

DECEMBER 1, 1977

MASTER

MAIN STEAM VENT LINE PIPING
AND VALVE SUPPORT REANALYSIS

M. E. Nitzel

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IDAHO NATIONAL ENGINEERING LABORATORY
LOFT TECHNICAL REPORT
LOFT PROGRAM

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Main Steam Vent Line Piping and Valve Support Analysis		
		LTR 115-23
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ABSTRACT

A new support configuration for the one-inch Schedule 80 main steam vent line has been developed at the request of the LOFT Plant Systems Branch. This configuration will adequately support valves CV-P4-58 and CV-P4-59 without requiring supports at the centers of gravity of these valves as previously recommended. Dead weight, thermal expansion, seismic, LOCE and LOCA loading conditions were considered. Results indicate that the main steam vent piping will meet criteria specified in the ASME Code provided the recommendations, as listed in the following pages, are followed. Briefly, these recommendations are:

1. Supports H10 and H11 should remain as described in Reference (1).
2. A 50,000 psi yield strength material should be used for supports S1-S7.
3. Supports designated S1-S7 should be installed as described in the following pages.

CONTENTS

ABSTRACT	ii
I. INTRODUCTION	1
II. ANALYSIS	3
III. RESULTS	5
IV. CONCLUSIONS	7
V. REFERENCES	11
APPENDIX A -- FINITE ELEMENT MODEL, SAMPLE INPUT, AND PDYN OUTPUT . .	A-i
APPENDIX B -- SUPAN COMPUTER OUTPUT	B-i
APPENDIX C -- SUPAN PROGRAM SOURCE LISTING	C-i
APPENDIX D -- MICROFICHE COPIES OF COMPUTER OUTPUT	D-i

FIGURES

1. Main Steam Line Isolated Model	2
2. Suggested Installation of S1-S7	9
3. Suggested Installation of S3	10

TABLES

I. Main Steam Isolated Model - Maximum Moments	6
----------------------------------------------------------	---

MAIN STEAM VENT LINE PIPING AND VALVE SUPPORT ANALYSIS

I. INTRODUCTION

The LOFT main steam vent line had been analyzed previously, as described in References (1) and (2). However, the LOFT Plant Systems Branch has requested additional analysis to determine an adequate support configuration such that valves CV-P4-58 and -59 would not require supports located at their centers of gravity as recommended in Reference (2). This report describes the valve support configuration resulting from the additional analysis. As explained in Reference (2), the vent line is normally empty downstream from CV-P4-59; thus, a failure of the vent piping downstream from this valve would not affect overall system operation. The current support configuration was developed such that any failure of the piping would occur downstream from CV-P4-59.

The subject piping is constructed from ASTM A106, Grade B, carbon steel. Design temperatures and pressures are as listed in the LOFT Line Designation Tables, Specification P-1.

A finite element model of the system was developed and is shown in Figure 1. The response spectra analysis option of the SAP IV^[3] computer program was used to analyze for normal, upset, emergency, and faulted conditions using Loss-of-Coolant Experiment (LOCE) loads, seismic loads, and Loss-of-Coolant Accident (LOCA) loads. The analysis was conducted using limits as specified by Subarticle NC-3650 of Section III of the ASME Boiler and Pressure Vessel Code.

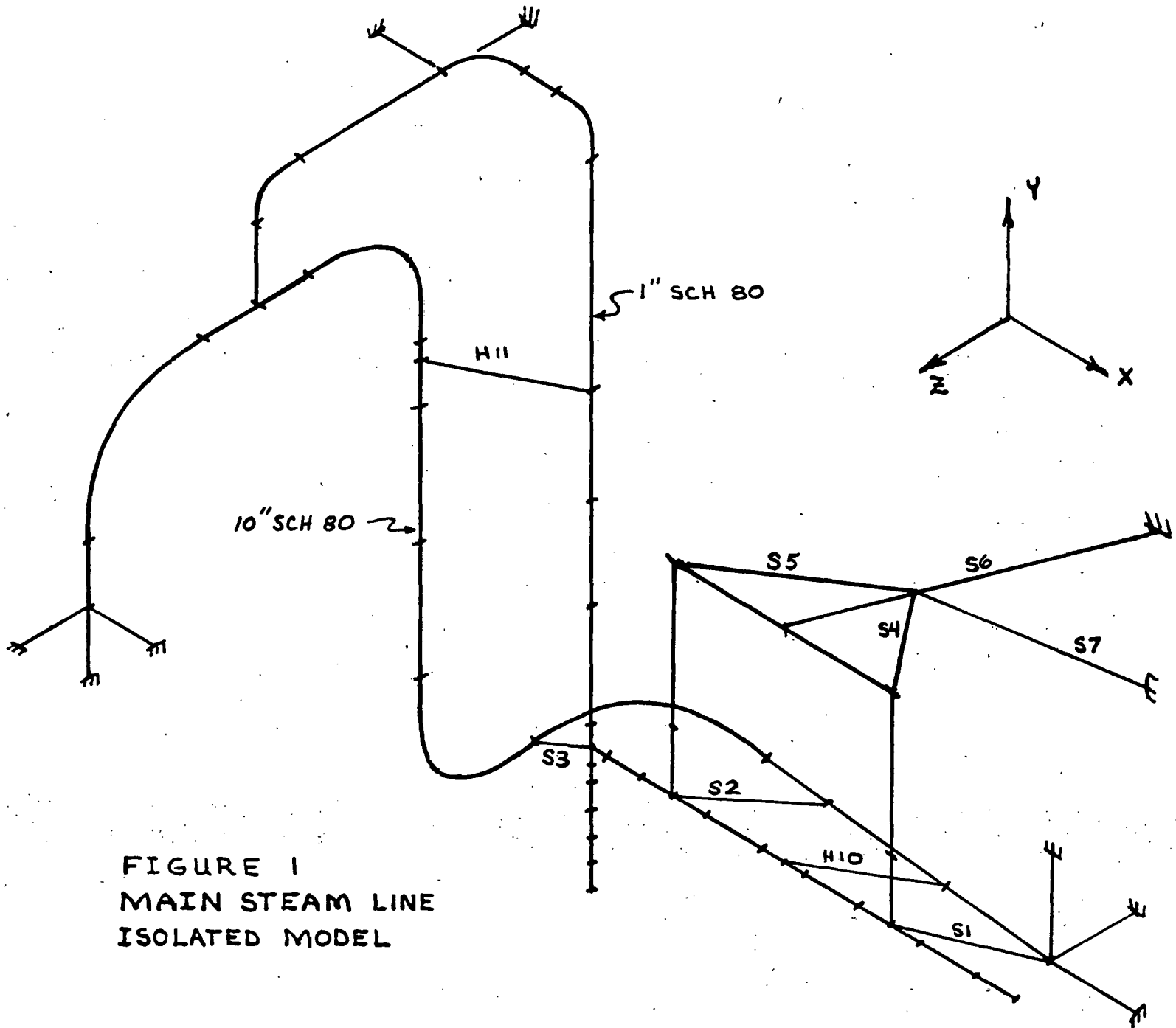


FIGURE 1
MAIN STEAM LINE
ISOLATED MODEL

II. ANALYSIS

A SAP IV^[3] finite element computer analysis was performed on the isolated model of the main steam and vent lines shown in Figure 1. This model includes the 10-inch main steam line from the steam generator downstream to the 10-inch line isolation point. The 1-inch vent line was modeled from its beginning on the 10-inch line to a point approximately 12 inches downstream of CV-P4-59. The valve operators and supports for CV-P4-58 and CV-P4-59 were also included in the model. There were 62 nodes, 43 pipe elements, 16 beam elements, and 11 boundary elements used to complete the model shown in Figure 1. The supports resulting from this analysis are designated S1-S7. The model was subjected to the following load cases:

1. Dead Weight
2. Thermal Expansion
3. Safe Shutdown Earthquake (SSE)
4. Loss-of-Coolant Experiment (LOCE)
5. Loss-of-Coolant Accident (LOCA).

These loadings were then used to analyze normal operating, upset, emergency, and faulted conditions. The same SSE, LOCA, and LOCE response spectra as used in References (1) and (2) were used in this analysis. The reader should refer to the Reference (1) report for further explanation of the use of these spectra and plots of their envelope curves. A plot of the model showing node and element numbers, typical input data, and PDYN post-processor computer output for the dynamic load cases is contained in Appendix A. The method of maximum allowable moments, as explained in Appendix B of the Reference (1) report was used to perform preliminary checks on computer results.

The Applied Mechanics Branch computer program SUPAN (SUPports ANalysis) was used to analyze the piping and valve supports. This analysis was performed in accordance with guidelines set forth in the AISC Steel Construction

Manual. This method is shown in detail in Attachment 2, Reference (2). The supports analysis computer output is shown in Appendix B while a source listing of the SUPAN program may be found in Appendix C. Microfiche copies of the SAP IV computer output may be found in Appendix D. The configuration control number of the SAP IV version used was S0066001.

III. RESULTS

The response spectra analysis option of the SAP IV finite element program was used to reanalyze the main steam vent piping configuration described above. The results of the piping analysis are summarized in Table I which lists maximum piping moments along with the maximum allowable moment for each pipe size present in the model. Results of the supports analysis, shown in Appendix B, indicate that all supports are within allowable limits.

TABLE I

MAIN STEAM ISOLATED MODEL -
MAXIMUM MOMENTS

CONDITION	PIPE SIZE	MAX. MOMENT	ALLOWABLE MOMENT
UPSET (LOCE) ↓	10" SCH 80	276364	473369
	1" SCH 80	1777	2690
	1/2" SCH 80	748	962
EMERGENCY (SSE) ↓	10" SCH 80	52469	788054
	1" SCH 80	501	4322
	1/2" SCH 80	223	1460
FAULTED (LOCA + SSE) ↓	10" SCH 80	363498	1.1027(10 ⁶)
	1" SCH 80	2613	5955
	1/2" SCH 80	1315	1960

NOTE - MOMENT VALUES ARE IN IN.-LB.

IV. CONCLUSIONS

The results of the analysis of this support configuration indicate that all ASME Boiler and Pressure Vessel Code^[4], Class 2 requirements will be met if the recommendations below are followed:

1. Material used to construct the supports should have a minimum yield strength of 36,000 psi.
2. Support S1 should be a 3/4-inch x 2-inch flat bar type support and support S2 should be a 1/2-inch x 2-inch flat bar type support. Both of these supports should be oriented with the 2-inch side in the vertical direction (Y as shown in Figure 1). These supports should be attached as closely as possible to the valves - preferably on the downstream sides.
3. S3 should be a 1/2-inch x 2-inch flat bar type support oriented with the 2-inch side in the vertical direction. This support should be attached as close as possible to the upstream side of the 1 x 1 x 1 tee.
4. S4 and S5 should be 1/2-inch x 2-inch flat bar type supports oriented with the 2-inch side in the horizontal direction. These supports should be attached to the existing 3 x 3 x 3/8 angle section member directly behind their respective valve operators and also attached to support S6 (6-inch Sch. 80 pipe) approximately 20 inches away from its attachment point to the 3 x 3 x 3/8 angle member.
5. S6 should be constructed from 6-inch Sch. 80 pipe. This support is attached to the existing 3 x 3 x 3/8 angle at the center point between the valves. This support is anchored to the existing 12 x 106 wide flange such that the center-line of the pipe intersects the center of the flange surface.

6. S7 should be constructed from 6-inch Sch. 80 pipe. This support is anchored to the existing 12 x 106 wide flange while the opposite end is connected to support S6. The S6-S7 connection should be approximately 50 inches from the 12 x 106 wide flange anchor point of S6. This support should be oriented at an angle as close as possible to 45° relative to the horizontal plane.
7. Existing supports designated as H10 and H11 should remain as recommended in Reference (1).
8. Lengths used in the supports analysis shown in Appendix B are approximate - field fitting will be required.
9. The Applied Mechanics Branch should be contacted for review of final design drawings.

Figures 2 and 3 show simplified sketches for the recommended installation of supports S1-S7.

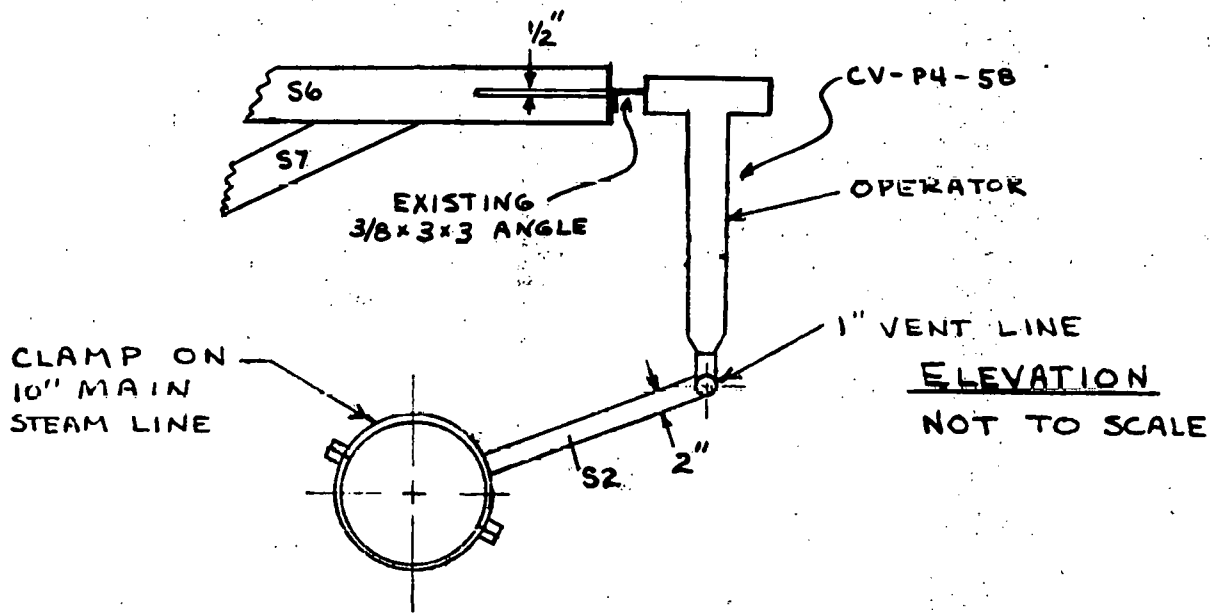
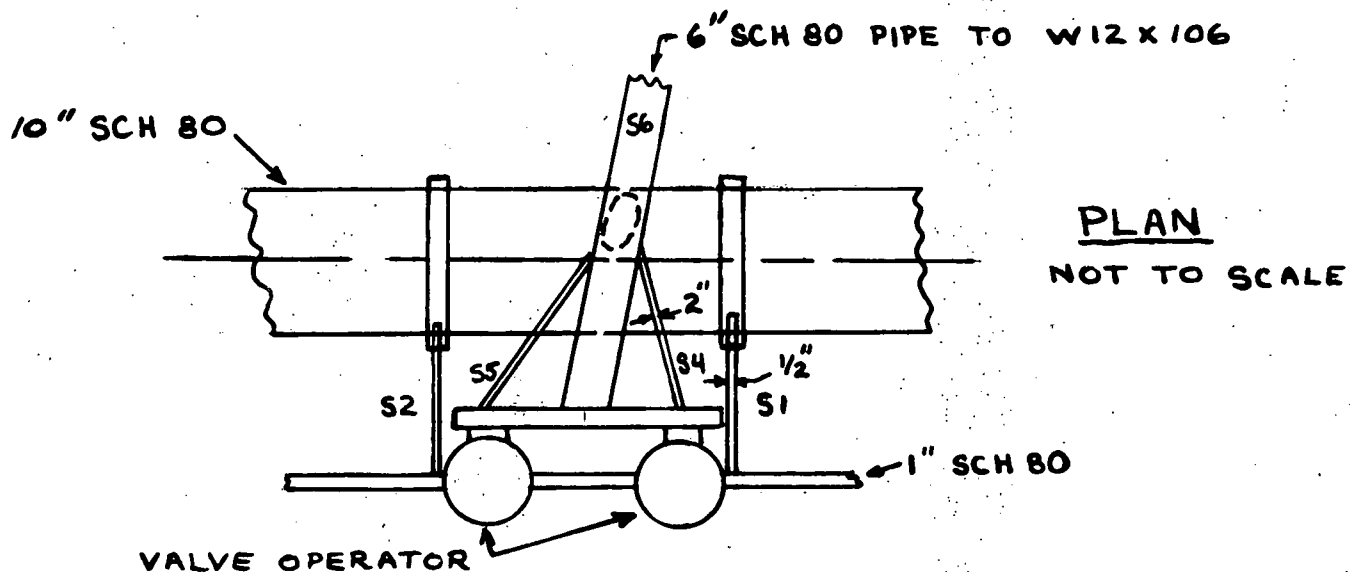


Figure 2
SUGGESTED INSTALLATION OF S1-S7

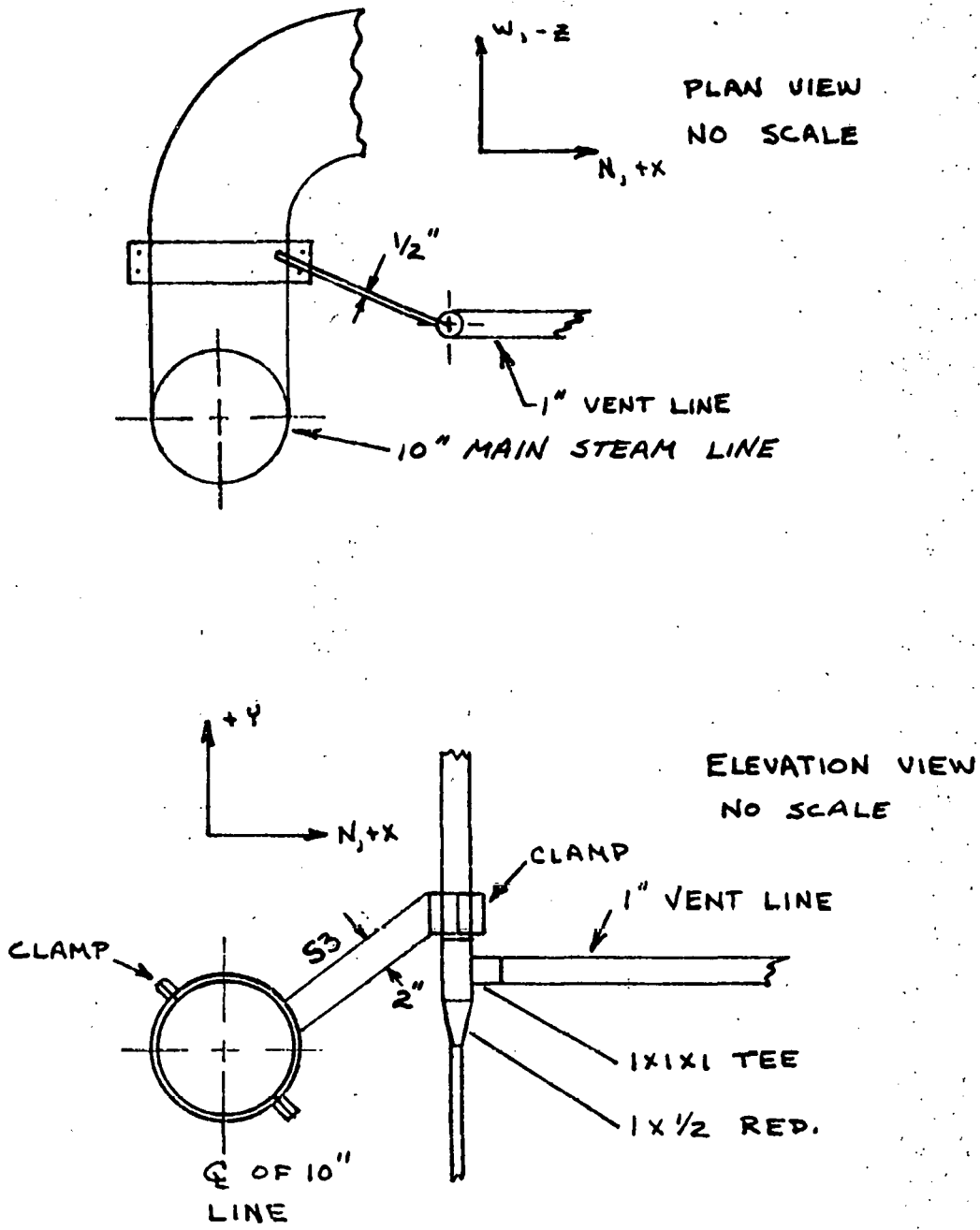


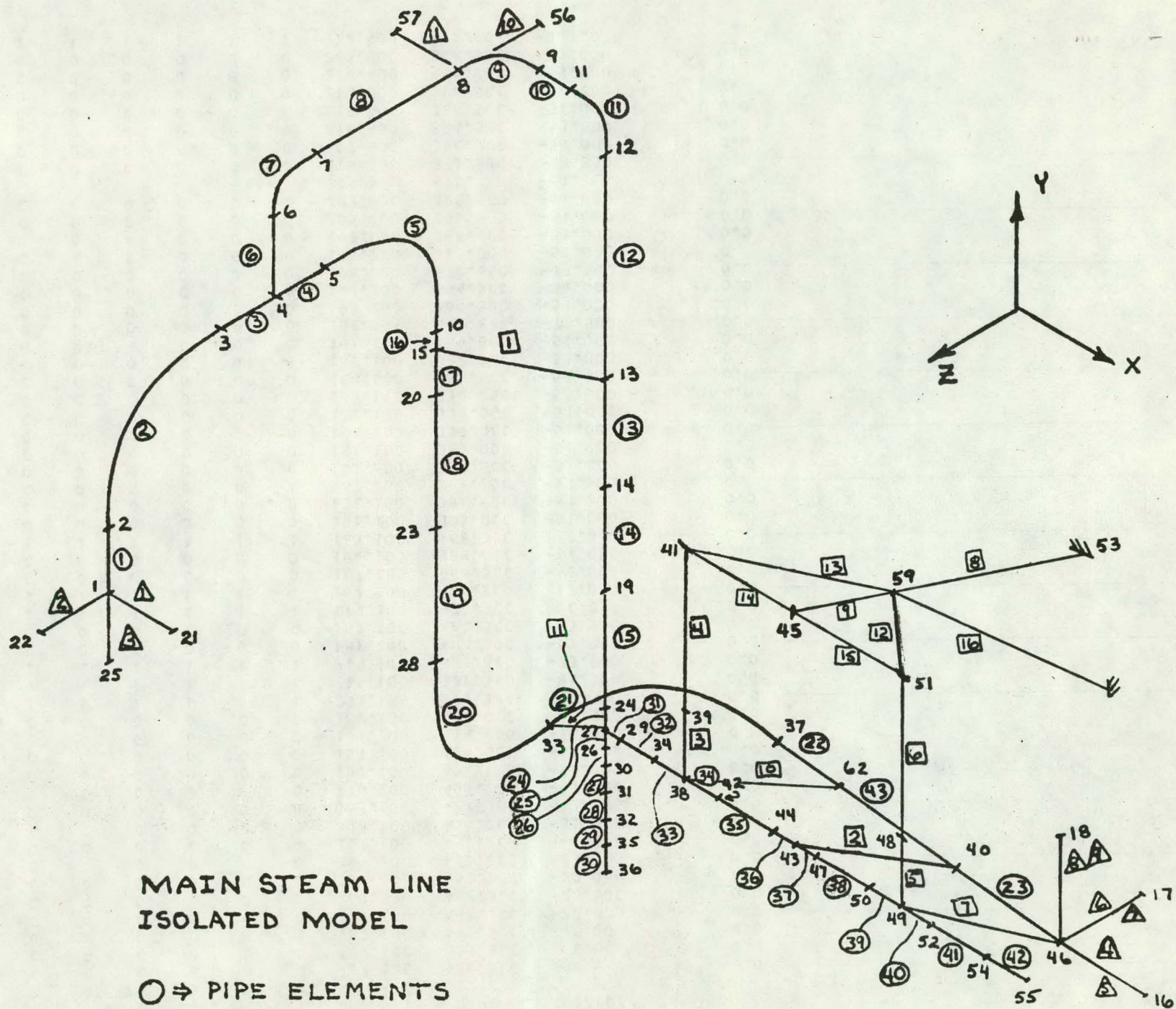
Figure 3
SUGGESTED INSTALLATION OF S3

V. REFERENCES

1. M. E. Nitzel, "LOFT Main Steam and Main Steam Vent Class 2 Piping Analysis", LOFT Technical Report LTR 115-10 (TR-790, AM-115), March 2, 1976.
2. M. E. Nitzel, "Main Steam Vent Line Alternate Supports Analysis", LOFT Technical Report LTR 115-18 (TR-859), June 11, 1976.
3. Klaus-Jurgen-Bathe, et al, "SAP-IV - A Structural Analysis Program for Static and Dynamic Response of Linear Systems", Earthquake Engineering Research Center, Berkeley, California, June 1973.
4. American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section III, Division 1, "Nuclear Power Plant Components", Sub-section NC, 1974 Edition plus Summer 1976 Addenda.

APPENDIX A
FINITE ELEMENT MODEL, SAMPLE
INPUT, AND PDYN OUTPUT

1-4



MAIN STEAM LINE
ISOLATED MODEL

- → PIPE ELEMENTS
- → BEAM "
- △ → BOUNDARY "

LTR 115 23 11

0 1 2 3 4 5 6 7 8
 1234567890123456789012345678901234567890123456789012345678901234567890

1	* MAIN STEAM ISOLATED MODEL - SPECIAL SUPPORTS - DYNAMIC 1 5/10/77											
2	62	3	0	20	3	0	0	141				
3	1	C	C	C	C	0	0	167.100	420.300	0.0	0.0	
4	2	C	0	0	0	0	0	167.100	427.300	0.0	0.0	
5	3	C	0	0	0	0	0	167.100	442.300	-15.000	0.0	
6	4	C	0	0	C	0	0	167.100	442.300	-22.000	0.0	
7	5	0	0	0	0	0	0	167.100	442.300	-28.500	0.0	
8	6	C	0	0	C	0	0	167.100	451.200	-22.000	0.0	
9	7	C	0	0	0	0	0	167.100	456.200	-27.000	0.0	
10	8	0	0	0	0	0	0	167.100	456.200	-46.000	0.0	
11	9	C	C	C	0	0	0	172.100	456.200	-51.000	0.0	
12	10	0	0	0	0	0	0	167.100	427.300	-43.500	0.0	
13	11	C	0	0	0	0	0	176.100	456.200	-51.000	0.0	
14	12	C	0	0	0	0	0	181.100	451.200	-51.000	0.0	
15	13	C	0	0	0	0	0	181.100	426.000	-51.000	0.0	
16	14	C	0	0	0	0	0	181.100	414.000	-51.000	0.0	
17	15	C	0	C	0	0	0	167.100	426.000	-43.500	0.0	
18	16	1	1	1	1	1	1	231.134	371.386	-73.500	0.0	
19	17	1	1	1	1	1	1	219.100	371.380	-85.500	0.0	
20	18	1	1	1	1	1	1	219.100	383.380	-73.500	0.0	
21	19	C	0	0	0	0	0	181.100	402.000	-51.000	0.0	
22	20	C	0	0	C	0	0	167.100	421.500	-43.500	0.0	
23	21	1	1	1	1	1	1	179.100	420.300	0.0	0.0	
24	22	1	1	1	1	1	1	167.100	420.300	12.000	0.0	
25	23	C	0	0	0	0	0	167.100	406.500	-43.500	0.0	
26	24	C	0	0	0	0	0	181.100	388.000	-51.000	0.0	
27	25	1	1	1	1	1	1	167.100	408.300	0.0	0.0	
28	26	0	0	0	0	0	0	181.100	385.000	-51.000	0.0	
29	27	C	0	0	0	0	0	181.100	386.500	-51.000	0.0	
30	28	C	0	C	0	0	0	167.100	391.250	-43.500	0.0	
31	29	C	0	0	0	0	0	182.600	386.500	-51.000	0.0	
32	30	C	0	C	0	0	0	181.100	383.000	-51.000	0.0	
33	31	C	0	0	0	0	0	181.100	379.000	-51.000	0.0	
34	32	C	0	0	0	0	0	181.100	376.000	-51.000	0.0	
35	33	C	0	0	0	0	0	167.100	376.250	-58.500	0.0	
36	34	0	0	0	0	0	0	188.600	386.500	-51.000	0.0	
37	35	C	0	0	0	0	0	181.100	372.000	-51.000	0.0	
38	36	C	0	0	0	0	0	181.100	369.000	-51.000	0.0	
39	37	0	0	0	0	0	0	182.034	374.846	-73.500	0.0	
40	38	C	0	0	0	0	0	193.200	386.500	-51.000	0.0	
41	39	C	0	0	0	0	0	193.200	394.500	-51.000	0.0	
42	40	C	0	0	0	0	0	206.000	372.690	-73.500	0.0	
43	41	C	0	0	0	0	0	193.200	415.000	-51.000	0	
44	42	0	0	0	0	0	0	197.800	386.500	-51.000	0.0	
45	43	C	0	0	0	0	0	205.800	386.500	-51.000	0.0	
46	44	C	0	0	C	0	0	203.800	386.500	-51.000	0.0	
47	45							205.8	415.	-51.		
48	46	C	0	0	0	0	0	219.100	371.380	-73.500	0.0	
49	47	C	0	0	0	0	0	207.800	386.500	-51.000	0.0	
50	48	C	0	0	0	0	0	218.400	394.500	-51.000	0.0	
51	49	C	0	C	0	0	0	218.400	386.500	-51.000	0.0	
52	50	0	0	0	0	0	0	213.800	386.500	-51.000	0.0	
53	51	C	0	0	0	0	0	218.400	415.000	-51.000		
54	52	0	0	0	0	0	0	223.000	386.500	-51.000	0.0	
55	53	1	1	1	1	1	1	218.400	415.000	-121.0		

A-2

LRI 15 23

0 1 2 3 4 5 6 7 8
 1234567890123456789012345678901234567890123456789012345678901234567890

C 1 2 3 4 5 6 7 8
 1234567890123456789012345678901234567890123456789012345678901234567890

56	54	C	0	0	0	0	0	229.000	386.500	-51.000	0.0
57	55	C	0	0	0	0	0	231.950	386.500	-51.000	0.0
58	56	1	1	1	1	1	1	167.100	456.200	-58.000	0.0
59	57	1	1	1	1	1	1	155.100	456.200	-46.000	0.
60	58	1	1	1	1	1	1	181.1	357.	-51.	
61	59							209.4	415.	-71.	
62	60	1	1	1	1	1	1	208.4	415.	-51.	
63	61	1	1	1	1	1	1	218.4	365.	-121.	
64	62							193.2	373.8	-73.5	
65	12	43	1	3	4	0	3	0	0	C	1
66	1	3	**	ALC6	CARBON	STEEL	MATERIAL	**			
67	100.	29000000.	0.30	.00000563							
68	70.	27900000.	0.30	.00000613							
69	600.	25700000.	0.30	.00000723							
70	1	10.75	0.593				6.212			10 IN. MAIN LINE	
71	2	1.315	0.179				0.2627			1 IN. SCH 80	
72	3	0.840	0.147				0.1848			.5IN. LINE	
73	4	1.8453	.4441				.2627			VALVES	
74											
75	1.0										
76											
77		1.0									
78	1.0										
79	1T	1	2	1	1		70.	0.	0.	0.	0
80	2B	2	3	1	1		70.	0.	0.	0.	0
81	15.0		CC	167.1	427.30		-15.0	0.50			
82	3T	3	4	1	1		70.	0.	0.	0.	0
83	4T	4	5	1	1		70.	0.	0.	0.	0
84	5B	5	10	1	1		70.	0.	0.	0.	0
85	15.0		CC	167.1	427.30		-28.50	0.50			
86	6T	4	6	1	2		70.	0.	0.	0.	0
87	7B	6	7	1	2		70.	0.	0.	0.	0
88	5.0		CC	167.1	451.2		-27.0	0.50			
89	8T	7	8	1	2		70.	0.	0.	0.	0
90	9B	8	9	1	2		70.	0.	0.	0.	0
91	5.0		CC	172.1	456.2		-46.0	0.50			
92	10T	9	11	1	2		70.	0.	0.	0.	0
93	11B	11	12	1	2		70.	0.	0.	0.	0
94	5.0		CC	176.1	451.2		-51.0	0.50			
95	12T	12	13	1	2		70.	0.	0.	0.	0
96	13T	13	14	1	2		70.	0.	0.	0.	0
97	14T	14	19	1	2		70.	0.	0.	0.	0
98	15T	19	24	1	2		70.	0.	0.	0.	0
99	16T	10	15	1	1		70.	0.	0.	0.	0
100	17T	15	20	1	1		70.	0.	0.	0.	0
101	18T	20	23	1	1		70.	0.	0.	0.	0
102	19T	23	28	1	1		70.	0.	0.	0.	0
103	20B	28	33	1	1		70.	0.	0.	0.	0
104	15.0		CC	167.1	391.25		-58.50	0.50			
105	21B	33	37	1	1		70.	0.	0.	0.	0
106	15.0		CC	182.034	374.846		-58.50	0.50			
107	22T	37	62	1	1		70.	0.	0.	0.	0
108	23T	40	46	1	1		70.	0.	0.	0.	0
109	24T	24	27	1	2		70.	0.	0.	0.	0
110	25T	27	26	1	2		70.	0.	0.	0.	0

A-3

LTR115 23

C 1 2 3 4 5 6 7 8
 123456789012345678901234567890123456789012345678901234567890

0 1 2 3 4 5 6 7 8
 1234567890123456789012345678901234567890123456789012345678901234567890

111	26T	26	30	1	3	70.	0.	0.	0.	0.	0.
112	27T	30	31	1	3	70.	0.	0.	0.	0.	0.
113	28T	31	32	1	3	70.	0.	0.	0.	0.	0.
114	29T	32	35	1	3	70.	0.	0.	0.	0.	0.
115	30T	35	36	1	3	70.	0.	0.	0.	0.	0.
116	31T	27	29	1	2	70.	0.	0.	0.	0.	0.
117	32T	29	34	1	2	70.	0.	0.	0.	0.	0.
118	33T	34	38	1	2	70.	0.	0.	0.	0.	0.
119	34T	38	42	1	2	70.	0.	0.	0.	0.	0.
120	35T	42	44	1	2	70.	0.	0.	0.	0.	0.
121	36T	44	43	1	2	70.	0.	0.	0.	0.	0.
122	37T	43	47	1	2	70.	0.	0.	0.	0.	0.
123	38T	47	50	1	2	70.	0.	0.	0.	0.	0.
124	39T	50	49	1	2	70.	0.	0.	0.	0.	0.
125	40T	49	52	1	2	70.	0.	0.	0.	0.	0.
126	41T	52	54	1	2	70.	0.	0.	0.	0.	0.
127	42T	54	55	1	2	70.	0.	0.	0.	0.	0.
128	43T	62	40	1	1	70.	0.	0.	0.	0.	0.

129	2	16	16	0	4						
130		126050000.		0.30		0.00075		0.29			
131		225750000.		0.30		0.00072		0.28			
132		325750000.		0.30		0.00071		0.2734			
133		425750000.		0.30							

A-4

134	1	2.25				.422		1.69		.1055	
135	2	2.25				0.4222		0.1055		1.69	
136	3	9.5				3.166		14.198		12.665	
137	4	6.62				26.542		13.27		13.27	
138	5	0.25				0.00521		0.0208		0.0013	
139	6	0.75				0.0352		0.250		0.0088	
140	7	16.				10.		10.		10.	
141	8	4.4605				10.		10.		10.	
142	9	10.				80.		80.		80.	
143	10	8.405				81.00		40.50		40.50	
144	11	1.5				.2813		.0703		.50	
145	12	1.0				0.0833		0.333		0.0208	
146	13	1.50				0.2813		0.50		0.0703	
147	14	1.0				0.0833		0.0208		0.333	
148	15	10.				100.		100.		100.	
149	16	1.5				0.070		2.0		0.0176	

150
 151 -1.0
 152

153	1	13	15	12	1	6	0	0	0	0	0	0
154	2	43	40	47	1	6	0	0	0	0	0	0
155	3	38	35	34	3	7	0	0	0	0	0	0
156	4	39	41	45	3	8	0	0	0	0	111	0
157	5	49	48	50	3	7	0	0	0	0	111	0
158	6	48	51	53	3	8	0	0	0	0	111	0
159	7	49	46	52	1	12	0	0	0	0	0	0
160	8	59	53	51	1	10	0	0	0	0	0	0
161	9	45	59	41	1	10	0	0	0	0	0	0
162	10	38	62	42	1	12	0	0	0	0	0	0
163	11	27	33	24	1	14	0	0	0	0	0	0
164	12	51	59	45	1	14	0	0	0	0	0	0
165	13	41	59	45	1	14	0	0	0	0	0	0

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166	14	45	51	59	4	15					
167	15	41	45	59	4	15					
168	16	59	61	53	1	10					
169	7	11	C	C							
170	1.0										
171	1	21	0	0	0	1	0	00.0	0.0	0.0	
172	1	22	0	0	0	1	0	00.0	0.0	C.0	
173	1	25	0	0	0	1	0	00.0	0.0	C.0	
174	8	56	0	0	0	1	1	00.0	0.0	1500.	
175	8	57	0	0	0	1	1	00.0	0.0	1500.	
176	46	16	0	0	0	1	0	00			
177	46	16	0	0	0	0	1	00.0	0.0	0.0	
178	46	17	0	0	0	1	0	00.0	0.0	C.0	
179	46	17	0	0	0	0	1	00.0	0.0	0.0	
180	46	18	0	0	0	1	0	00.0	0.0	C.0	
181	46	18	0	0	0	0	1	00.0	0.0	C.0	

182
 183
 184 1 100.
 185 1.0 1.0 .33 1
 186 *** RESP. SPECT. ANALYSIS, MAIN STEAM, ISOLATED MODEL, ** L O C E ****

187	10	1.									
188	.0010		800.								
189	.018		1400.								
190	.020		3300.								
191	.024		3600.								
192	.029		1500.								
193	.044		700.								
194	.059		700.								
195	.08		2230.								
196	.40		450.								
197	10.0		450.								

0 1 2 3 4 5 6 7 8
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A-5

LTR115 23

PDYN RESULTS FROM
5/10/77 CONFIG. SAP
RUN.

EL NO	END	TX	MY	MZ	RES-MR	END	TX	MY	MZ	RES-MR
1	I	0.	0.	0.	0.	J	0.	12500.	13800.	18620.
2	C	15900.	25900.	33000.	44602.	J	36600.	24100.	42800.	61255.
3	I	36600.	24100.	42800.	61255.	J	36600.	30800.	41700.	63459.
4	I	37100.	30800.	42800.	64474.	J	37100.	34800.	40300.	64896.
5	C	50200.	11000.	30200.	59608.	J	35100.	40500.	28000.	60467.
6	I	408.	1150.	1170.	1691.	J	408.	276.	236.	546.
7	C	271.	276.	525.	652.	J	298.	266.	642.	756.
8	I	298.	266.	642.	756.	J	298.	725.	201.	809.
9	C	260.	136.	781.	834.	J	257.	122.	506.	580.
10	I	257.	506.	122.	580.	J	257.	184.	364.	482.
11	C	216.	280.	658.	782.	J	161.	537.	897.	1058.
12	I	161.	897.	537.	1058.	J	161.	530.	459.	719.
13	I	227.	375.	366.	571.	J	227.	479.	294.	606.
14	I	227.	479.	294.	606.	J	227.	491.	298.	618.
15	I	227.	491.	298.	618.	J	227.	472.	542.	754.
16	I	35100.	40500.	28000.	60467.	J	35100.	41400.	28700.	61398.
17	I	35300.	41300.	28600.	61398.	J	35300.	45100.	31900.	65557.
18	I	35300.	45100.	31900.	65557.	J	35300.	61800.	46500.	85015.
19	I	35300.	61800.	46500.	85015.	J	35300.	80800.	64900.	109484.
20	C	81400.	54800.	59800.	114913.	J	58000.	24400.	19700.	102895.
21	C	85600.	30900.	18100.	52789.	J	71300.	55500.	17200.	91977.
22	I	71300.	17200.	55500.	91977.	J	71300.	35000.	94300.	123293.
23	I	70600.	63500.	168000.	192978.	J	70600.	94300.	250000.	276364.
24	I	227.	472.	542.	754.	J	227.	497.	603.	814.
25	I	0.	485.	927.	1046.	J	0.	429.	810.	917.
26	I	0.	429.	810.	917.	J	0.	354.	659.	748.
27	I	0.	354.	659.	748.	J	0.	209.	380.	434.
28	I	0.	209.	380.	434.	J	0.	115.	205.	235.
29	I	0.	115.	205.	235.	J	0.	24.	43.	49.
30	I	0.	24.	43.	49.	J	0.	0.	0.	0.
31	I	362.	947.	1460.	1777.	J	362.	660.	1030.	1276.
32	I	362.	660.	1030.	1276.	J	362.	567.	1100.	1289.
33	I	362.	567.	1100.	1289.	J	362.	1500.	2520.	2955. VALVE
34	I	97.	1240.	642.	1400. VALVE	J	97.	726.	409.	839.
35	I	97.	726.	409.	839.	J	97.	95.	221.	260.
36	I	97.	95.	221.	260.	J	97.	202.	250.	336. 1"
37	I	74.	240.	278.	375.	J	74.	184.	194.	277.
38	I	74.	184.	194.	277.	J	74.	50.	460.	469.
39	I	74.	50.	460.	469.	J	74.	136.	802.	817. VALVE
40	I	0.	94.	86.	127. VALVE	J	0.	46.	41.	62.
41	I	0.	46.	41.	62.	J	0.	6.	5.	7.
42	I	0.	6.	5.	7.	J	0.	0.	0.	0.
43	I	70100.	35400.	94200.	122641.	J	70100.	64300.	168000.	193061. 10"

LOCE

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VALVE

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VALVE

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IHC90C1 EXECUTION TERMINATING DUE TO ERROR COUNT FOR ERROR NUMBER 217

IHC217I FIGCS - END OF DATA SET ON UNIT 11

TRACEBACK ROUTINE CALLED FROM ISN REG. 14 REG. 15 REG. 0 REG. 1

IBCOM 0008923C C0089518 000C0C2C 00089228

MAIN 00011F8C 01088FDE F00C0C08 000A0FF8

ENTRY FCINT= 01088FDB

LR115 23

PDYN RESULTS FROM
5/10/77 CONFIG.
SAP RUN

EL NO	END	TX	MY	MZ	RES-MR	FND	TX	MY	MZ	RES-MR
1	I	0.	0.	0.	0.	J	0.	4840.	2050.	5256.
2	C	6250.	10300.	4830.	12985.	J	14500.	9690.	6200.	19509.
3	I	14500.	9690.	6200.	13509.	J	14500.	12900.	6360.	20423.
4	I	14500.	12700.	6420.	20214.	J	14500.	15100.	6550.	21935.
5	C	21400.	2460.	6380.	22466.	J	17100.	12700.	6890.	22387.
6	I	152.	228.	217.	350.	J	152.	100.	89.	202.
7	C	69.	138.	119.	195.	J	60.	122.	120.	181.
8	I	60.	122.	120.	181.	J	60.	222.	62.	238.
9	C	49.	53.	172.	186.	J	45.	59.	106.	129.
10	I	45.	106.	59.	129.	J	45.	52.	92.	115.
11	C	46.	55.	132.	150.	J	45.	100.	144.	181.
12	I	45.	144.	100.	181.	J	45.	146.	94.	179.
13	I	65.	136.	96.	179.	J	65.	120.	82.	159.
14	I	65.	120.	82.	159.	J	65.	77.	77.	127.
15	I	65.	77.	77.	127.	J	65.	162.	116.	210.
16	I	17100.	12700.	6890.	22387.	J	17100.	12700.	7000.	22421.
17	I	17200.	12700.	6990.	22494.	J	17200.	13200.	7420.	22916.
18	I	17200.	13200.	7420.	22916.	J	17200.	16200.	9120.	25327.
19	I	17200.	16200.	9120.	25327.	J	17200.	20700.	10900.	29037.
20	C	27800.	7610.	10200.	30574.	J	25600.	12400.	6820.	29251.
21	C	22400.	15200.	8040.	23293.	J	7430.	29300.	7130.	31057.
22	I	7430.	7130.	29300.	31057.	J	7430.	9040.	34200.	36146.
23	I	7450.	12900.	40900.	43528.	J	7450.	17500.	48900.	52469.
24	I	65.	162.	116.	210.	J	65.	181.	132.	233.
25	I	0.	176.	255.	310.	J	0.	155.	223.	272.
26	I	0.	155.	223.	272.	J	0.	129.	182.	223.
27	I	0.	129.	182.	223.	J	0.	76.	106.	131.
28	I	0.	76.	106.	131.	J	0.	42.	57.	71.
29	I	0.	42.	57.	71.	J	0.	9.	12.	15.
30	I	0.	9.	12.	15.	J	0.	0.	0.	0.
31	I	90.	254.	396.	501.	J	90.	199.	309.	378.
32	I	90.	159.	309.	378.	J	90.	197.	214.	304.
33	I	90.	197.	214.	304.	J	90.	500.	477.	697.
34	I	26.	416.	113.	432.	J	26.	239.	75.	252.
35	I	26.	239.	75.	252.	J	26.	15.	71.	77.
36	I	26.	15.	71.	77.	J	26.	71.	84.	113.
37	I	26.	86.	94.	130.	J	26.	66.	57.	91.
38	I	26.	66.	57.	91.	J	26.	16.	101.	106.
39	I	26.	16.	101.	106.	J	26.	44.	199.	206.
40	I	0.	27.	20.	34.	J	0.	14.	9.	17.
41	I	0.	14.	9.	17.	J	0.	2.	1.	2.
42	I	0.	2.	1.	2.	J	0.	0.	0.	0.
43	I	7380.	9060.	34200.	36141.	J	7380.	12900.	40900.	43516.

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IHC9J0I EXECUTION TERMINATING CUF TO ERROR COUNT FOR ERROR NUMBER 217

IHC217I FIOCS - END OF DATA SET CN UNIT 11

TRACEBACK ROUTINE CALLED FROM ISN REG. 14 REG. 15 REG. 0 REG. 1

IBCOM 0006DA3C 0006DD18 0003002C 0006DA28

MAIN 00011F80 0106D708 FD000008 000857F8

ENTRY POINT= 0106D708

PDYN RESULTS FROM
5/10/77 CONFIG.
SAP RUN

EL	NO	END	TX	MY	MZ	RES-MR	END	TX	MY	MZ	RES-MR
1	I	0.	0.	0.	0.	J	0.	16100.	16000.	22698.	
2	C	20600.	31600.	37800.	54600.	J	47500.	31400.	47700.	74280.	
3	I	47500.	31400.	47700.	74280.	J	47500.	40300.	46200.	77816.	
4	I	47800.	40600.	47300.	73552.	J	47800.	46900.	44500.	80403.	
5	C	67200.	13300.	33800.	76388.	J	50400.	48700.	32400.	77211.	
6	I	536.	1460.	1330.	2079.	J	536.	415.	347.	762.	
7	C	315.	400.	690.	858.	J	332.	370.	788.	932.	
8	I	322.	370.	788.	932.	J	333.	1000.	294.	1094.	
9	C	305.	201.	1010.	1074.	J	312.	171.	652.	743.	
10	I	312.	652.	171.	743.	J	312.	244.	434.	588.	
11	C	269.	348.	797.	910.	J	208.	678.	1000.	1226.	
12	I	208.	1000.	673.	1226.	J	208.	614.	563.	859.	
13	I	295.	452.	467.	714.	J	295.	575.	381.	750.	
14	I	295.	575.	381.	750.	J	295.	544.	398.	736.	
15	I	295.	544.	398.	736.	J	295.	602.	694.	965.	
16	I	50400.	48700.	32400.	77211.	J	50400.	49500.	33300.	78098.	
17	I	51000.	49400.	33200.	78381.	J	51000.	53300.	36900.	82483.	
18	I	51000.	53300.	36900.	82483.	J	51000.	71300.	52900.	102387.	
19	I	51000.	71300.	52900.	102387.	J	51000.	92800.	72000.	128050.	
20	C	101000.	59100.	65800.	134251.	J	113000.	35800.	24700.	121082.	
21	C	98800.	43500.	24300.	110653.	J	75500.	80700.	26300.	113598.	
22	I	75500.	26300.	80700.	113598.	J	75500.	47900.	118000.	148050.	
23	I	74900.	82700.	192000.	222066.	J	74900.	120000.	277000.	311029.	
24	I	295.	602.	694.	965.	J	295.	651.	782.	1059.	
25	I	0.	568.	1420.	1529.	J	0.	502.	1240.	1338.	
26	I	0.	502.	1240.	1338.	J	0.	415.	1010.	1092.	
27	I	0.	415.	1010.	1092.	J	0.	245.	585.	634.	
28	I	0.	245.	585.	634.	J	0.	135.	317.	345.	
29	I	0.	135.	317.	345.	J	0.	29.	66.	72.	
30	I	0.	29.	66.	72.	J	0.	0.	0.	0.	
31	I	437.	1050.	1780.	2112.	J	437.	742.	1310.	1568.	
32	I	437.	742.	1310.	1568.	J	437.	615.	1190.	1409.	
33	I	437.	615.	1190.	1409.	J	437.	1640.	2720.	3206.	
34	I	111.	1370.	689.	1538.	J	111.	799.	435.	916.	
35	I	111.	799.	435.	916.	J	111.	105.	235.	280.	
36	I	111.	105.	235.	280.	J	111.	219.	272.	367.	
37	I	83.	259.	301.	406.	J	83.	199.	215.	305.	
38	I	83.	199.	215.	305.	J	83.	65.	483.	494.	
39	I	83.	65.	483.	494.	J	83.	158.	840.	859.	
40	I	0.	122.	105.	161.	J	0.	61.	49.	78.	
41	I	0.	61.	49.	78.	J	0.	7.	6.	9.	
42	I	0.	7.	6.	9.	J	0.	0.	0.	0.	
43	I	74300.	48200.	118000.	147539.	J	74300.	83300.	192000.	222089.	

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A-8

LR115 23

IHC9001 EXECUTION TERMINATING DUE TO ERROR COUNT FCP ERROR NUMBER 217

IHC2171 FIDCS - END OF DATA SET ON UNIT 11

TRACEBACK ROUTINE CALLED FROM ISN REG. 14 REG. 15 REG. 0 REG. 1

IBCOM 00031A3C 00031D18 0000002C 00031A28

MAIN 00011F80 01031708 F0000008 000497F8

ENTRY POINT= 01031708

APPENDIX B
SUPAN COMPUTER OUTPUT

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9 5* MAIN STEAM ISOLATED MCDL + SPECIAL SUPPORTS - 5/10/77 CONFIG.

2	2	1	22.	1.2				
68.5			2.3	16.7	81.	244.	349.	
100.			17.8	133.	27.4	2202.	241.	
162.			4.	12.	5.2	229.	55.3	
56.			1.4	3.1	1.7	63.	19.5	
176.			4.3	14.6	6.2	271.	59.	
2	2	1	10.	1.2				
18.1			27.8	18.8	63.4	385.	244.	
24.4			99.2	8.7	33.6	88.6	806.	
91.5			31.8	115.	22.6	1730.	287.	
16.			4.9	30.8	8.3	460.	45.1	
100.			34.	173.	31.	2593.	310.	
1	3	1	22.	1.2				
1.5	.50	.1875		.578	.2168			
601.			5.5	436.5	44.6	6436.	110.	
954.			44.	558.	6.6	10110.	622.	
90.			10.	33.7	26.3	504.	135.	
27.8			3.3	9.8	5.4	148.	46.6	
110.			108.	39.	28.	581.	147.	
1	4	1	22.	1.2				
1.0	0.333	0.0832		0.578	0.1445			
516.			1.	309.	16.1	404.	17.	
1159.			24.5	757.	29.1	12460.	313.	
333.			19.	103.	56.	1433.	276.	
107.			6.2	22.6	15.	345.	91.	
395.			20.2	118.	60.	1639.	296.	
1	4	1	13.5	1.2				
107.			144.	5.3	43.6	2368.	63.	
18.7			43.8	97.5	190.	995.	414.	
433.			150.	83.3	59.7	1554.	894.	
154.			46.	26.	16.	381.	280.	
477.			90.	178.	80.	1845.	966.	
1	4	1	21.9	1.2				
48.			1.	1.	2.8	15.1	11.9	
85.5			1.4	1.	3.6	17.1	21.6	
82.			3.	1.	6.6	46.5	5.3	
30.3			1.	1.	1.4	17.4	1.4	
90.			1.	3.	8.	50.	7.	
1	4	1	25.7	1.2				
4.2			1.	1.	1.9	11.4	4.7	
1.7			1.	1.	3.7	17.6	19.2	
71.			2.2	1.	2.7	40.	10.1	
26.			1.	1.	1.	15.	2.1	
81.			2.3	1.	3.5	43.	13.	
3	5	1	71.1	1.2				
2780000.	35000.	60000.						
8.4	12.22	12.22		4.39	4.39			
361.	191.	241.		7321.	21820.	6314.		
2605.	822.	2198.		43980.	12970.	5034.		
1152.	633.	640.		5213.	13660.	31640.		
250.	222.	133.		1138.	2815.	11180.		
1446.	664.	789.		6740.	16870.	33150.		
3	5	1	71.	1.2				
587.	8.6	331.		4285.	15830.	536.		

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4528.	401.	59.	73.	4416.	20040.
1423.	119.	192.	5602.	14920.	6018.
300.	25.	60.	1934.	5146.	1242.
1766.	147.	210.	5945.	15690.	7437.
5					
1	1				
1	1	3			
2	1	2			
3	1	4			
4	1	4	5		

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LR115 23

B-3

*** PIPE SUPPORT ANALYSIS PROGRAM - WRITTEN ON MAY 10, 1976 ***

THERE ARE 9 SUPPORTS TO BE ANALYZED IN THIS RUN
5 LOAD CASES WILL BE READ

THE HEADING FOR THIS RUN IS:

* MAIN STEAM ISOLATED MODEL + SPECIAL SUPPORTS - 5/10/77 CONFIG.

THE FOLLOWING MATERIAL PROPERTIES ARE READY FOR USE

MATERIAL	E	SY	SU
1	27800000.0	36000.000	58000.000
2	27800000.0	50000.000	70000.000
3	27800000.0	35000.000	60000.000

84

THE FOLLOWING GEOMETRIES ARE READY FOR USE

GEOMETRY	AREA	ZS	ZW	RS	RW
1	0.2500	0.04167	0.01042	0.28900	0.07230
2	0.7500	0.25000	0.04687	0.57800	0.10840
3	1.5000	0.50000	0.18750	0.57800	0.21680
4	1.0000	0.33300	0.08320	0.57800	0.14450
5	8.4000	12.22000	12.22000	4.39000	4.39000

B-5

SUPPORT DATA FOLLOWS:
LENGTH IS IN INCHES

SUPPORT	LENGTH	FIXITY	MATERIAL	GEOMETRY
1	22.0000	1.2000	2	2
2	10.0000	1.2000	2	2
3	22.0000	1.2000	1	3
4	22.0000	1.2000	1	4
5	13.5000	1.2000	1	4
6	21.9000	1.2000	1	4
7	25.7000	1.2000	1	4
8	71.1000	1.2000	3	5
9	71.0000	1.2000	3	5

THE FOLLOWING LOADS WERE INPUT

P1,SV,WV ARE IN UNITS OF LBS.
T1,SM,WM ARE IN UNITS OF IN.-LB.

SUPPORT	LCAD	CASE	P1	SV	WV	T1	SM	WM
1	1	1	68.50	2.20	16.70	81.00	244.00	349.00
1	2	2	100.00	17.80	133.00	27.40	2202.00	241.00
1	3	3	162.00	4.00	12.00	5.20	229.00	55.30
1	4	4	56.00	1.40	3.10	1.70	63.00	19.50
1	5	5	176.00	4.30	14.60	6.20	271.00	59.00
2	1	1	18.10	27.80	18.80	63.40	385.00	244.00
2	2	2	24.40	99.20	8.70	33.60	88.60	806.00
2	3	3	91.50	31.80	115.00	22.60	1730.00	287.00
2	4	4	16.00	4.90	30.80	8.30	460.00	45.10
2	5	5	100.00	34.00	173.00	31.00	2593.00	310.00
3	1	1	601.00	5.50	436.50	44.60	6436.00	110.00
3	2	2	954.00	44.00	558.00	6.60	10110.00	622.00
3	3	3	90.00	10.00	33.70	26.30	504.00	135.00
3	4	4	27.80	3.30	9.80	5.40	148.00	46.60
3	5	5	110.00	108.00	39.00	28.00	581.00	147.00
4	1	1	516.00	1.00	309.00	16.10	404.00	17.00
4	2	2	1159.00	24.50	757.00	29.10	12460.00	313.00
4	3	3	333.00	19.00	103.00	56.00	1433.00	276.00
4	4	4	107.00	6.20	22.60	15.00	345.00	91.00
4	5	5	395.00	20.20	118.00	60.00	1639.00	296.00
5	1	1	107.00	144.00	5.30	43.60	2368.00	63.00
5	2	2	18.70	43.80	97.50	190.00	995.00	414.00
5	3	3	433.00	150.00	83.30	59.70	1554.00	894.00
5	4	4	154.00	46.00	26.00	16.00	381.00	280.00
5	5	5	477.00	90.00	178.00	80.00	1845.00	966.00
6	1	1	48.00	1.00	1.00	2.80	15.10	11.90
6	2	2	85.50	1.40	1.00	3.60	17.10	21.60
6	3	3	82.00	3.00	1.00	6.60	46.50	5.30
6	4	4	30.30	1.00	1.00	1.40	17.40	1.40
6	5	5	90.00	1.00	3.00	8.00	50.00	7.00
7	1	1	4.20	1.00	1.00	1.90	11.40	4.70
7	2	2	1.70	1.00	1.00	3.70	17.60	19.20
7	3	3	71.00	2.20	1.00	2.70	40.00	10.10
7	4	4	26.00	1.00	1.00	1.00	15.00	2.10
7	5	5	81.00	2.30	1.00	3.50	43.00	13.00
8	1	1	361.00	191.00	241.00	7321.00	21820.00	6314.00
8	2	2	2605.00	822.00	2198.00	43980.00	12970.00	5034.00
8	3	3	1152.00	633.00	640.00	5213.00	13660.00	31640.00
8	4	4	250.00	222.00	133.00	1138.00	2815.00	11180.00
8	5	5	1446.00	664.00	789.00	6740.00	16870.00	33150.00
9	1	1	587.00	8.60	331.00	4285.00	15830.00	536.00
9	2	2	4528.00	401.00	59.00	73.00	4416.00	20040.00
9	3	3	1423.00	119.00	192.00	5602.00	14920.00	6018.00
9	4	4	300.00	25.00	60.00	1934.00	5146.00	1242.00
9	5	5	1766.00	147.00	210.00	5945.00	15690.00	7437.00

COMBINED LOAD DATA FOLLOWS

COMBINED LOAD SET 1
 LIMIT CONDITION NUMBER IS 1
 LOAD CASES COMBINED FOR THIS SET ARE 1 0 0 0 0

COMBINED LOAD SET 2
 LIMIT CONDITION NUMBER IS 1
 LOAD CASES COMBINED FOR THIS SET ARE 1 3 0 0 0

COMBINED LOAD SET 3
 LIMIT CONDITION NUMBER IS 2
 LOAD CASES COMBINED FOR THIS SET ARE 1 2 0 0 0 ✓

COMBINED LOAD SET 4
 LIMIT CONDITION NUMBER IS 3
 LOAD CASES COMBINED FOR THIS SET ARE 1 4 0 0 0

COMBINED LOAD SET 5
 LIMIT CONDITION NUMBER IS 4
 LOAD CASES COMBINED FOR THIS SET ARE 1 4 5 0 0

THE FOLLOWING TABLE LISTS THE COMBINED LOADS

SUPPORT	COMBINATION	P1	SV	WV	T1	SM	WM
1	1	68.500	2.300	16.700	81.000	244.000	349.000
1	2	230.500	6.300	28.700	86.200	473.000	404.300
1	3	168.500	20.100	149.700	108.400	2446.000	590.000
1	4	124.500	3.700	19.800	82.700	307.000	368.500
1	5	300.500	8.000	34.400	88.900	578.000	427.500
2	1	18.100	27.800	18.800	63.400	385.000	244.000
2	2	109.600	59.600	133.800	86.000	2115.000	531.000
2	3	42.500	127.000	27.500	97.000	473.600	1050.000
2	4	34.100	32.700	49.600	71.700	845.000	289.100
2	5	134.100	66.700	222.600	102.700	3438.000	599.100
3	1	601.000	5.500	436.500	44.600	6436.000	110.000
3	2	691.000	15.500	470.200	70.900	6940.000	245.000
3	3	1555.000	49.500	994.500	51.200	16546.000	732.000
3	4	628.800	8.800	446.300	50.000	6584.000	156.600
3	5	738.800	116.800	485.300	78.000	7165.000	303.600
4	1	516.000	1.000	309.000	16.100	404.000	17.000
4	2	849.000	20.000	412.000	72.100	1837.000	293.000
4	3	1675.000	25.500	1066.000	45.200	12864.000	330.000
4	4	623.000	7.200	331.600	31.100	749.000	108.000
4	5	1018.000	27.400	449.600	91.100	2388.000	404.000
5	1	107.000	144.000	5.300	43.600	2368.000	63.000
5	2	540.000	294.000	88.600	103.300	3922.000	957.000
5	3	125.700	187.800	102.800	233.600	3363.000	477.000
5	4	261.000	190.000	31.300	59.600	2749.000	343.000
5	5	738.000	280.000	209.300	139.600	4594.000	1309.000
6	1	48.000	1.000	1.000	2.800	15.100	11.900
6	2	130.000	4.000	2.000	9.400	61.600	17.200

B-7

F15 23

B-8

6	3	131.500	2.400	2.000	6.400	32.200	33.500
6	4	78.300	2.000	2.000	4.200	32.500	13.300
6	5	168.300	3.000	5.000	12.200	82.500	20.300
7	1	4.200	1.000	1.000	1.900	11.400	4.700
7	2	75.200	3.200	2.000	4.600	51.400	14.800
7	3	5.900	2.000	2.000	5.600	29.000	23.900
7	4	30.200	2.000	2.000	2.900	26.400	6.800
7	5	111.200	4.300	3.000	6.400	69.400	19.800
8	1	351.000	191.000	241.000	7321.000	21820.000	6314.000
8	2	1513.000	824.000	881.000	12534.000	35480.000	37954.000
8	3	2956.000	1013.000	2439.000	51301.000	34790.000	11348.000
8	4	611.000	413.000	374.000	8459.000	24635.000	17494.000
8	5	2057.000	1077.000	1163.000	15199.000	41505.000	50644.000
9	1	587.000	3.000	331.000	4285.000	15830.000	536.000
9	2	2010.000	127.600	523.000	9887.000	30750.000	6554.000
9	3	5115.000	409.600	390.000	4358.000	20246.000	20576.000
9	4	887.000	33.600	391.000	6219.000	20976.000	1778.000
9	5	2653.000	180.600	601.000	12164.000	36666.000	9215.000

LTR115 23

8-9

THE LIMIT FACTORS USED IN THE CALCULATIONS FOLLOW

THERE ARE FOUR LIMIT CONDITIONS PROGRAMED:

1. DESIGN, NORMAL, AND UPSET CONDITIONS
2. RESTRAINT OF FREE END DISPLACEMENTS
3. EMERGENCY CONDITIONS
4. FAULTED CONDITIONS

MATERIAL	LIMIT CONDITION	FACTOR
1	1	1.0000
1	2	3.0000
1	3	1.3330
1	4	1.8796
2	1	1.0000
2	2	3.0000
2	3	1.3330
2	4	1.6333
3	1	1.0000
3	2	3.0000
3	3	1.3330
3	4	2.0000

THE FOLLOWING TABLE LISTS TENSION STRESS VALUES

NOTE - CLS = COMBINED LOAD SET

LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
STRESSES AND LIMITS ARE IN PSI.

SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	68.500	91.333	29999.996	0.0030
1	2	230.500	307.333	29999.996	0.0102
1	3	168.500	224.667	89999.938	0.0025
1	4	124.500	166.000	39989.969	0.0042
1	5	300.500	400.667	43999.988	0.0082
2	1	18.100	24.133	29999.996	0.0008
2	2	109.600	146.133	29999.996	0.0049
2	3	42.500	56.667	89999.938	0.0006
2	4	34.100	45.467	39989.969	0.0011
2	5	134.100	178.800	48999.988	0.0036
3	1	601.000	400.667	21599.996	0.0185
3	2	691.000	460.667	21599.996	0.0213
3	3	1555.000	1036.667	64799.988	0.0160
3	4	628.800	419.200	28792.777	0.0146
3	5	738.800	492.533	40599.980	0.0121
4	1	516.000	516.000	21599.996	0.0239
4	2	849.000	849.000	21599.996	0.0393
4	3	1675.000	1675.000	64799.988	0.0258
4	4	623.000	623.000	28792.777	0.0216
4	5	1018.000	1018.000	40599.980	0.0251
5	1	107.000	107.000	21599.996	0.0050
5	2	540.000	540.000	21599.996	0.0250
5	3	125.700	125.700	64799.988	0.0019
5	4	261.000	261.000	28792.777	0.0091
5	5	738.000	738.000	40599.980	0.0182
6	1	48.000	48.000	21599.996	0.0022
6	2	130.000	130.000	21599.996	0.0060
6	3	133.500	133.500	64799.988	0.0021
6	4	78.300	78.300	28792.777	0.0027
6	5	168.300	168.300	40599.980	0.0041
7	1	4.200	4.200	21599.996	0.0002
7	2	75.200	75.200	21599.996	0.0035
7	3	5.900	5.900	64799.988	0.0001
7	4	30.200	30.200	28792.777	0.0010
7	5	111.200	111.200	40599.980	0.0027
8	1	361.000	42.976	20999.996	0.0020
8	2	513.000	180.119	20999.996	0.0086
8	3	2966.000	353.095	62999.988	0.0056
8	4	611.000	72.738	27992.977	0.0026
8	5	2057.000	244.881	41999.992	0.0058
9	1	587.000	69.881	20999.996	0.0033
9	2	2010.000	239.286	20999.996	0.0114
9	3	5115.000	608.928	62999.988	0.0097
9	4	887.000	105.595	27992.977	0.0038
9	5	2653.000	315.833	41999.992	0.0075

B-10

THE FOLLOWING TABLE LISTS SHEAR STRESSES DUE TO LOADS IN THE DIRECTION OF THE WEAK BENDING AXIS

NOTE - CLS = COMBINED LOAD SET
LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
STRESSES AND LIMITS ARE IN PSI.

SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	16.700	22.267	19999.996	0.0011
1	2	28.700	38.267	19999.996	0.0019
1	3	149.700	199.600	59999.988	0.0033
1	4	19.800	26.400	26659.977	0.0010
1	5	34.400	45.867	32666.656	0.0014
2	1	18.800	25.067	19999.996	0.0013
2	2	133.800	178.400	19999.996	0.0089
2	3	27.500	36.667	59999.988	0.0006
2	4	49.600	66.133	26659.977	0.0025
2	5	222.600	296.800	32666.656	0.0091
3	1	436.500	291.000	14399.996	0.0202
3	2	470.200	313.467	14399.996	0.0218
3	3	994.500	663.000	43199.988	0.0153
3	4	446.300	297.533	19195.184	0.0155
3	5	485.300	323.533	27066.648	0.0120
4	1	309.000	309.000	14399.996	0.0215
4	2	412.000	412.000	14399.996	0.0286
4	3	1066.000	1066.000	43199.988	0.0247
4	4	331.600	331.600	19195.184	0.0173
4	5	449.600	449.600	27066.648	0.0166
5	1	5.300	5.300	14399.996	0.0004
5	2	88.600	88.600	14399.996	0.0062
5	3	102.800	102.800	43199.988	0.0024
5	4	31.300	31.300	19195.184	0.0016
5	5	209.300	209.300	27066.648	0.0077
6	1	1.000	1.000	14399.996	0.0001
6	2	2.000	2.000	14399.996	0.0001
6	3	2.000	2.000	43199.988	0.0000
6	4	2.000	2.000	19195.184	0.0001
6	5	5.000	5.000	27066.648	0.0002
7	1	1.000	1.000	14399.996	0.0001
7	2	2.000	2.000	14399.996	0.0001
7	3	2.000	2.000	43199.988	0.0000
7	4	2.000	2.000	19195.184	0.0001
7	5	3.000	3.000	27066.648	0.0001
8	1	241.000	28.690	13999.996	0.0020
8	2	881.000	104.881	13999.996	0.0075
8	3	2439.000	290.357	41999.988	0.0069
8	4	374.000	44.524	18661.980	0.0024
8	5	1163.000	138.452	27999.992	0.0049
9	1	331.000	39.405	13999.996	0.0028
9	2	523.000	62.262	13999.996	0.0044
9	3	390.000	46.429	41999.988	0.0011
9	4	391.000	46.548	18661.980	0.0025
9	5	601.000	71.548	27999.992	0.0026

B-11

LR15 23

THE FOLLOWING TABLE LISTS SHEAR STRESSES DUE TO LOADS IN THE DIRECTION OF THE STRONG BENDING AXIS

NOTE - CLS = COMBINED LOAD SET
LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
STRESSES AND LIMITS ARE IN PSI.

SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	2.300	3.067	19999.996	0.0002
1	2	6.300	8.400	19999.996	0.0004
1	3	20.100	26.800	59999.988	0.0004
1	4	3.700	4.933	26659.977	0.0002
1	5	8.000	10.667	32666.656	0.0003
2	1	27.800	37.067	19999.996	0.0019
2	2	59.600	79.467	19999.996	0.0040
2	3	127.000	169.333	59999.988	0.0028
2	4	32.700	43.600	26659.977	0.0016
2	5	66.700	88.933	32666.656	0.0027
3	1	5.500	3.667	14399.996	0.0003
3	2	15.500	10.333	14399.996	0.0007
3	3	49.500	33.000	43199.988	0.0008
3	4	8.800	5.867	19195.184	0.0003
3	5	116.800	77.867	27066.648	0.0029
4	1	1.000	1.000	14399.996	0.0001
4	2	20.000	20.000	14399.996	0.0014
4	3	25.500	25.500	43199.988	0.0006
4	4	7.200	7.200	19195.184	0.0004
4	5	27.400	27.400	27066.648	0.0010
5	1	144.000	144.000	14399.996	0.0100
5	2	294.000	294.000	14399.996	0.0204
5	3	187.800	187.800	43199.988	0.0043
5	4	190.000	190.000	19195.184	0.0059
5	5	280.000	280.000	27066.648	0.0103
6	1	1.000	1.000	14399.996	0.0001
6	2	4.000	4.000	14399.996	0.0003
6	3	2.400	2.400	43199.988	0.0001
6	4	2.000	2.000	19195.184	0.0001
6	5	3.000	3.000	27066.648	0.0001
7	1	1.000	1.000	14399.996	0.0001
7	2	3.200	3.200	14399.996	0.0002
7	3	2.000	2.000	43199.988	0.0000
7	4	2.000	2.000	19195.184	0.0001
7	5	4.300	4.300	27066.648	0.0002
8	1	191.000	22.738	13999.996	0.0016
8	2	824.000	98.095	13999.996	0.0070
8	3	1013.000	120.595	41999.988	0.0029
8	4	413.000	49.167	18661.980	0.0026
8	5	1077.000	128.214	27999.992	0.0046
9	1	8.600	1.024	13999.996	0.0001
9	2	127.600	15.190	13999.996	0.0011
9	3	409.600	48.762	41999.988	0.0012
9	4	33.600	4.000	18661.980	0.0002
9	5	180.600	21.500	27999.992	0.0008

B-12

LTR115 23

THE FOLLOWING TABLE LISTS COMPRESSIVE STRESSES

NOTE - CLS = COMBINED LOAD SET
 LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
 STRESSES AND LIMITS ARE IN PSI.

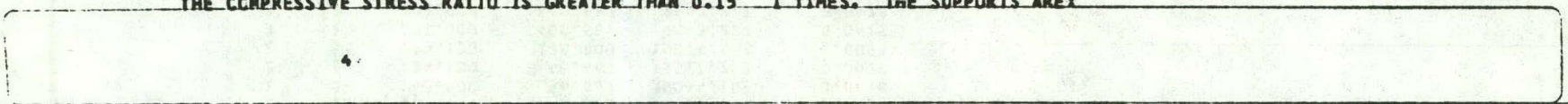
SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	68.500	91.333	2413.510	0.0378
1	2	230.500	307.333	2413.510	0.1273
1	3	168.500	224.667	7240.527	0.0310
1	4	124.500	166.000	3217.206	0.0516
1	5	300.500	400.667	3942.065	0.1016
2	1	18.100	24.133	11681.367	0.0021
2	2	109.600	146.133	11681.367	0.0125
2	3	42.500	56.667	35044.102	0.0016
2	4	34.100	45.467	15571.250	0.0029
2	5	134.100	178.800	19079.563	0.0094
3	1	601.000	400.667	9647.227	0.0415
3	2	691.000	460.667	9647.227	0.0478
3	3	1555.000	1036.667	28941.680	0.0358
3	4	628.800	419.200	12859.742	0.0326
3	5	738.800	492.533	18133.207	0.0272
4	1	516.000	516.000	4288.695	0.1203
4	2	849.000	849.000	4288.695	0.1980
4	3	1675.000	1675.000	12866.086	0.1302
4	4	623.000	623.000	5716.824	0.1090
4	5	1018.000	1018.000	8061.156	0.1263
5	1	107.000	107.000	11056.637	0.0097
5	2	540.000	540.000	11056.637	0.0488
5	3	125.700	125.700	33169.910	0.0038
5	4	261.000	261.000	14738.484	0.0177
5	5	738.000	738.000	20782.375	0.0355
6	1	48.000	48.000	4327.957	0.0111
6	2	130.000	130.000	4327.957	0.0300
6	3	133.500	133.500	12983.871	0.0103
6	4	78.300	78.300	5769.160	0.0136
6	5	168.300	168.300	8134.953	0.0207
7	1	4.200	4.200	3142.715	0.0013
7	2	75.200	75.200	3142.715	0.0239
7	3	5.900	5.900	9428.145	0.0006
7	4	30.200	30.200	4189.234	0.0072
7	5	111.200	111.200	5907.137	0.0188
8	1	361.000	42.976	20052.395	0.0021
8	2	1513.000	180.119	20052.395	0.0090
8	3	2966.000	353.095	60157.184	0.0059
8	4	611.000	72.738	26729.824	0.0027
8	5	2057.000	244.881	40104.789	0.0061
9	1	587.000	69.881	20053.988	0.0035
9	2	2010.000	239.286	20053.988	0.0119
9	3	5115.000	608.928	60161.965	0.0101
9	4	887.000	105.595	26731.949	0.0040
9	5	2653.000	315.833	40107.977	0.0079

B-13

115 23

8-14

THE COMPRESSIVE STRESS RATIO IS GREATER THAN 0.15 1 TIMES. THE SUPPORTS ARE:



LTR115 23

THE FOLLOWING TABLE LISTS BENDING STRESSES DUE TO MOMENTS ABOUT THE WEAK AXIS

NOTE - CLS = COMBINED LOAD SET
 LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
 STRESSES AND LIMITS ARE IN PSI.

SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	349.000	7446.125	37500.000	0.1986
1	2	404.300	8625.980	37500.000	0.2300
1	3	590.000	12588.008	112500.000	0.1119
1	4	368.500	7862.172	49987.469	0.1573
1	5	427.500	9120.973	61249.992	0.1489
2	1	244.000	5205.887	37500.000	0.1388
2	2	531.000	11329.207	37500.000	0.3021
2	3	1050.000	22402.391	112500.000	0.1991
2	4	289.100	6168.121	49987.469	0.1234
2	5	599.100	12782.160	61249.992	0.2087
3	1	110.000	586.667	27000.000	0.0217
3	2	245.000	1306.667	27000.000	0.0484
3	3	732.000	3904.000	81000.000	0.0482
3	4	156.600	835.200	35990.977	0.0232
3	5	303.600	1619.199	50749.984	0.0319
4	1	17.000	204.327	27000.000	0.0076
4	2	293.000	3521.635	27000.000	0.1304
4	3	330.000	3966.347	81000.000	0.0490
4	4	108.000	1298.077	35990.977	0.0361
4	5	404.000	4855.770	50749.984	0.0957
5	1	63.000	757.212	27000.000	0.0280
5	2	957.000	11502.406	27000.000	0.4260
5	3	477.000	5733.172	81000.000	0.0708
5	4	343.000	4122.594	35990.977	0.1145
5	5	1309.000	15733.176	50749.984	0.3100
6	1	11.900	143.029	27000.000	0.0053
6	2	17.200	206.731	27000.000	0.0077
6	3	33.500	402.644	81000.000	0.0050
6	4	13.300	159.856	35990.977	0.0044
6	5	20.300	243.990	50749.984	0.0048
7	1	4.700	56.490	27000.000	0.0021
7	2	14.800	177.885	27000.000	0.0066
7	3	23.900	287.260	81000.000	0.0035
7	4	6.800	81.731	35990.977	0.0023
7	5	19.800	237.981	50749.984	0.0047
8	1	6314.000	516.694	26250.000	0.0197
8	2	37954.000	3105.892	26250.000	0.1183
8	3	11348.000	928.642	78750.000	0.0118
8	4	17494.000	1431.587	34991.227	0.0409
8	5	50644.000	4144.352	52500.000	0.0789
9	1	536.000	43.863	26250.000	0.0017
9	2	6554.000	536.334	26250.000	0.0204
9	3	20576.000	1683.797	78750.000	0.0214
9	4	1778.000	145.499	34991.227	0.0042
9	5	9215.000	754.092	52500.000	0.0144

B-15

LTR 15 25

THE FOLLOWING TABLE LISTS BENDING STRESSES DUE TO MOMENTS ABOUT THE STRONG AXIS

NOTE - CLS = COMBINED LOAD SET
 LOADS ARE IN UNITS OF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.
 STRESSES AND LIMITS ARE IN PSI.

SUPPORT	CLS	LOAD	STRESS	LIMIT	RATIO
1	1	244.000	976.000	29999.996	0.0325
1	2	473.000	1892.000	29999.996	0.0631
1	3	2446.000	9784.000	89999.938	0.1087
1	4	307.000	1228.000	39989.969	0.0307
1	5	578.000	2312.000	48999.988	0.0472
2	1	385.000	1540.000	29999.996	0.0513
2	2	2115.000	8460.000	29999.996	0.2820
2	3	473.600	1894.399	39999.938	0.0210
2	4	845.000	3380.000	39989.969	0.0845
2	5	3438.000	13752.000	48999.988	0.2807
3	1	6436.000	12872.000	21599.996	0.5959
3	2	6940.000	13880.000	21599.996	0.6426
3	3	16546.000	33092.000	44799.988	0.5107
3	4	6584.000	13168.000	28792.777	0.4573
3	5	7165.000	14330.000	40599.980	0.3530
4	1	404.000	1213.213	21599.996	0.0562
4	2	1837.000	5516.516	21599.996	0.2554
4	3	12864.000	38630.637	64799.988	0.5962
4	4	749.000	2249.250	28792.777	0.0781
4	5	2388.000	7171.172	40599.980	0.1766
5	1	2368.000	7111.109	21599.996	0.3292
5	2	3922.000	11777.777	21599.996	0.5453
5	3	3363.000	10099.098	64799.988	0.1559
5	4	2749.000	8255.254	28792.777	0.2867
5	5	4594.000	13795.797	40599.980	0.3398
6	1	15.100	45.345	21599.996	0.0021
6	2	61.600	184.985	21599.996	0.0086
6	3	32.200	96.697	64799.988	0.0015
6	4	32.500	97.598	28792.777	0.0034
6	5	82.500	247.748	40599.980	0.0061
7	1	11.400	34.234	21599.996	0.0016
7	2	51.400	154.354	21599.996	0.0071
7	3	29.000	87.087	64799.988	0.0013
7	4	26.400	79.279	28792.777	0.0028
7	5	69.400	208.408	40599.980	0.0051
8	1	21820.000	1785.597	20999.996	0.0850
8	2	35480.000	2903.437	20999.996	0.1383
8	3	34790.000	2846.972	62999.988	0.0452
8	4	24635.000	2015.958	27992.977	0.0720
8	5	41505.000	3396.481	41999.992	0.0809
9	1	15830.000	1295.417	20999.996	0.0617
9	2	30750.000	2516.367	20999.996	0.1198
9	3	20246.000	1656.792	62999.988	0.0263
9	4	20976.000	1716.530	27992.977	0.0613
9	5	36666.000	3000.491	41999.992	0.0714

B-16

LR15 23

COMBINED STRESS - COMPRESSIVE - EQUATION 21 USED

ASTERISKS INDICATE WHERE THE COMPRESSIVE STRESS RATIO WAS GREATER THAN 0.15 AND EQUATIONS 19 AND 20 WERE USED

SUPPORT	CLS	TERM 1	TERM 2	TERM 3	TOTAL	LIMIT
1	1	0.0378	0.1986	0.0325	0.2689	1.0000
1	2	0.1273	0.2300	0.0631	0.4204	1.0000
1	3	0.0310	0.1119	0.1087	0.2516	1.0000
1	4	0.0516	0.1573	0.0307	0.2396	1.0000
1	5	0.1016	0.1489	0.0472	0.2977	1.0000
2	1	0.0021	0.1388	0.0513	0.1922	1.0000
2	2	0.0125	0.3021	0.2820	0.5966	1.0000
2	3	0.0016	0.1991	0.0210	0.2218	1.0000
2	4	0.0029	0.1234	0.0845	0.2108	1.0000
2	5	0.0094	0.2087	0.2807	0.4987	1.0000
3	1	0.0415	0.0217	0.5959	0.6592	1.0000
3	2	0.0478	0.0484	0.6426	0.7387	1.0000
3	3	0.0358	0.0482	0.5107	0.5947	1.0000
3	4	0.0326	0.0232	0.4573	0.5131	1.0000
3	5	0.0272	0.0319	0.3530	0.4120	1.0000
4	1	0.1203	0.0076	0.0562	0.1841	1.0000
4	2	*****	*****	*****	*****	1.0000
4	3	0.1302	0.0490	0.5962	0.7753	1.0000
4	4	0.1090	0.0361	0.0781	0.2232	1.0000
4	5	0.1263	0.0957	0.1766	0.3986	1.0000
5	1	0.0097	0.0280	0.3292	0.3669	1.0000
5	2	0.0488	0.4260	0.5453	1.0201	1.0000
5	3	0.0038	0.0708	0.1559	0.2304	1.0000
5	4	0.0177	0.1145	0.2867	0.4190	1.0000
5	5	0.0355	0.3100	0.3398	0.6853	1.0000
6	1	0.0111	0.0053	0.0021	0.0185	1.0000
6	2	0.0300	0.0077	0.0086	0.0463	1.0000
6	3	0.0103	0.0050	0.0015	0.0167	1.0000
6	4	0.0136	0.0044	0.0034	0.0214	1.0000
6	5	0.0207	0.0048	0.0061	0.0316	1.0000
7	1	0.0013	0.0021	0.0016	0.0050	1.0000
7	2	0.0239	0.0066	0.0071	0.0377	1.0000
7	3	0.0006	0.0035	0.0013	0.0055	1.0000
7	4	0.0072	0.0023	0.0028	0.0122	1.0000
7	5	0.0188	0.0047	0.0051	0.0286	1.0000
8	1	0.0021	0.0197	0.0850	0.1069	1.0000
8	2	0.0090	0.1183	0.1383	0.2656	1.0000
8	3	0.0059	0.0118	0.0452	0.0629	1.0000
8	4	0.0027	0.0409	0.0720	0.1157	1.0000
8	5	0.0061	0.0789	0.0809	0.1659	1.0000
9	1	0.0035	0.0017	0.0617	0.0668	1.0000
9	2	0.0119	0.0204	0.1198	0.1522	1.0000
9	3	0.0101	0.0214	0.0263	0.0578	1.0000
9	4	0.0040	0.0042	0.0613	0.0694	1.0000
9	5	0.0079	0.0144	0.0714	0.0937	1.0000

THE COMBINED STRESS TERMS EXCEEDED 1.0 1 TIMES. THE SUPPORTS ARE:

B-19

LR115 23 17

COMBINED STRESS - COMPRESSIVE - EQUATION 19

SUPPORT	CLS	TERM 1	TERM 2	TERM 3	TOTAL	LIMIT
4	2	0.1980	0.1382	0.2198	0.5560	1.0000

LTR115 23 14

B-18

B-19

COMBINED STRESS - COMPRESSIVE - EQUATION 20

SUPPORT	CLS	TERM 1	TERM 2	TERM 3	TOTAL	LIMIT
4	2	0.0393	0.1304	0.2554	0.4251	1.0000

DR 15 23

COMBINED STRESS - TENSION - EQUATION 20 USED

SUPPORT	CLS	TERM 1	TERM 2	TERM 3	TOTAL	LIMIT
1	1	0.0030	0.1986	0.0325	0.2341	1.0000
1	2	0.0102	0.2300	0.0631	0.3033	1.0000
1	3	0.0025	0.1119	0.1087	0.2231	1.0000
1	4	0.0042	0.1573	0.0307	0.1921	1.0000
1	5	0.0082	0.1489	0.0472	0.2043	1.0000
2	1	0.0008	0.1388	0.0513	0.1910	1.0000
2	2	0.0049	0.3021	0.2820	0.5890	1.0000
2	3	0.0006	0.1991	0.0210	0.2208	1.0000
2	4	0.0011	0.1234	0.0845	0.2091	1.0000
2	5	0.0036	0.2087	0.2807	0.4930	1.0000
3	1	0.0185	0.0217	0.5959	0.6362	1.0000
3	2	0.0213	0.0484	0.6426	0.7123	1.0000
3	3	0.0160	0.0482	0.5107	0.5749	1.0000
3	4	0.0146	0.0232	0.4573	0.4951	1.0000
3	5	0.0121	0.0319	0.3530	0.3970	1.0000
4	1	0.0239	0.0076	0.0562	0.0876	1.0000
4	2	0.0393	0.1304	0.2554	0.4251	1.0000
4	3	0.0258	0.0490	0.5962	0.6710	1.0000
4	4	0.0216	0.0361	0.0781	0.1358	1.0000
4	5	0.0251	0.0957	0.1766	0.2974	1.0000
5	1	0.0050	0.0280	0.3292	0.3622	1.0000
5	2	0.0250	0.4260	0.5453	0.9963	1.0000
5	3	0.0019	0.0708	0.1559	0.2286	1.0000
5	4	0.0091	0.1145	0.2867	0.4103	1.0000
5	5	0.0182	0.3100	0.3398	0.6680	1.0000
6	1	0.0022	0.0053	0.0021	0.0096	1.0000
6	2	0.0060	0.0077	0.0086	0.0222	1.0000
6	3	0.0021	0.0050	0.0015	0.0085	1.0000
6	4	0.0027	0.0044	0.0034	0.0106	1.0000
6	5	0.0041	0.0048	0.0061	0.0151	1.0000
7	1	0.0002	0.0021	0.0016	0.0039	1.0000
7	2	0.0035	0.0066	0.0071	0.0172	1.0000
7	3	0.0001	0.0035	0.0013	0.0050	1.0000
7	4	0.0010	0.0023	0.0028	0.0061	1.0000
7	5	0.0027	0.0047	0.0051	0.0126	1.0000
8	1	0.0020	0.0197	0.0850	0.1068	1.0000
8	2	0.0086	0.1183	0.1383	0.2652	1.0000
8	3	0.0056	0.0118	0.0452	0.0626	1.0000
8	4	0.0026	0.0409	0.0720	0.1155	1.0000
8	5	0.0058	0.0789	0.0809	0.1656	1.0000
9	1	0.0033	0.0017	0.0617	0.0667	1.0000
9	2	0.0114	0.0204	0.1198	0.1517	1.0000
9	3	0.0097	0.0214	0.0263	0.0573	1.0000
9	4	0.0038	0.0042	0.0613	0.0693	1.0000
9	5	0.0075	0.0144	0.0714	0.0933	1.0000

B-20

LR115 23 17

APPENDIX C
SUPAN PROGRAM SOURCE LISTING

COMPILER OPTIONS - NAME= MAIN,CPT=00,LINECNT=58,SIZE=CCCC,SCURGE,EPCCIC,NOLIST,NOCK,LCAD,MAP,NCEDIT,NOID,NOXREF

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C **** PROGRAM SUPAK ****
C *** DEVELOPED FOR THE APPLIED MECHANICS BRANCH BY M.E. NITZEL MAY, 1976
C *** PRESENT VERSION PERFORMS FLAT BAR TYPE SUPPORT ANALYSIS
C *** APPENDIX 17 EQUATIONS FOR TENSION, SHEAR, COMPRESSION, BENDING,
C AND COMBINED STRESS ARE USED.
C *** NSUP = NUMBER OF SUPPORTS
C *** MLC = NUMBER OF LOAD CASES
C *** NECESSARY PROPERTIES OF A242 AND A36 CARBON STEEL ARE IN MATERIAL
C BANK
C *** CERTAIN GEOMETRIC PROPERTIES OF 1/4 X 1 AND 3/8 X 2 FLAT BARS ARE
C IN PROGRAM
ISN 0002 EXTERNAL FABEND
ISN 0003 DIMENSION A(10),RS(10),Rw(10),ZS(10),Zw(10),SL(100),SK(100),
1 P1(100,10),SV(100,10),WV(100,10),T1(100,10),SM(100,10),
2 WM(100,10),E(10),SY(10),SU(10),MAT(100),NGEO(100),
3 CP1(100,10),CSV(100,10),CWV(100,10),CT1(100,10),CSM(100,10),
4 CWM(100,10),NLC(100,10),LCC(100,10),FAC(10,4),TENS(100,10,4),
5 SVS(100,10,4),WVS(100,10,4),NCT4(1000),COMPS(100,10,4),NCM(100),
6 BENDS(100,10,4),BENDW(100,10,4),NCT3(1000),NCNT(1000,2),
7 NCNT2(1000),TGTC(100,10),TOTT(100,10),T19C(100,10),T219(100,10),
8 T120(100,10),T120T(100,10),T319(100,10),T20C(100,10),HED(16)
ISN 0004 CALL ERPSET(207,2,0,2,FABEND)
ISN 0005 CALL ECHC
ISN 0006 PI=3.141593
C *** PROPERTY BANK
C *** SUBSCRIPT 1 IMPLIES A36 MATERIAL AND 1/4X1 GEOMETRY
C *** SUBSCRIPT 2 IMPLIES A242 MATERIAL AND 3/8X2 GEOMETRY
ISN 0007 E(1)= 27800000.
ISN 0008 E(2)= 27800000.
ISN 0009 SY(1) = 36000.
ISN 0010 SY(2) = 50000.
ISN 0011 SU(1) = 58000.
ISN 0012 SL(2) = 70000.
ISN 0013 A(1) = 0.250
ISN 0014 A(2) = 0.750
ISN 0015 RS(1) = 0.289
ISN 0016 RS(2) = 0.5780
ISN 0017 Rw(1) = 0.0723
ISN 0018 Pw(2) = 0.1084
ISN 0019 ZS(1)=0.04167
ISN 0020 ZS(2)=0.250
ISN 0021 Zw(1)=0.01042
ISN 0022 Zw(2)=0.04687
ISN 0023 N=2
ISN 0024 NN=2
C *** TITLE PRINT
ISN 0025 WRITE(6,6)
ISN 0026 6 FORMAT('1'//////T15,'*** PIPE SUPPORT ANALYSIS PROGRAM - WRITTEN C
IN MAY 10, 1976 ***'////)
C *** READ CONTROL CARD
ISN 0027 READ(5,1)NSUP,MLC,(HED(I),I=1,16)
ISN 0028 1 FORMAT(2I5,16A4)
ISN 0029 WRITE(6,1053)NSUP,MLC,(HED(I),I=1,16)
ISN 0030 1053 FORMAT(//T15,'THERE ARE',I5,' SUPPORTS TO BE ANALYZED IN THIS RUN'

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LTR 15 23

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1//T15,I5,' LOAD CASES WILL BE READ'///T15,'THE HEADING FOR THIS RU
2N IS:'///T25,16A4//)
C *** READ MATERIAL AND SUPPORT INFORMATION AND LOAD SETS
ISN 0031 DC 10 I=1,NSUP
ISN 0032 READ(5,2)MAT(I),NGEC(I),NCM(I),SL(I),SK(I)
ISN 0033 2 FCRMAT(3I5,2F10.0)
ISN 0034 IF(MAT(I).LE.N)GO TC 20
ISN 0036 N=N+1
ISN 0037 READ(5,3)E(N),SY(N),SU(N)
ISN 0038 3 FCRMAT(3F10.0)
ISN 0039 20 IF(NGEC(I).LE.NN)GC TC 30
ISN 0041 NN=NN+1
ISN 0042 READ(5,4) A(NN),ZS(NN),Zw(NN),RS(NN),RW(NN)
ISN 0043 4 FCRMAT(5F10.0)
ISN 0044 30 IF(N.GT.10)GO TC 40
ISN 0046 IF(NN.GT.10)GO TO 50
ISN 0048 GC TC 6C
ISN 0049 40 WRITE(6,41)N
ISN 0050 41 FCRMAT(/////T15,'MATERIAL NO.',I5,' WAS INPUT - MAX. NO. OF MATERI
LALS IS 10. PROGRAM TERMINATING'//)
GC TC 2C000
ISN 0051 50 WRITE(6,51)NN
ISN 0052 51 FCRMAT(/////T15,'GECMETRY NO.',I5,' WAS INPUT - MAX. NO. OF GEOMETR
IIES IS 10. PROGRAM TERMINATING'//)
ISN 0054 GC TC 2C000
ISN 0055 60 DO 5 J=1,MLC
ISN 0056 READ(5,61) P1(I,J),SV(I,J),WV(I,J),T1(I,J),SM(I,J),WM(I,J)
ISN 0057 61 FCRMAT(6F10.0)
ISN 0058 5 CCNTINUE
ISN 0059 10 CCNTINUE
C *** INTERMEDIATE PRINT STEP
ISN 0060 WRITE(6,70)
ISN 0061 70 FCRMAT(///T15,'THE FCLLOWING MATERIAL PROPERTIES ARE READY FOR USE
1'///T15, MATERIAL E SY SU'//)
DC 71 K=1,N
ISN 0062 71 WRITE(6,72)K,E(K),SY(K),SU(K)
ISN 0063 72 FCRMAT(T17,I3,T24,F10.1,T36,F10.3,T48,F10.3)
ISN 0064 WRITE(6,73)
ISN 0065 73 FCRMAT('1'/////T15,'THE FOLLOWING GECMETRIES ARE READY FOR USE'///
1T15,'GECMETRY AREA ZS Zw RS
2 RW'//)
ISN 0067 DC 75 K=1,NN
ISN 0068 75 WRITE(6,74) K,A(K),ZS(K),Zw(K),RS(K),RW(K)
ISN 0069 74 FCRMAT(T18,I3,T24,F10.4,T35,F10.5,T48,F10.5,T60,F10.5,T72,F10.5)
ISN 0070 WRITE(6,1043)
ISN 0071 1043 FORMAT('1'/////T15,'SUPPORT DATA FOLLOWS:'///T15,'LENGTH IS IN INCHE
IS'///T20,'SUPPORT LENGTH FIXITY MATERIAL GECMETRY'//
2)
ISN 0072 DC 1041 MN=1,NSUP
ISN 0073 1041 WRITE(6,1045)MN,SL(MN),SK(MN),MAT(MN),NGEC(MN)
ISN 0074 1045 FCRMAT(T22,I3,T29,F10.4,T41,F10.4,T56,I3,T68,I3)
ISN 0075 WRITE(6,76)
ISN 0076 76 FORMAT('1'/////T15,'THE FCLLOING LOADS WERE INPUT'///T15,'P1,SV,WV
1 ARE IN UNITS OF LBS.'//T15,'T1,SM,WM ARE IN UNITS OF IN.-LB.'//T15
2,'SUPPORT LCAD CASE P1 SV WV T1
3 SM WM')

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C-2

TR 1.5 23 4

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ISN 0077      DC 80 I=1,NSUP
ISN 0078      DC 78 J=1,MLC
ISN 0079      78 WRITE(6,77)I,J,P1(I,J),SV(I,J),WV(I,J),T1(I,J),SM(I,J),WM(I,J)
ISN 0080      77 FCRMAT(T18,I3,T27,I3,T35,F10.2,T47,F10.2,T59,F10.2,T71,F10.2,T83,F
              11C.2,T95,F10.2)
ISN 0081      80 CCNTINUE
C *** REAC LOAD CASE COMBINATION DATA AND LIMIT CONDITIONS
C *** NOTE - - LIMIT CCNCITICN 1 = DESIGN,NORMAL, AND UPSET LIMITS
C ***          LIMIT CCNCITICN 2 = RESTRAINT OF FREE END DISPLACEMENTS
C ***          LIMIT CCNCITICN 3 = EMERGENCY CONDITIONS
C ***          LIMIT CCNCITICN 4 = FAULTED CONDITIONS
C

ISN 0082      DC 200 I=1,100
ISN 0083      DC 210 J=1,10
ISN 0084      CP1(I,J)=0.0
ISN 0085      CSV(I,J)=0.0
ISN 0086      CWV(I,J)=0.0
ISN 0087      CT1(I,J)=0.0
ISN 0088      CWM(I,J)=0.0
ISN 0089      CSM(I,J)=0.0
ISN 0090      DC 1037 M=1,4
ISN 0091      TENS(I,J,M)=0.0
ISN 0092      SVS(I,J,M)=0.0
ISN 0093      WVS(I,J,M)=0.0
ISN 0094      CCMP(S(I,J,M)=0.0
ISN 0095      BENDS(I,J,M)=0.0
ISN 0096      1037 BENDW(I,J,M)=0.0
ISN 0097      210 CCNTINUE
ISN 0098      200 CCNTINUE
ISN 0099      WRITE(6,201)
ISN 0100      201 FORMAT('1'////T15,'COMBINED LOAD DATA FOLLOWS'//)
ISN 0101      READ(5,81)NCCM
ISN 0102      81 FORMAT(7I5)
ISN 0103      DC 90 I=1,NCOM
ISN 0104      READ(5,81) ILC,NC1,NC2,NC3,NC4,NC5
ISN 0105      IF(NC1.EQ.0) GO TO 150
ISN 0107      K=NC1
ISN 0108      CALL ACC(P1,SV,WV,T1,SM,WM,CP1,CSV,CWV,CT1,CSM,CWM,K,I,NSUP)
ISN 0109      IF(NC2.EQ.0)GO TO 160
ISN 0111      K=NC2
ISN 0112      CALL ACC(P1,SV,WV,T1,SM,WM,CP1,CSV,CWV,CT1,CSM,CWM,K,I,NSUP)
ISN 0113      IF(NC3.EQ.0)GO TO 160
ISN 0115      K=NC3
ISN 0116      CALL ACC(P1,SV,WV,T1,SM,WM,CP1,CSV,CWV,CT1,CSM,CWM,K,I,NSUP)
ISN 0117      IF(NC4.EQ.0)GO TO 160
ISN 0119      K=NC4
ISN 0120      CALL ACC(P1,SV,WV,T1,SM,WM,CP1,CSV,CWV,CT1,CSM,CWM,K,I,NSUP)
ISN 0121      IF(NC5.EQ.0)GO TO 160
ISN 0123      K=NC5
ISN 0124      CALL ACC(P1,SV,WV,T1,SM,WM,CP1,CSV,CWV,CT1,CSM,CWM,K,I,NSUP)
ISN 0125      160 DC 161 M=1,100
ISN 0126      161 LCC(M,I)=ILC
ISN 0127      GC TO 170
ISN 0128      150 WRITE(6,151)
ISN 0129      151 FORMAT(///T15,'*** ERROR - - AT LEAST ONE LOAD CASE MUST BE LISTED
              1 FOR EACH CCMBINATION'//)

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C-3

LTR115 23 17

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ISN 0130      GC TC 2C000
ISN 0131      170 WRITE(6,171)I,ILC,NC1,NC2,NC3,NC4,NC5
ISN 0132      171 FORMAT(/T15,'COMBINED LOAD SET ',I3/T15,'LIMIT CONDITION NUMBER IS
              1',I3/T15,'LOAD CASES COMBINED FOR THIS SET ARE ',5I3/)
ISN 0133      90 CONTINUE
C *** PRINT COMBINED LOADS
ISN 0134      WRITE(6,181)
ISN 0135      181 FORMAT(/T15,'THE FOLLOWING TABLE LISTS THE COMBINED LOADS'//T15,'S
              IUPPERT COMBINATION      P1      SV      WV      T1
              2      SM      WM'//)
ISN 0136      DC 204 I=1,NSUP
ISN 0137      DC 203 J=1,ACCM
ISN 0138      203 WRITE(6,202)I,J,CP1(I,J),CSV(I,J),CwV(I,J),CT1(I,J),CSM(I,J),CWM(I
              1,J)
ISN 0139      202 FORMAT(T17,I3,T27,I3,T37,F10.3,T49,F10.3,T61,F10.3,T73,F10.3,T85,F
              110.3,T97,F10.3)
ISN 0140      204 CONTINUE
C *** CALCULATE LIMIT FACTORS
ISN 0141      DC 215 I=1,N
ISN 0142      FAC(I,1)=1.0
ISN 0143      FAC(I,2)=3.0
ISN 0144      FAC(I,3)=1.333
ISN 0145      FT1=C.60*SY(I)
ISN 0146      FT2=0.50*SU(I)
ISN 0147      IF(FT1.LE.FT2)GO TO 212
ISN 0149      FT=FT2
ISN 0150      GC TO 213
ISN 0151      212 FT=FT1
ISN 0152      213 FF1=1.2*SY(I)/FT
ISN 0153      FF2=0.7*SU(I)/FT
ISN 0154      IF(FF1.LE.FF2) GO TO 218
ISN 0156      FAC(I,4)=FF2
ISN 0157      GC TO 215
ISN 0158      218 FAC(I,4)=FF1
ISN 0159      215 CONTINUE
C *** CALCULATE STRESSES
ISN 0160      MCNT1 = 0
ISN 0161      MCNT2=0
ISN 0162      MCNT3=0
ISN 0163      MCNT4=0
ISN 0164      DC 300 I=1,NSUP
ISN 0165      KK=MAT(I)
ISN 0166      KL=AGEC(I)
C *** TENSION STRESSES
ISN 0167      DC 290 J=1,NCOM
ISN 0168      FT1=0.6*SY(KK)
ISN 0169      FT2=0.5*SU(KK)
ISN 0170      IF(FT1.LE.FT2)GO TO 221
ISN 0172      FT=FT2
ISN 0173      GC TO 222
ISN 0174      221 FT=FT1
ISN 0175      222 JK=LCC(I,J)
ISN 0176      FLIM=          FT*FAC(KK,JK)
ISN 0177      TENS(I,J,3)=FLIM
ISN 0178      SIG=CP1(I,J)/A(KL)
ISN 0179      TENS(I,J,1)=CP1(I,J)

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C-4

LTR115 23

ISN 0180 TENS(I,J,2)=SIG
 ISN 0181 TENS(I,J,4)= SIG/FLIM
 C *** SHEAR STRESSES
 ISN 0182 VLIM= 0.40*SY(KK)*FAC(KK,JK)
 ISN 0183 SVS(I,J,3)=VLIM
 ISN 0184 WVS(I,J,3)=VLIM
 ISN 0185 SVS(I,J,1)=CSV(I,J)
 ISN 0186 WVS(I,J,1)=CWV(I,J)
 ISN 0187 SVS(I,J,2)=CSV(I,J)/A(KL)
 ISN 0188 WVS(I,J,2)=CWV(I,J)/A(KL)
 ISN 0189 SVS(I,J,4)= SVS(I,J,2)/VLIM
 ISN 0190 WVS(I,J,4) = WVS(I,J,2)/VLIM
 C *** BENDING STRESSES
 ISN 0191 BLIMS=0.60*SY(KK)*FAC(KK,JK)
 ISN 0192 BLIMW=0.75*SY(KK)*FAC(KK,JK)
 ISN 0193 BENCS(I,J,3)=BLIMS
 ISN 0194 BENCW(I,J,3)=BLIMW
 ISN 0195 BENCS(I,J,1)=CSM(I,J)
 ISN 0196 BENCW(I,J,1)=CWM(I,J)
 ISN 0197 BENCS(I,J,2)=CSM(I,J)/ZS(KL)
 ISN 0198 BENDS(I,J,4)=BENDS(I,J,2)/BLIMS
 ISN 0199 BENCW(I,J,2)=CWM(I,J)/ZS(KL)
 ISN 0200 BENCW(I,J,4)=BENCW(I,J,2)/BLIMW
 C *** COMPRESSIVE STRESSES
 ISN 0201 CCMP(S,I,J,1)=CPI(I,J)
 ISN 0202 CCMP(S,I,J,2)=CPI(I,J)/A(KL)
 ISN 0203 CSC= SQRT((2.*PI**2.*E(KK))/SY(KK))
 ISN 0204 XX=SK(I)*SL(I)/RW(KL)
 ISN 0205 IF(XX.LT.CSC)GO TO 250
 ISN 0207 FA=(12.*PI**2.*E(KK))/(23.*XX**2.)
 ISN 0208 GC TO 260
 ISN 0209 250 FNUM = (1.0 -(XX**2./(2.*CSC**2.)))*SY(KK)
 ISN 0210 DENCM = (5./3.) + (3.*XX/(8.*CSC)) - (XX**3./(8.*CSC**3.))
 ISN 0211 FA= FNUM/DENCM
 ISN 0212 260 CCMP(S,I,J,3)= FA*FAC(KK,JK)
 ISN 0213 CCMP(S,I,J,4)= CCMP(S,I,J,2)/CCMP(S,I,J,3)
 ISN 0214 IF(CCMP(S,I,J,4).LE.0.15) GO TO 265
 ISN 0216 MCNT1=MCNT1+1
 ISN 0217 NCNT(MCNT1,1)=I
 ISN 0218 NCNT(MCNT1,2)=J
 ISN 0219 265 CCNTINUE
 ISN 0220 IF(JK.NE.4) GO TO 270
 ISN 0222 PCR= (PI**2.*E(KK)*A(KL)*SK(I)*RW(KL)**2.)/SL(I)**2.
 ISN 0223 RAT= CPI(I,J)/PCR
 ISN 0224 IF(RAT.LE.0.67) GO TO 270
 ISN 0226 MCNT2=MCNT2+1
 ISN 0227 NCNT2(MCNT2)=I
 ISN 0228 270 CCNTINUE
 C *** COMBINED STRESS - COMPRESSIVE
 C *** EQUATION 21 TEST
 ISN 0229 IF(CCMP(S,I,J,4).LE.0.15) GO TO 280
 C *** CALCULATE EQ.19 AND 21
 ISN 0231 FPES=((12.*PI**2.*E(KK))/(23.*(SK(I)*SL(I)/RW(KL))**2.))
 1 *FAC(KK,JK)
 ISN 0232 FPEW=((12.*PI**2.*E(KK))/(23.*(SK(I)*SL(I)/RW(KL))**2.))
 1 *FAC(KK,JK)

APR 11 5 23

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ISN 0233      IF(INCM(1).EQ.1)GO TO 274
ISN 0235      IF(INCM(1).EQ.2)GO TO 275
ISN 0237      WRITE(6,271)I
ISN 0238      271 FORMAT(/T15,'AN INCORRECT OPTICN NUMBER FOR C SUB M WAS ENTERED IN
              1 SUPPORT',I5/)
ISN 0239      GC TO 20000
ISN 0240      274 CM=C.85
ISN 0241      GC TO 276
C *** ACTE - IN THE FOLLOWING EQUATION FOR CM THE 2ND TERM IS + BECAUSE
C             A SIMPLE FLAT BAR IS ASSUMED TO HAVE A SINGLE CURVATURE AS THE
C             FIRST BUCKLING MODE
ISN 0242      275 R1=CWM(I,J)/CSM(I,J)
ISN 0243      R2=1./R1
ISN 0244      IF(R1.LT.R2)GO TO 277
ISN 0246      RM=R2
ISN 0247      GC TO 278
ISN 0248      277 RM=R1
ISN 0249      278 CM=C.60 + 0.40*RM
ISN 0250      276 T219(I,J)=CM*BENDW(I,J,2)/((1.-(COMPS(I,J,2)/FPEW))*BENDW(I,J,3))
ISN 0251      T319(I,J)=CM*BENDS(I,J,2)/((1.-(COMPS(I,J,2)/FPES))*BENDS(I,J,3))
ISN 0252      IF(COMPS(I,J,4).LE.1.C)GO TO 3051
ISN 0254      T219(I,J)=CCMPS(I,J,4)
ISN 0255      T319(I,J)=CCMPS(I,J,4)
ISN 0256      3051 T19C(I,J)=CCMPS(I,J,4)+T219(I,J)+T319(I,J)
ISN 0257      T120(I,J)=COMPS(I,J,2)/(0.60*SY(KK)*FAC(KK,JK))
ISN 0258      T20C(I,J)=T120(I,J)+BENDW(I,J,4)+BENDS(I,J,4)
ISN 0259      TCTC(I,J)=1000000.
ISN 0260      IF(T19C(I,J).GT.1.0.OR.T20C(I,J).GT.1.0) GO TO 279
ISN 0262      GC TO 285
ISN 0263      279 MCNT3=MCNT3+1
ISN 0264      NCT3(MCNT3)=I
ISN 0265      GC TO 285
C *** ECLATION 21
ISN 0266      280 TCTC(I,J)= COMPS(I,J,4) + BENDW(I,J,4) + BENDS(I,J,4)
ISN 0267      IF(TOTC(I,J).LE.1.0) GO TO 285
ISN 0269      MCNT3=MCNT3+1
ISN 0270      NCT3(MCNT3)=I
C *** COMBINED STRESS-TENSION
ISN 0271      285 T120T(I,J)=TENS(I,J,2)/(0.60*SY(KK)*FAC(KK,JK))
ISN 0272      TCTT(I,J)=T120T(I,J)+BENDW(I,J,4)+BENDS(I,J,4)
ISN 0273      IF(TOTT(I,J).LE.1.0)GC TO 290
ISN 0275      MCNT4=MCNT4+1
ISN 0276      NCT4(MCNT4)=I
ISN 0277      290 CONTINUE
ISN 0278      300 CONTINUE
C *** END OF CURRENTLY PROGRAMMED CALCULATIONS
C *** BEGIN FINAL PRINT SECTION
ISN 0279      305 CSL=1.0
ISN 0280      WRITE(6,306)
ISN 0281      306 FORMAT('1'////T15,'THE LIMIT FACTORS USED IN THE CALCULATIONS FOLL
              1CM'//T15,'THERE ARE FOUR LIMIT CONDITIONS PROGRAMED:'//T20,'1. DE
              2SIGN,NORMAL,AND UPSET CONDITIONS'//T20,'2. RESTRAINT OF FREE END C
              3DISPLACEMENTS'//T20,'3. EMERGENCY CONDITIONS'//T20,'4. FAULTED COND
              4ITIONS'////T15,'MATERIAL LIMIT CONDITION FACTOR'//)
ISN 0282      DC 310 I=1,N
ISN 0283      DC 307 J=1,4

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LFR115 23

ISN 0284 307 WRITE(6,308)I,J,FAC(1,J)
 ISN 0285 308 FCRMAT(T17,I3,T32,I3,T42,F10.4)
 ISN 0286 310 CCNTINUE
 ISN 0287 311 FCRMAT(/T15,'NOTE - CLS = COMBINED LOAD SET'/T22,'LOADS ARE IN UNI
 ITS CF LB. EXCEPT WHEN TABLE IS FOR BENDING VALUES, THEN IN.-LB.'/
 T22,'STRESSES AND LIMITS ARE IN PSI.'///T15,'SUPPORT CLS LOAD
 3 STRESS LIMIT RATIO'/)
 ISN 0288 312 FORMAT(T18,I3,T24,I3,T29,F10.3,T41,F10.3,T53,F10.3,T65,F10.4)
 ISN 0289 WRITE(6,313)
 ISN 0290 313 FCRMAT('1'///T15,'THE FOLLOWING TABLE LISTS TENSION STRESS VALUES
 1'/)
 ISN 0291 WRITE(6,311)
 ISN 0292 DC 315 I=1,NSUP
 ISN 0293 DC 316 J=1,NCOM
 ISN 0294 316 WRITE(6,312)I,J,(TENS(I,J,M),M=1,4)
 ISN 0295 315 CCNTINUE
 ISN 0296 WRITE(6,317)
 ISN 0297 317 FCRMAT('1'///T15,'THE FOLLOWING TABLE LISTS SHEAR STRESSES DUE TO
 1 LOADS IN THE DIRECTION OF THE WEAK BENDING AXIS'/)
 ISN 0298 WRITE(6,311)
 ISN 0299 DC 320 I=1,NSUP
 ISN 0300 DC 321 J=1,NCOM
 ISN 0301 321 WRITE(6,312)I,J,(WVS(I,J,M),M=1,4)
 ISN 0302 320 CCNTINUE
 ISN 0303 WRITE(6,323)
 ISN 0304 323 FCRMAT('1'///T15,'THE FOLLOWING TABLE LISTS SHEAR STRESSES DUE TO
 1 LOADS IN THE DIRECTION OF THE STRONG BENDING AXIS'/)
 ISN 0305 WRITE(6,311)
 ISN 0306 DC 330 I=1,NSUP
 ISN 0307 DC 329 J=1,NCOM
 ISN 0308 329 WRITE(6,312)I,J,(SVS(I,J,M),M=1,4)
 ISN 0309 330 CCNTINUE
 ISN 0310 WRITE(6,331)
 ISN 0311 331 FCRMAT('1'///T15,'THE FOLLOWING TABLE LISTS COMPRESSIVE STRESSES'
 1'/)
 ISN 0312 WRITE(6,311)
 ISN 0313 DC 340 I=1,NSUP
 ISN 0314 DC 339 J=1,NCOM
 ISN 0315 339 WRITE(6,312)I,J,(CCMPS(I,J,M),M=1,4)
 ISN 0316 340 CCNTINUE
 ISN 0317 IF(MCNT1.EQ.0)GC TC 350
 ISN 0319 WRITE(6,341)MCNT1
 ISN 0320 341 FCRMAT(///T15,'THE COMPRESSIVE STRESS RATIO IS GREATER THAN 0.15'
 1,14,' TIMES. THE SUPPORTS ARE:'/)
 ISN 0321 WRITE(6,342)(NCNT(I,1),I=1,MCNT1)
 ISN 0322 342 FORMAT(T25,10I5)
 ISN 0323 350 IF(MCNT2.EQ.0)GC TC 360
 ISN 0325 WRITE(6,351)MCNT2
 ISN 0326 351 FORMAT(///T15,'THE AXIAL COMPRESSIVE LOAD EXCEEDS 0.67*CRITICAL B
 UCKLING LOAD',14,' TIMES. THE SUPPORTS ARE:'/)
 ISN 0327 WRITE(6,342)(NCNT2(I),I=1,MCNT2)
 ISN 0328 360 WRITE(6,361)
 ISN 0329 361 FCRMAT('1'///T15,'THE FOLLOWING TABLE LISTS BENDING STRESSES DUE
 1 TO MOMENTS ABOUT THE WEAK AXIS'/)
 ISN 0330 WRITE(6,311)
 ISN 0331 CC 370 I=1,NSUP

C-7

LTR115 23

ISN 0332 DC 369 J=1,NCOM
 ISN 0333 369 WRITE(6,312)I,J,(BENCH(I,J,M),M=1,4)
 ISN 0334 370 CCNTINUE
 ISN 0335 WRITE(6,371)
 ISN 0336 371 FORMAT('1'////T15,'THE FCLLOWING TABLE LISTS BENDING STRESSES DUE
 LTC MOMENTS ABOUT THE STRONG AXIS'/)
 ISN 0337 WRITE(6,311)
 ISN 0338 CC 380 I=1,NSUP
 ISN 0339 CC 379 J=1,NCOM
 ISN 0340 379 WRITE(6,312)I,J,(BENDS(I,J,M),M=1,4)
 ISN 0341 380 CCNTINUE
 ISN 0342 381 FORMAT(////T15,'SUPPORT CLS TERM 1 TERM 2 TERM 3
 1 TCTAL LIMIT'/)
 ISN 0343 382 FORMAT(T17,I3,T24,I3,T29,F10.4,T41,F10.4,T53,F10.4,T65,F10.4,T77,
 IF10.4)
 ISN 0344 WRITE(6,386)
 ISN 0345 386 FCRMAT('1'////T15,'CCMBINED STRESS - CCOMPRESSIVE - EQUATION 21 USE
 1D'//T15,'ASTERISKS INCICATE WERE THE CCOMPRESSIVE STRESS RATIO WAS
 2 GREATER THAN 0.15 ANC EQUATICNS 19 AND 20 WERE USED'/)
 ISN 0346 WRITE(6,381)
 ISN 0347 DC 400 I=1,NSUP
 ISN 0348 CC 390 J=1,NCOM
 ISN 0349 IF(CMPS(I,J,4).GT.0.15)GO TO 385
 ISN 0351 WRITE(6,382)I,J,CMPS(I,J,4),EENDW(I,J,4),BENDS(I,J,4),TOTC(I,J),
 ICSL
 ISN 0352 GC TC 390
 ISN 0353 385 WRITE(6,382)I,J,TCTC(I,J),TOTC(I,J),TOTC(I,J),TOTC(I,J),CSL
 ISN 0354 390 CCNTINUE
 ISN 0355 400 CCNTINUE
 ISN 0356 IF(MCNT3.EQ.0)GC TC 410
 ISN 0358 WRITE(6,403)MCNT3
 ISN 0359 403 FORMAT(////T15,'THE COMBINED STRESS TERMS EXCEEDED 1.0',I5,' TIMES
 1. THE SUPPORTS ARE: '/')
 ISN 0360 WRITE(6,342)(NCT3(I),I=1,MCNT3)
 ISN 0361 410 IF(MCNT1.EQ.0)GO TO 500
 ISN 0363 WRITE(6,401)
 ISN 0364 401 FORMAT('1'////T15,'CCMBINED STRESS - COMPRESSIVE - EQUATION 19'/)
 ISN 0365 WRITE(6,381)
 ISN 0366 CC 420 I=1,MCNT1
 ISN 0367 J=NCNT(I,1)
 ISN 0368 K=NCNT(I,2)
 ISN 0369 WRITE(6,382)J,K,CMPS(J,K,4),T219(J,K),T319(J,K),T19C(J,K),CSL
 ISN 0370 420 CCNTINUE
 ISN 0371 WRITE(6,421)
 ISN 0372 421 FORMAT('1'////T15,'COMBINED STRESS - COMPRESSIVE - EQUATICN 20'/)
 ISN 0373 WRITE(6,381)
 ISN 0374 DC 450 I=1,MCNT1
 ISN 0375 J=NCNT(I,1)
 ISN 0376 K=NCNT(I,2)
 ISN 0377 WRITE(6,382)J,K,T120(J,K),EENDW(J,K,4),BENDS(J,K,4),T20C(J,K),CSL
 ISN 0378 450 CCNTINUE
 ISN 0379 500 WRITE(6,501)
 ISN 0380 501 FCRMAT('1'////T15,'COMBINED STRESS - TENSION - EQUATION 20 USED'/)
 ISN 0381 WRITE(6,381)
 ISN 0382 DC 550 I=1,NSUP
 ISN 0383 CC 540 J=1,NCOM

C-8

LVR115 23

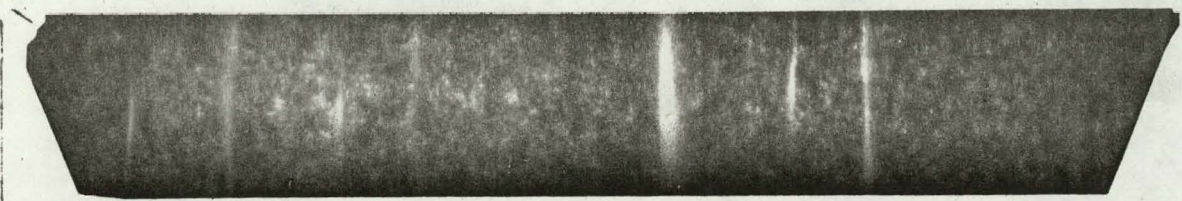
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ISN 0384      540 WRITE(6,382)I,J,T12CT(I,J),BENDW(I,J,4),BENDS(I,J,4),TCTT(I,J),CSL
ISN 0385      550 CONTINUE
ISN 0386      IF(MCNT4.EC.0)GC TC 20000
ISN 0388      WRITE(6,403)MCNT4
ISN 0389      WRITE(6,342)(NCT4(I),I=1,MCNT4)
ISN 0390      20000 STOP
ISN 0391      END
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C-9

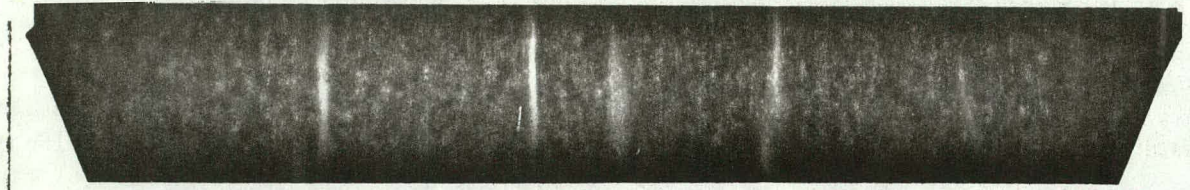


LTR115 23 4

APPENDIX D
MICROFICHE COPIES OF COMPUTER OUTPUT



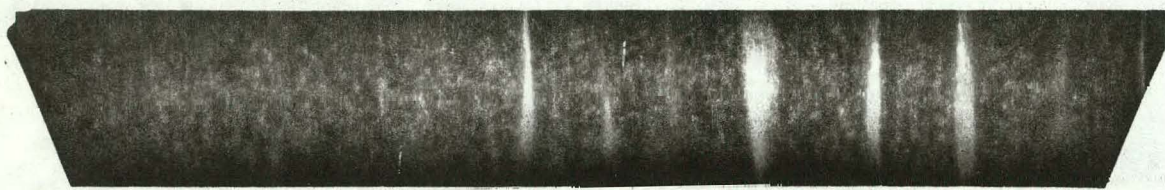
SAP IV
DEADWEIGHT & THERMAL



SAP IV
LOCE



SAP IV- SSE



SAP IV - LOCA