

# **SAMPLE CONSTRUCTION AND MATERIAL SPECIFICATIONS FOR THE ULTRABLOCK™ GRAVITY WALL SYSTEM**

The following paragraphs provide general guidelines on developing construction and material specifications for specific projects. It should be noted that the owner would hire services of a designer to perform a project-specific design. The design should be performed in accordance with the procedures outlined in this manual.

General guidelines given below should be modified to incorporate specific ULTRABLOCK™ facing unit criteria, to incorporate special project-specific requirements, and to provide consistency with construction drawings. Any unnecessary requirements given below may be deleted depending upon project details. These specifications should be used only for ULTRABLOCK units.

It should be noted that the physical and mechanical properties of ULTRABLOCK™ facing units and geogrid reinforcement properties are primarily important in ensuring satisfactory long-term performance of the ULTRABLOCK™ gravity wall systems.

The AIA A201-87, CSI 3-Part Format and CSI Page Format have been referred to develop general conditions and formats.

## **PART I: GENERAL**

### **1.01 Summary Description**

- A. This section includes ULTRABLOCK™ gravity retaining wall systems consisting of a column of ULTRABLOCK™ segmental concrete facing units retaining compacted soil backfill or a native ground cut. Work shall consist of furnishing all materials, labor, equipment, field supervision, and installing a ULTRABLOCK™ gravity wall system in accordance with given specifications. All installations should conform with project drawings provided by the Owner or the Owner's Engineer.
- B. Related Sections
  - 1. Section \_\_\_\_\_ - Site Preparation
  - 2. Section \_\_\_\_\_ - Earthwork

### **1.02 Reference Standards**

- A. Any reference standards that are not applicable to the project should be deleted. If there is a conflict between the given specifications and reference standards, the Owner's Engineer should make the final determination of applicable documents.
- B. American Association of State Highway and Transportation Officials (AASHTO)

1. LRFD
  2. Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Washington, D.C., August 1986
- C. American Society for Testing and Materials (ASTM)
1. ASTM D422 – Standard Test Method for Gradation of soils
  2. ASTM D424 – Standard Test Method for Determination of Atterberg Limits of Soils
  3. ASTM DG51 – Standard Test Method for Determination of Soil pH
  4. ASTM D698, D1997 – Standard Specification for Moisture Density Relationship for Soils, Standard Proctor and Modified Proctor Methods
  5. ASTM C33-99 - Standard Specification for Concrete Aggregates
  6. ASTM D3034 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
  7. ASTM D1248 – Standard Specification for Corrugated Plastic Pipe
  8. ASTM C150 – Use of Cement in Concrete Blocks
  9. ASTM C260 – Use of Admixtures in Concrete
  10. ASTM C494 – Use of Admixtures in Concrete
  11. ASTM C805 – Schmidt Hammer Test for the determination of Compressive Strength of Concrete
- D. National Concrete Masonry Association (NCMA)
1. TEK 2-4A - Specification for Segmental Retaining Wall Units
- E. Ultrablock, Inc.
1. Design Manual for Ultrablock Wall Systems, 4<sup>th</sup> Edition July 2008

### **1.03 Definitions**

- A. ULTRABLOCK<sup>TM</sup> Unit – A segmental concrete unit with shear keys generally made of "surplus concrete mix" in the yard of a ready-mix concrete supplier.
- B. Gravity Soil Mass - Compacted structural fill placed immediately behind the wall, which contributes to the gravity mass of the wall structure.
- C. Drainage Fill - Free-draining, well-graded and coarse-grained aggregates placed immediately behind the blocks to relieve hydrostatic pressures or seepage forces and to prevent clogging of aggregate drainage medium if a geotextile fabric is not used.
- D. Retained Soil - Native soils or compacted structural fill situated immediately behind drainage fill. The primary function of the gravity wall is to retain this soil mass without failure.
- E. Leveling Pad / Wall Foundation - Densely compacted and free draining crushed rock pad for distributing the weight of block wall over a wider area and for providing a working surface during construction.

- F. Foundation Subgrade - Competent native soil subgrade or compacted structural fill subgrade for supporting the block wall structure as approved by a qualified geotechnical engineer.
- G. Drainage / Discharge Pipe - Perforated pipe with adequate flow capacity placed typically at the base of the wall to discharge collected water into suitable receptacle by gravity flow. Location of discharge pipe behind the wall depends upon the drainage requirements of the wall structure and the design of drainage system.
- H. Drainage Swale - A small depression adjacent to the top of wall to collect surface water run-off and discharge by gravity flow.
- I. Geotextile filter – A filter fabric (with adequate permittivity or porosity) placed against the retained soil mass or between drainage media and retained soil mass to minimize clogging of drainage media.
- J. Backslope - Retained soil slope behind the wall. Slope inclination,  $\beta$ , is measured clockwise from the horizontal plane.
- K. Foreslope / Toeslope - Downslope in front of the toe of wall.
- L. Retained /Structural Backfill – Compacted structural fill placed behind the drainage fill or directly behind the ULTRABLOCK units as outlined on the plans.

#### **1.04 System Description**

- A. Design Requirements - Design the retaining wall system in accordance with the design guidelines presented in Design Manuals for ULTRABLOCK™ Gravity Wall Systems, 2008 provided by Ultrablock, Inc. Engage and pay for the services of a Designer to design and develop Design Data for the retaining wall system.
- B. Performance Requirements – The contractors, material suppliers, and wall system suppliers shall have sufficient past project experience and shall be approved by the Owner's Engineer at least two weeks prior to the bid opening.

#### **1.05 Submittals**

Following submittals shall be made 30 days prior to the start of construction. In addition, the contractor shall provide a list of successfully completed projects along with related project references.

- A. Geotechnical Reports – A geotechnical report prepared in accordance with local regulatory and industry standards shall be submitted for wall areas including any required slope stability analyses results.
- B. Product Data – Manufacturer's materials specifications, installation instructions, and

general recommendations.

- C. Plans – Engineering drawings, cross-sections, elevations, and large scale details of elevation, typical sections, details, and connections. Plans shall be stamped and signed by a qualified registered Professional Engineer.
- D. Quality Control and Certification Submittals - Design calculations and plans for the retaining wall system. All design data shall be stamped by the Designer. The designer shall be a qualified registered Professional Engineer.

### **1.06 Quality Assurance**

- A. Pre-Construction Meeting – A meeting between the geotechnical engineer, wall designer, contractor, material supplier, subcontractors, and the owner shall be held at the site in order to review the retaining wall design and construction requirements. A notification shall be sent to all the parties at least three 3 days in advance of the time of the meeting.
- B. Designer – The firm designing the wall shall have liability insurance (Errors and omissions) of at least \$1,000,000.00 per occurrence. The designer shall be a registered professional engineer, registered in the state where the project is located.

### **1.07 Delivery, Storage, and Handling**

- A. At the time of delivery, the contractor shall inspect and confirm proper type and grade of materials. All product specifications shall be reviewed to assure that all specified materials have been delivered.
- B. The contractor shall store and handle all materials in accordance with manufacturer's recommendations. The contractor shall avoid excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to materials.
- C. The contractor shall discard all damaged materials and not use them in wall construction.

## **PART II PRODUCTS**

### **2.01 Manufacturers**

- A. Ultrablock, Inc., Inter-Block, Inc. and United ULTRABLOCK Ltd are the sole manufacturers of LOCK-BLOCK™ Segmental Concrete Facing Units.
- B. Substitutions – See section \_\_\_\_\_.

## 2.02 Materials

### 2.02.01 ULTRABLOCK™ Segmental Unit

- A. The ULTRABLOCK™ units shall have 28-day compressive strength of at least 2,200 psi. The maximum absorption of 10 pcf and adequate freeze-thaw protection (absorption by weight 6%) shall, in general, satisfy the local requirements of high elevation (mountainous) areas where there is a potential for spalling due to freeze-thaw .
- B. All individual ULTRABLOCK™ units shall be free of cracks and other defects that would interfere with the placement and locking of units. All shear keys shall be free of damage.
- C. ULTRABLOCK™ Unit dimensions such as height, width, depth, and batter shall match details shown on plans. A tolerance of  $\pm 1/2$  inch for all dimensions except the height may be used. A tolerance of  $\pm 1/4$  inch shall be used for height.
- D. Architectural features such as surficial finishes, and color of ULTRABLOCK™ units shall match details shown on plans. Surface coloring or integral coloring generally costs extra.
- E. The chamfered corners of the ULTRABLOCK™ units shall provide approximately 8 in<sup>2</sup> of drainage area per unit. Clearance of roughly 1/2" around locking grooves/shear keys shall provide additional drainage.
- F. ULTRABLOCK™ units shall have following dimensions (select whatever is applicable).
1. ULTRABLOCK™ \_\_\_\_\_
    - a. Size: \_\_\_\_\_
    - b. Weight: \_\_\_\_\_
    - c. Color \_\_\_\_\_
  2. ULTRABLOCK™ \_\_\_\_\_
    - a. Size: \_\_\_\_\_
    - b. Weight: \_\_\_\_\_
    - c. Color \_\_\_\_\_
  3. ULTRABLOCK™ \_\_\_\_\_
    - a. Size: \_\_\_\_\_
    - b. Weight: \_\_\_\_\_
    - c. Color \_\_\_\_\_
  4. ULTRABLOCK™ \_\_\_\_\_
    - a. Size: \_\_\_\_\_
    - b. Weight: \_\_\_\_\_
    - c. Color \_\_\_\_\_
  5. ULTRABLOCK™ \_\_\_\_\_
    - a. Size: \_\_\_\_\_
    - b. Weight: \_\_\_\_\_
    - c. Color \_\_\_\_\_

6. ULTRABLOCK™ \_\_\_\_\_

- a. Size: \_\_\_\_\_ b. Weight:  
c. Color

### **2.02.02 Drainage Materials**

- A. Drainage fill materials shall consist of free draining, all-weather, coarse-grained materials that is placed behind the ULTRABLOCK™ units as specified on the plans. The drainage fill gradation shall be as follows as determined by ASTM D 422 test procedure:
- 100 to 75 percent passing in a 1-in. sieve
  - 50 to 75 percent passing a 3/4-in. sieve
  - 0 to 60 percent passing a No 4 sieve
  - 0 to 50 percent passing a No 40 sieve
  - 0 to 5 percent passing a No 200 sieve
- B. The Engineer and/or Architect may specify a substitute such as a drainage composite or other equivalent geosynthetic drainage materials to be approved by the designer. The drainage composite shall be – 6 oz. per sq.yd. polypropylene non-woven geotextile, AASHTO M288-96, Class 2, bonded to both sides of a polyethylene net structure, produced by \_\_\_\_\_. Minimum Allowable Transmissivity – Not less than 1.5 gal. per min. per ft. of width when tested in accordance with ASTM D4716-95 at a confirming pressure of 10,000 lbs per sq.ft. Minimum Allowable Peel Strength of Geotextile from the Polyethylene Net shall be not less than 250 gm. per in. of width when tested in accordance with ASTM F904-91.
- C. The drainage collection pipe shall be placed as shown on the plans. The pipe shall be a perforated or slotted, PVC or corrugated HDPE pipe. The pipe shall be wrapped in filter fabric. The pipe shall be manufactured in accordance with ASTM D3034.

### **2.02.03 Retained Backfill / Structural Backfill Materials**

- A. Retained/structural backfill materials shall consist of granular materials (GP, GW, SW, SP, SM per Unified Soil Classification) meeting the following gradation as determined by ASTM D 422 test procedure:
- 100 to 75 percent passing in a 2-in. sieve
  - 100 to 75 percent passing a 3/4-in. sieve
  - 100 to 20 percent passing a No 4 sieve
  - 0 to 60 percent passing a No 40 sieve
  - 0 to 35 percent passing a No 200 sieve
- B. The maximum aggregate size shall be limited to 3/4inch unless appropriate values for geogrid installation damage have been used.
- C. The plasticity index of materials passing No.200 sieve shall be less than 20.

- D. The pH value shall be in the range of 2 to 12 as determined by ASTM G51 procedure.

#### **2.02.04 Accessories**

- A. Geotextile Filter Fabric– A polypropylene non-woven geotextile produced by \_\_\_\_\_ or equal as approved by the designer with grab tensile strength (ASTM D4632) of \_\_\_\_\_lb/ft and water flow rate (ASTM D4491) of\_\_\_\_\_.
- B. Erosion Control Blanket – The ULTRABLOCK™ Retaining Wall System designer must include a reinforced, polymeric, permanent erosion control blanket on all soil structure/slope facings behind, in front, and adjacent to the retaining walls. All components shall be inert to chemicals normally encountered in a natural soil environment. The tensile strength shall be not less than\_\_\_\_\_ (ASTM D5035-95). The durability criteria shall include retaining a minimum of 80 percent of strength after 1,000 hours of ultraviolet exposure (ASTM D4355-92).

### **PART III CONSTRUCTION**

#### **3.01 Qualification**

- A. The constructor and the site supervisor shall have successfully completed several projects including the installation of ULTRABLOCK™ gravity wall systems. The contractor shall carry adequate insurance and bond.

#### **3.02 Excavation**

- A. Prior to the beginning of excavation, a ULTRABLOCK™ supplier's representative experienced in ULTRABLOCK™ wall construction shall assist the contractor regarding wall foundation excavation, specifically the preparation of foundation subgrade for design wall batter and other excavation procedures related to subgrade preparation, placement of blocks, and drainage envelope behind the wall.
- B. The contractor shall provide adequate excavation support during construction in accordance with local, state, and federal safety regulations. It shall be contractor's responsibility to assure site safety during excavation and other construction activities.
- C. The subgrade shall be excavated to meet design requirements shown on grading plans. Excavations shall be made vertically to the plan elevation and horizontally to the designed geogrid lengths so that over-excavation is minimized. Width of excavation should allow for wall base and drainpipe.
- D. Start excavation at the lowest wall level. If wall steps up in one block height, the base block should be installed at the lowest level in order to establish grade and face location of the second level.

- E. Overexcavated or filled areas shall be well compacted and inspected and approved by a qualified geotechnical engineer.
- F. A qualified geotechnical engineer shall evaluate and approve excavated materials that are used as backfill in the reinforcement zone. All backfill materials shall be protected from the weather.

### **3.03 Foundation Preparation**

- A. Foundation trench shall be excavated to the dimensions indicated on the construction drawings.
- B. A qualified geotechnical engineer shall inspect and approve the reinforced zone and leveling pad foundation soil subgrade in order to ensure adequate bearing capacity. Subgrade soil areas not meeting required bearing strength shall be marked in the field and the contractor shall remove and replace these areas with approved fill materials.
- C. Foundation subgrade soils and any backfill materials shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98 before placing the leveling pad.

### **3.04 Leveling Pad Installation**

- A. The leveling pad shall consist of 6 inches thick layer of ¾-inch minus well-graded aggregates compacted to 95% of ASTM D 1996 modified proctor density, unless specified otherwise by the design engineer.
- B. A ULTRABLOCK™ supplier's representative experienced in ULTRABLOCK™ wall construction shall assist the contractor regarding leveling pad preparation for achieving specified wall batter. The wall designer shall inspect and approve the leveling pad prior to the placement of blocks.
- C. As a minimum, start at the lowest wall level, locate the front face of the wall, run a string about 1 inch in front and 2 inches above the base. Use 2X6 or 2X8 pieces of wood boards and steel stakes to make a form for achieving design batter. Set front board in line with the string and at base elevation of the wall. Locate and place the back board at a distance equal to the base width of the wall. Set elevation of back board so that design batter can be achieved. Without moving the string line, start leap-frogging the boards in line with the string and move forward along the length of the wall. It is best to prepare the entire leveling pad/base before placing the blocks.

### **3.05 Unit/Block Installation**

- A. Installation shall be in accordance with manufacturer guidelines. A detailed installation guide can be found online ([www.ultrablock.com](http://www.ultrablock.com)).
- B. A track-mounted excavator is the ideal equipment for block installation. A wire

- rigging with swivel hooks, OSHA approved and rated for weight of the blocks can be attached to the excavator and used for lifting, moving, and placing the blocks.
- C. The contractor shall carefully place the first course of ULTRABLOCK™ units only after the leveling pad has been approved by the designer for adequate batter.
  - D. Block placement should start at the lowest elevation. At the start of the wall, make a line perpendicular to the face of the wall so the first block can be placed square to the wall face. Set blocks at the back of the wall first, i.e. if the width of the wall base is larger than the block width, then the first block shall be placed at the back followed by the front block.
  - E. All ULTRABLOCK™ units shall be placed together and parallel to the straight or curved line of the wall face.
  - F. The ULTRABLOCK™ units shall be installed free of all protrusions, debris before installing the next course of units and/or placing the geogrid materials.
  - G. Do not place any more than 5 to 6 blocks along the first course before starting on the second course.
  - H. At the completion of the placement of each course, a string line shall be pulled to confirm that the wall's geometry is being maintained.
  - I. All battered wall corners shall be installed and locked per the block manufacturer's recommendation as approved by the wall designer.

### **3.06 Drainage Fill, Unit Fill, and Drainage Pipe Placement**

- A. The ULTRABLOCK™ units do not require core fill since there are no voids.
- B. The drainage backfill shall be placed within an envelope of 12 inches behind the wall and shall consist of a free draining, coarse-grained granular materials or open graded materials meeting the requirements of Section 2.02.03 unless specified otherwise by the designer.
- C. The drainage collection pipe (minimum 3-inch diameter) shall be placed immediately behind the wall at the bottom of the wall with a minimum of 1.5% gradient to maintain a positive gravity flow into a suitable receptacle unless specified otherwise by the designer.

### **3.07 Retained Backfill Placement**

- A. As shown on the plans, the retained backfill material shall be placed in maximum lifts of 10 inches and shall be compacted to a minimum 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98.

- B. Only hand-operated compaction equipment shall be used within 5 feet of the back face of the ULTRABLOCK™ units. This area shall be compacted to a minimum 90 percent of Standard Proctor Dry Density in accordance with ASTM D698-98.
- C. Soil density testing shall not be performed within 5 feet of the tail of the ULTRABLOCK™ Segmental Concrete facing Units.
- D. The toe of the wall shall be filled and compacted as the wall is being constructed.
- E. The fill areas shall be graded or protected so that any surface water run-off is directed away from the wall face.

### **3.08 Tolerance**

- A. Wall batter tolerance of  $\pm 1/8$  in. per ft. maximum shall be allowed.

## **PART IV MEASUREMENT AND PAYMENT**

- A. Payment will be made on the quantity of full blocks, half blocks, and top blocks installed.
- B. The total quantity to be paid shall include all costs for material supply and installation. The contractor shall take into consideration all the blocks that are placed to achieve the design cross-section, thus, not missing any blocks that are placed behind the front face block.
- C. Any overexcavation of unsuitable materials and backfilling as directed and approved by the project geotechnical engineer and the owner shall be paid separately.
- D. The quantities as shown on the plans or as approved by the designer shall be used to determine and confirm the in place constructed wall area.

END OF SECTION