25 Delaware
25 Delaware Ave

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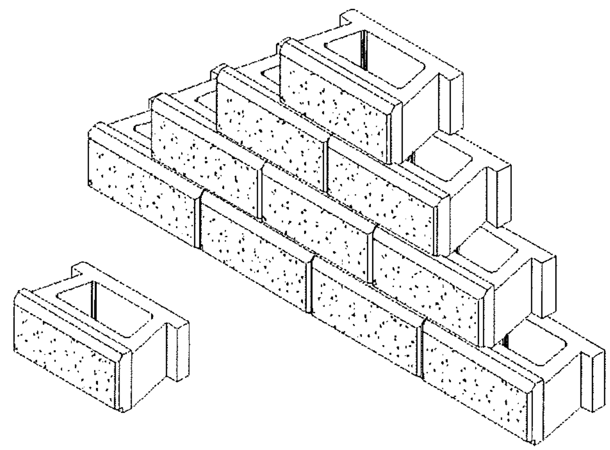

AB Classic

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License #: Date:

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Disclaimer

Allan Block provides this software as a service for its clients. The sole purpose of this software is to assist engineers in the design of mechanically stabilized retaining walls. The software uses evaluation techniques and engineering principles found in the Allan Block Engineering Manual. (Refer to R0904 and supporting references.) It is the responsibility of the engineer of record to determine the propriety and accuracy of input parameters and to review and verify the correctness of the results. ALLAN BLOCK CORPORATION, ITS LICENSEES OR AGENTS DO NOT ASSUME ANY LIABILITY OR RESPONSIBILITY FOR DAMAGES WHICH MAY RESULT FROM THE USE OR MISUSE OF THIS SOFTWARE.

This software only considers internal, external and internal compound stability (ICS) of the reinforced composite mass. The internal compound stability calculations are limited to an evaluation zone above the base material and back no further than 2 * H or He + L, whichever is greater. This program DOES NOT address global stability, defined as soil stability below the base material and beyond the limits for internal compound stability. Global Stability should be evaluated to determine if the overall site is stable. It is the responsibility of the owner to ensure the global stability is analyzed. The engineer of record must evaluate the project site for proper water management and all potential modes of failure within the segmental retaining wall evaluation zone. The geotechnical engineering firm contracted by the owner should provide a full global stability opinion of the site including the effects on the segmental retaining wall.

AB Walls contains DEFAULT values for all data inputs that the user MUST change or verify as appropriate for the project conditions being analyzed. These DEFAULT values do NOT ensure a conservative design for any site condition. The final design must provide for proper wall drainage to prevent the buildup of hydrostatic pressures over the service life of the structure. In the event additional water is introduced into the general wall area, either above or below grade, any designs from this software would be invalid unless otherwise noted by the engineer of record. It is also recommended that an independent assessment of the foundation soil for settlement potential and wall deflections for the proposed structure be performed. Changes in the subsoil conditions are not included in this software. These additional potential failure modes should be evaluated by the engineer of record prior to initiating wall construction and may require site inspection by the on-site soils engineer. All installations must conform to the Allan Block Spec Book. (Refer to R0901).

MathCAD files for hand calculations to support the software's consideration of internal, external and internal compound stability of the reinforced composite mass are provided in the AB Resources Drop Down Menu. These files are to be configured so that the engineer of record can evaluate the output of the software. Individual equations may be altered at the discretion of the engineer of record.

The Limit Equilibrium Method (LEM) of design used for the internal stability calculations in the terraced designs sections was developed by Professor Dov Leshchinsky over years of research and has been adopted by FHWA, AASHTO, and the NCMA as a viable design method for internal design calculations of geogrid reinforced earth wall structures and allows the evaluations of complex structures such as terraced walls. Like ICS, the LEM design envelope is limited to the same evaluation zone and neither replace the need for a full global stability analysis of the structure.

Specification Guidelines: Allan Block Modular Retaining Wall Systems

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 1: ALLAN BLOCK MODULAR RETAINING WALL SYSTEMS

PART 1: GENERAL

1.1 Scope
Work includes furnishing and installing modular concrete block retaining wall units to the lines and grades designated on the construction drawings and as specified herein.

1.2 Applicable Sections of Related Work
Section 2: Geogrid Wall Reinforcement

1.3 Reference Standards

- A. ASTM C1372 Standard Specification for Segmental Retaining Wall Units.
- B. ASTM C1262 Evaluating the Freeze thaw Durability of Manufactured CMUs and Related concrete Units
- C. ASTM D698 Moisture Density Relationship for Soils, Standard Method
- D. ASTM D422 Gradation of Soils
- E. ASTM C140 Sample and Testing concrete Masonry Units

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).

1.5 Contractor Requirements
Contractors shall be trained and certified by local manufacturer or equivalent accredited organization.

- A. Allan Block and NCMA have certification programs that are accredited. Identify when advanced certification levels are appropriate based on complexity and criticality of project application.
- B. Contractors shall provide a list of projects they have completed.

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 3000 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/ft3 (160 kg/m^3) for southern climates.

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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). Hollow cores to be filled with wall rock and compacted by using plate compactor on top of wall units (see Section 3.4). Unit weight of wall rock may be less than 100% depending on compaction levels.

E. Exterior face shall be textured. Color as specified by owner.
F. Freeze Thaw Durability: Like all concrete products, dry-cast concrete SRW units are susceptible to freeze-thaw degradation with exposure to de-icing salts and cold temperature. This is a concern in northern tier states or countries that use deicing salts. Based on good performance experience by several agencies, ASTM C1372 or equivalent governing standard or public authority, Standard Specification for Segmental Retaining Wall Units should be used as a model, except that, to increase durability, the compressive strength for the units should be increased to a minimum of 4,000 - 5,800 psi (28 - 40 MPa) unless local requirements dictate higher levels. Also, maximum water absorption should be reduced and requirements for freeze-thaw testing increased.

a. Require a current passing ASTM C 1262 or equivalent governing standard or public aurthority, test report from material supplier in northern or cold weather climates.

b. See the Allan Block Best Practices for SRW Design document for detailed information on freeze thaw durability testing criteria and regional temperature and exposure severity figures and tables to define the appropriate zone and requirements for the project.

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 Infill Soil

A. Infill material shall be site excavated soils when approved by the on-site soils engineer unless otherwise specified in the drawings. Unsuitable soils for backfill (heavy clays or organic soils) shall not be used in the reinforced soil mass. Fine grained cohesive soils with friction angle (φ) less than 31 degrees with a PI range between 6 and 20 and LL from 30 to 40, may be used in wall construction, but additional backfilling, compaction and water management efforts are required. Poorly graded sands, expansive clays and/or soils with a plasticity index (PI) greater than 20 or a liquid limit (LL) greater than 40 should not be used in wall construction.

B. The infill soil used must meet or exceed the designed friction angle and description noted on the design cross sections, and must be free of debris and consist of one of the following inorganic USCS soil types: GP, GW, SW, SP, GP-GM or SP-SM meeting the following gradation as determined in accordance with ASTM D422.

Sieve Size	Percent Passing
1 inch (25 mm)	100 - 75
No. 4 (4.75 mm)	100 - 20
No. 40 (0.425 mm)	0 - 60
No. 200 (0.075 mm)	0 - 35

C. Where additional fill is required, contractor shall submit sample and specifications to the wall design engineer or the onsite soils engineer for approval and the approving engineer must certify that the soils proposed for use has properties meeting or exceeding original design standards.

PART 3: WALL CONSTRUCTION

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3.1 Excavation

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

A. Foundation soil shall be defined as any soils located beneath a wall.
B. Foundation soil shall be excavated as dimensioned on the plans and compacted to a minimum of 95% of Standard Proctor (ASTM D698) prior to placement of the base material.
C. Foundation soil shall be examined by the on-site soils engineer to ensure that the actual foundation soil strength meets or exceeds assumed design strength. Soil not meeting the required strength shall be removed and replaced with acceptable material.

3.3 Base

A. The base material shall be the same as the Wall Rock material (Section 2.2) 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).

3.4 Unit Installation

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. 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 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. Fill all cavities in and around wall units and to a minimum of 12 in. (300 mm) depth behind block with wall rock. Block, wall rock and infill soil placed in uniform lifts not exceeding 8 in. (200 mm). Compaction requirements for all soils in areas in, around and behind the reinforced mass shall be compacted to 95% of maximum Standard Proctor dry density (ASTM D698) with a moisture content control of +1% to -3% of optimum.

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E. For taller wall applications, structural fill should be specified for a minimum bottom 1/3 to 1/2 of the reinforced fill. If structural fill is not utilized in the reinforced mass, the depth of wall rock behind the block should be increased. See the Best Practices for SRW Design document for more information.

F. The consolidation zone shall be defined as 3 ft (0.9 m) behind the wall. Compaction within the consolidation zone shall be accomplished by using a hand operated plate compactor and shall begin by running the plate compactor directly on the block and then compacting in parallel paths from the wall face 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). Expansive or fine-grained soils may require additional compaction passes and/or specific compaction equipment such as a sheepsfoot roller. Maximum lifts of 4 inches (100 mm) may be required to achieve adequate compaction within the consolidation zone. Employ methods using lightweight compaction equipment that will not disrupt the stability or batter of the wall. Final compaction requirements in the consolidation zone shall be established by the engineer of record.

G. Install each subsequent course in like manner. Repeat procedure to the extent of wall height.
Individual course height may vary due to allowable block manufacturing tolerances per ATSM C1372. Contractor must verify wall height, if noted as being critical, prior to completion of construction to ensure the elevation of the top of the wall or the controlling elevation matches desired plan elevation, if noted as critical. Contractor must follow this method for single walls or walls that branch off into a terraced orientation.

H. As with any construction work, some deviation from construction drawing alignments will occur. Variability in construction of SRWs is approximately equal to that of cast-in-place concrete retaining walls. As opposed to cast-in-place concrete walls, alignment of SRWs can be simply corrected or modified during construction. Based upon examination of numerous completed SRWs, the following recommended minimum tolerances can be achieved with good construction techniques.

Vertical Control - +-1.25 in. (32 mm) max. over 10 ft (3 m) distance
Horizontal Location Control - straight lines +-1.25 in. (32 mm) over a 10 ft (3 m) distance.
Rotation - from established plan wall batter: 2.0 Deg.

3.5 Additional Construction Notes

A. When one wall branches into two terraced walls, it is important to note that the soil behind the lower wall is also the foundation soil beneath the upper wall. This soil shall be compacted to a minimum of 95% of Standard Proctor (ASTM D698) prior to placement of the base material. Achieving proper compaction in the soil beneath an upper terrace prevents settlement and deformation of the upper wall. One way is to replace the soil with wall rock and compact in 8 in. (200 mm) lifts. When using on-site soils, compact in maximum lifts of 4 in. (100 mm) or as required to achieve specified compaction.

B. Vertical filter fabric use is not suggested for use with cohesive soils. Clogging of such fabric creates unacceptable hydrostatic pressures in soil reinforced structures. When filtration is deemed necessary in cohesive soils, use a three dimensional filtration system of clean sand or filtration aggregate. Vertical filter fabric may be used to separate the wall rock zone from fine grained, sandy infill soils if the design engineer deems it necessary based on potential water migration from above or below grade, through the reinforced zone into the wall rock on the project. Horizontal filter fabric should be placed above the wall rock column to prevent soils from migrating into the wall rock column.

C. Embankment protection fabric is used to stabilize rip rap and foundation soils in water applications and to separate infill materials from the retained soils. This fabric should permit the passage of fines to preclude clogging of the material. Embankment protection fabric shall be a high strength polypropylene monofilament material designed to meet or exceed typical Corps of Engineers plastic filter fabric specifications (CW-02215); stabilized against ultraviolet (UV) degradation and typically exceeding the values in Table 1, page 7 of the AB Spec Book.

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D. Water management is of extreme concern during and after construction. Steps must be taken to ensure that drain pipes are properly installed and vented to daylight or connected to an underground drainage system and a grading plan has been developed that routes water away from the retaining wall location. Site water management is required both during construction of the wall and after completion of construction.

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Specification Guidelines: Geogrid Reinforcement Systems

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 2

PART 1: GENERAL

1.1 Scope
Work includes furnishings and installing geogrid reinforcement, wall block, and backfill to the lines and grades designated on the construction drawings and as specified herein.

1.2 Applicable Sections of Related Work
Section 1: Allan Block Modular Retaining Wall Systems.

1.3 Reference Standards
See specific geogrid manufacturer's reference standards. Additional Standards:

A. ASTM D4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method
B. ASTM D5262 - Test Method for Evaluating the Unconfined Creep Behavior of Geogrids
C. ASTM D6638 Grid Connection Strength (SRW-U1)
D. ASTM D6916 SRW Block Shear Strength (SRW-U2)
E. GRI-GG4 - Grid Long Term Allowable Design Strength (LTADS)
F. ASTM D6706 - Grid Pullout of Soil

1.4 Delivery, Storage, and Handling

A. Contractor shall check the geogrid upon delivery to assure that the proper material has been received.
B. Geogrid shall be stored above -10 F (-23 C).
C. Contractor shall prevent excessive mud, cementitious material, or other foreign materials from coming in contact with the geogrid material.

PART 2: MATERIALS

2.1 Definitions

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. Concrete retaining wall units are as detailed on the drawings and shall be Allan Block Retaining Wall Units.

C. Drainage material is free draining granular material as defined in Section 1, 2.2 Wall Rock.
D. Infill soil is the soil used as fill for the reinforced soil mass.
E. Foundation soil is the in-situ soil.

2.2 Products

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Geogrid shall be the type as shown on the drawings having the property requirements as described within the manufacturer's specifications.

2.3 Acceptable Manufacturers

A manufacturer's product shall be approved by the wall design engineer.

PART 3: WALL CONSTRUCTION

3.1 Foundation Soil Preparation

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.

3.2 Wall Construction

Wall construction shall be as specified under Section 1, Part 3, Wall Construction.

3.3 Geogrid Installation

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 Allan Block 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 percent coverage.

H. Geogrid lengths shall be continuous. Splicing parallel to the wall face is not allowed.

3.4 Fill Placement

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.

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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 to the wall face 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 F, Page 3 of the AB Spec Book.

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 inch (20 cm) lifts is not provided, then the following testing frequency should be followed:

a. One test for every 8 inches (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.

3.5 Special Considerations
A. Geogrid can be interrupted by periodic penetration of a column, pier or footing structure.
B. Allan Block walls will accept vertical and horizontal reinforcing with rebar and grout.
C. If site conditions will not allow geogrid embedment length, consider the following alternatives:
Masonry Reinforced Walls - Soil Nailing -Increased Wall Batter - Earth Anchors - Double Allan Block Wall - Rock Bolts -No-Fines Concrete

See Design Details Page 16 and 17 of the AB Spec Book.
D. Allan Block may be used in a wide variety of water applications as indicated in Section 3, Part 1.8.

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Specification Guidelines: Water Management

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SECTION 3

PART 1: GENERAL DRAINAGE

1.1 Surface Drainage
Rainfall or other water sources such as irrigation activities collected by the ground surface atop the retaining wall can be defined as surface water. Retaining wall design shall take into consideration the management of this water.

A. At the end of each day's construction and at final completion, grade the backfill to avoid water accumulation behind the wall or in the reinforced zone.

B. Surface water must not be allowed to pond or be trapped in the area above the wall or at the toe of the wall.

C. Existing slopes adjacent to retaining wall or slopes created during the grading process shall include drainage details so that surface water will not be allowed to drain over the top of the slope face and/or wall. This may require a combination of berms and surface drainage ditches.

D. Irrigation activities at the site shall be done in a controlled and reasonable manner. If an irrigation system is employed, the design engineer or irrigation manufacturer shall provide details and specification for required equipment to ensure against over irrigation which could damage the structural integrity of the retaining wall system.

E. Surface water that cannot be diverted from the wall must be collected with surface drainage swales and drained laterally in order to disperse the water around the wall structure. Construction of a typical swale system shall be in accordance with Design Detail 5: Swales, of the AB Spec Book.

1.2 Grading
The shaping and re-contouring of land in order to prepare it for site development is grading. Site grading shall be designed to route water around the walls.

A. Establish final grade with a positive gradient away from the wall structure. Concentrations of surface water runoff shall be managed by providing necessary structures, such as paved ditches, drainage swales, catch basins, etc.

B. Grading designs must divert sources of concentrated surface flow, such as parking lots, away from the wall.

1.3 Drainage System
The internal drainage systems of the retaining wall can be described as the means of eliminating the buildup of incidental water which infiltrates the soils behind the wall. Drainage system design will be a function of the water conditions on the site. Possible drainage facilities include Toe and Heel drainage collection pipes and blanket or chimney rock drains or others. Design engineer shall determine the required drainage facilities to completely drain the retaining wall structure for each particular site condition.

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A. All walls will be constructed with a minimum of 12 in. (300 mm) of wall rock directly behind the wall facing. The material shall meet or exceed the specification for wall rock outlined in Section 1, 2.2 Wall Rock.
B. The drainage collection pipe, drain pipe, shall be a 4 in. (100 mm) perforated or slotted PVC, or corrugated HDPE pipe as approved by engineer of record.

C. All walls will be constructed with a 4 in. (100 mm) diameter drain pipe placed at the lowest possible elevation within the 12 in. (300 mm) of wall rock. This drain pipe is referred to as a toe drain, Section 3, 1.4 Toe Drain.

D. Geogrid Reinforced Walls shall be constructed with an additional 4 in. (100 mm) drain pipe at the back bottom of the reinforced soil mass. This drain pipe is referred to as a heel drain, Section 3, 1.5 Heel Drain.

1.4 Toe Drain

A toe drain pipe should be located at the back of the wall rock behind the wall as close to the bottom of the wall as allowed while still maintaining a positive gradient for drainage to daylight, or a storm water management system. Toe drains are installed for incidental water management not as a primary drainage system.

A. For site configurations with bottoms of the base on a level plane it is recommended that a minimum one percent gradient be maintained on the placement of the pipe with outlets on 50 ft (15 m) centers, or 100 ft (30 m) centers if pipe is crowned between the outlets. This would provide for a maximum height above the bottom of the base in a flat configuration of no more than 6 in. (150 mm).

B. For rigid drain pipes with drain holes the pipes should be positioned with the holes located down. Allan Block does not require that toe drain pipes be wrapped when installed into base rock complying with the specified wall rock material.

C. Pipes shall be routed to storm drains where appropriate or through or under the wall at low points when the job site grading and site layout allows for routing. Appropriate details shall be included to prevent pipes from being crushed, plugged, or infested with rodents.

D. On sites where the natural drop in grade exceeds the one percent minimum, drain pipes outlets shall be on 100 foot (30 m) centers maximum. This will provide outlets in the event that excessive water flow exceeds the capacity of pipe over long stretches.

E. When the drain pipe must be raised to accommodate outlets through the wall face, refer to the Design Detail 4: Alternate Drain, Page 13 of the AB Spec Book

1.5 Heel Drain

The purpose of the heel drain is to pick up any water that migrates from behind the retaining wall structure at the cut and route the water away from the reinforced mass during the construction process and for incidental water for the life of the structure.

A. The piping used at the back of the reinforced mass shall have a one percent minimum gradient over the length, but it is not critical for it to be positioned at the very bottom of the cut. The heel drain should be vented at 100ft (30m) intervals along the entire length of the wall and should not be tied into the toe drain.

B. The pipe may be a rigid pipe with holes at the bottom with an integral sock encasing the pipe or a corrugated perforated flexible pipe with a sock to filter out fines when required based on soil conditions. For infill soils with a high percentage of sand and/or gravel the heel drain pipe does not need to be surrounded by wall rock. When working with soils containing fine grained cohesive soils having a PI of greater than 6 and LL of 30 or greater, 1 cubic foot (0.03 cubic meter) of drainage rock is required around the pipe for each 1 ft. (30 cm) of pipe length.

1.6 Ground Water

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Ground water can be defined as water that occurs within the soil. It may be present because of surface infiltration or water table fluctuation. Ground water movement must not be allowed to come in contact with the retaining wall.

A. If water is encountered in the area of the wall during excavation or construction, a drainage system (chimney, composite or blanket) must be installed as directed by the wall design engineer.

B. Standard retaining wall designs do not include hydrostatic forces associated with the presence of ground water. If adequate drainage is not provided the retaining wall design must consider the presence of the water.

C. When non-free draining soils (soils with friction angles less than 30 degrees) are used in the reinforced zone, the incorporation of a chimney and blanket drain should be added to minimize the water penetration into the reinforced mass. Refer to Design Detail 6: Chimney and Blanket Drain, Page 13 of the AB Spec Book.

a. Drain material to be consistent with wall rock material. For more information on wall rock material see Specification Guidelines: Allan Block Modular Retaining Wall Systems, section 2.1.

b. Manufactured chimney and blanket drains to be approved by the geotechnical and/or the local engineer of record prior to use.

1.7 Concentrated Water Sources

All collection devices such as roof downspouts, storm sewers, and curb gutters are concentrated water sources. They must be designed to accommodate maximum flow rates and to vent outside of the wall area.

A. All roof downspouts of nearby structures shall be sized with adequate capacity to carry storm water from the roof away from the wall area. They shall be connected to a drainage system in closed pipe and routed around the retaining wall area.

B. Site layout must take into account locations of retaining wall structures and all site drainage paths. Drainage paths should always be away from retaining wall structures.

C. Storm sewers and catch basins shall be located away from retaining wall structures and designed so as not to introduce any incidental water into the reinforced soil mass.

D. A path to route storm sewer overflow must be incorporated into the site layout to direct water away from the retaining wall structure.

1.8 Water Application

Retaining walls constructed in conditions that allow standing or moving water to come in contact with the wall face are considered water applications. These walls require specific design and construction steps to ensure performance. Refer to Design Detail 7 and 8: Water Applications, Page 13 of the AB Spec Book.

A. The wall rock should be placed to the limits of the geogrid lengths up to a height equal to 12 inches (30 cm) higher than the determined high water mark. If the high water mark is unknown, the entire infill zone should be constructed with wall rock.

B. The drain pipe should be raised to the low water elevation to aid in the evacuation of water from the reinforced mass as water level fluctuates.

C. Embankment protection fabric should be used under the infill mass and up the back of the infill mass to a height of 12 inches (30 cm) higher than the determined high water mark.

i.) Embankment protection fabric is used to stabilize rip rap and foundation soils in water applications and to separate infill materials from the retained soils. This fabric should permit the passage of fines to preclude clogging of the material. Embankment protection fabric shall be a high strength polypropylene monofilament material designed to meet or exceed typical NTPEP specifications; stabilized against ultraviolet (UV) degradation and typically meets or exceeds the values in Table 1.

Table 1: Embankment Protection Fabric Specifications

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Mechanical Property	Determination Method
Tensile Strength = 225 lbs/ft (39.4 kN/m)	ASTM D-4595
Puncture Strength = 950 lbs (4228 N)	ASTM D-6241
Apparent Opening Size (AOS) = U.S Sieve #70 (0.212 mm)	ASTM D-4751
Trapezoidal Tear = 100 lbs. (445 N)	ASTM D-4533
Percent Open Area = 4%	COE-02215
Permeability = 0.01 cm/sec	ASTM D-4491

D. For walls having moving water or wave action, natural or manufactured rip-rap in front of the wall to protect the toe of the wall from scour effects is recommended.

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Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

General Notes

Construction Notes

1 - Soil loading considered in this design and calculations are based on the following parameters:

	Friction Angle	Cohesion	Unit WT	Soil Type
Infill Soil	0 - 30	0	0 - 120	Well compacted silty, sandy clay
Retained Soil	0 - 30	0	0 - 120	Well compacted silty, sandy clay
Foundation Soil	30	0	120	Well compacted silty, sandy clay

2 - Actual soil parameters must meet or exceed these listed conditions to be used in wall construction. In general, granular soils (friction angle greater than or equal to 32 degrees) are recommended as infill soil. Fine grained cohesive soils (friction angle less than 32 degrees) with low plasticity (PI less than 20) may be used in wall construction, but additional backfilling and compaction efforts are required. Allan Block Corporation has not verified these design conditions, and if required the soil parameters shall be confirmed by the Site Geotechnical Engineer or others prior to wall construction.

3 - Substitution of Infill Soils are strictly prohibited unless approved by the engineer of record.
4 - In this analysis, the effective friction angle without the addition of cohesion is used to determine the design strength of the soil when calculating lateral forces. At the discretion of the engineer of record, cohesion may be used when calculating the ultimate bearing capacity even though it is typically ignored.

5 - Global stability and seismic loading are not considered in this design.
6 - Hydrostatic loading is not considered in this analysis. Sufficient drainage must be provided such that hydrostatic loading (pore pressure) does not develop in the reinforced zone.
7 - Analysis assumes fill placement in 8 inch (200 mm) lifts compacted to 95% Standard Proctor Density. For any wall over 10 feet (3 meters), with a surcharge or contains cohesive soils, compaction test frequency and location shall be determined by the engineer of record or as otherwise specified.

8 - All fill placed above walls shall be placed and compacted in accordance with the requirements for all other reinforced material.

9 - Retaining wall units and installation shall conform to the Allan Block Modular Retaining Wall Systems Specification Guidelines, Geogrid Reinforcement Systems Specification Guidelines, and Water Management Specification Guidelines as published in the AB Spec Book and the AB Engineering Manual.

10 - Retaining walls must be installed and constructed according to the contract drawings. The retaining wall plan view is for wall identification only.

11 - Geogrid spacing is determined by structural cross-section design requirements. To insure proper geogrid placement, contractor must review both elevation view and cross sections prior to wall construction.
12 - Suggested Quality Assurance Requirements:
A qualified engineer or technician shall supervise the wall construction to verify field and site soil conditions. In the event that the Site Geotechnical Engineer does not perform this work, a qualified Geotechnical Engineer/Technician shall be consulted to assure the Allan Block Wall is constructed with proper soil parameters.

Surface Drainage Notes

1 - Rainfall and other water sources such as irrigation activities can be defined as surface water. The retaining wall design shall take into consideration the management of this water.

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Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

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2 - Site grading shall be designed to route surface water around and away from the wall.
3 - The internal drainage system of the retaining wall is designed to remove incidental water that infiltrates into the soil behind the wall. Adequate storm water drainage systems are required to completely drain the area around the retaining wall structure.

4 - Drain piping, toe drain, should be located at the back of the rock drain field behind the wall as close to the bottom of the wall as allowed while still maintaining a positive gradient for drainage to daylight, or to a storm water management system.

5 - A heel drain may be required at back of the cut to route water away from the reinforced soil mass during the construction process.

6 - Ground water can be present within the soil due to surface infiltration or water table fluctuation. If ground water is encountered during construction, an adequate drainage system must be installed or the wall design must consider the presence of water within the soil mass.

7 - All water collection devices such as roof downspouts, storm sewers, and curb gutters must be designed to accommodate maximum flow rates and outlet outside the retaining wall area.
8 - Retaining walls in conditions that allow standing water to overlap the wall face are considered water applications. These walls require specific design and construction steps to ensure performance.

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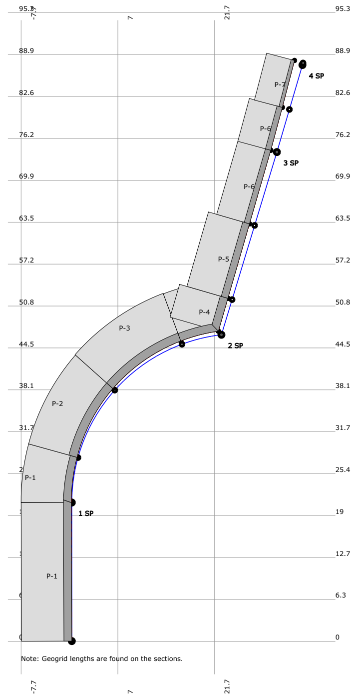
Signature:

Engineer:

License #: Date:



Panel Key # - Max Grid Length

Plan View

Note: For specific panel section information, see individual panel sections.

Station	0	1	2	3	4
x	0	0	22.72	31.14	35.02
y	0	21.01	46.45	74.15	87.35
Radius	0	25.64	0	0	0
Distance	0	21.01	37.32	28.95	13.76
Total	0	21.01	58.33	87.28	101.04

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Signature:

Engineer:

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Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
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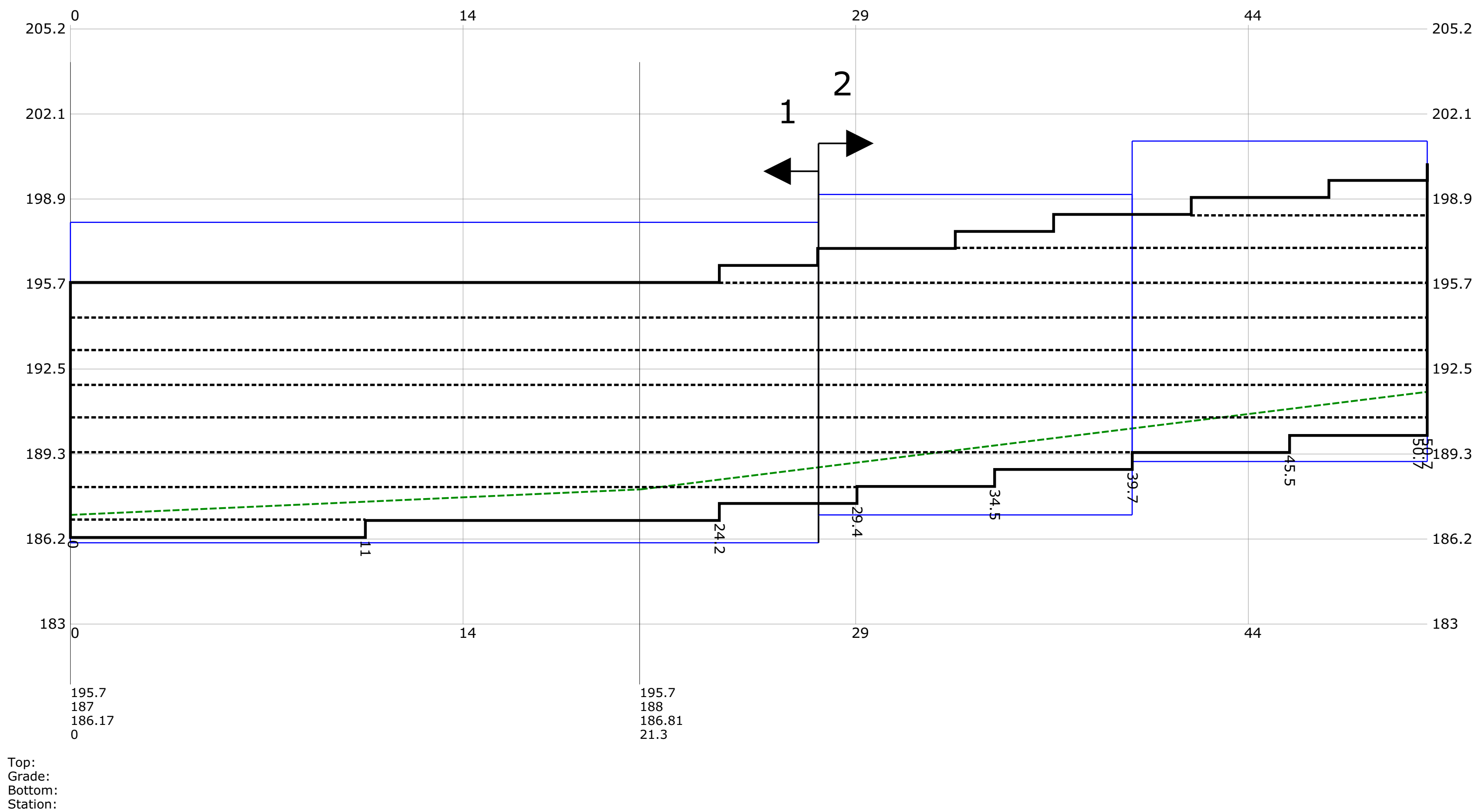

Elevation View

Section	1	2	3
Top	196.97	196.97	200.15
Grade	188.81	188.81	191.78
Bottom	187.44	187.44	190.62
Sta. Cut	27.91	27.91	52.15
Sta. End	27.91	39.66	52.15

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Signature:

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Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
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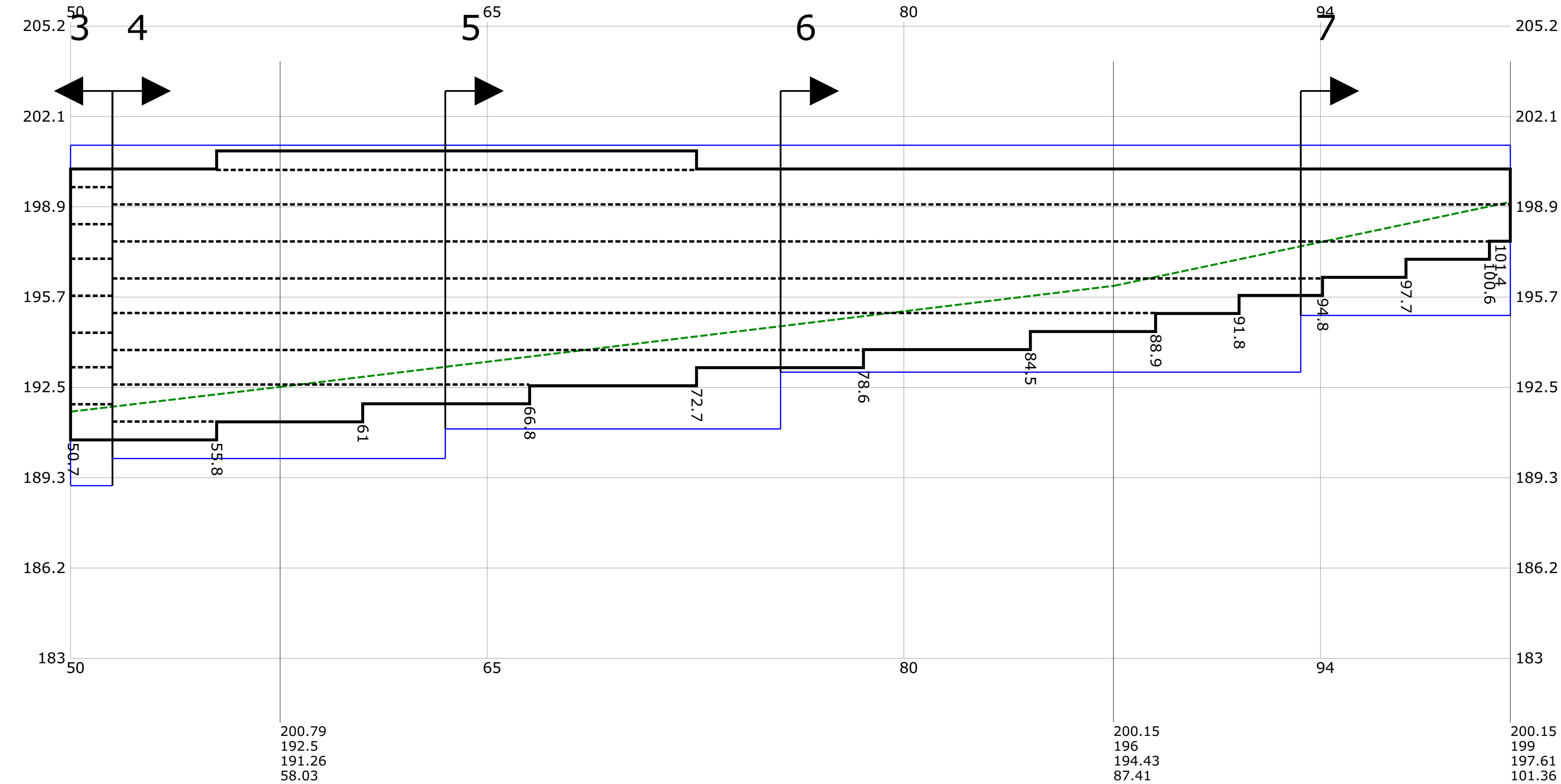

Elevation View

Section	3	4	5	6	7
Top	200.15	200.15	200.79	200.15	200.15
Grade	191.78	191.78	193.2	194.6	197.42
Bottom	190.62	190.62	191.89	193.16	195.7
Sta. Cut	52.15	52.15	63.9	75.65	94.02
Sta. End	52.15	63.9	75.65	94.02	101.36

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Signature:

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License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

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Wall Design Variables

AB Classic

Section Height 8.9 ft
Total Panel Height 10.17 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.45 >= 1.5

Actual Overturning
7.29 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 4.56
Sigma_ult - 5986.1 psf
Sigma_max - 1313.43 psf

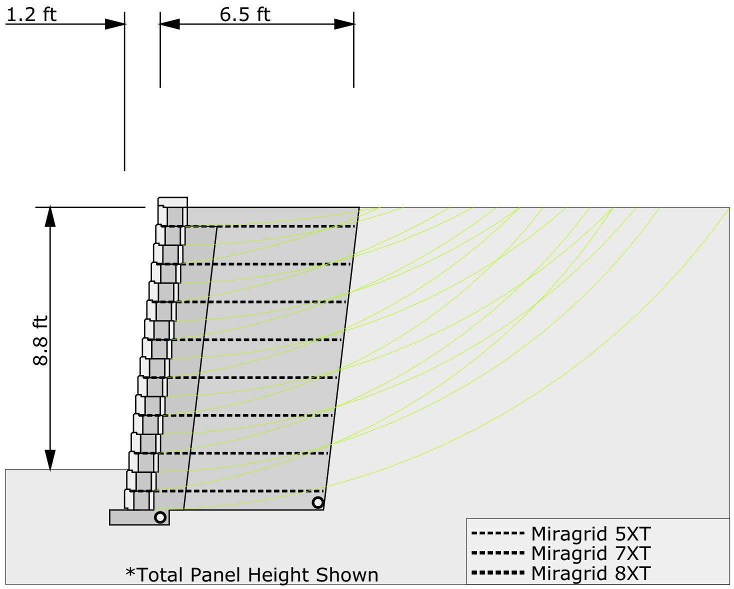
Internal Compound Stability

Factor of Safety 2.24
Course Number 0

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	9.53 ft	1 ft



AB Classic

Section 1 of 7

Section 0 ft - 27.9 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

8 x Miragrid 5XT @ 6.5 ft
Number Of Geogrid 8

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Signature:

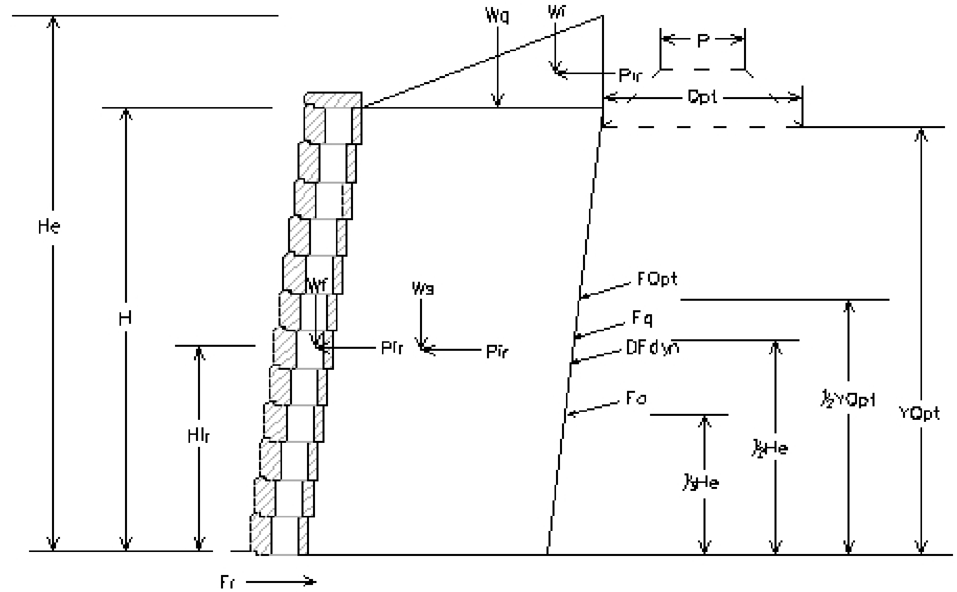
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 10.17 ft
H = Total Panel Height = 10.17 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 1290.97 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 6952.02 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 1562.81 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 1313.43 psf
Ultimate Bearing Capacity (s_ult) = 5986.1 psf
(Using Meyerhoff bearing capacity equation.)

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Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

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Internal Stability:
Section: 1
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
8A	15	6.5	22.95	0	0	0	22.95	22.95
7A	13	6.5	68.84	0	0	0	68.84	68.84
6A	11	6.5	114.73	0	0	0	114.73	114.73
5A	9	6.5	160.62	0	0	0	160.62	160.62
4A	7	6.5	206.52	0	0	0	206.52	206.52
3A	5	6.5	252.41	0	0	0	252.41	252.41
2A	3	6.5	298.3	0	0	0	298.3	298.3
1A	1	6.5	344.19	0	0	0	344.19	344.19

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Signature:

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Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
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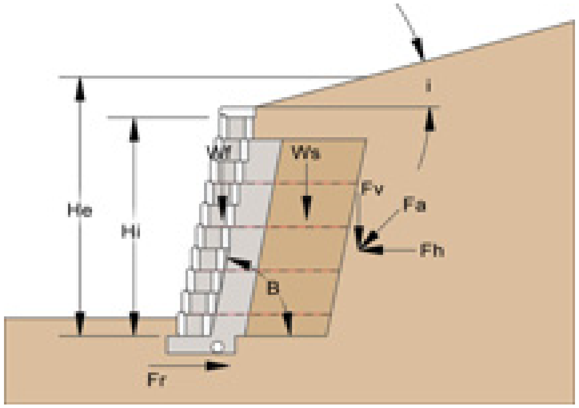
Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 10.17 ft
He = Effective Height = 10.17 ft
He_i = Effective Height = 10.17 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1290.97 plf
Wt = Total Weight = 8242.99 plf
Fa = Active Force = 1562.81 plf
Fav = Vertical Force = 534.51 plf
Fah = Horizontal Force = 1468.56 plf
Fr = Resistance Force = 5067.69 plf



Internal Design Calculations (Static)

Section: 1

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
8A	196.97	6.5	22.95	1789.33	116.97	87.05	6.91	1.28
7A	195.7	6.5	68.84	1789.33	38.99	30.97	6.51	3.85
6A	194.43	6.5	114.73	1789.33	23.39	19.75	6.68	6.41
5A	193.16	6.5	160.62	1789.33	16.71	14.94	8.25	8.98
4A	191.89	6.5	206.52	1789.33	13	12.27	9.82	11.54
3A	190.62	6.5	252.41	1789.33	10.63	10.57	11.39	14.11
2A	189.35	6.5	298.3	1789.33	9	9.39	12.95	16.67
1A	188.08	6.5	344.19	1789.33	7.8	8.53	14.52	19.24

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 6.5 ft

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Signature:

Engineer:

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Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
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Date: 03/11/21

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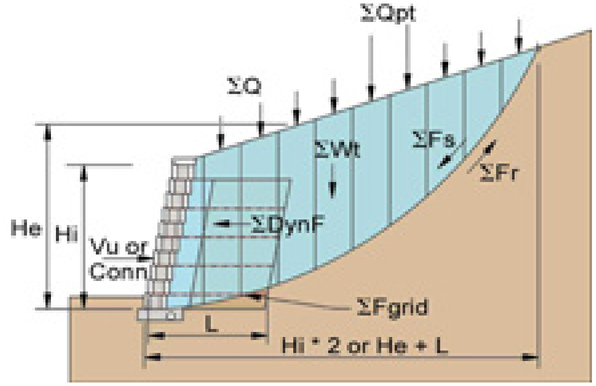
Internal Compound Stability Results:

The calculated values listed below are the worst case slip arcs for each block course. The highlighted is the worst case of all courses. To improve the internal compound stability safety factors the designer can lessen grid spacing, increase the infill soil strength requirements, increase geogrid strength or consider lengthening the geogrids. These calculations in no way represent a global stability analysis. If a global stability analysis is deemed necessary, a global stability program must be used.



Internal Compound Stability Results:
Section: 1

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
15	97.24	183.49	2146.51	23.96	0	0	316.82	0	0
14	31.21	422.03	2527.77	94.74	6.89	0	724.13	0	0
13	16.38	514.82	2831.8	205.11	13.21	0	871.66	0	0
12	11.06	1142.99	2904.4	370.64	52.96	0	1949.13	0	0
11	7.52	1202.45	2976.99	561.51	43.61	0	2036.11	0	0
10	6.41	2032.84	3049.59	814.01	135.55	0	3456.19	0	0
9	4.86	2077.43	3122.19	1080.44	52.79	0	3522.69	0	0
8	4.59	3131.32	3194.79	1417.36	178.79	0	5327.01	0	0
7	3.66	2953.67	3267.39	1728.53	106.91	0	5004.31	0	0
6	3.65	4434.57	3339.99	2176.21	177.41	0	7564.22	0	0
5	2.99	3999.74	3412.59	2499.52	67.04	0	6779.98	0	0
4	3.08	5651.55	3485.19	3052.52	267.64	0	9643.78	0	0
3	2.57	5255.6	3557.79	3458.96	85.98	0	8992.49	0	0
2	2.7	6988.48	3630.39	4054.59	340.04	0	11938.55	0	0
1	2.29	6462.01	3702.98	4500.2	120.83	0	11099.86	0	0
0	2.24	8998.68	2769.56	5294.73	87.7	0	15615.16	0	0

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

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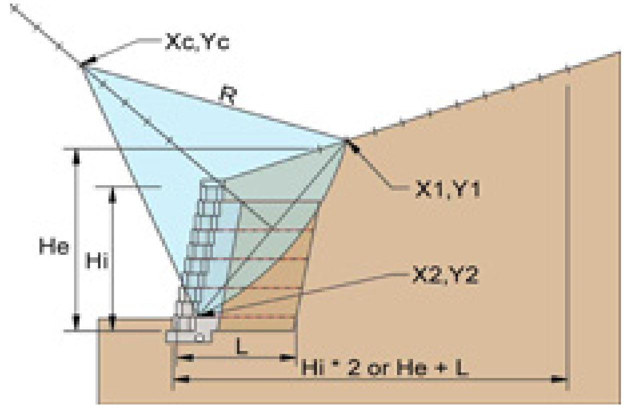
Internal Compound Stability Geometry:

The geometry information listed below represents the worst case slip arc entrance and exit points and the accociated acr radius and center of arc coordinates for each block course. The user could use these corrdinates in a drawing program such as AutoCAD to recreate the individual slip arcs.



Internal Compound Stability Geometry:

Section: 1

Course Number	Factor of Safety (Static)	Arc Center Xc (ft)	Arc Center Yc (ft)	Arc Radius R (ft)	Arc Exit X2 (ft)	Arc Exit Y2 (ft)	Arc Enter X1 (ft)	Arc Enter Y1 (ft)
15	97.24	1.85	45.54	36.01	2.03	9.53	8.59	10.17
14	31.21	1.85	31.78	22.88	1.96	8.9	9.37	10.17
13	16.38	-1.2	31.85	23.79	1.88	8.26	8.59	10.17
12	11.06	1.65	28.83	21.21	1.81	7.62	11.72	10.17
11	7.52	-1.74	31.98	25.23	1.73	6.99	10.94	10.17
10	6.41	1.46	26.59	20.24	1.66	6.35	13.29	10.17
9	4.86	-1.01	27.73	22.16	1.58	5.72	12.5	10.17
8	4.59	1.29	25.72	20.64	1.51	5.08	14.85	10.17
7	3.66	-0.74	24.1	19.78	1.43	4.45	13.29	10.17
6	3.65	1.12	25.41	21.6	1.36	3.81	16.42	10.17
5	2.99	-0.22	21.11	18	1.28	3.18	14.07	10.17
4	3.08	0.94	23.69	21.15	1.21	2.54	17.2	10.17
3	2.57	-1.04	22.57	20.78	1.13	1.91	15.64	10.17
2	2.7	0.77	22.37	21.11	1.06	1.27	17.98	10.17
1	2.29	-1.32	21.63	21.12	0.98	0.64	16.42	10.17
0	2.24	0.69	24.05	24.05	0.98	0	20.33	10.17

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Signature:

Engineer:

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Project Name: 25 Delaware
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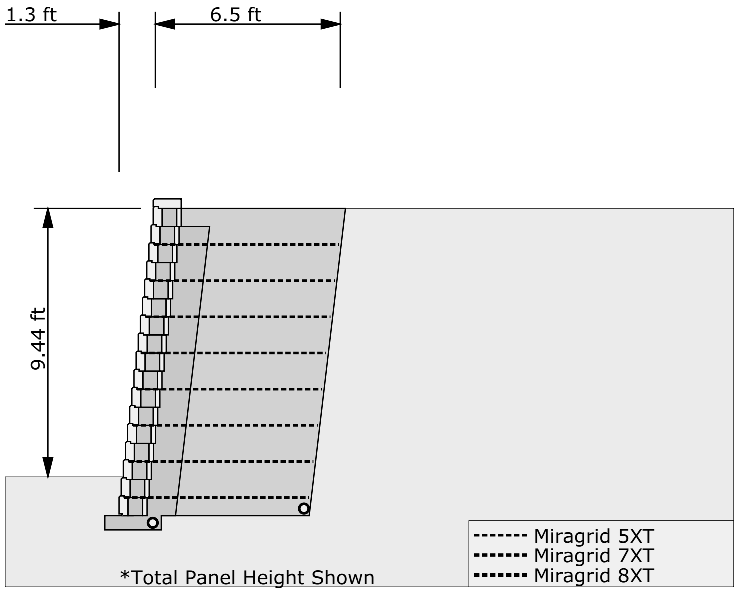


AB Classic

Section 2 of 7

Section 27.9 ft - 39.7 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

8 x Miragrid 5XT @ 6.5 ft
Number Of Geogrid 8

Wall Design Variables

AB Classic

Section Height 8.9 ft
Total Panel Height 10.8 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.26 >= 1.5

Actual Overturning
6.56 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 4.27
Sigma_ult - 5986.1 psf
Sigma_max - 1400.83 psf

Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	10.17 ft	1 ft

Allan Block Disclaimer:

Allan Block provides this software as a service for its clients. The sole purpose of this software is to assist engineers in the design of mechanically stabilized retaining walls. The software uses evaluation techniques and engineering principles found in the Allan Block Engineering Manual. (Refer to R0904 and supporting references.) It is the responsibility of the engineer of record to determine the propriety and accuracy of input parameters and to review and verify the correctness of the results. ALLAN BLOCK CORPORATION, ITS LICENSEES OR AGENTS DO NOT ASSUME ANY LIABILITY OR RESPONSIBILITY FOR DAMAGES WHICH MAY RESULT FROM THE USE OR MISUSE OF THIS SOFTWARE.

This software only considers internal, external and internal compound stability (ICS) of the reinforced composite mass. The internal compound stability calculations are limited to an evaluation zone above the base material and back no further than 2 * H or He + L, whichever is greater. This program DOES NOT address global stability, defined as soil stability below the base material and beyond the limits for internal compound stability. Global Stability should be evaluated to determine if the overall site is stable. It is the responsibility of the owner to ensure the global stability is analyzed. The engineer of record must evaluate the project site for proper water management and all potential modes of failure within the segmental retaining wall evaluation zone. The geotechnical engineering firm contracted by the owner should provide a full global stability opinion of the site including the effects on the segmental retaining wall.

AB Walls contains DEFAULT values for all data inputs that the user MUST change or verify as appropriate for the project conditions being analyzed. These DEFAULT values do NOT ensure a conservative design for any site condition. The final design must provide for proper wall drainage to prevent the buildup of hydrostatic pressures over the service life of the structure. In the event additional water is introduced into the general wall area, either above or below grade, any designs from this software would be invalid unless otherwise noted by the engineer of record. It is also recommended that an independent assessment of the foundation soil for settlement potential and wall deflections for the proposed structure be performed. Changes in the subsoil conditions are not included in this software. These additional potential failure modes should be evaluated by the engineer of record prior to initiating wall construction and may require site inspection by the on-site soils engineer. All installations must conform to the Allan Block Spec Book. (Refer to R0901).

MathCAD files for hand calculations to support the software’s consideration of internal, external and internal compound stability of the reinforced composite mass are provided in the AB Resources Drop Down Menu. These files are to be configured so that the engineer of record can evaluate the output of the software. Individual equations may be altered at the discretion of the engineer of record.

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

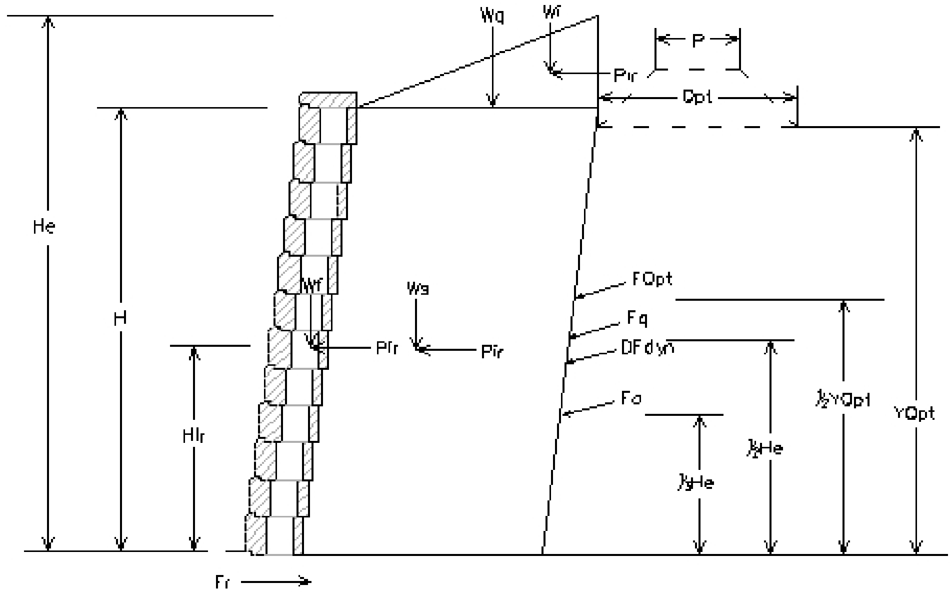
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 10.8 ft
H = Total Panel Height = 10.8 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 1371.66 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 7386.52 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 1764.27 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 1400.83 psf
Ultimate Bearing Capacity (s_ult) = 5986.1 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Internal Stability:
Section: 2
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
8A	15	6.5	51.63	0	0	0	51.63	51.63
7A	13	6.5	91.79	0	0	0	91.79	91.79
6A	11	6.5	137.68	0	0	0	137.68	137.68
5A	9	6.5	183.57	0	0	0	183.57	183.57
4A	7	6.5	229.46	0	0	0	229.46	229.46
3A	5	6.5	275.36	0	0	0	275.36	275.36
2A	3	6.5	321.25	0	0	0	321.25	321.25
1A	1	6.5	367.14	0	0	0	367.14	367.14

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

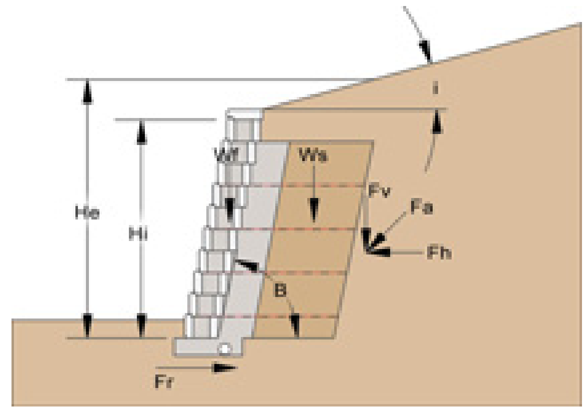
Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 10.8 ft
He = Effective Height = 10.8 ft
He_i = Effective Height = 10.8 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1371.66 plf
Wt = Total Weight = 8758.18 plf
Fa = Active Force = 1764.27 plf
Fav = Vertical Force = 603.42 plf
Fah = Horizontal Force = 1657.87 plf
Fr = Resistance Force = 5404.92 plf



Internal Design Calculations (Static)

Section: 2

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
8A	196.97	6.5	51.63	1789.33	51.99	39.99	5.51	2.89
7A	195.7	6.5	91.79	1789.33	29.24	23.96	5.8	5.13
6A	194.43	6.5	137.68	1789.33	19.49	16.94	6.68	7.69
5A	193.16	6.5	183.57	1789.33	14.62	13.44	8.25	10.26
4A	191.89	6.5	229.46	1789.33	11.7	11.34	9.82	12.82
3A	190.62	6.5	275.36	1789.33	9.75	9.93	11.39	15.39
2A	189.35	6.5	321.25	1789.33	8.35	8.93	12.95	17.95
1A	188.08	6.5	367.14	1789.33	7.31	8.18	14.52	20.52

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 6.5 ft

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

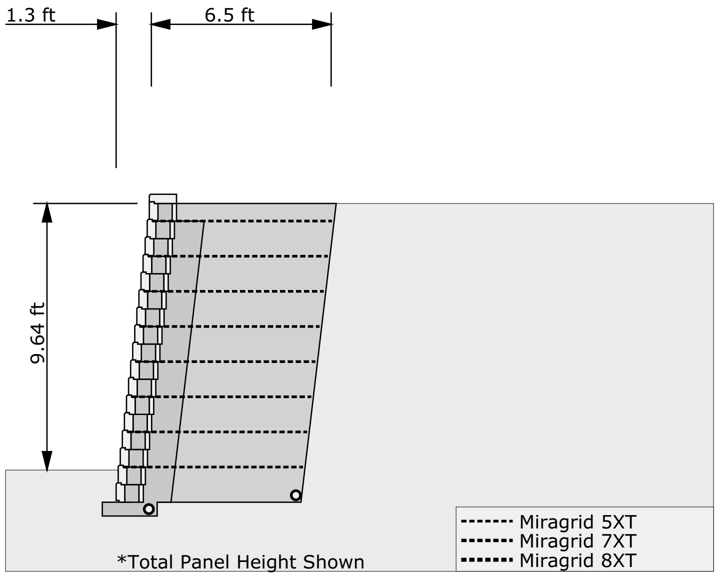
Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13



AB Classic

Section 3 of 7

Section 39.7 ft - 52.1 ft

Base Information:
Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:
8 x Miragrid 5XT @ 6.5 ft
Number Of Geogrid 8

Wall Design Variables

AB Classic

Section Height 9.53 ft
Total Panel Height 10.8 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.26 >= 1.5
Actual Overturning
6.56 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 3.95
Sigma_ult - 5537.12 psf
Sigma_max - 1400.83 psf

Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	10.17 ft	1 ft

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

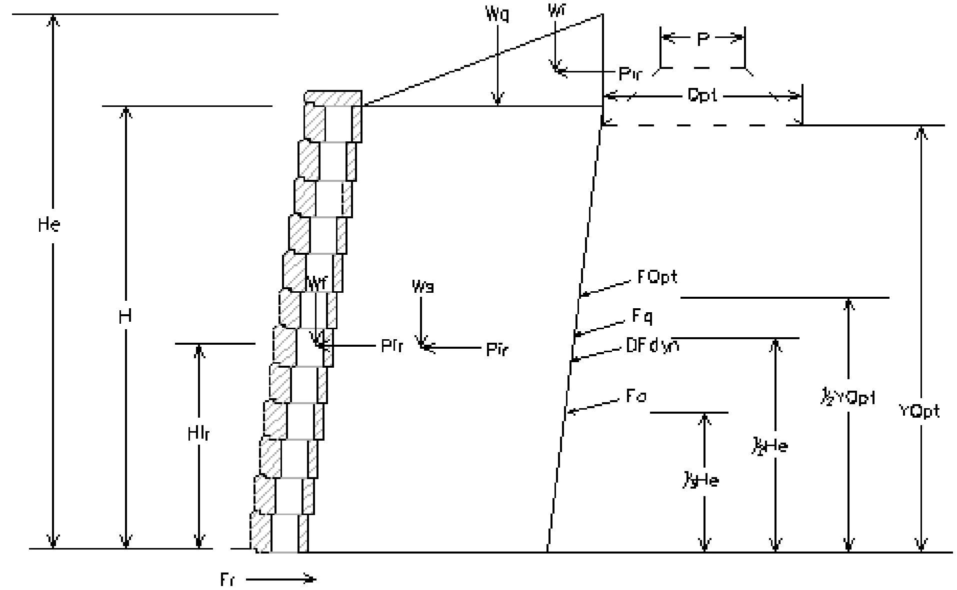
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 10.8 ft
H = Total Panel Height = 10.8 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 1371.66 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 7386.52 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 1764.27 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 1400.83 psf
Ultimate Bearing Capacity (s_ult) = 5537.12 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Internal Stability:
Section: 3
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
8A	16	6.5	22.95	0	0	0	22.95	22.95
7A	14	6.5	68.84	0	0	0	68.84	68.84
6A	12	6.5	114.73	0	0	0	114.73	114.73
5A	10	6.5	160.62	0	0	0	160.62	160.62
4A	8	6.5	206.52	0	0	0	206.52	206.52
3A	6	6.5	252.41	0	0	0	252.41	252.41
2A	4	6.5	298.3	0	0	0	298.3	298.3
1A	2	6.5	533.5	0	0	0	533.5	533.5

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

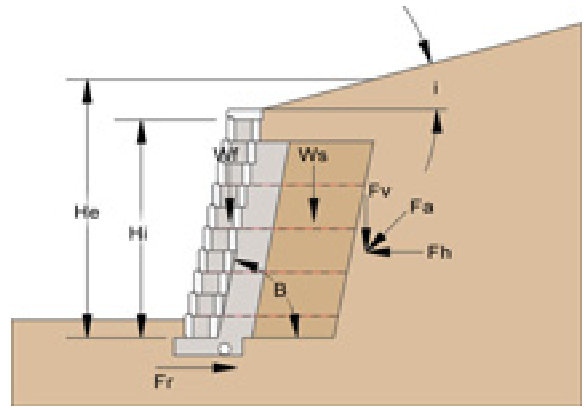
Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 10.8 ft
He = Effective Height = 10.8 ft
He_i = Effective Height = 10.8 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1371.66 plf
Wt = Total Weight = 8758.18 plf
Fa = Active Force = 1764.27 plf
Fav = Vertical Force = 603.42 plf
Fah = Horizontal Force = 1657.87 plf
Fr = Resistance Force = 5404.92 plf



Internal Design Calculations (Static)

Section: 3

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
8A	200.79	6.5	22.95	1789.33	116.97	87.05	6.4	1.28
7A	199.52	6.5	68.84	1789.33	38.99	30.97	6	3.85
6A	198.24	6.5	114.73	1789.33	23.39	19.75	5.9	6.41
5A	196.97	6.5	160.62	1789.33	16.71	14.94	7.47	8.98
4A	195.7	6.5	206.52	1789.33	13	12.27	9.03	11.54
3A	194.43	6.5	252.41	1789.33	10.63	10.57	10.6	14.11
2A	193.16	6.5	298.3	1789.33	9	9.39	12.17	16.67
1A	191.89	6.5	533.5	1789.33	5.03	5.5	8.86	29.82

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 6.5 ft

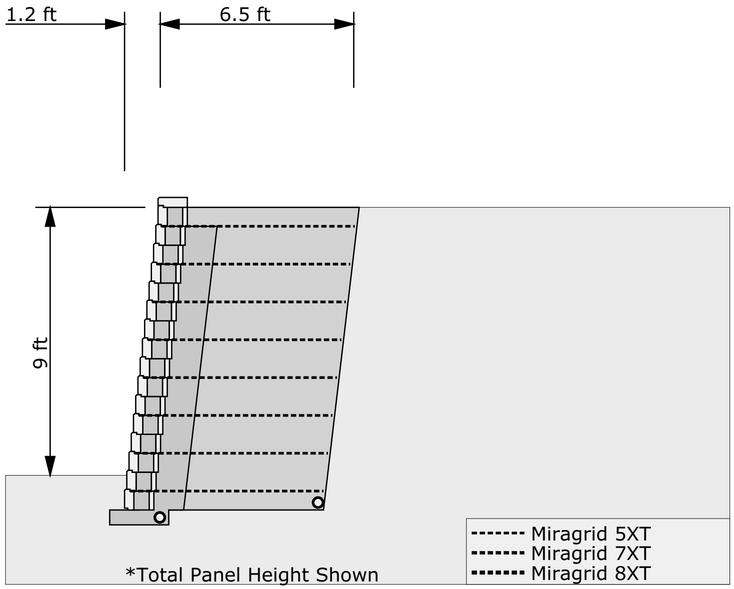
I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

v 21.0.13



AB Classic

Section 4 of 7

Section 52.1 ft - 63.9 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

8 x Miragrid 5XT @ 6.5 ft
Number Of Geogrid 8

Wall Design Variables

AB Classic

Section Height 9.53 ft
Total Panel Height 10.17 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.45 >= 1.5

Actual Overturning
7.29 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 4.22
Sigma_ult - 5537.12 psf
Sigma_max - 1313.43 psf

Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	9.53 ft	1 ft

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

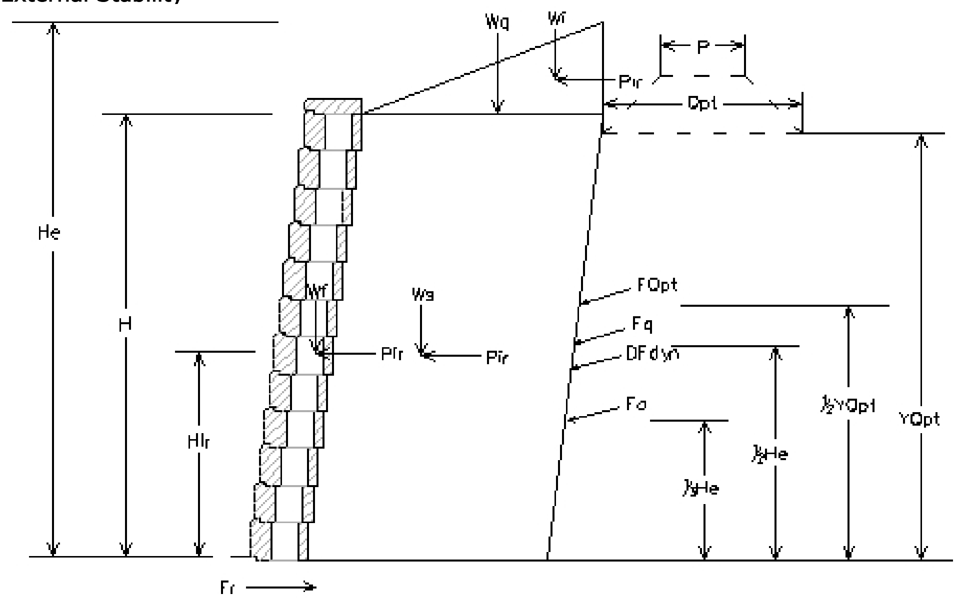
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 10.17 ft
H = Total Panel Height = 10.17 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 1290.97 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 6952.02 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 1562.81 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 1313.43 psf
Ultimate Bearing Capacity (s_ult) = 5537.12 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Internal Stability:
Section: 4
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
8A	15	6.5	22.95	0	0	0	22.95	22.95
7A	13	6.5	68.84	0	0	0	68.84	68.84
6A	11	6.5	114.73	0	0	0	114.73	114.73
5A	9	6.5	160.62	0	0	0	160.62	160.62
4A	7	6.5	206.52	0	0	0	206.52	206.52
3A	5	6.5	252.41	0	0	0	252.41	252.41
2A	3	6.5	298.3	0	0	0	298.3	298.3
1A	1	6.5	344.19	0	0	0	344.19	344.19

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

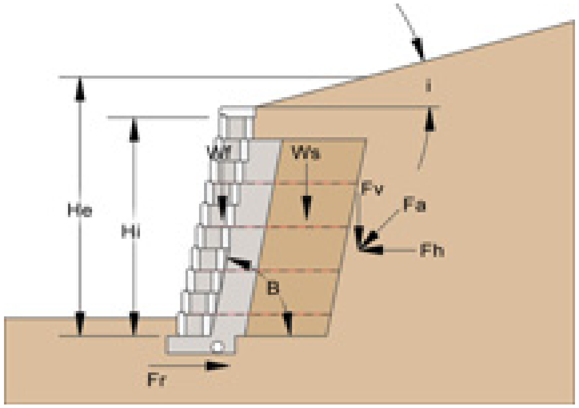
Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 10.17 ft
He = Effective Height = 10.17 ft
He_i = Effective Height = 10.17 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1290.97 plf
Wt = Total Weight = 8242.99 plf
Fa = Active Force = 1562.81 plf
Fav = Vertical Force = 534.51 plf
Fah = Horizontal Force = 1468.56 plf
Fr = Resistance Force = 5067.69 plf



Internal Design Calculations (Static)

Section: 4

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
8A	200.15	6.5	22.95	1789.33	116.97	87.05	6.91	1.28
7A	198.88	6.5	68.84	1789.33	38.99	30.97	6.51	3.85
6A	197.61	6.5	114.73	1789.33	23.39	19.75	6.68	6.41
5A	196.34	6.5	160.62	1789.33	16.71	14.94	8.25	8.98
4A	195.07	6.5	206.52	1789.33	13	12.27	9.82	11.54
3A	193.8	6.5	252.41	1789.33	10.63	10.57	11.39	14.11
2A	192.53	6.5	298.3	1789.33	9	9.39	12.95	16.67
1A	191.26	6.5	344.19	1789.33	7.8	8.53	14.52	19.24

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 6.5 ft

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

v 21.0.13

Wall Design Variables

AB Classic

Section Height 8.9 ft
Total Panel Height 8.9 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.37 >= 1.5

Actual Overturning
6.95 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 5.08
Sigma_ult - 5859.83 psf
Sigma_max - 1153.35 psf

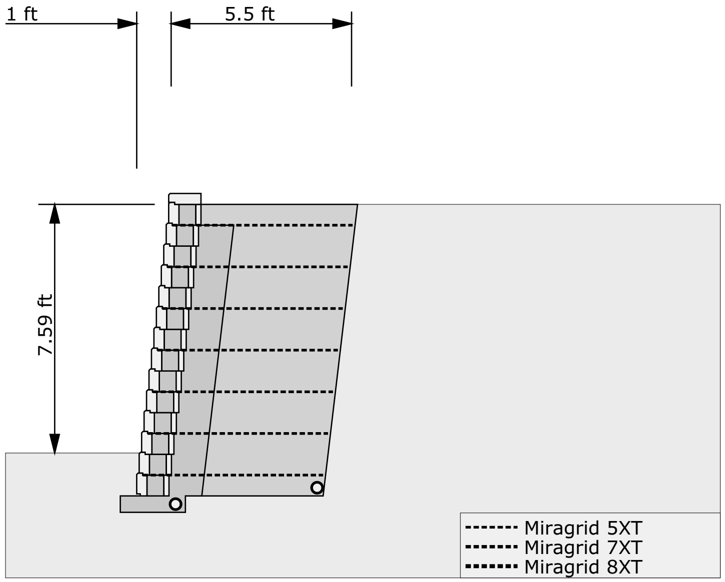
Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	8.26 ft	1 ft



AB Classic

Section 5 of 7

Section 63.9 ft - 75.7 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

7 x Miragrid 5XT @ 5.5 ft
Number Of Geogrid 7

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

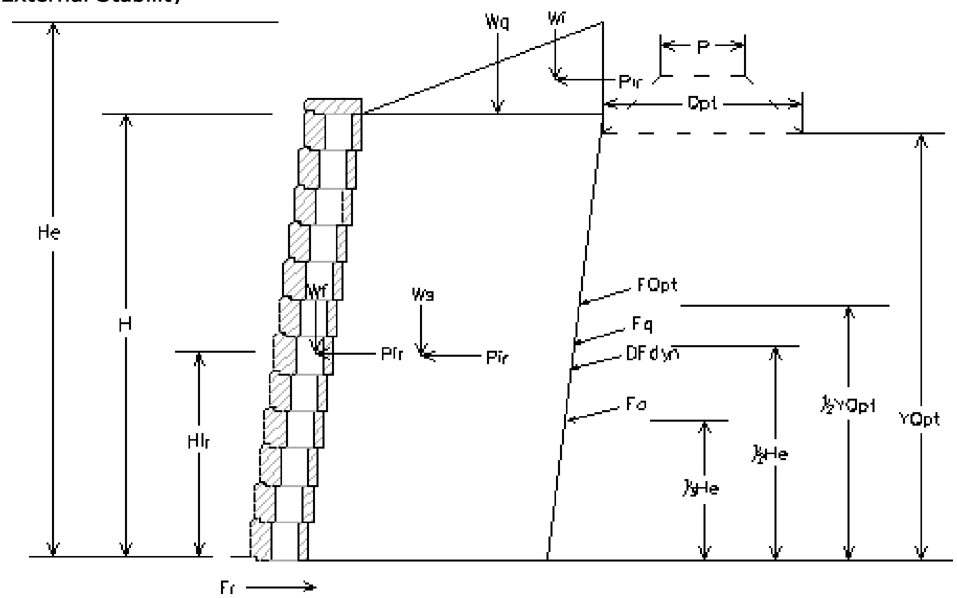
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 8.9 ft
H = Total Panel Height = 8.9 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 1129.6 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 5015.54 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 1196.53 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 1153.35 psf
Ultimate Bearing Capacity (s_ult) = 5859.83 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

Internal Stability:
Section: 5
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
7A	13	5.5	22.95	0	0	0	22.95	22.95
6A	11	5.5	68.84	0	0	0	68.84	68.84
5A	9	5.5	114.73	0	0	0	114.73	114.73
4A	7	5.5	160.62	0	0	0	160.62	160.62
3A	5	5.5	206.52	0	0	0	206.52	206.52
2A	3	5.5	252.41	0	0	0	252.41	252.41
1A	1	5.5	298.3	0	0	0	298.3	298.3

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

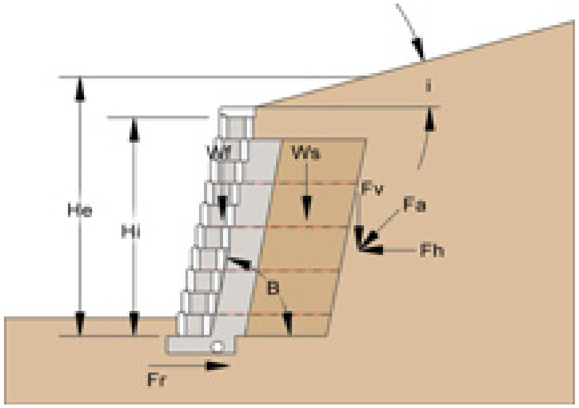
Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 8.9 ft
He = Effective Height = 8.9 ft
He_i = Effective Height = 8.9 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1129.6 plf
Wt = Total Weight = 6145.15 plf
Fa = Active Force = 1196.53 plf
Fav = Vertical Force = 409.24 plf
Fah = Horizontal Force = 1124.37 plf
Fr = Resistance Force = 3784.18 plf



Internal Design Calculations (Static)

Section: 5

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
7A	200.15	5.5	22.95	1789.33	116.97	87.05	5.25	1.28
6A	198.88	5.5	68.84	1789.33	38.99	30.97	4.85	3.85
5A	197.61	5.5	114.73	1789.33	23.39	19.75	5.56	6.41
4A	196.34	5.5	160.62	1789.33	16.71	14.94	7.13	8.98
3A	195.07	5.5	206.52	1789.33	13	12.27	8.7	11.54
2A	193.8	5.5	252.41	1789.33	10.63	10.57	10.27	14.11
1A	192.53	5.5	298.3	1789.33	9	9.39	11.84	16.67

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

Geogrid Legend

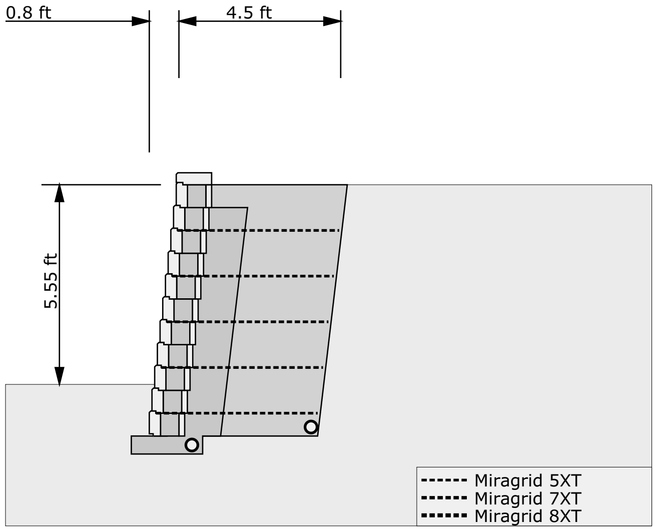
A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 5.5 ft

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:



AB Classic

Section 6 of 7

Section 75.7 ft - 94 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

5 x Miragrid 5XT @ 4.5 ft
Number Of Geogrid 5

Wall Design Variables

AB Classic

Section Height 6.99 ft
Total Panel Height 6.99 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
3.53 >= 1.5

Actual Overturning
7.57 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 6.78
Sigma_ult - 6140.44 psf
Sigma_max - 905.9 psf

Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	6.35 ft	1 ft

Allan Block Disclaimer:

Allan Block provides this software as a service for its clients. The sole purpose of this software is to assist engineers in the design of mechanically stabilized retaining walls. The software uses evaluation techniques and engineering principles found in the Allan Block Engineering Manual. (Refer to R0904 and supporting references.) It is the responsibility of the engineer of record to determine the propriety and accuracy of input parameters and to review and verify the correctness of the results. ALLAN BLOCK CORPORATION, ITS LICENSEES OR AGENTS DO NOT ASSUME ANY LIABILITY OR RESPONSIBILITY FOR DAMAGES WHICH MAY RESULT FROM THE USE OR MISUSE OF THIS SOFTWARE.

This software only considers internal, external and internal compound stability (ICS) of the reinforced composite mass. The internal compound stability calculations are limited to an evaluation zone above the base material and back no further than 2 * H or He + L, whichever is greater. This program DOES NOT address global stability, defined as soil stability below the base material and beyond the limits for internal compound stability. Global Stability should be evaluated to determine if the overall site is stable. It is the responsibility of the owner to ensure the global stability is analyzed. The engineer of record must evaluate the project site for proper water management and all potential modes of failure within the segmental retaining wall evaluation zone. The geotechnical engineering firm contracted by the owner should provide a full global stability opinion of the site including the effects on the segmental retaining wall.

AB Walls contains DEFAULT values for all data inputs that the user MUST change or verify as appropriate for the project conditions being analyzed. These DEFAULT values do NOT ensure a conservative design for any site condition. The final design must provide for proper wall drainage to prevent the buildup of hydrostatic pressures over the service life of the structure. In the event additional water is introduced into the general wall area, either above or below grade, any designs from this software would be invalid unless otherwise noted by the engineer of record. It is also recommended that an independent assessment of the foundation soil for settlement potential and wall deflections for the proposed structure be performed. Changes in the subsoil conditions are not included in this software. These additional potential failure modes should be evaluated by the engineer of record prior to initiating wall construction and may require site inspection by the on-site soils engineer. All installations must conform to the Allan Block Spec Book. (Refer to R0901).

MathCAD files for hand calculations to support the software's consideration of internal, external and internal compound stability of the reinforced composite mass are provided in the AB Resources Drop Down Menu. These files are to be configured so that the engineer of record can evaluate the output of the software. Individual equations may be altered at the discretion of the engineer of record.

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

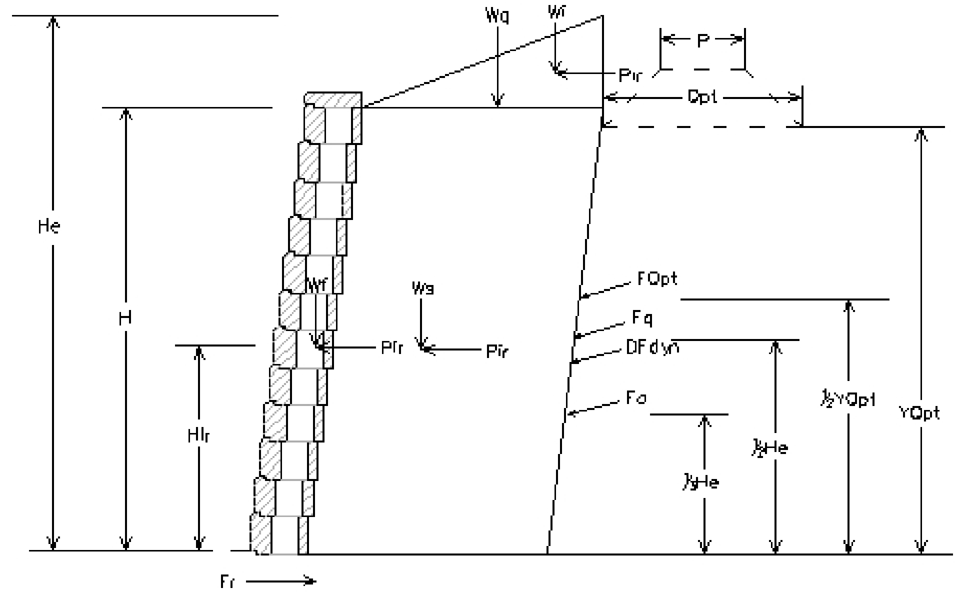
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 6.99 ft
H = Total Panel Height = 6.99 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 887.54 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 3102.06 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 738.67 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 905.9 psf
Ultimate Bearing Capacity (s_ult) = 6140.44 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Internal Stability:
Section: 6
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
5A	9	4.5	51.63	0	0	0	51.63	51.63
4A	7	4.5	91.79	0	0	0	91.79	91.79
3A	5	4.5	137.68	0	0	0	137.68	137.68
2A	3	4.5	183.57	0	0	0	183.57	183.57
1A	1	4.5	229.46	0	0	0	229.46	229.46

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

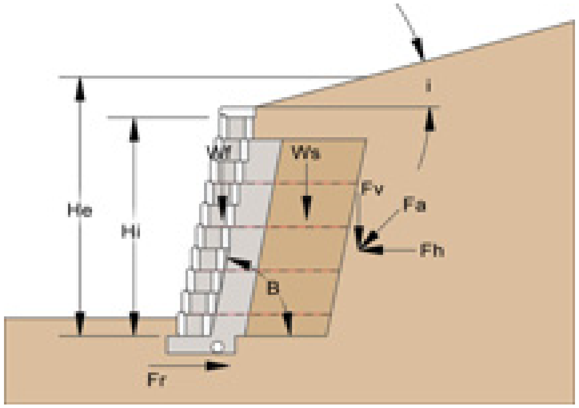
License #: Date:

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 6.99 ft
He = Effective Height = 6.99 ft
He_i = Effective Height = 6.99 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 887.54 plf
Wt = Total Weight = 3989.6 plf
Fa = Active Force = 738.67 plf
Fav = Vertical Force = 252.64 plf
Fah = Horizontal Force = 694.13 plf
Fr = Resistance Force = 2449.26 plf



Internal Design Calculations (Static)

Section: 6

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
5A	198.88	4.5	51.63	1789.33	51.99	39.99	3.47	2.89
4A	197.61	4.5	91.79	1789.33	29.24	23.96	4.45	5.13
3A	196.34	4.5	137.68	1789.33	19.49	16.94	6.01	7.69
2A	195.07	4.5	183.57	1789.33	14.62	13.44	7.58	10.26
1A	193.8	4.5	229.46	1789.33	11.7	11.34	9.15	12.82

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

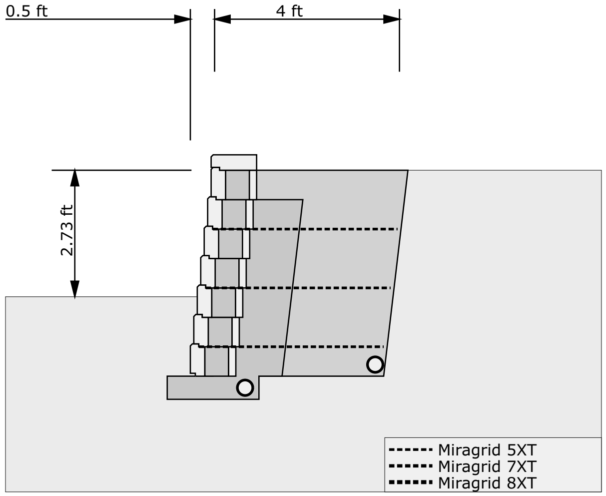
Engineer:

License #: Date:

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 4.5 ft

v 21.0.13



AB Classic

Section 7 of 7

Section 94 ft - 101.4 ft

Base Information:

Base Width: 2 ft
Base Depth: 0.5 ft
Base From Toe: 0.5 ft

Geogrid Information:

3 x Miragrid 5XT @ 4 ft
Number Of Geogrid 3

Wall Design Variables

AB Classic

Section Height 4.45 ft
Total Panel Height 4.45 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.98 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
4.88 >= 1.5

Actual Overturning
13.9 >= 2

Infill Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Retained Soil

Friction Angle 30 Deg.
Unit WT 120 pcf

Foundation Soil

Friction Angle 30 Deg.
Unit WT 120 pcf
Cohesion 0 psf

Bearing Capacity

Factor of Safety 11.91
Sigma_ult - 6757.78 psf
Sigma_max - 567.62 psf

Internal Compound Stability

ics not calculated

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	3.81 ft	1 ft

Allan Block Disclaimer:

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

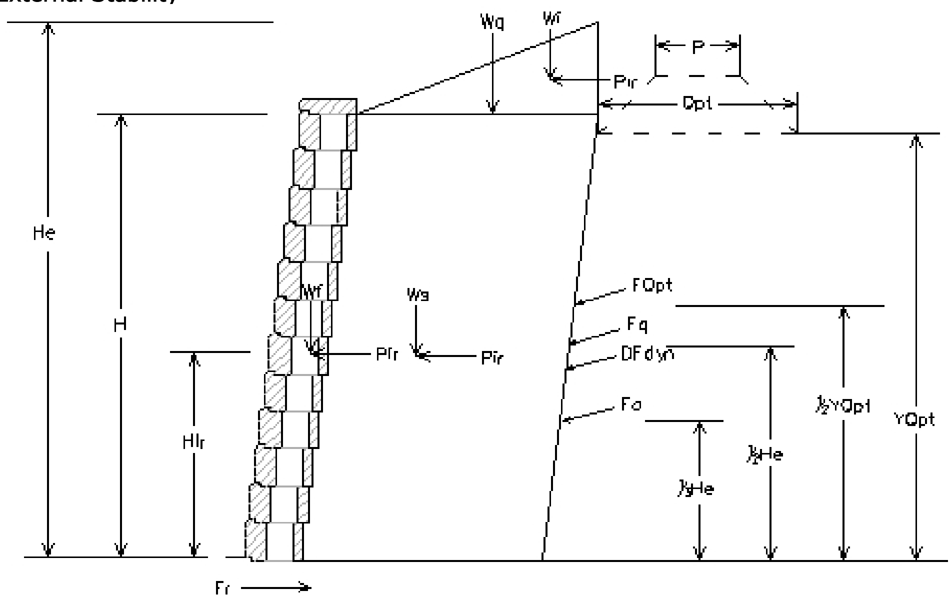
Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

External Stability



Unit Weight of Concrete = 135 pcf
Unit Weight of Wall Rock = 120 pcf

He = Effective Wall Height = 4.45 ft
H = Total Panel Height = 4.45 ft
Wi = Weight of the Backslope = 0 plf
Wq = Infill Surcharge Dead Load = 0 plf
Wf = Weight of the Allan Block Facing = 564.8 plf
Ws = Weight of the Geogrid Reinforced Soil Mass = 1707.17 plf
Pir = Seismic Inertial Force for For Each Gravity Force = 0 plf
Hir = Resultant Vertical Location = 0 ft
P = Point Load Surcharge = 0 psf
Qpt = Translated Point Load = 0 plf
DFdyn = Dynamic Earth Force = 0 plf
Fq = Surcharge Force = 0 plf
FQpt = Point Load Force = 0 plf

Fa = Active Earth Force = 299.13 plf

Bearing Capacity Calculations:
Bearing Pressure (s_max) = 567.62 psf
Ultimate Bearing Capacity (s_ult) = 6757.78 psf
(Using Meyerhoff bearing capacity equation.)

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Internal Stability:
Section: 7
Summary of Forces

Geogrid Number	Course Number	Geogrid Length ft	Active Earth Pressure plf	Dynamic Earth Pressure plf	Surcharge Force plf	Point Load Force plf	Seismic Internal Force plf	Static Tensile Force plf
3A	5	4	51.63	0	0	0	51.63	51.63
2A	3	4	91.79	0	0	0	91.79	91.79
1A	1	4	137.68	0	0	0	137.68	137.68

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Signature:

Engineer:

License #: Date:

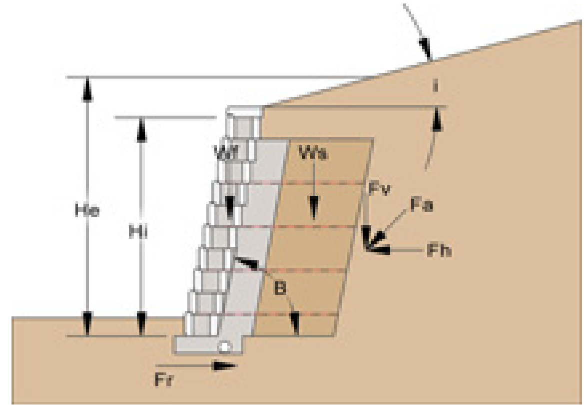
Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

v 21.0.13

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.252
Kar = Active Earth Pressure Coefficient Retained = 0.252
H = Wall Height = 4.45 ft
He = Effective Height = 4.45 ft
He_i = Effective Height = 4.45 ft
i = Slope = 0 Deg.
i_int = Effective Slope = 0 Deg.
i_ext = Effective Slope = 0 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 564.8 plf
Wt = Total Weight = 2271.97 plf
Fa = Active Force = 299.13 plf
Fav = Vertical Force = 102.31 plf
Fah = Horizontal Force = 281.09 plf
Fr = Resistance Force = 1370.79 plf



Internal Design Calculations (Static)

Section: 7

Geogrid Number	Geogrid Elevation ft	Geogrid Length ft	Tensile Force plf	Allowable Load plf	Factor Safety Overstress	Factor Safety Pullout Block	Factor Safety Pullout Soil	Efficiency
3A	198.88	4	51.63	1789.33	51.99	39.99	4.15	2.89
2A	197.61	4	91.79	1789.33	29.24	23.96	6.24	5.13
1A	196.34	4	137.68	1789.33	19.49	16.94	7.81	7.69

Project Name: 25 Delaware
Location: 25 Delaware Ave
Wall Number: 1
Project Number: 180244
Designer: Preliminary
Date: 03/11/21

I hereby certify that these calculations were prepared by me or under my direct supervision and that I am a duly licensed engineer certified and responsible for the content of these calculations.

Signature:

Engineer:

License #: Date:

Geogrid Legend

A - Miragrid 5XT
B - Miragrid 7XT
C - Miragrid 8XT
Min. Length of Geogrid: 4 ft

v 21.0.13