| ENGINEERING/REMEDIATION RESOURCES GROUP, INC. BY E. BINNING DATE 9/08 CLIENT US Forest Service SHEET | ERRG |
|---|------------|
| | 28-072 |
| Objective: Determine filter requirement for g | otestile |
| 1. Use soil results from ML-GS-O2C. | |
| Given: D20=0.14, D10=0.05, Cc=1.91, Cy=17. | |
| Method. Use Chart 1. (see attached) to determine | |
| From Linear Particle Distribution Cu, | ve |
| do=0.051 mm, do=5.818 mm, | d'50=0.546 |
| $C_0 = \int_{d_0}^{d_{00}} = 10.7$ | |
| Assume compacted soil is dense | |
| $O_{qs} \leq \frac{18}{C_u'} J_{so}', O_{qs} = Aos$ | |
| AOS < 18 (0.546) -> AOS < 0.918 mm | |
| Determine geotextile permeability requirem | erts: |
| Assume Ks = 1 x 10-3 cm/s | |
| is = 1.5 (for landfill Surfack Water Collection Removal System) | ~ + |
| $K_5 \ge i_5 K_5 \rightarrow K_5 \ge (1.5)(1 \times 10^{-7} \text{cm/see})$ | |
| Ky ≥ 1.5 × 10 ⁻³ cm/sec | |

ERRG

| - 0 | | -1-1 | | 110 | | | | EKKG |
|--|--|--|---------|--|--|--|--|---|
| BY E. BI | UNING DATE_ | 9/9/08 | _CLIENT | US | Forest | Service | SHEET | 2_0F_2 |
| CHECKED BY_ | D. TANG | DESCRIPTION_ | Fil | ter De | sign | | _ JOB NO | 8-072 |
| | Determi | ne ant | i-dogs | م المار | equinen | ients: | in continues and and | |
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| | | | | | | | | |
| | Su | re survee table | 2. | 8 | 7 | | The state of the s | |
| 2, For | ML-T | PDIB/C |)2 C : | | | | | |
| | | 31 , D ₁ | | , C _c | =1.70 | | | |
| | | | _1 | | | | account of the second |] |
| | | 61, d, | | | 25 | 30 | Consequently and the second se | |
| a speed once the second and | C'= 5 | 0.161 | - C | 1:5 | , 8 | | AUDICAL CONTRACTOR OF THE CONT | |
| and the same According to the same according | V. | 0.161 | | 7 | | | | |
| | Assume | 50 l | s de | \\$e | | | | |
| | Ansk | 18 10 | 0- \ | * 99 | Ans | 2.9 | The state of the s | |
| | | 5.8 | 0,930) | | 703 - | | 1. | |
| | | | | | | | ry repair against | |
| | kg is | Same | 25 | ML- | 95-02 | | Control (Care | |
| | | | | | | | e Stand a d'e company | |
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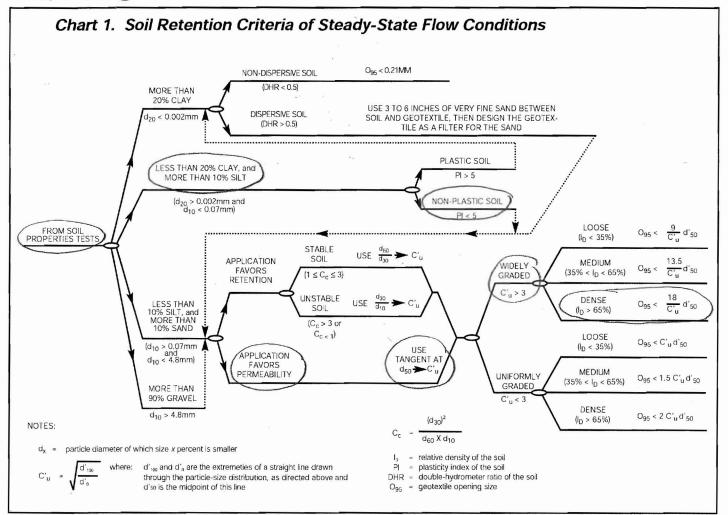
P THREE:

JETERMINE SOIL RETENTION REQUIREMENTS

Charts 1 and 2 indicate the use of particle-size parameters for determing retention criteria. These charts show that the amount of gravel, sand, silt and clay affects the retention criteria selection process. Chart 1 shows the numerical retention criteria for steady-state flow conditions; Chart 2 is for dynamic flow conditions.

For predominantly coarse grained soils, the grainsize distribution curve is used to calculate specific parameters such as C_u , C_u , C_c , that govern the retention criteria.

ML-GS-OZC



Solution

| Input data | | |
|---|----------|-------|
| Actual Particle Distribution Curve | | |
| d ₁₀ | 0.05 mm | |
| d_{20} | 0.14 mm | |
| d ₅₀ | 0.5 mm | |
| d_{60} | .86 mm | |
| d ₈₅ | 3 mm | |
| Output Data | | |
| Values of the Linear Particle Distribution Curve | | |
| d' ₀ | 0.051 mm | |
| d' ₁₀ | 0.082 mm | |
| d' ₂₀ | 0.132 mm | |
| d' ₅₀ | 0.546 mm | |
| d' ₆₀ | 0.876 mm | |
| d' ₈₅ | 2.861 mm | |
| d' ₁₀₀ | 5.818 mm | |
| | | ** |
| Coefficient of Determination (R ²) | 0.99858 | -r 1: |
| Indicates how acurate the linearization is | | |
| * | | |
| Coefficient of Uniformity | 17.20 | , , |
| lf greater than 1 and smaller than 5, it is said to be uniformly graded. | | |
| lf greater than 20, it is said to be broadly graded. | | |
| Linear Coefficient of Uniformity | 10.66 | |
| Maximum Filter Opening Size | 0.922 mm | |
| • | | |

Additional Assistance

| If you w | ould like to have | Advanced Geotech | Systems provide | e material s | specifications | that meet yo | our performance |
|-----------|--------------------|----------------------|------------------|---------------|----------------|---------------|-----------------|
| criteria, | please fill in the | following fields and | click the submit | button. All i | nformation is | kept strictly | confidential. |
| | | | | | | | |

| | _ | | |
|-------------------|---|----------|--|
| Name* | | Comments | |
| Company | | | |
| Email Address* | | | |
| Phone | | | |
| Project Reference | | J | |

*required fields

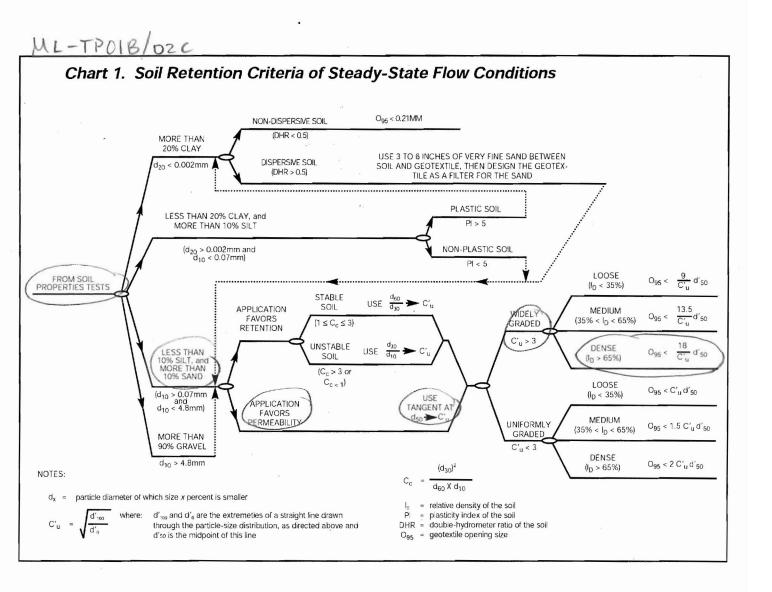
Submit Design Results

4P THREE:

JETERMINE SOIL RETENTION REQUIREMENTS

Charts 1 and 2 indicate the use of particle-size parameters for determing retention criteria. These charts show that the amount of gravel, sand, silt and clay affects the retention criteria selection process. Chart 1 shows the numerical retention criteria for steady-state flow conditions; Chart 2 is for dynamic flow conditions.

For predominantly coarse grained soils, the grainsize distribution curve is used to calculate specific parameters such as C_u , C'_u , C_c , that govern the retention criteria.



Solution

| Input data | | |
|---|----------|-----|
| Actual Particle Distribution Curve | | |
| d ₁₀ | 0.16 mm | |
| d_{20} | 0.31 mm | |
| d ₅₀ | 1.01 mm | |
| d ₆₀ | 1.35 mm | |
| d ₈₅ | 3 mm | |
| Output Data | | |
| Values of the Linear Particle Distribution Curve | | |
| d' ₀ | 0.161 mm | |
| d' ₁₀ | 0.229 mm | |
| d' ₂₀ | 0.325 mm | |
| d' ₅₀ | 0.930 mm | |
| d' ₆₀ | 1.321 mm | |
| d' ₈₅ | 3.175 mm | |
| d' ₁₀₀ | 5.373 mm | |
| Coefficient of Determination (R ²) | 0.99763 | c h |
| Indicates how acurate the linearization is | | 3 |
| Coefficient of Uniformity | 8.44 | |
| lf greater than 1 and smaller than 5, it is said to be uniformly graded. | | |
| lf greater than 20, it is said to be broadly graded. | | |
| Linear Coefficient of Uniformity | 5.78 | |
| Maximum Filter Opening Size | 2.896 mm | |

Additional Assistance

| If you would like to have Advanced Geotech Systems provide material specifications that meet your performance of the second seco | ormance |
|--|---------|
| criteria, please fill in the following fields and click the submit button. All information is kept strictly confider | ntial. |

| Name* | Comments | |
|-------------------|----------|--|
| Company | | |
| Email Address* | | |
| Phone | | |
| Project Reference | | |

*required fields

Submit Design Results

ERRO

| BY L. BINNING | _ DATE _ | 10/1/08 CLIENT FOREST SERVICE SHEET OF |
|---|------------------------------------|---|
| CHECKED BY D. T | ANG | DESCRIPTION GEOCOMPOSITE TENSILE STRENGITH JOB NO. 28-07Z |
| ussuumbaas, vantuus sagaa lähis tärtiinnäteki tinni, ettiini etti kirini. | inger ventrales | |
| OBJECTIVE | 6. | DETERMINE TENSILE STRENGTH REQUIREMENTS FOR GEOCOMPOSITE |
| AGUMPTIONS | • | VEHICLE LOADING FROM DIRT BIKE A TYPICAL DIRT BIKE WEIGHT = 250 lb PLUS 250 lb RIDER. LOAD = 500 lb; PER TIRE = 250 lb TIRE TRACK CONTACT AREA = 4" × 9" = 0.25 FT" CONTACT STRESS = 250 lb/0.25 FT" |
| METHOD | | = 1000 PSF |
| THE ENOUGH | emanti establi harrana esti muuree | FROM NAVFAC DM 7.1-167, FIGURE 3 USE SQUARE FOOTING CASE TO DETERMINE VERTICAL STRESS. FOR B = 1 FT & Z = 3 FT OR 3B, 6z = 0.06 P |
| | adalah ngapawanan pjahi wapawa wa | 6z = 0.06 (1000 PSF) = 60 PSF FOR $1^{PT}SECTION = 601b$ |
| STRUCTURAL EVALUATION | | USE GSE PERMANET UL GEOCOMPOSITE (60Z/YDZ) GRAB TENSILE 17016 > 6016 OK PUNCTURE STRENGTH 9016 > 6016 OK |
|) | | |





GSE STANDARD PRODUCTS

GSE PermaNet® UL Geocomposites (Double-Sided)

GSE PermaNet UL (Ultra Load) Geocomposites are drainage products manufactured with a geonet heat-bonded to a nonwoven, needlepunched geotextile on both sides. The creep resistant structure ensures continuous flow performance over a broad range of conditions and long durations. These products work as an efficient drainage medium and are ideal for extremely high compressive stress applications.

Depending on filtration and interface strength requirements of a specific project, GSE can bond any type of nonwoven, needlepunched geotextiles to the geonet. GSE PermaNet UL Geocomposites are available in a 6, 8, and 10 oz/yd^2 geotextile as described in the product specification chart below. For more information on the performance transmissivity under site-specific conditions, please contact a GSE representative.

Product Specifications

GSE Advantage Products

| TESTED PROPERTY | TEST METHOD | FREQUENCY | AVERAGE VALUE | | | |
|--|-------------------------------|---------------------------|-----------------------------|-----------------------------|--|--|
| Geocomposite | | | 6 oz/yd² | 8 oz/yd ² | 10 oz/yd² | |
| Product Code | | | FR82060060T | FR82080080T | FR82100100T | |
| Transmissivity ^[a] , gal/min/ft (m²/sec) | ASTM D 4716 | 1/540,000 ft ² | 4.8 (1 x 10 ⁻³) | 4.8 (1 x 10 ⁻³) | 4.8 (1 x 10 ⁻³) | |
| Ply Adhesion, lb/in (g/cm) | ASTM D 7005 | 1/50,000 ft² | 1.0 (178) | 1.0 (178) | 1.0 (178) | |
| Roll Width ^(b) , ft (m) | | | 15 (4.5) | 15 (4.5) | 15 (4.5) | |
| Roll Length ^(h) , ft (m) | | | 150 (45) | 140 (42) | 130 (39) | |
| Roll Area, ft² (m²) | | | 2,250 (202) | 2,100 (189) | 1,950 (175) | |
| Geonet Properties | <u> </u> | | A' | VERAGE VAL | UE | |
| Transmissivity ^(c) , gal/min/ft (m ² /sec) | ASTM D 4716 | | | 24 (5 x 10 ⁻³) | | |
| Compression Strength, lb/ft² (kPa) | ASTM D 1621 | 1/540,000 ft ² | | 40,000 (1,913) | | |
| Creep Reduction Factor | | once per formulation | | 1.3 @ 25,000 ps | <u> </u> | |
| Thickness, mill (mm) | ASTM D 5199 | 1/50,000 ft ² | | 300 (7.6) | The second secon | |
| Density, g/cm³ | ASTM D 1505 | 1/50,000 ft² | | 0.94 | With the same of t | |
| Tensile Strength (MD), lb/in (N/mm) | ASTM D 5035 | 1/50,000 ft ² | | 100 (17) | | |
| Carbon Black Content, % | ASTM D 1603*/4218 | 1/50,000 ft ² | | 2.0 | | |
| Geotextile Properties ^(d) | | | MINIMUM | AVERAGE RO | OLL VALUE | |
| Mass, oz/yd² (g/m²) | ASTM D 5261 | 1/90,000 ft ² | 6 (200) | 8 (270) | 10 (335) | |
| Grab Tensile, lb (N) | ASTM D 4632 | 1/90,000 ft ² | 170 (755) | 220 (975) | 260 (1,155) | |
| Puncture Strength, lb (N) | ASTM D 4833 | 1/90,000 ft ² | 90 (395) | 120 (525) | 165 (725) | |
| AOS, US sieve (mm) | ASTM D 4751 | 1/540,000 ft ² | 70 (0.21) | 80 (0.180) | 100 (0.150) | |
| Permittivity, (sec-1) | ASTM D 4491 | 1/540,000 ft ² | 1.5 | 1.5 | 1.2 | |
| Flow Rate, gpm/ft ² (lpm/m ²) | ASTM D 4491 | 1/540,000 ft ² | 110 (4,480) | 110 (4,480) | 85 (3,460) | |
| UV Resistance, % retained | ASTM D 4355 (after 500 hours) | once per formulation | 70 | 70 | 70 | |

NOTES:

- (a)This is an index transmissivity value measured at stress = 25,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate. Contact GSE for performance transmissivity value for use in design.
- |b|Roll widths and lengths have a tolerance of ±1%.
- ldThis is an index transmissivity value measured at stress = 25,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate
- id) All geotextile properties are minimum average roll values except AOS (in mm) which is a maximum average roll value (MaxARV); and UV resistance which is a typical value.
- *Modified.

DS023 PermaNetUL R05/06/08

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| North America | GSE Lining Technology, Inc. | Houston, Texas | B00.435.2008 | 281.443.8564 | Fax: 281.230.6739 |
|-----------------|---------------------------------------|--------------------------------|--------------|---------------|--------------------|
| South America | GSE Lining Technology Chile S.A. | Santiago, Chile | | 56.2.595.4200 | Fax: 56.2.595.4290 |
| Asia Pacific | GSE Lining Technology Company Limited | Bangkok, Thailand | | 66.2.937.0091 | Fax: 66.2.937.0097 |
| Europe & Africa | GSE Lining Technology GmbH | Hamburg, Germany | | 49.40.767420 | Fax: 49.40.7674234 |
| Middle East | GSE Lining Technology-Egypt | The 6th of October City, Egypt | | 20.2.828.8888 | Fax: 20.2.828.8889 |



| BY L. BIN | NING DATE | 10/17/08 | 8 CLIENT MEYERS LANDFILL SHEET / OF 3 |
|---|--|--|---|
| | | | FINAL CAP REINFORCEMENT CAL'CJOBNO. 28-072 |
| kan karangan ya 1 a sa sa karangan nganagangan at angan tangan tangan tangan sa s | ser entre in Mille heremone process annabes, "Mer it has not ser ser service". | des to the fill the section and the destination of the section of | |
| | OBJECTIV | E: To | DETERMINE FINAL CAP REINFORCEMENT SCHEDULE |
| | GILLEN | : 1) | FINAL CAP - COMPACTED ON SITE SAND TO 90% COMPACTION |
| | A | e e | φ=40° (TP-01B/02C |
| | attana sila eti Mari 1 fi kannifasi kala eti Maria eshian harasa alia esecunita eza askala | entering communication of a medical and and all and a medical and a medi | C = O DIRECT SHEAR TEST RESULT) |
| gengeline som frå her vælet kommen menenstræken verk fra | igen op de lighteden i Morre fylir folget film de de ode 1 hans fersen sjor oagste kreken | gat norm savada, yak isaa minir samata mini ganinasa daminingan mini samtiingang | AND OVERLYING GEOCOMPOSITE |
| | | | $\phi = 37^{\circ}$ (TP-01B/02C- CISE GEOCOMPOSITE) ADHESION = 110 PSF |
| kungan kanal salah salah dalah dalah kanal kungan berah dalah sebela dalah dalah sebela dalah dalah dalah dalah | natural de de la proposition della proposition d | nd and met warp uttplicet was relitationed to write a test to be discussed. | (NEGLECT ADHESION FOR LONG, TERM) |
| | | | USE \$ = 37° AND C=0 PSF IN DESIGN 8 = 120 PCF, 8SUB = 65 PCF |
| ang kang nganakang mengahang mengahan digi di terjebang galun digunakan, mengahan galun | nagang isa nasa terapakan maganganan peranahan kembanan kanan | the second of th | VEHICLE LOADING FROM DIRT BIKE USE |
| | 1 00 00 00 00 00 00 00 00 00 00 00 00 00 | | a) ASSUME A TYPICAL VEHICLE WEIGHT OF 250 16 PLUS 250 16 RIDER |
| g, etgiga ggrup, och mensis en nordelte til over englivligtererkel, storförlivli | and disk, well-up of the forest than the first was explanated the high Aven Table which the first the firs | underlief, allefitte, Neu anne Phil. e E. Neu derli eu adel als Amerika au acces 1939 i | LOAD = 500 16 PER TIRE = 250 16 |
| | | (i) (ii) (ii) (iii) (iii | b) ASSUME TIRE TRACK CONTACT AREA OF $4^{IN} \times 9^{IN} = 0.25 FT^2$ c) STRESS = $250 \cdot 16 / 0.25 FT^2$ |
| ggenerate eking geori interdisi denari silangi di kari silangi di kari silangi di kari silangi di kari silangi | avuskirigi, danda kanapa dahirinsida siri yani dari uyukurin idhirda saranda sush inini inisisisisi | indom ne bark pindoudale in leiduruuduslamay udo i noi attentiigite insoon 1 | = 1000 PSF |
| | | | DESIGN IS CONSIDERED GROUNDWATER EFFECT |
| | BEARING | CAPACITY | : Quet = c Nc (1+ 0.3 €)+[Ysu8+F(X-Ysu8)]× |
| | | | PALLOWABLE = QUIT/3 (NAVFAC 7.2-132) |

FDDC

BY L. BINNING DATE 10/17/08 CLIENT MEYERS LANDFILL SHEET 2 OF 3 CHECKED BY D. TANG DESCRIPTION FINAL CAP REINFORCEMENT CAL'C JOB NO. 28-072 SQUARE CONTACT AREA , B = L = 1 FT \$ = 37° , NY = 60 (NAV FAC 7.2-131) C = 0 , Nc = 0 SURFACE FOOTING; Ng = 0 Y = 120 PCF, Y SUB = 65 PCF TOTAL THICKNESS OF COVER = 4 FT BASED ON HELP, PEAR HEAD = 33 INCES (2.8 FT) d = 4 FT - 2.8 FT = 1.2 FT $\frac{d}{R} = \frac{1.2}{1} = 1.2$, $\phi = 40^{\circ}$ F = 0.9 (NAVFAC 7.2-132) QULT = CNC(1+0.3 B) + [YSUB + F(X-YSUB)] × 0.4BNX quet = [65 + 0.9(120-65)] x 0.4 x 1 x 60 = 2748 PSF JALLOWABLE = 2,748/3 = 916 PSF < 1000 PSF ADDITIONAL REINFORCEMENT IS REQUIRED

ERRG

| | NINGDATE 10/17/ | | | | | T_3_ 0F_ | |
|--|--|--|--|---|---|--|--|
| HECKED BY | D. TANG DESCRIPT | TION_FINAL | CAP REIN | FORCEMENT (| CAL JOB NO. | 28-072 | • |
| and the first production of the control of the cont | | rice specialised sciency and muse based in a climate Leaville Stateward and selection and selection and select | and a superior of the superior | energen geringen gemeiner im Steine Andreit von der eine Steine Andreit von der Andreit von der der Verscheit | a digi waga - sigaya ni | | nonhanning and standing pouls |
| 180 9 | 1 | 8 | | \$ \$ \$ | | To a second | |
| ili. | REINFORCEMENT | | VERTICAL | LOAD | = 1000 | PSF | P.S. San Frankling Dept. of Market |
| w. | DETERMINATION | N | | TAL STRESS TACT AREA) | = 1000 P | SF × KA | ŝ |
| emine thinky at the passage them all the sit the passage at the sit the site of the passage at the site of the | | in and the state of the state o | KA = - | tam 2 (45- | \$/z) | Materia depulgation projety sporred, regularity catherina constitution for | no se moderno ence |
| 1 4 4 4 | # # # # # # # # # # # # # # # # # # # | B | | tan 2 (45 - | 37/2) | * 140 2 3 24 4 | |
| | to the second se | na provincia de la compansión de la comp | KA = | 0.25 | | i i i i i i i i i i i i i i i i i i i | erontera de la proposación de la procesa |
| | | | | AL STRESS ELOW SURFAC | | PSF (NA) | vFAC -167 |
| | | | | AL STRESS ELOW SURFACE | | 8 8 | tigat o familiar agraem and a made made from a |
| i ay i shiriya ka kayayi a sakidi da kaya ka | endicular security and the security and | | | HORIZONTAL S | | | |
| w | * · · · · · · · · · · · · · · · · · · · | * | FOR 1 | SECTION | | 350 lb | FT |
| es i | | | NEGLECT | HORIZONTAL | STRESS BEL | OW 12 IN | CHES |
| e consider an establish terrain signify ago resortationes, identifysionist | GEOGRID SEL | ECTION : | MIRA | FI BXG II | t | s Anthroposius anno en | zo rene so a osago, makapa nene |
| | 2 3 4 | | \$ | LE STRENGTH | = | 300 lb/ | FT |
| | 1 s S | : | (- | . STRAIN' EEP STRAIN LO | w To | A E | |
| | | ndo-transfer since the American several results and the State of S | AV | OID SEPARATI | ON | Hedda washinish magai sharabanahan u akirish sakan sakan sharaban A | Makada da ata da |
| | | 5.7 | Gal | EOCOMPOSITE & | LLDPE) | | |
| iga Channagagan mangatangan atau Yagan atau atau | e. A mentalizat perspensiva per grant and samme same section of section development of the section of the secti | T | OTAL HOP | 2120NML ST | RESS = 35 | 016/FT | e de majo e e e e e e e e e e e e e e e e e e e |
| | USE | 2 LAYERS | OF CFOCO | RID @ 6" & | 12" BELOW | CROUND S | URFAC |

TOTAL TENSILE STRENGTH = 600 16/FT >350

OK; F.S. = 1.7

Vector Engineering Inc.

DIRECT SHEAR REPORT

ASTM D-3080, Consolidated - Drained Test

Laboratory Services

Project No. : 071713.01 Lab Log:

2589AR

Sample:

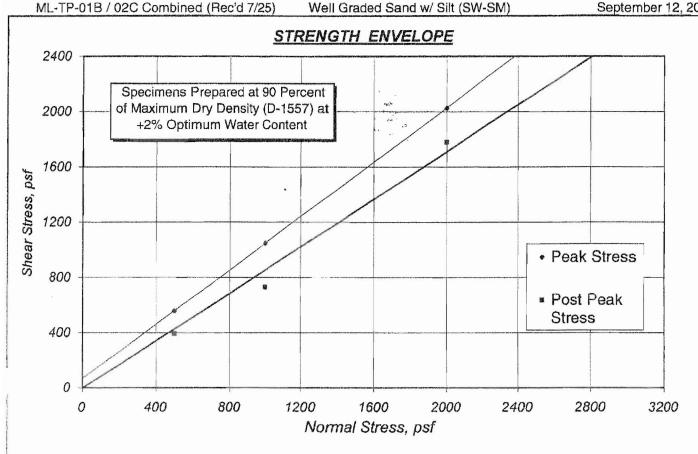
Client / Project Name:

ERRG / Meyers Landfill, # 28-072

Soil Description:

Well Graded Sand w/ Silt (SW-SM)

Report Date: September 12, 2008



| | in profession des tries accept to the first first accept and a section of the section and an electric condensations. | <u>Peak</u> | Post Peak |
|-------------------------|--|-------------|-----------|
| Coefficient of Friction | : | 0.978 | 0.842 |
| Friction Angle | • | 44.4 | 40.1 |
| Cohesion, psf: | | 70 | 0 |

Note: Intercept changed to "0" for post peak

| AND | Normal | Shear | Stress | l In | itial | Fii | nal |
|---|---------------|-------|-----------|-----------------------|-----------------------|-----------------------|-----------------------|
| Point No. | Stress psf | Peak | Post-Peak | Water Content % | Dry Density pcf | Water Content % | Dry Density pcf |
| 1 | 500 | 557 | 393 | 13.6 | 105.1 | 18.0 | 105.7 |
| 2 | 1000 | 1048 | 729 | 13.3 | 105.3 | 18.6 | 106.7 |
| 3 | 2000 | 2025 | 1780 | 13.9 | 104.5 | 17.8 | 106.6 |
| | | | | | | | |

Horizontal Displacement Rate, in. / min.:

0.017

Sample Diameter, in.:

2.50

The test results given here are based on a mathmatically determined best (It line. Further interpretation should be conducted by a qualified professional experienced in Geotechnical Engineering. By accepting the data and results presented on this page, Client agrees to limit the liability of Vector Engineering Inc. from Client and all other parties claims arrising out of the use of this data to the cost for the respective test(s) represented here, and Client agrees to indemnify and hold harmless Vector Engineering Inc. from and against all liability in excess of these limits.

L'Labexcel \ Projects \ 2007 \ 071713 \ 2589AR-SDS

Entered By:

Reviewed By:

Vector Engineering Inc.

LARGE SCALE DIRECT SHEAR REPORT

143E Spring Hill Drive, Grass Valley, CA 95945 (530) 272-2448

LABORATORY SERVICES

Test Method D-5321-B

October 21, 2008 Report Date: Client Name: ERRG Project Name: MEYERS LANDFILL, #28-072 Project No: 071713.01 Superstrate: Drain Gravel LSN: 2589A Material 1 ML-TP-01B & ML-TP-02C Mix (Well Graded Sand w/ Silt) Remolded Material 2 LSN: GSE PermaNet UL Geocomposite (Double sided 6 oz,) Roll# 131244854 APZ Clamped LSN: 2589A Substrate ML-TP-01B & ML-TP-02C Mix (Well Graded Sand w/ Silt) Remolded PEAK STRENGTH 3500 Test Normal Shear Secant Point Stress Stress Friction 3000 psi psf psf Angle 3.5 1. 500 500 45 2500 (bsd) 6.9 2. 1000 850 40 SHEAR STRESS (F 13.9 2000 1620 39 3. Adhesion: 110 psf 1000 Friction Angle: degrees Coefficient of 500 0.75 Friction: 500 1000 2500 3500 3000 NORMAL STRESS (psf) NOTE: GRAPH NOT TO SCALE STRENGTH ENVELOPE 3500 (at 3.0 in. displacement) Secant Test Normal Shear Point Stress Stress Friction 3000 psf Angle psi psf 3.5 490 44 1. 500 2500 (bst) 6.9 1000 850 2. 40 STRESS (2000 39 3. 13.9 1620 1500 Adhesion: 110 psf 1000 Friction Angle: degrees Coefficient of 500 0.75 Friction: 0 500 1000 1500 2000 2500 3000 3500 4000 NORMAL STRESS (psf) NOTE: GRAPH NOT TO SCALE

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L:Labexcel \ Projects \ 2007 \ 071713 \ 2589B-LSDS-rp

DCN: LSDS-rp (rev., 03/01/04)

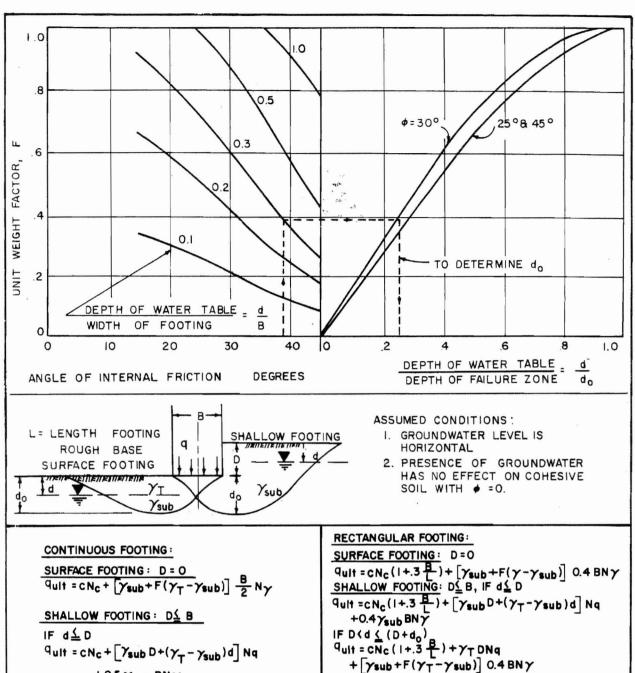
Entered By: JTB

Print Date:

10/27/08

Rev . By:

Lab Log:



+0.5 Ysub BNY

IF D (d (D+do)

quit = CNc+ YT DNq +

 $[\gamma_{\text{sub}} + F(\gamma_{\text{T}} - \gamma_{\text{sub}})] \frac{B}{2} N \gamma$

VALUES OF BEARING CAPACITY FACTORS No No AND Ny ARE SHOWN IN FIGURE I.

CIRCULAR FOOTING: RADIUS = R = B/2

SURFACE FOOTING: D = 0

quit =1.3CNc + [ysub+F(yT-ysub)] 0.6 RNy

SHALLOW FOOTING: D 2R, IF d 1 D

quit = 1.3 cNc+ [ysub D+(yT-ysub)d] Nq+0.6 ysub.

IF D(d (D+do)

Quit = 1.3 CNc+yT DNq+[ysub+F(yT-ysub] 0.6RNy

FIGURE 2

Ultimate Bearing Capacity With Groundwater Effect

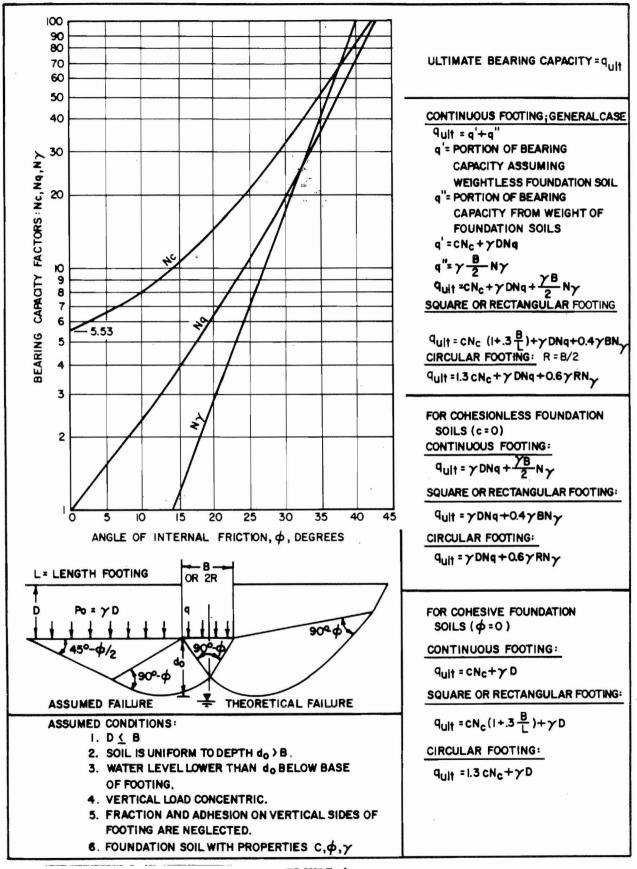
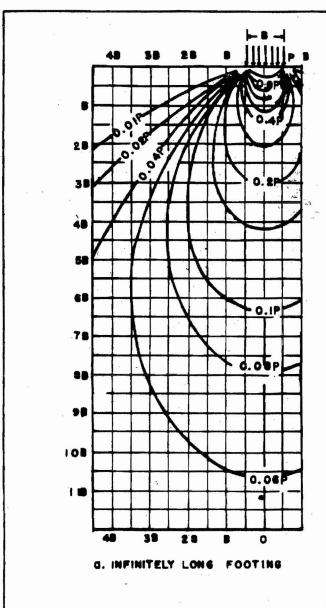
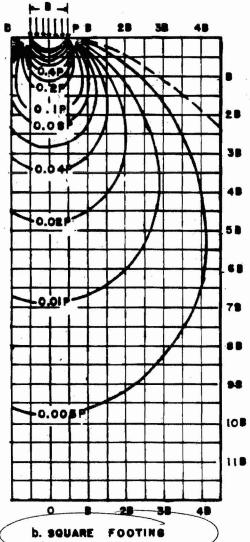


FIGURE 1
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads
7.2-131





B = 20 P = 2 TSF

| ₹ (FT) | <u>Z</u> | σ _E TSF | | | | |
|-----------|----------|-----------------------|---|------|--|--|
| 10 | 0.5 | 0.70 X 2 | = | 1.4 | | |
| 20 | 1 . | 0.38 X 2 | = | 0.76 | | |
| 30 | 1.5 | 0.19 X 2 | = | 0.38 | | |
| 40 | 2.0 | 0.12×2 | = | 0.24 | | |
| 50 | 2.5 | 0.07 X2 | = | 0.14 | | |
| 60 | 3.0 | 0.05 X 2 | = | 0.10 | | |

SQUARE FOOTING

GIVEN FOOTING SIZE = 20'X 20' UNIT PRESSURE P=2TSF

FIND PROFILE OF STRESS INCREASE BENEATH CENTER OF FOOTING DUE TO APPLIED LOAD

> FIGURE 3 Stress Contours and Their Application

> > 7.1-167

% TENCATE Mirafi





Mirafi[®] BXG 11

Mirafi® BXG 11 geogrid is composed of high molecular weight, high tenacity polyester multifilament yarns which are woven in tension and finished with a PVC coating. Mirafi® BXG 11 geogrid is inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

| Mechanical Properties | Test Method | Unit | Minimum Average Roll Value | | |
|---------------------------------|-------------|---------------------|-------------------------------|---------------|--|
| * | | | MD | CD | |
| Tensile Strength (at ultimate) | ASTM D 6637 | kN/m (lbs/ft) | 29.2 (2000) | 29.2 (2000) | |
| Tensile Strength (at 1% strain) | ASTM D 6637 | kN/m (lbs/ft) | 4.4 (300) | 4.4 (300) | |
| Tensile Strength (at 2% strain) | ASTM D 6637 | kN/m (lbs/ft) | 7.3 (500) | 7.3 (500) | |
| Tensile Strength (at 5% strain) | ASTM D 6637 | kN/m (lbs/ft) | 13.4 (920) | 13.4 (920) | |
| Tensile Modulus (at 1% strain) | ASTM D 6637 | kN/m (lbs/ft) | 437.8 (30000) | 437.8 (30000) | |
| UV Resistance (at 500 hours) | ASTM D 4355 | % strength retained | 70 | | |

| Physical Properties | Test Method | Unit | Typical Value |
|----------------------------------|--------------|-----------------------------------|---------------------|
| Percent Open Area | COE CW-02215 | % | 70 . |
| Grid Aperture Size (MD) | | mm (in) | 25.4 (1.0) |
| Grid Aperture Size (CMD) | ** | mm (in) | 25.4 (1.0) |
| Mass/Unit Area | ASTM D 5261 | g/m² (oz/yd²) | 308.5 (9.1) |
| Roll Dimensions (width x length) | **** | m (ft) | 4 (13.1) x 50 (164) |
| Roll Area | 4-1- | m ² (yd ²) | 200 (239) |
| Estimated Roll Weight | WA | kg (lbs) | 80 (176) |

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| Checked: D. Tang Date: 11/24/2008 | Settlement Analysis | 28-072 |

Scope/Objective:

The objective of this calculation is to determine the settlement in the refuse over the 30-year post closure period to evaluate if slope reverse will occur.

Assumptions:

The compression characteristics of the refuse are constant throughout the entire depth. Existing refuse has already undergone the both primary and secondary settlement.

1. Primary Settlement from Regrading of Refuse and Multilayer Cap Surcharge

Method:

From NAVFAC DM 7.3, Section 6, Special Problem Soil:

$$\Delta H = \ H \frac{C_c}{1 + e_0} log \bigg(\frac{\sigma'_0 + \Delta p'}{\sigma'_0} \bigg)$$

$$\frac{C_c}{1 + e_0} = 0.1 \text{ to } 0.4$$

Use 0.25 for settlement in the additional refuse (average value)

Use 0.10 for settlement in the existing refuse (low value, assumes that primary settlement has already occurred)

2. Secondary Settlement from Regrading of Refuse and Multilayer Cap Surcharge

Method:

From NAVFAC DM 7.3, Section 6, Special Problem Soil:

$$\Delta H = HC_{\infty} \log \left(\frac{t_2}{t_1}\right)$$

$$C_{\infty} = 0.02 \text{ to } 0.07$$

Use 0.04 for settlement in the additional refuse (average value)
Use 0.02 for settlement in the existing refuse (low value, assumes that secondary

settlement has already occurred)

 t_1 = time for pseudo-primary settlement to occur after completion of fill

 $t_1 = 1$ to 4 months (NAVFAC 7.3)

Use $t_1 = 4$ months

 $t_2 = 30$ years (post-closure period)

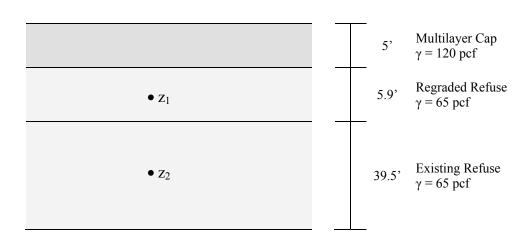
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Results:

| | Waste Thic | kness (ft) | Z | 1 | Z | ' -2 | ΔHp | ΔH _s | ΔH total |
|-------|------------|------------|-------------------|-----------------------|-------------------|-----------------------|-------|-----------------|----------|
| Point | Additional | Existing | σ'_0 (psf) | p' ₀ (psf) | σ'_0 (psf) | p' ₀ (psf) | (psf) | (psf) | (psf) |
| а | 0.0 | 32.4 | 0 | 600 | 1054 | 600 | 0.6 | 1.3 | 1.9 |
| b | 0.7 | 23.7 | 22 | 600 | 772 | 645 | 0.9 | 1.0 | 1.9 |
| С | 10.2 | 46.9 | 333 | 600 | 1523 | 1265 | 2.4 | 2.6 | 5.0 |
| d | 16.5 | 35.0 | 535 | 600 | 1136 | 1669 | 2.7 | 2.7 | 5.4 |
| е | 3.3 | 23.3 | 109 | 600 | 757 | 817 | 1.4 | 1.2 | 2.6 |
| f | 0.0 | 22.3 | 0 | 600 | 724 | 600 | 0.6 | 0.9 | 1.5 |
| g | 14.2 | 29.3 | 462 | 600 | 951 | 1525 | 2.5 | 2.3 | 4.8 |
| h | 10.8 | 40.8 | 350 | 600 | 1326 | 1299 | 2.4 | 2.4 | 4.8 |
| i | 5.9 | 39.5 | 190 | 600 | 1285 | 981 | 1.9 | 2.0 | 3.9 |

Sample Calculation for point i:

Given:



Calculation:

1. Primary Settlement

At point z_1 :

$$\sigma'_0 = \frac{5.9 \text{ ft}}{2} (65 \text{ pcf})$$

$$\sigma'_0 = 191.8 \text{ psf}$$

$$\Delta p' = (5 \text{ ft}) (120 \text{ pcf})$$

$$\Delta p' = 600 \text{ psf}$$

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At point z₂:

$$\sigma'_{0} = \frac{39.5 \text{ ft}}{2} (65 \text{ pcf})$$

$$\sigma'_{0} = 1283.8 \text{ psf}$$

$$\Delta p' = (5 \text{ ft})(120 \text{ pcf}) + (5.9 \text{ ft})(65 \text{ pcf})$$

$$\Delta p' = 983 \text{ psf}$$

Primary Settlement:

$$\begin{split} \Delta H_p &= (5.9 \text{ ft})(0.25) \log \left(\frac{192 \text{ psf} + 600 \text{ psf}}{192 \text{ psf}}\right) + \ (39.5 \text{ ft})(0.1) \log \left(\frac{1284 \text{ psf} + 983 \text{ psf}}{1284 \text{ psf}}\right) \\ \Delta H_p &= 0.9 \text{ feet} + 1.0 \text{ feet} \end{split}$$

$$\Delta H_p = 1.9 \text{ feet}$$

2. Secondary Settlement

$$\begin{split} \Delta H_s &= \ HC_{\propto} \log \left(\frac{t_2}{t_1}\right) \\ \Delta H_s &= (5.9 \ feet)(0.04) \log \left(\frac{30 \ years}{0.33 \ years}\right) + \ (39.5 \ feet)(0.02) \log \left(\frac{30 \ years}{0.33 \ years}\right) \\ \Delta H_s &= \ 1.5 \ feet + 0.5 \ feet \\ \Delta H_s &= \ 2.0 \ feet \end{split}$$

3. Total Settlement

$$\Delta H_T = H_p + H_s$$

$$\Delta H_T = 1.9 \text{ feet} + 2.0 \text{ feet}$$

$$\Delta H_T = 3.9 \text{ feet}$$

References:

1. NAVFAC DM 7.3, April 1983.

