PanGEO INCORPORATED
Geotechnical & Earthquake
Engineering Consultants

June 19, 2025
File No. 21-552.200

David and Karen Zimmer
4611 Forest Avenue SE
Mercer Island, WA 98040

Subject: **Response to Geotechnical Review Comments**
Proposed Zimmer Residence
4661 Forest Avenue SE, Mercer Island, Washington 98040
King County Parcel # 404500-0065

Dear David and Karen,

As requested, we prepared this letter to respond to additional city review comments related to the geotechnical aspect of the project. The following sections present our responses to the city review comments.

1. TEMPORARY EXCAVATIONS ALONG THE NORTH PROPERTY LINE

Based on review of the latest plans, we understand that temporary excavations along the north property line will consist of unsupported 1H:1V open cuts and an ultrablock wall where unsupported open cuts are not feasible. The ultrablock wall will be 3-row high with a small 1H:1V above it. Based on the borings drilled near this location, the soil within the excavation depth is anticipated to be predominately medium dense sandy silt. In our opinion, the temporary ultrablock as currently designed is feasible to support the excavations at this location. However, the ultrablock wall will need to be installed in sections and the voids behind the blocks to be backfilled immediately. The following sections present our recommendations for the design of temporary ultrablock shoring walls.

Ultrablocks are pre-cast concrete blocks that are 2½ x 2½ x 5½ feet in dimension. The Ultrablock walls should have a maximum height of 7½ feet (three blocks high) and installed with a 1H:10V batter, or flatter, combined with a 1H:1V slope above the wall. We recommend that the following be incorporated into the project plans:

- The maximum wall height of staggered blocks is 7½ feet (i.e., 3 blocks in height);
- The vertical wall face is no steeper than 1H (Horizontal):10V (Vertical);
- The backslope above the block wall shall be no steeper than 1H:1V (Maximum 4 feet high);
- The subgrade at the base of the Ultrablocks shall consist of native firm/dense native soil or leveling crushed rock placed on native firm/dense soil;
- No excavation shall be made until blocks are available on site;
- The width of unsupported cut face for block placement shall be limited to no more than about 12 feet at any given time;
- Blocks shall be placed immediately after the cut is made, otherwise the cut face shall be buttressed with on-site soils until the blocks can be placed;
- Any voids behind blocks shall be backfilled with gravel immediately after the block wall is installed; and
- PanGEO shall provide full-time observation during block wall installation.

2. GRAVITY WALL DESIGN

Based on the current plans, we understand that the existing grade to the werst of the house will be raised and retaining walls up to 8 feet in height will be needed to retain the fill. We also understand that gravity walls, such as redi-rock walls, are considered at this time. We used the following soil parameters as the foundation soil and backfill for the wall design.

Table 1 – Soil Parameters for Gravity Wall Design

Material Type	Unit Weight (pcf)	Cohesion (psf)	Friction Angles (degrees)
Unit 1 – Loose to Medium Dense Silty Sand/Sandy Silt	115	150 (seismic condition)	34

The wall was designed with redi-rock wall design software. Based on the design, for the seismic condition, the redi-rock wall up to 9 feet in height will need four 60-inch deep blocks at bottom and one 41-inch deep block and one 28-inch deep blocks at the top to satisfy the wall stability under the static and seismic conditions. The wall design section and calculations are attached at the end of this letter for reference.

3. STATEMENT OF MINIMUM RISKS

We understand that the site is mapped as a geologic hazard area. Per Mercer Island City Code Section 19.07.160.B.3, development within geologic hazard areas and critical slopes may occur if the geotechnical engineer provides a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area;

b. The landslide hazard area or seismic hazard area will be modified or the development has been designed so that the risk to the site and adjacent property is eliminated or mitigated such that the site is determined to be safe;

c. Construction practices are proposed for the alteration that would render the development as safe as if it were not located in a geologically hazardous area and do not adversely impact adjacent properties; or

d. The development is so minor as not to pose a threat to the public health, safety and welfare.

Based on our engineering analyses and our review of the current plans, it is our opinion that Criterion (b) and (c) can be met, provided that the project is properly constructed per the approved plans. We recommend that best management practices be implemented during construction, including the proper use of silt fence, to minimize earthwork activities during periods heavy precipitations, and to minimize exposed areas in wet season, etc. Permanent erosion control measures including landscape and hardscape installations will effectively mitigate the risk of erosion in the long term.

CLOSURE

We trust that the information presented herein meets your need at this time. Please call if you have any questions.

Sincerely,

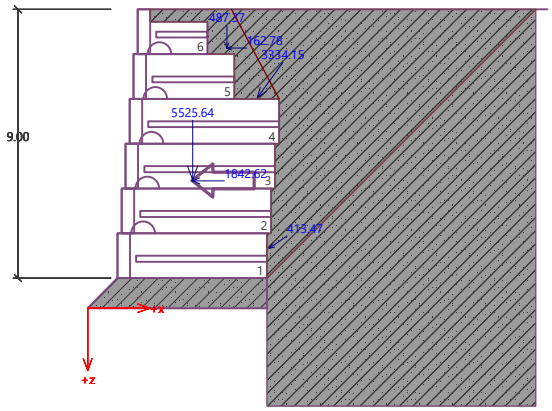
6/19/2025

Michael H. Xue, P.E.
Principal Geotechnical Engineer

Attachments:

Redi-Rock Wall design section and calculations

Name : Verification	Stage - analysis : 1 - 1



Analysis of Redi Rock wall

Input data

Date : 6/17/2025

Settings

USA - Safety factor

Wall analysis

Verification methodology :	Safety factors (ASD)
Active earth pressure calculation :	Coulomb
Passive earth pressure calculation :	Mazindrani (Rankine)
Earthquake analysis :	Mononobe-Okabe
Shape of earth wedge :	Calculate as skew
Allowable eccentricity :	0.333
Internal stability :	Standard - straight slip surface
Reduction coeff. of contact first block - base :	1.00

Safety factors			
Permanent design situation			
Safety factor for overturning :	SF_o =	1.50	[–]
Safety factor for sliding resistance :	SF_s =	1.50	[–]
Safety factor for bearing capacity :	SF_b =	2.00	[–]
Safety factor for sliding along geo-reinforcement :	SF_{sr} =	1.50	[–]
Safety factor for geo-reinforcement strength :	SF_{st} =	1.50	[–]
Safety factor for pull out resistance of geo-reinf. :	SF_{po} =	1.50	[–]
Safety factor for connection strength :	SF_{con} =	1.50	[–]

Blocks

No.	Description	Block height h [in]	Block width w [in]	Unit weight γ [pcf]
1	Block 41	18.00	40.50	120.00
2	Block 60	18.00	60.00	130.00
3	Top block 28	18.00	28.00	120.00

No.	Description	Shear bearing capacity of joint F_{min} [lbf/ft]	Max. shear strength F_{max} [lbf/ft]	Block friction f [°]
1	Block 41	6061.00	11276.00	44.00
2	Block 60	6061.00	11276.00	44.00
3	Top block 28	6061.00	11276.00	44.00

Setbacks

No.	Setback s [in]
1	0.000
2	0.033
3	0.135

No.	Setback s [in]
4	0.781
5	1.385

Geometry

No. group	Description	Count	Setback s [in]
1	Block 60	1	0.13
2	Block 60	2	0.13
3	Block 60	1	0.13
4	Block 41	1	0.13
5	Top block 28	1	-

Base

Geometry

Upper setback a_1 = 0.00 ft
Lower setback a_2 = 1.00 ft
Height h = 1.00 ft
Width b = 6.00 ft

Material

Soil creating foundation - Unit 1

Basic soil parameters

No.	Name	Pattern	φ_{ef} [°]	c_{ef} [psf]	γ [pcf]	γ_{su} [pcf]	δ [°]
1	Unit 1		34.00	150.0	115.00	52.50	34.00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Unit 1

Unit weight : γ = 115.0 pcf
Stress-state : effective
Angle of internal friction : φ_{ef} = 34.00 °
Cohesion of soil : c_{ef} = 150.0 psf
Angle of friction struc.-soil : δ = 34.00 °
Saturated unit weight : γ_{sat} = 115.0 pcf

Backfill

Assigned soil : Unit 1
Slope = 45.00 °

Geological profile and assigned soils

No.	Thickness of layer t [ft]	Depth z [ft]	Assigned soil	Pattern
1	-	0.00 .. ∞	Unit 1	

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Resistance on front face of the structure

Resistance on front face of the structure is not considered.

Earthquake

Factor of horizontal acceleration K_h = 0.3340
Factor of vertical acceleration K_v = 0.0000

Water below the GWT is restricted.

Settings of the stage of construction

Design situation : permanent
Reduction of soil/soil friction angle : do not reduce

Verification No. 1

Forces acting on construction

Name	F_{hor} [lbf/ft]	App.Pt. z [ft]	F_{vert} [lbf/ft]	App.Pt. x [ft]	Design coefficient
Weight - wall	0.0	-4.29	5525.6	3.51	1.000
Earthq.- constr.	1842.6	-4.26	0.0	3.49	1.000
Weight - earth wedge	0.0	-8.70	487.4	4.66	1.000
Earthquake - soil wedge	162.8	-8.70	0.0	4.66	1.000
Active pressure	337.8	-2.00	238.5	6.08	1.000
Earthq.- act.pressure	1966.2	-7.04	2692.7	5.67	1.000

Verification of complete wall

Check for overturning stability

Resisting moment M_{res} = 38397.9 lbfft/ft
Overturning moment M_{ovr} = 23789.6 lbfft/ft

Safety factor = 1.61 > 1.50
Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force H_{res} = 6522.93 lbf/ft
Active horizontal force H_{act} = 4309.34 lbf/ft

Safety factor = 1.51 > 1.50
Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Bearing capacity of foundation soil

Design load acting at the center of footing bottom

No.	Moment [lbfft/ft]	Norm. force [lbf/ft]	Shear Force [lbf/ft]	Eccentricity [–]	Stress [psf]
1	12224.3	8944.21	4309.34	0.228	2738.1

Service load acting at the center of footing bottom

No.	Moment [lbfft/ft]	Norm. force [lbf/ft]	Shear Force [lbf/ft]
1	12224.3	8944.21	4309.34

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification

Max. eccentricity of normal force $e = 0.228$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 2738.1$ psf

Allowable bearing capacity of foundation soil $R_d = 0.0$ psf

Safety factor = 0.00 < 2.00

Bearing capacity of foundation soil is NOT SATISFACTORY

Overall verification - bearing capacity of found. soil is NOT SATISFACTORY