### VERTI-BLOCK RETAINING WALL DESIGN PACKAGE LEGACY MOUNTAIN ESTATES WEBER COUNTY, UTAH



NOTE: THIS PLAN SET HAS BEEN PREPARED WITH COLOR LINE-TYPES TO MAKE SOME DETAILS AND SPECIFICATIONS MORE CLEAR. ANY COPIES OF THESE PLANS SHOULD BE MADE IN COLOR.

PROJECT AERIAL VIEW	
REFERENCE IMAGES FROM GOOGLE EARTH PRO, VERSION 7.3.4.824	18
BUILD DATE: JULY 16, 2021, IMAGE DATE: MAY 16, 2021	

SCALE: 1" = 500

REV	REVISION DESCRIPTION	DATE	BY	CHK
	REVISIONS			

12429 SOUTH 300 EAST DRAPER, UTAH 84020 (801) 748-4044

VERTI-BLOCK RETAINING WALLS LEGACY MOUNTAIN ESTATES WEBER COUNTY, UTAH

DESIGNED BY: LMP DRAWN BY: LMP CHECKED BY: BMJ APPROVED BY: LMP IGES PROJECT NO: 03835-001

COVER SHEET

DESIGN PACKAGE CONTENTS					
SHEET NO. DESCRIPTION					
	1	COVER SHEET			
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	8	TYPICAL SECTION VIEW - CUT			
SHOP DRAWINGS	9 NGS	TYPICAL SECTION VIEW - FILL			
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PACKAGE	SECTION 3	GLOBAL STABILITY RESULTS			







0 12 24 36 60 120 SCALE: 1" = 60'		REFERENCE IMAGE FROM GREAT BASIN F PROFILES, SHEE	<u>PLAN VIEW</u> ENGINEERING, INC., LEGACY MOUNTAIN ESTATES, RE ITS CG2.3 & CG2.4, SHEETS DATED 7-23-2021.	TAINING WALL
REV REVISION DESCRIPTION REVISIONS	DATE BY CHK	12429 SOUTH 300 EAST DRAPER, UTAH 84020 (801) 748-4044	VERTI-BLOCK RETAINING WALLS LEGACY MOUNTAIN ESTATES WEBER COUNTY, UTAH PLAN VIEW - WALLS 1-8	DESIGNED BY: LMP 9-1: DRAWN BY: LMP 9-1: CHECKED BY: BMJ 9-1: APPROVED BY: LMP 9-1 IGES PROJECT NO: SH 03835-001

#### NOTES:

#### TIERED WALLS MAY BE JOINED INTO SINGLE 1. TIERED WALLS IF THE ENGINEERING FOR THE NEW COMBINED HEIGHT IS FOLLOWED.

REV N/A

3



5-2021	PLOT S	CALE
5-2021	1=	1
5-2021	DWG SO	CALE
5-2021	1"=	50'
EET NO:	1	REV
	4	N/A







35 2.20 Acres ON 20.04 cG





0 6 12 18 30 60 SCALE: 1" = 30'	<u>PLAN VIEW</u> REFERENCE IMAGE FROM GREAT BASIN ENGINEERING, INC., LEGACY MOUNTAIN ESTATES, RETAINING W PROFILES, SHEET CG2.6, SHEET DATED 7-23-2021.					TAINING WALL
REV REVISION DESCRIPTION REVISIONS	DATE B	Y CHK	IGES EST. 1998	12429 SOUTH 300 EAST DRAPER, UTAH 84020 (801) 748-4044	VERTI-BLOCK RETAINING WALLS LEGACY MOUNTAIN ESTATES WEBER COUNTY, UTAH PLAN VIEW - WALL 18	DESIGNED BY: LMP 9 DRAWN BY: LMP 9 CHECKED BY: BMJ 9 APPROVED BY: LMP 9 IGES PROJECT NO: S 03835-001

5-2021	PLOT S	CALE
5-2021	1=	1
5-2021	DWG SO	CALE
5-2021	1"=	30'
EET NO:	7	REV
	/	N/A

OF

#### SECTION VIEW NOTES:

- SOIL CUT SHOULD BE BENCHED AS NEEDED TO PROTECT WORKERS AND TO COMPLY 1. WITH OSHA REQUIREMENTS.
- RETAINING WALLS ARE VULNERABLE TO EROSION AND HYDROSTATIC PRESSURES 2. IMMEDIATELY AFTER INSTALLATION BUT PRIOR TO THE PLACEMENT OF LANDSCAPING/FINISHING ELEMENTS (E.G. LANDSCAPING, HARDSCAPE, CURB & GUTTER, PAVEMENT, ETC.). TO PREVENT DAMAGE TO THE WALL DURING ADDITIONAL SITE WORK, ALL SURFACE DRAINAGE SHOULD BE DIRECTED AWAY FROM THE WALL. EXCESS WATER DURING HEAVY PRECIPITATION EVENTS, IF NOT DRAINED PROPERLY, CAN CAUSE WASHOUTS AT WALL ENDS AND 'BLOWOUTS' OF INTERIOR SECTIONS. THESE PRECAUTIONS SHOULD BE TAKEN DURING WALL CONSTRUCTION, AND AFTER, UNTIL THE FINAL SITE DRAINAGE, LANDSCAPING AND/OR PAVING ARE COMPLETE.

VERTI-BLOCK GRAVITY BLOCK SCHEDULE								
COURSE			BLOCK SI (COURSE FOR VAF	ZE FOR EACI 1 IS BOTTOM RIOUS WALL	H COURSE I COURSE) HEIGHTS			
	1 BLOCK (2/1-FT)	2 BLOCKS (3/4-FT)	3 BLOCKS (5/6-FT)	4 BLOCKS (7/8-FT)	5 BLOCKS (9/10-FT)	6 BLOCKS (11-FT)	6 BLOCKS (12-FT)	
6	-	-	-	-	-	1' TOP	ТОР	
5	-	-	-	-	1'TOP/TOP	36"	36"	
4	-	-	-	1' TOP/TOP	36"	48"	48"	
3	-	-	1'TOP/TOP	36"	36"	60"	60"	
2	-	1' TOP/TOP	36"	36"	48"	60"	60"	
1	TOP/1' TOP	36"	36"	48"	60"	60"	84"	

WHERE:

- 1' TOP = 1-FOOT STEP TOP BLOCK
- TOP = 36-INCH TOP BLOCK
- 36" = 36-INCH BLOCK
- 48" = 48-INCH BLOCK
- 60" = 60-INCH BLOCK
- 84" = 84-INCH BLOCK







5-2021	PLOT SO	CALE
5-2021	1=	1
5-2021	DWG SO	CALE
5-2021	1"=	-3'
EET NO:	0	REV
	0	N/A



VERTI-BLOCK MSE GRID SCHEDULE						
# OF BLOCKS	HEIGHT [FEET]	MINIMUM EMBEDMENT [INCHES]	GRID TYPE [MIRAFI]	MINIMUM GRID LENGTH [FEET]		
10	20	24.0	10XT	14.0		
10 (1' TOP)	19	23.0	8XT	13.0		
9	18	22.0	8XT	11.5		
9 (1' TOP)	17	21.0	8XT	11.5		
8	16	19.0	8XT	11.5		
8 (1' TOP)	15	18.0	8XT	9.5		
7	14	17.0	8XT	9.5		
7 (1' TOP)	13	16.0	8XT	9.5		
6	12	14.0	8XT	9.5		
6 (1' TOP)	11	13.0	8XT	8.0		
5	10	12.0	5XT	8.0		
5 (1' TOP)	9	11.0	5XT	8.0		
4	8	10.0	5XT	8.0		
4 (1' TOP)	7 OR LESS	8.0	5XT	6.0		

GRID SCHEDULE NOTES: 1. LOWEST GRID SHOULD START ON TOP OF 1ST COURSE AND MAY BE PLACED EVERY OTHER COURSE.

#### SECTION VIEW NOTES:

- SOIL CUT SHOULD BE BENCHED AS NEEDED TO PROTECT WORKERS AND TO COMPLY 1. WITH OSHA REQUIREMENTS.
- RETAINING WALLS ARE VULNERABLE TO EROSION AND HYDROSTATIC PRESSURES 2. IMMEDIATELY AFTER INSTALLATION BUT PRIOR TO THE PLACEMENT OF LANDSCAPING/FINISHING ELEMENTS (E.G. LANDSCAPING, HARDSCAPE, CURB & GUTTER, PAVEMENT, ETC.). TO PREVENT DAMAGE TO THE WALL DURING ADDITIONAL SITE WORK, ALL SURFACE DRAINAGE SHOULD BE DIRECTED AWAY FROM THE WALL. EXCESS WATER DURING HEAVY PRECIPITATION EVENTS, IF NOT DRAINED PROPERLY, CAN CAUSE WASHOUTS AT WALL ENDS AND 'BLOWOUTS' OF INTERIOR SECTIONS. THESE PRECAUTIONS SHOULD BE TAKEN DURING WALL CONSTRUCTION, AND AFTER, UNTIL THE FINAL SITE DRAINAGE, LANDSCAPING AND/OR PAVING ARE COMPLETE.



REV	REVISION DESCRIPTION	DATE	BY	CHK
	REVISIONS			

(801) 748-4044

DESIGNED BY: LM	ſP	9-1
DRAWN BY: LM	ſP	9-1
CHECKED BY: BM	IJ	9-1
APPROVED BY: LM	ſP	9-1
IGES PROJECT NO:		SH
03834	5-001	

**TYPICAL SECTION VIEW - FILL** 

		3.4.	SET AND CHECK THE FIRST ROW OF BLOCK UNITS FOR LEVEL AND
	CONSTRUCTION SPECIFICATIONS & NOTES	3.4	4.1. INSTALL VERTI-BLOCK ELEMENTS IN ACCORDANCE WITH VER
1. INT	RODUCTION	3.5.	POUR DRAINAGE INFILL GRAVEL INTO THE HOLLOW CORE OF EAG BLOCKS IS INSTALLED BEFORE ADDITIONAL COURSES OF BLOCKS
1.1.	FOLLOW THE GUIDANCE CONTAINED IN THE VERTI-BLOCK CONSTRUCTION MANUAL UNLESS SPECIFICALLY SUPERSEDED BY MORE STRIN SPECIFICATION OR MATERIAL PROPERTIES PROVIDED HEREIN OR ON THE DRAWINGS.	INGENI	AND NO AIR POCKETS ARE DETECTED.
1.1.1.	IN THE EVENT THERE IS ANY CONFLICT OR AMBIGUITY BETWEEN THE FOLLOWING SPECIFICATIONS AND THE REFERENCED GUID. BRING ALL SUCH ISSUES IMMEDIATELY TO THE ATTENTION OF IGES, INC. FOR WRITTEN CLARIFICATION.	DANCE,	THE RETAINING WALLS.
1.2.	DESIGN AND CONSTRUCTION INFORMATION IS BASED ON GEOTECHNICAL INFORMATION OBTAINED FROM, SITE OBSERVATIONS, PR PLANS, DISCUSSIONS WITH THE CLIENT AND THE ENGINEERING ANALYSIS PERFORMED AS PART OF THE SCOPE OF WORK FOR THIS PROJECTION INFORMATION I	ROJECT 5.0. ECT BY	NEXT COURSE.
1.3.	LOCATE ALL EXISTING UTILITIES PRIOR TO RETAINING WALL CONSTRUCTION.	3.7.	(MODIFIED PROCTOR). THINNER LIFTS MAY BE NECESSARY TO ACH
1.4.	IMPLEMENT THE FOLLOWING MEASURES TO REDUCE THE POTENTIAL FOR HYDROSTATIC PRESSURES TO BUILD UP BEHIND THE RETA	AINING 3.7	7.1. PERFORM DENSITY TESTING OF THE BACKFILL SOILS AT 50-FO
1 4 1	WALL:		7.2. USE ONLY SMALL, WALK-BEHIND TYPE COMPACTION EQUIPM
1.4.1.	CONSTRUCTION.	Owing 3.	7.3. IF ANY LOCATIONS EXIST WHERE THE RETAINING WALLS WI OF 95 PERCENT OF THE MAXIMUM DRY DENSITY PER ASTM D-1
1.4.2.	PLACE A 4-INCH MINIMUM PERFORATED DRAIN PIPE AT BOTTOM OF GRAVEL INFILL.	3.8.	INSTALL THE EACH SUBSEQUENT COURSE TO BOND ON TOP OF TH
1.5.	CONDITIONS SUCH AS LEAKY OR BROKEN IRRIGATION LINES AND/OR UNCONTROLLED RUNOFF FROM IMPROPER SITE GRADING (I.E. ALLO WALTER TO POND ABOVE THE RETAINING WALL) CAN LEAD TO SLOPE OR WALL MOVEMENT.	OWING 3.8	LOWER COURSE. BLOCKS SHALL BE PLACED AT A $2_{16}^{-1}$ INCH SETBAC 3.1. CHECK EACH BLOCK COURSE FOR PROPER ALIGNMENT AND L
1.5.1.	HYDROSTATIC CONDITIONS WERE NOT CONSIDERED IN THE ANALYSES AND MUST BE AVOIDED.	3.8	8.2. CONTINUE TO UNIT FILL AND BACKFILL BEHIND EACH COURS
1.5.2.	RETAINING WALLS ARE VULNERABLE TO EROSION AND HYDROSTATIC PRESSURES IMMEDIATELY AFTER INSTALLATION OF	OF THE 3.9.	INSTALL GEOGRID REINFORCEMENT AT THE ELEVATIONS INDICAT
	RETAINING WALL BLOCKS, BUT PRIOR TO THE PLACEMENT OF THE LANDSCAPING OR FINISHING ELEMENTS AT THE SITE (I.E. 8-INCH LOW PERMEABLE SOIL/HARDSCAPE, INSTALLATION OF CURB & GUTTER, VEGETATION OF SLOPES, ETC.). AS THESE ARE CRU	CHES OF RITICAL 3.9	9.1. SWEEP TOPS OF VERTI-BLOCK UNITS CLEAN OF ALL DEBRIS REINFORCEMENT
	INSTALLED UNTIL THE LANDSCAPING/FINISHING ELEMENTS ARE COMPLETED. WE RECOMMEND THAT THESE ELEMENTS BE INSTA	TALLED 3.9	2. INSTALL THE GEOGRID REINFORCEMENT TO THE MINIMUM LE
	IMMEDIATELY FOLLOWING THE INSTALLATION OF THE BLOCKS.	3.0	23. ROLL THE GEOGRID OUT FROM THE FACE OF THE WALL (MACH
1.5.	2.1. THE OWNER SHALL BE AWARE OF THE RISK IF THESE OR OTHER CONDITIONS OCCUR THAT COULD SATURATE OR ERODE THE	HE SOIL	9.4. PLACE THE GEOGRID ON THE FACING UNIT AND LOCATE AS DI
	BEHIND THE WALL, OK IF THE FINISHING/LANDSCAPING ELEMENTS ARE NOT INSTALLED IMMEDIATELY FOLLOWING INSTALLATION OF THE RETAINING WALL BLOCKS.	G THE 3.9	9.5. PULL THE GEOGRID TAUT TO REMOVE SLACK IN THE GEOGRID
1.6.	COMPLY WITH ALL ASPECTS OF OSHA 1926 SUBPART P APP B, SLOPING AND BENCHING FOR ALL EXCAVATED SLOPES.	3.9	9.6. OVERLAP THE GEOGRID AS NECESSARY THROUGH RADII TO F
2. VE	RTI-BLOCK RETAINING WALL MATERIALS		IS REQUIRED FOR ADJACENT PARALLEL PANELS. WHERE G
2.1.	GEOGRID REINFORCEMENT CONSISTING OF MIRAFI 5XT, 8XT, AND 10XT, AS SPECIFIED ON THE GRID SCHEDULE ON SHEET 9.		BETWEEN GEOGRID LAYERS.
2.2.	REINFORCED BACKFILL CONSISTING OF NATIVE GRANULAR SOILS OR IMPORT MATERIALS COMPLYING WITH THE FOLLOWING CRITERIA:	. 3.10	D. PROVIDE A FINAL GRADE ABOVE AND BELOW THE RETAINING WA
2.2.1	GRANULAR MATERIALS CONTAINING LESS THAN 25% FINES AND A MAXIMUM NOMINAL PARTICLE SIZE OF 4 INCHES	3.11	. PROTECT FINAL COMPLETED RETAINING WALL FROM ADDITIONAL
2.2.2	PH GREATER THAN 3 BUT LESS THAN 9 AND PI OF 6 OR LESS	3.1	SPECIFIED ON THE DESIGN CRITERIA SHEET.
2.2.3	REASONABLY FREE FROM ORGANIC OR OTHER DELETERIOUS MATERIALS	4. (	CONSTRUCTION OBSERVATION
2.2.4	MINIMUM EFFECTIVE FRICTION ANGLE OF 36 DEGREES	4.1.	TO FULFILL ANY CITY, COUNTY AND/OR STATE AGENCY REQUIR
2.2.5	ANY STRUCTURAL FILL USED BELOW OR BEHIND THE RETAINING WALL SHALL BE TESTED FOR COMPLIANCE WITH THE SPECIFICA' ABOVE	ATIONS	INC. MUST PERFORM PERIODIC CONSTRUCTION OBSERVATIONS TO
2.3. 2.3.1	LEVELING PAD 6-INCHES MINIMUM OF CLEAN 1-INCH MINUS CRUSHED STONE OR CRUSHED GRAVEL.		WALL CONSTRUCTION WITH THE DESIGN CRITERIA AND REC THE PERIODIC CONSTRUCTION OBSERVATIONS OUTLINED BE
2.4.	USE NEW BLOCK MATERIALS MEETING THE MINIMUM REQUIREMENTS OF VERTI-BLOCK RETAINING WALL SYSTEMS (VERTI-CRETE, LLC).	. 42	THE RETAINING WALLS.
2.5.	FACING FILL AND DRAINAGE GRAVEL FILL	4.2.	WALL OBSERVATIONS SCHEDULE.
2.5.1	CLEAN CRUSHED STONE OR CRUSHED GRAVEL THAT COMPLIES WITH THE FOLLOWING CRITERIA:	4.2	2.1. OBSERVE THE EXCAVATION OF THE LEVELING FAD FOUNDATION OF THE DETAINING WALL BLOCK
2.5.	1.1. <u>SIEVE SIZE</u> <u>% PASSING</u>		4.2.2. ASSESS MINIMUM EMBEDMENT REQUIREMENTS
	1" 100	2	4.2.2.2. ASSESS DEPTH OF GRAVEL DRAINAGE ZONE AND TYPE, LO
	$\frac{3}{4}$ " 75-100	4	4.2.2.3. ASSESS BLOCK PLACEMENT AND POSITIONING FOR COMP
	$\frac{3}{8}$ " 0-15	4.2	2.3. OBSERVE THE INSTALLATION OF THE REINFORCED BACKFILL
	NO. 4 0-10	2	4.2.3.1. VERIFY THAT THE BACKFILL MATERIALS MEET THE REQU
	NO. 200 0-5	2	4.2.3.2. OBSERVED INSTALLATION OF GEOGRID REINFORCEMENT.
2.6.	4-INCH MINIMUM PERFORATED PIPE (NO SOCK IS REQUIRED).		4.2.3.2.1. ASSESS LOOSE LIFT THICKNESS, FILL PLACEMENT AN
3. VE	RTI-BLOCK RETAINING WALL INSTALLATION		4.2.3.2.2. ASSESS COMPACTED BACKFILL MATERIAL FOR COMP
3.1.	FIELD VERIFY PROPOSED FINISHED GRADE AT BOTTOM OF WALL TO PROVIDE THE MINIMUM WALL EMBEDMENT AS SHOWN ON THE SEC DRAWING.	ECTION 4.2	<ul><li>2.4. OBSERVE THE COMPLETED RETAINING WALL SYSTEM.</li><li>4.2.4.1. ASSESS THE FINISHED RETAINING WALL HEIGHT AND BAT</li></ul>
3.2.	GRADE AND COMPACT FOUNDATION SUBGRADE SOILS FOR THE FULL LENGTH OF THE LEVELING PAD AND UP TO THE SOIL CUT PRIC PLACEMENT OF THE LEVELING PAD AND ANY BACKFILL.	IOR TO	4.2.4.2. OBSERVE THAT BACKSLOPE AND TOESLOPE GRADING COL 4.2.4.3. ASSESS SUITABILITY OF EROSION CONTROL MEASURES IN
3.2.1	. REMOVE ANY FOUNDATION SOILS FOUND TO BE UNSUITABLE OR UNSTABLE AND REPLACED WITH APPROVED FILL DETAILED IN SECTIONS ABOVE.	IN THE	
3.3.	SET THE LEVELING PAD LEVEL SIDE TO SIDE AND FRONT TO BACK.		
3.3.1	INSTALL LEVELING PAD TO A MINIMUM OF 6 INCHES THICK AND EXTEND LATERALLY A MINIMUM OF 6 INCHES BEYOND THE ENDS O BLOCKS BOTH FRONT AND BACK AS SHOWN ON THE DRAWINGS.	OF THE	
1			
	12429 SOUTH 300 FAST	VERTI-B	LOCK RETAINING WALLS DESIGNED BY: LMP 9-15
	DRAPER, UTAH 84020	LEGAC WE	BER COUNTY, UTAH
REV	REVISION DESCRIPTION DATE BY CHK (801) 748-4044	•• L	APPROVED BY: LMP 9-15
	REVISIONS EST. 1998 CONS	ISTRUCTIC	ON SPECIFICATIONS & NOTES   IGES PROJECT NO: 03835_001   SHE

#### ALIGNMENT.

RTI-BLOCK GUIDELINES.

CH VERTI-BLOCK AND BETWEEN AND WITHIN THE BLOCKS AS EACH ROW OF S ARE ADDED, THE CONTRACTOR MUST ENSURE THAT ALL VOIDS ARE FILLED

NE AND SHALL SLOPE TO DAYLIGHT AND DISCHARGE AT THE LOW ENDS OF

MATERIALS FROM THE TOP OF THE BLOCKS BEFORE CONTINUING TO THE

SE LIFTS AND COMPACT TO A MINIMUM OF 95 PERCENT OF ASTM D-1557 HIEVE REQUIRED COMPACTION.

OOT INTERVALS ON EVERY LIFT.

IENT WITHIN 3 FEET OF THE BACK OF THE RETAINING WALL BLOCK.

ILL NOT BE PLACED UPON NATIVE SOILS, COMPACT THE FILL TO A MINIMUM 1557 (MODIFIED PROCTOR)

HE BASE ROW. POSITION BLOCKS TO BE OFFSET FROM SEAMS OF BLOCKS ON CK AND RECESSED OVER THE ALIGNMENT HOOP.

EVEL.

SE OF UNITS AS DESCRIBED IN NOTES 3.5 THROUGH 3.7.

TED ON THE ELEVATION AND SECTION VIEW DRAWINGS.

BEFORE INSTALLING THE NEXT COURSE OF UNITS OR PLACING GEOGRID

ENGTH SPECIFIED ON THE ELEVATION VIEW AND SECTION VIEW DRAWINGS. HINE DIRECTION) AND INSTALL IN PRIMARY STRENGTH DIRECTION.

ETAILED IN THE VERTI-BLOCK CONSTRUCTION MANUAL.

D PRIOR TO FILL PLACEMENT ON THE GEOGRID.

PROVIDE FULL COVERAGE FOR THE ENTIRE REQUIRED LENGTH. NO OVERLAP EOGRID IS OVERLAPPED, INSTALL A MINIMUM OF 3 INCHES OF BACKFILL

LL THAT WILL ALLOW FOR POSITIVE DRAINAGE AND PREVENT PONDING. L SITE CONSTRUCTION.

LS ABOVE THE WALL THAT EXCEED THE DESIGN SURCHARGE LOADS AS

REMENTS, AND TO PROTECT THE CONTRACTOR AND DESIGN ENGINEER, IGES, PROVIDE A FINAL CONSTRUCTION OBSERVATION LETTER.

URING CONSTRUCTION, A FINAL LETTER REGARDING COMPLIANCE OF THE COMMENDATIONS CANNOT BE PROVIDED. IF IGES, INC. DOES NOT PERFORM ELOW, THE WALL CONTRACTOR/OWNER ASSUMES ALL RESPONSIBILITY FOR

ION SOILS AND ASSESS THE SUITABILITY OF THE FOUNDATION SOILS. K AT VARIOUS STAGES OF CONSTRUCTION.

OCATION AND DIAMETER OF DRAINAGE PIPE.

LIANCE WITH THE REQUIREMENTS IN THE SECTIONS ABOVE. MATERIAL.

JIREMENTS SET FORTH IN THE SECTIONS ABOVE.

CHECK FOR TYPE, LENGTH, DIRECTION, AND ELEVATION.

ND COMPACTION.

PLIANCE WITH REQUIREMENTS SET FORTH IN THE SECTIONS ABOVE.

ΓTER.

NDITIONS DO NOT EXCEED DESIGN GEOMETRY TOLERANCES. ISTALLED ABOVE THE RETAINING WALL.

5-2021	PLOT S	CALE
5-2021	1=1	1
5-2021	DWG SO	CALE
5-2021	NT	S
EET NO:	10	REV N/A





SOIL CONDITIONS USED IN DESIGN (ASSUMED)									
EARTH MATERIALS FRICTION ANGLE COHESION UNIT WEIGHT									
BACKFILL SOIL	36°	0 PSF	135 PCF						
RETAINED/ FOUNDATION SOIL	36°	100 PSF	130 PCF						

SOURCES & NOTES:

SOILS STRENGTHS ARE ASSUMED TO BE SIMILAR TO THE GENEVA ROCK SAMPLE PROVIDED TO IGES (SAMPLE NO. 1599710355, PLANT 75-2000-GREENFIELD). IF DURING CONSTRUCTION THE SOILS APPEAR TO BE SIGNIFICANTLY DIFFERENT THAN THE PROVIDED SAMPLE, IGES SHOULD BE CONTACTED TO EVALUATE THE SOILS AND MAKE ANY NECESSARY CHANGES TO THE ENGINEERING PRESENTED HEREIN.

<b>RETAINING WALL ANALYSIS USED IN DESIGN</b>						
ANALYSIS	DESIGN REFERENCES/SOFTWARE					
INTERNAL/EXTERNAL STABILITY	VERTI-BLOCK RETAINING WALLS, 2019 VERTICRETE WALL DESIGNER SOFTWARE, VERSION 5.0.19105.1600, BUILD DATE APRIL 15, 2019, AUTHOR - ROBERT RACE					
GLOBAL STABILITY	SLIDE 2: ROCSCIENCE, INC., 1998-2021, VERSION 9.018, BUILD DATE JUNE 26, 2021					

#### GENERAL NOTES:

REV

- THE ENGINEERING PRESENTED IN THIS DESIGN PACKAGE IS BASED ON SPECIFIC PRODUCTS (E.G. VERTI-BLOCKS, MIRAFI 5XT, MIRAFI 8XT, AND MIRAFI 10XT GEOGRID, FILL MATERIAL, ETC.). ANY SUBSTITUTION OF THE SPECIFIED PRODUCTS WILL INVALIDATE THIS ENGINEERING. ANY CHANGES IN WALL LOCATION, ELEVATIONS OF LEVELING PAD, GRADES AT THE TOE OR TOP OF THE WALL, AND SOIL PARAMETERS AT THE SITE WILL ALSO INVALIDATE THE ENGINEERING. FIELD ADJUSTMENTS/CHANGES MAY BE NEEDED TO MEET ACTUAL CONDITIONS ONCE CONSTRUCTION COMMENCES. IGES SHOULD BE CONSULTED WHERE FIELD CHANGES ARE REQUIRED.
- 2. THESE DOCUMENTS ARE INSTRUMENTS OF SERVICE AND SHALL REMAIN THE INTELLECTUAL PROPERTY OF IGES, INC. THE DESIGN PACKAGE HAS BEEN FURNISHED FOR THIS SPECIFIC PROJECT ONLY. ANY PARTY ACCEPTING THIS DOCUMENT DOES SO IN CONFIDENCE AND AGREES THAT NO USE OR RE-USE OF THESE DOCUMENTS (EITHER IN WHOLE OR IN PART) SHALL BE PERMITTED UNLESS EXPRESSLY AUTHORIZED IN WRITING BY IGES, INC.
- RETAINING WALLS ARE VULNERABLE TO EROSION AND HYDROSTATIC PRESSURES IMMEDIATELY AFTER INSTALLATION BUT 3. PRIOR TO THE PLACEMENT OF LANDSCAPING/FINISHING ELEMENTS AT THE SITE (E.G. LANDSCAPING, HARDSCAPE, CURB & GUTTER, PAVEMENT, ETC.). TO PREVENT DAMAGE TO THE WALL DURING ADDITIONAL SITE WORK, ALL SURFACE DRAINAGE SHOULD BE DIRECTED AWAY FROM THE WALL. EXCESS WATER DURING HEAVY RAIN EVENTS, IF NOT DRAINED PROPERLY, CAN CAUSE WASHOUTS AT WALL ENDS AND 'BLOWOUTS' OF INTERIOR SECTIONS. THESE PRECAUTIONS SHOULD BE TAKEN DURING WALL CONSTRUCTION, AND AFTER, UNTIL THE FINAL SITE DRAINAGE, LANDSCAPING AND PAVING ARE COMPLETE.
- 4. MINIMUM EMBEDMENT AT THE WALL TOE OF THE WALL MUST BE MAINTAINED THROUGHOUT THE LIFE OF THE RETAINING WALL.

DATE BY CHR

SEISMIC PARAMETERS USED IN DESIGN										
SEISMIC CRITERIA	MCE <sub>G</sub> PGA	SITE CLASS	F <sub>PGA</sub>	PGA <sub>M</sub>	MSE HORIZONTAL COEFFICIENTS (k)	GRAVITY HORIZONTAL COEFFICIENT (k <sub>h</sub> )	GLOBAL HORIZONTAL COEFFICIENT (k <sub>b</sub> )			
ASCE 7-16	0.386g	D	1.10	0.469g	0.078g (EXTERNAL) 0.201g (INTERNAL)	0.062g (EXTERNAL)	0.234g (GLOBAL)			

SOURCES & NOTES:

- SEISMIC PARAMETERS DEVELOPED FOLLOWING THE CRITERIA OUTLINED IN ASCE 7-16. THE ASCE 7 HAZARD 1 PEAK GROUND ACCELERATION WAS ADJUSTED FOR SITE CLASS EFFECTS (PGAM). 2. HORIZONTAL SEISMIC COEFFICIENT  $(k_h)$
- 2.1. TO DETERMINE THE EXTERNAL SEISMIC COEFFICIENT (k<sub>h-ext</sub>), THE BRAY ET AL (2010) METHODOLOGY WAS APPLIED. (SEE SECTION 4).
- 2.1.1. SECTIONS FOR BOTH GRAVITY AND MSE WALL CONDITIONS.
- 2.1.2. FOR THE WALLS ON THIS PROJECT.
- 2.1.3. AND 6 INCHES WHICH IS WITHIN THE TOLERABLE LIMITS FOR THIS WALL TYPE.
- TO DETERMINE THE INTERNAL COEFFICIENT (kh-int), THE FOLLOWING METHODOLOGY WAS USED: 2.2
- 2.2.1. DETERMINE k<sub>h-ext</sub> USING THE BRAY ET AL (2010) METHODOLOGY
- CALCULATE AN EQUIVALENT PEAK GROUND ACCELERATION (PGA<sub>EQ</sub>) [PGA<sub>EQ</sub> =  $(k_{h-ext})*2$ ] APPLY THE STANDARD INTERNAL COEFFICIENT EQUATION TO THE PGA<sub>EQ</sub>: 2.2.2. 2.2.3.
- 2.2.3.1.  $(k_{h-internal}) = (1.45-PGA_{EQ})*PGA_{EQ}$ SEISMIC GLOBAL STABILITY WAS ASSESSED USING A PSEUDO-STATIC APPROACH. A SEISMIC COEFFICIENT  $(k_h)$ 3.
- 3.1. LACKING ANY CRITICAL STRUCTURES OF FACILITIES WITHIN THE ASSUMED SLIDE MASS (I.E. PLAYGROUND/YARD), A THRESHOLD DISPLACEMENT OF 15 CM WAS CONSIDERED ACCEPTABLE.
- 4. REFERENCES
- 4.1. RESEARCH PROGRAM (NCHRP) REPORT 611.
- 4.2. EARTHQUAKE CENTER (SCEC), DATED JUNE 2002.
- 4.3. ENGINEERS, RESTION, VA, pp. 638-655.
- SEISMIC SLOPE STABILITY, IN EARTHQUAKE SPECTRA, 19(3), 697-712.

VERTI-BLOCK RETAINING WALLS	DESIGNED BY: LMP
LEGACY MOUNTAIN ESTATES	DRAWN BY: LMP
WEBER COUNTY LITAH	CHECKED BY: BMJ
WEDER COONTT, OTAIT	APPROVED BY: LMP
DECICN CRITERIA	IGES PROJECT NO:
DESIGN CRITERIA	03835-0

12429 SOUTH 300 EAST

DRAPER, UTAH 84020

(801) 748-4044

**REVISION DESCRIPTION** REVISIONS TOOL WAS USED TO DETERMINE THE MAPPED MCE<sub>G</sub> PEAK GROUND ACCELERATION (MCE<sub>G</sub> PGA) FOR THE SITE. SITE CLASS IS A PARAMETER THAT ACCOUNTS FOR SITE AMPLIFICATION EFFECTS OF SOFT SOILS AND IS BASED ON THE AVERAGE SHEAR WAVE VELOCITY OF THE UPPER 100 FEET. BASED ON OUR ENGINEERING JUDGEMENT, THE SITE SOIL CLASS IS REPRESENTED BY A SITE CLASS D. USING A SITE CLASS D, THE  $MCE_G$ 

THIS METHODOLOGY ACCOUNTS FOR THE HEIGHT OF THE WALLS. AS THERE ARE VARIOUS HEIGHTS THROUGHOUT THE PROJECT, SEISMIC VALUES WERE DETERMINED BASED ON THE TALLEST

LACKING ANY CRITICAL STRUCTURES OF FACILITIES WITHIN THE INFLUENCE ZONE OF THE WALLS, AN ALLOWABLE DISPLACEMENT OF 15 CENTIMETERS (~6 INCHES) WAS CONSIDERED ACCEPTABLE

THE BRAY METHOD WAS ALSO COUPLED WITH A NEWMARK DISPLACEMENT BLOCK MODEL TO ESTIMATE DISPLACEMENT FOR THE WALLS (SEE SECTION 4 FOR RESULTS). BASED ON OUR ANALYSIS, WE ESTIMATE THAT THE ANTICIPATED MEAN DISPLACEMENT FOR THE WALLS WILL BE BETWEEN 3

WAS SELECTED USING THE GUIDELINES PRESENTED IN BLAKE AND OTHERS (2002) WHICH RECOMMENDS A SEISMIC SCREENING COEFFICIENT BE OBTAINED USING THE STEWART AND OTHERS (2003) METHODOLOGY.

ANDERSON, D.G., MARTIN, G.R., LAM, I., WANG, J.N., 2008, SEISMIC ANALYSIS AND DESIGN OF RETAINING WALLS, BURIED STRUCTURES, SLOPES, AND EMBANKMENTS, NATIONAL COOPERATIVE HIGHWAY

BLAKE, T.F., HOLLINGSWORTH, R.A., AND STEWART, J.P. (EDITORS), 2002, "RECOMMENDED PROCEDURES FOR IMPLEMENTATION OF DMG SPECIAL PUBLICATION 117 GUIDELINES FOR ANALYZING AND MITIGATING LANDSLIDE HAZARDS IN CALIFORNIA," PUBLISHED BY SOUTHERN CALIFORNIA

BRAY, J.D., TRAVASAROU, T., AND ZUPAN, J., 2010, SEISMIC DISPLACEMENT DESIGN OF EARTH RETAINING STRUCTURES, ASCE EARTH RETENTION CONFERENCE 3, BELLEVUE, WA. AMERICAN SOCIETY OF CIVIL

STEWART, J.P., BLAKE, T.F., AND HOLLINGSWORTH, R.A., 2003, A SCREEN ANALYSIS PROCEDURE FOR

5-2021	PLOT S	CALE
5-2021	1=1	1
5-2021	DWG SO	CALE
5-2021	NT	S
EET NO:	12	REV N/A

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# **SECTION 4**





Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 10B (20')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	36 deg	0psf	135pcf
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	d Stone		

#### GEOMETRY

Shear:

Design Height:	20.00ft (18.00ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	2.00ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single De	pth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (St	atic / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



,			
FoS Sliding:	3.35 / [2.46 ]	FoS Overturning:	4.45
Bearing	3,240 / [ 3,276 ]	FoS Bearing:	17.3
Pullout	1.50		
Total Pullout	54,621	FoS Total Pullout	9.66
Total Pullout (S)	54,621	FoS Total Pullout (S)	9.66
Top FoSot:	27.27	FoS Connection:	2.37
Ht I noth Geogrid To th	Ta tasl Dc % TMax ITma	1 Tal/ES Isais1 ES Tal Is	

Top FoSot:		t:	27.27		F	FoS Connection: 2.37						
ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
5	18.00	14.00	SG600	3954 [6128]	100	306 [383]	2636 [5571]	12.92 [8.89]	2209 [3012]	10.83 [4.81]	3.45 [1.53]	30.99 [21.88]
4	14.00	12.00	SG600	3954 [6128]	100	918 [383]	2636 [5571]	4.31 [4.71]	2280 [3108]	3.72 [2.63]	2.20 [1.55]	13.94 [9.37]
3	10.00	12.00	SG600	3954 [6128]	100	1426 [383]	2636 [5571]	2.77 [3.39]	2350 [3205]	2.47 [1.95]	5.52 [4.35]	8.05 [5.99]
2	6.00	12.00	SG600	3954 [6128]	100	1787 [383]	2636 [5571]	2.21 [2.82]	2421 [3301]	2.03 [1.67]	9.13 [7.52]	5.67 [4.31]
1	2.00	12.00	SG600	3954 [6128]	100	1576 [383]	2636 [5571]	2.51 [3.13]	2491 [3397]	2.37 [1.91]	17.36 [13.96]	4.41 [3.38]
	lumn	Dooo	rintiono		-		-					

4.45 / [3.10]

17.37 / [ 17.18 ]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (Pql) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 10B (19')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

	Design Height:	19.00ft (17.10ft Exp.)	Live Load:	250psf
	Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
	Embedment:	1.90ft	LL2 Width:	25ft
	Leveling Pad Depth:	0.50ft	Dead Load:	0psf
	Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
	Slope Length:	8.0ft	Dead Load Width:	Oft
	Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth			Toe Slope Angle:	18.40
			Toe Slope Length:	100.00
			Toe Slope Bench:	2.00
FA	CTORS OF SAFETY (St	atic / Seismic)		
	Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
	Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
	Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10
	Shear:	1.50 / 1.10	Bending:	1.50 / 1.10





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FoS Sliding:	3.40 / [2.47 ]	FoS Overturning:	4.48
Bearing	3,105 / [ 3,143 ]	FoS Bearing:	17.3
Pullout	1.50		
Total Pullout	49,047	FoS Total Pullout	9.54
Total Pullout (S)	49,047	FoS Total Pullout (S)	9.54
Top FoSot:	151.76	FoS Connection:	1.78
114 Luceth Cooperial To the C	To the of De O/ This / This	1 Tal/EC Isaial EC Tal Is	

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
5	18.00	13.00	SG500	2780 [4310]	100	172 [356]	1854 [3918]	16.15 [8.16]	1591 [2169]	13.86 [4.52]	4.32 [1.41]	46.35 [30.02]
4	14.00	11.50	SG500	2780 [4310]	100	765 [356]	1854 [3918]	3.63 [3.84]	1644 [2241]	3.22 [2.20]	2.68 [1.83]	17.15 [11.63]
3	10.00	11.50	SG500	2780 [4310]	100	1324 [356]	1854 [3918]	2.10 [2.57]	1697 [2313]	1.92 [1.52]	5.39 [4.25]	9.01 [6.61]
2	6.00	11.50	SG500	2780 [4310]	100	1705 [356]	1854 [3918]	1.63 [2.09]	1749 [2386]	1.54 [1.27]	8.57 [7.09]	6.07 [4.56]
1	2.00	11.50	SG500	2780 [4310]	100	1516 [356]	1854 [3918]	1.83 [2.30]	1802 [2458]	1.78 [1.44]	16.16 [13.08]	4.60 [3.48]
$\overline{\mathbf{c}}$	Alumn Descriptions:											

4.48 / [3.09] 17.37 / [ 17.17 ]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (Pql) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 9B (18')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

Shear:

Design Height:	18.00ft (16.20ft Exp	o.) Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.80ft	LL2 Width:	25ft
Leveling Pad De	epth: 0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offse	t: 0.0ft		
Vertical δ on Sir	ngle Depth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFI	ETY (Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.10 1.10

1.50 / 1.10

Bending:



	FoS Sliding:	3.37 / [2.42 ]	FoS Overturning:	4.45 / [3.03 ]
	Bearing	2,894 / [ 2,933 ]	FoS Bearing:	17.84 / [ 17.60 ]
	Pullout	1.50		
	Total Pullout	41,221	FoS Total Pullout	8.85
	Total Pullout (S)	41,221	FoS Total Pullout (S)	8.85
	Top FoSot:	7.87	FoS Connection:	1.84
10	114 Lucath Occasivial To to F			

ID	Ht Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
4	14.00	11.50	SG500	2780 [4310]	100	689 [404]	1854 [3918]	4.04 [3.95]	1623 [2213]	3.54 [2.23]	2.64 [1.66]	20.54 [14.35]
3	10.00	11.00	SG500	2780 [4310]	100	1205 [404]	1854 [3918]	2.31 [2.68]	1676 [2285]	2.09 [1.56]	4.59 [3.44]	9.77 [7.13]
2	6.00	11.00	SG500	2780 [4310]	100	1621 [404]	1854 [3918]	1.72 [2.13]	1729 [2357]	1.60 [1.28]	7.61 [6.09]	6.30 [4.72]
1	2.00	11.00	SG500	2780 [4310]	100	1455 [404]	1854 [3918]	1.91 [2.32]	1782 [2429]	1.84 [1.44]	14.80 [11.58]	4.67 [3.57]
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Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 9B (17')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y			
Reinforced Soil:	36 deg	0psf	135pcf			
Retained Soil:	36 deg	0psf	130pcf			
Foundation Soil:	36 deg	50psf	130pcf			
Leveling Pad: Crushed Stone						

#### GEOMETRY

Shear:

Design Height:	17.00ft (15.30ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.70ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	tatic / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



- ( )			
FoS Sliding:	3.42 / [2.43 ]	FoS Overturning:	4.50 / [3.03 ]
Bearing	2,760 / [ 2,799 ]	FoS Bearing:	17.86 / [ 17.61 ]
Pullout	1.50		
Total Pullout	34,118	FoS Total Pullout	8.20
Total Pullout (S)	34,118	FoS Total Pullout (S)	8.20
Top FoSot:	15.85	FoS Connection:	1.91
Ht Logth Coogrid To the	To that Do 9/ TMay ITm	Tol/ES Ingint ES Tol In	aial RkCn Isaial RkCn/E

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
4	14.00	11.00	SG500	2780 [4310]	100	478 [373]	1854 [3918]	5.81 [5.07]	1617 [2205]	5.07 [2.85]	2.07 [1.17]	25.37 [17.81]
3	10.00	10.50	SG500	2780 [4310]	100	1069 [373]	1854 [3918]	2.60 [2.99]	1670 [2277]	2.34 [1.74]	3.86 [2.86]	11.29 [8.13]
2	6.00	10.50	SG500	2780 [4310]	100	1532 [373]	1854 [3918]	1.82 [2.26]	1723 [2350]	1.69 [1.36]	6.69 [5.38]	6.77 [5.01]
1	2.00	10.50	SG500	2780 [4310]	100	1392 [373]	1854 [3918]	2.00 [2.44]	1776 [2422]	1.91 [1.51]	13.47 [10.63]	4.88 [3.69]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 8B (16')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

Shear:

Design Height:	16.00ft (14.40ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.60ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	tatic / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



<b>`</b>	/		
FoS Sliding:	3.35 / [2.44 ]	FoS Overturning:	4.51 / [3.12 ]
Bearing	2,551 / [ 2,581 ]	FoS Bearing:	18.42 / [ 18.20 ]
Pullout	1.50		
Total Pullout	27,700	FoS Total Pullout	7.46
Total Pullout (S)	27,700	FoS Total Pullout (S	) 7.46
Top FoSot:	25.23	FoS Connection:	1.98
Ht I nath Geogrid Ta th	[Ta ths] Rc % TMay [Tm	dl Tal/ES [sais] ES Tal [	saist PkCn [saist PkCn

ID	Ht Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
4	14.00	11.50	SG500	2780 [4310]	100	306 [334]	1854 [3918]	9.09 [6.73]	1596 [2177]	7.82 [3.74]	3.37 [1.61]	30.97 [21.99]
3	10.00	10.00	SG500	2780 [4310]	100	918 [334]	1854 [3918]	3.03 [3.44]	1649 [2249]	2.69 [1.98]	2.78 [2.04]	13.04 [8.67]
2	6.00	10.00	SG500	2780 [4310]	100	1430 [334]	1854 [3918]	1.94 [2.44]	1702 [2321]	1.78 [1.45]	5.63 [4.57]	7.11 [5.24]
1	2.00	10.00	SG500	2780 [4310]	100	1327 [334]	1854 [3918]	2.09 [2.59]	1755 [2393]	1.98 [1.58]	12.10 [9.66]	4.93 [3.71]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 8B (15')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

Shear:

	Design Height:	15.00ft (13.50ft Exp.)	Live Load:	250psf
	Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
	Embedment:	1.50ft	LL2 Width:	25ft
	Leveling Pad Depth:	0.50ft	Dead Load:	0psf
	Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
	Slope Length:	8.0ft	Dead Load Width:	Oft
	Slope Toe Offset:	0.0ft		
Vertical δ on Single Depth		oth	Toe Slope Angle:	18.40
			Toe Slope Length:	100.00
			Toe Slope Bench:	2.00
FA	CTORS OF SAFETY (St	atic / Seismic)		
	Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
	Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
	Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.50 / 1.10

Bending:



	FoS Sliding:	3.25 / [2.33 ]	FoS Overturning:	4.29 / [2.88 ]	
	Bearing	2,415 / [ 2,450 ]	FoS Bearing:	17.74 / [ 17.48 ]	
	Pullout	1.50	-		-
	Total Pullout	19,218	FoS Total Pullout	6.01	
	Total Pullout (S)	19,218	FoS Total Pullout (S)	6.01	
	Top FoSot:	5.57	FoS Connection:	2.07	
ID	Ht Lnath Geogrid Ta th	ITa_tns1 Rc % TMax ITm	nd1 Tal/FS [seis1 FS Tal ]	seist PkCn [seist	PkCn/FS

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
3	10.00	9.50	SG500	2780 [4310]	100	937 [408]	1854 [3918]	2.97 [3.20]	1644 [2241]	2.63 [1.83]	1.67 [1.16]	15.37 [10.43]
2	6.00	9.00	SG500	2780 [4310]	100	1324 [408]	1854 [3918]	2.10 [2.49]	1697 [2313]	1.92 [1.47]	4.04 [3.09]	7.89 [5.64]
1	2.00	9.00	SG500	2780 [4310]	100	1266 [408]	1854 [3918]	2.20 [2.58]	1749 [2386]	2.07 [1.57]	9.72 [7.35]	5.10 [3.74]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 7B (14')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	36 deg	0psf	135pcf
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	Stone		

#### GEOMETRY

Shear:

Design Height:	14.00ft (12.60ft Exp	.) Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.40ft	LL2 Width:	25ft
Leveling Pad De	epth: 0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offse	t: 0.0ft		
Vertical δ on Sir	ngle Depth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFI	ETY (Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.50 / 1.10

Bending:



	FoS Sliding:	3.18 / [2.30 ]	FoS Overturning:	4.29 / [2.98 ]
	Bearing	2,201 / [ 2,236 ]	FoS Bearing:	18.41 / [ 18.12 ]
	Pullout	1.50		
	Total Pullout	15,539	FoS Total Pullout	5.56
	Total Pullout (S)	15,539	FoS Total Pullout (S)	5.56
	Top FoSot:	7.27	FoS Connection:	2.17
חו	Ht I nath Geogrid Ta th	Ta tasl Rc % TMay ITa	dl Tal/ES Ispisl ES Tal I	Saist PkCn [saist PkC

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
3	10.00	9.50	SG500	2780 [4310]	100	689 [361]	1854 [3918]	4.04 [4.11]	1623 [2213]	3.54 [2.32]	1.99 [1.30]	17.78 [12.49]
2	6.00	8.50	SG500	2780 [4310]	100	1205 [361]	1854 [3918]	2.31 [2.75]	1676 [2285]	2.09 [1.60]	3.28 [2.52]	8.67 [6.16]
1	2.00	8.50	SG500	2780 [4310]	100	1194 [361]	1854 [3918]	2.33 [2.77]	1729 [2357]	2.17 [1.67]	8.56 [6.57]	5.23 [3.82]

**Column Descriptions:** 

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 7B (13')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y
Reinforced Soil:	36 deg	0psf	135pcf
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	I Stone		

#### GEOMETRY

Shear:

Design Height:	13.00ft (11.70ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.30ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single De	epth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.50 / 1.10

Bending:



		•		
	FoS Sliding:	3.23 / [2.32 ]	FoS Overturning:	4.43 / [3.03 ]
	Bearing	2,073 / [ 2,109 ]	FoS Bearing:	18.42 / [ 18.11 ]
	Pullout	1.50		
	Total Pullout	11,692	FoS Total Pullout	4.99
	Total Pullout (S)	11,692	FoS Total Pullout (S)	4.99
	Top FoSot:	14.62	FoS Connection:	2.31
ID	Ht Lngth Geogrid Ta th	[Ta_tns] Rc % TMax [Trr	nd] Tal/FS [seis] FS Tal	seis]   PkCn [seis]   Pl

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
3	10.00	9.50	SG500	2780 [4310]	100	478 [340]	1854 [3918]	5.81 [5.27]	1617 [2205]	5.07 [2.96]	1.96 [1.14]	22.29 [15.91]
2	6.00	8.00	SG500	2780 [4310]	100	1069 [340]	1854 [3918]	2.60 [3.06]	1670 [2277]	2.34 [1.78]	2.37 [1.80]	9.93 [7.00]
1	2.00	8.00	SG500	2780 [4310]	100	1119 [340]	1854 [3918]	2.49 [2.95]	1723 [2350]	2.31 [1.77]	7.35 [5.64]	5.66 [4.08]
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Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 6B (12')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

Shear:

Design Height:	12.00ft (10.80ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	1.20ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single D	epth	Toe Slope Angle:	18.40
-		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (	Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.50 / 1.10

Bending:



	FoS Slidina:	3.17 / [2.25]	FoS Overturning:	4,47 / [3,01 ]
	Bearing	1,855 / [ 1,89	2   FoS Bearing:	19.34 / [ 18.96 ]
	Pullout	1.50		
	Total Pullout	8,849	FoS Total Pullout	4.49
	Total Pullout (S)	8,849	FoS Total Pullout (S	6) 4.49
	Top FoSot:	23.17	FoS Connection:	2.46
ID	Ht Lngth Geogrid	Ta tn [Ta tns] Rc %	TMax [Tmd]   Tal/FS [seis]   FS Tal	[seis]   PkCn [seis]   PkCn/FS [s

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
3	10.00	9.50	SG500	2780 [4310]	100	306 [296]	1854 [3918]	9.09 [7.16]	1596 [2177]	7.82 [3.98]	2.55 [1.30]	27.77 [20.10]
2	6.00	7.50	SG500	2780 [4310]	100	918 [296]	1854 [3918]	3.03 [3.55]	1649 [2249]	2.69 [2.04]	1.69 [1.28]	11.07 [7.38]
1	2.00	7.50	SG500	2780 [4310]	100	1038 [296]	1854 [3918]	2.68 [3.23]	1702 [2321]	2.46 [1.91]	6.28 [4.89]	5.95 [4.25]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 6B (11')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ	
Reinforced Soil:	36 deg	0psf	135pcf	
Retained Soil:	36 deg	0psf	130pcf	
Foundation Soil:	36 deg	50psf	130pcf	
Leveling Pad: Crushed Stone				

#### GEOMETRY

Shear:

	Design Height:	11.00ft (9.90ft Exp.)	Live Load:	250psf
	Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
	Embedment:	1.10ft	LL2 Width:	25ft
	Leveling Pad Depth:	0.50ft	Dead Load:	0psf
	Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
	Slope Length:	8.0ft	Dead Load Width:	Oft
	Slope Toe Offset:	0.0ft		
	Vertical $\delta$ on Single Dep	oth	Toe Slope Angle:	18.40
			Toe Slope Length:	100.00
			Toe Slope Bench:	2.00
FA	CTORS OF SAFETY (St	atic / Seismic)		
	Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
	Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
	Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



1.10 1.10

1.50 / 1.10

Bending:



	FoS Sliding:	3.27 / [2.28 ]	FoS Overturning:	4.72 / [3.08 ]	
	Bearing	1,729 / [ 1,767 ]	FoS Bearing:	19.41 / [ 18.99 ]	
	Pullout	1.50			
	Total Pullout	6,735	FoS Total Pullout	4.24	
	Total Pullout (S)	6,735	FoS Total Pullout (S	) 4.24	
	Top FoSot:	5.12	FoS Connection:	2.68	
חו	Ht I nath Geogrid Ta t	n [Ta ths] Rc % TMay [Tr	nd1 Tal/ES Iseis1 ES Tal	[seis] PkCn [seis]	PkCn

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
2	6.00	8.00	SG500	2780 [4310]	100	937 [396]	1854 [3918]	2.97 [3.23]	1644 [2241]	2.63 [1.85]	1.93 [1.36]	13.16 [9.09]
1	2.00	7.00	SG500	2780 [4310]	100	950 [396]	1854 [3918]	2.93 [3.20]	1697 [2313]	2.68 [1.89]	5.19 [3.66]	6.67 [4.72]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 5B (10')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

	Design Height:	10.00ft (9.00ft Exp.)	Live Load:	250psf
	Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
	Embedment:	1.00ft	LL2 Width:	25ft
	Leveling Pad Depth:	0.50ft	Dead Load:	0psf
	Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
	Slope Length:	8.0ft	Dead Load Width:	Oft
	Slope Toe Offset:	0.0ft		
	Vertical δ on Single Dep	oth	Toe Slope Angle:	18.40
			Toe Slope Length:	100.00
			Toe Slope Bench:	2.00
FA	CTORS OF SAFETY (St	atic / Seismic)		
	Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
	Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
	Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10
	Shear:	1.50 / 1.10	Bending:	1.50 / 1.10





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#### RESULTS (Static / Seismic)

FoS Sliding:	3.03 / [2.03 ]	FoS Overturning:	4.37 / [2.67 ]
Bearing	1,495 / [ 1,541 ]	FoS Bearing:	19.66 / [ 19.07
Pullout	1.50		
Total Pullout	4,129	FoS Total Pullout	3.42
Total Pullout (S)	4,129	FoS Total Pullout (S)	3.42
Top FoSot:	6.63	FoS Connection:	1.71
Ht Lnoth Cooperid To the	To that Do 9/ They ITm	dl Tol/ES Ingial ES Tol I	agial DkCn Ingial

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
2	6.00	8.00	SG200	1564 [2424]	100	689 [341]	1043 [2204]	2.27 [2.36]	947 [1292]	2.06 [1.38]	2.04 [1.36]	15.24 [10.98]
1	2.00	6.00	SG200	1564 [2424]	100	854 [341]	1043 [2204]	1.83 [2.03]	975 [1330]	1.71 [1.22]	3.19 [2.28]	6.99 [4.86]
-												

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (Pql) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Legacy Mountain Estates
Weber County, Utah
LMP
9/15/2021
Wall 1, MSE 5B (9')
NCMA_09_3rd_Ed, Include Vert. Force
VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y
Reinforced Soil:	36 deg	0psf	135pcf
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	I Stone		

#### GEOMETRY

Shear:

Design Height:	9.00ft (8.10ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	0.90ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single De	epth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



	FoS Sliding:	3.12 / [2.08 ]	FoS Overturning:	4.58 / [2.78 ]
	Bearing	1,381 / [ 1,423 ]	FoS Bearing:	19.61 / [ 19.03 ]
	Pullout	1.50		
	Total Pullout	2,696	FoS Total Pullout	3.16
	Total Pullout (S)	2,696	FoS Total Pullout (S	S) 3.16
	Top FoSot:	13.36	FoS Connection:	1.96
חו	Ht I nath Geogrid Ta	tn ITa tnsl Rc % TMay I	Imdi Tal/ES Isaisi ES Tal	[sais] PkCn [sais] PkCn/

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
2	6.00	8.00	SG200	1564 [2424]	100	478 [296]	1043 [2204]	3.27 [3.13]	944 [1288]	2.96 [1.83]	2.19 [1.35]	19.55 [14.38]
1	2.00	5.50	SG200	1564 [2424]	100	746 [296]	1043 [2204]	2.10 [2.33]	972 [1326]	1.96 [1.40]	2.21 [1.58]	8.20 [5.61]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 4B (8')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	γ
Reinforced Soil:	36 deg	0psf	135pcf
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	Stone		

#### GEOMETRY

Shear:

Design Height:	8.00ft (7.20ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	0.80ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single De	epth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



FoS Sliding:	3.19 / [2.14 ]	FoS Overturning:	5.14 / [3.19]	
Bearing	1,167 / [ 1,199 ]	FoS Bearing:	22.79 / [ 22.17 ]	
Pullout	1.50			ĺ
Total Pullout	2,288	FoS Total Pullout	3.29	1
Total Pullout (S)	2,288	FoS Total Pullout (S)	3.29	
Top FoSot:	21.01	FoS Connection:	2.28	
Ht Lnath Geogrid Ta th	ITa tasl Rc % TMay ITm	dl Tal/ES Isaisl ES Tal I	spiel PkCn [spiel PkCn/ES [sp	aie1

ID	Ht	Lngth	Geogrid	Ta_tn [Ta_tns]	Rc %	TMax [Tmd]	Tal/FS [seis]	FS Tal [seis]	PkCn [seis]	PkCn/FS [seis]	FS PO	FS Sldg
2	6.00	8.00	SG200	1564 [2424]	100	306 [239]	1043 [2204]	5.11 [4.45]	933 [1272]	4.57 [2.57]	2.76 [1.55]	24.86 [18.87]
1	2.00	5.50	SG200	1564 [2424]	100	631 [239]	1043 [2204]	2.48 [2.79]	961 [1311]	2.28 [1.66]	2.28 [1.66]	9.18 [6.46]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, MSE 4B (7')
Design Method:	NCMA_09_3rd_Ed, Include Vert. Force
Design Unit:	VertiBlock

Seismic Acc: 0.156

SOIL PARAMETERS	φ	coh	Y		
Reinforced Soil:	36 deg	0psf	135pcf		
Retained Soil:	36 deg	0psf	130pcf		
Foundation Soil:	36 deg	50psf	130pcf		
Leveling Pad: Crushed Stone					

#### GEOMETRY

Shear:

Design Height:	7.00ft (6.30ft Exp.)	Live Load:	250psf
Wall Batter/Tilt:	5.20/ 0.00 deg	Live Load Offset:	13.00ft
Embedment:	0.70ft	LL2 Width:	25ft
Leveling Pad Depth:	0.50ft	Dead Load:	0psf
Slope Angle:	26.6 deg	Dead Load Offset:	0.0ft
Slope Length:	8.0ft	Dead Load Width:	Oft
Slope Toe Offset:	0.0ft		
Vertical δ on Single D	epth	Toe Slope Angle:	18.40
		Toe Slope Length:	100.00
		Toe Slope Bench:	2.00
FACTORS OF SAFETY (S	Static / Seismic)		
Sliding:	1.50 / 1.10	Pullout:	1.50 / 1.10
Overturning:	2.00 / 1.50	Uncertainties:	1.50 / 1.10
Bearing:	2.00 / 1.50	Connection:	1.50 / 1.10

1.50 / 1.10



Bending:

1.50 / 1.10



FoS Sliding:	3.79 / [2.58 ]	FoS Overturning:	7.00
Bearing	1,074 / [ 1,095 ]	FoS Bearing:	26.0
Pullout	1.50		
Total Pullout	1,669	FoS Total Pullout	3.51
Total Pullout (S)	1,669	FoS Total Pullout (S)	3.51
Top FoSot:	5.95	FoS Connection:	2.09

ID Ht Lngth Geogrid Ta\_tn [Ta\_tns] Rc % TMax [Tmd] Tal/FS [seis] FS Tal [seis] PkCn [seis] PkCn/FS [seis] FS PO FS Sldg 1 2.00 6.00 SG200 1564 [2424] 689 [405] 1043 [2204] 2.27 [2.22] 958 [1307] 100 2.09 [1.31] 2.42 [1.53] 11.14 [7.85]

7.00 / [4.56]

2.09

26.00 / [ 25.50 ]

Column Descriptions:

Ta: allowable geogrid strength

Rc %: percent coverage for geosynthetics

EP (Pa) internal active earth pressure

LL (PqI) earth pressure due to live load surcharge

DL (Pqd) earth pressure due to dead load surcharge

Tmax maximum earth pressure on geosynthetic layer

FSstr factor of safety on geogrid strength (Ta/Tmax)

Ta cn allowable tension on the connection

FS Pkcn, factor of safety on the connection (Ta cn/Tmax)

FS PO, factor of safety on pullout (Ta pullout/(Tmax - LL)



Project:	Legacy Mountain Estates
Location:	Weber County, Utah
Designer:	LMP
Date:	9/15/2021
Section:	Wall 1, Gravity 6B (12')
Design Method:	NCMA_09_3rd_Ed
Design Unit:	VertiBlock
Seismic Acc:	0.123
SOIL PARAMETE	-RS φ coh

SOIL PARAMETERS	φ	con	γ
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	d Stone		
	40 deg	0psf	135pcf
GEOMETRY			

Design Height:	12.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.60ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	3.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (St	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	8.00ft
Overturning:	1.50 / 1.1





FoS Sliding:	2.18 (lvlpd) / 1.24	FoS Overturning:	2.94 / 1.40
Bearing:	1877.39 / 2451.80	FoS Bearing:	15.51 / 11.88

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBlk	10.00	0.200	0.300	52	78	35	52	24.44	24.69	11.16	8.06
036	8.00	0.200	0.302	208	314	81	208	8.98	8.40	4.75	3.32
048	6.00	0.295	0.584	690	1367	145	690	4.86	5.40	2.38	2.05
060	4.00	0.371	0.771	1542	3208	224	1542	3.43	4.08	1.77	1.67
060	2.00	0.353	0.747	2292	4852	304	2292	2.79	2.94	1.46	1.21
084	0.00	0.474	1.011	4439	9465	417	4439	2.18[100.00]	3.09	1.24[1.46]	1.40

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy N	lountain E	states	
Location:	Weber C	ounty, Uta	h	
Designer:	LMP			
Date:	9/15/202	1		
Section:	Wall 1, G	ravity 6B	(11')	
Design Method:	NCMA_0	9_3rd_Ed	. ,	
Design Unit:	VertiBloc	k – –		
Seismic Acc:	0.123			
SOIL PARAMET	ERS	φ	coh	γ
Retained Soil:		36 deg	0psf	13
Foundation S	Soil:	36 dea	50psf	13

Retained Soil:36 deg0psf130pcfFoundation Soil:36 deg50psf130pcfLeveling Pad: Crushed Stone40 deg0psf135pcf

GEOMETRY

Design Height:	11.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.55ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	3.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (St	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	6.00ft
Overturning:	1.50 / 1.1





FoS Sliding:	2.36 (lvlpd) / 1.20	FoS Overturning:	2.77 / 1.11
Bearing:	1819.51 / 2196.54	FoS Bearing:	12.96 / 10.74

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBHS	10.00	0.200	0.300	13	20	25	13	87.83	148.60	25.18	27.37
036	8.00	0.200	0.300	117	176	71	117	14.75	17.33	6.95	5.85
048	6.00	0.295	0.551	479	895	135	479	6.57	8.33	3.16	3.05
060	4.00	0.375	0.771	1195	2454	214	1195	4.19	5.48	2.09	2.15
060	2.00	0.353	0.742	1860	3907	294	1860	3.27	3.73	1.66	1.47
060	0.00	0.341	0.727	2682	5717	374	2682	2.36[100.00]	2.77	1.20[1.43]	1.11

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy Mountain Estates	
Location:	Weber County, Utah	
Designer:	LMP	
Date:	9/15/2021	
Section:	Wall 1, Gravity 5B (10')	
Design Method:	NCMA_09_3rd_Ed	
Design Unit:	VertiBlock	
Seismic Acc:	0.123	
SOIL PARAMET	ERS φ coh	

SOIL PARAMETERS	φ	coh	γ
Retained Soil:	36 deg	0psf	130pcf
Foundation Soil:	36 deg	50psf	130pcf
Leveling Pad: Crushed	Stone		
	40 deg	0psf	135pcf
GEOMETRY	-		

Design Height:	10.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (S	tatic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	6.00ft
Overturning:	1.50 / 1.1





FoS Sliding:	2.15 (lvlpd) / 1.13	FoS Overturning:	2.64 / 1.12
Bearing:	1620.04 / 2017.22	FoS Bearing:	13.76 / 11.05

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBlk	8.00	0.200	0.300	52	78	35	52	24.44	24.69	11.16	8.06
036	6.00	0.201	0.389	209	405	81	209	8.93	8.35	3.91	2.67
036	4.00	0.219	0.467	513	1093	128	513	4.88	4.01	2.15	1.32
048	2.00	0.319	0.686	1328	2856	191	1328	3.16	3.04	1.57	1.19
060	0.00	0.384	0.825	2494	5360	271	2494	2.15[100.00]	2.64	1.13[1.37]	1.12

#### **Column Descriptions:**

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy M	ountain E	states	
Location:	Weber Co	ounty, Utał	า	
Designer:	LMP			
Date:	9/15/2021			
Section:	Wall 1, Gr	ravity 5B (	9')	
Design Method:	NCMA_09	9_3rd_Ed		
Design Unit:	VertiBlock	ζ.		
Seismic Acc:	0.123			
SOIL PARAMETE	ERS	φ	coh	γ
Retained Soil:		36 deg	0psf	130pcf
Foundation Soil:		36 deg	50psf	130pcf
Leveling Pad: Crushed Stone				

40 deg 0psf

135pcf



Design Height:	9.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (St	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	6.00ft
Overturning:	1.50 / 1.1





FoS Sliding:	2.47 (lvlpd) / 1.26	FoS Overturning:	3.29 / 1.35
Bearing:	1387.78 / 1689.89	FoS Bearing:	17.02 / 13.97

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBHS	8.00	0.200	0.300	13	20	25	13	87.83	148.60	25.18	27.37
036	6.00	0.200	0.327	117	191	71	117	14.75	17.33	6.56	5.47
036	4.00	0.210	0.434	341	705	118	341	6.86	6.49	2.93	2.01
048	2.00	0.315	0.672	1003	2140	181	1003	3.92	4.15	1.87	1.54
060	0.00	0.387	0.829	2038	4363	261	2038	2.47[100.00]	3.29	1.26[1.54]	1.35

**Column Descriptions:** 

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy Mountain Estates								
Location:	Weber County, Utah								
Designer:	LMP								
Date:	9/15/2021								
Section:	Wall 1, Gr	avity 4B (	8')						
Design Method:	NCMA_09	3rd_Ed							
Design Unit:	VertiBlock	ζ							
Seismic Acc:	0.123								
SOIL PARAMETE	ERS	φ	coh	γ					
Retained Soi	l:	36 deg	0psf	130pcf					
Foundation S	Soil:	36 deg	50psf	130pcf					
Leveling Pad	: Crushed	Stone							
40 deg 0psf 135p									



GEOMETRY

Design Height:	8.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (St	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	5.00ft
Overturning:	1.50 / 1

1.50 / 1.1



FoS Sliding:	2.52 (lvlpd) / 1.21	FoS Overturning:	3.04 / 1.19
Bearing:	1184.20 / 1398.25	FoS Bearing:	17.39 / 14.73

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBlk	6.00	0.200	0.300	52	78	35	52	24.44	24.69	11.16	8.06
036	4.00	0.201	0.389	209	405	81	209	8.93	8.35	3.91	2.67
036	2.00	0.219	0.467	513	1093	128	513	4.88	4.01	2.15	1.32
048	0.00	0.319	0.686	1328	2856	191	1328	2.52[100.00]	3.04	1.21[1.54]	1.19

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy Mountain Estates								
Location:	Weber County, Utah								
Designer:	LMP								
Date:	9/15/202 <sup>-</sup>	9/15/2021							
Section:	Wall 1, G	ravity 4B (	(7')						
Design Method:	NCMA_0	9_3rd_Ed	, Include '	Vert. Force					
Design Unit:	VertiBloc	VertiBlock							
Seismic Acc:	0.123								
SOIL PARAMET	ERS	φ	coh	γ					
Retained So	il:	36 deg	0psf	130pcf					
Foundation S	36 deg	50psf	130pcf						
Leveling Pad	: Crushed	Stone							
		40 deg	0psf	135pcf					



GEOMETRY

Design Height:	7.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (S	tatic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	4.00ft
Overturning:	1.50 /

1.50 / 1.1



FoS Sliding:	3.12 (lvlpd) / 1.29	FoS Overturning:	3.36 / 1.11
Bearing:	998.74 / 1086.22	FoS Bearing:	18.82 / 17.30

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSs/	FoS OT	siesFSsl	FoS SeisOT
TBHS	6.00	0.200	0.300	13	20	25	13	87.83	148.60	25.18	27.37
036	4.00	0.200	0.327	117	191	71	117	14.75	17.33	6.56	5.47
036	2.00	0.210	0.434	341	705	118	341	6.86	6.49	2.93	2.01
036	0.00	0.228	0.492	725	1567	164	725	3.12[100.00]	3.36	1.29[1.70]	1.11

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project:	Legacy Mountain Estates					
Location:	Weber County, Utah					
Designer:	LMP					
Date:	9/15/2021					
Section:	Wall 1, G	ravity 3B (	(6')			
Design Method:	NCMA_0	9_3rd_Ed	, Include \	Vert. Force		
Design Unit:	VertiBlock	<				
Seismic Acc:	0.123					
SOIL PARAMET	ERS	φ	coh	γ		
Retained So	il:	36 deg	0psf	130pcf		
Foundation Soil:		36 deg	50psf	130pcf		
Leveling Pad	: Crushed	Stone				
		40 deg	0psf	135pcf		



GEOMETRY

Design Height:	6.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (St	tatic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	4.00ft
Overturning:	1.50 /

1.50 / 1.1



FoS Sliding:	3.48 (lvlpd) / 1.40	FoS Overturning:	4.01 / 1.32
Bearing:	783.17 / 843.18	FoS Bearing:	24.03 / 22.32

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBlk	4.00	0.200	0.300	52	78	35	52	24.44	24.69	11.16	8.06
036	2.00	0.201	0.389	209	405	81	209	8.93	8.35	3.91	2.67
036	0.00	0.219	0.467	513	1093	128	513	3.48[100.00]	4.01	1.40[1.95]	1.32

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project: Location: Designer: Date: Section: Design Method: Design Unit:	Legacy Me Weber Co LMP 9/15/2021 Wall 1, Gr NCMA_09 VertiBlock	ountain Es unty, Utah avity 3B ({ _3rd_Ed,	states 5') Include Ve	ert. Force
Seismic Acc:	0.123			
SOIL PARAMETERS Retained Soil: Foundation Soil: Leveling Pad: Crushed S		φ 36 deg 36 deg Stone 40 deg	coh Opsf 50psf Opsf	γ 130pcf 130pcf 135pcf



GEOMETRY

Design Height:	5.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (Sta	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	4.00ft
Overturning:	1.50 / 1.1



FoS Sliding:	4.79 (lvlpd) / 1.83	FoS Overturning:	6.49 / 2.01
Bearing:	654.30 / 688.55	FoS Bearing:	30.51 / 28.99

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSsl	FoS OT	siesFSsl	FoS SeisOT
TBHS	4.00	0.200	0.300	13	20	25	13	87.83	148.60	25.18	27.37
036	2.00	0.200	0.327	117	191	71	117	14.75	17.33	6.56	5.47
036	0.00	0.210	0.434	341	705	118	341	4.79[100.00]	6.49	1.83[2.62]	2.01

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.



Project: Location: Designer: Date: Section: Design Method: Design Unit:	Legacy Me Weber Co LMP 9/15/2021 Wall 1, Gr NCMA_09 VertiBlock	ountain Es ounty, Utah avity 2B (4 )_3rd_Ed,	states 1 1') Include Ve	ert. Force
Seismic Acc:	0.123			
SOIL PARAMETERS Retained Soil: Foundation Soil: Leveling Pad: Crushed		φ 36 deg 36 deg Stone 40 deg	coh Opsf 50psf Opsf	γ 130pcf 130pcf 135pcf



GEOMETRY

Design Height:	4.00ft
Wall Batter/Tilt:	5.20/ 0.00 deg
Embedment:	0.50ft
Leveling Pad Depth:	0.50ft
Slope Angle:	26.6 deg
Slope Length:	50.0ft
Slope Toe Offset:	2.0ft
Vert $\delta$ on Single Dpth	
FACTORS OF SAFETY (SI	atic / Seismic)
Sliding:	1.50 / 1.1
Bearing:	2.00 / 1.5

Live Load:	0psf
Live Load Offset:	0.00ft
Live Load Width:	Oft
Dead Load:	0psf
Dead Load Offset:	0.0ft
Dead Load Width:	Oft
Leveling Pad Width:	4.00ft
Overturning:	1.50 / 1.1

VertiBlock Wall Designer 5.0.20111



FoS Sliding:	5.64 (lvlpd) / 2.10	FoS Overturning:	8.35 / 2.67
Bearing:	482.27 / 501.30	FoS Bearing:	40.49 / 38.96

Name	Elev.	ka	kae	Pa	Pae	Pir	PaT	FSs/	FoS OT	siesFSsl	FoS SeisOT
TBlk	2.00	0.200	0.300	52	78	35	52	24.44	24.69	11.16	8.06
036	0.00	0.201	0.389	209	405	81	209	5.64[100.00]	8.35	2.10[3.34]	2.67

Column Descriptions:

ka: active earth pressure coefficient

kae: active seismic earth pressure coefficient

Pa: active earth pressure

Pae: dynamic earth pressure

Pir: inertia force

Paq: live surcharge earth pressure

Paq2: live load 2 surcharge earth pressure

Paqd: dead surcharge earth pressure

(PaC): reduction in load due to cohesion

PaT: sum of all earth pressures

FSsl(IvI Pad): factor of safety for sliding at each layer. (FS sliding below the leveling pad)

FSot: factor of safety of overturning about the toe.













### **Materials**

Retained/Foundation	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	130
Cohesion [psf]	100
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Ru Value	0
Verti-Block	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	3000
Friction Angle [deg]	0
Water Surface	Assigned per scenario
Ru Value	0
Gravel	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	130
Cohesion [psf]	0
Friction Angle [deg]	40
Water Surface	Assigned per scenario
Ru Value	0
Reinforced/Backfill	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	135
Cohesion [psf]	0
Friction Angle [deg]	36
Water Surface	Assigned per scenario
Ru Value	0

### Materials In Use

Material	Static	Seismic	Yield Acceleration	Static	Seismic
Retained/Foun dation	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
Verti-Block	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
Gravel	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$
Reinforced/Bac kfill	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$	$\checkmark$

## Support

Mirafi 10XT	
Color	
Туре	Geosynthetic
Force Application	Passive (Method B)
Force Orientation	Bisector of Parallel and Tangent
Strip Coverage (%)	100
Long Term Design Strength	5712 lbs/ft
Anchorage	None
Shear Strength Model	Linear
Adhesion	0 psf
Friction Angle	34 deg
Material Dependent	No
Use External Loads in Strength Computation	Yes



#### Horizontal Seismic Acceleration Coefficient Determination

Bray, J.D., Travasarou, T., and Zupan, J., 2010, Seismic Displacement Design of Earth Retaining Structures, ASCE Earth Retention Conference 3, Bellevue, WA. American Society of Civil Engineers, Restion, VA, pp.638-655. Also Found in AASHTO LRFD Bridge Design Specifications, see Section A11.5.3

Site Seismic Design Values								
PC	GA	0.386	g	Mapped MCE <sub>G</sub> Peak Ground Acceleration (from ASCE7 Hazard Tool)				
F	PGA	1.21		Site Coefficient from ASCE 7-16 Table 11.8-1				
PG	δA <sub>M</sub>	0.469	g	MCE <sub>G</sub> Peak Ground Acceleration adjusted for site class effects				
S	Ss	0.872	g	The mapped $MCE_R$ spectral response acceleration parameter for short periods				
S	<b>S</b> <sub>1</sub>	0.308	g	The mapped $MCE_R$ spectral response acceleration parameter at a period of 1 second				
I	Fa	1.15		Short-Period Site Coefficient from ASCE 7-16 Table 11.4-1				
F	Fv	1.99		Long-Period Site Coefficient from ASCE 7-16 Table 11.4-2				
S	DS	0.669	g	Design Short-Period Spectral Acceleration Parameters from ASCE 7-16 Equations 11.4-1 & 11.4-3				
S	D1	0.409	g	Design Long-Period Spectral Acceleration Parameters from ASCE 7-16 Equations 11.4-2 & 11.4-4				
]	Γ <sub>0</sub>	0.122	sec	Initial Period where $S_a$ is equal to $S_{DS}$ as per ASCE 7-16 Section 11.4.6				
Г	Гs	0.611	sec	Final Period where $S_a$ is equal to $S_{DS}$ as per ASCE 7-16 Section 11.4.6				

#### AASHTO LRFD Bridge Manual A11.5.3 - Bray et al. (2010), and Bray and Travasarou (2009):

Η	18.0	feet	Maximum Height of the retaining wall
H <sub>heel</sub>	18.0	feet	Height measured from bottom of heel of wall (back of blocks) to the ground surface directly above wall heel
H'	14.4	feet	80% of H <sub>heel</sub>
$V_s$	1200	ft/sec	The shear wave velocity of the soil behind the wall (estimated for a Site Class D)
T <sub>s</sub>	0.048	sec	The fundamental period of the wall (4*H' / Vs)
$1.5T_s$	0.072	sec	Degraded period at which Sa is determined from the five percent damped response spectra for the site
$\mathbf{S}_{\mathbf{a}}$	0.504	g	The five percent damped spectral acceleration coefficient from the site response spectra
d	15.0	cm	The maximum wall displacement allowed
М	6.69		The moment magnitude of the design earthquake
3	0		A normally distributed random variable with zero mean and a standard deviation of 0.66
а	3.218		$a = 2.83 - 0.566 \ln(S_a)$
b	2.348		$b = a^{2} - 1.33*[\ln(d) + 1.10 - 3.04*\ln(S_{a}) + 0.244*(\ln(S_{a}))^{2} - 1.5*T_{s}*0.278*(M-7) - \epsilon$
k <sub>h</sub>	0.078	g	Horizontal seismic acceleration coefficient ( $k_h = exp((-a + \sqrt{b})/0.66)$ )
	Η Η <sub>heel</sub> Γ <sub>s</sub> 1.5T <sub>s</sub> δ <sub>a</sub> d Μ ε a b <b>k<sub>h</sub></b>	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c } H & 18.0 & feet \\ H_{heel} & 18.0 & feet \\ H' & 14.4 & feet \\ \hline V_s & 1200 & ft/sec \\ \hline T_s & 0.048 & sec \\ 1.5T_s & 0.072 & sec \\ \hline s_a & 0.504 & g \\ d & 15.0 & cm \\ \hline M & 6.69 & \\ \hline \epsilon & 0 & \\ a & 3.218 & \\ \hline b & 2.348 & \\ \hline \mathbf{k_h} & 0.078 & g \\ \end{array}$

#### Newmark Displacement - AASHTO (A11.5.2) & Anderson et al. (2008) [Western US Sites - WUS-Soil]

Anderson, D.G., Martin, G.R., Lam, I., Wang, J.N., 2008, Seismic Analysis and Design of Retaining Walls, Buried Structuress, Slopes, and Embankments, National Cooperative Highway Research Program (NCHRP) Report 611

Input Parameters						
MCE <sub>G</sub> PGA	0.386	g				
Site Coefficient (F <sub>PGA</sub> )	1.21					
PGA <sub>M</sub> (MCE <sub>G</sub> PGA adjusted for site class effects)	0.469	g				
Long-Period Site Coefficient F <sub>v</sub>	1.99					
MCER Spectral Acceleration Parameter S <sub>1</sub> (long periods)	0.308	g				
Yield acceleration for slope stability analysis $(k_y)$	0.291	g				
Height of Retaining Wall (heel of wall to ground surface)	18.0	feet				

			_
 Output			_
 Peak Seismic Coefficient at the site (k <sub>max</sub> ) [Eq 7-1]	0.469	g	$[k_{max} = MCE_G PGA * F_{PGA}]$
Wall Height Acceleration Reduction Factor ( $\beta$ ) [Eq. 7-2]	1.309		$[\beta = F_v * S_1 / k_{max}]$
Wall Height Dependent Reduction Factor ( $\alpha$ ) [Eq. 7-2]	0.938		$[\alpha = 1 + 0.01 \text{H}^*[(0.5\beta) - 1]]$
Wall Height Dependent Reduction Factor ( $\alpha$ ) [Eq. 7-2]	1.000		$\alpha$ used in analysis (for practical purposes $\alpha = 1$ )
Peak Seismic Coefficient scaled for Heihgt (kav) [Eq. 7-1]	0.469	g	$[\mathbf{k}_{av} = \alpha * \mathbf{k}_{max}]$
Peak Ground Velocity (PGV) [AASHTO A11.5.2-5]	23.314	in/sec	$[PGV = 38*F_v*S_1]$
			$[\log(D)=-1.51-0.74*\log(k_v/k_{max})+3.27*\log(1-k_v/k_{max})]$
Mean Displacement (D) [Eq. 5-8]	5.31	inches	-0.8*LOG(kmax)+1.59*LOG(PGV)]
2 * Mean Displacment [84% Confidence Level]	10.61	inches	[Per Section 7.6]

