Specification Guidelines:
Complex Composite Structures with Allan Block

The following specifications provide Allan Block Corporation's typical requirements and recommendations. At the engineer of record's discretion these specifications may be revised to accommodate site specific design requirements.

SECTION 5: COMPLEX COMPOSITE STRUCTURES
PART 1: GENERAL

1.1 Scope

Work includes furnishing and installing modular concrete block retaining wall units in complex composite structure applications to the lines and grades designated on the construction drawings and as specified herein.

When evaluation of a single wall section with two different structures or reinforcement options must include external stability for both the upper and lower structures along with Internal Compound Stability to analyze the internal calculations. Running Internal Compound Stability does not replace the need to have a global analysis conducted to ensure the overall site stability is achieved. The upper structure calculations should also include a second external analysis of a gravity wall for those unreinforced courses above either the top layer of geogrid or above the No-fines mass. The lower structure can be a geogrid reinforced mass with grid lengths at least 60% of the height of the total structure or a No-fines concrete mass. A limiting ratio of the upper structure depth to the lower structure depth of 70% is recommended.

1.2 Applicable Sections of Related Work

Allan Block Modular Retaining Wall Systems
Geogrid Reinforced Systems
No Fines Concrete Backfill with Allan Block

1.3 Reference Standards

A. ASTM C1372 Standard Specification for Segmental Retaining Wall Units.
B. ASTM C1262 Evaluating the Freeze thaw Durability of Manufactured CMU's and Related Concrete Units
C. ASTM D698 Moisture Density Relationship for Soils, Standard Method
D. ASTM D422 Gradation of Soils
E. ASTM D4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method
F. ASTM D5262 - Test Method for Evaluating the Unconfined Creep Behavior of Geogrids
G. ASTM D6638 Grid Connection Strength (SRW-U1)
H. ASTM D6916 SRW Block Shear Strength (SRW-U2)
I. GRI-GG4 - Grid Long Term Allowable Design Strength (LTADS)
J. ASTM D6706 - Grid Pullout of Soil ASTM C140 Sample and Testing concrete Masonry Units
K. ASTM C33 Standard Specification for Concrete Aggregates
L. ASTM C94 Standard Specification for Ready Mixed Concrete

1.4 Delivery, Storage, and Handling

A. Contractor shall check the materials upon delivery to assure proper material has been received.
B. Contractor shall prevent excessive mud, cementitious material, and like construction debris from coming in contact with the materials.
C. Contractor shall protect the materials from damage. Damaged material shall not be incorporated in the project (ASTM C1372).
D. Geogrid shall be stored above -10 F (-23 C). Contractor shall be prepared for rapid placement of No-fines concrete upon delivery to site.
E. No-fines concrete backfill shall not be placed when ambient temperature is below 40°F (4°C) without utilizing cold weather construction practices.

PART 2: MATERIALS

2.1 Modular Wall Units

A. Wall units shall be Allan Block Retaining Wall units as produced by a licensed manufacturer.
B. Wall units shall have minimum 28-day compressive strength of 3,000 psi (20.7 MPa) in accordance with ASTM C1372. The concrete units shall have adequate freeze-thaw protection with an average absorption rate in accordance with ASTM C1372 or an average absorption rate of 7.5 lb/ft^3 (120 kg/m^3) for northern climates and 10 lb/ft^3 (160 kg/m^3) for southern climates.
C. Exterior dimensions shall be uniform and consistent. Maximum dimensional deviations on the height of any two units shall be 0.125 in. (3 mm).
D. Wall units shall provide a minimum of 110 lbs total weight per square foot of wall face area (555 kg/m^2). Fill contained within the units may be considered 80% effective weight.
E. Exterior face shall be textured. Color as specified by owner.

2.2 Wall Rock

A. Material must be well-graded compactable aggregate, 0.25 in. to 1.5 in., (6 mm - 38 mm) with no more than 10% passing the #200 sieve. (ASTM D422)
B. Material behind and within the blocks may be the same material.

2.3 Geogrid Reinforcement

A. Geogrid products shall be of high-density polyethylene or polyester yarns encapsulated in a protective coating specifically fabricated for use as a soil reinforcement material.
B. Geogrid shall be the type as shown on the drawings having the property requirements as described within the manufacturer's specifications.
C. A manufacturer's product shall be approved by the wall design engineer.

2.4 No-Fines Concrete Backfill/Stabilized Aggregate

A. No-fines concrete is a combination of coarse aggregate, cement, and water. The cement shall comply with the requirements for use in ready-mix concrete (ASTM C94). The water to cement ratio for No-fines concrete should range between 0.3-0.5
B. Coarse aggregate must meet the requirements for concrete aggregates (ASTM C33). Aggregate size should be poorly graded with sizes between 5/8 in. to 1 in. (19 mm to 25 mm) aggregate with an aggregate/ cement ratio of 5.5:1 to 6.5:1.
C. No-fines product density will range depending on the mix design. Typical unit weight will range between 100 lb/ft^3 to 135 lb/ft^3
D. No-fines concrete void content shall range between 18% - 35% (ASTM C140).
E. No-fines concrete should only be used with open celled (hollow core) blocks.

PART 3: WALL CONSTRUCTION

3.1 Excavation for Complex Composite Structures

A. Contractor shall excavate to the lines and grades shown on the construction drawings. Contractor shall use caution not to over-excavate beyond the lines shown, or to disturb the base elevations beyond those shown.
B. Contractor shall verify locations of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation.

3.2 Foundation Soil Preparation for Complex Composite Structures

A. Foundation soil shall be excavated to the lines and grades as shown on the construction drawings, or as directed by the on-site soils engineer.
B. Foundation soil shall be examined by the on-site soils engineer to assure that the actual foundation soil strength meets or exceeds assumed design strength.
C. Over-excavated areas shall be filled with compacted backfill material approved by on-site soils engineer.
D. Contractor shall verify locations of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation.

3.3 Base for Complex Composite Structures

A. The base material shall be the same as the Wall Rock material (Part 15.2) or a low permeable granular material.
B. Base material shall be placed as shown on the construction drawing. Top of base shall be located to allow bottom wall units to be buried to proper depths as per wall heights and specifications.
C. Base material shall be installed on undisturbed native soils or suitable replacement fills compacted to a minimum of 95% Standard Proctor (ASTM D698).
D. Base shall be compacted at 95% Standard Proctor (ASTM D698) to provide a level hard surface on which to place the first course of blocks. The base shall be constructed to ensure proper wall embedment and the final elevation shown on the plans. Well-graded sand can be used to smooth the top 1/2 in. (13 mm) on the base material.
E. Base material shall be a 4 in. (100 mm) minimum depth for walls under 4 ft (1.2 m) and a 6 in. (150 mm) minimum depth for walls over 4 ft (1.2 m).
F. Base material should be installed to allow for a minimum of one buried block to be extended into the slope to prevent erosion.

3.4 Unit Installation for Complex Composite Structures

A. Install units in accordance with the manufacturer's instructions and recommendations for the specific concrete retaining wall unit, and as specified in Section 1, Part 3.4 Unit Installation.
B. Ensure that units are in full contact with base. Proper care shall be taken to develop straight lines and smooth curves on base course as per wall layout.
C. Fill all cores and cavities and a minimum of 12 in. (300 mm) behind the base course with wall rock. Use infill soils behind the wall rock and approved soils in front of the base course to firmly lock in place. Check again for level and alignment. Use a plate compactor to consolidate the area behind the base course. All excess material shall be swept from top of units.
D. Install additional courses of wall units. Position blocks to be offset from seams of blocks below. Perfect "running bond" is not essential, but a 3 in. (75 mm) minimum offset is recommended. Check each block for proper alignment and level.
E. Install each subsequent course in like manner. Repeat procedure to the extent of wall height.

3.5 Geogrid Installation for Complex Composite Structures

A. Install Allan Block wall to designated height of first geogrid layer. Backfill and compact the wall rock and infill soil in layers not to exceed 8 in. (200 mm) lifts behind wall to depth equal to designed grid length before grid is installed.
B. Cut geogrid to designed embedment length and place on top of the Allan Block units to back edge of the raised front lip or within 1 in. (25 mm) of the concrete retaining wall face when using AB Fieldstone. Extend away from wall approximately 3% above horizontal on compacted infill soils.
C. Lay geogrid at the proper elevation and orientations shown on the construction drawings or as directed by the wall design engineer.
D. Correct orientation of the geogrid shall be verified by the contractor and on-site soils engineer. Strength direction is typically perpendicular to wall face.
E. Follow manufacturer's guidelines for overlap requirements. In curves and corners, layout shall be as specified in Design Detail 9-12: Using Grid with Corners and Curves, see page 14 of the AB Spec Book.
F. Place next course of Allan Block on top of grid and fill block cores with wall rock to lock in place. Remove slack and folds in grid and stake to hold in place.
G. Adjacent sheets of geogrid shall be butted against each other at the wall face to achieve 100% coverage.
H. Geogrid lengths shall be continuous. Splicing parallel to the wall face is not allowed.

3.6 Fill Placement for Complex Composite Structures

A. Infill soil shall be placed in lifts and compacted as specified under Section 1, Part 3.4 Unit Installation.
B. Infill soil shall be placed, spread and compacted in such a manner that minimizes the development of slack or movement of the geogrid.
C. Only hand-operated compaction equipment shall be allowed within 3 ft. (0.9 m) behind the wall. This area shall be defined as the consolidation zone. Compaction in this zone shall begin by running the plate compactor directly on the block and then compacting in parallel paths from the wall face back, until the entire consolidation zone has been compacted. A minimum of two passes of the plate compactor are required with maximum lifts of 8 in. (200 mm). Section 1, Part 3.4 Unit Installation.
D. When fill is placed and compaction cannot be defined in terms of Standard Proctor Density, then compaction shall be performed using ordinary compaction process and compacted so that no deformation is observed from the compaction equipment or to the satisfaction of the engineer of record or the site soils engineer.
E. Tracked construction equipment shall not be operated directly on the geogrid. A minimum fill thickness of 6 in. (150 mm) 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.
F. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds, less than 10 mph (16 Km/h). Sudden braking and sharp turning shall be avoided.
G. The infill soil shall be compacted to achieve 95% Standard Proctor (ASTM D698). Soil tests of the infill soil shall be submitted to the on-site soils engineer for review and approval prior to the placement of any material. The contractor is responsible for achieving the specified compaction requirements. The on-site soils engineer may direct the contractor to remove, correct or amend any soil found not in compliance with these written specifications.
H. An independent testing firm should be hired by the owner to provide services.
I. Independent firm to keep inspection log and provide written reports at predetermined intervals to the owner.

J. Testing frequency should be set to establish a proper compaction protocol to consistently achieve the minimum compaction requirements set by the design requirements. If full time inspection and testing at 8 in. (20 cm) lifts is not provided, then the following testing frequency should be followed:
    a. One test for every 8 in. (20 cm) of vertical fill placed and compacted, for every 25 lineal feet (7.6 m) of retaining wall length, starting on the first course of block.
    b. Vary compaction test locations to cover the entire area of reinforced zone; including the area compacted by the hand-operated compaction equipment.
    c. Once protocol is deemed acceptable, testing can be conducted randomly at locations and frequencies determined by the on-site soils engineer.
K. Slopes above the wall must be compacted and checked in a similar manner.

3.7 Unit Installation for Complex Composite Structure using No-Fines Concrete

A. Install units in accordance with the manufacturer's instructions and recommendations for the specific concrete retaining wall unit, and as specified herein.
B. Ensure that units are in full contact with base. Proper care shall be taken to develop straight lines and smooth curves on base course as per wall layout.
C. Install next course of wall units on top of base course. Position blocks to be offset from seams of blocks below. Perfect "running bond" is not essential, but a 3 in. (75 mm) minimum offset is recommended. Check each block for proper alignment and level.
D. Fill the voids of the block and backfill to the designated depth with No-fines concrete backfill. The vertical height of a pour should not exceed 16 in. (400 mm) or two courses of block.
E. The No-fines concrete backfill shall be placed and compacted as soon as possible after mixing as it tends to dry out rapidly because of its open structure. Compaction is achieved by rodding the concrete in and around the blocks; vibration is typically not required, and heavy tamping is not necessary.
F. Brush the top of the blocks to remove any excess material. It is recommended that this be done before allowing the concrete to harden.
G. Install additional courses of wall units. Position blocks to be offset from seams of blocks below. Perfect "running bond" is not essential, but a 3 in. (75 mm) minimum offset is recommended. Check each block for proper alignment and level.
H. Additional No-fines concrete backfill pours can be made as soon as the additional block courses are placed.
I. Install each subsequent course in like manner. Repeat procedure to the extent of wall height.
J. Allow 2-3 hours for the No-fines concrete to cure after a maximum of 4 ft. (1.2 m) of wall height.

3.8 Additional Construction Notes

A. Water management is of extreme concern. Steps must be taken to ensure that drainpipes are properly installed and vented to daylight and a grading plan has been developed that routes water away from the retaining wall location.
B. Drainpipes shall be extended to provide a path for water to be channeled away from the wall structure. Pipes at exit locations shall be marked to facilitate identification of where water is draining from.
C. Site water management is required both during construction of the wall and after completion of construction.

Consult the Allan Block Engineering Department to ensure you have the latest specifications or for more details at 800-899-5309. Specifications are subject to change without notice; this was last updated on 4/26/2021.