



## **Murata™ Mechanically Stabilized Earth (MSE) Retaining Wall Specifications**

### **PART 1: GENERAL**

#### **1.01 SCOPE**

- A. WORK SHALL CONSIST OF DESIGNING, FURNISHING, AND INSTALLING MURATA'S MODULAR CONCRETE BLOCK RETAINING WALL UNITS, GEOGRID REINFORCEMENT, BACKFILL, AND DRAINAGE TO MATCH THE CONSTRUCTION DRAWINGS AND THESE SPECIFICATIONS. NO ALTERNATE RETAINING WALL SYSTEMS OR GEOGRID SHALL BE CONSIDERED.

#### **1.02 RELATED WORK**

- A. ALL DESIGN AND INSTALLATION SHALL FOLLOW THE GEOTECHNICAL REPORT FOR ALLOWABLE SOIL BEARING AND LATERAL PRESSURES, MATERIAL TESTING, SITE PREPARATION, AND EARTHWORK SPECIFICATIONS.

#### **1.03 REFERENCE STANDARDS**

##### **A. ENGINEERING DESIGN**

1. NCMA DESIGN MANUAL FOR SEGMENTAL RETAINING WALLS, 3RD EDITION, 5<sup>TH</sup> PRINTING
2. ASTM D 6916 - STANDARD TEST METHOD FOR DETERMINING THE SHEAR STRENGTH BETWEEN SEGMENTAL CONCRETE UNITS

##### **B. SEGMENTAL RETAINING WALL UNITS**

1. ASTM C 140 - STANDARD TEST METHODS FOR SAMPLING AND TESTING CONCRETE MASONRY UNITS AND RELATED UNITS
2. ASTM C 1262 - STANDARD TEST METHOD FOR EVALUATING THE FREEZE-THAW DURABILITY OF MANUFACTURED CONCRETE MASONRY UNITS AND RELATED CONCRETE UNITS
3. ASTM C 1372 - STANDARD SPECIFICATION FOR DRY-CAST SEGMENTAL RETAINING WALL UNITS

##### **C. GEOSYNTHETIC REINFORCEMENT**

1. ASTM D 4595 – STANDARD TEST METHOD FOR TENSILE PROPERTIES OF GEOTEXTILES BY THE WIDE-WIDTH STRIP METHOD
2. ASTM D 5262 – STANDARD TEST METHODS FOR EVALUATING THE UNCONFINED TENSION CREEP AND CREEP RUPTURE BEHAVIOR OF GEOSYNTHETICS
3. ASTM D 5321 – STANDARD TEST METHOD FOR DETERMINING THE COEFFICIENT OF SOIL AND GEOSYNTHETIC OR GEOSYNTHETIC AND GEOSYNTHETIC FRICTION BY THE DIRECT SHEAR METHOD
4. ASTM D 5818 – STANDARD PRACTICE FOR EXPOSURE AND RETRIEVAL OF SAMPLES TO EVALUATE INSTALLATION DAMAGE OF GEOSYNTHETICS
5. ASTM D 6637 – STANDARD TEST METHOD FOR DETERMINING TENSILE PROPERTIES OF GEOGRIDS BY THE SINGLE OR MULTI-RIB TENSILE METHOD
6. ASTM D 6706 – STANDARD TEST METHOD FOR MEASURING GEOSYNTHETIC PULLOUT RESISTANCE IN SOIL
7. ASTM D 6992 – STANDARD TEST METHOD FOR ACCELERATED TENSILE CREEP AND CREEP-RUPTURE OF GEOSYNTHETIC MATERIALS BASED ON TIME-TEMPERATURE SUPERPOSITION USING STEPPED ISOTHERMAL METHOD

#### D. SOILS

1. ASTM D 422 – STANDARD TEST METHOD FOR PARTICLE-SIZE ANALYSIS OF SOILS
2. ASTM D 1556 – STANDARD TEST METHOD FOR DENSITY AND UNIT WEIGHT OF SOIL IN PLACE BY THE SAND-CONE METHOD
3. ASTM D1557 – STANDARD TEST METHOD FOR LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING MODIFIED EFFORT (56,000 FT-LBF/FT<sup>3</sup>)
4. ASTM D 2487 – STANDARD PRACTICE FOR CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (UNIFIED SOIL CLASSIFICATION SYSTEM)
5. ASTM D 6938 – STANDARD TEST METHOD FOR IN-PLACE DENSITY AND WATER CONTENT OF SOIL AND SOIL-AGGREGATE BY NUCLEAR METHODS (SHALLOW DEPTH)
6. ASTM D 4318 – STANDARD TEST METHODS FOR LIQUID LIMIT, PLASTIC

## LIMIT, AND PLASTICITY INDEX OF SOILS

7. ASTM D 6913 – STANDARD TEST METHODS FOR PARTICLE-SIZE DISTRIBUTION (GRADATION) OF SOILS USING SIEVE ANALYSIS
8. ASTM G 51 – STANDARD TEST METHOD FOR MEASURING PH OF SOIL FOR USE IN CORROSION TESTING

### E. GEOTEXTILE FILTER

1. ASTM D 4491 – STANDARD TEST METHOD FOR WATER PERMEABILITY OF GEOTEXTILES BY PERMITTIVITY
2. ASTM D 4533 – STANDARD TEST METHOD FOR TRAPEZOID TEARING STRENGTH OF GEOTEXTILES
3. ASTM D 4632 – STANDARD TEST METHOD FOR GRAB BREAKING LOAD AND ELONGATION OF GEOTEXTILES
4. ASTM D 4751 – STANDARD TEST METHOD FOR DETERMINING APPARENT OPENING SIZE OF A GEOTEXTILE
5. ASTM D 4833 – STANDARD TEST METHOD FOR INDEX PUNCTURE RESISTANCE OF GEOMEMBRANES AND RELATED PRODUCTS

### F. DRAINAGE PIPE

1. ASTM F 405 – STANDARD SPECIFICATION FOR CORRUGATED POLYETHYLENE (PE) PIPE AND FITTINGS
2. ASTM F 758 – STANDARD SPECIFICATION FOR SMOOTH-WALL POLY (VINYL CHLORIDE) (PVC) PLASTIC UNDERDRAIN SYSTEMS FOR HIGHWAY, AIRPORT, AND SIMILAR DRAINAGE

G. WHERE THE SPECIFICATIONS AND REFERENCE DOCUMENTS CONFLICT, THE STRUCTURAL DESIGN ENGINEER SHALL MAKE THE FINAL DETERMINATION OF APPLICABLE DOCUMENTS.

## 1.04 INSTALLATION

A. MATERIALS LISTED IN PART 2 SHALL BE INSTALLED PER THE MURATA GRAVITY WALL INSTALLATION GUIDE.

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. CONTRACTOR SHALL CHECK THE MATERIALS UPON DELIVERY TO ENSURE THE

PROPER MATERIALS HAVE BEEN RECEIVED ON SITE.

- B. CONTRACTOR SHALL PREVENT EXCESSIVE MUD, CEMENTITIOUS MATERIAL, AND OTHER SIMILAR CONSTRUCTION DEBRIS FROM COMING IN CONTACT WITH THE MATERIALS ON SITE BEFORE AND DURING INSTALLATION.
- C. CONTRACTOR SHALL PROTECT THE RECEIVED MATERIALS ON SITE FROM DAMAGE. DAMAGED MATERIAL SHALL NOT BE USED IN CONSTRUCTION OF THE PROJECT.

## **1.06 CONTRACTOR REQUIREMENTS**

- A. CONTRACTORS SHALL BE TRAINED AND CERTIFIED BY THE MANUFACTURER OR APPROVED ACCREDITED ORGANIZATION.
- B. WESTERN INTERLOCK HAS A TRAINING PROGRAM. NCMA HAS A CERTIFICATION PROGRAM THAT IS ACCREDITED. IDENTIFY WHEN ADVANCED CERTIFICATION LEVELS ARE APPROPRIATE BASED ON COMPLEXITY AND CRITICALITY OF PROJECT APPLICATION.
- C. CONTRACTORS SHALL PROVIDE A LIST OF SIMILAR PROJECTS THEY HAVE COMPLETED. THIS CAN INCLUDE BUT NOT LIMITED TO OTHER INSTALLATIONS OF MURATA RETAINING WALL SYSTEMS AND SIMILAR SEGMENTAL RETAINING WALLS.

## **1.07 SUBMITTALS**

- A. MATERIAL SUBMITTALS – THE CONTRACTOR SHALL SUBMIT MANUFACTURER’S CERTIFICATIONS, 30 DAYS PRIOR TO THE START OF WORK, STATING THAT THE SRW UNITS, AND THE MURATA FILL MEET THE REQUIREMENTS OF PART 2 OF THIS SPECIFICATION. THE CONTRACTOR SHALL PROVIDE A LIST OF SUCCESSFUL PROJECTS WITH REFERENCES SHOWING THAT THE INSTALLER FOR THE SEGMENTAL RETAINING WALL IS QUALIFIED AND HAS A RECORD OF SUCCESSFUL PERFORMANCE.

## **PART 2: MATERIALS**

### **2.01 MODULAR WALL UNITS**

- A. WALL UNITS SHALL BE MURATA RETAINING WALL UNITS AS PRODUCED BY THE LICENSED MANUFACTURER.
- B. WALL UNITS SHALL HAVE MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 5000 PSI IN ACCORDANCE WITH ASTM C1372. THE CONCRETE UNITS SHALL HAVE APPROPRIATE FREEZE-THAW PROTECTION WITH AN AVERAGE ABSORPTION RATE IN ACCORDANCE WITH ASTM C1372 WHEN TESTING IN ACCORDANCE

WITH ASTM C1262.

- C. EXTERIOR DIMENSIONS SHALL BE UNIFORM AND CONSISTENT. MAXIMUM DIMENSIONAL DEVIATIONS OF ANY TWO UNITS SHALL BE 1/8 INCHES (3.18 MILLIMETERS).
  - 1. WIDTH = 15.75 INCHES (400 MILLIMETERS)
  - 2. DEPTH = 11.61 INCHES (295 MILLIMETERS)
  - 3. HEIGHT = 7.87 INCHES (200 MILLIMETERS)
- D. WALL UNITS SHALL PROVIDE A MINIMUM OF 117.6 LBS TOTAL WEIGHT PER SQUARE FOOT OF WALL FACE AREA. COMPACTION OF THE BLOCK CORE MURATA FILL IS OPTIONAL.
- E. COLOR AS SPECIFIED BY OWNER.
- F. FREEZE-THAW DURABILITY: DRY-CAST CONCRETE SRW UNITS ARE SUSCEPTIBLE TO FREEZE-THAW DEGRADATION WITH EXPOSURE TO DEICING SALTS AND COLD TEMPERATURE LIKE ALL CONCRETE PRODUCTS. THIS IS A CONCERN IN STATES THAT USE DEICING SALTS. STANDARD SPECIFICATION FOR SEGMENTAL RETAINING WALL UNITS SHOULD BE USED AS A MODEL, EXCEPT THAT THE COMPRESSIVE STRENGTH FOR THE UNITS SHOULD BE INCREASED TO A MINIMUM OF 5,000 PSI UNLESS LOCAL REQUIREMENTS DICTATE HIGHER LEVELS. ALSO, MAXIMUM WATER ABSORPTION SHOULD BE REDUCED AND REQUIREMENTS FOR FREEZE-THAW TESTING INCREASED.

## **2.02 CAP ADHESIVE**

- A. SEK SUREBOND SB-20 FLEX BOND ADHESIVE OR SEK SUREBOND SB-15 RAPID SET SHALL BE USED TO ATTACH THE CAPSTONES TO THE TOP COURSE OF MURATA BLOCKS.

## **2.03 MURATA FILL**

- A. THE FILL SHALL BE PLACED WITHIN THE CORES OF, BETWEEN, AND BEHIND THE MURATA WALL UNITS AS INDICATED ON THE CONSTRUCTION DOCUMENTS.
- B. THE MURATA FILL USED SHALL MEET OR EXCEED THE DESIGN FRICTION ANGLE AND DESCRIPTION NOTED ON THE DESIGN CROSS SECTIONS, AND SHALL BE FREE OF DEBRIS AND CONSIST OF THE INORGANIC USCS SOIL TYPES GW OR GW-GM MEETING THE FOLLOWING GRADATION AS DETERMINED IN ACCORDANCE WITH ASTM D422 AND IN CONFORMANCE WITH THE FRACTURE AND SAND EQUIVALENT MINIMUM REQUIREMENTS FOR THE STATE DEPARTMENT OF TRANSPORTATION (DOT) WHERE THE PROJECT IS LOCATED. AGGREGATE SHALL BE SOUND DURABLE ROCK CONFORMING TO THE DURABILITY REQUIREMENTS OUTLINED BELOW:

### GRADATION

SIEVE SIZE	ODOT ¾"-0	¾" IDAHO DOT "B" GRADATION	⅝"-0 WSDOT TOP ROCK
	PERCENT PASSING		
1 ½"			
1 ¼"			
1"	100	100	
¾"	90 – 100	90 - 100	99 - 100
½"	--		80 - 100
⅜"	55 – 75		
¼"	40 – 60		
NO. 4	--	40 – 65	46 – 66
NO. 8		30 - 50	
NO. 40			8 - 24
NO. 200		3.0 – 9.0	0 – 10
% FRACTURE	70	60	75
SAND EQUIVALENT	NOT LESS THAN 30	NOT LESS THAN 30	NOT LESS THAN 40

### DURABILITY

TEST		TEST METHOD	REQUIREMENTS
ABRASION (LAR)		AASHTO T 96	35% MAXIMUM
DEGRADATION FACTORS			
ODOT	PASSING NO. 20 SIEVE	ODOT TM 208	30% MAXIMUM
ODOT	SEDIMENT HEIGHT	ODOT TM 208	3" MAXIMUM
IDAHO	DEGRADATION LOSS	IDAHO IT 15	8.0% LOSS
WSDOT	DEGRADATION FACTOR	WSDOT T113	25 MINIMUM

C. IF AN ALTERNATIVE FILL IS REQUESTED, CONTRACTOR SHALL SUBMIT SAMPLE AND SPECIFICATIONS TO THE WALL DESIGN ENGINEER OR THE GEOTECHNICAL ENGINEER FOR APPROVAL AND THE APPROVING ENGINEER SHALL CERTIFY THAT THE SOIL PROPOSED FOR USE HAS PROPERTIES MEETING OR EXCEEDING ORIGINAL DESIGN STANDARDS.

D. THE MURATA FILL INCLUDING LEVELING BASE FILL SHALL BE INSTALLED ON

UNDISTURBED NATIVE SOILS, ENGINEERED FILL, OR SUITABLE REPLACEMENT FILLS COMPACTED TO A MINIMUM OF 90% MODIFIED PROCTOR FOR GRANULAR SOILS (ASTM D1557). THE COMPACTION REQUIREMENT FOR NATIVE FINE GRAINED SOIL SUBGRADE MAY BE WAIVED AT THE DISCRETION OF THE GEOTECHNICAL ENGINEER.

- E. MURATA FILL SHALL BE PLACED WITHIN 1% OF OPTIMUM MOISTURE CONTENT.
- F. MURATA FILL SHALL BE PLACED IN MAXIMUM 8" (200 MILLIMETERS) HIGH LIFTS.
- G. THE MURATA FILL SHALL BE COMPACTED TO A MINIMUM OF 90% MODIFIED PROCTOR (ASTM D1557) TO PROVIDE A LEVEL HARD SURFACE.
- H. THE CONSOLIDATION ZONE SHALL BE DEFINED AS 3 FT (910 MILLIMETERS) BEHIND THE WALL. ONLY HAND-OPERATED COMPACTION EQUIPMENT IS ALLOWED IN THE CONSOLIDATION ZONE.

## 2.04 GEOGRID

- A. ALL GEOGRID INSTALLED WITH MURATA RETAINING WALL BLOCKS SHALL BE STRATAGRID SG350.
- B. STRATAGRID SG350 IS CONSTRUCTED OF HIGH MOLECULAR WEIGHT AND HIGH TENACITY POLYESTER YARNS UTILIZING A COMPLEX KNITTING PROCESS AND POLYMERIC COATING TO PROVIDE SUPERIOR ENGINEERING PROPERTIES. STRATAGRID SG350 IS ENGINEERED TO BE MECHANICALLY AND CHEMICALLY DURABLE, IN BOTH THE HARSH CONSTRUCTION INSTALLATION PHASE AND IN AGGRESSIVE SOIL ENVIRONMENTS (PH RANGE FROM 3 - 9).
- C. STRATAGRID SG350 GEOGRID SHALL HAVE THE FOLLOWING TESTED PROPERTIES:
  - 1. ULTIMATE TENSILE STRENGTH =  $T_{ULT} = 4,800$  LBS/FT WIDTH
  - 2. DURABILITY REDUCTION FACTOR =  $RF_D = 1.1$
  - 3. INSTALLATION DAMAGE REDUCTION FACTOR =  $RF_{ID} = 1.4$
  - 4. CREEP REDUCTION FACTOR =  $RF_{CR} = 1.55$
  - 5. LONG-TERM DESIGN STRENGTH (ALLOWABLE) =  $LTDS = 2,011$  LBS/FT WIDTH
- D. TRACKED CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY ON THE GEOGRID. A MINIMUM FILL THICKNESS OF 6 INCHES (150 MILLIMETERS) 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.

- E. RUBBER-TIRED EQUIPMENT MAY PASS OVER THE GEOGRID REINFORCEMENT AT SLOW SPEEDS, LESS THAN 10 MPH (16 KPH). SUDDEN BRAKING AND SHARP TURNING SHALL BE AVOIDED.

## **2.05 DRAINAGE PIPE**

- A. DRAINAGE PIPE SHALL BE PERFORATED OR SLOTTED PVC PIPE OR CORRUGATED POLYETHYLENE PIPE.
- B. THE PIPE SHALL BE PLACED IN MURATA FILL SURROUNDED BY GEOTEXTILE FILTER FABRIC.
- C. THE DRAINAGE PIPE SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM F405 OR ASTM F758.

## **2.06 GEOTEXTILE FILTER FABRIC**

- A. GEOTEXTILE FILTER FABRIC SHALL BE A NEEDLE-PUNCHED NONWOVEN FABRIC.
- B. THE GEOTEXTILE FILTER FABRIC SHALL MEET THE REQUIREMENTS OF ASTM D 4491, ASTM D 4533, ASTM D 4632, ASTM D 4751, AND ASTM D 4833.