McCOWNGORDON CONSTRUCTION

Submittal #33 3223 - 2.0 323223 - Segmental Retaining Walls

McCownGordon
850 Main Street
Kansas City, Missouri 64105
Phone: (816) 960-1111
Fax: (816) 960-1182

Project: 1-07-1256 - Lee's Summit R7 New Middle Sch
Country Lane and SE Bailey Road
Lee's Summit, Missouri 64081
Phone: (816) 960-1111

Shop Drawings

REVISION:	0	**SUBMITTAL MANAGER:**	Daniel Karanja **(McCownGordon Construction, LLC)**
STATUS:	In Review	**DATE CREATED:**	10/14/2020
ISSUE DATE:	10/14/2020	**SPEC SECTION:**	323223 - Segmental Retaining Walls
RESPONSIBLE CONTRACTOR:	BC Hardscapes LLC	**RECEIVED FROM:**	Travis Althoff
RECEIVED DATE:	10/14/2020	**SUBMIT BY:**	10/16/2020
FINAL DUE DATE:	11/5/2020	**LOCATION:**	Lee's Summit Middle School
SUB JOB:		**COST CODE:**	
		TYPE:	

APPROVERS: Daniel Karanja **(McCownGordon Construction, LLC)**, Kathy Walbert **(DLR Group)**

BALL IN COURT:
Daniel Karanja **(McCownGordon Construction, LLC)**

DISTRIBUTION:
Kathy Walbert **(DLR Group)**, Dana Schwartz **(DLR Group)**, Brett Taylor **(McCownGordon Construction, LLC)**, Daniel Karanja **(McCownGordon Construction, LLC)**, Jeff Clemmons **(McCownGordon Construction, LLC)**, Ryan Chushuk **(McCownGordon Construction, LLC)**

DESCRIPTION:

SUBMITTAL WORKFLOW

NAME	SENT DATE	DUE DATE	RETURNED DATE	RESPONSE	ATTACHMENTS	COMMENTS
General Information Attachments					LSMS 32 3223 Segmental Retaining Walls - Shop Drawings - IFR.pdf	
Travis Althoff	10/14/2020	10/16/2020	10/15/2020	Submitted	2020-10-13 Retaining Wall Plans & Report - Lees Summit MS 4.pdf	
Daniel Karanja	10/15/2020	10/15/2020		Pending		
Kathy Walbert		11/05/2020		Pending		

Project 1-07-1256 Submittal No. 33 3223 - 2.0

REVIEWED ONLY

Contractor's review is for general compliance with the information provided in the Contract Documents and for general conformance with the design concept of the project. Any action noted herein is subject to the requirements set forth in the Contract Documents. Subcontractor/Supplier is responsible for all dimensions which shall be confirmed at the jobsite; all fabrication processes and techniques of construction; the coordination of Subcontractor's work with that of all other trades, and the performance of Subcontractor's work in accordance with the Contract Documents

McCownGordon Construction
dkaranja 5:51:55 PM 10/15/2020

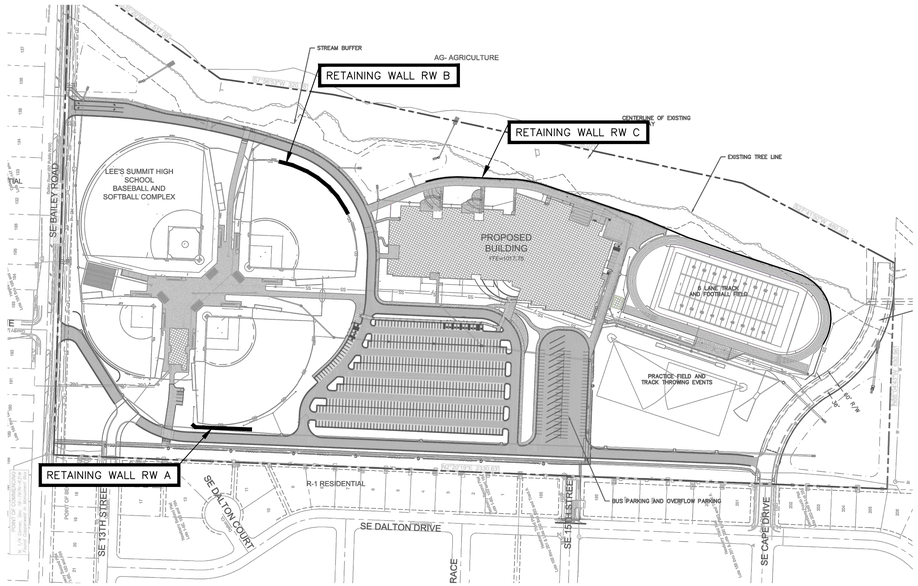
BY **DATE** **COPIES TO**

LEE'S SUMMIT MIDDLE SCHOOL #4
RETAINING WALL PLANS
LEE'S SUMMIT, MISSOURI

Know what's below. Call before you dig.

SHEET INDEX

W-00	COVER SHEET
W-01 - W-02	RETAINING WALL A
W-03 - W-04	RETAINING WALL B
W-05 - W-09	RETAINING WALL C
W-10	RETAINING WALL DETAILS
W-11	RETAINING WALL SPECIFICATIONS



RETAINING WALL - LOCATION MAP

NORTH

GRAPHIC SCALE

200 100 0 200 400

(SCALE IN FEET)

Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
NUMBER 2007021
PROFESSIONAL ENGINEER
10/12/2020

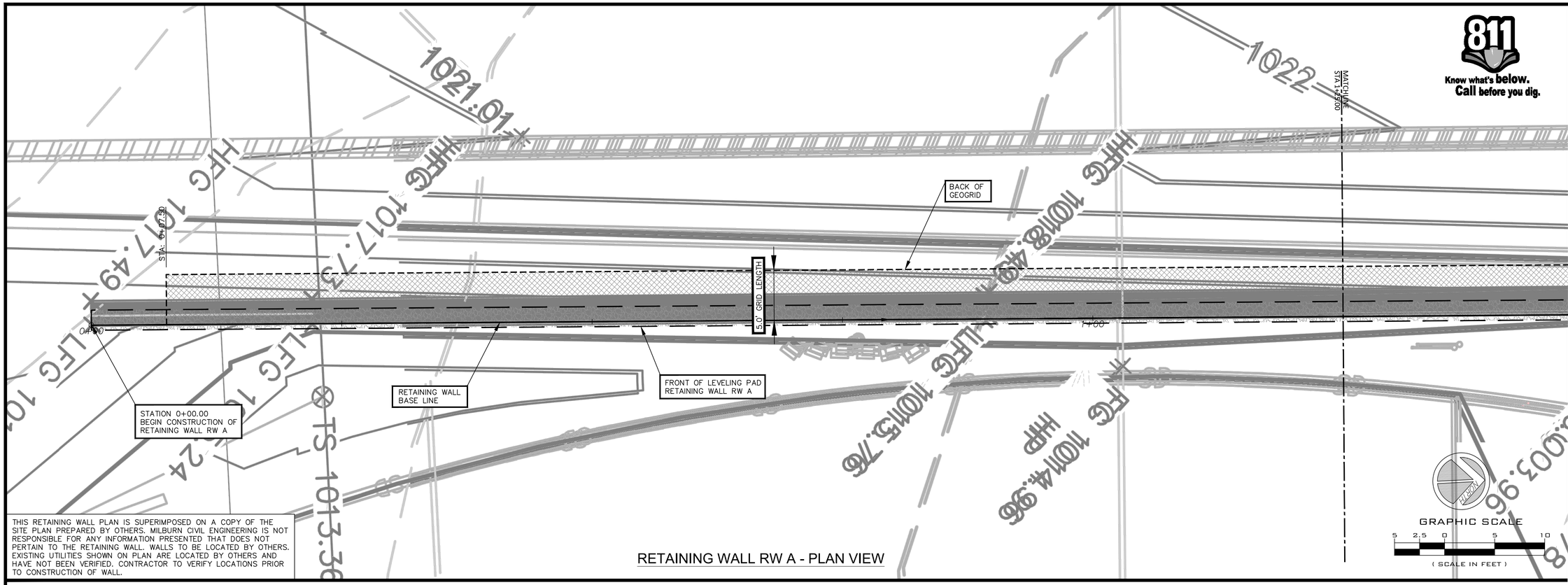
LEE'S SUMMIT MIDDLE SCHOOL #4
RETAINING WALL PLANS
1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE 10/12/2020
DESIGNED BY KF
CHECKED BY JPM

REVISIONS REVISIONS

COVER SHEET

W-00



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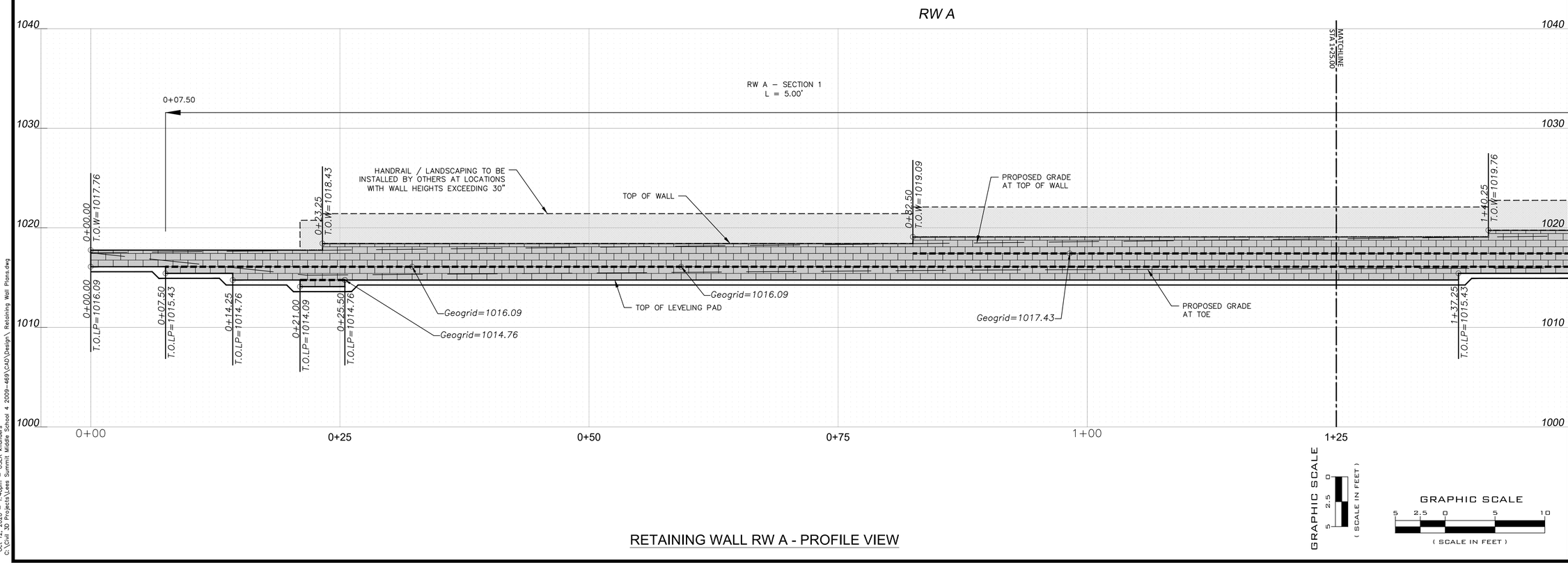
RETAINING WALL RW A - PLAN VIEW



RETAINING WALL RW A - PROFILE VIEW

Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
KYLE FLANDERS
2019021502
PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

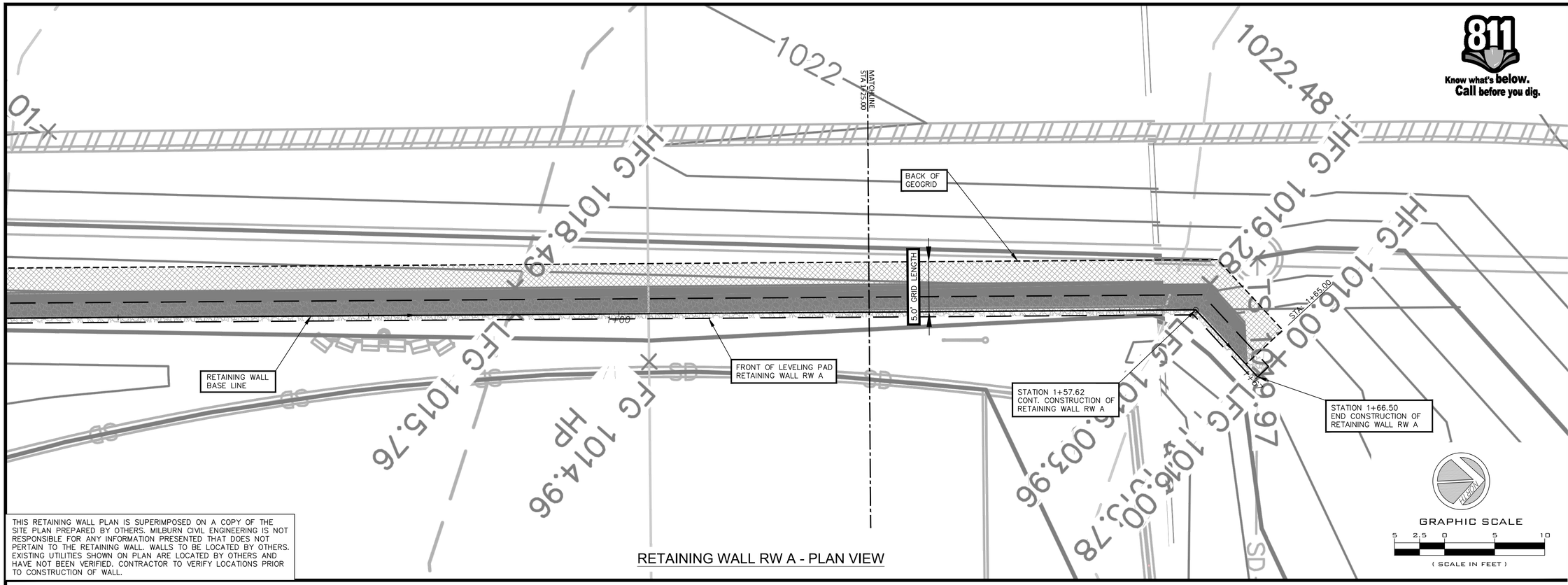
DATE	10/12/2020
DESIGNED BY	KF
CHECKED BY	JPM

REVISIONS REVISIONS

RETAINING WALL A
PLAN & PROFILE

W-01

Oct 12, 2020 – 1:40pm – USER kflanders
C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\C4D\Design\ Retaining Wall Plans.dwg



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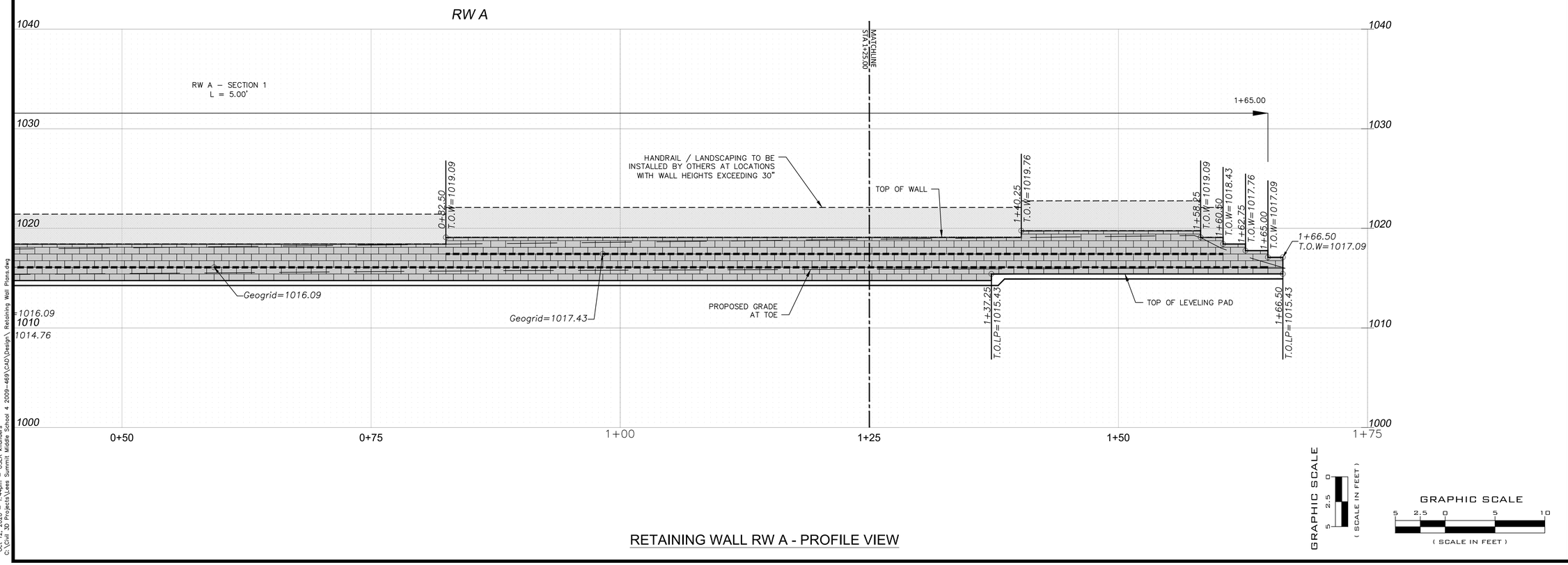
RETAINING WALL RW A - PLAN VIEW



RETAINING WALL RW A - PROFILE VIEW

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Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
NUMBER PE-2003037202
PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

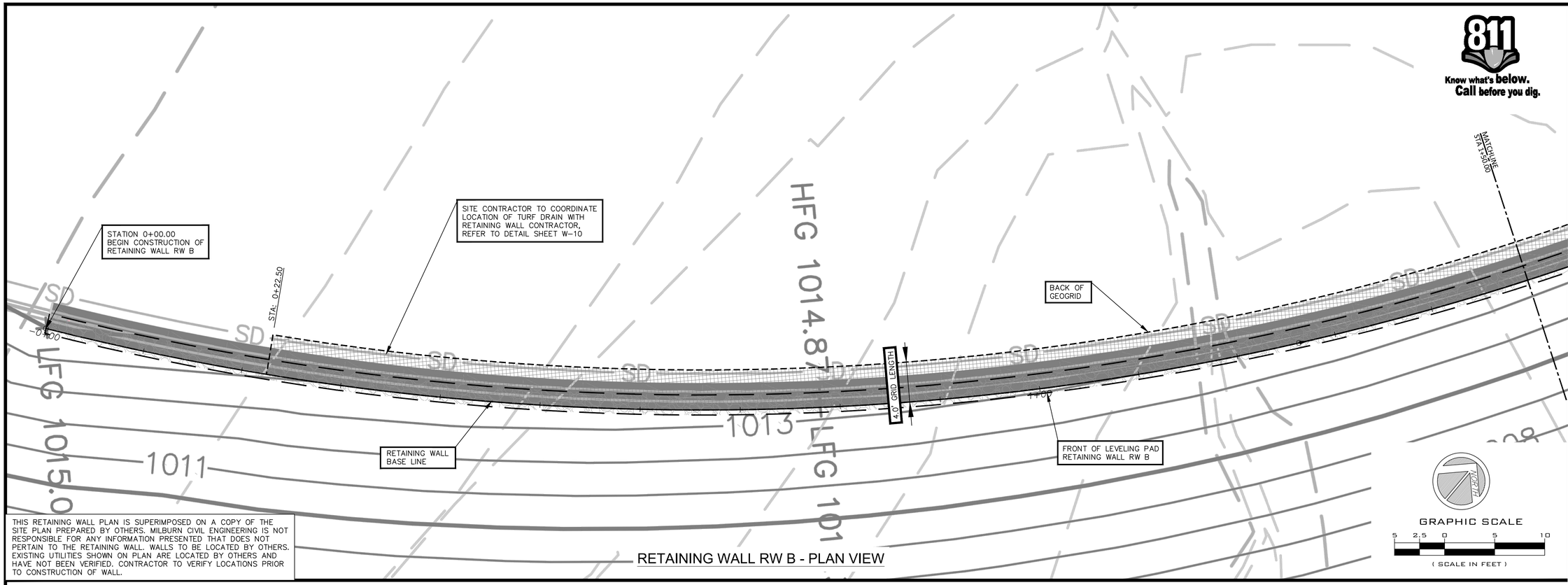
1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
DESIGNED BY	KF
CHECKED BY	JPM

REVISIONS	REVISIONS

RETAINING WALL A
PLAN & PROFILE

W-02



RETAINING WALL RW B - PLAN VIEW

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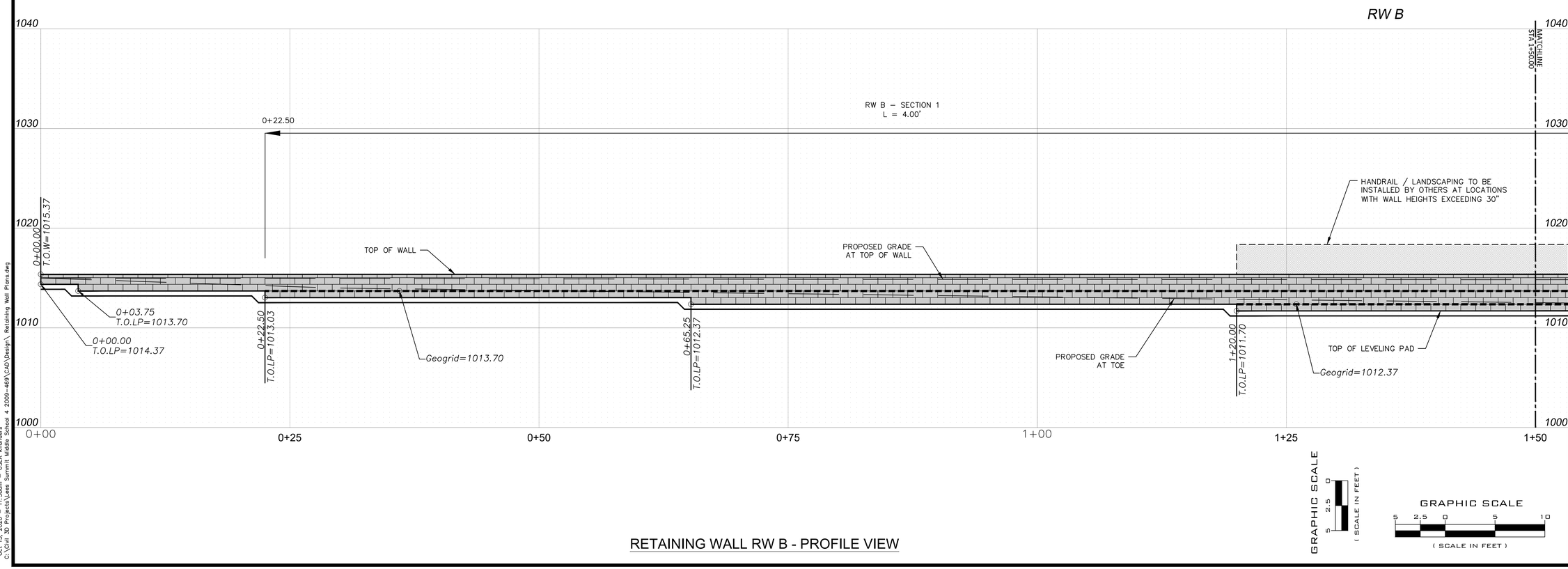

RETAINING WALL RW B - PROFILE VIEW

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33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
NUMBER 2012032427
PROFESSIONAL ENGINEER
10/12/2020

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
DESIGNED BY	KF
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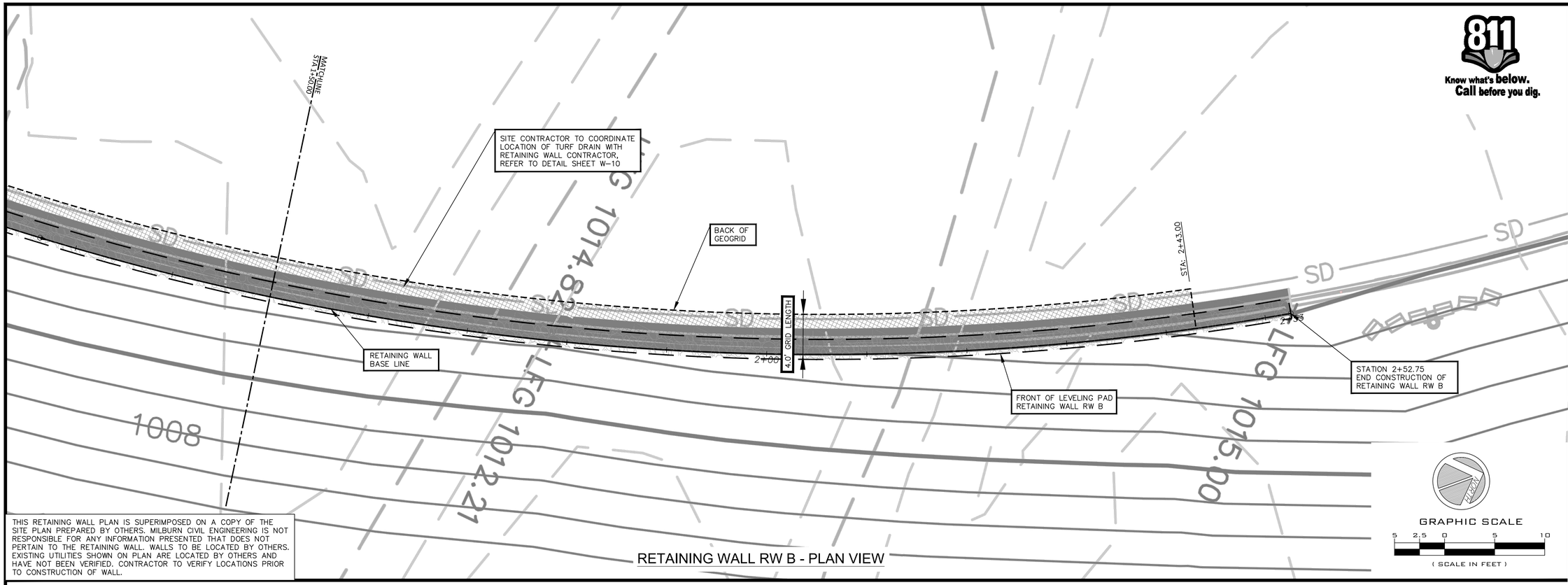
RETAINING WALL B
PLAN & PROFILE

W-03



RETAINING WALL RW B - PLAN VIEW

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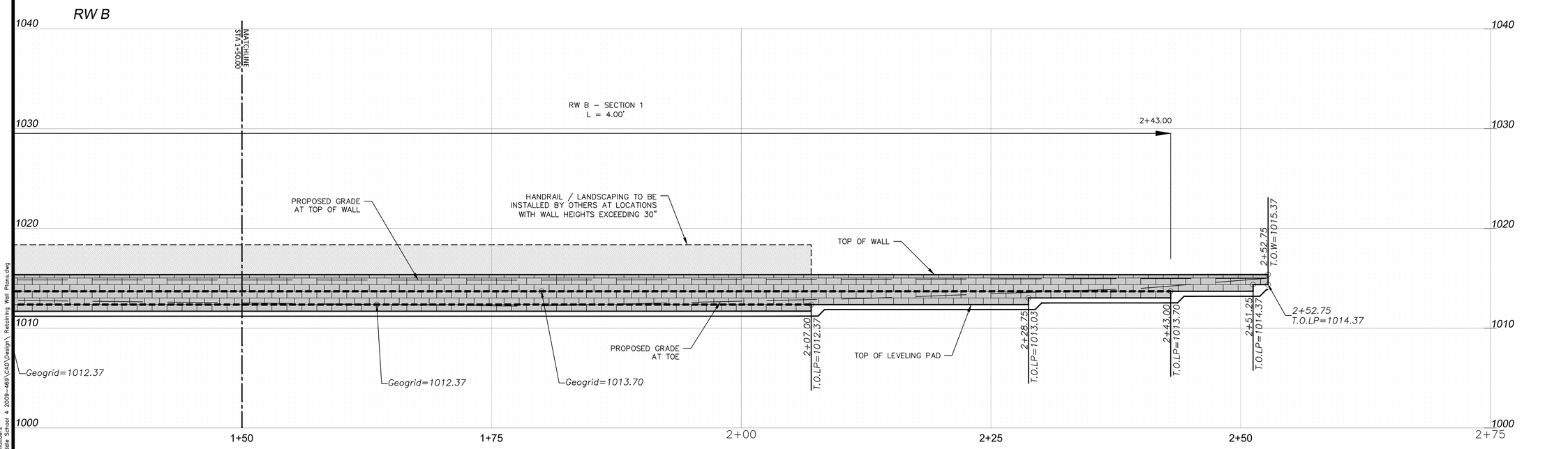
GRAPHIC SCALE
5 2.5 0 5 10
(SCALE IN FEET)



RETAINING WALL RW B - PROFILE VIEW

GRAPHIC SCALE
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(SCALE IN FEET)

GRAPHIC SCALE
5 2.5 0 5 10
(SCALE IN FEET)

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33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI KEVIN M. FLANDERS 2012032702 PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
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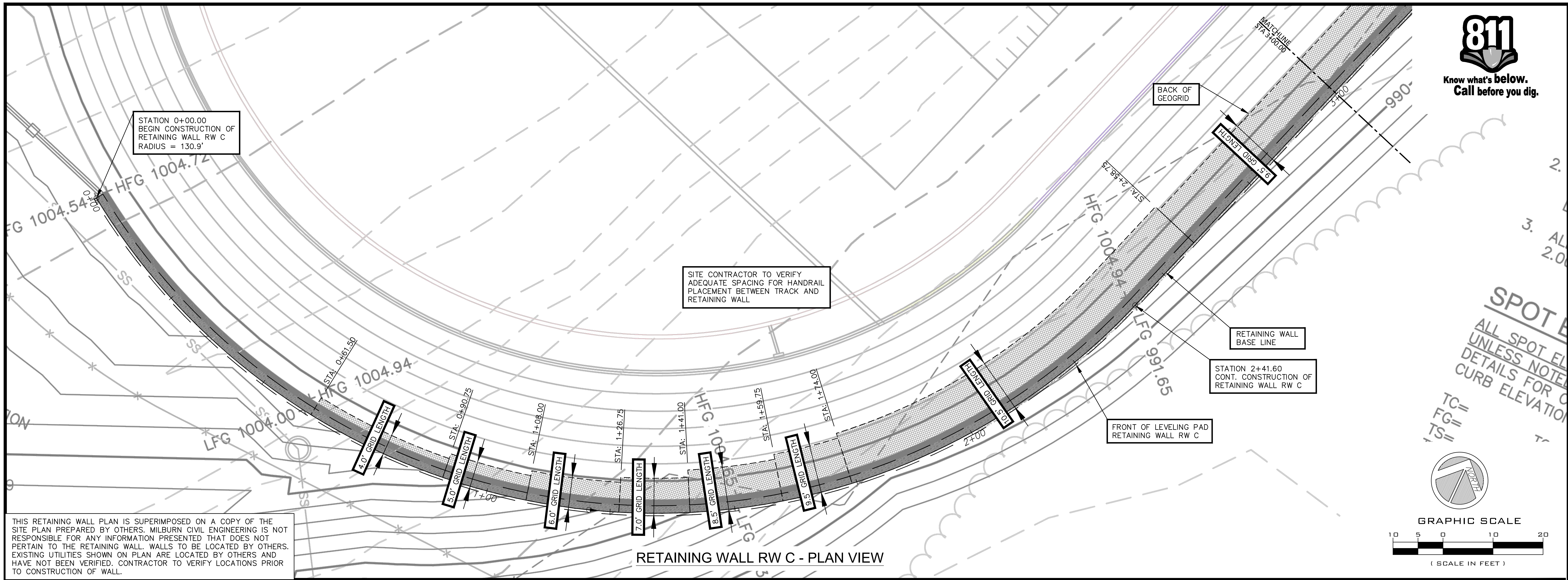
REVISIONS REVISIONS

RETAINING WALL B
PLAN & PROFILE

W-04



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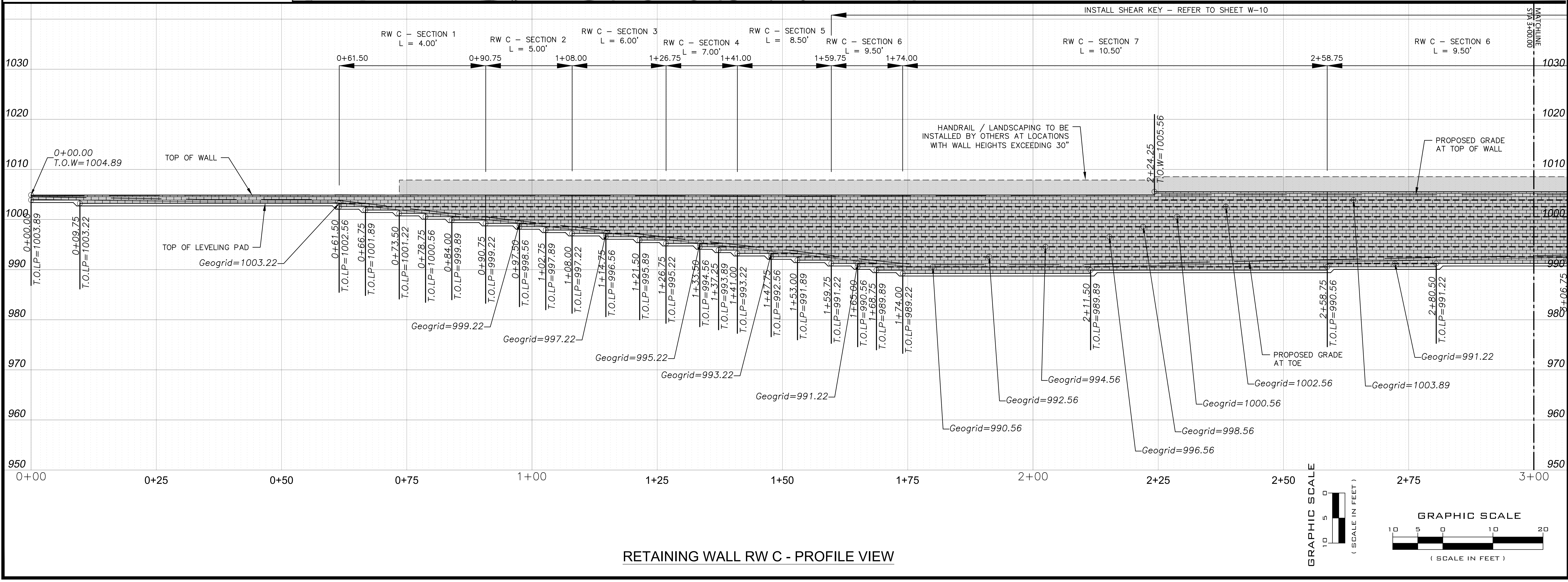
RETAINING WALL RW C - PLAN VIEW



RETAINING WALL RW C - PROFILE VIEW

GRAPHIC SCALE
0 5 10
(SCALE IN FEET)

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

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Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
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RETAINING WALL C
PLAN & PROFILE

W-05

811 Know what's below. Call before you dig.

MATCHLINE STA 3+00.00

MATCHLINE

SEE SHEET C1019

SITE CONTRACTOR TO VERIFY ADEQUATE SPACING FOR HANDRAIL PLACEMENT BETWEEN TRACK AND RETAINING WALL

STA: 3+61.50

STA: 4+52.25

STA: 5+75.25

HFG 100A.94 LF

HFG 100A.94 LF

HFG 996.50

MATCHLINE STA 6+00.00

9.5' GRID LENGTH

8.5' GRID LENGTH

7.0' GRID LENGTH

6.0' GRID LENGTH

BACK OF GEOGRID

RETAINING WALL BASE LINE

FRONT OF LEVELING PAD RETAINING WALL RW C

STATION 5+69.65 CONT. CONSTRUCTION OF RETAINING WALL RW C

3+00 4+00 5+00 6+00

990 991 992 994 995 998

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

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RETAINING WALL RW C - PLAN VIEW

INSTALL SHEAR KEY – REFER TO SHEET W-10

RW C – SECTION 6
L = 9.50'

RW C – SECTION 5
L = 8.50'

RW C – SECTION 4
L = 7.00'

RW C – SECTION 3
L = 6.00'

3+61.50 4+52.25 5+75.25

1030 1020 1010 1000 990 980 970 960 950

TOP OF WALL

PROPOSED GRADE AT TOP OF WALL

HANDRAIL / LANDSCAPING TO BE INSTALLED BY OTHERS AT LOCATIONS WITH WALL HEIGHTS EXCEEDING 30"

5+75.25 T/O W= 1004.89

3+06.75 T.O.LP=991.89

3+61.50 T.O.LP=992.56

3+86.25 T.O.LP=993.22

4+02.00 T.O.LP=993.89

4+52.25 T.O.LP=994.56

5+02.50 T.O.LP=995.22

5+60.25 T.O.LP=995.89

5+97.00 T.O.LP=996.56

Geogrid=992.56
Geogrid=994.56
Geogrid=996.56
Geogrid=998.56
Geogrid=1000.56
Geogrid=1002.56
Geogrid=993.22
Geogrid=1003.89
Geogrid=995.22
Geogrid=997.22

TOP OF LEVELING PAD

PROPOSED GRADE AT TOE

3+00 3+25 3+50 3+75 4+00 4+25 4+50 4+75 5+00 5+25 5+50 5+75 6+00

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

RETAINING WALL RW C - PROFILE VIEW

Oct 13, 2020 – 12:01pm – USER kfanders
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Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
NUMBER 2007018202
PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE 10/12/2020
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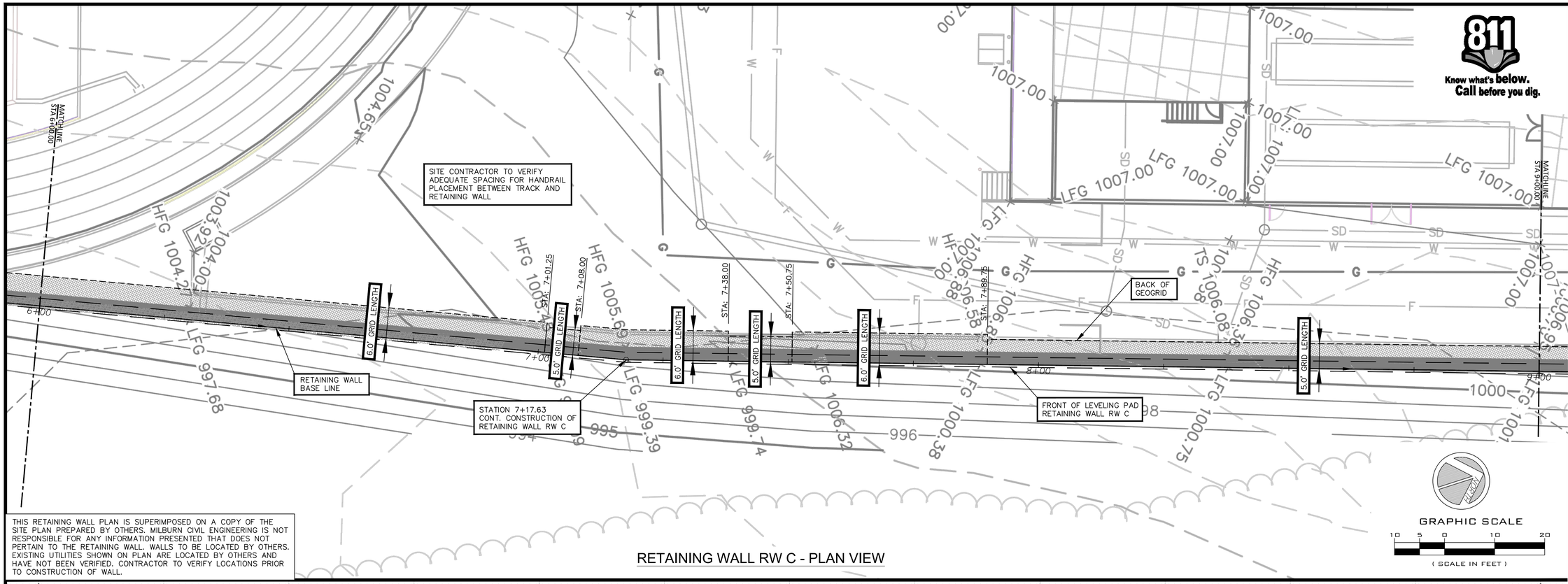
REVISIONS REVISIONS

RETAINING WALL C
PLAN & PROFILE

W-06



RETAINING WALL RW C - PLAN VIEW

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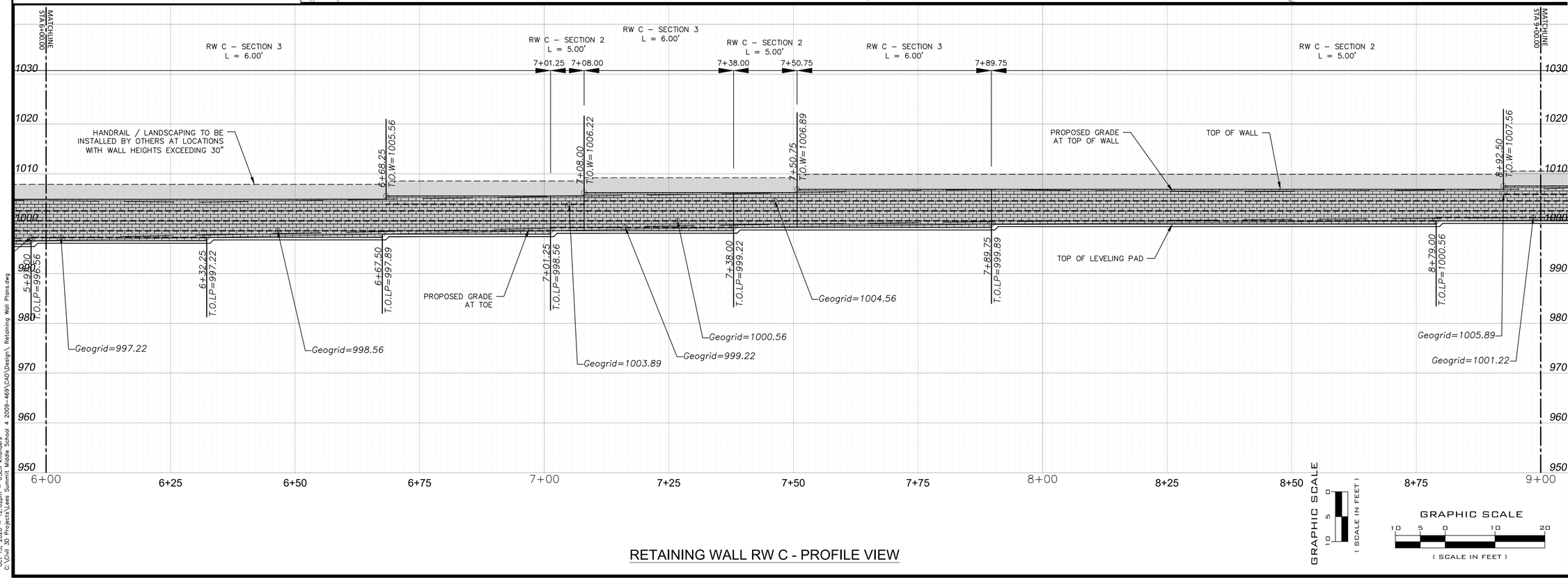

RETAINING WALL RW C - PROFILE VIEW

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33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
KEVIN FANDERS
NUMBER 2003037202
PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

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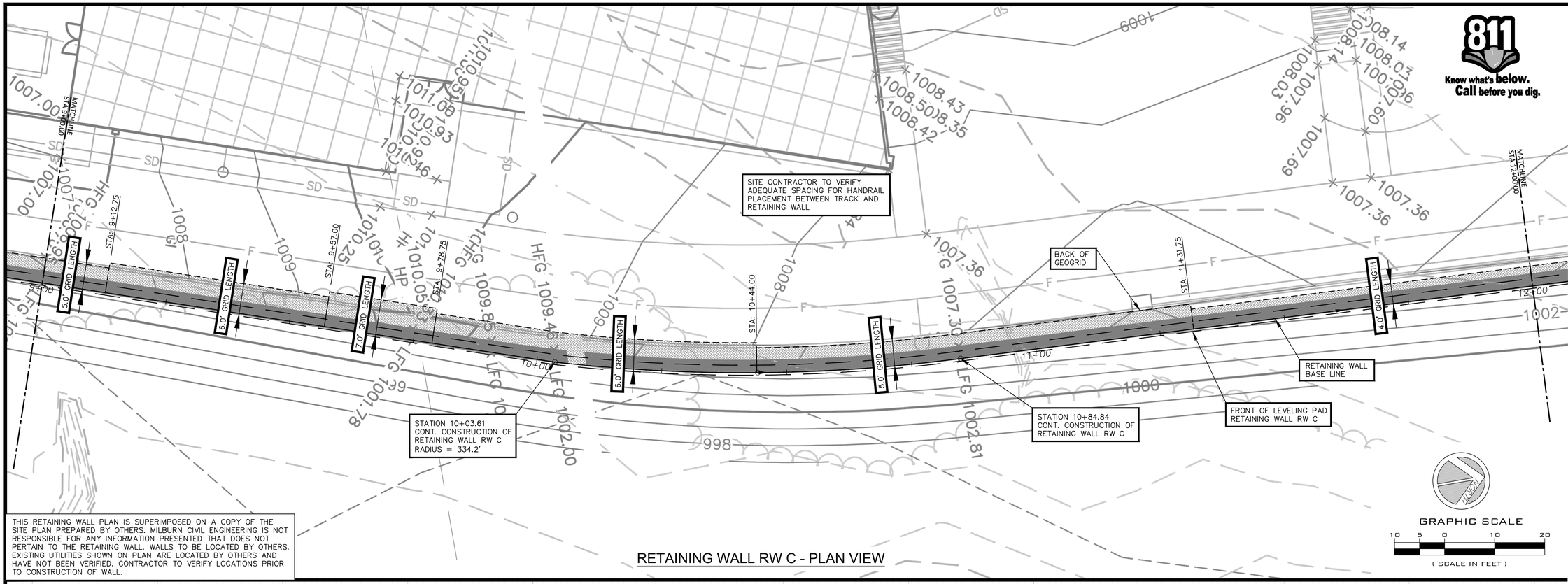
REVISIONS REVISIONS

RETAINING WALL C
PLAN & PROFILE

W-07



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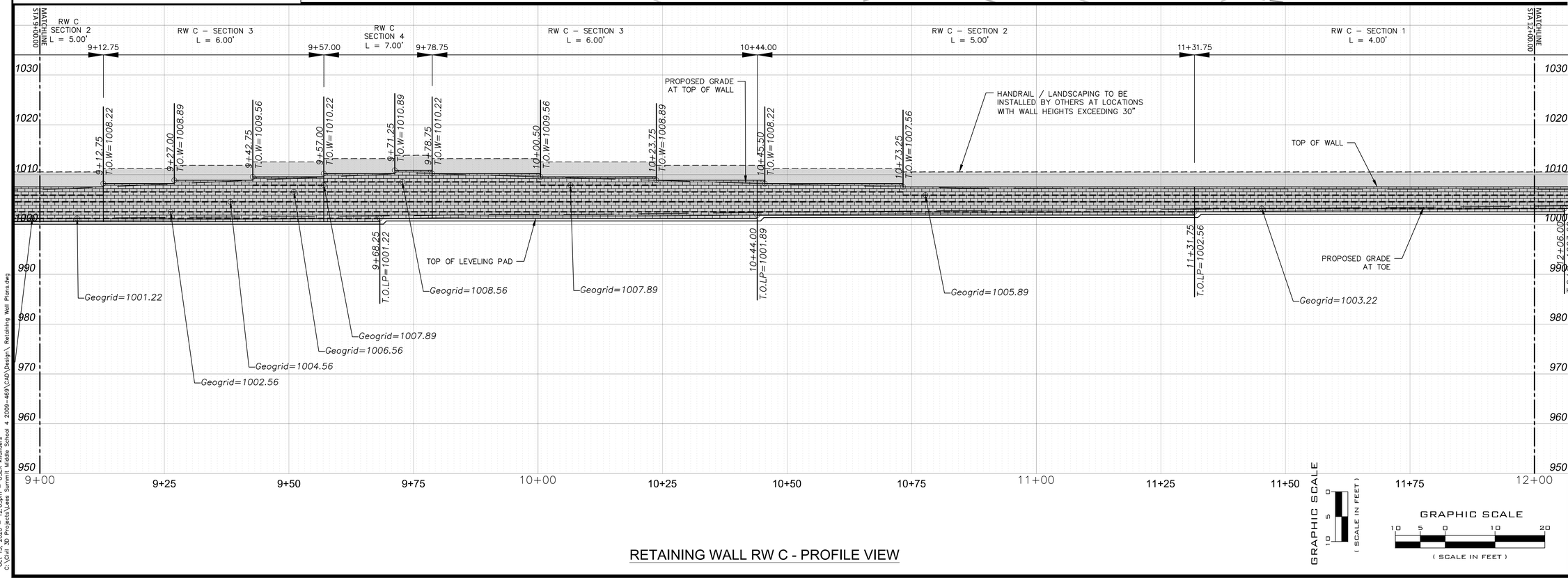
RETAINING WALL RW C - PLAN VIEW



RETAINING WALL RW C - PROFILE VIEW

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Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
KEVIN FLANDERS
2014034282
PROFESSIONAL ENGINEER

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE 10/12/2020
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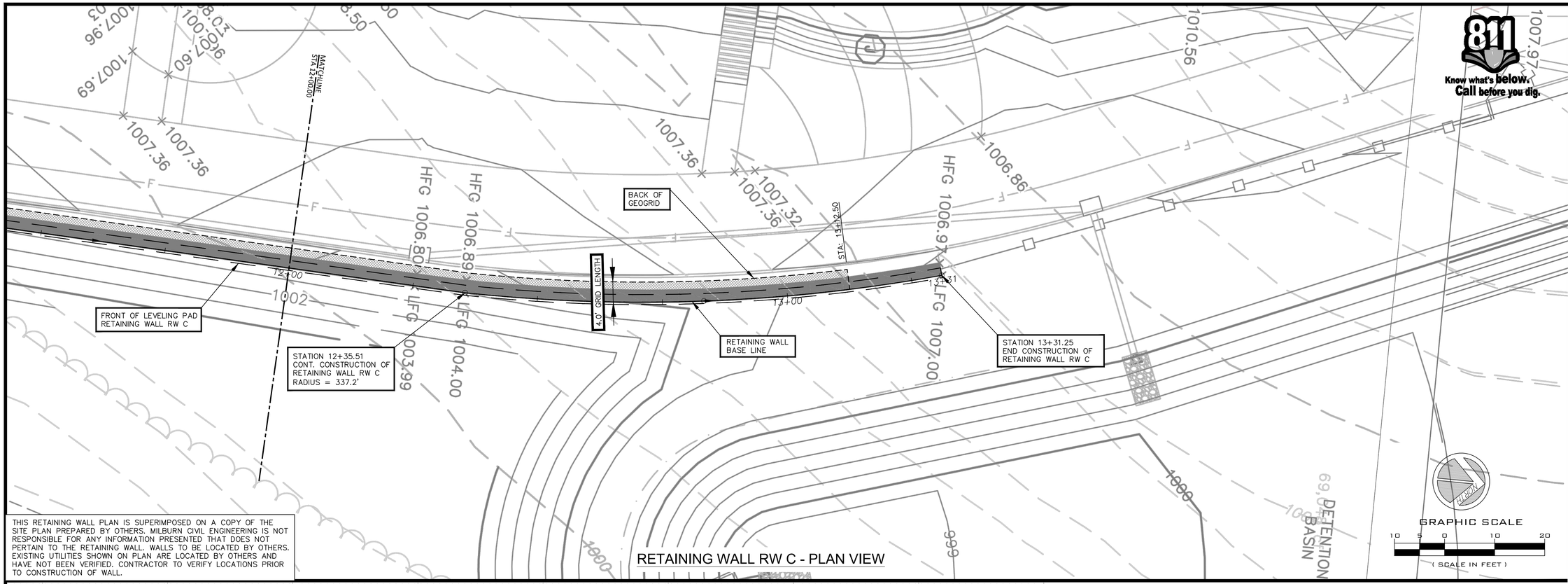
RETAINING WALL C
PLAN & PROFILE

W-08



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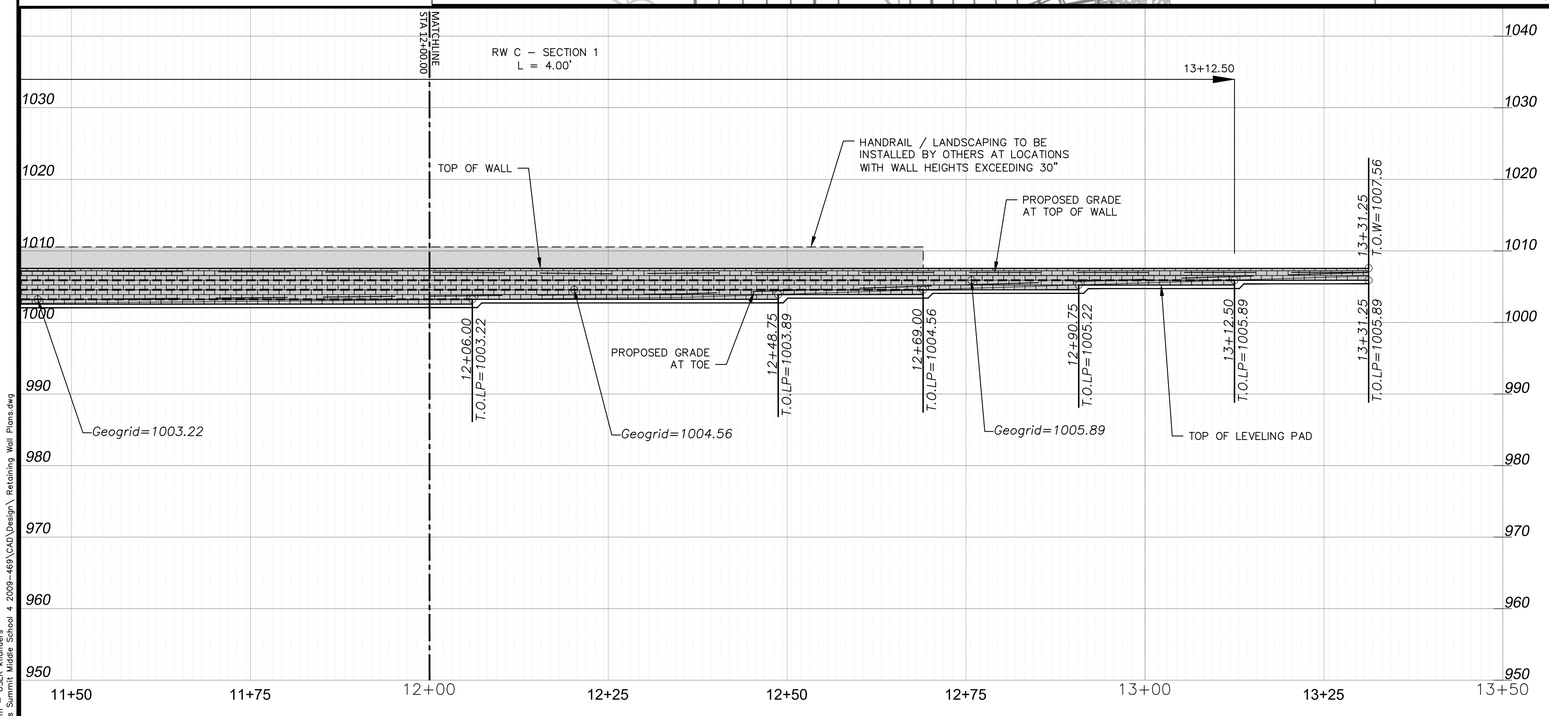

RETAINING WALL RW C - PROFILE VIEW

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

GRAPHIC SCALE
10 5 0 10 20
(SCALE IN FEET)

Milburn Civil Engineering, LLC

MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
PROFESSIONAL ENGINEER
10/12/2020

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

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REVISIONS REVISIONS

RETAINING WALL C
PLAN & PROFILE

W-09

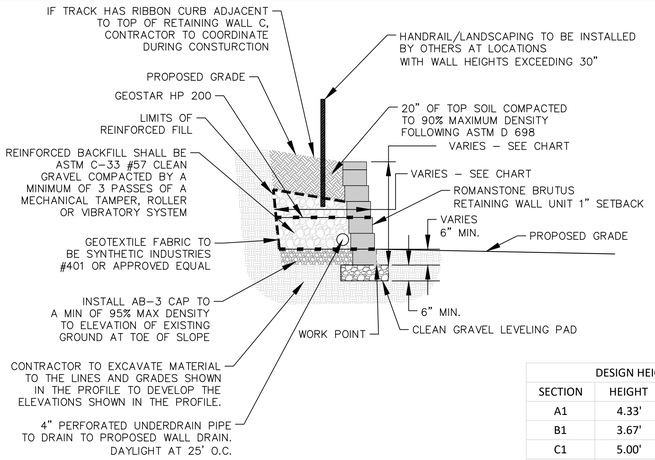
GEOTECHNICAL DESIGN PARAMETERS:
RETAINED BACKFILL: (CLAY)
UNIT WEIGHT = 120 PCF
FRICTION ANGLE = 24 DEGREES
REINFORCED BACKFILL: (CLEAN GRAVEL)
UNIT WEIGHT = 110 PCF
FRICTION ANGLE = 35 DEGREES
FOUNDATION SOIL: (CLAY)
UNIT WEIGHT = 120 PCF
FRICTION ANGLE = 24 DEGREES
COHESION = 25 PSF
BEARING CAPACITY = 2,500 PSF ALLOWABLE
LIVE LOAD SURCHARGE: 100 PSF, 250 PSF

SHOULD THE ACTUAL SOIL CONDITIONS OBSERVED DURING CONSTRUCTION DIFFER FROM THOSE USED FOR THE DESIGN, THE ACTUAL SOIL CONDITIONS SHALL BE REVIEWED BY THE WALL DESIGNER.

FOUNDATION PREPARATION NOTES:
CLAY FOUNDATION
IN AREAS THAT THE REINFORCED ZONE OF THE RETAINING WALL WILL BE FOUNDED
ON CLAY THE CONTRACTOR TO SCARIFY AND RECOMPACT THE EXPOSED SUBGRADE FROM THE TOP OF FOOTING DOWN 9". PRIOR TO RE-COMPACTION THE BEARING CAPACITY OF THE EXPOSED SOIL SHALL MEET A ALLOWABLE BEARING CAPACITY OF 2,500 PSF. IF THE CLAY MATERIAL DOES NOT MEET THE ALLOWABLE 2,500 PSF THE MATERIAL SHALL BE REMOVED DOWN TO SUITABLE BEARING MATERIAL AND RECOMPACTED TO THE FOLLOWING SPECIFICATION. THE COMPACTION OF RECOMPACTED CLAY SHALL BE WITHIN 95 TO 100 PERCENT OF STANDARD PROCTOR (ASTM D 698) MAXIMUM DRY DENSITY AT A MOISTURE CONTENT WET OF OPTIMUM MOISTURE CONTENT 0 TO 3 PERCENT.

ROCK FOUNDATION
IN AREAS THAT THE REINFORCED ZONE OF THE RETAINING WALL WILL BE FOUNDED ON
ROCK MATERIAL THE CONTRACTOR SHALL EXCAVATE TO THE TOP OF FOOTING ELEVATION
AND INSTALL A MIN. OF 6" AB-3. THE COMPACTION SHALL BE WITHIN 95 TO 100 PERCENT OF STANDARD PROCTOR (ASTM D 698) MAXIMUM DRY DENSITY AT A MOISTURE CONTENT WITHIN ±3 OF OPTIMUM MOISTURE.

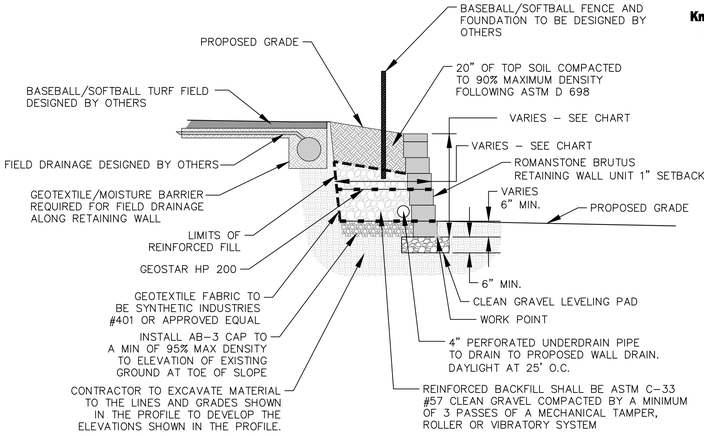
WALL LAYOUT
THE EXACT LOCATION OF WALL LAYOUT IS NOT SHOWN ON THESE PLANS. REFER TO CIVIL PLANS FOR THE EXACT LOCATION.



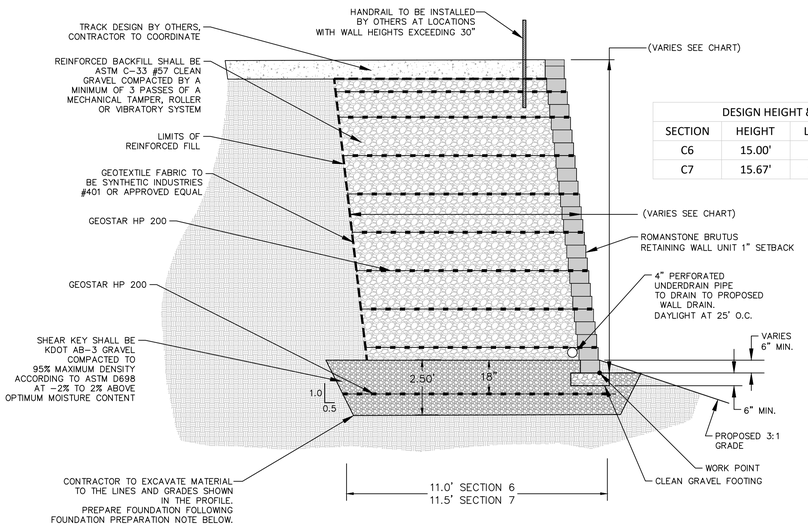
RETAINING WALL TYPICAL SECTION
SCALE: NONE

DESIGN HEIGHT & LENGTH			
SECTION	HEIGHT	LENGTH	# OF GRIDS
A1	4.33'	5.00'	1.5
B1	3.67'	4.00'	1.5
C1	5.00'	4.00'	2
C2	7.00'	5.00'	3
C3	9.00'	6.00'	4
C4	11.0'	7.00'	5.5
C5	13.00'	8.50'	6

811 Know what's below. Call before you dig.

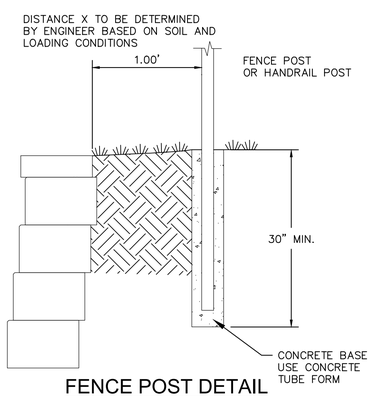


RETAINING WALL B (ADJACENT TO BASEBALL/SOFTBALL FIELD) SECTION
SCALE: NONE

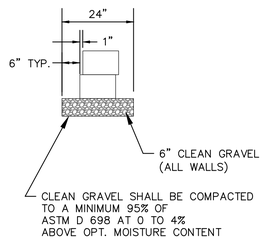


DESIGN HEIGHT & LENGTH			
SECTION	HEIGHT	LENGTH	# OF GRIDS
C6	15.00'	9.50'	7
C7	15.67'	10.50'	7

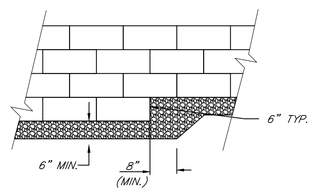
RW C - SECTION 6, 7
SCALE: NONE



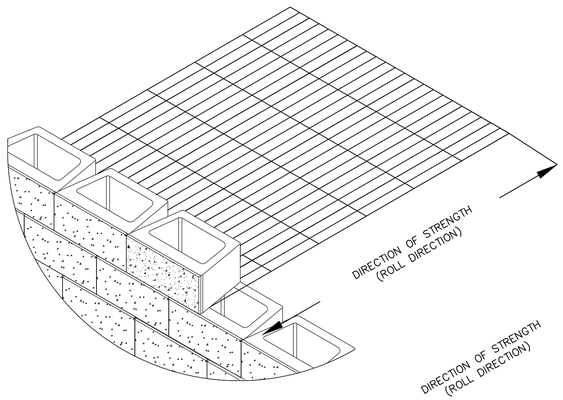
FENCE POST DETAIL
SCALE: NONE



LEVELING PAD DETAILS
SCALE: NONE



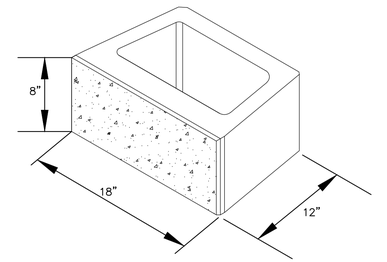
LEVELING PAD DETAILS
SCALE: NONE



NOTE:
FOLLOW GEOSYNTHETIC GRID MANUFACTURER'S INSTALLATION INSTRUCTIONS AND SPECIFICATIONS
–
GEOGRID LENGTH AND ELEVATION PLACEMENT SHALL BE DETERMINED BY WALL DESIGN ENGINEER

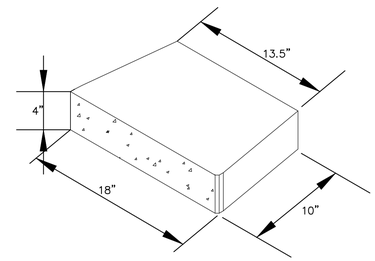
GEOSYNTHETIC INSTALLATION DETAIL
SCALE: NONE

WALL UNIT: BRUTUS
UNIT SIZE: 8" H X 18" W X 12" D
UNIT WEIGHT: 72 LBS
EXPOSED FACE: 1 SQ FT.



BRUTUS RETAINING WALL BLOCK
N.T.S.

WALL UNIT: CAP
UNIT SIZE: 4" H X 18" W X 10" D
UNIT WEIGHT: 56 LBS
EXPOSED FACE: 0.5 SQ FT.



BRUTUS RETAINING WALL CAP
N.T.S.

Milburn Civil Engineering, LLC
MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

STATE OF MISSOURI
JOHN P. MILBURN
2010027202
REGIONAL ENGINEER
10/12/2020

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
DESIGNED BY	KF
CHECKED BY	JPM

REVISIONS REVISIONS

RETAINING WALL DETAILS

W-10

MODULAR CONCRETE RETAINING WALL

PART 1: GENERAL

1.01 Description

A. Work shall consist of furnishing and construction of a Romanstone Brutus Retaining Wall System or equal in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.

B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.

C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

1.02 Related Sections

A. Section 02300 (31 00 00) - Earthwork

1.03 Reference Documents

A. American Society for Testing and Materials (ASTM)

1.	ASTM C140	Sampling and Testing Concrete Masonry Units
2.	ASTM C1372	Specification for Dry-Cast Segmental Retaining Wall Units
3.	ASTM D422	Particle-Size Analysis of Soils
4.	ASTM D698	Laboratory Compaction Characteristics of Soil -Standard Effort
5.	ASTM D1557	Laboratory Compaction Characteristics of Soil -Modified Effort
6.	ASTM D3034	Polyvinyl Chloride Pipe (PVC)
7.	ASTM D4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
8.	ASTM D4475	Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
9.	ASTM D4476	Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
10.	ASTM D4595	Tensile Properties of Geotextiles - Wide Width Strip
11.	ASTM D5262	Unconfined Tension Creep Behavior of Geosynthetics
12.	ASTM D5818	Evaluate Installation Damage of Geosynthetics
13.	ASTM D6637	Tensile Properties of Geogrids – Single or Multi-Rib
14.	ASTM D6638	Connection Strength - Reinforcement/Segmental Units
15.	ASTM D6706	Geosynthetic Pullout Resistance in Soil
16.	ASTM D6916	Shear Strength Between Segmental Concrete Units

B. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO M 252	Corrugated Polyethylene Drainage Pipe

C. Geosynthetic Research Institute (GRI)

1.	GRI-GG4	Determination of Long Term Design Strength of Geogrids
2.	GRI-GG5	Determination of Geogrid (soil) Pullout

D. National Concrete Masonry Association (NCMA)

1.	NCMA SRWU-1	Test Method for Determining Connection Strength of SRW
2.	NCMA SRWU-2	Test Method for Determining Shear Strength of SRW

1.04 Submittals/Certification

A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the state of the project. The engineering designs, techniques, and material evaluations shall be in accordance with the Manufacturer's Design Manual, NCMA Design Guidelines For Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges (whichever is applicable to designer).

C. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with ASTM D6638 (NCMA SRWU-1).

1.05 Quality Assurance

A. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units with fiberglass pins and specific geogrid):

1) Has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.; and

2) Has been successfully installed on a minimum of 1 million (1,000,000) square feet of retaining walls.

B. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the Romanstone Brutus retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.

C. Contractor shall provide evidence that the design engineer has a minimum of five years of documental experience in the design for reinforced soil structures. The design engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than $2,000,000.

D. Owner shall/may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide any quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.06 Delivery, Storage and Handling

A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.

B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Definitions

A. Modular Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates.

B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.

C. Unit Drainage Fill - drainage aggregate, which is placed within and immediately behind the modular concrete units.

D. Reinforced Backfill - compacted soil, which is placed within the reinforced soil volume as outlined on the plans.

2.02 Modular Concrete Retaining Wall Units

A. Modular concrete units shall conform to the following architectural requirements:

1. Face color - concrete gray, unless otherwise specified. The Owner, as indicated on the plans, may specify standard manufacturers' color or color blend.
2. Face finish - "weathered" rock face. Other face finishes will not be allowed without written approval of Owner.
3. Bond configuration – randomly utilize the various shapes to avoid repetition of the same unit size. Avoid stack bonding of unit joint for more than two courses vertically.
4. Exposed surfaces of units shall be free of cracks or major imperfections when viewed from a distance of 10 feet under diffused lighting. Chips and imperfections are expected with the "weathered" rock face texture and are acceptable unless adversely affecting installation or structural performance.

B. Modular concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.

C. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:

1. Compressive strength: ≥ 3000 psi minimum (21 MPa);
2. Absorption: ≤ 8% (6% in northern states) for standard weight aggregates;
3. Dimensional tolerances: ± 1/8" (3 mm) from nominal unit dimensions not including rough split face, ±1/16" (1.5 mm) unit height - top and bottom planes;
4. Unit size: 8" (203 mm)(H) x 12" (304 mm)(D) minimum; width of units varies from 7" to 18" (175 mm to 457 mm). Three or four unit sizes are typically available.
5. Unit weight: 35 lbs to 90 lbs (15 kg to 40 kg) per unit;

D. Modular concrete units shall conform to the following performance testing:

1. Inter-unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 1000-plf (14 kN/m) minimum at 2-psi (13 kPa) normal pressure;
2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 700-plf (10 kN/m) minimum at 2-psi (13 kPa) normal force.

E. Modular concrete units shall conform to the following constructability requirements:

1. Vertical setback = vertical (tilt wall back slightly to achieve positive batter) or 1" + per course per the design;
2. Maximum horizontal gap between erected units shall be ≤ 1/2 inch (13 mm).

2.03 Not Used

2.04 Base Leveling Pad Material

A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.05 Unit Drainage Fill

A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4	0 - 10
No. 50	0 - 5

B. One cubic foot (0.028 m3), minimum, of drainage fill shall be used for each square foot (0.093 m2) of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.

2.06 Reinforced Backfill

A. Reinforced backfill shall be free of debris and shall be clean gravel with a ASTM C-33 #57 stone.

B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.

C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.07 Geogrid Soil Reinforcement

A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.

B. Ta, Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

Ta = Tult / (RFcr*RFd*RFid*FS)
Ta shall be evaluated based on a 75-year design life.

1. Tult, Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637.
   Tult is based on the minimum average roll values (MARV).

2. RFcr, Reduction Factor for Long Term Tension Creep
   RFcr shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.

3. RFd, Reduction Factor for Durability
   RFd shall be determined from polymer specific durability testing covering the range of expected soil environments. RFd = 1.10 minimum.

4. RFid, Reduction Factor for Installation Damage
   RFid shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be provided for each product to be used with project specific or more severe soil type. RFid = 1.05 minimum.

5. FS, Overall Design Factor of Safety
   FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.

C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).

D. Soil Interaction Coefficient, Ci
Ci values shall be determined per ASTM D6706 (GRI:GG5) at a maximum 0.75-inch (19 mm) displacement.

E. Manufacturing Quality Control
The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.
The QC testing shall include:

Tensile Strength Testing
Melt Flow Index (HDPE)
Molecular Weight (Polyester)

2.08 Drainage Pipe

A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 Geotextile Filter Fabric

A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needlepunched nonwoven fabric.

PART 3: EXECUTION

3.01 Excavation

A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.

B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the modular wall unit.

B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.

C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Modular Unit Installation

A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated. If vertical unit alignment is chosen, units shall be uniformly tilted back towards the backfill slightly to create and maintain positive wall batter.

B. Place the front (any "weathered" finish side) of units side-by-side. Do not leave gaps between adjacent units along the exposed face(s). Layout of corners and curves shall be in accordance with manufacturer's recommendations.

C. Install shear/connecting pins per manufacturer's recommendations.

D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.

B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.

D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.

B. Reinforced backfill shall be placed and compacted in lifts not to exceed 12 inches.

C. Reinforced backfill shall be compacted with a minimum of 3 passes of a mechanical tamper, roller or vibratory system.

D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1m) from the tail of the modular concrete unit.

E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.

G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.07 As-built Construction Tolerances

A. Vertical Alignment: ± 1.5" (40 mm) over any 10' (3 m) distance.

B. Wall Batter: within 2 degrees of design batter.

C. Horizontal alignment: ± 1.5" (40 mm) over any 10' (3 mm) distance.
Corners, bends & curves: ± 1 ft (300 mm) to theoretical location.

D. Maximum horizontal gap between erected units shall be 1/2 inch (13 mm).

3.08 Field Quality Control

A. Quality Assurance - The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.

B. Quality assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications. *(Quality assurance is usually best performed by the site geotechnical engineer.)*

C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.

D. Quality control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.

Milburn Civil Engineering, LLC
MILBURN CIVIL ENGINEERING, LLC
33135 W 83RD ST
DE SOTO, KS 66018
913-583-0367

LEE'S SUMMIT MIDDLE SCHOOL #4

RETAINING WALL PLANS

1001 SE BAILEY ROAD
LEE'S SUMMIT, MO

DATE	10/12/2020
DESIGNED BY	KF
CHECKED BY	JPM

REVISIONS REVISIONS

RETAINING WALL SPECIFICATIONS

W-11

RETAINING WALL CALCULATIONS

FOR

Lee's Summit Middle School #4

Lee's Summit, MO

Prepared For:

BC Hardscapes, LLC

134 E. US 69 Highway

Claycomo, MO 64119

Prepared By:

Milburn Civil Engineering, LLC

Milburn Civil Engineering, LLC
33135 W. 83rd Street
De Soto, Kansas 66018
justin@milburnce.com

October 13, 2020

Table of Contents

Retaining Wall Calculations
Lee's Summit Middle School #4
Lee's Summit, MO

General Information

There are three (3) proposed segmental retaining walls to be constructed for the Lee's Summit Middle School #4 in Lee's Summit, MO. Two (2) of them will be located along outer baseball fields and one (1) will be located east of the proposed building and track and football field. Refer to the retaining wall plans for the location of the wall. The walls will be constructed out of Romanstone Brutus retaining wall block and Geostar HP 200 geogrid. The toe of the walls will be embedded a minimum of 6" beneath the proposed grade and will be founded on a 6" clean gravel leveling pad. The area behind the segmental retaining walls will be back filled with clean gravel. The stability of the proposed retaining walls was analyzed using SRWALL software and the design followed the National Concrete Masonry Association Design Manual for Segmental Retaining Walls. The retaining wall design sections meets the minimum required factors of safety for external and internal stability. A summary table of the factors of safety can be found in Appendix A along with the output from SR Wall. A global stability analysis was prepared on the critical retaining wall sections and can be found in Appendix B. If the wall locations or profiles changes, these calculations need to be updated to reflect those changes.

Appendix A

SR Wall Calculations

EXTERNAL STABILITY	Minimum Required	RW A - 1	RW B - 1	RW C - 1	RW C - 2	RW C - 3	RW C - 4	RW C - 5	RW C - 6	RW C - 7
FS Sliding	1.50	1.57	2.40	1.82	1.70	1.63	1.58	1.64	1.60	1.69
FS Overturning	2.00	5.19	8.01	4.88	4.33	4.04	3.85	4.12	3.97	4.38
FS Bearing Capacity	2.00	6.49	6.96	4.74	4.07	3.76	3.56	3.72	3.58	3.88
Base Reinforcement Length		5.00	4.00	4.00	5.00	6.00	7.00	8.50	9.50	10.50
Base Reinforcement Ratio	0.60	1.25	1.20	0.86	0.75	0.69	0.66	0.67	0.65	0.68
INTERNAL STABILITY (min. values)										
FS Overstress	1.50	12.68	16.33	9.74	6.85	5.28	4.30	3.54	2.99	2.84
FS Pullout	1.50	8.47	4.54	2.85	2.71	2.57	2.41	3.29	3.13	5.19
FS Sliding	1.50	3.61	7.48	4.62	3.41	2.91	2.64	2.60	2.48	2.58
Internal Compound Stability	1.30	2.21	3.06	2.24	1.74	1.55	1.48	1.48	1.39	1.43
Global Stability Analysis	1.30	2.18	1.42	-	-	-	-	1.46	1.37 (With Shear Key)	1.32 (With Shear Key)

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW A - Section 1**
Project File	: **RW A-1.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **4.00**
Embedment Wall Height(ft)	: **0.50**
Exposed Wall Design Height(ft)	: **3.50**
Number of Segmental Wall Units	: **6**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **17.50**
Broken Back Distance(ft)	: **10.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **50.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	2

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.245**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.235**
Internal Modified Back Slope(Bint)	**: 17.500**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 52.805**
Retained Soil(Static)(Ka)	**: 0.452**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.433**
External Modified Back Slope(Bext)	**: 17.500**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 39.854**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.57	> 1.50
FOS Overturning	5.19	> 2.00
FOS Bearing Capacity	6.49	> 2.00
Base Reinforcement Length (L)(ft)	5.00	
Base Reinforcement Ratio (L/H)	1.25	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
4	Synteen SF 35 - Geostar 200	2.00	5.00	2.73	13.46	8.47	5.27	OK
2	Synteen SF 35 - Geostar 200	0.67	5.00	3.58	12.68	14.78	3.61	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
4	2.00	Synteen SF 35 - Geostar 200	2.90	7.07
2	0.67	Synteen SF 35 - Geostar 200		6.92

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	2.183	2446	1216	1708	66	0	4036	26	0
2	2.258	1732	1173	1289	6	0	2874	25	0
3	2.624	1710	1131	1092	24	0	2825	25	0
4	2.983	1360	1089	821	0	0	2252	25	0
5	3.273	1017	879	579	0	0	1699	25	0
6	3.015	682	435	371	0	0	1168	25	0

Basic Internal Compound Stability Static Result

Lowest FOS : **2.183**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 1**

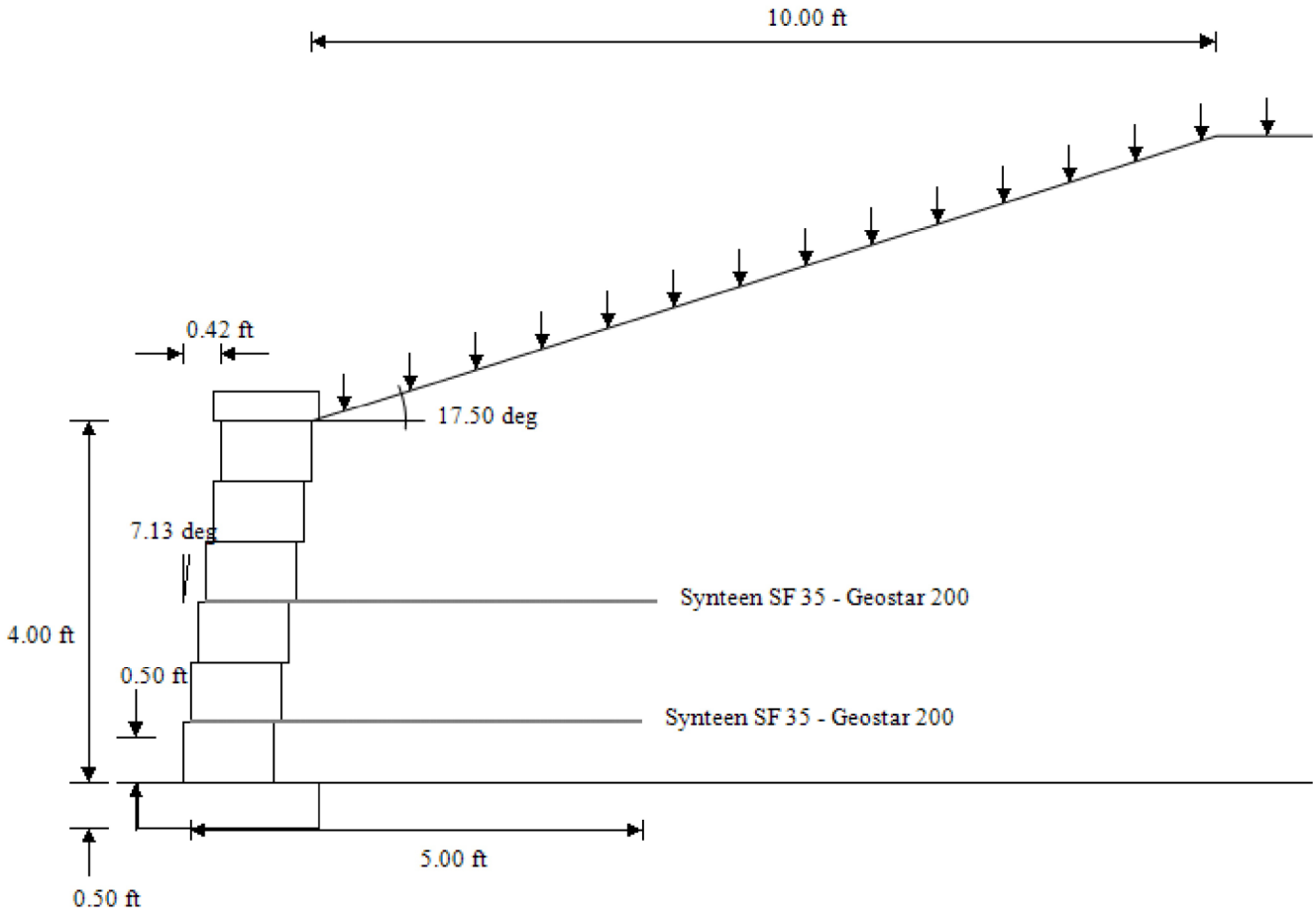
Elevation : **0.00 ft**

Distance to Entrance at Top Grade : **10.26 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	2.183	0.000	10.977	10.977	0.000	0.000	10.261	7.078
2	2.258	-2.766	16.475	16.063	0.083	0.667	10.261	7.078
3	2.624	0.167	13.075	11.742	0.167	1.333	10.261	7.078
4	2.983	0.250	14.408	12.408	0.250	2.000	10.261	7.078
5	3.273	0.333	16.044	13.378	0.333	2.667	10.261	7.078
6	3.015	0.417	18.147	14.814	0.417	3.333	10.261	7.078

Wall Reinforcement Layout

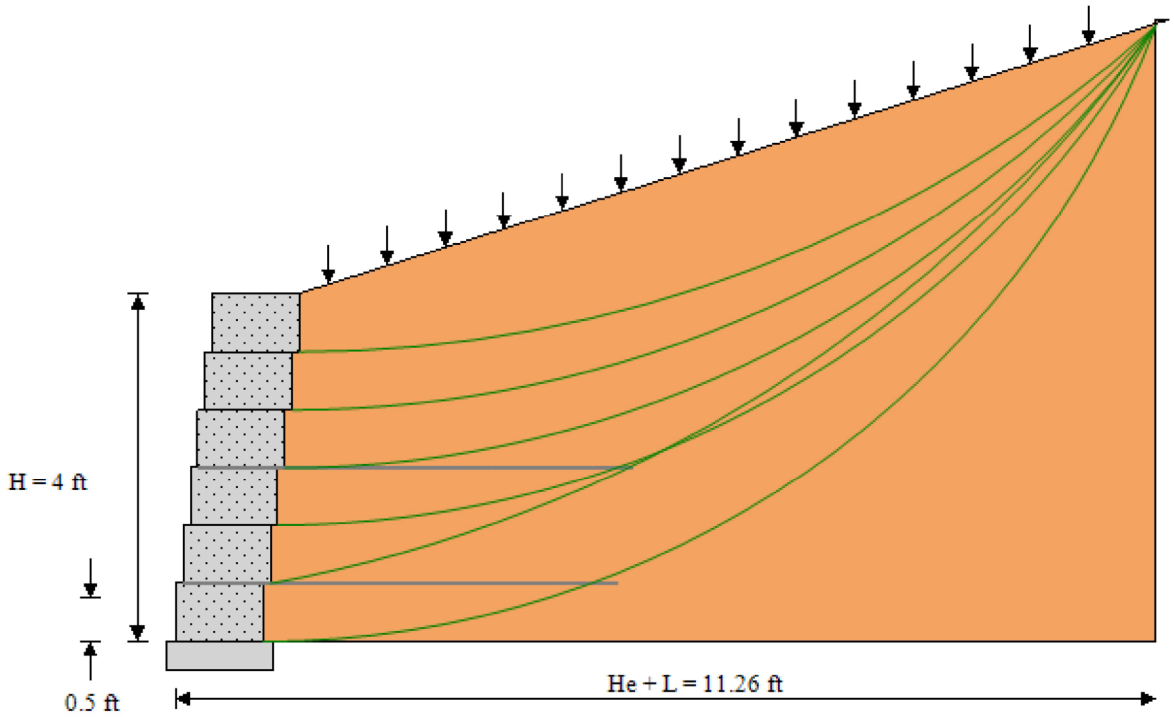


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW A - Section 1**
Vendor Data File	:
Project File	: **RW A-1.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 2.183



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW A - Section 1**
Vendor Data File	:
Project File	: **RW A-1.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW B - Section 1**
Project File	: **RW B-1.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **3.33**
Embedment Wall Height(ft)	: **0.50**
Exposed Wall Design Height(ft)	: **2.83**
Number of Segmental Wall Units	: **5**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **2.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	2

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.201**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.193**
Internal Modified Back Slope(Bint)	**: 2.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.925**
Retained Soil(Static)(Ka)	**: 0.327**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.313**
External Modified Back Slope(Bext)	**: 2.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.726**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	2.40	> 1.50
FOS Overturning	8.01	> 2.00
FOS Bearing Capacity	6.96	> 2.00
Base Reinforcement Length (L)(ft)	4.00	
Base Reinforcement Ratio (L/H)	1.20	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
4	Synteen SF 35 - Geostar 200	2.00	4.00	1.90	20.43	4.54	16.02	OK
2	Synteen SF 35 - Geostar 200	0.67	4.00	2.63	16.33	9.74	7.48	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
4	2.00	Synteen SF 35 - Geostar 200	3.90	10.53
2	0.67	Synteen SF 35 - Geostar 200		8.74

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	3.064	1544	1173	887	0	0	2476	669	0
2	3.397	953	1131	614	2	0	1445	549	0
3	4.620	909	1089	437	20	0	1413	609	0
4	6.548	469	1047	232	0	0	650	364	0
5	11.579	360	862	106	0	0	509	356	0

Basic Internal Compound Stability Static Result

Lowest FOS : **3.064**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 1**

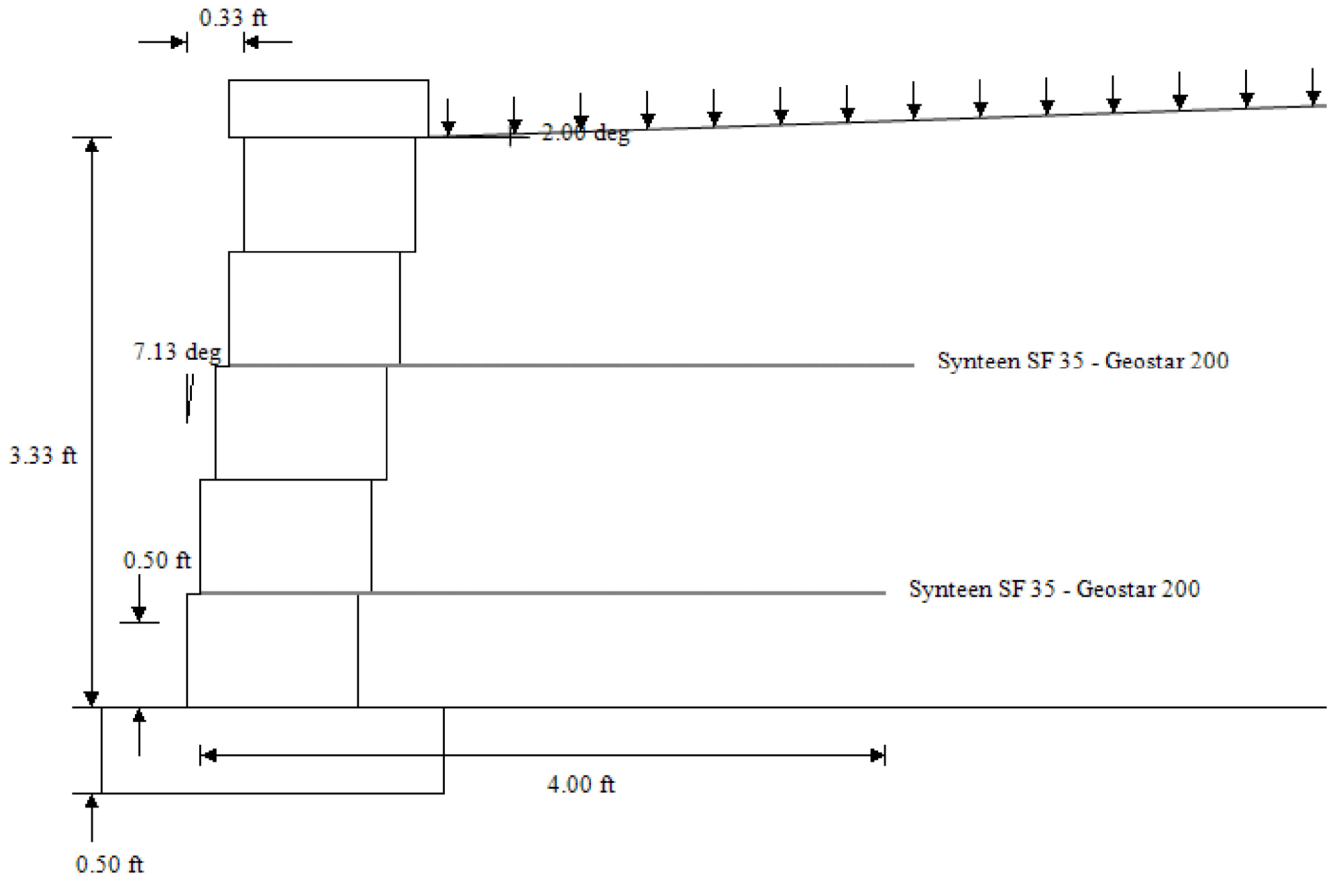
Elevation : **0.00 ft**

Distance to Entrance at Top Grade : **7.04 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	3.064	0.000	8.742	8.742	0.000	0.000	7.044	3.565
2	3.397	-8.805	25.922	26.774	0.083	0.667	5.863	3.524
3	4.620	-2.282	17.616	16.466	0.167	1.333	6.257	3.537
4	6.548	-4.276	18.627	17.232	0.250	2.000	3.894	3.455
5	11.579	-2.119	22.181	19.667	0.333	2.667	3.894	3.455

Wall Reinforcement Layout

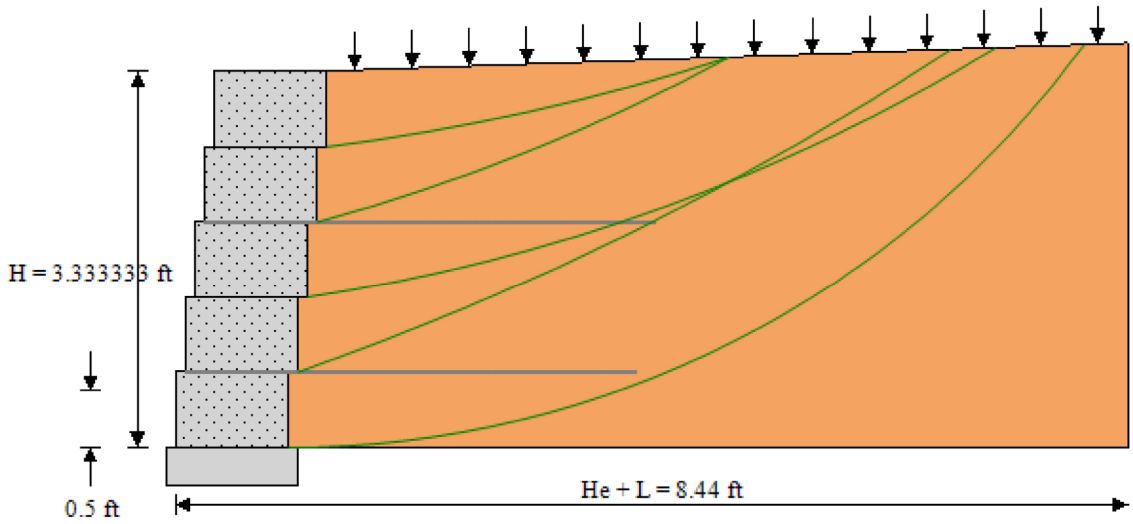


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW B - Section 1**
Vendor Data File	:
Project File	: **RW B-1.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 3.064



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW B - Section 1**
Vendor Data File	:
Project File	: **RW B-1.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 1**
Project File	: **RW C-1.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **4.67**
Embedment Wall Height(ft)	: **0.50**
Exposed Wall Design Height(ft)	: **4.17**
Number of Segmental Wall Units	: **7**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	2

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.82	> 1.50
FOS Overturning	4.88	> 2.00
FOS Bearing Capacity	4.74	> 2.00
Base Reinforcement Length (L)(ft)	4.00	
Base Reinforcement Ratio (L/H)	0.86	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
5	Synteen SF 35 - Geostar 200	2.67	4.00	1.52	10.69	2.85	9.81	OK
2	Synteen SF 35 - Geostar 200	0.67	4.00	2.63	9.74	8.70	4.62	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
5	2.67	Synteen SF 35 - Geostar 200	2.45	5.62
2	0.67	Synteen SF 35 - Geostar 200		5.42

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	2.239	2198	1116	1480	0	0	3619	740	0
2	2.314	1470	1216	1161	0	0	2338	683	0
3	2.727	1298	1173	908	4	0	2062	675	0
4	3.420	1398	1114	737	11	0	2385	857	0
5	4.304	789	1089	436	0	0	1179	540	0
6	4.672	479	653	242	0	0	673	377	0
7	7.030	371	435	115	0	0	527	368	0

Basic Internal Compound Stability Static Result

Lowest FOS : **2.239**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 1**

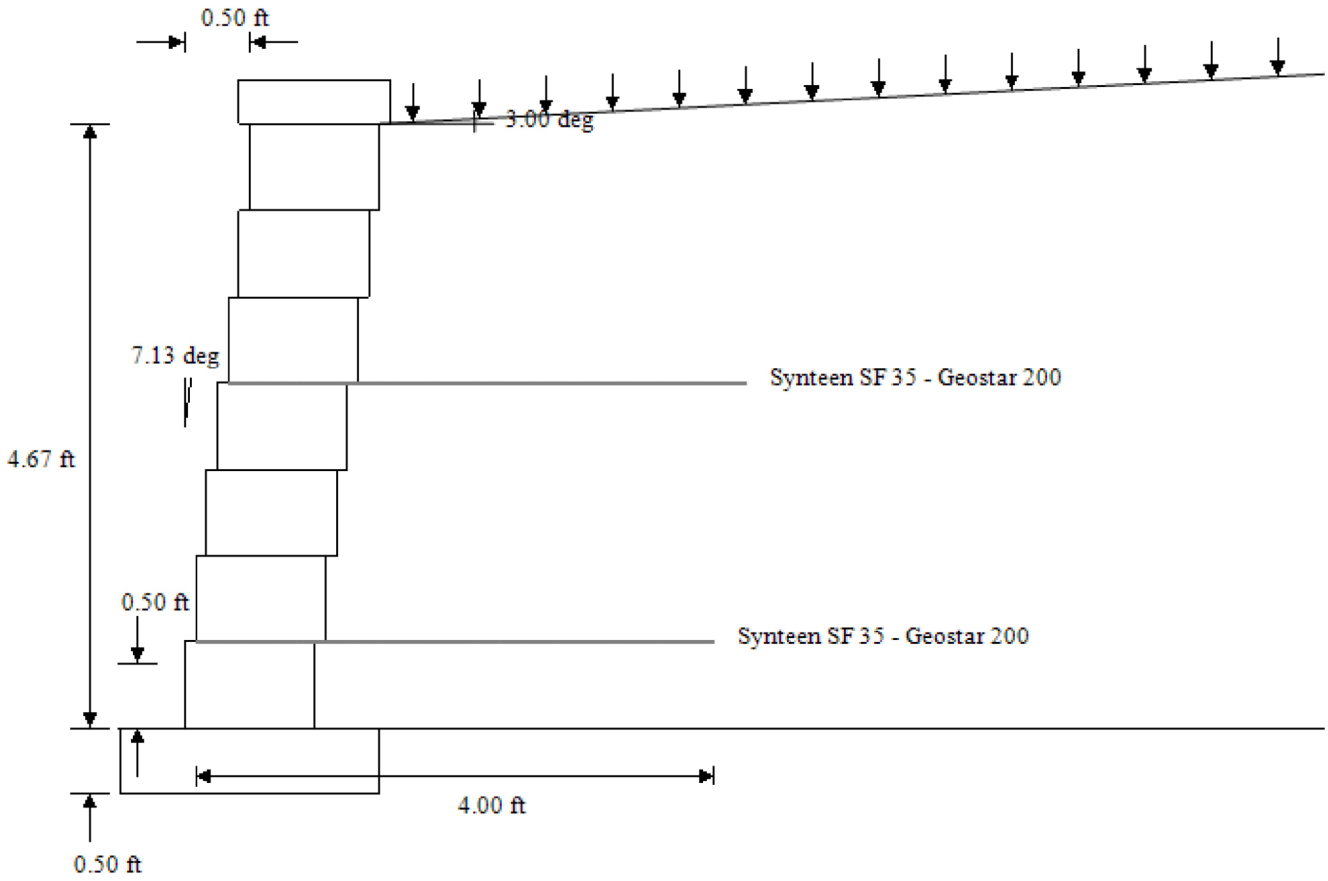
Elevation : **0.00 ft**

Distance to Entrance at Top Grade : **7.79 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	2.239	0.000	8.541	8.541	0.000	0.000	7.792	5.044
2	2.314	-13.452	31.168	33.370	0.083	0.667	7.277	5.017
3	2.727	-11.295	32.156	32.885	0.167	1.333	7.277	5.017
4	3.420	-3.881	26.843	25.185	0.250	2.000	8.824	5.099
5	4.304	-6.728	27.005	25.342	0.333	2.667	5.730	4.936
6	4.672	-4.318	20.469	17.777	0.417	3.333	4.182	4.855
7	7.030	-2.161	23.811	19.989	0.500	4.000	4.182	4.855

Wall Reinforcement Layout

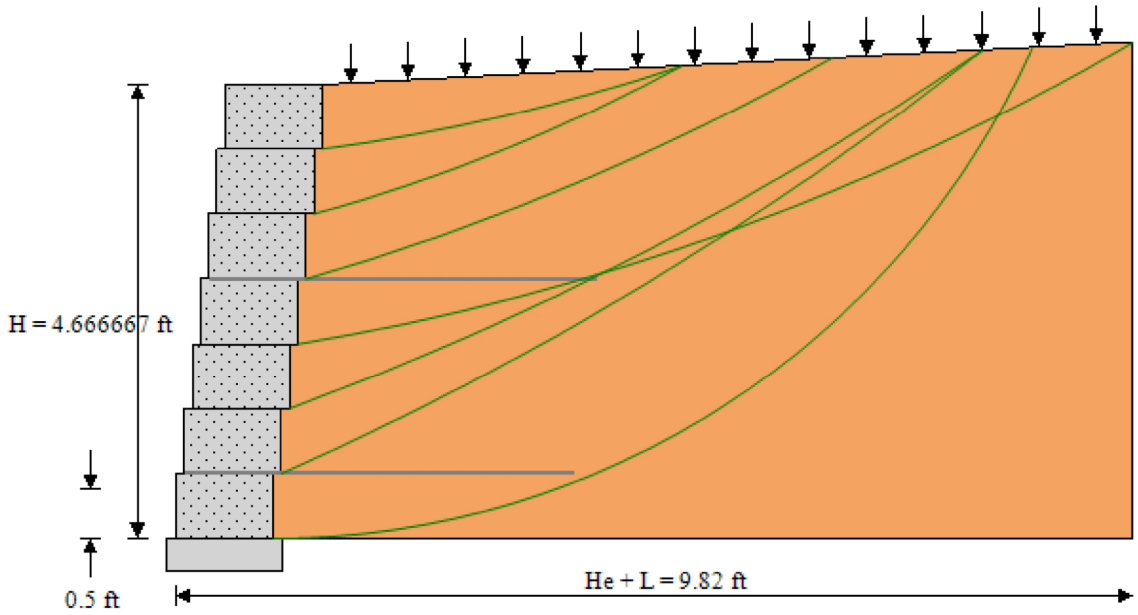


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 1**
Vendor Data File	:
Project File	: **RW C-1.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 2.239



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 1**
Vendor Data File	:
Project File	: **RW C-1.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 2**
Project File	: **RW C-2.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **6.67**
Embedment Wall Height(ft)	: **0.61**
Exposed Wall Design Height(ft)	: **6.06**
Number of Segmental Wall Units	: **10**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	3

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.70	> 1.50
FOS Overturning	4.33	> 2.00
FOS Bearing Capacity	4.07	> 2.00
Base Reinforcement Length (L)(ft)	5.00	
Base Reinforcement Ratio (L/H)	0.75	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
8	Synteen SF 35 - Geostar 200	4.67	5.00	1.41	10.69	2.71	10.38	OK
5	Synteen SF 35 - Geostar 200	2.67	5.00	2.52	7.86	6.81	5.14	OK
2	Synteen SF 35 - Geostar 200	0.67	5.00	3.63	6.85	12.63	3.41	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
8	4.67	Synteen SF 35 - Geostar 200	2.45	5.62
5	2.67	Synteen SF 35 - Geostar 200		4.37
2	0.67	Synteen SF 35 - Geostar 200		4.02

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.922	3979	1336	2783	34	0	6798	1031	0
2	1.739	2687	1342	2328	18	0	4599	952	0
3	1.994	2765	1300	2051	25	0	4803	1015	0
4	2.387	2732	1177	1700	149	0	4684	1007	0
5	2.400	1732	1216	1228	0	0	2779	788	0
6	2.822	1667	1126	994	12	0	2726	895	0
7	3.687	1700	1114	765	7	0	2835	961	0
8	4.392	786	1089	427	0	0	1101	508	0
9	4.931	635	653	261	0	0	904	499	0
10	7.453	497	435	125	0	0	709	491	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.739**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

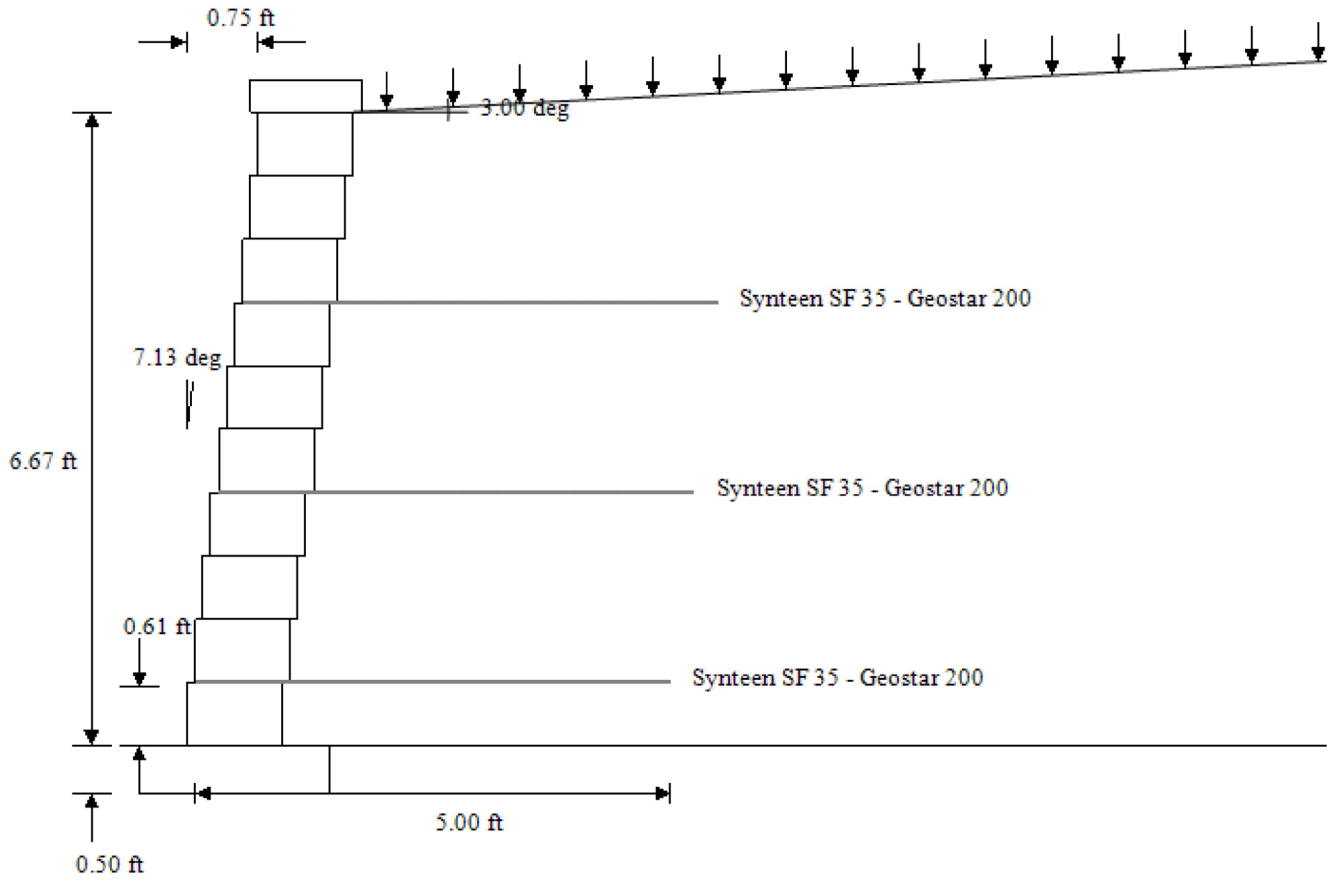
Elevation : **0.67 ft**

Distance to Entrance at Top Grade : **10.11 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.922	0.000	11.781	11.781	0.000	0.000	10.850	7.192
2	1.739	-11.447	29.479	31.034	0.083	0.667	10.108	7.153
3	1.994	-5.041	23.500	22.770	0.167	1.333	10.850	7.192
4	2.387	-0.904	17.773	15.815	0.250	2.000	10.850	7.192
5	2.400	-9.463	31.095	30.069	0.333	2.667	8.625	7.075
6	2.822	-8.825	37.695	35.583	0.417	3.333	9.367	7.114
7	3.687	-0.901	24.488	20.536	0.500	4.000	10.108	7.153
8	4.392	-6.426	27.298	23.692	0.583	4.667	5.658	6.920
9	4.931	-4.268	29.510	24.675	0.667	5.333	5.658	6.920
10	7.453	-2.111	34.830	28.972	0.750	6.000	5.658	6.920

Wall Reinforcement Layout

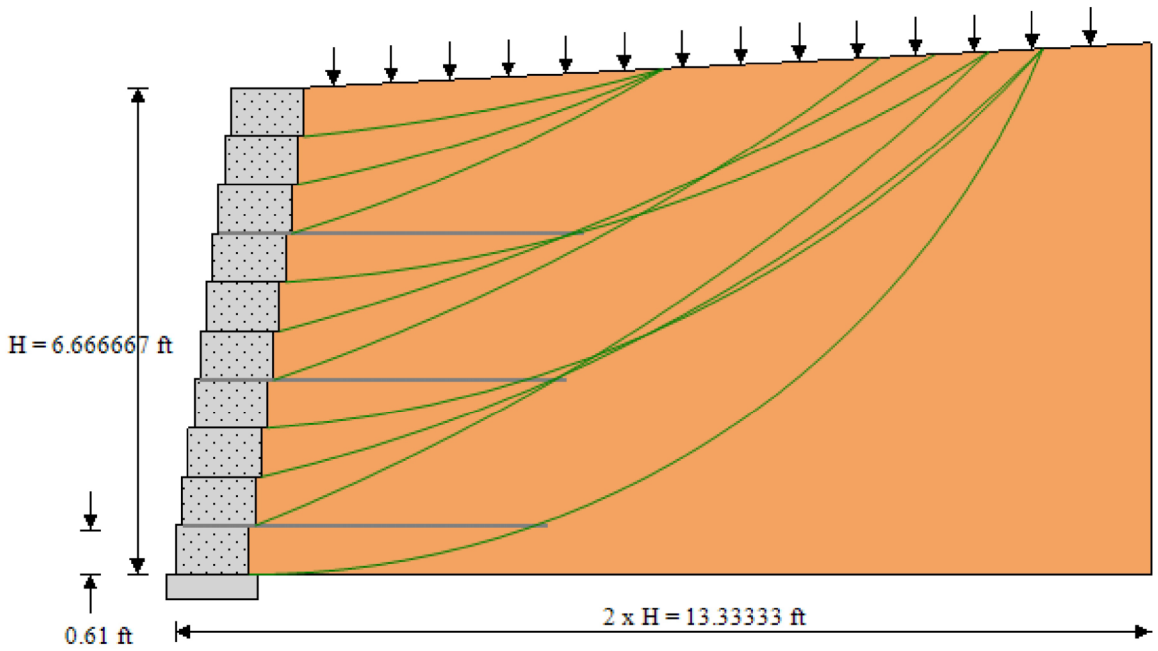


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 2**
Vendor Data File	:
Project File	: **RW C-2.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.739



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 2**
Vendor Data File	:
Project File	: **RW C-2.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 3**
Project File	: **RW C-3.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **8.67**
Embedment Wall Height(ft)	: **0.79**
Exposed Wall Design Height(ft)	: **7.88**
Number of Segmental Wall Units	: **13**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	4

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used **: Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.63	> 1.50
FOS Overturning	4.04	> 2.00
FOS Bearing Capacity	3.76	> 2.00
Base Reinforcement Length (L)(ft)	6.00	
Base Reinforcement Ratio (L/H)	0.69	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
11	Synteen SF 35 - Geostar 200	6.67	6.00	1.30	10.69	2.57	10.92	OK
8	Synteen SF 35 - Geostar 200	4.67	6.00	2.41	7.86	6.60	5.64	OK
5	Synteen SF 35 - Geostar 200	2.67	6.00	3.52	5.58	10.07	3.82	OK
2	Synteen SF 35 - Geostar 200	0.67	6.00	4.63	5.28	16.54	2.91	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
11	6.67	Synteen SF 35 - Geostar 200	2.45	5.62
8	4.67	Synteen SF 35 - Geostar 200		4.37
5	2.67	Synteen SF 35 - Geostar 200		3.28
2	0.67	Synteen SF 35 - Geostar 200		3.26

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.771	7054	1512	4852	26	0	12868	1552	0
2	1.548	4594	1469	3963	74	0	8172	1254	0
3	1.753	4844	1427	3616	66	0	8707	1343	0
4	2.016	4953	1240	3123	104	0	8750	1335	0
5	1.874	3319	1342	2495	16	0	5676	1134	0
6	2.122	3438	1189	2187	12	0	5975	1222	0
7	2.592	3487	1177	1812	34	0	5963	1278	0
8	2.539	1913	1216	1244	30	0	2958	820	0
9	3.034	2032	1126	1047	20	0	3327	1058	0
10	3.962	1992	1114	786	8	0	3245	1050	0
11	4.560	983	1089	454	0	0	1395	635	0
12	5.240	803	653	278	0	0	1148	627	0
13	7.859	630	435	136	0	0	901	618	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.548**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

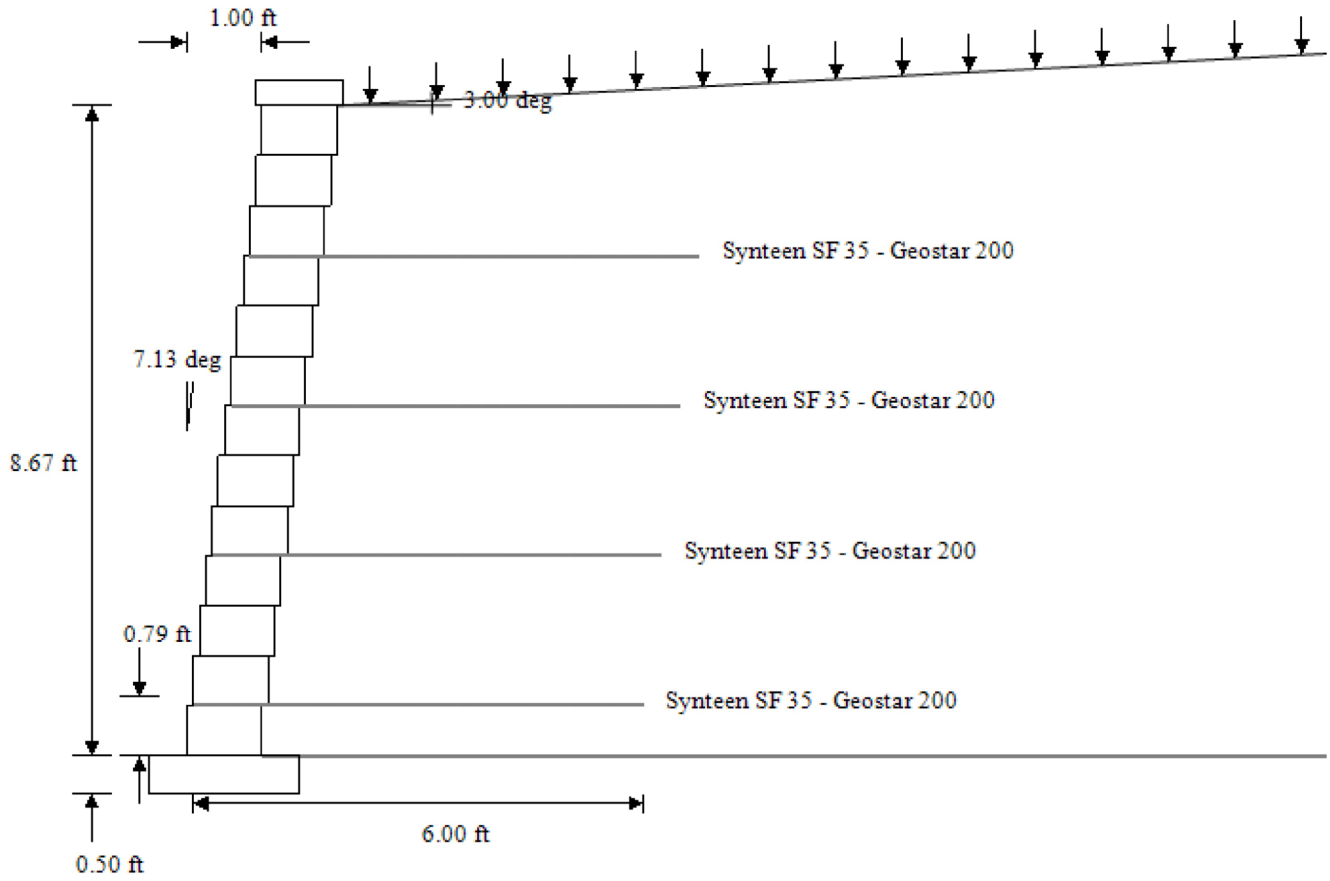
Distance to Entrance at Top Grade : **13.28 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.771	0.000	18.824	18.824	0.000	0.000	16.333	9.466
2	1.548	-7.596	26.804	27.242	0.083	0.667	13.283	9.306
3	1.753	-3.400	24.072	23.017	0.167	1.333	14.300	9.359
4	2.016	0.250	19.091	17.091	0.250	2.000	14.300	9.359
5	1.874	-8.448	32.682	31.273	0.333	2.667	12.267	9.253
6	2.122	-3.565	28.756	25.733	0.417	3.333	13.283	9.306
7	2.592	0.500	22.052	18.052	0.500	4.000	13.283	9.306
8	2.539	-6.302	28.729	25.028	0.583	4.667	9.217	9.093
9	3.034	-6.206	40.567	35.898	0.667	5.333	11.250	9.199
10	3.962	0.750	24.829	18.829	0.750	6.000	11.250	9.199
11	4.560	-6.383	36.273	30.474	0.833	6.667	7.183	8.986

12	5.240	-4.226	39.535	32.609	0.917	7.333	7.183	8.986
13	7.859	-2.069	47.111	39.232	1.000	8.000	7.183	8.986

Wall Reinforcement Layout

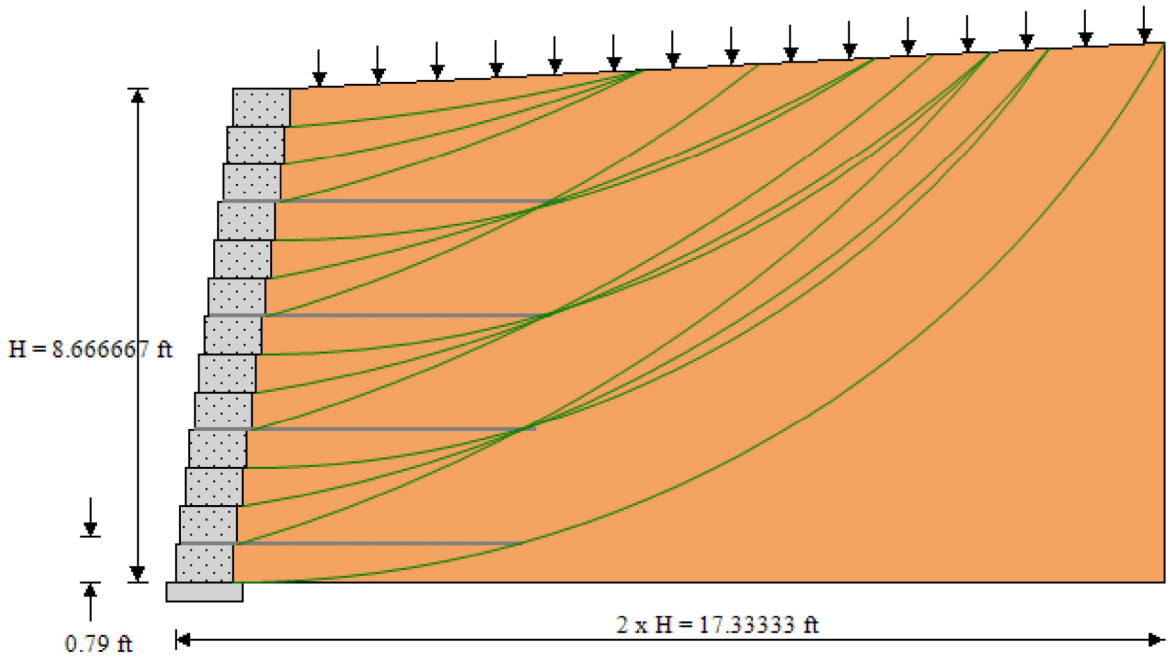


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 3**
Vendor Data File	:
Project File	: **RW C-3.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.548



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 3**
Vendor Data File	:
Project File	: **RW C-3.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 4**
Project File	: **RW C-4.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **10.67**
Embedment Wall Height(ft)	: **0.97**
Exposed Wall Design Height(ft)	: **9.70**
Number of Segmental Wall Units	: **16**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	5

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.58	> 1.50
FOS Overturning	3.85	> 2.00
FOS Bearing Capacity	3.56	> 2.00
Base Reinforcement Length (L)(ft)	7.00	
Base Reinforcement Ratio (L/H)	0.66	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
14	Synteen SF 35 - Geostar 200	8.67	7.00	1.19	10.69	2.41	11.44	OK
11	Synteen SF 35 - Geostar 200	6.67	7.00	2.30	7.86	6.38	6.13	OK
8	Synteen SF 35 - Geostar 200	4.67	7.00	3.41	5.58	9.84	4.22	OK
5	Synteen SF 35 - Geostar 200	2.67	7.00	4.52	4.33	13.32	3.24	OK
2	Synteen SF 35 - Geostar 200	0.67	7.00	5.63	4.30	20.45	2.64	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
14	8.67	Synteen SF 35 - Geostar 200	2.45	5.62
11	6.67	Synteen SF 35 - Geostar 200		4.37
8	4.67	Synteen SF 35 - Geostar 200		3.28
5	2.67	Synteen SF 35 - Geostar 200		2.67
2	0.67	Synteen SF 35 - Geostar 200		2.78

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.740	10538	1638	7183	323	0	19261	1932	0
2	1.475	7683	1596	6360	100	0	14493	1801	0
3	1.669	7714	1554	5587	54	0	13890	1670	0
4	1.837	6037	1303	4849	1565	0	10777	1662	0
5	1.684	5159	1469	4001	108	0	8861	1286	0
6	1.859	5407	1253	3653	133	0	9418	1401	0
7	2.222	6433	1240	3470	37	0	11673	1854	0
8	2.044	3937	1342	2591	17	0	6554	1263	0
9	2.334	3919	1189	2194	13	0	6452	1255	0
10	2.847	4291	1177	1941	58	0	7348	1571	0
11	2.706	2493	1216	1374	10	0	4012	1175	0
12	3.274	2398	1126	1081	15	0	3844	1167	0
13	4.264	2453	1114	839	12	0	4006	1288	0
14	4.742	1175	1089	477	0	0	1692	762	0
15	5.515	964	653	293	0	0	1395	754	0
16	8.157	756	435	146	0	0	1096	746	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.475**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

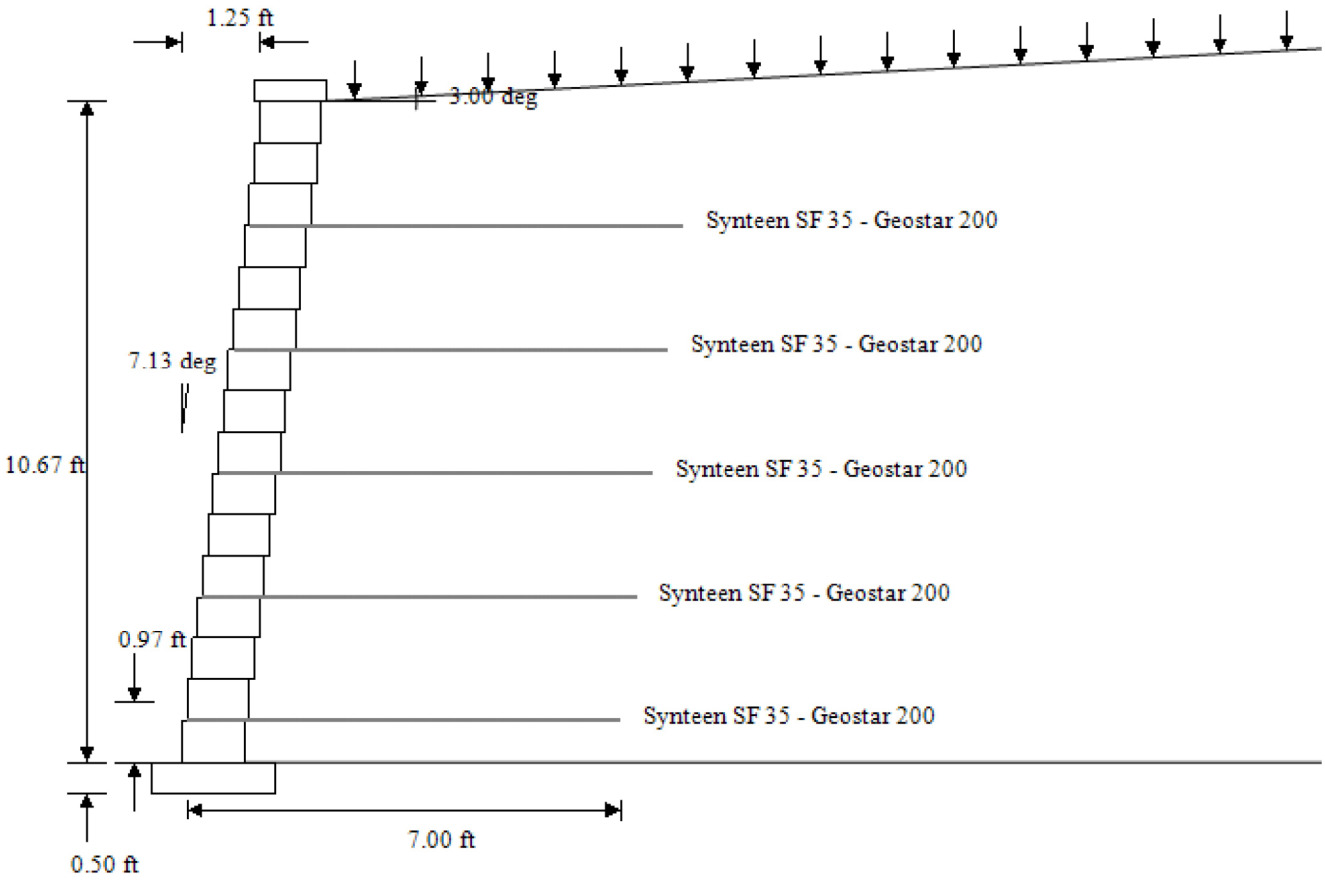
Distance to Entrance at Top Grade : **19.04 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.740	0.000	23.557	23.557	0.000	0.000	20.333	11.662
2	1.475	-9.630	39.427	39.959	0.083	0.667	19.042	11.595
3	1.669	-2.099	25.503	24.275	0.167	1.333	17.750	11.527
4	1.837	-25.155	69.503	72.125	0.250	2.000	17.750	11.527
5	1.684	-3.514	23.605	21.289	0.333	2.667	13.875	11.324
6	1.859	-1.374	24.140	20.883	0.417	3.333	15.167	11.392
7	2.222	0.500	30.431	26.431	0.500	4.000	19.042	11.595
8	2.044	-5.334	33.079	29.022	0.583	4.667	13.875	11.324

9	2.334	-0.665	25.825	20.535	0.667	5.333	13.875	11.324
10	2.847	0.750	31.329	25.329	0.750	6.000	16.458	11.459
11	2.706	-13.445	60.558	55.751	0.833	6.667	12.583	11.256
12	3.274	-2.570	37.013	29.884	0.917	7.333	12.583	11.256
13	4.264	1.000	34.597	26.597	1.000	8.000	13.875	11.324
14	4.742	-6.341	45.763	37.832	1.083	8.667	8.708	11.053
15	5.515	-4.184	50.192	41.207	1.167	9.333	8.708	11.053
16	8.157	-2.027	60.139	50.246	1.250	10.000	8.708	11.053

Wall Reinforcement Layout

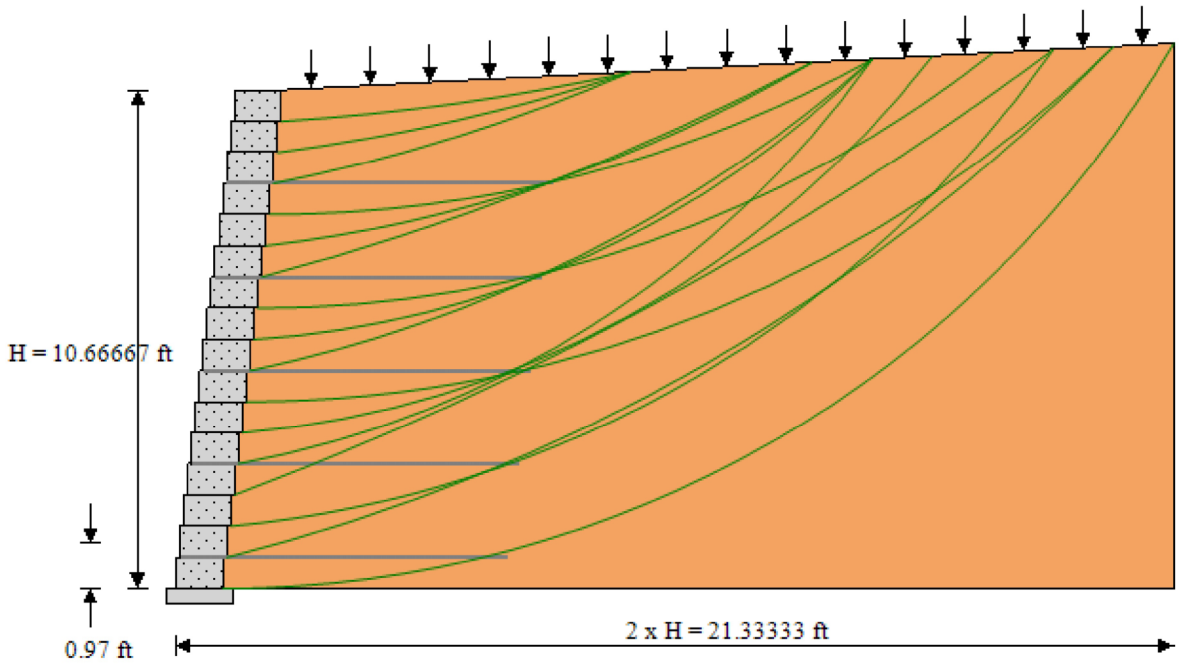


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 4**
Vendor Data File	:
Project File	: **RW C-4.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.475



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 4**
Vendor Data File	:
Project File	: **RW C-4.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 5**
Project File	: **RW C-5.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **12.67**
Embedment Wall Height(ft)	: **1.15**
Exposed Wall Design Height(ft)	: **11.52**
Number of Segmental Wall Units	: **19**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	6

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.64	> 1.50
FOS Overturning	4.12	> 2.00
FOS Bearing Capacity	3.72	> 2.00
Base Reinforcement Length (L)(ft)	8.50	
Base Reinforcement Ratio (L/H)	0.67	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
17	Synteen SF 35 - Geostar 200	10.67	8.50	1.58	10.69	3.29	12.18	OK
14	Synteen SF 35 - Geostar 200	8.67	8.50	2.69	7.86	7.58	6.84	OK
11	Synteen SF 35 - Geostar 200	6.67	8.50	3.80	5.58	11.09	4.80	OK
8	Synteen SF 35 - Geostar 200	4.67	8.50	4.91	4.33	14.59	3.73	OK
5	Synteen SF 35 - Geostar 200	2.67	8.50	6.02	3.54	18.10	3.06	OK
2	Synteen SF 35 - Geostar 200	0.67	8.50	7.13	3.63	26.21	2.60	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
17	10.67	Synteen SF 35 - Geostar 200	2.45	5.62
14	8.67	Synteen SF 35 - Geostar 200		4.37
11	6.67	Synteen SF 35 - Geostar 200		3.28
8	4.67	Synteen SF 35 - Geostar 200		2.67
5	2.67	Synteen SF 35 - Geostar 200		2.29
2	0.67	Synteen SF 35 - Geostar 200		2.50

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.749	12491	1765	9064	1601	0	22034	1879	0
2	1.483	9250	1723	8415	1504	0	16924	2016	0
3	1.599	9278	1681	7831	1566	0	16838	2008	0
4	1.700	9577	1377	7392	1615	0	17757	2144	0
5	1.641	8514	1596	6204	69	0	14977	1704	0
6	1.805	8568	1316	5551	136	0	14856	1696	0
7	2.005	7465	1303	5169	1595	0	13288	1976	0
8	1.902	6851	1469	4403	55	0	11692	1680	0
9	2.084	6838	1253	3883	0	0	11809	1672	0
10	2.486	5061	1240	3182	1608	0	8272	1520	0
11	2.277	4610	1342	2661	108	0	7453	1368	0
12	2.631	4798	1189	2331	146	0	7862	1583	0
13	3.180	5467	1177	2118	91	0	9610	2030	0
14	2.983	3095	1216	1454	26	0	4974	1415	0
15	3.610	2975	1126	1146	34	0	4765	1407	0
16	4.669	3214	1114	928	4	0	5381	1702	0
17	5.002	1440	1089	506	0	0	2102	935	0
18	5.867	1183	653	313	0	0	1734	927	0
19	8.499	928	435	160	0	0	1363	918	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.483**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

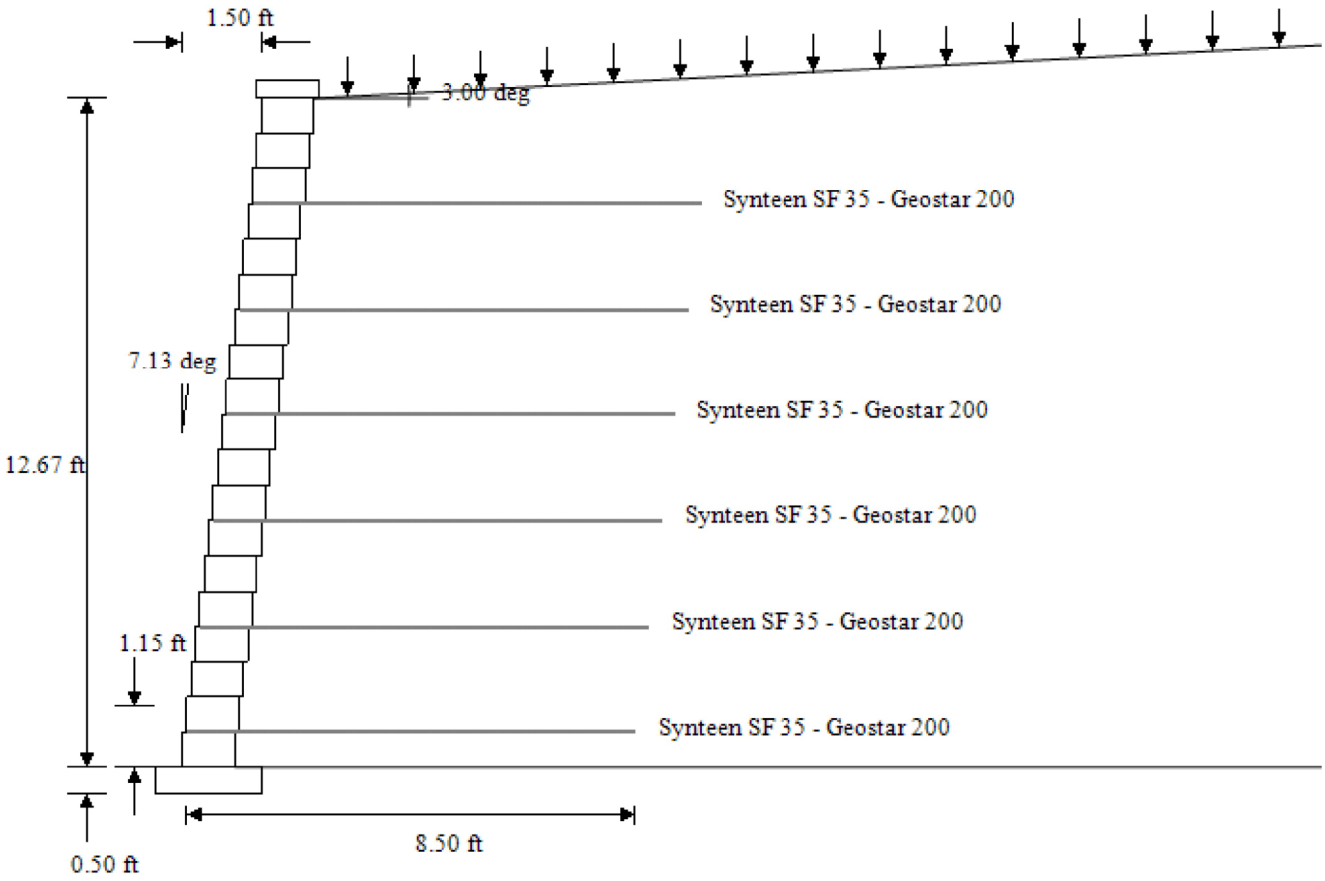
Distance to Entrance at Top Grade : **21.30 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.749	0.000	21.178	21.178	0.000	0.000	19.783	13.620
2	1.483	-40.465	90.460	98.524	0.083	0.667	21.300	13.700
3	1.599	-21.818	63.144	65.605	0.167	1.333	21.300	13.700
4	1.700	-15.456	59.595	59.698	0.250	2.000	22.817	13.779
5	1.641	-2.083	26.876	24.330	0.333	2.667	18.267	13.541

6	1.805	0.417	24.044	20.711	0.417	3.333	18.267	13.541
7	2.005	-18.900	72.751	71.436	0.500	4.000	21.300	13.700
8	1.902	-3.361	34.581	30.174	0.583	4.667	18.267	13.541
9	2.084	0.667	28.307	22.974	0.667	5.333	18.267	13.541
10	2.486	-10.857	51.774	47.223	0.750	6.000	16.750	13.462
11	2.277	-2.151	31.864	25.373	0.833	6.667	15.233	13.382
12	2.631	-0.445	34.370	27.071	0.917	7.333	16.750	13.462
13	3.180	1.000	46.998	38.998	1.000	8.000	21.300	13.700
14	2.983	-10.443	66.844	59.308	1.083	8.667	15.233	13.382
15	3.610	-1.532	45.172	35.940	1.167	9.333	15.233	13.382
16	4.669	1.250	52.658	42.658	1.250	10.000	18.267	13.541
17	5.002	-6.373	58.641	48.590	1.333	10.667	10.683	13.144
18	5.867	-4.215	64.786	53.749	1.417	11.333	10.683	13.144
19	8.499	-2.058	78.015	66.111	1.500	12.000	10.683	13.144

Wall Reinforcement Layout

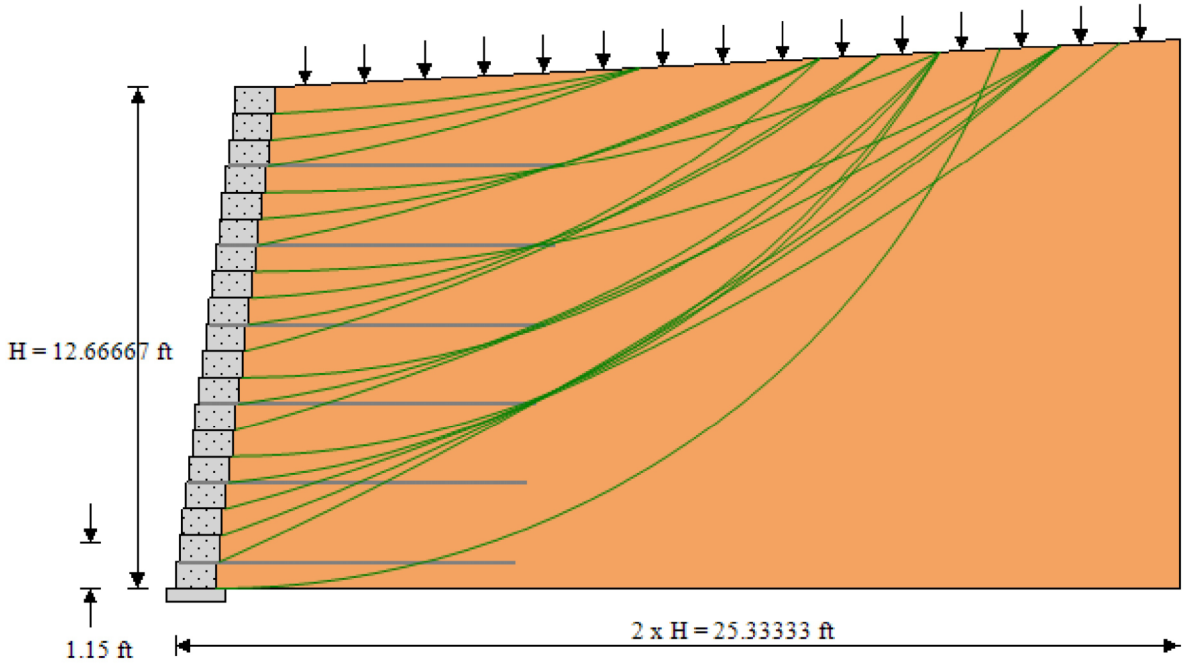


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 5**
Vendor Data File	:
Project File	: **RW C-5.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.483



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 5**
Vendor Data File	:
Project File	: **RW C-5.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 6**
Project File	: **RW C-6.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **14.67**
Embedment Wall Height(ft)	: **1.33**
Exposed Wall Design Height(ft)	: **13.34**
Number of Segmental Wall Units	: **22**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	7

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.60	> 1.50
FOS Overturning	3.97	> 2.00
FOS Bearing Capacity	3.58	> 2.00
Base Reinforcement Length (L)(ft)	9.50	
Base Reinforcement Ratio (L/H)	0.65	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
20	Synteen SF 35 - Geostar 200	12.67	9.50	1.46	10.69	3.13	12.64	OK
17	Synteen SF 35 - Geostar 200	10.67	9.50	2.58	7.86	7.37	7.30	OK
14	Synteen SF 35 - Geostar 200	8.67	9.50	3.69	5.58	10.86	5.18	OK
11	Synteen SF 35 - Geostar 200	6.67	9.50	4.80	4.33	14.36	4.04	OK
8	Synteen SF 35 - Geostar 200	4.67	9.50	5.91	3.54	17.87	3.33	OK
5	Synteen SF 35 - Geostar 200	2.67	9.50	7.02	2.99	21.37	2.84	OK
2	Synteen SF 35 - Geostar 200	0.67	9.50	8.13	3.13	30.13	2.48	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
20	12.67	Synteen SF 35 - Geostar 200	2.45	5.62
17	10.67	Synteen SF 35 - Geostar 200		4.37
14	8.67	Synteen SF 35 - Geostar 200		3.28
11	6.67	Synteen SF 35 - Geostar 200		2.67
8	4.67	Synteen SF 35 - Geostar 200		2.29
5	2.67	Synteen SF 35 - Geostar 200		2.06
2	0.67	Synteen SF 35 - Geostar 200		2.43

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.667	15648	1892	11483	1599	0	27021	2011	0
2	1.392	12094	1850	11170	1610	0	22354	2173	0
3	1.503	12168	1807	10454	1731	0	22237	2165	0
4	1.601	10096	1502	9109	2985	0	17769	1987	0
5	1.549	10216	1723	8699	1537	0	18623	2149	0
6	1.637	10212	1395	8067	1596	0	18523	2141	0
7	1.800	10391	1377	7428	1606	0	18654	2134	0
8	1.764	9833	1596	6530	91	0	17218	1955	0
9	1.888	7673	1316	5602	1587	0	13069	1777	0
10	2.098	7860	1303	5178	1699	0	13609	1940	0
11	2.012	7509	1469	4481	37	0	12735	1761	0
12	2.257	7952	1253	4079	4	0	13688	2025	0
13	2.585	5773	1240	3346	1637	0	9638	1838	0
14	2.421	5658	1342	2895	9	0	9535	1829	0
15	2.781	5181	1189	2361	195	0	8456	1642	0
16	3.444	6370	1177	2223	110	0	11194	2350	0
17	3.162	3399	1216	1474	48	0	5349	1446	0
18	3.833	3593	1126	1234	13	0	6007	1796	0
19	4.864	3666	1114	984	6	0	6295	1967	0
20	5.216	1648	1089	525	0	0	2407	1062	0
21	6.141	1356	653	327	0	0	1988	1054	0
22	8.659	2200	435	304	0	0	4055	2479	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.392**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

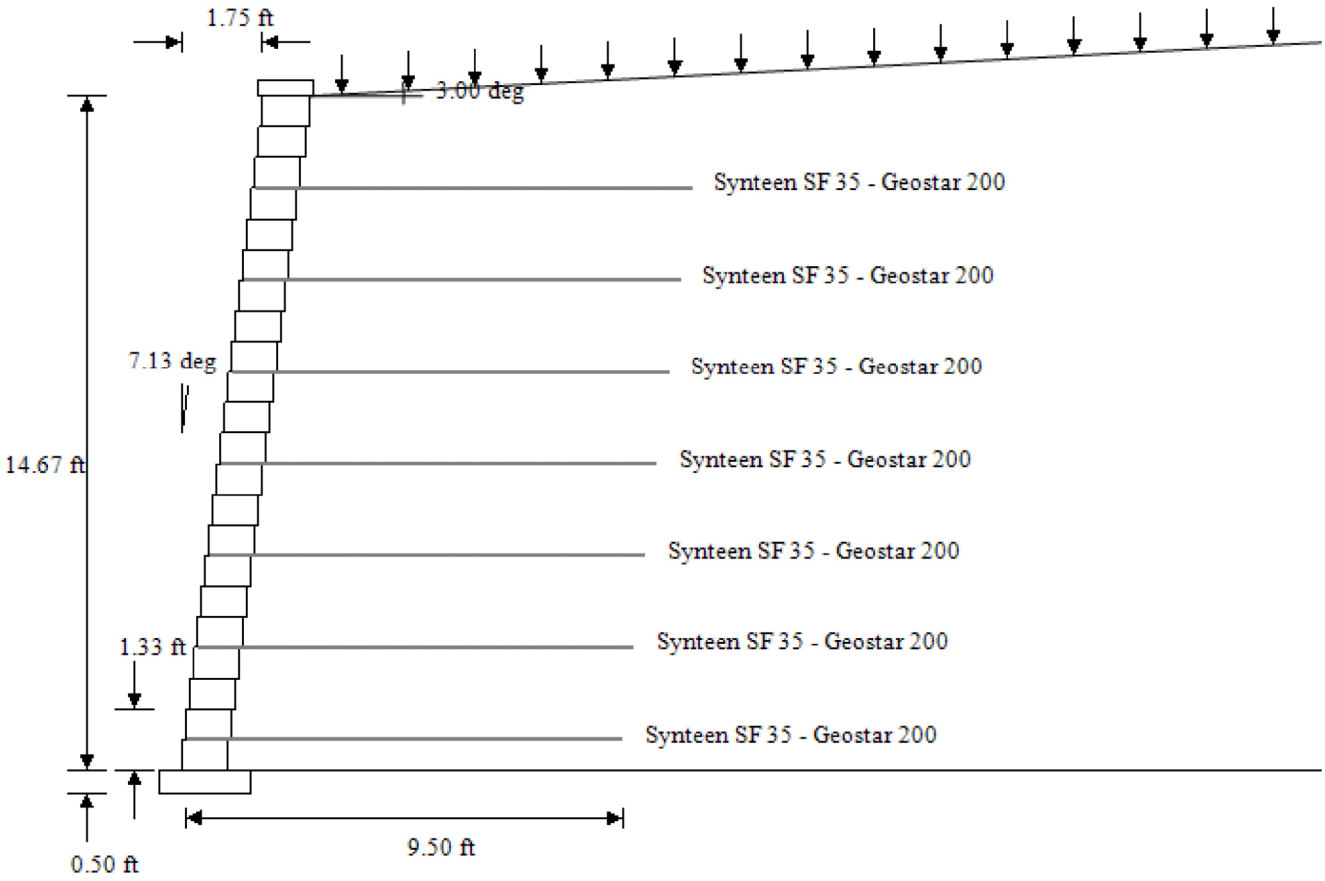
Distance to Entrance at Top Grade : **22.96 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.667	0.000	22.127	22.127	0.000	0.000	21.167	15.680
2	1.392	-20.059	56.039	58.922	0.083	0.667	22.958	15.774

3	1.503	-12.669	46.799	47.243	0.167	1.333	22.958	15.774
4	1.601	-30.150	71.312	75.686	0.250	2.000	21.167	15.680
5	1.549	-28.794	79.025	81.725	0.333	2.667	22.958	15.774
6	1.637	-16.171	60.031	59.075	0.417	3.333	22.958	15.774
7	1.800	-7.349	46.279	43.001	0.500	4.000	22.958	15.774
8	1.764	-1.864	33.982	29.417	0.583	4.667	21.167	15.680
9	1.888	-10.725	48.316	44.466	0.667	5.333	19.375	15.586
10	2.098	-10.005	55.056	50.222	0.750	6.000	21.167	15.680
11	2.012	-1.149	34.519	27.923	0.833	6.667	19.375	15.586
12	2.257	0.917	36.071	28.738	0.917	7.333	21.167	15.680
13	2.585	-12.486	66.714	60.243	1.000	8.000	19.375	15.586
14	2.421	-3.530	48.498	40.098	1.083	8.667	19.375	15.586
15	2.781	1.167	34.293	24.959	1.167	9.333	17.583	15.492
16	3.444	1.250	59.992	49.992	1.250	10.000	24.750	15.868
17	3.162	-3.924	51.188	40.861	1.333	10.667	15.792	15.398
18	3.833	-4.254	75.322	64.239	1.417	11.333	19.375	15.586
19	4.864	1.500	66.393	54.393	1.500	12.000	21.167	15.680
20	5.216	-6.330	69.184	57.069	1.583	12.667	12.208	15.210
21	6.141	-4.173	76.669	63.605	1.667	13.333	12.208	15.210
22	8.659	-4.353	248.777	234.856	1.750	14.000	26.542	15.962

Wall Reinforcement Layout

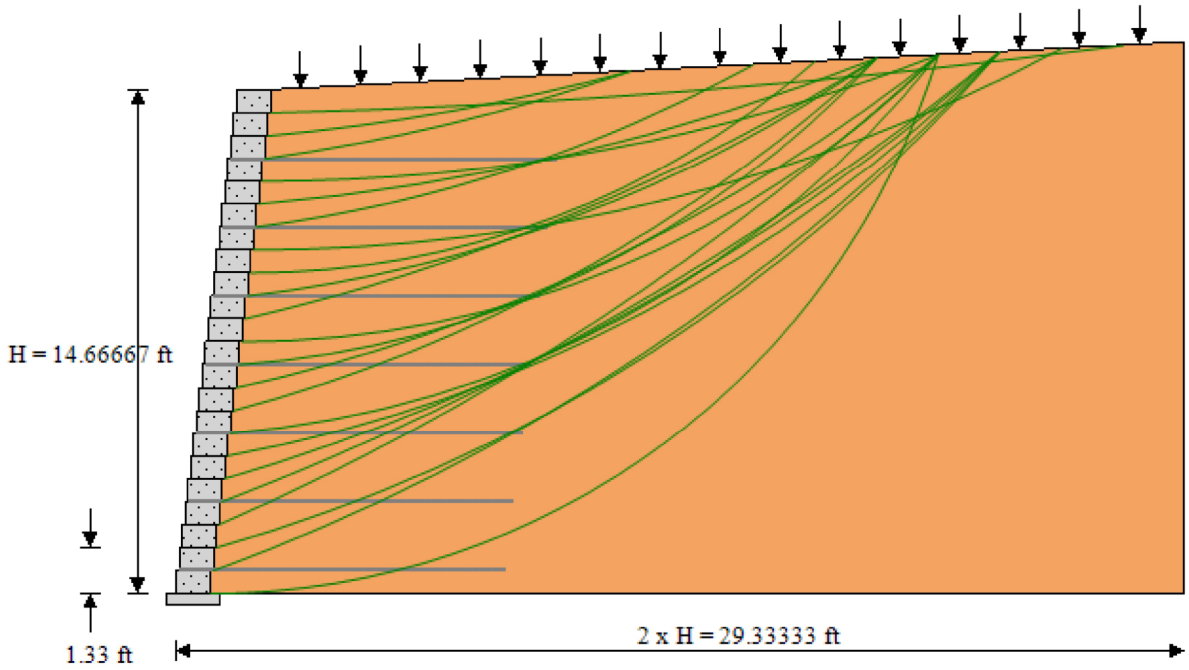


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 6**
Vendor Data File	:
Project File	: **RW C-6.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.392



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 6**
Vendor Data File	:
Project File	: **RW C-6.prj**
Date and Time	: **09/29/2020 10:21:46**

SRWall (Version 4) Report

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 7**
Project File	: **RW C-7.prj**
Vendor Data File	:
Date and Time	: **09/29/2020 10:21:46**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **15.33**
Embedment Wall Height(ft)	: **1.39**
Exposed Wall Design Height(ft)	: **13.94**
Number of Segmental Wall Units	: **23**
Wall Inclination(degrees)	: **7.13**

Grades

Top Slope(degrees)	: **3.00**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **100.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Clean Gravel	N/A	35.00	110.00
Retained Soil	Clay	N/A	24.00	120.00
Leveling Pad Soil	AB-3	N/A	35.00	130.00
Foundation Soil	Clay	25.00	24.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.00**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	Miragrid 10XT	0
	Miragrid 5XT	0
	Miragrid 8XT	0
	Strata 150	0
	Synteen SF 35 - Geostar 200	8

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
Miragrid 10XT	9500.00	1.58	1.10	1.25	4372.84	0.90	0.90
Miragrid 5XT	4700.00	1.58	1.10	1.25	2163.41	0.90	0.90
Miragrid 8XT	7400.00	1.58	1.10	1.25	3406.21	0.90	0.90
Strata 150	1875.00	1.58	1.10	1.50	719.22	0.90	0.90
Synteen SF 35 - Geostar 200	3600.00	1.58	1.10	1.25	1657.08	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
Miragrid 10XT	937.00	1930.00	2690.00	3863.00	3619.00
Miragrid 5XT	1161.00	1923.00	1782.00	3856.00	2105.00
Miragrid 8XT	1313.00	1500.00	1826.00	3000.00	2420.00
Strata 150	605.00	500.00	755.00	1500.00	1055.00
Synteen SF 35 - Geostar 200	820.00	1500.00	1112.00	3000.00	1932.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
Miragrid 10XT	962.00	26.00	1950.00
Miragrid 5XT	962.00	26.00	1950.00
Miragrid 8XT	962.00	26.00	1950.00
Strata 150	962.00	26.00	1950.00
Synteen SF 35 - Geostar 200	962.00	26.00	1950.00

Vertical Components

Vertical Components of Earth Pressures Used : **Yes**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.203**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.195**
Internal Modified Back Slope(Bint)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 55.773**
Retained Soil(Static)(Ka)	**: 0.331**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.317**
External Modified Back Slope(Bext)	**: 3.000**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 47.406**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.69	> 1.50
FOS Overturning	4.38	> 2.00
FOS Bearing Capacity	3.88	> 2.00
Base Reinforcement Length (L)(ft)	10.50	
Base Reinforcement Ratio (L/H)	0.68	> 0.60

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.00
22	Synteen SF 35 - Geostar 200	14.00	10.50	1.73	20.23	5.19	17.19	OK
20	Synteen SF 35 - Geostar 200	12.67	10.50	2.46	12.39	7.87	10.61	OK
17	Synteen SF 35 - Geostar 200	10.67	10.50	3.58	6.92	10.43	6.84	OK
14	Synteen SF 35 - Geostar 200	8.67	10.50	4.69	5.09	13.97	5.09	OK
11	Synteen SF 35 - Geostar 200	6.67	10.50	5.80	4.03	17.49	4.07	OK
8	Synteen SF 35 - Geostar 200	4.67	10.50	6.91	3.33	21.01	3.40	OK
5	Synteen SF 35 - Geostar 200	2.67	10.50	8.02	2.84	24.53	2.93	OK
2	Synteen SF 35 - Geostar 200	0.67	10.50	9.13	3.00	33.94	2.58	OK

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
22	14.00	Synteen SF 35 - Geostar 200	3.86	10.42
20	12.67	Synteen SF 35 - Geostar 200		6.63
17	10.67	Synteen SF 35 - Geostar 200		3.92
14	8.67	Synteen SF 35 - Geostar 200		3.04
11	6.67	Synteen SF 35 - Geostar 200		2.53
8	4.67	Synteen SF 35 - Geostar 200		2.19
5	2.67	Synteen SF 35 - Geostar 200		2.04
2	0.67	Synteen SF 35 - Geostar 200		2.41

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.649	18078	1934	13115	1620	0	32139	2301	0
2	1.437	14699	1892	12631	1562	0	27082	2465	0
3	1.542	15300	1850	12146	1575	0	28662	2630	0
4	1.620	12588	1561	10607	3039	0	22757	2449	0
5	1.588	12381	1765	9911	1596	0	22533	2442	0
6	1.683	12507	1439	9233	1589	0	22638	2434	0
7	1.834	12530	1414	8510	1665	0	22478	2426	0
8	1.794	9606	1638	7154	1591	0	16456	2073	0
9	1.912	9515	1337	6541	1655	0	16219	2065	0
10	2.117	9930	1324	6104	1667	0	17185	2347	0
11	2.068	9392	1512	5317	91	0	15910	2049	0
12	2.257	6905	1274	4348	1634	0	11133	1696	0
13	2.540	7115	1261	3961	1683	0	11641	1958	0
14	2.445	7064	1385	3457	3	0	11609	1950	0
15	2.762	7246	1211	3063	6	0	12124	2123	0
16	3.276	4836	1198	2346	1650	0	7689	1752	0
17	3.038	4440	1258	1897	65	0	6966	1562	0
18	3.580	4492	1147	1590	52	0	7174	1735	0
19	4.495	5249	1173	1431	8	0	9238	2453	0
20	4.738	3140	1131	904	13	0	5030	1718	0
21	6.192	3288	1089	709	15	0	5527	2073	0
22	7.525	1501	1047	339	0	0	2194	1157	0
23	10.046	2697	862	354	0	0	4992	2783	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.437**

Critical Failure Plane Location -

Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

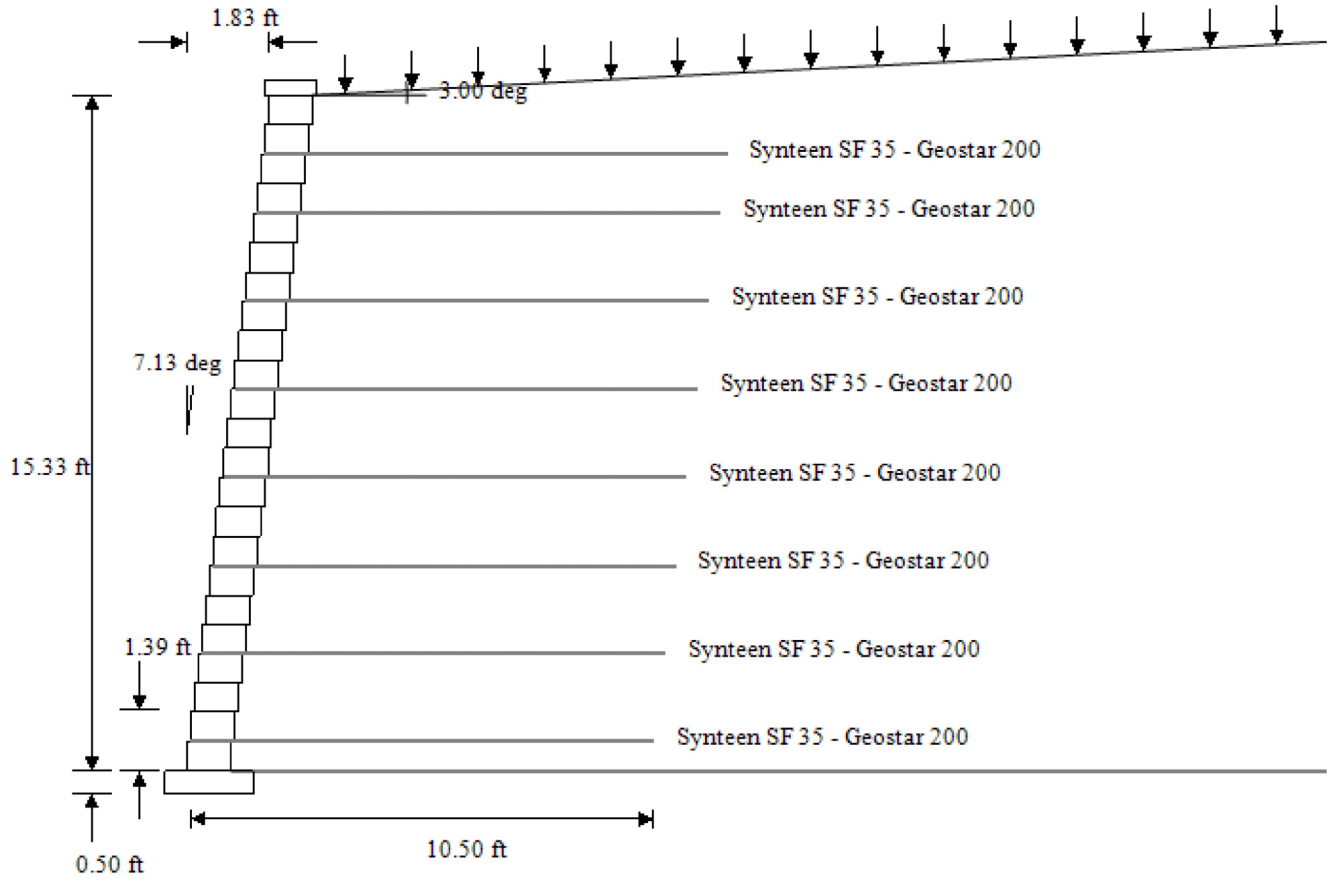
Distance to Entrance at Top Grade : **26.03 ft**

Internal Compound Stability Geometry

SRW Units	Factor Of Safety	Arc Center (Xc)	Arc Center (Yc)	Arc Radius (R)	Arc Exit (X2)	Arc Exit (Y2)	Arc Enter (X1)	Arc Enter (Y1)
1	1.649	0.000	26.020	26.020	0.000	0.000	24.217	16.502

2	1.437	-17.617	58.601	60.578	0.083	0.667	26.033	16.597
3	1.542	-13.486	58.569	58.841	0.167	1.333	27.850	16.692
4	1.620	-45.164	112.284	119.269	0.250	2.000	26.033	16.597
5	1.588	-27.528	84.738	86.672	0.333	2.667	26.033	16.597
6	1.683	-14.321	63.165	61.620	0.417	3.333	26.033	16.597
7	1.834	-7.898	53.198	49.909	0.500	4.000	26.033	16.597
8	1.794	-20.288	69.593	68.198	0.583	4.667	22.400	16.407
9	1.912	-11.637	56.346	52.475	0.667	5.333	22.400	16.407
10	2.117	-8.585	58.328	53.154	0.750	6.000	24.217	16.502
11	2.068	-1.331	40.206	33.609	0.833	6.667	22.400	16.407
12	2.257	-6.979	45.576	39.049	0.917	7.333	18.767	16.216
13	2.540	-6.388	52.634	45.241	1.000	8.000	20.583	16.312
14	2.445	-0.616	41.692	33.069	1.083	8.667	20.583	16.312
15	2.762	1.167	44.739	35.406	1.167	9.333	22.400	16.407
16	3.276	-11.183	72.821	64.039	1.250	10.000	18.767	16.216
17	3.038	0.121	39.220	28.579	1.333	10.667	16.950	16.121
18	3.580	1.417	44.598	33.265	1.417	11.333	18.767	16.216
19	4.495	1.500	79.760	67.760	1.500	12.000	26.033	16.597
20	4.738	-2.361	75.124	62.582	1.583	12.667	18.767	16.216
21	6.192	0.984	89.410	76.079	1.667	13.333	22.400	16.407
22	7.525	-4.257	85.597	71.848	1.750	14.000	13.317	15.931
23	10.046	1.833	198.353	183.687	1.833	14.667	29.667	16.788

Wall Reinforcement Layout

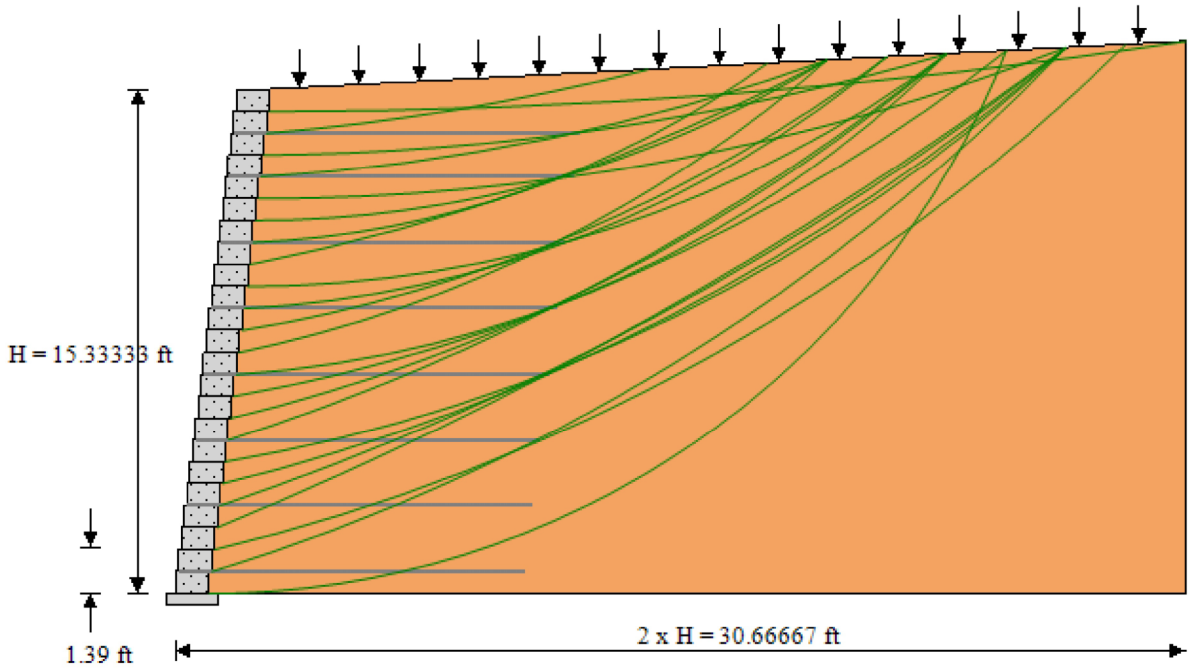


Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 7**
Vendor Data File	:
Project File	: **RW C-7.prj**
Date and Time	: **09/29/2020 10:21:46**

Internal Compound Stability Graphics

Lowest FOS : 1.437



Global Stability has not been addressed

Project Identification

Project ID	:
Project Name	: **Lee's Summit Middle School #4**
Owner	:
Client	:
Prepared By	: **Milburn Civil Engineering, LLC**
Company	: **Milburn Civil Engineering**
Address	: **33135 W. 83rd Street De Soto, KS 66018**
Telephone	: **9135830367**
Section	: **RW C - Section 7**
Vendor Data File	:
Project File	: **RW C-7.prj**
Date and Time	: **09/29/2020 10:21:46**

Appendix B

Global Stability Analysis

SLOPE/W Analysis

File Information

File Version: 8.15
Created By: Kim Flanders
Last Edited By: Kim Flanders
Revision Number: 221
Date: 10/12/2020
Time: 9:48:33 AM
Tool Version: 8.15.6.13446
File Name: Global Stability - RW a.gsz
Directory: C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\Report\Wall Calcs and Specs\GLOBAL STABILITY\

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop
Settings
- PWP Conditions Source: (none)

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

F of S Distribution
- F of S Calculation Option: Constant

Advanced
- Number of Slices: 30
- F of S Tolerance: 0.001
- Minimum Slip Surface Depth: 0.1 ft

Materials

Reinf Zone

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 35 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 25 psf
Phi': 24 °
Phi-B: 0 °

AB-3

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 100 psf
Phi': 35 °
Phi-B: 0 °

Bedrock

Model: Bedrock (Impenetrable)

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-10.441017, 19.962103) ft
Left-Zone Right Coordinate: (29, 14.5) ft
Left-Zone Increment: 12
Right Projection: Range
Right-Zone Left Coordinate: (31.921218, 9.885273) ft
Right-Zone Right Coordinate: (64.001893, 6.117233) ft
Right-Zone Increment: 12
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (-11, 20) ft
Right Coordinate: (65, 6) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)

	-9.5	21
	18.5	19
	28	16

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (30.833333, 10.83) ft
Inside Point: (25.833333, 10.83) ft
Length: 5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Factored Tensile Capacity: 2,000 lbs

Reinforcement 2

Type: Geosynthetic
Outside Point: (30.666667, 12.33) ft
Inside Point: (25.666667, 12.33) ft
Length: 5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Factored Tensile Capacity: 2,000 lbs

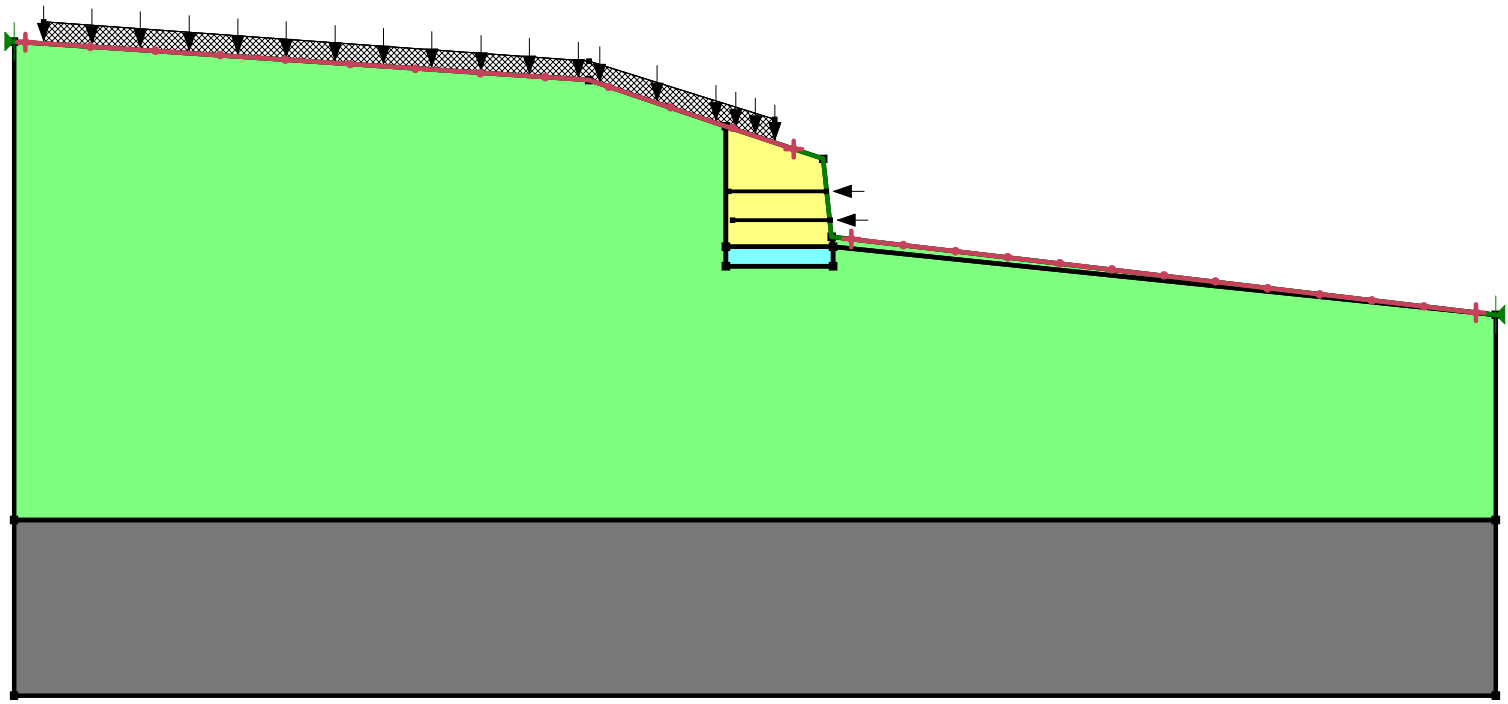
Points

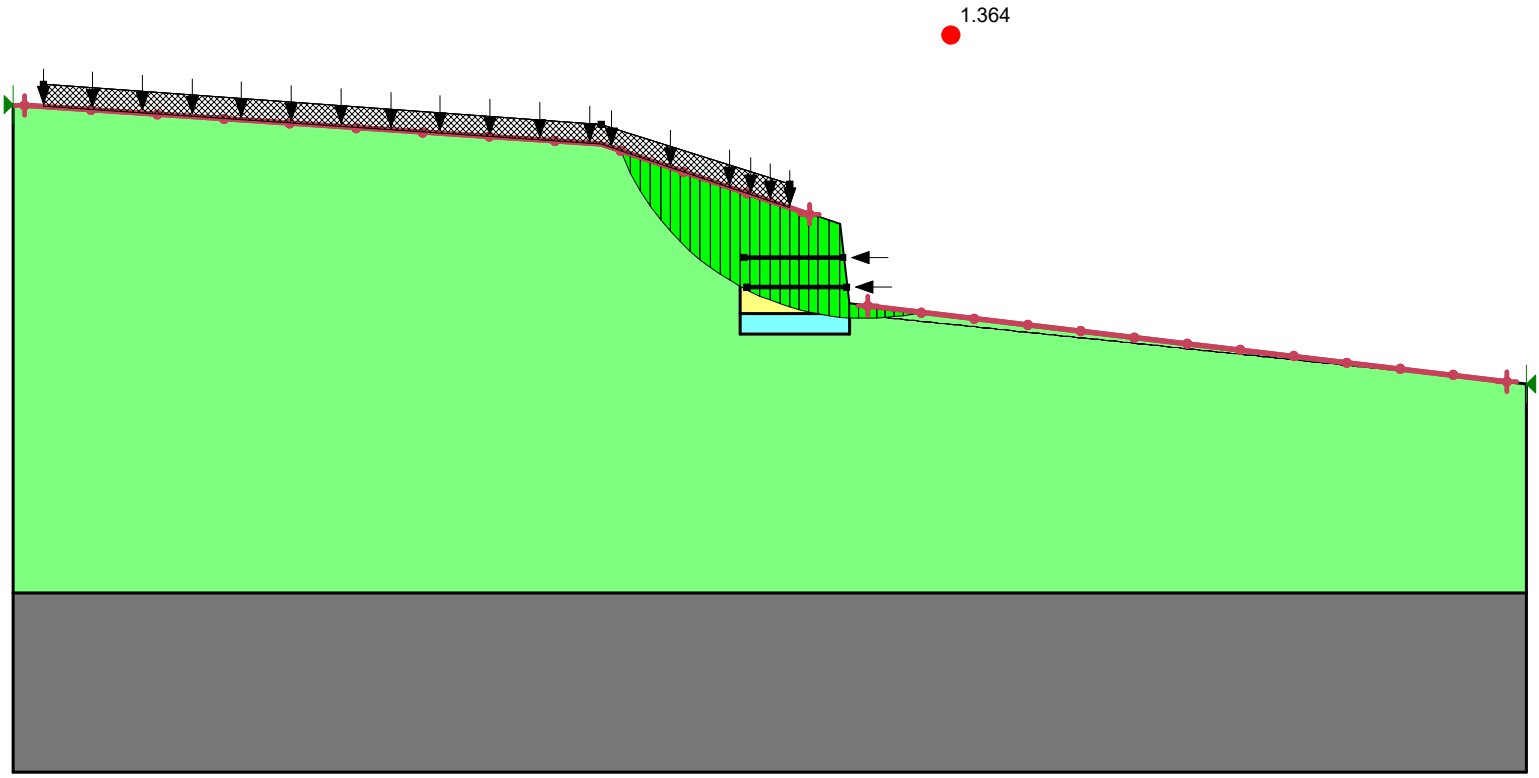
	X (ft)	Y (ft)
Point 1	31	9.5
Point 2	30.5	14
Point 3	18.5	18
Point 4	-11	20
Point 5	-11	-4.5

Point 6	65	-4.5
Point 7	65	6
Point 8	25.5	9.5
Point 9	25.5	15.666667
Point 10	25.5	8.5
Point 11	31	8.5
Point 12	-11	-13.5
Point 13	65	-13.5
Point 14	30.944444	10

Regions

	Material	Points	Area (ft²)
Region 1	Clay	1,11,10,8,9,3,4,5,6,7	1,330.6
Region 2	Reinf Zone	2,9,8,1,14	27.792
Region 3	AB-3	8,10,11,1	5.5
Region 4	Bedrock	5,12,13,6	684
Region 5	Clay	14,1,7	8.4028




1.364

SLOPE/W Analysis

File Information

File Version: 8.15
Created By: Kim Flanders
Last Edited By: Kim Flanders
Revision Number: 226
Date: 10/12/2020
Time: 9:47:31 AM
Tool Version: 8.15.6.13446
File Name: Global Stability - RW B.gsz
Directory: C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\Report\Wall Calcs and Specs\GLOBAL STABILITY\
Last Solved Date: 10/13/2020
Last Solved Time: 9:55:35 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced
    Number of Slices: 30

F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

Reinf Zone

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 35 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 25 psf
Phi': 24 °
Phi-B: 0 °

AB-3

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 100 psf
Phi': 35 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-3.788903, 16.487183) ft
Left-Zone Right Coordinate: (28, 14.533333) ft
Left-Zone Increment: 12
Right Projection: Range
Right-Zone Left Coordinate: (28.961074, 11.34965) ft
Right-Zone Right Coordinate: (60.5, 3.181818) ft
Right-Zone Increment: 12
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (-4, 16.5) ft
Right Coordinate: (62.5, 3) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-3.5	17.5
	24	16
	27	15.5

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (28.5, 11.6) ft
Inside Point: (24.5, 11.6) ft
Slip Surface Intersection: () ft
Length: 4 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (28.5, 13) ft
Inside Point: (24.5, 13) ft
Slip Surface Intersection: () ft
Length: 4 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft

Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	28.5	11
Point 2	28.5	14.5
Point 3	24	14.8
Point 4	24	11
Point 5	24	10
Point 6	28.5	10
Point 7	-4	16.5
Point 8	-4	-3.5
Point 9	62.5	-3.5
Point 10	62.5	3
Point 11	51.5	4
Point 12	28.5	11.5

Regions

	Material	Points	Area (ft^2)
Region 1	Reinf Zone	1,12,2,3,4	16.425
Region 2	AB-3	4,5,6,1	4.5
Region 3	Clay	3,7,8,9,10,11,12,1,6,5,4	932.7

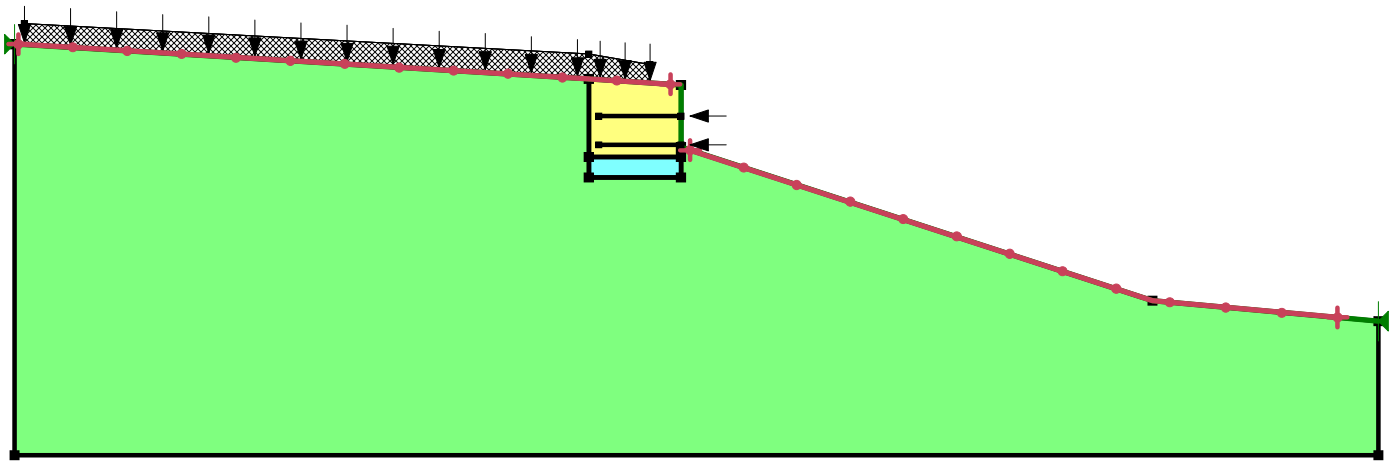
Current Slip Surface

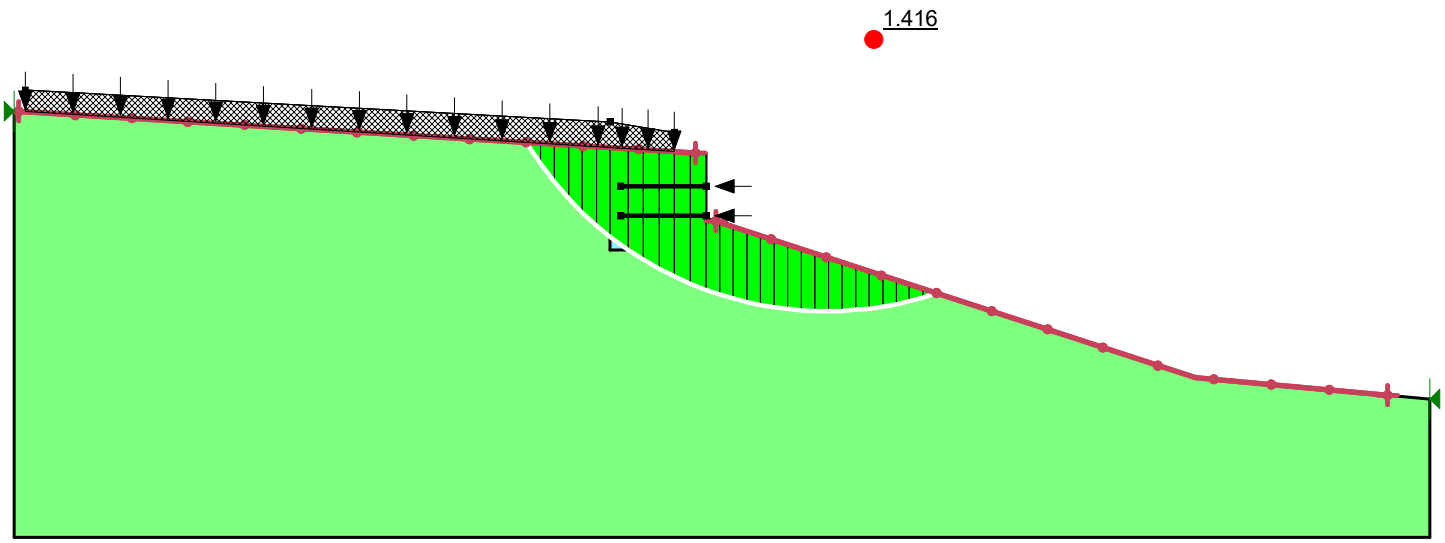
Slip Surface: 1,094
F of S: 1.416
Volume: 58.67513 ft^3
Weight: 6,919.1941 lbs
Resisting Moment: 67,539.385 lbs-ft
Activating Moment: 47,691.493 lbs-ft
F of S Rank (Analysis): 1 of 1,521 slip surfaces
F of S Rank (Query): 1 of 1,521 slip surfaces
Exit: (39.338, 7.9658694) ft
Entry: (20.053907, 15.039584) ft
Radius: 16.499753 ft
Center: (34.143148, 23.6265) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	20.382748	14.541512	0	100.53681	44.76187	25
Slice 2	21.04043	13.613142	0	183.55713	81.724902	25
Slice 3	21.698113	12.804681	0	260.36545	115.92217	25
Slice 4	22.355795	12.090509	0	331.56623	147.6228	25
Slice 5	23.013477	11.453837	0	397.6778	177.05756	25
Slice 6	23.671159	10.882948	0	459.13028	204.41797	25
Slice 7	24.419684	10.306362	0	418.36998	292.94581	100

Slice 8	25.199473	9.7676101	0	551.76892	245.66335	25
Slice 9	25.919684	9.328112	0	597.22366	265.90111	25
Slice 10	26.639895	8.9370646	0	638.28704	284.1837	25
Slice 11	27.375	8.5843954	0	600.27485	267.25958	25
Slice 12	28.125	8.2687167	0	639.77608	284.84666	25
Slice 13	28.818765	8.0130651	0	361.21691	160.82413	25
Slice 14	29.456294	7.8099042	0	366.06132	162.981	25
Slice 15	30.093824	7.6347309	0	367.72498	163.72171	25
Slice 16	30.731353	7.486632	0	366.22282	163.0529	25
Slice 17	31.368882	7.3648667	0	361.55385	160.97415	25
Slice 18	32.006412	7.2688458	0	353.70118	157.47791	25
Slice 19	32.643941	7.1981173	0	342.63167	152.54945	25
Slice 20	33.281471	7.1523548	0	328.29516	146.16642	25
Slice 21	33.919	7.1313502	0	310.62338	138.29844	25
Slice 22	34.55653	7.1350089	0	289.52817	128.90625	25
Slice 23	35.194059	7.1633472	0	264.89932	117.94078	25
Slice 24	35.831589	7.2164933	0	236.60151	105.34178	25
Slice 25	36.469118	7.2946896	0	204.4704	91.036087	25
Slice 26	37.106647	7.3982989	0	168.30759	74.935365	25
Slice 27	37.744177	7.5278126	0	127.87391	56.933131	25
Slice 28	38.381706	7.6838631	0	82.880689	36.90086	25
Slice 29	39.019236	7.8672401	0	32.978119	14.682804	25




1.416

SLOPE/W Analysis

File Information

File Version: 8.15
Created By: Kim Flanders
Last Edited By: Kim Flanders
Revision Number: 268
Date: 10/12/2020
Time: 10:06:11 AM
Tool Version: 8.15.6.13446
File Name: Global Stability - RW C.gsz
Directory: C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\Report\Wall Calcs and Specs\GLOBAL STABILITY\
Last Solved Date: 10/12/2020
Last Solved Time: 10:07:17 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced
    Number of Slices: 30

F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

Reinf Zone

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 35 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 25 psf
Phi': 24 °
Phi-B: 0 °

AB-3

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 100 psf
Phi': 35 °
Phi-B: 0 °

Bedrock

Model: Bedrock (Impenetrable)

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-13.624339, 22.991534) ft
Left-Zone Right Coordinate: (29.64257, 22.019054) ft
Left-Zone Increment: 12
Right Projection: Range
Right-Zone Left Coordinate: (32.214057, 10.128626) ft
Right-Zone Right Coordinate: (65.735984, 5.525863) ft
Right-Zone Increment: 12
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (-14, 23) ft
Right Coordinate: (66, 5.5) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-6.5	24
	28	23

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (31.4, 10) ft
Inside Point: (22.9, 10) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (31.3, 12) ft
Inside Point: (22.8, 12) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs

Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 3

Type: Geosynthetic
Outside Point: (31.2, 14) ft
Inside Point: (22.7, 14) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 4

Type: Geosynthetic
Outside Point: (31, 16) ft
Inside Point: (22.5, 16) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 5

Type: Geosynthetic
Outside Point: (30.9, 18) ft
Inside Point: (22.4, 18) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 6

Type: Geosynthetic
Outside Point: (30.7, 20) ft
Inside Point: (22.2, 20) ft
Slip Surface Intersection: () ft
Length: 8.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	31.5	9
Point 2	30.5	22
Point 3	21.5	22.2

Point 4	22.5	9
Point 5	22.5	8
Point 6	31.5	8
Point 7	-14	23
Point 8	-14	-5.5
Point 9	66	-5.5
Point 10	66	5.5
Point 11	41.5	7.9
Point 12	31.5	10.3
Point 13	-14	-14
Point 14	66	-14

Regions

	Material	Points	Area (ft²)
Region 1	Reinf Zone	1,12,2,3,4	118.45
Region 2	AB-3	4,5,6,1	9
Region 3	Clay	7,8,9,10,11,12,1,6,5,3	1,584.6
Region 4	Bedrock	8,13,14,9	680
Region 5	Clay	5,4,3	0.5

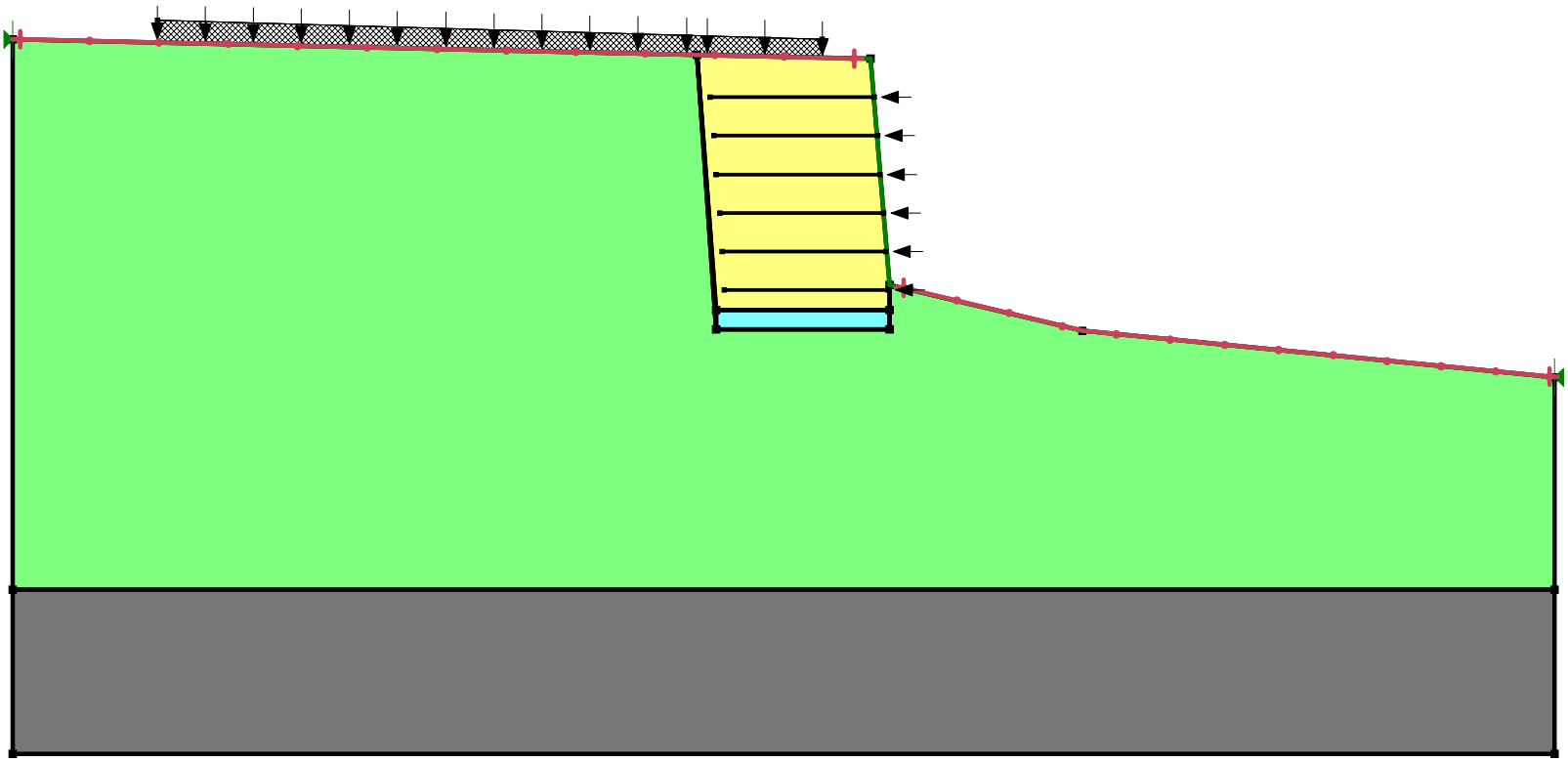
Current Slip Surface

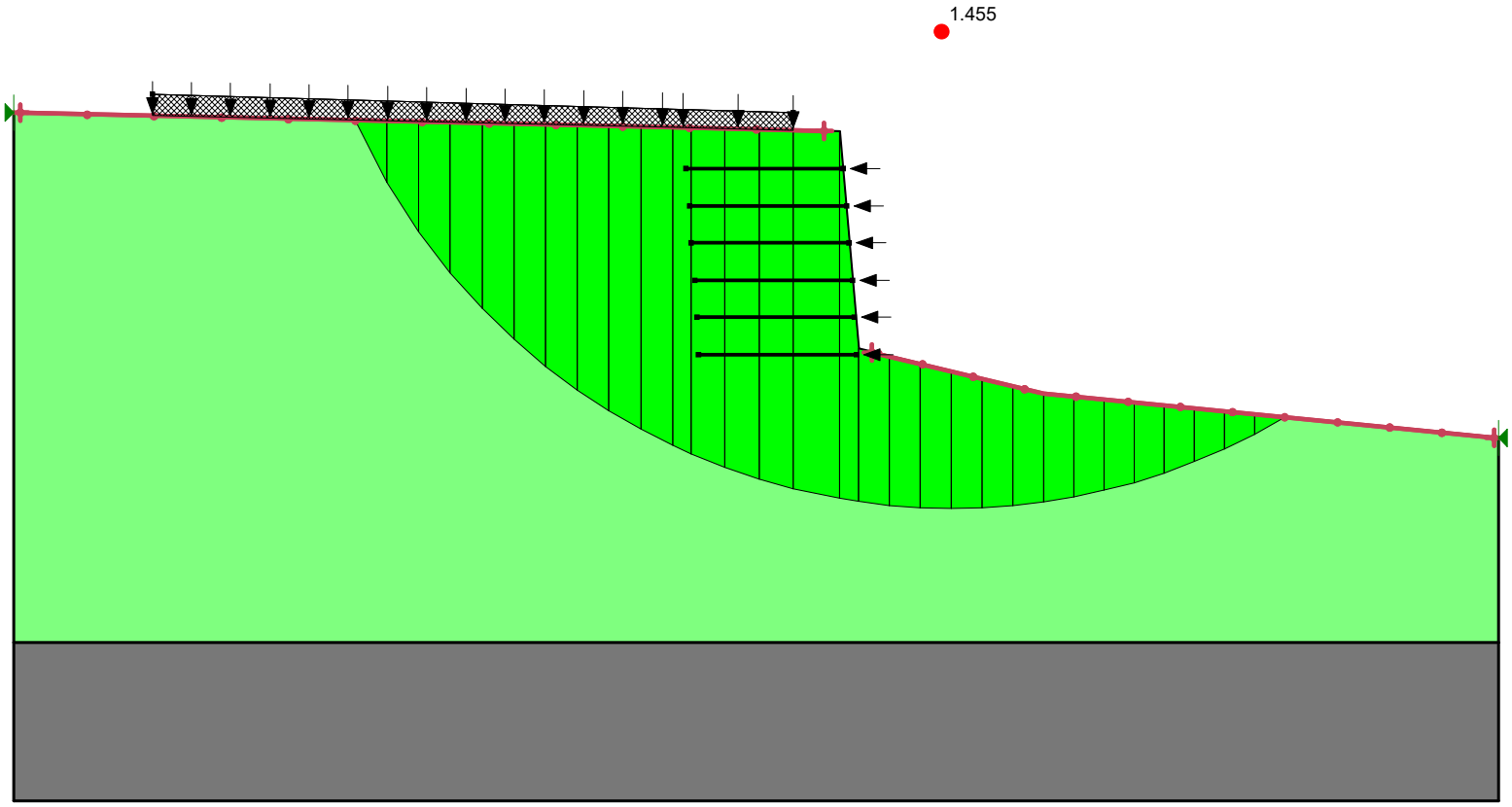
Slip Surface: 663
F of S: 1.455
Volume: 479.4151 ft³
Weight: 56,435.312 lbs
Resisting Moment: 987,274.96 lbs-ft
Activating Moment: 678,449.19 lbs-ft
F of S Rank (Analysis): 115 of 1,521 slip surfaces
F of S Rank (Query): 115 of 1,521 slip surfaces
Exit: (54.489275, 6.6275812) ft
Entry: (4.403516, 22.585273) ft
Radius: 35.237667 ft
Center: (36.571514, 36.969747) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	5.2583402	20.917739	0	171.34732	76.288743	25
Slice 2	6.9679886	17.921682	0	429.84746	191.38042	25
Slice 3	8.677637	15.483413	0	662.40544	294.9219	25
Slice 4	10.387285	13.42309	0	873.15482	388.75357	25
Slice 5	12.096934	11.646342	0	1,065.2246	474.26856	25
Slice 6	13.806582	10.096043	0	1,240.9474	552.50537	25
Slice 7	15.516231	8.7344648	0	1,402.0867	624.24922	25
Slice 8	17.225879	7.5351887	0	1,549.9989	690.10399	25
Slice 9	18.935527	6.4789291	0	1,685.7425	750.54093	25
Slice 10	20.645176	5.5511784	0	1,810.1519	805.93153	25
Slice 11	22	4.8907417	0	1,844.3059	821.1379	25

Slice 12	23.416667	4.2945774	0	1,880.9376	837.44738	25
Slice 13	25.25	3.6143962	0	1,983.6125	883.16117	25
Slice 14	27.083333	3.0468697	0	2,075.4066	924.03057	25
Slice 15	29.25	2.5247833	0	2,081.1072	926.56864	25
Slice 16	31	2.1790154	0	1,536.9703	684.30327	25
Slice 17	32.333333	1.9979531	0	935.48228	416.50355	25
Slice 18	34	1.8359692	0	921.78704	410.40603	25
Slice 19	35.666667	1.7535641	0	898.07189	399.84737	25
Slice 20	37.333333	1.7501779	0	864.06787	384.7078	25
Slice 21	39	1.8257876	0	819.41418	364.8267	25
Slice 22	40.666667	1.9809065	0	763.64392	339.99618	25
Slice 23	42.31183	2.2125187	0	711.75171	316.89228	25
Slice 24	43.935489	2.5201334	0	664.05061	295.65438	25
Slice 25	45.559149	2.9078818	0	604.68058	269.22114	25
Slice 26	47.182808	3.3785458	0	532.67513	237.16225	25
Slice 27	48.806467	3.9356792	0	446.81831	198.93633	25
Slice 28	50.430127	4.5837579	0	345.56176	153.85401	25
Slice 29	52.053786	5.3283883	0	226.90166	101.02313	25
Slice 30	53.677446	6.1766009	0	88.190054	39.264742	25




1.455

SLOPE/W Analysis

File Information

File Version: 8.15
Created By: Kim Flanders
Last Edited By: Kim Flanders
Revision Number: 283
Date: 10/12/2020
Time: 10:50:51 AM
Tool Version: 8.15.6.13446
File Name: Global Stability - RW C6.gsz
Directory: C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\Report\Wall Calcs and Specs\GLOBAL STABILITY\
Last Solved Date: 10/12/2020
Last Solved Time: 10:50:54 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced
    Number of Slices: 30

F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

Reinf Zone

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 35 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 25 psf
Phi': 24 °
Phi-B: 0 °

AB-3

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 100 psf
Phi': 35 °
Phi-B: 0 °

Bedrock

Model: Bedrock (Impenetrable)

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-13.580488, 24.990272) ft
Left-Zone Right Coordinate: (30.639284, 22.091807) ft
Left-Zone Increment: 12
Right Projection: Range
Right-Zone Left Coordinate: (32.214057, 10.128626) ft
Right-Zone Right Coordinate: (65.735984, 5.525863) ft
Right-Zone Increment: 12
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (-14, 25) ft
Right Coordinate: (66, 5.5) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-7.5	26
	29	25

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (31.4, 10) ft
Inside Point: (21.9, 10) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (31.3, 12) ft
Inside Point: (21.8, 12) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs

Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 3

Type: Geosynthetic
Outside Point: (31.2, 14) ft
Inside Point: (21.7, 14) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 4

Type: Geosynthetic
Outside Point: (31, 16) ft
Inside Point: (21.5, 16) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 5

Type: Geosynthetic
Outside Point: (30.9, 18) ft
Inside Point: (21.4, 18) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 6

Type: Geosynthetic
Outside Point: (30.7, 20) ft
Inside Point: (21.2, 20) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 7

Type: Geosynthetic
Outside Point: (30.645985, 22) ft
Inside Point: (21.145985, 22) ft
Slip Surface Intersection: () ft
Length: 9.5 ft
Direction: 0 °

F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 8

Type: Geosynthetic
Outside Point: (31.5002, 7.5) ft
Inside Point: (20.5002, 7.5) ft
Slip Surface Intersection: (21.034459, 7.5) ft
Length: 11 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 1,056.9547 lbs
Pullout Force per Length: 1,978.3558 lbs/ft
Available Length: 0.53425916 ft
Required Length: 0.53425916 ft
Governing Component: Pullout Resistance

Points

	X (ft)	Y (ft)
Point 1	31.5	9
Point 2	30.5	24
Point 3	20.5	24.2
Point 4	21.5	9
Point 5	20.5	6.5
Point 6	31.5	6.5
Point 7	-14	25
Point 8	-14	-5.5
Point 9	66	-5.5

Point 10	66	5.5
Point 11	41.5	7.9
Point 12	31.5	10.3
Point 13	-14	-14
Point 14	66	-14
Point 15	20.5	9

Regions

	Material	Points	Area (ft²)
Region 1	Reinf Zone	1,12,2,3,4	151.55
Region 2	AB-3	4,15,5,6,1	27.5
Region 3	Bedrock	8,13,14,9	680
Region 4	Clay	15,4,3,7,8,9,10,11,12,1,6,5	1,623

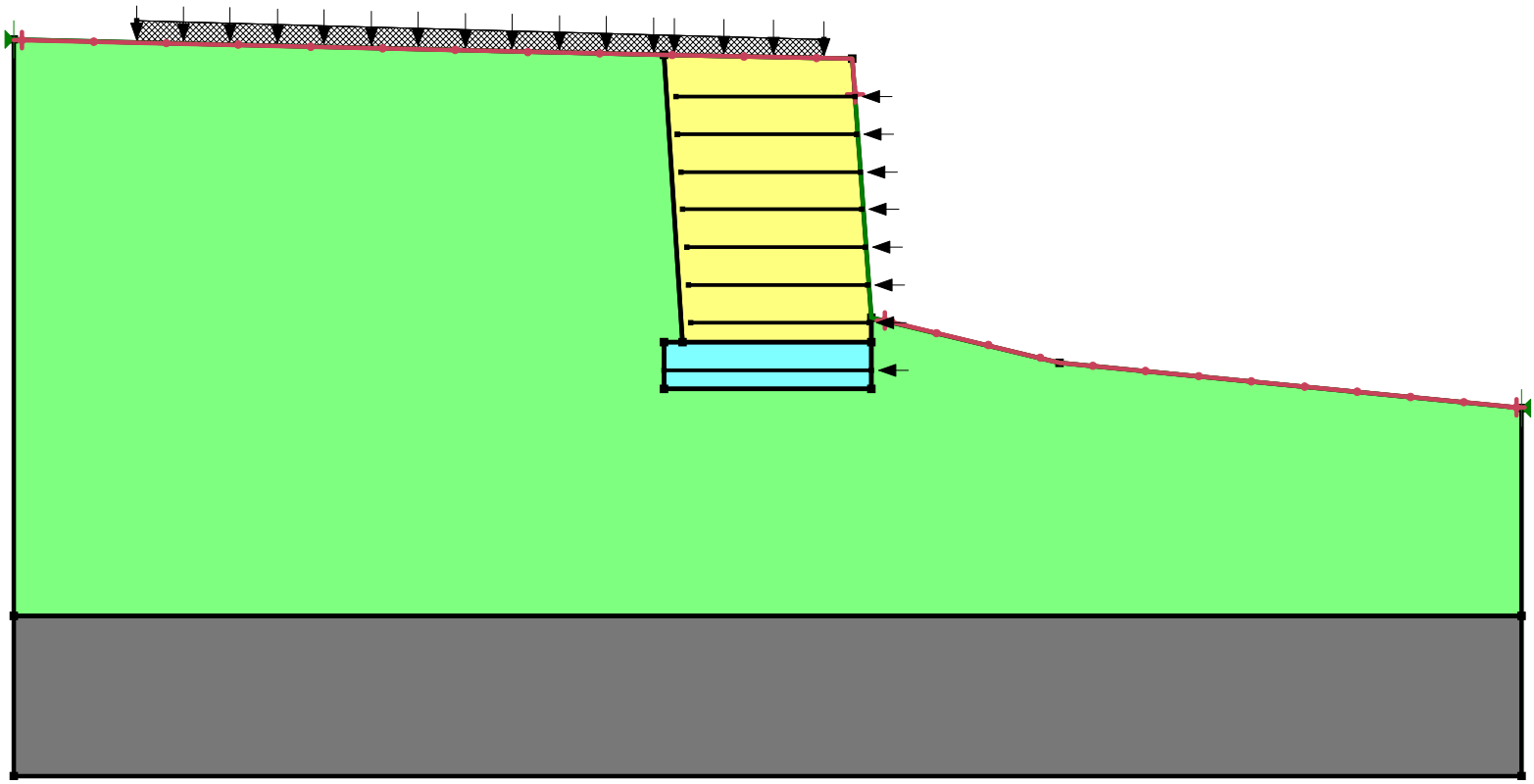
Current Slip Surface

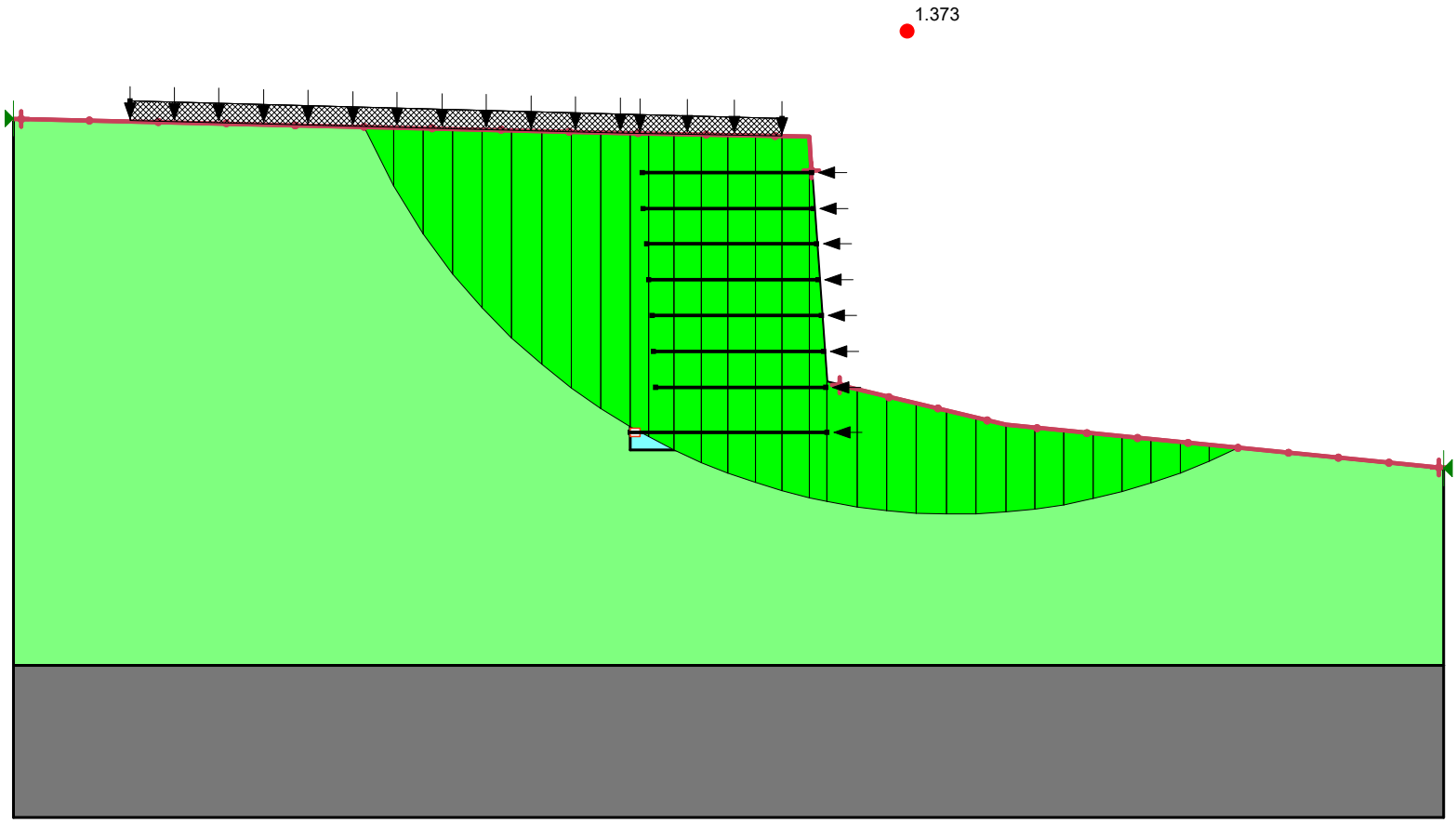
Slip Surface: 663
F of S: 1.373
Volume: 444.94744 ft³
Weight: 52,137.646 lbs
Resisting Moment: 1,017,792.1 lbs-ft
Activating Moment: 741,380.59 lbs-ft
F of S Rank (Analysis): 19 of 1,521 slip surfaces
F of S Rank (Query): 19 of 1,521 slip surfaces
Exit: (54.489275, 6.6275812) ft
Entry: (5.5830767, 24.5459) ft
Radius: 36.002217 ft
Center: (38.587918, 38.927836) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	6.4117947	22.883905	0	163.53538	72.810641	25
Slice 2	8.0692306	19.893206	0	415.03814	184.78689	25
Slice 3	9.7266665	17.450853	0	643.10151	286.32724	25
Slice 4	11.384102	15.379827	0	851.14895	378.95593	25
Slice 5	13.041538	13.587012	0	1,041.9128	463.88946	25
Slice 6	14.698974	12.015941	0	1,217.4822	542.05802	25
Slice 7	16.35641	10.629266	0	1,379.4628	614.17643	25
Slice 8	18.013846	9.4007809	0	1,529.1048	680.80132	25
Slice 9	19.671282	8.3113117	0	1,667.3943	742.37175	25
Slice 10	21	7.5192962	0	1,557.0505	1,090.2585	100
Slice 11	22.224191	6.869655	0	1,594.9643	1,116.8061	100
Slice 12	23.704835	6.1564581	0	1,851.2908	824.24776	25
Slice 13	25.217739	5.510264	0	1,945.58	866.22804	25
Slice 14	26.730643	4.9436811	0	2,032.5056	904.92979	25

Slice 15	28.243548	4.4527742	0	2,112.2826	940.44879	25
Slice 16	29.75	4.0358278	0	2,095.6739	933.05413	25
Slice 17	31	3.7380435	0	1,447.8132	644.60796	25
Slice 18	32.333333	3.4831788	0	748.01995	333.03994	25
Slice 19	34	3.2290305	0	743.21541	330.90082	25
Slice 20	35.666667	3.0540731	0	728.79176	324.479	25
Slice 21	37.333333	2.9571486	0	704.54195	313.68229	25
Slice 22	39	2.9376252	0	670.18075	298.38369	25
Slice 23	40.666667	2.9953764	0	625.33452	278.41687	25
Slice 24	42.31183	3.1280329	0	584.70145	260.32586	25
Slice 25	43.935489	3.3344495	0	548.69299	244.29386	25
Slice 26	45.559149	3.6166931	0	502	223.5048	25
Slice 27	47.182808	3.9766048	0	443.86278	197.62044	25
Slice 28	48.806467	4.4166201	0	373.3395	166.22146	25
Slice 29	50.430127	4.9398582	0	289.25313	128.78379	25
Slice 30	52.053786	5.5502436	0	190.11569	84.644959	25
Slice 31	53.677446	6.2526748	0	74.017418	32.954678	25




1.373

SLOPE/W Analysis

File Information

File Version: 8.15
Created By: Kim Flanders
Last Edited By: Kim Flanders
Revision Number: 264
Date: 10/12/2020
Time: 9:07:58 AM
Tool Version: 8.15.6.13446
File Name: Global Stability - RW C.gsz
Directory: C:\Civil 3D Projects\Lees Summit Middle School 4 2009-469\Report\Wall Calcs and Specs\GLOBAL STABILITY\
Last Solved Date: 10/12/2020
Last Solved Time: 9:16:42 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

SLOPE/W Analysis

Kind: SLOPE/W
Method: Bishop
Settings
    PWP Conditions Source: (none)
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Resisting Side Maximum Convex Angle: 1 °
    Driving Side Maximum Convex Angle: 5 °
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: (none)
F of S Distribution
    F of S Calculation Option: Constant
Advanced
    Number of Slices: 30

F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft

Materials

Reinf Zone

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 35 °
Phi-B: 0 °

Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 25 psf
Phi': 24 °
Phi-B: 0 °

AB-3

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 100 psf
Phi': 35 °
Phi-B: 0 °

Bedrock

Model: Bedrock (Impenetrable)

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (-13.574345, 24.989681) ft
Left-Zone Right Coordinate: (29.998057, 24.008729) ft
Left-Zone Increment: 12
Right Projection: Range
Right-Zone Left Coordinate: (32.214057, 10.128626) ft
Right-Zone Right Coordinate: (65.735984, 5.525863) ft
Right-Zone Increment: 12
Radius Increments: 8

Slip Surface Limits

Left Coordinate: (-14, 25) ft
Right Coordinate: (66, 5.5) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 100 pcf

Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	-6.5	26
	28	25

Reinforcements

Reinforcement 1

Type: Geosynthetic
Outside Point: (31.4, 10) ft
Inside Point: (20.9, 10) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 2

Type: Geosynthetic
Outside Point: (31.3, 12) ft
Inside Point: (20.8, 12) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs

Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 3

Type: Geosynthetic
Outside Point: (31.2, 14) ft
Inside Point: (20.7, 14) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 4

Type: Geosynthetic
Outside Point: (31, 16) ft
Inside Point: (20.5, 16) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 5

Type: Geosynthetic
Outside Point: (30.9, 18) ft
Inside Point: (20.4, 18) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 6

Type: Geosynthetic
Outside Point: (30.7, 20) ft
Inside Point: (20.2, 20) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 7

Type: Geosynthetic
Outside Point: (30.6, 22) ft
Inside Point: (20.1, 22) ft
Slip Surface Intersection: () ft
Length: 10.5 ft
Direction: 0 °

F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Reinforcement 8

Type: Geosynthetic
Outside Point: (31.5, 7.5) ft
Inside Point: (20, 7.5) ft
Slip Surface Intersection: () ft
Length: 11.5 ft
Direction: 0 °
F of S Dependent: Yes
Interface Adhesion: 0 psf
Interface Shear Angle: 35 °
Surface Area Factor: 2
Resistance Reduction Factor: 1
Force Distribution: Distributed
Anchorage: Yes
Tensile Capacity: 2,000 lbs
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 2,000 lbs
Pullout Force: 0 lbs
Pullout Force per Length: 0 lbs/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

Points

	X (ft)	Y (ft)
Point 1	31.5	9
Point 2	30.5	24
Point 3	19	24.2
Point 4	20	9
Point 5	20	6.5
Point 6	31.5	6.5
Point 7	-14	25
Point 8	-14	-5.5
Point 9	66	-5.5

Point 10	66	5.5
Point 11	41.5	7.9
Point 12	31.5	10.3
Point 13	-14	-14
Point 14	66	-14

Regions

	Material	Points	Area (ft²)
Region 1	Reinf Zone	1,12,2,3,4	174.2
Region 2	AB-3	4,5,6,1	28.75
Region 3	Clay	7,8,9,10,11,12,1,6,5,3	1,597.1
Region 4	Bedrock	8,13,14,9	680
Region 5	Clay	5,4,3	1.25

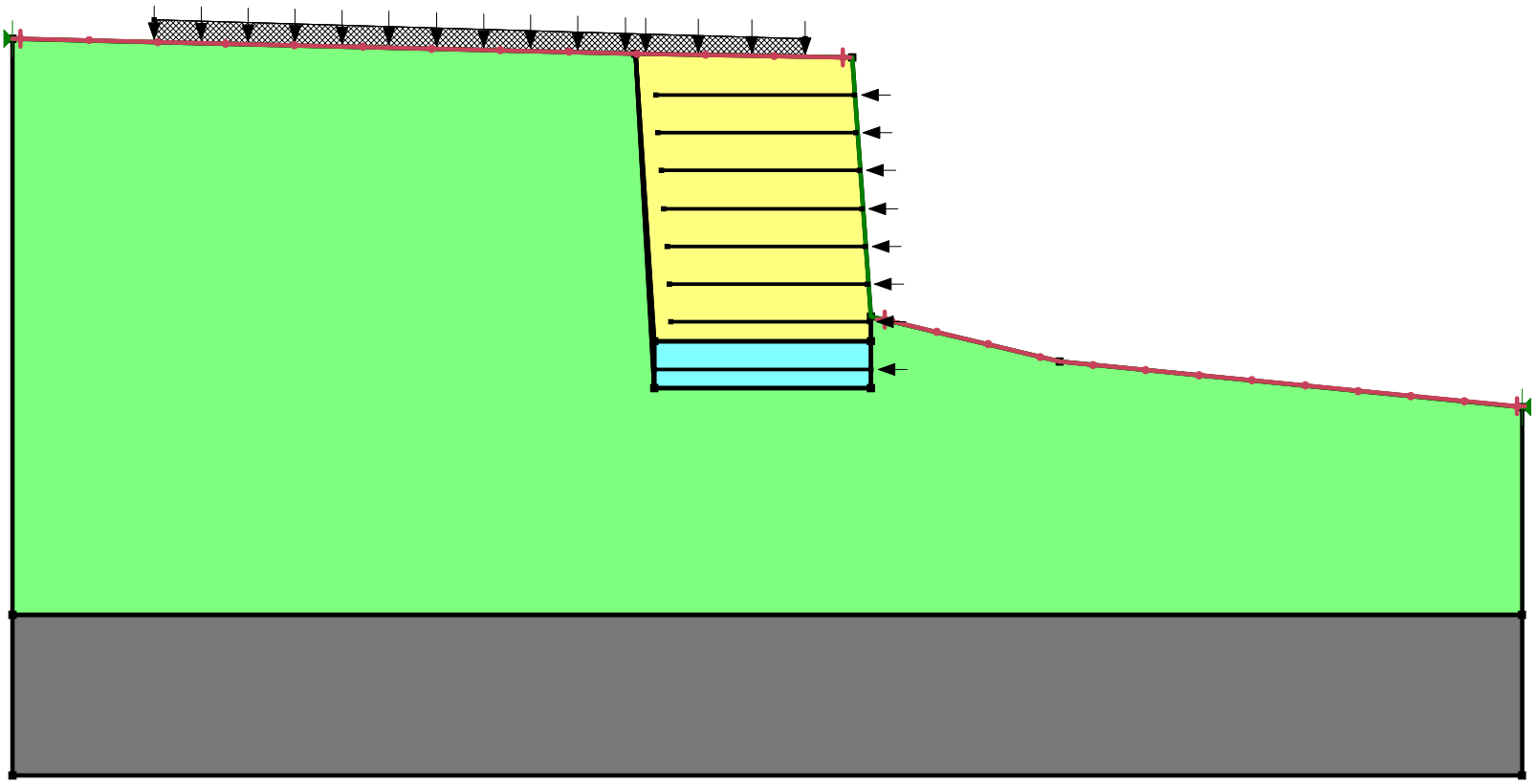
Current Slip Surface

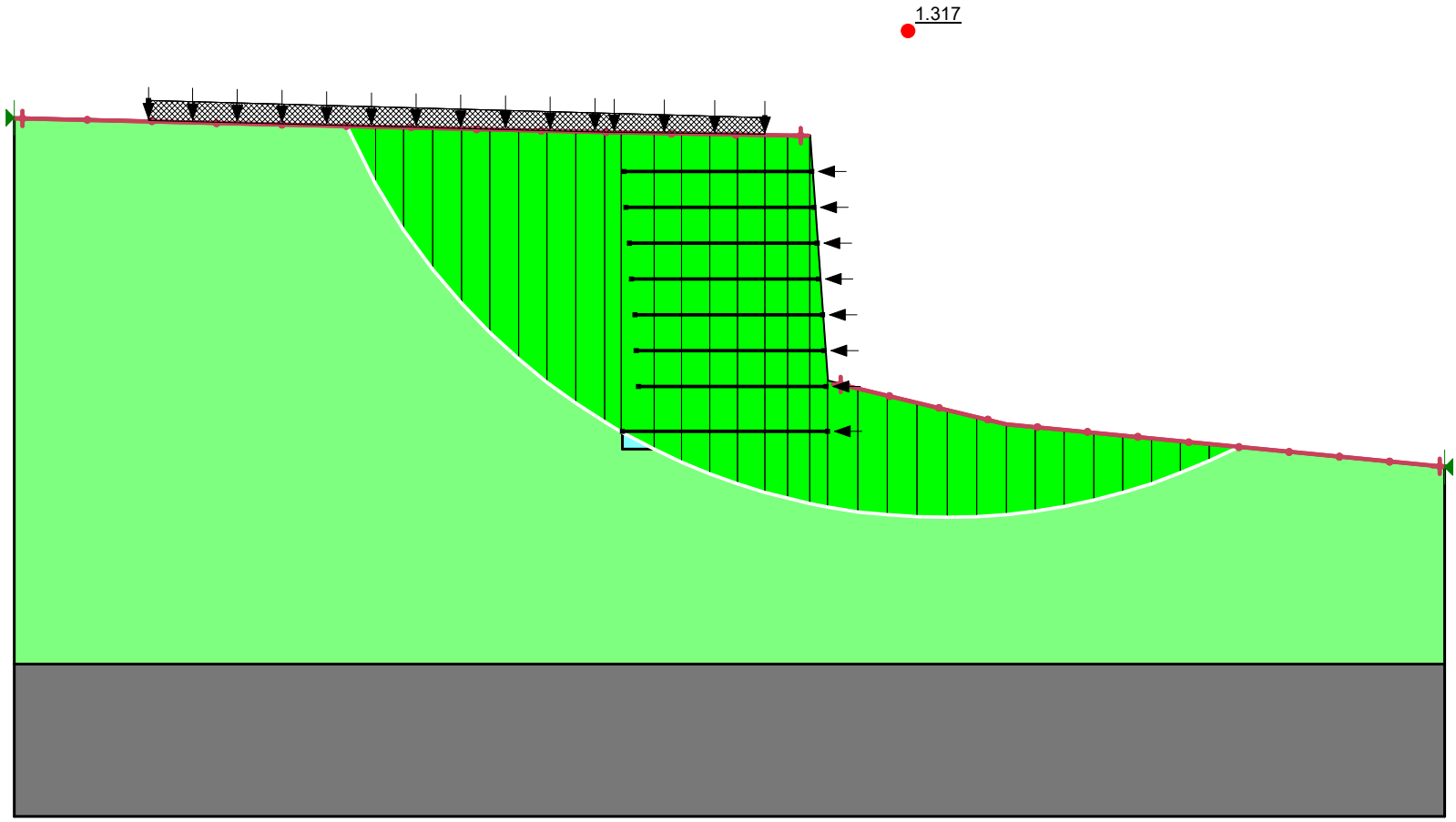
Slip Surface: 663
F of S: 1.317
Volume: 471.01538 ft³
Weight: 55,059.599 lbs
Resisting Moment: 1,016,115.5 lbs-ft
Activating Moment: 771,568.45 lbs-ft
F of S Rank (Analysis): 1 of 1,521 slip surfaces
F of S Rank (Query): 1 of 1,521 slip surfaces
Exit: (54.489275, 6.6275812) ft
Entry: (4.5801693, 24.549572) ft
Radius: 36.482209 ft
Center: (38.003536, 39.172504) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	5.381271	22.939643	0	157.9849	70.339408	25
Slice 2	6.9834744	20.031446	0	398.16551	177.27471	25
Slice 3	8.5856778	17.63877	0	617.62172	274.9829	25
Slice 4	10.187881	15.599094	0	819.03758	364.65902	25
Slice 5	11.790085	13.825346	0	1,004.6976	447.32018	25
Slice 6	13.392288	12.264151	0	1,176.4046	523.76906	25
Slice 7	14.994491	10.879939	0	1,335.5721	594.63502	25
Slice 8	16.596695	9.6476057	0	1,483.3173	660.41541	25
Slice 9	18.198898	8.5486938	0	1,620.5318	721.50726	25
Slice 10	19.472506	7.7519435	0	1,663.7946	740.76906	25
Slice 11	20.858563	6.9866358	0	1,553.8029	1,087.9845	100
Slice 12	22.550599	6.1358621	0	1,836.6819	817.74347	25
Slice 13	24.107571	5.4509264	0	1,935.8861	861.91202	25
Slice 14	25.664543	4.8502595	0	2,027.4502	902.67899	25

Slice 15	27.221514	4.3294914	0	2,111.6051	940.14715	25
Slice 16	28.625	3.9223071	0	2,094.5459	932.55193	25
Slice 17	29.875	3.6131527	0	2,152.041	958.1504	25
Slice 18	31	3.3724689	0	1,494.3054	665.30763	25
Slice 19	32.333333	3.1435052	0	789.79002	351.63717	25
Slice 20	34	2.9203264	0	782.27153	348.28973	25
Slice 21	35.666667	2.7747935	0	765.20449	340.69099	25
Slice 22	37.333333	2.7059749	0	738.34868	328.73401	25
Slice 23	39	2.7134352	0	701.38429	312.27641	25
Slice 24	40.666667	2.7972216	0	653.90047	291.13525	25
Slice 25	42.31183	2.9548038	0	610.68613	271.89498	25
Slice 26	43.935489	3.1851929	0	572.14482	254.73529	25
Slice 27	45.559149	3.4909163	0	522.80217	232.76652	25
Slice 28	47.182808	3.8739356	0	461.84564	205.62693	25
Slice 29	48.806467	4.3368064	0	388.26781	172.86796	25
Slice 30	50.430127	4.8827706	0	300.80786	133.92829	25
Slice 31	52.053786	5.5158829	0	197.86783	88.096433	25
Slice 32	53.677446	6.2411847	0	77.389182	34.455884	25

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