STONE & WEBSTER ENGINEERING CORPORATION

CLIENT & PROJECT	PAGE 1 OF ~~35~~ 37
PRIVATE FUEL STORAGE FACILITY-PRIVATE FUEL STORAGE, LLC	PLUS ~~54~~ 57 PGS OF ATTACHMENTS ⚠
CALCULATION TITLE: SEISMIC ANALYSIS OF CANISTER TRANSFER BUILDING	QA CATEGORY (X) X I - NUCLEAR SAFETY RELATED __ II __ III __ OTHER

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
05996.02	STRUCTURAL	SC-5	NA	300B

APPROVALS - SIGNATURE & DATE

PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)	REV. NO. OR NEW CALC. NO	SUPERSEDES CALC. NO. OR REV. NO.	CONFIRMATION REQUIRED (X) YES	NO
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B. E. Ebbeson 8/28/99	D.M. Bonner 8/31/99	D.M. Bonner 8/31/99	1	0	X P. 5	

* IDV CHECKLIST IN FILE Q2.9

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CALCULATION SHEET

J.O./W.O./CALCULATION NO.	REVISION	PAGE
05996.02-SC-5	1	2

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER
B.E. EBBESON 8-28-99	D. BONNER 8/31/99	D. BONNER 8/31/99

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
Seismic Analysis of Canister Transfer Building	I

TABLE OF CONTENTS AND HISTORICAL DATA
(Revisions, Additions, Deletions, Etc.)

HISTORICAL DATA - REVISION 0

Page No.	Description
None	Original Issue

HISTORICAL DATA - REVISION 1

Revision 1 of this calculation is issued to incorporate revised soil properties and to reflect the 2000 year return period design spectra.

Page No.	Description
2, 4, 6, 10, 11, 12, A-5, A-7, C-3, C-4	Revised pages
15-35 A-11 thru A-15 B-15 thru B-20 C-8 thru C-16 D-1	Replaced pages
36, 37, C-17, C-18, E-1	Added pages

OBJECTIVE:

The purpose of this calculation is to perform the seismic analysis of the Canister Transfer Building, in order to develop amplified response spectra for use in the seismic qualification of equipment and subsystems, and to obtain building accelerations for use in the design of the structure.

CALCULATION METHOD :

The SWEC computer program FRIDAY (Ref. 2) is used to perform the analysis. Input to this program consist of a lumped mass model of the building, which is developed in this calculation, soil impedance functions, which were developed in calculation 05996.02-SC-4 (Ref. 1), and ground acceleration time histories, which were developed in calculation 05996.02-G(PO-18)-3 (Ref. 4). The method of soil-structure interaction analysis is the impedance method, as described in ASCE 4-86 (Reference 3). The program FRIDAY performs the analysis using the complex frequency response method. Results are obtained for the best estimate, low range and high range soil cases, and results are enveloped.

ASSUMPTIONS:

1. The structural model developed in Revision 0 of this calculation was reviewed for conformance with the structural concrete drawings 05996.01-EC-2-A through 05996.02-EC-7-A, and minor changes to the model were made. Since this design is based on assumed critical load combinations, there may be minor changes made to the building configuration in the future. However, it is anticipated that any changes will be minor and will have little effect on results. 1

2. The bridge crane is assumed to weigh 700 kips.

3. Not used

4. Soil material damping values given in Reference 10 are used. Due to the high ground acceleration, the soil strains are assumed to be greater than the limit given in ASCE4-86 (ref. 3, sect. 3.3.2.3) 1

5. The cut-off frequency used in the FRIDAY analysis is 19.5 Hz. A test case was run using a cut-off frequency of 15 hz and results did not change significantly, indicating that frequencies above 15 Hz have little effect.

6. Translational accelerations at points away from the center of mass caused by rotation are considered insignificant.

7. Section 3.4.2.3 of ASCE4-86 (ref. 3) allows a 15 % reduction in the ARS peak amplitude. Due to the uncertainties discussed above, this reduction was not included.

8. Damping in the structure is taken to be 7 % of critical. This assumes that the stresses in the structure will exceed 50 % of ultimate strength.

SOURCES OF DATA AND EQUATIONS:

See the next page for a list of references used in this calculation.

CONCLUSION:

The seismic analysis of the Canister Transfer Building has been completed and the results appear to be reasonable. Results are contained on the computer runs (Attachment D), and response spectra have been enveloped and plotted, as shown on pages 15 - 30. Results at El. 170' and El. 100' have been peak broadened and are shown on pages 31-36. The analysis is based on a preliminary configuration of the building, and may require adjustment if the building configuration changes substantially. **CONFIRMATION REQUIRED**

References:

1. Calculation 05996.02-SC-4, Rev. 1, 'Development of Soil Impedance Functions for Canister Transfer Building'

2. SWEC Computer Program FRIDAY, ST-243, Version 02, Level 01.

3. ASCE 4, 'Standard for Seismic Analysis of Safety-Related Nuclear Structures',. 1986, American Society of Civil Engineers.

4. Calculation 05996.02-G(P018)-3, Rev. 0, 'Development of Time Histories for 2000 Year Return Period Design Spectra' ⚠1

5. SWEC Computer Program MASS, ST-237, Version 00, Level 01.

6. SWEC Computer Program RIG3, ST- 248, Version 01, Level 00.

7. SWEC Computer Program RIG4, ST- 249, Version 01, Level 00.

8. Computer Program GTSTRUDL, Version 9801 NT, Completion No. 3716, March 1998. ⚠1

9. Private Fuel Storage Facility Design Criteria, Revision 2, June 20, 1997, Stone & Webster Engineering Corporation, Denver, Colorado.

10. Calculation 05996.02-G(P018)-2, Rev. 0, 'Soil and Foundation Parameters for Dynamic Soil-Structure Interaction Analyses, 2000 Year Return Period Design Ground Motions'

11. Computer Program INTBSL, ST-307, Version 00, Level 02. ⚠1

PART 1 MODEL DEVELOPMENT

A lumped mass model of the building will be developed. A sketch of the model is shown on the following page. A node will be included at El. 95'-0", which is the bottom of the base mat. The mass properties at this node will consist of the contributions from the base mat, the major walls between El. 100'-0" and El 115'-0', and some of the interior partition walls. An allowance (5 %) will be made for miscellaneous equipment. A second node will be included at El. 130'-0", which will include the roofs at El. 130'-0", main walls between El. 115'-0" and El. 130'-0", walls between El. 130'-0" and el. 150'-0", and interior partition walls.

At the crane elevation, approximately El. 170'-0", two nodes will be included. Since the only shear walls in the East-West direction are on column lines 1, 8, and 11, the out-of plane response of the North-South wall may cause increased response at locations away from the E-W shear walls, especially when the crane is located in the middle of the building. To account for this, a mass point including a portion of the mass in the E-W direction is separated from the rest of the building, and is connected to the nodes at El. 130' and 190' with member selected such that the frequency in the E-W direction matches the out-of-plane stiffness of the N-S walls. In the N-S and vertical directions, the effect of the crane on the building response is not significant, therefore, the total mass between El. 150' and 180' will be included in the other mass point at El. 170'. See pages 9 and 10, and also Attachment C for details of crane model.

The top node of the model is at El. 190'-0", and includes the roof and walls between El. 180' and El. 190'. At the roof El. 190', the roof spans 65 feet from north to south walls. It is relatively flexible in the vertical direction compared to the walls. Therefore, a mass point is added to the stick model to account for this effect. The effective mass and member properties are selected such that it simulates the roof frequency. For detail of roof model, see Attachment C.

Mass properties and the center of mass for each node point are calculated using the SWEC computer program MASS (Ref. 5). Attachment A provides sketches showing attribute masses for each mass point location from walls, roof and mat, as well as computer input and output.

The stiffness of the members between nodes is representative of the walls between elevations. Hand calculations are used to develop the properties of these walls (i.e. area, shear areas, moments of inertia, torsional constant, and center of rigidity). Using these properties, the SWEC program RIG3 (Ref. 6) is used to develop a member stiffness matrix between El. 95'-0' and the center of mass at El. 130'-0". The SWEC program RIG4 (Ref. 7) was used to develop the stiffness matrices between the other nodes. The programs RIG3 and RIG4 account for the difference in location of the center of mass of the structure and the location of the center of rigidity. Attachment B provides calculation of member properties and computer input and output.

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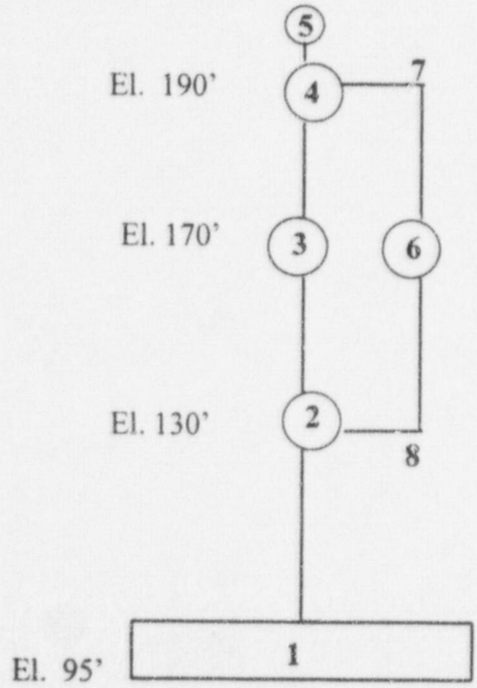
CALCULATION SHEET

J.O./W.O./CALCULATION NO. 05996.02-SC-5		REVISION 1	PAGE 8
PREPARER/DATE B.E. EBBESON 8-28-99	REVIEWER/CHECKER/DATE D. BONNER 8/31/99	INDEPENDENT REVIEWER D. BONNER 8/31/99	
SUBJECT/TITLE Seismic Analysis of Canister Transfer Building		QA CATEGORY/CODE CLASS I	

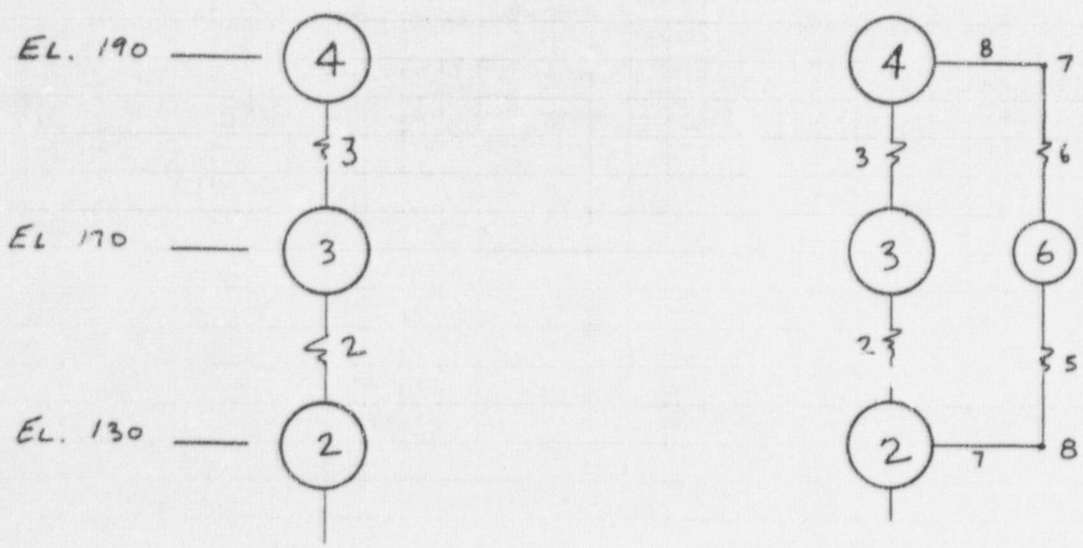


Canister Transfer Building Stick Model

MODEL OF CRANE & WALL

THE 700 K CRANE, WHEN IN A POSITION AWAY FROM E-W SHEAR WALLS, MAY CAUSE OUT-OF-PLANE BENDING OF THE WALLS IN N-S DIRECTION. THE FREQUENCY AND EFFECTIVE MASS OF THE WALL IS ESTIMATED IN ATTACHMENT C.

TO INCORPORATE THIS EFFECT INTO THE STICK MODEL, THE E-W MASS AT EL. 170' WILL BE DIVIDED INTO TWO PORTIONS, THE PORTION WHICH IS ASSUMED TO MOVE WITH THE SHEAR WALLS, AND THE PORTION WHICH MOVES OUT-OF-PLANE.



THE TOTAL MASS AT EL. 170. IS 277.5 (FROM 'MASS' RUN) PLUS $700/32.2$ (CRANE) = 299.2 $\frac{K-SEC^2}{FT}$

△1 THE MASS ASSIGNED TO JOINT 6 IS 142.2 $\frac{K-SEC^2}{FT}$

THE REMAINING E-W MASS AT JOINT 3 IS 299.2 - 142.2 = 157.0 $\frac{K-SEC^2}{FT}$. JOINT 6 WILL BE ASSIGNED SMALL INERTIA VALUES IN THE OTHER DEGREES OF FREEDOM.

JOINTS 7 & 8 WILL BE INTRODUCED TO ALLOW MEMBERS 5 & 6 TO BE ORIENTED VERTICALLY. THEY WILL BE ASSIGNED SMALL INERTIA VALUES.

MEMBERS 7 & 8 ARE ASSIGNED LARGE SECTIONAL PROPERTIES TO SIMULATE RIGID LINKS

MEMBERS 5 & 6 WILL BE ASSIGNED A MOMENT OF

△1 INERTIA OF 162.5 FT^4 (ABOUT LOCAL Y AXIS) TO MATCH THE FREQUENCY IN THE E-W DIRECTION. OTHER PROPERTIES (AX, IX & IZ) WILL BE MADE LARGE ENOUGH TO MAKE THE MASS AT JOINT 6 RIGID, BUT SMALL IN COMPARISON TO THE PROPERTIES OF MEMBERS 2 & 3, SO THAT NO SIGNIFICANT STIFFNESS BETWEEN EL. 130' & 190' WILL BE INTRODUCED.

PART 2 COMPUTER ANALYSIS

Computer program FRIDAY is used to generate response spectra for mass points at El. 100', 130', 170', and 190' plus roof. Three computer runs, best estimate soil case, low range and high range soil cases are performed. The results are contained on text files on the diskette included as Attachment D. The output from three computer runs are enveloped , which are plotted and attached in this calculation. For use in the crane specification, the response spectra at El. 170' and El. 100' have been peak broadened, and are attached. A fourth computer analysis was performed to obtain the acceleration time histories at node 1 for the high range soil case (see page 37). The horizontal acceleration time histories at node 1 were used as input to the baseline correction program INTBSL (Reference 11) to obtain the peak horizontal velocities. 1

The major input to the program is described below:

<u>IMPEDANCE FUNCTIONS</u>

The soil impedance functions were developed in calculation 05996.02-SC-4 (ref. 1). However, since the latest revision to the seismic analysis program FRIDAY (ref. 2), the output from 'REFUND' is no longer directly usable in FRIDAY. Consequently, the data had to be reformatted. The information was retrieved from mainframe disk files, reformatted, and stored on the same disk files. The data set names of these files are:

Best Estimate soil case

STRUCTRL.BEE.STIFFN

Low Range soil case

STRUCTRL.BEE.STIFFL

High Range soil case

STRUCTRL.BEE.STIFFH 1

<u>GROUND TIME HISTORIES</u>

The ground acceleration time histories were developed in Reference 4 and were tranmitted via e-mail. They were retrieved and stored under disk file name "STUCTRL.BEE(ATHORIG)", which are used as input to FRIDAY program. The FRIDAY limits the number of time points to 4000 (20 seconds for a time interval of .005 seconds), so only the first 20 seconds of the time histories were used. This will have negligible effect on results (see Attachment E).

MASS PROPERTIES AND STIFFNESS MATRIX

The masses, centroid of masses, and mass moment of inertia are output from MASS program, given in Attachment A. The stiffness matrices are output from RIG3 and RIG4 programs given in Attachment B.

RESPONSE SPECTRA FREQUENCIES

The response spectrum from computer output is calculated for 80 frequencies at various increments. These increments are verified to ensure that they meet the requirement of ASCE4-86 (ref. 3), and are shown on the following pages.

Computer Log

Input to and output from the computer program MASS (ST-237) are contained in Attachment A. Input to and output from the computer programs RIG3 (ST-248) and RIG4 (ST-249) are contained in Attachment B. Input to and output from the PC based computer program GTSTRUDL (ref. 8) are contained in Attachment C.

Attachment D contains text files of the four analyses using the program FRIDAY (ST-243). The analyses are:

File Name	Date	Description
SVBEST.ZIP	8/27/99	Best Estimate soil case
SVLOW.ZIP	8/27/99	Low Range soil case
SVHIGH.ZIP	8/27/99	High Range soil case
NODE1	8/27/99	Acceleration Time histories at Node 1. High Range soil

The two INTBSL computer runs to obtain maximum horizontal velocities (see p. 37) are also included in Attachment D.

NODE1X.ZIP	8/27/99	Velocity at Node 1 x direction
NODE1Z.ZIP	8/27/99	Velocity at Node 1 z direction

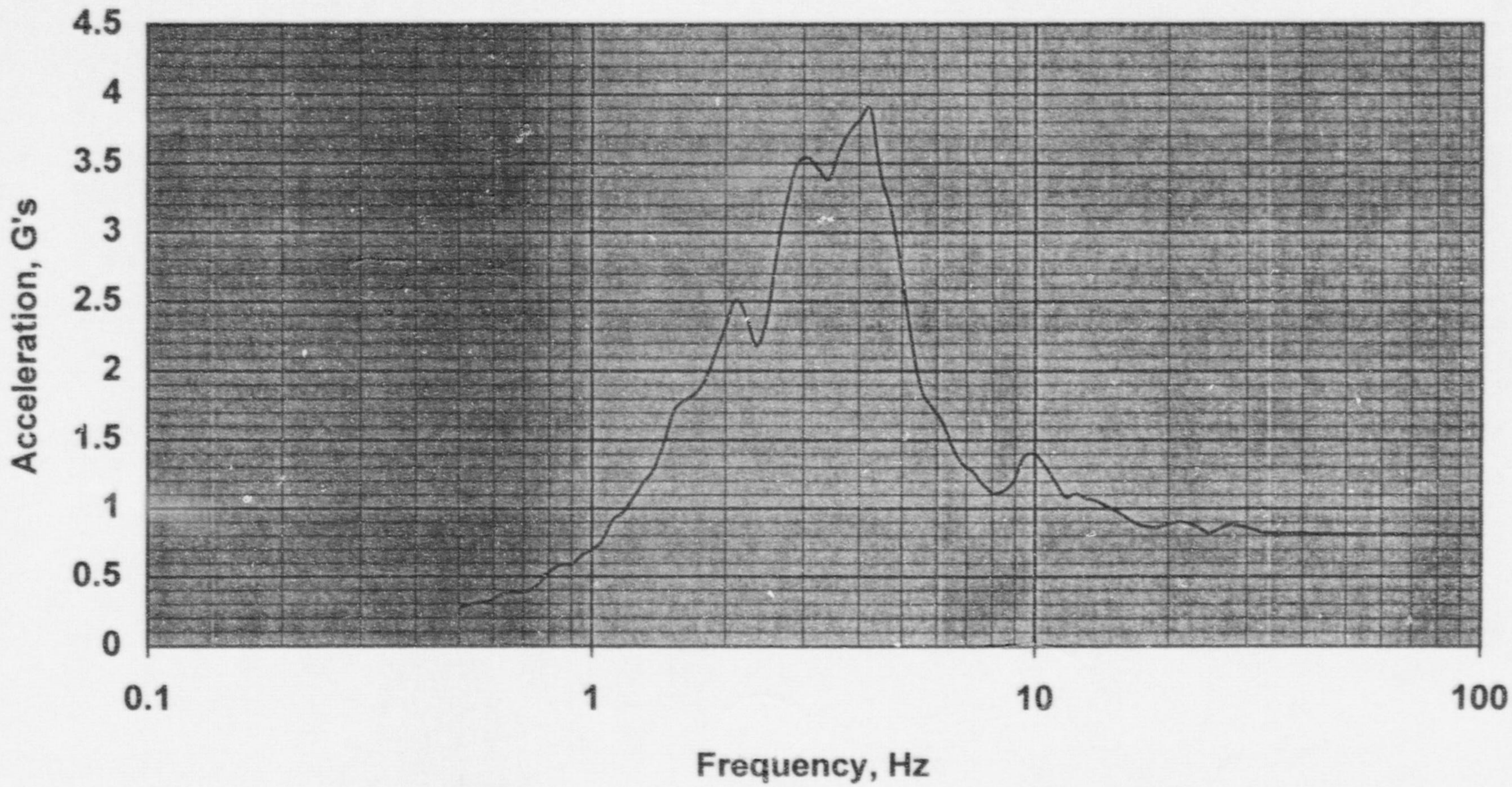
1

Frequency Increment Verification from Friday Output

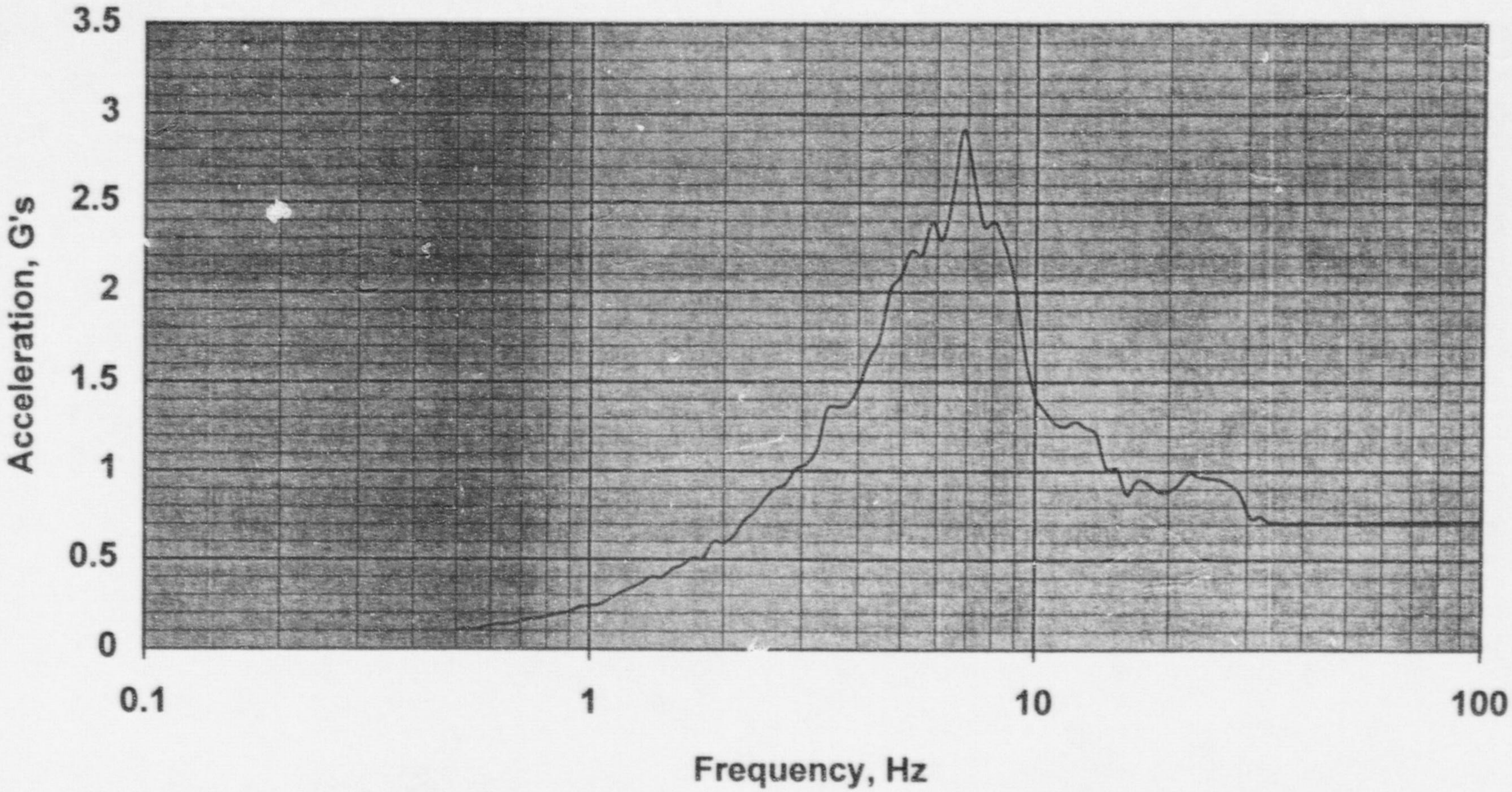
Frequencies Table 3400-1 Hz	Frequency Increments Hz	Frequencies Calculated Hz	Calculated Freq. Increments Hz	Comparison to req. increments	Periods Calculated second
0.5	0.1	0.500	0.027	less than 0.1 hz	2.00000
0.6		0.527	0.029		1.89597
0.7		0.556	0.031		1.79745
0.8		0.587	0.032		1.70386
0.9		0.619	0.034		1.61523
1		0.653	0.036		1.53122
1.1		0.689	0.038		1.45157
1.2		0.727	0.040		1.37607
1.3		0.767	0.042		1.30449
1.4		0.809	0.044		1.23664
1.5		0.853	0.047		1.17231
1.6	0.1	0.900	0.049		1.11134
1.8	0.2	0.949	0.052		1.05353
2		1.001	0.055		0.99873
2.2		1.056	0.058		0.94678
2.4		1.114	0.061		0.89753
2.6		1.175	0.064		0.85085
2.8	0.2	1.240	0.068		0.80659
3.1	0.3	1.308	0.072		0.76464
3.4		1.380	0.076		0.72487
3.7		1.455	0.080		0.68716
4	0.3	1.535	0.084		0.65142
4.5	0.5	1.619	0.089	less than 0.1 hz	0.61753
5		1.708	0.094	less than 0.2 hz	0.58541
5.5		1.802	0.099		0.55496
6		1.901	0.104		0.52610
6.5		2.005	0.110		0.49873
7		2.115	0.116		0.47279
7.5		2.231	0.122		0.44820
8		2.354	0.129		0.42489
8.5		2.483	0.136		0.40279
9	0.5	2.619	0.144		0.38183
10	1	2.763	0.152	less than 0.2 hz	0.36197
11		2.914	0.160	less than 0.3 hz	0.34315
12		3.074	0.169		0.32530
13		3.243	0.178		0.30838
14		3.421	0.188		0.29234
15		3.608	0.198		0.27713
16	1	3.806	0.209		0.26272
18	2	4.015	0.220	less than 0.3 hz	0.24905
20		4.235	0.232	less than 0.5 hz	0.23610

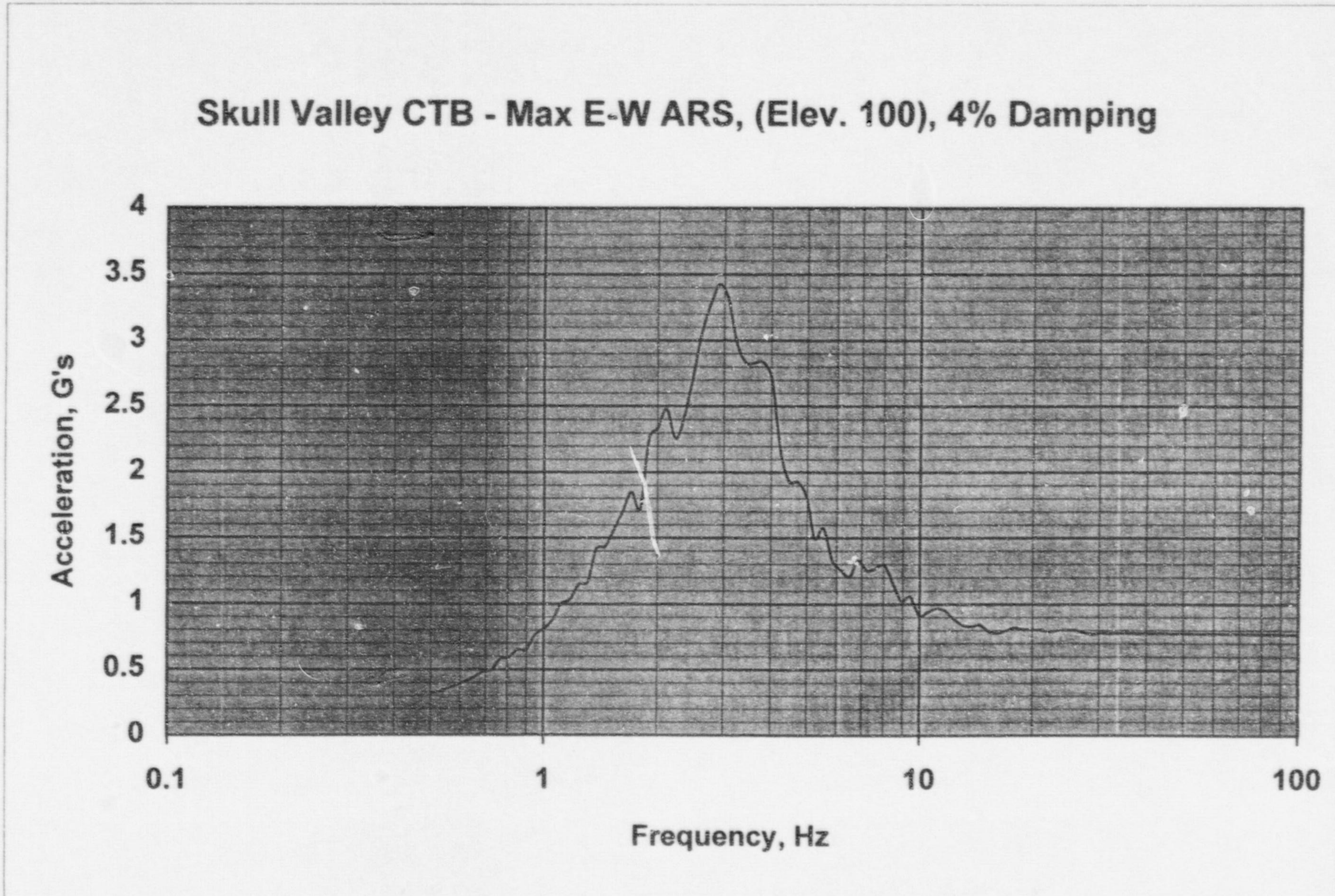
Frequencies Table 3400-1 Hz	Frequency Increments Hz	Frequencies Calculated Hz	Calculated Freq. Increments Hz	Comparison to req. increments	Periods Calculated second
22	2	4.468	0.245	less than 0.5 hz	0.22382
25	3	4.713	0.258		0.21217
28		4.972	0.273		0.20114
31		5.244	0.288		0.19068
34	3	5.532	0.303		0.18076
		5.836	0.320		0.17136
		6.156	0.338		0.16244
		6.494	0.356		0.15399
		6.850	0.376		0.14598
		7.226	0.397		0.13839
		7.623	0.418		0.13119
		8.041	0.441		0.12437
		8.482	0.465		0.11790
		8.947	0.491	less than 0.5 hz	0.11177
		9.438	0.518	less than 1 hz	0.10595
		9.956	0.546		0.10044
		10.502	0.577		0.09522
		11.079	0.607		0.09026
		11.686	0.641		0.08557
		12.327	0.676		0.08112
		13.004	0.714		0.07690
		13.717	0.752		0.07290
		14.470	0.795		0.06911
		15.265	0.838		0.06551
		16.103	0.884	less than 1 hz	0.06210
		16.987	0.931	less than 2 hz	0.05887
		17.918	0.982		0.05581
		18.900	1.036		0.05291
		19.936	1.094		0.05016
		21.030	1.157		0.04755
		22.188	1.215	less than 2 hz	0.04507
		23.403	1.283	less than 3 hz	0.04273
		24.685	1.356		0.04051
		26.042	1.431		0.03840
		27.473	1.505		0.03640
		28.977	1.595		0.03451
		30.572	1.676		0.03271
		32.248	1.766		0.03101
		34.014		less than 3 hz	0.02940

Skull Valley CTB - Max N-S ARS, (El. 100), 4% Damping

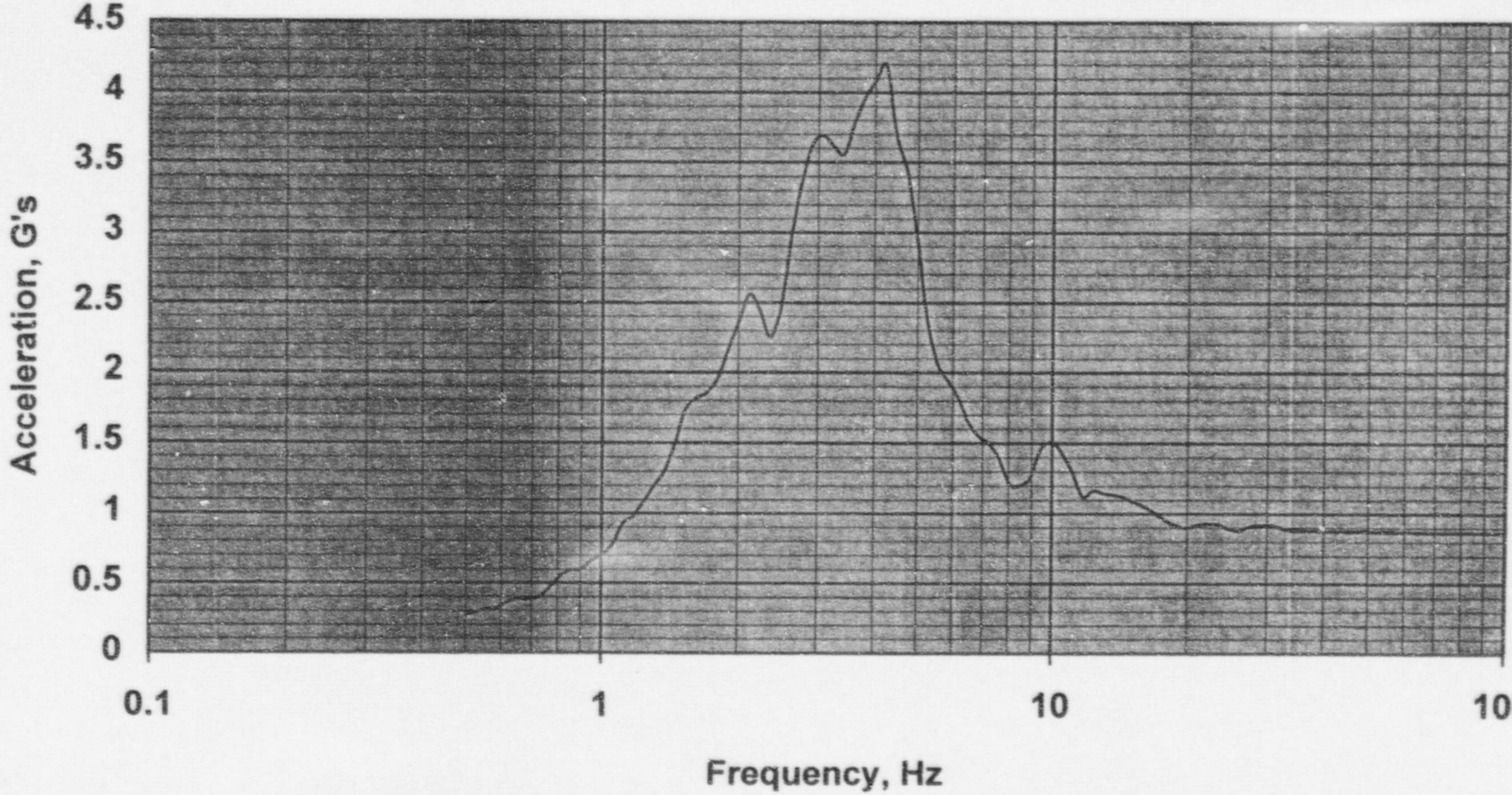


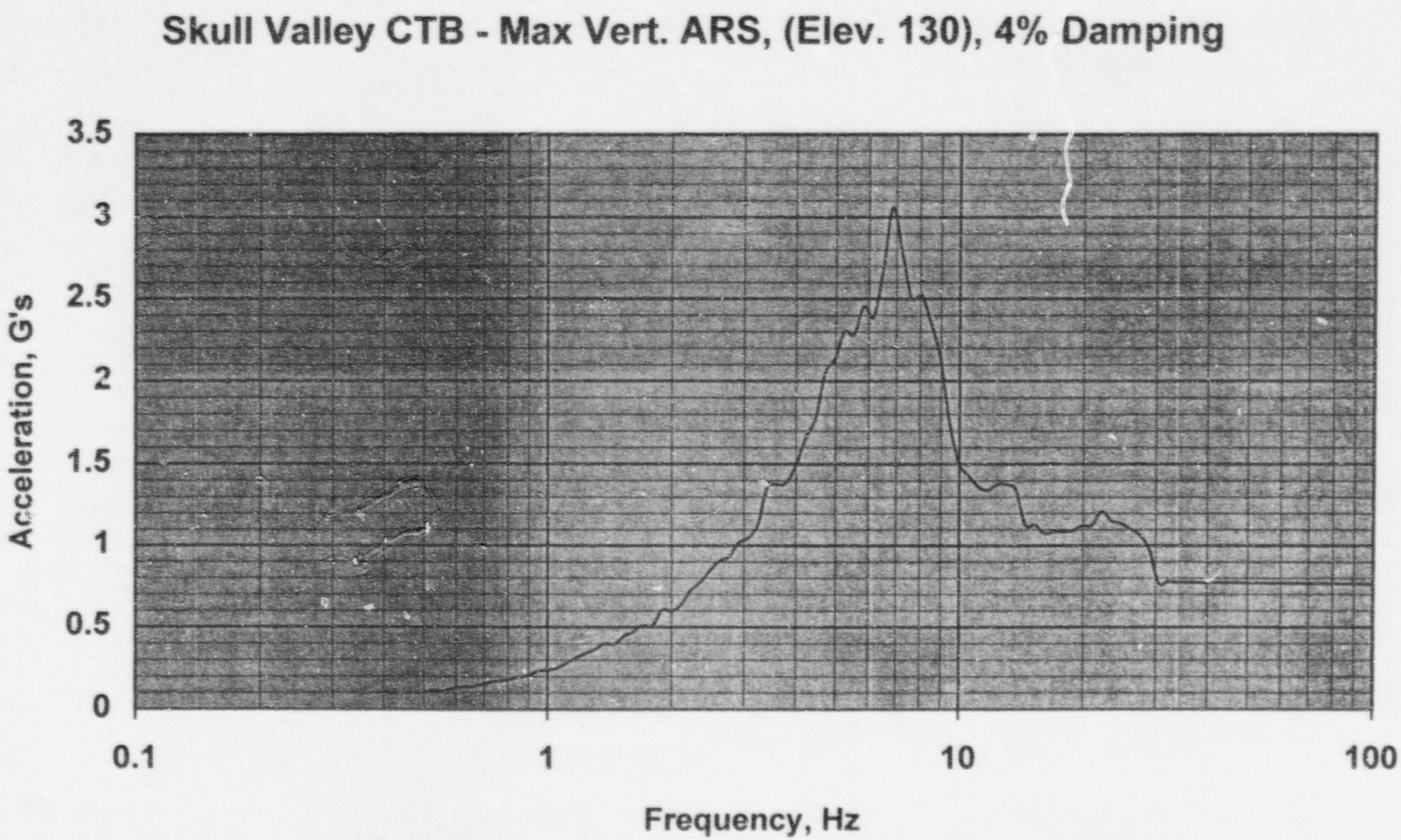
Skull Valley CTB - Max Vert. ARS, (Elev. 100), 4% Damping



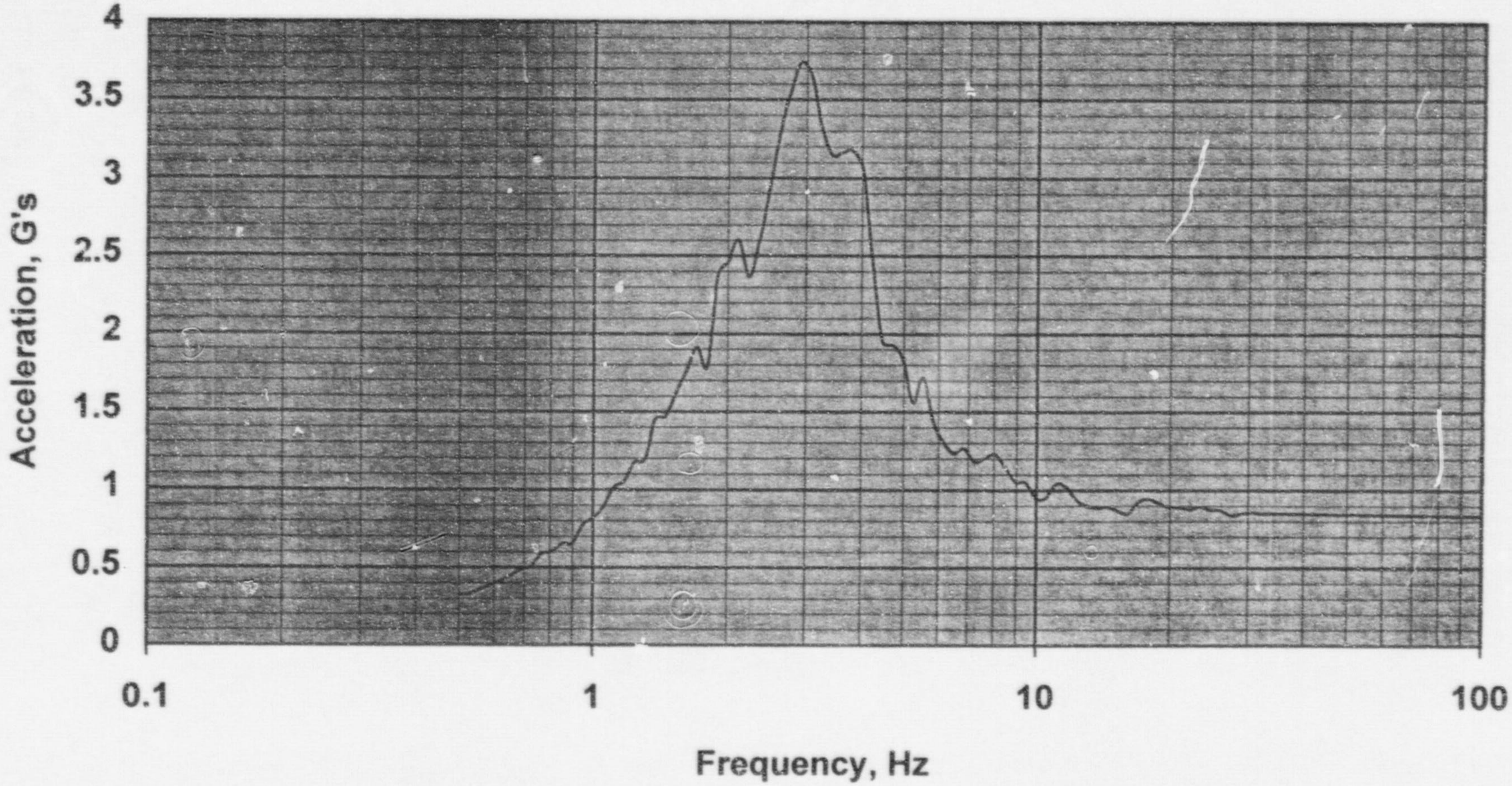

Skull Valley CTB - Max E-W ARS, (Elev. 100), 4% Damping
Acceleration, G's
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz

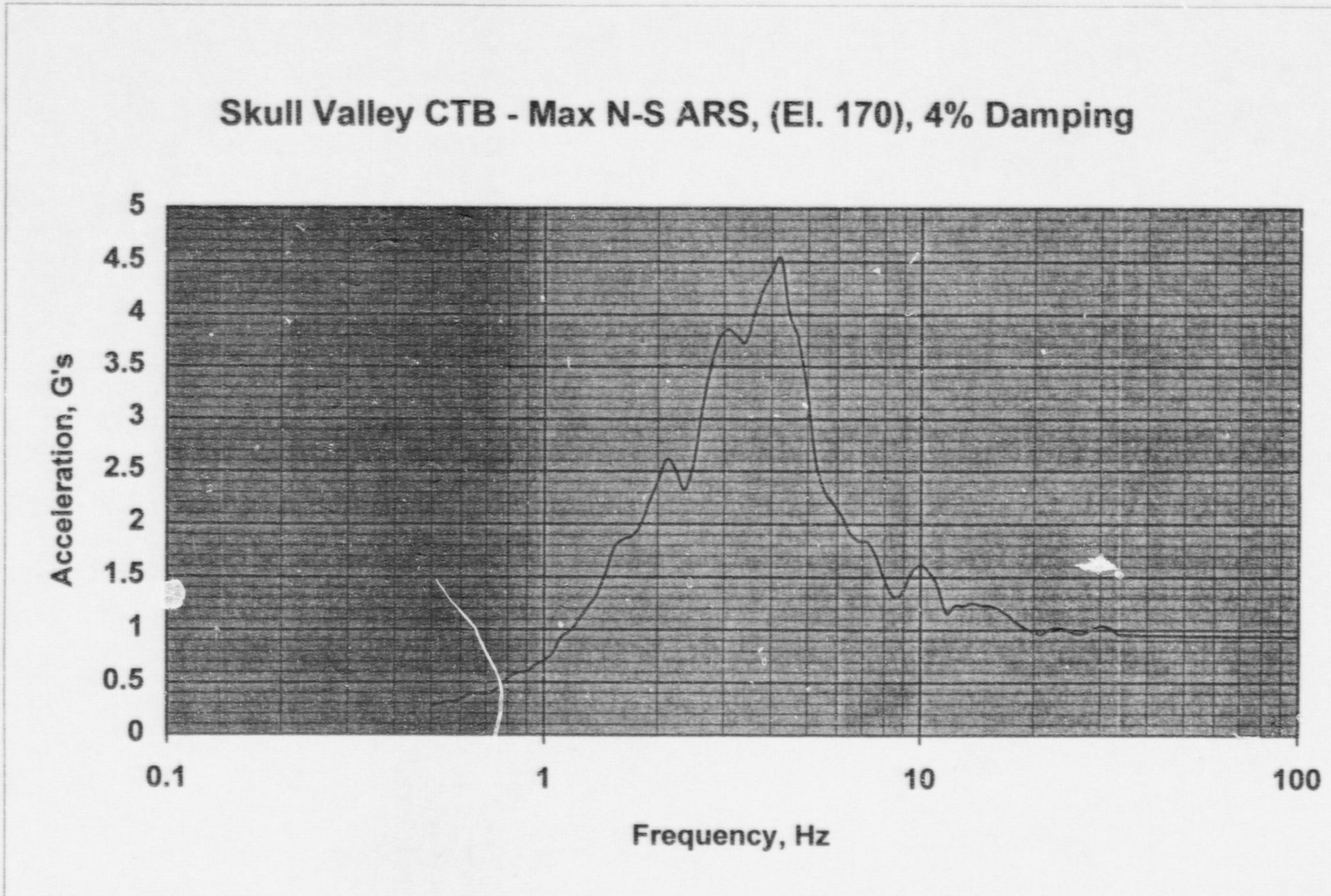
Skull Valley CTB - Max N-S ARS, (El. 130), 4% Damping

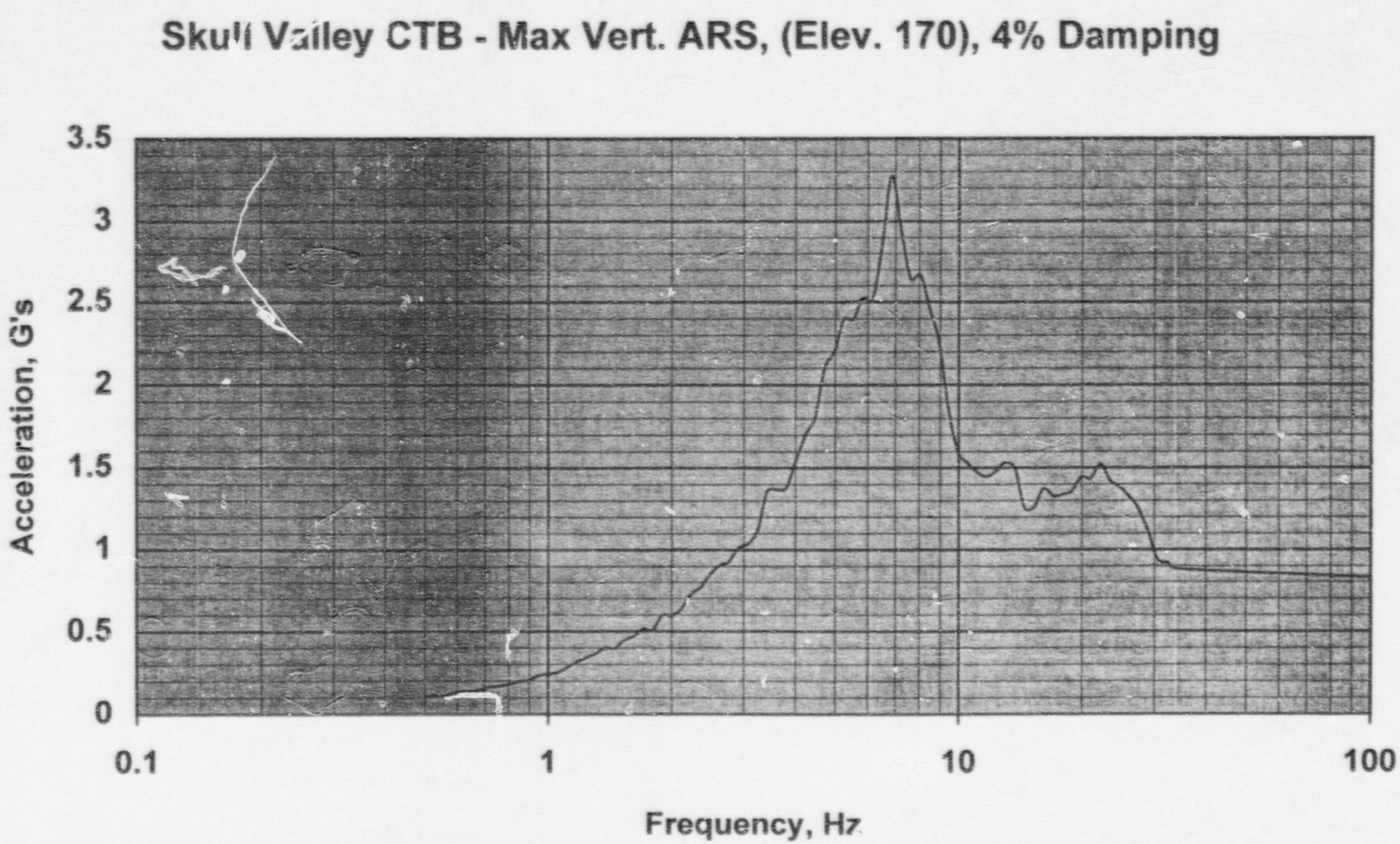



Skull Valley CTB - Max Vert. ARS, (Elev. 130), 4% Damping
Acceleration, G's
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz

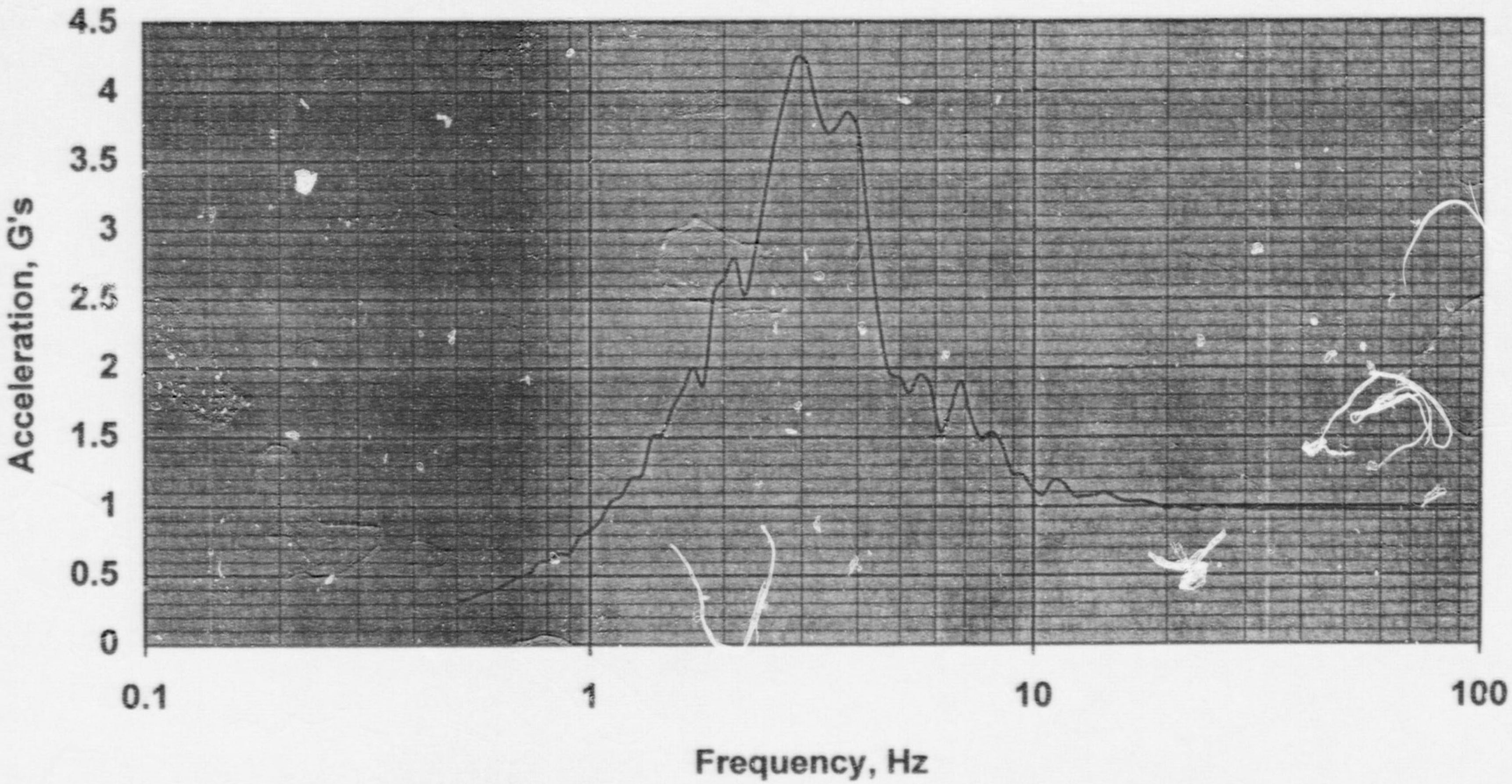
Skull Valley CTB - Max E-W ARS, (Elev. 130), 4% Damping

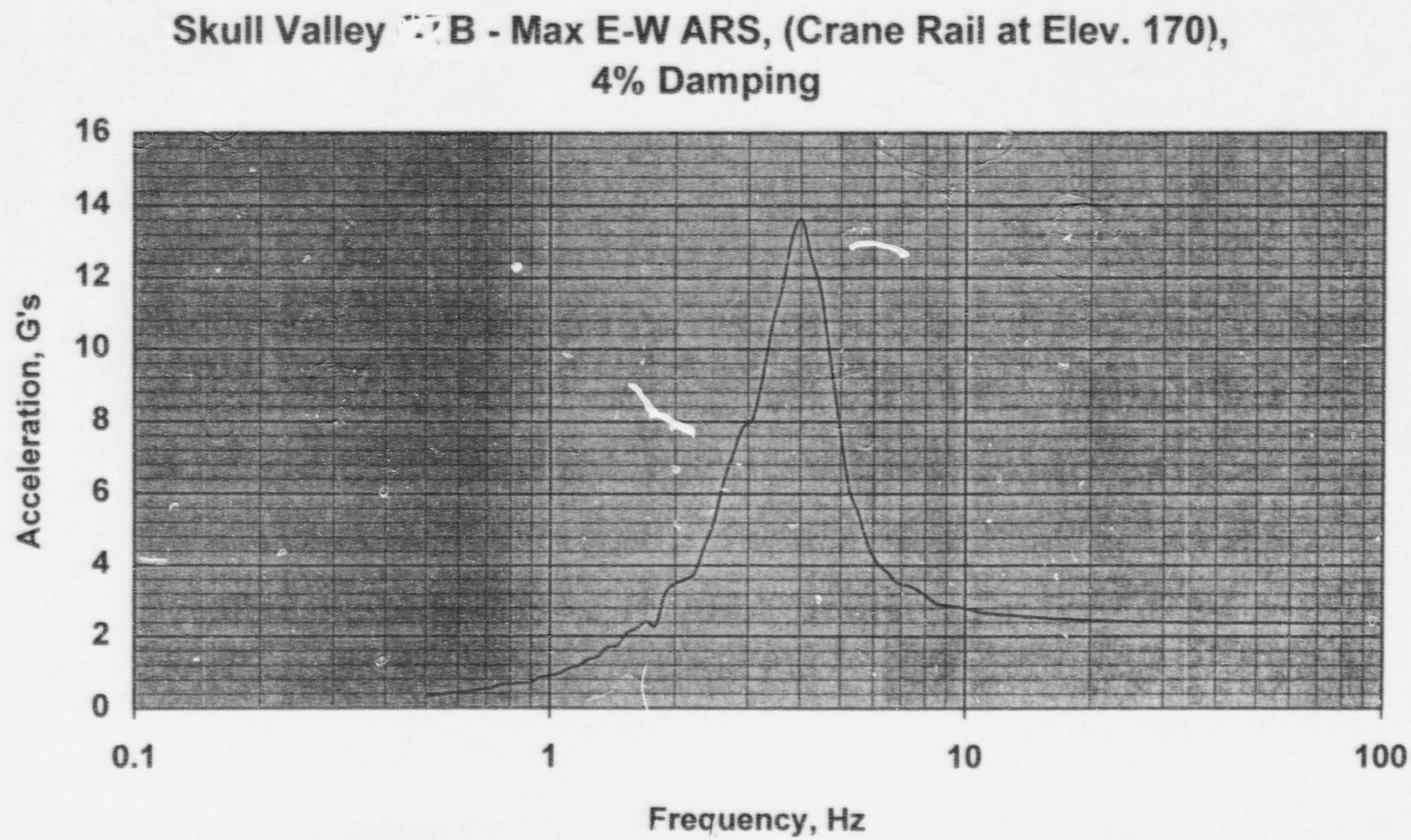



Skull Valley CTB - Max N-S ARS, (El. 170), 4% Damping
Acceleration, G's
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz


Skull Valley CTB - Max Vert. ARS, (Elev. 170), 4% Damping
3.5
3
2.5
2
1.5
1
0.5
0
Acceleration, G's
0.1
1
10
100
Frequency, Hz

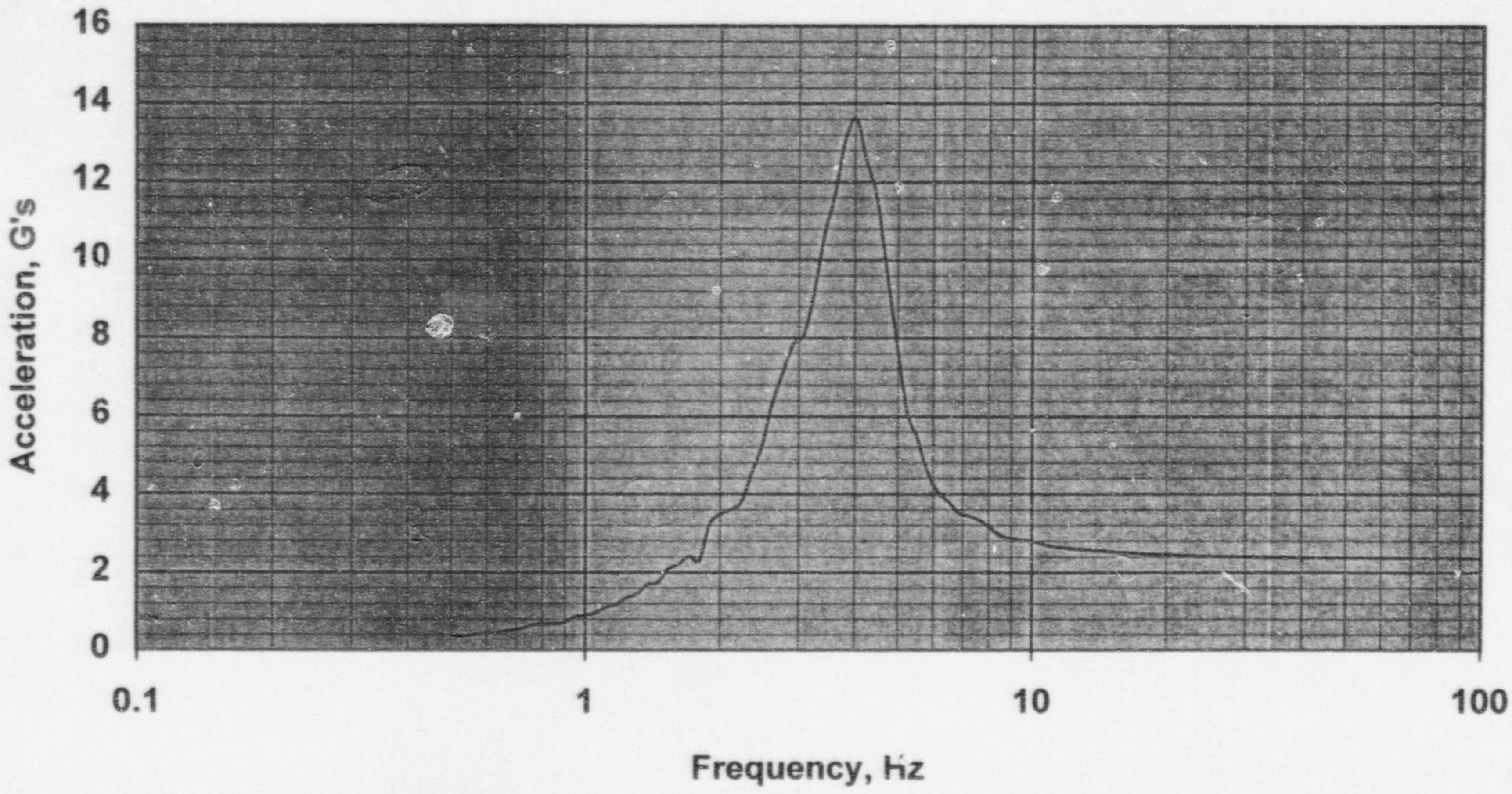
Skull Valley CTB - Max E-W ARS, (Elev. 170), 4% Damping

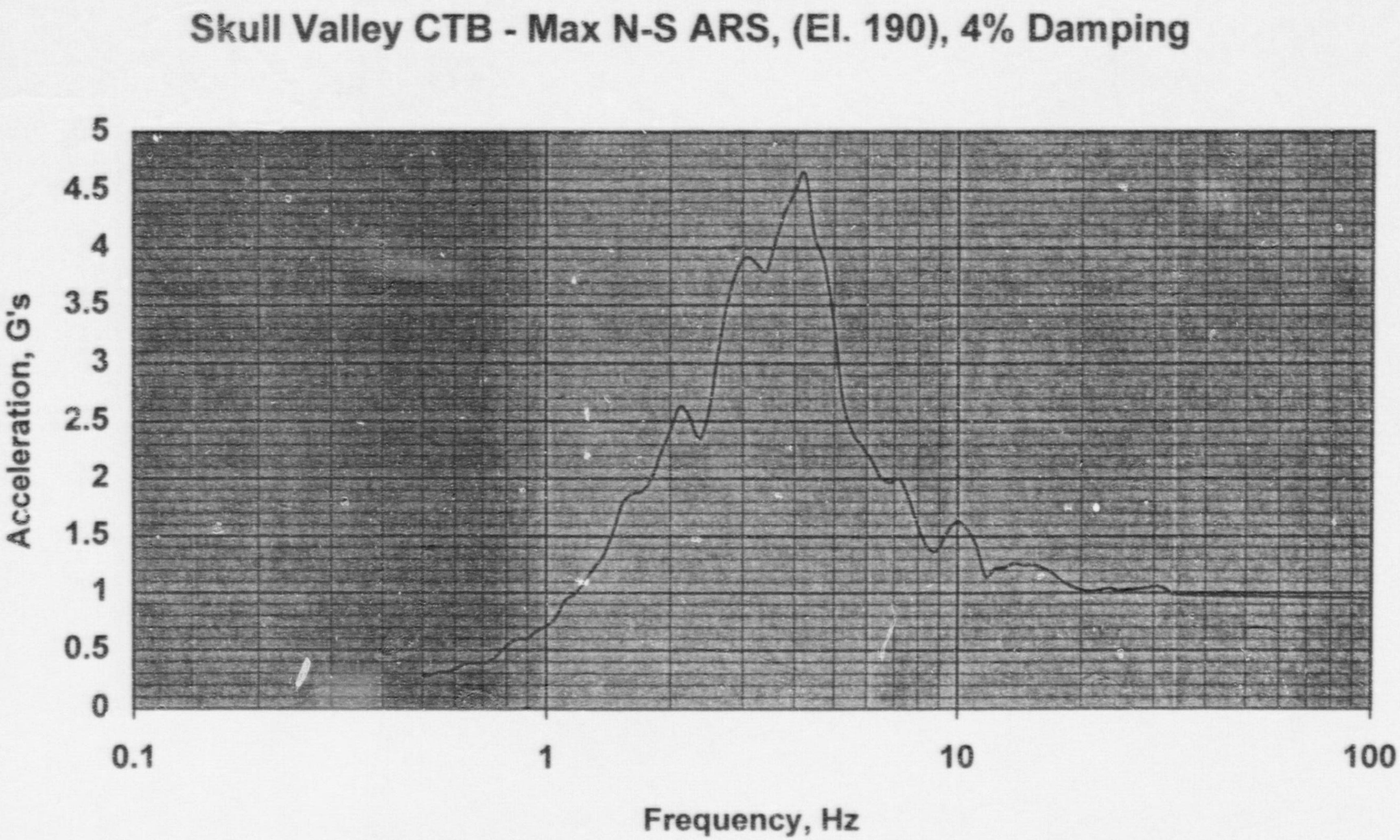




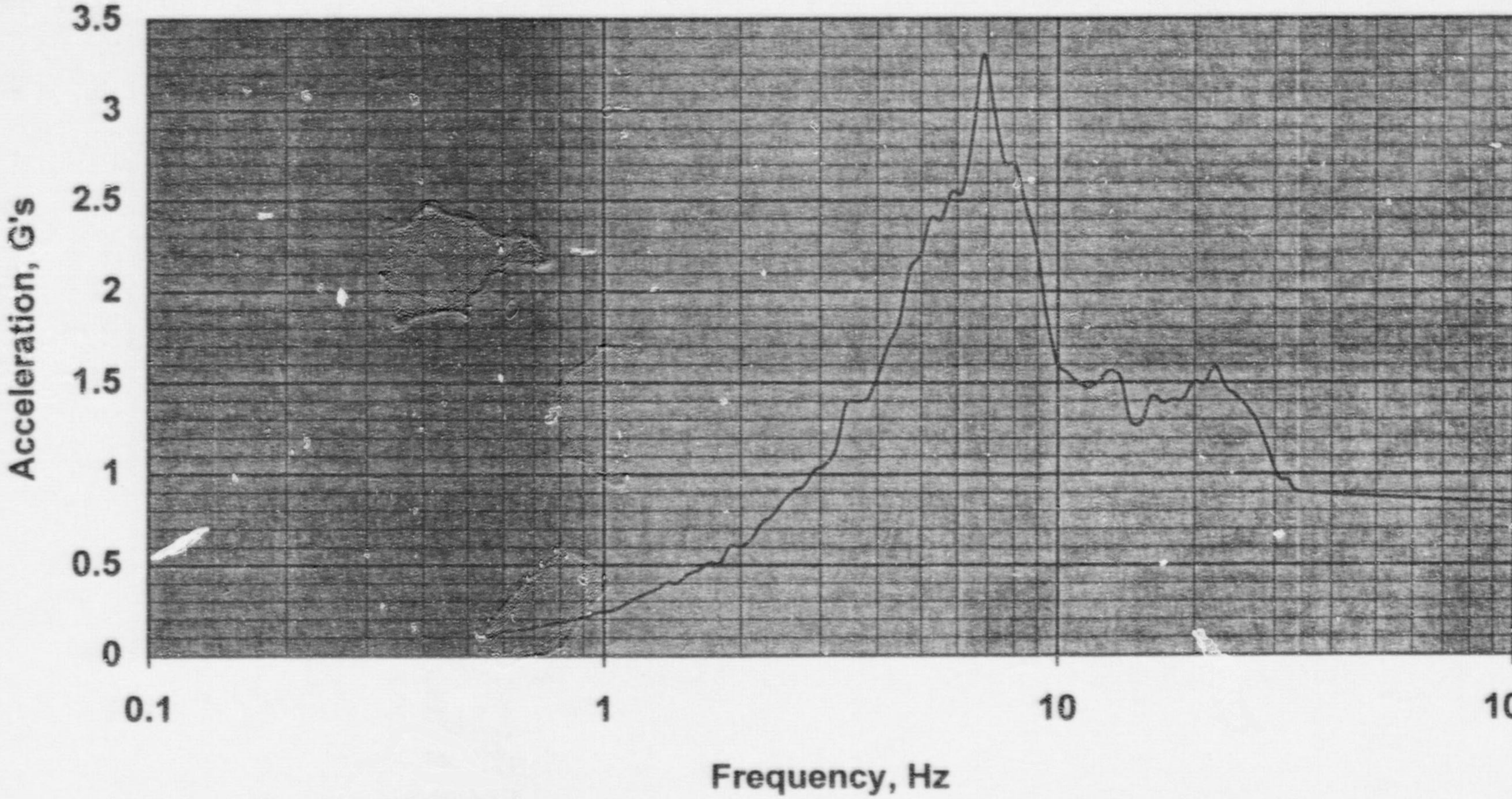
Skull Valley [illegible] B - Max E-W ARS, (Crane Rail at Elev. 170),
4% Damping
16
14
12
10
8
6
4
2
0
Acceleration, G's
0.1
1
10
100
Frequency, Hz

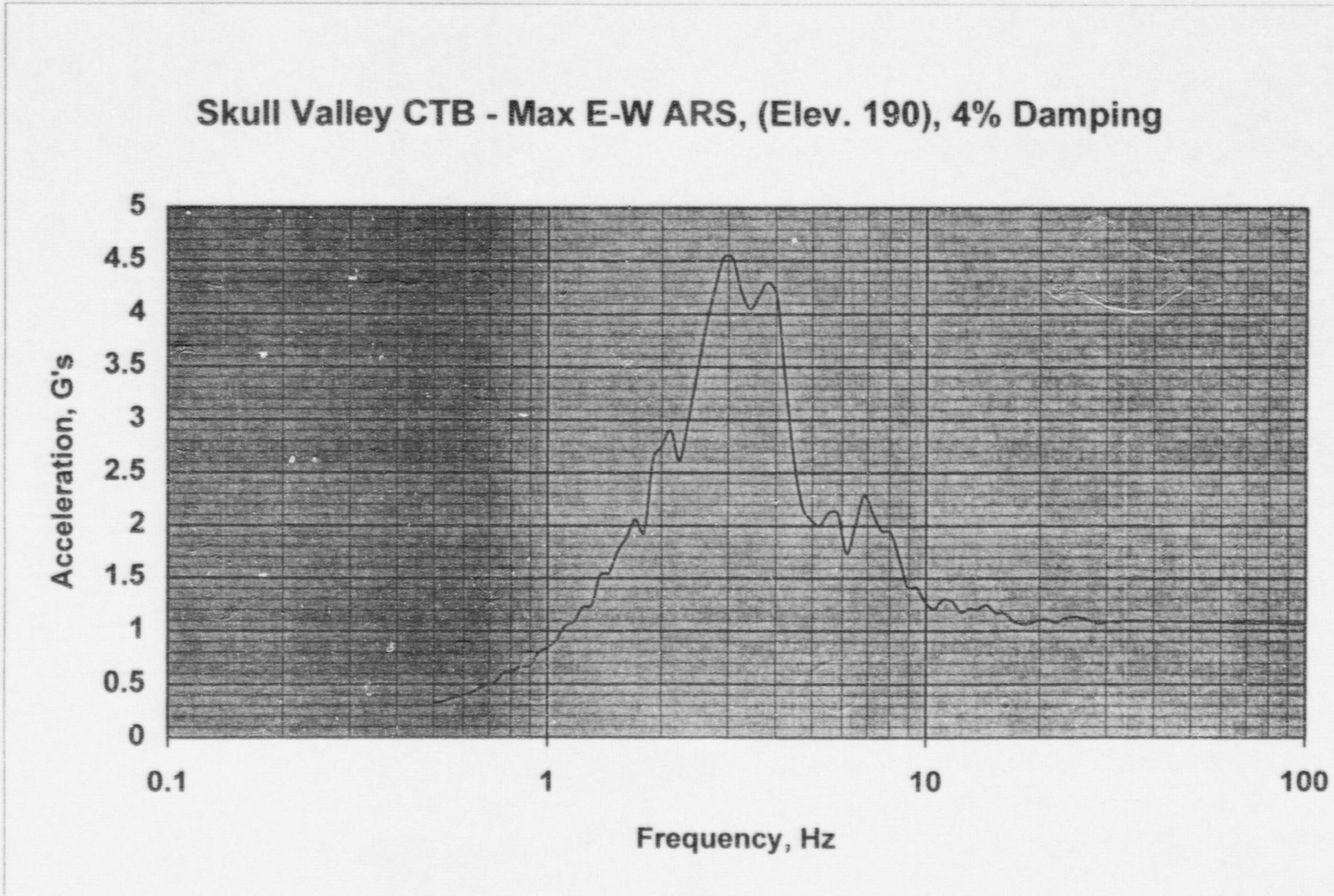
Skull Valley CTB - Max E-W ARS, (Elev. 170), 4% Damping
(Envelope of Crane Rail and Building)



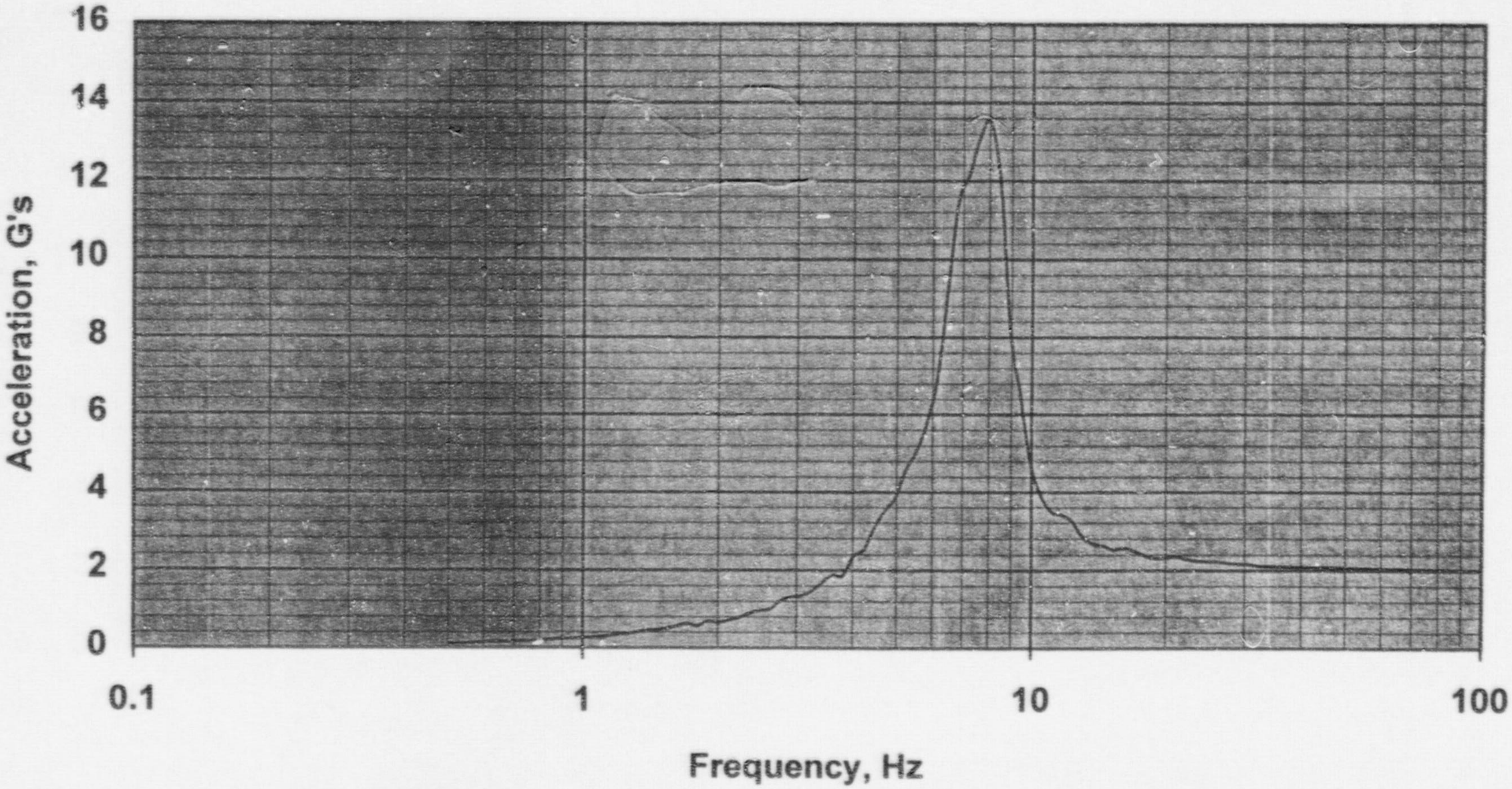

Skull Valley CTB - Max N-S ARS, (El. 190), 4% Damping
Acceleration, G's
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz

Skull Valley CTB - Max Vert. ARS, (Elev. 190), 4% Damping

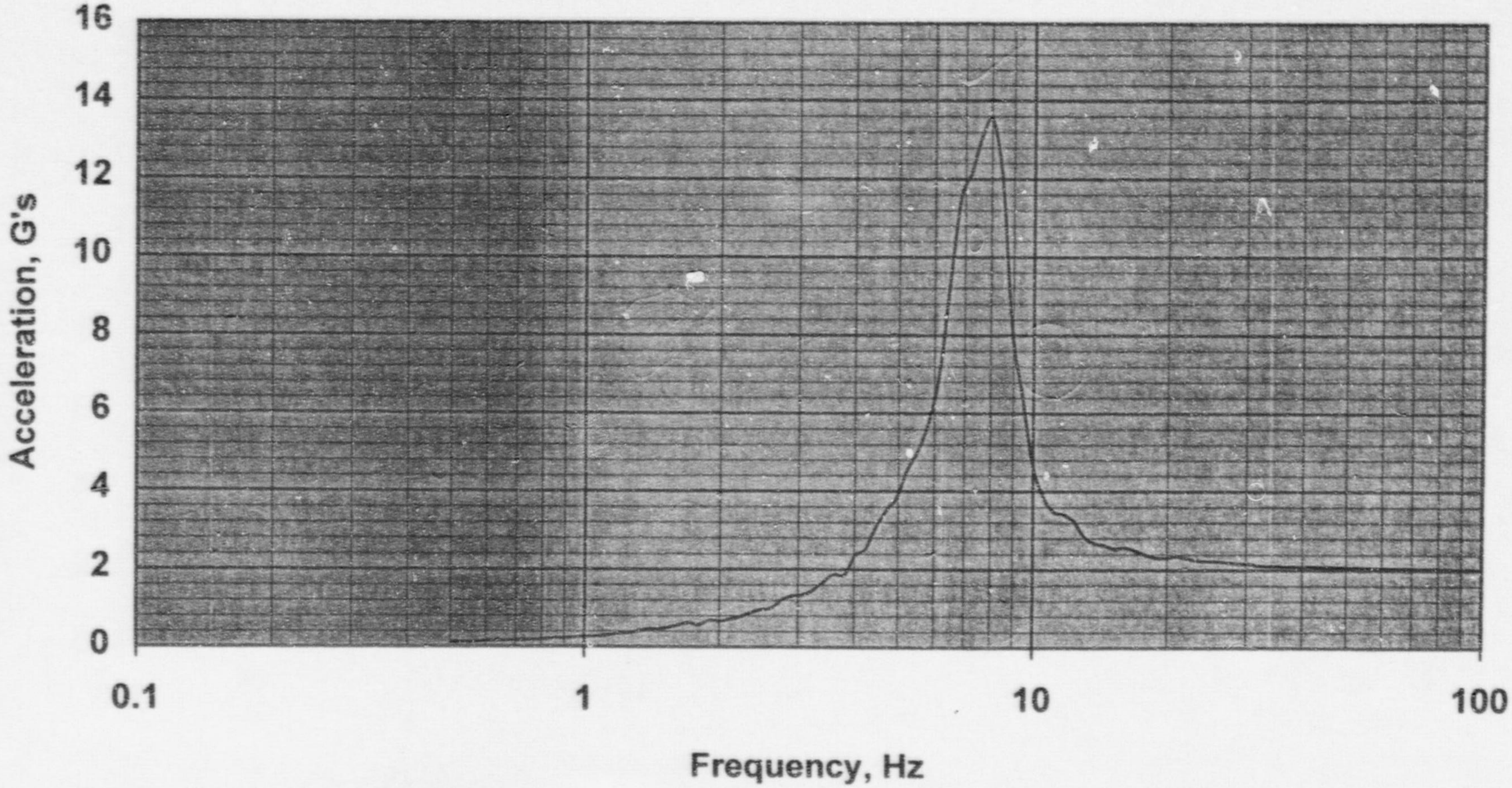



Skull Valley CTB - Max E-W ARS, (Elev. 190), 4% Damping
Acceleration, G's
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0.1
1
10
100
Frequency, Hz

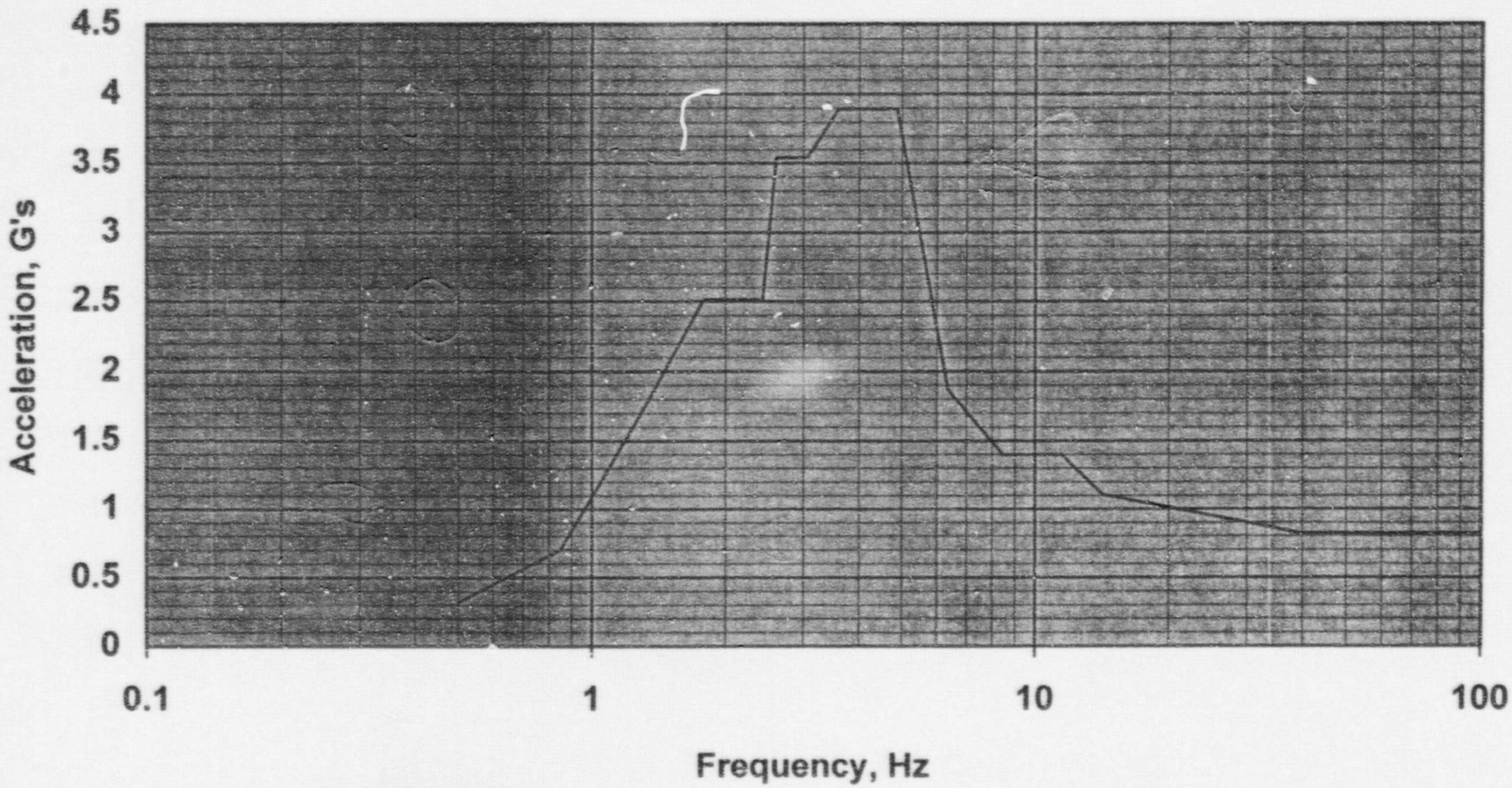
Skull Valley CTB - Max Vert. ARS, (Roof at Elev. 190), 4% Damping

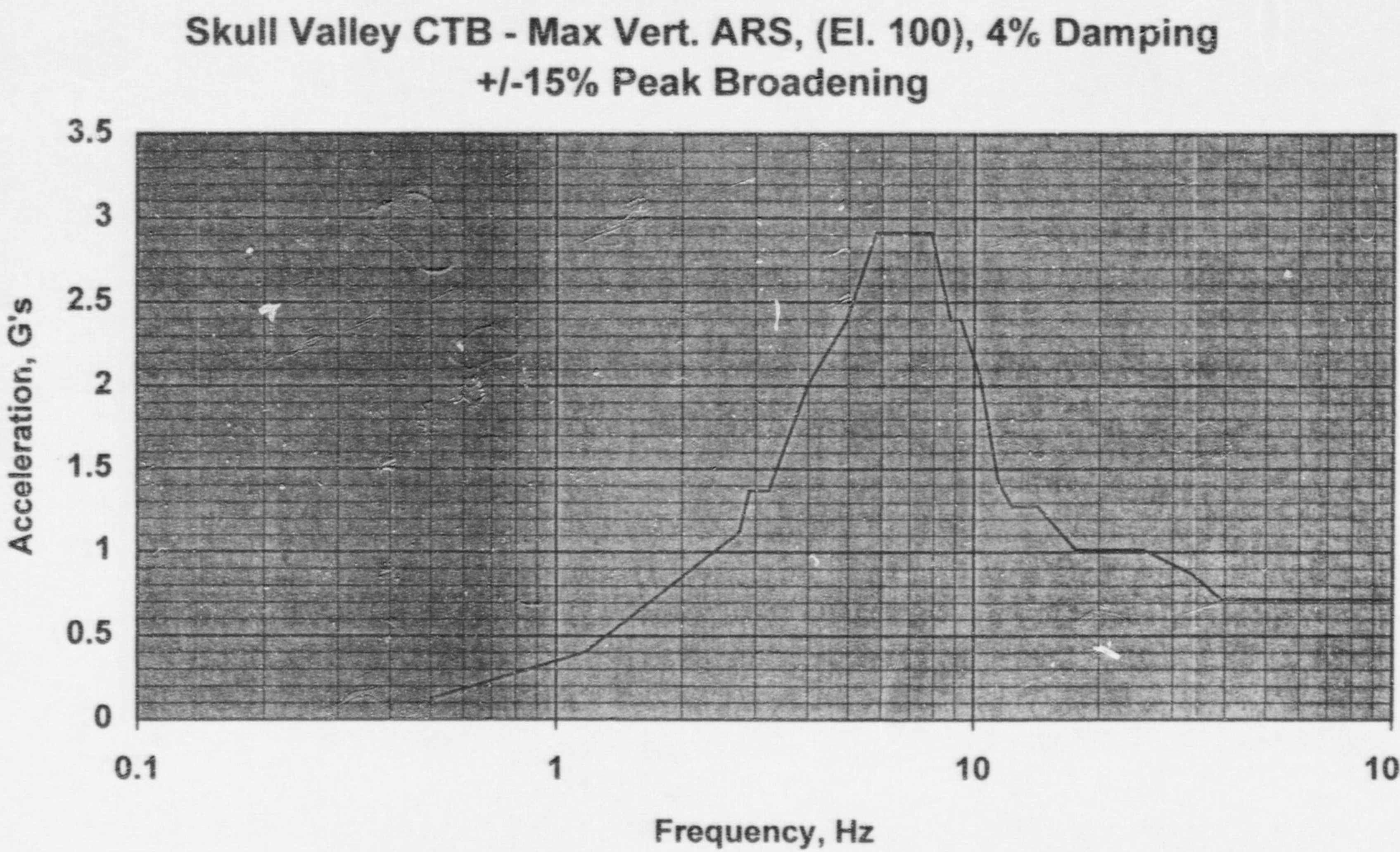


Skull Valley CTB - Max Vert. ARS, (Elev. 190), 4% Damping,
(Envelope of Roof and Building)

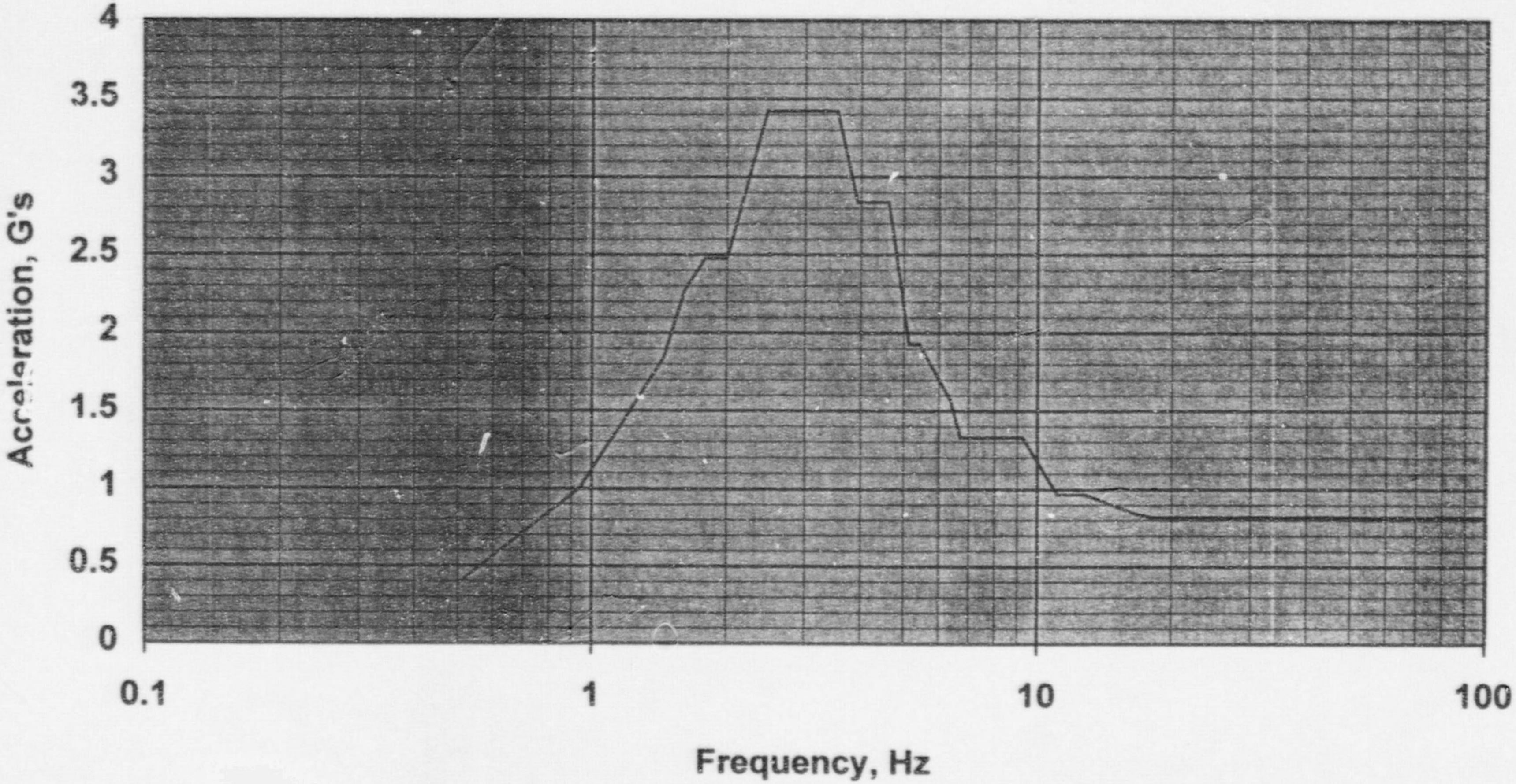


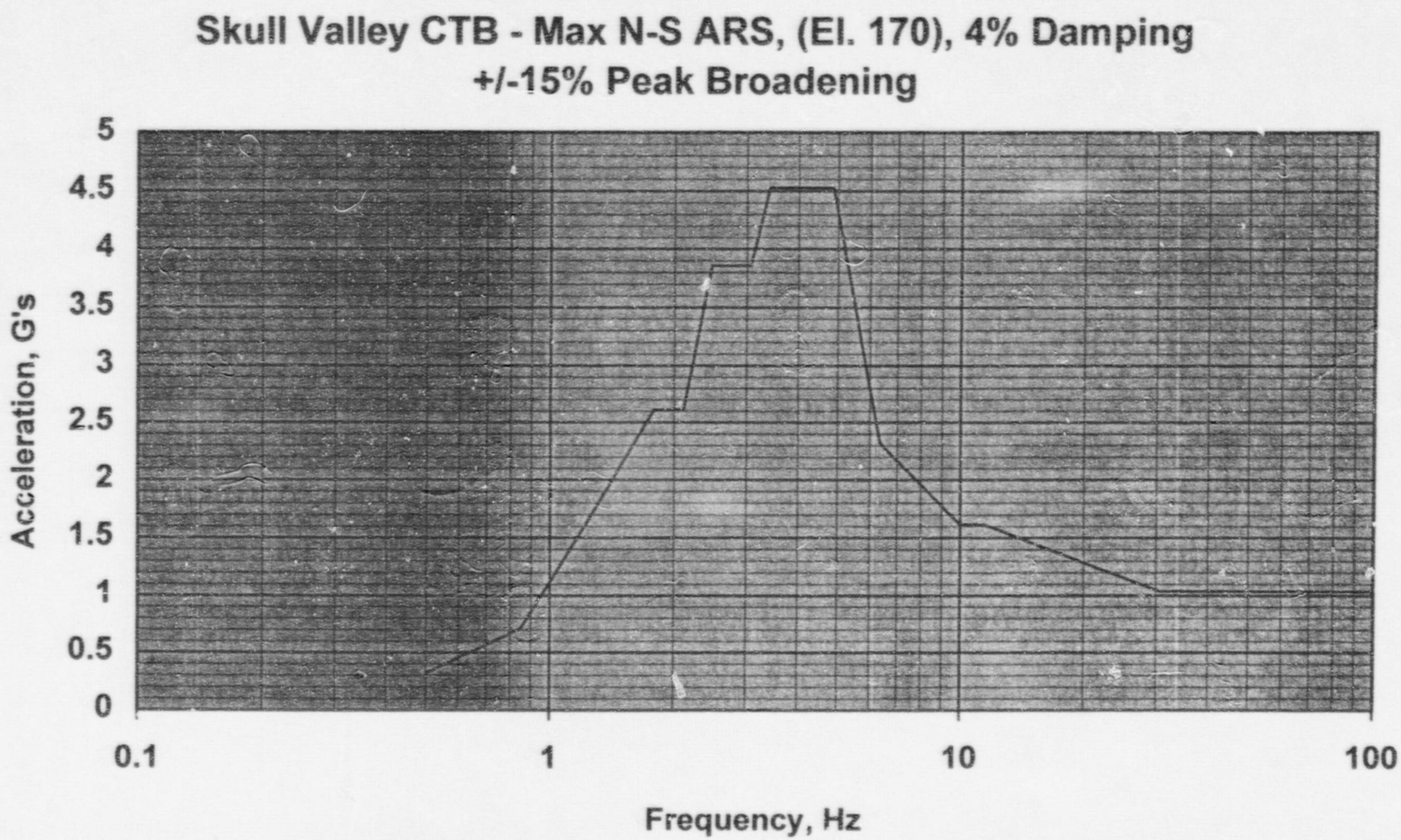
Skull Valley CTB - Max N-S ARS, (El. 100), 4% Damping
+/-15% Peak Broadening

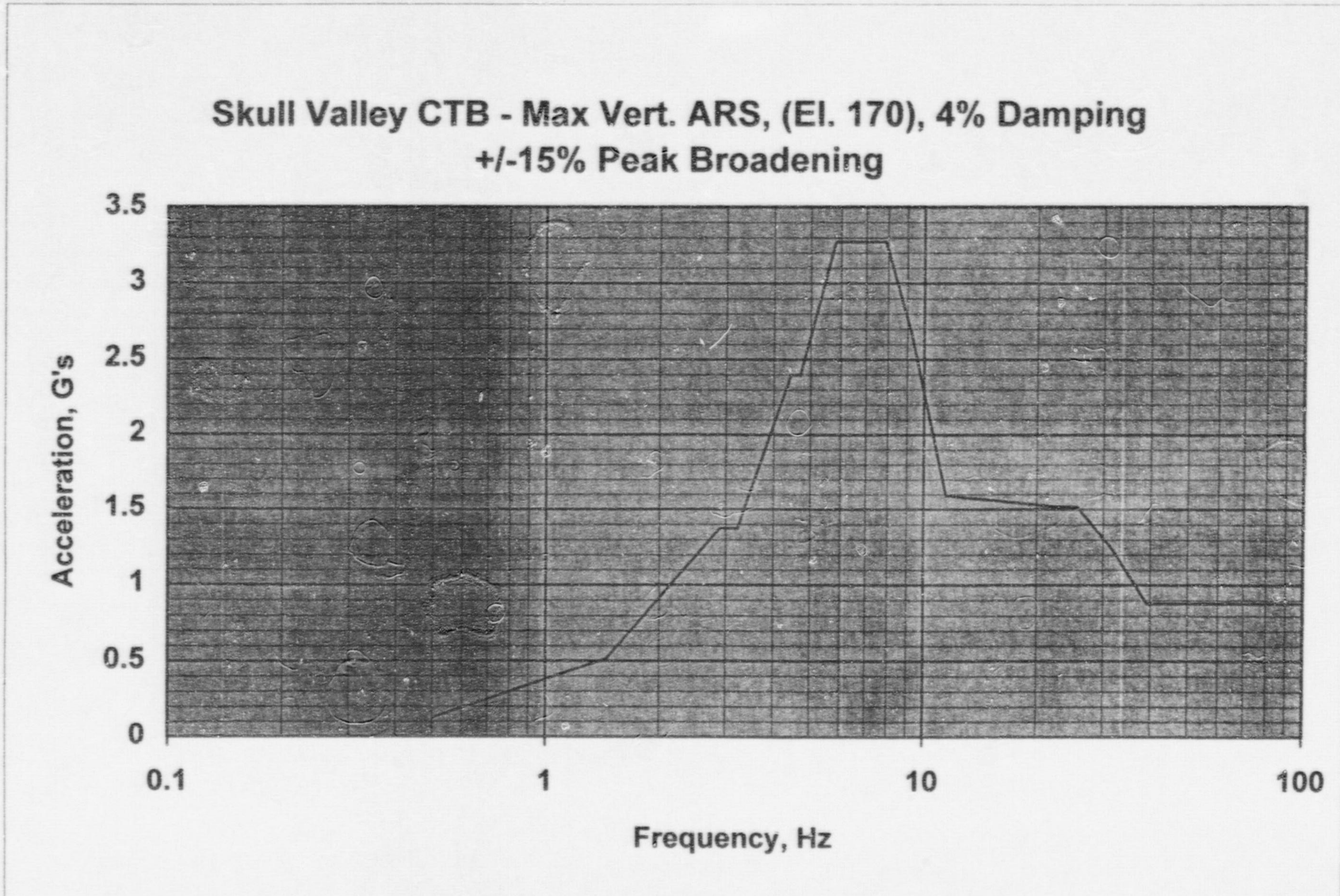



Skull Valley CTB - Max Vert. ARS, (El. 100), 4% Damping
+/-15% Peak Broadening
Acceleration, G's
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz

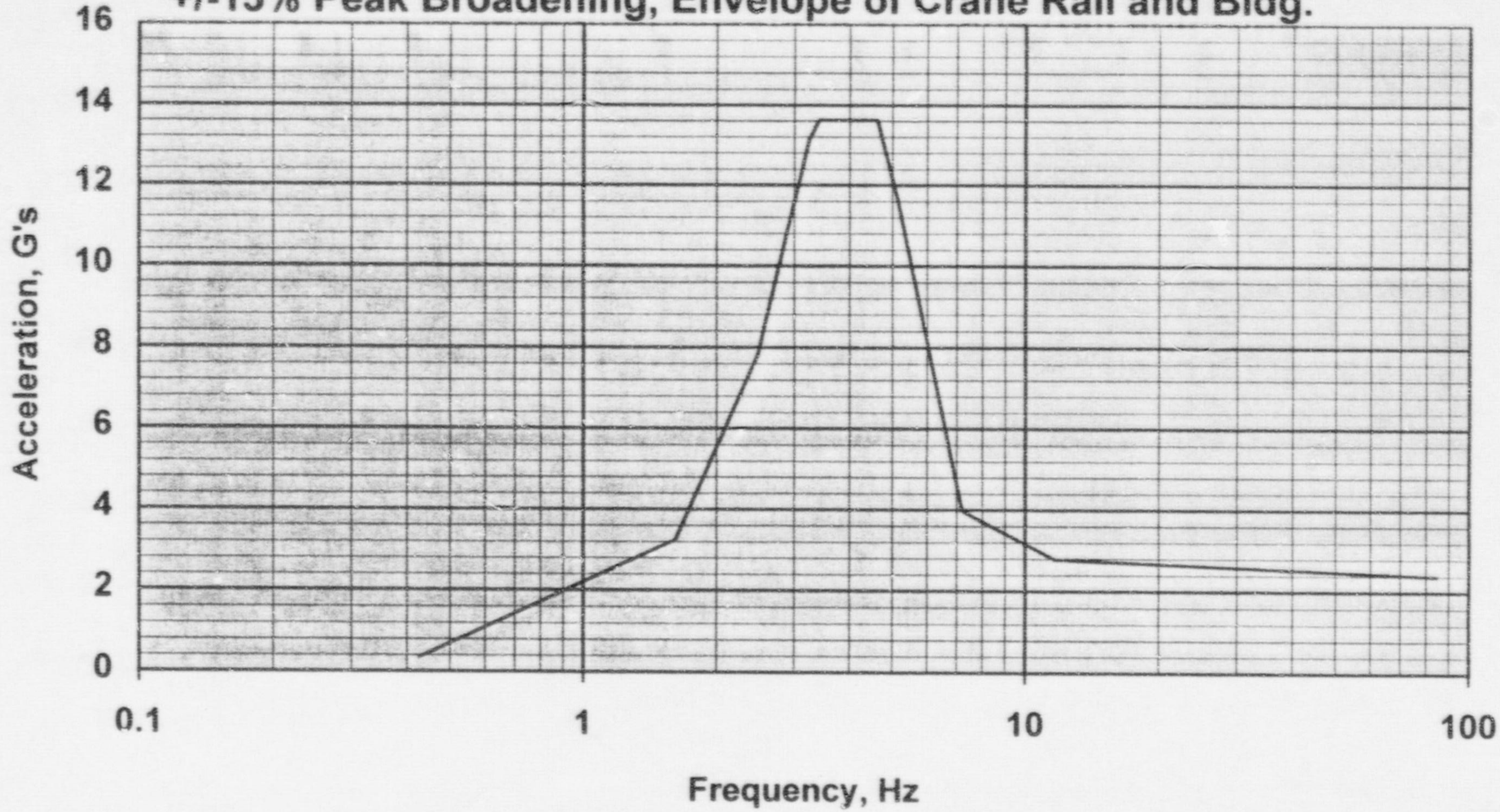
Skull Valley CTB - Max E-W ARS, (El. 100), 4% Damping +/-15% Peak Broadening




Skull Valley CTB - Max N-S ARS, (El. 170), 4% Damping
+/-15% Peak Broadening
Acceleration, G's
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.1
1
10
100
Frequency, Hz


Skull Valley CTB - Max Vert. ARS, (El. 170), 4% Damping
+/-15% Peak Broadening
Acceleration, G's
0
0.5
1
1.5
2
2.5
3
3.5
0.1
1
10
100
Frequency, Hz

Skull Valley CTB - Max E-W ARS, (El. 170), 4% Damping
+/-15% Peak Broadening, Envelope of Crane Rail and Bldg.



SLIDING AND UPLIFT FORCES

For use in the stability evaluation (Calculation 05996.02-G(B)-13, Rev. 1), horizontal and vertical forces are tabulated. Since the accelerations are highest for the high range soil case, only these results need be tabulated.

JOINT	EL.	MASS X	MASS Y	MASS Z	Ax	Ay	Az	SHEAR X	UPLIFT	SHEAR Z
1	95	1257.0	1257.0	1257.0	0.805	0.720	0.769	32583	29142	31126
2	130	490.7	490.7	490.7	0.864	0.764	0.834	13652	12072	13178
3	170	299.2	299.2	157.0	0.939	0.829	0.966	9047	7987	4884
4	190	219.8	166.9	219.8	0.955	0.839	1.067	6759	4509	7552
5	190	0.0	52.9	0.0	0.000	2.013	0.000	0	3429	0
6	170	0.0	0.0	142.2	0.000	0.000	2.366	0	0	10834
							TOTAL	62040	57139	67572
			WEIGHT	72988						

Additionally, acceleration time histories at the mat-soil interface (node 1 of the model) are required for the stability evaluation. An additional FRIDAY analysis was performed to generate these acceleration time histories. Again, since the accelerations for the high range soil case exceed those for the best estimate and low range soil cases, the high range results were provided. A text file of this analysis is included in Attachment D. The time histories were stored in the main frame disk file DSN=STRUCTRL.BEE.NODE1TH.

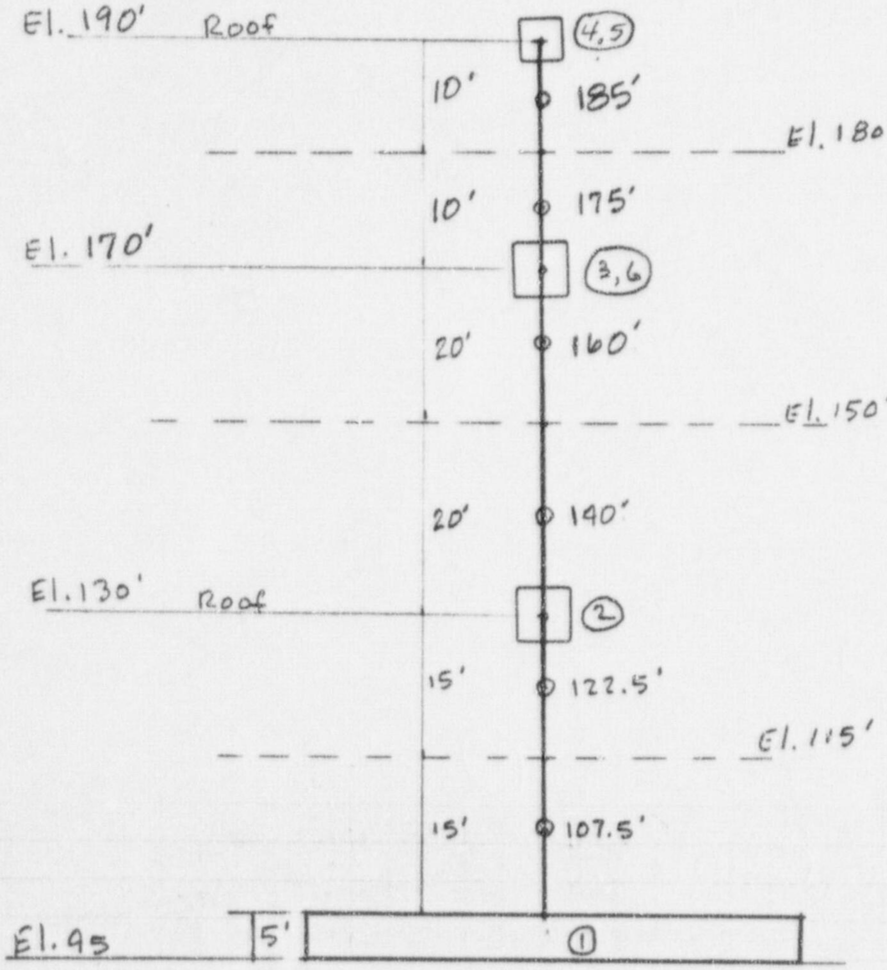
The maximum horizontal velocities of the mat (node 1 of the model) were also requested. To obtain this information, the acceleration time histories described above were used as input to the program INTBSL (Ref. 11), which among other things calculates the velocity time history and maximum velocity. Results are included in Attachment D. The maximum velocity in the X direction (N-S) is 21.7 in/sec and the maximum velocity in the Z direction (E-W) is 19.8 in/sec.

Attachment A Building Masses

The building masses are distributed at elevations 100', 130' 170' and 190'. The masses, centroid of masses, and mass moment of inertia are calculated at each elevation using SWEC computer program MASS. The attributed masses to each mass point location from walls, roofs and mat are shown on the attached sketches. The computer input and output are also attached.

Notice that the origin of the coordinate system is located on the north side of the building at the intersection of column lines 1 and D. The x axis points toward south and y axis toward east. The z axis points vertically upward.

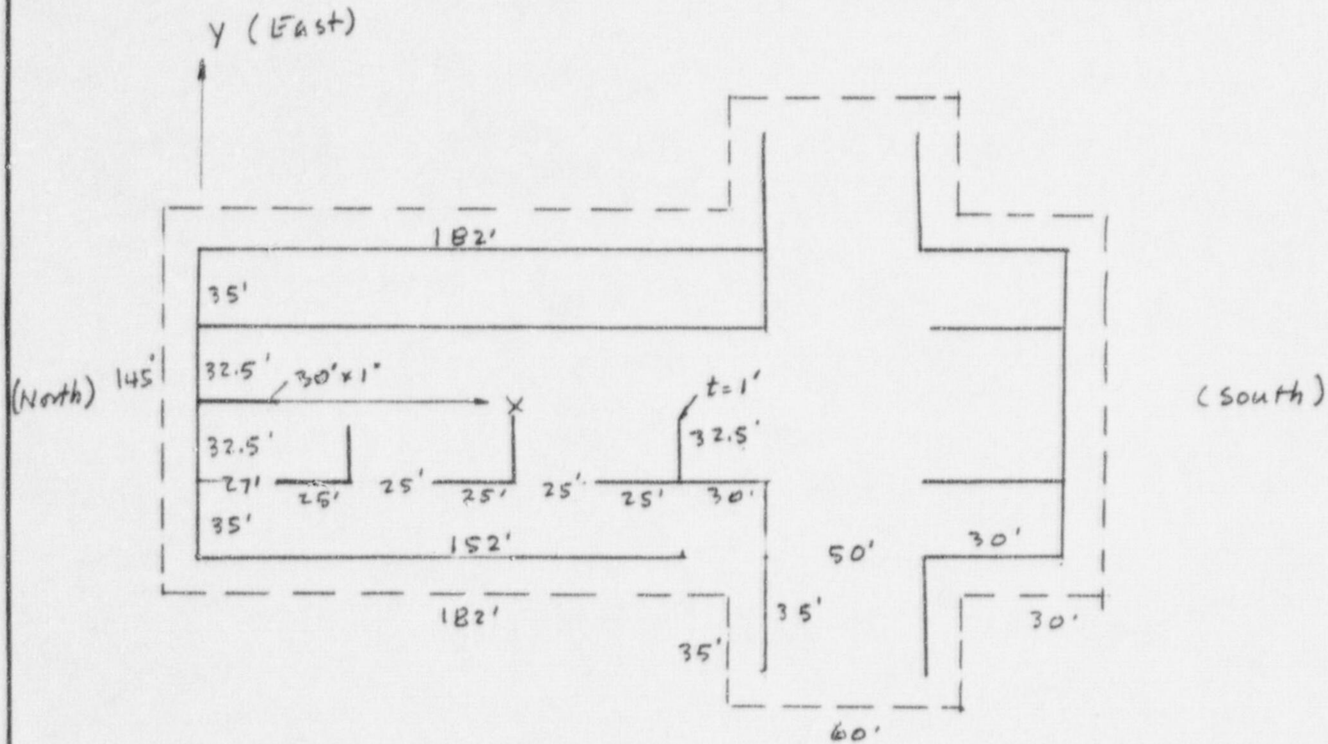
Estimate Building Mass



Masses @ El. 100'

--- mat

—— Wall (El. 100' – 130')



CALCULATION SHEET

5010.61

STONE & WEBSTER ENGINEERING CORPORATION

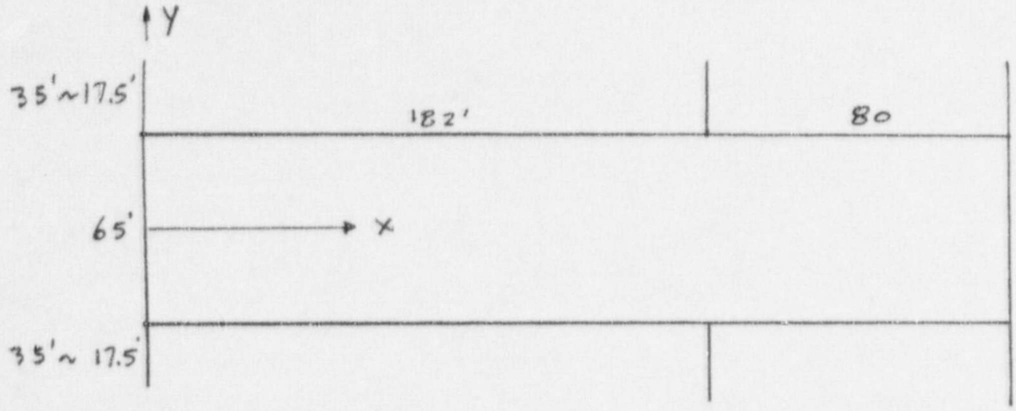
J.O./W.O./CALCULATION NO.	REVISION	PAGE
0599602-SC-5	0	A-4

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98	A. Grant 6/22/98	[illegible] 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	I

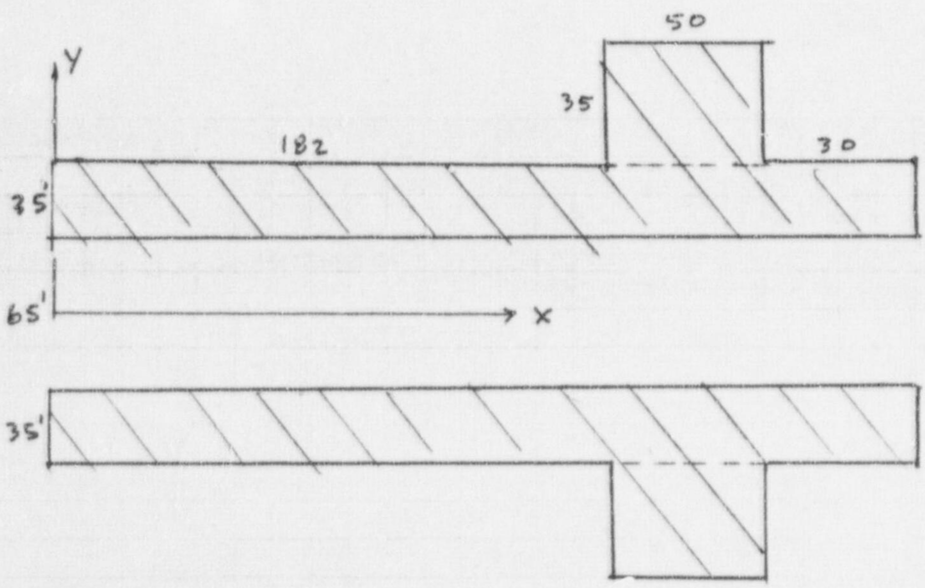
Masses @ El. 130'

Walls (El. 130' - 150')



walls (El. 115' - El. 130') Same as walls from El. 100' - 115'

Roof @ El. 130'



ATTACHMENT A

PAGE 4

CALC. NO. 05996.02-SC-5

CALCULATION SHEET

STONE & WEBSTER ENGINEERING CORPORATION

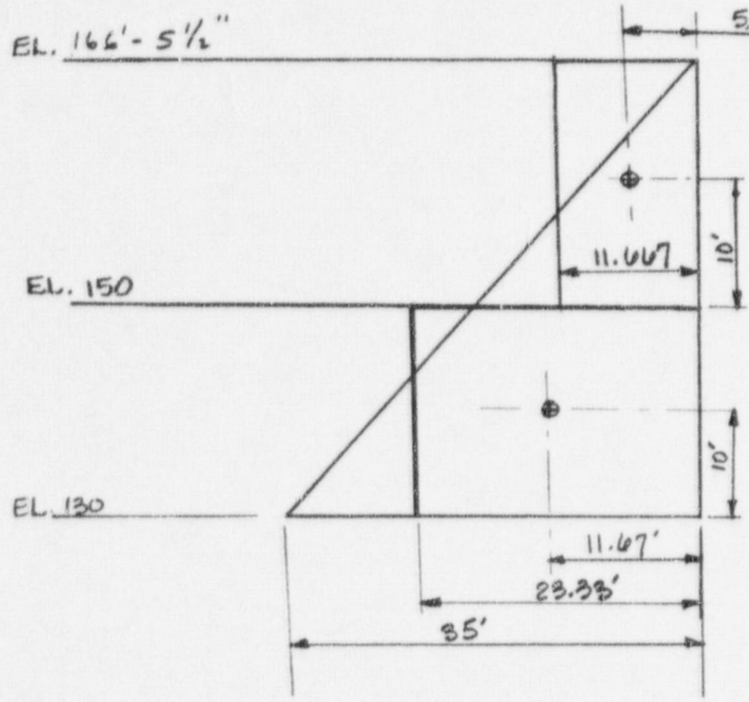
5010.61

J.O./W.O./CALCULATION NO.	REVISION	PAGE
05996.02-SC-5	1	A-5

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
BEC 8/21/99 S Chen 6/22/98	A. Grant 6/22/98	AJZ 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	I

△1



TRIANGULAR WALLS MODELED AS RECTANGULAR @ col. lines 1, 8 & 11.

LOWER RECTANGLE BASE DIMENSION:

$2/3 \times 35' = 23.33'$

UPPER RECTANGLE BASE DIMENSION:

$1/3 \times 35' = 11.667'$

ATTACHMENT A

PAGE 5

CALC. NO. 05996.02-SC-5

CALCULATION SHEET

STONE & WEBSTER ENGINEERING CORPORATION

5010.61

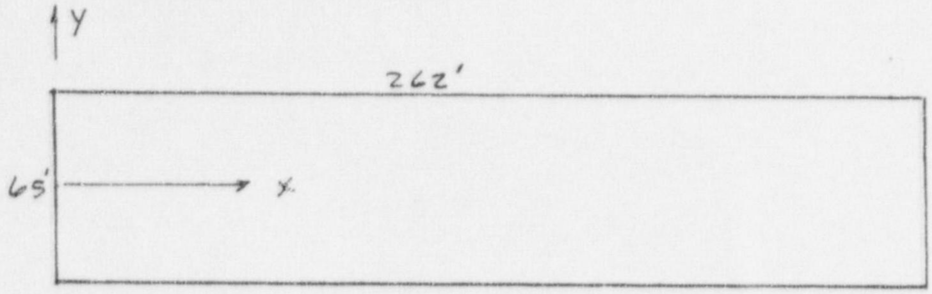
J.O./W.O./CALCULATION NO.	REVISION	PAGE
0599602-SC-5	0	A-6

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98	A. Grant 6/22/98	NJB 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	I

Masses @ El. 170'

Walls (El. 170' - 180')

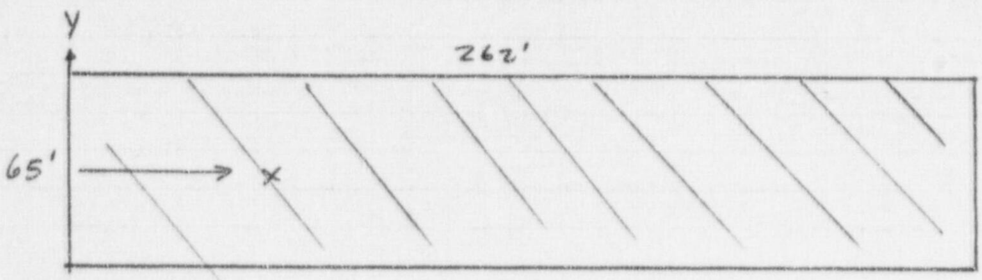


Walls (El. 150' ~ 170') same as walls from El. 130' - 150', except for the wing walls, which become 11.667' wide in lieu of 23.33'

Masses @ El. 190'

walls El 180' - 190' Same as walls from El. 170' - 180'

Roof @ EL 190'



ATTACHMENT A

PAGE 6

CALC. NO. 05996.02-SC-5

CALCULATION SHEET

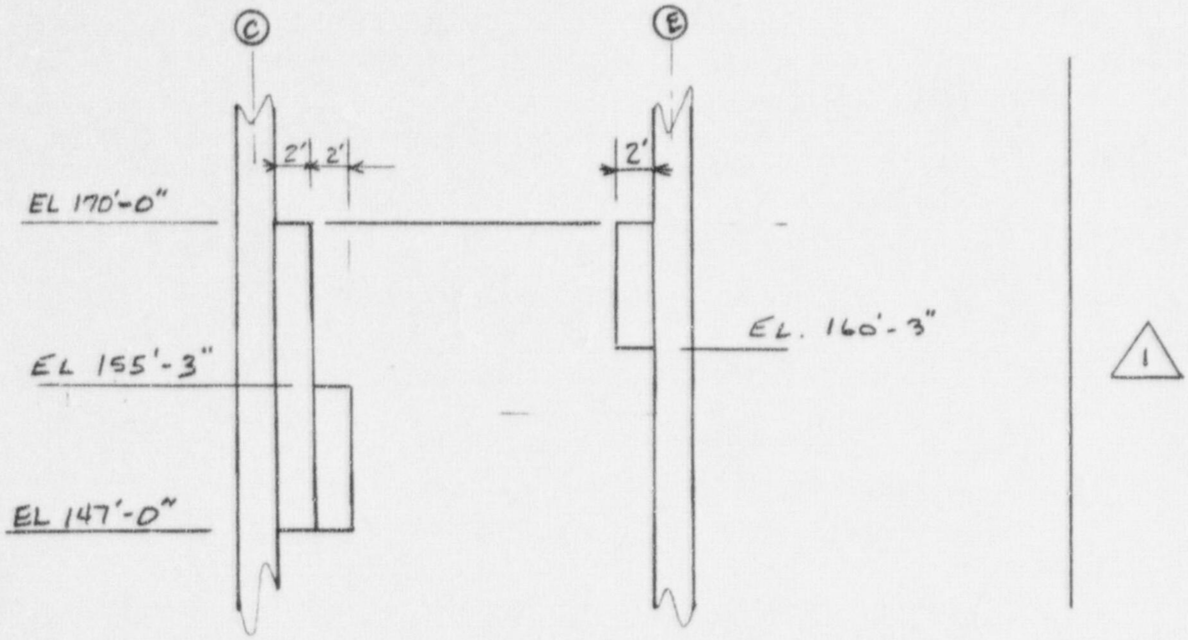
STONE & WEBSTER ENGINEERING CORPORATION

5010.61

J.O./W.O./CALCULATION NO.	REVISION	PAGE
0599602-SC-5	1	A-7

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98 BEC 3/21/99	A. Grant 6/22/98	RJB 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB Seismic Analysis	I



MODEL OF BUILT UP WALL SECTONS FOR CRANE RAILS

ATTACHMENT A
PAGE 7
CALC. NO. 05996.02-SC-5

```
I8PUZ3ECMASS VER. 0, LEVEL-01 77.301  08.57.37
          1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
SKULL VALLEY CTB  MASS EL. 100.
 15.       152.      2.        76.       -67.5     107.5
 15.       182.      2.        91.        67.5     107.5
 15.       182.      2.        91.        32.5     107.5
 15.        30.      2.        247.      -67.5     107.5
 15.        30.      2.        247.      -32.5     107.5
 15.        30.      2.        247.       67.5     107.5
 15.        30.      2.        247.       32.5     107.5
 15.        25.      2.        39.5      -32.5     107.5
 15.        25.      2.        89.5      -32.5     107.5
 15.        55.      2.        154.5     -32.5     107.5
 15.        30.      1.        15.         0.      107.5
9999.
 15.       135.      2.        0.          0.      107.5
 15.        70.      2.        182.      -67.5     107.5
 15.        70.      2.        182.       67.5     107.5
 15.        35.      2.        232.      -85.      107.5
 15.        35.      2.        232.       85.      107.5
 15.       135.      2.        262.        0.      107.5
 15.       32.5      1.         52.      -16.25    107.5
 15.       32.5      1.        102.      -16.25    107.5
 15.       32.5      1.        152.      -16.25    107.5
9999.
9999.
9999.
 182.      145.      5.        86.         0.      97.5          0.
  60.      215.      5.        207.        0.      97.5          0.
  30.      145.      5.        252.        0.      97.5          0.
9999.
9999.
9999.
9999.
 137.22    0.0       95.0      0.0
9999.
```

ATTACHMENT A

PAGE B

CALC. NO. 05996.02-SC-5

(REV. 0)

SKULL VALLEY CTB MASS EL. 100.

WALLS IN X DIRECTION

H	L	T	XO	YO	ZO
15.000	152.000	2.000	76.000	-67.500	107.500
15.000	182.000	2.000	91.000	67.500	107.500
15.000	182.000	2.000	91.000	32.500	107.500
15.000	30.000	2.000	247.000	-67.500	107.500
15.000	30.000	2.000	247.000	-32.500	107.500
15.000	30.000	2.000	247.000	67.500	107.500
15.000	30.000	2.000	247.000	32.500	107.500
15.000	25.000	2.000	39.500	-32.500	107.500
15.000	25.000	2.000	89.500	-32.500	107.500
15.000	55.000	2.000	154.500	-32.500	107.500
15.000	30.000	1.000	15.000	0.0	107.500

WALLS IN . DIRECTION

H	L	T	XO	YO	ZO
15.000	135.000	2.000	0.0	0.0	107.500
15.000	70.000	2.000	182.000	-67.500	107.500
15.000	70.000	2.000	182.000	67.500	107.500
15.000	35.000	2.000	232.000	-85.000	107.500
15.000	35.000	2.000	232.000	85.000	107.500
15.000	135.000	2.000	262.000	0.0	107.500
15.000	32.500	1.000	52.000	-16.250	107.500
15.000	32.500	1.000	102.000	-16.250	107.500
15.000	32.500	1.000	152.000	-16.250	107.500

RECT. FLOORS AND MAT

LX	LY	T	XO	YO	ZO	ALFA
182.000	145.000	5.000	86.000	0.0	97.500	0.0
60.000	215.000	5.000	207.000	0.0	97.500	0.0
30.000	145.000	5.000	252.000	0.0	97.500	0.0

XO= 137.22 YO= 0.44 ZO= 99.00 M= 1197.12

MASS MOMENTS OF INERTIA:

ORIGIN
IX= 14699297.0 IY= 41952976.0 IZ= 33144240.0 IXY= 58002.62

CENTROID
IX= 2965834.00 IY= 7679117.00 IZ= 10603392.0 IXY= -13694.37

BASE
IX= 14699069.0 IY= 19412352.0 IZ= 10603392.0 IXY= -13694.37

PRINCIPAL AXIS OF INERTIA AT -0.17 DEGREES:

ATTACHMENT A
PAGE 9
CALC. NO. 05996.02-SC-5
(REV. 0)

```
       IX=    2965793.00     IY=    7679156.00     IZ=   10603392.0      IXY=         -0.01
MASS PROPERTIES ABOUT THE NEW AXIS SYSTEM       137.220       0.0        95.000       0.0

       IX=    2985227.00     IY=    7698282.00     IZ=   10603620.0      IXY=    -13694.87
```

ATTACHMENT A
PAGE 10
CALC. NO. 05996.02-SC-5
(REV. 0)

```
IBPUZ3ECMASS VL    .0, LEVEL-01 77.301  08.57.37
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
SKULL VALLEY CTB  MASS EL. 130.
  15.       152.      2.        76.       -67.5     122.5
  15.       182.      2.        91.        67.5     122.5
  15.       182.      2.        91.        32.5     122.5
  15.        30.      2.        247.      -67.5     122.5
  15.        30.      2.        247.      -32.5     122.5
  15.        30.      2.        247.       67.5     122.5
  15.        30.      2.        247.       32.5     122.5
  15.        25.      2.        39.5      -32.5     122.5
  15.        25.      2.        89.5      -32.5     122.5
  15.        55.      2.        154.5     -32.5     122.5
  15.        30.      1.        15.        0        122.5
  20.       262.      2.        131.      -32.5     140.
  20.       262.      2.        131.       32.5     140.
   3.       182.      2.        91.       -30.5     148.5
   3.       182.      2.        91.       -28.5     148.5
9999.
  15.       135.      2.        0.         0.       122.5
  15.        70.      2.        182.      -67.5     122.5
  15.        70.      2.        182.       67.5     122.5
  15.        35.      2.        232.      -85.      122.5
  15.        35.      2.        232.       85.      122.5
  15.       135.      2.        262.       0.       122.5
  15.        32.5     1.        52.       -16.25    122.5
  15.        32.5     1.        102.      -16.25    122.5
  15.        32.5     1.        152.      -16.25    122.5
  20.       111.6     2.        0.         0.       140.
  20.       111.6     2.        262.       0.       140.
  20.        23.3     2.        182.      -44.17    140.
  20.        23.3     2.        182.       44.17    140.
9999.
9999.
9999.
 262.        35.      1.5       131.      -50.      130.        0.
  50.        35.      1.5       207.      -85.      130.        0.
 262.        35.      1.5       131.       50.      130.        0.
  50.        35.      1.5       207.       85.      130.        0.
9999.
9999.
9999.
9999.
 134.87     0.45      130.0     0.
9999.
```

ATTACHMENT A
PAGE 11
CALC. 05996.02-SC-5, R.1

SKULL VALLEY CTB MASS EL. 130.

WALLS IN X DIRECTION

H	L	T	XO	YO	ZO
15.000	152.000	2.000	76.000	-67.500	122.500
15.000	182.000	2.000	91.000	67.500	122.500
15.000	182.000	2.000	91.000	32.500	122.500
15.000	30.000	2.000	247.000	-67.500	122.500
15.000	30.000	2.000	247.000	-32.500	122.500
15.000	30.000	2.000	247.000	67.500	122.500
15.000	30.000	2.000	247.000	32.500	122.500
15.000	25.000	2.000	39.500	-32.500	122.500
15.000	25.000	2.000	89.500	-32.500	122.500
15.000	55.000	2.000	154.500	-32.500	122.500
15.000	30.000	1.000	15.000	0.0	122.500
20.000	262.000	2.000	131.000	-32.500	140.000
20.000	262.000	2.000	131.000	32.500	140.000
3.000	182.000	2.000	91.000	-30.500	148.500
3.000	182.000	2.000	91.000	-28.500	148.500

WALLS IN Y DIRECTION

H	L	T	XO	YO	ZO
15.000	135.000	2.000	0.0	0.0	122.500
15.000	70.000	2.000	182.000	-67.500	122.500
15.000	70.000	2.000	182.000	67.500	122.500
15.000	35.000	2.000	232.000	-85.000	122.500
15.000	35.000	2.000	232.000	85.000	122.500
15.000	135.000	2.000	262.000	0.0	122.500
15.000	32.500	1.000	52.000	-16.250	122.500
15.000	32.500	1.000	102.000	-16.250	122.500
15.000	32.500	1.000	152.000	-16.250	122.500
20.000	111.600	2.000	0.0	0.0	140.000
20.000	111.600	2.000	262.000	0.0	140.000
20.000	23.300	2.000	182.000	-44.170	140.000
20.000	23.300	2.000	182.000	44.170	140.000

RECT. FLOORS AND MAT

LX	LY	T	XO	YO	ZO	ALFA
262.000	35.000	1.500	131.000	-50.000	130.000	0.0
50.000	35.000	1.500	207.000	-85.000	130.000	0.0
262.000	35.000	1.500	131.000	50.000	130.000	0.0
50.000	35.000	1.500	207.000	85.000	130.000	0.0

XO= 134.87 YO= 0.45 ZO= 130.65 M= 490.70

MA'S MOMENTS OF INERTIA:

ORIGIN

ATTACHMENT A
PG. 12
CALC. 05996.02-SC-5, R.1

```
        IX=     [illegible]29968.00    IY=   20992992.0     IZ=   13796982.0      IXY=    3[illegible].37
CENTROID
        IX=     1253369.00    IY=    3690541.00     IZ=    4870929.00      IXY=       711.66
BASE
        IX=     9629867.00    IY=   12067039.0      IZ=    4870929.00      IXY=       711.66
PRINCIPAL AXIS OF INERTIA AT   0.02 DEGREES:
        IX=     1253368.00    IY=    3690541.00     IZ=    4870929.00      IXY=         0.00
 MASS PROPERTIES ABOUT THE NEW AXIS SYSTEM      134.870       0.450     130.000       0.0

        IX=     1253579.00    IY=    3690751.00     IZ=    4870929.00      IXY=       711.67
```

ATTACHMENT A
PAGE 13
CALC. NO. 05996.02-SC-5, R.1

```
I8PU23FCMBSS VL   .0, LEVEL-01 77.301  08.57.37
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
SKULL VALLEY CTB  MASS EL. 170.
 20.        262.      2.        131.      -32.5     160.
 20.        262.      2.        131.       32.5     160.
 10.        262.      2.        131.      -32.5     175.
 10.        262.      2.        131.       32.5     175.
 20.        262.      2.        131.      -30.5     160.
 5.25       182.      2.        91.       -28.5     152.625
 10.        262.      2.        131.       30.5     165.
9999.
 20.        88.34     2.        0.         0.       160.
 20.        88.34     2.        262.       0.       160.
 16.458     11.67     2.        182.      -38.33    158.229
 16.458     11.67     2.        182.       38.33    158.229
 10.        65.       2.        0.         0.       175.
 10.        65.       2.        262.       0.       175.
9999.
9999.
9999.
9999.
9999.
9999.
9999.
 130.37     -3.60     170.0      0.
9999.
```

ATTACHMENT A
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CALC. NO. 05996.02-SC-5, R.1

SKULL VALLEY CTB MASS EL. 170.

WALLS IN X DIRECTION

H	L	T	XO	YO	ZO
20.000	262.000	2.000	131.000	-32.500	160.000
20.000	262.000	2.000	131.000	32.500	160.000
10.000	262.000	2.000	131.000	-32.500	175.000
10.000	262.000	2.000	131.000	32.500	175.000
20.000	262.000	2.000	131.000	-30.500	160.000
5.250	182.000	2.000	91.000	-28.500	152.625
10.000	262.000	2.000	131.000	30.500	165.000

WALLS IN Y DIRECTION

H	L	T	XO	YO	ZO
20.000	88.340	2.000	0.0	0.0	160.000
20.000	88.340	2.000	262.000	0.0	160.000
16.458	11.670	2.000	182.000	-38.330	158.229
16.458	11.670	2.000	182.000	38.330	158.229
10.000	65.000	2.000	0.0	0.0	175.000
10.000	65.000	2.000	262.000	0.0	175.000

XO= 130.37 YG= -3.60 ZG= 163.48 M= 277.46

MASS MOMENTS OF INERTIA:

ORIGIN

IX= 7694774.00 IY= 14229031.0 IZ= 7056942.00 IXY= -120729.87

CENTROID

IX= 276007.00 IY= 2097743.00 IZ= 2337225.00 IXY= 9532.50

BASE

IX= 7691176.00 IY= 9512912.00 IZ= 2337225.00 IXY= 9532.50

PRINCIPAL AXIS OF INERTIA AT 0.30 DEGREES:

IX= 275957.00 IY= 2097791.00 IZ= 2337225.00 IXY= 0.02

MASS PROPERTIES ABOUT THE NEW AXIS SYSTEM 130.370 -3.600 170.000 0.0

IX= 287809.81 IY= 2109545.00 IZ= 2337225.00 IXY= 9532.50

ATTACHMENT A
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CALC. NO. 05996.02-SC-5, R1

```
1BPU23ECMASS VER. 00, LEVEL-01 77.301  08.57.37
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
SKULL VALLEY CTB  MASS EL. 190.
 10.       262.      2.        131.      -32.5     185.
 10.       262.      2.        131.       32.5     185.
9999.
 10.        65.      2.        0.         0.       185.
 10.        65.      2.        262.       0.       185.
9999.
9999.
9999.
 262.       65.      2.0       131.       0.       190.      0.
9999.
9999.
9999.
9999.
 131.0      0.       190.0     0.
9999.
```

ATTACHMENT A

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(Rev. 0)

SKULL VALLEY CTB MASS EL. 190.

WALLS IN X DIRECTION

H	L	T	XO	YO	ZO
10.000	262.000	2.000	131.000	-32.500	185.000
10.000	262.000	2.000	131.000	32.500	185.000

WALLS IN Y DIRECTION

H	L	T	XO	YO	ZO
10.000	65.000	2.000	0.0	0.0	185.000
10.000	65.000	2.000	262.000	0.0	185.000

RECT. FLOORS AND MAT

LX	LY	T	XO	YO	ZO	ALFA
262.000	65.000	2.000	131.000	0.0	190.000	0.0

XO= 131.00 YO= 0.0 ZO= 188.61 M= 219.80

MASS MOMENTS OF INERTIA:

ORIGIN
IX= 7932831.00 IY= 12989052.0 IZ= 5279849.00 IXY= 0.0

CENTROID
IX= 113480.00 IY= 1397702.00 IZ= 1507850.00 IXY= 0.0

BASE
IX= 7932831.00 IY= 9217053.00 IZ= 1507850.00 IXY= 0.0

PRINCIPAL AXIS OF INERTIA AT 0.0 DEGREES:

IX= 113480.00 IY= 1397702.00 IZ= 1507850.00 IXY= 0.0

MASS PROPERTIES ABOUT THE NEW AXIS SYSTEM 131.000 0.0 190.000 0.0

IX= 113903.06 IY= 1398125.00 IZ= 1507850.00 IXY= 0.0

ATTACHMENT A
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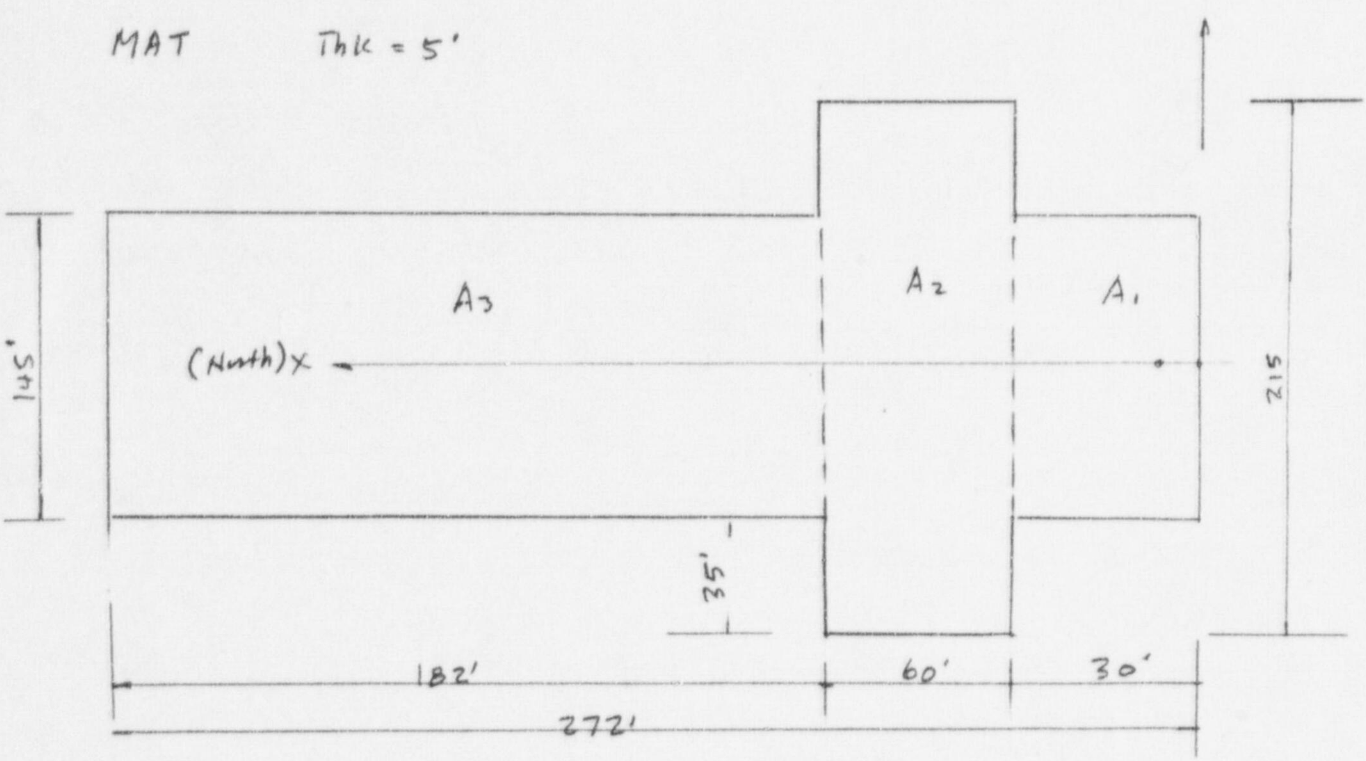
Attachment B Building Stiffness

The building stiffness for members between mass points is calculated manually. The calculations include cross section areas, moment of inertia, and center of rigidity. To account for the eccentric of the center of rigidity from the mass centroid, the stiffness matrix is calculated using SWEC program RIG3 and RIG4. The results are given in Attachment

Notice that the origin of the coordinate system used in RIG3 and RIG4 is located on the south side of the building at the intersection of column lines 11 and D. The x axis points toward north and z axis toward east, with y axis being vertical. This system is consistent with the coordinate system used in FRIDAY program. The properties from the output of MASS program are adjusted to match this coordinate system.

Estimate Bldg stiffness

MAT Thk = 5'



$A_1 = 145(30) = 4350 \ ft^2$

$A_2 = 215(60) = 12{,}900$

$A_3 = 145(182) = 26{,}390$

$43{,}640$

$$\bar{X} = \frac{4350 \times 15 + 12{,}900 \times 60 + 26{,}390(181)}{43{,}640} = 128.7'$$

(123.7' from origin of Bldg)

$W = (43{,}640)(5)(.15) = 32{,}730 \ K$

Note: For calculation of stiffness matrices (using Ref 3 & Ref 4), Youngs modulus of 519000 KSF & Shear modulus of 216000 KSF are used, corresponding to $f_c' = 4000$ psi (Ref 7)

Major Walls 100' — El. 130'

ATTACHMENT B
PAGE 3
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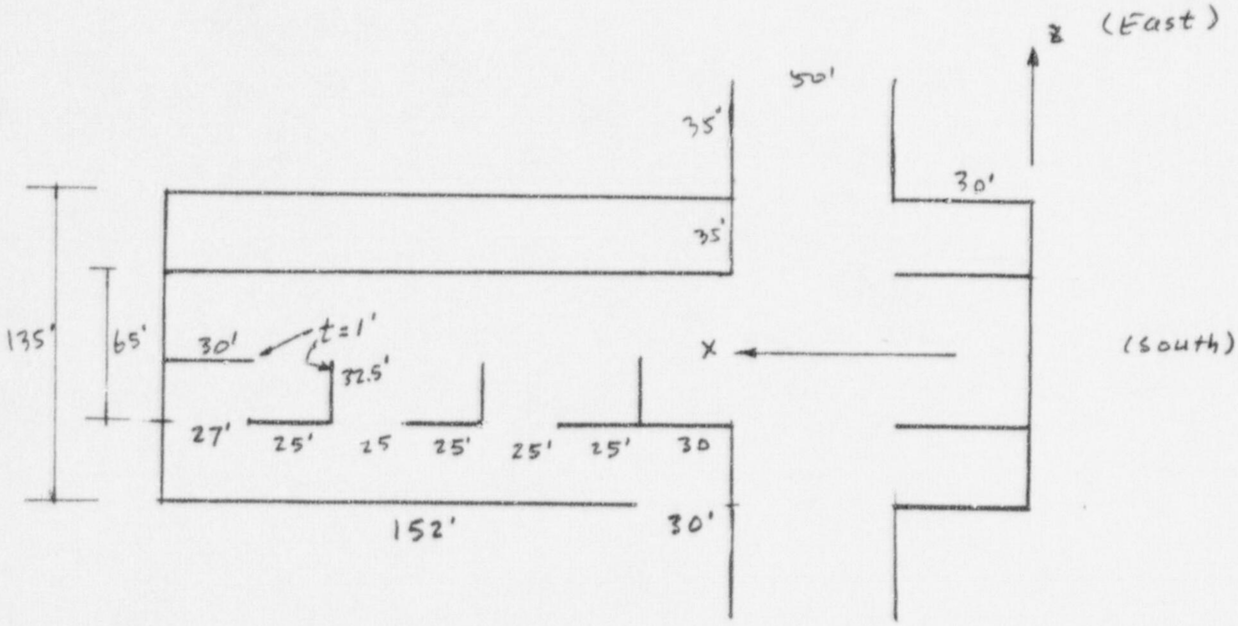
Vertical Direction



Area	x	z	Ax	Az	
182×2 = 364	171'	67.5	62,244	24,570	/
30×2 = 60	15	67.5	900	4,050	/
182×2 = 364	171	32.5	62244	11,830	
30×2 = 60	15	32.5	900	1,950	/
30×1 = 30	247	0	7,410	0	
25×2 = 50	222.5	-32.5	11,125	-1,625	
25×2 = 50	172.5	-32.5	8625	-1625	
55×2 = 110	107.5	-32.5	11825	-3575	
30×2 = 60	15	-32.5	900	-1950	/
152×2 = 304	186	-67.5	56544	-20,520	/
30×2 = 60	15	-67.5	900	-4,050	/

Area	x	z	Ax	Az
2×35×2 = 140	30	0	4,200	0
135×2 = 270	262	0	70,740	0
2×70×2 = 280	80	0	22,400	0
135×2 = 270	0	0	0	0
32.5×1 = 32.5	210	-16.25	6825	-528
32.5×1 = 32.5	160	-16.25	5200	-528
32.5×1 = 32.5	110	-16.25	3,575	-528
A = 2569.5			336,557	7471

$\bar{x} = 336{,}557/A = 130.98'$

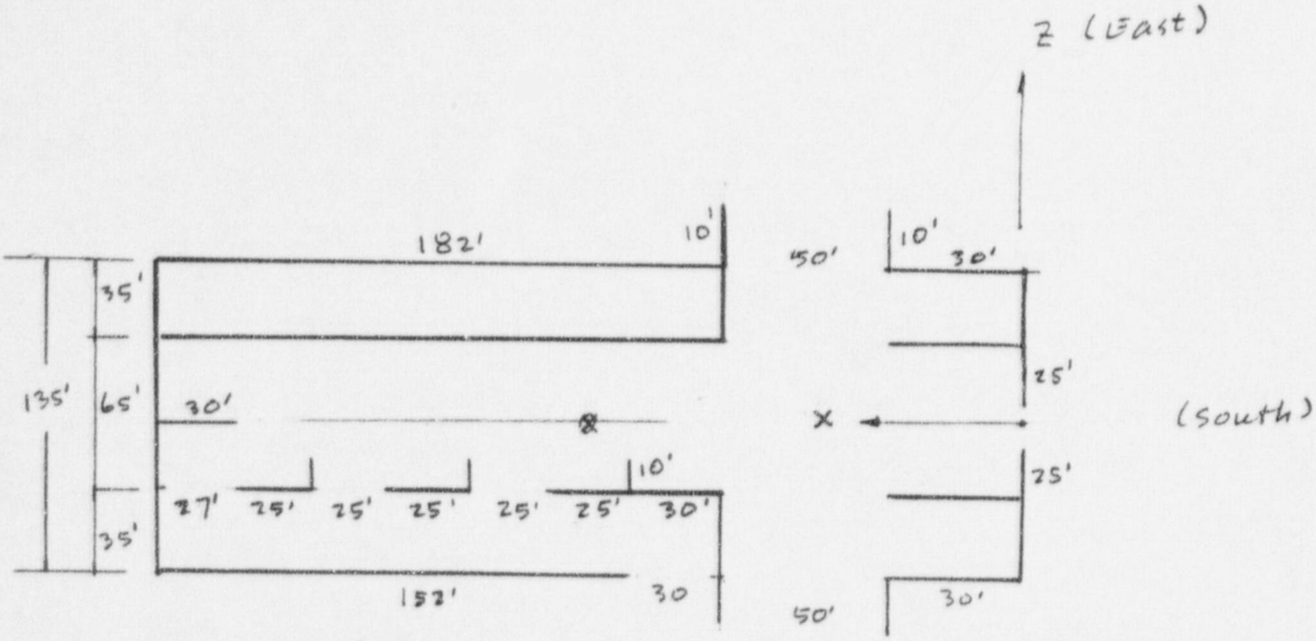
$\bar{z} = 7471/A = 2.91'$

I_y = Approximated by a hollow rectangle of 135' × 262' with wall thickness of 2'

$$I_y = \frac{4A^2t}{u} = \frac{4(135 \times 262)^2(2)}{2(135+262)} = 126 \times 10^5 \text{ ft}^4$$

Major Walls El. 100' - 130'

N-S Direction



	Area	X	AX
A_{N-S}	135' × 2' = 270 ft²	262'	70,740
	2 (45)(2) = 180	80'	14,400
	2 (10)(2) = 40	30'	1,200
	2 (60)(2) = 240	0	0
	10 × 1 = 10	210	2100
	10 × 1 = 10	160	1,600
	10 × 1 = 10	111	1110
	2 × 182 × 2 = 728	171	124,488
	4 × 30 × 2 = 240	15	3,600
	30 × 1 = 30	247	7,410
	25 × 2 = 50	222.5	11,125
	25 × 2 = 50	172.5	8,625
	55 × 2 = 110	107.5	11,825
	152 × 2 = 304	186	56,544
	2,272 ft²		314,767

$\bar{X} = 138.5'$

Walls El 100' - 130'

N-S Direction

$I_{EW} = I_Z$

$270 \times (262 - 138.5)^2$	$= 41.18 \times 10^5$
$180 \times (138.5 - 80)^2$	$= 6.16 \times 10^5$
$40 \times (138.5 - 30)^2$	$= 4.71 \times 10^5$
240×138.5^2	$= 46.04$
$10 \ (210 - 138.5)^2$	$= .51$
$10 \ (160 - 138.5)^2$	$= .05$
$10 \ (138.5 - 111)^2$	$= .08$
$2 \times \frac{1}{12} 2 (182)^3 + 728 (171 - 138.5)^2$	$= 27.78$
$4 \times \frac{1}{12} 2 (30)^3 + 240 (138.5 - 15)^2$	$= 36.79$
$\frac{1}{12}(1)(30)^3 + 30 (247 - 138.5)^2$	$= 3.55$
$\frac{1}{12}(2)(25)^3 + 50 (222.5 - 138.5)^2$	$= 3.55$
$\frac{1}{12}(2)(25)^3 + 50 (172.5 - 138.5)^2$	$= 0.60$
$\frac{1}{12}(2)(55)^3 + 110 (138.5 - 107.5)^2$	$= 1.33$
$\frac{1}{12}(2)(152)^3 + 304 (186 - 138.5)^2$	$= 12.71$
	185.04×10^5

Center of rigidity - $\bar{Z}$ (Note)

A	Z	AZ
182 × 2 = 364	67.5	24570
182 × 2 = 364	32.5	11,830
30 × 1 = 30	0	0
105 × 2 = 210	-32.5	-6,825
152 × 2 = 304	-67.5	-20,520
4 × 30 × 2 = 240	0	0
1512		9055

Note: only N-S shear walls are included, since E-W walls have negligible effect in resisting shear force in N-S direction

$\bar{Z} = 5.99' \approx 6.0'$

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

A5010.61

J.O./W.O./CALCULATION NO.	REVISION	PAGE
0599602-SC-5	0	B-7

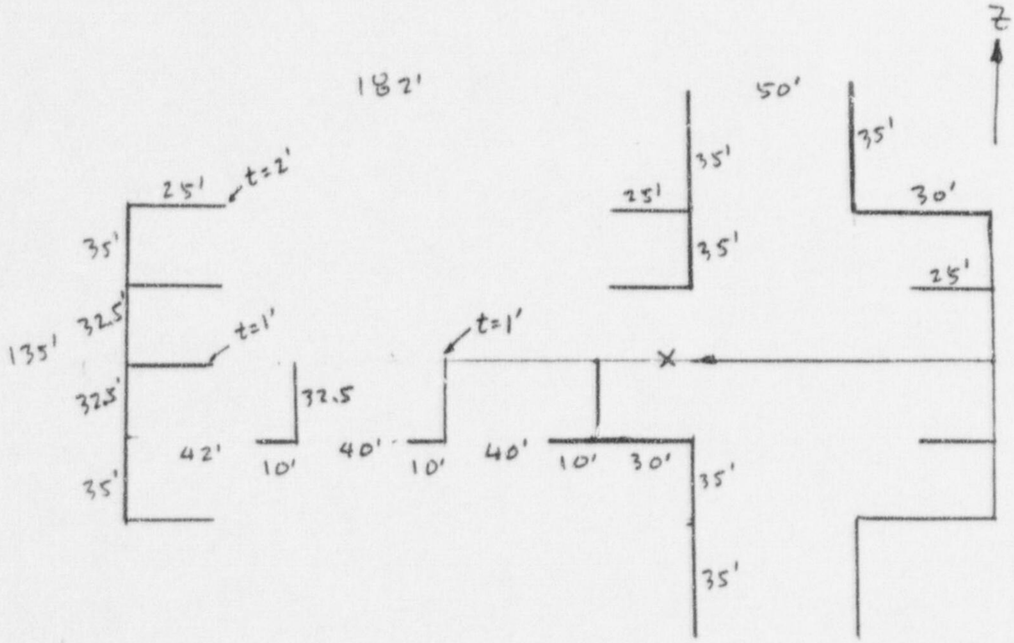
PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98	A. Brant 6/22/98	MJ 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	I

Walls El. 100' - 130'

E-W Direction

ATTACHMENT B
PAGE 7
CALC. NO. 05996.02-SC-5



Walls

El. 100' - 130' E-W Direction

A_{EW}	z	Az
80x2 = 160	67.5'	10,800
75x2 = 150	32.5	4875
30x1 = 30	0	0
85x2 = 170	-32.5	-5,525
55x2 = 110	-67.5	-7,425
2x135x2 = 540	0	0
3x32.5x1 = 97.5	-16.25	-1,584
70x2 = 140	67.5	
70x2 = 140	-67.5	
35x2 = 70	85	
35x2 = 70	-85	
A_{EW} = 1677.5		1141

$\bar{z}$ = 0.68'

El. 100' - 130' E-W Direction

$I_{NS} = I_x$

$160 \times (67.5 - 0.68)^2$	$= 7.14 \times 10^5$
$160 \times (32.5 - 0.68)^2$	$= 1.62 \times 10^5$
30×0.68^2	$= 0.00$
$170 \times (-32.5 - 0.68)^2$	$= 1.87$
$110 \times (-67.5 - 0.68)^2$	$= 5.11$
$2 \times \frac{1}{12} 2 (135)^3 + 540 (0.68)^2$	$= 8.20$
$3 \times \frac{1}{12} (1)(32.5)^3 + 97.5 (16.25 + 0.68)^2$	$= 0.37$
$\frac{1}{12}(2)(70)^3 + 140(67.5 - 0.68)^2$	$= 6.82$
$\frac{1}{12}(2)(70)^3 + 140(67.5 + 0.68)^2$	$= 7.08$
$\frac{1}{12}(2)(35)^3 + 70(85 - 0.68)^2$	$= 5.05$
$\frac{1}{12}(2)(35)^3 + 70(85 + 0.68)^2$	$= 5.21$
	$48.47 \times 10^5 \ ft^4$

Center of Rigidity $\bar{x}$ (Note)

A		x	Ax
135×2	= 270	262	70,740
32.5×1	= 32.5	210	6,825
32.5×1	= 32.5	160	5,200
32.5×1	= 32.5	110	3,575
2×70×2	= 280	80	22,400
2×35×2	= 140	30	4200
135×2	= 170	0	0
	957.5		112,940

Note: Only E-W shearwalls are included, since N-S walls have negligible effect in resisting shear force in E-W direction.

$\bar{x} = 117.95' \sim 118'$

Walls El. 130' — 170'

ATTACHMENT B
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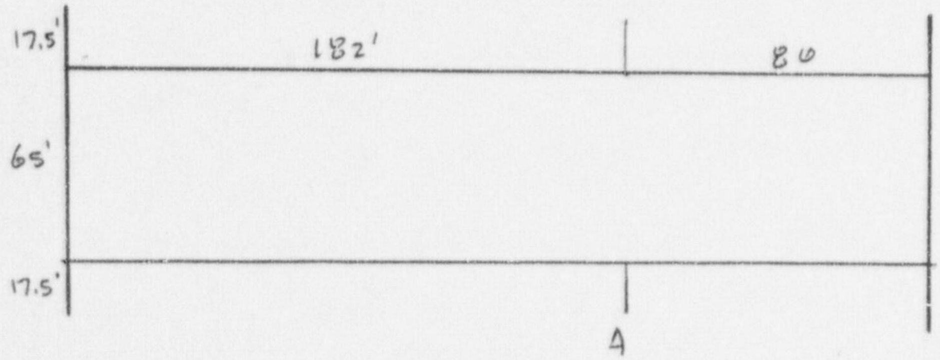
Vertical



Area

$2 \times 65 \times 2 = 260 \text{ ft}^2$

$6 \times 17.5 \times 2 = 210$

$2 \times 262 \times 2 = 1048$

1518 ft^2

I_{vert} (torsional stiffness)

Approximated by a hollow rectangle of 65' × 262' with wall thickness of 2'

$$I_y = \frac{4A^2t}{U} = \frac{4(65 \times 262)^2 \times 2}{2(65+262)} = 35.5 \times 10^5 \text{ ft}^4$$

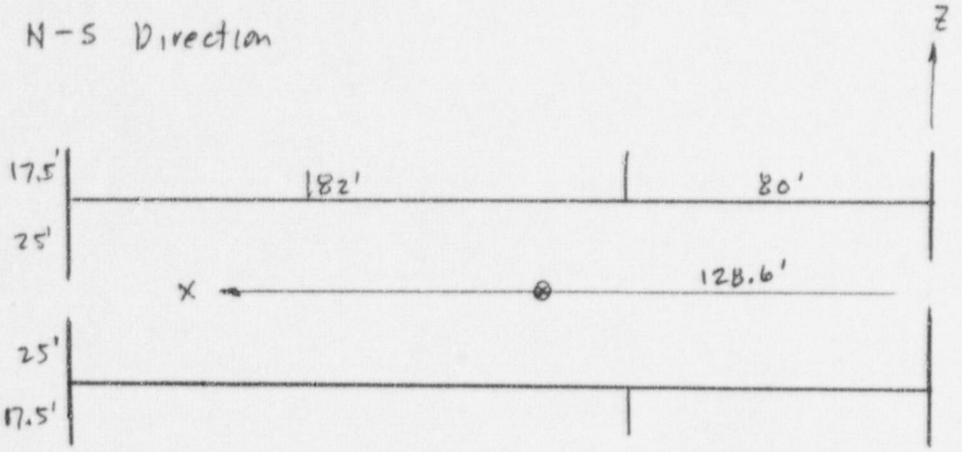
Vertical Center of rigidity

A	x	Ax
100 × 2 = 200	262	52,400
35 × 2 = 70	80	5,600
100 × 2 = 200	0	0
2 × 262 × 2 = 1048	131	137,288
1518		195,288

$\left(\bar{X} = 128.65' \quad \bar{Z} = 0 \right)$

Walls El. 130' - 170'

N-S Direction



Area

85 × 2	= 170 ft^2	× 262	=	44,540
2 × 17.5 × 2	= 70	× 80	=	5,600
85 × 2	= 170	× 0	=	0
2 × 262 × 2	= 1048	× 131	=	137,288
	1458 ft^2			187,428/1458 = $\bar{X}$ = 128.6'

I_{zc}

$170(262 - 128.6)^2 = 30.25 \times 10^5$

$70(128.6 - 80)^2 = 1.65 \times 10^5$

$170(128.6)^2 = 28.11 \times 10^5$

$2 \times \frac{1}{12}(2)(262)^3 + 1048(131 - 128.6)^2 = 60.01 \times 10^5$

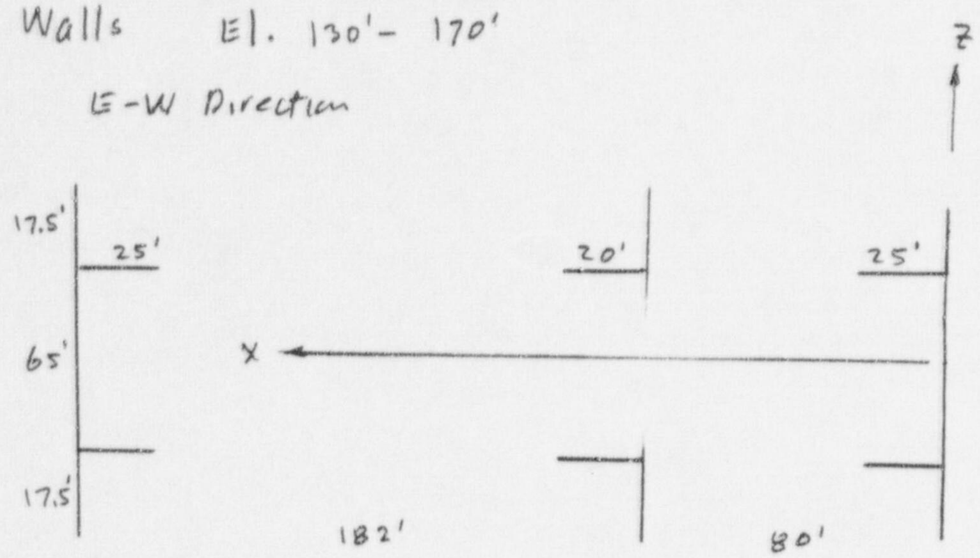
$I_{zc} = 120 \times 10^5 \ ft^4$

Center of rigidity

$\bar{Z} = 0$

Walls El. 130' - 170'

E-W Direction



A_{EW}

$$2 \times 100 \times 2 = 400 \ ft^2$$
$$1 \times 35 \times 2 = 70$$
$$2 \times (25 + 20 + 25)(2) = 280$$
$$750 \ ft^2$$

I_x

$$2 \times \frac{1}{12}(2)(100)^3 = 3.33 \times 10^5$$
$$280\,(32.5)^2 = 2.96 \times 10^5$$
$$2 \times \frac{1}{12}(2)(17.5)^3 + 70(41.25)^2 = 1.21 \times 10^5$$
$$7.5 \times 10^5$$

Center of Rigidity $\bar{x}$

A	x	AX
100×2 = 200	262	52,400
2×17.5×2 = 70	80	5,600
100×2 = 200	0	0
470		58,000

$\bar{x} = 123.4'$

ATTACHMENT B

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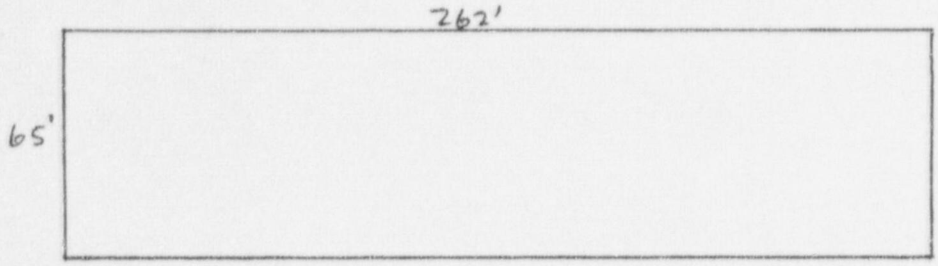
Walls El. 170' - 190'

Vertical Direction



A_{vert} = $2 \times 65 \times 2 = 260 \text{ ft}^2$

$2 \times 262 \times 2 = 1048$

1308 ft^2

Centroid

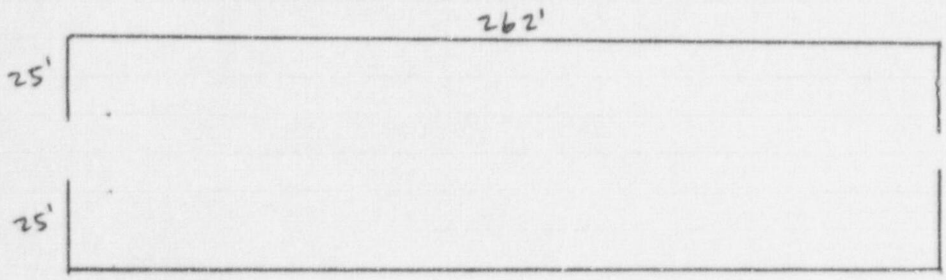
$x = 131$

$z = 0$

$I_{vert} = I_y$

$$\frac{4(65 \times 262)^2 \times 2}{2(65+262)} = 35.5 \times 10^5 \text{ ft}^4$$

N-S Direction



A_{NS} $\quad 2 \times 50 \times 2 = 200 \text{ ft}^2$

$2 \times 262 \times 2 = 1048$) 1248 ft^2

$I_{EW} = I_z$ $\quad 200 \times 131^2 = 34.32 \times 10^5$

$2 \times \frac{1}{12}(2)(262)^3 = 59.94 \times 10^5$

$94.3 \times 10^5 \text{ ft}^4$

Walls El. 170' - 190'

E-W Direction

ATTACHMENT B
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CALC. NO. 05996.02-SC-5

A_{EW} $\quad 2 \times 65 \times 2 = 260 \text{ ft}^2$

$4 \times 25 \times 2 = 200$

460 ft^2

$I_{NS} = I_x \quad 2 \times \frac{1}{12}(2)(65)^3 = 0.92 \times 10^5$

$200\,(32.5)^2 = 2.11 \times 10^5$

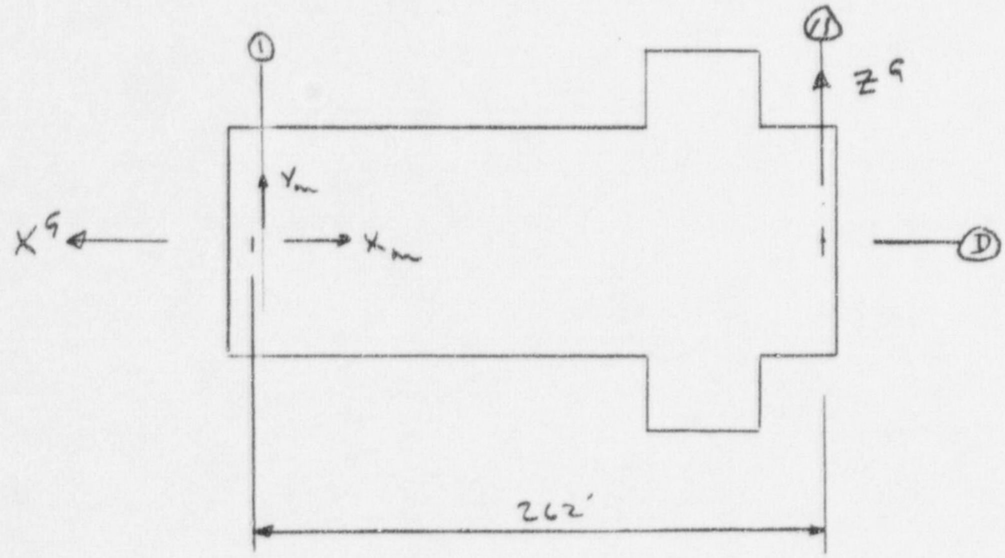
$3.03 \times 10^5 \text{ ft}^4$

Center of Rigidity

$\bar{x} = 131$

$\bar{z} = 0$

COORIDATE SYSTEMS AND NEW COORDINATES



$X = 262 - X_m$

Joint 1	X = 123.7'	(P. 2 Att. B)
Joint 2	X = 262 - 134.87 = 127.13	
Joint 3	X = 262 - 130.37 = 131.63	
Joint 4	X = 262 - 131.00 = 131.00	
Joint 5	X = 131.00	(same as 4)
Joint 6,7,8	X = 131.63	(same as 3)

THESE ARE THE X COORDINATES TO BE USED IN THE 'RIG3' 'RIG4' AND 'FRIDAY' PROGRAMS. THE Z COORDINATES ARE THE Y VALUES OF THE CENTER OF MASS (FROM 'MASS' PROGRAM)

```
SBPGS8ERBO3, VE.  .1 LEVEL-00 77.116  13.52.36
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
STIFFNESS MATRIX OF WALLS BETWEEN MAT AND EL. 130                                    1
123.7     0.0       95.0      100.                                                   2
127.13    0.45      130.00                                                           3
2569.5    2272.     1677.5    12600000.  4847000. 18500000.  519000.   216000.       4
118.0     6.0                                                                        5
130.98    2.91                                                                       6
0.                                                                                   7
```

ATTACHMENT B
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STIFFNESS MATRIX OF WALLS BETWEEN MAT AND EL. 130

```
0.256950D+04 0.227200D+04 0.167750D+04 0.126000D+08 0.484700D+07 0.185000D+08 0.519000D+06 0.216000D+06
0.118000D+03 0.600000D+01
0.130980D+03 0.291000D+01
0.123700D+03 0.0          0.950000D+02
0.127130D+03 0.450000D+00 0.130000D+03
0.100000D+03
0.0
```

THE LOCAL STIFFNESS MATRIX OF THE EQUIVALENT MEMBER

0.441792D+08	0.276325D+07	-0.551466D+05	0.181424D+07	0.855095D+08	0.206955D+09
0.276325D+07	0.164955D+08	0.557939D+06	-0.104517D+09	0.659562D+07	-0.224066D+09
-0.551466D+05	0.557939D+06	0.120225D+08	0.781964D+08	0.188945D+09	-0.840987D+07
0.181424D+07	-0.104517D+09	0.781964D+08	0.919204D+11	0.156450D+10	0.452418D+10
0.855095D+08	0.659562D+07	0.188945D+09	0.156450D+10	0.910194D+11	-0.299334D+11
0.206955D+09	-0.224066D+09	-0.840987D+07	0.452418D+10	-0.299334D+11	0.320464D+12

ATTACHMENT B
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CALC. NO. 059??6.02-SC-5, R.1

```
SNP049EZB04, VE.  .1 LEVEL-00 77.116  14.20.02
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
STIFFNESS MATRIX OF WALLS BETWEEN EL 130 AND EL. 170
127.13    0.45      130.
131.63    -3.60     170.00
1518.     1458.     750.      3550000.  750000.  12000000.  519000.   216000.
123       0.0
128.65    0.0
0.
STIFFNESS MATRIX OF WALLS BETWEEN EL 170 AND EL. 190
131.63    -3.60     170.
131.      0.0       190.00
1308.     1248.     460.      3550000.  303000.  9430000.   519000.   216000.
131.0     0.0
131.0     0.0
0.
```

ATTACHMENT B
PAGE 18
CALC. NO. 05996.02-SC-5, R.1

STIFFNESS MATRIX OF WALLS BETWEEN EL 130 AND EL. 170

0.151800D+04 0.145800D+04 0.750000D+03 0.355000D+07 0.750000D+06 0.120000D+08 0.519000D+06 0.216000D+06
0.123400D+03 0.0
0.128650D+03 0.0
0.127130D+03 0.450000D+00 0.130000D+03
0.131630D+03-0.360000D+01 0.170000D+03
0.0

THE LOCAL STIFFNESS MATRIX OF THE EQUIVALENT MEMBER

0.193902D+08	0.202092D+07	0.296409D+06	-0.290512D+07	0.189955D+08	-0.719640D+08
0.202092D+07	0.634372D+07	-0.195839D+07	0.575484D+07	-0.367088D+08	-0.133024D+09
0.296409D+06	-0.195839D+07	0.561970D+07	0.250104D+08	0.117459D+09	0.396139D+08
-0.290512D+07	0.575484D+07	0.250104D+08	0.205748D+11	-0.774113D+10	-0.109749D+11
0.189955D+08	-0.367088D+08	0.117459D+09	-0.774113D+10	0.762678D+11	0.724852D+11
-0.719640D+08	-0.133024D+09	0.396139D+08	-0.109749D+11	0.724852D+11	0.932131D+11

ATTACHMENT B
PAGE 19
CALC. NO. 05996.02-SC-5

STIFFNESS MATRIX OF WALLS BETWEEN EL 170 AND EL. 190

```
0.130800D+04 0.124800D+04 0.460000D+03 0.355000D+07 0.303000D+06 0.943000D+07 0.519000D+06 0.216000D+06
0.131000D+03 0.0
0.131000D+03 0.0
0.131630D+03-0.360000D+01 0.170000D+03
0.131000D+03 0.0          0.190000D+03
0.0
```

THE LOCAL STIFFNESS MATRIX OF THE EQUIVALENT MEMBER

0.330113D+08	0.509659D+07	0.262137D+06	-0.471214D+06	0.257867D+07	0.920495D+07
0.509659D+07	0.605205D+07	-0.143452D+07	0.257867D+07	-0.141115D+08	-0.503731D+08
0.262137D+06	-0.143452D+07	0.131985D+08	-0.237255D+08	0.129835D+09	0.145827D+08
-0.471214D+06	0.257867D+07	-0.237255D+08	0.448237D+11	-0.354812D+11	-0.725546D+10
0.257867D+07	-0.141115D+08	0.129835D+09	-0.354812D+11	0.232507D+12	0.397047D+11
0.920495D+07	-0.503731D+08	0.145827D+08	-0.725546D+10	0.397047D+11	0.154128D+11

ATTACHMENT B
PAGE 20
CALC. NO. 05996.02-SC-5

Attachment C Crane and Roof Model

The crane rail is approximately on El. 170'. The north and south walls supporting the crane is relatively flexible in the E-W direction, and may cause increased response especially when the crane is located in the middle of the building. The effective mass and member properties of the walls are calculated to simulate the crane frequency in the E-W direction. GTSTRUDL program is used for the frequency estimation.

The roof at El. 190 ft. spans 65 ft. from the north wall to the south wall. It is relatively flexible in the vertical direction compared to the walls. To account for this effect, a mass point 5 is added to the stick model. The frequency and effective mass of the roof are estimated.

CALCULATION SHEET

▲5010.61

STONE & WEBSTER ENGINEERING CORPORATION

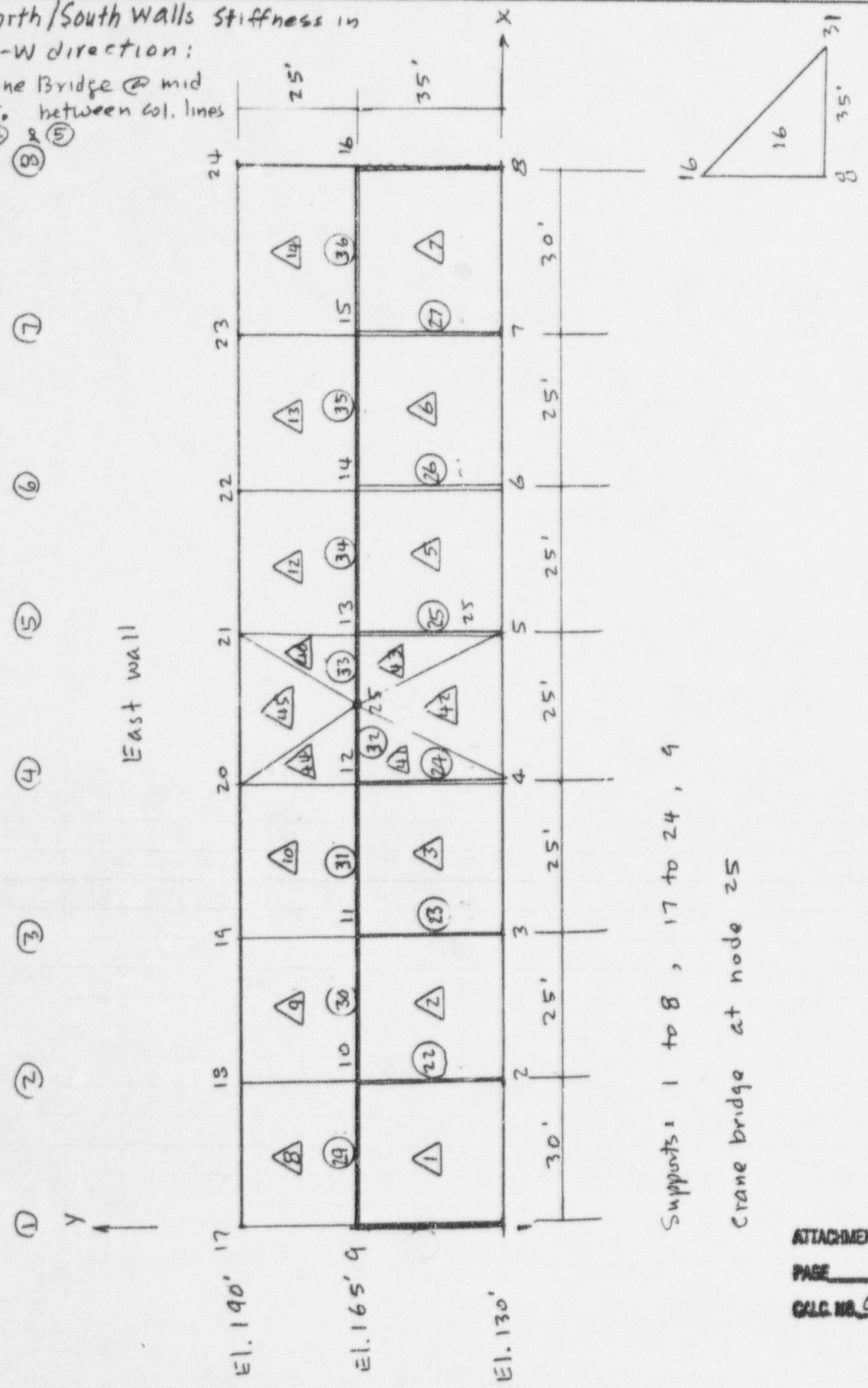
J.O./W.O./CALCULATION NO.	REVISION	PAGE
	0	C-2

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98	B. Elbhur 6/25/98	LJB 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB Seismic Analysis	I

North/South Walls Stiffness in E-W direction:

Crane Bridge @ mid pt. between col. lines ④ & ⑤



ATTACHMENT C

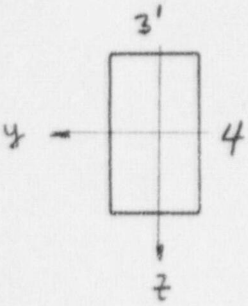
PAGE 2

CALC NO. 05996.02-SC-5

Member properties

Wall thickness ≈ 2'

22 TO 27



$A = 12.\ ft^2$

$I_x = \frac{1}{3}(4)(3)^3 = 36.\ ft^4$

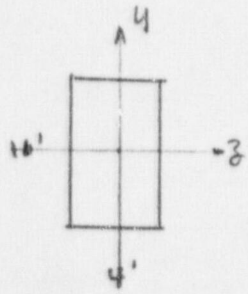
$I_y = \frac{1}{12}(3)(4)^3 = 16.$

$I_z = \frac{1}{12}(4)(3)^3 = 9.$

△1

△1

29 TO 36



$A = 40$

$I_x = \frac{1}{3}(10)(4)^3 = 213.3$

$I_y = \frac{1}{12}(10)(4)^3 = 53.3$

$I_z = \frac{1}{12}(4)(10)^3 = 333.3$

Crane Bridge

Estimated total weight = 700K

Half of the wt to E. wall and other half to W. wall

Frequency in E/W Direction

W = 350K $f \approx 4.36\ Hz$ △1

(See Attached computer output)

CALCULATION SHEET | STONE & WEBSTER ENGINEERING CORPORATION

5010.61

J.O./W.O./CALCULATION NO.	REVISION	PAGE
05996.02 - SC-5	1	C-4

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98 BEE 8/21/99	B. Eldelson 6/_/98	[illegible] 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	

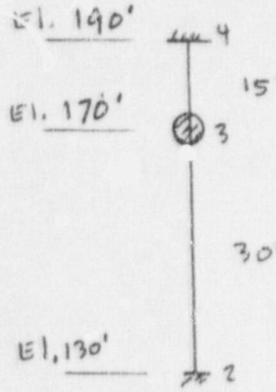
Estimate of Wall Stiffness

Bridge Crane @ mid pt between column Lines ④ & ⑤

Frequency in E W Direction

$f = 4.36$ Hz | △1

$W = 2290$ K (see * below)



$$\Delta = \frac{Pa^3b^3}{3EIL^3} \qquad K = \frac{P}{\Delta} = \frac{3EIL^3}{a^3b^3}$$

$$= \frac{3 \times 519{,}000\, I\, (60)^3}{(20 \times 40)^3}$$

$$= 656.9\, I$$

$$f = \frac{1}{2\pi}\sqrt{\frac{Kg}{W}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{656.9 I \times 32.2}{2290}} = 4.36 \text{ Hz}$$

$$I = 81.25 \text{ ft}^4$$

△1

For East and West walls together

$I_{NS} = 81.25 \times 2 = 162.5$ ft^4

$M_{EW} = (2290 \times 2)/32.2 = 142.2$ kslug (4580 K)

Note: Weight should be slightly less due to smaller column - little effect on results △1

* Attribute weight

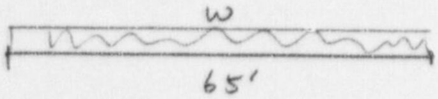
Wall	(35' × 125' × 2') × 0.15	=	1313 K
Beam	2 × 10 × 125 × .15	=	375 K
col.	6 (4 × 4 × 17.5) × .15	=	252
Bridge			350
			2290 K

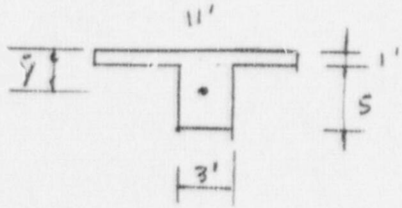
ATTACHMENT C

PAGE 4

CALC NO. 05996.02-SC-5

Roof Stiffness El. 1?0'





cross section / bay

Area $11 \times 1 = 11 \quad \times 0.5 = 5.5$

$5 \times 3 = 15 \quad \times 3.5 = 52.5$

$\quad\quad 26 \quad\quad\quad 58 \quad\quad \bar{y} = 58/26 = 2.23'$

$I = \frac{1}{12}(11)(1)^3 = 0.92$

$11(2.23 - 0.5)^2 = 32.92$

$\frac{1}{12}(3)(5)^3 = 31.25$

$15 \times (3.5 - 2.23)^2 = 24.19$

89.3 ft^4

Pinned - Ends

$$\Delta = \frac{5wL^4}{384EI} \qquad K = \frac{wL}{\Delta} = \frac{384}{5}\frac{EI}{L^3}$$

Fixed - Ends

$$\Delta = \frac{wL^4}{384EI} \qquad K = 384\frac{EI}{L^3}$$

Approximate by using average value

$$K = \frac{1}{2}\left(384 + \frac{384}{5}\right)\frac{EI}{L^3} \approx 230\frac{EI}{L^3}$$

E = 519000 ksf

L = 65'

K = 38,800 k/ft per bay 9 bays total

$K_{Total} = K \times 9 = 349{,}000$ k/ft

CALCULATION SHEET

STONE & WEBSTER ENGINEERING CORPORATION

A5010.61

J.O./W.O./CALCULATION NO.	REVISION	PAGE
05996.02 - SC - 5		C - 6

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
S Chen 6/22/98	B. Ebbesen 6/25/98	[illegible] 7/13/98

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CTB SEISMIC ANALYSIS	

Roof – Spring weight

$A = (65-8)(262-14) = 14{,}136\ ft^2$

Assume 300 psf

$Wt = 14{,}136 \times .300 = 4241\ K$

$f = \frac{1}{2\pi}\sqrt{\frac{Kg}{W}} = \frac{1}{2\pi}\left(\frac{349{,}000 \times 32.2}{4241}\right)^{1/2} \approx 8.2\ Hz$

(say 8 Hz)

ATTACHMENT C

PAGE 6

CALC. NO. 05996.02-SC-5

Add mass point to simulate roof response

Assume 1' length 1/3 of Roof Mass

M_y at 5 $= \frac{1}{3}(262')(65')(2')\left(\frac{.15}{32.2}\right) = 52.9 \frac{K\text{-}SEC^2}{FT}$

M_y at 4 $= 219.8 - 52.9 = 166.9 \frac{K\text{-}SEC^2}{FT}$

Properties of Member

$K = \frac{AE}{L} = \frac{A(519000)}{1} = 519000\,A$

$f = \frac{1}{2\pi}\sqrt{K/m} = 8.\ Hz$

$K/m = (16\pi)^2$

$519000\,A = (16\pi)^2(m) = 133658.$

$A = .258\ ft^2$

```
**** ACTIVE UNITS -  LENGTH   WEIGHT   ANGLE    TEMPERATURE   TIME
**** ASSUMED TO BE     INCH    POUND   RADIAN    FAHRENHEIT   SECOND

Reading global defaults file C:\Program Files\GTSTRUDL 9801\defaults.gts
{     1} > $ Put any startup commands in this file
{     1} >

{     2} > CINPUT 'c:\temp\wall.dat'
{     3} > STRUDL 'GTWALL' 'CANISTER WALL SUPPORTING CRANE BRIDGE, 700k'


*********************************************************************
*                                                                   *
*   ******                          G T S T R U D L                 *
*  ********                                                         *
*  **    **                                                         *
*  **            *****  ******  *****   **  **  *****   **          *
*  **  ********* ******  ******  ******  **  **  ******  **          *
*  **  ********** **        **    **  **  **  **  **  **  **        *
*  **      ****  *****      **    ******  **  **  **  **  **        *
*  **    ****     *****     **    *****   **  **  **  **  **        *
*   ******  **       **     **    **  **  **  **  **  **  **        *
*           **   ******     **    **  **  ******  ******  ******    *
*           **   *****      **    **  **   ****   *****   ******    *
*           **                                                      *
*           **              OWNED BY AND PROPRIETARY TO THE         *
*           **              GEORGIA TECH RESEARCH CORPORATION       *
*                                                                   *
*  RELEASE DATE        VERSION            COMPLETION NO.            *
*  March  1998         9801 NT                3716                  *
*                                                                   *
*********************************************************************


**** ACTIVE UNITS -  LENGTH   WEIGHT   ANGLE    TEMPERATURE   TIME
**** ASSUMED TO BE     INCH    POUND   RADIAN    FAHRENHEIT   SECOND

Reading global defaults file C:\Program Files\GTSTRUDL 9801\defaults.gts
{     4} > $ Put any startup commands in this file
{     4} >

{     5} > $ INPUT FILE C:\TEMP\WALL.DAT
{     6} > UNIT FT KIPS
{     7} > CONSTANTS
{     8} > E 519000.  ALL
{     9} > G 216000. ALL
{    10} > DENSITY .15 ALL
{    11} > JOINT COORDINATES
{    12} > 1  0.  0.  0.
{    13} > 2  30.  0.  0.
{    14} > 3  55.  0.  0.
```

ATTACHMENT C
PAGE 8
CALC. NO. 05996.02-SC-5, R.1

```
> 4  80.  0.  0.
> 5  105. 0.  0.
> 6  130. 0. 0.
> 7  155. 0. 0.
> 8  185. 0. 0.
> 9  0.   35. 0.
> 10 30.  35. 0.
> 11 55.  35. 0.
> 12 80.  35. 0.
> 13 105. 35. 0.
> 14 130. 35. 0.
> 15 155. 35. 0.
> 16 185. 35. 0.
> 17 0.   60. 0.
> 18 30.  60. 0.
> 19 55.  60  0.
> 20 80.  60. 0.
> 21 105. 60. 0.
> 22 130. 60. 0.
> 23 155. 60. 0.
> 24 185. 60. 0.
> 25 92.5 35. 0.
> 31 185. 0.  -35.
> $
> STATUS SUPPORT  1 TO 8 9 17 TO 24  31
> $ JOINT RELEASES
> $ MOM X Y Z KFX 3.5 KFZ 3.5 KFY 135.7
> type plate
> ELEMENT INCIDENCES
> 1     1    2     10    9
> 2     2    3     11    10
> 3     3    4     12    11
> 5     5    6     14    13
> 6     6    7     15    14
> 7     7    8     16    15
> 8     9    10    18    17
> 9     10   11    19    18
> 10    11   12    20    19
> 12    13   14    22    21
> 13    14   15    23    22
> 14    15   16    24    23
> 16    8    16    31
> $
> 41   25   12    4
> 42   4     5    25
> 43   13   25    5
> 44   12   25    20
> 45   21   20    25
> 46   25   13    21
> ELEMENT PROPERTIES
> 1 TO 3  5 to 10  12 to 14 TYPE 'SBCR' thi 2.
> 16  41 to 46 TYPE 'SBCT' THI 2.
> $
> TYPE SPACE FRAME
> MEMBER INCIDENCES
> 22   2   10
> 23   3   11
```

ATTACHMENT C
PG. 9
CALC. NO. 05996.02-SC-5, R1

```
{    72} > 24    4    12
{    73} > 25    5    13
{    74} > 26    6    14
{    75} > 27    7    15
{    76} > 29    9    10
{    77} > 30   10   11
{    78} > 31   11   12
{    79} > 32   12   25
{    80} > 33   25   13
{    81} > 34   13   14
{    82} > 35   14   15
{    83} > 36   15   16
{    84} > MEMBER PROPERTIES PRISMATIC
{    85} > 22 TO 27 AX 12.  AY 12. AZ 12. IX 36. IY 16. IZ 9.
{    86} > 29 TO 36 AX  40. AY 40.  AZ 40. IX 213.3 IY 53.3 IZ 333.3
{    87} > INERTIA OF NODES LUMPED
{    88} > DYNAMIC DEGREES OF FREEDOM STATIC CONDENSATION
{    89} > NODES 10 TO 15  25  TRANS X Y Z
{    90} > INERTIA OF JOINTS WEIGHT GRAVITY 32.2
{    91} > 25 TRANS ALL 350.
{    92} > UNITS CYCLES
{    93} > EIGEN PARAM
{    94} > FREQUENCY SPECS 0. TO 60.
{    95} > DYNAMIC ANALYSIS EIGENVALUE

**** WARNING_STCHCK -- Default value of Poisson's Ratio = 0.0
                       has been used for the following finite elements.  Use
                       CONSTANTS or MATERIAL command to specify a different
                       value for Poisson's Ratio.
                        1         2         3         5         6
                        7         8         9         10        12
                        13        14        16        41        42
                        43        44        45        46


BANDWIDTH INFORMATION BEFORE RENUMBERING.


THE MAXIMUM BANDWIDTH IS    5 AND OCCURS AT JOINT 25
THE AVERAGE BANDWIDTH IS                          1.250
THE STANDARD DEVIATION OF THE BANDWIDTH IS        1.479
                                             ----------
                                                  2.729
                                             ==========


BANDWIDTH INFORMATION AFTER  RENUMBERING.


THE MAXIMUM BANDWIDTH IS    1 AND OCCURS AT JOINT 11
THE AVERAGE BANDWIDTH IS                          0.875
THE STANDARD DEVIATION OF THE BANDWIDTH IS        0.331
                                             ----------
                                                  1.206
                                             ==========
```

ATTACHMENT C
PAGE 10
CALC. NO. 05996.02-SC-5, R. 1

TIME FOR CONSISTENCY CHECKS FOR 33 MEMBERS	0.01 SECONDS
TIME FOR BANDWIDTH REDUCTION	0.05 SECONDS
TIME TO GENERATE 33 ELEMENT STIF. MATRICES	0.09 SECONDS
TIME TO ASSEMBLE THE STIFFNESS MATRIX	0.04 SECONDS
TIME TO PROCESS 26 JOINTS	0.00 SECONDS
TIME TO GENERATE REDUCED STIFFNESS MATRIX	0.02 SECONDS
TIME TO ASSEMBLE LUMPED MASS MATRIX	0.13 SECONDS
TIME FOR CONDENSATION	0.03 SECONDS
TIME TO TRANSFORM EIGENPROBLEM	0.00 SECONDS
TIME FOR TRIDIAGONALIZATION	0.01 SECONDS
TIME TO COMPUTE EIGENVALUES	0.00 SECONDS
TIME TO COMPUTE EIGENVECTORS	0.01 SECONDS
TIME TO TRANSFORM EIGENVECTORS	0.00 SECONDS
TIME TO TRANSFORM EIGENVECTORS TO JOINTS	0.01 SECONDS

****
* EIGEN-SOLUTION CHECKS *
****

MODE	EIGENVALUE ((RAD/SEC)**2)	FREQUENCY (RAD/SEC)	FREQUENCY (CYC/SEC)	PERIOD (SEC/CYC)	ESTIMATED ACCURACY
1	7.491824D+02	2.737120D+01	4.356261D+00	2.295547D-01	5.394276D-12
2	1.129333D+03	3.360554D+01	5.348488D+00	1.869687D-01	2.800572D-12
3	1.465680D+03	3.828420D+01	6.093120D+00	1.641195D-01	1.298282D-12
4	3.226343D+03	5.680091D+01	9.040145D+00	1.106177D-01	2.629682D-13
5	4.599753D+03	6.782148D+01	1.079412D+01	9.264301D-02	2.144478D-13
6	1.002018D+04	1.001008D+02	1.593154D+01	6.276857D-02	6.961054D-14
7	2.880257D+04	1.697132D+02	2.701070D+01	3.702237D-02	6.314329D-14
8	6.829362D+04	2.613305D+02	4.159204D+01	2.404306D-02	5.669331D-14
9	1.021353D+05	3.195861D+02	5.086371D+01	1.966038D-02	1.713016D-14
10	1.339734D+05	3.660237D+02	5.825448D+01	1.716606D-02	1.803308D-14

ORTHOGONALITY CHECK

WITH RESPECT TO MASS

ATTACHMENT C
PAGE 11
CALC. NO. 05996.02-SC-5, R.1

```
OFF DIAGONALS:   MAXIMUM =   0.5773E-14
                 MINIMUM =   0.1751E-18
                    MEAN =   0.3563E-15

    DIAGONALS:   MAXIMUM =   0.1000E+01
                 MINIMUM =   0.1000E+01
                    MEAN =   0.1000E+01



WITH RESPECT TO STIFFNESS
-------------------------

OFF DIAGONALS:   MAXIMUM =   0.5496E-10
                 MINIMUM =   0.1137E-12
                    MEAN =   0.9512E-11

    DIAGONALS:   MAXIMUM =   0.1340E+06
                 MINIMUM =   0.7492E+03
                    MEAN =   0.3544E+05
```

ATTACHMENT C
PAGE 12
CALC. 05996.02-SC-5, R.1

```
*********************************
* END OF EIGEN-SOLUTION CHECKS *
*********************************

TIME TO CHECK EIGENSOLUTION                          0.04 SECONDS
{    96} > LIST DYNAMIC EIGENVALUES 10
1

    ****************************
    *RESULTS OF LATEST ANALYSES*
    ****************************


    PROBLEM - GTWALL    TITLE - CANISTER WALL SUPPORTING CRANE BRIDGE, 700k

    ACTIVE UNITS  FEET KIP  CYC  DEGF SEC



    EIGENVALUES
```

MODE	EIGENVALUE ((RAD/SEC)**2)	FREQUENCY (RAD/SEC)	FREQUENCY (CYC/SEC)	PERIOD (SEC/CYC)	STATUS
1	7.491824D+02	2.737120D+01	4.356261D+00	2.295547D-01	ACTIVE
2	1.129333D+03	3.360554D+01	5.348488D+00	1.869687D-01	ACTIVE
3	1.465680D+03	3.828420D+01	6.093120D+00	1.641195D-01	ACTIVE

```
   4     3.226343D+03    5.680091D+01    9.040145D+00    1.106177D-01    ACTIVE
   5     4.599753D+03    6.782148D+01    1.079412D+01    9.264301D-02    ACTIVE
   6     1.002018D+04    1.001008D+02    1.593154D+01    6.276857D-02    ACTIVE
   7     2.880257D+04    1.697132D+02    2.701070D+01    3.702237D-02    ACTIVE
   8     6.829362D+04    2.613305D+02    4.159204D+01    2.404306D-02    ACTIVE
   9     1.021353D+05    3.195861D+02    5.086371D+01    1.966038D-02    ACTIVE
  10     1.339734D+05    3.660237D+02    5.825448D+01    1.716606D-02    ACTIVE
{   97} > LIST DYNAMIC EIGENVECTORS 3
1

    *****************************
    *RESULTS OF LATEST ANALYSES*
    *****************************


     PROBLEM - GTWALL    TITLE - CANISTER WALL SUPPORTING CRANE BRIDGE, 700k


     ACTIVE UNITS  FEET KIP  CYC  DEGF SEC
```

ATTACHMENT C
PAGE 13
CALC. 05996.02-SC-5, R.1

```
     EIGENVECTORS   (UNITS: INCHES & RADIANS)


     MODE      1

 JOINT                         /--------------------TRANS--------------------//-
--------------------ROTATION----------------/
                                 X-TRANS          Y-TRANS          Z-TRANS
X-ROTATION        Y-ROTATION      Z-ROTATION
 JOINT 1          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00
 JOINT 2          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 3          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 4          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 5          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 6          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 7          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 8          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 9          GLOBAL         0.0000000E+00    0.0000000E+00    0.0000000E+00
0.0000000E+00    0.0000000E+00    0.0000000E+00
 JOINT 10         GLOBAL        -0.2044358E-06   -0.1061910E-09   -0.1469601
0.2759829E-04    0.7691143E-03    0.6205631E-11
 JOINT 11         GLOBAL        -0.4985082E-06   -0.2210803E-09   -0.4657946
0.1953751E-04    0.1310491E-02    0.1284191E-10
```

```
 JOINT 12         GLOBAL         -0.1083125E-05  -0.3564405E-09  -0.8866019      -
0.1319189E-04   0.1244130E-02   0.3581813E-10
 JOINT 13         GLOBAL         -0.2006933E-05  -0.8073441E-09  -0.8992041      -
0.1234029E-04  -0.1154040E-02   0.4595572E-10
 JOINT 14         GLOBAL         -0.4362429E-05  -0.3339971E-09  -0.5095986
0.2222902E-04  -0.1204710E-02   0.1661665E-09
 JOINT 15         GLOBAL         -0.9260458E-05  -0.1013408E-07  -0.2133538
0.3765972E-04  -0.7591495E-03  -0.6200242E-10
 JOINT 16         GLOBAL         -0.2284826E-04   0.1584283E-07   0.4223437E-03
0.7154282E-04  -0.4825602E-03   0.2484156E-08
 JOINT 17         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 18         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 19         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 20         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 21         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 22         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 23         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 24         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 25         GLOBAL         -0.1468714E-05  -0.5363540E-09  -1.000000
0.2122436E-03   0.3996363E-04  -0.5042452E-11
 JOINT 31         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00


     MODE      2

 JOINT                          /--------------------TRANS--------------------//-
--------------------ROTATION-----------------/
                                    X-TRANS         Y-TRANS         Z-TRANS
X-ROTATION      Y-ROTATION      Z-ROTATION
 JOINT 1          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 2          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 3          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 4          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 5          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 6          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 7          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 8          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 9          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
```

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```
 JOINT 10        GLOBAL          0.1345871E-05   0.7001832E-09  -0.3771777      -
0.3015787E-05   0.1272545E-02  -0.4086819E-10
 JOINT 11        GLOBAL          0.3277187E-05   0.1453140E-08  -0.6107591      -
0.3744271E-04   0.6665630E-04  -0.8449999E-10
 JOINT 12        GLOBAL          0.7108138E-05   0.2339083E-08  -0.4037960      -
0.3450674E-04  -0.1286383E-02  -0.2350472E-09
 JOINT 13        GLOBAL          0.1313815E-04   0.5273221E-08   0.1876766      -
0.6321055E-06  -0.2577756E-02  -0.3014655E-09
 JOINT 14        GLOBAL          0.2848449E-04   0.2207055E-08   0.9355829
0.4414980E-04  -0.1672709E-02  -0.1083749E-08
 JOINT 15        GLOBAL          0.6034192E-04   0.6599568E-07    1.000000
0.2695907E-05   0.1400016E-02   0.3972723E-09
 JOINT 16        GLOBAL          0.1485455E-03  -0.1030239E-06   0.1044104E-01  -
0.2579961E-03   0.3134547E-02  -0.1614867E-07
 JOINT 17        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 18        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 19        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 20        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 21        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 22        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 23        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 24        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 25        GLOBAL          0.9630609E-05   0.3514769E-08  -0.1611048
0.1881981E-04  -0.1939018E-02   0.3299575E-10
 JOINT 31        GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00


     MODE       3

 JOINT                          /---------------------TRANS--------------------//-
--------------------ROTATION-----------------/
                                   X-TRANS         Y-TRANS         Z-TRANS
X-ROTATION      Y-ROTATION      Z-ROTATION
 JOINT 1         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 2         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 3         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 4         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 5         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 6         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 7         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
```

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```
 JOINT 8          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 9          GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00   0.0000000E+00
 JOINT 10         GLOBAL          0.1003284E-05   0.5226761E-09   0.9593030
0.5372003E-04  -0.2397043E-02  -0.3047482E-10
 JOINT 11         GLOBAL          0.2439913E-05   0.1081723E-08    1.000000
0.8590967E-04   0.2230633E-02  -0.6296253E-10
 JOINT 12         GLOBAL          0.5283997E-05   0.1738729E-08  -0.6056595E-01  -
0.2299267E-04   0.3297798E-02  -0.1747188E-09
 JOINT 13         GLOBAL          0.9745119E-05   0.3903493E-08  -0.4115951      -
0.5935460E-04  -0.1142739E-02  -0.2240177E-09
 JOINT 14         GLOBAL          0.2107970E-04   0.1650405E-08   0.2546352
0.1172156E-04  -0.2330242E-02  -0.8012119E-09
 JOINT 15         GLOBAL          0.4457400E-04   0.4872468E-07   0.6501898
0.3009163E-04   0.2400720E-03   0.2890509E-09
 JOINT 16         GLOBAL          0.1095095E-03  -0.7596582E-07   0.1066491E-01  -
0.1564894E-03   0.2309010E-02  -0.1190381E-07
 JOINT 17         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 18         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 19         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 20         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 21         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 22         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 23         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 24         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 JOINT 25         GLOBAL          0.7153863E-05   0.2609394E-08  -0.4203155
0.4896093E-04   0.1174849E-02   0.2446507E-10
 JOINT 31         GLOBAL          0.0000000E+00   0.0000000E+00   0.0000000E+00
0.0000000E+00   0.0000000E+00
 {    98} > PRINT DYNAMIC DATA
1****************************************
 *  PROBLEM DATA FROM INTERNAL STORAGE  *
 ****************************************


 JOB ID - GTWALL       JOB TITLE - CANISTER WALL SUPPORTING CRANE BRIDGE, 700k

 ACTIVE UNITS -  LENGTH        WEIGHT       ANGLE       TEMPERATURE       TIME
                  FEET          KIP          CYC           DEGF            SEC


 ======================
```

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DYNAMIC STRUCTURAL DATA
=======================

```
 ---------------------------
 DYNAMIC DEGREES OF FREEDOM
 ---------------------------
0**** CONDENSATION METHOD: STATIC

0 JOINT   TRANSLATION   ROTATION
 10         X  Y  Z
 11         X  Y  Z
 12         X  Y  Z
 13         X  Y  Z
 14         X  Y  Z
 15         X  Y  Z
 25         X  Y  Z
```

```
 --------------
 JOINT INERTIAS
 --------------
0**** INERTIA OF JOINTS LUMPED HAS BEEN SPECIFIED
0**** EFFECTIVE FRACTIONAL MEMBER LENGTH FOR MASS MOMENT OF INERTIA TERMS IS
0.100E-01
0**** JOINT INERTIAS ARE IN THE CURRENT WEIGHT UNITS
0**** ACCELERATION OF GRAVITY =      32.20000
0JOINT          TRANS X        TRANS Y        TRANS Z        ROTAT X
ROTAT Y        ROTAT Z        DAMPING

 25             350.00         350.00         350.00         0.00000E+00
0.00000E+00    0.00000E+00    0.00000E+00
```

```
 --------------------
 MODAL DAMPING RATIOS
 --------------------
0**** MODAL DAMPING RATIOS HAVE NOT BEEN SPECIFIED
```

```
 -----------------
 MEMBER ADDED MASS
 -----------------

                                                                        LOCATION ALONG
MEMBER
 MEMBER   SYSTEM   EFFECTIVE DIRECTIONS   TYPE                  START            END
MASS VALUE
 ------   ------   --------------------   ----                  -----            ---
----------
```

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```
 ==================
 DYNAMIC PARAMETERS
 ==================
0NUMBER OF DYNAMIC DEGREES-OF-FREEDOM =     21
0NUMBER OF CONDENSED DEGREES-OF-FREEDOM =     27
0EIGENPROBLEM SOLUTION TECHNIQUE: TRIDIAGONALIZATION
0MAXIMUM FREQUENCY=     60.00000
0COMPUTE RIGID BODY MODES: NO
0EIGENVALUE TOLERANCE=   8.4294E-08
0EIGENVECTOR TOLERANCE=   8.4294E-08
0AVERAGE HALF BAND WIDTH OF THE STIFFNESS MATRIX=     10

0*****************************************
 *  END OF DATA FROM INTERNAL STORAGE    *
 *****************************************

 {    99} > LIST DYNAMIC MASS SUMMARY
1

    *****************************
    *RESULTS OF LATEST ANALYSES*
    *****************************

     PROBLEM - GTWALL    TITLE - CANISTER WALL SUPPORTING CRANE BRIDGE, 700k

     ACTIVE UNITS  FEET KIP  CYC  DEGF SEC
```

GLOBAL AXIS	CENTER OF MASS COORDINATE	TOTAL MASS	TOTAL WEIGHT	MASS MOMENT OF INERTIA
X	92.50000	88.94410	2864.000	0.1995791E-26
Y	35.00000	88.94410	2864.000	146084.0
Z	0.0000000E+00	88.94410	2864.000	146084.0

```
 {  100} > finish
1
 --------------------- RUN-TIME PERFORMANCE SUMMARY ----------------------

 CPU Time  00:00:01.00  Elapsed Time  0 00:00:01   On  Wed Aug 18 13:37:01 1999
```

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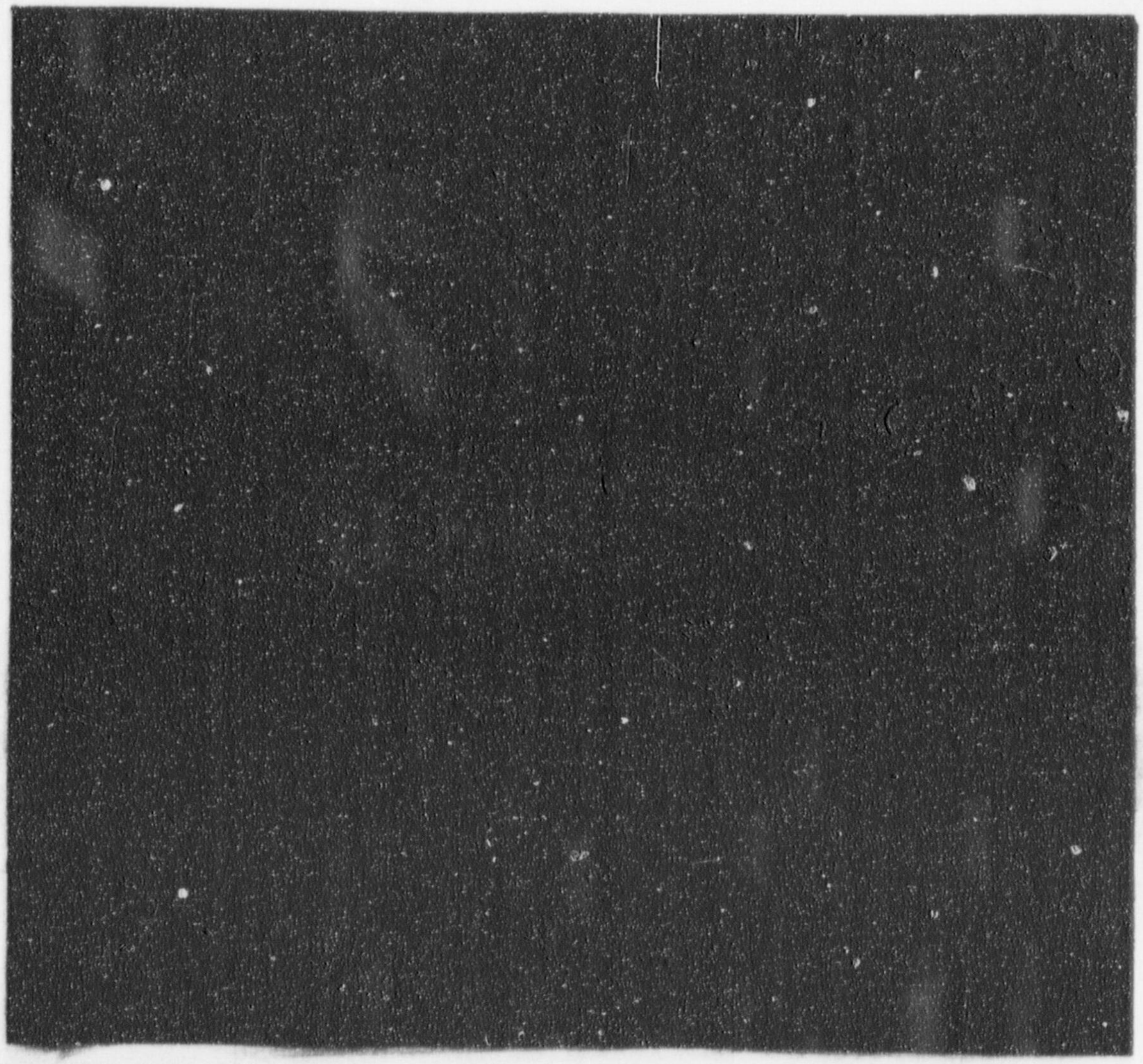
CALCULATION SHEET	J.O./W.O./CALCULATION NO. 05996.02-SC-5	REVISION 1	PAGE D-1
PREPARER/DATE B.E. EBBESON 8-28-99	REVIEWER/CHECKER/DATE D. BONNER 8/31/99	INDEPENDENT REVIEWER D. BONNER 8/31/99	
SUBJECT/TITLE Seismic Analysis of Canister Transfer Building		QA CATEGORY/CODE CLASS 1	

ATTACHMENT D

DISKETTE



Bob Youngs <BYoungs@geomatrix.com> on 08/17/99 02:05:21 AM

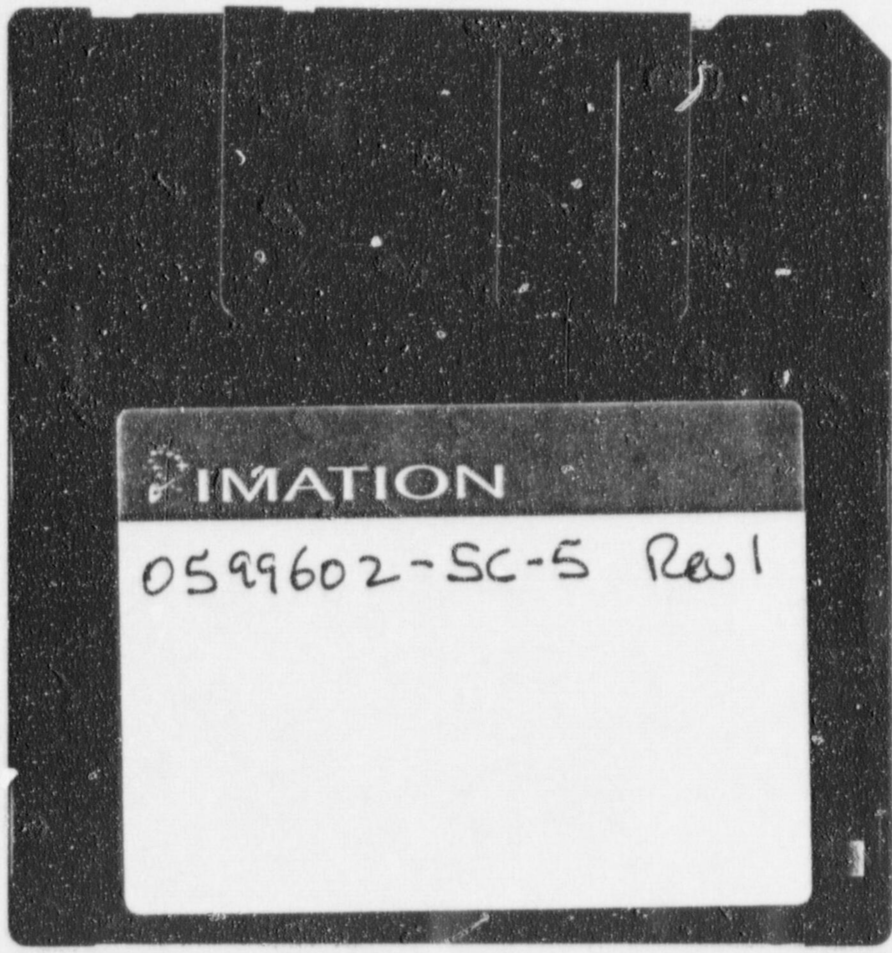
To: Bruce Ebbeson/Civil/SWEC@SWEC
cc:
Subject: RE: Skull Valley 2,000-yr time histories

The only problem is that a 20-sec duration for the fault normal component results in seven NRC frequencies with peak responses less than the design spectrum (instead of the maximum of 5 specified in the SRP). This can be fixed by multiplying the fault normal time history by a factor of 1.0058 (a 0.58% increase).

And yes, the time histories are in g's

-----Original Message-----
From: bruce.ebbeson@stoneweb.com [mailto:bruce.ebbeson@stoneweb.com]
Sent: Saturday, August 14, 1999 11:55 AM
To: Bob Youngs
Cc: Stanley.Macie@stoneweb.com
Subject: Re: Skull Valley 2,000-yr time histories

Thanks for the data. You didn't say, but I assume that the data is acceleration
in g's at time intervals of .005 sec. The program Im using can only accept up
to 4096 time points, so I truncated the time histories at 20 seconds. I hope
that's not a problem.


IMATION
0599602-SC-5 Rev 1