Appendix 3B. Figures

Figure 3-1. Frequency and Mode Shapes - Auxiliary Building - North South Direction (Sheet 1 of 2)

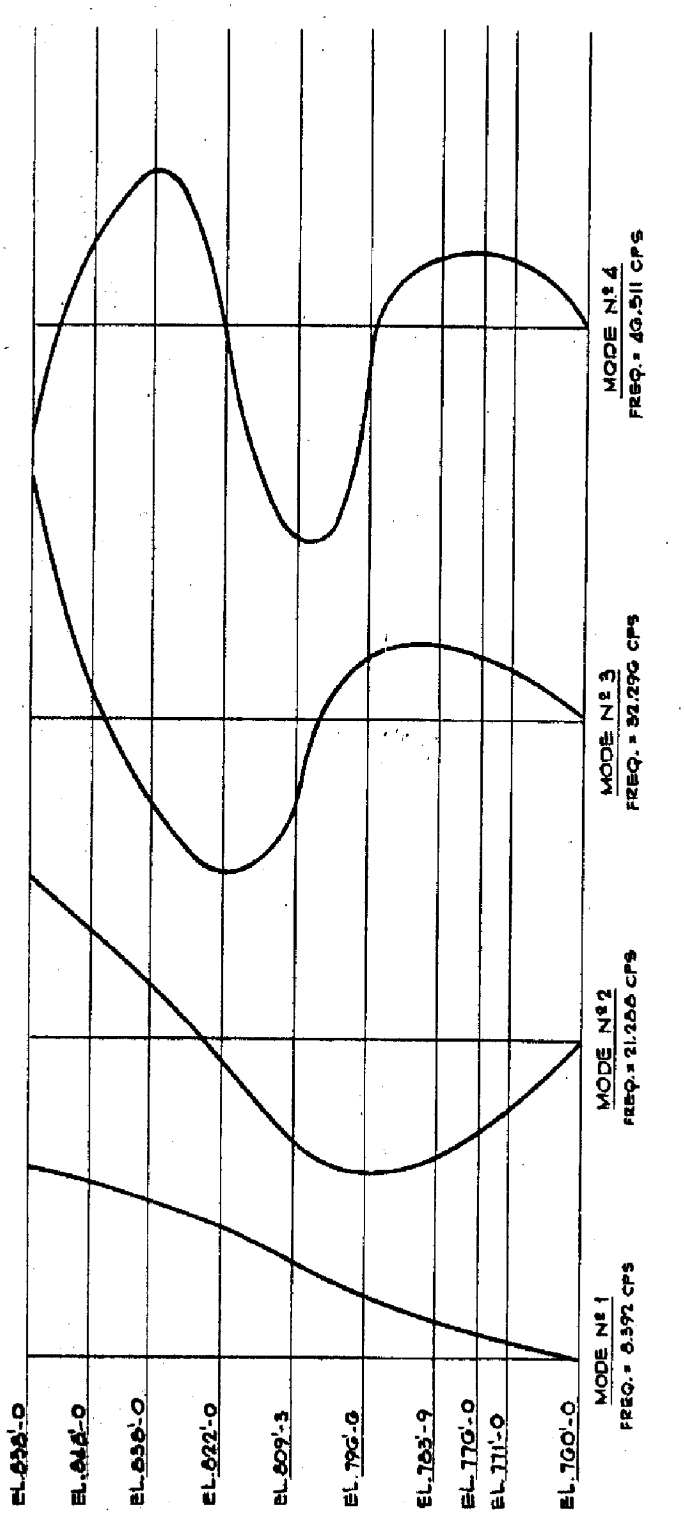


Figure 3-2. Frequency and Mode Shapes - Auxiliary Building - East West Direction (Sheet 2 of 2)

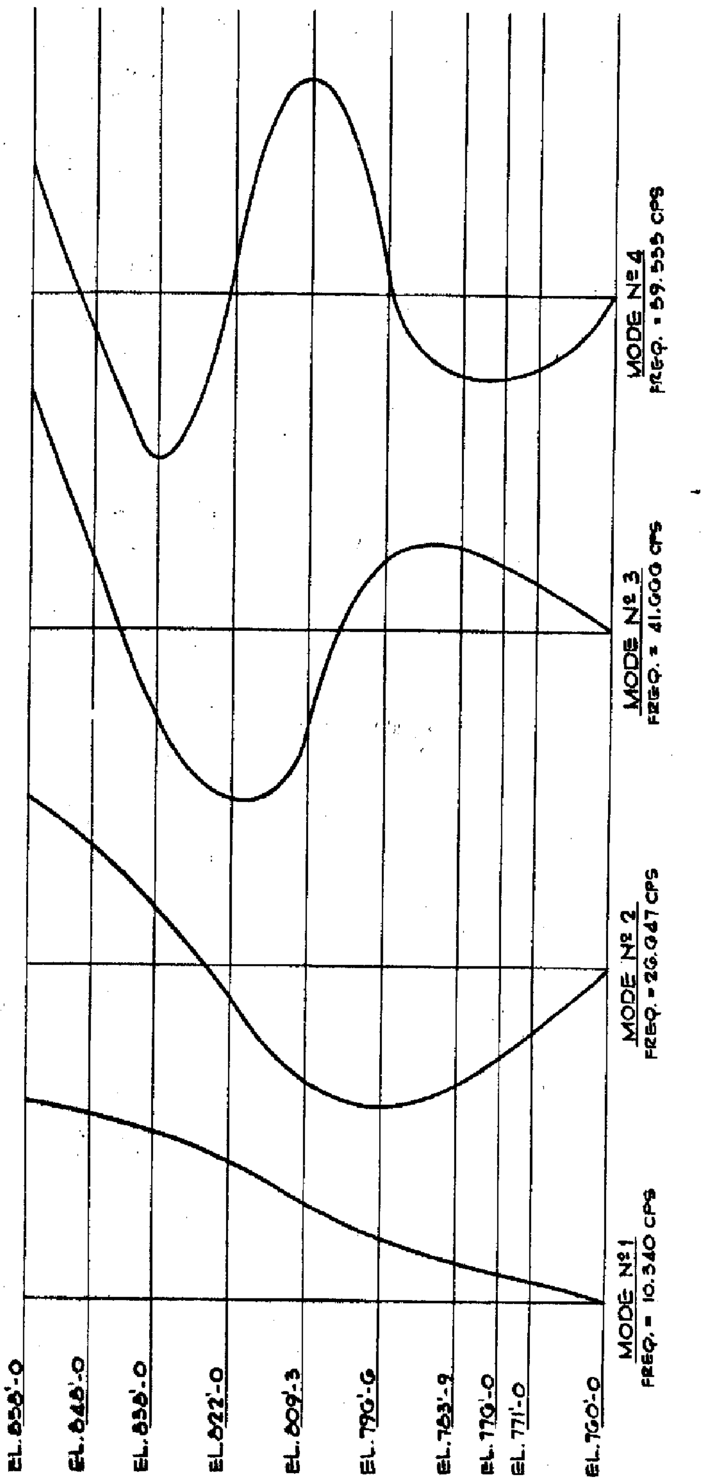


Figure 3-3. Auxiliary Building Mass Model

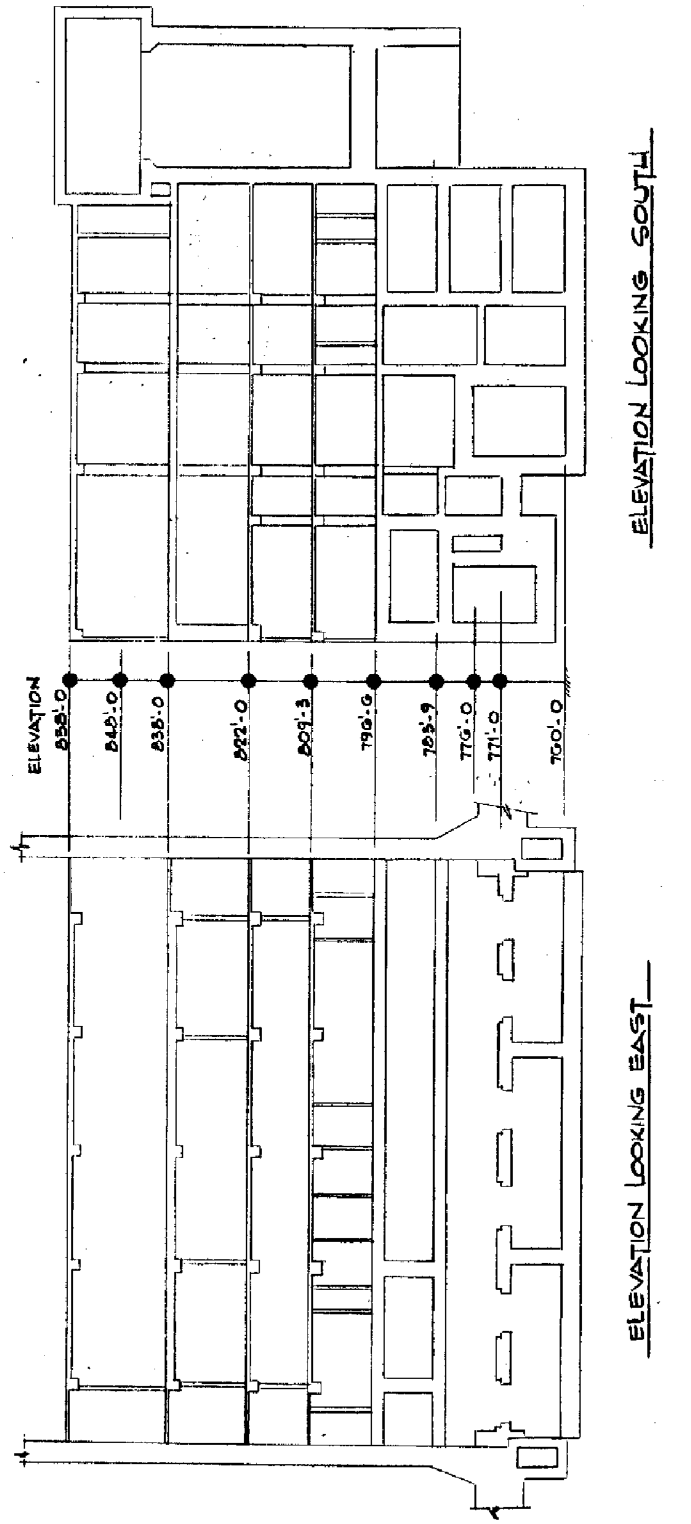


Figure 3-4. Auxiliary Building - East West Direction - Seismic Model Results (Sheet 1 of 2)

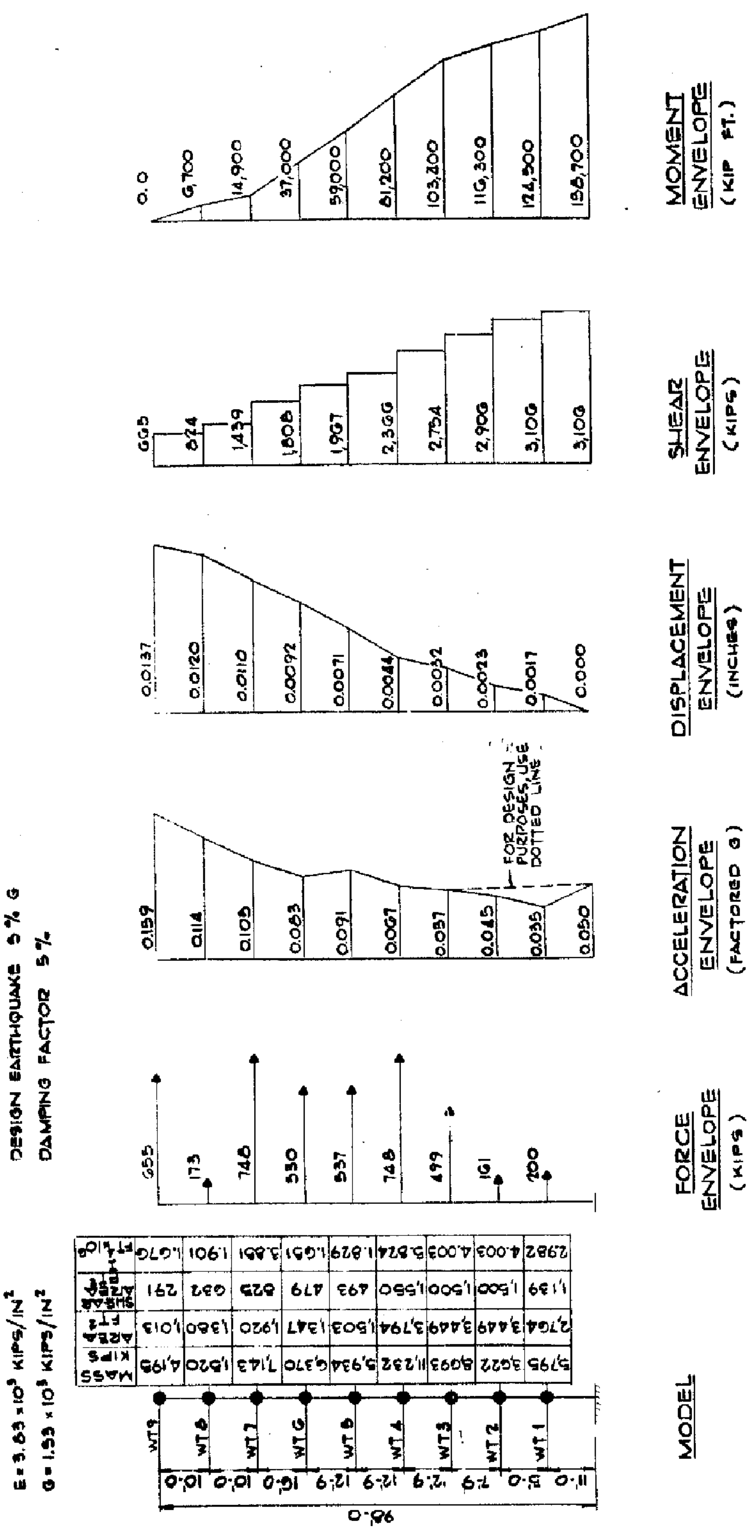


Figure 3-5. Auxiliary Building - North South Direction - Seismic Model Results (Sheet 2 of 2)

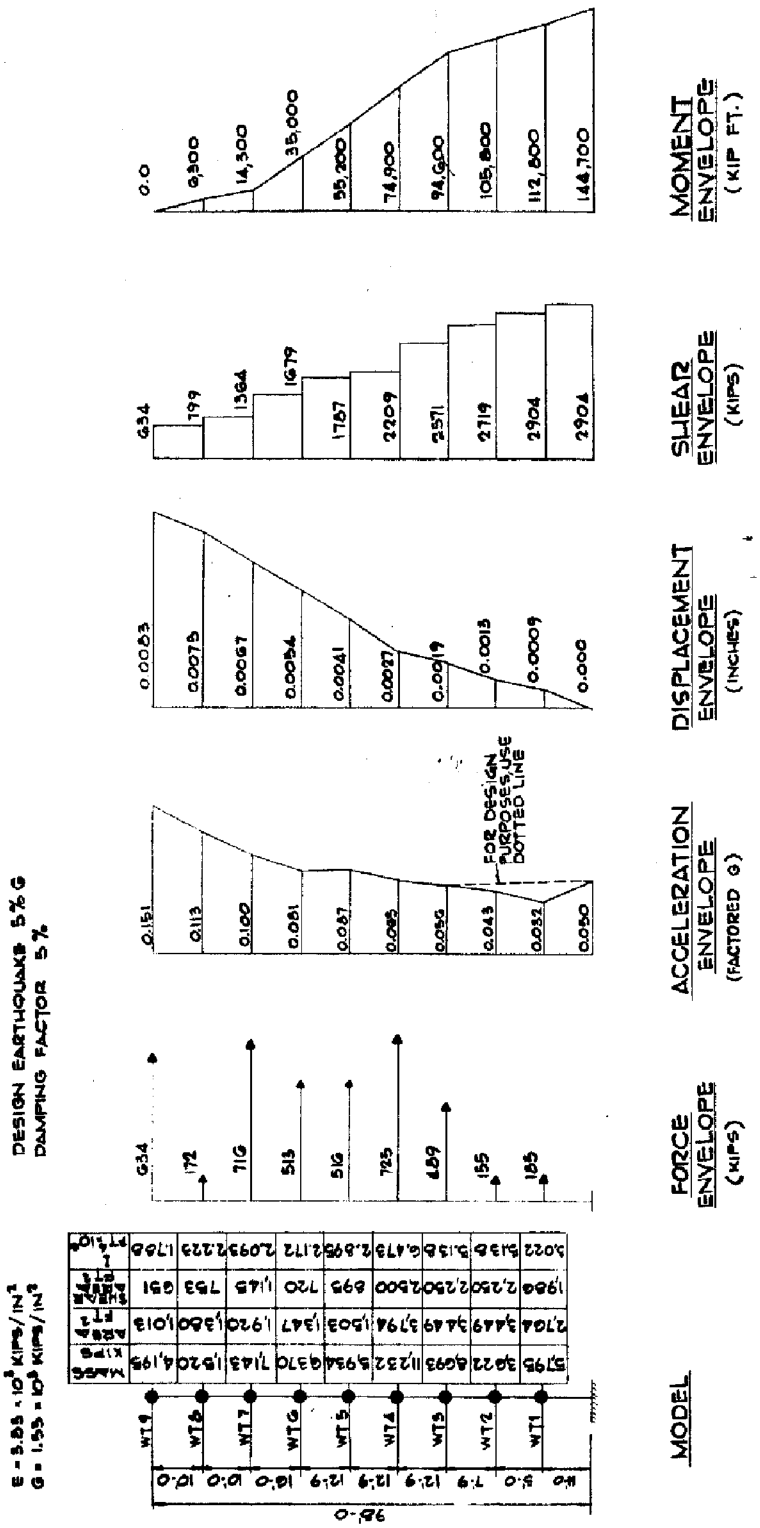


Figure 3-6. Example Spectrum Curves

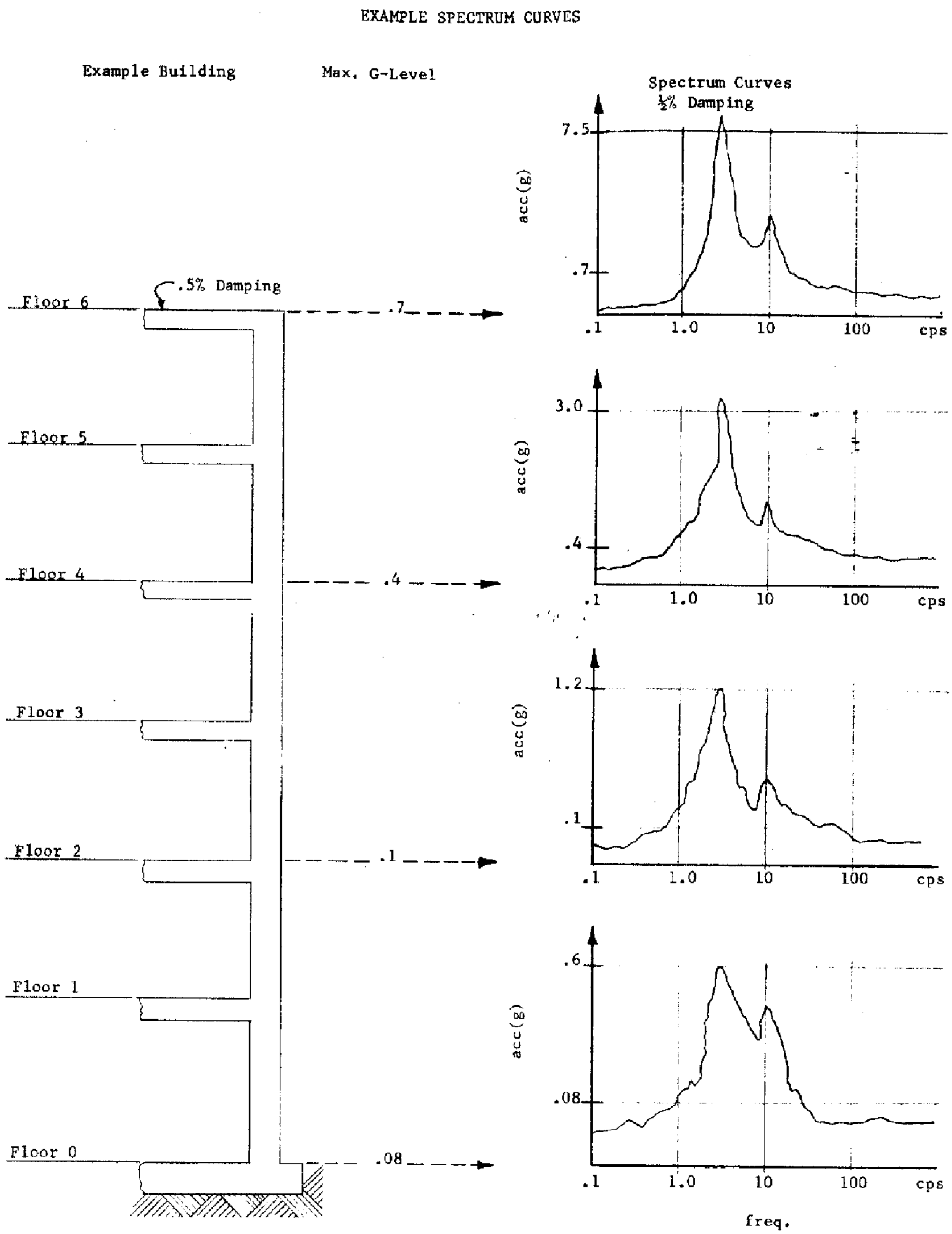


Figure 3-7. Reactor Building - Seismic Model Results (Sheet 1 of 2)

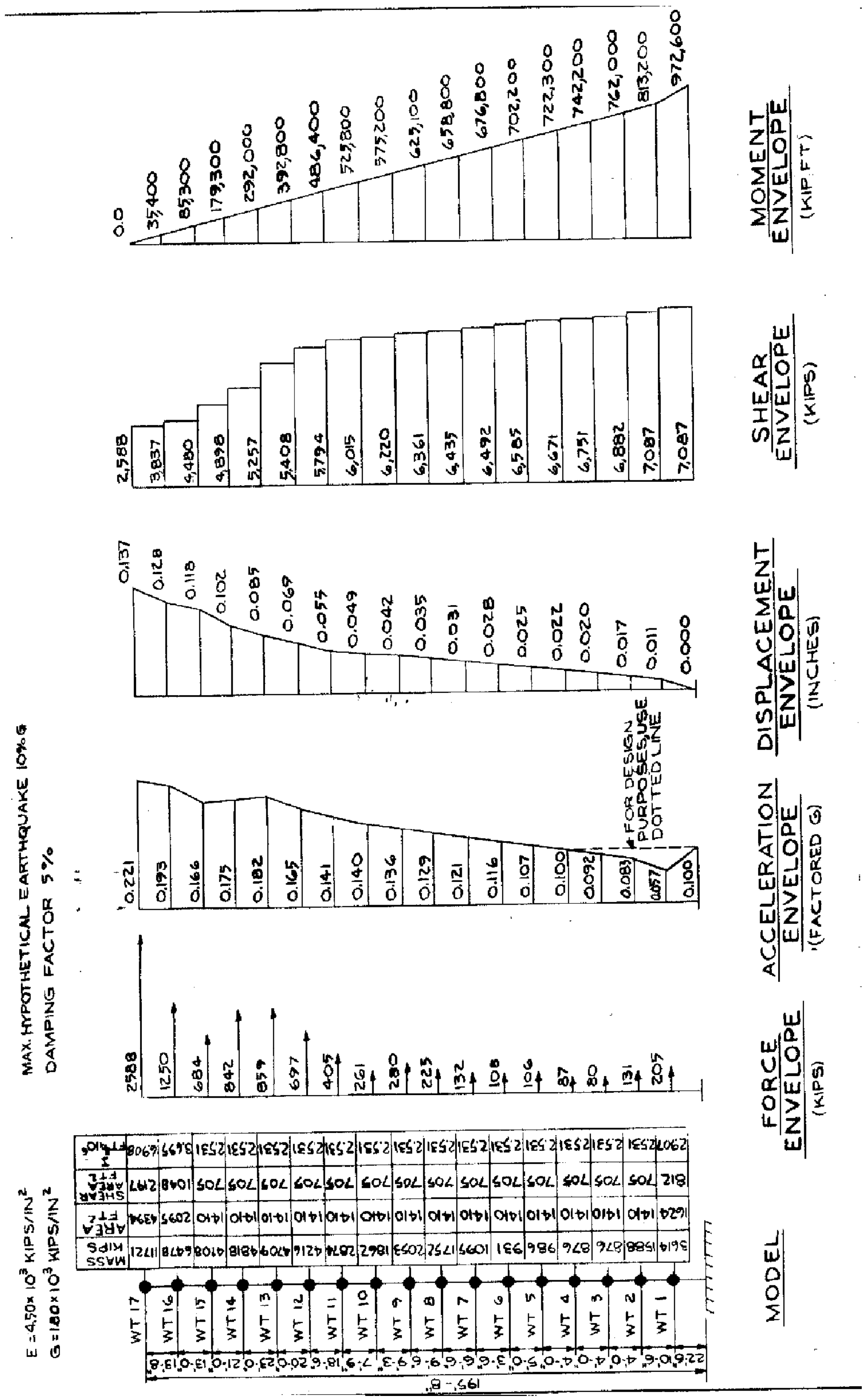


Figure 3-8. Reactor Building - Seismic Model Results (Sheet 2 of 2)

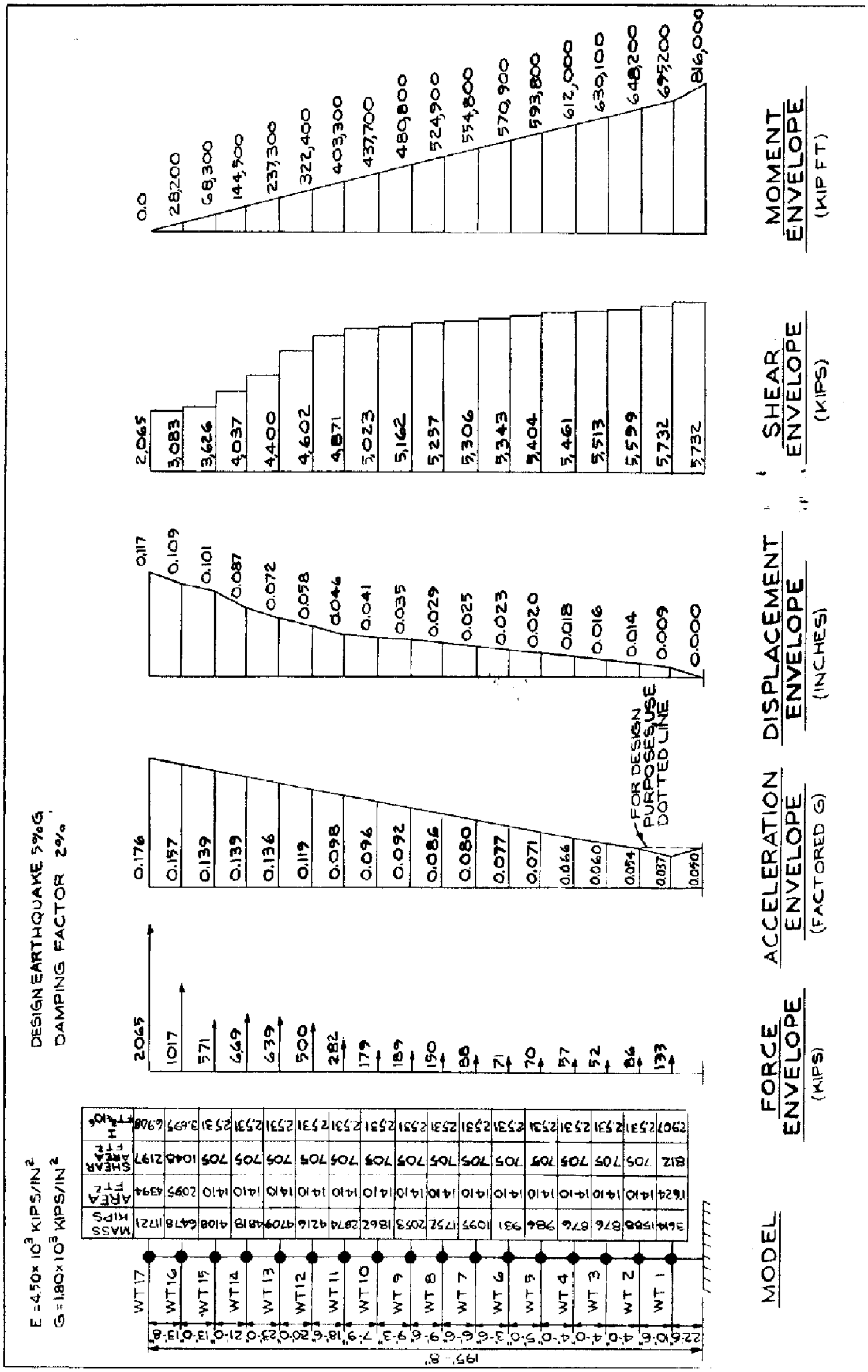


Figure 3-9. Main Steam System West Generator Problem Number 1-01-08. Calculation OSC 1296-06 "HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

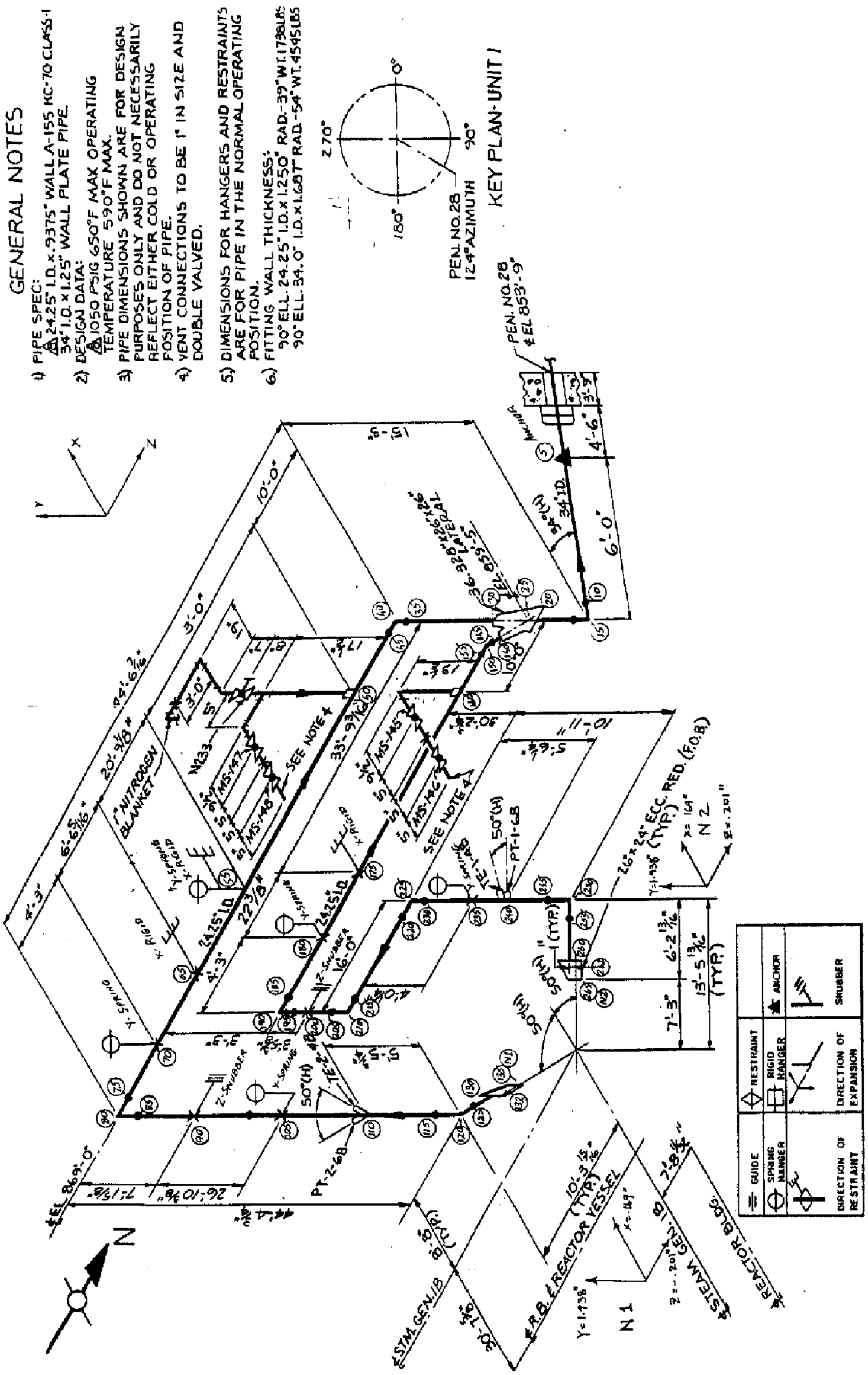


Figure 3-10. Core Flooding Tank 1A Problem Number 1-53-9. Calculation OSC 1300-06
"HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

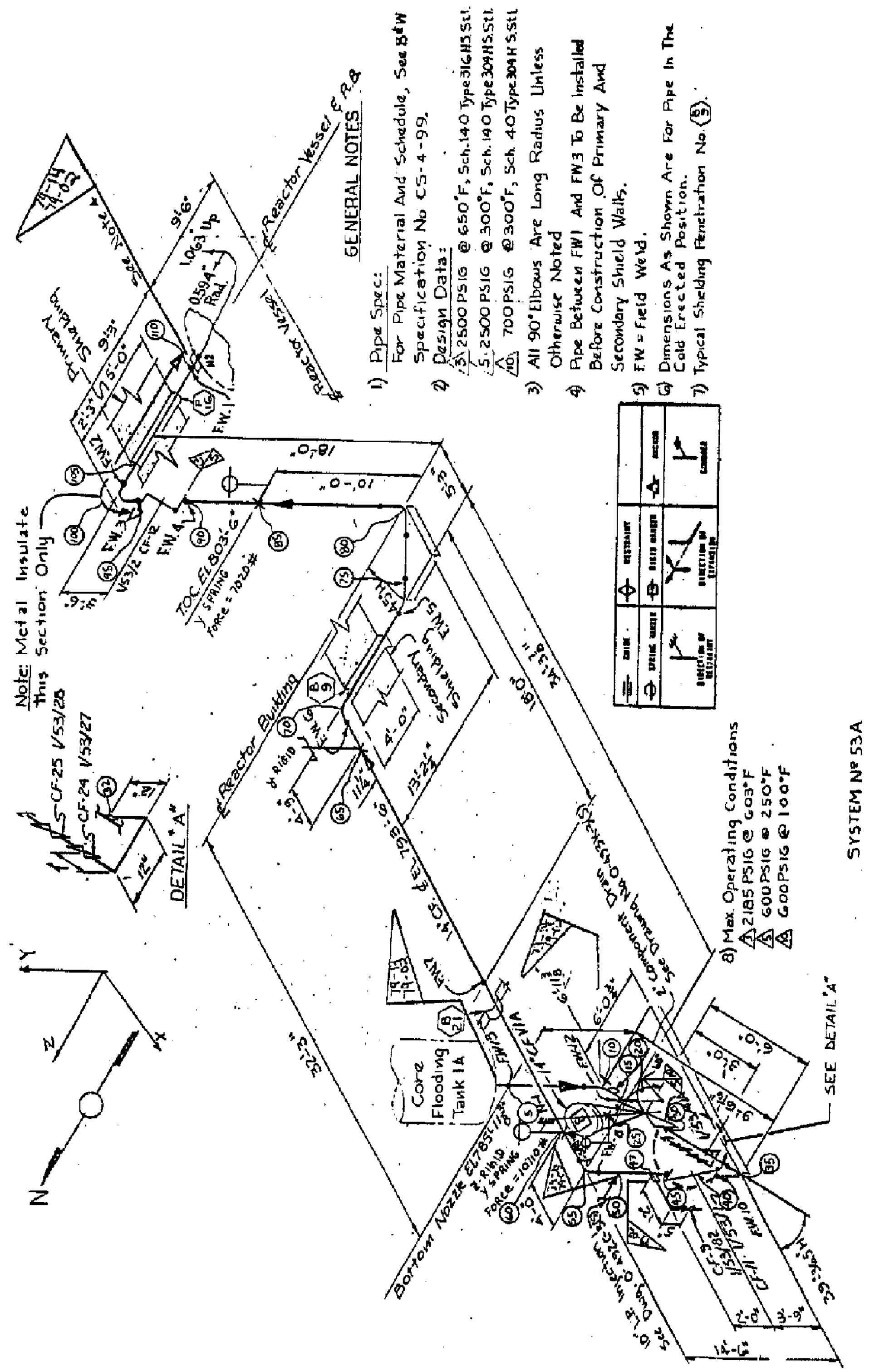


Figure 3-11. Low Pressure Injection System West Generator Problem Number 1-53-9. Calculation OSC 1300-06

"HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

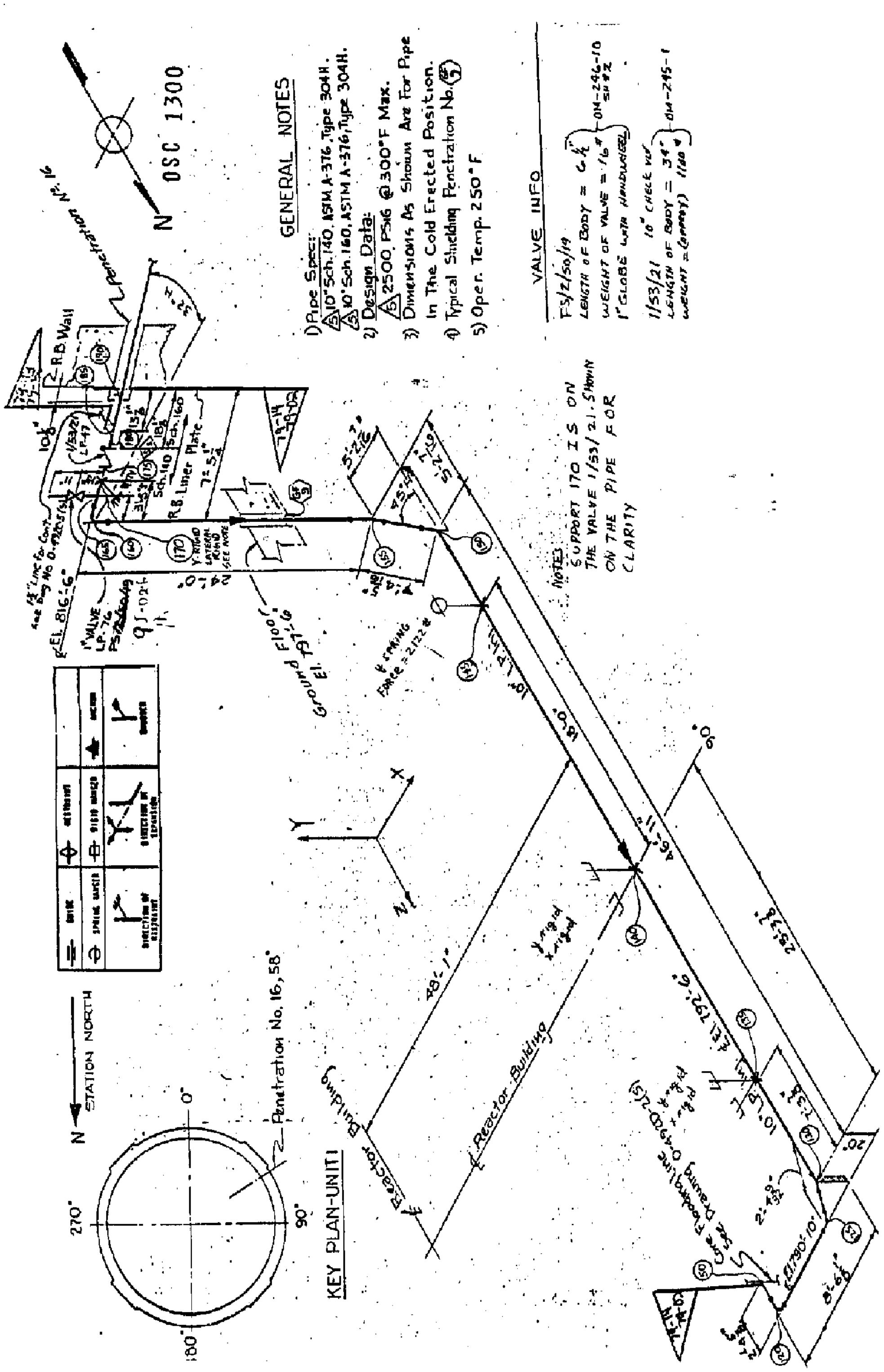


Figure 3-12. RCP Piping to HPI Letdown Coolers Problem Number 1-55-03. Calculation OSC 1660-11 "HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

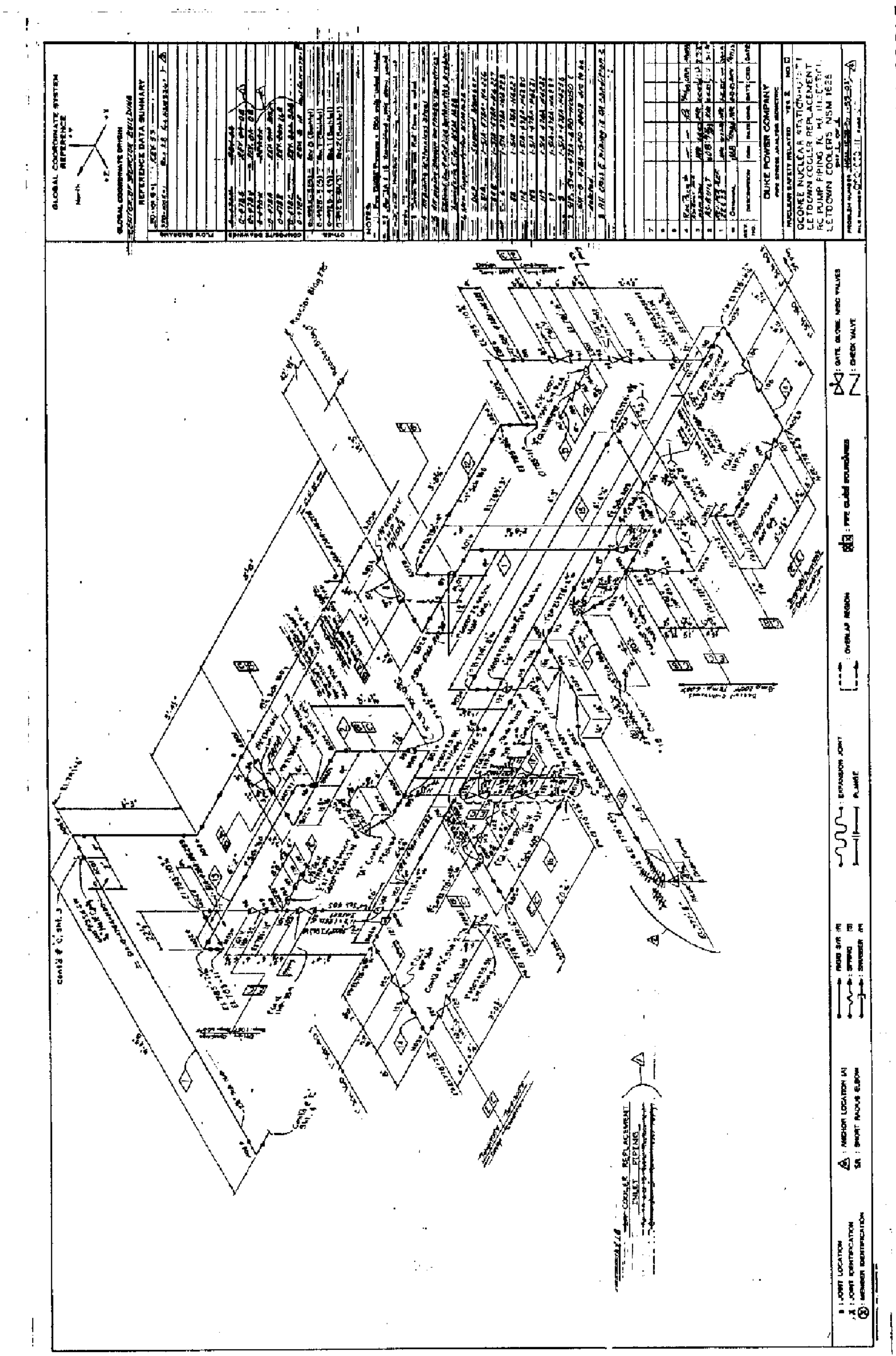


Figure 3-13. RCP Piping to HPI Letdown Coolers Problem Number 1-55-03. Calculation OSC 1660-11 "HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

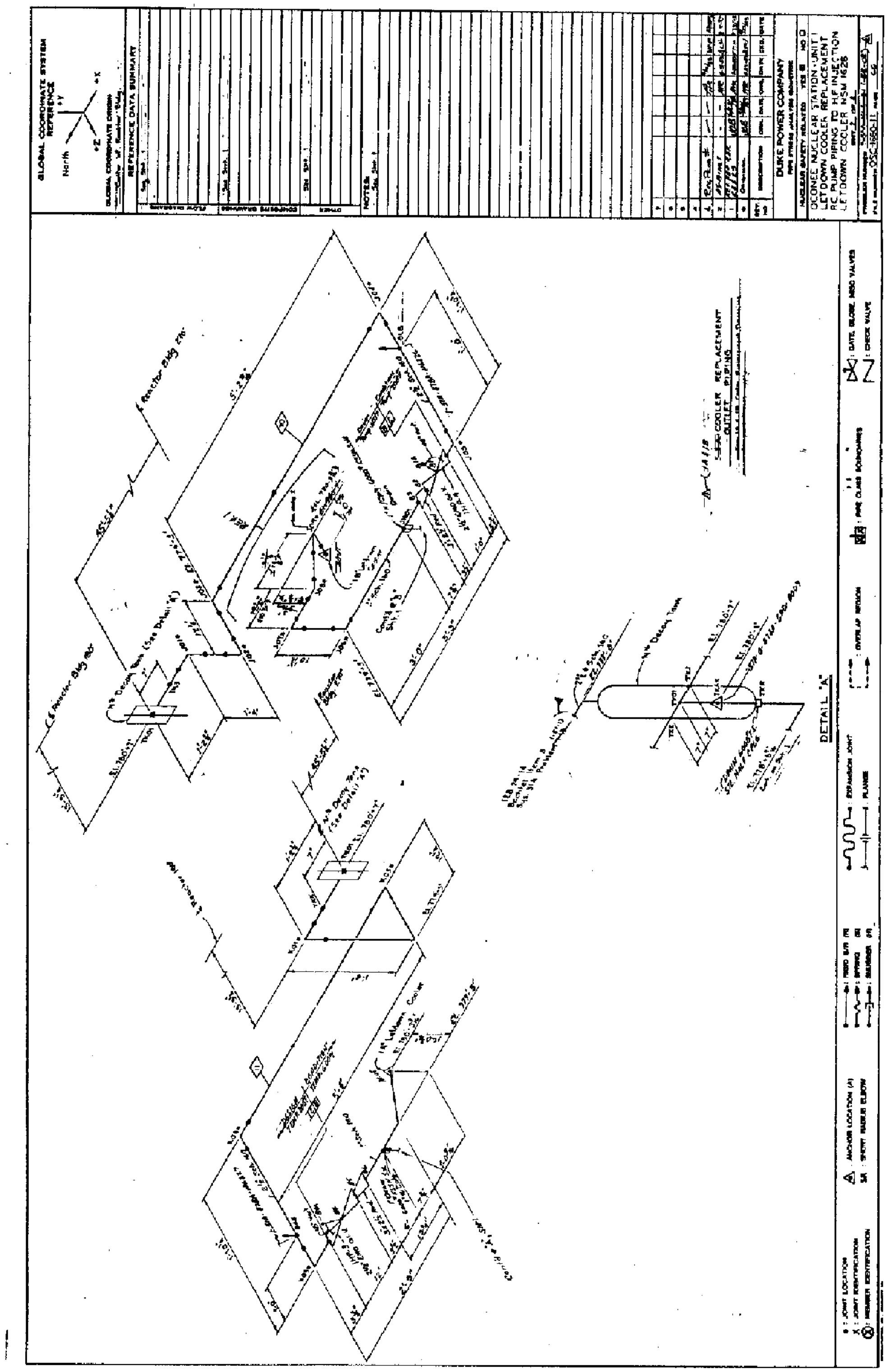


Figure 3-14. RCP Piping to HPI Letdown Coolers Problem Number 1-55-03. Calculation OSC 1660-11

"HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

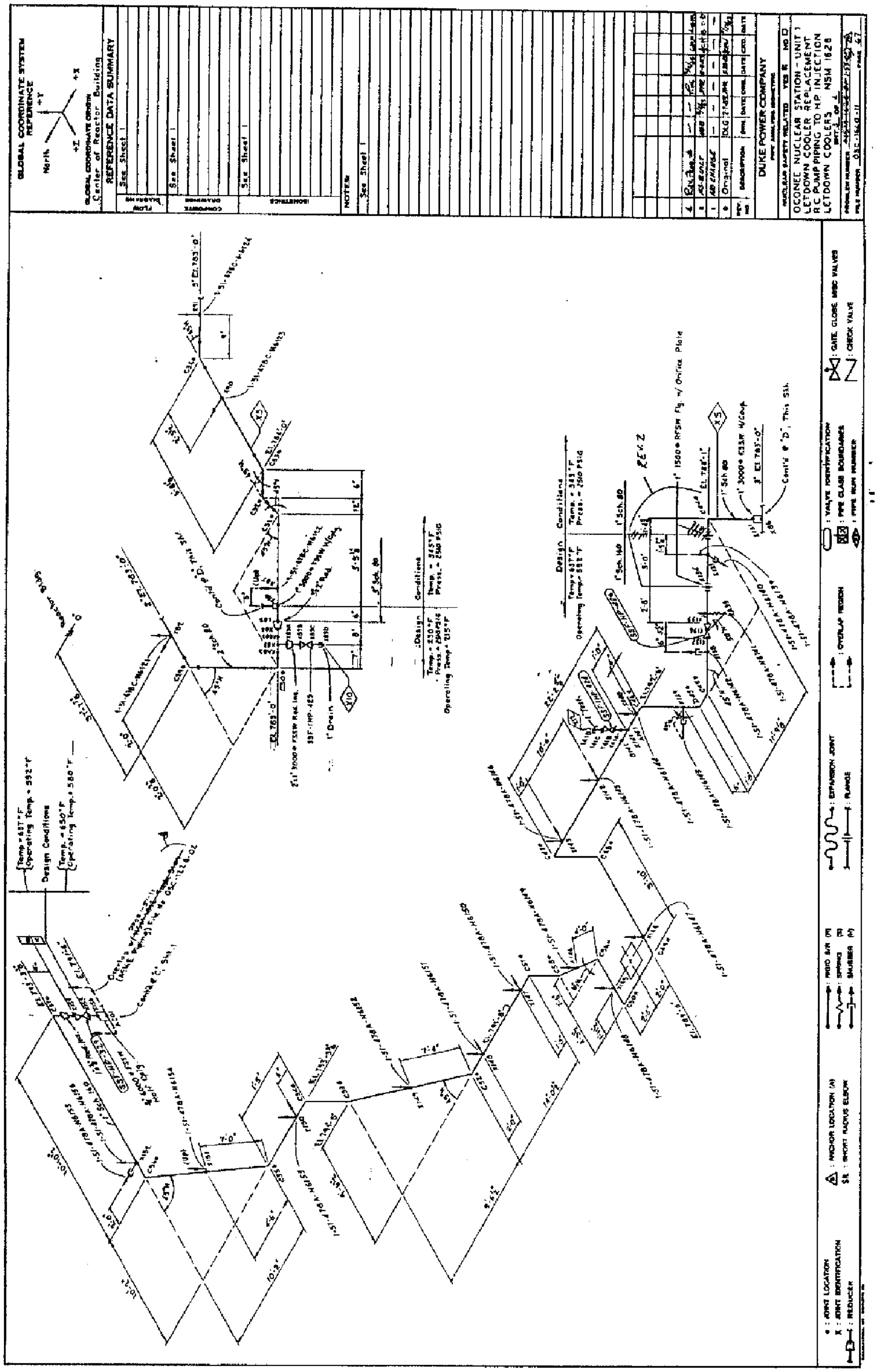


Figure 3-15. RCP Piping to HPI Letdown Coolers Problem Number 1-55-03. Calculation OSC 1660-11 "HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

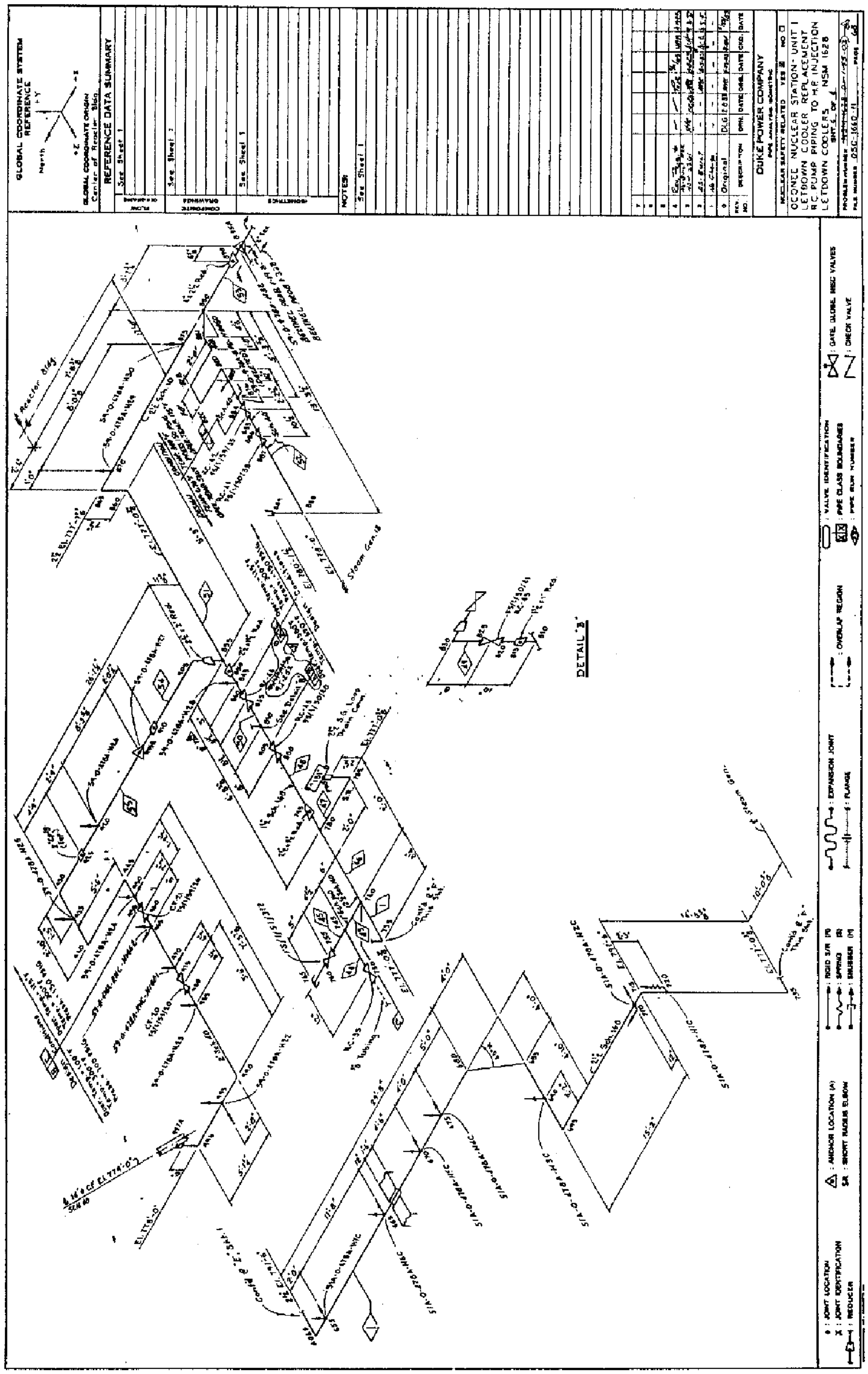
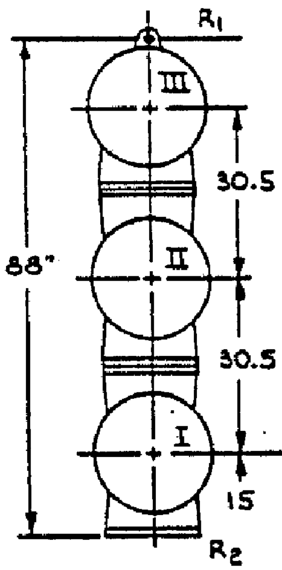
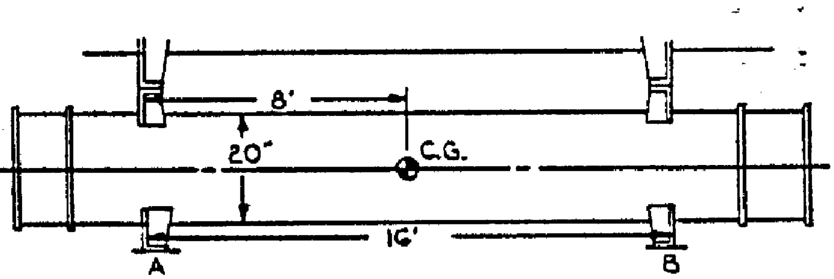


Figure 3-16. Seismic Analysis of Component Coolers

SEISMIC ANALYSIS OF
COMPONENT COOLERS



WEIGHT FULL OF WATER 9000 LBS EACH UNIT
VERTICAL SEISMIC LOAD 1.15 X 9000 = 10.300 LBS/IN
HORIZONAL SEISMIC LOAD .15 X 9000 = 1350 LBS/IN



FOUNDATION LOADS

VERTICAL (DOWNWARDS): 10300 X 3/2 = 15,450 LBS AT EACH SUPPORT
LONGITUDINAL: 1350 X 3 = 4050 LBS AT SUPPORT "A"
0 LBS AT SUPPORT "B" (SLOTTED HOLES)

LATERAL
R_1 = 2 X 675/2 X 88³ X (15² [73 + 2 X 88] + 45.5² [42.5 + 2 X 88] + 76² [12 + 2 X 88]) = 1660 LBS = TOTAL LOAD ON SEISMIC LUG

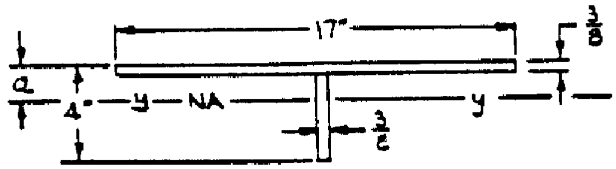
R_2 = 3 X 1350/2 - 1660/2 = 1195 LBS EACH SUPPORT ON FOUNDATION

LATERAL MOVEMENT
675/2 X 88² ([73 + 88] + [42.5 + 88] + [12 + 88] = 16.7 IN/LBS
(NEGLIGIBLE)

LOADS ON SUPPORTS OF UNIT I

VERTICAL (COMPRESSIVE)	15450 LBS
LATERAL (SHEAR)	1195 LBS
LONGITUDINAL (SHEAR)	4050 LBS
LONGITUDINAL MOMENT	4050 (15-10) = 20250 IN/LBS
LATERAL MOMENT	NEGLIGIBLE

Figure 3-17. Seismic Analysis of Component Coolers



AREA

$17 \times \frac{3}{8} + 3.625 \times \frac{3}{8}$

$= 6.4 + 1.34 = 7.74$ IN.^{2}

$6.4 \times .186 = 1.19$

$1.34 \times 2.188 = \underline{2.93}$

4.12

$a = 4.12/7.74 = .534$ IN.

$I_{y-y} = 6.4(.534 - .186)^2 + 17 \times .375^3/12 + 1.34 \times (2.188 - .534)^2 + .375 \times 3.625^3/12$

$= .775 + .075 + 3.66 + 1.49 = 6.00$ IN^4 S.M.$_{y-y} = \frac{6}{4 - .534} = 1.73$ IN^3

STRESSES IN SUPPORTS

COMPRESSIVE	15450/7.74 =	2000 PSI
MAX SHEAR	$\sqrt{1195^2 + 4050^2}/7.74 =$	545 PSI
BENDING STRESS	20250/1.73 =	11700 PSI

MAX STRESS FROM SIMULTANEOUS HORIZONTAL AND VERTICAL ACCEL

2000 + 11700 = 13700 PSI

LOADS ON SHELL AT LOWER SUPPORTS

DIRECT SUPPORT LOAD	15450 LBS
LONGITUDINAL MOVEMENT	4050 X 6 = 24300 IN/LBS
INTERNAL PRESSURE	100 PSI

EVALUATION OF LOCALIZED STRESSES IN SHELL AT LOWER SUPPORT USING O ROURKE FORMULAS FOR STRESS AND STRAIN - EDITION 1954 - PAGE 282

$K = .02 - .00012(150 - 90) = .0128$

EQUIVALENT DIRECT LOAD ON SHELL

$15450 + 24300/\frac{2}{3} \times 10 = 19090$ LBS

DURING SIMULTANEOUS HORIZONTAL AND VERTICAL ACCELERATION

$.0128 \times \frac{19090}{.25^2}$ Ly $\frac{20}{.25} = 17100$ PSI

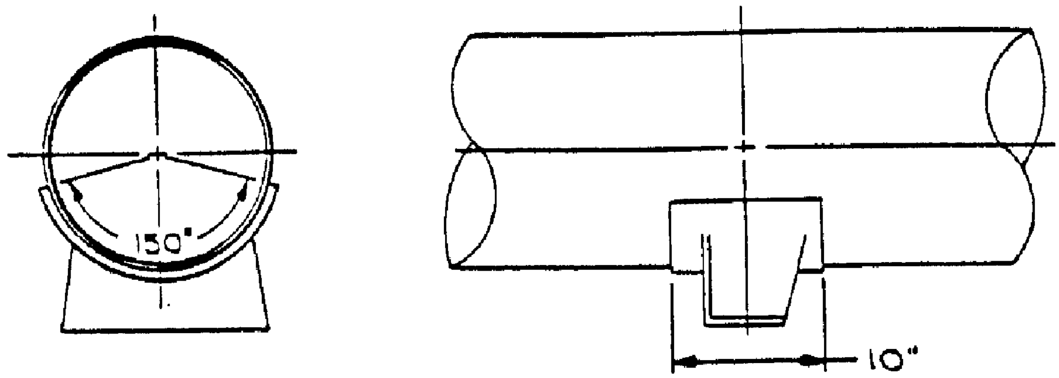
STRESS IN SHELL FROM PRESSURE

$\frac{100 \times 9.75}{.25} + .6 \times 100 = 3960$ PSI

THE SHELL WILL NOT COLLAPSE

Figure 3-18. Seismic Analysis of Component Coolers

TYPICAL SUPPORT SADDLE



SEISMIC LUG

MOMENT 2 X 1660 = 3320 IN LBS

SM OF LUG $\frac{3}{4} \times 3^2/6 = 1.13$ IN^2

STRESS IN LUG 3320/1.13 = 2930 PSI

EQUIVALENT DIRECT LOAD ON SHELL

$2 \times 3320/\frac{2}{3} \times 3 = 3320$ LBS

MAX. LOCAL STRESS IN SHELL

$.03 \times \frac{3320}{.25^2}$ $L_y \frac{20}{.25} = 7160$ PSI

STRESS IN SHELL FROM PRESSURE 3960 PSI

NO PAD REQUIRED

Figure 3-19. Reactor Building Typical Details

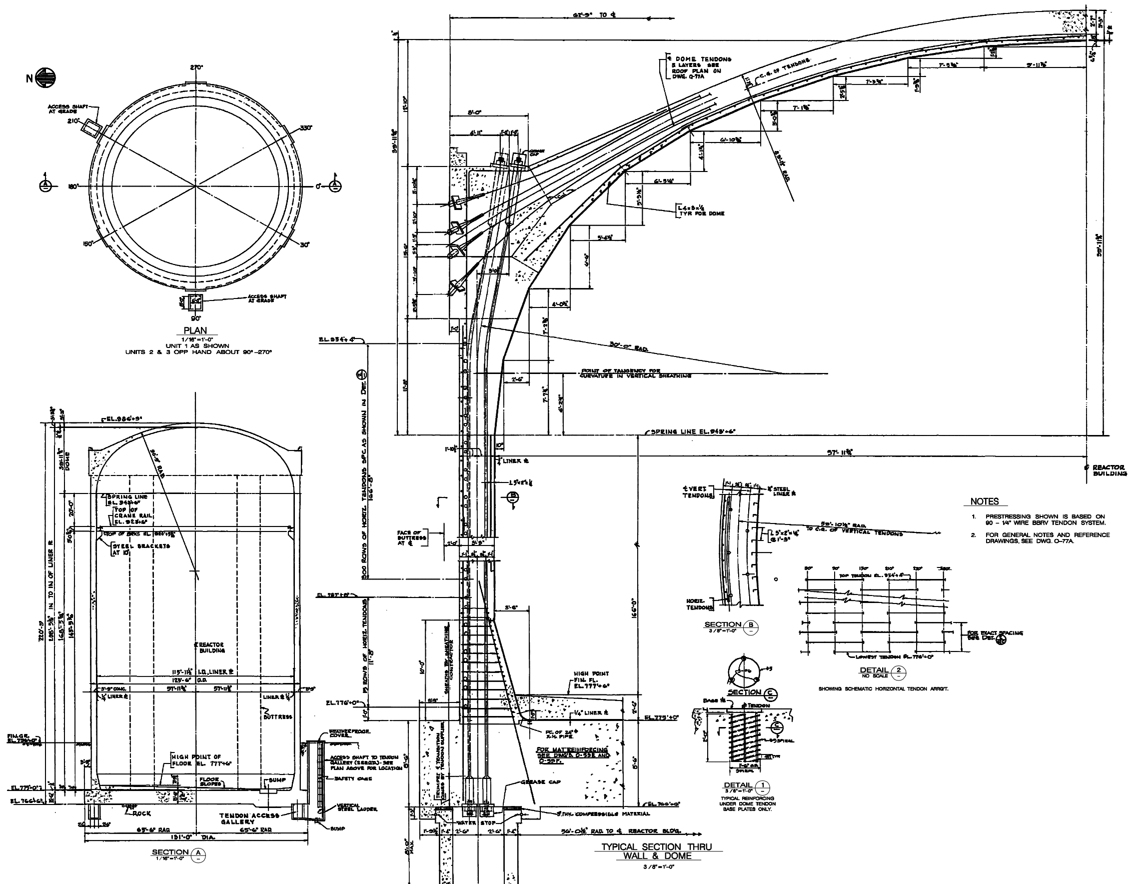
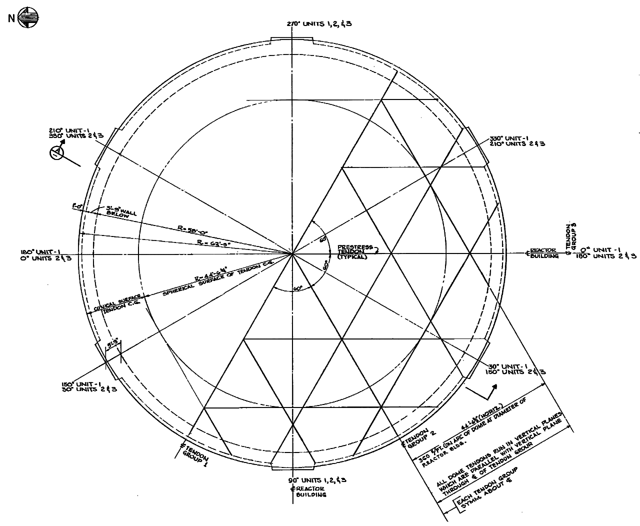
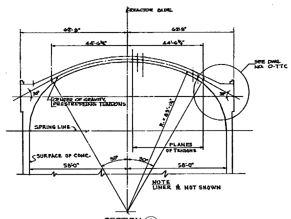


Figure 3-19 (Sheet 1 of 3)
Reactor Building Typical Details



ROOF PLAN
1/8" = 1'-0"
SHOWING PRESTRESSING TENDON ARRG'T.



SECTION A
1/16" = 1'-0"

GENERAL NOTES

1. UNLESS NOTED OTHERWISE ON THE DRAWINGS OR IN THE SPEC. NO. OS-161, ALL WORK SHALL BE IN ACCORDANCE WITH A.C.I. CODE 318-63.
2. CONCRETE STRENGTH SHALL BE AS FOLLOWS:
   WALL & DOME = 5000 PSI @ 28 DAYS
   FOUNDATION SLAB = 5000 PSI @ 28 DAYS
3. ASSUMED MODULUS OF ELASTICITY OF CONCRETE IS 3×10^6.
4. NON PRESTRESSED REINFORCING IS BY OWNER.
5. PRESTRESS LOSSES SHALL BE BASED ON THE FOLLOWING:
   DUE TO CREEP IN CONC. – 420×10^{-6} PSI
   DUE TO SHRINKAGE IN CONC. – 50×10^{-6} PSI
6. ALL PRESTRESSING FORCES ARE MINIMUM REQUIRED EFFECTIVE PRESTRESS VALUES AFTER LOSSES HAVE OCCURRED.
7. HORIZONTAL PRESTRESSING FORCES ARE SHOWN IN EACH BAY AND ARE CONSTANT BETWEEN THE BUTTRESSES.
8. THE TYPICAL DETAILS OF PRESTRESSING AROUND OPENINGS AND PENETRATIONS INDICATE THE GENERAL ARRANGEMENT ONLY. ACTUAL DESIGN DETAILS, INCLUDING THE SIZE, SPACING AND LAYOUT SHALL BE DEVELOPED BASED ON GENERAL ARRANGEMENT SHOWN.
9. THE PRESTRESSING ARRANGEMENT SHOWN ON THE DRAWING IS BASED ON THE BBRV, 1/4" 90 WIRE SYSTEM AND IS FOR INFORMATION AND GUIDANCE ONLY.
10. TENDON RELAXATION LOSS SHALL BE BASED ON A DESIGN LIFE OF 40 YEARS AND AN AVERAGE SERVICE TEMPERATURE OF 70°F.
11. BEARING PLATE THREADED HOLEDS TO BE PLUGGED WITH BOLTS PRIOR TO APPLYING COATING SYSTEM.

ITEM #90 (Furn. by Prescon Corp.)
COVERS THE FURN OF PRESTRESS SYSTEM FOR UNITS 1 & 2.

ITEM #90-1 (Furn. by Prescon Corp.)
COVERS THE FURN. OF PRESTRESS SYSTEM FOR UNIT 3.

ITEM #90-3 (Furn. in field)
COVERS THE FURN. OF BOLTS TO PLUG BEARING PLATE HOLES.

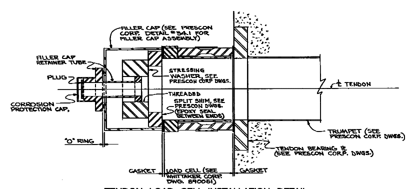
ITEM #93-1 (Furn. by Viscosity Oil)
COVERS THE FURN. OF TENDON SHEATH FILLER MATERIAL.

REFERENCE DRAWINGS

PRESTRESSING REQUIREMENTS, ROOF & MISC. DET.	O-77A
PRESTRESSING REQUIREMENTS, WALL DETAILS	O-77B
PRESTRESSING REQUIREMENTS, TYP. DETAILS	O-77C
PRESTRESSING REQUIREMENTS, HATCHES	O-77D
POST TENSIONING STRESSING COMPONENTS DETAILS	O-77E

REFERENCE SPECIFICATIONS

POST TENSIONING SYSTEM	OS-161
PRESTRESSING TENDON SHEATHS	OS-161-1
TENDON SHEATH FILLER MATERIAL	OS-161-3



TENDON LOAD CELL INSTALLATION DETAIL
(FOR LOCATION OF LOAD CELLS, SEE O-78A)

Figure 3-19 (Sheet 2 of 3)
Reactor Building Typical Details

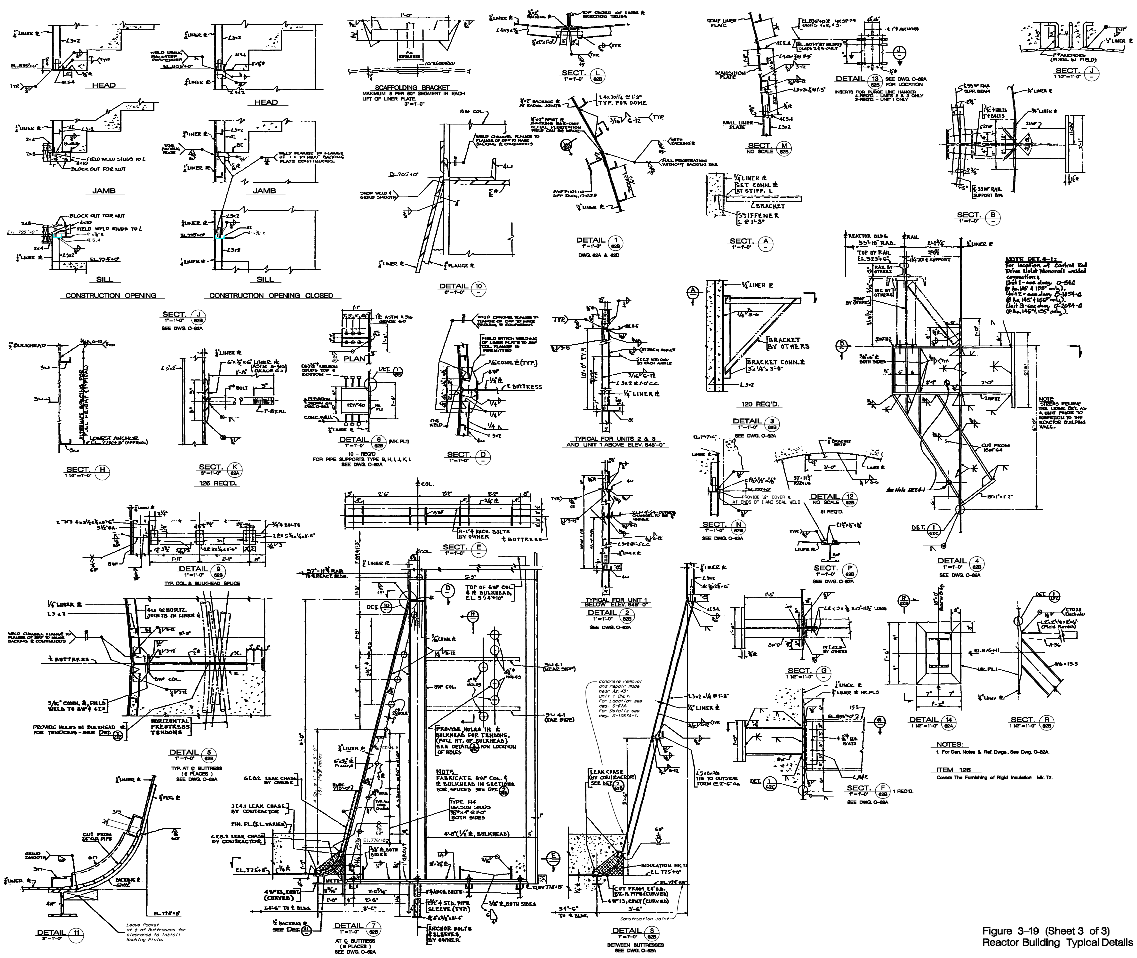


Figure 3-19 (Sheet 3 of 3)
Reactor Building Typical Details

Figure 3-20. Typical Electrical and Piping Penetrations

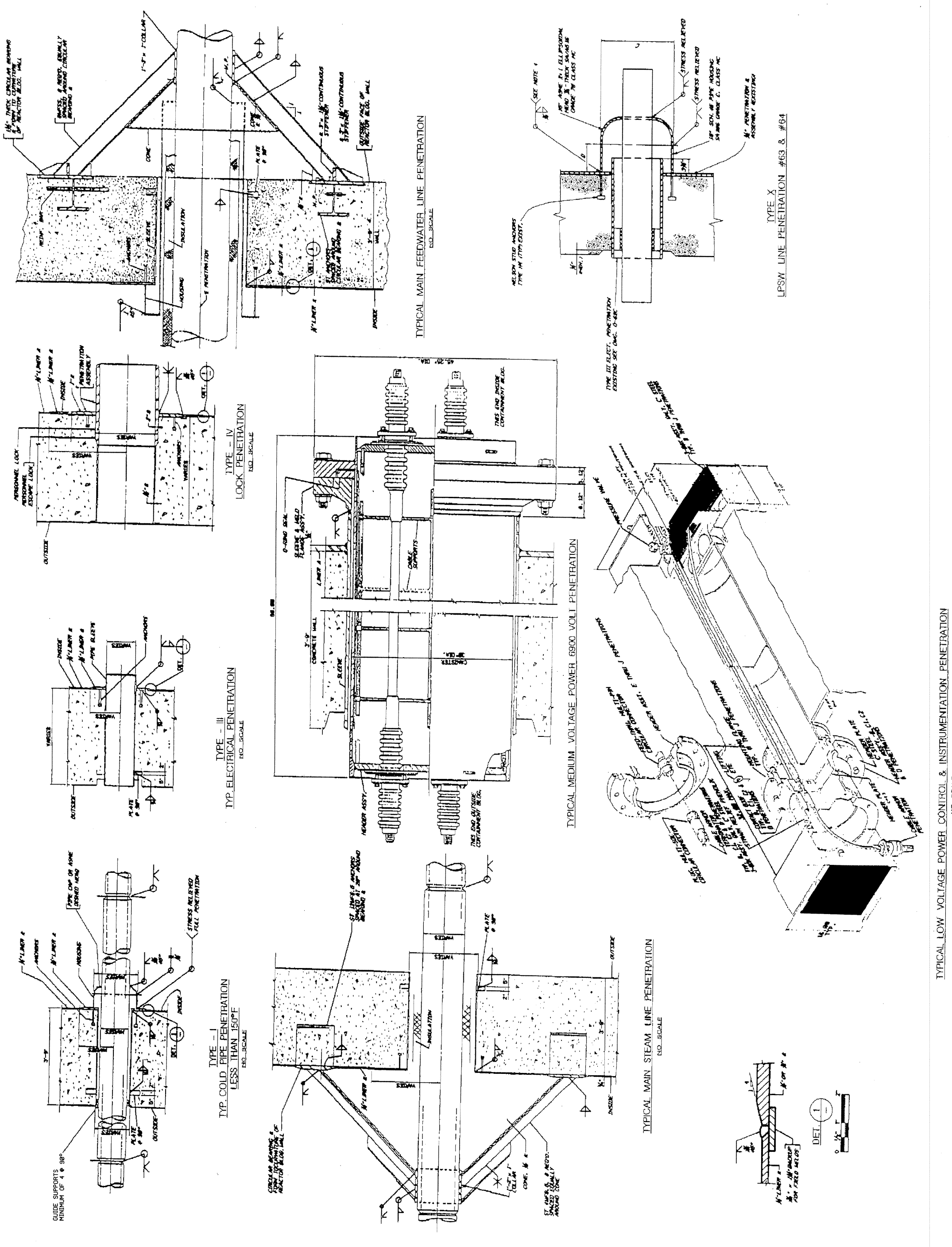


Figure 3-21. Details of Equipment Hatch and Personnel Hatch

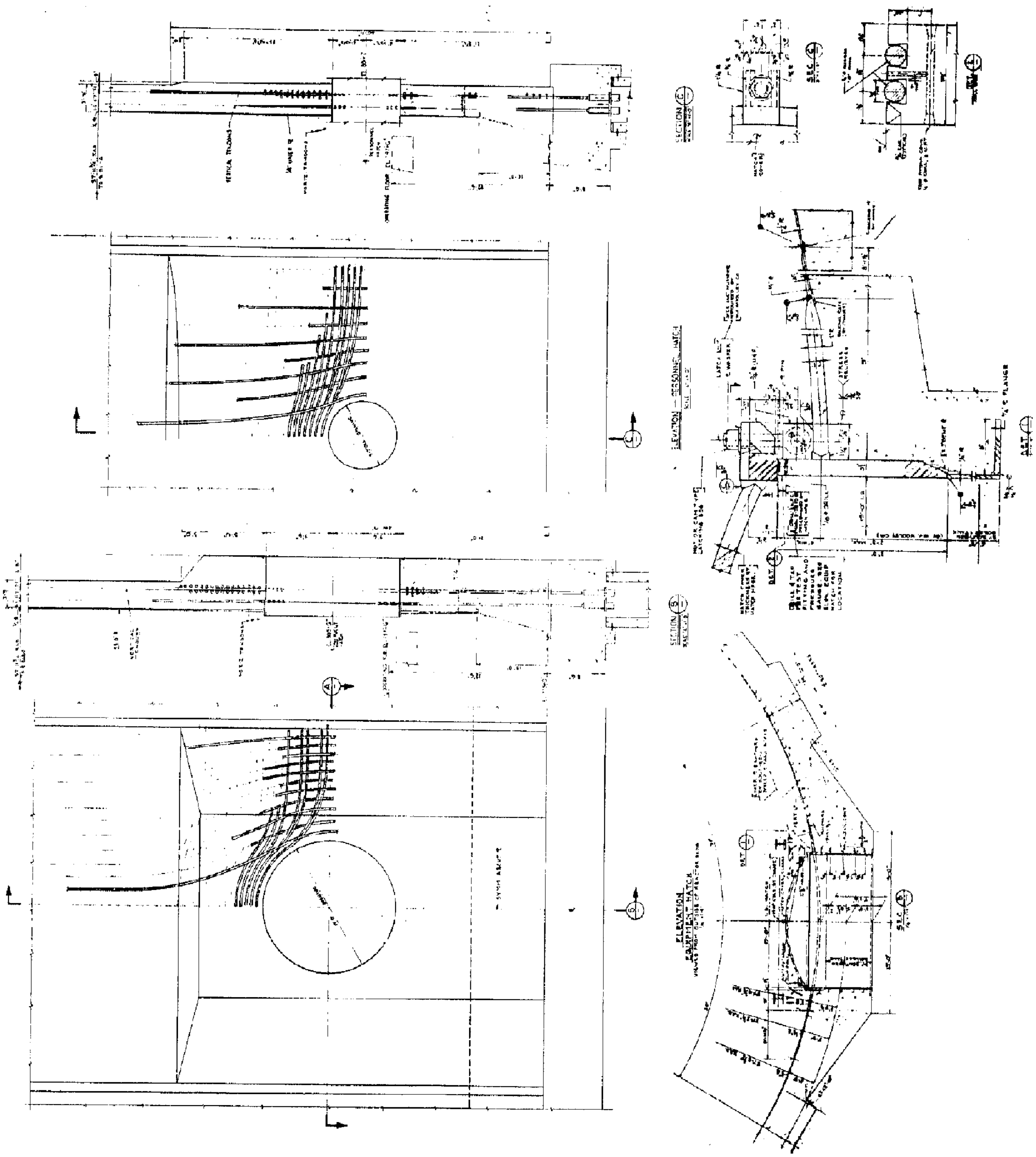


Figure 3-22. Reactor Building Finite Element Mesh

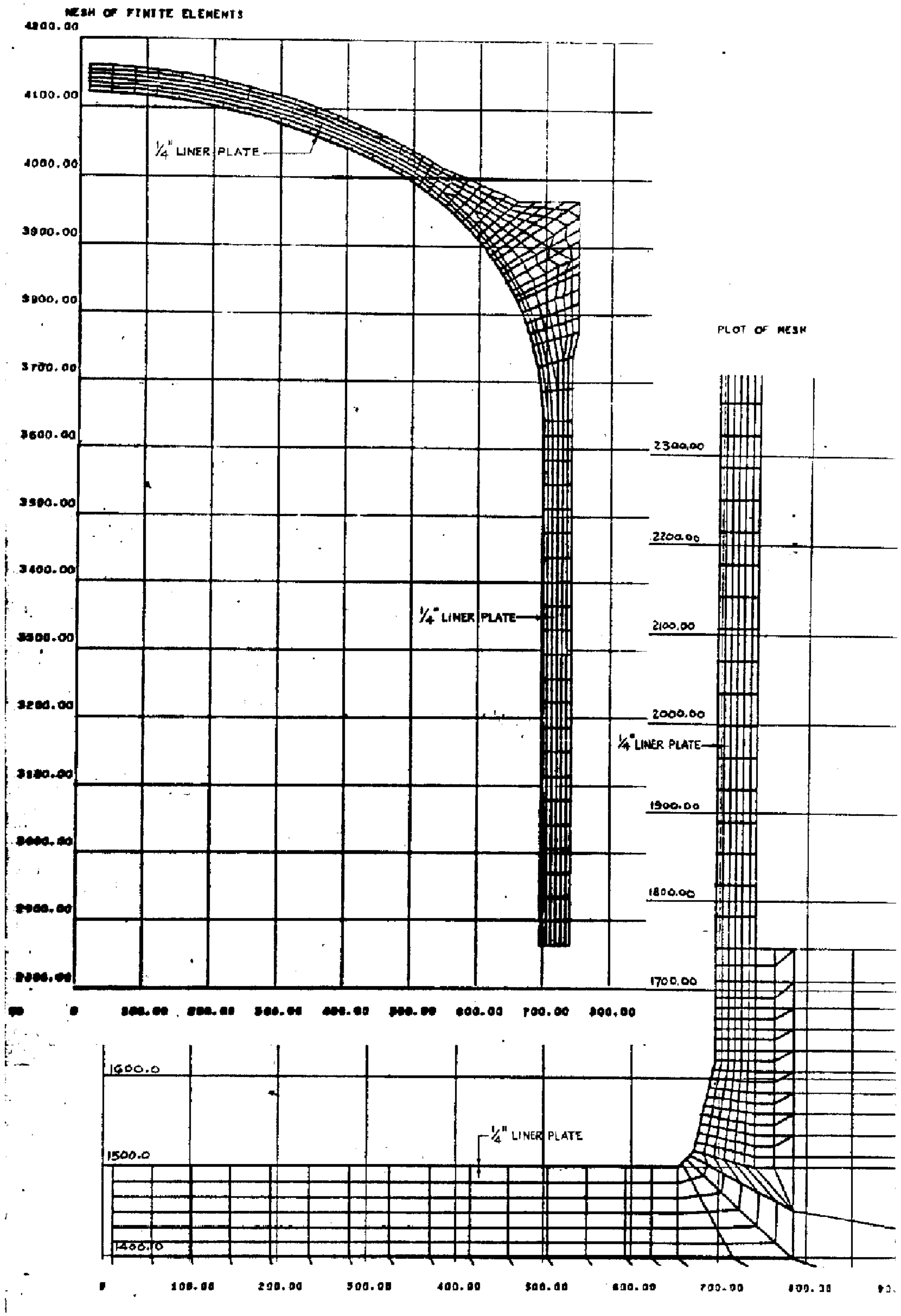


Figure 3-23. Reactor Building Finite Element Mesh

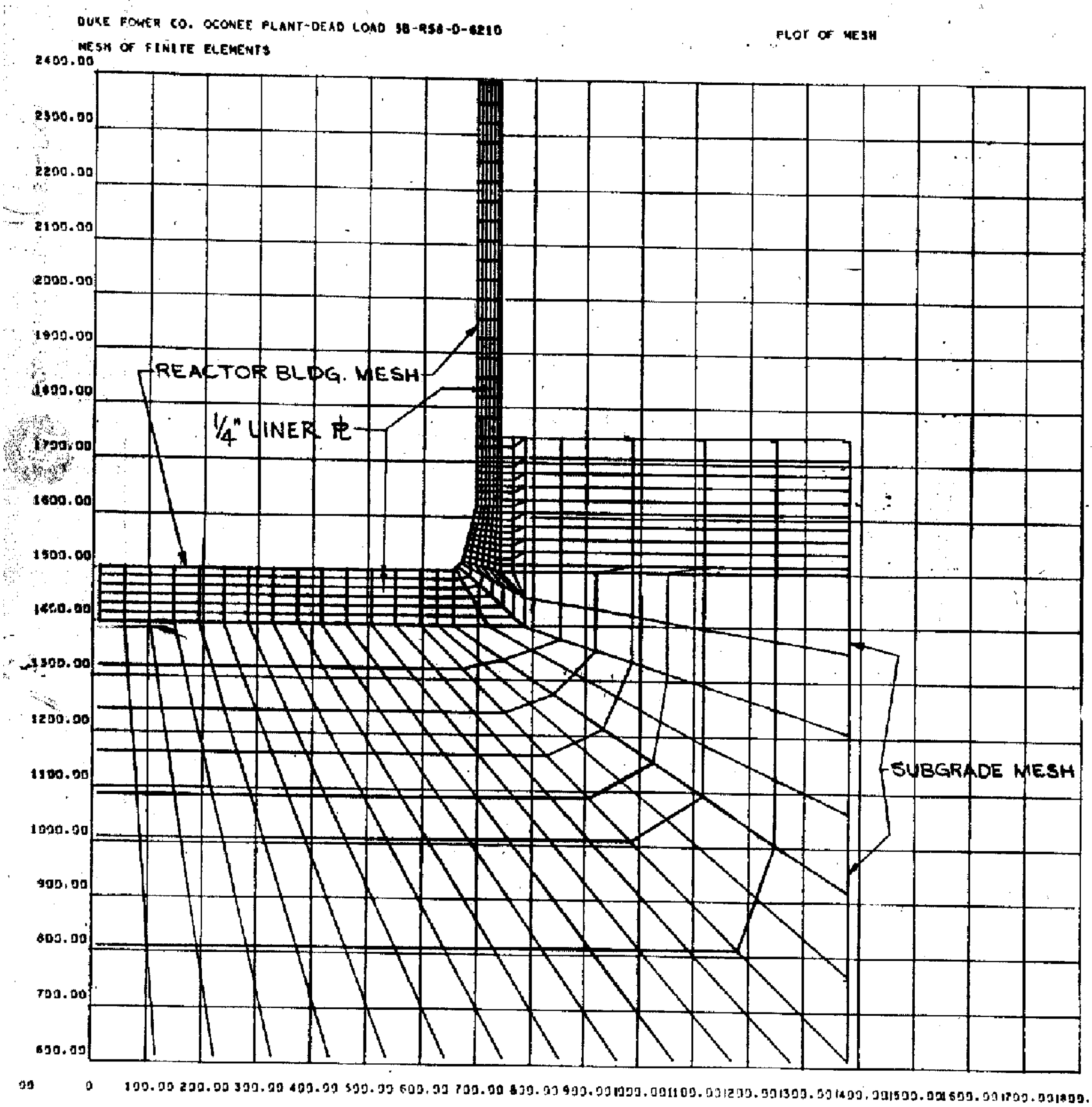


Figure 3-24. Reactor Building Thermal Gradient

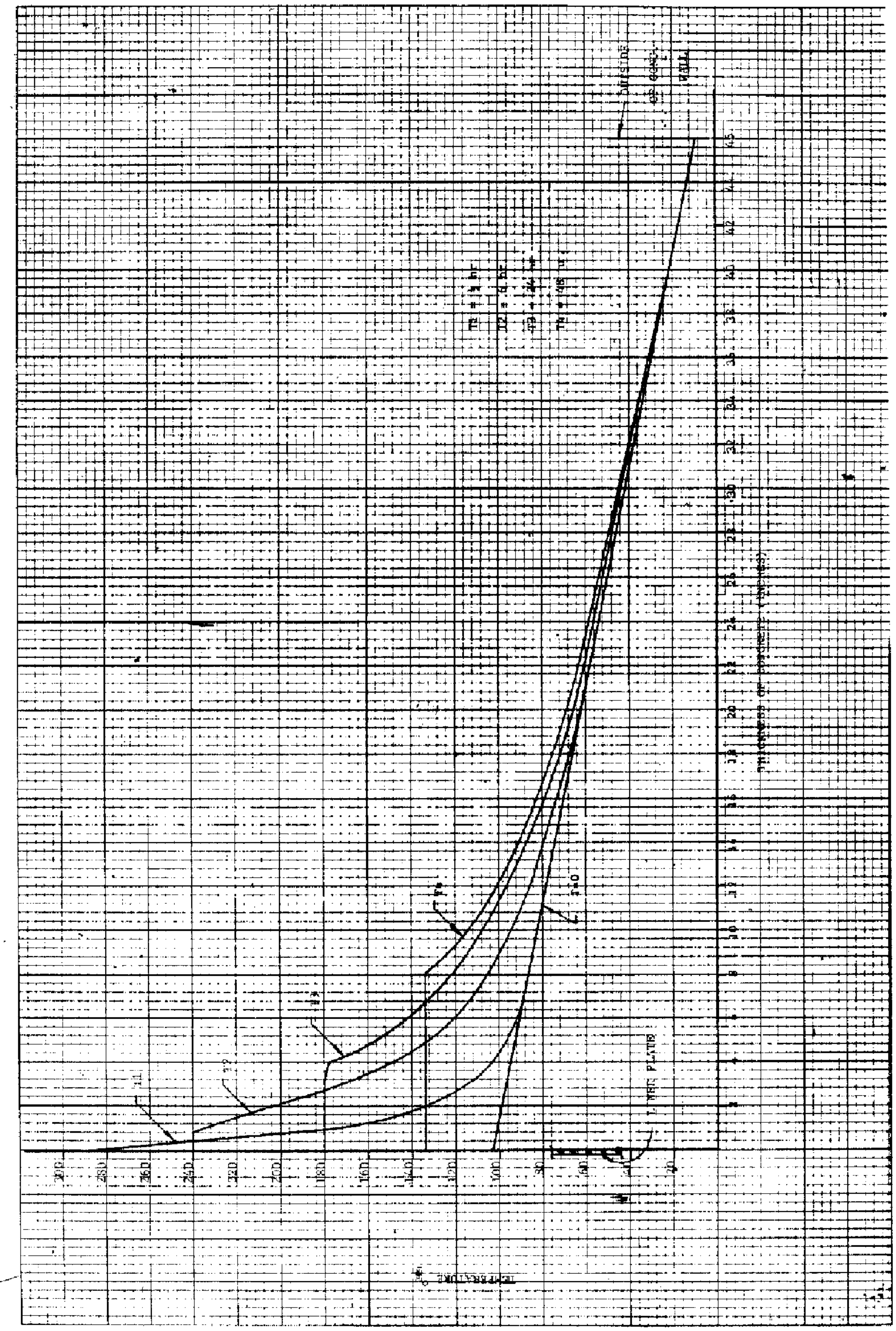
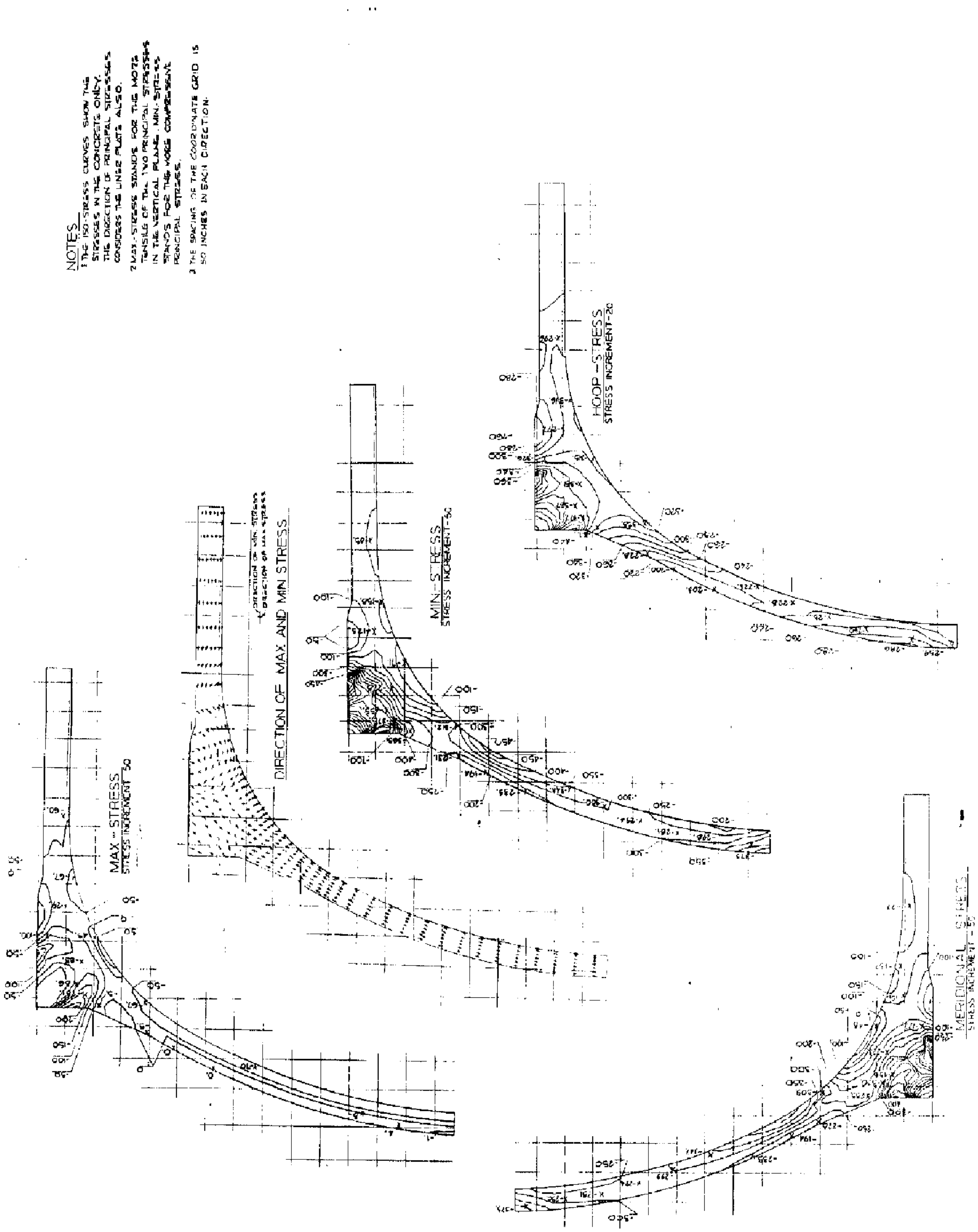
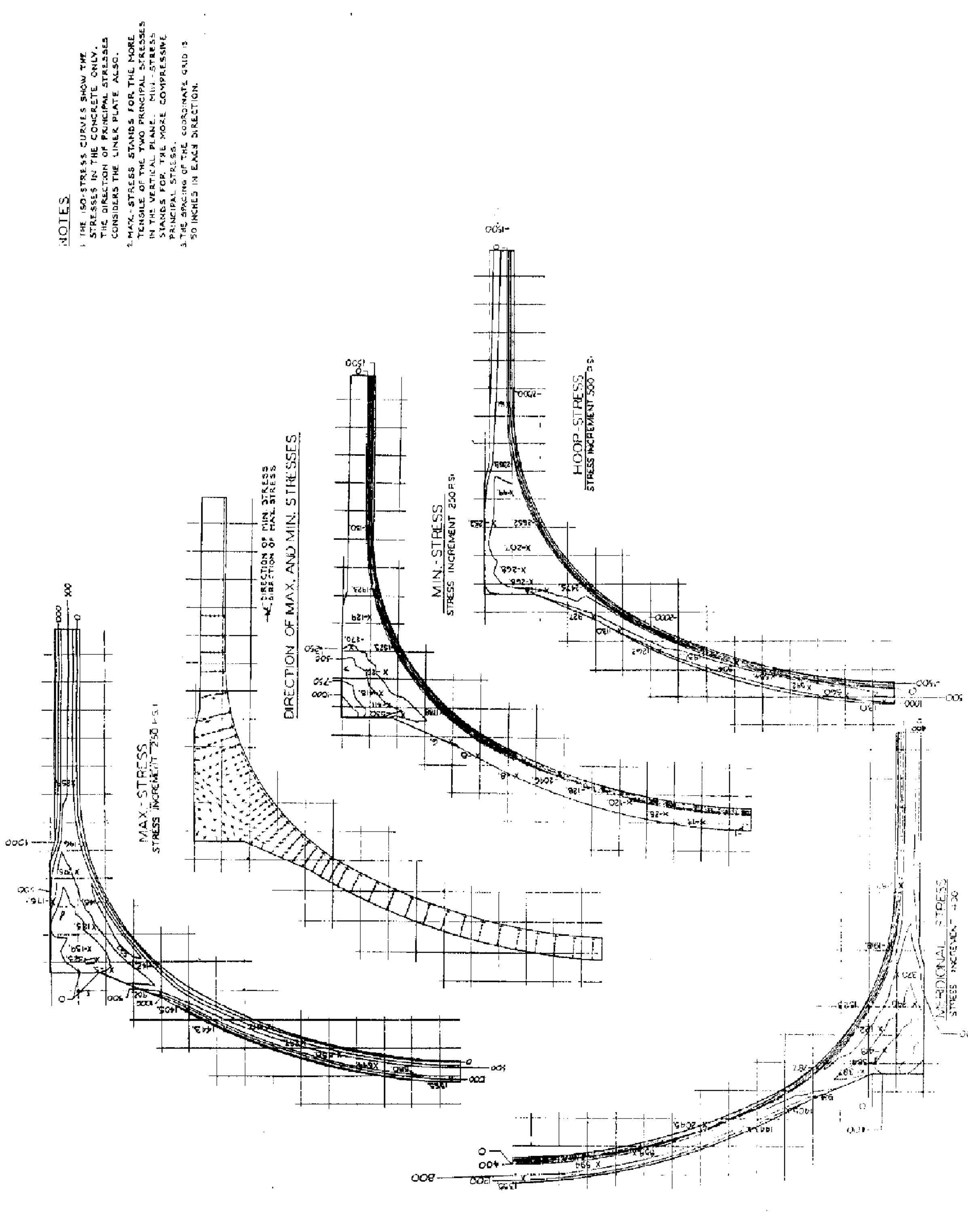
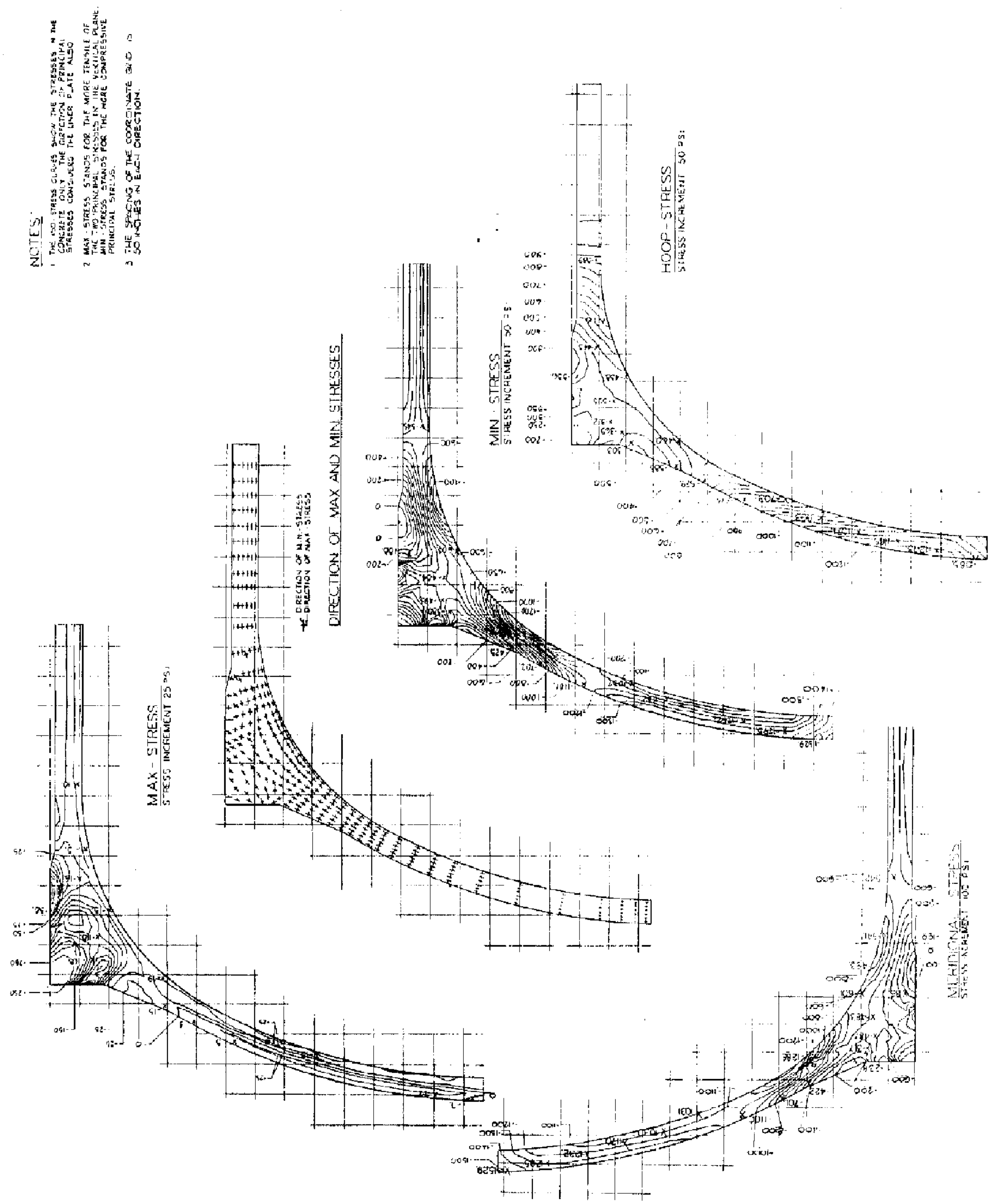


Figure 3-25. Reactor Building Isostress Plot Wall and Dome




NOTES
1. THE ISO-STRESS CURVES SHOW THE STRESSES IN THE CONCRETE ONLY. THE DIRECTION OF PRINCIPAL STRESSES CONSIDERS THE LINER PLATE ALSO.
2. MAX.-STRESS STANDS FOR THE MORE TENSILE OF THE TWO PRINCIPAL STRESSES IN THE VERTICAL PLANE. MIN.-STRESS STANDS FOR THE MORE COMPRESSIVE PRINCIPAL STRESS.
3. THE SPACING OF THE COORDINATE GRID IS 50 INCHES IN EACH DIRECTION.
MAX.-STRESS
STRESS INCREMENT 250 PSI
DIRECTION OF MAX. AND MIN. STRESSES
DIRECTION OF MIN. STRESS
DIRECTION OF MAX. STRESS
MIN.-STRESS
STRESS INCREMENT 250 PSI
HOOP-STRESS
STRESS INCREMENT 500 PSI
MERIDIONAL STRESS


NOTES:
MAX - STRESS
DIRECTION OF MAX AND MIN STRESSES
MIN - STRESS
STRESS INCREMENT 50 PSI
HOOP - STRESS
STRESS INCREMENT 50 PSI

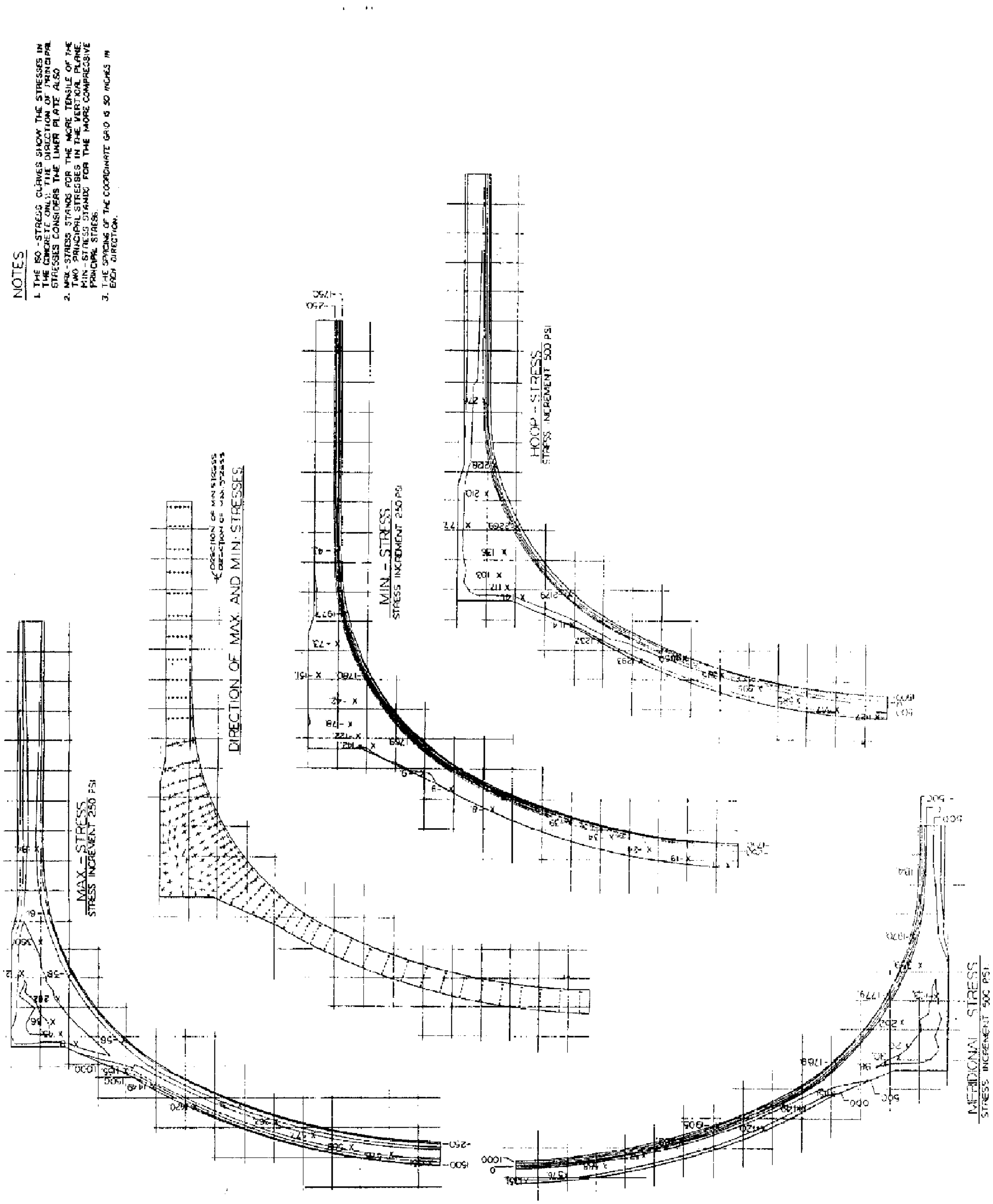
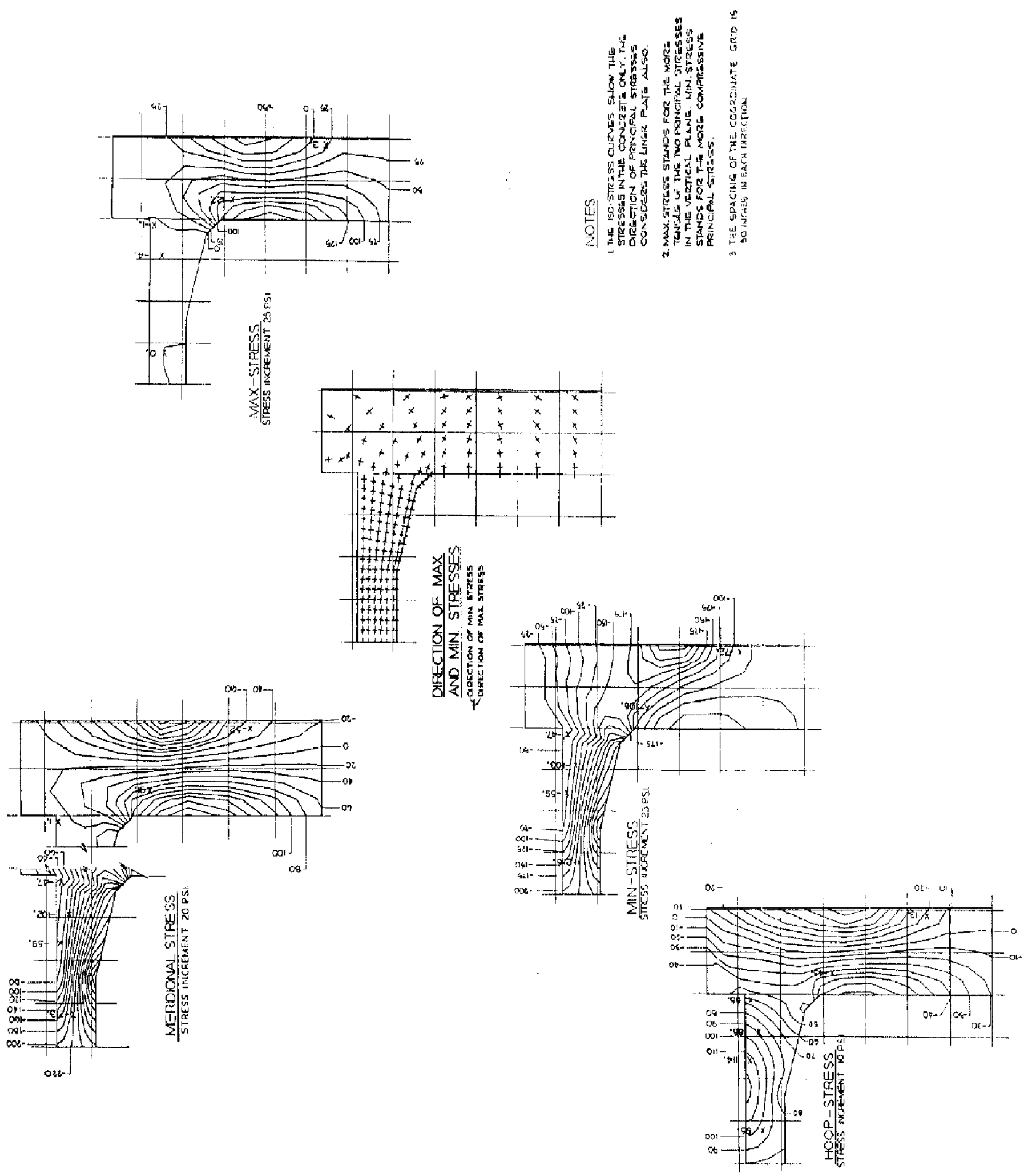
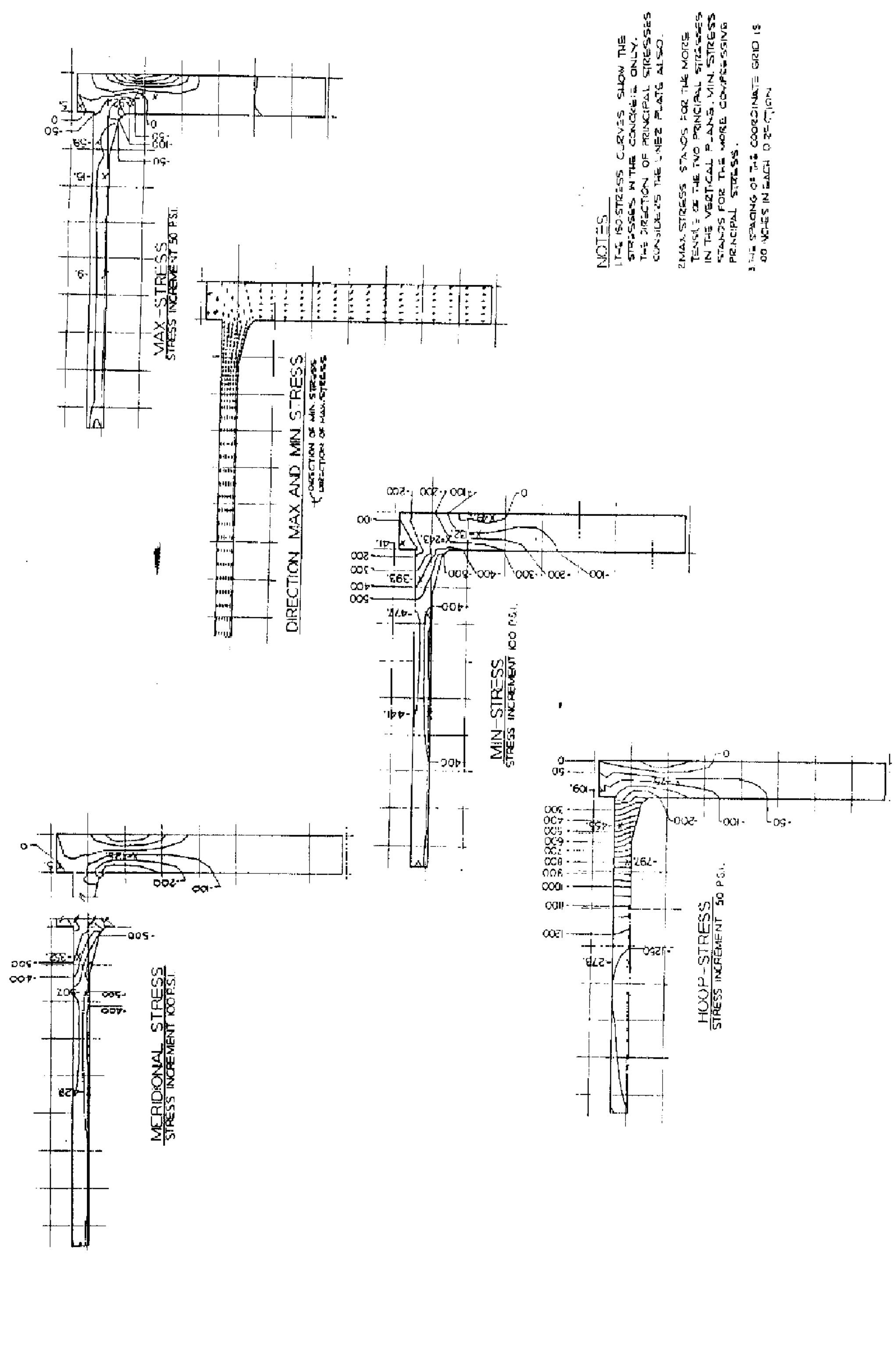
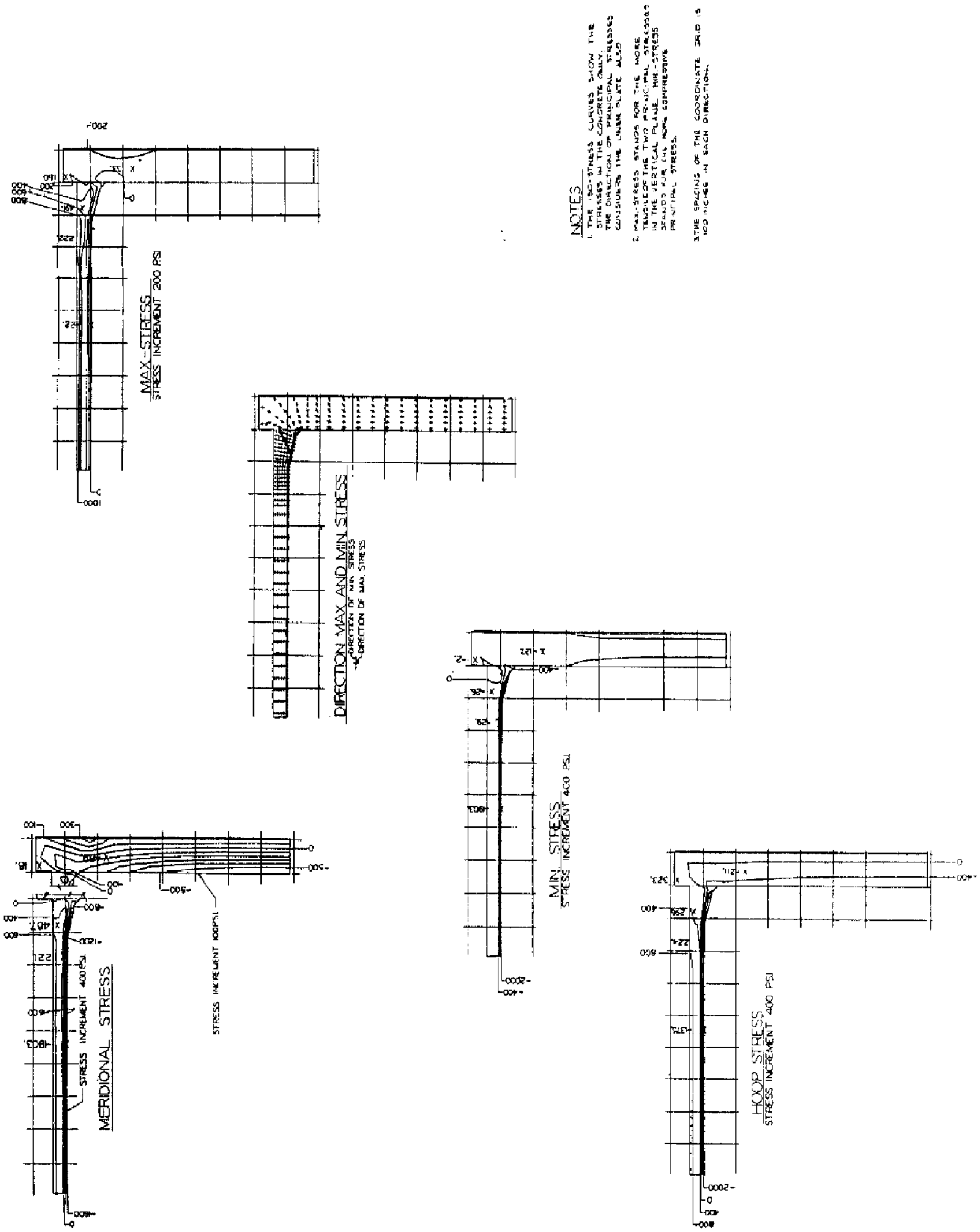
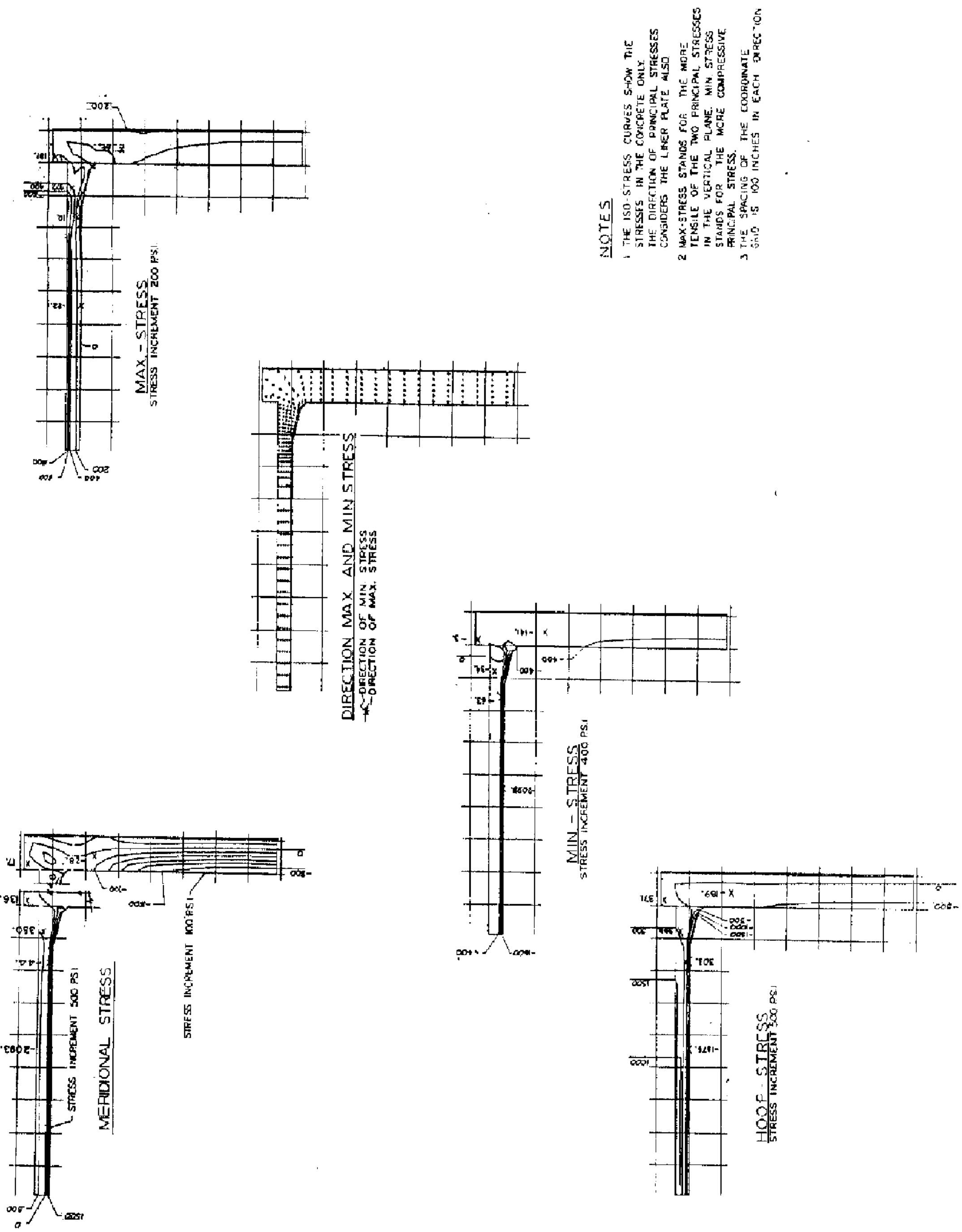

NOTES
1. THE ISO-STRESS CURVES SHOW THE STRESSES IN THE CONCRETE ONLY; THE DIRECTION OF PRINCIPAL STRESSES CONSIDERS THE LINER PLATE ALSO.
2. MAX.-STRESS STANDS FOR THE MORE TENSILE OF THE TWO PRINCIPAL STRESSES IN THE VERTICAL PLANE. MIN.-STRESS STANDS FOR THE MORE COMPRESSIVE PRINCIPAL STRESS.
3. THE SPACING OF THE COORDINATE GRID IS 50 INCHES IN EACH DIRECTION.
MAX.-STRESS
STRESS INCREMENT 250 PSI
DIRECTION OF MAX. AND MIN. STRESSES
MIN.-STRESS
STRESS INCREMENT 250 PSI
HOOP-STRESS
STRESS INCREMENT 500 PSI
MERIDIONAL STRESS
STRESS INCREMENT 500 PSI

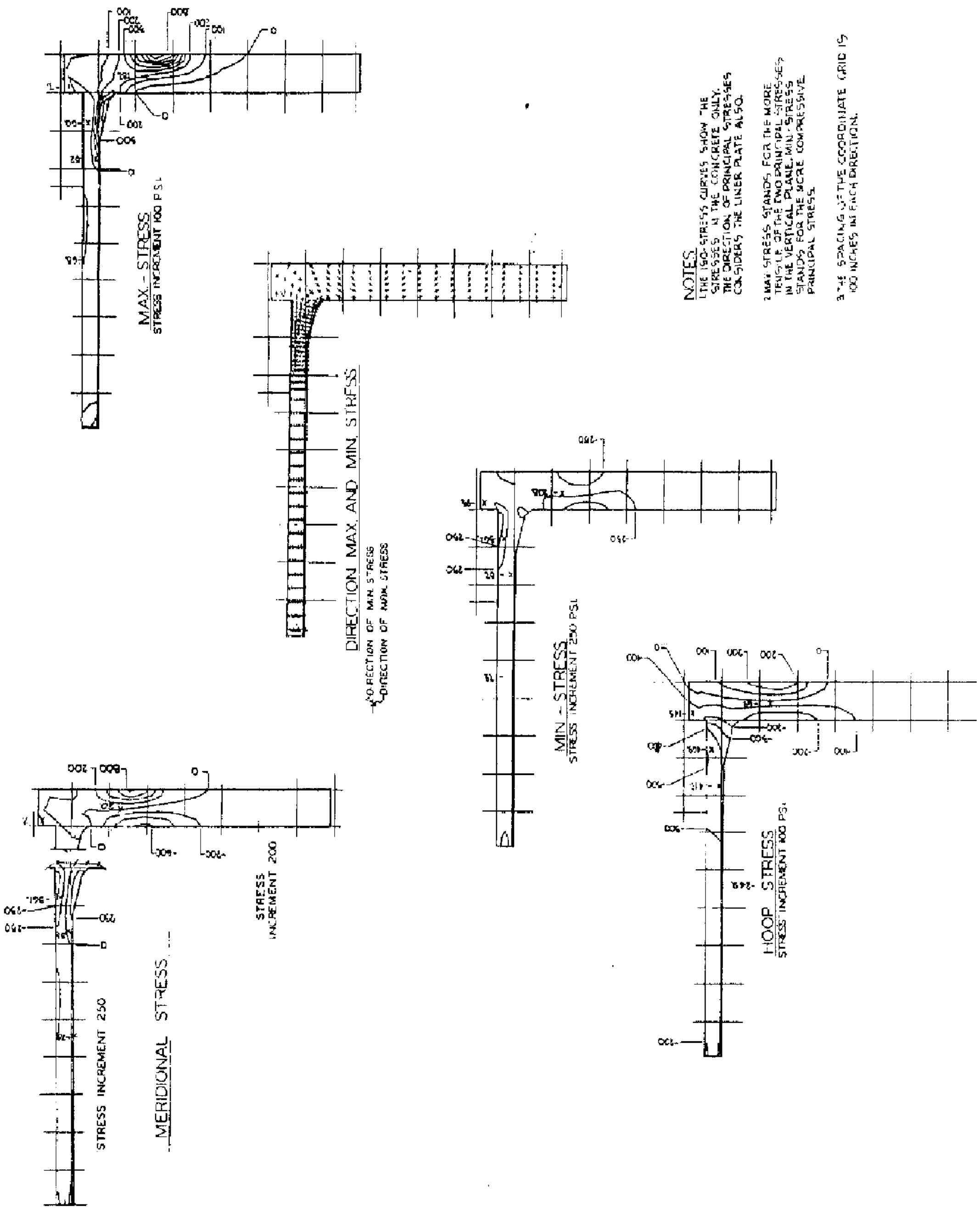
Figure 3-26. Reactor Building Isostress Plot Wall and Base




MAX-STRESS
STRESS INCREMENT 50 PSI.
DIRECTION MAX AND MIN STRESS
MIN-STRESS
STRESS INCREMENT 100 PSI.
HOOP-STRESS
STRESS INCREMENT 50 PSI.
MERIDIONAL STRESS
STRESS INCREMENT 100 PSI.
NOTES


NOTES
MAX-STRESS
STRESS INCREMENT 200 PSI
DIRECTION MAX AND MIN STRESS
DIRECTION OF MIN. STRESS
DIRECTION OF MAX. STRESS
MIN. STRESS
STRESS INCREMENT 400 PSI
MERIDIONAL STRESS
STRESS INCREMENT 400 PSI
STRESS INCREMENT 100PSI
HOOP STRESS
STRESS INCREMENT 400 PSI


MAX.-STRESS
STRESS INCREMENT 200 PSI
DIRECTION MAX AND MIN STRESS
DIRECTION OF MIN STRESS
DIRECTION OF MAX. STRESS
MIN.-STRESS
STRESS INCREMENT 400 PSI
MERIDIONAL STRESS
STRESS INCREMENT 500 PSI
STRESS INCREMENT 100 PSI
HOOP STRESS
STRESS INCREMENT 300 PSI
NOTES
1 THE ISO-STRESS CURVES SHOW THE STRESSES IN THE CONCRETE ONLY. THE DIRECTION OF PRINCIPAL STRESSES CONSIDERS THE LINER PLATE ALSO
2 MAX-STRESS STANDS FOR THE MORE TENSILE OF THE TWO PRINCIPAL STRESSES IN THE VERTICAL PLANE. MIN. STRESS STANDS FOR THE MORE COMPRESSIVE PRINCIPAL STRESS.
3 THE SPACING OF THE COORDINATE GRID IS 100 INCHES IN EACH DIRECTION


MAX - STRESS
STRESS INCREMENT 100 PSI
DIRECTION MAX. AND MIN. STRESS
DIRECTION OF MIN. STRESS
DIRECTION OF MAX. STRESS
MIN - STRESS
STRESS INCREMENT 250 PSI
HOOP STRESS
STRESS INCREMENT 100 PSI
MERIDIONAL STRESS
STRESS INCREMENT 250
STRESS INCREMENT 200
NOTES
1. THE ISO-STRESS CURVES SHOW THE STRESSES IN THE CONCRETE ONLY. THE DIRECTION OF PRINCIPAL STRESSES CONSIDERS THE LINER PLATE ALSO.
2. MAX. STRESS STANDS FOR THE MORE TENSILE OF THE TWO PRINCIPAL STRESSES IN THE VERTICAL PLANE. MIN. STRESS STANDS FOR THE MORE COMPRESSIVE PRINCIPAL STRESS.
3. THE SPACING OF THE COORDINATE GRID IS 100 INCHES IN EACH DIRECTION.

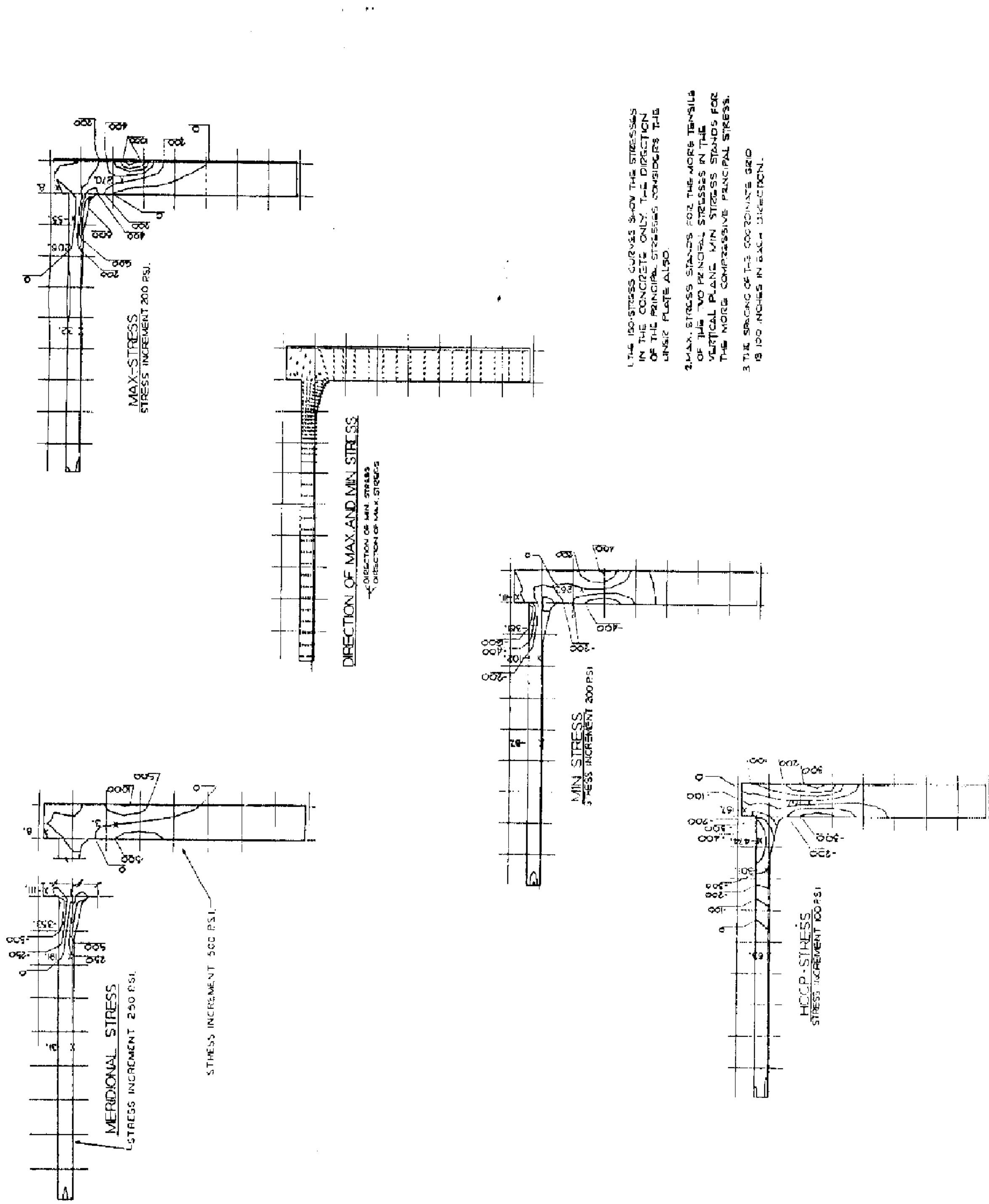
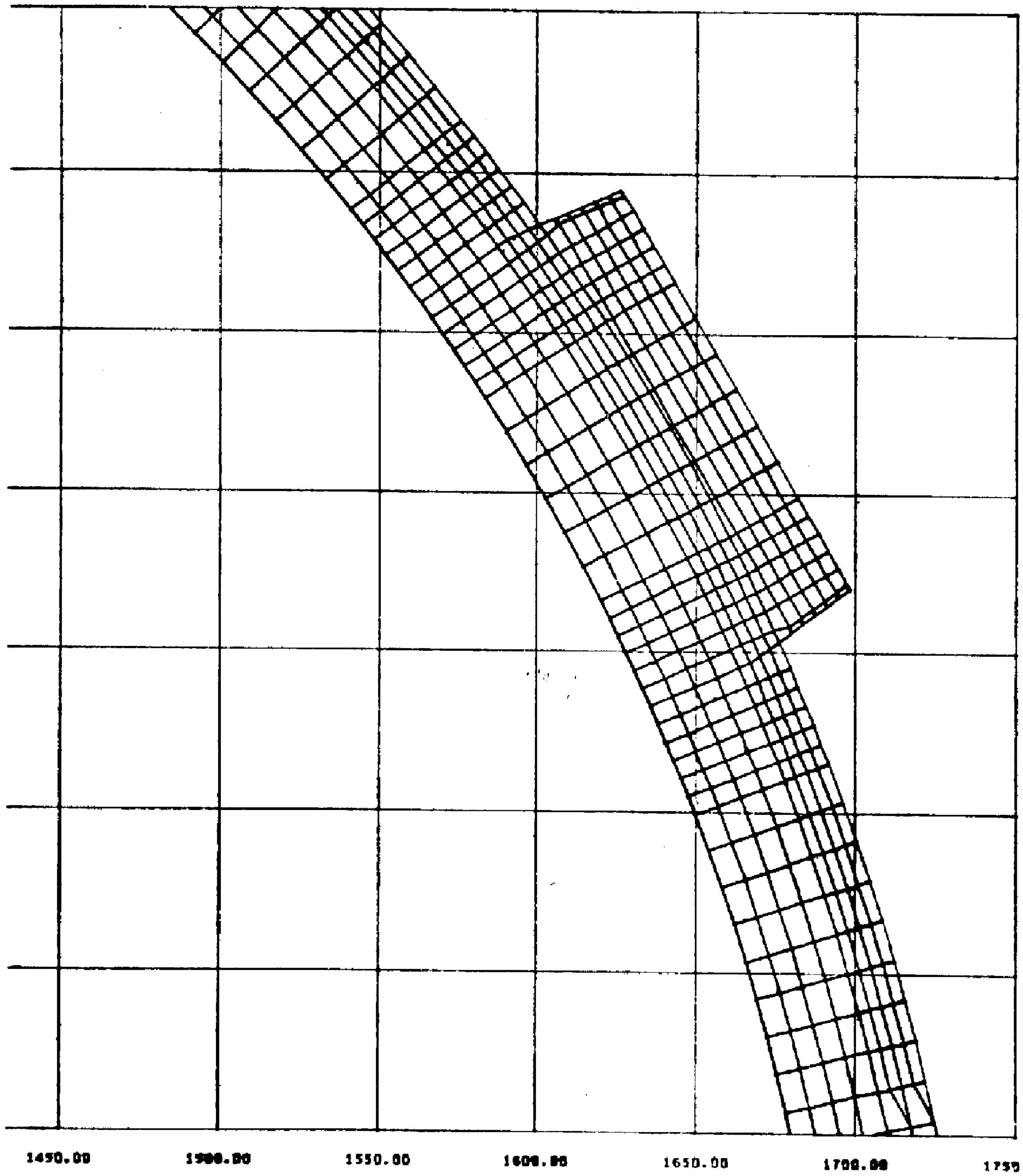
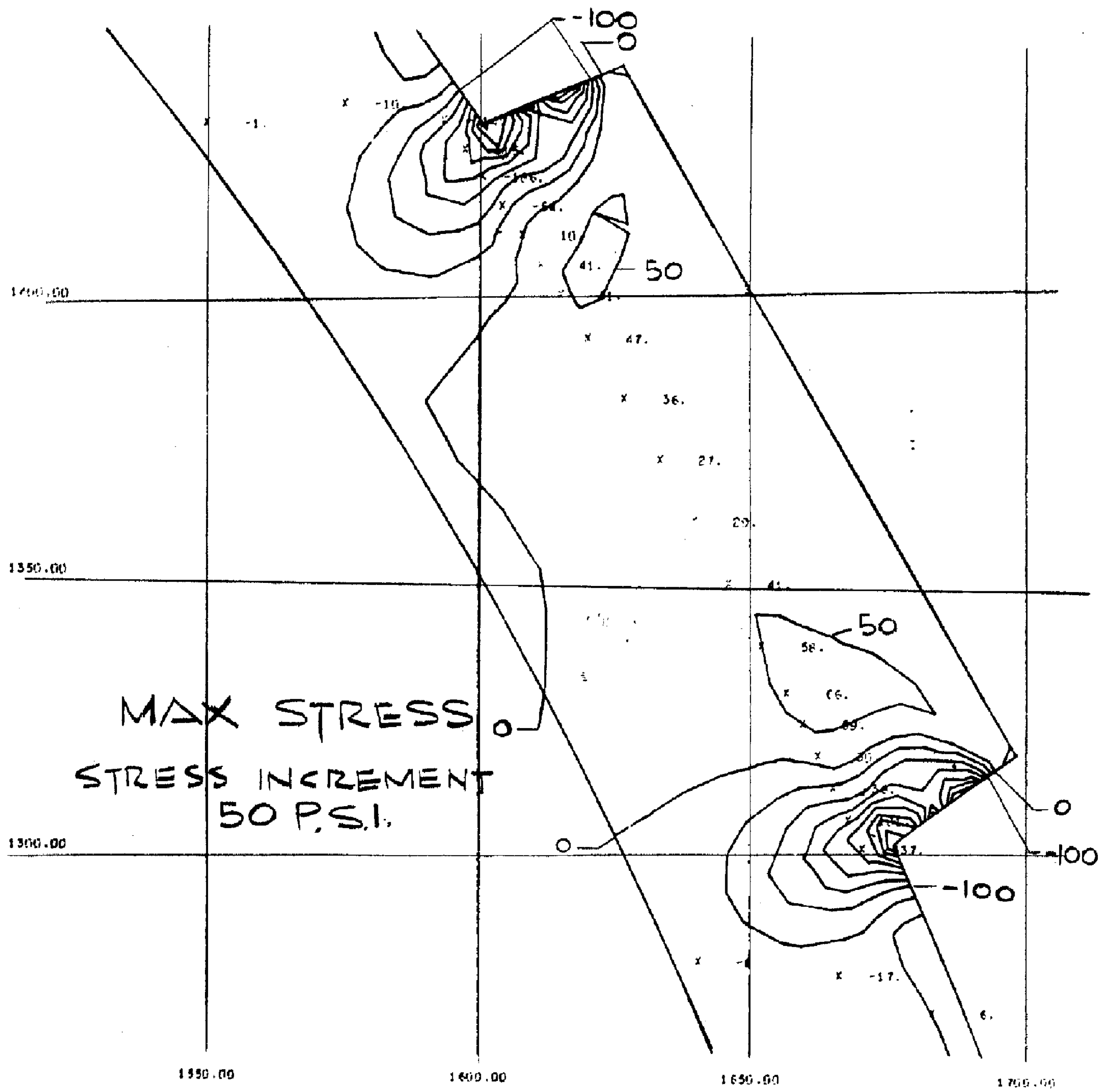

MAX-STRESS
STRESS INCREMENT 200 PSI.
DIRECTION OF MAX AND MIN STRESS
DIRECTION OF MIN. STRESS
DIRECTION OF MAX. STRESS
MIN STRESS
STRESS INCREMENT 200 PSI
MERIDIONAL STRESS
STRESS INCREMENT 250 PSI.
STRESS INCREMENT 500 PSI.
HOOP-STRESS
STRESS INCREMENT 100 PSI
1. THE ISO-STRESS CURVES SHOW THE STRESSES IN THE CONCRETE ONLY. THE DIRECTION OF THE PRINCIPAL STRESSES CONSIDERS THE LINER PLATE ALSO.
2. MAX. STRESS STANDS FOR THE MORE TENSILE OF THE TWO PRINCIPAL STRESSES IN THE VERTICAL PLANE. MIN STRESS STANDS FOR THE MORE COMPRESSIVE PRINCIPAL STRESS.
3. THE SPACING OF THE COORDINATE GRID IS 100 INCHES IN EACH DIRECTION.

Figure 3-27. Reactor Building Finite Element Mesh Wall Buttresses



REACTOR BUILDING FINITE ELEMENT
MESH WALL BUTTRESSES

Figure 3-28. Reactor Building Isostress Plot for Buttresses



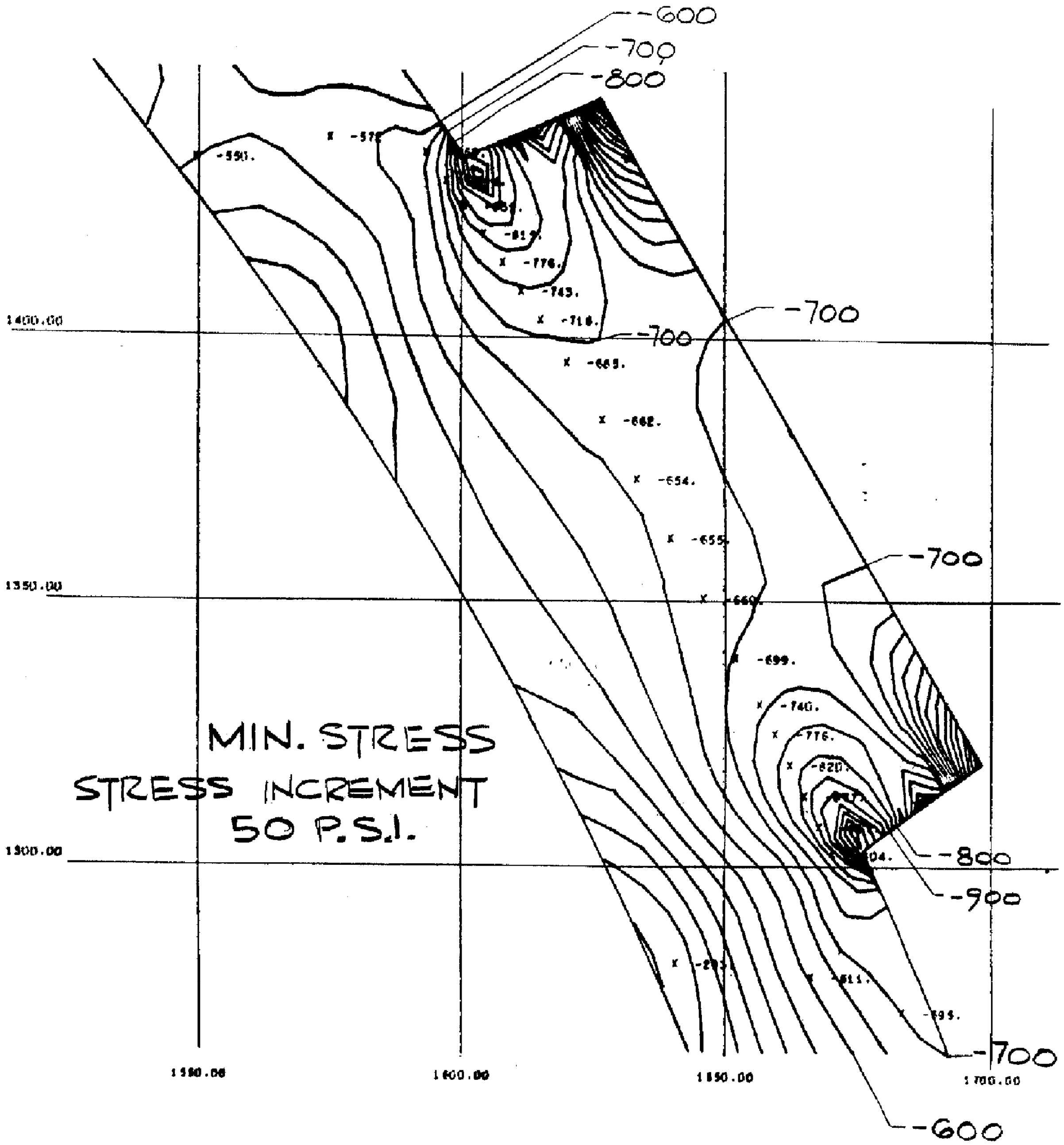

-600
-700
-800
-700
-700
-700
-800
-900
-700
-600
1400.00
1350.00
1300.00
1600.00
1650.00
1700.00
MIN. STRESS
STRESS INCREMENT
50 P.S.I.

Figure 3-29. Temperature Gradient at Buttress

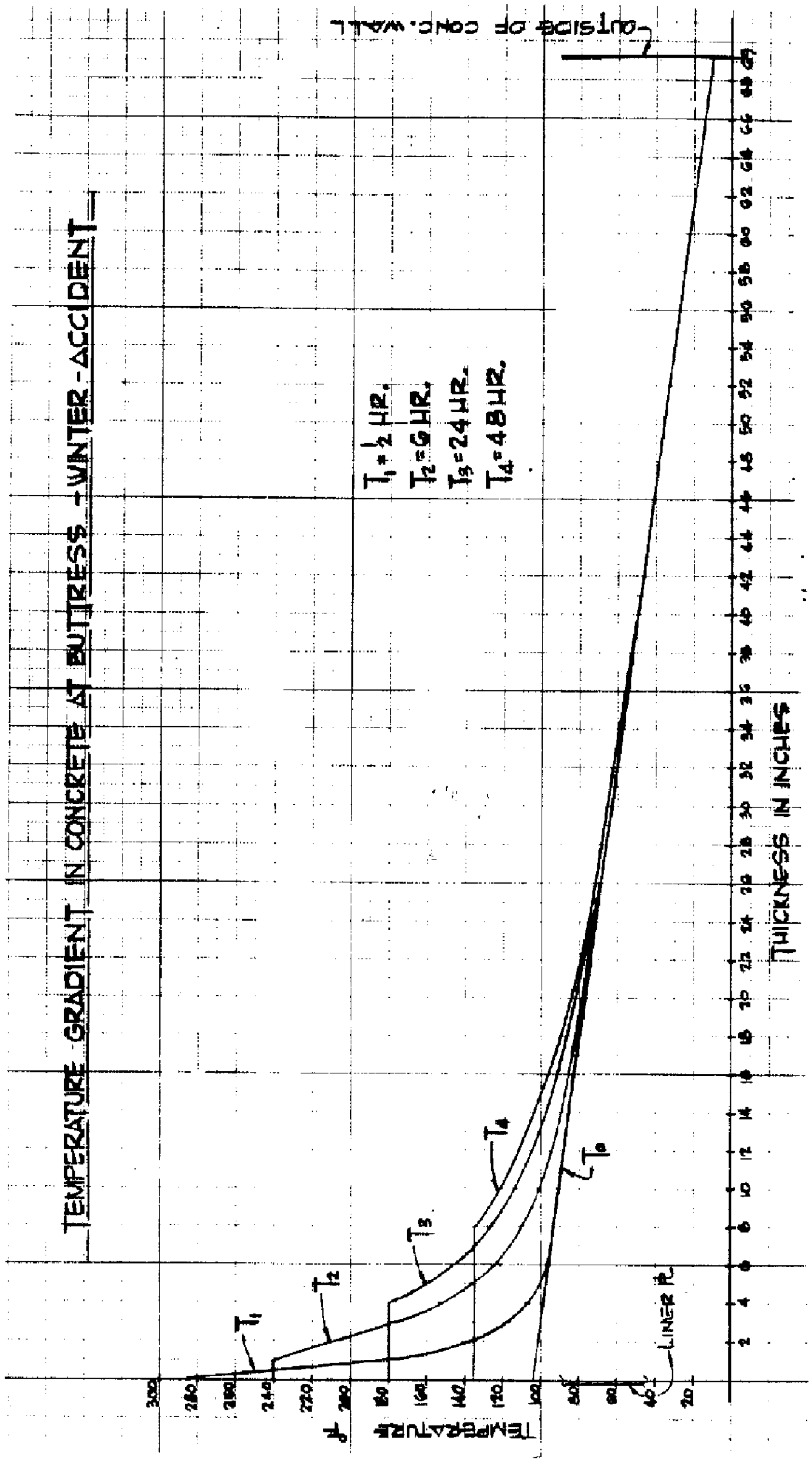


Figure 3-30. Buttress Reinforcing Details

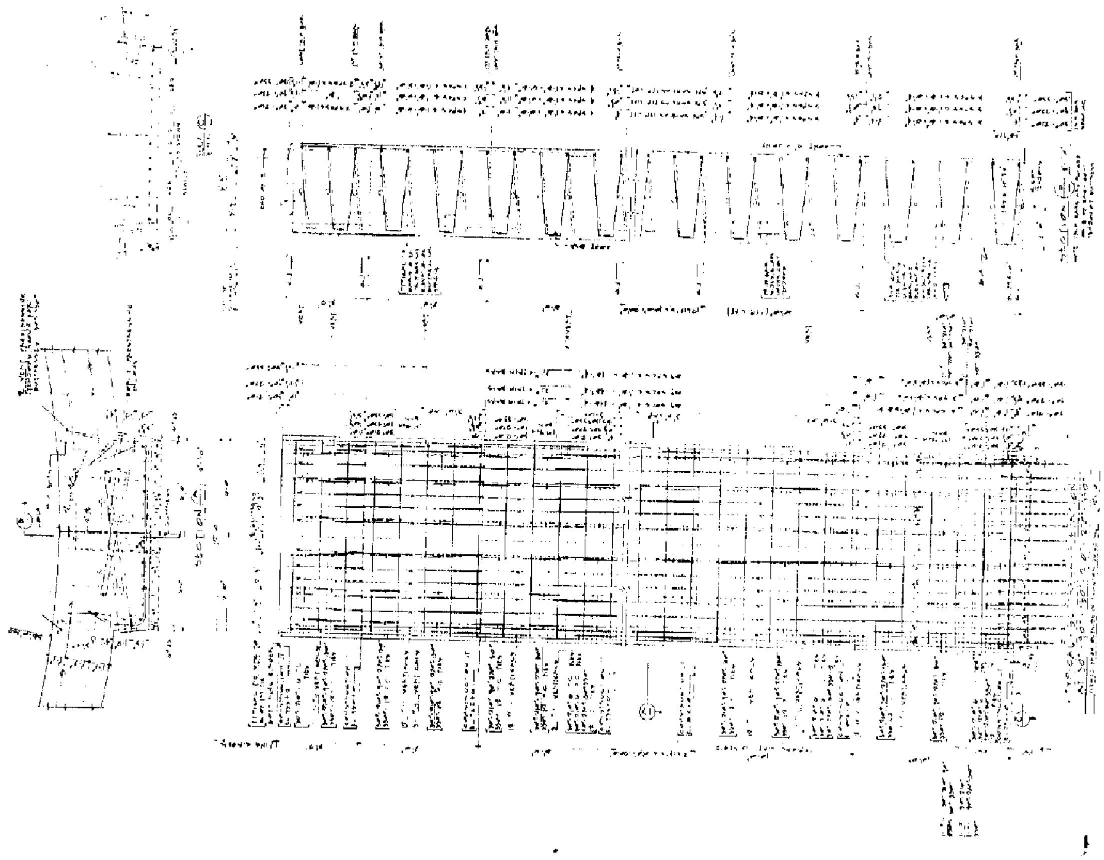


Figure 3-31. Reactor Building Equipment Hatch Mesh

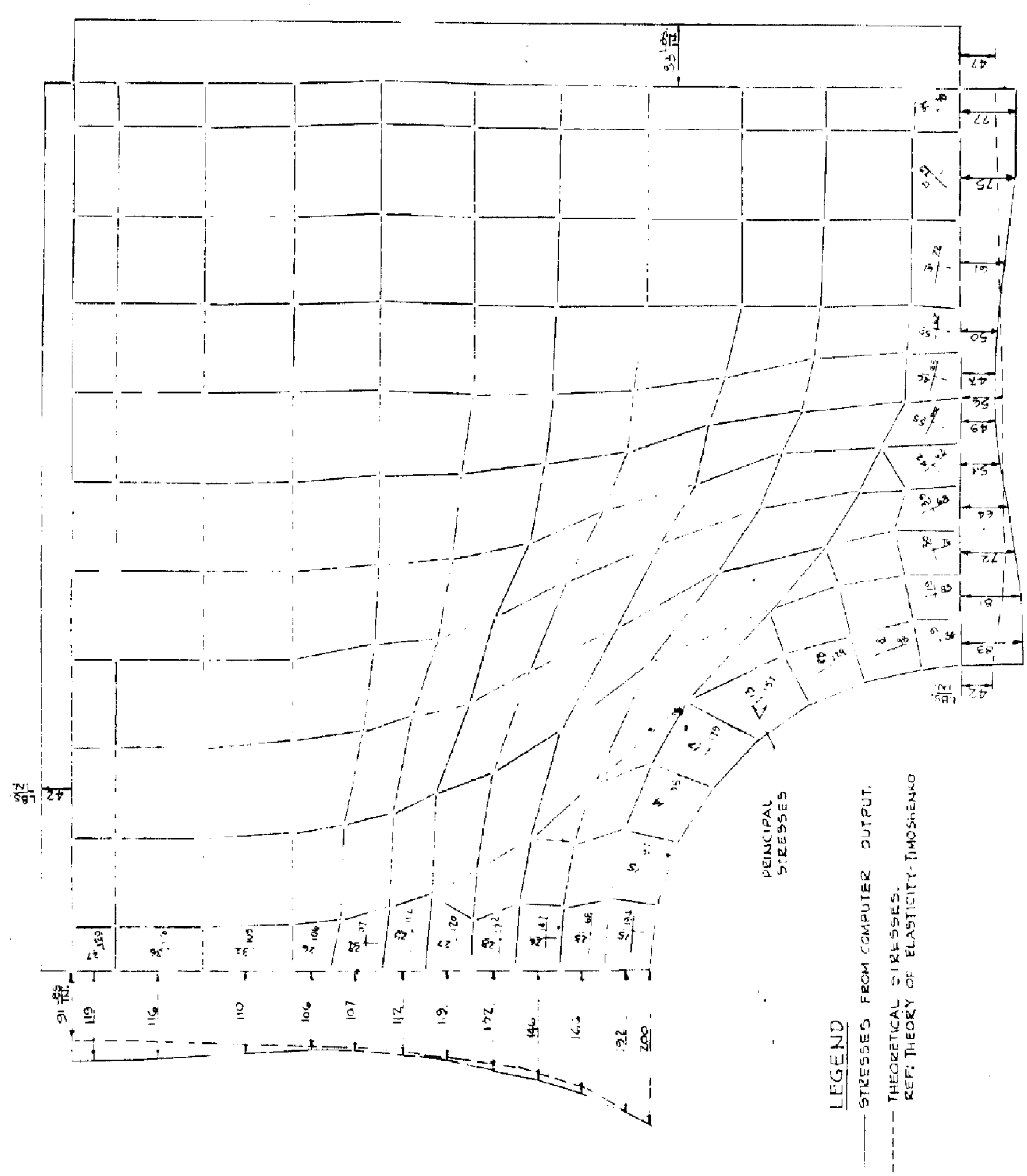


Figure 3-32. Reactor Building Penetration Loads

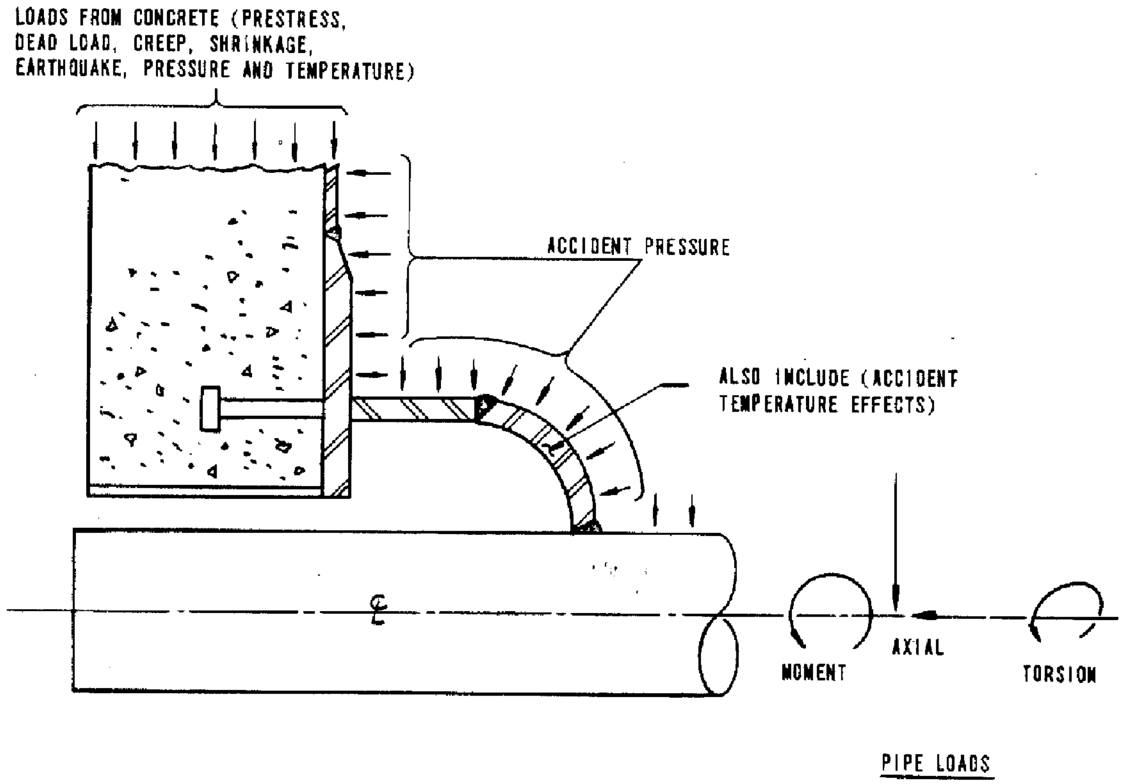
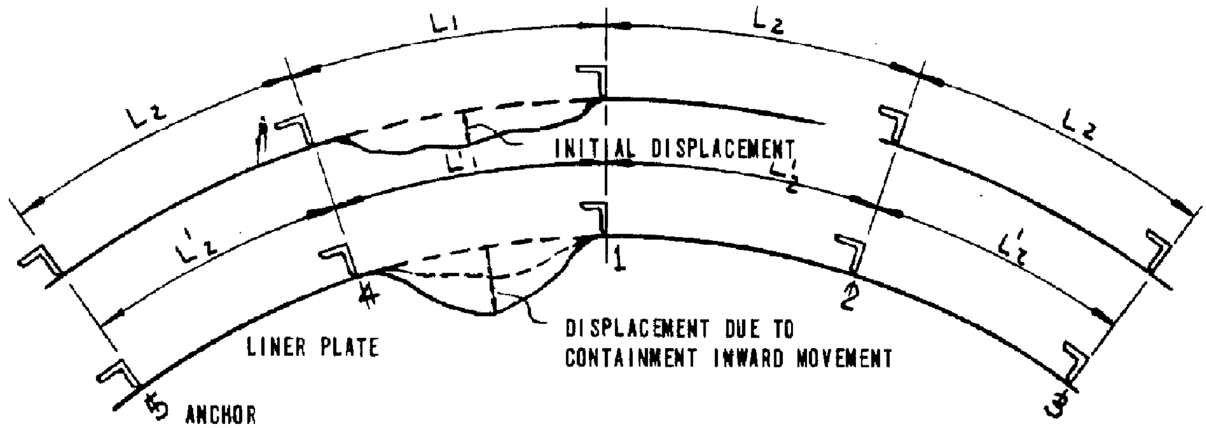


Figure 3-33. Reactor Building Model for Liner Plate Analysis for Radial Displacement



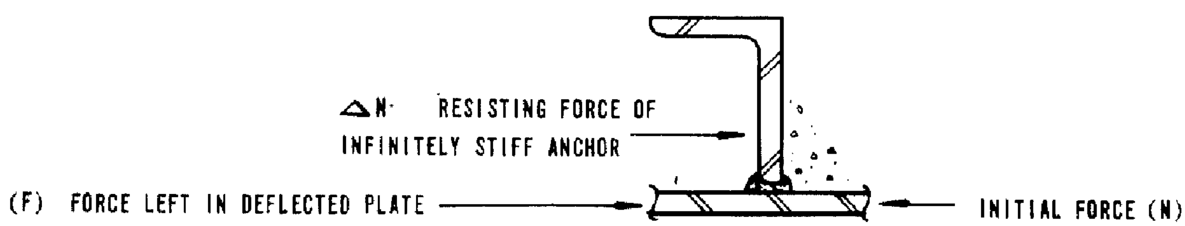
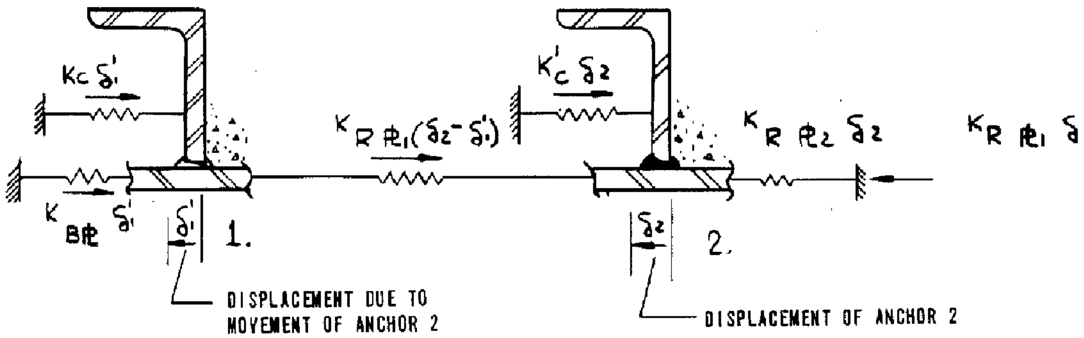


Figure 3-34. Reactor Building Model for Liner Analysis for Anchor Displacement



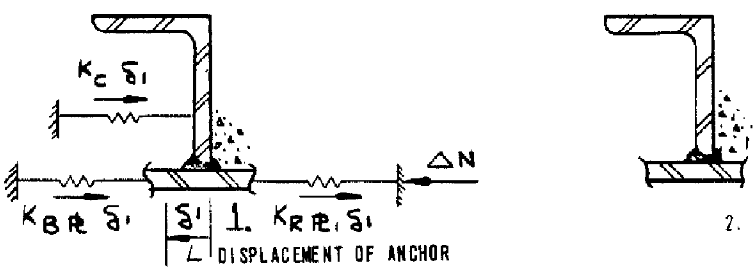
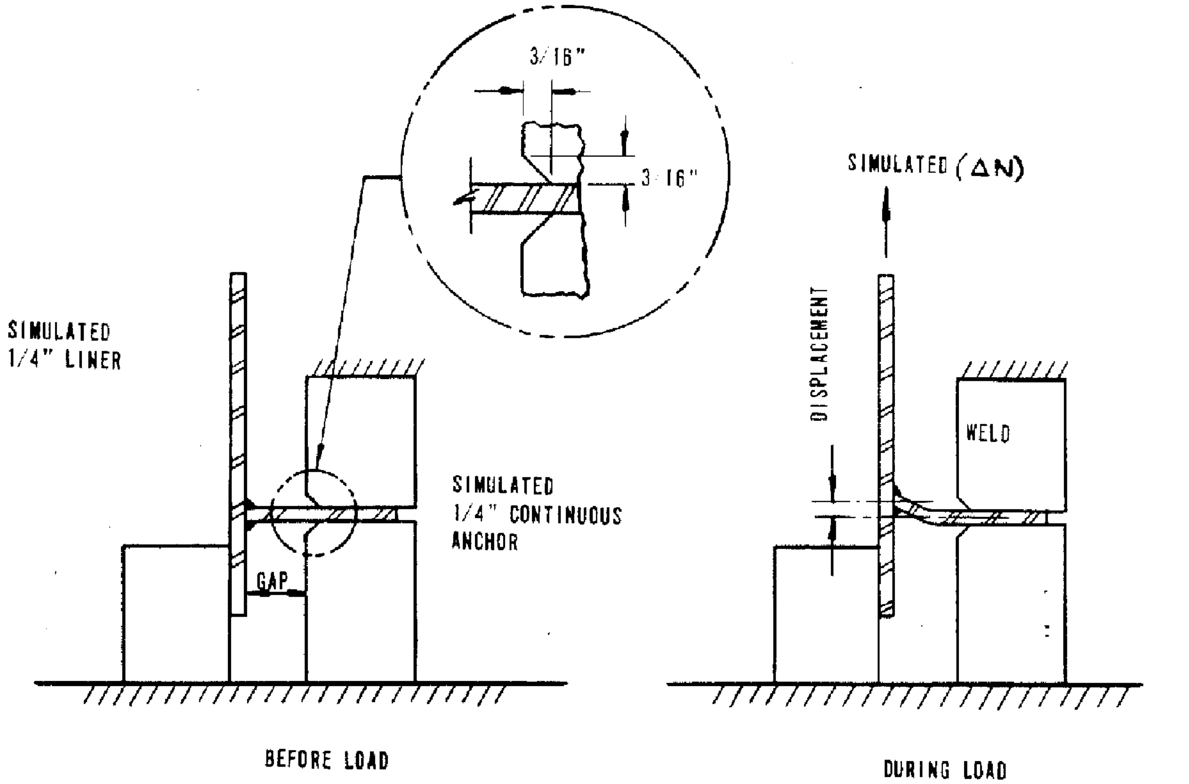


Figure 3-35. Reactor Building - Results from Tests on Liner Plate Anchors



WELD CONFIGURATION	GAP (IN)	ULTIMATE LOAD (K/IN)	ULTIMATE DISPLACEMENT (IN)	LOCATION OF FAILURE
3/16	0	14.95	.14	LINER PLATE
3/16	5/8	5.56	.68	ANCHOR WELD
3/16 6-12	0	7.65	.18	ANCHOR WELD
3/16 6-12	5/8	2.93	.60	ANCHOR WELD
3/16 4-12	0	6.67	.18	ANCHOR WELD
3/16 4-12	5/8	2.46	.30	ANCHOR WELD

Figure 3-36. Location of Plugged Sheaths

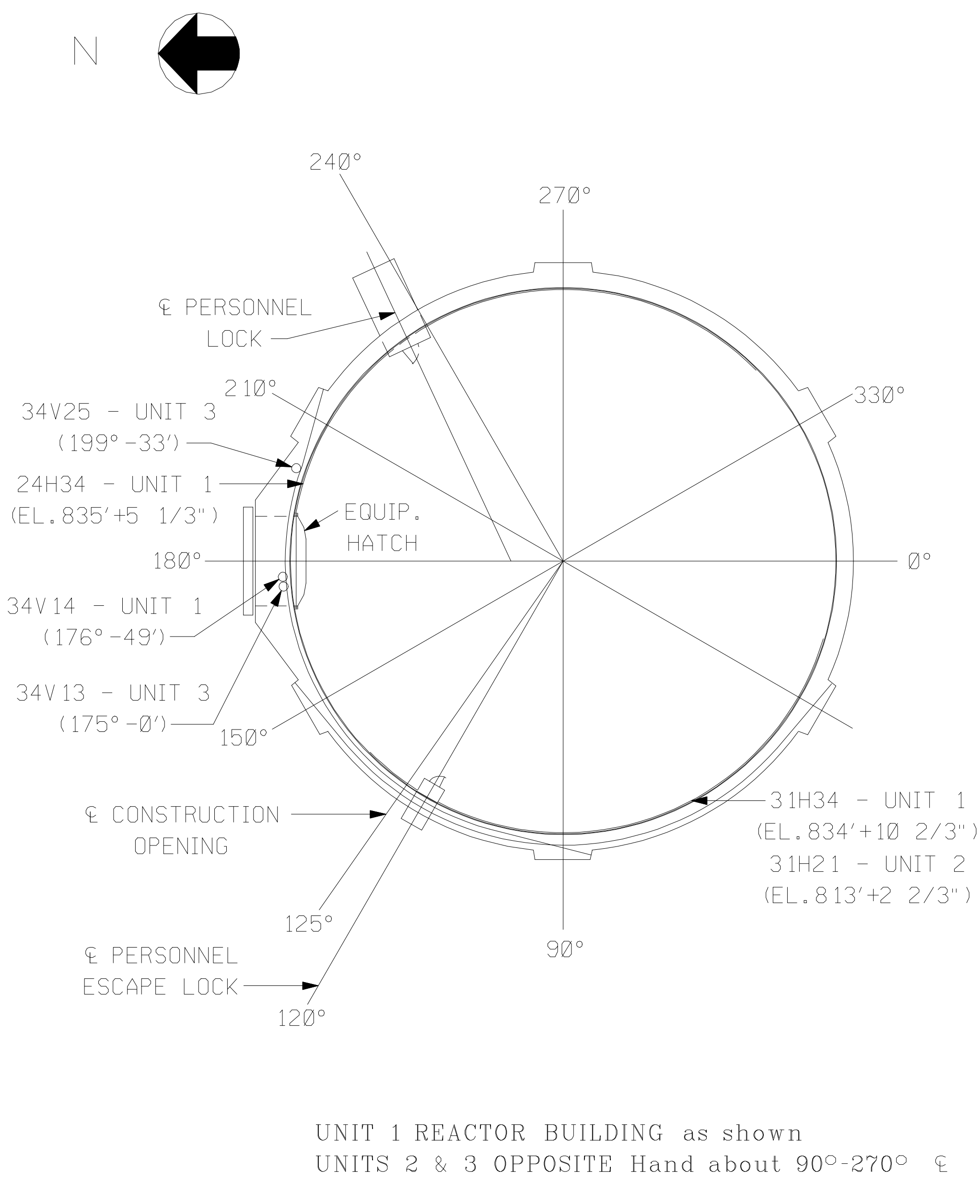
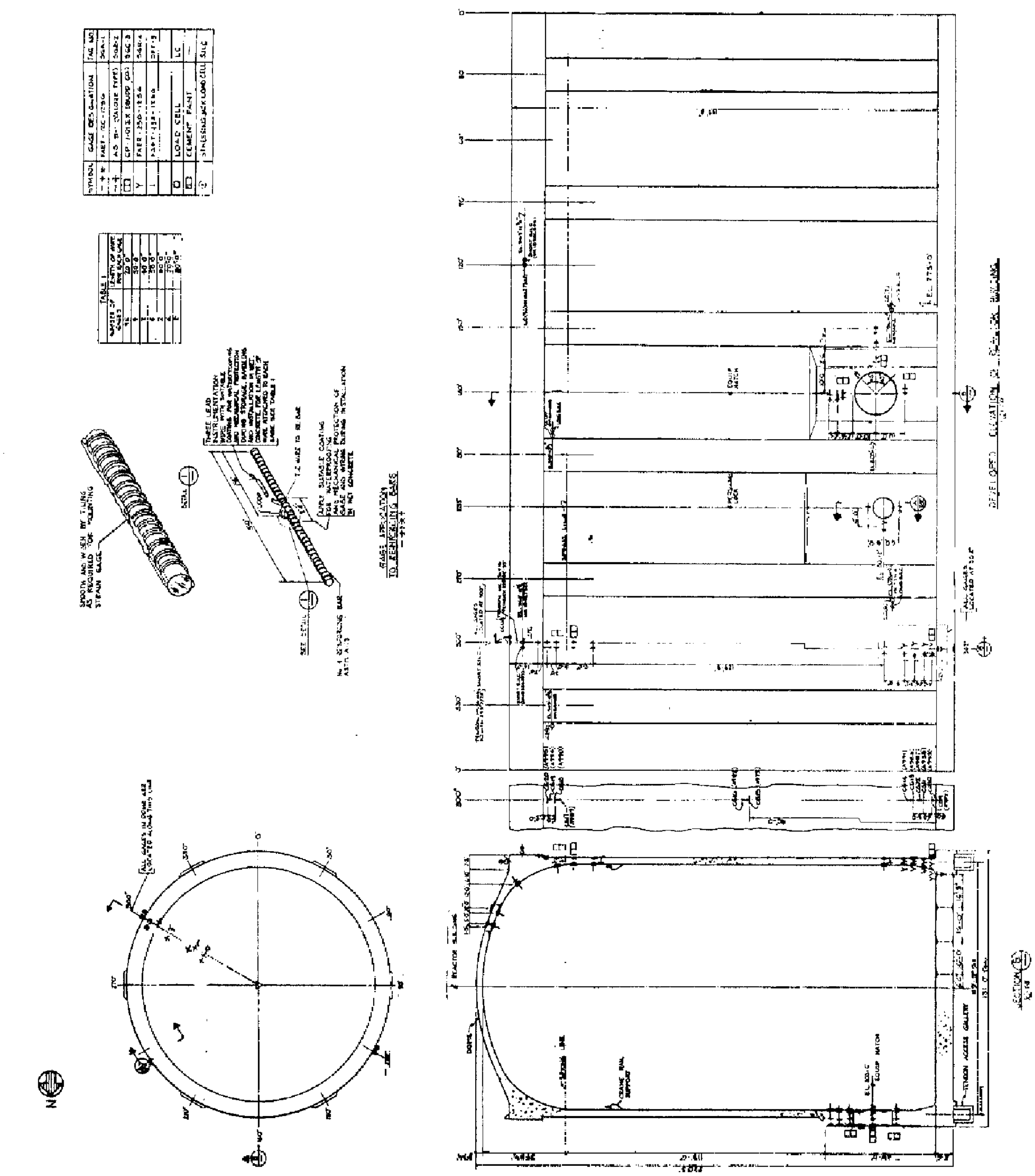
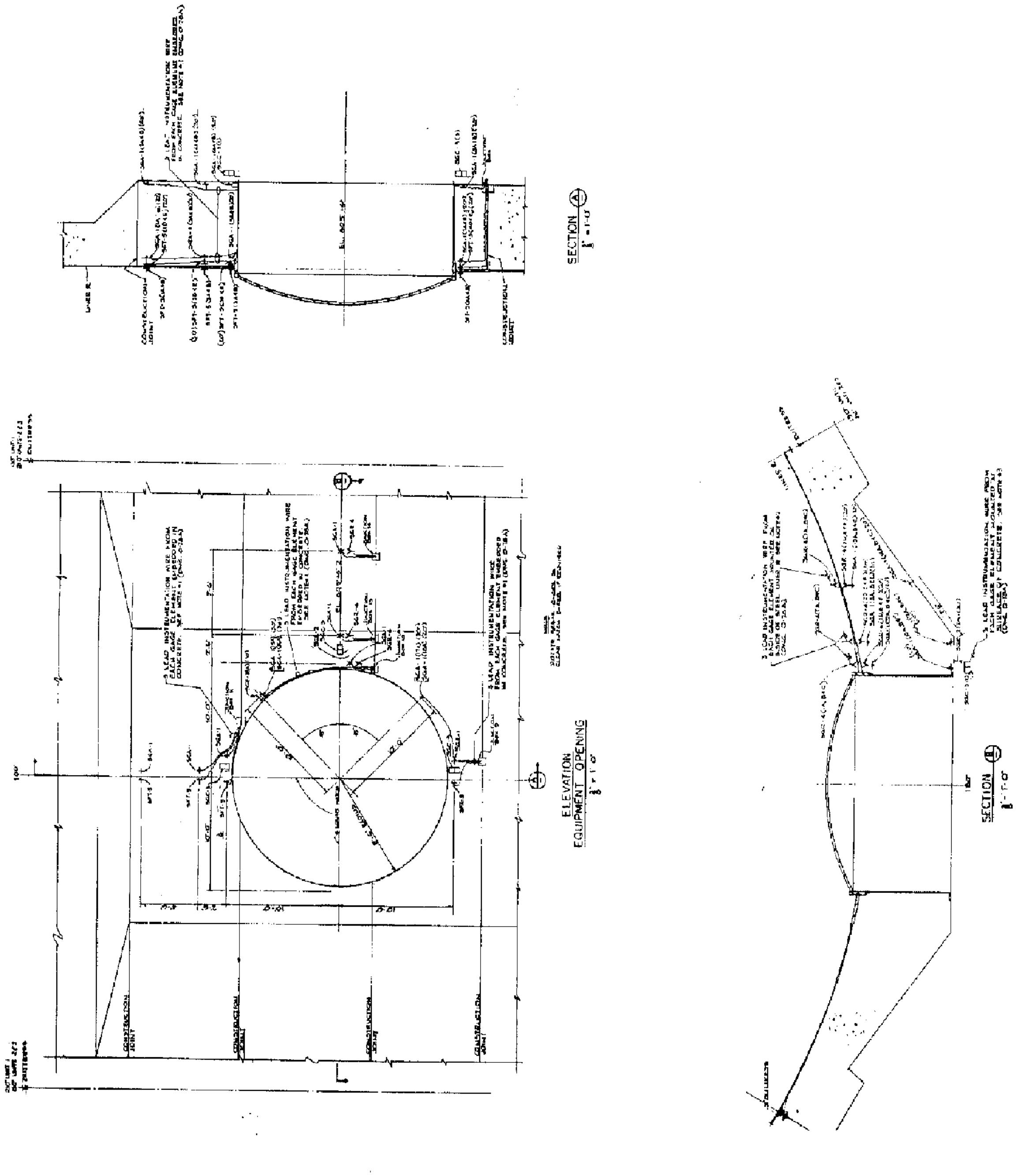
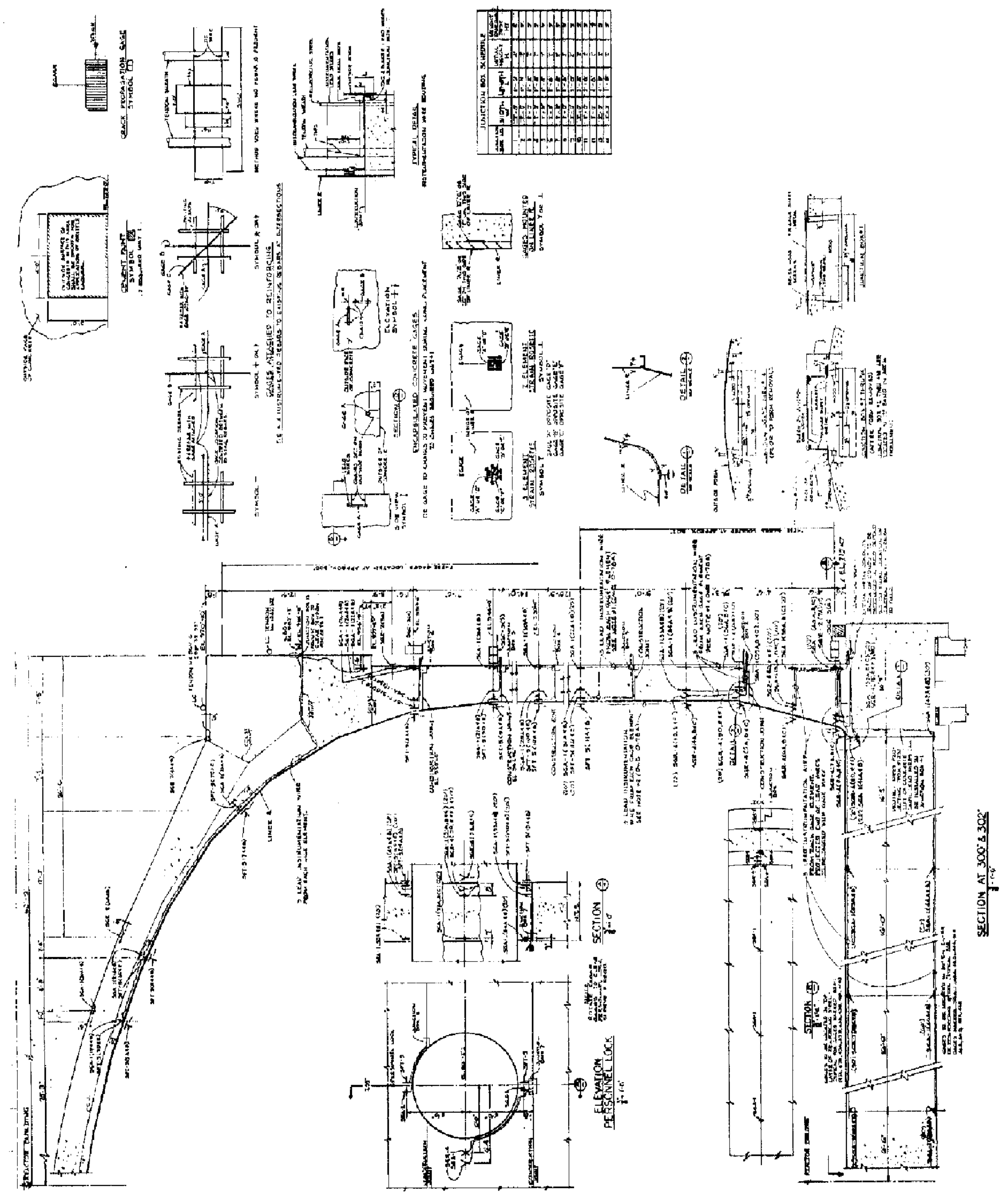
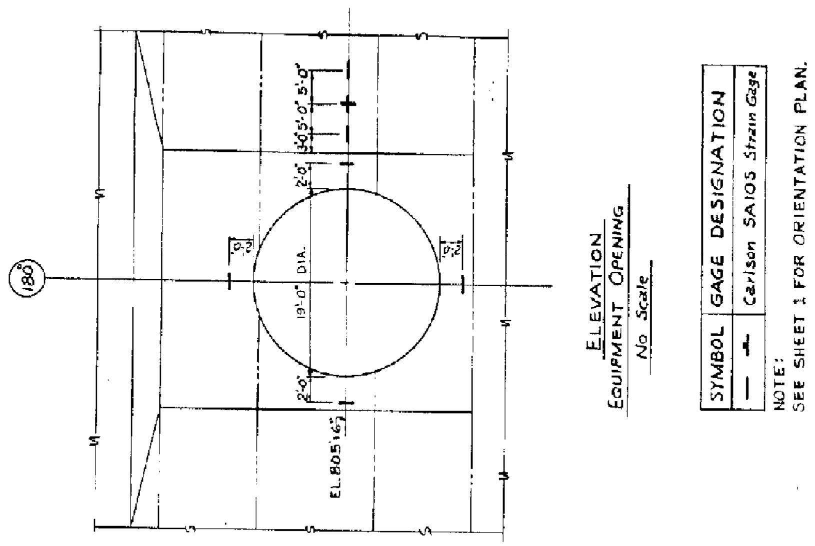


Figure 3-37. Reactor Building Instrumentation for Unit 1




SECTION A
ELEVATION EQUIPMENT OPENING
SECTION B


SECTION AT 300° & 302°
ELEVATION PERSONNEL LOCK
JUNCTION BOX SCHEDULE


180°
19'-0" DIA.
EL. 805'-6"
ELEVATION
EQUIPMENT OPENING
No Scale
SYMBOL | GAGE DESIGNATION
Carlson SA10S Strain Gage
NOTE:
SEE SHEET 1 FOR ORIENTATION PLAN.

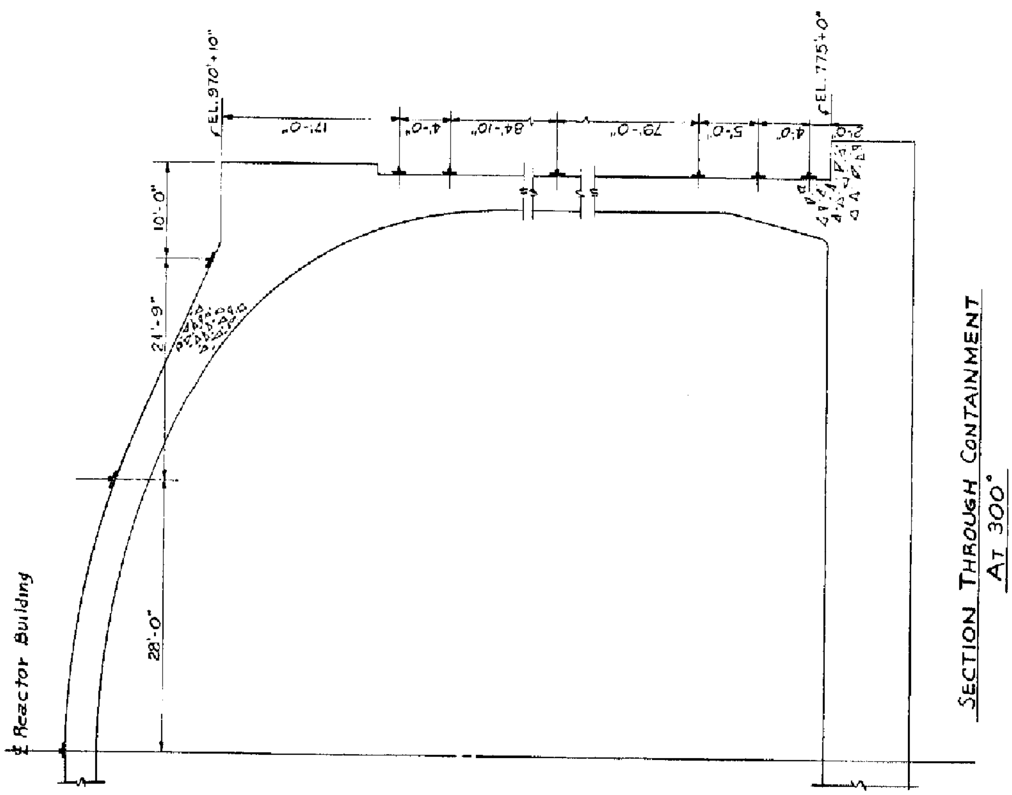

℄ Reactor Building
EL. 970'+10"
EL. 775'+0"
10'-0"
21'-9"
28'-0"
17'-0"
4'-0"
84'-10"
79'-0"
5'-0"
4'-0"
2'-0"
SECTION THROUGH CONTAINMENT
AT 300°

Figure 3-38. Turbine Building Cross-Section at Line 21

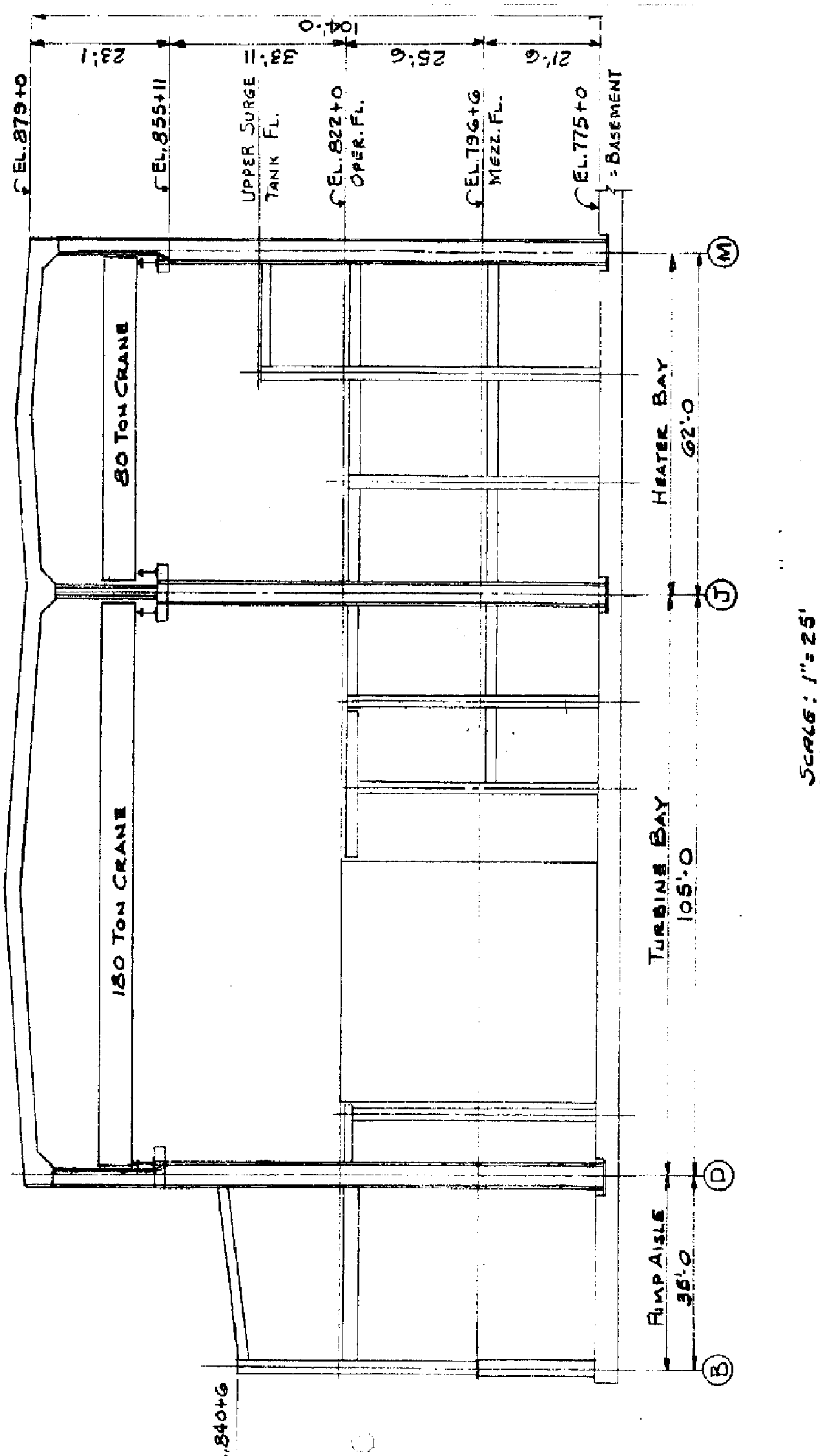


Figure 3-39. Deleted Per 1996 Update

Figure 3-40. Deleted Per 1996 Update

Figure 3-41. Deleted Per 1996 Update

Figure 3-42. Deleted Per 1996 Update

Figure 3-43. Deleted Per 1996 Update

Figure 3-44. Deleted Per 1996 Update

Figure 3-45. Deleted Per 1996 Update

Figure 3-46. Deleted Per 1996 Update

Figure 3-47. Deleted Per 1996 Update

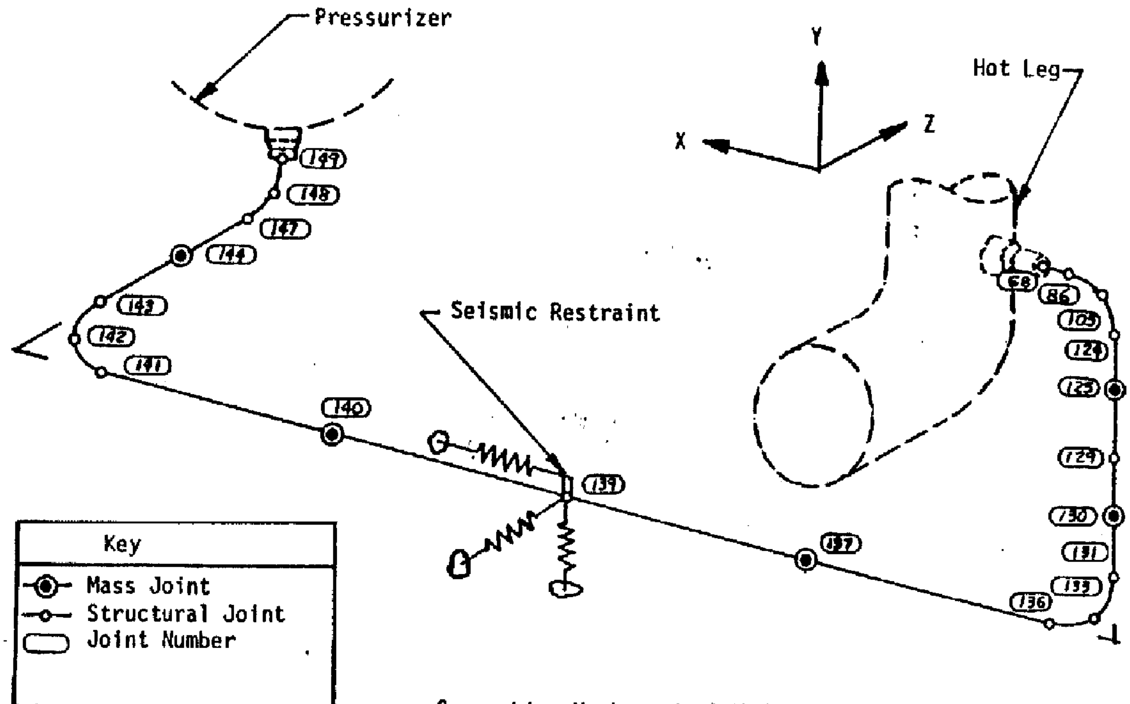
Figure 3-48. Deleted Per 1996 Update

Figure 3-49. Deleted Per 2004 Update

Figure 3-50. Deleted Per 2004 Update

Figure 3-51. Deleted Per 2004 Update

Figure 3-52. Seismic, Thermal, and Dead Load Analytical Model for the Pressurizer Surge Line Piping (Units 2 and 3)



Surge Line Mathematical Model

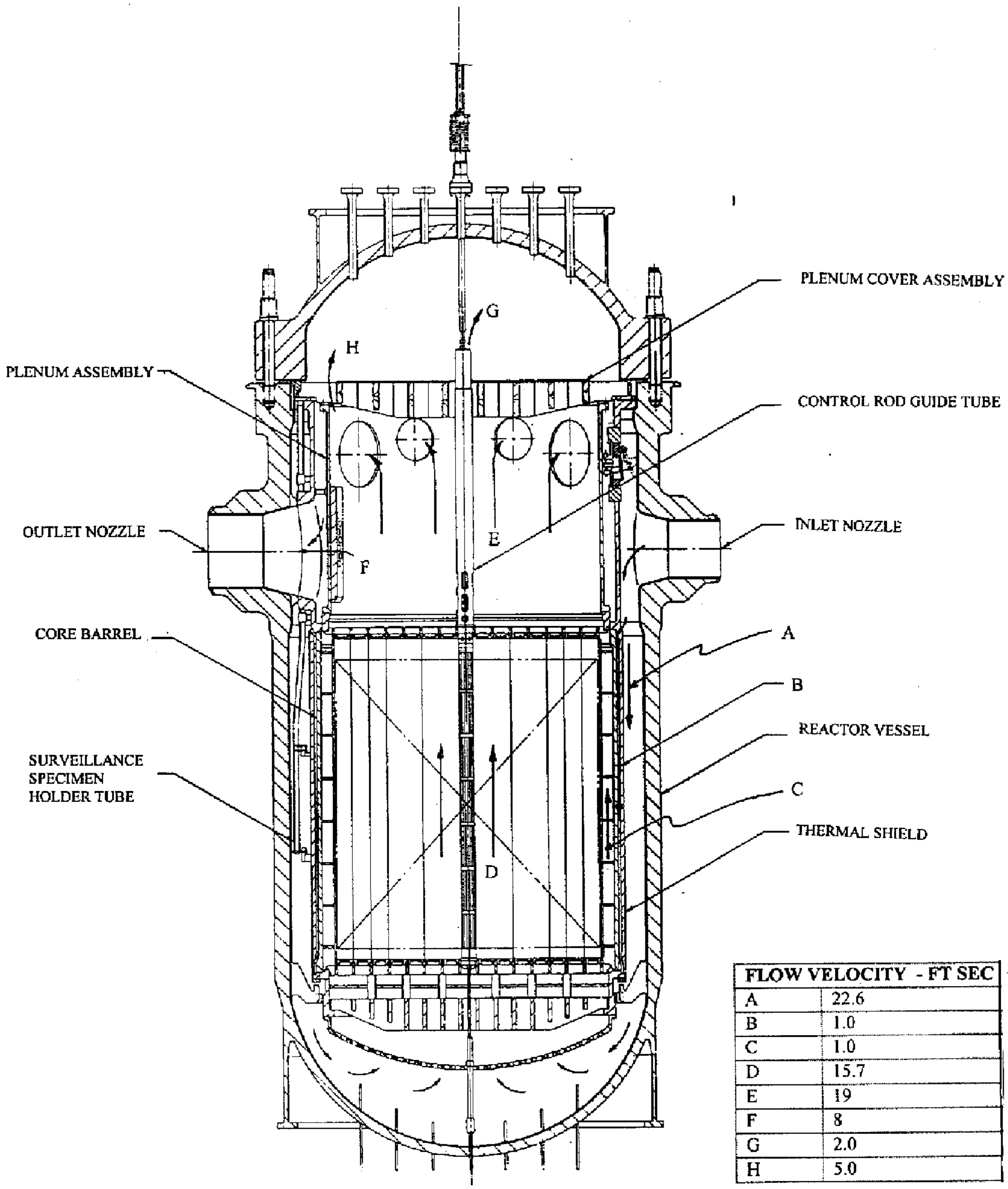
Figure 3-53. Deleted Per 2003 Update

Figure 3-54. Deleted Per 2003 Update

Figure 3-55. Deleted Per 2004 Update

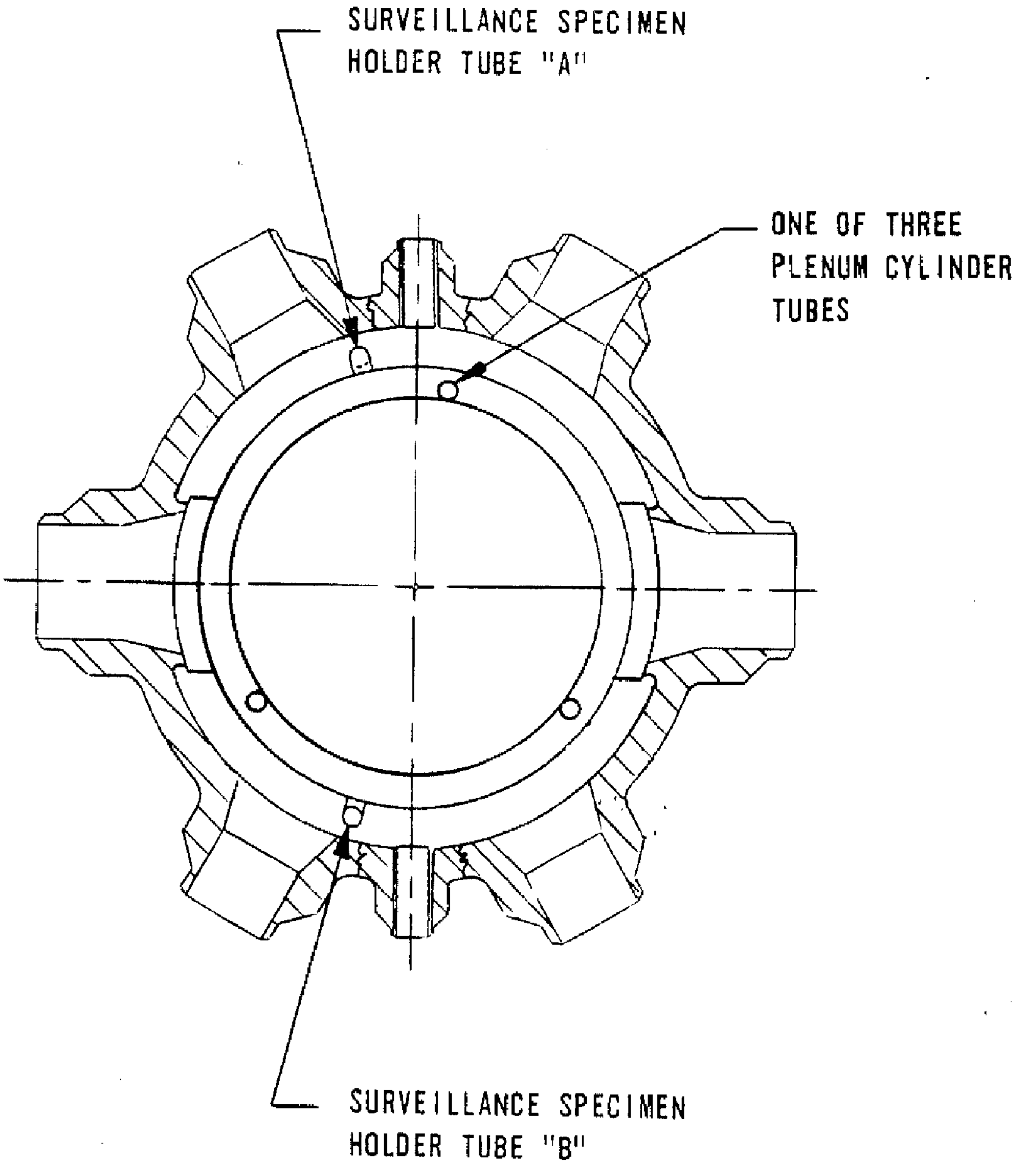
Figure 3-56. Deleted Per 2004 Update

Figure 3-57. Directions and Velocities of the Coolant Flow in the Reactor



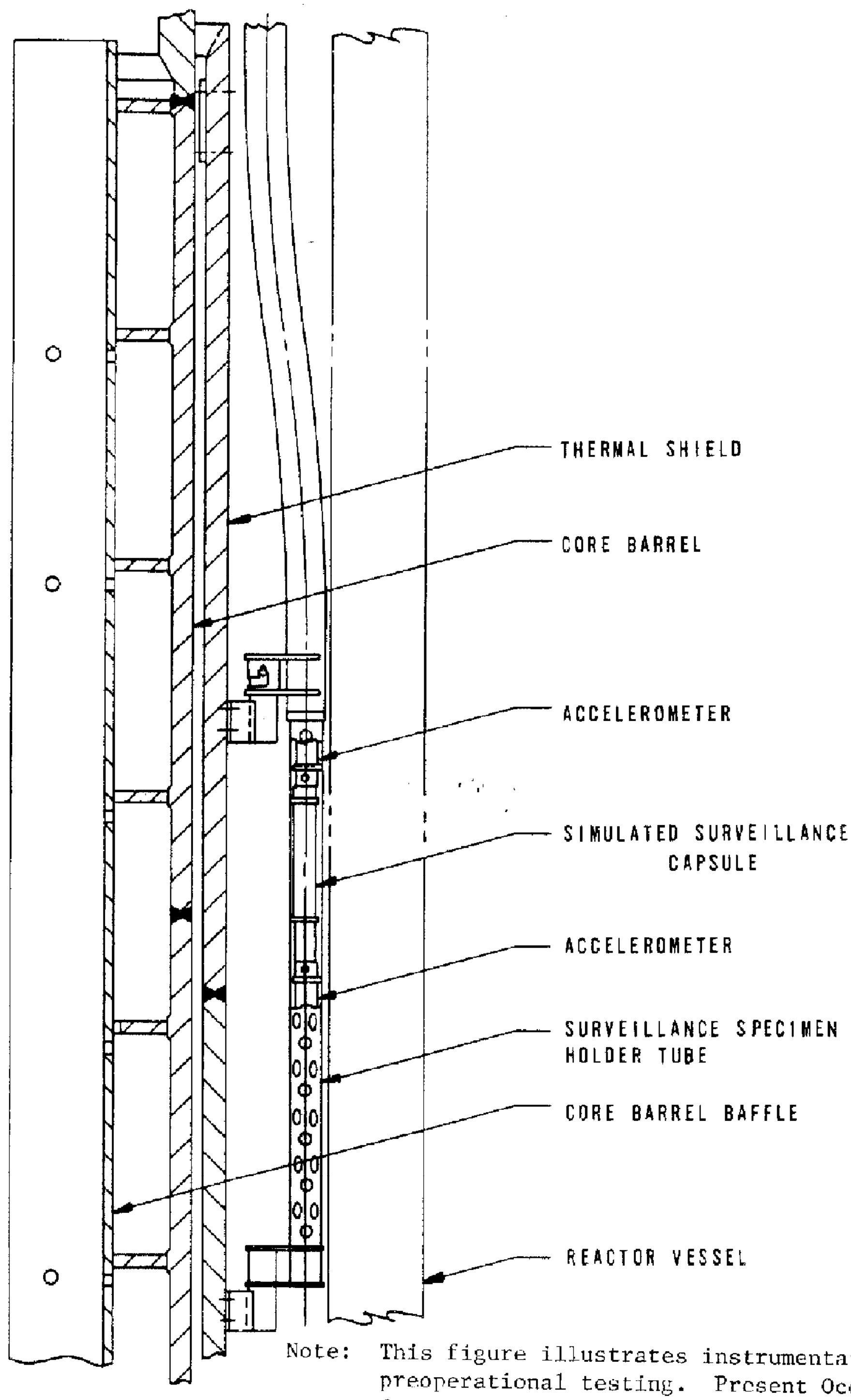
FLOW VELOCITY - FT SEC	
A	22.6
B	1.0
C	1.0
D	15.7
E	19
F	8
G	2.0
H	5.0

Figure 3-58. Location of Instrumentation Surveillance Specimen Holder Tubes and the Plenum Cylinder Tubes



Note: This figure illustrates location of instrumentation for preoperational testing. Present Oconee units do not use Specimen Holder Tubes. Instead, material samples are irradiated in a host reactor.

Figure 3-59. Location of the Instrumentation in the Specimen Holder Tube



Note: This figure illustrates instrumentation for preoperational testing. Present Oconee units do not use Specimen Holder Tubes. Instead, material samples are irradiated in a host reactor.

Figure 3-60. Location of the Accelerometer in Plenum Cylinder Tube