GravityStone ® EnCore Specifications

Following are specifications for the three main components in the construction of GravityStone ® EnCore segmental retaining wall (SRWs). Product and installation specifications for segmental retaining wall units, drainage aggregate and geosynthetic reinforcement are provided in standard Construction Specification Institute (CSI) format.

E.1 GRAVITYSTONE® RETAINING WALL

Section _____

GRAVITYSTONE ® RETAINING WALL

PART 1: GENERAL

1.01 Description

A. Work includes furnishing and installing a GravityStone ® EnCore retaining wall (SRW) to the lines and grades designated on the construction drawings or as directed by the Architect/Engineer.

B. Also included are furnishing and installing appurtenant materials required for construction of the retaining wall as shown on the construction drawings.

1.02 Related Work

A. Section _____ - Site Preparation

B. Section _____ - Earthwork

C. Section _____ - Drainage Aggregate

D. Section _____ - Geosynthetic Reinforcement

1.03 Reference Standards

A. American Society of Testing and Materials (ASTM)

1) ASTM C140 - Sampling and Testing Concrete Masonry Units

2) ASTM 1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units

3) ASTM C1372-04 Standard Specification for Dry-Cast Segmental Retaining Wall Units

4) ASTM D 422 Gradations of Soils

5) ASTM D698 - Moisture Density Relationship for Soils, Standard Method

6) ASTM D1557 Laboratory Compaction Characteristics of Soil -Modified Effort

7) ASTM D 2922 Standard Test Methods for Density of Soils and Soil-Aggregate in Place by Nuclear Methods

8) ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

9) ASTM D 5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics

10) ASTM D6638 Connection Strength - Reinforcement/Segmental Units

11) ASTM D6706 Geosynthetic Pullout Resistance in Soil

12) ASTM D6916 Shear Strength Between Segmental Concrete Units

B. National Concrete Masonry Association

1) NCMA TEK50A - Specifications for Segmental Retaining Wall Units

2) NCMA SRW Design Manual, 3rd Edition (2009)

Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of applicable document.

1.04 Certification

A. Contractor shall submit a manufacturer's certification prior to start of work providing test results and stating that the GravityStone ® units meet the requirements of this specification. Uncertified SRW units shall not be used on this project.

1.05 Delivery, Storage and Handling

A. Contractor shall check the materials upon delivery to assure that specified type, grade, color and texture of SRW unit have been received. Only the face blocks and cap blocks need be the appropriate color.

B. Contractor shall prevent excessive mud, wet concrete, epoxies, and like materials which may affix themselves from coming in contact with the materials.

C. Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the GravityStone ® wall.

1.06 Submittals

A. Contractor shall submit a manufacturer's certification that all products meet ASTM 1372 specifications.

B. Contractor shall submit shop drawings and stamped design calculations for project by professional engineer licensed in the state of the project.

1.07 Quality Assurance

A. Contractor shall submit a list of five (5) previous projects with similar scope of work.

B. Owner/Owner's agent shall provide soil testing and additional oversight during earthwork and wall construction.

1.08 Measurement and Payment

A. Measurement of the SRW units will be on a total square foot basis, measured perpendicular to a plane projected vertically from the leveling pad at the front face of the lowermost block along the wall length.

B. Payment shall cover supply and installation of GravityStone ® units along with appurtenant and incidental materials required for construction of the retaining wall as shown on the construction drawings. It shall include all compensation for labor, materials, supplies, equipment and permits associated with building these walls and proper disposal of construction debris generated by this work.

C. Quantity of retaining wall as shown on plans may be increased or decreased at the direction of the Architect/Engineer based on construction procedures and actual site conditions.

D. Accepted quantities of GravityStone ® units will be paid for at the agreed upon price per vertical square foot of wall face in place (total wall height). Face area of GravityStone ® Units in excess or less than that shown on the drawings shall be documented by "as-built" construction drawings approved by the Architect/Engineer prior to being included in the pay request of accepted quantities. Payment will be made under:

Pay Item	Pay Unit
Segmental Retaining Wall Units	SQ FT

PART 2: MATERIALS

2.01 GravityStone ® Retaining Wall Units

A. GravityStone ® units shall be machine formed concrete blocks specifically designed for retaining wall applications. The GravityStone ® units shall meet the minimum dimensions

shown on the plans. GravityStone ® units assembled to meet the dimensional requirements must have integral concrete connectors between components.

B. GravityStone ® units shall meet to the following architectural requirements:

1) Color of Face and Cap units shall be _____. *{Insert natural, gray, brown or beige}*

2) Finish of the Face units shall be _____. *{Insert split-faced, smooth, striated, etc.}*

3) Face Unit geometry shall be _____. *{Insert straight, beveled, offset split, or bi-/tri-plane split, etc.}*

4) Units shall be erected with a running bond configuration.

C. Unit's dimensions shall not be less than .97 sq ft and not more than + 1/8 inch from SRW unit molded dimensions.

D. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. Cracking or excessive chipping may be grounds for rejection

Note: All underlined items are to be changed by the Specifier for actual project and SRW system properties.

Note: In adapting specification please remove all italicized explanations and instructions in {brackets}.

E. The following Segmental Retaining Wall Units have been pre-approved:

1) GravityStone ® EnCore units

F. GravityStone ® units shall meet the following structural requirements:

1) Concrete used to manufacture GravityStone ® units shall have a minimum 28 day compressive strength of 3,000 psi {*or insert other strength, 3,000 min. to 6,000 max. psi}* in accordance with ASTM C-1372. The concrete shall have adequate freeze/thaw protection with a maximum moisture absorption rate, by weight, of: 7 % *{or insert other, 6 % min. to 8 % max.}*.

G. In climate where freeze thaw durability is a consideration the following recommendation should be considered.

Minimum Required Net Average Compressive Strength, psi (MPa)		**Maximum Water Absorption Requirements lb/ft^3 (kg/m^3)**		
		Weight Classification Oven-Dry Density of Concrete lb/ft^3 (kg/m^3)		
Average of 3 Units	Individual Unit	Lightweight: Less than 105 (1682)	Medium Weight: 105 (1682) to less than 125 (2002)	Normal Weight: 125 (2002) or more
3000 (20.7)	2500 (17.2)	18 (288)	15 (240)	13 (208)

H. GravityStone ® units shall meet the following constructability and geometric requirements:

1) Units shall be capable of attaining concave and convex curves to a minimum radius of 72 inches.

2) Vertical Wall: Units shall be positively engaged to the unit below so as to provide a maximum of a 7/8 Inch horizontal setback per vertical foot of wall height.

2.02 Leveling Pad and Unit Fill Material

A. Material for leveling Pad shall consist of crushed stone placed a minimum of 6 inches thick, or lean non reinforced concrete (500 psi) placed a minimum of 2 to 4 inches thick.

B. Unit Fill shall consist of free draining crushed stone.

1) Consolidate Unit Fill by running hand-operated vibrating compaction equipment behind units; do not run mechanical vibrating plate compactors directly on top of bare

concrete units. Compact unit fill to a minimum 95% standard proctor density (ASTM D-698) or 92% of modified proctor density (ASTM D-1557). See Section _____ Drainage Aggregate Part 2.02 for sizing

2.03 Drainage Aggregate

A. Drainage layer materials shall be free draining crushed stone, see Section _____ - Drainage Aggregate.

B. The vertical drainage layer placed within and behind the SRW unit shall be no less than 24 -inches wide as measured from the front face for SRW units.

2.04 Infill Soil/ Reinforced Backfill

A. The infill soil material shall be free of debris and consist of any of the following inorganic soil types according to their USCS designations (GP, GW, SW, SP, SM, ML, CL). {Soil types may be limited based upon design for drainage or strength.} The maximum particle size shall be can be up to 4 inches. {A smaller maximum particle size would minimize site damage to geosynthetic.} There shall be a maximum 35% by fines (passing the #200 sieve) having a plasticity index (PI) < 20. {A lower percentage of fines, such as < 10% will improve drainage.}

B. A sample of the compacted infill soil shall be tested by direct shear methods (ASTM D-3080) to ensure it possesses an angle of internal friction (ϕ) greater than __28___ degrees. {The minimum ϕ angle should be correlated to the allowable soil type and value utilized in the engineering design.}

C. The infill soil shall be compacted in maximum eight (8) inch lift thickness to the following minimum densities (percentage of the maximum standard proctor-ASTM D698):

1) fine grained (ML-CL, SC, SM) soils to a minimum of 95%; and

2) coarse grained (GP, GW, SW, SP) soils to a minimum of 98%. *{The minimum ϕ angle should be correlated to the allowable soil type and value utilized in the engineering design.}*

D. The in-place density of the reinforced (infill) soil should be tested at regular intervals to ensure proper compaction is being achieved. Density tests (3 min.) shall be taken at least once every 1,000 cubic yards of fill placed or every other (8 -inch) compacted lift thickness (i.e., 1.33 ft. in wall height, 2 courses). The contractor shall furnish these results in a timely manner to the Architect/Engineer.

2.05 Common Backfill

A. Soil placed behind the infill soil can be any inorganic soil with a liquid limit (LL) less than 50 and plasticity index (PI) less than 30, or as directed by the Architect/Engineer and project specifications. The common backfill soil shall be free of debris and consist of any inorganic soil type according to their USCS designations (GP, GW, SW, SP, SM, ML, CL). {Soil types may be limited based upon design for drainage or strength.}

B. The site geotechnical shall evaluate the borrow area for the common backfill and ensure that properly compacted common backfill soil shall possesses an angle of internal friction (ϕ) greater than __28___ degrees. Testing, if required shall be done according to ASTM D-3080. { the minimum ϕ angle should be correlated to the allowable soil type and value utilized in the engineering design. }

C. The common backfill soil shall be compacted in maximum eight (8) inch lift thickness to the following minimum densities (percentage of the maximum standard proctor-ASTM D698):

1) fine grained (ML-CL, SC, SM) soils to a minimum of 95%; and

2) coarse grained (GP, GW, SW, SP) soils to a minimum of 100%. *{Minimum ϕ angle should be correlated to available soil type and value utilized in the engineering design.}*

PART 3: PART 3: EXECUTION

3.01 Excavation

A. Contractor shall excavate to the lines and grades shown on the project grading plans and SRW plan and profile drawing. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Architect/Engineer, at the Contractor's expense.

B. Architect/Engineer will inspect the excavation and approve prior to placement of bearing pad material.

C. Excavation of deleterious soils and replacement with compacted infill material, as directed by the Architect/Engineer, will paid for at the contract unit prices for excavation and replacement, see Section ____ - Excavation.

D. Over-excavated areas in front of wall face shall be filled with compacted infill material at the Contractor's expense, or as directed by the Architect/Engineer.

E. 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 shall be designed and installed by the Contractor at no additional expense to the Owner.

3.02 Leveling Pad Construction

A. Foundation soil shall be proof-rolled and compacted to 95% of standard proctor and inspected by the Architect/Engineer prior to placement of leveling pad materials.

B. The drainage collection and conveyance / outlet pipe shall be installed in accordance with plans and day lighting no more than 50 feet apart through the wall. Section _____, Drainage Aggregate.

C. Leveling pad shall be placed as shown on the construction drawings with approved material and have a minimum width of 6 inches in front and behind wall unit.

D. Leveling pad material shall be compacted to provide a level hard surface on which to place the first course of units. Compaction will be with mechanical vibrating plate compactors to 95% of maximum proctor density (ASTM D698).

E. Leveling pad shall be prepared to ensure intimate contact of retaining wall unit with pad.

3.03 Segmental Unit Installation

A. The first course of GravityStone ® EnCore units shall be placed directly on the leveling pad. The units shall be checked for level, parallel and perpendicular, to wall face and for horizontal alignment.

B. Ensure that SRW units are in full contact with leveling pad or course below.

C. SRW units are to be placed side by side for full length of straight wall alignment. Alignment may be done by means of a string line or offset from base line to a molded finished of the SRW unit. Adjust unit spacing for curved sections according to manufacturers' recommendation.

D. Engage the next course of units forward and in full contact with the concrete alignment plug so to establish the desired horizontal setback.

E. Place Unit Fill within and behind SRW units to create drain. Place lifts of reinforced (infill) soil and common backfill soil.

F. Consolidate Unit Fill behind and within units. Compact lifts of reinforced (infill) soil and common backfill soil.

G. Clean all excess debris from top of units and install next course. Ensure each course is completely filled prior to proceeding to next course.

H. Lay each successive course ensuring that alignment lugs are engaged and stacking pattern is being maintained. The bond may wander slightly, particularly around curves.

I. Repeat procedures to the extent of the wall height.

J. Uppermost row of SRW units or caps shall be glued to underlying units with an adhesive, as recommended by the manufacturer.

K. Tolerances: The SRW Units shall be erected such that the completed location is within the following tolerances relative to the plan location and project drawings:

1) Vertical Control: $\pm$ 1.25 -inches from plan elevation.

   a) $\pm$ 1.25 -inches over a horizontal distance of 10 feet.

2) Horizontal Control: Straight walls; $\pm$ 1.25 -inches over a horizontal distance of 10 ft.

3) Corner locations; $\pm$ 1.0 foot

4) Curves & Radii: $\pm$ 10% of Radius or 2 feet, whichever is less

5) Wall Rotation: Wall Batter; $\pm$ 2.0 degrees Total horizontal setback: $\pm$ 10% of Plan setback

6) Wall Bulging: $\pm$ 1.25 -inches over a horizontal distance of 10 feet.

3.04 Contractor Quality Control

A. The contractor will perform quality control activities on their work. As a minimum, the contractor shall prepare a daily report of the quality control activities undertaken that day, summarizing all test data, measurements and observations gathered as part of that effort.

B. The contractor shall provide the Architect/Engineer with a copy of each quality control daily report.

END OF SECTION

E.2 GEOSYNTHETIC WALL REINFORCEMENT

Section _____

GEOSYNTHETIC WALL REINFORCEMENT

PART 1: GENERAL

1.01 Description

A. Work includes furnishing and installing geosynthetic reinforcement to the lines and grades designated on the SRW plan and profile drawings.

1.02 Related Work

A. Section _____ - Segmental Retaining Wall Units

B. Section _____ - Earthwork

C. Section _____ - Drainage Aggregate

1.03 Reference Standards

A. American Society of Testing and Materials (ASTM)

1) ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method

2) ASTM D 4632 - Tensile Properties of Geotextiles

3) ASTM D 5262 - Tension Creep Testing of Geosynthetics

4) ASTM D6637 Tensile Properties of Geogrids – Single or Multi-Rib

5) ASTM D6638 Connection Strength - Reinforcement/Segmental Units

6) NCMA SRW Design Manual, 3rd Edition (2009)

B. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of applicable document.

1.04 Certification

A. Contractor shall submit test results and a notarized manufacturer's certification, prior to start of work, stating that the geosynthetic reinforcement meets the requirements of this specification.

1.05 Delivery, Storage and Handling

A. Contractor shall check the geosynthetic upon delivery to ensure that the proper grade and type of material has been received. A product certification should be provided with each shipment. Un-certified material should not be used for this project.

B. The geosynthetic shall be stored above -20°F.

C. Contractor shall prevent excessive mud, wet cement, epoxy and like materials which may affix themselves, from coming in contact with the geosynthetic material.

D. Rolled geosynthetic material shall be stored in accordance with the manufacturer's recommendations.

1.06 Measurement and Payment

A. Measurement of the geosynthetic reinforcement is on a square yard basis.

B. Payment shall cover geosynthetic reinforcement actually installed, excluding waste and overlaps.

C. Quantity of geosynthetic reinforcement as shown on drawings may be increased or decreased at the direction of the Architect/Engineer based on construction procedures and actual site conditions.

D. The accepted quantities of geosynthetic reinforcement will be paid for per square yard installed. The Architect/Engineer prior to installation shall approve net quantities of installed geosynthetic reinforcement different from that shown on the construction drawings and an "as-built" drawing detailing the change must accompany the pay request. Waste and overlaps are incidental. Payment will be made under:

Pay Item	Pay Unit
Geosynthetic Reinforcement	SQ YD

PART 2: MATERIALS

2.01 Definitions

A. Geosynthetic reinforcement shall be a polymer product specifically manufactured as a retaining wall soil reinforcement element that meets the requirements of this specification.

B. Concrete segmental retaining wall (SRW) units are as detailed on the drawings and specified under Section _____ - Segmental Retaining Wall Units.

C. Leveling pad may consist of either compact crushed stone or low strength unreinforced concrete.

D. Unit Fill is a free draining granular material as specified under Section _____ - Drainage Aggregate.

E. Reinforced (infill) soil material is used within the reinforced soil mass. Acceptable soil materials are defined in Part 2.04 of Section _____ - Segmental Retaining Wall Units.

F. Common backfill is the soil placed behind the reinforced soil mass. Acceptable soil materials are defined in Part 2.05 of Section _____ - Segmental Retaining Wall Units.

G. Foundation soil supports the reinforced soil mass and bearing pad.

2.02 Geosynthetic Properties

A. The geosynthetic shall possess the following minimum design properties, determined by product specific testing as defined in the NCMA SRW Design Manual (Section 3.5).

B. Connection strength requirements as specified in Section 2.01.C.3 - Segmental Retaining Wall Units (see previous section).

C. The following Geosynthetic Reinforcements have been pre-approved:

All underlined *items are to be changed by the Specifier for actual project and SRW system properties.*

In adapting specification please remove all italicized explanations and instructions in {brackets}.

PART 3: EXECUTION

3.01 Foundation Soil Preparation

A. Foundation soil shall be proof-rolled and compacted to 95% of standard proctor (ASTM D-698) and inspected by the Architect/Engineer prior to placement of leveling pad or geosynthetic materials.

3.02 Wall Erection

A. Placement and filling of SRW units shall proceed as specified in Part 3.03 of Section _____ - Segmental Retaining Wall Units. The placement of the reinforced (infill) soil and common backfill to the same elevation shall also be done in accordance with Part 3.03 above.

B. The fill surface upon which the geosynthetic reinforcement is place shall be relatively uniform and within ± 1.5 -inches of the top of SRW Unit. The surface may be slightly sloping and/or undulating, uniform but not level, and sheep-feet indentations are permitted.

3.03 Geosynthetic Reinforcement Installations

A. The geosynthetic shall be installed at the wall height, horizontal location, and to the extents as shown on the project construction plans, or as directed by the Architect/Engineer on top of the SRW unit and Unit fill placed in accordance with Part 3.03 of Section _____ - Segmental Retaining Wall Units.

B. The geosynthetic shall be laid horizontally on compacted infill and connected to the concrete SRW units. Embedment (facing connection) detail shall be consistent with detail as shown on the project or SRW plans, and utilized in evaluation of connection strength, as tested per ASTM D6638.

C. Correct orientation (roll direction) of the geosynthetic to ensure the principal design strength direction is perpendicular to the wall face, shall be verified by the Contractor, prior to SRW and Unit Fill placement.

D. After the geosynthetic is installed, place the next course of SRW units and Unit Fill in accordance with Part 3.03 of Section _____ - Segmental Retaining Wall Units.

E. The geosynthetic should then be pulled taut and free of wrinkles prior to placement of soil fill. The geosynthetic may be secured in place with staples, pins or fill. Type of geosynthetic restraint will be based on fill properties, fill placement procedures, weather conditions; or as directed by the Architect/Engineer.

F. The procedure for tensioning geosynthetic reinforcement shall be uniform throughout wall length and height.

G. Overlaps:

1) Overlap of the geosynthetic in the design strength direction will not be permitted. The design strength direction is that length of geosynthetic perpendicular to the wall face and shall be one continuous piece of material.

2) In general, butting of adjacent roll edges of reinforcement is acceptable. If required, overlaps of adjacent rolls shall be in accordance with manufacturer's recommendations and shall occur only in the reinforced (infill) soil zone. An overlap within the SRW Unit or Unit fill is prohibited. Geosynthetic reinforcement will be continuous throughout wall length, except for curves, see drawings.

3.04 Fill Placement over Geosynthetic

A. Reinforced (infill) soil material shall be placed in maximum 8-inch compacted lifts on the geosynthetic according to the requirements of Part 2.04 of Section _____ - Segmental Retaining Wall Units, or as directed by the Engineer.

B. The geosynthetic shall be pre-tensioned by hand to remove wrinkles. Tensioning is usually facilitated by the use of steel rakes. Apply constant tension to each section of geosynthetic until soil fill has been placed. Soil fill shall be placed, spread, and compacted in such a manner that prevents the development of wrinkles and/or movement of the geosynthetic.

C. Only hand-operated compaction equipment shall be allowed within 3 feet of the front of wall face.

D. If possible, soil fill shall be placed from the wall face outward to ensure that the geosynthetic remains taut. Soil shall be placed in uniform lifts.

E. Tracked construction equipment shall not be operated directly on the geosynthetic. A minimum fill thickness of 8 inches is required prior to operation of tracked vehicles over the geosynthetic. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geosynthetic.

F. If in accordance with manufacturer's recommendations, rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds, less than 10 MPH. Sudden braking and sharp turning shall be avoided.

G. Surface drainage during, and after each day of construction of the wall shall be sloped away from wall face and provided to minimize water infiltration in the reinforced soil zone.

H. The General Contractor shall be responsible for securing the site against any water that could enter into the wall construction zone.

I. The uppermost row of SRW units and any caps or coping units shall be glued to underlying units with an adhesive, as recommended by the manufacturer.

3.05 3.05 Contractor Quality Control

A. The contractor will perform quality control activities on their work. As a minimum, the contractor shall prepare a daily report of the quality control activities undertaken that day, summarizing all test data, measurements and observations gathered as part of that effort.

B. The contractor shall provide the Architect/Engineer with a copy of each quality control daily report.

END OF SECTION

E.3 DRAINAGE AGGREGATE

Section _____

DRAINAGE AGGREGATE

PART 1: GENERAL

1.01 Description

A. Work includes providing and installing all drainage aggregate materials and collection/conveyance piping to the lines and grades designated on the project construction plans.

1.02 Related Work

A. Section _____ - Segmental Retaining Wall Units

B. Section _____ - Geosynthetic Wall Reinforcement

C. Section _____ - Site Preparation

D. Section _____ - Earthwork

1.03 Reference Standards

A. American Society of Testing and Materials (ASTM)

1) ASTM D 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe

2) AASHTO T-27 - Test Method for Gradation Limits Fine Filter Material

3) ASTM D 1248 - Specification for Corrugated Plastic Pipe

B. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of applicable document.

1.04 Certification

A. Contractor shall submit test results and a notarized manufacturer's certification, prior to start of work, stating that the drainage aggregate, piping, and geotextile (if required) meets the requirements of this specification.

1.05 Delivery, Storage, and Handling

A. Plastic pipe shall be stored in accordance with the manufacturer's recommendations to prevent damage and deleterious materials from becoming affixed.

B. Drainage aggregate shall be stored to prevent contamination with other site and/or fill soils.

1.06 Measurement and Payment

A. Measurement of the drainage aggregate is on a cubic yard basis. Drainage collection and conveyance piping is considered incidental to this work and therefore included in the drainage aggregate unit price. Measurement of the drainage filter (geotextile), when required, will be on a square yard basis.

B. Payment for Drainage Aggregate shall cover supply and installation of both drainage aggregate and collection/conveyance piping. Payment for Drainage Filter (geotextile), when required, will be for supply and installation.

C. Quantity of drainage aggregate and piping, or drainage filter (geotextile) as shown on drawings may be increased or decreased at the direction of the Architect/Engineer based on construction procedures and actual site conditions.

D. The accepted quantities of drainage aggregate will be paid for per cubic yard of neat quantities shown on the construction drawings. Pay quantities different than those shown on the drawings must be agreed to in writing, and related to an increase or decrease in wall face area or length. Waste and overfill are incidental. Payment will be made under:

Pay Item	Pay Unit
Drainage Aggregate	CUBIC YD

E. The accepted quantities of drainage filter (geotextile), when required, will be paid for per square yard of neat quantities shown on the construction drawings. Pay quantities different than those shown on the drawings must be agreed to in writing, and related to an increase or decrease in wall face area or length. Waste and overlaps of geotextile are incidental. Payment will be made under:

Drainage Filter (Geotextile)	SQAURE YD

PART 2: MATERIALS

2.01 Definitions

A. Drainage collection pipe shall be a perforated/slotted, PVC (ASTM D-3034) or corrugated HDPE pipe (ASTM D-1248). The pipe may be covered with a knitted or non-woven geotextile sock to function as a filter, but is not required. Drainage conveyance pipe shall be solid PVC or corrugated HDPE pipe.

B. Drainage aggregate shall be a free draining material, relative to the surrounding soil, so as to prevent build up of hydrostatic pressure.

C. Drainage filter (geotextile) shall provide a synthetic media which permits water to freely pass into the drainage aggregate, while preventing adjacent soil particles from entering and clogging the drainage aggregate.

2.02 Products

A. Drainage aggregate shall be a clean 1 -inch minus crushed stone or granular fill meeting the following gradation:

Sieve Size	Percent Passing
1 inch	100 - 90
1/2 inch	60 - 20
No. 4	0 - 60
No. 40	0 - 50
No. 200	0 – 5

B. Alternatively, drainage aggregate meeting the AASHTO #57 or #67 Stone designations may be used.

C. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

D. Drainage filter (geotextile), when required, shall have the following minimum properties or as recommended by the Design Engineer.

1)	AOS	ASTM D4751	70-100
2)	Grab Tensile	ASTM D4632	110 lbs.
3)	Trap Tear	ASTM D4533	40 lbs.
4)	Water Flow Rate	ASTM D4491	75 gpm / sq. ft.
5)	Puncture	ASTM D4833	40 lbs.

All underlined items are to be changed by the Specifier for actual project and SRW system properties. In adapting specification please remove all italicized explanations and instructions in {brackets}.

PART 3: EXECUTION

3.01 Drainage Collection or Conveyance Pipe

A. Drainage collection or conveyance pipe shall be installed according to the line, grades and sections shown in the project construction plans.

B. Drainage collection pipe shall be installed to maintain gravity flow of water to outside the reinforced soil zone. The drainage conveyance pipe should daylight at a storm sewer manhole or along a slope at an elevation lower than the lowest point of the pipe within the reinforced soil mass.

C. The main collection drain pipe just behind the segmental units shall be a minimum of 4 inches in diameter. A secondary collection drain pipe, when required to be installed at the back of the reinforced (infill) soil mass, can gravity flow independently or tie into the main collection drain pipe with laterals at a maximum of 50 foot spacing along the wall face.

3.02 Drainage Aggregate

A. Drainage aggregate shall be installed to the line, grades and sections shown on the project plans.

B. The drainage aggregate shall be placed to a minimum finished thickness and width shown on the details herein, or as directed by the Architect/Engineer.

C. When a blanket drain is installed, the drainage aggregate should be installed on top of a drainage filter (geotextile), as shown in the details provided on the project drawings.

3.03 Drainage Filter (Geotextile)

A. Drainage Filter (geotextile) when specifically required for a blanket or chimney drain shall be installed to the line, grades and sections shown on the project construction plans. Minimum overlap 12 -inches.

B. The Drainage Filter shall be placed directly against the foundation or common backfill (retained) soils as shown on the wall detail drawings, or as directed by the Engineer. Minimum overlap 12 -inches.

C. The drainage Filter (geotextile) may be omitted when not specifically shown on the project drawings.

END OF SECTION