STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 18
PRIVATE FUEL STORAGE, LLC - PRIVATE FUEL STORAGE FACILITY	

CALCULATION TITLE (Indicative of the Objective):	QA CATEGORY (✓)
DETERMINE THE THICKNESS OF STRUCTURAL FILL REQUIRED IN AREAS WHERE THE TRANSPORTER WILL TRAVEL CARRYING FULLY LOADED CASKS	☑ I - NUCLEAR SAFETY RELATED ☐ II ☐ III ☐ ______ OTHER

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.
05996.02	G(B)	18		

* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION *REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
PAUL J. TRUDEAU 4/1/99 Paul J. Trudeau	David L. Aloysius 4/2/99 David L. Aloysius	David L. Aloysius 4/2/99 David L. Aloysius	0			✓

DISTRIBUTION*

GROUP	NAME & LOCATION	COPY SENT (✓)	GROUP	NAME & LOCATION	COPY SENT (✓)
RECORDS MGT. FILES (OR FIRE FILE IF NONE)	JOB BOOK R4.2	ORIG			
	FIRE FILE - DEN	✓			
GEOTECH	PJTRUDEAU 245/2	✓			

9906290276 990622
PDR ADOCK 07200022
B PDR

TABLE OF CONTENTS

OBJECTIVE:

Determine the thickness of structural fill required to obtain an adequate factor of safety against a bearing capacity failure of the in situ silt, silty clay, clayey silt layer in areas where the fully loaded transporter must travel. Also estimate the settlement that will occur due to the resulting vertical stresses.

ASSUMPTIONS/DATA

Figure 1 presents the generalized soil profile. The critical portion of the soil profile from a bearing capacity perspective is the top layer, 0 ft to 30 ft, because the underlying soils are very dense, as indicated by SPT N-values > 100 blows/ft.

The groundwater table is greater than 100 ft below grade, based on the borings and the geophysical surveys (Geosphere (1997).

Bearing capacity failure mode for the top layer is a general shear failure.

To determine the effective width of the loaded area at the bottom of the structural fill, assume the loading due to the transporter is distributed at a slope of 2V:1H through the structural fill beneath the transporter crawler tracks, as shown in Figure 2.

The crawler tracks are 21" wide, as indicated on p E2 of Calculation 05996.01-G(B)-05, Rev 0.

FS = 3 is required for static loadings, as indicated in Calculation 05996.01-G(B)-05 Rev 0.

The soil properties for the top layer are presented in SWEC Calculations 05996.01-G(B)-01, Rev 3, -04, Rev 3, and -05, Rev 0, and are summarized as follows:

> Effective-stress strength parameters for drained analyses are estimated to be ϕ = 30° and c = 0, based on the plasticity index of this material.
>
> Total-stress strength parameters for undrained analyses (e.g., dynamic loadings) are estimated to be ϕ = 0° and c = 2.2 ksf, based on unconsolidated-undrained triaxial tests.
>
> Consolidation parameters:
>
> 6.20 ksf = σ_{mpp} = Maximum past pressure from consolidation tests - See p 4 Calculation 05996.01-G(B)-05, Rev 0

0.294 = CR, See p 4 Calculation 05996.01-G(B)-05, Rev 0

0.014 = RR, See p 4 Calculation 05996.01-G(B)-05, Rev 0

C_α = rate of secondary compression & is $f(\sigma_{vf}/\sigma_{mpp})$, as shown in Figure 3.

METHOD:

Bearing Capacity Calculation Methodology

This calculation uses the same method of calculating allowable bearing capacities of footings as is used in Calculation 05996.01-G(B)-04, Rev 3 (pp 9 & 10). The ultimate bearing capacity was calculated based on the general bearing capacity equation, as presented in Das, (1994), Eq 11.37:

$$q_{ult} = c\, N_c\, s_c\, d_c\, i_c + \gamma\, D_f\, N_q\, s_q\, d_q\, i_q + 1/2\, \gamma\, B\, N_\gamma\, s_\gamma\, d_\gamma\, i_\gamma$$

where:

$N_c = (N_q - 1)\ \cot(\phi)$ — Eq 11.33 Das (1994)

$N_q = e^{\pi \tan\phi}\ \tan^2(45 + \phi/2)$ — Eq 11.31 Das (1994)

$N_\gamma = 2\ (N_q + 1)\ \tan\phi$ — Eq 11.35 Das (1994)

$s_c = 1 + (B/L)(N_q/N_c)$ — Table 11.2 Das (1994)

$s_q = 1 + (B/L)\tan\phi$

$s_\gamma = 1 - 0.4\ (B/L)$

For $D_f/B \leq 1$: $d_c = d_q - (1-d_q) / (N_q \tan\phi)$

$d_q = 1 + 2\tan\phi\ (1 - \sin\phi)^2\ D_f/B$

$d_\gamma = 1$

For $D_f/B > 1$: $d_c = d_q - (1-d_q) / (N_q \tan\phi)$

$d_q = 1 + 2\tan\phi\ (1 - \sin\phi)^2\ \tan^{-1}(D_f/B)$

$d_\gamma = 1$

For $\phi = 0$: $d_c = 1 + 0.4\tan^{-1}(D_f/B)$

$d_\gamma = 1 + 0.4\ (D_f/B)$

$i_c = (1 - \beta/90)^2$

$i_q = i_c$

$i_\gamma = (1 - \beta/\phi)^2$

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 05996.02	DIVISION & GROUP G(B)	CALCULATION NO. 18	OPTIONAL TASK CODE	PAGE 5

The allowable bearing pressure is calculated as:

$$q_{all} = q_{ult} / FS$$

where FS = 3 for static loadings.

The actual bearing pressure at the top of the in situ silt, silty clay, clayey silt is calculated as:

$$q_{act} = \Delta\sigma_v = (q - \gamma_t D_f) \times I_{edge}$$

where: q = transporter loading,

γ_t = 125 pcf for the structural fill,

D_f = thickness of the structural fill,

$I_{edge} = 2 \times I_{corner}$

and I_{corner} = f(m & n) based on Fig 3.40 in Das (1995), copy included as Figure 4.

Settlement Calculation Methodology

This calculation uses the same method of calculating settlements as was used in Calculation 05996-G(B)-03, Rev 2 (pp 5 to 7). Stress distribution with depth was found using the Boussinesq equation (Figure 3.40 of Das, 1995, copy included as Figure 4).

Elastic settlement was found using the elastic modulus (E) for the given strain level and the change in vertical effective stress for each sublayer. A value of vertical strain was assumed for each sublayer. Using the G/G_{max} vs shear strain curve recommended by Geomatrix in Calculation 05996.01-G(PO5)-1, Rev 1 (p43/73 of Section 1.3, shown in Figure 5), a corresponding value of G/G_{max} was found. Because E is directly proportional to G, E/E_{max} was assumed to vary with respect to vertical strain as G varies with respect to shear strain. E for the assumed strain level was calculated as $E/E_{max} \bullet E_{max}$. Vertical strain was then calculated as $\Delta\sigma_v$ / E, and was compared to the assumed strain. Iterations were performed until the actual strain was approximately equal to the assumed strain.

Using the values of consolidation parameters presented above in **ASSUMPTIONS/DATA**, primary consolidation settlement was calculated as:

$$\Delta\rho_{primary} = [\Delta H \times 12 \text{ in./ft}] \times [RR \times \text{Log}(\sigma_{mpp} / \sigma_{vo}) + CR \times \text{Log}(\sigma_{vf} / \sigma_{mpp})]$$

Secondary compression was calculated as:

$$\Delta\rho_{secondary} = 12 \text{ in./ft} \times C_\alpha \times \text{Log}_{10}(\Delta t \text{ in min})$$

where:

C_α = rate of secondary compression & is $f(\sigma_{vf}/\sigma_{mpp})$, as shown in Figure 3.

Δt = elapsed time in minutes since end of loading.

DISCUSSION:

The next page details the calculation of the vertical stresses at the bottom of the transporter crawler track due to the weight of the transporter and the heaviest, fully loaded cask. This loading exceeds the allowable bearing pressure of the surface soils; therefore, structural fill will be used to distribute the loading from the transporter crawler tracks down to the underlying in situ soil.

Bearing capacity analyses were performed for various thicknesses of structural fill using both effective-stress and total-stress strength parameters. For these analyses, which are included in Table 1, the allowable bearing pressure was determined using a factor of safety of 3, which is applicable for static loadings. As shown in Table 1, the allowable bearing pressure is lower using the effective-stress strength parameters and the factor of safety against a bearing capacity failure is acceptable if 2 feet of structural fill is used to distribute the loading from the transporter crawler tracks down to the underlying in situ soil. Detailed calculations of the allowable bearing pressure for this case are presented on the next page.

Table 2 presents the calculation of estimated settlement of the transporter for this case. As indicated, the estimated settlement, which includes only the elastic and the primary consolidation settlement, is ~1 inch. Secondary compression will not occur as the transporter traverses the site; however, Table 2 includes calculation of the secondary compression for completeness.

Objective: Estimate vertical stresses at base of cask transporter track with heaviest cask.

Sources of Data: Calc 05996.01-G(B)-05 Rev 0

LOADS:

p C3	356.5 K	Holtec Cask Weight	Overpack w/fully loaded MPC-32
p C2	310 K	SNC Cask Weight	Storage Cask & Basket, Loaded, with Lids
p D17	135 K	Maximum Cask Transporter Weight	
	491.5 K	Total Weight of Transporter + Cask	

BEARING AREA:

p E2	18	Ground Shoes / Track
p E2	10 in.	Track Shoe Length

VERTICAL STRESSES AT BOTTOM OF CRAWLER TRACK:

q_{actual} = **9.36 KSF for 21 in. Track Shoe Width**

$$\frac{491.5\ \text{K} \times 144\ \text{in}^2/\text{ft}^2}{2\ \text{tracks} \times 18\ \text{shoes/track} \times 10\ \text{in.} \times 21\ \text{in./shoe}}$$

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 8
05996.02	G(B)	18		

ALLOWABLE BEARING CAPACITY

Track Width **21 in.**

Soil Properties:

$\phi =$	**30**	Total Stress Friction Angle (degrees)	
$c =$	**0**	Cohesion (psf)	
$\gamma =$	**80**	Unit weight of soil (pcf)	
$\gamma_{surch} =$	**125**	Unit weight of surcharge (pcf)	

Foundation Properties:

Eff B =	**3.75**	Footing Width (ft)	Eff L = **17.00** ft
$D_f =$	**2.00**	Depth of Footing (ft)	
$\beta =$	**0**	Angle of load inclination from vertical (degrees)	
FS =	**3**	Factor of Safety	

$$q_{ult} = c\,N_c\,s_c\,d_c\,i_c + \gamma\,D_f\,N_q\,s_q\,d_q\,i_q + 1/2\,\gamma\,B\,N_\gamma\,s_\gamma\,d_\gamma\,i_\gamma$$

General Bearing Capacity Equation

$N_c = (N_q - 1)\cot(\phi)$	=	30.14	Eq 11.33 Das (1994)
$N_q = e^{\pi \tan\phi}\tan^2(45 + \phi/2)$	=	18.40	Eq 11.31 Das (1994)
$N_\gamma = 2(N_q + 1)\tan\phi$	=	22.40	Eq 11.35 Das (1994)
$s_c = 1 + (B/L)(N_q/N_c)$	=	1.13	Table 11.2 Das (1994)
$s_q = 1 + (B/L)\tan\phi$	=	1.13	"
$s_\gamma = 1 - 0.4\,(B/L)$	=	0.91	"
$D_f/B =$		0.53	
For $D_f/B \le 1$: $d_c = d_q - (1-d_q)/(N_q\tan\phi)$	=	1.17	"
$d_q = 1 + 2\tan\phi\,(1-\sin\phi)^2\,D_f/B$	=	1.15	"
$d_\gamma = 1$	=	1.00	"
For $D_f/B > 1$: $d_c = d_q - (1-d_q)/(N_q\tan\phi)$	=	1.15	"
$d_q = 1+2\tan\phi\,(1-\sin\phi)^2\,\tan^{-1}(D_f/B)$	=	1.14	"
$d_\gamma = 1$	=	1.00	"
For $\phi = 0$: $d_c = 1 + 0.4\tan^{-1}(D_f/B)$	=	1.20	"
$d_\gamma = 1 + 0.4\,(D_f/B)$		1.21	"
			"
$i_c = (1 - \beta/90)^2$	=	1.00	"
$i_q = i_c$	=	1.00	"
$i_\gamma = (1 - \beta/\phi)^2$	=	1.00	"

			N_c term		N_q term		N_γ term
q_{ult} =	**9,048**	**psf =**	**0**	**+**	**5985**	**+**	**3064**

q_{allow} = 3,016 psf = q_{ult} / FS vs **q_{actual} = 2,409 psf**

[geot]j05996\calc\brng_cap\transp.xls on 4/1/99

CALCULATION IDENTIFICATION NUMBER				PAGE 9
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
05996.02	G(B)	18		

CONCLUSIONS:

Two feet of structural fill is required to obtain an adequate factor of safety against a bearing capacity failure of the in situ silt, silty clay, clayey silt layer in areas where the fully loaded transporter must travel . The estimated settlement that will occur due to the resulting vertical stresses at the bottom of the structural fill is ~1 inch.

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 10
05996.02	G(B)	18		

REFERENCES:

- Das, B., 1994, Principles of Geotechnical Engineering, PWS-Kent, Boston MA, pp 483 to 487.
- Das, B., 1995, Principles of Foundation Engineering, PWS-Kent, Boston MA.
- Geomatrix (1997), PFSF Calculation 05996.01-G(P05)-1, Rev 1, "Development of Soil and Foundation Parameters in Support of Dynamic Soil-structure Interaction Analyses," prepared by Geomatrix Consultants, Inc, San Francisco, CA, June 1997.
- Geosphere Midwest, PFSF Report No. 0599601-G(PO9)-1, Rev 0, "Seismic Survey of the Private Fuel Storage Facility — Skull Valley, Utah," prepared for Stone & Webster Engineering Corp by Geosphere Midwest, Midland, MI, February 1997.
- SWEC Calculation "Document Bases for Recommended Values of Dynamic Soil Properties and Coefficient of Subgrade Reaction," 05996.01-G(B)-01, Rev 3, Stone & Webster Engineering Corp, Boston, MA, July 1997.
- SWEC Calculation "Estimate Static Settlement of Storage Pads," 05996.01-G(B)-03, Rev 2, Stone & Webster Engineering Corp, Boston, MA, July 1997.
- SWEC Calculation "Stability Analyses of Storage Pads," 05996.01-G(B)-04, Rev 3, Stone & Webster Engineering Corp, Boston, MA, July 1997.
- SWEC Calculation "Document Bases for Geotechnical Parameters Provided in Geotechnical Design Criteria," 05996.01-G(B)-05, Rev 0, Stone & Webster Engineering Corp, Boston, MA, May 1997.

TABLE 1

CALCULATION OF ALLOWABLE BEARING PRESSURES BENEATH CENTER OF TRANSPORTER TRACK

q =	**9.36** ksf	γ_{fill} =	**125.00** pcf (Structural Fill)	Track Width	**21.00**	in.
B =	**1.75** ft	γ_t =	**80.00** pcf (Total unit weight of soil)	Length	**15.00**	ft
D_f =	**0.00** ft		GWT > 100 ft below grade			

LAYER	ΔH	z_{ftg}	~B_z	m	n	I_{corner}	Δq_{edge}	$\Delta\sigma_v$	q_{actual}	Effective Stress q_{allow}	Total Stress q_{allow}
	ft	ft	ft				ksf	ksf	ksf	ksf	ksf
1	0.00	0.00	1.75	10.000	»2 for strip	0.250	4.68	0.00	4.68	0.50	3.85
2	0.50	0.50	2.25	1.750	»2 for strip	0.236	4.42	0.02	4.44	1.08	4.24
3	0.50	1.00	2.75	0.875	»2 for strip	0.193	3.62	0.05	3.66	1.70	4.48
4	0.50	1.50	3.25	0.583	»2 for strip	0.153	2.87	0.07	2.94	2.35	4.65
5	***0.50***	***2.00***	***3.75***	***0.438***	***»2 for strip***	***0.124***	***2.32***	***0.09***	***2.41***	***3.02***	***4.78***
6	0.50	2.50	4.25	0.350	»2 for strip	0.103	1.92	0.11	2.04	3.70	4.89
7	0.50	3.00	4.75	0.292	»2 for strip	0.087	1.63	0.14	1.77	4.40	4.98
8	0.50	3.50	5.25	0.250	»2 for strip	0.075	1.41	0.16	1.57	5.11	5.06
9	0.50	4.00	5.75	0.219	1.88	0.066	1.24	0.18	1.42	5.84	5.13
10	0.50	4.50	6.25	0.194	1.67	0.059	1.10	0.20	1.30	6.57	5.19
11	0.50	5.00	6.75	0.175	1.50	0.052	0.98	0.23	1.21	7.30	5.25

Where:

z_{ftg} = thickness of structural fill

B_z = Effective width of loaded area at top of layer assuming 2V:1H distribution with depth.

I_{corner} = f(m & n) based on Fig 3.40 in Das(1995), where: $m=b/z_{ftg}$, b=B/2, and n = l/z, where l=L/2 (Copy included as Figure 4).

$\Delta q_{edge} = q \times I_{edge}$, where $I_{edge} = 2 \times I_{corner}$

$\Delta\sigma_v = (\gamma_{fill} - \gamma_t) * z_{ftg}$ $\qquad q_{actual} = q_{edge} + \Delta\sigma_v$

Shaded area indicates FS is too low (Layers 1 to 4).

Dashed line indicates the depth to the bottom of the storage pad (Layer 7).

Note: $q_{allow} > q_{actual}$ at z_{ftg} = 2 ft; therefore, use 2 ft of structural fill.

TABLE 2 (SHEET 1 OF 2)
ESTIMATED SETTLEMENTS BENEATH CENTER OF TRANSPORTER TRACK

q =	2.41 ksf	γ_t =	80.00 pcf	GWT > 100 ft below grade	**21.00 in.**
B =	3.75 ft	L =	17.00	$\rho_{immediate}$ =	**1.03 in.**
D_f =	2.00 ft	E_{max} =	3780 ksf (From Table 1 of Calc 05996.01-G(B)-01, Rev 3)		

STRESSES BENEATH FOOTING:

LAYER	ΔH	z_{grade}	σ_{vo}	z_{ftg}	m	n	I_{corner}	I_{center}	$\Delta\sigma_v$	σ_{vf}
	ft	ft	ksf	ft					ksf	ksf
1A	1.88	2.94	0.24	0.94	2.00	»2 for strip	0.240	0.96	2.16	2.39
1B	1.88	4.81	0.39	2.81	0.67	»2 for strip	0.166	0.67	1.50	1.88
1C	3.75	7.63	0.61	5.63	0.33	1.51	0.095	0.38	0.85	1.46
1D	7.50	13.25	1.06	11.25	0.17	0.76	0.041	0.17	0.37	1.43

Note: $\sigma_{vo} = z_{grade} \times \gamma_t$ $\quad \Delta\sigma_v = (q - \gamma_t D_f) \times I_{center}$ $\quad I_{center} = 4 \times I_{corner}$ $\quad \sigma_{vf} = \sigma_{vo} + \Delta\sigma_v$

I_{corner} = f(m & n) based on Fig 3.40 in Das(1995), where: $m=b/z_{ftg}$, b=B/2, n = l/z, where l=L/2.

ELASTIC SETTLEMENTS:

$\Delta\rho_{elastic} = \Delta H \times 12$ in./ft $\times\ \varepsilon_{actual}$

LAYER	ΔH	$\Delta\sigma_v$	$\varepsilon_{assumed}$	E / E_{max}	E	ε_{actual}	$\Delta\rho_{elastic}$
	ft	ksf	%		ksf	%	inches
1A	1.88	2.16	0.20	0.29	1106	0.20	0.04
1B	1.88	1.50	0.08	0.48	1828	0.08	0.02
1C	3.75	0.85	0.033	0.68	2586	0.033	0.015
1D	7.50	0.37	0.012	0.84	3161	0.012	0.011
						Total =	**0.09** inches

Note: $\varepsilon_{actual} = \Delta\sigma_v / E$

Assume: E / E_{max} From Figure 5 (Based on G/G_{max} from Geomatrix Calc 05996.01-G(P05)-1, Rev 1, p43/73 of Section 1.3)

NOTE: E is directly related to G; i.e., E = 2 x (1+μ) G

PRIMARY CONSOLIDATION SETTLEMENTS:

$\Delta\rho_{primary} = \Delta H \times 12$ in./ft $\times$ RR $\times \text{Log}(\sigma_{vf}/\sigma_{vo})$

LAYER	ΔH	σ_{vo}	σ_{vf}	$\Delta\rho_{primary}$
	ft	ksf	ksf	inches
1A	1.88	0.24	2.39	0.32
1B	1.88	0.39	1.88	0.22
1C	3.75	0.61	1.46	0.24
1D	7.50	1.06	1.43	0.16
			Total =	**0.94** inches

Note: 6.20 ksf =Maximum past pressure from consolidation tests - See p 4 Calc 05996.01-G(B)-05, Rev 0

0.014 = RR, See p 4 Calc 05996.01-G(B)-05, Rev 0

[geot]\j05996\calc\settle\transp.xls on 4/1/99

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

5010.65

CALCULATION IDENTIFICATION NUMBER

J.O. OR W.O. NO. 05996.02

DIVISION & GROUP G(B)

CALCULATION NO. 18

OPTIONAL TASK CODE

TABLE 2 (SHEET 2 OF 2)
ESTIMATED SETTLEMENTS BENEATH CENTER OF TRANSPORTER TRACK

$q =$ **2.41** ksf $\gamma_t =$ **80.00** pcf GWT > 100 ft below grade **21.00 in.**

$B =$ **3.75** ft $L =$ **17.00** $\rho_{immediate} =$ **1.03 in.**

$D_f =$ **2.00** ft $E_{max} =$ **3780** ksf (From Table 1 of Calc 05996.01-G(B)-01, Rev 3)

SECONDARY SETTLEMENTS:

Δ Secondary Settlement $= 12$ in./ft x C_α x $Log_{10}(\Delta t \text{ in min})$

LAYER	ΔH	σ_{vf}	σ_{vf}/σ_{mpp}	C_α	4.64	7.02	7.32
	ft	ksf		%/Log Cycle Time (min)	Log Cycles in 1 month inches	Log Cycles in 20 Yrs inches	Log Cycles in 40 Yrs inches
1A	1.88	2.39	0.39	0.039	0.04	0.06	0.06
1B	1.88	1.88	0.30	0.030	0.03	0.05	0.05
1C	3.75	1.46	0.24	0.027	0.06	0.09	0.09
1D	7.50	1.43	0.23	0.027	0.11	0.17	0.18
				Total =	**0.24**	**0.37**	**0.38**

7.32 $= Log_{10}$(40 yrs x 525,960 min/yr)

Totals in inches.

Note: C_α = rate of secondary compression & is $f(\sigma_{vf}/\sigma_{mpp})$ - From Figure 3.

525,960 min = 1 yr = 365.25 days x 24 hr/day x 60 min/hr

43,830 min/month = 525,960 min/yr / 12 months/yr

SUMMARY OF SETTLEMENTS:

LAYER	ΔH	z_{grade}	z_{ftg}	$\Delta\rho_{elastic}$	$\Delta\rho_{primary}$	Δ Secondary Settlement: 1 month	20 yrs	40 yrs
	ft	ft	ft	inches	inches	inches	inches	inches
1A	1.88	2.94	0.94	0.04	0.32	0.04	0.06	0.06
1B	1.88	4.81	2.81	0.02	0.22	0.03	0.05	0.05
1C	3.75	7.63	5.63	0.01	0.24	0.06	0.09	0.09
1D	7.50	13.25	11.25	0.01	0.16	0.11	0.17	0.18
			Total =	**0.09**	**0.94**	0.24	0.37	0.38

Totals in inches.

Total = **1.03 inches of immediate settlement**
1.27 inches after 1 month
1.39 inches after 20 years
1.41 inches after 40 years

[geot]\j05996\calc\settle\transp.xls on 4/1/99

STONE & WEBSTER ENGINEERING CORPORATION
CALCULATION SHEET
CALCULATION IDENTIFICATION NUMBER
J.O. OR W.O. NO. 05996.02
DIVISION & GROUP G(B)
CALCULATION NO. 18
OPTIONAL TASK CODE

5010.65

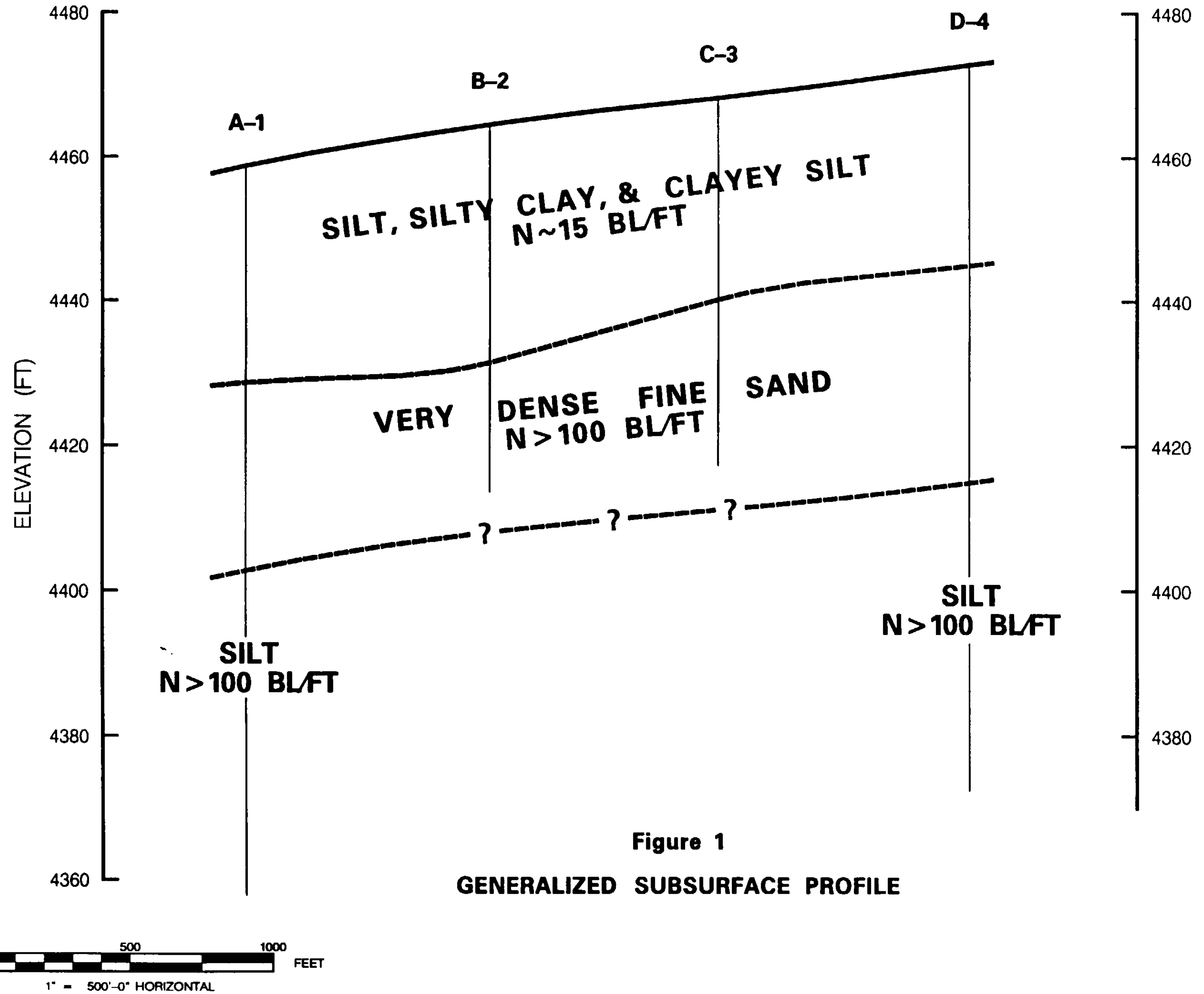


Figure 1

GENERALIZED SUBSURFACE PROFILE

STONE & WEBSTER ENGINEERING CORPORATION

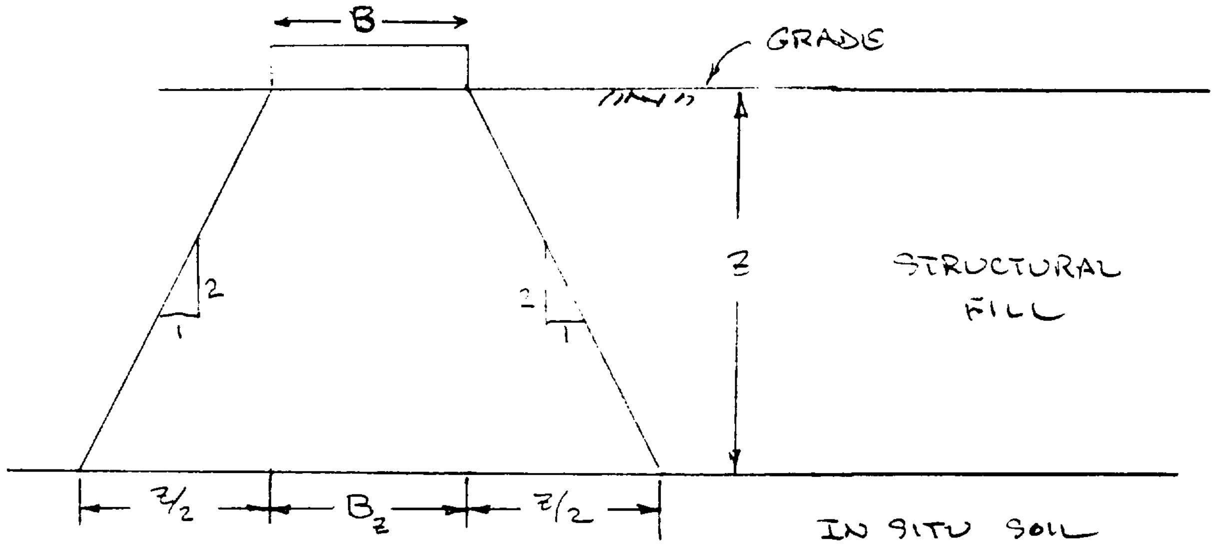
CALCULATION SHEET

▲ 5010 65

CALCULATION IDENTIFICATION NUMBER				PAGE 15
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
05996.02	G(B)	18		

TRANSPORTER

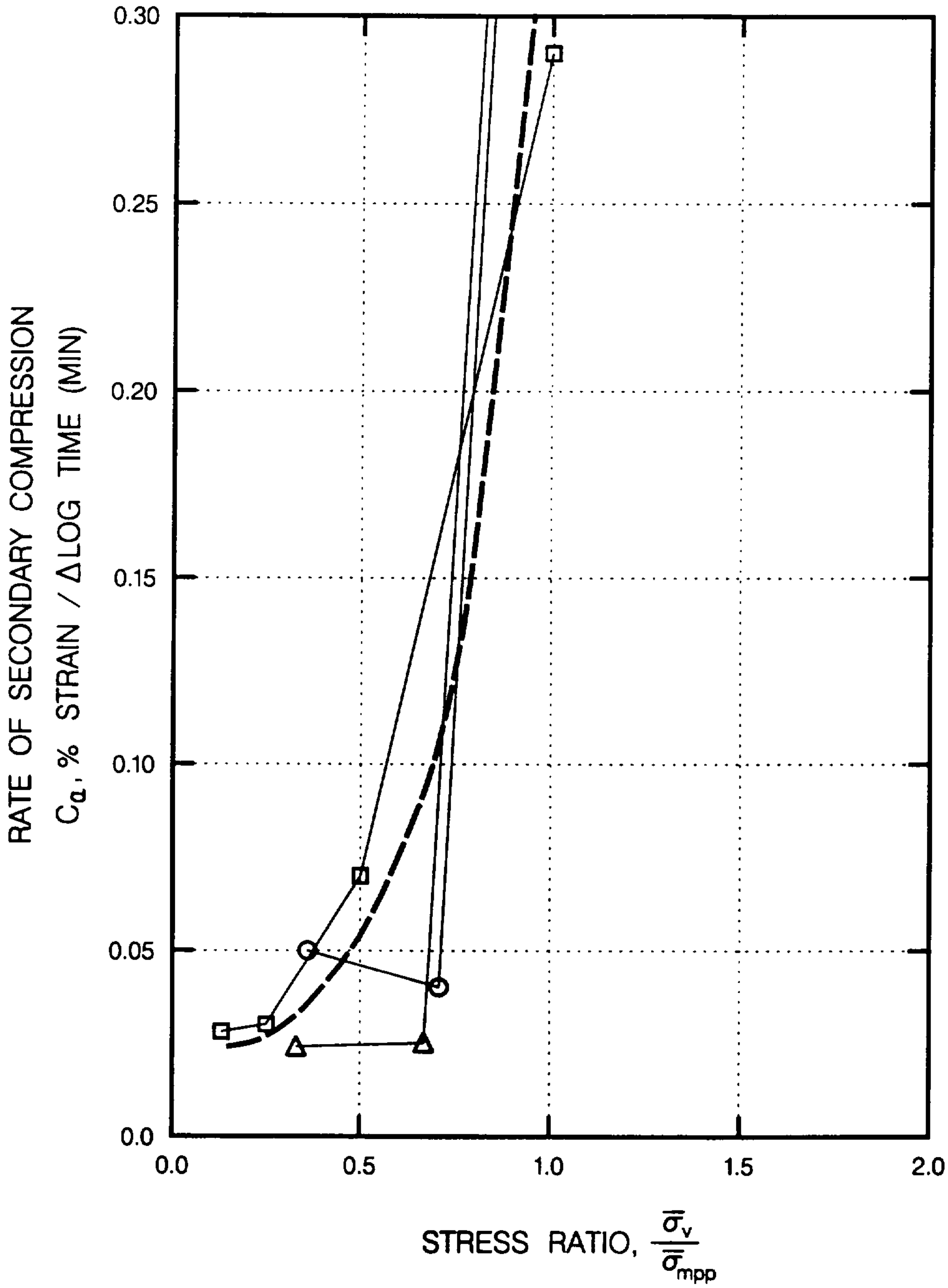
FIGURE 2
DISTRIBUTION OF LOADING FROM TRANSPORTER
THROUGH THE STRUCTURAL FILL



AT DEPTH Z, EFFECTIVE WIDTH $= B_Z = B + 2 \times \frac{Z}{2} = B + Z$

B = WIDTH OF CRAWLER TRACK

Z = THICKNESS OF STRUCTURAL FILL



KEY

SYMBOL	TEST ID
	C1–U3C
	C1–U3D
	C2–U2C

Figure 3

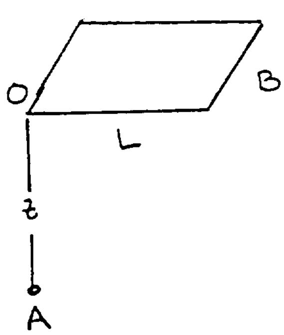
RATE OF SECONDARY COMPRESSION VS STRESS RATIO

BASED ON RELOADING PORTIONS OF CONSOLIDATION TESTS – SEE CALC 05996.01–G(B)–05–0.

CALCULATION IDENTIFICATION NUMBER				PAGE 17
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
05996.02	G(B)	18		

FIGURE 4

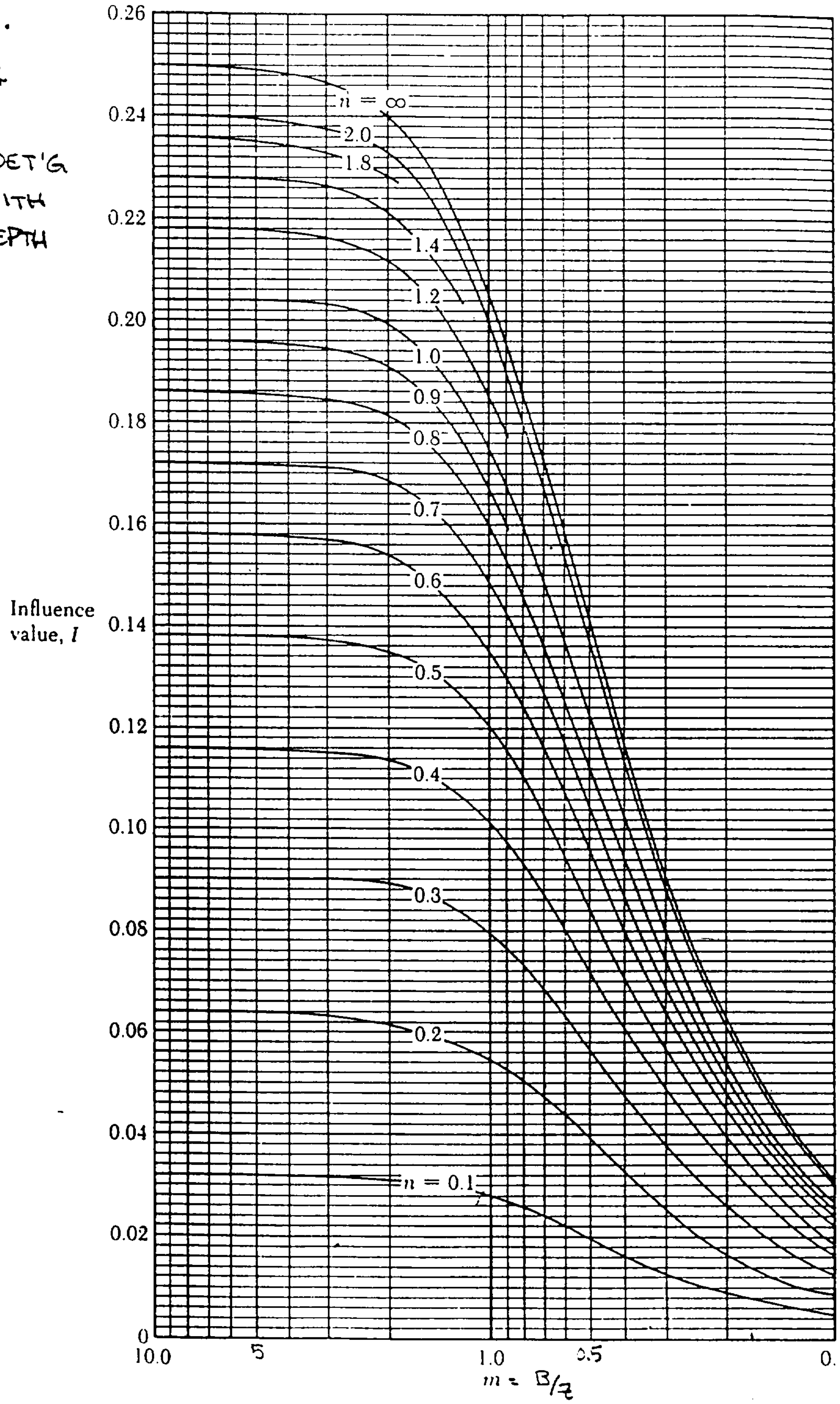
INFLUENCE VALUE FOR DET'G STRESSES WITH RESPECT TO DEPTH



$\Delta p_A = q_o I$

$m = B/z$

$n = L/z$



DAS (1995) ▼ **FIGURE 3.40** Variation of I with m and n—Eqs. (3.103) and (3.104)

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 18
05996.02	G(B)	18		

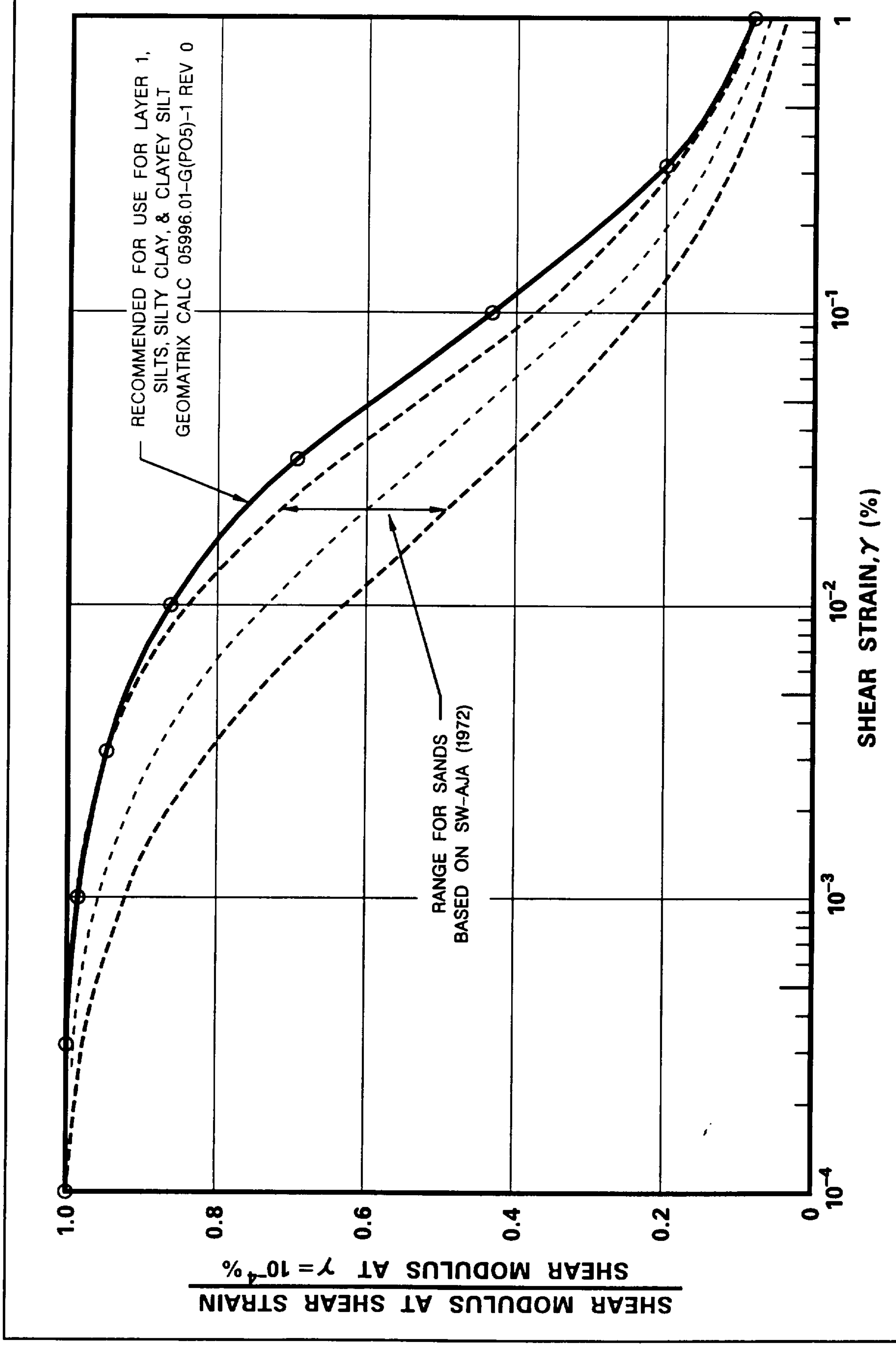


Figure 5

VARIATION OF SHEAR MODULUS WITH SHEAR STRAIN

QA CATEGORY I
CALCULATION CHECKLIST

Calculation No. 0599602-G(B)-18
Revision No. 0

Project No. 0599602
Job Book File Location Q2.9

	Yes	No	N/A
Method			
Identify the method used to verify the "Method" of the calculation			
• By design review	✓		
• Compare the Method with another calculation			✓
• Alternate calculation			✓
If the compare method was used, is the statement identifying the other calculation identified in this calculation?			✓
If an alternate calculation was used for a QA Category I calculation, is it included with the calculation?			✓
Is the calculation method acceptable?	✓		
Assumptions			
Affirmative answers to the following questions are required:			
• Are all assumptions uniquely identified as assumptions and adequately described?	✓		
• Are all assumptions reasonable?	✓		
• Are all assumptions that require confirmation at a later date specifically identified as assumptions that must be confirmed?			✓
For Revisions to the Calculation			
• Are changes clearly identified?			
• For QA Category I calculations, is a reason for the revision given?			
• Does the calculation identify the calculation, including revision, when applicable, which is superseded?			

CALC 05996.02-G(B)-18 REV 0

	Yes	No	N/A
• Are affected pages identified with the new calculation number or revision number?	___	___	___
• When applicable, is an alternate calculation included as part of the calculation?	___	___	___
• When applicable, is a statement identifying the calculation to which the method was compared included as part of the revision?	___	___	___

David L. Aloysius
Printed Name

[signature]
Signature

4-02-99
Date