SECTION 32 32 23 – segmental retaining walls

1. General
   1. Summary
      1. Work includes furnishing and installing modular concrete block retaining wall units to lines and grades indicated on Drawings.
      2. Related Requirements:
         1. Section 31 23 33 – Trenching and Backfilling.
   2. REFERENCE STANDARDS
      1. Engineering Design:
         1. NCMA Design Manual for Segmental Retaining Walls, Second Edition.
         2. NCMA TEK 2-4 - Specifications for Segmental Retaining Wall Units.
         3. NCMA SRWU-2 - Determination of Shear Strength between Segmental Concrete Units.
      2. Segmental Retaining Wall Units:
         1. ASTM C 140 - Sampling and Testing Concrete Masonry Units.
         2. ASTM C 1262 - Evaluating the Freeze - Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
         3. ASTM C 33 - Specification for Concrete Aggregates.
         4. ASTM C 90 - Standard Specification for Load-Bearing Concrete Masonry Units.
         5. ASTM C 150- Specification for Portland Cement.
         6. ASTM C 595 - Specification for Blended Hydraulic Cements.
      3. Geotextile Filter:
         1. ASTM D 4751 - Standard Test Method for Apparent Opening Size.
      4. Soils:
         1. ASTM D 698 - Moisture Density Relationship for Soils, Standard Method.
         2. ASTM D 422 - Gradation of Soils.
         3. ASTM D 424 - Atterberg Limits of Soils.
         4. ASTM D G51 - Soil pH.
      5. Drainage Pipe:
         1. ASTM D 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe.
         2. ASTM D 1248 - Specification for Corrugated Plastic Pipe.
   3. Submittals
      1. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
      2. Action Submittals:
         1. Design Submittals:
            1. Provide three (3) sets of stamped construction drawings and detailed design calculations, completed, and sealed by a Professional Engineer licensed to practice in the Province of Ontario.
         2. Samples: Submit samples of materials to Consultant for review and acceptance as follows:
            1. Concrete Unit Masonry Retaining Wall: Provide 305 mm x 305 mm (12" x 12") sample of each unit, identifying colour and texture, for approval by the Consultant prior to placing order.
            2. Accessories: Provide a sample of each type of accessory required for a complete installation. Accessories include but are not limited to the following:

Filter Fabric: Provide 406 mm x 406 mm (16" x 16") filter cloth sample for review and acceptance.

Drainage Piping: 305 mm (12") in length.

* + - 1. Data Sheets: Manufacturer's descriptive literature and recommended method of installation.
      2. Certificates: Manufacturer's certificates attesting that products meet specification requirements.
      3. Indicate horizontal and vertical dimensions as well as design grade elevations at the base and top of each wall, soil reinforcement and core fills, footing requirements and over burden restrictions.
  1. QUALITY ASSURANCE
     1. Contractor executing work of this Section shall employ installers having a minimum of five (5) years continuous experience in successful installation of work of type and quality shown and specified. Submit proof of experience upon Consultant's request.
  2. DELEGATED DESIGN SUBMITTALS
     1. The term Engineer shall refer to the individuals or firms who have been retained by the Contractor to provide design and inspection services for the retaining wall. The Engineer must be qualified in the area of segmental retaining wall design and construction and must be licensed to practice engineering in the Province of Ontario.
     2. The Engineer will perform the following tasks:
        1. Produce sealed construction drawings and detailed design calculations, completed in accordance with the design requirements outlined in these specifications.
        2. Review the site soil and geometric conditions to ensure the designed wall is compatible with the site prior to construction.
        3. Inspect the site conditions, materials incorporated into the retaining wall, and the construction practices used during the construction.
        4. Provide the Contractor with a letter after completion, certifying the design meets the requirements of this specification, the design was compatible with the site and the wall was constructed according to design.
  3. STORAGE, DELIVERY, HANDLING AND PROTECTION
     1. Deliver materials on manufacturer's original skids, or in original unopened protective packing.
     2. Protect materials during transportation, storage, and installation to avoid physical damage.

1. Products
   1. manufacturer
      1. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
         1. DuraHold Segmental Retaining Wall System as supplied by the RisiStone Retaining Wall Systems, or approved equivalent.
   2. DESIGN REQUIREMENTS
      1. Design Geometry:
         1. The length, height, and overall elevations of the retaining wall must comply with the requirements of the proposed elevation detail, station information and site grading plan.
         2. The structures' design height, H, shall be measured from the top of the leveling pad to the top of the wall where ground surface intercepts the wall facing.
         3. Slopes above and below all sections of the segmental retaining wall are detailed in the site grading plan.
            1. The minimum wall embedment shall be the greater of

The height of a segmental retaining wall unit.

150 mm (0.5')

The minimum embedment required because of the slope below the wall:

|  |  |
| --- | --- |
| **Slope Below Wall Level** | **Minimum embedment** |
| 3 : 1 (18.4 deg) | H/10 |
| 2 : 1 (26.5 deg) | H/7 |

* + - 1. The following surcharges shall be applied to the top of each design cross section based on the following proposed uses above the wall:

|  |  |
| --- | --- |
| **Use Above Wall** | **Minimum Surcharge** |
| No Traffic | 0 kPa (0 lb/sq. ft) |
| Light Traffic | 4.8 kPa (100 lb/sq. ft) |
| Heavy Traffic | 12.0 kPa (250 lb/sq. ft) |

* + 1. Settlement Control:
       1. It is the responsibility of the Engineer to determine if the foundation soils will require special treatment to control total and differential settlement.
  1. MATERIALS
     1. Modular Concrete Segmental Retaining Wall Units:
        1. The concrete wall modules shall be 305 x 1830 x 610 mm (12" x 72" x 24") with a maximum tolerance of plus or minus 3 mm (1/8") for each dimension.
        2. The retaining wall modules shall be solid units and have a minimum weight of 790 kg (1740 lbs.) per unit.
        3. The concrete wall modules shall have an integral shear key connection that shall be offset to permit a minimum wall batter of 1H: 8V.
        4. Concrete Wall Modules: Minimum 28-day compressive strength of 35 MPa (5000 psi) as tested in accordance with ASTM C 140 and have a maximum moisture absorption rate of 5 percent to ensure adequate freeze-thaw protection.
     2. Foundation Soil:
        1. The foundation soil shall be the native undisturbed on-site soils. The foundation soil shall be examined and approval by the Engineer prior to the placement of the base material.
     3. Levelling Base Material:
        1. The footing material shall be non-frost susceptible, well graded, compacted crushed stone (GW-Unified Soil Classification System), or a concrete leveling base.
     4. Drainage Soil:
        1. The drainage soil shall be a free draining angular granular material of uniform particle size smaller than 25 mm (1") separated from the retained soil by a geotextile filter. The drainage soil shall be installed directly behind the segmental retaining wall units.
     5. Drainage Pipe:
        1. The drainage pipe shall be perforated corrugated HDPE or PVC pipe, with a minimum diameter of 100 mm (4"), protected by a geotextile filter to prevent the migration of soil particles into the pipe.
     6. Geotextile Filter: As recommended by segmental retaining wall unit manufacturer.

1. Execution
   1. inspection
      1. Check graded subgrade for conformity with elevations and cross-sections before placing retaining wall units.
      2. Check for unstable areas and areas requiring additional compaction.
      3. Notify Consultant of unsatisfactory surfaces and conditions.
      4. Do not begin installation of retaining wall units until deficiencies have been corrected.
   2. INSTALLATION
      1. Drainage System:
         1. Set non-woven geotextile against back of the first retaining wall unit, over the prepared foundation, and extend towards the back of the excavation, up the excavation face and back over the top of the drainage material to the retaining wall.
         2. Place drainage pipe behind the leveling base, or lower course of facing units. Lay pipe at a minimum gradient of 2% to ensure adequate drainage to free outlets.
         3. Install T - Sections and outlet pipes on the drainage pipe at 15 m (50') centers.
         4. The remaining length of geotextile shall be pulled taut and pinned over the face of the retained soil. Geotextile overlaps shall be a minimum of 305 mm (12") and shall be shingled down the face of the excavation in order to prevent the infiltration of retained soil into the drainage layer.
      2. Levelling Base or Spread Footing Placement:
         1. The leveling base material shall be crushed stone compacted to 98% Standard Proctor Density, or vibrated concrete along the grades and dimensions indicated on the Drawings or as directed by the Engineer. The minimum thickness of the leveling base shall be 305 mm (12").
      3. Modular Concrete Retaining Wall Units:
         1. Place bottom row of retaining wall modules on prepared leveling base. Care shall be taken to ensure that the wall modules are aligned properly, leveled from side to side, and front to back and are in complete contact with the base material.
         2. Place wall modules above the bottom course such that the tongue and grove arrangement provide the design batter (i.e. setback) of the wall face. Place successive courses to create a running bond pattern with the edge of all units being approximately aligned with the middle of the unit in the course below it.
         3. Sweep clean wall modules before placing additional levels to ensure that no dirt, concrete or other foreign materials become lodged between successive lifts of the wall modules.
         4. A maximum of 3 courses of wall units can be placed above the level of the drainage material at any time.
         5. Check the level of wall modules with each lift to ensure that no gaps are formed between successive lifts.
         6. Care shall be taken to ensure that the wall is not broken or damaged during handling and placement.
      4. Drainage Soil:
         1. Place drainage soil behind the retaining wall modules with a minimum width of 300 mm (1 ft.) and separated from other soils using the approved non-woven geotextile.
         2. Place drainage soil behind the wall facing in maximum lifts of 150 mm (6") and compacted to a minimum density of 95% Standard Proctor.
         3. No heavy compaction equipment shall be allowed within 1 m (3') of the back of the wall facia.
      5. Retained Soil:
         1. Place retained soils and compact behind the drainage material in maximum lift thickness of 150 mm (6"). The retained soils shall be undisturbed native material or engineered fill compacted to a minimum density of 95% Standard Proctor.
         2. No heavy compaction equipment shall be allowed within 1 m (3') of the back of the wall modules.
      6. Finishing Wall:
         1. Secure coping units to the top of the wall with two 10 mm (3/8") beads of the approved flexible concrete adhesive positioned 50 mm (2") in front and behind the tongue of the last course of retaining wall units.
         2. Finish grading above the wall to direct surface run off water away from the segmental retaining wall. Use a soil with a low permeability to restrict the rate of water infiltration into the retaining wall structure.
   3. TOLERANCES
      1. The following tolerances are the maximum allowable deviation from the planned construction:
         1. Vertical Control: +/- 1.25" over a 10' distance; +/- 3" total.
         2. Horizontal Control: +/- 1.25" over a 10' distance; +/- 3" total.
         3. Rotation: +/- 2 degrees from planned wall batter.
         4. Bulging: 1.0" over a 10' distance.
   4. PROTECTION
      1. Take extreme care during trenching operations, installation of drainage piping and backfilling not to damage or displace other utilities.

END OF SECTION