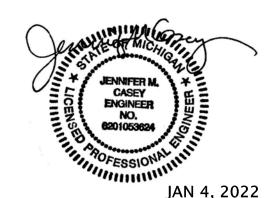
Mechanically Stabilized Earth Wall Plans and Specifications for

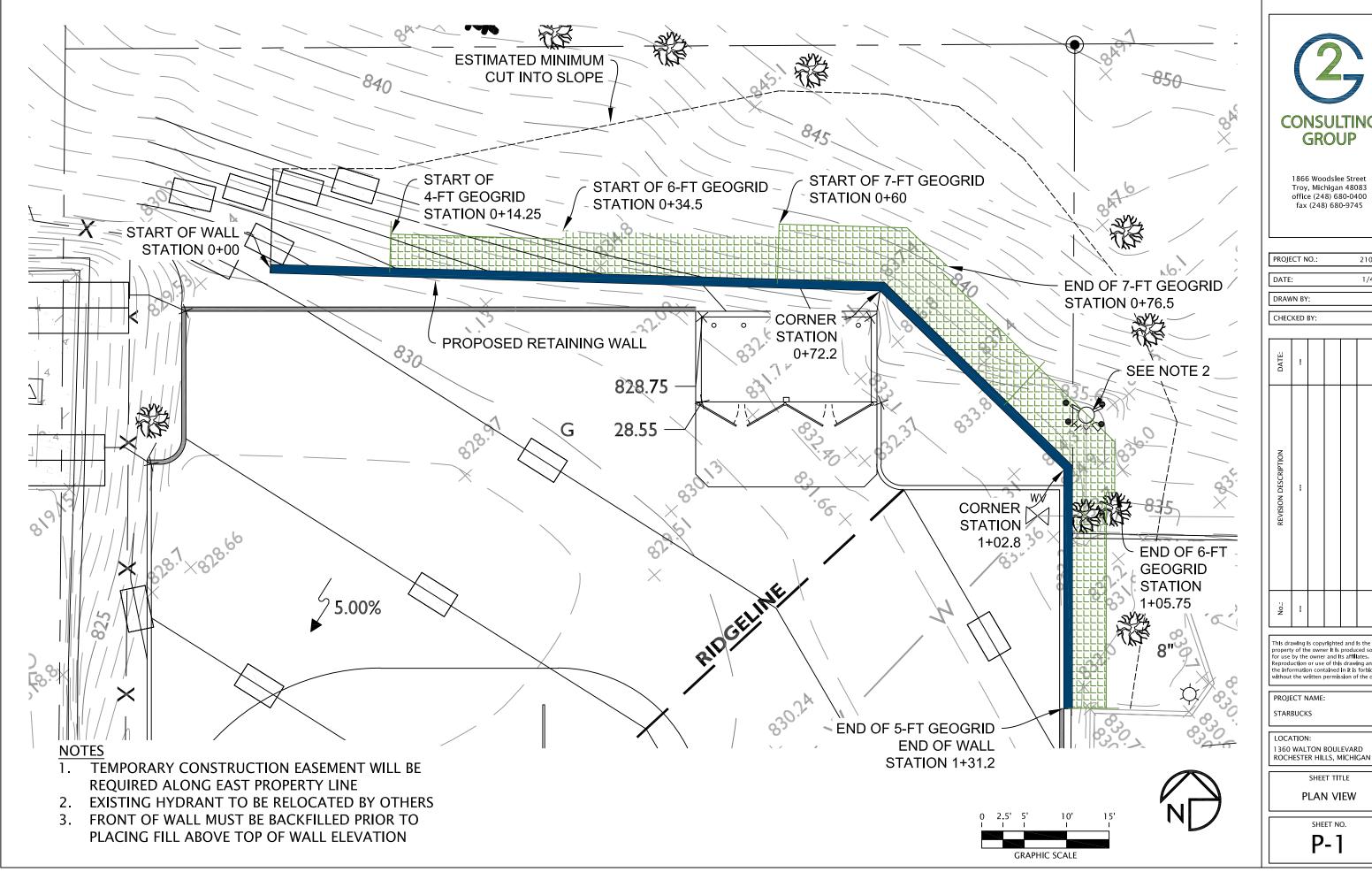
# Starbucks 1360 Walton Boulevard Rochester Hills, Michigan 48309 G2 Project No. 210816 January 4, 2022

P-1 PLAN VIEW
E-1 ELEVATION VIEW
S-1 and S-2 DETAILS
SP-1 SPECIFICATIONS





1866 Woodslee Street Troy, Michigan 48083 P (248) 680-0400 F (248) 680-9745



**CONSULTING GROUP** 

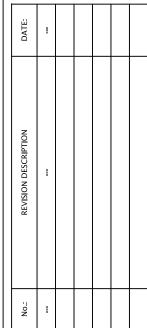
fax (248) 680-9745

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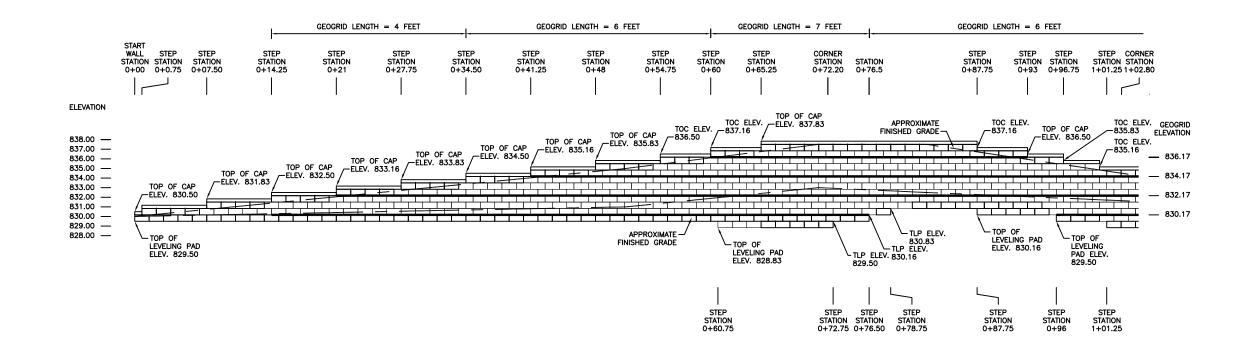
JMC

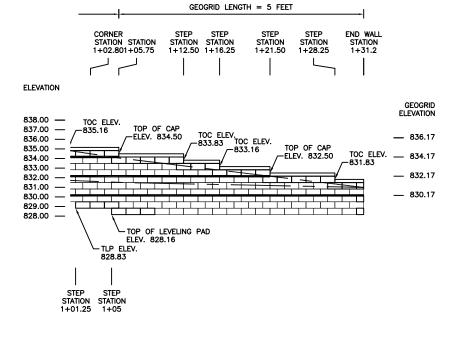
1/4/22



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**GENERAL NOTES** 





# **LEGEND**

1. BOTTOM OF WALL ELEVATION SHOWN ON THESE PLANS (TOP OF LEVELING PAD) WILL VARY FROM THAT PRESENTED ON GRADING PLAN DUE TO REQUIRED WALL EMBEDMENT.

2. VERIFY DIMENSIONS, EXISTING STRUCTURES, AND UTILITIES IN FIELD PRIOR TO CONSTRUCTION.

- 3. ELEVATIONS ARE APPROXIMATE AND MAY VARY DUE TO SHIMMING.
- RETAINING WALL SHALL BEAR ON NATIVE SOIL WITH A MINIMUM BEARING CAPACITY OF 1,500 PSF.
- BOTTOM OF WALL EMBEDMENT REFLECTS FUTURE EXCAVATION FOR PAVEMENT CONSTRUCTION.
- 6. CONTACT G2 IF CHANGES ARE REQUIRED OR IF FIELD CONDITIONS VARY FROM THOSE PRESENTED HEREIN.

STRATAGRID 150 GEOGRID

KEYSTONE COMPAC UNITS

**SCALE** 

**CONSULTING GROUP** 

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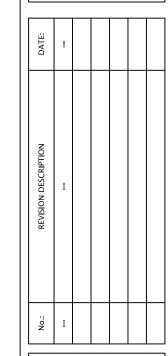
PROJECT NO.: 210816

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PROJECT NAME: STARBUCKS

LOCATION:

1360 WALTON BOULEVARD ROCHESTER HILLS, MICHIGAN

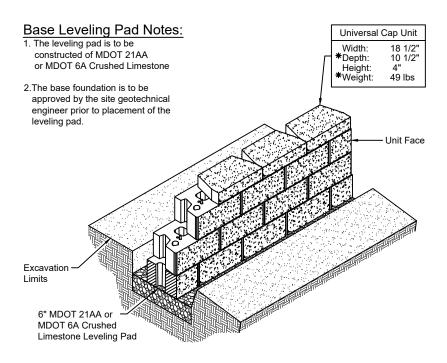
**ELEVATION VIEW** 

SHEET TITLE

SHEET NO.

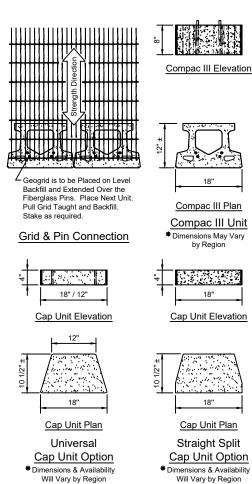
# Typical Reinforced Wall Section

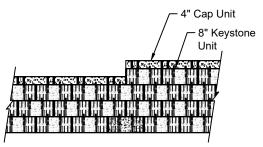
Near Vertical Setback



# Compac Unit/Base Pad Isometric Section View

\* Dimensions & Weight May Vary by Region

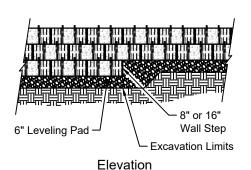




# Note:

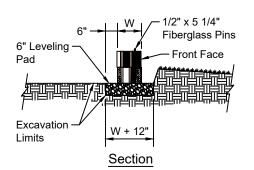
1. Secure all cap units with Keystone Kapseal or equal.

# Top of Wall Steps



Note:

- The leveling pad is to be constructed of MDOT 21AA or MDOT 6A Crushed Limestone.
- Where wall is installed flush with existing pavement or sidewalk, leveling pad shall extend to front face of wall only.



Leveling Pad Detail



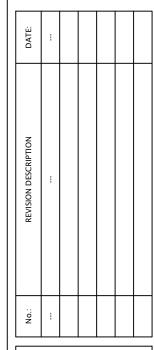
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 PROJECT NO.:
 210816

 DATE:
 1/4/22

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PROJECT NAME:

STARBUCKS

LOCATION: 1360 WALTON BOULEVARD ROCHESTER HILLS, MICHIGAN

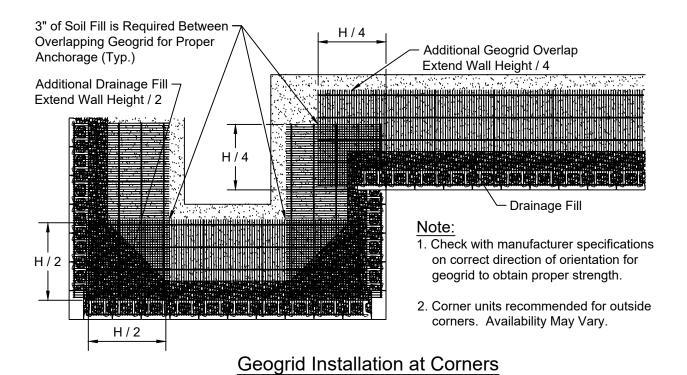
SHEET TITLE

SHEET NO.

S-1

|\2021 geotechnica|\210816 starbucks\retaining w

# Geogrid Installation on Curves



CONSULTING GROUP

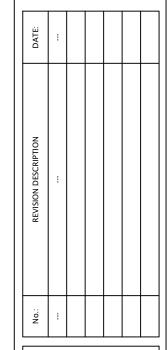
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PROJECT NO.: 210816

DATE: 1/4/22

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PROJECT NAME:

STARBUCKS

LOCATION: 1360 WALTON BOULEVARD ROCHESTER HILLS, MICHIGAN

SHEET TITLE

DETAILS

3111111

S-2

# SECTION 1

PART 1: GENERAL

## 1.1 Summary

A. Section Includes

- 1. Segmental retaining wall (SRW) units, soil reinforcement, and appurtenances
- 1.2 References
- A. ASTM International (ASTM)
- 1. ASTM C 140 Sampling and Testing Concrete Masonry Units and Related Units
- 2. ASTM C 150 Portland Cement
- 3. ASTM C 1262 Evaluating the Freeze/Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units
- 4. ASTM C 1372 Dry-Cast Segemental Retaining Wall Units
- 5. ASTM D 422 Particle Size Analysis of Soils
- 6. ASTM D 1557 Laboratory Compaction Characteristics of Soil Using Modified
- 7. ASTM D 2166 Unconfined Compressive Strength of Cohesive Soils
- 8. ASTM D 2949 3.25-in Outside Diameter poly(vinyl chloride)(pvc) plastic drain, waste, and vent pipe and fittings
- 9. ASTM D 2922 Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
- 10. ASTM D 3080 Direct Shear Test of Soils Under Consolidated Drained Conditions
- 11. ASTM D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- 12. ASTM G 51 Measuring pH of Soil for Use in Corrosion Testing
- 13. ASTM G 57 Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method
- B. National Concrete Masonry Association (NCMA)
- 1. NCMA Design Manual for Segmental Retaining Walls
- 2. NCMA SRWU-2 Shear Strength between Segmental Concrete Units
- C. American Association of Highway and Transportation Officials (AASHTO) 1. AASHTO - Standard Specifications for Highway Bridges
- 1.3 Definitions
- A. Soil Reinforcement: Structural geogrid formed by a regular network of integrally connected tensile elements with appertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as structural reinforcement.
- 1. Geosynthetic (extensible) Soil Reinforcement: Polymer product specifically manufactured as soil reinforcement element that meets requirements of this specification.
- B. Segmental Concrete Facing Unit: A modular concrete facing unit machine-made
- from Portland cement, water, and mineral aggregates. C. Cap Unit: A modular concrete cap unit machine-made.
- D. Unit Fill: Free draining "open" aggregate fill which is within and between the segmental concrete facing units.
- E. Drainage Fill: Free draining "open" aggregate fill (MDOT 6A) extending a minimum of 24 or 36 inches behind the face of the units.
- F. Reinforced Backfill: Compacted soil which is within the reinforced soil volume as outlined on Construction Drawings.
- G. Foundation Soil: Compacted import or in-situ soil beneath the entire wall
- H. Retained Soil: Compacted import or in-situ soil behind reinforced zone of retaining
- I. Leveling Pad: Level compacted MDOT 21AA crushed limestone upon which first course of segmental concrete facing units are placed.
- 1.4 Submittals
- A Certificates of Compliance: Submit manufacturer's certification to the Civil Engineering Consultant of Record and the Owner prior to start of work stating that the following meet requirements of this specification.
- Soil reinforcement

experience.

- 2. Reinforced backfill materials 3. Drainage materials
- B. Samples: Submit samples to Civil Engineering Consultant of SRW units showing finish and color prior to delivery of materials as required on Construction drawings.
- 1.5 Quality Assurance A. Qualifications: SRW System installer shall have a minimum of 100,000 square feet of documentable experience installing SRW systems over eight feet in height on a minimum of five projects over the previous two years. Provide to the Construction Manager at the pre-construction conference, a project list with current references and telephone numbers for the proposed SRW Installer substantiating the required
- Pre-Construction Meeting: A pre-construction meeting shall be conducted by the General Contractor prior to beginning construction on segmental retaining walls. Owner's Construction Manager shall be notified of the date, time, and location of the meeting. Mandatory attendees include the General Contractor, the wall design engineer of record, the project geotechnical engineer, the Contractor's testing agency, Owner's independent testing laboratory, and representatives of all sub-contractors involved with the foundation preparation, erection, and backfilling of the SRW. Meeting topics shall include, but are not limited to, contractor qualifications as stated above; schedule and phasing of wall construction; coordination with other on-site construction activities; responsibilities of parties; and sources, quality, and acceptance of materials.
- 1.6 Delivery, Storage, and Handling A. Segmental Concrete Facing Units
- 1. Check the materials upon delivery to assure the specified type, grade, color, and texture of units have been received.
- 2. Prevent excessive mud, wet concrete, epoxies, and like materials which may affix themselves from coming in contact with the materials.
- 3. Protect the materials from damage.
- Soil Reinforcement
- 1. Check the soil reinforcement upon delivery to assure the proper grade and type of material has been received. Provide a product certification with each shipment.
- 2. Store soil reinforcement material in accordance with manufacturer's

- C. Drainage Materials
- 1 Store plastic pipe in accordance with the manufacturer's recommendations to prevent deleterious materials from becoming affixed or deterioration from sun exposure.
- 2. Store drainage aggregate to prevent contamination with other materials.

# PART 2: PRODUCTS

- 2.1 Keystone Concrete Retaining Wall Units
- A. Keystone concrete retaining  $\bar{\text{wall}}$  units shall conform to the following architectural requirements
- 1. Face color concrete gray, unless otherwise specified. The Owner may specify standard
- 2. Face finish hard split in angular tri-plane or straight face configuration. Other face finishes will not be allowed without written approval of Owner.
- 3. Bond configuration running with bonds nominally located at midpoint in vertically adjacent units.
- 4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 20 feet (6 m) under diffused lighting.
- B. Keystone concrete units shall conform to the requirements of ASTM C1372 Standard Specifications for Segmental Retaining Wall Units.
- C. Keystone concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units: Compressive strength: ≥ 3000 psi (21 MPa).
- 2. Absorption: ≤ 8 % for standard weight aggregates.
- 3. Dimensional tolerances: ± 1/8" (3 mm) from nominal unit dimensions not including rough
- 4. Unit Size: 8" (203 mm) (H) x 18" (457 mm) (W) x 12" (304 mm)(D) minimum.
- D. Keystone concrete units shall conform to the following constructability requirements: Vertical setback: 1/8 inch (3 mm) ± per course (near vertical) or 1 1/8 inch (28 mm) + per
  - course, per the design. Alignment and grid attachment mechanism - fiberglass pins, two per unit.
- Maximum horizontal gap between erected units shall be ≤ 1/2 inch (13 mm).
- 2.2 Shear and Reinforcement Pin Connectors
- A. Shear and reinforcement pin connectors shall be 1/2-inch (12 mm) diameter thermoset isopthalic polyester resin pultruded fiberglass reinforcement rods to provide connection between vertically and horizontally adjacent units and geosynthetic reinforcement, with the following requirements:
- 1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.
- B. Shear and reinforcement pin connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.
- 2.3 Base Leveling Pad Material
- A. Base leveling pad material shall be MDOT 21AA dense-grade aggregate or MDOT 6A.
- 2.4 Unit Fill A. Unit fill shall be free-draining MDOT 6A material.
- 2.5 Soil Reinforcement
- A. Geosynthetic Soil Reinforcement
- 1. Properties: The geosynthetic soil reinforcement shall possess minimum strength and durability required by design as determined by product specific testing as defined in the NCMA Design Manual for Segemental Retaining Walls (Section 3.5), including provisions for minimum partial safety factors. Design submittals shall indicate the index tensile strength for each reinforcement type to be used in construction
- a. Stratagrid 150 by Strata Systems, Inc.
- 2.6 Drainage Materials
- A. Drainage collection pipe shall be perforated/slotted PVC pipe or corrogated HDPE
- The pipe shall be covered with a knitted or non-woven geotextile sock specifically designed to function as a filter
- C. Drainage aggregate shall be free-draining material, relative to the surrounding soil conforming to the SRW manufacturer's recommendations in order to prevent build-up of hydrostatic pressure. Drainage aggregate shall be a clean crushed stone or granular fill meeting the following gradation as determined in accordance with

Percent Passing
100
95-100
30-60
0-8
0-1

- D. Drainage Geotextile
- 1. Mirafi 140N by Mirafi Construction Products, Pendergrass, GS (888)795-0808 2.7 Reinforced Wall Backfill
- A. Reinforced soil backfill shall be free of debris and consist of MDOT Class II Sand 2.8 Retained Backfill
- A. Soil placed behind the reinforced backfill shall be satisfactory fill material placed in an engineered manner and compacted to 95 percent of the Modified Proctor Maximum Dry Density (ASTM D1557).

# PART 3: EXECUTION

- 3.1 Preparation
- A. Comply with federal, state, and local requirements for execution of the work. including local building codes and current OSHA excavation regulations. Provide excavation support as required to maintain stability of the area during excavation and wall construction and to protect structures, utilities, landscape features, or property or improvements.
- B. Prior to grading or excavation of site, confirm the location of the retaining wall and all underground features, including utility locations within the area of construction Ensure surrounding structures are protected from effects of wall excavation.
- C. Coordinate installation of underground utilities and other improvements with wall

- D. Control surface water drainage and prevent inundation of the retaining wall area during construction
- 3.2 Excavation
- A. Excavate to lines and grades shown on the Construction Drawings. Take precautions to minimize over-excavation. Over-excavation shall be backfilled with approved compacted material.
- B. Inspect excavation prior to placement of leveling pad material
- C. In areas where soft, disturbed or otherwise unsuitable soils are encountered within the zone of the wall loading in the excavations, such unsuitable soils shall be over-excavated to depths and extents required and replaced with select material and compacted to 98% of the Modified Proctor Maximum Dry Density.
- D. Fill over-excavated areas in front of wall face with approved compacted materia before wall construction reaches 4 feet in height.
- E. In areas where a retaining wall or portion of a retaining wall is to be installed into cut, the required excavation shall extend horizontally to the extent of the reinforced zone and vertically to the elevation of the top of the leveling pad. The retained zone shall be bench cut in order to permit controlled placement of retained backfill.
- Proof compact the base of the excavation to densify the bearing soils.
- 3.3 Leveling Pad Construction
- Place leveling pad as shown on the Construction Drawings with 6 inches of MDOT 21AA crushed limestone dense graded aggregate base. The leveling pad shall extend laterally a minimum distance of 6 inches from the toe and heel of the lower-most SRW Unit in accordance with manufacturer's recommendations.
- Foundation soil shall be proofrolled and tested for bearing capacity prior to placement of leveling pad materials. Required bearing capacity is shown on the Elevation View
- C. Compact granular leveling pad MDOT 21AA to provide a level hard surface on which to place the first course of units. Compact with mechanical plate compactors to a minimum of 95% of the Modified Proctor Maximum Dry Density (ASTM D
- 3.4 SRW Unit Installation
- Place first course of SRW units on the leveling pad. Level units side-to-side,
- front-to-rear and aligned with adjacent units. Ensure units are in full contact with base.
- Place the front of the units side-by-side without gaps between the fronts of adjacent
- units. Lavout of curves and corners shall be in accordance with SRW manufacturer's recommendations. Install mechanical fascia connections per SRW manufacturer's recommendations.
- Place and compact unit drainage fill within, between, and behind units. Place and
- compact infill soils behind drainage fill. Mechanical vibrating plate compactors shall not be used on top of the units. Compact fill between units and the three-foot zone behind the units by running hand-operated compaction equipment just behind units. Compact to a minimum of 80% Relative Density (ASTM 2949).
- F. Place core drainage fill in the previous course of units prior to stacking of subsequent segmental retaining wall units.
- G. Clean excess debris from top of units.
- H. Repeat procedure to the extent of wall height.
- 3.5 Soil Reinforcement Installation
- A. Soil reinforcement shall be oriented with the highest strength axis perpendicular to the wall alignment. Verify orientation (Roll direction) of geosynthetic
- B. Install soil reinforcement to wall height, horizontal location, and extent as shown on the Drawings.
- C. Lay the soil reinforcement horizontally on compacted backfill. Pull geogrid taut and connect to concrete SRW units according to connection detail shown on the Drawings or as recommended by manufacturer prior to backfill placement on geosynthetic reinforcement.
- D. Soil reinforcements shall be continuous throughout their embedments lengths Spliced connections between shorter pieces will not be allowed.
- E. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum backfill thickness of 6 inches is required prior to operation of tracked vehicles over the geosynthetic reinforcement. Turning of tracked vehicles should be kept to a minimum to prevent displacing the fill and damaging or moving the geosynthetic reinforcement.
- F. Rubber-tired equipment may pass over the geosynthetic reinforcement, if in accordance with the manufacturer's recommendations, at slow speeds less than 10 mph. Sudden braking and sharp turning should be avoided.
- G. Changes to soil reinforcement layout, including, but not limited to, length, soil reinforcement type, or elevation, may be subject to approval of the Engineer,
- H. Short slits shall be cut in geogrid where steel guardrail posts are to be installed to prevent excess damage to grid during driving operations for the steel posts. 3.6 Reinforced Backfill Placement
- A. Place reinforced backfill, spread, and compact in such a manner that will not develop slack in the soil reinforcement in accordance with Manufacturer's recommendations
- B. Place and compact reinforced backfill in lifts not to exceed 8 inches in compacted thickness. C. Compact reinforced backfill to a minimum of 95% of the Modified Proctor
- Maximum Dry Density (ASTM 1557) at a moisture content from 2% below to 2% above optimum. D. Compact reinforced backfill in all areas to the lines and grades shown on the

Construction Drawings including all sloped areas above walls

- E. At the end of the day, the contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.
- F. Where the retained soil is excavated for wall construction, sloughing of soils along the excavation slope is not permitted. If soils slough, recompaction of the soils to 95% of the Maximum dry density as determined by the Modified Proctor test is required prior to placement of reinforced soil.
- 3.7 Retained Backfill Placement
- A. Retained backfill shall be placed in maximum 8-inch thick lifts and compacted to a minimum of 95% of the Modified Proctor Maximum Dry Density (ASTM 1557).

- 3.8 Drainage System
- A. Drainage Collection Pipe
- 1. Install the drainage collection pipe according to line, grades, and sections shown on the drawings
- B. Drainage Aggregate
- 1. Install drainage aggregate to line, grades, and sections shown on the Drawings. 2. When blanket drain is installed, non-woven geotextile shall be installed prior to
- aggregate placement in accordance with the Drawings
- 3.9 SRW Cap Installation
- A. Place SRW Cap units per manufacturer's recommendations. Backfill and compact to finished grade
- B. Attach cap units to wall units with construction epoxy. Apply epoxy to bottom surface of cap unit and install on clean units below. Follow epoxy manufacturer's directions to ensure permanent bond.
- 3.10 Construction
- A. SRW Tolerances 1. Vertical control from plan: +/-1.25 inches over a 10 foot distance.
- 2. Horizontal location control from plan
- a. Straight lines: +/-1.25 inches over a 10 foot distance b. Straight & radius corner locations: +/- 1.0 foot
- Rotation of the wall face during construction:
- a. Maximum 2.0 degrees from established wall plan batter b. Maximum, +/- 10% from total established horizontal setback
- 4. Bulging: +/- 1.25 inches over a 10 foot distance
- B. Keystone concrete materials shall conform to the requirements of ASTM C1372 -Standard Specifications for Segmental Retaining Wall Units.
- C. Keystone concrete units shall conform to the following structural and geometric requirements measured in accordance with appropriate references:
- 2. Absorption: < 8 % (6% in northern states) for standard weight aggregates;
- Dimensional tolerances: ± 1/8" from nominal unit dimensions not including rough split face, ±1/16" unit height - top and bottom planes;
- 4. Unit size: 8" (H) x 18" (W) x 12" (D) minimum;

Compressive strength: 3000 psi minimum:

- 5. Unit weight: 75-lbs/unit minimum for standard weight aggregates
- Inter-unit shear strength: 600-plf minimum at 2-psi normal pressure: 7. Geogrid/unit peak connection strength: 500-plf minimum at 2-psi normal force.
- D. Keystone concrete units shall conform to the following constructability requirements:
- 1. Alignment and grid positioning mechanism: fiberglass pins, two per unit
- 2. Horizontal gap between erected units shall be < 1/2 inch
- 3. Vertical setback 1" +/- per course. E. Mechanical vibrating plate compactors shall not be used on top of the units. Compact fill between units and the backfill zone behind the units by running hand-operated compaction equipment just behind units. Perform compaction to manufacturer's recommendations.
- 3 11 Field Quality Control

the Project.

- A. The contractor shall engage inspection and testing service agencies, including independent laboratories, to provide quality control and testing services during construction. The Owner may engage a testing and inspection agency for quality assurance, but this does not relieve the General Contractor from providing the
- specified construction quality control and testing. B. Testing and inspection services shall be performed by trained and experienced technicians currently qualified for the work to be performed
- C. The testing agency shall submit written reports of inspections to the Contractor on a weekly basis. Such reports shall include description of work performed, deficiencies noted in construction, and corrective action taken to resolve such deficiencies. Owner shall be notified directly by the Contractor's testing agency of deficiencies noted by testing agency and provided with a summary and schedule for corrective action. Written reports will also include location, type, and result of all tests taken on
  - SRW has been installed in accordance with the contract documents. Segmental Retaining Wall Units 1. Compressive strength test specimens shall conform to the saw-cut coupon provisions of Section 5.2.4 of ASTM C140 with the following exceptions:

D. The Contractor shall provide a certification to the Owner stating that the completed

- a. Coupon shall have a minimum thickness of 1-1/2 inches.
- b. Coupon shall not be oven dried before testing. 2. The compressive strength shall be considered the average of three or more test
- 3. Run compressive strength testing for every 7,500 square feet of installed wall facing material or fraction thereof. The testing shall be performed immediately upon receipt from laboratory. F. Soil and Backfill Testing: Unless otherwise directed by the Owner or required by this technical scope of work. type, and minimum frequency of testing soils-related
- portions of construction shall be as follows:
- 1. Field density tests in accordance with ASTM D 2922: a. Subgrade Soils: One test for every 100 lineal feet
- b. Base Leveling Pad: One test for every 100 lineal feet
- c. Reinforced Backfill: One test for every 2,000 square feet per lift. Every lift shall be tested 2. Laboratory moisture-density relationships, ASTM 1557. One test for every
- compacted material type. 3. Gradation Analysis, ASTM D 422:
- a. Unit fill: One test for every 500 cubic yards of material.
- b. Reinforced Backfill: One test for every 500 cubic yards of material or when material type changes.

CONSULTING GROUP

> 1866 Woodslee Street Troy, Michigan 48083 office (248) 680-0400 fax (248) 680-9745

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PROIECT NAME: STARBUCKS

I OCATION 1360 WALTON BOULEVARD

ROCHESTER HILLS, MICHIGAN SHEET TITLE

**SPECIFICATIONS** 

SP-1