

APPENDIX 3.9D
NSSS COMPUTER CODE VERIFICATION

APPENDIX 3.9D

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WSES-FSAR-UNIT-3

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:

$$\begin{aligned}\sigma_x &= \sigma_{xpress} + \sigma_{xth} \pm \sigma_{xpipe} \\ &= -1.034(2.25) - 1.86 - \frac{.231}{2(1-.3)} (-19.1) \pm 1.63\end{aligned}$$

$$\sigma_x = .59, -2.67$$

$$\begin{aligned}\sigma_\theta &= \sigma_{\theta press} + \sigma_{\theta th} \\ &= .863(2.25) - .641 - \frac{.231}{2(1-.3)} (-19.1)\end{aligned}$$

$$= 4.45 \text{ ksi}$$

$$\sigma_r = 0$$

Note the radial Gradient

S_x = S_θ = 3.15 is

printed out by the program.

Inside Wall - Trans Al:

$$\begin{aligned}\sigma_x &= 2.496(2.25) + 1.887 \frac{.231}{2(1-.3)} (-19.1) \pm 1.63 \\ &= 5.98, 2.72\end{aligned}$$

$$= 5.98, 2.72$$

$$\begin{aligned}\sigma_\theta &= 3.435(2.25) + .299 + \frac{.231}{2(1-.3)} (-19.1)\end{aligned}$$

$$= 4.88$$

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

Note the radial Gradient

S_x = S_θ = -3.15

Principal Stresses:

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

$$S_2 = 5.43 - .57 = 4.86$$

$$S_3 = -2.25$$

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.

WSES - FSAR - UNIT - 3

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

TRN	SXC	TOTAL STRESSES			PRINCIPAL STRESSES			STRESS	INTENSITIES	
		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	0.00	-.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

WSES-FSAR-UNIT-3

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

TRN	SX1	TOTAL STRESSES			PRINCIPAL STRESSES			STRESS	INTENSITIES	
		ST1	SR1	TXT1	S1	S2	S3	S1-S2	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

WSES - FSAR - UNIT - 3

RANGE OF STRESS CRITERIA

<u>MIN</u>	<u>MAX</u>	<u>RANGE</u>		
-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

WSES - FSAR - UNIT - 3

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

TRN	PEAK STRESSES		SR0	PRINCIPAL STRESSES			STRESS INTENSITIES		
	SX0	ST0		S1	S2	S3	S1-S2	S1-S3	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	0.00	-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

WSES - FSAR - UNIT - 3

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

TRN	PEAK STRESSES			PRINCIPAL STRESSES			STRESS INTENSITIES		
	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

WSES-FSAR-UNIT-3

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS										SUM USE.FAC= 0.000000	
	TN	S PEAK	N SPEC	*	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
I	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.	*							

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS										SUM USE.FAC= 0.000000	
	TN	S PEAK	N SPEC	*	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.	*							

CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS										SUM USE.FAC= 0.000000	
	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	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.	*							

WSES-FSAR-UNIT-3

										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.	*							

WSES-FSAR-UNIT-3

				CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS					SUM USE.FAC= 0.000000	
	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.							

				CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS					SUM USE.FAC= 0.000000	
	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.							

				CYCLIC STRESSES AND CORRESPONDING USAGE FACTORS					SUM USE.FAC= 0.000000	
	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.							

WSES-FSAR-UNIT-3

										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.	*							

WSES-FSAR-UNIT-3

ATTACHMENT II
TABULATION OF SUMMARY OF
VERIFICATION RESULTS

BC 10286

SUPPORT SKIRT LOADING

WSES-FSAR-UNIT-3

PROBLEM #1

COMPARISON OF CLASSICAL SOLUTION AND COMPUTER SOLUTION

SKIRT STRESSES

		<u>COMPUTER SOLUTION</u>	<u>CLASSICAL SOLUTION</u>
Loc. A			
Max. Moment:	σ_m	-9.20	-9.20
	σ_B	-20.55	-20.55
	σ	-29.75	-29.75
	τ	3.22	3.22
	S	30.44	30.44
Loc. B			
Max. Moment:	σ_m	-9.20	-9.20
	σ_B	20.55	20.55
	σ	11.35	11.55
	τ	3.43	3.44
	S	13.27	13.27
Loc. A			
Max. Shear:	σ_m	-9.20	-9.20
	σ_B	-18.19	-18.19
	σ	-27.39	-27.39
	τ	3.65	3.65
	δ	28.34	28.35
Loc. B			
Max. Shear:	σ_m	-9.20	-9.20
	σ_B	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:	σ_B	15.17	15.39
	τ_γ	8.44	8.56
	τ_T	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.

WSES-FSAR-UNIT-3

PROBLEM #2

COMPARISON OF CLASSICAL SOLUTION AND COMPUTER SOLUTION

SKIRT STRESSES

		<u>COMPUTER SOLUTION</u>	<u>CLASSICAL SOLUTION</u>
Loc. A			
Max. Moment:	σ_m	-1.73	-1.73
	σ_B	-24.82	-24.82
	σ	-26.55	-26.55
	τ	0.23	0.23
	S	26.55	26.55
Loc. B			
Max. Moment:	σ_m	-1.73	-1.73
	σ_B	+24.82	+24.82
	σ	23.09	23.09
	τ	0.60	0.61
	δ	23.12	23.12
Loc. A			
Max. Shear:	σ_m	-1.73	-1.73
	σ_B	-5.91	-5.93
	σ	-7.64	-7.66
	τ	1.57	1.56
	δ	8.26	8.27
Loc. B			
Max. Shear:	σ_m	-1.73	-1.73
	σ_B	+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)

	<u>COMPUTER SOLUTION</u>	<u>CLASSICAL SOLUTION</u>
σ_B	31.76	31.74
τ_γ	13.62	13.61
τ_T	0.09	0.09
S Surface	31.76	31.74
δ Mid-Surface	13.62	13.61

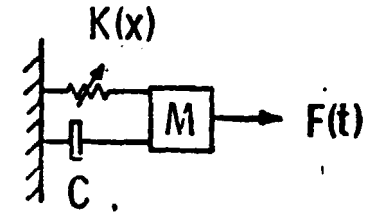
This indicates that the computer code is well within reasonable limits of accuracy.

SUMMARY OF THE METHODS EMPLOYED TO VERIFY THE CESHOCK CODE

<u>TYPE OF CECHOCK PROBLEM</u>	<u>METHOD OF VERIFICATION</u>
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

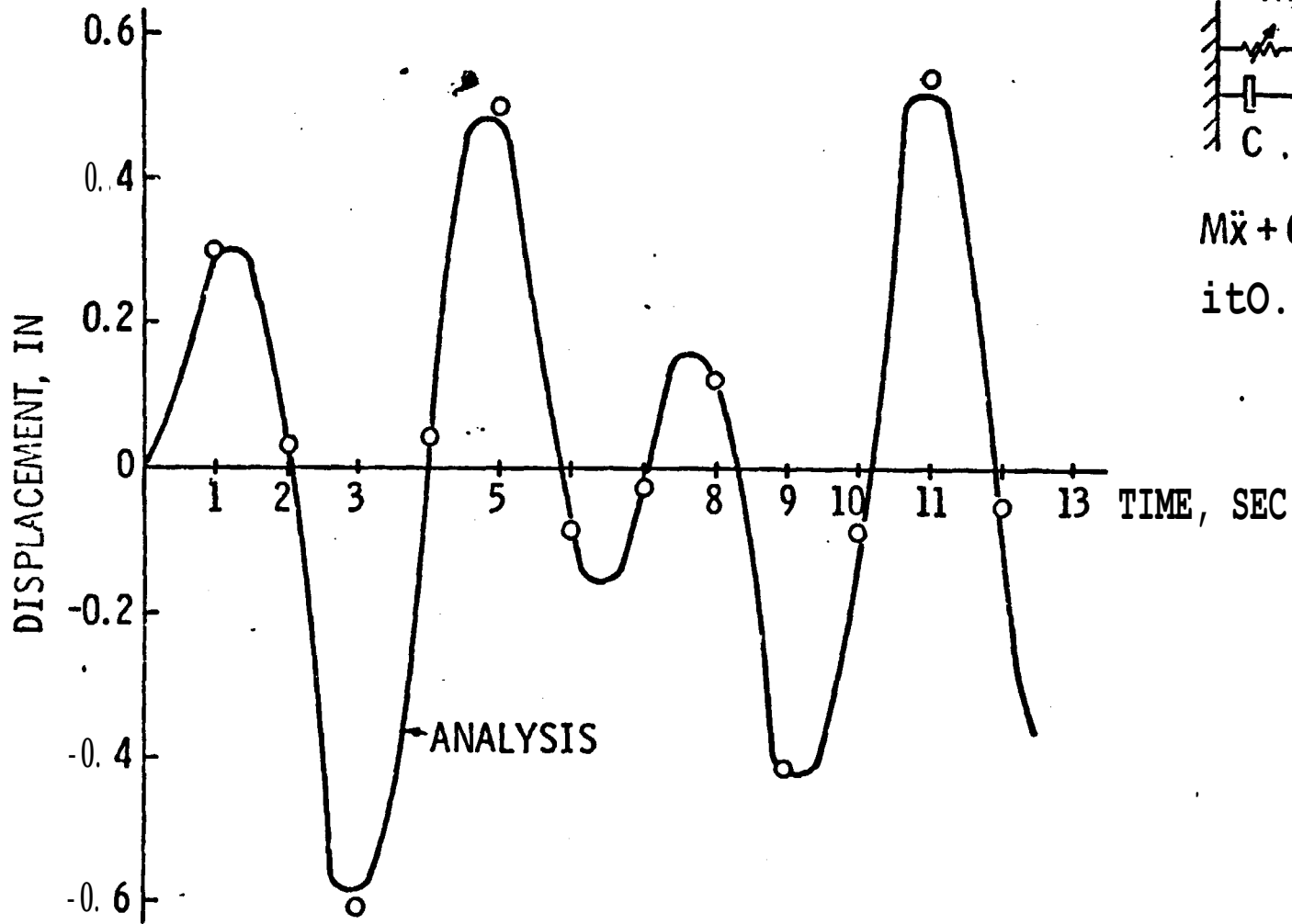
NONLINEAR, DAMPED PULSE EXCITED SYSTEM

DUFFING OSCILLATOR



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

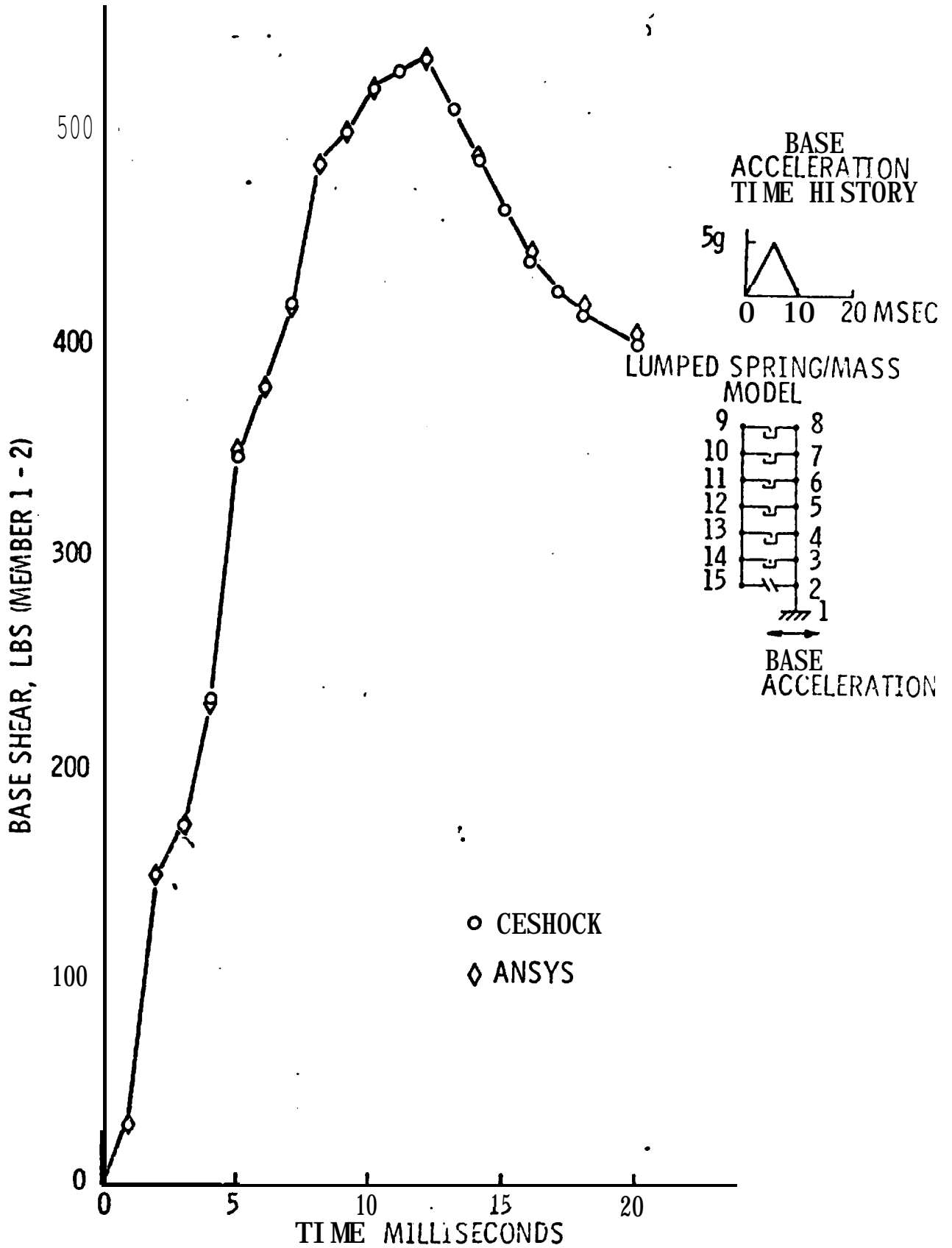
$$K(x) = 0.1 + x(1 + x^2) \cos \omega t$$



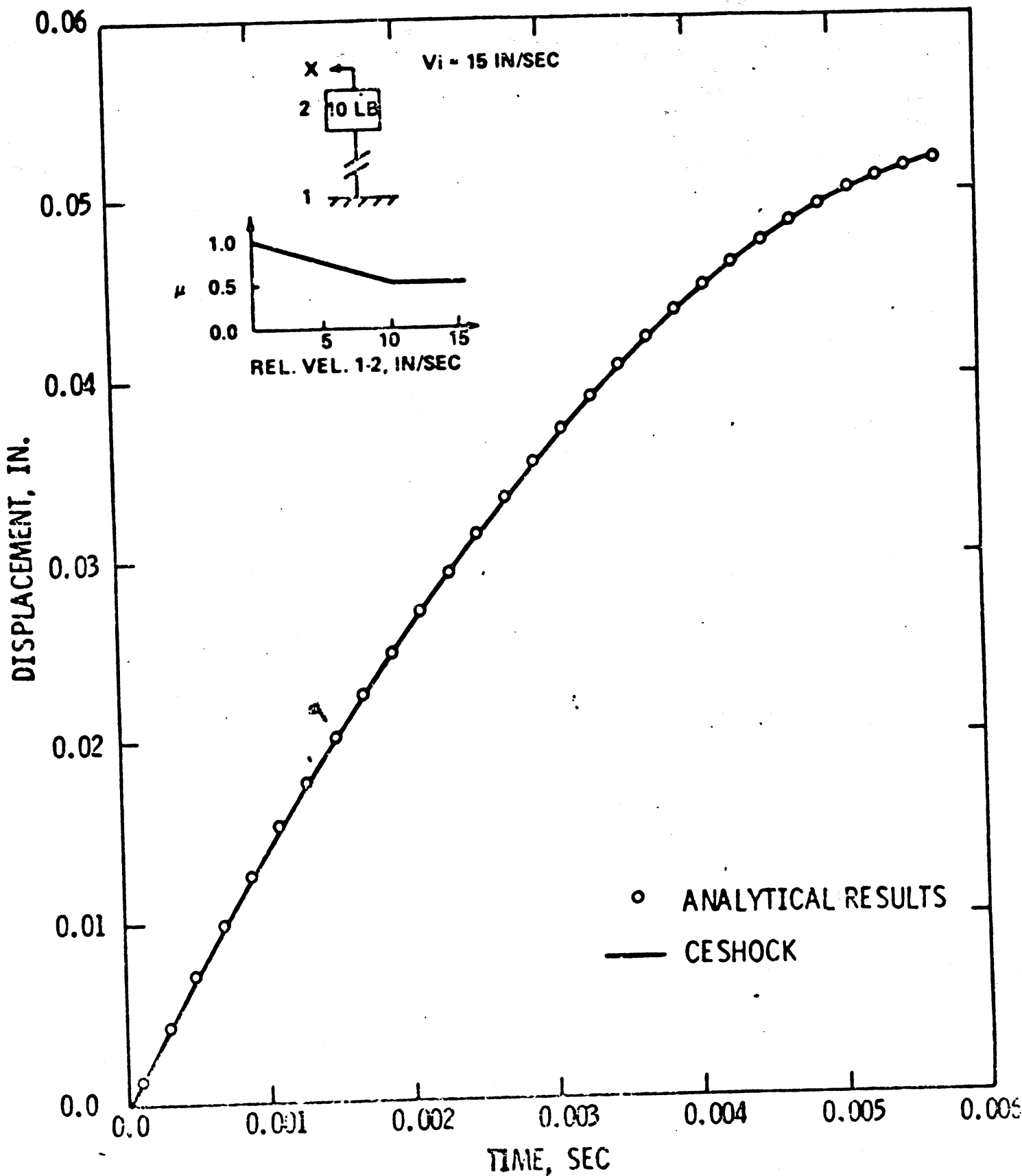
○ CESHOCK

II

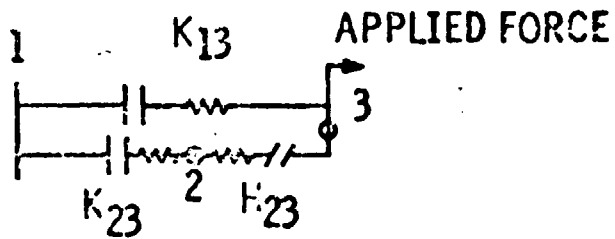
BASE EXCITATION PROBLEM INCLUDES, DAMPING, GAPS
HYDRODYNAMIC MASS



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



TWO DEGREE OF FREEDOM Hysteresis PROBLEM WITH GAPS

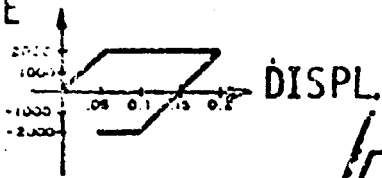


$$\text{FORCE} = \frac{F_{12} + F_{23}}{2} + F_{13}$$

$$\text{DISPLACEMENT} = \text{DISP. NODE3}$$

CHARACTERISTICS

FORCE



DISPL.

- CESHOCK
- ANSYS

