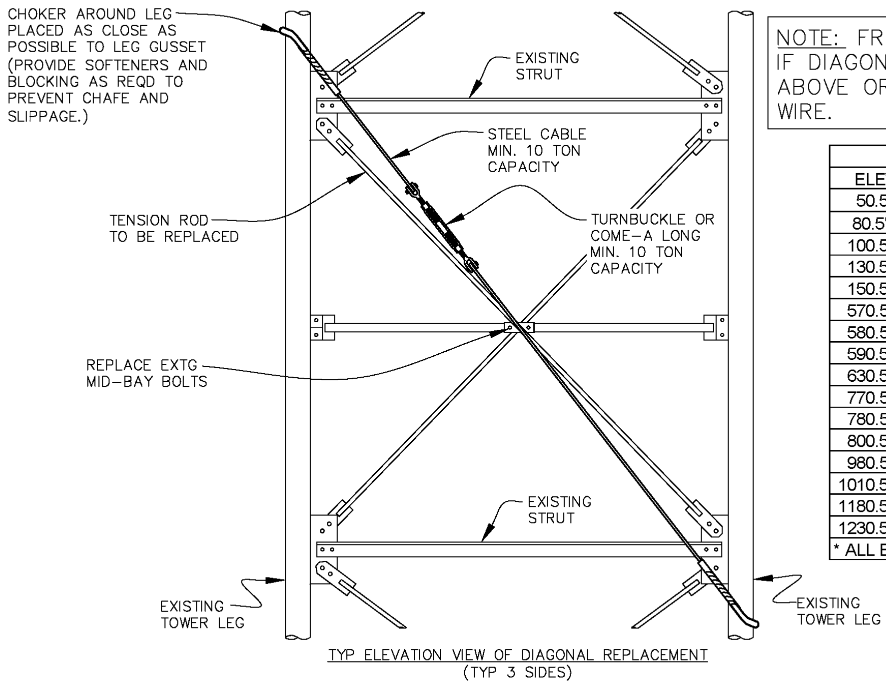
FIELD NOTES:
1. BOLD MEMBERS INDICATE UPGRADE.
(SEE G-2 FOR NOTES)
EL. 1890'-6"
GUY 9
EL. 1860'-6"
C63
EL. 1860'-6"
EL. 1830'-6"
C62
EL. 1800'-6"
C61
EL. 1770'-6"
C60
EL. 1740'-6"
C59
EL. 1740'-6"
EL. 1710'-6"
C58
EL. 1680'-6"
C57
EL. 1650'-6"
GUY 8
C56
EL. 1620'-6"
C55
EL. 1590'-6"
C54
EL. 1590'-6"
EL. 1560'-6"
C53
EL. 1530'-6"
C52
EL. 1500'-6"
C51
EL. 1470'-6"
C50
EL. 1440'-6"
C49
10'-0"


RELEASED FOR JOB USE
E-4
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
CROSS SECTION
SECTION – EL. 1877'-3"
SECTION – EL. 1870'-5"
@ BOTTOM BURY MOUNT
SECTION A
TYPICAL CROSS SECTION
SECTION – EL. 1860'-6"
ELEVATOR TOP SHEAVE MOUNT
ELEVATOR
GUY LINE A
GUY LINE B
GUY LINE C
FIELD DRILL
REMOVE (1) 6⅛" RIGID TO TOP
INSTALL (1) 6⅛" RIGID TO TOP
THROUGH BOLT @ EXISTING 2L'S
FIELD DRILL @ HORIZ. REINF. (7 LOCATIONS)
111SA1
111SA2
113SA6



TYP ELEVATION VIEW OF DIAGONAL REPLACEMENT
(TYP 3 SIDES)

NOTE: FRAME IS REQUIRED IF DIAGONAL IS REPLACED ABOVE OR BELOW A GUY WIRE.

NOTE: FRAME TO BE PROVIDED BY THE ERECTOR AND APPROVED BY TCI

DIAGONAL REPLACEMENT					
ELEVATION	BAYS	NEW DIAGONAL	END BOLTS*	MID-BAY BOLTS*	REAMING REQD
50.5' - 60.5'	1	101X3	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
80.5' - 100.5'	2	100X2	5/8"Ø A490X x 2	5/8"Ø A325X x 3	NO
100.5' - 110.5'	1	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
130.5' - 150.5'	2	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
150.5' - 160.5'	1	101X4	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
570.5' - 580.5'	1	102X6	3/4"Ø A490X x 2-1/2	5/8"Ø A325X x 3	NO
580.5' - 590.5'	1	103X8	3/4"Ø A490X x 2-1/2	5/8"Ø A325X x 3	NO
590.5' - 630.5'	4	100X2	5/8"Ø A490X x 2	5/8"Ø A325X x 3	NO
630.5' - 650.5'	2	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
770.5' - 780.5'	1	102X5	3/4"Ø A325X x 2-1/4	5/8"Ø A325X x 3	NO
780.5' - 800.5'	2	103X7	3/4"Ø A325X x 2-1/4	5/8"Ø A325X x 3	NO
800.5' - 830.5'	3	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
980.5' - 990.5'	1	102X5	3/4"Ø A325X x 2-1/4	5/8"Ø A325X x 3	NO
1010.5' - 1020.5'	1	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO
1180.5' - 1190.5'	1	103X7	3/4"Ø A325X x 2-1/4	5/8"Ø A325X x 3	NO
1230.5' - 1240.5'	1	100X1	5/8"Ø A325X x 2	5/8"Ø A325X x 3	NO

* ALL BOLTS REQUIRE (1) HARDENED WASHER AND (1) ANCO LOCKNUT EACH

NOTES FOR TEMPORARY BRACING DURING DIAGONAL REPLACEMENT:

1. ALL STRESS IN THE BAR DIAGONAL SHALL BE REMOVED BY THE USE OF A COME-A-LONG OR BY A TURNBUCKLE AS SHOWN IN THE ABOVE DIAGRAM BEFORE THE BAR DIAGONAL IS REPLACED WITH THE NEW MEMBER. THE RIGGING, INCLUDING COME-A-LONG OR TURNBUCKLE, CABLE SLING, ECT., SHALL HAVE A MINIMUM STRENGTH OF 20,000 LBS.
2. ONLY ONE DIAGONAL PER PANEL SHALL BE REPLACED AT A TIME, AND ALL BOLTS PROPERLY INSTALLED BEFORE PROCEEDING TO THE REPLACEMENT OF THE OTHER DIAGONAL IN THAT PANEL.
3. COAT ALL REAMED HOLES WITH A ZINC RICH TWO PART EPOXY AS REQUIRED.
4. A490 BOLTS SHALL BE COATED WITH A ZINC RICH TWO PART EPOXY MASTIC SUCH AS CARBOLINE CARBOMASTIC 15 OR EQUIVALENT.

RESTRICTIONS

- NO TOWER MEMBER IS TO BE REPLACED WHEN A WIND VELOCITY GREATER THAN 20 MPH EXISTS OR WHEN A WIND VELOCITY OF GREATER THAN 20 MPH IS PREDICTED DURING THE PROCEDURE.
- THE ABOVE PROCEDURES MUST BE FOLLOWED WITHOUT VARIATION UNLESS APPROVED BY THE ENGINEER ON RECORD.
- IF A DIAGONAL REPLACEMENT OCCURS ABOVE OR BELOW A GUY LEVEL, A TEMPORARY FRAME IS REQUIRED, ALONG WITH THE ABOVE PROCEDURE. THE TEMPORARY FRAME SHOULD BE PROVIDED BY THE ERECTOR AND APPROVED BY TCI BEFORE REPLACEMENT IS DONE. USE (2) COME-A-LONGS WHEN TEMPORARY FRAME IS IMPEDED BY EXISTING EQUIPMENT.

No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

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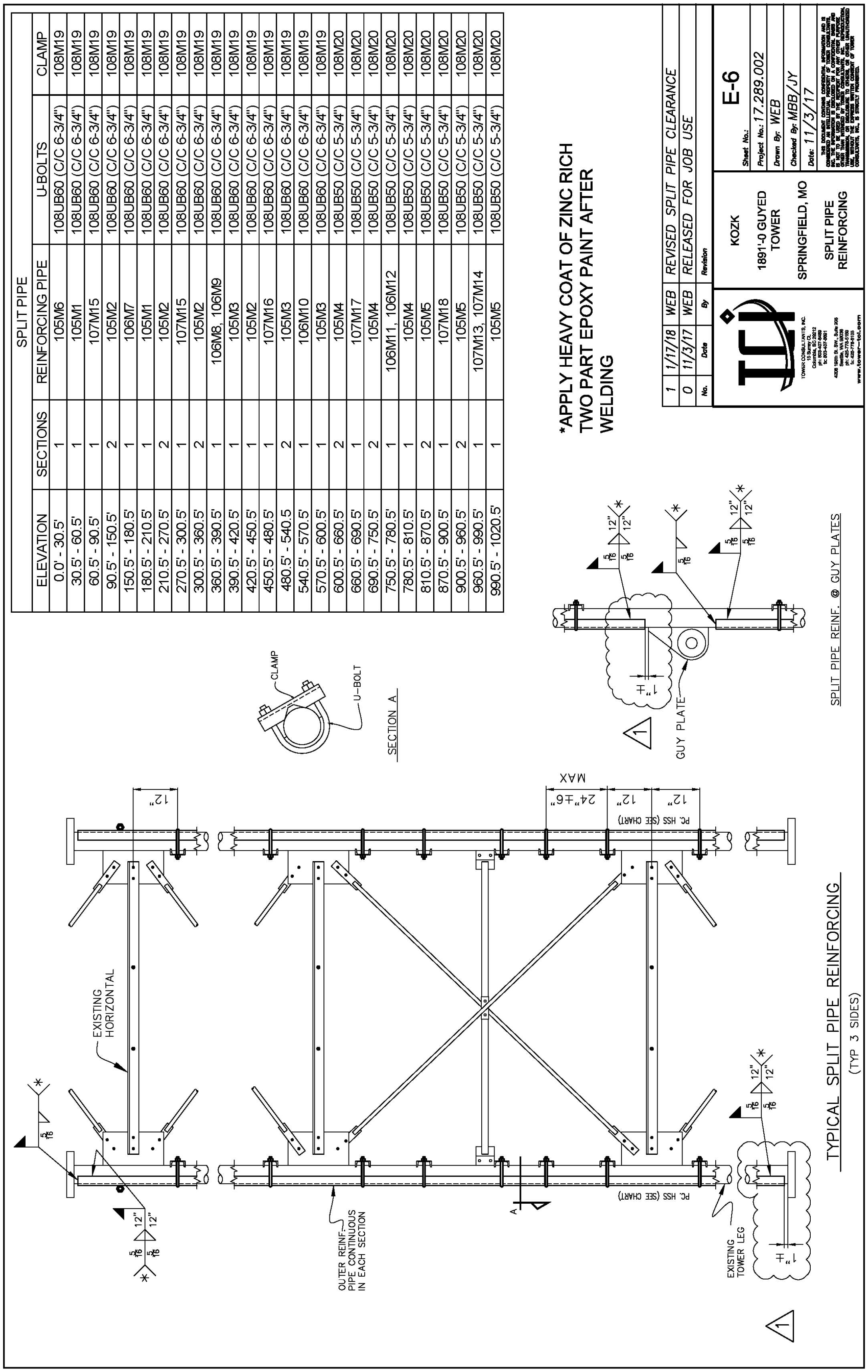
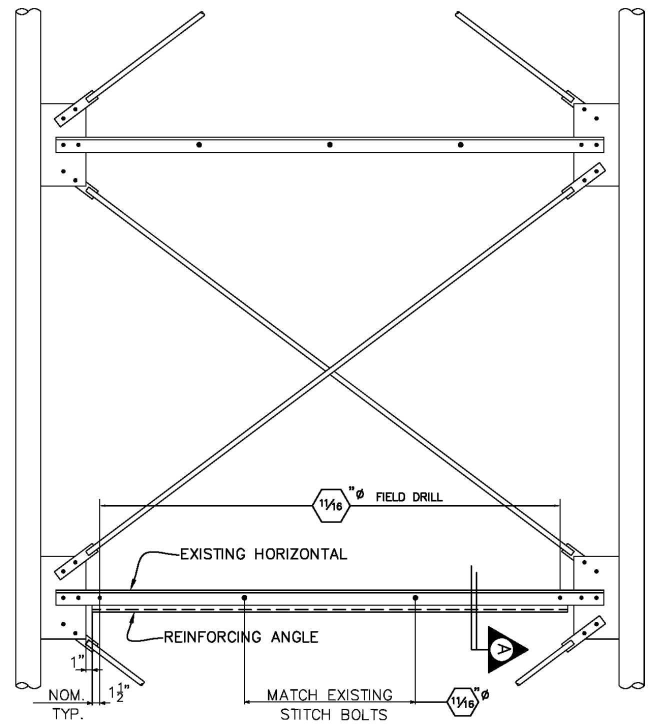
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
DIAGONAL REPLACEMENT

Sheet No.: E-5
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17



SPLIT PIPE				
ELEVATION	SECTIONS	REINFORCING PIPE	U-BOLTS	CLAMP
0.0' - 30.5'	1	105M6	108UB60 (C/C 6-3/4")	108M19
30.5' - 60.5'	1	105M1	108UB60 (C/C 6-3/4")	108M19
60.5' - 90.5'	1	107M15	108UB60 (C/C 6-3/4")	108M19
90.5' - 150.5'	2	105M2	108UB60 (C/C 6-3/4")	108M19
150.5' - 180.5'	1	106M7	108UB60 (C/C 6-3/4")	108M19
180.5' - 210.5'	1	105M1	108UB60 (C/C 6-3/4")	108M19
210.5' - 270.5'	2	105M2	108UB60 (C/C 6-3/4")	108M19
270.5' - 300.5'	1	107M15	108UB60 (C/C 6-3/4")	108M19
300.5' - 360.5'	2	105M2	108UB60 (C/C 6-3/4")	108M19
360.5' - 390.5'	1	106M8, 106M9	108UB60 (C/C 6-3/4")	108M19
390.5' - 420.5'	1	105M3	108UB60 (C/C 6-3/4")	108M19
420.5' - 450.5'	1	105M2	108UB60 (C/C 6-3/4")	108M19
450.5' - 480.5'	1	107M16	108UB60 (C/C 6-3/4")	108M19
480.5' - 540.5	2	105M3	108UB60 (C/C 6-3/4")	108M19
540.5' - 570.5'	1	106M10	108UB60 (C/C 6-3/4")	108M19
570.5' - 600.5'	1	105M3	108UB60 (C/C 6-3/4")	108M19
600.5' - 660.5'	2	105M4	108UB50 (C/C 5-3/4")	108M20
660.5' - 690.5'	1	107M17	108UB50 (C/C 5-3/4")	108M20
690.5' - 750.5'	2	105M4	108UB50 (C/C 5-3/4")	108M20
750.5' - 780.5'	1	106M11, 106M12	108UB50 (C/C 5-3/4")	108M20
780.5' - 810.5'	1	105M4	108UB50 (C/C 5-3/4")	108M20
810.5' - 870.5'	2	105M5	108UB50 (C/C 5-3/4")	108M20
870.5' - 900.5'	1	107M18	108UB50 (C/C 5-3/4")	108M20
900.5' - 960.5'	2	105M5	108UB50 (C/C 5-3/4")	108M20
960.5' - 990.5'	1	107M13, 107M14	108UB50 (C/C 5-3/4")	108M20
990.5' - 1020.5'	1	105M5	108UB50 (C/C 5-3/4")	108M20



TYPICAL STRUT REINFORCING
(TYPICAL 3 SIDES)

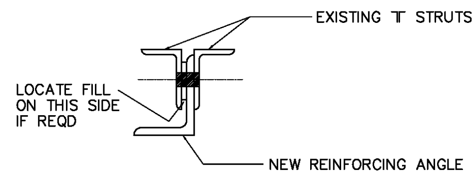
HORIZONTAL REINFORCEMENT			
ELEVATION	LEVELS	REINFORCING ANGLE	BOLTS*
590.5'	1	(3) 104S1	5/8"Ø A325X x 2-1/4"

*ALL BOLTS REQUIRE (1) HARDENED WASHER AND (1) ANCO LOCKNUT EACH

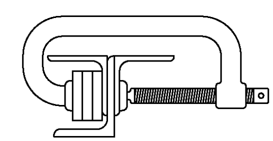
PROCEDURE TO REINFORCE DOUBLE ANGLE STRUTS

A. DOUBLE ANGLE STRUTS
1. CLAMP STRUT WITH "C" CLAMPS AND SHIMS (TACKED OR FASTENED TO THE CLAMP). USE ONE (1) CLAMP PER STITCH BOLT (LOCATED NEAR STITCH BOLT). SEE DETAIL "1" OTHER STYLE CLAMPS ARE PERMITTED PROVIDED STRUT ANGLES ARE RESTRAINED FROM MOVING HORIZONTALLY.
2. REMOVE STITCH BOLTS AND SPACERS FROM THE STRUT TO BE REINFORCED.
3. IMMEDIATELY INSERT REINFORCING ANGLE BETWEEN THE DOUBLE ANGLES, INSERT STITCH BOLTS AND TIGHTEN.
4. FIELD DRILL HOLES FOR END BOLTS AT $1\frac{1}{2}$" FROM EACH END OF THE REINFORCING ANGLE.
5. COAT ALL FIELD DRILLED HOLES WITH A ZINC RICH TWO PART EPOXY.
6. INSERT END BOLTS AND TIGHTEN.

B. OPERATIONAL CONSTRAINTS
1. NO TOWER MEMBER IS TO BE REINFORCED WHEN A WIND VELOCITY GREATER THAN 15 MPH EXISTS OR WHEN A WIND VELOCITY OF GREATER THAN 15 MPH IS PREDICTED DURING THE OPERATION OF REINFORCING THE TOWER MEMBER.
2. REINFORCE THE STRUSTS ONE AT A TIME. ONLY REINFORCE STRUTS WHEN "C" CLAMPS ARE INSTALLED.
3. THE ABOVE PROCEDURES TO BE FOLLOWED WITHOUT VARIATION.



SECTION A



DETAIL 1

No.	Date	By	Revision
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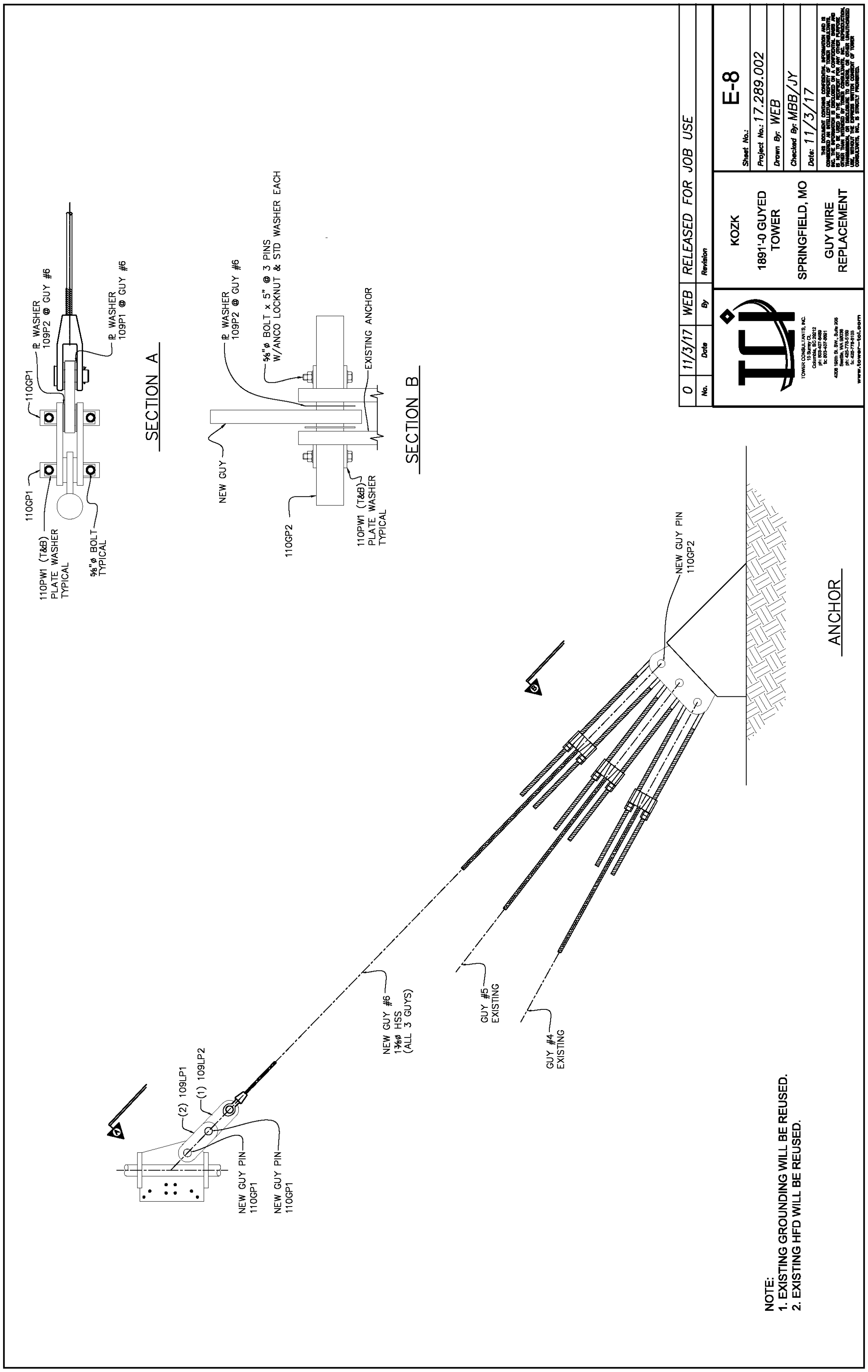
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
HORIZONTAL REINFORCING

Sheet No.: E-7
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17


PL WASHER 109P2 @ GUY #6
PL WASHER 109P1 @ GUY #6
110GP1
110PW1 (T&B) PLATE WASHER TYPICAL
SECTION A
EXISTING ANCHOR
NEW GUY
110GP2
SECTION B
NEW GUY PIN 110GP2
ANCHOR
GUY #5 EXISTING
GUY #4 EXISTING
(2) 109LP1
(1) 109LP2
NEW GUY PIN 110GP1
NOTE:
1. EXISTING GROUNDING WILL BE REUSED.
2. EXISTING HFD WILL BE REUSED.
0 11/3/17 WEB RELEASED FOR JOB USE
No. Date By Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
GUY WIRE REPLACEMENT
Sheet No.: E-8
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17

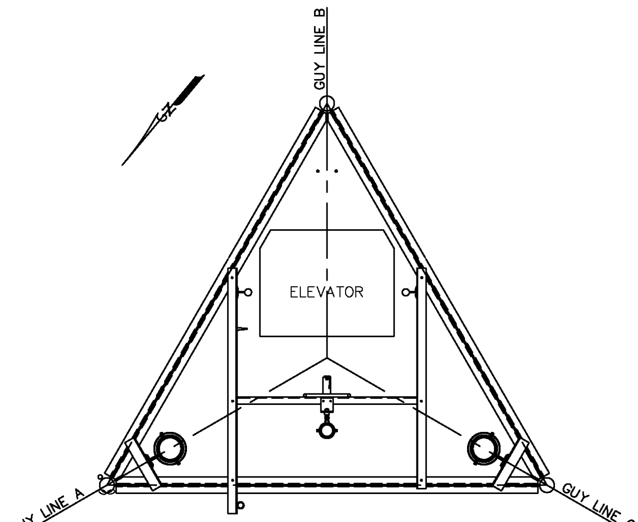
Guy Wire Initial Tension (kips)

Guy Level	Guy Elevation (ft)	Guy Size		Temp. (F) 30	40	50	60	70	80	90	100	110
9	1890.5	1-7/16" BS		28.34	28.13	27.92	27.72	27.52	27.32	27.13	26.93	26.74
8	1650.5	1-9/16" BS		33.84	33.55	33.28	33.00	32.73	32.46	32.20	31.94	31.69
7	1420.5	1-5/16" BS		21.76	21.57	21.38	21.20	21.02	20.84	20.67	20.50	20.33
6	1200.5	1-3/8" HSS		21.97	21.73	21.51	21.28	21.06	20.84	20.63	20.42	20.22
5	980.5	1-1/4" BS		17.95	17.72	17.50	17.28	17.07	16.86	16.66	16.46	16.27
4	770.5	1-1/8" BS		14.70	14.47	14.25	14.04	13.84	13.64	13.44	13.25	13.07
3	570.5	1-3/16" BS		14.67	14.36	14.06	13.76	13.47	13.20	12.93	12.66	12.41
2	370.5	1-1/16" BS		13.69	13.25	12.83	12.42	12.03	11.65	11.29	10.95	10.63
1	180.5	1-1/16" BS		18.86	18.08	17.31	16.56	15.84	15.14	14.48	13.89	13.30

Guy Wire Intercept (ft)

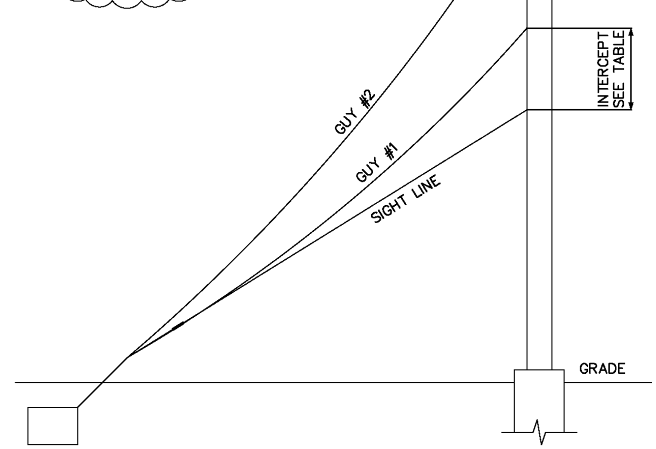
Guy Level	Guy Elevation (ft)	Guy Size	Transit Distance	Temp. (F) 30	40	50	60	70	80	90	100	110
9	1890.5	1-7/16" BS	10'	334.34	336.49	338.63	340.77	342.91	345.05	347.18	349.31	351.44
8	1650.5	1-9/16" BS	10'	283.35	285.45	287.55	289.66	291.75	293.85	295.94	298.03	300.12
7	1420.5	1-5/16" BS	10'	263.29	265.35	267.40	269.44	271.48	273.52	275.54	277.57	279.58
6	1200.5	1-3/8" HSS	10'	175.38	177.05	178.73	180.41	182.08	183.76	185.43	187.10	188.77
5	980.5	1-1/4" BS	10'	142.52	144.18	145.84	147.49	149.14	150.79	152.44	154.08	155.72
4	770.5	1-1/8" BS	10'	114.42	116.06	117.70	119.34	120.98	122.61	124.23	125.85	127.46
3	570.5	1-3/16" BS	10'	47.93	48.91	49.89	50.89	51.89	52.91	53.93	54.96	56.00
2	370.5	1-1/16" BS	10'	27.33	28.19	29.08	29.99	30.93	31.88	32.85	33.82	34.80
1	180.5	1-1/16" BS	10'	14.14	14.75	15.39	16.07	16.79	17.55	18.34	19.15	19.93

Adjust the guy wire intercept/tension based on the measurements of the guy wire in the B-line (Southeast) direction.



TYPICAL CROSS SECTION

NOTE: TENSION CHART IS ONLY VALID FOR TCI ANALYSIS REPORT 17.289.001 DATED MAY 19, 2017



ELEVATION VIEW

NOTES:

1. DURING THE INITIAL GUY TENSIONING PROCEDURES AND AT THE TIME OF INSPECTION, THE GUY TENSIONS AND/OR INTERCEPTS SHOULD BE IN ACCORDANCE WITH THE VALUES SHOWN ABOVE. USE THE TEMPERATURE WHICH ACTUALLY EXISTS AT THE TIME THE TENSION IS BEING CHECKED. FOR TEMPERATURES OTHER THAN THOSE SHOWN ABOVE, INTERPOLATE OR EXTRAPOLATE OTHER VALUES.
2. TOWER PLUMBING AND INITIAL TENSIONING OF GUYS SHOULD BE DONE ONLY IN CALM WEATHER AND WITH NO ICE ON GUYS.
3. INTERCEPTS AND TENSIONS ARE USED FOR GUY DIRECTION "B".
4. GUY #1 IS BOTTOM GUY; GUY #2 IS NEXT, ETC.
5. USE GUY SCOPE FOR DETERMINING GUY INTERCEPTS.
6. TENSION AND/OR INTERCEPT TOLERANCES ± 5%.
7. AFTER RETENSIONING FINAL SET OF GUYS GO BACK AND RECHECK ALL LEVELS, AND RETENSION WHERE REQUIRED.
8. PLUMB AND TWIST TO BE VERIFIED, RECORDED, AND IF REQUIRED ADJUSTED TO BE IN CONFORMANCE WITH ANSI/TIA-222-G.

No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

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KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
TENSION CHART

Sheet No.: E-9
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17

POST–MODIFICATION CHECKLIST

REQUIRED	SECTION	REPORT ITEM	BRIEF DESCRIPTION (SEE ENG–SOW–10007)
PRE–CONSTRUCTION			
X	6.1.1	MI CHECKLIST DRAWING	THIS CHECKLIST SHALL BE INCLUDED IN THE MI REPORT
NA	6.1.2	EOR APPROVED SHOP DRAWINGS	FABRICATION DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD FOR REVIEW. THE CONTRACTOR SHALL PROVIDE THE APPROVED SHOP DRAWINGS TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.1.3	FABRICATION INSPECTION	A LETTER FROM THE FABRICATOR, STATING THAT THE WORK WAS PERFORMED IN ACCORDANCE WITH INDUSTRY STANDARDS AND THE CONTRACT DOCUMENTS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.1.4	FABRICATOR CERTIFIED WELD INSPECTION	CRITICAL SHOP WELDS THAT REQUIRE TESTING ARE NOTED ON THESE CONTRACT DRAWINGS. A CERTIFIED WELD INSPECTOR SHALL PERFORM NON–DESTRUCTIVE TESTING AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	6.1.5	MATERIAL TEST REPORT (MTR)	MILL CERTIFICATION SHALL BE PROVIDED FOR ALL STEEL WITH A YIELD STRENGTH GREATER THAN 36 KSI AND THIS DOCUMENTATION SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.1.6	FABRICATOR NDE INSPECTION	A VISUAL OBSERVATION OF A PORTION OF THE EXISTING STRUCTURE (AS NOTED ON THESE DRAWINGS) IS REQUIRED AND A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.1.7	NDE REPORT OF MONOPOLE BASE PLATE (AS REQUIRED)	A VISUAL OBSERVATION OF THE POLE TO BASE PLATE CONNECTION IS REQUIRED AND A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	6.1.8	PACKING SLIPS	THE MATERIAL SHIPPING LIST SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
CONSTRUCTION			
X	6.2.1	CONSTRUCTION INSPECTIONS	A LETTER FROM THE GENERAL CONTRACTOR STATING THAT THE WORKMANSHIP WAS PERFORMED IN ACCORDANCE WITH INDUSTRY STANDARDS AND THESE CONTRACT DRAWINGS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.2	FOUNDATION INSPECTIONS	A VISUAL OBSERVATION OF THE EXCAVATION AND REBAR SHALL BE PERFORMED BEFORE PLACING THE CONCRETE. A WRITTEN REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.3	CONCRETE COMP. STRENGTH AND SLUMP TESTS	THE CONCRETE MIX DESIGN, SLUMP TEST, AND COMPRESSIVE STRENGTH TESTS SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.4	POST INSTALLED ANCHOR ROD VERIFICATION	POST INSTALLED ANCHOR ROD VERIFICATION SHALL BE PERFORMED IN ACCORDANCE WITH CROWN REQUIREMENTS AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.5	BASE PLATE GROUT VERIFICATION	A LETTER FROM THE GENERAL CONTRACTOR SHALL BE PROVIDED TO THE MI INSPECTOR THAT CERTIFIES THAT THE GROUT WAS INSTALLED IN ACCORDANCE WITH STANDARD INDUSTRY PRACTICES FOR INCLUSION IN THE MI REPORT.
NA	6.2.6	CONTRACTOR'S CERTIFIED WELD INSPECTION	A CERTIFIED WELD INSPECTOR SHALL INSPECT AND TEST AS NECESSARY ALL FIELD WELDS AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.7	EARTHWORK: LIFT AND DENSITY	FOUNDATION SUB–GRADES SHALL BE INSPECTED AND APPROVED BY A GEOTECHNICAL ENGINEER AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
NA	6.2.8	ON SITE COLD GALVANIZING VERIFICATION	THE GENERAL CONTRACTOR SHALL PROVIDE DOCUMENTATION TO THE MI INSPECTOR VERIFYING THAT ANY ON–SITE COLD GALVANIZING WAS APPLIED IN ACCORDANCE WITH STANDARD INDUSTRY PRACTICES.
X	6.2.9	GUY WIRE TENSION REPORT	THE GENERAL CONTRACTOR SHALL PROVIDE A REPORT TO THE MI INSPECTOR INDICATING THE TEMPERATURE AND TENSION IN EVERY GUY CABLE FOR INCLUSION IN THE MI REPORT.
X	6.2.10	GC AS–BUILT DOCUMENTS	THE GENERAL CONTRACTOR SHALL SUBMIT A COPY OF THE CONTRACT DRAWINGS EITHER STATING "INSTALLED AS DESIGNED" OR NOTING ANY CHANGES THAT WERE REQUIRED AND APPROVED BY THE ENGINEER OF RECORD DUE TO FIELD CONDITIONS.
POST–CONSTRUCTION			
X	6.3.1	MI INSPECTOR REDLINE OR RECORD DRAWING(S)	THE MI INSPECTOR SHALL OBSERVE AND REPORT ANY DISCREPANCIES BETWEEN THE CONTRACTORS REDLINE DRAWING AND THE ACTUAL COMPLETED INSTALLATION.
NA	6.3.2	POST INSTALLED ANCHOR ROD PULL–OUT TESTING	POST–INSTALLED ANCHOR RODS SHALL BE TESTED AND A REPORT SHALL BE PROVIDED TO THE MI INSPECTOR FOR INCLUSION IN THE MI REPORT.
X	6.3.3	PHOTOGRAPHS	PHOTOGRAPHS SHALL BE SUBMITTED TO THE MI WHICH DOCUMENT PHASES OF THE CONSTRUCTION. THE PHOTOS SHALL BE ORGANIZED IN A MANNER THAT EASILY IDENTIFIES THE EXACT LOCATION OF THE PHOTO.

NOTE: X DENOTES A DOCUMENT NEEDED FOR THE MI REPORT
NA DENOTES A DOCUMENT THAT IS NOT REQUIRED FOR THE MI REPORT

MODIFICATION INSPECTION NOTES:

GENERAL
THE MODIFICATION INSPECTION (MI) IS A VISUAL INSPECTION OF TOWER MODIFICATIONS AND A REVIEW OF CONSTRUCTION INSPECTIONS AND OTHER REPORTS TO ENSURE THE INSTALLATION WAS CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, NAMELY THE MODIFICATION DRAWINGS, AS DESIGNED BY THE ENGINEER OF RECORD (EOR).

THE MI IS TO CONFIRM INSTALLATION CONFIGURATION AND WORKMANSHIP ONLY AND IS NOT A REVIEW OF THE MODIFICATION DESIGN ITSELF, NOR DOES THE MI INSPECTOR TAKE OWNERSHIP OF THE MODIFICATION DESIGN. OWNERSHIP OF THE STRUCTURAL MODIFICATION DESIGN EFFECTIVENESS AND INTEGRITY RESIDES WITH THE EOR AT ALL TIMES.

ALL MI'S SHALL BE CONDUCTED BY A TOWER CONSULTANT, INC. (TCI) ENGINEERING OR ENGINEERING SERVICE VENDOR (AESV) THAT IS APPROVED TO PERFORM ELEVATED WORK.

TO ENSURE THAT THE REQUIREMENTS OF THE MI ARE MET, IT IS VITAL THAT THE GENERAL CONTRACTOR (GC) AND THE MI INSPECTOR BEGIN COMMUNICATING AND COORDINATING AS SOON AS A PO IS RECEIVED. IT IS EXPECTED THAT EACH PARTY WILL BE PROACTIVE IN REACHING OUT TO THE OTHER PARTY.

MI INSPECTOR
THE MI INSPECTOR IS REQUIRED TO CONTACT THE GC AS SOON AS RECEIVING A PO FOR THE MI TO, AT A MINIMUM:

- REVIEW THE REQUIREMENTS OF THE MI CHECKLIST
- WORK WITH THE GC TO DEVELOP A SCHEDULE TO CONDUCT ON–SITE INSPECTIONS, INCLUDING FOUNDATION INSPECTIONS

THE MI INSPECTOR IS RESPONSIBLE FOR COLLECTING ALL GENERAL CONTRACTOR (GC) INSPECTION AND TEST REPORTS, REVIEWING THE DOCUMENTS FOR ADHERENCE TO THE CONTRACT DOCUMENTS, CONDUCTING THE IN–FIELD INSPECTIONS, AND SUBMITTING THE MI REPORT TO CROWN.

GENERAL CONTRACTOR
THE GC IS REQUIRED TO CONTACT THE MI INSPECTOR AS SOON AS RECEIVING A PO FOR THE MODIFICATION INSTALLATION OR TURNKEY PROJECT TO, AT A MINIMUM:

- REVIEW THE REQUIREMENTS OF THE MI CHECKLIST
- WORK WITH THE MI INSPECTOR TO DEVELOP A SCHEDULE TO CONDUCT ON–SITE INSPECTIONS, INCLUDING FOUNDATION INSPECTIONS
- BETTER UNDERSTAND ALL INSPECTION AND TESTING REQUIREMENTS

THE GC SHALL PERFORM AND RECORD THE TEST AND INSPECTION RESULTS IN ACCORDANCE WITH THE REQUIREMENTS OF THE MI CHECKLIST.

RECOMMENDATIONS
THE FOLLOWING RECOMMENDATIONS AND SUGGESTIONS ARE OFFERED TO ENHANCE THE EFFICIENCY AND EFFECTIVENESS OF DELIVERING A MI REPORT:

- IT IS SUGGESTED THAT THE GC PROVIDE A MINIMUM OF 5 BUSINESS DAYS NOTICE, PREFERABLE 10, TO THE MI INSPECTOR AS TO WHEN THE SITE WILL BE READY FOR THE MI TO BE CONDUCTED.
- THE GC AND MI INSPECTOR COORDINATE CLOSELY THROUGHOUT THE ENTIRE PROJECT.
- IT IS PREFERRED TO HAVE THE GC AND MI INSPECTOR ON–SITE SIMULTANEOUSLY FOR ANY GUY WIRE TENSIONING OR RE–TENSIONING OPERATIONS
- IT MAY BE BENEFICIAL TO INSTALL ALL TOWER MODIFICATIONS PRIOR TO CONDUCTING THE FOUNDATION INSPECTIONS TO ALLOW FOUNDATION AND MI INSPECTION(S) TO COMMENCE WITH ONE SITE VISIT.
- IT IS PREFERRED TO HAVE THE GC AND MI INSPECTOR ON–SITE DURING THE MI TO HAVE ANY DEFICIENCIES CORRECTED DURING THE INITIAL MI. THEREFORE, THE GC MAY CHOOSE TO COORDINATE THE MI CAREFULLY TO ENSURE ALL CONSTRUCTION FACILITIES ARE AT THEIR DISPOSAL WHEN THE MI INSPECTOR IS ON SITE.

CANCELLATION OR DELAYS IN SCHEDULED MI
IF THE GC AND MI INSPECTOR AGREE TO A DATE ON WHICH THE MI WILL BE CONDUCTED, AND EITHER PARTY CANCELS OR DELAYS, TCI SHALL NOT BE RESPONSIBLE FOR ANY COSTS, FEES, LOSS OF DEPOSITS AND/OR OTHER PENALTIES RELATED TO THE CANCELLATION OR DELAY INCURRED BY EITHER PARTY FOR ANY TIME (E.G. TRAVEL AND LODGING, COSTS OF KEEPING EQUIPMENT ON–SITE, ETC.). IF TCI CONTRACTS DIRECTLY FOR A THIRD PARTY MI, EXCEPTIONS MAY BE MADE IN THE EVENT THAT THE DELAY/CANCELLATION IS CAUSED BY WEATHER OR OTHER CONDITIONS THAT MAY COMPROMISE THE SAFETY OF THE PARTIES INVOLVED.

CORRECTION OF FAILING MI'S
IF THE MODIFICATION INSTALLATION WOULD FAIL THE MI ("FAILED MI"), THE GC SHALL WORK WITH CUSTOMER TO COORDINATE A REMEDIATION PLAN IN ONE OF TWO WAYS:

- CORRECT FAILING ISSUES TO COMPLY WITH THE SPECIFICATIONS CONTAINED IN THE ORIGINAL CONTRACT DOCUMENTS AND COORDINATE A SUPPLEMENT MI.
- OR, WITH THE CUSTOMERS APPROVAL, THE GC MAY WORK WITH THE EOR TO RE–ANALYZE THE MODIFICATION/REINFORCEMENT USING THE AS–BUILT CONDITION

MI VERIFICATION INSPECTIONS
TCI RESERVES THE RIGHT TO CONDUCT A MI VERIFICATION INSPECTION TO VERIFY THE ACCURACY AND COMPLETENESS OF PREVIOUSLY COMPLETED MI INSPECTION(S) ON TOWER MODIFICATION PROJECTS.

ALL VERIFICATION INSPECTIONS SHALL BE HELD TO THE SAME SPECIFICATIONS AND REQUIREMENTS IN THE CONTRACT DOCUMENTS.

VERIFICATION INSPECTION MAY BE CONDUCTED BY AN INDEPENDENT AESV FIRM AFTER A MODIFICATION PROJECT IS COMPLETED, AS MARKED BY THE DATE OF AN ACCEPTED "PASSING MI" OR "PASS AS NOTED MI" REPORT FOR THE ORIGINAL PROJECT.

PHOTOS
BETWEEN THE GC AND THE MI INSPECTOR THE FOLLOWING PHOTOGRAPHS, AT A MINIMUM, ARE TO BE TAKEN AND INCLUDED IN THE MI REPORT:

- PRE–CONSTRUCTION GENERAL SITE CONDITION
- PHOTOGRAPHS DURING THE REINFORCEMENT MODIFICATION CONSTRUCTION/ERECTION AND INSPECTION
  - FOUNDATION MODIFICATIONS
  - FINAL INSTALLED CONDITION
- POST CONSTRUCTION PHOTOGRAPHS
  - FINAL INFIELD CONDITION

PHOTOS OF ELEVATED MODIFICATIONS TAKEN FROM THE GROUND SHALL BE CONSIDERED INADEQUATE.

No.	Date	By	Revision
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15 Surrey Ct.
Columbia, SC 29212
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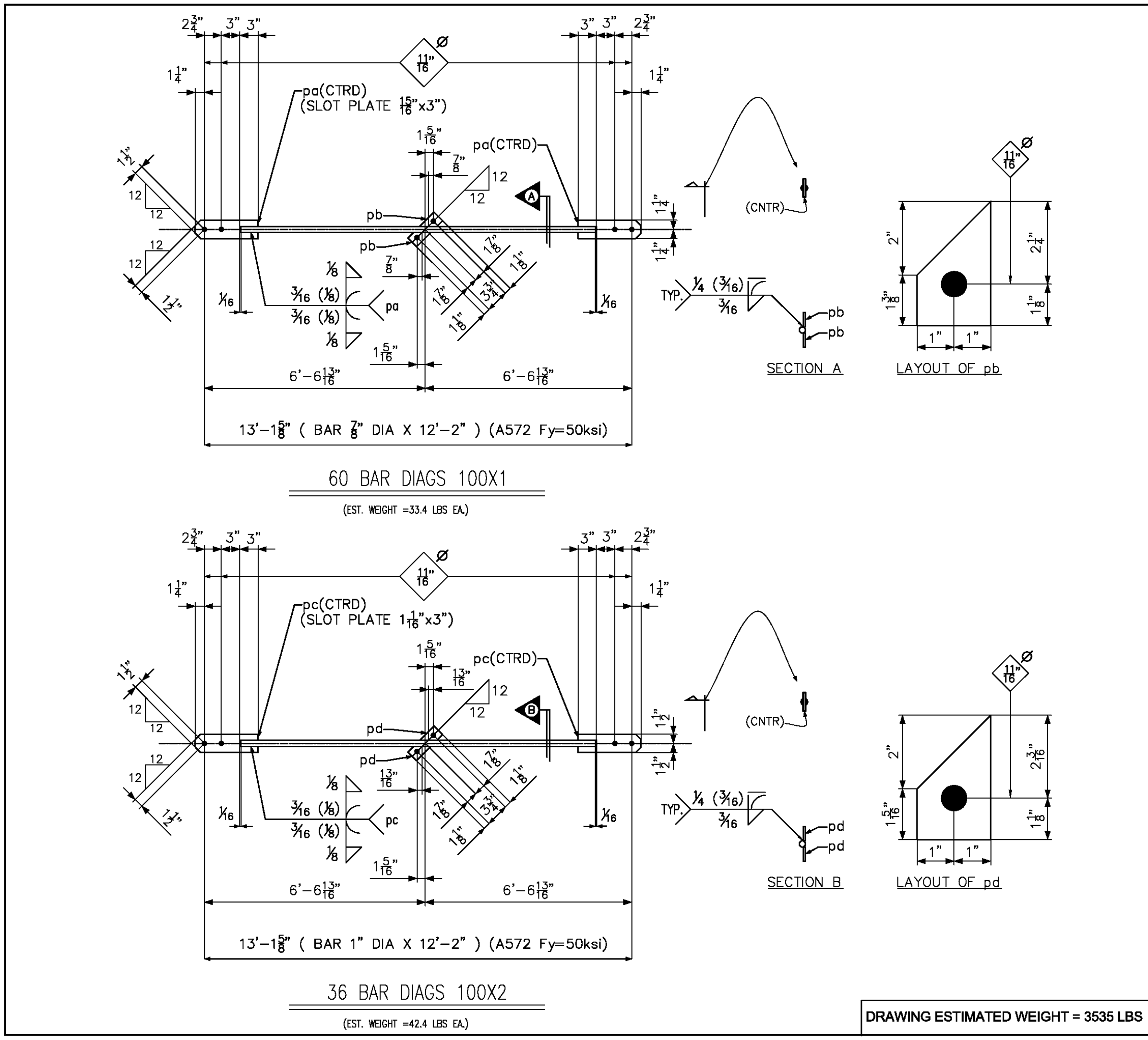
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
POST MODIFICATION CHECKLIST

Sheet No.: E-10
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17

Appendix B

FABRICATION DRAWINGS
(PREPARED BY TCI)



DRAWING ESTIMATED WEIGHT = 3535 LBS

SHOP BILL OF MATERIAL

Quan	Mark	Description	Ft.	Inches	Spec/Remarks
60	100X1	BAR DIAG			
60		BAR ⅞"ø	12	2	A572-50
120	pa	PL½x2½	0	10	
120	pb	PL⅜x2	0	3⅜	
240		⅝ø A325-X BOLT	0	2	W/(1)-ANCO LKNT, (1)-WASHER EACH
60		⅝ø A325-X BOLT	0	3	W/(1)-ANCO LKNT, (1)-WASHER EACH
36	100X2	BAR DIAG			
36		BAR 1"ø	12	2	A572-50
72	pc	PL½x3	0	10	
72	pd	PL⅜x2	0	3 5/16	
144		⅝ø A490-X BOLT	0	2	W/(1)-ANCO LKNT, (1)-WASHER EACH
36		⅝ø A325-X BOLT	0	3	W/(1)-ANCO LKNT, (1)-WASHER EACH

GENERAL NOTES

1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH:
   a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.

No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

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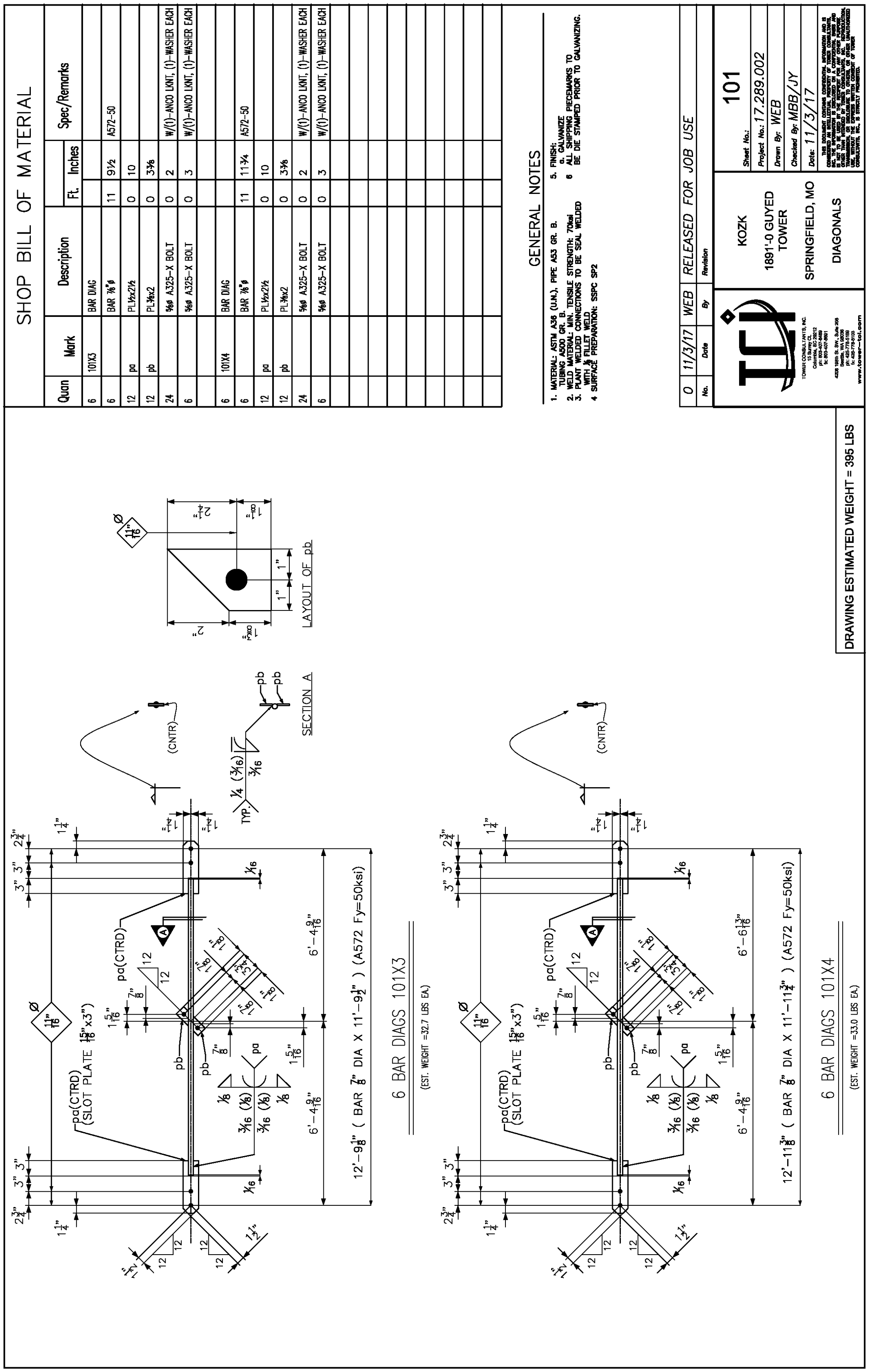
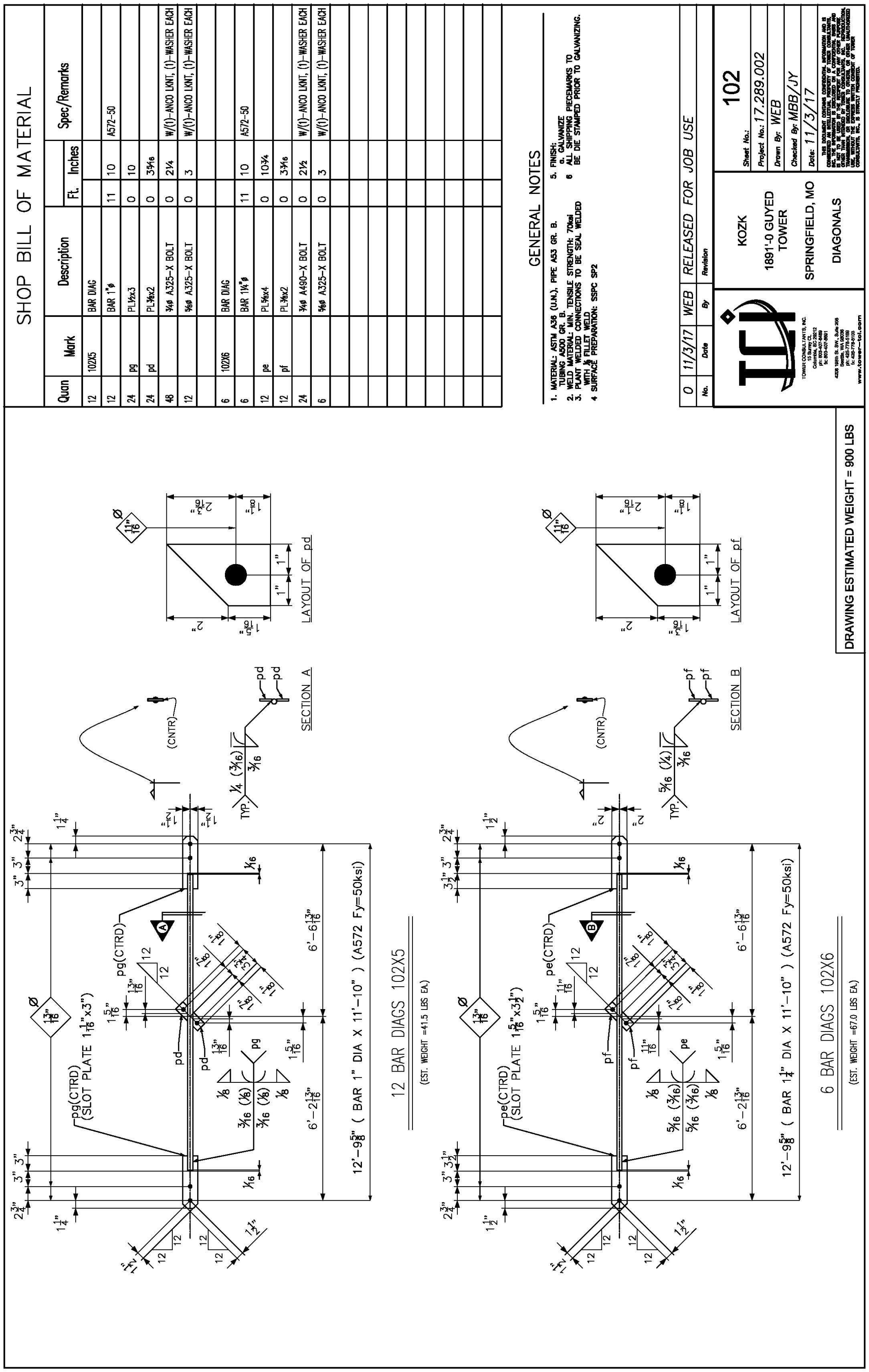
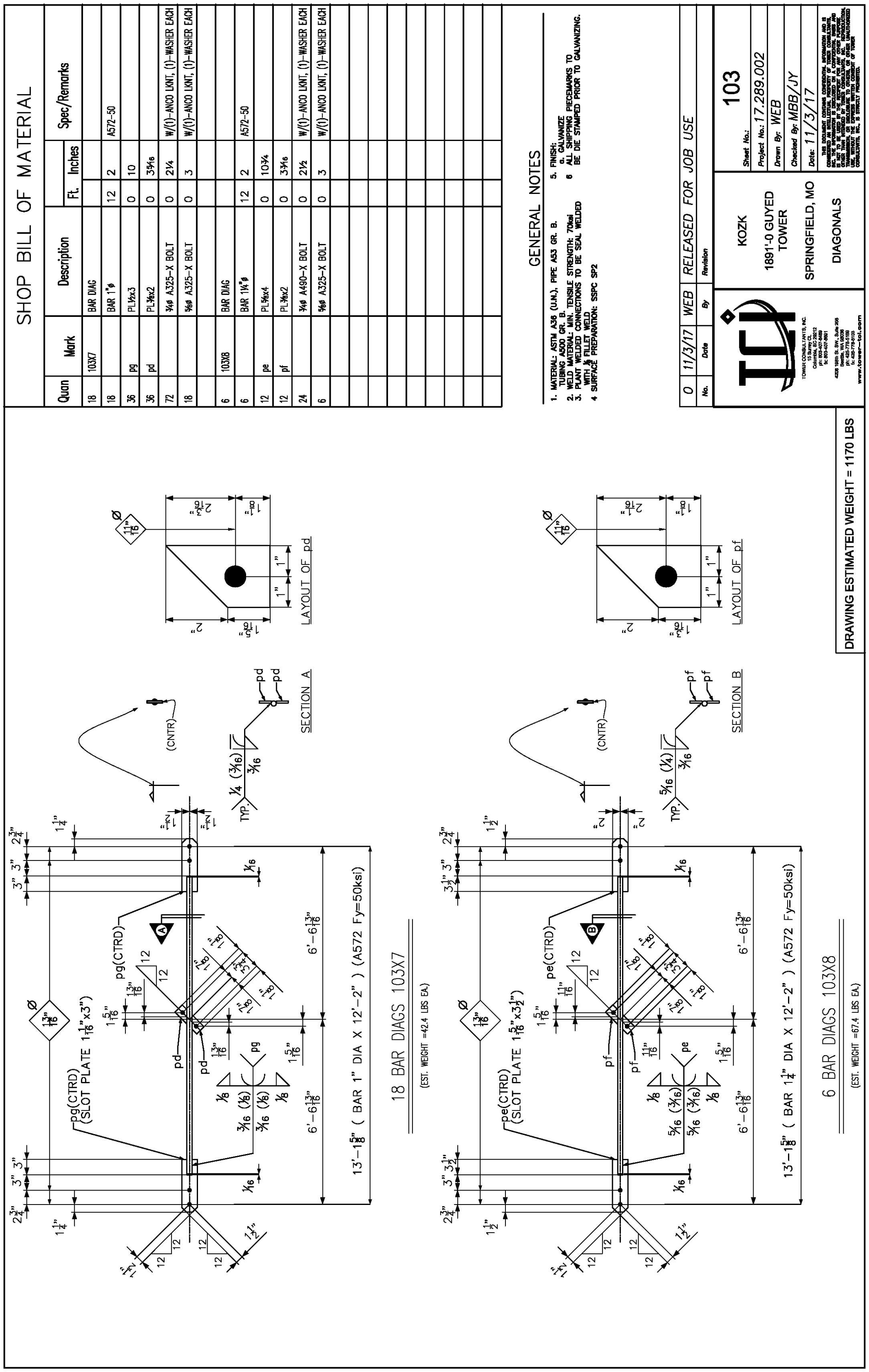
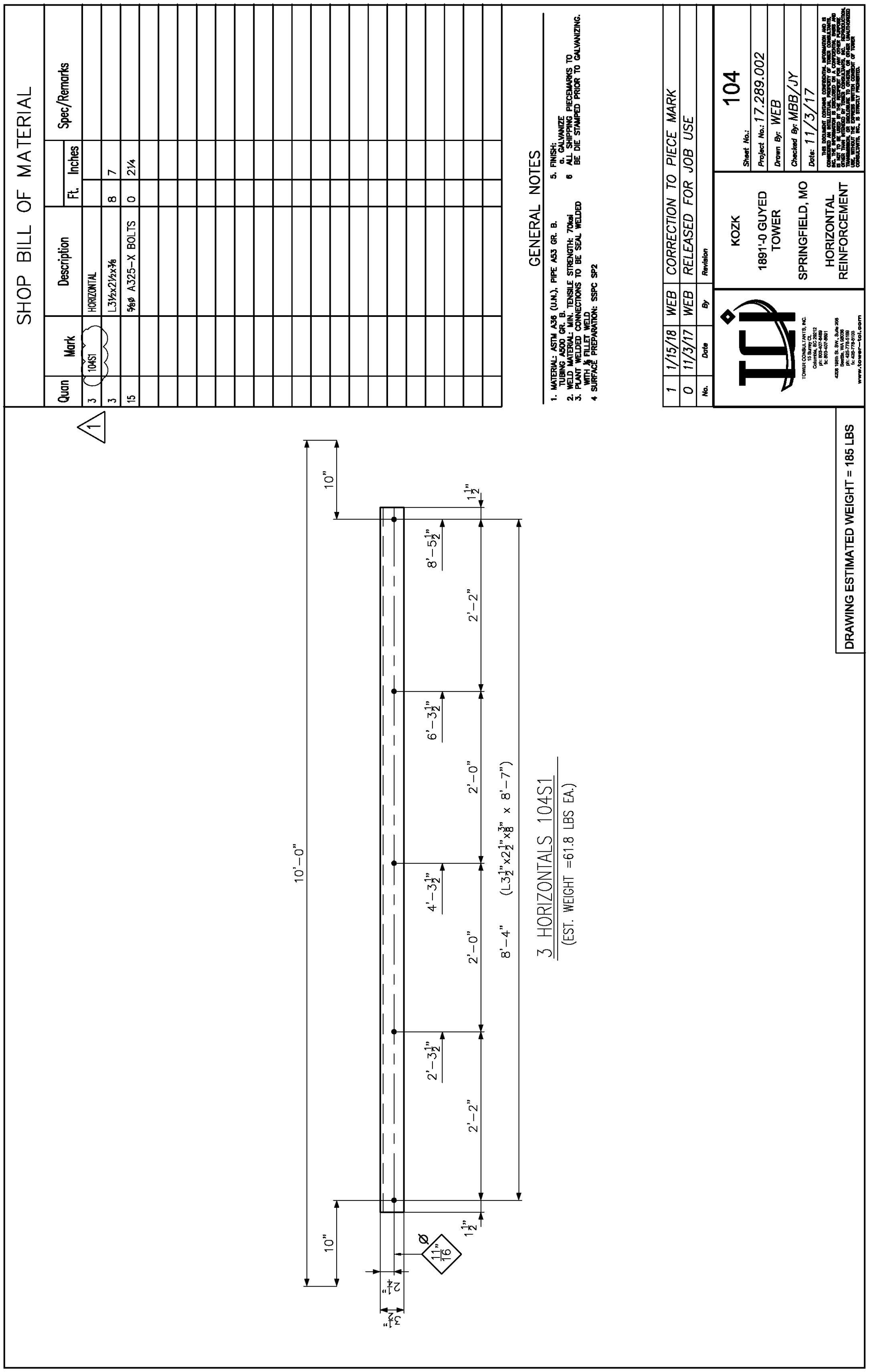
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
DIAGONALS

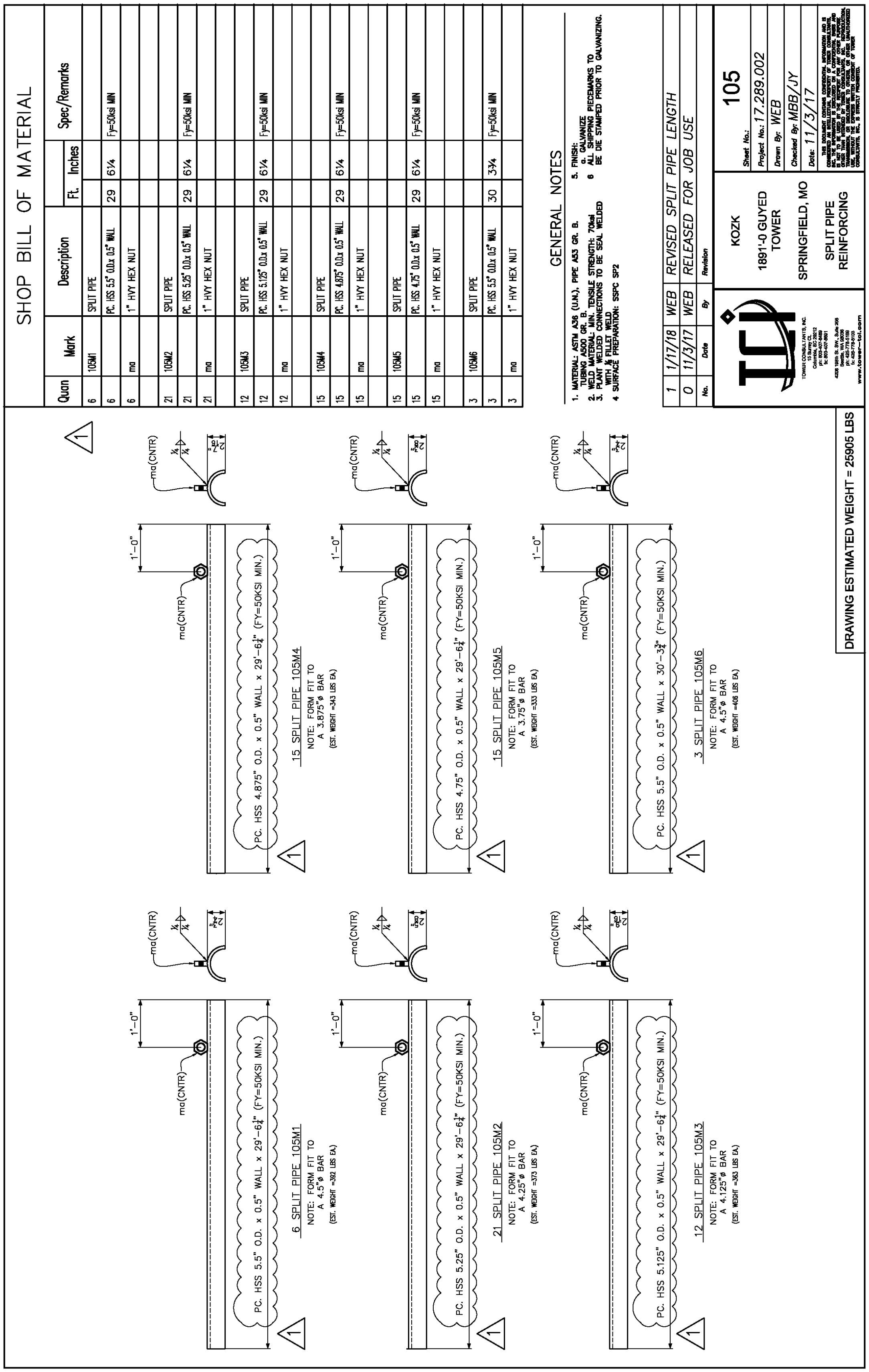
Sheet No.: 100
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17


SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
6 | 101X3 | BAR DIAG
6 | BAR 7/8"Ø | 11 | 9½ | A572-50
12 | pa | PL½x2½ | 0 | 10
12 | pb | PL3/8x2 | 0 | 3⅜
24 | 5/8Ø A325-X BOLT | 0 | 2 | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | 5/8Ø A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | 101X4 | BAR DIAG
6 | BAR 7/8"Ø | 11 | 11¾ | A572-50
12 | pa | PL½x2½ | 0 | 10
12 | pb | PL3/8x2 | 0 | 3⅜
24 | 5/8Ø A325-X BOLT | 0 | 2 | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | 5/8Ø A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH 3/16 FILLET WELD
4. SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6. ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
TCI
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
DIAGONALS
Sheet No.: 101
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
DRAWING ESTIMATED WEIGHT = 395 LBS
LAYOUT OF pb
SECTION A
(CNTR)
pa(CTRD)
pa(CTRD) (SLOT PLATE 15/16"x3")
6'-4 9/16"
12'-9⅛" (BAR 7/8" DIA X 11'-9½") (A572 Fy=50ksi)
6 BAR DIAGS 101X3
(EST. WEIGHT =32.7 LBS EA.)
6'-6 13/16"
12'-11⅜" (BAR 7/8" DIA X 11'-11¾") (A572 Fy=50ksi)
6 BAR DIAGS 101X4
(EST. WEIGHT =33.0 LBS EA.)


SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
12 | 102X5 | BAR DIAG
12 | | BAR 1"ϕ | 11 | 10 | A572-50
24 | pg | PL½x3 | 0 | 10
24 | pd | PL⅜x2 | 0 | 3⅝
48 | | ¾ϕ A325-X BOLT | 0 | 2¼ | W/(1)-ANCO LKNT, (1)-WASHER EACH
12 | | ⅝ϕ A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | 102X6 | BAR DIAG
6 | | BAR 1¼"ϕ | 11 | 10 | A572-50
12 | pe | PL⅝x4 | 0 | 10¾
12 | pf | PL⅜x2 | 0 | 3⅝
24 | | ¾ϕ A490-X BOLT | 0 | 2½ | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | | ⅝ϕ A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH 3/16 FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
DIAGONALS
Sheet No.: 102
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
DRAWING ESTIMATED WEIGHT = 900 LBS
LAYOUT OF pd
LAYOUT OF pf
SECTION A
SECTION B
(CNTR)
pg(CTRD) (SLOT PLATE 1 1/16"x3")
pe(CTRD) (SLOT PLATE 1 5/16"x3 1/2")
12'-9 5/8" (BAR 1" DIA X 11'-10") (A572 Fy=50ksi)
12'-9 5/8" (BAR 1 1/4" DIA X 11'-10") (A572 Fy=50ksi)
6'-2 13/16"
6'-6 13/16"
12 BAR DIAGS 102X5
(EST. WEIGHT =41.5 LBS EA.)
6 BAR DIAGS 102X6
(EST. WEIGHT =67.0 LBS EA.)

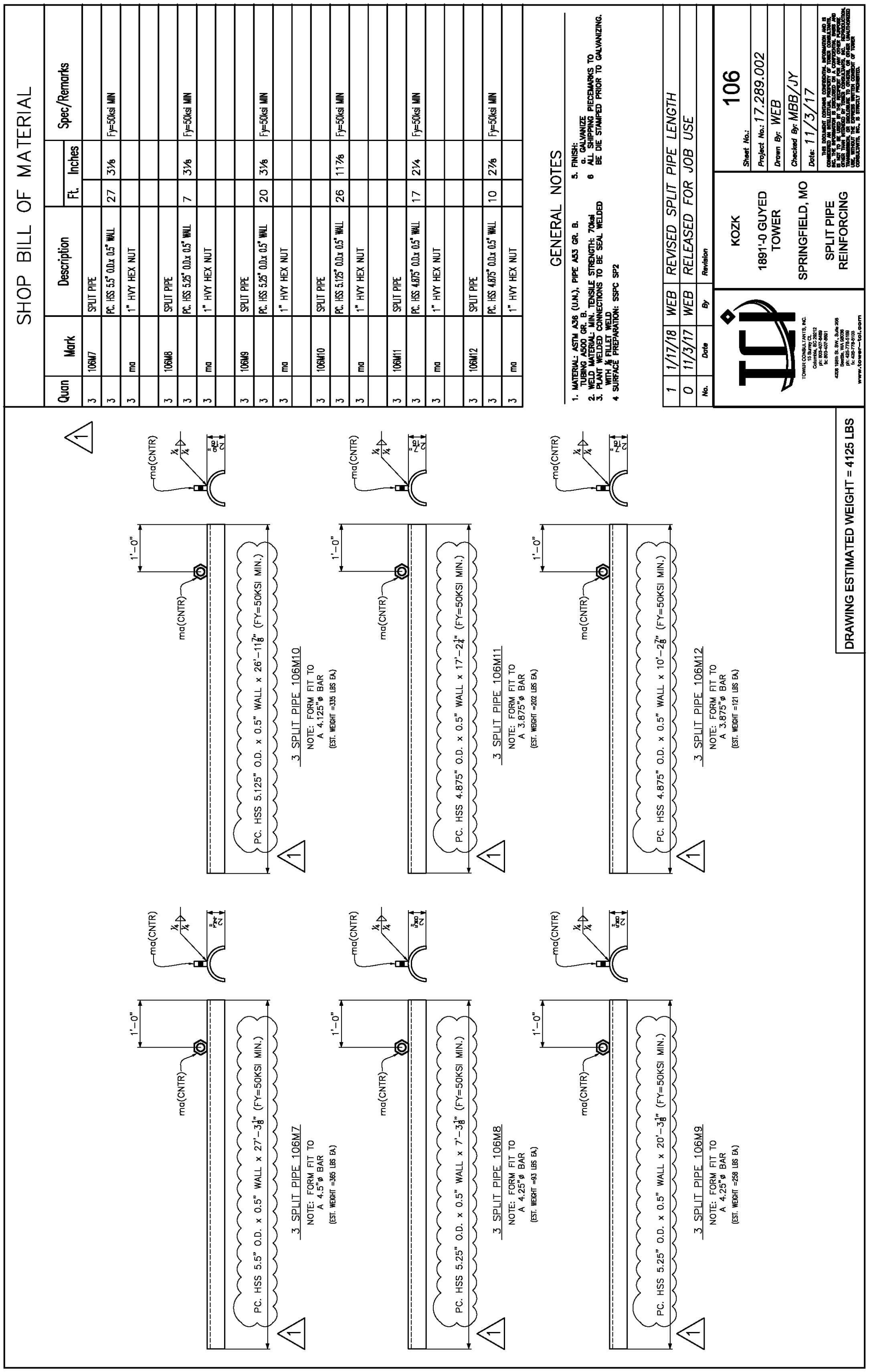

SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
18 | 103X7 | BAR DIAG
18 | | BAR 1"ϕ | 12 | 2 | A572-50
36 | pg | PL½x3 | 0 | 10
36 | pd | PL⅜x2 | 0 | 3⁹⁄₁₆
72 | | ¾ϕ A325-X BOLT | 0 | 2¼ | W/(1)-ANCO LKNT, (1)-WASHER EACH
18 | | ⅝ϕ A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | 103X8 | BAR DIAG
6 | | BAR 1¼"ϕ | 12 | 2 | A572-50
12 | pe | PL⅝x4 | 0 | 10¾
12 | pf | PL⅜x2 | 0 | 3⁹⁄₁₆
24 | | ¾ϕ A490-X BOLT | 0 | 2½ | W/(1)-ANCO LKNT, (1)-WASHER EACH
6 | | ⅝ϕ A325-X BOLT | 0 | 3 | W/(1)-ANCO LKNT, (1)-WASHER EACH
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4. SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6. ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
DIAGONALS
Sheet No.: 103
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
DRAWING ESTIMATED WEIGHT = 1170 LBS
LAYOUT OF pd
LAYOUT OF pf
SECTION A
SECTION B
(CNTR)
pg(CTRD) (SLOT PLATE 1¹⁄₁₆"x3")
pe(CTRD) (SLOT PLATE 1⁵⁄₁₆"x3½")
13'-1⅝" (BAR 1" DIA X 12'-2") (A572 Fy=50ksi)
13'-1⅝" (BAR 1¼" DIA X 12'-2") (A572 Fy=50ksi)
6'-6¹³⁄₁₆"
18 BAR DIAGS 103X7
(EST. WEIGHT =42.4 LBS EA.)
6 BAR DIAGS 103X8
(EST. WEIGHT =67.4 LBS EA.)

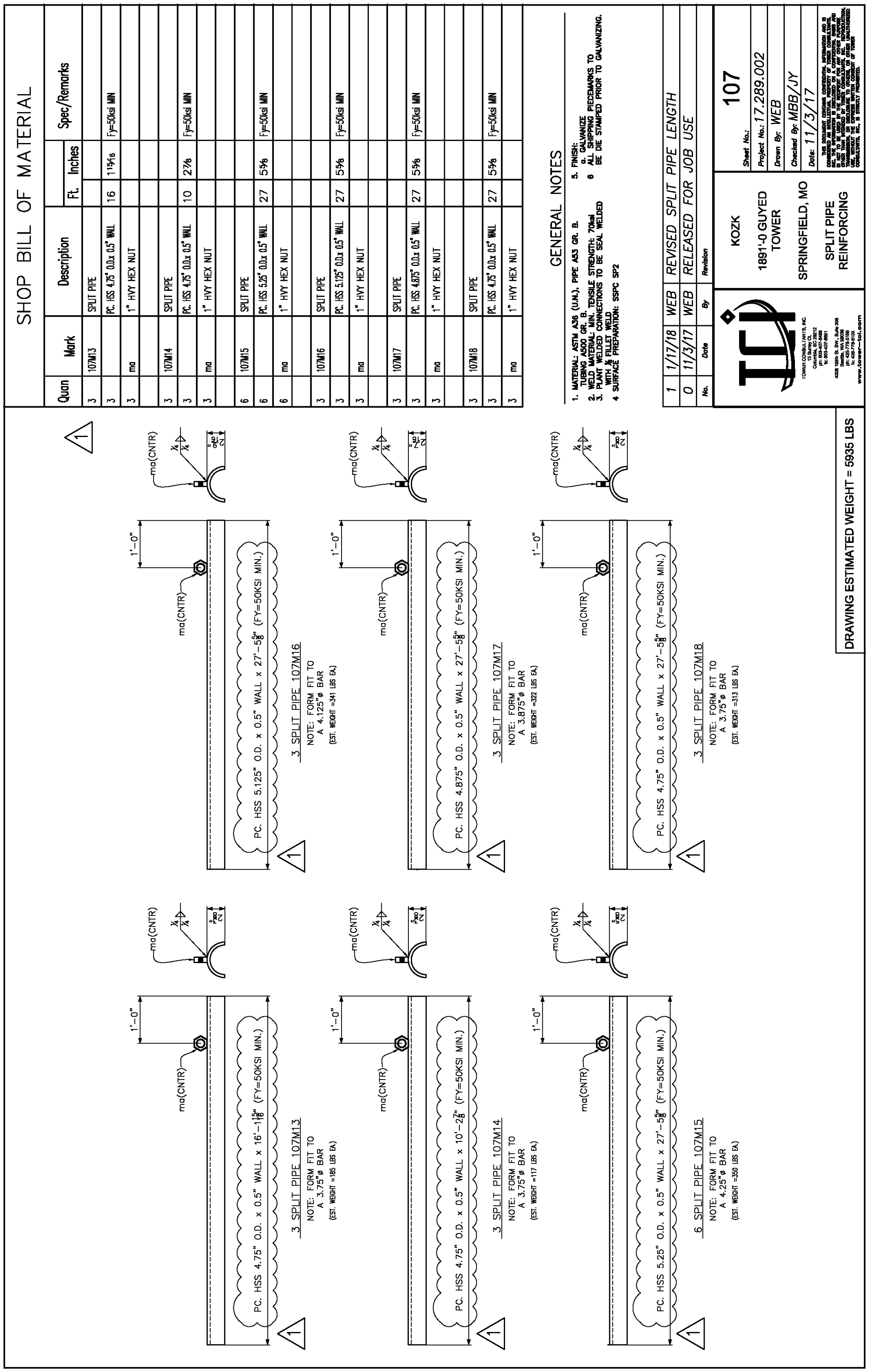

SHOP BILL OF MATERIAL
Quan
Mark
Description
Ft.
Inches
Spec/Remarks
3
104S1
HORIZONTAL
3
L3½x2½x⅜
8
7
15
⅝ø A325-X BOLTS
0
2¼
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED
4 SURFACE PREPARATION: SSPC SP2
5. FINISH:
a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
1
1/15/18
WEB
CORRECTION TO PIECE MARK
0
11/3/17
WEB
RELEASED FOR JOB USE
No.
Date
By
Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
HORIZONTAL REINFORCEMENT
Sheet No.: 104
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
www.tower-tci.com
DRAWING ESTIMATED WEIGHT = 185 LBS
10'-0"
10"
10"
1½"
8'-5½"
6'-3½"
4'-3½"
2'-3½"
2'-2"
2'-0"
2'-0"
2'-2"
8'-4"
(L3½"x2½"x⅜" x 8'-7")
3 HORIZONTALS 104S1
(EST. WEIGHT =61.8 LBS EA.)
ø 11/16"



SHOP BILL OF MATERIAL

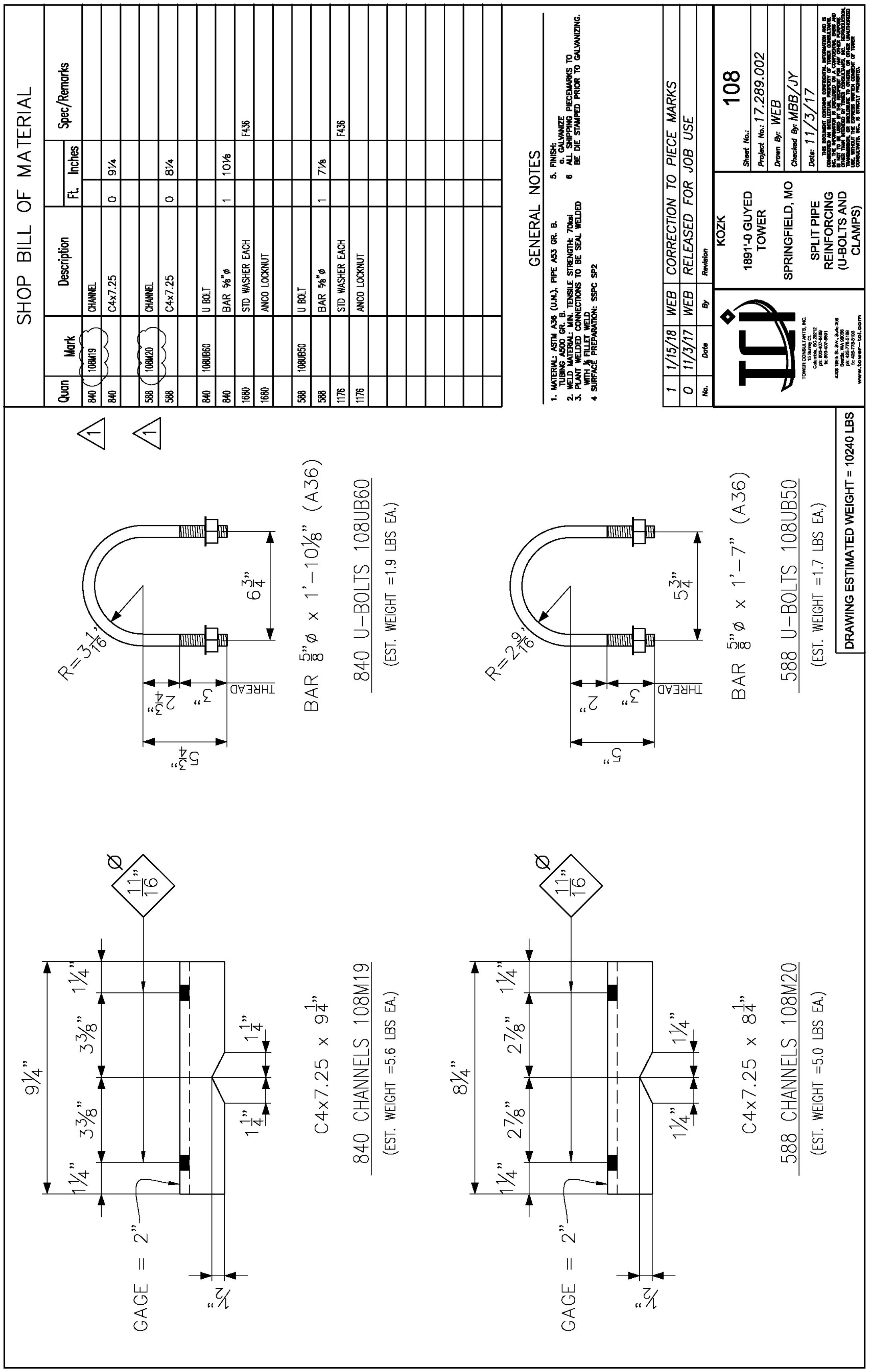
Quan	Mark	Description	Ft.	Inches	Spec/Remarks
6	105M1	SPLIT PIPE			
6		PC. HSS 5.5" O.D.x 0.5" WALL	29	6¼	Fy=50ksi MIN
6	ma	1" HVY HEX NUT			
21	105M2	SPLIT PIPE			
21		PC. HSS 5.25" O.D.x 0.5" WALL	29	6¼	Fy=50ksi MIN
21	ma	1" HVY HEX NUT			
12	105M3	SPLIT PIPE			
12		PC. HSS 5.125" O.D.x 0.5" WALL	29	6¼	Fy=50ksi MIN
12	ma	1" HVY HEX NUT			
15	105M4	SPLIT PIPE			
15		PC. HSS 4.875" O.D.x 0.5" WALL	29	6¼	Fy=50ksi MIN
15	ma	1" HVY HEX NUT			
15	105M5	SPLIT PIPE			
15		PC. HSS 4.75" O.D.x 0.5" WALL	29	6¼	Fy=50ksi MIN
15	ma	1" HVY HEX NUT			
3	105M6	SPLIT PIPE			
3		PC. HSS 5.5" O.D.x 0.5" WALL	30	3¾	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			

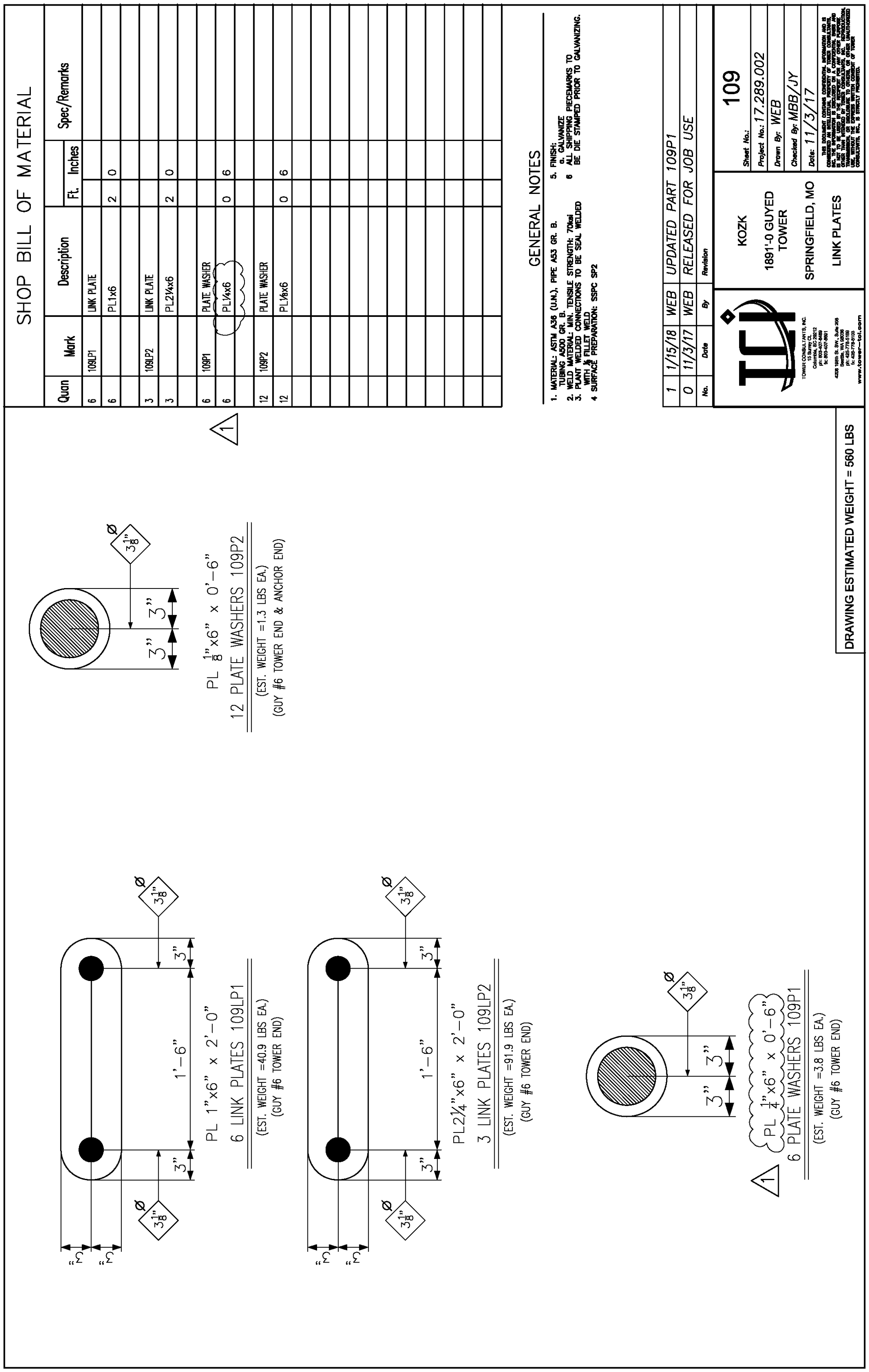

SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
3 | 106M7 | SPLIT PIPE
3 | PC. HSS 5.5" O.D.x 0.5" WALL | 27 | 3⅛ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
3 | 106M8 | SPLIT PIPE
3 | PC. HSS 5.25" O.D.x 0.5" WALL | 7 | 3⅛ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
3 | 106M9 | SPLIT PIPE
3 | PC. HSS 5.25" O.D.x 0.5" WALL | 20 | 3⅛ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
3 | 106M10 | SPLIT PIPE
3 | PC. HSS 5.125" O.D.x 0.5" WALL | 26 | 11⅞ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
3 | 106M11 | SPLIT PIPE
3 | PC. HSS 4.875" O.D.x 0.5" WALL | 17 | 2¼ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
3 | 106M12 | SPLIT PIPE
3 | PC. HSS 4.875" O.D.x 0.5" WALL | 10 | 2⅞ | Fy=50ksi MIN
3 | ma | 1" HVY HEX NUT
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
1 | 1/17/18 | WEB | REVISED SPLIT PIPE LENGTH
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
SPLIT PIPE REINFORCING
106
Sheet No.:
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
TOWER CONSULTANTS, INC.
www.tower-tci.com
DRAWING ESTIMATED WEIGHT = 4125 LBS
PC. HSS 5.5" O.D. x 0.5" WALL x 27'-3⅛" (FY=50KSI MIN.)
3 SPLIT PIPE 106M7
NOTE: FORM FIT TO A 4.5"ø BAR
(EST. WEIGHT =365 LBS EA.)
PC. HSS 5.25" O.D. x 0.5" WALL x 7'-3⅛" (FY=50KSI MIN.)
3 SPLIT PIPE 106M8
NOTE: FORM FIT TO A 4.25"ø BAR
(EST. WEIGHT =93 LBS EA.)
PC. HSS 5.25" O.D. x 0.5" WALL x 20'-3⅛" (FY=50KSI MIN.)
3 SPLIT PIPE 106M9
NOTE: FORM FIT TO A 4.25"ø BAR
(EST. WEIGHT =258 LBS EA.)
PC. HSS 5.125" O.D. x 0.5" WALL x 26'-11⅞" (FY=50KSI MIN.)
3 SPLIT PIPE 106M10
NOTE: FORM FIT TO A 4.125"ø BAR
(EST. WEIGHT =335 LBS EA.)
PC. HSS 4.875" O.D. x 0.5" WALL x 17'-2¼" (FY=50KSI MIN.)
3 SPLIT PIPE 106M11
NOTE: FORM FIT TO A 3.875"ø BAR
(EST. WEIGHT =202 LBS EA.)
PC. HSS 4.875" O.D. x 0.5" WALL x 10'-2⅞" (FY=50KSI MIN.)
3 SPLIT PIPE 106M12
NOTE: FORM FIT TO A 3.875"ø BAR
(EST. WEIGHT =121 LBS EA.)
ma(CNTR)
1'-0"

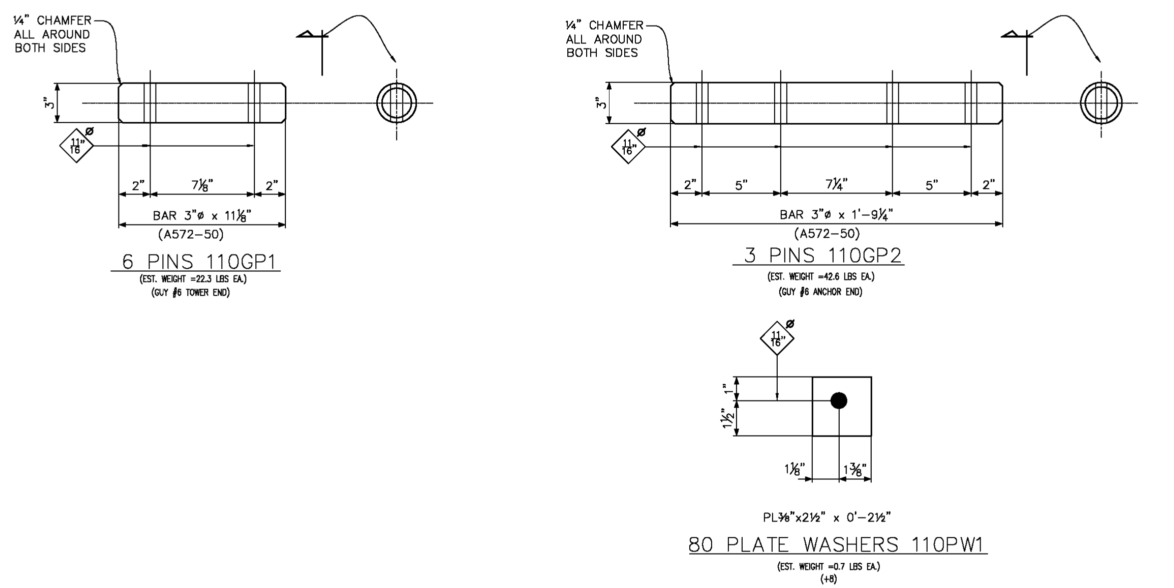


SHOP BILL OF MATERIAL

Quan	Mark	Description	Ft.	Inches	Spec/Remarks
3	107M13	SPLIT PIPE			
3		PC. HSS 4.75" O.D.x 0.5" WALL	16	1 15/16	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			
3	107M14	SPLIT PIPE			
3		PC. HSS 4.75" O.D.x 0.5" WALL	10	2 7/8	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			
6	107M15	SPLIT PIPE			
6		PC. HSS 5.25" O.D.x 0.5" WALL	27	5 5/8	Fy=50ksi MIN
6	ma	1" HVY HEX NUT			
3	107M16	SPLIT PIPE			
3		PC. HSS 5.125" O.D.x 0.5" WALL	27	5 5/8	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			
3	107M17	SPLIT PIPE			
3		PC. HSS 4.875" O.D.x 0.5" WALL	27	5 5/8	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			
3	107M18	SPLIT PIPE			
3		PC. HSS 4.75" O.D.x 0.5" WALL	27	5 5/8	Fy=50ksi MIN
3	ma	1" HVY HEX NUT			


SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
840 | 108M19 | CHANNEL
840 | | C4x7.25 | 0 | 9¼
588 | 108M20 | CHANNEL
588 | | C4x7.25 | 0 | 8¼
840 | 108UB60 | U BOLT
840 | | BAR ⅝"ø | 1 | 10⅛
1680 | | STD WASHER EACH | | | F436
1680 | | ANCO LOCKNUT
588 | 108UB50 | U BOLT
588 | | BAR ⅝"ø | 1 | 7⅛
1176 | | STD WASHER EACH | | | F436
1176 | | ANCO LOCKNUT
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
1 | 1/15/18 | WEB | CORRECTION TO PIECE MARKS
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
SPLIT PIPE REINFORCING (U-BOLTS AND CLAMPS)
Sheet No.: 108
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
DRAWING ESTIMATED WEIGHT = 10240 LBS
GAGE = 2"
9¼"
1¼"
3⅜"
3⅜"
1¼"
11/16"
½"
C4x7.25 x 9¼"
840 CHANNELS 108M19
(EST. WEIGHT =5.6 LBS EA.)
8¼"
2⅞"
2⅞"
C4x7.25 x 8¼"
588 CHANNELS 108M20
(EST. WEIGHT =5.0 LBS EA.)
R=3 1/16"
5¾"
2¾"
3"
THREAD
6¾"
BAR ⅝"ø x 1'–10⅛" (A36)
840 U–BOLTS 108UB60
(EST. WEIGHT =1.9 LBS EA.)
R=2 9/16"
5"
2"
5¾"
BAR ⅝"ø x 1'–7" (A36)
588 U–BOLTS 108UB50
(EST. WEIGHT =1.7 LBS EA.)


SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
6 | 109LP1 | LINK PLATE
6 | | PL1x6 | 2 | 0
3 | 109LP2 | LINK PLATE
3 | | PL2¼x6 | 2 | 0
6 | 109P1 | PLATE WASHER
6 | | PL¼x6 | 0 | 6
12 | 109P2 | PLATE WASHER
12 | | PL⅛x6 | 0 | 6
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅜ FILLET WELD
4. SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6. ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
1 | 1/15/18 | WEB | UPDATED PART 109P1
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
LINK PLATES
Sheet No.: 109
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
DRAWING ESTIMATED WEIGHT = 560 LBS
PL ⅛"x6" x 0'-6"
12 PLATE WASHERS 109P2
(EST. WEIGHT =1.3 LBS EA.)
(GUY #6 TOWER END & ANCHOR END)
PL 1"x6" x 2'-0"
6 LINK PLATES 109LP1
(EST. WEIGHT =40.9 LBS EA.)
(GUY #6 TOWER END)
PL2¼"x6" x 2'-0"
3 LINK PLATES 109LP2
(EST. WEIGHT =91.9 LBS EA.)
(GUY #6 TOWER END)
PL ¼"x6" x 0'-6"
6 PLATE WASHERS 109P1
(EST. WEIGHT =3.8 LBS EA.)
(GUY #6 TOWER END)
1'-6"
3"
Ø 3⅛"



SHOP BILL OF MATERIAL

Quan	Mark	Description	Ft.	Inches	Spec/Remarks
6	110GP1	PIN			
6		BAR 3ø	0	11⅛	A572–50
12		⅝"ø A325–X BOLT	0	5	W/(1)–ANCO LKNT, (1)–WASHER EACH
3	110GP2	PIN			
3		BAR 3ø	1	9¼	A572–50
6		⅝"ø A325–X BOLT	0	5	W/(1)–ANCO LKNT, (1)–WASHER EACH
80	110PW1	PLATE WASHER			
80		PL⅜x2½	0	2½	A36

GENERAL NOTES

1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH:
   a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.

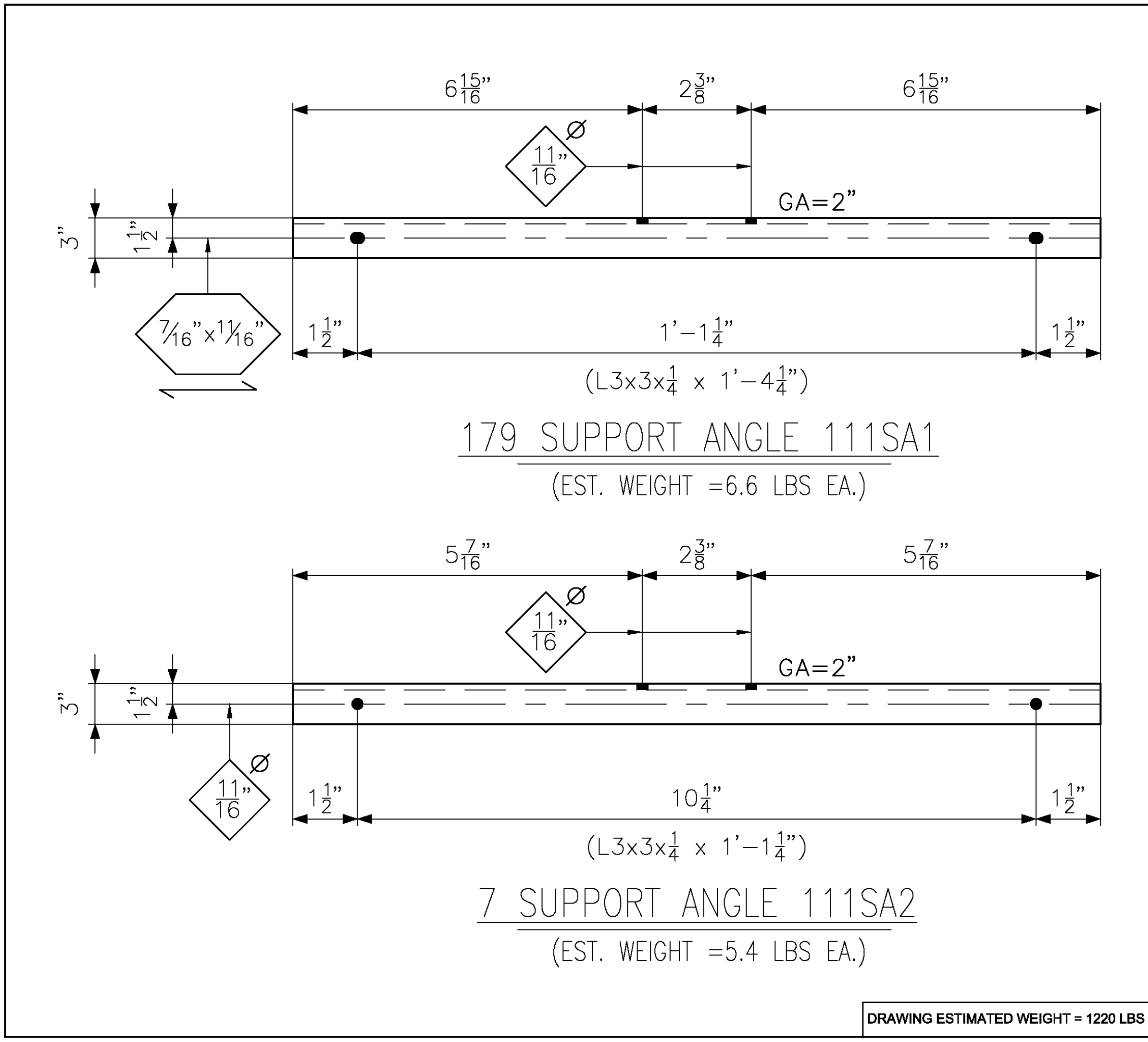
No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

TOWER CONSULTANTS, INC.
www.tower-tci.com

KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
GUY PINS

Sheet No.: 110
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17

DRAWING ESTIMATED WEIGHT = 320 LBS



SHOP BILL OF MATERIAL

Quan	Mark	Description	Ft.	Inches	Spec/Remarks
179	111SA1	SUPPORT ANGLE			
179		L3x3x1/4	1	4 1/4	
296		3/8"Ø A307 BOLT	0	3 3/4	W/(1)-ANCO LKNT, (1)-WASHER EACH
46		3/8"Ø A307 BOLT	0	4 1/4	W/(1)-ANCO LKNT, (1)-WASHER EACH
16		3/8"Ø A36 ALL THREAD	0	10 1/2	W/(2)-ANCO LKNT, (2)-WASHER EACH
7	111SA2	SUPPORT ANGLE			
7		L3x3x1/4	1	1 1/4	
14		5/8"Ø A325-X BOLT	0	1 3/4	W/(1)-ANCO LKNT, (1)-WASHER EACH

GENERAL NOTES

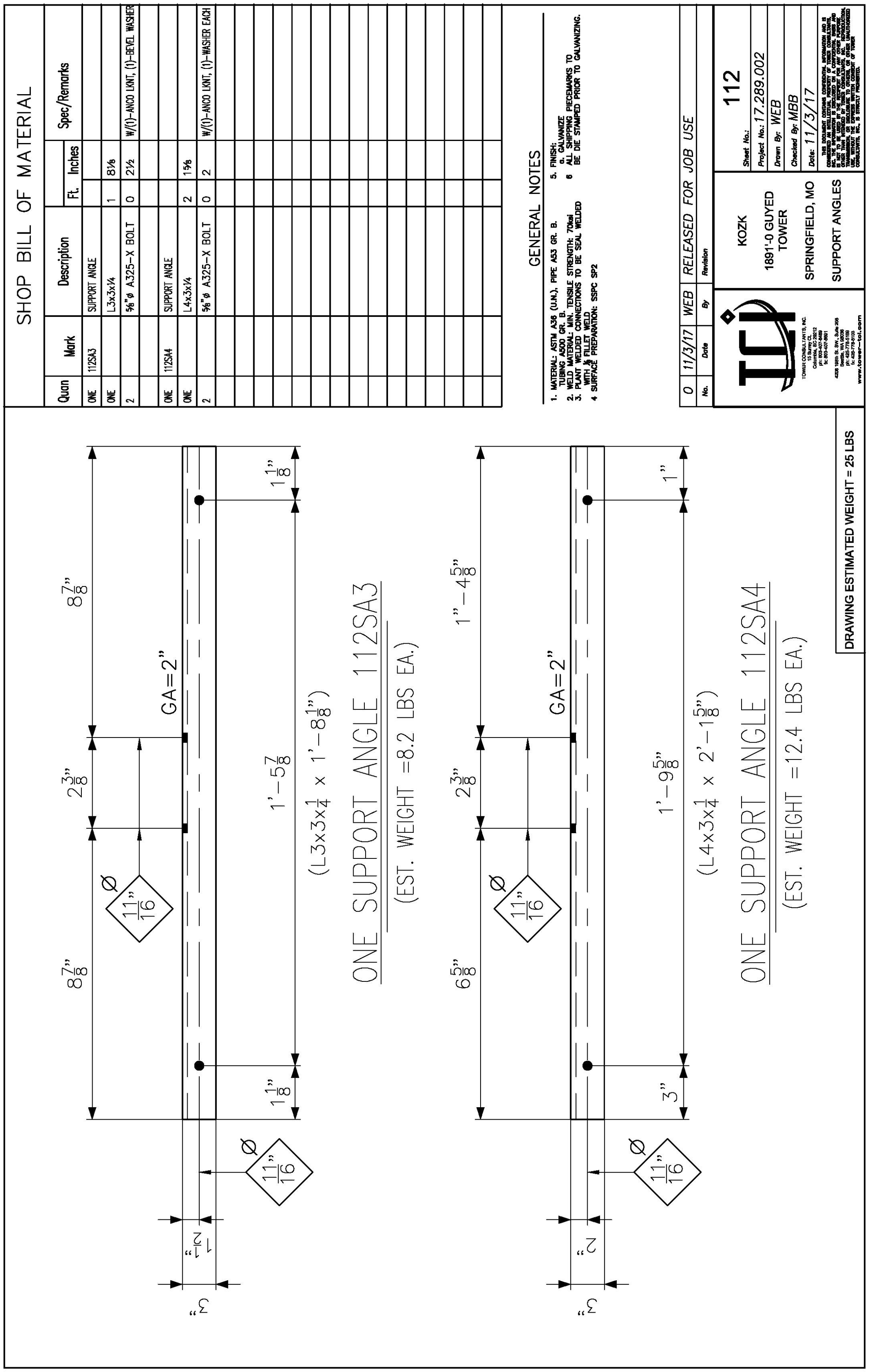
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH 3/16 FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH:
   a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.

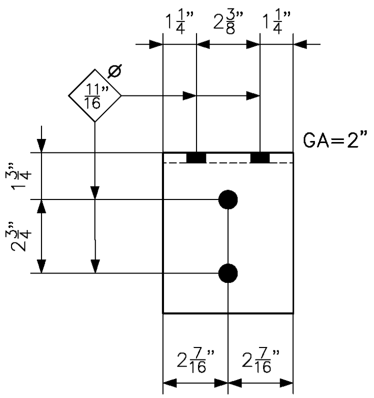
No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

TCI
TOWER CONSULTANTS, INC.
www.tower-tci.com

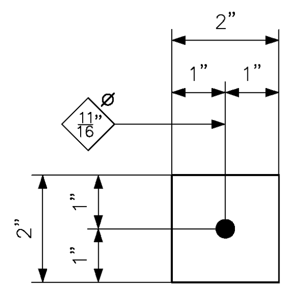
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
SUPPORT ANGLES

Sheet No.: 111
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17

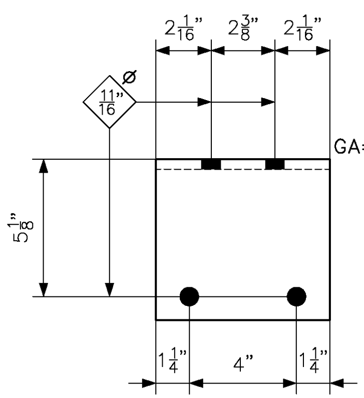

SHOP BILL OF MATERIAL
Quan | Mark | Description | Ft. | Inches | Spec/Remarks
ONE | 112SA3 | SUPPORT ANGLE
ONE | L3x3x¼ | 1 | 8⅛
2 | ⅝"ø A325-X BOLT | 0 | 2½ | W/(1)-ANCO LKNT, (1)-BEVEL WASHER
ONE | 112SA4 | SUPPORT ANGLE
ONE | L4x3x¼ | 2 | 1⅝
2 | ⅝"ø A325-X BOLT | 0 | 2 | W/(1)-ANCO LKNT, (1)-WASHER EACH
GENERAL NOTES
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH ⅛ FILLET WELD
4 SURFACE PREPARATION: SSPC SP2
5. FINISH: a. GALVANIZE
6 ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.
0 | 11/3/17 | WEB | RELEASED FOR JOB USE
No. | Date | By | Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
SUPPORT ANGLES
Sheet No.: 112
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17
www.tower-tci.com
DRAWING ESTIMATED WEIGHT = 25 LBS
GA=2"
ONE SUPPORT ANGLE 112SA3
(L3x3x¼ x 1'-8⅛")
(EST. WEIGHT =8.2 LBS EA.)
ONE SUPPORT ANGLE 112SA4
(L4x3x¼ x 2'-1⅝")
(EST. WEIGHT =12.4 LBS EA.)
8⅞"
2⅜"
1'-5⅞
1⅛"
6⅝"
1"-4⅝"
1'-9⅝"
3"
1"
2"
1½"
11/16"



L6x4x3/8 x 0'–4 7/8"
ONE SUPPORT ANGLE 113SA5
(EST. WEIGHT =5.0 LBS EA.)



PL1/4x2 x 0'–2"
ONE FILL PLATE 113FP1
(EST. WEIGHT =0.3 LBS EA.)



L6x4x3/8 x 0'–6 1/2"
ONE SUPPORT ANGLE 113SA6
(EST. WEIGHT =6.7 LBS EA.)

DRAWING ESTIMATED WEIGHT = 15 LBS

SHOP BILL OF MATERIAL

Quan	Mark	Description	Ft.	Inches	Spec/Remarks
ONE	113SA5	SUPPORT ANGLE			
ONE		L6x4x3/8	0	4 7/8	
2		5/8"Ø A325–X BOLT	0	2	W/(1)–ANCO LKNT, (1)–WASHER EACH
ONE	113SA6	SUPPORT ANGLE			
ONE		L6x4x3/8	0	6 1/2	
2		5/8"Ø A325–X BOLT	0	2	W/(1)–ANCO LKNT, (1)–WASHER EACH
ONE	113FP1	FILL PLATE			
ONE		PL1/4x2	0	2	

GENERAL NOTES

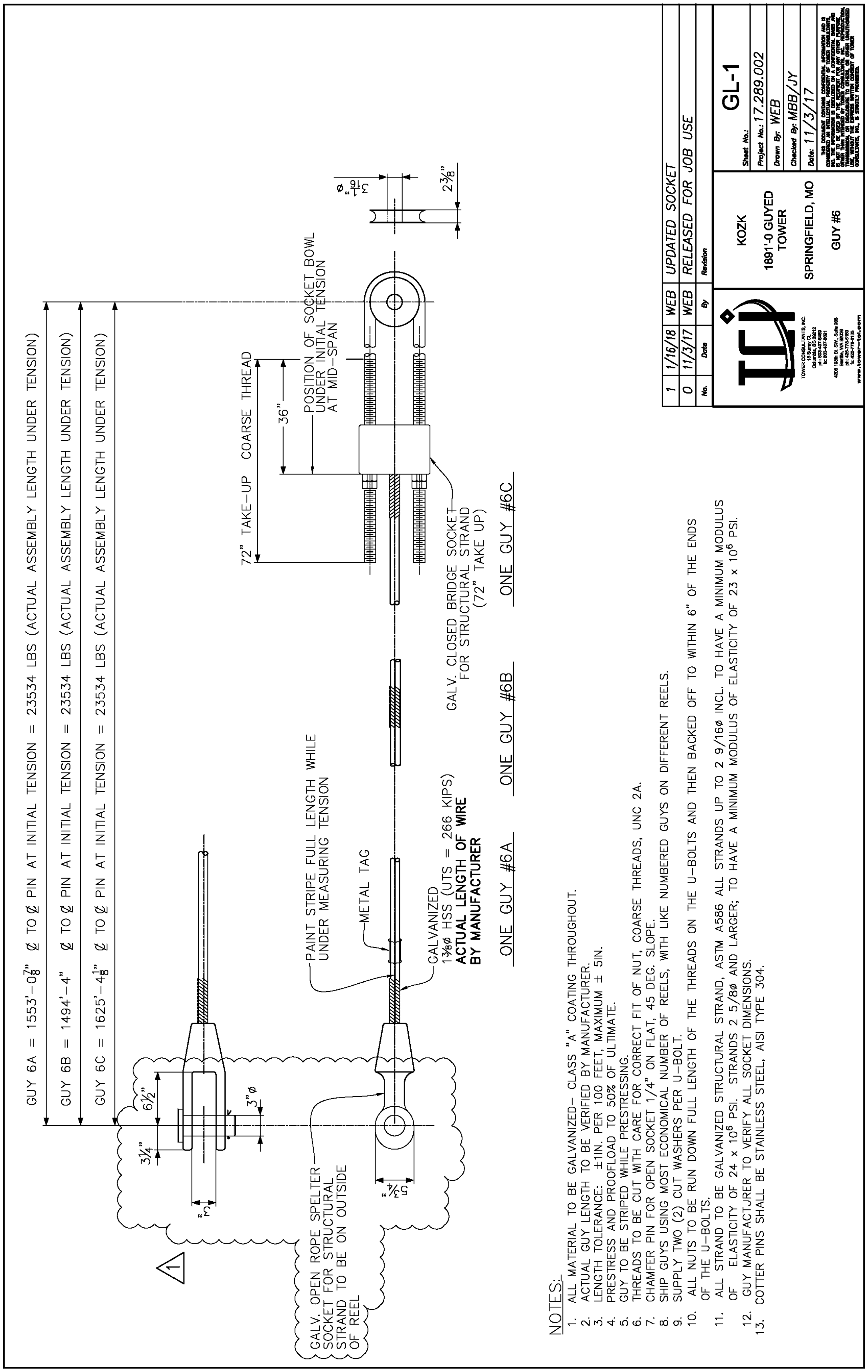
1. MATERIAL: ASTM A36 (U.N.), PIPE A53 GR. B. TUBING A500 GR. B.
2. WELD MATERIAL: MIN. TENSILE STRENGTH: 70ksi
3. PLANT WELDED CONNECTIONS TO BE SEAL WELDED WITH 1/8 FILLET WELD
4. SURFACE PREPARATION: SSPC SP2
5. FINISH:
   a. GALVANIZE
6. ALL SHIPPING PIECEMARKS TO BE DIE STAMPED PRIOR TO GALVANIZING.

No.	Date	By	Revision
0	11/3/17	WEB	RELEASED FOR JOB USE

TOWER CONSULTANTS, INC. www.tower-tci.com

KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
SUPPORT ANGLES

Sheet No.: 113
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB
Date: 11/3/17


GUY 6A = 1553'–0 7/8" ℄ TO ℄ PIN AT INITIAL TENSION = 23534 LBS (ACTUAL ASSEMBLY LENGTH UNDER TENSION)
GUY 6B = 1494'–4" ℄ TO ℄ PIN AT INITIAL TENSION = 23534 LBS (ACTUAL ASSEMBLY LENGTH UNDER TENSION)
GUY 6C = 1625'–4 1/8" ℄ TO ℄ PIN AT INITIAL TENSION = 23534 LBS (ACTUAL ASSEMBLY LENGTH UNDER TENSION)
1
3¼"
6½"
3"
3"ø
GALV. OPEN ROPE SPELTER SOCKET FOR STRUCTURAL STRAND TO BE ON OUTSIDE OF REEL
5¾"
PAINT STRIPE FULL LENGTH WHILE UNDER MEASURING TENSION
METAL TAG
GALVANIZED 1⅜ø HSS (UTS = 266 KIPS)
ACTUAL LENGTH OF WIRE BY MANUFACTURER
72" TAKE–UP COARSE THREAD
36"
POSITION OF SOCKET BOWL UNDER INITIAL TENSION AT MID–SPAN
GALV. CLOSED BRIDGE SOCKET FOR STRUCTURAL STRAND (72" TAKE UP)
3 1/16"ø
2⅜"
ONE GUY #6A
ONE GUY #6B
ONE GUY #6C
NOTES:
1. ALL MATERIAL TO BE GALVANIZED– CLASS "A" COATING THROUGHOUT.
2. ACTUAL GUY LENGTH TO BE VERIFIED BY MANUFACTURER.
3. LENGTH TOLERANCE: ±1IN. PER 100 FEET, MAXIMUM ± 5IN.
4. PRESTRESS AND PROOFLOAD TO 50% OF ULTIMATE.
5. GUY TO BE STRIPED WHILE PRESTRESSING.
6. THREADS TO BE CUT WITH CARE FOR CORRECT FIT OF NUT, COARSE THREADS, UNC 2A.
7. CHAMFER PIN FOR OPEN SOCKET 1/4" ON FLAT, 45 DEG. SLOPE.
8. SHIP GUYS USING MOST ECONOMICAL NUMBER OF REELS, WITH LIKE NUMBERED GUYS ON DIFFERENT REELS.
9. SUPPLY TWO (2) CUT WASHERS PER U–BOLT.
10. ALL NUTS TO BE RUN DOWN FULL LENGTH OF THE THREADS ON THE U–BOLTS AND THEN BACKED OFF TO WITHIN 6" OF THE ENDS OF THE U–BOLTS.
11. ALL STRAND TO BE GALVANIZED STRUCTURAL STRAND, ASTM A586 ALL STRANDS UP TO 2 9/16ø INCL. TO HAVE A MINIMUM MODULUS OF ELASTICITY OF 24 x 10^6 PSI. STRANDS 2 5/8ø AND LARGER; TO HAVE A MINIMUM MODULUS OF ELASTICITY OF 23 x 10^6 PSI.
12. GUY MANUFACTURER TO VERIFY ALL SOCKET DIMENSIONS.
13. COTTER PINS SHALL BE STAINLESS STEEL, AISI TYPE 304.
1 1/16/18 WEB UPDATED SOCKET
0 11/3/17 WEB RELEASED FOR JOB USE
No. Date By Revision
KOZK
1891'-0 GUYED TOWER
SPRINGFIELD, MO
GUY #6
GL-1
Sheet No.:
Project No.: 17.289.002
Drawn By: WEB
Checked By: MBB/JY
Date: 11/3/17
www.tower–tci.com

Appendix C

PHOTOGRAPHS
(APRIL 23, 2018)

Figure C- 1

Figure C- 2

Figure C- 3

Figure C- 4

Figure C- 5

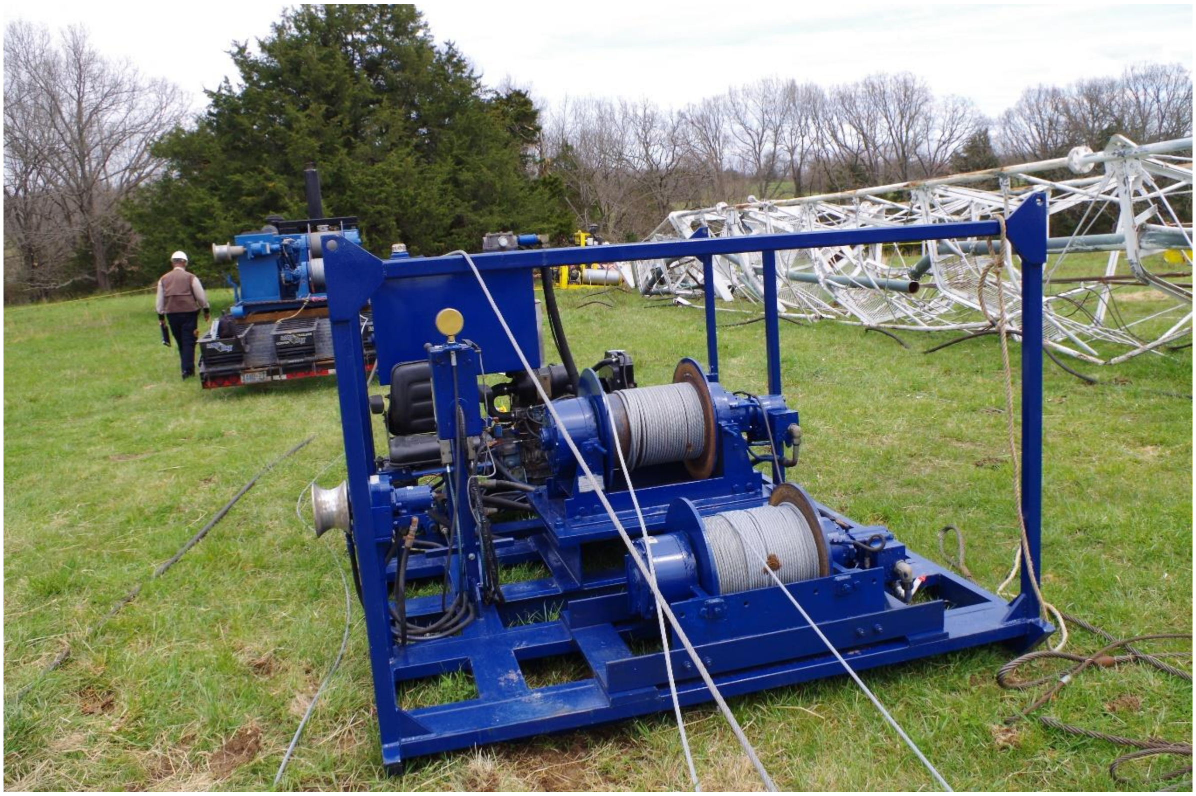


Figure C- 6

Figure C- 7

Figure C- 8

Figure C- 9

Figure C- 10

Figure C- 11

Figure C- 12

Figure C- 13

Figure C- 14

Appendix D

PHOTOGRAPHS
(AUGUST 1, 2018)

Figure D- 1

Figure D- 2

Figure D- 3

Figure D- 4

Figure D- 5

Figure D- 6

Figure D- 7

Figure D- 8

Figure D- 9

Figure D- 10

Figure D- 11

Figure D- 12