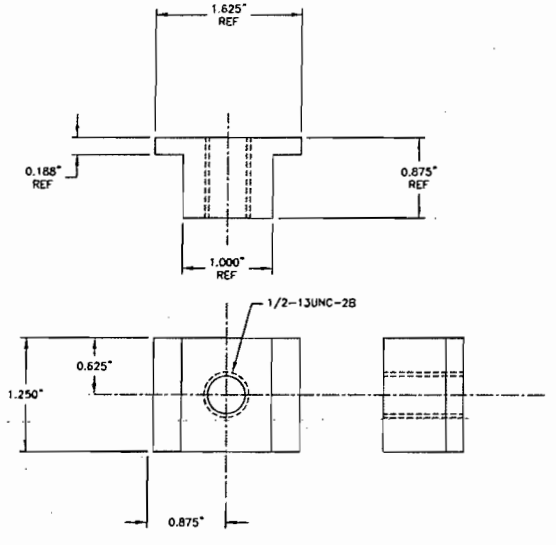
24

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
C	REDRAWN. DIMENSIONS CHANGED TO DECIMAL. NOTES ADDED.	7-27-00	



NOTES:

1. BREAK ALL SHARP EDGES AND CORNERS.
2. DEBURR TAPPED HOLE.
3. FOR USE WITH CAST SLIDELOK 03-120 OR WITH TOGGLE ASSEMBLY 2403-4.

	2403EP
	2403DP
	2403CP
	2403BP
	2403E
	2403D
	2403C
2403-7	2403B
NEXT ASSY.	USED ON
APPLICATION	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS: 0-24" ± 1/32
24" AND UP ± 1/16
DECIMALS: ± .010
ANGLES: ± 1°-0'

MATERIAL: EXTRUSION 2403-BA

FINISH:

CONTRACT NO.

PREPARED	S.A.S.	7-27-00
CHECKED		
APPROVED		

OTHER APPROVAL:

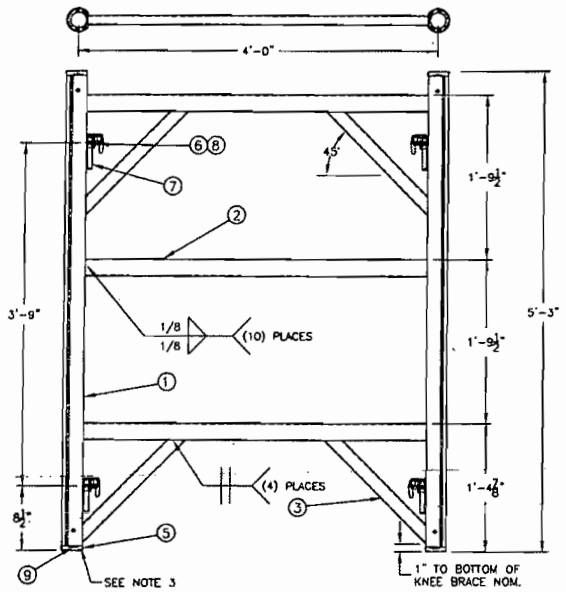
Patent Construction Systems
Harsco Corporation

SLIDELOK ADAPTER
FRAME LEG SUB-ASSEMBLY
FRAME
20KA ALUMINUM SHORING

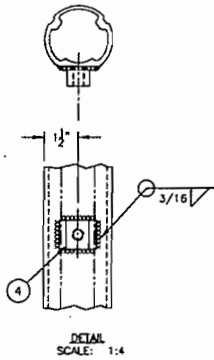
SIZE	CODE IDENT NO.	DRAWING NO.	REV.
B	45826	2403-8	C

SCALE FULL | UNIT WEIGHT 0.10 LBS. | SHEET 1 OF 1

Y:\ENGR\PARTS\20KA\2403-8



SCALE: 1:12



DETAIL
SCALE: 1:4

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
G	SUPERSEDES DRAWING 2403D REV F DATED 7-13-82. TOLERANCE BLOCK VALUES DOUBLED. ALTERNATE SLIDELOK ASSEMBLY CALLOUT AND NOTE REMOVED. DETAIL REVISED TO TWO VIEWS. 1/32" MISMATCH DIMENSION ADDED TO NOTE 1. NOTE 2 REWORDED. NOTE 3 ADDED. DUPLICATE DIMENSIONS FROM PART DETAIL DRAWINGS REMOVED. ITEM 4 WAS SLIDELOK ASSEMBLY 2403-10 OR 2403-7; ITEM 5 NAME WAS ADAPTOR CUP; ITEMS 6,7,8 AND 9 ADDED AS SEPARATE ITEMS.	7-27-00	
H	ADDED DIMENSIONS, PART CALLOUTS, WELD CALLOUTS	9-20-06	
I	REVISED RUNG DRAWING CALLOUT	9-21-06	
J	REMOVED 9/16" DIA. HOLES IN LEGS	7-20-07	

NOTES:

1. CUT AND MATCH LEGS AND RUNGS TO 1/32". DO NOT USE PARTS MISMATCHED BY MORE THAN 1/32".
2. SLIDELOK ADAPTOR, ITEM 4, MUST BE ORIENTED AS SHOWN IN DETAIL SO THAT SLIDELOK, ITEM 7, SLIDES VERTICALLY.
3. SEE DRAWING 2403-9A FOR ATTACHMENT PROCEDURE DETAILS FOR STEEL END CAP.

NO.	QTY.	DESCRIPTION	DWG. NO.
9	8	#6 X 3/8" LONG DRIVE SCREW, STEEL, ZINC PLATE SEE NOTE 3	
8	4	SPECIAL HEX NUT	03-122
7	4	SLIDELOK	03-120
6	4	1/2-13UNC-2A X 2 " LONG THREADED ROD, STEEL, ASTM A307 OR SAE J429 GRADE 2, ZINC PLATE CHROMATE DIP	
5	4	STEEL END CAP SEE NOTE 3	2403-9
4	4	SLIDELOK ADAPTOR SEE NOTE 2 AND DETAIL	2403-8
3	4	DIAGONAL	2403-3C
2	3	RUNG	2403-2A
1	2	FRAME LEG	2403-1C

NEXT ASSY.	USED ON
APPLICATION	

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS: 0-24" ± 1/32
24" AND UP ± 1/16
DECIMALS: ± .010
ANGLES: ± 1°-0'

MATERIAL:

FINISH:

CONTRACT NO.

PREPARED	S.A.S.	7-27-00
CHECKED		
APPROVED		

OTHER APPROVAL:

Patent
Patent Construction Systems
Harsco Corporation

5'-0" X 4'-0" WIDE FRAME WITH STEEL END CAPS

20KA ALUMINUM SHORING

SIZE	CODE IDENT NO.	DRAWING NO.	REV.
B	45826	2403C	J

SCALE NOTED | UNIT WEIGHT 36.5 LBS. | SHEET 1 OF 1

Y:\DWGS\PARTS\20KA\2403CREV.J

Project: 246 Spring Street | Engineer: JW | Date: 12/23/2008
Subject: Screw Jack Capacity | Checked by: | Date:

Design Component: Steel - Screw Jack
Design Method: Allowable Stress Design
Design Code: AISC - ASD 89

Buckling:

Fy =	55	ksi
E =	29000	ksi
K =	2	
L =	21	in
r =	0.638	in
A =	1.279	in^2
KL / r =	65.83072	
Cc =	102	
Fa =	23.23	ksi
Pa =	29.71	kips

Fixed-free assumption

Factor of Safety = 1.67
Buckling Strength Pultimate= 49.61 kips

Flextural: Eccentricity = 2 inch

Fy =	55	ksi
Sx =	0.51	in^3
Ma =	18.51	k-in

Mrupture = 28.05 k-in

Actual Load Input:
Pmax = 7 kips
Mmax = 14 k-in
Pmax / Pultimate + Mmax / Mrupture= 0.64

Tested Load Input:
Pmax = 14 kips
Mmax = 28 k-in
Pmax / Pultimate + Mmax / Mrupture= 1.28

Code Check (include 2% lateral load = 7kips x 2% = 140 lbs

Pmax = 7 kips
Mmax = 16.94 =M1+M2
M1 = 14 k-in
M2 = 2.94 k-in
Pmax / Pa + Mmax / Ma= 1.15

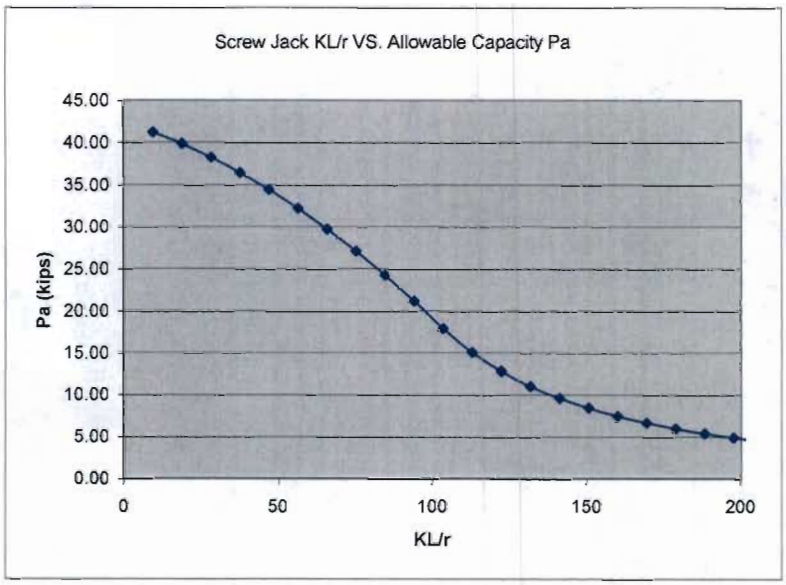
Project: 246 Spring Street | Engineer: JW | Date: 12/23/2008
Subject: Screw Jack Capacity | Checked by: | Date:

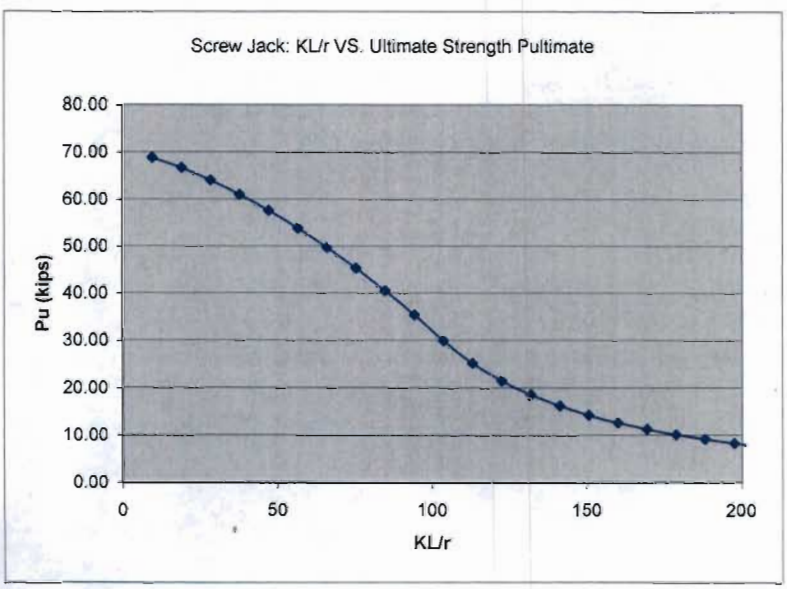
Design Component: Steel - Screw Jack
Design Method: Allowable Stress Design
Design Code: AISC - ASD 89 Factor of Safety = 1.67

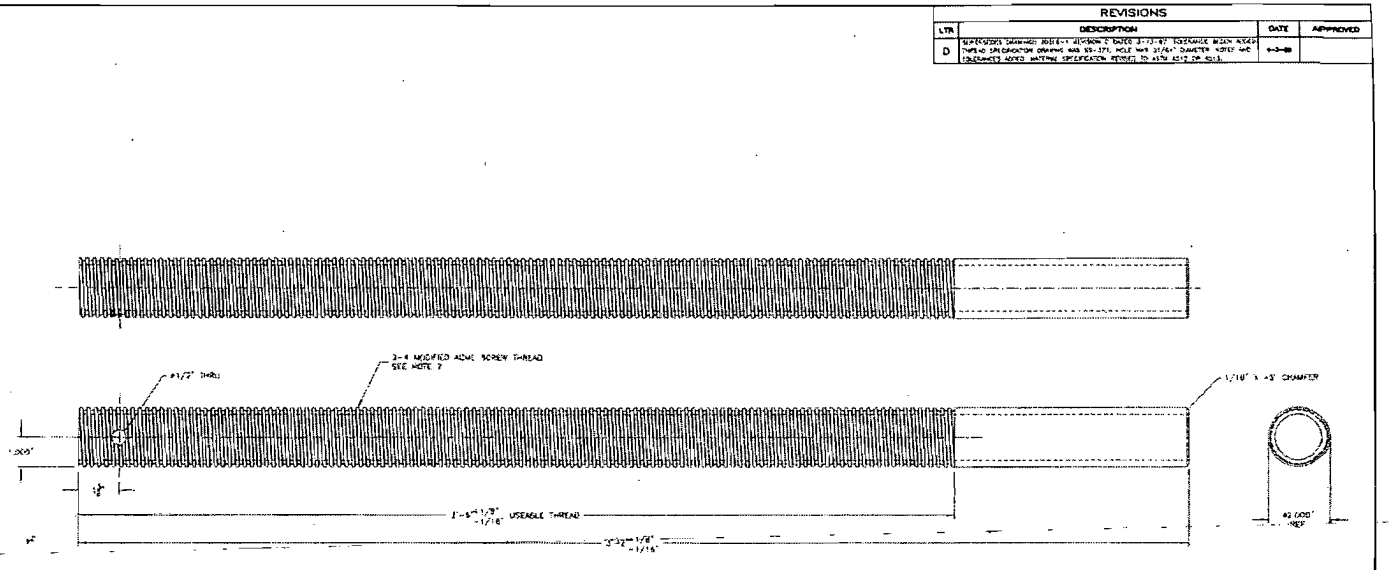
Fy =	55	ksi
E =	29000	ksi

r =	0.638	in
A =	1.279	in^2

Cc = 102







REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
D	SUPERSEDES DRAWING 202EE-1 REVISION C DATED 3-12-87. TOLERANCE ADDED AT 24" AND UP. ADDED APPLICATION DRAWING AND SS-371. HOLE WAS 37/64" DIAMETER. NOTES 1&2 TOLERANCES ADDED. MATERIAL SPECIFICATION REVISED TO ASTM A512 OR A513.	4-3-88	

NOTES:
1. MATERIAL: 2.000" O.D. x 0.250" WALL COLD DRAWN BUTTWELD CARBON STEEL MECHANICAL TUBE MANDREL DRAWN, GRADE 1020, 55,000 PSI MINIMUM YIELD STRENGTH, PER ASTM A512 OR ERW CARBON STEEL TUBE, MANDREL DRAWN, GRADE 1020, 55,000 PSI MINIMUM YIELD, PER ASTM A513.
2. SEE THREAD SPECIFICATION DRAWING 140-002.

202EE	202XZ
NEXT ASSY.	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS: 0-24" ± 1/32, 24" AND UP ± 1/16
DECIMALS: ± .010
ANGLES: ± 1°-0'
MATERIAL: SEE NOTE 1
FINISH:

CONTRACT NO.

PREPARED	B.A.S.	4-3-88
CHECKED		
APPROVED		

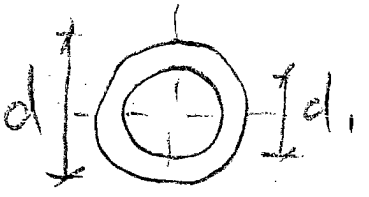
OTHER APPROVAL:

Patent — Patent Construction Systems, Harsco Corporation

SCREW
24" ADJUSTABLE SCREW LEG
20K SHORING

SIZE	CODE IDENT NO.	DRAWING NO.	REV.
C	45826	202EE-1	D

SCALE 1:10 | UNIT WEIGHT 6.73 LBS. | SHEET 1 OF 1



$$A = 3.1415 \times \left[\left(\frac{2}{2}\right)^2 - \left(\frac{2-.23\times2}{2}\right)^2\right]$$

$$= 1.279 \text{ in}^2$$

$$I = \frac{\pi(d^4 - d_1^4)}{64}$$

$$= .51 \text{ in}^4$$

$$S = \frac{\pi(d^4 - d_1^4)}{32\,d} \div 5\frac{13}{14}$$

$$r = \sqrt{\frac{d^2 + d_1^2}{4}} = .638"$$

$$z = \frac{d^3}{6} - \frac{d_1^3}{6} = .725 \text{ in}^3$$

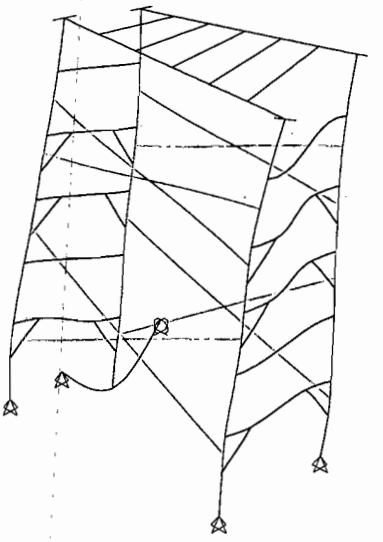
28

3.2 Single Tower - Allowable Stress Code Check

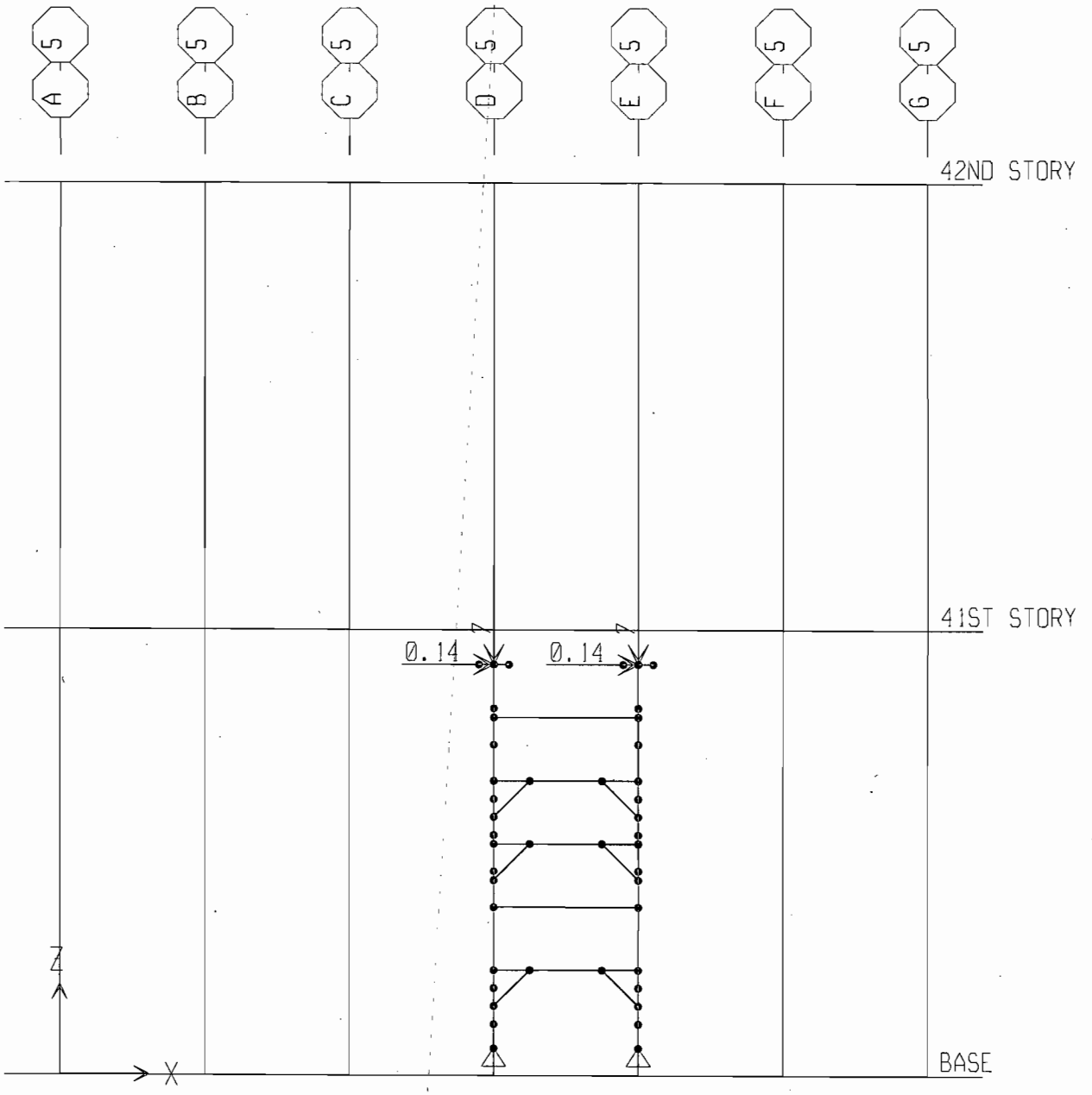
These computer analyses combine deadweight of concrete and formwork with a lateral force equivalent to 2% of the vertical load and a .8 deflection under one leg only. The 0.8 deflection was added as a result of the testing observations. Such deflection was likely at the 41st floor level in one leg as the plywood underneath was being punched. The vertical load on each leg is in the order of 7000 lbs as described above in section 14.2.1. The overall frame is made of 5'-3" bottom frame and 3'-6" top frame, and the frame is 8' apart. Two loading conditions have been considered and studied for the effect 0.8" deflection to all members in the tower.

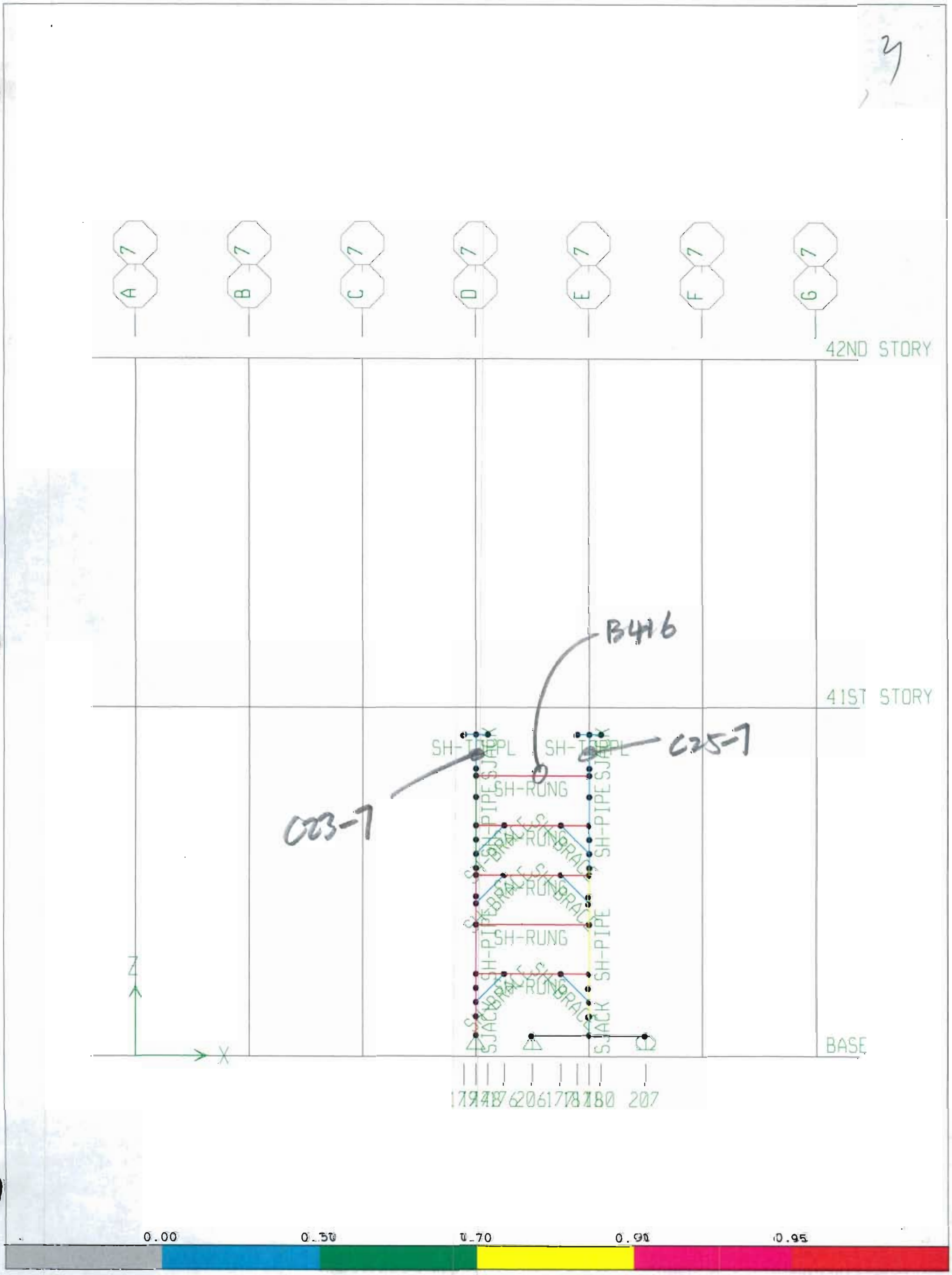
3.2.1 Allowable Stress Check - Condition 1, Load Case A.

- The model file is "246SpringST_2009_05_08_singleTowerDL_NoECCdeflectionLimitCodeCheckWith2%Lateral".
- A vertical load of 7,000 lbs and a horizontal load of 140 lbs placed at the center of top plate.
  Result: shore failure
- Screw jack allowable stresses produced by bending and compression are about 60% of the allowable.
- Aluminum shoring leg under bending and compression was stressed at about 90% of allowable.
- Horizontal members and connections from horizontal members to shoring legs do not meet allowable stress ratio combination. The ratio actual versus allowable is 2.
- Stress ratio in knee brace is insignificant.

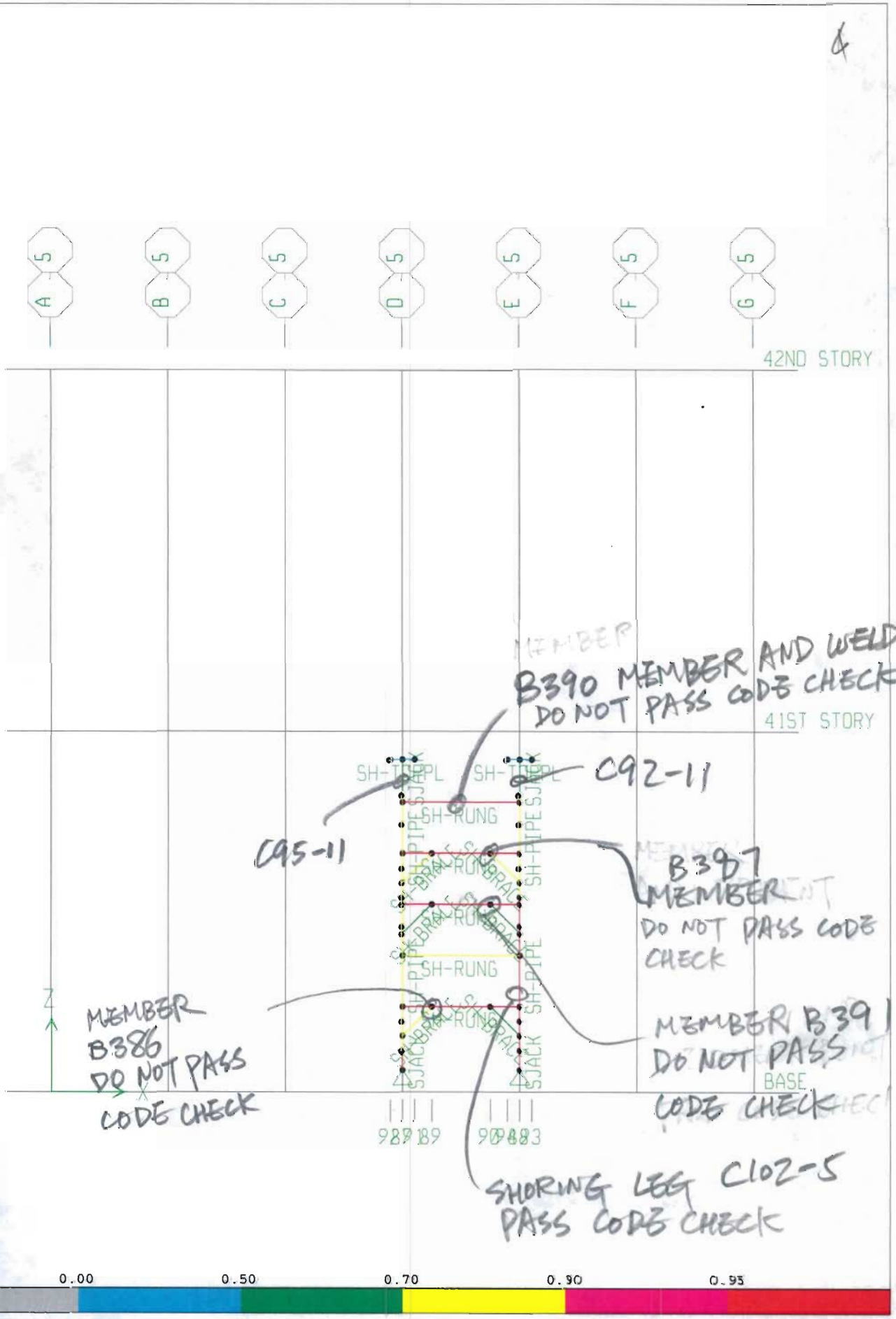


2




7 A
7 B
7 C
7 D
7 E
7 F
7 G
42ND STORY
41ST STORY
BASE
B416
SH-TOPPL
SH-TOPPL
C25-7
C23-7
SH-RUNG
SH-PIPE
SJACK
SH-BRACE
Z
X
207
0.00
0.50
0.70
0.90
0.95

4


A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
SH-RUNG
SH-RUNG
SH-RUNG
SH-PIPE
SH-PIPE
SJACK
SJACK
B390 MEMBER AND WELDMENT
DO NOT PASS CODE CHECK
C92-11
C95-11
B387
MEMBER
DO NOT PASS CODE
CHECK
MEMBER
B386
DO NOT PASS
CODE CHECK
MEMBER B391
DO NOT PASS
CODE CHECK
SHORING LEG C102-5
PASS CODE CHECK
Z
0.00
0.50
0.70
0.90
0.95

MEMBER DESIGNATION

LOC:0 — LOC: 48

START 48" — END

ETABS Steel Design

Engineer _____

Project _____

Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 0.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

TYPE OF ASSIGNED MEMBER

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.849 = 0.002 + 0.428 + 0.419

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.026	-2.697	-1.875	-0.113	-0.078

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.051	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	8.987	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	8.790	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.334	14.000	0.024
Minor Shear	0.417	14.000	0.030

MEMBER CAPACITY

$M_a = 6.4$ K-in $> M_{33} = 2.697$ K-in (OK)

ETABS Steel Design

Engineer
Project
Subject

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-7 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.312 = 0.168 + 0.144 + 0.004

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	-2.671	0.076	-0.118	0.007

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	32.025	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	5.245	36.300	1213.622	0.877	1.000	0.483	1.167
Minor Bending	0.149	36.300	1213.622	0.850	1.000	0.483	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.155	22.000	0.007
Minor Shear	0.009	22.000	0.000

1

ETABS Steel Design

Engineer ____________________

Project ____________________

Subject ____________________

AISC-ASD89 STEEL SECTION CHECK   Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C23-7 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.334 = 0.168 + 0.166 + 0.001

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	-3.071	0.020	-0.142	0.004

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	32.025	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	6.029	36.300	1213.622	0.871	1.000	0.483	1.177
Minor Bending	0.040	36.300	1213.622	0.850	1.000	0.483	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.187	22.000	0.009
Minor Shear	0.005	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.590 = 0.002 + 1.176 + 0.411

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.025	-7.414	1.843	0.309	-0.077

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.050	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	24.706	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	8.641	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.916	14.000	0.065
Minor Shear	0.409	14.000	0.029

MEMBER CAPACITY:

$M_a = 6.4\ K\text{-}in < M_{33} = 7.414\ K\text{-}in$

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C92-11 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.552 = 0.168 + 0.385 + 0.004

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	7.114	-0.076	0.421	-0.007

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	32.025	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	13.968	36.300	1213.622	0.850	1.000	0.483	1.238
Minor Bending	0.149	36.300	1213.622	0.850	1.000	0.483	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.556	22.000	0.025
Minor Shear	0.009	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C95-11 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.533 = 0.168 + 0.365 + 0.001

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	6.748	-0.020	0.399	-0.004

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	32.025	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	13.249	36.300	1213.622	0.850	1.000	0.483	1.237
Minor Bending	0.040	36.300	1213.622	0.850	1.000	0.483	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.526	22.000	0.024
Minor Shear	0.005	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B387 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.043 = 0.006 + 1.196 + 0.841

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.018	-7.536	3.768	0.624	-0.314

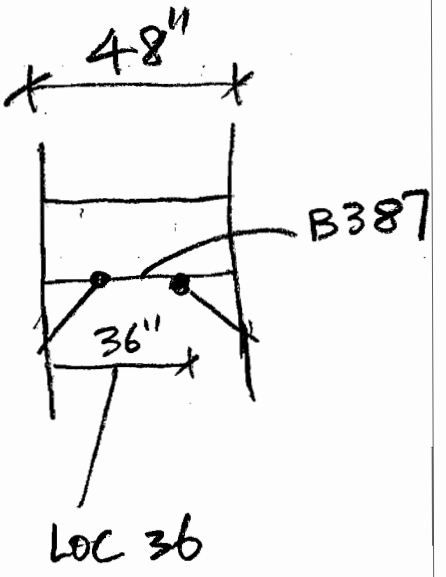
AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.036	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	25.111	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	17.669	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.850	14.000	0.132
Minor Shear	1.675	14.000	0.120



12

ETABS Steel Design

Engineer
Project
Subject

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in  (Summary for Combo and Station)
Level: 41ST STORY  Element: B391  Station Loc: 36.000  Section ID: SH-RUNG
Element Type:  Moment Resisting Frame   Classification:  Compact

L=48.000
A=0.503  i22=0.133  i33=0.338
s22=0.213  s33=0.300  r22=0.515  r33=0.820
E=10100.000  fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is  1.598 = 0.001 + 0.985 + 0.611

STRESS CHECK FORCES & MOMENTS
                             P         M33         M22         V2          V3
    Combo  DSTLS2       -0.004      -6.210       2.737       0.514      -0.228

AXIAL FORCE & BIAXIAL MOMENT DESIGN    (H1-3)
                            fa          Fa          Ft
                        Stress   Allowable   Allowable
    Axial                0.007       5.987      21.000

                            fb          Fb          Fe        Cm        K        L       Cb
                        Stress   Allowable   Allowable    Factor   Factor   Factor   Factor
    Major Bending       20.694      21.000      60.662     0.850    1.000    0.500    1.000
    Minor Bending       12.835      21.000       5.987     0.850    1.000    1.000

SHEAR DESIGN
                            fv          FV      Stress
                        Stress   Allowable       Ratio
    Major Shear          1.522      14.000       0.109
    Minor Shear          1.216      14.000       0.087
```

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ETABS Steel Design

Engineer________________
Project________________
Subject________________

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in  (Summary for Combo and Station)
Level: 41ST STORY  Element: B386  Station Loc: 36.000  Section ID: SH-RUNG
Element Type:  Moment Resisting Frame  Classification:  Compact

L=48.000
A=0.503  i22=0.133  i33=0.338
s22=0.213  s33=0.300  r22=0.515  r33=0.820
E=10100.000  fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is  1.429 = 0.003 + 1.207 + 0.219

STRESS CHECK FORCES & MOMENTS
                         P          M33         M22         V2          V3
    Combo  DSTLS2     -0.009      -7.605      -0.981       0.630       0.082

AXIAL FORCE & BIAXIAL MOMENT DESIGN    (H1-3)
                        fa         Fa          Ft
                     Stress   Allowable   Allowable
    Axial             0.018       5.987      21.000

                        fb         Fb          Fe        Cm        K        L       Cb
                     Stress   Allowable   Allowable  Factor    Factor   Factor  Factor
    Major Bending    25.344      21.000      60.662   0.850     1.000    0.500   1.000
    Minor Bending     4.598      21.000       5.987   0.850     1.000    1.000

SHEAR DESIGN
                        fv         FV        Stress
                     Stress   Allowable      Ratio
    Major Shear       1.867      14.000       0.133
    Minor Shear       0.436      14.000       0.031
```

ETABS Steel Design

Engineer ______________________
Project ______________________
Subject ______________________

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in  (Summary for Combo and Station)
Level: 41ST STORY  Element: C102-5  Station Loc: 12.000  Section ID: SH-PIPE
Element Type:  Moment Resisting Frame   Classification:  Compact

L=63.000
A=1.343  i22=1.367  i33=1.367
s22=0.912  s33=0.912  r22=1.009  r33=1.009
E=10100.000  fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is   0.973 = 0.418 + 0.024 + 0.555

STRESS CHECK FORCES & MOMENTS
                          P         M33         M22          V2          V3
    Combo  DSTLS2    -9.268      -0.553      11.025      -0.958      -0.591

AXIAL FORCE & BIAXIAL MOMENT DESIGN   (H1-1)
                         fa          Fa          Ft
                     Stress   Allowable   Allowable
    Axial             6.901      16.510      21.000

                         fb          Fb          Fe        Cm       K        L       Cb
                     Stress   Allowable   Allowable    Factor  Factor   Factor   Factor
    Major Bending     0.606      23.100     120.071     0.850   1.000    0.333    1.000
    Minor Bending    12.094      23.100      34.813     0.850   1.000    0.619

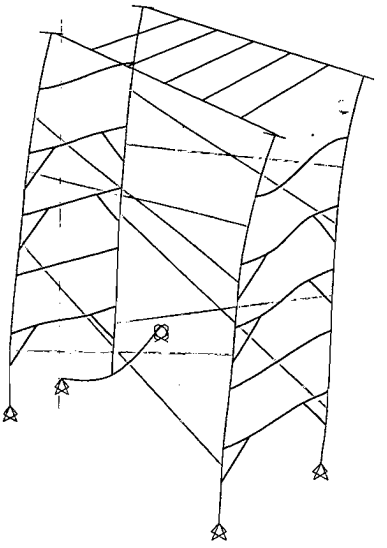
SHEAR DESIGN
                         fv          Fv      Stress
                     Stress   Allowable       Ratio
    Major Shear       1.322      14.000       0.094
    Minor Shear       0.815      14.000       0.058
```

3.2.2 Allowable Stress Check - Condition 2, Load Case B.

- The model file is "246SpringST_2009_05_08_singleTowerDL_2inchECCdeflectionLimitCodeCheckWith2%Lateral".
- A vertical load of 7,000 lbs and a horizontal load of 140 lbs placed at 2" away from the center of top plate.

Result: screw jack and shore failure

- Screw jack allowable stresses produced by bending and compression are about 140% of the allowable. Overstress condition.
- Aluminum shoring leg under bending and compression was stressed at about 140 % of allowable. Overstress condition.
- Horizontal members and connections from horizontal members to shoring legs do not meet allowable stress ratio combination. The ratio actual versus allowable is 2.62 Overstress condition.
- Stress ratio in knee brace is insignificant.



ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C92-11 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.335 = 0.168 + 1.167 + 0.005

STRESS CHECK FORCES & MOMENTS

		P	M33	M22	V2	V3
Combo	DSTLS2	-7.075	21.581	-0.097	0.441	-0.005

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	30.637	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	42.372	36.300	282.842	0.881	1.000	1.000	1.160
Minor Bending	0.191	36.300	282.842	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.583	22.000	0.027
Minor Shear	0.007	22.000	0.000

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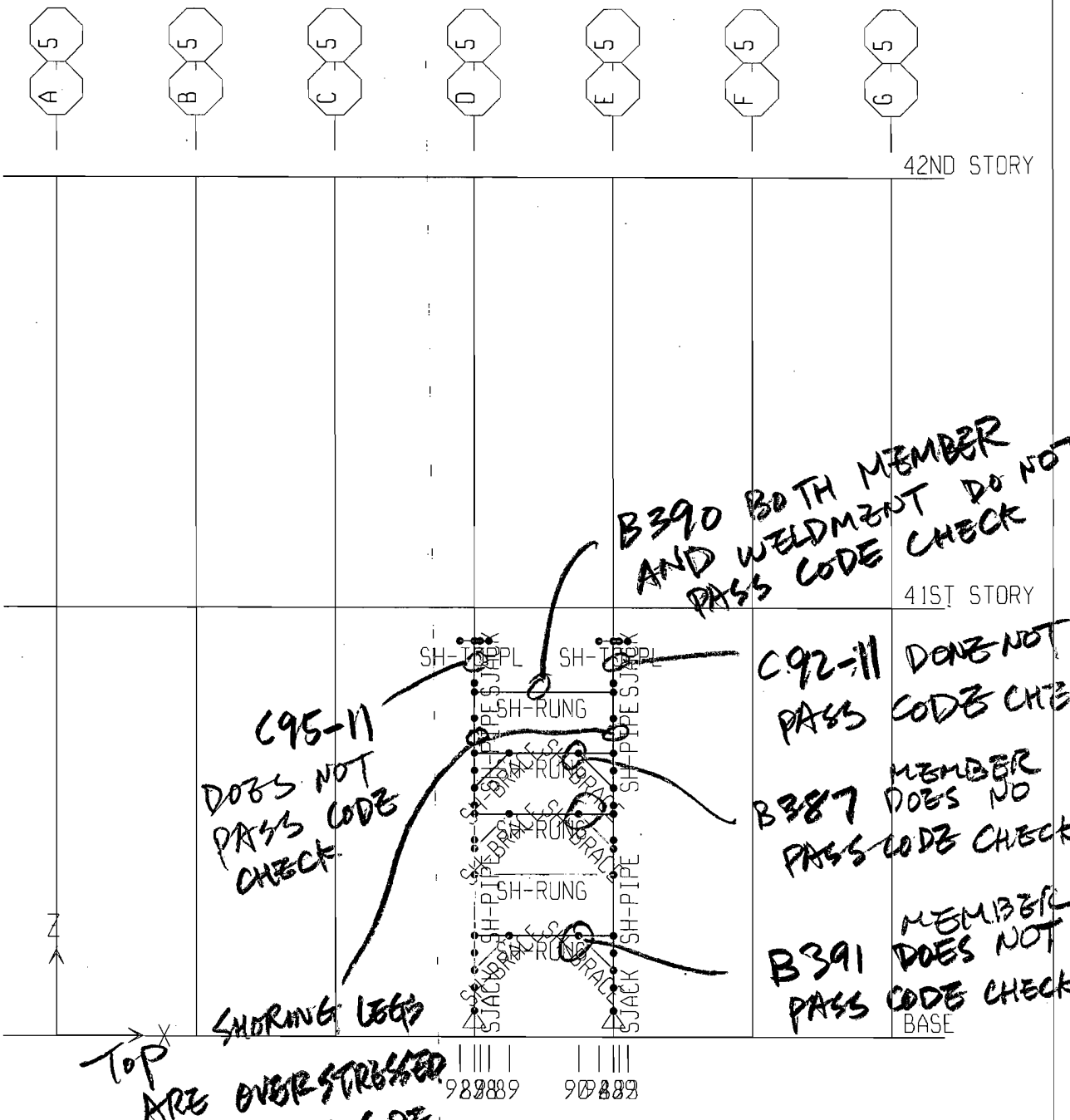
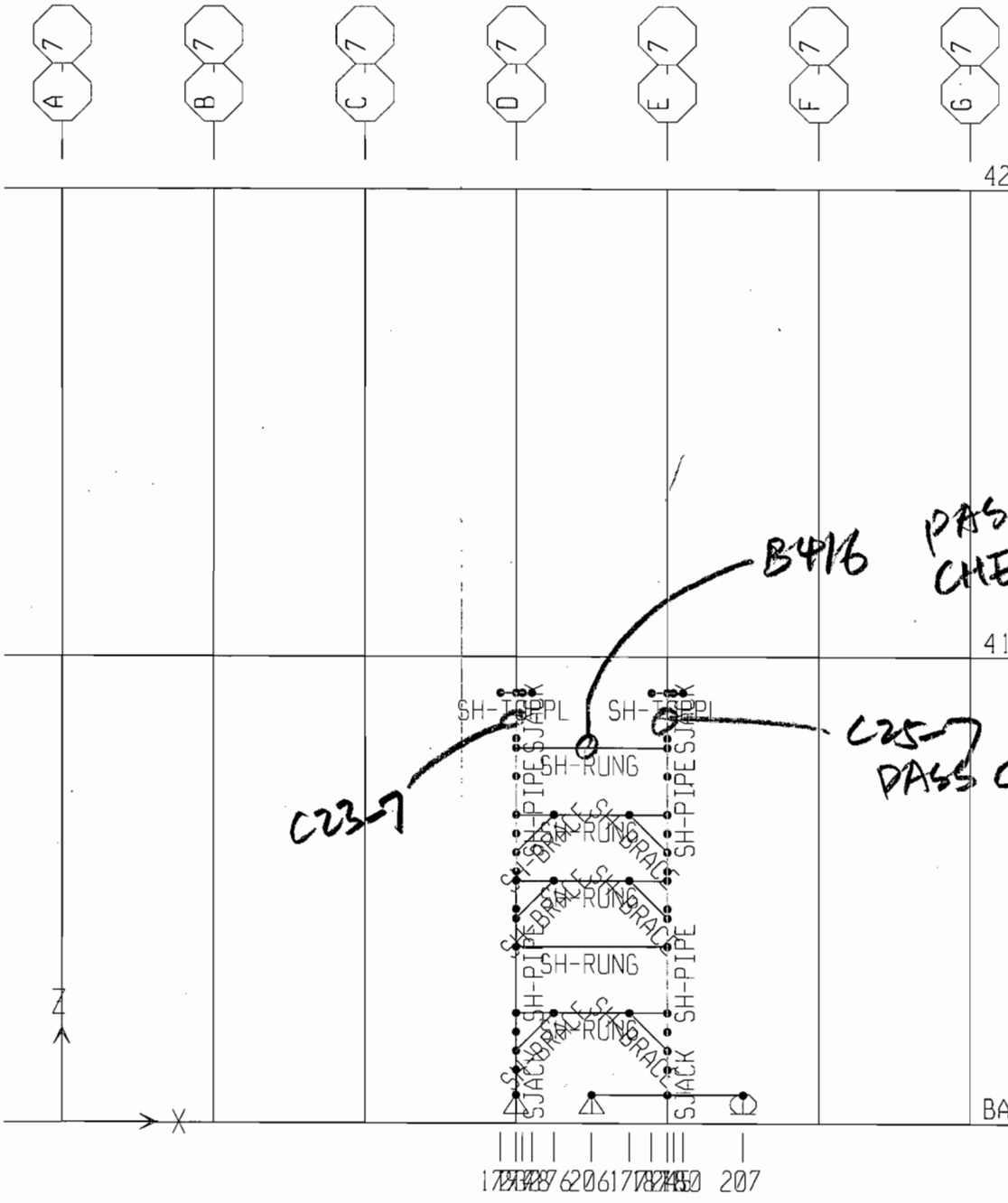

A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
SH-RUNG
SH-PIPE
SJACK
SHORING LEGS
B390 BOTH MEMBER AND WELDMENT DO NOT PASS CODE CHECK
C95-11 DOES NOT PASS CODE CHECK
C92-11 DOES NOT PASS CODE CHECK
B387 MEMBER DOES NO PASS CODE CHECK
B391 MEMBER DOES NOT PASS CODE CHECK
TOP
ARE OVERSTRESSED
DO NOT PASS CODE CHECK.
0.00
0.50
0.70
0.90
0.95

4



0.00 0.50 0.70 0.90 0.95

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.697 = 0.003 + 2.252 + 0.442

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.027	-14.191	1.981	0.592	-0.083

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.053	5.987	21.000

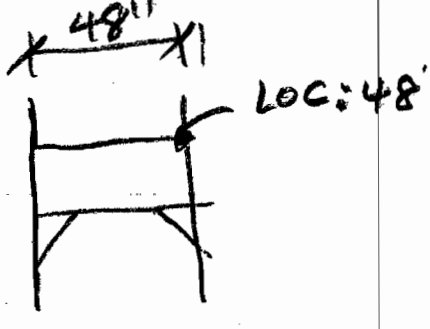
	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	47.290	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	9.288	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.753	14.000	0.125
Minor Shear	0.440	14.000	0.031

MEMBER CAPACITY:

$M_a = 6.4$ k-in $< M_{33} = 14.2$ k-in (NG)



ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B387 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.619 = 0.006 + 1.708 + 0.904

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.019	-10.766	4.050	0.894	-0.337

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.038	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	35.876	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	18.989	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.647	14.000	0.189
Minor Shear	1.800	14.000	0.129

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B391 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.813 = 0.001 + 1.155 + 0.656

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.003	-7.279	2.939	0.603	-0.245

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.007	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	24.257	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	13.783	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.786	14.000	0.128
Minor Shear	1.306	14.000	0.093

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B386 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.523 = 0.003 + 1.284 + 0.236

STRESS CHECK FORCES & MOMENTS

		P	M33	M22	V2	V3
Combo	DSTLS2	-0.009	-8.090	-1.057	0.670	0.088

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.018	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	26.957	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	4.959	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.986	14.000	0.142
Minor Shear	0.470	14.000	0.034

ETABS Steel Design

Engineer
Project
Subject

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in  (Summary for Combo and Station)
Level: 41ST STORY  Element: C95-11  Station Loc: 0.000  Section ID: SJACK
Element Type:  Moment Resisting Frame   Classification:  Compact

L=14.500
A=1.279  i22=0.509  i33=0.509
s22=0.509  s33=0.509  r22=0.631  r33=0.631
E=29000.000  fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is   1.314 = 0.168 + 1.146 + 0.002

STRESS CHECK FORCES & MOMENTS
                             P          M33          M22          V2          V3
   Combo  DSTLS2        -7.075       21.186       -0.032       0.417      -0.002

AXIAL FORCE & BIAXIAL MOMENT DESIGN    (H1-2)
                            fa           Fa           Ft
                        Stress    Allowable    Allowable
    Axial                5.532       30.637       33.000

                            fb           Fb           Fe        Cm        K        L        Cb
                        Stress    Allowable    Allowable    Factor   Factor   Factor   Factor
    Major Bending       41.597       36.300      282.842     0.886    1.000    1.000    1.153
    Minor Bending        0.063       36.300      282.842     0.850    1.000    1.000

SHEAR DESIGN
                            fv           FV       Stress
                        Stress    Allowable        Ratio
    Major Shear          0.551       22.000        0.025
    Minor Shear          0.002       22.000        0.000
```

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C92-11 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.335 = 0.168 + 1.167 + 0.005

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	21.581	-0.097	0.441	-0.005

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa	Fa	Ft
	Stress	Allowable	Allowable
Axial	5.532	30.637	33.000

	fb	Fb	Fe	Cm	K	L	Cb
	Stress	Allowable	Allowable	Factor	Factor	Factor	Factor
Major Bending	42.372	36.300	282.842	0.881	1.000	1.000	1.160
Minor Bending	0.191	36.300	282.842	0.850	1.000	1.000	

SHEAR DESIGN

	fv	FV	Stress
	Stress	Allowable	Ratio
Major Shear	0.583	22.000	0.027
Minor Shear	0.007	22.000	0.000

ETABS Steel Design

Engineer______________________
Project______________________
Subject______________________

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in  (Summary for Combo and Station)
Level: 41ST STORY  Element: C102-3  Station Loc: 39.000  Section ID: SH-PIPE
Element Type:  Moment Resisting Frame   Classification:  Compact

L=42.000
A=1.343  i22=1.367  i33=1.367
s22=0.912  s33=0.912  r22=1.009  r33=1.009
E=10100.000  fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is   1.339 = 0.251 + 1.088 + 0.005

STRESS CHECK FORCES & MOMENTS
                              P         M33         M22          V2          V3
    Combo  DSTLS2        -7.075      22.905      -0.113       0.441      -0.005

AXIAL FORCE & BIAXIAL MOMENT DESIGN    (H1-2)
                             fa          Fa          Ft
                         Stress   Allowable   Allowable
    Axial                 5.268      19.050      21.000

                             fb          Fb          Fe        Cm         K         L        Cb
                         Stress   Allowable   Allowable    Factor    Factor    Factor    Factor
    Major Bending        25.126      23.100     120.071     0.850     1.000     0.500     1.000
    Minor Bending         0.124      23.100     163.430     0.850     1.000     0.429

SHEAR DESIGN
                             fv          FV      Stress
                         Stress   Allowable       Ratio
    Major Shear           0.609      14.000       0.043
    Minor Shear           0.007      14.000       0.001
```

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C100-3 Station Loc: 39.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=42.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.316 = 0.251 + 1.066 + 0.002

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	22.438	-0.038	0.417	-0.002

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa	Fa	Ft
	Stress	Allowable	Allowable
Axial	5.268	19.050	21.000

	fb	Fb	Fe	Cm	K	L	Cb
	Stress	Allowable	Allowable	Factor	Factor	Factor	Factor
Major Bending	24.614	23.100	120.071	0.850	1.000	0.500	1.000
Minor Bending	0.041	23.100	163.430	0.850	1.000	0.429	

SHEAR DESIGN

	fv	FV	Stress
	Stress	Allowable	Ratio
Major Shear	0.576	14.000	0.041
Minor Shear	0.002	14.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-7 Station Loc: 14.500 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.874 = 0.167 + 0.706 + 0.001

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.069	13.057	0.020	-0.136	0.005

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.527	30.637	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	25.636	36.300	282.842	0.939	1.000	1.000	1.075
Minor Bending	0.039	36.300	282.842	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.180	22.000	0.008
Minor Shear	0.007	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C23-7 Station Loc: 14.500 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.871 = 0.167 + 0.703 + 0.000

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.069	13.003	0.007	-0.162	0.002

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.527	30.637	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	25.531	36.300	282.842	0.928	1.000	1.000	1.091
Minor Bending	0.013	36.300	282.842	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.214	22.000	0.010
Minor Shear	0.002	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.989 = 0.003 + 0.536 + 0.450

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.027	-3.381	2.015	0.141	-0.084

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.055	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	11.265	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	9.447	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.418	14.000	0.030
Minor Shear	0.448	14.000	0.032

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ETABS Steel Design

Engineer ______
Project ______
Subject ______

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AISC-ASD89 STEEL SECTION CHECK    Units: Kip-in   (Summary for Combo and Station)
Level: 41ST STORY  Element: B390  Station Loc: 48.000  Section ID: SH-RUNG
Element Type:  Moment Resisting Frame   Classification:  Compact

L=48.000
A=0.503  i22=0.133  i33=0.338
s22=0.213  s33=0.300  r22=0.515  r33=0.820
E=10100.000  fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is  2.697 = 0.003 + 2.252 + 0.442

STRESS CHECK FORCES & MOMENTS
                        P          M33         M22         V2          V3
    Combo  DSTLS2     0.027      14.191       1.981       0.592      -0.083

AXIAL FORCE & BIAXIAL MOMENT DESIGN   (H2-1)
                        fa          Fa          Ft
                     Stress   Allowable   Allowable
    Axial             0.053       5.987      21.000

                        fb          Fb          Fe        Cm        K        L       Cb
                     Stress   Allowable   Allowable   Factor   Factor   Factor   Factor
    Major Bending    47.290      21.000      15.165    1.000    1.000    1.000    2.300
    Minor Bending     9.288      21.000       5.987    1.000    1.000    1.000

SHEAR DESIGN
                        fv          FV      Stress
                     Stress   Allowable      Ratio
    Major Shear       1.753      14.000      0.125
    Minor Shear       0.440      14.000      0.031
```

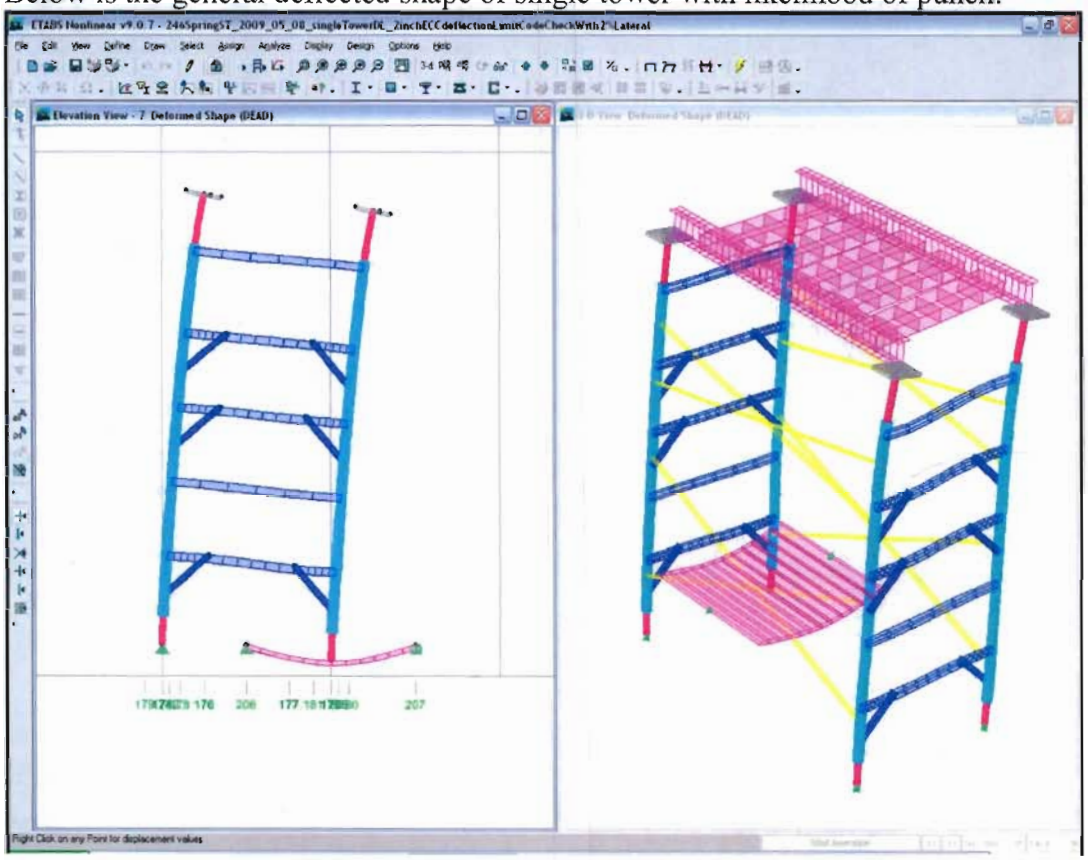
MEMBER CAPACITY:

$M_a = 6.4$ K-in $< M_{33} = 14.2$

3.3 Single Tower - Ultimate Condition.

The various computer models consider dead weight assumed existing at the time of the collapse (no construction live load or horizontal load.) only. The vertical load on each leg is in the order of 7000 lbs as described above in section 14.2.1. The overall frame is made of 5'-3" bottom frame and 3'-6" top frame, and the frame is 8'-0" apart. Four loading conditions have been considered and studied for the effect ".8" limited deflection on leg support" and "flexible leg support" to all members in the tower. The calculations use ultimate strength of materials.

Below is the general deflected shape of single tower with likelihood of punch:



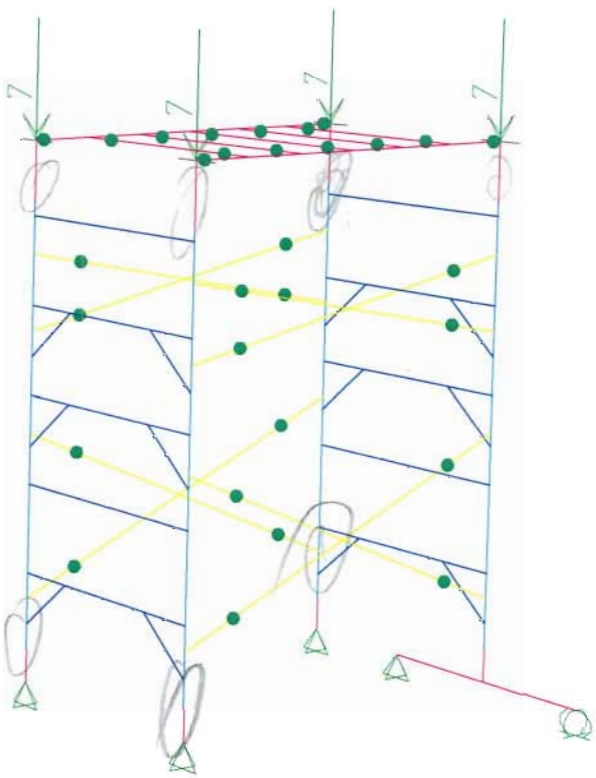
3.3.1 Ultimate Condition 1 - Load Case A, And The Bottom Shoring Leg Support Is Flexible.

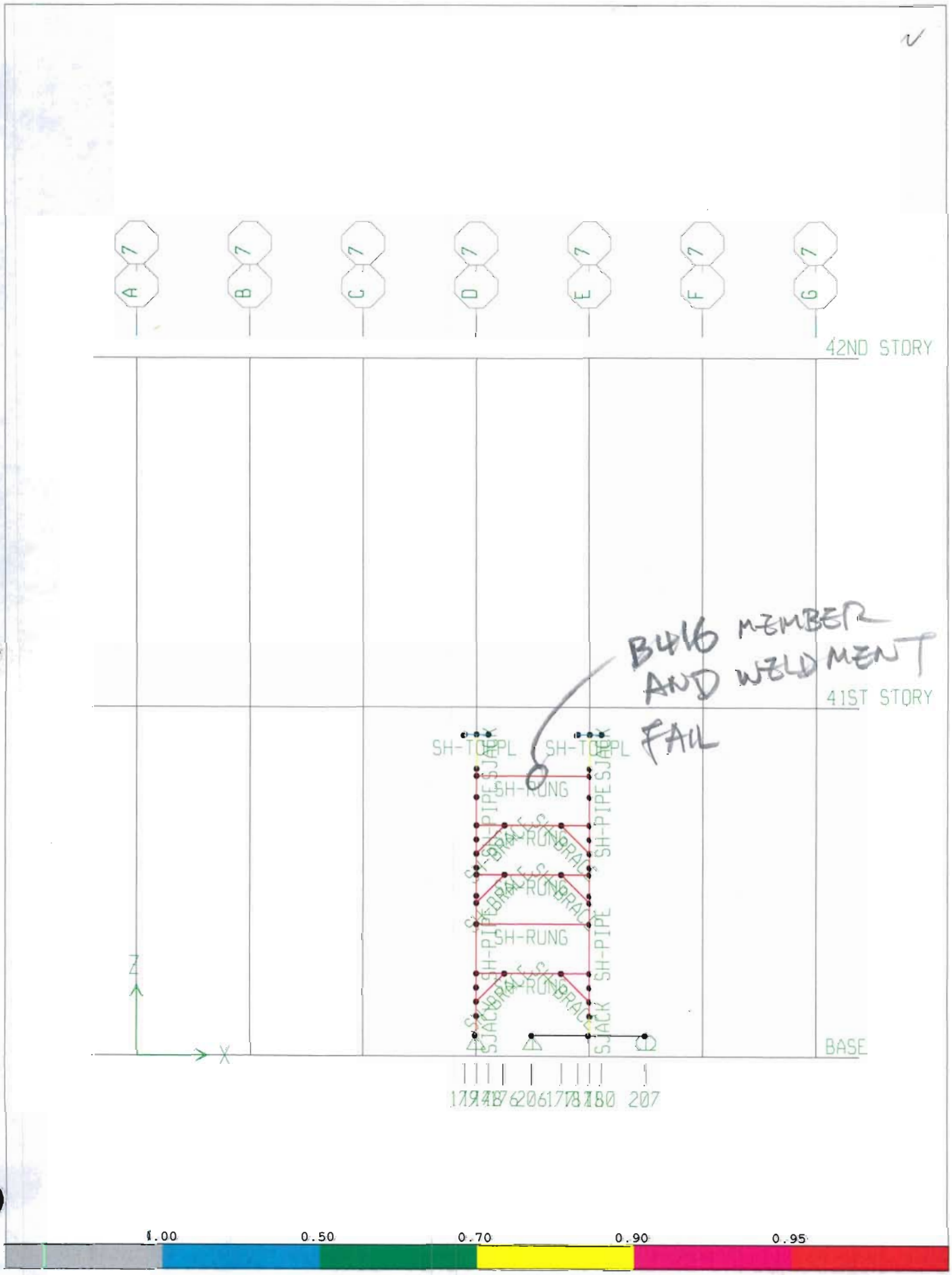
- The model file is "246SpringST_2009_05_08_singleTowerDL_NoECC".

Result: shore failure

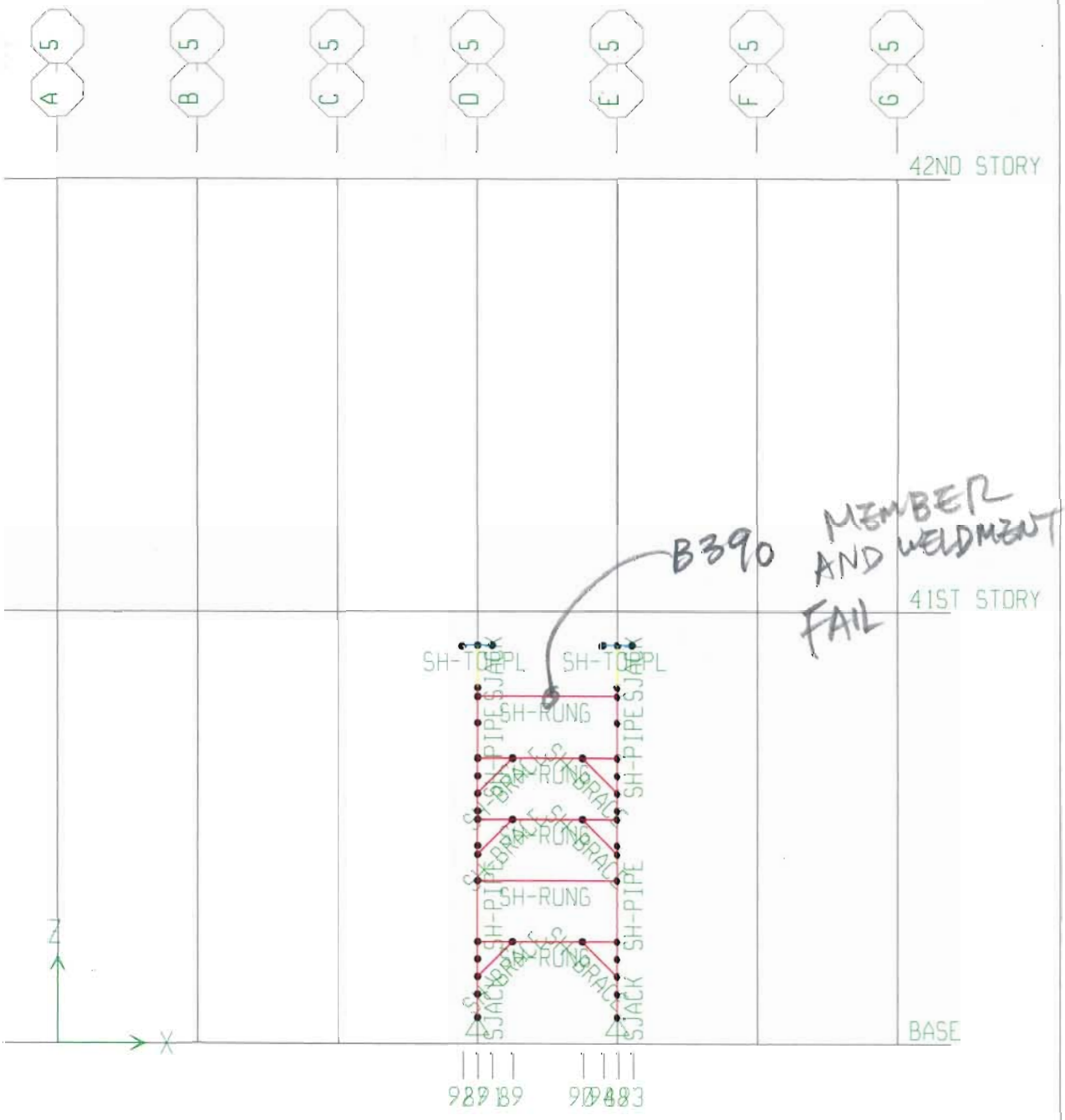
- Screw jacks do not fail.
- Shoring leg across from the flexible support leg may or may not fail in combination of axial compression and bending. Other 3 legs do not fail in buckle or bending.

- Horizontal members fail in bending, and connections from horizontal members to shoring leg fail in weldment.
- Knee brace does not fail .
- The downward deflection at the flexible support is 1.93".




A 7
B 7
C 7
D 7
E 7
F 7
G 7
42ND STORY
41ST STORY
BASE
B416 MEMBER AND WELDMENT FAIL
SH-TOPPL
SH-PIPE
SH-RUNG
SJACK
Z
X
1.00
0.50
0.70
0.90
0.95

27


A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
B390 MEMBER AND WELDMENT FAIL
SH-TOPPL
SH-PIPE
SH-RUNG
SJACK
Z
X
0.00
0.50
0.70
0.90
0.95

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 0.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.774 = 0.006 + 1.850 + 0.919

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.059	-11.658	-4.115	-0.485	-0.171

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.117	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	38.848	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	19.297	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.438	14.000	0.103
Minor Shear	0.914	14.000	0.065

MEMBER FAILURE STRENGTH

$M_{ultmate} = 10.5$ k-in $< M_{33}$ (FAIL)

WELD FAILURE STRENGTH

$M_{ultmate} = 3.6$ k-in $< M_{33}$ (FAIL)

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.757 = 0.005 + 1.849 + 0.903

STRESS CHECK FORCES & MOMENTS

		P	M33	M22	V2	V3
Combo	DSTLS2	0.057	-11.651	4.045	0.485	-0.169

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.114	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	38.825	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	18.967	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.437	14.000	0.103
Minor Shear	0.899	14.000	0.064

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-7 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.754 = 0.168 + 0.586 + 0.006

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	-10.832	0.108	-0.594	0.008

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

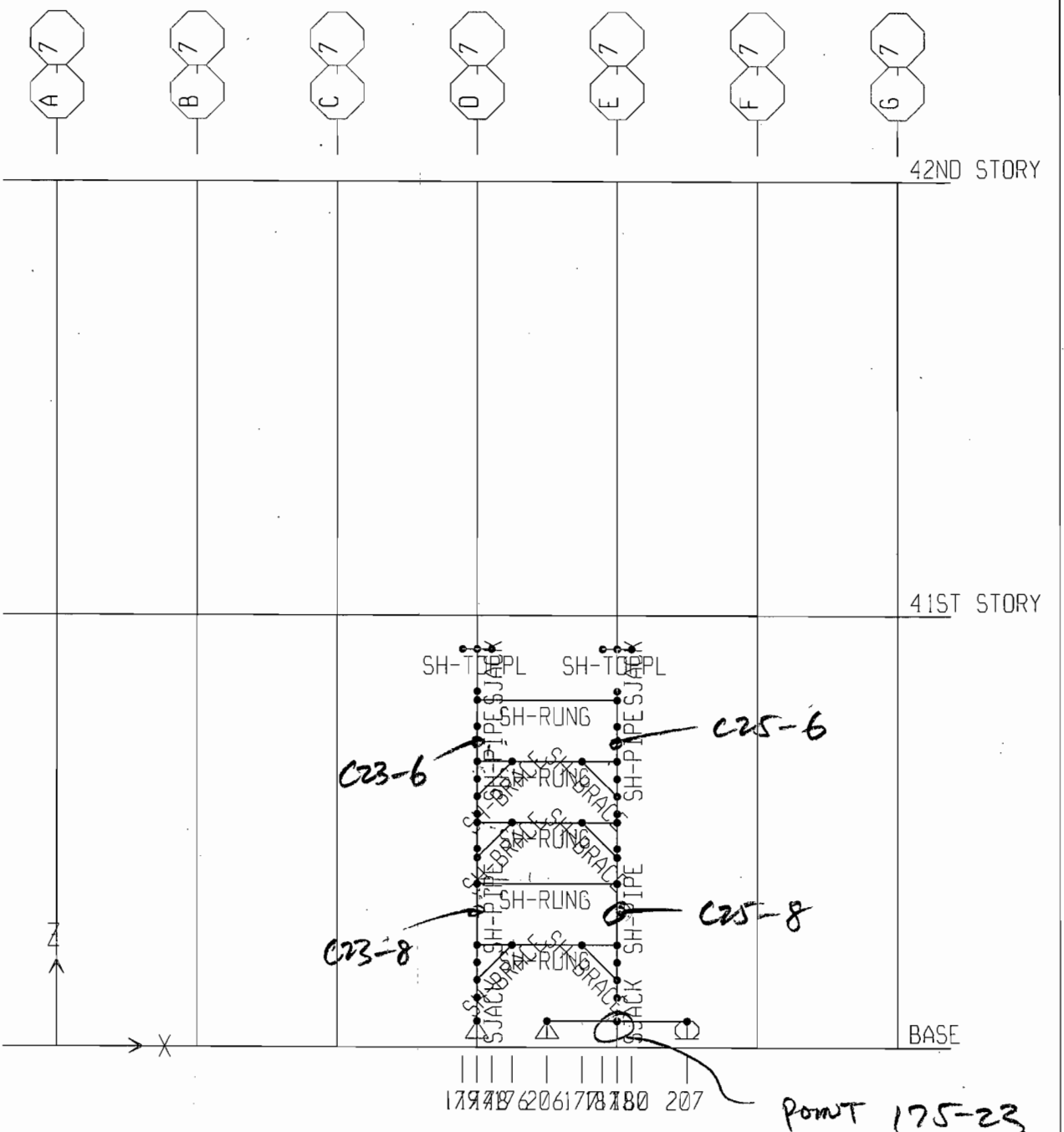
	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	32.025	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	21.269	36.300	1213.622	0.850	1.000	0.483	1.217
Minor Bending	0.211	36.300	1213.622	0.850	1.000	0.483	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.784	22.000	0.036
Minor Shear	0.011	22.000	0.001

6



POINT 175-23

$U_Z = -1.93''$

0.00 0.50 0.70 0.90 0.95

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-8 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.279 = 0.144 + 0.114 + 1.130

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-4.064	2.405	23.786	1.755	1.102

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	3.026	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	2.638	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	26.093	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.419	14.000	0.173
Minor Shear	1.519	14.000	0.108

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C23-8 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.772 = 0.498 + 0.090 + 1.271

STRESS CHECK FORCES & MOMENTS

		P	M33	M22	V2	V3
Combo	DSTLS2	-11.053	2.077	-24.036	1.566	1.289

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	8.230	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	2.278	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	26.368	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.160	14.000	0.154
Minor Shear	1.777	14.000	0.127

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-6 Station Loc: 18.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=42.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.051 = 0.227 + 0.706 + 0.424

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-6.399	-14.873	8.929	-0.659	0.907

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	4.764	19.050	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	16.316	23.100	120.071	0.850	1.000	0.500	1.000
Minor Bending	9.795	23.100	163.430	0.850	1.000	0.429	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.909	14.000	0.065
Minor Shear	1.251	14.000	0.089

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C23-6 Station Loc: 18.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=42.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.086 = 0.276 + 0.691 + 0.422

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.773	-14.560	-8.890	-0.600	-0.923

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.788	19.050	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	15.973	23.100	120.071	0.850	1.000	0.500	1.000
Minor Bending	9.752	23.100	163.430	0.850	1.000	0.429	

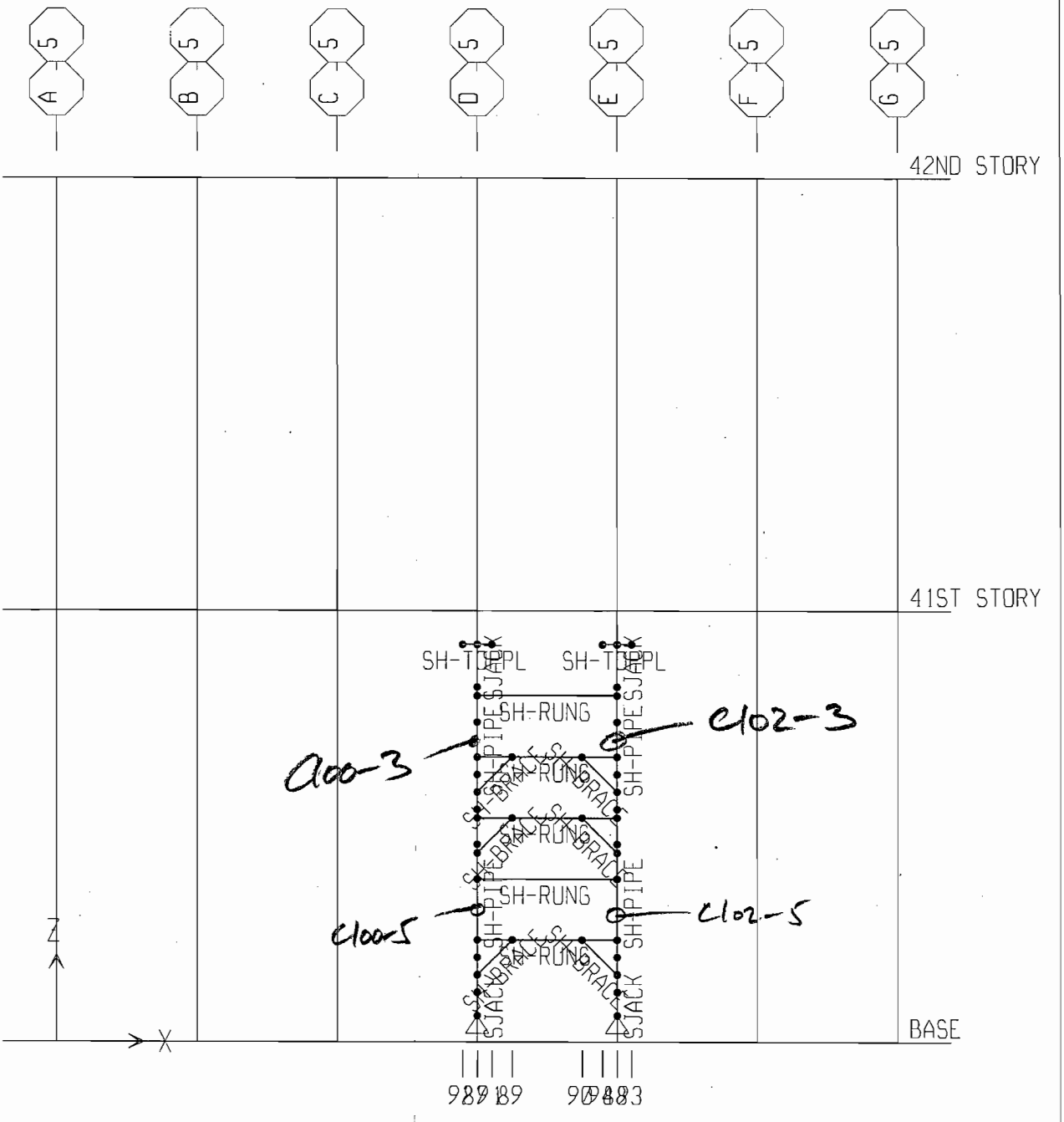
SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.827	14.000	0.059
Minor Shear	1.273	14.000	0.091

P O I N T D I S P L A C E M E N T S

STORY	POINT	LOAD	UX	UY	UZ	RX	RY	RZ
41ST STORY	175-23	DEAD	-0.0003	-0.0022	-1.9307	-0.00097	0.01481	0.00000

12


A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
SH-PIPE
SH-RUNG
SJACK
C100-3
C102-3
C100-5
C102-5
Z
X

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C102-5 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.779 = 0.503 + 0.038 + 1.276

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-11.156	-0.874	24.061	-1.468	-1.290

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	8.307	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	0.959	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	26.394	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.024	14.000	0.145
Minor Shear	1.778	14.000	0.127

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C100-5 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.273 = 0.141 + 0.047 + 1.131

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-3.989	-0.992	-23.810	-1.438	-1.101

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	2.970	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	1.089	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	26.119	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.983	14.000	0.142
Minor Shear	1.519	14.000	0.108

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C102-3 Station Loc: 18.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=42.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.087 = 0.276 + 0.692 + 0.423

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.773	14.578	8.903	0.599	0.922

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa	Fa	Ft
	Stress	Allowable	Allowable
Axial	5.788	19.050	21.000

	fb	Fb	Fe	Cm	K	L	Cb
	Stress	Allowable	Allowable	Factor	Factor	Factor	Factor
Major Bending	15.992	23.100	120.071	0.850	1.000	0.500	1.000
Minor Bending	9.766	23.100	163.430	0.850	1.000	0.429	

SHEAR DESIGN

	fv	FV	Stress
	Stress	Allowable	Ratio
Major Shear	0.826	14.000	0.059
Minor Shear	1.271	14.000	0.091

ETABS Steel Design

Engineer_____
Project_____
Subject_____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C100-3 Station Loc: 18.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=42.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.051 = 0.227 + 0.706 + 0.425

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-6.399	14.874	-8.942	0.659	-0.906

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	4.764	19.050	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	16.317	23.100	120.071	0.850	1.000	0.500	1.000
Minor Bending	9.809	23.100	163.430	0.850	1.000	0.429	

SHEAR DESIGN

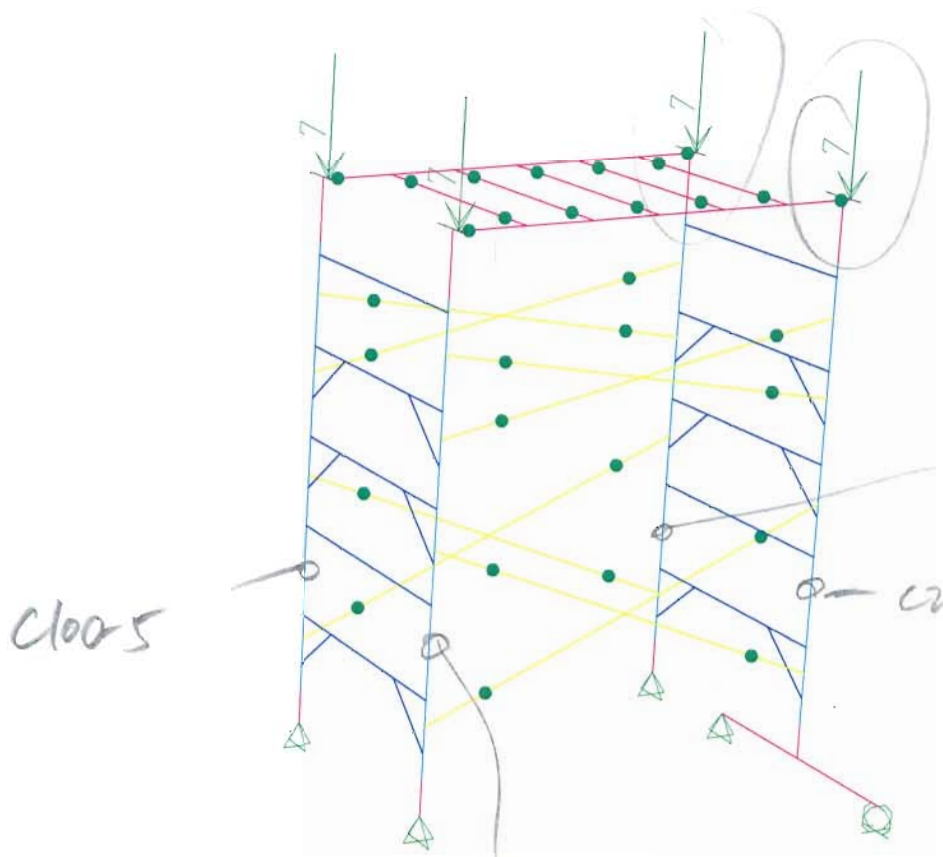
	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.909	14.000	0.065
Minor Shear	1.249	14.000	0.089

3.3.2 Ultimate Condition 2 - Load Case B, And The Bottom Shoring Leg Support Is Flexible.

- The model file is "246SpringST_2009_05_08_singleTowerDL_2inchECC".

Result: shore failure

- Screw jacks do not fail.
- Shoring leg across from the flexible support leg may or may not fail in combination of axial compression and bending. Other 3 legs do not fail.
- Horizontal members fail in bending, and connections from horizontal members to shoring leg fail in weldment.
- Knee brace does not fail.
- The downward deflection at the flexible support is 2.092".

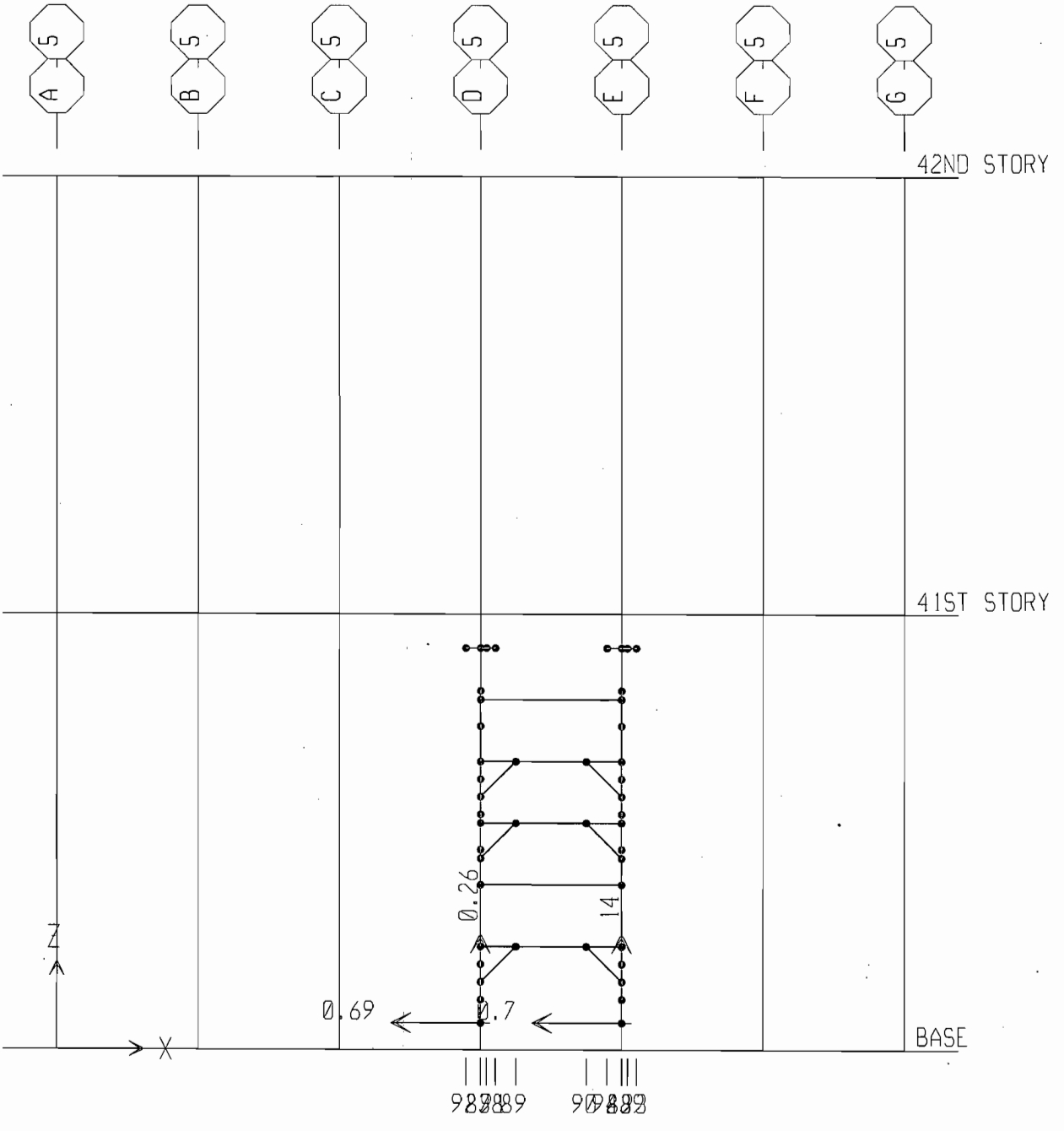

C23-8
C25-8
C100-5
C102-5
OVERSTRESSED

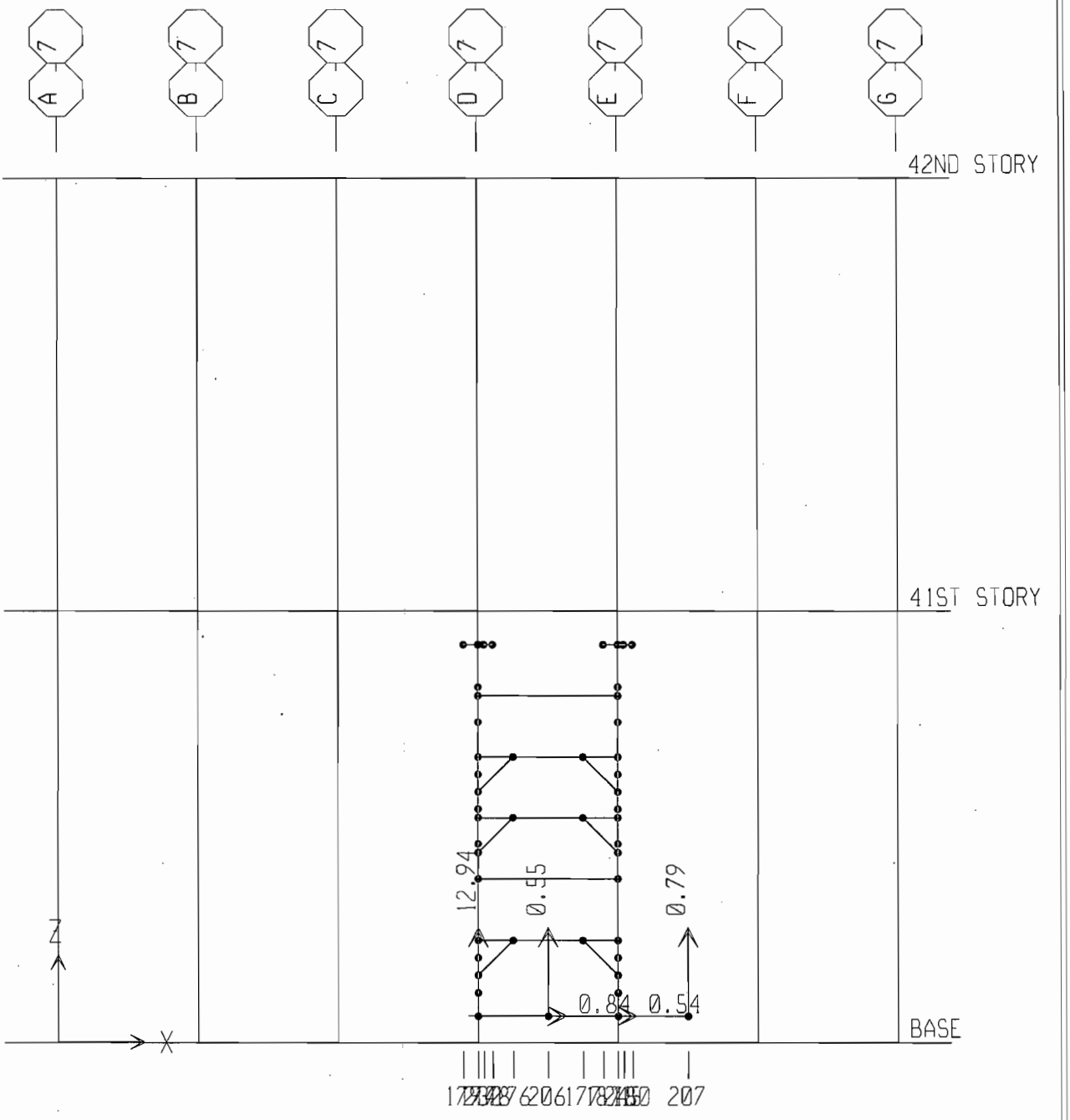
2

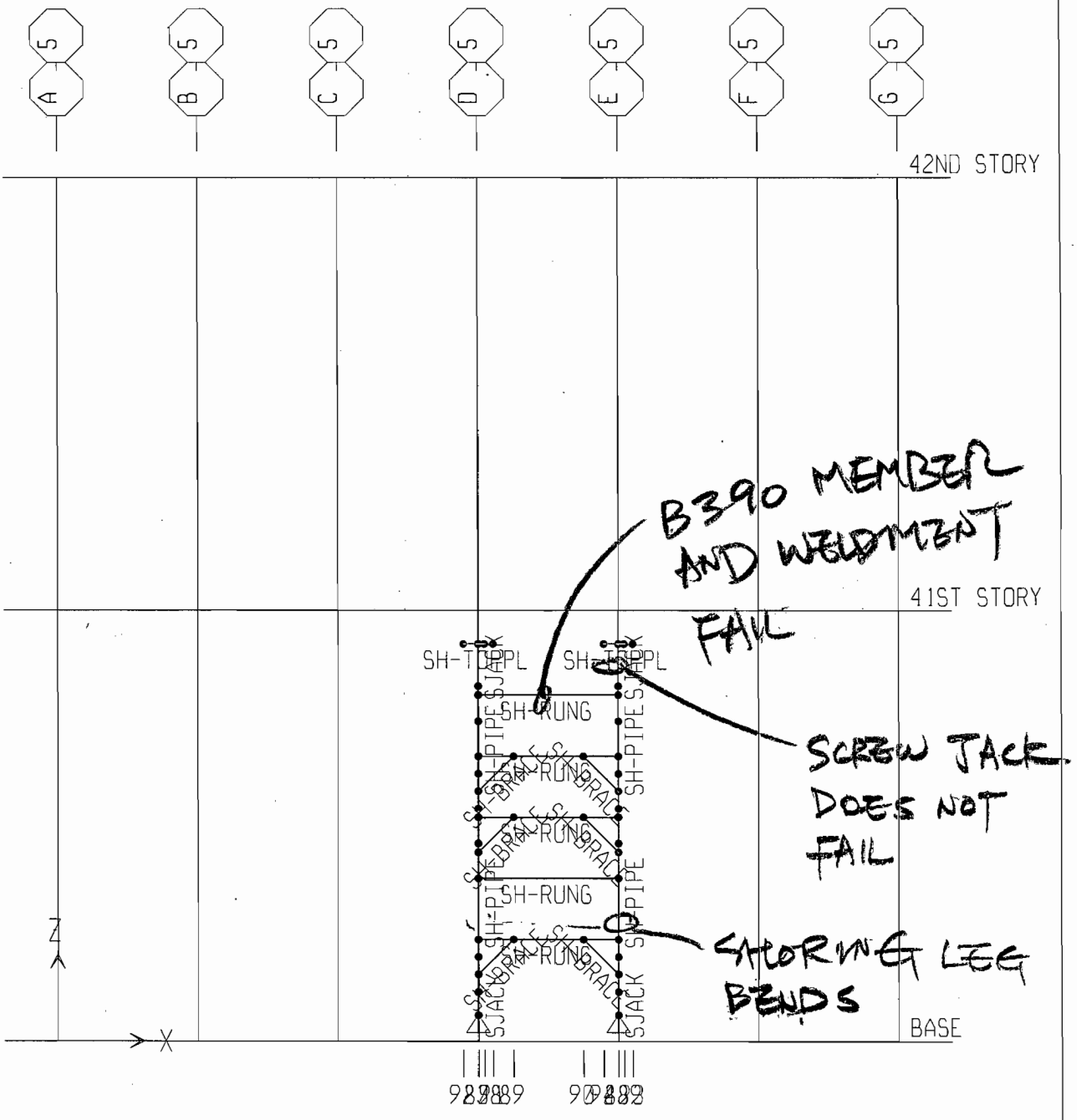
P O I N T D I S P L A C E M E N T S

STORY	POINT	LOAD	UX	UY	UZ	RX	RY	RZ
41ST STORY	175-23	DEAD	-0.0003	-0.0024	-2.0914	-0.00105	0.01617	0.00000

4

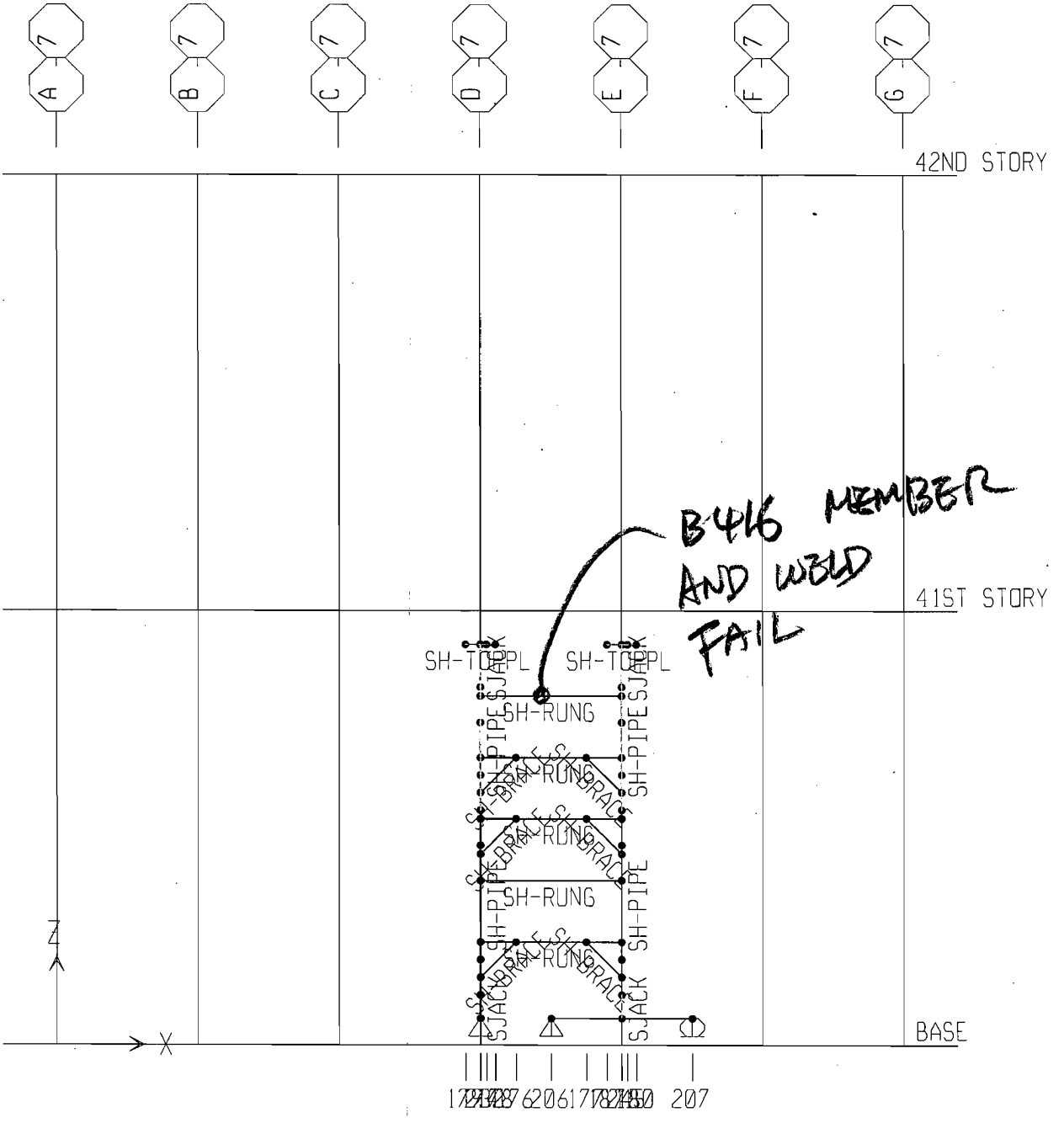



A
B
C
D
E
F
G
42ND STORY
41ST STORY
BASE
12.94
0.55
0.79
0.84
0.54
Z
X
207



0.00 0.50 0.70 0.90 0.95

6



0.00 0.50 0.70 0.90 0.95

ETABS Steel Design

Engineer_____
Project_____
Subject_____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 3.999 = 0.006 + 3.015 + 0.978

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.062	-18.998	4.382	0.791	-0.183

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.123	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	63.307	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	20.546	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.344	14.000	0.167
Minor Shear	0.974	14.000	0.070

MEMBER FAILURE STRENGTH

Multmate = 104 k-in < M_{33} = 19 k-in
(FAIL)

WELD FAILURE STRENGTH

Multmate = 3.6 k-in < M_{33} = 19 k-in
(FAIL)

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 0.000 Section ID: 8H-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.984 = 0.006 + 0.982 + 0.995

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.064	-6.190	-4.458	-0.257	-0.186

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.127	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	20.626	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	20.902	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.763	14.000	0.054
Minor Shear	0.991	14.000	0.071

MEMBER FAILURE STRENGTH

$M_{ultmate} = 10.4$ k-in (FAIL IN BIAXIAL BENDING)

WELD FAILURE STRENGTH

$M_{ultmate} = 3.6$ k-in $< M_{33} = 6.19$ k-in

(FAIL)

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C92-11 Station Loc: 0.000 Section ID: SJACK
Element Type: Moment Resisting Frame Classification: Compact

L=14.500
A=1.279 i22=0.509 i33=0.509
s22=0.509 s33=0.509 r22=0.631 r33=0.631
E=29000.000 fy=55.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.617 = 0.168 + 1.450 + 0.007

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-7.075	26.801	-0.132	0.702	-0.007

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	5.532	30.637	33.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	52.623	36.300	282.842	0.850	1.000	1.000	1.214
Minor Bending	0.259	36.300	282.842	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.927	22.000	0.042
Minor Shear	0.010	22.000	0.000

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C25-8 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.386 = 0.156 + 0.129 + 1.224

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-4.389	2.710	25.772	1.881	1.193

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-2)

	fa Stress	Fa Allowable	Ft Allowable
Axial	3.268	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	2.973	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	28.272	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.594	14.000	0.185
Minor Shear	1.645	14.000	0.118

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C23-8 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.857 = 0.487 + 0.102 + 1.366

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-10.806	2.362	-26.016	1.673	1.395

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	8.046	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	2.592	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	28.539	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.307	14.000	0.165
Minor Shear	1.923	14.000	0.137

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C102-5 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.962 = 0.544 + 0.037 + 1.418

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-12.062	-0.849	26.057	-1.605	-1.397

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1=1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	8.981	16.510	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	0.931	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	28.585	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	2.213	14.000	0.158
Minor Shear	1.926	14.000	0.138

ETABS Steel Design

Engineer_____
Project_____
Subject_____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: C100-5 Station Loc: 12.000 Section ID: SH-PIPE
Element Type: Moment Resisting Frame Classification: Compact

L=63.000
A=1.343 i22=1.367 i33=1.367
s22=0.912 s33=0.912 r22=1.009 r33=1.009
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.369 = 0.143 + 0.046 + 1.226

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-3.164	-0.967	-25.814	-1.575	-1.194

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa	Fa	Ft
	Stress	Allowable	Allowable
Axial	2.356	16.510	21.000

	fb	Fb	Fe	Cm	K	L	Cb
	Stress	Allowable	Allowable	Factor	Factor	Factor	Factor
Major Bending	1.061	23.100	120.071	0.850	1.000	0.333	1.000
Minor Bending	28.317	23.100	34.813	0.850	1.000	0.619	

SHEAR DESIGN

	fv	FV	Stress
	Stress	Allowable	Ratio
Major Shear	2.172	14.000	0.155
Minor Shear	1.646	14.000	0.118

LE

7

8

7 x 8 = 56

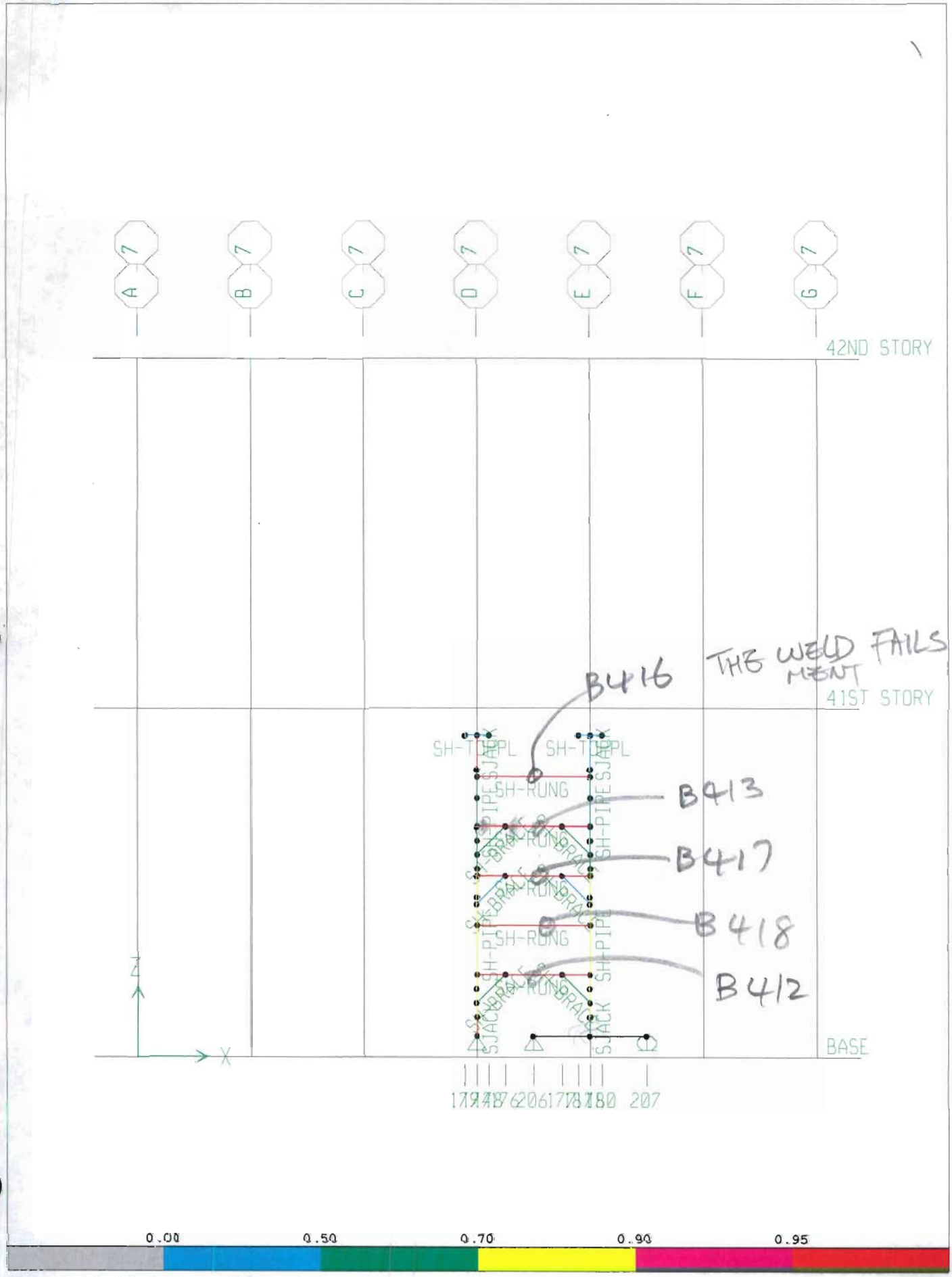
+10pgs

3.3.3 Ultimate Condition 3 - Load Case A, And The Bottom Shoring Leg Support Is With .8" Deflection Limit.

- The model file is "246SpringST_2009_05_08_singleTowerDL_NoECCdeflectionLimit".

Result: shore failure

- Screw jacks do not fail.
- All 4 Shoring legs do not fail in buckle or bending.
- The connections from the top horizontal members to the leg fail in weldment. The bottom horizontal members fail in bending, and the connections from the bottom horizontal members to the leg fail in weldment. The other horizontal members and connections are still ok.
- Knee brace does not fail in compression, tension or bending.


A 7
B 7
C 7
D 7
E 7
F 7
G 7
42ND STORY
41ST STORY
BASE
B416
THE WELD FAILS
MENT
B413
B417
B418
B412
SH-TOPPL
SH-RUNG
SH-PIPE
SJACK
Z
X
0.00
0.50
0.70
0.90
0.95

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 0.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.129 = 0.002 + 0.746 + 0.381

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.025	-4.702	-1.706	-0.196	-0.071

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.049	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	15.669	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	7.997	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.582	14.000	0.042
Minor Shear	0.379	14.000	0.027

MEMBER FAILURE STRENGTH

$M_{ultimate} = 10.4$ k-in $> M_{33} = 4.7$ k-in (OK)

WELD FAILURE STRENGTH

$M_{ultimate} = 3.6$ k-in $< M_{33} = 4.7$ k-in (FAIL)

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B413 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.525 = 0.006 + 0.754 + 0.766

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.017	-4.752	-3.429	-0.392	-0.286

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.034	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	15.837	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	16.079	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.163	14.000	0.083
Minor Shear	1.524	14.000	0.109

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B417 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.195 = 0.003 + 0.636 + 0.557

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.009	-4.006	-2.494	-0.330	-0.208

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.017	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	13.349	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	11.694	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.977	14.000	0.070
Minor Shear	1.108	14.000	0.079

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B418 Station Loc: 0.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.498 = 0.005 + 0.420 + 0.073 OK

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.058	-2.648	-0.326	-0.111	-0.014

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.115	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	8.823	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	1.528	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.330	14.000	0.024
Minor Shear	0.072	14.000	0.005

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B412 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.245 = 0.069 + 0.977 + 0.199

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.208	-6.156	0.890	-0.498	0.074

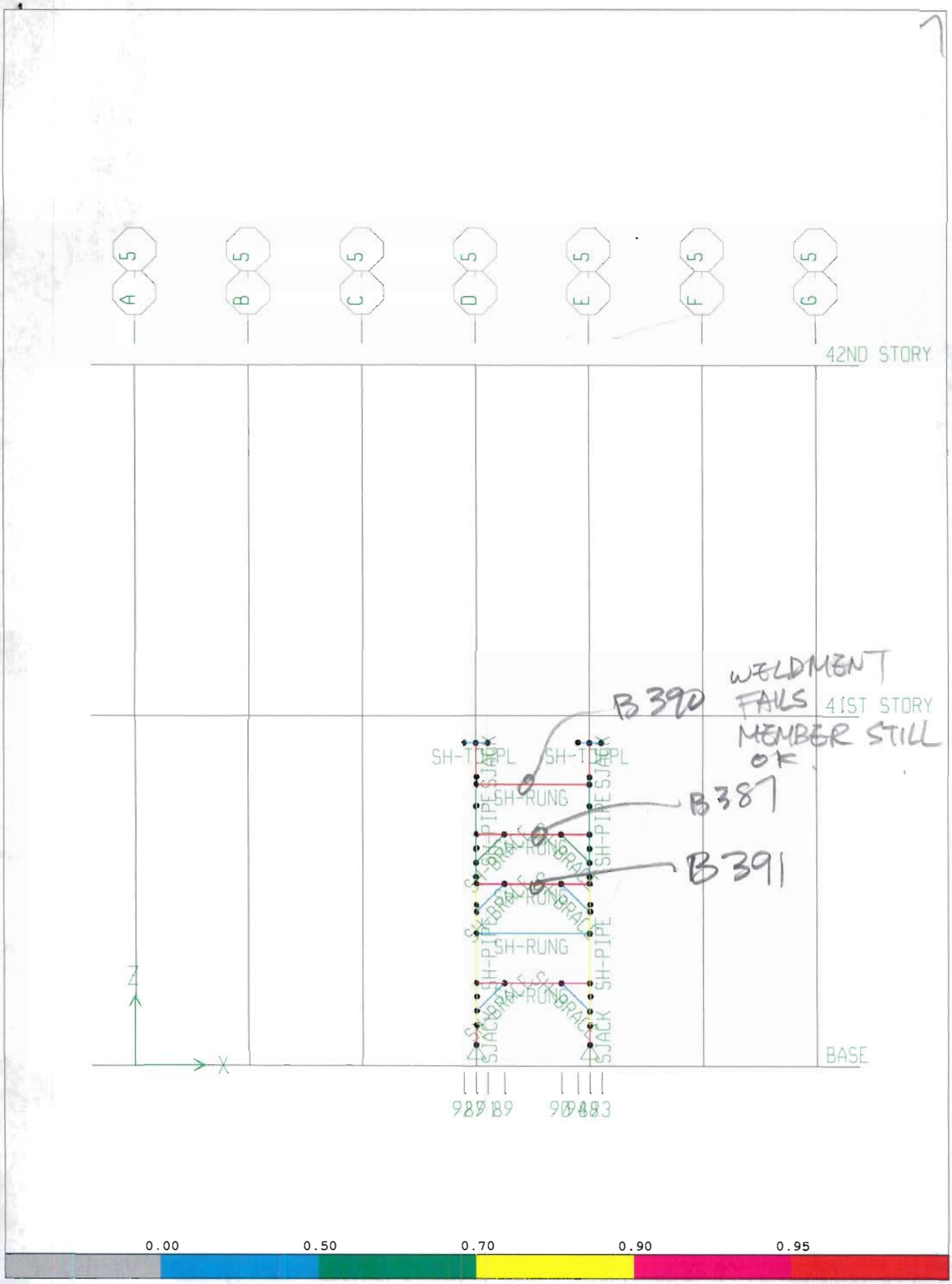
AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa	Fa	Ft
	Stress	Allowable	Allowable
Axial	0.413	5.987	21.000

	fb	Fb	Fe	Cm	K	L	Cb
	Stress	Allowable	Allowable	Factor	Factor	Factor	Factor
Major Bending	20.514	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	4.174	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv	FV	Stress
	Stress	Allowable	Ratio
Major Shear	1.477	14.000	0.105
Minor Shear	0.396	14.000	0.028


A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
B390
WELDMENT FAILS
MEMBER STILL OK.
B387
B391
SH-TOPPL
SH-PIPE
SH-RUNG
SJACK
Z
X
0.00
0.50
0.70
0.90
0.95

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

WELDMENT FAILS

P-M33-M22 Demand/Capacity Ratio is 1.121 = 0.002 + 0.745 + 0.374

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.024	-4.692	1.676	0.196	-0.070

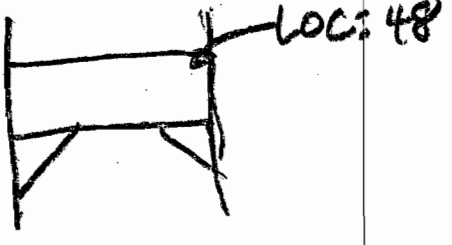
AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.048	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	15.635	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	7.860	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.580	14.000	0.041
Minor Shear	0.373	14.000	0.027



WELD FAIL STRENGTH

$M_{ultimate} = 3.6$ k-in $< M_{33} = 4.7$ k-in

(FAIL)

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B387 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.519 = 0.006 + 0.748 + 0.766

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.018	-4.711	3.428	0.389	-0.286

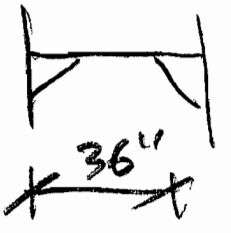
AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.035	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	15.698	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	16.076	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.152	14.000	0.082
Minor Shear	1.524	14.000	0.109



ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B391 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.171 = 0.001 + 0.613 + 0.557

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.004	-3.862	2.492	0.318	-0.208

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.007	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	12.871	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	11.687	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

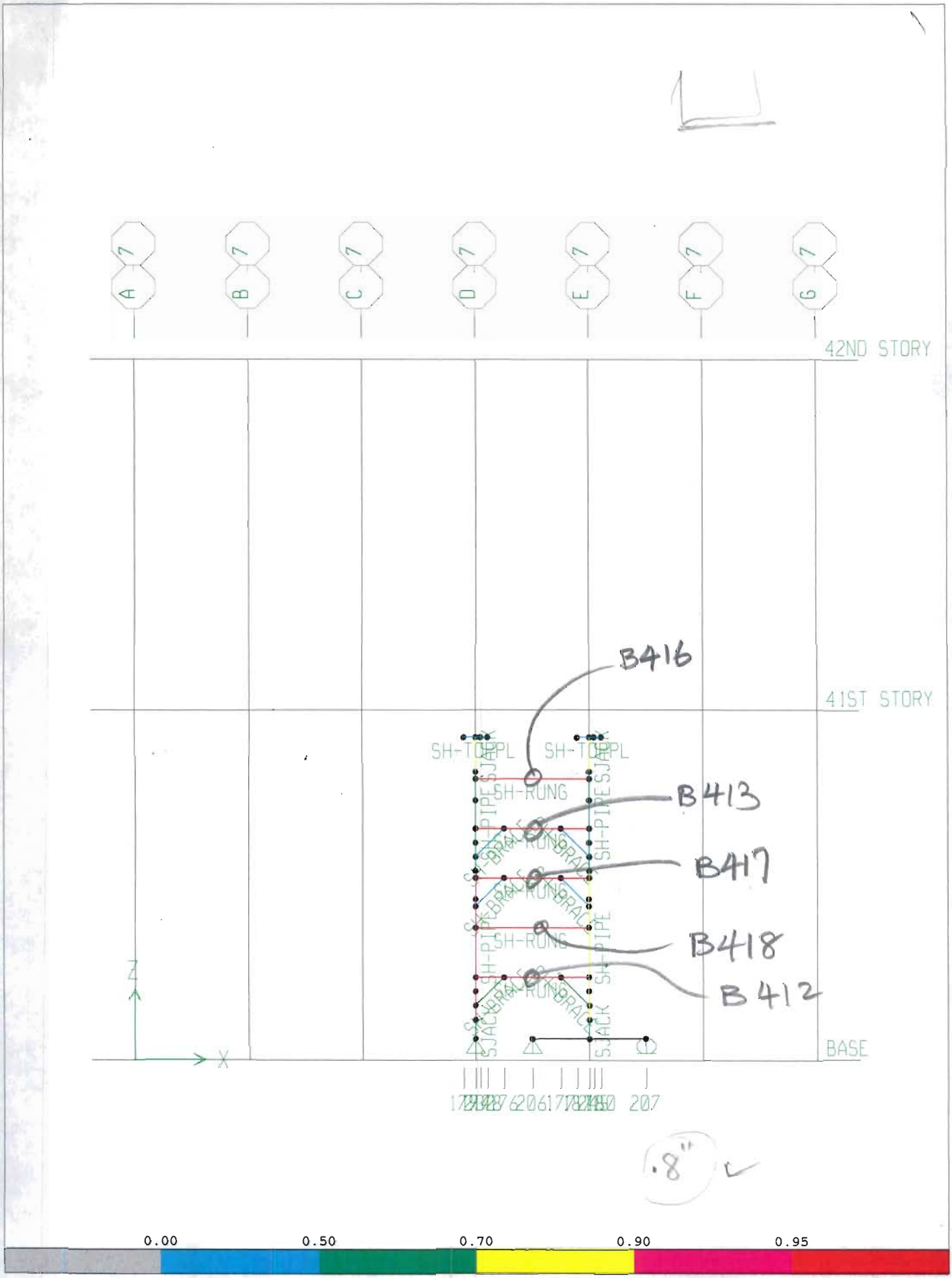
	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.942	14.000	0.067
Minor Shear	1.108	14.000	0.079

3.3.4 Ultimate Condition 4 – Load Case B, And The Bottom Shoring Leg Support Is With 0.8" Deflection Limit.

- The model file is "246SpringST_2009_05_08_singleTowerDL_2inchECCdeflectionLimit".

Result: shore failure

- Screw jacks do not fail.
- All 4 Shoring legs do not fail.
- The horizontal members fail in bending, connections from the top horizontal members to the leg fail in weldment.
- Knee brace does not fail



ETABS v9.0.7 - File: 246SpringST_2009_05_08_singleTowerDL_2inchECCdeflectionLimit - May 29,2009 19:12
Elevation View - 7 Steel Design Sections (AISC-ASD89) - Kip-in Units

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B416 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.633 = 0.003 + 0.218 + 0.412

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.026	-1.374	1.846	0.058	-0.077

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.053	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	4.578	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	8.654	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.171	14.000	0.012
Minor Shear	0.410	14.000	0.029

ETABS Steel Design

Engineer_____
Project_____
Subject_____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B413 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.194 = 0.006 + 0.359 + 0.829

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.018	-2.262	-3.711	-0.185	-0.309

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.036	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	7.538	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	17.403	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.548	14.000	0.039
Minor Shear	1.650	14.000	0.118

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B417 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.170 = 0.003 + 0.564 + 0.603

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.009	-3.553	-2.702	-0.292	-0.225

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.018	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	11.839	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	12.669	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.865	14.000	0.062
Minor Shear	1.201	14.000	0.086

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B418 Station Loc: 0.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 0.508 = 0.006 + 0.423 + 0.079

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.062	-2.668	-0.354	-0.112	-0.015

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.124	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	8.890	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	1.660	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	0.333	14.000	0.024
Minor Shear	0.079	14.000	0.006

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B412 Station Loc: 12.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.329 = 0.076 + 1.040 + 0.214

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.227	-6.552	0.960	-0.530	0.080

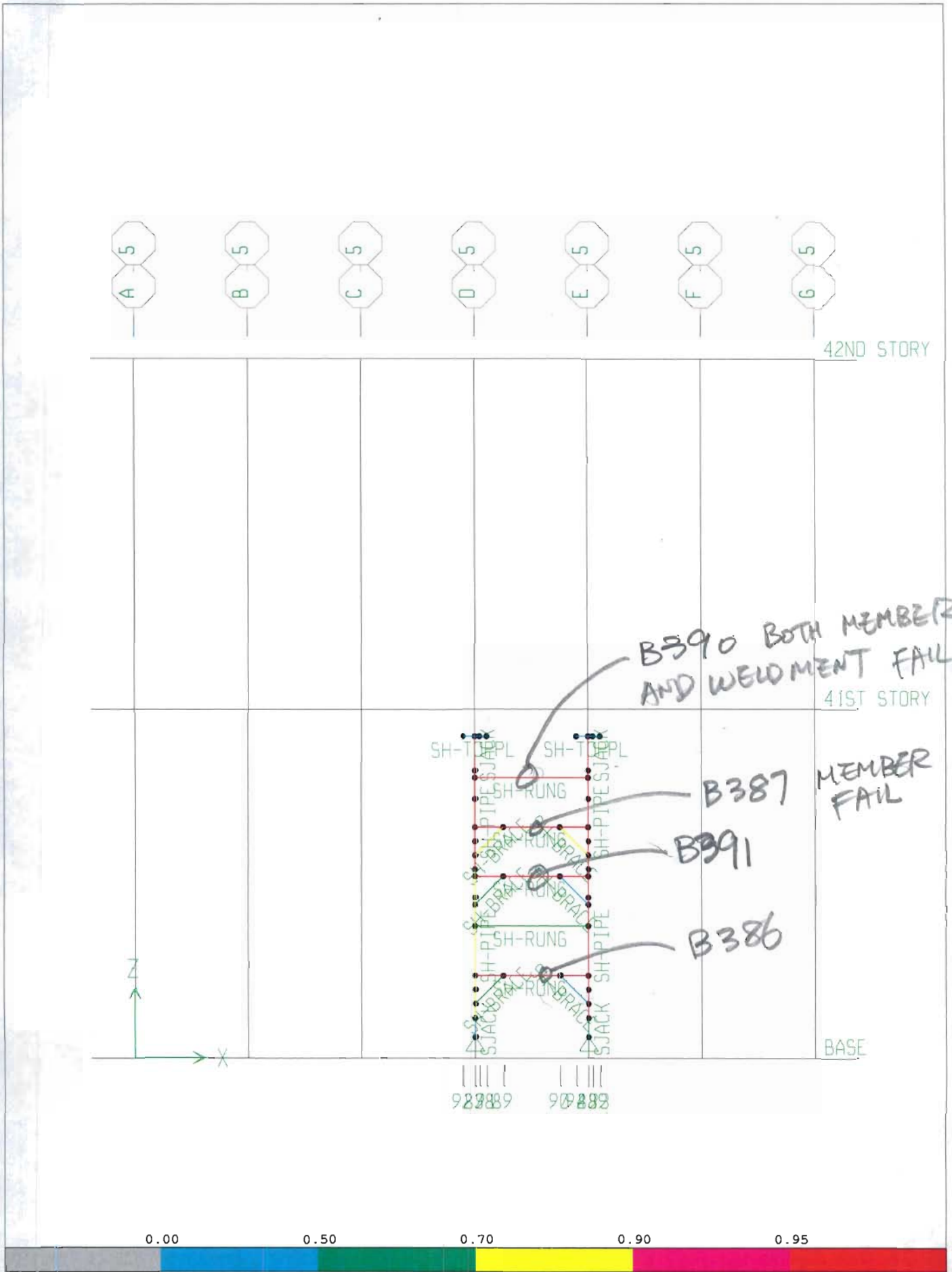
AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.452	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	21.833	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	4.500	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.571	14.000	0.112
Minor Shear	0.426	14.000	0.030


A 5
B 5
C 5
D 5
E 5
F 5
G 5
42ND STORY
41ST STORY
BASE
B390 BOTH MEMBER AND WELDMENT FAIL
B387 MEMBER FAIL
B391
B386
SH-RUNG
SH-PIPE
SJACK
Z
X
0.00
0.50
0.70
0.90
0.95

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B390 Station Loc: 48.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame | Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.228 = 0.002 + 1.820 + 0.405

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	0.026	-11.470	1.814	0.478	-0.076

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H2-1)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.051	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	38.221	21.000	15.165	1.000	1.000	1.000	2.300
Minor Bending	8.507	21.000	5.987	1.000	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.417	14.000	0.101
Minor Shear	0.403	14.000	0.029

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B387 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 2.095 = 0.006 + 1.260 + 0.828

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.019	-7.942	3.710	0.658	-0.309

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.037	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	26.465	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	17.395	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.950	14.000	0.139
Minor Shear	1.649	14.000	0.118

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B391 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.385 = 0.001 + 0.783 + 0.602

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.003	-4.932	2.694	0.407	-0.225

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.007	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	16.436	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	12.635	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.206	14.000	0.086
Minor Shear	1.198	14.000	0.086

ETABS Steel Design

Engineer _____
Project _____
Subject _____

AISC-ASD89 STEEL SECTION CHECK Units: Kip-in (Summary for Combo and Station)
Level: 41ST STORY Element: B386 Station Loc: 36.000 Section ID: SH-RUNG
Element Type: Moment Resisting Frame Classification: Compact

L=48.000
A=0.503 i22=0.133 i33=0.338
s22=0.213 s33=0.300 r22=0.515 r33=0.820
E=10100.000 fy=35.000
RLLF=1.000

P-M33-M22 Demand/Capacity Ratio is 1.044 = 0.003 + 0.826 + 0.216

STRESS CHECK FORCES & MOMENTS

	P	M33	M22	V2	V3
Combo DSTLS2	-0.009	-5.204	-0.966	0.430	0.081

AXIAL FORCE & BIAXIAL MOMENT DESIGN (H1-3)

	fa Stress	Fa Allowable	Ft Allowable
Axial	0.018	5.987	21.000

	fb Stress	Fb Allowable	Fe Allowable	Cm Factor	K Factor	L Factor	Cb Factor
Major Bending	17.340	21.000	60.662	0.850	1.000	0.500	1.000
Minor Bending	4.530	21.000	5.987	0.850	1.000	1.000	

SHEAR DESIGN

	fv Stress	FV Allowable	Stress Ratio
Major Shear	1.274	14.000	0.091
Minor Shear	0.429	14.000	0.031

3.4 Wood joists ultimate condition

Wood joists ultimate failure check-ultimate design values are based on Final Report from "Wood Advisory Services, Inc.".

- The 3" X 4" joists under 42" beam formwork spanned 4'-0" and and spaced at 8" o.c.
- Mean value ultimate Strength: Modulus of rupture Fb is 3132 psi, and shear strength Fv is 262 psi.
- The bending stress level is about 50 percent of the modulus of rupture strength, and the shear stress is about 46 percent of the ultimate shear strength.

Project: 246 SPRING STREET Date: 7/2/09 Page: 1 of 1

Subject: WOOD JOIST CHECK FOR RECONSTRUCTION OF FORMWORK Engr: GW Checked By: Date:

14.2.5

⇨ ALLOWABLE STRESS DESIGN – UNDER 42" BEAM FORMWORK

JOIST SPAN = 4'-0", JOIST SPACING = 8".

$$w = \frac{42"}{12} \times \frac{8"}{12} \times 150\,pcf + .50 \times \frac{8"}{12} = .383\ k/f$$

(CONSTRUCTION LIVE LOAD)

$$M_{max} = \frac{wL^2}{8} = \frac{.383 \times 4^2}{8} = .77\ k\text{-}ft$$

$$V_{max} = \frac{wL}{2} = \frac{.383 \times 4}{2} = .77\ k$$

- $F_b = 1700 \times C_D = 2125\ psi$

  $C_D = 1.25$ FOR 7 DAYS DURATION OF WORK

  $f_b = \frac{M_{max}}{S_x} = .77 \times 1000 \times 12/5.1 = 1812\ psi < F_b$ (ok)

  $S_x = 5.1\ in^3$

- $F_v = C_D \times 135 = 169\ psi$

  $f_v = \frac{3 \times V_{max}}{2 A_v} = \frac{3 \times .77}{2 \times 8.75} = 132\ psi < F_v$ (ok)

  $A_v = 8.75\ in^2$

– ULTIMATE FAILURE CHECK

- $F_b = 3132\ psi$; $F_v = 262\ psi$

  $w = 42/12 \times 8/12 \times 150\,pcf = .35$

  $f_b = .35/.383 \times 1812 = 1656\ psi < F_b = 3132\ psi$

  $f_v = .35/.383 \times 132 = 121\ psi < F_v = 262\ psi$

∴ WOOD JOIST IN COLLAPSED AREA IS ADEQUATE FOR DESIGN LOAD.

assigned based on that GCD. If no GCD was visible, then no visual grade was assigned to that piece and the piece was classified as no GCD, or "NGCD." Of the 396 fragmented pieces of lumber inspected, 184 were classified without a grade controlling defect. One could argue that these unclassified pieces should have been classified as select structural. However, it was our intent to determine the approximate distribution of actual grade characteristics and assign grades based on the worst characteristic observed. Therefore, arbitrarily assigning these pieces a grade of select structural would have no benefit to the objectives of this project.

Following the completion of this project, WAS, Inc. was provided Patent Construction Systems Drawing Number 4607K070 which appears to be the lumber and plywood specifications for the project at 246 Spring Street. A copy of this document is provided in Appendix V. A review of the lumber design values in this document and published allowable stresses for structural lumber indicated that the dimension lumber (3x4 and 4x4) should have been at a minimum No. 1 & Better (BTR) grade of a species grouping such as Douglas fir-larch, or a No. 2 dense southern pine. The current allowable stresses for these species groupings are published in the Supplement to the National Design Specification for Wood Construction. The published size adjusted base values are provided below. The inclusion of the spruce-pine-fir species grouping here will become evident subsequently in this report. In summary, the dimension lumber used on this project was spruce-pine-fir mill run quality. However, even select structural spruce-pine-fir will not meet the specifications.

Property	Drawing No. 4607K070 Required Design Values	Douglas fir - Larch No.1 & BTR	Southern Pine No. 2 Dense	Spruce - Pine - Fir Select Structural
F_b	1,640 psi	1,800 psi	1,700 psi	1,875 psi
F_v	180 psi	180 psi	175 psi	135 psi*
C_r	625 psi	625 psi	660 psi	425 psi*
C_f	1,350 psi	1,783 psi	1,850 psi	1,610 psi
MOE	1,600,000 psi	1,800,00 psi	1,700,00 psi	1,500,00 psi*

* Values more than 5% below specified allowable property

convert allowable design stresses to ultimate stresses, the general adjustment further must be removed from the allowable design stress. This was done to provide the data in the following summary. For stress calculations, we recommend using the L5% for both strength properties (F_b and F_v) since these values represent the samples which would fail first in a collapse.

Visual Grade	Removal of General Adjustment Factor = L5% or $\bar{x}^2$ (psi)				Estimated Allowable Mean Ultimate Stresses = $\bar{x}$ (psi)			
	F_b L5%	$E\bar{x}$	F_vL5%	$Fc_\perp\bar{x}$	$F_b\bar{x}$	$E\bar{x}$	$F_v\bar{x}$	$Fc_\perp\bar{x}$
SS	2,757	0.98x10⁶	202	603	4,683	0.98x10⁶	262	603
No. 1	1,930	0.92x10⁶	202	603	3,278	0.92x10⁶	262	603
No. 2	1,930	0.92x10⁶	202	603	3,278	0.92x10⁶	262	603
No. 3	1,103	0.79x10⁶	202	603	1,873	0.79x10⁶	262	603
CONST	1,470	0.86x10⁶	202	603	2,496	0.86x10⁶	262	603
STD	809	0.79x10⁶	202	603	1,374	0.79x10⁶	262	603
ECON[2]	405	----	----	----	689	----	----	----

Although the L5% exclusion value is technically the most important and most appropriate value to use for estimates of ultimate strength for the determination of failure, WAS, Inc. was also requested to provide an estimated mean strength value for the lumber used at 246 Spring Street. This was accomplished by computing a mean value weighted by the lumber grades observed during our inspection. The resulting values are 3132 psi for F_b, 262 psi for F_v, and 603 for $Fc_\perp$, and 916,000 psi for E.

3.5 Snap Tie Verification

The maximum load impose on the snaptie at typical spacing of 2'-6" is 1.28 kips which is about 57 percent of safe working load of 2.25 kips (Safe working load is based on safety factor of 2) for industry standard snaptie. In worse case scenario when one tie is loose (effective tie spaced at 5'-0"), the tie load (2 x 1.28 x 2 = 2.56 kips) is still less than the ultimate capacity (2 x 2.25 kips = 4.5 kips), and joists spanning 5'-0" is adequate to maintain the beam formwork.