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PRECAST MODULAR BLOCK RETAINING WALL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work includes furnishing and installing segmental retaining wall (SRW) units to the lines and grades designated on the construction drawings or as directed by the Architect/Engineer. Also included is furnishing and installing appurtenant materials required for construction of the retaining wall as shown on the construction drawings.

1.2 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)

1. AASHTO M288 Geotextile Specification for Highway Applications
2. AASHTO Standard Specifications for Highway Bridges

B. American Society for Testing and Materials (ASTM)

1. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
2. ASTM C1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units
3. ASTM C1372 Standard Specification for Segmental Retaining Wall Units
4. ASTM D422 Particle Size Analysis
5. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f3)(600 kN-m/m3)
6. ASTM D1248 Standard Specification for Corrugated Plastic Pipe
7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/f3)(2700 kN-m/m3)
8. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
10. ASTM D3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer pipe and Fittings
11. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
12. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
13. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics
14. ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
15. ASTM C94 Ready-Mixed Concrete

C. National Concrete Masonry Association (NCMA)

1. NCMA Design Manual For Segmental Retaining Walls, Second Edition, Second Printing (1997)
2. NCMA SRWU-1 Determination of Connection Strength Between Geosynthetics and Segmental Concrete Units
3. NCMA SRWU-2 Determination of Shear Strength Between Segmental Concrete Units

1.3 DEFINITIONS

A. SRW Units: A pre-cast modular concrete retaining wall element.

B. Reinforced Backfill: Soil or select fill (if applicable) which is used as fill behind the drainage aggregate, and within the reinforced soil mass (if applicable).

C. Drainage Aggregate: Material used within (if applicable), between, and directly behind the concrete retaining wall units.

D. Filter Fabric: Material used for separation and filtration of dissimilar soil types (if applicable).

E. Foundation Soil: Soil mass supporting the leveling pad and reinforced soil zone of the retaining wall system.

F. Leveling Pad: Aggregate base material or concrete used as a foundation for the blocks.

G. Project Geotechnical Engineer: A registered engineer employed by the Owner to perform site observations, provide recommendations for foundation support, and verify soil shear strength parameters.

H. Certification: The declaration of a Professional Engineer's professional judgment. Certification does not constitute a warranty or guarantee, express or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standard regulations, and ordinances.

1.4 REGULATORY REQUIREMENTS

A. Comply with Local, State, and/or Federal Codes.

B. Comply with City of Philadelphia Department of Licenses and Inspections requirements, including any required special inspections.

1.5 SUBMITTALS

A. Material Submittals: The Contractor shall submit manufacturers' certifications two weeks prior to start of work stating that the SRW units meet the requirements of Part 2 of this specification.

1.6 QUALITY ASSURANCE

A. Retaining Wall Installation Contractor Qualifications. In order to demonstrate basic competence in the construction of precast modular block walls, the Retaining Wall Installation Contractor shall document compliance with the following:

1. Demonstrate segmental retaining wall installation experience of similar size and scope.

2. Have a minimum of five (5) years' experience installing segmental retaining wall systems.

3. Retaining Wall Installation Contractor experience documentation for each qualifying project shall include:

    a. Project name and location
    b. Date (month and year) of construction completion
    c. Contact information of Owner or General Contractor
    d. Type (trade name) of precast modular block system built
    e. Maximum height of the wall constructed
    f. Face area of the wall constructed

1.8 QUALITY CONTROL

A. The Owner's Representative shall review all submittals for materials, design, Retaining Wall Design Engineer qualifications and the Retaining Wall Installation Contractor qualifications.

B. The Owner will retain the services of an Inspection and Testing Engineer who is experienced with the construction of precast modular block retaining wall structures to perform inspection and testing. Inspection shall be continuous throughout the construction of the retaining walls. The General Contractor shall coordinate the installation of the retaining wall with the Owner's Inspection and Testing Engineer so that the required inspections can be completed.

C. The Inspection Engineer shall perform the following duties:

1. Inspect the construction of the precast modular block structure for conformance with construction shop drawings and the requirements of this specification.

2. Verify that soil or aggregate fill placed and compacted in the reinforced, retained and foundation zones of the retaining wall conforms with and exhibits the shear strength parameters specified by the Retaining Wall Design Engineer.

3. Verify that the shear strength of the in-situ soil assumed by the Retaining Wall Design Engineer is appropriate.

4. Inspect and document soil compaction in accordance with these specifications:

    a. Required dry unit weight
    b. Actual dry unit weight
    c. Allowable moisture content
    d. Actual moisture content
    e. Pass/fail assessment
    f. Test location – wall station number
    g. Test elevation
    h. Distance of test location behind the wall face

5. Verify that all excavated slopes in the vicinity of the retaining wall are bench-cut as directed by the project Geotechnical Engineer.

6. Notify the Retaining Wall Installation Contractor of any deficiencies in the retaining wall construction and provide the Retaining Wall Installation Contractor a reasonable opportunity to correct the deficiency.

7. Notify the General Contractor, Owner and Retaining Wall Design Engineer of any construction deficiencies that have not been corrected timely.

8. Document all inspection results.

9. Test compacted density and moisture content of the retained backfill with the following frequency:

   a. At least once every 1,000 square feet (90 square meters) (in plan) per 9-inch (230 mm) vertical lift, and

   b. At least once per every 18 inches (460 mm) of vertical wall construction.

D. The General Contractor's engagement of the Inspection Engineer does not relieve the Retaining Wall Installation Contractor of responsibility to construct the proposed retaining wall in accordance with the approved construction shop drawings and these specifications.

E. The Retaining Wall Installation Contractor shall inspect the on-site grades and excavations prior to construction and notify the Retaining Wall Design Engineer and General Contractor if on-site conditions differ from the elevations and grading conditions depicted in the retaining wall construction shop drawings.

1.8 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall inspect the materials upon delivery to assure that proper type and grade material has been received.

B. The Contractor shall store and handle materials in accordance with manufacturer's recommendations.

C. The Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the segmental retaining wall.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Approved manufacturers:

1. Manufacturers of Redi-Rock Retaining Wall Systems as licensed by Redi-Rock International, LLC, 05481 US 31 South, Charlevoix, MI 49720 USA; telephone (866) 222-8400; website www.redi-rock.com.

2. Approved equal.

B. Concrete Retaining Wall Units: Redi-Rock 28", 41", 60" Series

1. Wall units shall be Redi-Rock as produced by a licensed manufacturer.

2. Wall units shall be made with Ready-Mixed concrete in accordance with ASTM C94, latest revision, and per the following chart:

Climate	Air Content	28 Day Compressive Strength (psi)	Slump*
Negligible	1½%-4½%	3000	5” ±1 ½”
Moderate	3%-6%	3000	5” ±1 ½”
Severe	4½%-7½%	3000	5” ±1 ½”

NOTE: For critical walls, steps, and pavers use a minimum of 4000 psi mix designs with frost-free aggregate.

*Higher slumps are allowed if achieved by use of appropriate admixtures.

Notwithstanding anything stated above, all material used in the wall units must meet applicable ASTM and local requirements for exterior concrete.

3. Exterior block dimensions shall be uniform and consistent. Maximum dimensional deviations shall be 1% excluding the architectural surface. Maximum width (face to back) deviation including the architectural surface shall be 1.0 inch.

4. Exposed face shall be finished as specified. Other surfaces to be smooth form type. Dime-size bug holes on the block face may be patched and/or shake-on color stain can be used to blend into the remainder of the block face.

B. Wall Backfill & Leveling Pad Base: Material shall consist of compacted AASHTO #57 stone or clean crushed stone meeting the following gradation as determined in accordance with ASTM D 422:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75 to 100
No. 4	0 to 60
No. 40	0 to 50
No. 200	0 to 5

C. Retained Soil: Undisturbed residual soils or compacted retained fill. Retained fill shall be compacted to a minimum 95% of the Standard Proctor Density (or as directed by the project geotechnical engineer). The soils should be compacted in no more than 9 inch compacted lift thickness. USCS soil type SM or coarser, with a gradation and maximum particle size that supports the collection of compaction testing data. Where slopes are present above the wall, the slope soil should be compacted with the same effort as the retained soil.

D. Low Permeability Material: Compacted clayey soil or other similar material used to cap the backfill zone and to prevent infiltration behind the wall.

E. Drainage Pipe: Perforated or slotted PVC or corrugated HDPE pipe manufactured in accordance with ASTM D 3034 and/or ASTM D 1248. The pipe may be covered with approved 16 oz non-woven geotextile filter fabric to function as a filter. Solid pipes shall be used to convey water through or beneath the wall to discharge or tie-in locations, as indicated.

F. Separation (Filter) Fabric: Approved 16 oz non-woven geotextile specifically manufactured for subsurface drainage applications.

G. Design Parameters: Materials meeting the requirements in Section 2.01, and the design criteria summarized separately on this sheet.

H. Construction Adhesive: Exterior grade adhesive as recommended by the retaining wall unit manufacturer.

PART 3 - CONSTRUCTION

3.1 EXAMINATION

A. The quality assurance representative shall examine the areas and conditions under which the retaining wall system is to be erected, and notify the Engineer, Owner, and Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Promptly notify the wall design engineer of site conditions which may affect wall performance, soil conditions observed other than those assumed, or other conditions that may require a reevaluation of the wall design.

C. Verify the location of existing structures and utilities prior to excavation.

3.2 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted structural backfill material or lean concrete, or as directed by the Engineer/Architect.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor.

3.3 FOUNDATION PREPARATION

A. Excavate leveling pad and aggregate drainage zone foundation soil as required for footing or base dimension shown on the Drawings, or as directed by the Project geotechnical engineer.

B. Prior to the placement of the leveling pad, the Project geotechnical engineer will visually examine and probe the foundation soil to ensure that the actual foundation soil strength meets or exceeds that indicated on the Drawings. Remove soil not meeting the required strength. Oversize resulting

space sufficiently from the front of the block to the back of the reinforcement, and backfill with suitable compacted backfill soils or lean concrete.

C. The Project geotechnical engineer will determine if the foundation soils will require special treatment or correction to control total and differential settlement.

3.4 LEVELING PAD PREPARATION

A. Place leveling pad and geotextile to the depths and widths shown on the Drawings, upon undisturbed soils, or foundation soils prepared in accordance with Section 3.3.

B. Extend the leveling pad laterally at least 12 inches in front and behind the lowermost concrete retaining wall unit or as specified in the retaining wall drawings.

C. Provide 12 inches of compacted #57 as indicated on the plans. The stone shall be placed in 6 nch lifts and compacted with multiple passes by a vibratory compactor. The number of passes with theequipment to achieve complete consolidation of the #57 stone shall be determined by the onsite geotechnical representative.

D. Prepare leveling pad to ensure complete contact with retaining wall units. Gaps are not allowed.

3.5 SRW PLACEMENT

A. General: Erect units in accordance with manufacturer's instructions and recommendations, and as specified herein.

B. Place first course of concrete wall units on the prepared base material. Check units for level and alignment. Maintain the same elevation at the top of each unit for each base course level.

C. Ensure that foundation units are in full contact with the leveling pad.

D. Place concrete wall units side-by-side for full length of wall alignment. Alignment may be done by using a string line measured from the back of the block. Gaps are not allowed between the foundation concrete wall units.

E. Place #57 stone backfill between, and directly behind the concrete wall units in maximum 9 inch lifts and compact with multiple passes by a vibratory compactor. The number of passes with the equipment to achieve complete consolidation of the #57 stone shall be determined by the onsite geotechnical representative.

1. Employ methods of lightweight compaction equipment that will not disrupt the stability or batter of the wall or damage liner systems.

F. Remove excess fill from top of units and install next course.

G. Check each course for level and alignment. Adjust units as necessary to maintain level and alignment prior to proceeding with each additional course.

H. Install each succeeding course. Backfill between units as each course is completed. Interlock wall segments that meet at corners by overlapping successive courses.

I. Cap the backfill with a low permeability material as shown on the plans.

3.6 CONSTRUCTION ADJACENT TO COMPLETED WALL

A. The Owner or Owner's Representative is responsible for ensuring that construction adjacent to the wall by others does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading.

B. The Wall Contractor is responsible for coordinating wall construction with other site improvements (contractors) that may encroach upon retaining wall elements.

C. The General Contractor is responsible for notifying the SRW installer of work occurring on/or within the wall reinforced zone after the conclusion of wall construction.

D. The General Contractor is responsible for ensuring that surface water runoff from adjacent construction areas is not allowed to enter the retaining wall area of the construction site.

3.7 FENCE, AS REQUIRED

A. The fence shall be placed at the time of wall construction as specified by the fence manufacturer. The fence system shall be mounted to the top block unit in accordance with the block and fence manufacturers' recommendations.

3.8 FIELD QUALITY ASSURANCE

A. The Owner shall engage a qualified construction testing firm to provide quality assurance during retaining wall construction. Neither the presence nor absence of quality assurance by the Owner shall relieve the Contractor of the responsibility for meeting the project specifications.

B. Quality assurance shall include, but not be limited to, evaluation of foundation soil bearing conditions; verification of geotechnical design parameters; and verification that construction is in general compliance with the design drawings and project specifications.

C. Only qualified and experienced field representatives and engineers shall perform construction observation and testing services.

D. If not conducted by Gilmore & Associates, Inc., documentation of completed quality assurance construction. This documentation shall include a cover letter, signed and sealed by a Professional Engineer, stating that wall construction was completed in accordance with these design drawings.

END OF SECTION 32 32 16