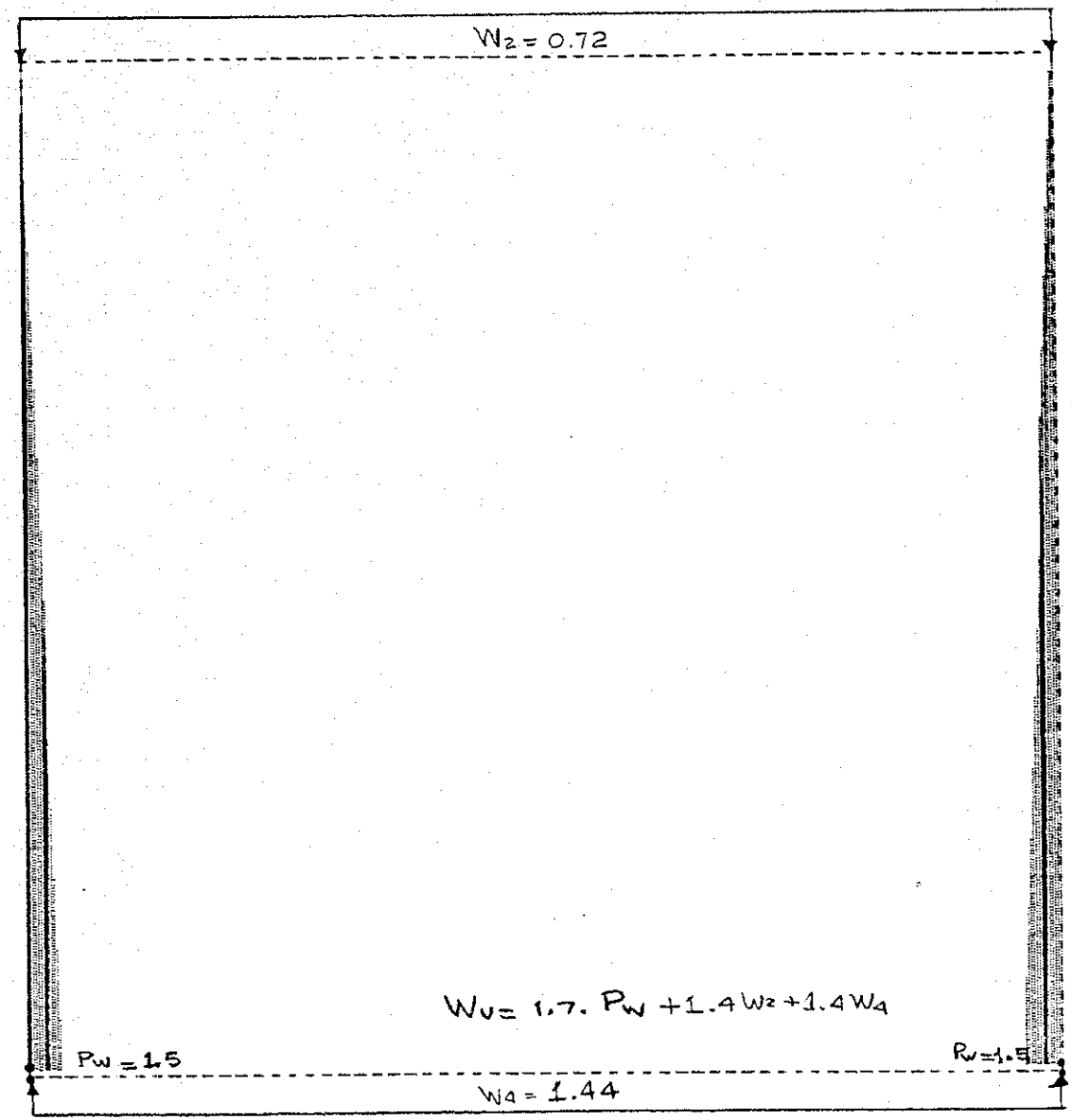


Y
X

al

FRAME
LOADS

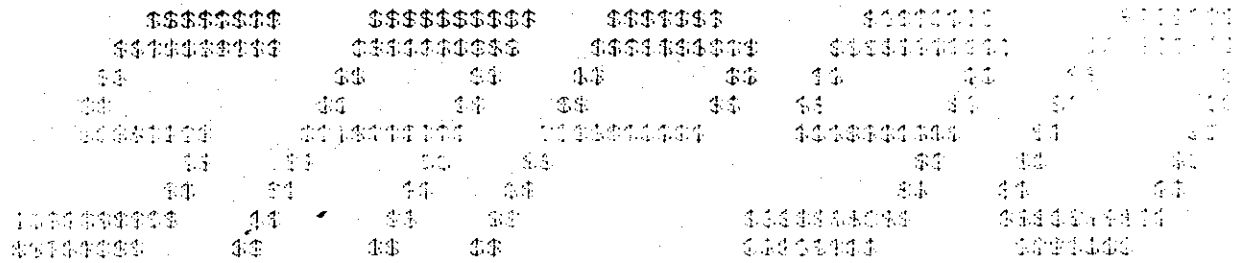
LOAD 2
ton/mt

MINIMA
u .1500E+01
P .0000E+00
MAXIMA
u .1500E+01
P .0000E+00

SAP90

```
ALCANTARILLA 1.2X1.2  h=10.0
YSTEM
=4

OINTS
    X=0    Y=0     Z=0
           Y=0.01
           Y=1.5
   x=1.5   y=1.5
   x=1.5   Y=.01
   x=.01   y=0
   x=1.49  Y=0
   X=1.5   Y=0

ESTRAINTS
 & 1  R=0,0,1,1,1,0
 & 7  R=1,1,1,1,1,0

RAME
M=2 NL=?
 1 A=? T= .30,1 E=2100000.
 SHAP T=.30,1
 WL=0,-15.27        ;w1
 WL=0,-0.72         ;w2
 WL=0,18.97         ;w4
 WL=0,2.16          ;w4
 WL=0               ;w3
 TRAP=0,-1.50,0,1.49              ;pw izq.
 TRAP=0,0,0,1.490,1.50            ;pw der.
 TRAP=0,-10.49,0,1.4900,-9.14 ;wt izq.
 TRAP=0,-9.14,0,1.4900,-10.49 ;wt der.
 1 2  M=1           LP=1,0
 2 3             WG=4,7,6
 3 4             WG=1,2
 4 5             WG=2,0,7
 [illegible]
 [illegible]
 [illegible]     WG=3,4,0,5
 7

OMBO
 C=1 7,1,4,0,1,7
   =0,1,1,1
```

4-54



STRUCTURAL ANALYSIS PROGRAMME

VERSION 5.41

ACTED

PROGRAM: SAP90/87 [illegible]

ALGONTARIO [illegible] PAGE 6

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	FACT FACT	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	A
1								
	1	.000			-24.050			
		.000	12.993	-4.992				
		.010	12.993	-4.862				
		.010			-24.050			
	2	.000			-.756			
		.000	-1.094	-.191				
		.010	-1.094	-.202				
		.010			-.756			
2								
	1	.000			-24.050			
		.000	12.993	-4.862				
		.730	.000	-.025				
		1.490	-11.866	-4.447				
		1.490			-24.050			
	2	.000			-.756			
		.000	-1.094	-.202				
		.330	.000	-.467				
		1.490	.805	.054				
		1.490			-.756			
3								
	1	.000			-11.868			
		.000	24.050	-4.447				
		.750	.000	4.369				
		1.500	-24.050	-4.449				
		1.500			-11.868			
	2	.000			.805			
		.000	.756	.054				
		.750	.000	.038				
		1.500	-.756	.054				
		1.500			.805			

4-44

1	.000			-24.050
	.000	11.868	-4.449	
	.737	.000	-.025	
	1.490	-12.993	-4.862	
	1.490			-24.050
2	.000			-.756
	.000	-.805	.054	
	.970	.000	-.467	
	1.490	1.094	-.202	
	1.490			-.756

A_SANTARILLA 1.2X1.2 h=10.0

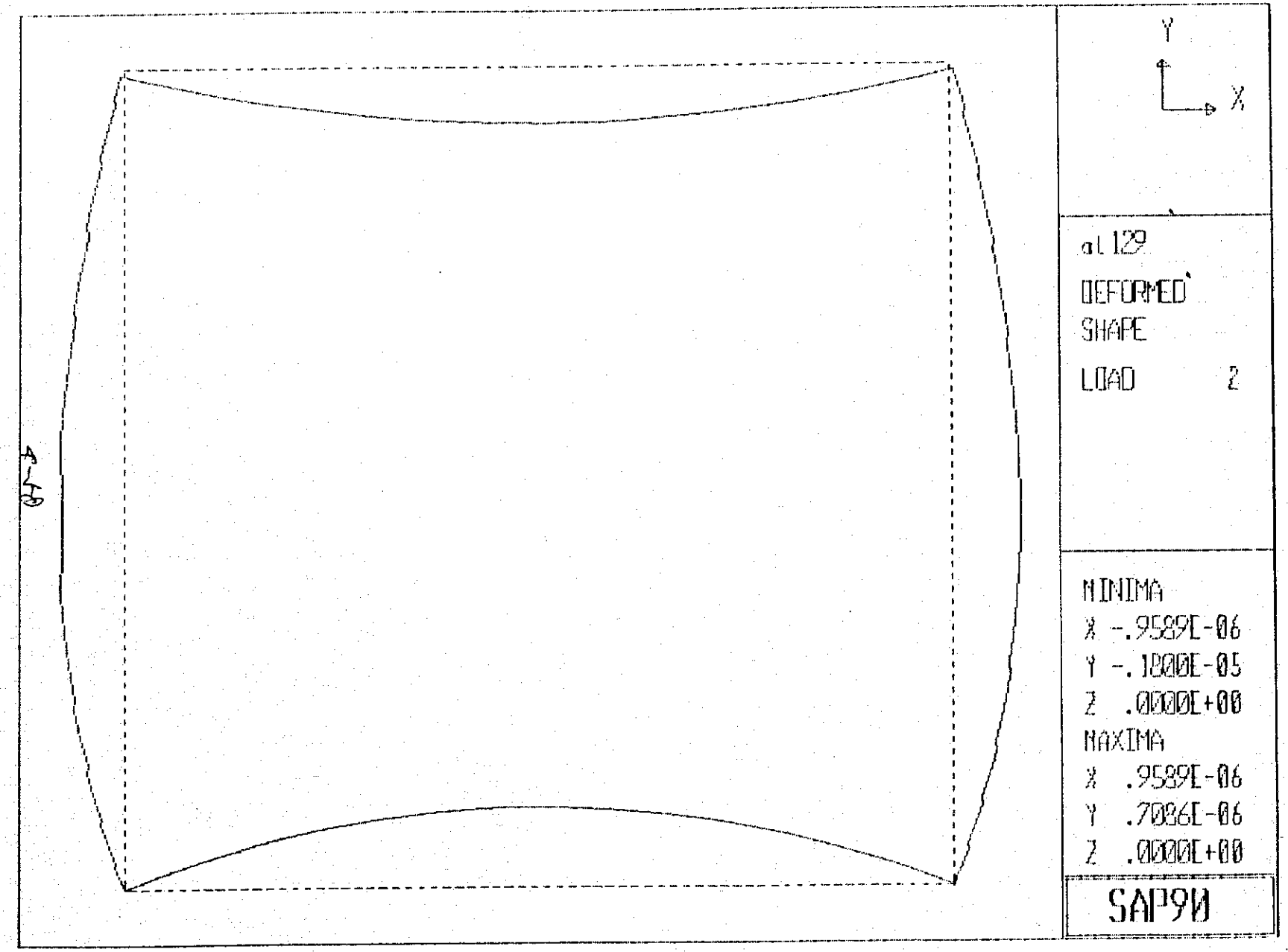
F R A M E E L E M E N T F O R C E S

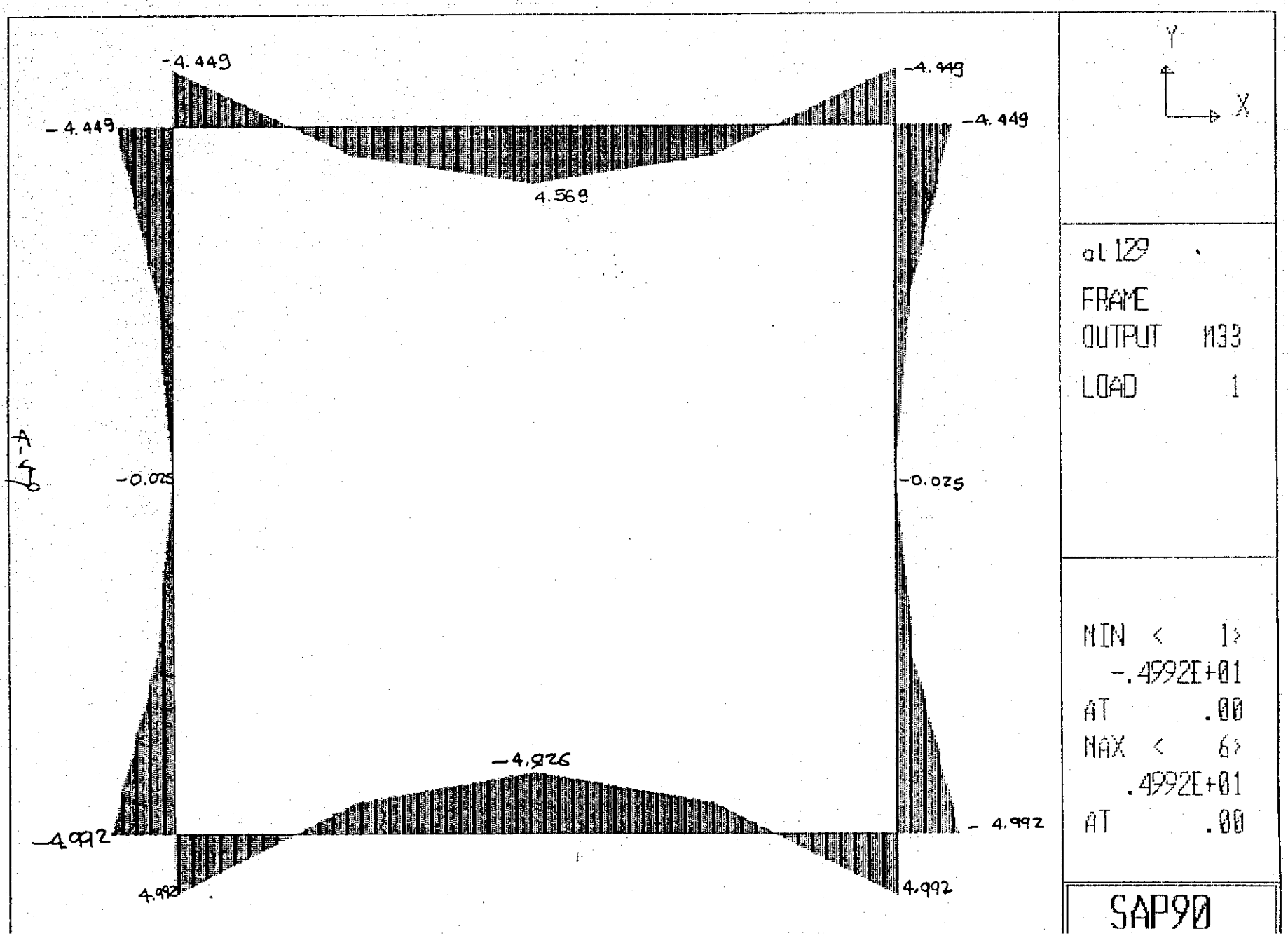
ELT ID	LOAD COMB	DIST SHDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	TOR
5								
	1	.000			-24.050			
		.000	-12.993	-4.862				
		.010	-12.993	-4.992				
		.010			-24.050			
	2	.000			-.756			
		.000	1.094	-.202				
		.010	1.094	-.191				
		.010			-.756			
6								
	1	.000			.000			
		.000	-26.102	4.992				
		.010	-26.102	4.731				
		.010			.000			
	2	.000			.000			
		.000	-2.238	.191				
		.010	-2.238	.169				
		.010			.000			
7								
	1	.000			.000			
		.000	-26.102	4.731				
		.740	.000	-4.936				
		1.480	26.102	4.731				
		1.480			.000			
	2	.000			.000			
		.000	-2.238	.169				
		.740	.000	-.659				
		1.480	2.238	.169				
		1.480			.000			
8								
	1	.000			.000			
		.000	26.102	4.731				
		.010	26.102	4.992				
		.010			.000			
	2	.000			.000			
		.000	2.238	.169				
		.010	2.238	.191				
		.010			.000			

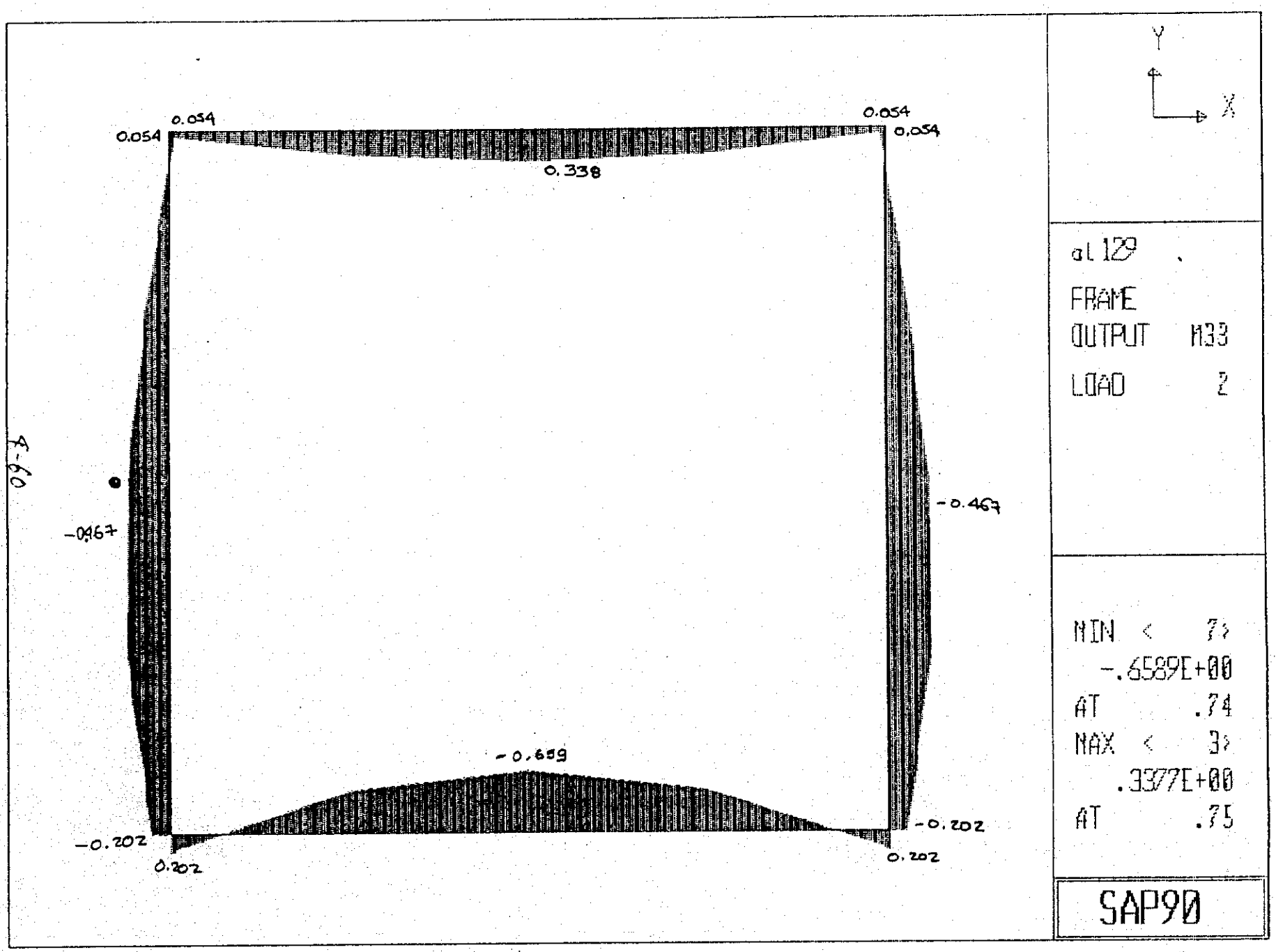
Y
X
el.129
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.1413E-04
Y -.5726E-04
Z .0000E+00
MAXIMA
X .1413E-04
Y .3915E-05
Z .0000E+00
SAP90

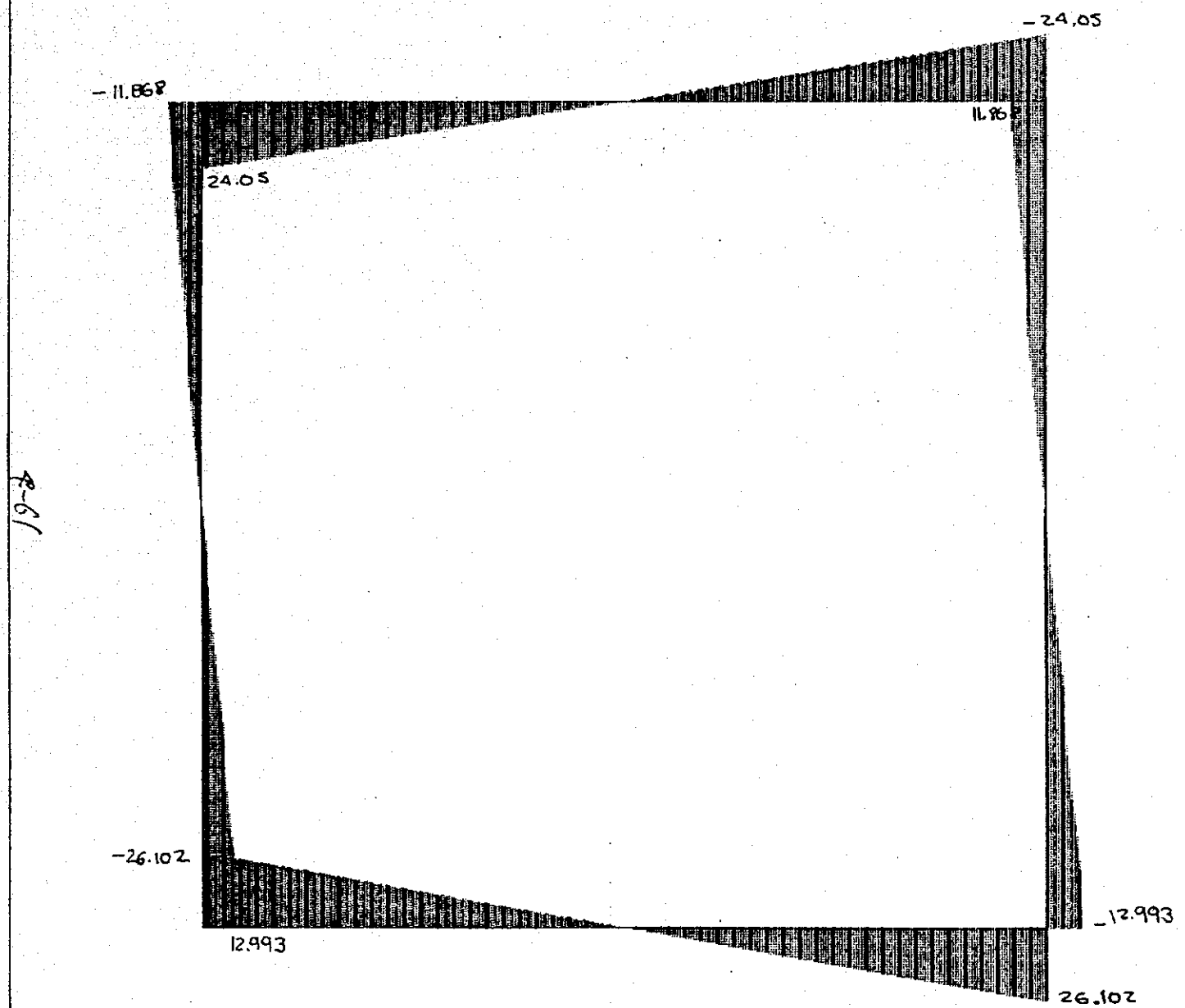
48

448


Y
X
at 129
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.9589E-06
Y -.1000E-05
Z .0000E+00
MAXIMA
X .9589E-06
Y .7036E-06
Z .0000E+00
SAP90


-4.449
-4.449
-4.449
-4.449
4.569
-0.025
-0.025
-4.826
-4.992
-4.992
4.992
4.992
Y
X
ol 129
FRAME
OUTPUT M33
LOAD 1
MIN < 1>
-.4992E+01
AT .00
MAX < 6>
.4992E+01
AT .00
SAP90


0.054
0.054
0.054
0.054
0.338
-0.467
-0.467
-0.659
-0.202
-0.202
0.202
0.202
Y
X
CL 129
FRAME
OUTPUT M33
LOAD 2
MIN < 7>
-.6589E+00
AT .74
MAX < 3>
.3377E+00
AT .75
SAP90



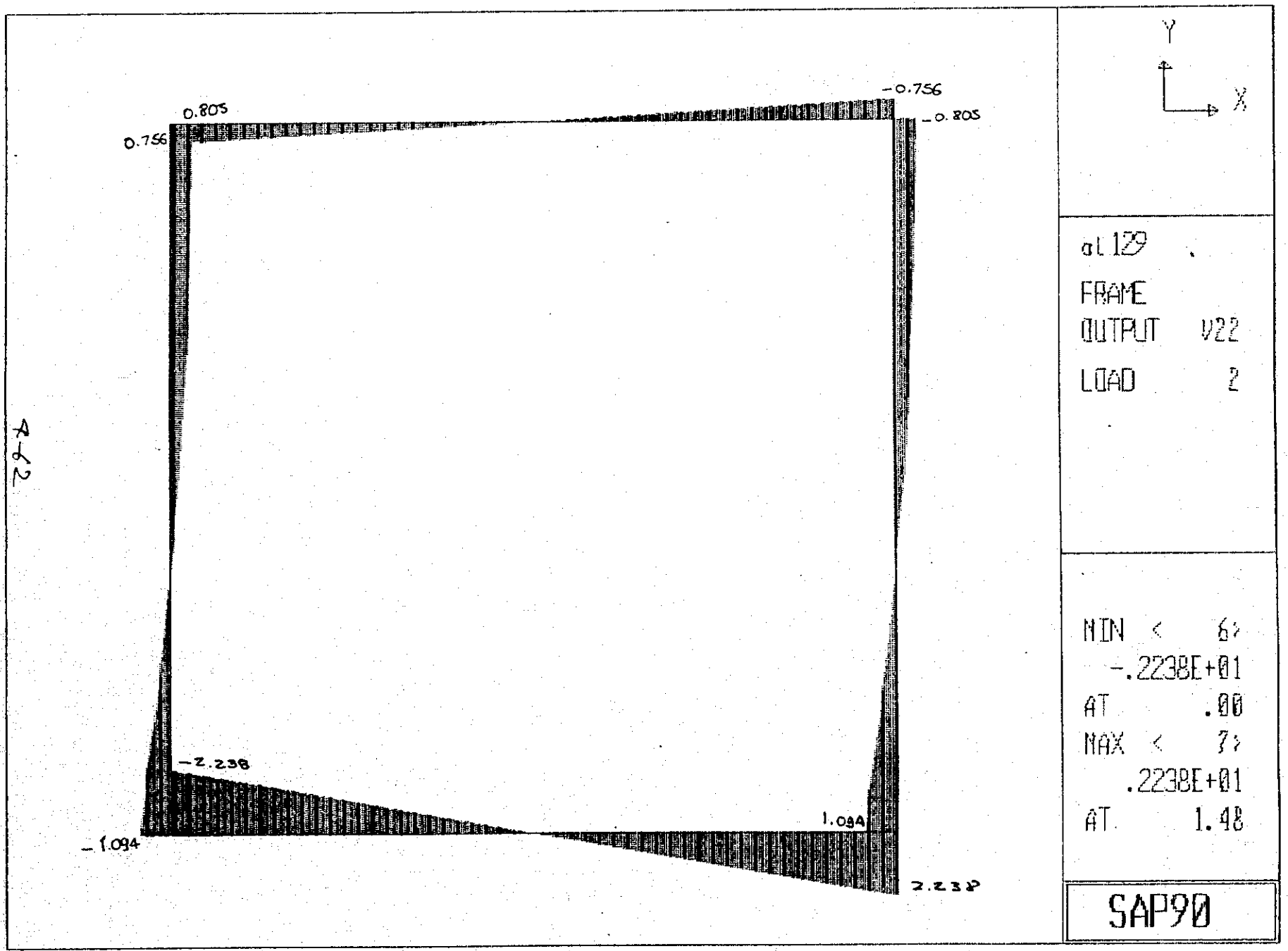
Y
X

al 129

FRAME
OUTPUT V22
LOAD 1

MIN < 6>
-.2610E+02
AT .00
MAX < 7>
.2610E+02
AT 1.48

SAP90



Y
X

al 129
FRAME
OUTPUT V22
LOAD 2

MIN < 6>
-.2238E+01
AT .00
MAX < 7>
.2238E+01
AT 1.48

SAP90

A-42

- DATA FOR REINFORCEMENT.

$f'_c = 180\ Kg/cm^2$

$f_y = 4200\ Kg/cm^2$

$b = 100\ cm$

$d = 23\ cm$

$r = 7\ cm$

$M_u = 4.992\ t-m$

$$A_s = \frac{4.992 \times 10^5}{0.9 \cdot 4.200\ (23 - 2.0)} = 6.288$$

$$a = \frac{6.288 \times 4200}{0.85 \times 180 \times 100} = 3.10$$

$$A_s = \frac{4.992 \times 10^5}{0.9 \cdot 4200\ (21.5)} = 6.142 \qquad \rho_{min} = \frac{14}{f_y} = \frac{14}{4,200} = 0.00333$$

CALCULATION WITH PROGRAM $A_s = 7.66\ cm^2 \Rightarrow 8\varnothing 12 \Rightarrow 1\varnothing 12 @ 15.5$

- SHEAR STRESS CHECK

$V_u = 12.998\ ton$

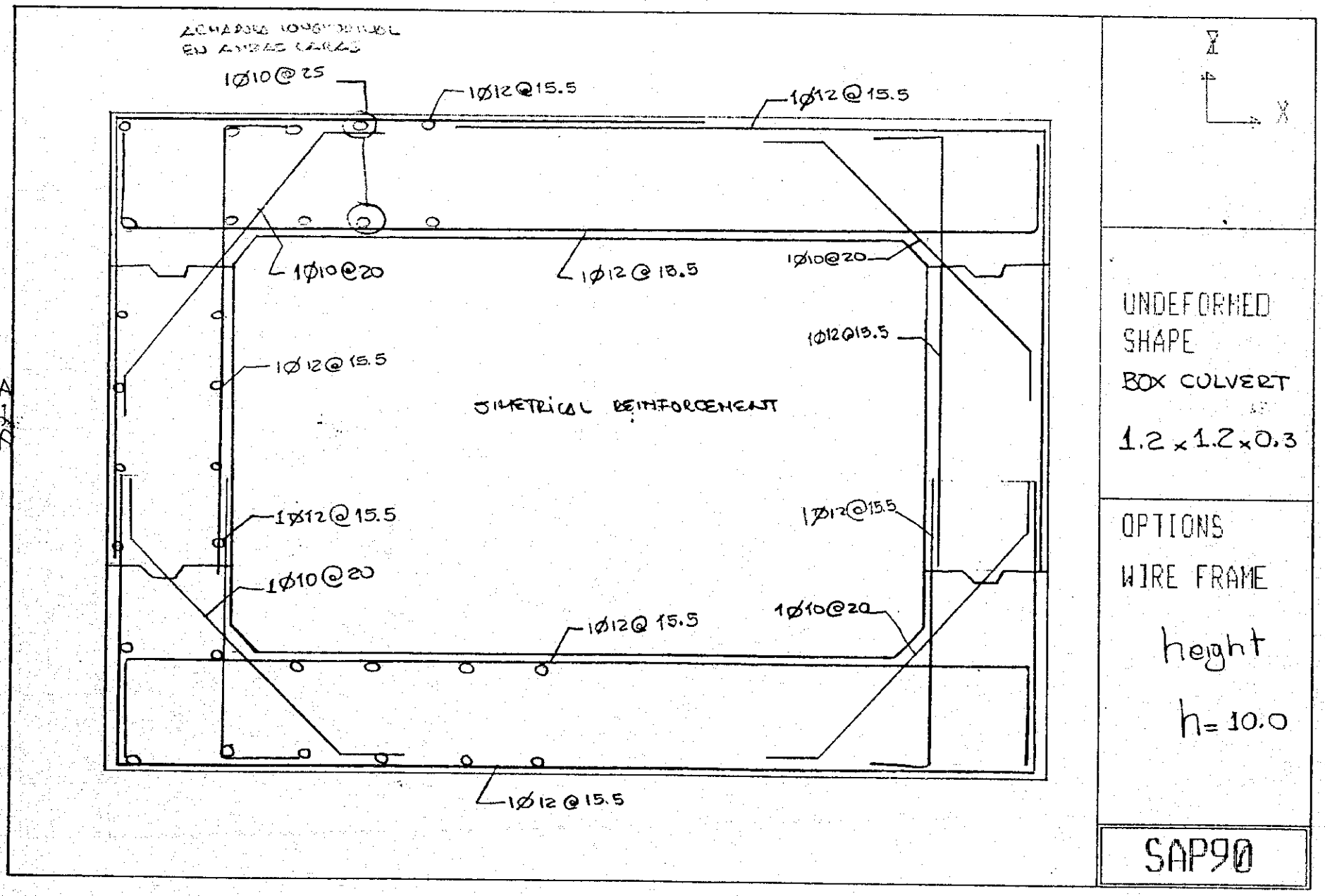
$V_c = 0.85 \times 0.53 \sqrt{180} \times 100 \times 23 = 13.901.41\ Kg.$ $\qquad V_c > V_u.$

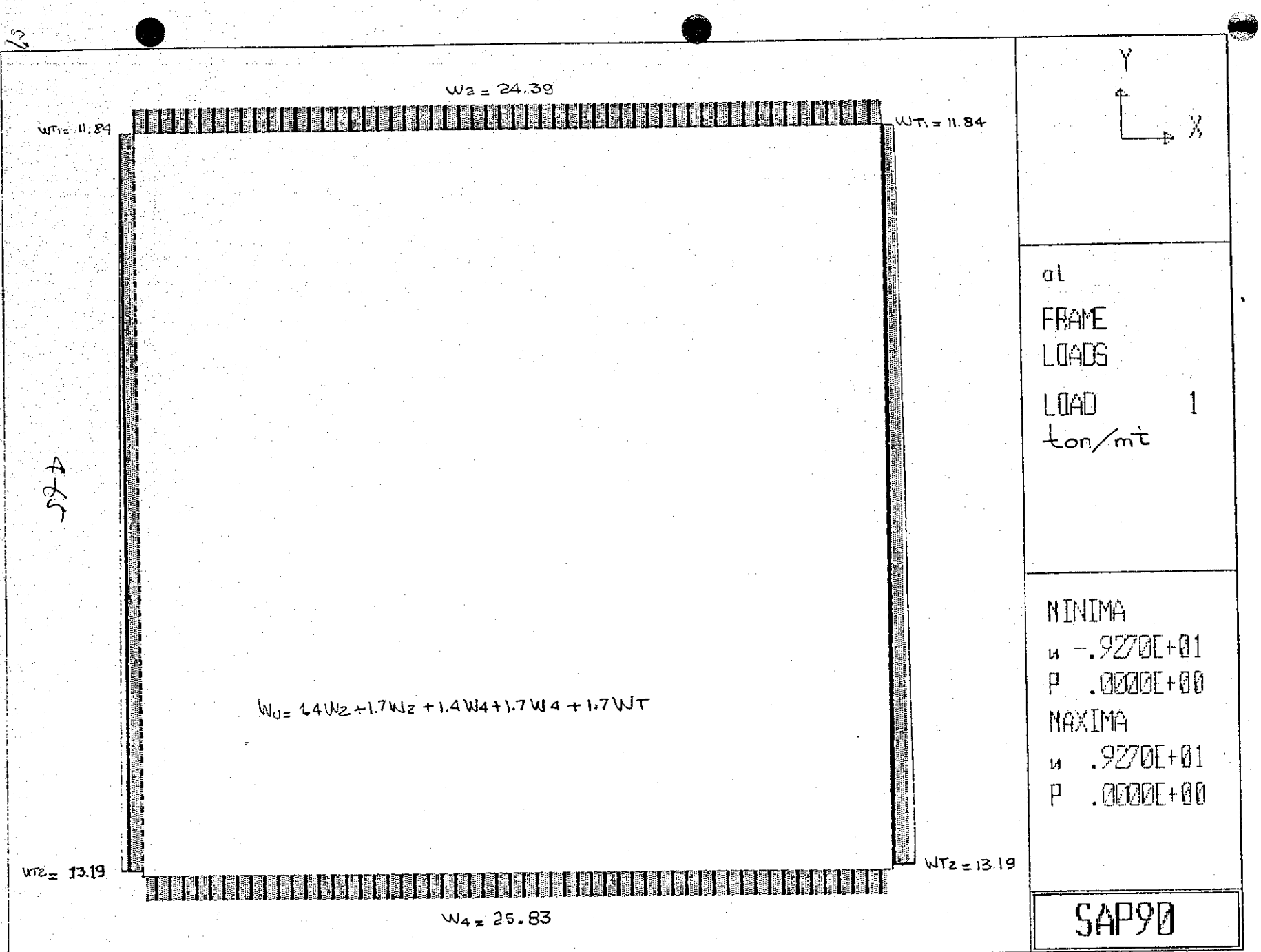
$V_u = 26.102\ ton$

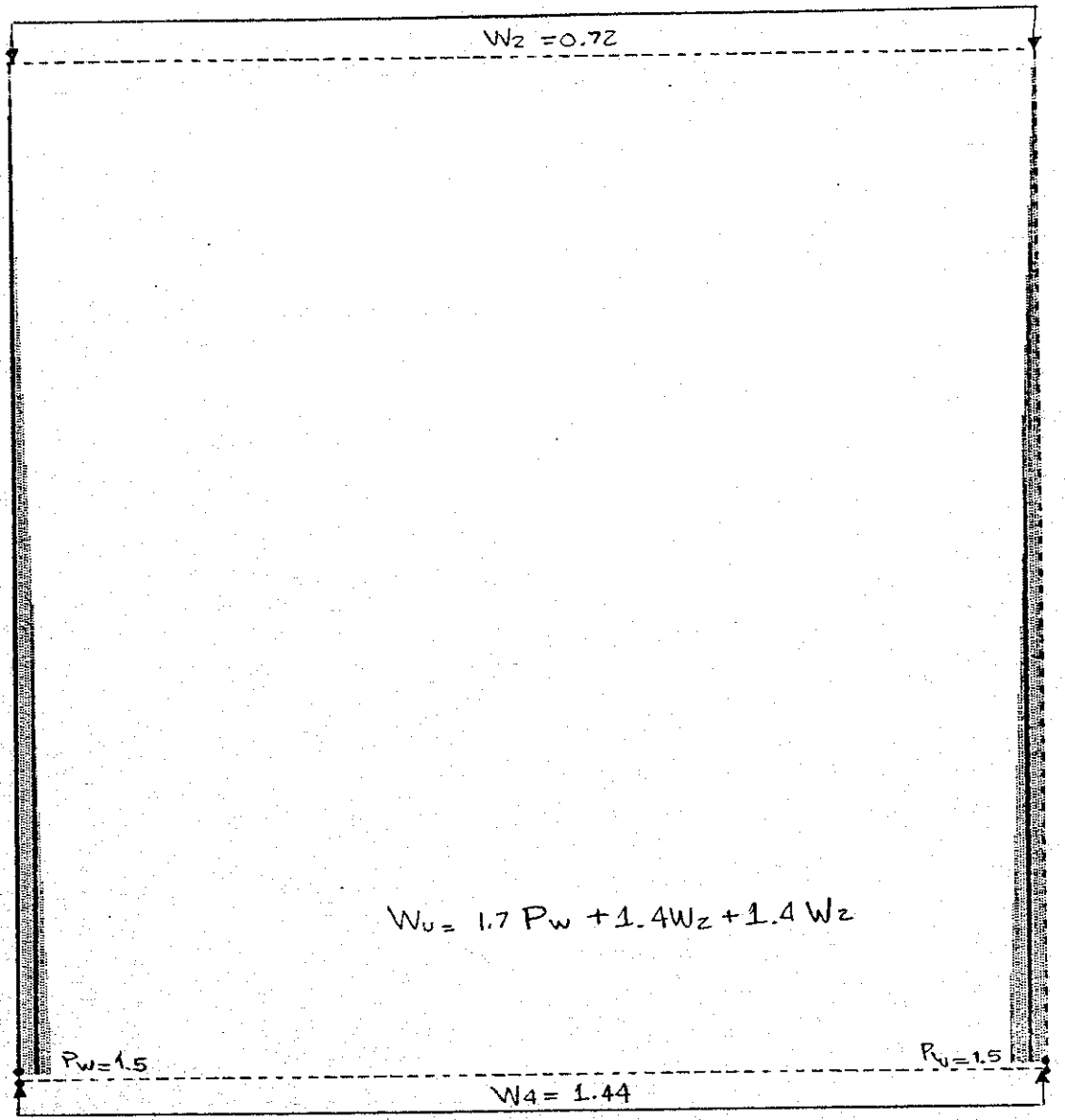
$V_s = 26.102 - 13.9 = 12.20\ ton$

$$A_v = \frac{12.20 \times 10^3}{0.85 \times 4200 \times \sin 45} = 4.83\ cm^2 \Rightarrow 1\varnothing 10 @ 20$$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


ACHARAGE LONGITUDINAL
EN ANGLE DROIT
1Ø10@25
1Ø12@15.5
1Ø12@15.5
1Ø10@20
1Ø12@15.5
1Ø10@20
1Ø12@15.5
1Ø12@15.5
SIMETRICAL REINFORCEMENT
1Ø12@15.5
1Ø12@15.5
1Ø10@20
1Ø12@15.5
1Ø10@20
1Ø12@15.5
Z
X
UNDEFORMED
SHAPE
BOX CULVERT
1.2 x 1.2 x 0.3
OPTIONS
WIRE FRAME
height
h= 10.0
SAP90


W2 = 24.39
WT1 = 11.84
WT1 = 11.84
WU = 1.4W2 + 1.7W2 + 1.4W4 + 1.7W4 + 1.7WT
WT2 = 13.19
WT2 = 13.19
W4 = 25.83
Y
X
al
FRAME
LOADS
LOAD 1
ton/mt
MINIMA
U -.9270E+01
P .0000E+00
MAXIMA
U .9270E+01
P .0000E+00
SAP90



99-A

Y
X

al

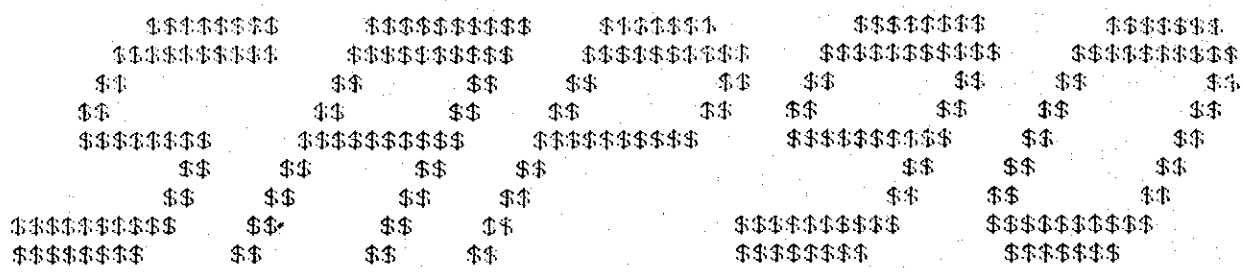
FRAME
LOADS

LOAD 2
ton/mt

MINIMA
u .1500E+01
P .0000E+00
MAXIMA
u .1500E+01
P .0000E+00

SAP90

```
ALCANTARILLA 1.2X1.2  h=13.0
SYSTEM
L=4

JOINTS
1   X=0    Y=0     Z=0
2          Y=0.01
3          Y=1.50
4   x=1.50  y=1.50
5   X=1.50  Y=.01
6   X=.01   y=0
7   X=1.49  Y=0
8   X=1.50  Y=0

RESTRAINTS
1 8 1  R=0,0,1,1,1,0
1 8 7  R=1,1,1,1,1,0

FRAME
NM=2 NL=9
1 SH=R T=.30,1 E=2100000.
2 SH=R T=.30,1
1 WL=0,-23.67    :w2
2 WL=0,-0.72     :w2
3 WL=0,23.67     :w4
4 WL=0,2.16      :w4
5 WL=0           :w3
6 TRAP=0,+1.50,0,1.49          :pw izq.
7 TRAP=0,0,0,1.490,1.50        :pw der.
8 TRAP=0,-13.19,0,1.4900,-11.84  :wt isq.
9 TRAP=0,-11.84,0,1.4900,-13.19  :wt der.
1 1 2  M=1        LP=1,0
2 2 3         NSL=8,0,6
3 3 4         nsl=1,2
4 4 5         nsl=9,0,7
5 5 8
6 1 6  M=1
7 6 7         nsl=3,4,0,5
8 7 8

COMBO
1 C=1.7,1.4,0,1.7
2 c=0,1.4,1.7
```



STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

ALCANTARILLA 1.2X1.2 h=13.0

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			-30.935			
		.000	16.414	-6.305				
		.010	16.414	-6.141				
		.010			-30.935			
	2	.000			-.756			
		.000	-1.094	-.191				
		.010	-1.094	-.202				
		.010			-.756			
2								
	1	.000			-30.935			
		.000	16.414	-6.141				
		.751	.000	-.029				
		1.490	-15.287	-5.726				
		1.490			-30.935			
	2	.000			-.756			
		.000	-1.094	-.202				
		.520	.000	-.467				
		1.490	.805	.054				
		1.490			-.756			
3								
	1	.000			-15.287			
		.000	30.935	-5.726				
		.750	-.000	5.875				
		1.500	-30.935	-5.726				
		1.500			-15.287			
	2	.000			.805			
		.000	.756	.054				
		.750	.000	.338				
		1.500	-.756	.054				
		1.500			.805			
4								

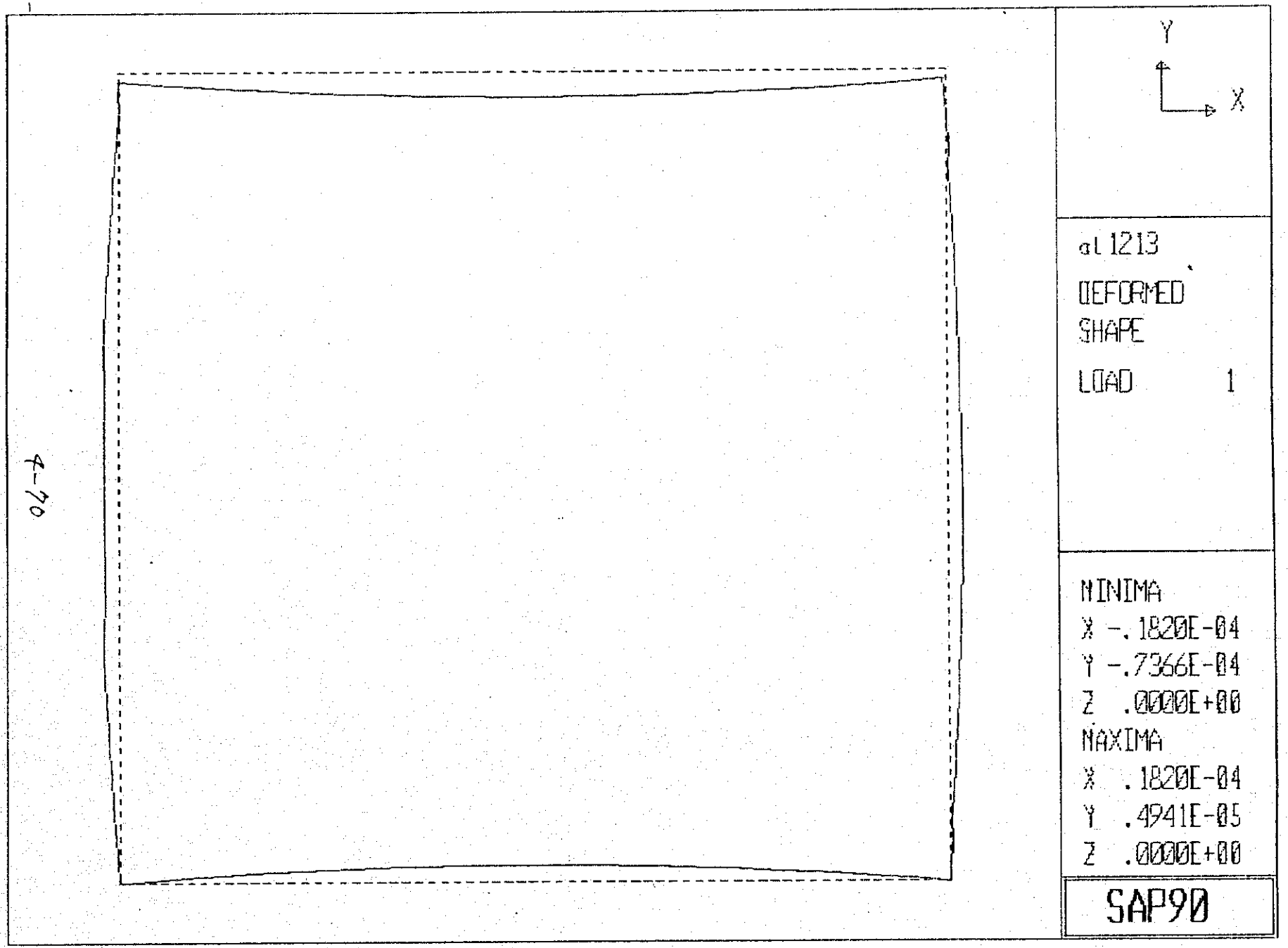
460

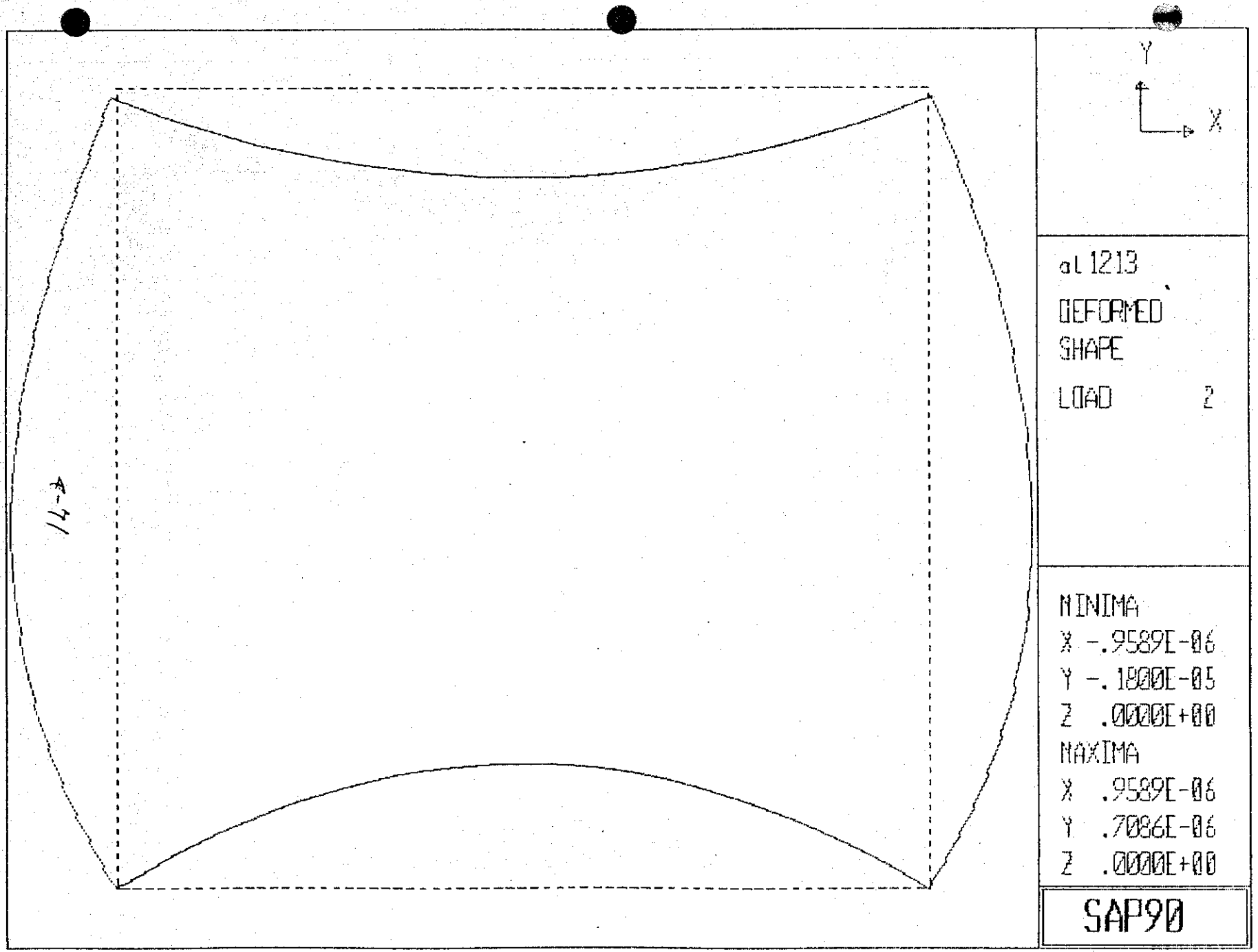
		.000	15.287	-5.726				
		.739	.000	-.029				
		1.490	-16.414	-6.141				
		1.490			-30.935			
	2	.000			-.756			
		.000	-.805	.054				
		.970	.000	-.467				
		1.490	1.094	-.202				
		1.490			-.756			

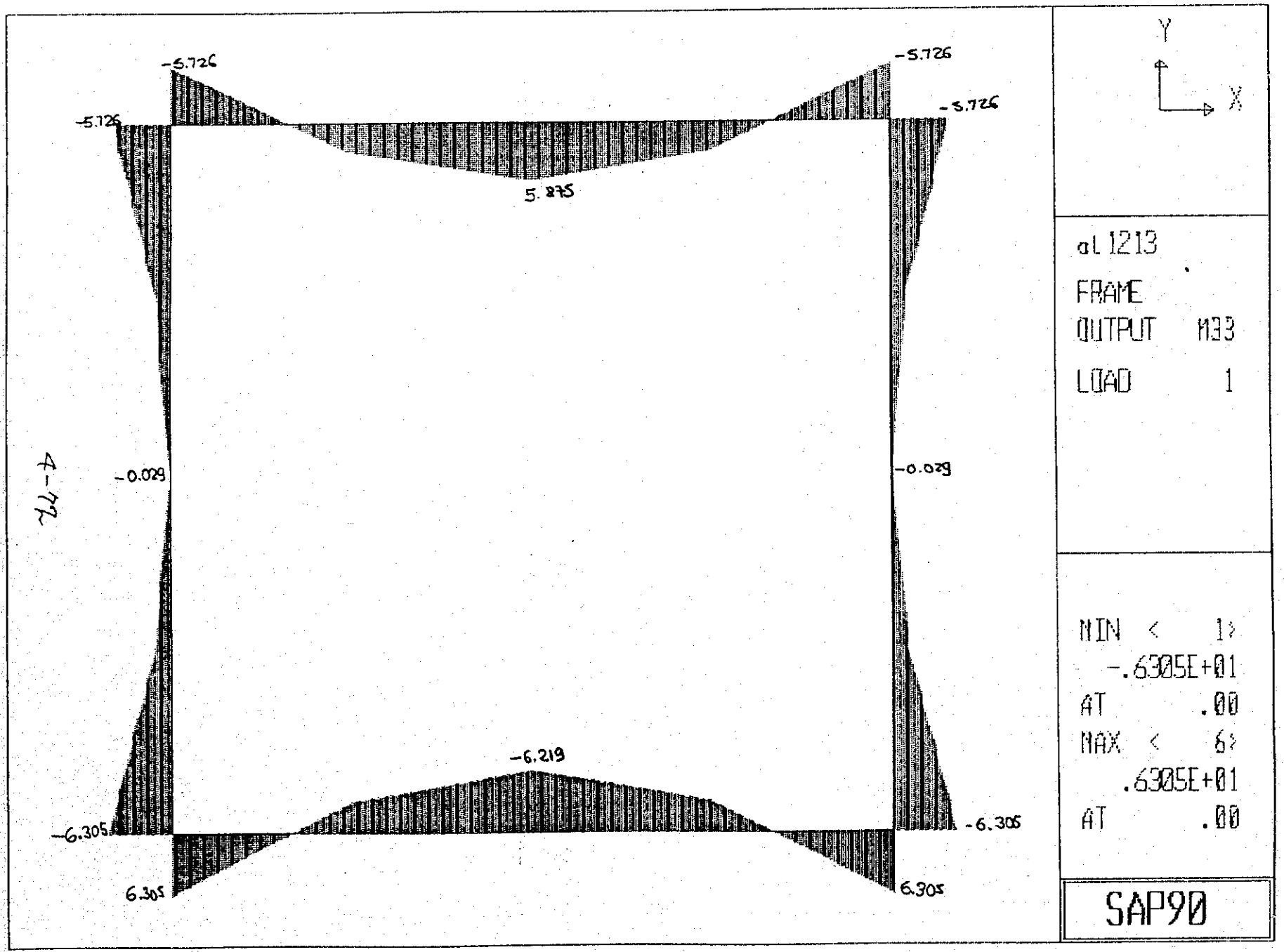
ALCANTARILLA 1.2X1.2 h=13.0

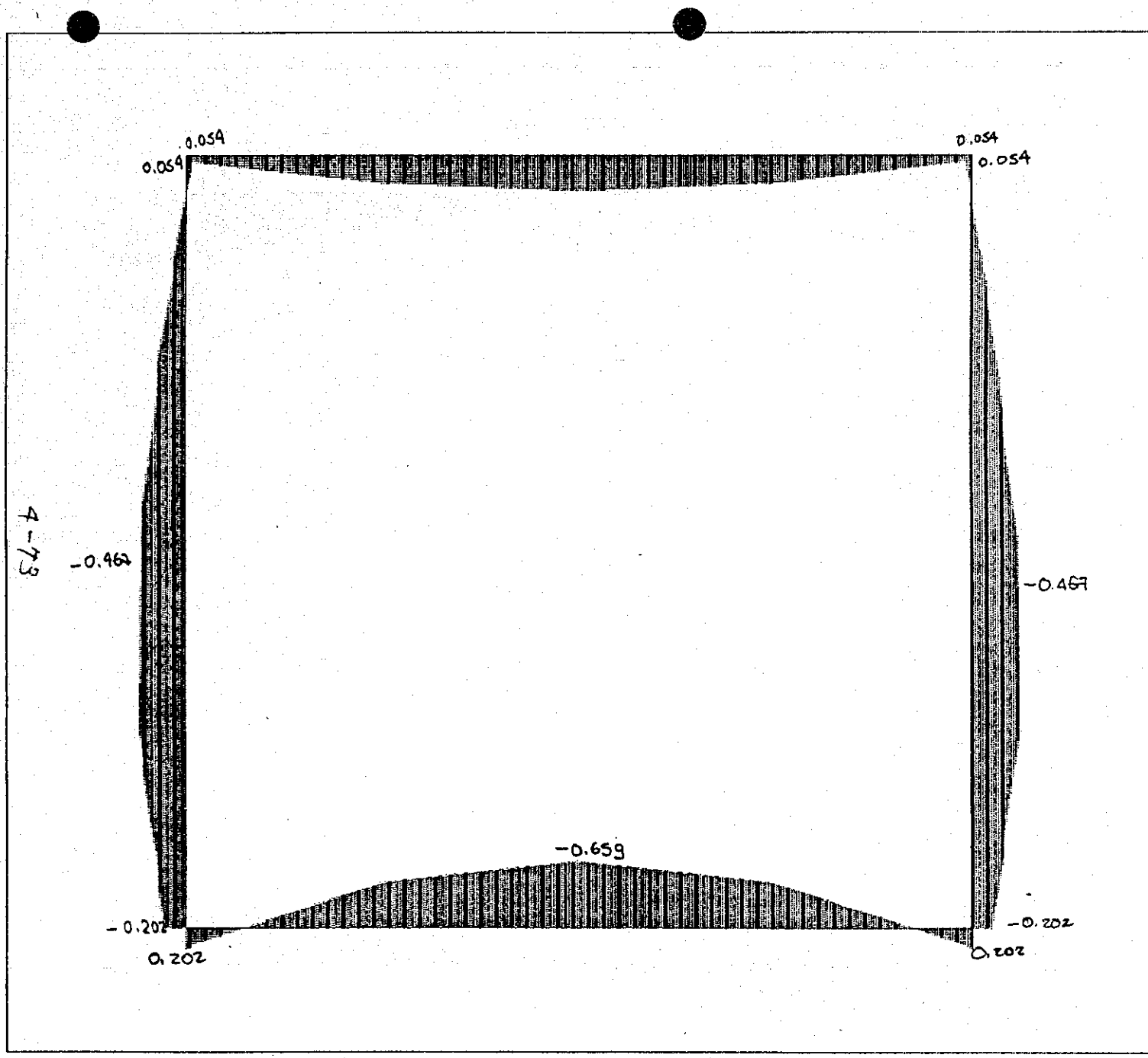
F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIA TOR
5								
	1	.000			-30.935			
		.000	-16.414	-6.141				
		.010	-16.414	-6.305				
		.010			-30.935			
	2	.000			-.756			
		.000	1.094	-.202				
		.010	1.094	-.191				
		.010			-.756			
6								
	1	.000			.000			
		.000	-32.958	6.305				
		.010	-32.958	5.976				
		.010			.000			
	2	.000			.000			
		.000	-2.238	.191				
		.010	-2.238	.169				
		.010			.000			
7								
	1	.000			.000			
		.000	-32.958	5.976				
		.740	.000	-6.219				
		1.480	32.958	5.976				
		1.480			.000			
	2	.000			.000			
		.000	-2.238	.169				
		.740	.000	-.659				
		1.480	2.238	.169				
		1.480			.000			
8								
	1	.000			.000			
		.000	32.958	5.976				
		.010	32.958	6.305				
		.010			.000			
	2	.000			.000			
		.000	2.238	.169				
		.010	2.238	.191				
		.010			.000			

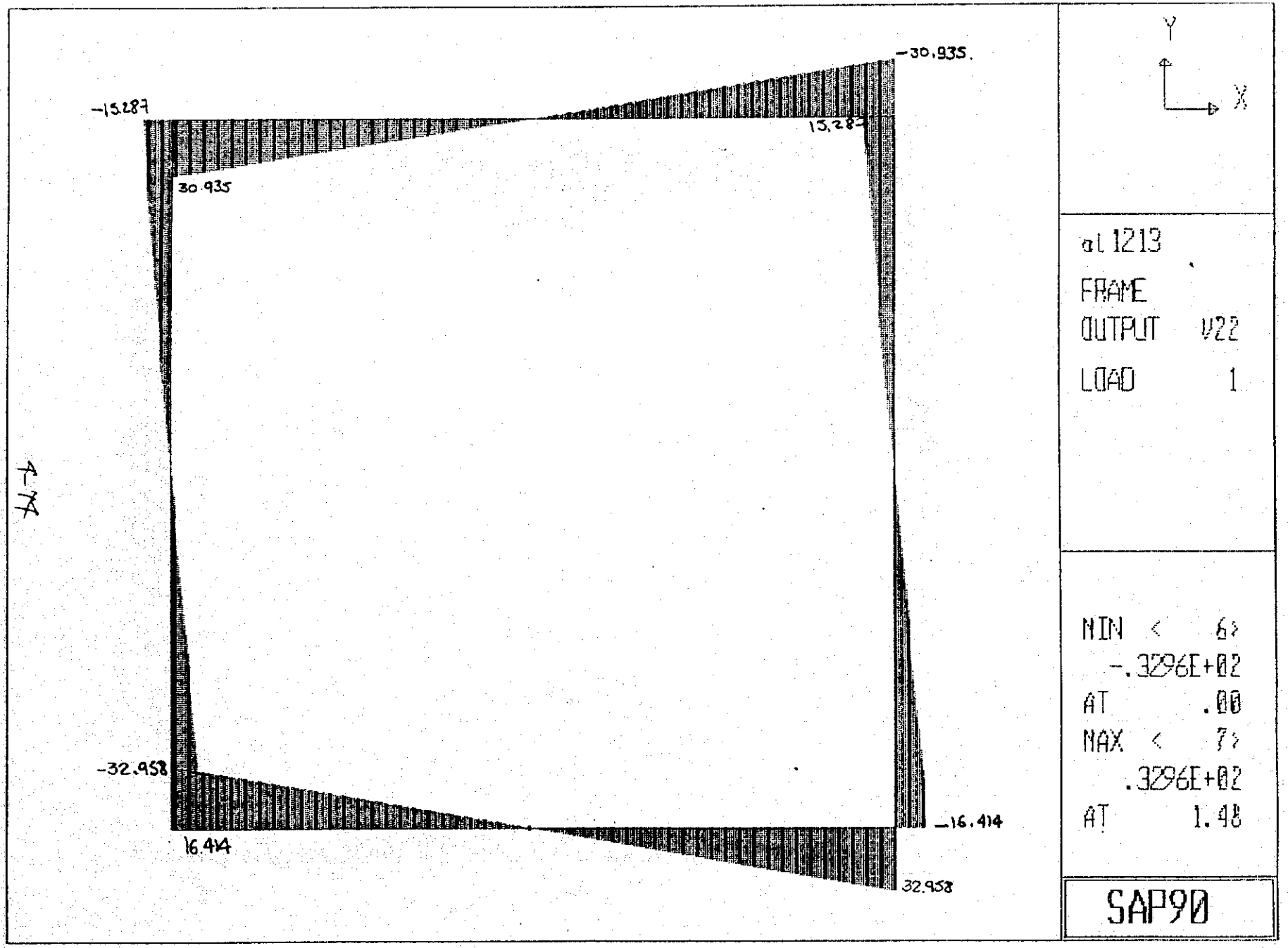

Y
X
4-70
al 1213
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.1820E-04
Y -.7366E-04
Z .0000E+00
MAXIMA
X .1820E-04
Y .4941E-05
Z .0000E+00
SAP90

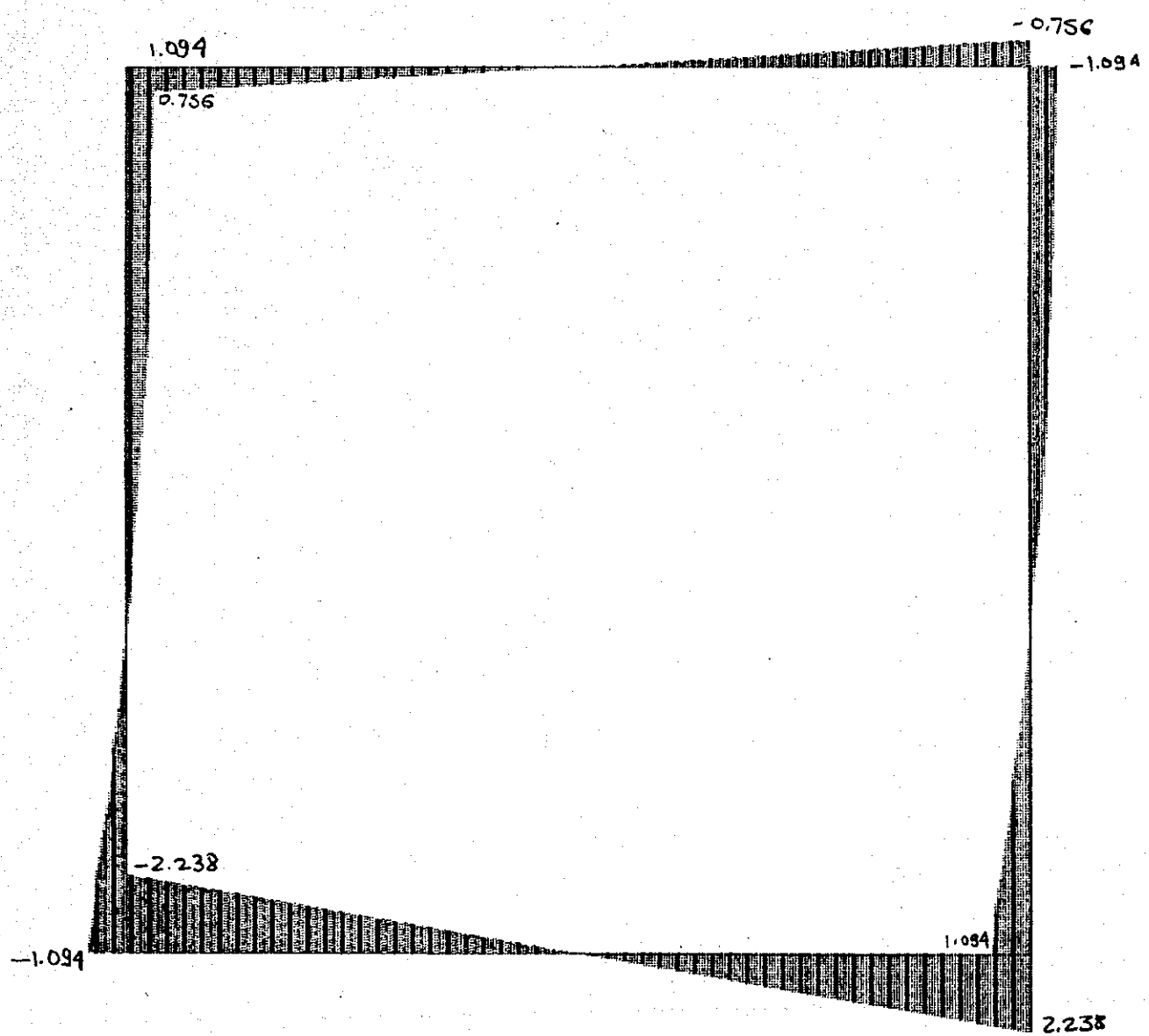

Y
X
al 1213
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.9589E-06
Y -.1000E-05
Z .0000E+00
MAXIMA
X .9589E-06
Y .7086E-06
Z .0000E+00
SAP90


-5.726
-5.726
-5.726
-5.726
5.875
-0.029
-0.029
-6.219
-6.305
-6.305
6.305
6.305
Y
X
al 1213
FRAME
OUTPUT M33
LOAD 1
MIN < 1>
-.6305E+01
AT .00
MAX < 6>
.6305E+01
AT .00
SAP90


0.054
0.054
0.054
0.054
-0.462
-0.469
-0.659
-0.202
0.202
-0.202
0.202
Y
X
al 1213
FRAME
OUTPUT M33
LOAD 2
MIN < 7>
-.6589E+00
AT .74
MAX < 3>
.3377E+00
AT .75
SAP90

4-73


-30.935
-15.287
13.287
30.935
-32.958
-16.414
16.414
32.958
A-A
Y
X
GL1213
FRAME
OUTPUT V22
LOAD 1
MIN < 6>
-.3296E+02
AT .00
MAX < 7>
.3296E+02
AT 1.48
SAP90



A-47

Y
X

el 1213
FRAME
OUTPUT V22
LOAD 2

MIN < 6>
-.2238E+01
AT .00
MAX < 7>
.2238E+01
AT 1.48

SAP90

ANALYSIS AND DESIGN OF BOX CULVERT 1.2×1.2×0.3

-DATA FOR CALCULATION OF REINFORCEMENT:

$f'_c = 180$ Kg/cm²

$f_y = 4200$ Kg/cm²

$b = 100$ cm

$d = 23$ cm

$r = 7.0$ cm

$M_u = 6.305$ ton-m

$$A_s = \frac{6.305 \times 10^5}{0.9 \times 4200 (23 - 1)} = 7.58 \text{ cm}^2$$

$$a = \frac{7.58 \times 4200}{0.85 \times 180 \times 100} = 2.08 \text{ cm}$$

$$\rho = \frac{7.58}{100 \times 23} = 0.00296$$

$\rho_{min} = 0.0033$; $A_{s\,min} = 0.0033 \times 100 \times 23 = 7.59 \text{ cm}^2 \Rightarrow 1\varnothing 12 @ 15.5$

-SHEAR STRESS CHECK

$V_u = 16.414$ ton

$V_c = 0.85 \times 0.53 \sqrt{180} \times 100 \times 23 = 13.901$ Kg.

$V_s = 16.414 - 13.901 = 2.512$ Kg.

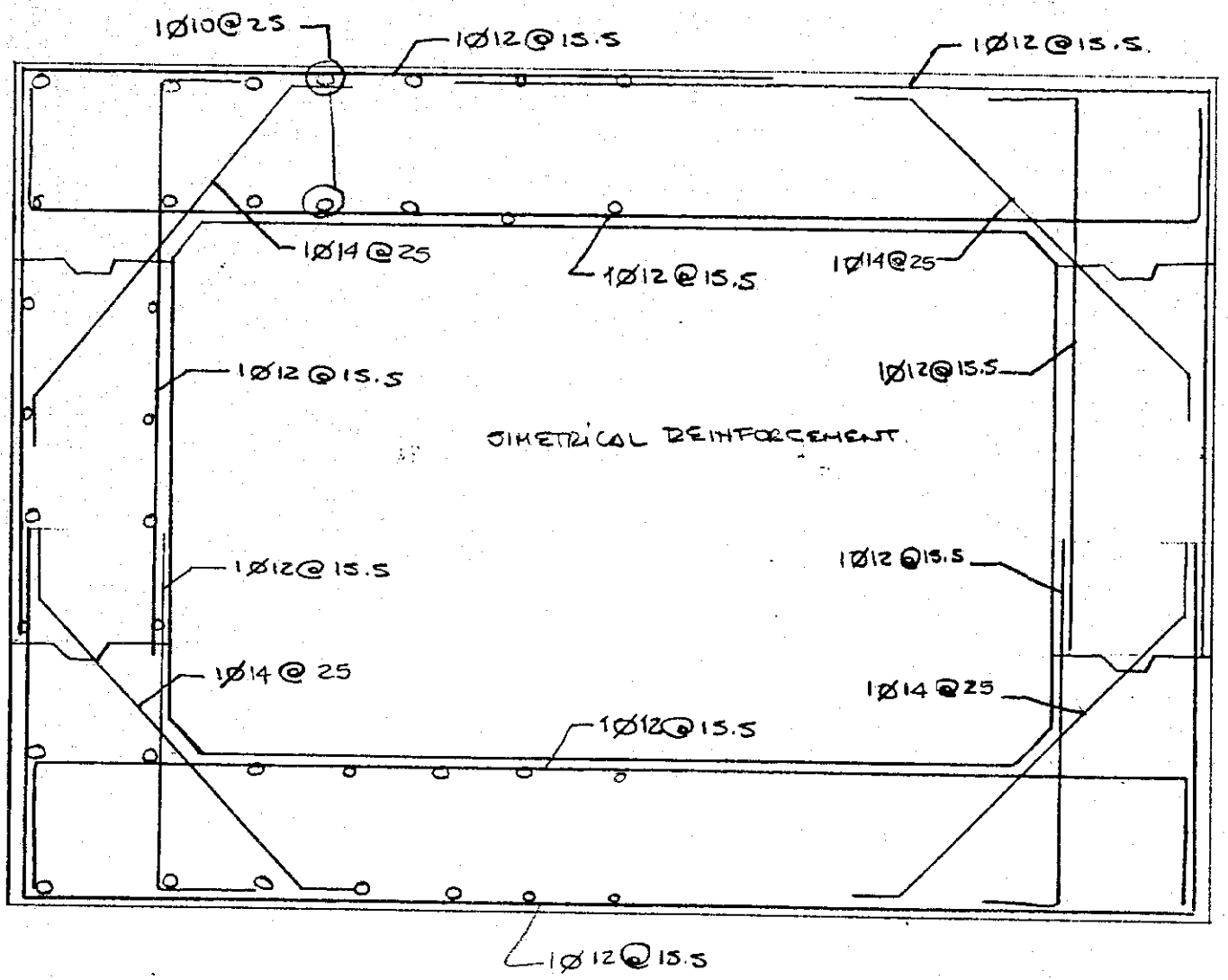
$$A_v = \frac{2.512}{4200 \times \sin 45} = 0.84 \text{ cm}^2$$

$V_s = 32.958 - 13.901 = 19.057$ Kg.

$$A_v = \frac{19.067}{0.85 \times 4200 \times \sin 45} = 7.54917 \text{ cm}^2 \Rightarrow 1\varnothing 14 @ 25$$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approved by: Aprobado por:	Date (Fecha) Aprobado por:

ARMADURA LONGITUDINAL
EN AMBAS CARAS.



UNDEFORMED SHAPE

BOX CULVERT

1.2 x 1.2 x 0.3

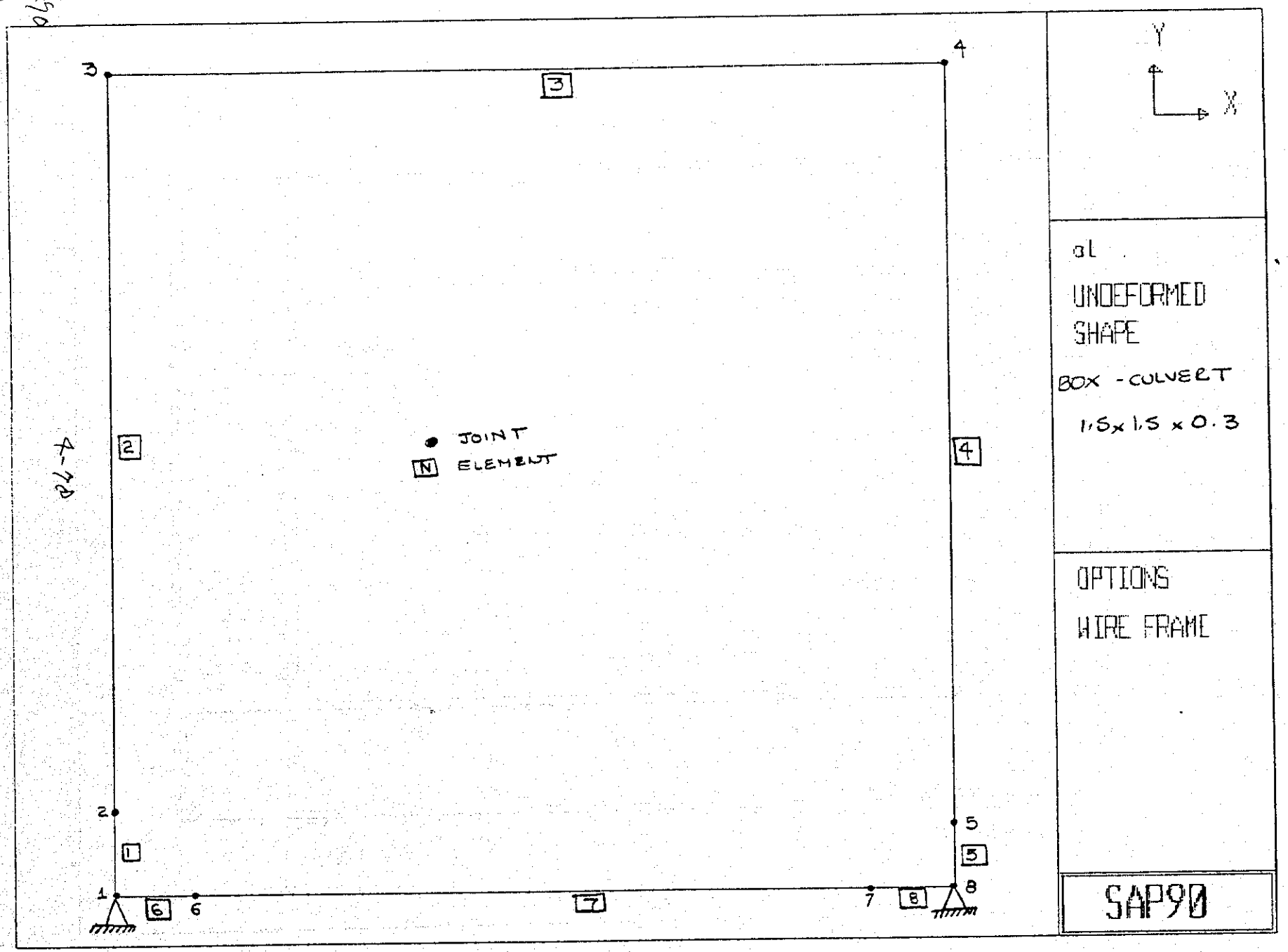
OPTIONS

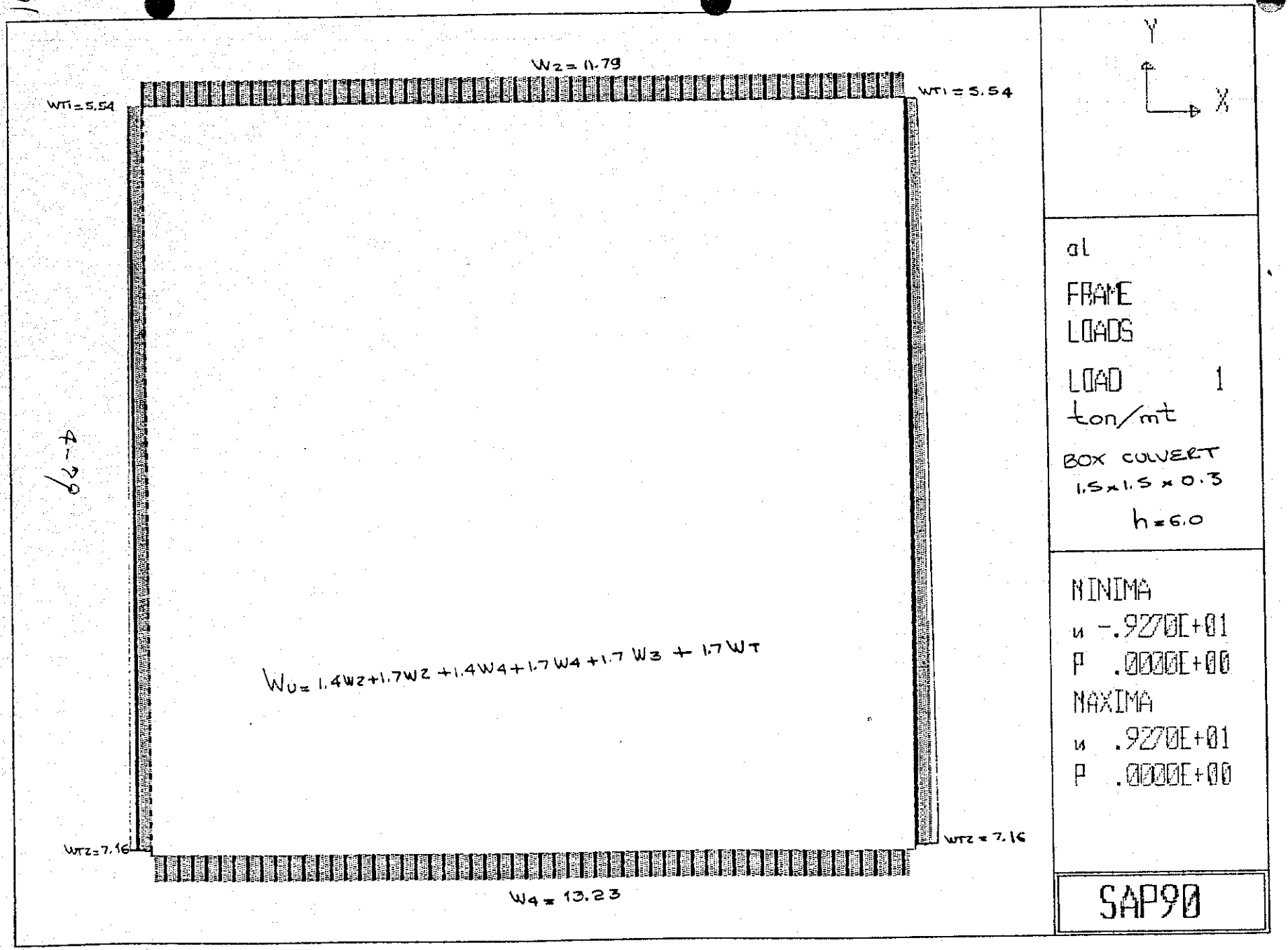
WIRE FRAME

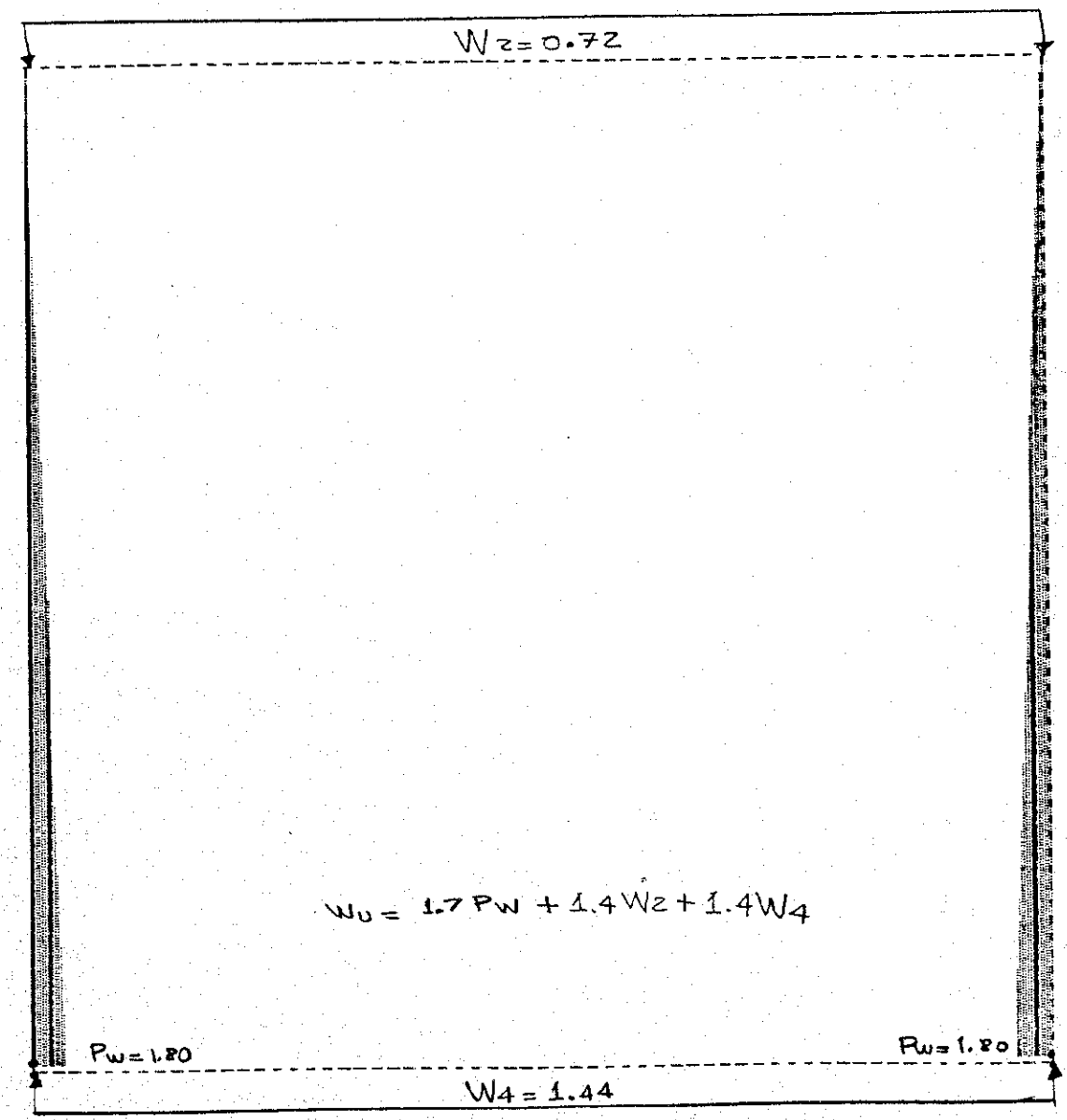
height

h = 13.0

SAP90


Y
X
3
4
3
2
4
JOINT
N ELEMENT
2
5
1
5
1
6
6
7
7
8
8
SAP90


W2 = 11.79
Wt1 = 5.54
Wt1 = 5.54
4.79
Wu = 1.4W2+1.7W2 +1.4W4+1.7 W4 +1.7 W3 + 1.7 Wt
Wt2=7.16
Wt2 = 7.16
W4 = 13.23
Y
X
gl
FRAME
LOADS
LOAD 1
ton/mt
BOX CULVERT
1.5x1.5 x 0.3
h=6.0
MINIMA
U -.9270E+01
P .0000E+00
MAXIMA
U .9270E+01
P .0000E+00
SAP90



Y
X

al

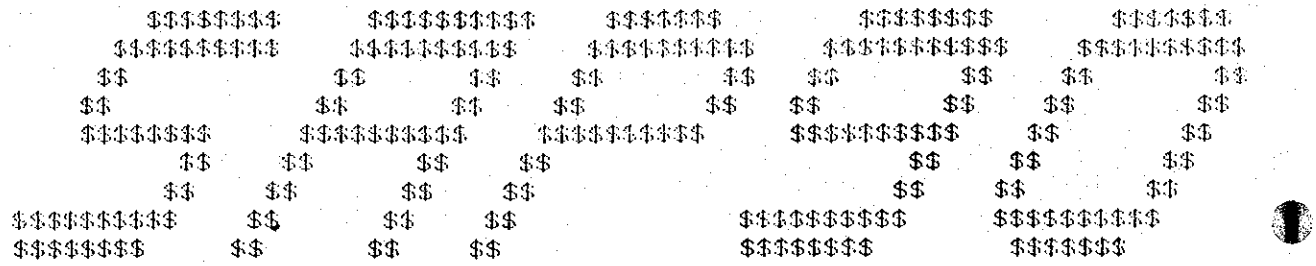
FRAME
LOADS

LOAD z
ton/mt

MINIMA
u .1500E+01
P .0000E+00
MAXIMA
u .1500E+01
P .0000E+00

SAP90

```
ALCANTARILLA 1.5X1.5  h=6.0
SYSTEM
L=4

JOINTS
1   X=0    Y=0     Z=0
2          Y=0.01
3          Y=1.80
4   x=1.80  y=1.80
5   X=1.80  Y=.01
6   X=.01   y=0.
7   X=1.79  Y=0.
8   X=1.80  Y=0.

RESTRAINTS
1 8 1  R=0,0,1,1,1,0
1 8 7  R=1,1,1,1,1,0

FRAME
NM=2 NL=9
1 SH=R T=.30,1 E=2100000.
2 SH=R T=.30,1
1 WL=0,-11.07     :w2
2 WL=0,-0.72      :w2
3 WL=0,11.07      :w4
4 WL=0,2.16       :w4
5 WL=0            :w3
6 TRAP=0,+1.80,0,1.79          :pw izq.
7 TRAP=0,0,0,1.79,1.80         :pw der.
8 TRAP=0,-7.16,0,1.79,-5.54    :wt isq.
9 TRAP=0,-5.54,0,1.79,-7.16    :wt der.
1 1 2  M=1          LP=1,0
2 2 3          NSL=8,0,6
3 3 4          nsl=1,2
4 4 5          nsl=9,0,7
5 5 8
6 1 6  M=1
7 6 7          nsl=3,4,0,5
8 7 8

COMBO
1 C=1.7,1.4,1.7,1.7
2 c=0,1.4,1.7
```



STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

ALCANTARILLA 1.5X1.5 h=6.0

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			-17.890			
		.000	8.402	-4.244				
		.010	8.402	-4.160				
		.010			-17.890			
	2	.000			-.901			
		.000	-1.608	-.249				
		.010	-1.608	-.265				
		.010			-.901			
2								
	1	.000			-17.890			
		.000	8.402	-4.160				
		.914	.000	-.308				
		1.780	-8.090	-3.801				
		1.790	-8.090	-3.882				
		1.790			-17.890			
	2	.000			-.901			
		.000	-1.608	-.265				
		.641	.000	-.742				
		1.780	1.116	.105				
		1.790	1.116	.117				
		1.790			-.901			
3								
	1	.000			-8.090			
		.000	17.890	-3.882				
		.902	.000	4.189				
		1.800	-17.798	-3.800				
		1.800			-8.090			
	2	.000			1.116			
		.000	.901	.117				
		.894	.000	520				
		1.800	-.913	106				
		1.800			1.117			

74

ALCANTARILLA 1.5X1.5 h=6.0

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
		1.780	1.608	-.264				
		1.790	1.608	-.248				
		1.790			-.913			
5								
	1	.000			-17.798			
		.000	-8.402	-4.242				
		.010	-8.402	-4.326				
		.010			-17.798			
	2	.000			-.913			
		.000	1.608	-.248				
		.010	1.608	-.232				
		.010			-.913			
6								
	1	.000			.000			
		.000	-19.395	4.244				
		.010	-19.395	4.050				
		.010			.000			
	2	.000			.000			
		.000	-2.701	.249				
		.010	-2.701	.222				
		.010			.000			
7								
	1	.000			.000			
		.000	-19.395	4.050				
		.888	.000	-4.561				
		1.780	19.486	4.131				
		1.780			.000			
	2	.000			.000			
		.000	-2.701	.222				
		.893	.000	-.984				
		1.780	2.682	.205				
		1.780			.000			
8								
	1	.000			.000			
		.000	19.486	4.131				
		.010	19.486	4.326				
		.010			.000			
	2	.000			.000			
		.000	2.682	.205				
		.010	2.682	.232				
		.010			.000			

SAP90

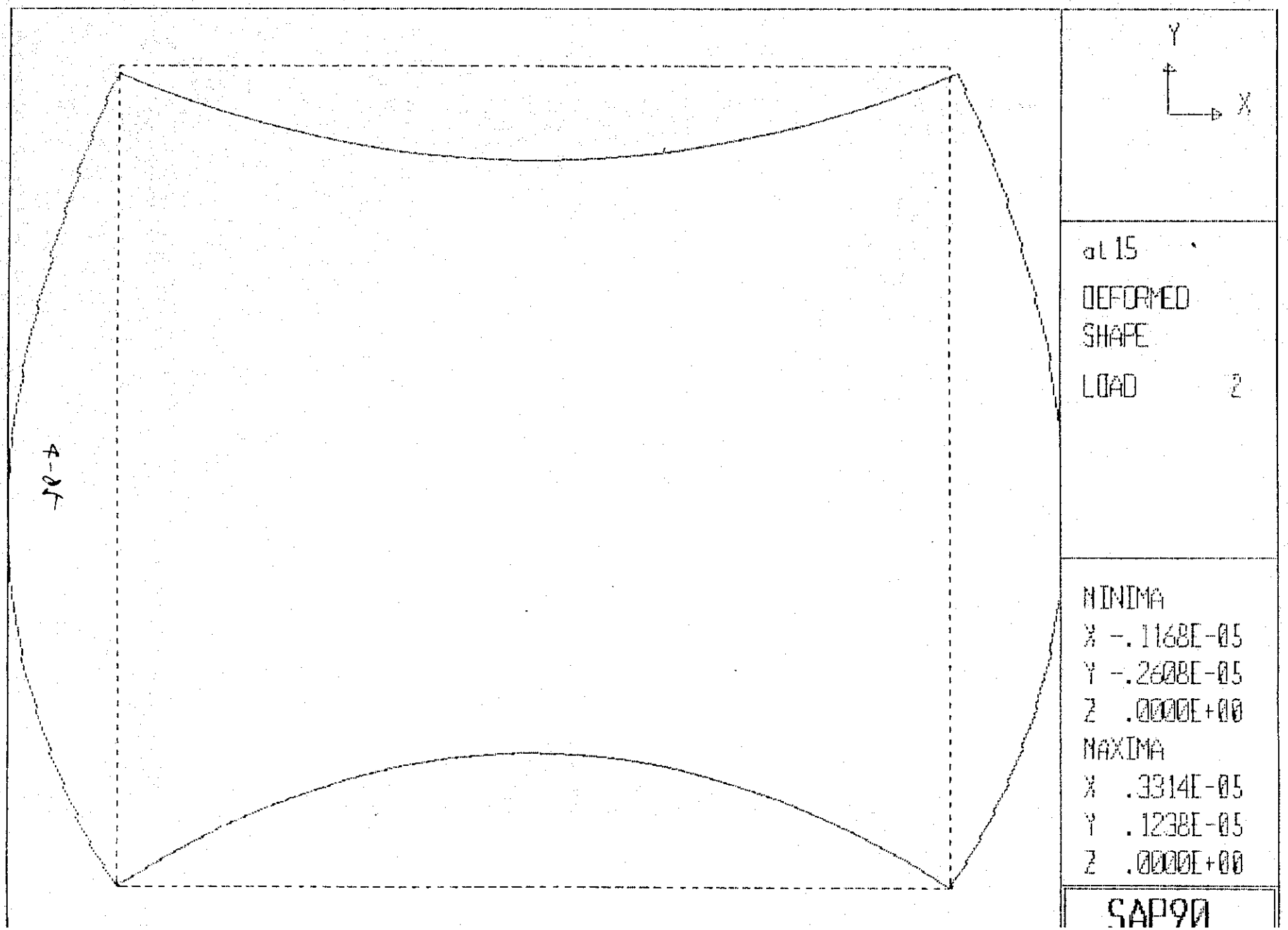
MINIMA
X -.212E-04
Y -.511E-04
Z .000E+00
MAXIMA
X .258E-05
Y .410E-05
Z .000E+00

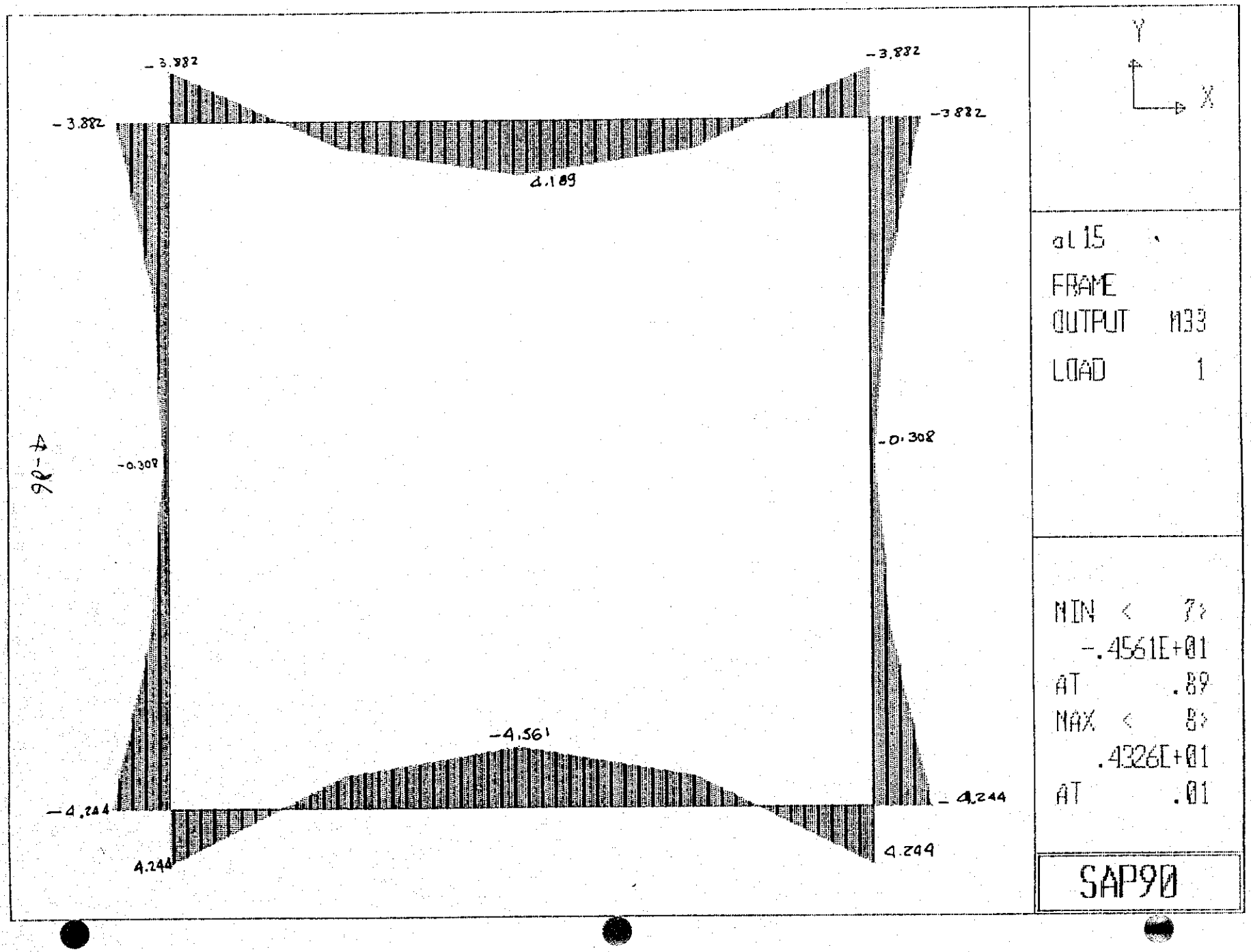
al 15
DEFORMED
SHAPE
LOAD 1

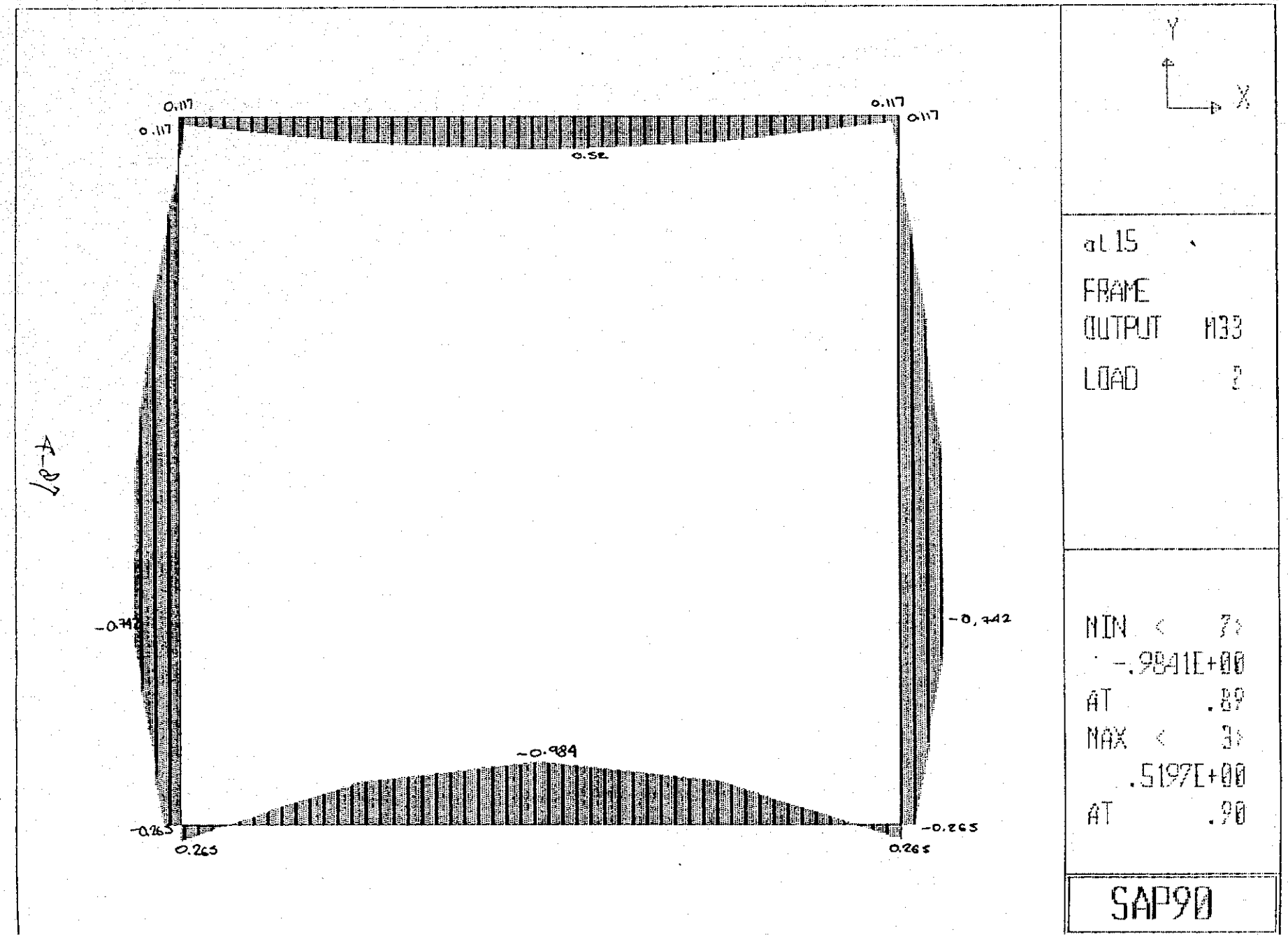
Y
X

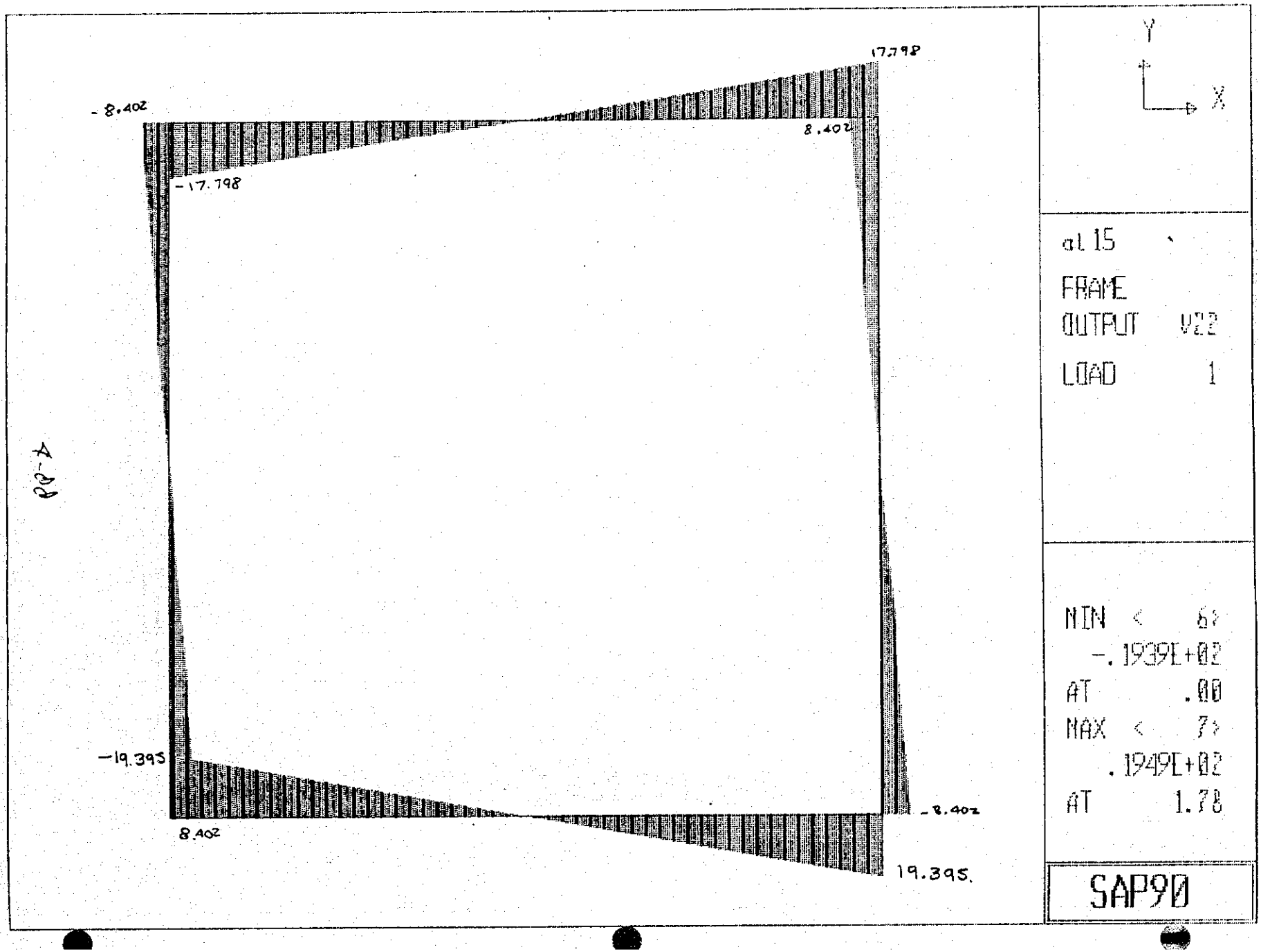
4-84

16


Y
X
at 15
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.1168E-05
Y -.2608E-05
Z .0000E+00
MAXIMA
X .3314E-05
Y .1238E-05
Z .0000E+00
SAP90


-3.882
-3.882
-3.882
4.189
-0.308
-0.308
-4.561
-4.244
-4.244
4.244
4.244
Y
X
9Q-4
aL 15
FRAME
OUTPUT M33
LOAD 1
MIN < 7>
-.4561E+01
AT .89
MAX < 8>
.4326E+01
AT .01
SAP90


Y
X
0.117
0.117
0.117
0.117
0.52
-0.742
-0.742
-0.984
-0.265
-0.265
0.265
0.265
aL 15
FRAME
OUTPUT M33
LOAD 2
MIN < 7>
-.9841E+00
AT .89
MAX < 3>
.5197E+00
AT .90
SAP90


17.798
-8.402
8.402
-17.798
-19.395
8.402
-8.402
19.395.
Y
X
at 15
FRAME
OUTPUT V22
LOAD 1
MIN < 6>
-.1939E+02
AT .00
MAX < 7>
.1949E+02
AT 1.78
SAP90

Y
X
el 15
FRAME
OUTPUT V22
LOAD 2
MIN < 6>
-.2701E+01
AT .00
MAX < 7>
.2682E+01
AT 1.78
SAP90
-0.913
-1.116
2.682
1.608
1.116
0.901
-2.701
-1.608

BOX CULVERT 1.5 x 1.5 x 0.3 h = 6.0

- DATA FOR CALCULATION OF REINFORCEMENT

$f'_c = 180\ Kg/cm^2$

$f_y = 4200\ Kg/cm^2$

$b = 100$

$d = 23$

$r = 7$

$Mu = 4.244$ ton-mt

$$A_s = \frac{4.244 \times 10^5}{0.9 \times 4200\ (23-1)} = 5.10\ cm^2$$

$$a = \frac{5.10 \times 4200}{0.85 \times 180 \times 100} = 1.40\ cm$$

$$\rho = \frac{5.10}{100 \times 23} = 0.002217 < \rho_{min}$$

$A_s = 0.0033 \times 100 \times 23 = 7.66\ cm^2$ $\quad 1\varnothing 12\ @\ 15.5$

- SHEAR STRESS CHECK

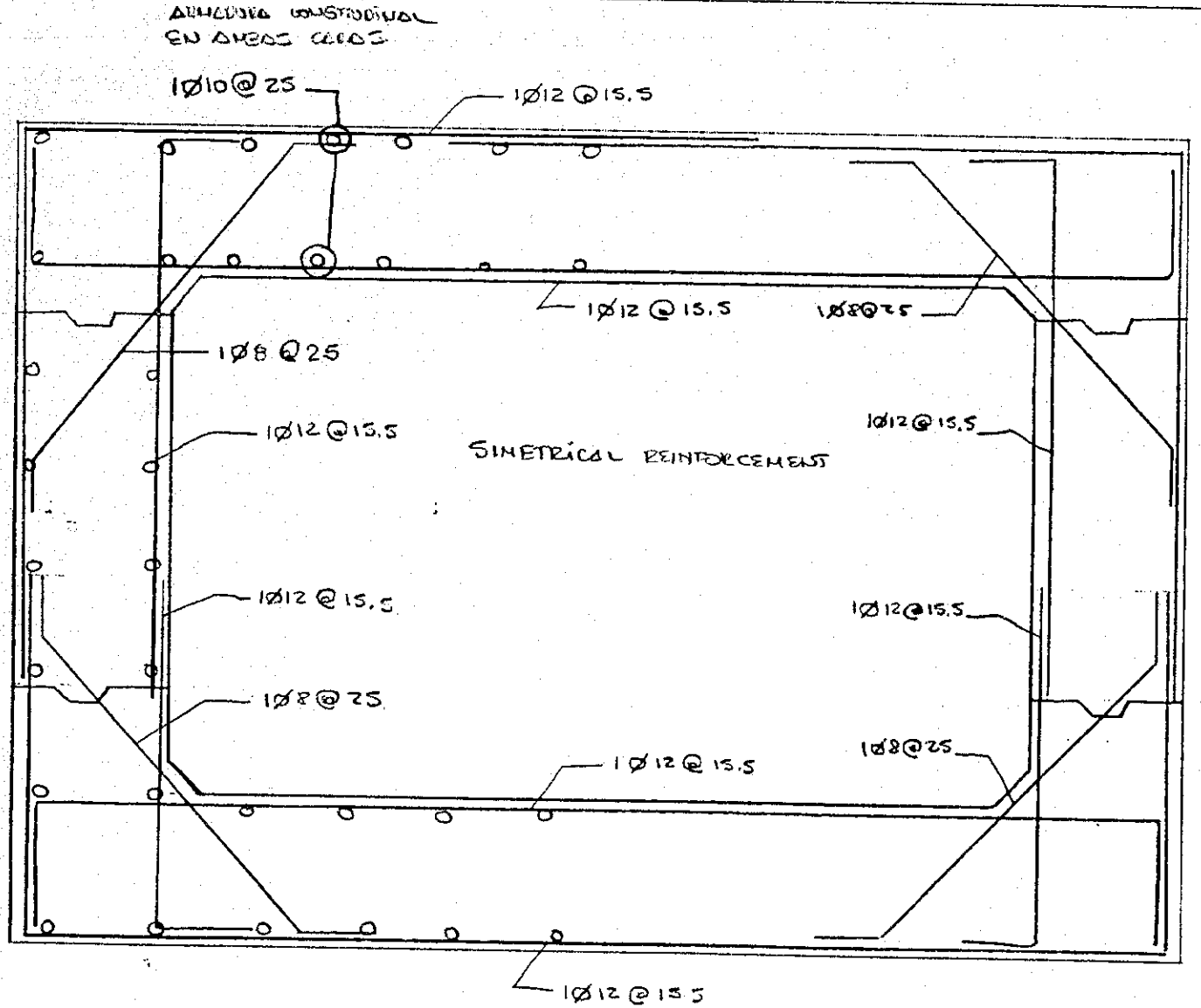
$Vu = 19.395$

$Vc = 0.85 \times 0.53 \sqrt{180} \times 100 \times 23 = 13.901.41\ Kg. < Vu$

$Vs = 19.395 - 13.901 = 5.49$ ton

$$A_v = \frac{5.49 \times 15^3}{0.85 \times 4.200 \times \sin 45} = 2.16\ cm^2 \quad 1\varnothing 8\ @\ 20$$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:



Z
Y

UNDEFORMED SHAPE

REINFORCEMENT

OPTIONS

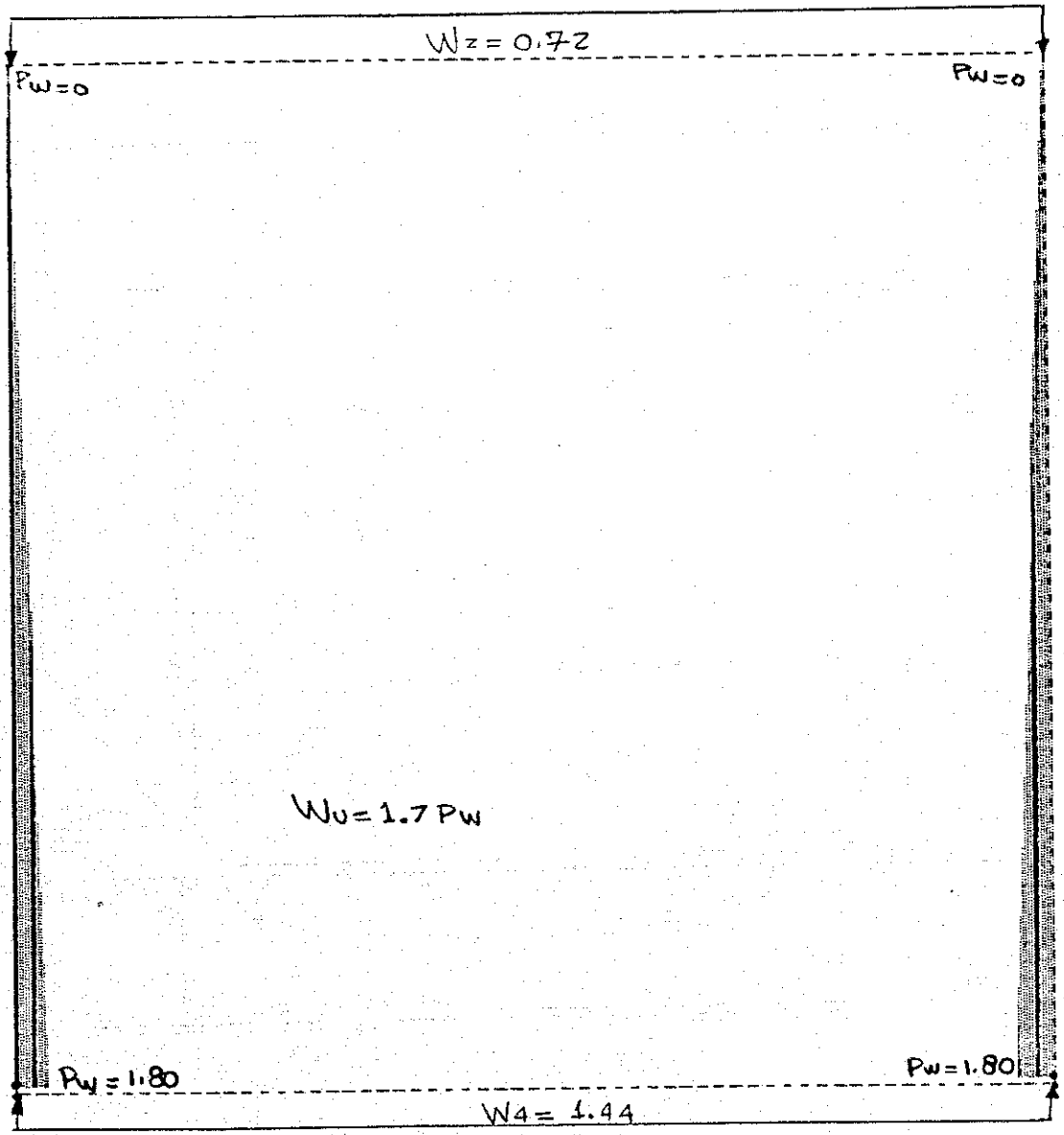
WIRE FRAME

BOX CULVERT
1.5 x 1.5 x 0.3

h = 6.0

SAP90

4-81



A-67

Y
X

al

FRAME
LOADS

LOAD 2
ton/mt

MINIMA
U .1500E+01
P .0000E+00
MAXIMA
U .1500E+01
P .0000E+00

SAP90

```
CANTARILLA 1.5X1.5  h=11.0
SYSTEM
SI

JOINTS
   X=0   Y=0    Z=0
         Y=0.01
         Y=1.80
   x=1.80  y=1.80
   x=1.80  Y=.01
   X=.02   y=0.
   x=1.79  Y=0.
   X=1.80  Y=0.

RESTRAINTS
 @ 1  R=0,0,1,1,1,0
 @ 7  R=1,1,1,1,1,0

MEMB
 1 2 M=3
 GM=R T=.30,1 E=2100000.
 GM=R T=.30,.
 WL=0,-20.07     ;w1
 WL=0,-0.72      ;w2
 WL=0,20.07      ;w4
 WL=0,2.16       ;w4
 WL=0            ;w3
 TRAP=0,+1.80,0,1.79          ;pw izq.
 TRAP=0,0,0,1.79,1.80         ;pw der.
 TRAP=0,-11.66,0,1.79,-10.04  ;wt izq.
 TRAP=0,-10.04,0,1.79,-11.66  ;wt der.
 1 2  M=1          LP=1,0
 2 3          MSL=0,0,0
 3 4          MSL=1,2
 4 5          MSL=0,0,7
 5 6
 6 7          MSL=2,4,5,5
 7 8

MISC
 C=1.7,1.4,1.7,1.7
 C=0,1.4,1.7
```

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STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

ALCANTARILLA 1.5x1.5 RALL.D

F R A M E   E L E M E N T   F O R C E S

ELT ID	LOAD COND	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			-31.698			
		.000	15.195	-7.329				
		.010	15.195	-7.176				
		.010			-31.698			
	2	.000			-.901			
		.000	-1.008	-.249				
		.010	-1.008	-.265				
		.010			-.901			
2								
	1	.000			-31.698			
		.000	15.195	-7.176				
		[illegible]	.000	-.309				
		1.780	-14.913	-6.044				
		1.790	-14.913	-6.093				
		1.790			-31.698			
	2	.000			-.901			
		.000	-1.008	-.265				
		.641	.000	-.742				
		1.780	1.116	.105				
		1.790	1.116	.117				
		1.790			-.901			
3								
	1	.000			-14.913			
		.000	31.698	-6.993				
		.902	-.000	7.308				
		1.800	-31.531	-6.843				
		1.800			-14.913			
	2	.000			1.116			
		.000	.901	.117				
		.994	.000	.520				
		1.800	-.913	.106				

98

		1.500			[illegible]			
4	1	.000			-31.331			
		.000	14.913	-6.043				
		.872	.000	[illegible]				
		1.750	-13.195	-7.174				
		1.750	-13.195	-7.326				
		1.750			-31.331			
	2	.000			-.913			
		.000	-1.116	.106				
		1.139	.000	-.741				

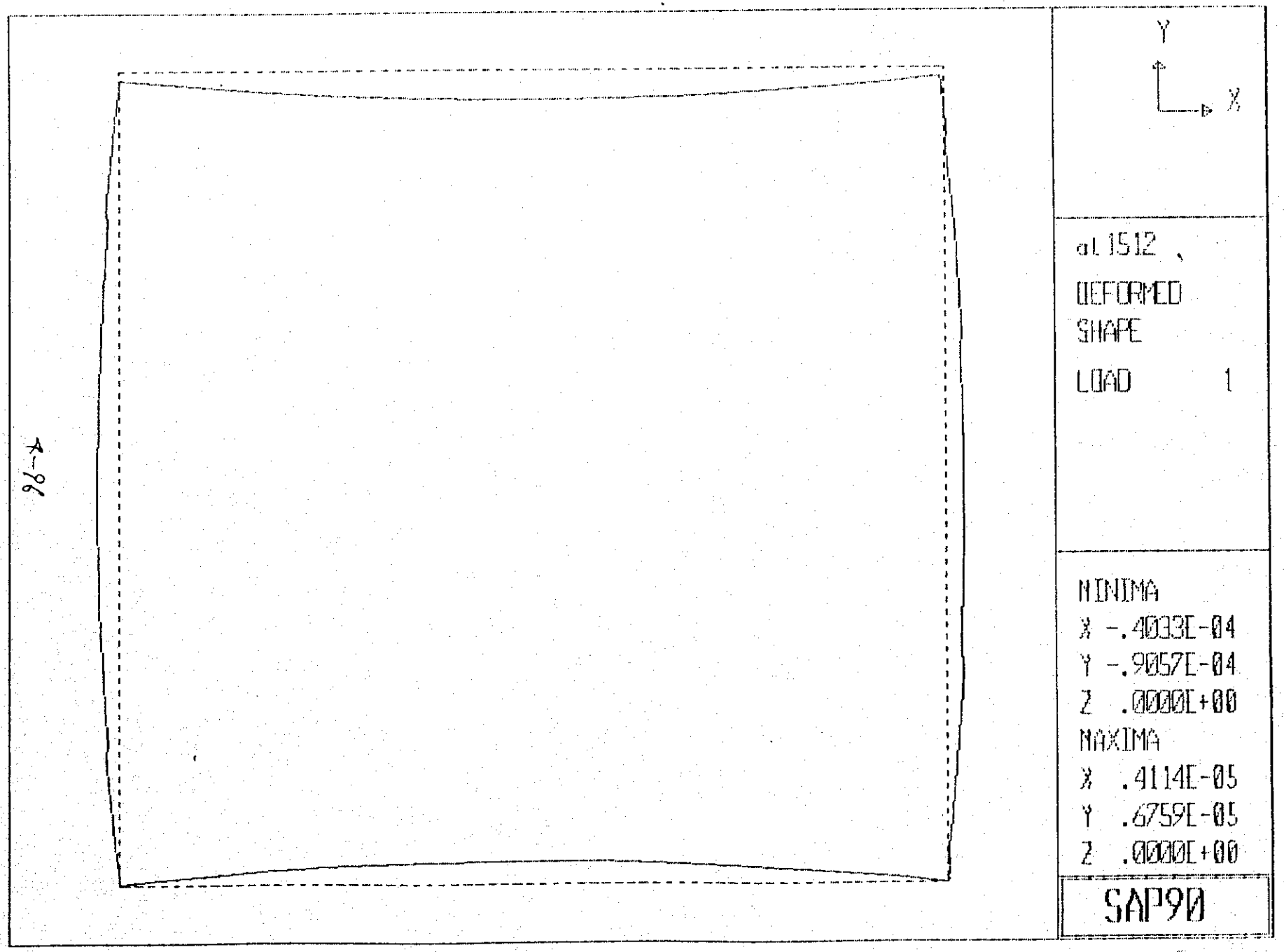
NOTES

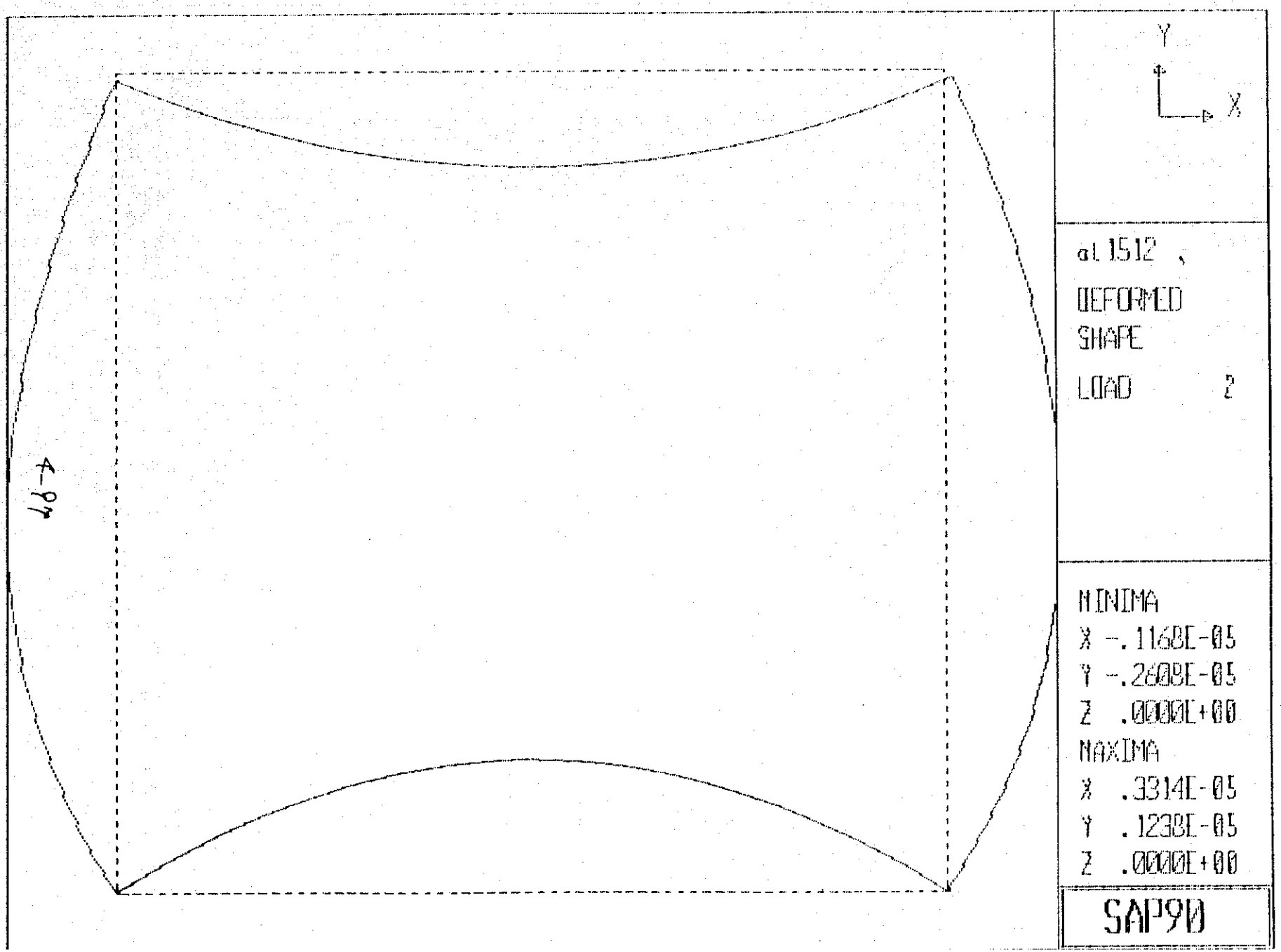
ALCANTARILLA 1.5X1.5 H=11.0

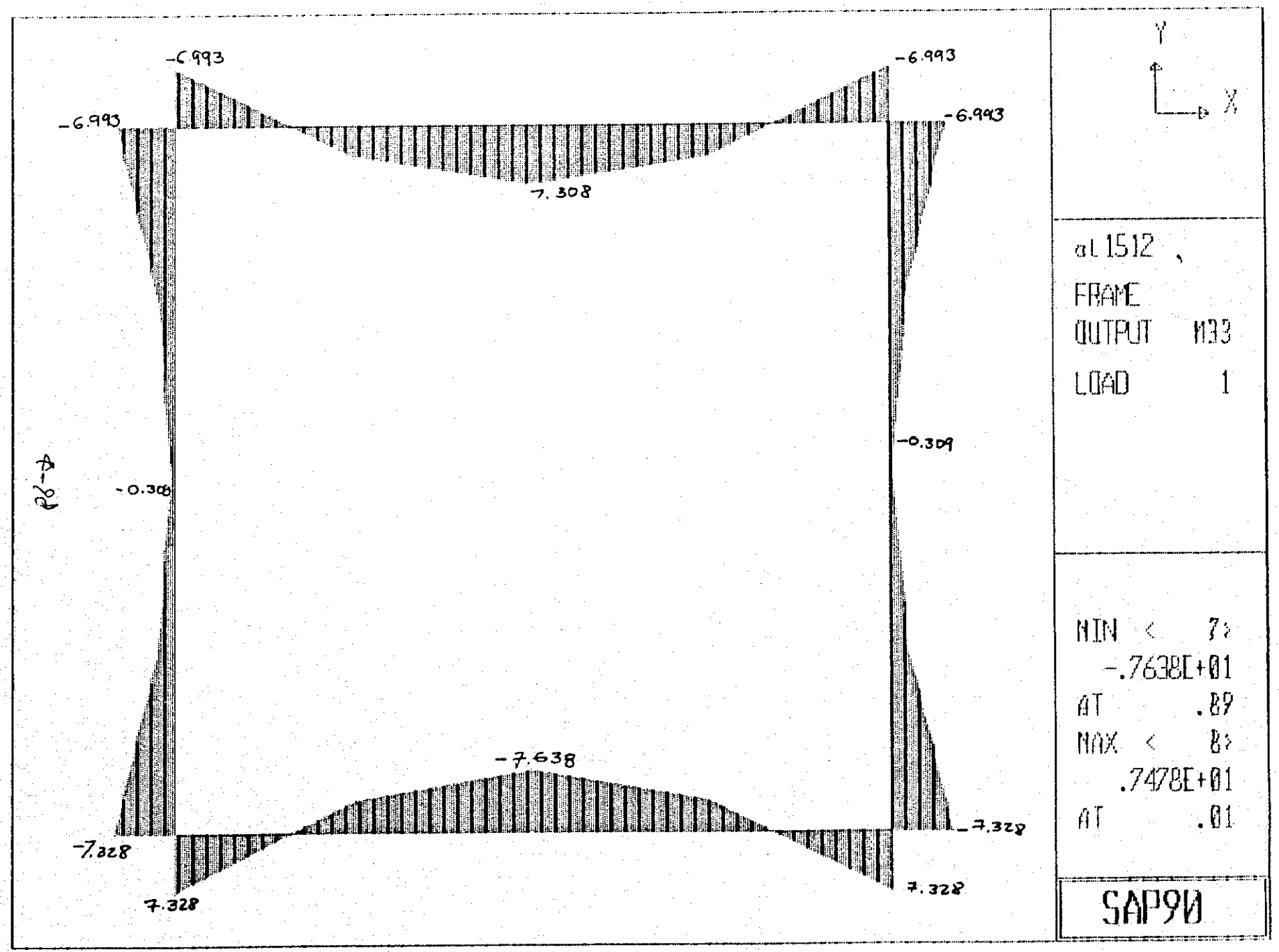
F R A M E   E L E M E N T   F O R C E S

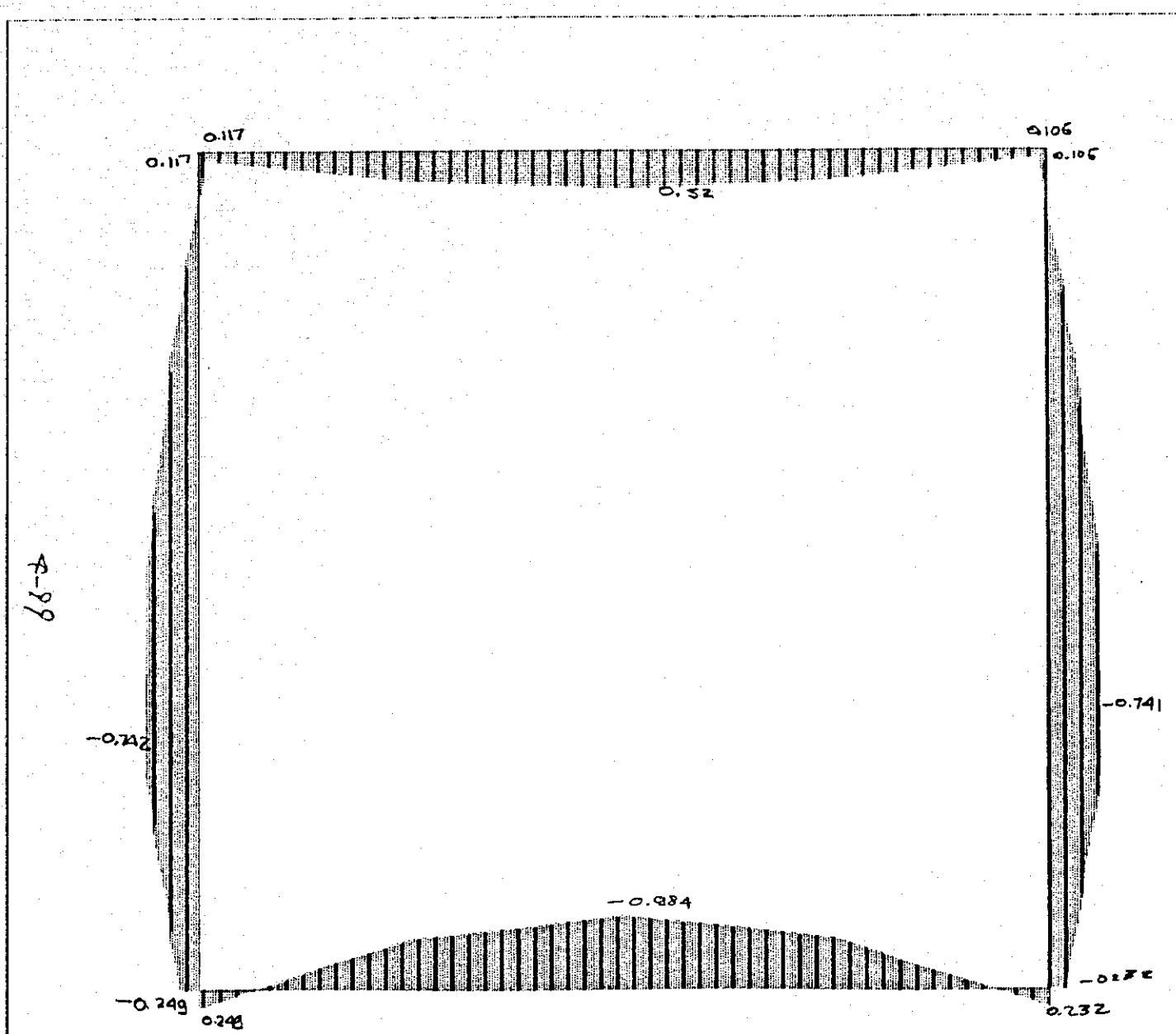
ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
		1.750	1.606	-.264				
		1.750	1.605	-.240				
		1.750			-.913			
5	1	.000			-31.331			
		.000	-13.195	-7.326				
		.010	-13.195	-7.478				
		.010			-31.331			
	2	.000			-.913			
		.000	1.606	-.240				
		.010	1.606	-.232				
		.010			-.913			
6	1	.000			.000			
		.000	-32.974	7.329				
		.010	-32.974	6.998				
		.010			.000			
	2	.000			.000			
		.000	-2.701	.249				
		.010	-2.701	.222				
		.010			.000			
7	1	.000			.000			
		.000	-32.974	6.998				
		.866	.000	-7.664				
		1.740	33.141	7.147				
		1.750			.000			
	2	.000			.000			
		.000	-2.701	.222				
		.893	.000	-.984				
		1.740	2.682	.205				
		1.750			.000			
8	1	.000			.000			
		.000	33.141	7.147				
		.010	33.141	7.478				
		.010			.000			
	2	.000			.000			
		.000	2.682	.205				
		.010	2.682	.232				
		.010			.000			

89


Y
X
al 1512
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.4033E-04
Y -.9057E-04
Z .0000E+00
MAXIMA
X .4114E-05
Y .6759E-05
Z .0000E+00
SAP90


Y
X
at 1512 ,
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.1168E-05
Y -.2608E-05
Z .0000E+00
MAXIMA
X .3314E-05
Y .1238E-05
Z .0000E+00
SAP90


-6.993
-6.993
-6.993
-6.993
7.308
-0.309
-0.309
-7.638
-7.328
-7.328
7.328
7.328
Y
X
aL 1512
FRAME
OUTPUT M33
LOAD 1
MIN < 7>
-.7638E+01
AT .89
MAX < 8>
.7478E+01
AT .01
SAP90



Y
X

at 1512

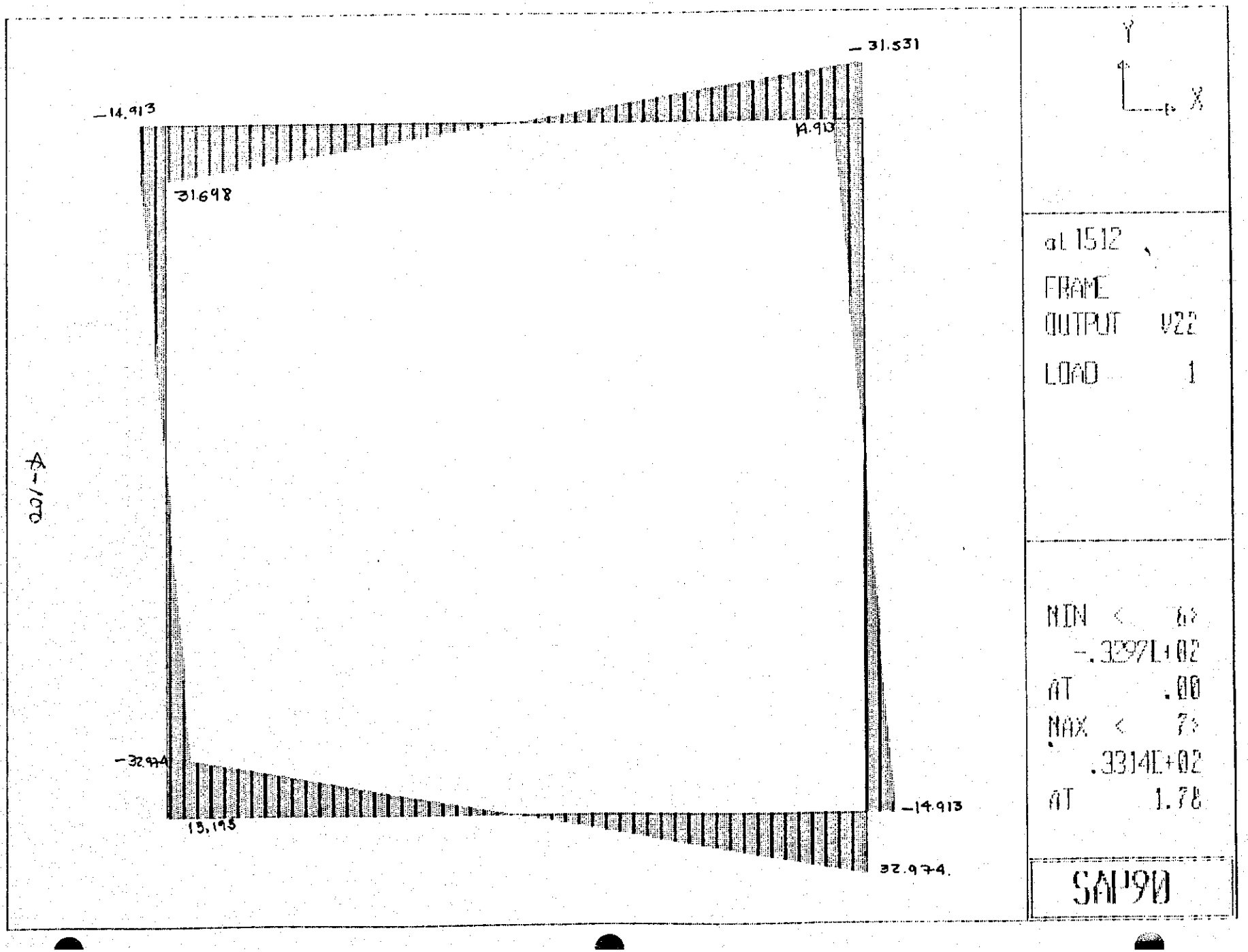
FRAME

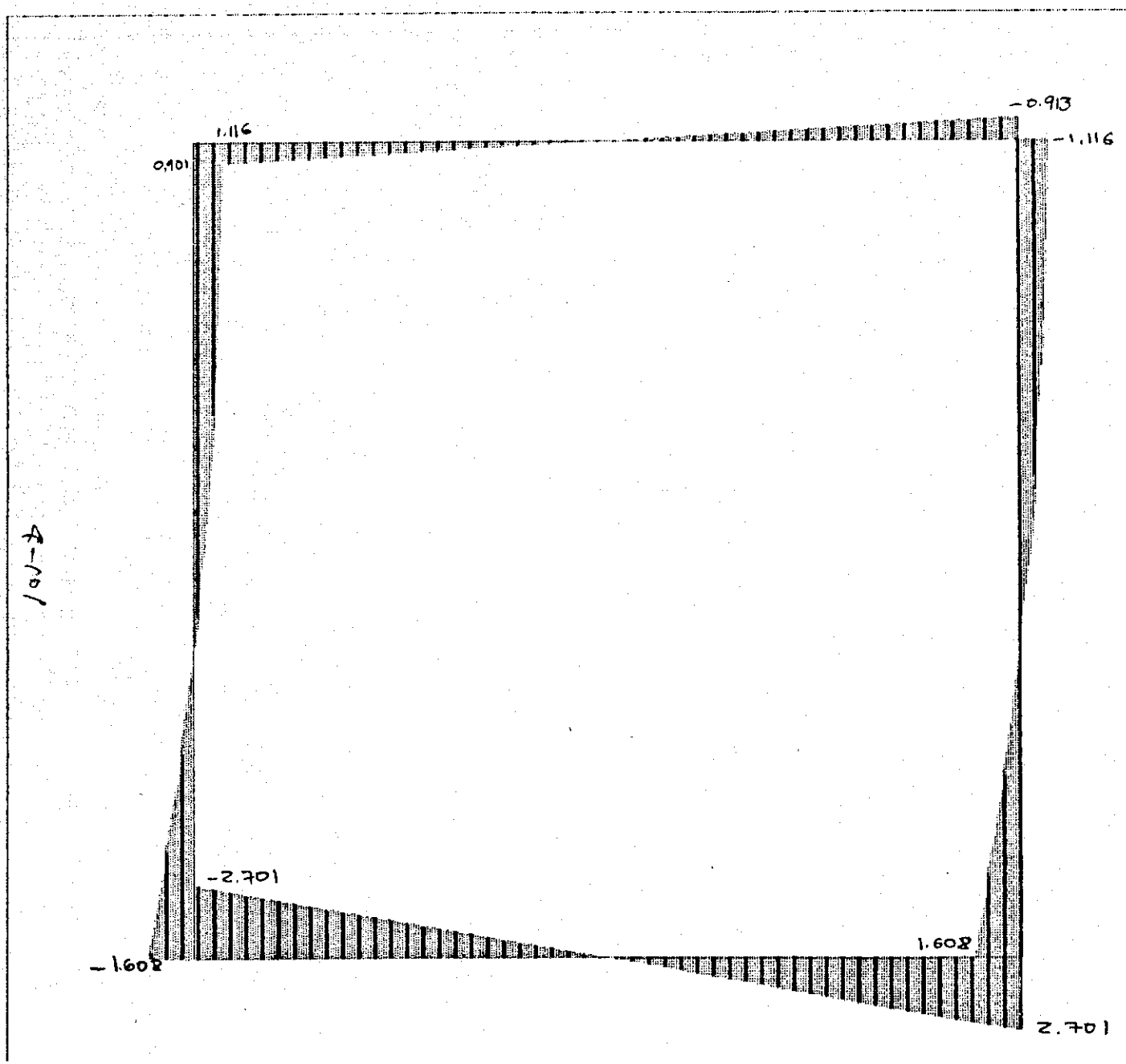
OUTPUT 133

LOAD 2

MIN < 7>
-.9841E+00
AT .89
MAX < 3>
.5197E+00
AT .90

SAP90


-31.531
-14.913
31.698
-32.974
15.195
-14.913
32.974
Y
X
gL 1512
FRAME
OUTPUT V22
LOAD 1
MIN < 6>
-.3397E+02
AT .00
MAX < 7>
.3314E+02
AT 1.78
SAP90



Y
X

at 1512
FRAME
OUTPUT V22
LOAD 2

MIN < 6>
-.2701E+01
AT .00
MAX < 7>
.2682E+01
AT 1.78

SAP90

- DATA FOR CALCULATION OF REINFORCEMENT

$F'_c = 180\ kg/cm^2$

$f_y = 4200\ kg/cm^2$

$b = 100$

$d = 23$

$r = 7$

$M_u = 7.328\ ton\text{-}m.$

$$A_s = \frac{7.328 \times 10^5}{0.9 \cdot 4200\ (22)} = 8.81\ cm^2$$

$$a = \frac{8.81 \times 4200}{0.85 \times 180 \times 100} = 2.42\ cm$$

$$\rho = \frac{8.81}{100 \times 23} = 0.00383 > \rho_{min} \qquad 1\varnothing 14 @ 20.$$

- SHEAR STRESS CHECK

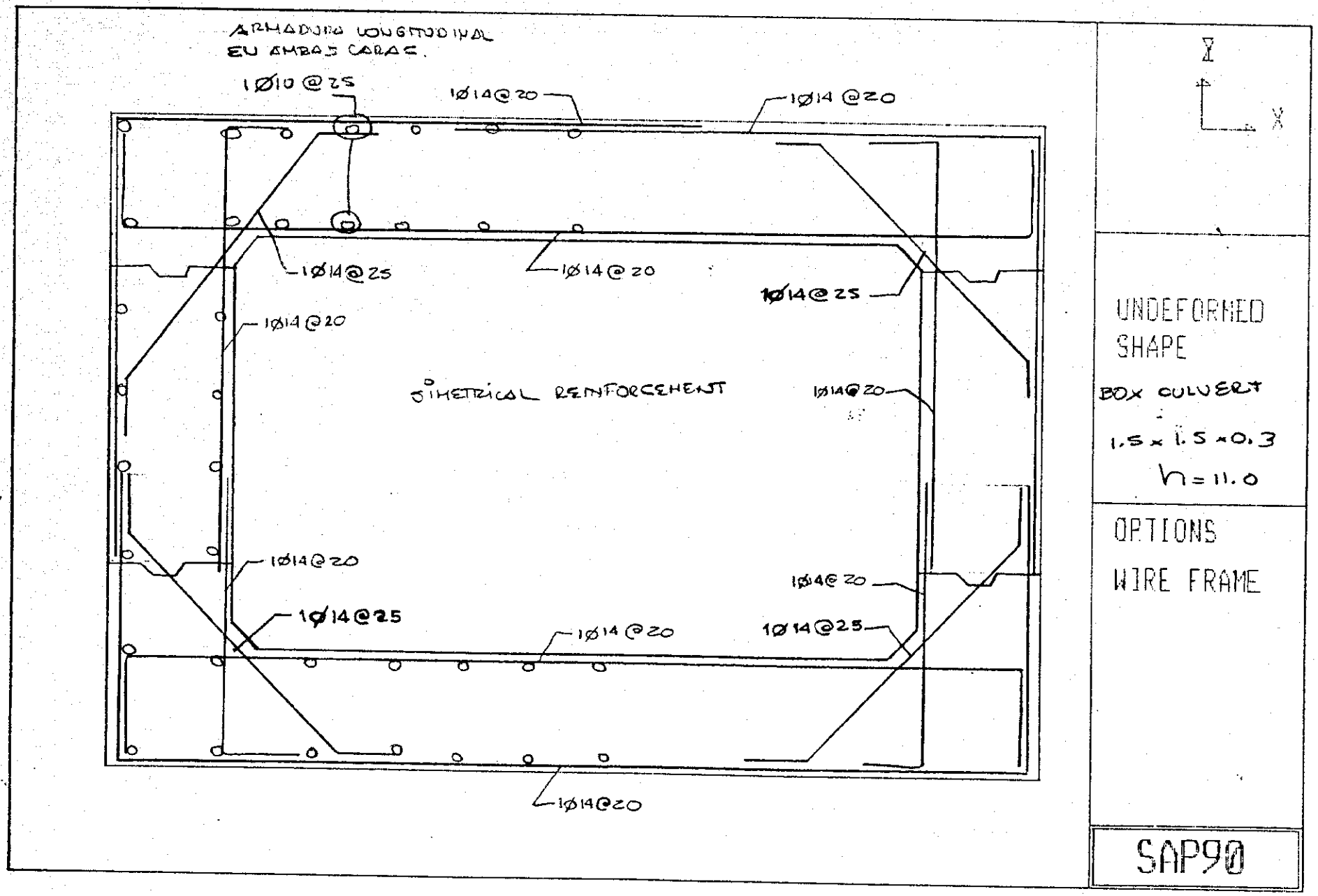
$V_u = 32.974\ ton$

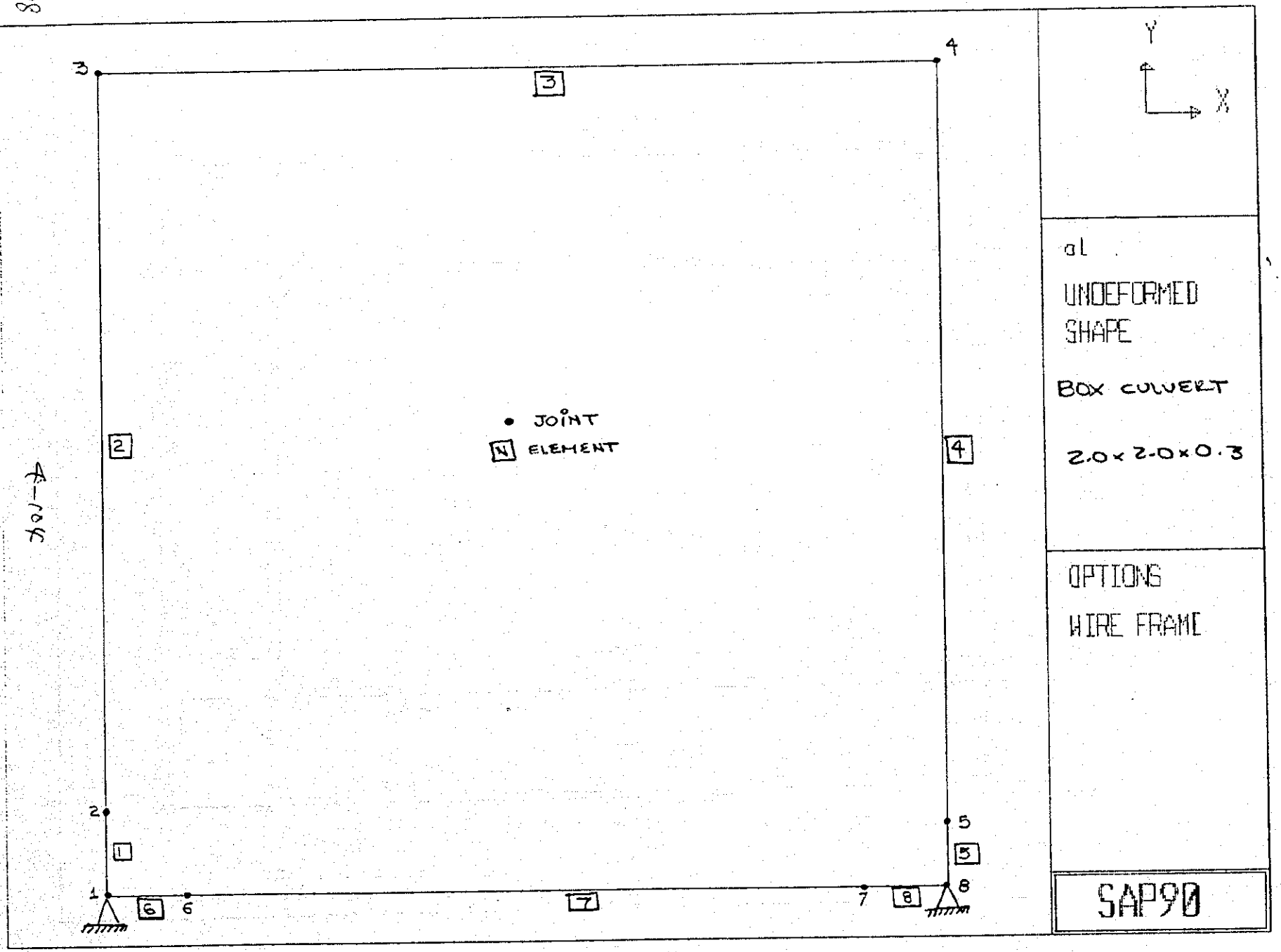
$V_c = 13.9\ ton < V_u$

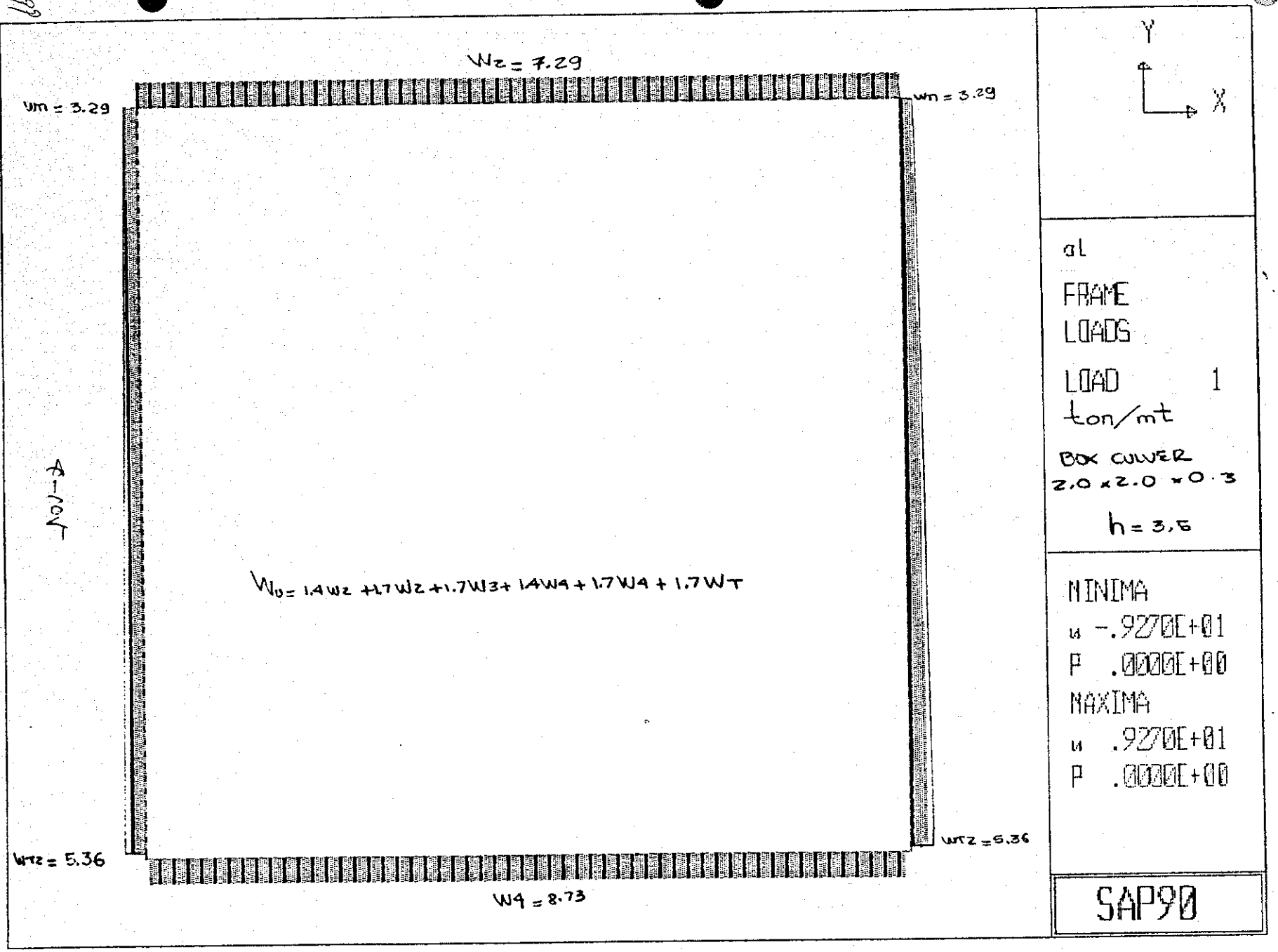
$V_s = 32.974 - 13.9 = 19.073\ ton.$

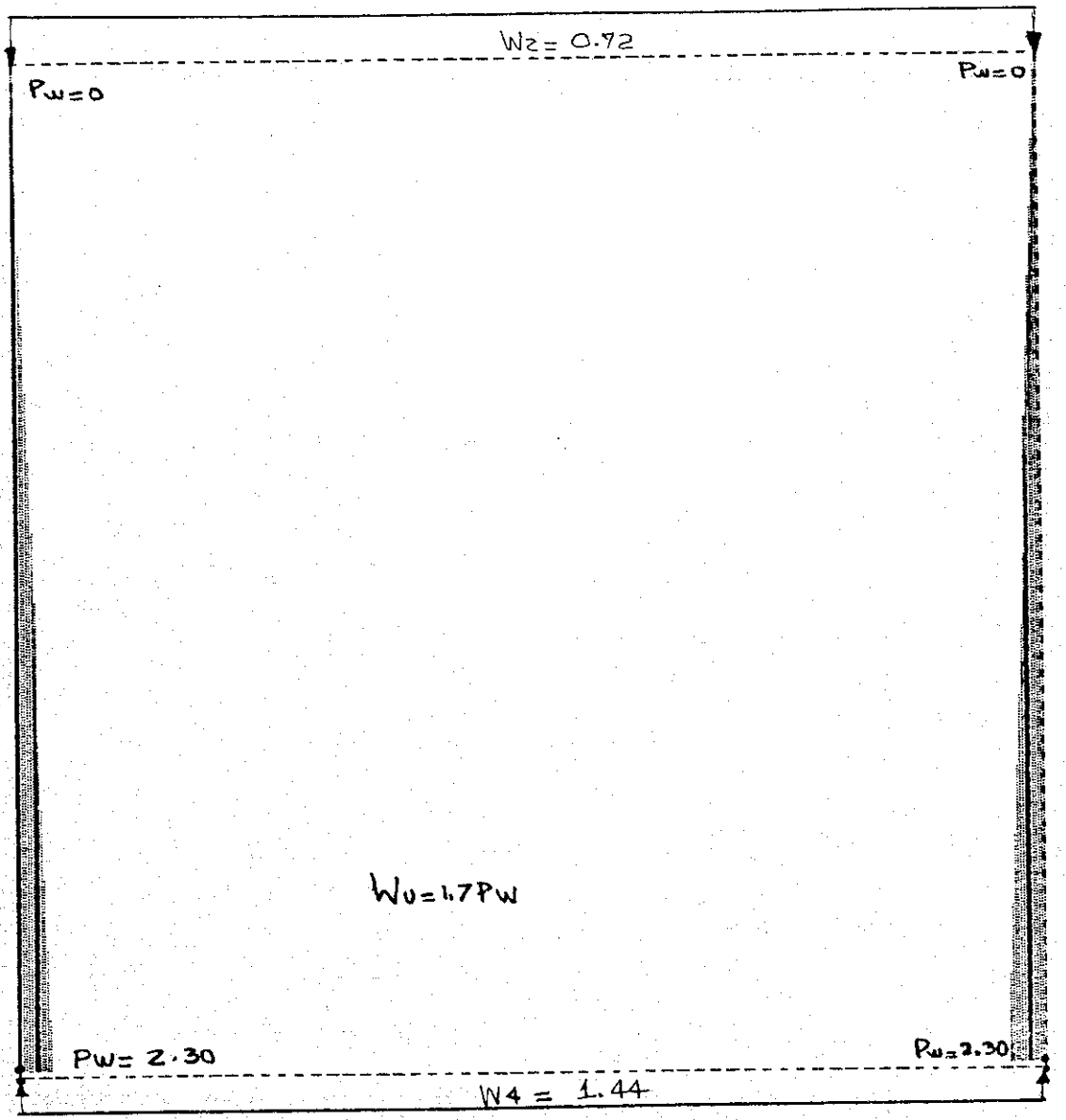
$$A_v = \frac{19.073 \times 10^3}{0.85 \times 4200 \times \sin 45} = 7.55\ cm^2 = 1\varnothing 14 @ 25$$

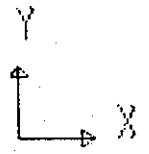
Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


ARMADURA LONGITUDINAL
EN AMBAS CARAS.
1Ø10 @25
1Ø14@20
1Ø14 @20
1Ø14@25
1Ø14 @20
1Ø14@25
1Ø14 @20
SIMETRICAL REINFORCEMENT
1Ø14@20
1Ø14@20
1Ø4@20
1Ø14@25
1Ø14 @20
1Ø14 @25
1Ø14@20
Z
X
UNDEFORMED
SHAPE
BOX CULVERT
1.5 x 1.5 x 0.3
h = 11.0
OPTIONS
WIRE FRAME
SAP90


Y
X
3
4
2
1
5
6
7
8
JOINT
ELEMENT
al
UNDEFORMED
SHAPE
BOX CULVERT
2.0×2.0×0.3
OPTIONS
WIRE FRAME
SAP90


Wz = 7.29
Wm = 3.29
Wm = 3.29
Wo = 1.4Wz + 1.7Wz + 1.7W3 + 1.4W9 + 1.7W4 + 1.7WT
Wrz = 5.36
Wrz = 5.36
W4 = 8.73
Y
X
al
FRAME
LOADS
LOAD 1
ton/mt
BOX CULVER
2.0 x 2.0 x 0.3
h = 3.5
MINIMA
M -.9270E+01
P .0000E+00
MAXIMA
M .9270E+01
P .0000E+00
SAP90





al

FRAME
LOADS

LOAD 2
ton/mt

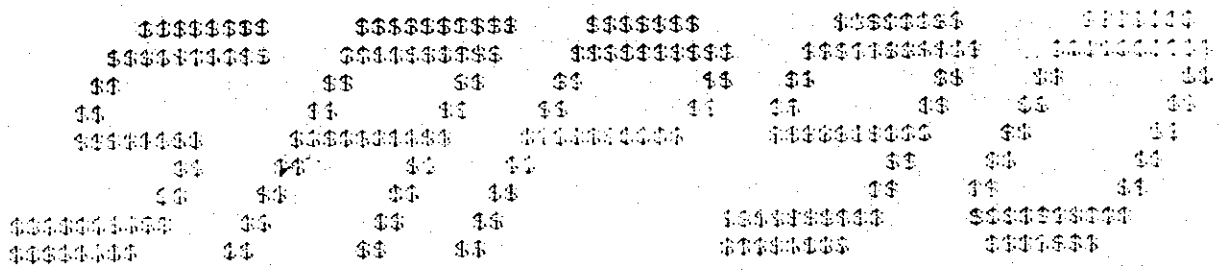
MINIMA
U .1500E+01
P .0000E+00
MAXIMA
U .1500E+01
P .0000E+00

SAP90

```
ALCANTARILLA 2.0X2.0  h=3.5
SYSTEM
L=4

JOINTS
1   X=0   Y=0     Z=0
2         Y=0.01
3         Y=2.3
4   x=2.3   y=2.3
5   X=2.3   Y=.01
6   X=.01   y=0
7   X=2.29  Y=0
8   X=2.3   Y=0

RESTRAINTS
1 6 1  R=0,0,1,1,1,0
1 8 7  R=1,1,1,1,1,0

FRAME
NM=2 NL=2
1 SH=R T=.30,1 E=2100000.
2 SH=R T=.30,1
1 WL=0,-0.57      ;w2
2 WL=0,-0.72      ;w2
3 WL=0,0.57       ;w4
4 WL=0,0.16       ;w4
5 WL=0            ;w3
6 TRAP=0,+2.30,0,2.29            ;pw izq.
7 TRAP=0,0.0,0,2.29,2.30         ;pw der.
8 TRAP=0,-2.30,0,2.2900,-2.29    ;wt izq.
9 TRAP=0,-2.29,0,2.2900,-2.76    ;wt der.
1 1 2  M=1          LP=1,
2 2 3          NCL=0,0,0
3 3 4          no)=1,2
4 4 5          no)=3,0,7
5 5 6
6 1 6  M=1
7 6 7          no)=2,4,0,5
8 7 8

COND.S
1 C=1.7,1.4,1.7,1.7
2 C=0,1.4,1.7
```

4-107

50/



STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

ALCANTARILLA 2.00C 0 hs3.5

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST END	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			-14.031			
		.000	6.347	-4.403				
		.010	6.347	-4.340				
		.010			-14.031			
	2	.000			-1.152			
		.000	-2.710	-.307				
		.010	-2.710	-.334				
		.010			-1.152			
2								
	1	.000			-14.031			
		.000	6.347	-4.340				
		1.197	.000	-.518				
		2.280	-5.959	-3.728				
		2.290	-5.959	-3.708				
		2.290			-14.031			
	2	.000			-1.152			
		.000	-2.710	-.334				
		.073	.000	-1.401				
		2.280	1.747	.261				
		2.290	1.747	.279				
		2.290			-1.152			
3								
	1	.000			-5.959			
		.000	14.031	-3.788				
		1.152	.000	4.295				
		2.300	-13.977	-3.726				
		2.300			-5.959			
	2	.000			1.747			
		.000	1.152	.279				
		1.145	.000	937				
		2.300	-1.167	.262				

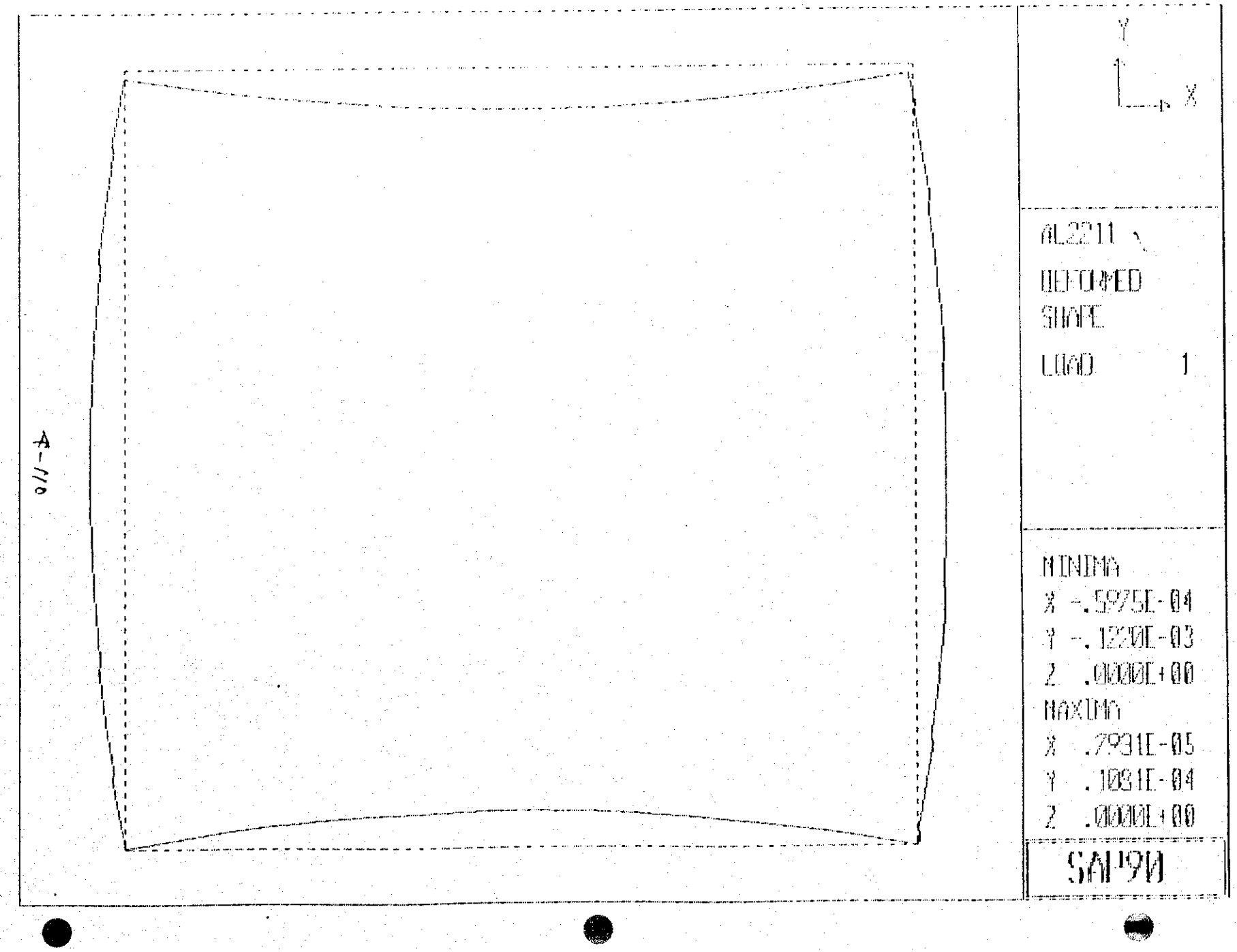
502

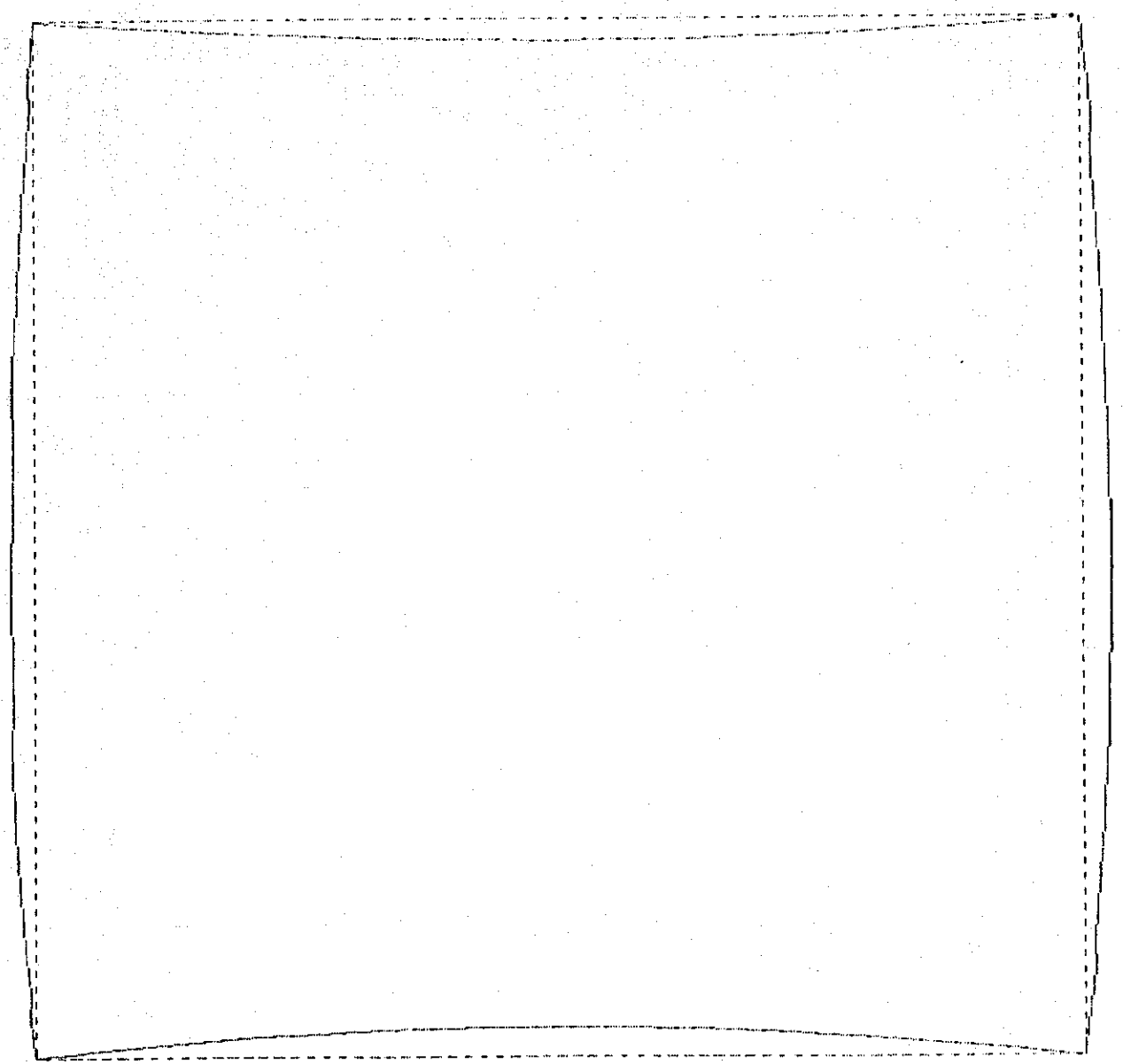
		2.300			1.747			
4								
	1	.000			-13.977			
		.000	5.959	-3.726				
		1.083	.000	-.516				
		2.280	-6.347	-4.338				
		2.290	-6.347	-4.401				
		2.290			-13.977			
	2	.000			-1.167			
		.000	-1.747	.262				
		1.427	.000	-1.401				

ALCANTARILLA 2.0X2.0 h=3.5

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TOR
		2.280	2.710	-.334				
		2.290	2.710	-.307				
		2.290			-1.167			
5								
	1	.000			-13.977			
		.000	-6.347	-4.401				
		.010	-6.347	-4.465				
		.010			-13.977			
	2	.000			-1.167			
		.000	2.710	-.307				
		.010	2.710	-.280				
		.010			-1.167			
6								
	1	.000			.000			
		.000	-16.153	4.403				
		.010	-16.153	4.242				
		.010			.000			
	2	.000			.000			
		.000	-3.459	.307				
		.010	-3.459	.273				
		.010			.000			
7								
	1	.000			.000			
		.000	-16.153	4.242				
		1.138	.000	-4.950				
		2.280	16.207	4.302				
		2.280			.000			
	2	.000			.000			
		.000	-3.459	.273				
		1.144	.000	-1.706				
		2.280	3.435	.245				
		2.280			.000			
8								
	1	.000			.000			
		.000	16.207	4.302				
		.010	16.207	4.465				
		.010			.000			
	2	.000			.000			
		.000	3.435	.245				
		.010	3.435	.280				
		.010			.000			


Y
X
AL2211
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.5975E-04
Y -.1220E-03
Z .0000E+00
MAXIMA
X .7931E-05
Y .1031E-04
Z .0000E+00
SAP90



A-11

Y
Z X

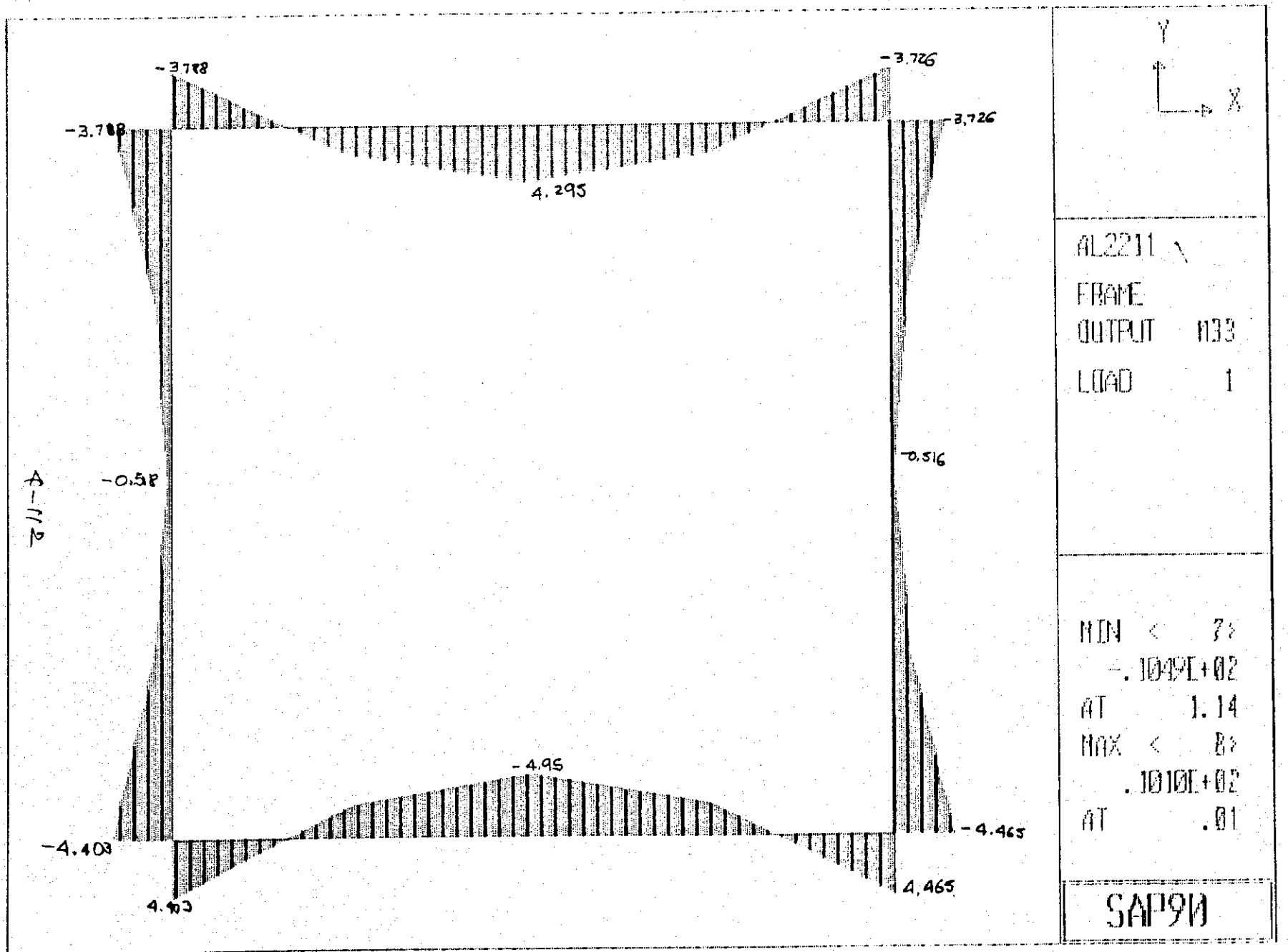
AL2211

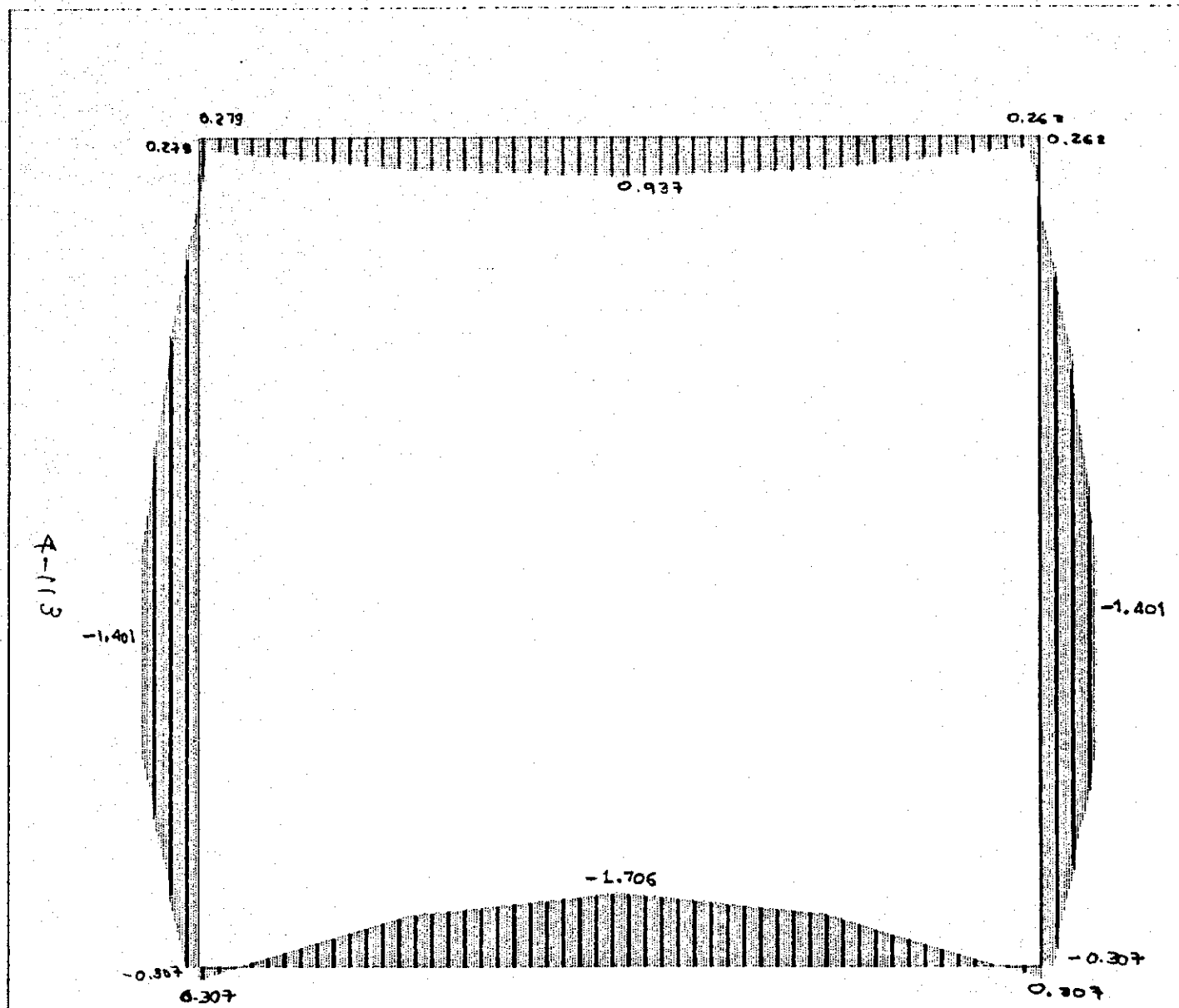
DEFORMED
SHAPE

LOAD 2

MINIMA
X -.2649E-05
Y -.4259E-05
Z .0000E+00
MAXIMA
X .7622E-05
Y .2715E-05
Z .0000E+00

SAP90


-3.788
-3.726
-3.788
-3.726
4.295
-0.516
-0.518
A-112
-4.95
-4.403
-4.465
4.403
4.465
Y
X
AL2211
FRAME
OUTPUT 033
LOAD 1
MIN < 7>
-.1049E+02
AT 1.14
MAX < 8>
.1010E+02
AT .01
SAP90

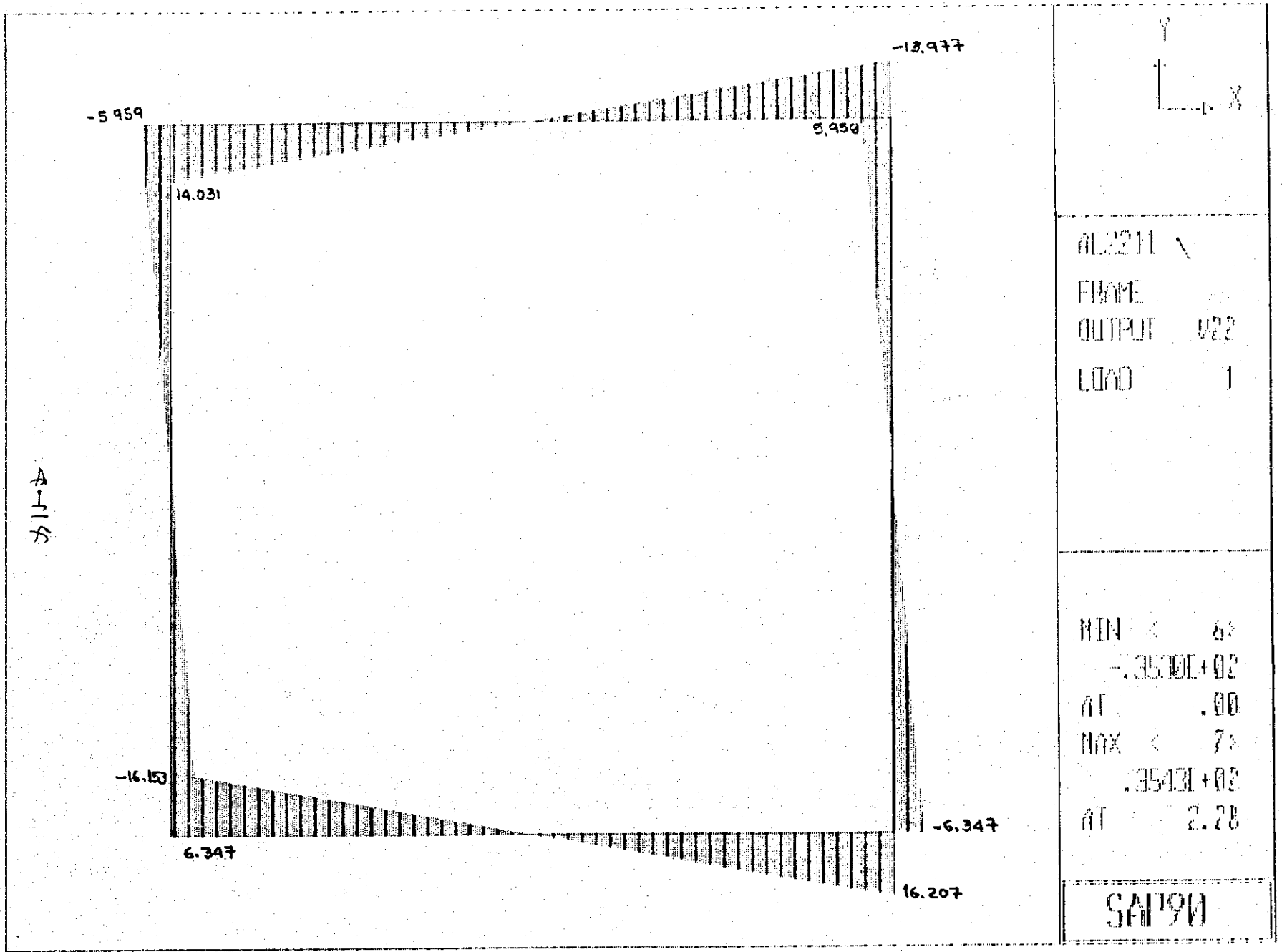


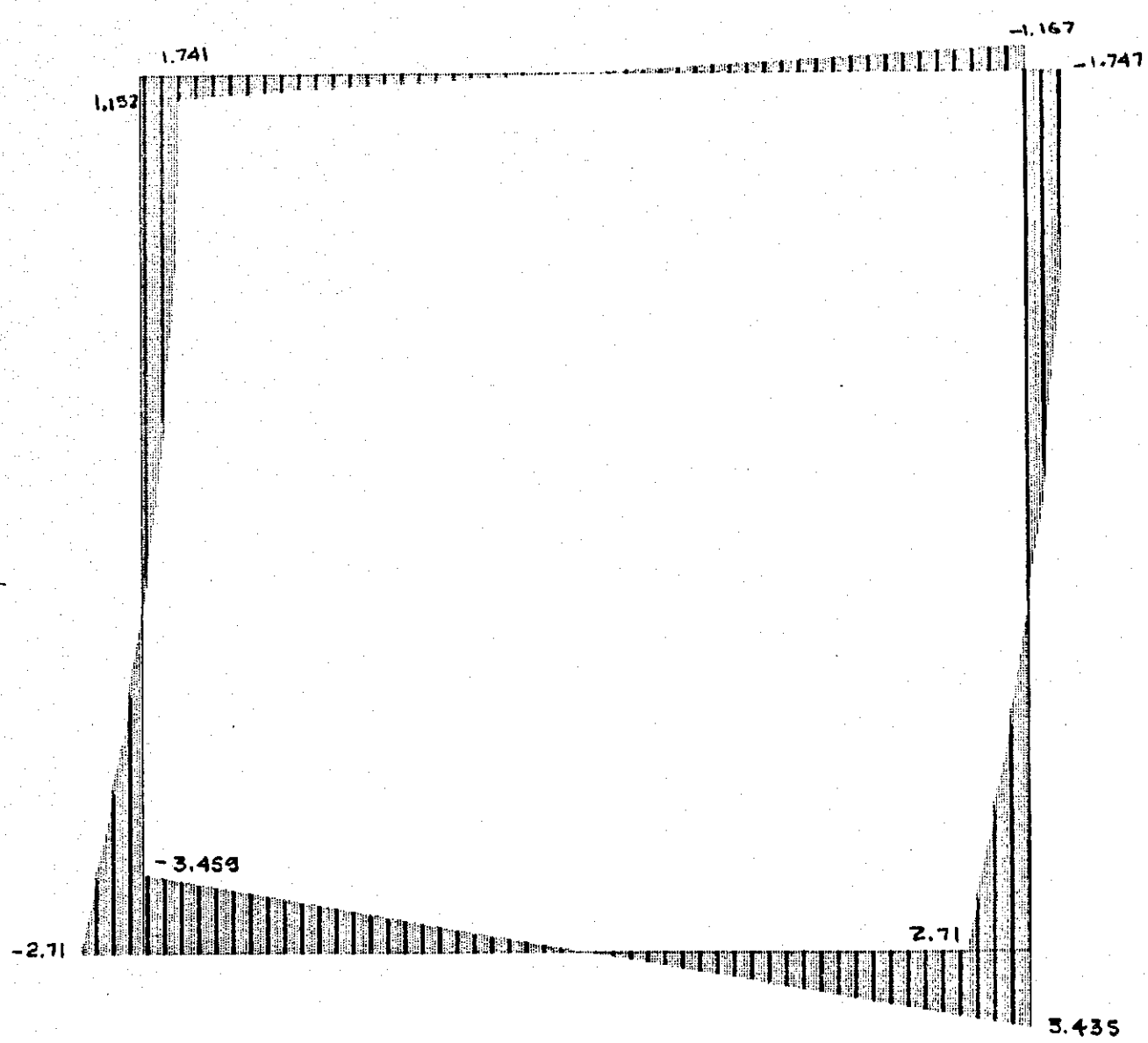
Y
X

AL2211
FRAME
OUTPUT M33
LOAD 2

MIN < 7>
-.1706E+01
AT 1.14
MAX < 3>
.9367E+00
AT 1.15

SAP90


-13.977
-5.959
5.959
14.031
-16.153
-6.347
6.347
16.207
Y
X
AL2211
FRAME
OUTPUT V22
LOAD 1
MIN < 6>
-.3508E+02
AT .00
MAX < 7>
.3543E+02
AT 2.28
SAP90



A-24

Y
↑
└→ X

AL2211
FRAME
OUTPUT V22
LOAD 2

MIN < 6>
-.3459E+01
AT .00
MAX < 7>
.3435E+01
AT 2.28

SAP90

- DATA FOR CALCULATION OF REINFORCEMENT

$f'_c = 180\ Kg/cm^2$

$f_y = 4200\ Kg/cm^2$

$b = 100\ cm$

$d = 23\ cm$

$r = 7\ cm$

$Mu = 4.950\ ton\text{-}mt$

$$As = \frac{4.950 \times 10^5}{0.9 \times 4200\ (23-1)} = 5.952\ cm^2$$

$$a = \frac{5.952 \times 4200}{0.85 \times 180 \times 100} = 1.634\ cm$$

$$\rho = \frac{5.952}{100 \times 23} = 0.00258 < \rho_{min}$$

$$A_s = 0.0033 \times 100 \times 23 = 7.66\ cm^2 \Rightarrow 1\varnothing 12\ @\ 15.5$$

- SHEAR STRESS CHECK

$Vu = 14.031\ ton$

$Vc = 13.9\ ton < Vu$

$Vs = 14.03 - 13.9 =$

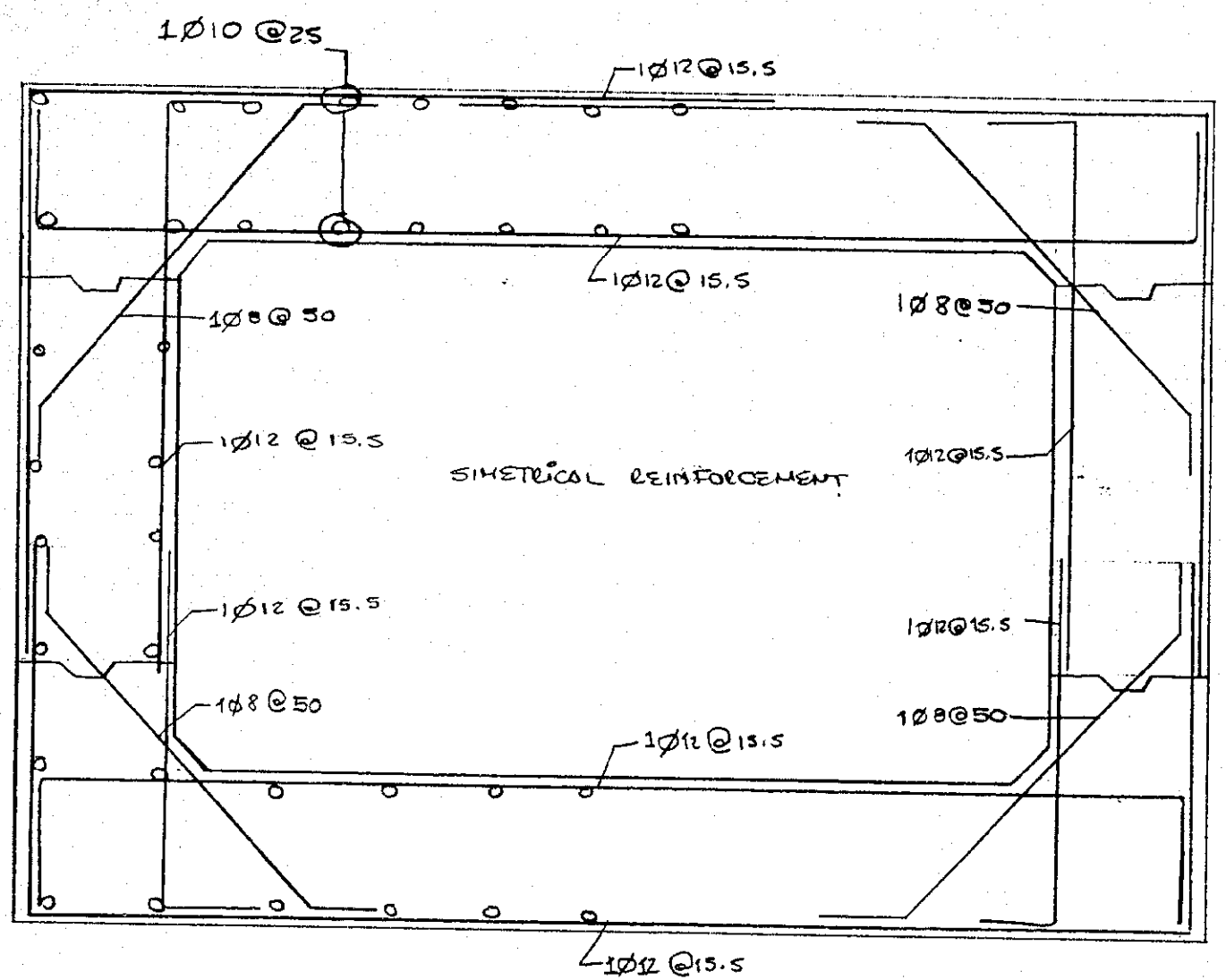
$$A_v = \frac{0.13 \times 10^3}{4200 \times \sin 45} = 0.04\ cm^2$$

$Vs = 16.153 - 13.9 = 2.253\ ton$

$$Av = \frac{2.2530 \times 10^3}{0.85 \times 4200 \times \sin 45} = 0.891 \qquad 1\varnothing 8\ @\ 50$$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approved by: Aprobado por:	Date (Fecha) Aprobado por:

ARMADURA LONGITUDINAL EN AMBAS CARAS.



UNDEFORMED SHAPE

BOX COLVERT

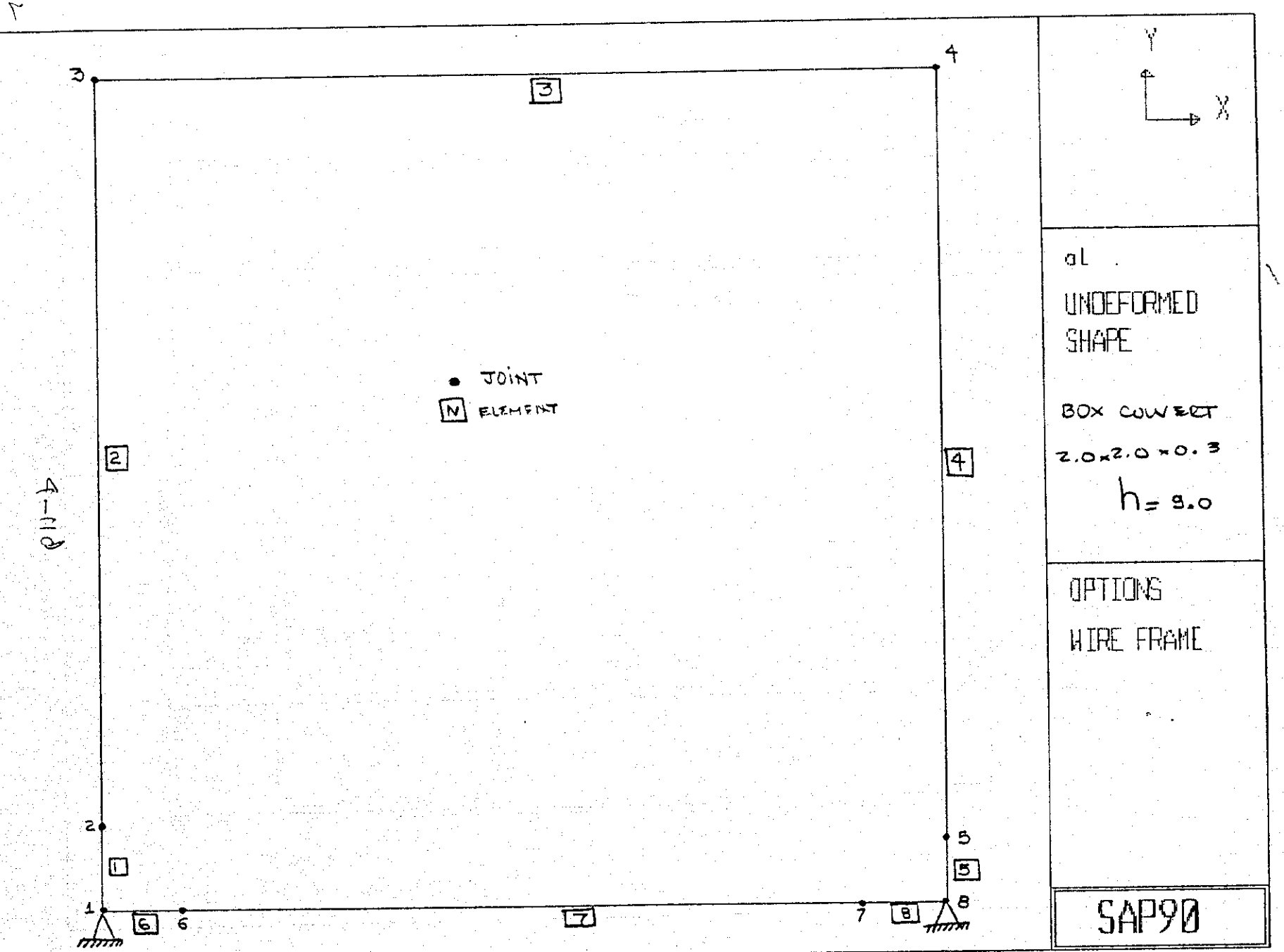
2.0×2.0 ×0.3

h= 3.5.

OPTIONS

WIRE FRAME

SAP90



dL

UNDEFORMED SHAPE

BOX CONVECT

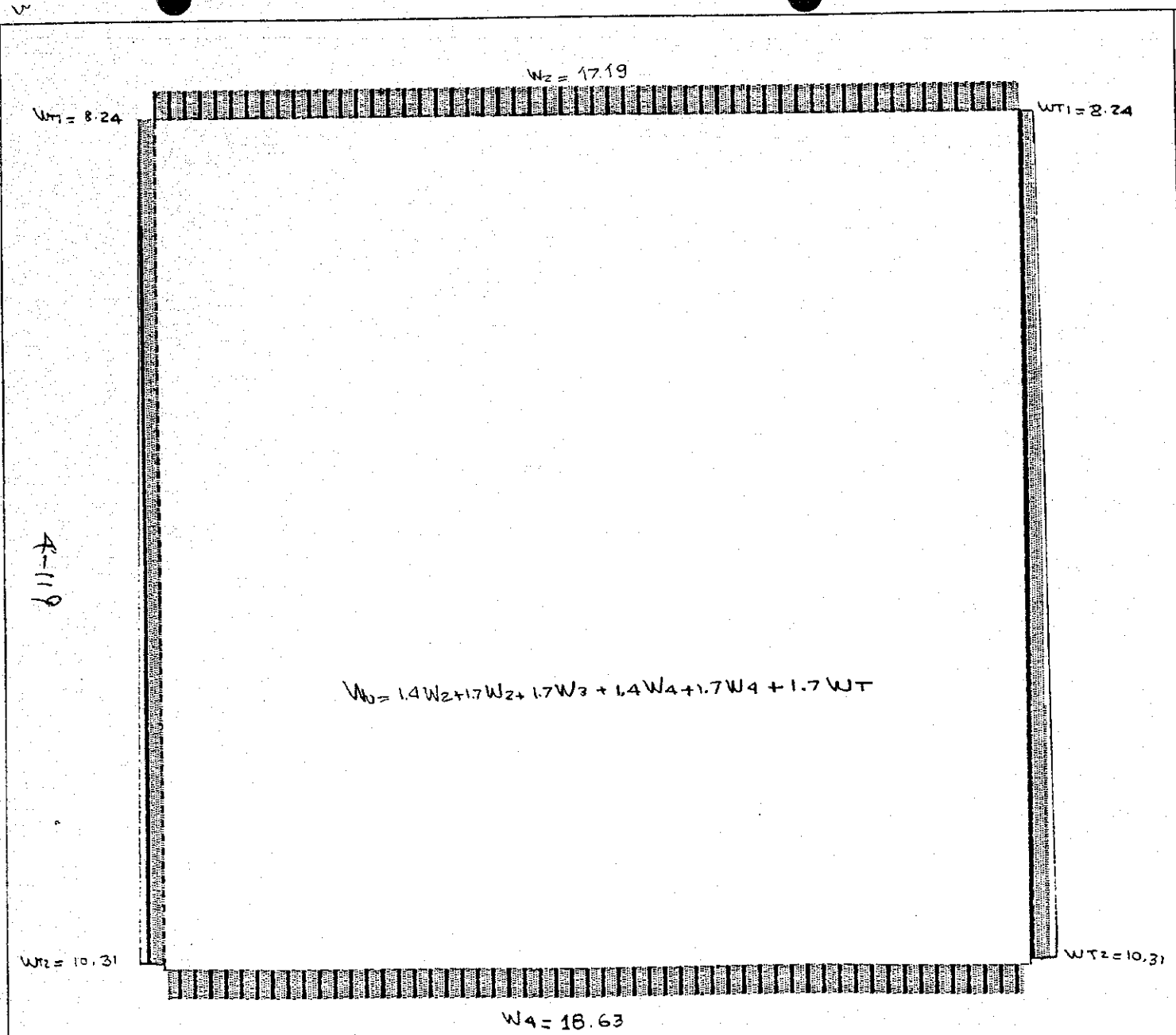
2.0×2.0×0.3

h = 9.0

OPTIONS

WIRE FRAME

SAP90



4-119

Y
X

al

FRAME
LOADS

LOAD 1
ton/mt

MINIMA
u -.9270E+01
P .0000E+00
MAXIMA
u .9270E+01
P .0000E+00

SAP90

Y
X
al
FRAME
LOADS
LOAD 2
ton/mt
MINIMA
M .1500E+01
P .0000E+00
MAXIMA
M .1500E+01
P .0000E+00
SAP90
Wz = 0.72
Pw = 0
Pw = 0
Pw = 2.3
W4 = 1.44
Pw = 2.3
Wu = 1.7 Pw

```
CANTARILLA 2.0X2.0  h=9.0
YSTEM
=4

[illegible]
  X=0     Y=0      Z=0
          Y=0.61
          Y=2.[illegible]
  X=2.3   Y=1.[illegible]
  X=2.[illegible]   Y=.01
  X=[illegible]   Y=0
  X=2.29  Y=0
  X=2.[illegible]   Y=0

[illegible]TRAINTS
 [illegible] 1  R=0,0,1,1,1,0
 [illegible] 7  R=1,[illegible],1,1,0

[illegible]AME
[illegible]2 NL=9
 SH=R [illegible] .70,1 E=2100000.
 SH=R [illegible] .50,1
 WL=0,-16.47        ;w1
 WL=0,-0.72         ;w2
 WL=0,16.47         ;w4
 WL=0,2 [illegible]          ;w4
 WL=0               ;w5
 TRAP=0,-2.30,0,2.29              ;pw izq.
 TRAP=0.[illegible],0,2.290,2.30           ;pw der.
 TRAP=0,-10.[illegible],0,2.2900,-8.24  ;wt isq.
 TRAP=0,-[illegible] 04,0,2.2900,-10.31  ;wt der.
 1 2  M=1            LP=1.0
 1 3            NSL=[illegible],0,0
 3 4            [illegible]=1.7
 4 5            [illegible]=[illegible].7
 [illegible] 6
 1 6  [illegible]=1
 6 7            [illegible]=3,4,0,5
 7 8

[illegible]
 [illegible]=1.7 1.[illegible],1.7,1.7
 [illegible]=0,[illegible]
```

4-121

STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

[illegible]

F R A M E   E L E M E N T   F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			-33.427			
		[illegible]	11.916	-9.942				
		[illegible]	11.918	-9.783				
		[illegible]			-33.427			
	2	[illegible]			-1.152			
		[illegible]	-2.710	-.367				
		[illegible]	-2.710	-.374				
		[illegible]			-1.152			
2								
	1	.000			-33.427			
		.000	17.918	-9.783				
		1.111	.000	-.324				
		2.2[illegible]	-13.574	-9.021				
		2.290	-13.574	-9.377				
		2.290			-33.427			
	2	[illegible]			-1.152			
		.000	-1.710	-.334				
		[illegible]	.000	-1.401				
		2.200	1.747	.261				
		2.290	1.747	.279				
		2.290			-1.152			
3								
	1	.000			-15.574			
		.000	33.427	-9.377				
		1.152	-.000	9.983				
		2.3[illegible]	-33.289	-9.219				
		2.300			-15.574			
	2	.000			1.747			
		.000	1.152	.279				
		1.162	.000	[illegible]				
		[illegible]	[illegible]	[illegible]				

16

		2.300			1.747			
4								
	1	.000			-33.289			
		.000	15.574	-9.219				
		1.119	.000	- 522				
		1.280	-15.918	-9.781				
		2.290	-15.918	-9.940				
		2.290			-33.289			
	2	.000			-1.167			
		.000	-1.747	.262				
		1.427	.000	-1.401				

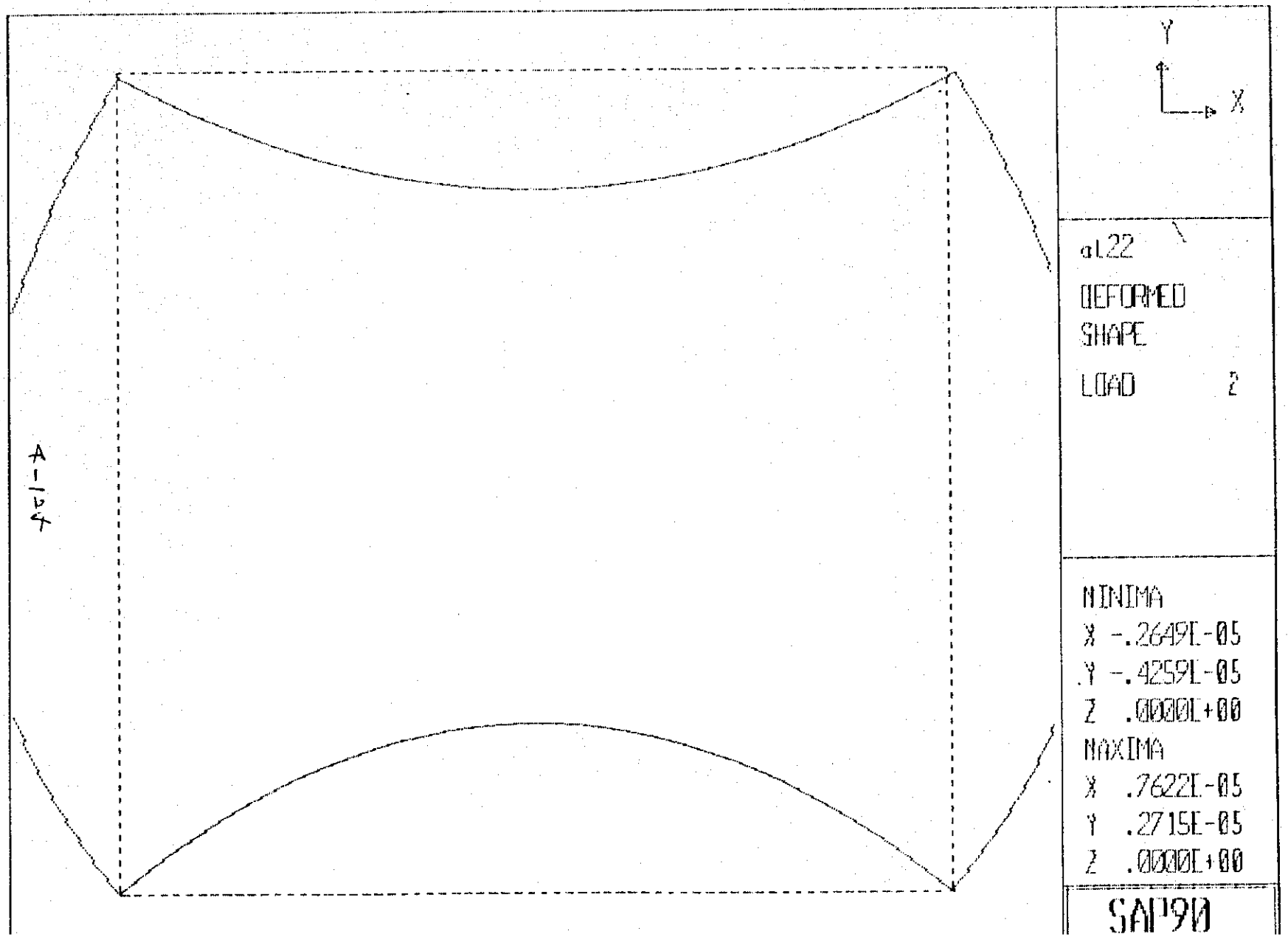
ALCANTARILLA 2.0X2.0 h=9.0

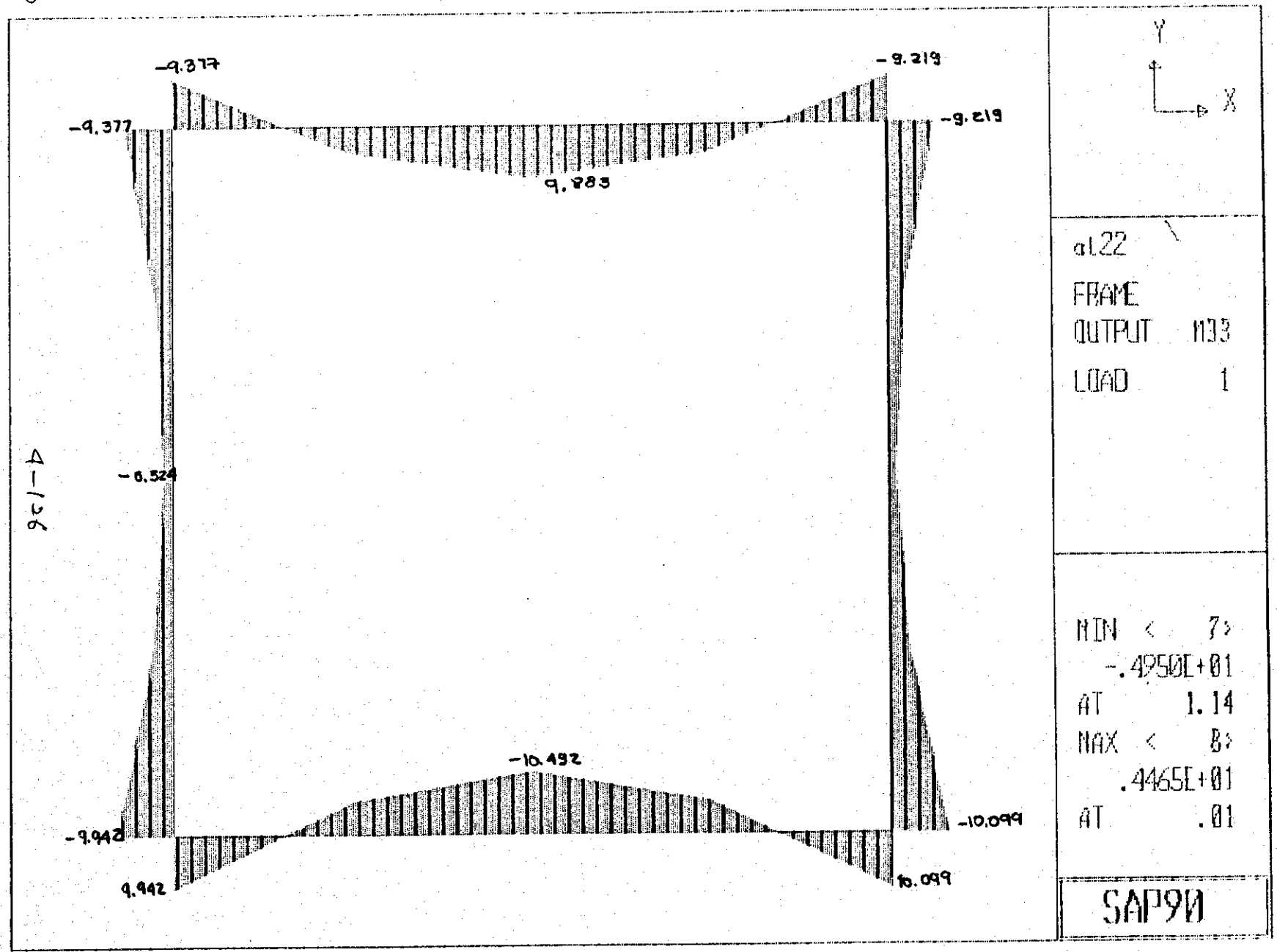
F R A M E E L E M E N T F O R C E S

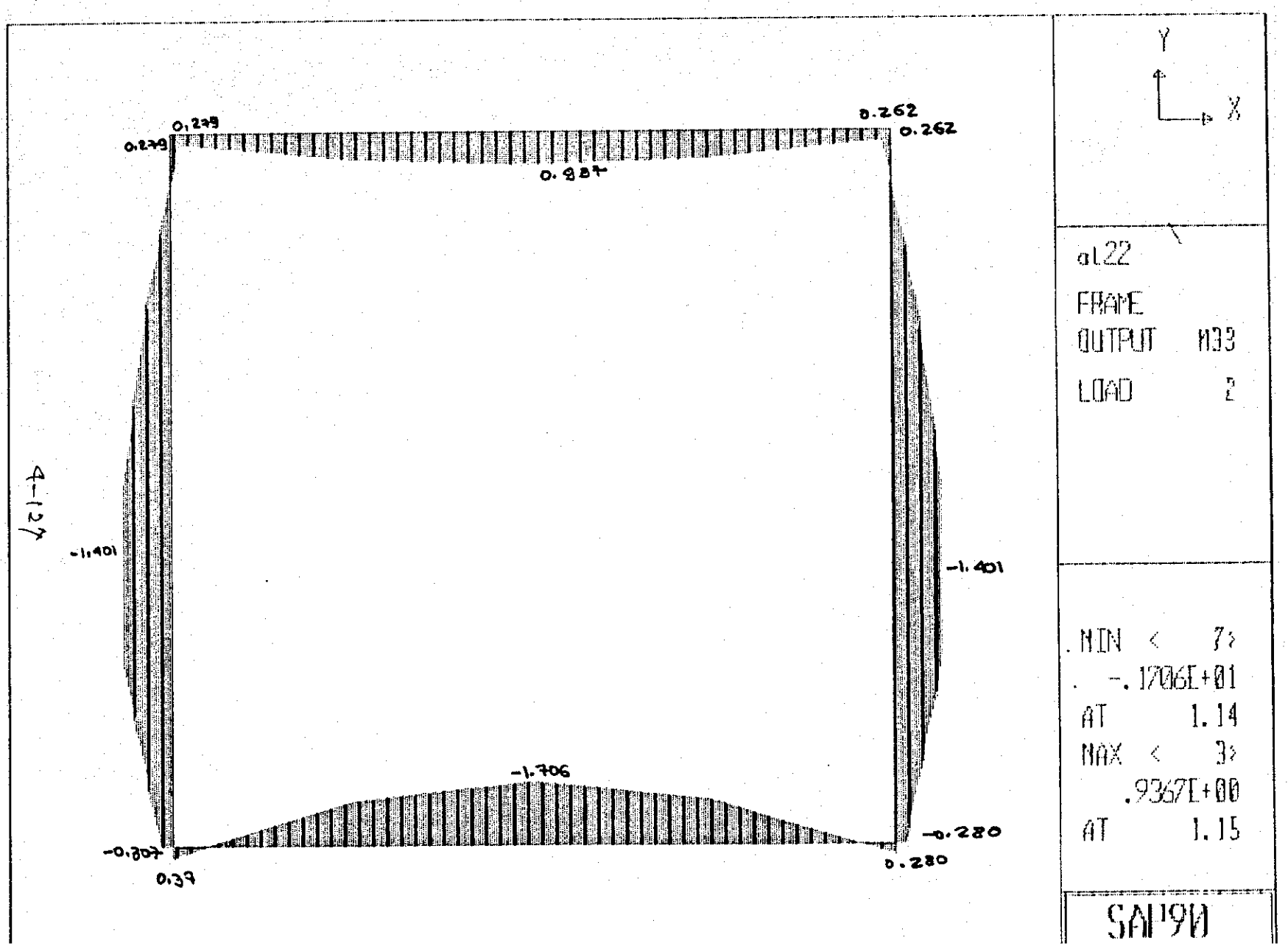
ELT	LOAD	DIST	1-2 PLANE		AXIAL	1-3 PLANE		AXIAL
ID	COMD	END	SHEAR	MOMENT	FORCE	SHEAR	MOMENT	TORQ
		2.280	2.710	-.334				
		2.290	2.710	-.307				
		2.290			-1.167			
5								
	A	.000			-33.289			
		.000	-15.918	-9.940				
		.010	-15.919	-10.099				
		.010			-33.289			
	2	.000			-1.167			
		.000	2.710	-.307				
		.010	2.710	-.280				
		.010			-1.167			
6								
	1	.000			.000			
		.000	-35.298	9.942				
		.010	-35.298	9.589				
		.010			.000			
	2	.000			.000			
		.000	-3.459	.307				
		.010	-3.459	.273				
		.010			000			
7								
	1	.000			.000			
		.000	-35.298	9.589				
		1.138	.000	-10.492				
		2.280	35.435	9.745				
		2.280			.000			
	2	.000			.000			
		.000	-3.459	.273				
		1.144	.000	-1.706				
		2.280	3.435	.243				
		2.280			.000			
8								
	1	.000			.000			
		.000	35.435	9.745				
		.010	35.435	10.099				
		.010			.000			
	2	.000			.000			
		.000	3.435	.243				
		.010	3.435	.280				
		.010			.000			

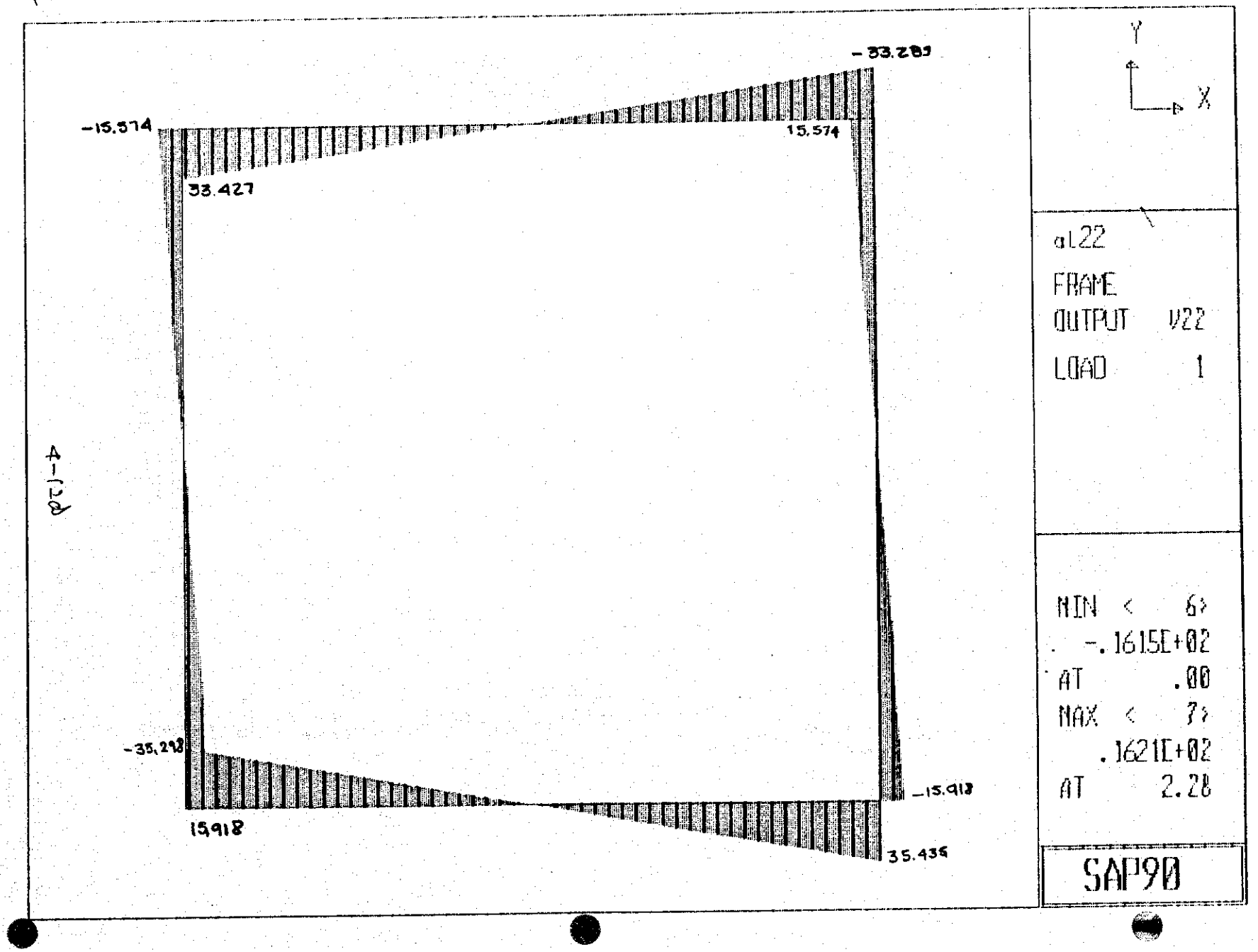
17

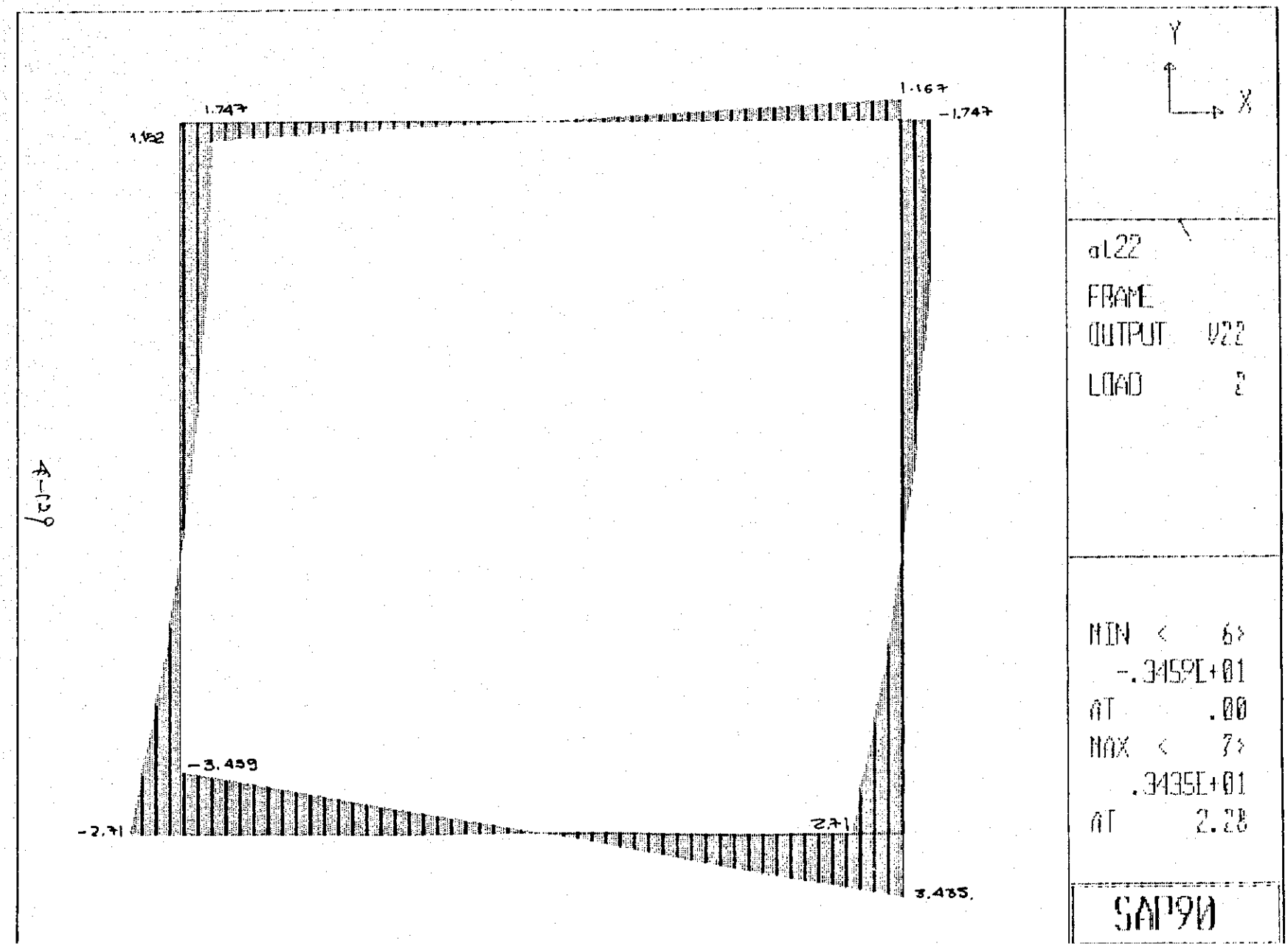
Y
X
a1.22
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.2312E-04
Y -.5122E-04
Z .0000E+00
MAXIMA
X .4047E-05
Y .5307E-05
Z .0000E+00
SAP90


Y
X
al.22
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.2649E-05
Y -.4259E-05
Z .0000E+00
MAXIMA
X .7622E-05
Y .2715E-05
Z .0000E+00
SAP90


-9.377
-9.377
-9.219
-9.219
9.883
-6.524
-10.492
-9.942
-10.099
9.942
10.099
Y
X
al22
FRAME
OUTPUT M33
LOAD 1
MIN < 7>
-.4950E+01
AT 1.14
MAX < 8>
.4465E+01
AT .01
SAP90


Y
X
0.239
0.262
0.262
0.884
-1.401
-1.401
-1.706
-0.280
-0.807
0.280
0.39
al22
FRAME
OUTPUT M33
LOAD 2
MIN < 7>
-.1706E+01
AT 1.14
MAX < 3>
.9367E+00
AT 1.15
SAP90


-33.283
-15.574
15.574
33.427
-35.298
15918
-15.918
35.436
Y
X
aL22
FRAME
OUTPUT V22
LOAD 1
MIN < 6>
-.1615E+02
AT .00
MAX < 7>
.1621E+02
AT 2.28
SAP90


Y
X
1.747
1.167
-1.747
1.152
-3.459
-2.71
2.71
3.435
al22
FRAME
OUTPUT V22
LOAD 2
MIN < 6>
-.3459E+01
AT .00
MAX < 7>
.3435E+01
AT 2.28
SAP90

BOX CULVER 2.0 x 2.0 x 0.3 h = 9.0

— DATA FOR CALCULATION OF REINFORCEMENT.

$f'_c = 180\ kg/cm^2$

$f_y = 4200\ kg/cm^2$

$b = 100$

$d = 23$

$r = 7$

$M_U = 10.492 \cdot tn - mt.$

$$A_s = \frac{10.492 \times 10^5}{0.9 \times 4200 \times 22} = 12.62\ cm^2$$

$$a = \frac{12.62 \times 4200}{0.85 \times 180 \times 100} = 3.46\ cm$$

$$\rho = \frac{12.62}{100 \times 23} = 0.005487 > \rho_{min}$$

CALCULATION FOR DISTRIBUTION REINFORCEMENT.

$\rho_{min} = 0.0018$ $\quad A_s = 0.0018 \times 100 \times 23 = 4.14$ $\quad 1\varnothing 10\ @\ 25$

— SHEAR STRESS CHECK.

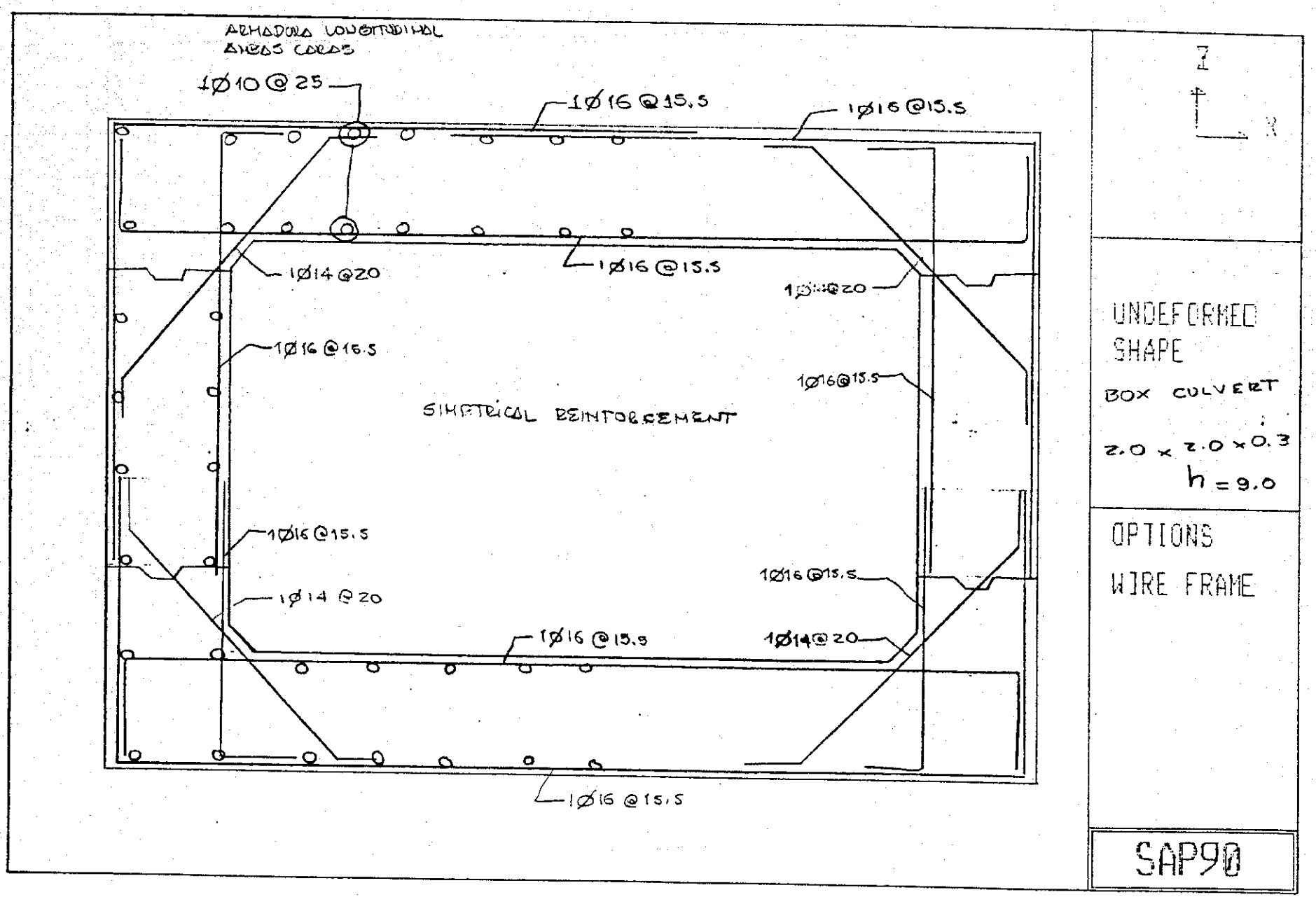
$V_U = 35.298$

$V_C = 13.9$

$V_S = 35.298 - 13.9 = 21.398\ tn.$

$$A_V = \frac{21.3980 \times 10^3}{0.85 \times 4200 \times \sin 45} = 8.47\ cm^2 \quad 1\varnothing 14\ @\ 20$$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


ARMADURA LONGITUDINAL
AREAS CORAS
1Ø10 @ 25
1Ø16 @15.5
1Ø16 @15.5
1Ø14 @20
1Ø16 @15.5
1Ø16 @15.5
1Ø16@15.5
SIMETRICAL REINTORCEMENT
1Ø16 @15.5
1Ø16 @15.5
1Ø14 @20
1Ø16 @15.5
1Ø16 @15.5
1Ø14@20
1Ø16 @15.5
Z
X
UNDEFORMED SHAPE
BOX CULVERT
2.0 x 2.0 x 0.3
h = 9.0
OPTIONS
WIRE FRAME
SAP90

JAPAN INTERNATIONAL COOPERATION AGENCY - AGENCIA INTERNACIONAL DE COOPERACION DEL JAPON

JICA STUDY TEAM - GRUPO DE ESTUDIOS JICA

Date: / Fecha:

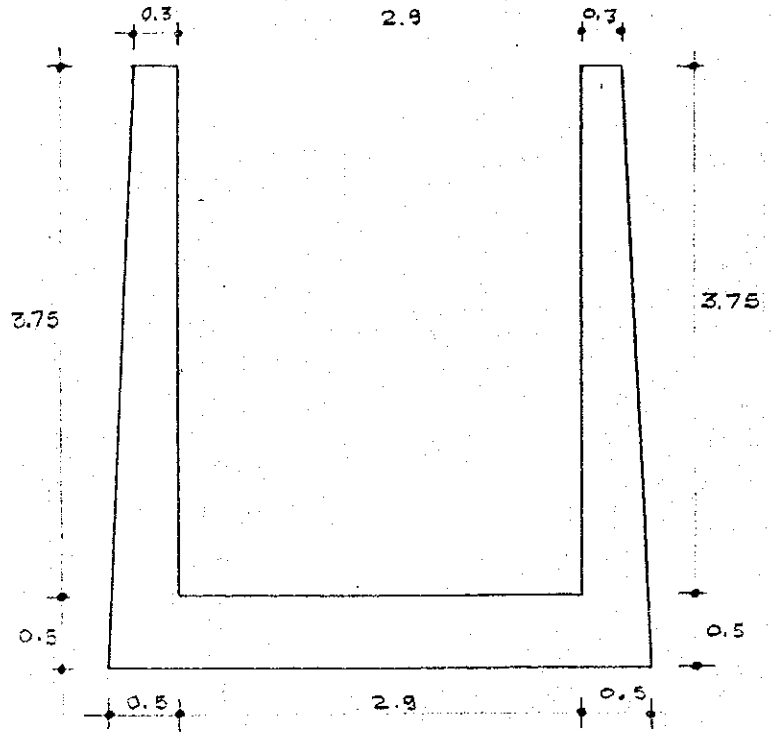
DAULE-PERIPA-LA ESPERANZA TRANSBASIN (TRASVASE DAULE PERIPA-LA ESPERANZA)

Calculated by: / Calculado por:

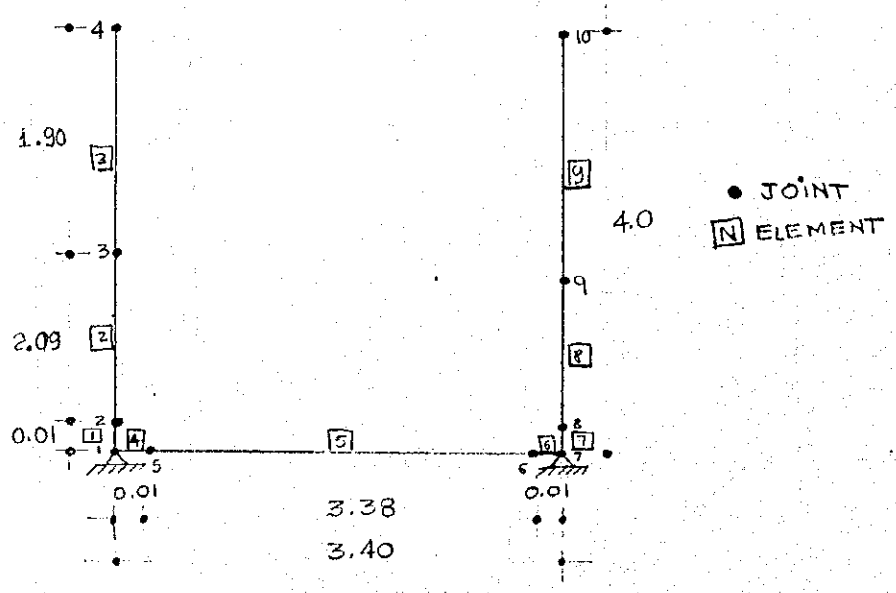
MEMBRILLO OUTLET ACCESS ROAD (CAMINO DE ACCESO SALIDA MEMBRILLO)

Sheet / Hoja: of 1 / de

TRANSITION - SHAPE AND DIMENSIONS



SHAPE AND DIMENSIONS FOR ANALYSIS AND DESIGN

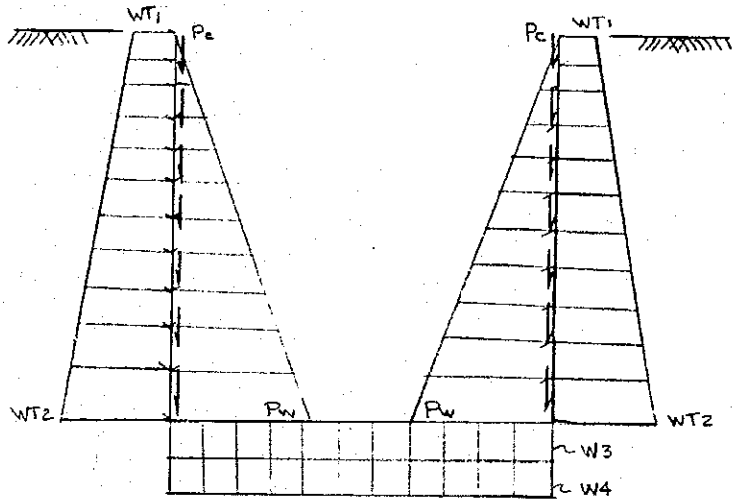


Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approved by: Aprobado por:	Date (Fecha) Aprobado por:

ANALYSIS AND DESIGN OF THE TRANSITION

- THE LOADS APPLIED IN THE DESIGN OF TRANSITION ARE AS FOLLOWS :

W1 = LIVE LOAD OF HS-20-44 TRAILER
W3 = SURCHARGE OF THE OUTLET ACT ON BOTTOM SLAB
W4 = REACTION LOAD ACT ON BOTTOM SLAB
WT = LATERAL EARTH PRESSURE
Pw = LATERAL WATER PRESSURE
Pc = LOAD OF CONCRETE.



DATA

$\gamma_{SOIL} = 1.9\ T/m^3$ UNIT WEIGHT
$\gamma_{CONCRETE} = 2.4$ " "
$K_a = 0.5$ COEFFICIENT OF EARTH PRESSURE
$f'_c = 210\ Kg/cm^2$
$f_y = 4200\ Kg/cm^2$
$E_c = 2.1 \times 10^5\ Kg/cm^2$
$E_s = 2.1 \times 10^6\ Kg/cm^2$

CASE / SECCION	W1	W2	W3	W4	WT1	WT2	Pc	Pw
MIDDLE				2.26	0.585	4.19	3.84	4.0

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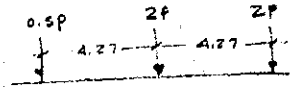
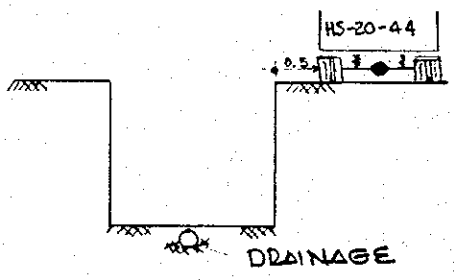
CALCULATION FOR LOADS

SURCHARGE HS-20-44





$W = 40.000$ lb

$2P = 0.8W$

$P = 7.30$ ton.

$W_1 = \frac{14.60}{4.27 \times 3.05} = 1.12\ T/m^2$ $\quad \gamma_{SOIL} = 1.8\ T/m^3$ UNIT WEIGHT

$h'_s = \frac{1.12}{1.80} = 0.622$ m (SOIL EQUIVALENT HEIGTH)

AASHTO $h's$ min $= 0.65$ mt.

$P_c = 0.3 \times 2.4 \times 4.00 + \frac{0.2 \times 4.0}{2} \times 2.4 = 3.84$

$W_1 = 0.65$ mt of SURCHARGE OF SOIL

$W_3 = 1 \times \frac{4.0}{2} = 2.00\ T/ml$ (WITHOUT DRAINAGE), $W_3 = 0$ (WITH DRAINAGE)

$W_4 = \frac{3.84 \times 2}{3.4} = 2.26\ T/ml$

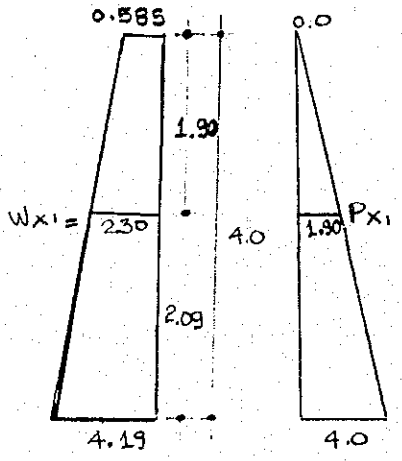
$W_{T1} = 0.65 \times 1.8 \times 0.5 = 0.585\ T/ml$

$W_{T2} = 4.65 \times 1.8 \times 0.5 = 4.19\ T/ml$

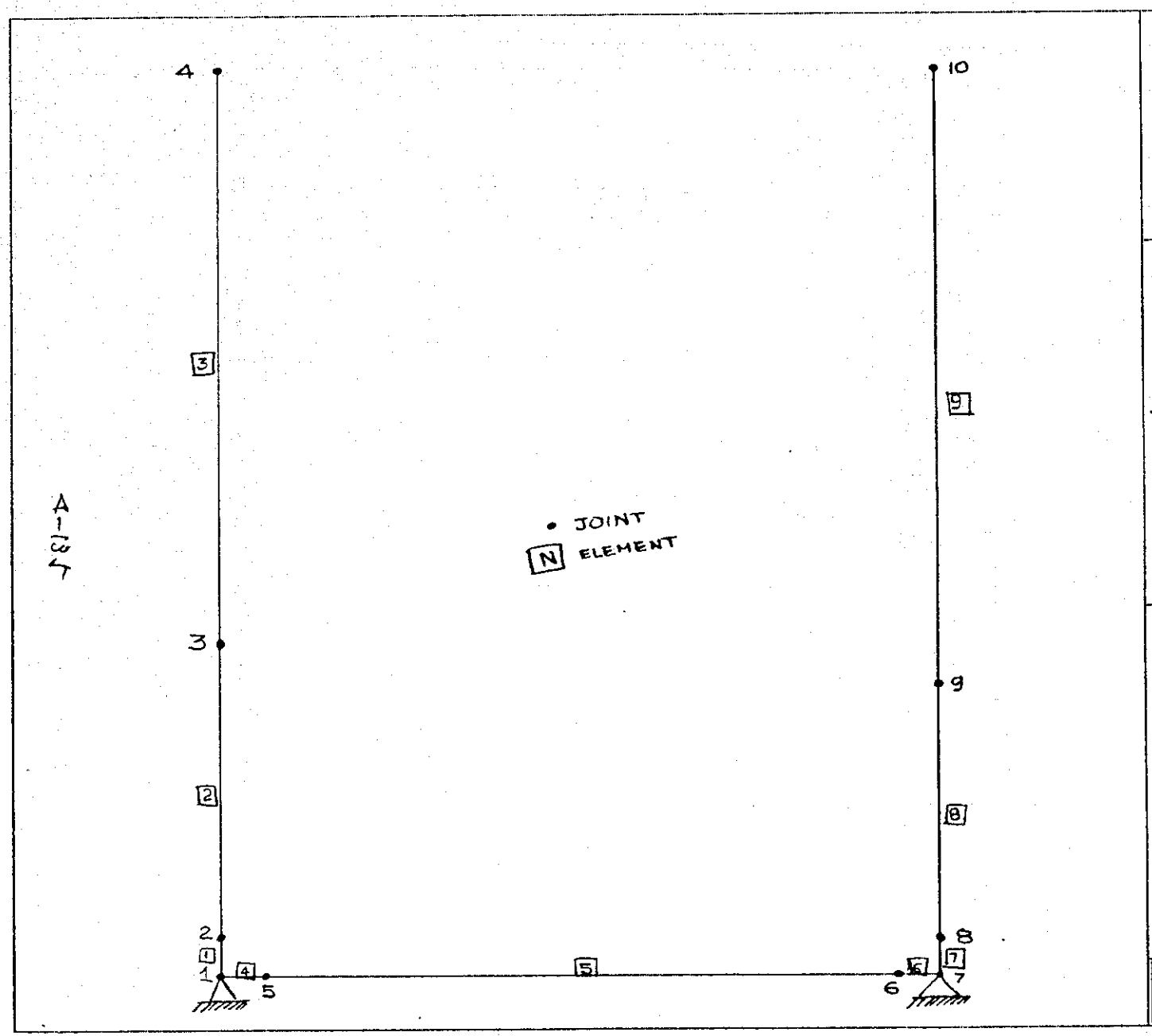
$P_W = 1.0 \times 4.00 = 4.00\ T/ml$

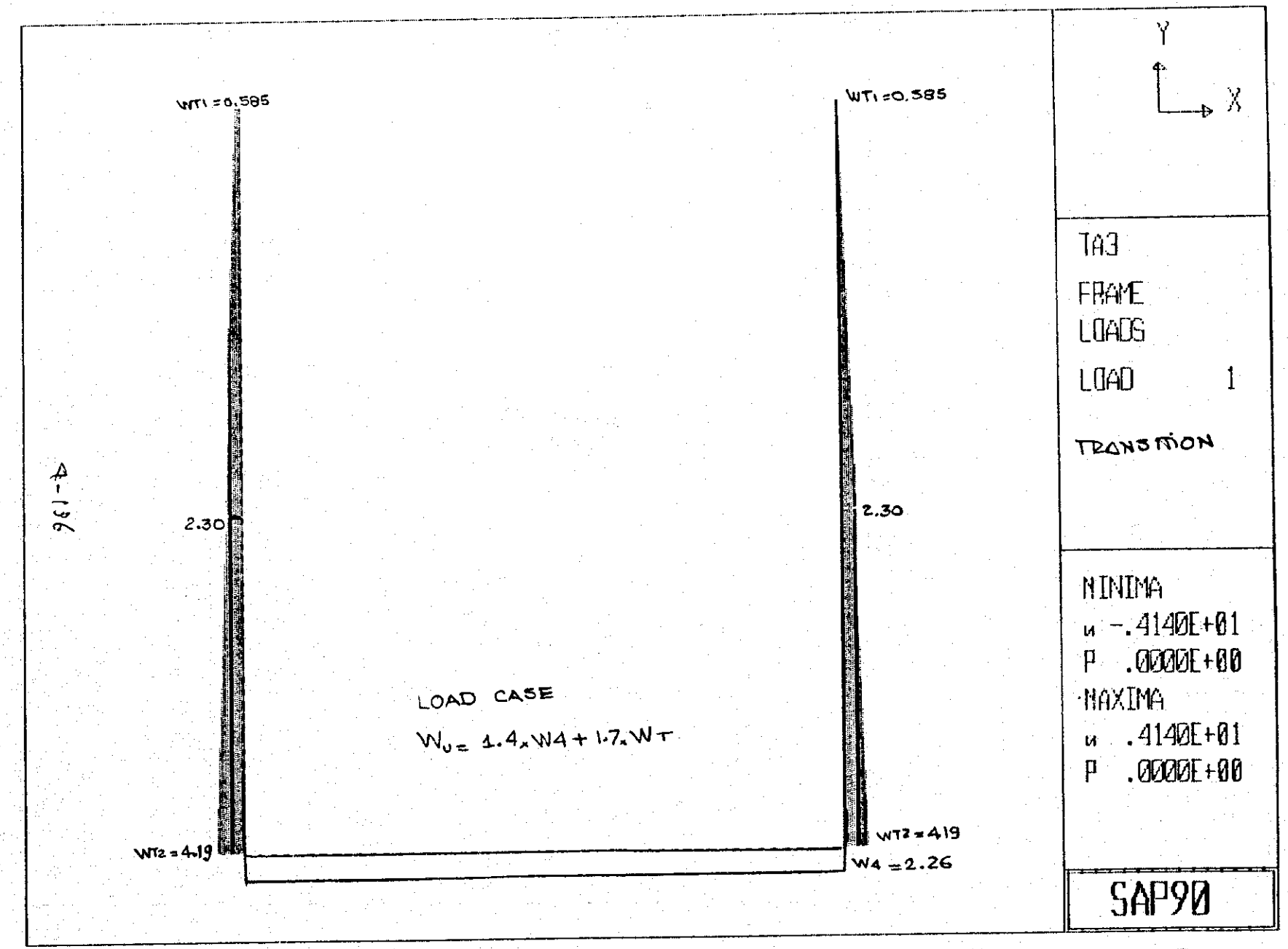
$\frac{4.00}{(4.19 - 0.585)} = \frac{1.90}{X_1} \Rightarrow W_{X_1} = 1.71 + 0.585 = 2.297$

$\frac{4.00}{4.00} = \frac{1.90}{P_{X_1}} \Rightarrow P_{X_1} = 1.90$

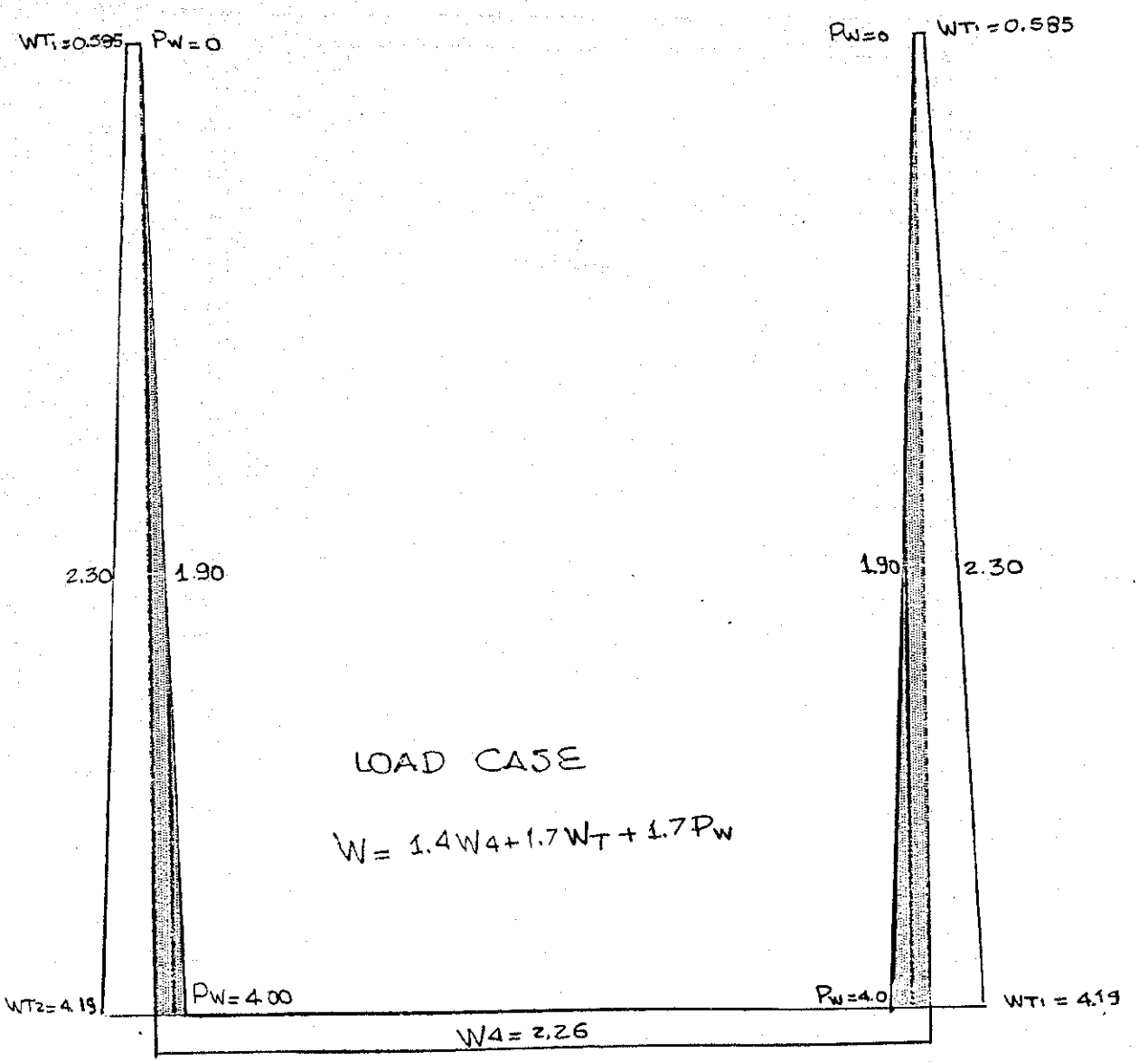


Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


4
10
3
9
3
9
2
8
2
8
1
7
1
5
6
7
5
JOINT
N ELEMENT
Y
X
TA3
UNDEFORMED
SHAPE
TRANSITION
OPTIONS
WIRE FRAME
SAP90


WT1 = 0.585
WT1 = 0.585
2.30
2.30
WT2 = 4.19
WT2 = 4.19
W4 = 2.26
LOAD CASE
$W_u = 1.4 \times W4 + 1.7 \times WT$
Y
X
TA3
FRAME
LOADS
LOAD 1
TRANSION
MINIMA
U -.4140E+01
P .0000E+00
MAXIMA
U .4140E+01
P .0000E+00
SAP90

4-196



Y
X

TA3

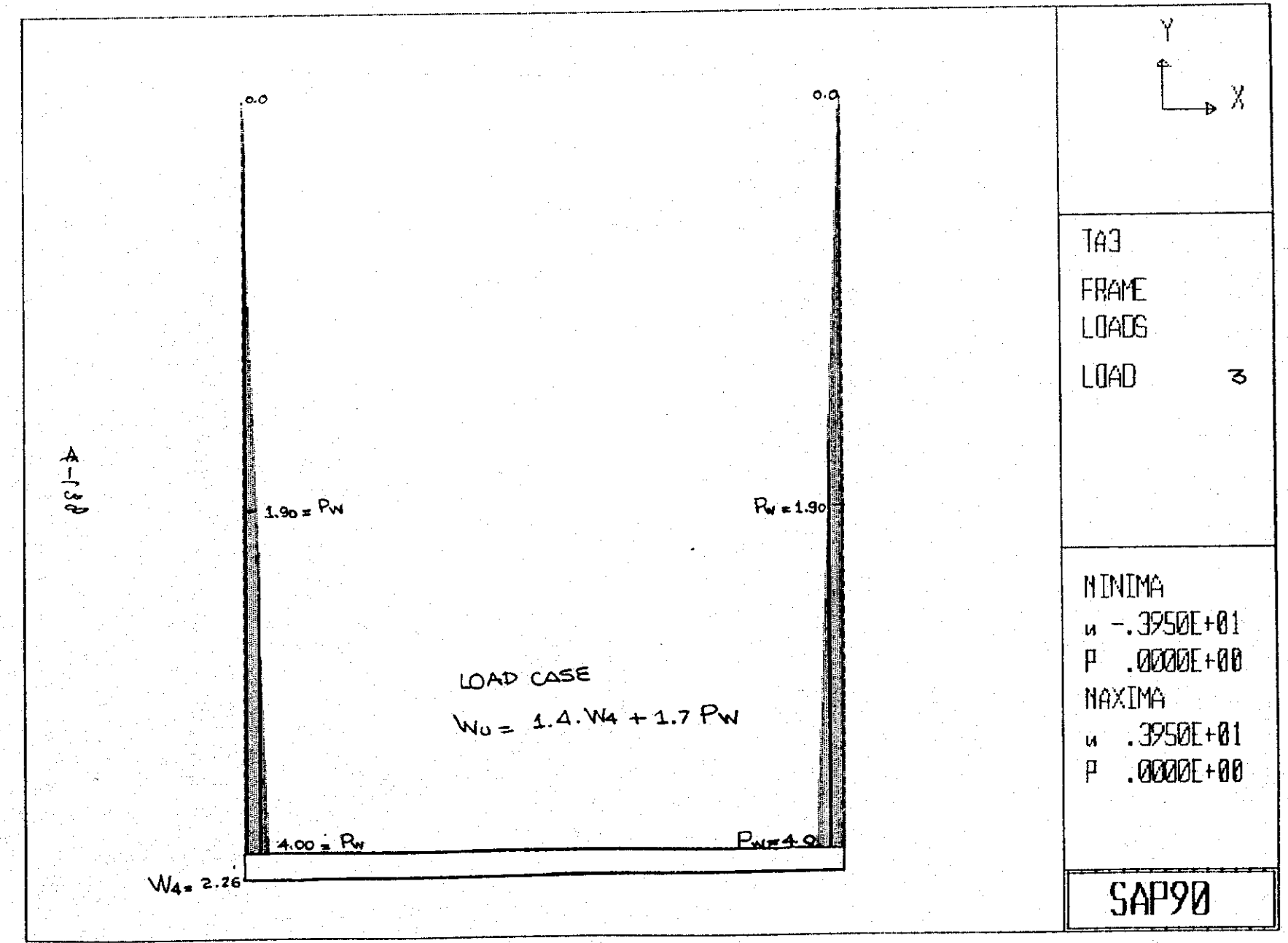
FRAME
LOADS

LOAD 2.

MINIMA
u -.3950E+01
P .0000E+00
MAXIMA
u .3950E+01
P .0000E+00

SAP90

A-134


Y
X
TA3
FRAME
LOADS
LOAD 3
0.0
0.0
1.90 = Pw
Pw = 1.90
LOAD CASE
Wu = 1.4.W4 + 1.7 Pw
4.00 = Pw
Pw = 4.00
W4 = 2.26
MINIMA
U -.3950E+01
P .0000E+00
MAXIMA
U .3950E+01
P .0000E+00
SAP90

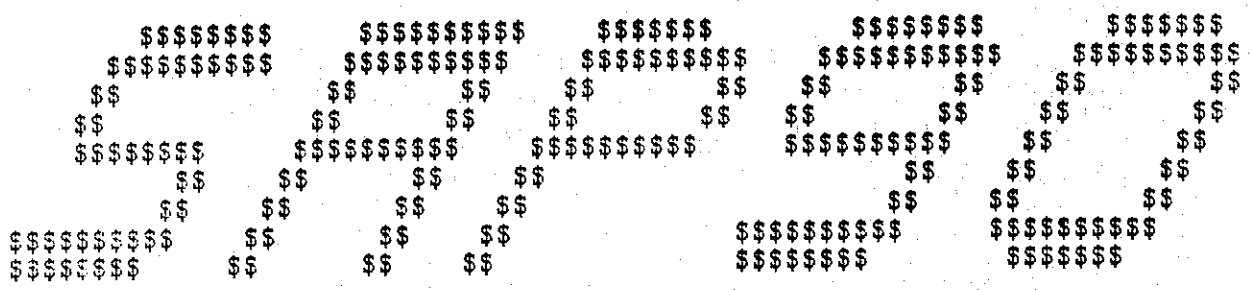
```
TRANSICION
SYSTEM
L=3

JOINTS
1    X=0    Y=0     Z=0
2           Y=0.01
3           Y=2.10
4           Y=4.00
5    X=.01  Y=0
6    X=3.39
7    X=3.40
8    X=3.40 Y=0.01
9    X=3.40 Y=2.10
10   X=3.40 Y=4.00

RESTRAINTS
1 10 1   R=0,0,1,1,1,0
1 7 6    R=1,1,1,1,1,0

FRAME
NM=3 NL=12
1 SH=R T=.50,1 E=2100000.
2 SH=R T=.395,1
3 SH=R T=.30,1
1 WL=0,2.26   :w4
2 WL=0,2.00   :w3
3 TRAP=0,-4.19,0,2.09,-2.297
4 TRAP=0,4.00,0,2.09,1.9
5 wl=0
6 TRAP=0,4.19,0,2.09,2.297
7 TRAP=0,-4.00,0,2.09,-1.9
8 TRAP=0,-2.297,0,1.90,-0.585
9 TRAP=0,2.297,0,1.90,0.585
10 TRAP=0,1.90,0,1.90,0.0
11 TRAP=0,-1.90,0,1.90,0.00
12 wl=0
1 1 2   M=1      nsl=0     LP=1,0
2 2 3   m=1,2,1  NSL=3,4
3 3 4   m=2,3,1  nsl=8,10
4 1 5   M=1      nsl=0
5 5 6   M=1      NSL=5,0,1
6 6 7   m=1      nsl=0
7 7 8   m=1      nsl=0
8 8 9   m=1,2,1  nsl=6,7
9 9 10  m=2,3,1  nsl=9,11

combo
1 c=1.7,0,1.4
2 c=1.7,1.7,1.4
3 c=0,1.7,1.4
```



STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

ANSICION

R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1								
	1	.000			.000			
		.000	16.179	-24.307				
		.010	16.179	-24.145				
		.010			.000			
	2	.000			.000			
		.000	2.629	-6.161				
		.010	2.629	-6.135				
		.010			.000			
	3	.000			.000			
		.000	-13.550	18.146				
		.010	-13.550	18.010				
		.010			.000			
2								
	1	.000			.000			
		.000	16.179	-24.145				
		2.090	4.654	-3.546				
		2.090			.000			
	2	.000			.000			
		.000	2.629	-6.135				
		2.090	1.586	-1.603				
		2.090			.000			
	3	.000			.000			
		.000	-13.550	18.010				
		2.090	-3.068	1.943				
		2.090			.000			
3								
	1	.000			.000			
		.000	4.654	-3.546				
		1.900	.000	.000				

TRANSICION

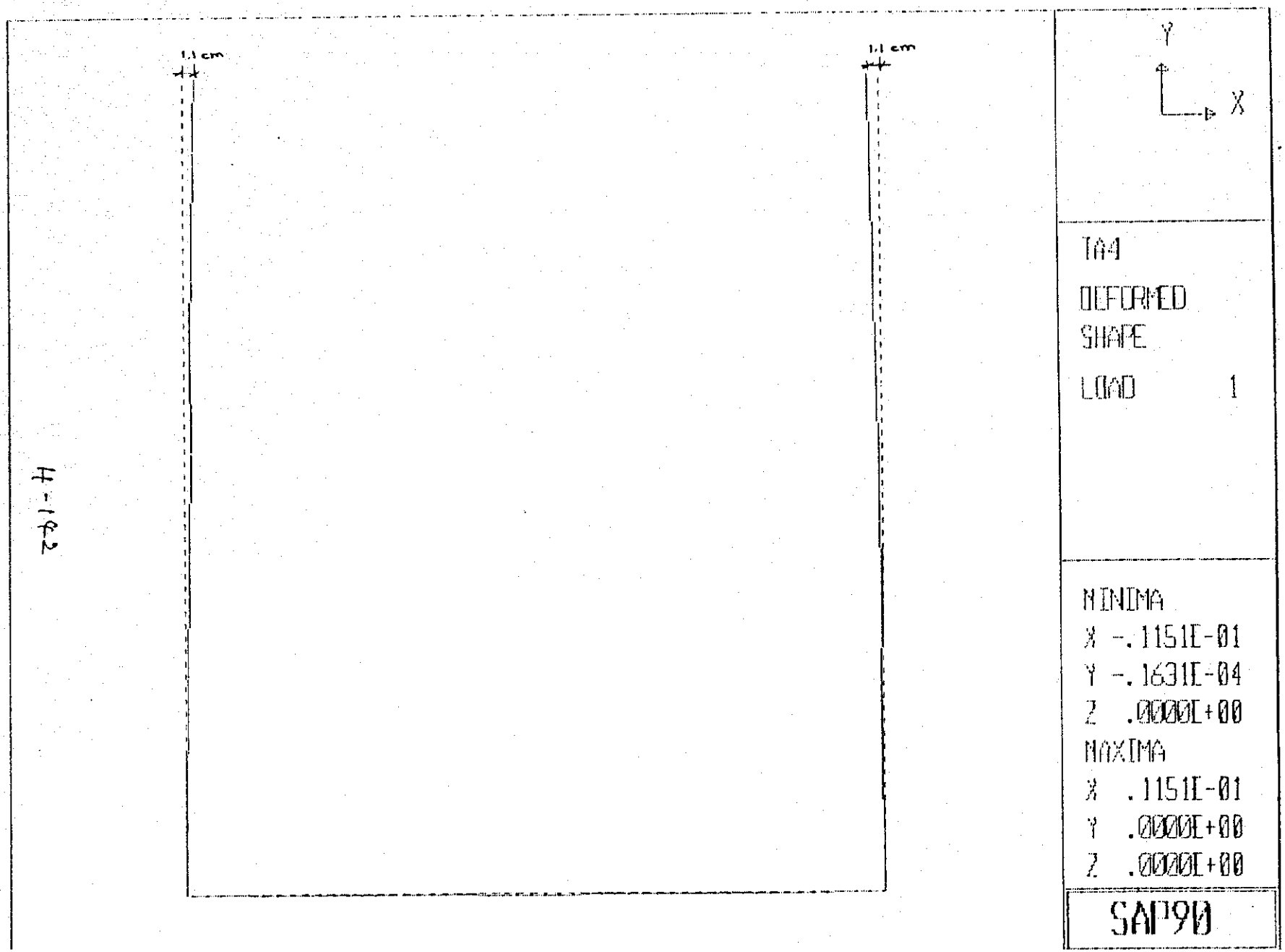
F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
		1.900			.000			
	2	.000			.000			
		.000	1.586	-1.603				
		1.900	.000	.000				
		1.900			.000			
	3	.000			.000			
		.000	-3.068	1.943				
		1.900	.000	.000				
		1.900			.000			
4								
	1	.000			.000			
		.000	-5.347	24.307				
		.010	-5.347	24.254				
		.010			.000			
	2	.000			.000			
		.000	-5.347	6.161				
		.010	-5.347	6.108				
		.010			.000			
	3	.000			.000			
		.000	-5.347	-18.146				
		.010	-5.347	-18.199				
		.010			.000			
5								
	1	.000			.000			
		.000	-5.347	24.254				
		1.690	.000	19.735				
		3.380	5.347	24.254				
		3.380			.000			
	2	.000			.000			
		.000	-5.347	6.108				
		1.690	.000	1.590				
		3.380	5.347	6.108				
		3.380			.000			
	3	.000			.000			
		.000	-5.347	-18.199				
		1.690	.000	-22.717				
		3.380	5.347	-18.199				
		3.380			.000			
6								
	1	.000			.000			
		.000	5.347	24.254				
		.010	5.347	24.307				
		.010			.000			
	2	.000			.000			
		.000	5.347	6.108				
		.010	5.347	6.161				
		.010			.000			
	3	.000			.000			
		.000	5.347	-18.199				
		.010	5.347	-18.146				

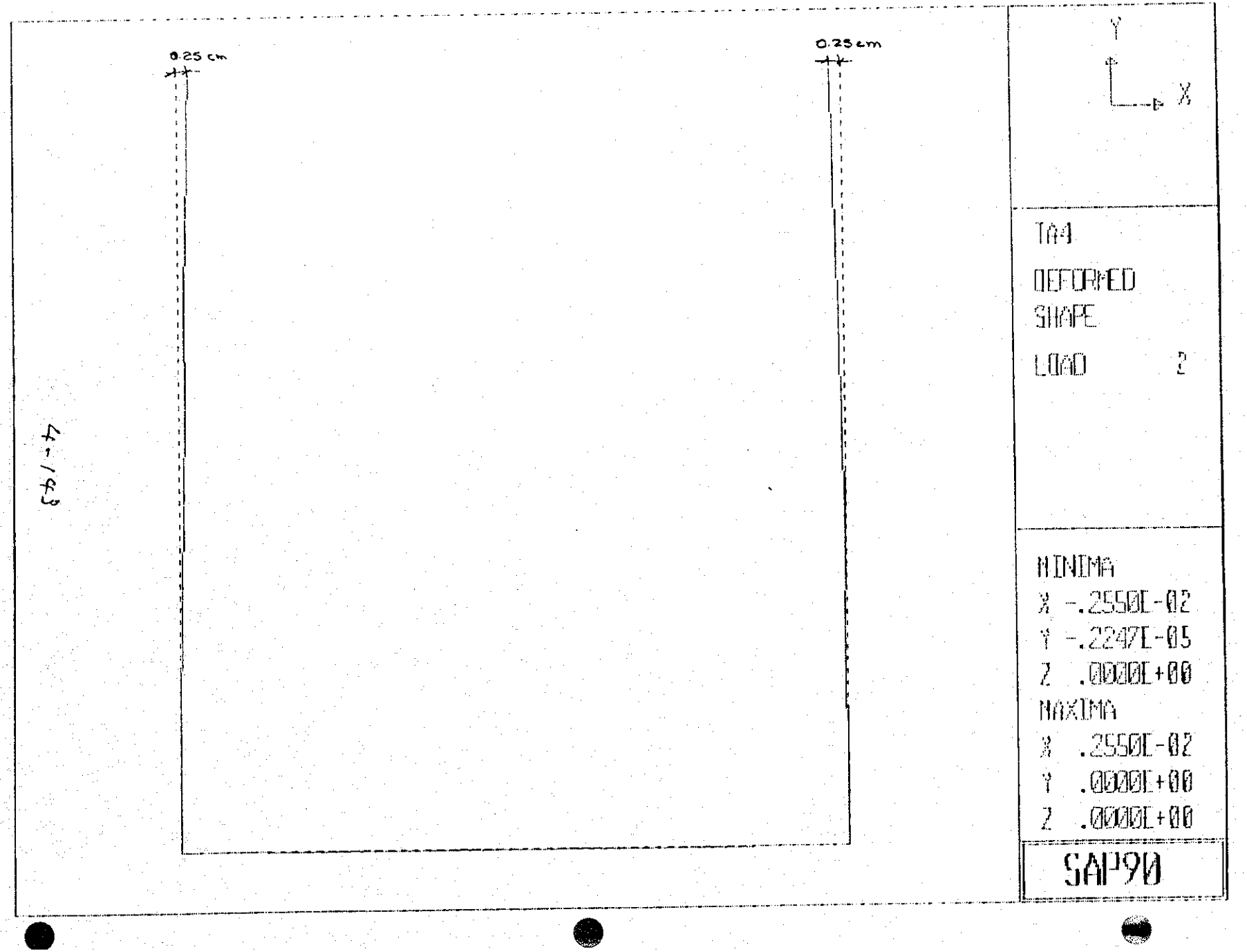
TRANSICION

F R A M E E L E M E N T F O R C E S

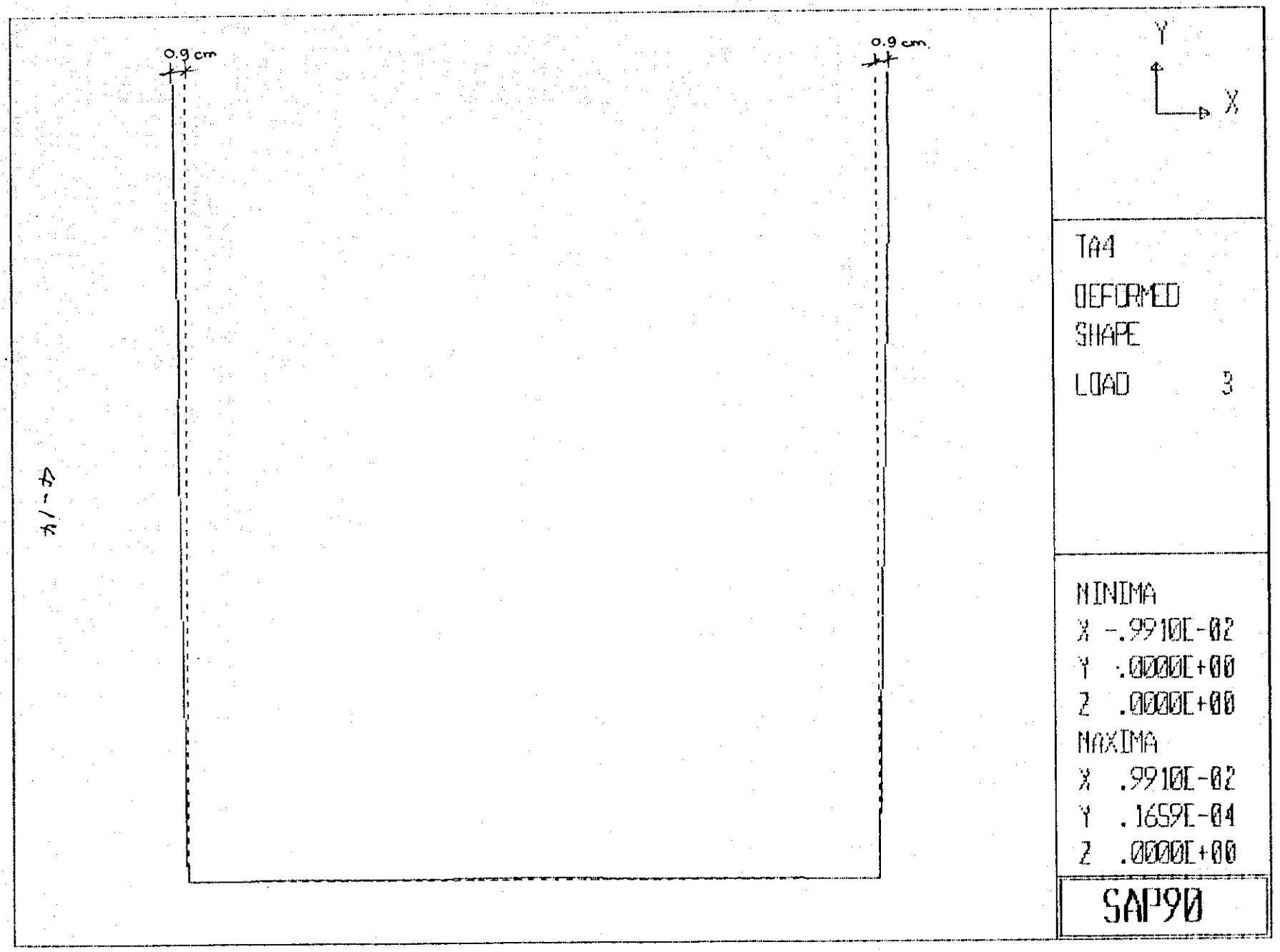
ELT	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
		.010			.000			
7								
	1	.000			.000			
		.000	-16.179	24.307				
		.010	-16.179	24.145				
		.010			.000			
	2	.000			.000			
		.000	-2.629	6.161				
		.010	-2.629	6.135				
		.010			.000			
	3	.000			.000			
		.000	13.550	-18.146				
		.010	13.550	-18.010				
		.010			.000			
8								
	1	.000			.000			
		.000	-16.179	24.145				
		2.090	-4.654	3.546				
		2.090			.000			
	2	.000			.000			
		.000	-2.629	6.135				
		2.090	-1.586	1.603				
		2.090			.000			
	3	.000			.000			
		.000	13.550	-18.010				
		2.090	3.069	-1.943				
		2.090			.000			
9								
	1	.000			.000			
		.000	-4.654	3.546				
		1.900	.000	.000				
		1.900			.000			
	2	.000			.000			
		.000	-1.586	1.603				
		1.900	.000	.000				
		1.900			.000			
	3	.000			.000			
		.000	3.069	-1.943				
		1.900	.000	.000				
		1.900			.000			

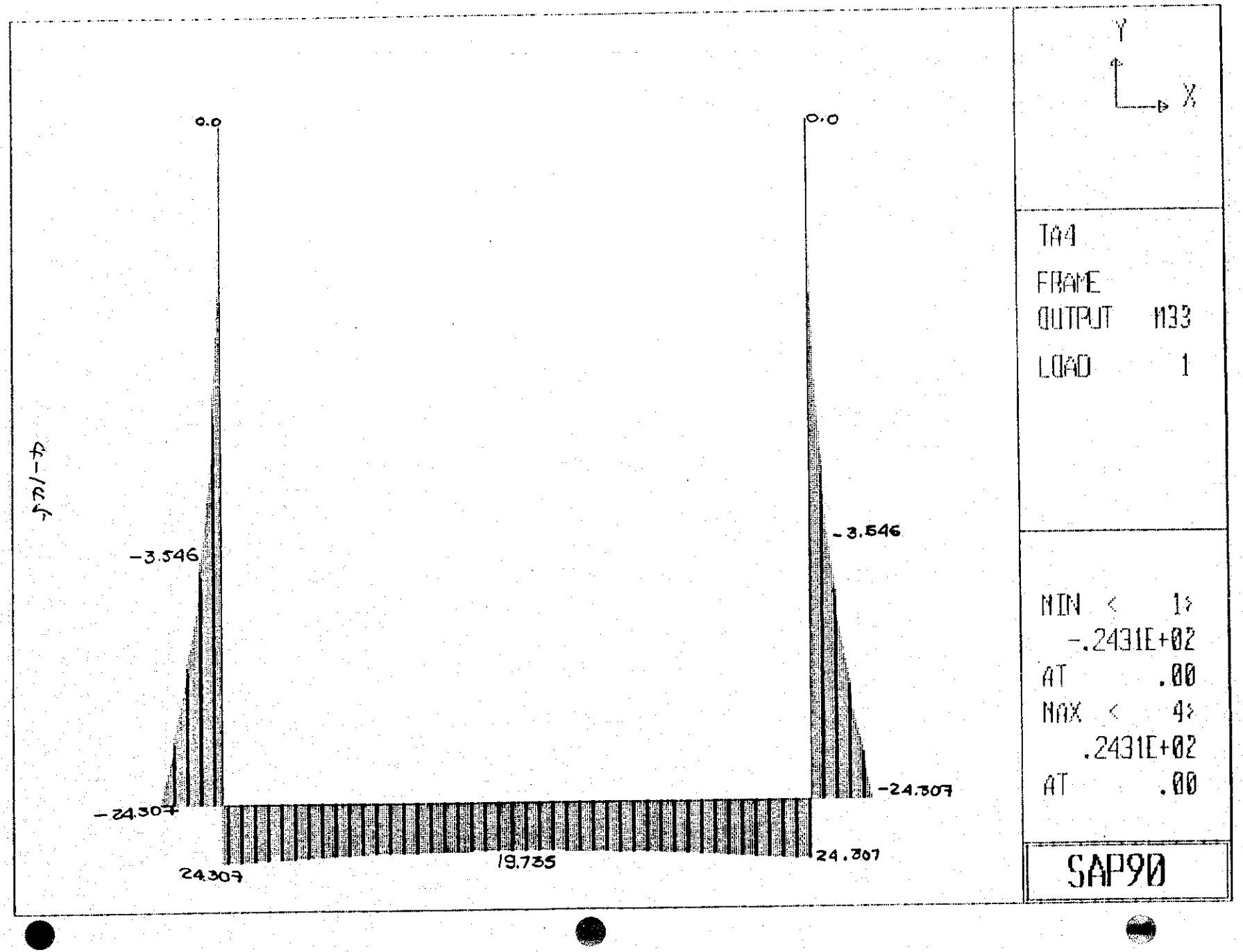

1.1 cm
1.1 cm
Y
X
TA4
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.1151E-01
Y -.1631E-04
Z .0000E+00
MAXIMA
X .1151E-01
Y .0000E+00
Z .0000E+00
SAP90

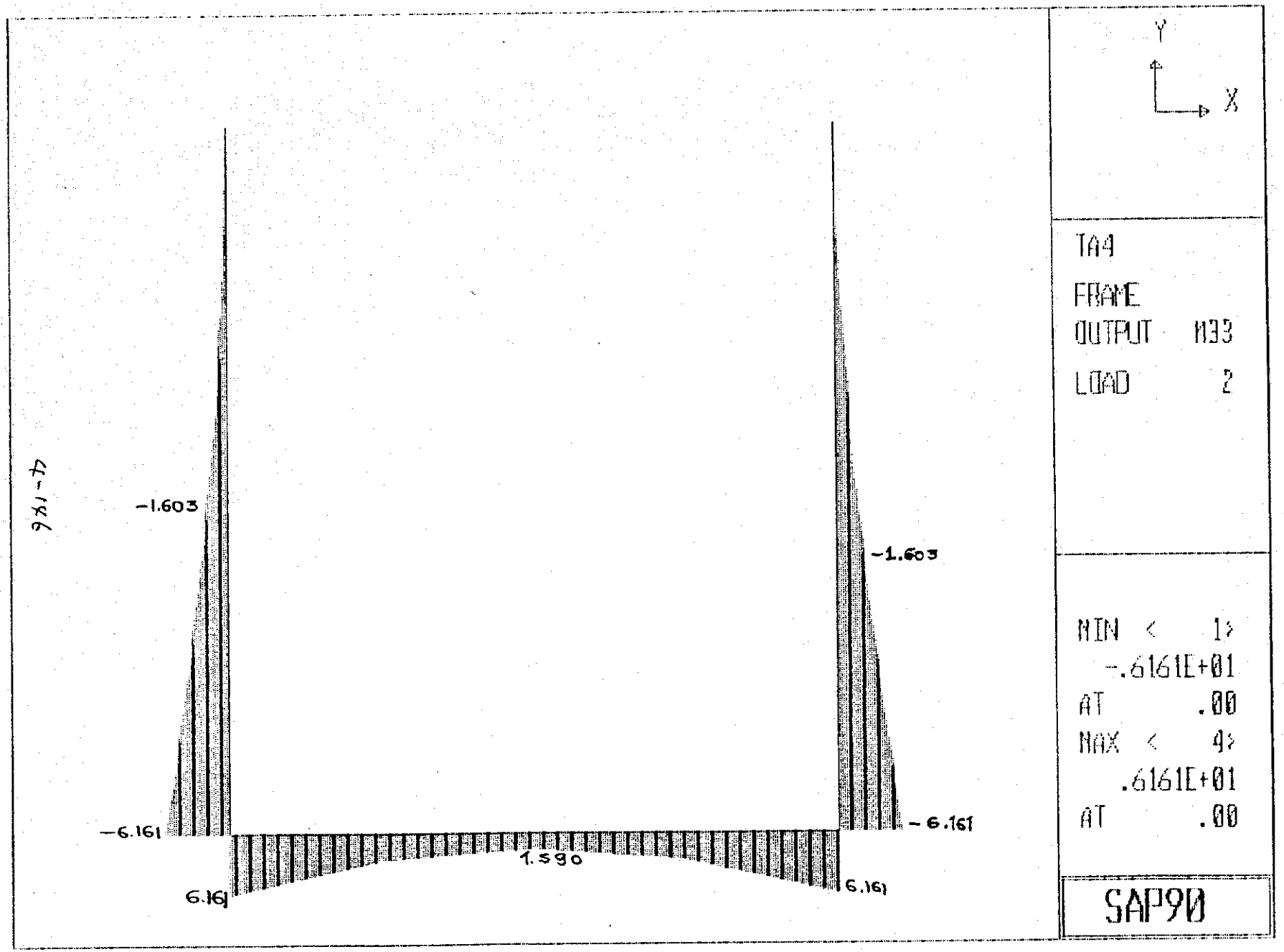
4-142


0.25 cm
0.25 cm
Y
X
TA4
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.2550E-02
Y -.2247E-05
Z .0000E+00
MAXIMA
X .2550E-02
Y .0000E+00
Z .0000E+00
SAP90

47-43

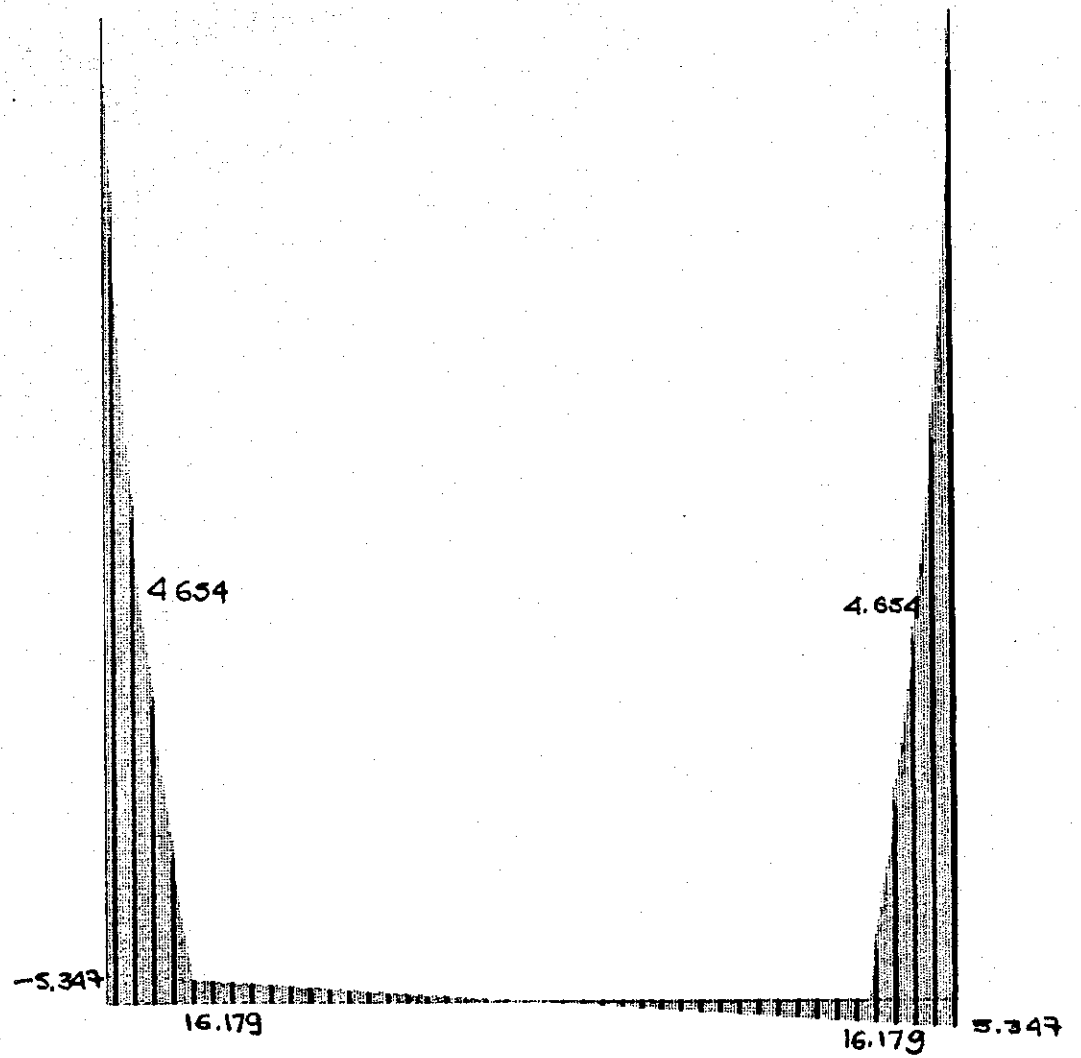

0.9 cm
0.9 cm.
Y
X
TA4
DEFORMED
SHAPE
LOAD 3
MINIMA
X -.9910E-02
Y .0000E+00
Z .0000E+00
MAXIMA
X .9910E-02
Y .1659E-04
Z .0000E+00
SAP90


0.0
0.0
-3.546
-3.546
-24.307
-24.307
24.307
19.735
24.307
Y
X
TA4
FRAME
OUTPUT M33
LOAD 1
MIN (1)
-.2431E+02
AT .00
MAX (4)
.2431E+02
AT .00
SAP90


Y
X
TA4
FRAME
OUTPUT M33
LOAD 2
MIN < 1>
-.6161E+01
AT .00
MAX < 4>
.6161E+01
AT .00
SAP90
-1.603
-1.603
-6.161
-6.161
1.590
6.161
6.161

Y
X
TAA
FRAME
OUTPUT A33
LOAD 3
MIN < 52
-.2272L+02
AT 1.69
MAX < 13
.1815L+02
AT .00
SAP90
-18.146
1.943
18.146
-22.719
1.943
18.146
-18.146

4-147



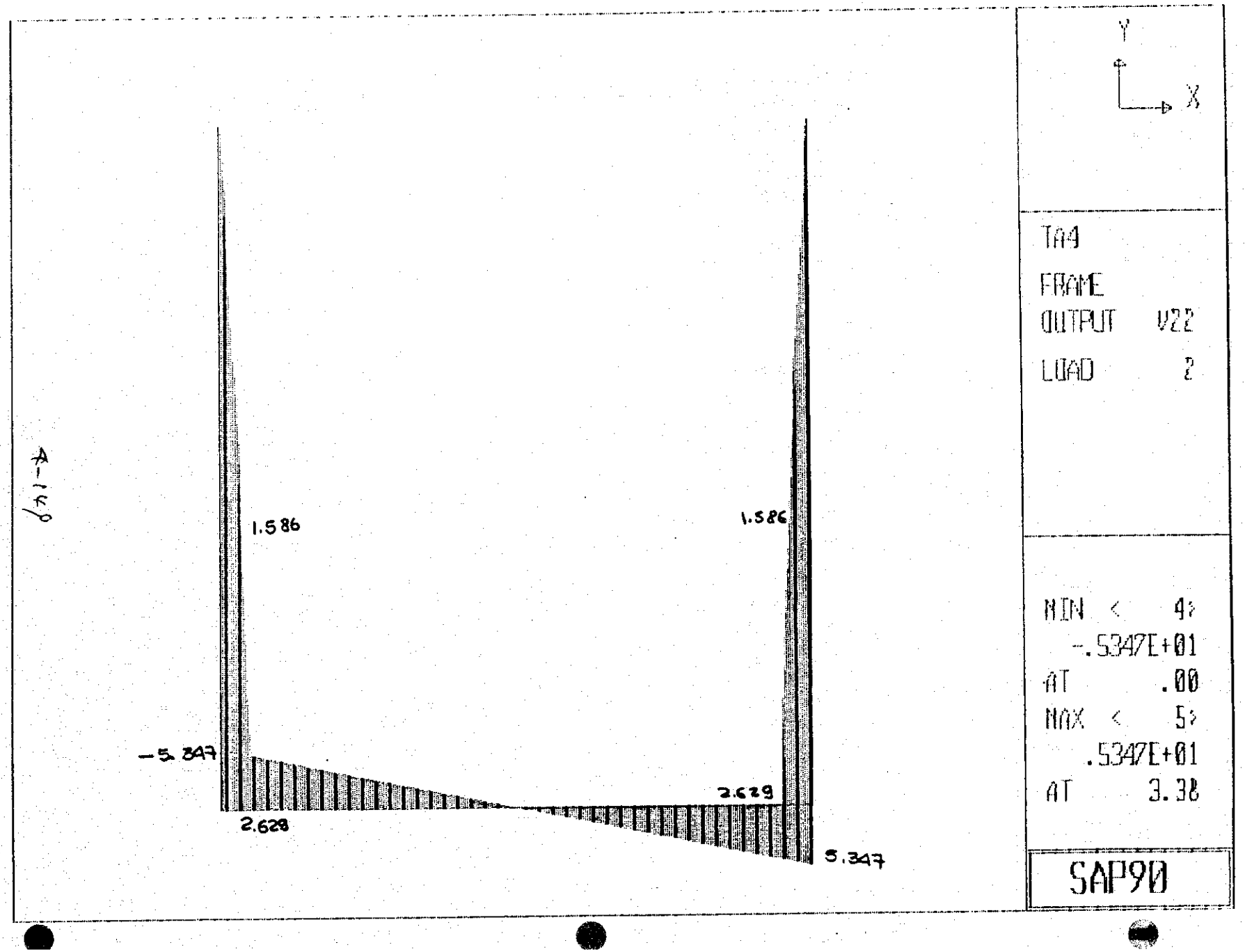
ケース4

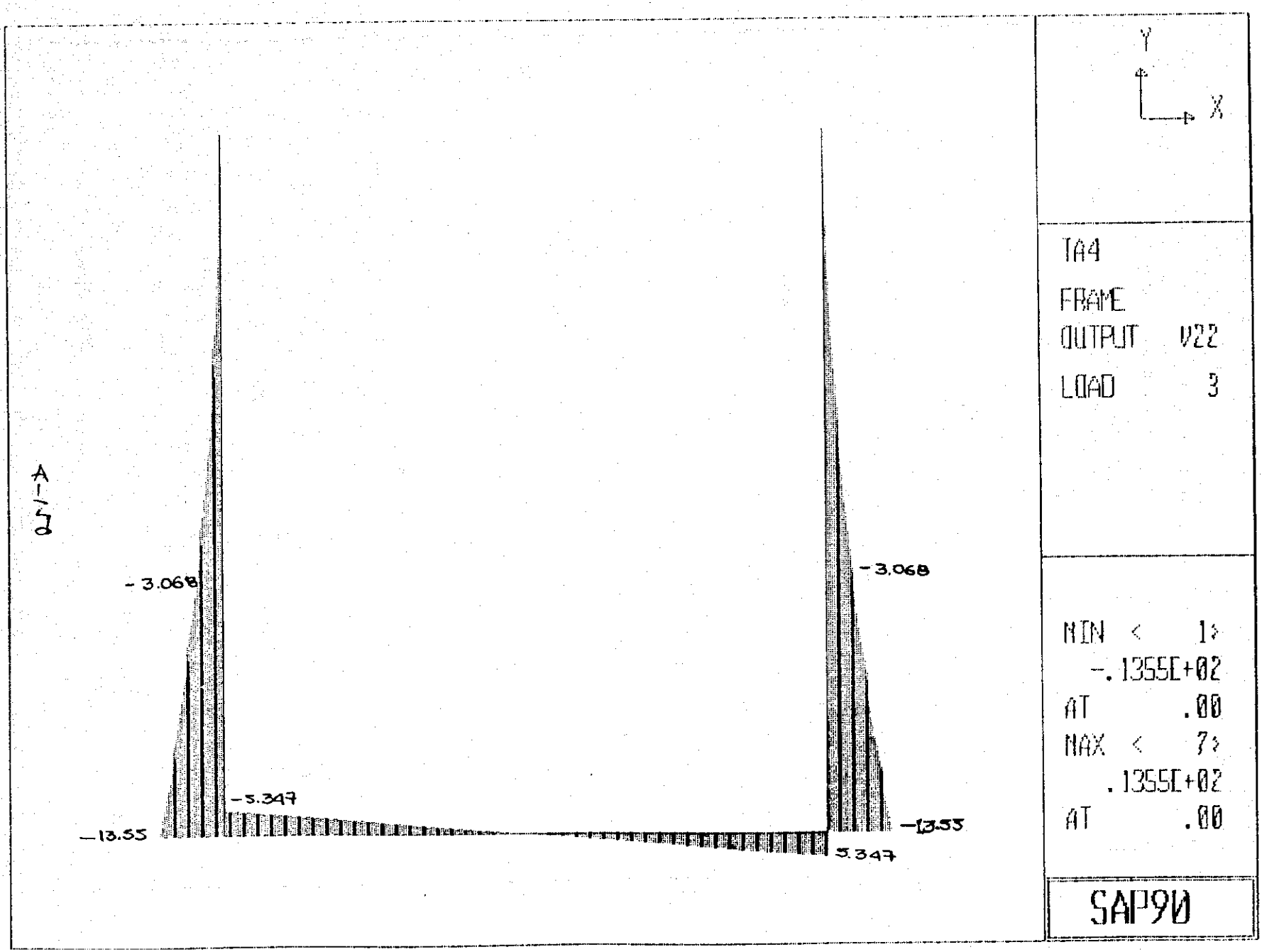
Y
X

TA4
FRAME
OUTPUT V22
LOAD 1

MIN < 7>
-.1618E+02
AT .00
MAX < 1>
.1618E+02
AT .00

SAP90


Y
X
TA9
FRAME
OUTPUT V22
LOAD 2
MIN < 4>
-.5347E+01
AT .00
MAX < 5>
.5347E+01
AT 3.38
SAP90
1.586
1.586
-5.347
2.628
2.629
5.347


Y
X
TA4
FRAME
OUTPUT V22
LOAD 3
A-5
-3.068
-3.068
-5.347
-13.55
-13.55
5.347
MIN < 1>
-.1355E+02
AT .00
MAX < 7>
.1355E+02
AT .00
SAP90

ANALISIS AND DESIGN OF THE TRANSITION.

— DATO FOR CALCULATION OF REINFORCEMENT

$f'_c = 210\ kg/cm^2$

$f_y = 4200\ kg/cm^2$

$b = 100\ cm$

$d = 43\ cm$

$r = 7\ cm$ (standard)

$M_u = -24.307\ ton\text{-}m$

$$A_s = \frac{24.307 \times 10^5}{0.9 \times 4200 \times \left(43 - \frac{7}{2}\right)} = 16.28\ cm^2$$

$$a = \frac{16.28 \times 4200}{0.85 \times 210 \times 100} = 3.83$$

$$\rho = \frac{16.28}{100 \times 43} = 0.003786$$

$\rho_{min} = 0.00333 < \rho$

— SHEAR STRES CHECK

$V_u = 16.19\ ton$

$$V_c = 0.85 \times 0.53 \sqrt{210} \times 100 \times 43 = 28.071$$

$V_c > V_u$ "OK"

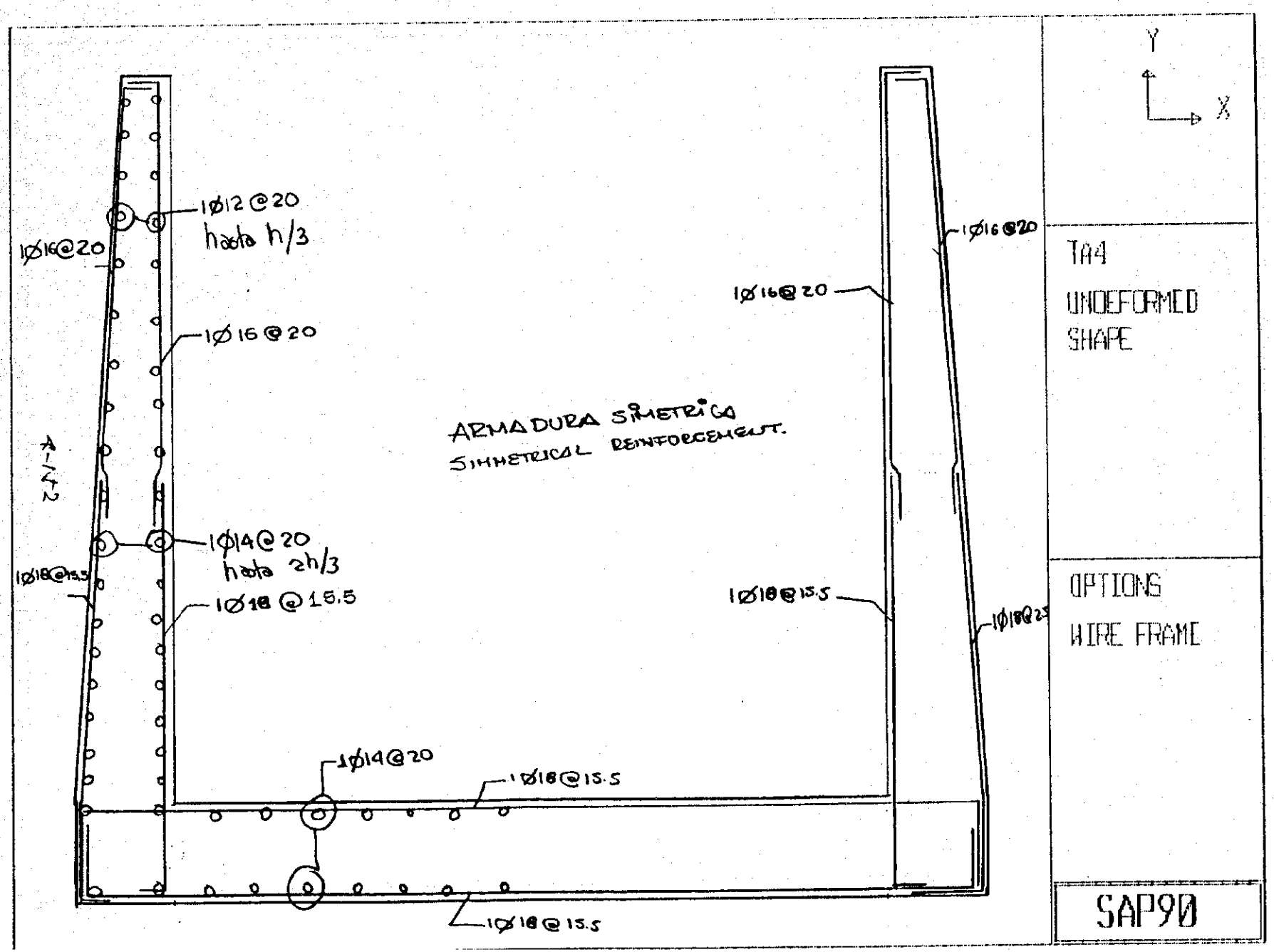
NO REQUIERE ESTRIBOS

— REINFORCEMEN FOR SHRINKAGE AND TEMPERATURE

$A_s = 0.002 \times 100 \times 43 = 8.6\ cm^2$ → 1Ø12 @ 12.5 o 1Ø14@20

$A_s = 0.002 \times 100 \times 33 = 6.6\ cm^2$ 1Ø12 @20

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


1Ø12 @20
hasta h/3
1Ø16@20
1Ø 16 @20
A-A'2
1Ø14@20
hasta 2h/3
1Ø18@15.5
1Ø18 @ 15.5
ARMADURA SIMETRICA
SIMMETRICAL REINFORCEMENT.
1Ø16@20
1Ø16@20
1Ø18@15.5
1Ø18@15.5
1Ø14@20
1Ø18@15.5
1Ø18 @ 15.5
Y
X
TA4
UNDEFORMED
SHAPE
OPTIONS
WIRE FRAME
SAP90

JAPAN INTERNATIONAL COOPERATION AGENCY - AGENCIA INTERNACIONAL DE COOPERACION DEL JAPON

JICA STUDY TEAM - GRUPO DE ESTUDIOS JICA

DAULE-PERIPA-LA ESPERANZA TRANSBASIN (TRASVASE DAULE PERIPA-LA ESPERANZA)

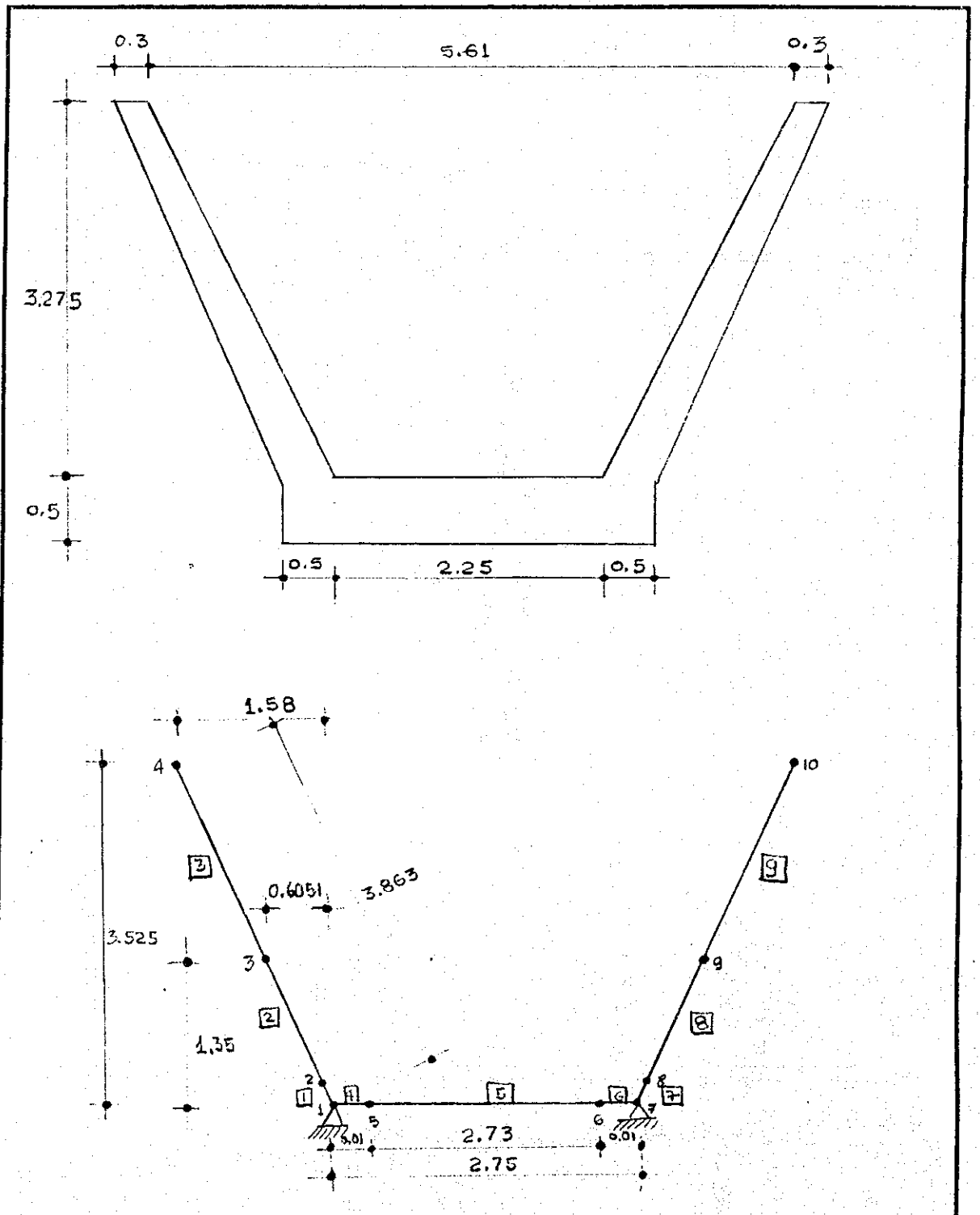
MEMBRILLO OUTLET ACCESS ROAD (CAMINO DE ACCESO SALIDA MEMBRILLO)

Date: Fecha:

Calculated by: Calculado por:

Sheet Hoja 1 of de

SHAPE AND DIMENSIONS OF THE TRANSITION



Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:

4-N3

LOADS IN TRANSITION

— THE LOAD APPLIED IN THE DESIGN OF THE TRANSITION ARE AS FOLLOWS :

W_1 = LIVE LOAD OF HS-20-44 TRAILER.

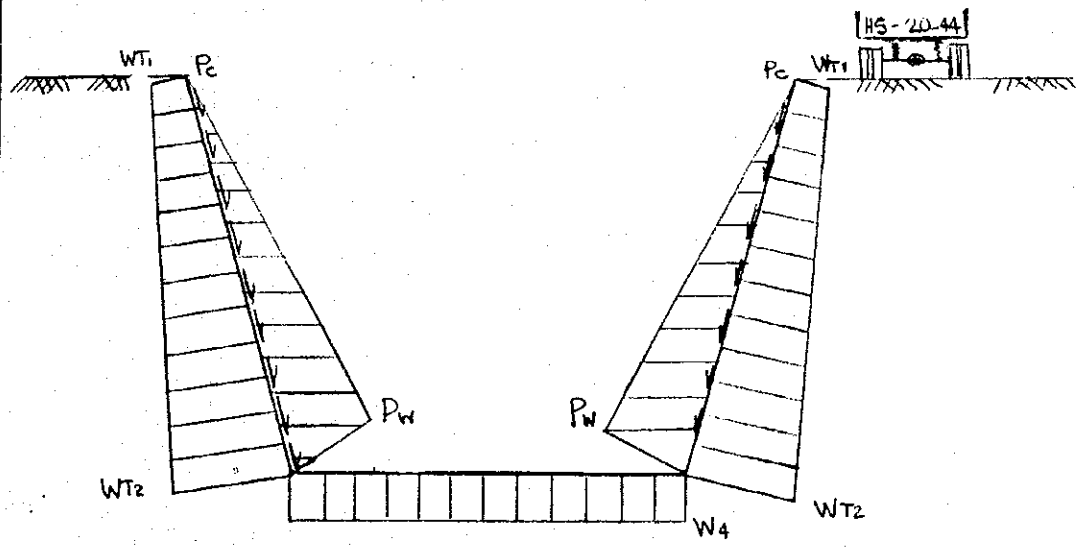
W_3 = SURCHARGE OF THE UPLIFT ACT ON BOTTON SLAB

W_4 = REACTION LOAD ACT ON BOTTON SLAB

W_T = LATERAL EARTH PRESSURE

P_W = LATERAL WATER PRESSURE

P_C = LOAD OF CONCRETE



CARGA / SECCION	W_1	W_2	W_3	W_4	W_{T1}	W_{T2}	P_C	P_W
VARIABLE				2.697	0.585	3.758	3.708	3.525

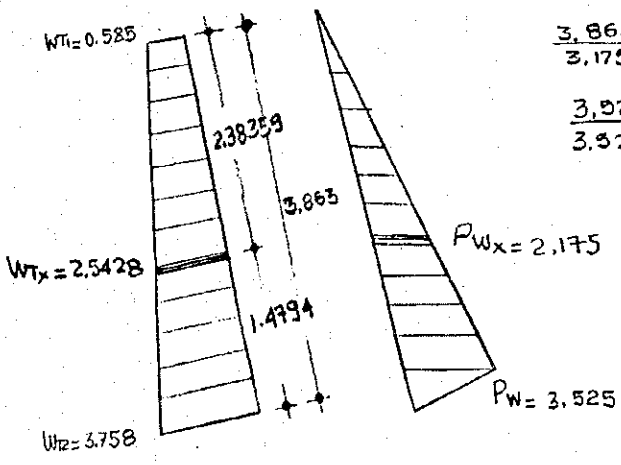
Revision	Checked by / Revisado por	Date (Fecha)	Approved by: / Aprobado por:	Date (Fecha)	Revision	Checked by: / Revisado por	Date (fecha)	Approbed by: / Aprobado por:	Date (Fecha) / Aprobado por:

$P_c = 0.4 \times 2.4 \times 3.863 = 3.708$ ton/m

$W_4 = \frac{2 \times 3.708}{2.75} = 2.697$ ton/m

$W_{T1} = 0.65 \times 1.8 \times 0.5 = 0.585$

$W_{T2} = 4.175 \times 1.8 \times 0.5 = 3.758$

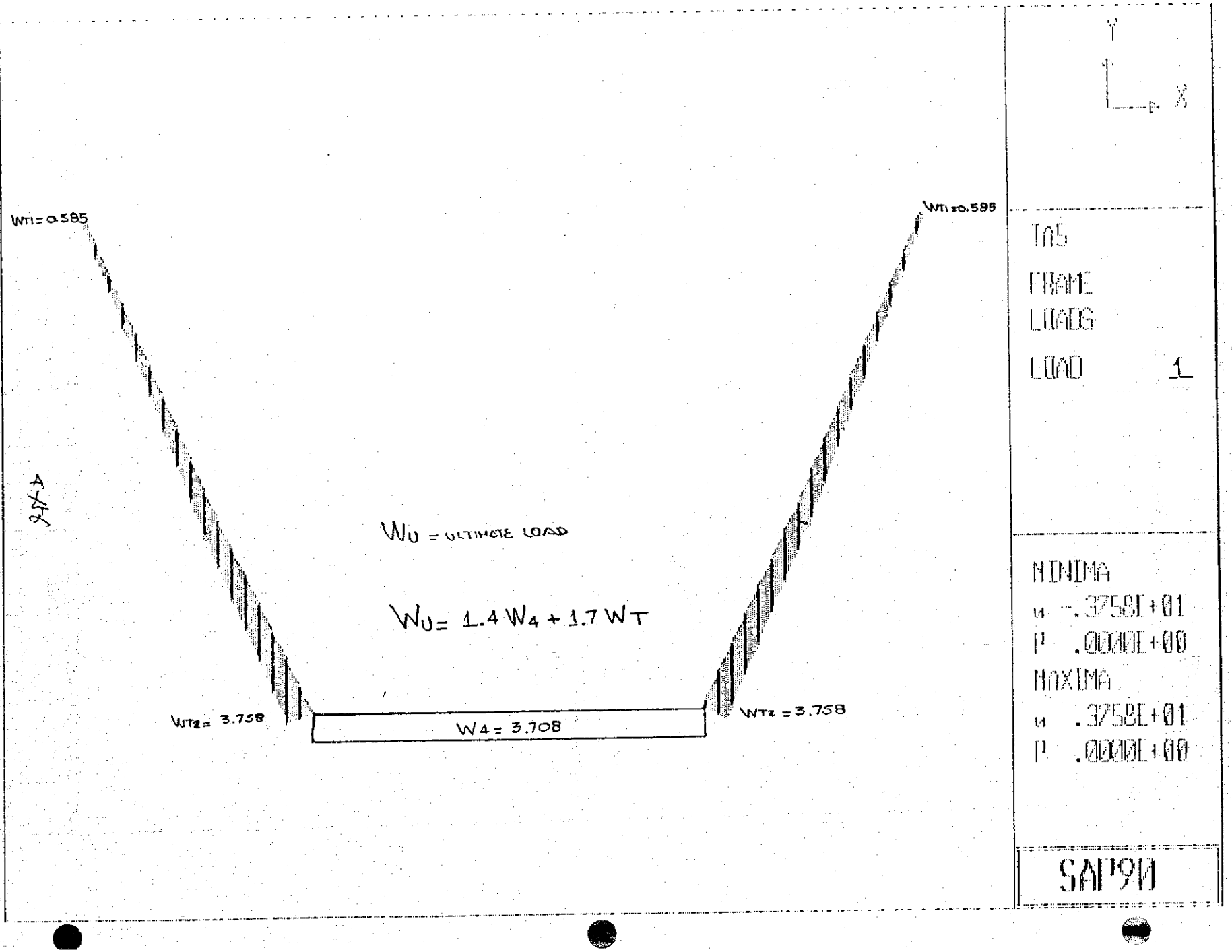


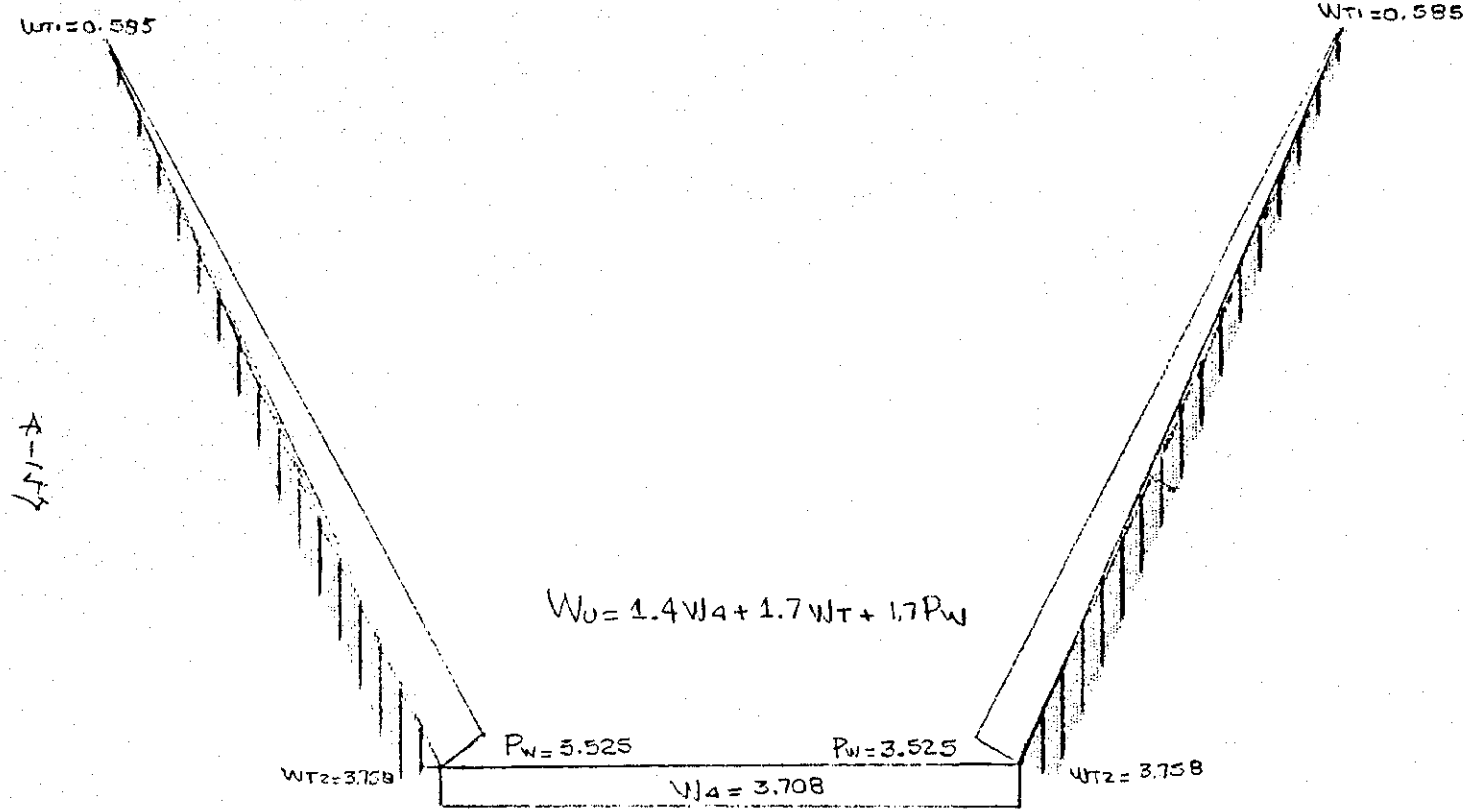
$\frac{3.863}{3.175} = \frac{2.38359}{X} \Rightarrow X = 1.9578$

$\frac{3.525}{3.525} = \frac{3.525 - 1.35}{P_{wx}}$; $P_{wx} = 2.175$

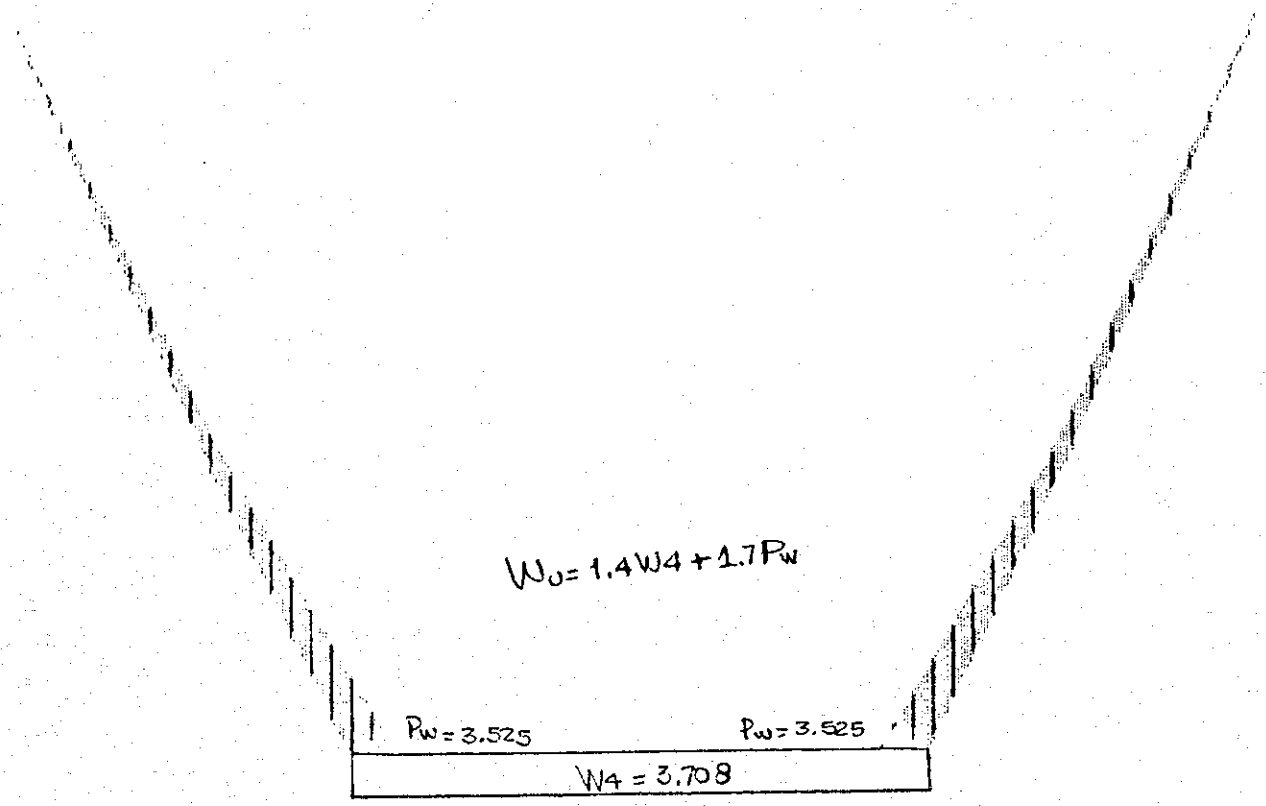
$W_{Tx} = 1.9578 + 0.585 = 2.5428$

Revision	Checked by Revisado por	Date (Fecha)	Approved by: Aprobado por:	Date (Fecha)	Revision	Checked by: Revisado por	Date (fecha)	Approbed by: Aprobado por:	Date (Fecha) Aprobado por:


Y
X
WT1 = 0.585
WT1 = 0.585
WT2 = 3.758
WT2 = 3.758
W4 = 3.708
W_U = ULTIMATE LOAD
$W_U = 1.4 W_4 + 1.7 W_T$
TAS
FRAME
LOADS
LOAD 1
MINIMA
U -.3758E+01
P .0000E+00
MAXIMA
U .3758E+01
P .0000E+00
SAP90


WT1=0.585
WT1=0.585
WU = 1.4WA + 1.7WT + 1.7PW
PW = 5.525
PW = 3.525
WT2=3.758
WT2 = 3.758
WA = 3.708

Y
X
LOAD
2
MINIMA
MAXIMA
SAP90



Y
|
|_ _ X

IAS

FRAME
LOADS

LOAD 3

MINIMA
U -.3863E+01
P .0000E+00
MAXIMA
U .3863E+01
P .0000E+00

SAP90

```
TRANSICION
SYSTEM
L=3

JOINTS
1   X=0   Y=0    Z=0
2         Y=0.01
3   X=-0.6051 Y=1.35
4   X=-1.58  Y=3.525
5   X=.01 Y=0
6   X=2.74
7   Y=2.75
8   X=2.75  Y=0.01
9   X=3.3551 Y=1.35
10  X=4.330 Y=3 525

RESTRAINTS
1 10 1  R=0,0,1,1,1,0
1 7 6   R=1,1,1,1,1,0

FRAME
NM=3 NL=12
1 SH=R T=.30,1 E=2100000.
2 SH=R T=.414,1
3 SH=R T=.30,1
1 WL=0,3.708 :w4
2 WL=0,2.05  :w3
3 TRAP=0,-3.7[illegible],0,1.4694,-2.5428
4 TRAP=[illegible],3.22[illegible],0,1.4694,2.175
5 WL=0
6 TRAP=0,[illegible].750,0,1.4694,2.5428
7 TRAP=[illegible],-3.[illegible],0,1.4694,-2.175
8 TRAP=0,-1.5428,0,2.38359,-0.565
9 TRAP=0,2.[illegible],0,2.38359,0.565
10 TRAP=0,2.1750,0,2.38359,0.0
11 TRAP=0,-2.1750,0,2.38359,0.00
[illegible]
1 1 2  M=1      NSL=0      LP=1,0
2 2 3  M=1,2,1  NSL=7,8
3 3 4  M=1,3,1  NSL=7,10
4 1 5  M=1      NSL=0
5 5 6  M=1      NSL=5,6,1
6 6 7  M=1      NSL=6
7 7 8  M=1      NSL=0
8 8 9  M=1,2,1  NSL=6,7
9 9 10 M=1,3,1  NSL=9,11

[illegible]
1 [illegible]
2 [illegible]
3 [illegible],1.4
```

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STRUCTURAL ANALYSIS PROGRAMS

VERSION 5.41

[illegible]

[illegible]

E L E M E N T   F O R C E S

ELT LOAD ID COND	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
1	.000			5.820			
	.000	12.931	-20.744				
	.010	12.931	-20.615				
	[illegible]			5.820			
2	.000			1.095			
	[illegible]	2.436	-8.898				
	[illegible]	2.436	-8.874				
	[illegible]			1.095			
3	[illegible]			-4.727			
	[illegible]	-10.493	14.546				
	[illegible]	[illegible]	14.74[illegible]				
	[illegible]			-4.7[illegible]			
[illegible]	.000			-.010			
	.000	[illegible]	-20.615				
	[illegible]	6.510	-5.932				
	[illegible]	6.510	-5.927				
	1.470			-.008			
[illegible]	.000			.003			
	.000	1.675	-5.974				
	1.460	1.922	-2.75[illegible]				
	1.470	1.922	-2.455				
	1.470			[illegible]			
	.000			.01[illegible]			
	[illegible]	-11.507	14.74[illegible]				
	[illegible]	-4.3[illegible]	[illegible]				
	1.470	-4.3[illegible]	3.472				
	1.470			.012			
[illegible]	.000			.006			
	[illegible]	[illegible]	[illegible]				

		.000	6.310	-5.927			
		2.374	.000	.000			
		2.383	.000	.000			
		2.383			.000		
	2	.000			.000		
		.000	1.922	-2.455			
		2.374	.000	.000			
		2.383	.000	.000			
		2.383			.000		
	3	.000			.000		
		.000	-4.388	3.472			

TRANSICION

F R A M E E L E M E N T F O R C E S

ELT ID	LOAD COMB	DIST ENDI	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
		2.374	.000	.000				
		2.383	.000	.000				
		2.383			.000			
4								
	1	.000			.000			
		.000	-7.086	20.744				
		.010	-7.086	20.673				
		.010			.000			
	2	.000			.000			
		.000	-7.086	5.898				
		.010	-7.086	5.827				
		.010			.000			
	3	.000			.000			
		.000	-7.086	-14.846				
		.010	-7.086	-14.917				
		.010			.000			
5								
	1	.000			.000			
		.000	-7.086	20.673				
		1.365	.000	15.837				
		2.730	7.086	20.673				
		2.730			.000			
	2	.000			.000			
		.000	-7.086	5.827				
		1.365	.000	.991				
		2.730	7.086	5.827				
		2.730			.000			
	3	.000			.000			
		.000	-7.086	-14.917				
		1.365	.000	-19.753				
		2.730	7.086	-14.917				
		2.730			.000			
6								
	1	.000			.000			
		.000	7.086	20.673				
		.010	7.086	20.744				
		.010			.000			
	2	.000			.000			
		.000	7.086	5.827				
		.010	7.086	5.898				
		.010			.000			

		.010			.000		
	3	.000			.000		

TRANSICION

F R A M E E L E M E N T F O R C E S

ET LOAD ID COMB	DIST END	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
	.000	7.086	-14.917				
	.010	7.086	-14.846				
	.010			.000			
7							
1	.000			5.820			
	.000	-12.931	20.744				
	.010	-12.931	20.615				
	.010			5.820			
2	.000			1.095			
	.000	-2.438	5.898				
	.010	-2.438	5.874				
	.010			1.095			
3	.000			-4.725			
	.000	10.493	-14.846				
	.010	10.493	-14.741				
	.010			-4.725			
1	.000			-.018			
	.000	-14.180	20.615				
	1.460	-6.310	5.932				
	1.470	-6.310	5.927				
	1.470			-.018			
2	.000			-.005			
	.000	-2.673	5.874				
	1.460	-1.922	2.456				
	1.470	-1.922	2.455				
	1.470			-.005			
3	.000			.012			
	.000	11.567	-14.741				
	1.460	4.366	-3.476				
	1.470	4.361	-3.471				
	1.470			.012			
1	.000			.000			
	.000	-6.310	5.927				
	2.274	.000	.000				
	2.283	.000	.000				
	2.283			.000			
2	.000			.000			
	.000	-1.922	2.455				
	2.283	.000	.000				
	2.283	.000	.000				
	2.283			.000			

TRANSICION

F R A M E E L E M E N T F O R C E S

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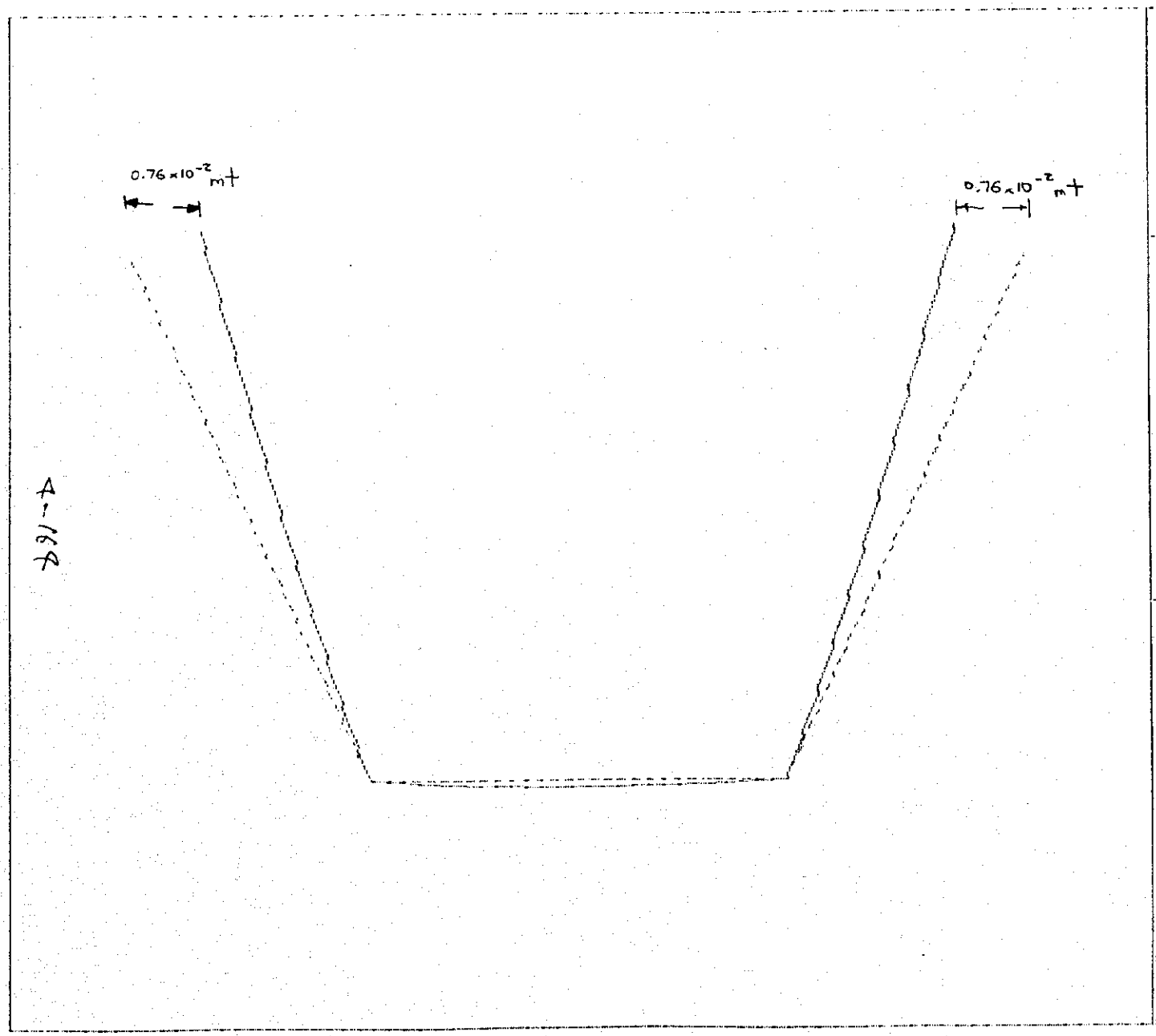
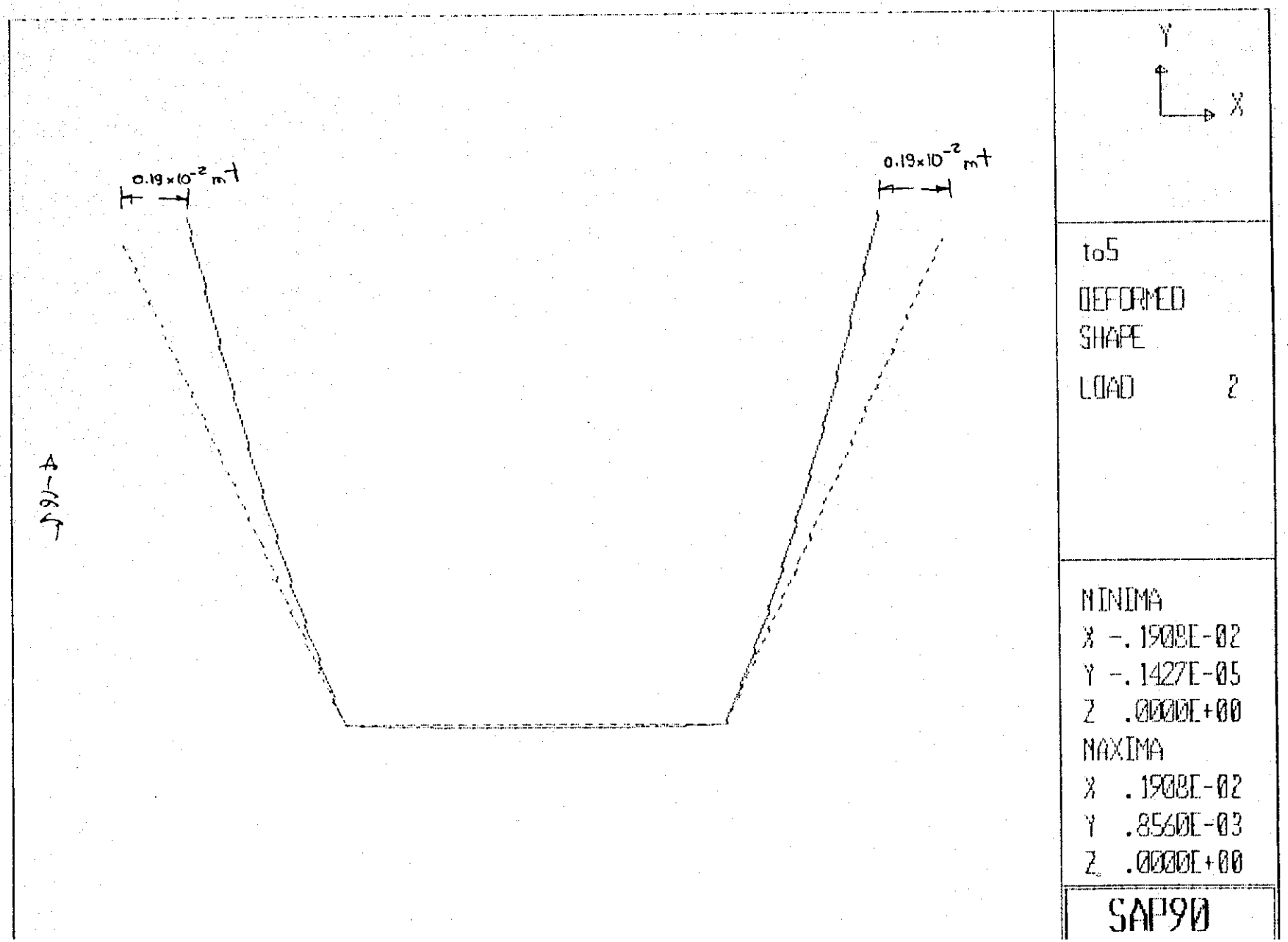
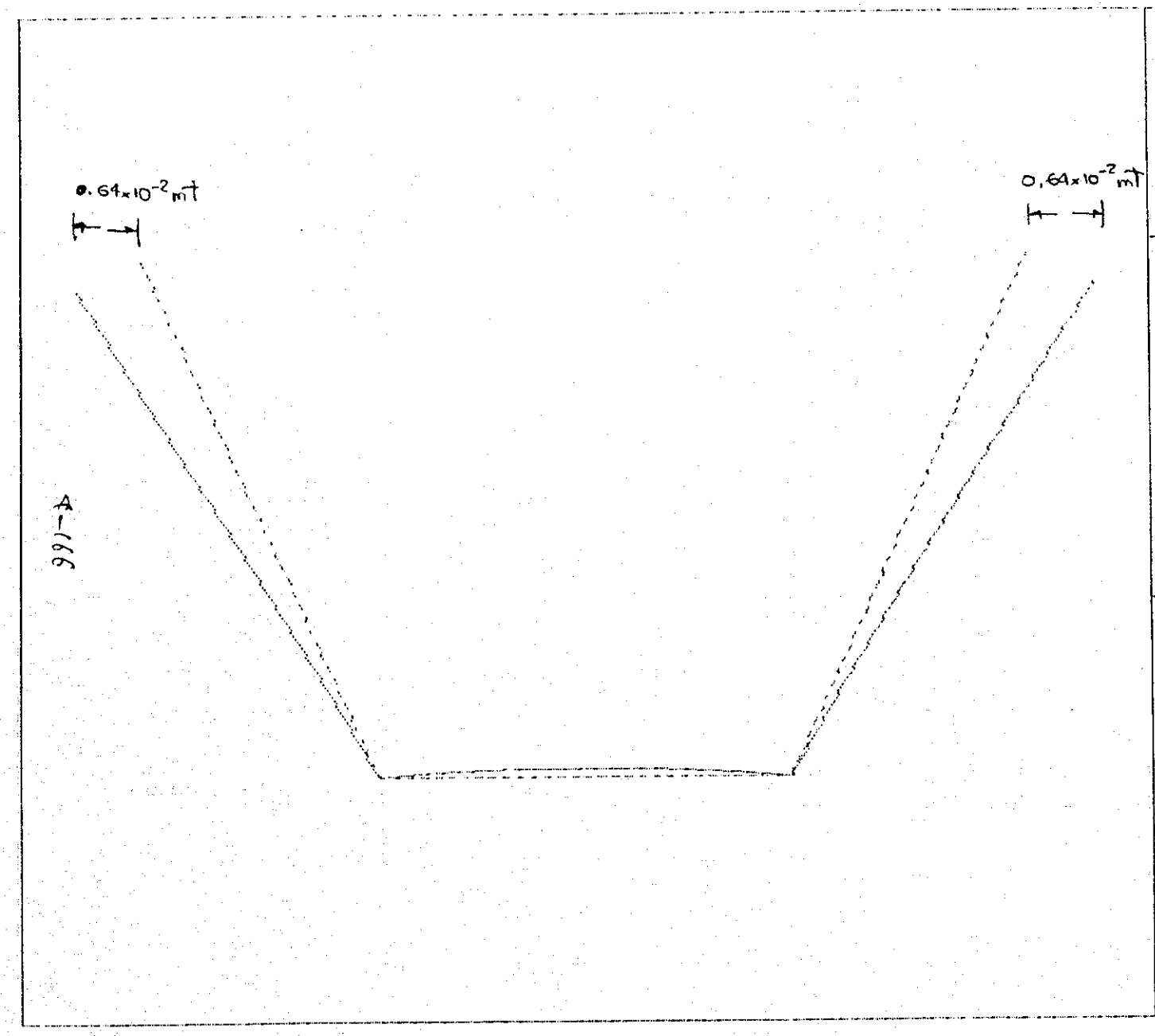
ET LOAD ID COMB	DIST END	1-2 PLANE SHEAR	1-2 PLANE MOMENT	AXIAL FORCE	1-3 PLANE SHEAR	1-3 PLANE MOMENT	AXIAL TORQ
3	.000			.000			
	.000	-1.922	2.455				
	2.283	.000	.000				
	2.283	.000	.000				
	2.283			.000			

3	.000			.000
	.000	4.388	-3.472	
	2.374	.000	.000	
	2.383	.000	.000	
	2.383			.000


0.76×10⁻² m
0.76×10⁻² m
Y
X
1 to 5
DEFORMED
SHAPE
LOAD 1
MINIMA
X -.7591E-02
Y -.1073E-04
Z .0000E+00
MAXIMA
X .7591E-02
Y .3405E-02
Z .0000E+00
SAP90

4-164


Y
X
0.19×10⁻² m
0.19×10⁻² m
to5
DEFORMED
SHAPE
LOAD 2
MINIMA
X -.1908E-02
Y -.1427E-05
Z .0000E+00
MAXIMA
X .1908E-02
Y .8560E-03
Z .0000E+00
SAP90



Y
X

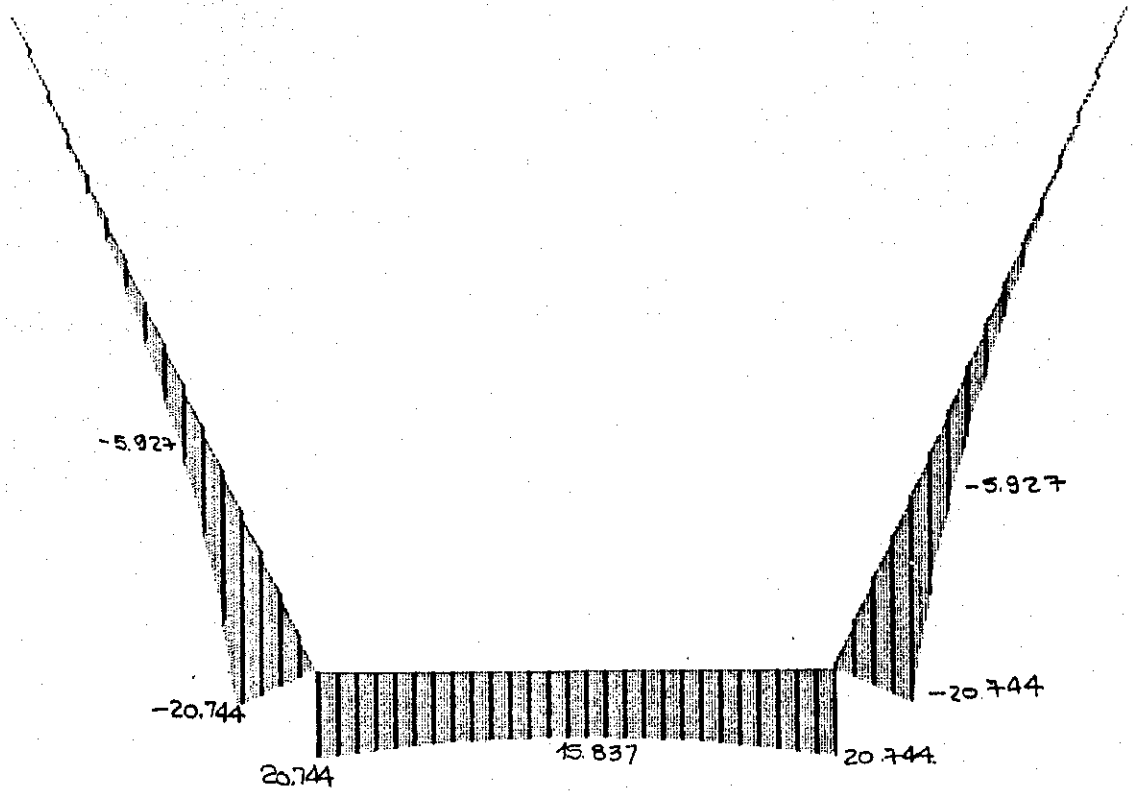
1o5

DEFORMED
SHAPE

LOAD 3

MINIMA
X -.6408E-02
Y -.2874E-02
Z .0000E+00
MAXIMA
X .6408E-02
Y .1156E-04
Z .0000E+00

SAP90



Y
X

1 of 5

FRAME
OUTPUT M33
LOAD 1

MIN < 1>
-.2074E+02
AT .00
MAX < 4>
.2074E+02
AT .00

SAP90

Y
X
toS
FRAME
OUTPUT M33
LOAD 2
MIN < 1>
-.5098E+01
AT .00
MAX < 4>
.5098E+01
AT .00
SAP90
-2.455
-5.898
5.898
0.991
5.898
-5.898
-2.455

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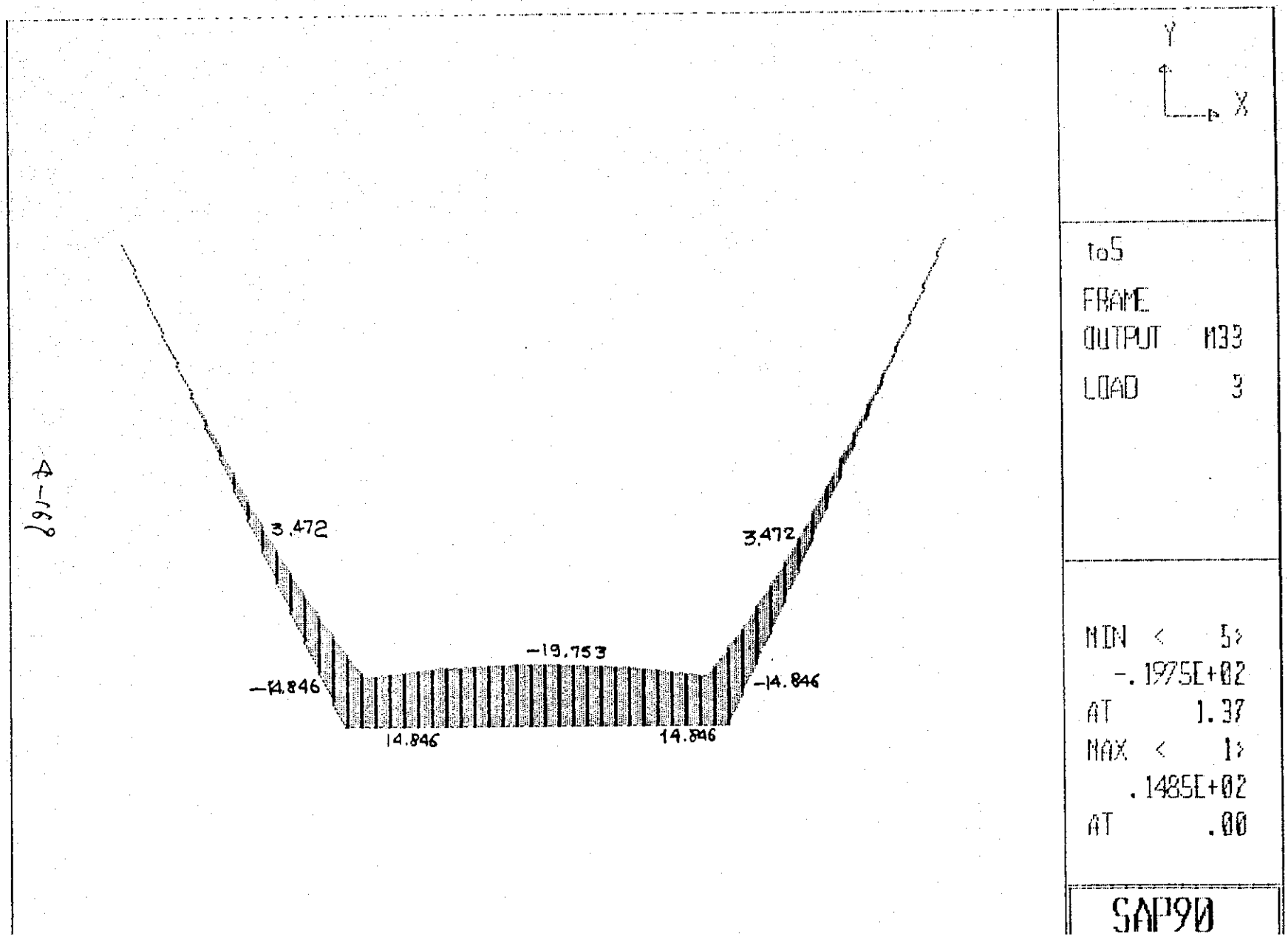
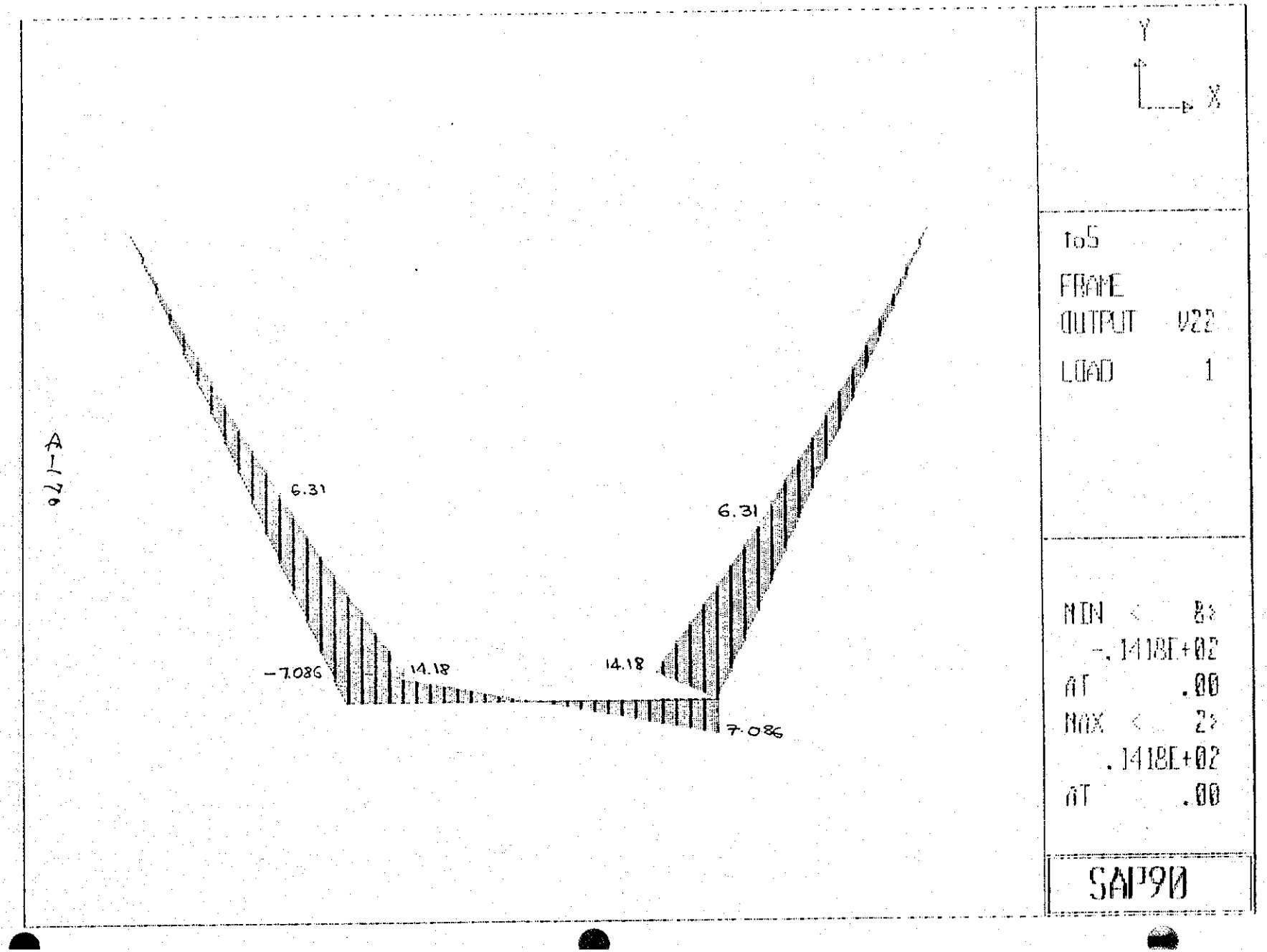

Y
X
1 to 5
FRAME
OUTPUT M33
LOAD 3
3.472
-14.846
-19.753
14.846
14.846
3.472
-14.846
MIN < 5>
-.1975E+02
AT 1.37
MAX < 1>
.1485E+02
AT .00
SAP90


Y
X
1o5
FRAME
OUTPUT 022
LOAD 1
MIN < 8>
-.1418E+02
AT .00
MAX < 2>
.1418E+02
AT .00
SAP90
6.31
-7.086
14.18
14.18
6.31
-7.086

Y
X
1o5
FRAME
OUTPUT V22
LOAD 2
MIN < 4>
-.7086L+01
AT .00
MAX < 5>
.7086L+01
AT 2.73
SAP90
1.922
2.673
7.086
-7.086
2.673
1.922

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