Evaluation of the Temporary Tent Cover Truss System, AP Primary Vent System

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Key Words: AP tank farms, Central Exhaust Station Enclosure, Tent Cover, Tubular Truss System

Abstract: The purpose of this calculation is to evaluate a temporary tent cover truss system. This system will be used to provide weather protection to the workers during replacement of the filter for the Primary Ventilation System in AP Tank Farm. The truss system has been fabricated utilizing tubes and couplers, which are normally used for scaffoldings.

J.E. Fox
Release Approval

12-31-2009
Date

Release Stamp

Approved For Public Release

Calculation Review Checklist.

Calculation Reviewed: RPP-CALC-44193 R0
Scope of Review: Entire Calculations
(e.g., document section or portion of calculation)
Engineer/Analyst: M. A. Haq [signature] Date: 12/30/09
Organizational Manager: M. A. Roberts [signature] Date: 12/30/2009

This document consists of 10 pages and the following attachments (if applicable):
ATTACH. A: Photos of Tent Cover Truss System
ATTACH B: Sketch for the Tent Cover truss System
ATTACH C: Field Sketch for Typical Tent Cover Truss
ATTACH D: Density of Snow Cover Info.l
ATTACH E: Alternate Calc. to veify the Strl Integrity of the Truss System during Hoisting & Rigging

Yes	No	NA*		
[x]	[ ]	[ ]	1.	Analytical and technical approaches and results are reasonable and appropriate.
[x]	[ ]	[ ]	2.	Necessary assumptions are reasonable, explicitly stated, and supported.
[x]	[ ]	[]	3.	Ensure calculations that use software include a paper printout, microfiche, CD-ROM, or other electronic file of the input data and identification to the computer codes and versions used, or provide alternate documentation to uniquely and clearly identify the exact coding and execution process.
[x]	[ ]	[ ]	4.	Input data were checked for consistency with original source information.
[x]	[ ]	[ ]	5.	Key input data (e.g., dimensions, performance characteristics) that may affect equipment design is identified.
[x]	[ ]	[ ]	6.	For both qualitative and quantitative data, uncertainties are recognized and discussed and the data is presented in a manner to minimize design interpretations.
[x]	[ ]	[ ]	7.	Mathematical derivations were checked, including dimensional consistency of results.
[x]	[ ]	[ ]	8.	Calculations are sufficiently detailed such that a technically qualified person can understand the analysis without requiring outside information.
[x]	[ ]	[]	9.	Software verification and validation are addressed adequately.
[x]	[ ]	[ ]	10.	Limits/criteria/guidelines applied to the analysis results are appropriate and referenced. Limits/criteria/guidelines were checked against references.
[x]	[ ]	[ ]	11.	Conclusions are consistent with analytical results and applicable limits.
[x]	[ ]	[ ]	12.	Results and conclusions address all points in the purpose.
[x]	[ ]	[ ]	13.	Referenced documents are retrievable or otherwise available.
[x]	[ ]	[ ]	14.	The version or revision of each reference is cited.
[x]	[ ]	[ ]	15.	The document was prepared in accordance with Attachment A, "Calculation Format and Preparation Instructions."
[]	[ ]	[x]	16.	Impacts on requirements have been assessed and change documentation initiated to incorporate revisions to affected documents, as appropriate.
[x]	[ ]	[ ]	17.	All checker comments have been dispositioned and the design media matches the calculations. or notation has been added

T.C. Mackey [signature] 12/30/09
Checker (printed name and signature) Date

* If No or NA is chosen, an explanation must be provided on or attached to this form.

Item 16: No impact to requirements and no change documentation is required.

ANALYTICAL COMPUTATIONS

Subject: Evaluation of the Temporary Tent Cover Truss System, AP Primary Vent. System
Originator: M. A. Haq *M A Haq* Date: 12/22/09
Checker: TC Mackey Date: *12/30/09*
Organizational Mgr. M A. Roberts *Mark Roberts* Date: *12/30/2009*

1.0 Objective/Purpose:

The purpose of this calculation is to evaluate the tent cover truss system (see Atttach. A for the photos of this sytstem). This system will be used to provide weather protection to the workers during replacement of the filter for the Primary Ventilation System in AP Tank Farm. The truss system has been fabricated utilizing tubes and couplers, which are normally used for scaffoldings. This system, presently located near the Primary Ventilation System, consists of 23 feet wide wide trusses, with their bottom chord members extending 26 feet wide, and is 36 feet long (see Attach. B for the field dimensions of the typical truss). This truss system will be lifted from the ground, and placed on top of the concrete walls of Central Exhaust Station Enclosure (see drawings H-2-90456, and H-2-90457, Sh 1 for the enclosure), as a temporary roof structure. The shorter side of the truss system, 23 feet wide, will be sitting on the east-west concrete walls (see Plan, dwg H-2-90456 for concrete walls, located with dimension of 23'-3", outer face of east wall to outer face of west wall). The truss system will overhang approximately 8' - (9-1/2)" beyond the south walll. The overhang portion of the truss system will be supported on two posts. The arrangement of the truss support system has been shown in Attach.B. Once installed, the truss system will be covered with tarp, for weather protection.

2.0 Results/Conclusions:

This is a temp tent. RPP-7933 only requires 55 mph. Conc. block sizes are only recommended but not required TCM 12/30/09

~~The truss support assembly meets the requirements for natural phenomena hazards loads in accordance with TFC-ENG-STD-06 (Ref. 3) for PC-1 structure.~~ **However, the temporary truss system is restricted for snow loading (up to 3/8" thick fresh snow). The truss system has to be cleared off snow, if snow exceeds more than 3/8"** . The tarp, covering the truss system, has not been evaluated for wear and tear due to snow or ice loadings.

No seismic analysis has been performed, since this is a temporary structure. Moreover, based on engineering judgement, it is expected that wind loading will govern.

Alternate calculations have been done to check the integrity of the truss system framing (see Attach E). **Add clamps over the horizontal member couplings** (where the tubular members are connected to each other). The truss system can be lifted by using the following two options:

a. Use four pick points on east and west sides of the truss system.
b. In case two interior pick points are used for lifting, add bracings (as shown on the Sketch on pg E-3). Double clamp the added bracings or use double bracings.

3.0 Input Data:

a. Dimensions of the truss system were obtained from the field (See Attach. C). The components of the truss system consist of 2" diameter tubes, and couplerss, normally used by Safway Scaffoldings.
b. Tent Cover Truss System weight is 3100 lbs. This weight was taken in the field by lifting the truss system from the ground, using a dynamometer. If proposed bracings, as shown on the Sketch on pg. E-3 are added, it will add approximately 400 lbs to the truss system.
c. The truss system assembly has been analyzed as PC-1 per TFC-ENG-STD-06 (Ref. 3). *for wind only. TCM 12/30/09*

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4.0 Assumptions:

None

5.0 Method of Analysis

Manual calculations are used for this analysis using MathCAD. The truss system is analyzed for wind loading per ASCE 7-05 (Ref. 1)

Design Wind Force

The wind loads are determined from ASCE 7-05 (Ref. 1) Method 1, Simplified Procedure.
V = 85 mph (Table 3, Ref. 3)

Evaluation of the Truss System

a). Evaluation of the Truss System Portion Positioned on the Concrete Walls

Slope of the roof truss (based on tan = 4'-0"/11'-6" from Attach. B) = 18.8 degrees

Using Fig. 6-2, pg 37 (Ref. 1), the maximum wind force in the longitudinal direction for a wind velocity of 85 mph, with angle roof of 20 degrees, Zone E (vertical pressure) is 13.8 psf. Note: Fig. 6.2 is based on a structure height of 30 feet, however the adjustment factor λ for this height, according to table on pg 40 of Ref. 1 is 1.

$w_1 := 13.8 \cdot psf$ Uplift pressure on the truss system

$L_1 := 27 \cdot ft$ Length of truss system

$L_2 := 36 \cdot ft$ Total length of the truss system

$W_1 := 23 \cdot ft$ Width of the truss system

$U_1 := w_1 \cdot L_1 \cdot W_1$ Total uplift force on the truss system

$U_1 = 8.57 \times 10^3 \text{ lbf}$

$w_{truss} := 3100 \cdot lbf$ Total weight of the truss system.

$w_{truss1} := w_{truss} \cdot \frac{L_1}{L_2}$ Weight of truss system, positioned on the concrete walls. Note: 27 feet length of truss system is being supported on concrete walls

$w_{truss1} = 2.325 \times 10^3 \text{ lbf}$

$U_{net1} := U_1 - w_{truss1}$ Net uplift on the truss system (positioned on the concrete walls)

$U_{net1} = 6.245 \times 10^3 \text{ lbf}$

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$U_{concblock1} := \frac{U_{net1}}{4}$

Uplift on each concrete block. Each corner of the truss system, positioned on the concrete walls, is to be tied with a a concrete block on the ground, using a guy wire or rope.

$U_{concblock1} = 1.561 \times 10^3$ lbf

$w_{concblock1} := 3600 \cdot lbf$

Weight of the concrete block, 2' x 6' x 2' (depth)

$w_{concblock1} > U_{concblock1}$

Okay

$F_{sliding1} := U_{concblock1}$

Horizontal sliding force, assuming that the guy wire from the truss system is attached to the concrete block at 45 degrees.

$\mu_{concrblock1} := 0.5$

Coefficient of friction between concrete block and gravelled surface (see pg C-3, Ref. 2)

$F_{resist1} := \mu_{concrblock1} \cdot w_{concblock1}$

Frictional force resisting sliding force

$F_{resist1} = 1.8 \times 10^3$ lbf

$F_{resist1} > F_{sliding1}$

Okay

Use Concrete Block, ~~2' x 6' x 2'~~ 2.5' x 5' x 2.5' WT Req'd = 1561 x (1561 x 2) = 4683# [initials] 12/30/09

Sizing concrete block size, in case the concrete block has to be positioned up to 45 degrees from its position to avoid interferances on the grade

$U_{concblock3} := U_{concblock1} \cdot \frac{1}{\cos(45 \cdot deg)}$

Net uplift from the truss system on the concrete block, in case it is orientated 45 degrees in the plan from its position Uplift is the same as above [initials] 12/30/09

$U_{concblock3} = 2.208 \times 10^3$ lbf

Weight of the concrete block, 2.5' x 5' x 2'.5'

$w_{concblock3} := 4600 \cdot lbf$

$w_{concblock3} > U_{concblock3}$

Okay

$F_{sliding3} := U_{concblock3}$

Horizontal sliding force, assuming that the guy wire from the truss system is attached to the concrete block at 45 degrees.

$\mu_{concrblock3} := 0.5$

Coefficient of friction between concrete block and gravelled surface (see pg C-3, Ref. 2)

$F_{resist3} := \mu_{concrblock3} \cdot w_{concblock3}$ — Frictional force resisting sliding force

$F_{resist3} = 2.3 \times 10^3 \text{ lbf}$

$F_{resist3} > F_{sliding1}$ — Okay

Use Concrete Block, 2.5' x 5' x 2.5, in case the concrete block has to be rotated up to 45 degrees (in the plan) to miss interferances on the grade (see Sketch on pg B-2 for conc. blocks, 4600 lbs).

Check Size of Guy Wire

Guy wire or rope will be attached from each corner of the truss system (positioned on the walls) to the concrete blocks as shown in Attach. B.

$P_{wire} := \dfrac{U_{concblock3}}{\sin(45 \cdot deg)}$ — Tension force on the wire

$P_{wire} = 3.122 \times 10^3 \text{ lbf}$

$P_{capacity} := 10.7 \cdot 2 \cdot kip$ — Tensile capacity of 1/2" ϕ, 6 x 19 Fiber Core Wire Rope (See pg A-13, Ref.2)

$FOS_{wire} := \dfrac{P_{capacity}}{P_{wire}}$

$FOS_{wire} = 6.854$ — Okay

Use 1/2" ϕ, 6 x 19 Fiber Core Wire Rope or equivalent wire rope, with a minimum breaking strength or capacity of 10 kips

b. Evaluation of the Truss System portion, positioned on the Posts

Using figure 6-2, pg 37 (Ref. 1), the maximum wind force in longitudinal direction for wind velocity of 85 mph, with angle roof 20 degrees, Zone E (vertical pressure) is 13.8 psf.

$w_1 := 13.8 \cdot psf$ — Uplift force on the truss system

$L_3 := 9 \cdot ft$ — Length of truss system

$L_2 := 36 \cdot ft$ — Total length of the truss system

$W_1 := 23 \cdot ft$ — Width of the truss system

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$U_2 := w_1 \cdot L_3 \cdot W_1$

Total uplift force on the truss system

$U_2 = 2.857 \times 10^3 \text{ lbf}$

$w_{truss} := 3100 \cdot \text{lbf}$ — Total weight of the truss system.

$w_{truss2} := w_{truss} \cdot \frac{L_3}{L_2}$

Weight of truss system, supported by the posts. Note: 9 feet length of truss system is being supported by the two posts

$w_{truss2} = 775 \text{ lbf}$

$U_{net2} := U_2 - w_{truss2}$

Net uplift on the truss system (supported on the posts)

$U_{net2} = 2.082 \times 10^3 \text{ lbf}$

$U_{concblock2} := \frac{U_{net2}}{4}$

Uplift on each concrete block. Each corner of the truss system, positioned on the concrete walls, is to be tied with a a concrete block on the ground, using a guy wire or rope.

$U_{concblock2} = 520.4 \text{ lbf}$ ✓

Weight of the concrete block, 3' x 3' x 1 (depth)'

$w_{concblock2} := 1350 \cdot \text{lbf}$

$w_{concblock2} > U_{concblock2}$ — Okay

$F_{sliding2} := U_{concblock2}$

Horizontal sliding force, assuming that the guy wire from the truss system is attached to the concrete block at 45 degrees.

$\mu_{concrblock2} := 0.5$

Coefficient of friction between concrete block and gravelled surface (see pg C-3, Ref.)

$F_{resist2} := \mu_{concrblock2} \cdot w_{concblock2}$

Frictional force resisting sliding force

$F_{resist2} = 675 \text{ lbf}$

$F_{resist2} > F_{sliding2}$ — Okay

Use Concrete Block, 3' x 3' x 1' 1350# + 200#

WT. Req'd = 520 + (520 x 2) = 1560#
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Check Post for supporting the Truss System (see Attach B)

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Try tubular size 2" ϕ (normally used by Safway Scaffolding)

Properties of tubular post 2" ϕ (See pg A-12, Ref. 2):

$A_{post} := 0.75 \cdot in^2$ Area of the post

$I_{post} := 0.29 \cdot in^4$ Moment of inertia of the post

$S_{post} := .310 \cdot in^3$ Section modulus of the post

$r_{post} := \sqrt{\dfrac{I_{post}}{A_{post}}}$ Radius of gyration of the post

$r_{post} = 0.622\,in$

$L_{post} := 8 \cdot ft + 3 \cdot in$ Height of the post

$K_{post} := 1$ Effective length factor of post, pg 3-5, Ref. 4

$F_y := 36 \cdot ksi$ Yield stress of steel

$E := 29 \cdot 10^3 \cdot ksi$ Elastic modulus of steel

$SL_{post} := \dfrac{K_{post} \cdot L_{post}}{r_{post}}$ Effective slenderness ratio of the post

$\dfrac{K_{post} \cdot L_{post}}{r_{post}} = 159.209$

$C_c := \sqrt{\dfrac{2 \cdot \pi^2 \cdot E}{F_y}}$

$C_c = 126.099$

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$$\frac{K_{post} \cdot L_{post}}{r_{post}} > C_c$$

$$F_a := \frac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{K_{post} \cdot L_{post}}{r_{post}}\right)^2}$$

Allowable Axial Stress per Eq E2-2, pg 5-42, Ref. 4

$$F_a = 5.891 \times 10^3 \text{ psi}$$

Load on the post

$w_{tarp} := 500 \cdot lbf$ Assume weight of the tarp on truss

$w_{truss} := 3100 \cdot lbf$ Weight of truss

$w := w_{truss} + w_{tarp}$ Total weight of the truss system

$$P_{deadload} := \left(w \cdot \frac{L_3}{L_1} \cdot \frac{1}{2}\right) \cdot \frac{1}{2}$$

Dead load on the post

$$P_{deadload} = 300 \text{ lbf}$$

$W_{snow} := 20 \cdot psf$ Snow load, Sect. 3.5.2, Ref. 3

$$P_{snow} := \left(\frac{W_{snow} \cdot L_3 \cdot W_1}{2}\right) \cdot \frac{1}{2}$$

Snow load on the post

$P_{post} := P_{deadload} + P_{snow}$ Total load on the post

$$P_{post} = 1.335 \times 10^3 \text{ lbf}$$

$$f_a := \frac{P_{post}}{A_{post}}$$

Axial Stress on the post

$$f_a = 1.78 \times 10^3 \text{ psi}$$

$F_a > f_a$ Okay

Use Tubular or Pipe with 2" ϕ

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Evaluation of the Typical Truss for Snow Loading

There are 10 trusses in the truss system, spaced at 4 feet c/c, as shown on the sketch on pg. B-2

$w_{truss3} := \frac{w}{9}$ Weight of a typical truss

$R_{truss} := \frac{w_{truss3}}{2}$ Reaction at the truss support for a typical truss

$R_{truss} = 200\ \text{lbf}$

$W_1 = 23\ \text{ft}$ Width of a truss

$h_1 := 4 \cdot \text{ft}$ Height of the truss

$S_{truss} := \left(\frac{h_1}{\frac{W_1}{2}} \right)$ Slope of the truss

$S_{truss} = 0.348$

$\theta_{truss} := 19.2$ Slope of the truss in degrees

$F_{top.chord} := \frac{R_{truss}}{\sin(\theta_{truss} \cdot \text{deg})}$ Force in the top chord of truss (at the end of truss)

$F_{top.chord} = 608.149\ \text{lbf}$

$F_{bot.chord} := F_{top.chord} \cdot \cos(\theta_{truss} \cdot \text{deg})$ Force in the bottom chord

$F_{bot.chord} = 574.322\ \text{lbf}$

The bottom chords of trusses, made of 2" diameter Safway tubular members is clamped with typical Safway clamps. These clamps, CRA-19 and CSA-19, have been rated with 1000 lbs load for new clamps, as shown on pg B-2., Ref 2. Peter Elsabally, Safway Scaffolding (1-206-523-6560), suggested downgrading it (with a .75 factor) for used clamps. The bottom chord at its clamped location needs to be checked for its structural integrity, since this will be the weakest link.

$P_{clamp} := 0.75 \cdot 1000 \cdot \text{lbf}$

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$P_{clamp} = 750 \text{ lbf}$

$P_{clamp} > F_{bot.chord}$ — Okay

$d_{snow} := 550 \cdot \frac{2.20}{3.281^3}$ — Density of firn snow (550 kg per cubic meter, see Attach. D

Note: 1 kg = 2.20 lbs, 1 meter = 3.281 feet

$d_{snow} = 34.258$ — Density of snow in lbs per cu ft

$w_{firn.snow} := \frac{d_{snow}}{12} \cdot \left(\frac{3}{8}\right)$ — Weight of snow (assuming 3/8 " thick) on the truss in psf

$w_{firn.snow} = 1.071$

$R_{truss.snow} := \frac{23 \cdot 4 \cdot w_{firn.snow}}{2} \cdot \text{lbf}$ — Reaction at the truss due to firn snow. Note that the typical truss is 23 ft wide, and spacing of trusses is 4 ft c/c.

$R_{truss.snow} = 49.246 \text{ lbf}$

$F_{bot.chord1} := F_{bot.chord} + F_{bot.chord} \cdot \frac{R_{truss.snow}}{R_{truss}}$ — Tension force at the bottom chord of truss by including 3/8" thick snow

$F_{bot.chord1} = 715.738 \text{ lbf}$

$F_{bot.chord1} < P_{clamp}$ — Okay

Remove snow on the truss system, if it exceeds 3/8" in thickness

NOTE: If proposed bracings, as shown on the Sketch on pg. E-3 are added, it will add approximately 400 lbs to the truss system. The extra weight will help in overcoming the uplift due to wind, and will make the truss system more conservative. Therefore, there is no need to reanalyze the truss system

6.0 References

1.0 ASCE 7-05, Minimum Design Loads for Buildings aand Other Structures, ASCE, Structural Engineering Institute.
2.0 RPP-CALC-42370, Analysis of Existing Scaffolds at AN & AW Tank Farm Skids, Rev. 0
3.0 TFC-ENG-STD-06, Rev. C-3, Design Loads for Tank Farm Facilities, CH2M Hill Hanford Group, Inc., Richland, Washington.
4.0 AISC, Steel construction, Allowable Stress Design, 9th Edition, American Institue of Steel

Construction, Chicago, Illnois.

5.0 H-2-90456, Sh 1, Structural, Central Exhaust STA Plans, Sect & Detail.

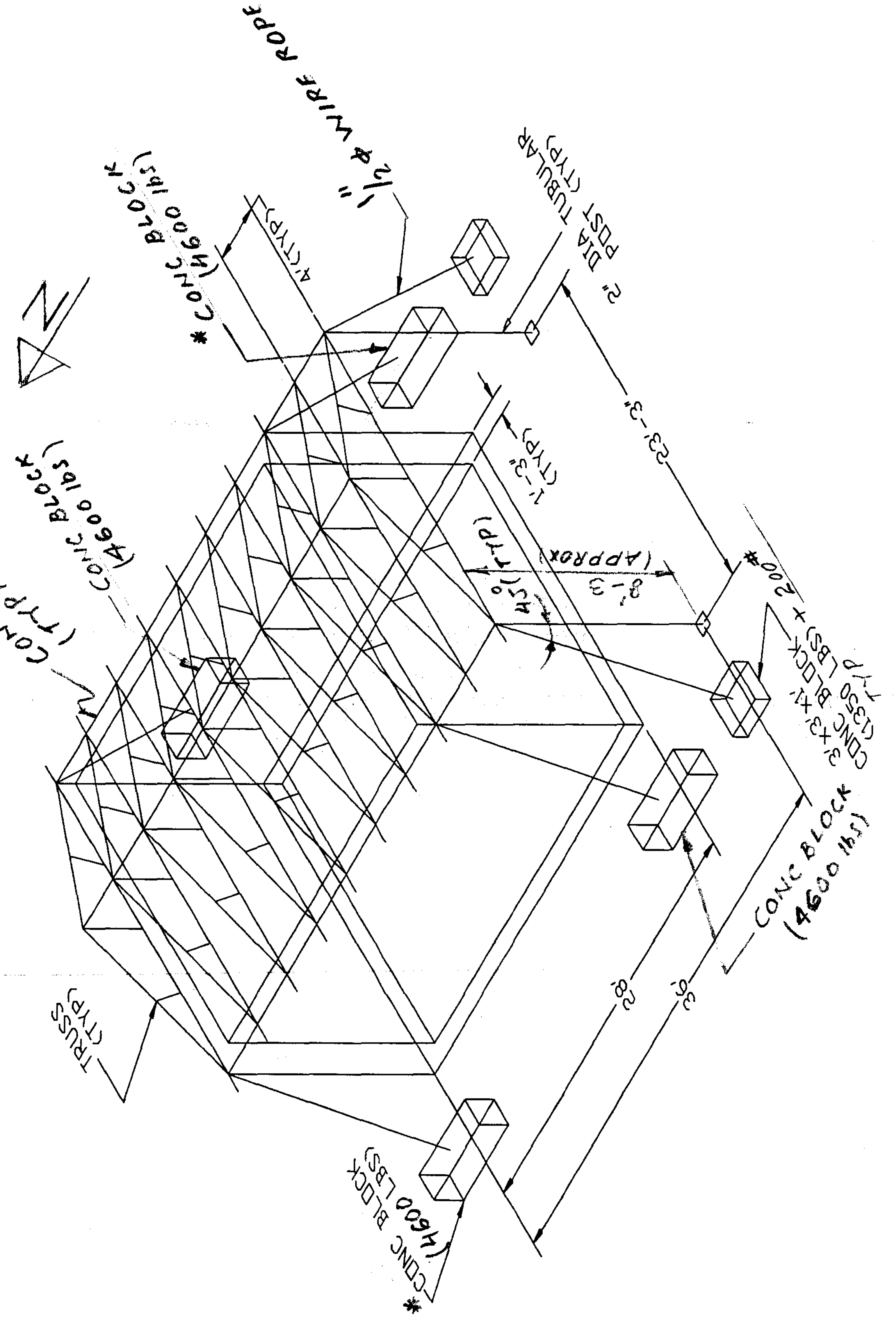
6.0 H-2-90457, Structural Central Exh Sta Sect & Det.

ATACHMENT A

(Photos of Tent Cover Truss System)

ATACHMENT B

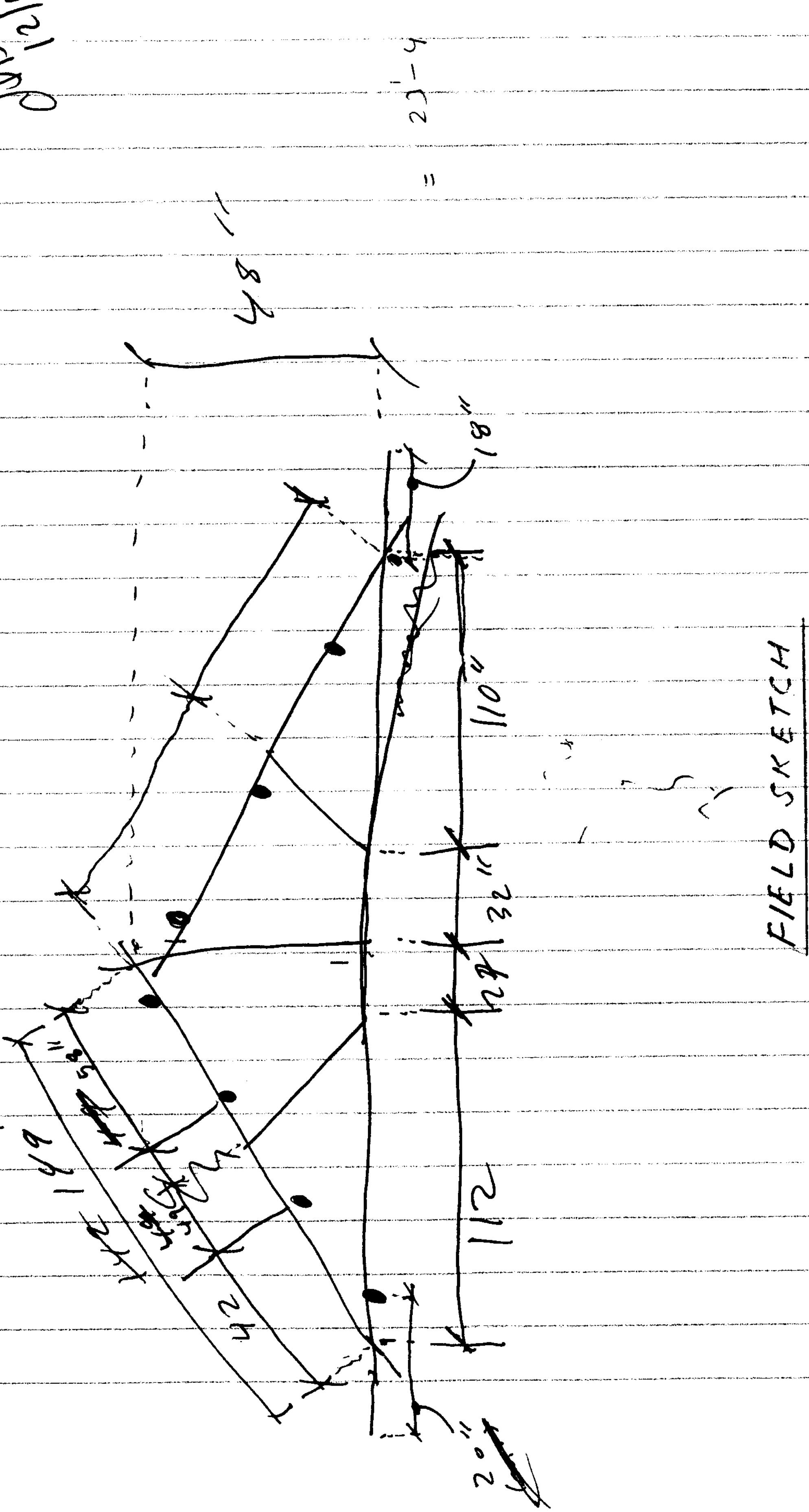
(Sketch for Tent Cover Truss System Support)



* THESE CONC BLOCKS MAY BE ORIENTATED UP TO 45° (IN PLAN) TO MISS INTERFERANCES

ATACHMENT C

(Field Sketch for Typical Tent Cover Truss)


FIELD SKETCH
110"
112
18"
48"

ATACHMENT D

(Density of Snow Cover Info.)

RPP-CALC-44193 R0

Density of Snow Cover

Snow Type	Density (kg/m^3)	Snow Depth for One Inch Water
Wild Snow	10 to 30	98" to 33"
Ordinary new snow immediately after falling in still air	50 to 65	20" to 15"
Settling Snow	70 to 90	14" to 11"
Average wind-toughened snow	280	3.5"
Hard wind slab	350	2.8"
New firn snow	400 to 550	2.5" to 1.8"
Advanced firn snow	550 to 650	1.8" to 1.5"
Thawing firn snow	600 to 700	1.6" to 1.4"

Slide 35 of 107

PG. D-1

ATACHMENT E

(Alternate Calc. to verify the Strl. Integrity of the Truss System during Hoisting & Rigging)

ANALYTICAL CALCULATIONS

Subject: AP VENT SYSTEM TENT COVER HOISTING CALC

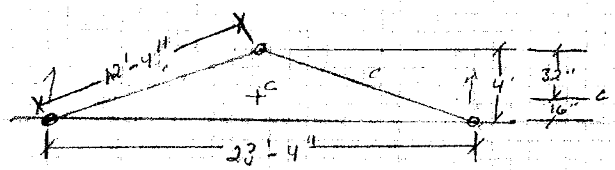
Originator: Paul DeBuigne (signature) Date: 12/28/09

Checker: T.C. Mackey (signature) Date: 12/29/09

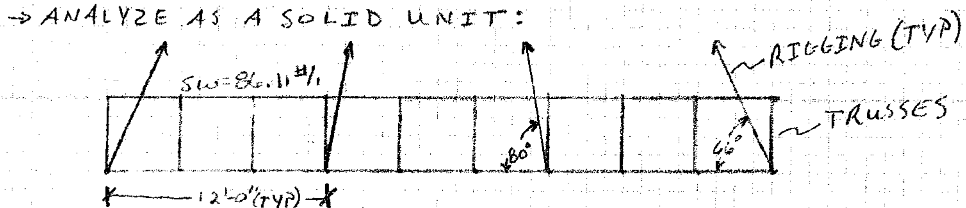
STATEMENT:

THIS IS AN ALTERNATIVE CALCULATION TO VERIFY THE STRUCTURAL INTEGRITY OF THE FRAMING OF THE TRUSS FOR HOISTING + RIGGING.

CALCULATION:



→ ANALYZE AS A SOLID UNIT:



⇒ WEIGHT OF TRUSS SYSTEM = 3100 lb, DIST'D LOAD(w) = $\frac{3100^{\#}}{36'}$ = 86.11 #/'

→ TRIANGLE PROPERTIES: AISC, LRFD, 3rd ed, pg. 17-34

$c = \frac{1}{3}(48")$ $c = 16"$, $c_1 = 32"$

$I_{TUBE} = 0.29 in^4$ $A_{TUBE} = 0.75 in^2$

$I = \Sigma I + Ad^2$ $I = 2(0.29 + 0.75(16")^2) + (0.29 + 0.75(32"))$ $I = 408.87 in^4$

$M_{max} = 0.100 wL^2 = 1240$ #-' $= 14.88$ k-" , $L = 12'-0"$

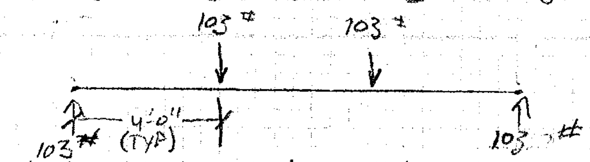
Top Chord (Compression):

$F_{b_T} = \frac{Mc}{I}$, $c = 32"$ $F_{b_T} = 1.16$ KSI x 1.25 IMPACT = 1.45 KSI ✓OK

Bottom Chord (Tension):

$F_{b_b} = \frac{Mc}{I}$, $c = 16"$ $F_{b_b} = 0.58$ KSI x 1.25 IMPACT = 0.73 KSI ✓OK

Check BOTTOM CHORD FOR LOCAL BUCKLING:



+25% IMPACT $M_{max} = 4.94$ k-" x 1.25 IMPACT

$M_{max} = 6.2$ k-"

INDIV. TRUSS WEIGHT = 310#

LOAD ON TOP + BOTTOM CHORDS:

$310^{\#}/3 = 103.34^{\#}$

$S_{TUBE} = 0.310 in^3$

$F_b = 0.6 F_y$, $F_y = 36$ KSI, $F_b = 21.6$ KSI

$f_b = 20$ KSI $(f_b = 20 KSI) < (F_b = 21.6 KSI)$ ✓OK

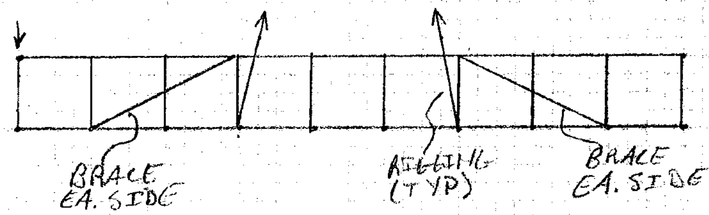
ANALYTICAL CALCULATIONS

Subject: AP VENT SYSTEM TENT COVER HOISTING CALC

Originator: Paul DeBuigne [signature] Date: 12/28/09

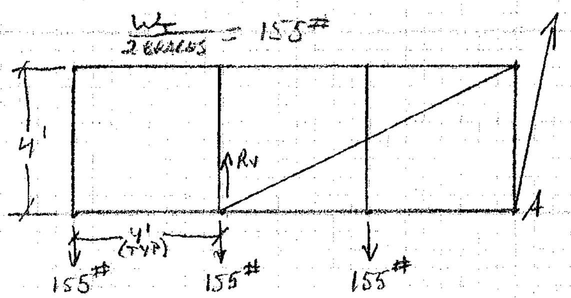
Checker: T.C. Mackey [signature] Date: 12/29/09

– TRY 4 INTERIOR PICK POINTS WITH ENDS BRACED:



TRUSS WEIGHT = 310# EACH

$\frac{W_T}{2\ BRACES} = 155^{\#}$



$A_{TUBE} = 0.75\ in^2$

$\Sigma M_A = 0 = 155^{\#}(4') + 155^{\#}(8') + 155^{\#}(12') - R_V(8')$

$R_V = 465^{\#}$

$L_{BRACE} = \sqrt{4^2 + 8^2}$ $L_{BRACE} = 8.944'$

$\frac{P_{BRACE}}{R_V} = \frac{L_{BRACE}}{4}$ $P_{BRACE} = 1040^{\#}$

$f_T = \frac{P}{A} = \frac{1040^{\#}}{0.75\ in^2}$

$f_T = 1.39\ KSI$

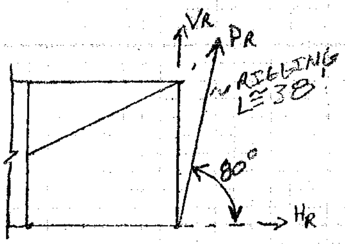
$F_T = 0.6\ F_Y$, $F_Y = 36\ KSI$

$F_T = 21.6\ KSI$

$f_T < F_T$ ✓ OK

→ 3 DIMENSIONAL STRESS OK BY INSPECTION.

– CHECK COMBINED BENDING + COMPRESSION BETWEEN PICK POINTS:

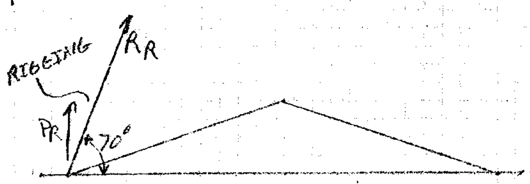


V_R = TRUSS SYSTEM WEIGHT / 4 SLINGS

$V_R = \frac{3100^{\#}}{4}$ $V_R = 775^{\#}$

$P_R = 775^{\#}/\cos(10°)$ $P_R = 786.96^{\#}$

$H_R = 775^{\#} \tan(10°)$ $H_R = 136.65^{\#} \times 1.25$ IMPACT $H_R = 170.8^{\#}$



$R_R = \frac{P_R}{\cos(20°)}$ $R_R = 837.5^{\#} \times 1.25$ IMPACT

$R_R = 1046.88^{\#}$

STRESS IN BOTTOM STRUTS FROM BENDING

$f_b = 20\ KSI$

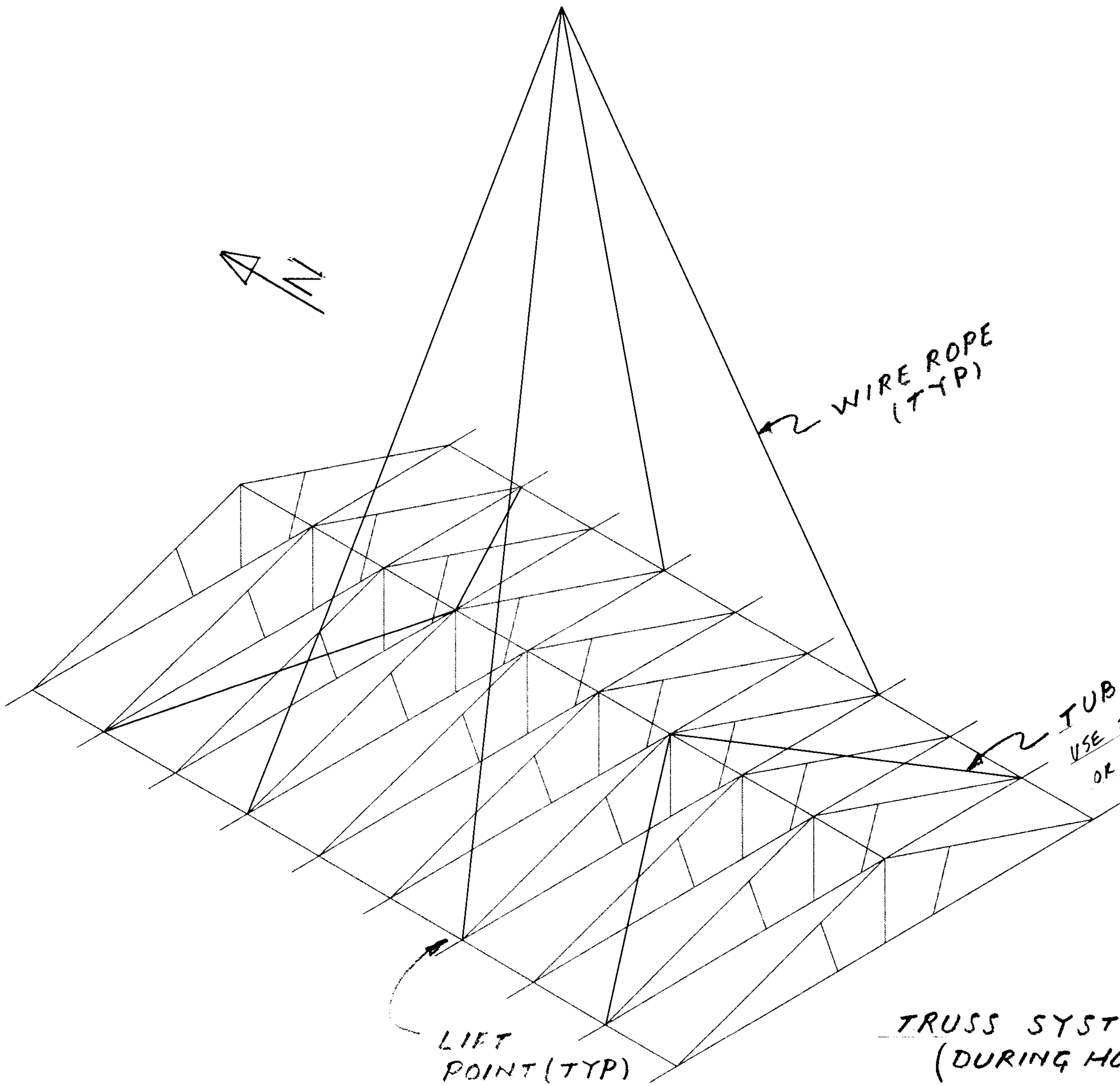
ADD AXIAL COMPRESSION, $H_R = 170.8^{\#}$

$f_c = \frac{P}{A} = \frac{H}{A}$ $f_c = 0.23\ KSI$

$F_c = 5.89\ KSI$

$F_b = 21.6\ KSI$

$\frac{f_c}{F_c} + \frac{f_b}{F_b} = \frac{0.23}{5.89} + \frac{20}{21.6} = 0.965 < 1.0$ ✓ OK



TRUSS SYSTEM
(DURING HOISTING & RIGGING)