Engineer's Report

Geogrid Reinforced Segmental
Block Retaining Wall

522 South Riverside Drive
Block 5213
Lot 1
Neptune Township
Monmouth County
New Jersey

File No. 200203

Date:

June 12, 2020

Prepared By:
………………………………………..
(SEAL)
John A. Buletza, PE, PP, CME

Purpose

This report provides design calculations and supporting data to construct a geogrid reinforced segmental block retaining wall.

Existing Site

The project is located in Neptune Township on South Riverside Drive. The subject property is known as Block 5213, Lot 1 as shown on the municipal tax map.

The site is currently vacant, except for the remains of a dwelling destroyed by a fire, and an asphalt driveway.

Areas of the property contain steep slopes. The existing grades in the steep slope areas are 2:1 (horizontal: vertical) or greater.

Proposed Improvements

It is proposed to complete the demolition of the existing dwelling and driveway, and construct a new single family home with a paved driveway and associated improvements.

The geo-grid reinforced segmental block retaining wall is located in the right side yard adjacent to the driveway. The maximum wall height is approximately 8-feet.

The municipal ordinance requires a protective fence along the top of the retaining wall where the wall height is 4-feet or greater. The wall will have a 4-foot high estate type fence installed along the top of the wall at this location.

The fence posts will be installed either 3-feet behind the back of the wall or inside Sleeve-It[tm] system HDPE tubes for a fence adjacent to the back of the wall. The Sleeve-It[tm] system components account for wind loading on the fence. If the Sleeve-It[tm] system is used, the HDPE tubes must be installed at 4-10 Feet on center (the spacing is based on the type of fence selected by the owner) during the construction of the walls, not afterward.

The retaining wall design incorporates a drainage system that includes stone backfill and two 4-inch perforated longitudinal drainpipes. The drainage system routes surface runoff around the wall, minimizes the increase of hydrostatic pressure behind the wall and extends the useful service life of the wall.

Soils and Groundwater

A soil boring near the proposed wall location was advanced to a depth of 84-inches. The expected seasonal high water table (SHWT) elevation at the soil boring location is 36.3 at a depth of 44-inches or 3.7-feet. There is a mix of sand, silt and clay at the depth of the bottom of wall footing. The load-bearing pressure of the in-situ soils at the soil boring location at the approximate bottom of proposed wall footing elevation from IRC 2018 TABLE R401.4.1 Presumptive Load-Bearing Values of Foundation Materials is 2,000 PSF.

The Web Soil Survey maps the subject property as Evesboro sand, 10 to 15 percent slopes (EveD). Evesboro series soils have a hydrologic soil group classification of ‘A’ and a classified depth to seasonal high water table (SHWT) of greater than 6-feet.

Soils with an internal angle of friction of 30 degrees, weighing 120 pounds per cubic foot with a bearing capacity of 2,000 PSF are used in the design calculations for the infill, retained and foundation soils.

Groundwater may be encountered during excavation for the wall and groundwater management during construction is expected to be required.

However, groundwater levels may fluctuate due to variations in rainfall, or other factors not evident at the time of the soil boring. Therefore, groundwater management during construction may not be necessary.

Select Fill and Compaction

Unsuitable soil encountered during excavation shall be removed entirely and backfilled with NJDOT 901.08 dense graded aggregate (DGA) or 57 stone compacted in 8-inch lifts to 95% of the maximum dry density per ASTM D-1557.

Acceptable soil materials for backfill and fill shall be free of clay, rock or gravel larger than 2-1/2-inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter and it shall comply with ASTM D-2487-91 soil classification groups GW, GP, SM, SW and SP. Acceptable soil materials for backfill shall also meet the specifications of the wall block manufacturer.

Fill material shall be placed in maximum 8" lifts and compacted to a minimum 95% of maximum dry density, based on ASTM D-1557. If fill is placed in confined areas, reduce the maximum lift size to 6". Fill placement and compaction shall also meet the specifications of the wall block manufacturer.

Construction & Inspection Notes

The wall cross sections show two longitudinal drains. The first drain, closest to the base of the wall, is a 4-inch perforated drainpipe placed in a layer of stone immediately behind the blocks. It must be installed to drain out any water that may collect behind the walls. This pipe must be pitched and vented to daylight, or drained through the face of the walls according to the "Alternate Drain Detail". The second drain, the heel drain, is located at the back of the excavated trench (farther from the wall). It is used to control surface or ground water runoff during construction. It must be pitched and vented to daylight. Both of these drains are required.

In order to ensure proper functioning and service life of the walls, the segmental blocks, longitudinal drains, geogrid, Sleeve-It[tm] system, fence, and soils must meet their respective specifications and be installed in accordance with the manufacturer's recommendations and the design parameters contained in this report.

Nelson Engineering Associates, Inc. provides the design services for this project. The soils, methods and materials of construction need to be inspected by a structural or geotechnical engineer during construction and certified by the engineer prior to the walls being placed into service.

Limitations

The conclusions and recommendations in this report are our best judgment and professional opinions for the design and construction of the project. There may be unknown subsurface conditions that were not encountered in the soil boring.

Areas of the property directly adjacent to the proposed retaining wall contain steep slopes. The existing grades in the steep slope areas are 2:1 (horizontal: vertical) or greater. The contractor shall make provision for the steep slopes during construction of the retaining wall.

Soils with an internal angle of friction of 30 degrees, weighing 120 pounds per cubic foot with a bearing capacity of 2,000 PSF are used in the design calculations for the infill, retained and foundation soils.

The expected seasonal high water table (SHWT) elevation at the soil boring location is 36.3 at a depth of 44-inches or 3.7-feet. Groundwater may be encountered during excavation for the wall and groundwater management during construction is expected to be required. However, groundwater levels may fluctuate due to variations in rainfall, or other factors not evident at the time of the soil boring. Therefore, groundwater management during construction may not be necessary.

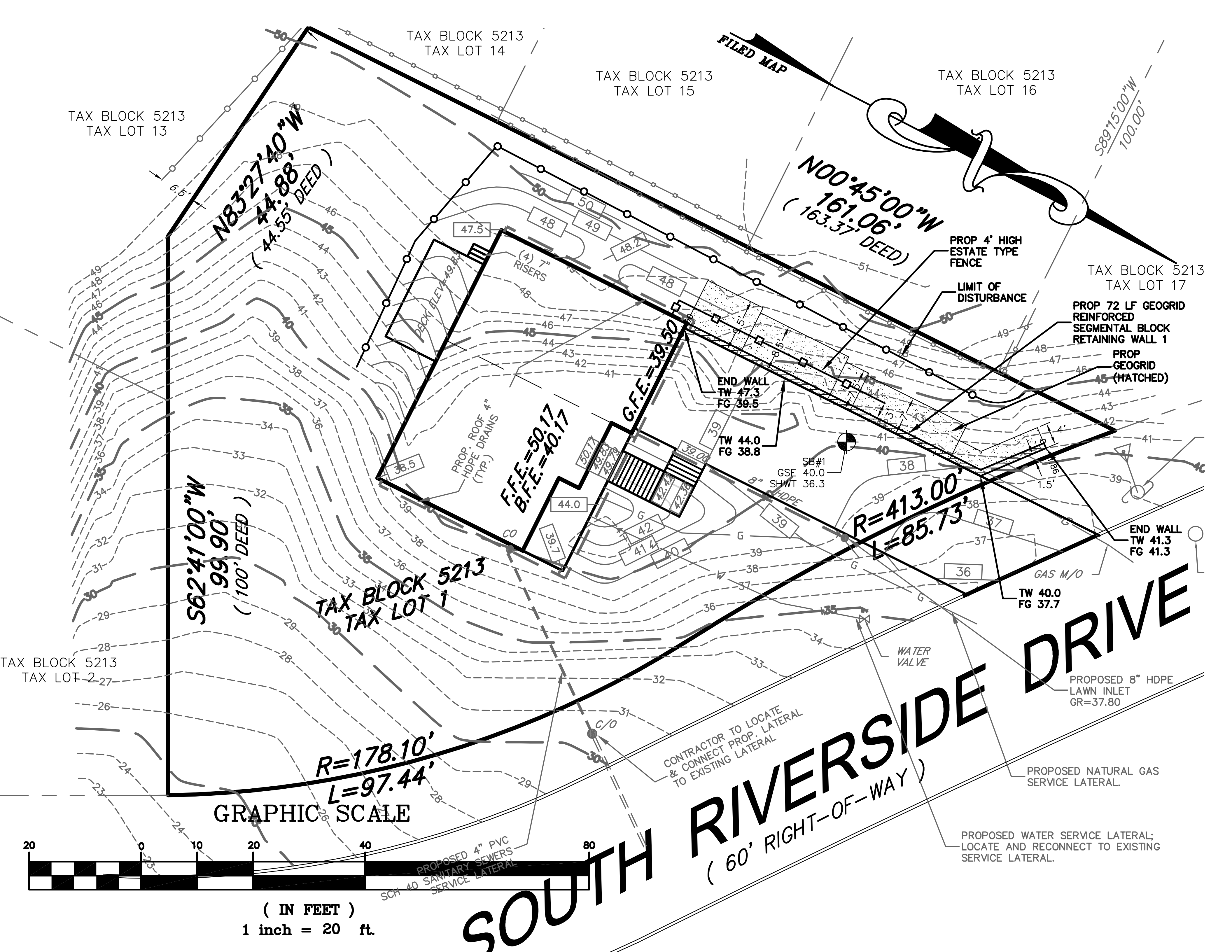
During construction, if any discrepancies are discovered between those noted in this report and the subsurface conditions encountered, they should be brought to our attention immediately; our recommendations and/or design will be re-evaluated.

Contractors, professionals or others that use the information in this report do at their own risk.

Unless specifically stated to the contrary in this report, no determination was made about environmental factors that may affect the project. The conclusions and recommendations in this report are not intended to supersede any NJDEP environmental permits or conditions.

This report is prepared according to generally accepted engineering standards and practices for the exclusive use of the Applicant. **No other warranty, express or implied, is made.**

Appendix



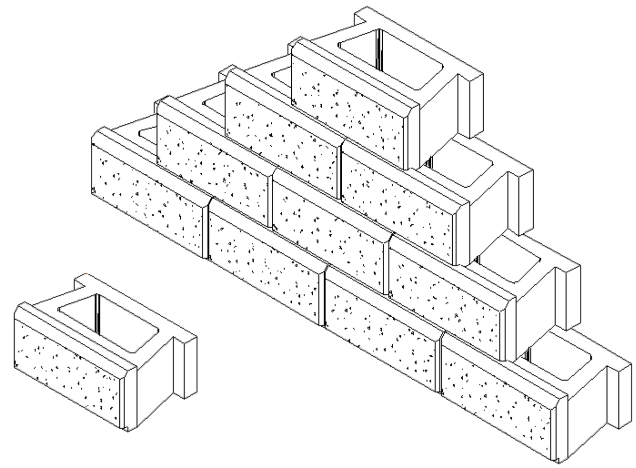
TAX BLOCK 5213
TAX LOT 13
TAX BLOCK 5213
TAX LOT 14
TAX BLOCK 5213
TAX LOT 15
TAX BLOCK 5213
TAX LOT 16
TAX BLOCK 5213
TAX LOT 17
TAX BLOCK 5213
TAX LOT 2
TAX BLOCK 5213
TAX LOT 1
FILED MAP
N83°27'40"W
44.88'
(44.55' DEED)
N00°45'00"W
161.06'
(163.37' DEED)
S89°15'00"W
100.00'
S62°41'00"W
99.90'
(100' DEED)
R=178.10'
L=97.44'
R=413.00'
L=85.73'
6.5'
PROP 4' HIGH
ESTATE TYPE
FENCE
LIMIT OF
DISTURBANCE
PROP 72 LF GEOGRID
REINFORCED
SEGMENTAL BLOCK
RETAINING WALL 1
PROP
GEOGRID
(HATCHED)
DECK ELEV=49.83
(4) 7"
RISERS
PROP. ROOF 4"
HDPE DRAINS
(TYP.)
F.F.E.=50.17
B.F.E.=40.17
G.F.E.=39.50
END WALL
TW 47.3
FG 39.5
TW 44.0
FG 38.8
SB#1
GSE 40.0
SHWT 36.3
END WALL
TW 41.3
FG 41.3
TW 40.0
FG 37.7
8" HDPE
GAS M/O
WATER
VALVE
CO
C/O
PROPOSED 8" HDPE
LAWN INLET
GR=37.80
CONTRACTOR TO LOCATE
& CONNECT PROP. LATERAL
TO EXISTING LATERAL
PROPOSED NATURAL GAS
SERVICE LATERAL.
PROPOSED WATER SERVICE LATERAL;
LOCATE AND RECONNECT TO EXISTING
SERVICE LATERAL.
PROPOSED 4" PVC
SCH 40 SANITARY SEWERS
SERVICE LATERAL
SOUTH RIVERSIDE DRIVE
(60' RIGHT-OF-WAY)
GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

522 SOUTH RIVERSIDE DRIVE

BLOCK 5213, LOT 1

NEPTUNE, NJ

Page Index



AB Classic

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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 Number: Date:

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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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 Number: Date:

Specification Guidelines: Water Management

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 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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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 Number: 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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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.

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.

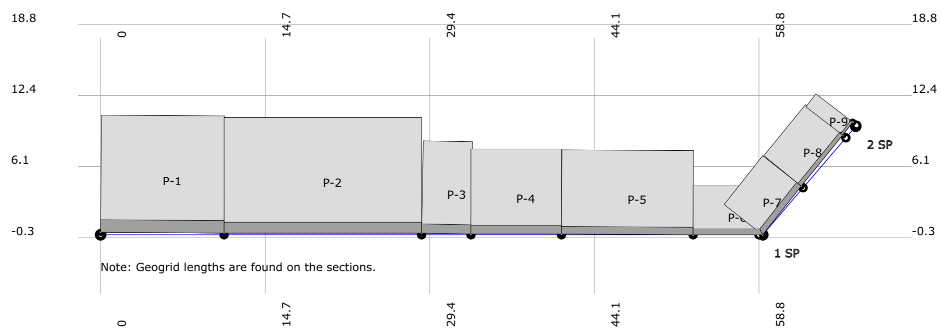
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Panel Key # - Max Grid Length

Plan View

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

Station	0	1	2
x	0	59.1	67.4
y	0	0	9.7
Radius	0	0	0
Distance	0	59.1	12.77
Total	0	59.1	71.87

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.

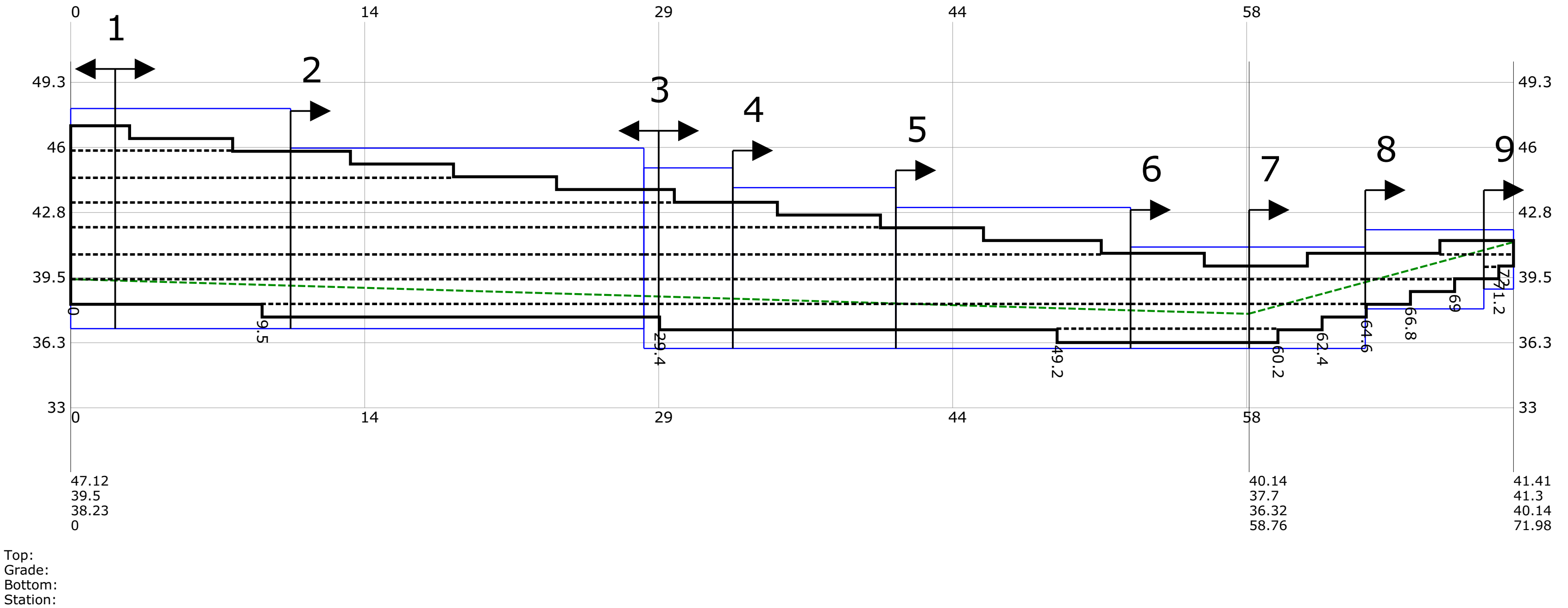
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Elevation View

Section	1	2	3	4	5	6	7	8	9
Top	47.12	45.85	43.95	43.31	42.04	40.77	40.14	40.77	41.41
Grade	39.43	39.16	37.96	38.49	38.24	37.88	37.7	39.3	40.9
Bottom	38.23	37.59	36.96	36.96	36.96	36.32	36.32	38.23	39.5
Sta. Cut	2.2	11.02	29.38	33.05	41.13	52.88	58.76	64.64	70.51
Sta. End	11.02	28.65	33.05	41.13	52.88	58.76	64.64	70.51	71.98

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.

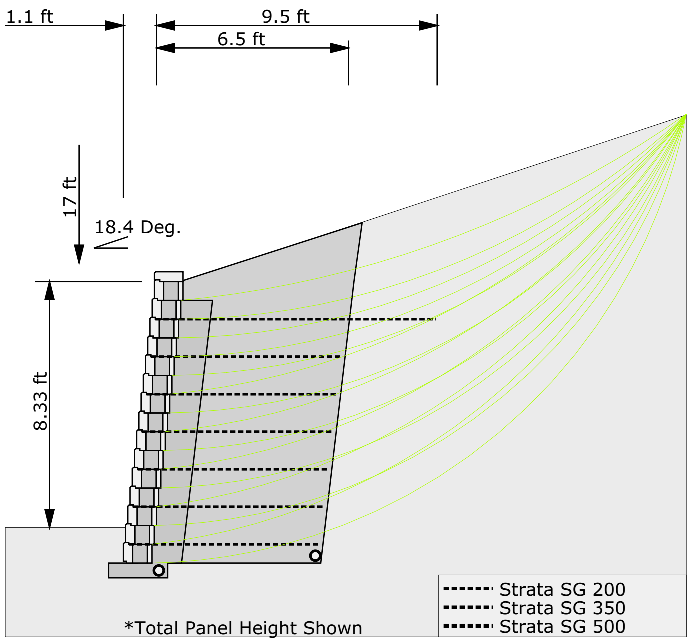
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 1 of 9

Section 0 ft - 11 ft

Base Information:

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

Geogrid Information:

1 x Strata SG 200 @ 9.5 ft
6 x Strata SG 200 @ 6.5 ft
Number Of Geogrid 7

Wall Design Variables

AB Classic
Section Height 8.9 ft
Total Panel Height 9.53 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External
Actual Sliding
2.18 >= 1.5
Actual Overturning
4.32 >= 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 4.04
Sigma_ult - 5606.62 psf
Sigma_max - 1387.2 psf

Internal Compound Stability
Factor of Safety 1.71
Course Number 1

Wall Rock Requirements
Variable Depth

	Height	Depth
Bottom	8.9 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 Number: Date:

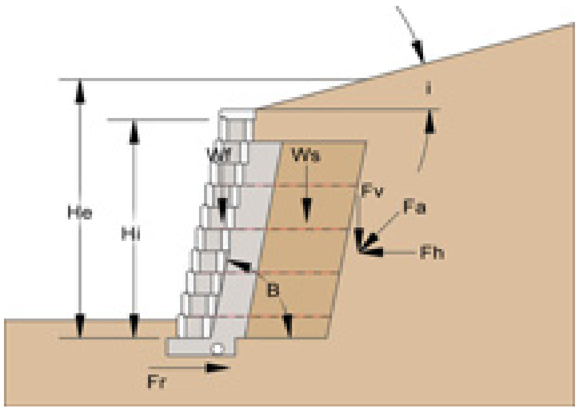
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.333
Kar = Active Earth Pressure Coefficient Retained = 0.333
H = Wall Height = 9.53 ft
He = Effective Height = 11.43 ft
He_i = Effective Height = 10.16 ft
i = Slope = 18.4 Deg.
i_int = Effective Slope = 18.4 Deg.
i_ext = Effective Slope = 18.4 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1191.08 plf
Wt = Total Weight = 7726.46 plf
Fa = Active Force = 2609.14 plf
Fav = Vertical Force = 892.38 plf
Fah = Horizontal Force = 2451.79 plf
Fr = Resistance Force = 5352.35 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
7A	46.49	9.5	109.92	1279.33	17.46	19.57	9.59	8.59
6A	45.22	6.5	151.4	1279.33	12.67	14.71	5.2	11.83
5A	43.95	6.5	212	1279.33	9.05	10.87	6.28	16.57
4A	42.68	6.5	272.59	1279.33	7.04	8.73	7.47	21.31
3A	41.41	6.5	333.19	1279.33	5.76	7.37	8.66	26.04
2A	40.14	6.5	393.78	1279.33	4.87	6.43	9.84	30.78
1A	38.86	6.5	454.37	1279.33	4.22	5.74	11.03	35.52

Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
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:

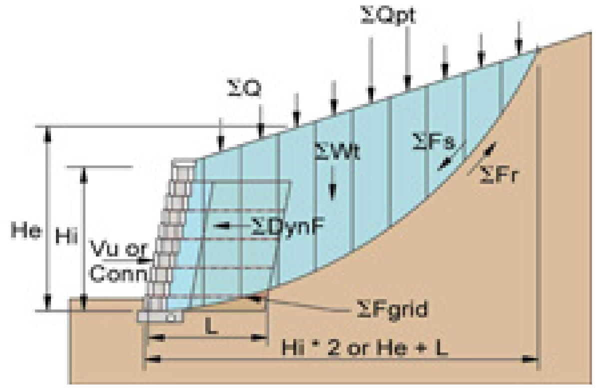
License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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)
14	1.94	1301.35	139.8	744.15	0	0	2332.21	0	0
13	3.67	2251.53	2283.36	1235.49	0	0	3819.35	0	0
12	4.63	2839.3	2661.49	1591.16	1861.25	0	4731.49	0	0
11	3.39	3363.94	2899.79	1979	440.07	0	5664.71	0	0
10	2.94	3916.27	2971.23	2396.96	155.28	0	6619.93	0	0
9	2.63	4039.52	3042.68	2695.6	0.01	0	6890.05	0	0
8	2.56	5089.77	3114.13	3315.45	299.68	0	8599.78	0	0
7	2.27	5222.58	3185.57	3696.53	0	0	8930.17	0	0
6	2.32	6327.74	3257.02	4332.38	471.06	0	10677.34	0	0
5	2.04	6358.13	3328.47	4765.96	26.04	0	10904.71	0	0
4	2.15	7634.07	3399.91	5435.53	652.28	0	12857.95	0	0
3	1.88	7460.45	3471.36	5910.49	176.36	0	12829.14	0	0
2	2.02	8968.18	3531.93	6610.35	831.74	0	15080.94	0	0
1	1.71	8685.08	3360	7152.22	193.17	0	15009.57	0	0
0	1.73	10152.28	2494.66	7845.16	913.59	0	17319.54	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.

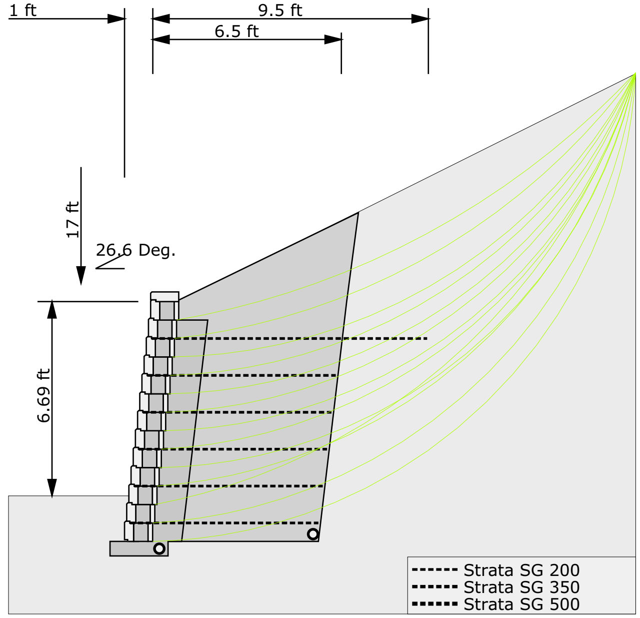
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 2 of 9

Section 11 ft - 28.6 ft

Base Information:

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

Geogrid Information:

1 x Strata SG 200 @ 9.5 ft
5 x Strata SG 200 @ 6.5 ft

Number Of Geogrid 6

Wall Design Variables

AB Classic

Section Height 8.26 ft
Total Panel Height 8.26 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
1.66 >= 1.5

Actual Overturning
3.46 >= 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 4.24
Sigma_ult - 6420.39 psf
Sigma_max - 1515.16 psf

Internal Compound Stability

Factor of Safety 1.34
Course Number 12

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	7.62 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 Number: Date:

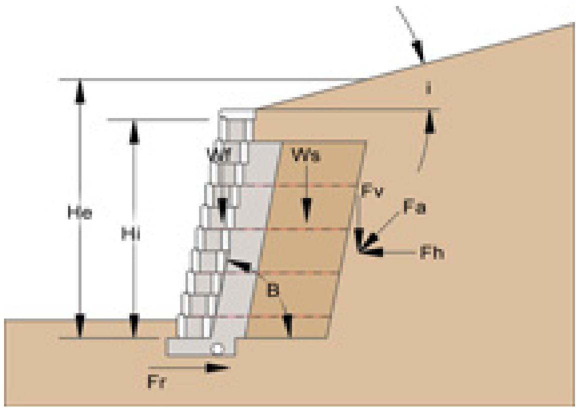
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.438
Kar = Active Earth Pressure Coefficient Retained = 0.438
H = Wall Height = 8.26 ft
He = Effective Height = 11.12 ft
He_i = Effective Height = 9.21 ft
i = Slope = 26.6 Deg.
i_int = Effective Slope = 26.6 Deg.
i_ext = Effective Slope = 26.6 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 1032.27 plf
Wt = Total Weight = 6696.27 plf
Fa = Active Force = 3248.8 plf
Fav = Vertical Force = 1111.16 plf
Fah = Horizontal Force = 3052.88 plf
Fr = Resistance Force = 5074.02 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
6A	44.58	9.5	201.89	1279.33	9.51	10.65	6.5	15.78
5A	43.31	6.5	219.27	1279.33	8.75	10.16	4.77	17.14
4A	42.04	6.5	298.99	1279.33	6.42	7.71	5.68	23.37
3A	40.77	6.5	378.71	1279.33	5.07	6.29	6.58	29.6
2A	39.5	6.5	458.42	1279.33	4.19	5.36	7.48	35.83
1A	38.23	6.5	538.14	1279.33	3.57	4.71	8.38	42.06

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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 Number: Date:

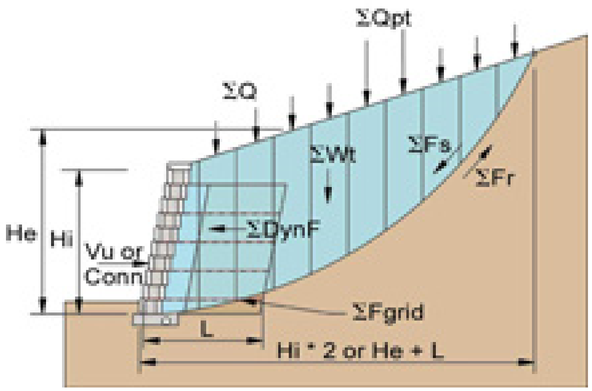
Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 6.5 ft

v 20.0.5

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: 2

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
12	1.34	1430.17	139.8	1171.21	0	0	2660.46	0	0
11	2.67	2336.16	2283.36	1727.28	0	0	3921.4	0	0
10	3.32	3413.52	2661.49	2388.38	1856.23	0	5534.32	0	0
9	3.07	3910.67	2899.79	2800.58	1792.82	0	6347.23	0	0
8	2.55	4520.6	2971.23	3302.5	913.32	0	7425.4	0	0
7	2.13	4941.11	3042.68	3760.56	18.71	0	8262.92	0	0
6	2.24	5715.15	3114.13	4305.15	811.23	0	9422.09	0	0
5	1.93	6018.98	3185.57	4775.22	0	0	10116.73	0	0
4	2.09	7002.1	3257.02	5384.81	1017.84	0	11528.13	0	0
3	1.79	7130.3	3328.47	5872.54	47.41	0	12030.66	0	0
2	1.98	7115.45	3379.32	6248.69	1846.73	0	11808.54	0	0
1	1.65	8471.79	3192.04	7085.37	11.79	0	14374.57	0	0
0	1.7	9510.4	2349.59	7724.17	1268.02	0	15943.15	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.

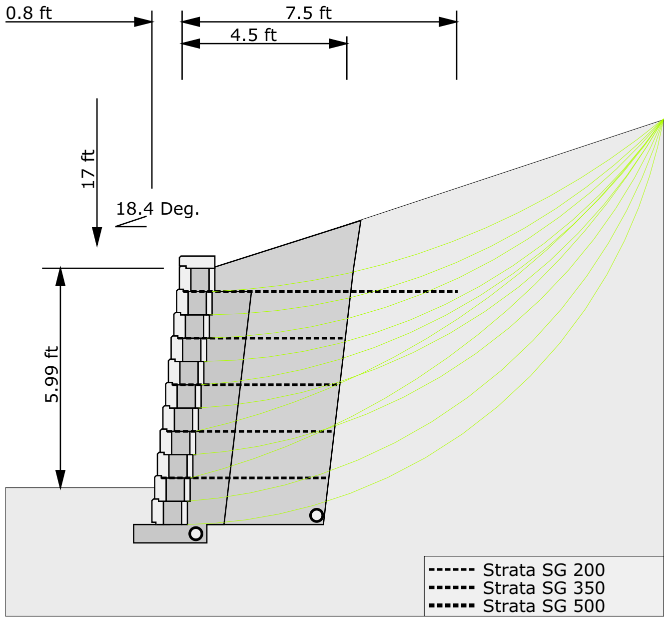
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 3 of 9

Section 28.6 ft - 33.1 ft

Base Information:

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

Geogrid Information:

1 x Strata SG 200 @ 7.5 ft
4 x Strata SG 200 @ 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 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
2.15 >= 1.5
Actual Overturning
4.16 >= 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 5.03
Sigma_ult - 5171.67 psf
Sigma_max - 1029.09 psf

Internal Compound Stability

Factor of Safety 1.62
Course Number 0

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 Number: Date:

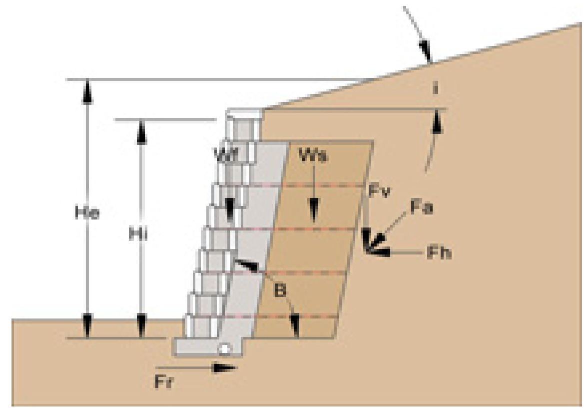
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.333
Kar = Active Earth Pressure Coefficient Retained = 0.333
H = Wall Height = 6.99 ft
He = Effective Height = 8.22 ft
He_i = Effective Height = 7.4 ft
i = Slope = 18.4 Deg.
i_int = Effective Slope = 18.4 Deg.
i_ext = Effective Slope = 18.4 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 873.46 plf
Wt = Total Weight = 3988.62 plf
Fa = Active Force = 1350.61 plf
Fav = Vertical Force = 461.93 plf
Fah = Horizontal Force = 1269.16 plf
Fr = Resistance Force = 2728.49 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
5A	43.95	7.5	53.12	1279.33	36.13	39.77	8.69	4.15
4A	42.68	4.5	110.53	1279.33	17.36	19.81	2.83	8.64
3A	41.41	4.5	171.12	1279.33	11.21	13.24	3.99	13.38
2A	40.14	4.5	231.72	1279.33	8.28	10.11	5.18	18.11
1A	38.86	4.5	461.19	1279.33	4.16	5.24	4.04	36.05

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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 Number: Date:

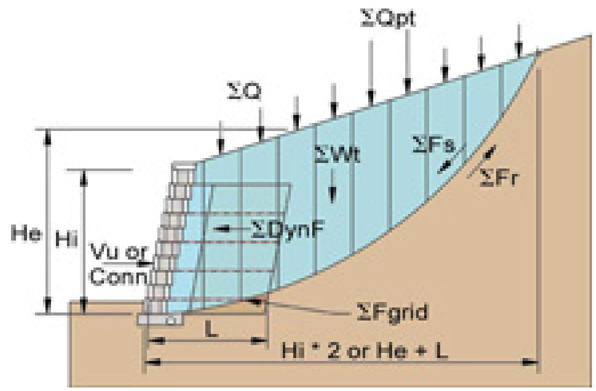
Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4.5 ft

v 20.0.5

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: 3

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
10	6.37	936.57	2243.33	499.44	0	0	1562.26	0	0
9	5.99	1417.93	2615.38	781.03	641.4	0	2342.04	0	0
8	4.46	1791.4	2828.34	1049.22	57.92	0	2968.37	0	0
7	3.76	2238.36	2899.79	1367.5	0	0	3705.26	0	0
6	3.31	2523.18	2971.23	1660.02	0	0	4187.65	0	0
5	2.97	2986.87	3042.68	2030.87	3.29	0	4952.28	0	0
4	2.65	2908.58	3114.13	2270.16	0	0	4867.74	0	0
3	2.46	3878.49	3029.38	2822.38	26.52	0	6445.24	0	0
2	2.09	3637.59	2832.84	3103.81	13.76	0	6172.11	0	0
1	1.87	4694.68	2156.94	3689.06	62.73	0	7976.15	0	0
0	1.62	5293.49	1421.58	4154.73	0	0	9124.73	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.

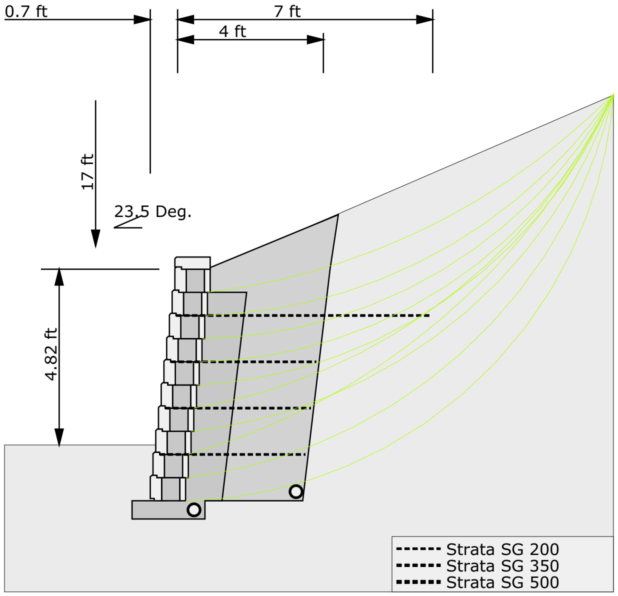
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 4 of 9

Section 33.1 ft - 41.1 ft

Base Information:

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

Geogrid Information:

1 x Strata SG 200 @ 7 ft
3 x Strata SG 200 @ 4 ft
Number Of Geogrid 4

Wall Design Variables

AB Classic

Section Height 6.35 ft
Total Panel Height 6.35 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
1.77 >= 1.5
Actual Overturning
3.33 >= 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 5.58
Sigma_ult - 6336.2 psf
Sigma_max - 1134.81 psf

Internal Compound Stability

Factor of Safety 1.58
Course Number 0

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	5.72 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 Number: Date:

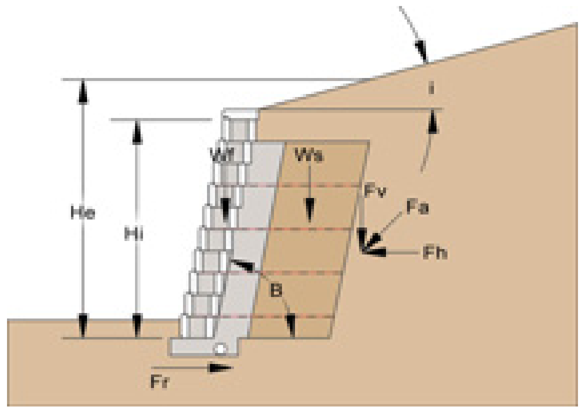
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.383
Kar = Active Earth Pressure Coefficient Retained = 0.383
H = Wall Height = 6.35 ft
He = Effective Height = 7.75 ft
He_i = Effective Height = 6.82 ft
i = Slope = 23.5 Deg.
i_int = Effective Slope = 23.5 Deg.
i_ext = Effective Slope = 23.5 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 794.05 plf
Wt = Total Weight = 3244.78 plf
Fa = Active Force = 1382.19 plf
Fav = Vertical Force = 472.74 plf
Fah = Horizontal Force = 1298.83 plf
Fr = Resistance Force = 2301.91 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
4A	42.04	7	121.63	1279.33	15.78	17.68	5.76	9.51
3A	40.77	4	165.23	1279.33	11.61	13.48	2.58	12.92
2A	39.5	4	235.04	1279.33	8.16	9.8	3.61	18.37
1A	38.23	4	483.47	1279.33	3.97	4.92	2.93	37.79

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 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:

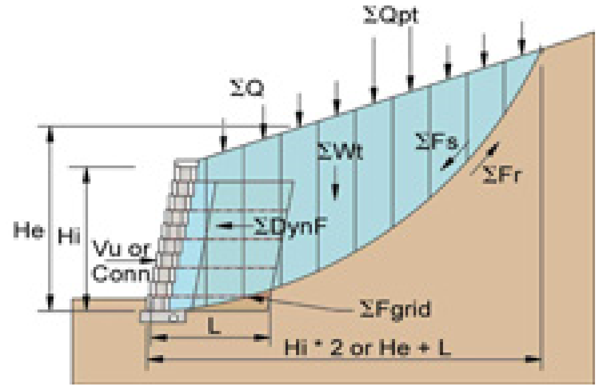
Engineer:

License Number: Date:

v 20.0.5

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: 4

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
9	1.64	789.48	139.8	568.22	0	0	1427.24	0	0
8	3.97	1433.96	2283.36	936.5	0	0	2343.73	0	0
7	4.5	1890.14	2661.49	1242.82	1042.18	0	3025.93	0	0
6	3.4	2282.21	2899.79	1561.25	133.36	0	3686.77	0	0
5	2.98	2604.93	2971.23	1874.81	3.42	0	4226.18	0	0
4	2.68	2693.84	3042.68	2137.75	1.95	0	4403.07	0	0
3	2.43	3296.96	2966.82	2586.44	30.56	0	5387.12	0	0
2	2.09	3140.36	2762.61	2829.25	0.03	0	5231.94	0	0
1	1.81	4034.81	2086.3	3410.75	63.95	0	6791.96	0	0
0	1.58	4743.26	1361.2	3875.71	0	0	8106.32	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.

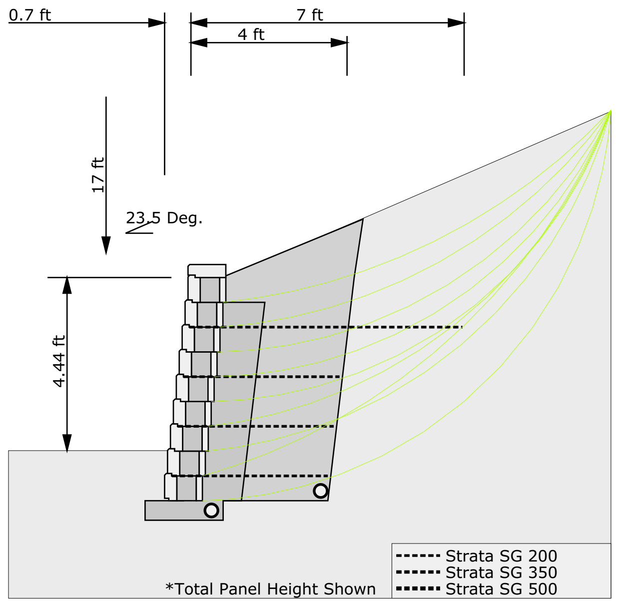
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 5 of 9

Section 41.1 ft - 52.9 ft

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

Geogrid Information:
1 x Strata SG 200 @ 7 ft
3 x Strata SG 200 @ 4 ft
Number Of Geogrid 4

Wall Design Variables

AB Classic

Section Height 5.08 ft
Total Panel Height 5.72 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
1.89 >= 1.5
Actual Overturning
3.81 >= 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 6.23
Sigma_ult - 5789.01 psf
Sigma_max - 929.71 psf

Internal Compound Stability

Factor of Safety 1.68
Course Number 8

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	5.08 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 Number: Date:

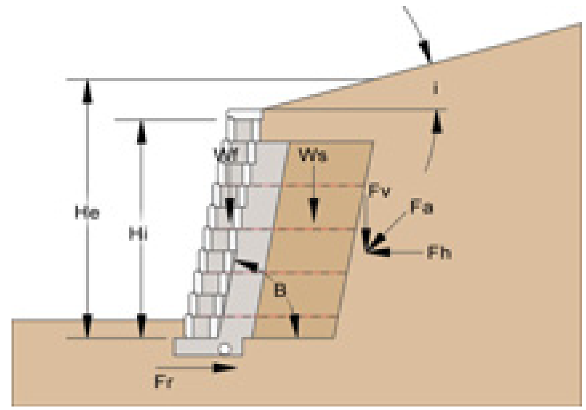
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.383
Kar = Active Earth Pressure Coefficient Retained = 0.383
H = Wall Height = 5.72 ft
He = Effective Height = 7.12 ft
He_i = Effective Height = 6.18 ft
i = Slope = 23.5 Deg.
i_int = Effective Slope = 23.5 Deg.
i_ext = Effective Slope = 23.5 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 714.65 plf
Wt = Total Weight = 2920.3 plf
Fa = Active Force = 1164.88 plf
Fav = Vertical Force = 398.41 plf
Fah = Horizontal Force = 1094.63 plf
Fr = Resistance Force = 2071.66 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
4A	41.41	7	121.63	1279.33	15.78	17.68	6.02	9.51
3A	40.14	4	165.23	1279.33	11.61	13.48	3.1	12.92
2A	38.86	4	235.04	1279.33	8.16	9.8	4.13	18.37
1A	37.59	4	304.86	1279.33	6.29	7.81	5.16	23.83

Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 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:

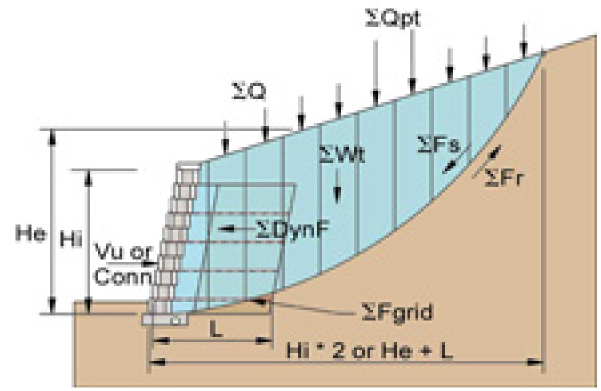
License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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: 5

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
8	1.68	686.76	139.8	491.39	0	0	1234.71	0	0
7	4.49	1145.31	2283.36	762.86	0	0	1858.3	0	0
6	5.16	1643.91	2661.49	1079.13	1257.67	0	2598.39	0	0
5	3.76	2007.27	2899.79	1372.04	255.37	0	3197.92	0	0
4	3.19	2394.37	2971.23	1686.77	15.29	0	3823.65	0	0
3	2.85	2548.56	3042.68	1965.48	3.78	0	4096.51	0	0
2	2.62	3022.9	3074.09	2341.99	32.04	0	4849.95	0	0
1	2.22	2853.3	2856.13	2580.25	6.34	0	4664.78	0	0
0	1.93	3959.62	2059.46	3113.94	0	0	6509.86	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.

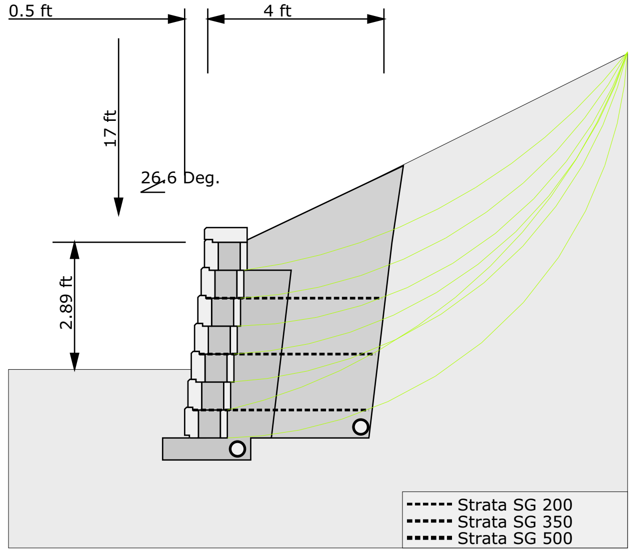
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 6 of 9

Section 52.9 ft - 58.8 ft

Base Information:

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

Geogrid Information:

3 x Strata SG 200 @ 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 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
1.86 >= 1.5
Actual Overturning
4.34 >= 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 9.18
Sigma_ult - 6392.33 psf
Sigma_max - 696.01 psf

Internal Compound Stability

Factor of Safety 1.54
Course Number 6

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 Number: Date:

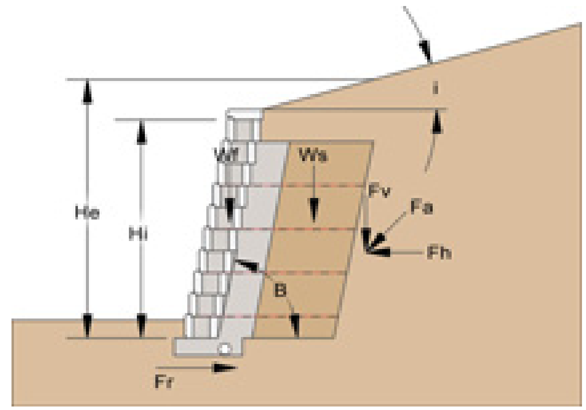
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.438
Kar = Active Earth Pressure Coefficient Retained = 0.438
H = Wall Height = 4.45 ft
He = Effective Height = 6.06 ft
He_i = Effective Height = 4.98 ft
i = Slope = 26.6 Deg.
i_int = Effective Slope = 26.6 Deg.
i_ext = Effective Slope = 26.6 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 555.84 plf
Wt = Total Weight = 2271.34 plf
Fa = Active Force = 963.71 plf
Fav = Vertical Force = 329.61 plf
Fah = Horizontal Force = 905.59 plf
Fr = Resistance Force = 1680.87 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
3A	39.5	4	147.27	1279.33	13.03	14.6	2.09	11.51
2A	38.23	4	193.09	1279.33	9.94	11.54	3.62	15.09
1A	36.96	4	272.81	1279.33	7.03	8.44	4.52	21.32

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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 Number: Date:

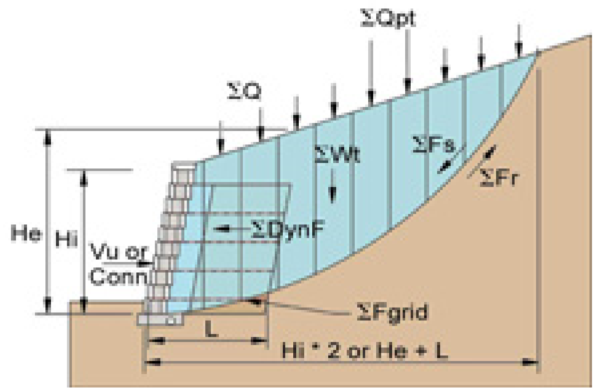
Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 ft

v 20.0.5

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: 6

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
6	1.54	601.7	139.8	480.62	0	0	1087.06	0	0
5	4.37	1103.83	2283.36	775.88	0	0	1748.04	0	0
4	3.95	1513.83	2680.43	1061.97	0	0	2372	0	0
3	3.56	1810.76	2899.79	1322.5	0	0	2829.15	0	0
2	3.15	2172.98	2921.47	1622.65	12.73	0	3393.75	0	0
1	2.63	2136.01	2688.17	1837.73	0	0	3394.51	0	0
0	2.13	2943.5	1914.39	2282.34	0	0	4744.38	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.

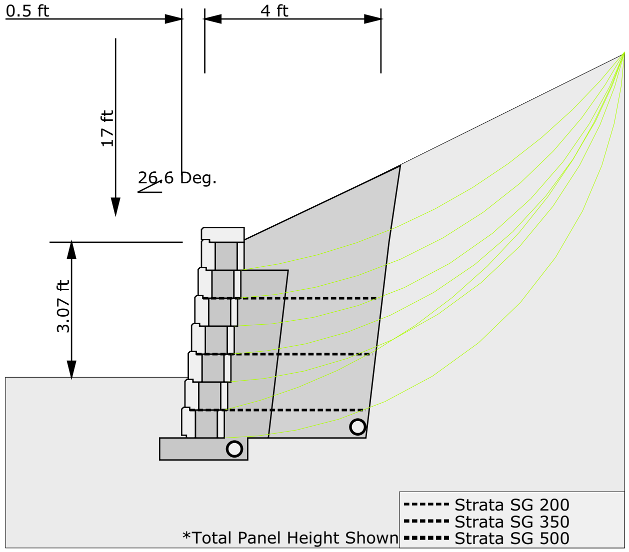
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 7 of 9

Section 58.8 ft - 64.6 ft

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

Geogrid Information:
3 x Strata SG 200 @ 4 ft
Number Of Geogrid 3

Wall Design Variables

AB Classic

Section Height 3.81 ft
Total Panel Height 4.45 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
1.86 >= 1.5
Actual Overturning
4.34 >= 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 8.62
Sigma_ult - 5999.47 psf
Sigma_max - 696.01 psf

Internal Compound Stability

Factor of Safety 1.54
Course Number 6

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 Number: Date:

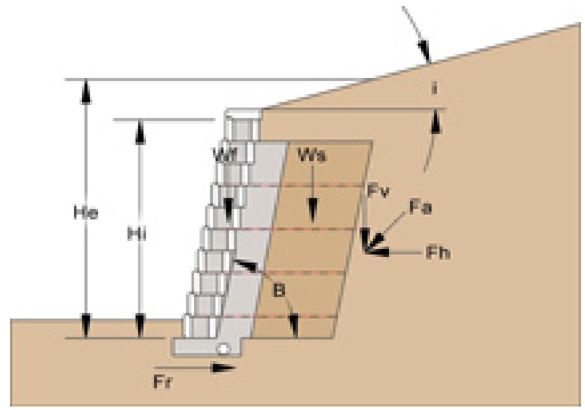
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.438
Kar = Active Earth Pressure Coefficient Retained = 0.438
H = Wall Height = 4.45 ft
He = Effective Height = 6.06 ft
He_i = Effective Height = 4.98 ft
i = Slope = 26.6 Deg.
i_int = Effective Slope = 26.6 Deg.
i_ext = Effective Slope = 26.6 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 555.84 plf
Wt = Total Weight = 2271.34 plf
Fa = Active Force = 963.71 plf
Fav = Vertical Force = 329.61 plf
Fah = Horizontal Force = 905.59 plf
Fr = Resistance Force = 1680.87 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	39.5	4	147.27	1279.33	13.03	14.6	2.09	11.51
2A	38.23	4	193.09	1279.33	9.94	11.54	3.62	15.09
1A	36.96	4	272.81	1279.33	7.03	8.44	4.52	21.32

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 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:

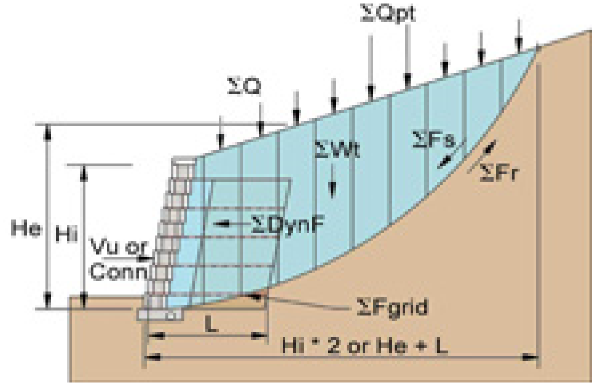
Engineer:

License Number: Date:

v 20.0.5

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: 7

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
6	1.54	601.7	139.8	480.62	0	0	1087.06	0	0
5	4.37	1103.83	2283.36	775.88	0	0	1748.04	0	0
4	3.95	1513.83	2680.43	1061.97	0	0	2372	0	0
3	3.56	1810.76	2899.79	1322.5	0	0	2829.15	0	0
2	3.15	2172.98	2921.47	1622.65	12.73	0	3393.75	0	0
1	2.63	2136.01	2688.17	1837.73	0	0	3394.51	0	0
0	2.13	2943.5	1914.39	2282.34	0	0	4744.38	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.

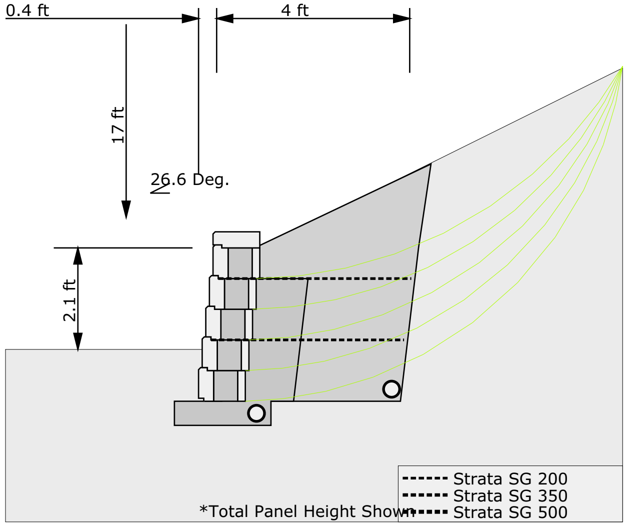
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 8 of 9

Section 64.6 ft - 70.5 ft

Base Information:

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

Geogrid Information:

2 x Strata SG 200 @ 4 ft
Number Of Geogrid 2

Wall Design Variables

AB Classic

Section Height 2.54 ft
Total Panel Height 3.18 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
2.18 >= 1.5
Actual Overturning
6.29 >= 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 10.42
Sigma_ult - 5326.01 psf
Sigma_max - 511.27 psf

Internal Compound Stability

Factor of Safety 2.03
Course Number 0

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	2.54 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 Number: Date:

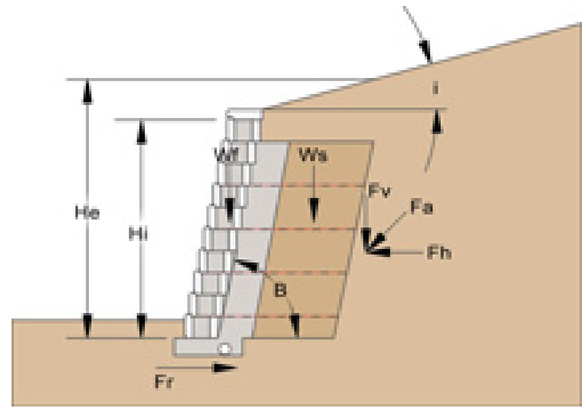
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.438
Kar = Active Earth Pressure Coefficient Retained = 0.438
H = Wall Height = 3.18 ft
He = Effective Height = 4.79 ft
He_i = Effective Height = 3.71 ft
i = Slope = 26.6 Deg.
i_int = Effective Slope = 26.6 Deg.
i_ext = Effective Slope = 26.6 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 397.03 plf
Wt = Total Weight = 1622.39 plf
Fa = Active Force = 601.77 plf
Fav = Vertical Force = 205.82 plf
Fah = Horizontal Force = 565.47 plf
Fr = Resistance Force = 1234.72 plf



Internal Design Calculations (Static)

Section: 8

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
2A	40.14	4	80.62	1279.33	23.8	26.21	3.08	6.3
1A	38.86	4	259.74	1279.33	7.39	8.43	2.4	20.3

Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 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:

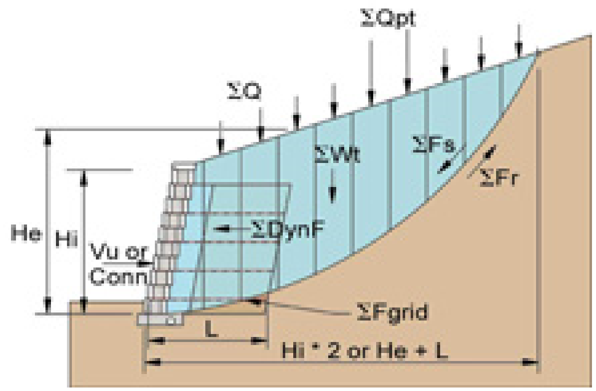
License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

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: 8

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
4	6.27	687.05	2186	457.94	0	0	1075.51	0	0
3	4.87	972.81	2266.88	666.1	1.01	0	1516.95	0	0
2	4.04	1277.46	2347.76	897.62	0	0	1984.38	0	0
1	2.88	1566.42	1733.13	1149.32	6.68	0	2478.9	0	0
0	2.03	1828.89	1059.27	1420.19	0	0	2998.96	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.

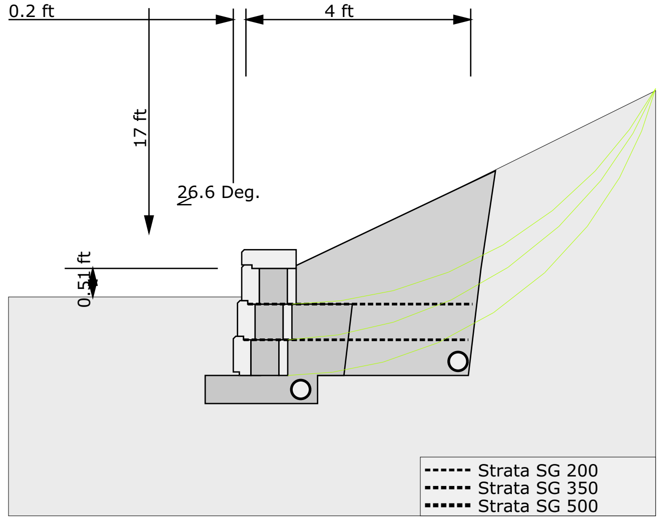
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



AB Classic

Section 9 of 9

Section 70.5 ft - 72 ft

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

Geogrid Information:
2 x Strata SG 200 @ 4 ft
Number Of Geogrid 2

Wall Design Variables

AB Classic

Section Height 1.91 ft
Total Panel Height 1.91 ft
0.635 ft
Angle of Setback 6 Deg.
Depth of Block 0.97 ft
Length of Block 1.47 ft

Safety Factors Static External

Actual Sliding
2.64 >= 1.5
Actual Overturning
10.24 >= 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 18.12
Sigma_ult - 6041.56 psf
Sigma_max - 333.47 psf

Internal Compound Stability

Factor of Safety 4.07
Course Number 0

Wall Rock Requirements

Variable Depth

	Height	Depth
Bottom	1.27 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 Number: Date:

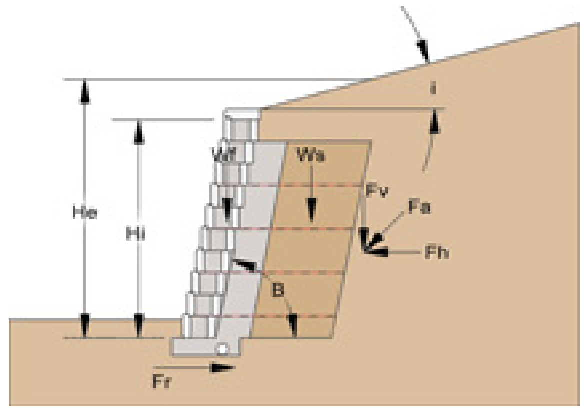
Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Wall Design Variables

Kai = Active Earth Pressure Coefficient Infill = 0.438
Kar = Active Earth Pressure Coefficient Retained = 0.438
H = Wall Height = 1.91 ft
He = Effective Height = 3.52 ft
He_i = Effective Height = 2.44 ft
i = Slope = 26.6 Deg.
i_int = Effective Slope = 26.6 Deg.
i_ext = Effective Slope = 26.6 Deg.

Setback = 90 - Beta Angle = 6.73 Deg.
Wf = Weight of Facing = 238.22 plf
Wt = Total Weight = 973.43 plf
Fa = Active Force = 324.65 plf
Fav = Vertical Force = 111.04 plf
Fah = Horizontal Force = 305.07 plf
Fr = Resistance Force = 805.33 plf



Internal Design Calculations (Static)

Section: 9

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
2A	40.77	4	54.77	1279.33	35.04	38.58	5.46	4.28
1A	40.14	4	92.5	1279.33	20.75	23.25	5.54	7.23

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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 Number: Date:

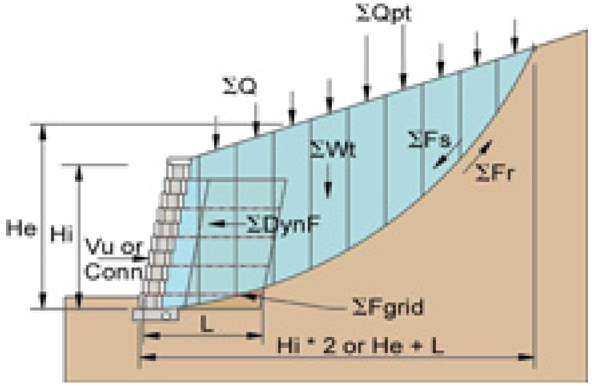
Geogrid Legend

A - Strata SG 200
B - Strata SG 350
C - Strata SG 500
Min. Length of Geogrid: 4 ft

v 20.0.5

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: 9

Course Number	Factor of Safety (Static)	SFr (plf)	SVu : SConn (plf)	SFs (plf)	SFgrid (plf)	SDynF (plf)	SWt (plf)	SQ (plf)	SQpt (plf)
2	8.77	543.07	2591.4	357.26	0	0	835.41	0	0
1	6.48	775.68	2638.71	531.33	26.54	0	1183.47	0	0
0	4.07	1060.07	1967.13	747.47	18.52	0	1627.24	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.

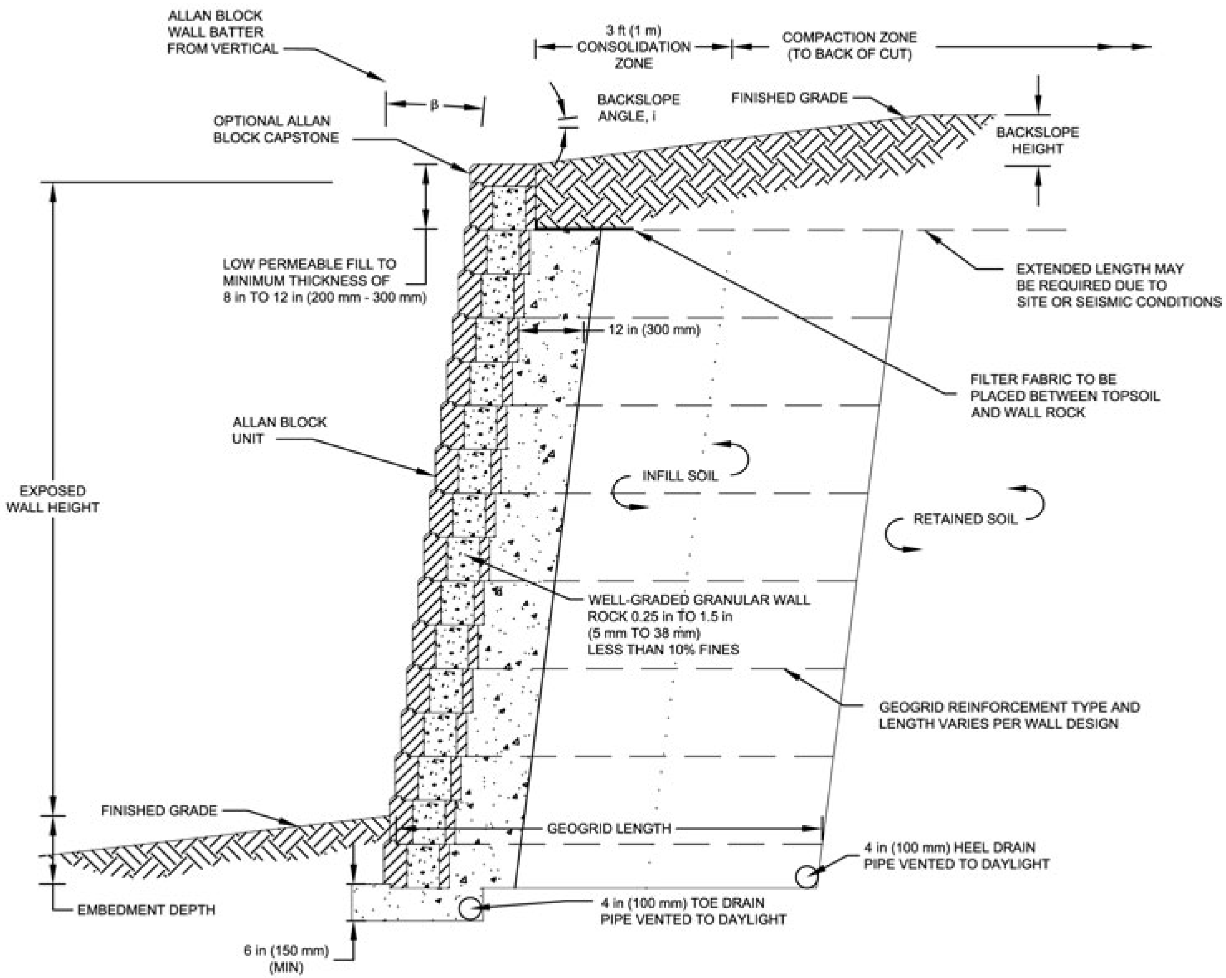
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Typical Reinforced Wall Section

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

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.

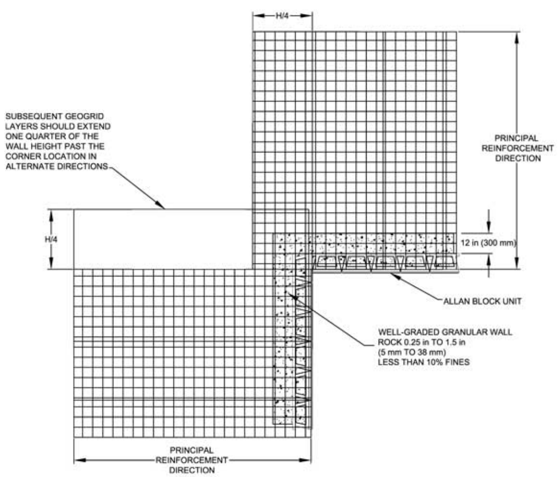
Signature:

Engineer:

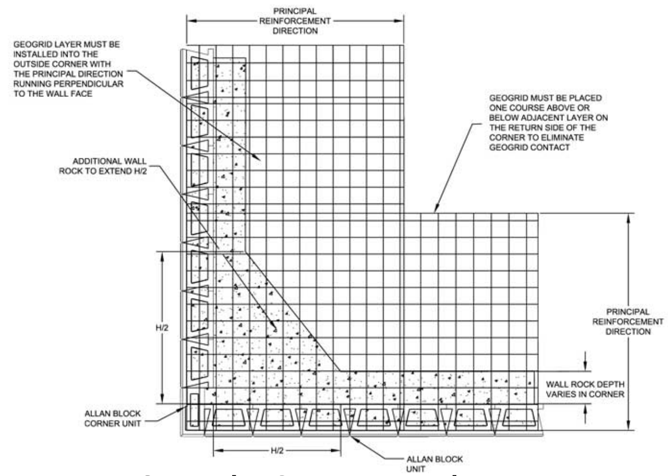
License Number: Date:

Note: Details Not To Scale

v 20.0.5



Inside Corner Application



Outside Corner Application

Note: Details Not To Scale

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.

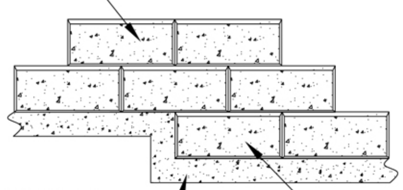
Signature:

Engineer:

License Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Step-Up at Base Course

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:

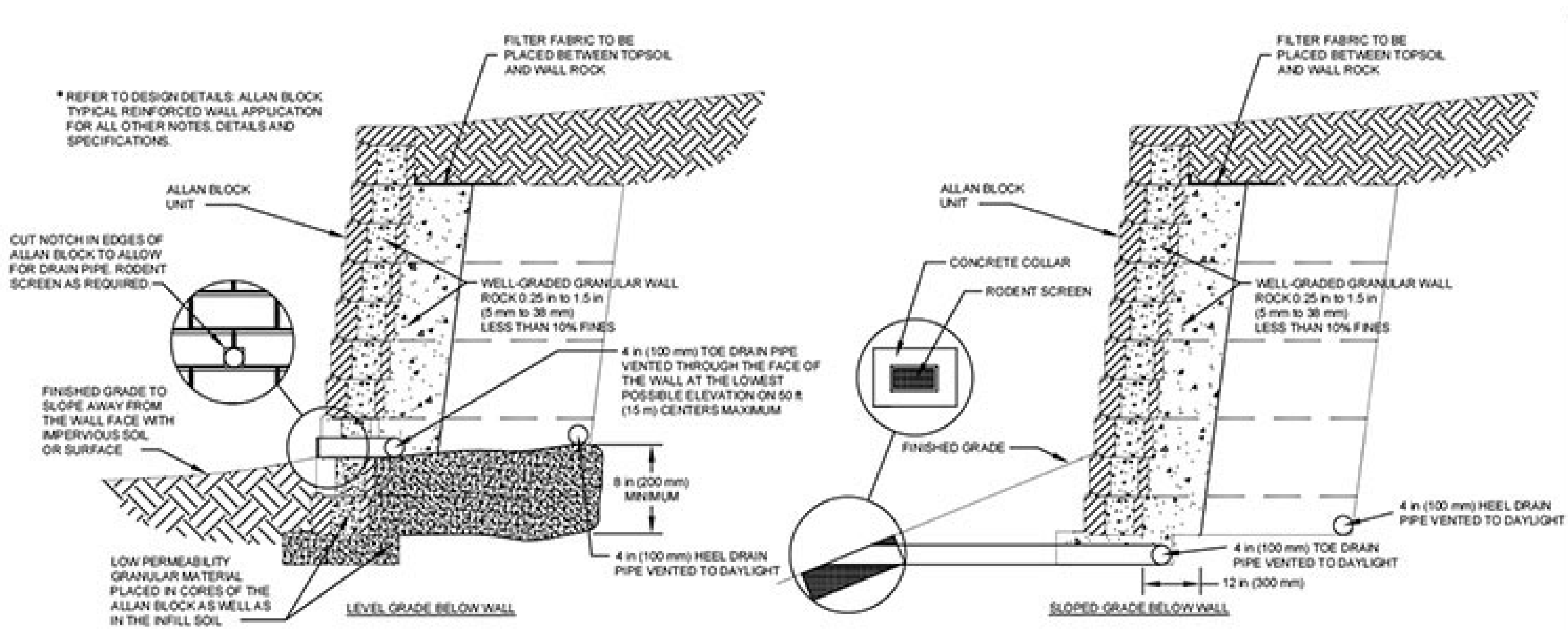
Engineer:

License Number: Date:

Note: Details Not To Scale

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Alternate Drain

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:

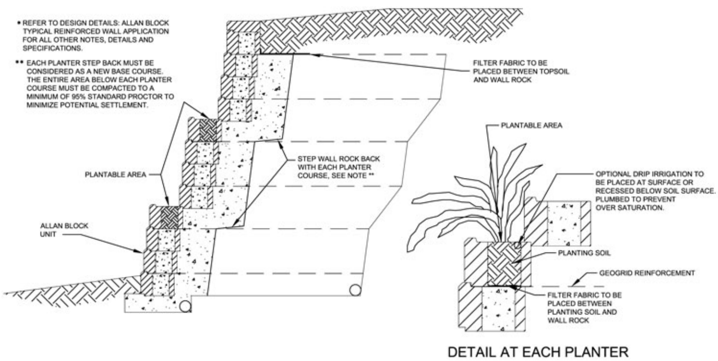
Engineer:

License Number: Date:

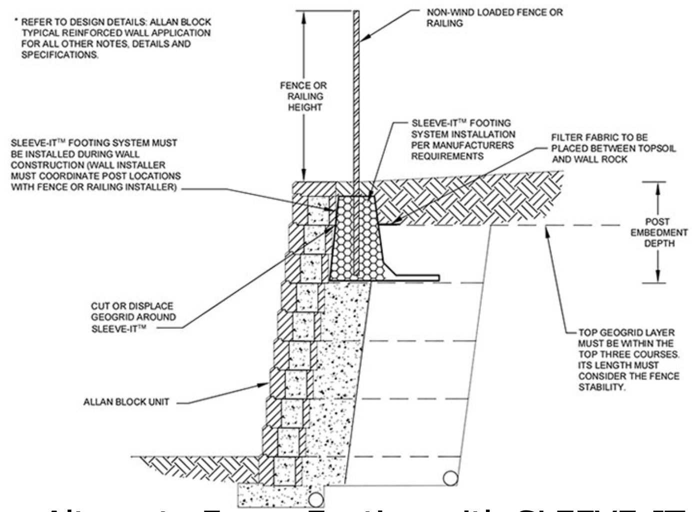
Note: Details Not To Scale

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Plantable Wall Section



Alternate Fence Footing with SLEEVE-IT

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:

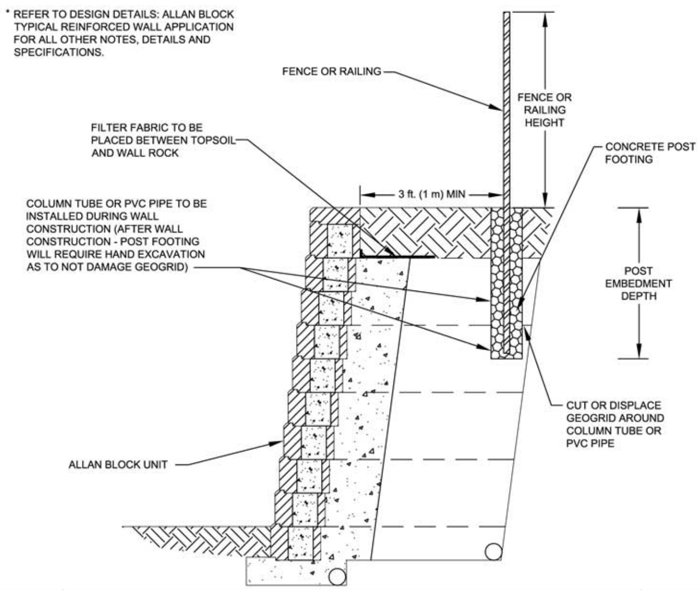
Engineer:

License Number: Date:

Note: Details Not To Scale

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5



Wind Fence Wall Section 2

Note: Details Not To Scale

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 Number: Date:

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

AB Wall Material and Labor Estimate Worksheet

Material Estimate (Using Plan View):

	Quantity	Unit	Overage	Quantity	Cost	Total
AB Classic	505	Blocks	0 %	505	$0.00	$0.00
Wall Caps	49	Blocks	0 %	49	$0.00	$0.00
Filter Fabric	16	yd^2	0 %	16	$0.00	$0.00
Strata SG 200	185.8	yd^2	0 %	185.8	$0.00	$0.00
Rock in Base	4.32	ton	0 %	4.3	$0.00	$0.00
Wall Rock	34.4	ton	0 %	34.4	$0.00	$0.00
1 Soil Type	56.1	yd^3	0 %	56.1	$0.00	$0.00
Drain Pipe	143.96	ft	0 %	144	$0.00	$0.00
						$0.00

Labor Estimate

	Length / Area	Unit	Cost / Hour	Total
Base Crew	72 ft	0 ft/hr	$0.00	$0.00
Wall Crew	426 ft^2	0 ft^2/hr	$0.00	$0.00
			Labor Total	$0.00

Engineering Estimate

	Wall Area	Cost/ft^2	Total
Engineering Cost	471.4 ft^2	$25.00	$11,785.00
		Engineering Total	$11,785.00

Subtotal	$11,785.00
Profit	0 %
Overhead	0 %
Project Total	$11,785.00
Cost / ft^2	$25.00

Block overage has not been added to the total wall area.

Project Name: 522 SOUTH RIVERSIDE DRIVE
Location: BLOCK 5213, LOT 1
Location: NEPTUNE, NJ
Wall Number: 1 OF 1
Project Number: 200203
Designer: JOHN A. BULETZA, PE
Date: 6-8-2020

v 20.0.5

Nelson Engineering Associates, Inc.

1750 Bloomsbury Avenue • Ocean, NJ 07712
(732) 918-2180 • FAX: (732) 918-0697

522 South Riverside Drive, Block(s): 5213; Lot(s): 1
Township of Neptune, Monmouth County, NJ 08736

NEAI File # 200203

Date & Time: Wednesday, June 10, 2020, 9:30 AM
Witnessed By: N/A

Weather conditions at time of test: 79° F, high clouds, sun
From: N/A

Soil Log Ground Surface Elevation: 40.0 **SB#1** Soil boring near retaining wall Sta. 0+35

Depth	Description	Munsell
0" - 2"	Very dark gray topsoil	5 YR 3/1
2" - 10"	Dark reddish gray loamy sand with some silt and 5% gravel, fine granular structure, moist, loose, common (20% Max.) roots, abrupt (1" Max.) boundary	5 YR 4/2
10" - 14"	Very dark gray sandy loam, subangular, fine granular structure, moist, loose, many (20% Min.) roots, abrupt (1" Max.) boundary	5 YR 3/1
14" - 30"	Light reddish brown sandy clay with some silt, fine granular structure, moist, loose, gradual (5" Max.) boundary. Unified Soil Classification: MH	5 YR 6/4
30" - 44"	Pale yellow sand with some silt and clay and 40% gravel, coarse granular structure, moist, loose, gradual (5" Max.) boundary. Unified Soil Classification: GM	2.5 Y 7/4
44" - 56"	Light yellowish brown sand with some silt and clay, fine granular structure, moist, loose, with many coarse, distinct olive yellow (2.5 Y 6/8) mottles throughout, diffuse (5" Min.) boundary	2.5 Y 6/4
56" - 70"	Brownish yellow sand with some silt and clay, iron staining from 64" to 70", fine & medium granular structure, moist, loose, clear (1" Max.) boundary	10 YR 6/6
70" - 84"	Light gray sand with some silt, fine granular structure, moist, loose, with many fine, faint yellow (2.5 Y 7/8) mottles throughout	10 YR 7/1

No water seepage encountered
Depth to expected seasonal high water table (SHWT): 44" = 3.7'

Expected seasonal high water table (SHWT) elevation: 36.3
No sample taken

The expected seasonal high water table (SHWT) elevation near the proposed retaining wall is 36.3. The load-bearing pressure of the in-situ soils at the approximate bottom of proposed wall footing elevation (24-inch depth) from IRC 2018 TABLE R401.4.1 Presumptive Load-Bearing Values of Foundation Materials is 2,000 PSF

I hereby certify, to the best of my professional knowledge and belief, that the above information is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58: 10A-et. Seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

John A. Buletza, PE, PP, CME
(SEAL)

6/10/2020
Date

Sleeve-It™ & Allan Block Instructions

SLEEVE-IT™

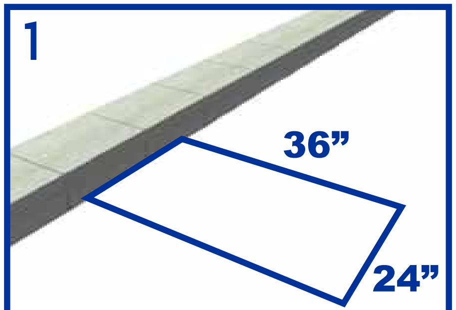
WHEN YOUR WALL NEEDS A FENCE

patents pending

INSTALLATION INSTRUCTIONS

Parts List:
(1) Steel Cantilever
(2) Steel Struts
(2) Plastic Sleeve Halves
(2) Plastic Ties
(1) Plastic Lid

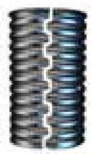
1



Prepare a level area approximately 24” wide by 36” deep behind the wall face.

The prepared area shoud be 24” below the proposed top of wall (not including the cap stone).

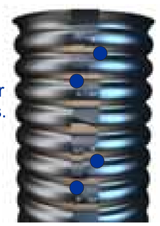
2



Take the two plastic sleeve halves, one front (no slots) and one back (with slots) and lay them on a level surface with the IN (smooth fingers) and the OUT (raised fingers) opposite each other.

Suggestion: Using the top of the Sleeve-It box as your level surface prevents having to bend over

Thumb Locations: ●
Note: Not actually on Sleeve



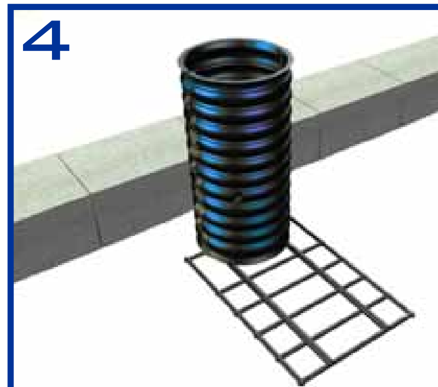
Interweave the two sleeve halves by pushing the IN finger sets under the OUT finger sets. Flip the sleeve over and follow the same procedure on the other side.

Stand the unit vertically and use two plastic ties to secure the sleeve halves into a cylindrical unit.

3

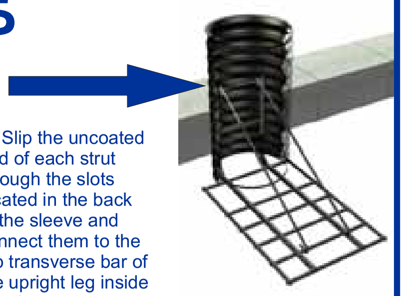
Place the PVC coated Steel Cantilever on the prepared area with the upright leg about 6” from the tail of the block.

4

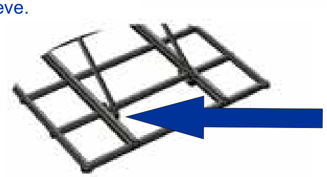


Slide the sleeve over the upright leg with the slotted slide of the sleeve facing away from the wall face.

5



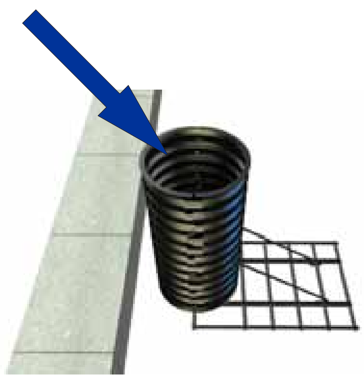
A) Slip the uncoated end of each strut through the slots located in the back of the sleeve and connect them to the top transverse bar of the upright leg inside the sleeve.



B) Connect the coated ends of the struts to the second transverse bar from the back.

6

Reposition the entire system as needed by lifting it using the top transverse bar of the upright leg inside the sleeve.



Make sure the wall batter for any remaining courses of block is accounted for when positioning the sleeve in its final location.

7

Place enough 3/4” clean stone around the system to encapsulate the exposed portion of the struts and stabilize the cantilever base. Set the lid in place and turn the handle perpendicular to the wall face. Use the handle as the center line measuring guide to ensure the next **SLEEVE-IT™** unit is placed with the proper spacing requirements as directed by the fence specifications.

8

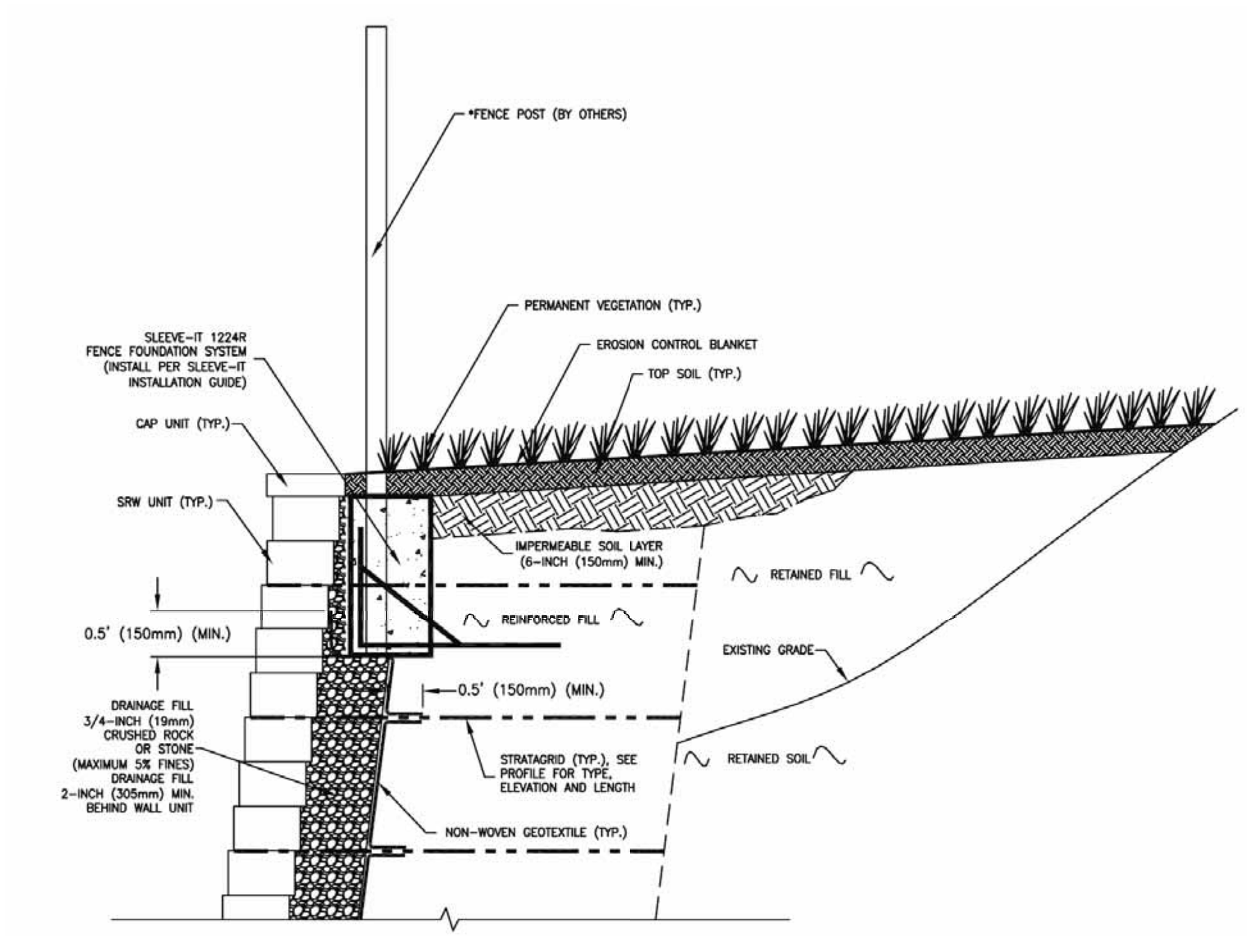
When installing geogrid around the **SLEEVE-IT™ SYSTEM**, slit the geogrid perpendicular to the wall face just enough to fold around the sleeve ensuring that the grid is properly attached to the wall face everywhere with the exception of where the sleeve is. This method is acceptable by geogrid manufacturers when obstacles such as fence post foundations are present.

IMPORTANT NOTE:

Care should be taken not to affect the integrity of the struts during the first 6"-8" backfill lift. Backfill and compaction within three feet of the wall face should be performed with hand operated equipment as recommended by the National Concrete Masonry Association (NCMA) SRW guidelines. For additional information visit www.geogrid.com ©2008

Strata Systems, Inc.
380 Dahlonega Road, Ste 200
Cumming, GA 30040

Phone: (770) 888-6688
Fax: (770) 888-6680
www.geogrid.com



SLEEVE-IT 1224R SYSTEM

FENCE AND PEDESTRIAN RAIL FOUNDATION

Sleeve-It 1224R System – Fence and Pedestrian Rail Foundation for Segmental Retaining Walls

Introduction

The segmental retaining wall industry is the mainstay of vertical grade separation structures for residential, commercial and private sector markets. Segmental retaining walls have become a part of many state highway department and federal highway administration projects. The inherit benefit of a dry-cast, mortarless retaining wall construction; ease of construction, economic structures, and hand-placed units, is in part a detriment to one important consideration that is critical in almost every project – lateral resistance for fence or pedestrian rail foundations .

Light-weight units combined with mortarless construction result in wall systems that have limited stability when not combined with soil reinforcement. Most segmental retaining wall systems incorporate relatively light-weight units (approx. 60 to 80 lbs each) having nominal dimension of 6 to 8 inches high by 12 inches wide (depth from front of unit to rear of unit) and 16 to 18 inches long (length along the wall face. These wall systems are typically stable without soil reinforcement up to vertical heights of 2 to 4 feet, retaining only soil fill. If a fence or pedestrian rail post is placed directly behind the unit even when encased in a 12" diameter by 24" deep concrete foundation, then the system is unable to provide adequate resistance against overturning and/or sliding and will not meet building code requirements for fall protection.

The Sleeve-It 1224R System is design specifically to address the need for small post foundations placed directly behind segmental retaining wall systems. The Sleeve-It System incorporates a cantilever base with a 12" diameter by 24" deep column foundation to provide the necessary lateral and uplift resistance to meet published building codes. The cantilever base uses D-4 and D-7 wire complying with ASTM A496, and the fabrication complies with ASTM A497. Two struts, comprised of W-4 wire meeting ASTM A82, are used to lateral restrain the vertical leg of the cantilever base and transfer lateral load from the post foundation to the cantilever base. The 12" diameter post foundation is comprised of two interlocking HDPE sleeve components that are field connected and provide openings for the two cantilever base struts. All portions of the cantilever base and struts that are not embedded in concrete are treated with an epoxy phenolic primer and then dipped in a proprietary PVC coating bonded by thermal fusion.

The Sleeve-It 1224R System utilizes a cantilever base system to provide increased resistance to sliding forces and overturning moments induced when a load is applied to a fence or pedestrian rail. The 1224R system behaves in much the same manner as a conventional cantilever wall system. The cantilever base extends the width of the 24" concrete post foundation, thus providing greater resistance to lateral sliding and uplift or overturning. The soil mass directly above the base adds vertical weight while the passive resistance developed during soil uplift provides further resistance to overturning. The increased capacity provides an effective fence and pedestrian post foundation system that meets building code requirements.

Building Codes – Residential and Commercial

Both residential and commercial building codes specifically state guards shall be provided when the vertical grade between different surfaces exceed a fixed vertical height. Commercial codes further define minimum load requirements that the guards are to provide. The codes are generally interpreted to require guards (protection) atop retaining wall structures and are applicable to fencing and pedestrian rail systems placed atop segmental retaining wall systems.

Residential Codes

The International Residential Code (IRC) states, Section R312 - Guards, that guards are required when raised surfaces are located more than 30 inches above the floor or grade below. The guard shall not be less than 36 inches (3 feet) in height. The requirement for guards applies to porches, balconies, decks, ramps and raised surfaces (i.e. retaining walls).

Commercial Codes

The International Building Code (IBC) states, Section 1013 – Guards, that guards shall be located along open-sided walking surfaces, mezzanines, industrial equipment platforms, stairways, ramps and landings that are located more than 30 inches above the floor or grade below. The guard shall provide adequate strength to meet the load requirements of Section 1607.7. Section 1607.7.1 requires guards and handrails to resist a load of 50 pounds per linear foot applied along the top, and Section 1607.7.1.1 states the assemblies and guards shall be able to resist a single concentrated load of 200 pound applied along the top.

Based on Section 1607.7.1, the minimum load required to be resisted will be a function of post spacing. The following table summarizes several common posts spacing and corresponding load condition.

Post Spacing (ft)	Applied Load (lbs)
Single Post (concentrated load)	200
4-ft post spacing	200
6-ft post spacing	300
8-ft post spacing	400
10-ft post spacing	500

The table above has several implications regarding required post or foundation capacity depending on the location of applied load. The building codes indicate the load shall be applied atop the guard. This implies the load shall be applied atop the post, which will result in an applied moment that is a function of both the post height and the post spacing. The following table indicates the minimum required moment as a function of post height or location of applied load above a 24-inch deep foundation.

Post Spacing (ft)	Applied Load (lbs)	3-ft Post above 24-inch Deep Foundation (minimum guard height per IRC)		6-ft Post above 24-inch Deep Foundation	
		Location of Applied Load (ft)	Applied Moment (lb-ft)	Location of Applied Load (ft)	Applied Moment (lb-ft)
Single Post (concentrated load)	200	5	1000	8	1600
4-ft post spacing	200	5	1000	8	1600
6-ft post spacing	300	5	1500	8	2400
8-ft post spacing	400	5	2000	8	3200
10-ft post spacing	500	5	2500	8	4000

It is generally inferred that fences or pedestrian rails (i.e. guards) are required atop any segmental retaining wall exceeding 30 inches in exposed height as a means of providing fall protection to the public. The Sleeve-It 1224R system is engineered to meet the IRC and IBC requirements for guards – fence and pedestrian rail systems.

Sleeve-It 1224R Testing

Product Development Testing (2005)

The development of the Sleeve-It 1224R System included full-scale load test to document the structural capacity of the system as well as documenting the insufficient capacity of conventional 12-inch diameter, 24-inch deep concrete post foundations placed directly behind segmental retaining units.

Initial development testing was formulated based on a review of the Pennsylvania Department of Transportation (PennDOT) fence post testing performed in the 1970 and a 2001 study of fence post anchoring systems published by Rutgers University in cooperation of the New Jersey Department of Transportation and the U.S. Department of Transportation Federal Highway Administration. The PennDOT study involved applying load at the top of conventional fence post installed in a standard foundation with sufficient lateral resistance on all sides. The PennDOT study indicated the post failed prior to the foundation and additional research is required. The Rutgers study involved installing post in a fully-lateral supported foundation and applying a load at 24-inches above grade, which is consistent with the typical height of a vehicle bumper. The Rutgers study found the foundations consistently failed prior to the post.

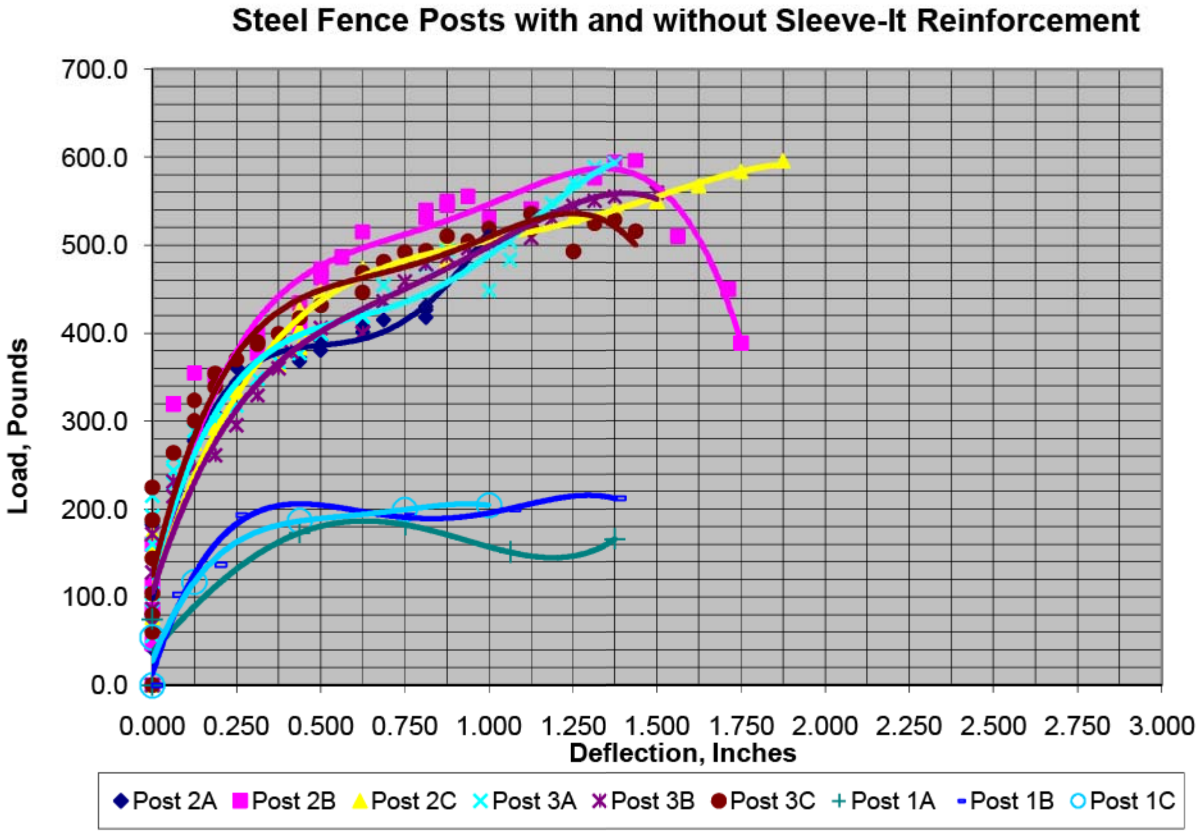
The initial development testing considered an applied load located 24-inches above grade and included 9 tests with steel fence posts. The tests were conducted with schedule 40 (steel) posts, commonly referred to as 2.5 inch line posts. The test program was divided as follows:

- (3) Tests – 12” diam. By 24” deep forms without Sleeve-It System – Tests 1A, 1B, 1C
- (3) Tests – Prototype Sleeve-It 1224R – Tests 2A, 2B, 2C
- (3) Tests – Prototype Sleeve-It 1224R with one layer of geogrid reinforcement approximately 8-inches above the cantilever base (or 16 inches below the top of wall) – Tests 3A, 3B, 3C
- All posts foundations were filled with ready mix concrete, 3000 psi, ¾-inch (max.) aggregate size, delivered to the test site by a local supplier

The posts foundations were installed as part of the construction for a 90-ft long by 52-inch high segmental retaining wall built in general accordance with manufacturers guidelines. The wall units utilized were nominally 8” high by 12” deep by 18” long with open core filled with aggregate. The units were installed without pins, clips or other concrete alignment devices. Backfill soil consisted primarily of silt with some clay and trace of sand and was compacted in 8-inch lifts. Compaction was performed wet of optimum to simulate worst case conditions.

Load test were performed using a Come-Along ratcheting cabled winch mechanism with inline S-type load cell. The system was attached to the post at 24-inches above grade and secured to a dead man, a Case tracked excavator with a gross vehicle weight of 29000 lbs. Deflection was manually measured to the nearest 1/16 inch.

The results of the test are summarized in the graph below. The data indicates the conventional 12-inch diameter, 24-inch deep concrete post foundation with an applied load located at 24-inches above grade provided a maximum resistance of 200 lbs. The six (6) tests incorporating the Prototype Sleeve-It 1224R provided a maximum resistance of 500 to 600 lbs.



In terms of resisting moments, the conventional fence post foundation provided only 800 lb-ft of moment capacity, as measured from the bottom of the 24-inch deep foundation. Building codes require all guards to be a minimum of 36 inches above grade, and this would require a minimum moment capacity of 1000 lb-ft (200 lbs concentrated load x (36" + 24"). The conventional post foundation has a limiting moment capacity of only 800 lb-ft so it can only accommodate a maximum concentrated load of 160 lbs, if applied at 36 inches above grade. The conventional post foundation does not meet building code requirements.

The Prototype Sleeve-It 1224R provided 500 to 600 lbs resistance, which equates to approximately 2750 lb-ft moment capacity. If the load were applied at 36 inches above grade in accordance with the reference building codes, then the prototype could resist 450 lbs of force. This exceeds the 200 lbs (min.) concentrated load as required by the IBC for guards.

Sleeve-It 1224R System Testing (2006)

Full-scale testing of the Sleeve-It 1224R System (commercial product) was initiated to demonstrate compliance with building code requirements. Testing was performed at Sleeve-It facilities using a full-scale segmental retaining wall constructed in a controlled, laboratory environment. The wall was constructed to 25 feet long by 4-1/4 feet (51 inches) tall with a compacted fill zone of 7 feet, as measured from the wall face.

The wall units were comprised of non-proprietary, hollow core 8"Hx16"Wx12"D units, and a single layer of geogrid reinforcement (ultimate tensile strength, T_{ULT} = 3000 lb/ft) was situated directly beneath the cantilever base (24" from top of wall). Backfill soil was a brown, silty sand (SM) with the following engineering properties: friction angle = 28 degrees, cohesion = 295 psf, maximum dry density (ASTM D698) = 108.5 pcf, and approximately 40 percent passing the #200 sieve. The fines content was slightly outside that recommended by the National Concrete Masonry Association (≤ 35% passing the # 200); however, the wall construction was considered to be a "worst case" scenario. All backfill was compacted to 95% maximum dry density.

Picture shows the full-scale test wall constructed at Sleeve-It Facilities. Two Sleeve-It 1224R Systems are visible in the foreground. A steel reaction frame used as part of the loading system is visible in the background.

Fence post installed for the full-scale test were W6x15 structural steel members. Structural steel members were selected, instead of conventional fence post, to prevent post failure and induce structural failure of the foundation in order to measure maximum system capacity. Each W6x15 structural steel member was placed in the 12-inch diameter, 24-inch deep Sleeve-It with approximately 1.5 cubic feet of concrete.

Lateral load was applied to the W6x15 structural steel using a hydraulic ram at a distance of 48 inches above finished grade (approximately 6 feet above the bottom of the 1224R foundation). Load was applied at 50-lb (nominal) increments and measured using an S-Type load cell placed between the ram and structural steel. Wall deflection was measured at the top of upper most 8"Hx16"Wx12"D unit with a dial gauge deflectometer. Load was incrementally increased until failure or excessive movement of the wall was observed.

Picture shows the hydraulic ram and load cell setup (on left), and dial gauge deflectometer and load cell readout panel (on right).

The test program involved six (6) total load tests; (3) control group – posts set in 12-inch diameter, 24-inch deep sonotube installed directly behind the wall, and (3) Sleeve-It 1224R – posts set in 1224R foundation system installed directly behind the wall.

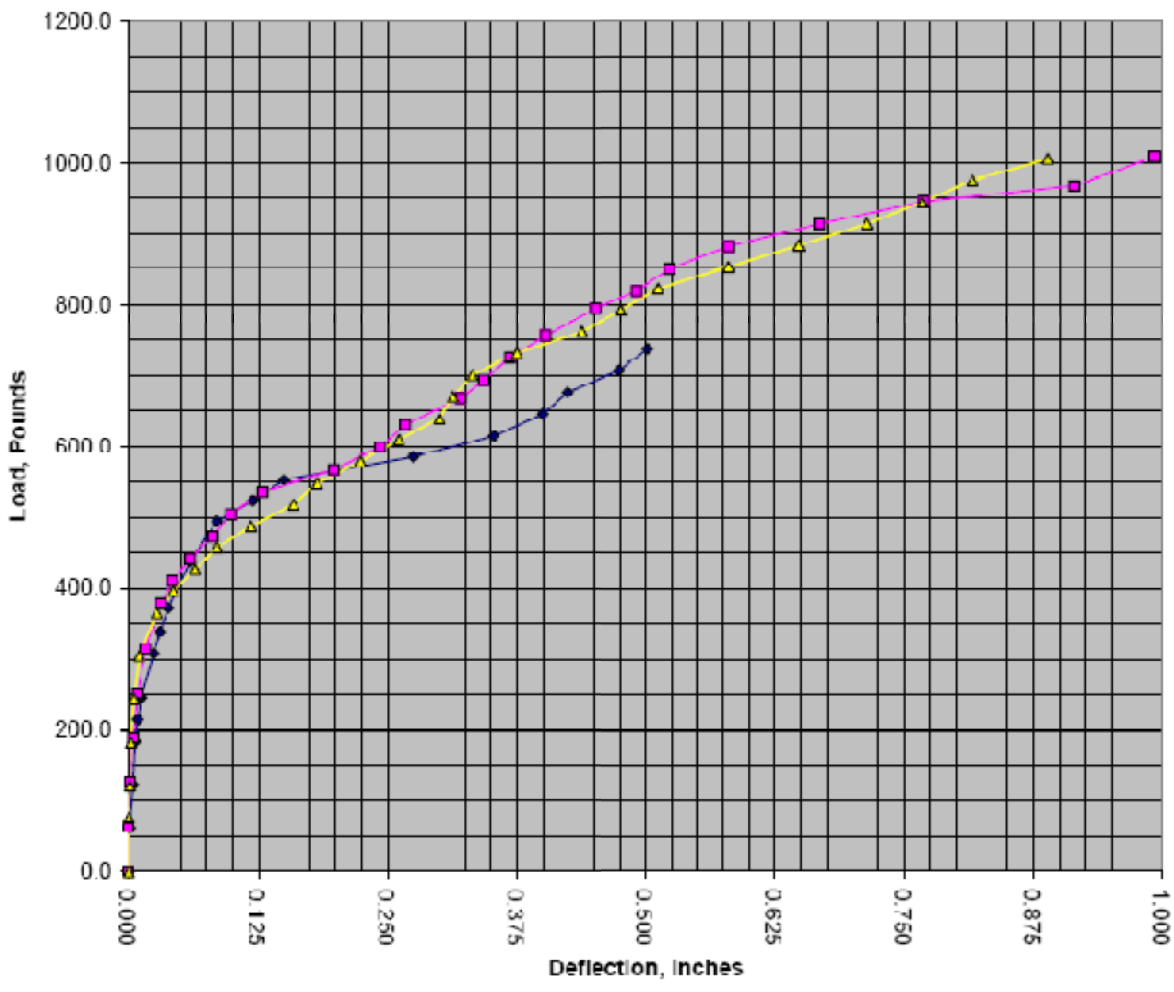
The results of the control group (conventional post foundation) showed the wall almost immediately deflect upon application of horizontal load. The averagely load capacity for the control group was approximately 100 lbs. Wall failure, defined as free wall movement without increase in load resistance, occurred between 75.6 and 138.7 pounds.

- It should be noted that these results are consistent with the results from the development testing performed in 2005. During development testing, the conventional post foundation achieved a maximum load capacity of 200 lbs at an applied load height of 24- inches, or a maximum moment capacity of 400 lb-ft. The results of this testing program showed a maximum load capacity of approximately 100 lbs at an applied load height of 48-inches, or a maximum moment capacity of 400 lb-ft. The results of both test programs indicated equal load capacity.

The Sleeve-It 1224R System group showed significant improvement over the control group. Three (3) load tests were conducted. The first test was carried out until a half inch of wall deflection due to limits in the initial dial gauge deflectometer setup. The two remaining tests were carried out to approximately 1000 lbs of load. The wall showed no wall movement at loads up to 400 pounds.

- These results indicated the Sleeve-It 1224R System has a maximum capacity of 1000 lbs for an applied load at 48 inches above grade (6 feet above the cantilever base). This equates to a maximum moment capacity of 6000 lb-ft. The building code does not define a service state limit; however, it is reasonable to consider a half inch limit for deflection. This results in a maximum load capacity of 800 lbs and maximum moment capacity of 4800 lb-ft.

The results of the control group and 1224R group are graphically displayed below:



Research Results / System Limits

The Sleeve-It 1224R System is a pre-engineered foundation system for fence and pedestrian rail applications that meets or exceed IRC and IBC code requirements for 'guards' or fall protection for the general public. The limits of the system are a function of post spacing and applied load location as measured from finished grade or bottom of the foundation system. The following table provides general guidance for the Sleeve-It 1224R System limits relative to the 'system limits' as determined from full-scale load tests. In each case, the maximum moment capacity is less than or equal to the Full-Scale Load Test (System Limits) condition.

Load Condition	Applied Load Height above 1224R cantilever (ft)	Applied Load (lbs)	Post Spacing (ft)	Applied Moment Capacity (lb-ft)
Full-Scale Load Test (System Limits)	6	800 at ½-inch deflection	N/A	4800
10-ft Fence Application	12	200 lbs concentrated or 50 lb/ft	8	4800
8-ft Fence Application	10	200 lbs concentrated or 50 lb/ft	8	4000
6-ft Fence Application	8	200 lbs concentrated or 50 lb/ft	10	4000
4-ft Fence Application	6	200 lbs concentrated or 50 lb/ft	10	3000
36-inch Pedestrian Rail	5	200 lbs concentrated or 50 lb/ft	6	1500
42-inch Pedestrian Rail	5.5	200 lbs concentrated or 50 lb/ft	8	2200

System Guidance

The Sleeve-It 1224R System has been tested using a pseudo-static load condition and has not been tested for dynamic load conditions such as those induced by wind or similar load applications. The Sleeve-It 1224R system IS NOT appropriate for the following applications:

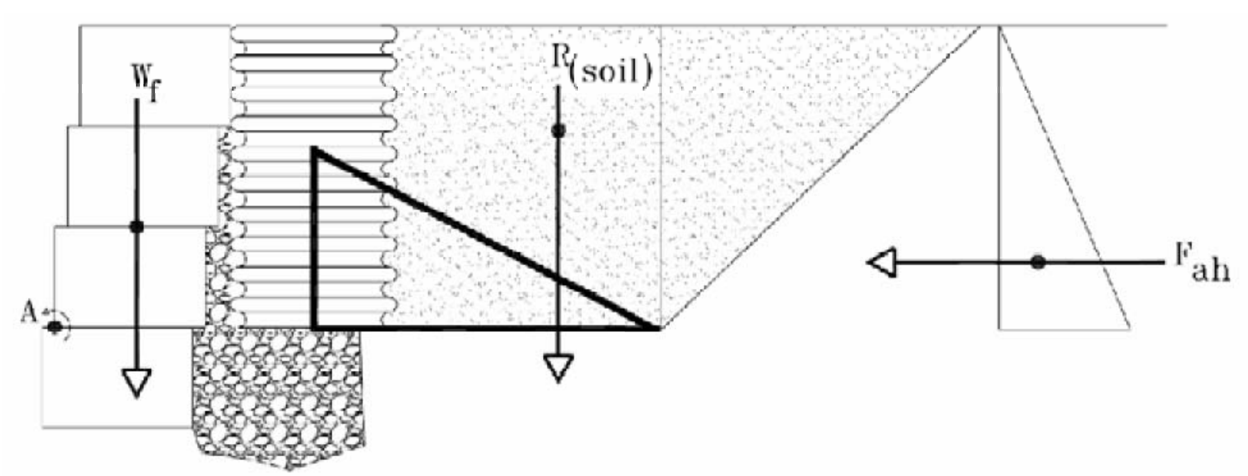
1. Fencing systems that employ wind screen fabrics.
2. Sound barrier or other conventional privacy wall structures.
3. Solid board privacy fences.
4. Fence systems where the vertical post height exceed 10 feet or post spacing exceeds 12 feet, without technical review by Strata Systems, Inc.

The Sleeve-It 1224R System is an appropriate foundation for the following applications:

1. Sleeve-It 1224R System cantilever base located 24-inches below finished grade.
2. Pedestrian Rail Systems limited to 42" height and maximum post spacing of 8 feet.
3. Chain link and open-board (gap-board) fence system
    a. Post – 10 feet above finished grade, Spacing 8 feet maximum
    b. Post – 8 feet above finished grade, Spacing 8 feet maximum
    c. Post – 6 feet above finished grade, Spacing 10 feet maximum
    d. Post – 4 feet above finished grade, Spacing 10 feet maximum

Design Model

A design model has been developed through back-calculations from the full-scale load tests with the Sleeve-It 1224R System so designers can evaluate system stability for other soil and load conditions. The design model is based on conventional soil mechanics and external stability. The model considers the weight of concrete infill, soil mass over the cantilever base, and wedge of resisting soil mass developed from passive earth pressure resistance for resisting forces. Driving forces and moments are a function of applied force and location of applied force above the cantilever base. The following free-body diagram is provided for reference.



Free-Body Diagram – Illustration of resisting and driving moments

Example or Hand Calculations

The attached design example illustrates the approach for checking the local stability of the Sleeve-It 1224R System. The design procedures can be adopted to evaluate other soil or load conditions that might be applicable to the Sleeve-It 1224R System.

SUPPLEMENTAL CALCULATIONS FOR THE SLEEVE-IT FOUNDATION SYSTEM

THE SLEEVE-IT SYSTEM STABILITY CALCULATIONS

WALL PARAMETERS

Wall Height: $H := 3$ courses

Backslope Angle: $I := 0.0 \cdot deg$

Post Spacing: $ps := 10 \cdot ft$

Fence Push Height: $fh := 48 \cdot in$

Fence Post Embedment: $fe := 3$ courses

Block Height: $bh := 0.667 \cdot ft$

Block Setback: $bs := 0.5 \cdot deg$ $\beta := 90 \cdot deg - bs$

Guard Loading:

Point Loading: $pl := 0 \cdot lbf$ acting at top of guide rail

Uniform Loading: $pw := 50 \cdot \frac{lbf}{ft}$

$Pw := pw \cdot ps$ $Pw = 500.0\,lbf$

This load of 500 lbs represents the maximum load required by the 2003 IBC, which specifies a minimum 200 lb concentrated load or a 50 plf distributed load. The distributed load applied to a maximum post spacing of 10 feet represents the critical load used in these calculations.

SOIL PARAMETERS

Internal Angle of Friction: $\phi := 28 \cdot deg$

Reduced Friction Angle: $\phi' := \frac{2}{3} \cdot \phi$ $\phi' = 18.7\,deg$

Unit Weight: $\gamma := 120 \cdot \frac{lbf}{ft^3}$

Active Earth Pressure Coefficient:

$$K_a := \left(\frac{\csc(\beta) \cdot \sin(\beta - \phi)}{\sqrt{\sin(\beta + \phi')} + \sqrt{\frac{\sin(\phi + \phi') \cdot \sin(\phi - I)}{\sin(\beta - I)}}} \right)^2 \qquad K_a = 0.318$$

ACTIVE PRESSURE DETERMINATION:

$F_a := \frac{1}{2} \cdot K_a \cdot \gamma \cdot (bh \cdot fe)^2$ $F_a = 76.3 \frac{lbf}{ft}$

$F_{ah} := F_a \cdot \cos(\phi')$ $F_{ah} = 72.3 \frac{lbf}{ft}$

$F_{av} := F_a \cdot \sin(\phi')$ $F_{av} = 24.4 \frac{lbf}{ft}$

FACING WEIGHT DETERMINATION:

$wf := [fe \cdot bh(1.0 \cdot ft)] \cdot 130 \cdot \frac{lbf}{ft^3}$ $wf = 260.1 \frac{lbf}{ft}$

SUM THE MOMENTS ABOUT THE TOE OF THE BOTTOM BLOCK, POSITIVE IS COUNTERCLOCKWISE:

Fence Post Loading (Driving Moment):

$$MFl := pl \cdot (fe \cdot bh + fh) + Pw \cdot (fe \cdot bh + fh) \qquad MFl = 3000.5\,ft \cdot lbf$$

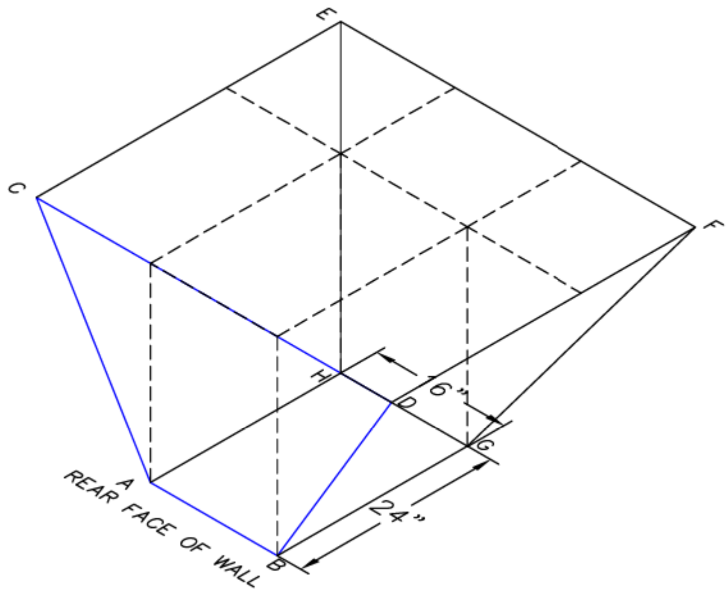
Horizontal Active Pressure (Driving Moment):

$$MFa := F_{ah} \cdot \frac{1}{3} \cdot fe \cdot bh \cdot (ps) \qquad MFa = 482.4\,ft \cdot lbf$$

Block Facing and Vertical Active Force (Resisting Moments):

$$MBF := wf \cdot [0.5 \cdot 1.0 \cdot ft + 0.5 \cdot (fe \cdot bh) \cdot \tan(bs)] \cdot ps \qquad MBF = 1323.4\,ft \cdot lbf$$

$$MFav := F_{av} \cdot \left[1.0 \cdot ft + \frac{1}{3} \cdot (fe \cdot bh) \cdot \tan(bs) \right] \cdot ps \qquad MFav = 245.7\,ft \cdot lbf$$



Determine the wedge of soil that is engaged by the base cantilever (16"X24") when it is covered by a depth of soil = 24"

CALCULATE THE WEIGHT OF THE AFFECTED SOIL VOLUME AS A RESULT OF THE CANTILEVER BASE:

First determine the lengths and areas of the various segments, using the geometry given and an angle of (phi + 45/2)

LENGTHS	AREAS
$AB := 16 \cdot in$	$ABCD := 730.1 \cdot in^2$
$CD := 44.84 \cdot in$	$EFGH := 851.8 \cdot in^2$
$BG := 24 \cdot in$	$BDFG := 902.4 \cdot in^2$
$BD := 28 \cdot in$	$ACEH := 902.4 \cdot in^2$
$GF := 31.49 \cdot in$	SURFACE AREA AVAILABLE TO PROVIDE SHEARING RESISTANCE IS:
$DF := 38.42 \cdot in$	$EFGH + BDFG + ACEH = 18.4\,ft^2$

The volume of soil engaged at failure is calculated as follows:

$$VOL_{soil} := \frac{CD \cdot DF + AB \cdot BG}{2} \cdot 24 \cdot in$$

Using the Average End Area method with a spacing equal to the height of the soil.

$$VOL_{soil} = 14.6\,ft^3$$

Therefore, the resulatant force available to resist the overturning moment as a result of the soil's contribution is:

$$R := VOL_{soil} \cdot \gamma \qquad R = 1755.6\,lbf$$

Which acts at a moment arm "X" from the toe of the bottom block face (which is 12" thick):

$$X := 12 \cdot in + \frac{\left(BG \cdot 24 \cdot in \cdot \frac{BG}{2}\right) + \left[\left(\frac{DF - BG}{3} + BG\right) \cdot 0.5 \cdot 24 \cdot in \cdot (DF - BG)\right]}{BG \cdot 24 \cdot in + 0.5 \cdot 24 \cdot in \cdot (DF - BG)} \qquad X = 27.9\,in$$

$$R \cdot X = 4079.3\,ft \cdot lbf$$

$$FS := \frac{MBF + MFav + R \cdot X}{MFl + MFa} \qquad FS = 1.6218$$

EXTERNAL STABLITY IS ADEQUATE TO RESIST OVERTURNING. NOW THE INTERNAL STABILITY MUST BE EVALUATED THROUGH A STRUCTURAL ANALYSIS OF THE INDIVIDUAL COMPONENTS.

Look at the critical bending moment of some various fence posts:

Steel	ASTM SPECIFICATION	GRADE	Fy Minimum Yield Stress (ksi)
Electric-Resistance Welded	A53 Type E	B	35
Seamless	Type S	B	35
Cold Formed	A 500	A	33
		B	42
		C	46
Hot Formed	A 501		36

SCHEDULE 40 STEEL 2.5" LINE POST AT 10 FEET ON CENTERS

$d_o := 2.375 \cdot in$ $\qquad d_i := 2.067 \cdot in$ $\qquad$ Schedule 40 Pipe $\qquad F_y := 36000 \cdot \frac{lbf}{in^2}$

$c := \frac{d_o}{2}$ $\qquad$ c is the distance from the neutral axis to the outermost fiber

$I_x := \frac{\pi \cdot \left(d_o^4 - d_i^4\right)}{64}$ $\qquad I_x = 0.6657\, in^4$ $\qquad$ Moment of Inertia about x-axis

$S_x := \frac{I_x}{c}$ $\qquad S_x = 0.5606\, in^3$ $\qquad$ Section modulus about x-axis

$M_{max} := S_x \cdot F_y$ $\qquad M_{max} = 1681.9\, lbf \cdot ft$

$fh_{max} := \frac{M_{max}}{Pw}$ $\qquad fh_{max} = 3.4\, ft$ $\qquad$ **Maximum push height at failure of fence post**

SCHEDULE 40 STEEL 3.0" CORNER POST AT 10 FEET ON CENTERS

$d_o := 2.875 \cdot in$ $\qquad d_i := 2.469 \cdot in$ $\qquad F_y := 36000 \cdot \frac{lbf}{in^2}$

$c := \frac{d_o}{2}$ $\qquad$ c is the distance from the neutral axis to the outermost fiber

$I_x := \frac{\pi \cdot \left(d_o^4 - d_i^4\right)}{64}$ $\qquad I_x = 1.5296\, in^4$ $\qquad$ Moment of Inertia about x-axis

$S_x := \frac{I_x}{c}$ $\qquad S_x = 1.0640\, in^3$ $\qquad$ Section modulus about x-axis

$M_{max} := S_x \cdot F_y$ $\qquad M_{max} = 3192.1\, lbf \cdot ft$

$fh_{max} := \frac{M_{max}}{Pw}$ $\qquad fh_{max} = 6.4\, ft$ $\qquad$ **Maximum push height at failure of fence post**

Based on empirical test data, the maximum force a 1224R strut with a hooked end can withstand before yielding (uncurling) is 510 lbs.

$Strut_{capac} := 510 \cdot lbf$ Structural capacity of a single strut

$Strut_{Num} := 2$ Number of struts for the Sleeve-It 1224R

$Strut_{Load} := Strut_{capac} \cdot Strut_{Num}$

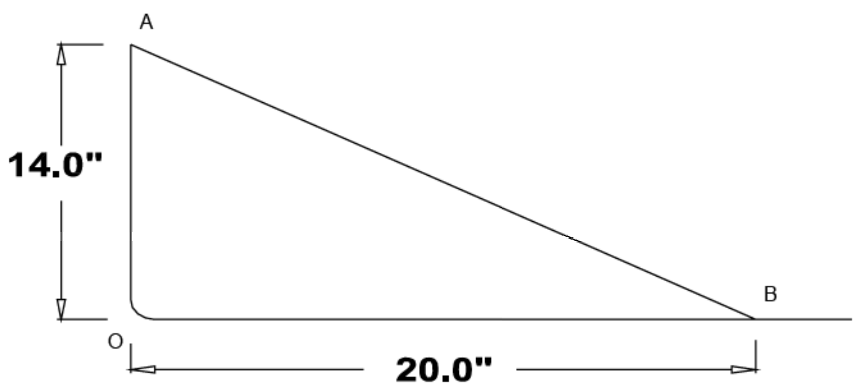
$Strut_{Load} = 1020.0\,lbf$ Load capacity of 1224R struts

Now look at the vector geometry of the strut configuration and verify that the horizontal component of the maximum load capacity is greater than the horizontal force being applied as a result of IBC 2003.

$P_W = 500.0\,lbf$ This is the maximum load of 50 plf applied at the maximum post spacing of 10 feet

From the strut and cantilever geometry, the upright leg to the rear hook of the strut is 20" horizontally and the strut vertical height is 14".

$\varpi := \operatorname{atan}\left(\frac{14}{20}\right)$ $\varpi = 35.0\,deg$ w is the angle from horizontal made by the strut



STRUT AND CANTILEVER GEOMETRY

$OA := 1020 \cdot lbf$

$OB := OA \cdot \cos(\varpi)$

$OB = 835.6\,lbf$ Maximum horizontal force available for the two struts at peak load

$AB := OA \cdot \sin(\varpi)$

$AB = 584.9\,lbf$

SINCE **OB > Pw** THE STRUTS WILL NOT FAIL AT THE MAXIMUM REQUIRED IBC LOADING.

The above calculations indicate that i) Schedule 40 steel fence posts will fail before the Sleeve-It Sytem fails; ii) The Sleeve-It System has significant additional capacity beyond that required by the 2003 IBC; iii) The theoretical method of failure of the Sleeve-It System is that the hooks will unravel under loads well beyond those required to satisfy 2003 IBC, which is a controlled method of failure and the failure is independent of soil type (i.e., friction angle and unit weight).