Appendix F – Calculations

Approach Embankments

Estimates of Long-term Settlement

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
DO-CEM-4801 (REV. 11/93) 7541-35420

SHEET | OF

JOB STAMP

ITEM

FILE NO. EA 091801

11-SD-905
Phase I
Siempre Viva Overcrossing

LOCATION 11-SD-905 KP 18.5/19.3

SEGREGATION YES NO

CALC BY M. SKYRMAN

DATE 12-6-00

CHK BY

DATE

SETTLEMENT CALCULATIONS FOR APPROACH EMBANKMENTS

Consolidation test data (attached):

Sample 600-5-1-11 (depth=6.5')

$C_R = .045$
$C_c = .18$
$\bar{\sigma}_p$ (preconsolidation pressure) = 5.1 tsf

Maximum Proposed Embankment at this location is approx. 25 feet

Assumed Unit Weight of Fill is 115 pcf (compacted, moist)

Maximum Incremental Stress at Original Ground is
$\gamma_{moist} \times H_{max} = (115\ pcf)(25\ ft) = 2875\ psf = \underline{1.44\ tsf}$

(1) Determine the variation in incremental stress with depth below original ground:

Utilize Soils & Foundation Manual (NHI) Fig. 11 to determine Pressure Coefficients Beneath the End of a Fill

Calculate at a point in center of embankment at a distance equivalent to top of endslope (abutment centroid) $= \frac{25}{85} b = .3b$

$b = \frac{50}{2} + \frac{120}{2} = 85'$

Assume middle of embankment correlates to b = 60 feet

Use chart to find pressure coefficients at various depths

depth	actual depth (ft)	K
.2b	17	0.95
.4b	34	0.82
.6b	51	0.72
.8b	68	0.60
1.0b	85	0.55
1.2b	102	0.50

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CEM-1801

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
DC-CEM-4801 (OLD HC-52 REV. 11.92) 7541-3520-0

SHEET 2 OF

JOB STAMP	ITEM	FILE NO.
11-SD-905 PHASE I SIEMPRE VIVA OVERCROSSING	LOCATION 11-SD-905 KP 18.5/19.3	SEGREGATION YES NO
	CALC. BY M. SKYRMAN	DATE 12-6-00
	CHK. BY	DATE

② Calculate Settlement Using Terzaghi's 1-D Consolidation Settlement Equation:

$$S = C_R \frac{H}{1+e_0} \log\left(\frac{\bar{\sigma}_P}{\bar{\sigma}_{V0}}\right) + C_C \frac{H}{1+e_0} \log\left(\frac{\bar{\sigma}_{V0} + \Delta\sigma_V}{\bar{\sigma}_P}\right)$$

Hand-calc for 1st sublayer, 0-10 feet (H)
midpoint @ 5'

$\bar{\sigma}_{V0}(5') = 5' \times 115\ pcf = 575\ psf$

$K = 0.98$
$\Delta\sigma_V = 2822\ psf$
$\bar{\sigma}_P = 10{,}200\ psf$
$e_0 = 0.96$

$$S = .045\left(\frac{10'}{1.96}\right)\log\left(\frac{575+2822}{575}\right) = .177\ feet$$

2 inches

For 2nd sublayer, 10-20 feet
mid point @ 15'

$\bar{\sigma}_{V0}(15') = 15' \times 115\ pcf = 1725\ psf$

Don't Include this layer, blow counts too high →

$K = 0.95$
$\Delta\sigma_V = 2736\ psf$
$\bar{\sigma}_P = 10{,}200\ psf$
$e_0 = 0.96$

$$S = 0.045\left(\frac{10'}{1.96}\right)\log\left(\frac{1725+2736}{1725}\right) = .095\ feet$$

1.2 inches

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

QUANTITY CALCULATIONS

DO-CEM-4801 (OLD HC-52 REV. 11-92) 7541-3520-0

SHEET 3 OF

JOB STAMP	ITEM	FILE NO.
11-SD-905 Phase I Siempre Viva OC	LOCATION 11-SD-905 KP 18.5/19.3	SEGREGATION YES NO
	CALC. BY M. SKYRMAN	DATE 12-6-00
	CHK. BY	DATE

Assume max. length of drainage path is 5 feet

From time-rate test data for sample 600-5-1-11, c_v (coeff. consolidation) = 1×10^{-3} in²/sec = 0.6 ft²/day

Assume double-drainage — sandy lenses within the Otay Fm will decrease the estimated time to 90% primary consolidation. Single-drainage is conservative.

$$t = \frac{T H_v^2}{c_v}$$

$$= \frac{(.848)(5\text{ feet})^2}{0.6\text{ ft}^2/\text{day}} = 35 \text{ days ?}$$

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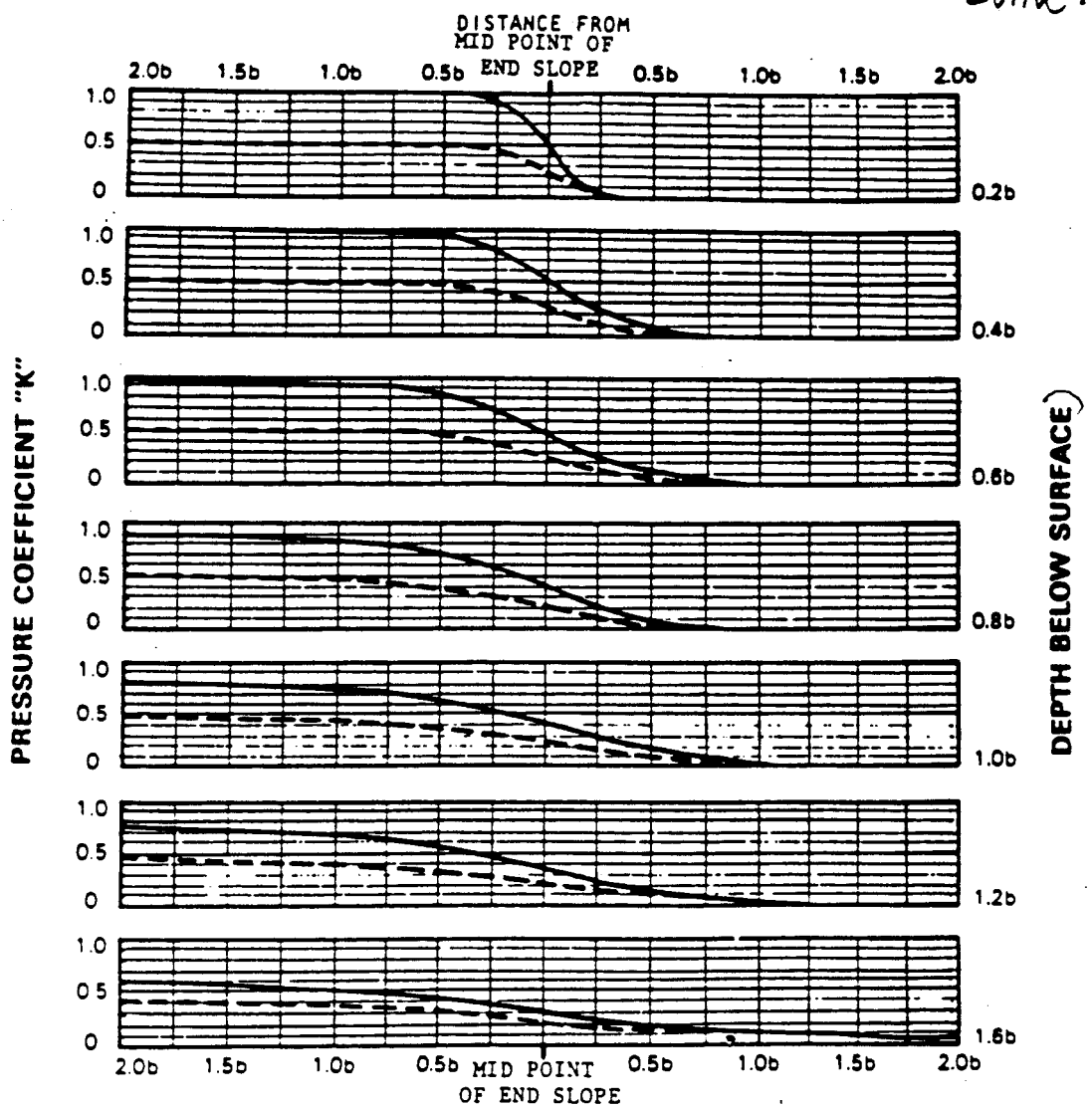
CEM-4801 (HC-52 REV. 11-92)

FIGURE 11
PRESSURE COEFFICIENTS BENEATH THE END OF A FILL

Solid line = ℄



Case of Long Strip-Uniform Loading
Vertical Pressures at End of Fill

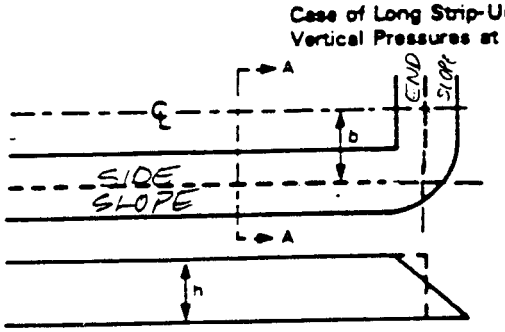
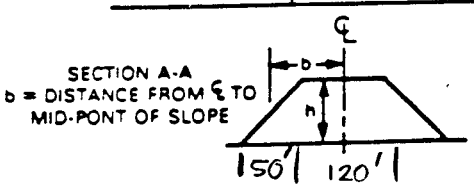


CHART
LEGEND: PRESSURE UNDER CENTER LINE = ——
PRESSURE UNDER Mid Point of Side Slope = - - - - -
VERTICAL PRESSURE "p" AT ANY POINT = $K \gamma_f h$
WHERE h = FILL HEIGHT
γ_f = UNIT WEIGHT OF FILL MATERIAL



SECTION A-A
b = DISTANCE FROM ℄ TO MID-PONT OF SLOPE

PRESSURE COEFFICIENTS BENEATH THE END OF A FILL

b = 60+25 = 85'

x = 25/85 = 0.3b

Bearing Capacity Analysis

Type I Retaining Walls
SV-1 and SV-2 Ramps

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
DO-CEM-4801 (OLD HC-52 REV. 11-90) 7541-3523-0

SHEET OF

JOB STAMP

11-SD-905
PHASE 1

EA 091801

ITEM

FILE NO.

LOCATION

SEGREGATION YES NO

CALC. BY SKYRMAN

DATE 3-20-01

CHK. BY

DATE

DIRECT SHEAR TEST RESULTS : OTAY FORMATION

AVERAGE OF PEAK VALUES : $c' = 1530$ psf
$\phi' = 35°$

AVERAGE OF RESIDUAL VALUES : $c' = 725$ psf
$\phi' = 38°$

→ FOR ANALYSES: USE $\phi' = 35°$
$c' = 725$ psf

> conservative

PREPARED BY

DATE

PAGE

DO-CEM-4801 (REV. 11-90)

CALCULATION SHEET

JOB STATE

SHEET 1 OF

FILE NO.

DESIGNATION YES NO

DATE 3-20-01

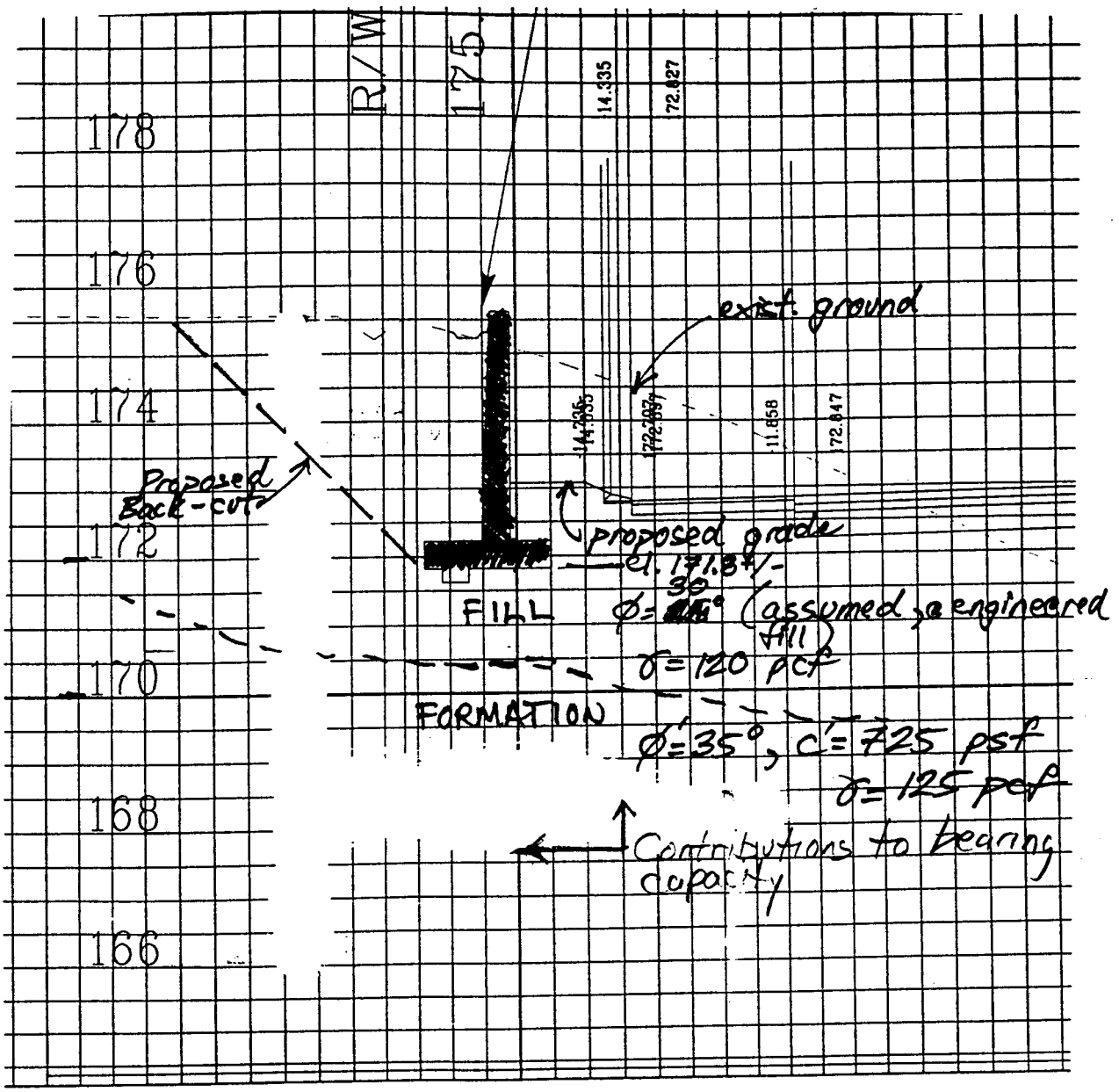
11-SD-905
PHASE 1
091801

SV-1

M. SKYRMAN

TYPE 1 RETAINING WALL (SV-1 RAMP)

STA. 12+98



Max. wall height = 4.8 m
Footing width = 2.75 m

JOB STAMP

11-SD-905
PHASE 1

091801

SV-1 WALL
M. SKYRMAN

SEGREGATION NO.
DATE 3-20-01

Estimate bearing capacity to a depth of 1.5 x footing width = 1.5 x 2.75 m = 4.125 m below footing base

Assume Case I Loading conditions, which conservatively assumes an 11.5 KPa live load traffic surcharge. Maximum toe pressure, per Std. Plans is 170 KPa

Conservatively, use shear strength properties of the fill ($\phi = 30°$) even though a failure surface would likely pass through the formational soil ($\phi = 35°$; $c = 725$ psf).

Use Terzaghi's bearing capacity equation:

$$q_{ult} = q N_q + 0.5 B \gamma N_\gamma$$

$$= (120 \text{ pcf})(3')(22.5) + (0.5)(9.0')(120)(19.7)$$

$$= 8100 + 10{,}638$$

$$= 18{,}738 \text{ psf}$$

$$q_{all} = q_{ult}/3 = 18{,}738/3 = 6{,}246 \text{ psf} = 299 \text{ KPa}$$

This exceeds max. toe pressure, so ok ✓

Bowles, 4th ed.

TABLE 4-2 **Bearing-capacity factors for the Terzaghi equations**

Values of N_γ for ϕ of 34 and 48° are original Terzaghi values and used to back-compute $K_{p\gamma}$

ϕ, deg	N_c	N_q	N_γ	$K_{p\gamma}$
0	5.7†	1.0	0.0	10.8
5	7.3	1.6	0.5	12.2
10	9.6	2.7	1.2	14.7
15	12.9	4.4	2.5	18.6
20	17.7	7.4	5.0	25.0
25	25.1	12.7	9.7	35.0
30	37.2	22.5	19.7	52.0
34	52.6	36.5	36.0	
35	57.8	41.4	42.4	82.0
40	95.7	81.3	100.4	141.0
45	172.3	173.3	297.5	298.0
48	258.3	287.9	780.1	
50	347.5	415.1	1153.2	800.0

† $= 1.5\pi + 1$.

TABLE 4-3 **Shape, depth, and inclination factors for the Meyerhof bearing-capacity equation of Table 4-1**

Factors	Value	For
Shape:	$s_c = 1 + 0.2K_p\dfrac{B}{L}$	Any ϕ
	$s_q = s_\gamma = 1 + 0.1K_p\dfrac{B}{L}$	$\phi > 10°$
	$s_q = s_\gamma = 1$	$\phi = 0$
Depth:	$d_c = 1 + 0.2\sqrt{K_p}\dfrac{D}{B}$	Any ϕ
	$d_q = d_\gamma = 1 + 0.1\sqrt{K_p}\dfrac{D}{B}$	$\phi > 10$
	$d_q = d_\gamma = 1$	$\phi = 0$
Inclination:	$i_c = i_q = \left(1 - \dfrac{\theta°}{90°}\right)^2$	Any ϕ
	$i_\gamma = \left(1 - \dfrac{\theta°}{\phi°}\right)^2$	$\phi > 0$
	$i_\gamma = 0$	$\phi = 0$

Where $K_p = \tan^2(45 + \phi/2)$ as on Fig. 4-2
θ = angle of resultant measured from vertical without a sign
B, L, D = previously defined

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
ADCEM-4R01 (OLD HC-52 REV. 11 93)

SHEET 1 OF

JOB STAMP
11-SD-905
PHASE 1
091801

ITEM

FILE NO.

LOCATION SV-2 WALL

SEGREGATION YES NO

CALC BY M. SKYRMAN

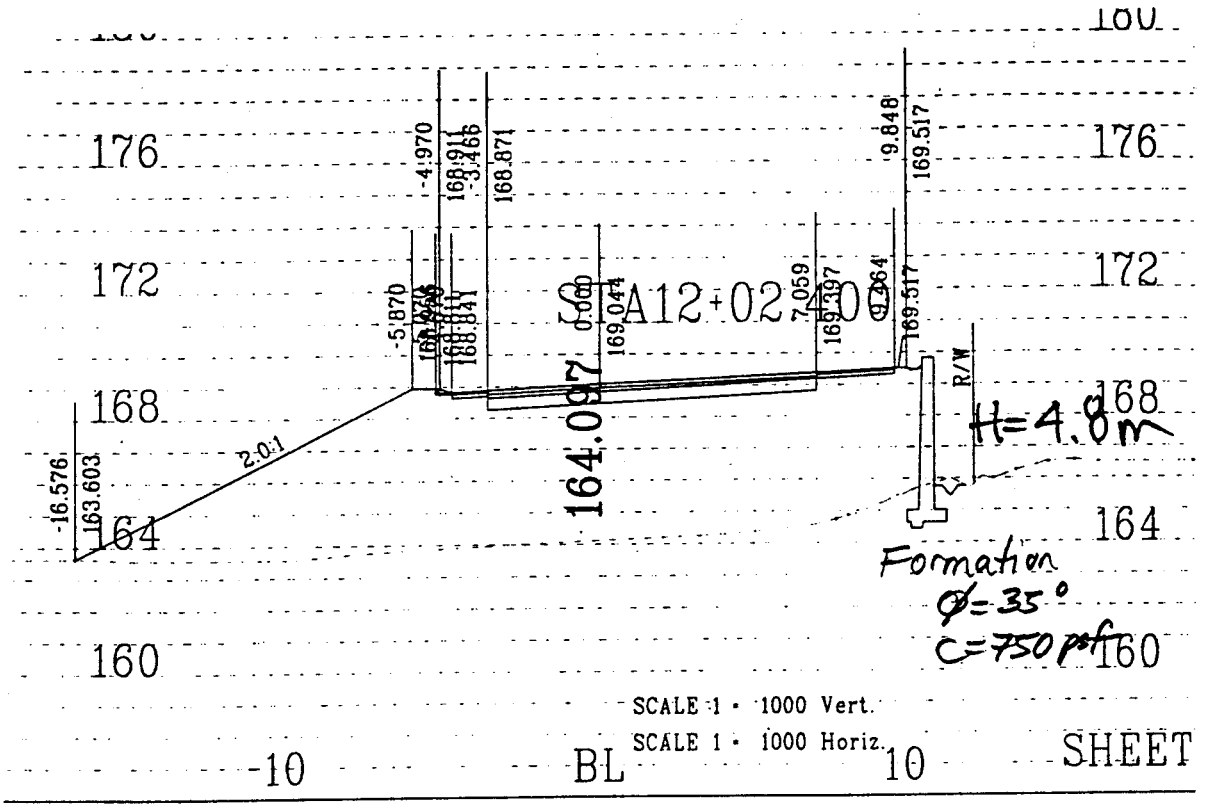
DATE 3-20-01

CHK BY

DATE

TYPE 1 RETAINING WALL (SV-2 RAMP)

STA. 12+02



MAX. WALL HEIGHT = 4.8m

FOOTING WIDTH = 2.75 m

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
QUANTITY CALCULATIONS
DESIGN ENGINEERING OLD HC-52 REV. 1/92, 7541 OF

SHEET 2 OF

JOB STAMP

FILE NO.

11-SD-905
PHASE 1
091801

SV-2 WALL
M. SKYRMAN

SEGREGATION YES NO

DATE 3-20-01

Use shear strength properties of formation:

$\phi = 35^\circ$

$C = 750$ psf

Assume Case II loading conditions, which assumes limited 1:2 slope above wall + 11.5 KPa live-load surcharge.

Terzaghi:

$$q_{ult} = cN_c + qN_q + 0.5B\gamma N_\gamma$$

$$= (750)(57.8) + (125)(3')(41.4) + (0.5)(9.0')(125)(42.$$

$$= 43{,}350 + 15{,}525 + 23{,}850$$

$$= 82{,}725 \text{ psf}$$

$$q_{all} = 82{,}725/3 = 27{,}575 \text{ psf} = 1320 \text{ KPa}$$

This far exceeds max. toe pressure ✓

Stability Analysis (XSTABL)

SV-1 Ramp

XSTABL File: SV1 4-11-** 17:32

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 Ä 96       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.105a                95 Ä 1474 *
*****************************************
```

Problem Description : Wall SV-1, Sta. 12+60 STATIC CASE

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (m)	y-left (m)	x-right (m)	y-right (m)	Soil Unit Below Segment
1	.1	10.0	10.0	10.0	2
2	10.0	10.0	10.1	11.3	3
3	10.1	11.3	11.3	11.9	3
4	11.3	11.9	12.5	12.5	2
5	12.5	12.5	18.3	14.8	1
6	18.3	14.8	28.3	14.8	1

4 SUBSURFACE boundary segments

Segment No.	x-left (m)	y-left (m)	x-right (m)	y-right (m)	Soil Unit Below Segment
1	12.5	12.3	28.3	12.3	2
2	10.0	10.0	10.1	9.2	2
3	10.1	9.2	11.2	9.2	2
4	11.2	9.2	11.3	11.9	2

ISOTROPIC Soil Parameters
---

3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (kN/m3)	Unit Weight Sat. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (kPa)	Water Surface No.
1	18.5	18.5	.0	30.00	.000	.0	0
2	19.0	19.0	34.7	35.00	.000	.0	0
3	22.0	22.0	200.0	45.00	.000	.0	0

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

400 trial surfaces will be generated and analyzed.

20 Surfaces initiate from each of 20 points equally spaced along the ground surface between x = 5.5 m
and x = 8.5 m

Each surface terminates between x = 12.0 m
and x = 22.0 m

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 m

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

1.0 m line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -30.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 15 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.55	10.00
2	8.47	9.59
3	9.42	9.31
4	10.41	9.14
5	11.41	9.11
6	12.41	9.20
7	13.38	9.41
8	14.32	9.75
9	15.21	10.21
10	16.04	10.77
11	16.79	11.44
12	17.44	12.19
13	18.00	13.02
14	18.45	13.92
15	18.75	14.80

** Corrected JANBU FOS = 4.126 ** (Fo factor = 1.079)

Failure surface No. 2 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.39	10.00
2	8.30	9.57
3	9.25	9.26
4	10.23	9.08
5	11.23	9.01
6	12.23	9.07
7	13.21	9.25
8	14.16	9.56
9	15.07	9.98
10	15.92	10.50
11	16.70	11.14
12	17.39	11.86
13	17.98	12.66
14	18.48	13.53
15	18.86	14.46
16	18.95	14.80

** Corrected JANBU FOS = 4.131 ** (Fo factor = 1.080)

Failure surface No. 3 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	8.18	10.00
2	9.07	9.54
3	10.02	9.21
4	11.00	9.01

5	11.99	8.95
6	12.99	9.01
7	13.97	9.22
8	14.91	9.55
9	15.80	10.01
10	16.62	10.59
11	17.35	11.27
12	17.98	12.04
13	18.51	12.90
14	18.91	13.81
15	19.18	14.77
16	19.19	14.80

** Corrected JANBU FOS = 4.132 ** (Fo factor = 1.082)

Failure surface No. 4 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.71	10.00
2	8.60	9.54
3	9.54	9.20
4	10.52	8.99
5	11.51	8.90
6	12.51	8.95
7	13.50	9.12
8	14.45	9.42
9	15.36	9.84
10	16.20	10.38
11	16.97	11.02
12	17.65	11.75
13	18.23	12.57
14	18.69	13.45
15	19.04	14.39
16	19.13	14.80

** Corrected JANBU FOS = 4.136 ** (Fo factor = 1.082)

Failure surface No. 5 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.24	10.00
2	8.15	9.60
3	9.11	9.31
4	10.10	9.15
5	11.10	9.11
6	12.09	9.19
7	13.07	9.40
8	14.02	9.72
9	14.91	10.16
10	15.75	10.71
11	16.51	11.36

12	17.19	12.10
13	17.77	12.91
14	18.24	13.80
15	18.60	14.73
16	18.62	14.80

** Corrected JANBU FOS = 4.159 ** (Fo factor = 1.079)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.55	10.00
2	8.43	9.52
3	9.36	9.16
4	10.34	8.92
5	11.33	8.81
6	12.33	8.82
7	13.32	8.96
8	14.28	9.22
9	15.21	9.60
10	16.07	10.10
11	16.87	10.70
12	17.59	11.40
13	18.21	12.19
14	18.72	13.04
15	19.13	13.96
16	19.38	14.80

** Corrected JANBU FOS = 4.160 ** (Fo factor = 1.082)

Failure surface No. 7 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.24	10.00
2	8.12	9.52
3	9.05	9.16
4	10.02	8.91
5	11.01	8.78
6	12.01	8.77
7	13.00	8.89
8	13.97	9.12
9	14.91	9.48
10	15.80	9.94
11	16.62	10.51
12	17.37	11.17
13	18.03	11.92
14	18.60	12.74
15	19.06	13.63
16	19.41	14.57
17	19.46	14.80

** Corrected JANBU FOS = 4.165 ** (Fo factor = 1.081)

Failure surface No. 8 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	8.18	10.00
2	9.05	9.50
3	9.98	9.13
4	10.95	8.89
5	11.95	8.79
6	12.94	8.82
7	13.93	9.00
8	14.88	9.31
9	15.78	9.75
10	16.60	10.31
11	17.35	10.98
12	17.99	11.75
13	18.52	12.60
14	18.92	13.52
15	19.19	14.48
16	19.24	14.80

** Corrected JANBU FOS = 4.187 ** (Fo factor = 1.084)

Failure surface No. 9 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.08	10.00
2	7.99	9.59
3	8.94	9.27
4	9.92	9.06
5	10.91	8.95
6	11.91	8.95
7	12.91	9.05
8	13.88	9.26
9	14.84	9.57
10	15.75	9.97
11	16.61	10.47
12	17.42	11.06
13	18.16	11.73
14	18.83	12.48
15	19.42	13.29
16	19.91	14.16
17	20.19	14.80

** Corrected JANBU FOS = 4.197 ** (Fo factor = 1.076)

Failure surface No.10 specified by 16 coordinate points

Point	x-surf	y-surf

No.	(m)	(m)
1	8.34	10.00
2	9.21	9.51
3	10.15	9.15
4	11.12	8.92
5	12.11	8.82
6	13.11	8.86
7	14.10	9.04
8	15.05	9.35
9	15.95	9.78
10	16.78	10.34
11	17.52	11.01
12	18.17	11.77
13	18.71	12.61
14	19.13	13.52
15	19.42	14.48
16	19.47	14.80

** Corrected JANBU FOS = 4.200 ** (Fo factor = 1.084)

```
*********************************************************************
**                                                                 **
**  Out of the    400 surfaces generated and analyzed by XSTABL,   **
**        54 surfaces were found to have MISLEADING FOS values.    **
**                                                                 **
*********************************************************************
```

The following is a summary of the TEN most critical surfaces

Problem Description : Wall SV-1, Sta. 12+60

	Modified JANBU FOS	Correction Factor	Initial x-coord (m)	Terminal x-coord (m)	Available Strength (kN)
1.	4.126	1.079	7.55	18.75	7.350E+02
2.	4.131	1.080	7.39	18.95	7.750E+02
3.	4.132	1.082	8.18	19.19	8.023E+02
4.	4.136	1.082	7.71	19.13	8.138E+02
5.	4.159	1.079	7.24	18.62	7.270E+02
6.	4.160	1.082	7.55	19.38	8.598E+02
7.	4.165	1.081	7.24	19.46	8.779E+02
8.	4.187	1.084	8.18	19.24	8.481E+02
9.	4.197	1.076	7.08	20.19	8.908E+02
10.	4.200	1.084	8.34	19.47	8.563E+02

* * * END OF FILE * * *

XSTABL File: SV1S 4-12-** 7:13

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*         Copyright (C) 1992 Ä 96       *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.105a                95 Ä 1474 *
*****************************************
```

Problem Description : Wall SV-1, Sta. 12+60 PSEUDOSTATIC CASE

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (m)	y-left (m)	x-right (m)	y-right (m)	Soil Unit Below Segment
1	.1	10.0	10.0	10.0	2
2	10.0	10.0	10.1	11.3	3
3	10.1	11.3	11.3	11.9	3
4	11.3	11.9	12.5	12.5	2
5	12.5	12.5	18.3	14.8	1
6	18.3	14.8	28.3	14.8	1

4 SUBSURFACE boundary segments

Segment No.	x-left (m)	y-left (m)	x-right (m)	y-right (m)	Soil Unit Below Segment
1	12.5	12.3	28.3	12.3	2
2	10.0	10.0	10.1	9.2	2
3	10.1	9.2	11.2	9.2	2
4	11.2	9.2	11.3	11.9	2

ISOTROPIC Soil Parameters
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3 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (kN/m3)	Unit Weight Sat. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (kPa)	Water Surface No.
1	18.5	18.5	.0	30.00	.000	.0	0
2	19.0	19.0	34.7	35.00	.000	.0	0
3	22.0	22.0	200.0	45.00	.000	.0	0

A horizontal earthquake loading coefficient
of .150 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

400 trial surfaces will be generated and analyzed.

20 Surfaces initiate from each of 20 points equally spaced
along the ground surface between x = 5.5 m
and x = 8.5 m

Each surface terminates between x = 12.0 m
and x = 22.0 m

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 m

* * * * * DEFAULT SEGMENT LENGTH SELECTED BY XSTABL * * * * *

1.0 m line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -30.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED JANBU METHOD * * * * *

The 10 most critical of all the failure surfaces examined are displayed below - the most critical first

Failure surface No. 1 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	8.18	10.00
2	9.07	9.54
3	10.02	9.21
4	11.00	9.01
5	11.99	8.95
6	12.99	9.01
7	13.97	9.22
8	14.91	9.55
9	15.80	10.01
10	16.62	10.59
11	17.35	11.27
12	17.98	12.04
13	18.51	12.90
14	18.91	13.81
15	19.18	14.77
16	19.19	14.80

** Corrected JANBU FOS = 3.009 ** (Fo factor = 1.082)

Failure surface No. 2 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.08	10.00
2	7.99	9.59
3	8.94	9.27
4	9.92	9.06
5	10.91	8.95
6	11.91	8.95
7	12.91	9.05
8	13.88	9.26
9	14.84	9.57
10	15.75	9.97
11	16.61	10.47
12	17.42	11.06
13	18.16	11.73
14	18.83	12.48
15	19.42	13.29
16	19.91	14.16
17	20.19	14.80

** Corrected JANBU FOS = 3.012 ** (Fo factor = 1.076)

Failure surface No. 3 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.39	10.00
2	8.30	9.57
3	9.24	9.24
4	10.21	9.01
5	11.21	8.88
6	12.21	8.86
7	13.20	8.95
8	14.18	9.14
9	15.14	9.43
10	16.06	9.83
11	16.93	10.32
12	17.75	10.89
13	18.50	11.55
14	19.17	12.29
15	19.77	13.10
16	20.27	13.96
17	20.66	14.80

** Corrected JANBU FOS = 3.013 ** (Fo factor = 1.077)

Failure surface No. 4 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.87	10.00
2	8.75	9.52
3	9.68	9.16
4	10.65	8.91
5	11.64	8.79
6	12.64	8.79
7	13.63	8.91
8	14.60	9.15
9	15.54	9.51
10	16.42	9.98
11	17.23	10.56
12	17.97	11.23
13	18.63	11.99
14	19.18	12.83
15	19.62	13.72
16	19.96	14.66
17	19.98	14.80

** Corrected JANBU FOS = 3.018 ** (Fo factor = 1.081)

Failure surface No. 5 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)

1	8.03	10.00
2	8.91	9.53
3	9.84	9.16
4	10.81	8.92
5	11.80	8.80
6	12.80	8.80
7	13.79	8.93
8	14.76	9.17
9	15.69	9.54
10	16.57	10.02
11	17.38	10.60
12	18.12	11.28
13	18.76	12.05
14	19.30	12.89
15	19.74	13.79
16	20.06	14.74
17	20.07	14.80

** Corrected JANBU FOS = 3.019 ** (Fo factor = 1.082)

Failure surface No. 6 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.71	10.00
2	8.60	9.54
3	9.54	9.20
4	10.52	8.99
5	11.51	8.90
6	12.51	8.95
7	13.50	9.12
8	14.45	9.42
9	15.36	9.84
10	16.20	10.38
11	16.97	11.02
12	17.65	11.75
13	18.23	12.57
14	18.69	13.45
15	19.04	14.39
16	19.13	14.80

** Corrected JANBU FOS = 3.020 ** (Fo factor = 1.082)

Failure surface No. 7 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.55	10.00
2	8.43	9.52
3	9.36	9.16
4	10.34	8.92
5	11.33	8.81

6	12.33	8.82
7	13.32	8.96
8	14.28	9.22
9	15.21	9.60
10	16.07	10.10
11	16.87	10.70
12	17.59	11.40
13	18.21	12.19
14	18.72	13.04
15	19.13	13.96
16	19.38	14.80

** Corrected JANBU FOS = 3.024 ** (Fo factor = 1.082)

Failure surface No. 8 specified by 17 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.24	10.00
2	8.12	9.52
3	9.05	9.16
4	10.02	8.91
5	11.01	8.78
6	12.01	8.77
7	13.00	8.89
8	13.97	9.12
9	14.91	9.48
10	15.80	9.94
11	16.62	10.51
12	17.37	11.17
13	18.03	11.92
14	18.60	12.74
15	19.06	13.63
16	19.41	14.57
17	19.46	14.80

** Corrected JANBU FOS = 3.026 ** (Fo factor = 1.081)

Failure surface No. 9 specified by 18 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.39	10.00
2	8.31	9.59
3	9.26	9.28
4	10.23	9.06
5	11.22	8.93
6	12.22	8.90
7	13.22	8.96
8	14.21	9.12
9	15.18	9.38
10	16.11	9.72
11	17.01	10.16

12	17.87	10.68
13	18.67	11.28
14	19.40	11.96
15	20.07	12.70
16	20.67	13.50
17	21.18	14.36
18	21.39	14.80

** Corrected JANBU FOS = 3.031 ** (Fo factor = 1.074)

Failure surface No.10 specified by 16 coordinate points

Point No.	x-surf (m)	y-surf (m)
1	7.39	10.00
2	8.30	9.57
3	9.25	9.26
4	10.23	9.08
5	11.23	9.01
6	12.23	9.07
7	13.21	9.25
8	14.16	9.56
9	15.07	9.98
10	15.92	10.50
11	16.70	11.14
12	17.39	11.86
13	17.98	12.66
14	18.48	13.53
15	18.86	14.46
16	18.95	14.80

** Corrected JANBU FOS = 3.032 ** (Fo factor = 1.080)

```
*********************************************************************
**                                                                 **
**  Out of the    400 surfaces generated and analyzed by XSTABL,   **
**       32 surfaces were found to have MISLEADING FOS values.     **
**                                                                 **
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The following is a summary of the TEN most critical surfaces

Problem Description : Wall SV-1, Sta. 12+60

	Modified JANBU FOS	Correction Factor	Initial x-coord (m)	Terminal x-coord (m)	Available Strength (kN)
1.	3.009	1.082	8.18	19.19	7.871E+02

2.	3.012	1.076	7.08	20.19	8.749E+02
3.	3.013	1.077	7.39	20.66	9.271E+02
4.	3.018	1.081	7.87	19.98	8.931E+02
5.	3.019	1.082	8.03	20.07	8.952E+02
6.	3.020	1.082	7.71	19.13	7.988E+02
7.	3.024	1.082	7.55	19.38	8.442E+02
8.	3.026	1.081	7.24	19.46	8.622E+02
9.	3.031	1.074	7.39	21.39	9.744E+02
10.	3.032	1.080	7.39	18.95	7.608E+02

* * * END OF FILE * * *