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1222284
EXC01
6/24/08

June 18, 2008

STRUCTURAL CALCULATIONS AND DETAILS
FOR THE
THE LOCK AND LOAD MSE RETAINING WALLS
SHRINERS HOSPITAL FOR CHILDREN ADDITION
PORTLAND, OREGON

PREPARED FOR:

KEY WEST RETAINING SYSTEMS INC.
P.O. BOX 1049
WILSONVILLE, OR 97070
(503)-682-8400

PREPARED BY

:

DAVID A. HALL/STRUCTURAL ENGINEERING
P.O. BOX 82228
PORTLAND, OR 97282-0228
(503)-231-8727

The design of these walls was prepared for the exclusive use of Key West Retaining Systems, Inc. The use of these plans by any others shall be approved in writing by The Engineer prior to construction.

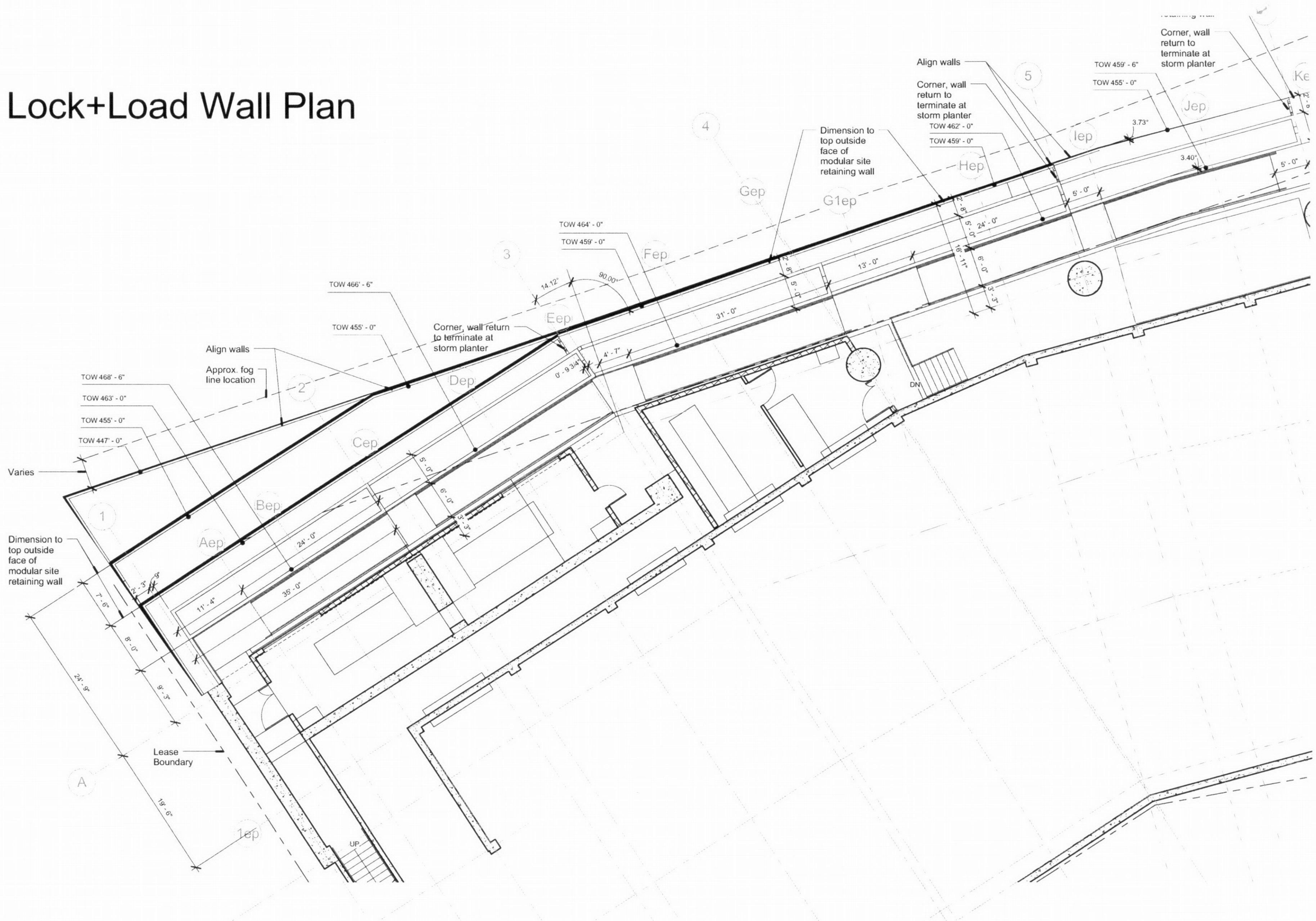
JOB #KEYX0255

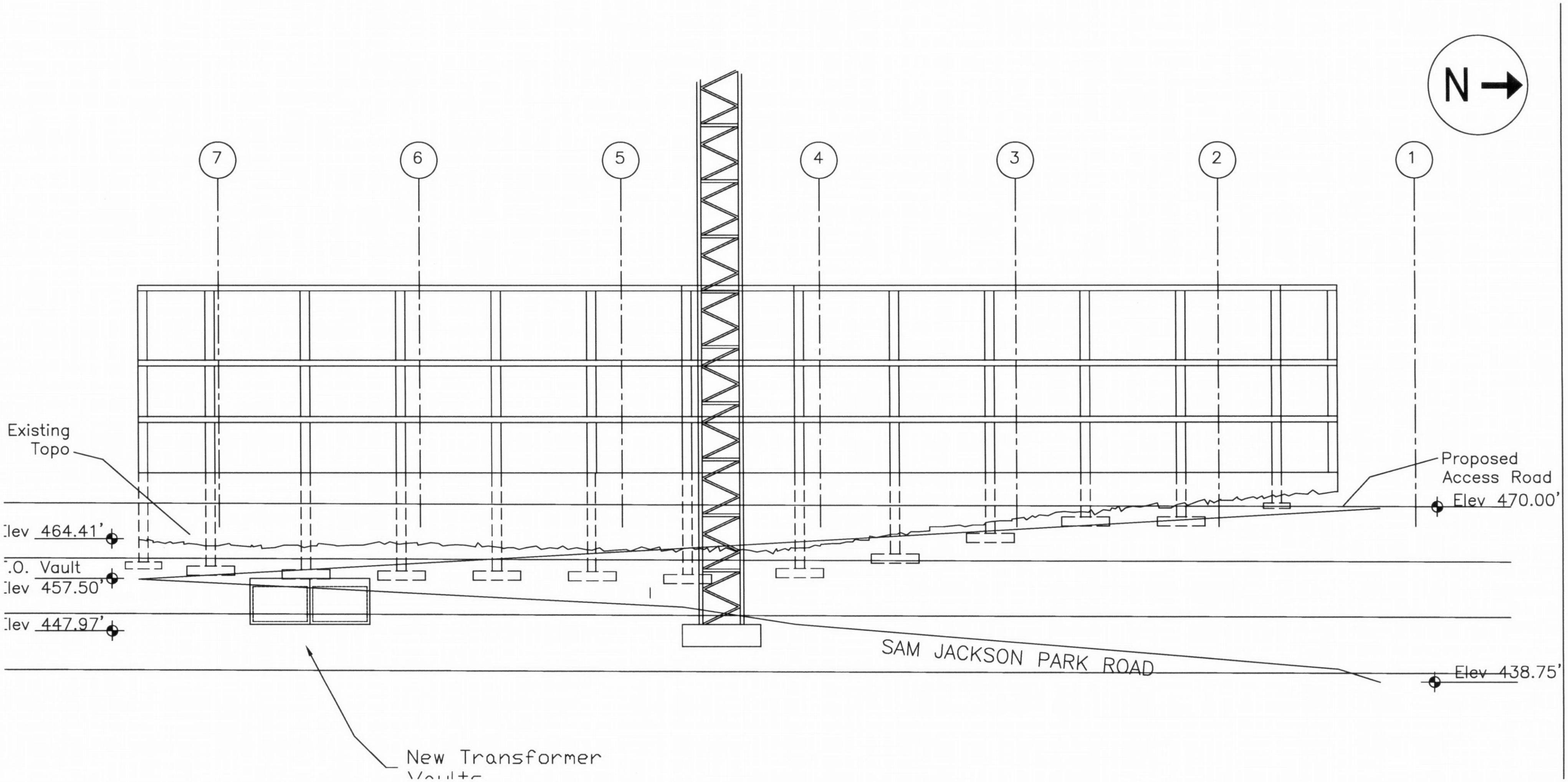
6/18/08

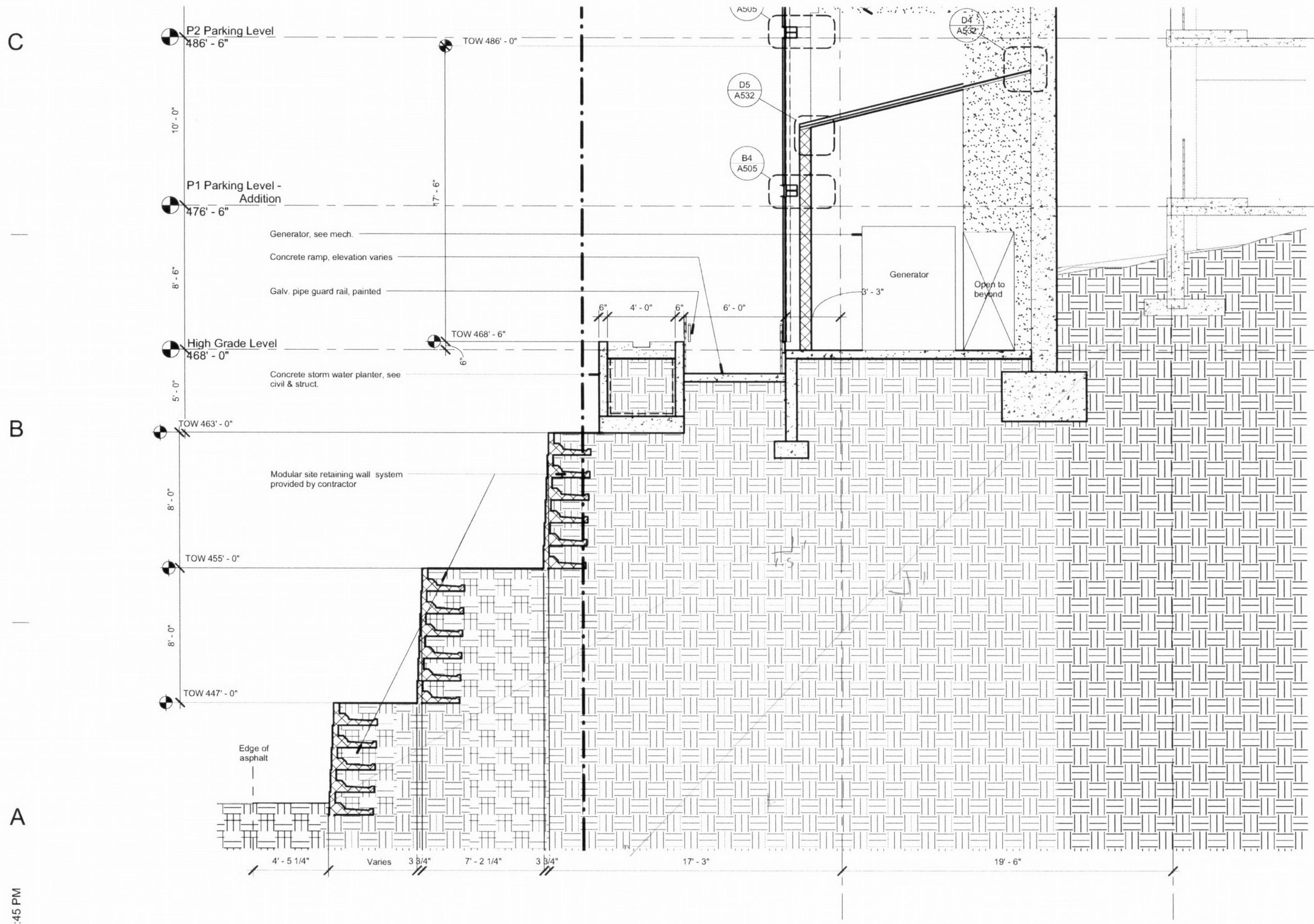
STRUCTURAL REGISTERED PROFESSIONAL ENGINEER
OREGON
SEPT. 17, 1991
DAVID A. HALL
EXPIRATION DATE: 6/30/09

07-113829 Rev

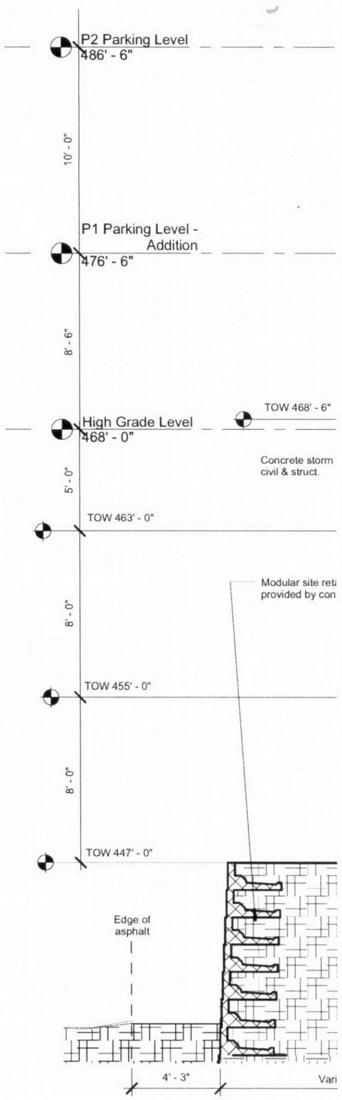
Lock+Load Wall Plan




N
7
6
5
4
3
2
1
Existing Topo
Proposed Access Road
Elev 470.00'
:lev 464.41'
.O. Vault
:lev 457.50'
:lev 447.97'
SAM JACKSON PARK ROAD
Elev 438.75'
New Transformer

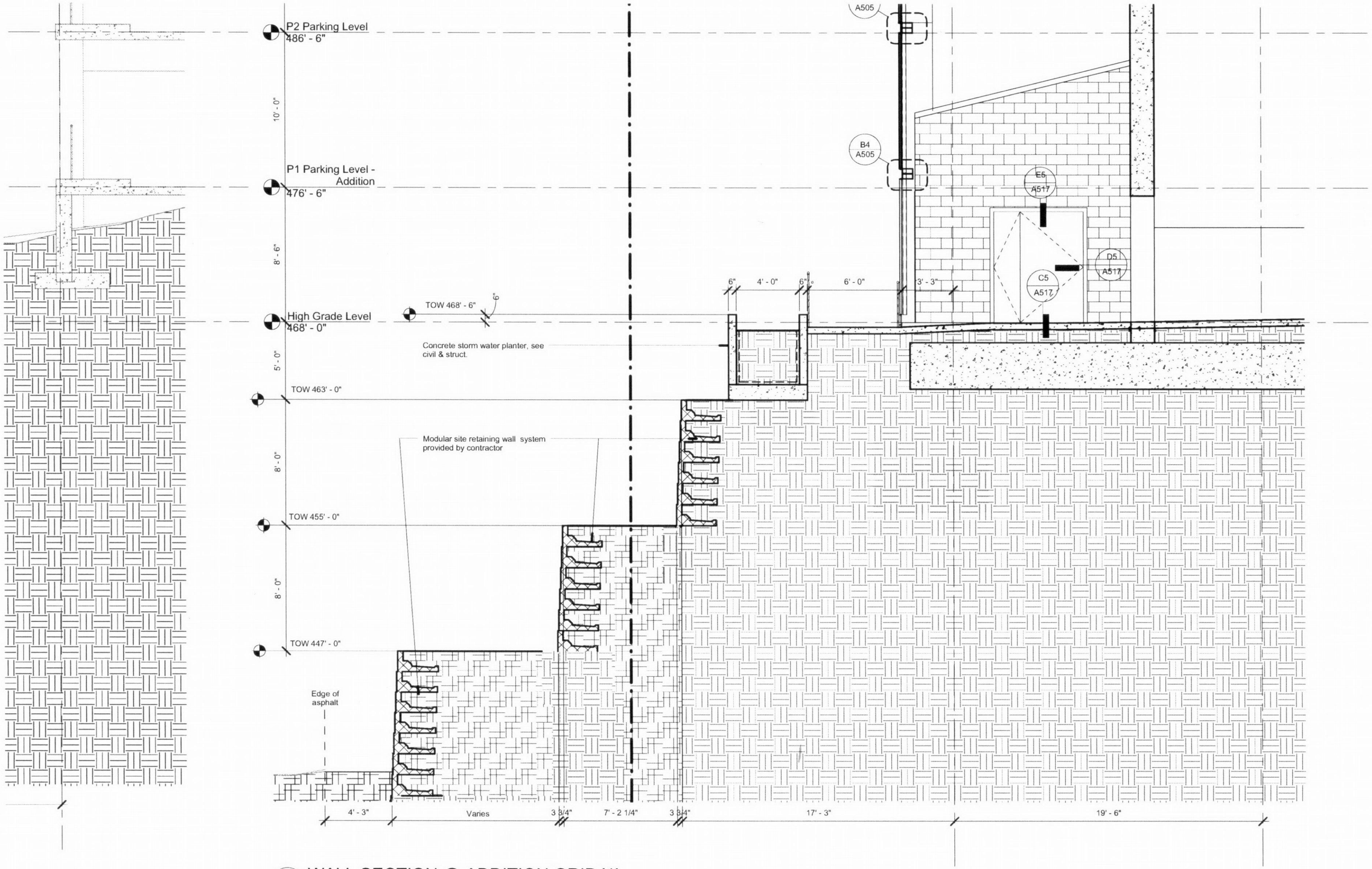


A1 WALL SECTION @ ADDITION GRID '2'
A317 1/4" = 1'-0"



A3 WALL SECTION @ AI
A317 1/4" = 1'-0"

5/11/2008 2:09:45 PM



A3
A317
WALL SECTION @ ADDITION GRID '1'
1/4" = 1'-0"

Shriners Hosp
Children - Por
Portland, Oregon

50% Construction Documents

Drawing Title
WALL SECTIONS

Revisions

No. Description Date

Drawn by
PSS/TT

Checked by
HAM

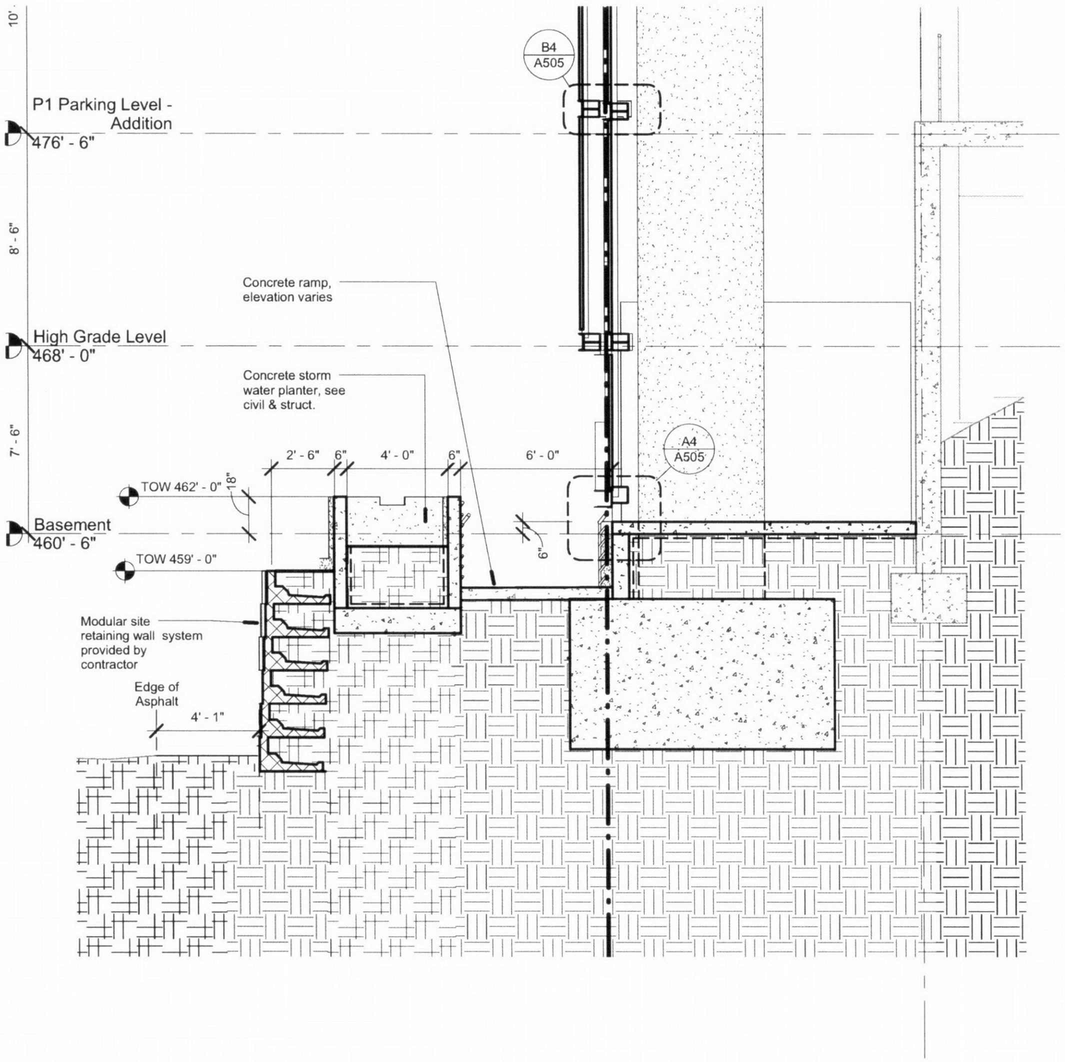
Date
06-02-08

Project No
2644

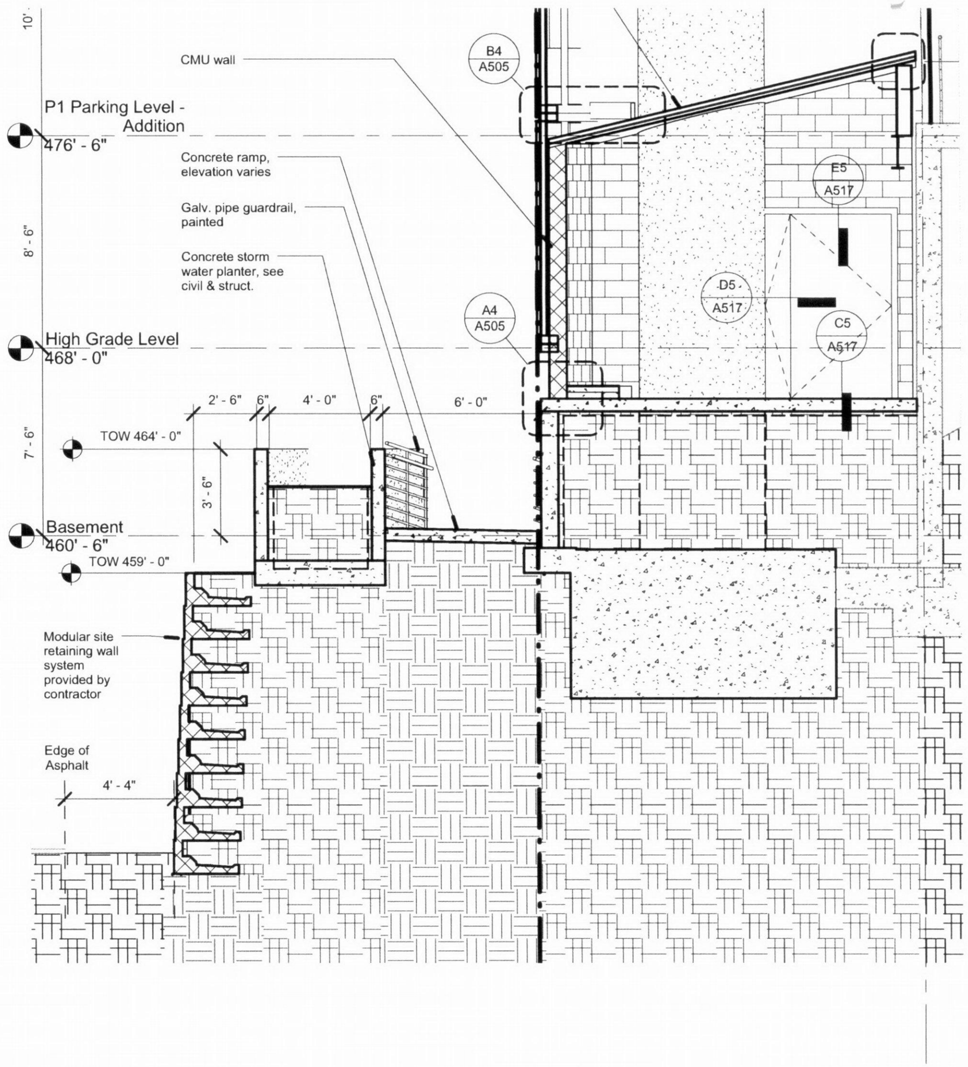
Consultant Project No

Owner Project No

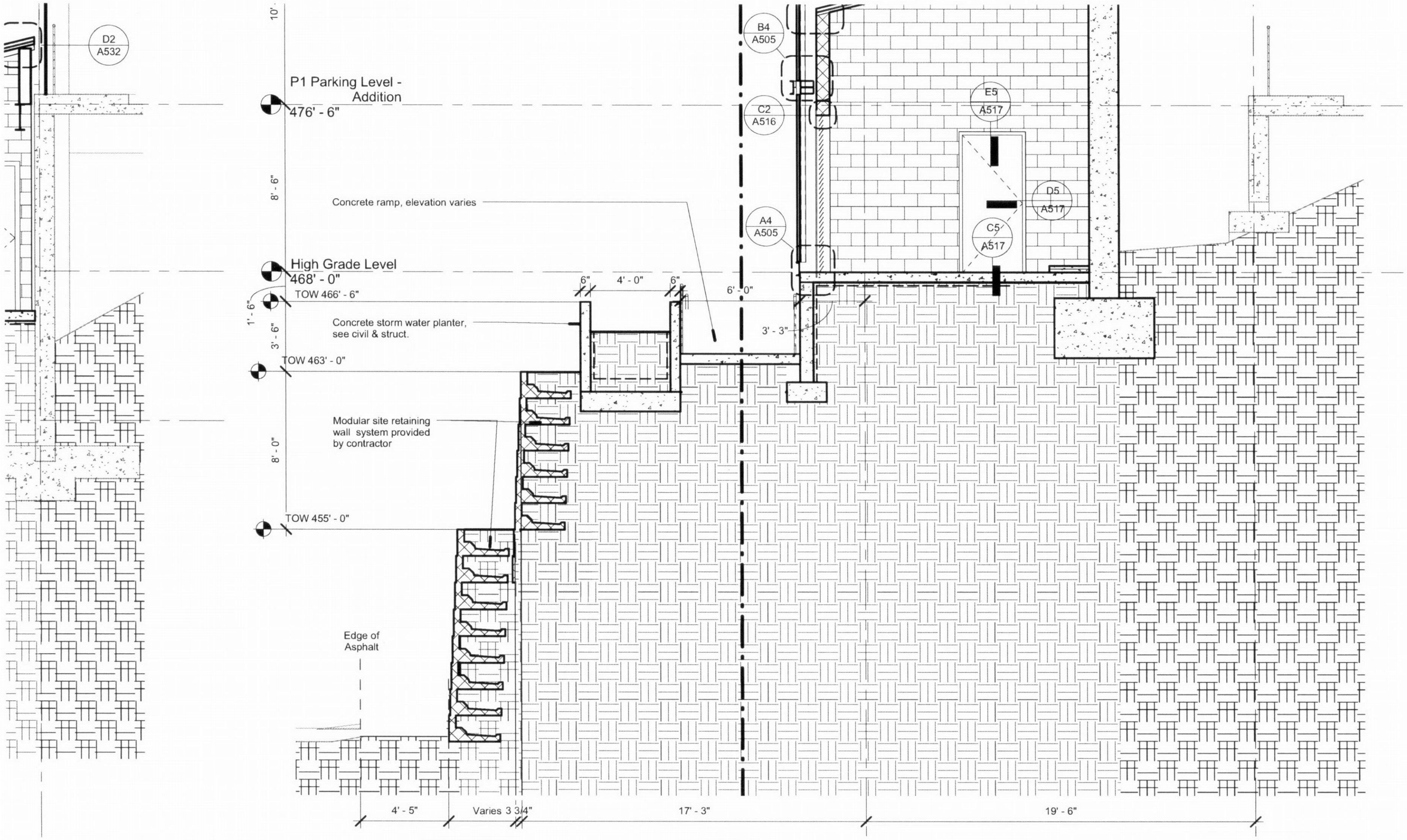
Drawing No
A317



A1
A318
WALL SECTION @ ADDITION GRID '5'
1/4" = 1'-0"



A2
A318
WALL SECTION @ ADDITION GRID '4'
1/4" = 1'-0"



A4
A318
WALL SECTION @ ADDITION GRID '3'
1/4" = 1'-0"

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50% Construction Documents

Drawing Title
WALL SECTIONS

Revisions

No.	Description	Date

Drawn by
PSS/TT

Checked by
HAM

Date
06-02-08

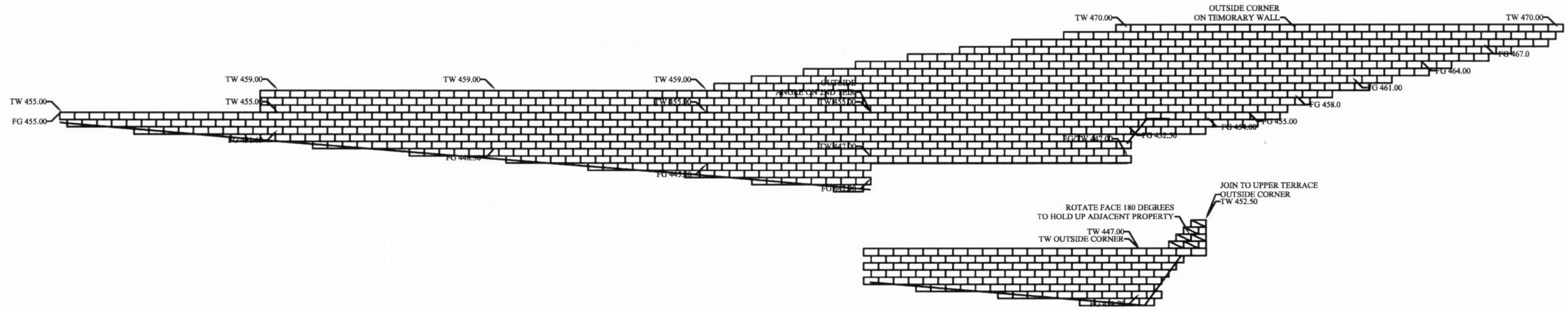
Project No
2644

Consultant Project No

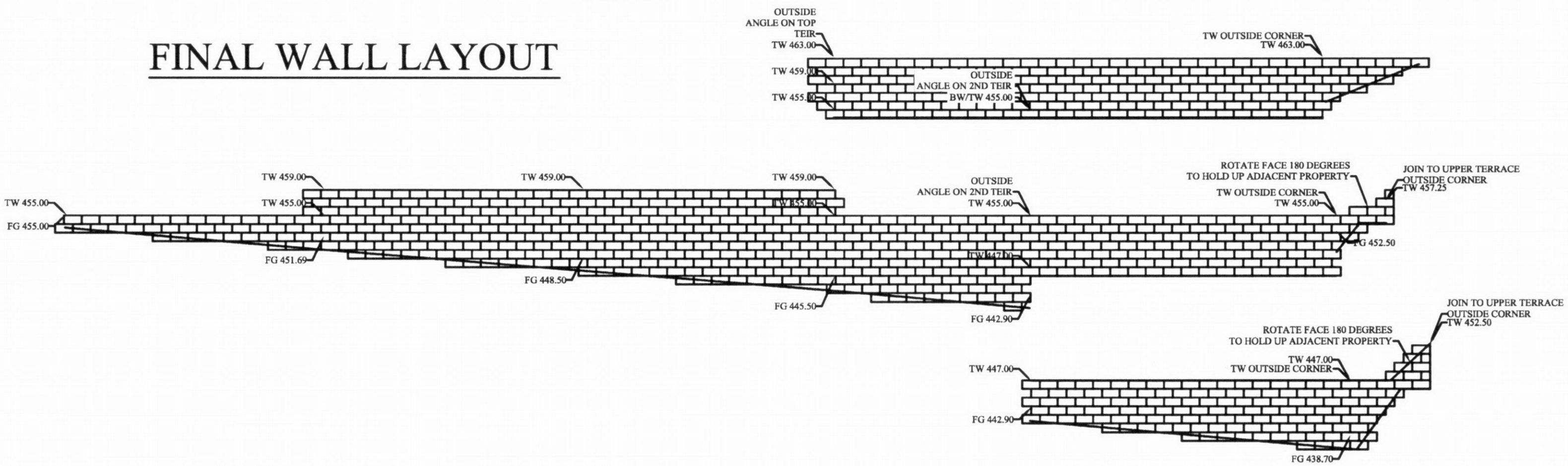
Owner Project No

Drawing No
A318

TEMPORARY/FINAL WALL LAYOUT



FINAL WALL LAYOUT



and clay decreases, and the basalt fragments become larger and less weathered. N-values in the severely weathered basalt ranged from 13 blows/ft to over 50 blows for 2 in. of sampler penetration. The natural moisture content of the severely weathered rock ranges from about 30 to 50C.

3. BASALT. Basalt was encountered beneath the severely weathered basalt and became sufficiently hard to permit coring at a depth of 25 ft below the ground surface. The quality of the basalt, as measured by hardness and weathering, was highly variable, with the majority of the cored basalt ranges from medium hard to very hard (RH-2 to RH-4). Core recovery ranged from 95 to 100C. The basalt typically contains close to very close joints and fractures, resulting in typical rock quality designations (Ro D) of 15 to 55C. The joints and fractures were generally close. Staining and occasional clay and other secondary mineral deposits were observed on some fracture surfaces.

Groundwater

We anticipate the static groundwater level at this site occurs at depth in the highly fractured, hard basalt; however, information developed during geotechnical investigations for other structures on the campus indicate perched groundwater can occur in the silt soils that mantle the site, particularly following intense and/or sustained precipitation. Deep excavations made for construction projects on the campus have encountered somewhat randomly occurring, localized zones of seepage. The recently completed i ohler Pavilion across the street from Shriners Hospital encountered large quantities of water in the fractured hard basalt.

CONCLUSIONS AND RECOMMENDATIONS

General

The subsurface conditions disclosed by the boring and geophysical investigation for this study are similar to the conditions encountered by GRI and others during investigations and excavations for the adjacent and nearby structures. The proposed hospital expansion site is mantled by fill material and silt soils that are underlain by basalt rock. The surface of the basalt is severely weathered, or decomposed, and has a soil-like consistency. The borings and geophysical testing indicate the top of hard rock is about 20 to 30 ft below the existing site grades on the downhill side of the structure. However, based on our experience at the OHSU campus, the depth to hard rock can vary significantly over short distances due primarily to non-uniform weathering of the basalt and various basalt flows.

Although detailed as-built information is not available, we understand the existing parking garage is supported on spread footings. Review of available subsurface information indicates the spread footings for at least the downhill portion of the parking garage are founded on residual soil or severely weathered basalt. Based on the estimated magnitude of the proposed foundation loads and proximity to the existing footings, it is our opinion it will be necessary to transfer structural loads to the underlying medium hard to very hard (RH-2 to RH-4) basalt to limit total and differential settlement to allowable values. Feasible foundation types include drilled piers or shafts and pin piles. Both drilled shafts and pin piles were successfully used to support the recently completed i ohler Pavilion and the Biomedical Research Building on the OHSU campus.

Site Preparation and Grading

Preparation of the site for construction will include removing existing trees and surficial organic matter within the project limits. All excavations required to remove existing root clumps should be shaped with 1H:1V side slopes and backfilled with compacted structural fill as recommended below.

The existing ground surface within the planned building area generally slopes from about 2H:1V to as steep as 1H:1V. Placing significant quantities of structural fill on the sloping site could adversely affect the stability of the slopes. For this reason, we anticipate filling will be limited to the backfilling of excavations made to remove existing features and utility trench backfill. Other potential areas of significant new fill should be reviewed by GRI on a case-by-case basis as the project design is developed.

In our opinion, imported granular material, such as sand, sandy gravel, or fragmental rock, should be used to construct structural fills for the project. The fill material should have a maximum size of about 4 in. and not more than about 5C passing the No. 200 sieve (washed analysis). Lifts should be placed 12 in. thick (loose) and compacted with a medium-weight (48-in.-diameter drum), smooth, steel-wheeled, vibratory roller until well-keyed and to not less than 95C of the maximum dry density as determined by ASTM D 698. A minimum of four passes with the roller is generally required to achieve compaction. Hand-operated compaction equipment should be used within 5 ft of any building walls or retaining walls.

In our opinion, permanent cut and fill slopes should be made no steeper than 2H:1V. Structural fill constructed on slopes steeper than 5H:1V should be benched into the existing grade. Since it is difficult to compact the surface of fill slopes, we recommend the slopes be overbuilt by 2 ft and trimmed back after construction to provide a surface that is more resistant to localized sloughing.

All backfill placed in utility trench excavations within the limits of the project should consist of sand, sand and gravel, or crushed rock with a maximum size of 1 1/2 in., with not more than about 5C passing the No. 200 sieve (washed analysis). The granular backfill should be placed in lifts and compacted using vibratory plate compactors or tamping units to at least 95C of the maximum dry density as determined by ASTM D 698. The thickness of the lifts will depend on the type of backfill material and the size and type of compaction equipment. Flooding or jetting the backfilled trenches with water to achieve the recommended compaction should not be permitted.

To reduce surface flow from entering the utility trenches, we recommend the upper 1 to 2 ft of backfill in all utility trenches in landscape areas and on the steep slopes adjacent to the structure consist of the on-site, fine-grained, relatively impermeable material compacted to about 90C of the maximum dry density as determined by ASTM D 698. To reduce potential for hydrostatic pressure in the trenches, which would increase the risk of instability on the slopes, all utility trenches crossing the slopes should be drained with a 4-in.-diameter, geotextile-wrapped, perforated pipe placed at the bottom of the trench. The outlet of the pipes should deposit the accumulated water to a suitable storm sewer or drainage area.

Seismic Considerations

General. We understand the project will be designed using the 2006 International Building Code (IBC) with 2007 Oregon Structural Specialty Code (OSSC) modifications. Based on the subsurface conditions disclosed by the recent boring, and the proposed foundation elevations, the site is classified as IBC Site Class C. The IBC design methodology uses two spectral response coefficients, S_s and S_1, corresponding to

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DESIGN SUMMARY SHEET

PROJECT DESCRIPTION: Shriners Hospital for Children
Portland, Oregon

GEOTECHNICAL REPORT:

*Design compliance of these MSE Retaining Walls was prepared with reference to the Geotechnical Report prepared by along with design Input Parameters listed below.

GRI, Inc.
Project #4666; Dated July 22, 2007

*The Contractor shall adhere to this report in it's entirety.

DESIGN INPUT PARAMETERS:

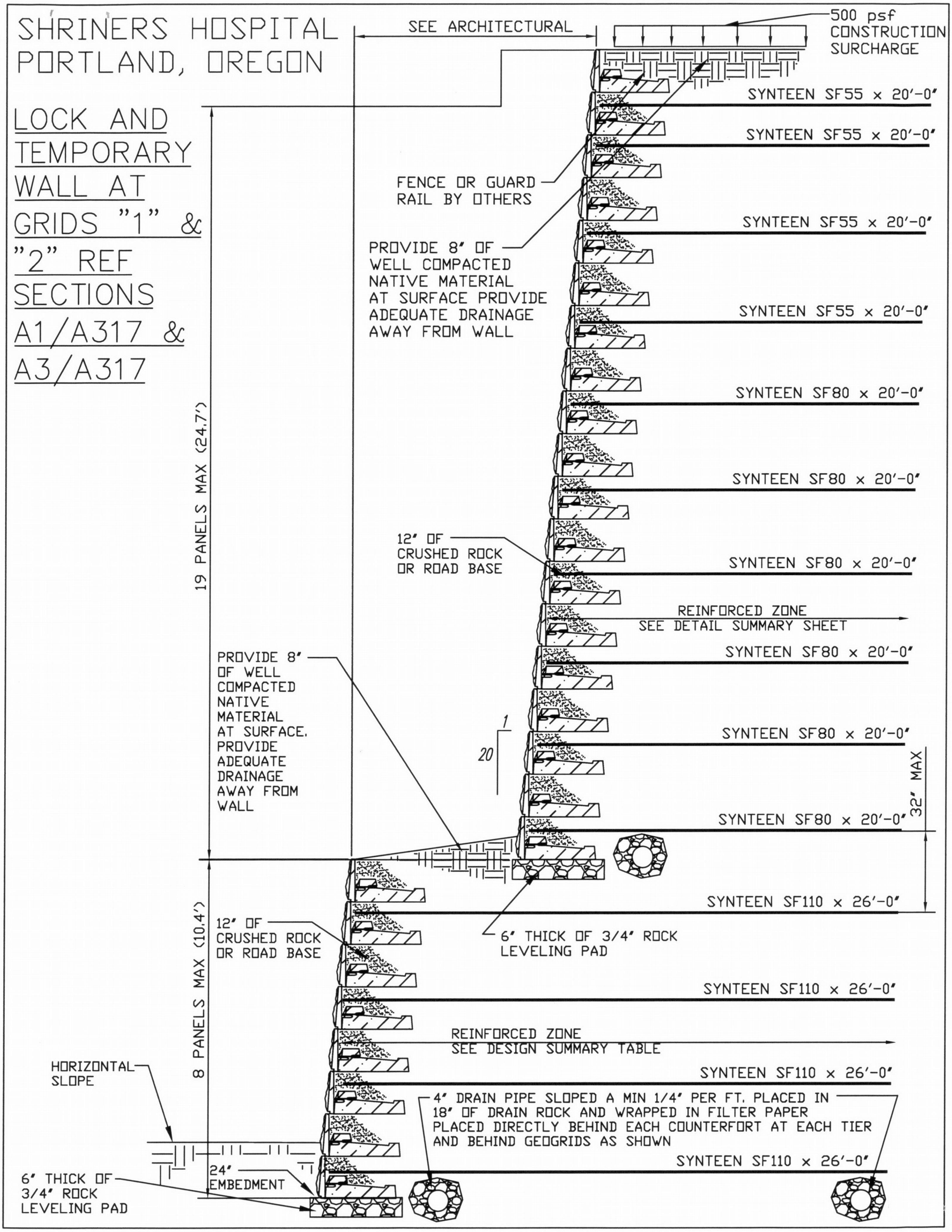
Angle of Friction the Reinforced Zone	37 Degrees
Total Unit Weight of Soil	130 pcf
Cohesion	0 psf
Angle of Friction Retained Zone	37 Degrees
Total Unit Weight of Soil	130 pcf
Cohesion	0 psf
Angle of Friction Foundation Zone	37 Degrees
Total Unit Weight of Soil	130 pcf
Cohesion	0 psf

COMPACTION REQUIREMENTS 95 % Modified Proctor per ASTM D1557

****THE FOUNDATIONS FOR THE FUTURE PROPOSED BUILDING SHALL BE DESIGNED SUCH THAT IT IS SUPPORTED INDEPENDENT OF THESE LOCK AND LOAD MSE RETAINING WALLS.**

SHRINERS HOSPITAL PORTLAND, OREGON

LOCK AND TEMPORARY WALL AT GRIDS "1" & "2" REF SECTIONS A1/A317 & A3/A317



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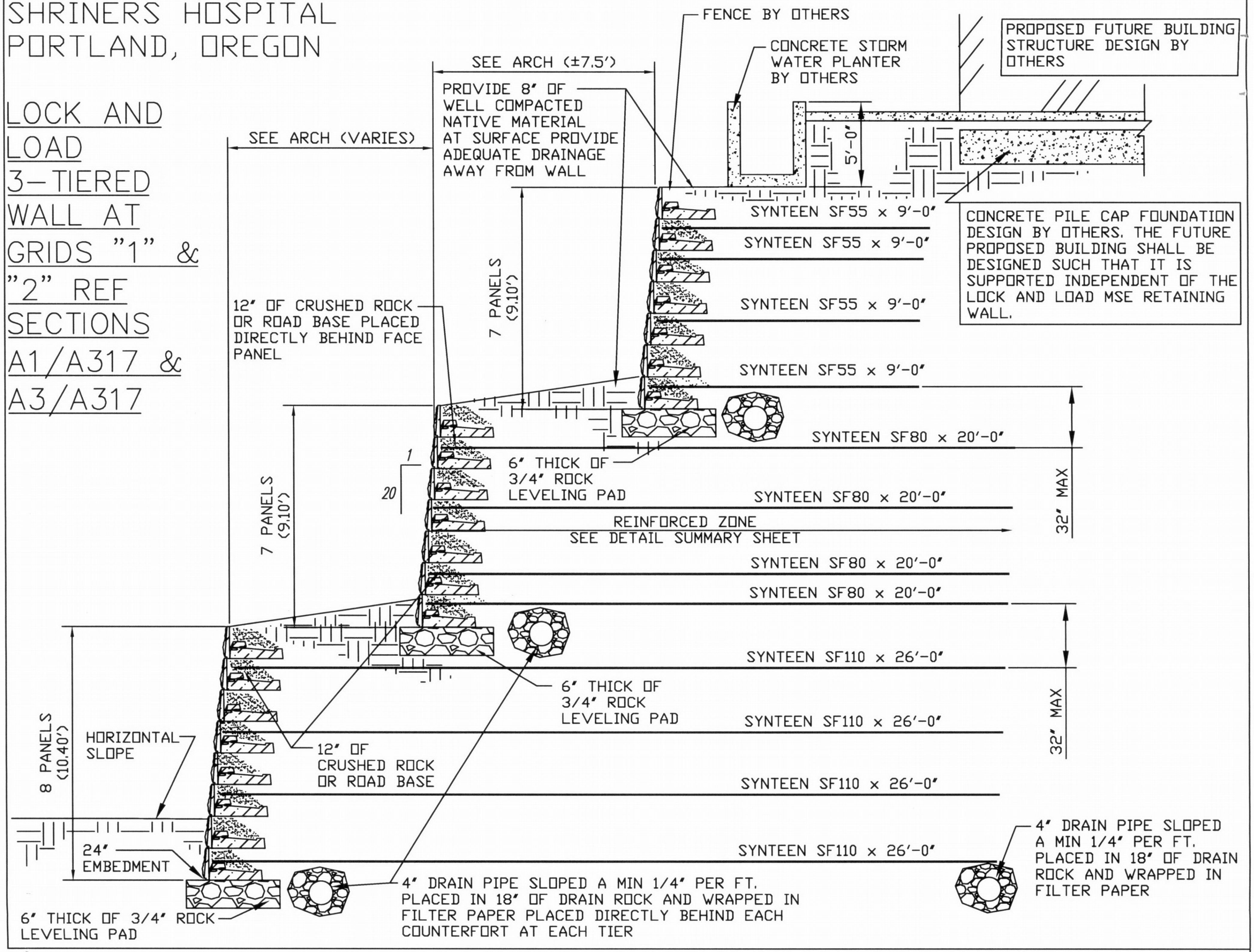
LOCK AND LOAD 3-TIERED WALL AT GRIDS "1" & "2" REF SECTIONS A1/A317 & A3/A317



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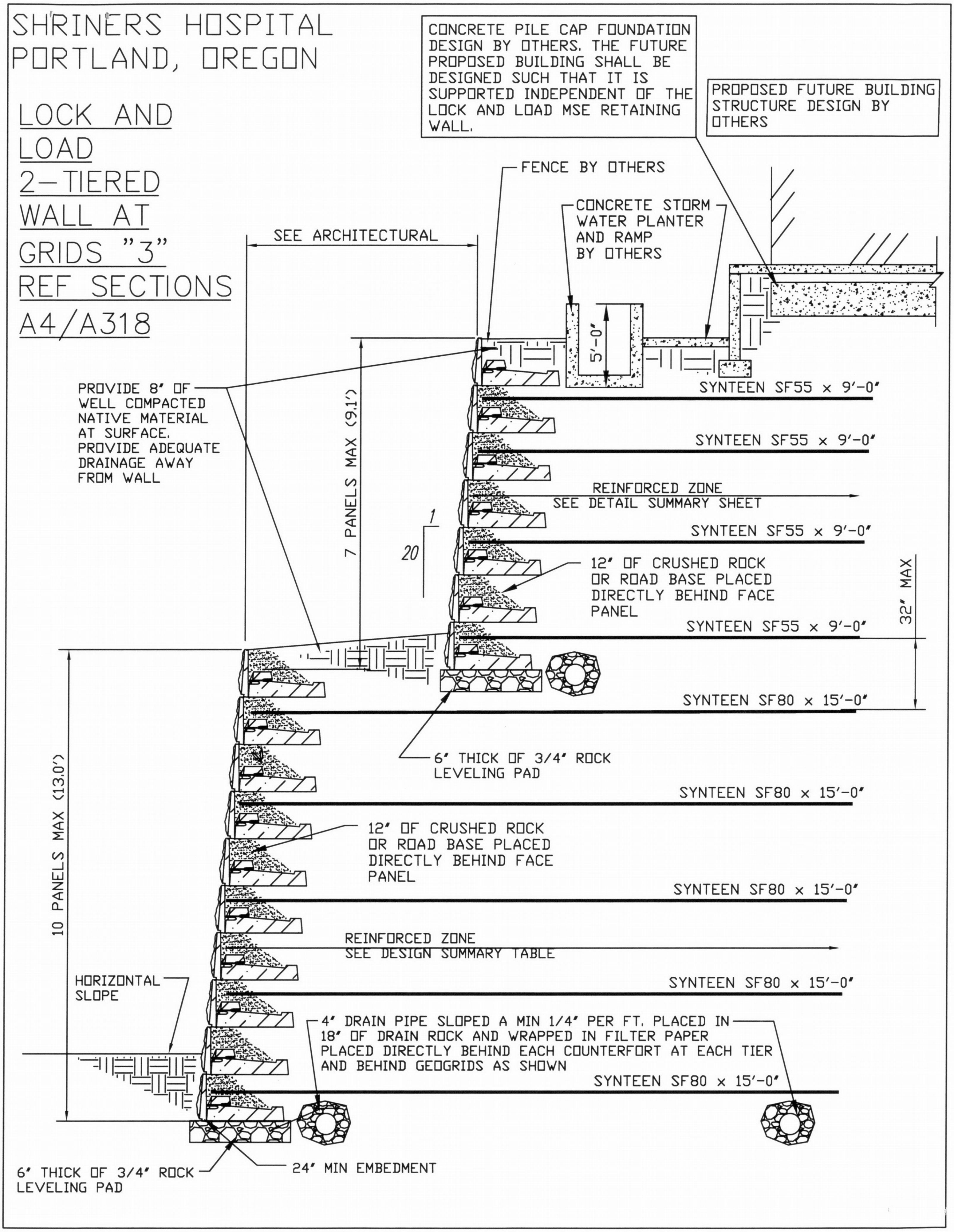
LOCK AND LOAD 2-TIERED WALL AT GRIDS "3" REF SECTIONS A4/A318



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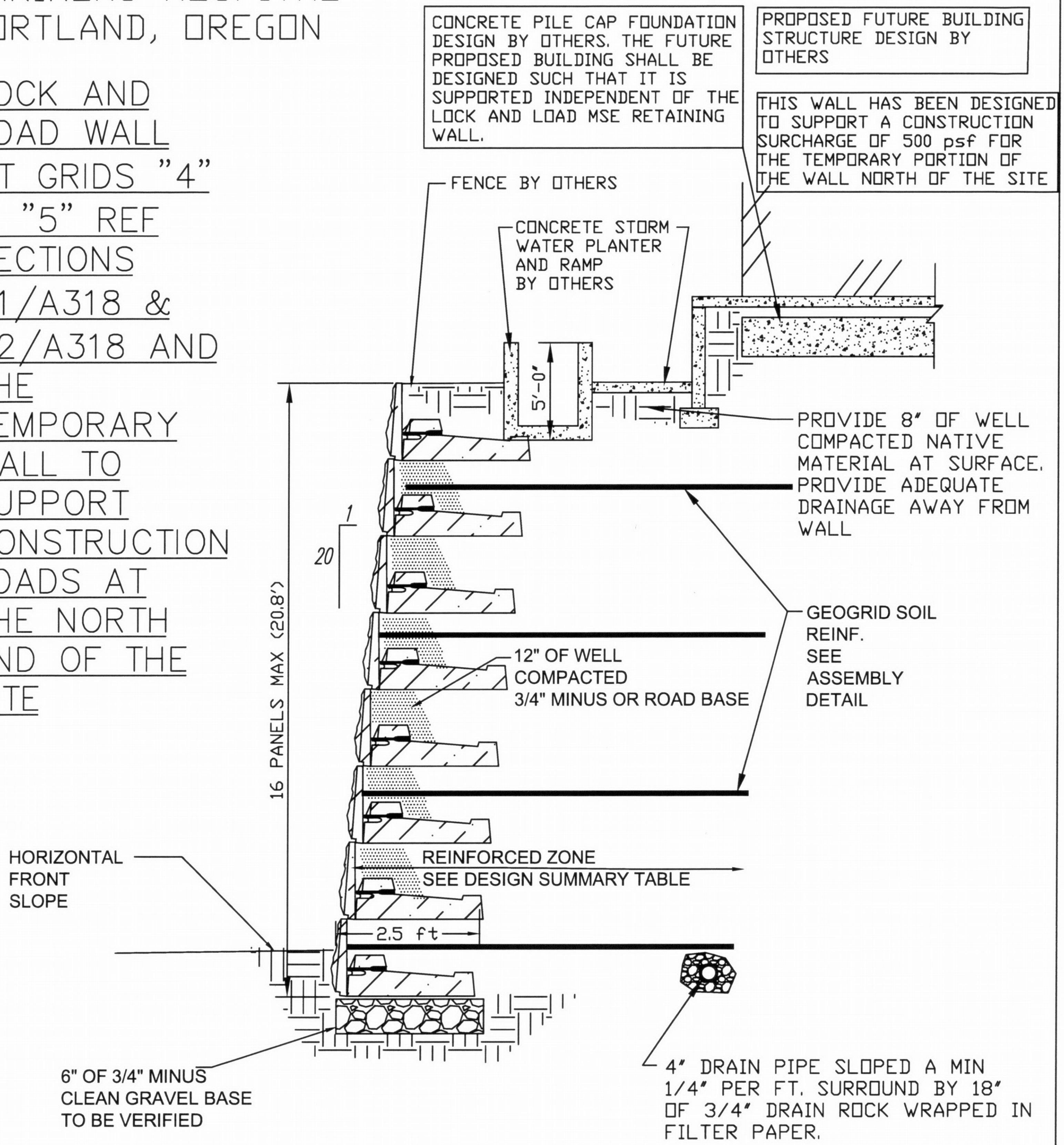
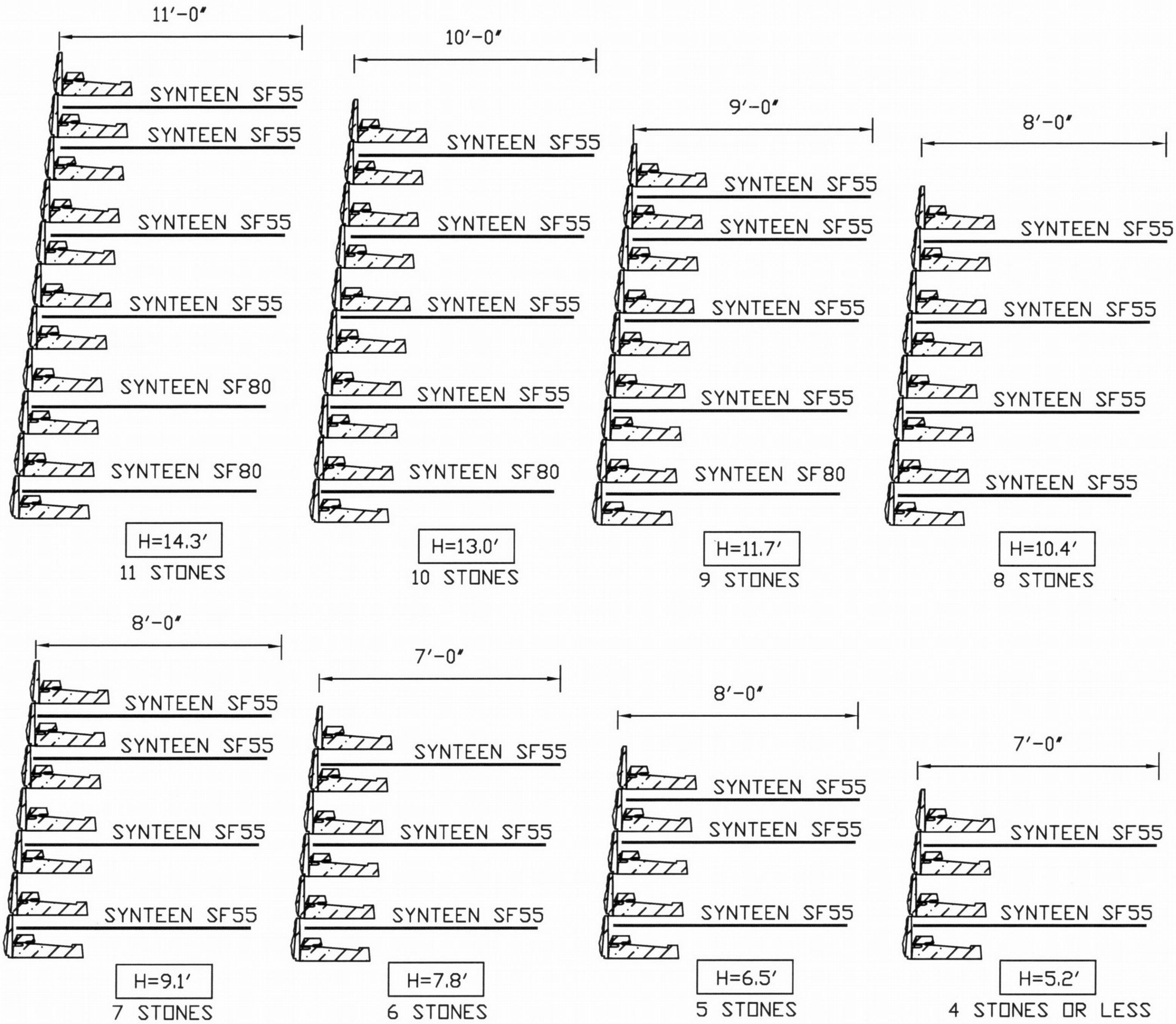
LOCK AND LOAD WALL AT GRIDS "4" & "5" REF SECTIONS A1/A318 & A2/A318 AND THE TEMPORARY WALL TO SUPPORT CONSTRUCTION LOADS AT THE NORTH END OF THE SITE

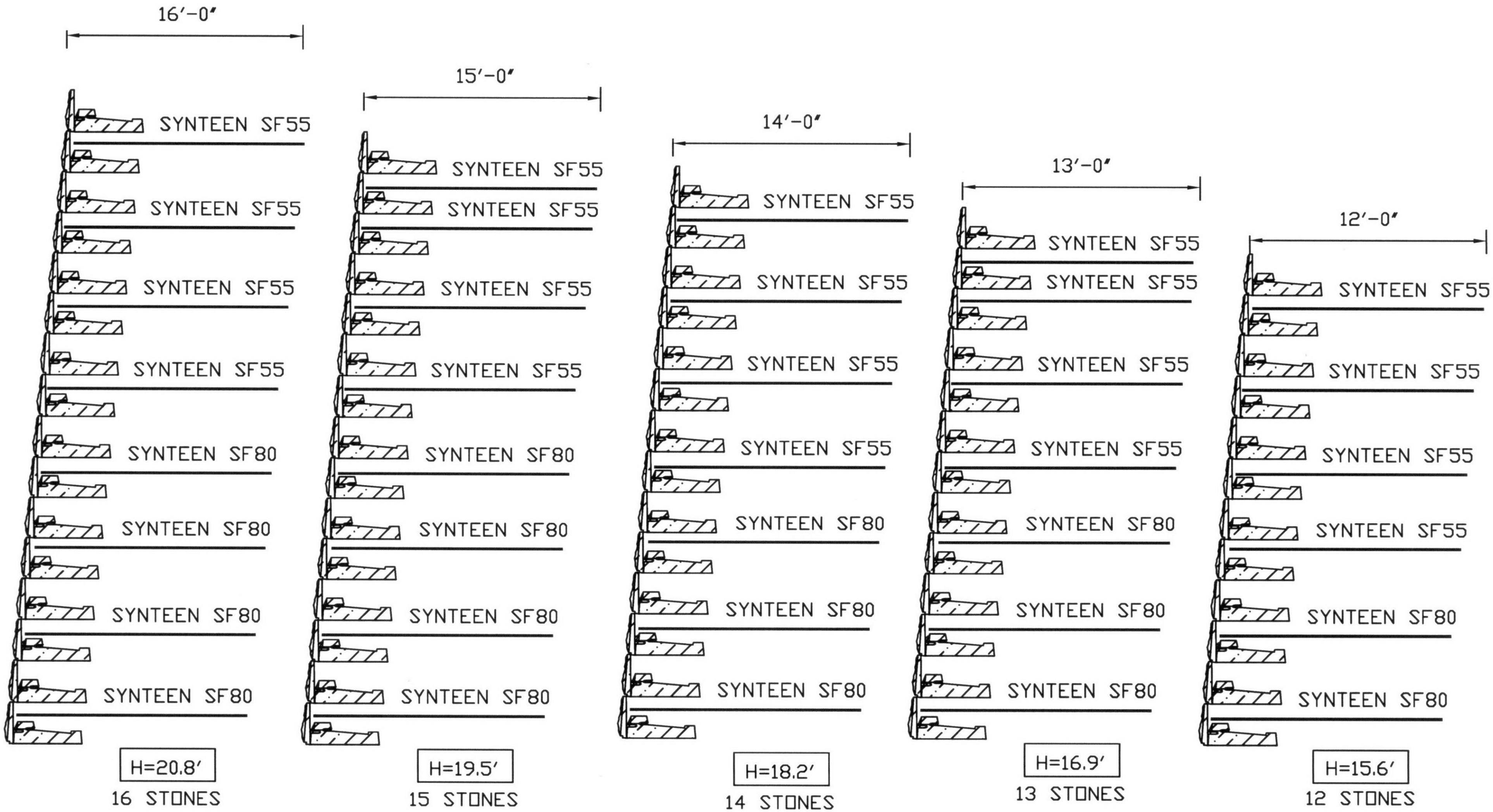


SHRINERS HOSPITAL
PORTLAND, OREGON



LOCK & LOAD ASSEMBLY DETAILS

SHRINERS HOSPITAL
PORTLAND, OREGON



LOCK & LOAD ASSEMBLY DETAILS

TECHNICAL SPECIFICATION FOR
MECHANICALLY STABILIZED LOCK+LOAD RETAINING WALLS

PART 1: - GENERAL

1.01 It is recommended that field observations be provided during construction. This includes the review of the bearing stratum, verification of the specified soil compaction in the reinforcing zone, and the review and verification that the geogrids and drainage system were installed per plan. All pertinent soil parameters during construction.

1.02 The design of these walls was prepared for the exclusive use of Key West Retaining Systems, inc.. The use of these plans by any others shall be approved in writing by The Engineer prior to construction.

1.03 The construction of LOCK+LOAD retaining walls shall be performed by either a Contractor that has been approved as knowledgeable and experienced in the construction of MSE retaining walls using LOCK+LOAD or a Representative of LOCK+LOAD shall be present at the beginning of construction until it has been determined by them that the Contractor is capable of constructing this type of wall system.

1.04 The design of LOCK+LOAD Mechanically Stabilized Earth Retaining Walls is based on the U.S. Department of Transportation Federal Highway Administration's publication No. FWHA-NHI-00-043 "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines" which has been adopted by the latest American Association of Highway and Transportation Officials (AASHTO) and the National Concrete and Masonry Association (NCMA) codes.

1.05 Design compliance is made with reference to that stated in the Design Summary Table

1.06 Design Compliance is made with the following Factors of Safety:

Sliding	FS > 1.5
Bearing Capacity	FS > 2.0
Overturning	FS > 2.0
Internal Stability	FS > 1.5
Seismic Stability	FS > 75% of Static FS

1.07 The work described and shown involves the supply and installation of reinforced soil retaining walls. The concrete wall panel and counterfort create a LOCK+LOAD Retaining Module. Counterfort and Geo-grid are the types of soil reinforcement. The work includes but is not limited to:

a. excavation to the lines and grades shown on the drawing; (or as required to obtain adequate bearing capacities) excavation to be coordinated with the General Contractor.
b. supply and installation of geogrid reinforcement;
c. supply and installation of drainage fill and piping;
d. supply and installation of segmental LOCK+LOAD Modules
e. supply and installation of reinforced soil fill.
f. removal of all deleterious materials to the satisfaction of the Engineer.

1.08 The walls will be constructed on existing, natural, undisturbed soil or placed on a ¾" rock base.

1.09 The Contractor shall confirm the locations and conditions of all man-made elements which may be affected or damaged by the Work. Elements which may be affected or damaged by the Work must be reported to the Engineer in advance of the work beginning. The Engineer may modify the design or approve of changes to installation techniques proposed by the Contractor to preclude damage or conflict with existing elements.

1.10 The Contractor shall verify all dimensions and report discrepancies to the Engineer.

PART 2 - MATERIALS

2.01 Concrete Panels and Counterforts are locked together to form a "Retaining Module". The retaining walls have been designed on the basis of Lock+Load retaining wall "Modules". Modules are to be purchased from a licensed LOCK+LOAD manufacturer. The LOCK+LOAD trademark on each pallet identifies LOCK+LOAD products.

Information on the purchase of LOCK+LOAD and a complete list of components can be Obtained through:

Lock & Load Retaining Walls Ltd.
Tel. (877) 901-9990 Website www.lock-load.com

2.02 Geogrid - The retaining walls have been designed to be erected as shown on the Plans. Other geogrid materials may be considered suitable provided that they meet the specification and requirements of the design and are approved in advance by the Engineer.

2.03 Modular Fill – The fill immediately behind the LOCK+LOAD panel and surrounding the counterfort shall be "dense graded" select free draining material.

2.04 Drainage Fill. Drainage fill placed around and above the perforated drainage pipe shall be granular aggregate composed of inert, clean, tough, durable particles of crushed rock capable of with standing the deleterious effects of exposure to water, freeze-thaw, handling, spreading and compacting. The aggregate particles shall be uniform in quality and free from an excess of flat or elongated pieces. The drainage fill shall consist of round or angular rock between 3/4 inch and 1 inch.

2.05 Reinforced Backfill. As shown on the Plans or as approved by the Design Engineer. The Reinforced backfill shall have an angle of internal friction as stated in the Design Summary Table and compacted as stated within.

PART 3 - EXECUTION

3.01 The Contractor shall excavate to the lines and grades shown on the construction drawings. The excavation shall be reviewed and the foundation approved prior to the placement of the levelling pad or retaining modules.

3.02 Over-excavation of deleterious soil or rock shall be replaced with Reinforced and Retained Backfill meeting the specifications of Section 2.04 above, and compacted to that stated in the Design Summary Table within 2% of the optimum moisture content of the soil.

3.03 The first course of concrete Lock+Load Modules shall be placed on the level compacted foundation and the alignment and level checked.

3.04 Modules shall be placed with the top of the panel level and parallel to the wall face. The counterfort base installs horizontal and perpendicular to the face of the retaining wall.

3.05 Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.

3.06 Geogrid reinforcement shall be placed at the elevations and to the extent shown on the Plans beginning at the back of the LOCK+LOAD panels and the top of the counterfort. The geogrid soil reinforcement shall be placed so that a minimum of 2 inches remains vertical and in contact with the panel after backfill is placed and compacted.

3.07 The geogrid shall be laid horizontally in the direction perpendicular to the face of the retaining wall and parallel to the alignment of the "Modules". The geogrid shall be pulled taut, free of wrinkles and anchored prior to backfill placement on the geogrid.

3.08 The geogrid reinforcement shall be continuous throughout their embedment lengths. Spliced connections between shorter pieces of geogrid are not permitted.

3.09 The drainage pipe discharge points shall be free and clear to allow drainage from the pipes.

3.10 Reinforced and Retained backfill shall be placed, spread and compacted in such a manner that minimizes the development of slack in the geogrid.

3.11 Connection, Reinforced and Retained backfill shall be placed and compacted in lifts not to exceed 8 inches where light compaction equipment (less than 1000Lb vibrating plate) is used and not more than 16 inches where heavy compaction equipment is used. **First** – compact over tail of counterfort then to the panel back and finally away from the retaining wall structure toward the end of the geogrid.

3.12 All backfill shall be compacted to that stated in the Design Summary Table or equivalent. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be within 2 percent of the optimum moisture content.

Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

Sieve Size (Percent Passing)	2 inch (100%) 3/4 inch (75%) No. 40 (60%) No. 200 (15%)**
Plasticity Index	(PI) <15
Liquid Limit	<40 per ASTM D-4318.

** Soils having more than 15% passing a 200 sieve must be approved by the project Design Engineer and have an engineered drainage system to insure that a hydrostatic pressure is not built up behind the reinforced soil zone.

The maximum aggregate size shall be limited to 3/4 inch unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.

Material can be site excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

3.13 Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Tracked vehicles should not turn while on the geogrid to prevent tracks from displacing the fill and geogrid and damage or slack to result in the geogrid.

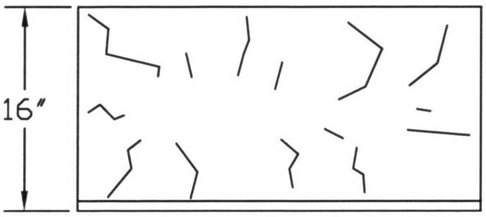
3.14 Rubber tired equipment may pass over the geogrid reinforcement at slow speeds less than 5 mph. Sudden braking and sharp turning shall be avoided.

3.15 Final grading in front of and behind the wall shall be achieved such that surface water is directed away from the structure and the reinforcement zone.

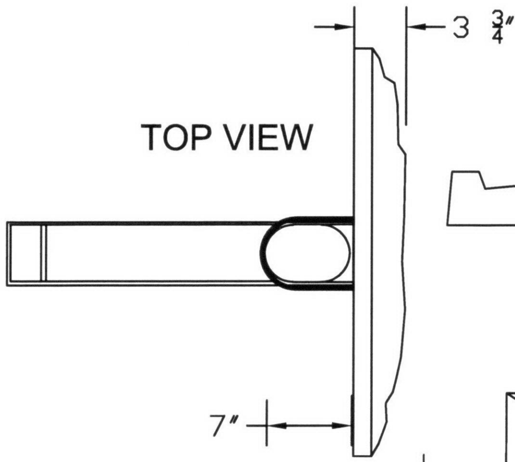
3.16 At the end of each day of operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

LOCK+LOAD - STONE - FILE 500

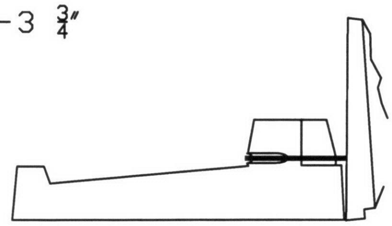
LOCK+LOAD Retaining Walls Ltd.
MASTER FILE 500 - STONE



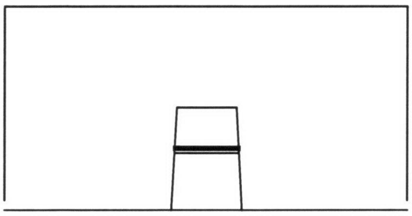
FRONT VIEW



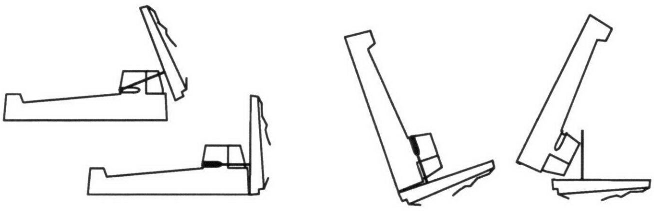
TOP VIEW

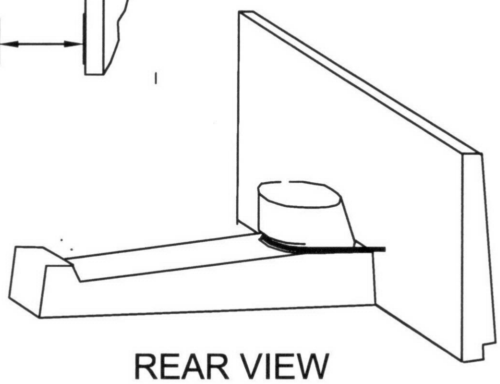


SIDE VIEW



BACK VIEW

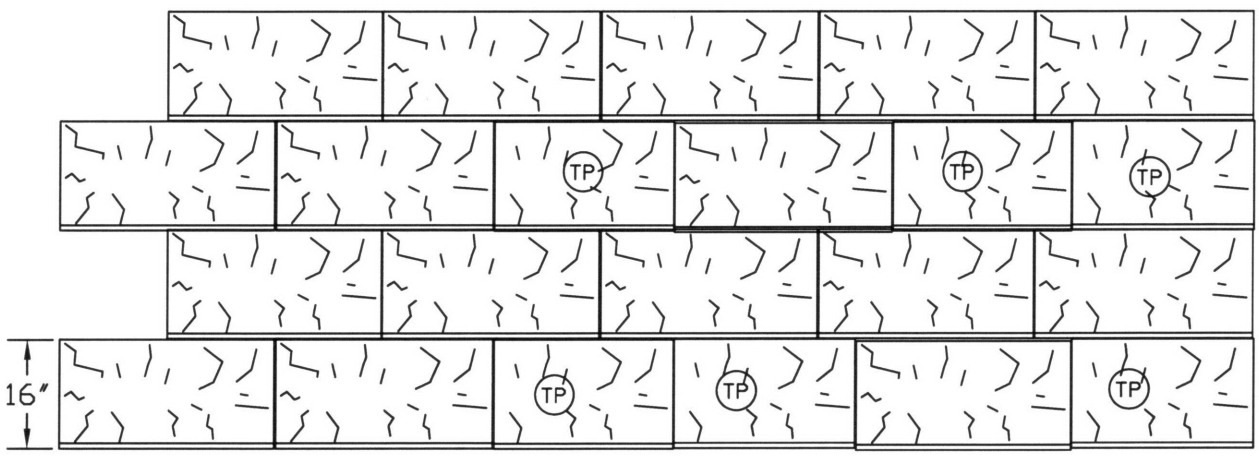




REAR VIEW

(TP) - DENOTES TRIMMED PANELS PANEL (665mm) LONG

-TRIMMED PANELS USED TO ADJUST 'BOND' AT INTERFACES



ELEVATION VIEW

TYPICAL "STONE" LAYOUT

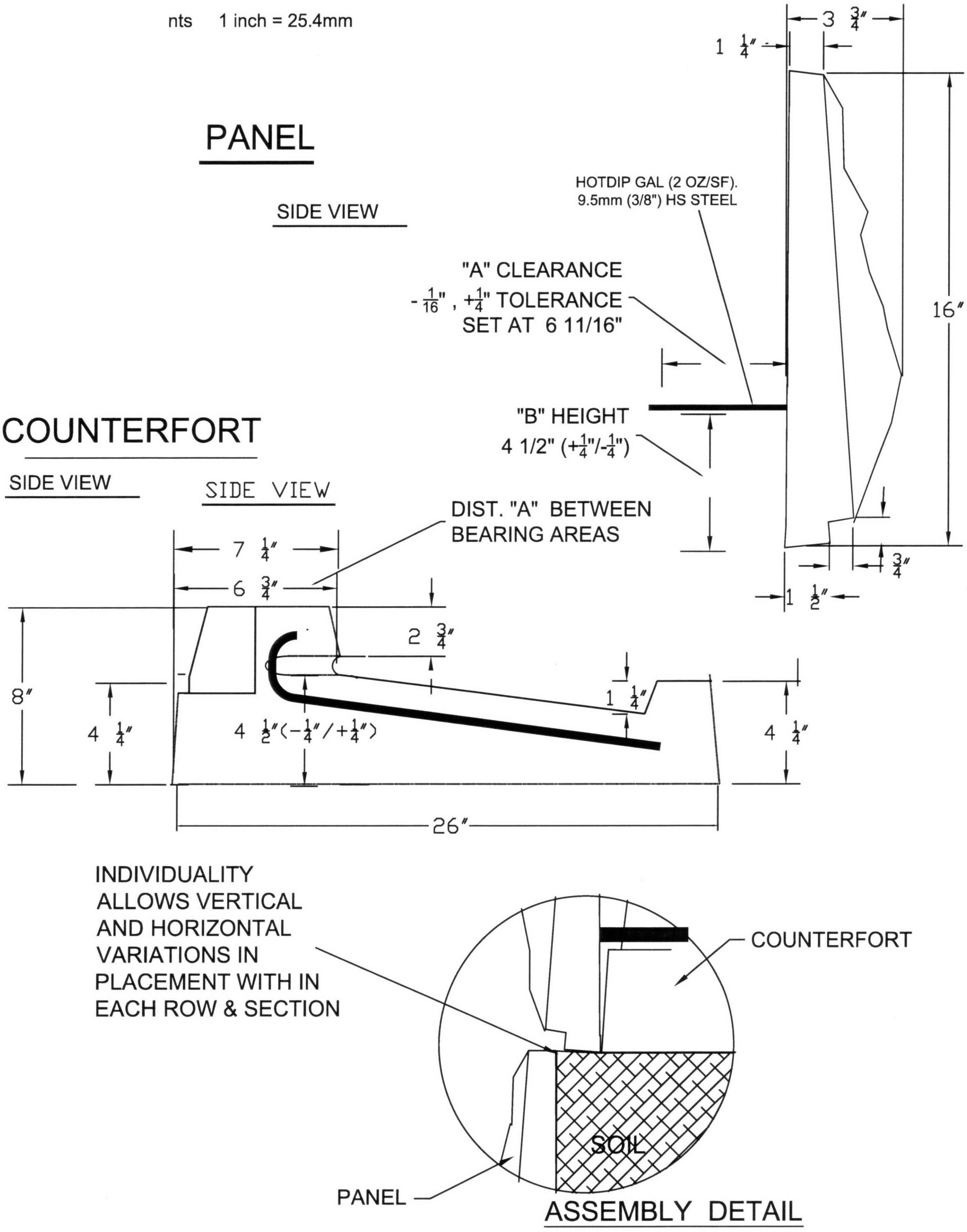
VERTICAL INTERFACE

nts 1 inch = 25.4mm

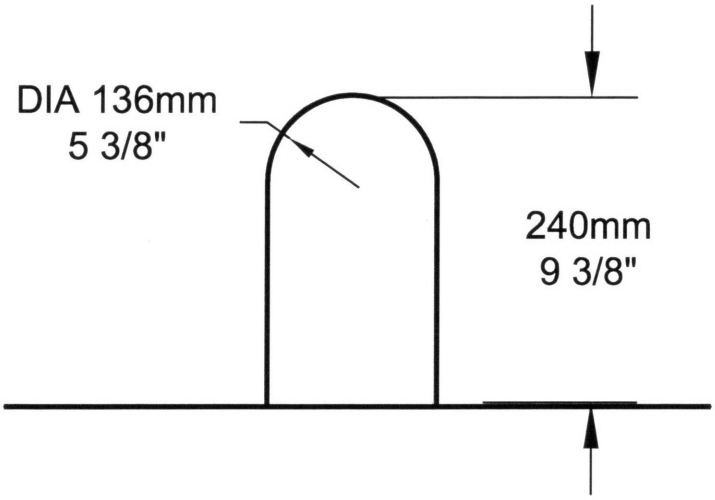
LOCK+LOAD-TOLERANCES-622

LOCK+LOAD Retaining Walls Ltd.

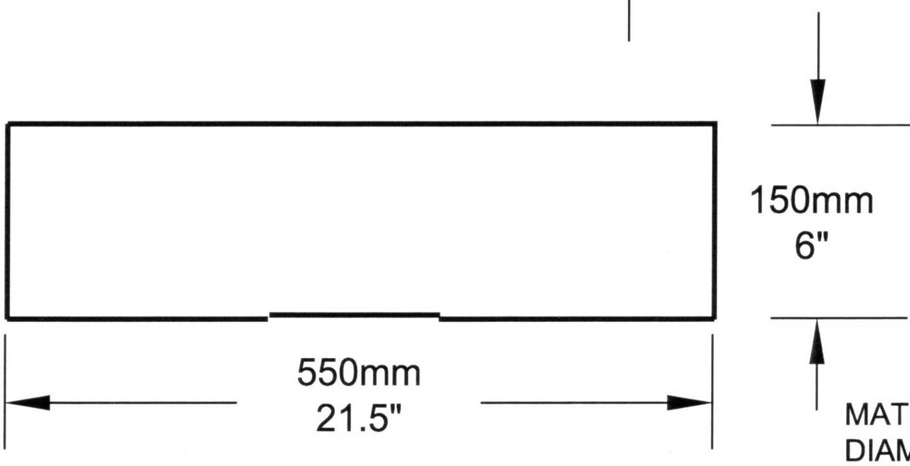
nts 1 inch = 25.4mm



CONNECTING LOOP - FILE 605



TOP VIEW
(AS PANEL INSTALLED)



FRONT VIEW
(AS PANEL INSTALLED)

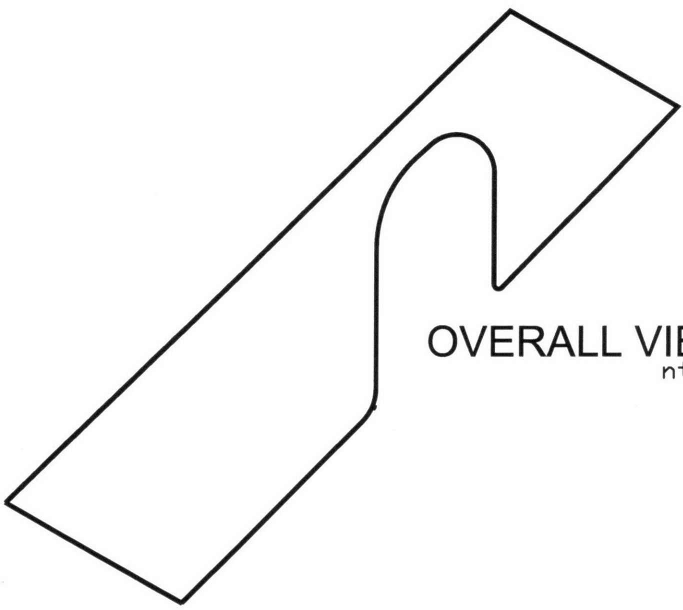
MATERIAL AND
DIAMETER OF LOOP

CONNECTING LOOP

3/8" 9.5mm DIA HS STEEL
HOT DIP GALVANIZE

1/4TO 5/16" STAINLESS
STEEL

1/4 TO 3/8" DIA.
FIBER REINFORCED
PLASTIC

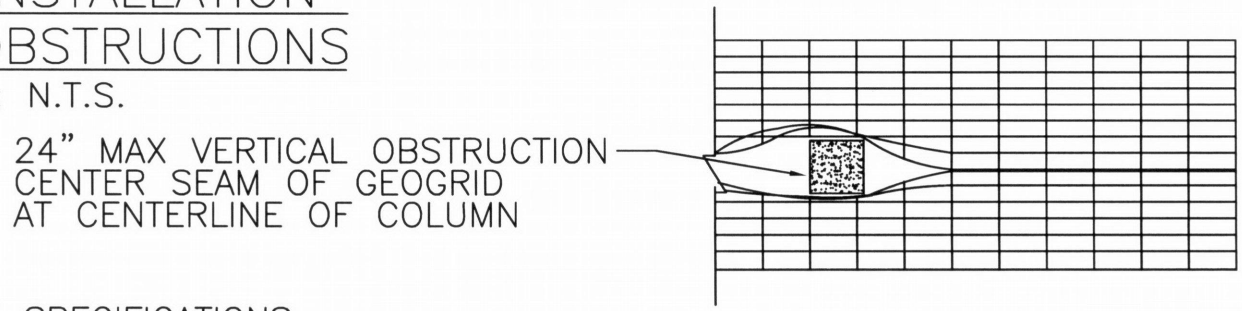


OVERALL VIEW
nts

LOCK+LOAD Retaining Walls Ltd.

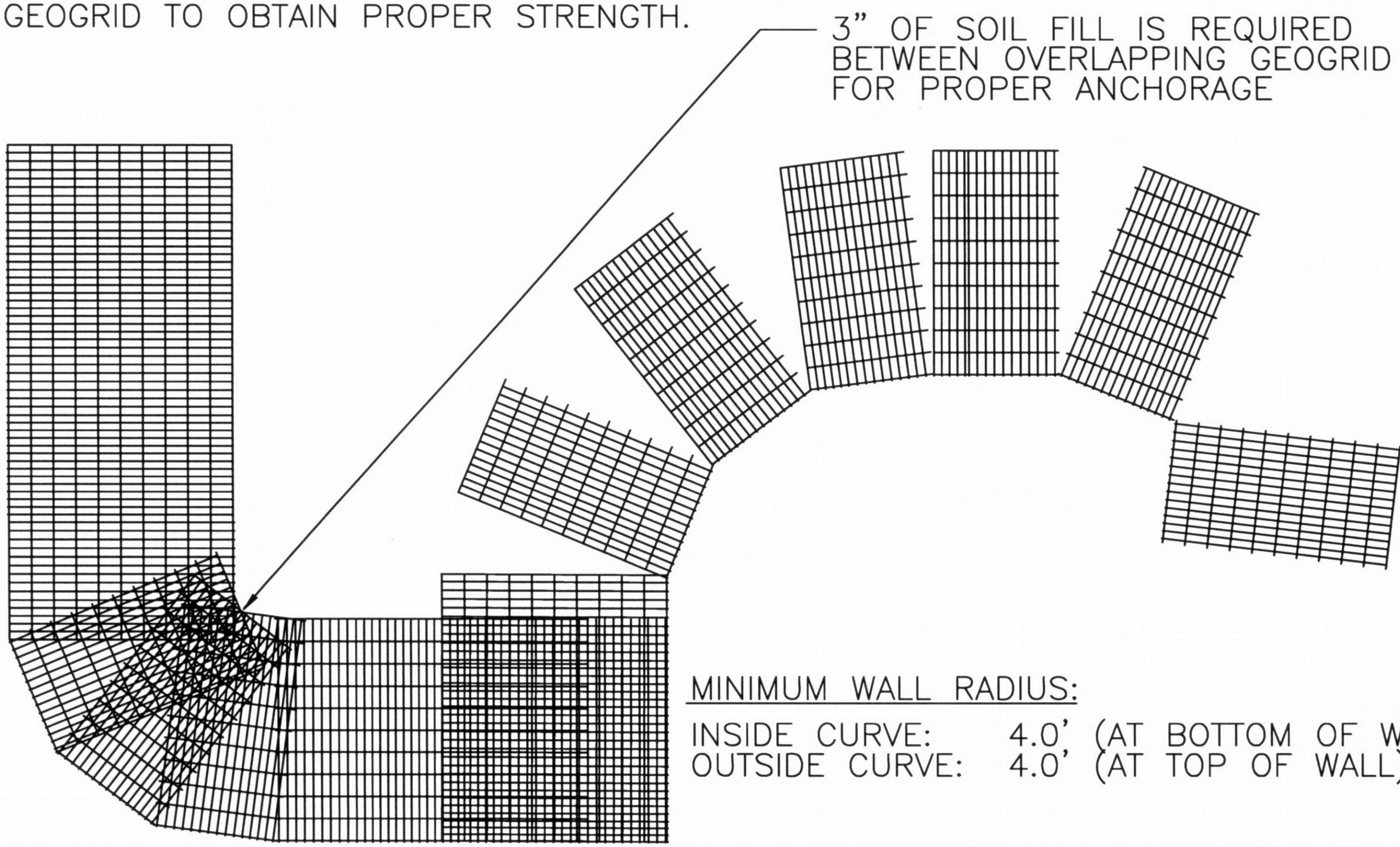
GEOGRID INSTALLATION AROUND OBSTRUCTIONS

SCALE: N.T.S.



NOTE:

1. CHECK WITH MANUFACTURER SPECIFICATIONS ON CORRECT DIRECTION OF ORIENTATION FOR GEOGRID TO OBTAIN PROPER STRENGTH.

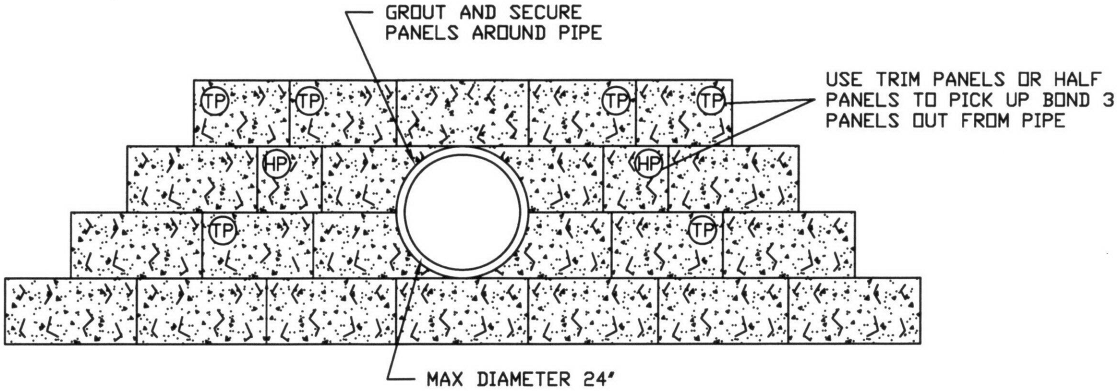


MINIMUM WALL RADIUS:

INSIDE CURVE: 4.0' (AT BOTTOM OF WALL)
OUTSIDE CURVE: 4.0' (AT TOP OF WALL)

GEOGRID INSTALLATION ON CURVES AND CORNERS

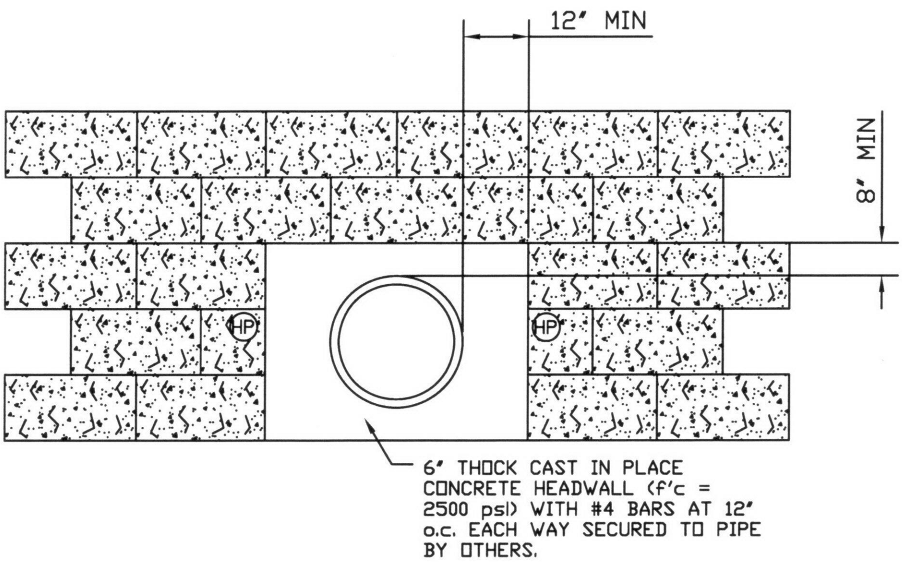
SCALE: N.T.S.



TP= TRIM PANEL
HP= HALF PANEL

1) CUT PANELS TO FIT PIPES OUTSIDE DIAMETER.

PIPE DIAMETERS 24" OR LESS



SPECIAL HEADWALL DESIGN IS REQUIRED FOR PIPE DIAMETERS GREATER THAN 5 FEET.

PIPE DIAMETERS GREATER THAN 24"

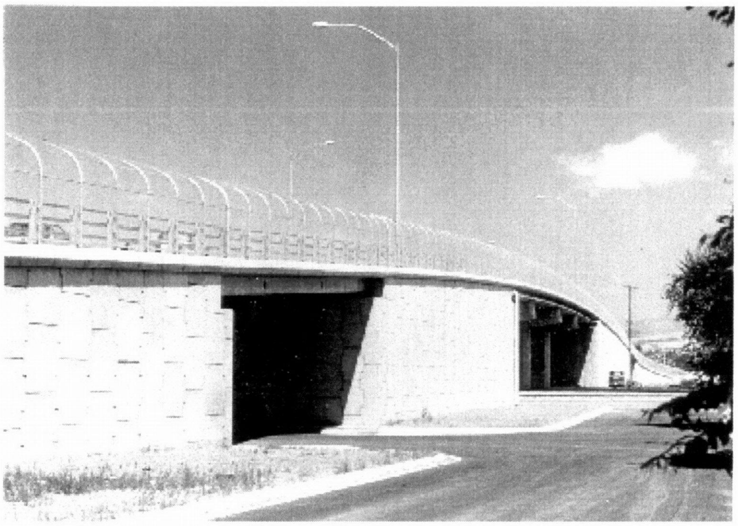
PIPE PENETRATION THROUGH WALL DETAIL

U.S. Department of Transportation
Federal Highway Administration

Publication No. FHWA-NHI-00-043

NHI Course No. 132042

MECHANICALLY STABILIZED EARTH WALLS AND REINFORCED SOIL SLOPES DESIGN & CONSTRUCTION GUIDELINES



NHI – National Highway Institute
Office of Bridge Technology

March 2001

may occur, armored slopes using natural or manufactured materials may be the only choice to reduce future maintenance. For additional guidance see chapter 6, section 6.5.

c. Performance Criteria

Performance criteria for MSE structures with respect to design requirements are governed by design practice or codes such as contained in Article 5.8 of 1996 AASHTO Specifications for Highway Bridges. These requirements consider the required margins of safety with respect to failure modes. They are equal for all types of MSEW structures. No specific AASHTO guidance is presently available for RSS structures.

With respect to lateral wall displacements, no method is presently available to definitely predict lateral displacements, most of which occur during construction. The horizontal movements depend on compaction effects, reinforcement extensibility, reinforcement length, reinforcement-to-panel connection details, and details of the facing system. A rough estimate of probable lateral displacements of simple structures that may occur during construction can be made based on the reinforcement length to wall-height ratio and reinforcement extensibility as shown in figure 10.

This figure indicates that increasing the length-to-height ratio of reinforcements from its theoretical lower limit of 0.5H to 0.7H, decreases the deformation by 50 percent. It further suggests that the anticipated construction deformation of MSE structures constructed with polymeric reinforcements (extensible) is approximately three times greater than if constructed with metallic reinforcements (inextensible).

Performance criteria are both site and structure-dependent. Structure-dependent criteria consist of safety factors or a consistent set of load and resistance factors as well as tolerable movement criteria of the specific MSE structure selected.

Recommended minimum factors of safety with respect to failure modes are as follows:

! External Stability

Sliding	:	F.S. $\geq$ 1.5 (MSEW); 1.3 (RSS)
Eccentricity e, at Base	:	$\leq$ L/6 in soil L/4 in rock
Bearing Capacity	:	F.S. $\geq$ 2.5
Deep Seated Stability	:	F.S. $\geq$ 1.3
Compound Stability	:	F.S. $\geq$ 1.3
Seismic Stability	:	F.S. $\geq$ 75% of static F.S. (All failure modes)

! Internal Stability

Pullout Resistance	:	F.S. $\geq$ 1.5 (MSEW and RSS)
Internal Stability for RSS	:	F.S $\geq$ 1.3
Allowable Tensile Strength		
for steel strip reinforcement	:	0.55 F_y
for steel grid reinforcement:		0.48 F_y (connected to concrete panels or blocks)
for geosynthetic reinforcements	:	T_a - See design life, below

(5) Calculate the factor of safety with respect to sliding and check if it is greater than the required value, using equation 21.

(6) If Not:

- Increase the reinforcement length, L, and repeat the calculations.

f. Bearing Capacity Failure

Two modes of bearing capacity failure exist, general shear failure and local shear failure. Local shear is characterized by a "squeezing" of the foundation soil when soft or loose soils exist below the wall.

! General Shear

To prevent bearing capacity failure, it is required that the vertical stress at the base calculated with the Meyerhof-type distribution, as discussed in (d) above, does not exceed the allowable bearing capacity of the foundation soil determined, considering a safety factor of 2.5 with respect to Group I loading applied to the ultimate bearing capacity:

$$\sigma_v \le q_a = \frac{q_{ult}}{FS} \tag{26}$$

A lesser FS of 2.0 could be used if justified by a geotechnical analysis which calculates settlement and determines it to be acceptable.

Calculation steps for an MSE wall with a sloping surcharge are as follows:

NOTE:
Lock and load panels do not stack - therefore settlement is not an issue and using an FS = 2.0 is acceptable,

(1) Obtain the eccentricity e of the resulting force at the base of the wall. Remember that under preliminary sizing if the eccentricity exceeded L/6, the reinforcement length at the base was increased.

(2) Calculate the vertical stress σ_v at the base assuming Meyerhof-type distribution:

$$\sigma_v = \frac{V_1 + V_2 + F_T \sin\beta}{L - 2e} \tag{27}$$

(3) Determine the ultimate bearing capacity q_{ult} using classical soil mechanics methods, e.g. for a level grade in front of the wall and no groundwater influence:

$$q_{ult} = c_f N_c + 0.5\,(L)\gamma_f N_\gamma \tag{28}$$

LOCK+LOAD Retaining Wall Design Procedure

Disclaimer: The information and applications depicted herein accurately represent the use and design of **LOCK+LOAD** retaining walls but the applicability to any specific project is the sole responsibility of the user. **LOCK+LOAD** assumes no responsibilities for the drawings and calculations provided, as they are intended to be only general examples of the proper use of the **LOCK+LOAD** product.

Forward:
Presented here are the locations of recommended references and software suitable for use in the design of **LOCK+LOAD** retaining structures.

General Background:
LOCK+LOAD "modules" are used either by themselves or with soil reinforcement (i.e. geogrids, metal mats, etc.) to erect mechanically stabilized earth (MSE) retaining walls where the stabilized earth mass acts as a traditional gravity retaining structure.

The two most general parameters governing retaining wall design are: soil strength and geometry. The design goal being to satisfactorily balance the "driving forces" from the retained earth with the "resistive forces" the MSE mass to give suitable factors of safety for the required design criteria.

LOCK+LOAD recommends that MSE retaining walls using its "modules" be designed using the procedures presented in the U.S. Dept. of Transportation Federal Highway Administration Publication No. FHWA NHI-00-043 Titled:

"Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines"

The FHWA design procedures are implemented in computer software by the program MSEW 3.0 by ADAMA Engineering (www.geoprograms.com) the use of which is presented within the FHWA document.

A copy of FHWA NHI-00-043, which can be downloaded as a PDF from:

http://www.fhwa.dot.gov/engineering/geotech/library_sub.cfm?keyword=020

Titled: Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines 2000
Document No.: FHWA-NHI-00-043.

For specific questions regarding the application of the above FHWA manual to the design of **LOCK+LOAD** retaining walls or for MSEW(3) "start" files with **LOCK+LOAD** and geo-grid data pre-entered please Email technical support at:

rwormus@lock-load.com

Relatively large earthquake shaking (i.e. $A \geq 0.29$) could result in significant permanent lateral and vertical wall deformations even if limit equilibrium criteria are met. In seismically active areas where such strong shaking could exist, a specialist should be retained to evaluate the anticipated deformation response of the structure.

The use of the full value of A_m for K_h in the Mononobe-Okabe method assumes that no wall lateral displacement is allowed. When using the Mononobe-Okabe method, this assumptions can result in excessively conservative wall designs. To provide a more economical structure, design for a small tolerable displacement rather than no displacement may be preferred. The 1996 AASHTO Specifications for Highway Bridges (with 1998 Interims), Article 5.2.2.4, in combination with Division 1A, Articles 6.4.3 and 7.4.3, allow Mononobe-Okabe earth pressure to be reduced to a residual seismic earth pressure behind the wall resulting from an outward lateral movement of the wall. This reduced seismic earth pressure is calculated through the use of reduced acceleration coefficient for K_h, which accounts for the allowance of some lateral wall displacement. This reduced K_h can be determined through a Newmark sliding block analysis, though the complexity of this type of analysis is beyond the scope of this manual.[28] A reduced K_h can be used for any gravity or semi-gravity wall if the following conditions are met:

- ! The wall system and any structures supported by the wall can tolerate lateral movement resulting from sliding of the structure.
- ! The wall is unrestrained regarding its ability to slide, other than soil friction along its base and minimal soil passive resistance.
- ! If the wall functions as an abutment, the top of the wall must also be unrestrained, e.g., the superstructure is supported by sliding bearings.

The 1996 AASHTO Specifications for Highway Bridges (with 1998 Interims), Division 1A, Articles 6.4.3 and 7.4.3, provide an approximation of this reduction to account for lateral wall displacement. The K_h used for Mononobe-Okabe analysis of gravity and semi-gravity free standing and abutment walls may be reduced to 0.5A, provided that displacements up to 250 A mm are acceptable. Kavazanjian et al.[29] developed an expression for K_h (i.e., N, the peak seismic resistance coefficient sustainable by the wall before it slides), and further simplified the Newmark analysis by assuming the ground velocity in the absence information on the time history of the ground motion, to be equal to 30A. For MSE walls the maximum wall acceleration coefficient at the centroid of the wall mass, A_m (eq. 30), is used with this expression, and K_h is computed as:

$$K_h = 1.66 A_m \left(\frac{A_m}{d} \right)^{0.25} \tag{37b}$$

where, "d" is the lateral wall displacement in mm. It should be noted that this equation should not be used for displacements of less than 25 mm (1 inch) or greater than approximately 200 mm (8 inches). It is recommended that this reduced acceleration value only be used for external stability calculations, to be consistent with the concept of the MSE wall behaving as a rigid block. Internally, the lateral deformation response of the MSE wall

Shriners Hospital Temp- 19P_8P_Seismic

PROJECT IDENTIFICATION

Title:	Shriners Hospital Temp- 19P_8P_Seismic
Project Number:	KEYX0255 -
Client:	Key West Retaining Systems
Designer:	dh

Description:

19 Panel Upper tier (24.7') and 8 Panel Lower tier (10.4') - 2 tier wall system to support construction equipment. 1:20 face batter. Seismic Zone 3

Company's information:

Name:	DAH/SE
Street:	PO Box 82228
	Portland, OR 97282
Telephone #:	503-231-8727
Fax #:	503-231-8726
E-Mail:	structbear@earthlink.net

Original file path and name: F:\Key Wes ..... ns\Shriners Two Tiers Temporary Seismic_19P_8P.MSE
Original date and time of creating this file: Mon Jun 16 13:07:46 2008

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [lb/ft ³]	Internal angle of friction, ϕ [deg.]	Cohesion, c [lb/ft ²]
....1....... Reinforced Soil..................................	130.0	37.0	0.0
....2....... Retained Soil.....................................	130.0	37.0	0.0
....3....... Foundation Soil.................................	130.0	37.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [lb/ft]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Coverage Ratio, Rc
2	SF55	4200.00	1.10	1.15	1.55	1.00
3	SF80	7400.00	1.10	1.15	1.55	1.00
4	SF110	10250.00	1.10	1.15	1.55	1.00

Interaction Parameters		== Direct Sliding ==		==== Pullout ====	
Type #	Geosynthetic Designated Name	Cds-phi	Cds-c	Ci	Alpha
2	SF55	0.83	0.00	0.67	0.80
3	SF80	0.83	0.00	0.67	0.80
4	SF110	0.83	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.440
Design horizontal seismic coefficient, kh = Am = 0.5 x Ao = 0.220 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

DRAWING OF SPECIFIED GEOMETRY - COMPLEX - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

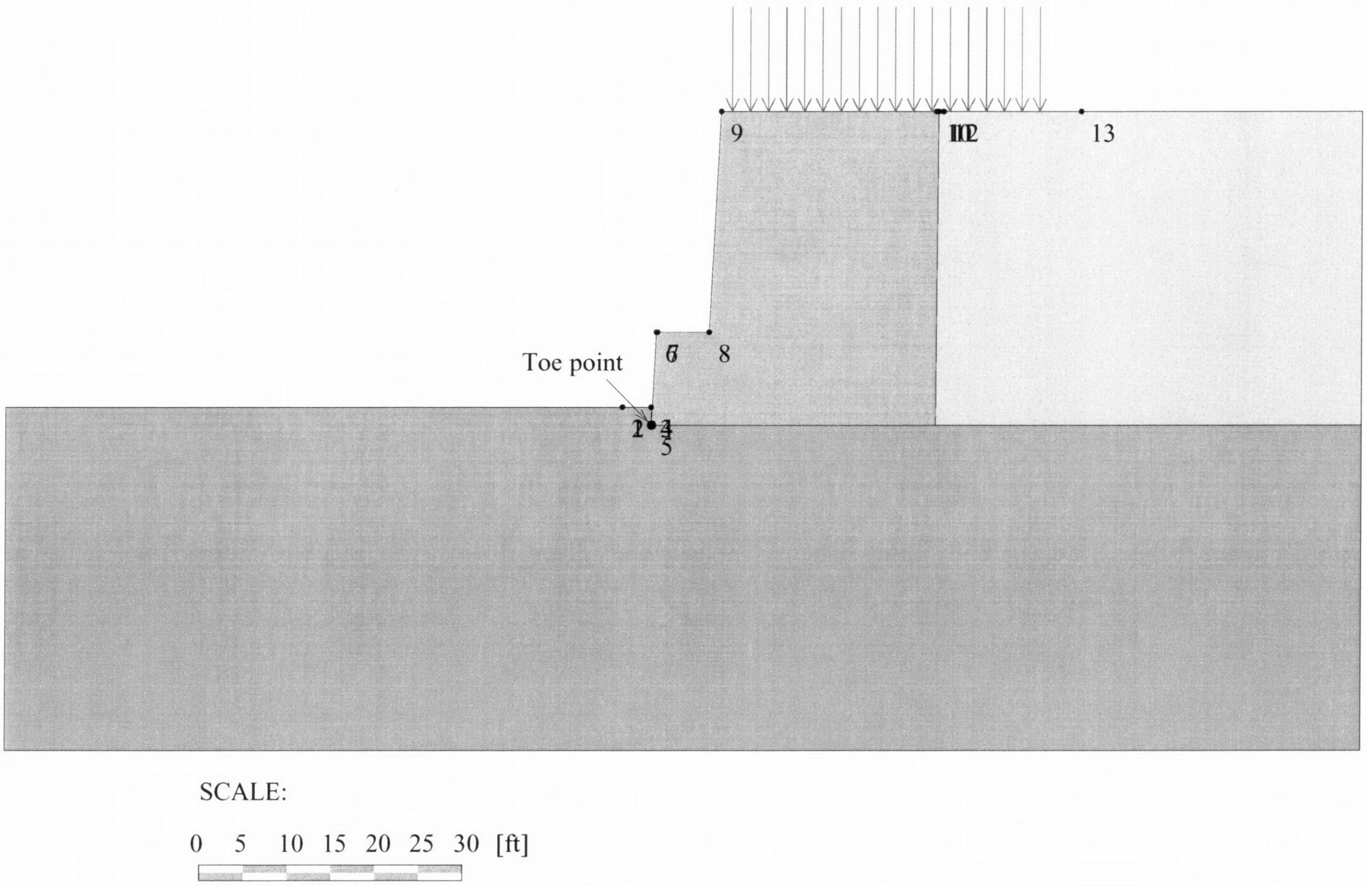
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Load Q1 = 500.00 [lb/ft²] inclined from verical at 0.00 degrees, starts at X1s = 109.00 and ends at X1e = 145.00 [ft].
Surcharge load, Q2.................................... None
Surcharge load, Q3.................................... None

STRIP LOAD

............................None..................................



TABULATED DETAILS OF QUICK SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

	#	Xi	Yi
Top of Layer 1	1	96.72	202.00
	2	99.97	202.00
	3	100.00	200.00
	4	100.52	210.40
	5	100.65	210.40
	6	106.52	210.40
	7	107.80	235.10
	8	132.80	235.10
	9	148.41	235.10
Top of Layer 2	10	96.72	202.00
	11	99.97	202.00
	12	100.00	200.00
	13	132.00	200.00
	14	132.25	235.10
	15	148.41	235.10
Top of Layer 3	16	96.72	202.00
	17	99.97	202.00
	18	100.00	200.00

TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

#	X	Y1	Y2	Y3
1	96.72	202.00	202.00	202.00
2	96.72	202.00	202.00	202.00
3	99.97	202.00	202.00	202.00
4	99.97	202.00	202.00	201.83
5	100.00	200.00	200.00	200.00
6	100.52	210.40	200.00	200.00
7	100.65	210.40	200.00	200.00
8	106.52	210.40	200.00	200.00
9	107.80	235.10	200.00	200.00
10	132.00	235.10	200.00	200.00
11	132.25	235.10	235.10	200.00
12	132.80	235.10	235.10	200.00
13	148.41	235.10	235.10	200.00

DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER

A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [ft]	L [ft]	L1 [ft]	L2 [ft]	L3 [ft]	Tfe [lb/ft]	Tavailable [lb/ft]
1	SF110	0.65	26.00	0.92	2.20	22.88	4757.11	5227.59
2	SF110	3.25	26.00	3.51	2.36	20.13	3554.76	5227.59
3	SF110	5.85	26.00	7.12	2.56	16.32	2456.97	5227.59
4	SF110	8.45	26.00	7.74	2.82	15.44	2456.97	5227.59
5	SF80	11.25	20.00	1.80	2.26	15.93	1773.81	3774.07
6	SF80	13.65	20.00	0.00	2.53	17.47	3774.07	3774.07
7	SF80	16.25	20.00	0.00	2.89	17.11	3774.07	3774.07
8	SF80	18.85	20.00	0.00	3.35	16.65	3774.07	3774.07
9	SF80	21.45	20.00	0.59	3.97	15.44	3547.62	3774.07
10	SF80	24.05	20.00	1.35	4.89	13.77	2943.77	3774.07
11	SF55	26.65	20.00	0.00	3.64	16.36	2142.04	2142.04
12	SF55	29.25	20.00	0.82	5.25	13.93	1863.57	2142.04
13	SF55	31.85	20.00	3.48	9.42	7.11	1370.90	2142.04
14	SF55	34.45	20.00	0.00	20.00	0.00	908.90	908.90 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength

RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [ft]		Exit Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
2	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
3	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
4	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
5	129.11	235.10	72.87	202.34	91.27	235.41	37.84	1.95	
6	132.46	235.10	72.90	202.37	93.54	235.36	38.92	1.68	
7	135.81	235.10	73.12	202.25	95.47	235.84	40.34	1.54	
8	139.16	235.10	73.50	202.00	95.06	240.90	44.48	1.47	
9	142.51	235.10	73.12	202.22	96.68	242.16	46.37	1.42	
10	145.86	235.10	73.43	202.04	96.55	247.25	50.78	1.39	
11	149.21	235.10	72.99	202.23	96.25	253.10	55.94	1.38	. On extreme X-entry

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points)

Exit Point #	Exit Point (X, Y) [ft]		Entry Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
. 1	72.99	202.23	149.21	235.10	96.25	253.10	55.94	1.38	. On extreme X-exit
2	75.24	202.30	149.21	235.10	97.30	252.35	54.70	1.39	
3	77.75	202.25	149.21	235.10	98.38	251.54	53.43	1.40	
4	80.31	202.19	149.21	235.10	99.47	250.66	52.12	1.42	
5	82.92	202.11	149.21	235.10	100.59	249.71	50.78	1.44	
6	85.59	202.02	149.21	235.10	101.73	248.70	49.39	1.46	
7	87.56	202.17	149.21	235.10	102.90	247.63	47.97	1.49	
8	90.25	202.09	145.86	235.10	104.24	241.87	42.17	1.54	
9	92.48	202.18	149.21	235.10	107.90	240.96	41.73	1.63	
10	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
11	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

RESULTS OF TRANSLATIONAL ANALYSIS

Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [ft]	(Xa, Ya) [ft]		(Xb, Yb) [ft]		(Xc, Yc) [ft]		Fs	STATUS
At toe elevation	0.00	100.00	200.00	105.32	200.00	151.90	235.10	1.16	OK
Reinf. Layer #1	0.65	100.03	200.65	105.58	200.65	151.29	235.10	1.15	OK
Reinf. Layer #2	3.25	100.16	203.25	105.68	203.25	145.01	235.10	1.16	OK
Reinf. Layer #3	5.85	100.29	205.85	105.78	205.85	139.43	235.10	1.18	OK
Reinf. Layer #4	8.45	100.42	208.45	105.98	208.45	147.02	235.10	1.20	OK
Reinf. Layer #5	11.25	106.56	211.25	106.90	211.25	130.75	235.10	1.24	Minimum on Edge
Reinf. Layer #6	13.65	106.69	213.65	107.00	213.65	131.68	235.10	1.35	Minimum on Edge
Reinf. Layer #7	16.25	106.82	216.25	107.20	216.25	132.21	235.10	1.42	Minimum on Edge
Reinf. Layer #8	18.85	106.96	218.85	107.30	218.85	124.73	235.10	1.51	Minimum on Edge
Reinf. Layer #9	21.45	107.09	221.45	107.40	221.45	123.10	235.10	1.59	Minimum on Edge
Reinf. Layer #10	24.05	107.23	224.05	107.60	224.05	120.77	235.10	1.60	Minimum on Edge
Reinf. Layer #11	26.65	107.36	226.65	107.70	226.65	117.08	235.10	1.71	Minimum on Edge
Reinf. Layer #12	29.25	107.50	229.25	107.80	229.25	113.26	235.10	1.88	Minimum on Edge
Reinf. Layer #13	31.85	107.63	231.85	108.00	231.85	112.01	235.10	2.12	Minimum on Edge
Reinf. Layer #14	34.45	107.77	234.45	112.08	234.45	112.83	235.10	5.84	OK

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

RESULTS OF 3-PART WEDGE ANALYSIS

Results in the table below represent the critical slip surface composed of a three-part wedge and identified by the specified points (X-left, Y-left) and (X-right, Y-right) and angles Zeta(L) and Zeta(R). ReSSA finds the (X,Y) coordinates, as well as the angles Zeta, based on user-specified search domain. The trace of the critical three-part wedge is fully defined by four points: (X1, Y1), (X-left, Y-left), (X-right, Y-right), (X2, Y2).

Critical 3-part wedge (Automatic search):

(X2, Y2) [ft]	Zeta(L) [degrees]	(X-left, Y-left) [ft]	(X-right, Y-right) [ft]	Zeta(R) [degrees]	(X1, Y1) [ft]	Fs
(61.23, 202.00)	10.00	(102.45, 194.73)	(115.40, 198.50)	35.00	(167.67, 235.10)	1.219

CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.38
Critical Circle: Xc = 96.25[ft], Yc = 253.10[ft], R = 55.94[ft]. (Number of slices used = 62)

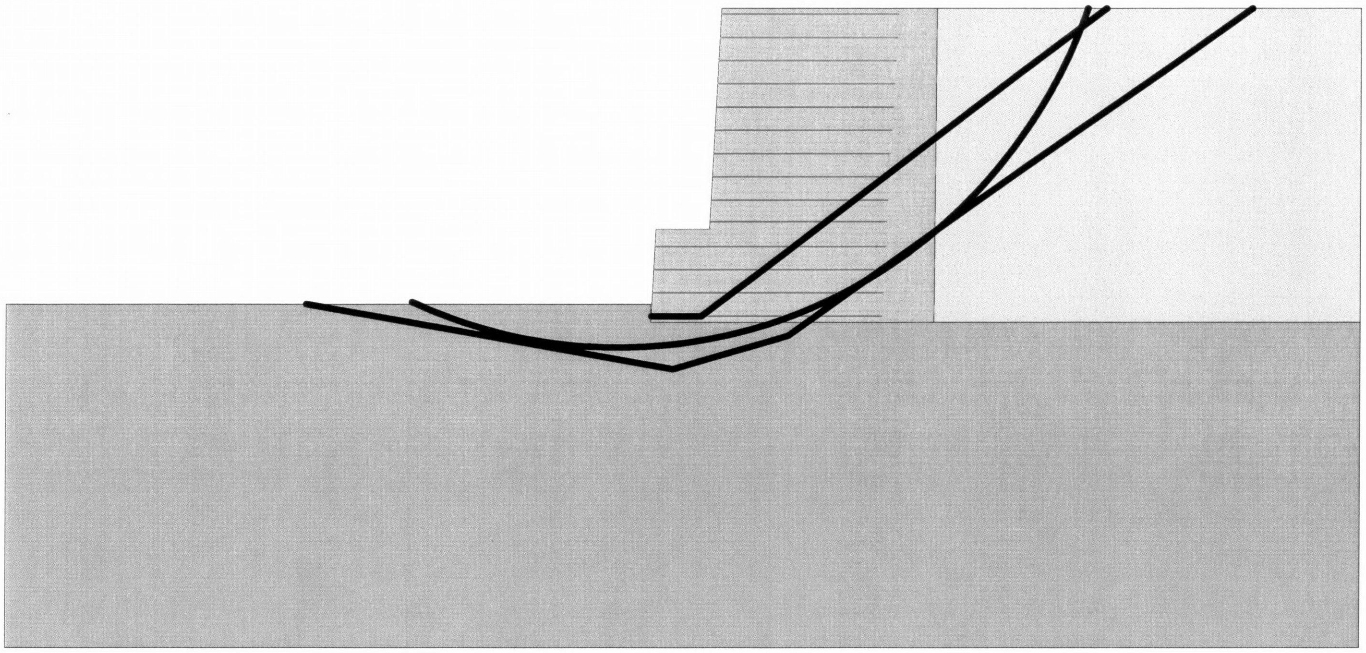
Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

Minimum Factor of Safety = 1.15
Critical Two-Part Wedge: (Xa = 100.03, Ya = 200.65) [ft]
(Xb = 105.58, Yb = 200.65) [ft]
(Xc = 151.29, Yc = 235.10) [ft]
(Number of slices used = 30)
Interslice resultant force inclination = 35.93 [degrees]

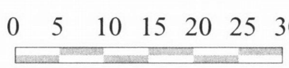
Three-Part Wedge Stability Analysis

Minimum Factor of Safety = 1.22
Critical Three-Part Wedge: (X2 = 61.23, Y2 = 202.00) [ft]
(X-left = 102.45, Y-left = 194.73) [ft]
(X-right = 115.40, Y-right = 198.50) [ft]
(X1 = 167.67, Y1 = 235.10) [ft]
(Number of slices used = 45)
Interslice resultant force inclination = 20.88 [degrees]

REINFORCEMENT LAYOUT: DRAWING



SCALE:



REINFORCEMENT LAYOUT: TABULATED DATA & QUANTITIES

Layer #	Reinf. Type #	Geosynthetic Designated Name	Height Relative to Toe [ft]	Embedded Length [ft]	Covergae Ratio, Rc	(X, Y) front [ft]		(X, Y) rear [ft]		Lsv * [ft]	Lre [ft]
1	4	SF110	0.65	26.00	1.00	328.12	656.82	354.12	656.82	0.00	0.00
2	4	SF110	3.25	26.00	1.00	328.25	659.42	354.25	659.42	0.00	0.00
3	4	SF110	5.85	26.00	1.00	328.38	662.02	354.38	662.02	0.00	0.00
4	4	SF110	8.45	26.00	1.00	328.51	664.62	354.51	664.62	0.00	0.00
5	3	SF80	11.25	20.00	1.00	334.65	667.42	354.65	667.42	0.00	0.00
6	3	SF80	13.65	20.00	1.00	334.77	669.82	354.77	669.82	0.00	0.00
7	3	SF80	16.25	20.00	1.00	334.91	672.42	354.91	672.42	0.00	0.00
8	3	SF80	18.85	20.00	1.00	335.04	675.02	355.04	675.02	0.00	0.00
9	3	SF80	21.45	20.00	1.00	335.18	677.62	355.18	677.62	0.00	0.00
10	3	SF80	24.05	20.00	1.00	335.31	680.22	355.31	680.22	0.00	0.00
11	2	SF55	26.65	20.00	1.00	335.45	682.82	355.45	682.82	0.00	0.00
12	2	SF55	29.25	20.00	1.00	335.58	685.42	355.58	685.42	0.00	0.00
13	2	SF55	31.85	20.00	1.00	335.72	688.02	355.72	688.02	0.00	0.00
14	2	SF55	34.45	20.00	1.00	335.85	690.62	355.85	690.62	0.00	0.00

* Vertical distance between layers.

QUANTITIES

Reinf. Type #	Designated Name	Coverage Ratio	Area of reinforcemnt [ft²] / length of slope [ft]
2	SF55	1.00	80.00
3	SF80	1.00	120.00
4	SF110	1.00	104.00

Shriners Hospital Temp- 19P_8P_Static

PROJECT IDENTIFICATION

Title:	Shriners Hospital Temp- 19P_8P_Static
Project Number:	KEYX0255 -
Client:	Key West Retaining Systems
Designer:	dh

Description:

19 Panel Upper tier (24.7') and 8 Panel Lower tier (10.4') - 2 tier wall system to support construction equipment. 1:20 face batter.

Company's information:

Name:	DAH/SE
Street:	PO Box 82228
	Portland, OR 97282
Telephone #:	503-231-8727
Fax #:	503-231-8726
E-Mail:	structbear@earthlink.net

Original file path and name: F:\Key Wes ..... uns\Shriners Two Tiers Temporary Static_19P_8P.MSE
Original date and time of creating this file: Mon Jun 16 13:07:46 2008

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [lb/ft ³]	Internal angle of friction, ϕ [deg.]	Cohesion, c [lb/ft ²]
....1....... Reinforced Soil..................................	130.0	37.0	0.0
....2....... Retained Soil.....................................	130.0	37.0	0.0
....3....... Foundation Soil.................................	130.0	37.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [lb/ft]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Coverage Ratio, Rc
2	SF55	4200.00	1.10	1.15	1.55	1.00
3	SF80	7400.00	1.10	1.15	1.55	1.00
4	SF110	10250.00	1.10	1.15	1.55	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
2	SF55	0.83	0.00	0.67	0.80
3	SF80	0.83	0.00	0.67	0.80
4	SF110	0.83	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Not Applicable

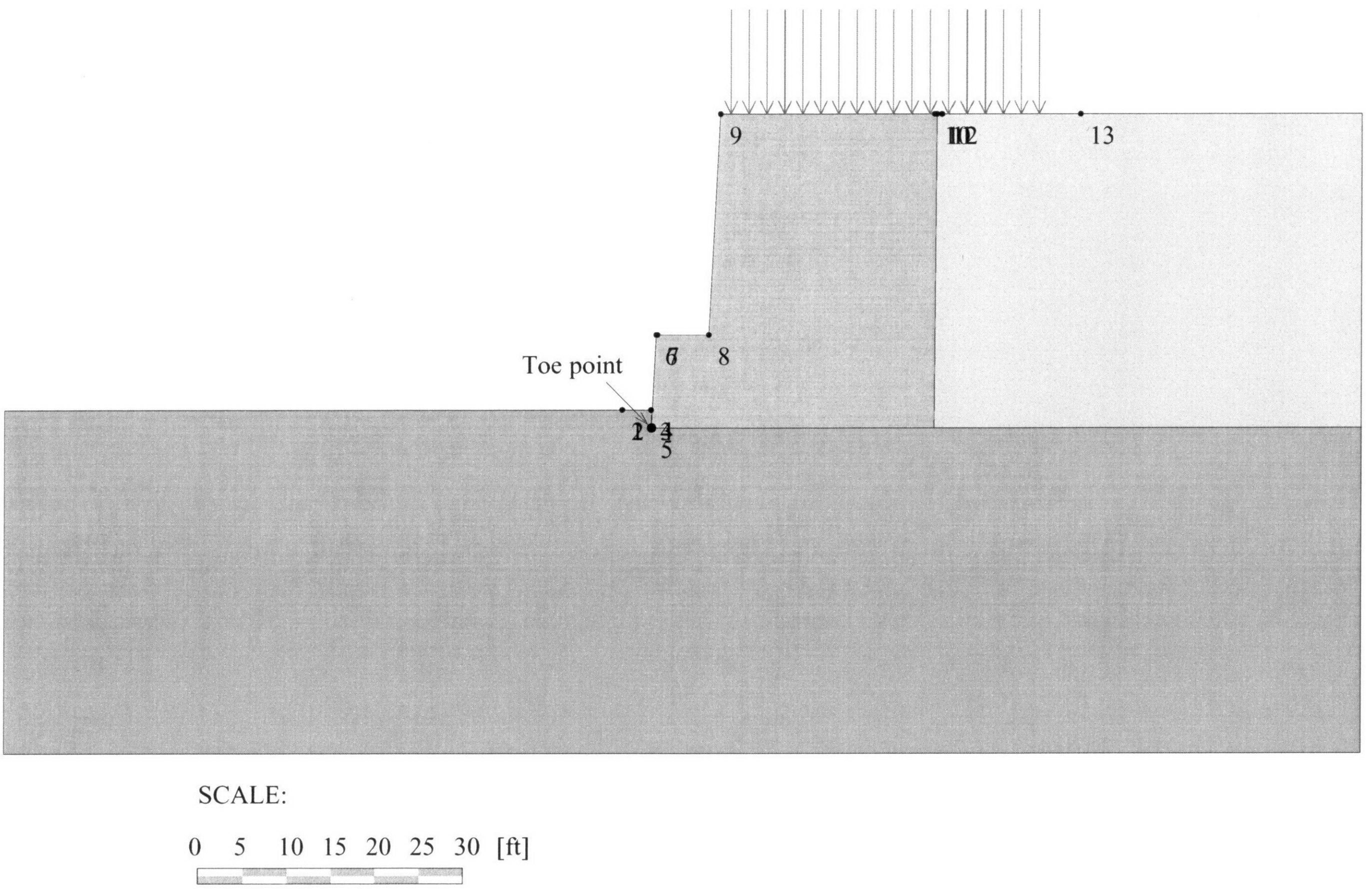
DRAWING OF SPECIFIED GEOMETRY - COMPLEX - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE
Load Q1 = 500.00 [lb/ft²] inclined from verical at 0.00 degrees, starts at X1s = 109.00 and ends at X1e = 145.00 [ft].
Surcharge load, Q2.................................... None
Surcharge load, Q3.................................... None

STRIP LOAD
............................None...................................



TABULATED DETAILS OF QUICK SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

	#	Xi	Yi
Top of Layer 1	1	96.72	202.00
	2	99.97	202.00
	3	100.00	200.00
	4	100.52	210.40
	5	100.65	210.40
	6	106.52	210.40
	7	107.80	235.10
	8	132.80	235.10
	9	148.41	235.10
Top of Layer 2	10	96.72	202.00
	11	99.97	202.00
	12	100.00	200.00
	13	132.00	200.00
	14	132.25	235.10
	15	148.41	235.10
Top of Layer 3	16	96.72	202.00
	17	99.97	202.00
	18	100.00	200.00

TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

#	X	Y1	Y2	Y3
1	96.72	202.00	202.00	202.00
2	96.72	202.00	202.00	202.00
3	99.97	202.00	202.00	202.00
4	99.97	202.00	202.00	201.83
5	100.00	200.00	200.00	200.00
6	100.52	210.40	200.00	200.00
7	100.65	210.40	200.00	200.00
8	106.52	210.40	200.00	200.00
9	107.80	235.10	200.00	200.00
10	132.00	235.10	200.00	200.00
11	132.25	235.10	235.10	200.00
12	132.80	235.10	235.10	200.00
13	148.41	235.10	235.10	200.00

DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER

A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [ft]	L [ft]	L1 [ft]	L2 [ft]	L3 [ft]	Tfe [lb/ft]	Tavailable [lb/ft]
1	SF110	0.65	26.00	0.92	2.20	22.88	4757.11	5227.59
2	SF110	3.25	26.00	3.51	2.36	20.13	3554.76	5227.59
3	SF110	5.85	26.00	7.12	2.56	16.32	2456.97	5227.59
4	SF110	8.45	26.00	7.74	2.82	15.44	2456.97	5227.59
5	SF80	11.25	20.00	1.80	2.26	15.93	1773.81	3774.07
6	SF80	13.65	20.00	0.00	2.53	17.47	3774.07	3774.07
7	SF80	16.25	20.00	0.00	2.89	17.11	3774.07	3774.07
8	SF80	18.85	20.00	0.00	3.35	16.65	3774.07	3774.07
9	SF80	21.45	20.00	0.59	3.97	15.44	3547.62	3774.07
10	SF80	24.05	20.00	1.35	4.89	13.77	2943.77	3774.07
11	SF55	26.65	20.00	0.00	3.64	16.36	2142.04	2142.04
12	SF55	29.25	20.00	0.82	5.25	13.93	1863.57	2142.04
13	SF55	31.85	20.00	3.48	9.42	7.11	1370.90	2142.04
14	SF55	34.45	20.00	0.00	20.00	0.00	908.90	908.90 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength

RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [ft]		Exit Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
2	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
3	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
4	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
5	129.11	235.10	72.87	202.34	91.27	235.41	37.84	2.77	
6	132.46	235.10	72.90	202.37	93.54	235.36	38.92	2.30	
7	135.81	235.10	75.84	202.06	96.67	235.19	39.14	2.07	
8	139.16	235.10	75.41	202.36	98.61	235.62	40.56	1.97	
9	142.51	235.10	75.69	202.17	100.21	236.68	42.33	1.92	
10	145.86	235.10	73.46	202.03	98.76	242.42	47.67	1.91	OK
11	149.21	235.10	72.88	202.35	98.71	247.48	52.00	1.93	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points)

Exit Point #	Exit Point (X, Y) [ft]		Entry Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	73.46	202.03	145.86	235.10	98.76	242.42	47.67	1.91	On extreme X-exit
2	75.90	202.02	145.86	235.10	99.87	241.84	46.48	1.91	
3	78.20	202.11	142.51	235.10	101.37	236.12	41.15	1.93	
4	80.75	202.02	142.51	235.10	102.55	235.51	39.96	1.94	
5	82.81	202.23	145.86	235.10	103.73	239.01	42.31	1.97	
6	85.43	202.09	145.86	235.10	102.26	243.11	44.33	2.01	
7	88.04	202.02	142.51	235.10	103.84	237.39	38.74	2.06	
8	90.25	202.09	145.86	235.10	104.24	241.87	42.17	2.12	
9	92.43	202.23	145.86	235.10	108.25	236.38	37.64	2.20	
10	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff
11	100.00	200.00	100.00	200.00	100.00	200.00	0.00	N/A	#10 - Overhanging Cliff

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

RESULTS OF TRANSLATIONAL ANALYSIS

Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [ft]	(Xa, Ya) [ft]		(Xb, Yb) [ft]		(Xc, Yc) [ft]		Fs	STATUS
At toe elevation	0.00	100.00	200.00	105.32	200.00	142.96	235.10	1.52	OK
Reinf. Layer #1	0.65	100.03	200.65	105.58	200.65	141.25	235.10	1.50	OK
Reinf. Layer #2	3.25	100.16	203.25	105.68	203.25	138.66	235.10	1.51	OK
Reinf. Layer #3	5.85	100.29	205.85	105.78	205.85	136.07	235.10	1.52	OK
Reinf. Layer #4	8.45	100.42	208.45	105.98	208.45	136.64	235.10	1.53	OK
Reinf. Layer #5	11.25	106.56	211.25	106.90	211.25	127.63	235.10	1.51	Minimum on Edge
Reinf. Layer #6	13.65	106.69	213.65	107.00	213.65	127.71	235.10	1.66	Minimum on Edge
Reinf. Layer #7	16.25	106.82	216.25	107.20	216.25	124.78	235.10	1.72	Minimum on Edge
Reinf. Layer #8	18.85	106.96	218.85	107.30	218.85	120.00	235.10	1.80	Minimum on Edge
Reinf. Layer #9	21.45	107.09	221.45	107.40	221.45	117.69	235.10	1.85	Minimum on Edge
Reinf. Layer #10	24.05	107.23	224.05	107.60	224.05	116.55	235.10	1.85	Minimum on Edge
Reinf. Layer #11	26.65	107.36	226.65	107.70	226.65	115.05	235.10	1.96	Minimum on Edge
Reinf. Layer #12	29.25	107.50	229.25	107.80	229.25	113.26	235.10	2.11	Minimum on Edge
Reinf. Layer #13	31.85	107.63	231.85	108.00	231.85	111.74	235.10	2.40	Minimum on Edge
Reinf. Layer #14	34.45	107.77	234.45	108.10	234.45	109.23	235.10	10.59	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

RESULTS OF 3-PART WEDGE ANALYSIS

Results in the table below represent the critical slip surface composed of a three-part wedge and identified by the specified points (X-left, Y-left) and (X-right, Y-right) and angles Zeta(L) and Zeta(R). ReSSA finds the (X,Y) coordinates, as well as the angles Zeta, based on user-specified search domain. The trace of the critical three-part wedge is fully defined by four points: (X1, Y1), (X-left, Y-left), (X-right, Y-right), (X2, Y2).

Critical 3-part wedge (Automatic search):

(X2, Y2) [ft]	Zeta(L) [degrees]	(X-left, Y-left) [ft]	(X-right, Y-right) [ft]	Zeta(R) [degrees]	(X1, Y1) [ft]	Fs
(61.23, 202.00)	10.00	(102.45, 194.73)	(115.40, 198.50)	45.00	(152.00, 235.10)	1.772

CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.91

Critical Circle: Xc = 98.76[ft], Yc = 242.42[ft], R = 47.67[ft]. (Number of slices used = 62)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

Minimum Factor of Safety = 1.50

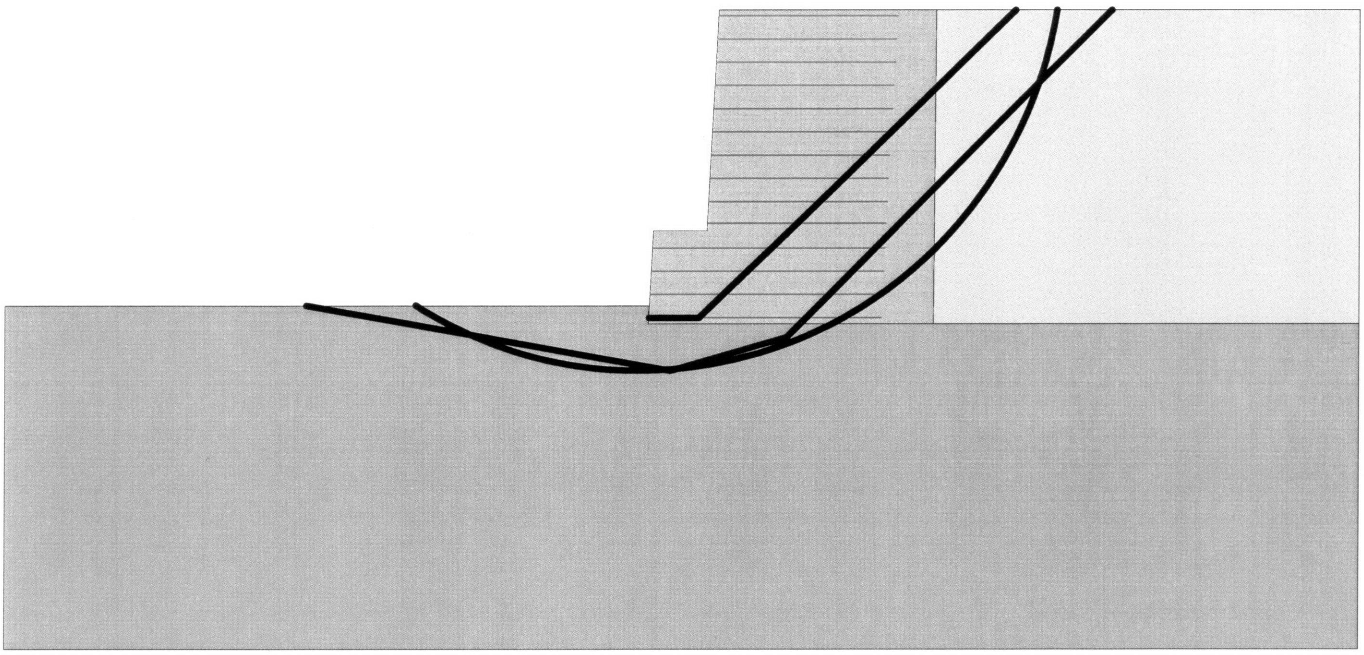
Critical Two-Part Wedge: (Xa = 100.03, Ya = 200.65) [ft]
(Xb = 105.58, Yb = 200.65) [ft]
(Xc = 141.25, Yc = 235.10) [ft]
(Number of slices used = 30)
Interslice resultant force inclination = 41.93 [degrees]

Three-Part Wedge Stability Analysis

Minimum Factor of Safety = 1.77

Critical Three-Part Wedge: (X2 = 61.23, Y2 = 202.00) [ft]
(X-left = 102.45, Y-left = 194.73) [ft]
(X-right = 115.40, Y-right = 198.50) [ft]
(X1 = 152.00, Y1 = 235.10) [ft]
(Number of slices used = 45)
Interslice resultant force inclination = 24.88 [degrees]

REINFORCEMENT LAYOUT: DRAWING



SCALE:

0 5 10 15 20 25 30 [ft]

REINFORCEMENT LAYOUT: TABULATED DATA & QUANTITIES

Layer #	Reinf. Type #	Geosynthetic Designated Name	Height Relative to Toe [ft]	Embedded Length [ft]	Covergae Ratio, Rc	(X, Y) front [ft]		(X, Y) rear [ft]		Lsv * [ft]	Lre [ft]
1	4	SF110	0.65	26.00	1.00	328.12	656.82	354.12	656.82	0.00	0.00
2	4	SF110	3.25	26.00	1.00	328.25	659.42	354.25	659.42	0.00	0.00
3	4	SF110	5.85	26.00	1.00	328.38	662.02	354.38	662.02	0.00	0.00
4	4	SF110	8.45	26.00	1.00	328.51	664.62	354.51	664.62	0.00	0.00
5	3	SF80	11.25	20.00	1.00	334.65	667.42	354.65	667.42	0.00	0.00
6	3	SF80	13.65	20.00	1.00	334.77	669.82	354.77	669.82	0.00	0.00
7	3	SF80	16.25	20.00	1.00	334.91	672.42	354.91	672.42	0.00	0.00
8	3	SF80	18.85	20.00	1.00	335.04	675.02	355.04	675.02	0.00	0.00
9	3	SF80	21.45	20.00	1.00	335.18	677.62	355.18	677.62	0.00	0.00
10	3	SF80	24.05	20.00	1.00	335.31	680.22	355.31	680.22	0.00	0.00
11	2	SF55	26.65	20.00	1.00	335.45	682.82	355.45	682.82	0.00	0.00
12	2	SF55	29.25	20.00	1.00	335.58	685.42	355.58	685.42	0.00	0.00
13	2	SF55	31.85	20.00	1.00	335.72	688.02	355.72	688.02	0.00	0.00
14	2	SF55	34.45	20.00	1.00	335.85	690.62	355.85	690.62	0.00	0.00

* Vertical distance between layers.

QUANTITIES

Reinf. Type #	Designated Name	Coverage Ratio	Area of reinforcemnt [ft²] / length of slope [ft]
2	SF55	1.00	80.00
3	SF80	1.00	120.00
4	SF110	1.00	104.00

AASHTO DESIGN METHOD
Shriners Hospital Temp- 19P_8P

PROJECT IDENTIFICATION

Title:	Shriners Hospital Temp- 19P_8P
Project Number:	KEYX0255
Client:	Key West Retaining Systems
Designer:	rw
Station Number:	

Description:

19 Panel Upper tier (24.7') and 8 Panel Lower tier (10.4')-2 tier wall system to support construction equipment. 1:20 face batter. Seismic zone 3.

Company's information:

Name: DAH/SE
Street: P.O. Box 82228

Portland, OR 97282
Telephone #: (503) 231-8727
Fax #: (503) 231-8726
E-Mail: structbear@earthlink.net

Original file path and name: F:\Key West Retaining Walls\Shriners Hospital\MSEW Runs.....
.....Temporary_19P_8P.BEN
Original date and time of creating this file: 6/16/08

PROGRAM MODE: ANALYSIS
of SUPERIMPOSED WALL
using GEOGRID as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

RETAINED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	130.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	37.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 63.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 55.63 N γ= 66.19

SEISMICITY

Maximum ground acceleration coefficient, A = 0.220
Design acceleration coefficient in Internal Stability: Kh = Am = 0.271
Design acceleration coefficient in External Stability: Kh = 0.271 (Am = 0.000)

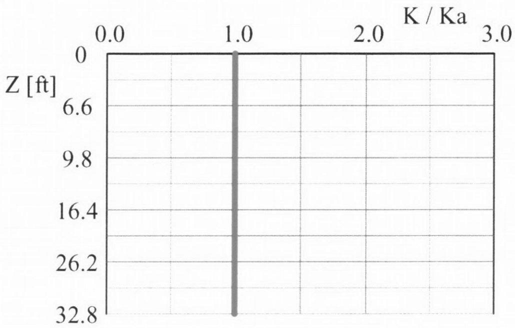
Kae (Kh > 0) = 0.4210 Kae (Kh = 0) = 0.2486 Δ Kae = 0.1724 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

INPUT DATA: Geogrids
(Analysis)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [lb/ft]	3055.0	4200.0	7400.0	10250.0	27397.0
Durability reduction factor, RFd	1.15	1.15	1.15	1.15	1.15
Installation-damage reduction factor, RFid	1.10	1.10	1.10	1.10	1.10
Creep reduction factor, RFc	1.55	1.55	1.55	1.55	1.55
Fs-overall for strength	N/A	N/A	N/A	N/A	N/A
Coverage ratio, Rc	1.000	1.000	1.000	1.000	1.000
Friction angle along geogrid-soil interface, ρ	32.00	32.00	32.00	32.00	32.00
Pullout resistance factor, F*	0.67·tarϕ	0.67·tanϕ	0.67·tanϕ	0.67·tanϕ	0.67·tanϕ
Scale-effect correction factor, α	0.8	0.8	0.8	0.8	0.8

Variation of Lateral Earth Pressure Coefficient With Depth

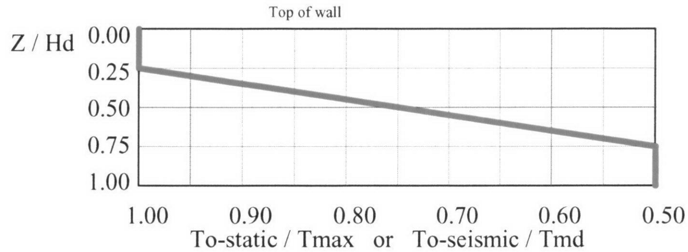
Z	K / Ka
0 ft	1.00
3.3 ft	1.00
6.6 ft	1.00
9.8 ft	1.00
13.1 ft	1.00
16.4 ft	1.00
19.7 ft	1.00



INPUT DATA: Facia and Connection (according to revised Demo 82)
(Analysis)

FACIA type: Facing enabling frictional connection of reinforcement (e.g., modular concrete blocks, gabions)
Depth/height of block is 2.50/1.30 ft. Horizontal distance to Center of Gravity of block is 1.25 ft.
Average unit weight of block is γ_f = 135.00 lb/ft ^{3}

Z / Hd	To-static / Tmax or To-seismic / Tmd
0.00	1.00
0.25	1.00
0.50	0.75
0.75	0.50
1.00	0.50



Geogrid Type #1		Geogrid Type #2		Geogrid Type #3		Geogrid Type #4		Geogrid Type #5	
σ (1)	CRult (2)	σ	CRult	σ	CRult	σ	CRult	σ	CRult
104.0	0.26	250.0	0.23	250.0	0.14	1000.0	0.24	1500.0	0.14
522.0	0.38	668.0	0.34	814.0	0.20	2220.0	0.65	5936.0	0.65
1745.0	1.00	2400.0	1.00	4228.0	1.00	3416.0	1.00	9132.0	1.00

Geogrid Type #1 (3)		Geogrid Type #2		Geogrid Type #3		Geogrid Type #4		Geogrid Type #5	
σ	CRcr	σ	CRcr	σ	CRcr	σ	CRcr	σ	CRcr
104.0	0.26	250.0	0.23	250.0	0.14	1000.0	0.24	1500.0	0.14
522.0	0.38	668.0	0.34	814.0	0.20	2220.0	0.65	5936.0	0.65
1135.0	0.65	1560.0	0.65	2750.0	0.65	3416.0	0.65	9132.0	0.65

(1) σ = Confining stress in between stacked blocks [lb/ft ^{2}]
(2) CRult = Tc-ult / Tult
(3) CRcr = Tcre / Tult

In seismic analysis, long term strength is reduced to 100% of its static value.

D A T A (for connection only)	Type #1	Type #2	Type #3	Type #4	Type #5
Product Name	SF35	SF55	SF80	SF110	SF350
Connection strength reduction factor, RFd	1.00	1.00	1.00	1.00	1.00
Creep reduction factor, RFc	N/A	N/A	N/A	N/A	N/A

INPUT DATA: Geometry and Surcharge loads (of SUPERIMPOSED wall)

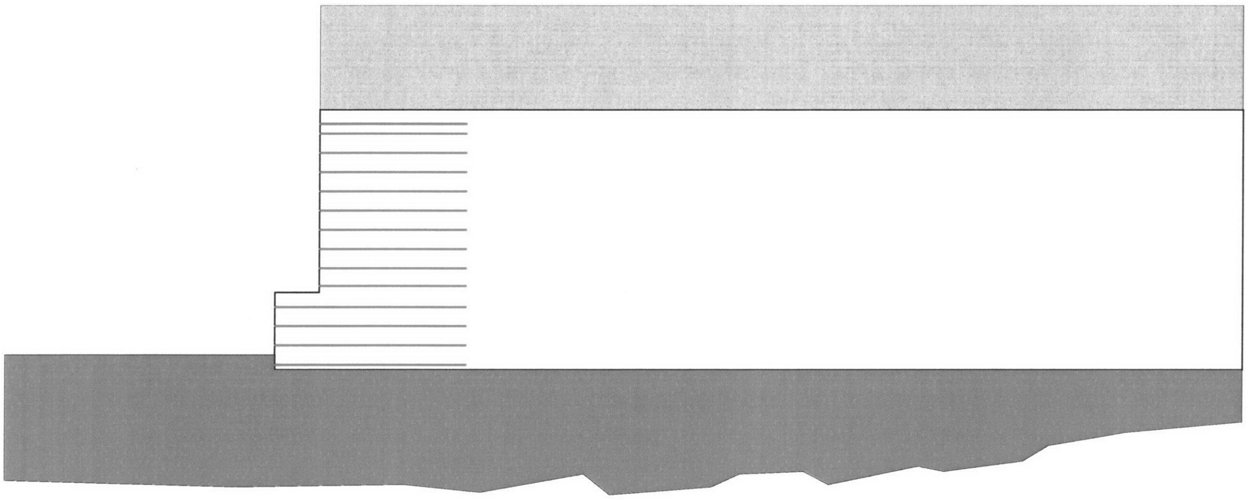
Design height, Hd	35.10	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 33.10 ft, where H1 = 24.70 and H2 = 8.40 }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

Offset of upper segment from lower one, Offset = 6.0 ft, Blackslope2 = 0.0 deg. and Backslope rise, S2 = 0.0 ft.

UNIFORM SURCHARGE

Uniformly distributed dead load is 0.0 [lb/ft ²], and live load is 500.0 [lb/ft ²]

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 5 10 15 20 25 30 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, Fs = 23.44, Meyerhof stress = 4480 lb/ft².

Foundation Interface: Direct sliding, Fs = 3.085, Eccentricity, e/L = 0.0452, Fs-overturning = 4.80

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	26.00	4	3.46	5.09	2.545	51.020	2.589	0.0401	SF110
2	3.25	26.00	4	1.93	4.10	2.052	36.480	2.714	0.0193	SF110
3	5.85	26.00	4	2.11	4.49	2.244	35.177	2.849	-0.0023	SF110
4	8.45	26.00	4	1.70	3.62	1.811	24.447	2.992	-0.0253	SF110
5	11.25	20.00	3	4.62	3.63	2.070	31.108	3.188	0.0874	SF80
6	13.65	20.00	3	3.69	2.90	1.850	23.830	3.450	0.0733	SF80
7	16.25	20.00	3	3.28	2.78	1.979	21.250	3.788	0.0593	SF80
8	18.85	20.00	3	2.90	2.84	2.235	19.640	4.200	0.0468	SF80
9	21.45	20.00	3	2.57	2.98	2.567	18.029	4.711	0.0356	SF80
10	24.05	20.00	2	2.25	1.83	1.711	16.405	5.365	0.0259	SF55
11	26.65	20.00	2	2.05	2.07	2.073	14.795	6.229	0.0175	SF55
12	29.25	20.00	2	1.97	2.63	2.629	13.184	7.425	0.0105	SF55
13	31.85	20.00	2	2.51	4.58	4.580	14.029	9.189	0.0050	SF55
14	33.15	20.00	2	2.27	4.95	4.954	16.152	10.428	0.0027	SF55

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, Fs = 11.33, Meyerhof stress = 6446 lb/ft².

Foundation Interface: Direct sliding, Fs = 1.572, Eccentricity, e/L = 0.2028, Fs-overturning = 2.07

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	26.00	4	2.59	4.18	2.091	29.542	1.327	0.1912	SF110
2	3.25	26.00	4	1.54	3.52	1.759	22.534	1.428	0.1460	SF110
3	5.85	26.00	4	1.67	3.83	1.915	21.485	1.550	0.1022	SF110
4	8.45	26.00	4	1.42	3.20	1.601	15.819	1.699	0.0592	SF110
5	11.25	20.00	3	3.71	3.06	1.745	18.626	1.529	0.2204	SF80
6	13.65	20.00	3	3.00	2.50	1.600	14.821	1.678	0.1809	SF80
7	16.25	20.00	3	2.64	2.40	1.713	13.174	1.876	0.1424	SF80
8	18.85	20.00	3	2.32	2.44	1.923	11.981	2.127	0.1085	SF80
9	21.45	20.00	3	2.03	2.55	2.192	10.762	2.456	0.0792	SF80
10	24.05	20.00	2	1.77	1.55	1.447	9.492	2.906	0.0544	SF55
11	26.65	20.00	2	1.58	1.73	1.728	8.155	3.557	0.0342	SF55
12	29.25	20.00	2	1.46	2.14	2.144	6.672	4.583	0.0185	SF55
13	31.85	20.00	2	1.64	3.40	3.404	5.313	6.442	0.0074	SF55
14	33.15	20.00	2	1.47	3.68	3.675	4.123	8.082	0.0036	SF55

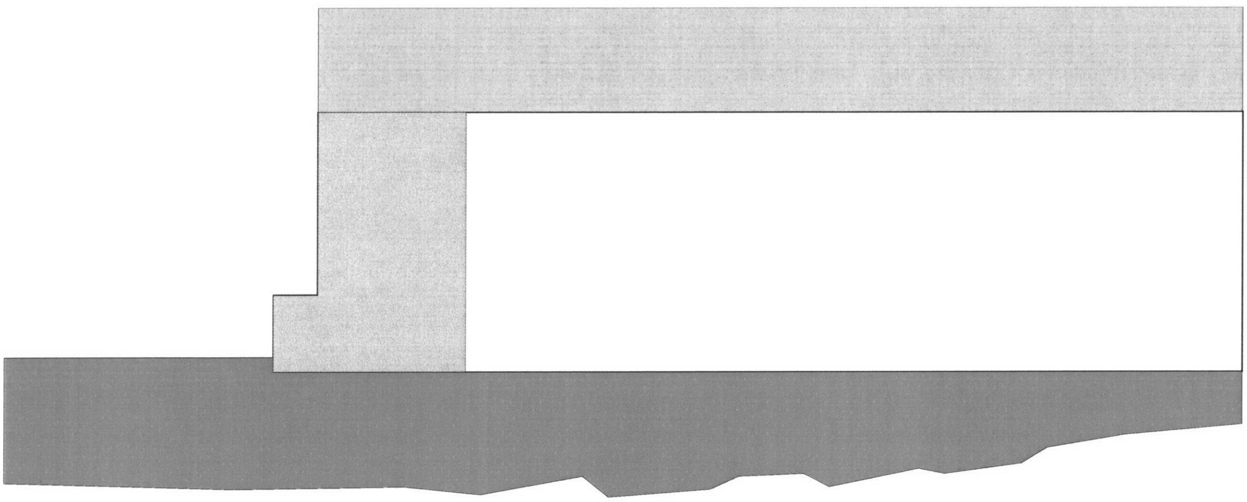
GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

STATIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 1.760
(it corresponds to a critical circle at Xc = -17.55, Yc = 63.18 and R = 65.57 [ft]).

SEISMIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 1.238
(it corresponds to a critical circle at Xc = -17.55, Yc = 63.18 and R = 65.57 [ft]).

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	105035	73004	[lb/ft ²]
Meyerhof stress, σ_V	4480.2	6446	[lb/ft ²]
Eccentricity, e	0.79	4.52	[ft]
Eccentricity, e/L	0.031	0.174	
Fs calculated	23.44	11.33	
Base length	26.00	26.00	[ft]



SCALE:

0 5 10 15 20 25 30 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for GEOGRID reinforcements)

Along reinforced and foundation soils interface: Fs-static = 3.085 and Fs-seismic = 1.572

#	Geogrid Elevation [ft]	Geogrid Length [ft]	Fs Static	Fs Seismic	Geogrid Type #	Product name
1	0.65	26.00	2.589	1.327	4	SF110
2	3.25	26.00	2.714	1.428	4	SF110
3	5.85	26.00	2.849	1.550	4	SF110
4	8.45	26.00	2.992	1.699	4	SF110
5	11.25	20.00	3.188	1.529	3	SF80
6	13.65	20.00	3.450	1.678	3	SF80
7	16.25	20.00	3.788	1.876	3	SF80
8	18.85	20.00	4.200	2.127	3	SF80
9	21.45	20.00	4.711	2.456	3	SF80
10	24.05	20.00	5.365	2.906	2	SF55
11	26.65	20.00	6.229	3.557	2	SF55
12	29.25	20.00	7.425	4.583	2	SF55
13	31.85	20.00	9.189	6.442	2	SF55
14	33.15	20.00	10.428	8.082	2	SF55

ECCENTRICITY for GIVEN LAYOUT

At interface with foundation: e/L static = 0.0452, e/L seismic = 0.2028; Overturning: Fs-static = 4.80, Fs-seismic = 2.07

#	Geogrid Elevation [ft]	Geogrid Length [ft]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.65	26.00	0.0401	0.1912	4	SF110
2	3.25	26.00	0.0193	0.1460	4	SF110
3	5.85	26.00	-0.0023	0.1022	4	SF110
4	8.45	26.00	-0.0253	0.0592	4	SF110
5	11.25	20.00	0.0874	0.2204	3	SF80
6	13.65	20.00	0.0733	0.1809	3	SF80
7	16.25	20.00	0.0593	0.1424	3	SF80
8	18.85	20.00	0.0468	0.1085	3	SF80
9	21.45	20.00	0.0356	0.0792	3	SF80
10	24.05	20.00	0.0259	0.0544	2	SF55
11	26.65	20.00	0.0175	0.0342	2	SF55
12	29.25	20.00	0.0105	0.0185	2	SF55
13	31.85	20.00	0.0050	0.0074	2	SF55
14	33.15	20.00	0.0027	0.0036	2	SF55

RESULTS for STRENGTH Live Load included in calculating Tmax

#	Geogrid Elevation [ft]	Tavailable [lb/ft]	Tmax [lb/ft]	Tmd [lb/ft]	Specified minimum Fs-overall static	Actual calculated Fs-overall static	Specified minimum Fs-overall seismic	Actual calculated Fs-overall seismic	Product name
1	0.65	5228	2054.22	691.43	N/A	2.545	N/A	2.091	SF110
2	3.25	5228	2547.81	656.52	N/A	2.052	N/A	1.759	SF110
3	5.85	5228	2329.36	621.61	N/A	2.244	N/A	1.915	SF110
4	8.45	5228	2886.61	586.71	N/A	1.811	N/A	1.601	SF110
5	11.25	3774	1823.24	527.17	N/A	2.070	N/A	1.745	SF80
6	13.65	3774	2039.63	494.95	N/A	1.850	N/A	1.600	SF80
7	16.25	3774	1906.96	460.04	N/A	1.979	N/A	1.713	SF80
8	18.85	3774	1688.50	425.13	N/A	2.235	N/A	1.923	SF80
9	21.45	3774	1470.05	390.22	N/A	2.567	N/A	2.192	SF80
10	24.05	2142	1251.59	355.31	N/A	1.711	N/A	1.447	SF55
11	26.65	2142	1033.14	320.40	N/A	2.073	N/A	1.728	SF55
12	29.25	2142	814.68	285.50	N/A	2.629	N/A	2.144	SF55
13	31.85	2142	467.65	250.59	N/A	4.580	N/A	3.404	SF55
14	33.15	2142	432.39	233.13	N/A	4.954	N/A	3.675	SF55

RESULTS for PULLOUT Live Load NOT included in calculating Tmax

NOTE: Live load is not included in calculating the overburden pressure used to assess pullout resistance.

#	Geogrid Elevation [ft]	Coverage Ratio	Tmax [lb/ft]	Tmd [lb/ft]	Le [ft] (see NOTE)	La [ft]	Avail.Static Pullout, Pr [lb/ft]	Specified Static Fs	Actual Static Fs	Avail.Seism. Pullout, Pr [lb/ft]	Specified Seismic Fs	Actual Seismic Fs
1	0.65	1.000	1811.9	691.4	25.68	0.32	92441.2	N/A	51.020	73953.0	N/A	29.542
2	3.25	1.000	2224.7	656.5	24.38	1.62	81154.8	N/A	36.480	64923.8	N/A	22.534
3	5.85	1.000	2006.2	621.6	23.08	2.92	70571.9	N/A	35.177	56457.6	N/A	21.485
4	8.45	1.000	2482.7	586.7	21.79	4.21	60692.8	N/A	24.447	48554.2	N/A	15.819
5	11.25	1.000	1568.4	527.2	19.58	0.42	48791.5	N/A	31.108	39033.2	N/A	18.626
6	13.65	1.000	1728.9	494.9	18.38	1.62	41200.5	N/A	23.830	32960.4	N/A	14.821
7	16.25	1.000	1583.8	460.0	17.08	2.92	33655.8	N/A	21.250	26924.7	N/A	13.174
8	18.85	1.000	1365.3	425.1	15.79	4.21	26814.8	N/A	19.640	21451.8	N/A	11.981
9	21.45	1.000	1146.9	390.2	14.49	5.51	20677.4	N/A	18.029	16541.9	N/A	10.762
10	24.05	1.000	928.4	355.3	13.19	6.81	15231.0	N/A	16.405	12184.8	N/A	9.492
11	26.65	1.000	710.0	320.4	11.90	8.10	10503.8	N/A	14.795	8403.0	N/A	8.155
12	29.25	1.000	491.5	285.5	10.60	9.40	6480.3	N/A	13.184	5184.2	N/A	6.672
13	31.85	1.000	225.3	250.6	9.31	10.69	3160.4	N/A	14.029	2528.3	N/A	5.313
14	33.15	1.000	109.2	233.1	8.66	11.34	1764.3	N/A	16.152	1411.4	N/A	4.123

RESULTS for CONNECTION (static conditions)

Live Load included in calculating Tmax

#	Geogrid Elevation [ft]	Connection force, To [lb/ft]	Reduction factor for connection (short-term strength) CRult	Reduction factor for connection (long-term strength) CRcr	Available connection strength [lb/ft]	Available Geogrid strength, Tavailable [lb/ft]	Fs-overall connection strength Specified	Fs-overall connection strength Actual	Fs-overall Geogrid strength Specified	Fs-overall Geogrid strength Actual	Product name
1	0.65	1027	0.35	0.35	3549	5228	N/A	3.46	N/A	5.09	SF110
2	3.25	1274	0.24	0.24	2460	5228	N/A	1.93	N/A	4.10	SF110
3	5.85	1165	0.24	0.24	2460	5228	N/A	2.11	N/A	4.49	SF110
4	8.45	1443	0.24	0.24	2460	5228	N/A	1.70	N/A	3.62	SF110
5	11.25	1040	0.76	0.65	4810	3774	N/A	4.62	N/A	3.63	SF80
6	13.65	1303	0.69	0.65	4810	3774	N/A	3.69	N/A	2.90	SF80
7	16.25	1360	0.61	0.60	4457	3774	N/A	3.28	N/A	2.78	SF80
8	18.85	1329	0.52	0.52	3853	3774	N/A	2.90	N/A	2.84	SF80
9	21.45	1266	0.44	0.44	3249	3774	N/A	2.57	N/A	2.98	SF80
10	24.05	1170	0.65	0.63	2630	2142	N/A	2.25	N/A	1.83	SF55
11	26.65	1033	0.52	0.50	2118	2142	N/A	2.05	N/A	2.07	SF55
12	29.25	815	0.39	0.38	1606	2142	N/A	1.97	N/A	2.63	SF55
13	31.85	468	0.28	0.28	1175	2142	N/A	2.51	N/A	4.58	SF55
14	33.15	432	0.23	0.23	981	2142	N/A	2.27	N/A	4.95	SF55

RESULTS for CONNECTION (seismic conditions)

Live Load included in calculating Tmax

#	Geogrid Elevation [ft]	Connection force, To [lb/ft]	Reduction factor for connection (short-term strength) CRult	Reduction factor for connection (long-term strength) CRcr	Available connection strength [lb/ft]	Available Geogrid strength, Tavailable [lb/ft]	Fs-overall connection strength Specified	Fs-overall connection strength Actual	Fs-overall Geogrid strength Specified	Fs-overall Geogrid strength Actual	Product name
1	0.65	1373	0.35	0.35	3549	5228	N/A	2.59	N/A	4.18	SF110
2	3.25	1602	0.24	0.24	2460	5228	N/A	1.54	N/A	3.52	SF110
3	5.85	1475	0.24	0.24	2460	5228	N/A	1.67	N/A	3.83	SF110
4	8.45	1737	0.24	0.24	2460	5228	N/A	1.42	N/A	3.20	SF110
5	11.25	1341	0.76	0.65	4810	3774	N/A	3.71	N/A	3.06	SF80
6	13.65	1619	0.69	0.65	4810	3774	N/A	3.00	N/A	2.50	SF80
7	16.25	1688	0.61	0.60	4457	3774	N/A	2.64	N/A	2.40	SF80
8	18.85	1664	0.52	0.52	3853	3774	N/A	2.32	N/A	2.44	SF80
9	21.45	1602	0.44	0.44	3249	3774	N/A	2.03	N/A	2.55	SF80
10	24.05	1503	0.65	0.63	2630	2142	N/A	1.77	N/A	1.55	SF55
11	26.65	1354	0.52	0.50	2118	2142	N/A	1.58	N/A	1.73	SF55
12	29.25	1100	0.39	0.38	1606	2142	N/A	1.46	N/A	2.14	SF55
13	31.85	718	0.28	0.28	1175	2142	N/A	1.64	N/A	3.40	SF55
14	33.15	666	0.23	0.23	981	2142	N/A	1.47	N/A	3.68	SF55

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

A horizontal seismic coefficient, Kh='A', equal to 0.220 has been applied.
The seismic force is applied at the center of the sliding mass.

STATIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 1.760
(it corresponds to a critical circle at Xc = -17.55, Yc = 63.18 and R = 65.57 [ft] where (x=0, y=0) is taken at the TOE or Xc = 112.45, Yc = 1063.18 and R = 65.57 [ft] when the terrain coordinate system is used as shown in the table below.)

SEISMIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 1.238
(it corresponds to a critical circle at Xc = -17.55, Yc = 63.18 and R = 65.57 [ft] where (x=0, y=0) is taken at the TOE or Xc = 112.45, Yc = 1063.18 and R = 65.57 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 130.00 [lb/ft ^{3}]			ϕ = 37.0°		c = 0.00 [lb/ft ^{2}]					
x [ft]	25.0	50.0	75.0	100.0	125.0	327.6	335.4	343.2	351.0	370.5	390.0
y [ft]	1002.0	1002.0	1002.0	1002.0	1002.0	1000.0	1000.0	1000.0	1000.0	1078.0	1078.0

Shriners Hospital Three Tiered Final Wal

PROJECT IDENTIFICATION

Title:	Shriners Hospital Three Tiered Final Wal
Project Number:	-
Client:	Key West Retaining Systems
Designer:	dh

Description:
3 tier wall (8 panel base (10.4') , 7 panel middle (9.1') & 7 panel top 9.1')). 1:20 face batter. Seismic zone 3. Surcharge by planter box

Company's information:

Name:	DAH/SE
Street:	PO Box 82228
	Portland, OR 97282
Telephone #:	503-231-8727
Fax #:	503-231-8726
E-Mail:	structbear@earthlink.net

Original file path and name: F:\Key Wes ..... ReSSA Runs\Shriners Three Tiers_8P_7P_7P_final.MSE
Original date and time of creating this file: 6/16/08

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [lb/ft^3]	Internal angle of friction, ϕ [deg.]	Cohesion, c [lb/ft^2]
....1....... Reinforced Soil..................................	130.0	37.0	0.0
....2....... Retained Soil......................................	130.0	37.0	0.0
....3....... Foundation Soil..................................	130.0	37.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [lb/ft]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Coverage Ratio, Rc
2	SF55	4200.00	1.10	1.15	1.55	1.00
3	SF80	7400.00	1.10	1.15	1.55	1.00
4	SF110	10250.00	1.10	1.15	1.55	1.00

Interaction Parameters		== Direct Sliding ==		==== Pullout ====	
Type #	Geosynthetic Designated Name	Cds-phi	Cds-c	Ci	Alpha
2	SF55	0.90	0.00	0.80	0.80
3	SF80	0.90	0.00	0.80	0.80
4	SF110	0.90	0.00	0.80	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.440
Design horizontal seismic coefficient, kh = Am = 0.5 x Ao = 0.220 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

DRAWING OF SPECIFIED GEOMETRY - COMPLEX - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

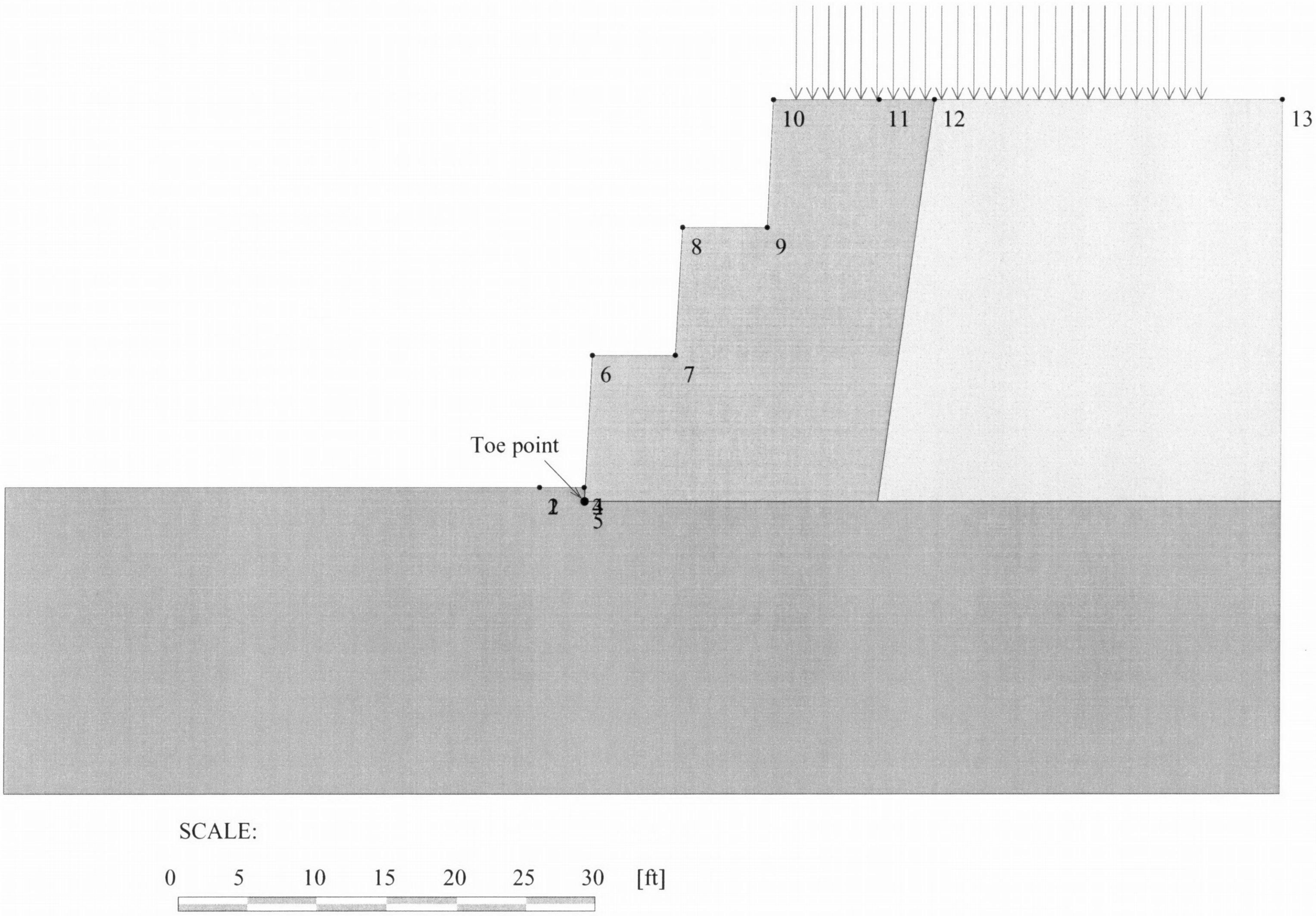
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Load Q1 = 750.00 [lb/ft²] inclined from verical at 0.00 degrees, starts at X1s = 115.00 and ends at X1e = 145.00 [ft].
Surcharge load, Q2.................................... None
Surcharge load, Q3.................................... None

STRIP LOAD

............................None...................................



TABULATED DETAILS OF QUICK SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

	#	Xi	Yi
Top of Layer 1	1	96.72	101.00
	2	99.97	101.00
	3	100.00	100.00
	4	100.52	110.40
	5	106.52	110.40
	6	107.00	119.50
	7	113.00	119.50
	8	113.40	128.60
	9	125.00	128.60
	10	150.00	128.60
Top of Layer 2	11	96.72	101.00
	12	99.97	101.00
	13	100.00	100.00
	14	121.00	100.00
	15	125.00	128.60
	16	150.00	128.60
Top of Layer 3	17	96.72	101.00
	18	99.97	101.00
	19	100.00	100.00

TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

#	X	Y1	Y2	Y3
1	96.72	101.00	101.00	101.00
2	96.72	101.00	101.00	101.00
3	99.97	101.00	101.00	101.00
4	99.97	101.00	101.00	100.91
5	100.00	100.00	100.00	100.00
6	100.52	110.40	100.00	100.00
7	106.52	110.40	100.00	100.00
8	107.00	119.50	100.00	100.00
9	113.00	119.50	100.00	100.00
10	113.40	128.60	100.00	100.00
11	121.00	128.60	100.00	100.00
12	125.00	128.60	128.60	100.00
13	150.00	128.60	128.60	100.00

DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER

A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [ft]	L [ft]	L1 [ft]	L2 [ft]	L3 [ft]	Tfe [lb/ft]	Tavailable [lb/ft]
1	SF110	0.65	26.00	1.64	2.26	22.10	4077.52	5227.59
2	SF110	3.25	26.00	3.51	2.49	20.00	3241.11	5227.59
3	SF110	5.85	26.00	6.82	2.76	16.42	2404.69	5227.59
4	SF110	8.45	26.00	7.25	3.12	15.63	3345.66	5227.59
5	SF80	11.05	20.00	3.12	2.59	14.29	1736.07	3774.07
6	SF80	13.65	20.00	1.15	3.05	15.80	3283.44	3774.07
7	SF80	16.25	20.00	5.09	3.67	11.24	2415.40	3774.07
8	SF80	18.85	20.00	8.33	4.66	7.01	1736.07	3774.07
9	SF55	21.45	9.00	1.44	3.61	3.95	1370.90	2142.04
10	SF55	24.05	9.00	3.15	5.64	0.21	985.34	2142.04
11	SF55	26.65	9.00	2.90	6.10	0.00	514.09	985.59 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength

RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [ft]		Exit Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	125.70	128.60	76.10	101.31	93.29	128.78	32.41	2.44	
2	128.32	128.60	76.30	101.20	94.84	129.09	33.49	2.01	
3	130.94	128.60	76.42	101.14	96.72	128.69	34.23	1.73	
4	133.56	128.60	78.49	101.32	98.85	129.44	34.72	1.59	
5	136.18	128.60	78.67	101.18	99.18	132.17	37.17	1.51	
6	138.80	128.60	76.40	101.12	98.01	136.64	41.57	1.45	
7	141.42	128.60	75.96	101.42	99.72	136.61	42.46	1.41	
8	144.04	128.60	76.15	101.26	99.64	140.90	46.08	1.38	
. 9	146.66	128.60	76.35	101.13	99.42	145.79	50.27	1.37 .	OK
10	149.28	128.60	76.56	101.02	99.04	151.40	55.17	1.38	
11	151.90	128.60	76.04	101.29	101.44	149.75	54.71	1.39	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points)

Exit Point #	Exit Point (X, Y) [ft]		Entry Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
. 1	76.35	101.13	146.66	128.60	99.42	145.79	50.27	1.37	. On extreme X-exit
2	78.77	101.08	146.66	128.60	100.45	145.10	49.07	1.38	
3	81.24	101.02	146.66	128.60	101.49	144.35	47.83	1.39	
4	83.04	101.26	146.66	128.60	102.56	143.54	46.56	1.40	
5	85.50	101.23	144.04	128.60	103.99	137.97	41.13	1.42	
6	88.26	101.02	146.66	128.60	104.75	141.72	43.92	1.44	
7	90.29	101.14	146.66	128.60	105.88	140.71	42.54	1.47	
8	92.41	101.21	146.66	128.60	107.04	139.65	41.13	1.51	
9	95.26	101.02	149.28	128.60	107.55	143.64	44.36	1.56	
10	97.09	101.30	144.04	128.60	112.14	129.43	31.91	1.74	
11	100.00	100.00	100.00	100.00	100.00	100.00	0.00	N/A	#10 - Overhanging Cliff

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

RESULTS OF TRANSLATIONAL ANALYSIS

Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [ft]	(Xa, Ya) [ft]		(Xb, Yb) [ft]		(Xc, Yc) [ft]		Fs	STATUS
At toe elevation	0.00	100.00	100.00	110.44	100.00	152.84	128.60	1.35	OK
Reinf. Layer #1	0.65	100.03	100.65	110.76	100.65	150.67	128.60	1.32	OK
Reinf. Layer #2	3.25	100.16	103.25	110.86	103.25	148.44	128.60	1.33	OK
Reinf. Layer #3	5.85	100.29	105.85	110.96	105.85	144.68	128.60	1.35	OK
Reinf. Layer #4	8.45	100.42	108.45	111.16	108.45	143.40	128.60	1.41	OK
Reinf. Layer #5	11.05	106.55	111.05	110.88	111.05	130.37	128.60	1.38	OK
Reinf. Layer #6	13.65	106.69	113.65	114.96	113.65	130.44	128.60	1.46	OK
Reinf. Layer #7	16.25	106.83	116.25	115.16	116.25	130.41	128.60	1.41	OK
Reinf. Layer #8	18.85	106.97	118.85	115.26	118.85	128.19	128.60	1.36	OK
Reinf. Layer #9	21.45	113.09	121.45	113.40	121.45	119.62	128.60	1.38	Minimum on Edge
Reinf. Layer #10	24.05	113.20	124.05	113.50	124.05	117.46	128.60	1.43	Minimum on Edge
Reinf. Layer #11	26.65	113.31	126.65	113.60	126.65	116.38	128.60	1.64	Minimum on Edge

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

RESULTS OF 3-PART WEDGE ANALYSIS

Results in the table below represent the critical slip surface composed of a three-part wedge and identified by the specified points (X-left, Y-left) and (X-right, Y-right) and angles Zeta(L) and Zeta(R). ReSSA finds the (X,Y) coordinates, as well as the angles Zeta, based on user-specified search domain. The trace of the critical three-part wedge is fully defined by four points: (X1, Y1), (X-left, Y-left), (X-right, Y-right), (X2, Y2).

Critical 3-part wedge (Automatic search):

(X2, Y2) [ft]	Zeta(L) [degrees]	(X-left, Y-left) [ft]	(X-right, Y-right) [ft]	Zeta(R) [degrees]	(X1, Y1) [ft]	Fs
(70.92, 101.00)	10.00	(101.55, 95.60)	(124.60, 103.30)	45.00	(149.90, 128.60)	1.272

CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.37

Critical Circle: Xc = 99.42[ft], Yc = 145.79[ft], R = 50.27[ft]. (Number of slices used = 61)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

Minimum Factor of Safety = 1.32

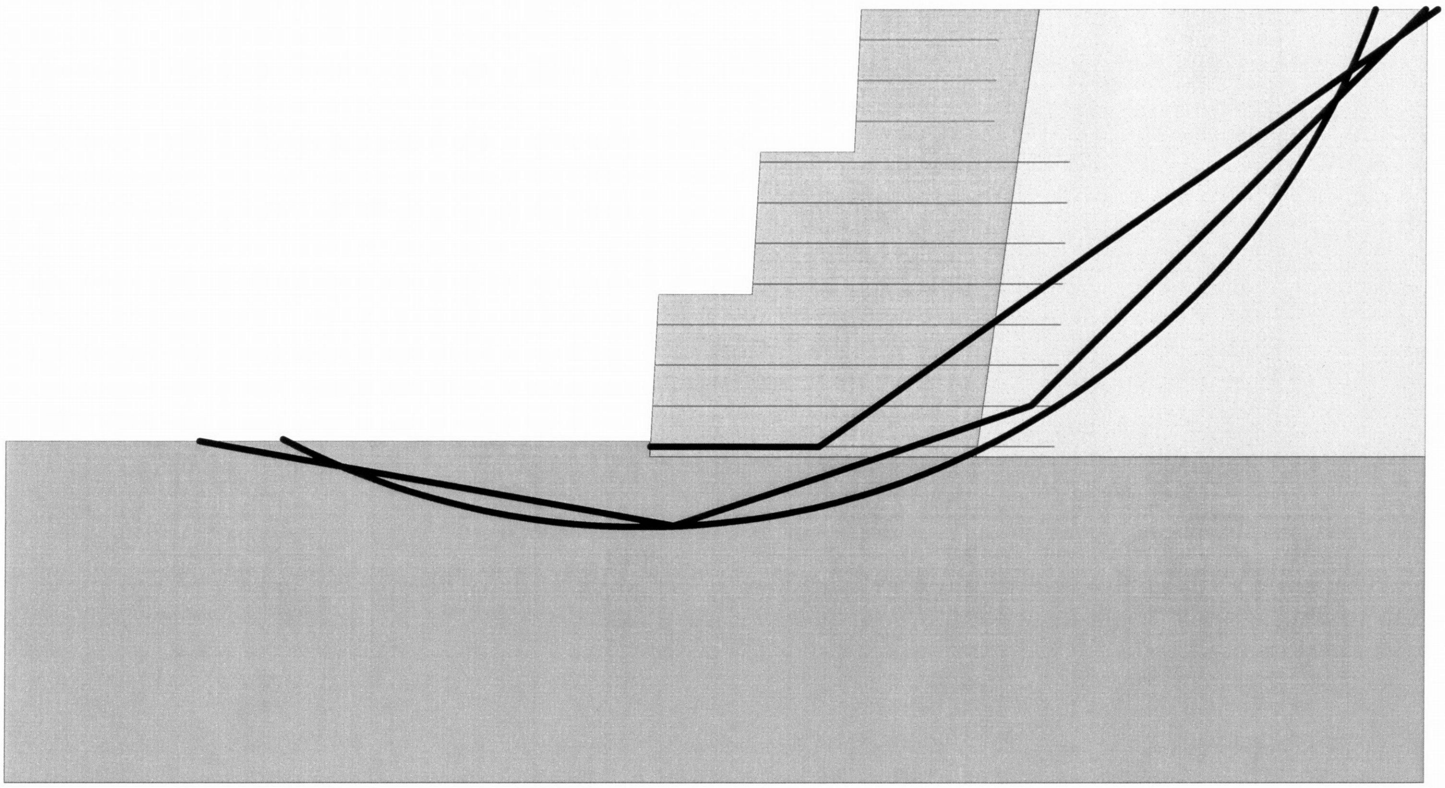
Critical Two-Part Wedge: (Xa = 100.03, Ya = 100.65) [ft]
(Xb = 110.76, Yb = 100.65) [ft]
(Xc = 150.67, Yc = 128.60) [ft]
(Number of slices used = 30)
Interslice resultant force inclination = 31.32 [degrees]

Three-Part Wedge Stability Analysis

Minimum Factor of Safety = 1.27

Critical Three-Part Wedge: (X2 = 70.92, Y2 = 101.00) [ft]
(X-left = 101.55, Y-left = 95.60) [ft]
(X-right = 124.60, Y-right = 103.30) [ft]
(X1 = 149.90, Y1 = 128.60) [ft]
(Number of slices used = 45)
Interslice resultant force inclination = 23.71 [degrees]

REINFORCEMENT LAYOUT: DRAWING



SCALE:

0 5 10 15 20 25 30 [ft]

REINFORCEMENT LAYOUT: TABULATED DATA & QUANTITIES

Layer #	Reinf. Type #	Geosynthetic Designated Name	Height Relative to Toe [ft]	Embedded Length [ft]	Covergae Ratio, Rc	(X, Y) front [ft]		(X, Y) rear [ft]		Lsv * [ft]	Lre [ft]
1	4	SF110	0.65	26.00	1.00	328.12	328.73	354.12	328.73	0.00	0.00
2	4	SF110	3.25	26.00	1.00	328.25	331.33	354.25	331.33	0.00	0.00
3	4	SF110	5.85	26.00	1.00	328.38	333.93	354.38	333.93	0.00	0.00
4	4	SF110	8.45	26.00	1.00	328.51	336.53	354.51	336.53	0.00	0.00
5	3	SF80	11.05	20.00	1.00	334.64	339.13	354.64	339.13	0.00	0.00
6	3	SF80	13.65	20.00	1.00	334.78	341.73	354.78	341.73	0.00	0.00
7	3	SF80	16.25	20.00	1.00	334.91	344.33	354.91	344.33	0.00	0.00
8	3	SF80	18.85	20.00	1.00	335.05	346.93	355.05	346.93	0.00	0.00
9	2	SF55	21.45	9.00	1.00	341.17	349.53	350.17	349.53	0.00	0.00
10	2	SF55	24.05	9.00	1.00	341.28	352.13	350.28	352.13	0.00	0.00
11	2	SF55	26.65	9.00	1.00	341.40	354.73	350.40	354.73	0.00	0.00

* Vertical distance between layers.

QUANTITIES

Reinf. Type #	Designated Name	Coverage Ratio	Area of reinforcemnt [ft²] / length of slope [ft]
2	SF55	1.00	27.00
3	SF80	1.00	80.00
4	SF110	1.00	104.00

Shriners Hospital Two Tiered Wall-7P_10P

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PROJECT IDENTIFICATION

Title:	Shriners Hospital Two Tiered Wall-7P_10P
Project Number:	-
Client:	Key West Retaining Systems
Designer:	rw

Description:

2 tier wall (10 panel base (13') & 7 (9.1') panel top). 1:20 face batter. Seismic zone 3. Surcharge from planter box added.

Company's information:

Name:	DAH/SE
Street:	P.O. Box 82228 Portland, OR 97282
Telephone #:	503-231-8727
Fax #:	503-231-8726
E-Mail:	structbear@earthlink.net

Original file path and name: F:\Key Wes ..... Hospital\ReSSA Runs\Shriners Two Tiers_10P_7P.MSE
Original date and time of creating this file: 6/16/08

PROGRAM MODE: Analysis of a General Slope using GEOSYNTHETIC as reinforcing material.

INPUT DATA (EXCLUDING REINFORCEMENT LAYOUT)

SOIL DATA

=========== Soil Layer #: ===========	Unit weight, γ [lb/ft ³]	Internal angle of friction, ϕ [deg.]	Cohesion, c [lb/ft ²]
....1...... Reinforced Soil..................................	130.0	37.0	0.0
....2...... Retained Soil.....................................	130.0	37.0	0.0
....3...... Foundation Soil.................................	130.0	37.0	0.0

REINFORCEMENT

Reinforcement Type #	Geosynthetic Designated Name	Ultimate Strength, Tult [lb/ft]	Reduction Factor for Installation Damage, RFid	Reduction Factor for Durability, RFd	Reduction Factor for Creep, RFc	Coverage Ratio, Rc
2	SF55	4200.00	1.10	1.15	1.55	1.00
3	SF80	7400.00	1.10	1.15	1.55	1.00

Interaction Parameters Type #	Geosynthetic Designated Name	== Direct Sliding == Cds-phi	Cds-c	==== Pullout ==== Ci	Alpha
2	SF55	0.83	0.00	0.67	0.80
3	SF80	0.83	0.00	0.67	0.80

Relative Orientation of Reinforcement Force, ROR = 0.00. Assigned Factor of Safety to resist pullout, Fs-po = 1.50
Design method for Global Stability: Comprehensive Bishop.

WATER

Water is not present

SEISMICITY

Horizontal peak ground acceleration coefficient, Ao = 0.440
Design horizontal seismic coefficient, kh = Am = 0.5 x Ao = 0.220 & design vertical seismic coefficient, kv (down) = 0.000 x kh = 0.000

DRAWING OF SPECIFIED GEOMETRY - COMPLEX - Quick Input

-- Problem geometry is defined along sections selected by user at x,y coordinates.
-- X1,Y1 represents the coordinates of soil surface. X2,Y2 represent the coordinates of the end of soil layer 1 and start of soil layer 2, and so on.

GEOMETRY

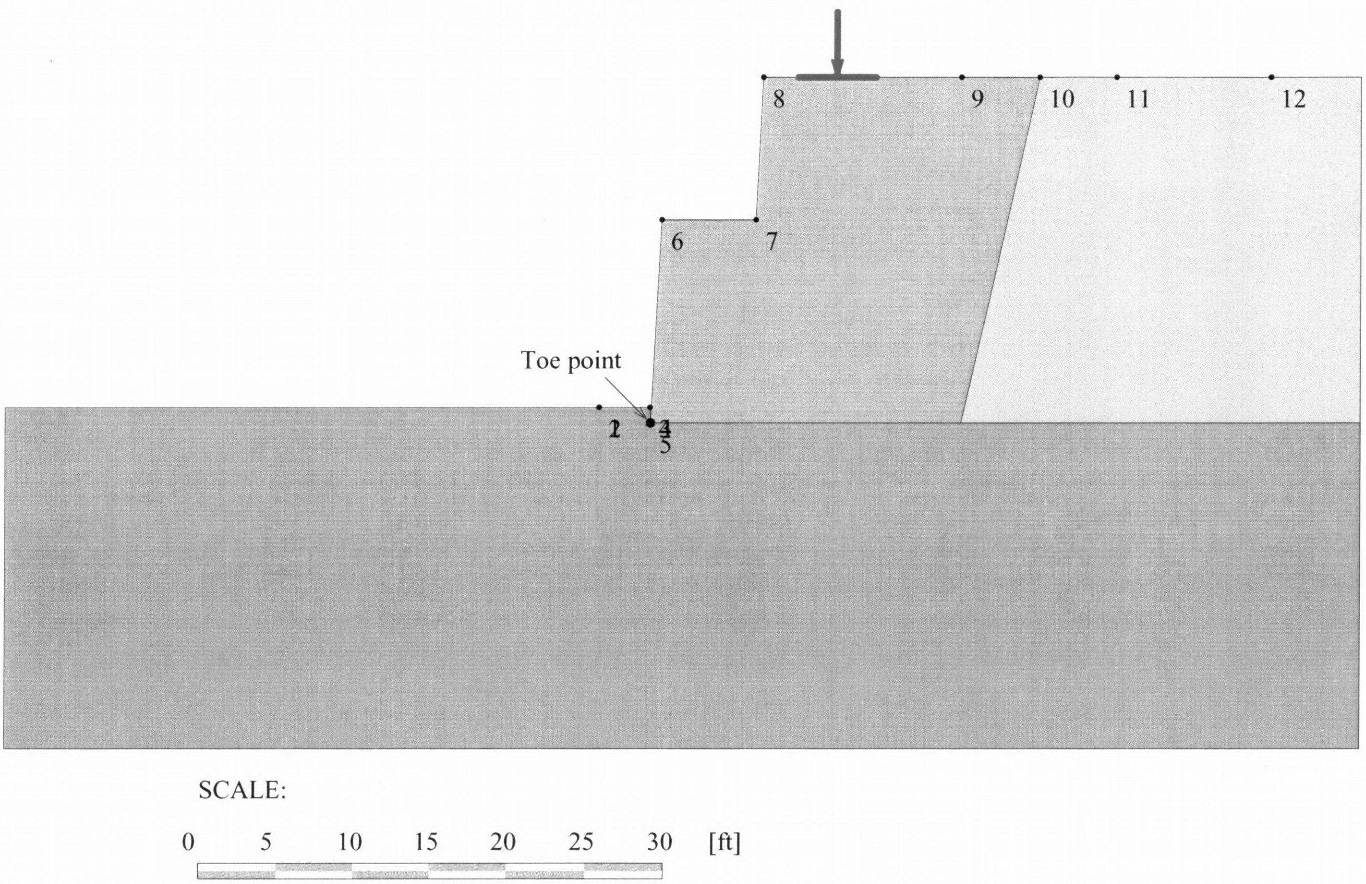
Soil profile contains 3 layers (see details in next page)

UNIFORM SURCHARGE

Surcharge load, Q1.................................... None
Surcharge load, Q2.................................... None
Surcharge load, Q3.................................... None

STRIP LOAD

Strip Load #1.. 750.00 [lb/ft²] Width of base, b = 5.00 [ft] Distance from toe point, d = 12.00 [ft]



TABULATED DETAILS OF QUICK SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

	#	Xi	Yi
Top of Layer 1	1	96.72	101.00
	2	99.97	101.00
	3	100.00	100.00
	4	100.70	113.00
	5	106.80	113.00
	6	107.26	122.10
	7	120.00	122.10
	8	130.00	122.10
Top of Layer 2	9	96.72	101.00
	10	99.97	101.00
	11	100.00	100.00
	12	120.00	100.00
	13	125.00	122.10
	14	140.00	122.10
Top of Layer 3	15	96.72	101.00
	16	99.97	101.00
	17	100.00	100.00

TABULATED DETAILS OF SPECIFIED GEOMETRY

Soil profile contains 3 layers. Coordinates in [ft.]

#	X	Y1	Y2	Y3
1	96.72	101.00	101.00	101.00
2	96.72	101.00	101.00	101.00
3	99.97	101.00	101.00	101.00
4	99.97	101.00	101.00	100.91
5	100.00	100.00	100.00	100.00
6	100.70	113.00	100.00	100.00
7	106.80	113.00	100.00	100.00
8	107.26	122.10	100.00	100.00
9	120.00	122.10	100.00	100.00
10	125.00	122.10	122.10	100.00
11	130.00	122.10	122.10	100.00
12	140.00	122.10	122.10	100.00

DISTRIBUTION OF AVAILABLE STRENGTH ALONG EACH REINFORCEMENT LAYER

A = Front-end of reinforcement (at face of slope)
B = Rear-end of reinforcement
AB = L1 + L2 + L3 = Embedded length of reinforcement

Tavailable = Long-term strength of reinforcement
Tfe = Available front-end strength (e.g., connection to facing)

L1 = Front-end 'pullout' length
L2 = Rear-end pullout length
Tavailable prevails along L3

Factor of safety on resistance to pullout on either end of reinforcement, Fs-po = 1.50

Reinforcement Layer #	Designated Name	Height Relative to Toe [ft]	L [ft]	L1 [ft]	L2 [ft]	L3 [ft]	Tfe [lb/ft]	Tavailable [lb/ft]
1	SF80	0.65	15.00	1.28	2.53	11.19	2943.77	3774.07
2	SF80	3.25	15.00	2.36	2.89	9.75	2339.92	3774.07
3	SF80	5.85	15.00	4.27	3.35	7.39	1736.07	3774.07
4	SF80	8.45	15.00	4.40	3.97	6.63	2415.40	3774.07
5	SF80	11.05	15.00	7.94	4.89	2.17	1736.07	3774.07
6	SF55	13.65	9.00	0.69	3.64	4.67	1863.57	2142.04
7	SF55	16.25	9.00	2.03	5.25	1.72	1370.90	2142.04
8	SF55	18.85	9.00	2.31	6.69	0.00	985.34	1503.12 (*)
9	SF55	20.15	9.00	0.86	8.14	0.00	985.34	1101.41 (*)

(*) This Tavailable is dictated by the pullout resistance capacity, which is smaller than the long-term strength of the reinforcement that is related to its specified ultimate strength

RESULTS OF ROTATIONAL STABILITY ANALYSIS

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each entry point (considering all specified exit points)

Entry Point #	Entry Point (X, Y) [ft]		Exit Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	120.00	122.10	79.65	101.24	94.35	122.27	25.66	1.65	
2	123.00	122.10	82.25	101.17	97.03	122.54	25.98	1.48	
3	126.00	122.10	82.46	101.03	97.10	126.29	29.20	1.41	
4	129.00	122.10	79.77	101.12	95.74	131.90	34.67	1.38	
5	132.00	122.10	79.67	101.19	97.78	131.80	35.57	1.36	
. 6	135.00	122.10	77.31	101.10	96.46	138.22	41.77	1.35 .	OK
7	138.00	122.10	74.76	101.11	95.39	144.73	48.25	1.35	
8	141.00	122.10	74.41	101.24	95.31	151.26	54.21	1.37	
9	144.00	122.10	74.63	101.14	95.50	157.33	59.94	1.38	
10	147.00	122.10	74.92	101.03	95.55	164.26	66.51	1.41	
11	150.00	122.10	77.33	101.05	97.01	169.06	70.80	1.44	

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-entry' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

****

Results in the tables below represent critical circles identified between specified points on entry and exit. (Theta-exit set to 50.00 deg.) The most critical circle is obtained from a search considering all the combinations of input entry and exit points.

Critical circles for each exit point (considering all specified entry points)

Exit Point #	Exit Point (X, Y) [ft]		Entry Point (X, Y) [ft]		Critical Circle (Xc, Yc, R) [ft]			Fs	STATUS
1	74.76	101.11	138.00	122.10	95.39	144.73	48.25	1.35	
. 2	77.31	101.10	135.00	122.10	96.46	138.22	41.77	1.35 .	OK
3	79.94	101.03	135.00	122.10	98.00	136.32	39.64	1.35	
4	82.15	101.17	135.00	122.10	99.22	135.28	38.13	1.35	
5	84.45	101.26	135.00	122.10	100.46	134.16	36.59	1.37	
6	87.21	101.15	132.00	122.10	101.62	128.71	31.10	1.41	
7	89.69	101.09	132.00	122.10	99.56	134.33	34.68	1.44	
8	92.32	101.05	132.00	122.10	100.98	132.65	32.77	1.49	
9	94.65	101.12	138.00	122.10	105.63	133.71	34.39	1.58	
10	97.16	101.16	132.00	122.10	107.75	122.99	24.27	1.87	
11	100.00	100.00	100.00	100.00	100.00	100.00	0.00	N/A	#10 - Overhanging Cliff

Note: In the 'Status' column, OK means the critical circle was identified within the specified search domain. 'On extreme X-exit' means that the critical result is on the edge of the search domain; a lower Fs may result if the search domain is expanded.

RESULTS OF TRANSLATIONAL ANALYSIS

Results in the table below represent critical two-part wedges identified between specified starting (X1) and ending (X2) search points. Wedges along all reinforcement layers and at elevation zero are reported. The critical two-part wedge, one for each predetermined elevation, is defined by Xa, Xb and Xc where Xa is the front end of the passive wedge (slope face), Xb is where the passive wedge ends and the active one starts, and Xc is the X-ordinate at which the active wedge starts.

Critical two-part wedge along each interface:

Interface	Height Relative to Toe [ft]	(Xa, Ya) [ft]		(Xb, Yb) [ft]		(Xc, Yc) [ft]		Fs	STATUS
At toe elevation	0.00	100.00	100.00	106.04	100.00	140.07	122.10	1.24	OK
Reinf. Layer #1	0.65	100.03	100.65	106.36	100.65	136.99	122.10	1.20	OK
Reinf. Layer #2	3.25	100.17	103.25	106.46	103.25	133.38	122.10	1.24	OK
Reinf. Layer #3	5.85	100.31	105.85	109.53	105.85	131.10	122.10	1.27	OK
Reinf. Layer #4	8.45	100.45	108.45	109.73	108.45	127.85	122.10	1.37	OK
Reinf. Layer #5	11.05	100.59	111.05	106.86	111.05	120.02	122.10	1.35	OK
Reinf. Layer #6	13.65	106.83	113.65	107.20	113.65	114.55	122.10	1.44	Minimum on Edge
Reinf. Layer #7	16.25	106.96	116.25	109.08	116.25	114.53	122.10	1.49	OK
Reinf. Layer #8	18.85	107.10	118.85	109.18	118.85	112.66	122.10	1.71	OK
Reinf. Layer #9	20.15	107.16	120.15	109.28	120.15	111.60	122.10	1.71	OK

Note: In the 'Status' column, OK means the critical two part-wedge was identified within the specified search domain. 'Minimum on Edge' means the critical result corresponds to a minimum on the edge of the search domain; i.e., either on X1 or X2 or the internally preset limits on Xc.

RESULTS OF 3-PART WEDGE ANALYSIS

Results in the table below represent the critical slip surface composed of a three-part wedge and identified by the specified points (X-left, Y-left) and (X-right, Y-right) and angles Zeta(L) and Zeta(R). ReSSA finds the (X,Y) coordinates, as well as the angles Zeta, based on user-specified search domain. The trace of the critical three-part wedge is fully defined by four points: (X1, Y1), (X-left, Y-left), (X-right, Y-right), (X2, Y2).

Critical 3-part wedge (Automatic search):

(X2, Y2) [ft]	Zeta(L) [degrees]	(X-left, Y-left) [ft]	(X-right, Y-right) [ft]	Zeta(R) [degrees]	(X1, Y1) [ft]	Fs
(78.72, 101.00)	15.00	(99.00, 95.57)	(118.82, 102.00)	40.00	(142.78, 122.10)	1.254

CRITICAL RESULTS OF ROTATIONAL AND TRANSLATIONAL STABILITY ANALYSES

Rotational (Circular Arc; Bishop) Stability Analysis

Minimum Factor of Safety = 1.35

Critical Circle: Xc = 96.46[ft], Yc = 138.22[ft], R = 41.77[ft]. (Number of slices used = 59)

Translational (2-Part Wedge; Spencer), Direct Sliding, Stability Analysis

Minimum Factor of Safety = 1.20

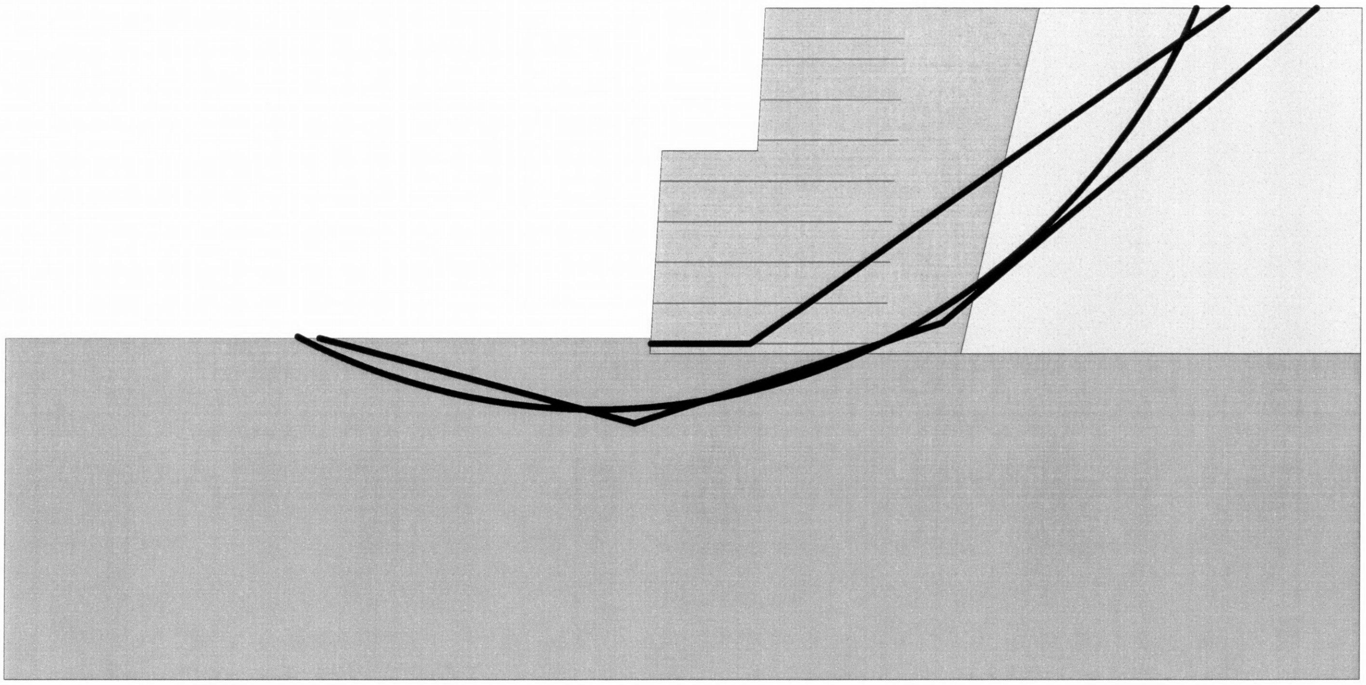
Critical Two-Part Wedge: (Xa = 100.03, Ya = 100.65) [ft]
(Xb = 106.36, Yb = 100.65) [ft]
(Xc = 136.99, Yc = 122.10) [ft]
(Number of slices used = 30)
Interslice resultant force inclination = 31.68 [degrees]

Three-Part Wedge Stability Analysis

Minimum Factor of Safety = 1.25

Critical Three-Part Wedge: (X2 = 78.72, Y2 = 101.00) [ft]
(X-left = 99.00, Y-left = 95.57) [ft]
(X-right = 118.82, Y-right = 102.00) [ft]
(X1 = 142.78, Y1 = 122.10) [ft]
(Number of slices used = 45)
Interslice resultant force inclination = 19.35 [degrees]

REINFORCEMENT LAYOUT: DRAWING



SCALE:

0 5 10 15 20 25 30 [ft]

REINFORCEMENT LAYOUT: TABULATED DATA & QUANTITIES

Layer #	Reinf. Type #	Geosynthetic Designated Name	Height Relative to Toe [ft]	Embedded Length [ft]	Covergae Ratio, Rc	(X, Y) front [ft]		(X, Y) rear [ft]		Lsv * [ft]	Lre [ft]
1	3	SF80	0.65	15.00	1.00	328.12	328.73	343.12	328.73	0.00	0.00
2	3	SF80	3.25	15.00	1.00	328.26	331.33	343.26	331.33	0.00	0.00
3	3	SF80	5.85	15.00	1.00	328.40	333.93	343.40	333.93	0.00	0.00
4	3	SF80	8.45	15.00	1.00	328.54	336.53	343.54	336.53	0.00	0.00
5	3	SF80	11.05	15.00	1.00	328.68	339.13	343.68	339.13	0.00	0.00
6	2	SF55	13.65	9.00	1.00	334.92	341.73	343.92	341.73	0.00	0.00
7	2	SF55	16.25	9.00	1.00	335.05	344.33	344.05	344.33	0.00	0.00
8	2	SF55	18.85	9.00	1.00	335.18	346.93	344.18	346.93	0.00	0.00
9	2	SF55	20.15	9.00	1.00	335.25	348.23	344.25	348.23	0.00	0.00

* Vertical distance between layers.

QUANTITIES

Reinf. Type #	Designated Name	Coverage Ratio	Area of reinforcemnt [ft²] / length of slope [ft]
2	SF55	1.00	36.00
3	SF80	1.00	75.00

AASHTO DESIGN METHOD
Shriners Hospital Two Tiered Wall-7P-10P

PROJECT IDENTIFICATION

Title:	Shriners Hospital Two Tiered Wall-7P-10P
Project Number:	
Client:	Key West Retaining Systems
Designer:	rw
Station Number:	

Description:

20.8 ft 2 tier wall (10 panel base (13') & 7 (9.1') panel top). 1:20 face batter. Seismic zone 3. Surcharge by planter

Company's information:

Name: DAH/SE
Street: P.O. Box 82228

Portland, OR 97282
Telephone #: (503) 231-8727
Fax #: (503) 231-8726
E-Mail: structbear@earthlink.net

Original file path and name: F:\Key West Retaining Walls\Shriners Hospital\MSEW Runs.....
.....Two Tiers_7P_10P.BEN
Original date and time of creating this file: 6/15/08

PROGRAM MODE: ANALYSIS
of SUPERIMPOSED WALL
using GEOGRID as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

RETAINED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	130.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	37.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ= 63.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 55.63   N γ= 66.19

SEISMICITY

Maximum ground acceleration coefficient, A = 0.220
Design acceleration coefficient in Internal Stability: Kh = Am = 0.271
Design acceleration coefficient in External Stability: Kh = 0.271 (Am = 0.000)

Kae (Kh > 0) = 0.4210   Kae (Kh = 0) = 0.2486 Δ Kae = 0.1724   (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

INPUT DATA: Geometry and Surcharge loads (of SUPERIMPOSED wall)

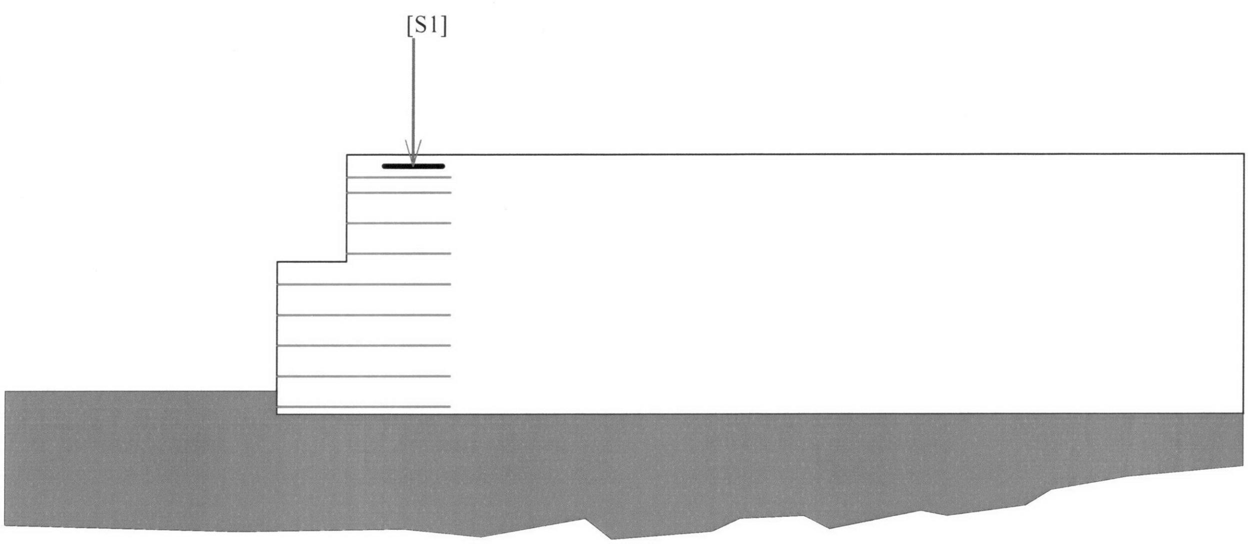
Design height, Hd	22.10	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 20.10 ft, where H1 = 9.10 and H2 = 11.00 }
Batter, ω	0.0	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

Offset of upper segment from lower one, Offset = 6.0 ft, Blackslope2 = 0.0 deg. and Backslope rise, S2 = 0.0 ft.

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 750.0 and Qv-l = 0.0 [lb/ft ²].
Footing width, b=5.0 [ft]. Distance of center of footing from wall face, d = 5.8 [ft] @ depth of 1.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10[ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, Fs = 22.71, Meyerhof stress = 2744 lb/ft².

Foundation Interface: Direct sliding, Fs = 3.795, Eccentricity, e/L = 0.0172, Fs-overturning = 5.95

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	15.00	3	2.16	2.77	2.684	24.693	3.234	0.0091	SF80
2	3.25	15.00	3	1.63	2.62	2.232	16.635	3.636	-0.0236	SF80
3	5.85	15.00	3	1.59	3.46	2.541	15.025	4.150	-0.0583	SF80
4	8.45	15.00	3	1.67	4.76	2.937	13.406	4.830	-0.0979	SF80
5	11.05	15.00	3	1.57	5.66	2.828	9.638	5.764	-0.1488	SF80
6	13.65	9.00	2	6.39	6.46	3.231	10.915	7.386	-0.0117	SF55
7	16.25	9.00	2	4.33	5.77	2.887	5.681	11.972	-0.0379	SF55
8	18.85	9.00	2	3.55	6.47	4.564	4.055	27.652	-0.0662	SF55
9	20.15	9.00	2	3.21	7.00	5.768	2.718	61.342	-0.0856	SF55

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, Fs = 9.93, Meyerhof stress = 4150 lb/ft².

Foundation Interface: Direct sliding, Fs = 1.731, Eccentricity, e/L = 0.1808, Fs-overturning = 2.22

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	15.00	3	1.68	2.33	2.265	15.355	1.486	0.1608	SF80
2	3.25	15.00	3	1.34	2.30	1.958	10.933	1.731	0.0841	SF80
3	5.85	15.00	3	1.30	3.02	2.221	9.826	2.091	0.0116	SF80
4	8.45	15.00	3	1.35	4.14	2.557	8.716	2.687	-0.0594	SF80
5	11.05	15.00	3	1.31	5.02	2.511	6.451	5.518	-0.1484	SF80
6	13.65	9.00	2	4.81	5.30	2.651	6.520	3.033	0.0481	SF55
7	16.25	9.00	2	3.46	4.96	2.479	3.621	4.916	-0.0123	SF55
8	18.85	9.00	2	2.67	5.34	3.768	2.443	11.354	-0.0601	SF55
9	20.15	9.00	2	2.35	5.67	4.666	1.592	25.187	-0.0840	SF55

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

STATIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 2.017
(it corresponds to a critical circle at Xc = -11.05, Yc = 50.83 and R = 52.02 [ft]).

SEISMIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 1.306
(it corresponds to a critical circle at Xc = -11.05, Yc = 50.83 and R = 52.02 [ft]).

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

A horizontal seismic coefficient, Kh='A', equal to 0.220 has been applied.
The seismic force is applied at the center of the sliding mass.

STATIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 2.017
(it corresponds to a critical circle at Xc = -11.05, Yc = 50.83 and R = 52.02 [ft] where (x=0, y=0) is taken at the TOE or Xc = 118.95, Yc = 1050.83 and R = 52.02 [ft] when the terrain coordinate system is used as shown in the table below.)

SEISMIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 1.306
(it corresponds to a critical circle at Xc = -11.05, Yc = 50.83 and R = 52.02 [ft] where (x=0, y=0) is taken at the TOE or Xc = 118.95, Yc = 1050.83 and R = 52.02 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 130.00 [lb/ft ^{3}]			ϕ = 37.0°		c = 0.00 [lb/ft ^{2}]					
x [ft]	25.0	50.0	75.0	100.0	125.0	327.6	335.4	343.2	351.0	370.5	390.0
y [ft]	1002.0	1002.0	1002.0	1002.0	1002.0	1000.0	1000.0	1000.0	1000.0	1078.0	1078.0

AASHTO DESIGN METHOD
Shriners Hospital Single Wall-16 P

PROJECT IDENTIFICATION

Title:	Shriners Hospital Single Wall-16 P
Project Number:	
Client:	Key West Retaining Systems
Designer:	rw
Station Number:	

Description:

16 panel (20.8') wall. 1:20 face batter. Seismic zone 3.

Company's information:

Name: DAH/SE
Street: P.O. Box 82228

Portland, OR 97282
Telephone #: (503) 231-8727
Fax #: (503) 231-8726
E-Mail: structbear@earthlink.net

Original file path and name: F:\Key West Retaining Walls\Shriners Hospital\MSEW Runs.....
..... Single Tier_16P.BEN
Original date and time of creating this file: 6/16/08

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

RETAINED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	0.0 °
Equivalent cohesion, $c_{equiv.}$	5000.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 63.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 N γ= 0.00

SEISMICITY

Maximum ground acceleration coefficient, A = 0.220
Design acceleration coefficient in Internal Stability: Kh = Am = 0.271
Design acceleration coefficient in External Stability: Kh = 0.271 (Am = 0.000)

Kae (Kh > 0) = 0.4008 Kae (Kh = 0) = 0.2303 Δ Kae = 0.1706 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

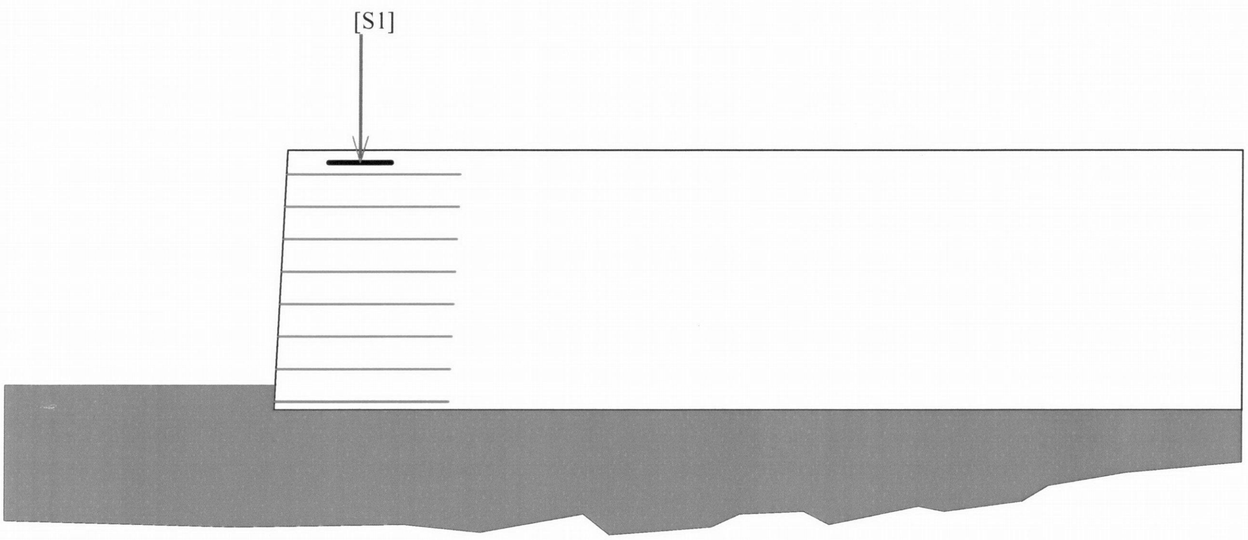
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	20.80	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 18.80 ft }
Batter, ω	2.9	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

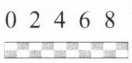
U N I F O R M   S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 750.0 and Qv-l = 0.0 [lb/ft ²].
Footing width, b=5.0 [ft]. Distance of center of footing from wall face, d = 5.8 [ft] @ depth of 1.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:



ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, Fs = 7.68, Meyerhof stress = 3346 lb/ft².

Foundation Interface: Direct sliding, Fs = 4.334, Eccentricity, e/L = 0.0709, Fs-overturning = 5.98

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	14.00	3	7.07	5.60	2.802	22.670	3.725	0.0661	SF80
2	3.25	14.00	3	5.15	4.68	2.338	15.599	4.356	0.0490	SF80
3	5.85	14.00	3	4.75	5.04	2.680	14.150	5.231	0.0354	SF80
4	8.45	14.00	3	3.73	4.77	3.133	12.694	6.524	0.0254	SF80
5	11.05	14.00	2	3.03	2.73	2.132	11.031	8.619	0.0194	SF55
6	13.65	14.00	2	2.50	2.88	2.607	8.943	12.555	0.0180	SF55
7	16.25	14.00	2	2.04	3.19	3.185	6.272	22.349	0.0231	SF55
8	18.85	14.00	2	1.87	4.08	4.080	2.351	74.108	0.0419	SF55

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, Fs = 4.38, Meyerhof stress = 5868 lb/ft².

Foundation Interface: Direct sliding, Fs = 1.823, Eccentricity, e/L = 0.2553, Fs-overturning = 1.90

GEOGRID				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	14.00	3	4.88	4.34	2.170	12.497	1.567	0.2385	SF80
2	3.25	14.00	3	3.83	3.83	1.913	9.282	1.832	0.1774	SF80
3	5.85	14.00	3	3.50	4.10	2.177	8.335	2.201	0.1265	SF80
4	8.45	14.00	3	2.71	3.84	2.522	7.382	2.745	0.0857	SF80
5	11.05	14.00	2	2.19	2.17	1.696	6.308	3.626	0.0554	SF55
6	13.65	14.00	2	1.77	2.26	2.046	5.020	5.281	0.0361	SF55
7	16.25	14.00	2	1.41	2.48	2.478	3.479	9.401	0.0296	SF55
8	18.85	14.00	2	1.27	3.13	3.133	1.281	31.174	0.0428	SF55

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

STATIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 2.272
(it corresponds to a critical circle at Xc = -10.40, Yc = 45.76 and R = 46.93 [ft]).

SEISMIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 1.789
(it corresponds to a critical circle at Xc = -10.40, Yc = 45.76 and R = 46.93 [ft]).

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

A horizontal seismic coefficient, Kh=half of 'A', equal to 0.110 has been applied.
The seismic force is applied at the center of the sliding mass.

STATIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 2.272
(it corresponds to a critical circle at Xc = -10.40, Yc = 45.76 and R = 46.93 [ft] where (x=0, y=0) is taken at the TOE or Xc = 119.60, Yc = 1045.76 and R = 46.93 [ft] when the terrain coordinate system is used as shown in the table below.)

SEISMIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 1.789
(it corresponds to a critical circle at Xc = -10.40, Yc = 45.76 and R = 46.93 [ft] where (x=0, y=0) is taken at the TOE or Xc = 119.60, Yc = 1045.76 and R = 46.93 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 120.00 [lb/ft ^{3}]			ϕ = 0.0°		c = 5000.00 [lb/ft ^{2}]					
x [ft]	25.0	50.0	75.0	100.0	125.0	327.6	335.4	343.2	351.0	370.5	390.0
y [ft]	1002.0	1002.0	1002.0	1002.0	1002.0	1000.0	1000.0	1000.0	1000.0	1078.0	1078.0

AASHTO DESIGN METHOD
Shriners Hospital Single Wall-12 P

PROJECT IDENTIFICATION

Title:	Shriners Hospital Single Wall-12 P
Project Number:	
Client:	Key West Retaining Systems
Designer:	rw
Station Number:	

Description:

12 panel (15.6') wall. 1:20 face batter. Seismic zone 3.

Company's information:

Name: DAH/SE
Street: P.O. Box 82228

Portland, OR 97282
Telephone #: (503) 231-8727
Fax #: (503) 231-8726
E-Mail: structbear@earthlink.net

Original file path and name: F:\Key West Retaining Walls\Shriners Hospital\MSEW Runs.....
..... Single Tier_12P.BEN

Original date and time of creating this file: 6/16/08

PROGRAM MODE: ANALYSIS
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

RETAINED SOIL

Unit weight, γ	130.0 lb/ft ^{3}
Design value of internal angle of friction, ϕ	37.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	120.0 lb/ft ^{3}
Equivalent internal angle of friction, $\phi_{equiv.}$	0.0 °
Equivalent cohesion, $c_{equiv.}$	5000.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 63.50° (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.2486 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity coefficients (calculated by MSEW): Nc = 5.14 N γ= 0.00

SEISMICITY

Maximum ground acceleration coefficient, A = 0.220
Design acceleration coefficient in Internal Stability: Kh = Am = 0.271
Design acceleration coefficient in External Stability: Kh = 0.271 (Am = 0.000)

Kae (Kh > 0) = 0.4008 Kae (Kh = 0) = 0.2303 Δ Kae = 0.1706 (see eq. 37 in DEMO 82)
Seismic soil-geogrid friction coefficient, F* is 80.0% of its specified static value.

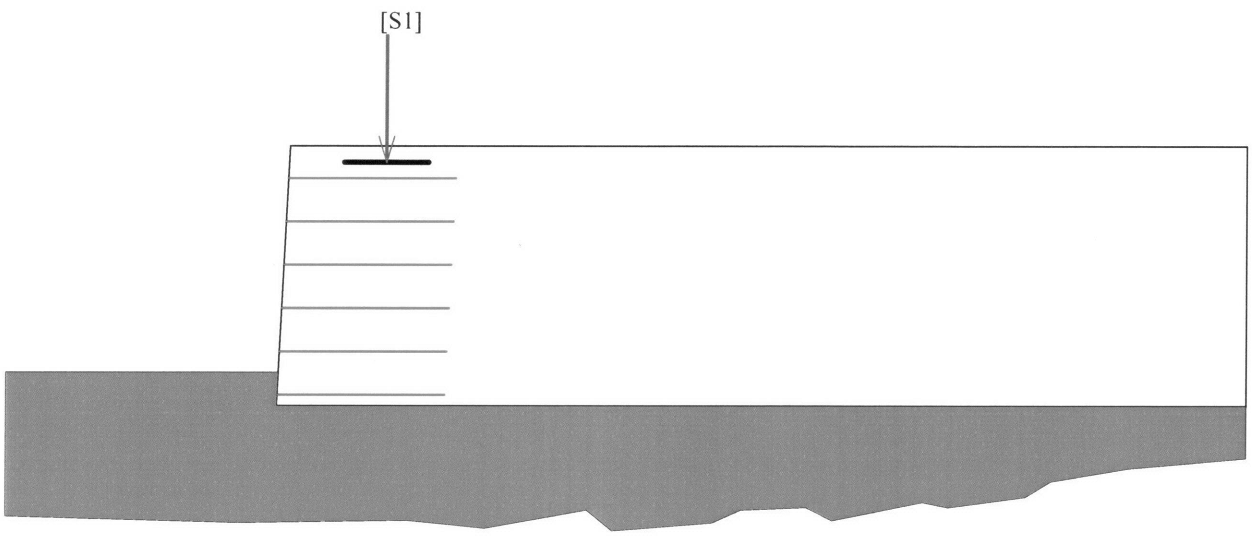
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	15.60	[ft]	{ Embedded depth is E = 2.00 ft, and height above top of finished bottom grade is H = 13.60 ft }
Batter, ω	2.9	[deg]	
Backslope, β	0.0	[deg]	
Backslope rise	0.0	[ft]	Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

UNIFORM SURCHARGE
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 750.0 and Qv-l = 0.0 [lb/ft ²].
Footing width, b=5.0 [ft]. Distance of center of footing from wall face, d = 5.8 [ft] @ depth of 1.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6 8 10 [ft]

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, Fs = 10.02, Meyerhof stress = 2566 lb/ft².

Foundation Interface: Direct sliding, Fs = 4.454, Eccentricity, e/L = 0.0472, Fs-overturning = 6.15

GEOGRID #	Elevation [ft]	Length [ft]	Type #	CONNECTION Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	10.00	3	6.85	7.28	3.640	16.190	3.886	0.0398	SF80
2	3.25	10.00	3	4.89	6.27	3.133	10.624	4.896	0.0137	SF80
3	5.85	10.00	2	3.78	3.41	2.132	9.166	6.556	-0.0071	SF55
4	8.45	10.00	2	2.86	3.29	2.607	7.690	9.743	-0.0232	SF55
5	11.05	10.00	2	2.12	3.32	3.185	6.209	17.929	-0.0363	SF55
6	13.65	10.00	2	1.87	4.08	4.080	4.065	63.795	-0.0510	SF55

ANALYSIS: CALCULATED FACTORS (Seismic conditions)

Bearing capacity, Fs = 5.85, Meyerhof stress = 4395 lb/ft².

Foundation Interface: Direct sliding, Fs = 1.873, Eccentricity, e/L = 0.2356, Fs-overturning = 1.96

GEOGRID #	Elevation [ft]	Length [ft]	Type #	CONNECTION Fs-overall [connection strength]	Fs-overall [geogrid strength]	Geogrid strength Fs	Pullout resistance Fs	Direct sliding Fs	Eccentricity e/L	Product name
1	0.65	10.00	3	4.76	5.67	2.833	8.987	1.635	0.2114	SF80
2	3.25	10.00	3	3.67	5.15	2.577	6.371	2.060	0.1262	SF80
3	5.85	10.00	2	2.84	2.79	1.743	5.448	2.758	0.0593	SF55
4	8.45	10.00	2	2.12	2.68	2.120	4.536	4.098	0.0095	SF55
5	11.05	10.00	2	1.57	2.71	2.594	3.671	7.542	-0.0250	SF55
6	13.65	10.00	2	1.39	3.33	3.332	2.413	26.836	-0.0496	SF55

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

STATIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 2.379
(it corresponds to a critical circle at Xc = -6.24, Yc = 37.44 and R = 37.96 [ft]).

SEISMIC CONDITIONS: For the specified search grid, the calculated minimum Fs is 1.863
(it corresponds to a critical circle at Xc = -6.24, Yc = 37.44 and R = 37.96 [ft]).

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

A horizontal seismic coefficient, Kh=half of 'A', equal to 0.110 has been applied.
The seismic force is applied at the center of the sliding mass.

STATIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 2.379
(it corresponds to a critical circle at Xc = -6.24, Yc = 37.44 and R = 37.96 [ft] where (x=0, y=0) is taken at the TOE or Xc = 123.76, Yc = 1037.44 and R = 37.96 [ft] when the terrain coordinate system is used as shown in the table below.)

SEISMIC CONDITIONS:
For the specified search grid, the calculated minimum Fs is 1.863
(it corresponds to a critical circle at Xc = -6.24, Yc = 37.44 and R = 37.96 [ft] where (x=0, y=0) is taken at the TOE or Xc = 123.76, Yc = 1037.44 and R = 37.96 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 120.00 [lb/ft ^{3}]			ϕ = 0.0°		c = 5000.00 [lb/ft ^{2}]					
x [ft]	25.0	50.0	75.0	100.0	125.0	327.6	335.4	343.2	351.0	370.5	390.0
y [ft]	1002.0	1002.0	1002.0	1002.0	1002.0	1000.0	1000.0	1000.0	1000.0	1078.0	1078.0