GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists
& Environmental Specialists

November 3, 2021 G-4638

Mr. Farzad Ghazvinian
7683 SE 27th St, #178
Mercer Island, WA 98040

Subject: ADDENDUM LETTER 11
PROPOSED DEVELOPMENT – UPPER BUILDING
4276 EAST MERCER WAY
MERCER ISLAND, WA

References: See End of Letter

Dear Mr. Ghazvinian:

You have requested that we review the City of Mercer Island plan review comments for the upper building permit and provide responses to some of the comments.

The following letter has been prepared in order to provide further clarification regarding the referenced report and earlier addendums. This letter shall serve as an Addendum to the referenced report.

The plan review comments were provided via notes on a shared pdf of the submitted plan set. Therefore, comments are associated with selected sheets of the plan set. We have reproduced the geotechnically related reviewer's comments below along with our response to each comment. We have abbreviated those comments for which there have been multiple rounds of comment/response:

Page 1 - Comment #1:

The structural engineer shall indicate what magnitude of potential slope displacement is acceptable under seismic loading conditions. The geotechnical engineer has currently assumed 11 cm as the allowable magnitude of displacement. Coordinate with geotechnical engineer on the acceptable level of deformation that will not impact the structural integrity of the proposed development.

Page 1 – Comment #1 – GGNW Response:

GEO Group Northwest has discussed the potential for seismically related ground displacements at the project site with the structural engineer. Based upon that discussion we understand that the

anticipated amount of displacement under seismic loading conditions is not considered critical to the structural system. We leave it up to the structural engineer to provide further comment.

Page 1 - Comment #2:

See earlier addendums and plan review comments for more detail on this item. Due to length of earlier comment/responses we reproduce only the latest comment from the reviewer below:

Our calculation of the seismic coefficient based on the Bray equations in the 2011 paper you originally cited for the basis for using a seismic coefficient of 0.15 resulted in a higher coefficient of 0.22 for a 15 cm allowed displacement and 0.24 for the current 11 cm allowed displacement. Use of either of these higher coefficients would likely result in FS <1 or slope movement under seismic conditions.

We were unable to correlate the equations cited in the spreadsheet included in Addendum #9 with the newly cited reference, Macedo, Bray and Travarasou (2017). The equations used in the spreadsheet were not provided for review.

To proceed with design using a seismic coefficient of 0.15, please provide a letter from the applicant asking the City of Mercer Island for an applicant-paid 3rd party review of the geotechnical recommendations.

The applicant should include names and contact information of three geotechnical engineers licensed in the State of Washington to conduct this review to Don Cole, Mercer Island Building Official.

Based on the need for this third party review, additional stability analyses should be delayed until the third party review is completed with respect to the seismic coefficient.

However, please note that Cross Section F did not include the structural loading on the lower part of the slope (the area where infinite strength was assigned). I understand that you are forcing the failure search below the structural wall in this location, but you need to include the associated structural loading of the footing on the slope. And although the deck footings are not at this section F location, their loading should be included in the analyses. Revise and resubmit stability analyses after 3rd party review is completed.

Page 1 – Comment #2 – GGNW Response:

GEO Group Northwest has previously provided several responses to the reviewer's concerns regarding the selected pseudostatic acceleration coefficient used in our models and we also note that the City of Mercer Island has already approved and construction has begun on the lower building at the subject site short plat based upon the GEO Group Northwest analyses. Also, as previously noted we have used our experience and professional judgement with regard to determination of appropriate seismic design parameters per standard practice. It is our opinion that the selection of a 0.15g horizontal seismic acceleration is appropriate for the anticipated

design ground motions and known site conditions. We have attached a full print out of the calculation spreadsheet based upon studies by Bray and Traverasou, including formulas which are locked within the password protected cells. Following submittal of this addendum, if it would be helpful for the current 3rd party reviewer, GEO Group Northwest can email a copy of the spreadsheet to the reviewer for their review. Please note that the displacement model for the subduction ground motion indicates that for the modeled 0.15g pseudostatic acceleration the anticipated displacement is 11 cm or less at the 50% probability of exceedance level. The displacement may be as much as 22 cm at the 16% probability of exceedance level.

The cross-section F did include the structural loading at the lower part of the slope. We discussed how we modeled the loading in our earlier response. Loading was modeled by representing a material unit with appropriate unit weight at the locations where the cross-section indicates a footing is present. From scaling our Section F analyses the modeled unit area for the downhill wall of the building is approximately 64.4 sq ft. For the unit weight of 115.4 pcf then the subgrade below this unit is acted on by 7,432 lb (along the footing length – lineal foot). This load appears to be appropriate for the proposed 2-story wood framed building having the proposed relatively significant concrete stem wall, at the downhill side of the building.

With regard to the requested additional 3rd party review process, we have discussed our difference of professional opinion regarding the current 3rd party reviewer's seismic loading concerns, with the City of Mercer Island Building Official. We have also made required geologic hazard risk statements per the City of Mercer Island Municipal Code

Page 10 - Comment #1:

Sub 2 Comment: Allowable soil bearing pressure and passive resistance for use in designing foundations on a slope is reduced from those values given for horizontal ground conditions. This is the standard of practice for geotechnical engineering design.

Sub 1 comment remains to be addressed. Provide calculations for allowable bearing pressure and passive resistance that takes into account sloping ground conditions.

Page 10 – Comment #1 – GGNW Response:

GEO Group Northwest has recommended as documented in our referenced reports and documents that the foundation areas be over-excavated to remove loose overlying soils such that the new shallow spread footings may be constructed on top of competent medium dense site soils or compacted structural fills placed on top of the competent medium dense site soils. Additionally, over-excavation is recommended at slab subgrade areas. And finally, the perimeter of the building is to be backfilled with clean crushed rock for finish grades of no steeper than 3H:1V thereby mitigating permanent erosion concerns. Considering these conditions, it is our

opinion that an 18-inch footing embedment below adjacent grade at the building perimeter is acceptable and that no reduction to the bearing capacities is warranted. However, in the interest of resolving this disagreement with the 3rd party reviewer, mitigating risks and further insuring stable foundation subgrade conditions we modify our earlier recommendation for foundations at the upper building such that new perimeter footings, including deck footings, which are not pile supported have a minimum embedment of 24-inches below the adjacent lowest grade. We recommend that the plans are revised to reflect the footing minimum depth change.

We appreciate the opportunity to provide geotechnical consulting regarding the proposed development. Please contact us if there are any questions or concerns.

Sincerely,
GEO GROUP NORTHWEST, INC.

Adam Gaston
Project Engineer

William Chang, P.E.
Principal

Attachment: Spreadsheet Output: Pseudostatic Seismic Acceleration (6 pages)

REFERENCES

"Addendum Letter #10 With Plan Review Statement, Proposed Development – Upper Building, 4276 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Sept. 2, 2021.

"Addendum Letter 9, Proposed Development – Upper Building, 4276 East Mercer Way, Mercer Island, WA", GEO Group Northwest, July 22, 2021.

"Addendum Letter 8, Proposed Development – Lower Building, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, May 21, 2021.

"Addendum Letter 7, Proposed Development – Upper Building, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Mar. 3, 2021.

"Addendum Letter 6 – Response to Plan Review Comments, Proposed Development – Lower Building, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Nov. 13, 2020.

"Addendum Letter 5 - Response to Plan Review Comments, Proposed Development - Lower Building, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, June 9, 2020.

"Addendum Letter #4, Lower Building Development, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Nov. 4, 2019.

"Addendum Letter – Response to Sept. 4, 2019 Review, Proposed Development, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Oct. 18, 2019.

"Addendum Letter – Response to 3rd Party Review, Proposed Development, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, Aug. 16, 2019.

"Addendum Letter, Proposed Development, 4270 East Mercer Way, Mercer Island, WA", GEO Group Northwest, December 27, 2018.

"Geotechnical Report, Proposed Development, 4270 East Mercer Way, Mercer Island, Washington", GEO Group Northwest, July 13, 2018.

Simplified Procedure for Estimating Seismic Slope Displacements in Subduction Zones

by Jonathan D. Bray, Jorge Macedo and Thaleia Travasarou

Simplified Procedure for Estimating Seismic Slope Displacements for Subduction Zone Earthquakes, ASCE JGGE Journal, under review

SEE NOTES BELOW FOR GUIDANCE IN THE USE OF SPREADSHEET

Input Parameters			
Yield Coefficient (ky)	0.150		Based on pseudostatic analysis
Initial Fundamental Period (Ts)	0.13	seconds	1D: Ts=4H/Vs 2D: Ts=2.6H/Vs
Degraded Period (1.5Ts)	0.20	seconds	
Moment Magnitude (Mw)	7.5		
Spectral Acceleration (Sa(1.5Ts))	0.934	g	Input the Spectral Acceleration at the base of the sliding mass assuming there is no material above it.

Additional Input Parameters		
Probability of Exceedance #1 (P1)	84	%
Probability of Exceedance #2 (P2)	50	%
Probability of Exceedance #3 (P3)	16	%
Displacement Threshold (d_threshold)	1	cm

Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	11.39	cm	eq. (4) or (5) 2.43307419
Standard Deviation of Non-Zero Seismic D	0.73		

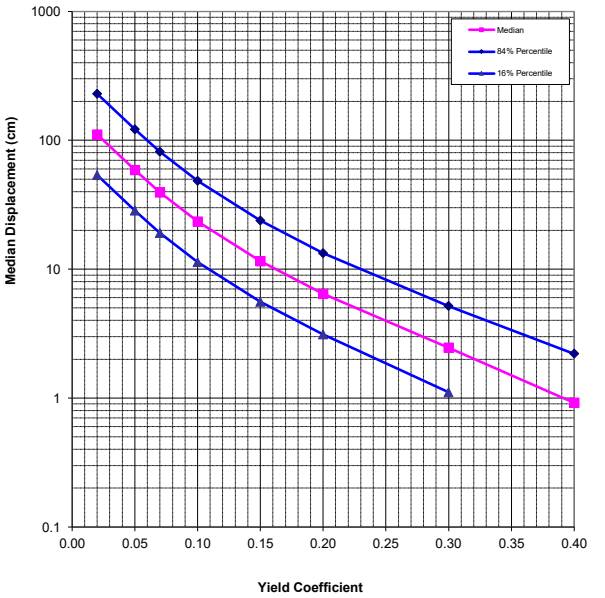
Results			
Probability of Negligible Displ. (P(D=0))	0.00		eq. (2) or (3)
D1	5.5	cm	calc. using eq. (6)
D2	11.4	cm	calc. using eq. (6)
D3	23.5	cm	calc. using eq. (6)
P(D>d_threshold)	1.00		eq. (6)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow heading.
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced movement).
6. ky may range between 0.01 and 0.8, Ts between 0 and 2 s, Sa between 0.002 and 4.5 g, M between 5.5 and 9
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 1cm
9. ky should be estimated with a slope stability program; the simplified equations shown below provide approximate values.
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs2)]/(h1 + h2)

Dependence on ky

ky	P(D="0")	D (cm)	Dmedian (cm)	D-84% (cm)	D-16% (cm)
0.020	0.00	111.2	111.2	229.9	53.8
0.05	0.00	58.8	58.8	121.5	28.5
0.07	0.00	39.5	39.5	81.6	19.1
0.1	0.00	23.5	23.5	48.6	11.4
0.15	0.00	11.5	11.5	23.9	5.6
0.2	0.00	6.5	6.5	13.3	3.1
0.3	0.04	2.5	2.5	5.2	1.1
0.4	0.23	1.22	0.92	2.21	<1



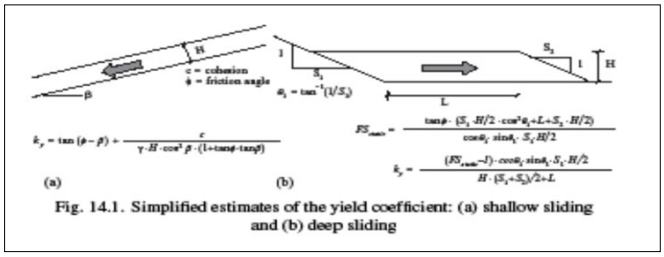


Fig. 14.1. Simplified estimates of the yield coefficient: (a) shallow sliding and (b) deep sliding

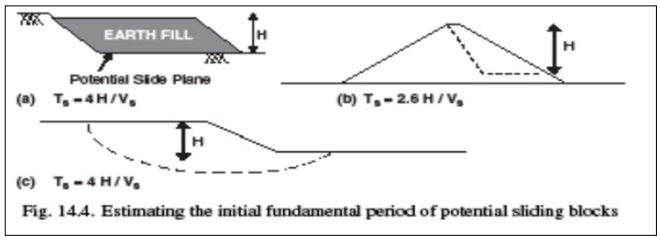


Fig. 14.4. Estimating the initial fundamental period of potential sliding blocks

Figures from Bray, J.D. (2007) "Chapter 14: Simplified Seismic Slope Displacement Procedures," Earthquake Geotechnical Engineering, 4th Inter. Conf. on Earthquake Geotechnical Engineering - Invited Lectures, in Geotechnical, Geological, and Earthquake Engineering Series, Vol. 6, Pitilakis, Kyriazis D., Ed., Springer, Vol. 6, pp. 327-353.

Pseudostatic Seismic Coefficient Based on the Macedo, Bray and Travasarou (2017) Seismic Slope Displacement Methodology

Input Parameters		
Da (cm)	11	Allowable Seismic Displacement Threshold
Ts (s)	0.13	Initial Fundamental Period of Slide Mass
1.5Ts (s)	0.20	Degraded Period of Slide Mass
Sa(1.5Ts) (g)	0.934	Spectral Acceleration at 1.5Ts (5% damping) at the base of the sliding mass assuming there is no material above it
Mw	7.5	Moment Magnitude
e	0	Normally distributed random variable with zero mean and standard deviation of 0.73
		Set to 0.0 for Da at the median (50%) estimate level, and set to 0.73 for Da at the 16% probability of exceedance level

Intermediate Parameters		
x1 =	0.780	constant
a =	3.390	Eq. 8b
x2 =	4.992	value in brackets in Eq. 8c
b =	3.703	Eq. 8c
x3 =	-1.879	value in brackets in Eq. 8a

Pseudostatic k value		
k =	0.1528	solution of Eq. 2a

With this **k** value, if the pseudostatic FS >= 1.0, then the displacement will be less than 11 cm at the 50% or 16% probability of exceedance level (i.e., ε = 0 or 0.73, respectively).

Model for Probability of Zero

P("0")= 1-Φ(a+blnky+cln(ky)^2+dTslnky+eTs +flnSA15)

	For Ts <= 0.7 s		For Ts > 0.7 s
a	-2.640	a	-3.531
b	-3.200	b	-4.783
c	-0.170	c	-0.342
d	-0.490	d	-0.300
e	2.094	e	-0.672
f	2.908	f	2.658

Model for Displacement Estimate

ln(D)=a+blnky + clnky2 + dlnky*lnSA15 + e*ln(SA15) + f*[ln(SA15)]^2 + g*Ts + h*(M)+i*Ts^2

Coefficients	Values
a	-6.896
b	-3.353
c	-0.390
d	0.538
e	3.060
f	-0.225
g	3.081
h	0.550
i	-0.803
σ	0.730

Simplified Procedure for Estimating Seismic Slope Displacements in Subductio
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Input Parameters			
Yield Coefficient (ky)	0.15		Based on pseudostatic ana
Initial Fundamental Period (Ts)	0.13	seconds	1D: Ts=4H/Vs 2D: Ts=2.6
Degraded Period (1.5Ts)	=B9*1.5	seconds	
Moment Magnitude (Mw)	7.5		
Spectral Acceleration (Sa(1.5Ts))	0.934	g	Input the Spectral Acceleral
			base of the sliding mass as
			there is no material above it

Additional Input Parameters		
Probability of Exceedance #1 (P1)	84	%
Probability of Exceedance #2 (P2)	50	%
Probability of Exceedance #3 (P3)	16	%
Displacement Threshold (d_threshold)	1	cm

Intermediate Calculated Parameters			
Non-Zero Seismic Displacement Est (D)	=EXP('Model Coefficients_Subduction'!B16+'M	cm	eq. (4) or (5) =+LN(B21)
Standard Deviation of Non-Zero Seismic D	0.73		

Results			
Probability of Negligible Displ. (P(D=0))	=+IF(B9<=0.7,1-NORMSDIST('Model Coefficien		eq. (2) or (3)
D1	=IF(ISERROR(EXP(LN($B$21)+$B$22*NORM	cm	calc. using eq. (6)
D2	=IF(ISERROR(EXP(LN($B$21)+$B$22*NORM	cm	calc. using eq. (6)
D3	=IF(ISERROR(EXP(LN($B$21)+$B$22*NORM	cm	calc. using eq. (6)
P(D>d_threshold)	=+(1-$B$25)*(1-NORMSDIST((LN($B$18)-LN('		eq. (6)

Notes

1. Values highlighted in blue are input parameters, and results are presented in the table with the yellow hea
2. Probability of Exceedance is the desired probability of exceeding a particular displacement value.
3. Displacements D1, D2, and D3 correspond to P1, P2, and P3, respectively.
   (e.g., the probability of exceeding displacement D1 is P1)
4. The 16%, 50%, and 84% percentile displacement values at selected ky values are shown to the right.
5. Calculated seismic displacements are due to deviatoric deformation only (add in volumetrically induced m
6. ky may range between 0.01 and 0.8, Ts between 0 and 2 s, Sa between 0.002 and 4.5 g, M between 5.5
7. Rigid slope is assumed for Ts < 0.05 s, i.e. Ts = 0.0. If Ts is just less than 0.05 s, set Ts = 0.050 s
8. When a value for D is not calculated, D is < 1cm
9. ky should be estimated with a slope stability program; the simplified equations shown below provide appro
10. Examples of how Ts is estimated are shown below.
11. Vs = weighted avg. shear wave velocity for the sliding mass, e.g., for 2 layers, Vs = [(h1)(Vs1) + (h2)(Vs

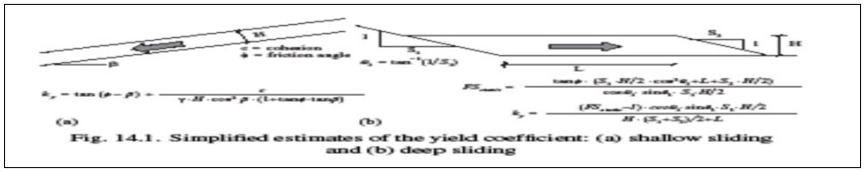


Fig. 14.1. Simplified estimates of the yield coefficient: (a) shallow sliding and (b) deep sliding

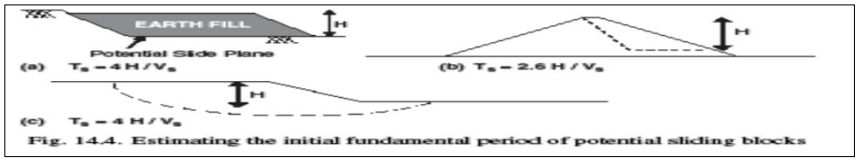
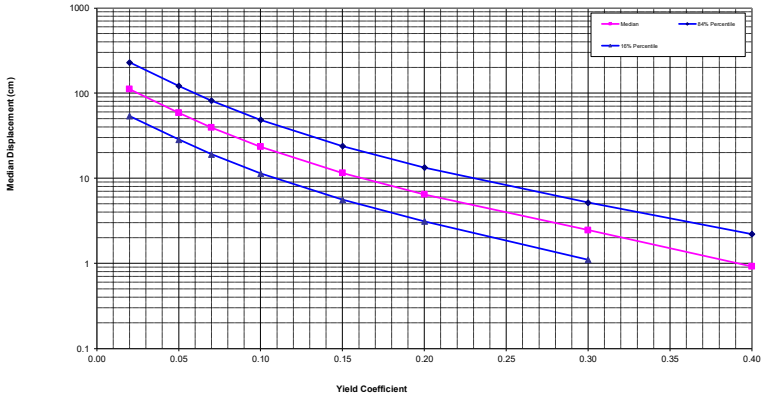


Fig. 14.4. Estimating the initial fundamental period of potential sliding blocks

Figures from Bray, J.D. (2007) "Chapter 14: Simplified Seismic Slope Displacement Pr
Earthquake Geotechnical Engineering, 4th Inter. Conf. on Earthquake Geotechnical Ea
Invited Lectures, in Geotechnical, Geological, and Earthquake Engineering Series, Vol
Pitilakis, Kyriazis D., Ed., Springer, Vol. 6, pp. 327-353.

Dependence on ky

ky	P(D="0")	D (cm)	Dmedian (cm)	D-84% (cm)	D-16% (cm)
0.02	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I9)+$B	=IF(ISERROR(EXP(LN($I9)+$B	=IF(ISERROR(EXP(LN($I9)+$B
0.05	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I10)+$E	=IF(ISERROR(EXP(LN($I10)+$E	=IF(ISERROR(EXP(LN($I10)+$E
0.07	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I11)+$E	=IF(ISERROR(EXP(LN($I11)+$E	=IF(ISERROR(EXP(LN($I11)+$E
0.1	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I12)+$E	=IF(ISERROR(EXP(LN($I12)+$E	=IF(ISERROR(EXP(LN($I12)+$E
0.15	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I13)+$E	=IF(ISERROR(EXP(LN($I13)+$E	=IF(ISERROR(EXP(LN($I13)+$E
0.2	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I14)+$E	=IF(ISERROR(EXP(LN($I14)+$E	=IF(ISERROR(EXP(LN($I14)+$E
0.3	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I15)+$E	=IF(ISERROR(EXP(LN($I15)+$E	=IF(ISERROR(EXP(LN($I15)+$E
0.4	=$B$9<0.7 1-NORMSDIST('Mod	=$B$9<0.7 1-NORMSDIST('Mod	=IF(ISERROR(EXP(LN($I16)+$E	=IF(ISERROR(EXP(LN($I16)+$E	=IF(ISERROR(EXP(LN($I16)+$E



Pseudostatic Seismic Coeffi

Input Parameters		
Da (cm)	11	Allowable Seismic Disp
Ts (s)	0.13	Initial Fundamental Pe
1.5Ts (s)	=1.5*(B6)	Degraded Period of Sli
Sa(1.5Ts) (g)	0.934	Spectral Acceleration a
Mw	7.5	Moment Magnitude
e	0	Normally distributed ra
		Set to 0.0 for Da at the

Intermediate Parameters		
x1 =	0.78	constant
a =	=3.353-0.538*LN(B8)	Eq. 8b
x2 =	=IF(B6>=0.1,6.896-3.0	value in brackets in Eq
b =	=B15^2-2*B14*B16	Eq. 8c
x3 =	=(-$B$15+SQRT($B$1	value in brackets in Eq

Pseudostatic k value		
k =	=EXP(B18)	solution of Eq. 2a

With this **k** value, if the pseud

=(B5) cm at the 50%

Model for Probability of Zer

P("0")= 1-Φ(a+blnky+cln(ky)^

	For Ts <= 0.7 s		For Ts > 0.7 s
a	-2.64	a	-3.531
b	-3.2	b	-4.783
c	-0.17	c	-0.342
d	-0.49	d	-0.3
e	2.094	e	-0.672
f	2.908	f	2.658

Model for Displacement Est

ln(D)=a+blnky + clnky2 + dlnk

Coefficients	Values
a	=+IF('Seismic Displacement_Su
b	-3.353
c	-0.39
d	0.538
e	3.06
f	-0.225
g	=+IF('Seismic Displacement_Su
h	0.55
i	=+IF(AND('Seismic Displacemen
σ	0.73