

# •• T •• Mobile •

15 Commerce Way  
Suite B  
Norton, MA 02766

## STRUCTURAL ANALYSIS 4DE4268D - BO268 / CONCRETE SERVICE



Address:  
116 WORCESTER STREET  
GRAFTON, MA 01536

Date:  
**FEBRUARY 24, 2016**



**C** CHAPPELL  
ENGINEERING  
ASSOCIATES, LLC  
*Civil • Structural • Land Surveying*

**FILE**

**RECEIVED**

FEB 25 2016

**PLANNING BOARD  
GRAFTON, MA**

February 24, 2016

**•T-Mobile•**

15 Commerce Way  
Suite B  
Norton, MA 02766

**RE:**

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Candidate Number      4DE4268D  
Candidate Name        BO268 / Concrete Service  
Candidate Address     116 Worcester Street, Grafton, MA 01536

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To whom it may concern:

Chappell Engineering Associates, LLC has performed an analysis of the existing antenna support structure at the above-referenced location. Based upon the site audit completed on 10-13-2015, the existing antenna mounts consist of the following:

<b>Sector</b>	<b>Antenna</b>	<b>Dimensions (in)</b>	<b>Location</b>
Alpha	(1) Ericsson AIR21 B2A/B4P	56H x 12.1W x 7.9D	Guyed Antenna Mast on Steel Frame
	(1) Twin TMA	7.0H x 6.0W x 3.0D	Guyed Antenna Mast on Steel Frame
Beta	(1) Ericsson AIR21 B2A/B4P	56H x 12.1W x 7.9D	Guyed Antenna Mast on Steel Frame
	(1) Twin TMA	7.0H x 6.0W x 3.0D	Guyed Antenna Mast on Steel Frame
Gamma	(1) Ericsson AIR21 B2A/B4P	56H x 12.1W x 7.9D	Guyed Antenna Mast on Steel Frame
	(1) Twin TMA	7.0H x 6.0W x 3.0D	Guyed Antenna Mast on Steel Frame

T-Mobile currently proposes to install three (3) total Ericsson AIR32 B4A/B2P antennas, three (3) RRUS-11 remote radio units, 1 of each located at each of the (3) sector locations. The proposed 700MHz sector antennas and RRUS-11's will supplement the existing antennas currently installed. The existing in-service RBS 6102 equipment cabinet is also to be replaced with a proposed RBS 6131 equipment cabinet.

The proposed 700MHz sector antennas will be mounted to the existing guyed antenna support mast atop the existing rooftop steel frame. The proposed antennas will be located below the existing in-service antennas, and the proposed RRH's and TMA's will be located on the lower portion of the antenna support mast. We have also confirmed the existing structural support under the existing RBS 6102 cabinet. The proposed RBS 6131 will be similarly supported on the existing steel support beam under the existing roof. The proposed antenna configuration and the attachment details are included on our enclosed construction drawings.

Based upon our review of the loads, our analysis of the existing guyed antenna support mast, Chappell Engineering Associates, LLC has determined that the existing antenna support structure and the existing cabinet support beam have adequate capacity to support the proposed configuration. The appropriate antenna mounting plan and details for the proposed antennas have been included in our drawings which are also enclosed for your convenience.

If you have any questions regarding this matter, please do not hesitate to call.

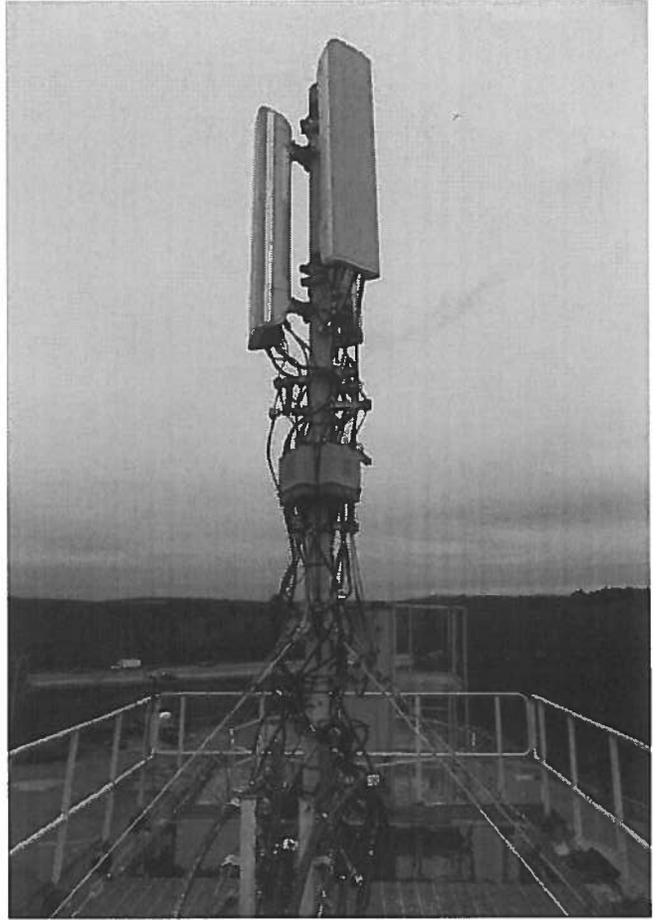
Very truly yours,  
CHAPPELL ENGINEERING ASSOCIATES, LLC




Clement J Salek, P.E.  
CJS/cjs



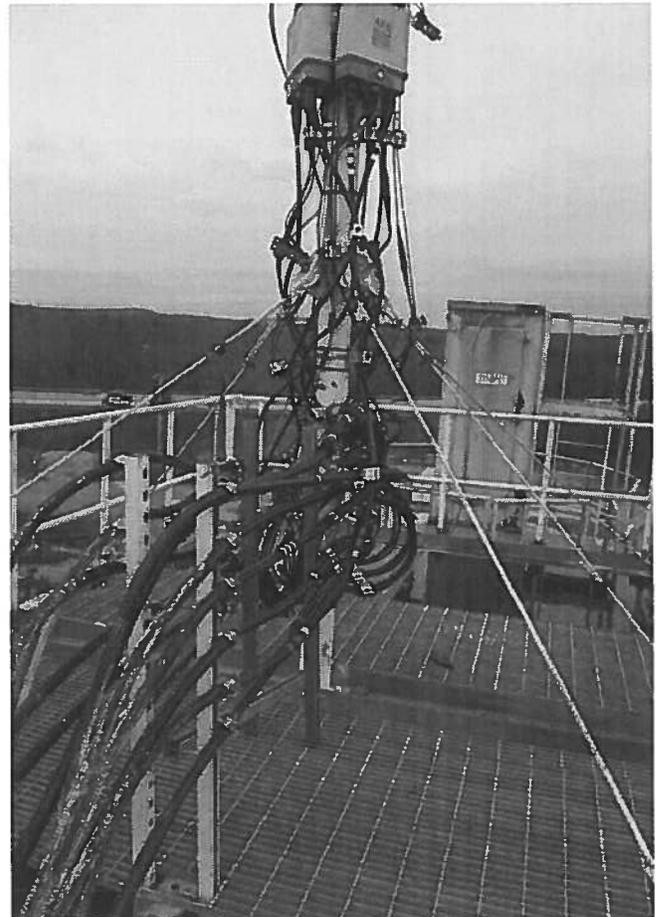
Existing Antenna Mast



Existing Antenna Platform



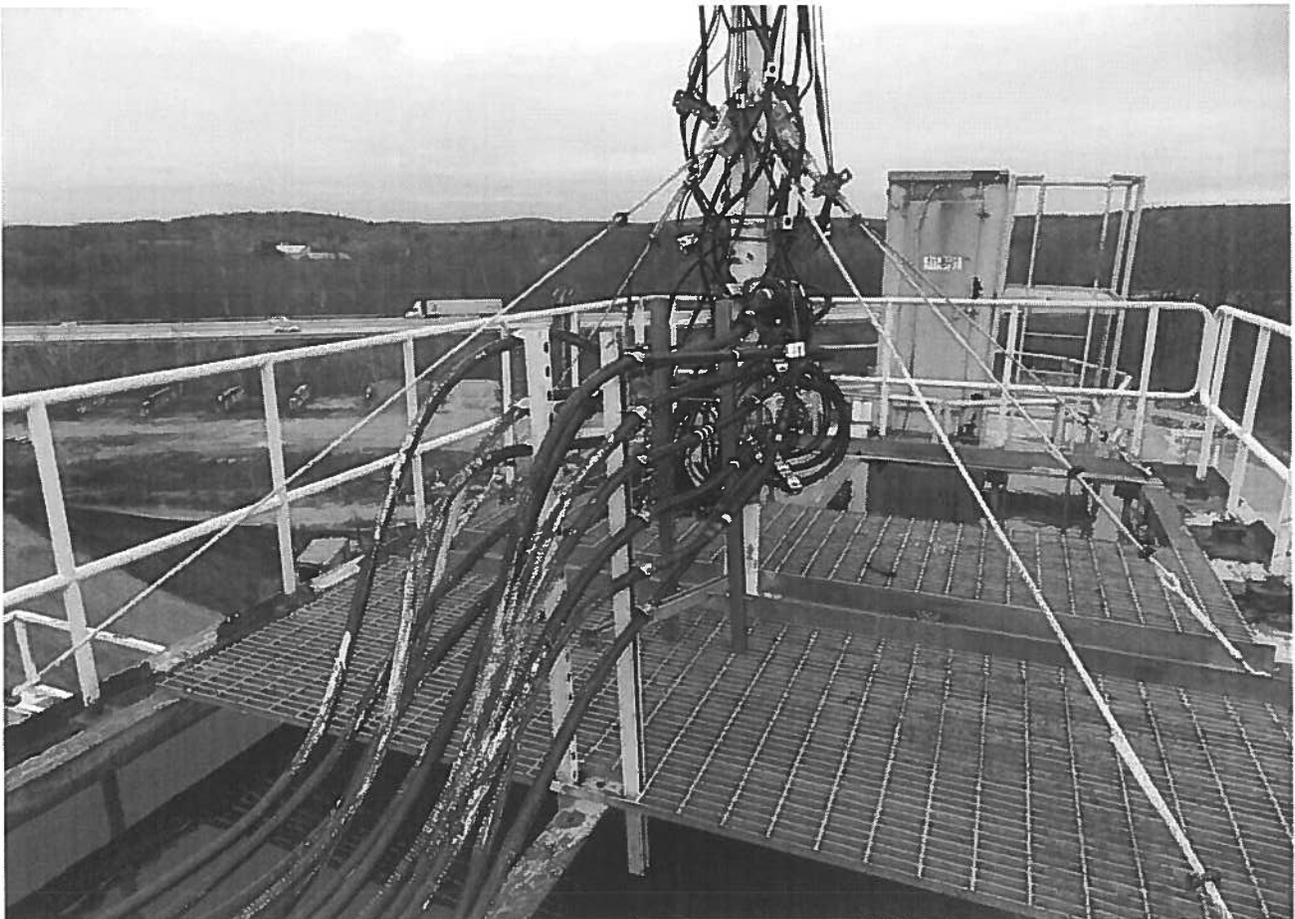
Existing Antennas



Existing Coax Cables and Jumpers



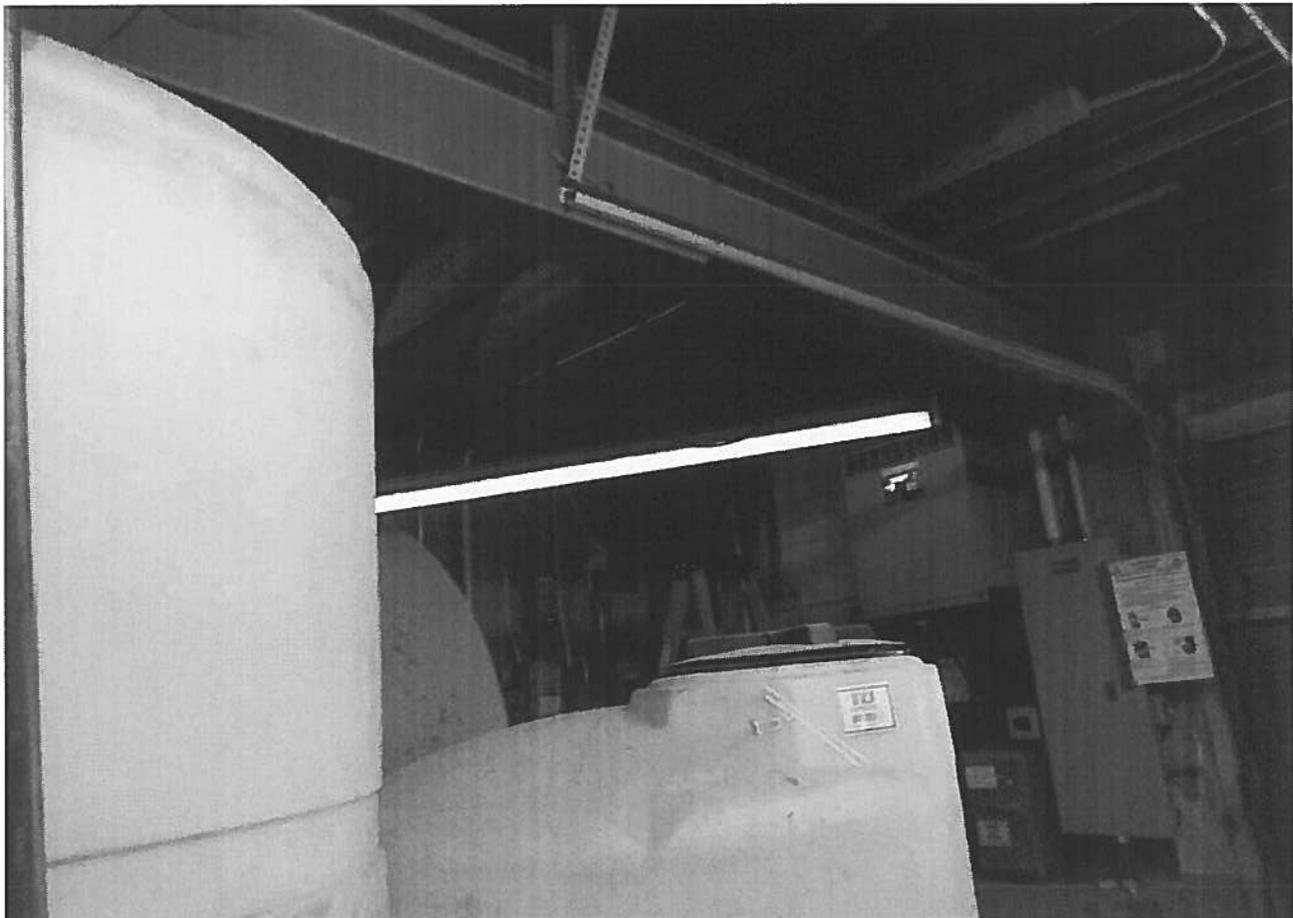
Existing Antenna Platform



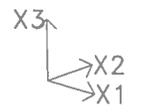
Existing Guy Wires



Existing RBS 6102 Equipment Cabinet

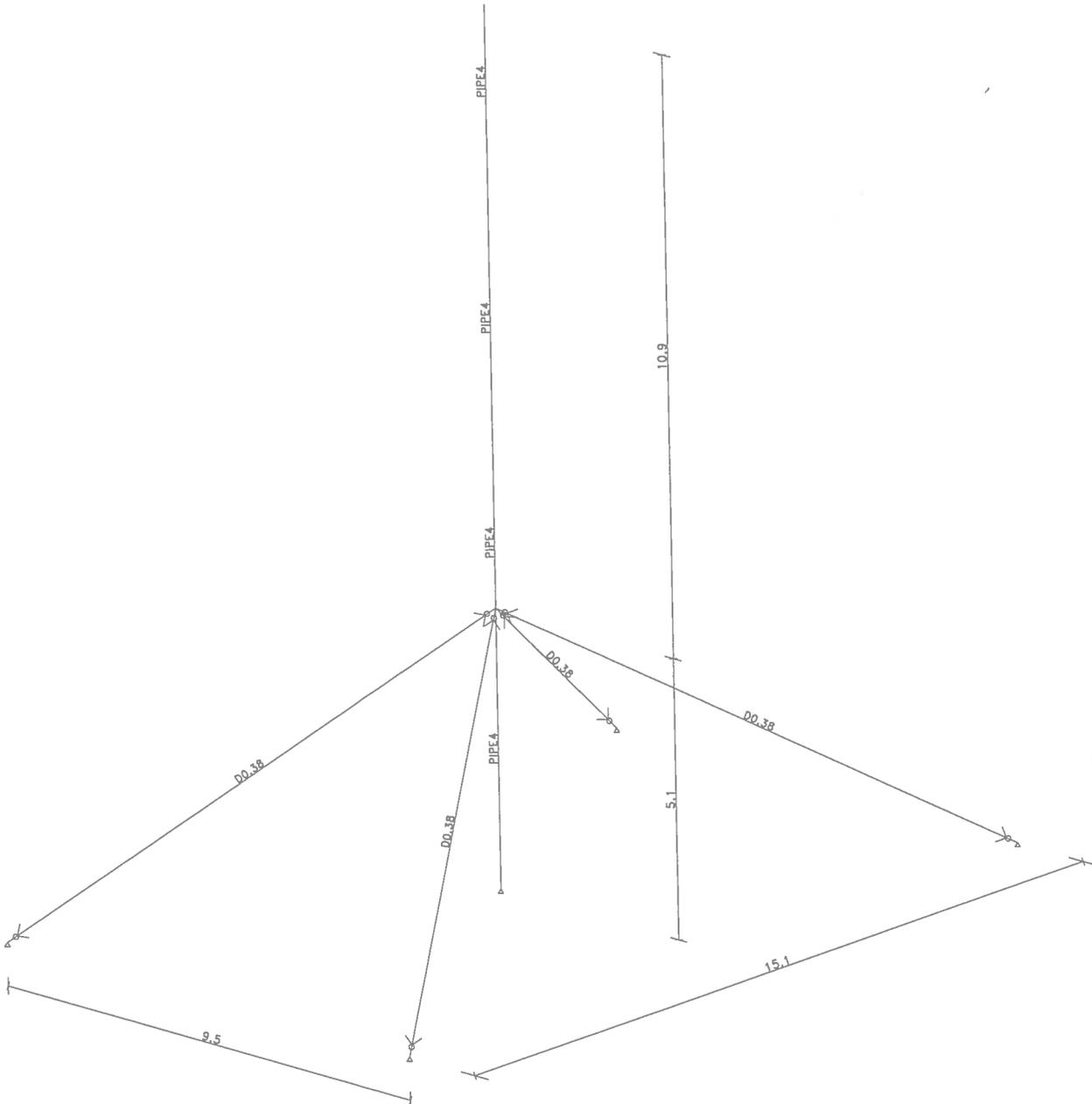


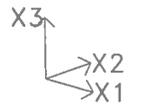
Existing Cabinet Support Beam



SCALE = 1:33

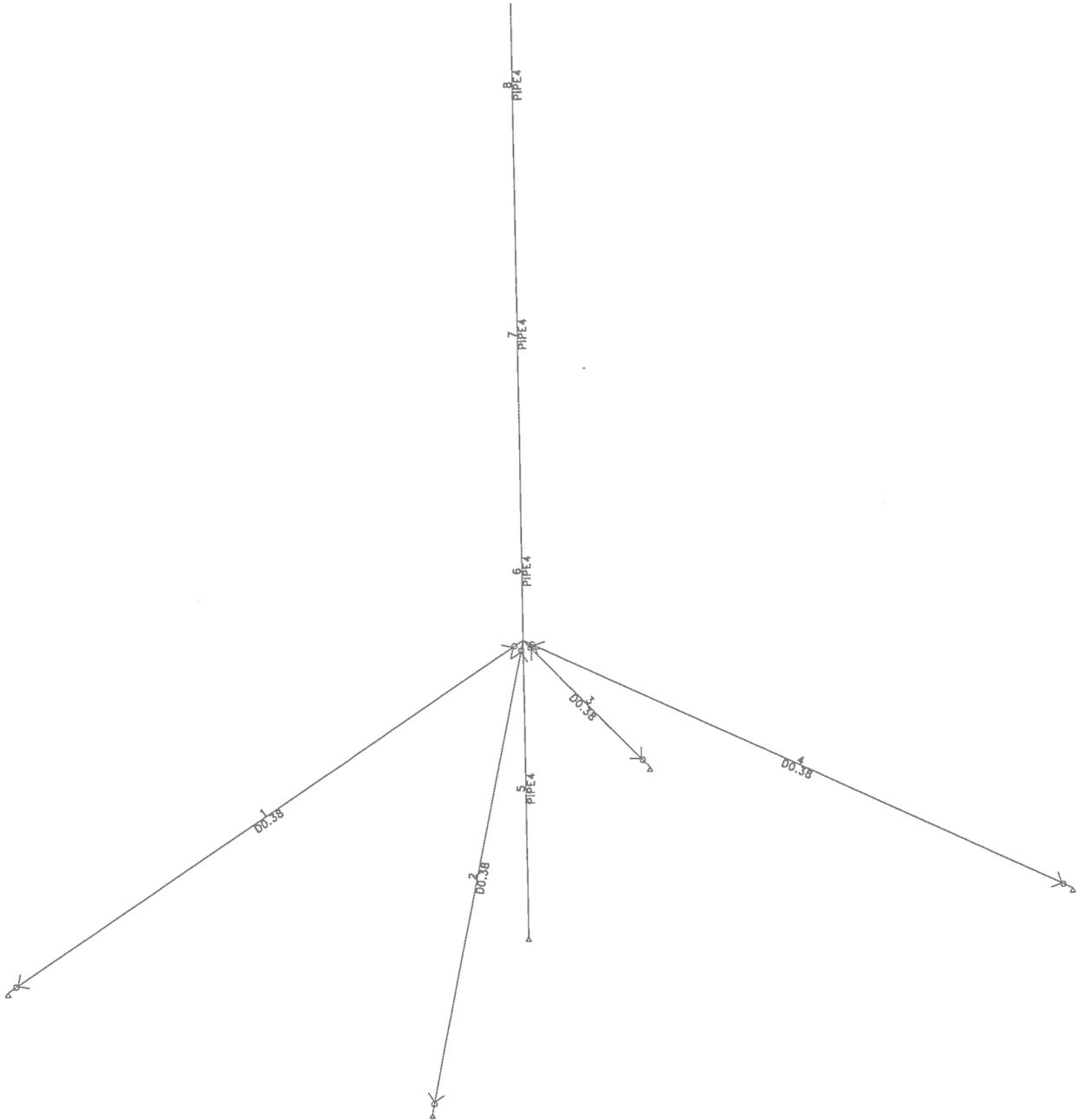
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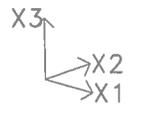


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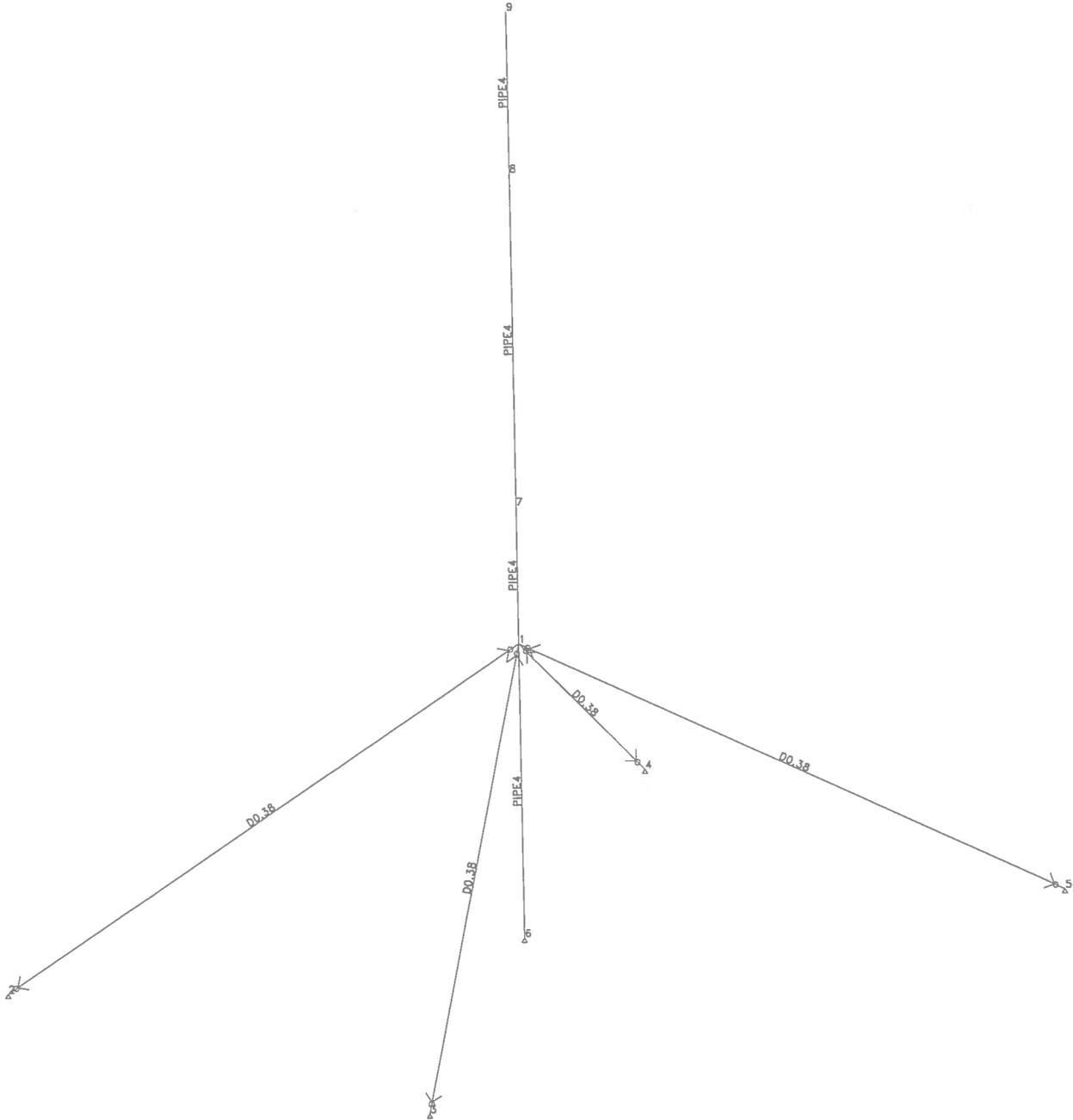


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SCALE = 1:31

DATE: 2/12/16



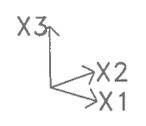
4DE4268 Aggregate Industries Grafton

Page: 2  
Date: 2/12/16

Prepared by:

**Load no. 1: Selfweight (units - kips ft.)**/ BEAM LOADS  
SELF X3 -1. B 1 TO 8  
/ END**FORCE SUMMATION**FX1=0. kip  
FX2=0. kip  
FX3=-0.1883 kip**Load no. 2: X1 Wind (units - kips ft.)**/ JOINT LOADS  
/ BEAM LOADS  
/ BEAM LOADS  
/ BEAM LOADS  
/ BEAM LOADS  
DIST GL FX1 0.01 B 8 7 6 5/ JOINT LOADS  
FX1 0.5 FX3 -0.3 N 8 7  
/ END**FORCE SUMMATION**FX1=1.16 kip  
FX2=0. kip  
FX3=-0.6 kip**Load no. 3: X2 Wind (units - kips ft.)**/ JOINT LOADS  
/ BEAM LOADS  
/ BEAM LOADS  
DIST GL FX2 0.01 B 8 7 6 5  
/ JOINT LOADSFX2 0.5 FX3 -0.3 N 8 7  
/ END STATIC**FORCE SUMMATION**FX1=0. kip  
FX2=1.16 kip  
FX3=-0.6 kip

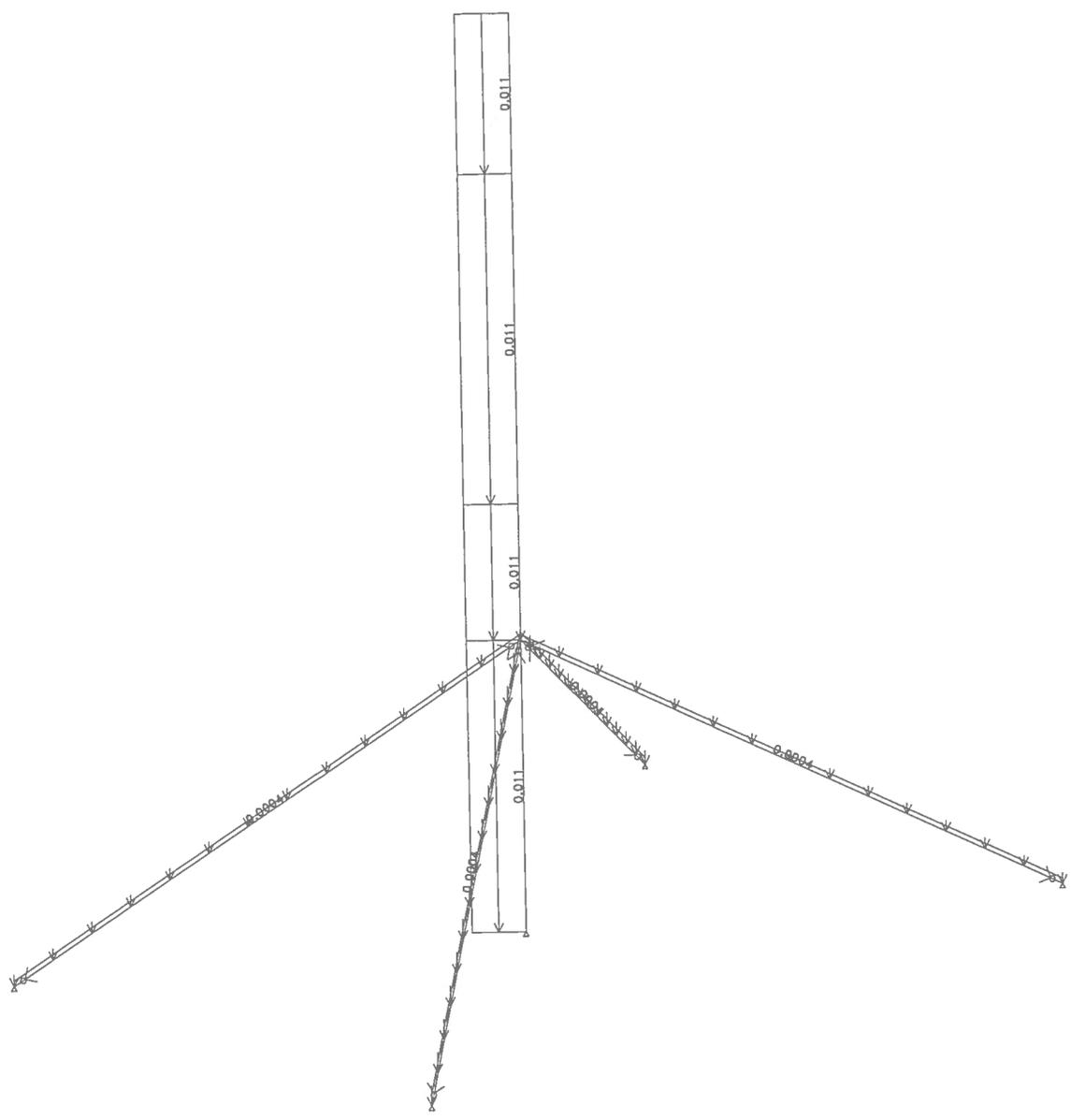
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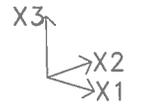


SCALE = 1:34

UNITS: kip ft

DATE: 2/12/16

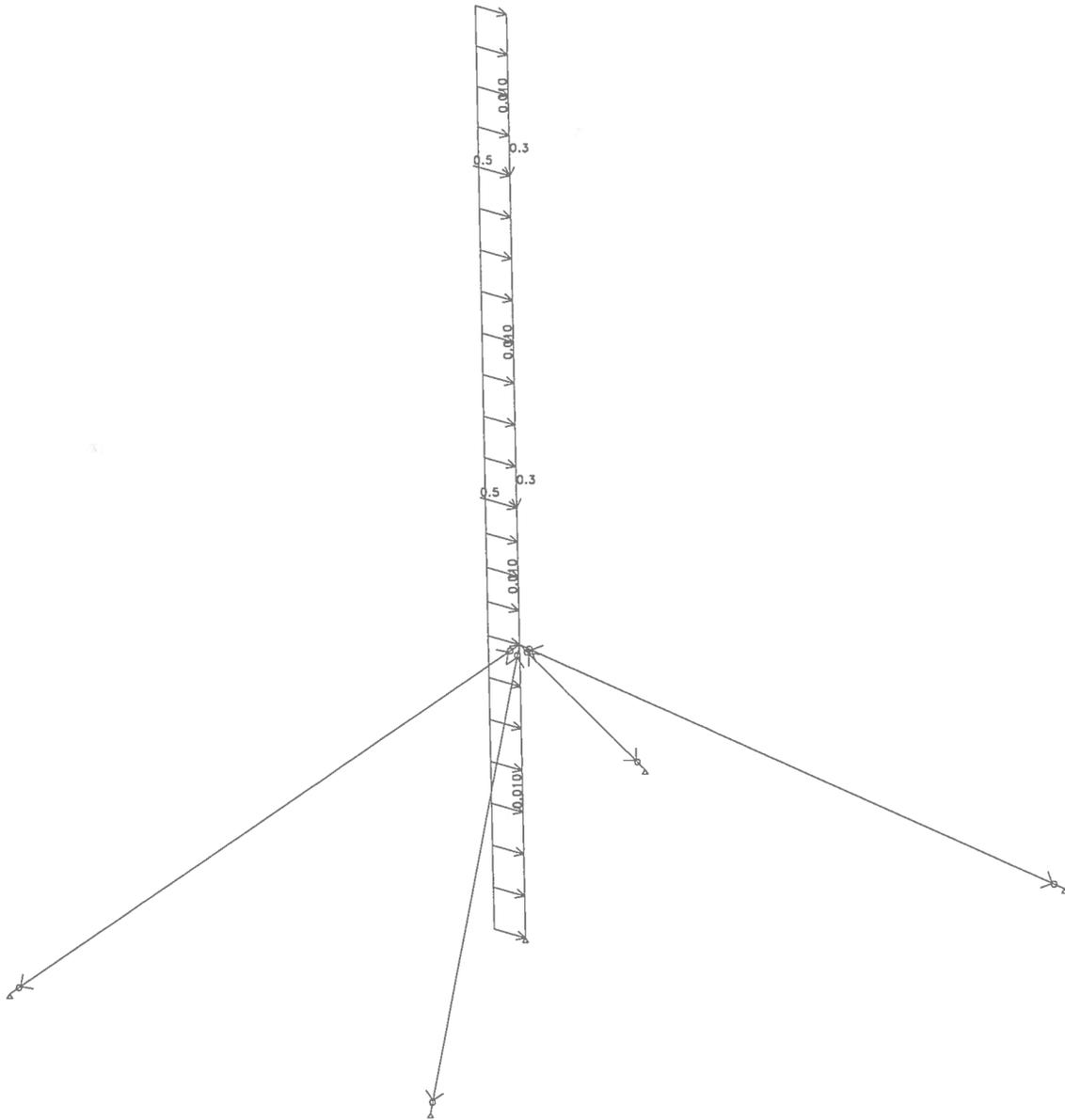


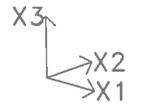


SCALE = 1:34

UNITS: kip ft

DATE: 2/12/16

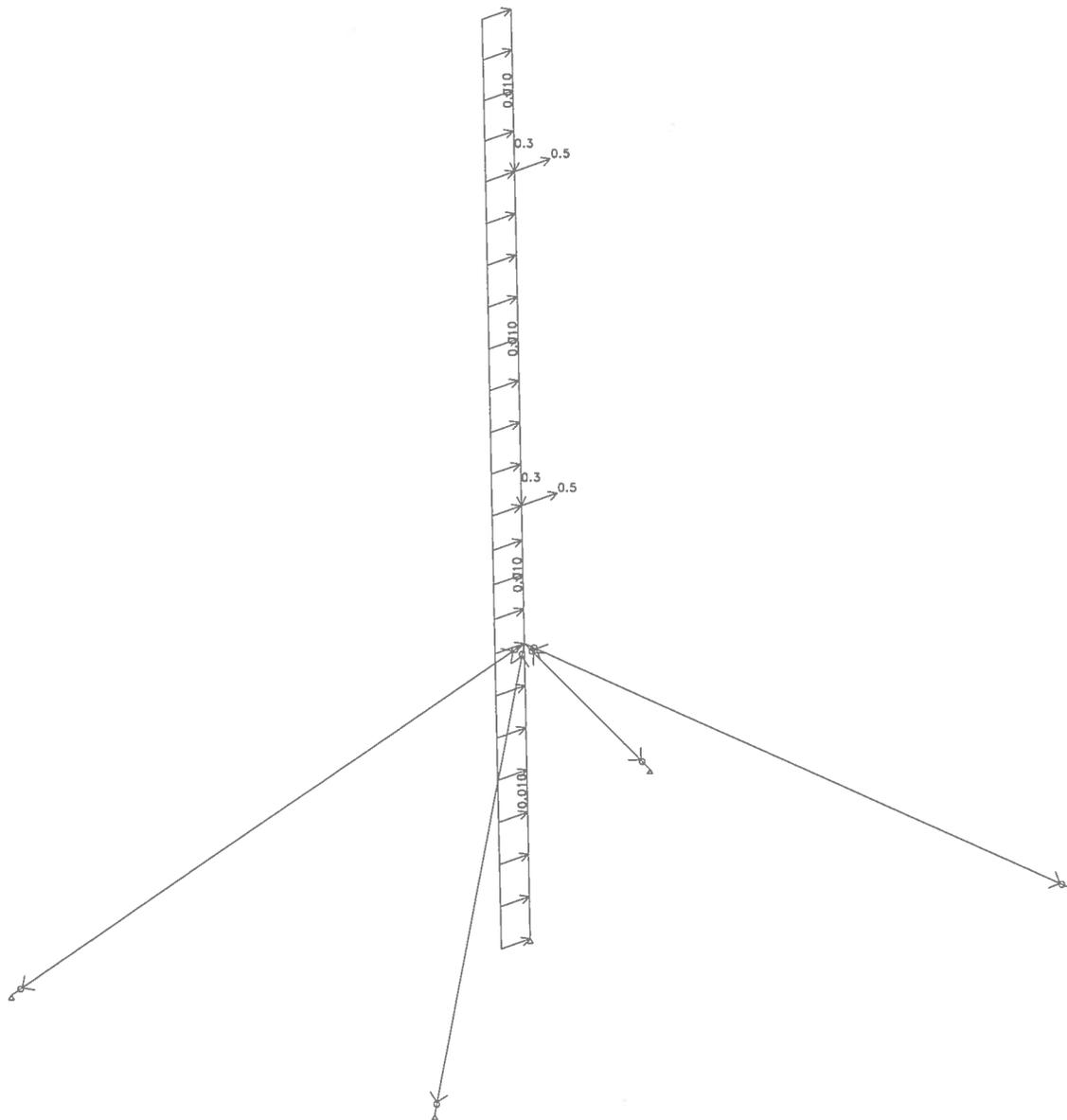




SCALE = 1:34

UNITS: kip ft

DATE: 2/12/16



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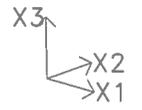
Prepared by:

Date: 2/12/16

**COMBINATIONS TABLE**

Comb.			
X1 Wind	1	1 * 1.00	+ 2 * 1.00
X2 Wind	2	1 * 1.00	+ 3 * 1.00

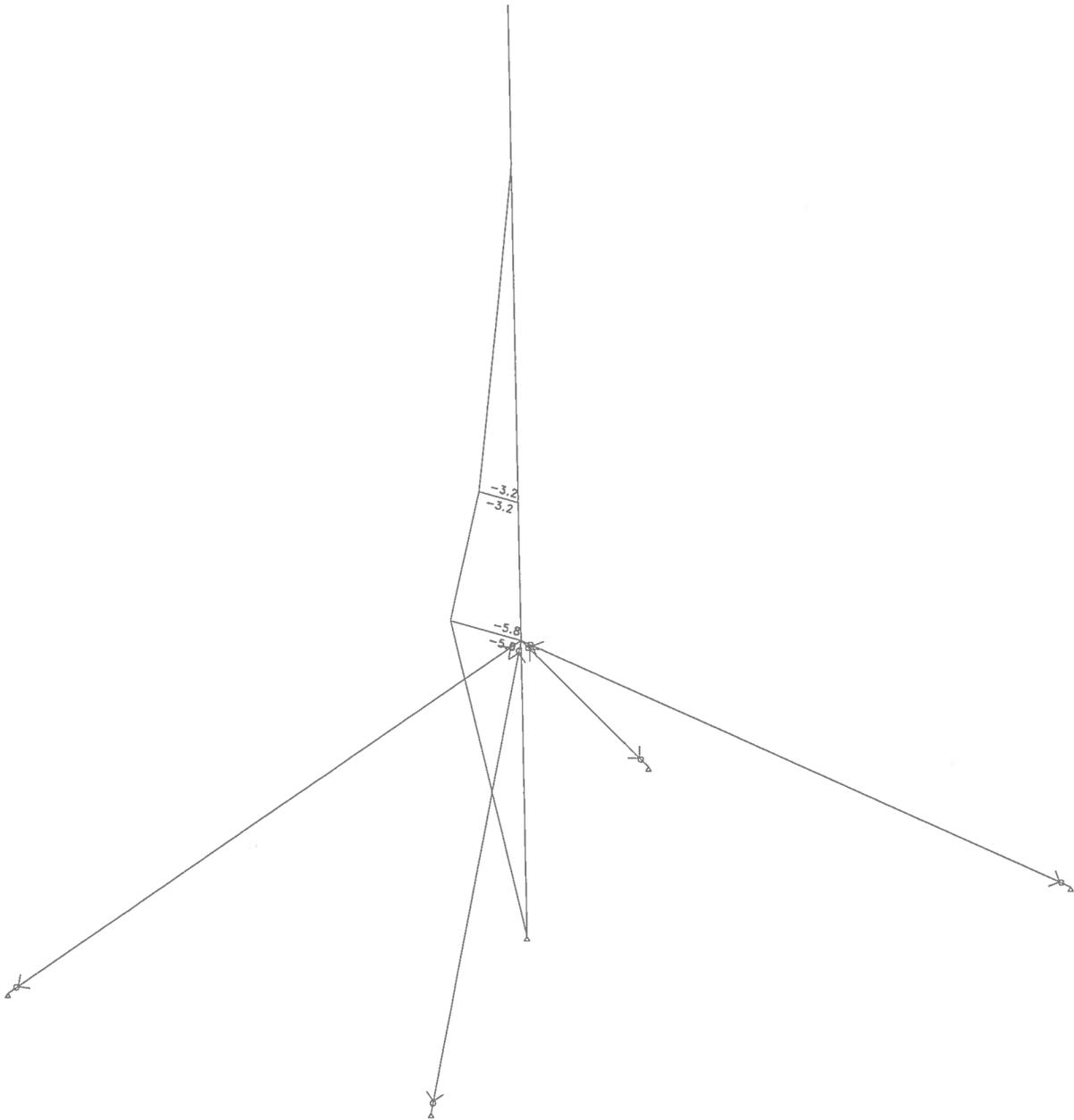
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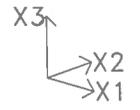
SCALE = 1:32

UNITS: kip\*ft

DATE: 2/12/16



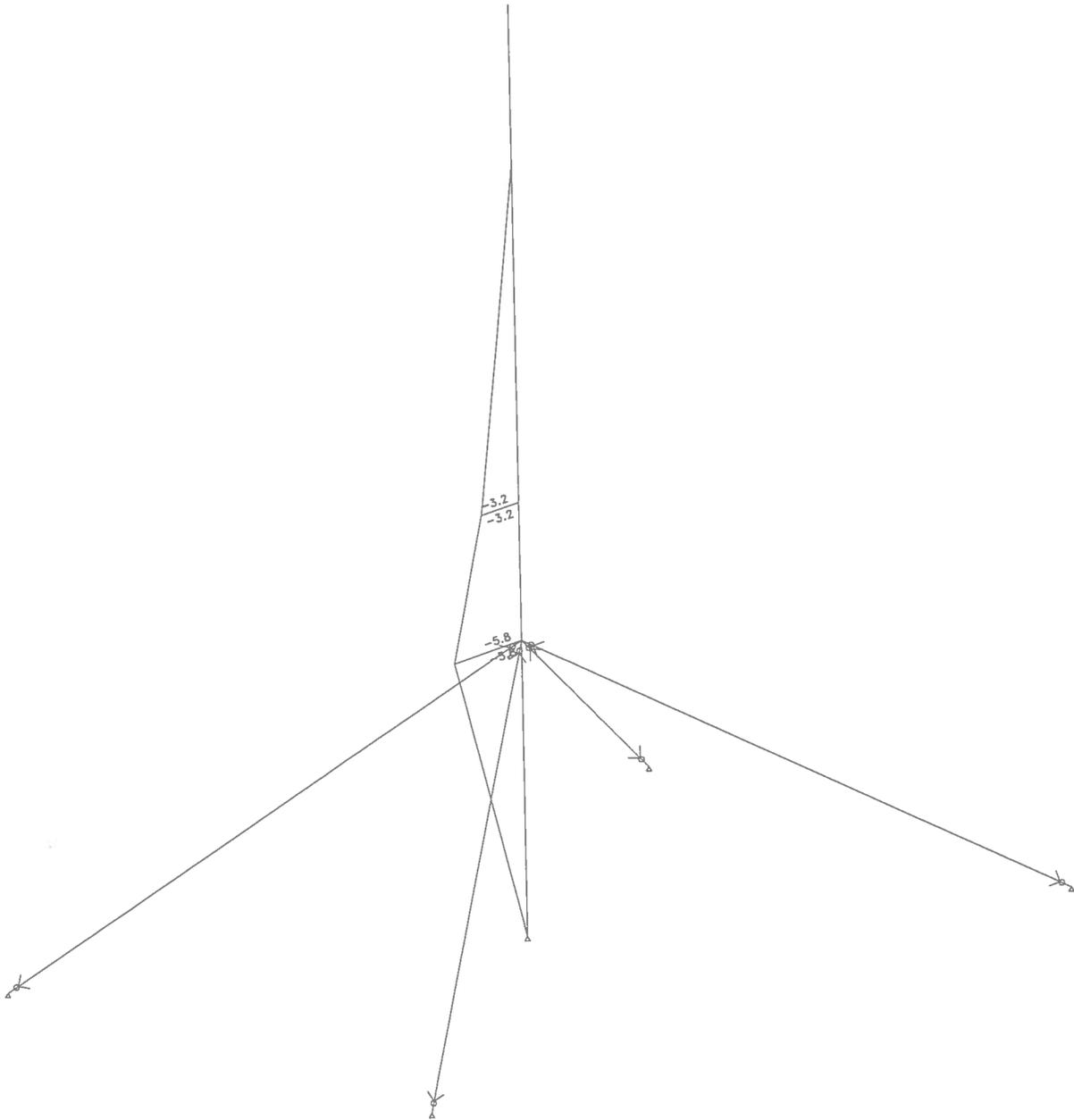
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SCALE = 1:32

UNITS: kip\*ft

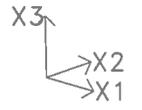
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M3 MOMENT

COMB. NO. 2 X2 Wind

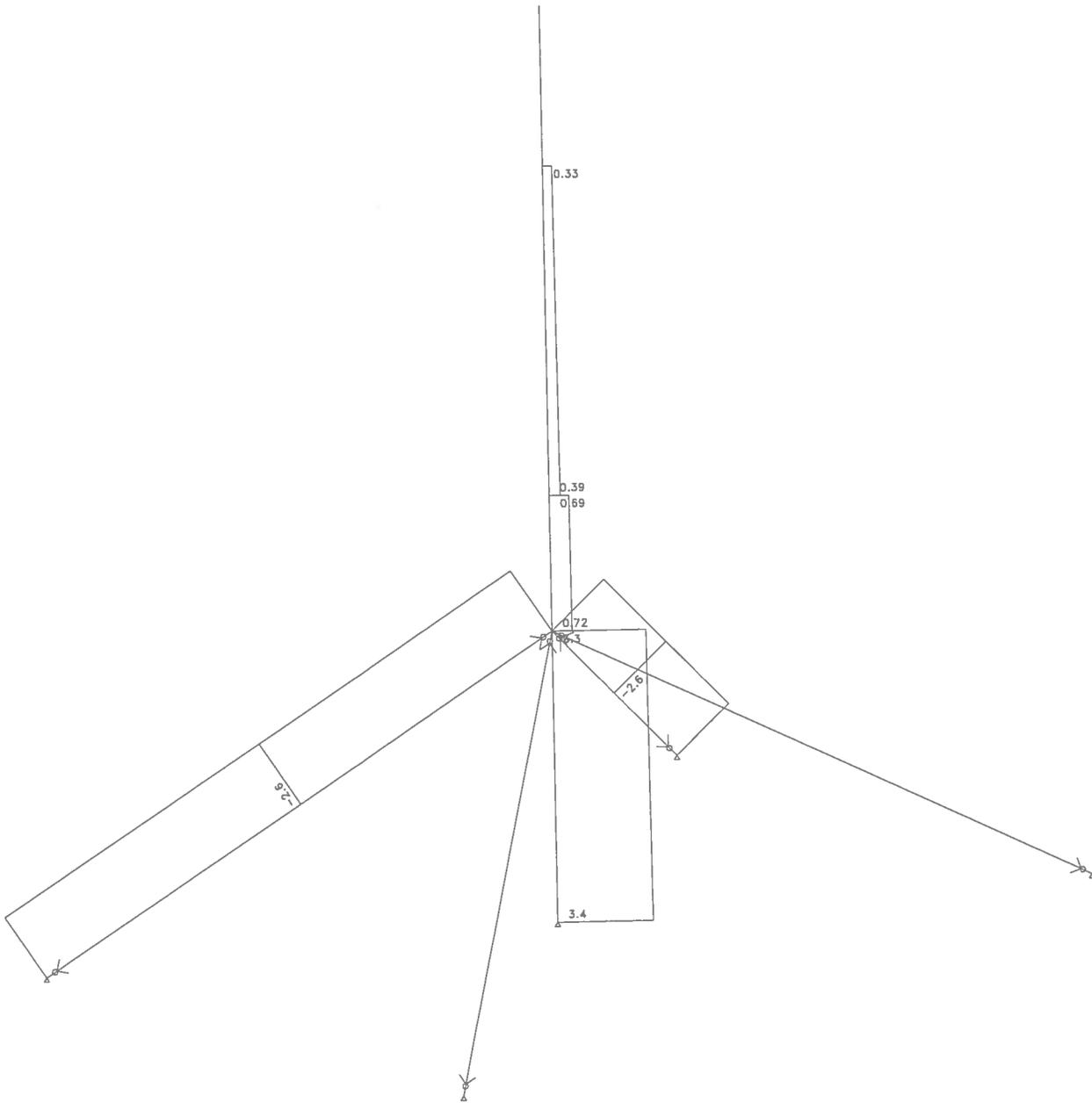
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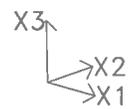


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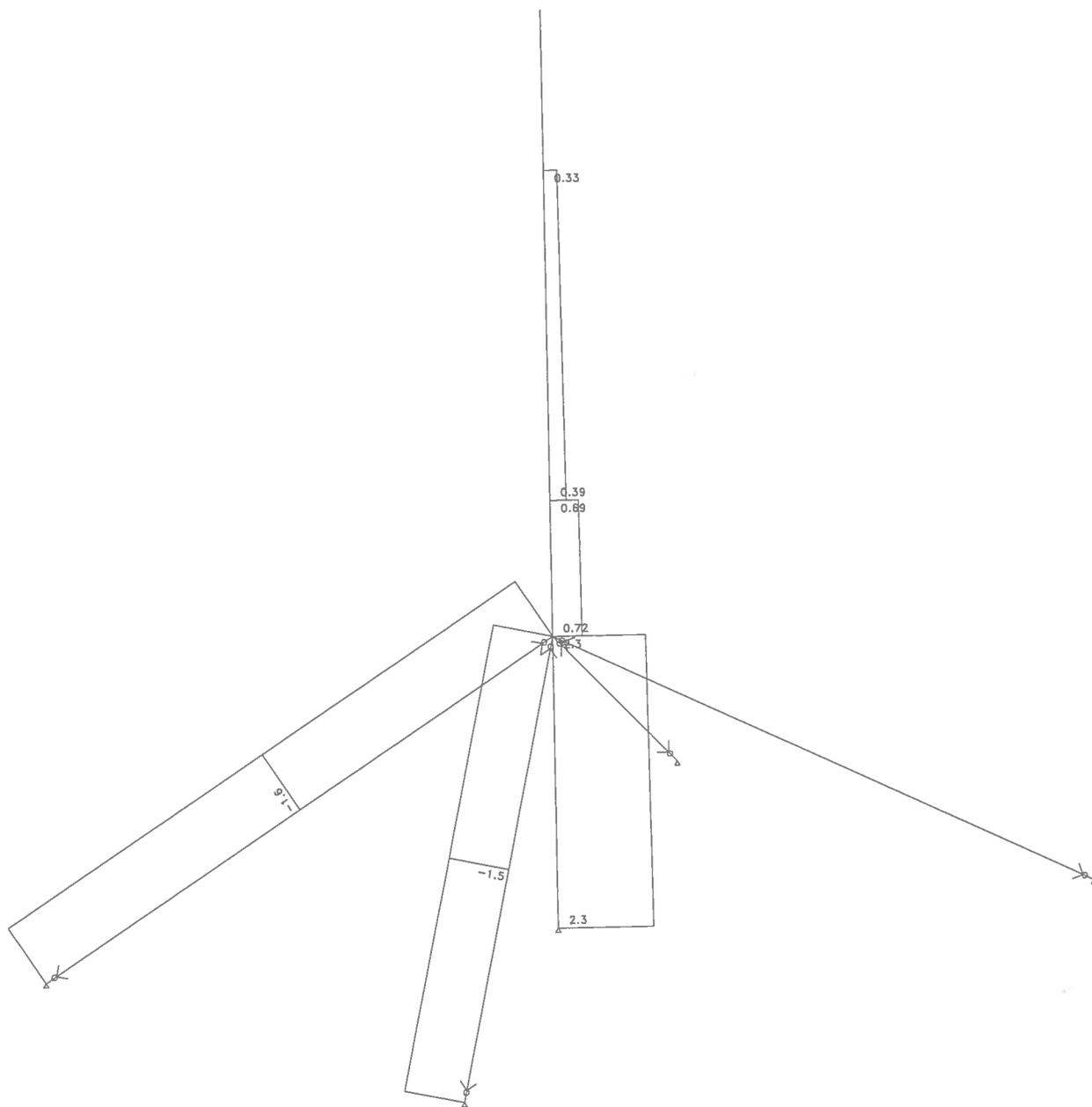




SCALE = 1:32

UNITS: kip

DATE: 2/12/16



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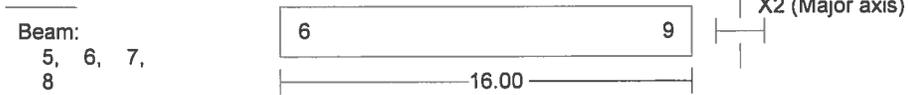
Code: AISC-ASD

Prepared by:

Date: 2/12/16

**Detailed Results Table**

Moments: kips\*foot , Forces: kips , Stresses: ksi , Section prop.: inch



**CONSTRAINTS**

- Sections : Check
- Steel Grade: A53

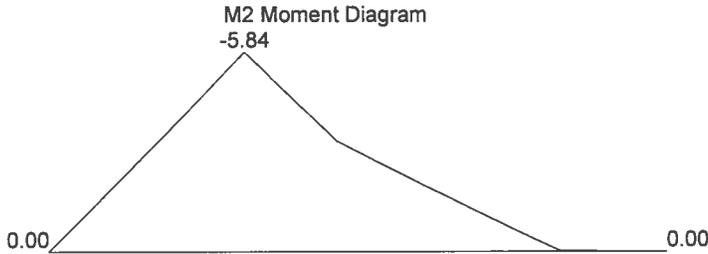
**DESIGN DATA**

- Kx = 1.00 - Ky = 1.00
- Allow. Slend. : 200 (compr.) 300 (tens.)
- Allowable Deflection : 1/240
- Tension Area Reduction Factor : 1.00
- Building type : Unbraced

Section: PIPE 4

ix = 7.23 ly = 7.23in4 Sx = 3.21 Sy = 3.21in3 Area = 3.17  
 D = 4.50 t = 0.24in  
 J = 14.47 Cw = 0.00in6

DESIGN COMBINATION = 1



Max. AXIAL Force = -3.39 (compr.) Max. SHEAR Force = 1.17

DESIGN	EQUATION	FACTORS	VALUES	RESULT
V3 Shear (F4-1)	$V/(A_v * F_v) < 1.00$ $F_v = 0.4 * F_y$	$A_v = 1.90$	$V = 1.17$ $F_v = 14.00$	0.04
M2 Moment (F3-1)	$M / (S * F_b) < 1.00$	$S = 3.21$ $F_b = 0.660 * F_y$	$M = 5.84$ $S * F_b = 6.20$	0.94
Deflection	$defl. / (L / 240) < 1.00$		$defl = 0.76327$	0.95
Combined Stresses (Local) (H1-2) (H2-1)	$f_a + \frac{f_{bx}}{0.6F_y} + \frac{f_{by}}{F_{by}} < 1.00$	$f_{bx} = 21.78$ $F_{bx} = 23.10$ $f_{by} = 0.00$ $F_{by} = 0.00$	$P = 3.39$ $A = 3.17$ $F_u = 60.00$ $f_b = M/S$	0.99
Axial Force (E2-1/2)	$f_a / F_a < 1.00$	$(kL/r)_x = 77$ $(kL/r)_y = 77$ $C_c = 128.10$	$P = 3.39$ $A_g = 3.17$ $F_a = 15.38$	0.07
Combined Stresses (tension) (H2-1)	$f_a + \frac{f_{bx}}{F_t} + \frac{f_{by}}{F_{by}} < 1.00$	$F_{bx} = 23.10$ $F_{by} = 23.10$	$f_{bx} = 21.78$ $f_{by} = 0.00$	0.94