



**Note: This guide specification should not be included entirely “as-is”. Specification writers must edit areas in red which may or may not be relevant to a specific project or where mutually exclusive choices are referenced.**

## SECTION 32 32 16 PRECAST MODULAR BLOCK RETAINING WALL

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Related Sections:
1. Section 312000 Earth Moving
  2. Section 099313.13 Exterior Staining
  3. Section 099723 Concrete and Masonry Coatings
  4. Section 099623 Graffiti-Resistance Coatings

#### 1.2 REFERENCES

- A. Precast Modular Block Units:
1. ASTM C-33 Specification for Concrete Aggregates
  2. ASTM C-39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
  3. ASTM C-94 Specification for Ready-Mixed Concrete
  4. ASTM C-138 Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
  5. ASTM C-143 Test Method for Slump of Hydraulic-Cement Concrete
  6. ASTM C-260 Specification for Air-Entraining Admixtures for Concrete
  7. ASTM C-494 Specification for Chemical Admixtures for Concrete
  8. ASTM C1611 Test Method for Slump Flow of Self-Consolidating Concrete
  9. ASTM C-1776 Standard Specification for Wet-Cast Precast Modular Block Retaining Wall Units
- B. Drain Pipe:
1. ASTM D-3034 Standard Specification for Type PSM (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  2. ASTM F-2648 Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications
- C. Geosynthetics:
1. ASTM D-4595 Tensile Properties of Geotextiles - Wide Width Strip
  2. ASTM D-4873 Standard Guide for Identification, Storage and Handling of Geosynthetics
  3. ASTM D-5262 Unconfined Tension Creep Behavior of Geosynthetics
  4. ASTM D-5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
  5. ASTM D-5818 Standard Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage
  6. ASTM D-5970 Standard Test Method for Deterioration of Geotextiles from Outdoor Exposure
  7. ASTM D-6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single- or Multi-Rib Tensile Method
  8. ASTM D-6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units
  9. ASTM D-6706 Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil



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- D. Engineering Design:
  - 1. NCMA Design Manual for Segmental Retaining Walls, Current Edition
  - 2. AASHTO LRFD Bridge Design Specifications, Current Edition
  - 3. International Building Code (IBC), Current Edition
  - 4. Minimum Design Loads for Buildings and Structures, ASCE 7, Current Edition
- E. Soils:
  - 1. ASTM D-422 Standard Test Method for Particle-Size Analysis of Soils
  - 2. ASTM D-448 Standard Classification for Sizes of Aggregates for Road and Bridge Construction
  - 3. ASTM D-698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f<sup>3</sup>) (600 kN-m/m<sup>3</sup>)
  - 4. ASTM D-1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses
  - 5. ASTM D-1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
  - 6. ASTM D-1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f<sup>3</sup>) (2700 kN-m/m<sup>3</sup>)
  - 7. ASTM D-2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  - 8. ASTM D-3080 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
  - 9. ASTM D-4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - 10. ASTM D-4767 Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils
  - 11. ASTM D-6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
  - 12. ASTM D-G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing
- F. County Materials Rib Rock Construction Detail Drawings can be found at: [www.countymaterials.com](http://www.countymaterials.com)

### 1.3 DEFINITIONS

- A. County Materials Rib Rock Retaining Wall Unit: Concrete, modular facing block manufactured by County Materials Corporation.
- B. Geogrid: A geosynthetic material manufactured of high tensile materials specifically for the purpose of reinforcing and creating a structural soil mass.
- C. Drainage Aggregate: Clean, crushed rock located within and immediately behind Rib Rock units to facilitate drainage and avoid compaction in close proximity to Rib Rock wall units.
- D. Reinforced Soil: Soil zone extending from the drainage aggregate zone to the back of the embedded geogrid.
- E. Foundation Soil: Soil zone immediately beneath the retaining wall facing units, the wall leveling pad and the reinforced soil zone.
- F. Retained Soil: Soil immediately behind retaining wall facing and drainage aggregate for modular gravity structures or behind the reinforced soil for wall that utilize geogrid.
- G. Project Approving Professional Engineer: Approver of construction drawings and installation guidelines per project specifications.
- H. Construction Drawings: Approved final plan for construction prepared and stamped by the Project Approving Professional Engineer licensed to practice in the state where the project is located.



#### 1.4 Submittals

- A. Contractor shall submit County Materials Corporation product data and guidelines instructions for approval to the Project Approving Professional Engineer.
  - 1. It is recommended the design be prepared by a Professional Engineer licensed to practice in the state where the project is located.
  - 2. Follow NCMA Design Guidelines for Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges, whichever is applicable as determined by the retaining wall design engineer.
    - a. Contractor shall submit to Project Approving Professional Engineer County Materials Corporation's Letter of Compliance, prior to start of work, indicating Segmental Retaining Wall System components meet the requirements of this specification and the structure design.
    - b. Contractor shall submit to the Project Approving Professional Engineer construction drawings and design calculations for the retaining wall system prepared and stamped by the Project Approving Professional Engineer registered where the state of project is located in. The engineering designs, techniques, and material evaluations shall be in accordance with the Industry Standards and/or NCMA Design Guidelines for Segmental Retaining Walls.
    - c. Contractor shall submit to the Project Approving Professional Engineer test report documenting strength of 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 ).
- B. See Industry Standards if geogrid reinforcement is needed.
- C. Submit gradation reports for aggregates used for the wall leveling pad, unit / drainage fill and for select reinforced fill if required in the final approved engineered wall design, as determined by the Project Approving Professional Engineer.
- D. All submittals must be provided for review and approval by the Project Approving Professional Engineer prior to the start of retaining wall construction.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall inspect all products at delivery to determine the proper materials have been delivered and are usable. Damaged material shall not be incorporated into the work.
- B. Rib Rock Block retaining wall units shall be stored in a location and manner that protects against excessive weathering and any type of damage.
- C. At all times, Rib Rock Block units should be protected from excessive soiling and coming in contact with substances which may stain or adhere to the finished visual surfaces of the unit.
- D. Faces of the Rib Rock Block shall be free of excessive chipping, cracking and stains.

#### 1.6 QUALITY ASSURANCE RECOMMENDATIONS

- A. Utilize a qualified and experienced installation personal as determined by the Project Approving Professional Engineer.
- B. Utilize the services of an independent geotechnical or materials engineering firm to provide soil testing and quality assurance inspection for wall construction and soils work. Contractor shall provide, order and/or perform or conduct any quality control testing or inspection not provided by the Owner, but required per the Project Approving Professional Engineer.



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- C. Project Approving Professional Engineer Qualifications: The Project Approving Professional Engineer shall be licensed to practice in the state in which the project is located. Additionally, the Project Approving Professional Engineer shall be independently capable of performing all Rib Rock retaining wall analysis calculations (internal and external stability, seismic analysis, water analysis, and global stability) and have designed at similar wall projects similar to that of this project.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

County Materials Corporation, Marathon, WI 54448-0100

### Concrete Mix Properties

Freeze Thaw Exposure Class <sup>(1)</sup>	Minimum 28-Day Compressive Strength <sup>(2)</sup>	Maximum Water Cement Ratio	Nominal Maximum Aggregate Size	Aggregate Class Designation <sup>(3)</sup>	Air Content <sup>(4)</sup>
Moderate	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3M	4.5% +/- 1.5%
Severe	4,000 psi (27.6 MPa)	0.45	1 inch (25 mm)	3S	6.0% +/- 1.5%
Very Severe	4,500 psi (30.0 MPa)	0.40	1 inch (25 mm)	4S	6.0% +/- 1.5%
<b>Maximum Water-Soluble Chloride Ion (Cl<sup>-</sup>) Content in Concrete, Percent by Weight of Cement<sup>(5,6)</sup></b>					0.15
<b>Maximum Chloride as Cl<sup>-</sup> Concentration in Mixing Water, Parts Per Million</b>					1000
<b>Maximum Percentage of Total Cementitious Materials By Weight <sup>(7,9)</sup> (Very Severe Exposure Class Only):</b>					
Fly Ash or Other Pozzolans Conforming to ASTM C618					25

### MATERIALS – Listed Below are NCMA Standards

- A. Segmented retaining wall units.
- The block unit shall consist of concrete with the average 28-day compressive strength of no less than 4000 psi.
  - Concrete shall have air entrainment by volume (as measured in the plastic state in accordance with ASTM C172) of:
    - 5.5 – 8.5 percent, or
    - In conformity with ASTM C94, latest revision.
  - Exterior dimensions of the face shall be 48-inches by 16-inches for full and corner unit, and 24-inches by 16-inches for half unit.
  - Depth of unit should be as per Construction Drawings and is available in depths from 24-inches up to 84-inches (dimensions in inches: 24, 39, 45, 60, 66, 72, 78, 84).
  - Rib Rock Units used shall maintain tolerances of:
    - Height: +/- 3/16-inch
    - Width: +/- 1/2-inch unless field cut for fitting purposes.
    - Depth: No less than the unit design depth (i.e. 24-inch, 39-inch, etc.) with the textured face portion of the block is considered as 4-inches
  - Special shape units should be obtained and used where indicated on the final engineered construction drawings. Reference Rib Rock Drawing #101 for overview of standard unit types.



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7. Rib Rock Unit Face Texture [Specify choice (or choices) as required. Check local availability]:
  - a. Shall be "Standard finish"
  - <or>
  - b. Shall be "Dry Stack"
- B. Geogrid Reinforcement: Geosynthetic reinforcement shall be high tensile geogrid or geotextile manufactured specifically for soil reinforcement applications.
  1. Construction Drawings shall indicate the type, strength, location and lengths of reinforcement used.
  2. The geosynthetic manufacturer shall provide all relevant testing to the Project Approving Professional Engineer for incorporation in the wall design and shall be included in the submittal for the Construction Drawings.
  3. No substitutions of geosynthetic shall be allowed that was not evaluated in the Construction Drawings.
- C. Base Leveling Pad: The wall base leveling pad material shall consist of a compacted crushed stone base or non-reinforced concrete as indicated in the Construction Drawings.
- D. Drainage Aggregate: Drainage aggregate shall consist of clean 3/4" crushed stone or gravel meeting the requirements of the Construction Drawings.
- E. Reinforced Soil: All reinforced soil, borrow or imported, shall meet all requirements of the Construction Drawings. Reinforced soils, by gradation, shall have no more than 35 percent passing the number 200 sieve for walls less than 20-feet in height and no more than 15 percent passing the number 200 sieve for walls greater than 20-feet in height.
- F. Drainage Pipe: If required in Construction Drawings, drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or ASTM D-2412. Drainage pipe may also be covered with a geotextile filter fabric.
- G. Unit Adhesive: Adhesive shall be a premium, construction grade suitable for concrete and exterior applications.

## 2.2 CLEANING

- A. After completion of wall installation, remove construction debris and restore any adjacent finished areas affected by wall construction to their pre-construction state.
- B. Wash wall face to remove soiling and stains. Do not use acid or detergents that may "burn" or discolor face.

## 2.3 FINISHES

- A. Rib Rock retaining wall color [Specify choice (or color) as required]
  1. Finished wall shall be left in natural (as-cast) color.
  - <or>
  2. Finished retaining wall shall be stained in accordance with Section 099313.13 "Exterior Staining".
    - a. Recommended product stains:
      1. Sherwin Williams H & C SHIELD PLUS CONCRETE STAIN
      2. TK Products TRI-SHEEN PIGMENTED STAIN TK-5272
    - b. Color shall match [Define reference or sample to match]
    - <or>
    - c. Color shall be [Designate existing color]
  3. Sealing [Optional, list here and specify in Section 099723 Concrete and Masonry Coatings or 099623 Graffiti Resistant Coatings]
    - a. Recommended sealers and anti-graffiti coatings
      1. TK Products TK-290 Tri-SILOXANE OTC (sealer)
      2. TK Products 1496 TK Prermaclean OTC (anti-graffiti)



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### 3.1 EXCAVATION

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. The contractor shall be careful not to disturb the base beyond the lines indicated.
- B. Foundation soils shall be excavated as required for footing base / leveling pad dimensions shown on the construction drawings, or as directed by the Project Approving Professional Engineer.
- C. Over-excavated areas shall be filled with suitable base or backfill material and compacted to 95 percent standard proctor.

### 3.2 FOUNDATION SOILS PREPARATION

- A. Foundation soils shall be evaluated by a Geotechnical Engineer or Owners Representative to ensure that the bearing soils meet or exceed the design conditions or assumptions, or as approved by the Project Approving Professional Engineer.
- B. Compact foundation soil zone to 95 percent standard proctor prior to installing base / leveling pad.

### 3.3 BASE / LEVELING PAD

- A. Base shall be located as indicated on the Construction Drawings and shall have a minimum thickness of 6-inches. Base materials are to be as specified by the Project Approving Professional Engineer (generally crushed stone, 3/4-inch minus, or similar).
- B. Width of the base pad must extend a minimum of 6-inches in front and 6-inches in back of the Rib Rock Base Block footprint.
- C. Base material shall be compacted so as to provide a smooth, hard surface on which to place the first course of units.
- D. Compact base material to 95 percent of standard proctor.
- E. Base shall be prepared to ensure full contact of the wall unit with base material. Spacing or gaps between units shall no exceed 1/2-inch.
- F. Contractor may elect to substitute a portion of the specified granular base materials with a lean, unreinforced concrete topping.
- G. When a reinforced footing is required by the Construction Drawings, it shall be located below the frost line.

### 3.4 UNIT INSTALLATION

- A. First course of units shall be Base Block units and shall be placed in full contact with the base material.
- B. Check units for level from side-to-side, front to back, and check to maintain unit batter front-to-back.
- C. Place unit faces in contact side to side and avoid any gaps greater than 1/2-inch.
- D. Fill and compact fill to grade in front of embedded units prior to compaction behind the wall units.
- E. Fill voids between Rib Rock units with 3/4-inch clean crushed rock to a distance of one foot behind the unit depth unless otherwise instructed in the Construction Drawings.
- F. Sweep and clean the top of each course before setting additional courses.
- G. Lay each successive course making sure that the bottom recess is in full contact with the unit locators of the course below. Pull unit forward as far as possible. Backfill and compact soil behind the units.
- H. Check and maintain level and wall batter by use of shims when necessary.
- I. Follow Rib Rock recommended procedures to maintain acceptable running bond when constructing curved walls and / or corners. Build in accordance with Construction Drawings or Rib Rock Construction Detail Drawings.



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- J. Handle units with proper lifting devices that have been certified for the loads associated with the weights of the units. Avoid applying forces to the lifting loops in excess of the normal force associated with the weight of the unit (i.e., avoid dynamic loads from bouncing or swinging of a unit). If the unit is to be transported over a significant distance in the field, it is recommended that a CABLE be used in lieu of a chain.

### 3.5 GEOGRID INSTALLATION – Per Geogrid Manufacture Instructions

- A. Install geosynthetic reinforcement in accordance with manufacturer's recommendations and the Construction Drawings.
- B. Locate geosynthetic reinforcement at elevations and to the lengths shown on the Construction Drawings.
- C. Prior to installation of geosynthetic reinforcement, level and compact backfill material to the level of the reinforcement layer.
- D. Reinforcement design strength direction must be oriented perpendicular to wall face.
- E. Position reinforcement on Rib Rock units over the tongue and groove and to within 2-inches of the front exposed face. The next course of units shall be placed such that the geogrid is deformed over the tongue and groove. The next course of units must be slid forward such that the back edge of the groove on this unit is up against the back edge of the tongue on the lower unit with the geogrid pinched between the tongue and groove. Hold in place by installing the next course of units.
- F. Remove all wrinkles or folds in reinforcement by pulling taut prior to backfill placement. Secure using soil staples, stakes or hand tension until reinforcement is covered with sufficient fill to maintain tensioned position.
- G. Reinforcement shall be continuous throughout the embedment length. Splicing along reinforcement strength direction is not allowed.
- H. Position reinforcement sections side-by-side to provide 100 percent coverage along wall face.
- I. Where curved wall sections cause overlap areas in reinforcement, maintain at least 3-inches of soil between layers where overlap occurs.

### 3.6 REINFORCED BACKFILL PLACEMENT RECOMMENDATIONS PER APPROVED PLANS AND INSTRUCTIONS AND PROJECT APPROVING PROFESSIONAL ENGINEER.

- A. Wall fill material shall be placed in lifts no greater than 8-inches in depth and shall be less if necessary to achieve necessary compaction.
- B. Compact backfill material to 95 percent of standard proctor.
- C. Only hand-operated compaction equipment shall be used within 3-feet of the back of the Rib Rock unit. Heavy-duty compaction equipment should be kept a minimum of 5-feet from the back of the Rib Rock unit to avoid wall rotation.
- D. Wherever possible, backfill should be placed beginning at the face of the wall. Backfill shall be placed, spread, and compacted in a manner that minimizes the development of wrinkles, folds or movement of geogrid.
- E. Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 6-inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.
- F. Rubber tired equipment may pass over the geogrid reinforcement at slow speeds, (less than 10 MPH). Avoid sudden braking and sharp turning.
- G. At the conclusion of each day's work, slope backfill at both the crest and bottom of wall away from wall face to prevent surface drainage from scouring or ponding.
- H. During wall construction, the General Contractor shall be responsible for coordination of other project site operations so as to avoid adjacent construction site drainage from affecting wall construction area.
- I. Upon completion of wall construction work, the General Contractor shall:
  1. Ensure finished grading directs normal drainage away from the finished wall.



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2. Ensure other trades do not operate heavy equipment or excavate near the wall and reinforced soil zone.

### 3.7 OTHER CONSTRUCTION DETAILS

- A. Rib Rock provides several Construction Detail Drawing samples (see Section 1.2F) which can be found on County Materials Corporation's website ([www.countymaterials.com](http://www.countymaterials.com)) and should be referred to for guidance on Rib Rock Retaining Wall specific applications, contact your local County Materials Corporation Representative for additional information.
- B. Follow all installation recommendations of Project Approved Professional Engineer. County Materials Corporation accepts no responsibility or liability for engineering, installation and/or use of the Rib Rock Retaining Wall System.

### 3.8 SITE TOLERANCES RECOMMENDATIONS PER INDUSTRY STANDARDS

- A. Straight walls
  1. Vertical Alignment: +/- 1.5-inches over any 12-foot distance and no more than +/- 3-inches over the entire length of wall.
- B. Horizontal Alignment Control:
  2. Corners and radius location: +/- 1-foot to theoretical location indicated on the Grading Plan.
  3. Radii: +/- 2-feet from theoretical lines indicated on the Grading Plan.
- C. Wall Batter at Completion of Work: +/- 2-degrees from the design batter and no batter less than 2-degrees.

### 3.9 FIELD QUALITY CONTROL

- A. Contractor shall be responsible for proper installation and quality control of all Rib Rock wall components and appurtenant materials.
- B. Owner shall, at their expense, retain a qualified professional to monitor and perform quality assurance checks of the installer's work.
- C. Quality Assurance should include foundation soil inspection, frequent backfill compaction testing, verification of geotechnical design parameters and compliance with Construction Drawings and Project Specifications.
- D. All quality control, and field installation is per the Project Approving Professional Engineer.