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August 1, 2007

Mr. Patrick Plews, P.E.
Structural Engineer
TranSystems Corporation
720 East Pete Rose Way, Suite 360
Cincinnati, Ohio 45205

B-13
SCI-823-1357 L/R

Re: Structure: Mainline SR 823 over Morris Lane-Blue Run Road
Spread Footing Details - Revised
DLZ Job No.: 0121-3070.03 Portsmouth Bypass

Dear Mr. Plews:

This document presents the findings of additional evaluations performed for the proposed structure location cited above. This document is an addendum to the Report of Subsurface Exploration for SR 823 Bridge over Morris Lane-Blue Run Road (CR 54), dated May 17, 2007. Furthermore, this document presents the revised findings of spread footing evaluations and supercedes the document previously submitted on July 13, 2007. Revisions to the dead load, supported by the spread footings have been made based on information provided by TranSystems Corporation.

It is our understanding that spread footings are now being considered to support the abutments of the proposed structure. As such, the stability of the spill through slopes has been re-evaluated. The new stability analyses incorporated the preliminary footing loads and higher factor of safety requirement for global stability. Additionally, calculations have been performed to estimate the anticipated amount of settlement at the abutments due to the embankment loads and the spread footing loads. It is assumed that the proposed piers will be founded on rock or deep foundations. Consequently, no settlement is anticipated at the pier locations.

At the abutment locations, the spread footings may be designed based upon an allowable bearing capacity of 3.5 ksf if the embankments are constructed in accordance with ODOT specifications and reflect the material properties assumed. See attached calculations based upon FHWA and AASHTO guidelines.

The results of the global stability analyses including spread footing loads indicate that the spill through slopes for the rear and forward abutments may be constructed using 2H:1V or flatter slopes.

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Calculations indicate that the total primary consolidation of the foundation soils at the forward abutment, due only to the embankment loading, will be approximately 2.6 inches. No appreciable settlement of the existing foundation soil is anticipated at the rear abutment, due to the presence of hard foundation soils and the shallow depth (6.0 to 6.5 feet) to bedrock. From the influence of the spread footing loads, it is anticipated that approximately 2.4 inches of elastic settlement will occur in the embankment fill at both the rear and forward abutments. Additionally, approximately 0.7 inches of consolidation is anticipated in the existing foundation soils at the forward abutment due to the spread footing loads.

To prevent excessive differential settlement, calculations indicate that at least 60 percent of the total primary consolidation (U=60%) should be achieved prior to constructing the spread footings at the forward abutment. Time-rate of settlement calculations indicate that a waiting period (after embankment construction and prior to constructing spread footings) of approximately 50 days will be necessary to achieve this degree of consolidation. It is expected that a significant portion of the consolidation will occur during construction. However, because the construction schedule is not known, the amount of consolidation that will occur during construction cannot be estimated at this time. The ODOT construction representative may adjust the required waiting period based upon readings from settlement platforms.

As per Type Study Review comments, dated June 26, 2007, it is understood that a surcharge load may be considered to expedite the settlement process. The details of the surcharge loads and associated items should be provided by representatives of ODOT.

It is recommended that settlement be monitored using settlement platforms. A drawing illustrating the recommended placement of the settlement platforms is included as an attachment to this document. It should, however, be noted that the final field location of the settlement platforms and recommended surcharge periods should be provided by representatives of ODOT.

Please do not hesitate to call if you need any additional information.

Sincerely,

DLZ OHIO, INC.

Steven J. Riedy
Geotechnical Engineer

Dorothy A. Adams

Dorothy A. Adams, P.E.
Senior Geotechnical Engineer

Encl: Stability and Settlement Analyses and Calculations, Settlement Platform Illustration

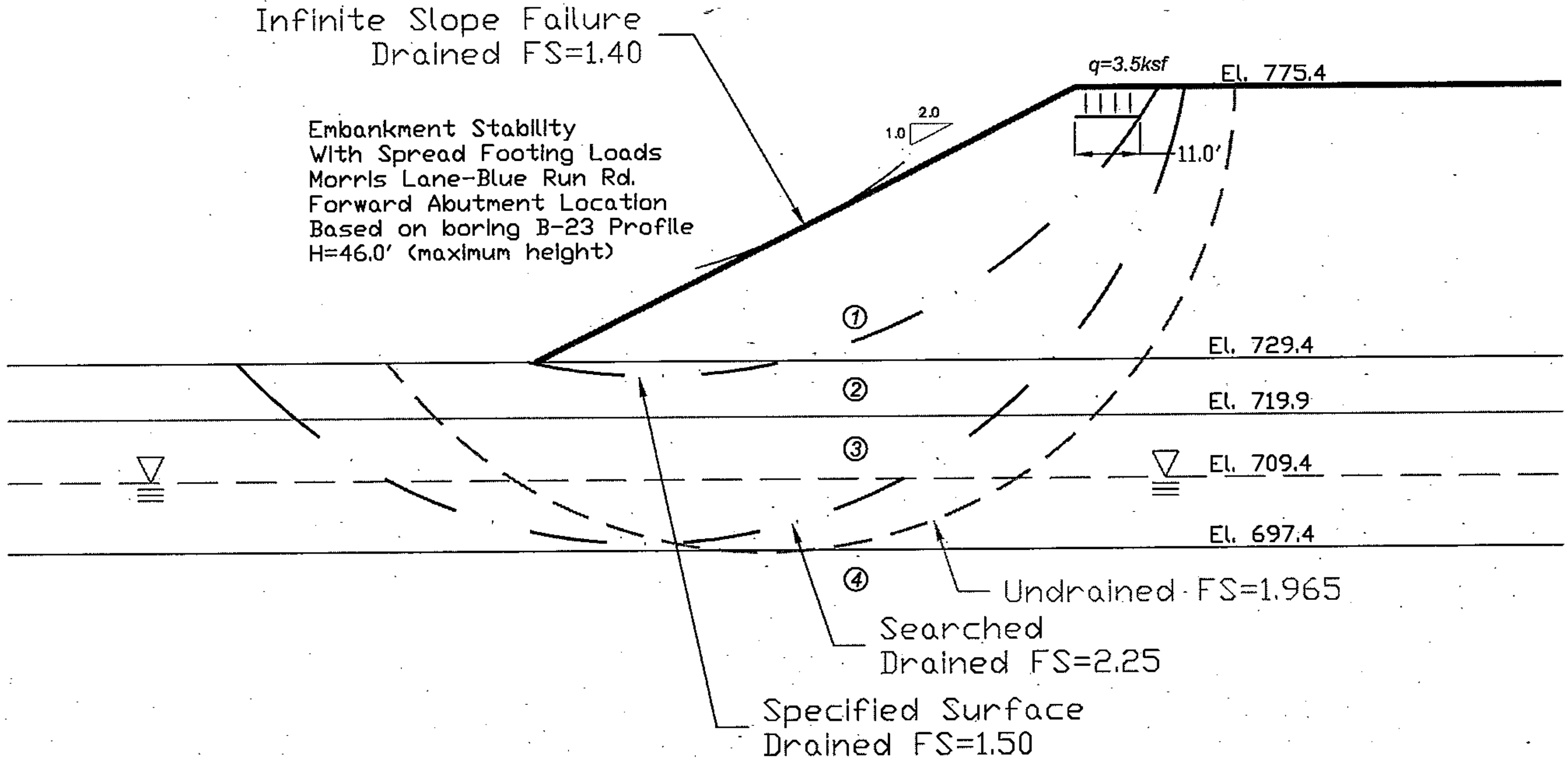
cc: file

sjr:sjr

M:\proj\0121\3070.03\Structures\Morris Ln CR54\Final\Morris Lane Spread Footing Letter 7-31-07 sjr.doc

			Undrained		Drained		
Material	Consistency	Soil Type	c (psf)	φ (deg)	c' (psf)	φ' (deg)	γ (pcf)
Material 1	Compacted	Emb. Fill	0	35	0	35	120
Material 2	Hard/Dense	Sandy Silt	4500	0	0	32	120
Material 3	Stiff	Sandy Silt	1750	0	0	30	120
Material 4		Bedrock	10000	45	10000	45	145

Embankment Stability
With Spread Footing Loads
Morris Lane-Blue Run Rd.
Forward Abutment Location
Based on boring B-23 Profile
H=46.0' (maximum height)



Sheet 1 of 14 SJK/DAA

MORRIS LANE BLUE RUN ROAD
Global Stability Analyses
Including Spread Footing Loads

Spill Through Slope Analyses

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 07/09/07

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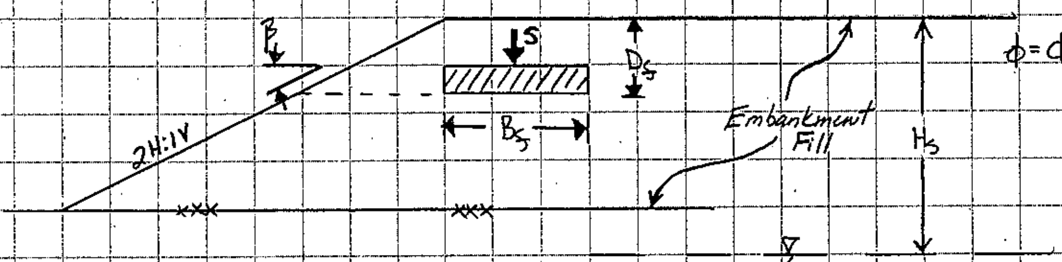
CLIENT TranSystems Corp. / ODOT D-9 PROJECT NO. 0121-3070.03
PROJECT SCI-823 Portsmouth Bypass SHEET NO. 2 OF 14
SUBJECT Bearing Capacity of Spread Ftng. COMP. BY SJK DATE 7-2-07
SR 823 over Morris Lane-Blue Run Road CHECKED BY DAA DATE 7/12/07

* Spread Footings at abutment locations

* From TranSystems ; $B_f = 11'$
* Assume $D = 5'$
* From TranSystems ; DL = 26.1 K/ft
LL = 4.53 K/ft



Preliminary Structural Loading:

* Assuming Continuous Footings $C = 0$, $\phi = 30°$, $\beta = \tan^{-1}(\frac{1}{2}) = 26.6°$

$$q_{ULT} = \cancel{c}^{\,0}(N_{cq}) + \frac{1}{2}\cdot\gamma(B_f)(N_{\gamma q})$$ [FHWA-IF-02-054]

$N_{\gamma q}$ taken from graph [FHWA-IF-02-054, Fig 5-7 (f)]
for cohesionless soils (c=0).
1.) Interpolate between $\beta = 0°$ and $\beta = 30°$ for solution to $\beta = 26.6°$
2.) Also, interpolate between $D_f/B_f = 0$ and $D_f/B_f = 1$ for solution to $D_f/B_f = 0$

$D_f = 5'$ $b = 0$ $B_f = 11'$ $\phi = \phi' = 30°$ $\beta = 26.6°$ $D_f/B_f = 5/11 = 0.45$

For $\beta = 0°$

$D_f/B_f = 0 \longrightarrow$ * $N_{\gamma q} = 15$ * Taken from graph
$D_f/B_f = 1 \longrightarrow$ * $N_{\gamma q} = 54$

• For $\beta = 0$ & $D_f/B_f = 0.45$

$N_{\gamma q} = 32.6$

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CLIENT TranSystems Corp / ODOT D-9
PROJECT SCI-823 Portsmouth Bypass
SUBJECT Bearing Capacity of spread ftng. SR 823 over Morris Lane - Blue Run Rd.

PROJECT NO. 0121-3070.03

COMP. BY SJK DATE 7-2-07
CHECKED BY DAA DATE 7-12-07

Bearing Capacity (cont)

For $\beta = 30°$

$D_f/B_f = 0 \rightarrow {}^*N_{\gamma q} = 2$

$D_f/B_f = 1 \rightarrow {}^*N_{\gamma q} = 24$

*Taken from graph

• For $\beta = 30°$ & $D_f/B_f = 0.45$

$N_{\gamma q} = 11.9$

For $\beta = 26.6°$

Interpolate to find solution for $\beta = 26.6°$

$$N_{\gamma q} = 11.9 + \left[\frac{(32.6 - 11.9)}{30°}\right](30 - 26.6) = 14.2$$

$$\boxed{\text{Use } N_{\gamma q} = 14}$$

$$q_{ULT} = \cancel{c N_{cq}} + \tfrac{1}{2}\gamma B_f N_{\gamma q} \qquad [\text{FHWA-IF-02-054}]$$

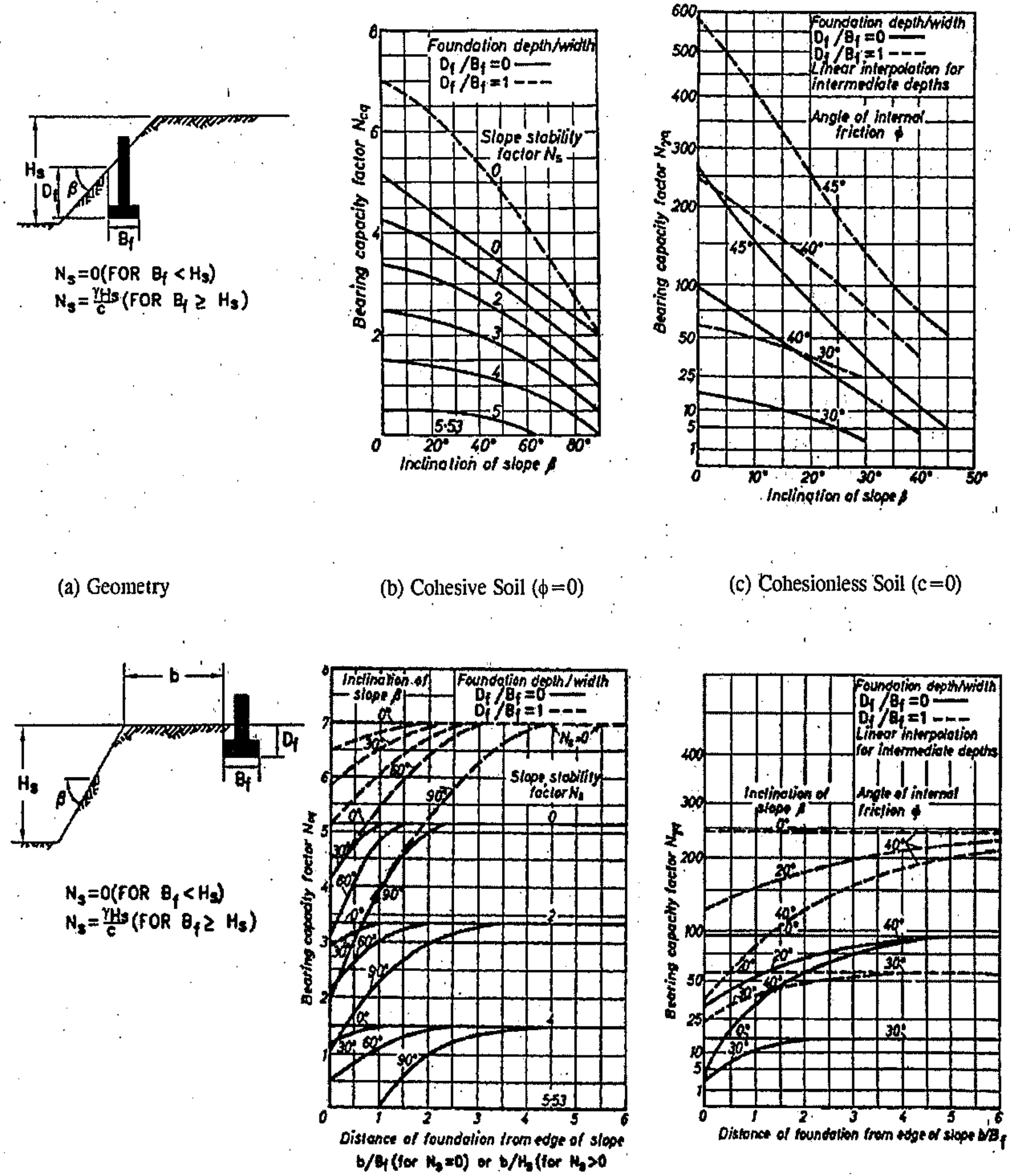
$$q_{ULT} = \tfrac{1}{2}(120\,\text{pcf})(11')(14) = 9{,}240 \text{ psf}$$

$$q_{allow} = \frac{q_{ULT}}{F.S.} = \frac{9{,}240 \text{ psf}}{2.5} = 3{,}696 \text{ psf}$$

$$\boxed{\text{Use } q_a = 3.5 \text{ ksf}}$$

Ref: FHWA-IF-02-054

Also: AASHTO Fig. 4.4.7.1.1.4B



(a) Geometry (b) Cohesive Soil (φ=0) (c) Cohesionless Soil (c=0)

(d) Geometry (e) Cohesive Soil (φ=0) (f) Cohesionless Soil (c=0)

Figure 5-7: Modified Bearing Capacity Factors for Footing on Sloping Ground, (after Meyerhof, 1957, from AASHTO, 1996)

* Immediate Settlement of embankment fill material

Assume well-compacted embankment fill ⟶ Approx 1% settlement

↳ will occur prior to construction of abutments *NOT FROM FOOTING LOAD*

- Rear Abutment: Max Height = 72.0' embankment

  Settlement of fill ≃ $(0.01)(72.0')(12''/ft.) = 8.6''$

- Forward Abutment: Max Height = 46.0' embankment

  Settlement of fill ≃ $(0.01)(46.0')(12''/ft.) = 5.5''$

Consolidation of foundation soils from footing loads (Dead Load Only)

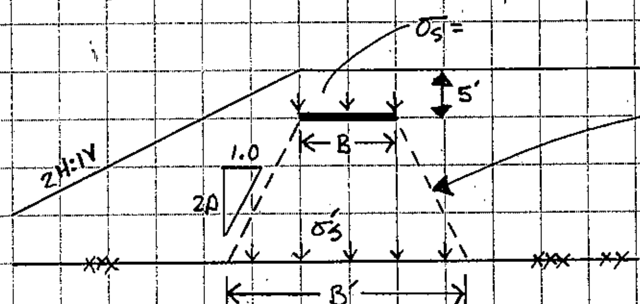
* Change in verticle stress due to spread footing load

Assume $q_a = 3.5$ ksf $B = 11'$

Average applied pressure from footing, σ_s:

$DL = 26.1$ k/ft

$\sigma_s = (26.1\ \text{k/ft}) / 11' = 2.37$ ksf



Approximat Stress Distribution

- $B' = B + 2(H-5)(\frac{1}{2})$
- $\sigma_s' = \frac{q \cdot B}{B'}$

- Rear Abutment: Proposed embankment founded on bedrock.

  ∴ Not necessary to compute

- Forward Abutment:

  H = 46.0' embankment $B' = B + 2(H-5)\frac{1}{2} = 11' + 2(46-5)\frac{1}{2} = 52'$

  $\sigma_s' = \frac{2.37\ \text{ksf}\ (11')}{52'} = 0.50$ ksf $= 500$ psf * From footing DL on Existing Ground Surface

AASHTO Std. Spec. for Highway Bridges 17th Ed., 2002
Sheet 5 of 14

TABLE 4.4.7.2.2A Elastic Constants of Various Soils
Modified after U.S. Department of the Navy (1982) and Bowles (1982)

Typical Range of Values			Estimating E_s From N[1]	
Soil Type	Young's Modulus, E_s (ksf)	Poisson's Ratio, ν (dim)	Soil Type	E_s (ksf)
Clay:				
Soft sensitive	50-300	0.4-0.5 (undrained)	Silts, sandy silts, slightly cohesive mixtures	$8N_1$[2]
Medium stiff to stiff	300-1,000		Clean fine to medium sands and slightly silty sands	$14N_1$
Very stiff	1,000-2,000		Coarse sands and sands with little gravel	$20N_1$
Loess	300-1,200	0.1-0.3	Sandy gravel and gravels	$24N_1$
Silt	40-400	0.3-0.35		
Fine sand:			**Estimating E_s From s_u[3]**	
Loose	160-240			
Medium dense	240-400	0.25	Soft sensitive clay	$400s_u$-$1{,}000s_u$
Dense	400-600		Medium stiff to stiff clay	$1{,}500s_u$-$2{,}400s_u$
Sand:			Very stiff clay	$3{,}000s_u$-$4{,}000s_u$
Loose	200-600	0.2-0.35		
Medium dense	600-1,000		**Estimating E_s From q_c[4]**	
Dense	1,000-1,600	0.3-0.4		
Gravel:			Sandy soils	$4q_c$
Loose	600-1,600	0.2-0.35		
Medium dense	1,600-2,000			
Dense	2,000-4,000	0.3-0.4		

(1) N = Standard Penetration Test (SPT) resistance.
(2) N_1 = SPT corrected for depth.
(3) s_u = Undrained shear strength (ksf).
(4) q_c = Cone penetration resistance (ksf).

* Use E_s = 1000 ksf = 500 tsf for Compacted Granular Fill

TABLE 4.4.7.2.2B Elastic Shape and Rigidity Factors EPRI (1983)

L/B	β_z Flexible (average)	β_z Rigid
Circular	1.04	1.13
1	1.06	1.08
2	1.09	1.10
3	1.13	1.15
5	1.22	1.24
10	1.41	1.41

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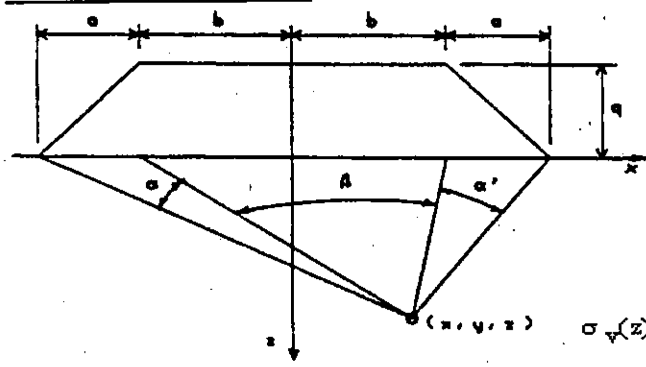
SUBJECT			
Client TranSystems / ODOT D-9	JOB NUMBER	0121-3070.03	
Project SCI-823 Portsmouth Bypass	SHEET NO.	7 OF 14	
Item Consolidation Parameters	COMP. BY	S/K	DATE 7-2-07
823 over Morris Lane - Blue Run Road	CHECKED BY	DAA	DATE 7-12-07

* For Consolidation Parameters See May 17, 2007 Bridge Report, Sheet 1 of 14

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 25.0 ft

Embankment Height: H = 46 ft **Embankment Loading Only**

Fill Unit Weight: γ_{emb} = 120 pcf q = 5,520 psf

Width of Slope: a = 92

Top half-width of Emb: b = 52.5

Distance from CL: x = 0

Output Range: z = 0 to 36 ft

**See Data output Attached*

$$\sigma_v(z) := \left(\frac{q}{\pi\, a}\right)(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z)))$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	Cohesionless Soils C'	Cohesive Soils C_r	C_c	e_o
1	9.5	ft	Sandy Silt	120	6,090	570	5,520	6,090	0.0	0.01	0.11	0.531
2	22.0	ft	Sandy Silt	120	7,396	1,890	5,506	7,396	0.0	0.01	0.14	0.575
3	35.5	ft	Sandy Silt	120	8,659	3,216	5,443	8,659	72.0	0.00	0.00	0.000
4	0.0			0	0							
5	0.0			0	0							
6	0.0			0	0							
7	0.0			0	0							
8	0.0			0	0							
9	0.0			0	0							
10	0.0			0	0							

No.	Settlement:	
1	0.070	ft
2	0.066	ft
3	0.081	ft
4		
5		
6		
7		
8		
9		
10		

Total Settlement

0.217 ft

2.6 in

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \Sigma \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \Sigma\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

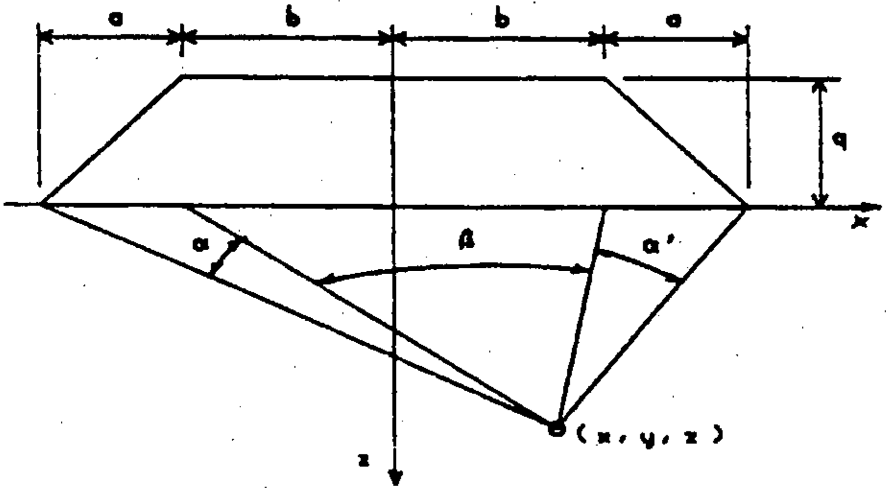
$$(\delta_c)_{ult} = \Sigma \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \Sigma \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

INCREASE IN VERTICAL STRESS DUE TO EMBANKMENT LOADING



q = 5520 load

a = 92 width of slope

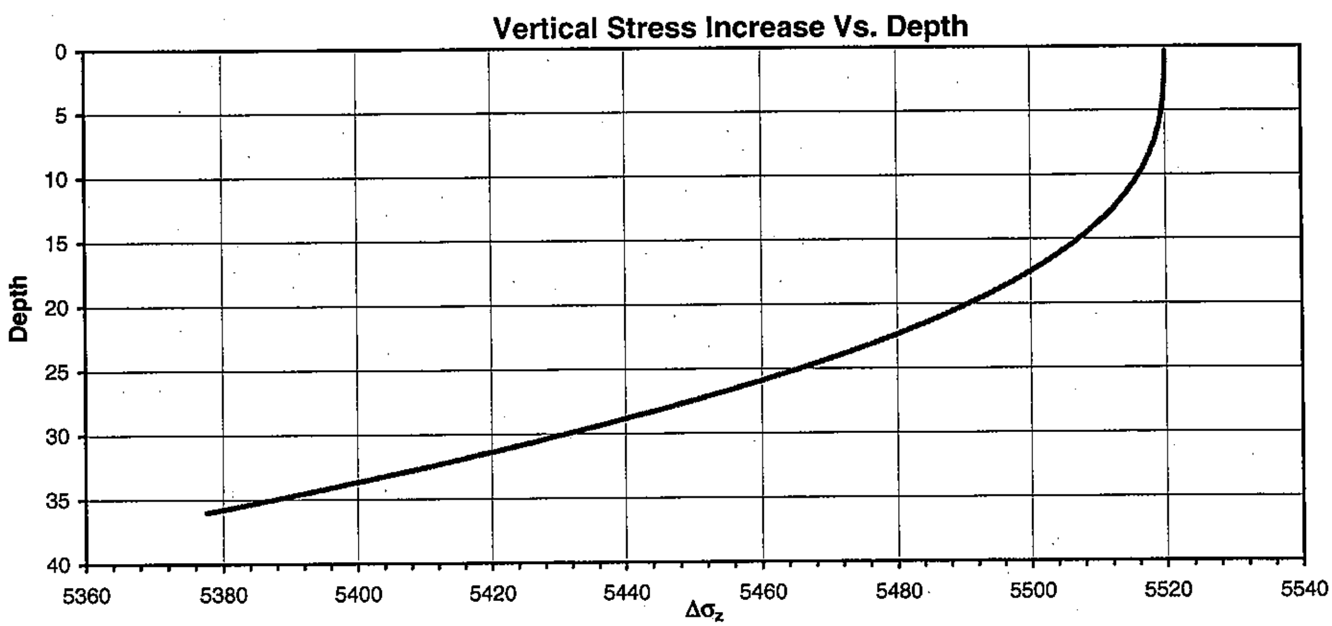
b = 52.5 top half-width of embankment

x = 0 distance from CL

z = 0 to 36 depth range

$$\sigma_V(z) := \left(\frac{q}{\pi \cdot a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z))+b\cdot(\alpha(z)+\alpha'(z))+x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right]+\operatorname{atan}\left[\frac{(b+x)}{z}\right] ; \quad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right]-\operatorname{atan}\left[\frac{(b-x)}{z}\right] \quad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right]-\operatorname{atan}\left[\frac{(b+x)}{z}\right]$$



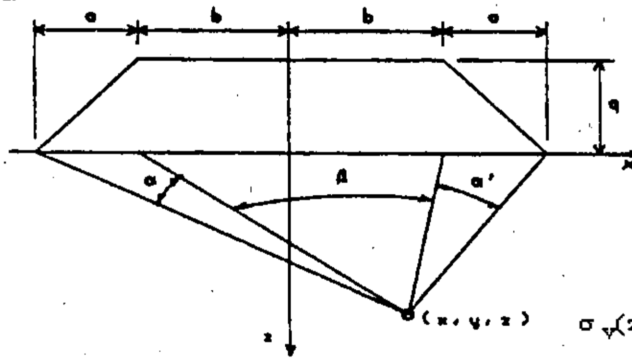
Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

DLZ SUBJECT

Client TranSystems / ODOT D-9	JOB NUMBER	0121-3070.03	
Project SCI-823 Portsmouth Bypass	SHEET NO.	9	OF 14
Item Consolidation Parameters	COMP. BY	SAK	DATE 7-31-07
823 over Morris Lane - Blue Run Road	CHECKED BY	DAA	DATE 7-31-07

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:



Groundwater Table: D= 25.0 ft
Embankment Height: H = 46 ft
Fill Unit Weight: γ_{emb} = 120 pcf
Width of Slope: a = 92
Top half-width of Emb: b = 52.5
Distance from CL: x = 0
Output Range: z = 0 to 36 ft

**See Data output Attached*

Embankment + Footing
σ_s'=500 psf
q = **6,020** psf

$$\sigma_v(z) := \left(\frac{q}{\pi\ a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] \qquad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \qquad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Soil Properites: *Settlement is calculated at mid-point of layer*

No.	Bot. of Laye		Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma z$ (psf)	σ'_f (psf)	Cohesionless Soils C'	Cohesive Soils C_r	C_c	e_o
1	9.5	ft	Sandy Silt	120	6,090	570	6,020	6,590	0.0	0.01	0.11	0.531
2	22.0	ft	Sandy Silt	120	7,396	1,890	6,005	7,895	0.0	0.01	0.14	0.575
3	35.5	ft	Sandy Silt	120	8,659	3,216	5,936	9,152	72.0	0.00	0.00	0.000
4	0.0			0	0							
5	0.0			0	0							
6	0.0			0	0							
7	0.0			0	0							
8	0.0			0	0							
9	0.0			0	0							
10	0.0			0	0							

No.	Settlement:	
1	0.094	ft
2	0.097	ft
3	0.085	ft
4		
5		
6		
7		
8		
9		
10		

Total Settlement

$\boxed{0.276 \text{ ft}}$

$\boxed{3.3 \text{ in}}$

From Footing Load only:

$\delta_{c_{footing}} = 3.3'' - 2.6'' = 0.7''$

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_0<\sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \Sigma \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Overconsolidated Soils - Case II ($\sigma'_0<\sigma'_c<\sigma_f$) Eqn:11.25

$$(\delta_c)_{ult} = \Sigma\left[\frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_c}{\sigma'_0}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_c}\right)\right]$$

Normally Consolidated Soils ($\sigma'_0=\sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \Sigma \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

Reference: FHWA NHI-00-045

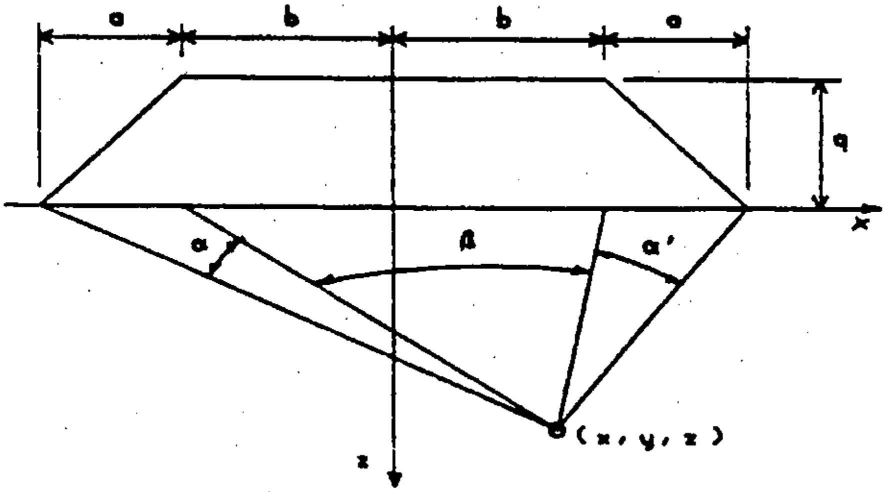
Cohesionless Soils ($\sigma'_0=\sigma'_c$)

$$(\delta_c)_{ult} = \Sigma \frac{1}{C'} H \log\left(\frac{\sigma'_f}{\sigma'_0}\right)$$

DLZ SUBJECT

Client	TranSystems / ODOT D-9	JOB NUMBER	0121-3070.03
Project	SCI-823 Portsmouth Bypass	SHEET NO.	10 OF 14
Item	Consolidation Parameters	COMP. BY	SJK DATE 7-31-07
823 over Morris Lane - Blue Run Road		CHECKED BY	DAA DATE 7-31-07

INCREASE IN VERTICAL STRESS DUE TO EMBANKMENT LOADING

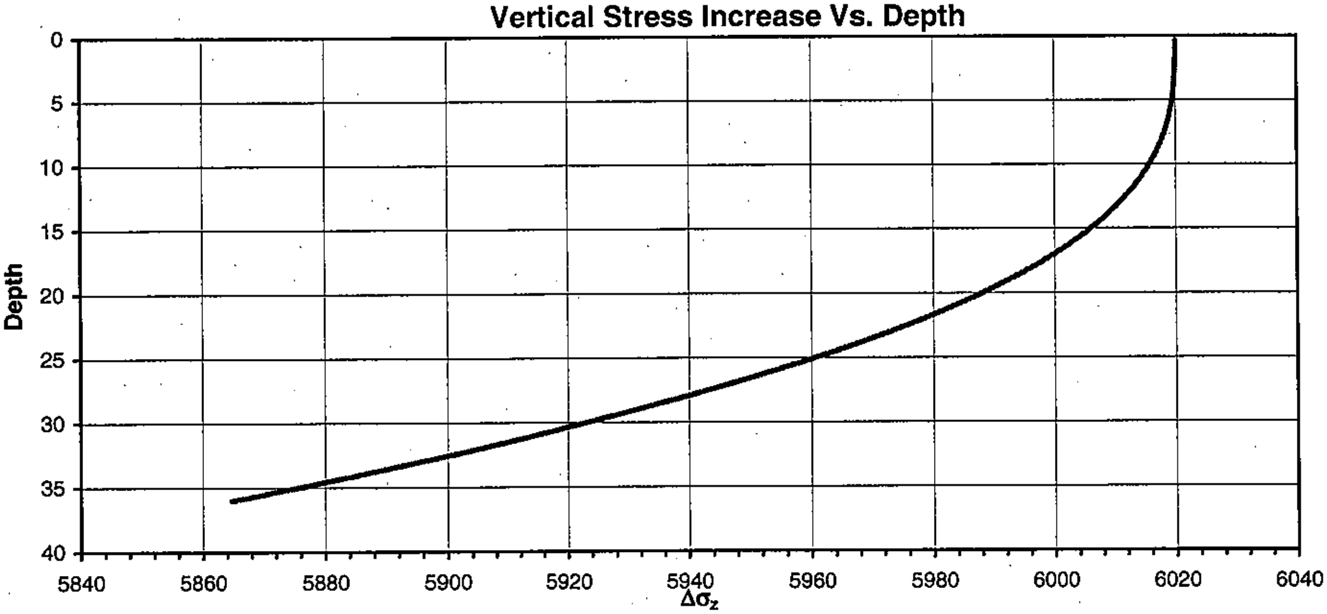


q =	6020	load
a =	92	width of slope
b =	52.5	top half-width of embankment
x =	0	distance from CL
z =	0 to 36	depth range

$$\sigma_v(z) := \left(\frac{q}{\pi \cdot a}\right)\left(a\cdot(\alpha(z)+\beta(z)+\alpha'(z)) + b\cdot(\alpha(z)+\alpha'(z)) + x\cdot(\alpha(z)-\alpha'(z))\right)$$

$$\beta(z) := \operatorname{atan}\left[\frac{(b-x)}{z}\right] + \operatorname{atan}\left[\frac{(b+x)}{z}\right] ; \quad \alpha'(z) := \operatorname{atan}\left[\frac{(a+b-x)}{z}\right] - \operatorname{atan}\left[\frac{(b-x)}{z}\right] \quad \alpha(z) := \operatorname{atan}\left[\frac{(a+b+x)}{z}\right] - \operatorname{atan}\left[\frac{(b+x)}{z}\right]$$

Vertical Stress Increase Vs. Depth



Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

SETTLEMENT ANALYSIS OF SHALLOW FOUNDATIONS
Schmertmann Method

 SJR 7-31-07

Elastic Settlement of Embankment fill under influence of footing load.

Date July 31, 2007
Identification SR 823 over Morris Lane-Blue Run Road

Input

Units	E	E or SI
Shape	co	SQ, CI, CO, or RE
B =	11	ft
L =	95	ft
D =	5	ft
P =	30.63	k/ft → DL + LL = 26.1 + 4.53 = 30.63 K/ft
Dw =	70	ft
gamma =	120	lb/ft^3
t =	0.1	yr

Results

q =	3535	lb/ft^2
delta =	2.44	in

Assumes E_s = 500 tsf (Compacted Granular Fill)

Depth to Soil Layer Top (ft)	Bottom (ft)	Es (lb/ft^2)	zf (ft)	I epsilon	strain (%)	delta (in)
0.0	5.0					
5.0	6.0	1000000	0.5	0.408	0.0785	0.0094
6.0	7.0	1000000	1.5	0.825	0.1586	0.0190
7.0	8.0	1000000	2.5	1.242	0.2388	0.0287
8.0	9.0	1000000	3.5	1.658	0.3189	0.0383
9.0	10.0	1000000	4.5	2.075	0.3990	0.0479
10.0	11.0	1000000	5.5	2.491	0.4791	0.0575
11.0	12.0	1000000	6.5	2.908	0.5593	0.0671
12.0	13.0	1000000	7.5	3.325	0.6394	0.0767
13.0	14.0	1000000	8.5	3.741	0.7195	0.0863
14.0	15.0	1000000	9.5	4.158	0.7996	0.0960
15.0	16.0	1000000	10.5	4.574	0.8797	0.1056
16.0	17.0	1000000	11.5	4.705	0.9050	0.1086
17.0	18.0	1000000	12.5	4.561	0.8771	0.1053
18.0	19.0	1000000	13.5	4.416	0.8493	0.1019
19.0	20.0	1000000	14.5	4.271	0.8214	0.0986
20.0	21.0	1000000	15.5	4.126	0.7936	0.0952
21.0	22.0	1000000	16.5	3.982	0.7657	0.0919
22.0	23.0	1000000	17.5	3.837	0.7379	0.0885
23.0	24.0	1000000	18.5	3.692	0.7100	0.0852
24.0	25.0	1000000	19.5	3.547	0.6822	0.0819
25.0	26.0	1000000	20.5	3.402	0.6544	0.0785
26.0	27.0	1000000	21.5	3.258	0.6265	0.0752
27.0	28.0	1000000	22.5	3.113	0.5987	0.0718
28.0	29.0	1000000	23.5	2.968	0.5708	0.0685
29.0	30.0	1000000	24.5	2.823	0.5430	0.0652
30.0	31.0	1000000	25.5	2.678	0.5151	0.0618
31.0	32.0	1000000	26.5	2.534	0.4873	0.0585
32.0	33.0	1000000	27.5	2.389	0.4594	0.0551
33.0	34.0	1000000	28.5	2.244	0.4316	0.0518
34.0	35.0	1000000	29.5	2.099	0.4038	0.0485
35.0	36.0	1000000	30.5	1.955	0.3759	0.0451
36.0	37.0	1000000	31.5	1.810	0.3481	0.0418
37.0	38.0	1000000	32.5	1.665	0.3202	0.0384
38.0	39.0	1000000	33.5	1.520	0.2924	0.0351
39.0	40.0	1000000	34.5	1.375	0.2645	0.0317
40.0	41.0	1000000	35.5	1.231	0.2367	0.0284
41.0	42.0	1000000	36.5	1.086	0.2088	0.0251
42.0	43.0	1000000	37.5	0.941	0.1810	0.0217
43.0	44.0	1000000	38.5	0.796	0.1531	0.0184
44.0	45.0	1000000	39.5	0.652	0.1253	0.0150
45.0	46.0	1000000	40.5	0.507	0.0975	0.0117

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CLIENT Tran Systems Corp — PROJECT NO. 0121-3070.03
PROJECT SCI-823 Portsmouth Bypass — SHEET NO. 12 OF 14
SUBJECT Elastic Settlement - AASHTO Method — COMP. BY SJK DATE 8-1-07
CHECKED BY EWT DATE 8-1-07

Elastic Settlement of Embankment Fill using AASHTO.

$$S_e = \frac{\left[q_o(1-\nu^2)\sqrt{A}\right]}{E_s}\,\beta_z \qquad (4.4.7.2.2-1)$$

* Assumed Parameters for Compacted Granular Fill
$E_s = 1000$ ksf
$\nu = 0.3$

* Assumed Footing Details
$B = 11'$ $L = 95'$ $A = 1045\ ft^2$ $L/B = 8.6$

For β_z interpolate from table 4.4.7.2.2B
* Assume Rigid Footing

$$\beta_z = 1.41 - (10-8.6)\left[\frac{1.41-1.24}{10-5}\right] = 1.36$$

$$q_o = (DL+LL)/B = (26.1\ k/ft + 4.53\ k/ft)/11' = 2.78\ ksf$$

$$S_e = \frac{\left[2.78\ ksf\,(1-0.3^2)\sqrt{1045\ ft^2}\right]}{1000\ ksf}(1.36) = 0.11\ ft = 1.3\ in.^*$$

* Do not use: For conservative design use elastic settlement value from Schmertmann Method, $S_e = 2.4$ in.
See pg 11 of 14

• Rear Abutment Location

Span Length = 100.0'
As per AASHTO, differential settlement should be limited to 0.4%
→ Allowable differential settlement; $DS = 100'(12''/ft)(0.004) = \boxed{4.8''}$
Elastic Settlement of embankment fill = 2.4" (due to footing load)
Consolidation Settlement of foundation Soils = 0.0" (on bedrock)
2.4"

• Forward Abutment Location

Span Length = 90.0'
As per AASHTO, differential settlement should be limited to 0.4%
→ Allowable differential settlement; $DS = 90.0'(12''/ft)(0.004) = \boxed{4.3''}$
Elastic Settlement of embankment fill = 2.4" (due to footing load)
Consolidation Settlement of foundation Soil = 0.7" (due to footing load)
3.1"

Remaining allowable Settlement at Forward Abutment = 4.3" - 3.1" = 1.2"

* Determine Percentage of Consolidation required prior to constructing the footings.

$1.2''/2.6'' = 0.46$ $U_{Req} = 1 - 0.46 = 0.54$ or 54 percent

It is recommended that at least 60% of the total primary consolidation be achieved prior to constructing footings.

$t = \dfrac{T_v \cdot H^2}{C_v}$

* Assume double drainage, $H_{dr} = 11'$
* $U = 60\% \rightarrow T_v = 0.29$

$$t_{60\%} = \frac{(0.29)(11^2)}{0.7\ ft^2/day} = 50 \text{ days}$$

* A waiting period of 50 days is recommended. At least $U = 60\%$

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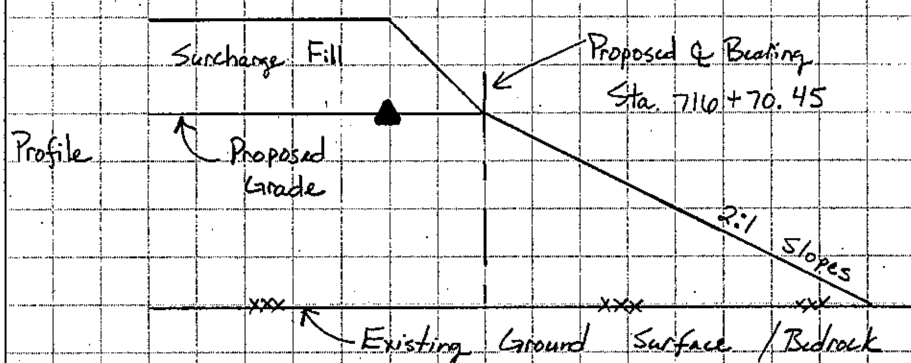
CLIENT: TranSystems Corp. / ODOT D-9
PROJECT: SCI-823 Portsmouth Bypass
SUBJECT: Morris Lane Blue Run Rd.
Instrumentation and Surcharge Load

PROJECT NO. 0121-3070.03
SHEET NO. 14 OF 14
COMP. BY SJK DATE 7-2-07
CHECKED BY DAA DATE 7-12-07

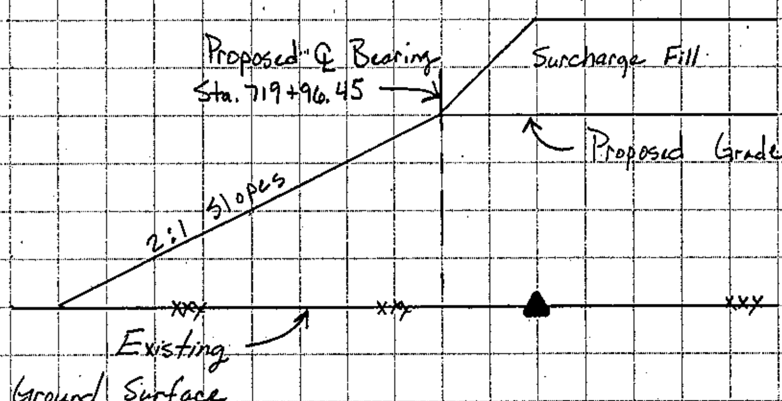
*Not to Scale

• Rear Abutment Location, as per ODOT's OSE.



▲ = Settlement Platform Recommended to be placed at Sta. 716+60 on BL.

• Forward Abutment Location, as per ODOT's OSE.



▲ = Settlement Platform Recommended to be placed at sta. 720+07 on BL.

* Actual locations of settlement platforms may be modified by ODOT representatives.

* Details of Surcharge load are to be determined by ODOT representatives. See Structure Type Study Review, 6-26-07.

inter-office communication

to: James Brushart, District 9 Deputy Director **date:** June 26, 2007

from: Tim Keller, Administrator, Office of Structural Engineering **by:** Jeff Crace, P.E.

subject: SCI-823-XXXX over Morris Lane Blue Run Road (C. R. 29); PID 19415; Structure Type Study Review

We have reviewed the information furnished in the preliminary design submittal prepared and submitted by TranSystems Corporation for the above referenced bridge and offer the following comments:

1) We recommend that the rear and forward abutments be supported by spread footings. The in-situ soil at the forward abutment has good strength characteristics and being granular in nature the primary settlement will occur quickly and long term consolidation will be small. The embankment for the rear abutment will be placed basically on the bedrock

2) We recommend utilizing a surcharge load in order to minimize the settlement of the in-situ soil and the proposed embankment after the surcharge load is removed and the abutments are constructed.

3) We recommend that settlement platforms be utilized to monitor the settlement. The settlement platforms at the rear abutment should be placed at the top of the proposed embankment below the surcharge. The settlement platforms at the forward abutment should be placed at the top of the in-situ soul below the proposed embankment.

4) Provide a note or notes requiring greater control (maximum of 6 inch lifts a minimum distance from the abutment) on the construction of the embankment for this structure. See the ODOT Bridge Design Manual, notes 24,26,

We recommend that this submittal be approved subject to compliance with or resolution of the above comments.

If there are questions regarding our review comments for this project, please contact our office.

TJK:JS:jc

c: District 9 - Tom Barnitz
District 9 – John Wetzel
District 9 – June Wayland
District 9 - Doug Buskirk
District 9 - Larry Wills
Preliminary Design
file