APPENDIX 3.9D
NSSS COMPUTER CODE VERIFICATION

APPENDIX 3.9D

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ATTACHMENT I

TABULATION OF SUMMARY OF

VERIFICATION RESULTS

BCH 10192

NOZZLE PRIMARY PLUS SECONDARY

STRESS RANGE CHECK, PEAK STRESS

CALCULATION AND MAXIMUM USAGE

FACTOR LOCATION

II. Sample Problem - (Hand Solution)

Cut F

The required input quantities as given on sheet for this cut are listed on sheet as printed by the program. A sample calculation to show the inside and outside primary plus secondary stress validity is shown below.

Outside Wall - Trans Al:

$$^{\sigma}x = {}^{\sigma}\text{xpress} + {}^{\sigma}\text{xth} \pm {}^{\sigma}\text{xpipe}$$

$$= -1.034(2.25) - 1.86 - \frac{.231}{2(1-.3)}(-19.1) \pm 1.63$$

$$^{\sigma}x = .59, \quad -2.67$$

$$\sigma\theta = \sigma\theta\text{press} + \sigma\theta\text{th}$$

$$= .863(2.25) - .641 - \frac{.231}{(2(1-.3)}(-19.1)$$

$$= 4.45 \quad \text{ksi}$$

Note the radial Gradient

Sx = Sθ = 3.15 is

printed out by the program.

$$\sigma_r = 0$$

Inside Wall - Trans Al:

$$\sigma_x = 2.496(2.25) + 1.887 \frac{.231}{2(1-.3)}(-19.1) \pm 1.63$$

$$= 5.98, 2.72$$

$$\sigma\theta = 3.435(2.25) + .299 + \frac{.231}{2(1-.3)}(-19.1)$$

Note the radial Gradient

Sx = Sθ = -3.15

$$= 4.88$$

$$\sigma_r = -2.25 \qquad \tau = .13$$

Principal Stresses:

$$S_1 = \frac{5.98+4.88}{2} + 1/2 \quad \sqrt{(5.98-4.88)^2 + 4(.13)^2} = 6.00$$

$S_2 = 5.43 - .57 = 4.86$

$S_3 = -2.25$

Stress Intensities: $S_1 - S_2 = 1.13$ ksi
$S_1 - S_3 = 8.25$ ksi
$S_2 - S_3 = 7.11$ ksi

The 3 S_m stress range check is made without round off. It is tabulated for all three stress intensities for the outside and inside surfaces, first for + pipe loads and then for (-) pipe.

Peak Stresses

Outside

$$\sigma_{xpeak} = {}^{Kt}[\sigma_{xpri} + \sec] = 1.0\,(.59), 1.0(-2.67)$$

$$\sigma\theta_{peak} = \sigma\theta_{press} + \underset{\text{axial}}{\sigma\theta_{th}} \pm \sigma\theta_{pipe} + (K_t - 1)\mu\,\sigma_{\text{xbending}} - [1+\mu(K_t-1)]\sigma\theta_{\text{Thlinear}}$$

$$= \sigma\theta_{pri} + \sec = 4.45 \text{ ksi}$$

$$\sigma_r = 0$$

Inside

$$\sigma_{xpeak} = K_t[\sigma_{xpri+\sec.} + \frac{E\alpha}{1-\mu}\Delta T_2]$$

$$= 1.44[5.98 + \frac{.231}{.7}(-10.1)] = 3.82$$

$$2.72 \qquad\qquad -.88$$

Note the radial gradient

$S_x = S_\theta = -3.33$ is printed by the program

$$\sigma_{\theta peak} = \sigma_{\theta press} + \sigma_{\theta th} \pm \sigma_{\theta pipe} + (K_t - 1)\mu\left|\sigma_{xbending}\right| + [1 +_{\mu} (K_t - 1)][\sigma_{\theta th} + \frac{E\alpha}{1-\mu}\Delta T]$$

Linear

$$= 7.73 + .299 + (.44)(.3)(2.7) + [1 + .3(.44)][-3.15 - 3.33]$$

$$= 1.04$$

$$\sigma_r = -2.25$$

Principal stresses and stress intensities are taken as the stress components calculated above since shear is generally small.

Usage Factor

For the example given no significant usage was developed, however, it can be seen that the mechanism is performed properly. Starting with the outside wall each stress intensity is arranged in descending order then each is arranged for the inside wall, (+pipe). This is then repeated for each intensity for (-) pipe. Pairing the max intensity with the min can then be made in each case permitting computation of the stress range and alternating stress. The program will help to locate the maximum usage factor however, its limitation have been duly noted on page 1.

TOTAL STRESSES, PRINCIPAL STRESSES AND STRESS INTENSITIES
AT THE OUTSIDE WALL OF CUT F

		TOTAL STRESSES			PRINCIPAL STRESSES			STRESS	INTENSITIES	
TRN	SXC	STG	SRO	TXTO	S1	S2	S3	S1-S2	S1-S2	S2-S3
A1 1	.59	4.45	0.00	.13	.59	4.46	0.00	3.87	.59	4.46
	-2.67	4.45	0.00	.13	-2.07	4.45	0.00	-7.12	-2.67	4.45
B1 1	-1.58	-5.49	0.00	.13	-1.58	-5.50	0.00	3.92	-1.58	-5.50
	-4.84	-5.49	0.00	.13	-4.82	-5.52	0.00	.70	-4.82	-5.52
C1 1	-3.08	.05	0.00	.13	-3.09	.05	0.00	-3.14	-3.09	.05
	-6.34	.05	0.00	.13	-6.34	.05	0.00	-6.39	-6.34	.05
C2 1	-2.59	.13	0.00	.13	-2.59	.14	0.00	-2.73	-2.59	.14
	-5.85	.13	0.00	.13	-5.85	.14	0.00	-5.98	-5.85	.14
C3 1	-5.30	-4.31	0.00	.13	-5.31	-4.30	0.00	-1.02	-5.31	-4.30
	-8.56	-4.31	0.00	.13	-8.56	-4.31	0.00	-3.22	-2.14	1.08
C4 1	-2.14	1.07	0.00	.13	-2.14	1.08	0.00	-3.22	-2.14	1.08
	-5.40	1.07	0.00	.13	-5.40	1.07	0.00	-6.47	-5.40	1.07
D1 1	-1.65	.25	0.00	.13	-1.66	.26	0.00	-1.92	-1.66	.26
	-4.91	.25	0.00	.13	-4.91	.26	0.00	-5.17	-4.91	.26
D2 1	-1.67	.99	0.00	.13	-1.68	1.00	0.00	-2.67	-1.68	1.00
	-4.93	.99	0.00	.13	-4.93	.99	0.00	-5.93	-4.93	.99
D3 1	-.48	1.76	0.00	.13	-.49	1.77	0.00	-2.26	-.49	1.77
	-3.74	1.76	0.00	.13	-3.74	1.77	0.00	-5.51	-3.74	1.77
E1 1	-.80	2.03	0.00	.13	-.81	2.03	0.00	-2.84	-.81	2.03
	-4.06	2.03	0.00	.13	-4.06	2.03	0.00	-6.09	-4.06	2.03
E2 1	-.59	1.86	0.00	.13	-.60	1.86	0.00	-2.46	-.60	1.86
	-3.85	1.86	0.00	.13	-3.86	1.86	0.00	-5.71	-3.86	1.86
H1 1	-1.60	2.70	0.00	.13	-1.61	2.70	0.00	-4.31	-1.61	2.70
	-4.86	2.70	0.00	.13	-4.86	2.70	0.00	-7.56	-4.86	2.70
I1 1	-1.02	2.84	0.00	.13	-1.03	2.84	0.00	-3.87	-1.03	2.84
	-4.28	2.84	0.00	.13	-4.28	2.84	0.00	-7.12	-4.28	2.84
I2 1	1.18	1.52	0.00	.13	1.14	1.57	0.00	-.43	1.14	1.57
	-2.08	1.52	0.00	. 13	-2.08	1.53	0.00	-3.61	-2.08	1.53
S1 1	1.15	2.03	0.00	. 44	.97	2.21	0.00	-1.24	.97	2.21
	-5.79	2.03	0.00	.44	-5.81	2.05	0.00	-7.87	-5.81	2.05
S2 1	-2.53	2.03	00.0	-.18	-2.54	2.04	0.00	-4.57	-2.54	2.04
	02.11	2.03	0.00	-.18	-2.12	2.04	0.00	-4.15.	-2.12	2.04

TOTAL STRESSES, PRINCIPAL STRESSES AND STRESS INTENSITIES AT THE OUTSIDE WALL OF CUT F

		TOTAL STRESSES			PRINCIPAL STRESSES			STRESS INTENSITIES	
TRN	SX1	ST1	SR1	TXT1	S1	S2	S3	S1-S2	S2-S3
A1 1	5.96	4.88	2.25	.13	6.00	4.86	-2.25	1.14	8.25	7.11
	-2.72	4.88	2.25	.13	2.71	4.88	-2.25	-2.17	-4.96	7.13
B1 1	4.77	6.15	.01	.13	4.76	6.16	-.01	-1.40	4.77	6.17
	1.51	6.15	.01	.13	1.51	6.16	-.01	-4.64	1.52	6.17
C1 1	9.74	10.47	2.25	.13	9.71	10.49	-2.25	-.78	11.96	12.74
	6.48	10.47	2.25	.13	6.47	10.47	-2.25	-4.00	8.72	12.72
C2 1	9.25	9.98	2.35	.13	5.99	9.99	-2.35	-.78	11.58	12.35
	5.99	9.98	2.35	.13	5.99	9.99	-2.35	-4.00	8.72	12.72
C3 1	11.02	11.74	1.73	.13	11.00	11.77	-1.73	-.77	12.73	13.50
	7.76	11.74	1.73	.13	11.00	11.75	-1.73	-.77	12.73	13.50
C4 1	8.88	8.60	2.30	.13	8.93	8.55	-2.30	.38	11.23	10.85
	5.62	8.60	2.30	.13	8.93	8.61	-2.30	-3.00	7.91	10.91
D1 1	7.79	8.26	1.99	.13	7.76	8.29	-1.99	-.53	9.75	10.28
	4.53	8.26	1.99	.13	4.53	8.26	-1.99	-3.73	6.52	10.25
D2 1	8.26	9.12	2.25	.13	8.24	9.14	-2.25	-.90	10.49	11.39
	5.00	9.12	2.25	.13	5.00	9.13	-2.25	-4.13	7.25	11.38
D3 1	6.71	7.33	2.00	.13	6.69	7.35	-2.00	-.67	8.69	9.35
	3.45	7.33	2.00	.13	3.45	7.33	-2.00	-3.88	5.45	9.33
E1 1	7.50	8.07	2.35	.13	7.47	8.10	-2.35	-.63	9.82	10.45
	4.24	8.07	2.35	.13	4.23	8.08	-2.35	-3.85	6.58	10.43
E2 1	7.00	7.39	2.15	.13	6.96	7.42	-2.15	-.47	9.11	9.57
	3.74	7.39	2.15	.13	3.73	7.39	-2.15	-3.66	5.88	9.54
H1 1	9.43	10.73	3.13	.13	9.42	10.75	-3.13	-1.33	12.54	13.87
	8.17	10.73	3.13	.13	6.17	10.74	-3.13	-4.57	9.29	13.86
I1 1	7.60	6.49	2.25	.13	4.33	6.48	-2.25	1.14	9.86	8.73
	4.34	6.49	2.25	.13	7.61	6.50	-2.25	-2.17	6.58	8.75
I2 1	5.28	8.77	2.25	.13	5.28	8.77	-2.25	-3.49	7.53	11.02
	2.02	8.77	2.25	. 13	2.02	8.77	-2.25	-6.75	4.27	11.02
S1 1	9.19	8.09	2.35	. 44	9.35	7.93	2.35	1.42	11.70	10.28
	2.25	8.09	2.35	.44	2.22	8.12	2.35	-5.90	4.57	10.47
S2 1	5.51	8.09	2.35	-.18	5.50	8.10	2.35	-2.60	7.85	10.45
	5.93	8.09	2.35	-.18	5.92	8.10	2.35	-2.18.	-8.27	10.45

RANGE OF STRESS CRITERIA

MIN	MAX	RANGE		
-4.5731	3.9177	8.4908	S1-S2	OUTSIDE
-5.3145	1.1392	8.4537	S1-S3	OUTSIDE
-5.4954	4.4562	9.9516	S2-S3	OUTSIDE
-3.4904	1.4160	4.9064	S1-S2	INSIDE
4.7725	12.7311	7.9586	S1-S3	INSIDE
6.1742	13.8722	7.5980	S2-S3	INSIDE
-7.8683	.6992	8.5675	S1-S2	OUTSIDE
-8.5616	-2.0815	6.4801	S1-S3	OUTSIDE
-5.5161	4.4542	9.9704	S2-S3	OUTSIDE
-6.7458	-2.1704	4.5754	S1-S2	INSIDE
1.5210	9.4896	7.9686	S1-S3	INSIDE
6.1657	13.8631	7.6974	S2-S3	INSIDE

PEAK STRESSES, PRINCIPAL STRESSES AND STRESS INTENSITIES
AT THE OUTSIDE WALL OF CUT F

	PEAK STRESSES			PRINCIPAL STRESSES			STRESS INTENSITIES		
TRN	SX0	ST0	SR0	S1	S2	S3	S1-S2	S1-S2	S2-S3
A1	.59	4.45	0.00	.59	4.46	0.00	-3.86	.59	4.45
	-2.67	4.45	0.00	-2.67	4.45	0.00	-7.12	-2.67	4.45
B1	-1.58	-5.49	0.00	-1.58	-5.49	0.00	3.91	-1.56	-5.49
	-4.84	-5.49	0.00	-4.84	-5.49	0.00	.65	-4.84	-5.49
C1	-3.08	.05	0.00	-3.08	.05	0.00	-6.39	-6.34	.05
	-6.34	.05	0.00	-6.34	.05	0.00	-6.39	-6.34	.05
C2	-2.59	.13	0.00	-2.59	.13	0.00	-2.72	-2.59	.13
	-5.85	.13	0.00	-5.85	.13	0.00	-5.98	-5.85	.13
C3	-5.30	-4.31	0.00	-5.30	-4.31	0.00	-.98	-5.30	-4.31
	-8.56	-4.31	0.00	-8.56	-4.31	0.00	-4.24	-8.56	-4.31
C4	-2.14	1.07	0.00	-2.14	1.07	0.00	-3.21	-2.14	1.07
	5.40	1.07	0.00	-5.40	1.07	0.00	-6.47	-5.40	1.07
D1	-1.65	.25	0.00	-1.65	.25	0.00	-1.90	-1.65	.25
	-4.91	.25	0.00	-4.91	.25	0.00	-5.16	-4.91	.25
D2	1.67	.99	0.00	-1.67	.99	0.00	-2.66	-1.67	.99
	-4.93	.99	0.00	-4.93	.99	0.00	-5.92	-4.93	.99
D3	-.48	1.76	0.00	-.48	1.76	0.00	-2.24	-.48	1.76
	-3.74	1.76	0.00	-3.74	1.76	0.00	-5.50	-3.74	1.76
E1	-.80	2.03	0.00	-.80	2.03	00.0	-2.83	-.80	2.03
	-4.06	2.03	0.00	-4.06	2.03	0.00	-2.83	-.80	2.03
E2	-.59	1.86	0.00	-.59	1.86	0.00	-2.45	-.59	1.86
	-3.86	1.86	0.00	-3.85	1.86	0.00	-5.71	-3.85	1.86
H1	-1.60	2.70	0.00	-1.60	2.70	0.00	-4.30	-1.60	2.70
	-4.86	2.70	0.00	-4.86	2.70	0.00	-7.56	-4.86	2.70
I1	-1.02	2.84	0.00	-1.02	2.84	0.00	-3.86	-1.02	2.84
	-4.28	2.84	0.00	-4.28	2.84	0.00	-7.12	-4.28	2.84
I2	1.18	1.52	0.00	1.18	1.52	0.00	-.34	1.18	1.52
	-2.08	1.52	0.00	-2.08	1.52	0.00	-3.60	-2.08	1.52
S1	1.15	2.03	0.00	1.15	2.03	0.00	-.88	1.15	2.03
	-5.79	2.03	0.00	-5.79	2.03	0.00	-7.82	-5.79	2.03
S2	-2.53	2.03	0.00	-2.53	2.03	0.00	-4.56	-2.53	2.03
	-2.11	2.03	0.00	-2.11	2.03	0.00	-4.14	-2.11	2.03

PEAK STRESSES, PRINCIPAL STRESSES AND STRESS INTENSITIES
AT THE INSIDE WALL OF CUT F

	PEAK STRESSES			PRINCIPAL STRESSES			STRESS INTENSITIES		
TRN	SX0	ST0	SR0	S1	S2	S3	S1 - S2	S1 - S3	S2 - S3
A1	3.81	1.04	2.25	3.81	1.04	-2.25	2.77	6.06	3.29
	-.88	1.04	2.25	-.88	1.04	-2.25	-1.92	1.37	3.29
B1	18.28	16.41	.01	18.28	16.41	-.01	1.87	18.29	16.42
	13.59	16.41	.01	13.59	16.41	-.01	-2.82	13.60	16.42
C1	15.21	12.43	2.25	15.21	12.43	-2.25	2.78	17.46	14.68
	10.51	12.43	2.25	10.51	12.43	-2.25	2.78	12.76	14.68
C2	25.82	20.84	2.35	25.82	20.84	-2.35	4.98	28.17	23.19
	21.13	20.84	2.35	21.13	20.84	-2.35	.29	23.48	23.19
C3	25.52	21.16	1.73	25.52	21.16	-1.73	4.36	27.25	22.89
	20.83	21.16	1.73	20.83	21.16	-1.73	-.34	22.56	22.89
C4	3.42	2.02	2.30	3.42	2.02	-2.30	1.40	5.72	4.32
	-1.27	2.02	2.30	-1.27	2.02	-2.30	-3.29	1.03	4.32
D1	14.26	11.47	1.99	14.26	11.47	-1.99	2.80	16.25	13.46
	9.57	11.47	1.99	9.57	11.47	-1.99	-1.90	11.56	13.46
D2	12.61	10.44	2.25	12.61	10.44	-2.25	2.18	14.86	12.69
	7.92	10.44	2.25	7.92	10.44	-2.25	-2.52	10.17	12.69
D3	7.39	5.98	2.00	7.39	5.98	-2.00	1.41	9.39	7.98
	2.69	5.98	2.00	2.69	5.98	-2.00	-3.29	4.69	7.98
E1	1.29	1.15	2.35	1.29	1.15	2.35	-4.55	-1.05	3.50
	-3.40	1.15	2.35	-3.40	1.15	2.35	-4.55	-1.05	3.50
E2	19.58	15.36	2.15	19.58	15.36	-2.15	4.22	21.73	17.51
	14.88	15.36	2.15	14.88	15.36	-2.15	-.47	17.03	17.51
H1	13.58	11.46	3.13	13.58	11.46	-3.13	2.12	16.70	14.59
	8.88	11.46	3.13	8.88	11.46	-3.13	-2.58	12.01	14.59
I1	8.61	5.03	2.25	8.61	5.03	-2.25	3.58	10.86	7.28
	-3.92	5.03	2.25	3.92	5.03	-2.25	-1.11	6.17	7.28
I2	9.94	11.07	2.25	9.94	11.07	-2.25	-1.13	12.19	13.32
	5.24	11.07	2.25	5.24	11.07	-2.25	-5.83	7.49	13.32
S1	13.24	8.62	2.35	13.24	8.62	-2.35	4.62	15.59	10.97
	3.25	8.62	2.35	3.25	8.62	-2.35	-5.37	5.60	10.97
S2	7.94	8.62	2.35	7.94	8.62	-2.35	-.68	10.29	10.97
	8.55	8.62	2.35	8.55	8.62	-2.35	-.07	10.90	10.97

SUM USE.FAC= 0.000000

	TN	S PEAK	N SPEC	*	CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS S MAX	S MIN	SR	SA	N ALL	N LIFE	U
B	1	3.91	0.	*	3.91	-4.56	8.47	4.23	*02097152.	500.	0.000000
1	2	-.34	200.	*							
S	1	-.88	-300.	*							
C	3	-.98	30500.	*							
D	1	-1.90	25000.	*							
E	2	-2.45	945000.	*							
D	2	-2.66	25000.	*							
E	1	-2.83	945000.	*							
C	4	-3.21	30500.	*							
A	1	-3.86	500.	*							
I	1	-3.86	200.	*							
H	1	-4.30	10.	*							
S	2	-4.56	1500.	*							

SUM USE.FAC= 0.000000

	TN	S PEAK	N SPEC	*	CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS S MAX	S MIN	SR	SA	N ALL	N LIFE	U
I	2	1.18	0.	*	1.18	-5.30	6.48	3.24	*2097152.	200.	0.000000
S	1	1.15	200.	*							
A	1	.59	500.	*							
D	3	-.48	25000.	*							
E	2	-.59	945000.	*							
E	1	-.80	945000.	*							
I	1	-1.02	0.	*							
B	1	-1.58	500.	*							
H	1	-1.60	10.	*							
D	2	-1.67	25000.	*							
C	4	-2.14	30300.	*							
S	2	-2.53	2000.	*							
C	3	-5.30	30300.	*							

SUM USE.FAC= 0.000000

	TN	S PEAK	N SPEC	*	CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS S MAX	S MIN	SR	SA	N ALL	N LIFE	U
A	1	4.45	0.	*	4.45	-5.49	9.94	4.97	*02097152.	500.	0.000000
I	1	2.84	200.	*							
H	1	2.70	10.	*							
S	2	2.03	2000.	*							
S	1	2.03	200.	*							
E	1	2.03	945000.	*							
E	2	1.86	945000.	*							
D	3	1.76	25000.	*							
I	2	1.52	200.	*							
C	4	1.07	30500.	*							
D	1	.25	25000.	*							
C	3	-4.31	30500.	*							
B	1	-5.49	0.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	2	4.98	30300.	*	4.98	-1.13	6.11	3.06	*02097152.	200.	0.000000
S	1	4.62	200.	*							
E	2	4.22	945000.	*							
I	1	3.58	0.	*							
D	1	2.80	25000.	*							
A	1	2.77	500.	*							
H	1	2.12	10.	*							
B	1	1.87	500.	*							
D	3	1.41	25000.	*							
C	4	1.40	30300.	*							
E	1		945000.	*							
S	2		2000.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	2	28.17	0.	*	28.17	3.64	24.53	12.27	*2097152.	30500.	0.000000
E	2	21.73	914500.	*							
B	1	18.29	500.	*							
H	1	16.70	10.	*							
D	1	16.25	25000.	*							
S	1	15.59	200.	*							
I	2	12.19	200.	*							
I	1	10.86	200.	*							
S	2	10.29	2000.	*							
D	3	9.39	25000.	*							
A	1	8.06	500.	*							
C	4	5.72	0.	*							
E	1	3.64	914500.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	2	23.19	30000.	*	23.19	3.29	19.90	9.95	*02097152.	500.	0.000000
E	2	17.51	945000.	*							
B	1	16.42	500.	*							
H	1	14.59	10.	*							
D	1	13.46	25000.	*							
I	2	13.32	200.	*							
S	1	10.97	200.	*							
S	2	10.97	2000.	*							
D	3	7.98	25000.	*							
I	1	7.28	200.	*							
C	4	4.32	30000.	*							
E	1	3.50	945000.	*							
A	1	3.29	0.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
B	-1	.65	300.	*	.65	-7.82	8.47	4.23	*2097152.	200.	0.000000
I	-2	-3.60	200.	*							
S	-2	-4.14	0.	*							
C	-3	-4.24	30500.	*							
D	-1	-5.16	25000.	*							
E	-2	-5.71	945000.	*							
D	-2	-5.92	25000.	*							
E	-1	-6.09	945000.	*							
C	-4	-6.47	30500.	*							
A	-1	-7.12	500.	*							
I	-1	-7.12	200.	*							
H	-1	-7.56	10.	*							
S	-1	-7.82	0.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
I	-2	-2.08	0.	*	-2.08	-8.56	6.48	3.24	*02097152.	200.	0.000000
S	-2	-2.11	2000.	*							
A	-1	-2.67	500.	*							
D	-3	-3.74	25000.	*							
E	-2	-3.85	945000.	*							
E	-1	-4.06	945000.	*							
I	-1	-4.28	0.	*							
B	-1	-4.84	500.	*							
H	-1	-4.86	10.	*							
D	-2	-4.93	25000.	*							
C	-4	.40	30300.	*							
S	-1	.79	200.	*							
C	-3	-8.56	30300.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
A	-1	4.45	0.	*	4.45	-5.49	9.94	4.97	*02097152.	500.	0.000000
I	-1	2.84	200.	*							
H	-1	2.70	10.	*							
S	-1	2.03	200.	*							
S	-2	2.03	2000.	*							
E	-1	2.03	945000.	*							
E	-2	1.86	945500.	*							
D	-3	1.76	25000.	*							
I	-2	1.52	200.	*							
C	-4	1.07	30500.	*							
D	-1	.25	25000.	*							
C	-3	-4.31	30500.	*							
B	-1	-5.49	0.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	-2	.29	30300.	*	.29	-5.83	6.11	3.06	*02097152.	200.	0.000000
S	-2	-.07	2000.	*							
E	-2	-.47	945000.	*							
I	-1	-1.11	0.	*							
D	-1	-1.90	25000.	*							
A	-1	-1.92	500.	*							
H	-1	-2.58	10.	*							
B	-1	-2.82	500.	*							
D	-3	-3.29	25000.	*							
C	-4	-3.29	30300.	*							
E	-1	-4.55	945000.	*							
S	-1	-5.37	200.	*							
I	-2	-5.83	0.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	-2	23.48	0.	*	23.48	-1.05	24.53	12.27	*02097152	30500.	0.000000
E	-2	17.03	914500.	*							
B	-1	13.60	500.	*							
H	-1	12.01	10.	*							
D	-1	11.56	25000.	*							
S	-2	10.90	2000.	*							
I	-2	7.49	200.	*							
I	-1	6.17	200.	*							
S	-1	5.60	200.	*							
D	-3	4.69	25000.	*							
A	-1	1.37	500.	*							
C	-4	1.03	0.	*							
E	-1	-1.05	914500.	*							

SUM USE.FAC= 0.000000

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS

	TN	S PEAK	N SPEC	*	S MAX	S MIN	SR	SA	N ALL	N LIFE	U
C	-2	23.19	30000.	*	23.19	3.29	19.90	9.95	*02097152.	500.	0.000000
E	-2	17.51	945000.	*							
B	-1	16.42	500.	*							
H	-1	14.59	10.	*							
D	-1	13.46	25000.	*							
I	-2	13.32	200.	*							
S	-1	10.97	200.	*							
S	-2	10.97	2000.	*							
D	-3	7.98	25000.	*							
I	-1	7.28	200.	*							
C	-4	32	30000.	*							
E	-1	0	94500.	*							
A	-1	-3.29	0.	*							

ATTACHMENT II
TABULATION OF SUMMARY OF VERIFICATION RESULTS

BC 10286

SUPPORT SKIRT LOADING

PROBLEM #1

COMPARISON OF CLASSICAL SOLUTION AND COMPUTER SOLUTION

SKIRT STRESSES

		COMPUTER SOLUTION	CLASSICAL SOLUTION
Loc. A			
Max. Moment:	σm	-9.20	-9.20
	σB	-20.55	-20.55
	σ	-29.75	-29.75
	τ	3.22	3.22
	S	30.44	30.44
Loc. B			
Max. Moment:	σm	-9.20	-9.20
	σB	20.55	20.55
	σ	11.35	11.55
	τ	3.43	3.44
	S	13.27	13.27
Loc. A			
Max. Shear:	σm	-9.20	-9.20
	σB	-18.19	-18.19
	σ	-27.39	-27.39
	τ	3.65	3.65
	δ	28.34	28.35
Loc. B			
Max. Shear:	σm	-9.20	-9.20
	σB	18.19	18.19
	σ	8.99	8.99
	τ	3.87	3.87
	S	11.86	11.86

FLANGE STRESSES

Bolt Load		123.81	125.64
Bolt Stress		31.14	31.60
FLANGE STRESSES:	σB	15.17	15.39
	$\tau\gamma$	8.44	8.56
	τT	0.05	0.05
	S Surface	15.17	15.39
	δ Mid-Surface	8.44	8.56

This indicates that the computer code is well within reasonable limits of accuracy.

PROBLEM #2

COMPARISON OF CLASSICAL SOLUTION AND COMPUTER SOLUTION

SKIRT STRESSES

		COMPUTER SOLUTION	CLASSICAL SOLUTION
Loc. A			
Max. Moment:	σm	-1.73	-1.73
	σB	-24.82	-24.82
	σ	-26.55	-26.55
	τ	0.23	0.23
	S	26.55	26.55
Loc. B			
Max. Moment:	σm	-1.73	-1.73
	σB	+24.82	+24.82
	σ	23.09	23.09
	τ	0.60	0.61
	δ	23.12	23.12
Loc. A			
Max. Shear:	σm	-1.73	-1.73
	σB	-5.91	-5.93
	σ	-7.64	-7.66
	τ	1.57	1.56
	δ	8.26	8.27
Loc. B			
Max. Shear:	σm	-1.73	-1.73
	σB	+5.91	+5.93
	σ	+4.17	+4.20
	τ	1.94	1.94
	S	5.70	5.72

FLANGE STRESSES

Bolt Load	150.35	150.24
Bolt Stress	43.66	43.63

SKIRT STRESSES (Cont'd)

FLANGE STRESSES (Cont'd)

	COMPUTER SOLUTION	CLASSICAL SOLUTION
σB	31.76	31.74
$\tau\gamma$	13.62	13.61
τT	0.09	0.09
S Surface	31.76	31.74
δ Mid-Surface	13.62	13.61

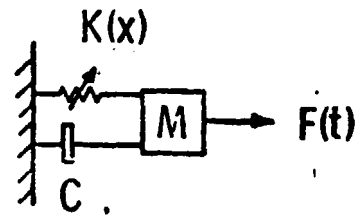
This indicates that the computer code is well within reasonable limits of accuracy.

SUMMARY OF THE METHODS EMPLOYED TO VERIFY THE CESHOCK CODE

TYPE OF CECHOCK PROBLEM	METHOD OF VERIFICATION
I. NONLINEAR, DAMPED PULSE EXCITED SYSTEM SOLUTION A. DEGREE OF NONLINEARITY VARIED (DUFFING OSCILLATOR) B. TYPE OF PULSE VARIED	PUBLISHED CLASSICAL
II. MULTI-DEGREE OF FREEDOM BASE EXITED LATERAL SYSTEM WITH FRICTION, GAPS, AND DAMPING A. WITHOUT HYDRODYNAMIC MASS B. WITH HYDRODYNAMIC MASS	INDEPENDENT COMPUTER CODE
III. FRICTION ELEMENT WITH STATIC AND DYNAMIC COEFFICIENTS OF FRICTION A. COEFFICIENT OF FRICTION VELOCITY NON-DEPENDENT B. COEFFICIENT OF FRICTION VELOCITY DEPENDENT	ANALYTICAL SOLUTION
IV. IMPACT ELEMENT WITH COEFFICIENT OF RESTITUTION	ANALYTICAL SOLUTION
V. HYSTERESIS ELEMENT: TWO DOF SYSTEM WITH SPRING AND GAP ELEMENTS	INDEPENDENT COMPUTER CODE

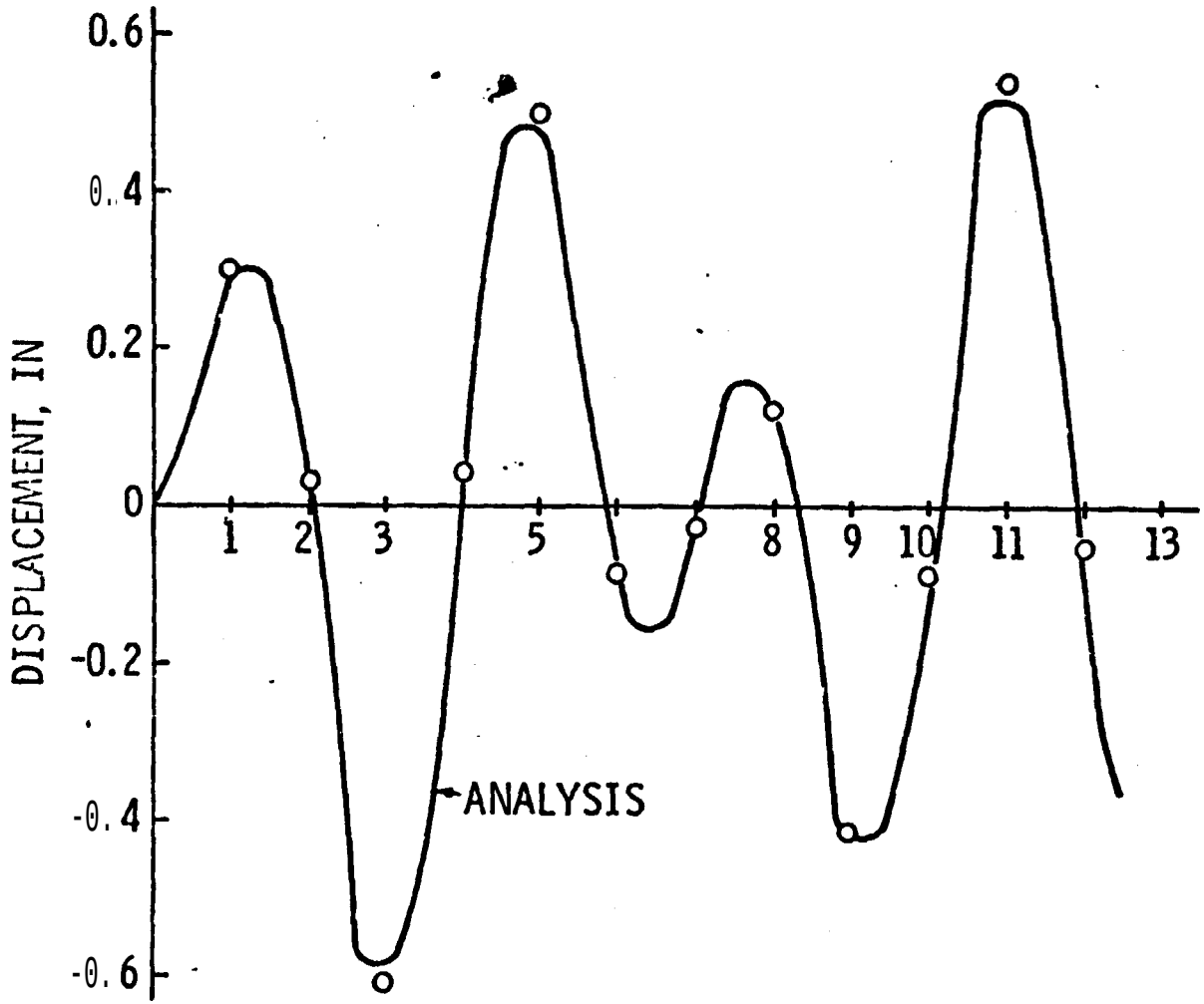
NONLINEAR, DAMPED PULSE
EXCITED SYSTEM

DUFFING OSCILLATOR



$M\ddot{x} + C\dot{x} + K(x) = F(t)$

itO.li+x(l+x3~cosa

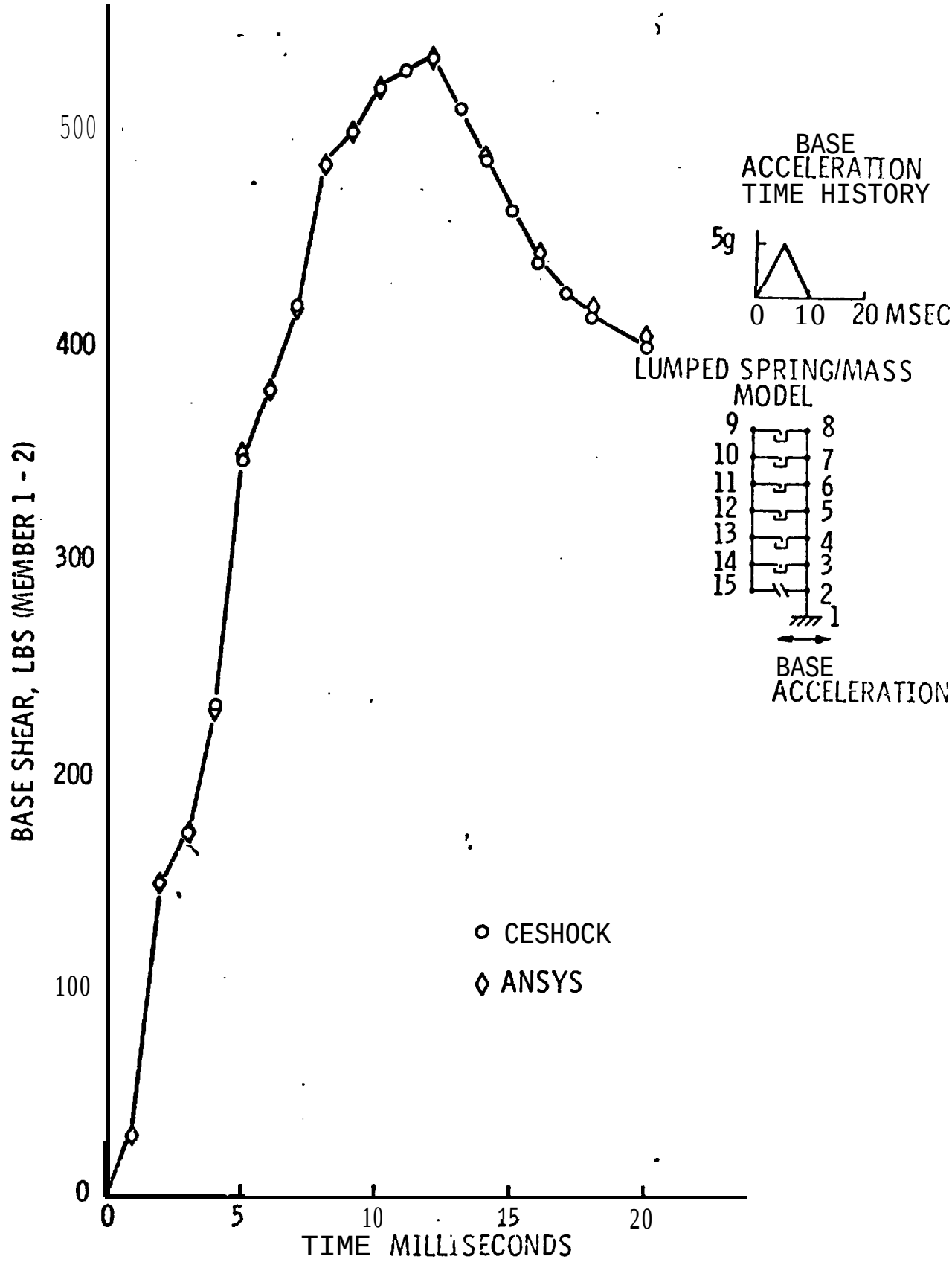


o CESHOCK

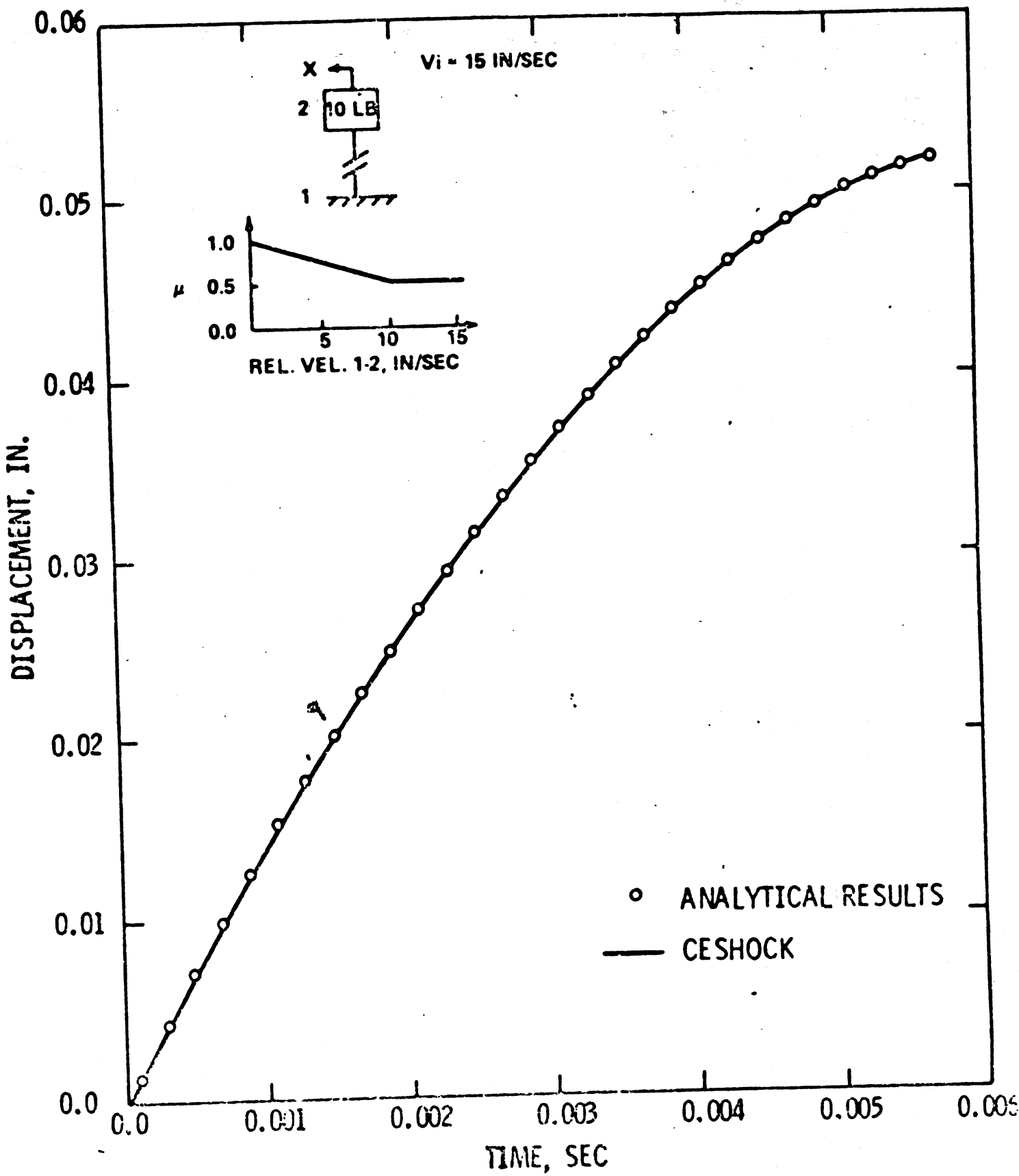
II

BASE EXCITATION PROBLEM INCLUDES, DAMPING, GAPS

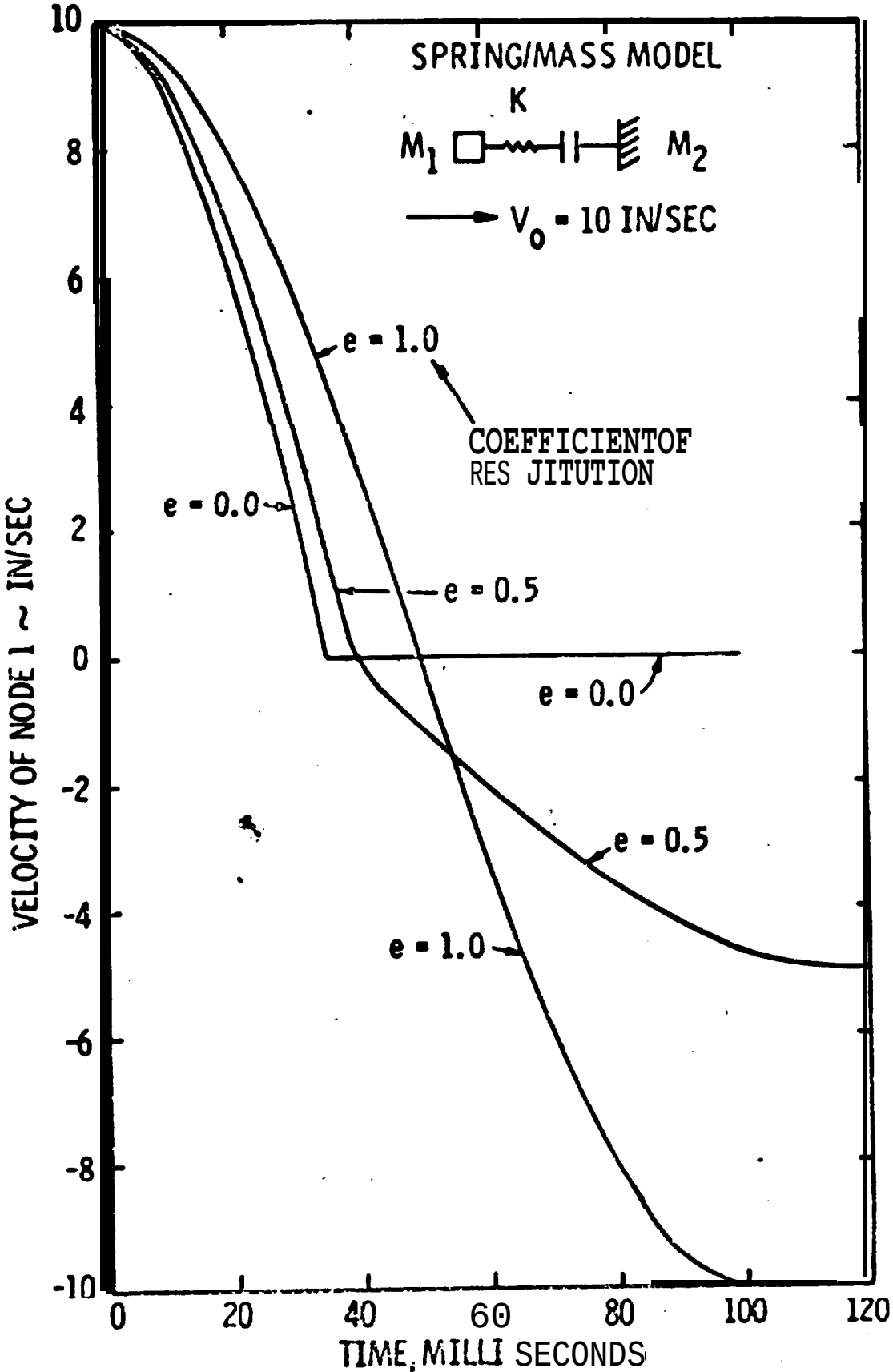
HYDRODYNAMIC MASS



SLIP/STICK FRICTION ELEMENT W/VELOCITY DEPENDENT COEFFICIENT OF FRICTION



IMPACT ELEMENT WITH COEFFICIENT OF RESTITUTION



TWO DEGREE OF FREEDOM HYSTERESIS PROBLEM WITH GAPS