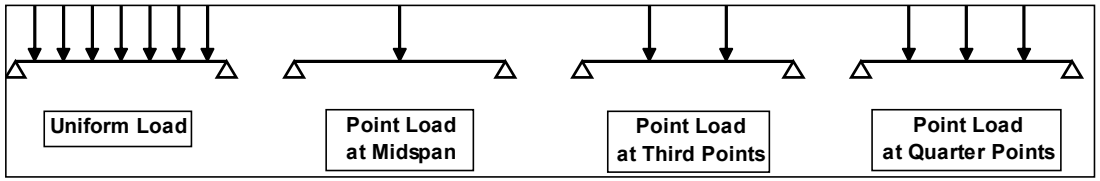
CHRISTIE LITES

ALLOWABLE LOAD DATA

CHRISTIE LITES 16" x 16" TRUSS



Number of Sections	Span[1] (ft)	Uniform Load[2, 3, 4, 6]			Maximum Allowable Point Loads[4, 5, 6]					
					Center Point		Third Point		Quarter Point	
		Load (plf)	Total Load (lbs)	Deflection (in)	Load (lbs)	Deflection (in)	Load (lbs)	Deflection (in)	Load (lbs)	Deflection (in)
1	8	820 bc	6560	0.14"	6400	0.21"	2 x 3300	0.21"	3 x 2200	0.21"
		770 tc	6160	0.14"						
2	16	240	3840	0.3"	1920	0.26"	2 x 1430	0.3"	3 x 960	0.3"
3	24	120	2880	0.6"	1900	0.77"	2 x 900	0.77"	3 x 725	0.77"
4	32	60	1920	1.1"	940	0.86"	2 x 700	1.1"	3 x 470	1.1"
5	40	40	1600	1.6"	900	1.64"	2 x 550	1.64"	3 x400	1.64"
6	48	25	1200	2.26"	600	1.85"	2 x 450	2.26"	3 x 300	2.26"

FOOTNOTES

1) Span indicates distance between truss supports.
2) Uniform loads shall be distributed evenly across both truss chords and can be applied to either top or bottom chords.
3) Values at single span truss labeled "bc" are for uniform loads applied to truss bottom chord. Values at single span truss labeled "tc" are for uniform loads applied to truss top chord.
4) Maximum point load that may be applied to truss chords **between** panel points is 250 Lbs at each chord member simultaneously.
5) For truss to support indicated loads, point loads shall be hung from truss panel points only. Truss shall be oriented to ensure load is applied at panel points.
6) For point loads at intervals not indicated, use equivalent uniform load to determine capacity.
7) Loads shown require trusses to be connected at end supports to each chord member (i.e. 4 connections ea end of truss).
8) Capacity of additional support structures, components or connections are outside the scope of this analysis.

650 Sussex Boulevard Kingston, Ontario K7M 5A8 (613) 389-1072 KOHAR ENGINEERING

ADLER METAL WORKS

16 INCH BY 16 INCH LIGHTING TRUSS

STRUCTURAL ANALYSIS

Prepared by: Rick J. Kohar, P.Eng. 6 February [illegible]

ADLER METAL WORKS

16 INCH BY 16 INCH LIGHTING TRUSS

STRUCTURAL ANALYSIS

TABLE OF CONTENTS

ADLER METAL WORKS

16 INCH BY 16 INCH LIGHTING TRUSS

DESIGN SUMMARY

A truss, 16" high by 16" deep in cross section, made up of 5 welded sections pinned together to form a total span of 40 feet, has been analyzed with a point load of 1000 pounds force at mid span.

Weld design, and analysis has been carried out in accordance with the American Welding Society's Standard D1.2-90, Structural Welding Code for Aluminum.

In particular section 10.0, of AWS Standard D1.2-90, and the Aluminum Association's Specifications for Aluminum Structures - Construction Manual Series, Section 1 for allowable stresses for bridges, and other similar structures, has been used for the 6061 T6 aluminum.

In summary, the design has been reviewed and found acceptable in the following areas:

1) Weld stresses.

2) Pin shear and bearing loads

3) Member bending, compression and shear loads.

4) Member buckling.

5) Eye and Jaw Connector Bearing and Axial Stresses

Rick J. Kohar

Professional Engineer
Ontario, Canada

MAIN MENU
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Modify
Construct
Files
Inquire
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aUto mesh
Transfer
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Quit

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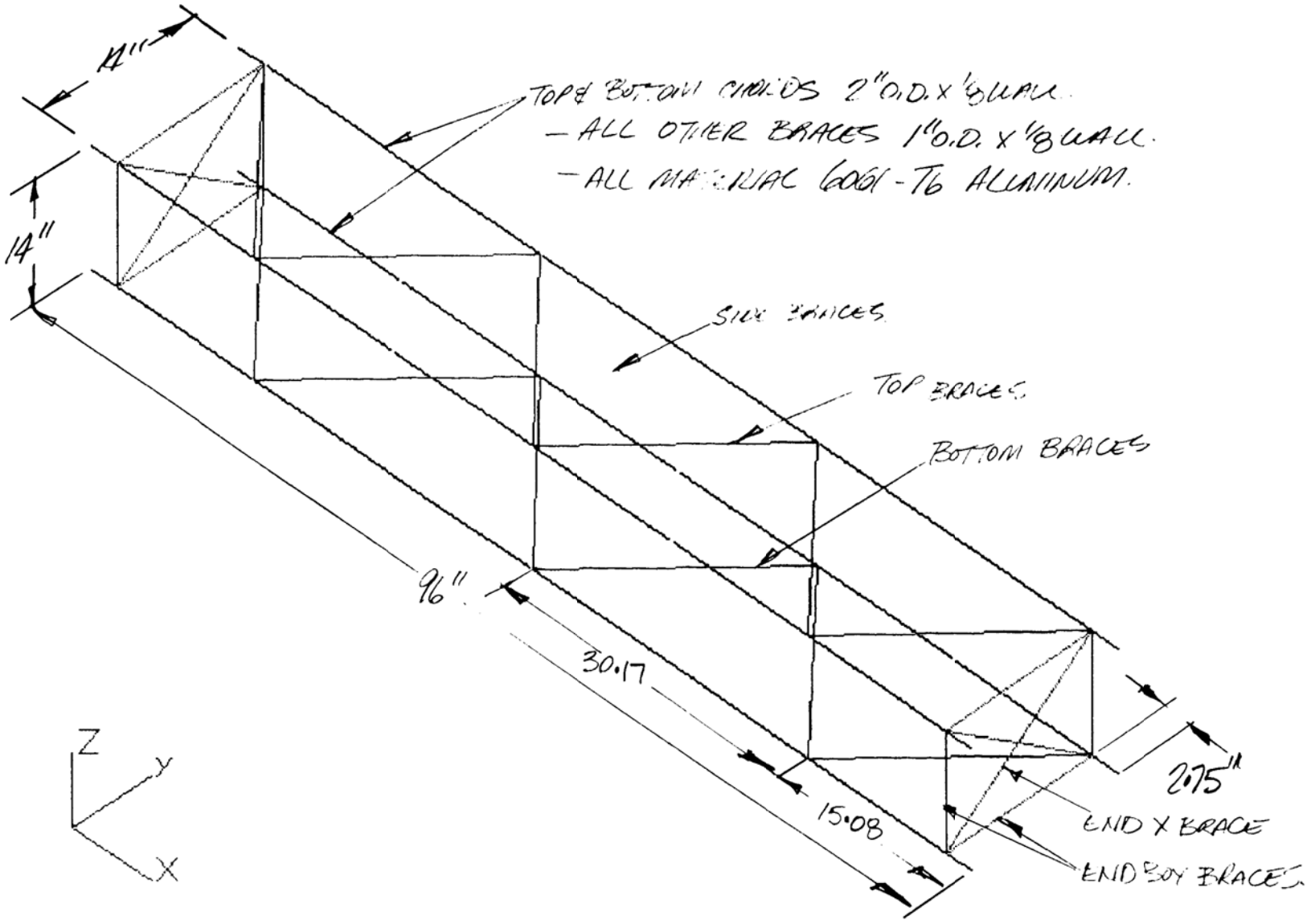

TRUSS DESIGN GEOMETRY

1Help 2Undo
3Inp 4Snap
5Cur 6Swtc
7Big 8Menu
9Top 0Draw

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F2=* S=N C= 6 VU= 7 L= 0 G= 1 C X=20.5005 Y=-29.999 Z=-35.708

ADLER BEAM MODEL

5FEB96

BEAM AREA PROPERTIES

ID #	DESCRIPTION	AREA A (in²)	POLAR MOMENT OF INERTIA J (in⁴)	MOMENT OF INERTIA I_2 (in⁴)	MOMENT OF INERTIA I_3 (in⁴)	SECTION MODULUS S_2 (in³)	SECTION MODULUS S_3 (in³)	J_{pr} (in³)
4,5,7	1" O.D. x 1/8" WALL	.344	.068	.034	.034	.067	.067	.136
2,3,6,8	2" O.D. x 1/8 WALL	.7363	0.650	.325	.325	.325	.325	.650

MAIN MENU
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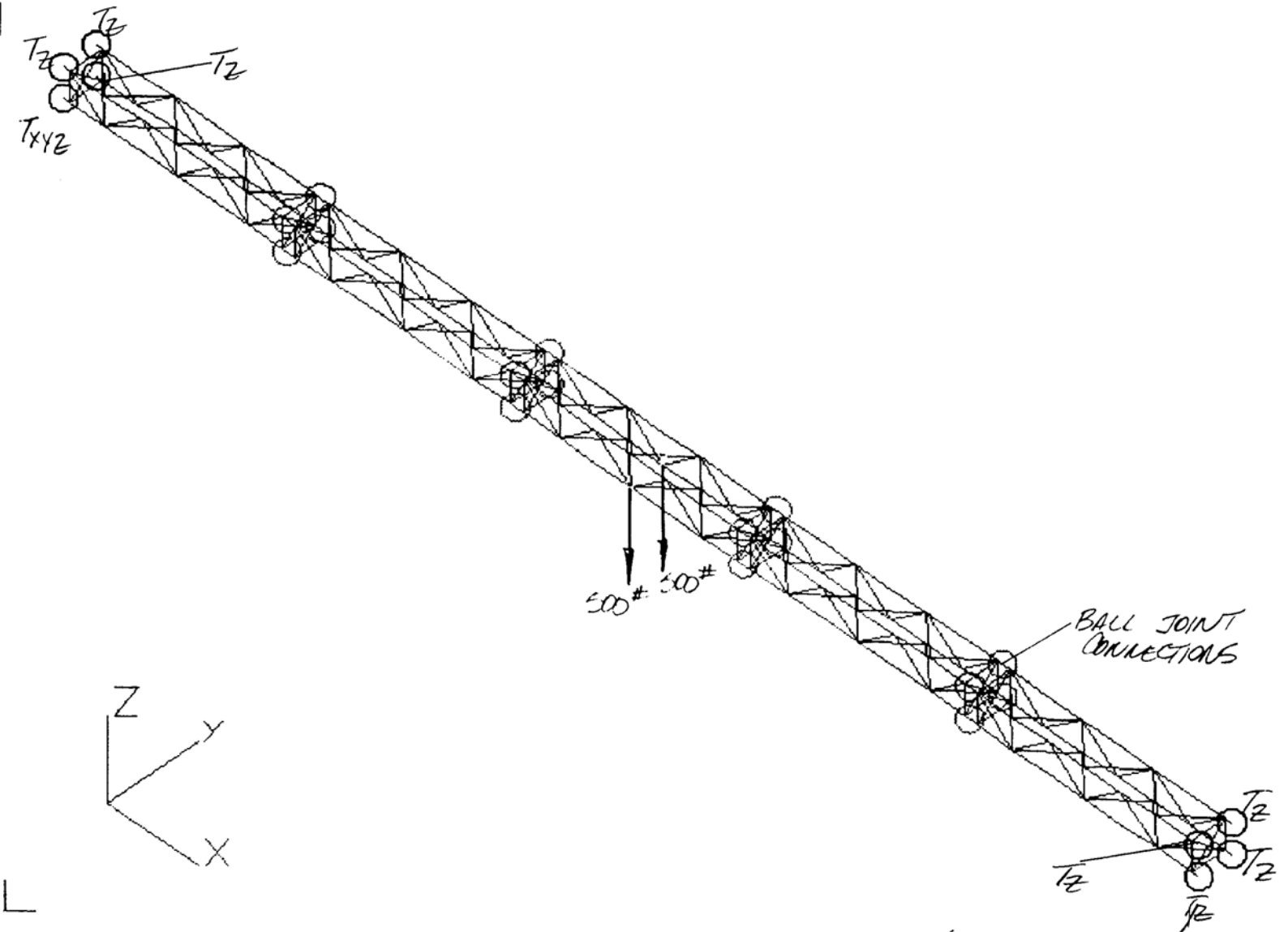

TRUSS LOADS & BOUNDARY CONDITIONS

Z
Y
X

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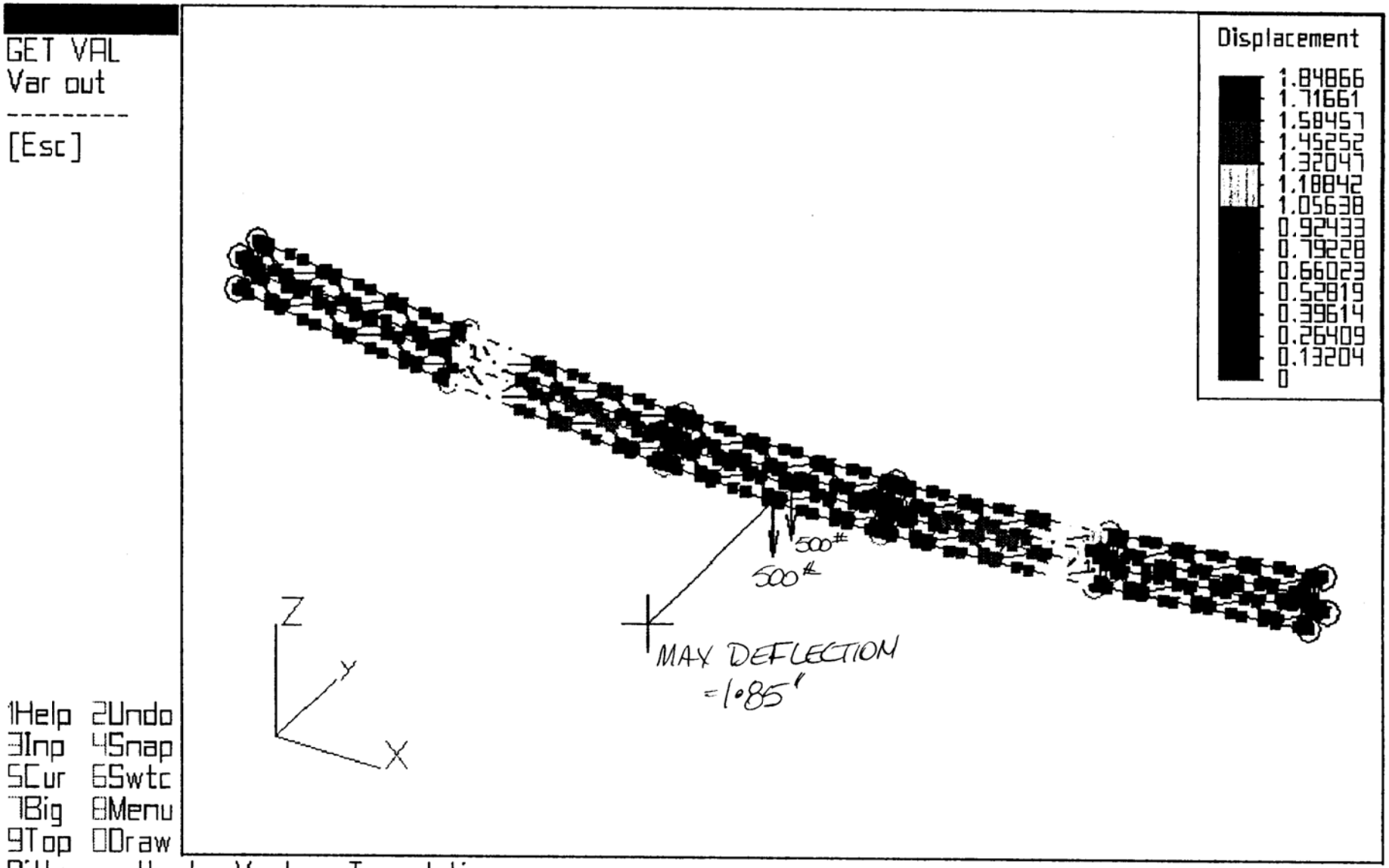
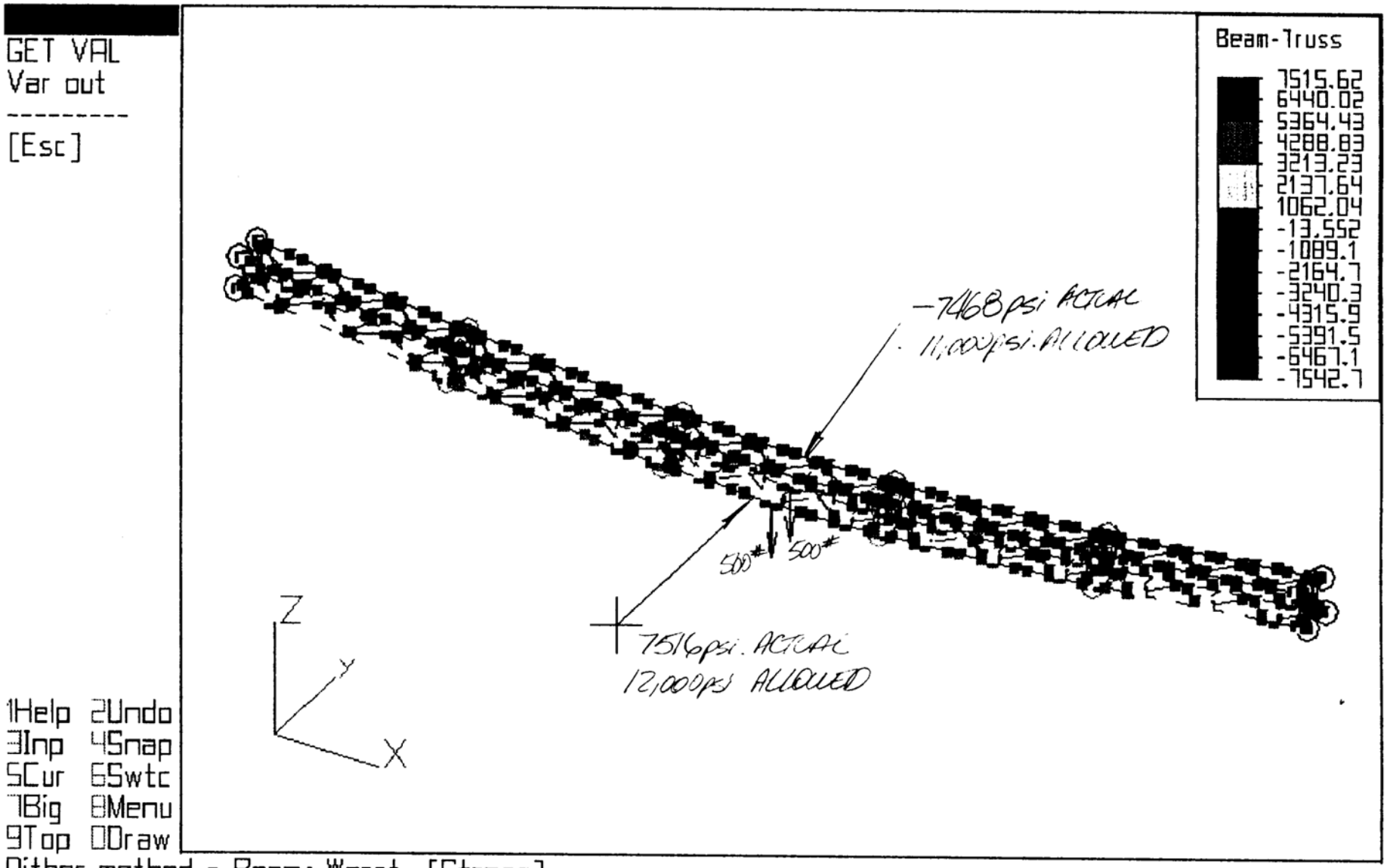
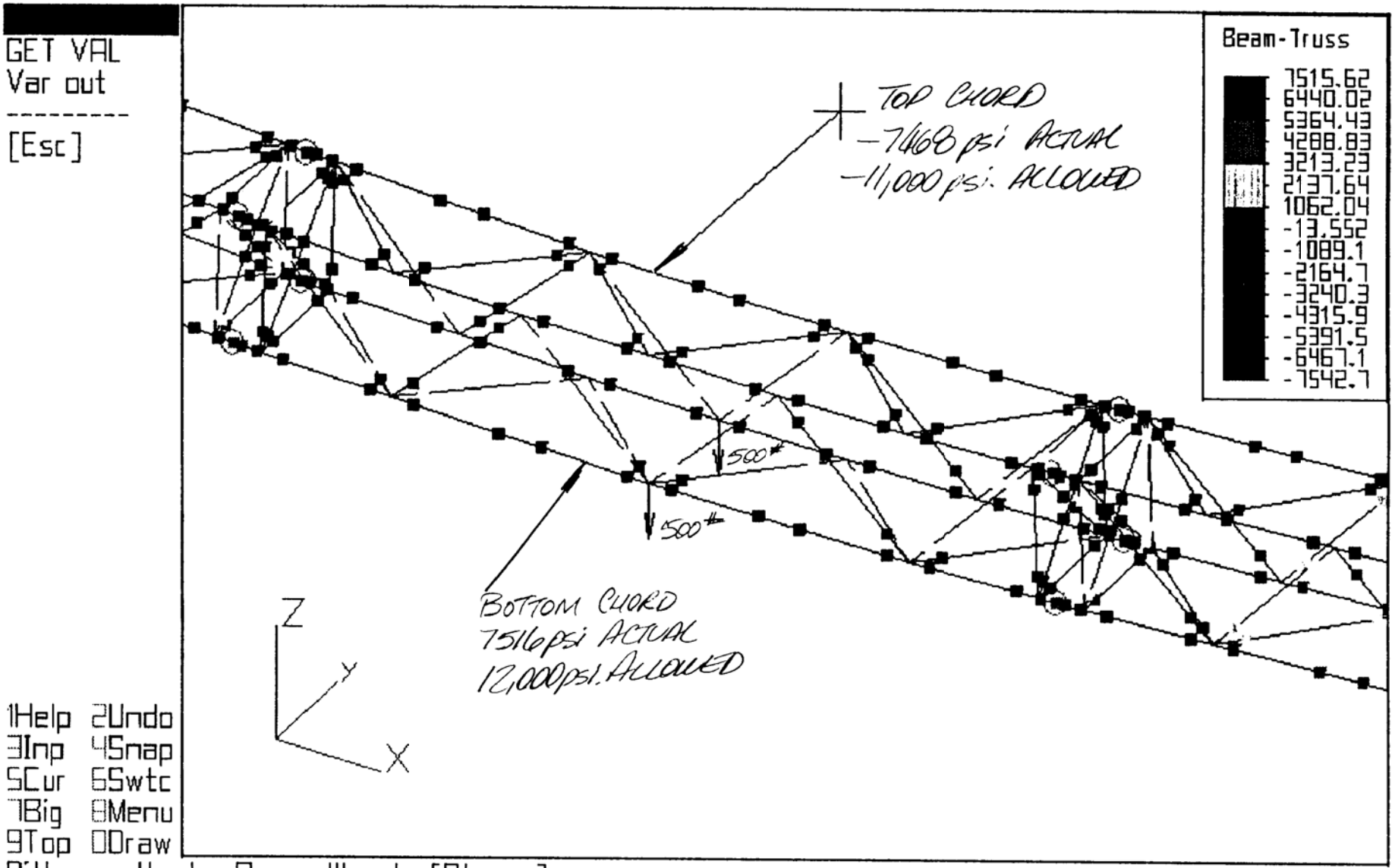


TRUSS DEFLECTION.

(VI)



TRUSS MAXIMUM STRESS OVERVIEW



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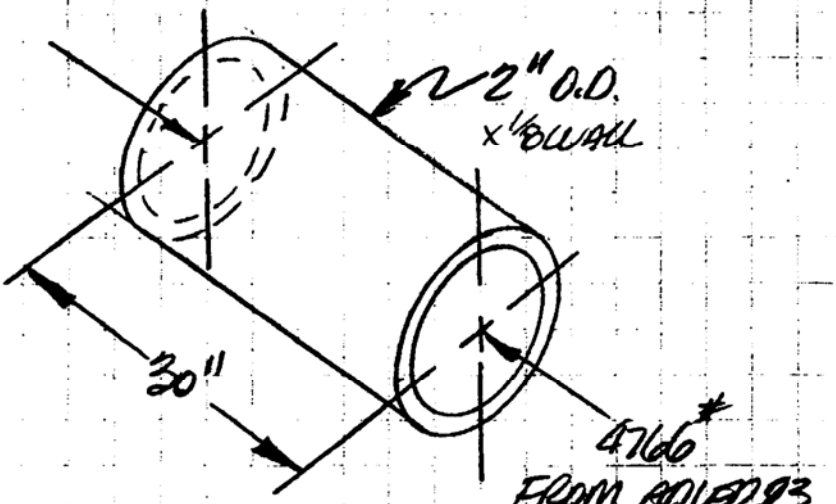
CLOSE UP OF CHORD MAXIMUM STRESS

✓ 5 FEB 96

TOP CHORD BUCKLING CALCULATION. ①



$A = .7363\ in^2$

$J = 0.650\ in^4$

$I = .325\ in^4$

$Z = .325\ in^4$

$K = \sqrt{\frac{d^2+d_i^2}{16}}$

$K = \sqrt{\frac{2^2+0.75^2}{16}} = .6611\ in.$

USING EULER METHOD

$P_{CR} = \frac{n\pi^2 E I}{l^2}$ WHERE $n = 1.2$ FOR FIXED-FIXED

$P_{CR} = \frac{1.2(\pi^2)(10.3\times10^6)(.325)}{30^2}$

$P_{CR} = 44,051\#$

SINCE $P_{CR} >> 4766\#$ ACTUAL.

TRY SECANT FORMULA WITH VARIOUS ECCENTRICITIES.

STEP 9b ②

TOP CHORD BUCKLING (CONT'D)

SECANT FORMULA: $\frac{P_{cr}}{A} = \frac{S_y}{1 + \frac{ec}{K^2} \sec \frac{l}{K}\sqrt{\frac{P_{cr}}{4AE}}}$

WHERE e = ECCENTRICITY, c = DISTANCE FROM CENTER TO OUTER MOST FIBRE

$S_y = 35\ Ksi$

THEN SOLVING $P_{cr} = \frac{S_y A}{1 + \frac{ec}{K^2} \sec \frac{l}{K}\sqrt{\frac{P_{cr}}{4AE}}}$

$$\Rightarrow P_{cr} = \frac{(35{,}000)(.7363)}{1 + \frac{e(.5)}{(.6644)^2}\left(\frac{1}{\cos\left(\frac{30}{.6644}\sqrt{\frac{P_{cr}}{4(.7363\times 10.3\times 10^6)}}\right)}\right)}$$

SOLVING ITERATIVELY

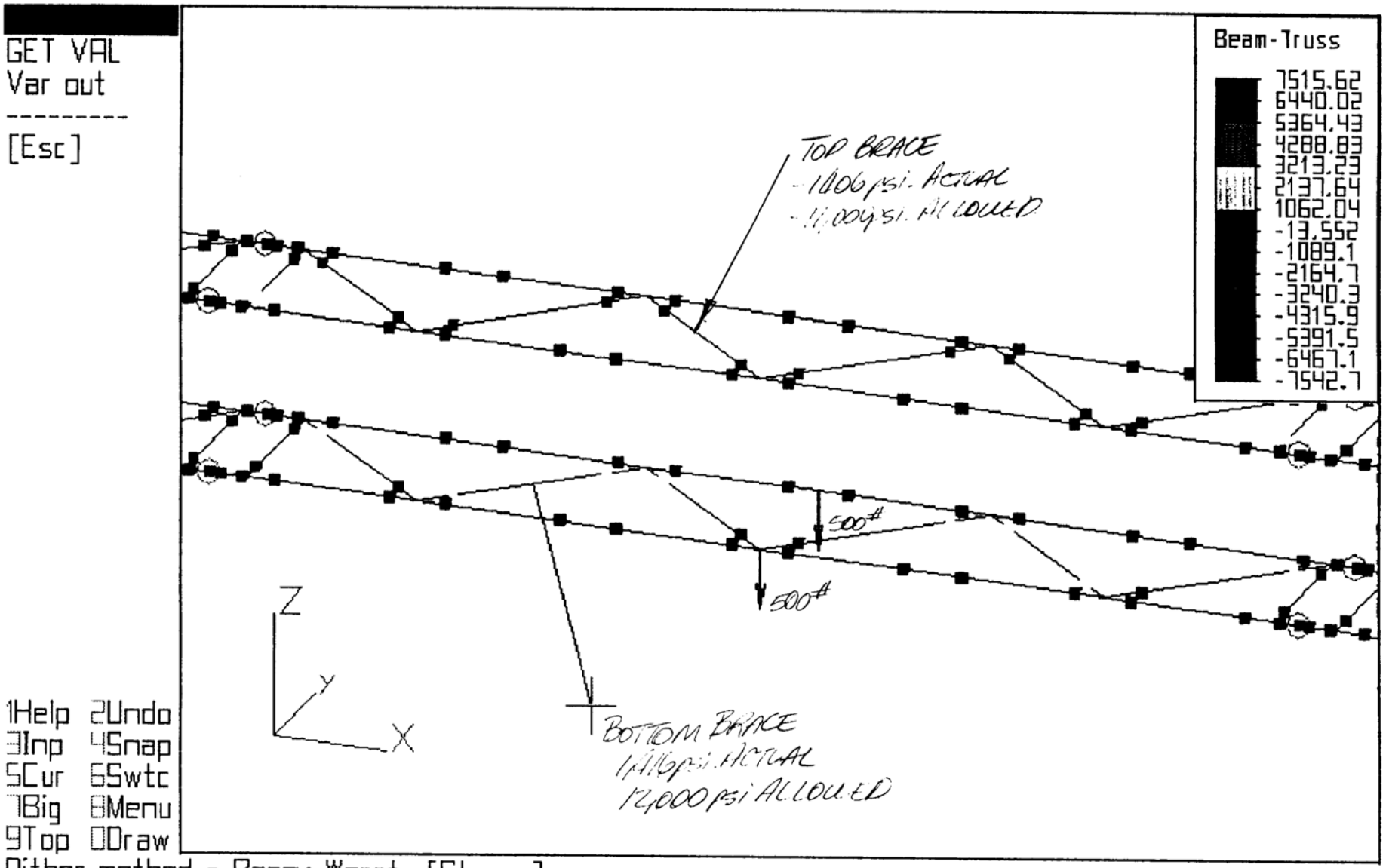
FOR $e = \frac{1}{8}'' \Rightarrow P_{cr} = 20{,}083^{\#}$

$\Rightarrow$ SAFETY $= \frac{20{,}083}{4{,}766} = \boxed{4.21 \text{ TO } 1}$

FOR $e = \frac{1}{4}'' \Rightarrow P_{cr} = 16{,}450^{\#}$

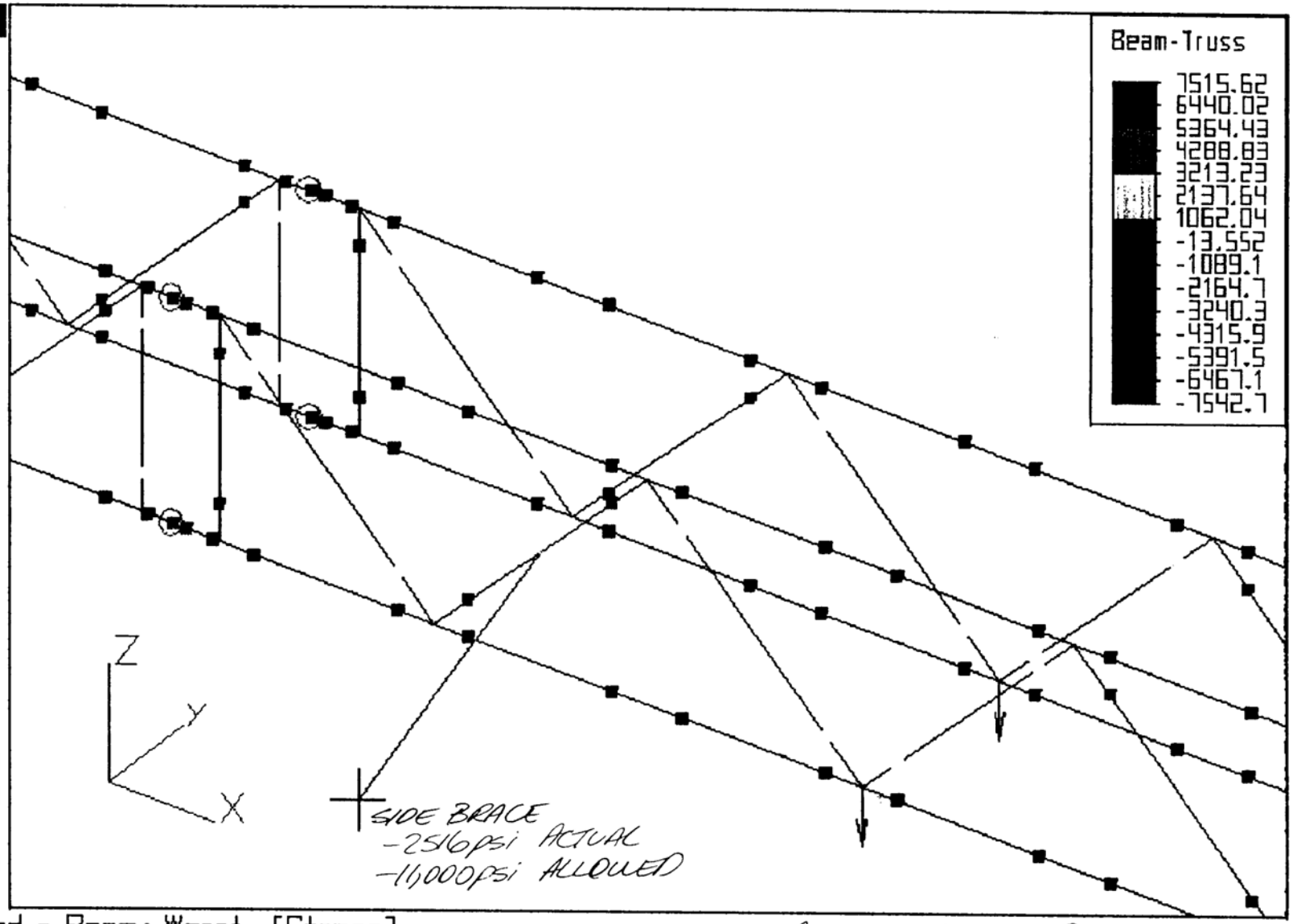
$\Rightarrow$ SAFETY $= \frac{16{,}450^{\#}}{4{,}766} = \boxed{3.45 \text{ TO } 1}$

DESIGN IS ACCEPTABLE



CLOSE UP OF TOP & BOTTOM BRACE

MAXIMUM STRESS



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Var out

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3Inp 4Snap
5Cur 6Swtc
7Big 8Menu
9Top 0Draw

Dither method = Beam: Worst [Stress]
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(23)-2.516E+03 (117)-2.196E+03
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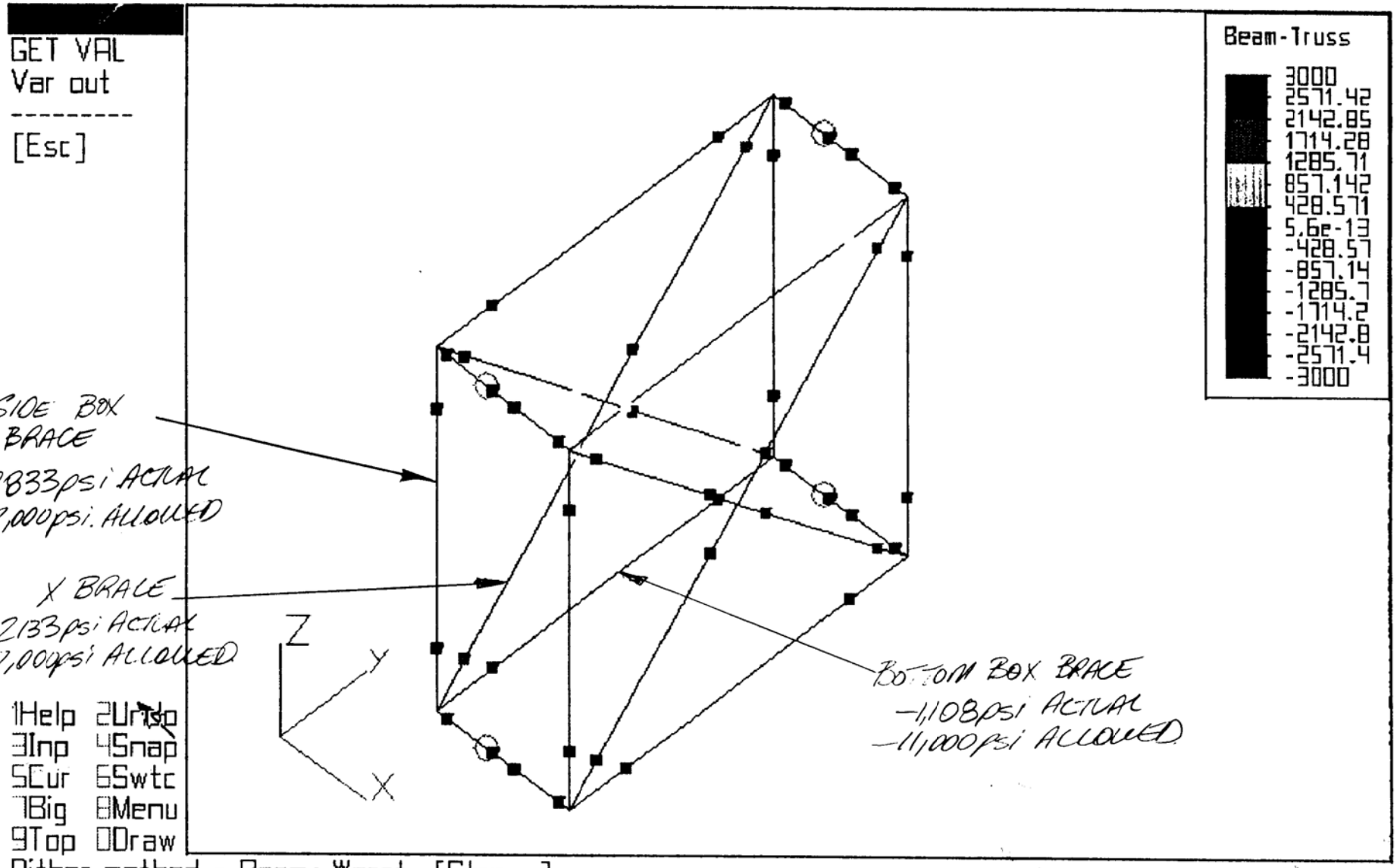
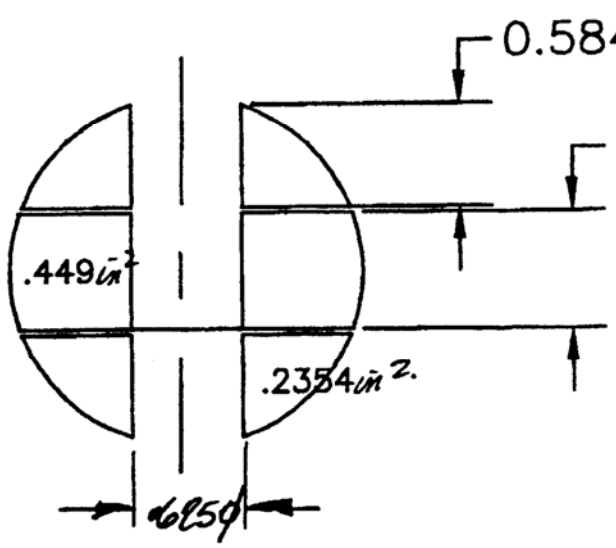
CLOSE UP OF SIDE BRACE
MAXIMUM STRESS



CLOSE UP OF END, BOX AND CROSS BRACE MAXIMUM STRESS

(21)

5FEB96.V



JAW & EYE BEARING STRESSES

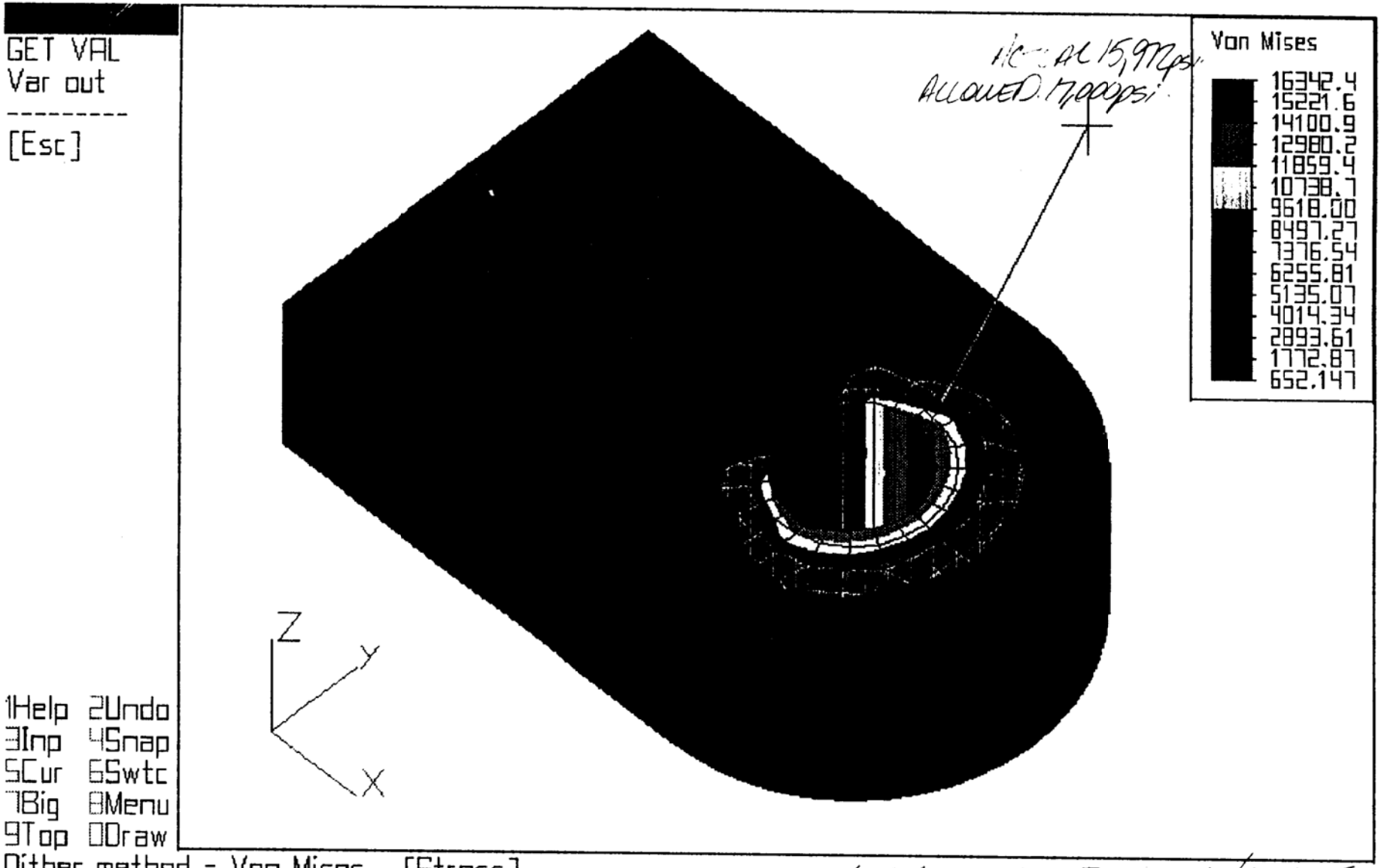
- MAXIMUM PIN FORCE = 3986# FROM ADLER23

$$\text{JAW BEARING STRESS} = \frac{3986^{\#}}{2(.5849)(.625)} = 5{,}451 \text{ psi} < 20 \text{ KSI FOR 6061 T-6 BEARING STRESS PER AWS}$$

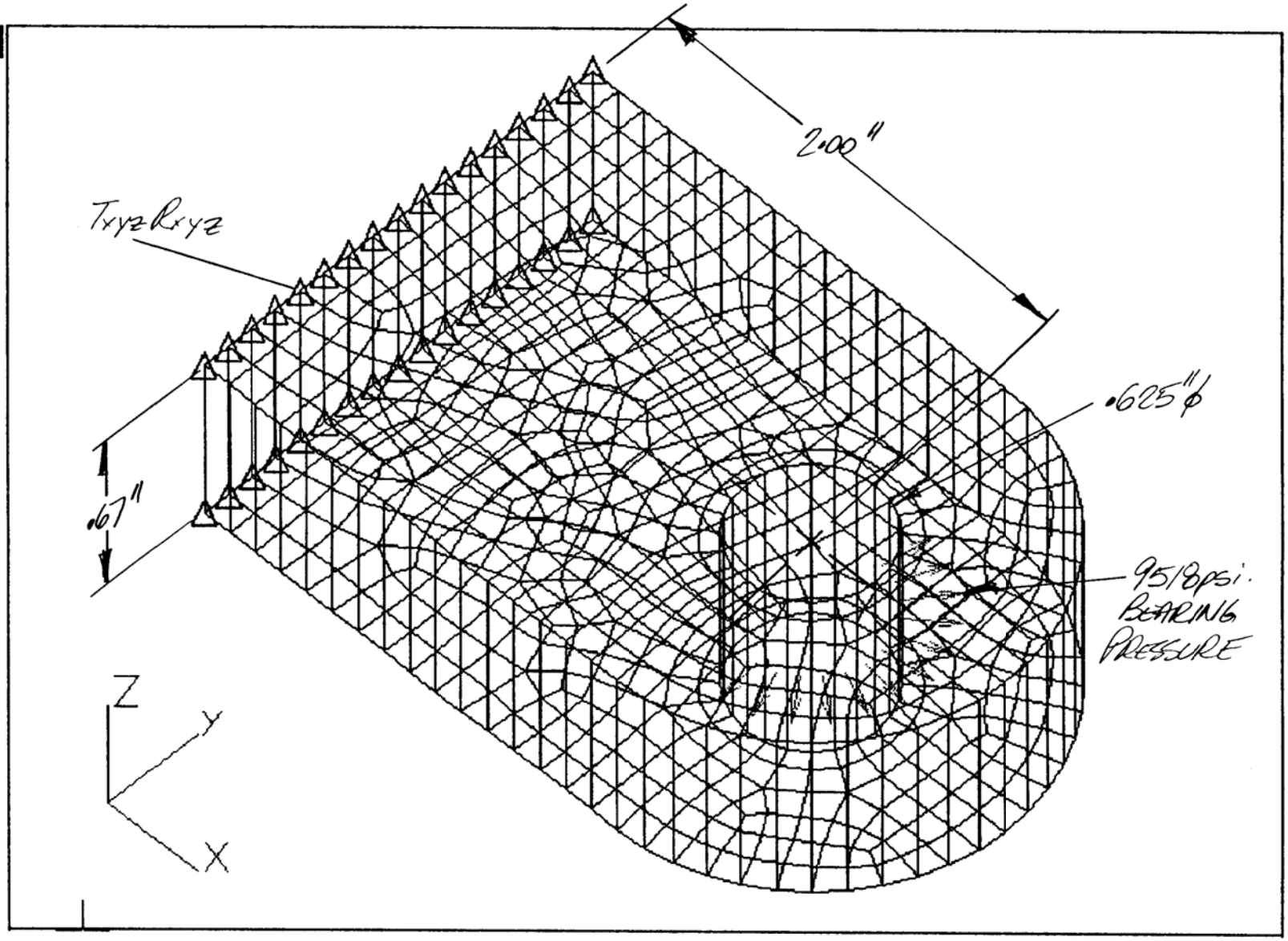
⇨ DESIGN IS O.K.

$$\text{EYE BEARING STRESS} = \frac{3986^{\#}}{(.67)(.625)} = 9{,}518 \text{ psi} < 20 \text{ KSI FOR 6061 T-6 BEARING STRESS PER AWS}$$

⇨ DESIGN IS O.K.



EYE MAXIMUM BENDING/AXIAL STRESS WITH 9513psi BEARING PRESSURE APPLIED.



(4E GEOMETRY, LOADS & BOUNDARY CONDITIONS

Select new view.

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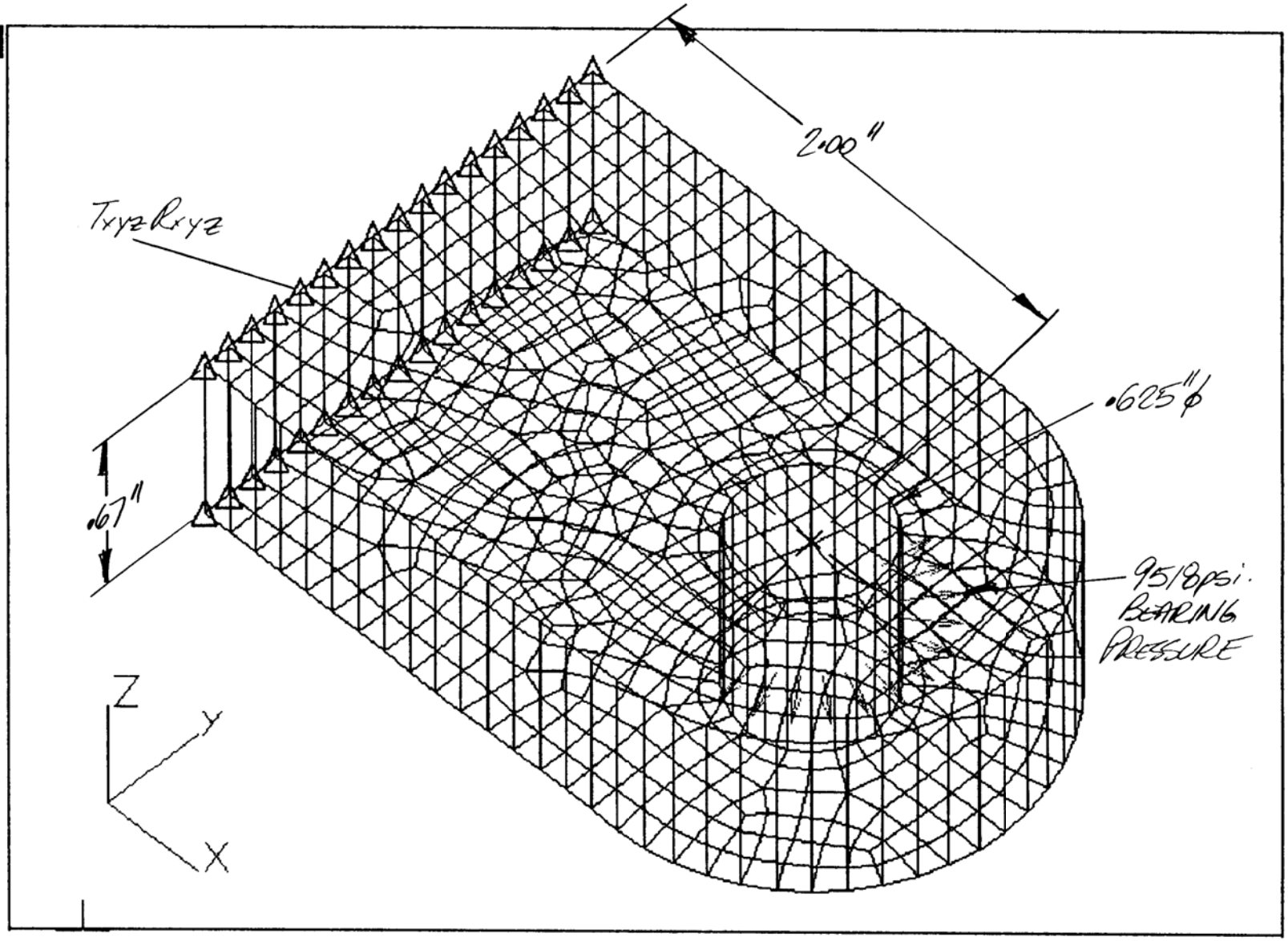

(4E GEOMETRY, LOADS & BOUNDARY CONDITIONS

Select new view.

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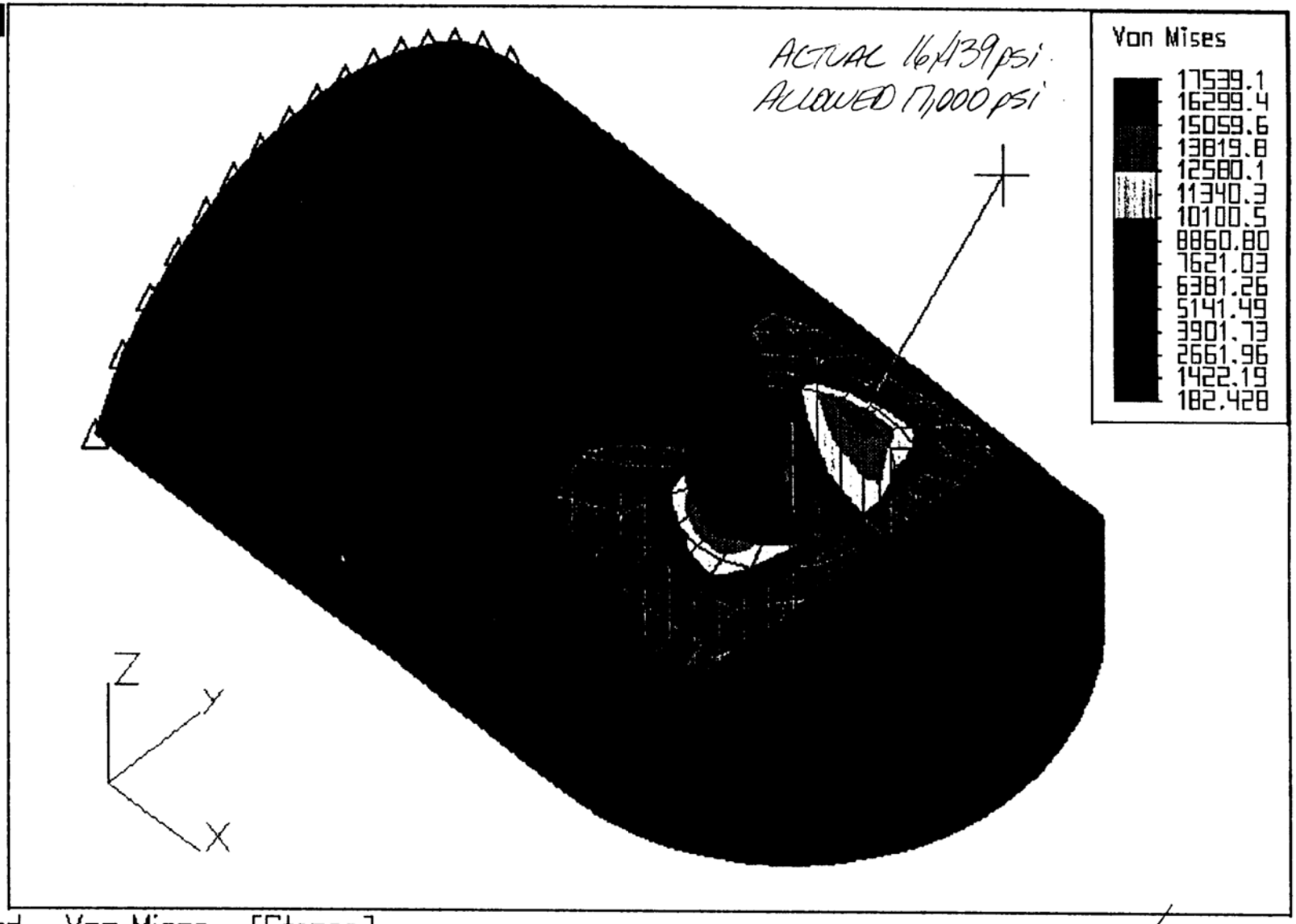
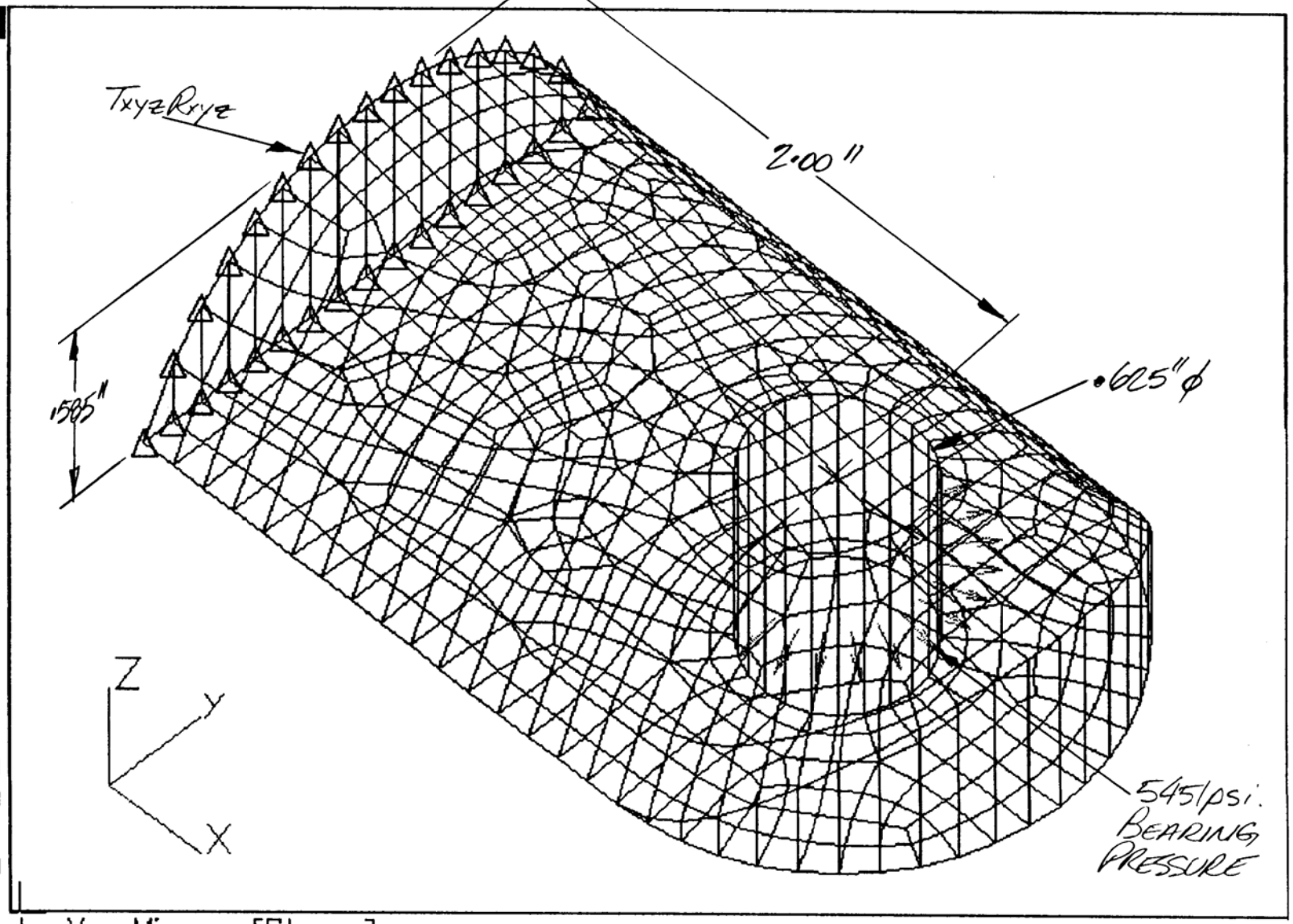


JAW MAXIMUM BENDING/AXIAL STRESS WITH 5451 psi. BEARING PRESSURE APPLIED



GET VAL
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1Help 2Undo
3Inp 4Snap
5Cur 6Swtc
7Big 8Menu
9Top 0Draw

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[Auto range] [No frills]
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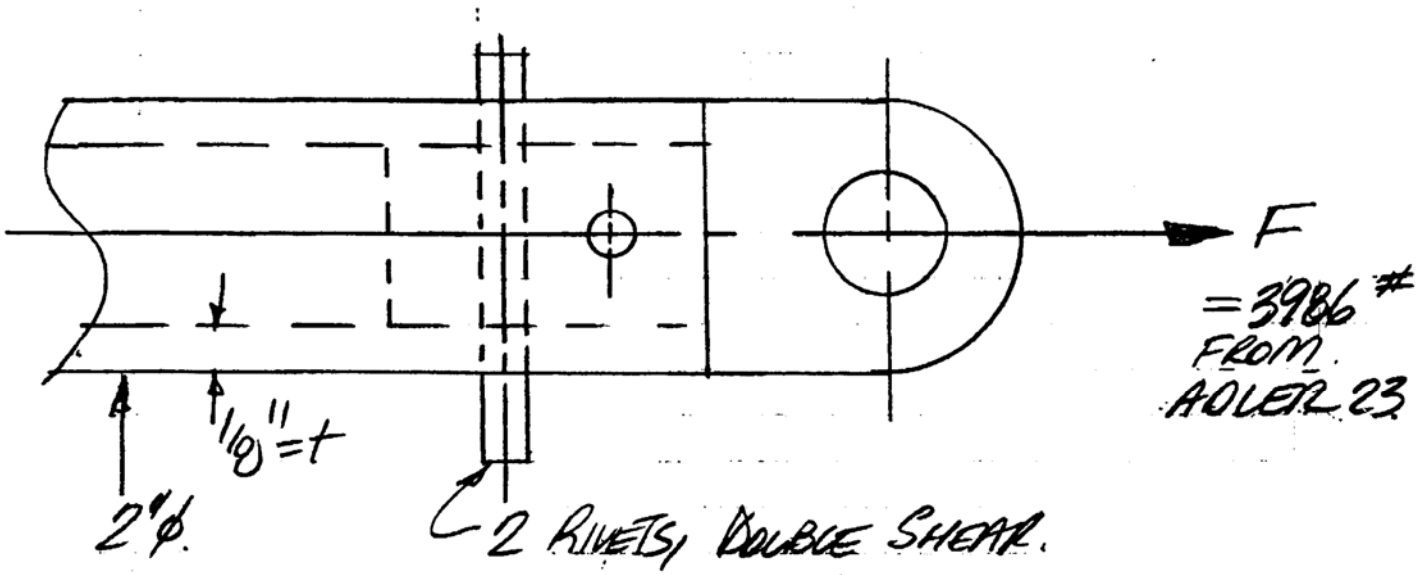
TAU GEOMETRY, LOADS & BOUNDARY CONDITIONS

(5)

AMW

(18) 6 FEB 96 ✓

JAW & EYE RIVET STRESS



— NOT IN WELD ZONE
(ie 1" PAST WELD MIN.)

— FROM AWS THEN $S_A = 30$ KSI FOR 6061-T6
FOR BOLT/RIVET BEARING STRESS

BEARING AREA $A_B = 2$ RIVETS $\times$ 2 SHEAR $\times$ $t \times d$

$= 4td$ WHERE d = RIVET ϕ

$$S_A = \frac{F}{A_B} \Rightarrow 30{,}000 = \frac{3986\#}{4td}$$

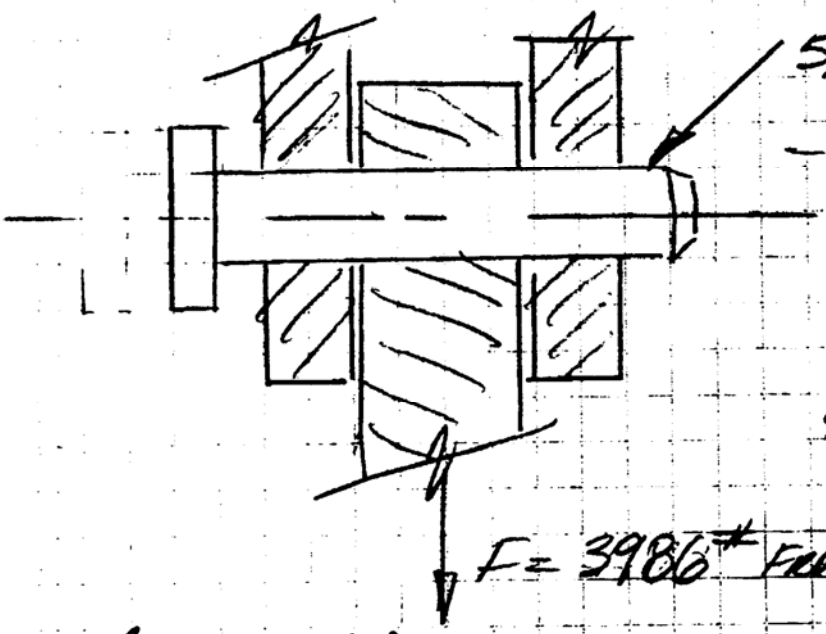
$$d = \frac{3986\#}{(4)(30{,}000)(t)} \quad \text{WHERE } t = \frac{1}{8}"$$

THEN RIVET ϕ $\Rightarrow$ $d = 0.2657"$ MINIMUM.

@ 30,000 psi AWS ALLOWABLE BEARING STRESS

AMW. 2FEB96

PIN BEARING & SHEAR STRESSES



- SAE 1018-20 STEEL (ANNEALED)
- $S_{UT} = 60$ KSI
- $S_y = 40$ KSI
- $S_{sy} = 23.1$ KSI

$$A_{PIN} = \frac{\pi (5/8)^2}{4} = 0.3068 \text{ in}^2$$

$$\text{PIN SHEAR STRESS} = \frac{F}{2A} = \frac{3986}{2(.3068)} \text{ psi}$$

$\tau_{PIN} = 6,496$ psi (STATIC) < ALLOWABLE FOR $>10^7$ CYCLES $= (.577)(24\text{KSI}) = 13.85$ KSI.

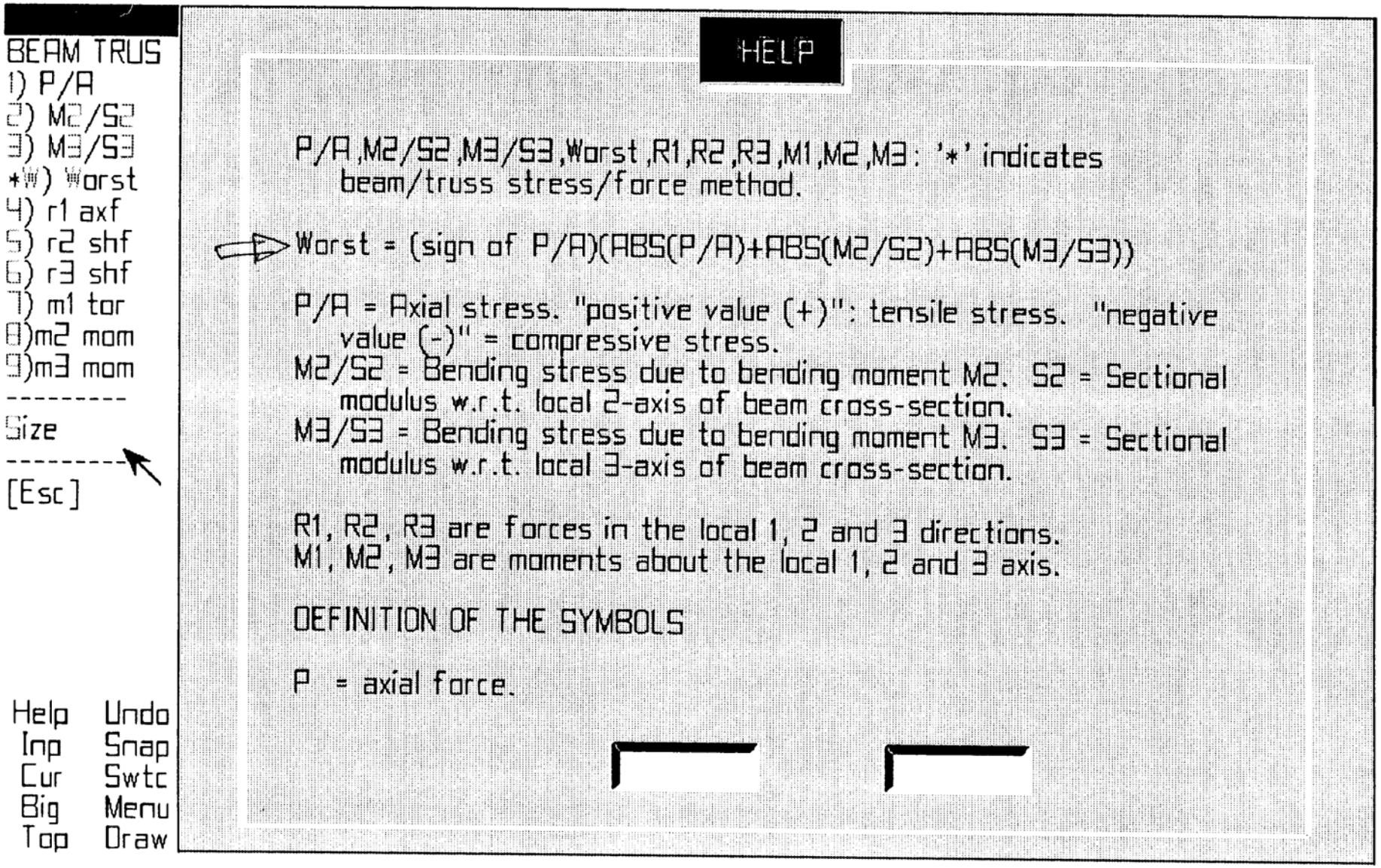
∴ PIN SHEAR DESIGN IS O.K.

BEARING STRESSES ARE SAME AS JAW & EYE & ALLOWS ALLOWS 24KSI FOR $>10^7$ CYCLES FOR STEEL

∴ JAW BEARING STRESS = 5,451 psi STATIC

& EYE BEARING STRESS = 9,518 psi STATIC.

∴ PIN DESIGN IS ACCEPTABLE.



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