BSC	Design Calculation or Analysis Cover Sheet *Complete only applicable items.*	1. QA: QA 2. Page 1

3. System Initial Handling Facility	4. Document Identifier 51A-SYC-IH00-00500-000-00C
5. Title Initial Handling Facility (IHF) Soil Springs and Damping	
6. Group Civil/Structural/Architectural	
7. Document Status Designation ☐ Preliminary ☒ Committed ☐ Confirmed ☐ Cancelled/Superseded	

8. Notes/Comments

a. Note for Revision 00A:
This calculation supersedes calculation # 51A-SYC-IH00-00200-000, Rev. 00A. The new calculation was issued based on the new layout features provided by IOM No. CCU.20071011.0006 and CCU.20070905.0011 (See Attachments A and D)

b. Notes for Revision 00B:
Rev. A of this calculation was based on strain compatible soil properties given in Data Tracking Numbers (DTN's) MO0706SCSPS5E4.002 and MO0706SCSPS1E4.002. These DTN's were un-qualified and were subsequently superseded by DTN's MO0801SCSPS5E4.003 and MO0801SCSPS1E4.003. Rev. B of this calculation evaluates the new DTN's and assesses the impact on the computed impedance functions.

Rev. B of this calculation added page A-3 and Attachment F, revised pages 3, 4, 6, 7, 8, 10, 11, 12 to 47, 49 to 54 , A-1, A-2 and 118.

c. Notes for Revision 00C:
Rev. C of this calculation is to evaluate the extended condition of the Condition Report (CR) #11888, resulting in a revision to the mass properties calculation (Ref. 2.2.2), which affects the results of this calculation. A summary of the results and conclusion is shown on page 118.

Rev. C of this calculation has added pages 113-1 through 113-57 in addition to the revised pages 3, 4, 5, 6, 8, 11 & 118. Certain sections of the added pages are duplicates, which was done for ease of calculating the new values for the updated data.

Attachments	Total Number of Pages
A. IHF Ground Floor Plan and Facility Gridlines	3
B. IHF Part 1 Newmark's Influence Charts	8
C. IHF Part 2 Newmark's Influence Charts	7
D. Emails and Interoffice Memorandums	14
E. Nuclear Facility Buildings Exile Hill Fault Splay Location Plan	2
F. Assessment of Revised Soil Properties	38

RECORD OF REVISIONS

9. No.	10. Reason For Revision	11. Total # of Pgs.	12. Last Pg. #	13. Originator (Print/Sign/Date)	14. Checker (Print/Sign/Date)	15. EGS (Print/Sign/Date)	16. Approved/Accepted (Print/Sign)
00A	Initial Issue	151	E-2 of Attach. E	Kuo-Chu Hsu 11/8/07	Kirit Parikh 11/8/07	Salvador Macias 11/9/07	Raj Rajagopal 11/9/07
00B	See Notes in block 8 for Rev. 00B above	190	F-38 of Attach. F	Kuo-Chu Hsu 2/29/08	Elmer Acaac 2/29/08	Salvador Macias 2/29/08	Raj Rajagopal 2/29/08
00C	See Notes in block 8 for Rev. 00C	247	F-38 of Attach. F	Dustin Croft [signature] 6/17/08	Ken McEwan [signature] 6/17/08	Salvador Macias [signature] 6/17/08	Raj Rajagopal [signature] 6/17/08

DISCLAIMER

CONTENTS

FIGURES

PAGE

TABLES

PAGE

TABLES (Continued)

ACRONYMS

BSC	Bechtel SAIC Company, LLC
IHF	Initial Handling Facility
IOM	Interoffice Memorandum
ITS	Important to Safety
BDBGM	Beyond Design Basis Ground Motion: Mean annual probability of exceedance of 1 x 10^{-4} (10,000-year return period, 1E-4)
DBGM-2	Design Basis Ground Motion-2: Mean annual probability of exceedance of 5 x 10^{-4} (2,000-year return period, 5E-4)
ASCE	American Society of Civil Engineers
Gs	Symbol of shear modulus used in MathCAD calculation
G'	Symbol of shear modulus used in Excel spreadsheet calculation
lb	Pound
μ	Poisson's Ratio
Kip	1,000 Pounds
pcf	Pound per cubic foot
psf	Pound per square foot
psi	Pound per square inch
kcf	Kip per cubic foot
ksf	Kip per square foot
ksi	Kip per square inch
fps	Foot per second

1. PURPOSE

The purpose of this calculation is to provide equivalent soil spring constants and damping coefficients for use in the calculations of Initial Handling Facility (IHF) Foundation Design and Initial Handling Facility (IHF) Tier-1 In-Structure Response Spectra.

Soil spring and damping values are calculated for 2000 year return period (Annual Exceedance Frequency of 5E-4) and 10,000 year return period (Annual Exceedance Frequency of 1E-4) seismic events.

Also the purpose of revision '00B' is described on page F-1 of Attachment F.

2. REFERENCES

2.1 PROJECT PROCEDURES/DIRECTIVES

2.1.1 BSC (Bechtel SAIC Company) 2008. EG-PRO-3DP-G04B-00037, Rev. 12. *Calculations and Analyses*. Las Vegas, Nevada: Bechtel SAIC Company. ACC:ENG.20080519.0005.

2.1.2 BSC (Bechtel SAIC Company) 2008. IT-PRO-0011 Rev. 009, *Software Management*. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20080416.0010.

2.2 DESIGN INPUTS

2.2.1 BSC (Bechtel SAIC Company) 2008. *Basis of Design for the TAD Canister-Based Repository Design Concept.* 000-3DR-MGR0-00300-000-002. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080229.0007

2.2.2 BSC (Bechtel SAIC Company) 2008. *Initial Handling Facility (IHF) Mass Properties*. 51A-SYC-IH00-00400-000-00B. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080616.0016

2.2.3 ASCE 4-98. 2000. *Seismic Analysis of Safety-Related Nuclear Structures and Commentary*, Reston, VA. American Society of Civil Engineers. TIC: 253158 [ISBN: 0-7844-0433-X]

2.2.4 Bowles, J.E. 1996. *Foundation Analysis and Design.* 5th Edition. New York, New York: McGraw-Hill. TIC: 247039. [ISBN: 0-07-912247-7]

2.2.5 MO0801SCSPS5E4.003. *Strain Compatible Material Properties for the Surface Facilities Area at 5E-4 Annual Probability of Exceedance*. Submittal date:01/11/2008 [DIRS: 184682].

2.2.6 Young, W.C. 1989. *Roark's Formulas for Stress and Strain.* 6th Edition. New York, New York: McGraw-Hill. TIC:10191. [ISBN: 0-072541-1]

2.2.7 Hadjian, A.H. and Ellison, B. 1985. "Equivalent Properties for Layered Media." *Soil Dynamics and Earthquake Engineering, 4,* (4), 203-209. [Southampton, England]: CML Publications. TIC: 255744. [ISSN: 0267-7261]

2.2.8 Biggs, J.M. 1964. *Introduction to Structural Dynamics.* New York, New York: McGraw-Hill. TIC: 240633. [ISBN: 07-005255-7]

2.2.9 BSC (Bechtel SAIC Company) 2007. *Project Design Criteria Document*. 000-3DR-MGR0-00100-000-007. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071016.0005.

2.2.10 Not Used.

2.2.11 MO0801SCSPS1E4.003. *Strain Compatible Material Properties for the Surface Facilities Area at 1E-4 Annual Probability of Exceedance*. Submittal date:01/11/2008 [DIRS: 184683].

2.2.12 IOM # 0904071711 dated 09/05/2007; CCU.20070905.0011 (Reference information for IHF) / with Emails.

2.2.13 IOM # 1010071991 dated 10/10/2007; CCU.20071011.0006 (Reference information for IHF) / with Emails.

2.2.14 SNL (Sandia National Laboratories) 2007. *Geotechnical Data for a Potential Waste Handling Building and for a Ground Motion Analyses for the Yucca Mountain Site Characterization Project*. TDR-MGR-GE-000010 REV 00. Las Vegas, NV: Sandia National Laboratories. [DIRS: 183779].

2.2.15 BSC (Bechtel SAIC Company) 2007. *Nuclear Facilities Buildings Exile Hill Fault Splay Location Plan.* 100-S0K-MGR0-00101-000 Rev. 00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071107.0001.

2.2.16 BSC (Bechtel SAIC Company) 2007. *Seismic Analysis and Design Approach Document.* 000-30R-MGR0-02000-000-001. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071220.0029.

2.3 DESIGN CONSTRAINTS

None

2.4 DESIGN OUTPUTS

2.4.1 Results of this Calculation will be used as input to the *Initial Handling Facility (IHF) Foundation Design.*

2.4.2 Results of this Calculation will be used as input to the *Initial Handling Facility (IHF) Tier-1 In-Structure Response Spectra.*

3. ASSUMPTIONS

3.1 ASSUMPTIONS REQUIRING VERIFICATION

3.1.1 None.

3.2 ASSUMPTIONS NOT REQUIRING VERIFICATION

3.2.1 None.

4. METHODOLOGY

4.1 QUALITY ASSURANCE

This calculation was prepared in accordance with EG-PRO-3DP-G04B-00037, *Calculations and Analyses* (Ref. 2.1.1). Section 3.1.2 of the *Basis of Design for the TAD Canister–Based Repository Design Concept* (Ref. 2.2.1) classifies the IHF structure as Important to safety (ITS). The approved record version of this calculation is designated as QA:QA.

4.2 USE OF SOFTWARE

Excel 2003 and Word 2003, which are part of the Microsoft Office 2003 suite of programs, were used in this calculation. Microsoft Office 2003 as used in this calculation is classified as Level 2 software usage as defined in IT-PRO-0011 (Ref. 2.1.2). Microsoft Office 2003 is listed on the current Software Report.

MathCAD Version 13 was utilized to compute the soil spring and damping values. MathCAD was operated on a PC system running the Windows XP operating system. MathCAD, as used in this calculation, is considered as level 2 software usage as defined in IT-PRO-0011 (Ref. 2.1.2). MathCAD Version 13 is listed on the current Software Report.

All MathCAD input values and equations are stated in the calculation. Equations used in the MathCAD template were taken from the references as noted throughout the calculation. The results have been verified by visual inspection and the MathCAD template was checked by using a hand calculator.

The software was executed on a PC system running Microsoft Windows XP operating system.

4.3 CALCULATION METHOD

4.3.1 SOIL SPRINGS

The soil impedance functions computed in Section 6 and summarized in Tables 7.1.1 through 7.1.8 are based on data contained in DTN's MO0706SCSPS5E4.002 and MO0706SCSPS1E4.002, which have been superseded by DTN's MO0801SCSPS5E4.003 (Ref. 2.2.5) and MO0801SCSPS1E4.003 (Ref. 2.2.11). The impact of the superseding data, given in References 2.2.5 and 2.2.11, on the computed impedance functions is addressed in Attachment F of the calculation. Results of this assessment are discussed in Section 7.3.

The Initial Handling Facility rests on a layered alluvial material with varying properties. Section 6.2.2.2 of Reference 2.2.14 described the depth of alluvium for soil foundation of Initial Handling Facility (IHF). The depth of alluvium is shown as 30 ft, 70 ft, and 100 ft (Ref. 2.2.14). For purposes of dynamic analysis of the soil-structure interaction problem, it will be necessary to define the foundation impedance functions. For use in the Tier-1 seismic analysis, a set of frequency independent soils springs and corresponding percent of critical damping will be computed in accordance with ASCE 4-98 (Ref. 2.2.3) Section 3.3.4.2.

Building layout is shown on Figures A-1 and A-2 of Attachment A. Figure A-1 on page A-2 shows Part 1 mat foundation plan and Figure A-2 on page A-3 shows Part 2 mat foundation plan. Per Attachment E the relative location of the IHF to the Exile Hill Fault is shown to be to the south (Ref. 2.2.15).

The formulas of frequency independent soil springs and corresponding damping values for a rectangular foundation with length = B and width = L are given in Table 3.3-3 and Figure 3.3-3 of ASCE 4-98 (Ref. 2.2.3). The required functions for soil springs calculation are coefficients β_x, β_z, β_ψ, (determined based on L/B ratio in Figure 3.3-3), foundation dimensions B and L, soil dynamic shear modulus G', and Poisson's ratio μ. Damping coefficients are computed using Tables 3.3-1 and 3.3-3 of ASCE 4-98 (Ref. 2.2.3). Computation of the dynamic shear modulus follows the procedure recommended in references 2.2.7 and 2.2.9 and is summarized below:

Since the shear wave velocity and thus the dynamic shear modulus varies with depth, an equivalent shear modulus needs to be computed for use in determining the frequency independent soil springs. A method for solving this problem is discussed in a paper " *Equivalent Properties for Layered Media*" by A.H Hadjian and Byrwec Ellison (Ref. 2.2.7) published in Soil Dynamics and Earthquake Engineering, 1985 Volume 4 No. 4.

As discussed in this paper, the method derived is adequate for use in Tier-1 analysis calculations. The method discussed in the paper is summarized below:

The relative vertical displacements for layers of soil are given by:

$\Delta_1 = (P * h_1)/ (A_1*E_1) \quad = (q_1*h_1)/ E_1$

$\Delta_2 = (P * h_2)/ (A_2*E_2) \quad = (q_2*h_2)/ E_2$

$\Delta_n = (P * h_n)/ (A_n*E_n) \quad = (q_n*h_n)/ E_n$

(Ref. 2.2.6 Young 1989, Section 6.1, Eq. 3)

Thus the total vertical displacement is: $\Delta = (q_1*h_1)/ E_1 + (q_2*h_2)/ E_2 +\ldots+ (q_n*h_n)/ E_n$ (Eq. 1)

WhereP = Wei ght of Building above the soil layers.
n = Total number of soil layers.
$\Delta_1, \Delta_2, \ldots\Delta_n$ = Vertical displacements for soil layer 1, soil layer 2, …, and soil layer n, respectively.
$h_1, h_2, \ldots h_n$ = Thickness for soil layer 1, soil layer 2, ……., and soil layer n, respectively.
(Note: **H** is a symbol for thickness of soil layer in the calculation spreadsheet instead of **h** as shown here)
$A_1, A_2, \ldots A_n$ = Effective area for soil layer 1, soil layer 2, ……., and soil layer n, respectively.
$E_1, E_2, \ldots E_n$ = Modulus of Elasticity for soil layer 1, soil layer 2, …, and soil layer n, respectively.
$q_1, q_2, \ldots q_n$ = Boussinesq coefficient from Newmark's influence diagrams for soil layer 1, soil layer 2, …….., and soil layer n, respectively. (Ref. 2.2.4 pages 289-296)

If the elastic modulus were uniform throughout the medium the total displacement would be calculated as:

$\Delta = (q_1*h_1)/ E+ (q_2*h_2)/ E +\ldots(q_n*h_n)/ E$

or $\Delta =\{(q_1*h_1) + (q_2*h_2) +\ldots(q_n*h_n)\} / E$ (Eq. 2)

Solve Eq. 1 and Eq. 2, we obtain

$E = \{(q_1*h_1) + (q_2*h_2) +\ldots+ (q_n*h_n)\} / \{(q_1*h_1)/ E_1 + (q_2*h_2)/ E_2 +\ldots+ (q_n*h_n)/ E_n\}$

Which may be rewritten as:

$$E = \frac{\sum_{i=1}^{n}(q_i * h_i)}{\sum_{i=1}^{n}(q_i * h_i / E_i)} \qquad \text{(Eq. 3)}$$

Once E has been determined, the dynamic shear modulus can be computed as $G' = E / [2(1 + \mu)]$ (Ref. 2.2.4 page 121) where μ is Poisson's ratio of soil to match the E and/or G value we calculated or we used.

Process as shown below:

1. Divide the soil media into layers and determine the representative shear wave velocity for each layer. Figures 6.1 to 6.3 are plots of the shear wave velocity versus depth for the South 30', South 70' and South 100' alluvium cases for the 5E-4 event (DBGM-2). Figures 6.4 to 6.6 are plots of the shear wave velocity versus depth for the South 30', South 70' and South 100' alluvium cases for the 1E-4 event (BDBGM). The soil has been divided into 45 layers for the South 30', South 70', and South 100' alluvium cases. The shear wave velocity and Poison's ratio for each layer were taken from MO0706SCSPS5E4.002 for the 5E-4 event and MO0706SCSPS1E4.002 for the 1E-4 event.

2. Compile a table of shear wave velocities, Poisson's ratios and densities for each layer based on strain compatible soil properties and Figures 6.1 to 6.6.

3. Compute dynamic shear modulus, G', for each layer based on the shear wave velocities for each layer using Eq. 20-15 from Bowles Foundation Analysis and Design, 5th Edition (Ref. 2.2.4 page 1108).

4. Compute soil modulus E for each individual soil layer based on Poisson's ratio (listed in tables of DTN's MO0706SCSPS5E4.002 and MO0706SCSPS1E4.002 for each soil layer) and the G' values computed in step 3.

5. Determine the Newmark's influence coefficient ($q_{1,}$ q_2, ... q_n in Eq. 2 & 3 = Nq in the calculation spreadsheet) using Figures 6.7 and 6.8 for the midpoint depth of each layer. A discussion of Newmark's influence coefficient follows.

   To determine the Newmark influence coefficient, the foundation is plotted to scale on Newmark's influence chart (Ref. 2.2.4, Bowles Foundation Analysis and Design, 5th ed. Page 290). The depth at which the soil stress is being evaluated determines the scale of the drawing. The line segment AB is set equal to the depth at which the soil stress is desired, thus if the desired depth is 300 feet then AB is set equal to 300 ft and the foundation is drawn at that scale. The numbers of units covered by the foundation are counted and the influence coefficient is calculated by multiplying the number of units counted by the influence value of the chart, in our case the charts influence value is 0.005. This procedure was done for depths of 15' (Part 1 only), 50', 100', 200', 300', 400' and 500'. These charts are shown in Attachments B and C. A plot of the resulting influence coefficients as a function of depth is given in Figures 6.7 and 6.8.

6. Compute an equivalent E for the entire depth to 500' using Eq. 3.

7. Using the equivalent E from step 6 compute an equivalent shear modulus, G'.

8. Compute soil spring values using ASCE 4-98 (Ref. 2.2.3) and the shear modulus values computed in step 7. However, bounding depths of alluvium (30 ft and 100 ft) are used for the calculation of soil springs and damping values.

9. Figures 6.1 through 6.8 and Attachments B and C were verified by visual inspection.

4.3.2 SOIL DAMPING VALUES

Equivalent damping coefficients are calculated for six degrees of freedom from Equations presented in Table 3.3-1 of Ref. 2.2.3. These equations utilize an equivalent radius of circular base mat calculated per equations in Table 3.3-3 of the Ref. 2.2.3.

The Critical damping values are calculated for each degree of freedom based on equation 1.13 of Ref. 2.2.8. The mass properties from Ref. 2.2.2 and soil stiffness values (soil springs) from this calculation are used to calculate critical damping values. The ratio of damping coefficient and critical damping is presented as a percent of critical damping for soil damping.

The critical damping values have been re-evaluated as a result of the revised mass properties calculation (Ref. 2.2.2). In order to accommodate the changes and simultaneously capture the difference of old data to the new, the original soil springs and damping calculation has been untouched (pages 57 through 113); however, additional pages have been incorporated into this calculation (pages 113-1 through 113-57) in order to show this difference (see Section 7.2, Summary of Damping Values).

5. LIST OF ATTACHMENTS

Number of Pages

* See pages A-2 and A-3 for Part 1 and Part 2 definition.

6. BODY OF CALCULATION

6.1 SOIL SPRINGS AND DAMPING FOR 5E-4 (DBGM-2) and 1E-4 (BDBGM) SEISMIC EVENTS

6.1.1 DYNAMIC SHEAR MODULUS

The following spreadsheets are utilized to determine the dynamic shear modulus G' for the lower bound, median, and upper bound soil profiles for both the South 30' depth of alluvium and the South 100' depth of alluvium conditions based on the methodology discussed in Section 4.3.

The influence coefficients from Newmark's Charts are derived for base area of the IHF. Attachment A shows the basemat dimensions used in these calculations. Attachment A identifies the location of the two parts of the basemat, Part 1 and Part 2. Attachment A is considered the latest IHF Ground Floor Plan and Facility Gridlines based on IOM #0904071711, CCU.200905.0011) and IOM #1010071991, CCU.20071011.0006. See Attachments D and E, References 2.2.12, 2.2.13 and 2.2.14 for detailed description.

MathCAD was used to calculate soil springs and damping values. The calculation method was described in Sections 4.3.1 and 4.3.2.

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1

MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	897.97	2815.3	0.367	7699.7	0.02667	1	4.0000	5.20E-04
2	4.00	6.00	112.32	871.73	2653.2	0.387	7359.7	0.08000	1	4.0000	5.43E-04
3	4.00	10.00	112.32	1069.20	3991.4	0.388	11077.4	0.13333	1	4.0000	3.61E-04
4	4.00	14.00	112.32	1240.30	5371.1	0.387	14902.0	0.18667	1	4.0000	2.68E-04
5	4.00	18.00	112.32	1313.30	6021.9	0.389	16725.7	0.24000	0.972	3.8869	2.32E-04
6	8.00	24.00	112.32	1366.00	6514.9	0.391	18124.3	0.32000	0.915	7.3211	4.04E-04
7	2.00	29.00	112.32	1708.50	10191.5	0.365	27821.6	0.38667	0.868	1.7369	6.24E-05
8	10.00	35.00	137.28	2237.60	21365.9	0.282	54793.7	0.46668	0.811	8.1143	1.48E-04
9	10.00	45.00	137.28	2486.90	26392.0	0.278	67439.6	0.60001	0.717	7.1714	1.06E-04
10	10.00	55.00	137.28	2601.50	28880.4	0.274	73571.8	0.73335	0.636	6.3620	8.65E-05
11	10.00	65.00	137.28	2689.10	30858.2	0.273	78572.3	0.86668	0.569	5.6860	7.24E-05
12	10.00	75.00	137.28	2833.00	34249.1	0.268	86853.0	1.00001	0.501	5.0100	5.77E-05
13	10.00	85.00	137.28	2943.00	36960.4	0.270	93911.2	1.13335	0.433	4.3340	4.61E-05
14	10.00	95.00	137.28	3009.10	38639.3	0.273	98381.1	1.26668	0.366	3.6580	3.72E-05
15	10.00	105.00	137.28	3093.40	40834.6	0.276	104173.2	1.40001	0.321	3.2110	3.08E-05
16	10.00	115.00	137.28	3172.80	42957.8	0.276	109628.2	1.53335	0.299	2.9930	2.73E-05
17	10.00	125.00	137.28	3191.70	43471.1	0.276	110902.5	1.66668	0.278	2.7750	2.50E-05
18	10.00	135.00	137.28	3236.60	44702.8	0.277	114178.0	1.80001	0.256	2.5570	2.24E-05
19	15.00	147.50	137.28	3278.00	45853.7	0.279	117335.0	1.96668	0.228	3.4268	2.92E-05
20	15.00	162.50	137.28	3434.00	50321.9	0.280	128866.3	2.16668	0.196	2.9363	2.28E-05
21	15.00	177.50	137.28	3520.60	52892.0	0.284	135787.4	2.36668	0.163	2.4458	1.80E-05
22	15.00	192.50	137.28	3534.50	53310.4	0.284	136871.3	2.56668	0.130	1.9553	1.43E-05
23	15.00	207.50	137.28	3560.80	54106.7	0.283	138822.7	2.76668	0.110	1.6448	1.18E-05
24	15.00	222.50	137.28	3617.50	55843.6	0.285	143529.2	2.96668	0.101	1.5143	1.06E-05
25	7.50	233.75	137.28	3643.90	56661.6	0.287	145819.9	3.11668	0.094	0.7082	4.86E-06
26	7.50	241.25	137.28	3646.60	56745.6	0.289	146299.3	3.21668	0.090	0.6756	4.62E-06
27	7.50	248.75	137.28	3646.00	56727.0	0.286	145910.8	3.31668	0.086	0.6429	4.41E-06
28	7.50	256.25	137.28	3678.50	57742.8	0.288	148783.5	3.41668	0.081	0.6103	4.10E-06
29	7.50	263.75	137.28	3736.40	59574.8	0.288	153442.2	3.51668	0.077	0.5777	3.76E-06
30	7.50	271.25	137.28	3754.30	60147.0	0.289	155002.5	3.61668	0.073	0.5451	3.52E-06
31	7.50	278.75	137.28	3780.20	60979.8	0.288	157032.7	3.71668	0.068	0.5124	3.26E-06
32	7.50	286.25	137.28	3812.10	62013.3	0.287	159634.6	3.81668	0.064	0.4798	3.01E-06
33	7.50	293.75	137.28	3829.10	62567.6	0.289	161329.4	3.91668	0.060	0.4472	2.77E-06
34	7.50	301.25	137.28	3862.50	63663.9	0.288	164055.5	4.01668	0.056	0.4185	2.55E-06
35	7.50	308.75	137.28	3899.00	64872.8	0.290	167329.0	4.11668	0.055	0.4095	2.45E-06
36	7.50	316.25	137.28	3962.40	66999.7	0.287	172458.6	4.21668	0.053	0.4005	2.32E-06
37	10.16	325.08	137.28	3995.00	68106.7	0.288	175474.2	4.33439	0.052	0.5280	3.01E-06
38	9.84	335.08	137.28	4051.30	70039.8	0.286	180145.2	4.46773	0.050	0.4960	2.75E-06
39	10.16	345.08	137.28	4057.40	70250.9	0.285	180588.4	4.60105	0.049	0.4955	2.74E-06
40	9.84	355.08	137.28	4086.80	71272.7	0.284	183061.0	4.73440	0.047	0.4645	2.54E-06
41	20.00	370.00	137.28	4175.30	74392.9	0.283	190956.2	4.93335	0.045	0.8960	4.69E-06
42	20.00	390.00	137.28	4202.50	75365.3	0.282	193307.6	5.20001	0.042	0.8320	4.30E-06
43	20.00	410.00	137.28	4230.50	76373.0	0.282	195788.2	5.46668	0.038	0.7640	3.90E-06
44	20.00	430.00	137.28	4344.10	80529.7	0.281	206365.3	5.73335	0.035	0.6920	3.35E-06
45	20.00	450.00	137.28	4468.20	85196.4	0.281	218297.1	6.00001	0.031	0.6200	2.84E-06
						0.349			Σ=	106.9553	3.23E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	33118	ksf
G' = E/(2*(1+μ)) =:	12278	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1875.2	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1696.2	fps (density =137.28)

USE G' (South 30' Alluvium) = 12300 ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	870.06	2643.0	0.369	7234.5	0.02667	1	4.0000	5.53E-04
2	4.00	6.00	112.32	863.62	2604.1	0.388	7230.1	0.08000	1	4.0000	5.53E-04
3	4.00	10.00	112.32	982.50	3370.3	0.392	9383.5	0.13333	1	4.0000	4.26E-04
4	4.00	14.00	112.32	1150.60	4622.3	0.392	12866.2	0.18667	1	4.0000	3.11E-04
5	4.00	18.00	112.32	1282.70	5744.6	0.392	15987.5	0.24000	0.972	3.8869	2.43E-04
6	8.00	24.00	112.32	1306.40	5958.8	0.395	16625.5	0.32000	0.915	7.3211	4.40E-04
7	8.00	32.00	112.32	1528.10	8152.9	0.375	22427.8	0.42667	0.840	6.7177	3.00E-04
8	8.00	40.00	112.32	1598.50	8921.4	0.364	24339.4	0.53333	0.764	6.1143	2.51E-04
9	8.00	48.00	112.32	1677.00	9819.1	0.357	26644.7	0.64000	0.689	5.5109	2.07E-04
10	8.00	56.00	112.32	1863.50	12124.5	0.341	32521.4	0.74667	0.623	4.9856	1.53E-04
11	10.00	65.00	112.32	1911.00	12750.5	0.341	34184.1	0.86667	0.553	5.5300	1.62E-04
12	10.00	75.00	137.28	2556.80	27896.5	0.303	72686.6	1.00000	0.475	4.7500	6.53E-05
13	10.00	85.00	137.28	2691.60	30915.6	0.302	80497.3	1.13333	0.397	3.9700	4.93E-05
14	10.00	95.00	137.28	2948.00	37086.1	0.268	94036.3	1.26667	0.319	3.1900	3.39E-05
15	10.00	105.00	137.28	2995.90	38301.1	0.270	97313.8	1.40000	0.271	2.7060	2.78E-05
16	10.00	115.00	137.28	3107.00	41194.5	0.273	104867.9	1.53333	0.252	2.5180	2.40E-05
17	10.00	125.00	137.28	3134.10	41916.2	0.275	106881.3	1.66667	0.233	2.3300	2.18E-05
18	10.00	135.00	137.28	3179.30	43133.9	0.276	110037.3	1.80000	0.214	2.1420	1.95E-05
19	15.00	147.50	137.28	3218.30	44198.7	0.276	112750.8	1.96667	0.191	2.8605	2.54E-05
20	15.00	162.50	137.28	3315.40	46906.0	0.277	119785.6	2.16667	0.163	2.4375	2.03E-05
21	15.00	177.50	137.28	3411.80	49673.3	0.279	127075.3	2.36667	0.134	2.0145	1.59E-05
22	15.00	192.50	137.28	3487.40	51899.1	0.280	132907.3	2.56667	0.106	1.5915	1.20E-05
23	15.00	207.50	137.28	3570.80	54411.1	0.284	139700.4	2.76667	0.089	1.3395	9.59E-06
24	15.00	222.50	137.28	3635.10	56388.3	0.284	144773.6	2.96667	0.084	1.2585	8.69E-06
25	7.50	233.75	137.28	3691.00	58135.9	0.283	149148.8	3.11667	0.080	0.5989	4.02E-06
26	7.50	241.25	137.28	3693.30	58208.4	0.285	149604.8	3.21667	0.077	0.5786	3.87E-06
27	7.50	248.75	137.28	3680.30	57799.3	0.287	148751.1	3.31667	0.074	0.5584	3.75E-06
28	7.50	256.25	137.28	3754.80	60163.0	0.289	155051.0	3.41667	0.072	0.5381	3.47E-06
29	7.50	263.75	137.28	3798.80	61581.3	0.285	158323.1	3.51667	0.069	0.5179	3.27E-06
30	7.50	271.25	137.28	3829.70	62587.2	0.288	161241.0	3.61667	0.066	0.4976	3.09E-06
31	7.50	278.75	137.28	3886.40	64454.2	0.288	165979.9	3.71667	0.064	0.4774	2.88E-06
32	7.50	286.25	137.28	3880.20	64248.7	0.288	165552.2	3.81667	0.061	0.4571	2.76E-06
33	7.50	293.75	137.28	3891.50	64623.5	0.287	166399.0	3.91667	0.058	0.4369	2.63E-06
34	7.50	301.25	137.28	3891.00	64606.9	0.287	166303.2	4.01667	0.056	0.4179	2.51E-06
35	7.50	308.75	137.28	3927.60	65828.0	0.289	169720.4	4.11667	0.054	0.4056	2.39E-06
36	7.50	316.25	137.28	4014.10	68759.5	0.288	177147.8	4.21667	0.052	0.3932	2.22E-06
37	10.16	325.08	137.28	4050.10	69998.3	0.289	180513.1	4.33437	0.050	0.5128	2.84E-06
38	9.84	335.08	137.28	4091.90	71450.7	0.287	183885.4	4.46772	0.048	0.4752	2.58E-06
39	10.16	345.08	137.28	4142.50	73228.7	0.288	188641.5	4.60104	0.046	0.4681	2.48E-06
40	9.84	355.08	137.28	4169.40	74182.8	0.286	190778.9	4.73439	0.044	0.4319	2.26E-06
41	20.00	370.00	137.28	4233.00	76463.2	0.285	196516.7	4.93333	0.041	0.8120	4.13E-06
42	20.00	390.00	137.28	4304.40	79064.5	0.284	203026.5	5.20000	0.036	0.7240	3.57E-06
43	20.00	410.00	137.28	4368.00	81418.2	0.283	208951.7	5.46667	0.033	0.6600	3.16E-06
44	20.00	430.00	137.28	4425.40	83572.1	0.282	214317.3	5.73333	0.031	0.6200	2.89E-06
45	20.00	450.00	137.28	4465.20	85082.1	0.281	218061.9	6.00000	0.029	0.5800	2.66E-06
						0.362			Σ=	100.3360	4.00E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	25107	ksf
G' = E/(2*(1+μ)) =:	9219	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1625.0	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1469.8	fps (density =137.28)

USE G' (South 70' Alluvium)= 9200 Ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	878.11	2692.2	0.367	7362.7	0.02667	1	4.0000	5.43E-04
2	4.00	6.00	112.32	815.09	2319.6	0.391	6452.2	0.08000	1	4.0000	6.20E-04
3	4.00	10.00	112.32	926.63	2997.9	0.394	8360.0	0.13333	1	4.0000	4.78E-04
4	4.00	14.00	112.32	1103.10	4248.5	0.393	11839.5	0.18667	1	4.0000	3.38E-04
5	4.00	18.00	112.32	1251.80	5471.1	0.393	15238.2	0.24000	0.972	3.8869	2.55E-04
6	8.00	24.00	112.32	1336.10	6232.8	0.394	17379.4	0.32000	0.915	7.3211	4.21E-04
7	8.00	32.00	112.32	1560.30	8500.1	0.374	23357.2	0.42667	0.840	6.7177	2.88E-04
8	8.00	40.00	112.32	1624.60	9215.1	0.363	25112.6	0.53333	0.764	6.1143	2.43E-04
9	8.00	48.00	112.32	1663.90	9666.3	0.358	26244.2	0.64000	0.689	5.5109	2.10E-04
10	8.00	56.00	112.32	1884.60	12400.6	0.341	33262.5	0.74667	0.623	4.9856	1.50E-04
11	10.00	65.00	112.32	1896.20	12553.8	0.342	33699.6	0.86667	0.553	5.5300	1.64E-04
12	10.00	75.00	112.32	2065.10	14889.8	0.336	39798.9	1.00000	0.475	4.7500	1.19E-04
13	10.00	85.00	112.32	2188.90	16728.5	0.335	44662.8	1.13333	0.397	3.9700	8.89E-05
14	10.00	95.00	112.32	2291.60	18335.1	0.334	48927.3	1.26667	0.319	3.1900	6.52E-05
15	10.00	105.00	137.28	2719.30	31555.2	0.304	82266.2	1.40000	0.271	2.7060	3.29E-05
16	10.00	115.00	137.28	2813.20	33772.1	0.303	88014.7	1.53333	0.252	2.5180	2.86E-05
17	10.00	125.00	137.28	2956.80	37307.8	0.276	95191.7	1.66667	0.233	2.3300	2.45E-05
18	10.00	135.00	137.28	3046.20	39598.0	0.276	101065.9	1.80000	0.214	2.1420	2.12E-05
19	15.00	147.50	137.28	3109.40	41258.1	0.276	105291.5	1.96667	0.191	2.8605	2.72E-05
20	15.00	162.50	137.28	3179.60	43142.1	0.278	110239.3	2.16667	0.163	2.4375	2.21E-05
21	15.00	177.50	137.28	3342.90	47687.3	0.280	122040.5	2.36667	0.134	2.0145	1.65E-05
22	15.00	192.50	137.28	3396.30	49223.0	0.281	126105.5	2.56667	0.106	1.5915	1.26E-05
23	15.00	207.50	137.28	3465.50	51249.3	0.284	131643.1	2.76667	0.089	1.3395	1.02E-05
24	15.00	222.50	137.28	3526.20	53060.3	0.284	136292.9	2.96667	0.084	1.2585	9.23E-06
25	7.50	233.75	137.28	3623.70	56035.2	0.283	143809.8	3.11667	0.080	0.5989	4.16E-06
26	7.50	241.25	137.28	3637.30	56456.6	0.286	145149.8	3.21667	0.077	0.5786	3.99E-06
27	7.50	248.75	137.28	3663.70	57279.1	0.287	147445.5	3.31667	0.074	0.5584	3.79E-06
28	7.50	256.25	137.28	3771.50	60699.4	0.288	156392.0	3.41667	0.072	0.5381	3.44E-06
29	7.50	263.75	137.28	3809.00	61912.5	0.285	159132.4	3.51667	0.069	0.5179	3.25E-06
30	7.50	271.25	137.28	3822.90	62365.2	0.288	160634.0	3.61667	0.066	0.4976	3.10E-06
31	7.50	278.75	137.28	3874.70	64066.7	0.287	164941.0	3.71667	0.064	0.4774	2.89E-06
32	7.50	286.25	137.28	3927.20	65814.6	0.288	169523.9	3.81667	0.061	0.4571	2.70E-06
33	7.50	293.75	137.28	3959.60	66905.0	0.287	172194.8	3.91667	0.058	0.4369	2.54E-06
34	7.50	301.25	137.28	3986.30	67810.4	0.286	174458.5	4.01667	0.056	0.4179	2.40E-06
35	7.50	308.75	137.28	4006.40	68495.9	0.289	176514.0	4.11667	0.054	0.4056	2.30E-06
36	7.50	316.25	137.28	4074.80	70854.7	0.288	182467.9	4.21667	0.052	0.3932	2.15E-06
37	10.16	325.08	137.28	4118.60	72386.1	0.289	186592.7	4.33437	0.050	0.5128	2.75E-06
38	9.84	335.08	137.28	4157.00	73742.2	0.286	189701.9	4.46772	0.048	0.4752	2.51E-06
39	10.16	345.08	137.28	4188.20	74853.3	0.288	192753.3	4.60104	0.046	0.4681	2.43E-06
40	9.84	355.08	137.28	4269.50	77787.6	0.285	199954.5	4.73439	0.044	0.4319	2.16E-06
41	20.00	370.00	137.28	4281.10	78210.8	0.285	200929.9	4.93333	0.041	0.8120	4.04E-06
42	20.00	390.00	137.28	4308.80	79226.2	0.283	203372.1	5.20000	0.036	0.7240	3.56E-06
43	20.00	410.00	137.28	4327.10	79900.6	0.283	205010.6	5.46667	0.033	0.6600	3.22E-06
44	20.00	430.00	137.28	4401.90	82686.9	0.282	211992.6	5.73333	0.031	0.6200	2.92E-06
45	20.00	450.00	137.28	4412.60	83089.3	0.281	212916.4	6.00000	0.029	0.5800	2.72E-06
						0.372			Σ=	100.3360	4.25E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	23595	ksf
G' = E/(2*(1+μ)) =:	8596	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1569.1	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1419.3	fps (density =137.28)

USE G' (South 100' Alluvium)= 8600 Ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY[(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	634.96	1407.7	0.367	3849.8	0.02667	1	4.0000	1.04E-03
2	4.00	6.00	112.32	616.40	1326.6	0.387	3679.8	0.08000	1	4.0000	1.09E-03
3	4.00	10.00	112.32	756.04	1995.7	0.388	5538.7	0.13333	1	4.0000	7.22E-04
4	4.00	14.00	112.32	877.03	2685.6	0.387	7451.1	0.18667	1	4.0000	5.37E-04
5	4.00	18.00	112.32	928.65	3011.0	0.389	8363.0	0.24000	0.972	3.8869	4.65E-04
6	8.00	24.00	112.32	965.94	3257.7	0.391	9062.8	0.32000	0.915	7.3211	8.08E-04
7	2.00	29.00	112.32	1208.10	5095.8	0.365	13911.0	0.38667	0.868	1.7369	1.25E-04
8	10.00	35.00	137.28	1736.80	12872.3	0.282	33011.5	0.46668	0.811	8.1143	2.46E-04
9	10.00	45.00	137.28	2030.50	17593.9	0.278	44957.7	0.60001	0.717	7.1714	1.60E-04
10	10.00	55.00	137.28	2124.10	19253.3	0.274	49047.1	0.73335	0.631	6.3100	1.29E-04
11	10.00	65.00	137.28	2195.60	20571.3	0.273	52379.6	0.86668	0.553	5.5300	1.06E-04
12	10.00	75.00	137.28	2313.10	22832.1	0.268	57900.3	1.00001	0.475	4.7500	8.20E-05
13	10.00	85.00	137.28	2402.90	24639.3	0.270	62604.9	1.13335	0.397	3.9700	6.34E-05
14	10.00	95.00	137.28	2456.90	25759.1	0.273	65586.3	1.26668	0.319	3.1900	4.86E-05
15	10.00	105.00	137.28	2521.70	27135.8	0.276	69226.2	1.40001	0.271	2.7060	3.91E-05
16	10.00	115.00	137.28	2590.60	28638.9	0.276	73086.6	1.53335	0.252	2.5180	3.45E-05
17	10.00	125.00	137.28	2606.00	28980.4	0.276	73934.3	1.66668	0.233	2.3300	3.15E-05
18	10.00	135.00	137.28	2642.70	29802.4	0.277	76120.2	1.80001	0.214	2.1420	2.81E-05
19	15.00	147.50	137.28	2676.50	30569.7	0.279	78224.7	1.96668	0.191	2.8605	3.66E-05
20	15.00	162.50	137.28	2803.80	33546.7	0.280	85907.8	2.16668	0.163	2.4375	2.84E-05
21	15.00	177.50	137.28	2874.60	35262.3	0.284	90527.6	2.36668	0.134	2.0145	2.23E-05
22	15.00	192.50	137.28	2885.90	35540.1	0.284	91247.1	2.56668	0.106	1.5915	1.74E-05
23	15.00	207.50	137.28	2907.40	36071.6	0.283	92549.7	2.76668	0.089	1.3395	1.45E-05
24	15.00	222.50	137.28	2953.70	37229.7	0.285	95687.7	2.96668	0.084	1.2585	1.32E-05
25	7.50	233.75	137.28	2975.20	37773.6	0.287	97211.2	3.11668	0.080	0.5989	6.16E-06
26	7.50	241.25	137.28	2977.40	37829.5	0.289	97530.5	3.21668	0.077	0.5786	5.93E-06
27	7.50	248.75	137.28	2977.00	37819.3	0.286	97277.4	3.31668	0.074	0.5584	5.74E-06
28	7.50	256.25	137.28	3003.50	38495.6	0.288	99190.2	3.41668	0.072	0.5381	5.43E-06
29	7.50	263.75	137.28	3050.70	39715.1	0.288	102291	3.51668	0.069	0.5179	5.06E-06
30	7.50	271.25	137.28	3065.40	40098.7	0.289	103337	3.61668	0.066	0.4976	4.82E-06
31	7.50	278.75	137.28	3086.50	40652.6	0.288	104687	3.71668	0.064	0.4774	4.56E-06
32	7.50	286.25	137.28	3112.60	41343.1	0.287	106425	3.81668	0.061	0.4571	4.30E-06
33	7.50	293.75	137.28	3126.50	41713.2	0.289	107557	3.91668	0.058	0.4369	4.06E-06
34	7.50	301.25	137.28	3153.70	42442.1	0.288	109369	4.01668	0.056	0.4179	3.82E-06
35	7.50	308.75	137.28	3183.50	43248.0	0.290	111551	4.11668	0.054	0.4056	3.64E-06
36	7.50	316.25	137.28	3235.30	44666.8	0.287	114973	4.21668	0.052	0.3932	3.42E-06
37	10.16	325.08	137.28	3261.90	45404.4	0.288	116983	4.33439	0.050	0.5128	4.38E-06
38	9.84	335.08	137.28	3307.90	46694.0	0.286	120099	4.46773	0.048	0.4752	3.96E-06
39	10.16	345.08	137.28	3312.80	46832.4	0.285	120388	4.60105	0.046	0.4681	3.89E-06
40	9.84	355.08	137.28	3336.90	47516.3	0.284	122044	4.73440	0.044	0.4319	3.54E-06
41	20.00	370.00	137.28	3409.20	49597.7	0.283	127310	4.93335	0.041	0.8120	6.38E-06
42	20.00	390.00	137.28	3431.40	50245.7	0.282	128877	5.20001	0.036	0.7240	5.62E-06
43	20.00	410.00	137.28	3454.20	50915.6	0.282	130526	5.46668	0.033	0.6600	5.06E-06
44	20.00	430.00	137.28	3546.90	53685.1	0.281	137574	5.73335	0.031	0.6200	4.51E-06
45	20.00	450.00	137.28	3648.30	56798.6	0.281	145534	6.00001	0.029	0.5800	3.99E-06
						0.353			Σ=	100.3401	5.98E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 16780 ksf
G' = E/(2*(1+μ)) =: 6203 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 1333 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1206 fps (density =137.28)

USE G' (South 30' Alluvium) = 6200 ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY (4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ (1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	615.23	1321.5	0.369	3617.3	0.02667	1	4.0000	1.11E-03
2	4.00	6.00	112.32	610.67	1302.0	0.388	3615.0	0.08000	1	4.0000	1.11E-03
3	4.00	10.00	112.32	694.73	1685.1	0.392	4691.7	0.13333	1	4.0000	8.53E-04
4	4.00	14.00	112.32	813.57	2311.0	0.392	6432.7	0.18667	1	4.0000	6.22E-04
5	4.00	18.00	112.32	907.01	2872.3	0.392	7993.8	0.24000	0.972	3.8869	4.86E-04
6	8.00	24.00	112.32	923.79	2979.6	0.395	8313.2	0.32000	0.915	7.3211	8.81E-04
7	8.00	32.00	112.32	1080.60	4077.0	0.375	11215.4	0.42667	0.840	6.7177	5.99E-04
8	8.00	40.00	112.32	1130.30	4460.6	0.364	12169.5	0.53333	0.764	6.1143	5.02E-04
9	8.00	48.00	112.32	1185.80	4909.4	0.357	13322.0	0.64000	0.689	5.5109	4.14E-04
10	8.00	56.00	112.32	1317.70	6062.3	0.341	16260.8	0.74667	0.623	4.9856	3.07E-04
11	10.00	65.00	112.32	1351.30	6375.4	0.341	17092.5	0.86667	0.553	5.5300	3.24E-04
12	10.00	75.00	137.28	1963.80	16457.0	0.303	42880.0	1.00000	0.475	4.7500	1.11E-04
13	10.00	85.00	137.28	2100.70	18831.5	0.302	49033.0	1.13333	0.397	3.9700	8.10E-05
14	10.00	95.00	137.28	2407.00	24723.4	0.268	62689.2	1.26667	0.319	3.1900	5.09E-05
15	10.00	105.00	137.28	2446.10	25533.2	0.270	64873.6	1.40000	0.271	2.7060	4.17E-05
16	10.00	115.00	137.28	2536.90	27463.9	0.273	69914.4	1.53333	0.252	2.5180	3.60E-05
17	10.00	125.00	137.28	2559.00	27944.5	0.275	71255.2	1.66667	0.233	2.3300	3.27E-05
18	10.00	135.00	137.28	2595.90	28756.2	0.276	73358.9	1.80000	0.214	2.1420	2.92E-05
19	15.00	147.50	137.28	2627.70	29465.1	0.276	75165.4	1.96667	0.191	2.8605	3.81E-05
20	15.00	162.50	137.28	2707.00	31270.3	0.277	79856.3	2.16667	0.163	2.4375	3.05E-05
21	15.00	177.50	137.28	2785.70	33115.0	0.279	84715.5	2.36667	0.134	2.0145	2.38E-05
22	15.00	192.50	137.28	2847.40	34598.2	0.280	88601.8	2.56667	0.106	1.5915	1.80E-05
23	15.00	207.50	137.28	2915.60	36275.4	0.284	93137.1	2.76667	0.089	1.3395	1.44E-05
24	15.00	222.50	137.28	2968.10	37593.5	0.284	96519.2	2.96667	0.084	1.2585	1.30E-05
25	7.50	233.75	137.28	3013.70	38757.5	0.283	99433.3	3.11667	0.080	0.5989	6.02E-06
26	7.50	241.25	137.28	3015.50	38803.9	0.285	99732.1	3.21667	0.077	0.5786	5.80E-06
27	7.50	248.75	137.28	3004.90	38531.5	0.287	99164.0	3.31667	0.074	0.5584	5.63E-06
28	7.50	256.25	137.28	3065.80	40109.2	0.289	103368.6	3.41667	0.072	0.5381	5.21E-06
29	7.50	263.75	137.28	3101.70	41054.0	0.285	105548.3	3.51667	0.069	0.5179	4.91E-06
30	7.50	271.25	137.28	3126.90	41723.8	0.288	107491.4	3.61667	0.066	0.4976	4.63E-06
31	7.50	278.75	137.28	3173.30	42971.3	0.288	110658.0	3.71667	0.064	0.4774	4.31E-06
32	7.50	286.25	137.28	3168.20	42833.3	0.288	110370.2	3.81667	0.061	0.4571	4.14E-06
33	7.50	293.75	137.28	3177.40	43082.4	0.287	110932.9	3.91667	0.058	0.4369	3.94E-06
34	7.50	301.25	137.28	3177.00	43071.6	0.287	110869.7	4.01667	0.056	0.4179	3.77E-06
35	7.50	308.75	137.28	3206.90	43886.1	0.289	113148.9	4.11667	0.054	0.4056	3.58E-06
36	7.50	316.25	137.28	3277.50	45839.7	0.288	118098.6	4.21667	0.052	0.3932	3.33E-06
37	10.16	325.08	137.28	3306.90	46665.8	0.289	120342.6	4.33437	0.050	0.5128	4.26E-06
38	9.84	335.08	137.28	3341.00	47633.1	0.287	122588.6	4.46772	0.048	0.4752	3.88E-06
39	10.16	345.08	137.28	3382.30	48818.1	0.288	125758.2	4.60104	0.046	0.4681	3.72E-06
40	9.84	355.08	137.28	3404.30	49455.2	0.286	127185.9	4.73439	0.044	0.4319	3.40E-06
41	20.00	370.00	137.28	3456.20	50974.6	0.285	131008.8	4.93333	0.041	0.8120	6.20E-06
42	20.00	390.00	137.28	3514.50	52708.8	0.284	135348.9	5.20000	0.036	0.7240	5.35E-06
43	20.00	410.00	137.28	3566.50	54280.1	0.283	139304.5	5.46667	0.033	0.6600	4.74E-06
44	20.00	430.00	137.28	3613.30	55714.0	0.282	142876.3	5.73333	0.031	0.6200	4.34E-06
45	20.00	450.00	137.28	3645.80	56720.7	0.281	145373.0	6.00000	0.029	0.5800	3.99E-06
						0.360			Σ=	100.3360	7.81E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 12841 ksf
G' = E/(2*(1+μ)) =: 4721 ksf **USE G' (South 70' Alluvium) = 4700 ksf for Lower Bound Soil Case**
Vs=(G'*1000*32.17/ρ)^0.5=: 1162.9 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1051.9 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY [(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	620.92	1346.1	0.367	3681.4	0.02667	1	4.0000	1.09E-03
2	4.00	6.00	112.32	576.36	1159.8	0.391	3226.1	0.08000	1	4.0000	1.24E-03
3	4.00	10.00	112.32	655.23	1499.0	0.394	4180.0	0.13333	1	4.0000	9.57E-04
4	4.00	14.00	112.32	780.00	2124.2	0.393	5919.6	0.18667	1	4.0000	6.76E-04
5	4.00	18.00	112.32	885.18	2735.7	0.393	7619.5	0.24000	0.972	3.8869	5.10E-04
6	8.00	24.00	112.32	944.77	3116.4	0.394	8689.8	0.32000	0.915	7.3211	8.42E-04
7	8.00	32.00	112.32	1103.30	4250.0	0.374	11678.6	0.42667	0.840	6.7177	5.75E-04
8	8.00	40.00	112.32	1148.80	4607.8	0.363	12557.0	0.53333	0.764	6.1143	4.87E-04
9	8.00	48.00	112.32	1176.50	4832.7	0.358	13120.9	0.64000	0.689	5.5109	4.20E-04
10	8.00	56.00	112.32	1339.60	6265.5	0.341	16806.1	0.74667	0.623	4.9856	2.97E-04
11	10.00	65.00	112.32	1340.80	6276.7	0.342	16849.4	0.86667	0.553	5.5300	3.28E-04
12	10.00	75.00	112.32	1489.30	7744.1	0.336	20699.2	1.00000	0.475	4.7500	2.29E-04
13	10.00	85.00	112.32	1581.80	8735.9	0.335	23323.7	1.13333	0.397	3.9700	1.70E-04
14	10.00	95.00	112.32	1663.40	9660.5	0.334	25779.0	1.26667	0.319	3.1900	1.24E-04
15	10.00	105.00	137.28	2120.20	19182.7	0.304	50010.5	1.40000	0.271	2.7060	5.41E-05
16	10.00	115.00	137.28	2267.60	21942.7	0.303	57185.6	1.53333	0.252	2.5180	4.40E-05
17	10.00	125.00	137.28	2414.20	24871.5	0.276	63460.2	1.66667	0.233	2.3300	3.67E-05
18	10.00	135.00	137.28	2487.30	26400.5	0.276	67382.1	1.80000	0.214	2.1420	3.18E-05
19	15.00	147.50	137.28	2538.80	27505.1	0.276	70193.6	1.96667	0.191	2.8605	4.08E-05
20	15.00	162.50	137.28	2596.20	28762.9	0.278	73496.7	2.16667	0.163	2.4375	3.32E-05
21	15.00	177.50	137.28	2729.50	31792.3	0.280	81362.3	2.36667	0.134	2.0145	2.48E-05
22	15.00	192.50	137.28	2773.10	32816.1	0.281	84072.3	2.56667	0.106	1.5915	1.89E-05
23	15.00	207.50	137.28	2829.60	34167.0	0.284	87764.0	2.76667	0.089	1.3395	1.53E-05
24	15.00	222.50	137.28	2879.20	35375.3	0.284	90866.4	2.96667	0.084	1.2585	1.39E-05
25	7.50	233.75	137.28	2958.70	37355.8	0.283	95870.7	3.11667	0.080	0.5989	6.25E-06
26	7.50	241.25	137.28	2969.90	37639.2	0.286	96770.3	3.21667	0.077	0.5786	5.98E-06
27	7.50	248.75	137.28	2991.40	38186.1	0.287	98297.1	3.31667	0.074	0.5584	5.68E-06
28	7.50	256.25	137.28	3079.50	40468.5	0.288	104267.0	3.41667	0.072	0.5381	5.16E-06
29	7.50	263.75	137.28	3110.10	41276.7	0.285	106092.7	3.51667	0.069	0.5179	4.88E-06
30	7.50	271.25	137.28	3121.40	41577.2	0.288	107090.4	3.61667	0.066	0.4976	4.65E-06
31	7.50	278.75	137.28	3163.70	42711.7	0.287	109962.1	3.71667	0.064	0.4774	4.34E-06
32	7.50	286.25	137.28	3206.50	43875.2	0.288	113012.8	3.81667	0.061	0.4571	4.04E-06
33	7.50	293.75	137.28	3233.00	44603.4	0.287	114796.6	3.91667	0.058	0.4369	3.81E-06
34	7.50	301.25	137.28	3254.80	45206.9	0.286	116305.6	4.01667	0.056	0.4179	3.59E-06
35	7.50	308.75	137.28	3271.20	45663.6	0.289	117675.2	4.11667	0.054	0.4056	3.45E-06
36	7.50	316.25	137.28	3327.10	47237.6	0.288	121648.2	4.21667	0.052	0.3932	3.23E-06
37	10.16	325.08	137.28	3362.80	48256.8	0.289	124393.4	4.33437	0.050	0.5128	4.12E-06
38	9.84	335.08	137.28	3394.10	49159.3	0.286	126462.2	4.46772	0.048	0.4752	3.76E-06
39	10.16	345.08	137.28	3419.60	49900.7	0.288	128498.4	4.60104	0.046	0.4681	3.64E-06
40	9.84	355.08	137.28	3486.10	51860.4	0.285	133308.2	4.73439	0.044	0.4319	3.24E-06
41	20.00	370.00	137.28	3495.50	52140.5	0.285	133953.0	4.93333	0.041	0.8120	6.06E-06
42	20.00	390.00	137.28	3518.10	52816.9	0.283	135579.8	5.20000	0.036	0.7240	5.34E-06
43	20.00	410.00	137.28	3533.10	53268.2	0.283	136676.6	5.46667	0.033	0.6600	4.83E-06
44	20.00	430.00	137.28	3594.10	55123.5	0.282	141325.5	5.73333	0.031	0.6200	4.39E-06
45	20.00	450.00	137.28	3602.90	55393.7	0.281	141946.4	6.00000	0.029	0.5800	4.09E-06
						0.370			Σ=	100.3360	8.35E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	12016	ksf
G' = E/(2*(1+μ)) =:	4387	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1120.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1013.9	fps (density =137.28)

USE G' (South 100' Alluvium) = 4400 ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING 30' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1269.90	5630.5	0.367	15398.8	0.02667	1	4.0000	2.60E-04
2	4.00	6.00	112.32	1232.80	5306.3	0.387	14719.1	0.08000	1	4.0000	2.72E-04
3	4.00	10.00	112.32	1512.10	7983.0	0.388	22155.4	0.13333	1	4.0000	1.81E-04
4	4.00	14.00	112.32	1754.10	10742.7	0.387	29805.7	0.18667	1	4.0000	1.34E-04
5	4.00	18.00	112.32	1857.30	12044.0	0.389	33451.9	0.24000	0.972	3.8869	1.16E-04
6	8.00	24.00	112.32	1931.90	13030.9	0.391	36251.8	0.32000	0.915	7.3211	2.02E-04
7	2.00	29.00	112.32	2416.20	20383.2	0.365	55644.0	0.38667	0.868	1.7369	3.12E-05
8	10.00	35.00	137.28	2882.70	35461.3	0.282	90942.0	0.46668	0.811	8.1143	8.92E-05
9	10.00	45.00	137.28	3045.80	39587.6	0.278	101158.1	0.60001	0.717	7.1714	7.09E-05
10	10.00	55.00	137.28	3186.10	43318.7	0.274	110352.6	0.73335	0.631	6.3100	5.72E-05
11	10.00	65.00	137.28	3293.40	46285.5	0.273	117854.0	0.86668	0.553	5.5300	4.69E-05
12	10.00	75.00	137.28	3469.60	51370.6	0.268	130271.8	1.00001	0.475	4.7500	3.65E-05
13	10.00	85.00	137.28	3604.40	55439.9	0.270	140864.9	1.13335	0.397	3.9700	2.82E-05
14	10.00	95.00	137.28	3685.40	57959.6	0.273	147573.3	1.26668	0.319	3.1900	2.16E-05
15	10.00	105.00	137.28	3794.60	61445.2	0.276	156752.9	1.40001	0.271	2.7060	1.73E-05
16	10.00	115.00	137.28	3885.90	64437.6	0.276	164444.8	1.53335	0.252	2.5180	1.53E-05
17	10.00	125.00	137.28	3909.10	65209.3	0.276	166360.8	1.66668	0.233	2.3300	1.40E-05
18	10.00	135.00	137.28	3964.00	67053.8	0.277	171266.2	1.80001	0.214	2.1420	1.25E-05
19	15.00	147.50	137.28	4014.70	68780.0	0.279	176001.2	1.96668	0.191	2.8605	1.63E-05
20	15.00	162.50	137.28	4205.70	75480.2	0.280	193292.6	2.16668	0.163	2.4375	1.26E-05
21	15.00	177.50	137.28	4311.90	79340.3	0.284	203687.1	2.36668	0.134	2.0145	9.89E-06
22	15.00	192.50	137.28	4328.90	79967.1	0.284	205310.7	2.56668	0.106	1.5915	7.75E-06
23	15.00	207.50	137.28	4361.10	81161.2	0.283	208236.8	2.76668	0.089	1.3395	6.43E-06
24	15.00	222.50	137.28	4430.50	83764.8	0.285	215292.4	2.96668	0.084	1.2585	5.85E-06
25	7.50	233.75	137.28	4462.80	84990.6	0.287	218725.1	3.11668	0.080	0.5989	2.74E-06
26	7.50	241.25	137.28	4466.20	85120.2	0.289	219453.4	3.21668	0.077	0.5786	2.64E-06
27	7.50	248.75	137.28	4465.40	85089.7	0.286	218864.3	3.31668	0.074	0.5584	2.55E-06
28	7.50	256.25	137.28	4505.30	86617.1	0.288	223182.8	3.41668	0.072	0.5381	2.41E-06
29	7.50	263.75	137.28	4576.10	89360.8	0.288	230159.6	3.51668	0.069	0.5179	2.25E-06
30	7.50	271.25	137.28	4598.10	90222.1	0.289	232507.8	3.61668	0.066	0.4976	2.14E-06
31	7.50	278.75	137.28	4629.80	91470.4	0.288	235551.0	3.71668	0.064	0.4774	2.03E-06
32	7.50	286.25	137.28	4668.90	93021.9	0.287	239457.1	3.81668	0.061	0.4571	1.91E-06
33	7.50	293.75	137.28	4689.70	93852.6	0.289	241997.1	3.91668	0.058	0.4369	1.81E-06
34	7.50	301.25	137.28	4730.60	95496.8	0.288	246085.6	4.01668	0.056	0.4179	1.70E-06
35	7.50	308.75	137.28	4775.20	97305.9	0.290	250985.1	4.11668	0.054	0.4056	1.62E-06
36	7.50	316.25	137.28	4852.90	100498.3	0.287	258684.7	4.21668	0.052	0.3932	1.52E-06
37	10.16	325.08	137.28	4892.90	102161.9	0.288	263216.0	4.33439	0.050	0.5128	1.95E-06
38	9.84	335.08	137.28	4961.90	105063.6	0.286	270227.7	4.46773	0.048	0.4752	1.76E-06
39	10.16	345.08	137.28	4969.30	105377.2	0.285	270884.7	4.60105	0.046	0.4681	1.73E-06
40	9.84	355.08	137.28	5005.30	106909.5	0.284	274592.9	4.73440	0.044	0.4319	1.57E-06
41	20.00	370.00	137.28	5113.70	111590.4	0.283	286436.8	4.93335	0.041	0.8120	2.83E-06
42	20.00	390.00	137.28	5147.00	113048.4	0.282	289962.4	5.20001	0.036	0.7240	2.50E-06
43	20.00	410.00	137.28	5181.30	114560.2	0.282	293684.2	5.46668	0.033	0.6600	2.25E-06
44	20.00	430.00	137.28	5320.40	120793.8	0.281	309546.3	5.73335	0.031	0.6200	2.00E-06
45	20.00	450.00	137.28	5472.40	127794.4	0.281	327445.1	6.00001	0.029	0.5800	1.77E-06
						0.358			Σ=	100.3401	1.71E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	58760	ksf	
G' = E/(2*(1+μ)) =:	21640	ksf	USE G' (South 30' Alluvium) = 21600 ksf for Upper Bound Soil Case
Vs=(G'*1000*32.17/ρ)^0.5=:	2489.6	fps (density =112.32)	
Vs=(G'*1000*32.17/ρ)^0.5=:	2251.9	fps (density =137.28)	

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))
WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY (4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1230.50	5286.5	0.369	14470.2	0.02667	1	4.0000	2.76E-04
2	4.00	6.00	112.32	1221.30	5207.8	0.388	14459.2	0.08000	1	4.0000	2.77E-04
3	4.00	10.00	112.32	1389.50	6741.0	0.392	18768.0	0.13333	1	4.0000	2.13E-04
4	4.00	14.00	112.32	1627.10	9243.5	0.392	25729.4	0.18667	1	4.0000	1.55E-04
5	4.00	18.00	112.32	1814.00	11489.0	0.392	31974.7	0.24000	0.972	3.8869	1.22E-04
6	8.00	24.00	112.32	1847.60	11918.5	0.395	33253.6	0.32000	0.915	7.3211	2.20E-04
7	8.00	32.00	112.32	2161.10	16306.3	0.375	44857.4	0.42667	0.840	6.7177	1.50E-04
8	8.00	40.00	112.32	2260.60	17842.4	0.364	48678.0	0.53333	0.764	6.1143	1.26E-04
9	8.00	48.00	112.32	2371.70	19639.3	0.357	53292.4	0.64000	0.689	5.5109	1.03E-04
10	8.00	56.00	112.32	2635.40	24249.3	0.341	65043.4	0.74667	0.623	4.9856	7.67E-05
11	10.00	65.00	112.32	2702.60	25501.7	0.341	68370.1	0.86667	0.553	5.5300	8.09E-05
12	10.00	75.00	137.28	3328.70	47283.1	0.303	123199.8	1.00000	0.475	4.7500	3.86E-05
13	10.00	85.00	137.28	3448.80	50756.6	0.302	132158.9	1.13333	0.397	3.9700	3.00E-05
14	10.00	95.00	137.28	3610.50	55627.7	0.268	141050.6	1.26667	0.319	3.1900	2.26E-05
15	10.00	105.00	137.28	3669.20	57451.2	0.270	145969.7	1.40000	0.271	2.7060	1.85E-05
16	10.00	115.00	137.28	3805.30	61792.3	0.273	157303.3	1.53333	0.252	2.5180	1.60E-05
17	10.00	125.00	137.28	3838.40	62871.9	0.275	160315.8	1.66667	0.233	2.3300	1.45E-05
18	10.00	135.00	137.28	3893.90	64703.2	0.276	165061.8	1.80000	0.214	2.1420	1.30E-05
19	15.00	147.50	137.28	3941.50	66294.8	0.276	169118.0	1.96667	0.191	2.8605	1.69E-05
20	15.00	162.50	137.28	4060.50	70358.3	0.277	179676.8	2.16667	0.163	2.4375	1.36E-05
21	15.00	177.50	137.28	4178.50	74507.0	0.279	190605.3	2.36667	0.134	2.0145	1.06E-05
22	15.00	192.50	137.28	4271.10	77845.9	0.280	199354.0	2.56667	0.106	1.5915	7.98E-06
23	15.00	207.50	137.28	4373.30	81615.9	0.284	209548.8	2.76667	0.089	1.3395	6.39E-06
24	15.00	222.50	137.28	4452.10	84583.6	0.284	217163.3	2.96667	0.084	1.2585	5.80E-06
25	7.50	233.75	137.28	4520.60	87206.4	0.283	223729.8	3.11667	0.080	0.5989	2.68E-06
26	7.50	241.25	137.28	4523.30	87310.6	0.285	224402.2	3.21667	0.077	0.5786	2.58E-06
27	7.50	248.75	137.28	4507.40	86697.9	0.287	223123.9	3.31667	0.074	0.5584	2.50E-06
28	7.50	256.25	137.28	4598.70	90245.7	0.289	232579.3	3.41667	0.072	0.5381	2.31E-06
29	7.50	263.75	137.28	4652.50	92369.6	0.285	237478.5	3.51667	0.069	0.5179	2.18E-06
30	7.50	271.25	137.28	4690.40	93880.6	0.288	241860.9	3.61667	0.066	0.4976	2.06E-06
31	7.50	278.75	137.28	4759.90	96683.4	0.288	248975.2	3.71667	0.064	0.4774	1.92E-06
32	7.50	286.25	137.28	4752.20	96370.8	0.288	248322.6	3.81667	0.061	0.4571	1.84E-06
33	7.50	293.75	137.28	4766.10	96935.4	0.287	249599.0	3.91667	0.058	0.4369	1.75E-06
34	7.50	301.25	137.28	4765.40	96907.0	0.287	249446.2	4.01667	0.056	0.4179	1.68E-06
35	7.50	308.75	137.28	4810.30	98741.7	0.289	254579.8	4.11667	0.054	0.4056	1.59E-06
36	7.50	316.25	137.28	4916.20	103137.2	0.288	265716.5	4.21667	0.052	0.3932	1.48E-06
37	10.16	325.08	137.28	4960.40	105000.1	0.289	270776.3	4.33437	0.050	0.5128	1.89E-06
38	9.84	335.08	137.28	5011.50	107174.6	0.287	275824.4	4.46772	0.048	0.4752	1.72E-06
39	10.16	345.08	137.28	5073.50	109842.8	0.288	282961.6	4.60104	0.046	0.4681	1.65E-06
40	9.84	355.08	137.28	5106.50	111276.4	0.286	286173.8	4.73439	0.044	0.4319	1.51E-06
41	20.00	370.00	137.28	5184.30	114692.9	0.285	294769.9	4.93333	0.041	0.8120	2.75E-06
42	20.00	390.00	137.28	5271.80	118597.1	0.284	304540.7	5.20000	0.036	0.7240	2.38E-06
43	20.00	410.00	137.28	5349.70	122127.9	0.283	313429.2	5.46667	0.033	0.6600	2.11E-06
44	20.00	430.00	137.28	5420.00	125358.8	0.282	321477.6	5.73333	0.031	0.6200	1.93E-06
45	20.00	450.00	137.28	5468.80	127626.3	0.281	327101.2	6.00000	0.029	0.5800	1.77E-06
						0.364				Σ= 100.3360	2.06E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	48791	ksf
G' = E/(2*(1+μ)) =:	17886	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2263.4	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2047.3	fps (density =137.28)

USE G' (South 70' Alluvium) = 17900 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY [(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1241.80	5384.1	0.367	14724.6	0.02667	1	4.0000	2.72E-04
2	4.00	6.00	112.32	1152.70	4639.2	0.391	12904.1	0.08000	1	4.0000	3.10E-04
3	4.00	10.00	112.32	1310.50	5996.3	0.394	16721.2	0.13333	1	4.0000	2.39E-04
4	4.00	14.00	112.32	1560.00	8496.8	0.393	23678.4	0.18667	1	4.0000	1.69E-04
5	4.00	18.00	112.32	1770.40	10943.3	0.393	30479.3	0.24000	0.972	3.8869	1.28E-04
6	8.00	24.00	112.32	1889.50	12465.2	0.394	34757.8	0.32000	0.915	7.3211	2.11E-04
7	8.00	32.00	112.32	2206.70	17001.7	0.374	46718.7	0.42667	0.840	6.7177	1.44E-04
8	8.00	40.00	112.32	2297.60	18431.3	0.363	50228.1	0.53333	0.764	6.1143	1.22E-04
9	8.00	48.00	112.32	2353.10	19332.4	0.358	52488.0	0.64000	0.689	5.5109	1.05E-04
10	8.00	56.00	112.32	2651.30	24542.8	0.341	65831.6	0.74667	0.623	4.9856	7.57E-05
11	10.00	65.00	112.32	2681.70	25108.8	0.342	67402.6	0.86667	0.553	5.5300	8.20E-05
12	10.00	75.00	112.32	2863.50	28628.6	0.336	76521.4	1.00000	0.475	4.7500	6.21E-05
13	10.00	85.00	112.32	3028.90	32031.4	0.335	85519.4	1.13333	0.397	3.9700	4.64E-05
14	10.00	95.00	112.32	3156.90	34795.9	0.334	92852.8	1.26667	0.319	3.1900	3.44E-05
15	10.00	105.00	137.28	3487.60	51905.0	0.304	135319.6	1.40000	0.271	2.7060	2.00E-05
16	10.00	115.00	137.28	3490.00	51976.5	0.303	135458.0	1.53333	0.252	2.5180	1.86E-05
17	10.00	125.00	137.28	3621.30	55961.0	0.276	142785.5	1.66667	0.233	2.3300	1.63E-05
18	10.00	135.00	137.28	3730.90	59399.6	0.276	151605.6	1.80000	0.214	2.1420	1.41E-05
19	15.00	147.50	137.28	3808.20	61886.5	0.276	157935.5	1.96667	0.191	2.8605	1.81E-05
20	15.00	162.50	137.28	3894.20	64713.2	0.278	165359.0	2.16667	0.163	2.4375	1.47E-05
21	15.00	177.50	137.28	4094.30	71534.5	0.280	183069.7	2.36667	0.134	2.0145	1.10E-05
22	15.00	192.50	137.28	4159.60	73834.5	0.281	189158.1	2.56667	0.106	1.5915	8.41E-06
23	15.00	207.50	137.28	4244.40	76875.7	0.284	197469.0	2.76667	0.089	1.3395	6.78E-06
24	15.00	222.50	137.28	4318.70	79590.7	0.284	204439.8	2.96667	0.084	1.2585	6.16E-06
25	7.50	233.75	137.28	4438.10	84052.4	0.283	215713.9	3.11667	0.080	0.5989	2.78E-06
26	7.50	241.25	137.28	4454.80	84686.2	0.286	217728.2	3.21667	0.077	0.5786	2.66E-06
27	7.50	248.75	137.28	4487.10	85918.7	0.287	221168.5	3.31667	0.074	0.5584	2.52E-06
28	7.50	256.25	137.28	4619.20	91052.1	0.288	234595.6	3.41667	0.072	0.5381	2.29E-06
29	7.50	263.75	137.28	4665.10	92870.6	0.285	238703.4	3.51667	0.069	0.5179	2.17E-06
30	7.50	271.25	137.28	4682.10	93548.7	0.288	240953.3	3.61667	0.066	0.4976	2.07E-06
31	7.50	278.75	137.28	4745.60	96103.3	0.287	247420.0	3.71667	0.064	0.4774	1.93E-06
32	7.50	286.25	137.28	4809.80	98721.2	0.288	254284.0	3.81667	0.061	0.4571	1.80E-06
33	7.50	293.75	137.28	4849.50	100357.6	0.287	258292.3	3.91667	0.058	0.4369	1.69E-06
34	7.50	301.25	137.28	4882.20	101715.5	0.286	261687.7	4.01667	0.056	0.4179	1.60E-06
35	7.50	308.75	137.28	4906.80	102743.2	0.289	264769.1	4.11667	0.054	0.4056	1.53E-06
36	7.50	316.25	137.28	4990.60	106282.5	0.288	273702.9	4.21667	0.052	0.3932	1.44E-06
37	10.16	325.08	137.28	5044.30	108582.0	0.289	279896.3	4.33437	0.050	0.5128	1.83E-06
38	9.84	335.08	137.28	5091.20	110610.5	0.286	284545.6	4.46772	0.048	0.4752	1.67E-06
39	10.16	345.08	137.28	5129.40	112276.6	0.288	289121.3	4.60104	0.046	0.4681	1.62E-06
40	9.84	355.08	137.28	5229.10	116683.7	0.285	299937.7	4.73439	0.044	0.4319	1.44E-06
41	20.00	370.00	137.28	5243.30	117318.3	0.285	301400.0	4.93333	0.041	0.8120	2.69E-06
42	20.00	390.00	137.28	5277.10	118835.7	0.283	305048.8	5.20000	0.036	0.7240	2.37E-06
43	20.00	410.00	137.28	5299.60	119851.2	0.283	307516.6	5.46667	0.033	0.6600	2.15E-06
44	20.00	430.00	137.28	5391.20	124030.1	0.282	317988.4	5.73333	0.031	0.6200	1.95E-06
45	20.00	450.00	137.28	5404.30	124633.6	0.281	319373.6	6.00000	0.029	0.5800	1.82E-06
						0.375			Σ=	100.3360	2.18E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	46124	ksf	
G' = E/(2*(1+μ)) =:	16773	ksf	USE G' (South 100' Alluvium) = 16800 ksf for Upper Bound Soil Case
Vs=(G'*1000*32.17/ρ)^0.5=:	2191.8	fps (density =112.32)	
Vs=(G'*1000*32.17/ρ)^0.5=:	1982.6	fps (density =137.28)	

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	897.97	2815.3	0.367	7699.7	0.01176	1.000	4.0000	5.20E-04
2	4.00	6.00	112.32	871.73	2653.2	0.387	7359.7	0.03529	1.000	4.0000	5.43E-04
3	4.00	10.00	112.32	1069.20	3991.4	0.388	11077.4	0.05882	1.000	4.0000	3.61E-04
4	4.00	14.00	112.32	1240.30	5371.1	0.387	14902.0	0.08235	1.000	4.0000	2.68E-04
5	4.00	18.00	112.32	1313.30	6021.9	0.389	16725.7	0.10588	1.000	4.0000	2.39E-04
6	8.00	24.00	112.32	1366.00	6514.9	0.391	18124.3	0.14118	1.000	8.0000	4.41E-04
7	2.00	29.00	112.32	1708.50	10191.5	0.365	27821.6	0.17059	1.000	2.0010	7.19E-05
8	10.00	35.00	137.28	2237.60	21365.9	0.282	54793.7	0.20589	1.000	10.0000	1.83E-04
9	10.00	45.00	137.28	2486.90	26392.0	0.278	67439.6	0.26471	0.994	9.9400	1.47E-04
10	10.00	55.00	137.28	2601.50	28880.4	0.274	73571.8	0.32354	0.897	8.9680	1.22E-04
11	10.00	65.00	137.28	2689.10	30858.2	0.273	78572.3	0.38236	0.842	8.4240	1.07E-04
12	10.00	75.00	137.28	2833.00	34249.1	0.268	86853.0	0.44118	0.788	7.8800	9.07E-05
13	10.00	85.00	137.28	2943.00	36960.4	0.270	93911.2	0.50001	0.734	7.3360	7.81E-05
14	10.00	95.00	137.28	3009.10	38639.3	0.273	98381.1	0.55883	0.679	6.7920	6.90E-05
15	10.00	105.00	137.28	3093.40	40834.6	0.276	104173	0.61765	0.634	6.3400	6.09E-05
16	10.00	115.00	137.28	3172.80	42957.8	0.276	109628	0.67648	0.598	5.9800	5.45E-05
17	10.00	125.00	137.28	3191.70	43471.1	0.276	110903	0.73530	0.562	5.6200	5.07E-05
18	10.00	135.00	137.28	3236.60	44702.8	0.277	114178	0.79412	0.526	5.2600	4.61E-05
19	15.00	147.50	137.28	3278.00	45853.7	0.279	117335	0.86765	0.481	7.2150	6.15E-05
20	15.00	162.50	137.28	3434.00	50321.9	0.280	128866	0.95589	0.427	6.4050	4.97E-05
21	15.00	177.50	137.28	3520.60	52892.0	0.284	135787	1.04412	0.373	5.5950	4.12E-05
22	15.00	192.50	137.28	3534.50	53310.4	0.284	136871	1.13236	0.319	4.7850	3.50E-05
23	15.00	207.50	137.28	3560.80	54106.7	0.283	138823	1.22059	0.281	4.2180	3.04E-05
24	15.00	222.50	137.28	3617.50	55843.6	0.285	143529	1.30883	0.260	3.8940	2.71E-05
25	7.50	233.75	137.28	3643.90	56661.6	0.287	145820	1.37501	0.243	1.8255	1.25E-05
26	7.50	241.25	137.28	3646.60	56745.6	0.289	146299	1.41912	0.233	1.7445	1.19E-05
27	7.50	248.75	137.28	3646.00	56727.0	0.286	145911	1.46324	0.222	1.6635	1.14E-05
28	7.50	256.25	137.28	3678.50	57742.8	0.288	148784	1.50736	0.211	1.5825	1.06E-05
29	7.50	263.75	137.28	3736.40	59574.8	0.288	153442	1.55148	0.200	1.5015	9.79E-06
30	7.50	271.25	137.28	3754.30	60147.0	0.289	155002	1.59559	0.189	1.4205	9.16E-06
31	7.50	278.75	137.28	3780.20	60979.8	0.288	157033	1.63971	0.179	1.3395	8.53E-06
32	7.50	286.25	137.28	3812.10	62013.3	0.287	159635	1.68383	0.168	1.2585	7.88E-06
33	7.50	293.75	137.28	3829.10	62567.6	0.289	161329	1.72795	0.157	1.1775	7.30E-06
34	7.50	301.25	137.28	3862.50	63663.9	0.288	164055	1.77206	0.147	1.1044	6.73E-06
35	7.50	308.75	137.28	3899.00	64872.8	0.290	167329	1.81618	0.143	1.0706	6.40E-06
36	7.50	316.25	137.28	3962.40	66999.7	0.287	172459	1.86030	0.138	1.0369	6.01E-06
37	10.16	325.08	137.28	3995.00	68106.7	0.288	175474	1.91223	0.133	1.3504	7.70E-06
38	9.84	335.08	137.28	4051.30	70039.8	0.286	180145	1.97106	0.127	1.2496	6.94E-06
39	10.16	345.08	137.28	4057.40	70250.9	0.285	180588	2.02988	0.121	1.2285	6.80E-06
40	9.84	355.08	137.28	4086.80	71272.7	0.284	183061	2.08871	0.115	1.1315	6.18E-06
41	20.00	370.00	137.28	4175.30	74392.9	0.283	190956	2.17648	0.106	2.1200	1.11E-05
42	20.00	390.00	137.28	4202.50	75365.3	0.282	193308	2.29412	0.094	1.8800	9.73E-06
43	20.00	410.00	137.28	4230.50	76373.0	0.282	195788	2.41177	0.086	1.7160	8.76E-06
44	20.00	430.00	137.28	4344.10	80529.7	0.281	206365	2.52942	0.081	1.6280	7.89E-06
45	20.00	450.00	137.28	4468.20	85196.4	0.281	218297	2.64706	0.077	1.5400	7.05E-06
						0.312			Σ=	175.2224	3.88E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 45168 ksf
G' = E/(2*(1+μ)) =: 17216 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 2220.6 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 2008.6 fps (density =137.28)

USE G' (South 30' Alluvium) = **17200** ksf for Median Soil Case

MEDIAN ' CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY[(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	870.06	2643.0	0.369	7234.5	0.01176	1.000	4.0000	5.53E-04
2	4.00	6.00	112.32	863.62	2604.1	0.388	7230.1	0.03529	1.000	4.0000	5.53E-04
3	4.00	10.00	112.32	982.50	3370.3	0.392	9383.5	0.05882	1.000	4.0000	4.26E-04
4	4.00	14.00	112.32	1150.60	4622.3	0.392	12866.2	0.08235	1.000	4.0000	3.11E-04
5	4.00	18.00	112.32	1282.70	5744.6	0.392	15987.5	0.10588	1.000	4.0000	2.50E-04
6	8.00	24.00	112.32	1306.40	5958.8	0.395	16625.5	0.14118	1.000	8.0000	4.81E-04
7	8.00	32.00	112.32	1528.10	8152.9	0.375	22427.8	0.18824	1.000	8.0000	3.57E-04
8	8.00	40.00	112.32	1598.50	8921.4	0.364	24339.4	0.23529	1.000	8.0000	3.29E-04
9	8.00	48.00	112.32	1677.00	9819.1	0.357	26644.7	0.28235	0.952	7.6160	2.86E-04
10	8.00	56.00	112.32	1863.50	12124.5	0.341	32521.4	0.32941	0.891	7.1309	2.19E-04
11	10.00	65.00	112.32	1911.00	12750.5	0.341	34184.1	0.38235	0.842	8.4240	2.46E-04
12	10.00	75.00	137.28	2556.80	27896.5	0.303	72686.6	0.44118	0.788	7.8800	1.08E-04
13	10.00	85.00	137.28	2691.60	30915.6	0.302	80497.3	0.50000	0.734	7.3360	9.11E-05
14	10.00	95.00	137.28	2948.00	37086.1	0.268	94036.3	0.55882	0.679	6.7920	7.22E-05
15	10.00	105.00	137.28	2995.90	38301.1	0.270	97313.8	0.61765	0.634	6.3400	6.52E-05
16	10.00	115.00	137.28	3107.00	41194.5	0.273	104867.9	0.67647	0.598	5.9800	5.70E-05
17	10.00	125.00	137.28	3134.10	41916.2	0.275	106881.3	0.73529	0.562	5.6200	5.26E-05
18	10.00	135.00	137.28	3179.30	43133.9	0.276	110037.3	0.79412	0.526	5.2600	4.78E-05
19	15.00	147.50	137.28	3218.30	44198.7	0.276	112750.8	0.86765	0.481	7.2150	6.40E-05
20	15.00	162.50	137.28	3315.40	46906.0	0.277	119785.6	0.95588	0.427	6.4050	5.35E-05
21	15.00	177.50	137.28	3411.80	49673.3	0.279	127075.3	1.04412	0.373	5.5950	4.40E-05
22	15.00	192.50	137.28	3487.40	51899.1	0.280	132907.3	1.13235	0.319	4.7850	3.60E-05
23	15.00	207.50	137.28	3570.80	54411.1	0.284	139700.4	1.22059	0.281	4.2180	3.02E-05
24	15.00	222.50	137.28	3635.10	56388.3	0.284	144773.6	1.30882	0.260	3.8940	2.69E-05
25	7.50	233.75	137.28	3691.00	58135.9	0.283	149148.8	1.37500	0.243	1.8255	1.22E-05
26	7.50	241.25	137.28	3693.30	58208.4	0.285	149604.8	1.41912	0.233	1.7445	1.17E-05
27	7.50	248.75	137.28	3680.30	57799.3	0.287	148751.1	1.46324	0.222	1.6635	1.12E-05
28	7.50	256.25	137.28	3754.80	60163.0	0.289	155051.0	1.50735	0.211	1.5825	1.02E-05
29	7.50	263.75	137.28	3798.80	61581.3	0.285	158323.1	1.55147	0.200	1.5015	9.48E-06
30	7.50	271.25	137.28	3829.70	62587.2	0.288	161241.0	1.59559	0.189	1.4205	8.81E-06
31	7.50	278.75	137.28	3886.40	64454.2	0.288	165979.9	1.63971	0.179	1.3395	8.07E-06
32	7.50	286.25	137.28	3880.20	64248.7	0.288	165552.2	1.68382	0.168	1.2585	7.60E-06
33	7.50	293.75	137.28	3891.50	64623.5	0.287	166399.0	1.72794	0.157	1.1775	7.08E-06
34	7.50	301.25	137.28	3891.00	64606.9	0.287	166303.2	1.77206	0.147	1.1044	6.64E-06
35	7.50	308.75	137.28	3927.60	65828.0	0.289	169720.4	1.81618	0.143	1.0706	6.31E-06
36	7.50	316.25	137.28	4014.10	68759.5	0.288	177147.8	1.86029	0.138	1.0369	5.85E-06
37	10.16	325.08	137.28	4050.10	69998.3	0.289	180513.1	1.91222	0.133	1.3504	7.48E-06
38	9.84	335.08	137.28	4091.90	71450.7	0.287	183885.4	1.97105	0.127	1.2496	6.80E-06
39	10.16	345.08	137.28	4142.50	73228.7	0.288	188641.5	2.02987	0.121	1.2285	6.51E-06
40	9.84	355.08	137.28	4169.40	74182.8	0.286	190778.9	2.08870	0.115	1.1315	5.93E-06
41	20.00	370.00	137.28	4233.00	76463.2	0.285	196516.7	2.17647	0.106	2.1200	1.08E-05
42	20.00	390.00	137.28	4304.40	79064.5	0.284	203028.5	2.29412	0.094	1.8800	9.26E-06
43	20.00	410.00	137.28	4368.00	81418.2	0.283	208951.7	2.41176	0.086	1.7160	8.21E-06
44	20.00	430.00	137.28	4425.40	83572.1	0.282	214317.3	2.52941	0.081	1.6280	7.60E-06
45	20.00	450.00	137.28	4465.20	85082.1	0.281	218061.9	2.64706	0.077	1.5400	7.06E-06
						0.339			Σ=	175.0603	4.94E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 35471 ksf
G' = E/(2*(1+μ)) =: 13243 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 1947.6 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1761.6 fps (density =137.28)

USE G' (South 70' Alluvium) = **13200** ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	878.11	2692.2	0.367	7362.7	0.01176	1.000	4.0000	5.43E-04
2	4.00	6.00	112.32	815.09	2319.6	0.391	6452.2	0.03529	1.000	4.0000	6.20E-04
3	4.00	10.00	112.32	926.63	2997.9	0.394	8360.0	0.05882	1.000	4.0000	4.78E-04
4	4.00	14.00	112.32	1103.10	4248.5	0.393	11839.5	0.08235	1.000	4.0000	3.38E-04
5	4.00	18.00	112.32	1251.80	5471.1	0.393	15238.2	0.10588	1.000	4.0000	2.62E-04
6	8.00	24.00	112.32	1336.10	6232.8	0.394	17379.4	0.14118	1.000	8.0000	4.60E-04
7	8.00	32.00	112.32	1560.30	8500.1	0.374	23357.2	0.18824	1.000	8.0000	3.43E-04
8	8.00	40.00	112.32	1624.60	9215.1	0.363	25112.6	0.23529	1.000	8.0000	3.19E-04
9	8.00	48.00	112.32	1663.90	9666.3	0.358	26244.2	0.28235	0.952	7.6160	2.90E-04
10	8.00	56.00	112.32	1884.60	12400.6	0.341	33262.5	0.32941	0.891	7.1309	2.14E-04
11	10.00	65.00	112.32	1896.20	12553.8	0.342	33699.6	0.38235	0.842	8.4240	2.50E-04
12	10.00	75.00	112.32	2065.10	14889.8	0.336	39798.9	0.44118	0.788	7.8800	1.98E-04
13	10.00	85.00	112.32	2188.90	16728.5	0.335	44662.8	0.50000	0.734	7.3360	1.64E-04
14	10.00	95.00	112.32	2291.60	18335.1	0.334	48927.3	0.55882	0.679	6.7920	1.39E-04
15	10.00	105.00	137.28	2719.30	31555.2	0.304	82266.2	0.61765	0.634	6.3400	7.71E-05
16	10.00	115.00	137.28	2813.20	33772.1	0.303	88014.7	0.67647	0.598	5.9800	6.79E-05
17	10.00	125.00	137.28	2956.80	37307.8	0.276	95191.7	0.73529	0.562	5.6200	5.90E-05
18	10.00	135.00	137.28	3046.20	39598.0	0.276	101065.9	0.79412	0.526	5.2600	5.20E-05
19	15.00	147.50	137.28	3109.40	41258.1	0.276	105291.5	0.86765	0.481	7.2150	6.85E-05
20	15.00	162.50	137.28	3179.60	43142.1	0.278	110239.3	0.95588	0.427	6.4050	5.81E-05
21	15.00	177.50	137.28	3342.90	47687.3	0.280	122040.5	1.04412	0.373	5.5950	4.58E-05
22	15.00	192.50	137.28	3396.30	49223.0	0.281	126105.5	1.13235	0.319	4.7850	3.79E-05
23	15.00	207.50	137.28	3465.50	51249.3	0.284	131643.1	1.22059	0.281	4.2180	3.20E-05
24	15.00	222.50	137.28	3526.20	53060.3	0.284	136292.9	1.30882	0.260	3.8940	2.86E-05
25	7.50	233.75	137.28	3623.70	56035.2	0.283	143809.8	1.37500	0.243	1.8255	1.27E-05
26	7.50	241.25	137.28	3637.30	56456.6	0.286	145149.8	1.41912	0.233	1.7445	1.20E-05
27	7.50	248.75	137.28	3663.70	57279.1	0.287	147445.5	1.46324	0.222	1.6635	1.13E-05
28	7.50	256.25	137.28	3771.50	60699.4	0.288	156392.0	1.50735	0.211	1.5825	1.01E-05
29	7.50	263.75	137.28	3809.00	61912.5	0.285	159132.4	1.55147	0.200	1.5015	9.44E-06
30	7.50	271.25	137.28	3822.90	62365.2	0.288	160634.0	1.59559	0.189	1.4205	8.84E-06
31	7.50	278.75	137.28	3874.70	64066.7	0.287	164941.0	1.63971	0.179	1.3395	8.12E-06
32	7.50	286.25	137.28	3927.20	65814.6	0.288	169523.9	1.68382	0.168	1.2585	7.42E-06
33	7.50	293.75	137.28	3959.60	66905.0	0.287	172194.8	1.72794	0.157	1.1775	6.84E-06
34	7.50	301.25	137.28	3986.30	67810.4	0.286	174458.5	1.77206	0.147	1.1044	6.33E-06
35	7.50	308.75	137.28	4006.40	68495.9	0.289	176514.0	1.81618	0.143	1.0706	6.07E-06
36	7.50	316.25	137.28	4074.80	70854.7	0.288	182467.9	1.86029	0.138	1.0369	5.68E-06
37	10.16	325.08	137.28	4118.60	72386.1	0.289	186592.7	1.91222	0.133	1.3504	7.24E-06
38	9.84	335.08	137.28	4157.00	73742.2	0.286	189701.9	1.97105	0.127	1.2496	6.59E-06
39	10.16	345.08	137.28	4188.20	74853.3	0.288	192753.3	2.02987	0.121	1.2285	6.37E-06
40	9.84	355.08	137.28	4269.50	77787.6	0.285	199954.5	2.08870	0.115	1.1315	5.66E-06
41	20.00	370.00	137.28	4281.10	78210.8	0.285	200929.9	2.17647	0.106	2.1200	1.06E-05
42	20.00	390.00	137.28	4308.80	79226.2	0.283	203372.1	2.29412	0.094	1.8800	9.24E-06
43	20.00	410.00	137.28	4327.10	79900.6	0.283	205010.6	2.41176	0.086	1.7160	8.37E-06
44	20.00	430.00	137.28	4401.90	82686.9	0.282	211992.6	2.52941	0.081	1.6280	7.68E-06
45	20.00	450.00	137.28	4412.60	83089.3	0.281	212916.4	2.64706	0.077	1.5400	7.23E-06
						0.342			Σ=	175.0603	5.32E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	32906	ksf
G' = E/(2*(1+μ)) =:	12260	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1873.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1695.0	fps (density =137.28)

USE G' (South 100' Alluvium) = **12300** ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	634.96	1407.7	0.367	3849.8	0.01178	1.000	4.0000	1.04E-03
2	4.00	6.00	112.32	616.40	1326.6	0.387	3679.8	0.03529	1.000	4.0000	1.09E-03
3	4.00	10.00	112.32	756.04	1995.7	0.388	5538.7	0.05882	1.000	4.0000	7.22E-04
4	4.00	14.00	112.32	877.03	2685.6	0.387	7451.1	0.08235	1.000	4.0000	5.37E-04
5	4.00	18.00	112.32	928.65	3011.0	0.389	8363.0	0.10588	1.000	4.0000	4.78E-04
6	8.00	24.00	112.32	965.94	3257.7	0.391	9062.8	0.14118	1.000	8.0000	8.83E-04
7	2.00	29.00	112.32	1208.10	5095.8	0.365	13911.0	0.17059	1.000	2.0010	1.44E-04
8	10.00	35.00	137.28	1736.80	12872.3	0.282	33011.5	0.20589	1.000	10.0000	3.03E-04
9	10.00	45.00	137.28	2030.50	17593.9	0.278	44957.7	0.26471	0.994	9.9400	2.21E-04
10	10.00	55.00	137.28	2124.10	19253.3	0.274	49047.1	0.32354	0.897	8.9680	1.83E-04
11	10.00	65.00	137.28	2195.60	20571.3	0.273	52379.6	0.38236	0.842	8.4240	1.61E-04
12	10.00	75.00	137.28	2313.10	22832.1	0.268	57900.3	0.44118	0.788	7.8800	1.36E-04
13	10.00	85.00	137.28	2402.90	24639.3	0.270	62604.9	0.50001	0.734	7.3360	1.17E-04
14	10.00	95.00	137.28	2456.90	25759.1	0.273	65586.3	0.55883	0.679	6.7920	1.04E-04
15	10.00	105.00	137.28	2521.70	27135.8	0.276	69226.2	0.61765	0.634	6.3400	9.16E-05
16	10.00	115.00	137.28	2590.60	28638.9	0.276	73086.6	0.67648	0.598	5.9800	8.18E-05
17	10.00	125.00	137.28	2606.00	28980.4	0.276	73934.3	0.73530	0.562	5.6200	7.60E-05
18	10.00	135.00	137.28	2642.70	29802.4	0.277	76120.2	0.79412	0.526	5.2600	6.91E-05
19	15.00	147.50	137.28	2676.50	30569.7	0.279	78224.7	0.86765	0.481	7.2150	9.22E-05
20	15.00	162.50	137.28	2803.80	33546.7	0.280	85907.8	0.95589	0.427	6.4050	7.46E-05
21	15.00	177.50	137.28	2874.60	35262.3	0.284	90527.6	1.04412	0.373	5.5950	6.18E-05
22	15.00	192.50	137.28	2885.90	35540.1	0.284	91247.1	1.13236	0.319	4.7850	5.24E-05
23	15.00	207.50	137.28	2907.40	36071.6	0.283	92549.7	1.22059	0.281	4.2180	4.56E-05
24	15.00	222.50	137.28	2953.70	37229.7	0.285	95687.7	1.30883	0.260	3.8940	4.07E-05
25	7.50	233.75	137.28	2975.20	37773.6	0.287	97211.2	1.37501	0.243	1.8255	1.88E-05
26	7.50	241.25	137.28	2977.40	37829.5	0.289	97530.5	1.41912	0.233	1.7445	1.79E-05
27	7.50	248.75	137.28	2977.00	37819.3	0.286	97277.4	1.46324	0.222	1.6635	1.71E-05
28	7.50	256.25	137.28	3003.50	38495.6	0.288	99190.2	1.50736	0.211	1.5825	1.60E-05
29	7.50	263.75	137.28	3050.70	39715.1	0.288	102290.9	1.55148	0.200	1.5015	1.47E-05
30	7.50	271.25	137.28	3065.40	40098.7	0.289	103336.8	1.59559	0.189	1.4205	1.37E-05
31	7.50	278.75	137.28	3086.50	40652.6	0.288	104687.1	1.63971	0.179	1.3395	1.28E-05
32	7.50	286.25	137.28	3112.60	41343.1	0.287	106425.4	1.68383	0.168	1.2585	1.18E-05
33	7.50	293.75	137.28	3126.50	41713.2	0.289	107556.5	1.72795	0.157	1.1775	1.09E-05
34	7.50	301.25	137.28	3153.70	42442.1	0.288	109369.1	1.77206	0.147	1.1044	1.01E-05
35	7.50	308.75	137.28	3183.50	43248.0	0.290	111551.3	1.81618	0.143	1.0706	9.60E-06
36	7.50	316.25	137.28	3235.30	44666.8	0.287	114973.4	1.86030	0.138	1.0369	9.02E-06
37	10.16	325.08	137.28	3261.90	45404.4	0.288	116982.5	1.91223	0.133	1.3504	1.15E-05
38	9.84	335.08	137.28	3307.90	46694.0	0.286	120098.8	1.97106	0.127	1.2496	1.04E-05
39	10.16	345.08	137.28	3312.80	46832.4	0.285	120388.4	2.02988	0.121	1.2285	1.02E-05
40	9.84	355.08	137.28	3336.90	47516.3	0.284	122043.7	2.08871	0.115	1.1315	9.27E-06
41	20.00	370.00	137.28	3409.20	49597.7	0.283	127310.2	2.17648	0.106	2.1200	1.67E-05
42	20.00	390.00	137.28	3431.40	50245.7	0.282	128877.2	2.29412	0.094	1.8800	1.46E-05
43	20.00	410.00	137.28	3454.20	50915.6	0.282	130526.3	2.41177	0.086	1.7160	1.31E-05
44	20.00	430.00	137.28	3546.90	53685.1	0.281	137573.5	2.52942	0.081	1.6280	1.18E-05
45	20.00	450.00	137.28	3648.30	56798.6	0.281	145533.8	2.64706	0.077	1.5400	1.06E-05
						0.318			Σ=	175.2224	7.07E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	24781	ksf
G' = E/(2*(1+μ)) =:	9402	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1641.0	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1484.3	fps (density =137.28)

USE G' (South 30' Alluvium) = **9400** ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	615.23	1321.5	0.369	3617.3	0.01176	1.000	4.0000	1.11E-03
2	4.00	6.00	112.32	610.67	1302.0	0.388	3615.0	0.03529	1.000	4.0000	1.11E-03
3	4.00	10.00	112.32	694.73	1685.1	0.392	4691.7	0.05882	1.000	4.0000	8.53E-04
4	4.00	14.00	112.32	813.57	2311.0	0.392	6432.7	0.08235	1.000	4.0000	6.22E-04
5	4.00	18.00	112.32	907.01	2872.3	0.392	7993.8	0.10588	1.000	4.0000	5.00E-04
6	8.00	24.00	112.32	923.79	2979.6	0.395	8313.2	0.14118	1.000	8.0000	9.62E-04
7	8.00	32.00	112.32	1080.60	4077.0	0.375	11215.4	0.18824	1.000	8.0000	7.13E-04
8	8.00	40.00	112.32	1130.30	4460.6	0.364	12169.5	0.23529	1.000	8.0000	6.57E-04
9	8.00	48.00	112.32	1185.80	4909.4	0.357	13322.0	0.28235	0.952	7.6160	5.72E-04
10	8.00	56.00	112.32	1317.70	6062.3	0.341	16260.8	0.32941	0.891	7.1309	4.39E-04
11	10.00	65.00	112.32	1351.30	6375.4	0.341	17092.5	0.38235	0.842	8.4240	4.93E-04
12	10.00	75.00	137.28	1963.80	16457.0	0.303	42880.0	0.44118	0.788	7.8800	1.84E-04
13	10.00	85.00	137.28	2100.70	18831.5	0.302	49033.0	0.50000	0.734	7.3360	1.50E-04
14	10.00	95.00	137.28	2407.00	24723.4	0.268	62689.2	0.55882	0.679	6.7920	1.08E-04
15	10.00	105.00	137.28	2446.10	25533.2	0.270	64873.6	0.61765	0.634	6.3400	9.77E-05
16	10.00	115.00	137.28	2536.90	27463.9	0.273	69914.4	0.67647	0.598	5.9800	8.55E-05
17	10.00	125.00	137.28	2559.00	27944.5	0.275	71255.2	0.73529	0.562	5.6200	7.89E-05
18	10.00	135.00	137.28	2595.90	28756.2	0.276	73358.9	0.79412	0.526	5.2600	7.17E-05
19	15.00	147.50	137.28	2627.70	29465.1	0.276	75165.4	0.86765	0.481	7.2150	9.60E-05
20	15.00	162.50	137.28	2707.00	31270.3	0.277	79856.3	0.95588	0.427	6.4050	8.02E-05
21	15.00	177.50	137.28	2785.70	33115.0	0.279	84715.5	1.04412	0.373	5.5950	6.60E-05
22	15.00	192.50	137.28	2847.40	34598.2	0.280	88601.8	1.13235	0.319	4.7850	5.40E-05
23	15.00	207.50	137.28	2915.60	36275.4	0.284	93137.1	1.22059	0.281	4.2180	4.53E-05
24	15.00	222.50	137.28	2968.10	37593.5	0.284	96519.2	1.30882	0.260	3.8940	4.03E-05
25	7.50	233.75	137.28	3013.70	38757.5	0.283	99433.3	1.37500	0.243	1.8255	1.84E-05
26	7.50	241.25	137.28	3015.50	38803.9	0.285	99732.1	1.41912	0.233	1.7445	1.75E-05
27	7.50	248.75	137.28	3004.90	38531.5	0.287	99164.0	1.46324	0.222	1.6635	1.68E-05
28	7.50	256.25	137.28	3065.80	40109.2	0.289	103369	1.50735	0.211	1.5825	1.53E-05
29	7.50	263.75	137.28	3101.70	41054.0	0.285	105548	1.55147	0.200	1.5015	1.42E-05
30	7.50	271.25	137.28	3126.90	41723.8	0.288	107491	1.59559	0.189	1.4205	1.32E-05
31	7.50	278.75	137.28	3173.30	42971.3	0.288	110658	1.63971	0.179	1.3395	1.21E-05
32	7.50	286.25	137.28	3168.20	42833.3	0.288	110370	1.68382	0.168	1.2585	1.14E-05
33	7.50	293.75	137.28	3177.40	43082.4	0.287	110933	1.72794	0.157	1.1775	1.06E-05
34	7.50	301.25	137.28	3177.00	43071.6	0.287	110870	1.77206	0.147	1.1044	9.96E-06
35	7.50	308.75	137.28	3206.90	43886.1	0.289	113149	1.81618	0.143	1.0706	9.46E-06
36	7.50	316.25	137.28	3277.50	45839.7	0.288	118099	1.86029	0.138	1.0369	8.78E-06
37	10.16	325.08	137.28	3306.90	46665.8	0.289	120343	1.91222	0.133	1.3504	1.12E-05
38	9.84	335.08	137.28	3341.00	47633.1	0.287	122589	1.97105	0.127	1.2496	1.02E-05
39	10.16	345.08	137.28	3382.30	48818.1	0.288	125758	2.02987	0.121	1.2285	9.77E-06
40	9.84	355.08	137.28	3404.30	49455.2	0.286	127186	2.08870	0.115	1.1315	8.90E-06
41	20.00	370.00	137.28	3456.20	50974.6	0.285	131009	2.17647	0.106	2.1200	1.62E-05
42	20.00	390.00	137.28	3514.50	52708.8	0.284	135349	2.29412	0.094	1.8800	1.39E-05
43	20.00	410.00	137.28	3566.50	54280.1	0.283	139304	2.41176	0.086	1.7160	1.23E-05
44	20.00	430.00	137.28	3613.30	55714.0	0.282	142876	2.52941	0.081	1.6280	1.14E-05
45	20.00	450.00	137.28	3645.80	56720.7	0.281	145373	2.64706	0.077	1.5400	1.06E-05
						0.338			Σ=	175.0603	9.44E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 18539 ksf

G' = E/(2*(1+μ)) =: 6926 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1408.4 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1274.0 fps (density =137.28)

USE G' (South 70' Alluvium) = **6900** ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE:
Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	620.92	1346.1	0.367	3681.4	0.01176	1.000	4.0000	1.09E-03
2	4.00	6.00	112.32	576.36	1159.8	0.391	3226.1	0.03529	1.000	4.0000	1.24E-03
3	4.00	10.00	112.32	655.23	1499.0	0.394	4180.0	0.05882	1.000	4.0000	9.57E-04
4	4.00	14.00	112.32	780.00	2124.2	0.393	5919.6	0.08235	1.000	4.0000	6.76E-04
5	4.00	18.00	112.32	885.18	2735.7	0.393	7619.5	0.10588	1.000	4.0000	5.25E-04
6	8.00	24.00	112.32	944.77	3116.4	0.394	8689.8	0.14118	1.000	8.0000	9.21E-04
7	8.00	32.00	112.32	1103.30	4250.0	0.374	11678.6	0.18824	1.000	8.0000	6.85E-04
8	8.00	40.00	112.32	1148.80	4607.8	0.363	12557.0	0.23529	1.000	8.0000	6.37E-04
9	8.00	48.00	112.32	1176.50	4832.7	0.358	13120.9	0.28235	0.952	7.6160	5.80E-04
10	8.00	56.00	112.32	1339.60	6265.5	0.341	16806.1	0.32941	0.891	7.1309	4.24E-04
11	10.00	65.00	112.32	1340.80	6276.7	0.342	16849.4	0.38235	0.842	8.4240	5.00E-04
12	10.00	75.00	112.32	1489.30	7744.1	0.336	20699.2	0.44118	0.788	7.8800	3.81E-04
13	10.00	85.00	112.32	1581.80	8735.9	0.335	23323.7	0.50000	0.734	7.3360	3.15E-04
14	10.00	95.00	112.32	1663.40	9660.5	0.334	25779.0	0.55882	0.679	6.7920	2.63E-04
15	10.00	105.00	137.28	2120.20	19182.7	0.304	50010.5	0.61765	0.634	6.3400	1.27E-04
16	10.00	115.00	137.28	2267.60	21942.7	0.303	57185.6	0.67647	0.598	5.9800	1.05E-04
17	10.00	125.00	137.28	2414.20	24871.5	0.276	63460.2	0.73529	0.562	5.6200	8.86E-05
18	10.00	135.00	137.28	2487.30	26400.5	0.276	67382.1	0.79412	0.526	5.2600	7.81E-05
19	15.00	147.50	137.28	2538.80	27505.1	0.276	70193.6	0.86765	0.481	7.2150	1.03E-04
20	15.00	162.50	137.28	2596.20	28762.9	0.278	73496.7	0.95588	0.427	6.4050	8.71E-05
21	15.00	177.50	137.28	2729.50	31792.3	0.280	81362.3	1.04412	0.373	5.5950	6.88E-05
22	15.00	192.50	137.28	2773.10	32816.1	0.281	84072.3	1.13235	0.319	4.7850	5.69E-05
23	15.00	207.50	137.28	2829.60	34167.0	0.284	87764.0	1.22059	0.281	4.2180	4.81E-05
24	15.00	222.50	137.28	2879.20	35375.3	0.284	90866.4	1.30882	0.260	3.8940	4.29E-05
25	7.50	233.75	137.28	2958.70	37355.8	0.283	95870.7	1.37500	0.243	1.8255	1.90E-05
26	7.50	241.25	137.28	2969.90	37639.2	0.286	96770.3	1.41912	0.233	1.7445	1.80E-05
27	7.50	248.75	137.28	2991.40	38186.1	0.287	98297.1	1.46324	0.222	1.6635	1.69E-05
28	7.50	256.25	137.28	3079.50	40468.5	0.288	104267.0	1.50735	0.211	1.5825	1.52E-05
29	7.50	263.75	137.28	3110.10	41276.7	0.285	106092.7	1.55147	0.200	1.5015	1.42E-05
30	7.50	271.25	137.28	3121.40	41577.2	0.288	107090.4	1.59559	0.189	1.4205	1.33E-05
31	7.50	278.75	137.28	3163.70	42711.7	0.287	109962.1	1.63971	0.179	1.3395	1.22E-05
32	7.50	286.25	137.28	3206.50	43875.2	0.288	113012.8	1.68382	0.168	1.2585	1.11E-05
33	7.50	293.75	137.28	3233.00	44603.4	0.287	114796.6	1.72794	0.157	1.1775	1.03E-05
34	7.50	301.25	137.28	3254.80	45206.9	0.286	116305.6	1.77206	0.147	1.1044	9.50E-06
35	7.50	308.75	137.28	3271.20	45663.6	0.289	117675.2	1.81618	0.143	1.0706	9.10E-06
36	7.50	316.25	137.28	3327.10	47237.6	0.288	121648.2	1.86029	0.138	1.0369	8.52E-06
37	10.16	325.08	137.28	3362.80	48256.8	0.289	124393.4	1.91222	0.133	1.3504	1.09E-05
38	9.84	335.08	137.28	3394.10	49159.3	0.286	126462.2	1.97105	0.127	1.2496	9.88E-06
39	10.16	345.08	137.28	3419.60	49900.7	0.288	128498.4	2.02987	0.121	1.2285	9.56E-06
40	9.84	355.08	137.28	3486.10	51860.4	0.285	133308.2	2.08870	0.115	1.1315	8.49E-06
41	20.00	370.00	137.28	3495.50	52140.5	0.285	133953.0	2.17647	0.106	2.1200	1.58E-05
42	20.00	390.00	137.28	3518.10	52816.9	0.283	135579.8	2.29412	0.094	1.8800	1.39E-05
43	20.00	410.00	137.28	3533.10	53268.2	0.283	136676.6	2.41176	0.086	1.7160	1.26E-05
44	20.00	430.00	137.28	3594.10	55123.5	0.282	141325.5	2.52941	0.081	1.6280	1.15E-05
45	20.00	450.00	137.28	3602.90	55393.7	0.281	141946.4	2.64706	0.077	1.5400	1.08E-05
						0.342			Σ=	175.0603	1.03E-02

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 17070 ksf
G' = E/(2*(1+μ)) =: 6361 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 1349.7 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1220.9 fps (density =137.28)

USE G' (South 100' Alluvium) = **6400** ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1269.90	5630.5	0.367	15398.8	0.01176	1.000	4.0000	2.60E-04
2	4.00	6.00	112.32	1232.80	5306.3	0.387	14719.1	0.03529	1.000	4.0000	2.72E-04
3	4.00	10.00	112.32	1512.10	7983.0	0.388	22155.4	0.05882	1.000	4.0000	1.81E-04
4	4.00	14.00	112.32	1754.10	10742.7	0.387	29805.7	0.08235	1.000	4.0000	1.34E-04
5	4.00	18.00	112.32	1857.30	12044.0	0.389	33451.9	0.10588	1.000	4.0000	1.20E-04
6	8.00	24.00	112.32	1931.90	13030.9	0.391	36251.8	0.14118	1.000	8.0000	2.21E-04
7	2.00	29.00	112.32	2416.20	20383.2	0.365	55644.0	0.17059	1.000	2.0010	3.60E-05
8	10.00	35.00	137.28	2882.70	35461.3	0.282	90942.0	0.20589	1.000	10.0000	1.10E-04
9	10.00	45.00	137.28	3045.80	39587.6	0.278	101158.1	0.26471	0.994	9.9400	9.83E-05
10	10.00	55.00	137.28	3186.10	43318.7	0.274	110352.6	0.32354	0.897	8.9680	8.13E-05
11	10.00	65.00	137.28	3293.40	46285.5	0.273	117854.0	0.38236	0.842	8.4240	7.15E-05
12	10.00	75.00	137.28	3469.60	51370.6	0.268	130271.8	0.44118	0.788	7.8800	6.05E-05
13	10.00	85.00	137.28	3604.40	55439.9	0.270	140864.9	0.50001	0.734	7.3360	5.21E-05
14	10.00	95.00	137.28	3685.40	57959.6	0.273	147573.3	0.55883	0.679	6.7920	4.60E-05
15	10.00	105.00	137.28	3794.60	61445.2	0.276	156752.9	0.61765	0.634	6.3400	4.04E-05
16	10.00	115.00	137.28	3885.90	64437.6	0.276	164444.8	0.67648	0.598	5.9800	3.64E-05
17	10.00	125.00	137.28	3909.10	65209.3	0.276	166360.8	0.73530	0.562	5.6200	3.38E-05
18	10.00	135.00	137.28	3964.00	67053.8	0.277	171266.2	0.79412	0.526	5.2600	3.07E-05
19	15.00	147.50	137.28	4014.70	68780.0	0.279	176001.2	0.86765	0.481	7.2150	4.10E-05
20	15.00	162.50	137.28	4205.70	75480.2	0.280	193292.6	0.95589	0.427	6.4050	3.31E-05
21	15.00	177.50	137.28	4311.90	79340.3	0.284	203687.1	1.04412	0.373	5.5950	2.75E-05
22	15.00	192.50	137.28	4328.90	79967.1	0.284	205310.7	1.13236	0.319	4.7850	2.33E-05
23	15.00	207.50	137.28	4361.10	81161.2	0.283	208236.8	1.22059	0.281	4.2180	2.03E-05
24	15.00	222.50	137.28	4430.50	83764.8	0.285	215292.4	1.30883	0.260	3.8940	1.81E-05
25	7.50	233.75	137.28	4462.80	84990.6	0.287	218725.1	1.37501	0.243	1.8255	8.35E-06
26	7.50	241.25	137.28	4466.20	85120.2	0.289	219453.4	1.41912	0.233	1.7445	7.95E-06
27	7.50	248.75	137.28	4465.40	85089.7	0.286	218864.3	1.46324	0.222	1.6635	7.60E-06
28	7.50	256.25	137.28	4505.30	86617.1	0.288	223182.8	1.50736	0.211	1.5825	7.09E-06
29	7.50	263.75	137.28	4576.10	89360.8	0.288	230159.6	1.55148	0.200	1.5015	6.52E-06
30	7.50	271.25	137.28	4598.10	90222.1	0.289	232507.8	1.59559	0.189	1.4205	6.11E-06
31	7.50	278.75	137.28	4629.80	91470.4	0.288	235551.0	1.63971	0.179	1.3395	5.69E-06
32	7.50	286.25	137.28	4668.90	93021.9	0.287	239457.1	1.68383	0.168	1.2585	5.26E-06
33	7.50	293.75	137.28	4689.70	93852.6	0.289	241997.1	1.72795	0.157	1.1775	4.87E-06
34	7.50	301.25	137.28	4730.60	95496.8	0.288	246085.6	1.77206	0.147	1.1044	4.49E-06
35	7.50	308.75	137.28	4775.20	97305.9	0.290	250985.1	1.81618	0.143	1.0706	4.27E-06
36	7.50	316.25	137.28	4852.90	100498.3	0.287	258684.7	1.86030	0.138	1.0369	4.01E-06
37	10.16	325.08	137.28	4892.90	102161.9	0.288	263216.0	1.91223	0.133	1.3504	5.13E-06
38	9.84	335.08	137.28	4961.90	105063.6	0.286	270227.7	1.97106	0.127	1.2496	4.62E-06
39	10.16	345.08	137.28	4969.30	105377.2	0.285	270884.7	2.02988	0.121	1.2285	4.54E-06
40	9.84	355.08	137.28	5005.30	106909.5	0.284	274592.9	2.08871	0.115	1.1315	4.12E-06
41	20.00	370.00	137.28	5113.70	111590.4	0.283	286436.8	2.17648	0.106	2.1200	7.40E-06
42	20.00	390.00	137.28	5147.00	113048.4	0.282	289962.4	2.29412	0.094	1.8800	6.48E-06
43	20.00	410.00	137.28	5181.30	114560.2	0.282	293684.2	2.41177	0.086	1.7160	5.84E-06
44	20.00	430.00	137.28	5320.40	120793.8	0.281	309546.3	2.52942	0.081	1.6280	5.26E-06
45	20.00	450.00	137.28	5472.40	127794.4	0.281	327445.1	2.64706	0.077	1.5400	4.70E-06
						0.306			Σ=	175.2224	2.17E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	80864	ksf
G' = E/(2*(1+μ)) =:	30962	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2977.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2693.6	fps (density =137.28)

USE G' (South 30' Alluvium) = 31000 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1230.50	5286.5	0.369	14470.2	0.01176	1.000	4.0000	2.76E-04
2	4.00	6.00	112.32	1221.30	5207.8	0.388	14459.2	0.03529	1.000	4.0000	2.77E-04
3	4.00	10.00	112.32	1389.50	6741.0	0.392	18768.0	0.05882	1.000	4.0000	2.13E-04
4	4.00	14.00	112.32	1627.10	9243.5	0.392	25729.4	0.08235	1.000	4.0000	1.55E-04
5	4.00	18.00	112.32	1814.00	11489.0	0.392	31974.7	0.10588	1.000	4.0000	1.25E-04
6	8.00	24.00	112.32	1847.60	11918.5	0.395	33253.6	0.14118	1.000	8.0000	2.41E-04
7	8.00	32.00	112.32	2161.10	16306.3	0.375	44857.4	0.18824	1.000	8.0000	1.78E-04
8	8.00	40.00	112.32	2260.60	17842.4	0.364	48678.0	0.23529	1.000	8.0000	1.64E-04
9	8.00	48.00	112.32	2371.70	19639.3	0.357	53292.4	0.28235	0.952	7.6160	1.43E-04
10	8.00	56.00	112.32	2635.40	24249.3	0.341	65043.4	0.32941	0.891	7.1309	1.10E-04
11	10.00	65.00	112.32	2702.60	25501.7	0.341	68370.1	0.38235	0.842	8.4240	1.23E-04
12	10.00	75.00	137.28	3328.70	47283.1	0.303	123199.8	0.44118	0.788	7.8800	6.40E-05
13	10.00	85.00	137.28	3448.80	50756.6	0.302	132158.9	0.50000	0.734	7.3360	5.55E-05
14	10.00	95.00	137.28	3610.50	55627.7	0.268	141050.6	0.55882	0.679	6.7920	4.82E-05
15	10.00	105.00	137.28	3669.20	57451.2	0.270	145969.7	0.61765	0.634	6.3400	4.34E-05
16	10.00	115.00	137.28	3805.30	61792.3	0.273	157303.3	0.67647	0.598	5.9800	3.80E-05
17	10.00	125.00	137.28	3838.40	62871.9	0.275	160315.8	0.73529	0.562	5.6200	3.51E-05
18	10.00	135.00	137.28	3893.90	64703.2	0.276	165061.8	0.79412	0.526	5.2600	3.19E-05
19	15.00	147.50	137.28	3941.50	66294.8	0.276	169118.0	0.86765	0.481	7.2150	4.27E-05
20	15.00	162.50	137.28	4060.50	70358.3	0.277	179676.8	0.95588	0.427	6.4050	3.56E-05
21	15.00	177.50	137.28	4178.50	74507.0	0.279	190605.3	1.04412	0.373	5.5950	2.94E-05
22	15.00	192.50	137.28	4271.10	77845.9	0.280	199354.0	1.13235	0.319	4.7850	2.40E-05
23	15.00	207.50	137.28	4373.30	81615.9	0.284	209548.8	1.22059	0.281	4.2180	2.01E-05
24	15.00	222.50	137.28	4452.10	84583.6	0.284	217163.3	1.30882	0.260	3.8940	1.79E-05
25	7.50	233.75	137.28	4520.60	87206.4	0.283	223729.8	1.37500	0.243	1.8255	8.16E-06
26	7.50	241.25	137.28	4523.30	87310.6	0.285	224402.2	1.41912	0.233	1.7445	7.77E-06
27	7.50	248.75	137.28	4507.40	86697.9	0.287	223123.9	1.46324	0.222	1.6635	7.46E-06
28	7.50	256.25	137.28	4598.70	90245.7	0.289	232579.3	1.50735	0.211	1.5825	6.80E-06
29	7.50	263.75	137.28	4652.50	92369.6	0.285	237478.5	1.55147	0.200	1.5015	6.32E-06
30	7.50	271.25	137.28	4690.40	93880.6	0.288	241860.9	1.59559	0.189	1.4205	5.87E-06
31	7.50	278.75	137.28	4759.90	96683.4	0.288	248975.2	1.63971	0.179	1.3395	5.38E-06
32	7.50	286.25	137.28	4752.20	96370.8	0.288	248322.6	1.68382	0.168	1.2585	5.07E-06
33	7.50	293.75	137.28	4766.10	96935.4	0.287	249599.0	1.72794	0.157	1.1775	4.72E-06
34	7.50	301.25	137.28	4765.40	96907.0	0.287	249446.2	1.77206	0.147	1.1044	4.43E-06
35	7.50	308.75	137.28	4810.30	98741.7	0.289	254579.8	1.81618	0.143	1.0706	4.21E-06
36	7.50	316.25	137.28	4916.20	103137.2	0.288	265716.5	1.86029	0.138	1.0369	3.90E-06
37	10.16	325.08	137.28	4960.40	105000.1	0.289	270776.3	1.91222	0.133	1.3504	4.99E-06
38	9.84	335.08	137.28	5011.50	107174.6	0.287	275824.4	1.97105	0.127	1.2496	4.53E-06
39	10.16	345.08	137.28	5073.50	109842.8	0.288	282961.6	2.02987	0.121	1.2285	4.34E-06
40	9.84	355.08	137.28	5106.50	111276.4	0.286	286173.8	2.08870	0.115	1.1315	3.95E-06
41	20.00	370.00	137.28	5184.30	114692.9	0.285	294769.9	2.17647	0.106	2.1200	7.19E-06
42	20.00	390.00	137.28	5271.80	118597.1	0.284	304540.7	2.29412	0.094	1.8800	6.17E-06
43	20.00	410.00	137.28	5349.70	122127.9	0.283	313429.2	2.41176	0.086	1.7160	5.47E-06
44	20.00	430.00	137.28	5420.00	125358.8	0.282	321477.6	2.52941	0.081	1.6280	5.06E-06
45	20.00	450.00	137.28	5468.80	127626.3	0.281	327101.2	2.64706	0.077	1.5400	4.71E-06
						0.341			Σ=	175.0603	2.61E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 67124 ksf

G' = E/(2*(1+μ)) =: 25032 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 2677.6 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 2422.0 fps (density =137.28)

USE G' (South 70' Alluvium) = **25000** ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS5E4.002 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1241.80	5384.1	0.367	14724.6	0.01176	1.000	4.0000	2.72E-04
2	4.00	6.00	112.32	1152.70	4639.2	0.391	12904.1	0.03529	1.000	4.0000	3.10E-04
3	4.00	10.00	112.32	1310.50	5996.3	0.394	16721.2	0.05882	1.000	4.0000	2.39E-04
4	4.00	14.00	112.32	1560.00	8496.8	0.393	23678.4	0.08235	1.000	4.0000	1.69E-04
5	4.00	18.00	112.32	1770.40	10943.3	0.393	30479.3	0.10588	1.000	4.0000	1.31E-04
6	8.00	24.00	112.32	1889.50	12465.2	0.394	34757.8	0.14118	1.000	8.0000	2.30E-04
7	8.00	32.00	112.32	2206.70	17001.7	0.374	46718.7	0.18824	1.000	8.0000	1.71E-04
8	8.00	40.00	112.32	2297.60	18431.3	0.363	50228.1	0.23529	1.000	8.0000	1.59E-04
9	8.00	48.00	112.32	2353.10	19332.4	0.358	52488.0	0.28235	0.952	7.8160	1.45E-04
10	8.00	56.00	112.32	2651.30	24542.8	0.341	65831.6	0.32941	0.891	7.1309	1.08E-04
11	10.00	65.00	112.32	2681.70	25108.8	0.342	67402.6	0.38235	0.842	8.4240	1.25E-04
12	10.00	75.00	112.32	2863.50	28628.6	0.336	76521.4	0.44118	0.788	7.8800	1.03E-04
13	10.00	85.00	112.32	3028.90	32031.4	0.335	85519.4	0.50000	0.734	7.3360	8.58E-05
14	10.00	95.00	112.32	3156.90	34795.9	0.334	92852.8	0.55882	0.679	6.7920	7.31E-05
15	10.00	105.00	137.28	3487.60	51905.0	0.304	135319.6	0.61765	0.634	6.3400	4.69E-05
16	10.00	115.00	137.28	3490.00	51976.5	0.303	135458.0	0.67647	0.598	5.9800	4.41E-05
17	10.00	125.00	137.28	3621.30	55961.0	0.276	142785.5	0.73529	0.562	5.6200	3.94E-05
18	10.00	135.00	137.28	3730.90	59399.6	0.276	151605.6	0.79412	0.526	5.2600	3.47E-05
19	15.00	147.50	137.28	3808.20	61886.5	0.276	157935.5	0.86765	0.481	7.2150	4.57E-05
20	15.00	162.50	137.28	3894.20	64713.2	0.278	165359.0	0.95588	0.427	6.4050	3.87E-05
21	15.00	177.50	137.28	4094.30	71534.5	0.280	183069.7	1.04412	0.373	5.5950	3.06E-05
22	15.00	192.50	137.28	4159.60	73834.5	0.281	189158.1	1.13235	0.319	4.7850	2.53E-05
23	15.00	207.50	137.28	4244.40	76875.7	0.284	197469.0	1.22059	0.281	4.2180	2.14E-05
24	15.00	222.50	137.28	4318.70	79590.7	0.284	204439.8	1.30882	0.260	3.8940	1.90E-05
25	7.50	233.75	137.28	4438.10	84052.4	0.283	215713.9	1.37500	0.243	1.8255	8.46E-06
26	7.50	241.25	137.28	4454.80	84686.2	0.286	217728.2	1.41912	0.233	1.7445	8.01E-06
27	7.50	248.75	137.28	4487.10	85918.7	0.287	221168.5	1.46324	0.222	1.6635	7.52E-06
28	7.50	256.25	137.28	4619.20	91052.1	0.288	234595.6	1.50735	0.211	1.5825	6.75E-06
29	7.50	263.75	137.28	4665.10	92870.6	0.285	238703.4	1.55147	0.200	1.5015	6.29E-06
30	7.50	271.25	137.28	4682.10	93548.7	0.288	240953.3	1.59559	0.189	1.4205	5.90E-06
31	7.50	278.75	137.28	4745.60	96103.3	0.287	247420.0	1.63971	0.179	1.3395	5.41E-06
32	7.50	286.25	137.28	4809.80	98721.2	0.288	254284.0	1.68382	0.168	1.2585	4.95E-06
33	7.50	293.75	137.28	4849.50	100357.6	0.287	258292.3	1.72794	0.157	1.1775	4.56E-06
34	7.50	301.25	137.28	4882.20	101715.5	0.286	261687.7	1.77206	0.147	1.1044	4.22E-06
35	7.50	308.75	137.28	4906.80	102743.2	0.289	264769.1	1.81618	0.143	1.0706	4.04E-06
36	7.50	316.25	137.28	4990.60	106282.5	0.288	273702.9	1.86029	0.138	1.0369	3.79E-06
37	10.16	325.08	137.28	5044.30	108582.0	0.289	279896.3	1.91222	0.133	1.3504	4.82E-06
38	9.84	335.08	137.28	5091.20	110610.5	0.286	284545.6	1.97105	0.127	1.2496	4.39E-06
39	10.16	345.08	137.28	5129.40	112276.6	0.288	289121.3	2.02987	0.121	1.2285	4.25E-06
40	9.84	355.08	137.28	5229.10	116683.7	0.285	299937.7	2.08870	0.115	1.1315	3.77E-06
41	20.00	370.00	137.28	5243.30	117318.3	0.285	301400.0	2.17647	0.106	2.1200	7.03E-06
42	20.00	390.00	137.28	5277.10	118835.7	0.283	305048.8	2.29412	0.094	1.8800	8.16E-06
43	20.00	410.00	137.28	5299.60	119851.2	0.283	307516.6	2.41176	0.086	1.7160	5.58E-06
44	20.00	430.00	137.28	5391.20	124030.1	0.282	317988.4	2.52941	0.081	1.6280	5.12E-06
45	20.00	450.00	137.28	5404.30	124633.6	0.281	319373.6	2.64706	0.077	1.5400	4.82E-06
						0.345			Σ=	175.0603	2.78E-03

(1) Poisson Ratio from DTN: MO0706SCSPS5E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN MO0706SCSPS5E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	62890	ksf
G' = E/(2*(1+μ)) =:	23383	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2587.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2340.9	fps (density =137.28)

USE G' (South 100' Alluvium) = 23400 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))
WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	801.63	2243.6	0.386	6218.6	0.02667	1	4.0000	6.43E-04
2	4.00	6.00	112.32	732.70	1874.4	0.411	5287.7	0.08000	1	4.0000	7.56E-04
3	4.00	10.00	112.32	833.89	2427.9	0.412	6858.0	0.13333	1	4.0000	5.83E-04
4	4.00	14.00	112.32	966.38	3260.6	0.412	9210.2	0.18667	1	4.0000	4.34E-04
5	4.00	18.00	112.32	1005.80	3532.1	0.414	9990.2	0.24000	0.972	3.8869	3.89E-04
6	8.00	24.00	112.32	1040.10	3777.1	0.417	10703.8	0.32000	0.915	7.3211	6.84E-04
7	2.00	29.00	112.32	1371.60	6568.4	0.395	18320.9	0.38667	0.868	1.7369	9.48E-05
8	10.00	35.00	137.28	2200.70	20667.0	0.291	53343.6	0.46668	0.811	8.1143	1.52E-04
9	10.00	45.00	137.28	2445.90	25529.0	0.286	65675.9	0.60001	0.717	7.1714	1.09E-04
10	10.00	55.00	137.28	2569.50	28174.3	0.281	72179.2	0.73335	0.631	6.3100	8.74E-05
11	10.00	65.00	137.28	2653.10	30037.5	0.281	76950.6	0.86668	0.553	5.5300	7.19E-05
12	10.00	75.00	137.28	2793.80	33307.9	0.276	85023.0	1.00001	0.475	4.7500	5.59E-05
13	10.00	85.00	137.28	2901.00	35913.0	0.279	91854.0	1.13335	0.397	3.9700	4.32E-05
14	10.00	95.00	137.28	2964.60	37504.9	0.282	96126.6	1.26668	0.319	3.1900	3.32E-05
15	10.00	105.00	137.28	3045.80	39587.6	0.284	101668	1.40001	0.271	2.7060	2.66E-05
16	10.00	115.00	137.28	3123.30	41627.8	0.285	106955	1.53335	0.252	2.5180	2.35E-05
17	10.00	125.00	137.28	3149.70	42334.5	0.283	108646	1.66668	0.233	2.3300	2.14E-05
18	10.00	135.00	137.28	3193.20	43511.9	0.285	111799	1.80001	0.214	2.1420	1.92E-05
19	15.00	147.50	137.28	3233.00	44603.4	0.287	114819	1.96668	0.191	2.8605	2.49E-05
20	15.00	162.50	137.28	3388.80	49005.9	0.288	126217	2.16668	0.163	2.4375	1.93E-05
21	15.00	177.50	137.28	3474.30	51509.9	0.291	132977	2.36668	0.134	2.0145	1.51E-05
22	15.00	192.50	137.28	3486.30	51866.4	0.291	133930	2.56668	0.106	1.5915	1.19E-05
23	15.00	207.50	137.28	3510.60	52591.9	0.291	135740	2.76668	0.089	1.3395	9.87E-06
24	15.00	222.50	137.28	3565.80	54258.8	0.293	140282	2.96668	0.084	1.2585	8.97E-06
25	7.50	233.75	137.28	3590.80	55022.3	0.294	142443	3.11668	0.080	0.5989	4.20E-06
26	7.50	241.25	137.28	3592.60	55077.5	0.297	142842	3.21668	0.077	0.5786	4.05E-06
27	7.50	248.75	137.28	3591.10	55031.5	0.294	142420	3.31668	0.074	0.5584	3.92E-06
28	7.50	256.25	137.28	3627.30	56146.6	0.296	145507	3.41668	0.072	0.5381	3.70E-06
29	7.50	263.75	137.28	3684.70	57937.6	0.295	150086	3.51668	0.069	0.5179	3.45E-06
30	7.50	271.25	137.28	3701.90	58479.8	0.296	151577	3.61668	0.066	0.4976	3.28E-06
31	7.50	278.75	137.28	3728.00	59307.3	0.295	153608	3.71668	0.064	0.4774	3.11E-06
32	7.50	286.25	137.28	3759.50	60313.8	0.295	156160	3.81668	0.061	0.4571	2.93E-06
33	7.50	293.75	137.28	3775.90	60841.1	0.297	157778	3.91668	0.058	0.4369	2.77E-06
34	7.50	301.25	137.28	3809.00	61912.5	0.296	160462	4.01668	0.056	0.4179	2.60E-06
35	7.50	308.75	137.28	3845.40	63101.4	0.297	163685	4.11668	0.054	0.4056	2.48E-06
36	7.50	316.25	137.28	3908.70	65196.0	0.294	168772	4.21668	0.052	0.3932	2.33E-06
37	10.16	325.08	137.28	3941.20	66284.7	0.295	171741	4.33439	0.050	0.5128	2.99E-06
38	9.84	335.08	137.28	3997.70	68198.8	0.293	176399	4.46773	0.048	0.4752	2.69E-06
39	10.16	345.08	137.28	4003.00	68379.7	0.293	176785	4.60106	0.046	0.4681	2.65E-06
40	9.84	355.08	137.28	4032.00	69374.1	0.292	179215	4.73439	0.044	0.4319	2.41E-06
41	20.00	370.00	137.28	4120.60	72456.5	0.291	187043	4.93335	0.041	0.8120	4.34E-06
42	20.00	390.00	137.28	4146.90	73384.3	0.290	189307	5.20001	0.036	0.7240	3.82E-06
43	20.00	410.00	137.28	4173.70	74335.9	0.289	191671	5.46668	0.033	0.6600	3.44E-06
44	20.00	430.00	137.28	4287.30	78437.5	0.289	202151	5.73335	0.031	0.6200	3.07E-06
45	20.00	450.00	137.28	4411.20	83036.6	0.288	213946	6.00001	0.029	0.5800	2.71E-06
						0.381			Σ=	100.3401	4.39E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	22879	ksf
G' = E/(2*(1+μ)) =:	8283	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1540.2	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1393.2	fps (density =137.28)

USE G' (South 30' Alluvium) = 8300 ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	777.49	2110.6	0.387	5852.7	0.02667	1	4.0000	6.83E-04
2	4.00	6.00	112.32	731.52	1868.4	0.411	5273.2	0.08000	1	4.0000	7.59E-04
3	4.00	10.00	112.32	796.52	2215.1	0.416	6274.7	0.13333	1	4.0000	6.37E-04
4	4.00	14.00	112.32	893.86	2789.6	0.416	7901.2	0.18667	1	4.0000	5.06E-04
5	4.00	18.00	112.32	992.42	3438.7	0.416	9741.2	0.24000	0.972	3.8869	3.99E-04
6	8.00	24.00	112.32	992.31	3438.0	0.420	9766.5	0.32000	0.915	7.3211	7.50E-04
7	8.00	32.00	112.32	1151.70	4631.1	0.406	13020.5	0.42667	0.840	6.7177	5.16E-04
8	8.00	40.00	112.32	1188.50	4931.8	0.398	13794.1	0.53333	0.764	6.1143	4.43E-04
9	8.00	48.00	112.32	1235.60	5330.4	0.394	14857.4	0.64000	0.689	5.5109	3.71E-04
10	8.00	56.00	112.32	1495.70	7810.8	0.381	21573.9	0.74667	0.623	4.9856	2.31E-04
11	10.00	65.00	112.32	1521.20	8079.4	0.382	22324.7	0.86667	0.553	5.5300	2.48E-04
12	10.00	75.00	137.28	2421.70	25026.3	0.315	65835.2	1.00000	0.475	4.7500	7.21E-05
13	10.00	85.00	137.28	2568.10	28143.6	0.315	73995.2	1.13333	0.397	3.9700	5.37E-05
14	10.00	95.00	137.28	2910.10	36138.7	0.275	92173.1	1.26667	0.319	3.1900	3.46E-05
15	10.00	105.00	137.28	2954.90	37259.9	0.278	95246.8	1.40000	0.271	2.7060	2.84E-05
16	10.00	115.00	137.28	3064.20	40067.3	0.281	102617	1.53333	0.252	2.5180	2.45E-05
17	10.00	125.00	137.28	3095.30	40884.8	0.282	104834	1.66667	0.233	2.3300	2.22E-05
18	10.00	135.00	137.28	3138.60	42036.7	0.283	107856	1.80000	0.214	2.1420	1.99E-05
19	15.00	147.50	137.28	3177.10	43074.3	0.283	110508	1.96667	0.191	2.8605	2.59E-05
20	15.00	162.50	137.28	3273.00	45713.9	0.284	117399	2.16667	0.163	2.4375	2.08E-05
21	15.00	177.50	137.28	3367.80	48400.4	0.286	124509	2.36667	0.134	2.0145	1.62E-05
22	15.00	192.50	137.28	3441.70	50547.8	0.288	130175	2.56667	0.106	1.5915	1.22E-05
23	15.00	207.50	137.28	3524.00	52994.2	0.291	136817	2.76667	0.089	1.3395	9.79E-06
24	15.00	222.50	137.28	3587.10	54909.0	0.291	141766	2.96667	0.084	1.2585	8.88E-06
25	7.50	233.75	137.28	3641.70	56593.2	0.290	146020	3.11667	0.080	0.5989	4.10E-06
26	7.50	241.25	137.28	3642.80	56627.4	0.292	146375	3.21667	0.077	0.5786	3.95E-06
27	7.50	248.75	137.28	3628.70	56189.9	0.294	145448	3.31667	0.074	0.5584	3.84E-06
28	7.50	256.25	137.28	3706.60	58628.3	0.296	151907	3.41667	0.072	0.5381	3.54E-06
29	7.50	263.75	137.28	3750.10	60012.5	0.293	155136	3.51667	0.069	0.5179	3.34E-06
30	7.50	271.25	137.28	3780.60	60992.7	0.295	157980	3.61667	0.066	0.4976	3.15E-06
31	7.50	278.75	137.28	3837.00	62826.1	0.294	162655	3.71667	0.064	0.4774	2.93E-06
32	7.50	286.25	137.28	3829.70	62587.2	0.295	162150	3.81667	0.061	0.4571	2.82E-06
33	7.50	293.75	137.28	3841.30	62967.0	0.294	163015	3.91667	0.058	0.4369	2.68E-06
34	7.50	301.25	137.28	3840.00	62924.3	0.294	162870	4.01667	0.056	0.4179	2.57E-06
35	7.50	308.75	137.28	3876.00	64109.7	0.296	166192	4.11667	0.054	0.4056	2.44E-06
36	7.50	316.25	137.28	3962.80	67013.2	0.295	173574	4.21667	0.052	0.3932	2.27E-06
37	10.16	325.08	137.28	3998.60	68229.5	0.296	176885	4.33438	0.050	0.5128	2.90E-06
38	9.84	335.08	137.28	4040.10	69653.1	0.294	180223	4.46771	0.048	0.4752	2.64E-06
39	10.16	345.08	137.28	4090.40	71398.3	0.295	184900	4.60105	0.046	0.4681	2.53E-06
40	9.84	355.08	137.28	4117.00	72329.9	0.293	187012	4.73438	0.044	0.4319	2.31E-06
41	20.00	370.00	137.28	4180.20	74567.6	0.292	192671	4.93333	0.041	0.8120	4.21E-06
42	20.00	390.00	137.28	4251.20	77122.2	0.291	199099	5.20000	0.036	0.7240	3.64E-06
43	20.00	410.00	137.28	4314.10	79421.2	0.290	204918	5.46667	0.033	0.6600	3.22E-06
44	20.00	430.00	137.28	4370.30	81504.0	0.289	210143	5.73333	0.031	0.6200	2.95E-06
45	20.00	450.00	137.28	4409.80	82983.9	0.288	213836	6.00000	0.029	0.5800	2.71E-06
						0.390			Σ=	100.3360	5.96E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	16843	ksf
G' = E/(2*(1+μ)) =:	6059	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1317.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1191.6	fps (density =137.28)

USE G' (South 70' Alluvium) = 6100 ksf for Median Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	791.08	2185.0	0.385	6052.3	0.02667	1	4.0000	6.61E-04
2	4.00	6.00	112.32	700.85	1715.0	0.415	4853.6	0.08000	1	4.0000	8.24E-04
3	4.00	10.00	112.32	772.49	2083.5	0.419	5913.7	0.13333	1	4.0000	6.76E-04
4	4.00	14.00	112.32	865.48	2615.3	0.419	7419.7	0.18667	1	4.0000	5.39E-04
5	4.00	18.00	112.32	950.75	3156.0	0.418	8949.3	0.24000	0.972	3.8869	4.34E-04
6	8.00	24.00	112.32	1003.00	3512.4	0.420	9972.4	0.32000	0.915	7.3211	7.34E-04
7	8.00	32.00	112.32	1192.00	4960.9	0.404	13931.6	0.42667	0.840	6.7177	4.82E-04
8	8.00	40.00	112.32	1224.50	5235.1	0.397	14629.4	0.53333	0.764	6.1143	4.18E-04
9	8.00	48.00	112.32	1225.20	5241.1	0.395	14624.9	0.64000	0.689	5.5109	3.77E-04
10	8.00	56.00	112.32	1528.40	8156.1	0.382	22537.8	0.74667	0.623	4.9856	2.21E-04
11	10.00	65.00	112.32	1503.30	7890.4	0.384	21842.6	0.86667	0.553	5.5300	2.53E-04
12	10.00	75.00	112.32	1687.50	9942.5	0.379	27417.9	1.00000	0.475	4.7500	1.73E-04
13	10.00	85.00	112.32	1789.30	11178.2	0.377	30790.2	1.13333	0.397	3.9700	1.29E-04
14	10.00	95.00	112.32	1870.80	12219.7	0.377	33649.6	1.26667	0.319	3.1900	9.48E-05
15	10.00	105.00	137.28	2579.20	28387.4	0.316	74743.6	1.40000	0.271	2.7060	3.62E-05
16	10.00	115.00	137.28	2676.20	30562.8	0.316	80457.8	1.53333	0.252	2.5180	3.13E-05
17	10.00	125.00	137.28	2917.90	36332.6	0.283	93244.1	1.66667	0.233	2.3300	2.50E-05
18	10.00	135.00	137.28	3005.30	38541.8	0.284	98952.2	1.80000	0.214	2.1420	2.16E-05
19	15.00	147.50	137.28	3067.10	40143.2	0.284	103054	1.96667	0.191	2.8605	2.78E-05
20	15.00	162.50	137.28	3134.80	41934.9	0.285	107801	2.16667	0.163	2.4375	2.26E-05
21	15.00	177.50	137.28	3297.40	46398.0	0.287	119429	2.36667	0.134	2.0145	1.69E-05
22	15.00	192.50	137.28	3348.60	47850.1	0.289	123313	2.56667	0.106	1.5915	1.29E-05
23	15.00	207.50	137.28	3415.60	49784.0	0.292	128634	2.76667	0.089	1.3395	1.04E-05
24	15.00	222.50	137.28	3474.60	51518.8	0.292	133125	2.96667	0.084	1.2585	9.45E-06
25	7.50	233.75	137.28	3571.60	54435.5	0.291	140531	3.11667	0.080	0.5989	4.26E-06
26	7.50	241.25	137.28	3584.20	54820.2	0.293	141774	3.21667	0.077	0.5786	4.08E-06
27	7.50	248.75	137.28	3609.80	55606.1	0.295	143982	3.31667	0.074	0.5584	3.88E-06
28	7.50	256.25	137.28	3728.80	59332.7	0.294	153604	3.41667	0.072	0.5381	3.50E-06
29	7.50	263.75	137.28	3766.10	60525.7	0.291	156333	3.51667	0.069	0.5179	3.31E-06
30	7.50	271.25	137.28	3779.30	60950.7	0.294	157753	3.61667	0.066	0.4976	3.15E-06
31	7.50	278.75	137.28	3830.90	62626.5	0.293	162013	3.71667	0.064	0.4774	2.95E-06
32	7.50	286.25	137.28	3883.30	64351.4	0.294	166547	3.81667	0.061	0.4571	2.74E-06
33	7.50	293.75	137.28	3917.50	65489.9	0.293	169324	3.91667	0.058	0.4369	2.58E-06
34	7.50	301.25	137.28	3943.70	66368.8	0.292	171537	4.01667	0.056	0.4179	2.44E-06
35	7.50	308.75	137.28	3963.20	67026.8	0.294	173518	4.11667	0.054	0.4056	2.34E-06
36	7.50	316.25	137.28	4031.80	69367.2	0.293	179445	4.21667	0.052	0.3932	2.19E-06
37	10.16	325.08	137.28	4075.50	70879.1	0.295	183522	4.33437	0.050	0.5128	2.79E-06
38	9.84	335.08	137.28	4113.40	72203.5	0.292	186587	4.46772	0.048	0.4752	2.55E-06
39	10.16	345.08	137.28	4144.00	73281.7	0.293	189556	4.60104	0.046	0.4681	2.47E-06
40	9.84	355.08	137.28	4225.40	76188.9	0.291	196724	4.73439	0.044	0.4319	2.20E-06
41	20.00	370.00	137.28	4236.10	76575.3	0.290	197629	4.93333	0.041	0.8120	4.11E-06
42	20.00	390.00	137.28	4262.70	77540.0	0.290	199976	5.20000	0.036	0.7240	3.62E-06
43	20.00	410.00	137.28	4279.90	78167.0	0.289	201522	5.46667	0.033	0.6600	3.28E-06
44	20.00	430.00	137.28	4354.00	80897.1	0.288	208397	5.73333	0.031	0.6200	2.98E-06
45	20.00	450.00	137.28	4363.50	81250.5	0.288	209223	6.00000	0.029	0.5800	2.77E-06
						0.393			Σ=	100.3360	6.30E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 15937 ksf
G' = E/(2*(1+μ)) =: 5721 ksf USE G' (South 100' Alluvium) = 5700 ksf for Median Soil Case
Vs=(G'*1000*32.17/ρ)^0.5=: 1280.0 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1157.8 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	566.84	1121.8	0.386	3109.3	0.02667	1	4.0000	1.29E-03
2	4.00	6.00	112.32	518.09	937.2	0.411	2643.8	0.08000	1	4.0000	1.51E-03
3	4.00	10.00	112.32	589.65	1213.9	0.412	3429.0	0.13333	1	4.0000	1.17E-03
4	4.00	14.00	112.32	683.33	1630.3	0.412	4605.1	0.18667	1	4.0000	8.69E-04
5	4.00	18.00	112.32	711.22	1766.1	0.414	4995.3	0.24000	0.972	3.8869	7.78E-04
6	8.00	24.00	112.32	735.48	1888.6	0.417	5352.2	0.32000	0.915	7.3211	1.37E-03
7	2.00	29.00	112.32	969.86	3284.2	0.395	9160.3	0.38667	0.868	1.7369	1.90E-04
8	10.00	35.00	137.28	1691.60	12211.0	0.291	31517.8	0.46668	0.811	8.1143	2.57E-04
9	10.00	45.00	137.28	1992.80	16946.6	0.286	43596.9	0.60001	0.717	7.1714	1.64E-04
10	10.00	55.00	137.28	2098.00	18783.1	0.281	48120.0	0.73335	0.631	6.3100	1.31E-04
11	10.00	65.00	137.28	2166.30	20026.0	0.281	51302.9	0.86668	0.553	5.5300	1.08E-04
12	10.00	75.00	137.28	2274.90	22084.2	0.276	56372.9	1.00001	0.475	4.7500	8.43E-05
13	10.00	85.00	137.28	2368.00	23928.7	0.279	61202.0	1.13335	0.397	3.9700	6.49E-05
14	10.00	95.00	137.28	2420.60	25003.6	0.282	64085.2	1.26668	0.319	3.1900	4.98E-05
15	10.00	105.00	137.28	2462.60	25878.8	0.284	66461.4	1.40001	0.271	2.7060	4.07E-05
16	10.00	115.00	137.28	2533.60	27392.5	0.285	70380.2	1.53335	0.252	2.5180	3.58E-05
17	10.00	125.00	137.28	2565.80	28093.2	0.283	72097.9	1.66668	0.233	2.3300	3.23E-05
18	10.00	135.00	137.28	2607.30	29009.4	0.285	74536.1	1.80001	0.214	2.1420	2.87E-05
19	15.00	147.50	137.28	2639.70	29734.8	0.287	76544.0	1.96668	0.191	2.8605	3.74E-05
20	15.00	162.50	137.28	2767.00	32671.9	0.288	84147.8	2.16668	0.163	2.4375	2.90E-05
21	15.00	177.50	137.28	2836.80	34341.1	0.291	88654.2	2.36668	0.134	2.0145	2.27E-05
22	15.00	192.50	137.28	2846.50	34576.3	0.291	89283.6	2.56668	0.106	1.5915	1.78E-05
23	15.00	207.50	137.28	2866.40	35061.4	0.291	90493.6	2.76668	0.089	1.3395	1.48E-05
24	15.00	222.50	137.28	2911.40	36171.0	0.293	93517.1	2.96668	0.084	1.2585	1.35E-05
25	7.50	233.75	137.28	2931.90	36682.1	0.294	94963.4	3.11668	0.080	0.5989	6.31E-06
26	7.50	241.25	137.28	2933.30	36717.2	0.297	95225.2	3.21668	0.077	0.5786	6.08E-06
27	7.50	248.75	137.28	2932.10	36687.1	0.294	94945.6	3.31668	0.074	0.5584	5.88E-06
28	7.50	256.25	137.28	2961.70	37431.6	0.296	97006.2	3.41668	0.072	0.5381	5.55E-06
29	7.50	263.75	137.28	3008.60	38626.5	0.295	100061	3.51668	0.069	0.5179	5.18E-06
30	7.50	271.25	137.28	3022.60	38986.8	0.296	101052	3.61668	0.066	0.4976	4.92E-06
31	7.50	278.75	137.28	3043.90	39538.2	0.295	102406	3.71668	0.064	0.4774	4.66E-06
32	7.50	286.25	137.28	3069.60	40208.7	0.295	104105	3.81668	0.061	0.4571	4.39E-06
33	7.50	293.75	137.28	3083.00	40560.5	0.297	105185	3.91668	0.058	0.4369	4.15E-06
34	7.50	301.25	137.28	3110.00	41274.0	0.296	106972	4.01668	0.056	0.4179	3.91E-06
35	7.50	308.75	137.28	3139.70	42066.1	0.297	109120	4.11668	0.054	0.4056	3.72E-06
36	7.50	316.25	137.28	3191.50	43465.6	0.294	112519	4.21668	0.052	0.3932	3.49E-06
37	10.16	325.08	137.28	3218.00	44190.4	0.295	114496	4.33439	0.050	0.5128	4.48E-06
38	9.84	335.08	137.28	3264.10	45465.6	0.293	117599	4.46773	0.048	0.4752	4.04E-06
39	10.16	345.08	137.28	3268.40	45585.5	0.293	117854	4.60105	0.046	0.4681	3.97E-06
40	9.84	355.08	137.28	3292.10	46249.0	0.292	119476	4.73440	0.044	0.4319	3.62E-06
41	20.00	370.00	137.28	3364.40	48302.7	0.291	124692	4.93335	0.041	0.8120	6.51E-06
42	20.00	390.00	137.28	3385.90	48922.0	0.290	126202	5.20001	0.036	0.7240	5.74E-06
43	20.00	410.00	137.28	3407.80	49556.9	0.289	127780	5.46668	0.033	0.6600	5.17E-06
44	20.00	430.00	137.28	3500.60	52292.7	0.289	134770	5.73335	0.031	0.6200	4.60E-06
45	20.00	450.00	137.28	3601.70	55356.8	0.288	142628	6.00001	0.029	0.5800	4.07E-06
						0.382			Σ=	100.3401	8.40E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	11941	ksf
G' = E/(2*(1+μ)) =:	4321	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1112.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1006.3	fps (density =137.28)

USE G' (South 30' Alluvium) = 4300 ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	549.77	1055.3	0.387	2926.4	0.02667	1	4.0000	1.37E-03
2	4.00	6.00	112.32	517.27	934.2	0.411	2636.7	0.08000	1	4.0000	1.52E-03
3	4.00	10.00	112.32	563.22	1107.5	0.416	3137.3	0.13333	1	4.0000	1.27E-03
4	4.00	14.00	112.32	632.05	1394.8	0.416	3950.5	0.18667	1	4.0000	1.01E-03
5	4.00	18.00	112.32	701.75	1719.4	0.416	4870.6	0.24000	0.972	3.8869	7.98E-04
6	8.00	24.00	112.32	701.67	1719.0	0.420	4883.3	0.32000	0.915	7.3211	1.50E-03
7	8.00	32.00	112.32	814.36	2315.5	0.406	6510.0	0.42667	0.840	6.7177	1.03E-03
8	8.00	40.00	112.32	840.38	2465.8	0.398	6896.8	0.53333	0.764	6.1143	8.87E-04
9	8.00	48.00	112.32	873.69	2665.1	0.394	7428.5	0.64000	0.689	5.5109	7.42E-04
10	8.00	56.00	112.32	1057.60	3905.3	0.381	10786.5	0.74667	0.623	4.9856	4.62E-04
11	10.00	65.00	112.32	1075.70	4040.1	0.382	11163.3	0.86667	0.553	5.5300	4.95E-04
12	10.00	75.00	137.28	1712.40	12513.1	0.315	32917.6	1.00000	0.475	4.7500	1.44E-04
13	10.00	85.00	137.28	1874.60	14995.9	0.315	39427.3	1.13333	0.397	3.9700	1.01E-04
14	10.00	95.00	137.28	2376.10	24092.7	0.275	61449.4	1.26667	0.319	3.1900	5.19E-05
15	10.00	105.00	137.28	2412.70	24840.6	0.278	63499.6	1.40000	0.271	2.7060	4.26E-05
16	10.00	115.00	137.28	2501.90	26711.4	0.281	68411.0	1.53333	0.252	2.5180	3.68E-05
17	10.00	125.00	137.28	2527.30	27256.5	0.282	69889.4	1.66667	0.233	2.3300	3.33E-05
18	10.00	135.00	137.28	2562.60	28023.2	0.283	71900.8	1.80000	0.214	2.1420	2.98E-05
19	15.00	147.50	137.28	2594.10	28716.4	0.283	73672.4	1.96667	0.191	2.8605	3.88E-05
20	15.00	162.50	137.28	2672.40	30476.1	0.284	78266.2	2.16667	0.163	2.4375	3.11E-05
21	15.00	177.50	137.28	2749.80	32267.0	0.286	83006.2	2.36667	0.134	2.0145	2.43E-05
22	15.00	192.50	137.28	2810.10	33697.7	0.288	86780.9	2.56667	0.106	1.5915	1.83E-05
23	15.00	207.50	137.28	2877.30	35328.6	0.291	91209.3	2.76667	0.089	1.3395	1.47E-05
24	15.00	222.50	137.28	2928.80	36604.6	0.291	94507.2	2.96667	0.084	1.2585	1.33E-05
25	7.50	233.75	137.28	2973.40	37727.9	0.290	97344.1	3.11667	0.080	0.5989	6.15E-06
26	7.50	241.25	137.28	2974.40	37753.3	0.292	97587.8	3.21667	0.077	0.5786	5.93E-06
27	7.50	248.75	137.28	2962.80	37459.4	0.294	96963.7	3.31667	0.074	0.5584	5.76E-06
28	7.50	256.25	137.28	3026.40	39084.9	0.296	101269.7	3.41667	0.072	0.5381	5.31E-06
29	7.50	263.75	137.28	3061.90	40007.2	0.293	103421	3.51667	0.069	0.5179	5.01E-06
30	7.50	271.25	137.28	3086.80	40660.5	0.295	105317	3.61667	0.066	0.4976	4.73E-06
31	7.50	278.75	137.28	3132.90	41884.1	0.294	108437	3.71667	0.064	0.4774	4.40E-06
32	7.50	286.25	137.28	3127.00	41726.5	0.295	108104	3.81667	0.061	0.4571	4.23E-06
33	7.50	293.75	137.28	3136.40	41977.7	0.294	108676	3.91667	0.058	0.4369	4.02E-06
34	7.50	301.25	137.28	3135.30	41948.3	0.294	108576	4.01667	0.056	0.4179	3.85E-06
35	7.50	308.75	137.28	3164.80	42741.4	0.296	110799	4.11667	0.054	0.4056	3.66E-06
36	7.50	316.25	137.28	3235.60	44675.1	0.295	115715	4.21667	0.052	0.3932	3.40E-06
37	10.16	325.08	137.28	3264.90	45487.9	0.296	117927	4.33437	0.050	0.5128	4.35E-06
38	9.84	335.08	137.28	3298.80	46437.4	0.294	120154	4.46772	0.048	0.4752	3.96E-06
39	10.16	345.08	137.28	3339.80	47598.9	0.295	123267	4.60104	0.046	0.4681	3.80E-06
40	9.84	355.08	137.28	3361.50	48219.5	0.293	124673	4.73439	0.044	0.4319	3.46E-06
41	20.00	370.00	137.28	3413.10	49711.2	0.292	128446	4.93333	0.041	0.8120	6.32E-06
42	20.00	390.00	137.28	3471.10	51415.1	0.291	132733	5.20000	0.036	0.7240	5.45E-06
43	20.00	410.00	137.28	3522.50	52949.1	0.290	136616	5.46667	0.033	0.6600	4.83E-06
44	20.00	430.00	137.28	3568.30	54334.9	0.289	140093	5.73333	0.031	0.6200	4.43E-06
45	20.00	450.00	137.28	3600.60	55323.0	0.288	142559	6.00000	0.029	0.5800	4.07E-06
						0.385			Σ=	100.3360	1.18E-02

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	8529	ksf
G' = E/(2*(1+μ)) =:	3079	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	939.1	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	849.5	fps (density =137.28)

USE G' (South 70' Alluvium) = 3100 ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	559.38	1092.5	0.385	3026.2	0.02667	1	4.0000	1.32E-03
2	4.00	6.00	112.32	500.00	872.9	0.415	2470.3	0.08000	1	4.0000	1.62E-03
3	4.00	10.00	112.32	546.23	1041.7	0.419	2956.8	0.13333	1	4.0000	1.35E-03
4	4.00	14.00	112.32	611.99	1307.7	0.419	3709.9	0.18667	1	4.0000	1.08E-03
5	4.00	18.00	112.32	672.28	1578.0	0.418	4474.6	0.24000	0.972	3.8869	8.69E-04
6	8.00	24.00	112.32	709.19	1756.0	0.420	4985.6	0.32000	0.915	7.3211	1.47E-03
7	8.00	32.00	112.32	842.88	2480.5	0.404	6966.0	0.42667	0.840	6.7177	9.64E-04
8	8.00	40.00	112.32	865.87	2617.6	0.397	7315.0	0.53333	0.784	6.1143	8.36E-04
9	8.00	48.00	112.32	866.35	2620.6	0.395	7312.5	0.84000	0.689	5.5109	7.54E-04
10	8.00	56.00	112.32	1080.70	4077.7	0.382	11268.0	0.74667	0.623	4.9856	4.42E-04
11	10.00	65.00	112.32	1063.00	3945.2	0.384	10921.4	0.86667	0.553	5.5300	5.06E-04
12	10.00	75.00	112.32	1193.20	4970.9	0.379	13708.0	1.00000	0.475	4.7500	3.47E-04
13	10.00	85.00	112.32	1265.30	5589.8	0.377	15396.9	1.13333	0.397	3.9700	2.58E-04
14	10.00	95.00	112.32	1322.90	6110.3	0.377	16826.0	1.26667	0.319	3.1900	1.90E-04
15	10.00	105.00	137.28	1834.80	14365.9	0.316	37825.2	1.40000	0.271	2.7060	7.15E-05
16	10.00	115.00	137.28	2002.20	17106.9	0.316	45034.6	1.53333	0.252	2.5180	5.59E-05
17	10.00	125.00	137.28	2382.50	24222.7	0.283	62165.1	1.66667	0.233	2.3300	3.75E-05
18	10.00	135.00	137.28	2453.80	25694.2	0.284	65967.2	1.80000	0.214	2.1420	3.25E-05
19	15.00	147.50	137.28	2504.30	26762.6	0.284	68704.0	1.96667	0.191	2.8605	4.16E-05
20	15.00	162.50	137.28	2559.50	27955.4	0.285	71864.5	2.16667	0.163	2.4375	3.39E-05
21	15.00	177.50	137.28	2692.30	30931.7	0.287	79618.7	2.36667	0.134	2.0145	2.53E-05
22	15.00	192.50	137.28	2734.10	31899.6	0.289	82207.1	2.56667	0.106	1.5915	1.94E-05
23	15.00	207.50	137.28	2788.80	33188.8	0.292	85754.4	2.76667	0.089	1.3395	1.56E-05
24	15.00	222.50	137.28	2837.00	34345.9	0.292	88749.8	2.96667	0.084	1.2585	1.42E-05
25	7.50	233.75	137.28	2916.20	36290.3	0.291	93687.1	3.11667	0.080	0.5989	6.39E-06
26	7.50	241.25	137.28	2926.50	36547.1	0.293	94516.7	3.21667	0.077	0.5786	6.12E-06
27	7.50	248.75	137.28	2947.40	37071.0	0.295	95988.7	3.31667	0.074	0.5584	5.82E-06
28	7.50	256.25	137.28	3044.60	39556.4	0.294	102406	3.41667	0.072	0.5381	5.25E-06
29	7.50	263.75	137.28	3075.00	40350.3	0.291	104222	3.51667	0.069	0.5179	4.97E-06
30	7.50	271.25	137.28	3085.80	40634.2	0.294	105169	3.61667	0.066	0.4976	4.73E-06
31	7.50	278.75	137.28	3127.90	41750.5	0.293	108008	3.71667	0.064	0.4774	4.42E-06
32	7.50	286.25	137.28	3170.70	42900.9	0.294	111031	3.81667	0.061	0.4571	4.12E-06
33	7.50	293.75	137.28	3198.60	43659.2	0.293	112881	3.91667	0.058	0.4369	3.87E-06
34	7.50	301.25	137.28	3220.00	44245.4	0.292	114357	4.01667	0.056	0.4179	3.65E-06
35	7.50	308.75	137.28	3236.00	44686.2	0.294	115683	4.11667	0.054	0.4056	3.51E-06
36	7.50	316.25	137.28	3292.00	46246.2	0.293	119633	4.21667	0.052	0.3932	3.29E-06
37	10.16	325.08	137.28	3327.60	47251.8	0.295	122345	4.33437	0.050	0.5128	4.19E-06
38	9.84	335.08	137.28	3358.60	48136.3	0.292	124393	4.46772	0.048	0.4752	3.82E-06
39	10.16	345.08	137.28	3383.60	48855.6	0.293	126374	4.60104	0.046	0.4681	3.70E-06
40	9.84	355.08	137.28	3450.10	50794.8	0.291	131155	4.73439	0.044	0.4319	3.29E-06
41	20.00	370.00	137.28	3458.70	51048.4	0.290	131748	4.93333	0.041	0.8120	6.16E-06
42	20.00	390.00	137.28	3480.40	51691.0	0.290	133311	5.20000	0.036	0.7240	5.43E-06
43	20.00	410.00	137.28	3494.50	52110.6	0.289	134346	5.46667	0.033	0.6600	4.91E-06
44	20.00	430.00	137.28	3555.00	53930.6	0.288	138930	5.73333	0.031	0.6200	4.46E-06
45	20.00	450.00	137.28	3562.80	54167.5	0.288	139484	6.00000	0.029	0.5800	4.16E-06
						0.393			Σ=	100.3360	1.24E-02

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	8060	ksf	
G' = E/(2*(1+μ)) =:	2894	ksf	USE G' (South 100' Alluvium) = 2900 ksf for Lower Bound Soil Case
Vs=(G'*1000*32.17/ρ)^0.5=:	910.4	fps (density =112.32)	
Vs=(G'*1000*32.17/ρ)^0.5=:	823.5	fps (density =137.28)	

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY (4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1133.70	4487.5	0.386	12437.7	0.02667	1	4.0000	3.22E-04
2	4.00	6.00	112.32	1036.20	3748.8	0.411	10575.6	0.08000	1	4.0000	3.78E-04
3	4.00	10.00	112.32	1179.30	4855.7	0.412	13716.0	0.13333	1	4.0000	2.92E-04
4	4.00	14.00	112.32	1366.70	6521.6	0.412	18421.4	0.18667	1	4.0000	2.17E-04
5	4.00	18.00	112.32	1422.40	7064.0	0.414	19980.0	0.24000	0.972	3.8869	1.95E-04
6	8.00	24.00	112.32	1471.00	7554.9	0.417	21409.8	0.32000	0.915	7.3211	3.42E-04
7	2.00	29.00	112.32	1939.70	13136.4	0.395	36640.5	0.38667	0.868	1.7369	4.74E-05
8	10.00	35.00	137.28	2863.00	34978.3	0.291	90282.5	0.46668	0.811	8.1143	8.99E-05
9	10.00	45.00	137.28	3001.90	38454.6	0.286	98928.4	0.60001	0.717	7.1714	7.25E-05
10	10.00	55.00	137.28	3147.00	42262.0	0.281	108270	0.73335	0.631	6.3100	5.83E-05
11	10.00	65.00	137.28	3249.40	45057.0	0.281	115428	0.86668	0.553	5.5300	4.79E-05
12	10.00	75.00	137.28	3430.90	50231.1	0.276	128222	1.00001	0.475	4.7500	3.70E-05
13	10.00	85.00	137.28	3554.10	53903.3	0.279	137867	1.13335	0.397	3.9700	2.88E-05
14	10.00	95.00	137.28	3630.90	56258.1	0.282	144192	1.26668	0.319	3.1900	2.21E-05
15	10.00	105.00	137.28	3767.10	60557.9	0.284	155523	1.40001	0.271	2.7060	1.74E-05
16	10.00	115.00	137.28	3850.20	63259.1	0.285	162533	1.53335	0.252	2.5180	1.55E-05
17	10.00	125.00	137.28	3866.60	63799.1	0.283	163733	1.66668	0.233	2.3300	1.42E-05
18	10.00	135.00	137.28	3910.90	65269.4	0.285	167702	1.80001	0.214	2.1420	1.28E-05
19	15.00	147.50	137.28	3959.60	66905.0	0.287	172228	1.96668	0.191	2.8605	1.66E-05
20	15.00	162.50	137.28	4150.40	73508.3	0.288	189323	2.16668	0.163	2.4375	1.29E-05
21	15.00	177.50	137.28	4255.10	77263.7	0.291	199463	2.36668	0.134	2.0145	1.01E-05
22	15.00	192.50	137.28	4269.80	77798.5	0.291	200893	2.56668	0.106	1.5915	7.92E-06
23	15.00	207.50	137.28	4299.60	78888.2	0.291	203611	2.76668	0.089	1.3395	6.58E-06
24	15.00	222.50	137.28	4367.10	81384.6	0.293	210413	2.96668	0.084	1.2585	5.98E-06
25	7.50	233.75	137.28	4397.90	82536.7	0.294	213673	3.11668	0.080	0.5989	2.80E-06
26	7.50	241.25	137.28	4400.00	82615.5	0.297	214262	3.21668	0.077	0.5786	2.70E-06
27	7.50	248.75	137.28	4398.20	82547.9	0.294	213632	3.31668	0.074	0.5584	2.61E-06
28	7.50	256.25	137.28	4442.50	84219.2	0.296	218259	3.41668	0.072	0.5381	2.47E-06
29	7.50	263.75	137.28	4512.90	86909.6	0.295	225138	3.51668	0.069	0.5179	2.30E-06
30	7.50	271.25	137.28	4533.90	87720.3	0.296	227367	3.61668	0.066	0.4976	2.19E-06
31	7.50	278.75	137.28	4565.90	88962.9	0.295	230418	3.71668	0.064	0.4774	2.07E-06
32	7.50	286.25	137.28	4604.40	90469.5	0.295	234236	3.81668	0.061	0.4571	1.95E-06
33	7.50	293.75	137.28	4624.60	91265.1	0.297	236676	3.91668	0.058	0.4369	1.85E-06
34	7.50	301.25	137.28	4665.00	92866.6	0.296	240688	4.01668	0.056	0.4179	1.74E-06
35	7.50	308.75	137.28	4709.60	94650.8	0.297	245524	4.11668	0.054	0.4056	1.65E-06
36	7.50	316.25	137.28	4787.20	97795.6	0.294	253162	4.21668	0.052	0.3932	1.55E-06
37	10.16	325.08	137.28	4827.00	99428.5	0.295	257615	4.33439	0.050	0.5128	1.99E-06
38	9.84	335.08	137.28	4896.20	102300	0.293	264602	4.46773	0.048	0.4752	1.80E-06
39	10.16	345.08	137.28	4902.70	102572	0.293	265182	4.60105	0.046	0.4681	1.77E-06
40	9.84	355.08	137.28	4938.10	104058	0.292	268815	4.73440	0.044	0.4319	1.61E-06
41	20.00	370.00	137.28	5046.60	108681	0.291	280556	4.93335	0.041	0.8120	2.89E-06
42	20.00	390.00	137.28	5078.80	110072	0.290	283949	5.20001	0.036	0.7240	2.55E-06
43	20.00	410.00	137.28	5111.80	111507	0.289	287515	5.46668	0.033	0.6600	2.30E-06
44	20.00	430.00	137.28	5250.90	117659	0.289	303232	5.73335	0.031	0.6200	2.04E-06
45	20.00	450.00	137.28	5402.60	124555	0.288	320919	6.00001	0.029	0.5800	1.81E-06
						0.382			Σ=	100.3401	2.31E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	43370	ksf
G' = E/(2*(1+μ)) =:	15696	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2120.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1917.8	fps (density =137.28)

USE G' (South 30' Alluvium) = 15700 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1099.50	4220.8	0.387	11704.7	0.02667	1	4.0000	3.42E-04
2	4.00	6.00	112.32	1034.50	3736.5	0.411	10545.9	0.08000	1	4.0000	3.79E-04
3	4.00	10.00	112.32	1126.40	4429.9	0.416	12548.3	0.13333	1	4.0000	3.19E-04
4	4.00	14.00	112.32	1264.10	5579.2	0.416	15802.2	0.18667	1	4.0000	2.53E-04
5	4.00	18.00	112.32	1403.50	6877.5	0.416	19482.6	0.24000	0.972	3.8869	2.00E-04
6	8.00	24.00	112.32	1403.30	6875.5	0.420	19531.9	0.32000	0.915	7.3211	3.75E-04
7	8.00	32.00	112.32	1628.70	9261.6	0.406	26039.5	0.42667	0.840	6.7177	2.58E-04
8	8.00	40.00	112.32	1680.80	9863.7	0.398	27588.5	0.53333	0.764	6.1143	2.22E-04
9	8.00	48.00	112.32	1747.40	10660.8	0.394	29714.7	0.64000	0.689	5.5109	1.85E-04
10	8.00	56.00	112.32	2115.20	15621.0	0.381	43146.1	0.74667	0.623	4.9856	1.16E-04
11	10.00	65.00	112.32	2151.40	16160.3	0.382	44653.4	0.86667	0.553	5.5300	1.24E-04
12	10.00	75.00	137.28	3424.90	50055.5	0.315	131678.1	1.00000	0.475	4.7500	3.61E-05
13	10.00	85.00	137.28	3518.20	52819.9	0.315	138874	1.13333	0.397	3.9700	2.86E-05
14	10.00	95.00	137.28	3564.10	54207.1	0.275	138257	1.26667	0.319	3.1900	2.31E-05
15	10.00	105.00	137.28	3619.00	55889.9	0.278	142870	1.40000	0.271	2.7060	1.89E-05
16	10.00	115.00	137.28	3752.90	60102.2	0.281	153929	1.53333	0.252	2.5180	1.64E-05
17	10.00	125.00	137.28	3791.00	61328.7	0.282	157255	1.66667	0.233	2.3300	1.48E-05
18	10.00	135.00	137.28	3844.00	63055.5	0.283	161785	1.80000	0.214	2.1420	1.32E-05
19	15.00	147.50	137.28	3891.10	64610.2	0.283	165759	1.96667	0.191	2.8605	1.73E-05
20	15.00	162.50	137.28	4008.60	68571.2	0.284	176099	2.16667	0.163	2.4375	1.38E-05
21	15.00	177.50	137.28	4124.70	72600.7	0.286	186764	2.36667	0.134	2.0145	1.08E-05
22	15.00	192.50	137.28	4215.20	75821.5	0.288	195262	2.56667	0.106	1.5915	8.15E-06
23	15.00	207.50	137.28	4316.00	79491.2	0.291	205226	2.76667	0.089	1.3395	6.53E-06
24	15.00	222.50	137.28	4393.20	82360.3	0.291	212641	2.96667	0.084	1.2585	5.92E-06
25	7.50	233.75	137.28	4460.20	84891.6	0.290	219034	3.11667	0.080	0.5989	2.73E-06
26	7.50	241.25	137.28	4461.50	84941.1	0.292	219563	3.21667	0.077	0.5786	2.64E-06
27	7.50	248.75	137.28	4444.20	84283.7	0.294	218168	3.31667	0.074	0.5584	2.56E-06
28	7.50	256.25	137.28	4539.60	87941.0	0.296	227857	3.41667	0.072	0.5381	2.36E-06
29	7.50	263.75	137.28	4592.90	90018.2	0.293	232702	3.51667	0.069	0.5179	2.23E-06
30	7.50	271.25	137.28	4630.20	91486.2	0.295	236962	3.61667	0.066	0.4976	2.10E-06
31	7.50	278.75	137.28	4699.30	94237.2	0.294	243978	3.71667	0.064	0.4774	1.96E-06
32	7.50	286.25	137.28	4690.50	93884.6	0.295	243234	3.81667	0.061	0.4571	1.88E-06
33	7.50	293.75	137.28	4704.60	94449.9	0.294	244521	3.91667	0.058	0.4369	1.79E-06
34	7.50	301.25	137.28	4703.00	94385.7	0.294	244302	4.01667	0.056	0.4179	1.71E-06
35	7.50	308.75	137.28	4747.10	96164.1	0.296	249286	4.11667	0.054	0.4056	1.63E-06
36	7.50	316.25	137.28	4853.40	100519	0.295	260358	4.21667	0.052	0.3932	1.51E-06
37	10.16	325.08	137.28	4897.30	102346	0.296	265331	4.33437	0.050	0.5128	1.93E-06
38	9.84	335.08	137.28	4948.10	104480	0.294	270336	4.46772	0.048	0.4752	1.76E-06
39	10.16	345.08	137.28	5009.70	107098	0.295	277351	4.60104	0.046	0.4681	1.69E-06
40	9.84	355.08	137.28	5042.20	108492	0.293	280510	4.73439	0.044	0.4319	1.54E-06
41	20.00	370.00	137.28	5119.60	111848	0.292	288997	4.93333	0.041	0.8120	2.81E-06
42	20.00	390.00	137.28	5206.70	115686	0.291	298655	5.20000	0.036	0.7240	2.42E-06
43	20.00	410.00	137.28	5283.70	119133	0.290	307380	5.46667	0.033	0.6600	2.15E-06
44	20.00	430.00	137.28	5352.50	122256	0.289	315215	5.73333	0.031	0.6200	1.97E-06
45	20.00	450.00	137.28	5400.90	124477	0.288	320757	6.00000	0.029	0.5800	1.81E-06
						0.381			Σ=	100.3360	3.03E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	33131	ksf
G' = E/(2*(1+μ)) =:	11995	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1853.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1676.6	fps (density =137.28)

USE G' (South 70' Alluvium) = 12000 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 1
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY[(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[(1)]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1118.80	4370.3	0.385	12105.6	0.02667	1	4.0000	3.30E-04
2	4.00	6.00	112.32	991.15	3429.9	0.415	9707.1	0.08000	1	4.0000	4.12E-04
3	4.00	10.00	112.32	1092.50	4167.2	0.419	11828.2	0.13333	1	4.0000	3.38E-04
4	4.00	14.00	112.32	1224.00	5230.8	0.419	14840.0	0.18667	1	4.0000	2.70E-04
5	4.00	18.00	112.32	1344.60	6312.4	0.418	17899.5	0.24000	0.972	3.8869	2.17E-04
6	8.00	24.00	112.32	1418.40	7024.3	0.420	19943.1	0.32000	0.915	7.3211	3.67E-04
7	8.00	32.00	112.32	1685.80	9922.4	0.404	27865.2	0.42667	0.840	6.7177	2.41E-04
8	8.00	40.00	112.32	1731.70	10470.1	0.397	29258.7	0.53333	0.764	6.1143	2.09E-04
9	8.00	48.00	112.32	1732.70	10482.2	0.395	29250.0	0.64000	0.689	5.5109	1.88E-04
10	8.00	56.00	112.32	2161.50	16312.3	0.382	45076.2	0.74667	0.623	4.9856	1.11E-04
11	10.00	65.00	112.32	2126.10	15782.4	0.384	43689.8	0.86667	0.553	5.5300	1.27E-04
12	10.00	75.00	112.32	2386.40	19883.5	0.379	54831.9	1.00000	0.475	4.7500	8.66E-05
13	10.00	85.00	112.32	2530.50	22357.3	0.377	61562.6	1.13333	0.397	3.9700	6.45E-05
14	10.00	95.00	112.32	2645.70	24439.2	0.377	67298.8	1.26667	0.319	3.1900	4.74E-05
15	10.00	105.00	137.28	3625.60	56093.9	0.316	147694	1.40000	0.271	2.7060	1.83E-05
16	10.00	115.00	137.28	3577.10	54603.2	0.316	143745	1.53333	0.252	2.5180	1.75E-05
17	10.00	125.00	137.28	3573.70	54499.5	0.283	139867	1.66667	0.233	2.3300	1.67E-05
18	10.00	135.00	137.28	3680.80	57815.0	0.284	148434	1.80000	0.214	2.1420	1.44E-05
19	15.00	147.50	137.28	3756.50	60217.5	0.284	154588	1.96667	0.191	2.8605	1.85E-05
20	15.00	162.50	137.28	3839.30	62901.4	0.285	161699	2.16667	0.163	2.4375	1.51E-05
21	15.00	177.50	137.28	4038.40	69594.5	0.287	179138	2.36667	0.134	2.0145	1.12E-05
22	15.00	192.50	137.28	4101.20	71775.8	0.289	184971	2.56667	0.106	1.5915	8.60E-06
23	15.00	207.50	137.28	4183.30	74678.3	0.292	192957	2.76667	0.089	1.3395	6.94E-06
24	15.00	222.50	137.28	4255.50	77278.3	0.292	199687	2.96667	0.084	1.2585	6.30E-06
25	7.50	233.75	137.28	4374.30	81653.2	0.291	210796	3.11667	0.080	0.5989	2.84E-06
26	7.50	241.25	137.28	4389.70	82229.2	0.293	212658	3.21667	0.077	0.5786	2.72E-06
27	7.50	248.75	137.28	4421.10	83409.8	0.295	215975	3.31667	0.074	0.5584	2.59E-06
28	7.50	256.25	137.28	4566.90	89001.9	0.294	230413	3.41667	0.072	0.5381	2.34E-06
29	7.50	263.75	137.28	4612.50	90788.1	0.291	234498	3.51667	0.069	0.5179	2.21E-06
30	7.50	271.25	137.28	4628.70	91427.0	0.294	236631	3.61667	0.066	0.4976	2.10E-06
31	7.50	278.75	137.28	4691.90	93940.7	0.293	243023	3.71667	0.064	0.4774	1.96E-06
32	7.50	286.25	137.28	4756.00	96525.0	0.294	249814	3.81667	0.061	0.4571	1.83E-06
33	7.50	293.75	137.28	4797.90	98233.3	0.293	253982	3.91667	0.058	0.4369	1.72E-06
34	7.50	301.25	137.28	4830.00	99552.1	0.292	257302	4.01667	0.056	0.4179	1.62E-06
35	7.50	308.75	137.28	4853.90	100540	0.294	260275	4.11667	0.054	0.4056	1.56E-06
36	7.50	316.25	137.28	4938.00	104054	0.293	269175	4.21667	0.052	0.3932	1.46E-06
37	10.16	325.08	137.28	4991.40	106317	0.295	275277	4.33437	0.050	0.5128	1.86E-06
38	9.84	335.08	137.28	5037.80	108302	0.292	279873	4.46772	0.048	0.4752	1.70E-06
39	10.16	345.08	137.28	5075.30	109921	0.293	284330	4.60104	0.046	0.4681	1.65E-06
40	9.84	355.08	137.28	5175.10	114286	0.291	295094	4.73439	0.044	0.4319	1.46E-06
41	20.00	370.00	137.28	5188.10	114861	0.290	296438	4.93333	0.041	0.8120	2.74E-06
42	20.00	390.00	137.28	5220.70	116309	0.290	299961	5.20000	0.036	0.7240	2.41E-06
43	20.00	410.00	137.28	5241.70	117247	0.289	302274	5.46667	0.033	0.6600	2.18E-06
44	20.00	430.00	137.28	5332.50	121344	0.288	312592	5.73333	0.031	0.6200	1.98E-06
45	20.00	450.00	137.28	5344.20	121877	0.288	313838	6.00000	0.029	0.5800	1.85E-06
						0.393			Σ=	100.3360	3.18E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	31503	ksf
G' = E/(2*(1+μ)) =:	11305	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1799.4	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1627.7	fps (density =137.28)

USE G' (South 100' Alluvium) = 11300 ksf for Upper Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	801.63	2243.6	0.386	6218.6	0.01176	1.000	4.0000	6.43E-04
2	4.00	6.00	112.32	732.70	1874.4	0.411	5287.7	0.03529	1.000	4.0000	7.56E-04
3	4.00	10.00	112.32	833.89	2427.9	0.412	6858.0	0.05882	1.000	4.0000	5.83E-04
4	4.00	14.00	112.32	966.38	3260.6	0.412	9210.2	0.08235	1.000	4.0000	4.34E-04
5	4.00	18.00	112.32	1005.80	3532.1	0.414	9990.2	0.10588	1.000	4.0000	4.00E-04
6	8.00	24.00	112.32	1040.10	3777.1	0.417	10703.8	0.14118	1.000	8.0000	7.47E-04
7	2.00	29.00	112.32	1371.60	6568.4	0.395	18320.9	0.17059	1.000	2.0010	1.09E-04
8	10.00	35.00	137.28	2200.70	20667.0	0.291	53343.6	0.20589	1.000	10.0000	1.87E-04
9	10.00	45.00	137.28	2445.90	25529.0	0.286	65675.9	0.26471	0.994	9.9400	1.51E-04
10	10.00	55.00	137.28	2569.50	28174.3	0.281	72179.2	0.32354	0.897	8.9680	1.24E-04
11	10.00	65.00	137.28	2653.10	30037.5	0.281	76950.6	0.38236	0.842	8.4240	1.09E-04
12	10.00	75.00	137.28	2793.80	33307.9	0.276	85023.0	0.44118	0.788	7.8800	9.27E-05
13	10.00	85.00	137.28	2901.00	35913.0	0.279	91854.0	0.50001	0.734	7.3360	7.99E-05
14	10.00	95.00	137.28	2964.60	37504.9	0.282	96126.6	0.55883	0.679	6.7920	7.07E-05
15	10.00	105.00	137.28	3045.80	39587.6	0.284	101668	0.61765	0.634	6.3400	6.24E-05
16	10.00	115.00	137.28	3123.30	41627.8	0.285	106955	0.67648	0.598	5.9800	5.59E-05
17	10.00	125.00	137.28	3149.70	42334.5	0.283	108646	0.73530	0.562	5.6200	5.17E-05
18	10.00	135.00	137.28	3193.20	43511.9	0.285	111799	0.79412	0.526	5.2600	4.70E-05
19	15.00	147.50	137.28	3233.00	44603.4	0.287	114819	0.86765	0.481	7.2150	6.28E-05
20	15.00	162.50	137.28	3388.80	49005.9	0.288	126217	0.95589	0.427	6.4050	5.07E-05
21	15.00	177.50	137.28	3474.30	51509.9	0.291	132977	1.04412	0.373	5.5950	4.21E-05
22	15.00	192.50	137.28	3486.30	51866.4	0.291	133930	1.13236	0.319	4.7850	3.57E-05
23	15.00	207.50	137.28	3510.60	52591.9	0.291	135740	1.22059	0.281	4.2180	3.11E-05
24	15.00	222.50	137.28	3565.80	54258.8	0.293	140282	1.30883	0.260	3.8940	2.78E-05
25	7.50	233.75	137.28	3590.80	55022.3	0.294	142443	1.37501	0.243	1.8255	1.28E-05
26	7.50	241.25	137.28	3592.60	55077.5	0.297	142842	1.41912	0.233	1.7445	1.22E-05
27	7.50	248.75	137.28	3591.10	55031.5	0.294	142420	1.46324	0.222	1.6635	1.17E-05
28	7.50	256.25	137.28	3627.30	56146.6	0.296	145507	1.50736	0.211	1.5825	1.09E-05
29	7.50	263.75	137.28	3684.70	57937.6	0.295	150086	1.55148	0.200	1.5015	1.00E-05
30	7.50	271.25	137.28	3701.90	58479.8	0.296	151577	1.59559	0.189	1.4205	9.37E-06
31	7.50	278.75	137.28	3728.00	59307.3	0.295	153608	1.63971	0.179	1.3395	8.72E-06
32	7.50	286.25	137.28	3759.50	60313.8	0.295	156160	1.68383	0.168	1.2585	8.06E-06
33	7.50	293.75	137.28	3775.90	60841.1	0.297	157778	1.72795	0.157	1.1775	7.46E-06
34	7.50	301.25	137.28	3809.00	61912.5	0.296	160462	1.77206	0.147	1.1044	6.88E-06
35	7.50	308.75	137.28	3845.40	63101.4	0.297	163685	1.81618	0.143	1.0706	6.54E-06
36	7.50	316.25	137.28	3908.70	65196.0	0.294	168772	1.86030	0.138	1.0369	6.14E-06
37	10.16	325.08	137.28	3941.20	66284.7	0.295	171741	1.91223	0.133	1.3504	7.86E-06
38	9.84	335.08	137.28	3997.70	68198.8	0.293	176399	1.97106	0.127	1.2496	7.08E-06
39	10.16	345.08	137.28	4003.00	68379.7	0.293	176785	2.02988	0.121	1.2285	6.95E-06
40	9.84	355.08	137.28	4032.00	69374.1	0.292	179215	2.08871	0.115	1.1315	6.31E-06
41	20.00	370.00	137.28	4120.60	72456.5	0.291	187043	2.17648	0.106	2.1200	1.13E-05
42	20.00	390.00	137.28	4146.90	73384.3	0.290	189307	2.29412	0.094	1.8800	9.93E-06
43	20.00	410.00	137.28	4173.70	74335.9	0.289	191671	2.41177	0.086	1.7160	8.95E-06
44	20.00	430.00	137.28	4287.30	78437.5	0.289	202151	2.52942	0.081	1.6280	8.05E-06
45	20.00	450.00	137.28	4411.20	83036.6	0.288	213946	2.64706	0.077	1.5400	7.20E-06
						0.348			Σ=	175.2224	5.14E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 34079 ksf

G' = E/(2*(1+μ)) =: 12642 ksf USE G' (South 30' Alluvium) = **12600** ksf for Median Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 1902.9 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1721.2 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	777.49	2110.6	0.387	5852.7	0.01176	1.000	4.0000	6.83E-04
2	4.00	6.00	112.32	731.52	1868.4	0.411	5273.2	0.03529	1.000	4.0000	7.59E-04
3	4.00	10.00	112.32	796.52	2215.1	0.416	6274.7	0.05882	1.000	4.0000	6.37E-04
4	4.00	14.00	112.32	893.86	2789.6	0.416	7901.2	0.08235	1.000	4.0000	5.06E-04
5	4.00	18.00	112.32	992.42	3438.7	0.416	9741.2	0.10588	1.000	4.0000	4.11E-04
6	8.00	24.00	112.32	992.31	3438.0	0.420	9766.5	0.14118	1.000	8.0000	8.19E-04
7	8.00	32.00	112.32	1151.70	4631.1	0.406	13020.5	0.18824	1.000	8.0000	6.14E-04
8	8.00	40.00	112.32	1188.50	4931.8	0.398	13794.1	0.23529	1.000	8.0000	5.80E-04
9	8.00	48.00	112.32	1235.60	5330.4	0.394	14857.4	0.28235	0.952	7.6160	5.13E-04
10	8.00	56.00	112.32	1495.70	7810.8	0.381	21573.9	0.32941	0.891	7.1309	3.31E-04
11	10.00	65.00	112.32	1521.20	8079.4	0.382	22324.7	0.38235	0.842	8.4240	3.77E-04
12	10.00	75.00	137.28	2421.70	25026.3	0.315	65835.2	0.44118	0.788	7.8800	1.20E-04
13	10.00	85.00	137.28	2568.10	28143.6	0.315	73995.2	0.50000	0.734	7.3360	9.91E-05
14	10.00	95.00	137.28	2910.10	36138.7	0.275	92173.1	0.55882	0.679	6.7920	7.37E-05
15	10.00	105.00	137.28	2954.90	37259.9	0.278	95246.8	0.61765	0.634	6.3400	6.66E-05
16	10.00	115.00	137.28	3064.20	40067.3	0.281	102617	0.67647	0.598	5.9800	5.83E-05
17	10.00	125.00	137.28	3095.30	40884.8	0.282	104834	0.73529	0.562	5.6200	5.36E-05
18	10.00	135.00	137.28	3138.60	42036.7	0.283	107856	0.79412	0.526	5.2600	4.88E-05
19	15.00	147.50	137.28	3177.10	43074.3	0.283	110508	0.86765	0.481	7.2150	6.53E-05
20	15.00	162.50	137.28	3273.00	45713.9	0.284	117399	0.95588	0.427	6.4050	5.46E-05
21	15.00	177.50	137.28	3367.80	48400.4	0.286	124509	1.04412	0.373	5.5950	4.49E-05
22	15.00	192.50	137.28	3441.70	50547.8	0.288	130175	1.13235	0.319	4.7850	3.68E-05
23	15.00	207.50	137.28	3524.00	52994.2	0.291	136817	1.22059	0.281	4.2180	3.08E-05
24	15.00	222.50	137.28	3587.10	54909.0	0.291	141766	1.30882	0.260	3.8940	2.75E-05
25	7.50	233.75	137.28	3641.70	56593.2	0.290	146020	1.37500	0.243	1.8255	1.25E-05
26	7.50	241.25	137.28	3642.80	56627.4	0.292	146375	1.41912	0.233	1.7445	1.19E-05
27	7.50	248.75	137.28	3628.70	56189.9	0.294	145448	1.46324	0.222	1.6635	1.14E-05
28	7.50	256.25	137.28	3706.60	58628.3	0.296	151907	1.50735	0.211	1.5825	1.04E-05
29	7.50	263.75	137.28	3750.10	60012.5	0.293	155136	1.55147	0.200	1.5015	9.68E-06
30	7.50	271.25	137.28	3780.60	60992.7	0.295	157980	1.59559	0.189	1.4205	8.99E-06
31	7.50	278.75	137.28	3837.00	62826.1	0.294	162655	1.63971	0.179	1.3395	8.24E-06
32	7.50	286.25	137.28	3829.70	62587.2	0.295	162150	1.68382	0.168	1.2585	7.76E-06
33	7.50	293.75	137.28	3841.30	62967.0	0.294	163015	1.72794	0.157	1.1775	7.22E-06
34	7.50	301.25	137.28	3840.00	62924.3	0.294	162870	1.77206	0.147	1.1044	6.78E-06
35	7.50	308.75	137.28	3876.00	64109.7	0.296	166192	1.81618	0.143	1.0706	6.44E-06
36	7.50	316.25	137.28	3962.80	67013.2	0.295	173574	1.86029	0.138	1.0369	5.97E-06
37	10.16	325.08	137.28	3998.60	68229.5	0.296	176885	1.91222	0.133	1.3504	7.63E-06
38	9.84	335.08	137.28	4040.10	69653.1	0.294	180223	1.97105	0.127	1.2496	6.93E-06
39	10.16	345.08	137.28	4090.40	71398.3	0.295	184900	2.02987	0.121	1.2285	6.64E-06
40	9.84	355.08	137.28	4117.00	72329.9	0.293	187012	2.08870	0.115	1.1315	6.05E-06
41	20.00	370.00	137.28	4180.20	74567.6	0.292	192671	2.17647	0.106	2.1200	1.10E-05
42	20.00	390.00	137.28	4251.20	77122.2	0.291	199099	2.29412	0.094	1.8800	9.44E-06
43	20.00	410.00	137.28	4314.10	79421.2	0.290	204918	2.41176	0.086	1.7160	8.37E-06
44	20.00	430.00	137.28	4370.30	81504.0	0.289	210143	2.52941	0.081	1.6280	7.75E-06
45	20.00	450.00	137.28	4409.80	82983.9	0.288	213836	2.64706	0.077	1.5400	7.20E-06
						0.378			Σ=	175.0603	7.19E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 24353 ksf

G' = E/(2*(1+μ)) =: 8833 ksf USE G' (South 70' Alluvium) = **8800** ksf for Median Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 1590.6 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1438.8 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
MEDIAN VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	791.08	2185.0	0.385	6052.3	0.01176	1.000	4.0000	6.61E-04
2	4.00	6.00	112.32	700.85	1715.0	0.415	4853.6	0.03529	1.000	4.0000	8.24E-04
3	4.00	10.00	112.32	772.49	2083.5	0.419	5913.7	0.05882	1.000	4.0000	6.76E-04
4	4.00	14.00	112.32	865.48	2615.3	0.419	7419.7	0.08235	1.000	4.0000	5.39E-04
5	4.00	18.00	112.32	950.75	3156.0	0.418	8949.3	0.10588	1.000	4.0000	4.47E-04
6	8.00	24.00	112.32	1003.00	3512.4	0.420	9972.4	0.14118	1.000	8.0000	8.02E-04
7	8.00	32.00	112.32	1192.00	4960.9	0.404	13931.6	0.18824	1.000	8.0000	5.74E-04
8	8.00	40.00	112.32	1224.50	5235.1	0.397	14629.4	0.23529	1.000	8.0000	5.47E-04
9	8.00	48.00	112.32	1225.20	5241.1	0.395	14624.9	0.28235	0.952	7.6160	5.21E-04
10	8.00	56.00	112.32	1528.40	8156.1	0.382	22537.8	0.32941	0.891	7.1309	3.16E-04
11	10.00	65.00	112.32	1503.30	7890.4	0.384	21842.6	0.38235	0.842	8.4240	3.86E-04
12	10.00	75.00	112.32	1687.50	9942.5	0.379	27417.9	0.44118	0.788	7.8800	2.87E-04
13	10.00	85.00	112.32	1789.30	11178.2	0.377	30790.2	0.50000	0.734	7.3360	2.38E-04
14	10.00	95.00	112.32	1870.80	12219.7	0.377	33649.6	0.55882	0.679	6.7920	2.02E-04
15	10.00	105.00	137.28	2579.20	28387.4	0.316	74743.6	0.61765	0.634	6.3400	8.48E-05
16	10.00	115.00	137.28	2676.20	30562.8	0.316	80457.8	0.67647	0.598	5.9800	7.43E-05
17	10.00	125.00	137.28	2917.90	36332.6	0.283	93244.1	0.73529	0.562	5.6200	6.03E-05
18	10.00	135.00	137.28	3005.30	38541.8	0.284	98952.2	0.79412	0.526	5.2600	5.32E-05
19	15.00	147.50	137.28	3067.10	40143.2	0.284	103054	0.86765	0.481	7.2150	7.00E-05
20	15.00	162.50	137.28	3134.80	41934.9	0.285	107801	0.95588	0.427	6.4050	5.94E-05
21	15.00	177.50	137.28	3297.40	46398.0	0.287	119429	1.04412	0.373	5.5950	4.68E-05
22	15.00	192.50	137.28	3348.60	47850.1	0.289	123313	1.13235	0.319	4.7850	3.88E-05
23	15.00	207.50	137.28	3415.60	49784.0	0.292	128634	1.22059	0.281	4.2180	3.28E-05
24	15.00	222.50	137.28	3474.60	51518.8	0.292	133125	1.30882	0.260	3.8940	2.93E-05
25	7.50	233.75	137.28	3571.60	54435.5	0.291	140531	1.37500	0.243	1.8255	1.30E-05
26	7.50	241.25	137.28	3584.20	54820.2	0.293	141774	1.41912	0.233	1.7445	1.23E-05
27	7.50	248.75	137.28	3609.80	55606.1	0.295	143982	1.46324	0.222	1.6635	1.16E-05
28	7.50	256.25	137.28	3728.80	59332.7	0.294	153604	1.50735	0.211	1.5825	1.03E-05
29	7.50	263.75	137.28	3766.10	60525.7	0.291	156333	1.55147	0.200	1.5015	9.60E-06
30	7.50	271.25	137.28	3779.30	60950.7	0.294	157753	1.59559	0.189	1.4205	9.00E-06
31	7.50	278.75	137.28	3830.90	62626.5	0.293	162013	1.63971	0.179	1.3395	8.27E-06
32	7.50	286.25	137.28	3883.30	64351.4	0.294	166547	1.68382	0.168	1.2585	7.56E-06
33	7.50	293.75	137.28	3917.50	65489.9	0.293	169324	1.72794	0.157	1.1775	6.95E-06
34	7.50	301.25	137.28	3943.70	66368.8	0.292	171537	1.77206	0.147	1.1044	6.44E-06
35	7.50	308.75	137.28	3963.20	67026.8	0.294	173518	1.81618	0.143	1.0706	6.17E-06
36	7.50	316.25	137.28	4031.80	69367.2	0.293	179445	1.86029	0.138	1.0369	5.78E-06
37	10.16	325.08	137.28	4075.50	70879.1	0.295	183522	1.91222	0.133	1.3504	7.36E-06
38	9.84	335.08	137.28	4113.40	72203.5	0.292	186587	1.97105	0.127	1.2496	6.70E-06
39	10.16	345.08	137.28	4144.00	73281.7	0.293	189556	2.02987	0.121	1.2285	6.48E-06
40	9.84	355.08	137.28	4225.40	76188.9	0.291	196724	2.08870	0.115	1.1315	5.75E-06
41	20.00	370.00	137.28	4236.10	76575.3	0.290	197629	2.17647	0.106	2.1200	1.07E-05
42	20.00	390.00	137.28	4262.70	77540.0	0.290	199976	2.29412	0.094	1.8800	9.40E-06
43	20.00	410.00	137.28	4279.90	78167.0	0.289	201522	2.41176	0.086	1.7160	8.52E-06
44	20.00	430.00	137.28	4354.00	80897.1	0.288	208397	2.52941	0.081	1.6280	7.81E-06
45	20.00	450.00	137.28	4363.50	81250.5	0.288	209223	2.64706	0.077	1.5400	7.36E-06
						0.382			Σ=	175.0603	7.75E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 22595 ksf

G' = E/(2*(1+μ)) =: 8177 ksf USE G' (South 100' Alluvium) = **8200** ksf for Median Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 1530.3 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1384.3 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	566.84	1121.8	0.386	3109.3	0.01176	1.000	4.0000	1.29E-03
2	4.00	6.00	112.32	518.09	937.2	0.411	2643.8	0.03529	1.000	4.0000	1.51E-03
3	4.00	10.00	112.32	589.65	1213.9	0.412	3429.0	0.05882	1.000	4.0000	1.17E-03
4	4.00	14.00	112.32	683.33	1630.3	0.412	4605.1	0.08235	1.000	4.0000	8.69E-04
5	4.00	18.00	112.32	711.22	1766.1	0.414	4995.3	0.10588	1.000	4.0000	8.01E-04
6	8.00	24.00	112.32	735.48	1888.6	0.417	5352.2	0.14118	1.000	8.0000	1.49E-03
7	2.00	29.00	112.32	969.86	3284.2	0.395	9160.3	0.17059	1.000	2.0010	2.18E-04
8	10.00	35.00	137.28	1691.60	12211.0	0.291	31517.8	0.20589	1.000	10.0000	3.17E-04
9	10.00	45.00	137.28	1992.80	16946.6	0.286	43596.9	0.26471	0.994	9.9400	2.28E-04
10	10.00	55.00	137.28	2098.00	18783.1	0.281	48120.0	0.32354	0.897	8.9680	1.86E-04
11	10.00	65.00	137.28	2166.30	20026.0	0.281	51302.9	0.38236	0.842	8.4240	1.64E-04
12	10.00	75.00	137.28	2274.90	22084.2	0.276	56372.9	0.44118	0.788	7.8800	1.40E-04
13	10.00	85.00	137.28	2368.00	23928.7	0.279	61202.0	0.50001	0.734	7.3360	1.20E-04
14	10.00	95.00	137.28	2420.60	25003.6	0.282	64085.2	0.55883	0.679	6.7920	1.06E-04
15	10.00	105.00	137.28	2462.60	25878.8	0.284	66461.4	0.61765	0.634	6.3400	9.54E-05
16	10.00	115.00	137.28	2533.60	27392.5	0.285	70380.2	0.67648	0.598	5.9800	8.50E-05
17	10.00	125.00	137.28	2565.80	28093.2	0.283	72097.9	0.73530	0.562	5.6200	7.79E-05
18	10.00	135.00	137.28	2607.30	29009.4	0.285	74536.1	0.79412	0.526	5.2600	7.06E-05
19	15.00	147.50	137.28	2639.70	29734.8	0.287	76544.0	0.86765	0.481	7.2150	9.43E-05
20	15.00	162.50	137.28	2767.00	32671.9	0.288	84147.8	0.95589	0.427	6.4050	7.61E-05
21	15.00	177.50	137.28	2836.80	34341.1	0.291	88654.2	1.04412	0.373	5.5950	6.31E-05
22	15.00	192.50	137.28	2846.50	34576.3	0.291	89283.6	1.13236	0.319	4.7850	5.36E-05
23	15.00	207.50	137.28	2866.40	35061.4	0.291	90493.6	1.22059	0.281	4.2180	4.66E-05
24	15.00	222.50	137.28	2911.40	36171.0	0.293	93517.1	1.30883	0.260	3.8940	4.16E-05
25	7.50	233.75	137.28	2931.90	36682.1	0.294	94963.4	1.37501	0.243	1.8255	1.92E-05
26	7.50	241.25	137.28	2933.30	36717.2	0.297	95225.2	1.41912	0.233	1.7445	1.83E-05
27	7.50	248.75	137.28	2932.10	36687.1	0.294	94945.6	1.46324	0.222	1.6635	1.75E-05
28	7.50	256.25	137.28	2961.70	37431.6	0.296	97006.2	1.50736	0.211	1.5825	1.63E-05
29	7.50	263.75	137.28	3008.60	38626.5	0.295	100061	1.55148	0.200	1.5015	1.50E-05
30	7.50	271.25	137.28	3022.60	38986.8	0.296	101052	1.59559	0.189	1.4205	1.41E-05
31	7.50	278.75	137.28	3043.90	39538.2	0.295	102406	1.63971	0.179	1.3395	1.31E-05
32	7.50	286.25	137.28	3069.60	40208.7	0.295	104105	1.68383	0.168	1.2585	1.21E-05
33	7.50	293.75	137.28	3083.00	40560.5	0.297	105185	1.72795	0.157	1.1775	1.12E-05
34	7.50	301.25	137.28	3110.00	41274.0	0.296	106972	1.77206	0.147	1.1044	1.03E-05
35	7.50	308.75	137.28	3139.70	42066.1	0.297	109120	1.81618	0.143	1.0706	9.81E-06
36	7.50	316.25	137.28	3191.50	43465.6	0.294	112519	1.86030	0.138	1.0369	9.22E-06
37	10.16	325.08	137.28	3218.00	44190.4	0.295	114496	1.91223	0.133	1.3504	1.18E-05
38	9.84	335.08	137.28	3264.10	45465.6	0.293	117599	1.97106	0.127	1.2496	1.06E-05
39	10.16	345.08	137.28	3268.40	45585.5	0.293	117854	2.02988	0.121	1.2285	1.04E-05
40	9.84	355.08	137.28	3292.10	46249.0	0.292	119476	2.08871	0.115	1.1315	9.47E-06
41	20.00	370.00	137.28	3364.40	48302.7	0.291	124692	2.17648	0.106	2.1200	1.70E-05
42	20.00	390.00	137.28	3385.90	48922.0	0.290	126202	2.29412	0.094	1.8800	1.49E-05
43	20.00	410.00	137.28	3407.80	49556.9	0.289	127780	2.41177	0.086	1.7160	1.34E-05
44	20.00	430.00	137.28	3500.60	52292.7	0.289	134770	2.52942	0.081	1.6280	1.21E-05
45	20.00	450.00	137.28	3601.70	55356.8	0.288	142628	2.64706	0.077	1.5400	1.08E-05
						0.352			Σ=	175.2224	9.59E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 18270 ksf

G' = E/(2*(1+μ)) =: 6755 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1391.0 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1258.2 fps (density =137.28)

USE G' (South 30' Alluvium) = **6800** ksf for Lower Bound Soil Case

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ [1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	549.77	1055.3	0.387	2926.4	0.01176	1.000	4.0000	1.37E-03
2	4.00	6.00	112.32	517.27	934.2	0.411	2636.7	0.03529	1.000	4.0000	1.52E-03
3	4.00	10.00	112.32	563.22	1107.5	0.416	3137.3	0.05882	1.000	4.0000	1.27E-03
4	4.00	14.00	112.32	632.05	1394.8	0.416	3950.5	0.08235	1.000	4.0000	1.01E-03
5	4.00	18.00	112.32	701.75	1719.4	0.416	4870.6	0.10588	1.000	4.0000	8.21E-04
6	8.00	24.00	112.32	701.67	1719.0	0.420	4883.3	0.14118	1.000	8.0000	1.64E-03
7	8.00	32.00	112.32	814.36	2315.5	0.406	6510.0	0.18824	1.000	8.0000	1.23E-03
8	8.00	40.00	112.32	840.38	2465.8	0.398	6896.8	0.23529	1.000	8.0000	1.16E-03
9	8.00	48.00	112.32	873.69	2665.1	0.394	7428.5	0.28235	0.952	7.6160	1.03E-03
10	8.00	56.00	112.32	1057.60	3905.3	0.381	10786.5	0.32941	0.891	7.1309	6.61E-04
11	10.00	65.00	112.32	1075.70	4040.1	0.382	11163.3	0.38235	0.842	8.4240	7.55E-04
12	10.00	75.00	137.28	1712.40	12513.1	0.315	32917.6	0.44118	0.788	7.8800	2.39E-04
13	10.00	85.00	137.28	1874.60	14995.9	0.315	39427.3	0.50000	0.734	7.3360	1.86E-04
14	10.00	95.00	137.28	2376.10	24092.7	0.275	61449.4	0.55882	0.679	6.7920	1.11E-04
15	10.00	105.00	137.28	2412.70	24840.6	0.278	63499.6	0.61765	0.634	6.3400	9.98E-05
16	10.00	115.00	137.28	2501.90	26711.4	0.281	68411.0	0.67647	0.598	5.9800	8.74E-05
17	10.00	125.00	137.28	2527.30	27256.5	0.282	69889.4	0.73529	0.562	5.6200	8.04E-05
18	10.00	135.00	137.28	2562.60	28023.2	0.283	71900.8	0.79412	0.526	5.2600	7.32E-05
19	15.00	147.50	137.28	2594.10	28716.4	0.283	73672.4	0.86765	0.481	7.2150	9.79E-05
20	15.00	162.50	137.28	2672.40	30476.1	0.284	78266.2	0.95588	0.427	6.4050	8.18E-05
21	15.00	177.50	137.28	2749.80	32267.0	0.286	83006.2	1.04412	0.373	5.5950	6.74E-05
22	15.00	192.50	137.28	2810.10	33697.7	0.288	86780.9	1.13235	0.319	4.7850	5.51E-05
23	15.00	207.50	137.28	2877.30	35328.6	0.291	91209.3	1.22059	0.281	4.2180	4.62E-05
24	15.00	222.50	137.28	2928.80	36604.6	0.291	94507.2	1.30882	0.260	3.8940	4.12E-05
25	7.50	233.75	137.28	2973.40	37727.9	0.290	97344.1	1.37500	0.243	1.8255	1.88E-05
26	7.50	241.25	137.28	2974.40	37753.3	0.292	97587.8	1.41912	0.233	1.7445	1.79E-05
27	7.50	248.75	137.28	2962.80	37459.4	0.294	96963.7	1.46324	0.222	1.6635	1.72E-05
28	7.50	256.25	137.28	3026.40	39084.9	0.296	101270	1.50735	0.211	1.5825	1.56E-05
29	7.50	263.75	137.28	3061.90	40007.2	0.293	103421	1.55147	0.200	1.5015	1.45E-05
30	7.50	271.25	137.28	3086.80	40660.5	0.295	105317	1.59559	0.189	1.4205	1.35E-05
31	7.50	278.75	137.28	3132.90	41884.1	0.294	108437	1.63971	0.179	1.3395	1.24E-05
32	7.50	286.25	137.28	3127.00	41726.5	0.295	108104	1.68382	0.168	1.2585	1.16E-05
33	7.50	293.75	137.28	3136.40	41977.7	0.294	108676	1.72794	0.157	1.1775	1.08E-05
34	7.50	301.25	137.28	3135.30	41948.3	0.294	108576	1.77206	0.147	1.1044	1.02E-05
35	7.50	308.75	137.28	3164.80	42741.4	0.296	110799	1.81618	0.143	1.0706	9.66E-06
36	7.50	316.25	137.28	3235.60	44675.1	0.295	115715	1.86029	0.138	1.0369	8.96E-06
37	10.16	325.08	137.28	3264.90	45487.9	0.296	117927	1.91222	0.133	1.3504	1.15E-05
38	9.84	335.08	137.28	3298.80	46437.4	0.294	120154	1.97105	0.127	1.2496	1.04E-05
39	10.16	345.08	137.28	3339.80	47598.9	0.295	123267	2.02987	0.121	1.2285	9.97E-06
40	9.84	355.08	137.28	3361.50	48219.5	0.293	124673	2.08870	0.115	1.1315	9.08E-06
41	20.00	370.00	137.28	3413.10	49711.2	0.292	128446	2.17647	0.106	2.1200	1.65E-05
42	20.00	390.00	137.28	3471.10	51415.1	0.291	132733	2.29412	0.094	1.8800	1.42E-05
43	20.00	410.00	137.28	3522.50	52949.1	0.290	136616	2.41176	0.086	1.7160	1.26E-05
44	20.00	430.00	137.28	3568.30	54334.9	0.289	140093	2.52941	0.081	1.6280	1.16E-05
45	20.00	450.00	137.28	3600.60	55323.0	0.288	142559	2.64706	0.077	1.5400	1.08E-05
						0.377			Σ=	175.0603	1.40E-02

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 12509 ksf

G' = E/(2*(1+μ)) =: 4540 ksf USE G' (South 70' Alluvium) = **4500** ksf for Lower Bound Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 1140.4 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1031.5 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
16% (LOWER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ [1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	559.38	1092.5	0.385	3026.2	0.01176	1.000	4.0000	1.32E-03
2	4.00	6.00	112.32	500.00	872.9	0.415	2470.3	0.03529	1.000	4.0000	1.62E-03
3	4.00	10.00	112.32	546.23	1041.7	0.419	2956.8	0.05882	1.000	4.0000	1.35E-03
4	4.00	14.00	112.32	611.99	1307.7	0.419	3709.9	0.08235	1.000	4.0000	1.08E-03
5	4.00	18.00	112.32	672.28	1578.0	0.418	4474.6	0.10588	1.000	4.0000	8.94E-04
6	8.00	24.00	112.32	709.19	1756.0	0.420	4985.6	0.14118	1.000	8.0000	1.60E-03
7	8.00	32.00	112.32	842.88	2480.5	0.404	6966.0	0.18824	1.000	8.0000	1.15E-03
8	8.00	40.00	112.32	865.87	2617.6	0.397	7315.0	0.23529	1.000	8.0000	1.09E-03
9	8.00	48.00	112.32	866.35	2620.6	0.395	7312.5	0.28235	0.952	7.6160	1.04E-03
10	8.00	56.00	112.32	1080.70	4077.7	0.382	11268.0	0.32941	0.891	7.1309	6.33E-04
11	10.00	65.00	112.32	1063.00	3945.2	0.384	10921.4	0.38235	0.842	8.4240	7.71E-04
12	10.00	75.00	112.32	1193.20	4970.9	0.379	13708.0	0.44118	0.788	7.8800	5.75E-04
13	10.00	85.00	112.32	1265.30	5589.8	0.377	15396.9	0.50000	0.734	7.3360	4.76E-04
14	10.00	95.00	112.32	1322.90	6110.3	0.377	16826.0	0.55882	0.679	6.7920	4.04E-04
15	10.00	105.00	137.28	1834.80	14365.9	0.316	37825.2	0.61765	0.634	6.3400	1.68E-04
16	10.00	115.00	137.28	2002.20	17106.9	0.316	45034.6	0.67647	0.598	5.9800	1.33E-04
17	10.00	125.00	137.28	2382.50	24222.7	0.283	62165.1	0.73529	0.562	5.6200	9.04E-05
18	10.00	135.00	137.28	2453.80	25694.2	0.284	65967.2	0.79412	0.526	5.2600	7.97E-05
19	15.00	147.50	137.28	2504.30	26762.6	0.284	68704.0	0.86765	0.481	7.2150	1.05E-04
20	15.00	162.50	137.28	2559.50	27955.4	0.285	71864.5	0.95588	0.427	6.4050	8.91E-05
21	15.00	177.50	137.28	2692.30	30931.7	0.287	79618.7	1.04412	0.373	5.5950	7.03E-05
22	15.00	192.50	137.28	2734.10	31899.6	0.289	82207.1	1.13235	0.319	4.7850	5.82E-05
23	15.00	207.50	137.28	2788.80	33188.8	0.292	85754.4	1.22059	0.281	4.2180	4.92E-05
24	15.00	222.50	137.28	2837.00	34345.9	0.292	88749.8	1.30882	0.260	3.8940	4.39E-05
25	7.50	233.75	137.28	2916.20	36290.3	0.291	93687.1	1.37500	0.243	1.8255	1.95E-05
26	7.50	241.25	137.28	2926.50	36547.1	0.293	94516.7	1.41912	0.233	1.7445	1.85E-05
27	7.50	248.75	137.28	2947.40	37071.0	0.295	95988.7	1.46324	0.222	1.6635	1.73E-05
28	7.50	256.25	137.28	3044.60	39556.4	0.294	102406	1.50735	0.211	1.5825	1.55E-05
29	7.50	263.75	137.28	3075.00	40350.3	0.291	104222	1.55147	0.200	1.5015	1.44E-05
30	7.50	271.25	137.28	3085.80	40634.2	0.294	105169	1.59559	0.189	1.4205	1.35E-05
31	7.50	278.75	137.28	3127.90	41750.5	0.293	108008	1.63971	0.179	1.3395	1.24E-05
32	7.50	286.25	137.28	3170.70	42900.9	0.294	111031	1.68382	0.168	1.2585	1.13E-05
33	7.50	293.75	137.28	3198.60	43659.2	0.293	112881	1.72794	0.157	1.1775	1.04E-05
34	7.50	301.25	137.28	3220.00	44245.4	0.292	114357	1.77206	0.147	1.1044	9.66E-06
35	7.50	308.75	137.28	3236.00	44686.2	0.294	115683	1.81618	0.143	1.0706	9.25E-06
36	7.50	316.25	137.28	3292.00	46246.2	0.293	119633	1.86029	0.138	1.0369	8.67E-06
37	10.16	325.08	137.28	3327.60	47251.8	0.295	122345	1.91222	0.133	1.3504	1.10E-05
38	9.84	335.08	137.28	3358.60	48136.3	0.292	124393	1.97105	0.127	1.2496	1.00E-05
39	10.16	345.08	137.28	3383.60	48855.6	0.293	126374	2.02987	0.121	1.2285	9.72E-06
40	9.84	355.08	137.28	3450.10	50794.8	0.291	131155	2.08870	0.115	1.1315	8.63E-06
41	20.00	370.00	137.28	3458.70	51048.4	0.290	131748	2.17647	0.106	2.1200	1.61E-05
42	20.00	390.00	137.28	3480.40	51691.0	0.290	133311	2.29412	0.094	1.8800	1.41E-05
43	20.00	410.00	137.28	3494.50	52110.6	0.289	134346	2.41176	0.086	1.7160	1.28E-05
44	20.00	430.00	137.28	3555.00	53930.6	0.288	138930	2.52941	0.081	1.6280	1.17E-05
45	20.00	450.00	137.28	3562.80	54167.5	0.288	139484	2.64706	0.077	1.5400	1.10E-05
						0.381			Σ=	175.0603	1.52E-02

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 11544 ksf

G' = E/(2*(1+μ)) =: 4178 ksf USE G' (South 100' Alluvium) = **4200** ksf for Lower Bound Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 1094.0 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 989.5 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1133.70	4487.5	0.386	12437.7	0.01176	1.000	4.0000	3.22E-04
2	4.00	6.00	112.32	1036.20	3748.8	0.411	10575.6	0.03529	1.000	4.0000	3.78E-04
3	4.00	10.00	112.32	1179.30	4855.7	0.412	13716.0	0.05882	1.000	4.0000	2.92E-04
4	4.00	14.00	112.32	1366.70	6521.6	0.412	18421.4	0.08235	1.000	4.0000	2.17E-04
5	4.00	18.00	112.32	1422.40	7064.0	0.414	19980.0	0.10588	1.000	4.0000	2.00E-04
6	8.00	24.00	112.32	1471.00	7554.9	0.417	21409.8	0.14118	1.000	8.0000	3.74E-04
7	2.00	29.00	112.32	1939.70	13136.4	0.395	36640.5	0.17059	1.000	2.0010	5.46E-05
8	10.00	35.00	137.28	2863.00	34978.3	0.291	90282.5	0.20589	1.000	10.0000	1.11E-04
9	10.00	45.00	137.28	3001.90	38454.6	0.286	98928.4	0.26471	0.994	9.9400	1.00E-04
10	10.00	55.00	137.28	3147.00	42262.0	0.281	108270	0.32354	0.897	8.9680	8.28E-05
11	10.00	65.00	137.28	3249.40	45057.0	0.281	115428	0.38236	0.842	8.4240	7.30E-05
12	10.00	75.00	137.28	3430.90	50231.1	0.276	128222	0.44118	0.788	7.8800	6.15E-05
13	10.00	85.00	137.28	3554.10	53903.3	0.279	137867	0.50001	0.734	7.3360	5.32E-05
14	10.00	95.00	137.28	3630.90	56258.1	0.282	144192	0.55883	0.679	6.7920	4.71E-05
15	10.00	105.00	137.28	3767.10	60557.9	0.284	155523	0.61765	0.634	6.3400	4.08E-05
16	10.00	115.00	137.28	3850.20	63259.1	0.285	162533	0.67648	0.598	5.9800	3.68E-05
17	10.00	125.00	137.28	3866.60	63799.1	0.283	163733	0.73530	0.562	5.6200	3.43E-05
18	10.00	135.00	137.28	3910.90	65269.4	0.285	167702	0.79412	0.526	5.2600	3.14E-05
19	15.00	147.50	137.28	3959.60	66905.0	0.287	172228	0.86765	0.481	7.2150	4.19E-05
20	15.00	162.50	137.28	4150.40	73508.3	0.288	189323	0.95589	0.427	6.4050	3.38E-05
21	15.00	177.50	137.28	4255.10	77263.7	0.291	199463	1.04412	0.373	5.5950	2.81E-05
22	15.00	192.50	137.28	4269.80	77798.5	0.291	200893	1.13236	0.319	4.7850	2.38E-05
23	15.00	207.50	137.28	4299.60	78888.2	0.291	203611	1.22059	0.281	4.2180	2.07E-05
24	15.00	222.50	137.28	4367.10	81384.6	0.293	210413	1.30883	0.260	3.8940	1.85E-05
25	7.50	233.75	137.28	4397.90	82536.7	0.294	213673	1.37501	0.243	1.8255	8.54E-06
26	7.50	241.25	137.28	4400.00	82615.5	0.297	214262	1.41912	0.233	1.7445	8.14E-06
27	7.50	248.75	137.28	4398.20	82547.9	0.294	213632	1.46324	0.222	1.6635	7.79E-06
28	7.50	256.25	137.28	4442.50	84219.2	0.296	218259	1.50736	0.211	1.5825	7.25E-06
29	7.50	263.75	137.28	4512.90	86909.6	0.295	225138	1.55148	0.200	1.5015	6.67E-06
30	7.50	271.25	137.28	4533.90	87720.3	0.296	227367	1.59559	0.189	1.4205	6.25E-06
31	7.50	278.75	137.28	4565.90	88962.9	0.295	230418	1.63971	0.179	1.3395	5.81E-06
32	7.50	286.25	137.28	4604.40	90469.5	0.295	234236	1.68383	0.168	1.2585	5.37E-06
33	7.50	293.75	137.28	4624.60	91265.1	0.297	236676	1.72795	0.157	1.1775	4.98E-06
34	7.50	301.25	137.28	4665.00	92866.6	0.296	240688	1.77206	0.147	1.1044	4.59E-06
35	7.50	308.75	137.28	4709.60	94650.8	0.297	245524	1.81618	0.143	1.0706	4.36E-06
36	7.50	316.25	137.28	4787.20	97795.6	0.294	253162	1.86030	0.138	1.0369	4.10E-06
37	10.16	325.08	137.28	4827.00	99428.5	0.295	257615	1.91223	0.133	1.3504	5.24E-06
38	9.84	335.08	137.28	4896.20	102300	0.293	264602	1.97106	0.127	1.2496	4.72E-06
39	10.16	345.08	137.28	4902.70	102572	0.293	265182	2.02988	0.121	1.2285	4.63E-06
40	9.84	355.08	137.28	4938.10	104058	0.292	268815	2.08871	0.115	1.1315	4.21E-06
41	20.00	370.00	137.28	5046.60	108681	0.291	280556	2.17648	0.106	2.1200	7.56E-06
42	20.00	390.00	137.28	5078.80	110072	0.290	283949	2.29412	0.094	1.8800	6.62E-06
43	20.00	410.00	137.28	5111.80	111507	0.289	287515	2.41177	0.086	1.7160	5.97E-06
44	20.00	430.00	137.28	5250.90	117659	0.289	303232	2.52942	0.081	1.6280	5.37E-06
45	20.00	450.00	137.28	5402.60	124555	0.288	320919	2.64706	0.077	1.5400	4.80E-06
						0.344			Σ=	175.2224	2.80E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 62604 ksf

G' = E/(2*(1+μ)) =: 23286 ksf USE G' (South 30' Alluvium) = **23300** ksf for Upper Bound Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 2582.5 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 2336.0 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1099.50	4220.8	0.387	11704.7	0.01176	1.000	4.0000	3.42E-04
2	4.00	6.00	112.32	1034.50	3736.5	0.411	10545.9	0.03529	1.000	4.0000	3.79E-04
3	4.00	10.00	112.32	1126.40	4429.9	0.416	12548.3	0.05882	1.000	4.0000	3.19E-04
4	4.00	14.00	112.32	1264.10	5579.2	0.416	15802.2	0.08235	1.000	4.0000	2.53E-04
5	4.00	18.00	112.32	1403.50	6877.5	0.416	19482.6	0.10588	1.000	4.0000	2.05E-04
6	8.00	24.00	112.32	1403.30	6875.5	0.420	19531.9	0.14118	1.000	8.0000	4.10E-04
7	8.00	32.00	112.32	1628.70	9261.6	0.406	26039.5	0.18824	1.000	8.0000	3.07E-04
8	8.00	40.00	112.32	1680.80	9863.7	0.398	27588.5	0.23529	1.000	8.0000	2.90E-04
9	8.00	48.00	112.32	1747.40	10660.8	0.394	29714.7	0.28235	0.952	7.6160	2.56E-04
10	8.00	56.00	112.32	2115.20	15621.0	0.381	43146.1	0.32941	0.891	7.1309	1.65E-04
11	10.00	65.00	112.32	2151.40	16160.3	0.382	44653.4	0.38235	0.842	8.4240	1.89E-04
12	10.00	75.00	137.28	3424.90	50055.5	0.315	131678	0.44118	0.788	7.8800	5.98E-05
13	10.00	85.00	137.28	3518.20	52819.9	0.315	138874	0.50000	0.734	7.3360	5.28E-05
14	10.00	95.00	137.28	3564.10	54207.1	0.275	138257	0.55882	0.679	6.7920	4.91E-05
15	10.00	105.00	137.28	3619.00	55889.9	0.278	142870	0.61765	0.634	6.3400	4.44E-05
16	10.00	115.00	137.28	3752.90	60102.2	0.281	153929	0.67647	0.598	5.9800	3.88E-05
17	10.00	125.00	137.28	3791.00	61328.7	0.282	157255	0.73529	0.562	5.6200	3.57E-05
18	10.00	135.00	137.28	3844.00	63055.5	0.283	161785	0.79412	0.526	5.2600	3.25E-05
19	15.00	147.50	137.28	3891.10	64610.2	0.283	165759	0.86765	0.481	7.2150	4.35E-05
20	15.00	162.50	137.28	4008.60	68571.2	0.284	176099	0.95588	0.427	6.4050	3.64E-05
21	15.00	177.50	137.28	4124.70	72600.7	0.286	186764	1.04412	0.373	5.5950	3.00E-05
22	15.00	192.50	137.28	4215.20	75821.5	0.288	195262	1.13235	0.319	4.7850	2.45E-05
23	15.00	207.50	137.28	4316.00	79491.2	0.291	205226	1.22059	0.281	4.2180	2.06E-05
24	15.00	222.50	137.28	4393.20	82360.3	0.291	212641	1.30882	0.260	3.8940	1.83E-05
25	7.50	233.75	137.28	4460.20	84891.6	0.290	219034	1.37500	0.243	1.8255	8.33E-06
26	7.50	241.25	137.28	4461.50	84941.1	0.292	219563	1.41912	0.233	1.7445	7.95E-06
27	7.50	248.75	137.28	4444.20	84283.7	0.294	218168	1.46324	0.222	1.6635	7.62E-06
28	7.50	256.25	137.28	4539.60	87941.0	0.296	227857	1.50735	0.211	1.5825	6.95E-06
29	7.50	263.75	137.28	4592.90	90018.2	0.293	232702	1.55147	0.200	1.5015	6.45E-06
30	7.50	271.25	137.28	4630.20	91486.2	0.295	236962	1.59559	0.189	1.4205	5.99E-06
31	7.50	278.75	137.28	4699.30	94237.2	0.294	243978	1.63971	0.179	1.3395	5.49E-06
32	7.50	286.25	137.28	4690.50	93884.6	0.295	243234	1.68382	0.168	1.2585	5.17E-06
33	7.50	293.75	137.28	4704.60	94449.9	0.294	244521	1.72794	0.157	1.1775	4.82E-06
34	7.50	301.25	137.28	4703.00	94385.7	0.294	244302	1.77206	0.147	1.1044	4.52E-06
35	7.50	308.75	137.28	4747.10	96164.1	0.296	249286	1.81618	0.143	1.0706	4.29E-06
36	7.50	316.25	137.28	4853.40	100519	0.295	260358	1.86029	0.138	1.0369	3.98E-06
37	10.16	325.08	137.28	4897.30	102346	0.296	265331	1.91222	0.133	1.3504	5.09E-06
38	9.84	335.08	137.28	4948.10	104480	0.294	270336	1.97105	0.127	1.2496	4.62E-06
39	10.16	345.08	137.28	5009.70	107098	0.295	277351	2.02987	0.121	1.2285	4.43E-06
40	9.84	355.08	137.28	5042.20	108492	0.293	280510	2.08870	0.115	1.1315	4.03E-06
41	20.00	370.00	137.28	5119.60	111848	0.292	288997	2.17647	0.106	2.1200	7.34E-06
42	20.00	390.00	137.28	5206.70	115686	0.291	298655	2.29412	0.094	1.8800	6.29E-06
43	20.00	410.00	137.28	5283.70	119133	0.290	307380	2.41176	0.086	1.7160	5.58E-06
44	20.00	430.00	137.28	5352.50	122256	0.289	315215	2.52941	0.081	1.6280	5.16E-06
45	20.00	450.00	137.28	5400.90	124477	0.288	320757	2.64706	0.077	1.5400	4.80E-06
						0.380			Σ=	175.0603	3.72E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 47050 ksf
G' = E/(2*(1+μ)) =: 17050 ksf USE G' (South 70' Alluvium) = **17100** ksf for Upper Bound Soil Case
Vs=(G'*1000*32.17/ρ)^0.5=: 2209.9 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1998.9 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT PART 2
84% (UPPER BOUND) VALUES:
REFERENCE: DTN MO0706SCSPS1E4.002 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; G' = Vs^2*ρ/(1000*32.17)
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1118.80	4370.3	0.385	12105.6	0.01176	1.000	4.0000	3.30E-04
2	4.00	6.00	112.32	991.15	3429.9	0.415	9707.1	0.03529	1.000	4.0000	4.12E-04
3	4.00	10.00	112.32	1092.50	4167.2	0.419	11828.2	0.05882	1.000	4.0000	3.38E-04
4	4.00	14.00	112.32	1224.00	5230.8	0.419	14840.0	0.08235	1.000	4.0000	2.70E-04
5	4.00	18.00	112.32	1344.60	6312.4	0.418	17899.5	0.10588	1.000	4.0000	2.23E-04
6	8.00	24.00	112.32	1418.40	7024.3	0.420	19943.1	0.14118	1.000	8.0000	4.01E-04
7	8.00	32.00	112.32	1685.80	9922.4	0.404	27865.2	0.18824	1.000	8.0000	2.87E-04
8	8.00	40.00	112.32	1731.70	10470.1	0.397	29258.7	0.23529	1.000	8.0000	2.73E-04
9	8.00	48.00	112.32	1732.70	10482.2	0.395	29250.0	0.28235	0.952	7.6160	2.60E-04
10	8.00	56.00	112.32	2161.50	16312.3	0.382	45076.2	0.32941	0.891	7.1309	1.58E-04
11	10.00	65.00	112.32	2126.10	15782.4	0.384	43689.8	0.38235	0.842	8.4240	1.93E-04
12	10.00	75.00	112.32	2386.40	19883.5	0.379	54831.9	0.44118	0.788	7.8800	1.44E-04
13	10.00	85.00	112.32	2530.50	22357.3	0.377	61582.6	0.50000	0.734	7.3360	1.19E-04
14	10.00	95.00	112.32	2645.70	24439.2	0.377	67298.8	0.55882	0.679	6.7920	1.01E-04
15	10.00	105.00	137.28	3625.60	56093.9	0.316	147694	0.61765	0.634	6.3400	4.29E-05
16	10.00	115.00	137.28	3577.10	54603.2	0.316	143745	0.67647	0.598	5.9800	4.16E-05
17	10.00	125.00	137.28	3573.70	54499.5	0.283	139867	0.73529	0.562	5.6200	4.02E-05
18	10.00	135.00	137.28	3680.80	57815.0	0.284	148434	0.79412	0.526	5.2600	3.54E-05
19	15.00	147.50	137.28	3756.50	60217.5	0.284	154588	0.86765	0.481	7.2150	4.67E-05
20	15.00	162.50	137.28	3839.30	62901.4	0.285	161699	0.95588	0.427	6.4050	3.96E-05
21	15.00	177.50	137.28	4038.40	69594.5	0.287	179138	1.04412	0.373	5.5950	3.12E-05
22	15.00	192.50	137.28	4101.20	71775.8	0.289	184971	1.13235	0.319	4.7850	2.59E-05
23	15.00	207.50	137.28	4183.30	74678.3	0.292	192957	1.22059	0.281	4.2180	2.19E-05
24	15.00	222.50	137.28	4255.50	77278.3	0.292	199687	1.30882	0.260	3.8940	1.95E-05
25	7.50	233.75	137.28	4374.30	81653.2	0.291	210796	1.37500	0.243	1.8255	8.66E-06
26	7.50	241.25	137.28	4389.70	82229.2	0.293	212658	1.41912	0.233	1.7445	8.20E-06
27	7.50	248.75	137.28	4421.10	83409.8	0.295	215975	1.46324	0.222	1.6635	7.70E-06
28	7.50	256.25	137.28	4566.90	89001.9	0.294	230413	1.50735	0.211	1.5825	6.87E-06
29	7.50	263.75	137.28	4612.50	90788.1	0.291	234498	1.55147	0.200	1.5015	6.40E-06
30	7.50	271.25	137.28	4628.70	91427.0	0.294	236631	1.59559	0.189	1.4205	6.00E-06
31	7.50	278.75	137.28	4691.90	93940.7	0.293	243023	1.63971	0.179	1.3395	5.51E-06
32	7.50	286.25	137.28	4756.00	96525.0	0.294	249814	1.68382	0.168	1.2585	5.04E-06
33	7.50	293.75	137.28	4797.90	98233.3	0.293	253982	1.72794	0.157	1.1775	4.64E-06
34	7.50	301.25	137.28	4830.00	99552.1	0.292	257302	1.77206	0.147	1.1044	4.29E-06
35	7.50	308.75	137.28	4853.90	100540	0.294	260275	1.81618	0.143	1.0706	4.11E-06
36	7.50	316.25	137.28	4938.00	104054	0.293	269175	1.86029	0.138	1.0369	3.85E-06
37	10.16	325.08	137.28	4991.40	106317	0.295	275277	1.91222	0.133	1.3504	4.91E-06
38	9.84	335.08	137.28	5037.80	108302	0.292	279873	1.97105	0.127	1.2496	4.46E-06
39	10.16	345.08	137.28	5075.30	109921	0.293	284330	2.02987	0.121	1.2285	4.32E-06
40	9.84	355.08	137.28	5175.10	114286	0.291	295094	2.08870	0.115	1.1315	3.83E-06
41	20.00	370.00	137.28	5188.10	114861	0.290	296438	2.17647	0.106	2.1200	7.15E-06
42	20.00	390.00	137.28	5220.70	116309	0.290	299961	2.29412	0.094	1.8800	6.27E-06
43	20.00	410.00	137.28	5241.70	117247	0.289	302274	2.41176	0.086	1.7160	5.68E-06
44	20.00	430.00	137.28	5332.50	121344	0.288	312592	2.52941	0.081	1.6280	5.21E-06
45	20.00	450.00	137.28	5344.20	121877	0.288	313838	2.64706	0.077	1.5400	4.91E-06
						0.383			Σ=	175.0603	3.97E-03

(1) Poisson Ratio from DTN: MO0706SCSPS1E4.002
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ...q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from DTN: MO0706SCSPS1E4.002

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 44058 ksf

G' = E/(2*(1+μ)) =: 15934 ksf — USE G' (South 100' Alluvium) = **15900** ksf for Upper Bound Soil Case

Vs=(G'*1000*32.17/ρ)^0.5=: 2136.3 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1932.3 fps (density =137.28)

Table 6.1.1 – Part 1
Summary of Dynamic Shear Modulus (*G'*) in *ksf* and Poisson's Ratio (μ) for 5E-4 Seismic Event

	South 30' Alluvium			South 70' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
G' =	6200	12300	21600	4700	9200	17900	4400	8600	16800
μ =	0.353	0.349	0.358	0.360	0.362	0.364	0.370	0.372	0.375

Table 6.1.2 – Part 2
Summary of Dynamic Shear Modulus (*G'*) in *ksf* and Poisson's Ratio (μ) for 5E-4 Seismic Event

	South 30' Alluvium			South 70' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
G' =	9400	17200	31000	6900	13200	25000	6400	12300	23400
μ =	0.318	0.312	0.306	0.338	0.339	0.341	0.342	0.342	0.345

Table 6.1.3 – Part 1
Summary of Dynamic Shear Modulus (*G'*) in *ksf* and Poisson's Ratio (μ) for 1E-4 Seismic Event

	South 30' Alluvium			South 70' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
G' =	4300	8300	15700	3100	6100	12000	2900	5700	11300
μ =	0.382	0.381	0.382	0.385	0.390	0.381	0.393	0.393	0.393

Table 6.1.4 – Part 2
Summary of Dynamic Shear Modulus (*G'*) in *ksf* and Poisson's Ratio (μ) for 1E-4 Seismic Event

	South 30' Alluvium			South 70' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
G' =	6800	12600	23300	4500	8800	17100	4200	8200	15900
μ =	0.352	0.348	0.344	0.377	0.378	0.380	0.381	0.382	0.383

Figure 6.1
Shear Wave Velocity for South 30ft Alluvium Over Tuff, 5E-4 (DBGM-2) Event
(Taken from MO0706SCSPS5E4.002)
South 30ft

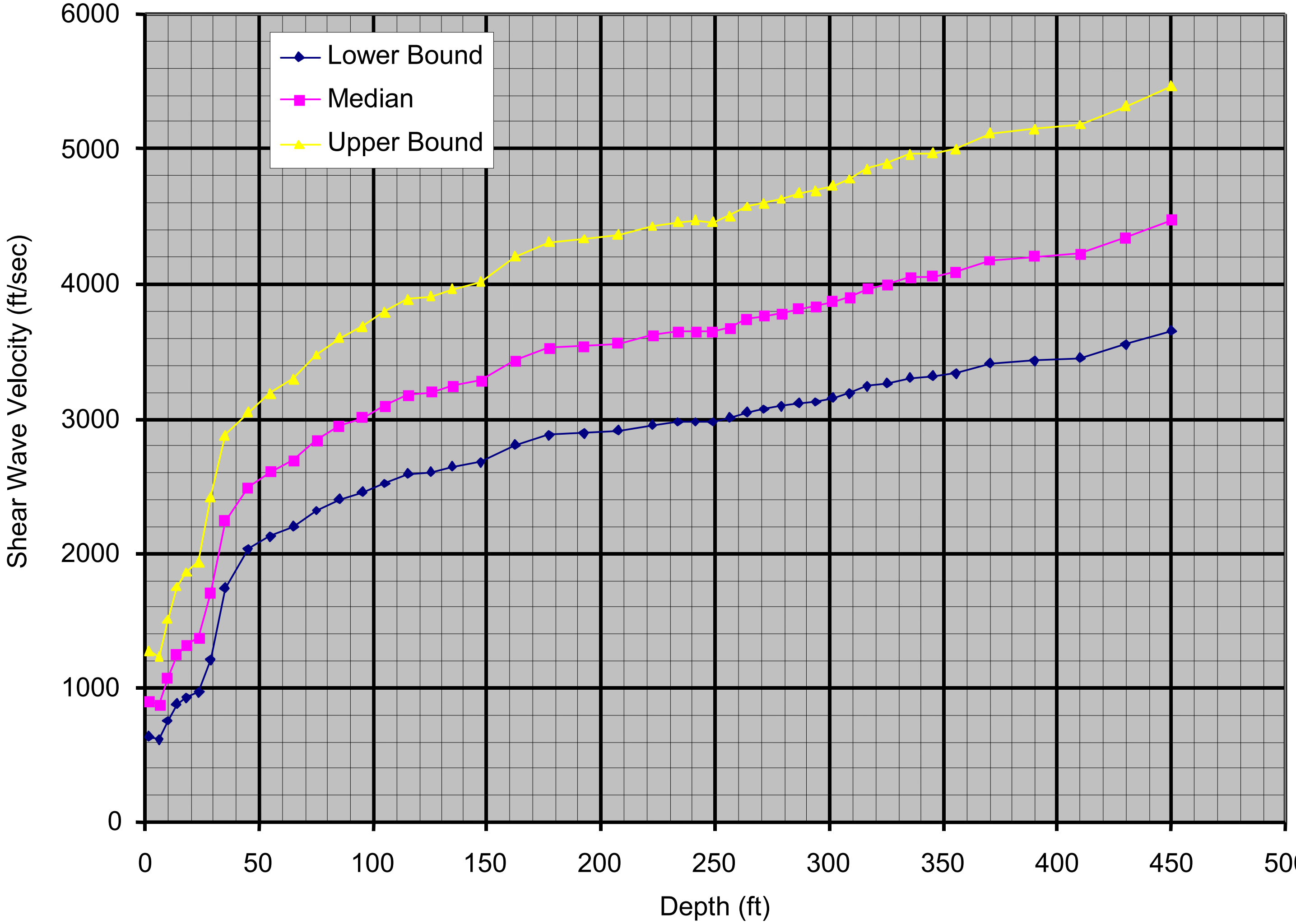


Figure 6.2
Shear Wave Velocity for South 70ft Alluvium Over Tuff, 5E-4 (DBGM-2) Event
(Taken from MO0706SCSPS5E4.002)
South 70ft

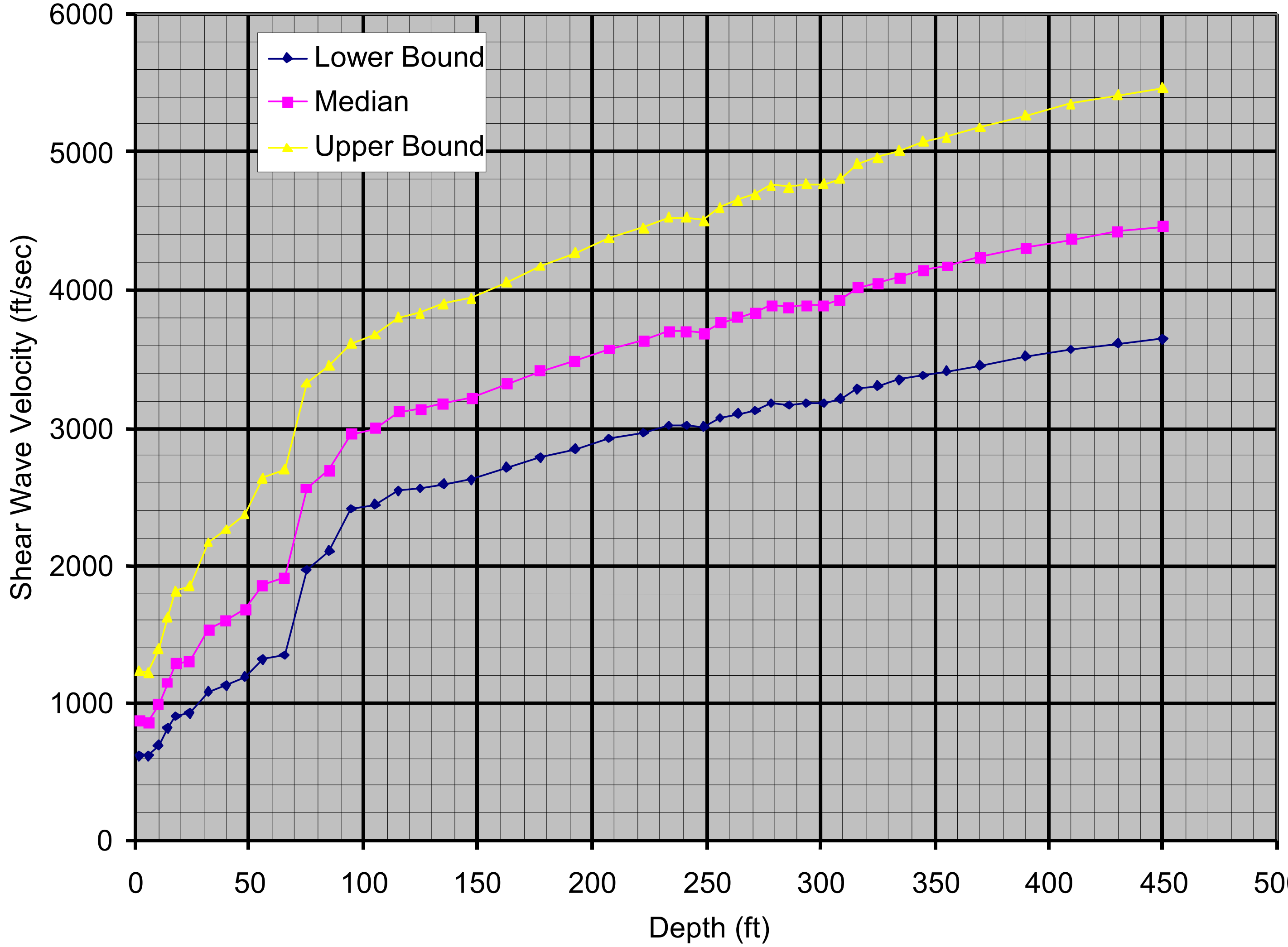


Figure 6.3
Shear Wave Velocity for South 100ft Alluvium Over Tuff, 5E-4 (DBGM-2) Event
(Taken from MO0706SCSPS5E4.002)
South 100ft

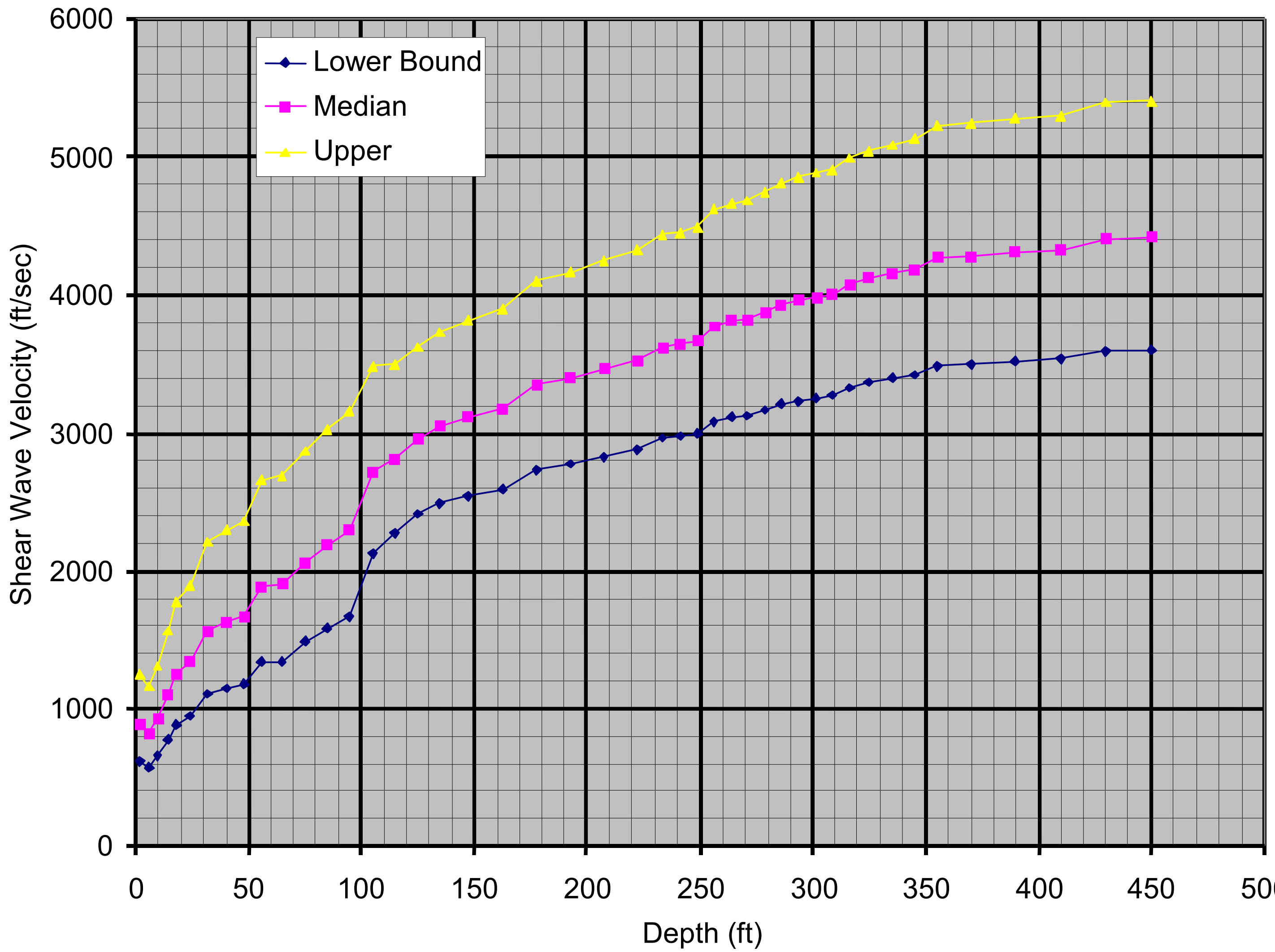


Figure 6.4
Shear Wave Velocity for South 30ft Alluvium Over Tuff, 1E-4 (BDBGM) Event
(Taken from MO0706SCSPS1E4.002)
South 30ft

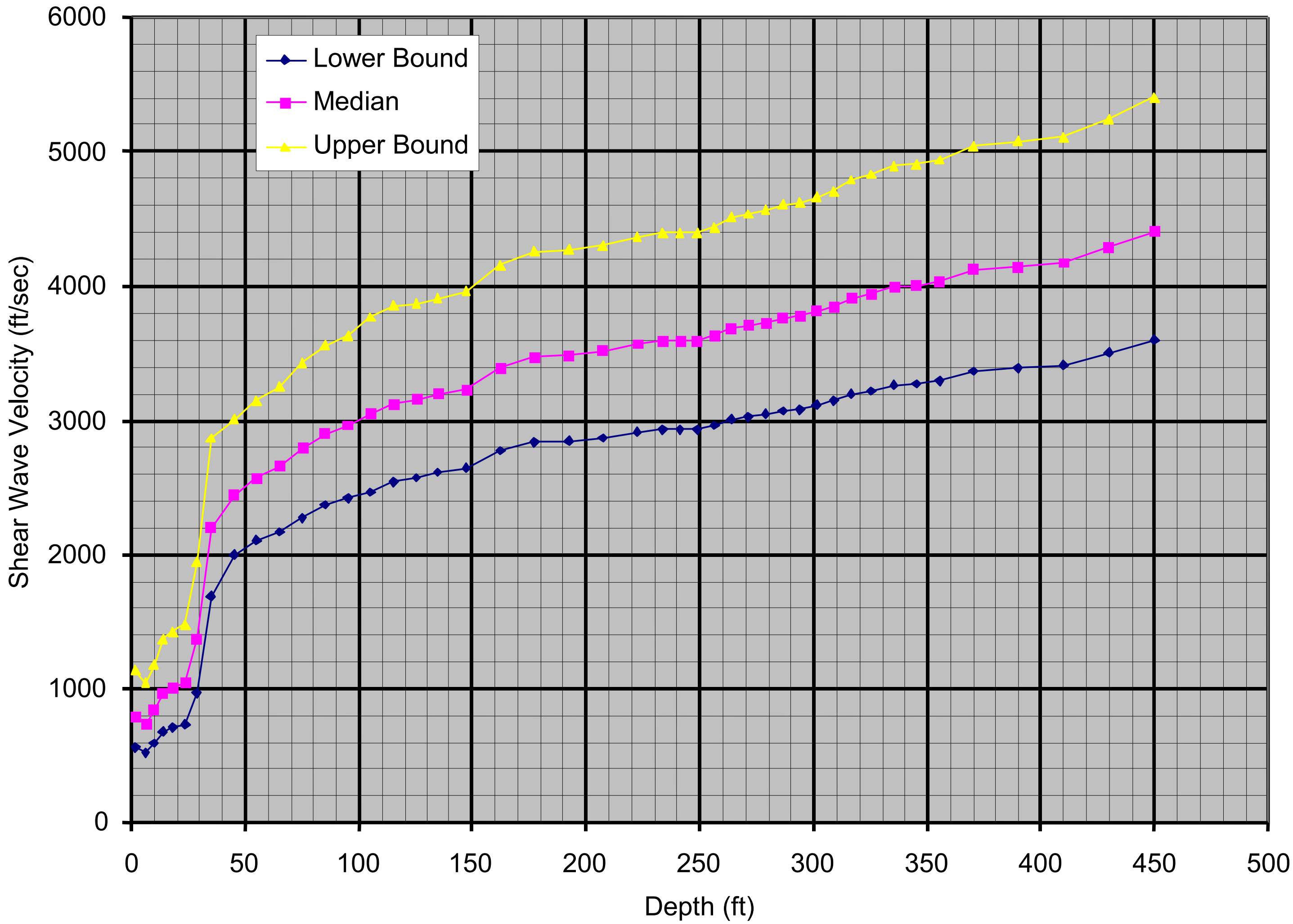


Figure 6.5
Shear Wave Velocity for South 70ft Alluvium Over Tuff, 1E-4 (BDBGM) Event
(Taken from MO0706SCSPS1E4.002)
South 70ft

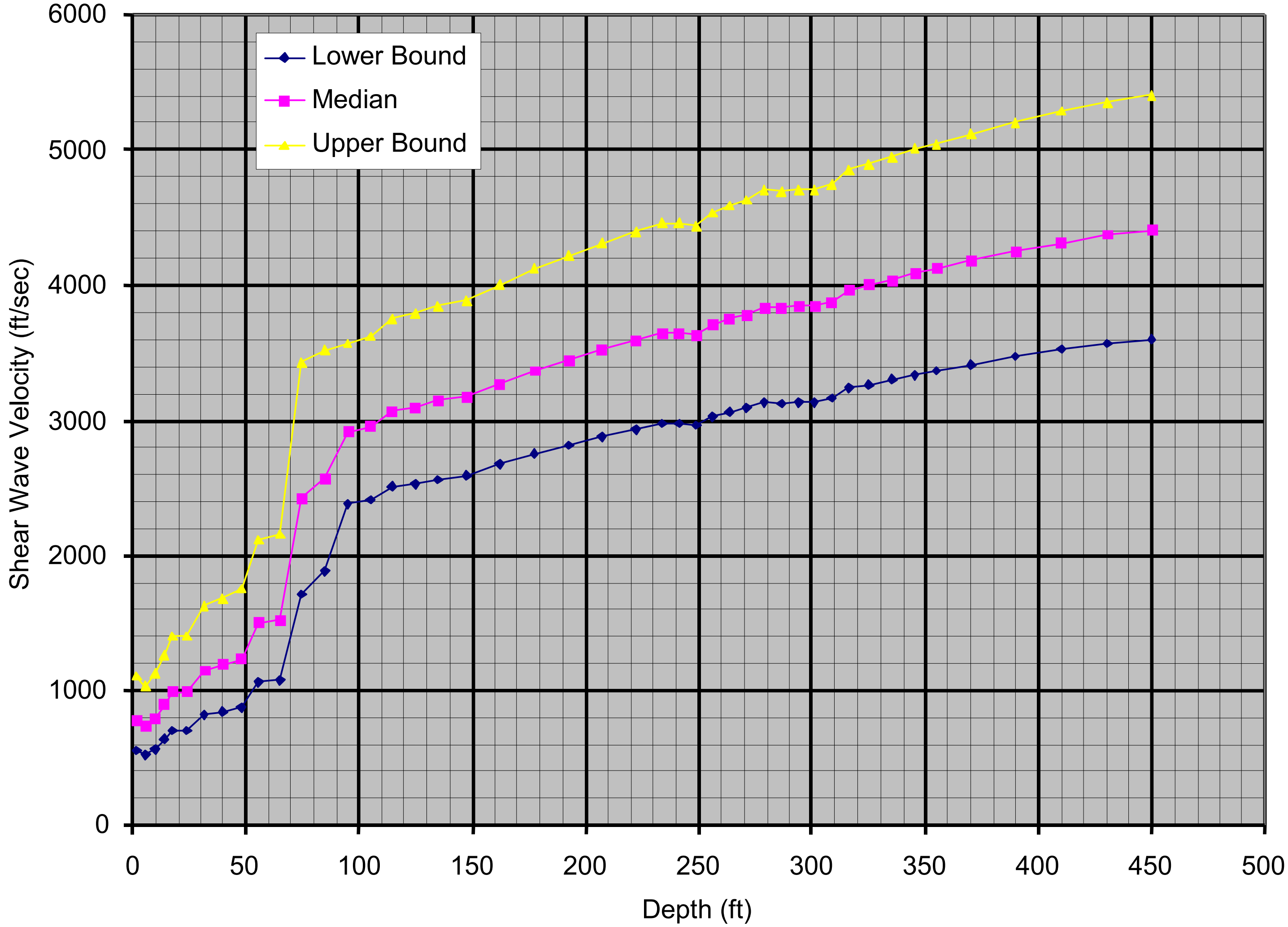
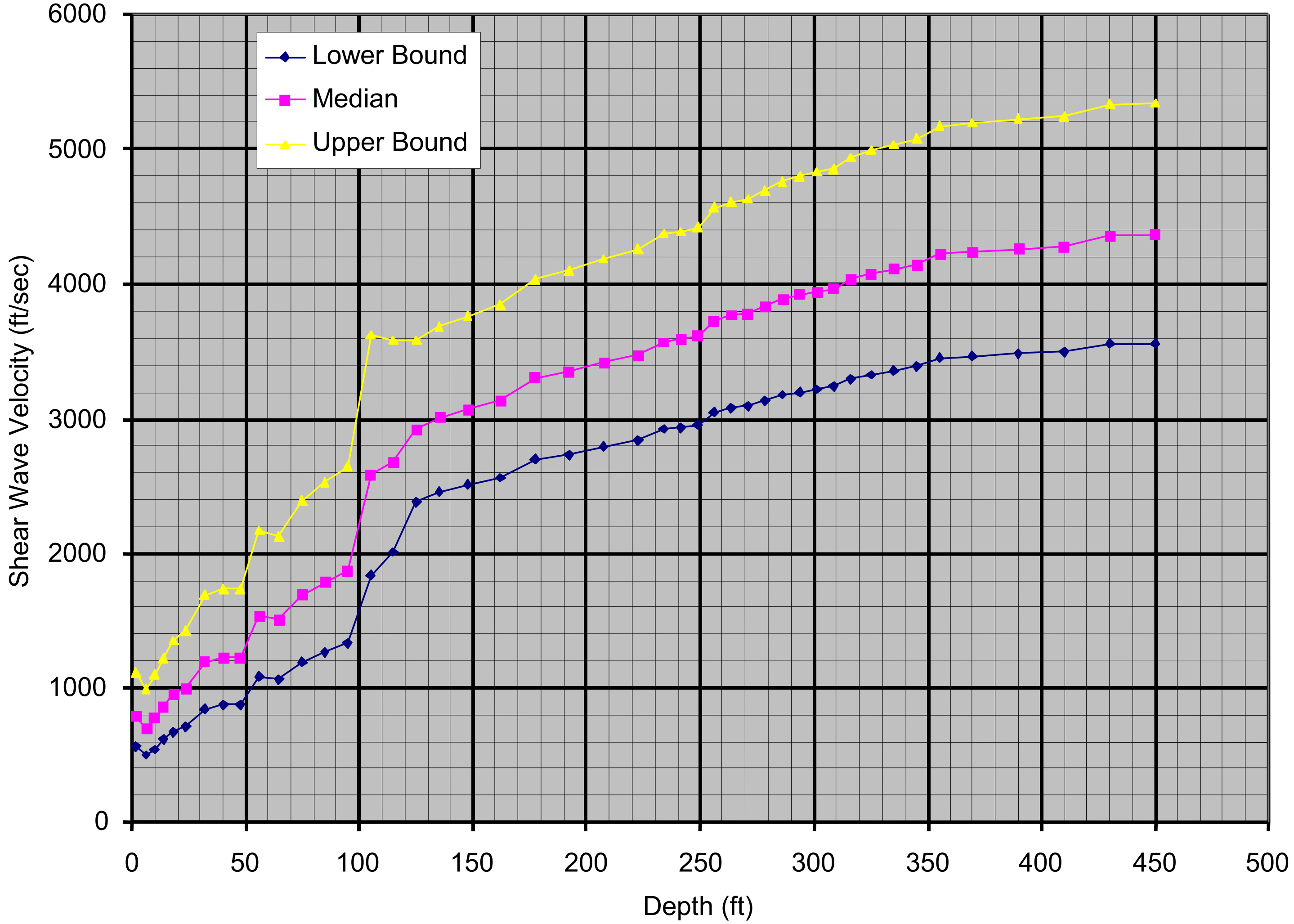


Figure 6.6
Shear Wave Velocity for South 100ft Alluvium Over Tuff, 1E-4 (BDBGM) Event
(Taken from MO0706SCSPS1E4.002)
South 100ft



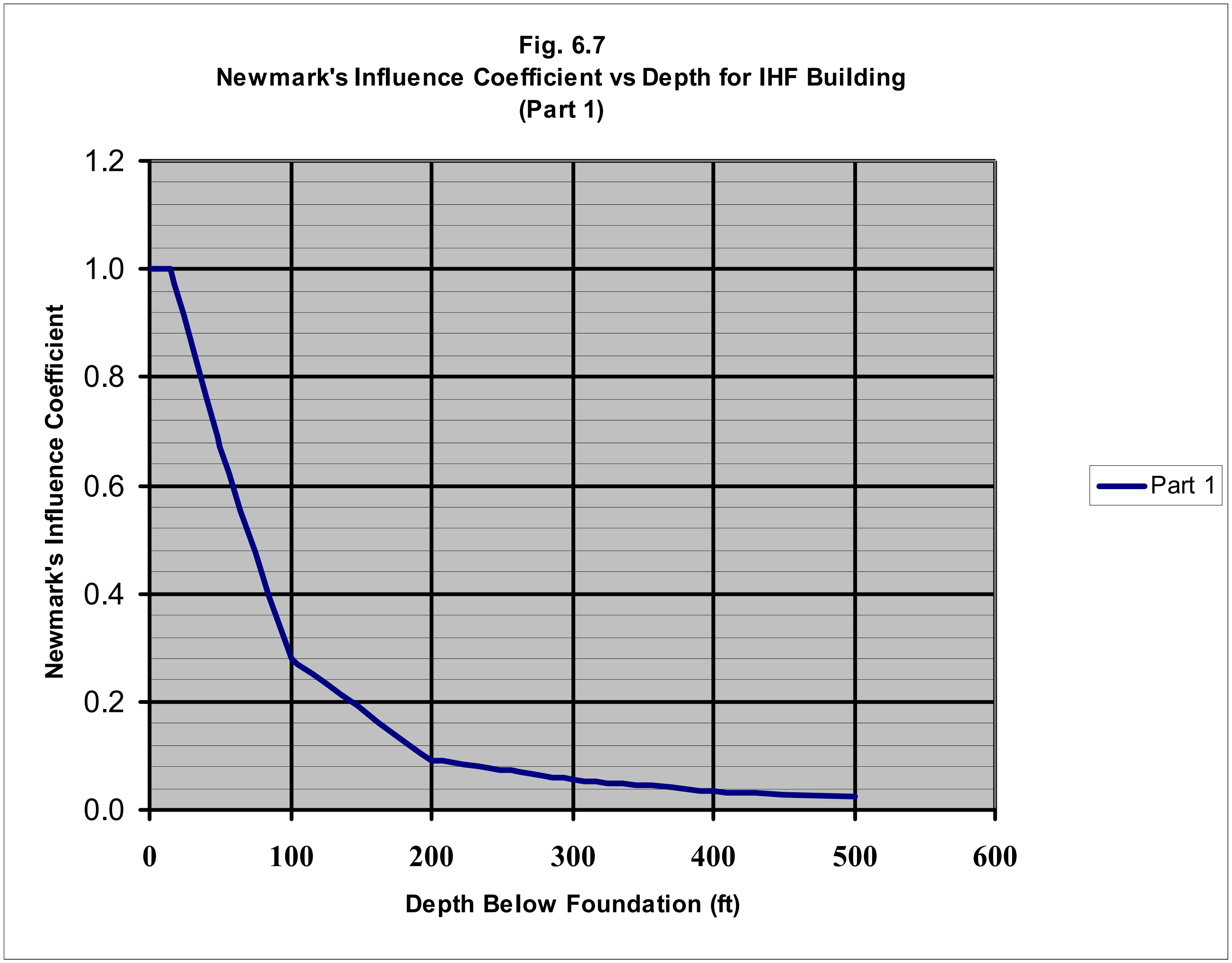


Fig. 6.7
Newmark's Influence Coefficient vs Depth for IHF Building
(Part 1)
Newmark's Influence Coefficient
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
100
200
300
400
500
600
Depth Below Foundation (ft)
Part 1

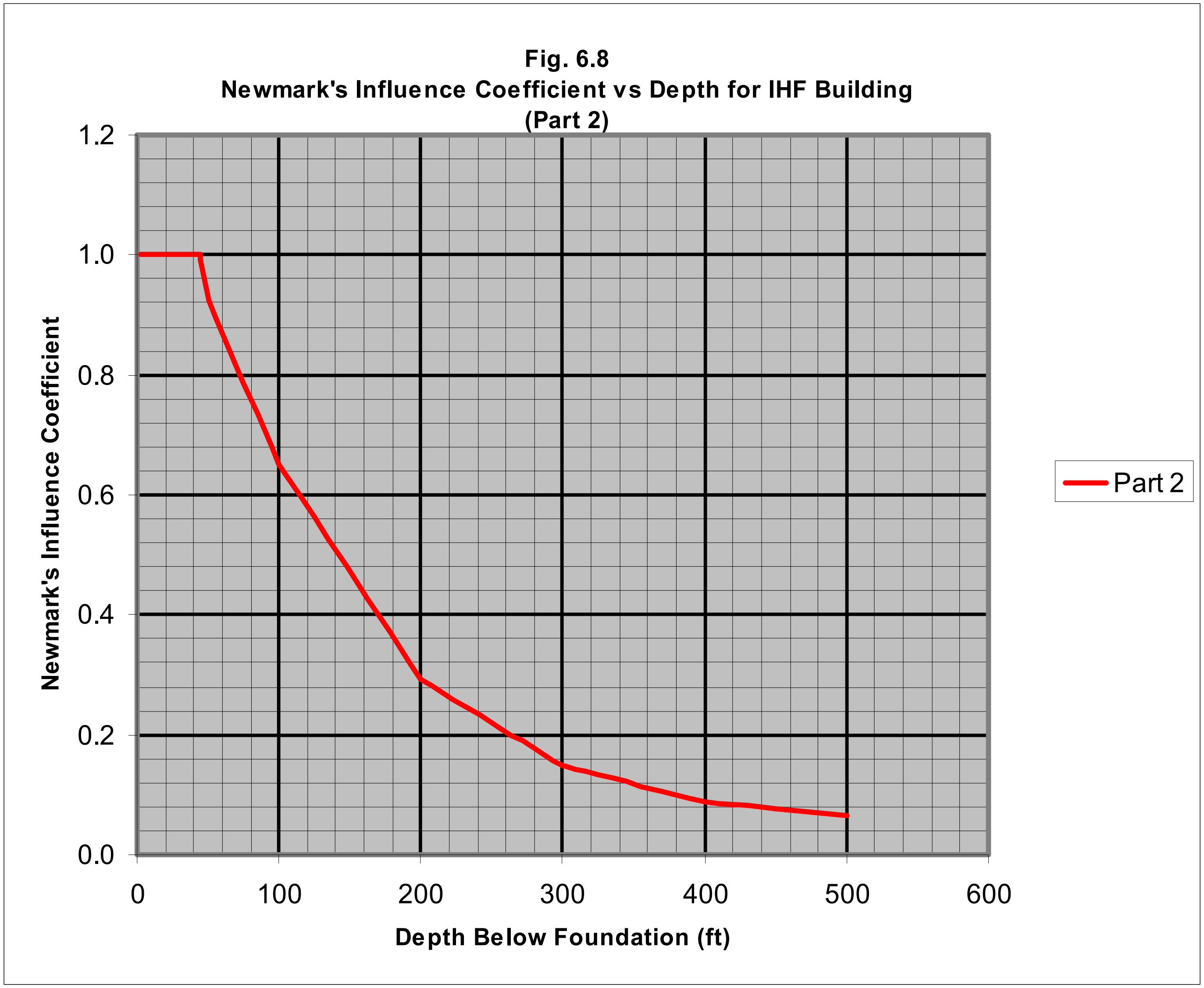


Fig. 6.8
Newmark's Influence Coefficient vs Depth for IHF Building
(Part 2)
Newmark's Influence Coefficient
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
100
200
300
400
500
600
Depth Below Foundation (ft)
Part 2

6.1.2 PART 1 STRUCTURE - SOIL SPRINGS FOR 5E-4 (DBGM-2) SEISMIC EVENT

The following calculations determine translational and rotational springs (Kx,Ky,Kz, Kψx,Kψy and Kψz) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for South 30' alluvium and South 100' alluvium for Lower, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.1.2.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.1) - See Acronyms for symbols G_s and μ

$$G_s := \begin{pmatrix} 6200 \\ 12300 \\ 21600 \\ 4400 \\ 8600 \\ 16800 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.353 \\ 0.349 \\ 0.358 \\ 0.370 \\ 0.372 \\ 0.375 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.1.2.2 Seismic Motion in X Direction (Horizontal)

For seismic loads in the x-direction (141.5' building dimension - See Attachment A page A-2):

$L := 141.5 \cdot ft$ (length of basemat in X direction)

$B := 75 \cdot ft$ (width of basemat perpendicular to X direction)

$$\frac{L}{B} = 1.887$$

for L/B = 1.887 $\beta x := 0.98$ $\beta z := 2.2$ (Ref. 2.2.3, Figure 3.3-3)

$$Kx := \overrightarrow{2 \cdot \left[(1+\mu) \cdot G_s\right] \cdot \beta x \cdot \sqrt{B \cdot L}}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 1.694 \times 10^6 \\ 3.35 \times 10^6 \\ 5.923 \times 10^6 \\ 1.217 \times 10^6 \\ 2.382 \times 10^6 \\ 4.664 \times 10^6 \end{pmatrix} \frac{k}{ft} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.1.2.3 Seismic Motion in Z Direction (Vertical)

$$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta z \cdot \sqrt{B \cdot L}\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 2.172 \times 10^6 \\ 4.282 \times 10^6 \\ 7.625 \times 10^6 \\ 1.583 \times 10^6 \\ 3.104 \times 10^6 \\ 6.092 \times 10^6 \end{pmatrix} \frac{k}{ft} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.1.2.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (75' building dimension):

$L := 75 \cdot ft$ (length of basemat in Y direction)

$B := 141.5 \cdot ft$ (width of basemat perpendicular to Y direction)

$$\frac{L}{B} = 0.53$$

for L/B = 0.53 $\beta x := 1.02$ (Ref. 2.2.3, Figure 3.3-3)

$$Ky := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right]} \cdot \beta x \cdot \sqrt{B \cdot L}$$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 1.763 \times 10^6 \\ 3.487 \times 10^6 \\ 6.164 \times 10^6 \\ 1.267 \times 10^6 \\ 2.48 \times 10^6 \\ 4.855 \times 10^6 \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.2.5 Rocking Motion About X-Axis

$L := 75 \cdot ft$ $B := 141.5 \cdot ft$ $\frac{L}{B} = 0.53$ $\beta\psi := 0.45$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 3.432 \times 10^9 \\ 6.767 \times 10^9 \\ 1.205 \times 10^{10} \\ 2.502 \times 10^9 \\ 4.905 \times 10^9 \\ 9.628 \times 10^9 \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.2.6 Rocking Motion About Y-Axis

$L := 141.5 \cdot ft$ $B := 75 \cdot ft$ $\frac{L}{B} = 1.887$ $\beta\psi := 0.60$ (Ref. 2.2.3, Figure 3.3-3)

(Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 8.634 \times 10^{9} \\ 1.702 \times 10^{10} \\ 3.031 \times 10^{10} \\ 6.293 \times 10^{9} \\ 1.234 \times 10^{10} \\ 2.422 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.2.7 Torsional Motion About Z-Axis

$L := 141.5 \cdot ft$ $\quad B := 75ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25} \qquad R = 61.644\,ft$$

(Table 3.3-3 of Ref. 2.2.3)

$$K\psi z := \overrightarrow{\frac{16 \cdot G_s \cdot R^3}{3}}$$

(Table 3.3-1 of Ref. 2.2.3)

$$K\psi z = \begin{pmatrix} 7.746 \times 10^{9} \\ 1.537 \times 10^{10} \\ 2.698 \times 10^{10} \\ 5.497 \times 10^{9} \\ 1.074 \times 10^{10} \\ 2.099 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.3 PART 1 STRUCTURE - SOIL DAMPING FOR 5E-4 (DBGM-2) SEISMIC EVENT

LEGEND:

Gs = shear modulus of foundation medium (Calculated in Section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat
Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.1, 7.1.2, 7.1.5, & 7.1.6)

Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
βψ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' alluvium and South 100' alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.1.

6.1.3.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 20 of Ref. 2.2.2)

$m_x := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 1.69 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 2.62 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 1.76 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (141.5' building dimension)

$L := 141.5 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 75 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 58.121\ ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Ref. 2.2.5)

$g = 32.174 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 4.255 \times 10^4 \\ 5.975 \times 10^4 \\ 7.971 \times 10^4 \\ 3.629 \times 10^4 \\ 5.082 \times 10^4 \\ 7.118 \times 10^4 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (75' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 4.429 \times 10^4 \\ 6.219 \times 10^4 \\ 8.297 \times 10^4 \\ 3.778 \times 10^4 \\ 5.289 \times 10^4 \\ 7.408 \times 10^4 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 141.5 \cdot ft \qquad B := 75 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}} \qquad R = 58.121\ ft$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 8.051 \times 10^{4} \\ 1.127 \times 10^{5} \\ 1.514 \times 10^{5} \\ 6.965 \times 10^{4} \\ 9.769 \times 10^{4} \\ 1.372 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 141.5 \cdot ft$ $L := 75 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}}$ $R = 50.167\, ft$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi x := \overrightarrow{\left[3(1-\mu) \cdot \frac{Io_{x}}{8 \cdot \rho \cdot R^{5}}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 0.37 \\ 0.372 \\ 0.367 \\ 0.36 \\ 0.359 \\ 0.357 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_{s}}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi x = \begin{pmatrix} 2.83 \times 10^{7} \\ 3.955 \times 10^{7} \\ 5.335 \times 10^{7} \\ 2.466 \times 10^{7} \\ 3.461 \times 10^{7} \\ 4.867 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 75 \cdot ft \qquad L := 141.5 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}} \qquad R = 68.907\,ft$

$B\psi y := \overrightarrow{\left[3(1-\mu)\right] \cdot \frac{Io_y}{8 \cdot \rho \cdot R^5}}$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi y = \begin{pmatrix} 0.117 \\ 0.118 \\ 0.116 \\ 0.114 \\ 0.114 \\ 0.113 \end{pmatrix}$$

$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 1.199 \times 10^8 \\ 1.677 \times 10^8 \\ 2.257 \times 10^8 \\ 1.04 \times 10^8 \\ 1.459 \times 10^8 \\ 2.05 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 141.5 \cdot ft \qquad L := 75 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L \cdot (B^2 + L^2)}{6 \cdot \pi}} \qquad R = 61.644\,ft$

$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2\frac{I_t}{\rho \cdot R^5}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 5.474 \times 10^{7} \\ 7.711 \times 10^{7} \\ 1.022 \times 10^{8} \\ 4.612 \times 10^{7} \\ 6.448 \times 10^{7} \\ 9.012 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.3.2 Critical Damping

$Cc := 2 \cdot \sqrt{k \cdot m}$ $\quad Cc\psi := 2 \cdot \sqrt{k\psi \cdot Io}$ (Eq. 1.13 of Ref. 2.2.8 on Page 18)

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for I_{ox}, I_{oy} and I_t is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

A) Seismic Motion in X Direction (Horizontal) $Ccx := 2\sqrt{Kx \cdot m_x}$

$$Ccx = \begin{pmatrix} 8.248 \times 10^{4} \\ 1.16 \times 10^{5} \\ 1.542 \times 10^{5} \\ 6.991 \times 10^{4} \\ 9.782 \times 10^{4} \\ 1.369 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seimic Motion in Y Direction (Horizontal) $Ccy := 2\sqrt{Ky \cdot m_y}$

$$Ccy = \begin{pmatrix} 8.414 \times 10^{4} \\ 1.183 \times 10^{5} \\ 1.573 \times 10^{5} \\ 7.133 \times 10^{4} \\ 9.979 \times 10^{4} \\ 1.396 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical) $Ccz := 2\sqrt{Kz \cdot m_z}$

$$Ccz = \begin{pmatrix} 9.339 \times 10^4 \\ 1.311 \times 10^5 \\ 1.75 \times 10^5 \\ 7.973 \times 10^4 \\ 1.116 \times 10^5 \\ 1.564 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis $C c\psi x := 2\sqrt{K\psi x \cdot Io_x}$

$$C c\psi x = \begin{pmatrix} 1.523 \times 10^8 \\ 2.139 \times 10^8 \\ 2.854 \times 10^8 \\ 1.3 \times 10^8 \\ 1.821 \times 10^8 \\ 2.551 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis $C c\psi y := 2\sqrt{K\psi y \cdot Io_y}$

$$C c\psi y = \begin{pmatrix} 3.008 \times 10^8 \\ 4.224 \times 10^8 \\ 5.636 \times 10^8 \\ 2.568 \times 10^8 \\ 3.596 \times 10^8 \\ 5.038 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis $Cct := 2\sqrt{K\psi z \cdot I_t}$

$$Cct = \begin{pmatrix} 2.335 \times 10^8 \\ 3.289 \times 10^8 \\ 4.359 \times 10^8 \\ 1.967 \times 10^8 \\ 2.75 \times 10^8 \\ 3.844 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.3.3 Damping Ratios: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 0.516 \\ 0.515 \\ 0.517 \\ 0.519 \\ 0.52 \\ 0.52 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

51.5%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 0.526 \\ 0.526 \\ 0.527 \\ 0.53 \\ 0.53 \\ 0.531 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

52.6%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 0.862 \\ 0.859 \\ 0.865 \\ 0.874 \\ 0.875 \\ 0.877 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

85.9%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 0.186 \\ 0.185 \\ 0.187 \\ 0.19 \\ 0.19 \\ 0.191 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

18.5%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 0.399 \\ 0.397 \\ 0.4 \\ 0.405 \\ 0.406 \\ 0.407 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

39.7%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

23.4%

6.1.4 PART 1 STRUCTURE - SOIL SPRINGS FOR 1E-4 (BDBGM) SEISMIC EVENT

The following calculations determine translational and rotational springs (Kx,Ky,Kz, $K\psi x$,$K\psi y$ and $K\psi z$) per ASCE 4-98 (Ref. 2.2.3) Section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) Section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower , Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.1.4.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.3)

$$G_s := \begin{pmatrix} 4300 \\ 8300 \\ 15700 \\ 2900 \\ 5700 \\ 11300 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.382 \\ 0.381 \\ 0.382 \\ 0.393 \\ 0.393 \\ 0.393 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.1.4.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the x-direction (141.5' building dimension):

$L := 141.5 \cdot ft$ (length of basemat in X Direction)

$B := 75 \cdot ft$ (width of basemat perpendicular to X Direction)

$$\frac{L}{B} = 1.887$$

for L/B = 1.887 $\beta x := 0.98$ $\beta z := 2.20$ (Ref. 2.2.3, Figure 3.3-3)

$$Kx := \overrightarrow{\left[2\cdot(1+\mu)\cdot G_s\cdot \beta x\cdot\sqrt{B\cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 1.2\times10^{6} \\ 2.314\times10^{6} \\ 4.381\times10^{6} \\ 8.157\times10^{5} \\ 1.603\times10^{6} \\ 3.178\times10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.4.3 Seismic Motion in Z Direction (Vertical)

$$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot \beta z\cdot\sqrt{B\cdot L}\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 1.577\times10^{6} \\ 3.039\times10^{6} \\ 5.758\times10^{6} \\ 1.083\times10^{6} \\ 2.128\times10^{6} \\ 4.219\times10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.4.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (75' building dimension):

$L := 75\cdot ft$ (length of basemat in Y Direction)

$B := 141.5\cdot ft$ (width of basemat perpendicular to Y Direction)

$$\frac{L}{B} = 0.53$$

for L/B = 0.53 $\beta x := 1.02$ (Ref. 2.2.3, Figure 3.3-3)

$$Ky := \overrightarrow{\left[2\cdot(1+\mu)\cdot G_s\cdot \beta x\cdot\sqrt{B\cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 1.249\times10^{6} \\ 2.409\times10^{6} \\ 4.56\times10^{6} \\ 8.49\times10^{5} \\ 1.669\times10^{6} \\ 3.308\times10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.4.5 Rocking Motion About X-Axis

$L := 75\cdot ft$ $B := 141.5\cdot ft$ $\frac{L}{B} = 0.53$ $\beta\psi := 0.45$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot\beta\psi\cdot B\cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 2.492\times10^{9} \\ 4.803\times10^{9} \\ 9.099\times10^{9} \\ 1.711\times10^{9} \\ 3.363\times10^{9} \\ 6.668\times10^{9} \end{pmatrix}\frac{ft\cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.4.6 Rocking Motion About Y-Axis

$L := 141.5\cdot ft$ $B := 75\cdot ft$ $\frac{L}{B} = 1.887$ $\beta\psi := 0.60$ (Ref. 2.2.3, Figure 3.3-3)

(Ref. 2.2.3, Table 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot\beta\psi\cdot B\cdot L^2\right)}$$

$$K\psi y = \begin{pmatrix} 6.269 \times 10^{9} \\ 1.208 \times 10^{10} \\ 2.289 \times 10^{10} \\ 4.305 \times 10^{9} \\ 8.461 \times 10^{9} \\ 1.677 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.4.7 Torsional Motion About Z-Axis

$L := 141.5 \cdot ft \qquad B := 75ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25} \qquad R = 61.644\,ft$$

(Ref. 2.2.3, Table 3.3-3)

$$K\psi z := \overrightarrow{\frac{\left(16 \cdot G_s \cdot R^3\right)}{3}}$$

(Ref. 2.2.3, Table 3.3-1)

$$K\psi z = \begin{pmatrix} 5.372 \times 10^{9} \\ 1.037 \times 10^{10} \\ 1.961 \times 10^{10} \\ 3.623 \times 10^{9} \\ 7.121 \times 10^{9} \\ 1.412 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.5 PART 1 STRUCTURE - SOIL DAMPING FOR 1E-4 (BDBGM) SEISMIC EVENT

LEGEND:

Gs = shear modulus of foundation medium (Calculated in section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat
Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.1, 7.1.2, 7.1.5 & 7.1.6)

Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.1.

6.1.5.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 20 of Ref. 2.2.2)

$m_x := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 1.69 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 2.62 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 1.76 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (141.5' building dimension)

$L := 141.5 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 75 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 58.121\ ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Ref. 2.2.5)

$g = 32.174 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 3.619 \times 10^{4} \\ 5.025 \times 10^{4} \\ 6.916 \times 10^{4} \\ 2.996 \times 10^{4} \\ 4.2 \times 10^{4} \\ 5.914 \times 10^{4} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (75' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 3.767 \times 10^{4} \\ 5.23 \times 10^{4} \\ 7.198 \times 10^{4} \\ 3.118 \times 10^{4} \\ 4.372 \times 10^{4} \\ 6.155 \times 10^{4} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 141.5 \cdot ft \quad B := 75 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 58.121\,ft$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 7.019 \times 10^{4} \\ 9.737 \times 10^{4} \\ 1.341 \times 10^{5} \\ 5.869 \times 10^{4} \\ 8.228 \times 10^{4} \\ 1.159 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 141.5 \cdot ft$ $L := 75 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}}$ $R = 50.167\,ft$ (Ref. 2.2.3, Table 3.3-3)

$B\psi x := \overrightarrow{[3(1-\mu)]} \cdot \frac{Io_x}{8 \cdot \rho \cdot R^5}$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 0.353 \\ 0.354 \\ 0.353 \\ 0.347 \\ 0.347 \\ 0.347 \end{pmatrix}$$

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$

$$C\psi x = \begin{pmatrix} 2.498 \times 10^{7} \\ 3.463 \times 10^{7} \\ 4.772 \times 10^{7} \\ 2.098 \times 10^{7} \\ 2.941 \times 10^{7} \\ 4.141 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 75 \cdot ft \qquad L := 141.5 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}} \qquad R = 68.907\,ft$

$B\psi y := \overrightarrow{[3(1-\mu)] \cdot \frac{Io_y}{8 \cdot \rho \cdot R^5}}$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 0.112 \\ 0.112 \\ 0.112 \\ 0.11 \\ 0.11 \\ 0.11 \end{pmatrix}$$

$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 1.05 \times 10^8 \\ 1.456 \times 10^8 \\ 2.007 \times 10^8 \\ 8.796 \times 10^7 \\ 1.233 \times 10^8 \\ 1.736 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 141.5 \cdot ft \qquad L := 75 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L \cdot (B^2 + L^2)}{6 \cdot \pi}} \qquad R = 61.644\,ft$

$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2\frac{I_t}{\rho \cdot R^5}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 4.559 \times 10^{7} \\ 6.334 \times 10^{7} \\ 8.712 \times 10^{7} \\ 3.744 \times 10^{7} \\ 5.249 \times 10^{7} \\ 7.391 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.5.2 Critical Damping

$Cc := 2 \cdot \sqrt{k \cdot m}$ Eq. 1.13 (page 18) of Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

A) Seismic Motion in X Direction (Horizontal) $Ccx := 2\sqrt{Kx \cdot m_x}$

$$Ccx = \begin{pmatrix} 6.942 \times 10^{4} \\ 9.641 \times 10^{4} \\ 1.326 \times 10^{5} \\ 5.723 \times 10^{4} \\ 8.024 \times 10^{4} \\ 1.13 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal) $Ccy := 2\sqrt{Ky \cdot m_y}$

$$Ccy = \begin{pmatrix} 7.082 \times 10^{4} \\ 9.836 \times 10^{4} \\ 1.353 \times 10^{5} \\ 5.839 \times 10^{4} \\ 8.186 \times 10^{4} \\ 1.153 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 7.958 \times 10^4 \\ 1.105 \times 10^5 \\ 1.521 \times 10^5 \\ 6.594 \times 10^4 \\ 9.245 \times 10^4 \\ 1.302 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$Cc\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$Cc\psi x = \begin{pmatrix} 1.298 \times 10^8 \\ 1.802 \times 10^8 \\ 2.48 \times 10^8 \\ 1.076 \times 10^8 \\ 1.508 \times 10^8 \\ 2.123 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$Cc\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$Cc\psi y = \begin{pmatrix} 2.563 \times 10^8 \\ 3.558 \times 10^8 \\ 4.898 \times 10^8 \\ 2.124 \times 10^8 \\ 2.978 \times 10^8 \\ 4.193 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.945 \times 10^{8} \\ 2.702 \times 10^{8} \\ 3.716 \times 10^{8} \\ 1.597 \times 10^{8} \\ 2.239 \times 10^{8} \\ 3.153 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.5.3 Damping Ratios; C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 0.521 \\ 0.521 \\ 0.521 \\ 0.523 \\ 0.523 \\ 0.523 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

52.1%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 0.532 \\ 0.532 \\ 0.532 \\ 0.534 \\ 0.534 \\ 0.534 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

53.2%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 0.882 \\ 0.881 \\ 0.882 \\ 0.89 \\ 0.89 \\ 0.89 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

88.1%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 0.192 \\ 0.192 \\ 0.192 \\ 0.195 \\ 0.195 \\ 0.195 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

19.2%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 0.41 \\ 0.409 \\ 0.41 \\ 0.414 \\ 0.414 \\ 0.414 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

40.9%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \\ 0.234 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

23.4%

6.1.6 PART 2 STRUCTURE - SOIL SPRINGS FOR 5E-4 (DBGM-2) SEISMIC EVENT

The following calculations determine translational and rotational springs (Kx,Ky,Kz, $K\psi$x,$K\psi$y and $K\psi z$) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.1.6.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.2)

$$G_s := \begin{pmatrix} 9400 \\ 17200 \\ 31000 \\ 6400 \\ 12300 \\ 23400 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.318 \\ 0.312 \\ 0.306 \\ 0.342 \\ 0.342 \\ 0.345 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.1.6.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the x-direction (170' building dimension):

$L := 170 \cdot ft$ (length of basemat in X direction)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to X direction)

$$\frac{L}{B} = 8.651 \times 10^{-1}$$

for L/B = 0.865 $\beta x := 0.95$ $\beta z := 2.15$ (Ref. 2.2.3, Figure 3.3-3)

$$Kx := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right] \cdot \beta x \cdot \sqrt{B \cdot L}}$$ (Ref. 2.2.3, Table 3.3-3)

$$\overrightarrow{Kx} = \begin{pmatrix} 4.302 \times 10^{6} \\ 7.836 \times 10^{6} \\ 1.406 \times 10^{7} \\ 2.983 \times 10^{6} \\ 5.732 \times 10^{6} \\ 1.093 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.6.3 Seismic Motion in Z Direction (Vertical)

$$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta z \cdot \sqrt{B \cdot L}\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 5.416 \times 10^{6} \\ 9.824 \times 10^{6} \\ 1.755 \times 10^{7} \\ 3.822 \times 10^{6} \\ 7.346 \times 10^{6} \\ 1.404 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.6.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (196.5' building dimension):

$L := 196.5 \cdot ft$ (length of basemat in Y direction)

$B := 170 \cdot ft$ (width of basemat perpendicular to Y direction)

$$\frac{L}{B} = 1.156 \times 10^{0}$$

for L/B = 1.156 $\beta x := 1.0$ (Ref. 2.2.3, Figure 3.3-3)

$$Ky := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right] \cdot \beta x \cdot \sqrt{B \cdot L}}$$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 4.529 \times 10^{6} \\ 8.249 \times 10^{6} \\ 1.48 \times 10^{7} \\ 3.14 \times 10^{6} \\ 6.034 \times 10^{6} \\ 1.15 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.6.5 Rocking Motion About X-Axis

$L := 196.5 \cdot ft \quad B := 170 \cdot ft \qquad \frac{L}{B} = 1.156 \times 10^{0} \qquad \beta\psi := 0.53$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 4.795 \times 10^{10} \\ 8.697 \times 10^{10} \\ 1.554 \times 10^{11} \\ 3.384 \times 10^{10} \\ 6.503 \times 10^{10} \\ 1.243 \times 10^{11} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.6.6 Rocking Motion About Y-Axis

$L := 170 \cdot ft \quad B := 196.5 \cdot ft \qquad \frac{L}{B} = 8.651 \times 10^{-1} \qquad \beta\psi := 0.49$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 3.835 \times 10^{10} \\ 6.957 \times 10^{10} \\ 1.243 \times 10^{11} \\ 2.707 \times 10^{10} \\ 5.202 \times 10^{10} \\ 9.941 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.6.7 Torsional Motion About Z-Axis

$L := 170 \cdot ft \qquad B := 196.5ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25} \qquad R = 1.046 \times 10^2 \, ft$$ (Ref. 2.2.3, & Table 3.3-3)

$$K\psi z := \overrightarrow{\frac{16 \cdot G_s \cdot R^3}{3}}$$ (Ref. 2.2.3, & Table 3.3-1)

$$K\psi z = \begin{pmatrix} 5.735 \times 10^{10} \\ 1.049 \times 10^{11} \\ 1.891 \times 10^{11} \\ 3.905 \times 10^{10} \\ 7.505 \times 10^{10} \\ 1.428 \times 10^{11} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.7 PART 2 STRUCTURE - SOIL DAMPING FOR 5E-4 (DBGM-2) SEISMIC EVENT

LEGEND:

Gs = shear modulus of foundation medium (Calculated in Section 6.1.1)
R = equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat

Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base

kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.3, 7.1.4, 7.1.7 & 7.1.8)
Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in table 7.2.2.

6.1.7.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000
(Page 37 of Ref. 2.2.2)

$m_x := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 7.61 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 6.38 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 8.58 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the X-direction (170' building dimension)

$L := 170 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 1.031 \times 10^2 \, ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Page 13 of Ref. 2.2.5)

$g = 3.217 \times 10^1 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 1.557 \times 10^5 \\ 2.097 \times 10^5 \\ 2.802 \times 10^5 \\ 1.308 \times 10^5 \\ 1.814 \times 10^5 \\ 2.507 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the Y-direction (196.5' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$

(Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 1.639 \times 10^5 \\ 2.207 \times 10^5 \\ 2.95 \times 10^5 \\ 1.377 \times 10^5 \\ 1.909 \times 10^5 \\ 2.639 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 170 \cdot ft$ $\quad B := 196.5 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $\quad R = 1.031 \times 10^2 \, ft$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 2.893 \times 10^{5} \\ 3.879 \times 10^{5} \\ 5.163 \times 10^{5} \\ 2.474 \times 10^{5} \\ 3.43 \times 10^{5} \\ 4.753 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 170 \cdot ft$ $L := 196.5 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}}$ $R = 1.082 \times 10^{2}\ ft$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi x := \overrightarrow{\left[3(1-\mu)\cdot\frac{Io_{x}}{8 \cdot \rho \cdot R^{5}}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 3.766 \times 10^{-2} \\ 3.799 \times 10^{-2} \\ 3.833 \times 10^{-2} \\ 3.634 \times 10^{-2} \\ 3.634 \times 10^{-2} \\ 3.617 \times 10^{-2} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_{s}}}\right)}$$

$$C\psi x = \begin{pmatrix} 9.138 \times 10^{8} \\ 1.225 \times 10^{9} \\ 1.63 \times 10^{9} \\ 7.825 \times 10^{8} \\ 1.085 \times 10^{9} \\ 1.503 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 196.5 \cdot ft \quad L := 170 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}} \qquad R = 1.006 \times 10^{2}\, ft$

$$B\psi y := \overrightarrow{[3(1-\mu)] \cdot \frac{Io_y}{8 \cdot \rho \cdot R^{5}}}$$

(Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 4.536 \times 10^{-2} \\ 4.576 \times 10^{-2} \\ 4.615 \times 10^{-2} \\ 4.376 \times 10^{-2} \\ 4.376 \times 10^{-2} \\ 4.356 \times 10^{-2} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 6.748 \times 10^{8} \\ 9.045 \times 10^{8} \\ 1.203 \times 10^{9} \\ 5.78 \times 10^{8} \\ 8.013 \times 10^{8} \\ 1.11 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 170 \cdot ft$ $L := 196.5 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L \cdot (B^2 + L^2)}{6 \cdot \pi}}$ $R = 1.046 \times 10^{2}\ ft$

$$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2 \frac{I_t}{\rho \cdot R^5}} \right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 5.036 \times 10^{8} \\ 6.813 \times 10^{8} \\ 9.146 \times 10^{8} \\ 4.156 \times 10^{8} \\ 5.761 \times 10^{8} \\ 7.946 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.7.2 Critical Damping

$Cc := 2\cdot\sqrt{k\cdot m}$ eq. 1.13, Introduction to Structural Dynamics, Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

A) Seismic Motion in X Direction (Horizontal)

$Ccx := 2\sqrt{Kx\cdot m_x}$

$$Ccx = \begin{pmatrix} 1.741\times10^5 \\ 2.349\times10^5 \\ 3.147\times10^5 \\ 1.449\times10^5 \\ 2.009\times10^5 \\ 2.775\times10^5 \end{pmatrix}\frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

$Ccy := 2\sqrt{Ky\cdot m_y}$

$$Ccy = \begin{pmatrix} 1.786\times10^5 \\ 2.411\times10^5 \\ 3.229\times10^5 \\ 1.487\times10^5 \\ 2.062\times10^5 \\ 2.847\times10^5 \end{pmatrix}\frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 1.953 \times 10^5 \\ 2.631 \times 10^5 \\ 3.516 \times 10^5 \\ 1.641 \times 10^5 \\ 2.275 \times 10^5 \\ 3.145 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$Cc\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$Cc\psi x = \begin{pmatrix} 1.208 \times 10^9 \\ 1.627 \times 10^9 \\ 2.175 \times 10^9 \\ 1.015 \times 10^9 \\ 1.407 \times 10^9 \\ 1.945 \times 10^9 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$Cc\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$Cc\psi y = \begin{pmatrix} 9.893 \times 10^8 \\ 1.332 \times 10^9 \\ 1.781 \times 10^9 \\ 8.311 \times 10^8 \\ 1.152 \times 10^9 \\ 1.593 \times 10^9 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.403 \times 10^{9} \\ 1.898 \times 10^{9} \\ 2.548 \times 10^{9} \\ 1.158 \times 10^{9} \\ 1.605 \times 10^{9} \\ 2.214 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.7.3 Damping Ratio: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 8.946 \times 10^{-1} \\ 8.925 \times 10^{-1} \\ 8.905 \times 10^{-1} \\ 9.027 \times 10^{-1} \\ 9.027 \times 10^{-1} \\ 9.037 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

89.1%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 9.178 \times 10^{-1} \\ 9.157 \times 10^{-1} \\ 9.136 \times 10^{-1} \\ 9.261 \times 10^{-1} \\ 9.261 \times 10^{-1} \\ 9.271 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

91.4%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 1.481 \times 10^{0} \\ 1.475 \times 10^{0} \\ 1.468 \times 10^{0} \\ 1.508 \times 10^{0} \\ 1.508 \times 10^{0} \\ 1.511 \times 10^{0} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

146.8%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 7.563 \times 10^{-1} \\ 7.528 \times 10^{-1} \\ 7.493 \times 10^{-1} \\ 7.71 \times 10^{-1} \\ 7.71 \times 10^{-1} \\ 7.729 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

74.9%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 6.821 \times 10^{-1} \\ 6.788 \times 10^{-1} \\ 6.756 \times 10^{-1} \\ 6.955 \times 10^{-1} \\ 6.955 \times 10^{-1} \\ 6.972 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

67.5%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

35.9%

6.1.8 PART 2 STRUCTURE - SOIL SPRINGS FOR 1E-4 (BDBGM) SEISMIC EVENT

The following calculations determine translational and rotational springs (Kx,Ky,Kz, Kψx,Kψy and Kψz) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for Souh 30' depth of alluvium and So 100' depth of alluvium for Lower , Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.1.8.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.4)

$$G_s := \begin{pmatrix} 6800 \\ 12600 \\ 23300 \\ 4200 \\ 8200 \\ 15900 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.352 \\ 0.348 \\ 0.344 \\ 0.381 \\ 0.382 \\ 0.383 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the X-direction (170' building dimension):

$L := 170 \cdot ft$ (length of basemat in X direction)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to X direction)

$\frac{L}{B} = 8.651 \times 10^{-1}$

for L/B = 0.865 $\beta x := 0.95$ $\beta z := 2.15$ (Ref. 2.2.3, Figure 3.3-3)

$Kx := \overrightarrow{\left[2 \cdot (1+\mu) \cdot G_s \cdot \beta x \cdot \sqrt{B \cdot L}\right]}$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 3.193 \times 10^{6} \\ 5.898 \times 10^{6} \\ 1.087 \times 10^{7} \\ 2.014 \times 10^{6} \\ 3.935 \times 10^{6} \\ 7.636 \times 10^{6} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.3 Seismic Motion in Z Direction (Vertical)

$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta z \cdot \sqrt{B \cdot L}\right)}$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 4.124 \times 10^{6} \\ 7.594 \times 10^{6} \\ 1.396 \times 10^{7} \\ 2.666 \times 10^{6} \\ 5.214 \times 10^{6} \\ 1.013 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (170' building dimension):

$L := 196.5 \cdot ft$ (length of basemat in Y direction)

$B := 170 \cdot ft$ (width of basemat perpendicular to Y direction)

$$\frac{L}{B} = 1.156 \times 10^{0}$$

for L/B = 1.156 $\beta x := 1.0$ (Ref. 2.2.3, Figure 3.3-3)

$$Ky := \overrightarrow{\left[2 \cdot (1+\mu) \cdot G_s \cdot \beta x \cdot \sqrt{B \cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 3.361 \times 10^{6} \\ 6.209 \times 10^{6} \\ 1.145 \times 10^{7} \\ 2.12 \times 10^{6} \\ 4.142 \times 10^{6} \\ 8.038 \times 10^{6} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.5 Rocking Motion About X-Axis

$L := 196.5 \cdot ft$ $B := 170 \cdot ft$ $\frac{L}{B} = 1.156 \times 10^{0}$ $\beta\psi := 0.53$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 3.651\times10^{10} \\ 6.723\times10^{10} \\ 1.236\times10^{11} \\ 2.361\times10^{10} \\ 4.616\times10^{10} \\ 8.965\times10^{10} \end{pmatrix} \frac{ft\cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.6 Rocking Motion About Y-Axis

$L := 170\cdot ft$ $\quad B := 196.5\cdot ft$ $\quad \frac{L}{B} = 8.651\times10^{-1}$ $\quad \beta\psi := 0.49$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot\beta\psi\cdot B\cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 2.92\times10^{10} \\ 5.377\times10^{10} \\ 9.883\times10^{10} \\ 1.888\times10^{10} \\ 3.692\times10^{10} \\ 7.171\times10^{10} \end{pmatrix} \frac{ft\cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.8.7 Torsional Motion About Z-Axis

$L := 170\cdot ft$ $\quad B := 196.5ft$

$$R := \left[\frac{(B\cdot L)\cdot\left(B^2+L^2\right)}{6\cdot\pi}\right]^{.25}$$ $R = 1.046\times10^2\,ft$ (Ref. 2.2.3, & Table 3.3-3)

$$K\psi z := \frac{\overrightarrow{\left(16\cdot G_s\cdot R^3\right)}}{3}$$ (Ref. 2.2.3, & Table 3.3-1)

$$K\psi z = \begin{pmatrix} 4.149 \times 10^{10} \\ 7.688 \times 10^{10} \\ 1.422 \times 10^{11} \\ 2.563 \times 10^{10} \\ 5.003 \times 10^{10} \\ 9.701 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.9 PART 2 STRUCTURE - SOIL DAMPING FOR 1E-4 (BDBGM) SEISMIC EVENT

LEGEND:

Gs = shear modulus of foundation medium (Calculated in section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat

Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base

kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.3, 7.1.4, 7.1.7 & 7.1.8)
Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.2.

6.1.9.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) Methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 37 of Ref. 2.2.2)

$m_x := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1761 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 7.61 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 6.38 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 8.58 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (170' building dimension)

$L := 170 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 1.031 \times 10^2 \, ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Page 13 or Ref. 2.2.5)

$g = 3.217 \times 10^1 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 1.359 \times 10^5 \\ 1.844 \times 10^5 \\ 2.5 \times 10^5 \\ 1.091 \times 10^5 \\ 1.525 \times 10^5 \\ 2.125 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (170' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 1.43 \times 10^5 \\ 1.941 \times 10^5 \\ 2.632 \times 10^5 \\ 1.148 \times 10^5 \\ 1.605 \times 10^5 \\ 2.237 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 170 \cdot ft \qquad B := 196.5 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}} \qquad R = 1.031 \times 10^{2}\, ft$ (Ref. 2.2.3, Table 3.3-3)

$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 2.59 \times 10^{5} \\ 3.504 \times 10^{5} \\ 4.735 \times 10^{5} \\ 2.131 \times 10^{5} \\ 2.982 \times 10^{5} \\ 4.159 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

D) Rocking Motion About X-Axis

$B := 170 \cdot ft \qquad L := 196.5 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}} \qquad R = 1.082 \times 10^{2}\, ft$ (Ref. 2.2.3, Table 3.3-3)

$B\psi x := \overrightarrow{[3(1 - \mu)]} \cdot \frac{Io_x}{8 \cdot \rho \cdot R^{5}}$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 3.579 \times 10^{-2} \\ 3.601 \times 10^{-2} \\ 3.623 \times 10^{-2} \\ 3.418 \times 10^{-2} \\ 3.413 \times 10^{-2} \\ 3.407 \times 10^{-2} \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$

$$C\psi x = \begin{pmatrix} 8.195 \times 10^{8} \\ 1.108 \times 10^{9} \\ 1.498 \times 10^{9} \\ 6.752 \times 10^{8} \\ 9.451 \times 10^{8} \\ 1.318 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 196.5 \cdot ft$ $\quad L := 170 \cdot ft$ $\quad R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}}$ $\quad R = 1.006 \times 10^{2}\, ft$

$$B\psi y := 3(1 - \mu) \cdot \frac{Io_y}{8 \cdot \rho \cdot R^5}$$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 4.31 \times 10^{-2} \\ 4.336 \times 10^{-2} \\ 4.363 \times 10^{-2} \\ 4.117 \times 10^{-2} \\ 4.11 \times 10^{-2} \\ 4.103 \times 10^{-2} \end{pmatrix}$$

$$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 6.054\times10^{8} \\ 8.188\times10^{8} \\ 1.106\times10^{9} \\ 4.99\times10^{8} \\ 6.984\times10^{8} \\ 9.741\times10^{8} \end{pmatrix}\frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 170\cdot ft$ $\quad L := 196.5\cdot ft$ $\quad R := \sqrt[4]{\frac{B\cdot L\cdot\left(B^2+L^2\right)}{6\cdot\pi}}$ $\quad R = 1.046\times10^{2}\ ft$

$$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z\cdot I_t}}{1+2\frac{I_t}{\rho\cdot R^5}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 4.284\times10^{8} \\ 5.831\times10^{8} \\ 7.929\times10^{8} \\ 3.367\times10^{8} \\ 4.704\times10^{8} \\ 6.55\times10^{8} \end{pmatrix}\frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.9.2 Critical Damping

$Cc := 2\cdot\sqrt{k\cdot m}$ eq. 1.13, Introduction to Structural Dynamics, Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

A) Seismic Motion in X Direction (Horizontal)

$$Ccx := 2\sqrt{Kx \cdot m_x}$$

$$Ccx = \begin{pmatrix} 1.5\times10^5 \\ 2.038\times10^5 \\ 2.768\times10^5 \\ 1.191\times10^5 \\ 1.665\times10^5 \\ 2.319\times10^5 \end{pmatrix} \frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

$$Ccy := 2\sqrt{Ky \cdot m_y}$$

$$Ccy = \begin{pmatrix} 1.539\times10^5 \\ 2.091\times10^5 \\ 2.84\times10^5 \\ 1.222\times10^5 \\ 1.708\times10^5 \\ 2.38\times10^5 \end{pmatrix} \frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 1.704\times10^5 \\ 2.313\times10^5 \\ 3.136\times10^5 \\ 1.37\times10^5 \\ 1.916\times10^5 \\ 2.671\times10^5 \end{pmatrix} \frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$C c\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$C c\psi x = \begin{pmatrix} 1.054 \times 10^{9} \\ 1.431 \times 10^{9} \\ 1.939 \times 10^{9} \\ 8.477 \times 10^{8} \\ 1.185 \times 10^{9} \\ 1.652 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$C c\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$C c\psi y = \begin{pmatrix} 8.632 \times 10^{8} \\ 1.171 \times 10^{9} \\ 1.588 \times 10^{9} \\ 6.941 \times 10^{8} \\ 9.707 \times 10^{8} \\ 1.353 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.193 \times 10^{9} \\ 1.624 \times 10^{9} \\ 2.209 \times 10^{9} \\ 9.378 \times 10^{8} \\ 1.31 \times 10^{9} \\ 1.825 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.1.9.3 Damping Ratios: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 9.06 \times 10^{-1} \\ 9.047 \times 10^{-1} \\ 9.033 \times 10^{-1} \\ 9.157 \times 10^{-1} \\ 9.16 \times 10^{-1} \\ 9.163 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

90.3%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 9.296 \times 10^{-1} \\ 9.282 \times 10^{-1} \\ 9.268 \times 10^{-1} \\ 9.395 \times 10^{-1} \\ 9.398 \times 10^{-1} \\ 9.402 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

92.7%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 1.519 \times 10^{0} \\ 1.515 \times 10^{0} \\ 1.51 \times 10^{0} \\ 1.555 \times 10^{0} \\ 1.556 \times 10^{0} \\ 1.557 \times 10^{0} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

151.0%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 7.773 \times 10^{-1} \\ 7.748 \times 10^{-1} \\ 7.723 \times 10^{-1} \\ 7.966 \times 10^{-1} \\ 7.973 \times 10^{-1} \\ 7.979 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

77.2%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 7.013 \times 10^{-1} \\ 6.989 \times 10^{-1} \\ 6.966 \times 10^{-1} \\ 7.188 \times 10^{-1} \\ 7.195 \times 10^{-1} \\ 7.201 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

69.7%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \\ 3.59 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

35.9%

As stated in Section 4.3.2, the Mass Properties calculation (Ref. 2.2.2) has been revised resulting in changes to the damping calculations. Section 6.2 provides revisions to the damping values using the new mass properties. Note that Sections 6.2 through 6.2.1.7 are duplicates of Sections 6.1.2 through 6.1.2.7. This was done for ease of calculating the new values for the updated data.

6.2 SOIL SPRINGS AND DAMPING FOR 5E-4 (DBGM-2) AND 1E-4 (BDBGM) SEISMIC EVENTS (Revised)

6.2.1 PART 1 STRUCTURE - SOIL SPRINGS FOR 5E-4 (DBGM-2) SEISMIC EVENT (Revised)

The following calculations determine translational and rotational springs (Kx,Ky,Kz, Kψx,Kψy and Kψz) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for South 30' alluvium and South 100' alluvium for Lower, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.2.1.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.1) - See Acronyms for symbols G_s and μ

$$G_s := \begin{pmatrix} 6200 \\ 12300 \\ 21600 \\ 4400 \\ 8600 \\ 16800 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.353 \\ 0.349 \\ 0.358 \\ 0.370 \\ 0.372 \\ 0.375 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.2.1.2 Seismic Motion in X Direction (Horizontal)

For seismic loads in the x-direction (141.5' building dimension - See Attachment A page A-2):

$L := 141.5 \cdot ft$ (length of basemat in X direction)

$B := 75 \cdot ft$ (width of basemat perpendicular to X direction)

$\frac{L}{B} = 1.887$

for L/B = 1.887 $\beta x := 0.98$ $\beta z := 2.2$ (Ref. 2.2.3, Figure 3.3-3)

$Kx := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right]} \cdot \beta x \cdot \sqrt{B \cdot L}$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 1.694 \times 10^6 \\ 3.35 \times 10^6 \\ 5.923 \times 10^6 \\ 1.217 \times 10^6 \\ 2.382 \times 10^6 \\ 4.664 \times 10^6 \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.1.3 Seismic Motion in Z Direction (Vertical)

$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta z \cdot \sqrt{B \cdot L}\right)}$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 2.172 \times 10^6 \\ 4.282 \times 10^6 \\ 7.625 \times 10^6 \\ 1.583 \times 10^6 \\ 3.104 \times 10^6 \\ 6.092 \times 10^6 \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.1.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (75' building dimension):

$L := 75 \cdot ft$ (length of basemat in Y direction)

$B := 141.5 \cdot ft$ (width of basemat perpendicular to Y direction)

$\frac{L}{B} = 0.53$

for L/B = 0.53 $\beta x := 1.02$ (Ref. 2.2.3, Figure 3.3-3)

$Ky := 2\cdot\overrightarrow{\left[(1+\mu)\cdot G_s\right]}\cdot\beta x\cdot\sqrt{B\cdot L}$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 1.763\times10^{6} \\ 3.487\times10^{6} \\ 6.164\times10^{6} \\ 1.267\times10^{6} \\ 2.48\times10^{6} \\ 4.855\times10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.1.5 Rocking Motion About X-Axis

$L := 75\cdot ft$ $B := 141.5\cdot ft$ $\frac{L}{B} = 0.53$ $\beta\psi := 0.45$ (Ref. 2.2.3, Figure 3.3-3)

$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot\beta\psi\cdot B\cdot L^2\right)}$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 3.432\times10^{9} \\ 6.767\times10^{9} \\ 1.205\times10^{10} \\ 2.502\times10^{9} \\ 4.905\times10^{9} \\ 9.628\times10^{9} \end{pmatrix}\frac{ft\cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.1.6 Rocking Motion About Y-Axis

$L := 141.5\cdot ft$ $B := 75\cdot ft$ $\frac{L}{B} = 1.887$ $\beta\psi := 0.60$ (Ref. 2.2.3, Figure 3.3-3)

(Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 8.634 \times 10^{9} \\ 1.702 \times 10^{10} \\ 3.031 \times 10^{10} \\ 6.293 \times 10^{9} \\ 1.234 \times 10^{10} \\ 2.422 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.1.7 Torsional Motion About Z-Axis

$L := 141.5 \cdot ft \qquad B := 75ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25} \qquad R = 61.644\,ft$$ (Table 3.3-3 of Ref. 2.2.3)

$$K\psi z := \overrightarrow{\frac{16 \cdot G_s \cdot R^3}{3}}$$ (Table 3.3-1 of Ref. 2.2.3)

$$K\psi z = \begin{pmatrix} 7.746 \times 10^{9} \\ 1.537 \times 10^{10} \\ 2.698 \times 10^{10} \\ 5.497 \times 10^{9} \\ 1.074 \times 10^{10} \\ 2.099 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.2 PART 1 STRUCTURE - SOIL DAMPING FOR 5E-4 (DBGM-2) SEISMIC EVENT (Revised)

LEGEND:

Gs = shear modulus of foundation medium (Calculated in Section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat
Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at

base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.1, 7.1.2, 7.1.5, & 7.1.6)

Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' alluvium and South 100' alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.1(a).

6.2.2.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 20 (a) of Ref. 2.2.2)

$m_x := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 1.70 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 2.65 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 1.79 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (141.5' building dimension)

$L := 141.5 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 75 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 58.121\ ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Ref. 2.2.5)

$g = 32.174 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 4.255 \times 10^{4} \\ 5.975 \times 10^{4} \\ 7.971 \times 10^{4} \\ 3.629 \times 10^{4} \\ 5.082 \times 10^{4} \\ 7.118 \times 10^{4} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (75' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 4.429 \times 10^{4} \\ 6.219 \times 10^{4} \\ 8.297 \times 10^{4} \\ 3.778 \times 10^{4} \\ 5.289 \times 10^{4} \\ 7.408 \times 10^{4} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 141.5 \cdot ft$ $B := 75 \cdot ft$

$$R := \sqrt{\frac{B \cdot L}{\pi}}$$ $R = 58.121\ ft$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 8.051 \times 10^4 \\ 1.127 \times 10^5 \\ 1.514 \times 10^5 \\ 6.965 \times 10^4 \\ 9.769 \times 10^4 \\ 1.372 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 141.5 \cdot ft$ $L := 75 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}}$ $R = 50.167\,ft$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi x := \overrightarrow{\left[3(1-\mu) \cdot \frac{Io_x}{8 \cdot \rho \cdot R^5}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 0.372 \\ 0.374 \\ 0.369 \\ 0.362 \\ 0.361 \\ 0.359 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi x = \begin{pmatrix} 2.826 \times 10^7 \\ 3.949 \times 10^7 \\ 5.326 \times 10^7 \\ 2.462 \times 10^7 \\ 3.456 \times 10^7 \\ 4.86 \times 10^7 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 75 \cdot ft$ $L := 141.5 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}}$ $R = 68.907\, ft$

$$B\psi y := \overrightarrow{\left[3(1-\mu)\right] \cdot \frac{Io_y}{8 \cdot \rho \cdot R^5}}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi y = \begin{pmatrix} 0.119 \\ 0.119 \\ 0.118 \\ 0.115 \\ 0.115 \\ 0.115 \end{pmatrix}$$

$$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 1.197 \times 10^8 \\ 1.675 \times 10^8 \\ 2.254 \times 10^8 \\ 1.039 \times 10^8 \\ 1.457 \times 10^8 \\ 2.048 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 141.5 \cdot ft$ $L := 75 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}}$ $R = 61.644\, ft$

$$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2 \frac{I_t}{\rho \cdot R^5}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 5.471 \times 10^{7} \\ 7.706 \times 10^{7} \\ 1.021 \times 10^{8} \\ 4.609 \times 10^{7} \\ 6.444 \times 10^{7} \\ 9.006 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.2.2 Critical Damping

$Cc := 2 \cdot \sqrt{k \cdot m}$ $\quad Cc\psi := 2 \cdot \sqrt{k\psi \cdot Io}$ (Eq. 1.13 of Ref. 2.2.8 on Page 18)

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for I_{ox}, I_{oy} and I_t is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

A) Seismic Motion in X Direction (Horizontal) $Ccx := 2\sqrt{Kx \cdot m_x}$

$$Ccx = \begin{pmatrix} 8.248 \times 10^{4} \\ 1.16 \times 10^{5} \\ 1.542 \times 10^{5} \\ 6.991 \times 10^{4} \\ 9.782 \times 10^{4} \\ 1.369 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seimic Motion in Y Direction (Horizontal) $Ccy := 2\sqrt{Ky \cdot m_y}$

$$Ccy = \begin{pmatrix} 8.414 \times 10^{4} \\ 1.183 \times 10^{5} \\ 1.573 \times 10^{5} \\ 7.133 \times 10^{4} \\ 9.979 \times 10^{4} \\ 1.396 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 9.339 \times 10^4 \\ 1.311 \times 10^5 \\ 1.75 \times 10^5 \\ 7.973 \times 10^4 \\ 1.116 \times 10^5 \\ 1.564 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$Cc\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$Cc\psi x = \begin{pmatrix} 1.528 \times 10^8 \\ 2.145 \times 10^8 \\ 2.863 \times 10^8 \\ 1.304 \times 10^8 \\ 1.826 \times 10^8 \\ 2.559 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$Cc\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$Cc\psi y = \begin{pmatrix} 3.025 \times 10^8 \\ 4.248 \times 10^8 \\ 5.669 \times 10^8 \\ 2.583 \times 10^8 \\ 3.616 \times 10^8 \\ 5.067 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 2.355 \times 10^8 \\ 3.317 \times 10^8 \\ 4.396 \times 10^8 \\ 1.984 \times 10^8 \\ 2.774 \times 10^8 \\ 3.877 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.2.3 Damping Ratios: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 0.516 \\ 0.515 \\ 0.517 \\ 0.519 \\ 0.52 \\ 0.52 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

51.5%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 0.526 \\ 0.526 \\ 0.527 \\ 0.53 \\ 0.53 \\ 0.531 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

52.6%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 0.862 \\ 0.859 \\ 0.865 \\ 0.874 \\ 0.875 \\ 0.877 \end{pmatrix} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

85.9%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 0.185 \\ 0.184 \\ 0.186 \\ 0.189 \\ 0.189 \\ 0.19 \end{pmatrix} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

18.4%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 0.396 \\ 0.394 \\ 0.398 \\ 0.402 \\ 0.403 \\ 0.404 \end{pmatrix} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

39.4%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \end{pmatrix} \quad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

23.2%

As stated in Section 4.3.2, the Mass Properties calculation (Ref. 2.2.2) has been revised resulting in changes to the damping calculations. Section 6.2.3 provides revisions to the damping values using the new mass properties. Note that Sections 6.2.3 through 6.2.3.7 are duplicates of Sections 6.1.4 through 6.1.4.7. This was done for ease of calculating the new values for the updated data.

6.2.3 PART 1 STRUCTURE - SOIL SPRINGS FOR 1E-4 (BDBGM) SEISMIC EVENT (Revised)

The following calculations determine translational and rotational springs (Kx,Ky,Kz, $K\psi x$,$K\psi y$ and $K\psi z$) per ASCE 4-98 (Ref. 2.2.3) Section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) Section 3.3.

$k := 1000 \cdot \text{lbf}$

The soil springs will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower , Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.2.3.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.3)

$$G_s := \begin{pmatrix} 4300 \\ 8300 \\ 15700 \\ 2900 \\ 5700 \\ 11300 \end{pmatrix} \text{ksf} \qquad \mu := \begin{pmatrix} 0.382 \\ 0.381 \\ 0.382 \\ 0.393 \\ 0.393 \\ 0.393 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.2.3.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the x-direction (141.5' building dimension):

$L := 141.5 \cdot \text{ft}$ (length of basemat in X Direction)

$B := 75 \cdot \text{ft}$ (width of basemat perpendicular to X Direction)

$$\frac{L}{B} = 1.887$$

for L/B = 1.887 $\beta x := 0.98$ $\beta z := 2.20$ (Ref. 2.2.3, Figure 3.3-3)

$$Kx := \overrightarrow{\left[2\cdot(1+\mu)\cdot G_s\cdot \beta x\cdot\sqrt{B\cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 1.2\times 10^{6} \\ 2.314\times 10^{6} \\ 4.381\times 10^{6} \\ 8.157\times 10^{5} \\ 1.603\times 10^{6} \\ 3.178\times 10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.3.3 Seismic Motion in Z Direction (Vertical)

$$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot \beta z\cdot\sqrt{B\cdot L}\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 1.577\times 10^{6} \\ 3.039\times 10^{6} \\ 5.758\times 10^{6} \\ 1.083\times 10^{6} \\ 2.128\times 10^{6} \\ 4.219\times 10^{6} \end{pmatrix}\frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.3.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (75' building dimension):

$L := 75\cdot ft$ (length of basemat in Y Direction)

$B := 141.5\cdot ft$ (width of basemat perpendicular to Y Direction)

$$\frac{L}{B} = 0.53$$

for L/B = 0.53 $\beta x := 1.02$ (Ref. 2.2.3, Figure 3.3-3)

$$Ky := \overrightarrow{\left[2\cdot(1+\mu)\cdot G_s\cdot \beta x\cdot \sqrt{B\cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 1.249\times 10^{6} \\ 2.409\times 10^{6} \\ 4.56\times 10^{6} \\ 8.49\times 10^{5} \\ 1.669\times 10^{6} \\ 3.308\times 10^{6} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.3.5 Rocking Motion About X-Axis

$L := 75\cdot ft$ $B := 141.5\cdot ft$ $\frac{L}{B} = 0.53$ $\beta\psi := 0.45$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot \beta\psi\cdot B\cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 2.492\times 10^{9} \\ 4.803\times 10^{9} \\ 9.099\times 10^{9} \\ 1.711\times 10^{9} \\ 3.363\times 10^{9} \\ 6.668\times 10^{9} \end{pmatrix} \frac{ft\cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.3.6 Rocking Motion About Y-Axis

$L := 141.5\cdot ft$ $B := 75\cdot ft$ $\frac{L}{B} = 1.887$ $\beta\psi := 0.60$ (Ref. 2.2.3, Figure 3.3-3)

(Ref. 2.2.3, Table 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot \beta\psi\cdot B\cdot L^2\right)}$$

$$K\psi y = \begin{pmatrix} 6.269 \times 10^{9} \\ 1.208 \times 10^{10} \\ 2.289 \times 10^{10} \\ 4.305 \times 10^{9} \\ 8.461 \times 10^{9} \\ 1.677 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.3.7 Torsional Motion About Z-Axis

$L := 141.5 \cdot ft \qquad B := 75ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25} \qquad R = 61.644\,ft$$

(Ref. 2.2.3, Table 3.3-3)

$$K\psi z := \frac{\overrightarrow{\left(16 \cdot G_s \cdot R^3\right)}}{3}$$

(Ref. 2.2.3, Table 3.3-1)

$$K\psi z = \begin{pmatrix} 5.372 \times 10^{9} \\ 1.037 \times 10^{10} \\ 1.961 \times 10^{10} \\ 3.623 \times 10^{9} \\ 7.121 \times 10^{9} \\ 1.412 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.4 PART 1 STRUCTURE - SOIL DAMPING FOR 1E-4 (BDBGM) SEISMIC EVENT (Revised)

LEGEND:

Gs = shear modulus of foundation medium (Calculated in section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat
Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.1, 7.1.2, 7.1.5 & 7.1.6)

Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.1(a).

6.2.4.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 20 (a) of Ref. 2.2.2)

$m_x := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1004 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 1.70 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 2.65 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 1.79 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (141.5' building dimension)

$L := 141.5 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 75 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 58.121\, ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Ref. 2.2.5)

$g = 32.174 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 3.619 \times 10^4 \\ 5.025 \times 10^4 \\ 6.916 \times 10^4 \\ 2.996 \times 10^4 \\ 4.2 \times 10^4 \\ 5.914 \times 10^4 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (75' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 3.767 \times 10^4 \\ 5.23 \times 10^4 \\ 7.198 \times 10^4 \\ 3.118 \times 10^4 \\ 4.372 \times 10^4 \\ 6.155 \times 10^4 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 141.5 \cdot ft \quad B := 75 \cdot ft$

$$R := \sqrt{\frac{B \cdot L}{\pi}} \qquad R = 58.121\,ft$$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 7.019 \times 10^{4} \\ 9.737 \times 10^{4} \\ 1.341 \times 10^{5} \\ 5.869 \times 10^{4} \\ 8.228 \times 10^{4} \\ 1.159 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 141.5 \cdot ft$ $L := 75 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}}$ $R = 50.167\,ft$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi x := \overrightarrow{[3(1-\mu)]} \cdot \frac{Io_{x}}{8 \cdot \rho \cdot R^{5}}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 0.355 \\ 0.356 \\ 0.355 \\ 0.349 \\ 0.349 \\ 0.349 \end{pmatrix}$$

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_{s}}}\right)}$$

$$C\psi x = \begin{pmatrix} 2.494 \times 10^{7} \\ 3.458 \times 10^{7} \\ 4.765 \times 10^{7} \\ 2.095 \times 10^{7} \\ 2.937 \times 10^{7} \\ 4.135 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 75 \cdot ft$ $\quad L := 141.5 \cdot ft$ $\quad R := \sqrt[4]{\frac{B \cdot L^3}{3 \cdot \pi}}$ $\quad R = 68.907\,ft$

$B\psi y := \overrightarrow{[3(1 - \mu)] \cdot \frac{Io_y}{8 \cdot \rho \cdot R^5}}$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 0.113 \\ 0.113 \\ 0.113 \\ 0.111 \\ 0.111 \\ 0.111 \end{pmatrix}$$

$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 1.049 \times 10^8 \\ 1.455 \times 10^8 \\ 2.004 \times 10^8 \\ 8.786 \times 10^7 \\ 1.232 \times 10^8 \\ 1.734 \times 10^8 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 141.5 \cdot ft$ $\quad L := 75 \cdot ft$ $\quad R := \sqrt[4]{\frac{B \cdot L \cdot (B^2 + L^2)}{6 \cdot \pi}}$ $\quad R = 61.644\,ft$

$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2\frac{I_t}{\rho \cdot R^5}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 4.557 \times 10^{7} \\ 6.331 \times 10^{7} \\ 8.707 \times 10^{7} \\ 3.742 \times 10^{7} \\ 5.246 \times 10^{7} \\ 7.387 \times 10^{7} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.4.2 Critical Damping

$Cc := 2 \cdot \sqrt{k \cdot m}$ Eq. 1.13 (page 18) of Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.1, 7.1.2, 7.1.5, and 7.1.6.

A) Seismic Motion in X Direction (Horizontal) $Ccx := 2\sqrt{Kx \cdot m_x}$

$$Ccx = \begin{pmatrix} 6.942 \times 10^{4} \\ 9.641 \times 10^{4} \\ 1.326 \times 10^{5} \\ 5.723 \times 10^{4} \\ 8.024 \times 10^{4} \\ 1.13 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal) $Ccy := 2\sqrt{Ky \cdot m_y}$

$$Ccy = \begin{pmatrix} 7.082 \times 10^{4} \\ 9.836 \times 10^{4} \\ 1.353 \times 10^{5} \\ 5.839 \times 10^{4} \\ 8.186 \times 10^{4} \\ 1.153 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 7.958 \times 10^{4} \\ 1.105 \times 10^{5} \\ 1.521 \times 10^{5} \\ 6.594 \times 10^{4} \\ 9.245 \times 10^{4} \\ 1.302 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$Cc\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$Cc\psi x = \begin{pmatrix} 1.302 \times 10^{8} \\ 1.807 \times 10^{8} \\ 2.487 \times 10^{8} \\ 1.079 \times 10^{8} \\ 1.512 \times 10^{8} \\ 2.129 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$Cc\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$Cc\psi y = \begin{pmatrix} 2.578 \times 10^{8} \\ 3.579 \times 10^{8} \\ 4.926 \times 10^{8} \\ 2.136 \times 10^{8} \\ 2.995 \times 10^{8} \\ 4.217 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.961 \times 10^{8} \\ 2.725 \times 10^{8} \\ 3.747 \times 10^{8} \\ 1.611 \times 10^{8} \\ 2.258 \times 10^{8} \\ 3.179 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.4.3 Damping Ratios; C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 0.521 \\ 0.521 \\ 0.521 \\ 0.523 \\ 0.523 \\ 0.523 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

52.1%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 0.532 \\ 0.532 \\ 0.532 \\ 0.534 \\ 0.534 \\ 0.534 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

53.2%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 0.882 \\ 0.881 \\ 0.882 \\ 0.89 \\ 0.89 \\ 0.89 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

88.1%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 0.192 \\ 0.191 \\ 0.192 \\ 0.194 \\ 0.194 \\ 0.194 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

19.1%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 0.407 \\ 0.407 \\ 0.407 \\ 0.411 \\ 0.411 \\ 0.411 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

40.7%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \\ 0.232 \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

23.2%

As stated in Section 4.3.2, the Mass Properties calculation (Ref. 2.2.2) has been revised resulting in changes to the damping calculations. Section 6.2.5 provides revisions to the damping values using the new mass properties. Note that Sections 6.2.5 through 6.2.5.7 are duplicates of Sections 6.1.6 through 6.1.6.7. This was done for ease of calculating the new values for the updated data.

6.2.5 PART 2 STRUCTURE - SOIL SPRINGS FOR 5E-4 (DBGM-2) SEISMIC EVENT (Revised)

The following calculations determine translational and rotational springs (Kx,Ky,Kz, $K\psi x$,$K\psi y$ and $K\psi z$) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.2.5.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.2)

$$G_s := \begin{pmatrix} 9400 \\ 17200 \\ 31000 \\ 6400 \\ 12300 \\ 23400 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.318 \\ 0.312 \\ 0.306 \\ 0.342 \\ 0.342 \\ 0.345 \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the x-direction (170' building dimension):

$L := 170 \cdot ft$ (length of basemat in X direction)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to X direction)

$$\frac{L}{B} = 8.651 \times 10^{-1}$$

for L/B = 0.865 $\beta x := 0.95$ $\beta z := 2.15$ (Ref. 2.2.3, Figure 3.3-3)

$Kx := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right]} \cdot \beta x \cdot \sqrt{B \cdot L}$ (Ref. 2.2.3, Table 3.3-3)

$$\overrightarrow{Kx} = \begin{pmatrix} 4.302 \times 10^{6} \\ 7.836 \times 10^{6} \\ 1.406 \times 10^{7} \\ 2.983 \times 10^{6} \\ 5.732 \times 10^{6} \\ 1.093 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.3 Seismic Motion in Z Direction (Vertical)

$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta z \cdot \sqrt{B \cdot L}\right)}$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 5.416 \times 10^{6} \\ 9.824 \times 10^{6} \\ 1.755 \times 10^{7} \\ 3.822 \times 10^{6} \\ 7.346 \times 10^{6} \\ 1.404 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (196.5' building dimension):

$L := 196.5 \cdot ft$ (length of basemat in Y direction)

$B := 170 \cdot ft$ (width of basemat perpendicular to Y direction)

$\frac{L}{B} = 1.156 \times 10^{0}$

for L/B = 1.156 $\beta x := 1.0$ (Ref. 2.2.3, Figure 3.3-3)

$Ky := 2 \cdot \overrightarrow{\left[(1+\mu) \cdot G_s\right]} \cdot \beta x \cdot \sqrt{B \cdot L}$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 4.529 \times 10^{6} \\ 8.249 \times 10^{6} \\ 1.48 \times 10^{7} \\ 3.14 \times 10^{6} \\ 6.034 \times 10^{6} \\ 1.15 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.5 Rocking Motion About X-Axis

$L := 196.5 \cdot ft$ $B := 170 \cdot ft$ $\frac{L}{B} = 1.156 \times 10^{0}$ $\beta\psi := 0.53$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi x := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 4.795 \times 10^{10} \\ 8.697 \times 10^{10} \\ 1.554 \times 10^{11} \\ 3.384 \times 10^{10} \\ 6.503 \times 10^{10} \\ 1.243 \times 10^{11} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.6 Rocking Motion About Y-Axis

$L := 170 \cdot ft$ $B := 196.5 \cdot ft$ $\frac{L}{B} = 8.651 \times 10^{-1}$ $\beta\psi := 0.49$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 3.835 \times 10^{10} \\ 6.957 \times 10^{10} \\ 1.243 \times 10^{11} \\ 2.707 \times 10^{10} \\ 5.202 \times 10^{10} \\ 9.941 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.5.7 Torsional Motion About Z-Axis

$L := 170 \cdot ft$ $B := 196.5ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25}$$ $R = 1.046 \times 10^2 \, ft$ (Ref. 2.2.3, & Table 3.3-3)

$$K\psi z := \overrightarrow{\frac{16 \cdot G_s \cdot R^3}{3}}$$ (Ref. 2.2.3, & Table 3.3-1)

$$K\psi z = \begin{pmatrix} 5.735 \times 10^{10} \\ 1.049 \times 10^{11} \\ 1.891 \times 10^{11} \\ 3.905 \times 10^{10} \\ 7.505 \times 10^{10} \\ 1.428 \times 10^{11} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.6 PART 2 STRUCTURE - SOIL DAMPING FOR 5E-4 (DBGM-2) SEISMIC EVENT (Revised)

LEGEND:

Gs = shear modulus of foundation medium (Calculated in Section 6.1.1)
R = equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat

Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.3, 7.1.4, 7.1.7 & 7.1.8)
Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound, Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in table 7.2.2(a).

6.2.6.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 37 (a) of Ref. 2.2.2)

$m_x := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 8.03 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 6.78 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 8.75 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the X-direction (170' building dimension)

$L := 170 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 1.031 \times 10^2\ ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Page 13 of Ref. 2.2.5)

$g = 3.217 \times 10^1 \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3} \frac{k \cdot sec^2}{ft^4}$

$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 1.557 \times 10^5 \\ 2.097 \times 10^5 \\ 2.802 \times 10^5 \\ 1.308 \times 10^5 \\ 1.814 \times 10^5 \\ 2.507 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the Y-direction (196.5' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right]}$$

(Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 1.639 \times 10^5 \\ 2.207 \times 10^5 \\ 2.95 \times 10^5 \\ 1.377 \times 10^5 \\ 1.909 \times 10^5 \\ 2.639 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 170 \cdot ft$ $B := 196.5 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 1.031 \times 10^2\, ft$ (Ref. 2.2.3, Table 3.3-3)

$$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}} \right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 2.893 \times 10^{5} \\ 3.879 \times 10^{5} \\ 5.163 \times 10^{5} \\ 2.474 \times 10^{5} \\ 3.43 \times 10^{5} \\ 4.753 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 170 \cdot ft \quad L := 196.5 \cdot ft \quad R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}}$ $\quad R = 1.082 \times 10^{2}\ ft$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi x := \overrightarrow{\left[3(1-\mu) \cdot \frac{Io_x}{8 \cdot \rho \cdot R^{5}}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 3.974 \times 10^{-2} \\ 4.009 \times 10^{-2} \\ 4.044 \times 10^{-2} \\ 3.834 \times 10^{-2} \\ 3.834 \times 10^{-2} \\ 3.817 \times 10^{-2} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x} \cdot K\psi x \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$

$$C\psi x = \begin{pmatrix} 9.119 \times 10^{8} \\ 1.222 \times 10^{9} \\ 1.626 \times 10^{9} \\ 7.81 \times 10^{8} \\ 1.083 \times 10^{9} \\ 1.5 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 196.5 \cdot ft \quad L := 170 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}} \qquad R = 1.006 \times 10^{2}\ ft$

$$B\psi y := \overrightarrow{[3(1-\mu)] \cdot \frac{Io_{y}}{8 \cdot \rho \cdot R^{5}}}$$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 4.82 \times 10^{-2} \\ 4.862 \times 10^{-2} \\ 4.905 \times 10^{-2} \\ 4.65 \times 10^{-2} \\ 4.65 \times 10^{-2} \\ 4.629 \times 10^{-2} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y} \cdot K\psi y \cdot R \cdot \sqrt{\frac{\rho}{G_{s}}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 6.73 \times 10^{8} \\ 9.02 \times 10^{8} \\ 1.2 \times 10^{9} \\ 5.765 \times 10^{8} \\ 7.992 \times 10^{8} \\ 1.108 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 170 \cdot ft$ $L := 196.5 \cdot ft$ $R := \sqrt[4]{\frac{B \cdot L \cdot \left(B^{2} + L^{2}\right)}{6 \cdot \pi}}$ $R = 1.046 \times 10^{2}\ ft$

$$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z \cdot I_t}}{1 + 2\frac{I_t}{\rho \cdot R^{5}}}\right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 5.058 \times 10^{8} \\ 6.842 \times 10^{8} \\ 9.185 \times 10^{8} \\ 4.173 \times 10^{8} \\ 5.786 \times 10^{8} \\ 7.98 \times 10^{8} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.6.2 Critical Damping

$Cc := 2\cdot\sqrt{k\cdot m}$ eq. 1.13, Introduction to Structural Dynamics, Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

A) Seismic Motion in X Direction (Horizontal)

$Ccx := 2\sqrt{Kx\cdot m_x}$

$$Ccx = \begin{pmatrix} 1.761\times10^5 \\ 2.376\times10^5 \\ 3.183\times10^5 \\ 1.466\times10^5 \\ 2.032\times10^5 \\ 2.806\times10^5 \end{pmatrix}\frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

$Ccy := 2\sqrt{Ky\cdot m_y}$

$$Ccy = \begin{pmatrix} 1.806\times10^5 \\ 2.438\times10^5 \\ 3.265\times10^5 \\ 1.504\times10^5 \\ 2.085\times10^5 \\ 2.879\times10^5 \end{pmatrix}\frac{k\cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$$Ccz := 2\sqrt{Kz \cdot m_z}$$

$$Ccz = \begin{pmatrix} 1.975 \times 10^5 \\ 2.66 \times 10^5 \\ 3.556 \times 10^5 \\ 1.659 \times 10^5 \\ 2.3 \times 10^5 \\ 3.18 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$C c\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$C c\psi x = \begin{pmatrix} 1.241 \times 10^9 \\ 1.671 \times 10^9 \\ 2.234 \times 10^9 \\ 1.043 \times 10^9 \\ 1.445 \times 10^9 \\ 1.998 \times 10^9 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$C c\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$C c\psi y = \begin{pmatrix} 1.02 \times 10^9 \\ 1.374 \times 10^9 \\ 1.836 \times 10^9 \\ 8.567 \times 10^8 \\ 1.188 \times 10^9 \\ 1.642 \times 10^9 \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.417 \times 10^{9} \\ 1.916 \times 10^{9} \\ 2.573 \times 10^{9} \\ 1.169 \times 10^{9} \\ 1.621 \times 10^{9} \\ 2.235 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.6.3 Damping Ratio: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 8.846 \times 10^{-1} \\ 8.825 \times 10^{-1} \\ 8.805 \times 10^{-1} \\ 8.926 \times 10^{-1} \\ 8.926 \times 10^{-1} \\ 8.936 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

88.1%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 9.075 \times 10^{-1} \\ 9.055 \times 10^{-1} \\ 9.034 \times 10^{-1} \\ 9.158 \times 10^{-1} \\ 9.158 \times 10^{-1} \\ 9.168 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

90.3%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 1.465 \times 10^{0} \\ 1.458 \times 10^{0} \\ 1.452 \times 10^{0} \\ 1.491 \times 10^{0} \\ 1.491 \times 10^{0} \\ 1.494 \times 10^{0} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

145.2%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 7.348 \times 10^{-1} \\ 7.314 \times 10^{-1} \\ 7.28 \times 10^{-1} \\ 7.491 \times 10^{-1} \\ 7.491 \times 10^{-1} \\ 7.51 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

72.8%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 6.599 \times 10^{-1} \\ 6.567 \times 10^{-1} \\ 6.536 \times 10^{-1} \\ 6.729 \times 10^{-1} \\ 6.729 \times 10^{-1} \\ 6.746 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

65.4%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

35.7%

As stated in Section 4.3.2, the Mass Properties calculation (Ref. 2.2.2) has been revised resulting in changes to the damping calculations. Section 6.2.7 provides revisions to the damping values using the new mass properties. Note that Sections 6.2.7 through 6.2.7.7 are duplicates of Sections 6.1.8 through 6.1.8.7. This was done for ease of calculating the new values for the updated data.

6.2.7 PART 2 STRUCTURE - SOIL SPRINGS FOR 1E-4 (BDBGM) SEISMIC EVENT (Revised)

The following calculations determine translational and rotational springs (Kx,Ky,Kz, Kψx,Kψy and Kψz) per ASCE 4-98 (Ref. 2.2.3) section 3.3 methodology for the Initial Handling Facility.

These results are presented in tabular form in Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

Note: All variables used in the computation of the equivalent soil springs and damping values are defined in ASCE 4-98 (Ref. 2.2.3) section 3.3.

$k := 1000 \cdot lbf$

The soil springs will be calculated for Souh 30' depth of alluvium and So 100' depth of alluvium for Lower , Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium

Case 2 : Median Estimate : South 30' Depth of Alluvium

Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium

Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium

Case 5 : Median Estimate : South 100' Depth of Alluvium

Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

6.2.7.1 Soil Properties

Shear Modulus and Poisson's Ratio (Table 6.1.4)

$$G_s := \begin{pmatrix} 6800 \\ 12600 \\ 23300 \\ 4200 \\ 8200 \\ 15900 \end{pmatrix} ksf \qquad \mu := \begin{pmatrix} 0.352 \\ 0.348 \\ 0.344 \\ 0.381 \\ 0.382 \\ 0.383 \end{pmatrix} \qquad \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

6.2.7.2 Seismic Motion in X Direction (Horizontal)

For Seismic loads in the X-direction (170' building dimension):

$L := 170 \cdot ft$ (length of basemat in X direction)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to X direction)

$$\frac{L}{B} = 8.651 \times 10^{-1}$$

for L/B = 0.865 $\beta x := 0.95$ $\beta z := 2.15$ (Ref. 2.2.3, Figure 3.3-3)

$$Kx := \overrightarrow{\left[2\cdot(1+\mu)\cdot G_s\cdot\beta x\cdot\sqrt{B\cdot L}\right]}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kx = \begin{pmatrix} 3.193 \times 10^{6} \\ 5.898 \times 10^{6} \\ 1.087 \times 10^{7} \\ 2.014 \times 10^{6} \\ 3.935 \times 10^{6} \\ 7.636 \times 10^{6} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.7.3 Seismic Motion in Z Direction (Vertical)

$$Kz := \overrightarrow{\left(\frac{G_s}{1-\mu}\cdot\beta z\cdot\sqrt{B\cdot L}\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$Kz = \begin{pmatrix} 4.124 \times 10^{6} \\ 7.594 \times 10^{6} \\ 1.396 \times 10^{7} \\ 2.666 \times 10^{6} \\ 5.214 \times 10^{6} \\ 1.013 \times 10^{7} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.7.4 Seismic Motion in Y Direction (Horizontal)

For Seismic loads in the Y-direction (170' building dimension):

$L := 196.5 \cdot ft$ (length of basemat in Y direction)

$B := 170 \cdot ft$ (width of basemat perpendicular to Y direction)

$\frac{L}{B} = 1.156 \times 10^{0}$

for L/B = 1.156 $\beta x := 1.0$ (Ref. 2.2.3, Figure 3.3-3)

$Ky := \overrightarrow{\left[2 \cdot (1 + \mu) \cdot G_s \cdot \beta x \cdot \sqrt{B \cdot L}\right]}$ (Ref. 2.2.3, Table 3.3-3)

$$Ky = \begin{pmatrix} 3.361 \times 10^{6} \\ 6.209 \times 10^{6} \\ 1.145 \times 10^{7} \\ 2.12 \times 10^{6} \\ 4.142 \times 10^{6} \\ 8.038 \times 10^{6} \end{pmatrix} \frac{k}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.7.5 Rocking Motion About X-Axis

$L := 196.5 \cdot ft$ $B := 170 \cdot ft$ $\frac{L}{B} = 1.156 \times 10^{0}$ $\beta\psi := 0.53$ (Ref. 2.2.3, Figure 3.3-3)

$K\psi x := \overrightarrow{\left(\frac{G_s}{1 - \mu} \cdot \beta\psi \cdot B \cdot L^{2}\right)}$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi x = \begin{pmatrix} 3.651 \times 10^{10} \\ 6.723 \times 10^{10} \\ 1.236 \times 10^{11} \\ 2.361 \times 10^{10} \\ 4.616 \times 10^{10} \\ 8.965 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.7.6 Rocking Motion About Y-Axis

$L := 170 \cdot ft$ $B := 196.5 \cdot ft$ $\frac{L}{B} = 8.651 \times 10^{-1}$ $\beta\psi := 0.49$ (Ref. 2.2.3, Figure 3.3-3)

$$K\psi y := \overrightarrow{\left(\frac{G_s}{1-\mu} \cdot \beta\psi \cdot B \cdot L^2\right)}$$ (Ref. 2.2.3, Table 3.3-3)

$$K\psi y = \begin{pmatrix} 2.92 \times 10^{10} \\ 5.377 \times 10^{10} \\ 9.883 \times 10^{10} \\ 1.888 \times 10^{10} \\ 3.692 \times 10^{10} \\ 7.171 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.7.7 Torsional Motion About Z-Axis

$L := 170 \cdot ft$ $B := 196.5ft$

$$R := \left[\frac{(B \cdot L) \cdot \left(B^2 + L^2\right)}{6 \cdot \pi}\right]^{.25}$$ $R = 1.046 \times 10^2\ ft$ (Ref. 2.2.3, & Table 3.3-3)

$$K\psi z := \frac{\overrightarrow{\left(16 \cdot G_s \cdot R^3\right)}}{3}$$ (Ref. 2.2.3, & Table 3.3-1)

$$K\psi z = \begin{pmatrix} 4.149 \times 10^{10} \\ 7.688 \times 10^{10} \\ 1.422 \times 10^{11} \\ 2.563 \times 10^{10} \\ 5.003 \times 10^{10} \\ 9.701 \times 10^{10} \end{pmatrix} \frac{ft \cdot k}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.8 PART 2 STRUCTURE - SOIL DAMPING FOR 1E-4 (BDBGM) SEISMIC EVENT (Revised)

LEGEND:

Gs = shear modulus of foundation medium (Calculated in section 6.1.1)
R = Equivalent radius of circular basemat
γ = density of foundation medium
g = acceleration of gravity
ρ = mass density of foundation medium
I_t (mt) = polar mass moment of inertia of structure and basemat

Io_x (=mψx), Io_y(=) = total mass moment of inertia of structure & basemat about rocking axis at base
kx, kψy, kψx, kz, ky, kt = equivalent spring constants (note kt=kψz shown in Tables 7.1.3, 7.1.4, 7.1.7 & 7.1.8)
Cx, Cψx, Cz, Ct, Cψy,Cy = equivalent damping coefficients
Cc = critical damping value
$\beta\psi$ = constants that are functions of the basemat dimensional ratio, L/B

Damping Cases:
The equivalent soil damping coefficient and critical damping values will be calculated for South 30' depth of alluvium and South 100' depth of alluvium for Lower Bound,Median and Upper Bound cases as follows.

Case 1 : Lower Bound Estimate : South 30' Depth of Alluvium
Case 2 : Median Estimate : South 30' Depth of Alluvium
Case 3 : Upper Bound Estimate : South 30' Depth of Alluvium
Case 4 : Lower Bound Estimate : South 100' Depth of Alluvium
Case 5 : Median Estimate : South 100' Depth of Alluvium
Case 6 : Upper Bound Estimate : South 100' Depth of Alluvium

UNITS:

kips (k), feet (ft), radians (rad), seconds (sec)

RESULTS:

Results are presented in tabular form in Table 7.2.2(a).

6.2.8.1 Equivalent Damping Coefficients

Determine Equivalent Damping Coefficients per ASCE 4-98 Section 3.3, (Ref. 2.2.3) Methodology for the Initial Handing Facility.

Calculated mass and mass moment of inertia : 51A-SYC-IH00-00400-000 (Page 37 (a) of Ref. 2.2.2)

$m_x := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal X

$m_y := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Horizontal Y

$m_z := 1801 \cdot \frac{k \cdot sec^2}{ft}$ Vertical Z

$Io_x := 8.03 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about X

$Io_y := 6.78 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Rocking about Y

$I_t := 8.75 \cdot 10^6 \cdot k \cdot ft \cdot sec^2$ Torsion

A) Seismic Motion in X Direction (Horizontal)

Seismic load in the x-direction (170' building dimension)

$L := 170 \cdot ft$ (length of basemat in direction of seismic motion)

$B := 196.5 \cdot ft$ (width of basemat perpendicular to direction of seismic motion)

$R := \sqrt{\frac{B \cdot L}{\pi}}$ $R = 1.031 \times 10^2\ ft$ (Ref. 2.2.3, Table 3.3-3)

$\gamma := 0.11232 \cdot \frac{k}{ft^3}$ (Page 13 or Ref. 2.2.5)

$g = 3.217 \times 10^1\ \frac{ft}{sec^2}$ $\rho := \frac{\gamma}{g}$ $\rho = 3.491 \times 10^{-3}\ \frac{k \cdot sec^2}{ft^4}$

$$Cx := \overrightarrow{\left(0.576 \cdot Kx \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cx = \begin{pmatrix} 1.359 \times 10^5 \\ 1.844 \times 10^5 \\ 2.5 \times 10^5 \\ 1.091 \times 10^5 \\ 1.525 \times 10^5 \\ 2.125 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

Seismic load in the y-direction (170' building dimension), R is same as Horizontal -X

$$Cy := \overrightarrow{\left[[0.576(Ky)] \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right]}$$ (Ref. 2.2.3, Table 3.3-1)

$$Cy = \begin{pmatrix} 1.43 \times 10^5 \\ 1.941 \times 10^5 \\ 2.632 \times 10^5 \\ 1.148 \times 10^5 \\ 1.605 \times 10^5 \\ 2.237 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$L := 170 \cdot ft \qquad B := 196.5 \cdot ft$

$R := \sqrt{\frac{B \cdot L}{\pi}} \qquad R = 1.031 \times 10^{2}\,ft$ (Ref. 2.2.3, Table 3.3-3)

$Cz := \overrightarrow{\left(0.85 \cdot Kz \cdot R \cdot \sqrt{\frac{\rho}{G_s}}\right)}$ (Ref. 2.2.3, Table 3.3-1)

$$Cz = \begin{pmatrix} 2.59 \times 10^{5} \\ 3.504 \times 10^{5} \\ 4.735 \times 10^{5} \\ 2.131 \times 10^{5} \\ 2.982 \times 10^{5} \\ 4.159 \times 10^{5} \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$B := 170 \cdot ft \qquad L := 196.5 \cdot ft \qquad R := \sqrt[4]{\frac{B \cdot L^{3}}{3 \cdot \pi}} \qquad R = 1.082 \times 10^{2}\,ft$ (Ref. 2.2.3, Table 3.3-3)

$B\psi x := \overrightarrow{[3(1-\mu)] \cdot \frac{Io_x}{8 \cdot \rho \cdot R^{5}}}$ (Ref. 2.2.3, Table 3.3-1)

$$B\psi x = \begin{pmatrix} 3.776 \times 10^{-2} \\ 3.799 \times 10^{-2} \\ 3.823 \times 10^{-2} \\ 3.607 \times 10^{-2} \\ 3.601 \times 10^{-2} \\ 3.595 \times 10^{-2} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

$$C\psi x := \overrightarrow{\left(\frac{0.3}{1 + B\psi x}\cdot K\psi x\cdot R\cdot\sqrt{\frac{\rho}{G_s}}\right)}$$

$$C\psi x = \begin{pmatrix} 8.179\times10^{8} \\ 1.106\times10^{9} \\ 1.495\times10^{9} \\ 6.74\times10^{8} \\ 9.433\times10^{8} \\ 1.316\times10^{9} \end{pmatrix}\frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$B := 196.5\cdot ft$ $\quad L := 170\cdot ft$ $\quad R := \sqrt[4]{\frac{B\cdot L^3}{3\cdot\pi}}$ $\quad R = 1.006\times10^{2}\,ft$

$$B\psi y := 3(1-\mu)\cdot\frac{Io_y}{8\cdot\rho\cdot R^5}$$ (Ref. 2.2.3, Table 3.3-3)

$$B\psi y = \begin{pmatrix} 4.58\times10^{-2} \\ 4.608\times10^{-2} \\ 4.636\times10^{-2} \\ 4.375\times10^{-2} \\ 4.368\times10^{-2} \\ 4.361\times10^{-2} \end{pmatrix}$$

$$C\psi y := \overrightarrow{\left(\frac{0.3}{1 + B\psi y}\cdot K\psi y\cdot R\cdot\sqrt{\frac{\rho}{G_s}}\right)}$$ (Ref. 2.2.3, Table 3.3-1)

$$C\psi y = \begin{pmatrix} 6.038\times 10^{8} \\ 8.166\times 10^{8} \\ 1.103\times 10^{9} \\ 4.977\times 10^{8} \\ 6.967\times 10^{8} \\ 9.717\times 10^{8} \end{pmatrix} \frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$B := 170\cdot ft$ $\quad L := 196.5\cdot ft$ $\quad R := \sqrt[4]{\dfrac{B\cdot L\cdot\left(B^2+L^2\right)}{6\cdot\pi}}$ $\quad R = 1.046\times 10^{2}\,ft$

$$Ct := \overrightarrow{\left(\frac{\sqrt{K\psi z\cdot I_t}}{1+2\dfrac{I_t}{\rho\cdot R^5}}\right)}$$

(Ref. 2.2.3, Table 3.3-1)

$$Ct = \begin{pmatrix} 4.302\times 10^{8} \\ 5.856\times 10^{8} \\ 7.963\times 10^{8} \\ 3.381\times 10^{8} \\ 4.724\times 10^{8} \\ 6.578\times 10^{8} \end{pmatrix} \frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.8.2 Critical Damping

$Cc := 2\cdot\sqrt{k\cdot m}$ eq. 1.13, Introduction to Structural Dynamics, Ref. 2.2.8

Units for kx, kz, and ky is kip/ft, for kψx, kψy and kt is ft-k/rad, for mx, my, mz is kip-sec^2/ft, for mψx, mψy and mt is kip-ft-sec^2, for Ccx, Ccy, Ccz is kip-sec/ft and for Ccψx, Ccψy and Cct is ft-k-sec/rad. All k values are taken from Tables 7.1.3, 7.1.4, 7.1.7, and 7.1.8.

A) Seismic Motion in X Direction (Horizontal)

$Ccx := 2\sqrt{Kx \cdot m_x}$

$$Ccx = \begin{pmatrix} 1.517 \times 10^5 \\ 2.061 \times 10^5 \\ 2.799 \times 10^5 \\ 1.205 \times 10^5 \\ 1.684 \times 10^5 \\ 2.345 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

B) Seismic Motion in Y Direction (Horizontal)

$Ccy := 2\sqrt{Ky \cdot m_y}$

$$Ccy = \begin{pmatrix} 1.556 \times 10^5 \\ 2.115 \times 10^5 \\ 2.872 \times 10^5 \\ 1.236 \times 10^5 \\ 1.727 \times 10^5 \\ 2.406 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

C) Seismic Motion in Z Direction (Vertical)

$Ccz := 2\sqrt{Kz \cdot m_z}$

$$Ccz = \begin{pmatrix} 1.724 \times 10^5 \\ 2.339 \times 10^5 \\ 3.171 \times 10^5 \\ 1.386 \times 10^5 \\ 1.938 \times 10^5 \\ 2.701 \times 10^5 \end{pmatrix} \frac{k \cdot sec}{ft}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

D) Rocking Motion About X-Axis

$$Cc\psi x := 2\sqrt{K\psi x \cdot Io_x}$$

$$Cc\psi x = \begin{pmatrix} 1.083\times10^{9} \\ 1.47\times10^{9} \\ 1.992\times10^{9} \\ 8.707\times10^{8} \\ 1.218\times10^{9} \\ 1.697\times10^{9} \end{pmatrix} \frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

E) Rocking Motion About Y-Axis

$$Cc\psi y := 2\sqrt{K\psi y \cdot Io_y}$$

$$Cc\psi y = \begin{pmatrix} 8.899\times10^{8} \\ 1.208\times10^{9} \\ 1.637\times10^{9} \\ 7.156\times10^{8} \\ 1.001\times10^{9} \\ 1.395\times10^{9} \end{pmatrix} \frac{ft\cdot k\cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

F) Torsional Motion About Z-Axis

$$Cct := 2\sqrt{K\psi z \cdot I_t}$$

$$Cct = \begin{pmatrix} 1.205 \times 10^{9} \\ 1.64 \times 10^{9} \\ 2.231 \times 10^{9} \\ 9.47 \times 10^{8} \\ 1.323 \times 10^{9} \\ 1.843 \times 10^{9} \end{pmatrix} \frac{ft \cdot k \cdot sec}{rad}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

6.2.8.3 Damping Ratios: C/Cc

A) Seismic Motion in X Direction (Horizontal)

$$\frac{Cx}{Ccx} = \begin{pmatrix} 8.959 \times 10^{-1} \\ 8.946 \times 10^{-1} \\ 8.932 \times 10^{-1} \\ 9.055 \times 10^{-1} \\ 9.058 \times 10^{-1} \\ 9.061 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

89.3%

B) Seismic Motion in Y Direction (Horizontal)

$$\frac{Cy}{Ccy} = \begin{pmatrix} 9.192 \times 10^{-1} \\ 9.178 \times 10^{-1} \\ 9.165 \times 10^{-1} \\ 9.29 \times 10^{-1} \\ 9.293 \times 10^{-1} \\ 9.297 \times 10^{-1} \end{pmatrix}$$

Case 1
Case 2
Case 3
Case 4
Case 5
Case 6

91.7%

C) Seismic Motion in Z Direction (Vertical)

$$\frac{Cz}{Ccz} = \begin{pmatrix} 1.503 \times 10^{0} \\ 1.498 \times 10^{0} \\ 1.493 \times 10^{0} \\ 1.537 \times 10^{0} \\ 1.539 \times 10^{0} \\ 1.54 \times 10^{0} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

149.3%

D) Rocking Motion About X-Axis

$$\frac{C\psi x}{Cc\psi x} = \begin{pmatrix} 7.553 \times 10^{-1} \\ 7.528 \times 10^{-1} \\ 7.503 \times 10^{-1} \\ 7.74 \times 10^{-1} \\ 7.747 \times 10^{-1} \\ 7.754 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

75.0%

E) Rocking Motion About Y-Axis

$$\frac{C\psi y}{Cc\psi y} = \begin{pmatrix} 6.785 \times 10^{-1} \\ 6.762 \times 10^{-1} \\ 6.74 \times 10^{-1} \\ 6.956 \times 10^{-1} \\ 6.962 \times 10^{-1} \\ 6.968 \times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

67.4%

F) Torsional Motion About Z-Axis

$$\frac{Ct}{Cct} = \begin{pmatrix} 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \\ 3.57\times 10^{-1} \end{pmatrix} \begin{matrix} \text{Case 1} \\ \text{Case 2} \\ \text{Case 3} \\ \text{Case 4} \\ \text{Case 5} \\ \text{Case 6} \end{matrix}$$

35.7%

7. RESULTS AND CONCLUSIONS

7.1 SOIL SPRINGS FOR 5E-4 (DBGM-2) AND 1E-4 (BDBGM) SEISMIC EVENTS

Table 7.1.1 Part 1 Frequency Independent Soil Springs South 30' Alluvium 5E-4 Seismic Event

Soil Spring Constant	Lower Bound South 30' Alluvium	Median South 30' Alluvium	Upper Bound South 30' Alluvium
KX – Horizontal spring constant in x direction of foundation	1.694×10^6 kips/ft	3.350×10^6 kips/ft	5.923×10^6 kips/ft
KY – Horizontal spring constant in y direction of foundation	1.763×10^6 kips/ft	3.487×10^6 kips/ft	6.164×10^6 kips/ft
KZ – Vertical spring constant in z direction of foundation	2.172×10^6 kips/ft	4.282×10^6 kips/ft	7.625×10^6 kips/ft
KΨX –Rocking spring constant about x axis of foundation	3.432×10^9 ft-kips/rad	6.767×10^9 ft-kips/rad	1.205×10^{10} ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	8.634×10^9 ft-kips/rad	1.702×10^{10} ft-kips/rad	3.031×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	7.746×10^9 ft-kips/rad	1.537×10^{10} ft-kips/rad	2.698×10^{10} ft-kips/rad

Table 7.1.2 Part 1 Frequency Independent Soil Springs South 30' Alluvium 1E-4 Seismic Event

Soil Spring Constant	Lower Bound South 30' Alluvium	Median South 30' Alluvium	Upper Bound South 30' Alluvium
KX – Horizontal spring constant in x direction of foundation	1.200×10^6 kips/ft	2.314×10^6 kips/ft	4.381×10^6 kips/ft
KY – Horizontal spring constant in y direction of foundation	1.249×10^6 kips/ft	2.409×10^6 kips/ft	4.560×10^6 kips/ft
KZ – Vertical spring constant in z direction of foundation	1.577×10^6 kips/ft	3.039×10^6 kips/ft	5.758×10^6 kips/ft
KΨX –Rocking spring constant about x axis of foundation	2.492×10^9 ft-kips/rad	4.803×10^9 ft-kips/rad	9.099×10^9 ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	6.269×10^9 ft-kips/rad	1.208×10^{10} ft-kips/rad	2.289×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	5.372×10^9 ft-kips/rad	1.037×10^{10} ft-kips/rad	1.961×10^{10} ft-kips/rad

Table 7.1.3 Part 2 Frequency Independent Soil Springs South 30' Alluvium 5E-4 Seismic Event

Soil Spring Constant	Lower Bound South 30' Alluvium	Median South 30' Alluvium	Upper Bound South 30' Alluvium
KX – Horizontal spring constant in x direction of foundation	4.302 X 10^6 kips/ft	7.836 X 10^6 kips/ft	1.406 X 10^7 kips/ft
KY – Horizontal spring constant in y direction of foundation	4.529 X 10^6 kips/ft	8.249 X 10^6 kips/ft	1.480 X 10^7 kips/ft
KZ – Vertical spring constant in z direction of foundation	5.416 X 10^6 kips/ft	9.824 X 10^6 kips/ft	1.755 X 10^7 kips/ft
KΨX –Rocking spring constant about x axis of foundation	4.795 X 10^{10} ft-kips/rad	8.697 X 10^{10} ft-kips/rad	1.554 X 10^{11} ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	3.835 X 10^{10} ft-kips/rad	6.957 X 10^{10} ft-kips/rad	1.243 X 10^{11} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	5.735 X 10^{10} ft-kips/rad	1.049 X 10^{11} ft-kips/rad	1.891 X 10^{11} ft-kips/rad

Table 7.1.4 Part 2 Frequency Independent Soil Springs South 30' Alluvium 1E-4 Seismic Event

Soil Spring Constant	Lower Bound South 30' Alluvium	Median South 30' Alluvium	Upper Bound South 30' Alluvium
KX – Horizontal spring constant in x direction of foundation	3.193 X 10^6 kips/ft	5.898 X 10^6 kips/ft	1.087 X 10^7 kips/ft
KY – Horizontal spring constant in y direction of foundation	3.361 X 10^6 kips/ft	6.209 X 10^6 kips/ft	1.145 X 10^7 kips/ft
KZ – Vertical spring constant in z direction of foundation	4.124 X 10^6 kips/ft	7.594 X 10^6 kips/ft	1.396 X 10^7 kips/ft
KΨX –Rocking spring constant about x axis of foundation	3.651 X 10^{10} ft-kips/rad	6.723 X 10^{10} ft-kips/rad	1.236 X 10^{11} ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	2.920 X 10^{10} ft-kips/rad	5.377 X 10^{10} ft-kips/rad	9.883 X 10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	4.149X 10^{10} ft-kips/rad	7.688 X 10^{10} ft-kips/rad	1.422 X 10^{11} ft-kips/rad

Table 7.1.5 Part 1 Frequency Independent Soil Springs South 100' Alluvium 5E-4 Seismic Event

Soil Spring	Lower Bound South 100' Alluvium	Median South 100' Alluvium	Upper Bound South 100' Alluvium
KX – Horizontal spring constant in x direction of foundation	1.217×10^6 kips/ft	2.382×10^6 kips/ft	4.664×10^6 kips/ft
KY – Horizontal spring constant in y direction of foundation	1.267×10^6 kips/ft	2.480×10^6 kips/ft	4.855×10^6 kips/ft
KZ – Vertical spring constant in z direction of foundation	1.583×10^6 kips/ft	3.104×10^6 kips/ft	6.092×10^6 kips/ft
KΨX – Rocking spring constant about x axis of foundation	2.502×10^9 ft-kips/rad	4.905×10^9 ft-kips/rad	9.628×10^9 ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	6.293×10^9 ft-kips/rad	1.234×10^{10} ft-kips/rad	2.422×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	5.497×10^9 ft-kips/rad	1.074×10^{10} ft-kips/rad	2.099×10^{10} ft-kips/rad

Table 7.1.6 Part 1 Frequency Independent Soil Springs South 100' Alluvium 1E-4 Seismic Event

Soil Spring	Lower Bound South 100' Alluvium	Median South 100' Alluvium	Upper Bound South 100' Alluvium
KX – Horizontal spring constant in x direction of foundation	8.157×10^5 kips/ft	1.603×10^6 kips/ft	3.178×10^6 kips/ft
KY – Horizontal spring constant in y direction of foundation	8.490×10^5 kips/ft	1.669×10^6 kips/ft	3.308×10^6 kips/ft
KZ – Vertical spring constant in z direction of foundation	1.083×10^5 kips/ft	2.128×10^6 kips/ft	4.219×10^6 kips/ft
KΨX – Rocking spring constant about x axis of foundation	1.711×10^9 ft-kips/rad	3.363×10^9 ft-kips/rad	6.668×10^9 ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	4.305×10^9 ft-kips/rad	8.461×10^9 ft-kips/rad	1.677×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	3.623×10^9 ft-kips/rad	7.121×10^9 ft-kips/rad	1.412×10^{10} ft-kips/rad

Table 7.1.7 Part 2 Frequency Independent Soil Springs South 100' Alluvium 5E-4 Seismic Event

Soil Spring	Lower Bound South 100' Alluvium	Median South 100' Alluvium	Upper Bound South 100' Alluvium
KX – Horizontal spring constant in x direction of foundation	2.983×10^{6} kips/ft	5.732×10^{6} kips/ft	1.093×10^{7} kips/ft
KY – Horizontal spring constant in y direction of foundation	3.140×10^{6} kips/ft	6.034×10^{6} kips/ft	1.150×10^{7} kips/ft
KZ – Vertical spring constant in z direction of foundation	3.822×10^{6} kips/ft	7.346×10^{6} kips/ft	1.404×10^{7} kips/ft
KΨX –Rocking spring constant about x axis of foundation	3.384×10^{10} ft-kips/rad	6.503×10^{10} ft-kips/rad	1.243×10^{11} ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	2.707×10^{10} ft-kips/rad	5.202×10^{10} ft-kips/rad	9.941×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	3.905×10^{10} ft-kips/rad	7.505×10^{10} ft-kips/rad	1.428×10^{11} ft-kips/rad

Table 7.1.8 Part 2 Frequency Independent Soil Springs South 100' Alluvium 1E-4 Seismic Event

Soil Spring	Lower Bound South 100' Alluvium	Median South 100' Alluvium	Upper Bound South 100' Alluvium
KX – Horizontal spring constant in x direction of foundation	2.014×10^{6} kips/ft	3.935×10^{6} kips/ft	7.636×10^{6} kips/ft
KY – Horizontal spring constant in y direction of foundation	2.120×10^{6} kips/ft	4.142×10^{6} kips/ft	8.038×10^{6} kips/ft
KZ – Vertical spring constant in z direction of foundation	2.666×10^{6} kips/ft	5.214×10^{6} kips/ft	1.013×10^{7} kips/ft
KΨX –Rocking spring constant about x axis of foundation	2.361×10^{10} ft-kips/rad	4.616×10^{10} ft-kips/rad	8.965×10^{10} ft-kips/rad
KΨY – Rocking spring constant about y axis of foundation	1.888×10^{10} ft-kips/rad	3.692×10^{10} ft-kips/rad	7.171×10^{10} ft-kips/rad
KΨZ – Torsional spring constant about z axis (vertical) of foundation	2.563×10^{10} ft-kips/rad	5.003×10^{10} ft-kips/rad	9.701×10^{10} ft-kips/rad

Tables 7.1.1 to 7.1.8 present lower bound, median and upper bound soil springs for South 30' and South 100' of alluvium suitable for use in a lumped mass stick model seismic analysis of the Initial Handling Facility. Use of this set of soil springs is reasonable for Tier-1, seismic design for 5E-4 and 1E-4 annual exceedance frequency levels. As the design matures soil structure interaction effects will be included in the analysis by modeling the actual soil properties in SASSI (System for Analysis of Soil Structure Interaction). Use of these soil springs is limited to the Tier-1 seismic analysis of the Initial Handling Facility.

7.2 SUMMARY OF DAMPING VALUES

As shown the percent of critical damping is independent of the shear wave velocity. Thus for the Tier –1 seismic analysis of the Initial Handling Facility the % of critical damping to be used in the analysis is summarized in Tables 7.2.1 and 7.2.2 below for 5E-4 (DBGM-2) and 1E-4 (BDBGM) Seismic Events.

Table 7.2.1 - Summary of Damping Values (Part 1)

Degree of Freedom	% of Critical Damping for 5E-4 Seismic Event	% of Critical Damping for 1E-4 Seismic Event
Horizontal Translation-X	51.5%	52.1%
Horizontal Translation-Y	52.6%	53.2%
Vertical Translation-Z	85.9%	88.1%
Rocking about-X	18.5%	19.2%
Rocking about-Y	39.7%	40.9%
Torsion	23.4%	23.4%

Table 7.2.2 - Summary of Damping Values (Part 2)

Degree of Freedom	% of Critical Damping for 5E-4 Seismic Event	% of Critical Damping for 1E-4 Seismic Event
Horizontal Translation-X	89.1%	90.3%
Horizontal Translation-Y	91.4%	92.7%
Vertical Translation-Z	146.8%	151.0%
Rocking about-X	74.9%	77.2%
Rocking about-Y	67.5%	69.7%
Torsion	35.9%	35.9%

Table 7.2.1(a) - Summary of Changed Damping Values (Part 1)

Degree of Freedom	% of Critical Damping for 5E-4 Seismic Event	% of Critical Damping for 1E-4 Seismic Event
Horizontal Translation-X	51.5%	52.1%
Horizontal Translation-Y	52.6%	53.2%
Vertical Translation-Z	85.9%	88.1%
Rocking about-X	18.4%	19.1%
Rocking about-Y	39.4%	40.7%
Torsion	23.2%	23.2%

Table 7.2.2(a) - Summary of Changed Damping Values (Part 2)

Degree of Freedom	% of Critical Damping for 5E-4 Seismic Event	% of Critical Damping for 1E-4 Seismic Event
Horizontal Translation-X	88.1%	89.3%
Horizontal Translation-Y	90.3%	91.7%
Vertical Translation-Z	145.2%	149.3%
Rocking about-X	72.8%	75.0%
Rocking about-Y	65.4%	67.4%
Torsion	35.7%	35.7%

Table 7.2.1(b) - Summary of Percent Change in Damping Values (Part 1)

Degree of Freedom	% Change for 5E-4 Seismic Event	% Change for 1E-4 Seismic Event
Horizontal Translation-X	0.00%	0.00%
Horizontal Translation-Y	0.00%	0.00%
Vertical Translation-Z	0.00%	0.00%
Rocking about-X	-0.54%	-0.52%
Rocking about-Y	-0.76%	-0.49%
Torsion	-0.85%	-0.85%

Table 7.2.2(b) - Summary of Percent Change in Damping Values (Part 2)

Degree of Freedom	% Change for 5E-4 Seismic Event	% Change for 1E-4 Seismic Event
Horizontal Translation-X	-1.12%	-1.11%
Horizontal Translation-Y	-1.20%	-1.08%
Vertical Translation-Z	-1.09%	-1.13%
Rocking about-X	-2.80%	-2.85%
Rocking about-Y	-3.11%	-3.30%
Torsion	-0.56%	-0.56%

Soil damping coefficients, critical damping, and damping ratios are calculated in Sections 6.1.3, 6.1.5, 6.1.7, and 6.1.9. For a Tier-1 seismic analysis of IHF structure, 75% of the computing damping coefficients computed for the translational degrees of freedom and the full damping coefficients computing for the rotational degrees of freedom are considered in the SAP2000 analytical model.

7.3 REVISED STRAIN COMPATIBLE SOIL PROPERTIES

See discussion of assessment results in Attachment F, page F-1.

7.4 CONCLUSIONS

The above computed results are reasonable and are suitable for use in a Tier-1 seismic analysis of the Initial Handling Facility.

The decrease in critical damping identified in section 7.2 (Tables 7.2.1 (a) & (b) as well as 7.2.2 (a) & (b)) has negligible impact to the overall results and conclusion of this calculation. Therefore, the critical damping values located on tables 7.2.1 and 7.2.2 are acceptable for use.

Attachment A

IHF Ground Floor Plan & Facility Gridlines

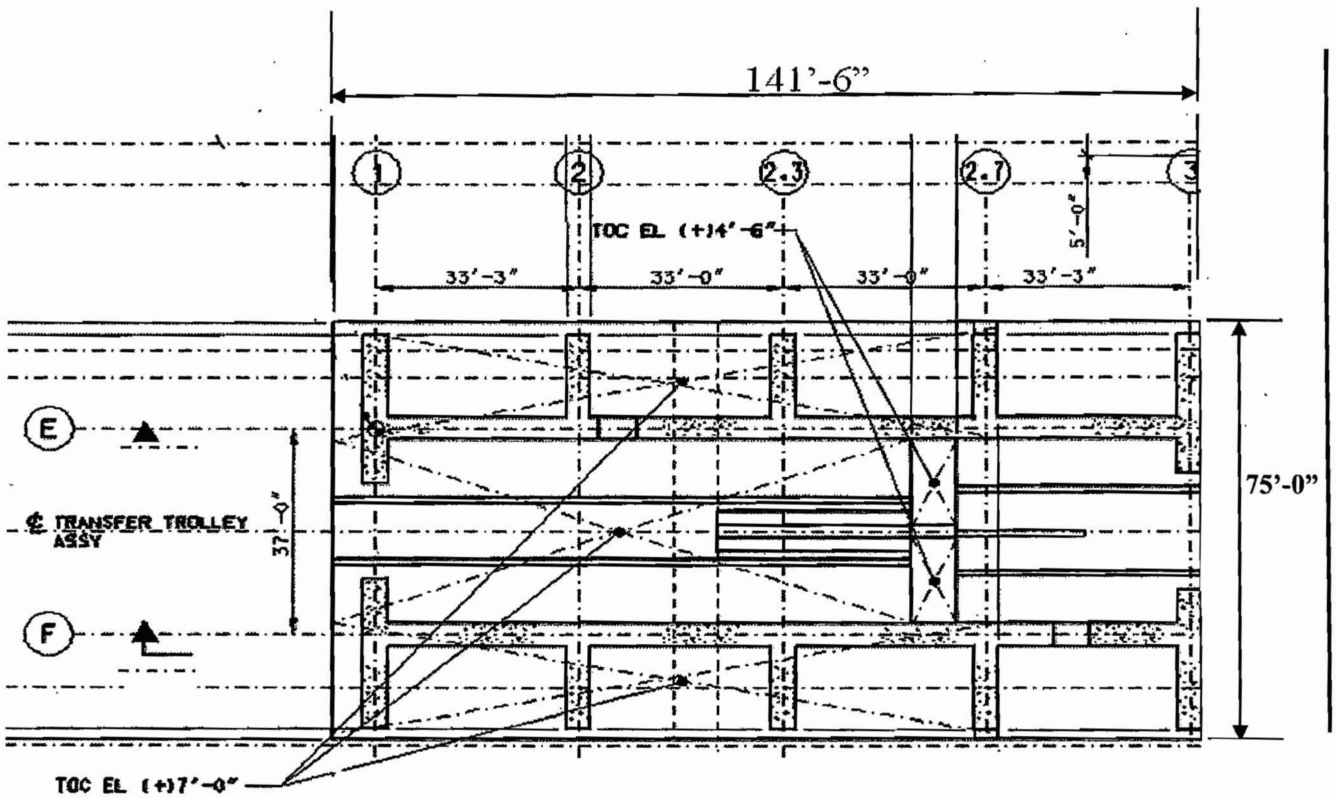


Figure A-1: IHF PART 1 Mat Foundation Plan

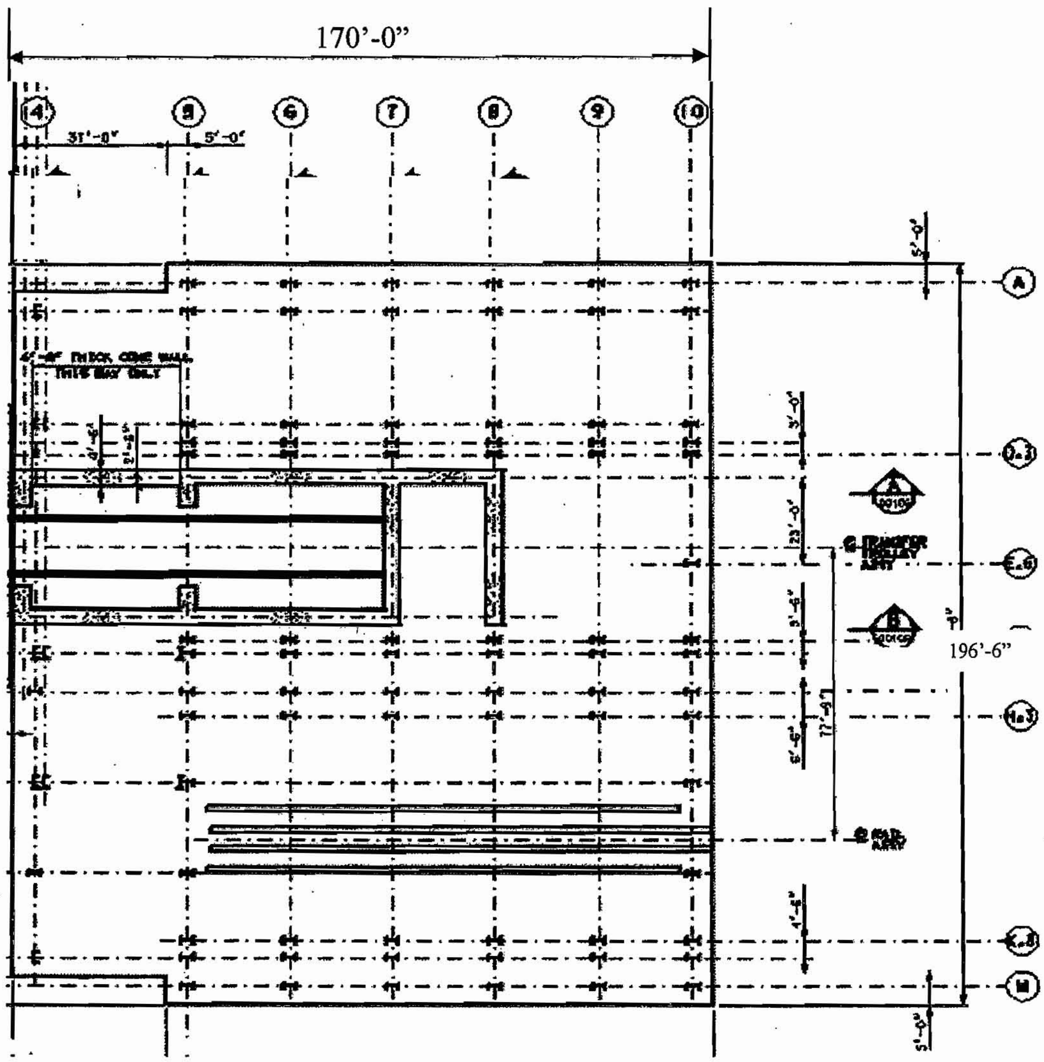
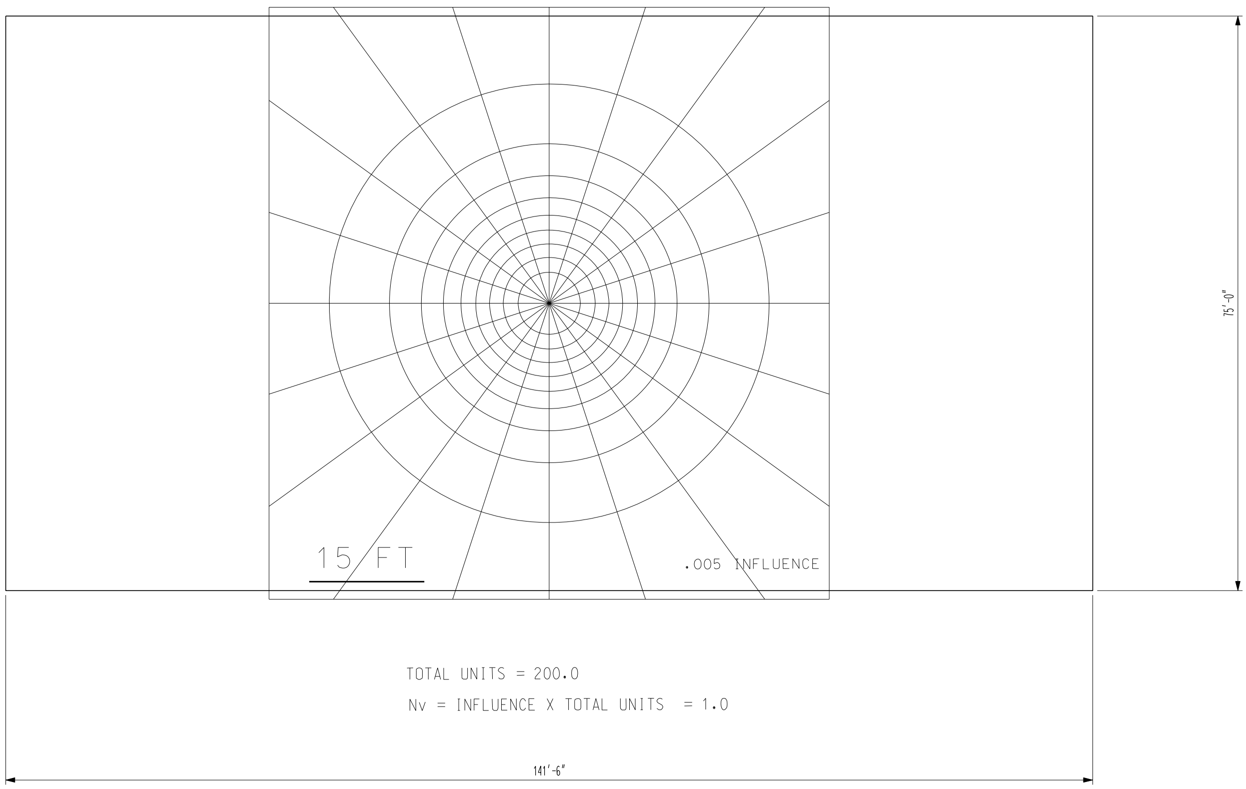


Figure A-2: IHF PART 2 Mat Foundation Plan

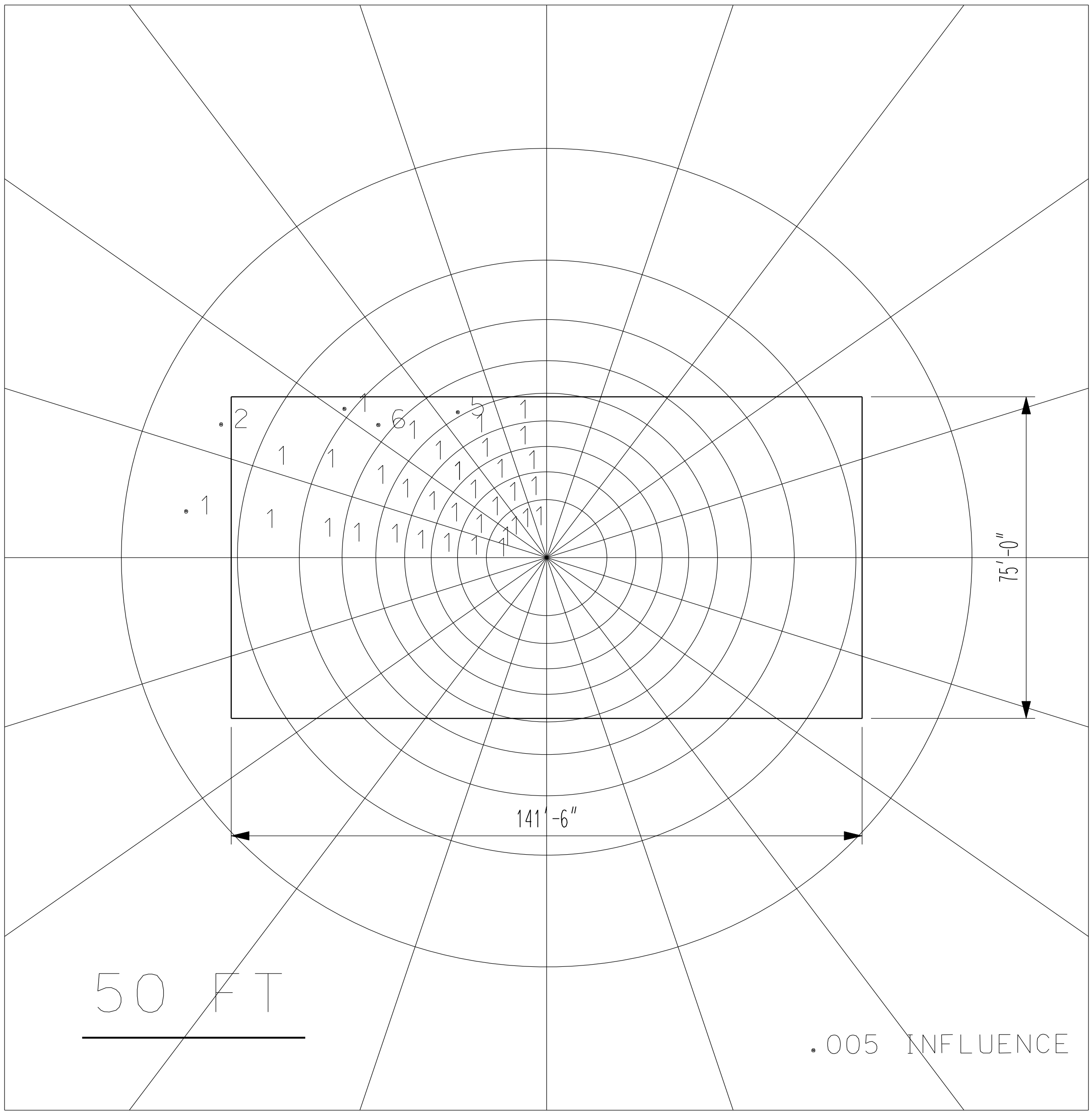
Attachment B

IHF Part 1 – Newmark's Influence Charts

Attachment B
IHF PART 1
Newmark's Influence Charts, 1 of 7 (Ref.2.2.4) For 15' Depth



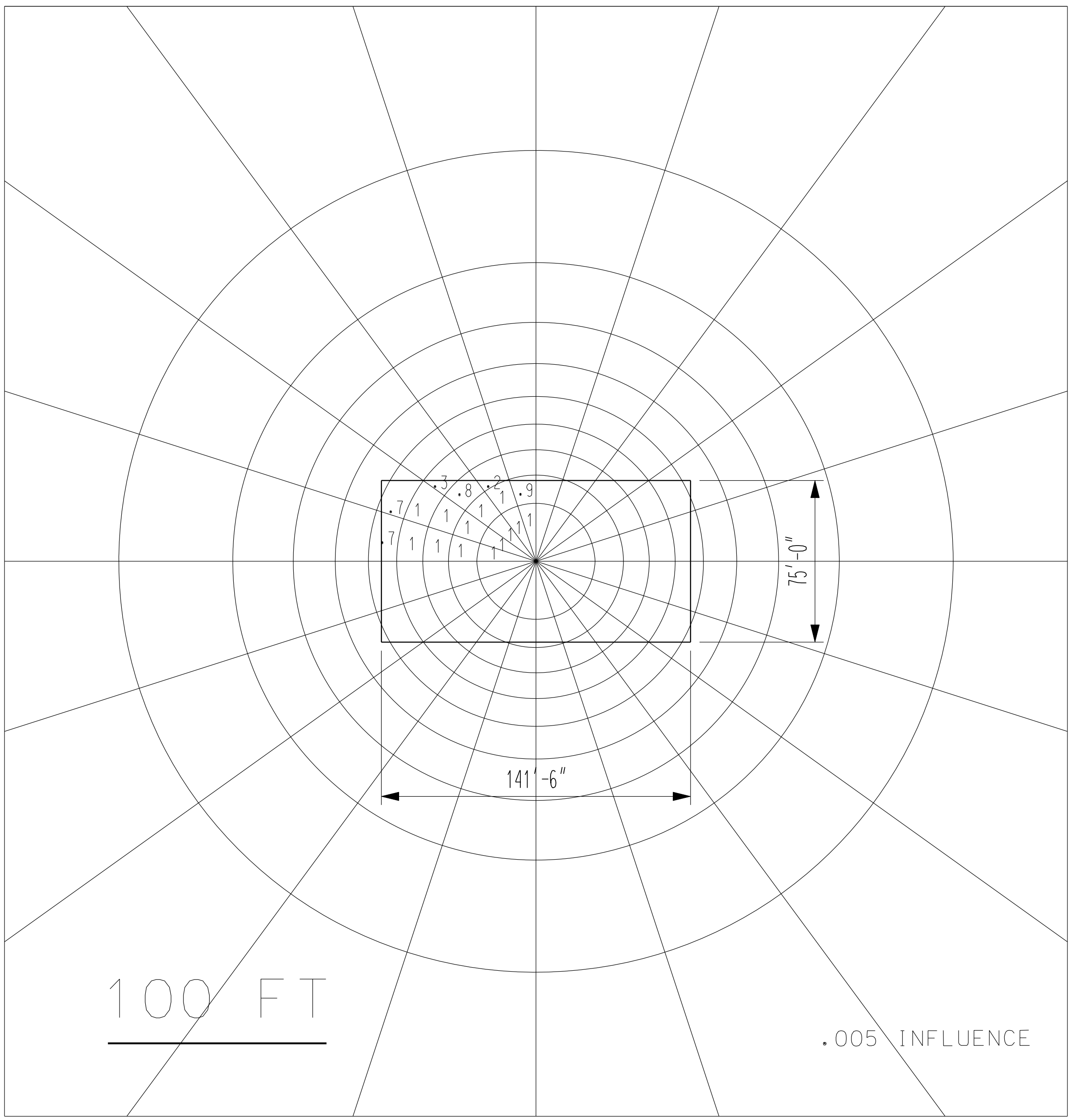
Attachment B
IHF PART 1
Newmark's Influence Charts, 2 of 7 (Ref.2.2.4) For 50' Depth



TOTAL UNITS = 134

Nv = INFLUENCE X TOTAL UNITS = 0.67

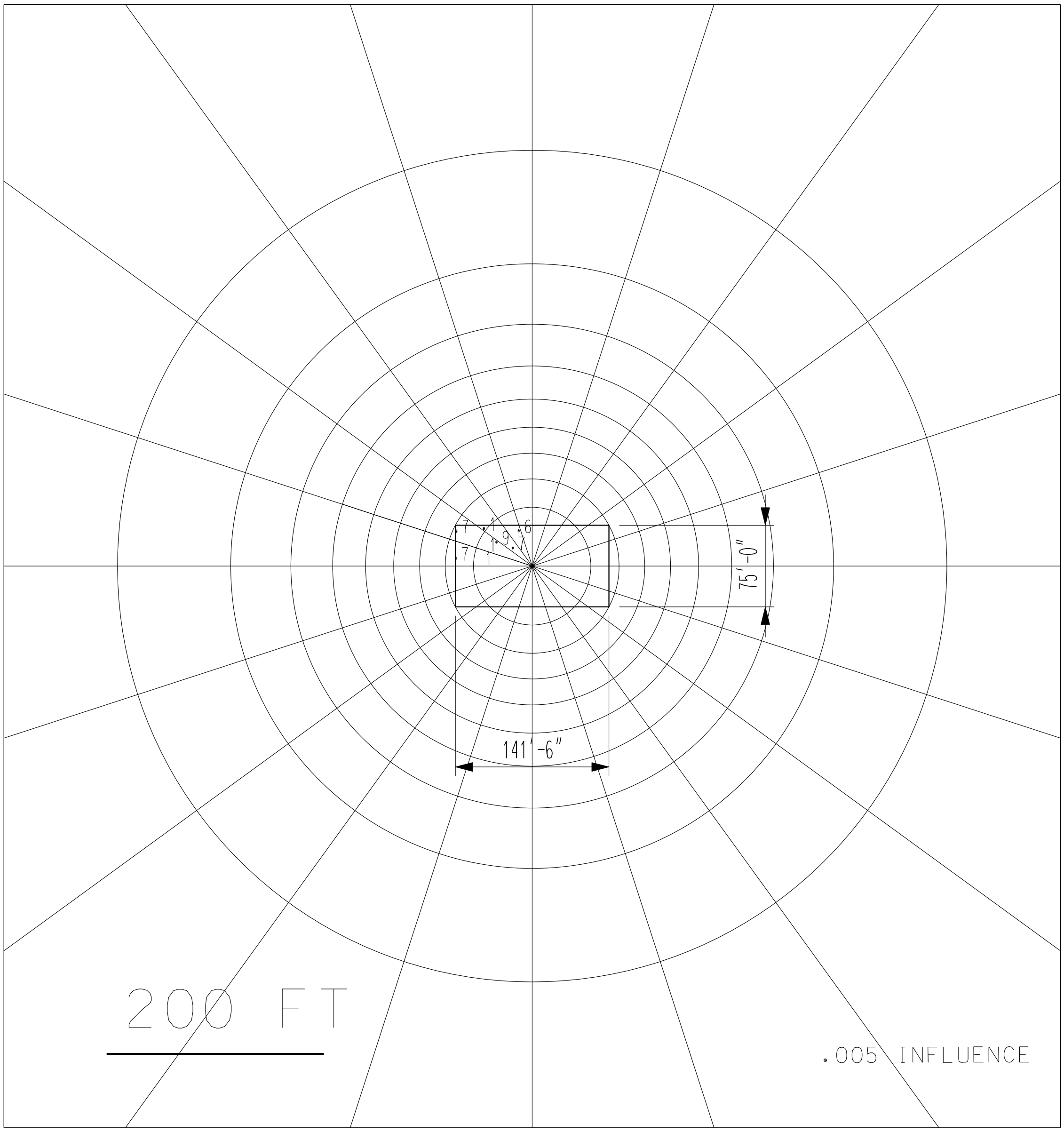
Attachment B
IHF PART 1
Newmark's Influence Charts, 3 of 7 (Ref.2.2.4) For 100' Depth



TOTAL UNITS = 66.4

Nv = INFLUENCE X TOTAL UNITS = 0.332

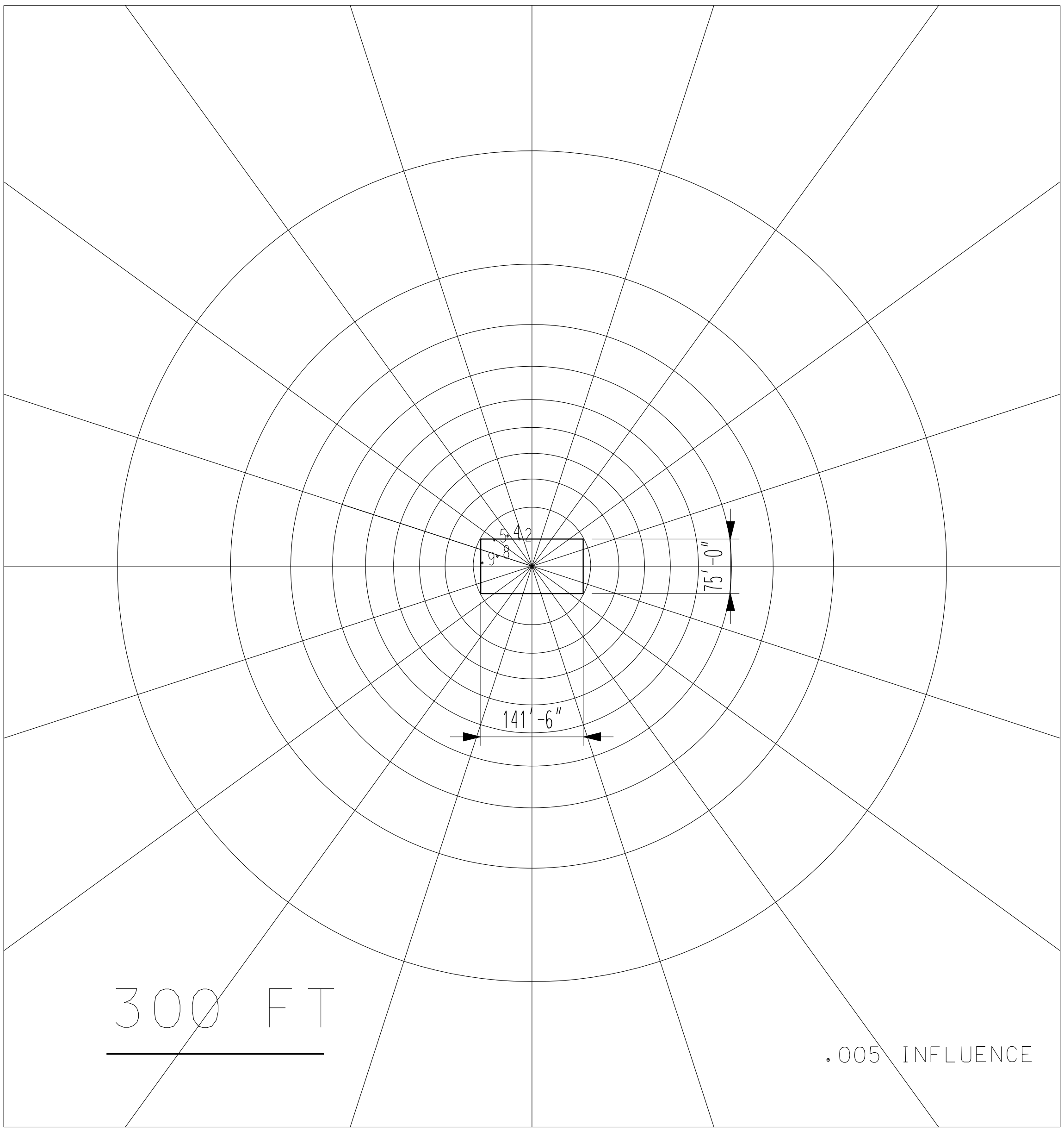
Attachment B
IHF PART 1
Newmark's Influence Charts, 4 of 7 (Ref.2.2.4) For 200' Depth



TOTAL UNITS = 22.8

Nv = INFLUENCE X TOTAL UNITS = 0.114

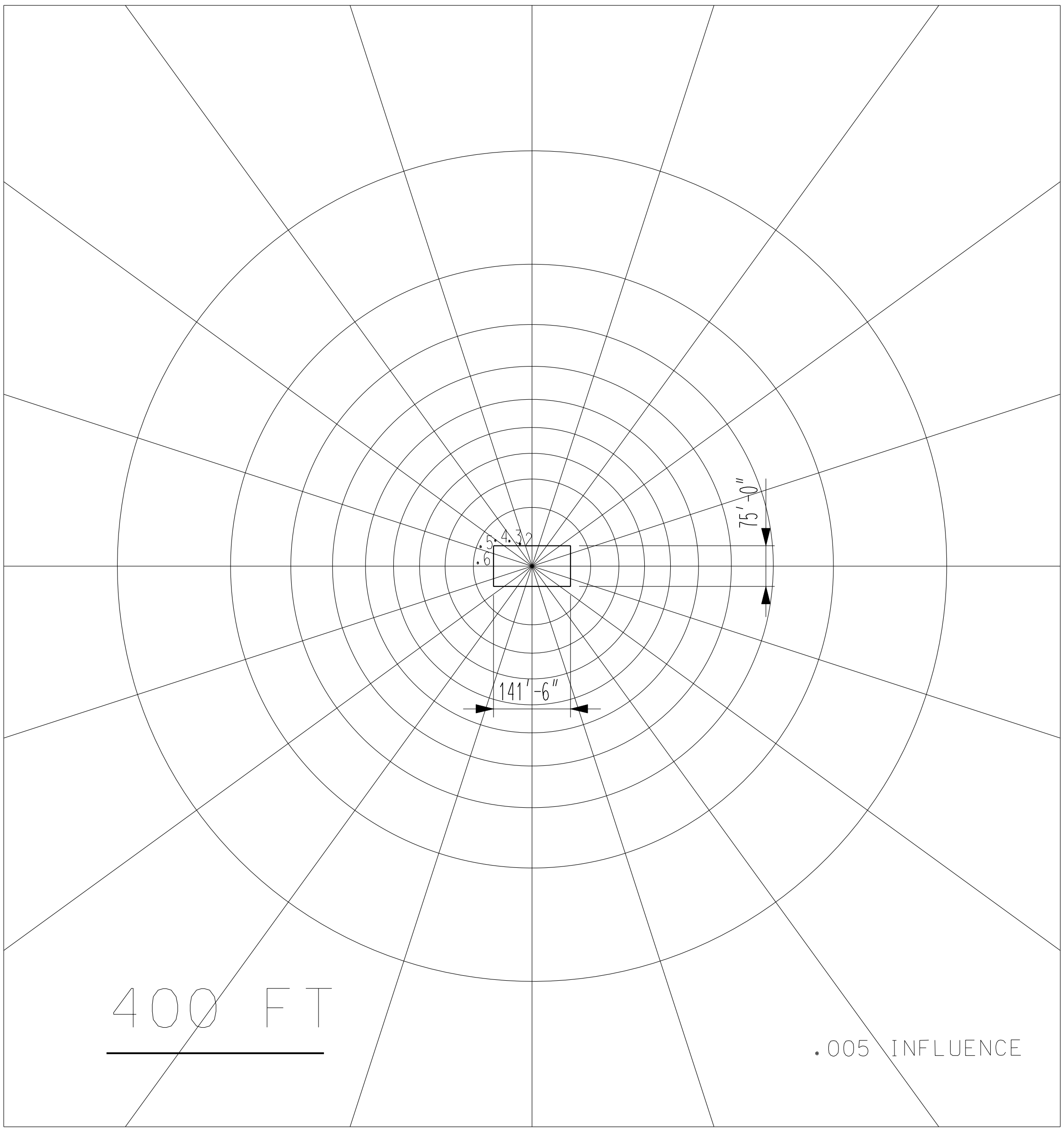
Attachment B
IHF PART 1
Newmark's Influence Charts, 5 of 7 (Ref.2.2.4) For 300' Depth



TOTAL UNITS = 11.2

Nv = INFLUENCE X TOTAL UNITS = 0.056

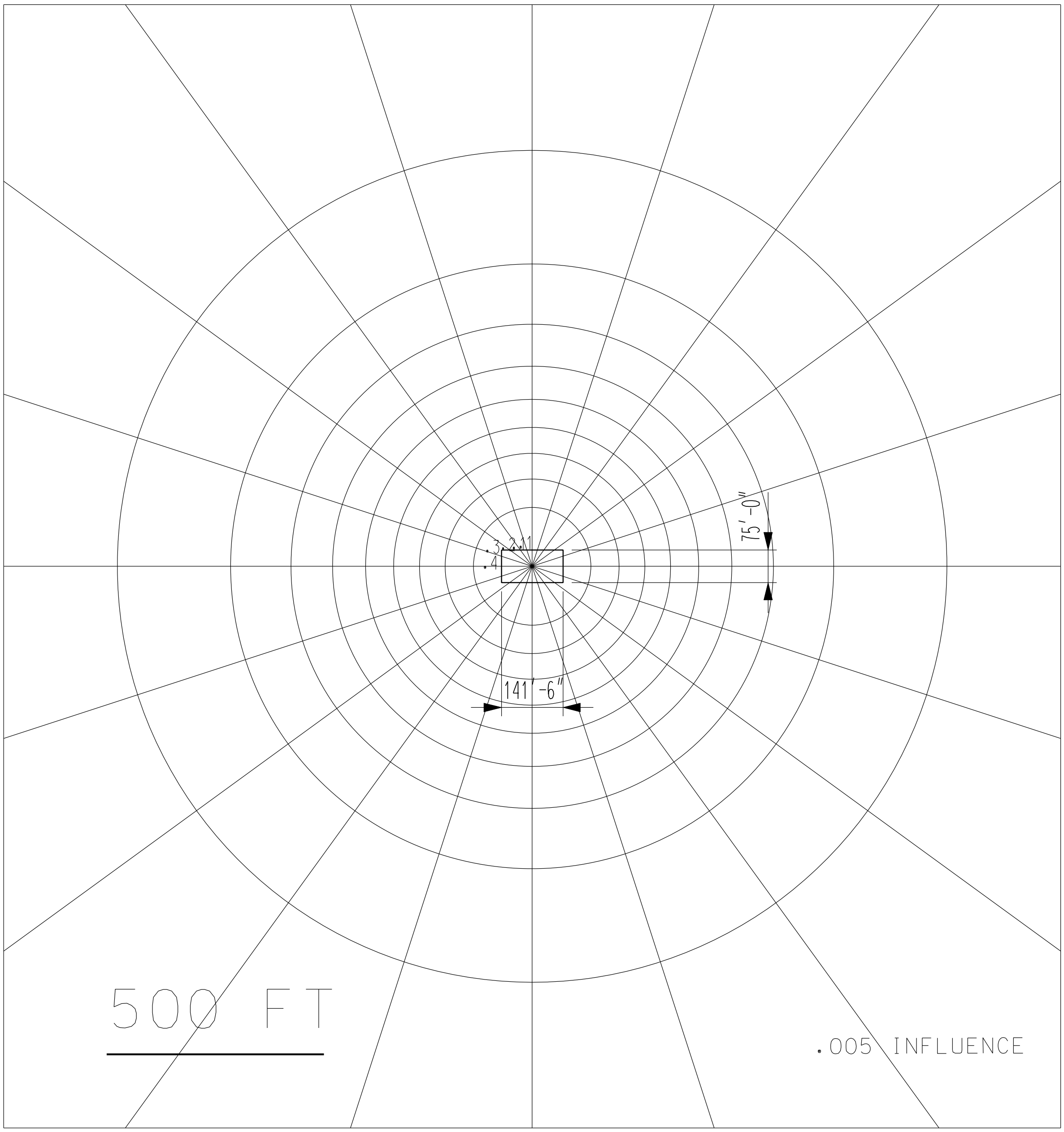
Attachment B
IHF PART 1
Newmark's Influence Charts, 6 of 7 (Ref.2.2.4) For 400' Depth



TOTAL UNITS = 8

Nv = INFLUENCE X TOTAL UNITS = 0.04

Attachment B
IHF PART 1
Newmark's Influence Charts, 7 of 7 (Ref.2.2.4) For 500' Depth



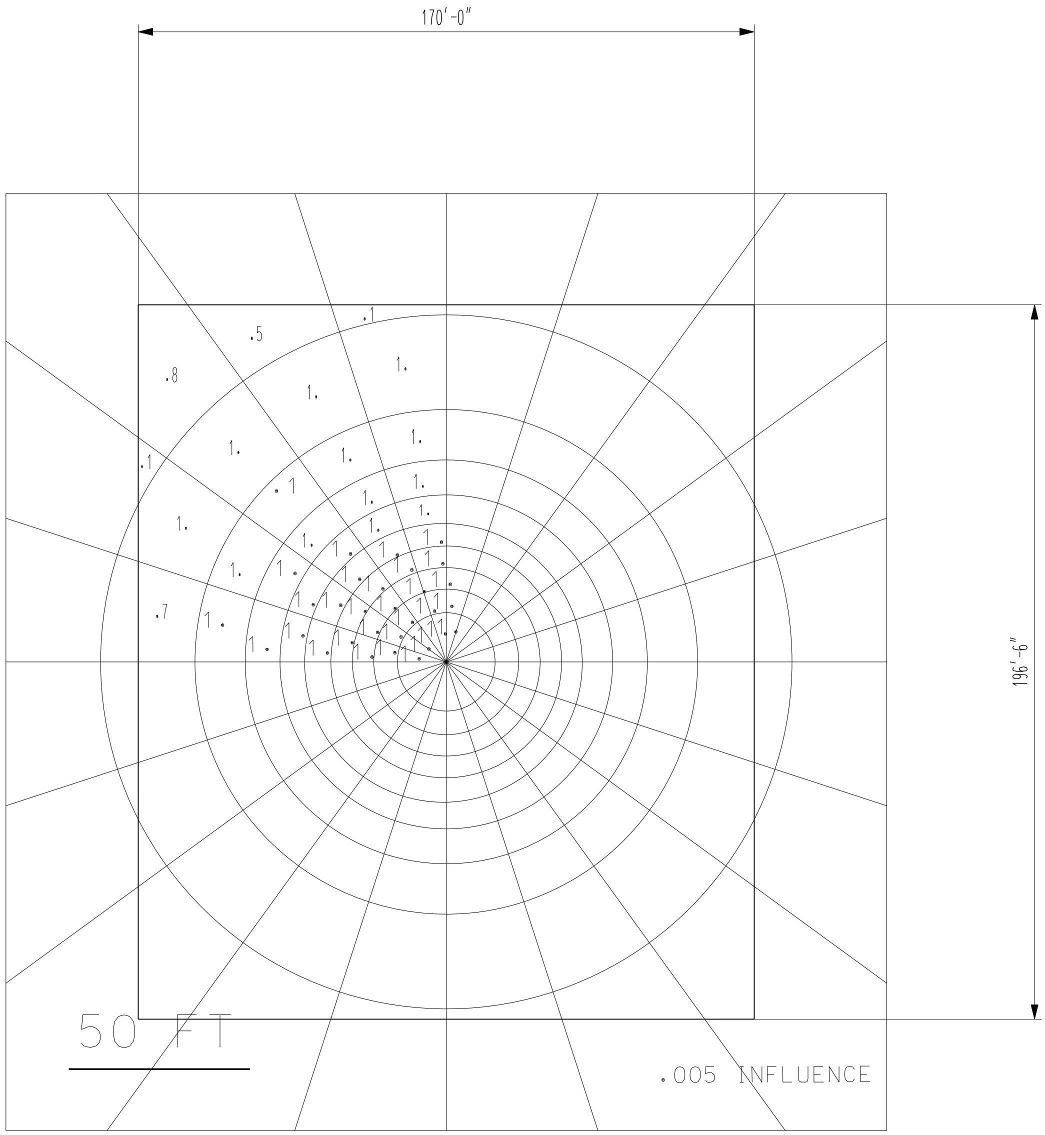
TOTAL UNITS = 4.4

Nv = INFLUENCE X TOTAL UNITS = 0.022

Attachment C

IHF Part 2 – Newmark's Influence Charts

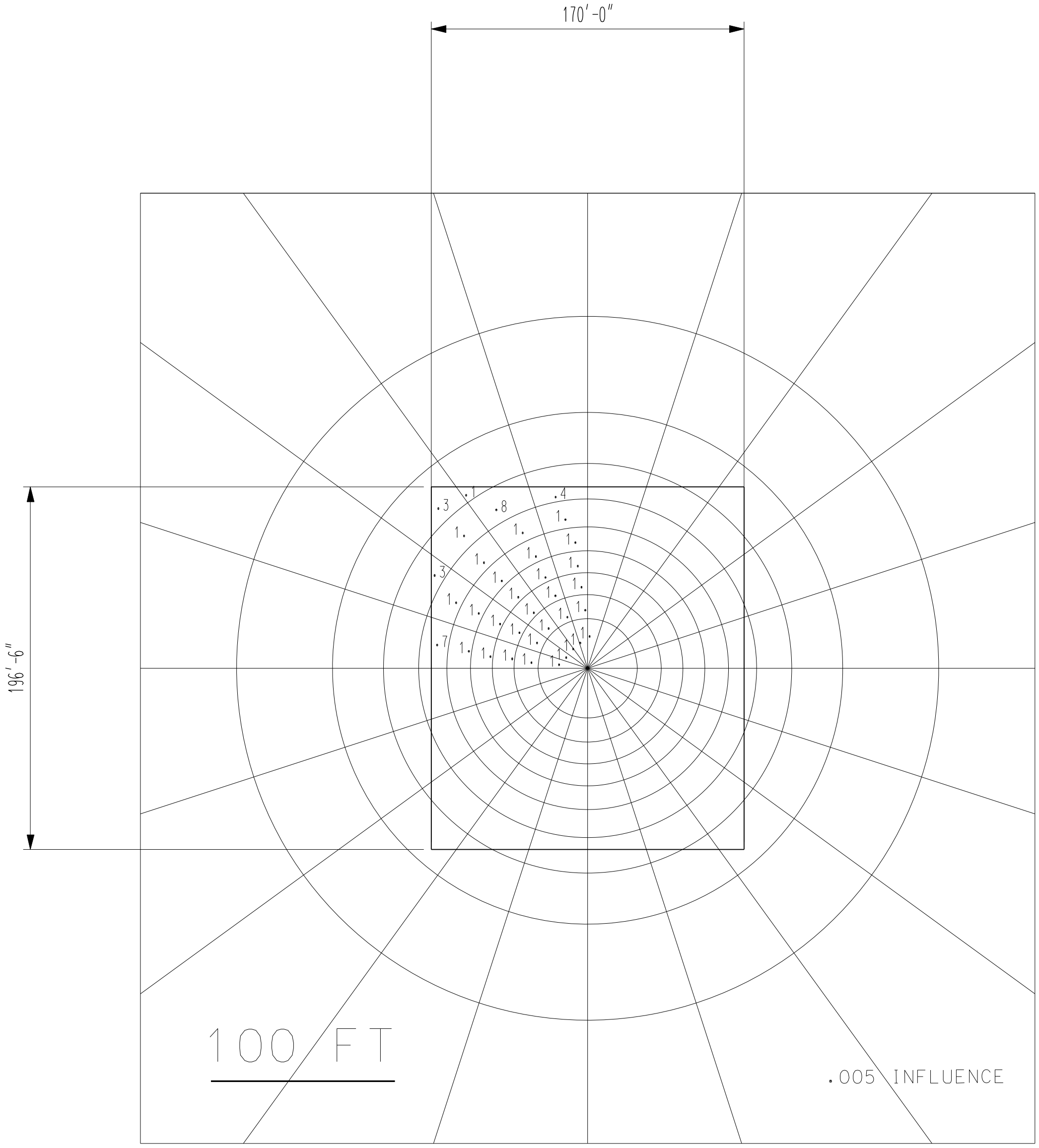
Attachment C
IHF PART 2
Newmark's Influence Charts, 1 of 6 (Ref.2.2.4) For 50' Depth



TOTAL UNITS = 184.8

Nv = INFLUENCE X TOTAL UNITS = 0.924

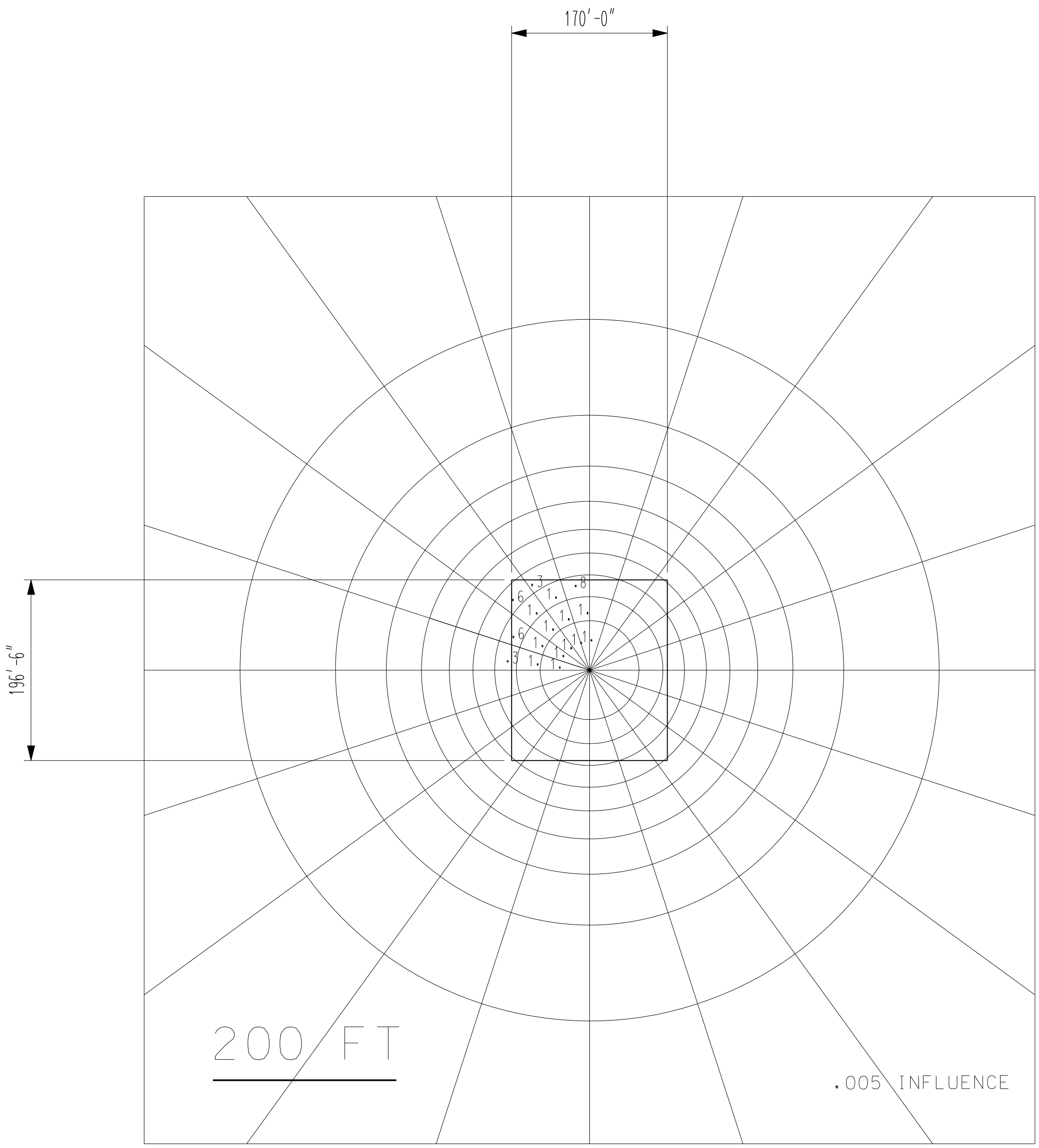
Attachment C
IHF PART 2
Newmark's Influence Charts, 2 of 6 (Ref.2.2.4) For 100' Depth



TOTAL UNITS = 130.4

Nv = INFLUENCE X TOTAL UNITS = 0.652

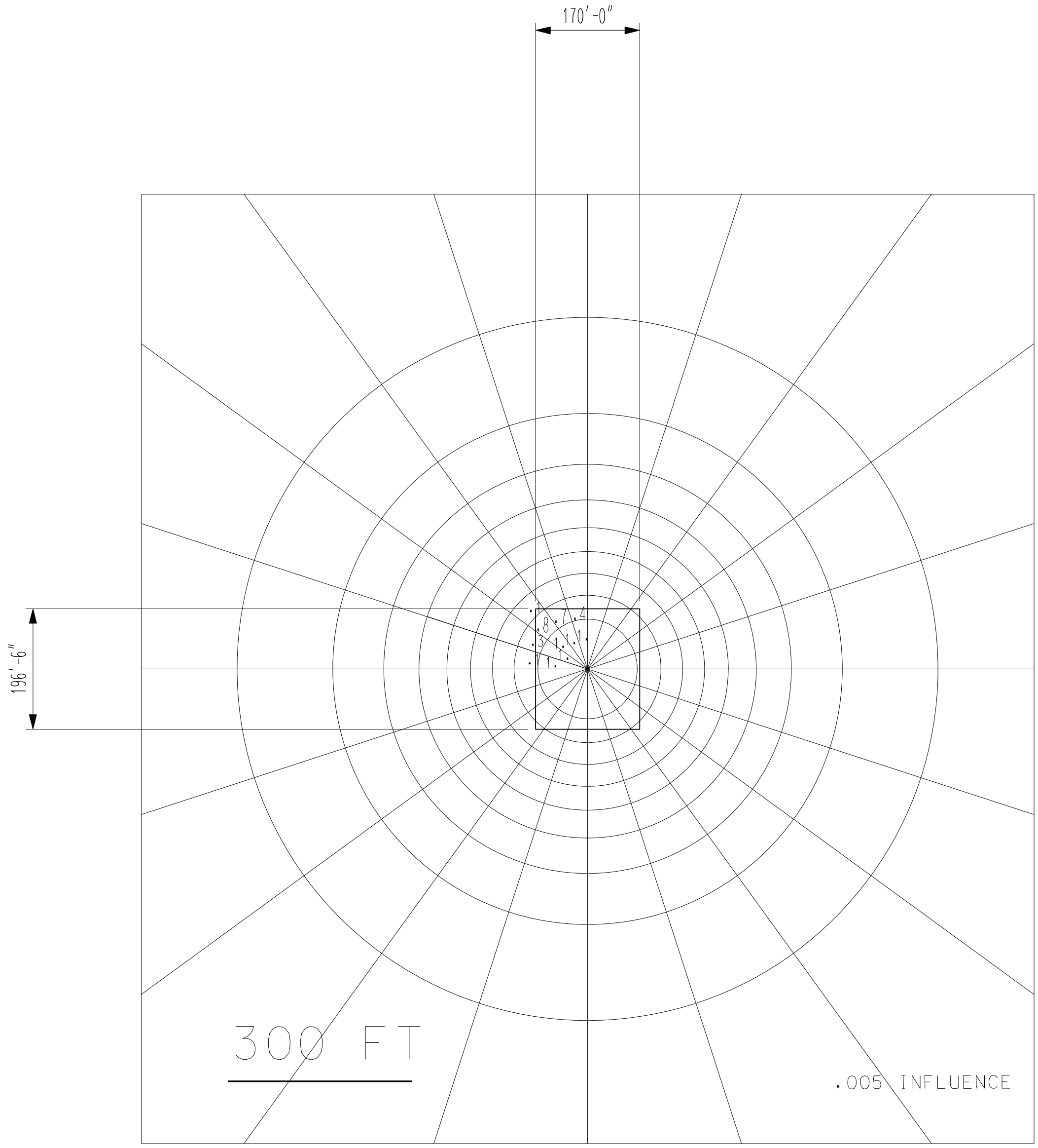
Attachment C
IHF PART 2
Newmark's Influence Charts, 3 of 6 (Ref.2.2.4) For 200' Depth



TOTAL UNITS = 58.4

Nv = INFLUENCE X TOTAL UNITS = 0.292

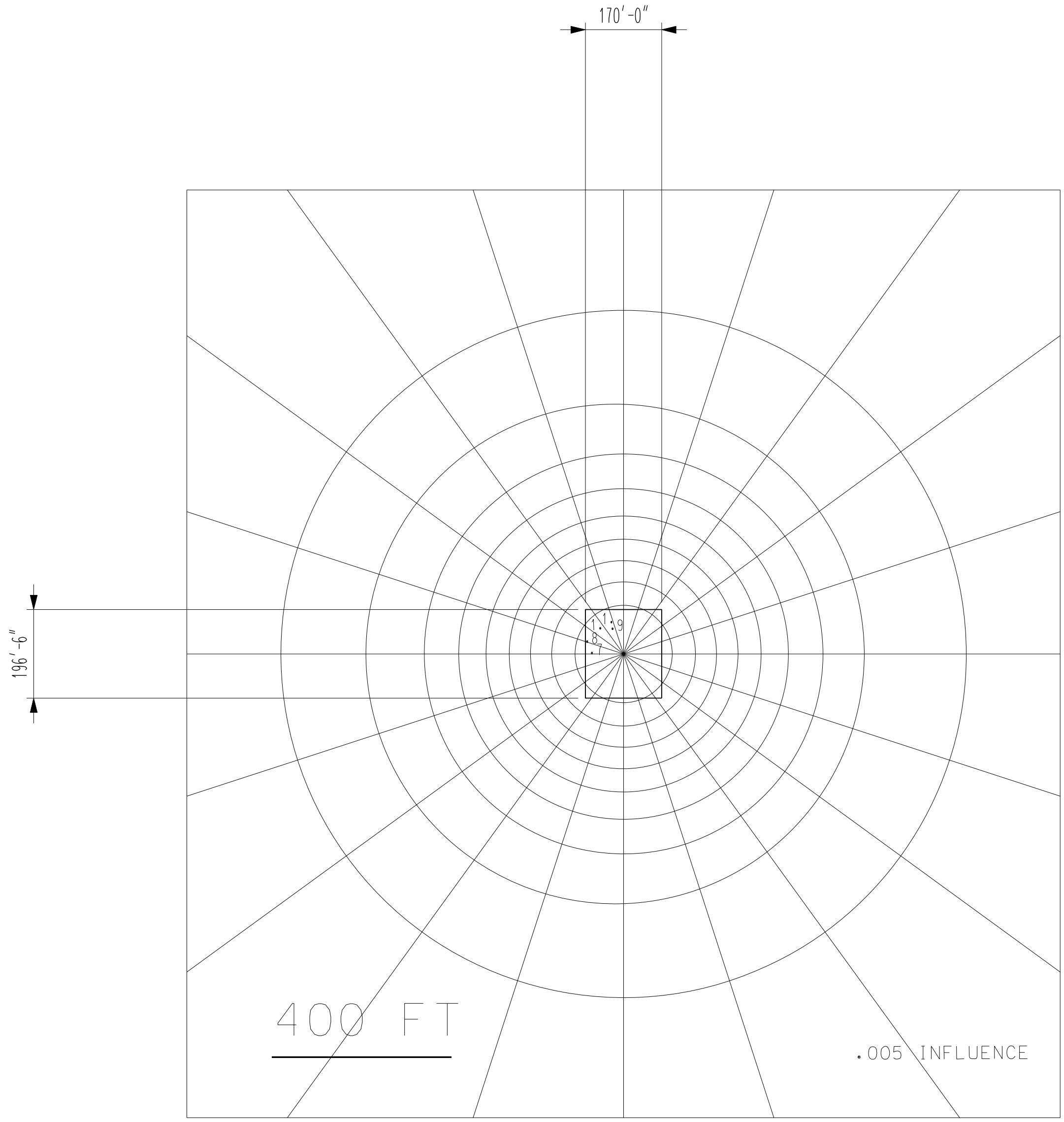
Attachment C
IHF PART 2
Newmark's Influence Charts, 4 of 6 (Ref.2.2.4) For 300' Depth



TOTAL UNITS = 29.6

Nv = INFLUENCE X TOTAL UNITS = 0.148

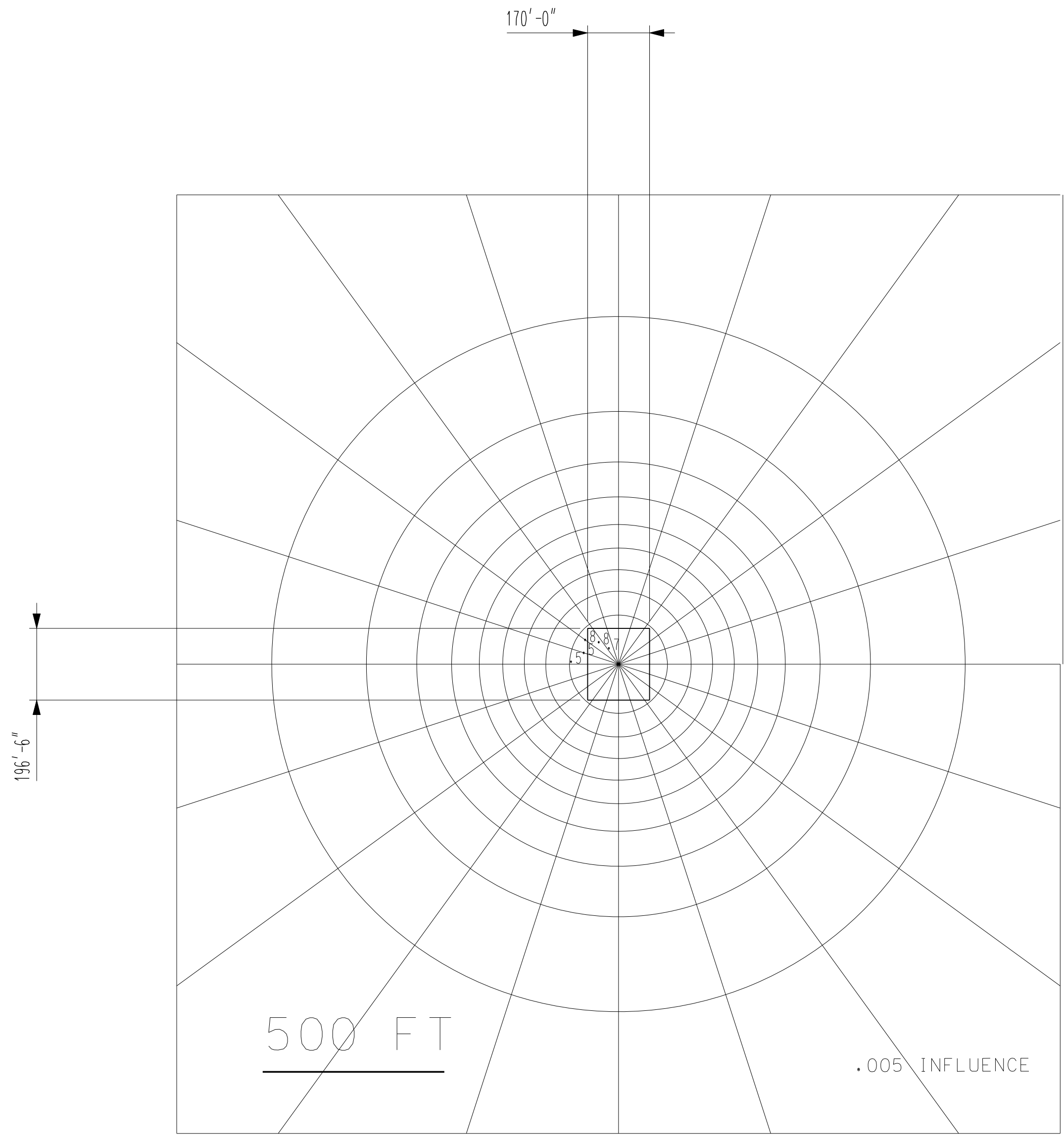
Attachment C
IHF PART 2
Newmark's Influence Charts, 5 of 6 (Ref.2.2.4) For 400' Depth



TOTAL UNITS = 17.6

Nv = INFLUENCE X TOTAL UNITS = 0.088

Attachment C
IHF PART 2
Newmark's Influence Charts, 6 of 6 (Ref.2.2.4) For 500' Depth



TOTAL UNITS = 13.2
Nv = INFLUENCE X TOTAL UNITS = 0.066

ATTACHMENT D

Emails and Interoffice Memorandums

Email From:	Salvador Macias
Date:	10/11/2007
To:	IHF Group Engineers
Subject:	Fw: IHF Gridline Coordinate System – Correspondence Log # 1010071991
Page number:	D-2, D-3, D-4, and D-5
Interoffice Memorandum From:	David W. Tooker
Interoffice Memorandum No:	1010071991; CCU.20071011.0006
Date:	10/10/2007
To:	Distribution
Re:	IHF Gridline Coordinate System
Page Number:	D-6 and D-7
Email From:	Salvador Macias
Date:	10/12/2007
To:	IHF Group Engineers
Subject:	Fw: Reference Information for IHF Include New Coordinates, Rail to Rail Dimensions, and New Control Point Information
Page number:	D-8, D-9, D-10, and D-11
Interoffice Memorandum From:	David W. Tooker
Interoffice Memorandum No:	0904071711; CCU.20070905.0011
Date:	09/05/2007
To:	Distribution
Re:	Reference Information for IHF Include New Coordinates, Rail-to-Rail Dimensions, and New Control Point Information
Page Number:	D-12, D-13, and D-14

ATTACHMENT D

DOCUMENT ID:

51A-SYC-1H00-00500-000-00C

Salvador Macias
10/11/2007 01:44 PM

To: Jason Paredes/YM/RWDOE@CRWMS, Charles Lew/YM/RWDOE@CRWMS, Luis Alires/YM/RWDOE@CRWMS, Ray Chou/YM/RWDOE@CRWMS, Hsien-Hsiu Ko/YM/RWDOE@CRWMS, Kuo-Chu Hsu/YM/RWDOE@CRWMS, Elmer Acaac/YM/RWDOE@CRWMS, Alan Ketin/YM/RWDOE@CRWMS, Kiritkumar Parikh/YM/RWDOE@CRWMS, Chyi-Ching Lu/YM/RWDOE@CRWMS, Ken McEwan/YM/RWDOE@CRWMS
cc: Thomas Frankert/YM/RWDOE@CRWMS
Subject: Fw: IHF GRIDLINE COORDINATE SYSTEM - CORRESPONDENCE LOG #1010071991

LSN: Not Relevant - Not Privileged
User Filed as: Excl/AdminMgmt-14-4/QA:N/A

All,

This IOM is a DESIGN INPUT for our calculations: Mass Properties, Soil Springs, Steel calculations, Concrete calculations, etc.......
Please ensure to reference this IOM into each of our structural calcualtions.

CALCULATIONS AND ANALYSES
EG-PRO-3DP-G04B-00037, REVISION 9

7. Engineering sketches (EG-PRO-3DP-G04B-00046, *Engineering Drawings*) and studies may be used as design input in preliminary calculations and in committed calculations provided the calculations are not used for procurement, fabrication or construction purposes. Sketches shall be replaced by appropriate drawings in confirmed calculations and committed calculations that are used for procurement, fabrication or construction. The results of engineering studies (EG-PRO-3DP-G04B-00016, *Engineering Studies*) shall be confirmed and replaced by engineering calculations or technical reports prior to using as input in confirmed calculations.

8. When using data from an email or IOM as design input to a calculation or analysis, the originator (as well as the checker and approver) must verify that the data is appropriate for use in the calculation. IOMs are tracked through the correspondence control unit (CCU). The originator shall request the RPM Document Control to log the IOM from CCU into InfoWorks and then establish a link to the IOM. Email should be attached to the calculation with a statement in the body of the calculation as to how (and/or why) the information in the email is being used.

I have attached a copy of "Part of the Calculation and Analyses Procedure, Section 3.2.2. - Section F (Design Inputs), Paragraph 8" for your convenience & to ensure all originators follow the same process.

Thanks,
Sal Macias

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C

ATTACHMENT D

---------------------- Forwarded by Salvador Macias/YM/RWDOE on 10/11/2007 01:26 PM ---------------------------

BSC Correspondence Control Unit 10/11/2007 01:12 PM

[redacted] Work Safe America

Sent by: Linda Mantor

To: Thomas Frankert/YM/RWDOE@CRWMS, Lisa Green/YM/RWDOE@CRWMS, Tracy Johnson/YM/RWDOE@CRWMS, Norman Kahler/YM/RWDOE@CRWMS, Maurice LaFountain/YM/RWDOE@CRWMS, Salvador Macias/YM/RWDOE@CRWMS, Arsenio Mendiola/YM/RWDOE@CRWMS, Steve Ployhar/YM/RWDOE@CRWMS, Charles Sauer/YM/RWDOE@CRWMS, Robert Slovic/YM/RWDOE@CRWMS, Frank Trapanese/YM/RWDOE@CRWMS
cc: David Tooker/YM/RWDOE@CRWMS, Leticia Catino/YM/RWDOE@CRWMS, CMS Coordinator@CRWMS
Subject: IHF GRIDLINE COORDINATE SYSTEM - CORRESPONDENCE LOG #1010071991

LSN: Not Relevant - Not Privileged
User Filed as: Excl/AdminMgmt-14-4/QA:N/A

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Please call Linda Mantor at (702) 821-7301 if you have any questions.

Thank you.

ATTACHMENT D

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C

Correspondence Data Entry Form

Log No:
1010071991

Signed Date	10/10/2007
Subject: IHF GRIDLINE COORDINATE SYSTEM	

○ Outgoing Correspondence
● Interoffice Memorandum
○ Incoming Correspondence

Attached File	1010071991.pdf Enclosure: 1010071991_enc.pdf		CO/TD L No.	
To Name	Distribution	To Org	BSC/Repository Project Management	
cc	Leticia Catino/YM/RWDOE, CMS Coordinator	bcc		
From Name	David Tooker/YM/RWDOE	From Org	BSC/Repository Project Management	
Author	Neils Sorensen/YM/RWDOE	Concurrence	David Tooker/YM/RWDOE	
Related Correspondence		Classification	QA: N/A (Not LSN Relevant)	
From/Creator View Only	○ Y ● N	Commitment	○ Y ● N	
Status	Signed	Status Date	10/11/2007	
Comments	Transmitted 10/11/2007 @ 1:12 pm.			
Record Accession	CCU.20071011.0	Creator of Log	Leticia Catino	

ATTACHMENT D

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C

Number	006	Entry	
Open ATS Database	Open RISWeb		

ATTACHMENT D

~~CCU.20071011.0006~~
FOR REF: KP 10-19-07

OCT 1 0 2007

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C

BECHTEL SAIC COMPANY, LLC

Interoffice Memorandum

QA: N/A

To: Distribution

No.: 1010071991

From: David W. Tooker

Date: Oct. 10, 2007

Re: IHF Gridline Coordinate System

CC:

The purpose of this interoffice memorandum (IOM) is to provide a suitable reference / basis for the facility gridline layout of the Initial Handling Facility (IHF). This IOM will serve as a suitable reference to support the issuance of various IHF drawings. Use of the information contained in this IOM will ensure that work is aligned with the Plant Design equipment model and the Central Support Area Frameworks model.

The following sketch contains the current IHF ground floor plan and facility gridlines, and should be used as input to documents regarding the IHF layout. This sketch has been determined not be Official Use Only.

If you have any questions or require clarification, please call me at (702) 821-7580.

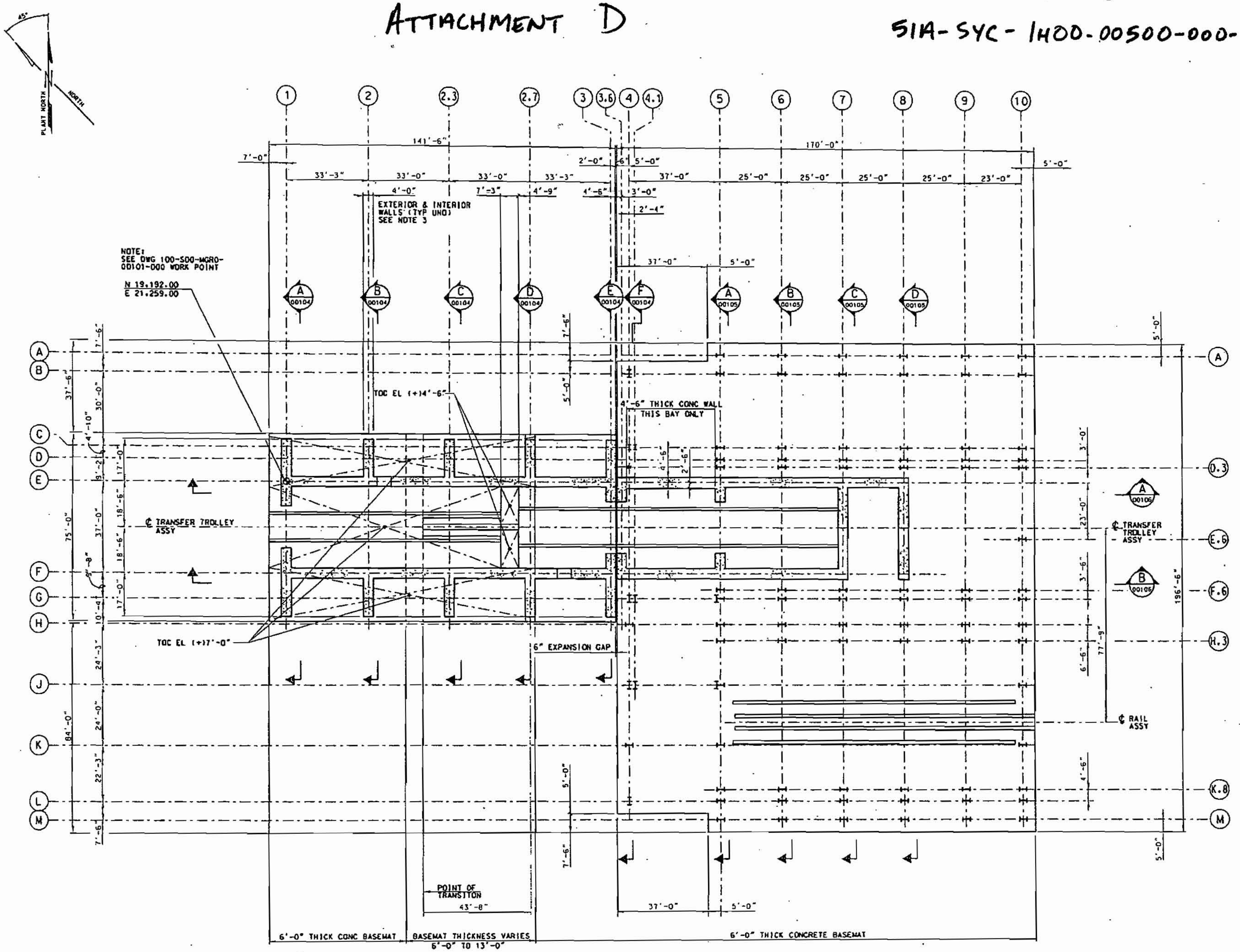
Enclosure:
IHF Layout Design Drawing

Distribution:
Thomas Frankert, BSC, Las Vegas, NV
Lisa V. Green, BSC, Las Vegas, NV
Tracy L. Johnson, BSC, Las Vegas, NV
Norman Kahler, BSC, Las Vegas, NV
Maurice A. LaFountain, BSC, Las Vegas, NV
Salvador C. Macias, BSC, Las Vegas, NV
Arsenio M. Mendiola, BSC, Las Vegas, NV
Steve J. Ployhar, BSC, Las Vegas, NV
Charles L. Sauer, BSC, Las Vegas, NV
Robert C. Slovic, BSC, Las Vegas, NV
Frank X. Trapanese, BSC, Las Vegas, NV

RECEIVED BY BSC CC
DATE: 10/11/2007

ATTACHMENT D

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C



PAGE D-7

GROUND FLOOR CONCRETE FORMING PLAN AT TOC EL 0'-0", TYP UNO

NOTE: IHF EL (+)17'-0" = SITE EL 3678.0 FT

DOCUMENT ID:
51A-SYC-IH00-00500-000-00C

ATTACHMENT D

Salvador Macias
10/12/2007 10:29 AM

To: Jason Paredes/YM/RWDOE@CRWMS, Charles Lew/YM/RWDOE@CRWMS, Luis Alires/YM/RWDOE@CRWMS, Ray Chou/YM/RWDOE@CRWMS, Hsien-Hsiu Ko/YM/RWDOE@CRWMS, Kuo-Chu Hsu/YM/RWDOE@CRWMS, Elmer Acaac/YM/RWDOE@CRWMS, Alan Ketin/YM/RWDOE@CRWMS, Kiritkumar Parikh/YM/RWDOE@CRWMS, Chyi-Ching Lu/YM/RWDOE@CRWMS, Ken McEwan/YM/RWDOE@CRWMS
cc: Thomas Frankert/YM/RWDOE@CRWMS
Subject: Fw: REFERENCE INFORMATION FOR IHF INCLUDE NEW COORDINATES, RAIL TO RAIL DIMENSIONS, AND NEW CONTROL POINT INFORMATION

LSN: Not Relevant - Not Privileged
User Filed as: Excl/AdminMgmt-14-4/QA:N/A

All,

Here is a copy of the 2nd IOM to be used as a DESIGN INPUT for our calculations: Mass Properties, Soil Springs, Steel calculations, Concrete calculations, etc.......Please ensure to reference this IOM into each of our structural calculations.

Thanks,
Sal Macias

---------------------- Forwarded by Salvador Macias/YM/RWDOE on 10/12/2007 10:29 AM ---------------------------

BSC Correspondence Control Unit 09/05/2007 03:22 PM

Work Safe America

Sent by: Linda Mantor

To: Thomas Frankert/YM/RWDOE@CRWMS, Lisa Green/YM/RWDOE@CRWMS, Tracy Johnson/YM/RWDOE@CRWMS, Norman Kahler/YM/RWDOE@CRWMS, Maurice LaFountain/YM/RWDOE@CRWMS, Salvador Macias/YM/RWDOE@CRWMS, Arsenio Mendiola/YM/RWDOE@CRWMS, Steve Ployhar/YM/RWDOE@CRWMS, Charles Sauer/YM/RWDOE@CRWMS, Robert Slovic/YM/RWDOE@CRWMS, Frank Trapanese/YM/RWDOE@CRWMS
cc: David Tooker/YM/RWDOE@CRWMS, Leticia Catino/YM/RWDOE@CRWMS, Ernest Stemley/YM/RWDOE@CRWMS, CMS Coordinator@CRWMS
Subject: REFERENCE INFORMATION FOR IHF INCLUDE NEW COORDINATES, RAIL TO RAIL DIMENSIONS, AND NEW CONTROL POINT INFORMATION
CORRESPONDENCE LOG #0904071711

LSN: Not Relevant - Not Privileged
User Filed as: Excl/AdminMgmt-14-4/QA:N/A

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If you are on copy for the correspondence attached in the doclink above, it is provided for your information only.

DOCUMENT ID:

ATTACHMENT D

51A-SYC-IH00-00500-000-00C

Should you experience difficulty with the doclink, access the Correspondence Control System in Lotus Notes and sort by Log Number to locate correspondence log #0904071711.

Please call Linda Mantor at (702) 821-7301 if you have any questions.

Thank you.

ATTACHMENT D

DOCUMENT ID: 51A-SYC-1H00-00500-000-~~X6~~ -00C

Correspondence Data Entry Form

Log No.
0904071711

Signed Date	09/05/2007
Subject: REFERENCE INFORMATION FOR IHF INCLUDE NEW COORDINATES, RAIL TO RAIL DIMENSIONS, AND NEW CONTROL POINT INFORMATION	

○ Outgoing Correspondence
● Interoffice Memorandum
○ Incoming Correspondence

Attached File	0904071711.pdf Enclosure: 0904071711_enc.pdf	CO/TD L No.	
To Name	Distribution	To Org	BSC/Repository Project Management
cc	Leticia Catino/YM/RWDOE, Ernest Stemley/YM/RWDOE, CMS Coordinator	bcc	
From Name	David Tooker/YM/RWDOE	From Org	BSC/Repository Project Management
Author	David Tooker/YM/RWDOE	Concurrence	
Related Correspondence		Classification	QA: N/A (LSN Relevant)
From/Creator View Only	○ Y ● N	Commitment	○ Y ● N
Status	Signed	Status Date	09/05/2007

DOCUMENT ID:

ATTACHMENT D

51A-SYC-1H00-00500-000-00C

Comments	Transmitted 09/05/2007 @ 3:22 pm.		
Record Accession Number	CCU.20070905.0011	**Creator of Log Entry**	Leticia Catino
Open ATS Database	Open RISWeb		

ATTACHMENT D

~~CCU.20070905.0011~~

FOR Ref:- KP 10-19-07

SEP 05 2007

DOCUMENT ID:
51A-SYC-IHOO-00500-000-00C

BECHTEL SAIC COMPANY, LLC

Interoffice Memorandum

QA: N/A

To:	Distribution	**No.:**	0904071711
From:	David W. Tooker [signature]	**Date:**	Sept. 05, 2007
Re:	Reference Information for IHF Include New Coordinates, Rail-to-Rail Dimensions, and New Control Point Information	**CC:**	

The purpose of this interoffice memorandum (IOM) is to provide a suitable reference / basis for selected layout features of the Initial Handling Facility (i.e., the new (IHF) coordinate grid line identification, new rail centerline-to-centerline dimensions for all of the IHF cranes, and the revised control point information – working point coordinates and elevation of the IHF Building). This IOM will serve as a suitable reference to support preparation and issuance of selected IHF drawings (i.e., the IHF General Arrangement (GA) drawings Revision 00B, and revisions to various mechanical equipment envelope (MEE) drawings until such time that the civil structural drawings and other reference drawings are issued. Use of the information contained within this IOM and enclosure will ensure that all disciplines are aligned with one another and with the Plant Design equipment model and Central Support Area (CSA) Frameworks model.

The information contained in the CSA discipline prepared sketches represents the current up-to-date positions / locations of the steel columns and the up-to-date definition of the coordinate grid lines for the IHF. The CSA sketch of the IHF Ground Floor Plan is located on the L:\\ Drive at the following location: **L:\\ STRU \ LA \ 51A(IHF) ** and the file name is **51ABD0IH0000101.DGN**. The IHF coordinate grid numbering was changed to reflect the addition of structural steel columns and the re-location of several rows of structural steel columns in the facility. The new IHF steel and relocated IHF steel column location changes were made to improve the structural / seismic response of the facility to high seismic conditions that have been imposed on the design of the facility. These necessitated changes for the layout changes and the coordinate grid system for this facility.

Enclosure 1 represents the current up-to-date definition of the crane rail centerline-to-centerline spacing for each of the major cranes in the IHF. The crane rail centerline-to-centerline information contained in enclosure 1 shall be used by all engineering disciplines for the IHF and is consistent with the dimensions that were used in the CSA Frameworks model for the IHF.

The control point information for the IHF is as presented below and on Drawing Number 100-C00-MGR0-00501-000, Revision 00C:

RECEIVED BY BSC CC
DATE: 09/05/2007

ATTACHMENT D

SEP 05 2007

DOCUMENT ID:

51A-SYC-1H00-00500-000-00C

Control Point (E/1)

Plant N Coordinate 19,192.0, Plant E Coordinate 21,259.0, and Elevation 3678.00

Please consider this as direction to proceed on the basis of the information contained in this IOM and in enclosure 1 for completion of the near-term IHF calculations and associated IHF drawings (i.e., GA drawings and Mechanical Handling MEE drawings). In the future, the CSA structural discipline IHF calculations and concrete and steel drawings will be issued that will utilize the new IHF coordinate system and the crane rail centerline-to-centerline dimensions as presented above.

If you have any questions or require clarification, please call me at (702) 821-7580.

Enclosure:
Tabulation of IHF Cranes Rail
Centerline-to-Centerline Dimensions

Distribution:
Thomas Frankert, BSC, Las Vegas, NV
Lisa V. Green, BSC, Las Vegas, NV
Tracy L. Johnson, BSC, Las Vegas, NV
Norman Kahler, BSC, Las Vegas, NV
Maurice A. LaFountian, BSC, Las Vegas, NV
Salvador C. Macias, BSC, Las Vegas, NV
Arsenio M. Mendiola, BSC, Las Vegas, NV
Steve J. Ployhar, BSC, Las Vegas, NV
Charles L. Sauer, BSC, Las Vegas, NV
Robert C. Slovic, BSC, Las Vegas, NV
Frank X. Trapanese, BSC, Las Vegas, NV

ATTACHMENT D

DOCUMENT ID:
51A-SYC-IH00-00500-000-00C

September 04, 2007 IOM from
D. Tooker to Distribution
Enclosure 1, Sheet 1 of 1

TABULATION OF INITIAL HANDLING FACILITY (IHF) CRANES RAIL CENTERLINE-TO-CENTERLINE DIMENSIONS

IHF CRANE NAME	CRANE RAIL-CENTERLINE-TO-RAIL-CENTERLINE DIMENSION
IHF Canister Transfer Machine (CTM) rail-to-rail dimension	= 49'-4"
IHF CTM Maintenance rail-to-rail dimension	= 51'-4"
IHF Cask Handling Crane rail to rail dimension	= 59'-6"
IHF Cask Preparation Crane rail to rail dimension	= 65'-6"
IHF Waste Package Closure System (WPCS) Remote Handling System (RHS) rail to rail dimension	= 28'-4"
IHF Waste Package Closure Room Crane rail to rail dimension	= 28'-4"

ATTACHMENT E

Nuclear Facility Buildings
Exile Hill Fault Splay Location Plan

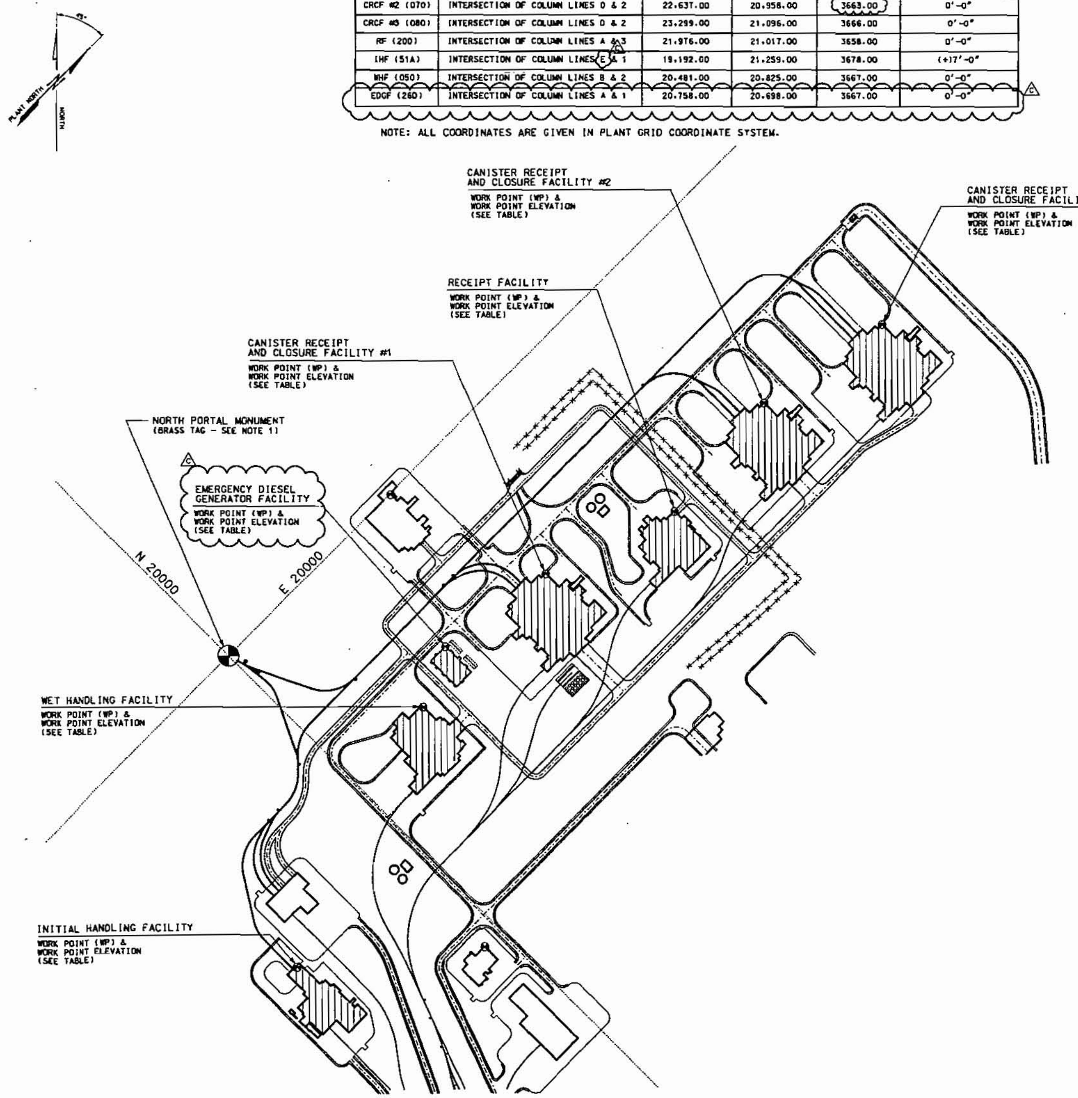
ATTACHMENT E

DOCUMENT ID:
51A-SYC-1H00-00500-000-00C

BUILDING LOCATION TABLE

FACILITY	WORK POINT LOCATION	PLANT N COORDINATE	PLANT E COORDINATE	ACTUAL EL (FT)	BUILDING REF EL
CRCF #1 (060)	INTERSECTION OF COLUMN LINES D & 2	21,333.00	20,794.00	3662.00	0'-0"
CRCF #2 (070)	INTERSECTION OF COLUMN LINES D & 2	22,637.00	20,958.00	3663.00	0'-0"
CRCF #3 (080)	INTERSECTION OF COLUMN LINES D & 2	23,299.00	21,096.00	3666.00	0'-0"
RF (200)	INTERSECTION OF COLUMN LINES A & 3	21,976.00	21,017.00	3658.00	0'-0"
IHF (51A)	INTERSECTION OF COLUMN LINES E & 1	19,192.00	21,259.00	3678.00	(+)7'-0"
WHF (050)	INTERSECTION OF COLUMN LINES B & 2	20,481.00	20,825.00	3667.00	0'-0"
EDGF (26D)	INTERSECTION OF COLUMN LINES A & 1	20,758.00	20,698.00	3667.00	0'-0"

NOTE: ALL COORDINATES ARE GIVEN IN PLANT GRID COORDINATE SYSTEM.



NUCLEAR FACILITIES BUILDINGS LOCATION PLAN

NOTES:

1. ALL NUCLEAR FACILITIES BUILDINGS SHALL BE LOCATED RELATIVE TO AN EXISTING SITE MONUMENT (BRASS TAG) LOCATED AT THE NORTH PORTAL WITH A PLANT GRID COORDINATE CORRESPONDING TO N20,000.00, E20,000.00. THIS COORDINATE CORRESPONDS TO NSP (NEVADA STATE PLANE SYSTEM, CENTRAL ZONE, NAD-27) GRID COORDINATE OF N765352.70, E569814.37 WITH A REFERENCE ELEVATION OF 3683.95 FT.

REFERENCE DRAWINGS:

000-S0J-MGR0-00101-000	NUCLEAR FACILITIES BUILDINGS GENERAL NOTES, CONCRETE NOTES, STRUCTURAL STEEL NOTES, ABBREVIATIONS AND LEGEND
100-C00-MGR0-00501-000	GEOLOGIC REPOSITORY OPERATIONS AREA NORTH PORTAL SITE PLAN
100-S00-MGR0-00102-000	NUCLEAR FACILITIES BUILDINGS DRAWING INDEX

REVISION NOTES

CORRECTED ACTUAL ELEVATION OF CRCF #2 PER INFO ON IOM #0110070154, AND IHF WORK POINT LOCATION FROM "C1" TO "E1" PER NORTH PORTAL SITE PLAN DWG 100-C00-MGR0-00501-000 ISSUED 08/27/07 REMOVED DESIGN INPUT REFERENCE LIST, HOLDS, NOTE 2 & REVISED SAFETY CLASSIFICATION

REVISION HISTORY

NO	DESCRIPTION	DATE							
C	RE-ISSUED FOR LA- SEE REVISION NOTES FOR DETAILS	10/1/07	TO	JO			N/A	N/A	N/A
B	REVISED BLDG LOC TABLE, NOTE 2 & AS SHOWN	6/29/07	NAC	HR	TF	DN	N/A	N/A	PB
A	ISSUED FOR LA	5/26/07	LV	JB	TF	DN	N/A	N/A	JO

U.S. DEPARTMENT OF ENERGY
Office of Civilian Radioactive Waste Management
BECHTEL SAIC — Management and Operation of the Office of Civilian Radioactive Waste Management Program

N. CABATO	LV/NAC 5/25/07
J. BISSET	JRB 5/25/07
T. FRANKERT	TF 5/25/07
D. NEVERGOLD	DN 5/26/07
N/A	N/A
N/A	N/A
J. OSHIKANLU	JO 5/25/07

NUCLEAR FACILITIES BUILDINGS LOCATION PLAN

NON-ITS & NON-ITWI — 100-S00-MGR0-00101-000
E1 — NTS — 100s00mgr000101.dgn — 00C

THIS DRAWING IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION, PROCUREMENT OR FABRICATION.

ANSI E- 34"x44" — RECORD DESIGNATOR — QA: N/A

ATTACHMENT F

ASSESSMENT FOR REVISED SOIL PROPERTIES

The purpose of this attachment is to assess the impact on the computed foundation impedances for the revised strain compatible soil properties given in DTN's MO0801SCSPS5E4.003 (Ref. 2.2.5) and MO0801SCSPS1E4.003 (Ref. 2.2.11). Soil spring values computed in the body of this calculation and used in subsequent seismic analysis calculations of the IHF were based on DTN's MO0706SCSPS5E4.002 and MO0706SCSPS1E4.002, which have been superseded by the above referenced DTN's.

To assess the impact of the new strain compatible soil properties on the foundation impedance functions, the composite soil column shear modulus, G's, is recomputed using the data in references 2.2.5 and 2.2.11. A comparison of the shear modulus for each of the soil cases computed using both the current data and the superceded data is made.

Soil impedances calculated in section 6 of this calculation were computed using the formulas of equivalent spring constant and equivalent damping coefficient given in Table 3.3-3 of ASCE 4-98 (Ref. 2.2.3). In reviewing the formulas of spring constant given, it is observed that both the translation and rotational spring constants are linear functions of the soil shear modulus, G′. Thus the computed spring values will be directly proportional to the percentage increase or decrease in the computed soil shear modulus as determined in this attachment. As stated in section 6 of the calculation, the soil damping ratio (= C/Cc) values are independent of the shear modulus and thus are not impacted by the revised soil properties.

The equivalent soil shear modulus computed in this attachment uses the same method described in section 4.3 and carried out in section 6 using the applicable strain compatible soil properties given in Ref. 2.2.5 and 2.2.11. These shear modulus calculations are carried out in excel spreadsheets on pages F-3 through F-38.

Revised shear modulus values for each of the soil cases (upper bound, median, lower bound) and each of the alluvium depths (South 30′ and South 100′) for both the 5E-4 and 1E-4 cases are summarized and compared to the values computed using the superseded data in Tables F1 and F2.

As seen in Tables F1 and F2, the maximum change in G′ and thus the corresponding change in soil spring constant values from the new data compared to the superceded data used in the foundation spring calculations is 4.76%. The effect of this change in foundation spring constant on the seismic analysis results is even less since the natural frequency of a system is proportional to the square root of the corresponding foundation spring constant. Thus a 4.76% change in spring constant will result in a ($\sqrt{1+0.0476}$ -1) x 100% or 2.35 % shift in natural frequency. Given the broadband nature of the YMP input ground spectra (Ref. 2.2.16) the effect of this 2.35% change in natural frequency will have a negligible impact on the computed seismic analysis results. The existing seismic analysis results, based on the foundation springs computed using the superceded data contained in MO0706SCSPS5E4.002 and MO0706SCSPS1E4.002, are adequate for use in the preliminary design of the Initial Handling Facility.

Table F1: Soil Shear Modulus (G') Comparison for 5E-4 Seismic Event (Unit in ksf):

IHF Part 1:

DTN:	South 30' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
MO0706SCSPS5E4.002:	6203	12278	21640	4387	8596	16773
(Reference Page No.)	*15*	*12*	*18*	*17*	*14*	*20*
MO0801SCSPS5E4.003:	6292	12454	21950	4596	9001	17543
(Reference Page No.)	*F-6*	*F-3*	*F-9*	*F-8*	*F-5*	*F-11*
% Change:	1.43	1.43	1.43	4.76	4.71	4.59

IHF Part 2:

DTN:	South 30' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
MO0706SCSPS5E4.002:	9402	17216	30962	6361	12260	23383
(Reference Page No.)	*24*	*21*	*27*	*26*	*23*	*29*
MO0801SCSPS5E4.003:	9542	17472	31408	6635	12838	24447
(Reference Page No.)	*F-15*	*F-12*	*F-18*	*F-17*	*F-14*	*F-20*
% Change:	1.49	1.49	1.44	4.31	4.71	4.55

Table F2: Soil Shear Modulus (G') Comparison for 1E-4 Seismic Event (Unit in ksf):

IHF Part 1:

DTN:	South 30' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
MO0706SCSPS1E4.002:	4321	8283	15696	2894	5721	11305
(Reference Page No.)	*33*	*30*	*36*	*35*	*32*	*38*
MO0801SCSPS1E4.003:	4373	8387	15907	3006	5946	11717
(Reference Page No.)	*F-24*	*F-21*	*F-27*	*F-26*	*F-23*	*F-29*
% Change:	1.20	1.26	1.34	3.87	3.93	3.64

IHF Part 2:

DTN:	South 30' Alluvium			South 100' Alluvium		
	Lower Bound	Median	Upper Bound	Lower Bound	Median	Upper Bound
MO0706SCSPS1E4.002:	6755	12642	23286	4178	8177	15934
(Reference Page No.)	*42*	*39*	*45*	*44*	*41*	*47*
MO0801SCSPS1E4.003:	6840	12806	23605	4334	8469	16445
(Reference Page No.)	*F-33*	*F-30*	*F-36*	*F-35*	*F-32*	*F-38*
% Change:	1.26	1.30	1.37	3.73	3.57	3.21

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**

MEDIAN VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))
WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY[(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	914.20	2918.0	0.367	7978.8	0.02667	1	4.0000	5.01E-04
2	4.00	6.00	112.32	875.13	2673.9	0.387	7418.1	0.08000	1	4.0000	5.39E-04
3	4.00	10.00	112.32	1066.50	3971.3	0.388	11025.8	0.13333	1	4.0000	3.63E-04
4	4.00	14.00	112.32	1249.10	5447.5	0.387	15113.1	0.18667	1	4.0000	2.65E-04
5	4.00	18.00	112.32	1314.80	6035.7	0.389	16765.8	0.24000	0.972	3.8869	2.32E-04
6	8.00	24.00	112.32	1385.70	6704.2	0.391	18647.0	0.32000	0.915	7.3211	3.93E-04
7	2.00	29.00	112.32	1726.90	10412.1	0.365	28424.8	0.38667	0.868	1.7369	6.11E-05
8	10.00	35.00	137.28	2238.40	21381.2	0.283	54847.8	0.46668	0.811	8.1143	1.48E-04
9	10.00	45.00	137.28	2498.50	26638.8	0.278	68078.7	0.60001	0.717	7.1714	1.05E-04
10	10.00	55.00	137.28	2611.40	29100.7	0.274	74136.9	0.73335	0.636	6.3620	8.58E-05
11	10.00	65.00	137.28	2708.90	31314.3	0.273	79736.1	0.86668	0.569	5.6860	7.13E-05
12	10.00	75.00	137.28	2853.60	34749.0	0.268	88122.8	1.00001	0.501	5.0100	5.69E-05
13	10.00	85.00	137.28	2974.70	37760.9	0.270	95939.2	1.13335	0.433	4.3340	4.52E-05
14	10.00	95.00	137.28	3039.10	39413.6	0.273	100348.6	1.26668	0.366	3.6580	3.65E-05
15	10.00	105.00	137.28	3124.20	41651.8	0.275	106252.9	1.40001	0.321	3.2110	3.02E-05
16	10.00	115.00	137.28	3197.40	43626.5	0.276	111333.9	1.53335	0.299	2.9930	2.69E-05
17	10.00	125.00	137.28	3211.30	44006.6	0.275	112256.5	1.66668	0.278	2.7750	2.47E-05
18	10.00	135.00	137.28	3251.90	45126.4	0.277	115249.2	1.80001	0.256	2.5570	2.22E-05
19	15.00	147.50	137.28	3292.50	46260.2	0.280	118427.1	1.96668	0.228	3.4268	2.89E-05
20	15.00	162.50	137.28	3451.60	50839.0	0.282	130357.3	2.16668	0.196	2.9363	2.25E-05
21	15.00	177.50	137.28	3519.80	52867.9	0.283	135673.9	2.36668	0.163	2.4458	1.80E-05
22	15.00	192.50	137.28	3547.70	53709.4	0.284	137914.9	2.56668	0.130	1.9553	1.42E-05
23	15.00	207.50	137.28	3561.40	54125.0	0.288	139410.8	2.76668	0.110	1.6448	1.18E-05
24	15.00	222.50	137.28	3620.40	55933.2	0.287	144004.4	2.96668	0.101	1.5143	1.05E-05
25	7.50	233.75	137.28	3664.50	57304.1	0.288	147626.8	3.11668	0.094	0.7082	4.80E-06
26	7.50	241.25	137.28	3661.90	57222.8	0.289	147481.5	3.21668	0.090	0.6756	4.58E-06
27	7.50	248.75	137.28	3671.70	57529.5	0.289	148270.8	3.31668	0.086	0.6429	4.34E-06
28	7.50	256.25	137.28	3695.40	58274.6	0.288	150081.5	3.41668	0.081	0.6103	4.07E-06
29	7.50	263.75	137.28	3762.00	60394.0	0.287	155474.7	3.51668	0.077	0.5777	3.72E-06
30	7.50	271.25	137.28	3777.00	60876.6	0.289	156896.0	3.61668	0.073	0.5451	3.47E-06
31	7.50	278.75	137.28	3813.20	62049.1	0.289	159963.8	3.71668	0.068	0.5124	3.20E-06
32	7.50	286.25	137.28	3854.60	63403.7	0.288	163377.5	3.81668	0.064	0.4798	2.94E-06
33	7.50	293.75	137.28	3869.30	63888.3	0.290	164799.7	3.91668	0.060	0.4472	2.71E-06
34	7.50	301.25	137.28	3895.60	64759.7	0.288	166828.8	4.01668	0.056	0.4185	2.51E-06
35	7.50	308.75	137.28	3927.80	65834.7	0.288	169531.0	4.11668	0.055	0.4095	2.42E-06
36	7.50	316.25	137.28	3968.40	67202.8	0.288	173166.7	4.21668	0.053	0.4005	2.31E-06
37	10.16	325.08	137.28	3965.80	67114.7	0.286	172660.7	4.33439	0.052	0.5280	3.06E-06
38	9.84	335.08	137.28	4033.70	69432.6	0.285	178502.9	4.46773	0.050	0.4960	2.78E-06
39	10.16	345.08	137.28	4046.90	69887.8	0.284	179524.9	4.60105	0.049	0.4955	2.76E-06
40	9.84	355.08	137.28	4100.00	71733.8	0.284	184162.2	4.73440	0.047	0.4645	2.52E-06
41	20.00	370.00	137.28	4192.80	75017.8	0.282	192369.7	4.93335	0.045	0.8960	4.66E-06
42	20.00	390.00	137.28	4200.10	75279.3	0.282	192957.4	5.20001	0.042	0.8320	4.31E-06
43	20.00	410.00	137.28	4261.30	77489.1	0.283	198864.8	5.46668	0.038	0.7640	3.84E-06
44	20.00	430.00	137.28	4418.90	83326.8	0.284	213971.5	5.73335	0.035	0.6920	3.23E-06
45	20.00	450.00	137.28	4492.30	86118.0	0.284	221068.2	6.00001	0.031	0.6200	2.80E-06
					μ for E below =	0.349			Σ=	106.9553	3.18E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	33597	ksf
G' = E/(2*(1+μ)) =:	12454	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1888.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1708.3	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
MEDIAN VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE:
Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 75 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	880.98	2709.8	0.368	7416.6	0.02667	1	4.0000	5.39E-04
2	4.00	6.00	112.32	867.65	2628.4	0.388	7297.9	0.08000	1	4.0000	5.48E-04
3	4.00	10.00	112.32	990.65	3426.5	0.392	9539.1	0.13333	1	4.0000	4.19E-04
4	4.00	14.00	112.32	1148.70	4607.0	0.392	12827.7	0.18667	1	4.0000	3.12E-04
5	4.00	18.00	112.32	1273.90	5666.0	0.392	15774.3	0.24000	0.972	3.8869	2.46E-04
6	8.00	24.00	112.32	1321.70	6099.2	0.395	17017.3	0.32000	0.915	7.3211	4.30E-04
7	8.00	32.00	112.32	1517.70	8042.3	0.377	22140.5	0.42667	0.840	6.7177	3.03E-04
8	8.00	40.00	112.32	1609.00	9039.0	0.362	24617.6	0.53333	0.764	6.1143	2.48E-04
9	8.00	48.00	112.32	1705.90	10160.5	0.356	27557.0	0.64000	0.689	5.5109	2.00E-04
10	8.00	56.00	112.32	1895.40	12543.2	0.337	33542.7	0.74667	0.623	4.9856	1.49E-04
11	10.00	65.00	112.32	1971.70	13573.4	0.337	36304.2	0.86667	0.553	5.5300	1.52E-04
12	10.00	75.00	137.28	2752.70	32335.1	0.268	82004.4	1.00000	0.475	4.7500	5.79E-05
13	10.00	85.00	137.28	2843.10	34493.8	0.270	87645.2	1.13333	0.397	3.9700	4.53E-05
14	10.00	95.00	137.28	3002.20	38462.3	0.273	97902.0	1.26667	0.319	3.1900	3.26E-05
15	10.00	105.00	137.28	3032.70	39247.8	0.275	100109.3	1.40000	0.271	2.7060	2.70E-05
16	10.00	115.00	137.28	3136.20	41972.4	0.276	107090.9	1.53333	0.252	2.5180	2.35E-05
17	10.00	125.00	137.28	3160.90	42636.1	0.275	108749.4	1.66667	0.233	2.3300	2.14E-05
18	10.00	135.00	137.28	3212.20	44031.3	0.277	112446.2	1.80000	0.214	2.1420	1.90E-05
19	15.00	147.50	137.28	3241.50	44838.2	0.280	114788.5	1.96667	0.191	2.8605	2.49E-05
20	15.00	162.50	137.28	3312.20	46815.5	0.282	120076.0	2.16667	0.163	2.4375	2.03E-05
21	15.00	177.50	137.28	3400.80	49353.5	0.283	126689.6	2.36667	0.134	2.0145	1.59E-05
22	15.00	192.50	137.28	3476.00	51560.3	0.284	132426.5	2.56667	0.106	1.5915	1.20E-05
23	15.00	207.50	137.28	3562.20	54149.3	0.288	139476.7	2.76667	0.089	1.3395	9.60E-06
24	15.00	222.50	137.28	3679.80	57783.6	0.287	148740.8	2.96667	0.084	1.2585	8.46E-06
25	7.50	233.75	137.28	3741.60	59740.8	0.288	153873.1	3.11667	0.080	0.5989	3.89E-06
26	7.50	241.25	137.28	3751.00	60041.3	0.288	154709.7	3.21667	0.077	0.5786	3.74E-06
27	7.50	248.75	137.28	3738.00	59625.9	0.288	153644.0	3.31667	0.074	0.5584	3.63E-06
28	7.50	256.25	137.28	3789.30	61273.7	0.287	157776.1	3.41667	0.072	0.5381	3.41E-06
29	7.50	263.75	137.28	3838.90	62888.3	0.287	161869.4	3.51667	0.069	0.5179	3.20E-06
30	7.50	271.25	137.28	3872.50	63994.0	0.288	164894.5	3.61667	0.066	0.4976	3.02E-06
31	7.50	278.75	137.28	3917.00	65473.2	0.289	168757.1	3.71667	0.064	0.4774	2.83E-06
32	7.50	286.25	137.28	3914.70	65396.3	0.288	168498.8	3.81667	0.061	0.4571	2.71E-06
33	7.50	293.75	137.28	3925.80	65767.7	0.290	169633.3	3.91667	0.058	0.4369	2.58E-06
34	7.50	301.25	137.28	3925.30	65750.9	0.288	169377.0	4.01667	0.056	0.4179	2.47E-06
35	7.50	308.75	137.28	3945.30	66422.7	0.288	171053.0	4.11667	0.054	0.4056	2.37E-06
36	7.50	316.25	137.28	4032.00	69374.1	0.288	178745.1	4.21667	0.052	0.3932	2.20E-06
37	10.16	325.08	137.28	4051.00	70029.4	0.286	180133.9	4.33437	0.050	0.5128	2.85E-06
38	9.84	335.08	137.28	4092.40	71468.1	0.285	183718.8	4.46772	0.048	0.4752	2.59E-06
39	10.16	345.08	137.28	4102.20	71810.8	0.284	184451.8	4.60104	0.046	0.4681	2.54E-06
40	9.84	355.08	137.28	4159.90	73845.2	0.284	189564.9	4.73439	0.044	0.4319	2.28E-06
41	20.00	370.00	137.28	4224.40	76152.9	0.282	195277.3	4.93333	0.041	0.8120	4.16E-06
42	20.00	390.00	137.28	4351.40	80800.5	0.281	207057.8	5.20000	0.036	0.7240	3.50E-06
43	20.00	410.00	137.28	4394.10	82394.1	0.283	211421.6	5.46667	0.033	0.6600	3.12E-06
44	20.00	430.00	137.28	4471.50	85322.3	0.284	219095.8	5.73333	0.031	0.6200	2.83E-06
45	20.00	450.00	137.28	4498.20	86344.3	0.284	221659.7	6.00000	0.029	0.5800	2.62E-06
					μ for E below =	0.360			Σ=	100.3360	3.93E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	25541	ksf
G' = E/(2*(1+μ)) =:	9390	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1640.0	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1483.4	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
MEDIAN VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	902.96	2846.7	0.366	7779.8	0.02667	1	4.0000	5.14E-04
2	4.00	6.00	112.32	853.75	2544.9	0.389	7071.3	0.08000	1	4.0000	5.66E-04
3	4.00	10.00	112.32	938.64	3076.1	0.394	8575.8	0.13333	1	4.0000	4.66E-04
4	4.00	14.00	112.32	1128.60	4447.2	0.393	12390.3	0.18667	1	4.0000	3.23E-04
5	4.00	18.00	112.32	1290.60	5815.5	0.392	16188.6	0.24000	0.972	3.8869	2.40E-04
6	8.00	24.00	112.32	1375.40	6604.9	0.393	18405.5	0.32000	0.915	7.3211	3.98E-04
7	8.00	32.00	112.32	1591.70	8845.6	0.374	24314.5	0.42667	0.840	6.7177	2.76E-04
8	8.00	40.00	112.32	1638.50	9373.4	0.361	25513.2	0.53333	0.764	6.1143	2.40E-04
9	8.00	48.00	112.32	1683.00	9889.5	0.357	26848.0	0.64000	0.689	5.5109	2.05E-04
10	8.00	56.00	112.32	1891.70	12494.3	0.338	33426.9	0.74667	0.623	4.9856	1.49E-04
11	10.00	65.00	112.32	1914.10	12791.9	0.340	34275.4	0.86667	0.553	5.5300	1.61E-04
12	10.00	75.00	112.32	2060.50	14823.5	0.338	39653.8	1.00000	0.475	4.7500	1.20E-04
13	10.00	85.00	112.32	2205.40	16981.7	0.336	45360.1	1.13333	0.397	3.9700	8.75E-05
14	10.00	95.00	112.32	2326.10	18891.3	0.334	50415.3	1.26667	0.319	3.1900	6.33E-05
15	10.00	105.00	137.28	2850.60	34676.0	0.276	88500.0	1.40000	0.271	2.7060	3.06E-05
16	10.00	115.00	137.28	2936.90	36807.3	0.276	93968.4	1.53333	0.252	2.5180	2.68E-05
17	10.00	125.00	137.28	3003.00	38482.8	0.276	98175.8	1.66667	0.233	2.3300	2.37E-05
18	10.00	135.00	137.28	3082.10	40536.8	0.277	103533.5	1.80000	0.214	2.1420	2.07E-05
19	15.00	147.50	137.28	3161.50	42652.3	0.280	109190.8	1.96667	0.191	2.8605	2.62E-05
20	15.00	162.50	137.28	3229.70	44512.4	0.283	114176.0	2.16667	0.163	2.4375	2.13E-05
21	15.00	177.50	137.28	3384.00	48867.1	0.283	125417.5	2.36667	0.134	2.0145	1.61E-05
22	15.00	192.50	137.28	3463.20	51181.3	0.284	131420.3	2.56667	0.106	1.5915	1.21E-05
23	15.00	207.50	137.28	3525.80	53048.3	0.288	136630.2	2.76667	0.089	1.3395	9.80E-06
24	15.00	222.50	137.28	3575.20	54545.2	0.287	140427.8	2.96667	0.084	1.2585	8.96E-06
25	7.50	233.75	137.28	3679.50	57774.2	0.288	148812.4	3.11667	0.080	0.5989	4.02E-06
26	7.50	241.25	137.28	3679.50	57774.2	0.288	148877.1	3.21667	0.077	0.5786	3.89E-06
27	7.50	248.75	137.28	3708.80	58698.0	0.288	151248.2	3.31667	0.074	0.5584	3.69E-06
28	7.50	256.25	137.28	3807.40	61860.5	0.287	159269.7	3.41667	0.072	0.5381	3.38E-06
29	7.50	263.75	137.28	3858.00	63515.6	0.287	163465.1	3.51667	0.069	0.5179	3.17E-06
30	7.50	271.25	137.28	3871.00	63944.4	0.288	164756.6	3.61667	0.066	0.4976	3.02E-06
31	7.50	278.75	137.28	3904.70	65062.6	0.289	167693.7	3.71667	0.064	0.4774	2.85E-06
32	7.50	286.25	137.28	3966.70	67145.2	0.288	172975.4	3.81667	0.061	0.4571	2.64E-06
33	7.50	293.75	137.28	4006.00	68482.3	0.289	176588.4	3.91667	0.058	0.4369	2.47E-06
34	7.50	301.25	137.28	4028.50	69253.7	0.288	178340.7	4.01667	0.056	0.4179	2.34E-06
35	7.50	308.75	137.28	4053.00	70098.6	0.287	180454.9	4.11667	0.054	0.4056	2.25E-06
36	7.50	316.25	137.28	4150.90	73526.0	0.288	189375.0	4.21667	0.052	0.3932	2.08E-06
37	10.16	325.08	137.28	4172.90	74307.4	0.286	191066.7	4.33437	0.050	0.5128	2.68E-06
38	9.84	335.08	137.28	4211.80	75699.3	0.285	194521.4	4.46772	0.048	0.4752	2.44E-06
39	10.16	345.08	137.28	4211.20	75677.7	0.284	194313.1	4.60104	0.046	0.4681	2.41E-06
40	9.84	355.08	137.28	4282.70	78269.3	0.283	200850.0	4.73439	0.044	0.4319	2.15E-06
41	20.00	370.00	137.28	4291.80	78602.3	0.282	201509.5	4.93333	0.041	0.8120	4.03E-06
42	20.00	390.00	137.28	4319.50	79620.2	0.281	204025.1	5.20000	0.036	0.7240	3.55E-06
43	20.00	410.00	137.28	4358.80	81075.6	0.283	208028.6	5.46667	0.033	0.6600	3.17E-06
44	20.00	430.00	137.28	4465.90	85108.7	0.284	218525.2	5.73333	0.031	0.6200	2.84E-06
45	20.00	450.00	137.28	4485.60	85861.3	0.283	220402.4	6.00000	0.029	0.5800	2.63E-06
					μ for E below =	0.370			Σ=	100.3360	4.07E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	24670	ksf
G' = E/(2*(1+μ)) =:	9001	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1605.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1452.3	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	646.44	1459.0	0.367	3989.4	0.02667	1	4.0000	1.00E-03
2	4.00	6.00	112.32	618.81	1337.0	0.387	3709.0	0.08000	1	4.0000	1.08E-03
3	4.00	10.00	112.32	754.14	1985.7	0.388	5513.1	0.13333	1	4.0000	7.26E-04
4	4.00	14.00	112.32	883.28	2724.0	0.387	7557.1	0.18667	1	4.0000	5.29E-04
5	4.00	18.00	112.32	929.70	3017.8	0.389	8382.8	0.24000	0.972	3.8869	4.64E-04
6	8.00	24.00	112.32	979.83	3352.0	0.391	9323.3	0.32000	0.915	7.3211	7.85E-04
7	2.00	29.00	112.32	1221.10	5206.1	0.365	14212.3	0.38667	0.868	1.7369	1.22E-04
8	10.00	35.00	137.28	1728.60	12751.0	0.283	32709.4	0.46668	0.811	8.1143	2.48E-04
9	10.00	45.00	137.28	2040.00	17758.9	0.278	45385.1	0.60001	0.717	7.1714	1.58E-04
10	10.00	55.00	137.28	2132.20	19400.5	0.274	49424.6	0.73335	0.631	6.3100	1.28E-04
11	10.00	65.00	137.28	2211.80	20876.0	0.273	53157.1	0.86668	0.553	5.5300	1.04E-04
12	10.00	75.00	137.28	2327.00	23107.3	0.268	58599.6	1.00001	0.475	4.7500	8.11E-05
13	10.00	85.00	137.28	2428.80	25173.3	0.270	63957.7	1.13335	0.397	3.9700	6.21E-05
14	10.00	95.00	137.28	2481.40	26275.4	0.273	66898.3	1.26668	0.319	3.1900	4.77E-05
15	10.00	105.00	137.28	2539.50	27520.3	0.275	70203.7	1.40001	0.271	2.7060	3.85E-05
16	10.00	115.00	137.28	2610.70	29085.1	0.276	74224.5	1.53335	0.252	2.5180	3.39E-05
17	10.00	125.00	137.28	2622.00	29337.4	0.275	74836.8	1.66668	0.233	2.3300	3.11E-05
18	10.00	135.00	137.28	2655.20	30085.0	0.277	76834.8	1.80001	0.214	2.1420	2.79E-05
19	15.00	147.50	137.28	2688.30	30839.8	0.280	78950.5	1.96668	0.191	2.8605	3.62E-05
20	15.00	162.50	137.28	2818.20	33892.2	0.282	86903.7	2.16668	0.163	2.4375	2.80E-05
21	15.00	177.50	137.28	2873.90	35245.2	0.283	90449.0	2.36668	0.134	2.0145	2.23E-05
22	15.00	192.50	137.28	2896.70	35806.6	0.284	91944.2	2.56668	0.106	1.5915	1.73E-05
23	15.00	207.50	137.28	2907.80	36081.6	0.288	92936.0	2.76668	0.089	1.3395	1.44E-05
24	15.00	222.50	137.28	2956.00	37287.7	0.287	96000.1	2.96668	0.084	1.2585	1.31E-05
25	7.50	233.75	137.28	2992.10	38204.0	0.288	98421.0	3.11668	0.080	0.5989	6.08E-06
26	7.50	241.25	137.28	2989.90	38147.8	0.289	98319.1	3.21668	0.077	0.5786	5.89E-06
27	7.50	248.75	137.28	2998.00	38354.8	0.289	98851.8	3.31668	0.074	0.5584	5.65E-06
28	7.50	256.25	137.28	3017.30	38850.2	0.288	100055.6	3.41668	0.072	0.5381	5.38E-06
29	7.50	263.75	137.28	3071.70	40263.7	0.287	103652	3.51668	0.069	0.5179	5.00E-06
30	7.50	271.25	137.28	3083.90	40584.2	0.289	104597	3.61668	0.066	0.4976	4.76E-06
31	7.50	278.75	137.28	3113.50	41367.0	0.289	106645	3.71668	0.064	0.4774	4.48E-06
32	7.50	286.25	137.28	3147.30	42270.0	0.288	108921	3.81668	0.061	0.4571	4.20E-06
33	7.50	293.75	137.28	3159.30	42593.0	0.290	109869	3.91668	0.058	0.4369	3.98E-06
34	7.50	301.25	137.28	3180.80	43174.7	0.288	111223	4.01668	0.056	0.4179	3.76E-06
35	7.50	308.75	137.28	3207.00	43888.8	0.288	113018	4.11668	0.054	0.4056	3.59E-06
36	7.50	316.25	137.28	3240.20	44802.3	0.288	115446	4.21668	0.052	0.3932	3.41E-06
37	10.16	325.08	137.28	3238.10	44744.2	0.286	115110	4.33439	0.050	0.5128	4.45E-06
38	9.84	335.08	137.28	3293.50	46288.3	0.285	119002	4.46773	0.048	0.4752	3.99E-06
39	10.16	345.08	137.28	3304.30	46592.4	0.284	119685	4.60105	0.046	0.4681	3.91E-06
40	9.84	355.08	137.28	3347.60	47821.5	0.284	122772	4.73440	0.044	0.4319	3.52E-06
41	20.00	370.00	137.28	3423.40	50011.7	0.282	128246	4.93335	0.041	0.8120	6.33E-06
42	20.00	390.00	137.28	3429.30	50184.2	0.282	128633	5.20001	0.036	0.7240	5.63E-06
43	20.00	410.00	137.28	3479.40	51661.3	0.283	132581	5.46668	0.033	0.6600	4.98E-06
44	20.00	430.00	137.28	3608.10	55553.7	0.284	142654	5.73335	0.031	0.6200	4.35E-06
45	20.00	450.00	137.28	3668.00	57413.6	0.284	147383	6.00001	0.029	0.5800	3.94E-06
					μ for E below =	0.352			Σ=	100.3401	5.90E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	17019	ksf
G' = E/(2*(1+μ)) =:	6292	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1342	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1214	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **$G' = Vs^2 \cdot \rho/(1000 \cdot 32.17)$**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY [(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	622.94	1354.9	0.368	3708.2	0.02667	1	4.0000	1.08E-03
2	4.00	6.00	112.32	613.52	1314.2	0.388	3648.9	0.08000	1	4.0000	1.10E-03
3	4.00	10.00	112.32	700.50	1713.3	0.392	4769.6	0.13333	1	4.0000	8.39E-04
4	4.00	14.00	112.32	812.26	2303.5	0.392	6413.9	0.18667	1	4.0000	6.24E-04
5	4.00	18.00	112.32	900.75	2832.8	0.392	7886.5	0.24000	0.972	3.8869	4.93E-04
6	8.00	24.00	112.32	934.55	3049.4	0.395	8508.1	0.32000	0.915	7.3211	8.60E-04
7	8.00	32.00	112.32	1073.20	4021.3	0.377	11070.7	0.42667	0.840	6.7177	6.07E-04
8	8.00	40.00	112.32	1137.70	4519.2	0.362	12308.0	0.53333	0.764	6.1143	4.97E-04
9	8.00	48.00	112.32	1206.20	5079.8	0.356	13777.3	0.64000	0.689	5.5109	4.00E-04
10	8.00	56.00	112.32	1342.10	6288.9	0.337	16817.7	0.74667	0.623	4.9856	2.96E-04
11	10.00	65.00	112.32	1401.10	6854.0	0.337	18332.1	0.86667	0.553	5.5300	3.02E-04
12	10.00	75.00	137.28	2247.60	21557.3	0.268	54671.0	1.00000	0.475	4.7500	8.69E-05
13	10.00	85.00	137.28	2321.40	22996.2	0.270	58431.1	1.13333	0.397	3.9700	6.79E-05
14	10.00	95.00	137.28	2451.30	25641.8	0.273	65268.7	1.26667	0.319	3.1900	4.89E-05
15	10.00	105.00	137.28	2476.20	26165.4	0.275	66740.1	1.40000	0.271	2.7060	4.05E-05
16	10.00	115.00	137.28	2560.70	27981.7	0.276	71394.1	1.53333	0.252	2.5180	3.53E-05
17	10.00	125.00	137.28	2580.90	28424.9	0.275	72501.6	1.66667	0.233	2.3300	3.21E-05
18	10.00	135.00	137.28	2622.80	29355.3	0.277	74967.0	1.80000	0.214	2.1420	2.86E-05
19	15.00	147.50	137.28	2646.70	29892.7	0.280	76527.2	1.96667	0.191	2.8605	3.74E-05
20	15.00	162.50	137.28	2704.40	31210.3	0.282	80050.7	2.16667	0.163	2.4375	3.04E-05
21	15.00	177.50	137.28	2776.70	32901.4	0.283	84457.2	2.36667	0.134	2.0145	2.39E-05
22	15.00	192.50	137.28	2838.10	34372.5	0.284	88281.7	2.56667	0.106	1.5915	1.80E-05
23	15.00	207.50	137.28	2908.60	36101.4	0.288	92989.3	2.76667	0.089	1.3395	1.44E-05
24	15.00	222.50	137.28	3004.50	38521.3	0.287	99157.6	2.96667	0.084	1.2585	1.27E-05
25	7.50	233.75	137.28	3055.00	39827.1	0.288	102581.9	3.11667	0.080	0.5989	5.84E-06
26	7.50	241.25	137.28	3062.70	40028.1	0.288	103141.2	3.21667	0.077	0.5786	5.61E-06
27	7.50	248.75	137.28	3052.00	39748.9	0.288	102425.0	3.31667	0.074	0.5584	5.45E-06
28	7.50	256.25	137.28	3093.90	40847.8	0.287	105180.7	3.41667	0.072	0.5381	5.12E-06
29	7.50	263.75	137.28	3134.50	41926.9	0.287	107916.5	3.51667	0.069	0.5179	4.80E-06
30	7.50	271.25	137.28	3161.90	42663.1	0.288	109930.9	3.61667	0.066	0.4976	4.53E-06
31	7.50	278.75	137.28	3198.20	43648.3	0.289	112503.5	3.71667	0.064	0.4774	4.24E-06
32	7.50	286.25	137.28	3196.30	43596.5	0.288	112329.8	3.81667	0.061	0.4571	4.07E-06
33	7.50	293.75	137.28	3205.40	43845.1	0.290	113088.7	3.91667	0.058	0.4369	3.86E-06
34	7.50	301.25	137.28	3205.00	43834.1	0.288	112918.4	4.01667	0.056	0.4179	3.70E-06
35	7.50	308.75	137.28	3221.30	44281.1	0.288	114033.6	4.11667	0.054	0.4056	3.56E-06
36	7.50	316.25	137.28	3292.10	46249.0	0.288	119162.4	4.21667	0.052	0.3932	3.30E-06
37	10.16	325.08	137.28	3307.70	46688.3	0.286	120094.6	4.33437	0.050	0.5128	4.27E-06
38	9.84	335.08	137.28	3341.50	47647.4	0.285	122484.3	4.46772	0.048	0.4752	3.88E-06
39	10.16	345.08	137.28	3349.50	47875.8	0.284	122972.9	4.60104	0.046	0.4681	3.81E-06
40	9.84	355.08	137.28	3396.50	49228.8	0.284	126373.3	4.73439	0.044	0.4319	3.42E-06
41	20.00	370.00	137.28	3449.30	50771.3	0.282	130191.8	4.93333	0.041	0.8120	6.24E-06
42	20.00	390.00	137.28	3552.90	53866.9	0.281	138038.3	5.20000	0.036	0.7240	5.24E-06
43	20.00	410.00	137.28	3587.80	54930.4	0.283	140950.3	5.46667	0.033	0.6600	4.68E-06
44	20.00	430.00	137.28	3651.00	56882.7	0.284	146066.7	5.73333	0.031	0.6200	4.24E-06
45	20.00	450.00	137.28	3672.70	57560.8	0.284	147767.9	6.00000	0.029	0.5800	3.93E-06
					μ for E below =	0.359			Σ=	100.3360	7.66E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

$E = SUM(Nq \cdot H) / SUM(Nq \cdot H/E_i)$ =:	13094	ksf
$G' = E/(2 \cdot (1+\mu))$ =:	4818	ksf
$Vs=(G' \cdot 1000 \cdot 32.17/\rho)^{0.5}$=:	1174.8	fps (density =112.32)
$Vs=(G' \cdot 1000 \cdot 32.17/\rho)^{0.5}$=:	1062.6	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	638.49	1423.4	0.366	3889.9	0.02667	1	4.0000	1.03E-03
2	4.00	6.00	112.32	603.69	1272.4	0.389	3535.6	0.08000	1	4.0000	1.13E-03
3	4.00	10.00	112.32	663.72	1538.1	0.394	4287.9	0.13333	1	4.0000	9.33E-04
4	4.00	14.00	112.32	798.01	2223.4	0.393	6194.7	0.18667	1	4.0000	6.46E-04
5	4.00	18.00	112.32	912.58	2907.7	0.392	8094.1	0.24000	0.972	3.8869	4.80E-04
6	8.00	24.00	112.32	972.58	3302.6	0.393	9203.2	0.32000	0.915	7.3211	7.95E-04
7	8.00	32.00	112.32	1125.50	4422.8	0.374	12157.2	0.42667	0.840	6.7177	5.53E-04
8	8.00	40.00	112.32	1158.60	4686.8	0.361	12756.7	0.53333	0.764	6.1143	4.79E-04
9	8.00	48.00	112.32	1190.10	4945.1	0.357	13424.9	0.64000	0.689	5.5109	4.10E-04
10	8.00	56.00	112.32	1337.60	6246.8	0.338	16712.6	0.74667	0.623	4.9856	2.98E-04
11	10.00	65.00	112.32	1353.50	6396.2	0.340	17138.4	0.86667	0.553	5.5300	3.23E-04
12	10.00	75.00	112.32	1457.00	7411.8	0.338	19827.1	1.00000	0.475	4.7500	2.40E-04
13	10.00	85.00	112.32	1567.50	8578.7	0.336	22914.7	1.13333	0.397	3.9700	1.73E-04
14	10.00	95.00	112.32	1715.00	10269.1	0.334	27405.3	1.26667	0.319	3.1900	1.16E-04
15	10.00	105.00	137.28	2327.50	23117.2	0.276	58999.8	1.40000	0.271	2.7060	4.59E-05
16	10.00	115.00	137.28	2398.00	24538.9	0.276	62647.2	1.53333	0.252	2.5180	4.02E-05
17	10.00	125.00	137.28	2451.90	25654.4	0.276	65448.5	1.66667	0.233	2.3300	3.56E-05
18	10.00	135.00	137.28	2516.50	27024.0	0.277	69021.0	1.80000	0.214	2.1420	3.10E-05
19	15.00	147.50	137.28	2581.40	28435.9	0.280	72796.4	1.96667	0.191	2.8605	3.93E-05
20	15.00	162.50	137.28	2637.10	29676.3	0.283	76120.8	2.16667	0.163	2.4375	3.20E-05
21	15.00	177.50	137.28	2763.00	32577.5	0.283	83610.2	2.36667	0.134	2.0145	2.41E-05
22	15.00	192.50	137.28	2827.70	34121.1	0.284	87614.1	2.56667	0.106	1.5915	1.82E-05
23	15.00	207.50	137.28	2878.80	35365.5	0.288	91086.5	2.76667	0.089	1.3395	1.47E-05
24	15.00	222.50	137.28	2919.10	36362.5	0.287	93616.1	2.96667	0.084	1.2585	1.34E-05
25	7.50	233.75	137.28	3004.30	38516.1	0.288	99208.3	3.11667	0.080	0.5989	6.04E-06
26	7.50	241.25	137.28	3004.30	38516.1	0.288	99251.5	3.21667	0.077	0.5786	5.83E-06
27	7.50	248.75	137.28	3028.20	39131.4	0.288	100830.6	3.31667	0.074	0.5584	5.54E-06
28	7.50	256.25	137.28	3108.70	41239.5	0.287	106177.8	3.41667	0.072	0.5381	5.07E-06
29	7.50	263.75	137.28	3150.00	42342.6	0.287	108973.7	3.51667	0.069	0.5179	4.75E-06
30	7.50	271.25	137.28	3160.60	42628.0	0.288	109833.7	3.61667	0.066	0.4976	4.53E-06
31	7.50	278.75	137.28	3188.20	43375.8	0.289	111797.6	3.71667	0.064	0.4774	4.27E-06
32	7.50	286.25	137.28	3238.80	44763.5	0.288	115317.2	3.81667	0.061	0.4571	3.96E-06
33	7.50	293.75	137.28	3270.90	45655.3	0.289	117726.6	3.91667	0.058	0.4369	3.71E-06
34	7.50	301.25	137.28	3289.30	46170.4	0.288	118897.0	4.01667	0.056	0.4179	3.52E-06
35	7.50	308.75	137.28	3309.30	46733.5	0.287	120306.1	4.11667	0.054	0.4056	3.37E-06
36	7.50	316.25	137.28	3389.20	49017.4	0.288	126250.3	4.21667	0.052	0.3932	3.11E-06
37	10.16	325.08	137.28	3407.20	49539.5	0.286	127380.9	4.33437	0.050	0.5128	4.03E-06
38	9.84	335.08	137.28	3438.90	50465.6	0.285	129679.4	4.46772	0.048	0.4752	3.66E-06
39	10.16	345.08	137.28	3438.50	50453.8	0.284	129547.3	4.60104	0.046	0.4681	3.61E-06
40	9.84	355.08	137.28	3496.80	52179.2	0.283	133899.2	4.73439	0.044	0.4319	3.23E-06
41	20.00	370.00	137.28	3504.30	52403.3	0.282	134344.3	4.93333	0.041	0.8120	6.04E-06
42	20.00	390.00	137.28	3526.90	53081.4	0.281	136020.1	5.20000	0.036	0.7240	5.32E-06
43	20.00	410.00	137.28	3558.90	54049.0	0.283	138682.2	5.46667	0.033	0.6600	4.76E-06
44	20.00	430.00	137.28	3646.40	56739.4	0.284	145684.1	5.73333	0.031	0.6200	4.26E-06
45	20.00	450.00	137.28	3662.50	57241.6	0.283	146936.8	6.00000	0.029	0.5800	3.95E-06
					μ for E below =	0.366			Σ=	100.3360	7.99E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	12552	ksf
G' = E/(2*(1+μ)) =:	4596	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1147.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1037.8	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING 30' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1292.90	5836.3	0.367	15958.2	0.02667	1	4.0000	2.51E-04
2	4.00	6.00	112.32	1237.60	5347.7	0.387	14835.7	0.08000	1	4.0000	2.70E-04
3	4.00	10.00	112.32	1508.30	7942.9	0.388	22052.8	0.13333	1	4.0000	1.81E-04
4	4.00	14.00	112.32	1766.60	10896.4	0.387	30229.8	0.18667	1	4.0000	1.32E-04
5	4.00	18.00	112.32	1859.40	12071.2	0.389	33531.2	0.24000	0.972	3.8869	1.16E-04
6	8.00	24.00	112.32	1959.70	13408.7	0.391	37294.8	0.32000	0.915	7.3211	1.96E-04
7	2.00	29.00	112.32	2442.20	20824.2	0.365	56849.3	0.38667	0.868	1.7369	3.06E-05
8	10.00	35.00	137.28	2898.60	35853.6	0.283	91973.1	0.46668	0.811	8.1143	8.82E-05
9	10.00	45.00	137.28	3060.00	39957.6	0.278	102116.4	0.60001	0.717	7.1714	7.02E-05
10	10.00	55.00	137.28	3198.30	43651.0	0.274	111205.4	0.73335	0.631	6.3100	5.67E-05
11	10.00	65.00	137.28	3317.70	46971.1	0.273	119603.4	0.86668	0.553	5.5300	4.62E-05
12	10.00	75.00	137.28	3499.30	52253.9	0.268	132514.8	1.00001	0.475	4.7500	3.58E-05
13	10.00	85.00	137.28	3643.20	56639.9	0.270	143904.9	1.13335	0.397	3.9700	2.76E-05
14	10.00	95.00	137.28	3722.10	59119.7	0.273	150521.1	1.26668	0.319	3.1900	2.12E-05
15	10.00	105.00	137.28	3843.50	63039.1	0.275	160811.5	1.40001	0.271	2.7060	1.68E-05
16	10.00	115.00	137.28	3916.00	65439.7	0.276	167000.9	1.53335	0.252	2.5180	1.51E-05
17	10.00	125.00	137.28	3933.00	66009.1	0.275	168382.7	1.66668	0.233	2.3300	1.38E-05
18	10.00	135.00	137.28	3982.80	67691.4	0.277	172878.3	1.80001	0.214	2.1420	1.24E-05
19	15.00	147.50	137.28	4032.40	69387.8	0.280	177634.3	1.96668	0.191	2.8605	1.61E-05
20	15.00	162.50	137.28	4227.40	76261.1	0.282	195542.5	2.16668	0.163	2.4375	1.25E-05
21	15.00	177.50	137.28	4310.80	79299.8	0.283	203505.4	2.36668	0.134	2.0145	9.90E-06
22	15.00	192.50	137.28	4345.00	80563.0	0.284	206869.7	2.56668	0.106	1.5915	7.69E-06
23	15.00	207.50	137.28	4361.80	81187.2	0.288	209115.6	2.76668	0.089	1.3395	6.41E-06
24	15.00	222.50	137.28	4434.00	83897.2	0.287	216000.1	2.96668	0.084	1.2585	5.83E-06
25	7.50	233.75	137.28	4488.10	85957.0	0.288	221442.4	3.11668	0.080	0.5989	2.70E-06
26	7.50	241.25	137.28	4484.90	85834.5	0.289	221222.9	3.21668	0.077	0.5786	2.62E-06
27	7.50	248.75	137.28	4496.90	86294.4	0.289	222406.6	3.31668	0.074	0.5584	2.51E-06
28	7.50	256.25	137.28	4525.90	87411.0	0.288	225120.1	3.41668	0.072	0.5381	2.39E-06
29	7.50	263.75	137.28	4607.50	90591.4	0.287	233213.0	3.51668	0.069	0.5179	2.22E-06
30	7.50	271.25	137.28	4625.80	91312.4	0.289	235337.7	3.61668	0.066	0.4976	2.11E-06
31	7.50	278.75	137.28	4670.20	93073.7	0.289	239946.0	3.71668	0.064	0.4774	1.99E-06
32	7.50	286.25	137.28	4721.00	95109.6	0.288	245076.4	3.81668	0.061	0.4571	1.87E-06
33	7.50	293.75	137.28	4738.90	95832.2	0.290	247199.1	3.91668	0.058	0.4369	1.77E-06
34	7.50	301.25	137.28	4771.10	97138.9	0.288	250241.5	4.01668	0.056	0.4179	1.67E-06
35	7.50	308.75	137.28	4810.60	98754.0	0.288	254301.4	4.11668	0.054	0.4056	1.59E-06
36	7.50	316.25	137.28	4860.20	100800.9	0.288	259741.8	4.21668	0.052	0.3932	1.51E-06
37	10.16	325.08	137.28	4857.10	100672.4	0.286	258991.8	4.33439	0.050	0.5128	1.98E-06
38	9.84	335.08	137.28	4940.20	104146.6	0.285	267748.5	4.46773	0.048	0.4752	1.77E-06
39	10.16	345.08	137.28	4956.40	104830.8	0.284	269285.2	4.60105	0.046	0.4681	1.74E-06
40	9.84	355.08	137.28	5021.40	107598.4	0.284	276237.4	4.73440	0.044	0.4319	1.56E-06
41	20.00	370.00	137.28	5135.10	112526.3	0.282	288553.4	4.93335	0.041	0.8120	2.81E-06
42	20.00	390.00	137.28	5144.00	112916.7	0.282	289430.3	5.20001	0.036	0.7240	2.50E-06
43	20.00	410.00	137.28	5219.00	116233.4	0.283	298296.7	5.46668	0.033	0.6600	2.21E-06
44	20.00	430.00	137.28	5412.10	124993.6	0.284	320966.1	5.73335	0.031	0.6200	1.93E-06
45	20.00	450.00	137.28	5502.00	129180.6	0.284	331611.8	6.00001	0.029	0.5800	1.75E-06
					μ for E below =	0.358			Σ=	100.3401	1.68E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	59636	ksf
G' = E/(2*(1+μ)) =:	21950	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2507.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2268.0	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1245.90	5419.7	0.368	14833.4	0.02667	1	4.0000	2.70E-04
2	4.00	6.00	112.32	1227.00	5256.5	0.388	14594.8	0.08000	1	4.0000	2.74E-04
3	4.00	10.00	112.32	1401.00	6853.0	0.392	19078.5	0.13333	1	4.0000	2.10E-04
4	4.00	14.00	112.32	1624.50	9213.9	0.392	25655.1	0.18667	1	4.0000	1.56E-04
5	4.00	18.00	112.32	1801.50	11331.2	0.392	31546.2	0.24000	0.972	3.8869	1.23E-04
6	8.00	24.00	112.32	1869.10	12197.5	0.395	34032.3	0.32000	0.915	7.3211	2.15E-04
7	8.00	32.00	112.32	2146.30	16083.7	0.377	44278.8	0.42667	0.840	6.7177	1.52E-04
8	8.00	40.00	112.32	2275.50	18078.4	0.362	49236.5	0.53333	0.764	6.1143	1.24E-04
9	8.00	48.00	112.32	2412.50	20320.8	0.356	55113.7	0.64000	0.689	5.5109	1.00E-04
10	8.00	56.00	112.32	2676.80	25017.2	0.337	66900.4	0.74667	0.623	4.9856	7.45E-05
11	10.00	65.00	112.32	2774.90	26884.4	0.337	71906.7	0.86667	0.553	5.5300	7.69E-05
12	10.00	75.00	137.28	3371.40	48503.9	0.268	123009.8	1.00000	0.475	4.7500	3.86E-05
13	10.00	85.00	137.28	3482.10	51741.5	0.270	131469.9	1.13333	0.397	3.9700	3.02E-05
14	10.00	95.00	137.28	3677.00	57695.7	0.273	146858.6	1.26667	0.319	3.1900	2.17E-05
15	10.00	105.00	137.28	3714.30	58872.2	0.275	150165.3	1.40000	0.271	2.7060	1.80E-05
16	10.00	115.00	137.28	3841.10	62960.4	0.276	160640.9	1.53333	0.252	2.5180	1.57E-05
17	10.00	125.00	137.28	3871.40	63957.6	0.275	163132.9	1.66667	0.233	2.3300	1.43E-05
18	10.00	135.00	137.28	3934.20	66049.4	0.277	168675.7	1.80000	0.214	2.1420	1.27E-05
19	15.00	147.50	137.28	3970.10	67260.3	0.280	172190.5	1.96667	0.191	2.8605	1.66E-05
20	15.00	162.50	137.28	4056.60	70223.2	0.282	180114.1	2.16667	0.163	2.4375	1.35E-05
21	15.00	177.50	137.28	4165.10	74029.9	0.283	190033.2	2.36667	0.134	2.0145	1.06E-05
22	15.00	192.50	137.28	4257.20	77340.0	0.284	198638.6	2.56667	0.106	1.5915	8.01E-06
23	15.00	207.50	137.28	4362.80	81224.5	0.288	209216.3	2.76667	0.089	1.3395	6.40E-06
24	15.00	222.50	137.28	4506.80	86674.8	0.287	223109.6	2.96667	0.084	1.2585	5.64E-06
25	7.50	233.75	137.28	4582.50	89611.0	0.288	230809.2	3.11667	0.080	0.5989	2.59E-06
26	7.50	241.25	137.28	4594.00	90061.3	0.288	232062.7	3.21667	0.077	0.5786	2.49E-06
27	7.50	248.75	137.28	4578.10	89439.0	0.288	230466.3	3.31667	0.074	0.5584	2.42E-06
28	7.50	256.25	137.28	4640.90	91909.5	0.287	236661.6	3.41667	0.072	0.5381	2.27E-06
29	7.50	263.75	137.28	4701.70	94333.5	0.287	242806.9	3.51667	0.069	0.5179	2.13E-06
30	7.50	271.25	137.28	4742.80	95990.0	0.288	247339.3	3.61667	0.066	0.4976	2.01E-06
31	7.50	278.75	137.28	4797.30	98208.7	0.289	253132.9	3.71667	0.064	0.4774	1.89E-06
32	7.50	286.25	137.28	4794.50	98094.1	0.288	252747.3	3.81667	0.061	0.4571	1.81E-06
33	7.50	293.75	137.28	4808.10	98651.4	0.290	254449.5	3.91667	0.058	0.4369	1.72E-06
34	7.50	301.25	137.28	4807.50	98626.8	0.288	254066.5	4.01667	0.056	0.4179	1.64E-06
35	7.50	308.75	137.28	4831.90	99630.4	0.288	256570.3	4.11667	0.054	0.4056	1.58E-06
36	7.50	316.25	137.28	4938.10	104058.1	0.288	268109.9	4.21667	0.052	0.3932	1.47E-06
37	10.16	325.08	137.28	4961.50	105046.6	0.286	270207.3	4.33437	0.050	0.5128	1.90E-06
38	9.84	335.08	137.28	5012.20	107204.5	0.285	275584.2	4.46772	0.048	0.4752	1.72E-06
39	10.16	345.08	137.28	5024.20	107718.4	0.284	276683.4	4.60104	0.046	0.4681	1.69E-06
40	9.84	355.08	137.28	5094.80	110767.0	0.284	284345.6	4.73439	0.044	0.4319	1.52E-06
41	20.00	370.00	137.28	5173.90	114233.2	0.282	292925.9	4.93333	0.041	0.8120	2.77E-06
42	20.00	390.00	137.28	5329.40	121202.9	0.281	310592.0	5.20000	0.036	0.7240	2.33E-06
43	20.00	410.00	137.28	5381.70	123593.4	0.283	317138.1	5.46667	0.033	0.6600	2.08E-06
44	20.00	430.00	137.28	5476.50	127986.0	0.284	328650.1	5.73333	0.031	0.6200	1.89E-06
45	20.00	450.00	137.28	5509.10	129514.2	0.284	332483.8	6.00000	0.029	0.5800	1.74E-06
					μ for E below =	0.362			Σ=	100.3360	2.03E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	49460	ksf
G' = E/(2*(1+μ)) =:	18163	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2280.8	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2063.1	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1277.00	5693.6	0.366	15560.1	0.02667	1	4.0000	2.57E-04
2	4.00	6.00	112.32	1207.40	5089.9	0.389	14143.0	0.08000	1	4.0000	2.83E-04
3	4.00	10.00	112.32	1327.40	6151.9	0.394	17150.7	0.13333	1	4.0000	2.33E-04
4	4.00	14.00	112.32	1596.00	8893.5	0.393	24778.1	0.18667	1	4.0000	1.61E-04
5	4.00	18.00	112.32	1825.20	11631.3	0.392	32377.7	0.24000	0.972	3.8869	1.20E-04
6	8.00	24.00	112.32	1945.20	13211.0	0.393	36814.5	0.32000	0.915	7.3211	1.99E-04
7	8.00	32.00	112.32	2251.00	17691.2	0.374	48628.8	0.42667	0.840	6.7177	1.38E-04
8	8.00	40.00	112.32	2317.20	18747.1	0.361	51026.9	0.53333	0.764	6.1143	1.20E-04
9	8.00	48.00	112.32	2380.20	19780.3	0.357	53699.6	0.64000	0.689	5.5109	1.03E-04
10	8.00	56.00	112.32	2675.20	24987.3	0.338	66850.4	0.74667	0.623	4.9856	7.46E-05
11	10.00	65.00	112.32	2706.90	25582.9	0.340	68548.5	0.86667	0.553	5.5300	8.07E-05
12	10.00	75.00	112.32	2914.00	29647.3	0.338	79308.3	1.00000	0.475	4.7500	5.99E-05
13	10.00	85.00	112.32	3103.10	33620.0	0.336	89803.0	1.13333	0.397	3.9700	4.42E-05
14	10.00	95.00	112.32	3154.90	34751.8	0.334	92742.1	1.26667	0.319	3.1900	3.44E-05
15	10.00	105.00	137.28	3491.30	52015.2	0.276	132753.3	1.40000	0.271	2.7060	2.04E-05
16	10.00	115.00	137.28	3597.00	55212.5	0.276	140956.3	1.53333	0.252	2.5180	1.79E-05
17	10.00	125.00	137.28	3677.90	57724.0	0.276	147263.0	1.66667	0.233	2.3300	1.58E-05
18	10.00	135.00	137.28	3774.80	60805.7	0.277	155301.3	1.80000	0.214	2.1420	1.38E-05
19	15.00	147.50	137.28	3872.10	63980.8	0.280	163792.0	1.96667	0.191	2.8605	1.75E-05
20	15.00	162.50	137.28	3955.60	66769.9	0.283	171267.6	2.16667	0.163	2.4375	1.42E-05
21	15.00	177.50	137.28	4144.50	73299.4	0.283	188122.9	2.36667	0.134	2.0145	1.07E-05
22	15.00	192.50	137.28	4241.60	76774.3	0.284	197136.3	2.56667	0.106	1.5915	8.07E-06
23	15.00	207.50	137.28	4318.20	79572.3	0.288	204944.7	2.76667	0.089	1.3395	6.54E-06
24	15.00	222.50	137.28	4378.70	81817.6	0.287	210641.0	2.96667	0.084	1.2585	5.97E-06
25	7.50	233.75	137.28	4506.40	86659.4	0.288	223213.8	3.11667	0.080	0.5989	2.68E-06
26	7.50	241.25	137.28	4506.40	86659.4	0.288	223310.9	3.21667	0.077	0.5786	2.59E-06
27	7.50	248.75	137.28	4542.30	88045.6	0.288	226869.0	3.31667	0.074	0.5584	2.46E-06
28	7.50	256.25	137.28	4663.10	92791.0	0.287	238905.2	3.41667	0.072	0.5381	2.25E-06
29	7.50	263.75	137.28	4725.10	95274.8	0.287	245201.2	3.51667	0.069	0.5179	2.11E-06
30	7.50	271.25	137.28	4740.90	95913.1	0.288	247125.8	3.61667	0.066	0.4976	2.01E-06
31	7.50	278.75	137.28	4782.20	97591.4	0.289	251534.1	3.71667	0.064	0.4774	1.90E-06
32	7.50	286.25	137.28	4858.20	100718.0	0.288	259463.6	3.81667	0.061	0.4571	1.76E-06
33	7.50	293.75	137.28	4906.30	102722.2	0.289	264879.5	3.91667	0.058	0.4369	1.65E-06
34	7.50	301.25	137.28	4933.90	103881.2	0.288	267512.8	4.01667	0.056	0.4179	1.56E-06
35	7.50	308.75	137.28	4963.90	105148.3	0.287	270683.3	4.11667	0.054	0.4056	1.50E-06
36	7.50	316.25	137.28	5083.80	110289.2	0.288	284063.2	4.21667	0.052	0.3932	1.38E-06
37	10.16	325.08	137.28	5110.80	111463.8	0.286	286607.0	4.33437	0.050	0.5128	1.79E-06
38	9.84	335.08	137.28	5158.40	113549.8	0.285	291784.3	4.46772	0.048	0.4752	1.63E-06
39	10.16	345.08	137.28	5157.70	113518.9	0.284	291475.8	4.60104	0.046	0.4681	1.61E-06
40	9.84	355.08	137.28	5245.30	117407.8	0.283	301284.8	4.73439	0.044	0.4319	1.43E-06
41	20.00	370.00	137.28	5256.40	117905.2	0.282	302268.9	4.93333	0.041	0.8120	2.69E-06
42	20.00	390.00	137.28	5290.30	119430.9	0.281	306039.4	5.20000	0.036	0.7240	2.37E-06
43	20.00	410.00	137.28	5338.40	121612.6	0.283	312040.8	5.46667	0.033	0.6600	2.12E-06
44	20.00	430.00	137.28	5469.50	127659.0	0.284	327777.3	5.73333	0.031	0.6200	1.89E-06
45	20.00	450.00	137.28	5493.80	128795.9	0.283	330613.8	6.00000	0.029	0.5800	1.75E-06
					μ for E below =	0.375			Σ=	100.3360	2.08E-03

(1) Poisson's Ratio from Reference 2.2.5
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	48243	ksf
G' = E/(2*(1+μ)) =:	17543	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2241.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2027.6	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
MEDIAN VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))
WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	914.20	2918.0	0.367	7978.8	0.01176	1.000	4.0000	5.01E-04
2	4.00	6.00	112.32	875.13	2673.9	0.387	7418.1	0.03529	1.000	4.0000	5.39E-04
3	4.00	10.00	112.32	1066.50	3971.3	0.388	11025.8	0.05882	1.000	4.0000	3.63E-04
4	4.00	14.00	112.32	1249.10	5447.5	0.387	15113.1	0.08235	1.000	4.0000	2.65E-04
5	4.00	18.00	112.32	1314.80	6035.7	0.389	16765.8	0.10588	1.000	4.0000	2.39E-04
6	8.00	24.00	112.32	1385.70	6704.2	0.391	18647.0	0.14118	1.000	8.0000	4.29E-04
7	2.00	29.00	112.32	1726.90	10412.1	0.365	28424.8	0.17059	1.000	2.0010	7.04E-05
8	10.00	35.00	137.28	2238.40	21381.2	0.283	54847.8	0.20589	1.000	10.0000	1.82E-04
9	10.00	45.00	137.28	2498.50	26638.8	0.278	68078.7	0.26471	0.994	9.9400	1.46E-04
10	10.00	55.00	137.28	2611.40	29100.7	0.274	74136.9	0.32354	0.897	8.9680	1.21E-04
11	10.00	65.00	137.28	2708.90	31314.3	0.273	79736.1	0.38236	0.842	8.4240	1.06E-04
12	10.00	75.00	137.28	2853.60	34749.0	0.268	88122.8	0.44118	0.788	7.8800	8.94E-05
13	10.00	85.00	137.28	2974.70	37760.9	0.270	95939.2	0.50001	0.734	7.3360	7.65E-05
14	10.00	95.00	137.28	3039.10	39413.6	0.273	100348.6	0.55883	0.679	6.7920	6.77E-05
15	10.00	105.00	137.28	3124.20	41651.8	0.275	106253	0.61765	0.634	6.3400	5.97E-05
16	10.00	115.00	137.28	3197.40	43626.5	0.276	111334	0.67648	0.598	5.9800	5.37E-05
17	10.00	125.00	137.28	3211.30	44006.6	0.275	112256	0.73530	0.562	5.6200	5.01E-05
18	10.00	135.00	137.28	3251.90	45126.4	0.277	115249	0.79412	0.526	5.2600	4.56E-05
19	15.00	147.50	137.28	3292.50	46260.2	0.280	118427	0.86765	0.481	7.2150	6.09E-05
20	15.00	162.50	137.28	3451.60	50839.0	0.282	130357	0.95589	0.427	6.4050	4.91E-05
21	15.00	177.50	137.28	3519.80	52867.9	0.283	135674	1.04412	0.373	5.5950	4.12E-05
22	15.00	192.50	137.28	3547.70	53709.4	0.284	137915	1.13236	0.319	4.7850	3.47E-05
23	15.00	207.50	137.28	3561.40	54125.0	0.288	139411	1.22059	0.281	4.2180	3.03E-05
24	15.00	222.50	137.28	3620.40	55933.2	0.287	144004	1.30883	0.260	3.8940	2.70E-05
25	7.50	233.75	137.28	3664.50	57304.1	0.288	147627	1.37501	0.243	1.8255	1.24E-05
26	7.50	241.25	137.28	3661.90	57222.8	0.289	147481	1.41912	0.233	1.7445	1.18E-05
27	7.50	248.75	137.28	3671.70	57529.5	0.289	148271	1.46324	0.222	1.6635	1.12E-05
28	7.50	256.25	137.28	3695.40	58274.6	0.288	150082	1.50736	0.211	1.5825	1.05E-05
29	7.50	263.75	137.28	3762.00	60394.0	0.287	155475	1.55148	0.200	1.5015	9.66E-06
30	7.50	271.25	137.28	3777.00	60876.6	0.289	156896	1.59559	0.189	1.4205	9.05E-06
31	7.50	278.75	137.28	3813.20	62049.1	0.289	159964	1.63971	0.179	1.3395	8.37E-06
32	7.50	286.25	137.28	3854.60	63403.7	0.288	163377	1.68383	0.168	1.2585	7.70E-06
33	7.50	293.75	137.28	3869.30	63888.3	0.290	164800	1.72795	0.157	1.1775	7.15E-06
34	7.50	301.25	137.28	3895.60	64759.7	0.288	166829	1.77206	0.147	1.1044	6.62E-06
35	7.50	308.75	137.28	3927.80	65834.7	0.288	169531	1.81618	0.143	1.0706	6.32E-06
36	7.50	316.25	137.28	3968.40	67202.8	0.288	173167	1.86030	0.138	1.0369	5.99E-06
37	10.16	325.08	137.28	3965.80	67114.7	0.286	172661	1.91223	0.133	1.3504	7.82E-06
38	9.84	335.08	137.28	4033.70	69432.6	0.285	178503	1.97106	0.127	1.2496	7.00E-06
39	10.16	345.08	137.28	4046.90	69887.8	0.284	179525	2.02988	0.121	1.2285	6.84E-06
40	9.84	355.08	137.28	4100.00	71733.8	0.284	184162	2.08871	0.115	1.1315	6.14E-06
41	20.00	370.00	137.28	4192.80	75017.8	0.282	192370	2.17648	0.106	2.1200	1.10E-05
42	20.00	390.00	137.28	4200.10	75279.3	0.282	192957	2.29412	0.094	1.8800	9.74E-06
43	20.00	410.00	137.28	4261.30	77489.1	0.283	198865	2.41177	0.086	1.7160	8.63E-06
44	20.00	430.00	137.28	4418.90	83326.8	0.284	213971	2.52942	0.081	1.6280	7.61E-06
45	20.00	450.00	137.28	4492.30	86118.0	0.284	221068	2.64706	0.077	1.5400	6.97E-06
					μ for E below =	0.311			Σ=	175.2224	3.83E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	45804	ksf
G' = E/(2*(1+μ)) =:	17472	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2237.0	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2023.4	fps (density =137.28)

MEDIAN VCALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	880.98	2709.8	0.368	7416.6	0.01176	1.000	4.0000	5.39E-04
2	4.00	6.00	112.32	867.65	2628.4	0.388	7297.9	0.03529	1.000	4.0000	5.48E-04
3	4.00	10.00	112.32	990.65	3426.5	0.392	9539.1	0.05882	1.000	4.0000	4.19E-04
4	4.00	14.00	112.32	1148.70	4607.0	0.392	12827.7	0.08235	1.000	4.0000	3.12E-04
5	4.00	18.00	112.32	1273.90	5666.0	0.392	15774.3	0.10588	1.000	4.0000	2.54E-04
6	8.00	24.00	112.32	1321.70	6099.2	0.395	17017.3	0.14118	1.000	8.0000	4.70E-04
7	8.00	32.00	112.32	1517.70	8042.3	0.377	22140.5	0.18824	1.000	8.0000	3.61E-04
8	8.00	40.00	112.32	1609.00	9039.0	0.362	24617.6	0.23529	1.000	8.0000	3.25E-04
9	8.00	48.00	112.32	1705.90	10160.5	0.356	27557.0	0.28235	0.952	7.6160	2.76E-04
10	8.00	56.00	112.32	1895.40	12543.2	0.337	33542.7	0.32941	0.891	7.1309	2.13E-04
11	10.00	65.00	112.32	1971.70	13573.4	0.337	36304.2	0.38235	0.842	8.4240	2.32E-04
12	10.00	75.00	137.28	2752.70	32335.1	0.268	82004.4	0.44118	0.788	7.8800	9.61E-05
13	10.00	85.00	137.28	2843.10	34493.8	0.270	87645.2	0.50000	0.734	7.3360	8.37E-05
14	10.00	95.00	137.28	3002.20	38462.3	0.273	97902.0	0.55882	0.679	6.7920	6.94E-05
15	10.00	105.00	137.28	3032.70	39247.8	0.275	100109.3	0.61765	0.634	6.3400	6.33E-05
16	10.00	115.00	137.28	3136.20	41972.4	0.276	107090.9	0.67647	0.598	5.9800	5.58E-05
17	10.00	125.00	137.28	3160.90	42636.1	0.275	108749.4	0.73529	0.562	5.6200	5.17E-05
18	10.00	135.00	137.28	3212.20	44031.3	0.277	112446.2	0.79412	0.526	5.2600	4.68E-05
19	15.00	147.50	137.28	3241.50	44838.2	0.280	114788.5	0.86765	0.481	7.2150	6.29E-05
20	15.00	162.50	137.28	3312.20	46815.5	0.282	120076.0	0.95588	0.427	6.4050	5.33E-05
21	15.00	177.50	137.28	3400.80	49353.5	0.283	126689.6	1.04412	0.373	5.5950	4.42E-05
22	15.00	192.50	137.28	3476.00	51560.3	0.284	132426.5	1.13235	0.319	4.7850	3.61E-05
23	15.00	207.50	137.28	3562.20	54149.3	0.288	139476.7	1.22059	0.281	4.2180	3.02E-05
24	15.00	222.50	137.28	3679.80	57783.6	0.287	148740.8	1.30882	0.260	3.8940	2.62E-05
25	7.50	233.75	137.28	3741.60	59740.8	0.288	153873.1	1.37500	0.243	1.8255	1.19E-05
26	7.50	241.25	137.28	3751.00	60041.3	0.288	154709.7	1.41912	0.233	1.7445	1.13E-05
27	7.50	248.75	137.28	3738.00	59625.9	0.288	153644.0	1.46324	0.222	1.6635	1.08E-05
28	7.50	256.25	137.28	3789.30	61273.7	0.287	157776.1	1.50735	0.211	1.5825	1.00E-05
29	7.50	263.75	137.28	3838.90	62888.3	0.287	161869.4	1.55147	0.200	1.5015	9.28E-06
30	7.50	271.25	137.28	3872.50	63994.0	0.288	164894.5	1.59559	0.189	1.4205	8.61E-06
31	7.50	278.75	137.28	3917.00	65473.2	0.289	168757.1	1.63971	0.179	1.3395	7.94E-06
32	7.50	286.25	137.28	3914.70	65396.3	0.288	168498.8	1.68382	0.168	1.2585	7.47E-06
33	7.50	293.75	137.28	3925.80	65767.7	0.290	169633.3	1.72794	0.157	1.1775	6.94E-06
34	7.50	301.25	137.28	3925.30	65750.9	0.288	169377.0	1.77206	0.147	1.1044	6.52E-06
35	7.50	308.75	137.28	3945.30	66422.7	0.288	171053.0	1.81618	0.143	1.0706	6.26E-06
36	7.50	316.25	137.28	4032.00	69374.1	0.288	178745.1	1.86029	0.138	1.0369	5.80E-06
37	10.16	325.08	137.28	4051.00	70029.4	0.286	180133.9	1.91222	0.133	1.3504	7.50E-06
38	9.84	335.08	137.28	4092.40	71468.1	0.285	183718.8	1.97105	0.127	1.2496	6.80E-06
39	10.16	345.08	137.28	4102.20	71810.8	0.284	184451.8	2.02987	0.121	1.2285	6.66E-06
40	9.84	355.08	137.28	4159.90	73845.2	0.284	189564.9	2.08870	0.115	1.1315	5.97E-06
41	20.00	370.00	137.28	4224.40	76152.9	0.282	195277.3	2.17647	0.106	2.1200	1.09E-05
42	20.00	390.00	137.28	4351.40	80800.5	0.281	207057.8	2.29412	0.094	1.8800	9.08E-06
43	20.00	410.00	137.28	4394.10	82394.1	0.283	211421.6	2.41176	0.086	1.7160	8.12E-06
44	20.00	430.00	137.28	4471.50	85322.3	0.284	219095.8	2.52941	0.081	1.6280	7.43E-06
45	20.00	450.00	137.28	4498.20	86344.3	0.284	221659.7	2.64706	0.077	1.5400	6.95E-06
					μ for E below =	0.338			Σ=	175.0603	4.84E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =: 36159 ksf

G' = E/(2*(1+μ)) =: 13517 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 1967.6 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1779.7 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
MEDIAN VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [(4)] ρ (PCF)	SHEAR WAVE VELOCITY[(4)] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[(1)]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [(2)]	Z/W	INFLUENCE COEFFICIENT Nq [(3)]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	902.96	2846.7	0.366	7779.8	0.01176	1.000	4.0000	5.14E-04
2	4.00	6.00	112.32	853.75	2544.9	0.389	7071.3	0.03529	1.000	4.0000	5.66E-04
3	4.00	10.00	112.32	938.64	3076.1	0.394	8575.8	0.05882	1.000	4.0000	4.66E-04
4	4.00	14.00	112.32	1128.60	4447.2	0.393	12390.3	0.08235	1.000	4.0000	3.23E-04
5	4.00	18.00	112.32	1290.60	5815.5	0.392	16188.6	0.10588	1.000	4.0000	2.47E-04
6	8.00	24.00	112.32	1375.40	6604.9	0.393	18405.5	0.14118	1.000	8.0000	4.35E-04
7	8.00	32.00	112.32	1591.70	8845.6	0.374	24314.5	0.18824	1.000	8.0000	3.29E-04
8	8.00	40.00	112.32	1638.50	9373.4	0.361	25513.2	0.23529	1.000	8.0000	3.14E-04
9	8.00	48.00	112.32	1683.00	9889.5	0.357	26848.0	0.28235	0.952	7.6160	2.84E-04
10	8.00	56.00	112.32	1891.70	12494.3	0.338	33426.9	0.32941	0.891	7.1309	2.13E-04
11	10.00	65.00	112.32	1914.10	12791.9	0.340	34275.4	0.38235	0.842	8.4240	2.46E-04
12	10.00	75.00	112.32	2060.50	14823.5	0.338	39653.8	0.44118	0.788	7.8800	1.99E-04
13	10.00	85.00	112.32	2205.40	16981.7	0.336	45360.1	0.50000	0.734	7.3360	1.62E-04
14	10.00	95.00	112.32	2326.10	18891.3	0.334	50415.3	0.55882	0.679	6.7920	1.35E-04
15	10.00	105.00	137.28	2850.60	34676.0	0.276	88500.0	0.61765	0.634	6.3400	7.16E-05
16	10.00	115.00	137.28	2936.90	36807.3	0.276	93968.4	0.67647	0.598	5.9800	6.36E-05
17	10.00	125.00	137.28	3003.00	38482.8	0.276	98175.8	0.73529	0.562	5.6200	5.72E-05
18	10.00	135.00	137.28	3082.10	40536.8	0.277	103533.5	0.79412	0.526	5.2600	5.08E-05
19	15.00	147.50	137.28	3161.50	42652.3	0.280	109190.8	0.86765	0.481	7.2150	6.61E-05
20	15.00	162.50	137.28	3229.70	44512.4	0.283	114176.0	0.95588	0.427	6.4050	5.61E-05
21	15.00	177.50	137.28	3384.00	48867.1	0.283	125417.5	1.04412	0.373	5.5950	4.46E-05
22	15.00	192.50	137.28	3463.20	51181.3	0.284	131420.3	1.13235	0.319	4.7850	3.64E-05
23	15.00	207.50	137.28	3525.80	53048.3	0.288	136630.2	1.22059	0.281	4.2180	3.09E-05
24	15.00	222.50	137.28	3575.20	54545.2	0.287	140427.8	1.30882	0.260	3.8940	2.77E-05
25	7.50	233.75	137.28	3679.50	57774.2	0.288	148812.4	1.37500	0.243	1.8255	1.23E-05
26	7.50	241.25	137.28	3679.50	57774.2	0.288	148877.1	1.41912	0.233	1.7445	1.17E-05
27	7.50	248.75	137.28	3708.80	58698.0	0.288	151248.2	1.46324	0.222	1.6635	1.10E-05
28	7.50	256.25	137.28	3807.40	61860.5	0.287	159269.7	1.50735	0.211	1.5825	9.94E-06
29	7.50	263.75	137.28	3858.00	63515.6	0.287	163465.1	1.55147	0.200	1.5015	9.19E-06
30	7.50	271.25	137.28	3871.00	63944.4	0.288	164756.6	1.59559	0.189	1.4205	8.62E-06
31	7.50	278.75	137.28	3904.70	65062.6	0.289	167693.7	1.63971	0.179	1.3395	7.99E-06
32	7.50	286.25	137.28	3966.70	67145.2	0.288	172975.4	1.68382	0.168	1.2585	7.28E-06
33	7.50	293.75	137.28	4006.00	68482.3	0.289	176588.4	1.72794	0.157	1.1775	6.67E-06
34	7.50	301.25	137.28	4028.50	69253.7	0.288	178340.7	1.77206	0.147	1.1044	6.19E-06
35	7.50	308.75	137.28	4053.00	70098.6	0.287	180454.9	1.81618	0.143	1.0706	5.93E-06
36	7.50	316.25	137.28	4150.90	73526.0	0.288	189375.0	1.86029	0.138	1.0369	5.48E-06
37	10.16	325.08	137.28	4172.90	74307.4	0.286	191066.7	1.91222	0.133	1.3504	7.07E-06
38	9.84	335.08	137.28	4211.80	75699.3	0.285	194521.4	1.97105	0.127	1.2496	6.42E-06
39	10.16	345.08	137.28	4211.20	75677.7	0.284	194313.1	2.02987	0.121	1.2285	6.32E-06
40	9.84	355.08	137.28	4282.70	78269.3	0.283	200850.0	2.08870	0.115	1.1315	5.63E-06
41	20.00	370.00	137.28	4291.80	78602.3	0.282	201509.5	2.17647	0.106	2.1200	1.05E-05
42	20.00	390.00	137.28	4319.50	79620.2	0.281	204025.1	2.29412	0.094	1.8800	9.21E-06
43	20.00	410.00	137.28	4358.80	81075.6	0.283	208028.6	2.41176	0.086	1.7160	8.25E-06
44	20.00	430.00	137.28	4465.90	85108.7	0.284	218525.2	2.52941	0.081	1.6280	7.45E-06
45	20.00	450.00	137.28	4485.60	85861.3	0.283	220402.4	2.64706	0.077	1.5400	6.99E-06
					μ for E below =	0.335			Σ=	175.0603	5.11E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	34281	ksf
G' = E/(2*(1+μ)) =:	12838	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1917.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1734.5	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	646.44	1459.0	0.367	3989.4	0.01176	1.000	4.0000	1.00E-03
2	4.00	6.00	112.32	618.81	1337.0	0.387	3709.0	0.03529	1.000	4.0000	1.08E-03
3	4.00	10.00	112.32	754.14	1985.7	0.388	5513.1	0.05882	1.000	4.0000	7.26E-04
4	4.00	14.00	112.32	883.28	2724.0	0.387	7557.1	0.08235	1.000	4.0000	5.29E-04
5	4.00	18.00	112.32	929.70	3017.8	0.389	8382.8	0.10588	1.000	4.0000	4.77E-04
6	8.00	24.00	112.32	979.83	3352.0	0.391	9323.3	0.14118	1.000	8.0000	8.58E-04
7	2.00	29.00	112.32	1221.10	5206.1	0.365	14212.3	0.17059	1.000	2.0010	1.41E-04
8	10.00	35.00	137.28	1728.60	12751.0	0.283	32709.4	0.20589	1.000	10.0000	3.06E-04
9	10.00	45.00	137.28	2040.00	17758.9	0.278	45385.1	0.26471	0.994	9.9400	2.19E-04
10	10.00	55.00	137.28	2132.20	19400.5	0.274	49424.6	0.32354	0.897	8.9680	1.81E-04
11	10.00	65.00	137.28	2211.80	20876.0	0.273	53157.1	0.38236	0.842	8.4240	1.58E-04
12	10.00	75.00	137.28	2327.00	23107.3	0.268	58599.6	0.44118	0.788	7.8800	1.34E-04
13	10.00	85.00	137.28	2428.80	25173.3	0.270	63957.7	0.50001	0.734	7.3360	1.15E-04
14	10.00	95.00	137.28	2481.40	26275.4	0.273	66898.3	0.55883	0.679	6.7920	1.02E-04
15	10.00	105.00	137.28	2539.50	27520.3	0.275	70203.7	0.61765	0.634	6.3400	9.03E-05
16	10.00	115.00	137.28	2610.70	29085.1	0.276	74224.5	0.67648	0.598	5.9800	8.06E-05
17	10.00	125.00	137.28	2622.00	29337.4	0.275	74836.8	0.73530	0.562	5.6200	7.51E-05
18	10.00	135.00	137.28	2655.20	30085.0	0.277	76834.8	0.79412	0.526	5.2600	6.85E-05
19	15.00	147.50	137.28	2688.30	30839.8	0.280	78950.5	0.86765	0.481	7.2150	9.14E-05
20	15.00	162.50	137.28	2818.20	33892.2	0.282	86903.7	0.95589	0.427	6.4050	7.37E-05
21	15.00	177.50	137.28	2873.90	35245.2	0.283	90449.0	1.04412	0.373	5.5950	6.19E-05
22	15.00	192.50	137.28	2896.70	35806.6	0.284	91944.2	1.13236	0.319	4.7850	5.20E-05
23	15.00	207.50	137.28	2907.80	36081.6	0.288	92936.0	1.22059	0.281	4.2180	4.54E-05
24	15.00	222.50	137.28	2956.00	37287.7	0.287	96000.1	1.30883	0.260	3.8940	4.06E-05
25	7.50	233.75	137.28	2992.10	38204.0	0.288	98421.0	1.37501	0.243	1.8255	1.85E-05
26	7.50	241.25	137.28	2989.90	38147.8	0.289	98319.1	1.41912	0.233	1.7445	1.77E-05
27	7.50	248.75	137.28	2998.00	38354.8	0.289	98851.8	1.46324	0.222	1.6635	1.68E-05
28	7.50	256.25	137.28	3017.30	38850.2	0.288	100055.6	1.50736	0.211	1.5825	1.58E-05
29	7.50	263.75	137.28	3071.70	40263.7	0.287	103652.5	1.55148	0.200	1.5015	1.45E-05
30	7.50	271.25	137.28	3083.90	40584.2	0.289	104596.8	1.59559	0.189	1.4205	1.36E-05
31	7.50	278.75	137.28	3113.50	41367.0	0.289	106644.9	1.63971	0.179	1.3395	1.26E-05
32	7.50	286.25	137.28	3147.30	42270.0	0.288	108920.6	1.68383	0.168	1.2585	1.16E-05
33	7.50	293.75	137.28	3159.30	42593.0	0.290	109868.6	1.72795	0.157	1.1775	1.07E-05
34	7.50	301.25	137.28	3180.80	43174.7	0.288	111223.1	1.77206	0.147	1.1044	9.93E-06
35	7.50	308.75	137.28	3207.00	43888.8	0.288	113018.2	1.81618	0.143	1.0706	9.47E-06
36	7.50	316.25	137.28	3240.20	44802.3	0.288	115445.5	1.86030	0.138	1.0369	8.98E-06
37	10.16	325.08	137.28	3238.10	44744.2	0.286	115109.8	1.91223	0.133	1.3504	1.17E-05
38	9.84	335.08	137.28	3293.50	46288.3	0.285	119001.8	1.97106	0.127	1.2496	1.05E-05
39	10.16	345.08	137.28	3304.30	46592.4	0.284	119684.7	2.02988	0.121	1.2285	1.03E-05
40	9.84	355.08	137.28	3347.60	47821.5	0.284	122772.2	2.08871	0.115	1.1315	9.22E-06
41	20.00	370.00	137.28	3423.40	50011.7	0.282	128246.0	2.17648	0.106	2.1200	1.65E-05
42	20.00	390.00	137.28	3429.30	50184.2	0.282	128633.2	2.29412	0.094	1.8800	1.46E-05
43	20.00	410.00	137.28	3479.40	51661.3	0.283	132581.4	2.41177	0.086	1.7160	1.29E-05
44	20.00	430.00	137.28	3608.10	55553.7	0.284	142654.2	2.52942	0.081	1.6280	1.14E-05
45	20.00	450.00	137.28	3668.00	57413.6	0.284	147383.0	2.64706	0.077	1.5400	1.04E-05
					μ for E below =	0.316			Σ=	175.2224	6.97E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	25123	ksf
G' = E/(2*(1+μ)) =:	9542	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1653.2	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1495.4	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	622.94	1354.9	0.368	3708.2	0.01176	1.000	4.0000	1.08E-03
2	4.00	6.00	112.32	613.52	1314.2	0.388	3648.9	0.03529	1.000	4.0000	1.10E-03
3	4.00	10.00	112.32	700.50	1713.3	0.392	4769.6	0.05882	1.000	4.0000	8.39E-04
4	4.00	14.00	112.32	812.26	2303.5	0.392	6413.9	0.08235	1.000	4.0000	6.24E-04
5	4.00	18.00	112.32	900.75	2832.8	0.392	7886.5	0.10588	1.000	4.0000	5.07E-04
6	8.00	24.00	112.32	934.55	3049.4	0.395	8508.1	0.14118	1.000	8.0000	9.40E-04
7	8.00	32.00	112.32	1073.20	4021.3	0.377	11070.7	0.18824	1.000	8.0000	7.23E-04
8	8.00	40.00	112.32	1137.70	4519.2	0.362	12308.0	0.23529	1.000	8.0000	6.50E-04
9	8.00	48.00	112.32	1206.20	5079.8	0.356	13777.3	0.28235	0.952	7.6160	5.53E-04
10	8.00	56.00	112.32	1342.10	6288.9	0.337	16817.7	0.32941	0.891	7.1309	4.24E-04
11	10.00	65.00	112.32	1401.10	6854.0	0.337	18332.1	0.38235	0.842	8.4240	4.60E-04
12	10.00	75.00	137.28	2247.60	21557.3	0.268	54671.0	0.44118	0.788	7.8800	1.44E-04
13	10.00	85.00	137.28	2321.40	22996.2	0.270	58431.1	0.50000	0.734	7.3360	1.26E-04
14	10.00	95.00	137.28	2451.30	25641.8	0.273	65268.7	0.55882	0.679	6.7920	1.04E-04
15	10.00	105.00	137.28	2476.20	26165.4	0.275	66740.1	0.61765	0.634	6.3400	9.50E-05
16	10.00	115.00	137.28	2560.70	27981.7	0.276	71394.1	0.67647	0.598	5.9800	8.38E-05
17	10.00	125.00	137.28	2580.90	28424.9	0.275	72501.6	0.73529	0.562	5.6200	7.75E-05
18	10.00	135.00	137.28	2622.80	29355.3	0.277	74967.0	0.79412	0.526	5.2600	7.02E-05
19	15.00	147.50	137.28	2646.70	29892.7	0.280	76527.2	0.86765	0.481	7.2150	9.43E-05
20	15.00	162.50	137.28	2704.40	31210.3	0.282	80050.7	0.95588	0.427	6.4050	8.00E-05
21	15.00	177.50	137.28	2776.70	32901.4	0.283	84457.2	1.04412	0.373	5.5950	6.62E-05
22	15.00	192.50	137.28	2838.10	34372.5	0.284	88281.7	1.13235	0.319	4.7850	5.42E-05
23	15.00	207.50	137.28	2908.60	36101.4	0.288	92989.3	1.22059	0.281	4.2180	4.54E-05
24	15.00	222.50	137.28	3004.50	38521.3	0.287	99157.6	1.30882	0.260	3.8940	3.93E-05
25	7.50	233.75	137.28	3055.00	39827.1	0.288	102581.9	1.37500	0.243	1.8255	1.78E-05
26	7.50	241.25	137.28	3062.70	40028.1	0.288	103141.2	1.41912	0.233	1.7445	1.69E-05
27	7.50	248.75	137.28	3052.00	39748.9	0.288	102425.0	1.46324	0.222	1.6635	1.62E-05
28	7.50	256.25	137.28	3093.90	40847.8	0.287	105181	1.50735	0.211	1.5825	1.50E-05
29	7.50	263.75	137.28	3134.50	41926.9	0.287	107916	1.55147	0.200	1.5015	1.39E-05
30	7.50	271.25	137.28	3161.90	42663.1	0.288	109931	1.59559	0.189	1.4205	1.29E-05
31	7.50	278.75	137.28	3198.20	43648.3	0.289	112504	1.63971	0.179	1.3395	1.19E-05
32	7.50	286.25	137.28	3196.30	43596.5	0.288	112330	1.68382	0.168	1.2585	1.12E-05
33	7.50	293.75	137.28	3205.40	43845.1	0.290	113089	1.72794	0.157	1.1775	1.04E-05
34	7.50	301.25	137.28	3205.00	43834.1	0.288	112918	1.77206	0.147	1.1044	9.78E-06
35	7.50	308.75	137.28	3221.30	44281.1	0.288	114034	1.81618	0.143	1.0706	9.39E-06
36	7.50	316.25	137.28	3292.10	46249.0	0.288	119162	1.86029	0.138	1.0369	8.70E-06
37	10.16	325.08	137.28	3307.70	46688.3	0.286	120095	1.91222	0.133	1.3504	1.12E-05
38	9.84	335.08	137.28	3341.50	47647.4	0.285	122484	1.97105	0.127	1.2496	1.02E-05
39	10.16	345.08	137.28	3349.50	47875.8	0.284	122973	2.02987	0.121	1.2285	9.99E-06
40	9.84	355.08	137.28	3396.50	49228.8	0.284	126373	2.08870	0.115	1.1315	8.95E-06
41	20.00	370.00	137.28	3449.30	50771.3	0.282	130192	2.17647	0.106	2.1200	1.63E-05
42	20.00	390.00	137.28	3552.90	53866.9	0.281	138038	2.29412	0.094	1.8800	1.36E-05
43	20.00	410.00	137.28	3587.80	54930.4	0.283	140950	2.41176	0.086	1.7160	1.22E-05
44	20.00	430.00	137.28	3651.00	56882.7	0.284	146067	2.52941	0.081	1.6280	1.11E-05
45	20.00	450.00	137.28	3672.70	57560.8	0.284	147768	2.64706	0.077	1.5400	1.04E-05
					μ for E below =	0.336			Σ=	175.0603	9.23E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	18964	ksf
G' = E/(2*(1+μ)) =:	7096	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1425.7	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1289.6	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: 170 FT

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	638.49	1423.4	0.366	3889.9	0.01176	1.000	4.0000	1.03E-03
2	4.00	6.00	112.32	603.69	1272.4	0.389	3535.6	0.03529	1.000	4.0000	1.13E-03
3	4.00	10.00	112.32	663.72	1538.1	0.394	4287.9	0.05882	1.000	4.0000	9.33E-04
4	4.00	14.00	112.32	798.01	2223.4	0.393	6194.7	0.08235	1.000	4.0000	6.46E-04
5	4.00	18.00	112.32	912.58	2907.7	0.392	8094.1	0.10588	1.000	4.0000	4.94E-04
6	8.00	24.00	112.32	972.58	3302.6	0.393	9203.2	0.14118	1.000	8.0000	8.69E-04
7	8.00	32.00	112.32	1125.50	4422.8	0.374	12157.2	0.18824	1.000	8.0000	6.58E-04
8	8.00	40.00	112.32	1158.60	4686.8	0.361	12756.7	0.23529	1.000	8.0000	6.27E-04
9	8.00	48.00	112.32	1190.10	4945.1	0.357	13424.9	0.28235	0.952	7.6160	5.67E-04
10	8.00	56.00	112.32	1337.60	6246.8	0.338	16712.6	0.32941	0.891	7.1309	4.27E-04
11	10.00	65.00	112.32	1353.50	6396.2	0.340	17138.4	0.38235	0.842	8.4240	4.92E-04
12	10.00	75.00	112.32	1457.00	7411.8	0.338	19827.1	0.44118	0.788	7.8800	3.97E-04
13	10.00	85.00	112.32	1567.50	8578.7	0.336	22914.7	0.50000	0.734	7.3360	3.20E-04
14	10.00	95.00	112.32	1715.00	10269.1	0.334	27405.3	0.55882	0.679	6.7920	2.48E-04
15	10.00	105.00	137.28	2327.50	23117.2	0.276	58999.8	0.61765	0.634	6.3400	1.07E-04
16	10.00	115.00	137.28	2398.00	24538.9	0.276	62647.2	0.67647	0.598	5.9800	9.55E-05
17	10.00	125.00	137.28	2451.90	25654.4	0.276	65448.5	0.73529	0.562	5.6200	8.59E-05
18	10.00	135.00	137.28	2516.50	27024.0	0.277	69021.0	0.79412	0.526	5.2600	7.62E-05
19	15.00	147.50	137.28	2581.40	28435.9	0.280	72796.4	0.86765	0.481	7.2150	9.91E-05
20	15.00	162.50	137.28	2637.10	29676.3	0.283	76120.8	0.95588	0.427	6.4050	8.41E-05
21	15.00	177.50	137.28	2763.00	32577.5	0.283	83610.2	1.04412	0.373	5.5950	6.69E-05
22	15.00	192.50	137.28	2827.70	34121.1	0.284	87614.1	1.13235	0.319	4.7850	5.46E-05
23	15.00	207.50	137.28	2878.80	35365.5	0.288	91086.5	1.22059	0.281	4.2180	4.63E-05
24	15.00	222.50	137.28	2919.10	36362.5	0.287	93616.1	1.30882	0.260	3.8940	4.16E-05
25	7.50	233.75	137.28	3004.30	38516.1	0.288	99208.3	1.37500	0.243	1.8255	1.84E-05
26	7.50	241.25	137.28	3004.30	38516.1	0.288	99251.5	1.41912	0.233	1.7445	1.76E-05
27	7.50	248.75	137.28	3028.20	39131.4	0.288	100830.6	1.46324	0.222	1.6635	1.65E-05
28	7.50	256.25	137.28	3108.70	41239.5	0.287	106177.8	1.50735	0.211	1.5825	1.49E-05
29	7.50	263.75	137.28	3150.00	42342.6	0.287	108973.7	1.55147	0.200	1.5015	1.38E-05
30	7.50	271.25	137.28	3160.60	42628.0	0.288	109833.7	1.59559	0.189	1.4205	1.29E-05
31	7.50	278.75	137.28	3188.20	43375.8	0.289	111797.6	1.63971	0.179	1.3395	1.20E-05
32	7.50	286.25	137.28	3238.80	44763.5	0.288	115317.2	1.68382	0.168	1.2585	1.09E-05
33	7.50	293.75	137.28	3270.90	45655.3	0.289	117726.6	1.72794	0.157	1.1775	1.00E-05
34	7.50	301.25	137.28	3289.30	46170.4	0.288	118897.0	1.77206	0.147	1.1044	9.29E-06
35	7.50	308.75	137.28	3309.30	46733.5	0.287	120306.1	1.81618	0.143	1.0706	8.90E-06
36	7.50	316.25	137.28	3389.20	49017.4	0.288	126250.3	1.86029	0.138	1.0369	8.21E-06
37	10.16	325.08	137.28	3407.20	49539.5	0.286	127380.9	1.91222	0.133	1.3504	1.06E-05
38	9.84	335.08	137.28	3438.90	50465.6	0.285	129679.4	1.97105	0.127	1.2496	9.64E-06
39	10.16	345.08	137.28	3438.50	50453.8	0.284	129547.3	2.02987	0.121	1.2285	9.48E-06
40	9.84	355.08	137.28	3496.80	52179.2	0.283	133899.2	2.08870	0.115	1.1315	8.45E-06
41	20.00	370.00	137.28	3504.30	52403.3	0.282	134344.3	2.17647	0.106	2.1200	1.58E-05
42	20.00	390.00	137.28	3526.90	53081.4	0.281	136020.1	2.29412	0.094	1.8800	1.38E-05
43	20.00	410.00	137.28	3558.90	54049.0	0.283	138682.2	2.41176	0.086	1.7160	1.24E-05
44	20.00	430.00	137.28	3646.40	56739.4	0.284	145684.1	2.52941	0.081	1.6280	1.12E-05
45	20.00	450.00	137.28	3662.50	57241.6	0.283	146936.8	2.64706	0.077	1.5400	1.05E-05
					μ for E below =	0.339			Σ=	175.0603	9.85E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	17771	ksf
G' = E/(2*(1+μ)) =:	6635	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1378.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1246.9	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1292.90	5836.3	0.367	15958.2	0.01176	1.000	4.0000	2.51E-04
2	4.00	6.00	112.32	1237.60	5347.7	0.387	14835.7	0.03529	1.000	4.0000	2.70E-04
3	4.00	10.00	112.32	1508.30	7942.9	0.388	22052.8	0.05882	1.000	4.0000	1.81E-04
4	4.00	14.00	112.32	1766.60	10896.4	0.387	30229.8	0.08235	1.000	4.0000	1.32E-04
5	4.00	18.00	112.32	1859.40	12071.2	0.389	33531.2	0.10588	1.000	4.0000	1.19E-04
6	8.00	24.00	112.32	1959.70	13408.7	0.391	37294.8	0.14118	1.000	8.0000	2.15E-04
7	2.00	29.00	112.32	2442.20	20824.2	0.365	56849.3	0.17059	1.000	2.0010	3.52E-05
8	10.00	35.00	137.28	2898.60	35853.6	0.283	91973.1	0.20589	1.000	10.0000	1.09E-04
9	10.00	45.00	137.28	3060.00	39957.6	0.278	102116.4	0.26471	0.994	9.9400	9.73E-05
10	10.00	55.00	137.28	3198.30	43651.0	0.274	111205.4	0.32354	0.897	8.9680	8.06E-05
11	10.00	65.00	137.28	3317.70	46971.1	0.273	119603.4	0.38236	0.842	8.4240	7.04E-05
12	10.00	75.00	137.28	3499.30	52253.9	0.268	132514.8	0.44118	0.788	7.8800	5.95E-05
13	10.00	85.00	137.28	3643.20	56639.9	0.270	143904.9	0.50001	0.734	7.3360	5.10E-05
14	10.00	95.00	137.28	3722.10	59119.7	0.273	150521.1	0.55883	0.679	6.7920	4.51E-05
15	10.00	105.00	137.28	3843.50	63039.1	0.275	160811.5	0.61765	0.634	6.3400	3.94E-05
16	10.00	115.00	137.28	3916.00	65439.7	0.276	167000.9	0.67648	0.598	5.9800	3.58E-05
17	10.00	125.00	137.28	3933.00	66009.1	0.275	168382.7	0.73530	0.562	5.6200	3.34E-05
18	10.00	135.00	137.28	3982.80	67691.4	0.277	172878.3	0.79412	0.526	5.2600	3.04E-05
19	15.00	147.50	137.28	4032.40	69387.8	0.280	177634.3	0.86765	0.481	7.2150	4.06E-05
20	15.00	162.50	137.28	4227.40	76261.1	0.282	195542.5	0.95589	0.427	6.4050	3.28E-05
21	15.00	177.50	137.28	4310.80	79299.8	0.283	203505.4	1.04412	0.373	5.5950	2.75E-05
22	15.00	192.50	137.28	4345.00	80563.0	0.284	206869.7	1.13236	0.319	4.7850	2.31E-05
23	15.00	207.50	137.28	4361.80	81187.2	0.288	209115.6	1.22059	0.281	4.2180	2.02E-05
24	15.00	222.50	137.28	4434.00	83897.2	0.287	216000.1	1.30883	0.260	3.8940	1.80E-05
25	7.50	233.75	137.28	4488.10	85957.0	0.288	221442.4	1.37501	0.243	1.8255	8.24E-06
26	7.50	241.25	137.28	4484.90	85834.5	0.289	221222.9	1.41912	0.233	1.7445	7.89E-06
27	7.50	248.75	137.28	4496.90	86294.4	0.289	222406.6	1.46324	0.222	1.6635	7.48E-06
28	7.50	256.25	137.28	4525.90	87411.0	0.288	225120.1	1.50736	0.211	1.5825	7.03E-06
29	7.50	263.75	137.28	4607.50	90591.4	0.287	233213.0	1.55148	0.200	1.5015	6.44E-06
30	7.50	271.25	137.28	4625.80	91312.4	0.289	235337.7	1.59559	0.189	1.4205	6.04E-06
31	7.50	278.75	137.28	4670.20	93073.7	0.289	239946.0	1.63971	0.179	1.3395	5.58E-06
32	7.50	286.25	137.28	4721.00	95109.6	0.288	245076.4	1.68383	0.168	1.2585	5.14E-06
33	7.50	293.75	137.28	4738.90	95832.2	0.290	247199.1	1.72795	0.157	1.1775	4.76E-06
34	7.50	301.25	137.28	4771.10	97138.9	0.288	250241.5	1.77206	0.147	1.1044	4.41E-06
35	7.50	308.75	137.28	4810.60	98754.0	0.288	254301.4	1.81618	0.143	1.0706	4.21E-06
36	7.50	316.25	137.28	4860.20	100800.9	0.288	259741.8	1.86030	0.138	1.0369	3.99E-06
37	10.16	325.08	137.28	4857.10	100672.4	0.286	258991.8	1.91223	0.133	1.3504	5.21E-06
38	9.84	335.08	137.28	4940.20	104146.6	0.285	267748.5	1.97106	0.127	1.2496	4.67E-06
39	10.16	345.08	137.28	4956.40	104830.8	0.284	269285.2	2.02988	0.121	1.2285	4.56E-06
40	9.84	355.08	137.28	5021.40	107598.4	0.284	276237.4	2.08871	0.115	1.1315	4.10E-06
41	20.00	370.00	137.28	5135.10	112526.3	0.282	288553.4	2.17648	0.106	2.1200	7.35E-06
42	20.00	390.00	137.28	5144.00	112916.7	0.282	289430.3	2.29412	0.094	1.8800	6.50E-06
43	20.00	410.00	137.28	5219.00	116233.4	0.283	298296.7	2.41177	0.086	1.7160	5.75E-06
44	20.00	430.00	137.28	5412.10	124993.6	0.284	320966.1	2.52942	0.081	1.6280	5.07E-06
45	20.00	450.00	137.28	5502.00	129180.6	0.284	331611.8	2.64706	0.077	1.5400	4.64E-06
					μ for E below =	0.306			Σ=	175.2224	2.14E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	82034	ksf
G' = E/(2*(1+μ)) =:	31408	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2999.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2713.0	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1245.90	5419.7	0.368	14833.4	0.01176	1.000	4.0000	2.70E-04
2	4.00	6.00	112.32	1227.00	5256.5	0.388	14594.8	0.03529	1.000	4.0000	2.74E-04
3	4.00	10.00	112.32	1401.00	6853.0	0.392	19078.5	0.05882	1.000	4.0000	2.10E-04
4	4.00	14.00	112.32	1624.50	9213.9	0.392	25655.1	0.08235	1.000	4.0000	1.56E-04
5	4.00	18.00	112.32	1801.50	11331.2	0.392	31546.2	0.10588	1.000	4.0000	1.27E-04
6	8.00	24.00	112.32	1869.10	12197.5	0.395	34032.3	0.14118	1.000	8.0000	2.35E-04
7	8.00	32.00	112.32	2146.30	16083.7	0.377	44278.8	0.18824	1.000	8.0000	1.81E-04
8	8.00	40.00	112.32	2275.50	18078.4	0.362	49236.5	0.23529	1.000	8.0000	1.62E-04
9	8.00	48.00	112.32	2412.50	20320.8	0.356	55113.7	0.28235	0.952	7.6160	1.38E-04
10	8.00	56.00	112.32	2676.80	25017.2	0.337	66900.4	0.32941	0.891	7.1309	1.07E-04
11	10.00	65.00	112.32	2774.90	26884.4	0.337	71906.7	0.38235	0.842	8.4240	1.17E-04
12	10.00	75.00	137.28	3371.40	48503.9	0.268	123009.8	0.44118	0.788	7.8800	6.41E-05
13	10.00	85.00	137.28	3482.10	51741.5	0.270	131469.9	0.50000	0.734	7.3360	5.58E-05
14	10.00	95.00	137.28	3677.00	57695.7	0.273	146858.6	0.55882	0.679	6.7920	4.62E-05
15	10.00	105.00	137.28	3714.30	58872.2	0.275	150165.3	0.61765	0.634	6.3400	4.22E-05
16	10.00	115.00	137.28	3841.10	62960.4	0.276	160640.9	0.67647	0.598	5.9800	3.72E-05
17	10.00	125.00	137.28	3871.40	63957.6	0.275	163132.9	0.73529	0.562	5.6200	3.45E-05
18	10.00	135.00	137.28	3934.20	66049.4	0.277	168675.7	0.79412	0.526	5.2600	3.12E-05
19	15.00	147.50	137.28	3970.10	67260.3	0.280	172190.5	0.86765	0.481	7.2150	4.19E-05
20	15.00	162.50	137.28	4056.60	70223.2	0.282	180114.1	0.95588	0.427	6.4050	3.56E-05
21	15.00	177.50	137.28	4165.10	74029.9	0.283	190033.2	1.04412	0.373	5.5950	2.94E-05
22	15.00	192.50	137.28	4257.20	77340.0	0.284	198638.6	1.13235	0.319	4.7850	2.41E-05
23	15.00	207.50	137.28	4362.80	81224.5	0.288	209216.3	1.22059	0.281	4.2180	2.02E-05
24	15.00	222.50	137.28	4506.80	86674.8	0.287	223109.6	1.30882	0.260	3.8940	1.75E-05
25	7.50	233.75	137.28	4582.50	89611.0	0.288	230809.2	1.37500	0.243	1.8255	7.91E-06
26	7.50	241.25	137.28	4594.00	90061.3	0.288	232062.7	1.41912	0.233	1.7445	7.52E-06
27	7.50	248.75	137.28	4578.10	89439.0	0.288	230466.3	1.46324	0.222	1.6635	7.22E-06
28	7.50	256.25	137.28	4640.90	91909.5	0.287	236661.6	1.50735	0.211	1.5825	6.69E-06
29	7.50	263.75	137.28	4701.70	94333.5	0.287	242806.9	1.55147	0.200	1.5015	6.18E-06
30	7.50	271.25	137.28	4742.80	95990.0	0.288	247339.3	1.59559	0.189	1.4205	5.74E-06
31	7.50	278.75	137.28	4797.30	98208.7	0.289	253132.9	1.63971	0.179	1.3395	5.29E-06
32	7.50	286.25	137.28	4794.50	98094.1	0.288	252747.3	1.68382	0.168	1.2585	4.98E-06
33	7.50	293.75	137.28	4808.10	98651.4	0.290	254449.5	1.72794	0.157	1.1775	4.63E-06
34	7.50	301.25	137.28	4807.50	98626.8	0.288	254066.5	1.77206	0.147	1.1044	4.35E-06
35	7.50	308.75	137.28	4831.90	99630.4	0.288	256570.3	1.81618	0.143	1.0706	4.17E-06
36	7.50	316.25	137.28	4938.10	104058.1	0.288	268109.9	1.86029	0.138	1.0369	3.87E-06
37	10.16	325.08	137.28	4961.50	105046.6	0.286	270207.3	1.91222	0.133	1.3504	5.00E-06
38	9.84	335.08	137.28	5012.20	107204.5	0.285	275584.2	1.97105	0.127	1.2496	4.53E-06
39	10.16	345.08	137.28	5024.20	107718.4	0.284	276683.4	2.02987	0.121	1.2285	4.44E-06
40	9.84	355.08	137.28	5094.80	110767.0	0.284	284345.6	2.08870	0.115	1.1315	3.98E-06
41	20.00	370.00	137.28	5173.90	114233.2	0.282	292925.9	2.17647	0.106	2.1200	7.24E-06
42	20.00	390.00	137.28	5329.40	121202.9	0.281	310592.0	2.29412	0.094	1.8800	6.05E-06
43	20.00	410.00	137.28	5381.70	123593.4	0.283	317138.1	2.41176	0.086	1.7160	5.41E-06
44	20.00	430.00	137.28	5476.50	127986.0	0.284	328650.1	2.52941	0.081	1.6280	4.95E-06
45	20.00	450.00	137.28	5509.10	129514.2	0.284	332483.8	2.64706	0.077	1.5400	4.63E-06
					μ for E below =	0.337			Σ=	175.0603	2.57E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	68095	ksf
G' = E/(2*(1+μ)) =:	25463	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2700.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2442.7	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS:5E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.5 MO0801SCSPS5E4.003 FOR DBGM-2 STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO-μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1277.00	5693.6	0.366	15560.1	0.01176	1.000	4.0000	2.57E-04
2	4.00	6.00	112.32	1207.40	5089.9	0.389	14143.0	0.03529	1.000	4.0000	2.83E-04
3	4.00	10.00	112.32	1327.40	6151.9	0.394	17150.7	0.05882	1.000	4.0000	2.33E-04
4	4.00	14.00	112.32	1596.00	8893.5	0.393	24778.1	0.08235	1.000	4.0000	1.61E-04
5	4.00	18.00	112.32	1825.20	11631.3	0.392	32377.7	0.10588	1.000	4.0000	1.24E-04
6	8.00	24.00	112.32	1945.20	13211.0	0.393	36814.5	0.14118	1.000	8.0000	2.17E-04
7	8.00	32.00	112.32	2251.00	17691.2	0.374	48628.8	0.18824	1.000	8.0000	1.65E-04
8	8.00	40.00	112.32	2317.20	18747.1	0.361	51026.9	0.23529	1.000	8.0000	1.57E-04
9	8.00	48.00	112.32	2380.20	19780.3	0.357	53699.6	0.28235	0.952	7.6160	1.42E-04
10	8.00	56.00	112.32	2675.20	24987.3	0.338	66850.4	0.32941	0.891	7.1309	1.07E-04
11	10.00	65.00	112.32	2706.90	25582.9	0.340	68548.5	0.38235	0.842	8.4240	1.23E-04
12	10.00	75.00	112.32	2914.00	29647.3	0.338	79308.3	0.44118	0.788	7.8800	9.94E-05
13	10.00	85.00	112.32	3103.10	33620.0	0.336	89803.0	0.50000	0.734	7.3360	8.17E-05
14	10.00	95.00	112.32	3154.90	34751.8	0.334	92742.1	0.55882	0.679	6.7920	7.32E-05
15	10.00	105.00	137.28	3491.30	52015.2	0.276	132753.3	0.61765	0.634	6.3400	4.78E-05
16	10.00	115.00	137.28	3597.00	55212.5	0.276	140956.3	0.67647	0.598	5.9800	4.24E-05
17	10.00	125.00	137.28	3677.90	57724.0	0.276	147263.0	0.73529	0.562	5.6200	3.82E-05
18	10.00	135.00	137.28	3774.80	60805.7	0.277	155301.3	0.79412	0.526	5.2600	3.39E-05
19	15.00	147.50	137.28	3872.10	63980.8	0.280	163792.0	0.86765	0.481	7.2150	4.40E-05
20	15.00	162.50	137.28	3955.60	66769.9	0.283	171267.6	0.95588	0.427	6.4050	3.74E-05
21	15.00	177.50	137.28	4144.50	73299.4	0.283	188122.9	1.04412	0.373	5.5950	2.97E-05
22	15.00	192.50	137.28	4241.60	76774.3	0.284	197136.3	1.13235	0.319	4.7850	2.43E-05
23	15.00	207.50	137.28	4318.20	79572.3	0.288	204944.7	1.22059	0.281	4.2180	2.06E-05
24	15.00	222.50	137.28	4378.70	81817.6	0.287	210641.0	1.30882	0.260	3.8940	1.85E-05
25	7.50	233.75	137.28	4506.40	86659.4	0.288	223213.8	1.37500	0.243	1.8255	8.18E-06
26	7.50	241.25	137.28	4506.40	86659.4	0.288	223310.9	1.41912	0.233	1.7445	7.81E-06
27	7.50	248.75	137.28	4542.30	88045.6	0.288	226869.0	1.46324	0.222	1.6635	7.33E-06
28	7.50	256.25	137.28	4663.10	92791.0	0.287	238905.2	1.50735	0.211	1.5825	6.62E-06
29	7.50	263.75	137.28	4725.10	95274.8	0.287	245201.2	1.55147	0.200	1.5015	6.12E-06
30	7.50	271.25	137.28	4740.90	95913.1	0.288	247125.8	1.59559	0.189	1.4205	5.75E-06
31	7.50	278.75	137.28	4782.20	97591.4	0.289	251534.1	1.63971	0.179	1.3395	5.33E-06
32	7.50	286.25	137.28	4858.20	100718.0	0.288	259463.6	1.68382	0.168	1.2585	4.85E-06
33	7.50	293.75	137.28	4906.30	102722.2	0.289	264879.5	1.72794	0.157	1.1775	4.45E-06
34	7.50	301.25	137.28	4933.90	103881.2	0.288	267512.8	1.77206	0.147	1.1044	4.13E-06
35	7.50	308.75	137.28	4963.90	105148.3	0.287	270683.3	1.81618	0.143	1.0706	3.96E-06
36	7.50	316.25	137.28	5083.80	110289.2	0.288	284063.2	1.86029	0.138	1.0369	3.65E-06
37	10.16	325.08	137.28	5110.80	111463.8	0.286	286607.0	1.91222	0.133	1.3504	4.71E-06
38	9.84	335.08	137.28	5158.40	113549.8	0.285	291784.3	1.97105	0.127	1.2496	4.28E-06
39	10.16	345.08	137.28	5157.70	113518.9	0.284	291475.8	2.02987	0.121	1.2285	4.21E-06
40	9.84	355.08	137.28	5245.30	117407.8	0.283	301284.8	2.08870	0.115	1.1315	3.76E-06
41	20.00	370.00	137.28	5256.40	117905.2	0.282	302268.9	2.17647	0.106	2.1200	7.01E-06
42	20.00	390.00	137.28	5290.30	119430.9	0.281	306039.4	2.29412	0.094	1.8800	6.14E-06
43	20.00	410.00	137.28	5338.40	121612.6	0.283	312040.8	2.41176	0.086	1.7160	5.50E-06
44	20.00	430.00	137.28	5469.50	127659.0	0.284	327777.3	2.52941	0.081	1.6280	4.97E-06
45	20.00	450.00	137.28	5493.80	128795.9	0.283	330613.8	2.64706	0.077	1.5400	4.66E-06
					μ for E below =	0.340			Σ=	175.0603	2.67E-03

(1) Poisson Ratio from Reference 2.2.5
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.5

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	65504	ksf
G' = E/(2*(1+μ)) =:	24447	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2646.1	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	2393.5	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	816.84	2329.6	0.385	6455.2	0.02667	1	4.0000	6.20E-04
2	4.00	6.00	112.32	735.49	1888.7	0.411	5329.0	0.08000	1	4.0000	7.51E-04
3	4.00	10.00	112.32	828.28	2395.3	0.413	6767.8	0.13333	1	4.0000	5.91E-04
4	4.00	14.00	112.32	976.32	3328.1	0.412	9398.8	0.18667	1	4.0000	4.26E-04
5	4.00	18.00	112.32	1009.50	3558.1	0.414	10064.1	0.24000	0.972	3.8869	3.86E-04
6	8.00	24.00	112.32	1049.70	3847.1	0.417	10899.8	0.32000	0.915	7.3211	6.72E-04
7	2.00	29.00	112.32	1388.90	6735.2	0.394	18784.2	0.38667	0.868	1.7369	9.25E-05
8	10.00	35.00	137.28	2200.80	20668.9	0.291	53363.0	0.46668	0.811	8.1143	1.52E-04
9	10.00	45.00	137.28	2456.90	25759.1	0.286	66275.7	0.60001	0.717	7.1714	1.08E-04
10	10.00	55.00	137.28	2579.10	28385.2	0.281	72725.8	0.73335	0.631	6.3100	8.68E-05
11	10.00	65.00	137.28	2672.60	30480.6	0.281	78085.9	0.86668	0.553	5.5300	7.08E-05
12	10.00	75.00	137.28	2814.10	33793.7	0.276	86259.0	1.00001	0.475	4.7500	5.51E-05
13	10.00	85.00	137.28	2932.50	36697.1	0.279	93844.9	1.13335	0.397	3.9700	4.23E-05
14	10.00	95.00	137.28	2994.40	38262.7	0.281	98055.9	1.26668	0.319	3.1900	3.25E-05
15	10.00	105.00	137.28	3076.60	40392.3	0.284	103720	1.40001	0.271	2.7060	2.61E-05
16	10.00	115.00	137.28	3147.90	42286.1	0.285	108639	1.53335	0.252	2.5180	2.32E-05
17	10.00	125.00	137.28	3168.90	42852.2	0.283	109964	1.66668	0.233	2.3300	2.12E-05
18	10.00	135.00	137.28	3208.00	43916.2	0.285	112831	1.80001	0.214	2.1420	1.90E-05
19	15.00	147.50	137.28	3246.70	44982.2	0.288	115849	1.96668	0.191	2.8605	2.47E-05
20	15.00	162.50	137.28	3405.60	49493.0	0.289	127636	2.16668	0.163	2.4375	1.91E-05
21	15.00	177.50	137.28	3472.20	51447.7	0.291	132792	2.36668	0.134	2.0145	1.52E-05
22	15.00	192.50	137.28	3498.00	52215.1	0.291	134869	2.56668	0.106	1.5915	1.18E-05
23	15.00	207.50	137.28	3509.50	52559.0	0.296	136182	2.76668	0.089	1.3395	9.84E-06
24	15.00	222.50	137.28	3566.90	54292.3	0.295	140624	2.96668	0.084	1.2585	8.95E-06
25	7.50	233.75	137.28	3609.80	55606.1	0.296	144118	3.11668	0.080	0.5989	4.16E-06
26	7.50	241.25	137.28	3606.20	55495.3	0.297	143905	3.21668	0.077	0.5786	4.02E-06
27	7.50	248.75	137.28	3615.10	55769.5	0.297	144625	3.31668	0.074	0.5584	3.86E-06
28	7.50	256.25	137.28	3644.00	56664.7	0.295	146784	3.41668	0.072	0.5381	3.67E-06
29	7.50	263.75	137.28	3710.40	58748.6	0.295	152110	3.51668	0.069	0.5179	3.40E-06
30	7.50	271.25	137.28	3724.80	59205.5	0.296	153464	3.61668	0.066	0.4976	3.24E-06
31	7.50	278.75	137.28	3760.60	60349.1	0.296	156472	3.71668	0.064	0.4774	3.05E-06
32	7.50	286.25	137.28	3801.80	61678.6	0.296	159840	3.81668	0.061	0.4571	2.86E-06
33	7.50	293.75	137.28	3815.90	62137.0	0.297	161195	3.91668	0.058	0.4369	2.71E-06
34	7.50	301.25	137.28	3842.00	62989.9	0.295	163204	4.01668	0.056	0.4179	2.56E-06
35	7.50	308.75	137.28	3874.20	64050.2	0.295	165882	4.11668	0.054	0.4056	2.44E-06
36	7.50	316.25	137.28	3914.40	65386.3	0.296	169446	4.21668	0.052	0.3932	2.32E-06
37	10.16	325.08	137.28	3911.10	65276.1	0.294	168914	4.33439	0.050	0.5128	3.04E-06
38	9.84	335.08	137.28	3979.20	67569.0	0.293	174719	4.46773	0.048	0.4752	2.72E-06
39	10.16	345.08	137.28	3991.80	67997.6	0.292	175696	4.60106	0.046	0.4681	2.66E-06
40	9.84	355.08	137.28	4044.50	69804.9	0.291	180259	4.73439	0.044	0.4319	2.40E-06
41	20.00	370.00	137.28	4137.50	73052.0	0.290	188408	4.93335	0.041	0.8120	4.31E-06
42	20.00	390.00	137.28	4143.40	73260.5	0.289	188889	5.20001	0.036	0.7240	3.83E-06
43	20.00	410.00	137.28	4203.60	75404.8	0.291	194639	5.46668	0.033	0.6600	3.39E-06
44	20.00	430.00	137.28	4361.40	81172.3	0.291	209600	5.73335	0.031	0.6200	2.96E-06
45	20.00	450.00	137.28	4433.90	83893.4	0.291	216559	6.00001	0.029	0.5800	2.68E-06
					μ for E below =	0.381			**Σ=**	100.3401	4.33E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	23172	ksf
G' = E/(2*(1+μ)) =:	8387	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1549.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1402.0	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	790.56	2182.1	0.386	6050.1	0.02667	1	4.0000	6.61E-04
2	4.00	6.00	112.32	731.67	1869.1	0.411	5275.7	0.08000	1	4.0000	7.58E-04
3	4.00	10.00	112.32	800.06	2234.9	0.416	6331.1	0.13333	1	4.0000	6.32E-04
4	4.00	14.00	112.32	884.02	2728.5	0.417	7731.6	0.18667	1	4.0000	5.17E-04
5	4.00	18.00	112.32	984.91	3386.9	0.417	9599.1	0.24000	0.972	3.8869	4.05E-04
6	8.00	24.00	112.32	1004.20	3520.8	0.421	10003.7	0.32000	0.915	7.3211	7.32E-04
7	8.00	32.00	112.32	1134.10	4490.6	0.407	12637.9	0.42667	0.840	6.7177	5.32E-04
8	8.00	40.00	112.32	1196.30	4996.7	0.397	13963.9	0.53333	0.764	6.1143	4.38E-04
9	8.00	48.00	112.32	1248.50	5442.3	0.394	15168.0	0.64000	0.689	5.5109	3.63E-04
10	8.00	56.00	112.32	1530.40	8177.4	0.378	22544.1	0.74667	0.623	4.9856	2.21E-04
11	10.00	65.00	112.32	1588.10	8805.7	0.379	24294.5	0.86667	0.553	5.5300	2.28E-04
12	10.00	75.00	137.28	2718.00	31525.0	0.276	80425.3	1.00000	0.475	4.7500	5.91E-05
13	10.00	85.00	137.28	2805.20	33580.2	0.278	85843.2	1.13333	0.397	3.9700	4.62E-05
14	10.00	95.00	137.28	2962.70	37456.9	0.280	95903.1	1.26667	0.319	3.1900	3.33E-05
15	10.00	105.00	137.28	2990.10	38152.9	0.283	97911.8	1.40000	0.271	2.7060	2.76E-05
16	10.00	115.00	137.28	3091.60	40787.1	0.284	104711	1.53333	0.252	2.5180	2.40E-05
17	10.00	125.00	137.28	3122.10	41595.8	0.282	106679	1.66667	0.233	2.3300	2.18E-05
18	10.00	135.00	137.28	3171.60	42925.3	0.284	110233	1.80000	0.214	2.1420	1.94E-05
19	15.00	147.50	137.28	3198.80	43664.7	0.287	112423	1.96667	0.191	2.8605	2.54E-05
20	15.00	162.50	137.28	3267.60	45563.2	0.290	117536	2.16667	0.163	2.4375	2.07E-05
21	15.00	177.50	137.28	3354.50	48018.9	0.291	123974	2.36667	0.134	2.0145	1.62E-05
22	15.00	192.50	137.28	3427.70	50137.4	0.292	129525	2.56667	0.106	1.5915	1.23E-05
23	15.00	207.50	137.28	3512.80	52657.8	0.295	136412	2.76667	0.089	1.3395	9.82E-06
24	15.00	222.50	137.28	3629.70	56220.9	0.294	145537	2.96667	0.084	1.2585	8.65E-06
25	7.50	233.75	137.28	3690.40	58117.0	0.295	150536	3.11667	0.080	0.5989	3.98E-06
26	7.50	241.25	137.28	3699.00	58388.2	0.296	151306	3.21667	0.077	0.5786	3.82E-06
27	7.50	248.75	137.28	3684.90	57943.9	0.296	150177	3.31667	0.074	0.5584	3.72E-06
28	7.50	256.25	137.28	3740.70	59712.0	0.294	154590	3.41667	0.072	0.5381	3.48E-06
29	7.50	263.75	137.28	3789.80	61289.9	0.294	158611	3.51667	0.069	0.5179	3.27E-06
30	7.50	271.25	137.28	3823.00	62368.4	0.295	161568	3.61667	0.066	0.4976	3.08E-06
31	7.50	278.75	137.28	3867.10	63815.6	0.296	165363	3.71667	0.064	0.4774	2.89E-06
32	7.50	286.25	137.28	3864.00	63713.4	0.295	165056	3.81667	0.061	0.4571	2.77E-06
33	7.50	293.75	137.28	3874.50	64060.1	0.297	166126	3.91667	0.058	0.4369	2.63E-06
34	7.50	301.25	137.28	3873.30	64020.4	0.295	165836	4.01667	0.056	0.4179	2.52E-06
35	7.50	308.75	137.28	3892.60	64660.0	0.295	167447	4.11667	0.054	0.4056	2.42E-06
36	7.50	316.25	137.28	3979.80	67589.4	0.295	175094	4.21667	0.052	0.3932	2.25E-06
37	10.16	325.08	137.28	3998.50	68226.1	0.293	176467	4.33438	0.050	0.5128	2.91E-06
38	9.84	335.08	137.28	4039.60	69635.9	0.292	180003	4.46771	0.048	0.4752	2.64E-06
39	10.16	345.08	137.28	4048.80	69953.4	0.292	180697	4.60105	0.046	0.4681	2.59E-06
40	9.84	355.08	137.28	4106.50	71961.4	0.291	185761	4.73438	0.044	0.4319	2.33E-06
41	20.00	370.00	137.28	4170.60	74225.5	0.289	191399	4.93333	0.041	0.8120	4.24E-06
42	20.00	390.00	137.28	4297.70	78818.5	0.288	203079	5.20000	0.036	0.7240	3.57E-06
43	20.00	410.00	137.28	4339.20	80348.1	0.290	207293	5.46667	0.033	0.6600	3.18E-06
44	20.00	430.00	137.28	4415.50	83198.6	0.291	214795	5.73333	0.031	0.6200	2.89E-06
45	20.00	450.00	137.28	4441.30	84173.7	0.291	217262	6.00000	0.029	0.5800	2.67E-06
					μ for E below =	0.390			**Σ=**	100.3360	5.88E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	17078	ksf
G' = E/(2*(1+μ)) =:	6145	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1326.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1200.0	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	817.67	2334.3	0.384	6460.5	0.02667	1	4.0000	6.19E-04
2	4.00	6.00	112.32	721.88	1819.4	0.414	5144.2	0.08000	1	4.0000	7.78E-04
3	4.00	10.00	112.32	776.77	2106.6	0.419	5979.8	0.13333	1	4.0000	6.69E-04
4	4.00	14.00	112.32	872.57	2658.3	0.418	7540.9	0.18667	1	4.0000	5.30E-04
5	4.00	18.00	112.32	988.64	3412.6	0.417	9670.9	0.24000	0.972	3.8869	4.02E-04
6	8.00	24.00	112.32	1055.80	3892.0	0.419	11043.6	0.32000	0.915	7.3211	6.63E-04
7	8.00	32.00	112.32	1223.00	5222.3	0.405	14676.9	0.42667	0.840	6.7177	4.58E-04
8	8.00	40.00	112.32	1218.90	5187.3	0.397	14492.2	0.53333	0.764	6.1143	4.22E-04
9	8.00	48.00	112.32	1223.50	5226.5	0.396	14588.6	0.64000	0.689	5.5109	3.78E-04
10	8.00	56.00	112.32	1522.30	8091.1	0.380	22324.9	0.74667	0.623	4.9856	2.23E-04
11	10.00	65.00	112.32	1516.40	8028.5	0.383	22199.2	0.86667	0.553	5.5300	2.49E-04
12	10.00	75.00	112.32	1644.30	9439.9	0.380	26057.0	1.00000	0.475	4.7500	1.82E-04
13	10.00	85.00	112.32	1767.40	10906.3	0.378	30057.9	1.13333	0.397	3.9700	1.32E-04
14	10.00	95.00	112.32	1868.80	12193.6	0.377	33584.3	1.26667	0.319	3.1900	9.50E-05
15	10.00	105.00	137.28	2809.60	33685.7	0.284	86512.2	1.40000	0.271	2.7060	3.13E-05
16	10.00	115.00	137.28	2893.60	35730.0	0.285	91796.8	1.53333	0.252	2.5180	2.74E-05
17	10.00	125.00	137.28	2965.70	37532.8	0.283	96286.6	1.66667	0.233	2.3300	2.42E-05
18	10.00	135.00	137.28	3042.80	39509.6	0.284	101480.5	1.80000	0.214	2.1420	2.11E-05
19	15.00	147.50	137.28	3119.90	41537.2	0.287	106937	1.96667	0.191	2.8605	2.67E-05
20	15.00	162.50	137.28	3185.40	43299.6	0.290	111703	2.16667	0.163	2.4375	2.18E-05
21	15.00	177.50	137.28	3339.50	47590.4	0.290	122820	2.36667	0.134	2.0145	1.64E-05
22	15.00	192.50	137.28	3417.10	49827.8	0.291	128662	2.56667	0.106	1.5915	1.24E-05
23	15.00	207.50	137.28	3477.30	51598.9	0.295	133642	2.76667	0.089	1.3395	1.00E-05
24	15.00	222.50	137.28	3524.90	53021.2	0.295	137288	2.96667	0.084	1.2585	9.17E-06
25	7.50	233.75	137.28	3629.00	56199.2	0.295	145567	3.11667	0.080	0.5989	4.11E-06
26	7.50	241.25	137.28	3628.00	56168.2	0.296	145562	3.21667	0.077	0.5786	3.98E-06
27	7.50	248.75	137.28	3656.60	57057.3	0.296	147862	3.31667	0.074	0.5584	3.78E-06
28	7.50	256.25	137.28	3760.50	60345.8	0.294	156180	3.41667	0.072	0.5381	3.45E-06
29	7.50	263.75	137.28	3810.70	61967.8	0.294	160312	3.51667	0.069	0.5179	3.23E-06
30	7.50	271.25	137.28	3822.90	62365.2	0.295	161525	3.61667	0.066	0.4976	3.08E-06
31	7.50	278.75	137.28	3855.90	63446.5	0.295	164380	3.71667	0.064	0.4774	2.90E-06
32	7.50	286.25	137.28	3918.10	65509.9	0.295	169633	3.81667	0.061	0.4571	2.69E-06
33	7.50	293.75	137.28	3957.20	66824.0	0.296	173189	3.91667	0.058	0.4369	2.52E-06
34	7.50	301.25	137.28	3979.50	67579.2	0.294	174925	4.01667	0.056	0.4179	2.39E-06
35	7.50	308.75	137.28	4003.40	68393.4	0.294	176977	4.11667	0.054	0.4056	2.29E-06
36	7.50	316.25	137.28	4101.70	71793.3	0.294	185837	4.21667	0.052	0.3932	2.12E-06
37	10.16	325.08	137.28	4123.20	72547.9	0.292	187493	4.33437	0.050	0.5128	2.73E-06
38	9.84	335.08	137.28	4161.60	73905.5	0.291	190886	4.46772	0.048	0.4752	2.49E-06
39	10.16	345.08	137.28	4160.10	73852.3	0.291	190619	4.60104	0.046	0.4681	2.46E-06
40	9.84	355.08	137.28	4231.90	76423.5	0.290	197130	4.73439	0.044	0.4319	2.19E-06
41	20.00	370.00	137.28	4239.80	76709.1	0.289	197702	4.93333	0.041	0.8120	4.11E-06
42	20.00	390.00	137.28	4266.20	77667.4	0.288	200104	5.20000	0.036	0.7240	3.62E-06
43	20.00	410.00	137.28	4304.00	79049.8	0.290	203934	5.46667	0.033	0.6600	3.24E-06
44	20.00	430.00	137.28	4410.30	83002.7	0.291	214255	5.73333	0.031	0.6200	2.89E-06
45	20.00	450.00	137.28	4428.70	83696.8	0.290	216010	6.00000	0.029	0.5800	2.69E-06
					μ for E below =	0.392			**Σ=**	100.3360	6.06E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	16547	ksf
G' = E/(2*(1+μ)) =:	5946	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1304.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1180.4	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY (4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ (1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	577.59	1164.8	0.385	3227.5	0.02667	1	4.0000	1.24E-03
2	4.00	6.00	112.32	520.07	944.3	0.411	2664.5	0.08000	1	4.0000	1.50E-03
3	4.00	10.00	112.32	585.68	1197.6	0.413	3383.9	0.13333	1	4.0000	1.18E-03
4	4.00	14.00	112.32	690.36	1664.0	0.412	4699.3	0.18667	1	4.0000	8.51E-04
5	4.00	18.00	112.32	713.83	1779.1	0.414	5032.1	0.24000	0.972	3.8869	7.72E-04
6	8.00	24.00	112.32	742.24	1923.5	0.417	5449.8	0.32000	0.915	7.3211	1.34E-03
7	2.00	29.00	112.32	982.13	3367.8	0.394	9392.7	0.38667	0.868	1.7369	1.85E-04
8	10.00	35.00	137.28	1681.30	12062.8	0.291	31143.6	0.46668	0.811	8.1143	2.61E-04
9	10.00	45.00	137.28	1989.20	16885.5	0.286	43444.6	0.60001	0.717	7.1714	1.65E-04
10	10.00	55.00	137.28	2105.80	18923.0	0.281	48482.7	0.73335	0.631	6.3100	1.30E-04
11	10.00	65.00	137.28	2182.20	20321.0	0.281	52058.8	0.86668	0.553	5.5300	1.06E-04
12	10.00	75.00	137.28	2280.90	22200.8	0.276	56668.0	1.00001	0.475	4.7500	8.38E-05
13	10.00	85.00	137.28	2384.90	24271.5	0.279	62069.0	1.13335	0.397	3.9700	6.40E-05
14	10.00	95.00	137.28	2437.50	25353.9	0.281	64974.5	1.26668	0.319	3.1900	4.91E-05
15	10.00	105.00	137.28	2480.90	26264.8	0.284	67443.4	1.40001	0.271	2.7060	4.01E-05
16	10.00	115.00	137.28	2550.80	27765.7	0.285	71334.0	1.53335	0.252	2.5180	3.53E-05
17	10.00	125.00	137.28	2581.80	28444.7	0.283	72992.5	1.66668	0.233	2.3300	3.19E-05
18	10.00	135.00	137.28	2619.30	29277.0	0.285	75219.7	1.80001	0.214	2.1420	2.85E-05
19	15.00	147.50	137.28	2650.90	29987.7	0.288	77231.5	1.96668	0.191	2.8605	3.70E-05
20	15.00	162.50	137.28	2780.70	32996.2	0.289	85093.3	2.16668	0.163	2.4375	2.86E-05
21	15.00	177.50	137.28	2835.00	34297.5	0.291	88525.3	2.36668	0.134	2.0145	2.28E-05
22	15.00	192.50	137.28	2856.10	34809.9	0.291	89912.6	2.56668	0.106	1.5915	1.77E-05
23	15.00	207.50	137.28	2865.50	35039.4	0.296	90788.6	2.76668	0.089	1.3395	1.48E-05
24	15.00	222.50	137.28	2912.40	36195.8	0.295	93751.5	2.96668	0.084	1.2585	1.34E-05
25	7.50	233.75	137.28	2947.40	37071.0	0.296	96079.1	3.11668	0.080	0.5989	6.23E-06
26	7.50	241.25	137.28	2944.50	36998.1	0.297	95939.8	3.21668	0.077	0.5786	6.03E-06
27	7.50	248.75	137.28	2951.70	37179.3	0.297	96415.5	3.31668	0.074	0.5584	5.79E-06
28	7.50	256.25	137.28	2975.30	37776.2	0.295	97855.3	3.41668	0.072	0.5381	5.50E-06
29	7.50	263.75	137.28	3029.50	39165.0	0.295	101404	3.51668	0.069	0.5179	5.11E-06
30	7.50	271.25	137.28	3041.30	39470.7	0.296	102310	3.61668	0.066	0.4976	4.86E-06
31	7.50	278.75	137.28	3070.50	40232.3	0.296	104313	3.71668	0.064	0.4774	4.58E-06
32	7.50	286.25	137.28	3104.20	41120.2	0.296	106563	3.81668	0.061	0.4571	4.29E-06
33	7.50	293.75	137.28	3115.70	41425.5	0.297	107465	3.91668	0.058	0.4369	4.07E-06
34	7.50	301.25	137.28	3137.00	41993.8	0.295	108804	4.01668	0.056	0.4179	3.84E-06
35	7.50	308.75	137.28	3163.30	42700.9	0.295	110590	4.11668	0.054	0.4056	3.67E-06
36	7.50	316.25	137.28	3196.10	43591.0	0.296	112964	4.21668	0.052	0.3932	3.48E-06
37	10.16	325.08	137.28	3193.40	43517.4	0.294	112609	4.33439	0.050	0.5128	4.55E-06
38	9.84	335.08	137.28	3249.00	45045.9	0.293	116479	4.46773	0.048	0.4752	4.08E-06
39	10.16	345.08	137.28	3259.30	45332.0	0.292	117132	4.60105	0.046	0.4681	4.00E-06
40	9.84	355.08	137.28	3302.30	46536.0	0.291	120171	4.73440	0.044	0.4319	3.59E-06
41	20.00	370.00	137.28	3378.30	48702.7	0.290	125609	4.93335	0.041	0.8120	6.46E-06
42	20.00	390.00	137.28	3383.10	48841.1	0.289	125928	5.20001	0.036	0.7240	5.75E-06
43	20.00	410.00	137.28	3432.30	50272.1	0.291	129765	5.46668	0.033	0.6600	5.09E-06
44	20.00	430.00	137.28	3561.00	54112.8	0.291	139728	5.73335	0.031	0.6200	4.44E-06
45	20.00	450.00	137.28	3620.30	55930.1	0.291	144376	6.00001	0.029	0.5800	4.02E-06
					μ for E below =	0.382			**Σ=**	100.3401	8.30E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	12085	ksf
G' = E/(2*(1+μ)) =:	4373	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1119.2	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1012.3	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	559.01	1091.1	0.386	3025.1	0.02667	1	4.0000	1.32E-03
2	4.00	6.00	112.32	517.37	934.6	0.411	2637.8	0.08000	1	4.0000	1.52E-03
3	4.00	10.00	112.32	565.73	1117.4	0.416	3165.6	0.13333	1	4.0000	1.26E-03
4	4.00	14.00	112.32	625.10	1364.3	0.417	3865.9	0.18667	1	4.0000	1.03E-03
5	4.00	18.00	112.32	696.44	1693.5	0.417	4799.6	0.24000	0.972	3.8869	8.10E-04
6	8.00	24.00	112.32	710.04	1760.2	0.421	5001.3	0.32000	0.915	7.3211	1.46E-03
7	8.00	32.00	112.32	801.91	2245.2	0.407	6318.7	0.42667	0.840	6.7177	1.06E-03
8	8.00	40.00	112.32	845.91	2498.4	0.397	6981.9	0.53333	0.764	6.1143	8.76E-04
9	8.00	48.00	112.32	882.84	2721.3	0.394	7584.3	0.64000	0.689	5.5109	7.27E-04
10	8.00	56.00	112.32	1082.20	4089.0	0.378	11273.0	0.74667	0.623	4.9856	4.42E-04
11	10.00	65.00	112.32	1122.90	4402.4	0.379	12146.0	0.86667	0.553	5.5300	4.55E-04
12	10.00	75.00	137.28	2214.30	20923.2	0.276	53378.6	1.00000	0.475	4.7500	8.90E-05
13	10.00	85.00	137.28	2276.30	22111.3	0.278	56524.6	1.13333	0.397	3.9700	7.02E-05
14	10.00	95.00	137.28	2419.00	24970.5	0.280	63933.6	1.26667	0.319	3.1900	4.99E-05
15	10.00	105.00	137.28	2441.40	25435.1	0.283	65274.2	1.40000	0.271	2.7060	4.15E-05
16	10.00	115.00	137.28	2524.30	27191.8	0.284	69808.5	1.53333	0.252	2.5180	3.61E-05
17	10.00	125.00	137.28	2549.20	27730.9	0.282	71120.3	1.66667	0.233	2.3300	3.28E-05
18	10.00	135.00	137.28	2589.60	28616.8	0.284	73488.6	1.80000	0.214	2.1420	2.91E-05
19	15.00	147.50	137.28	2611.80	29109.6	0.287	74947.9	1.96667	0.191	2.8605	3.82E-05
20	15.00	162.50	137.28	2668.00	30375.8	0.290	78358.0	2.16667	0.163	2.4375	3.11E-05
21	15.00	177.50	137.28	2738.90	32011.7	0.291	82647.1	2.36667	0.134	2.0145	2.44E-05
22	15.00	192.50	137.28	2798.70	33424.8	0.292	86349.6	2.56667	0.106	1.5915	1.84E-05
23	15.00	207.50	137.28	2868.20	35105.5	0.295	90942.2	2.76667	0.089	1.3395	1.47E-05
24	15.00	222.50	137.28	2963.60	37479.6	0.294	97022.0	2.96667	0.084	1.2585	1.30E-05
25	7.50	233.75	137.28	3013.20	38744.7	0.295	100357.3	3.11667	0.080	0.5989	5.97E-06
26	7.50	241.25	137.28	3020.20	38924.9	0.296	100869.2	3.21667	0.077	0.5786	5.74E-06
27	7.50	248.75	137.28	3008.70	38629.0	0.296	100117.2	3.31667	0.074	0.5584	5.58E-06
28	7.50	256.25	137.28	3054.20	39806.2	0.294	103055.2	3.41667	0.072	0.5381	5.22E-06
29	7.50	263.75	137.28	3094.40	40861.0	0.294	105743	3.51667	0.069	0.5179	4.90E-06
30	7.50	271.25	137.28	3121.50	41579.8	0.295	107714	3.61667	0.066	0.4976	4.62E-06
31	7.50	278.75	137.28	3157.40	42541.8	0.296	110237	3.71667	0.064	0.4774	4.33E-06
32	7.50	286.25	137.28	3154.90	42474.4	0.295	110034	3.81667	0.061	0.4571	4.15E-06
33	7.50	293.75	137.28	3163.50	42706.3	0.297	110749	3.91667	0.058	0.4369	3.94E-06
34	7.50	301.25	137.28	3162.50	42679.3	0.295	110555	4.01667	0.056	0.4179	3.78E-06
35	7.50	308.75	137.28	3178.30	43106.8	0.295	111632	4.11667	0.054	0.4056	3.63E-06
36	7.50	316.25	137.28	3249.50	45059.8	0.295	116730	4.21667	0.052	0.3932	3.37E-06
37	10.16	325.08	137.28	3264.80	45485.1	0.293	117647	4.33437	0.050	0.5128	4.36E-06
38	9.84	335.08	137.28	3298.30	46423.4	0.292	120001	4.46772	0.048	0.4752	3.96E-06
39	10.16	345.08	137.28	3305.80	46634.7	0.292	120462	4.60104	0.046	0.4681	3.89E-06
40	9.84	355.08	137.28	3352.90	47973.1	0.291	123838	4.73439	0.044	0.4319	3.49E-06
41	20.00	370.00	137.28	3405.30	49484.2	0.289	127601	4.93333	0.041	0.8120	6.36E-06
42	20.00	390.00	137.28	3509.10	52547.0	0.288	135389	5.20000	0.036	0.7240	5.35E-06
43	20.00	410.00	137.28	3542.90	53564.1	0.290	138192	5.46667	0.033	0.6600	4.78E-06
44	20.00	430.00	137.28	3605.20	55464.5	0.291	143194	5.73333	0.031	0.6200	4.33E-06
45	20.00	450.00	137.28	3626.30	56115.6	0.291	144841	6.00000	0.029	0.5800	4.00E-06
					μ for E below =	0.383			**Σ=**	100.3360	1.16E-02

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	8681	ksf
G' = E/(2*(1+μ)) =:	3140	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	948.3	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	857.7	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	578.18	1167.2	0.384	3230.3	0.02667	1	4.0000	1.24E-03
2	4.00	6.00	112.32	510.45	909.7	0.414	2572.2	0.08000	1	4.0000	1.56E-03
3	4.00	10.00	112.32	549.26	1053.3	0.419	2989.9	0.13333	1	4.0000	1.34E-03
4	4.00	14.00	112.32	617.00	1329.2	0.418	3770.4	0.18667	1	4.0000	1.06E-03
5	4.00	18.00	112.32	699.07	1706.3	0.417	4835.4	0.24000	0.972	3.8869	8.04E-04
6	8.00	24.00	112.32	746.58	1946.1	0.419	5522.1	0.32000	0.915	7.3211	1.33E-03
7	8.00	32.00	112.32	864.76	2610.9	0.405	7337.9	0.42667	0.840	6.7177	9.15E-04
8	8.00	40.00	112.32	861.89	2593.6	0.397	7246.1	0.53333	0.764	6.1143	8.44E-04
9	8.00	48.00	112.32	865.17	2613.4	0.396	7294.7	0.64000	0.689	5.5109	7.55E-04
10	8.00	56.00	112.32	1076.40	4045.3	0.380	11161.9	0.74667	0.623	4.9856	4.47E-04
11	10.00	65.00	112.32	1072.30	4014.6	0.383	11100.5	0.86667	0.553	5.5300	4.98E-04
12	10.00	75.00	112.32	1162.70	4720.0	0.380	13028.6	1.00000	0.475	4.7500	3.65E-04
13	10.00	85.00	112.32	1249.80	5453.6	0.378	15030.4	1.13333	0.397	3.9700	2.64E-04
14	10.00	95.00	112.32	1321.50	6097.3	0.377	16793.7	1.26667	0.319	3.1900	1.90E-04
15	10.00	105.00	137.28	2294.10	22458.5	0.284	57678.4	1.40000	0.271	2.7060	4.69E-05
16	10.00	115.00	137.28	2362.60	23819.7	0.285	61197.1	1.53333	0.252	2.5180	4.11E-05
17	10.00	125.00	137.28	2421.50	25022.2	0.283	64191.9	1.66667	0.233	2.3300	3.63E-05
18	10.00	135.00	137.28	2484.50	26341.1	0.284	67657.2	1.80000	0.214	2.1420	3.17E-05
19	15.00	147.50	137.28	2547.40	27691.8	0.287	71291.9	1.96667	0.191	2.8605	4.01E-05
20	15.00	162.50	137.28	2600.90	28867.1	0.290	74470.3	2.16667	0.163	2.4375	3.27E-05
21	15.00	177.50	137.28	2726.70	31727.1	0.290	81880.8	2.36667	0.134	2.0145	2.46E-05
22	15.00	192.50	137.28	2790.00	33217.3	0.291	85771.8	2.56667	0.106	1.5915	1.86E-05
23	15.00	207.50	137.28	2839.20	34399.2	0.295	89094.6	2.76667	0.089	1.3395	1.50E-05
24	15.00	222.50	137.28	2878.10	35348.3	0.295	91527.2	2.96667	0.084	1.2585	1.38E-05
25	7.50	233.75	137.28	2963.10	37467.0	0.295	97047.0	3.11667	0.080	0.5989	6.17E-06
26	7.50	241.25	137.28	2962.30	37446.8	0.296	97044.8	3.21667	0.077	0.5786	5.96E-06
27	7.50	248.75	137.28	2985.60	38038.2	0.296	98574.4	3.31667	0.074	0.5584	5.66E-06
28	7.50	256.25	137.28	3070.40	40229.6	0.294	104118	3.41667	0.072	0.5381	5.17E-06
29	7.50	263.75	137.28	3111.40	41311.2	0.294	106873	3.51667	0.069	0.5179	4.85E-06
30	7.50	271.25	137.28	3121.30	41574.5	0.295	107677	3.61667	0.066	0.4976	4.62E-06
31	7.50	278.75	137.28	3148.30	42296.9	0.295	109584	3.71667	0.064	0.4774	4.36E-06
32	7.50	286.25	137.28	3199.10	43672.9	0.295	113087	3.81667	0.061	0.4571	4.04E-06
33	7.50	293.75	137.28	3231.10	44551.0	0.296	115464	3.91667	0.058	0.4369	3.78E-06
34	7.50	301.25	137.28	3249.20	45051.5	0.294	116613	4.01667	0.056	0.4179	3.58E-06
35	7.50	308.75	137.28	3268.80	45596.6	0.294	117988	4.11667	0.054	0.4056	3.44E-06
36	7.50	316.25	137.28	3349.00	47861.5	0.294	123890	4.21667	0.052	0.3932	3.17E-06
37	10.16	325.08	137.28	3366.60	48365.9	0.292	124997	4.33437	0.050	0.5128	4.10E-06
38	9.84	335.08	137.28	3397.90	49269.4	0.291	127255	4.46772	0.048	0.4752	3.73E-06
39	10.16	345.08	137.28	3396.70	49234.6	0.291	127078	4.60104	0.046	0.4681	3.68E-06
40	9.84	355.08	137.28	3455.30	50948.1	0.290	131417	4.73439	0.044	0.4319	3.29E-06
41	20.00	370.00	137.28	3461.80	51139.9	0.289	131803	4.93333	0.041	0.8120	6.16E-06
42	20.00	390.00	137.28	3483.40	51780.1	0.288	133407	5.20000	0.036	0.7240	5.43E-06
43	20.00	410.00	137.28	3514.20	52699.8	0.290	135956	5.46667	0.033	0.6600	4.85E-06
44	20.00	430.00	137.28	3601.00	55335.3	0.291	142837	5.73333	0.031	0.6200	4.34E-06
45	20.00	450.00	137.28	3616.00	55797.3	0.290	144005	6.00000	0.029	0.5800	4.03E-06
					μ for E below =	0.391			**Σ=**	100.3360	1.20E-02

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	8365	ksf
G' = E/(2*(1+μ)) =:	3006	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	927.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	839.3	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1155.20	4659.3	0.385	12910.6	0.02667	1	4.0000	3.10E-04
2	4.00	6.00	112.32	1040.10	3777.1	0.411	10657.1	0.08000	1	4.0000	3.75E-04
3	4.00	10.00	112.32	1171.40	4790.9	0.413	13536.5	0.13333	1	4.0000	2.95E-04
4	4.00	14.00	112.32	1380.70	6655.9	0.412	18796.8	0.18667	1	4.0000	2.13E-04
5	4.00	18.00	112.32	1427.70	7116.7	0.414	20129.6	0.24000	0.972	3.8869	1.93E-04
6	8.00	24.00	112.32	1484.50	7694.3	0.417	21799.7	0.32000	0.915	7.3211	3.36E-04
7	2.00	29.00	112.32	1964.30	13471.7	0.394	37572.2	0.38667	0.868	1.7369	4.62E-05
8	10.00	35.00	137.28	2880.60	35409.7	0.291	91420.7	0.46668	0.811	8.1143	8.88E-05
9	10.00	45.00	137.28	3034.70	39299.6	0.286	101113.8	0.60001	0.717	7.1714	7.09E-05
10	10.00	55.00	137.28	3158.70	42576.8	0.281	109086	0.73335	0.631	6.3100	5.78E-05
11	10.00	65.00	137.28	3273.30	45722.3	0.281	117132	0.86668	0.553	5.5300	4.72E-05
12	10.00	75.00	137.28	3472.10	51444.7	0.276	131314	1.00001	0.475	4.7500	3.62E-05
13	10.00	85.00	137.28	3606.00	55489.1	0.279	141901	1.13335	0.397	3.9700	2.80E-05
14	10.00	95.00	137.28	3678.60	57745.9	0.281	147985	1.26668	0.319	3.1900	2.16E-05
15	10.00	105.00	137.28	3815.30	62117.4	0.284	159506	1.40001	0.271	2.7060	1.70E-05
16	10.00	115.00	137.28	3884.70	64397.8	0.285	165447	1.53335	0.252	2.5180	1.52E-05
17	10.00	125.00	137.28	3889.60	64560.4	0.283	165670	1.66668	0.233	2.3300	1.41E-05
18	10.00	135.00	137.28	3929.00	65874.9	0.285	169249	1.80001	0.214	2.1420	1.27E-05
19	15.00	147.50	137.28	3976.40	67474.0	0.288	173775	1.96668	0.191	2.8605	1.65E-05
20	15.00	162.50	137.28	4171.00	74239.8	0.289	191455	2.16668	0.163	2.4375	1.27E-05
21	15.00	177.50	137.28	4252.50	77169.4	0.291	199182	2.36668	0.134	2.0145	1.01E-05
22	15.00	192.50	137.28	4284.20	78324.1	0.291	202308	2.56668	0.106	1.5915	7.87E-06
23	15.00	207.50	137.28	4298.30	78840.6	0.296	204279	2.76668	0.089	1.3395	6.56E-06
24	15.00	222.50	137.28	4368.50	81436.8	0.295	210931	2.96668	0.084	1.2585	5.97E-06
25	7.50	233.75	137.28	4421.10	83409.8	0.296	216178	3.11668	0.080	0.5989	2.77E-06
26	7.50	241.25	137.28	4416.70	83243.8	0.297	215860	3.21668	0.077	0.5786	2.68E-06
27	7.50	248.75	137.28	4427.60	83655.2	0.297	216940	3.31668	0.074	0.5584	2.57E-06
28	7.50	256.25	137.28	4463.00	84998.2	0.295	220179	3.41668	0.072	0.5381	2.44E-06
29	7.50	263.75	137.28	4544.30	88123.2	0.295	228165	3.51668	0.069	0.5179	2.27E-06
30	7.50	271.25	137.28	4561.90	88807.1	0.296	230193	3.61668	0.066	0.4976	2.16E-06
31	7.50	278.75	137.28	4605.80	90524.5	0.296	234710	3.71668	0.064	0.4774	2.03E-06
32	7.50	286.25	137.28	4656.30	92520.5	0.296	239767	3.81668	0.061	0.4571	1.91E-06
33	7.50	293.75	137.28	4673.60	93209.3	0.297	241802	3.91668	0.058	0.4369	1.81E-06
34	7.50	301.25	137.28	4705.50	94486.1	0.295	244810	4.01668	0.056	0.4179	1.71E-06
35	7.50	308.75	137.28	4744.90	96075.0	0.295	248823	4.11668	0.054	0.4056	1.63E-06
36	7.50	316.25	137.28	4794.10	98077.7	0.296	254165	4.21668	0.052	0.3932	1.55E-06
37	10.16	325.08	137.28	4790.00	97910.0	0.294	253360	4.33439	0.050	0.5128	2.02E-06
38	9.84	335.08	137.28	4873.50	101353	0.293	262077	4.46773	0.048	0.4752	1.81E-06
39	10.16	345.08	137.28	4888.90	101995	0.292	263541	4.60105	0.046	0.4681	1.78E-06
40	9.84	355.08	137.28	4953.50	104708	0.291	270390	4.73440	0.044	0.4319	1.60E-06
41	20.00	370.00	137.28	5067.40	109579	0.290	282615	4.93335	0.041	0.8120	2.87E-06
42	20.00	390.00	137.28	5074.70	109895	0.289	283344	5.20001	0.036	0.7240	2.56E-06
43	20.00	410.00	137.28	5148.40	113110	0.291	291966	5.46668	0.033	0.6600	2.26E-06
44	20.00	430.00	137.28	5341.60	121758	0.291	314400	5.73335	0.031	0.6200	1.97E-06
45	20.00	450.00	137.28	5430.40	125840	0.291	324839	6.00001	0.029	0.5800	1.79E-06
					μ for E below =	0.382			Σ=	100.3401	2.28E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	43973	ksf
G' = E/(2*(1+μ)) =:	15907	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	2134.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1930.7	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1118.00	4364.0	0.386	12099.9	0.02667	1	4.0000	3.31E-04
2	4.00	6.00	112.32	1034.70	3738.0	0.411	10550.5	0.08000	1	4.0000	3.79E-04
3	4.00	10.00	112.32	1131.50	4470.1	0.416	12663.3	0.13333	1	4.0000	3.16E-04
4	4.00	14.00	112.32	1250.20	5457.1	0.417	15463.5	0.18667	1	4.0000	2.59E-04
5	4.00	18.00	112.32	1392.90	6774.0	0.417	19198.9	0.24000	0.972	3.8869	2.02E-04
6	8.00	24.00	112.32	1420.10	7041.2	0.421	20005.9	0.32000	0.915	7.3211	3.66E-04
7	8.00	32.00	112.32	1603.80	8980.6	0.407	25274.0	0.42667	0.840	6.7177	2.66E-04
8	8.00	40.00	112.32	1691.80	9993.2	0.397	27927.0	0.53333	0.764	6.1143	2.19E-04
9	8.00	48.00	112.32	1765.70	10885.3	0.394	30337.9	0.64000	0.689	5.5109	1.82E-04
10	8.00	56.00	112.32	2164.30	16354.6	0.378	45087.8	0.74667	0.623	4.9856	1.11E-04
11	10.00	65.00	112.32	2245.90	17611.1	0.379	48588.4	0.86667	0.553	5.5300	1.14E-04
12	10.00	75.00	137.28	3336.20	47496.4	0.276	121170.8	1.00000	0.475	4.7500	3.92E-05
13	10.00	85.00	137.28	3457.00	50998.2	0.278	130370	1.13333	0.397	3.9700	3.05E-05
14	10.00	95.00	137.28	3628.50	56183.7	0.280	143851	1.26667	0.319	3.1900	2.22E-05
15	10.00	105.00	137.28	3662.10	57229.1	0.283	146867	1.40000	0.271	2.7060	1.84E-05
16	10.00	115.00	137.28	3786.40	61180.0	0.284	157065	1.53333	0.252	2.5180	1.60E-05
17	10.00	125.00	137.28	3823.80	62394.5	0.282	160021	1.66667	0.233	2.3300	1.46E-05
18	10.00	135.00	137.28	3884.40	64387.9	0.284	165349	1.80000	0.214	2.1420	1.30E-05
19	15.00	147.50	137.28	3917.70	65496.6	0.287	168633	1.96667	0.191	2.8605	1.70E-05
20	15.00	162.50	137.28	4002.00	68345.6	0.290	176306	2.16667	0.163	2.4375	1.38E-05
21	15.00	177.50	137.28	4108.40	72028.0	0.291	185961	2.36667	0.134	2.0145	1.08E-05
22	15.00	192.50	137.28	4198.10	75207.6	0.292	194291	2.56667	0.106	1.5915	8.19E-06
23	15.00	207.50	137.28	4302.30	78987.4	0.295	204620	2.76667	0.089	1.3395	6.55E-06
24	15.00	222.50	137.28	4445.40	84329.2	0.294	218300	2.96667	0.084	1.2585	5.77E-06
25	7.50	233.75	137.28	4519.70	87171.7	0.295	225794	3.11667	0.080	0.5989	2.65E-06
26	7.50	241.25	137.28	4530.30	87581.0	0.296	226956	3.21667	0.077	0.5786	2.55E-06
27	7.50	248.75	137.28	4513.00	86913.4	0.296	225259	3.31667	0.074	0.5584	2.48E-06
28	7.50	256.25	137.28	4581.30	89564.0	0.294	231874	3.41667	0.072	0.5381	2.32E-06
29	7.50	263.75	137.28	4641.50	91933.3	0.294	237912	3.51667	0.069	0.5179	2.18E-06
30	7.50	271.25	137.28	4682.20	93552.7	0.295	242352	3.61667	0.066	0.4976	2.05E-06
31	7.50	278.75	137.28	4736.20	95723.0	0.296	248043	3.71667	0.064	0.4774	1.92E-06
32	7.50	286.25	137.28	4732.40	95569.5	0.295	247582	3.81667	0.061	0.4571	1.85E-06
33	7.50	293.75	137.28	4745.20	96087.1	0.297	249181	3.91667	0.058	0.4369	1.75E-06
34	7.50	301.25	137.28	4743.80	96030.4	0.295	248753	4.01667	0.056	0.4179	1.68E-06
35	7.50	308.75	137.28	4767.40	96988.3	0.295	251167	4.11667	0.054	0.4056	1.61E-06
36	7.50	316.25	137.28	4874.20	101382	0.295	262637	4.21667	0.052	0.3932	1.50E-06
37	10.16	325.08	137.28	4897.10	102337	0.293	264696	4.33437	0.050	0.5128	1.94E-06
38	9.84	335.08	137.28	4947.50	104455	0.292	270007	4.46772	0.048	0.4752	1.76E-06
39	10.16	345.08	137.28	4958.80	104932	0.292	271051	4.60104	0.046	0.4681	1.73E-06
40	9.84	355.08	137.28	5029.40	107942	0.291	278640	4.73439	0.044	0.4319	1.55E-06
41	20.00	370.00	137.28	5107.90	111337	0.289	287097	4.93333	0.041	0.8120	2.83E-06
42	20.00	390.00	137.28	5263.60	118228	0.288	304620	5.20000	0.036	0.7240	2.38E-06
43	20.00	410.00	137.28	5314.40	120522	0.290	310938	5.46667	0.033	0.6600	2.12E-06
44	20.00	430.00	137.28	5407.80	124795	0.291	322186	5.73333	0.031	0.6200	1.92E-06
45	20.00	450.00	137.28	5439.50	126262	0.291	325899	6.00000	0.029	0.5800	1.78E-06
					μ for E below =	0.378			Σ=	100.3360	3.00E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from Reference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	33424	ksf
G' = E/(2*(1+μ)) =:	12124	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1863.5	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1685.6	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 1**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **75 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1156.40	4669.0	0.384	12922.0	0.02667	1	4.0000	3.10E-04
2	4.00	6.00	112.32	1020.90	3638.9	0.414	10288.6	0.08000	1	4.0000	3.89E-04
3	4.00	10.00	112.32	1098.50	4213.1	0.419	11959.2	0.13333	1	4.0000	3.34E-04
4	4.00	14.00	112.32	1234.00	5316.6	0.418	15081.8	0.18667	1	4.0000	2.65E-04
5	4.00	18.00	112.32	1398.10	6824.7	0.417	19340.5	0.24000	0.972	3.8869	2.01E-04
6	8.00	24.00	112.32	1493.20	7784.7	0.419	22089.4	0.32000	0.915	7.3211	3.31E-04
7	8.00	32.00	112.32	1729.50	10443.5	0.405	29350.9	0.42667	0.840	6.7177	2.29E-04
8	8.00	40.00	112.32	1723.80	10374.8	0.397	28984.9	0.53333	0.764	6.1143	2.11E-04
9	8.00	48.00	112.32	1730.30	10453.2	0.396	29177.6	0.64000	0.689	5.5109	1.89E-04
10	8.00	56.00	112.32	2152.90	16182.8	0.380	44651.6	0.74667	0.623	4.9856	1.12E-04
11	10.00	65.00	112.32	2144.50	16056.8	0.383	44397.9	0.86667	0.553	5.5300	1.25E-04
12	10.00	75.00	112.32	2325.40	18880.0	0.380	52114.4	1.00000	0.475	4.7500	9.11E-05
13	10.00	85.00	112.32	2499.50	21812.8	0.378	60116.6	1.13333	0.397	3.9700	6.60E-05
14	10.00	95.00	112.32	2643.00	24389.4	0.377	67174.6	1.26667	0.319	3.1900	4.75E-05
15	10.00	105.00	137.28	3441.10	50530.2	0.284	129773	1.40000	0.271	2.7060	2.09E-05
16	10.00	115.00	137.28	3543.90	53594.4	0.285	137694	1.53333	0.252	2.5180	1.83E-05
17	10.00	125.00	137.28	3632.20	56298.4	0.283	144428	1.66667	0.233	2.3300	1.61E-05
18	10.00	135.00	137.28	3726.70	59265.9	0.284	152225	1.80000	0.214	2.1420	1.41E-05
19	15.00	147.50	137.28	3821.10	62306.5	0.287	160407	1.96667	0.191	2.8605	1.78E-05
20	15.00	162.50	137.28	3901.30	64949.4	0.290	167554	2.16667	0.163	2.4375	1.45E-05
21	15.00	177.50	137.28	4090.00	71384.3	0.290	184227	2.36667	0.134	2.0145	1.09E-05
22	15.00	192.50	137.28	4185.00	74739.0	0.291	192986	2.56667	0.106	1.5915	8.25E-06
23	15.00	207.50	137.28	4258.80	77398.2	0.295	200463	2.76667	0.089	1.3395	6.68E-06
24	15.00	222.50	137.28	4317.10	79531.7	0.295	205932	2.96667	0.084	1.2585	6.11E-06
25	7.50	233.75	137.28	4444.70	84302.6	0.295	218361	3.11667	0.080	0.5989	2.74E-06
26	7.50	241.25	137.28	4443.40	84253.3	0.296	218346	3.21667	0.077	0.5786	2.65E-06
27	7.50	248.75	137.28	4478.40	85585.9	0.296	221792	3.31667	0.074	0.5584	2.52E-06
28	7.50	256.25	137.28	4605.60	90516.7	0.294	234264	3.41667	0.072	0.5381	2.30E-06
29	7.50	263.75	137.28	4667.10	92950.2	0.294	240464	3.51667	0.069	0.5179	2.15E-06
30	7.50	271.25	137.28	4682.00	93544.7	0.295	242279	3.61667	0.066	0.4976	2.05E-06
31	7.50	278.75	137.28	4722.50	95170.0	0.295	246570	3.71667	0.064	0.4774	1.94E-06
32	7.50	286.25	137.28	4798.70	98266.0	0.295	254452	3.81667	0.061	0.4571	1.80E-06
33	7.50	293.75	137.28	4846.60	100237.6	0.296	259788	3.91667	0.058	0.4369	1.68E-06
34	7.50	301.25	137.28	4873.80	101365.8	0.294	262379	4.01667	0.056	0.4179	1.59E-06
35	7.50	308.75	137.28	4903.10	102588	0.294	265462	4.11667	0.054	0.4056	1.53E-06
36	7.50	316.25	137.28	5023.50	107688	0.294	278751	4.21667	0.052	0.3932	1.41E-06
37	10.16	325.08	137.28	5049.90	108823	0.292	281243	4.33437	0.050	0.5128	1.82E-06
38	9.84	335.08	137.28	5096.80	110854	0.291	286318	4.46772	0.048	0.4752	1.66E-06
39	10.16	345.08	137.28	5095.10	110780	0.291	285932	4.60104	0.046	0.4681	1.64E-06
40	9.84	355.08	137.28	5183.00	114635	0.290	295695	4.73439	0.044	0.4319	1.46E-06
41	20.00	370.00	137.28	5192.60	115060	0.289	296545	4.93333	0.041	0.8120	2.74E-06
42	20.00	390.00	137.28	5225.00	116501	0.288	300155	5.20000	0.036	0.7240	2.41E-06
43	20.00	410.00	137.28	5271.30	118575	0.290	305901	5.46667	0.033	0.6600	2.16E-06
44	20.00	430.00	137.28	5401.50	124504	0.291	321383	5.73333	0.031	0.6200	1.93E-06
45	20.00	450.00	137.28	5424.00	125544	0.290	324011	6.00000	0.029	0.5800	1.79E-06
					μ for E below =	0.392			**Σ=**	100.3360	3.08E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.7 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H) / SUM(Nq*H/E_i) =:	32622	ksf
G' = E/(2*(1+μ)) =:	11717	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1831.9	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1657.1	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	816.84	2329.6	0.385	6455.2	0.01176	1.000	4.0000	6.20E-04
2	4.00	6.00	112.32	735.49	1888.7	0.411	5329.0	0.03529	1.000	4.0000	7.51E-04
3	4.00	10.00	112.32	828.28	2395.3	0.413	6767.8	0.05882	1.000	4.0000	5.91E-04
4	4.00	14.00	112.32	976.32	3328.1	0.412	9398.8	0.08235	1.000	4.0000	4.26E-04
5	4.00	18.00	112.32	1009.50	3558.1	0.414	10064.1	0.10588	1.000	4.0000	3.97E-04
6	8.00	24.00	112.32	1049.70	3847.1	0.417	10899.8	0.14118	1.000	8.0000	7.34E-04
7	2.00	29.00	112.32	1388.90	6735.2	0.394	18784.2	0.17059	1.000	2.0010	1.07E-04
8	10.00	35.00	137.28	2200.80	20668.9	0.291	53363.0	0.20589	1.000	10.0000	1.87E-04
9	10.00	45.00	137.28	2456.90	25759.1	0.286	66275.7	0.26471	0.994	9.9400	1.50E-04
10	10.00	55.00	137.28	2579.10	28385.2	0.281	72725.8	0.32354	0.897	8.9680	1.23E-04
11	10.00	65.00	137.28	2672.60	30480.6	0.281	78085.9	0.38236	0.842	8.4240	1.08E-04
12	10.00	75.00	137.28	2814.10	33793.7	0.276	86259.0	0.44118	0.788	7.8800	9.14E-05
13	10.00	85.00	137.28	2932.50	36697.1	0.279	93844.9	0.50001	0.734	7.3360	7.82E-05
14	10.00	95.00	137.28	2994.40	38262.7	0.281	98055.9	0.55883	0.679	6.7920	6.93E-05
15	10.00	105.00	137.28	3076.60	40392.3	0.284	103720	0.61765	0.634	6.3400	6.11E-05
16	10.00	115.00	137.28	3147.90	42286.1	0.285	108639	0.67648	0.598	5.9800	5.50E-05
17	10.00	125.00	137.28	3168.90	42852.2	0.283	109964	0.73530	0.562	5.6200	5.11E-05
18	10.00	135.00	137.28	3208.00	43916.2	0.285	112831	0.79412	0.526	5.2600	4.66E-05
19	15.00	147.50	137.28	3246.70	44982.2	0.288	115849	0.86765	0.481	7.2150	6.23E-05
20	15.00	162.50	137.28	3405.60	49493.0	0.289	127636	0.95589	0.427	6.4050	5.02E-05
21	15.00	177.50	137.28	3472.20	51447.7	0.291	132792	1.04412	0.373	5.5950	4.21E-05
22	15.00	192.50	137.28	3498.00	52215.1	0.291	134869	1.13236	0.319	4.7850	3.55E-05
23	15.00	207.50	137.28	3509.50	52559.0	0.296	136182	1.22059	0.281	4.2180	3.10E-05
24	15.00	222.50	137.28	3566.90	54292.3	0.295	140624	1.30883	0.260	3.8940	2.77E-05
25	7.50	233.75	137.28	3609.80	55606.1	0.296	144118	1.37501	0.243	1.8255	1.27E-05
26	7.50	241.25	137.28	3606.20	55495.3	0.297	143905	1.41912	0.233	1.7445	1.21E-05
27	7.50	248.75	137.28	3615.10	55769.5	0.297	144625	1.46324	0.222	1.6635	1.15E-05
28	7.50	256.25	137.28	3644.00	56664.7	0.295	146784	1.50736	0.211	1.5825	1.08E-05
29	7.50	263.75	137.28	3710.40	58748.6	0.295	152110	1.55148	0.200	1.5015	9.87E-06
30	7.50	271.25	137.28	3724.80	59205.5	0.296	153464	1.59559	0.189	1.4205	9.26E-06
31	7.50	278.75	137.28	3760.60	60349.1	0.296	156472	1.63971	0.179	1.3395	8.56E-06
32	7.50	286.25	137.28	3801.80	61678.6	0.296	159840	1.68383	0.168	1.2585	7.87E-06
33	7.50	293.75	137.28	3815.90	62137.0	0.297	161195	1.72795	0.157	1.1775	7.30E-06
34	7.50	301.25	137.28	3842.00	62989.9	0.295	163204	1.77206	0.147	1.1044	6.77E-06
35	7.50	308.75	137.28	3874.20	64050.2	0.295	165882	1.81618	0.143	1.0706	6.45E-06
36	7.50	316.25	137.28	3914.40	65386.3	0.296	169446	1.86030	0.138	1.0369	6.12E-06
37	10.16	325.08	137.28	3911.10	65276.1	0.294	168914	1.91223	0.133	1.3504	7.99E-06
38	9.84	335.08	137.28	3979.20	67569.0	0.293	174719	1.97106	0.127	1.2496	7.15E-06
39	10.16	345.08	137.28	3991.80	67997.6	0.292	175696	2.02988	0.121	1.2285	6.99E-06
40	9.84	355.08	137.28	4044.50	69804.9	0.291	180259	2.08871	0.115	1.1315	6.28E-06
41	20.00	370.00	137.28	4137.50	73052.0	0.290	188408	2.17648	0.106	2.1200	1.13E-05
42	20.00	390.00	137.28	4143.40	73260.5	0.289	188889	2.29412	0.094	1.8800	9.95E-06
43	20.00	410.00	137.28	4203.60	75404.8	0.291	194639	2.41177	0.086	1.7160	8.82E-06
44	20.00	430.00	137.28	4361.40	81172.3	0.291	209600	2.52942	0.081	1.6280	7.77E-06
45	20.00	450.00	137.28	4433.90	83893.4	0.291	216559	2.64706	0.077	1.5400	7.11E-06
					μ for E below =	0.347			**Σ=**	175.2224	5.08E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 34510 ksf

G' = E/(2*(1+μ)) =: 12806 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1915.2 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1732.3 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' MEDIAN CURVE:

Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2; **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ (1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	790.56	2182.1	0.386	6050.1	0.01176	1.000	4.0000	6.61E-04
2	4.00	6.00	112.32	731.67	1869.1	0.411	5275.7	0.03529	1.000	4.0000	7.58E-04
3	4.00	10.00	112.32	800.06	2234.9	0.416	6331.1	0.05882	1.000	4.0000	6.32E-04
4	4.00	14.00	112.32	884.02	2728.5	0.417	7731.6	0.08235	1.000	4.0000	5.17E-04
5	4.00	18.00	112.32	984.91	3386.9	0.417	9599.1	0.10588	1.000	4.0000	4.17E-04
6	8.00	24.00	112.32	1004.20	3520.8	0.421	10003.7	0.14118	1.000	8.0000	8.00E-04
7	8.00	32.00	112.32	1134.10	4490.6	0.407	12637.9	0.18824	1.000	8.0000	6.33E-04
8	8.00	40.00	112.32	1196.30	4996.7	0.397	13963.9	0.23529	1.000	8.0000	5.73E-04
9	8.00	48.00	112.32	1248.50	5442.3	0.394	15168.0	0.28235	0.952	7.6160	5.02E-04
10	8.00	56.00	112.32	1530.40	8177.4	0.378	22544.1	0.32941	0.891	7.1309	3.16E-04
11	10.00	65.00	112.32	1588.10	8805.7	0.379	24294.5	0.38235	0.842	8.4240	3.47E-04
12	10.00	75.00	137.28	2718.00	31525.0	0.276	80425.3	0.44118	0.788	7.8800	9.80E-05
13	10.00	85.00	137.28	2805.20	33580.2	0.278	85843.2	0.50000	0.734	7.3360	8.55E-05
14	10.00	95.00	137.28	2962.70	37456.9	0.280	95903.1	0.55882	0.679	6.7920	7.08E-05
15	10.00	105.00	137.28	2990.10	38152.9	0.283	97911.8	0.61765	0.634	6.3400	6.48E-05
16	10.00	115.00	137.28	3091.60	40787.1	0.284	104711	0.67647	0.598	5.9800	5.71E-05
17	10.00	125.00	137.28	3122.10	41595.8	0.282	106679	0.73529	0.562	5.6200	5.27E-05
18	10.00	135.00	137.28	3171.60	42925.3	0.284	110233	0.79412	0.526	5.2600	4.77E-05
19	15.00	147.50	137.28	3198.80	43664.7	0.287	112423	0.86765	0.481	7.2150	6.42E-05
20	15.00	162.50	137.28	3267.60	45563.2	0.290	117536	0.95588	0.427	6.4050	5.45E-05
21	15.00	177.50	137.28	3354.50	48018.9	0.291	123974	1.04412	0.373	5.5950	4.51E-05
22	15.00	192.50	137.28	3427.70	50137.4	0.292	129525	1.13235	0.319	4.7850	3.69E-05
23	15.00	207.50	137.28	3512.80	52657.8	0.295	136412	1.22059	0.281	4.2180	3.09E-05
24	15.00	222.50	137.28	3629.70	56220.9	0.294	145537	1.30882	0.260	3.8940	2.68E-05
25	7.50	233.75	137.28	3690.40	58117.0	0.295	150536	1.37500	0.243	1.8255	1.21E-05
26	7.50	241.25	137.28	3699.00	58388.2	0.296	151306	1.41912	0.233	1.7445	1.15E-05
27	7.50	248.75	137.28	3684.90	57943.9	0.296	150177	1.46324	0.222	1.6635	1.11E-05
28	7.50	256.25	137.28	3740.70	59712.0	0.294	154590	1.50735	0.211	1.5825	1.02E-05
29	7.50	263.75	137.28	3789.80	61289.9	0.294	158611	1.55147	0.200	1.5015	9.47E-06
30	7.50	271.25	137.28	3823.00	62368.4	0.295	161568	1.59559	0.189	1.4205	8.79E-06
31	7.50	278.75	137.28	3867.10	63815.6	0.296	165363	1.63971	0.179	1.3395	8.10E-06
32	7.50	286.25	137.28	3864.00	63713.4	0.295	165056	1.68382	0.168	1.2585	7.62E-06
33	7.50	293.75	137.28	3874.50	64060.1	0.297	166126	1.72794	0.157	1.1775	7.09E-06
34	7.50	301.25	137.28	3873.30	64020.4	0.295	165836	1.77206	0.147	1.1044	6.66E-06
35	7.50	308.75	137.28	3892.60	64660.0	0.295	167447	1.81618	0.143	1.0706	6.39E-06
36	7.50	316.25	137.28	3979.80	67589.4	0.295	175094	1.86029	0.138	1.0369	5.92E-06
37	10.16	325.08	137.28	3998.50	68226.1	0.293	176467	1.91222	0.133	1.3504	7.65E-06
38	9.84	335.08	137.28	4039.60	69635.9	0.292	180003	1.97105	0.127	1.2496	6.94E-06
39	10.16	345.08	137.28	4048.80	69953.4	0.292	180697	2.02987	0.121	1.2285	6.80E-06
40	9.84	355.08	137.28	4106.50	71961.4	0.291	185761	2.08870	0.115	1.1315	6.09E-06
41	20.00	370.00	137.28	4170.60	74225.5	0.289	191399	2.17647	0.106	2.1200	1.11E-05
42	20.00	390.00	137.28	4297.70	78818.5	0.288	203079	2.29412	0.094	1.8800	9.26E-06
43	20.00	410.00	137.28	4339.20	80348.1	0.290	207293	2.41176	0.086	1.7160	8.28E-06
44	20.00	430.00	137.28	4415.50	83198.6	0.291	214795	2.52941	0.081	1.6280	7.58E-06
45	20.00	450.00	137.28	4441.30	84173.7	0.291	217262	2.64706	0.077	1.5400	7.09E-06
					μ for E below =	0.379			Σ=	175.0603	7.07E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 24773 ksf

G' = E/(2*(1+μ)) =: 8985 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1604.2 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1451.0 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
MEDIAN VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' MEDIAN CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	817.67	2334.3	0.384	6460.5	0.01176	1.000	4.0000	6.19E-04
2	4.00	6.00	112.32	721.88	1819.4	0.414	5144.2	0.03529	1.000	4.0000	7.78E-04
3	4.00	10.00	112.32	776.77	2106.6	0.419	5979.8	0.05882	1.000	4.0000	6.69E-04
4	4.00	14.00	112.32	872.57	2658.3	0.418	7540.9	0.08235	1.000	4.0000	5.30E-04
5	4.00	18.00	112.32	988.64	3412.6	0.417	9670.9	0.10588	1.000	4.0000	4.14E-04
6	8.00	24.00	112.32	1055.80	3892.0	0.419	11043.6	0.14118	1.000	8.0000	7.24E-04
7	8.00	32.00	112.32	1223.00	5222.3	0.405	14676.9	0.18824	1.000	8.0000	5.45E-04
8	8.00	40.00	112.32	1218.90	5187.3	0.397	14492.2	0.23529	1.000	8.0000	5.52E-04
9	8.00	48.00	112.32	1223.50	5226.5	0.396	14588.6	0.28235	0.952	7.6160	5.22E-04
10	8.00	56.00	112.32	1522.30	8091.1	0.380	22324.9	0.32941	0.891	7.1309	3.19E-04
11	10.00	65.00	112.32	1516.40	8028.5	0.383	22199.2	0.38235	0.842	8.4240	3.79E-04
12	10.00	75.00	112.32	1644.30	9439.9	0.380	26057.0	0.44118	0.788	7.8800	3.02E-04
13	10.00	85.00	112.32	1767.40	10906.3	0.378	30057.9	0.50000	0.734	7.3360	2.44E-04
14	10.00	95.00	112.32	1868.80	12193.6	0.377	33584.3	0.55882	0.679	6.7920	2.02E-04
15	10.00	105.00	137.28	2809.60	33685.7	0.284	86512.2	0.61765	0.634	6.3400	7.33E-05
16	10.00	115.00	137.28	2893.60	35730.0	0.285	91796.8	0.67647	0.598	5.9800	6.51E-05
17	10.00	125.00	137.28	2965.70	37532.8	0.283	96286.6	0.73529	0.562	5.6200	5.84E-05
18	10.00	135.00	137.28	3042.80	39509.6	0.284	101480.5	0.79412	0.526	5.2600	5.18E-05
19	15.00	147.50	137.28	3119.90	41537.2	0.287	106937	0.86765	0.481	7.2150	6.75E-05
20	15.00	162.50	137.28	3185.40	43299.6	0.290	111703	0.95588	0.427	6.4050	5.73E-05
21	15.00	177.50	137.28	3339.50	47590.4	0.290	122820	1.04412	0.373	5.5950	4.56E-05
22	15.00	192.50	137.28	3417.10	49827.8	0.291	128662	1.13235	0.319	4.7850	3.72E-05
23	15.00	207.50	137.28	3477.30	51598.9	0.295	133642	1.22059	0.281	4.2180	3.16E-05
24	15.00	222.50	137.28	3524.90	53021.2	0.295	137288	1.30882	0.260	3.8940	2.84E-05
25	7.50	233.75	137.28	3629.00	56199.2	0.295	145567	1.37500	0.243	1.8255	1.25E-05
26	7.50	241.25	137.28	3628.00	56168.2	0.296	145562	1.41912	0.233	1.7445	1.20E-05
27	7.50	248.75	137.28	3656.60	57057.3	0.296	147862	1.46324	0.222	1.6635	1.13E-05
28	7.50	256.25	137.28	3760.50	60345.8	0.294	156180	1.50735	0.211	1.5825	1.01E-05
29	7.50	263.75	137.28	3810.70	61967.8	0.294	160312	1.55147	0.200	1.5015	9.37E-06
30	7.50	271.25	137.28	3822.90	62365.2	0.295	161525	1.59559	0.189	1.4205	8.79E-06
31	7.50	278.75	137.28	3855.90	63446.5	0.295	164380	1.63971	0.179	1.3395	8.15E-06
32	7.50	286.25	137.28	3918.10	65509.9	0.295	169633	1.68382	0.168	1.2585	7.42E-06
33	7.50	293.75	137.28	3957.20	66824.0	0.296	173189	1.72794	0.157	1.1775	6.80E-06
34	7.50	301.25	137.28	3979.50	67579.2	0.294	174925	1.77206	0.147	1.1044	6.31E-06
35	7.50	308.75	137.28	4003.40	68393.4	0.294	176977	1.81618	0.143	1.0706	6.05E-06
36	7.50	316.25	137.28	4101.70	71793.3	0.294	185837	1.86029	0.138	1.0369	5.58E-06
37	10.16	325.08	137.28	4123.20	72547.9	0.292	187493	1.91222	0.133	1.3504	7.20E-06
38	9.84	335.08	137.28	4161.60	73905.5	0.291	190886	1.97105	0.127	1.2496	6.55E-06
39	10.16	345.08	137.28	4160.10	73852.3	0.291	190619	2.02987	0.121	1.2285	6.44E-06
40	9.84	355.08	137.28	4231.90	76423.5	0.290	197130	2.08870	0.115	1.1315	5.74E-06
41	20.00	370.00	137.28	4239.80	76709.1	0.289	197702	2.17647	0.106	2.1200	1.07E-05
42	20.00	390.00	137.28	4266.20	77667.4	0.288	200104	2.29412	0.094	1.8800	9.40E-06
43	20.00	410.00	137.28	4304.00	79049.8	0.290	203934	2.41176	0.086	1.7160	8.41E-06
44	20.00	430.00	137.28	4410.30	83002.7	0.291	214255	2.52941	0.081	1.6280	7.60E-06
45	20.00	450.00	137.28	4428.70	83696.8	0.290	216010	2.64706	0.077	1.5400	7.13E-06
					μ for E below =	0.380			Σ=	175.0603	7.49E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 23371 ksf

G' = E/(2*(1+μ)) =: 8469 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1557.5 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1408.8 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	$Nq*H/E_i$
1	4.00	2.00	112.32	577.59	1164.8	0.385	3227.5	0.01176	1.000	4.0000	1.24E-03
2	4.00	6.00	112.32	520.07	944.3	0.411	2664.5	0.03529	1.000	4.0000	1.50E-03
3	4.00	10.00	112.32	585.68	1197.6	0.413	3383.9	0.05882	1.000	4.0000	1.18E-03
4	4.00	14.00	112.32	690.36	1664.0	0.412	4699.3	0.08235	1.000	4.0000	8.51E-04
5	4.00	18.00	112.32	713.83	1779.1	0.414	5032.1	0.10588	1.000	4.0000	7.95E-04
6	8.00	24.00	112.32	742.24	1923.5	0.417	5449.8	0.14118	1.000	8.0000	1.47E-03
7	2.00	29.00	112.32	982.13	3367.8	0.394	9392.7	0.17059	1.000	2.0010	2.13E-04
8	10.00	35.00	137.28	1681.30	12062.8	0.291	31143.6	0.20589	1.000	10.0000	3.21E-04
9	10.00	45.00	137.28	1989.20	16885.5	0.286	43444.6	0.26471	0.994	9.9400	2.29E-04
10	10.00	55.00	137.28	2105.80	18923.0	0.281	48482.7	0.32354	0.897	8.9680	1.85E-04
11	10.00	65.00	137.28	2182.20	20321.0	0.281	52058.8	0.38236	0.842	8.4240	1.62E-04
12	10.00	75.00	137.28	2280.90	22200.8	0.276	56668.0	0.44118	0.788	7.8800	1.39E-04
13	10.00	85.00	137.28	2384.90	24271.5	0.279	62069.0	0.50001	0.734	7.3360	1.18E-04
14	10.00	95.00	137.28	2437.50	25353.9	0.281	64974.5	0.55883	0.679	6.7920	1.05E-04
15	10.00	105.00	137.28	2480.90	26264.8	0.284	67443.4	0.61765	0.634	6.3400	9.40E-05
16	10.00	115.00	137.28	2550.80	27765.7	0.285	71334.0	0.67648	0.598	5.9800	8.38E-05
17	10.00	125.00	137.28	2581.80	28444.7	0.283	72992.5	0.73530	0.562	5.6200	7.70E-05
18	10.00	135.00	137.28	2619.30	29277.0	0.285	75219.7	0.79412	0.526	5.2600	6.99E-05
19	15.00	147.50	137.28	2650.90	29987.7	0.288	77231.5	0.86765	0.481	7.2150	9.34E-05
20	15.00	162.50	137.28	2780.70	32996.2	0.289	85093.3	0.95589	0.427	6.4050	7.53E-05
21	15.00	177.50	137.28	2835.00	34297.5	0.291	88525.3	1.04412	0.373	5.5950	6.32E-05
22	15.00	192.50	137.28	2856.10	34809.9	0.291	89912.6	1.13236	0.319	4.7850	5.32E-05
23	15.00	207.50	137.28	2865.50	35039.4	0.296	90788.6	1.22059	0.281	4.2180	4.65E-05
24	15.00	222.50	137.28	2912.40	36195.8	0.295	93751.5	1.30883	0.260	3.8940	4.15E-05
25	7.50	233.75	137.28	2947.40	37071.0	0.296	96079.1	1.37501	0.243	1.8255	1.90E-05
26	7.50	241.25	137.28	2944.50	36998.1	0.297	95939.8	1.41912	0.233	1.7445	1.82E-05
27	7.50	248.75	137.28	2951.70	37179.3	0.297	96415.5	1.46324	0.222	1.6635	1.73E-05
28	7.50	256.25	137.28	2975.30	37776.2	0.295	97855.3	1.50736	0.211	1.5825	1.62E-05
29	7.50	263.75	137.28	3029.50	39165.0	0.295	101404	1.55148	0.200	1.5015	1.48E-05
30	7.50	271.25	137.28	3041.30	39470.7	0.296	102310	1.59559	0.189	1.4205	1.39E-05
31	7.50	278.75	137.28	3070.50	40232.3	0.296	104313	1.63971	0.179	1.3395	1.28E-05
32	7.50	286.25	137.28	3104.20	41120.2	0.296	106563	1.68383	0.168	1.2585	1.18E-05
33	7.50	293.75	137.28	3115.70	41425.5	0.297	107465	1.72795	0.157	1.1775	1.10E-05
34	7.50	301.25	137.28	3137.00	41993.8	0.295	108804	1.77206	0.147	1.1044	1.02E-05
35	7.50	308.75	137.28	3163.30	42700.9	0.295	110590	1.81618	0.143	1.0706	9.68E-06
36	7.50	316.25	137.28	3196.10	43591.0	0.296	112964	1.86030	0.138	1.0369	9.18E-06
37	10.16	325.08	137.28	3193.40	43517.4	0.294	112609	1.91223	0.133	1.3504	1.20E-05
38	9.84	335.08	137.28	3249.00	45045.9	0.293	116479	1.97106	0.127	1.2496	1.07E-05
39	10.16	345.08	137.28	3259.30	45332.0	0.292	117132	2.02988	0.121	1.2285	1.05E-05
40	9.84	355.08	137.28	3302.30	46536.0	0.291	120171	2.08871	0.115	1.1315	9.42E-06
41	20.00	370.00	137.28	3378.30	48702.7	0.290	125609	2.17648	0.106	2.1200	1.69E-05
42	20.00	390.00	137.28	3383.10	48841.1	0.289	125928	2.29412	0.094	1.8800	1.49E-05
43	20.00	410.00	137.28	3432.30	50272.1	0.291	129765	2.41177	0.086	1.7160	1.32E-05
44	20.00	430.00	137.28	3561.00	54112.8	0.291	139728	2.52942	0.081	1.6280	1.17E-05
45	20.00	450.00	137.28	3620.30	55930.1	0.291	144376	2.64706	0.077	1.5400	1.07E-05
					μ for E below =	0.351			Σ=	175.2224	9.48E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

$E = SUM(Nq*H)/SUM(Nq*H/E_i)$ =:	18484	ksf
G' = E/(2*(1+μ)) =:	6840	ksf
Vs=(G'*1000*32.17/ρ)^0.5=:	1399.6	fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=:	1266.0	fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY [4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	559.01	1091.1	0.386	3025.1	0.01176	1.000	4.0000	1.32E-03
2	4.00	6.00	112.32	517.37	934.6	0.411	2637.8	0.03529	1.000	4.0000	1.52E-03
3	4.00	10.00	112.32	565.73	1117.4	0.416	3165.6	0.05882	1.000	4.0000	1.26E-03
4	4.00	14.00	112.32	625.10	1364.3	0.417	3865.9	0.08235	1.000	4.0000	1.03E-03
5	4.00	18.00	112.32	696.44	1693.5	0.417	4799.6	0.10588	1.000	4.0000	8.33E-04
6	8.00	24.00	112.32	710.04	1760.2	0.421	5001.3	0.14118	1.000	8.0000	1.60E-03
7	8.00	32.00	112.32	801.91	2245.2	0.407	6318.7	0.18824	1.000	8.0000	1.27E-03
8	8.00	40.00	112.32	845.91	2498.4	0.397	6981.9	0.23529	1.000	8.0000	1.15E-03
9	8.00	48.00	112.32	882.84	2721.3	0.394	7584.3	0.28235	0.952	7.6160	1.00E-03
10	8.00	56.00	112.32	1082.20	4089.0	0.378	11273.0	0.32941	0.891	7.1309	6.33E-04
11	10.00	65.00	112.32	1122.90	4402.4	0.379	12146.0	0.38235	0.842	8.4240	6.94E-04
12	10.00	75.00	137.28	2214.30	20923.2	0.276	53378.6	0.44118	0.788	7.8800	1.48E-04
13	10.00	85.00	137.28	2276.30	22111.3	0.278	56524.6	0.50000	0.734	7.3360	1.30E-04
14	10.00	95.00	137.28	2419.00	24970.5	0.280	63933.6	0.55882	0.679	6.7920	1.06E-04
15	10.00	105.00	137.28	2441.40	25435.1	0.283	65274.2	0.61765	0.634	6.3400	9.71E-05
16	10.00	115.00	137.28	2524.30	27191.8	0.284	69808.5	0.67647	0.598	5.9800	8.57E-05
17	10.00	125.00	137.28	2549.20	27730.9	0.282	71120.3	0.73529	0.562	5.6200	7.90E-05
18	10.00	135.00	137.28	2589.60	28616.8	0.284	73488.6	0.79412	0.526	5.2600	7.16E-05
19	15.00	147.50	137.28	2611.80	29109.6	0.287	74947.9	0.86765	0.481	7.2150	9.63E-05
20	15.00	162.50	137.28	2668.00	30375.8	0.290	78358.0	0.95588	0.427	6.4050	8.17E-05
21	15.00	177.50	137.28	2738.90	32011.7	0.291	82647.1	1.04412	0.373	5.5950	6.77E-05
22	15.00	192.50	137.28	2798.70	33424.8	0.292	86349.6	1.13235	0.319	4.7850	5.54E-05
23	15.00	207.50	137.28	2868.20	35105.5	0.295	90942.2	1.22059	0.281	4.2180	4.64E-05
24	15.00	222.50	137.28	2963.60	37479.6	0.294	97022.0	1.30882	0.260	3.8940	4.01E-05
25	7.50	233.75	137.28	3013.20	38744.7	0.295	100357.3	1.37500	0.243	1.8255	1.82E-05
26	7.50	241.25	137.28	3020.20	38924.9	0.296	100869.2	1.41912	0.233	1.7445	1.73E-05
27	7.50	248.75	137.28	3008.70	38629.0	0.296	100117.2	1.46324	0.222	1.6635	1.66E-05
28	7.50	256.25	137.28	3054.20	39806.2	0.294	103055	1.50735	0.211	1.5825	1.54E-05
29	7.50	263.75	137.28	3094.40	40861.0	0.294	105743	1.55147	0.200	1.5015	1.42E-05
30	7.50	271.25	137.28	3121.50	41579.8	0.295	107714	1.59559	0.189	1.4205	1.32E-05
31	7.50	278.75	137.28	3157.40	42541.8	0.296	110237	1.63971	0.179	1.3395	1.22E-05
32	7.50	286.25	137.28	3154.90	42474.4	0.295	110034	1.68382	0.168	1.2585	1.14E-05
33	7.50	293.75	137.28	3163.50	42706.3	0.297	110749	1.72794	0.157	1.1775	1.06E-05
34	7.50	301.25	137.28	3162.50	42679.3	0.295	110555	1.77206	0.147	1.1044	9.99E-06
35	7.50	308.75	137.28	3178.30	43106.8	0.295	111632	1.81618	0.143	1.0706	9.59E-06
36	7.50	316.25	137.28	3249.50	45059.8	0.295	116730	1.86029	0.138	1.0369	8.88E-06
37	10.16	325.08	137.28	3264.80	45485.1	0.293	117647	1.91222	0.133	1.3504	1.15E-05
38	9.84	335.08	137.28	3298.30	46423.4	0.292	120001	1.97105	0.127	1.2496	1.04E-05
39	10.16	345.08	137.28	3305.80	46634.7	0.292	120462	2.02987	0.121	1.2285	1.02E-05
40	9.84	355.08	137.28	3352.90	47973.1	0.291	123838	2.08870	0.115	1.1315	9.14E-06
41	20.00	370.00	137.28	3405.30	49484.2	0.289	127601	2.17647	0.106	2.1200	1.66E-05
42	20.00	390.00	137.28	3509.10	52547.0	0.288	135389	2.29412	0.094	1.8800	1.39E-05
43	20.00	410.00	137.28	3542.90	53564.1	0.290	138192	2.41176	0.086	1.7160	1.24E-05
44	20.00	430.00	137.28	3605.20	55464.5	0.291	143194	2.52941	0.081	1.6280	1.14E-05
45	20.00	450.00	137.28	3626.30	56115.6	0.291	144841	2.64706	0.077	1.5400	1.06E-05
					μ for E below =	0.378			Σ=	175.0603	1.37E-02

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 12796 ksf

G' = E/(2*(1+μ)) =: 4644 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1153.3 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1043.2 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
16% (LOWER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 16% (Lower Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY (4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ (1)	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	578.18	1167.2	0.384	3230.3	0.01176	1.000	4.0000	1.24E-03
2	4.00	6.00	112.32	510.45	909.7	0.414	2572.2	0.03529	1.000	4.0000	1.56E-03
3	4.00	10.00	112.32	549.26	1053.3	0.419	2989.9	0.05882	1.000	4.0000	1.34E-03
4	4.00	14.00	112.32	617.00	1329.2	0.418	3770.4	0.08235	1.000	4.0000	1.06E-03
5	4.00	18.00	112.32	699.07	1706.3	0.417	4835.4	0.10588	1.000	4.0000	8.27E-04
6	8.00	24.00	112.32	746.58	1946.1	0.419	5522.1	0.14118	1.000	8.0000	1.45E-03
7	8.00	32.00	112.32	864.76	2610.9	0.405	7337.9	0.18824	1.000	8.0000	1.09E-03
8	8.00	40.00	112.32	861.89	2593.6	0.397	7246.1	0.23529	1.000	8.0000	1.10E-03
9	8.00	48.00	112.32	865.17	2613.4	0.396	7294.7	0.28235	0.952	7.6160	1.04E-03
10	8.00	56.00	112.32	1076.40	4045.3	0.380	11161.9	0.32941	0.891	7.1309	6.39E-04
11	10.00	65.00	112.32	1072.30	4014.6	0.383	11100.5	0.38235	0.842	8.4240	7.59E-04
12	10.00	75.00	112.32	1162.70	4720.0	0.380	13028.6	0.44118	0.788	7.8800	6.05E-04
13	10.00	85.00	112.32	1249.80	5453.6	0.378	15030.4	0.50000	0.734	7.3360	4.88E-04
14	10.00	95.00	112.32	1321.50	6097.3	0.377	16793.7	0.55882	0.679	6.7920	4.04E-04
15	10.00	105.00	137.28	2294.10	22458.5	0.284	57678.4	0.61765	0.634	6.3400	1.10E-04
16	10.00	115.00	137.28	2362.60	23819.7	0.285	61197.1	0.67647	0.598	5.9800	9.77E-05
17	10.00	125.00	137.28	2421.50	25022.2	0.283	64191.9	0.73529	0.562	5.6200	8.75E-05
18	10.00	135.00	137.28	2484.50	26341.1	0.284	67657.2	0.79412	0.526	5.2600	7.77E-05
19	15.00	147.50	137.28	2547.40	27691.8	0.287	71291.9	0.86765	0.481	7.2150	1.01E-04
20	15.00	162.50	137.28	2600.90	28867.1	0.290	74470.3	0.95588	0.427	6.4050	8.60E-05
21	15.00	177.50	137.28	2726.70	31727.1	0.290	81880.8	1.04412	0.373	5.5950	6.83E-05
22	15.00	192.50	137.28	2790.00	33217.3	0.291	85771.8	1.13235	0.319	4.7850	5.58E-05
23	15.00	207.50	137.28	2839.20	34399.2	0.295	89094.6	1.22059	0.281	4.2180	4.73E-05
24	15.00	222.50	137.28	2878.10	35348.3	0.295	91527.2	1.30882	0.260	3.8940	4.25E-05
25	7.50	233.75	137.28	2963.10	37467.0	0.295	97047.0	1.37500	0.243	1.8255	1.88E-05
26	7.50	241.25	137.28	2962.30	37446.8	0.296	97044.8	1.41912	0.233	1.7445	1.80E-05
27	7.50	248.75	137.28	2985.60	38038.2	0.296	98574.4	1.46324	0.222	1.6635	1.69E-05
28	7.50	256.25	137.28	3070.40	40229.6	0.294	104118	1.50735	0.211	1.5825	1.52E-05
29	7.50	263.75	137.28	3111.40	41311.2	0.294	106873	1.55147	0.200	1.5015	1.40E-05
30	7.50	271.25	137.28	3121.30	41574.5	0.295	107677	1.59559	0.189	1.4205	1.32E-05
31	7.50	278.75	137.28	3148.30	42296.9	0.295	109584	1.63971	0.179	1.3395	1.22E-05
32	7.50	286.25	137.28	3199.10	43672.9	0.295	113087	1.68382	0.168	1.2585	1.11E-05
33	7.50	293.75	137.28	3231.10	44551.0	0.296	115464	1.72794	0.157	1.1775	1.02E-05
34	7.50	301.25	137.28	3249.20	45051.5	0.294	116613	1.77206	0.147	1.1044	9.47E-06
35	7.50	308.75	137.28	3268.80	45596.6	0.294	117988	1.81618	0.143	1.0706	9.07E-06
36	7.50	316.25	137.28	3349.00	47861.5	0.294	123890	1.86029	0.138	1.0369	8.37E-06
37	10.16	325.08	137.28	3366.60	48365.9	0.292	124997	1.91222	0.133	1.3504	1.08E-05
38	9.84	335.08	137.28	3397.90	49269.4	0.291	127255	1.97105	0.127	1.2496	9.82E-06
39	10.16	345.08	137.28	3396.70	49234.6	0.291	127078	2.02987	0.121	1.2285	9.67E-06
40	9.84	355.08	137.28	3455.30	50948.1	0.290	131417	2.08870	0.115	1.1315	8.61E-06
41	20.00	370.00	137.28	3461.80	51139.9	0.289	131803	2.17647	0.106	2.1200	1.61E-05
42	20.00	390.00	137.28	3483.40	51780.1	0.288	133407	2.29412	0.094	1.8800	1.41E-05
43	20.00	410.00	137.28	3514.20	52699.8	0.290	135956	2.41176	0.086	1.7160	1.26E-05
44	20.00	430.00	137.28	3601.00	55335.3	0.291	142837	2.52941	0.081	1.6280	1.14E-05
45	20.00	450.00	137.28	3616.00	55797.3	0.290	144005	2.64706	0.077	1.5400	1.07E-05
					μ for E below =	0.380			Σ=	175.0603	1.46E-02

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 11961 ksf

G' = E/(2*(1+μ)) =: 4334 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 1114.2 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 1007.8 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 30' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO, μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1155.20	4659.3	0.385	12910.6	0.01176	1.000	4.0000	3.10E-04
2	4.00	6.00	112.32	1040.10	3777.1	0.411	10657.1	0.03529	1.000	4.0000	3.75E-04
3	4.00	10.00	112.32	1171.40	4790.9	0.413	13536.5	0.05882	1.000	4.0000	2.95E-04
4	4.00	14.00	112.32	1380.70	6655.9	0.412	18796.8	0.08235	1.000	4.0000	2.13E-04
5	4.00	18.00	112.32	1427.70	7116.7	0.414	20129.6	0.10588	1.000	4.0000	1.99E-04
6	8.00	24.00	112.32	1484.50	7694.3	0.417	21799.7	0.14118	1.000	8.0000	3.67E-04
7	2.00	29.00	112.32	1964.30	13471.7	0.394	37572.2	0.17059	1.000	2.0010	5.33E-05
8	10.00	35.00	137.28	2880.60	35409.7	0.291	91420.7	0.20589	1.000	10.0000	1.09E-04
9	10.00	45.00	137.28	3034.70	39299.6	0.286	101113.8	0.26471	0.994	9.9400	9.83E-05
10	10.00	55.00	137.28	3158.70	42576.8	0.281	109086	0.32354	0.897	8.9680	8.22E-05
11	10.00	65.00	137.28	3273.30	45722.3	0.281	117132	0.38236	0.842	8.4240	7.19E-05
12	10.00	75.00	137.28	3472.10	51444.7	0.276	131314	0.44118	0.788	7.8800	6.00E-05
13	10.00	85.00	137.28	3606.00	55489.1	0.279	141901	0.50001	0.734	7.3360	5.17E-05
14	10.00	95.00	137.28	3678.60	57745.9	0.281	147985	0.55883	0.679	6.7920	4.59E-05
15	10.00	105.00	137.28	3815.30	62117.4	0.284	159506	0.61765	0.634	6.3400	3.97E-05
16	10.00	115.00	137.28	3884.70	64397.8	0.285	165447	0.67648	0.598	5.9800	3.61E-05
17	10.00	125.00	137.28	3889.60	64560.4	0.283	165670	0.73530	0.562	5.6200	3.39E-05
18	10.00	135.00	137.28	3929.00	65874.9	0.285	169249	0.79412	0.526	5.2600	3.11E-05
19	15.00	147.50	137.28	3976.40	67474.0	0.288	173775	0.86765	0.481	7.2150	4.15E-05
20	15.00	162.50	137.28	4171.00	74239.8	0.289	191455	0.95589	0.427	6.4050	3.35E-05
21	15.00	177.50	137.28	4252.50	77169.4	0.291	199182	1.04412	0.373	5.5950	2.81E-05
22	15.00	192.50	137.28	4284.20	78324.1	0.291	202308	1.13236	0.319	4.7850	2.37E-05
23	15.00	207.50	137.28	4298.30	78840.6	0.296	204279	1.22059	0.281	4.2180	2.06E-05
24	15.00	222.50	137.28	4368.50	81436.8	0.295	210931	1.30883	0.260	3.8940	1.85E-05
25	7.50	233.75	137.28	4421.10	83409.8	0.296	216178	1.37501	0.243	1.8255	8.44E-06
26	7.50	241.25	137.28	4416.70	83243.8	0.297	215860	1.41912	0.233	1.7445	8.08E-06
27	7.50	248.75	137.28	4427.60	83655.2	0.297	216940	1.46324	0.222	1.6635	7.67E-06
28	7.50	256.25	137.28	4463.00	84998.2	0.295	220179	1.50736	0.211	1.5825	7.19E-06
29	7.50	263.75	137.28	4544.30	88123.2	0.295	228165	1.55148	0.200	1.5015	6.58E-06
30	7.50	271.25	137.28	4561.90	88807.1	0.296	230193	1.59559	0.189	1.4205	6.17E-06
31	7.50	278.75	137.28	4605.80	90524.5	0.296	234710	1.63971	0.179	1.3395	5.71E-06
32	7.50	286.25	137.28	4656.30	92520.5	0.296	239767	1.68383	0.168	1.2585	5.25E-06
33	7.50	293.75	137.28	4673.60	93209.3	0.297	241802	1.72795	0.157	1.1775	4.87E-06
34	7.50	301.25	137.28	4705.50	94486.1	0.295	244810	1.77206	0.147	1.1044	4.51E-06
35	7.50	308.75	137.28	4744.90	96075.0	0.295	248823	1.81618	0.143	1.0706	4.30E-06
36	7.50	316.25	137.28	4794.10	98077.7	0.296	254165	1.86030	0.138	1.0369	4.08E-06
37	10.16	325.08	137.28	4790.00	97910.0	0.294	253360	1.91223	0.133	1.3504	5.33E-06
38	9.84	335.08	137.28	4873.50	101353	0.293	262077	1.97106	0.127	1.2496	4.77E-06
39	10.16	345.08	137.28	4888.90	101995	0.292	263541	2.02988	0.121	1.2285	4.66E-06
40	9.84	355.08	137.28	4953.50	104708	0.291	270390	2.08871	0.115	1.1315	4.18E-06
41	20.00	370.00	137.28	5067.40	109579	0.290	282615	2.17648	0.106	2.1200	7.50E-06
42	20.00	390.00	137.28	5074.70	109895	0.289	283344	2.29412	0.094	1.8800	6.64E-06
43	20.00	410.00	137.28	5148.40	113110	0.291	291966	2.41177	0.086	1.7160	5.88E-06
44	20.00	430.00	137.28	5341.60	121758	0.291	314400	2.52942	0.081	1.6280	5.18E-06
45	20.00	450.00	137.28	5430.40	125840	0.291	324839	2.64706	0.077	1.5400	4.74E-06
					μ for E below =	0.345			Σ=	175.2224	2.76E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, …q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are from reference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 63480 ksf

G' = E/(2*(1+μ)) =: 23605 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 2600.1 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 2351.9 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 70' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY [4] ρ (PCF)	SHEAR WAVE VELOCITY[4] Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO,μ[1]	YOUNGS MODULUS E_i (KSF) $E_i=2(1+\mu)G'$ [2]	Z/W	INFLUENCE COEFFICIENT Nq [3]	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1118.00	4364.0	0.386	12099.9	0.01176	1.000	4.0000	3.31E-04
2	4.00	6.00	112.32	1034.70	3738.0	0.411	10550.5	0.03529	1.000	4.0000	3.79E-04
3	4.00	10.00	112.32	1131.50	4470.1	0.416	12663.3	0.05882	1.000	4.0000	3.16E-04
4	4.00	14.00	112.32	1250.20	5457.1	0.417	15463.5	0.08235	1.000	4.0000	2.59E-04
5	4.00	18.00	112.32	1392.90	6774.0	0.417	19198.9	0.10588	1.000	4.0000	2.08E-04
6	8.00	24.00	112.32	1420.10	7041.2	0.421	20005.9	0.14118	1.000	8.0000	4.00E-04
7	8.00	32.00	112.32	1603.80	8980.6	0.407	25274.0	0.18824	1.000	8.0000	3.17E-04
8	8.00	40.00	112.32	1691.80	9993.2	0.397	27927.0	0.23529	1.000	8.0000	2.86E-04
9	8.00	48.00	112.32	1765.70	10885.3	0.394	30337.9	0.28235	0.952	7.6160	2.51E-04
10	8.00	56.00	112.32	2164.30	16354.6	0.378	45087.8	0.32941	0.891	7.1309	1.58E-04
11	10.00	65.00	112.32	2245.90	17611.1	0.379	48588.4	0.38235	0.842	8.4240	1.73E-04
12	10.00	75.00	137.28	3336.20	47496.4	0.276	121171	0.44118	0.788	7.8800	6.50E-05
13	10.00	85.00	137.28	3457.00	50998.2	0.278	130370	0.50000	0.734	7.3360	5.63E-05
14	10.00	95.00	137.28	3628.50	56183.7	0.280	143851	0.55882	0.679	6.7920	4.72E-05
15	10.00	105.00	137.28	3662.10	57229.1	0.283	146867	0.61765	0.634	6.3400	4.32E-05
16	10.00	115.00	137.28	3786.40	61180.0	0.284	157065	0.67647	0.598	5.9800	3.81E-05
17	10.00	125.00	137.28	3823.80	62394.5	0.282	160021	0.73529	0.562	5.6200	3.51E-05
18	10.00	135.00	137.28	3884.40	64387.9	0.284	165349	0.79412	0.526	5.2600	3.18E-05
19	15.00	147.50	137.28	3917.70	65496.6	0.287	168633	0.86765	0.481	7.2150	4.28E-05
20	15.00	162.50	137.28	4002.00	68345.6	0.290	176306	0.95588	0.427	6.4050	3.63E-05
21	15.00	177.50	137.28	4108.40	72028.0	0.291	185961	1.04412	0.373	5.5950	3.01E-05
22	15.00	192.50	137.28	4198.10	75207.6	0.292	194291	1.13235	0.319	4.7850	2.46E-05
23	15.00	207.50	137.28	4302.30	78987.4	0.295	204620	1.22059	0.281	4.2180	2.06E-05
24	15.00	222.50	137.28	4445.40	84329.2	0.294	218300	1.30882	0.260	3.8940	1.78E-05
25	7.50	233.75	137.28	4519.70	87171.7	0.295	225794	1.37500	0.243	1.8255	8.08E-06
26	7.50	241.25	137.28	4530.30	87581.0	0.296	226956	1.41912	0.233	1.7445	7.69E-06
27	7.50	248.75	137.28	4513.00	86913.4	0.296	225259	1.46324	0.222	1.6635	7.38E-06
28	7.50	256.25	137.28	4581.30	89564.0	0.294	231874	1.50735	0.211	1.5825	6.82E-06
29	7.50	263.75	137.28	4641.50	91933.3	0.294	237912	1.55147	0.200	1.5015	6.31E-06
30	7.50	271.25	137.28	4682.20	93552.7	0.295	242352	1.59559	0.189	1.4205	5.86E-06
31	7.50	278.75	137.28	4736.20	95723.0	0.296	248043	1.63971	0.179	1.3395	5.40E-06
32	7.50	286.25	137.28	4732.40	95569.5	0.295	247582	1.68382	0.168	1.2585	5.08E-06
33	7.50	293.75	137.28	4745.20	96087.1	0.297	249181	1.72794	0.157	1.1775	4.73E-06
34	7.50	301.25	137.28	4743.80	96030.4	0.295	248753	1.77206	0.147	1.1044	4.44E-06
35	7.50	308.75	137.28	4767.40	96988.3	0.295	251167	1.81618	0.143	1.0706	4.26E-06
36	7.50	316.25	137.28	4874.20	101382	0.295	262637	1.86029	0.138	1.0369	3.95E-06
37	10.16	325.08	137.28	4897.10	102337	0.293	264696	1.91222	0.133	1.3504	5.10E-06
38	9.84	335.08	137.28	4947.50	104455	0.292	270007	1.97105	0.127	1.2496	4.63E-06
39	10.16	345.08	137.28	4958.80	104932	0.292	271051	2.02987	0.121	1.2285	4.53E-06
40	9.84	355.08	137.28	5029.40	107942	0.291	278640	2.08870	0.115	1.1315	4.06E-06
41	20.00	370.00	137.28	5107.90	111337	0.289	287097	2.17647	0.106	2.1200	7.38E-06
42	20.00	390.00	137.28	5263.60	118228	0.288	304620	2.29412	0.094	1.8800	6.17E-06
43	20.00	410.00	137.28	5314.40	120522	0.290	310938	2.41176	0.086	1.7160	5.52E-06
44	20.00	430.00	137.28	5407.80	124795	0.291	322186	2.52941	0.081	1.6280	5.05E-06
45	20.00	450.00	137.28	5439.50	126262	0.291	325899	2.64706	0.077	1.5400	4.73E-06
					μ for E below =	0.381			Σ=	175.0603	3.68E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient $q_1, q_2, \ldots q_n$ on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 47516 ksf

G' = E/(2*(1+μ)) =: 17203 ksf

Vs=(G'*1000*32.17/ρ)^0.5=: 2219.8 fps (density =112.32)

Vs=(G'*1000*32.17/ρ)^0.5=: 2007.8 fps (density =137.28)

CALCULATION OF EQUIVALENT SHEAR MODULUS: 1E-4 EVENT **PART 2**
84% (UPPER BOUND) VALUES:
REF.2.2.11, MO0801SCSPS1E4.003 FOR BDBGM STRAIN COMPATIBLE SOIL PROPERTIES

USING SOUTH 100' 84% (Upper Bound) CURVE: **Dynamic Shear Modulus of Soil (G') = Mass Density*Velocity^2;** **G' = Vs^2*ρ/(1000*32.17)**
(Ref.2.2.4 Bowles Foundation Analysis and Design, 5th Ed. Eq (20-15))

WIDTH OF BUILDING (W) =: **170 FT**

Note: Elevation 0.0' is at soil surface

LAYER	LAYER THICKNESS H (FT)	DEPTH (Z) TO MID-HEIGHT (FT)	DENSITY (4) ρ (PCF)	SHEAR WAVE VELOCITY(4) Vs (FPS)	DYNAMIC SHEAR MODULUS G' (KSF)	POISSON'S RATIO,μ(1)	YOUNGS MODULUS E_i (KSF) E_i=2(1+μ)G' (2)	Z/W	INFLUENCE COEFFICIENT Nq (3)	Nq*H	Nq*H/E_i
1	4.00	2.00	112.32	1156.40	4669.0	0.384	12922.0	0.01176	1.000	4.0000	3.10E-04
2	4.00	6.00	112.32	1020.90	3638.9	0.414	10288.6	0.03529	1.000	4.0000	3.89E-04
3	4.00	10.00	112.32	1098.50	4213.1	0.419	11959.2	0.05882	1.000	4.0000	3.34E-04
4	4.00	14.00	112.32	1234.00	5316.6	0.418	15081.8	0.08235	1.000	4.0000	2.65E-04
5	4.00	18.00	112.32	1398.10	6824.7	0.417	19340.5	0.10588	1.000	4.0000	2.07E-04
6	8.00	24.00	112.32	1493.20	7784.7	0.419	22089.4	0.14118	1.000	8.0000	3.62E-04
7	8.00	32.00	112.32	1729.50	10443.5	0.405	29350.9	0.18824	1.000	8.0000	2.73E-04
8	8.00	40.00	112.32	1723.80	10374.8	0.397	28984.9	0.23529	1.000	8.0000	2.76E-04
9	8.00	48.00	112.32	1730.30	10453.2	0.396	29177.6	0.28235	0.952	7.6160	2.61E-04
10	8.00	56.00	112.32	2152.90	16182.8	0.380	44651.6	0.32941	0.891	7.1309	1.60E-04
11	10.00	65.00	112.32	2144.50	16056.8	0.383	44397.9	0.38235	0.842	8.4240	1.90E-04
12	10.00	75.00	112.32	2325.40	18880.0	0.380	52114.4	0.44118	0.788	7.8800	1.51E-04
13	10.00	85.00	112.32	2499.50	21812.8	0.378	60116.6	0.50000	0.734	7.3360	1.22E-04
14	10.00	95.00	112.32	2643.00	24389.4	0.377	67174.6	0.55882	0.679	6.7920	1.01E-04
15	10.00	105.00	137.28	3441.10	50530.2	0.284	129773	0.61765	0.634	6.3400	4.89E-05
16	10.00	115.00	137.28	3543.90	53594.4	0.285	137694	0.67647	0.598	5.9800	4.34E-05
17	10.00	125.00	137.28	3632.20	56298.4	0.283	144428	0.73529	0.562	5.6200	3.89E-05
18	10.00	135.00	137.28	3726.70	59265.9	0.284	152225	0.79412	0.526	5.2600	3.46E-05
19	15.00	147.50	137.28	3821.10	62306.5	0.287	160407	0.86765	0.481	7.2150	4.50E-05
20	15.00	162.50	137.28	3901.30	64949.4	0.290	167554	0.95588	0.427	6.4050	3.82E-05
21	15.00	177.50	137.28	4090.00	71384.3	0.290	184227	1.04412	0.373	5.5950	3.04E-05
22	15.00	192.50	137.28	4185.00	74739.0	0.291	192986	1.13235	0.319	4.7850	2.48E-05
23	15.00	207.50	137.28	4258.80	77398.2	0.295	200463	1.22059	0.281	4.2180	2.10E-05
24	15.00	222.50	137.28	4317.10	79531.7	0.295	205932	1.30882	0.260	3.8940	1.89E-05
25	7.50	233.75	137.28	4444.70	84302.6	0.295	218361	1.37500	0.243	1.8255	8.36E-06
26	7.50	241.25	137.28	4443.40	84253.3	0.296	218346	1.41912	0.233	1.7445	7.99E-06
27	7.50	248.75	137.28	4478.40	85585.9	0.296	221792	1.46324	0.222	1.6635	7.50E-06
28	7.50	256.25	137.28	4605.60	90516.7	0.294	234264	1.50735	0.211	1.5825	6.76E-06
29	7.50	263.75	137.28	4667.10	92950.2	0.294	240464	1.55147	0.200	1.5015	6.24E-06
30	7.50	271.25	137.28	4682.00	93544.7	0.295	242279	1.59559	0.189	1.4205	5.86E-06
31	7.50	278.75	137.28	4722.50	95170.0	0.295	246570	1.63971	0.179	1.3395	5.43E-06
32	7.50	286.25	137.28	4798.70	98266.0	0.295	254452	1.68382	0.168	1.2585	4.95E-06
33	7.50	293.75	137.28	4846.60	100237.6	0.296	259788	1.72794	0.157	1.1775	4.53E-06
34	7.50	301.25	137.28	4873.80	101365.8	0.294	262379	1.77206	0.147	1.1044	4.21E-06
35	7.50	308.75	137.28	4903.10	102588	0.294	265462	1.81618	0.143	1.0706	4.03E-06
36	7.50	316.25	137.28	5023.50	107688	0.294	278751	1.86029	0.138	1.0369	3.72E-06
37	10.16	325.08	137.28	5049.90	108823	0.292	281243	1.91222	0.133	1.3504	4.80E-06
38	9.84	335.08	137.28	5096.80	110854	0.291	286318	1.97105	0.127	1.2496	4.36E-06
39	10.16	345.08	137.28	5095.10	110780	0.291	285932	2.02987	0.121	1.2285	4.30E-06
40	9.84	355.08	137.28	5183.00	114635	0.290	295695	2.08870	0.115	1.1315	3.83E-06
41	20.00	370.00	137.28	5192.60	115060	0.289	296545	2.17647	0.106	2.1200	7.15E-06
42	20.00	390.00	137.28	5225.00	116501	0.288	300155	2.29412	0.094	1.8800	6.26E-06
43	20.00	410.00	137.28	5271.30	118575	0.290	305901	2.41176	0.086	1.7160	5.61E-06
44	20.00	430.00	137.28	5401.50	124504	0.291	321383	2.52941	0.081	1.6280	5.07E-06
45	20.00	450.00	137.28	5424.00	125544	0.290	324011	2.64706	0.077	1.5400	4.75E-06
					μ for E below =	0.379			Σ=	175.0603	3.86E-03

(1) Poisson Ratio from Reference 2.2.11
(2) Ref.2.2.4, Bowles Foundation Analysis and Design, 5th Ed. Page 121
(3) From Figure 6.8 (Influence coefficient, Nq = Boussinesq coefficient q_1, q_2, ….q_n on Section 4.3.1)
(4) Shear Wave Velocity and density values are fromreference 2.2.11

E = SUM(Nq*H)/SUM(Nq*H/E_i) =: 45350 ksf

G' = E/(2*(1+μ)) =: 16445 ksf
Vs=(G'*1000*32.17/ρ)^0.5=: 2170.3 fps (density =112.32)
Vs=(G'*1000*32.17/ρ)^0.5=: 1963.1 fps (density =137.28)