associated earth sciences incorporated

February 8, 2019
Revised April 24, 2019
Project No. 180127E001

Ron Beresky
8100 SE 48th Street
Mercer Island, Washington 98040

Subject: Revised Segmental Block Retaining Wall Design
8100 SE 48th Street
Mercer Island, Washington

Reference: Geotechnical Engineering Report
New Retaining Wall Feasibility
8100 SE 48th Street
Mercer Island, Washington
Date: October 2, 2018

Dear Mr. Beresky:

As requested, Associated Earth Sciences, Inc. (AESI) is pleased to present the attached revised design details, sections, elevations (Figures 1 and 2) and associated calculations for a new terraced Allan Block™ mechanically stabilized earth (MSE) wall system for your property. Our latest design reflects the use of three terraced gravity walls to be constructed with a minimum 2-foot-wide section of "no fines concrete" with a Classic Allan Block facing as shown on Figures 1 and 2, attached.

Our work has been performed in accordance with our proposal, dated October 2, 2018. We have revised our original drawings transmitted to you on October 2, 2018, to reflect design changes based on multiple meetings with your wall construction contractor, Western Landscaping and Pavers. We understand that the City of Mercer Island must approve our design prior to construction.

Global slope stability modeling was completed on critical Section B-B' (Figure 2) utilizing GeoStudio 2018 R2 software. This program accepts inputs that we provide based on published geologic mapping, available topographic information, our engineering experience in similar soils, and other sources. The model identifies critical slope failure surfaces that are then analyzed to determine

their factor of safety against failure under the input conditions. The factor of safety is a ratio between forces driving slope failure and forces resisting slope failure. A factor of safety of 1.0 is indicative of a failure surface with driving and resisting forces that are equal, and a slope failure is predicted. Factors of safety that exceed 1.0 indicate that resisting forces are greater than driving forces. For new construction, a static factor of safety of 1.5 or more is considered typical. Under design earthquake loads, pseudostatic (dynamic) factors of safety of 1.1 are required for work within the City of Mercer Island. For this project, we modeled the design earthquake using an acceleration of 0.30g or one-half of the Peak Ground Acceleration (PGA) as determined using the United States Geological Survey's (USGS's) online Design Maps tool, which is consistent with local standards of practice for slope modeling applications, in our opinion.

Existing topography inputs for slope stability modeling were developed based on a "Topographic Survey" by Harmsen and Associates, dated May 17, 2018. Slope stability modeling requires soil strength parameters. For this project, the site sediments that were modeled included surficial colluvium and the underlying very dense pre-Olympia till encountered at a depth of approximately 3 feet in two hand borings excavated on March 21, 2019, at the locations shown on Figure 1. Both hand borings encountered 3 feet of loose, silty sand with abundant organic material and roots (colluvium) overlying very dense, gray, silty sand with gravel (native pre-Olympia till). Both hand borings were terminated at a depth of 4 feet in the till due to refusal. We did not generate soil logs of the hand borings.

The model geometry is shown on Figure SS1, attached. For Sections B-B', the footing loads for the proposed deck and existing home were modeled as direct line loads applied at the locations shown on Figure 2 and the slope stability output Figures SS1 through SS4, attached.

Soil parameters used for our stability analyses are summarized on the slope stability model output Figures SS1 through SS4, attached. The composite "no fines concrete" with block facing was modeled with a conservative cohesion value of 2,000 pound per square foot (psf) that would be resistant to internal shearing. Soil parameters used to model the pre-Olympia glacial till deposits are based on the soils encountered in our borings (refer to our referenced geotechnical report), established published correlations, and previous experience with similar soils in the Puget Sound area. The parameters used represent mid-range values of the published information as shown in "Geotechnical Properties of Geologic Materials, Engineering Geology in Washington, Volume I, Bulletin 78, 1989" by Kowalski, J.W., Schwarz, S.D., and Tubbs, D.W.

Based on our slope stability modeling, a minimum static factor of safety of 1.5 was generated with the failure circle primarily involving the surficial colluvium (Figure SS2). Under seismic conditions, the minimum factor of safety involving failure circles in the pre-Olympia till is 1.1 (Figure SS3). Based on the modeling, it is likely that surficial land sliding similar to what has occurred on the property in the past could occur during a design level earthquake (Figure SS4). However, these failure circles are confined to the surface colluvium below the proposed new walls. Therefore, it is imperative that the lowest tier of the wall system is founded in competent, undisturbed pre-

Olympia till and that the wedge of soil at the toe of the proposed walls must be constructed in accordance with the sections shown on Figures 1 and 2 with either sufficiently compacted crushed rock or concrete.

The attached design calculations for Sections A-A' through C-C' were completed utilizing the software program AB Walls™ version 19.00.08 - 4/15/2019. Our latest design reflects the use of three terraced gravity walls to be constructed with a minimum 2-foot-wide section of "no fines concrete" with a Classic Allan Block facing as shown on Figures 1 and 2, attached. AB Walls™ software output for Sections A-A' through C-C' is also attached to this letter.

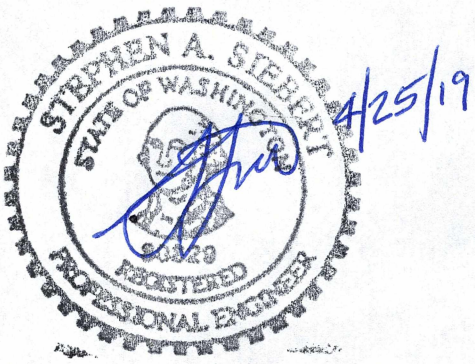
We modeled the loading from the upper gravity walls as a 600 psf uniform surcharge pressure starting 4 feet behind the lower-most wall. For Sections B-B' and C-C', the deck foundation was superimposed on the upper terrace loads as a 1,000 psf line load. On Section B-B', this line load does not appear to influence the loading on the base wall because of its positioning a minimum horizontal distance of 12 feet from the bottom wall, although it was included in the calculation. Section C-C' also includes a surcharge pressure for the proposed 2H:1V (Horizontal:Vertical) slope to be constructed above the wall in addition to the deck foundation load (Figure 2). As demonstrated by the AB Walls software output, the proposed configuration demonstrates adequate factors of safety for sliding and overturning under static and seismic (earthquake) loading conditions.

Our design is predicated on AESI being present onsite full-time during wall construction to verify bearing soils have been exposed in the foundation cut for all terraces, during no fines concrete and drainage installation, and during installation during backfill of the area at the toe of the new wall system. All soils excavated from the site must be removed from the site and specifically not placed on the slope beneath the new walls. In addition, surface and groundwater must be controlled at all times and must not be allowed to flow over the on- or off-site slopes under any circumstances. If utilities are identified within the slope that will conflict with our design, we should be notified prior to commencement of any further work. All work must be performed during the dry summer months between May and September unless specific permission is granted by the City of Mercer Island.

We appreciate the opportunity to be of continued service to you on this project. Should you have any questions regarding the attached documents, please call us at your earliest convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Susan G. Beckham, P.E.
Senior Geotechnical Engineer



Bruce L. Blyton, P.E.
Senior Principal Engineer

Stephen A. Siebert, P.E.
Associate Geotechnical Engineer

Attachments: Figures 1 & 2: Allan Block Wall, Beresky Residence - 8100 SE 48th Street, Mercer Island, Washington
Figures SS1–SS4: Slope Stability Output
AB Walls™ computer analysis output Sections A-A' through C-C'

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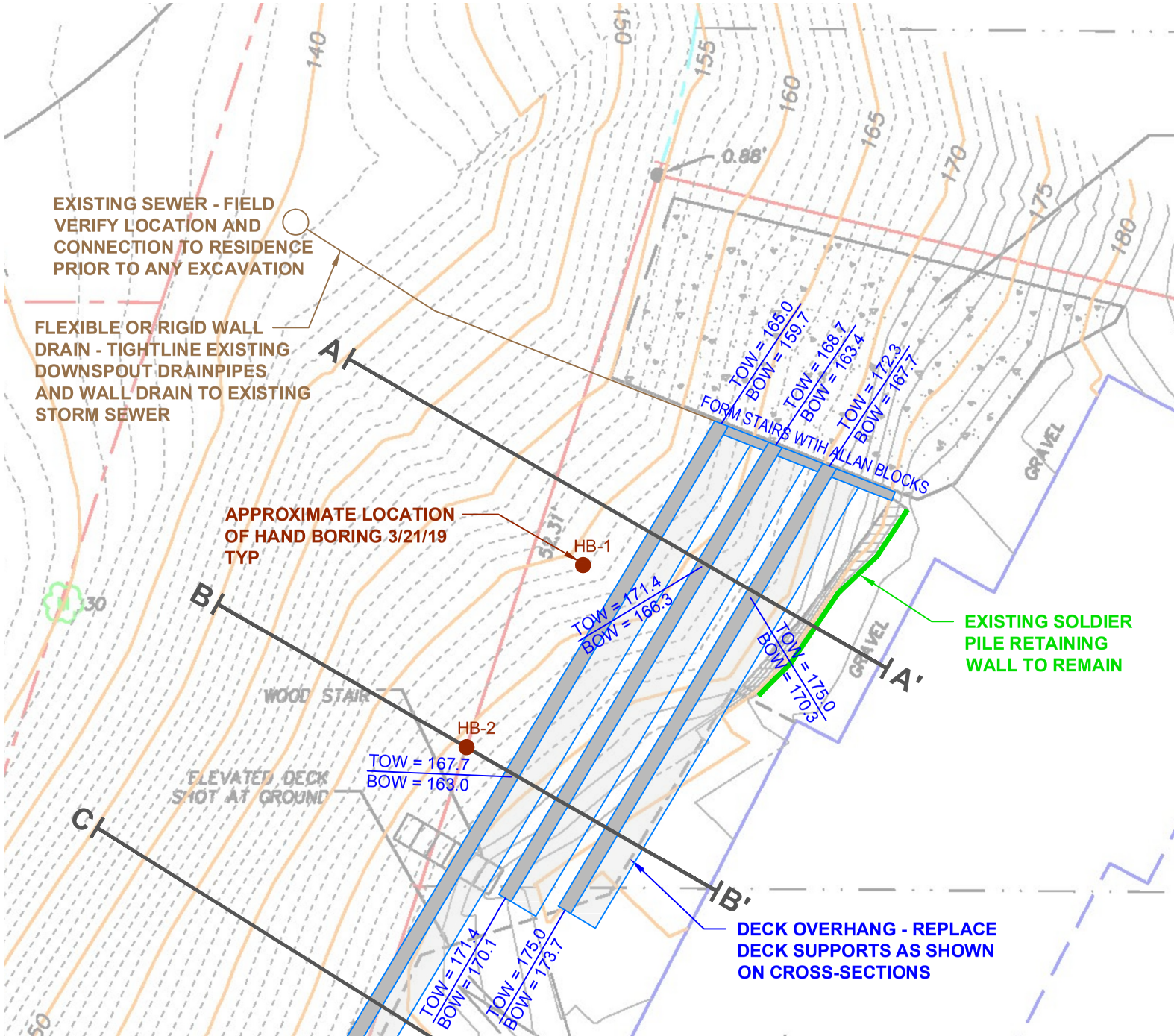
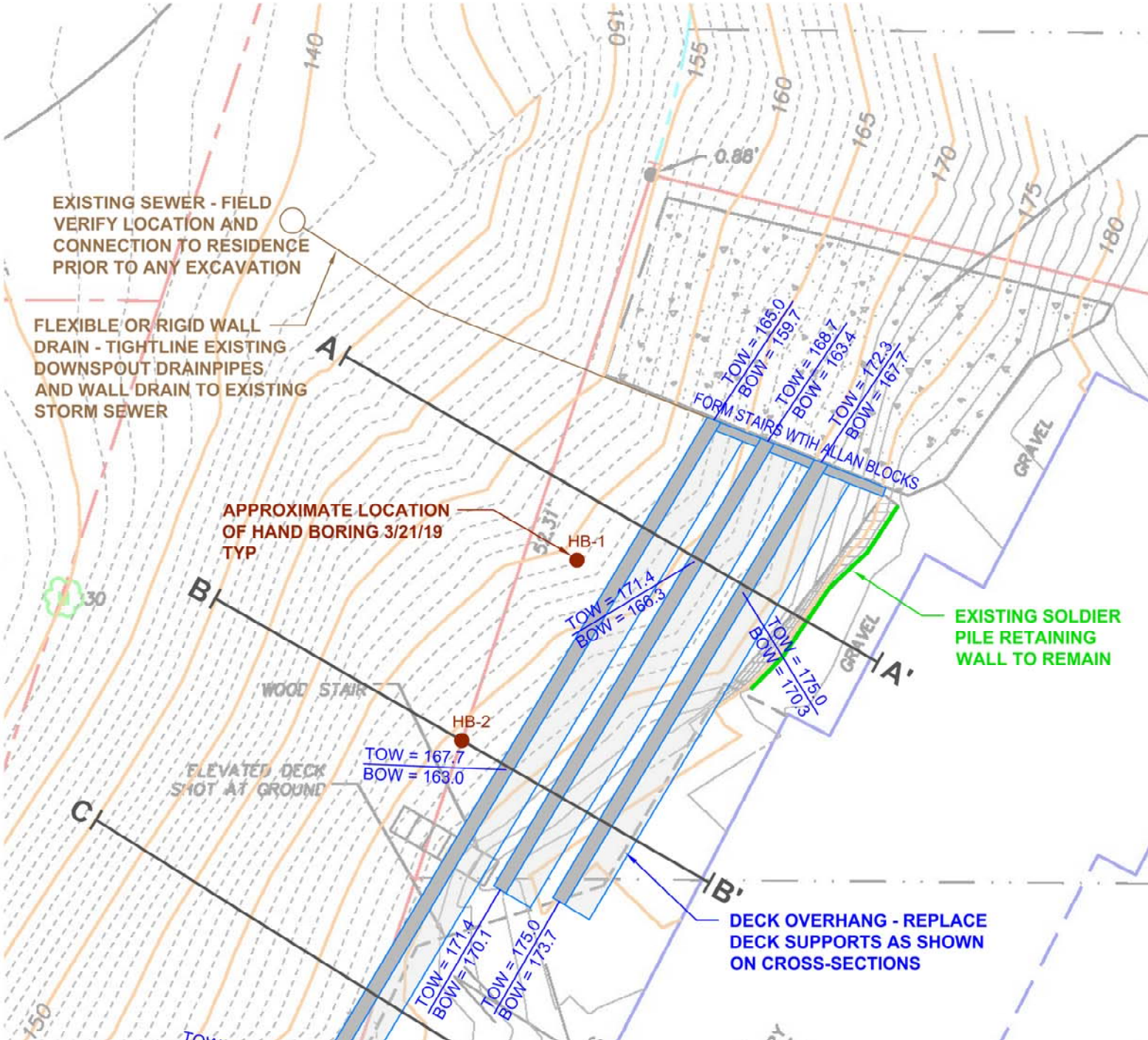

EXISTING SEWER - FIELD VERIFY LOCATION AND CONNECTION TO RESIDENCE PRIOR TO ANY EXCAVATION
FLEXIBLE OR RIGID WALL DRAIN - TIGHTLINE EXISTING DOWNSPOUT DRAINPIPES AND WALL DRAIN TO EXISTING STORM SEWER
APPROXIMATE LOCATION OF HAND BORING 3/21/19 TYP
HB-1
HB-2
A
A'
B
B'
C
TOW = 165.0
BOW = 159.7
TOW = 168.7
BOW = 163.4
TOW = 172.3
BOW = 167.7
FORM STAIRS WTIH ALLAN BLOCKS
TOW = 171.4
BOW = 166.3
TOW = 175.0
BOW = 170.3
EXISTING SOLDIER PILE RETAINING WALL TO REMAIN
WOOD STAIR
ELEVATED DECK SHOT AT GROUND
TOW = 167.7
BOW = 163.0
TOW = 171.4
BOW = 170.1
TOW = 175.0
BOW = 173.7
DECK OVERHANG - REPLACE DECK SUPPORTS AS SHOWN ON CROSS-SECTIONS
GRAVEL
GRAVEL
0.88'
53.3'
140
150
155
160
165
170
175
180
30
60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FLEXIBLE OR RIGID WALL DRAIN - TIGHTLINE EXISTING DOWNSPOUT DRAINPIPES AND WALL DRAIN TO EXISTING STORM SEWER
APPROXIMATE LOCATION OF HAND BORING 3/21/19 TYP
HB-1
HB-2
A
A'
B
B'
C
TOW = 165.0
BOW = 159.7
TOW = 168.7
BOW = 163.4
TOW = 172.3
BOW = 167.7
FORM STAIRS WTIH ALLAN BLOCKS
TOW = 171.4
BOW = 166.3
TOW = 175.0
BOW = 170.3
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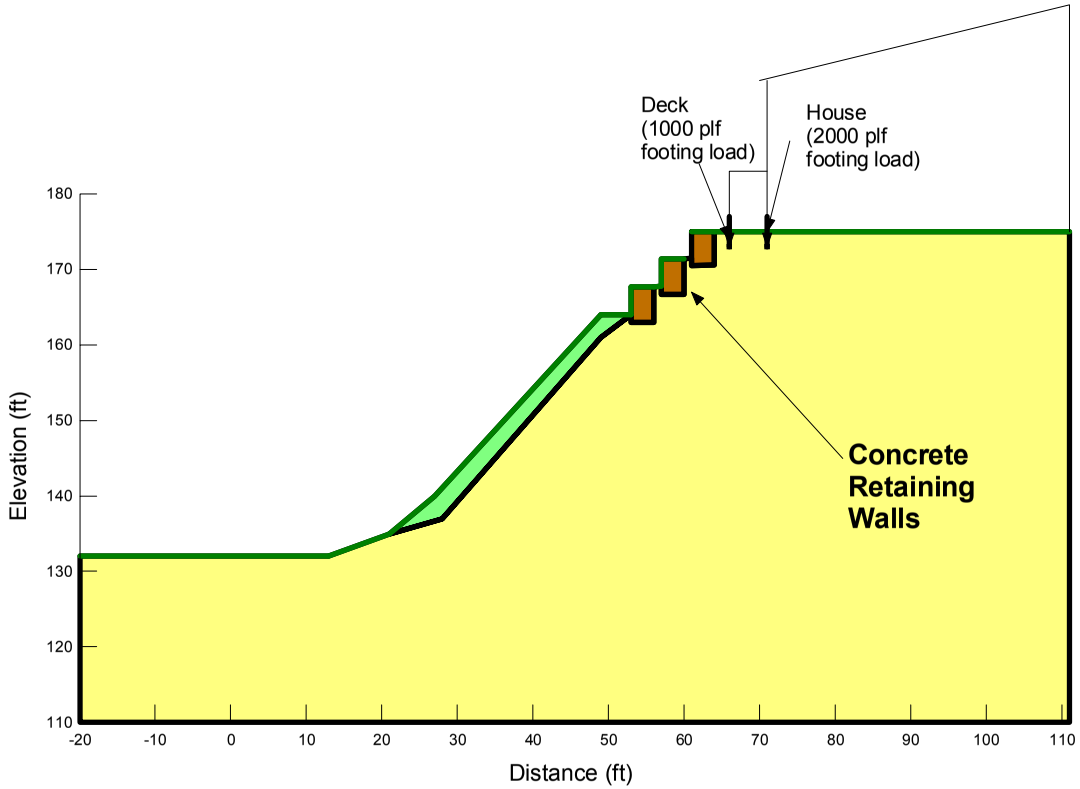
GRAVEL
WOOD STAIR
ELEVATED DECK SHOT AT GROUND
TOW = 167.7
BOW = 163.0
TOW = 171.4
BOW = 170.1
TOW = 175.0
BOW = 173.7
DECK OVERHANG - REPLACE DECK SUPPORTS AS SHOWN ON CROSS-SECTIONS
0.88'
52.31'
30
140
150
155
160
165
170
175
180

Beresky Retaining Walls
180127E001
Critical Section B-B'

Slope Geometry

Figure SS1 - 4/19/19

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	colluvium	110	0	30	0
	concrete walls	135	2,000	0	0
	pre-Olympia Till	120	500	32	0

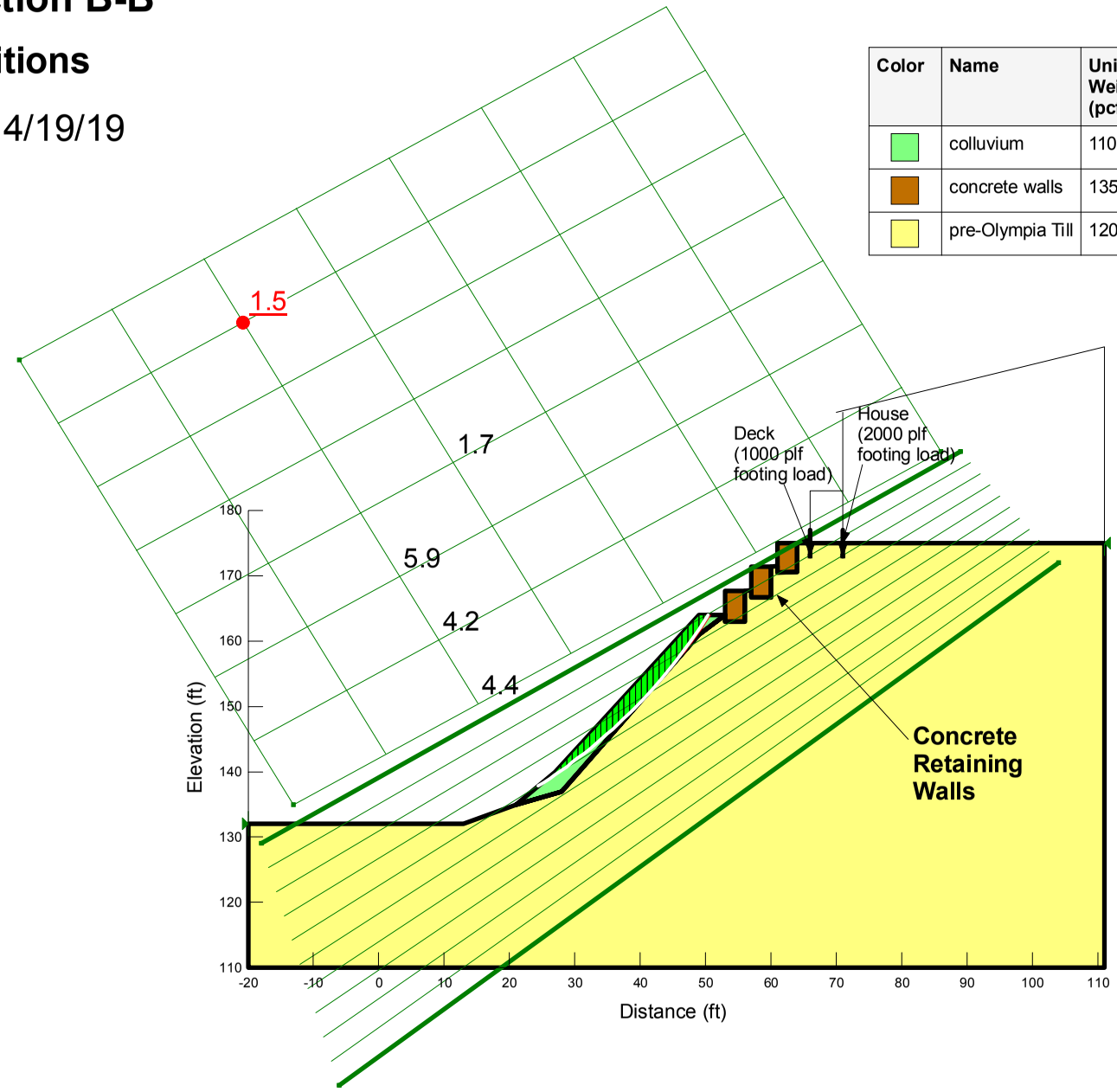


Beresky Retaining Walls
180127E001
Critical Section B-B'

Static Conditions

Figure SS2 - 4/19/19

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	colluvium	110	0	30	0
	concrete walls	135	2,000	0	0
	pre-Olympia Till	120	500	32	0

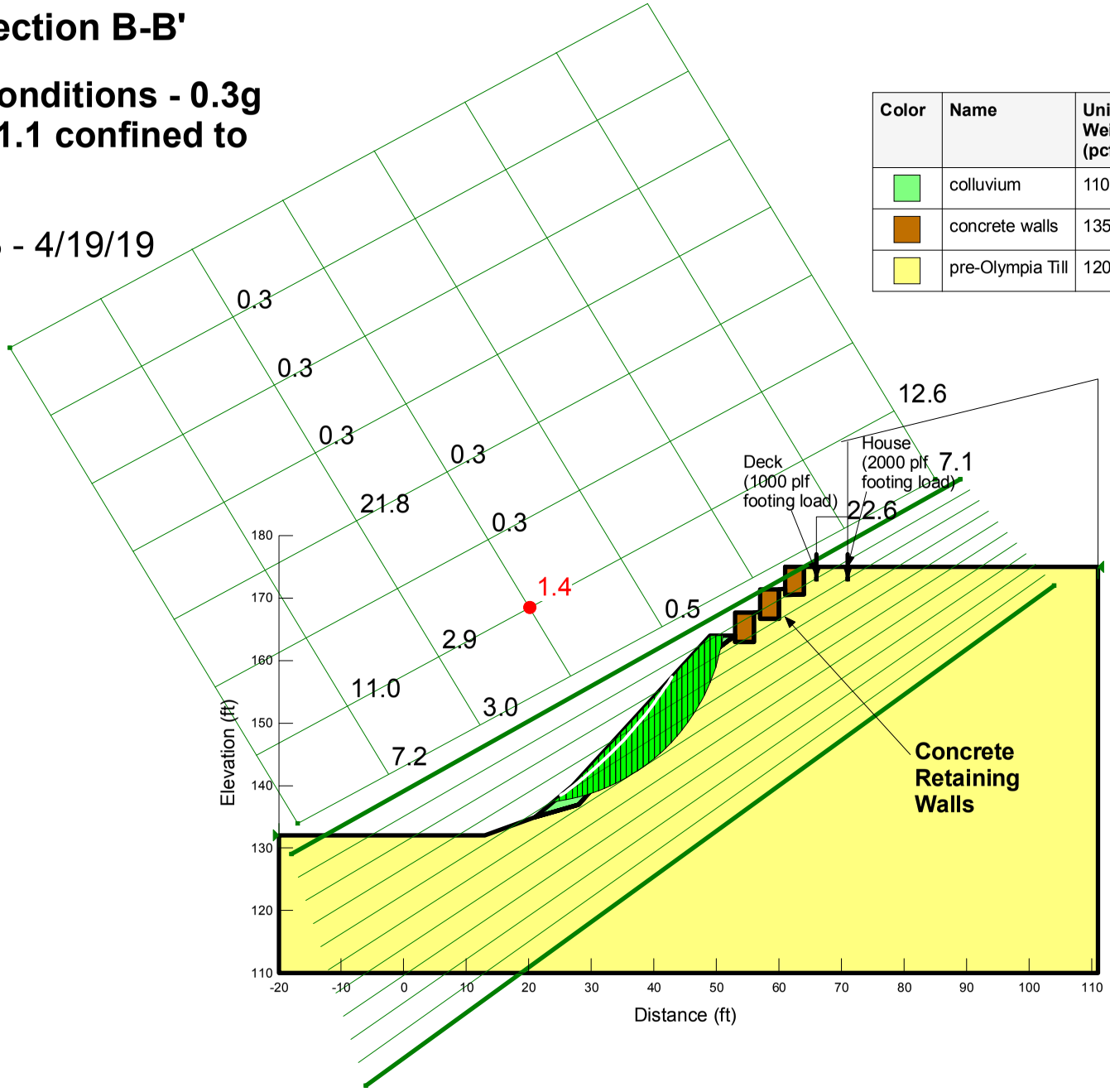


Beresky Retaining Walls
180127E001
Critical Section B-B'

Seismic Conditions - 0.3g
All FOS < 1.1 confined to colluvium

Figure SS3 - 4/19/19

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	colluvium	110	0	30	0
	concrete walls	135	2,000	0	0
	pre-Olympia Till	120	500	32	0

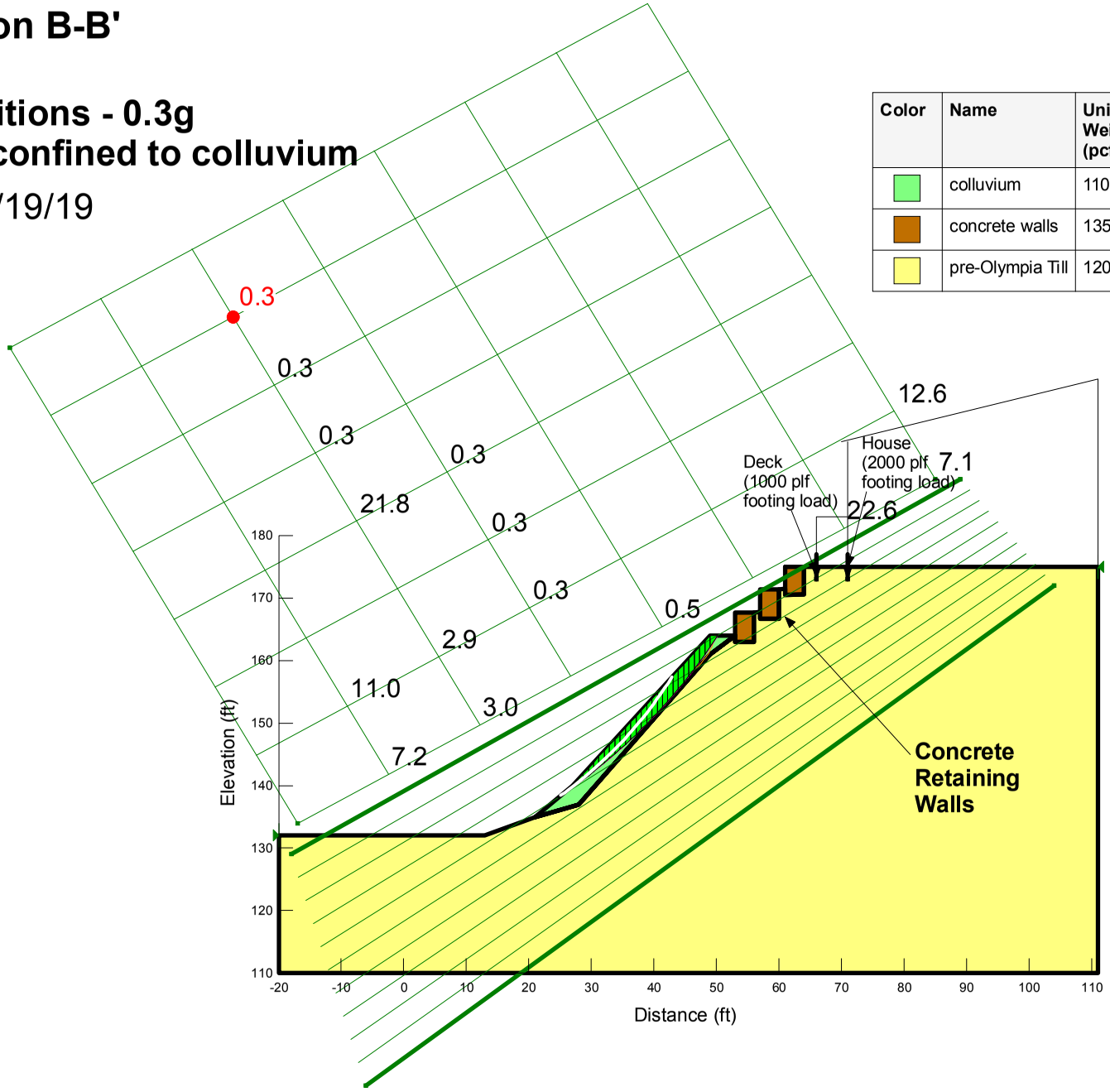


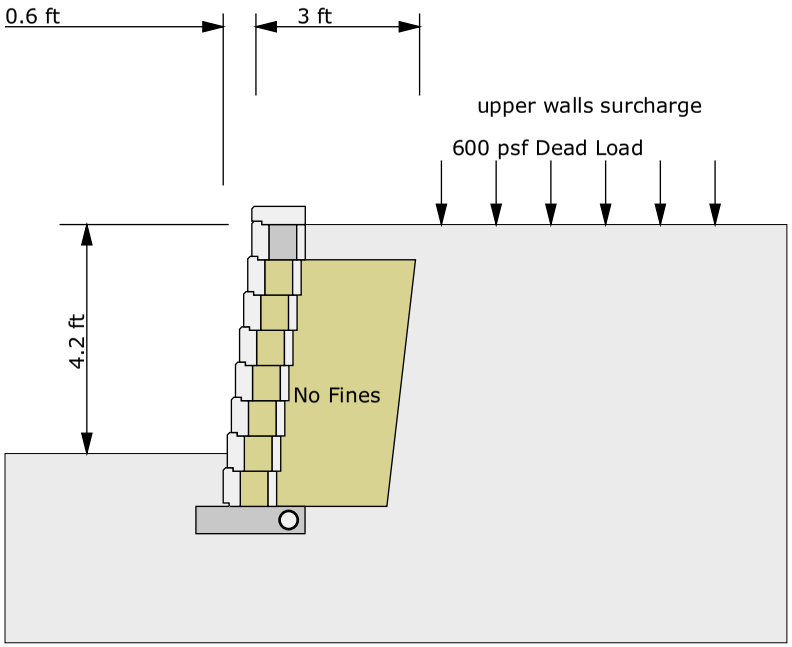
Beresky Retaining Walls
180127E001
Critical Section B-B'

Seismic Conditions - 0.3g
All FOS < 1.1 confined to colluvium

Figure SS4 - 4/19/19

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	colluvium	110	0	30	0
	concrete walls	135	2,000	0	0
	pre-Olympia Till	120	500	32	0





AB Classic

Section A-A'

Base Information:
Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Wall Design Variables

AB Classic
Total Panel Height 5.17 ft
Block Height 0.646 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Surcharge Parameters
600 psf Dead Load @ 4 ft
(Distance measured from toe of wall)

Safety Factors Static External
Actual Sliding
1.53 >= 1.5
Actual Overturning
2.6 >= 2

Safety Factors Seismic External
Peak Ground Acceleration = 0.3
Actual Sliding
1.16 >= 1.125
Actual Overturning
1.84 >= 1.5

Infill Soil
Friction Angle 75 Deg.
Unit WT 110 pcf

Retained Soil
Friction Angle 32 Deg.
Unit WT 120 pcf

Foundation Soil
Friction Angle 32 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity
Factor of Safety 4.37
Sigma_ult - 6727.47 psf
Sigma_max - 1539.2 psf

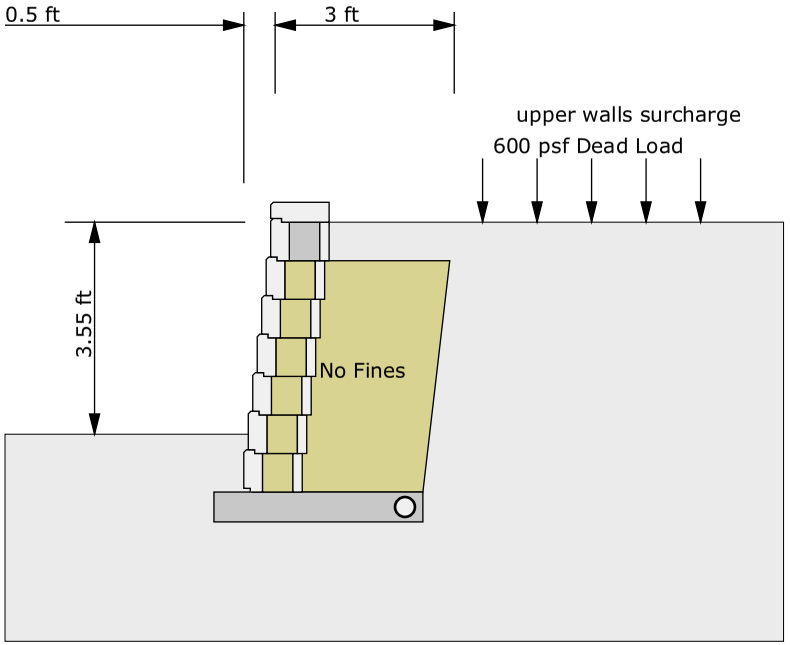
Internal Compound Stability
ics not calculated

Wall Rock Requirements
Variable Depth

	Height	Depth
Bottom	4.52 ft	1 ft

Project Name: Beresky Residence
Location: Section A-A'
Location: Mercer Island, WA
Wall Number:
Project Number: 180127E001
Designer: AESI
Date: 4/18/19

v 19.0.8



AB Classic

Section B-B'

Base Information:
Base Width: 3.5 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Wall Design Variables

AB Classic
Total Panel Height 4.52 ft
Block Height 0.646 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Surcharge Parameters
600 psf Dead Load @ 4 ft
1000 psf Dead Load: 12 ft - 13 ft
(Distance measured from toe of wall)

Safety Factors Static External
Actual Sliding
1.68 >= 1.5
Actual Overturning
3.34 >= 2

Safety Factors Seismic External
Peak Ground Acceleration = 0.3
Actual Sliding
1.27 >= 1.125
Actual Overturning
2.34 >= 1.5

Infill Soil
Friction Angle 75 Deg.
Unit WT 110 pcf

Retained Soil
Friction Angle 32 Deg.
Unit WT 120 pcf

Foundation Soil
Friction Angle 32 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity
Factor of Safety 8.3
Sigma_ult - 8709.49 psf
Sigma_max - 1049.35 psf

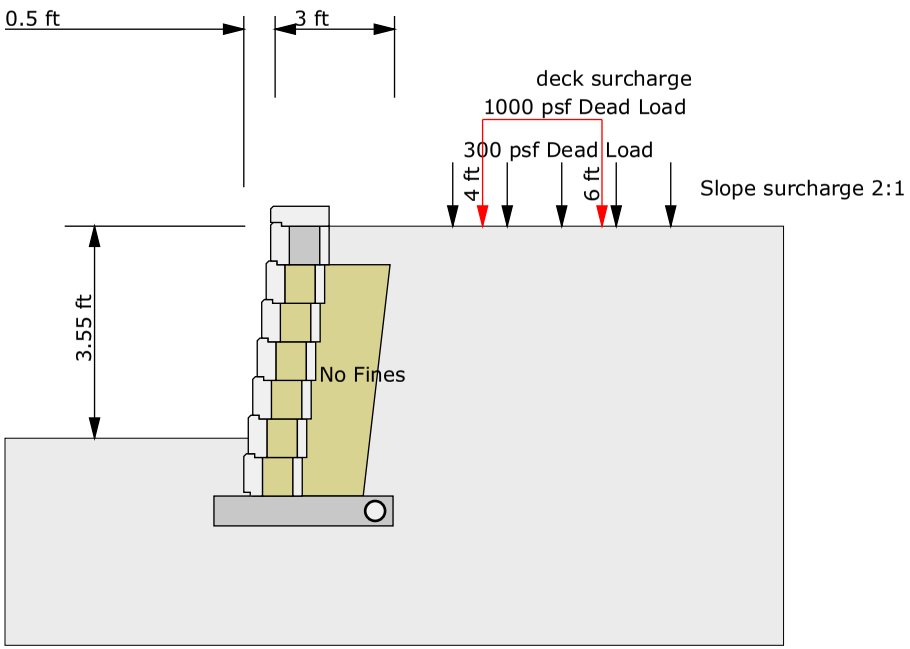
Internal Compound Stability
ics not calculated

Wall Rock Requirements
Variable Depth

	Height	Depth
Bottom	3.87 ft	1 ft

Project Name: Beresky Residence
Location: Section B-B'
Location: Mercer Island, WA
Wall Number:
Project Number: 180127E001
Designer: AESI
Date: 4/18/19

v 19.0.8



AB Classic

Section C-C'

Base Information:
Base Width: 3 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Wall Design Variables

AB Classic
Total Panel Height 4.52 ft
Block Height 0.646 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Surcharge Parameters
300 psf Dead Load @ 3.5 ft
1000 psf Dead Load: 4 ft - 6 ft
(Distance measured from toe of wall)

Safety Factors Static External
Actual Sliding
1.54 >= 1.5
Actual Overturning
4.53 >= 2

Safety Factors Seismic External
Peak Ground Acceleration = 0.3
Actual Sliding
1.15 >= 1.125
Actual Overturning
2.63 >= 1.5

Infill Soil
Friction Angle 75 Deg.
Unit WT 110 pcf

Retained Soil
Friction Angle 32 Deg.
Unit WT 120 pcf

Foundation Soil
Friction Angle 32 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity
Factor of Safety 9.69
Sigma_ult - 8048.82 psf
Sigma_max - 830.76 psf

Internal Compound Stability
ics not calculated

Wall Rock Requirements
Variable Depth

	Height	Depth
Bottom	3.87 ft	1 ft

Project Name: Beresky Residence
Location: Section C-C'
Location: Mercer Island, WA
Wall Number:
Project Number: 180127E001
Designer: AESI
Date: 4/18/19

v 19.0.8