October 16, 1995

Mr. Nicholas J. Liparulo
Nuclear Safety and Regulatory Activities
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, Pennsylvania 15230

SUBJECT: SAMPLE PROBLEM FOR COMPUTER CODE VALIDATION REGARDING THE CONTAINMENT VESSEL DESIGN FOR THE AP600

Dear Mr. Liparulo:

As agreed during the August 30 and 31, 1995, meeting regarding the containment vessel AP600 design, the Nuclear Regulatory Commission has prepared a sample problem for Westinghouse to validate the Chicago Bridge and Iron Company in-house computer code "E0781B" and resolve the staff's concern of Draft Safety Evaluation Report Open Item 3.8.2.4-8. The attached sample problem involves the axisymmetric model for internal pressure and wind analyses. If you have any questions, please contact Diane Jackson at (301) 415-8548 or Thomas Cheng at (301) 415-2770.

Sincerely,
Original signed by
Diane T. Jackson, Project Manager
Standardization Project Directorate
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

Enclosure: As stated

cc: See next page

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Westinghouse Electric Corporation

Docket No. 52-003
AP600

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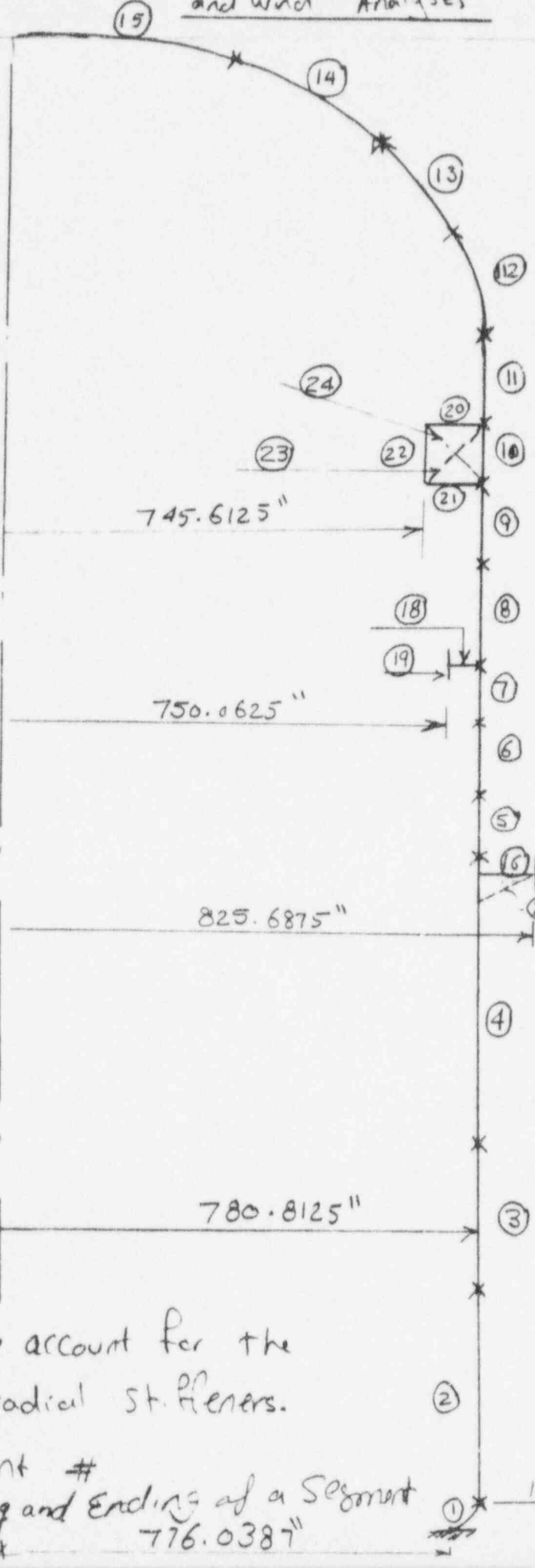
Axisymmetric Model for Internal pressure and wind Analyses



Elevation

256' 8½"

218' 8½"

≈208' 5"

≈ 202' 5"

170'

131' 9"

104' 1½"

100'

Note: • All Radial distances are measured to the shell center.

• Segments # 23, 24 and 25 were used to account for the effect of the radial stiffeners.

• ○ = Segment #

• X = Beginning and Ending of a Segment

Attachment

	r_1 (a)	r_2 (b)	z_1 (a)	z_2 (b)	# of Heights	Remark
1	776.0387	780.8125	−49.5	0	6	
2	780.8125	〃	0	125	8	
3	〃	〃	125	200.5	5	
4	〃	〃	200.5	347.75	10	
5	〃	〃	347.75	476.25	9	
6	〃	〃	476.25	621.25	10	
7	〃	〃	621.25	790.5	11	
8	〃	〃	790.5	985.0	12	
9	〃	〃	985.0	1179.5	12	
10	〃	〃	1179.5	1251.5	5	
11	〃	〃	1251.5	1375	8	
12	780 8125	736.2974	1375	1525	11	
13	736.2974	582.6925	1525	1675	11	
14	582.6925	259.8404	1675	1800	21	
15	259.8404	0	1800	1825.69	21	
16	780.8125	826	331	331	5	
17	825.6875	825.6875	327	336	5	
18	780.8125	750.0625	790.5	790.5	5	
19	750.0625	750.0625	783.5	797.5	5	
20	780.8125	736.8125	1251.5	1251.5	5	
21	780.8125	736.8125	1179.5	1179.5	5	
22	745.6125	1179.5	745.6125	1251	5	
23	745.6125	1179.5	780.8125	1251	5	(C)
24	780.8125	745.6125	1179.5	1251	5	(D)
25	780.8125	826.0	315.139	331.5	5	(E)

(a) = Radial and Vertical Coordinates at the beginning of a segment

(b) = Radial and Vertical Cordinates at the End of a segment

(c) = Fake segment with

E_θ = 10 Psi and E_ϕ = 1770607.0 Psi

(D) = Fake segment with

E_θ = 10 Psi and E_ϕ = 1770607.0 Psi

(E) = Fake segment with

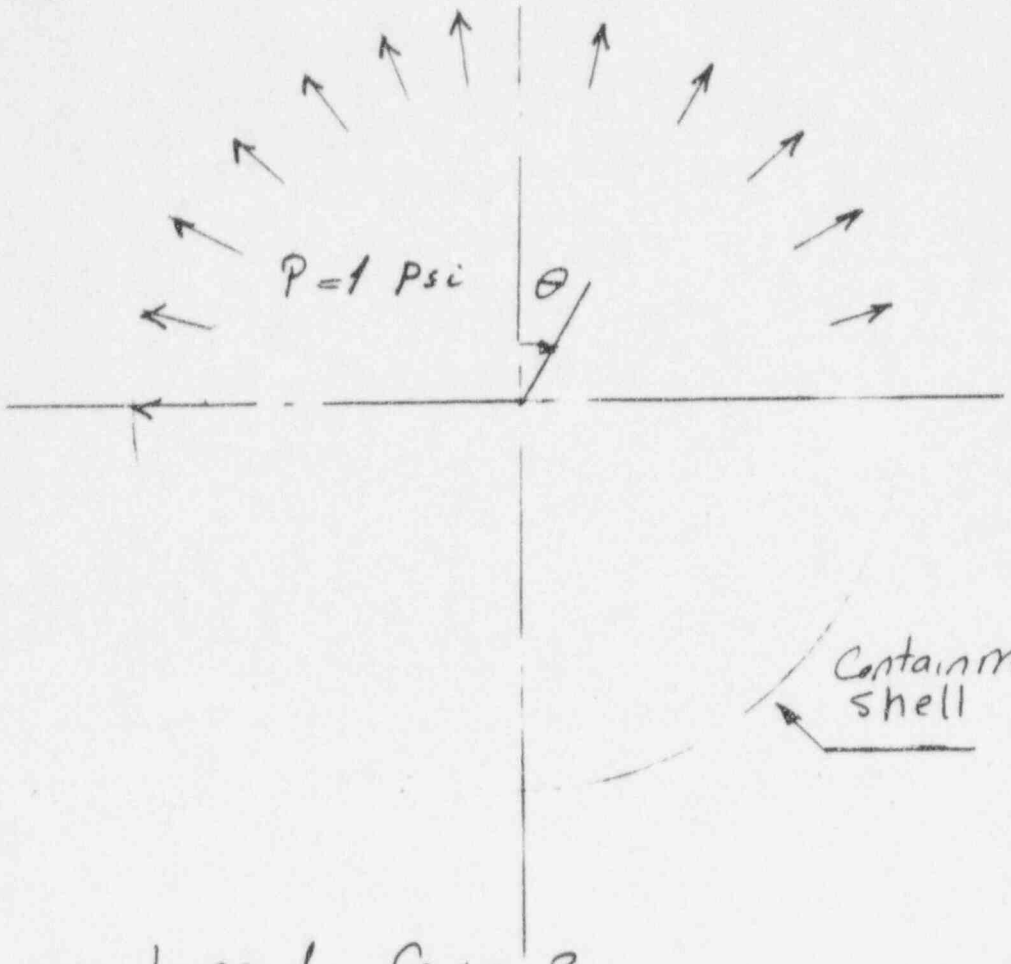
E_θ = 10 Psi and E_ϕ = 18376900 Psi

Other segments use: $\nu = 0.3$, $E = 27,400,000$ Psi

Loading:

1- Case 1 : Uniform Internal Pressure of 45 Psig was applied on segments 1 through 15.

2- Case 2 : The Pressure distribution shown in the Figure on next page was applied on segments 6 through 15. 80 Fourier harmonics were used in the Analysis

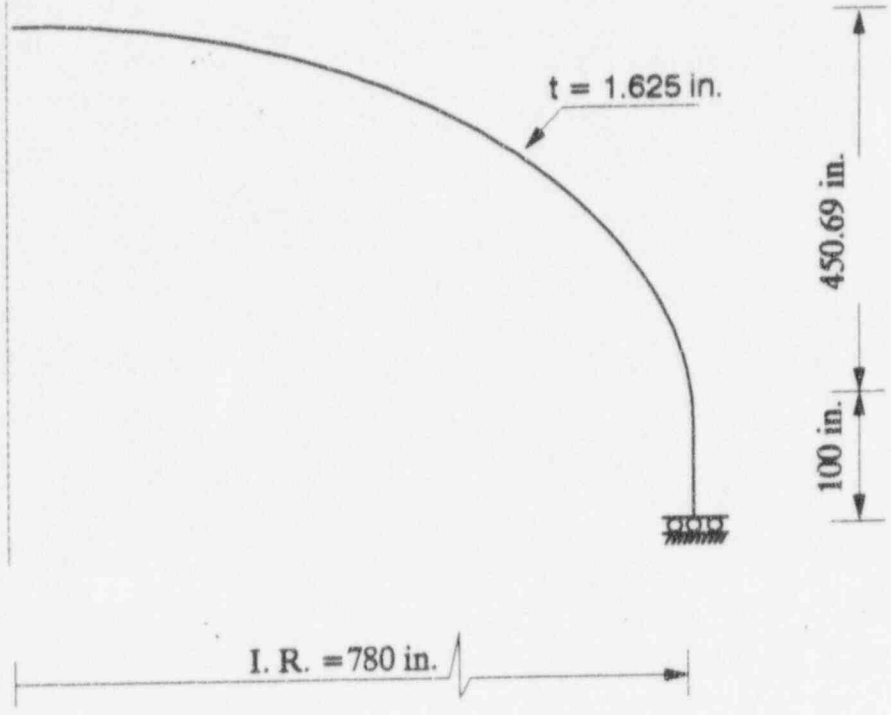


Load Case 2.

Output

- Load Case 1: obtain Stresses and displacement at all mesh points. (surface)
- Load Case 2: obtain Stresses and displacement at all mesh points along θ=0 and θ=180 (surface)

Axisymmetric Model For the Containment Head Buckling



Loading Type = Internal pressure
Young's Modulus = 29,500,000 psi
Yield stress = 60,000 psi
Elastic - Perfect plastic Stress-Strain relationship

The analysis was performed using five segments. The head was modeled as described in the axisymmetric model using four segments.

The problem was analyzed three times to study the effects of reducing the element size on the buckling load. The number of elements used in the analyses were 74, 148 and 296 respectively.