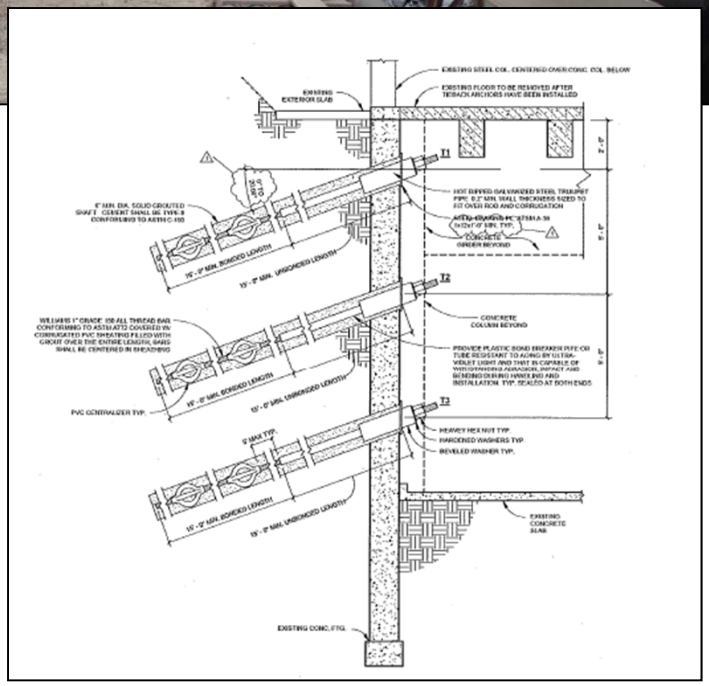
A3GEO

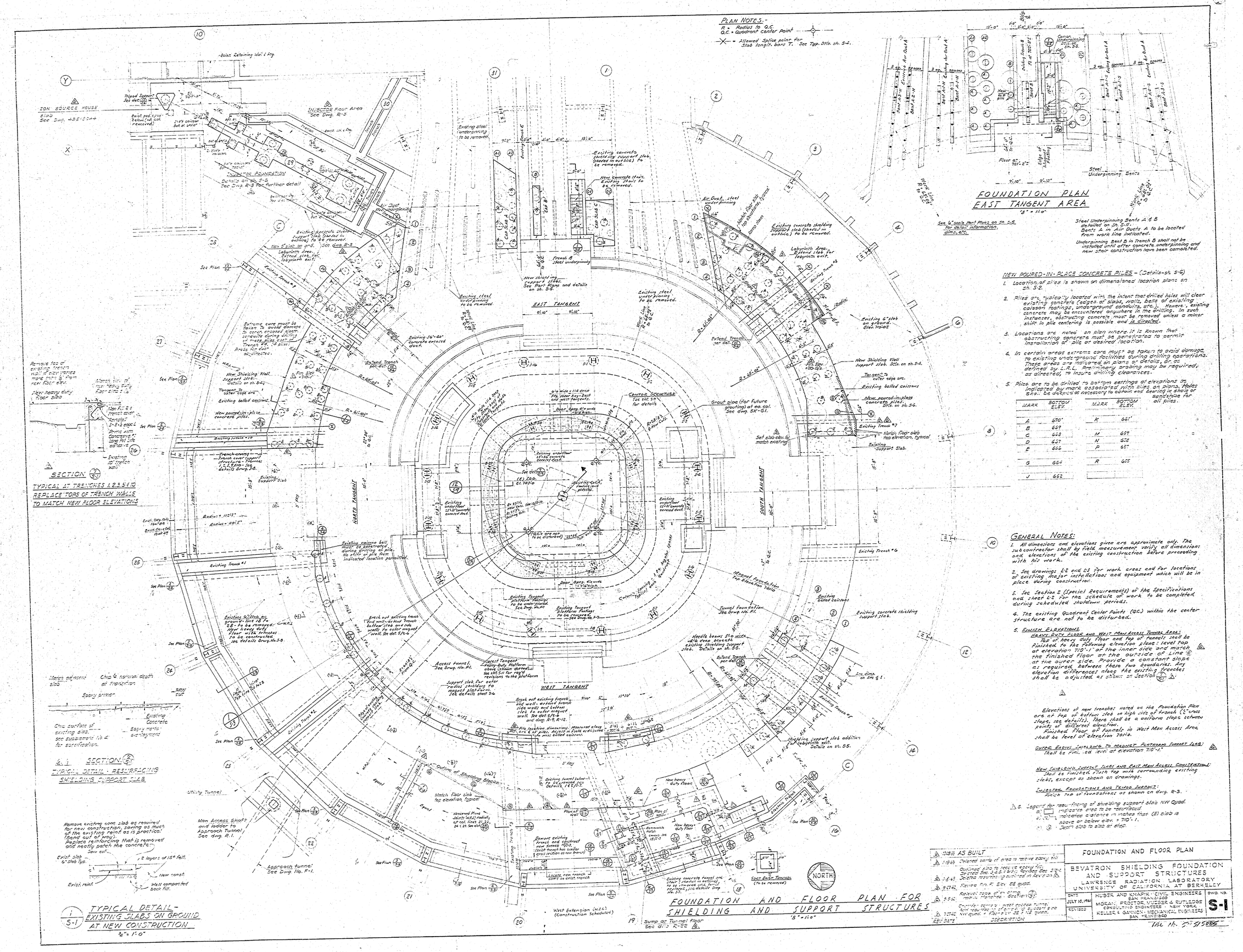
FY 2014 Investigation
Integrative Genomics Building (IGB)

Previous Plans and Calculations



September 30, 2014 Compilation

Huber and Knapik, et al, 1961, “Bevatron Shielding Foundation and Support Structures, Lawrence Radiation Laboratory, University of California at Berkeley,” drawing no. S-1 Foundation and Floor Plan dated July 10, 1961.


PLAN NOTES.-
R = Radius to Q.C.
Q.C. = Quadrant Center Point
= Allowed Splice point for Slab longit. bars T. See Typ. Dtls. sh. S-4.
ION SOURCE HOUSE
INJECTOR Floor Area
See Dwg. R-3
ION SOURCE FOUNDATION
EAST TANGENT
NORTH TANGENT
SOUTH TANGENT
WEST TANGENT
CENTER STRUCTURE
See sht. S-9 for details
Grout pipe (for future grouting) at ea. col. See dwg. SK-61.
Existing concrete shielding support slab.
Existing concrete shielding support slab (sheet in outline) to be removed.
Existing steel underpinning to be removed.
Existing steel underpinning to be removed.
Existing steel underpinning to be removed.
Existing 6" slab on ground. Elev. 710.0±
New Shielding Wall Support slab. See on sh. S-4.
Tangent to outer edge arc.
Existing belled caissons
New poured-in-place concrete piles. Dtls. on sh. S-6.
Existing Trench #7
Match floor slab top elevation, typical
Existing Support Slab.
Set slab btw. to match existing
Existing Trench #6
Existing Trench #5
Existing Trench #4
Existing Trench #3
Existing Trench #2
Existing Trench #1
Needle beams 5'-0" wide, 4'-0" deep, beneath existing shielding support slab. Details on sh. S-5.
Extend Trench per det.
Shielding support slab addition for labyrinth exit. Details on sh. S-5.
Existing concrete shielding support slab (sheet in outline) to be removed.
Labyrinth Area. Extend slab for labyrinth exit.
Air Duct. steel underpinning
Steel Underpinning Bents
Floor el. 721.0±
Edge of Existing Paving
Steel Underpinning Bents A & B detailed on sh. S-11.
Bents A in Air Ducts A to be located from work line indicated.
Underpinning Bent B in Trench B shall not be installed until after concrete underpinning and new stair construction have been completed.
See "A" sheets Part Plans on sh. S-5. for detail information, dims. etc.
FOUNDATION PLAN
EAST TANGENT AREA
1/8" = 1'-0"
NEW POURED-IN-PLACE CONCRETE PILES - (Details-sh. S-6)
1. Location of piles is shown on dimensioned location plans on sh. S-2.
2. Piles are typically located with the intent that drilled holes will clear existing concrete (edges of slabs, walls, bells of existing caisson footings, underground conduits, etc.). However, existing concrete may be encountered anywhere in the drilling. In such instances, obstructing concrete must be removed unless a minor shift in pile centering is possible and is directed.
3. Locations are noted on plan where it is known that obstructing concrete must be penetrated to permit installation of pile at desired location.
4. In certain areas extreme care must be taken to avoid damage to existing underground facilities during drilling operations. These areas are indicated on plans or details, or as defined by L.R.L. Preliminary probing may be required, as directed, to insure drilling clearances.
5. Piles are to be drilled to certain settings of elevations as indicated by mark associated with piles on plans. Holes shall be deepened as necessary to obtain end bearing in shale or sandstone for all piles.
MARK | BOTTOM ELEV. | MARK | BOTTOM ELEV.
A 670' | K 661'
B 669 | L
C 668 | M 659
D 667 | N 658
E 666 | P 657
G 664 | R 655
J 662
GENERAL NOTES:
1. All dimensions and elevations given are approximate only. The subcontractor shall by field measurement verify all dimensions and elevations of the existing construction before proceeding with his work.
2. See drawings L-2 and L-3 for work areas and for locations of existing major installations and equipment which will be in place during construction.
3. See Section 2 (Special Requirements) of the Specifications and sheet L-2 for the schedule of work to be completed during scheduled shutdown periods.
4. The existing Quadrant Center Points (Q.C.) within the center structure are not to be disturbed.
5. FINISH ELEVATIONS
HEAVY DUTY FLOOR AND WEST MAN ACCESS TUNNEL AREA:
Top of heavy duty floor and top of tunnel shall be finished to the following elevation plane: level top at elevation 710'-1" at the inner side and match the finished floor at the outside of Line ⓒ at the outer side. Provide a constant slope as required between these two boundaries. Any elevation differences along the existing trenches shall be adjusted as shown on Section
Elevations of new trenches noted on the Foundation Plan are at top of bottom slab on high side of trench (½" cross slope, see details). There shall be a uniform slope between points of different elevation.
Finished floor at tunnels in West Man Access Area shall be level at elevation 710'-0.
OUTER EQUIP. TUNNEL TO MAGNET PLATFORM SUPPORT SLAB:
Shall be finished level at elevation 710'-1"
NEW SHIELDING SUPPORT SLABS AND EAST MAN ACCESS CONSTRUCTION:
Shall be finished flush top with surrounding existing slabs, except as shown on drawings.
TRENCHES, FOUNDATIONS AND TRIPOD SUPPORTS:
Finish top of foundations as shown on dwg. R-3.
6. Legend for resurfacing of shielding support slab NW Quad.
indicate area to be resurfaced
indicate elevations in metres that (2) slab is above or below elev. + 710'-1".
Depth slab to slab at step
SECTION
TYPICAL AT TRENCHES 1,2,3,5 & 10
REPLACE TOPS OF TRENCH WALLS TO MATCH NEW FLOOR ELEVATIONS
SECTION
TYPICAL DETAIL - RESURFACING SHIELDING SUPPORT SLAB
TYPICAL DETAIL - EXISTING SLABS ON GROUND AT NEW CONSTRUCTION
3/8" = 1'-0"
Remove existing conc. slab as required for new construction, saving as much of the existing reinf. as is practical. (Bend out of way). Replace reinforcing that is removed and neatly patch the concrete.
Approach tunnel See Dwg. No. F-1.
Man Access Shaft and ladder to Approach Tunnel See dwg. R-1.
Utility Tunnel
West Extension (W.E.C.) (Construction Schedule)
Sump at Tunnel Floor See dwg. R-22
EXIST. EXIST. TUNNEL (To be removed)
NORTH
FOUNDATION AND FLOOR PLAN FOR SHIELDING AND SUPPORT STRUCTURES
1/8" = 1'-0"
AS BUILT
FOUNDATION AND FLOOR PLAN
BEVATRON SHIELDING FOUNDATION AND SUPPORT STRUCTURES
LAWRENCE RADIATION LABORATORY
UNIVERSITY OF CALIFORNIA AT BERKELEY
HUBER AND KNAPIK - CIVIL ENGINEERS SAN FRANCISCO
MORAN, PROCTOR, MUESER & RUTLEDGE CONSULTING ENGINEERS - NEW YORK
KELLER & GANNON - MECHANICAL ENGINEERS SAN FRANCISCO
JULY 10, 1961
S-1
REDUCTION 30X

Paul F. Fratessa Associates, Inc. (PFFA), Consulting Structural Engineers, 1992, “Structural Calculations, Lawrence Berkeley Laboratory, Seismic Slope Stabilization Project, Berkeley, California,” PFFA Job No. 1509-025, dated September 30, 1992.

PAUL F. FRATESSA ASSOCIATES, INC.
CONSULTING STRUCTURAL ENGINEERS
11881 Skyline Blvd., Oakland, CA 94619 415/482-3341

Paul F. Fratessa, S.E.
Michael A. Forbes, S.E.

Lawrence Berkeley Laboratory
Seismic Slope Stabilization Project
Berkeley, California

PFFA Job No. 1509-025

September 30, 1992

Structural Calculations

UNIVERSITY OF CALIFORNIA
LAWRENCE BERKELEY LABORATORY

SEP 30 1992

PLANT ENGINEERING

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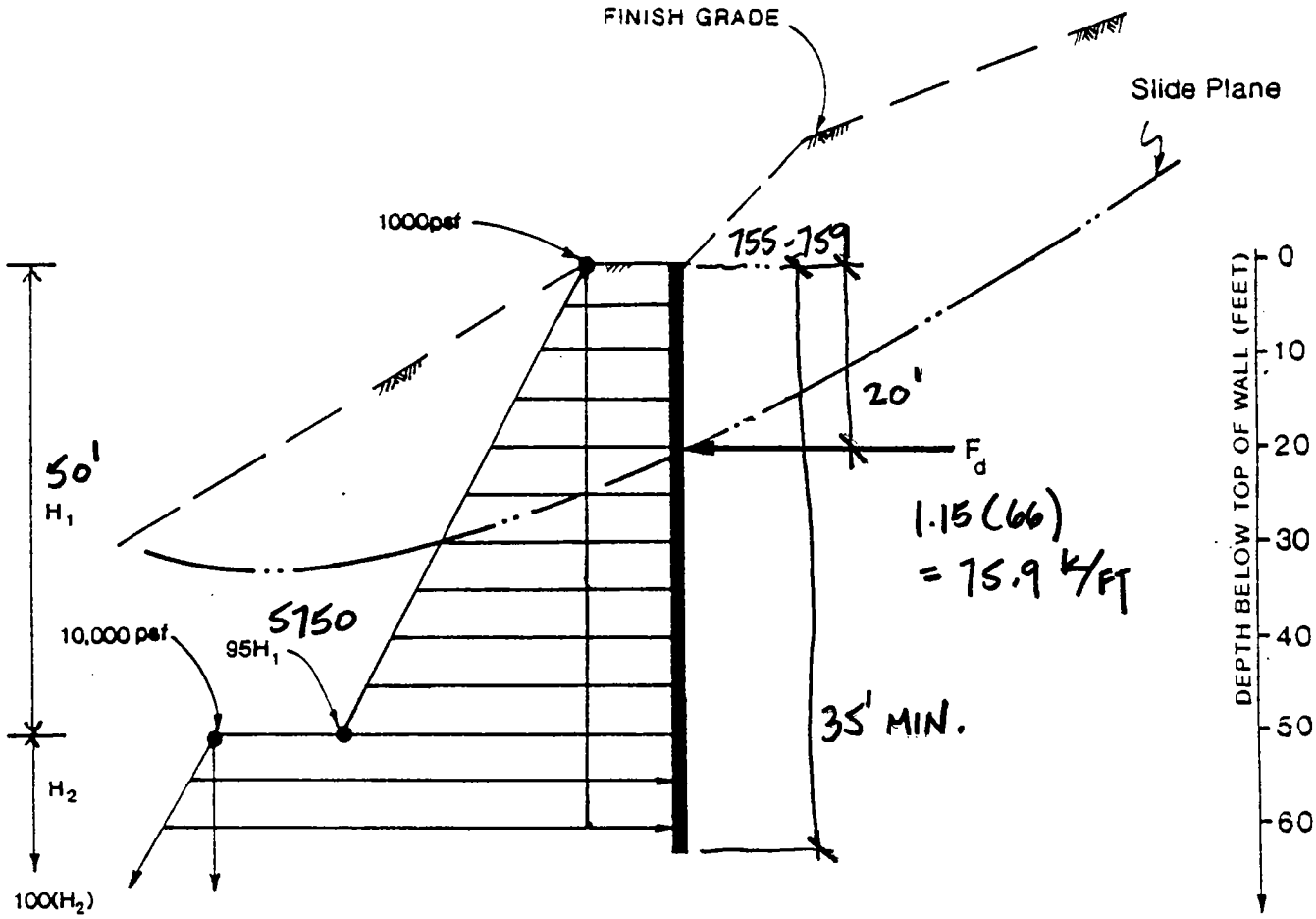
Design Profile I	A1	to	A5
Design Profile II	B1	to	B4
Design Profile III	C1	to	C2
Design Profile IV	D1	to	D3
Design Profile V	E1	to	E2
Details	F1	to	F4



Required shearing resistance (F_d)

H_1 = 50 Feet

H_2 = Varies

NOTES:

1. Minimum depth of embedment for design profile I is 35 feet. Refer to report text for details and Table 7 for required shear resistance.
2. Refer to Site Plan-Building 51, Figure 5 for location of design profile I.
3. Refer to text of report for description of the pressure diagrams.
4. The depths noted above are referenced to the existing ground surface at the top of the SPSE system.

Kaldveer Associates
Geoscience Consultants
A California Corporation

DESIGN PROFILE I

LAWRENCE BERKELEY LABORATORY
SEISMIC SLOPE STABILIZATION PROJECT
Berkeley, California

PROJECT NO.	DATE	
K1226-1-164	February 1992	Figure 20

A1

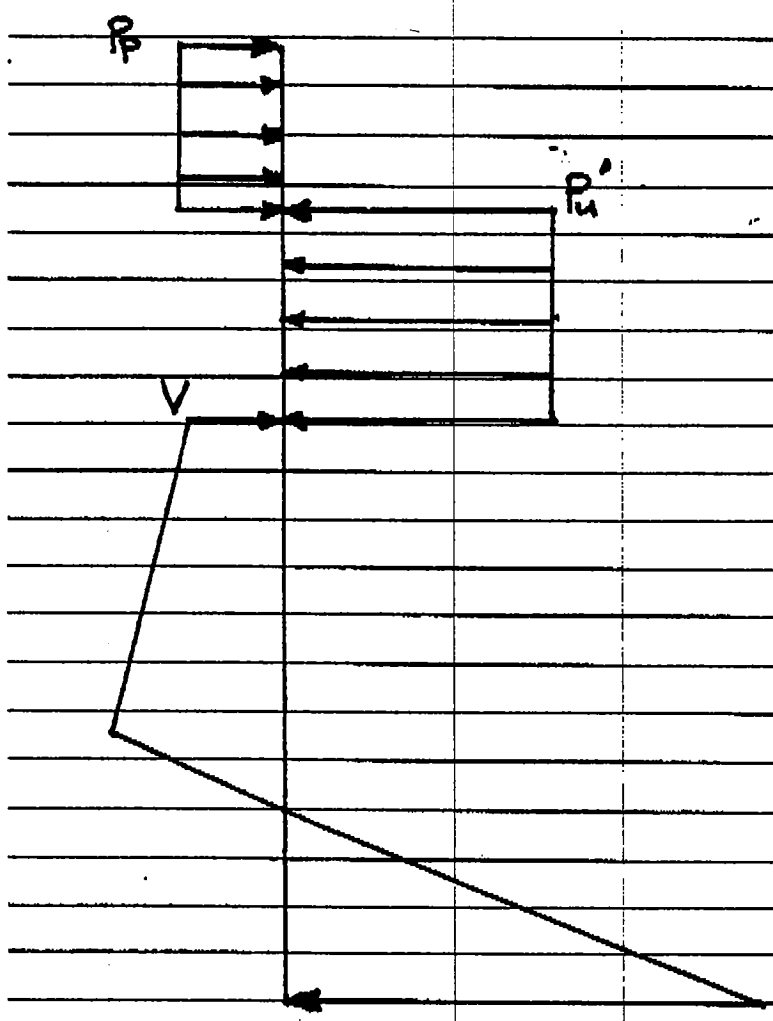
K1226-2 -

GAP 9/2/92

42

1992

MODIFIED LOADING DIAGRAM



$P_u' = P_u - 60H$

where H = Height of Retaining Wall

P_u = Distributed Design Force Previously Used In Computations For Design Profiles I to V

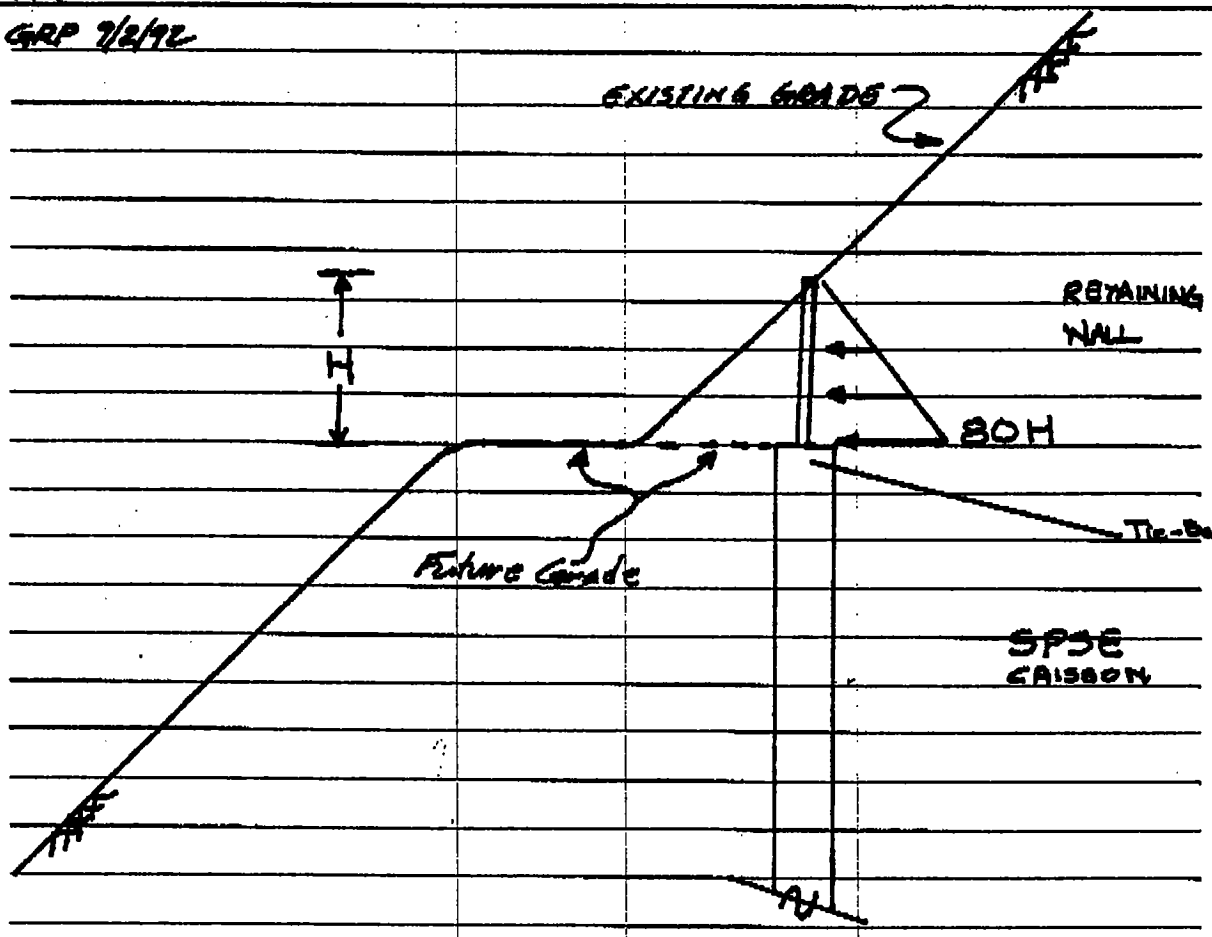
Resisting forces of the retaining wall will be developed in the SPSE caisson in accordance with our previous recommendations.

K1226-2-

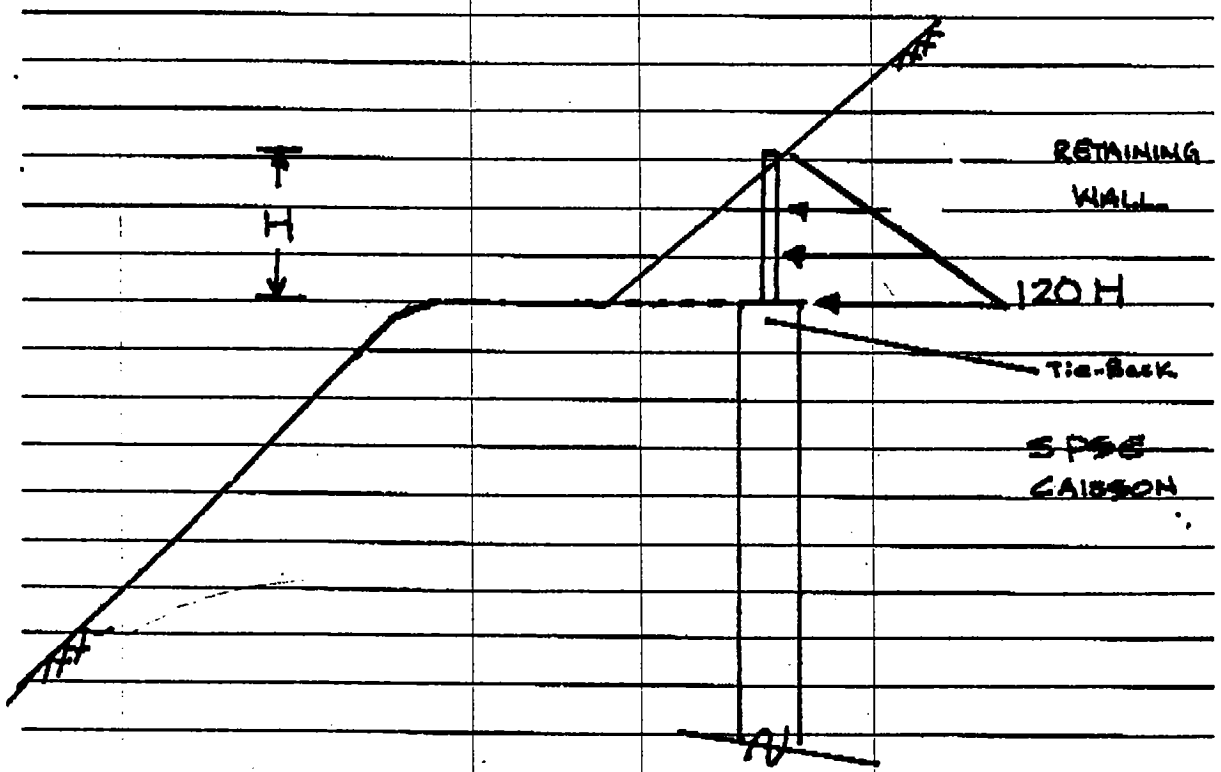
GRP 7/2/92

1/2

1992



I) STATIC DRAINED CONDITIONS



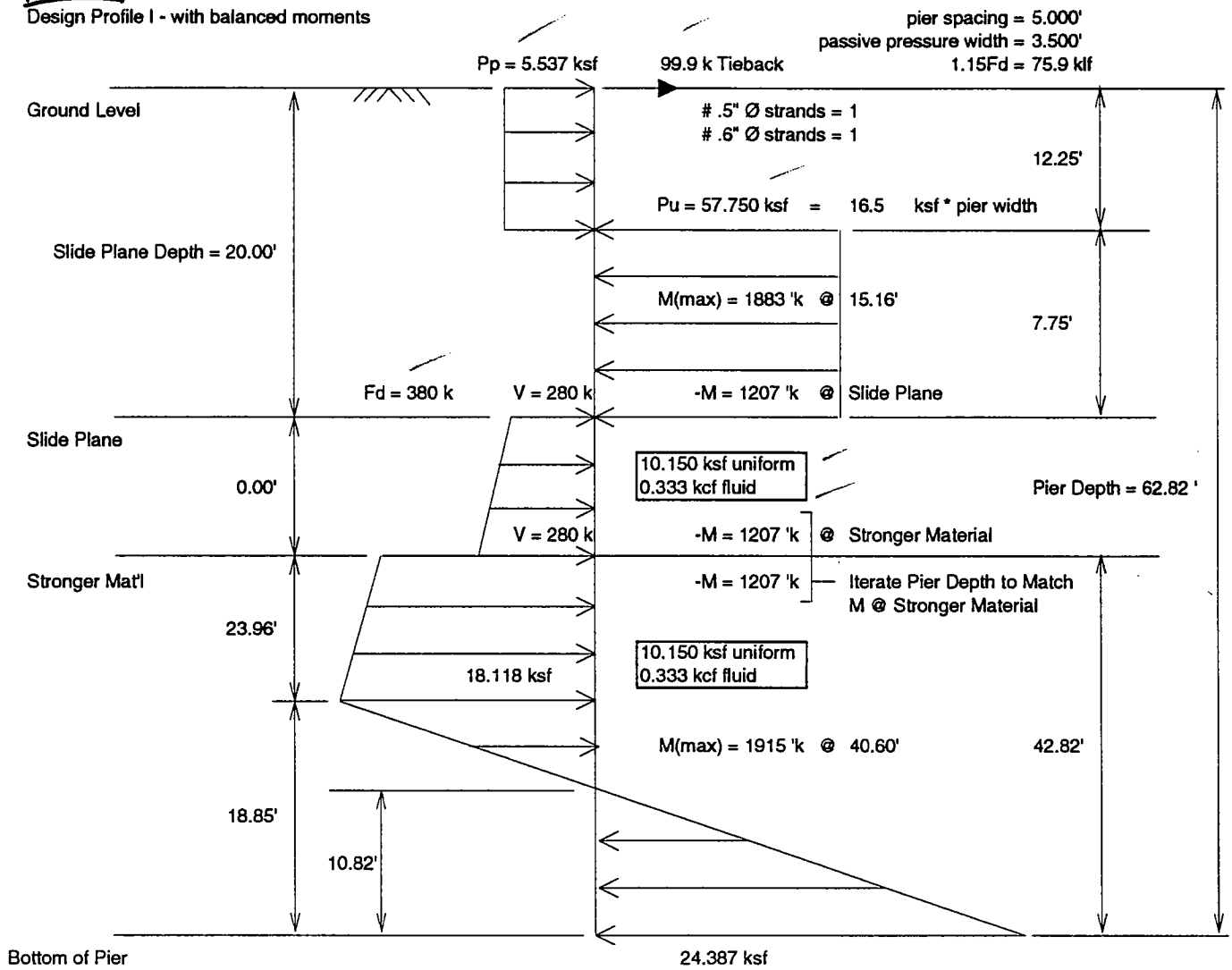
II) PSUEDO-STATIC DRAINED CONDITIONS

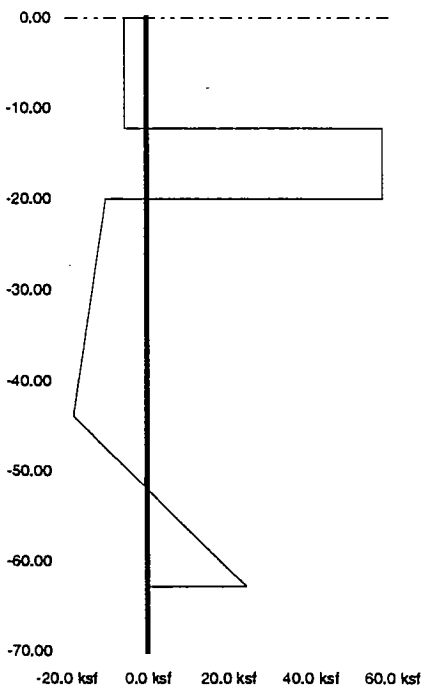
HARZA ENGINEERING COMPANY Sears Tower • 233 S. Wacker Dr. • Chicago, IL 60606 • Tel. (312) 831-3000 • Fax (312) 831-3999

A16

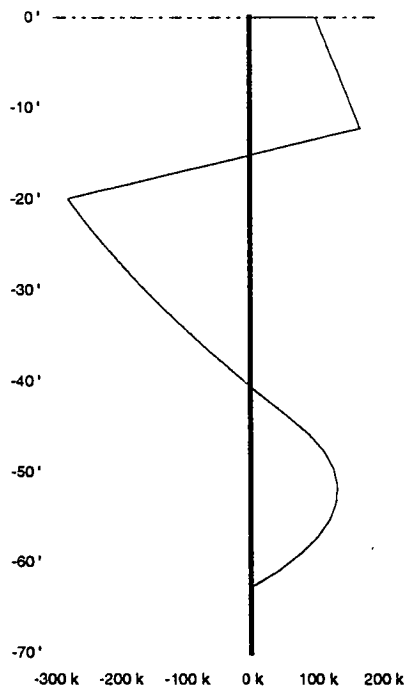
PRELIM.

Design Profile I - with balanced moments

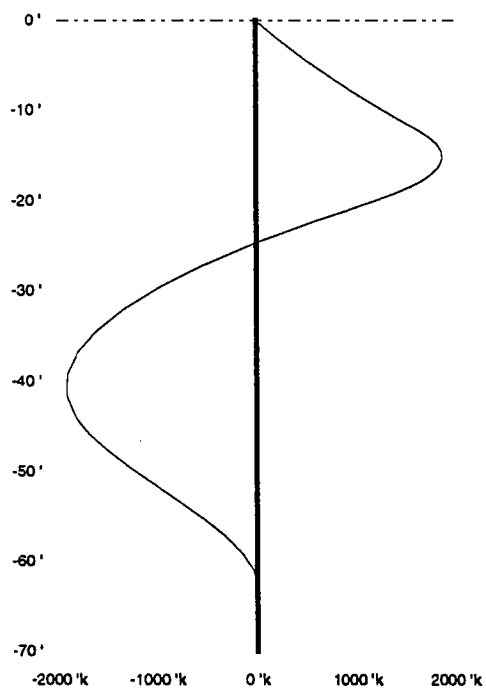




Pressure Diagram



Shear Diagram



Moment Diagram

PRELIM.

Design Profile I - with balanced moments

pier spacing = 5.000'
passive pressure width = 3.500'
1.15Fd = 75.9 klf

Pp = 5.537 ksf

99.9 k Tieback

Ground Level

.5" Ø strands = 1
.6" Ø strands = 1

12.25'

Pu = 57.750 ksf = 16.5 ksf * pier width

Slide Plane Depth = 20.00'

M(max) = 1883 'k @ 15.16'

7.75'

Fd = 380 k

V = 280 k

-M = 1207 'k @ Slide Plane

Slide Plane

27.20'

10.150 ksf uniform
0.333 kcf fluid

Pier Depth = 59.88 '

-V = 119 k

M = 1529 'k @ Stronger Material

Stronger Mat'l

M = 1529 'k — Iterate Pier Depth to Match M @ Stronger Material

0.03'

19.194 ksf uniform
1.500 kcf fluid

19.237 ksf

M(max) = 2015 'k @ 36.51'

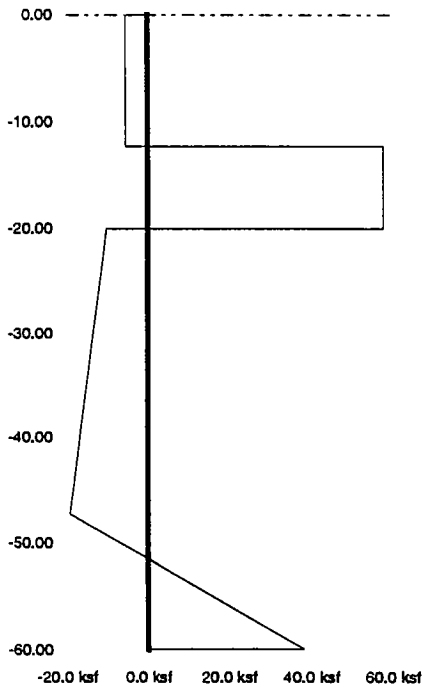
12.68'

12.65'

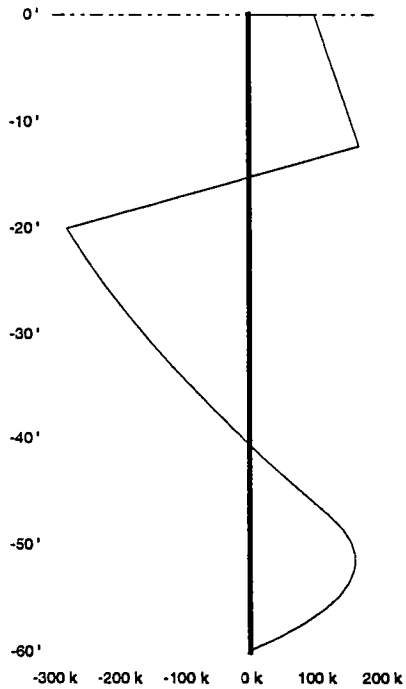
8.41'

Bottom of Pier

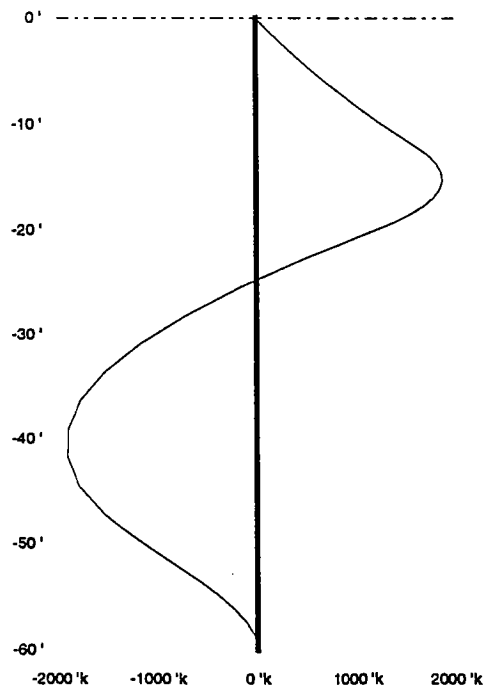
38.214 ksf
38.285 ksf = passive pressure width * (10+.095*(pier depth-50)



Pressure Diagram



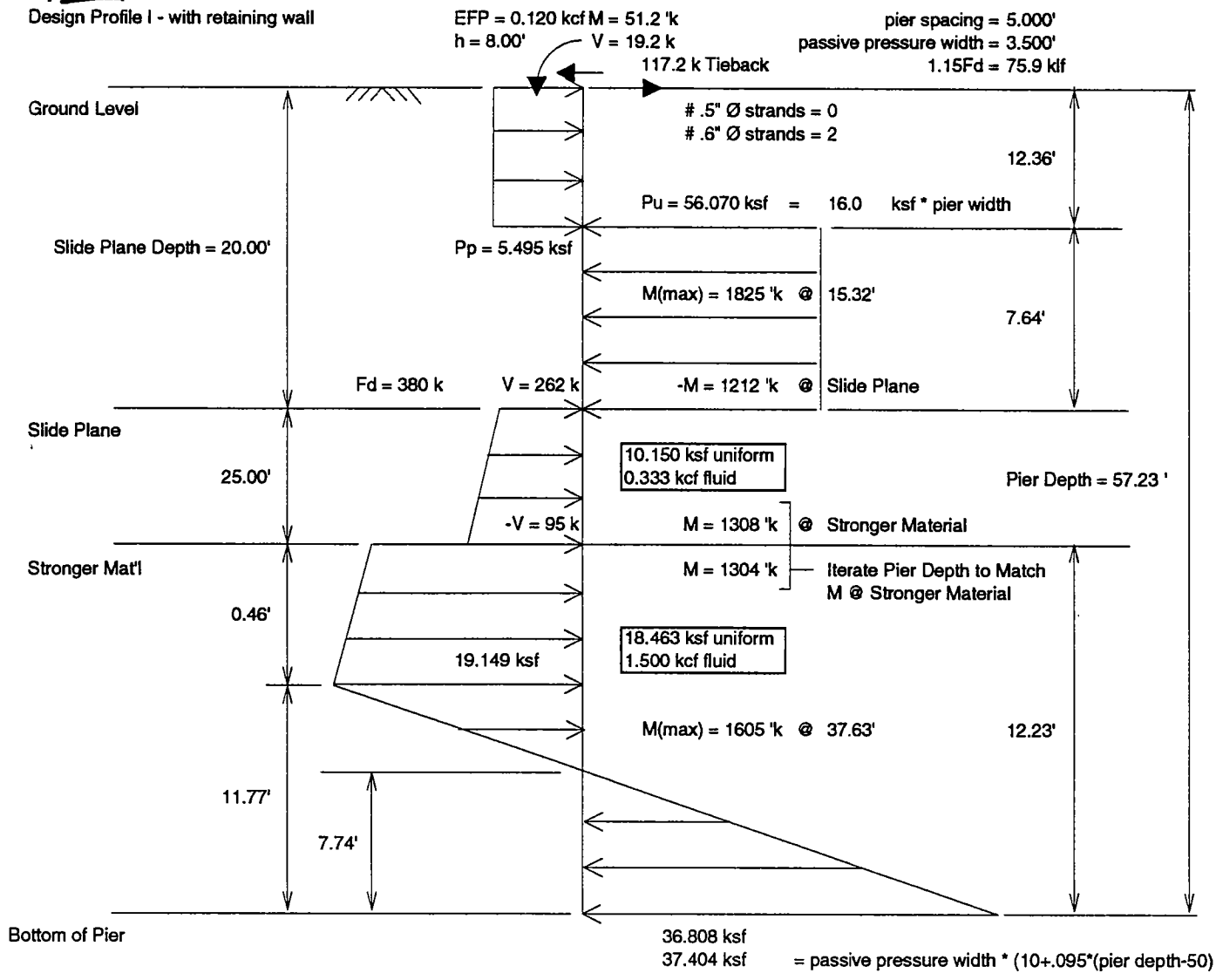
Shear Diagram

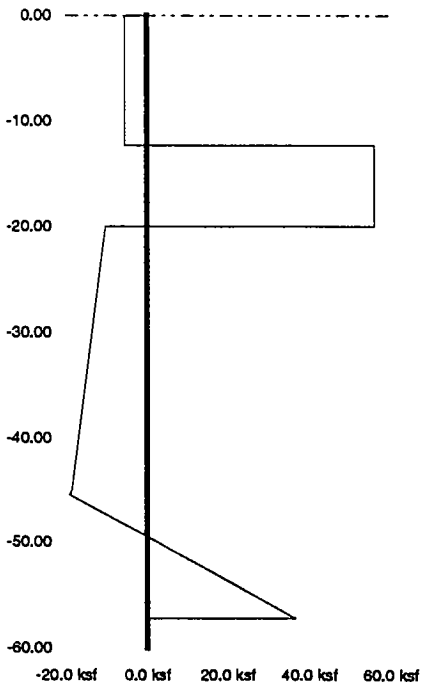


Moment Diagram

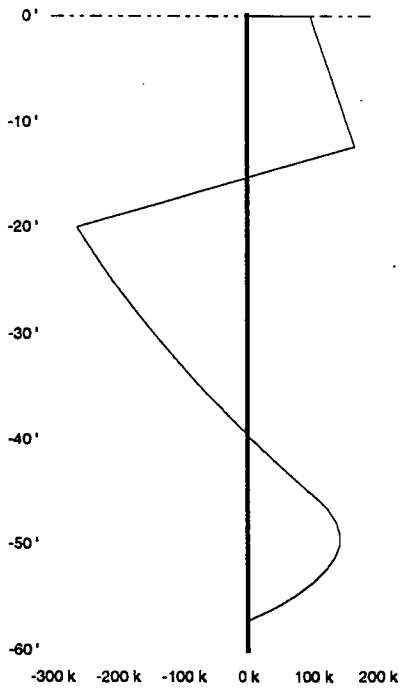
FINAL

Design Profile I - with retaining wall

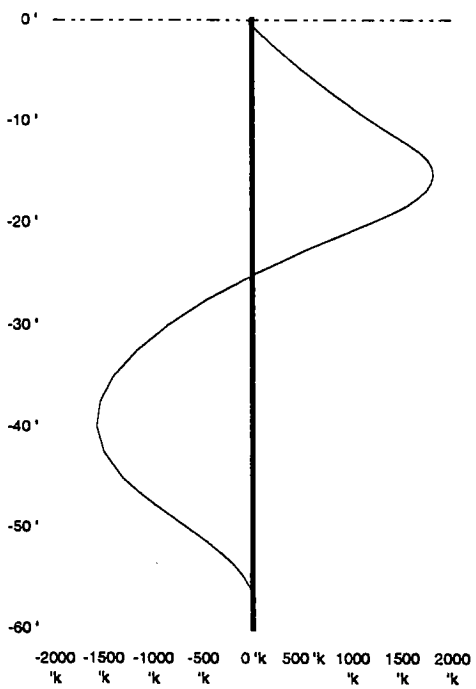




Pressure Diagram

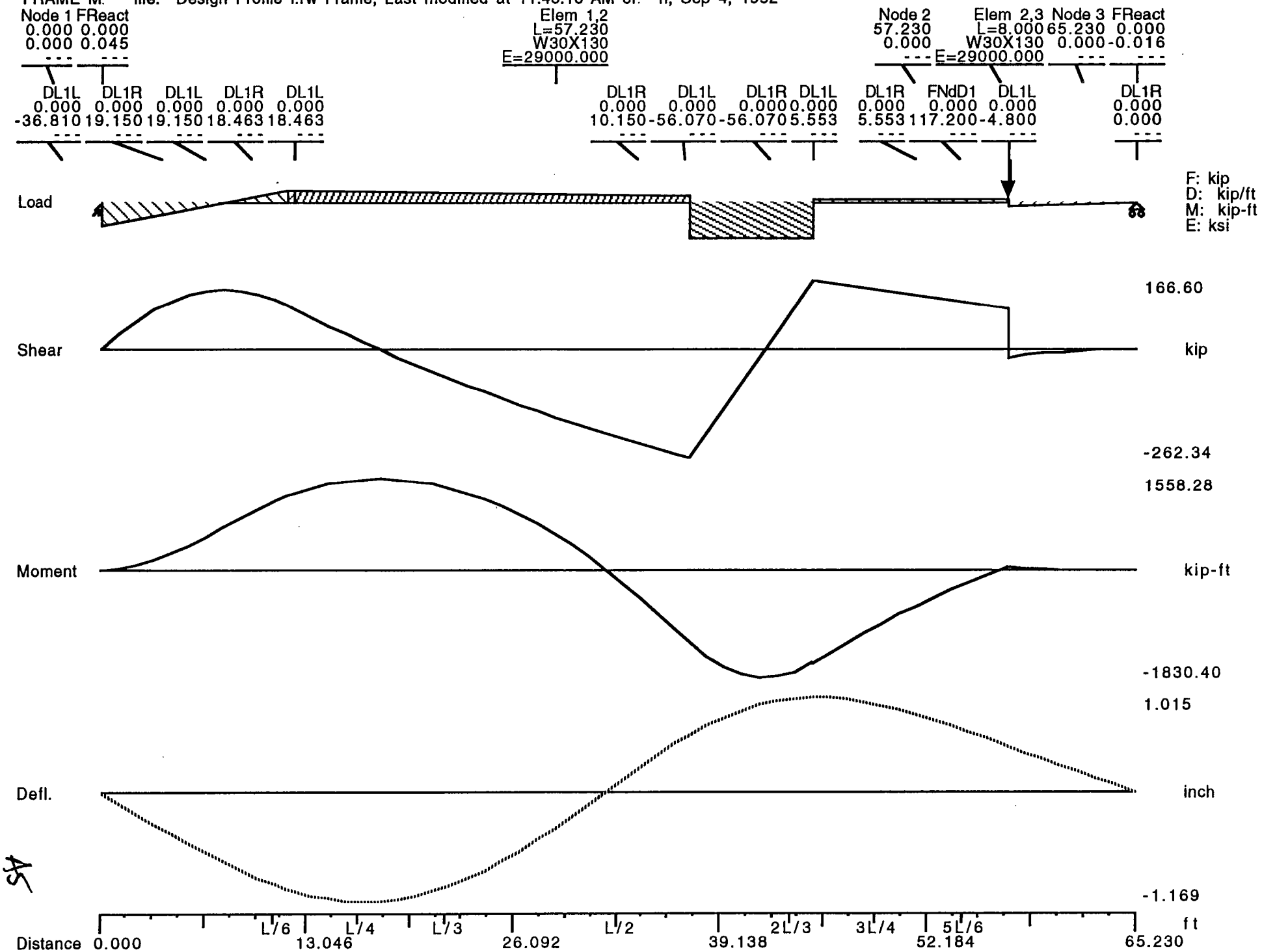


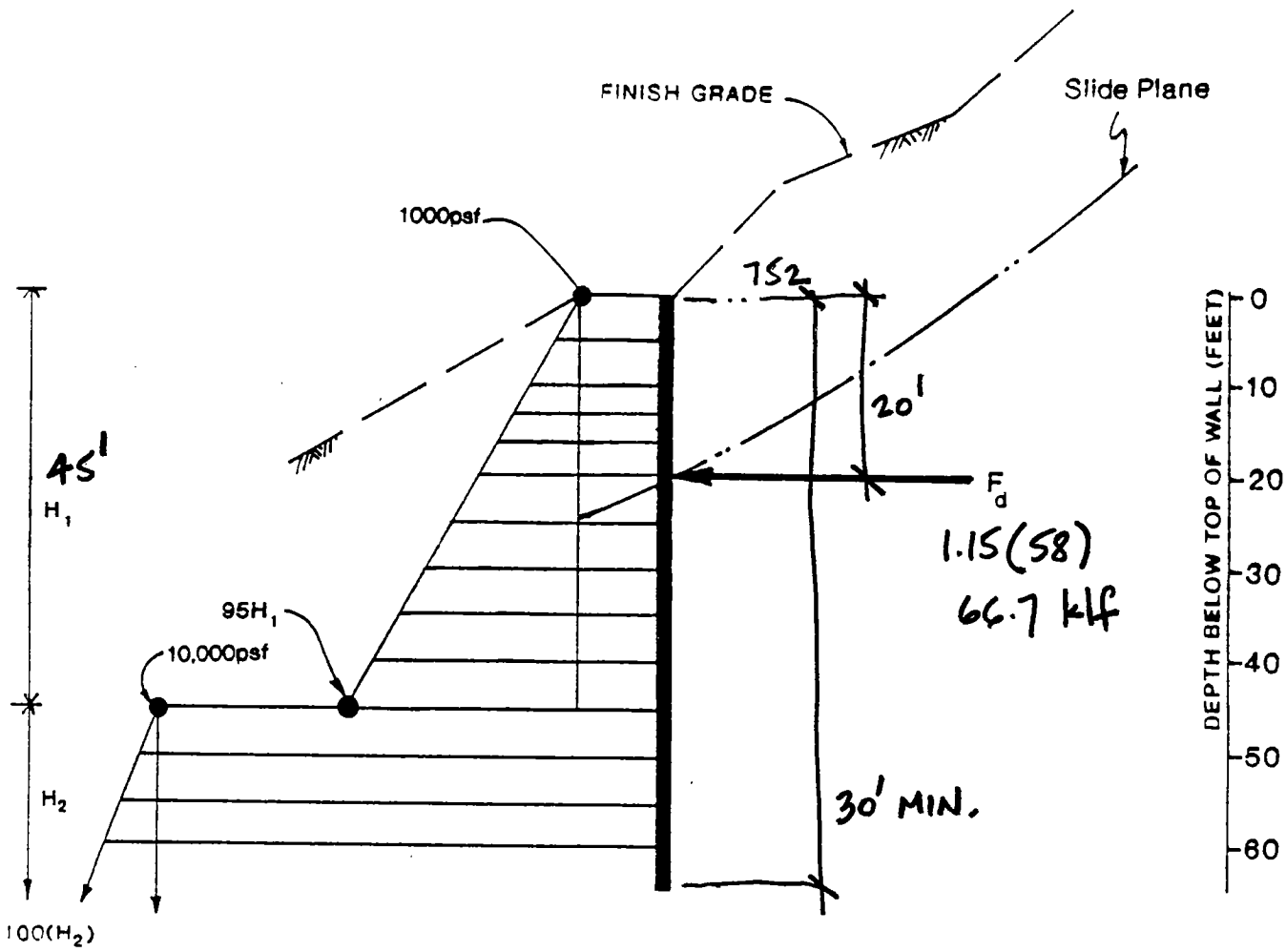
Shear Diagram



Moment Diagram

FRAME M. file: Design Profile I.rw Frame; Last modified at 11:46:16 AM on Fri, Sep 4, 1992





Required shearing resistance (F_d)

H_1 = 45 Feet

H_2 = Varies

NOTES:

1. Minimum depth of embedment for design profile II is 30 feet. Refer to report test for details and Table 7 for required shear resistance.
2. Refer to Site Plan-Building 51, Figure 5 for location of design profile II.
3. Refer to text of report for description of the pressure diagrams.
4. The depths noted above are referenced to the existing ground surface at the top of the proposed SPSE system.

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Geoscience Consultants
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DESIGN PROFILE II

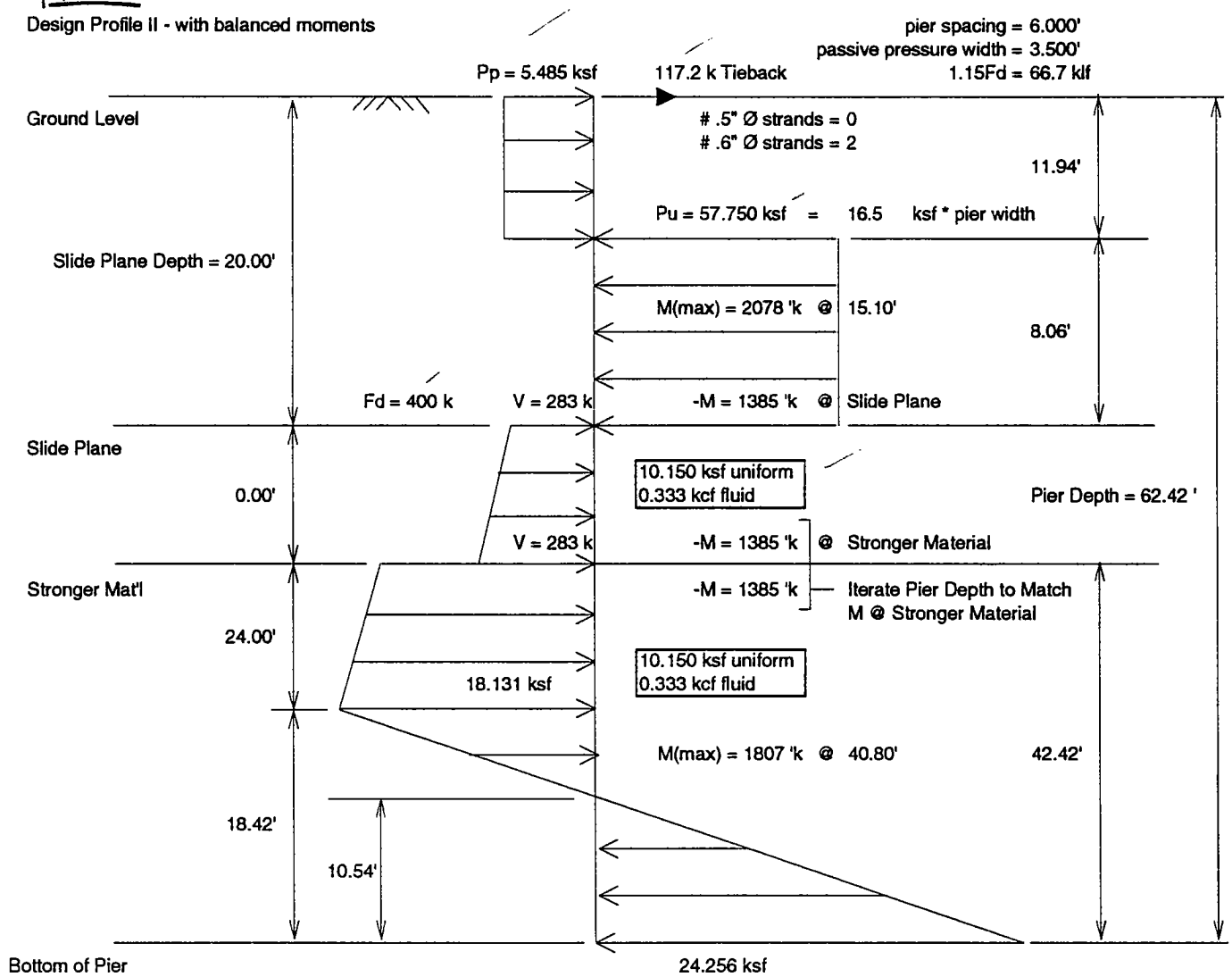
LAWRENCE BERKELEY LABORATORY
SEISMIC SLOPE STABILIZATION PROJECT
Berkeley, California

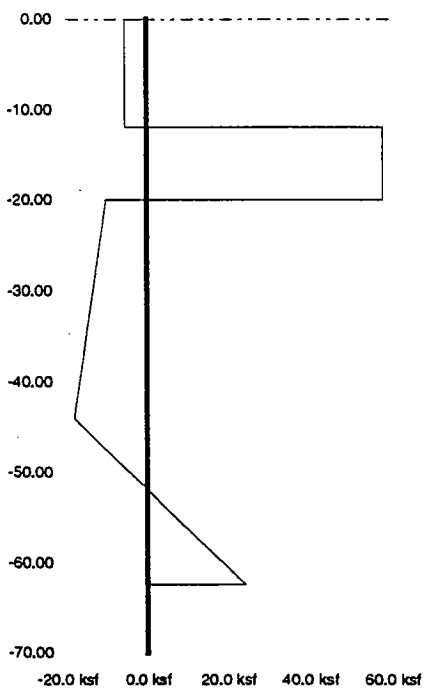
PROJECT NO.	DATE	Figure 21
K1226-1-164	February 1992	

B1

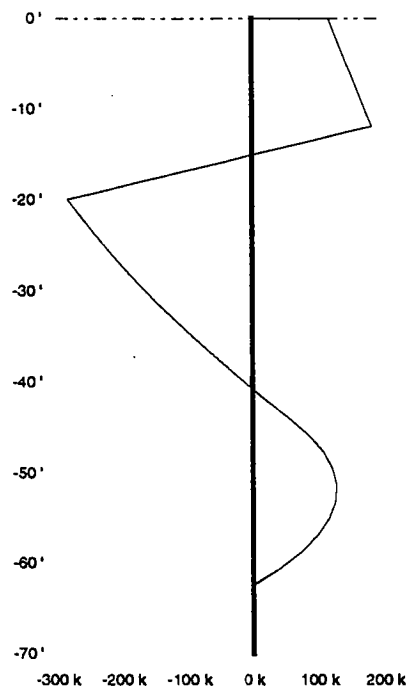
PRELIM.

Design Profile II - with balanced moments

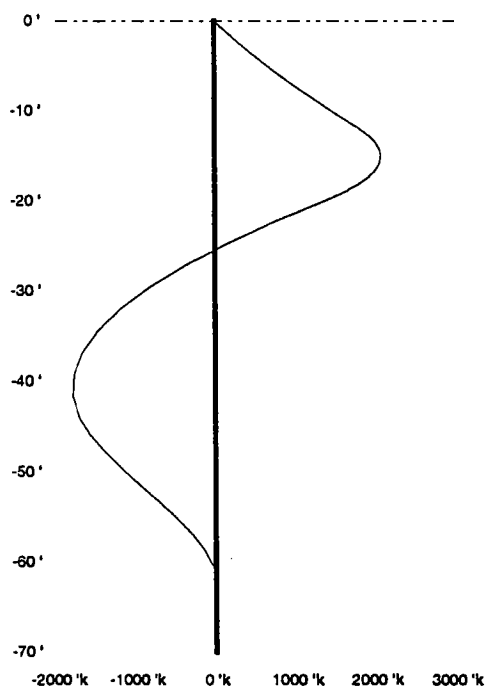




Pressure Diagram



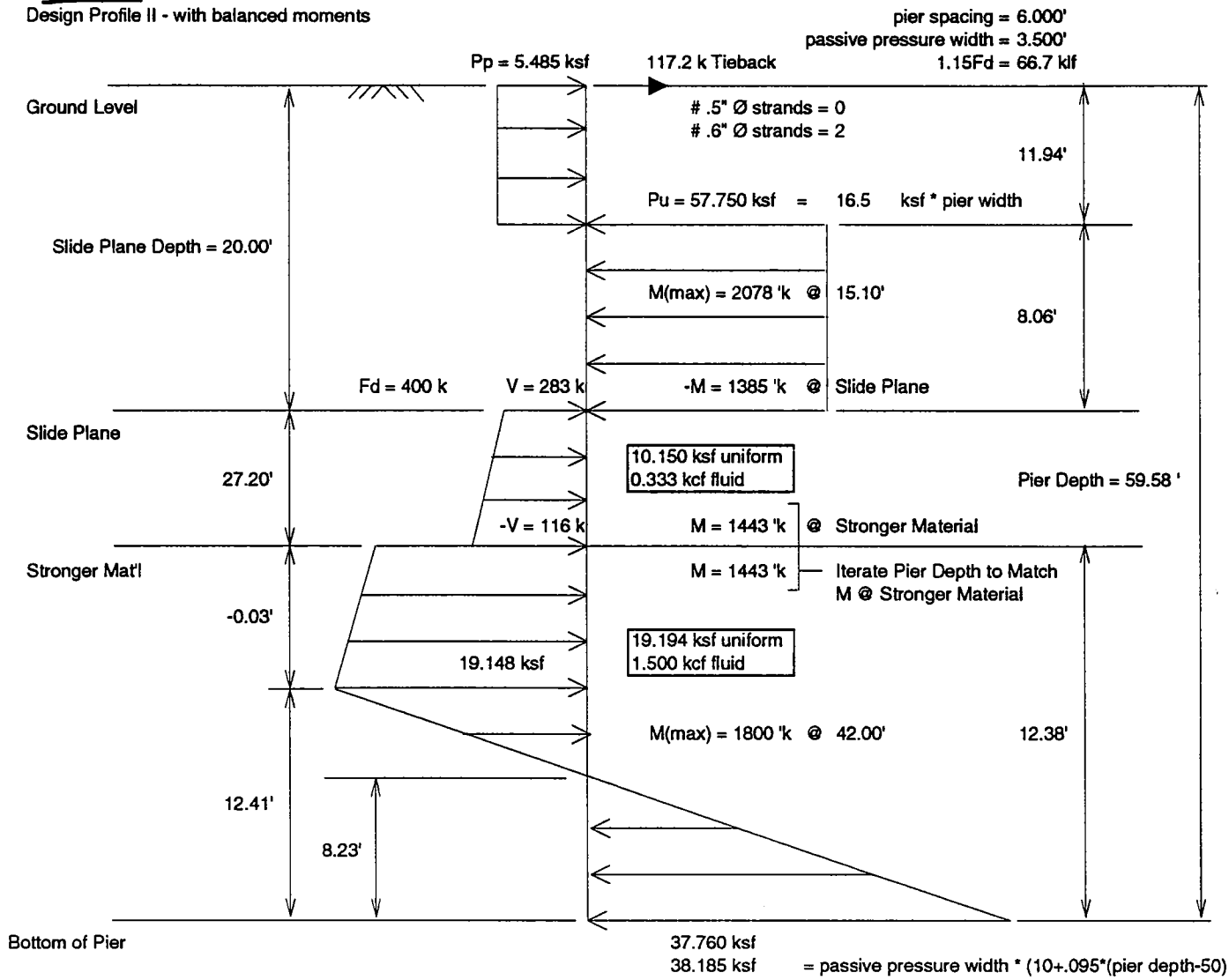
Shear Diagram

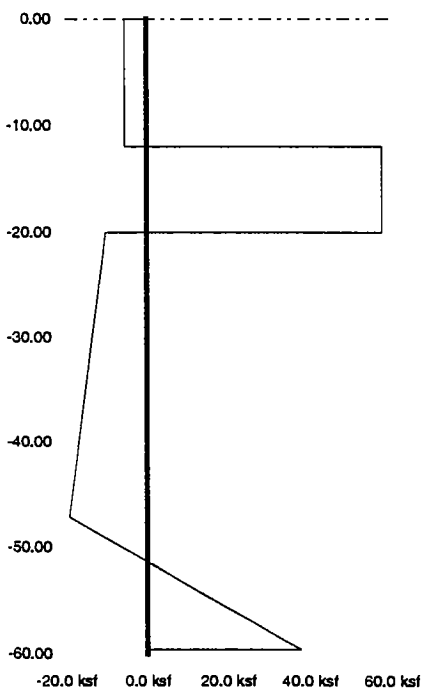


Moment Diagram

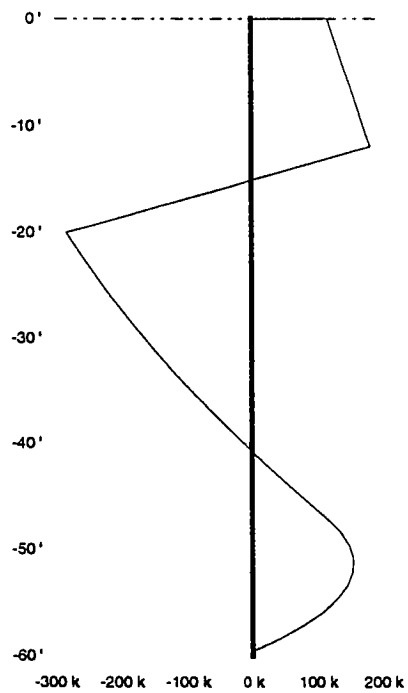
PRELIM.

Design Profile II - with balanced moments

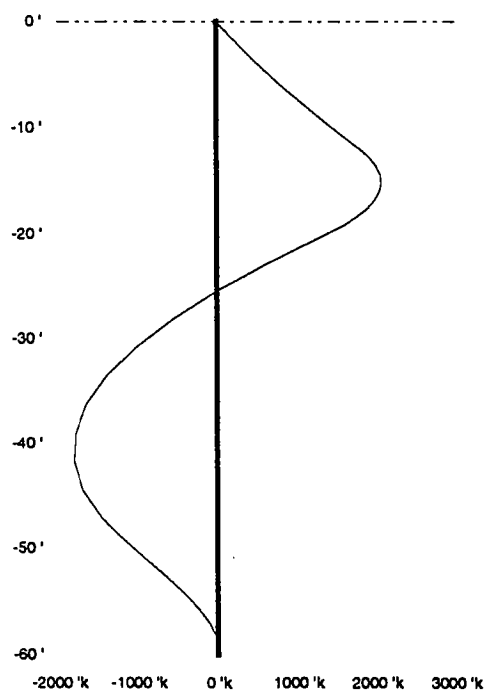




Pressure Diagram



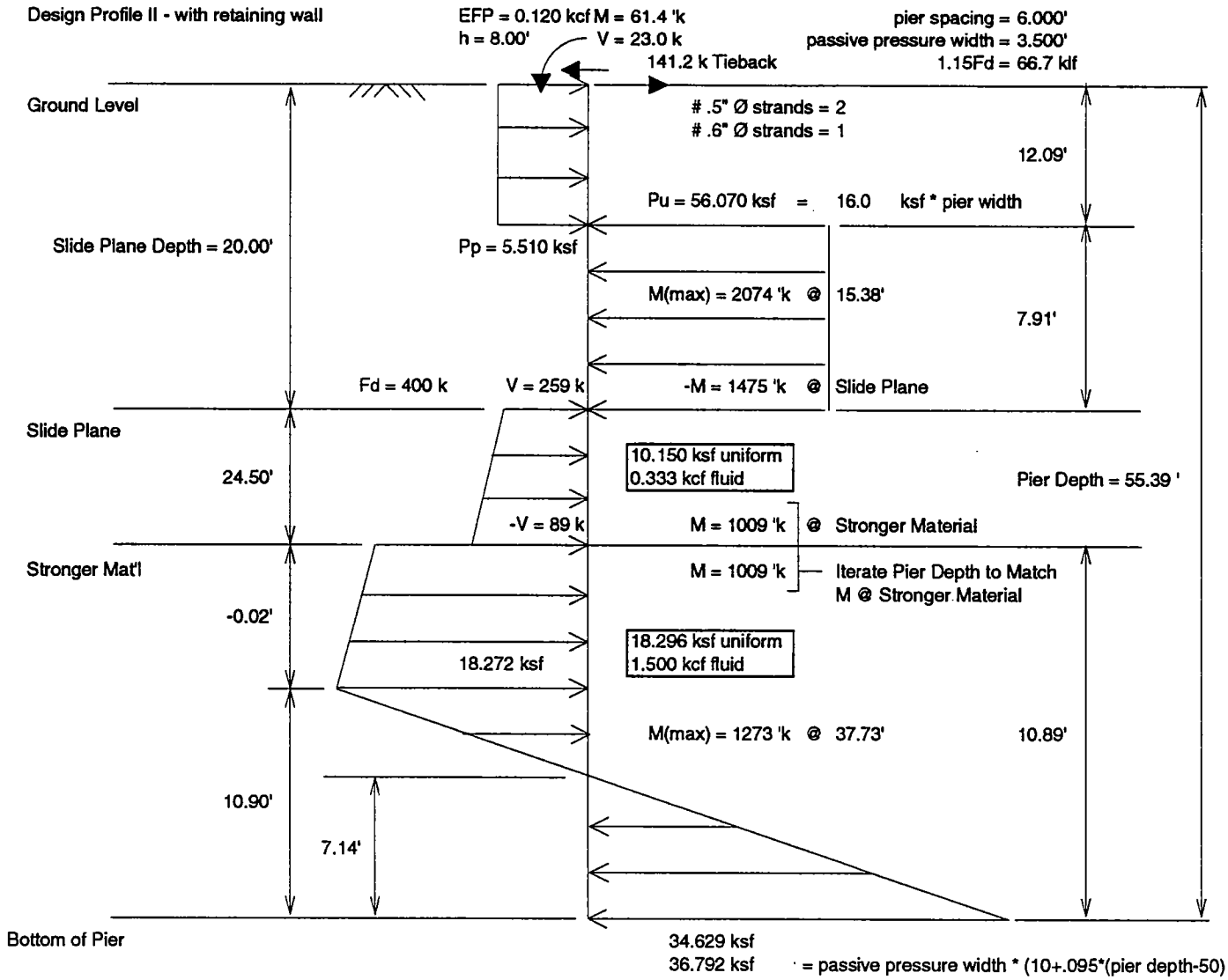
Shear Diagram

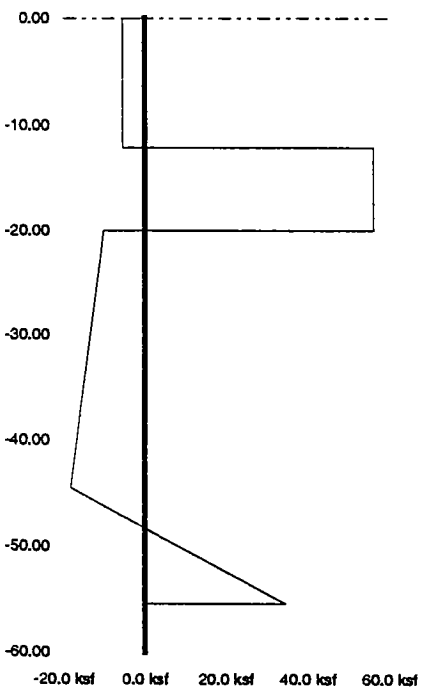


Moment Diagram

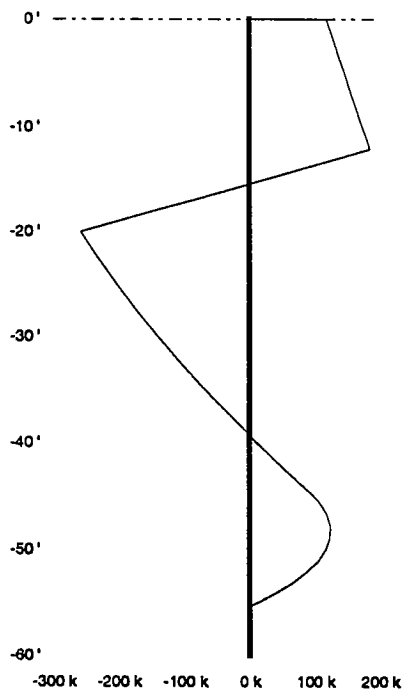
FINAL

Design Profile II - with retaining wall

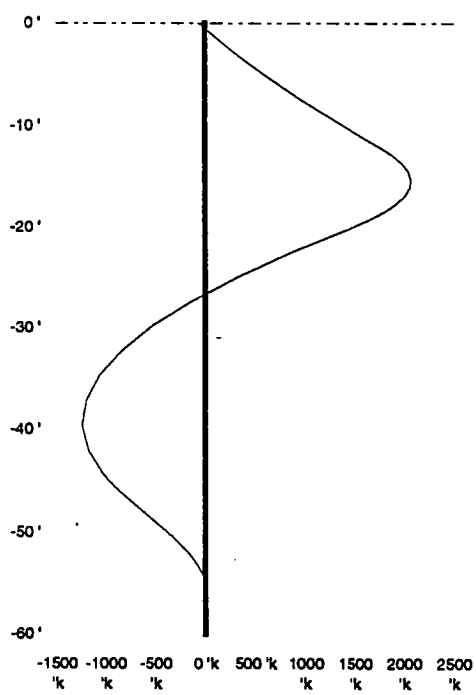




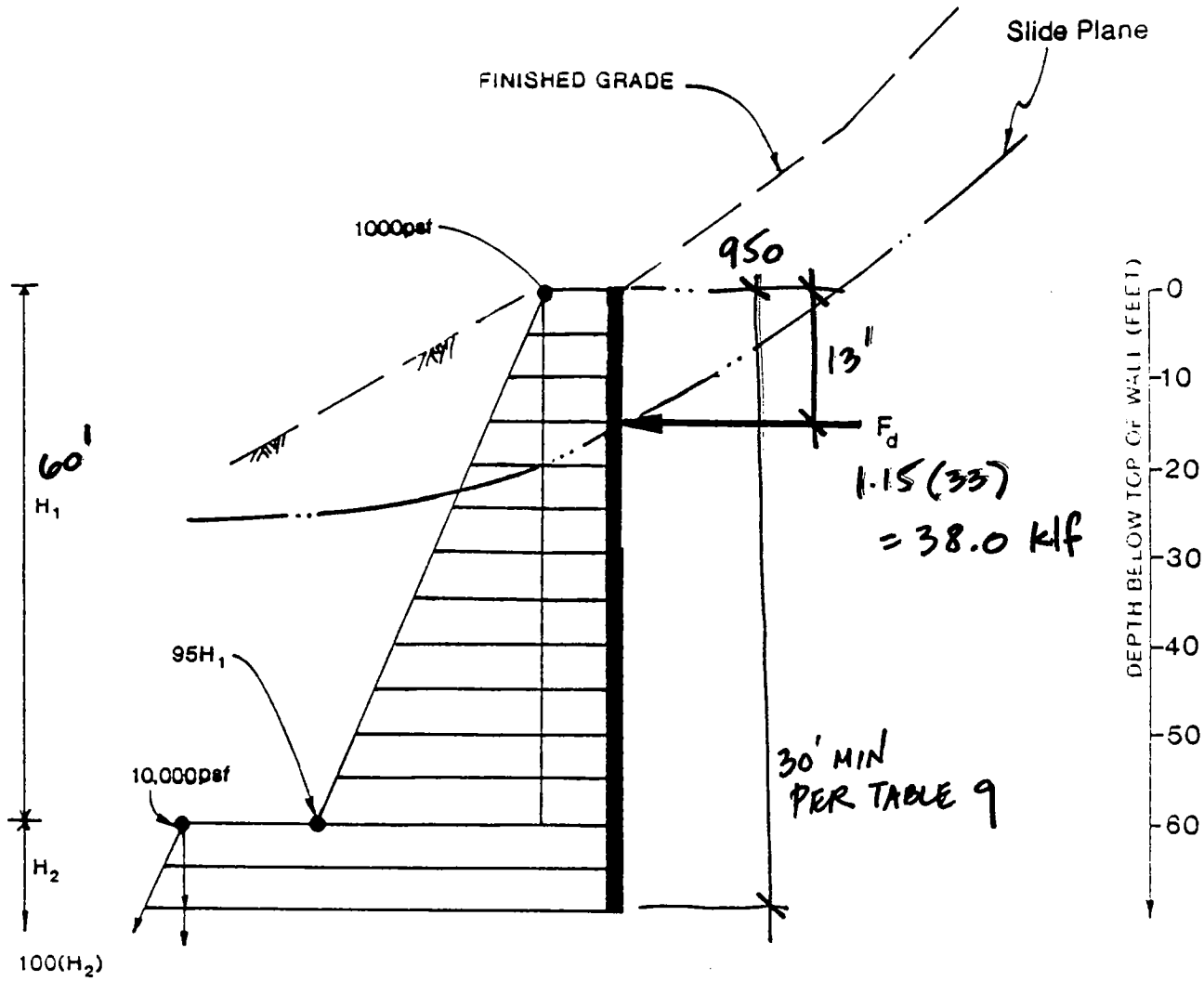
Pressure Diagram



Shear Diagram



Moment Diagram



Required shearing resistance (F_d)

H_1 = 60 Feet

H_2 = Varies

NOTES:

1. Minimum depth of embedment for design profile III is 25 feet. Refer to report test for details and Table 9 for required shear resistance.
2. Refer to Site Plan-Building 77. Figure 6 for location of design profile III.
3. Refer to text of report for description of the pressure diagrams.
4. The depths noted above are referenced to the existing ground surface at the top of the proposed SPSE system.

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DESIGN PROFILE III

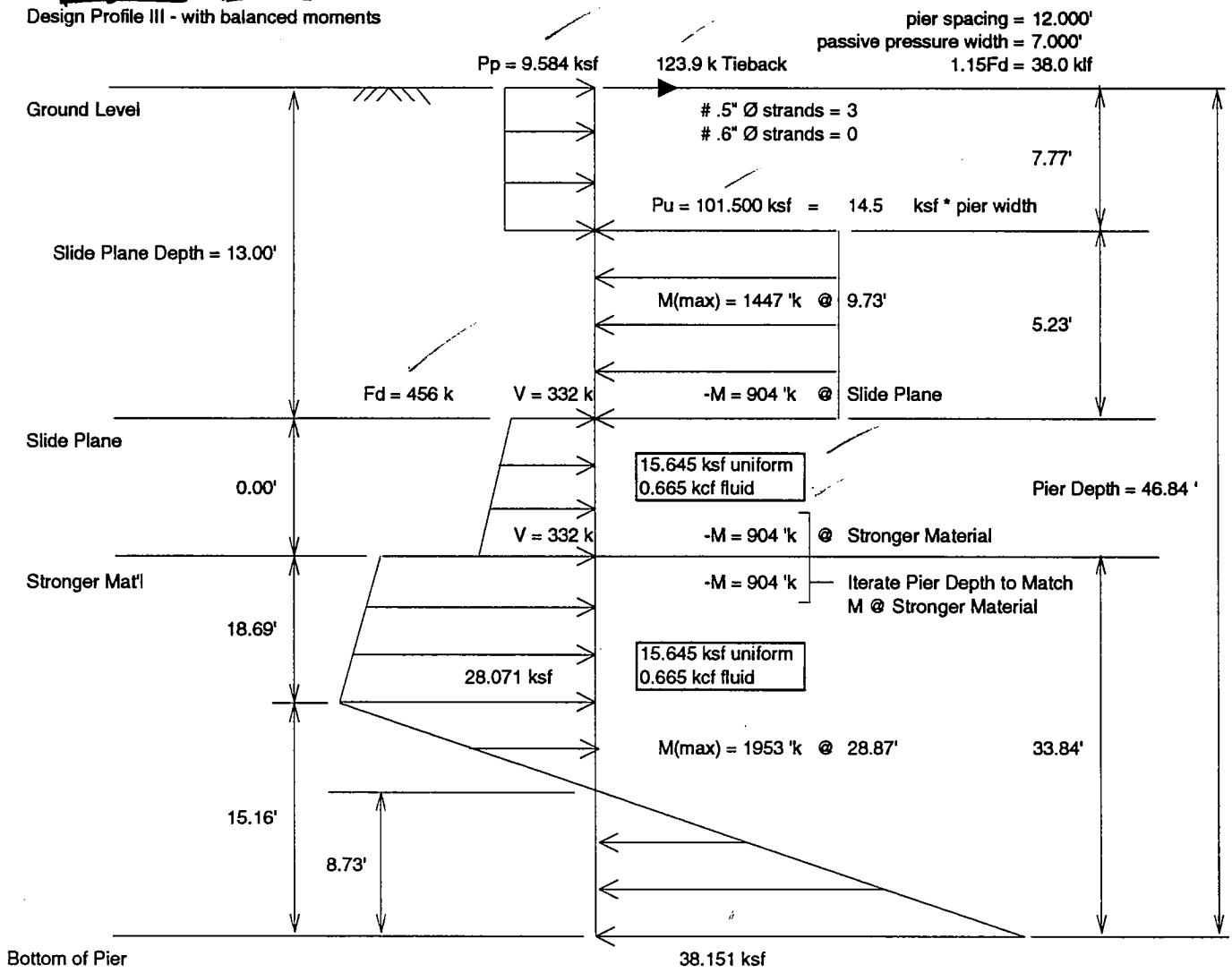
LAWRENCE BERKELEY LABORATORY
SEISMIC SLOPE STABILIZATION PROJECT
Berkeley, California

PROJECT NO.	DATE	Figure 22
K1226-1-164	February 1992	

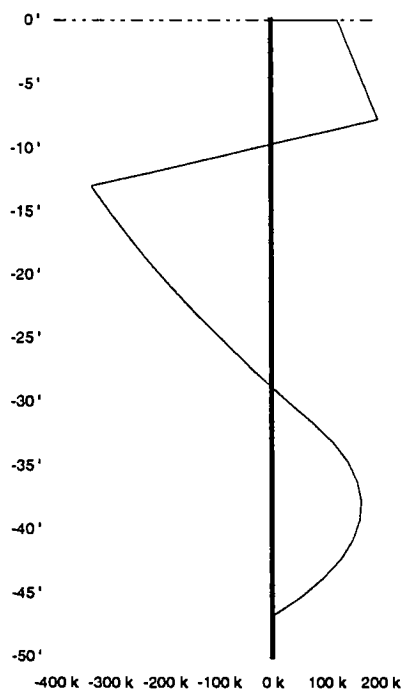
C1

FINAL

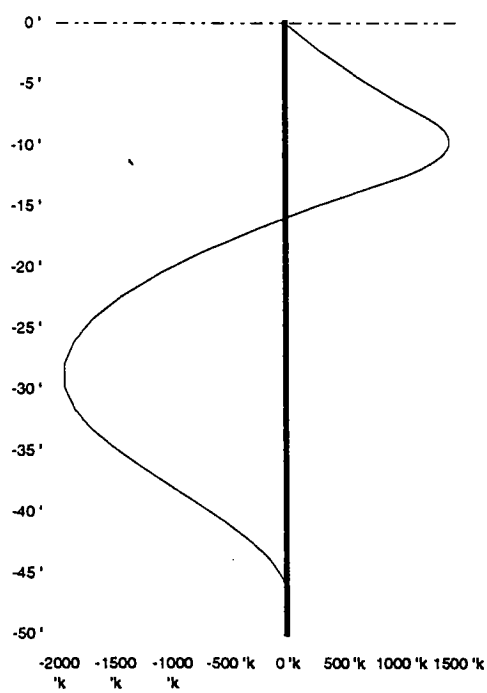
Design Profile III - with balanced moments



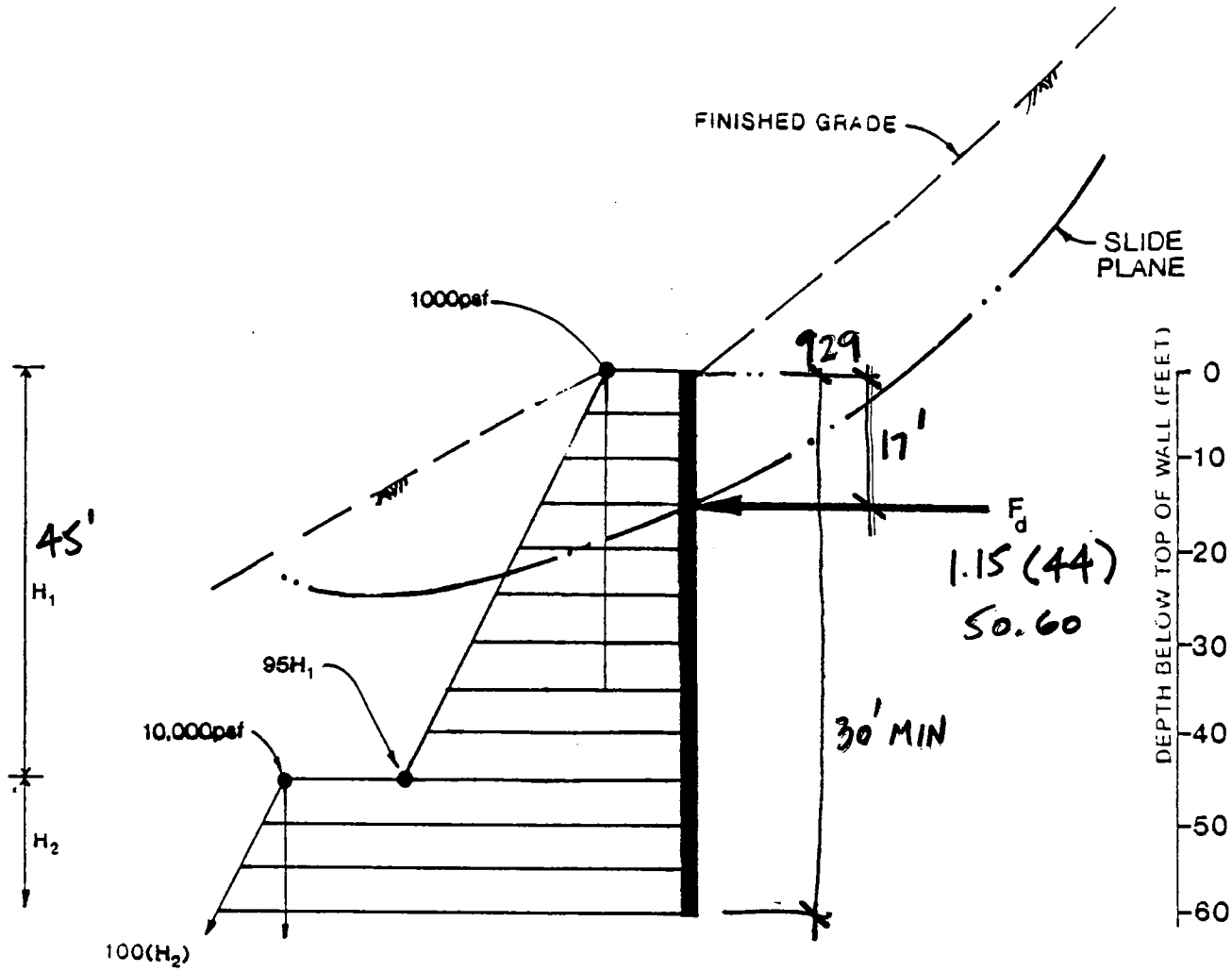
Pressure Diagram



Shear Diagram



Moment Diagram



Required shearing resistance (F_d)

H1= 45feet

H2= Varies

NOTES:

1. Minimum depth of embedment for design profile IV is 30 feet. Refer to report test for details and Table 9 for required shear resistance.
2. Refer to Site Plan-Building 77, Figure 6 for location of design profile IV.
3. Refer to text of report for description of the pressure diagrams.
4. The depths noted above are referenced to the existing ground surface at the top of the proposed SPSE system.

Kaldveer Associates
Geoscience Consultants
A California Corporation

DESIGN PROFILE IV

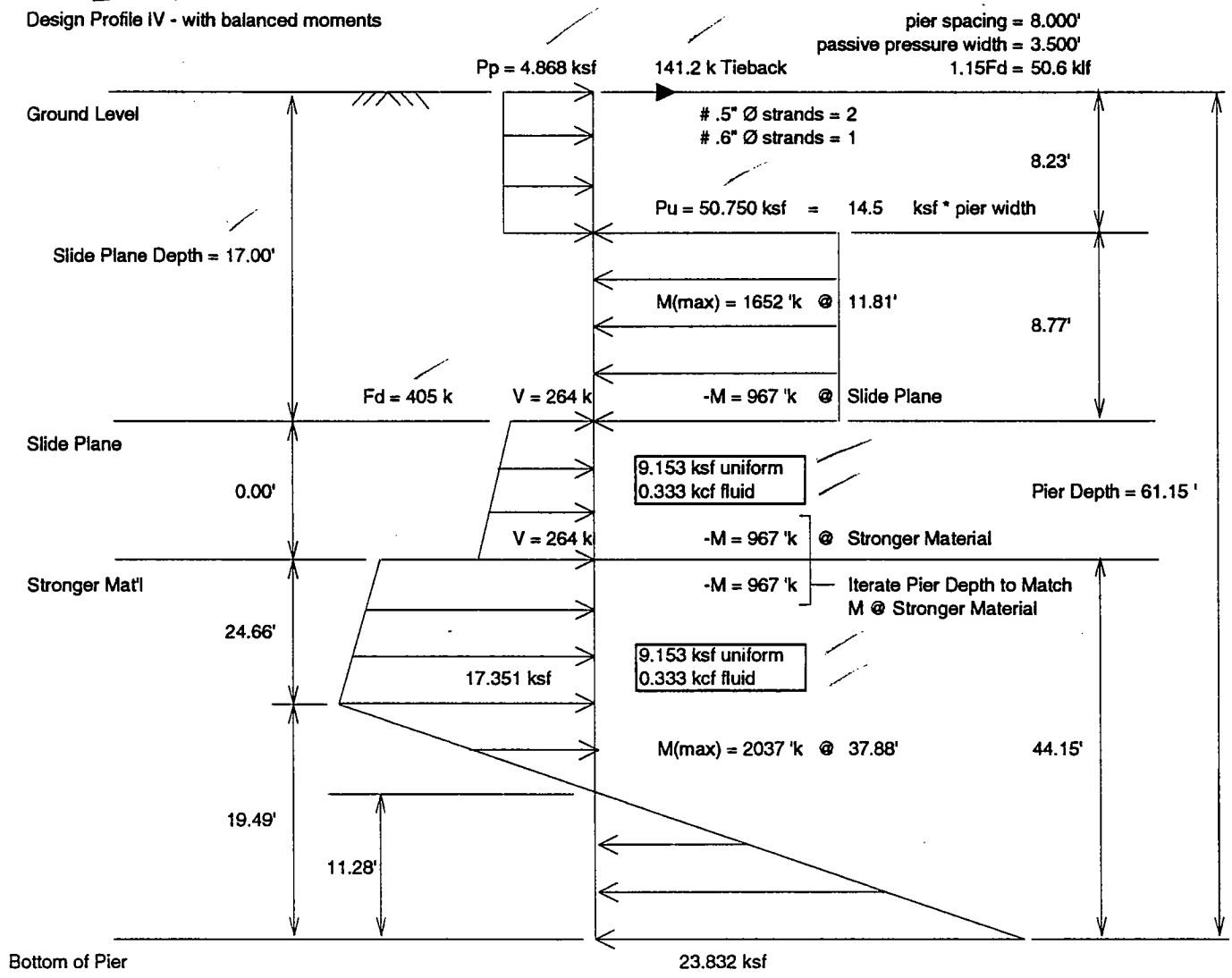
LAWRENCE BERKELEY LABORATORY
SEISMIC SLOPE STABILIZATION PROJECT
Berkeley, California

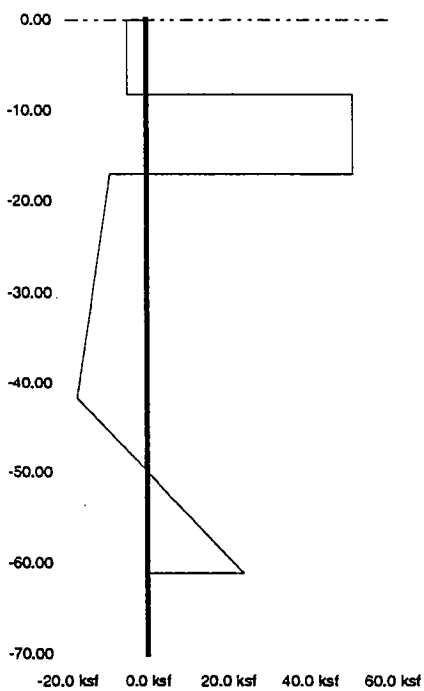
PROJECT NO.	DATE	Figure 23
K1226-1-164	February 1992	

D1

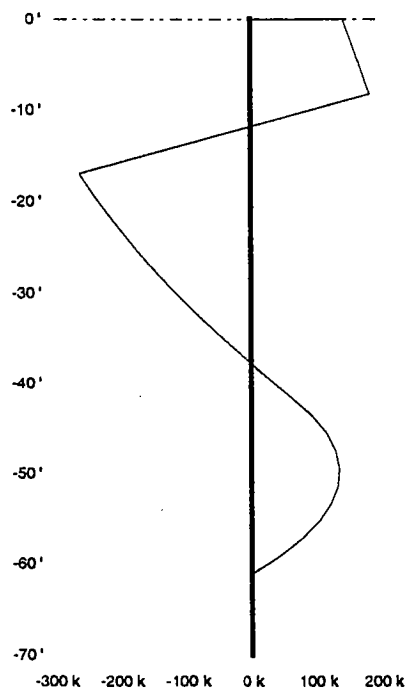
PRELIM.

Design Profile IV - with balanced moments

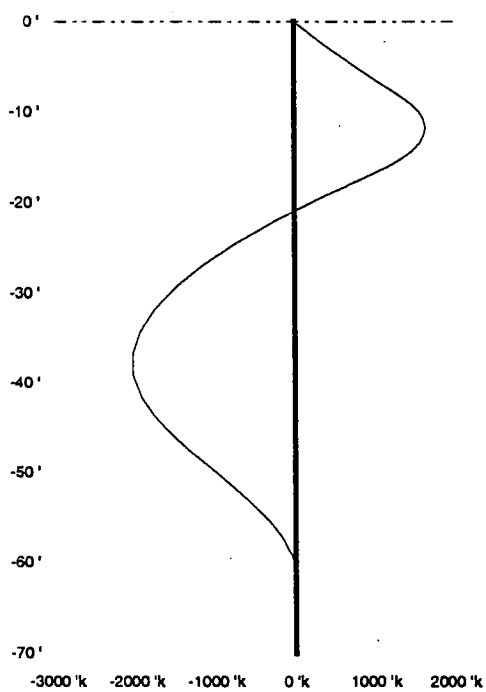




Pressure Diagram



Shear Diagram



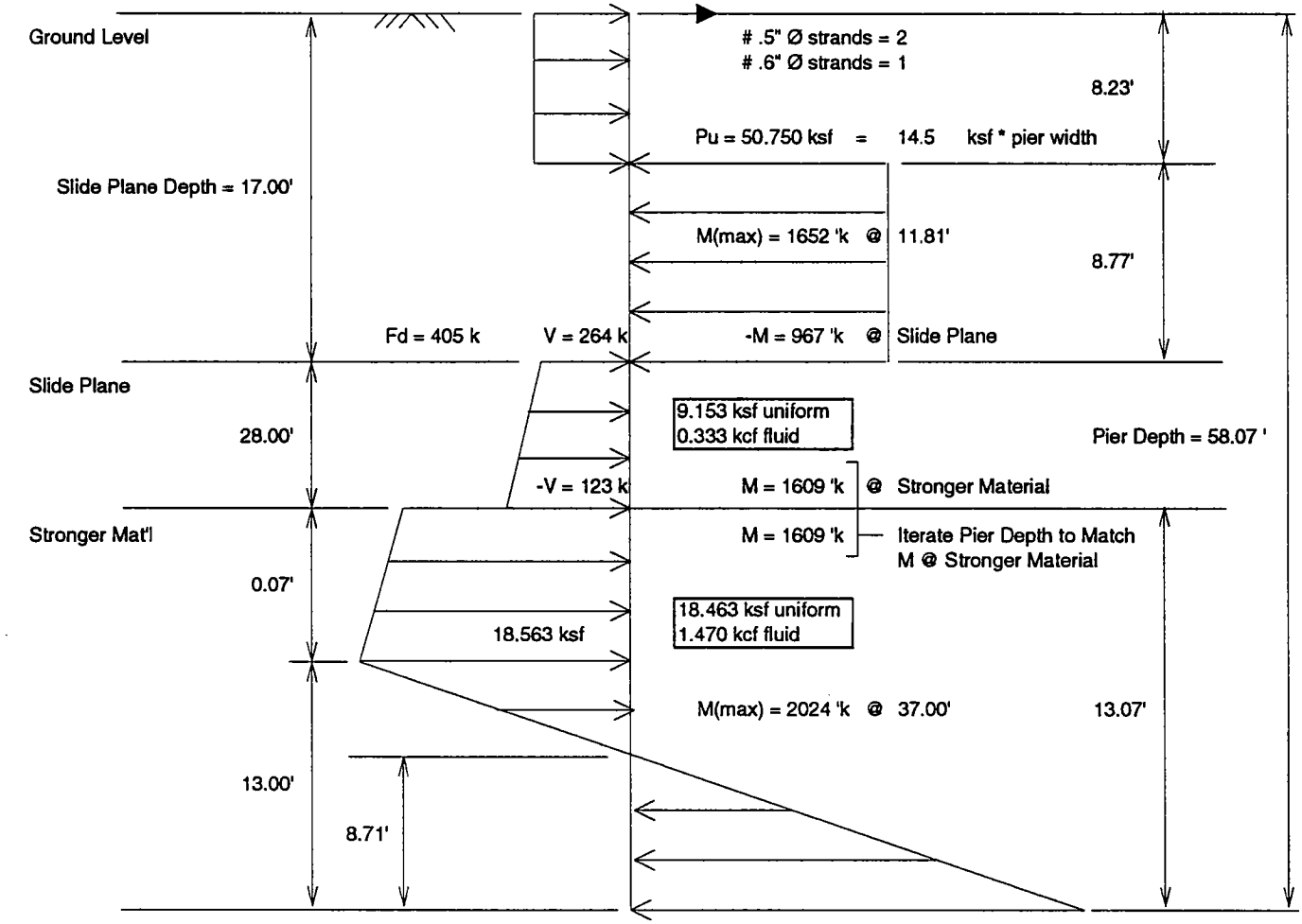
Moment Diagram

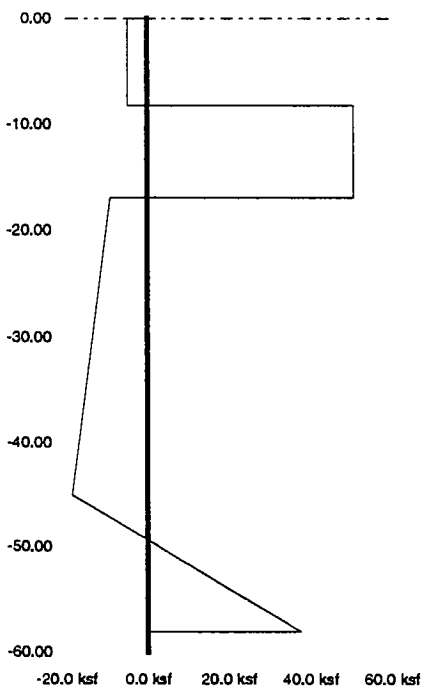
000-016_00016

FINAL

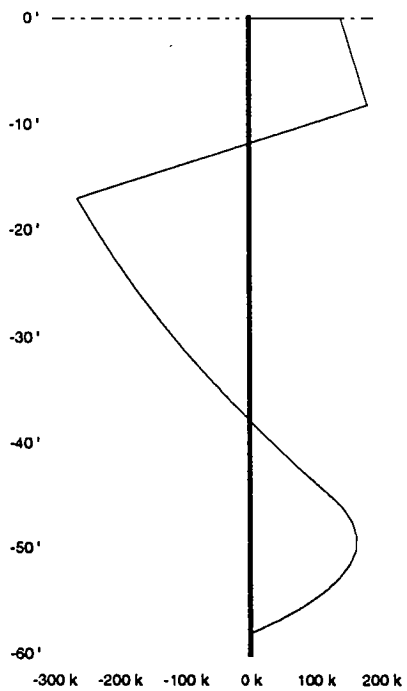
Design Profile IV - with balanced moments

pier spacing = 8.000'
passive pressure width = 3.500'
1.15Fd = 50.6 klf

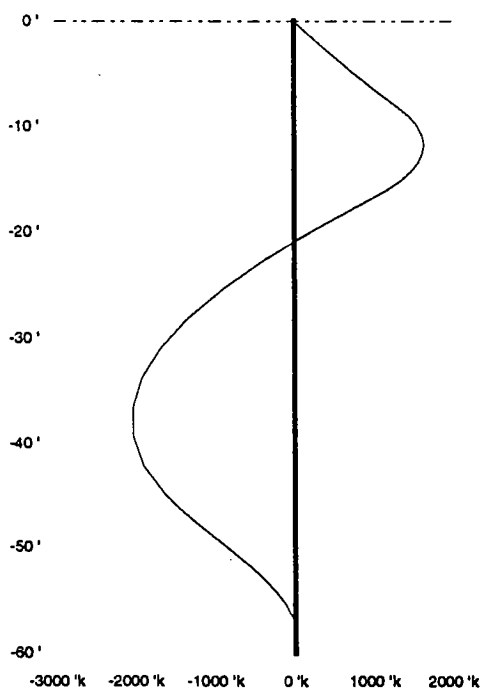




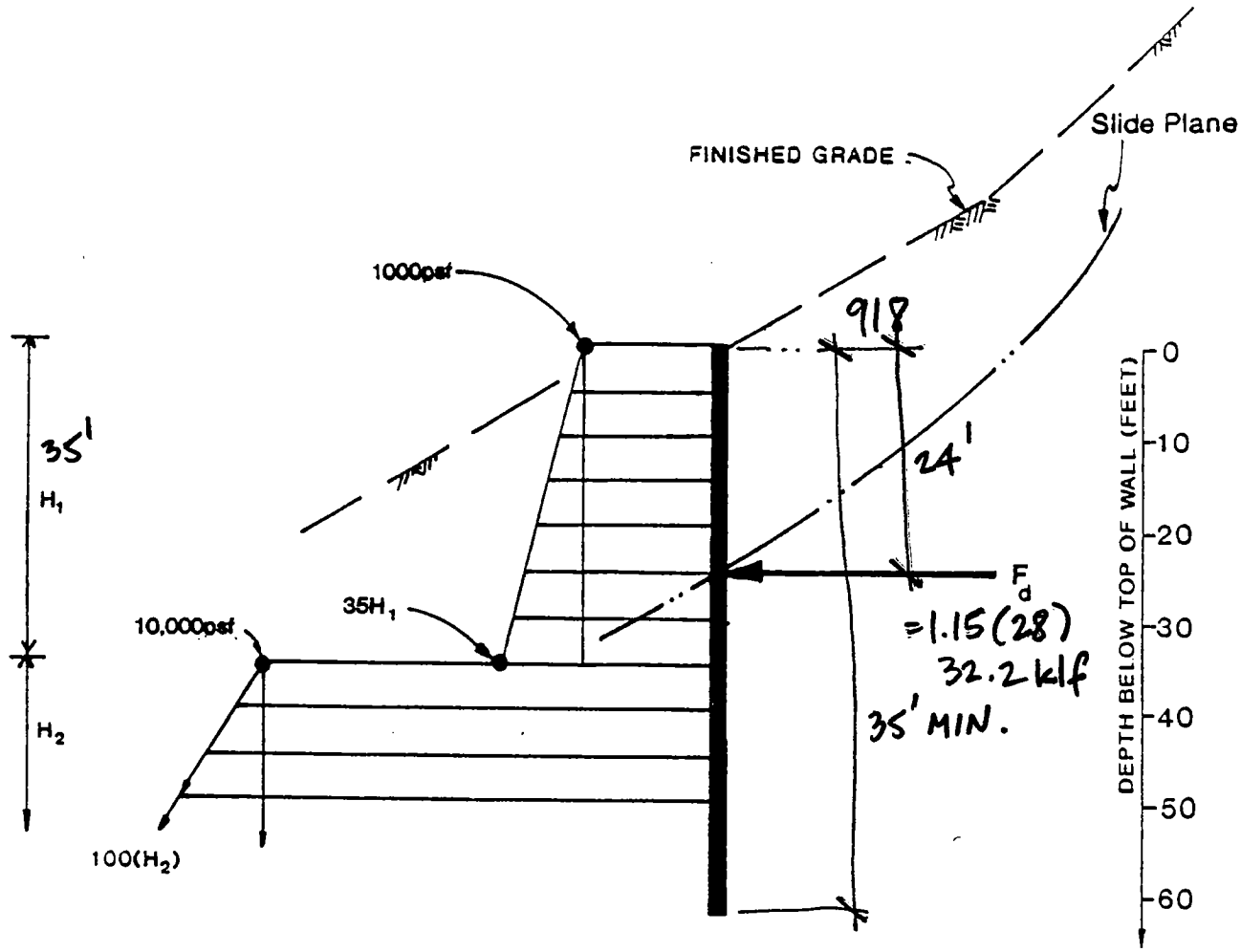
Pressure Diagram



Shear Diagram



Moment Diagram



Required shearing resistance (F_d)

H_1 = 35 Feet

H_2 = Varies

NOTES:

1. Minimum depth of embedment for design profile V is 35 feet. Refer to report test for details and Table 9 for required shear resistance.
2. Refer to Site Plan-Building 77, Figure 6 for location of design profile
3. Refer to text of report for description of the pressure diagrams.
4. The depths noted above are referenced to the existing ground surface at the top of the proposed SPSE system.

Kaldveer Associates
Geoscience Consultants
A California Corporation

DESIGN PROFILE V

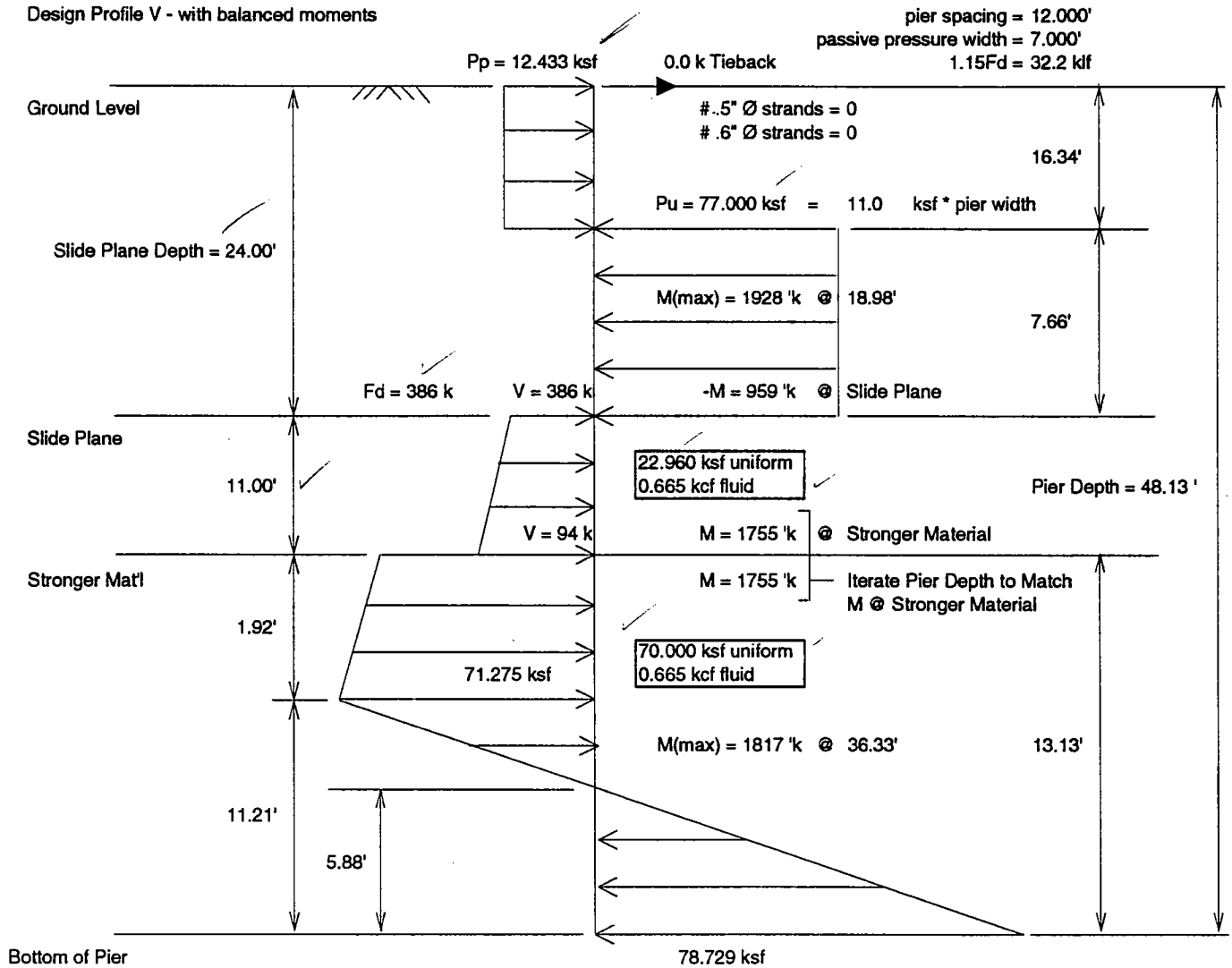
LAWRENCE BERKELEY LABORATORY
SEISMIC SLOPE STABILIZATION PROJECT
Berkeley, California

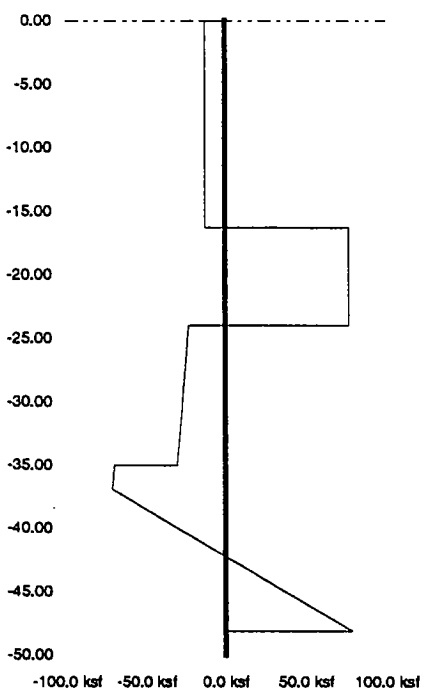
PROJECT NO.	DATE	
K1226-1-164	February 1992	Figure 24

E1

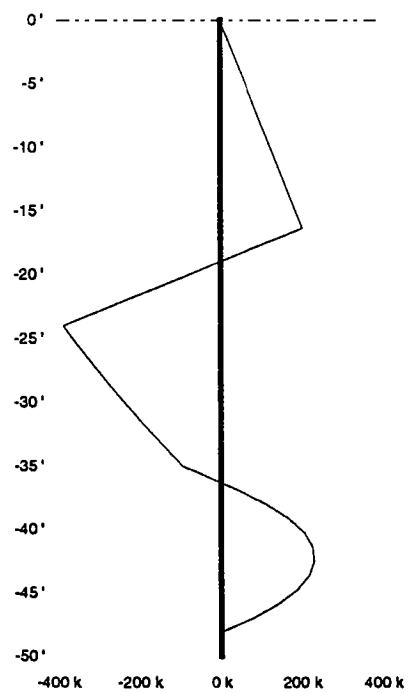
FINAL

Design Profile V - with balanced moments

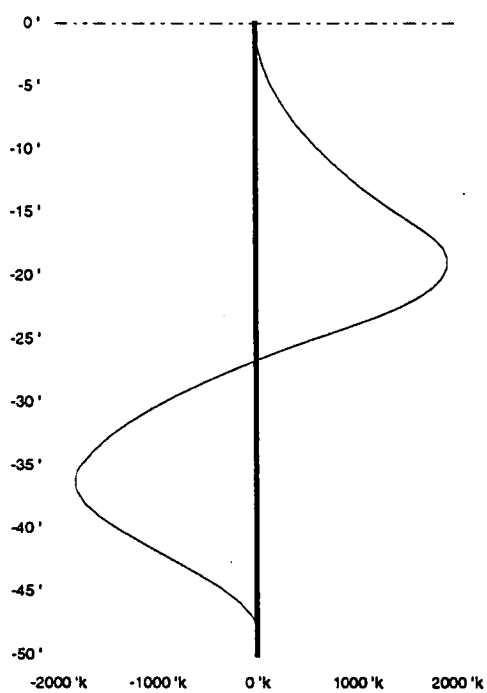




Pressure Diagram

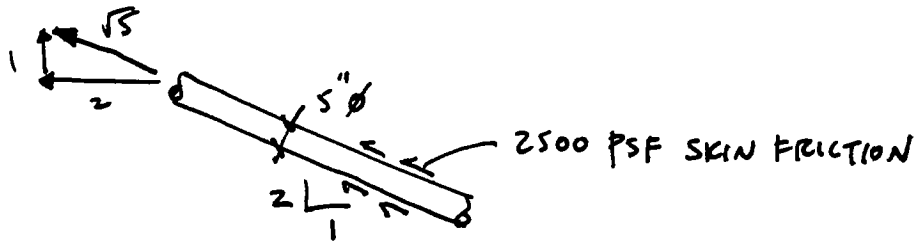


Shear Diagram



Moment Diagram

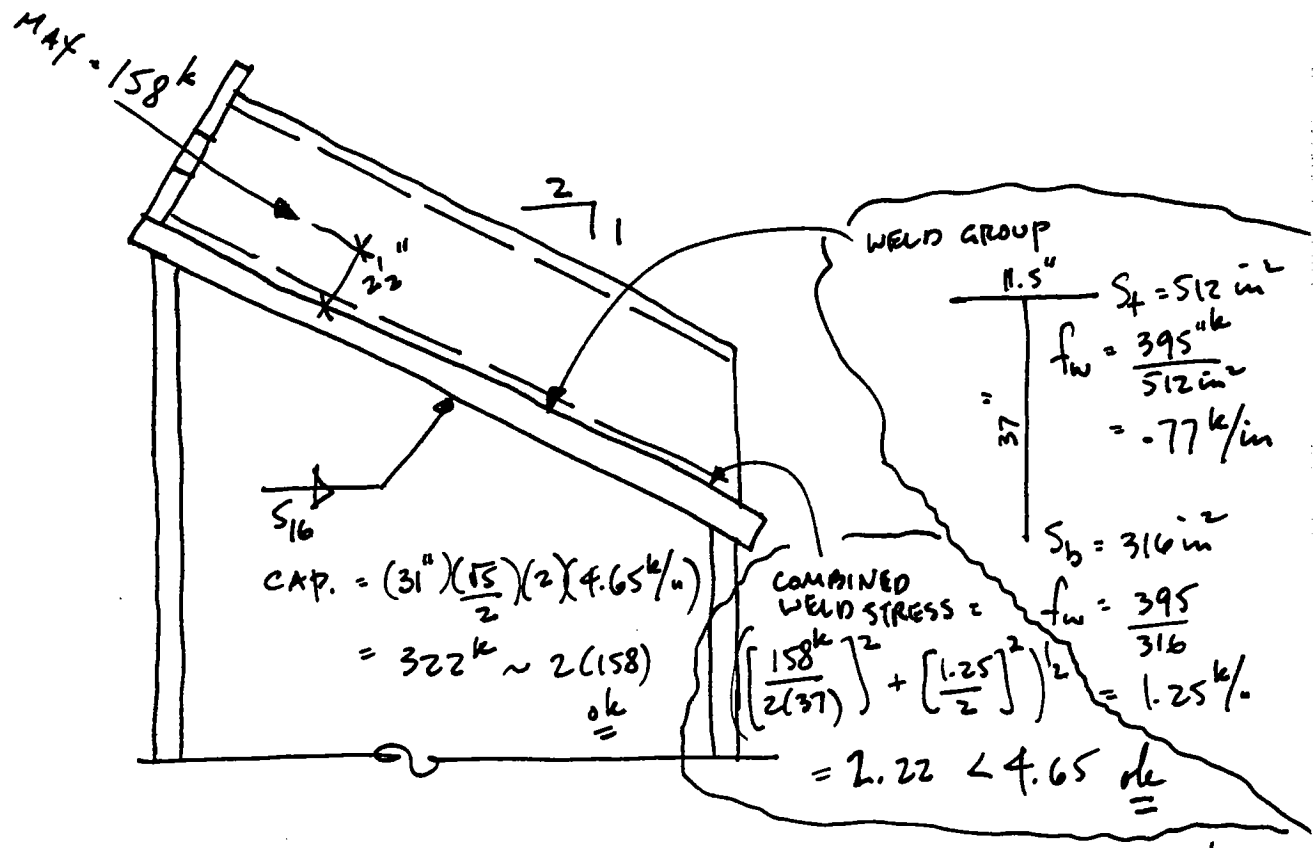
TIE BACK DESIGN - BONDED LENGTH



CAPACITY FOR HORIZ. LOAD $= \frac{2}{\sqrt{5}} \frac{5}{12} \pi \; 2500 = 2927$ PLF

DESIGN PROFILE	TIE BACK	LENGTH REQ'D
I	117.2^k	40'
II	141.2^k	48'
III	123.9^k	42'
IV	141.2^k	48'

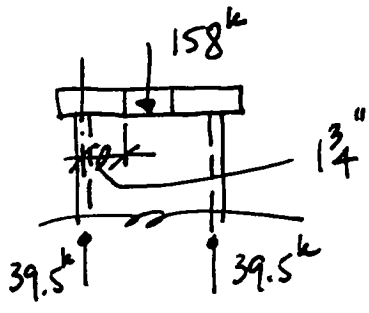
TIE BACK CONNECTION DESIGN



CHECK PL 6" TUBE, L = 5½" P = 158k $M = \frac{158^k(5\frac{1}{2}")}{4} = 217^{"k}$

FOR PL 6×6×⅞ $S = \frac{6(.875)^2}{6} = .765\ in^3$

$f_b = 217^{"k}$ TOO HIGH, SEE BELOW FOR REVISED CALC



$M = 39.5(1.75") = 69^{"k}$

1" PL $f_b = 69$ ksi

2" PL $f_b = 17$ ksi

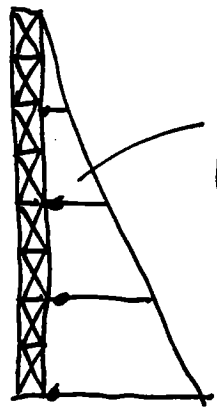
1⅝" PL $f_b = 26$ ksi

TRY 5" TUBE BEARING $= \frac{158}{20(.5")} = 15.8$ ksi ok 1½" PL $M = 39.5(1.25) = 49$ $f_b = 22$ ksi

PAUL F. FRATESSA ASSOCIATES, INC. CONSULTING STRUCTURAL ENGINEERS 11881 Skyline Blvd., Oakland, CA 94619 415/482-3341	project LBL			
	job no. 1509025	by GW	date 9-4-92	sheet no. F2

LAGGING DESIGN

PIERS SPACED @ 6'-0 O.C., CENTER TO CENTER OF SUPPORTS = 5.5'



80 H STATIC
120 H PSEUDO-STATIC

$$\frac{120}{1.33 \text{ ALLOW STRESS INCR.}} = 90.2$$

USE 90.2 H w/o STRESS INCR.

FOR D.F. #2 $F_b = 1250$ $S = \frac{12t^2}{6} = 2t^2$

$$F_b = \frac{M}{S} = 1250 = \frac{(90.2H)\frac{5.5^2}{8}(12)}{2t^2}$$

$$H = .6108\,t^2$$

FOR $t = 1.5$ $H = 1.37'$
$t = 2.5$ $H = 3.818'$
$t = 3.5$ $H = 7.482$

USE 3×12 LAGGING UP TO 4'-0 DEEP
4×12 LAGGING UP TO 8'-0 DEEP

FOR DOUBLE W6 PER PIER $L = \cancel{4}\ 3.83'$ & $L = 2'$

FOR $L = \cancel{4}\ 3.83'$ $H = \cancel{1.155}\ 1.26\,t^2$
$t = 1.5$ $H = 2.8'$
$t = 2.5$ $H = 7.88'$

FOR $L = 2'$ $H = 4.62\,t^2$,
$t = 1.5$ $H = 10.4'$

FOR $L = 2.83'$ $H = 2.307\,t^2$
$t = 1.5$ $H = 5.2'$
$t = 2.5$ $H = 14.4'$

PAUL F. FRATESSA ASSOCIATES, INC. CONSULTING STRUCTURAL ENGINEERS 11881 Skyline Blvd., Oakland, CA 94619 510/482-3341	project LBC			
	job no. 1509025	by GW	date 9/4/92	sheet no. F3

CHECK LAGGING FOR SHEAR STRESS

FOR $L = 2'$, $H = 8'$, 2×LAG $V = (90.2H)(\frac{L}{2}) = 722^{\#}$ ok

$$f_v = \frac{1.5V}{(1.5'')(12'')} = 60 < 95 \text{ ok}$$

FOR $L = 3'$, $H = 5'$, 2×LAG $V = 676$ $f_v = 56 < 95$ ok

$L = 3'$, $H = 8'$, 3×LAG $V = 1082$ $f_v = 54 < 95$ ok

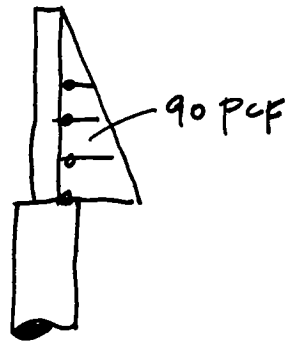
FOR $L = 4'$, $H = 3'$, 2×LAG $V = 541$ $f_v = 45 < 95$ ok

$L = 4'$, $H = 8'$, 3×LAG $V = 1443$ $f_v = 72 < 95$ ok

PAUL F. FRATESSA ASSOCIATES, INC.
CONSULTING STRUCTURAL ENGINEERS
11881 Skyline Blvd., Oakland, CA 94619 415/482-3341

project			
LBL			
job no.	by	date	sheet no.
1509025	GW	9.25-92	F3a

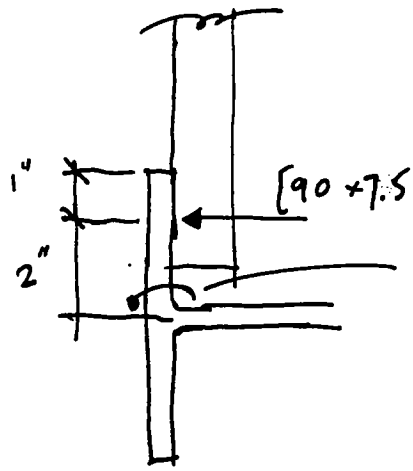
SOLDIER BEAMS



FOR $s = 6'$, $h = 8'$ $\quad M = \frac{(.090^{k/ft^3})(6')(8')^3}{6} = 46^{'k}$

2-W6×20 $\quad S = 2(13.4) = 26.8$

$f_b = 20.6^{'k}$



$[90 \times 7.5 = 675 \text{ PSF}][2' \text{ TRIB}] = 1.35^k/\text{FT.}$

$M = 1.35^k(2') = 2.7^{'k}/\text{FT}$

CHECK $\frac{1}{4}$" FLANGE, $S = \frac{12(.25)^2}{6} = .125$

$f_b = \frac{2.7}{.125} = 21.6^{ksi}$

PAUL F. FRATESSA ASSOCIATES, INC. CONSULTING STRUCTURAL ENGINEERS 11881 Skyline Blvd., Oakland, CA 94619 510/482-3341	project LBL			
	job no. 1509025	by GW	date 9/4/92	sheet no. F4

Creegan + D'Angelo (C+D), 1992, "Slope and Seismic Stabilization Project, Subcontract No. 693, Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720," Sheets C1 through C5 with Sheets S1 and S2 by Paul F. Fratessa Associates, Inc. (PFFA) dated October 9, 1992 (revision 1 3/94 as-builts).

PLANS FOR:

SLOPE AND SEISMIC STABILIZATION PROJECT - PHASE II

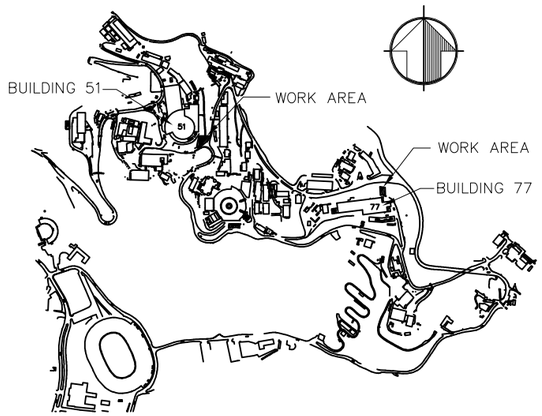
SUBCONTRACT No. 711

LAWRENCE BERKELEY LABORATORY

UNIVERSITY OF CALIFORNIA

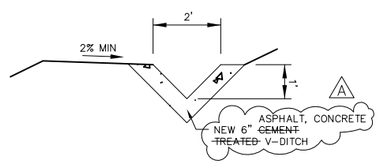
BERKELEY, CALIFORNIA 94720

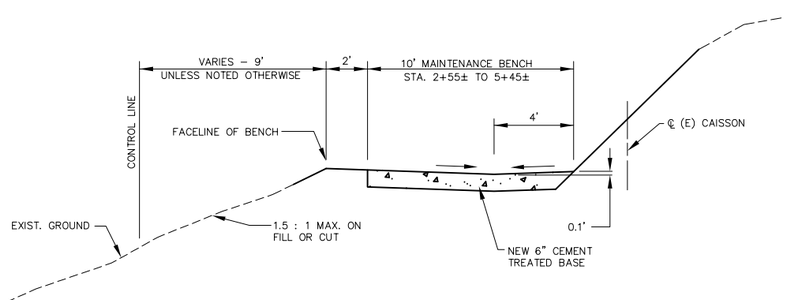
DECEMBER, 1994



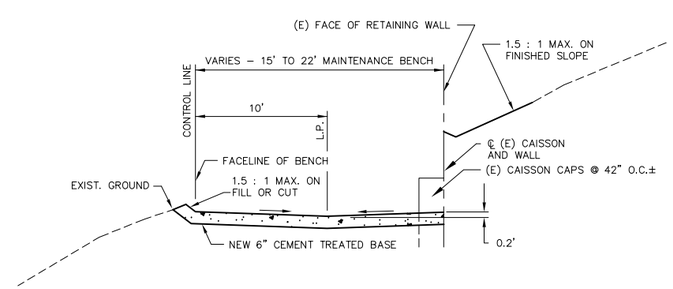
VICINITY MAP
NO SCALE

STA. 5+45 TO 7+76





TYPICAL BUILDING 77 BENCH
NOT TO SCALE



TYPICAL BUILDING 51 BENCH
NOT TO SCALE

TITLE SHEET
DECEMBER, 1994

REV.	DATE	DESCRIPTION	BY
A	1/96	AS-BUILT CHANGES	

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SCALE: NONE

HARZA
Consulting Engineers and Scientists
1970 BROADWAY
OAKLAND, CALIFORNIA 94612
PHONE: (510) 444-7901
FAX: (510) 388-5825

SLOPE AND SEISMIC STABILIZATION PROJECT
PHASE II
SUBCONTRACT NO. 711
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER
C1
OF SHEETS
DRAWING NO.

PLOTTED 2-6-95

LBLCOVA.DWG

BUILDING 51 PLAN

SEPTEMBER, 1992

REV.	DATE	DESCRIPTION	BY
0	10-15-92	100% SUBMITTAL	RSJ
0	9-30-92	99% SUBMITTAL	RSJ
0	9-24-92	90% SUBMITTAL	RSJ
0	8-14-92	50% SUBMITTAL	RSJ

DESIGNED BY: PHS
DRAWN BY: PHS
CHECKED BY: RSJ
SCALED: 1" = 20'

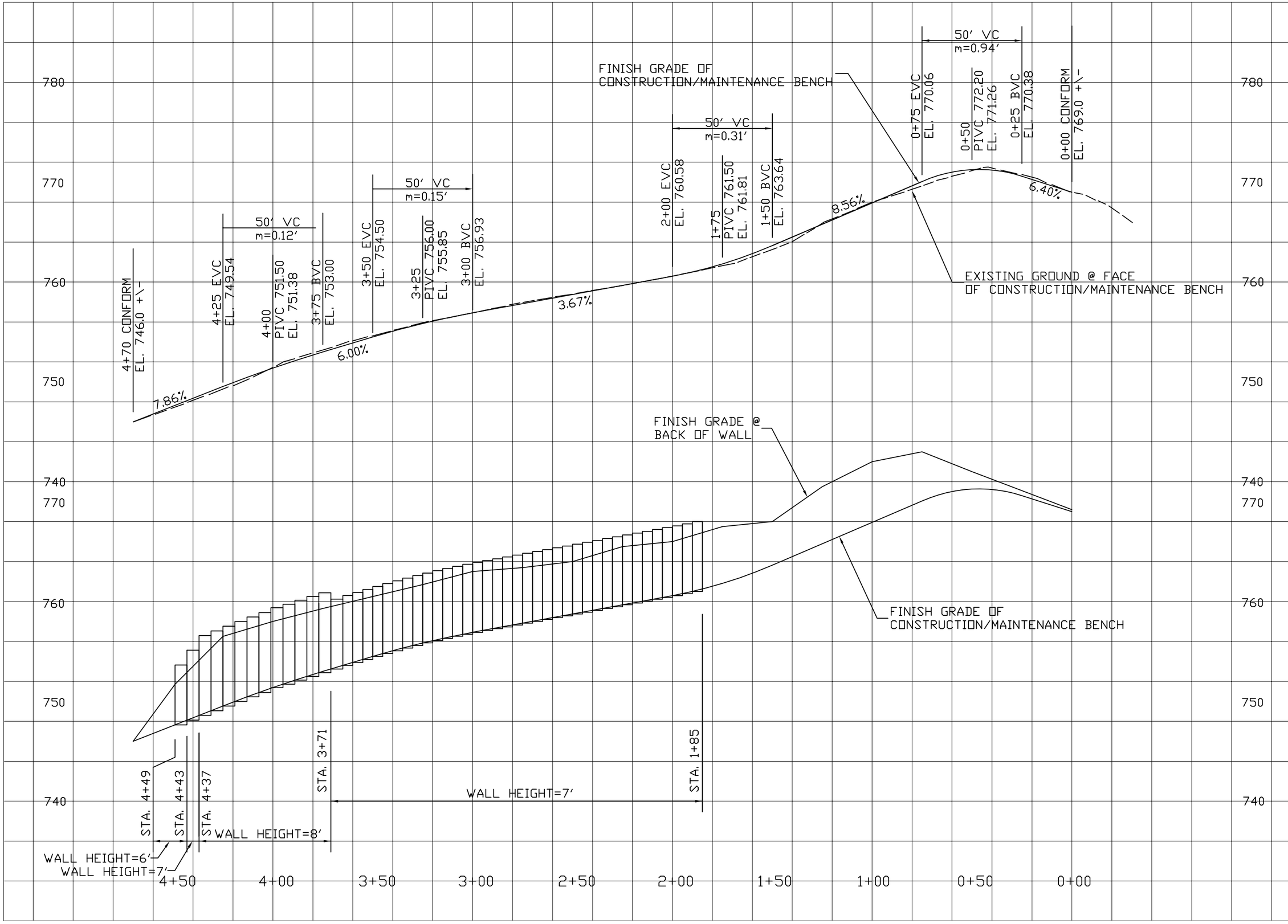
CREEGAN+D'ANGELO
Engineers · Planners · Surveyors
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, CALIFORNIA · PHOENIX, ARIZONA

APPROVED BY: _____ EOP: DATE _____ R.E. NO. _____ DATE _____

SLOPE AND SEISMIC STABILIZATION PROJECT
SUBCONTRACT NO. 693
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER C2 OF 10 SHEETS

DRAWING NO.



BUILDING 51 PROFILE

SEPTEMBER, 1992

REV.	DATE	DESCRIPTION	BY
0	10-15-92	100% SUBMITTAL	RSJ
0	9-28-92	99% SUBMITTAL	RSJ
0	9-14-92	90% SUBMITTAL	RSJ
0	8-24-92	50% SUBMITTAL	RSJ

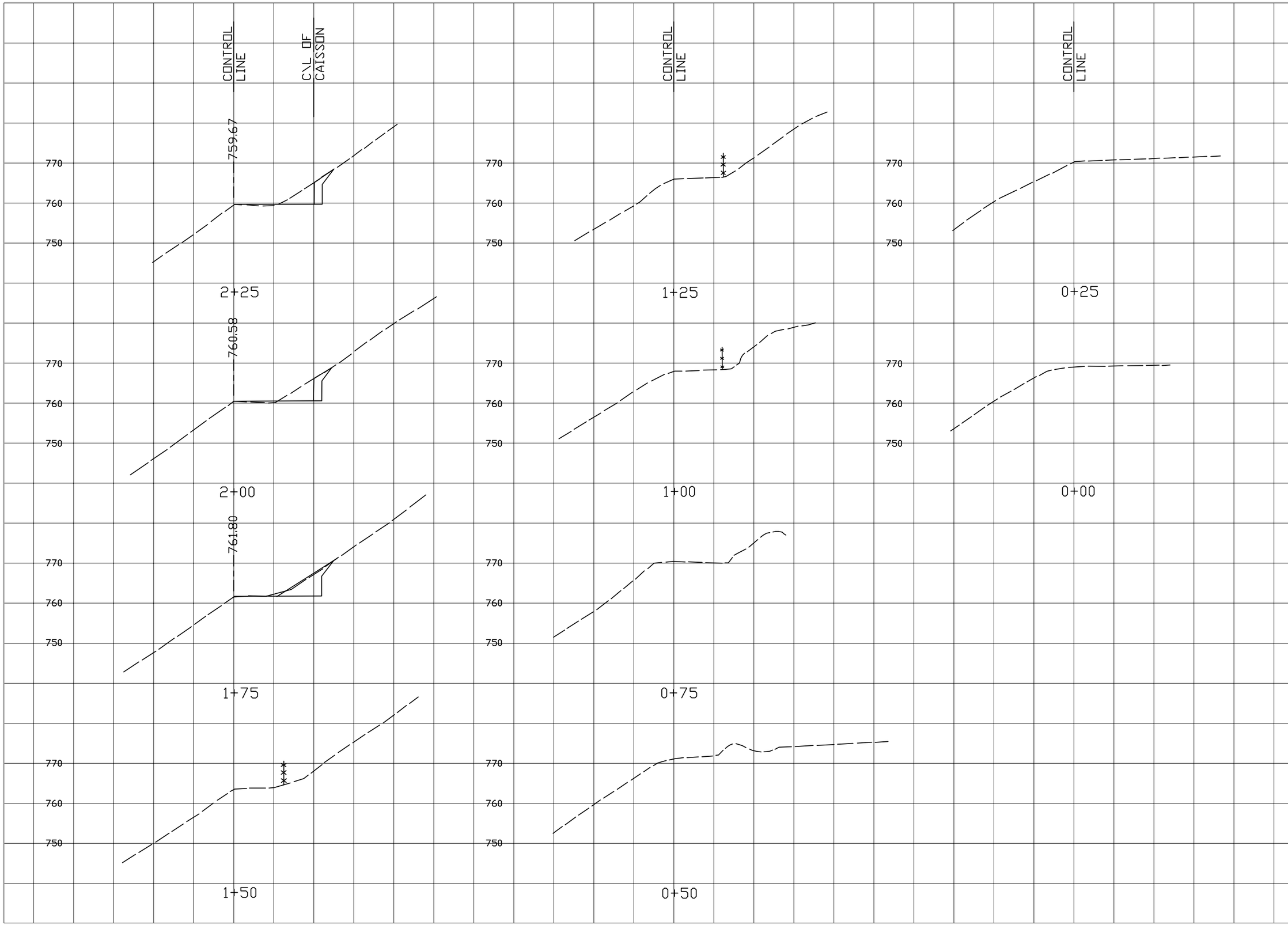
DESIGNED BY: PHS
DRAWN BY: PHS
CHECKED BY: RSJ
SCALE: HORIZ: 1"=20' VERT: 1"=4'

CREEGAN+D'ANGELO
Engineers · Planners · Surveyors
SANJOSE, FAIRFIELD, MONTEREY, PLEASANTON, CALIFORNIA · PHOENIX, ARIZONA

APPROVED BY: _____ EXP. DATE _____ R.E. NO. _____ DATE _____

SLOPE AND SEISMIC STABILIZATION PROJECT
SUBCONTRACT NO. 693
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER
C3
OF 10 SHEETS
DRAWING NO.



BUILDING 51 CROSS SECTIONS

SEPTEMBER, 1992

REV.	DATE	DESCRIPTION	BY
0	11-5-92	100% SUBMITTAL	RSJ
0	9-28-92	99% SUBMITTAL	RSJ
0	9-16-92	90% SUBMITTAL	RSJ
0	8-14-92	50% SUBMITTAL	RSJ

DESIGNED BY: PHS
DRAWN BY: PHS
CHECKED BY: RSJ
SCALE: HORIZ. 1"=10' VERT. 1"=10'

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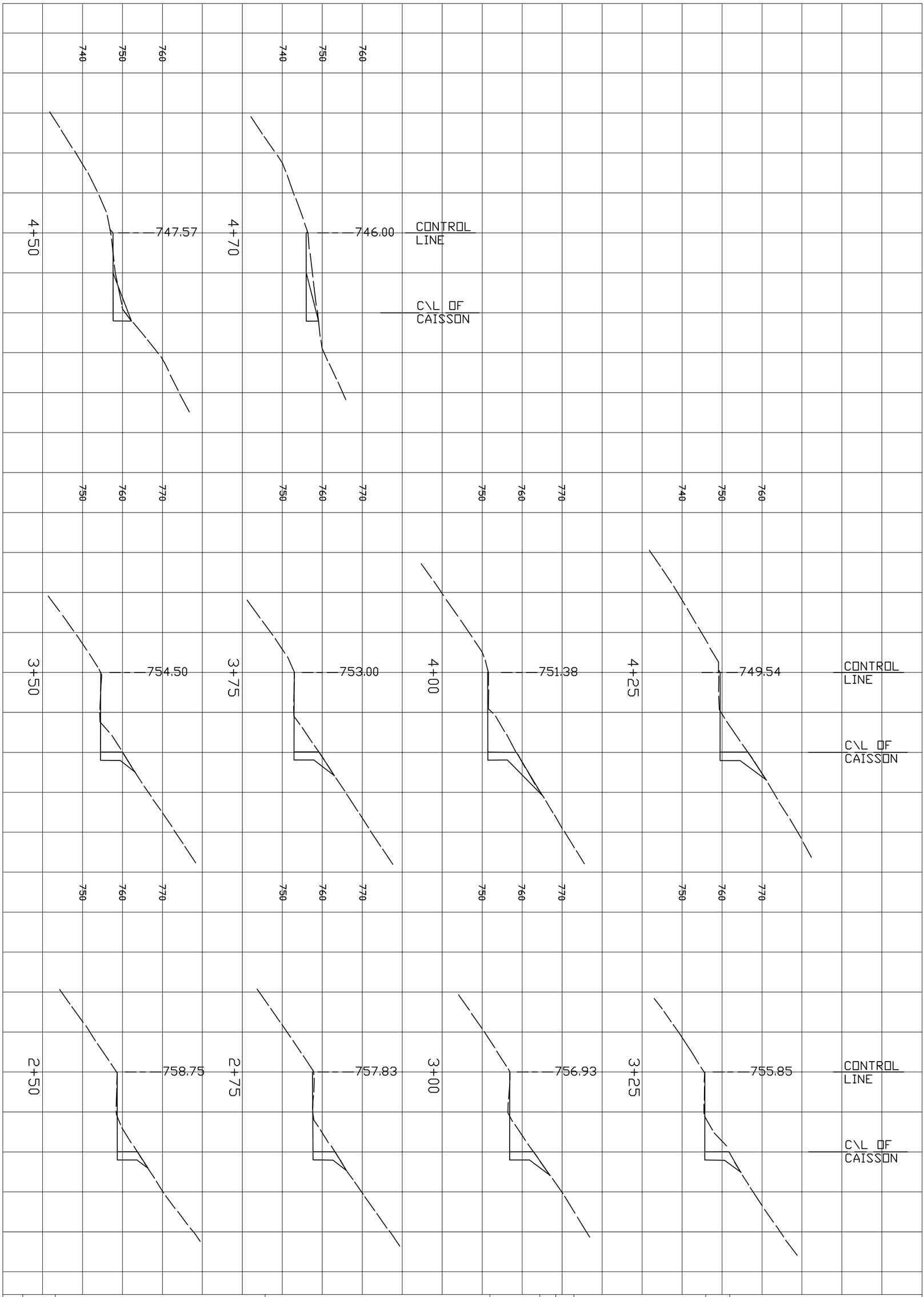
APPROVED BY: _____ EXP. DATE _____ R.E. NO. _____ DATE _____

SLOPE AND SEISMIC STABILIZATION PROJECT
SUBCONTRACT NO. 693
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER
C4
OF 10 SHEETS
DRAWING NO.



SLOPE AND SEISMIC STABILIZATION PROJECT

SUBCONTRACT NO. 693

LAWRENCE BERKELEY LABORATORY

UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

CREEGAN+D'ANGELO
Engineers · Planners · Surveyors
SAN JOSE, FAIRFIELD, MONTEREY, PLEASANTON, CALIFORNIA · PHOENIX, ARIZONA

APPROVED BY: _____ EXP. DATE _____ R.E. NO. _____ DATE _____

DESIGNED BY: PHS
DRAWN BY: PHS
CHECKED BY: RSJ
SCALE: HORIZ.: 1"=10' VERT.: 1"=10'

REV.	DATE	DESCRIPTION	BY
0	10-15-92	100% SUBMITTAL	RSJ
0	9-30-92	99% SUBMITTAL	RSJ
0	9-16-92	90% SUBMITTAL	RSJ
0	8-14-92	50% SUBMITTAL	RSJ

BUILDING 51 CROSS SECTIONS

SEPTEMBER, 1992

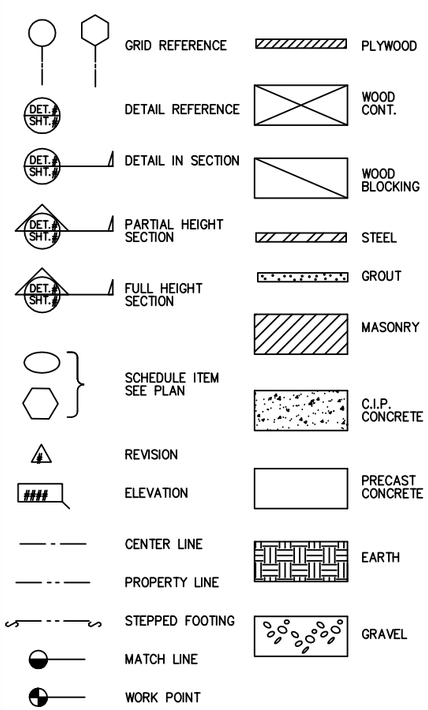
SHEET NUMBER C5 OF 10 SHEETS

DRAWING NO.

ABBREVIATIONS

∠, L	ANGLE	HORIZ.	HORIZONTAL
DIAM.	DIAMETER	HT.	HEIGHT
?, PL	PLATE	INCL.	INCLUDE
?, CL	CENTER LINE	JT.	JOINT
#	NUMBER OF POUNDS	LONGIT'L	LONGITUDINAL
□, SQ.	SQUARE	MAS.	MASONRY
@	AT	MAX.	MAXIMUM
		M.B.	MACHINE BOLT
A.B.	ANCHOR BOLT	MECH.	MECHANICAL
A.S.	AS SHOWN	MFR.	MANUFACTURER
APPROX.	APPROXIMATE	MIN.	MINIMUM
ARCH.	ARCHITECTURAL	MISC.	MISCELLANEOUS
		MTL.	METAL
BLDG.	BUILDING	(N)	NEW
BLK	BLOCK	N.I.C.	NOT IN CONTRACT
BLK'G	BLOCKING	N.T.S.	NOT TO SCALE
BM.	BEAM	NO.	NUMBER
BMU	BRICK MASONRY UNIT		
B.O.	BOTTOM OF	O.C.	ON CENTER
BOT.	BOTTOM	O.H.	OPPOSITE HAND
BTWN	BETWEEN	OPNG.	OPENING
		OPP.	OPPOSITE
C/	CENTERLINE		
C/P.	CAST IN PLACE	P.C.	PRECAST
CLR.	CLEAR	P.J.	POUR JOINT
C.M.U.	CONCRETE MASONRY UNIT	P.T.	POST-TENSION
COL.	COLUMN	P.W.	PLYWOOD
CONC.	CONCRETE		
CONN.	CONNECTION		
C.J.	CONSTRUCTION JOINT	RDWD	REDWOOD
CONT.	CONTINUOUS	REINF.	REINFORCE
CTR.	CENTER	REINF'G	REINFORCING
		REQ'D	REQUIRED
DBL.	DOUBLE	R.D.	ROOF DRAIN
DET.	DETAIL		
DIA.	DIAMETER	S.A.D.	SEE ARCH. DWGS.
DIM.	DIMENSION	SCHED.	SCHEDULE
DN.	DOWN	SECT.	SECTION
DWG.	DRAWING	SHT'G	SHEATHING
		SIM.	SIMILAR
(E)	EXISTING	STD.	STANDARD
EA.	EACH	STL.	STEEL
E.O.S.	EDGE OF SLAB	STRUCT.	STRUCTURAL
E.J.	EXPANSION JOINT		
ELEC.	ELECTRICAL	T. & G.	TONGUE & GROOVE
ELEV.	ELEVATION	T.O.	TOP OF
EMB.	EMBEDMENT	T.O.S.	TOP OF SHEATHING OR TOP OF SLAB
EQ.	EQUAL		
EXP. JT.	EXPANSION JOINT	T.O.W.	TOP OF WALL
EXT.	EXTERIOR	T.S.	TUBE STEEL
		T. & B.	TOP AND BOTTOM
F.D.	FLOOR DRAIN	TYP.	TYPICAL
F.O.	FACE OF	TRANSV.	TRANSVERSE
F.O.C.	FACE OF CONCRETE		
F.O.M.	FACE OF MASONRY	U.B.C.	UNIFORM BUILDING CODE
F.O.S.	FACE OF STUD	U.O.N.	UNLESS OTHERWISE NOTED
F.O.W.	FACE OF WALL		
FIN. FLR.	FINISH FLOOR	VERT.	VERTICAL
FLR.	FLOOR		
FTG.	FOOTING	W/	WITH
		W/O	WITHOUT
GA.	GAUGE	W.O.	WHERE OCCURS
G.B.	GYPSUM BOARD	WD.	WOOD
GL	GLULAM	W.W.F.	WELDED WIRE FABRIC
GR.	GRADE		
GYP.BD.	GYPSUM BOARD		

SYMBOLS AND MATERIALS



GENERAL NOTES

GENERAL

1. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE PROJECT DOCUMENTS.
2. THE PROJECT DOCUMENTS INDICATE GENERAL AND TYPICAL DETAILS OF CONSTRUCTION. WHERE CONDITIONS ARE NOT SPECIFICALLY INDICATED, DETAILS OF A CHARACTER SIMILAR TO THOSE SHOWN SHALL BE USED SUBJECT TO REVIEW.
3. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING THE WORK OF ALL TRADES AND SHALL CHECK ALL DIMENSIONS. DISCREPANCIES SHALL BE CALLED TO THE ATTENTION OF THE ENGINEER AND SHALL BE RESOLVED BEFORE PROCEEDING WITH THE WORK.
4. PROVISIONS FOR OPENINGS NOT SHOWN OR DETAILED ON THE STRUCTURAL DRAWINGS WHICH PENETRATE STRUCTURAL ELEMENTS SHALL BE SUBJECT TO REVIEW.
5. SHOP DRAWINGS REQUIRED BY THE SPECIFICATIONS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW PRIOR TO FABRICATION.
6. DURING THE CONSTRUCTION PERIOD, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF ALL PERSONS ON OR ABOUT THE CONSTRUCTION SITE. THE CONTRACTOR SHALL PROVIDE ADEQUATE SHORING IN ACCORDANCE WITH ALL APPLICABLE SAFETY ORDINANCES.

SUBMITTALS

1. SUBMITTALS AS REQUIRED SHALL BE PROCESSED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2. SUBMITTALS SHALL CONFORM TO THE PROJECT DOCUMENTS. NO DESIGN IS REQUIRED ON THE PART OF THE CONTRACTOR EXCEPT WHERE CHANGES ARE REQUESTED. WHERE CHANGES ARE REQUESTED, THE SUBMITTAL REQUIRES DESIGN BY A LICENSED STRUCTURAL ENGINEER FOR THAT ELEMENT OF THE STRUCTURE. THE DESIGN WILL BE REVIEWED AND CHANGES MAY BE REQUIRED FOR CONFORMANCE WITH THE THE STRUCTURAL CONCEPTS OF THE OVERALL PROJECT. RESPONSIBILITY FOR THE DESIGN ADEQUACY IS MAINTAINED BY THE PROJECT ENGINEER OF RECORD.
3. DEVIATIONS FROM THE PROJECT DOCUMENTS REQUESTED BY THE CONTRACTOR SHALL BE CLEARLY INDICATED ON EACH SUBMITTAL.
4. THE CONTRACTOR IS RESPONSIBLE FOR ALL DIMENSIONS SHOWN ON THE SHOP DRAWINGS AND FOR THE COORDINATION OF THE TRADES RELATING TO EACH SUBMITTAL.
5. WHERE SHOP DRAWINGS ARE RESUBMITTED THEY WILL BE REVIEWED FOR CHANGES ONLY. ALL CHANGES SHALL BE CLEARLY NOTED .

SPECIAL INSPECTION

1. WHERE SPECIAL INSPECTION IS REQUIRED, THE QUALIFICATIONS OF THE SPECIAL INSPECTOR(S) SHALL BE SUBMITTED FOR REVIEW.
2. SPECIAL INSPECTION SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE 1991 UNIFORM BUILDING CODE, SECTION 306.
3. STRUCTURAL OBSERVATION BY PAUL F. FRATESSA ASSOC. IS REQUIRED PER SECTION 306 OF THE 1991 UNIFORM BUILDING CODE.

DESIGN CRITERIA

1. 1991 UNIFORM BUILDING CODE.
2. THE DESIGN IS BASED UPON THE REPORT BY HARZA KALDVEER NUMBER K1226-1-164, 17368, DATED FEBRUARY 28, 1992. A PSEUDO-STATIC COEFFICIENT (K) OF 0.15 AND A FACTOR OF SAFETY OF 1.15 AS DISCUSSED IN THE ABOVE REPORT IS USED IN DETERMINING THE REQUIRED SHEAR FORCE RESISTANCE TO BE PROVIDED BY THE SLIP PLANE SHEAR ENHANCEMENT (SPSE) SYSTEM.
3. FREE-STANDING, UNRESTRAINED RETAINING WALLS ARE DESIGNED FOR AN 80 PCF EQUIVALENT FLUID WEIGHT FOR THE STATIC CONDITION AND A 120 PCF FOR THE PSEUDO-STATIC CONDITION PER FURTHER RECOMMENDATIONS PROVIDED BY HARZA KALDVEER. PROVIDE PERMEABLE BACKFILL BEHIND ALL RETAINING WALL PER A/S2.
4. SPECIAL INSPECTION OF CAISSON EXCAVATIONS IS REQUIRED PER SECTION 306(a)11 OF THE UNIFORM BUILDING CODE.

REINFORCING

1. ALL REINFORCING SHALL CONFORM TO ASTM SPECIFICATION A-615 GRADE 60. SEE ALSO SPECIFICATIONS.
2. ALL REINFORCING STEEL SHALL BE LAP SPLICED AS INDICATED. PROPOSED LAP SPLICE LOCATIONS NOT SPECIFICALLY INDICATED ARE SUBJECT TO REVIEW. LAP SPLICES SHALL BE STAGGERED EXCEPT AS SPECIFICALLY NOTED OTHERWISE ON PROJECT DOCUMENTS.

CONCRETE

1. ALL CONCRETE SHALL BE REGULAR WEIGHT (145 PCF) WITH A 28-DAY COMPR. STRENGTH (F'c) OF 3500 PSI.
2. SPECIAL INSPECTION IS REQUIRED PER SECTION 306(a)1 OF THE UNIFORM BUILDING CODE FOR ALL CONCRETE.
3. CEMENT SHALL CONFORM TO ASTM C-150, TYPE II.
4. AGGREGATE SHALL CONFORM TO ASTM C33 FOR NORMAL WEIGHT CONCRETE.
5. SUBMIT MIX DESIGNS FOR ALL CLASSES OF CONCRETE. SEE ALSO SPECIFICATIONS.
6. PLACEMENT OF CONCRETE SHALL BE IN CONFORMANCE WITH THE REQUIREMENTS OF SPECIFICATIONS.

TIE-BACK ANCHORS

1. SHOP DRAWINGS WHICH SHOW STRAND PROFILES, LOCATIONS, SPACINGS, END DETAILS, INITIAL AND FINAL STRESSING VALUES, NUMBER OF STRANDS, STRAND SUPPORT DETAILS AND LOCATIONS OF STRESSING AND DEAD ENDS SHALL BE SUBMITTED.
2. THE POST-TENSIONING SYSTEM SHALL BE AN ICBO APPROVED MULTI-STRAND SYSTEM CONSISTING OF 0.5" AND 0.6" NOMINAL DIAMETER STRANDS. THE STRAND SHALL BE 7-WIRE COLD DRAWN, LOW RELAXATION, f_{pu} = 270 KSI AND SHALL CONFORM TO ASTM A-416 AND CSA STANDARD G279-M 1982.
3. SEE SPECIFICATIONS FOR CORROSION PROTECTION SYSTEM AND GROUTING REQUIREMENTS.
4. SEE SPECIFICATIONS FOR LOAD TEST REQUIREMENTS. FINAL STRESS AT TRANSFER SHALL BE 25% OF f_{pu}.
5. ELONGATIONS SHALL BE SUBMITTED TO THE ENGINEER. TENDONS SHALL NOT BE CUT OFF UNTIL THESE RECORDS HAVE BEEN REVIEWED AND APPROVED BY THE ENGINEER OR HIS AUTHORIZED REPRESENTATIVE.
6. SPECIAL INSPECTION PER SECTION 306(a)1 AND 4 IS REQUIRED FOR PLACEMENT OF GROUT AND PRESTRESSING STEEL.

STEEL

1. ALL STRUCTURAL AND MISCELLANEOUS STEEL SHALL CONFORM TO ASTM A-36 UNLESS OTHERWISE NOTED ON STRUCTURAL DRAWINGS AS ASTM A572 GRADE 50 AND SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH A.I.S.C. SPECIFICATIONS FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, LATEST EDITION. SEE ALSO SPECIFICATIONS.
2. TUBE STEEL SHALL CONFORM TO ASTM A-500, GRADE B.
3. SUBMIT AND OBTAIN REVIEW OF SHOP DRAWINGS, PRIOR TO FABRICATION.

WELDING

1. ALL WELDING SHALL BE DONE BY CERTIFIED WELDERS USING PREQUALIFIED WELDING PROCEDURES.
2. SPECIAL INSPECTION OF WELDING PER SECTION 306(a)5 OF THE UNIFORM BUILDING CODE IS REQUIRED.

LAGGING

1. LAGGING SHALL BE GRADE MARKED PER WWPA SPECIFICATIONS. LAGGING SHALL HAVE A MAXIMUM MOISTURE CONTENT OF 19% AT TIME OF INSTALLATION. SEE SPECIFICATIONS FOR OTHER REQUIREMENTS.
2. LAGGING SHALL BE NO. 2 PRESSURE TREATED DOUGLAS FIR, IN ACCORDANCE WITH AWPB LP-22, BEARING AWPB STAMP. LAGGING SHALL NOT BE CUT OR NOTCHED UNLESS SPECIFICALLY SHOWN, NOTED, OR APPROVED.
3. SEE SPECIFICATIONS FOR PRESSURE TREATMENT OF LUMBER. TREAT FIELD CUTS, HOLES AND INJURIES WITH COPPER NAPTHENATE BY THOROUGH BRUSHING, SPRAYING, DIPPING, SOAKING OR COATING. BORED HOLES ARE TO BE POURED FULL OF PRESERVATIVE. IF A HOLE PASSES THROUGH A CHECK, THEN BRUSHING IS NEEDED TO OBTAIN FULL COVERAGE.

SLIP PLANE SHEAR ENHANCEMENT SYSTEM SCHEDULE

CAISSON NUMBER	BUILDING NUMBER	DESIGN PROFILE	SECTION MARK	CAISSON SPACING	CAISSON DEPTH	TIE BACK STRANDS*	UNBONDED LENGTH	BOND LENGTH	TEST LOAD	LOCK OFF LOAD
1	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	30'-0"	30'-0"	93.7 kips	29.3 kips
2	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	30'-0"	30'-0"	93.7 kips	29.3 kips
3	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	30'-0"	30'-0"	93.7 kips	29.3 kips
4	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	30'-0"	30'-0"	93.7 kips	29.3 kips
5	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	30'-0"	30'-0"	93.7 kips	29.3 kips
6	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
7	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
8	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
9	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
10	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
11	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
12	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
13	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
14	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
15	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
16	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
17	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
18	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
19	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
20	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
21	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
22	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
23	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
24	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
25	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
26	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
27	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
28	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	55'-0"	30'-0"	93.7 kips	29.3 kips
29	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
30	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
31	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
32	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
33	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
34	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
35	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	40'-0"	30'-0"	93.7 kips	29.3 kips
36	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
37	51	I	A/S2	5'-0"	58'-0"	2 - 0.6"	45'-0"	30'-0"	93.7 kips	29.3 kips
38	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
39	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
40	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
41	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
42	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
43	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
44	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
45	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
46	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	45'-0"	45'-0"	140.6 kips	44 kips
47	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
48	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
49	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
50	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
51	51	II	A/S2	6'-0"	56'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
52	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	15'-0"	45'-0"	140.6 kips	44 kips
53	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	15'-0"	45'-0"	140.6 kips	44 kips
54	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	35'-0"	45'-0"	**	20 kips
55	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	35'-0"	45'-0"	140.6 kips	44 kips
56	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	35'-0"	45'-0"	140.6 kips	44 kips
57	77	III	A/S3	12'-0"	48'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
58	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
59	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
60	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
61	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
62	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
63	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
64	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
65	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
66	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	20'-0"	45'-0"	140.6 kips	44 kips
67	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	35'-0"	45'-0"	140.6 kips	44 kips
68	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	35'-0"	45'-0"	140.6 kips	44 kips
69	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	35'-0"	45'-0"	140.6 kips	44 kips
70	77	IV	A/S3	5'-4"	73'-0"	2 - 0.6"	35'-0"	45'-0"	93.7 kips	29.3 kips
70A	77	IV	A/S3	5'-4"	73'-0"	2 - 0.6"	35'-0"	45'-0"	93.7 kips	29.3 kips
71	77	IV	A/S3	5'-4"	73'-0"	2 - 0.6"	35'-0"	45'-0"	93.7 kips	29.3 kips
72	77	IV	A/S3	5'-4"	73'-0"	2 - 0.6"	50'-0"	45'-0"	93.7 kips	29.3 kips
72A	77	IV	A/S3	5'-4"	73'-0"	2 - 0.6"	50'-0"	45'-0"	93.7 kips	29.3 kips
73	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
74	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
75	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
76	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	**	20 kips
77	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
78	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
79	77	IV	A/S3	8'-0"	58'-0"	3 - 0.6"	50'-0"	45'-0"	140.6 kips	44 kips
80	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
81	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
82	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
83	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
84	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
85	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
86	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
86A	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
87	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
88	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
89	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
90	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A
91	77	V	A/S4	11'-0"	48'-0"	N/A	N/A	N/A	N/A	N/A

** TIE-BACK CAPACITY IS APPROXIMATELY 50% OF DESIGN CAPACITY

REV.	DATE	DESCRIPTION	BY
1	3/94	AS-BUILTS	GW

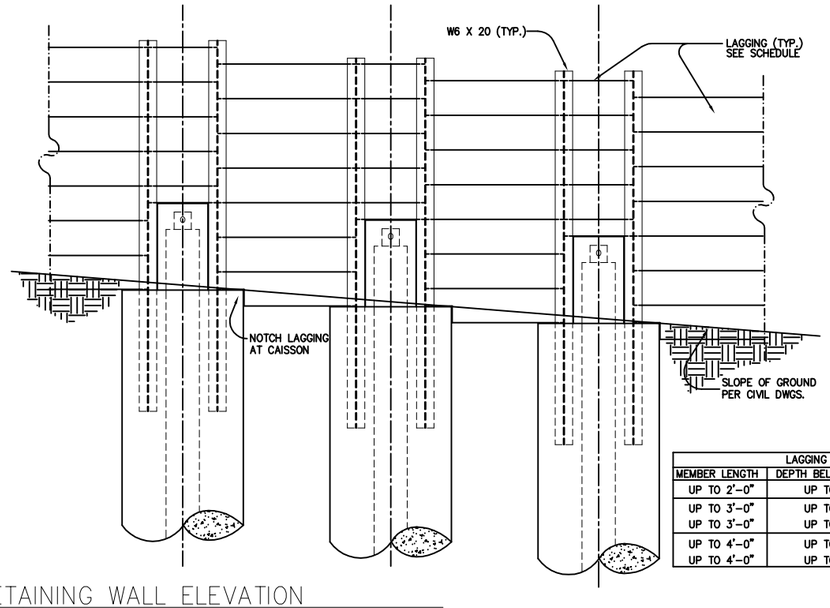
DATE: OCT. 9, 1992
DRAWN BY: D.A.R.
CHECKED BY: P.F.F.
SCALE: AS SHOWN

PAUL F. FRATESSA ASSOCIATES, INC.
CONSULTING STRUCTURAL ENGINEERS
11881 SKYLINE BLVD., OAKLAND, CA 94619 510/482-3541

SLOPE AND SEISMIC STABILIZATION PROJECT
SUBCONTRACT NO. 693
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA, BERKELEY, CA 94720

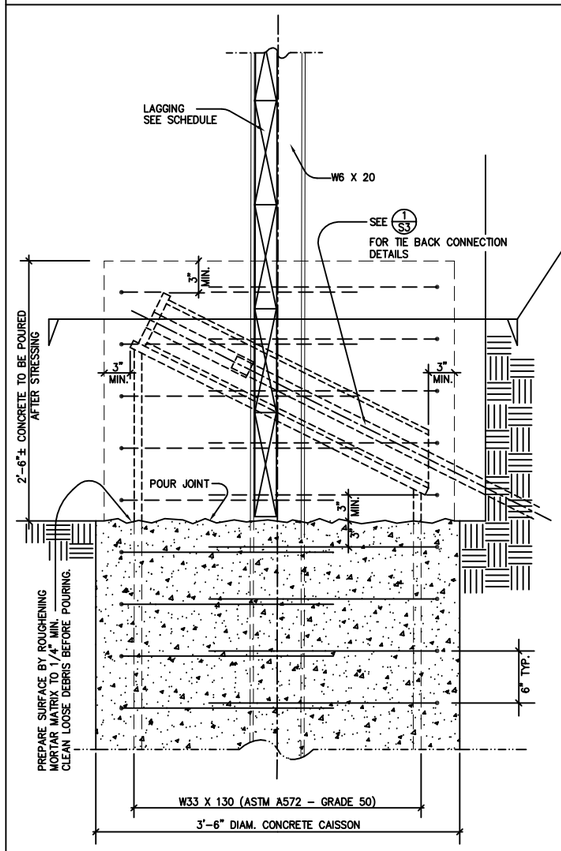
GENERAL NOTES & CAISSON SCHEDULE

SHEET NUMBER
S1
OF SHTS.
DRAWING NUMBER

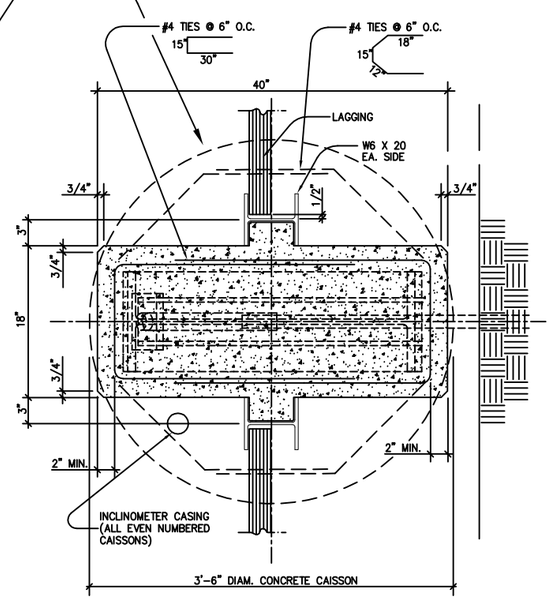


LAGGING SCHEDULE		
MEMBER LENGTH	DEPTH BELOW BACKFILL	SIZE OF LAGGING
UP TO 2'-0"	UP TO 8'-0"	2X LAGGING
UP TO 3'-0"	UP TO 5'-0"	2X LAGGING
UP TO 3'-0"	UP TO 8'-0"	3X LAGGING
UP TO 4'-0"	UP TO 3'-0"	2X LAGGING
UP TO 4'-0"	UP TO 8'-0"	3X LAGGING

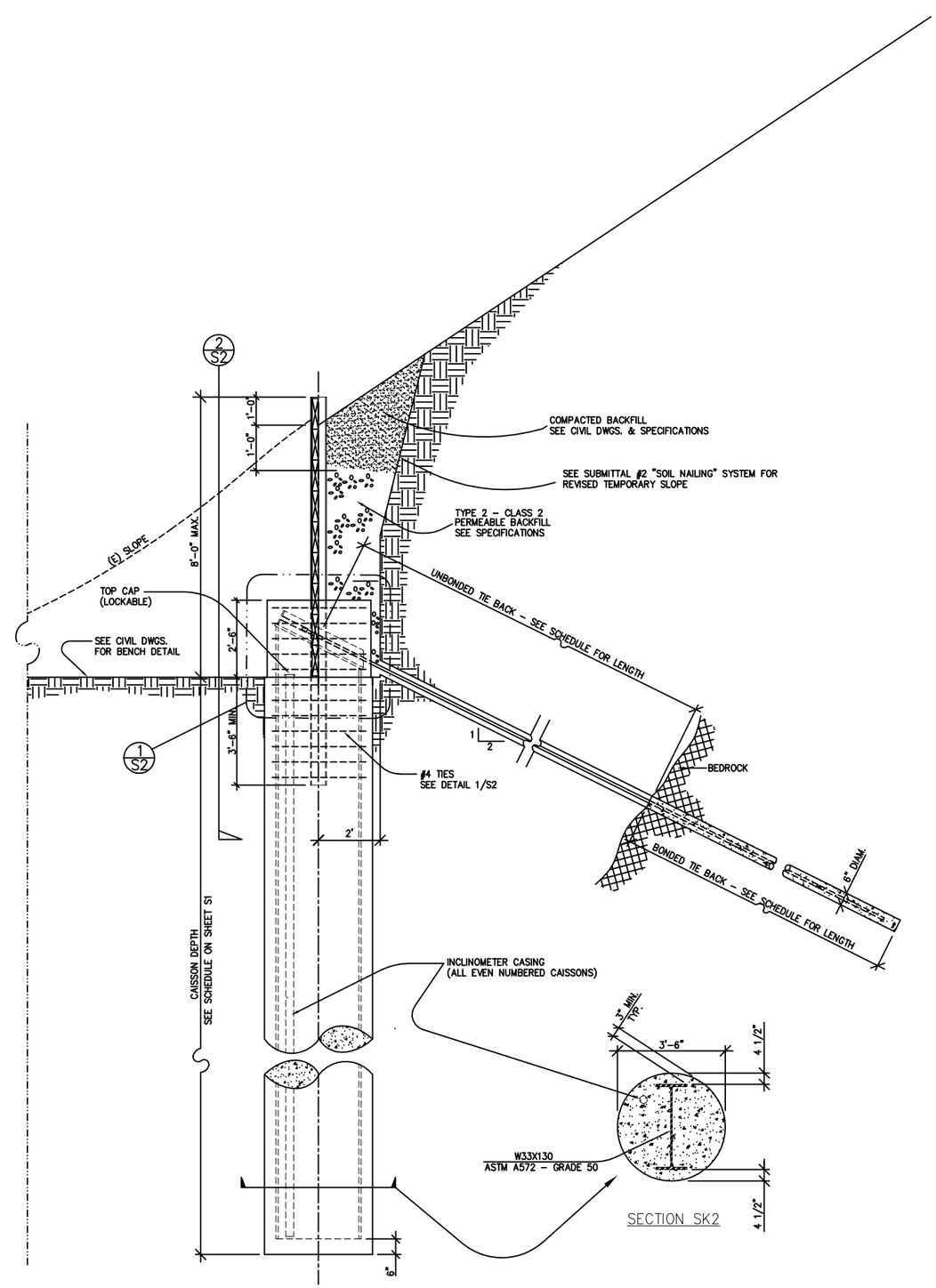
2/S2 RETAINING WALL ELEVATION
1/2" = 1'-0"



1/S2 RETAINING WALL SECTION
1-1/2" = 1'-0"



PLAN SECTION



A/S2 SLIP PLANE SHEAR ENHANCEMENT SYSTEM (SPSE) SECTION
1/2" = 1'-0"

REV.	DATE	DESCRIPTION	BY
1	3/94	AS-BUILTS	GW

DATE: OCT. 9, 1992
DRAWN BY: D.A.R.
CHECKED BY: P.F.F.
SCALE: AS SHOWN

PAUL F. FRATESSA ASSOCIATES, INC.
CONSULTING STRUCTURAL ENGINEERS
11891 SKYLINE BLVD., OAKLAND, CA 94619 510/482-3341

SLOPE AND SEISMIC STABILIZATION PROJECT
SUBCONCTRACT NO. 693
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA, BERKELEY, CA 94720

BUILDING 51 – DESIGN PROFILES I & II

SHEET NUMBER
S2
OF SHTS.
DRAWING NUMBER

Harza, 1994b,"Slope and Seismic Stabilization Project, Phase II, Subcontract No. 711, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720," plan sheets C1, C2 and C4 dated December 1994.

PLANS FOR:

SLOPE AND SEISMIC STABILIZATION PROJECT - PHASE II

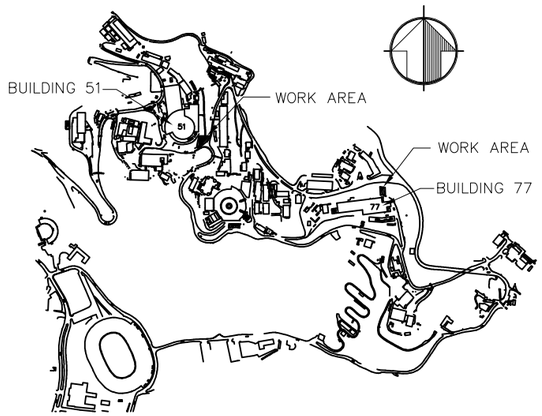
SUBCONTRACT No. 711

LAWRENCE BERKELEY LABORATORY

UNIVERSITY OF CALIFORNIA

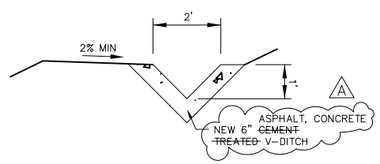
BERKELEY, CALIFORNIA 94720

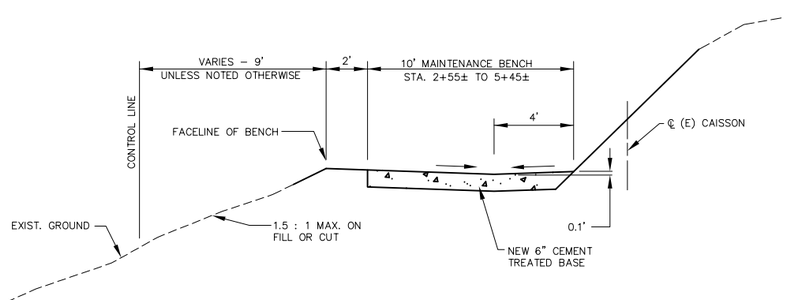
DECEMBER, 1994



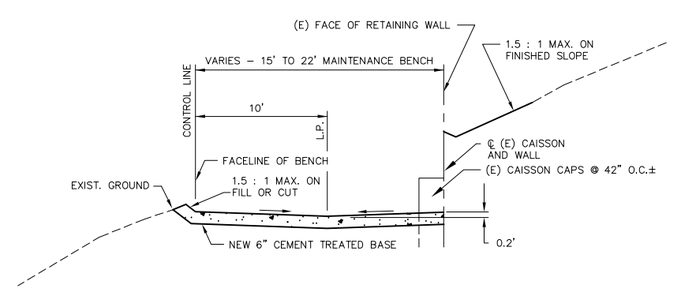
VICINITY MAP
NO SCALE

STA. 5+45 TO 7+76





TYPICAL BUILDING 77 BENCH
NOT TO SCALE



TYPICAL BUILDING 51 BENCH
NOT TO SCALE

TITLE SHEET
DECEMBER, 1994

REV.	DATE	DESCRIPTION	BY
A	1/96	AS-BUILT CHANGES	

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SCALE: NONE

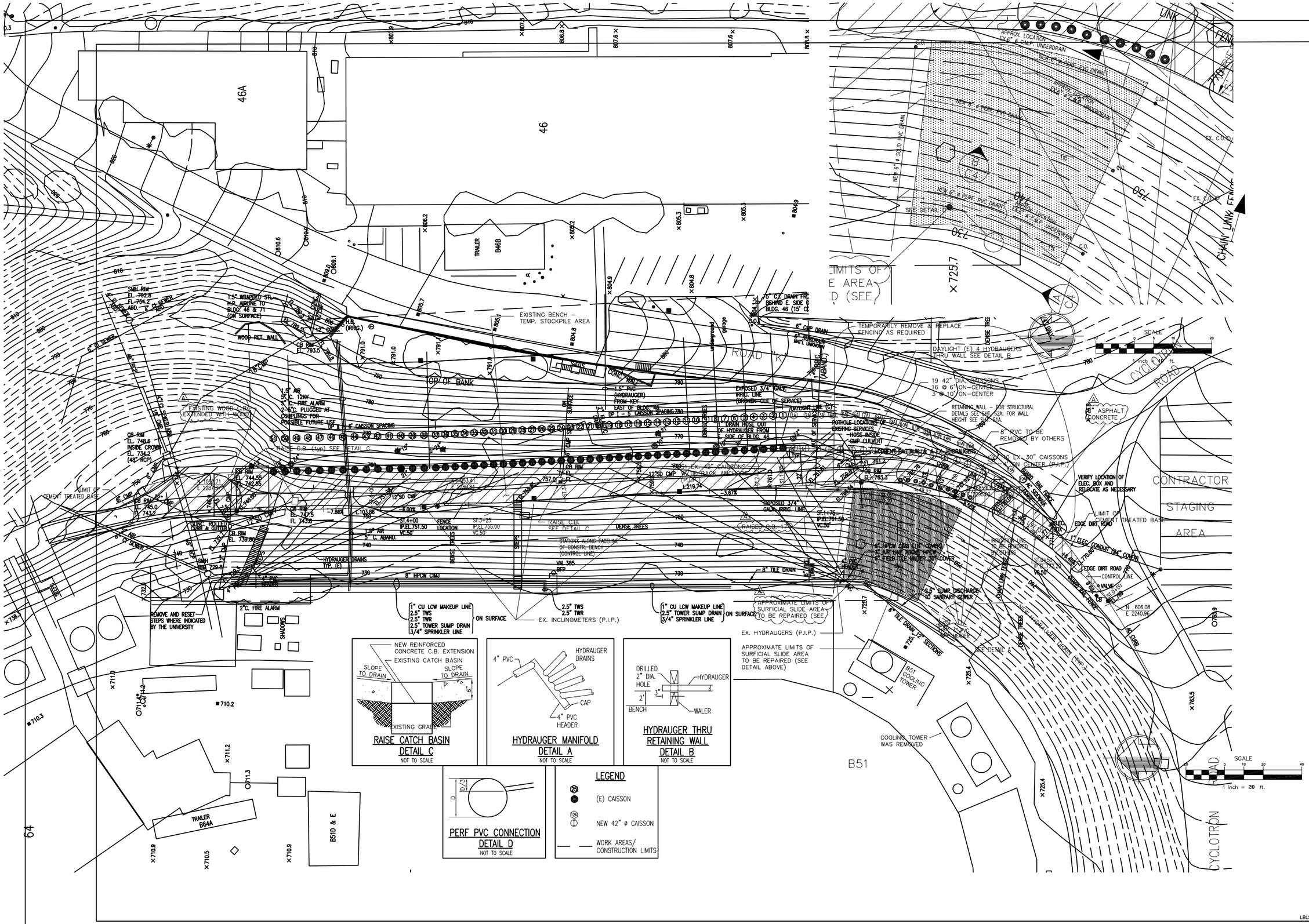
HARZA
Consulting Engineers and Scientists
1970 BROADWAY
OAKLAND, CALIFORNIA 94612
PHONE: (510) 444-7901
FAX: (510) 388-5825

SLOPE AND SEISMIC STABILIZATION PROJECT
PHASE II
SUBCONTRACT NO. 711
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER
C1
OF SHEETS
DRAWING NO.

PLOTTED 2-6-95

LBLCOVA.DWG



REV.	DATE	DESCRIPTION	BY
A	1/96	AS-BUILT CHANGES	

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SCALE: AS SHOWN

BUILDING 51 PLAN

DECEMBER, 1994

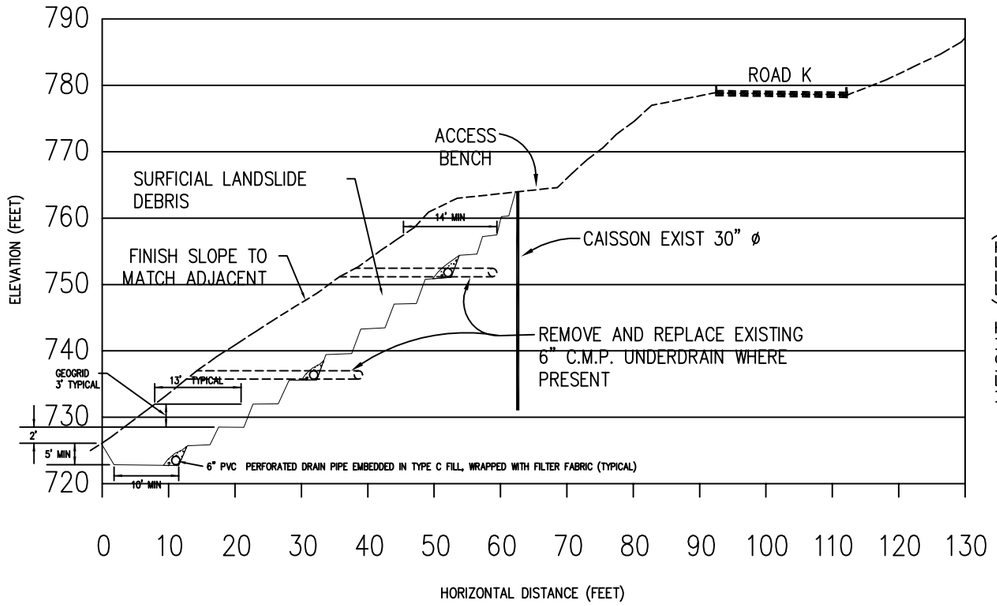
HARZA
Consulting Engineers and Scientists
425 3rd STREET
OAKLAND, CALIFORNIA 94621
TEL: (510) 586-2500
FAX: (510) 586-2508

SLOPE AND SEISMIC STABILIZATION PROJECT
PHASE II

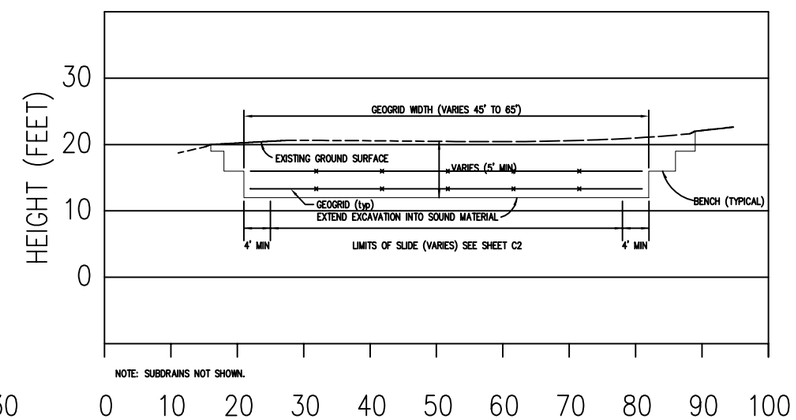
SUBCONTRACT NO. 711
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER C2
OF SHEETS
DRAWING NO.

LBL51A.DWG



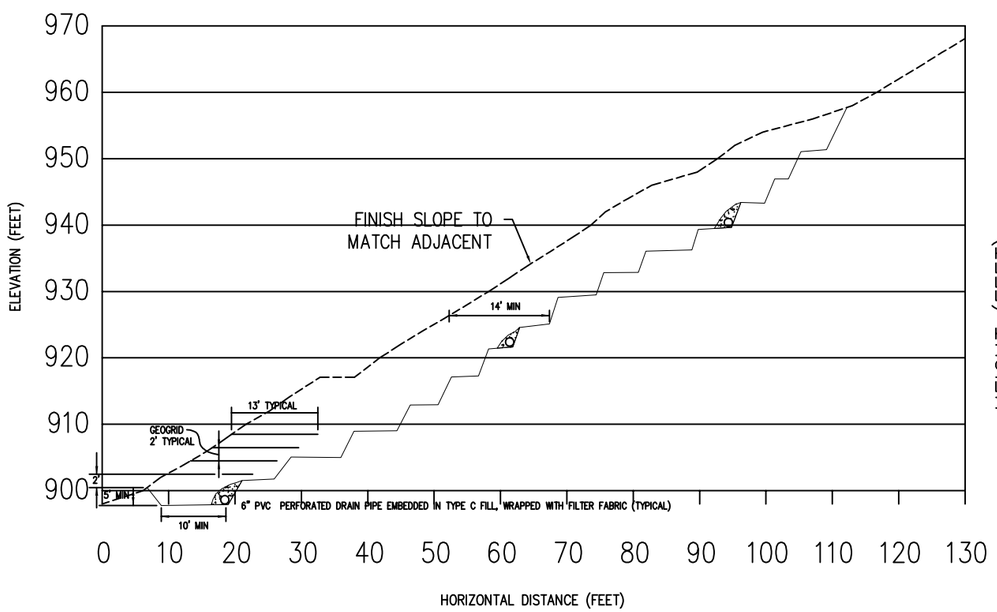
SECTION A –A (BLDG. 51)



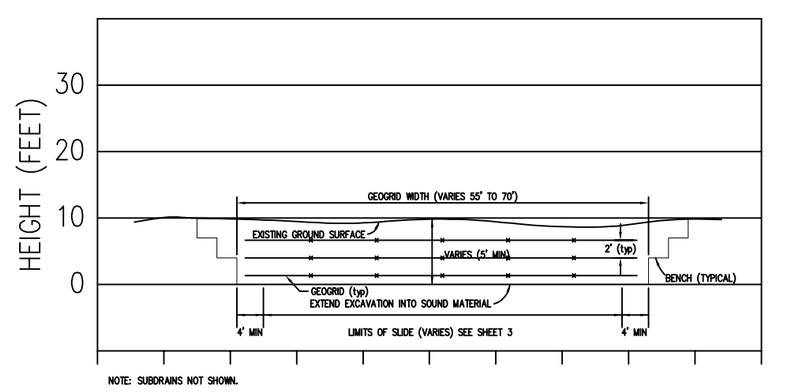
SECTION B –B (BLDG. 51)

GENERAL NOTES

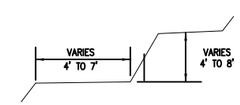
1. TYPE F FILL FOR REPAIR OF SLIDE AREAS SHALL BE COMPACTED TO AT LEAST 95 PERCENT RELATIVE COMPACTION AS DETERMINED BY ASTM D 1557–91.
2. LIMITS OF SLIDE MATERIALS ARE SHOWN ON SHEET C4. ALL SLIDE MATERIALS SHALL BE REMOVED BY THE EXCAVATION AND NEW FILL KEYED INTO SOUND UNDERLYING MATERIAL.
3. MATERIALS REMOVED FROM THE SLIDE AREAS CAN BE USED AS TYPE F FILL PROVIDED IT IS PROPERLY MOISTURE CONDITIONED TO MEET THE SPECIFICATION REQUIREMENTS.
4. COMPLETED FILL SLOPES SHALL BE COMPACTED BY ROLLING THE SURFACE OF THE SLOPE WITH A SHEEPS FOOT ROLLER OR BY OVERBUILDING AND CUTTING BACK TO ATTAIN THE REQUIRED FINISHED SLOPE.
5. SLOPE REINFORCING GEOGRIDS SHALL BE TENSAR BX1100, MIRAFI MIRIGRID 5T, OR APPROVED EQUAL.
6. EXISTING IMPROVEMENTS TO BE PROTECTED IN PLACE (P.I.P.) EXCEPT WHERE SPECIFIED TO BE REMOVED.
7. EXTEND NEW SUBDRAIN PIPE TO THE GROUND SURFACE AT 1:1 SLOPE WHERE CLEANOUTS ARE SPECIFIED. PROVIDE REMOVABLE SCREW–TYPE CAP FOR CLEANOUTS.
8. REMOVE ALL EXCESS SLIDE MATERIAL, NOT USED IN SLOPE RECONSTRUCTION.



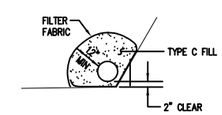
SECTION C – C (BLDG. 77)



SECTION D – D (BLDG. 77)



TYPICAL BENCH



TYPICAL SUBDRAIN

CROSS SECTIONS
SLIDE REPAIR AREAS
BUILDINGS. 51 & 77
DEC, 1994

REV.	DATE	DESCRIPTION	BY

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SCALE: NONE

HARZA
Consulting Engineers and Scientists
4235 ROLAND AVE.
OAKLAND, CALIFORNIA 94621
TEL: (510) 568-4001
FAX: (510) 568-2205

SLOPE AND SEISMIC STABILIZATION PROJECT
PHASE II
SUBCONTRACT NO. 711
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA BERKELEY, CA 94720

SHEET NUMBER
C4
OF SHEETS
DRAWING NO.

PLOTTED: 2–6–95
SECT.DWG

Cartwright Engineers, 2010a, "Calculations for LBNL Bevatron D&D Retaining Walls East of Column Line Y, Berkeley California," structural calculation package dated March 10, 2010, Cartwright Project # 108096.2

STRUCTURAL CALCULATIONS

Calculations for LBNL Bevatron D & D
Retaining Walls East of Column Line Y
Berkeley, California

March 10, 2010

Cartwright Project #: 108096.2

Prepared For:
Lawrence Berkeley National Lab

Prepared By:

CARTWRIGHT
ENGINEERS

REGISTERED PROFESSIONAL ENGINEER
CRAIG A. CARTWRIGHT
No. 3657
Exp. 3/31/10
3/10/10
STRUCTURAL
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8	Wall Footing Bearing Capacity / Demand (South Room)
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10	Tieback Design (T1 - T3)
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PROJECT: LBNL BUILDING 51 D+D DESIGNED BY: EBM DATE: MARCH 2010

SUBJECT: LATERAL EARTH PRESSURE CHECKED BY: CAC PAGE: 1

RETAINING WALL DESIGN

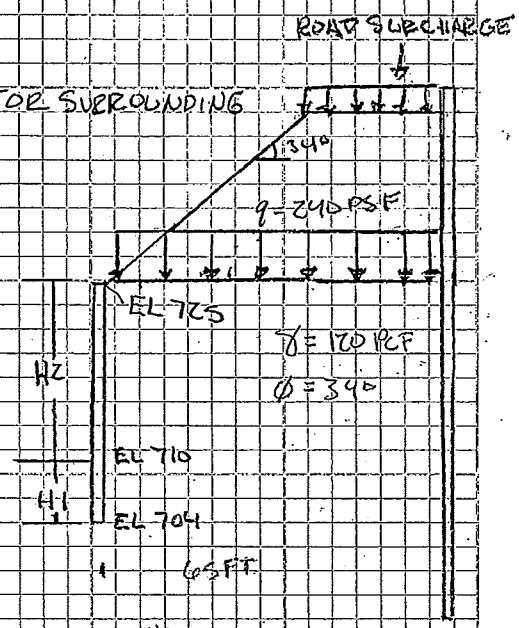
* DESIGN BASED ON PRE CONSTRUCTION SOILS REPORT PROVIDED BY LBNL ACTUAL BACKFILL MATERIAL IS UNKNOWN THEREFORE EXISTISTING CONDITIONS MUST BE VERIFIED DURING CONSTRUCTION

* ROAD SURCHARGE NEGLECTED DUE TO DISTANCE FROM WALL
  65 FT > .5 H (AASHTO 5.5.2)

* DRAINED CONDITIONS ASSUMED PER WALL DETAILS FOR SURROUNDING RETAINING WALLS AND ORIGIONAL WALL CALCS

* 2 FEET OF SOIL USED TO COMPENSATE FOR SLOPE ANGLE $\beta > \phi$. WITH 2 FT OF SOIL ADDED $\beta = \phi$ ALLOWING THE USE OF LOG SPIRAL METHOD AS EXPLAINED IN THE CALTRANS TRENCHING AND SHORING MANUAL SECTION 6-20

  $q = 2\text{ FT} \times 120\text{ PCF} = 240\text{ PSF}$
  ↳ γ

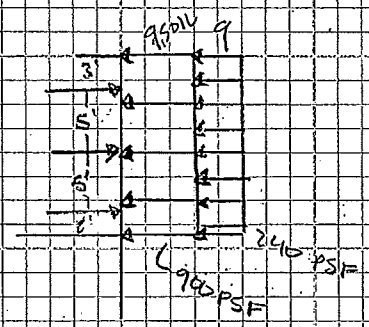


LATERAL EARTH PRESSURE

$q_{SOIL} = .65\ K_a\ \gamma\ H$ (AASHTO FIG 5.7.2A) (SHEET 17)

$K_a = .78$ (SEE SHEET 15)

$q_{SOIL} = 912$ PSF



$q_{TOTAL} = 900 + 240 = 1140$ PSF

$P = q_{TOTAL}\ (\text{HEIGHT})\ (\text{SPACING})$

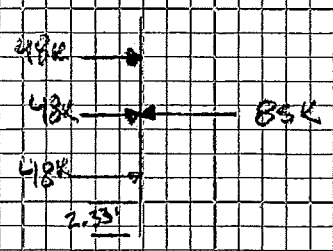
$= 1140\text{ PSF}\ (15\text{ FT})\ (5\text{ FT}) = 85.5$ KIPS
↳ TIE BACK SPACING

* PASSIVE PRESSURE AT TOE NEGLECTED DUE TO SHALLOW FOOTING + UNKNOWN AFFECTS OF DEMO SURROUNDING WALL
  THIS APPROACH IS SEEN AS CONSERVATIVE

FS OVERTURN (SOUTH ROOM)

MOMENT OVERTURN

85.5(9.833) = 840.72



RIGHTING MOMENT (TRY 48 KIPS)

FOR TERM = 48 KIPS (15.33 FT) = 736 K-FT
FOR TERM = 48 KIPS (10.33 FT) = 496 K-FT
FOR TERM = 48 KIPS (5.33 FT) = 256 K-FT

Σ = 1488

$FS = \frac{M_{RIGHT}}{M_{OVERTURN}} \Rightarrow \frac{1488 \text{ K-FT}}{841 \text{ K-FT}} = 1.77$ ∴ OK

FS SLIDE

DRIVING FORCE

= 85.5 KIPS

RESISTING FORCE

= 48 (3) = 144K
3 PINS

$FS = \frac{144K}{85.5K} = 1.68 > 1.5$ ∴ OK

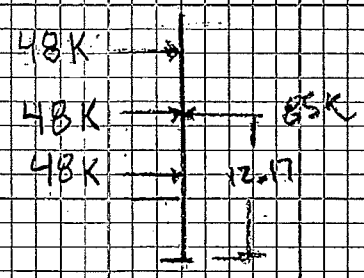
PROJECT: LBNL BUILDING 51 D+D DESIGNED BY: EBM DATE: MARCH 2010

SUBJECT: RT. WALL DESIGN CHECKED BY: CAC PAGE: 3

F.S. OVERTURN (NORTH ROOM)

MOMENT OVERTURN

85.5K (12.17 FT) = 1040.54 K-FT



RIGHTING MOMENT

FOR T1 M = 48 KIPS (17.67) = 848 K-FT

FOR T2 M = 48 KIPS (12.67) = 608 K-FT

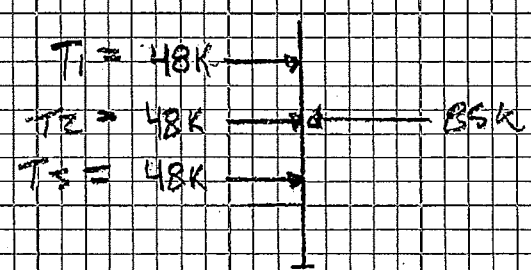
FOR T3 M = 48 KIPS (7.67) = 368 K-FT

Σ = 1824 K-FT

$$F.S. = \frac{M\ RIGHT}{OVERTURN} = \frac{1824\ K\text{-}FT}{1041\ K\text{-}FT} = \underline{1.75 > 1.5 \therefore OK}$$

F.S SLIDE

$$FS = \frac{RESISTING\ FORCE}{DRIVING\ FORCE}$$



RESISTING FORCE

= 48 (3) = 144 KIPS

DRIVING FORCE

= 85 KIPS

$$F.S = 144K / 85K = \underline{1.69 > 1.5 \therefore OK}$$

PROJECT: LBNL BUILDING 51 D+O DESIGNED BY: EBM DATE: MARCH 2010

SUBJECT: R.T. WALL DESIGN CHECKED BY: CAC PAGE: 4

WALL CHECK SOUTH ROOM

SHEAR CHECK

FROM KSA (SHEETS 18-24)

SHEAR X = 10.53 K (PLATE 1975A) (IDENTIFIED BY HOTSPOTS ON CONTOUR PLOT TYP.)

SHEAR Y = -10.16 K (PLATE 568)

WALL SHEAR CAPACITY = 13.66 K (SEE SHEET 5)

D/C RATIO = 10.53 / 13.66K = .77 < 1 ∴ OK

BENDING CHECK

VALUES TAKEN FROM KSA: LOCALIZED HOTSPOTS IDENTIFIED ON THE CONTOUR PLOTS (SHEETS 18-22) VALUES FOR PLATES SURROUNDING HOTSPOTS (TYPICALLY AROUND TIEBACK) WERE THEN AVERAGED USING VALUES TAKEN FROM THE PLATE FORCES REPORT TO OBTAIN THE MAX POSITIVE AND NEGATIVE MOMENT. (SHEETS 23-60)

MAX POSITIVE MOMENT: (X) PLATES 1570, 1571, 1540, 1541

X+XY = 5.84 K-FT/FT

MAX POSITIVE MOMENT: (Y) PLATES 1250, 1190, 1220, 1250

Y+XY = 4.99 K-FT

MAX NEGATIVE MOMENT (X) PLATES 1666, 1696, 1665, 1695

X+XY = -4.17 K-FT/FT

MAX NEGATIVE MOMENT (Y) PLATES 1605, 1635, 1665, 1695, 1725, 1755

Y+XY = -5.83 K-FT/FT

MAX MOMENT CAPACITY = 6.1 K-FT (SHEET 6)

D/C RATIO = 5.84 / 6.1 = .96 < 1 ∴ OK

Shear Capacity Calculator — *Referenced Code*

Location ID: South Retaining Wall (Worst Case)

b =	12	in	*ACI 318-05*
d =	12	in	
f'c =	4000	psi	
phi =	0.75		
Vc (one way) =	**13,661.04**	lbs	*Section 11.3*

Shear Calculator: Two Way

b_o =	80	in	
d =	12	in	
f'c =	4000	psi	
phi =	0.75		*Section 11.12.2*
Ratio of column =	1		
Column Location =	30		
Vc C =	182,147.19	lbs	
Vc A =	273,220.79	lbs	
Vc B =	295,989.19	lbs	
Vc (two way) =	**182,147.19**	lbs	

Punching Shear Demand (Worst Case)

$T_{1\text{-}3}$ = 51100 lbs (See Sheet 10)

Punching Shear Demand Capacity Ratio

0.28 **OK**

Moment Calculator — *Referenced Code*

Location ID: North Room Retaining Wall Located at Col. Line 7 From Y to Z (Worst Case)

M_u =	6.06	k ft	(See Sheet 7)
As =	0.31	in^2	
# of bars =	0.55	Equiv. Number of bars per foot (#5 bar at 16" oc.)*	
d =	12	in	
b =	12	in*	
h =	14	in	
f'c =	4	ksi	
fy =	40	ksi	
E_s =	29000	ksi	
phi =	0.9		
a =	0.167		

$$a = \frac{A_s f_y}{0.85 f'c * b}$$

Check c/d — *ACI 9.3.2*

c =	0.197	
c/d =	0.016	phi = 0.9

$$c = \frac{a}{\beta_1}$$

Check pmax

β_1 =	0.85	
ε_s =	0.005	
pmax =	0.027	
p=	0.001	ok

$$\rho_{max} = 0.85\beta_1 \frac{f'c}{f_y}\left(\frac{e_{cu}}{e_{cu}+0.004}\right)$$

$$\rho = \frac{A_s}{b * d}$$

phi*Mn =	**73.143**	kip in
	6.095	kip ft
	ok	

$$\phi M_n = \phi A_s f_y \left(d - \frac{a}{2}\right)$$

Deflection

Length =	5	ft
W_{DL} =	0	plf
W_{LL} =	1140	plf
	Pinned	

$M_{a,\ fixed}$ =	28.5	lb in	Uniform Load		
$M_{a,\ pinned}$ =	42.75	lb in		Δ =	**0.002** in
M_a =	42.75	lb in		L/# =	3,085.26
E_c =	3,604,996.53	psi			
n =	8.0444				
p =	0.0012				
k =	0.1288				
f_r =	474.34	psi			
M_{cr} =	185,941.93	lb in			
I_g =	2,744.00	in^4			
I_{cr} =	164.67	in^4			
I_e =	2,744.00	in^4			

*Based on a 5 foot section of wall with 1 bar cut durring tieback installation.

WALL CHECK NORTH ROOM

SHEAR CHECK

FROM RISA (SHEETS 61, 62)

SHEAR x = -10.02 K (PLATE 454) ←

SHEAR Y = -9.73 (PLATE 519)

WALL SHEAR CAPACITY = 13.66 K (SHEET 5)

D/C RATIO = 10.02 / 13.66 = .73 < 1 ∴ OK

BENDING CHECK

VALUES TAKEN FROM RISA (SEE NOTE ON SHEET 4) (SHEETS 63-65, 66-90)

MAX POSITIVE MOMENT (X) PLATES 1155, 1185, 1215, 1245

X + XY = 3.02 K-FT/FT

MAX POSITIVE MOMENT = (Y) PLATES 125, 1155, 1185, 1215, 1245, 1275

Y + XY = 6.06 K-FT / FT ←

MAX NEGATIVE MOMENT (X) PLATES 248, 249, 312, 313

X + XY = -5.73 K-FT / FT

MAX NEGATIVE MOMENT (Y) PLATES 248, 249, 312, 313

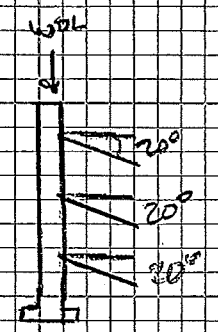
Y + XY = -5.96 K-FT / FT

MAX MOMENT CAPACITY = 6.10 K-FT (SHEET 6)

D/C RATIO = 6.06 / 6.10 = .99 < 1 ∴ OK ←

CHECK WALL FOOTING BEARING CAPACITY / DEMAND (SOUTH ROOM)

WALL AXIAL LOAD (WORST CASE)



WALL DEAD LOAD

= 150 PCF (14.12 FT) (16 FT) = 2800 PLF
↳ B ↳ H

FOOTING DEAD LOAD

= 150 PCF (1.5 FT) (1.33 FT) ≈ 300 PLF
↳ B ↳ D

GRADE BEAM DEAD LOAD

= 150 PCF (1.5) (1.5) = 338 PLF
↳ H ↳ D

FLOOR TILE DEAD LOAD

150 PCF (.5 FT) (1.5 FT) = 113 PLF
↳ T ↳ W

WDL = 2800 + 300 + 338 + 113 = 3551 PLF

VERTICAL COMPONENT OF TIEBACK (WORST CASE)

$T_V = T_{1V} + T_{2V} + T_{3V}$

$T_{1,2,3V}$ = TAN 20° (48 K) = 17.47 KIPS

T_V = 17.47 (3) = 52.41 / 5 FT = 10.48 KLF

T_V + WDL = 10.48 + 3.55 = 14 KLF

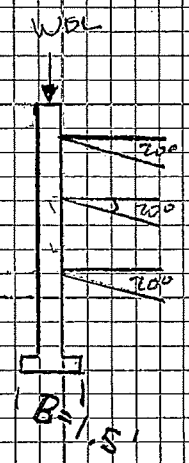
14 / 1.5 = 9.35 KSF

SOIL BEARING CAPACITY = 10 KSF (ASSUME MIN FOOTING DEPTH)
(SEE SHEET 16)

D/C RATIO = 9.35 / 10 = .94 ≤ 1.0 OK

CHECK WALL FOOTING BEARING CAPACITY / DEMAND (NORTH ROOM)

WALL AXIAL LOAD (WORST CASE)



WALL DEAD LOAD

WDL = 150 PCF (19/12 FT) (18.5 FT) ≈ 3238 PLF
↳ B ↳ H

FOOTING DEAD LOAD

= 150 PCF (1.5) (1.33) ≈ 300 PLF
↳ B ↳ D

GRADE BEAM DEAD LOAD

= 150 PCF (1.5) (1.5) ≈ 338 PLF
↳ B ↳ H

FLOOR TIE DEAD LOAD

150 PCF (.5 FT) (1.5 FT) = 113 PLF
↳ T

WDL = 3238 + 300 + 338 + 113 = 3989 PLF

VERTICAL COMPONENT OF TIE BACK (WORST CASE)

$T_V = T_{1V} + T_{2V} + T_{3V}$

$T_{1,2,3V}$ = TAN 20° (48 K) = 17.47 KIPS

T_V = 17.47 (3) = 52.41 KIPS / 5 FT = 10.48 KLF
↳ 3 WIRES

T_V + WDL = 4 + 10.48 = 14.48

14.48 / 1.5 = 9.65 KSF
↳ B

SOIL BEARING CAPACITY = 10 KSF (ASSUME MIN FOOT PATCH SHEET 16)

9.65 / 10 KSF = .97 < 1 ∴ OK ←

TIEBACK DESIGN

DESIGN LOAD

T_{1-3} HORIZ = 48 KIPS

T_1 VERT = 17.5 KIPS

(DL) T_{1-3} = 51.1 KIPS

LOCKOFF LOAD = DL * .8 = 41K (CALTRANS 9-16)

PULLOUT CAPACITY

ULTIMATE BOND STRESS = 4 K/FT (AASHTO TBL 5.7.6.2B)

FOR HARD CLAY, MUST BE CONFIRMED BY TESTING DURRING INSTALLATION

FOR TIEBACK LENGTH = 30'

MIN UN-BONDED LENGTH 15' (AASHTO FIG 5.7.1A)

MIN BONDED LENGTH = 15'

BOND CAPACITY = 4 K/FT x 15 FT = 60 KIPS

$$F_{S.} = \frac{\text{BOND CAPACITY}}{\text{BOND DEMAND}} + FS_{SOIL} \Rightarrow \frac{60K}{51.1} + 1.5 = 2.67 \therefore OK$$

USE AASHTO MIN BOND LENGTH

BAR DESIGN

USE WILLIAMS 1" 150 KSI ALL THREAD BAR (SEE SHEET 91)

ALLOWABLE TENSILE STRESSES

F_u = 128 K

F_y = 102 K

AT DESIGN LOAD $f_t \leq 0.6 F_{pu}$

AT PROOF LOAD $f_t \leq 0.8 F_{pu}$

CHECK 1

0.6 x 128 = 76.8 ≥ 51.1 ∴ OK

CHECK 2 .8(128) = 102.4 ≥ 68 ∴ OK

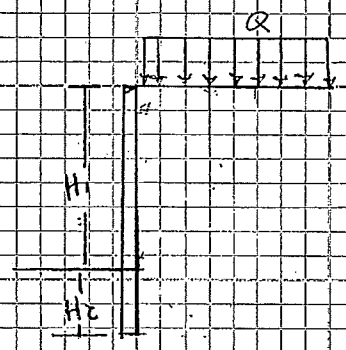
↳ 1.33 (51)

∴ OK USE WILLIAMS 1" 150 KSI ALL THREAD BAR OR APPROVED EQUAL

EARTH PRESSURES (LEVEL SECTION)

$\gamma = 120$ PCF $H_1 = 15'$

$\phi = 34°$ $H_2 = 4.67$



(Q) 72 PSF SURCHARGE LOAD ADDED FOR CONST LOAD (CALTRANS 6-1)

PASSIVE PRESSURE NEGLECTED DUE TO POSSIBILITY OF DISTURBANCE OF SOIL DURING DEMO AND SHALLOW FOOTING

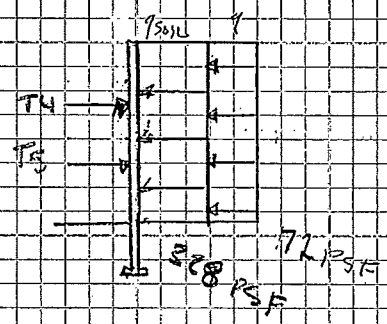
LATERAL EARTH PRESSURE

$P = .65\ K_a \gamma H$ (AASHTO FIG 5.7.2A)

$K_a = .28$ (SEE SHEET 13)

$q_{SOIL} = 328$ PSF

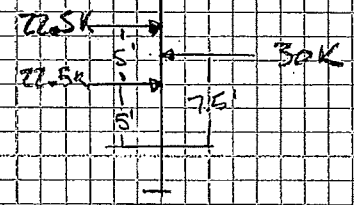
$q_{TOTAL} = 328 + 72 = 400$ PSF



$P_{SOIL} = q_{TOTAL}$ (HEIGHT) (SPACING)

$400\ (15)(5') = 30$ KIPS

@ TIEBACK SPACING



PIN LOADINGS

$T_{4,5} = 400\text{PSF}\ (5\text{ FT})\ (7.5\text{ FT})\ (1.5) = \underline{\underline{22\,500\#}}$

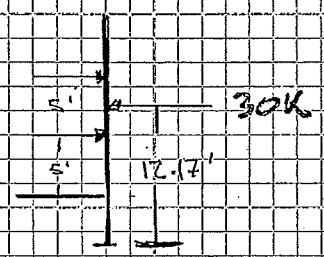
↳ W ↳ H ↳ F.S

F.S. OVERTURN LEVEL SECTIONS

NORTH ROOM

MOMENT OVERTURN

$= 30K\,(12.17) = 365\ K\text{-}FT$



NORTH ROOM

RIGHTING MOMENT

FOR T4 $M = 22.5K(14.67) = 330\ K\text{-}FT$

FOR T5 $M = 22.5K(9.67) = 218\ K\text{-}FT$

$\Sigma = 548\ K\text{-}FT$

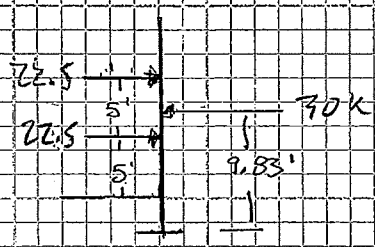
$$F.S. = \frac{M_{RIGHT}}{M_{OVERTURN}} \Rightarrow \frac{548\ K\text{-}FT}{365\ K\text{-}FT} = \underline{\underline{1.50\ \therefore OK}}$$

SOUTH ROOM

SEE NORTH ROOM CALCS

$\underline{\underline{F.S = 1.5}}$

F.S. SLIDE LEVEL SECTIONS (NORTH + SOUTH)



SOUTH ROOM

$$F.S. = \frac{\text{RESISTING FORCE}}{\text{DRIVING FORCE}}$$

RESISTING FORCE

$= \underset{T4}{22.5K} + \underset{T5}{22.5K} = 45K$

DRIVING FORCE

$= 30$ KIPS

$$F.S = \frac{45K}{30K} = \underline{\underline{1.5\ \therefore OK}}$$

CHECK WALL FOOTING BEARING CAPACITY / DEMAND (LEVEL SECTIONS)

WALL AXIAL LOAD (WORST CASE)

WALL DEAD LOAD

= 150 PCF (14/12 FT)(19 FT) = 3325 PLF

FOOTING DEAD LOAD

150 PCF (2 FT)(1.33) = 400 PLF
GB GD

FLOOR TRIB DEAD LOAD

150 PCF (.5 FT)(10.67) = 800 PLF

BEAMS

4 @ (28/12)(1)(150 PCF)(10.67) = 3735 #

3735 (4) = 14,958 / 30 FT ≈ 500 PLF
↳ WALL LENGTH

Σ = 5025 PLF

VERTICAL COMPONENT OF TIEBACK (WORST CASE)

$T_V = T_{4V} + T_{5V}$

$T_{4,5V}$ = TAN 20° (22.54) = 8.2 KIPS

T_V = 8.2 (2) = 16.4 K / 5 FT = 3.3 KLF

T_V + WDL = 5 + 3.3 = 8.3

8.3 / 2 = 4.15 KSF
GB

SOIL BEARING CAPACITY = 10 KSF (ASSUME MIN FOOT DEPTH)
SHEET 16)

4.15 / 10 KSF = .42 < 1.2 OK

TIEBACK DESIGN

(DL) T_{4-5} HORIZ = 22.5K

T_{4-5} VERT = 8.2K

T_{4-5} = 24 K

LOCKOFF LOAD = .8 DL = 19.2K (CALTRANS 9-16)

PULLOUT CAPACITY

ULTIMATE BOND STRESS = 4 KIFT (AASHTO TBL 5.7.6.2B)
FOR HARD CLAY (MUST BE FIELD VERIFIED)

FOR TIEBACK LENGTH = 30'

MIN UNBONDED LENGTH = 15' (AASHTO FIG 5.7.1A)

MIN BONDED LENGTH = 15'

BOND CAPACITY = 4KLF (15') = 60 KIPS

$$F.S. = \frac{\text{BOND CAPACITY}}{\text{BOND DEMAND}} = \frac{60 \text{ KIPS}}{24 \text{ KIPS}} = 2.5 \therefore \text{OK}$$

∴ USE AASHTO MIN BOND LENGTH

BAR DESIGN

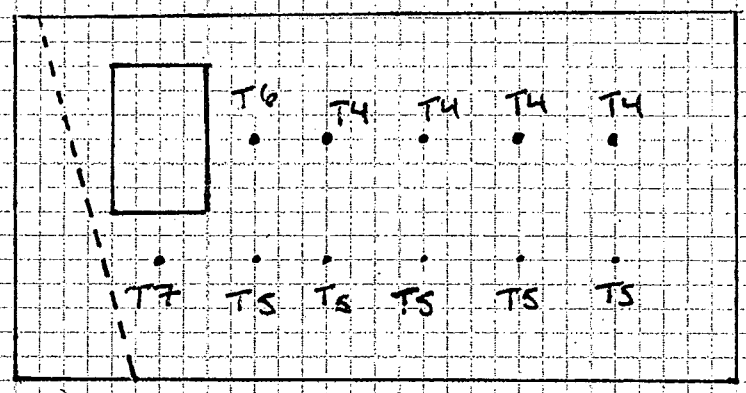
USE WILLIAMS 1" 150KSI ALL THREAD BAR (SEE SHEET 9)

T = 24 K < 51 K ∴ OK (SEE SHEET 10)

USE WILLIAMS MIN 1" 150KSI ALL THREAD BAR OR APPROVED EQUAL.

SOUTH ROOM

RXN'S FOR TIEBACKS SURROUNDING FLOOR TUNNEL



SKETCH

TIEBACK LENGTHS

T4 = 30 FT

T5 = 30 FT

T6 = 45 FT

T7 = 30 FT

RXN @ T4 = 22.5 K (SHEET 14)

@ T5 = 22.5 K

@ T6 = 41 K (FROM RISA NODE 1807)

@ T7 = 31 K (FROM RISA NODE 1953)

RXN'S @ T6 - T7 < 48 K ∴ OK (SEE SHEET 10 FOR TIE-BACK CAPACITIES)

LOCK OFFLOAD FOR T6 TIEBACK

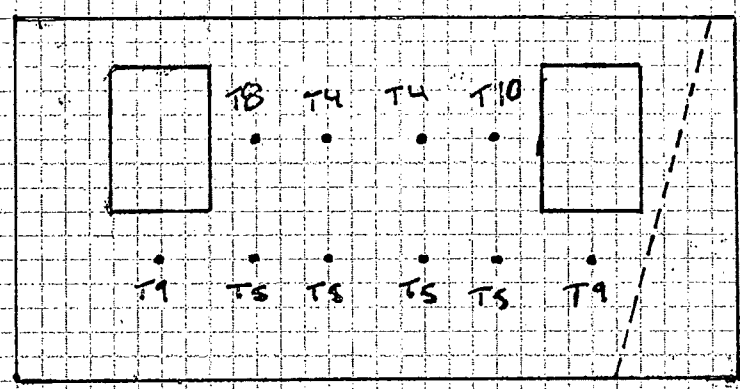
= [41K / COS 20°] .8 = 35 K

LOCK OFF LOAD FOR T7 TIEBACK

= [31K / COS 20°] .8 = 26 K

NORTH ROOM

RXN'S FOR TIEBACKS SURROUNDING FLOOR TUNNEL



TIEBACK LENGTHS

T4 = 30 FT

T5 = 30 FT

T8 = 35 FT

T9 = 30 FT

T10 = 45 FT

RXN @ T4 = 22.5K (SHEET 14

@ T5 = 22.5K

@ T8 = 41K (FROM RISA NODE 1299)

@ T9 = 31K (FROM RISA NODE 1445)

RXN'S @ T8-T9 < 48K ∴ OK SEE SHEET 10 FOR TIEBACK CAPACITIES

LOCK OFF LOAD FOR T8 TIEBACK

= 35K (SEE SHEET 10A)

LOCK OFF LOAD FOR T9 TIEBACK

= 26K (SEE SHEET 10A)

T6, T8 + T10 TIEBACKS EXTENDED TO 35 - 45 FEET RESPECTIVELY
↓ ↓ ↓
45' 45' 35'

TO ENSURE AT LEAST 15 FT. OF BONDED LENGTH WHEN FLOOR TUNNEL IS REMOVED.
BECAUSE THE MIN. BOND LENGTH WILL BE 15 FT. OR GREATER A SEPERATE CAPACITY HAS NOT BEEN CALCULATED THIS IS CONSERVATIVE

MOVE TIEBACK DOWN 2 FEET TO AVOID HITTING EXTERIOR MANHOLE. THE MANHOLE IS APPROX. 5 FT. DEEP AND LOCATED 9 FT. FROM THE PROPOSED RETAINING WALL

WALL CHECK (FROM RISA PLATES 277, 278, 341, 342)

MAX MOMENT X ($M_x + M_{xy}$)

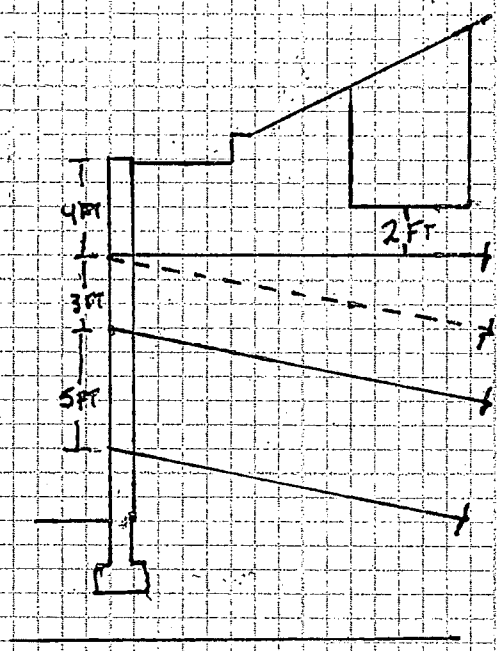
= -3.55 K-FT

MAX MOMENT Y ($M_y + M_{xy}$)

= -5.48 K-FT ←

M_{ALLOW} = 6.1 K-FT (SHEET 6)

D/C = 5.48 / 6.1 = .9 < 1 ∴ OK ←



SKETCH

MAX SHEAR X (PLATE 342)

= 8.84 K/FT

MAX SHEAR Y (PLATE 278)

= 9.5 K/FT

SHEAR ALLOW (ONE WAY)

= 13.7 K/FT > 9.5 ∴ OK ←

MAX PUNCHING SHEAR

1140 PSF × 1.5 × 5.5 FT × 5 FT = 47K < 48 ∴ USE 48 (SHEET 37)
↳ F.S. ↳ H ↳ B

PUNCHING SHEAR OK SEE SHEET 5

∴ IS OK TO MOVE (1) TIEBACK DOWN (2) FEET TO AVOID EXTERIOR MANHOLE ←

MOVE (2) SOUTHERNMOST "T1" TIEBACKS DOWN 2 FEET TO AVOID 2.5" DEEP BEAM

WALL CHECK (FROM RISA PLATES 249, 313, 377, 441)

MAX MOMENT x ($M_x + M_{xy}$)

= -3.16 K-FT/FT

MAX MOMENT y ($M_y + M_{xy}$)

= -5.42 K-FT/FT

M_{ALLOW} = 6.1 K-FT (SHEET 6)

D/C = 5.42 / 6.1 = .89 < 1 ∴ OK ←

MAX SHEAR x (PLATE 313)

= 10.38 K/FT

MAX SHEAR y (PLATE 313)

= 11.21 K/FT

SHEAR ALLOW (ONE WAY)

= 13.7 K > 11.21 ∴ OK

MAX PUNCHING SHEAR

= 1140 PSF (1.5) (5.5 FT) (5 FT) = 47K < 48K ∴ USE 4B (SHEET 8)

F.S. H B

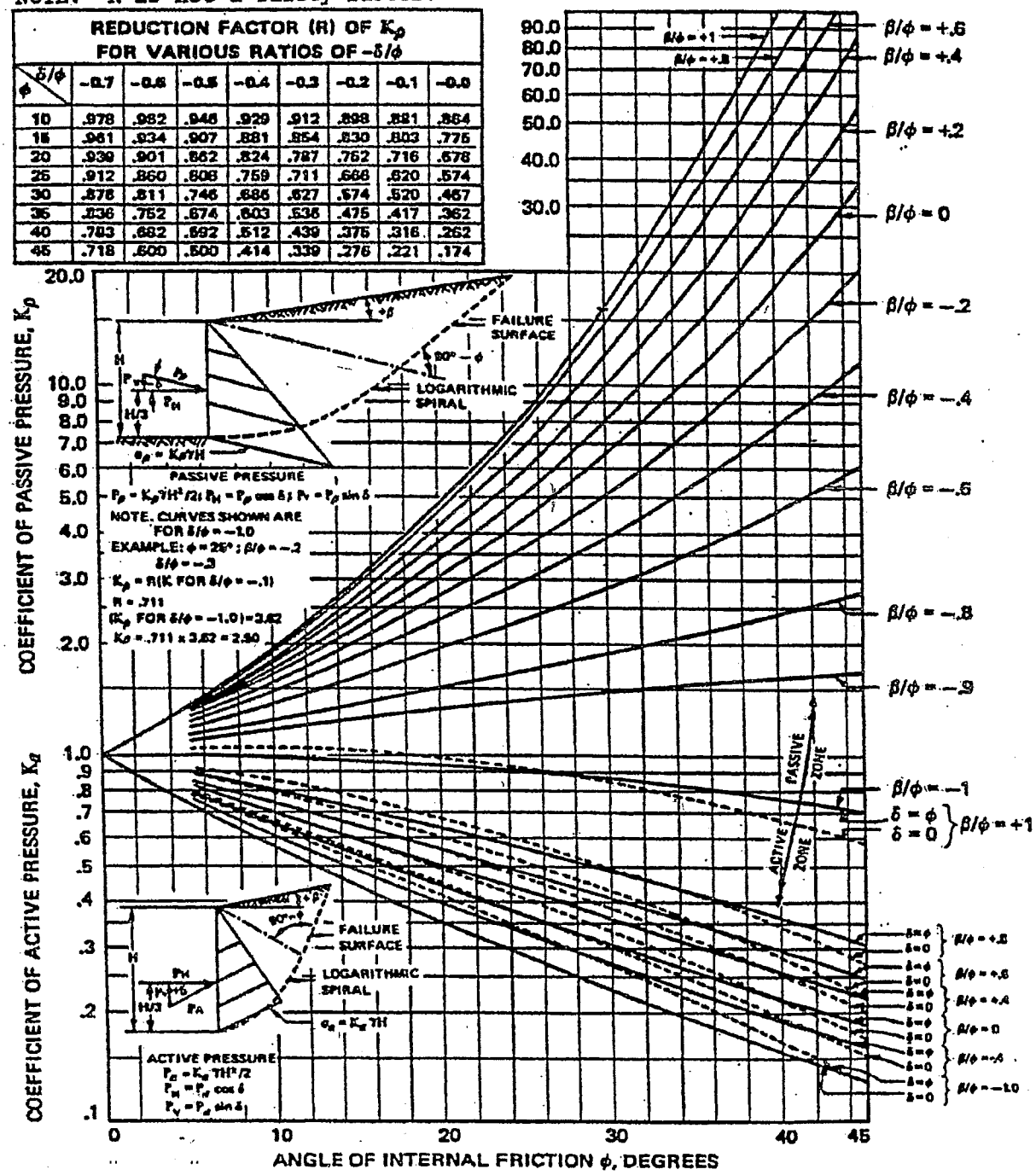
∴ OK TO MOVE (2) TIEBACKS DOWN (2) FEET TO AVOID 2.5' BEAM ←

LOG - SPIRAL FAILURE SURFACE

NOTE: R is not a safety factor.

REDUCTION FACTOR (R) OF K_p FOR VARIOUS RATIOS OF $-\delta/\phi$

ϕ \ δ/ϕ	-0.7	-0.6	-0.5	-0.4	-0.3	-0.2	-0.1	-0.0
10	.978	.982	.946	.929	.912	.898	.881	.864
15	.961	.934	.907	.881	.854	.830	.803	.776
20	.939	.901	.862	.824	.787	.752	.716	.678
25	.912	.860	.808	.759	.711	.666	.620	.574
30	.876	.811	.746	.686	.627	.574	.520	.467
35	.836	.752	.674	.603	.536	.475	.417	.362
40	.783	.682	.592	.512	.439	.375	.316	.262
45	.718	.600	.500	.414	.339	.276	.221	.174

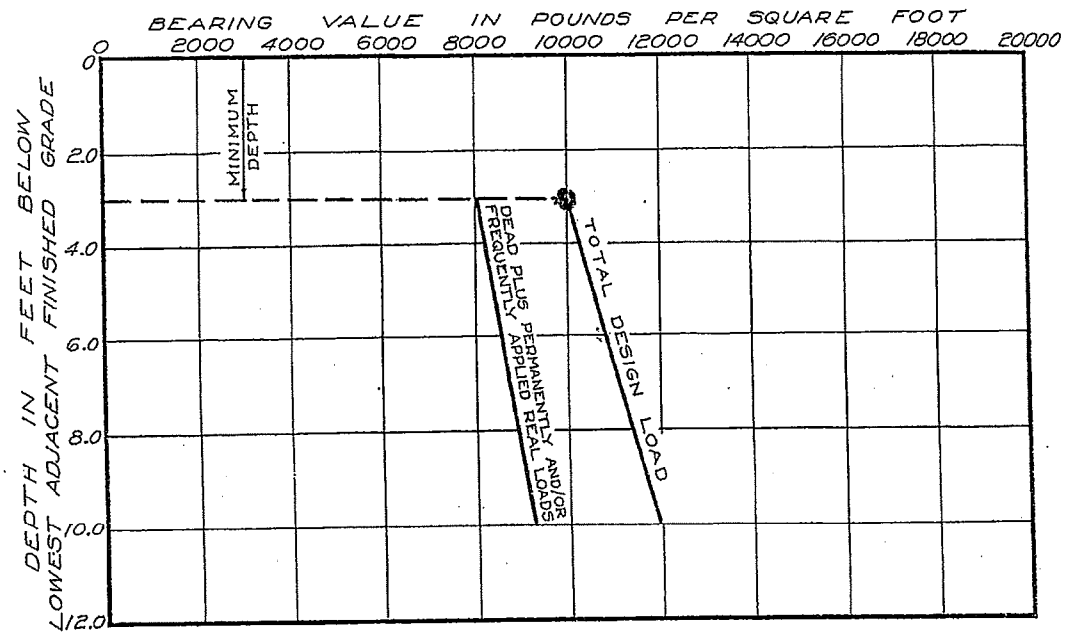


Active and passive coefficients with wall friction (sloping backfill)

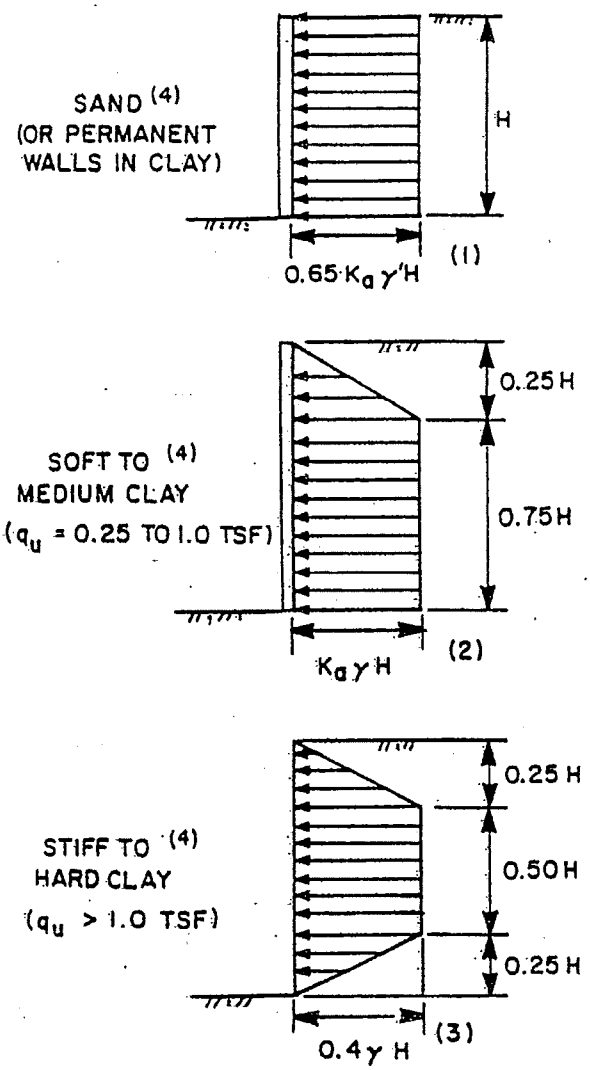
FROM USS STEEL SHEET PILING DESIGN MANUAL

FIGURE 8

ALLOWABLE BEARING PRESSURES ON SHALE FORMATION



THE GRAF SHOWN ABOVE WAS TAKEN FROM THE ORIGINAL BEVETRON FOUNDATION INVESTIGATION PERFORMED IN 1948



H - FINAL WALL HEIGHT

K_a - ACTIVE EARTH PRESSURE COEFFICIENT

γ' - EFFECTIVE SOIL UNIT WEIGHT

γ - TOTAL SOIL UNIT WEIGHT

m - REDUCTION FACTOR

q_u - UNCONFINED COMPRESSIVE STRENGTH

NOTES

(1) $K_a = \tan^2(45 - \frac{\phi'}{2})$

(2) $K_a = 1 - m\,(2q_u/\gamma H)$ BUT NOT LESS THAN 0.25
m = 1 FOR OVERCONSOLIDATED CLAYS
m = 0.4 FOR NORMALLY CONSOLIDATED CLAY

(3) VALUE OF 0.4 SHOULD BE USED FOR LONG-TERM EXCAVATIONS; VALUES BETWEEN 0.4 AND 0.2 MAY BE USED FOR SHORT-TERM CONDITIONS.

(4) SURCHARGE AND WATER PRESSURES MUST BE ADDED TO THESE EARTH PRESSURE DIAGRAMS. THE TWO LOWER DIAGRAMS ARE NOT VALID FOR PERMANENT WALLS OR WALLS WHERE WATER LEVEL LIES ABOVE BOTTOM OF EXCAVATION.

FIGURE 5.7.2A Guidelines for Estimating Earth Pressure on Walls with Two or More Levels of Anchors Constructed from the Top Down Modified after Terzaghi and Peck (1967)

5.7.4 Seismic Pressure

Refer to Section 6 of Division I-A—Seismic Design for guidance regarding the design of anchored retaining walls subjected to dynamic and seismic loads. In general, the pseudo-static approach developed by Mononobe and Okabe may be used to estimate the equivalent static forces provided the maximum lateral earth pressure be computed using a seismic coefficient k_h=1.5A. Forces resulting from wall inertia effects may be ignored in estimating the seismic lateral earth pressure.

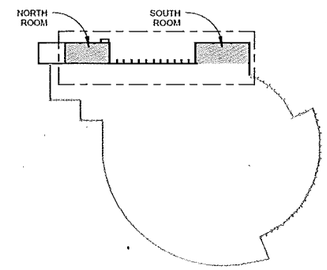
5.7.5 Structure Dimensions and External Stability

The design of anchored walls includes determination of the following:

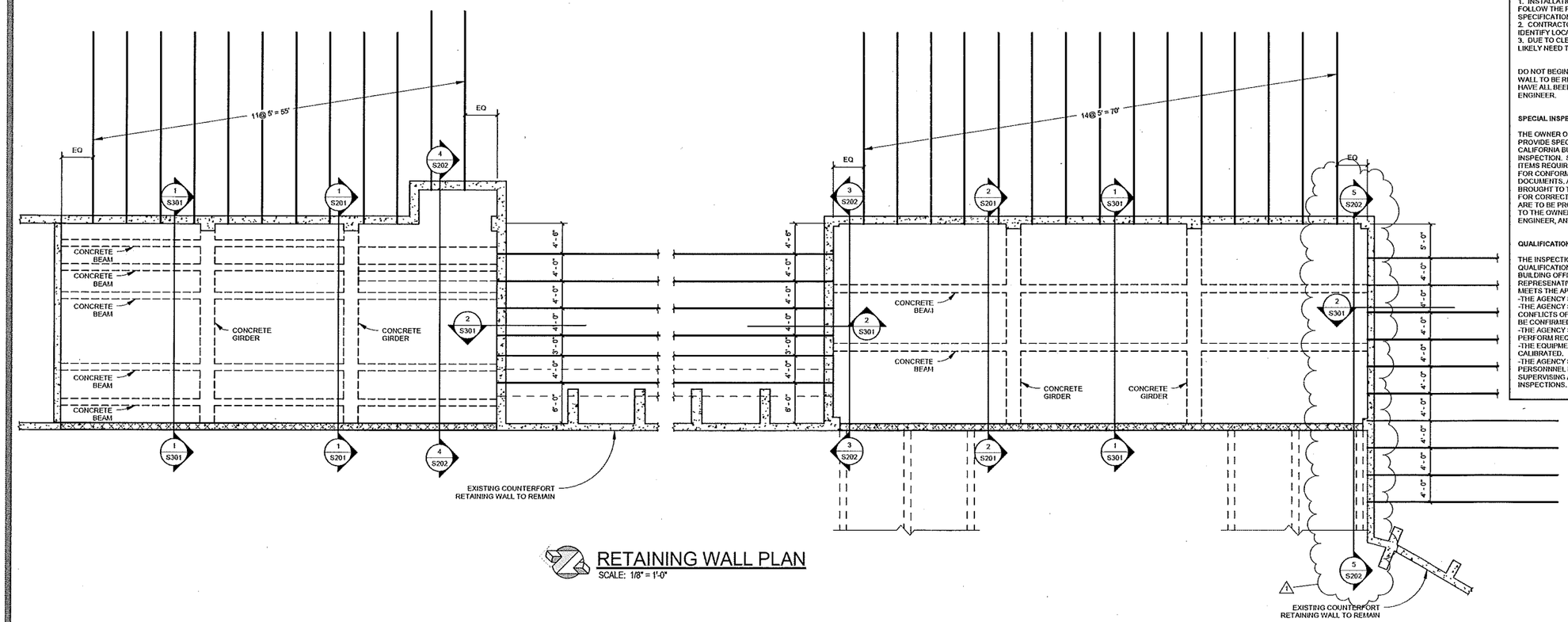
- Size, spacing, and depth of embedment of vertical wall elements and facing;
- Type, capacity, spacing, depth, inclination and corrosion protection of anchors; and
- Structural capacity and stability of the wall, wall foundation, and surrounding soil mass for all intermediate and final stages of construction.

COPIED FROM AASHTO STANDARD SPECIFICATIONS for HIGHWAY BRIDGES (SIXTEENTH ED. - 1996)

Cartwright Engineers, 2010b, "Bevatron Field Order #2, Retaining Wall, Berkeley, California," structural plan sheets S101, S201, S202 and S301 dated April 23, 2010, Cartwright Project # 108096.2



KEY PLAN
SCALE: NTS



RETAINING WALL PLAN
SCALE: 1/8" = 1'-0"

TIE BACK GENERAL NOTES

GENERAL

1. WHERE NO CONSTRUCTION DETAILS ARE SHOWN OR NOTED FOR ANY PART OF THE WORK THE DETAILS USED SHALL BE THE SAME AS FOR OTHER SIMILAR WORK PROVIDED THAT PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.
2. THE DESIGN IS BASED ON AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES DIVISION 1 SECTION 5 DESIGN OF RETAINING WALLS.
3. INSTALLATION AND DETAILING OF GROUND ANCHOR SYSTEM SHALL FOLLOW SPECIFICATION SECTION 02410.

SOILS CRITERIA

SOILS INFORMATION USED IN THE DESIGN OF THE RETAINING WALL WAS TAKEN FROM THE ORIGINAL BEVATRON FOUNDATION INVESTIGATION FROM 1948 PROVIDED BY LBNL. THE ACTUAL BACKFILL MATERIAL INTO WHICH THE TIEBACKS WILL BE INSTALLED IS UNKNOWN THEREFORE IT IS POSSIBLE THAT THE SOIL CHARACTERISTICS USED IN THE DESIGN COULD DIFFER FROM THE ACTUAL BACKFILL MATERIAL. LENGTHS OF TIEBACKS SHOWN REPRESENT MINIMUM VALUES THAT ARE SUBJECT TO CHANGE AS THE PROJECT PROGRESSES AND MORE INFORMATION IS AVAILABLE CONCERNING THE BACKFILL MATERIAL. THE ACTUAL TIEBACK LENGTHS SHALL BE DETERMINED BY TESTING THE ANCHOR CAPACITY WITH RESPECT TO THE DESIGN LOAD AS OUTLINED IN THE CONTRACT DOCUMENTS.

1.FOUNDATION SOIL: SOFT SHALE
BACKFILL SOIL: STIFF CLAY
FRICTION ANGLE = 34°
UNIT WEIGHT = 120 PCF

LOAD TESTING

LOAD TESTING SHALL FOLLOW THE PROCEDURE OUTLINED IN THE PROJECT SPECIFCATION SECTION 02410.3.04

CONSTRUCTION PROCEDURES

1. INSTALLATION OF TIEBACK ANCHORS SHALL FOLLOW THE PROCEDURE OUTLINED IN THE PROJECT SPECIFICATION, SECTION 02410.3.03
2. CONTRACTOR SHALL COORDINATE WITH LBNL TO IDENTIFY LOCATIONS OF EXISTING UTILITIES.
3. DUE TO CLEARANCE ISSUES T-1 TIEBACKS WILL LIKELY NEED TO BE INSTALLED HORIZONTALLY.

DO NOT BEGIN DEMO OF SLABS OR WALLS NEAR WALL TO BE RETAINED UNTIL ALL GROUND ANCHORS HAVE ALL BEEN INSTALLED AND INSPECTED BY ENGINEER.

SPECIAL INSPECTIONS

THE OWNER OR OWNERS REPRESENATIVE SHALL PROVIDE SPECIAL INSPECTION AS REQUIRED BY THE CALIFORNIA BUILDING CODE SECTION 1704, SPECIAL INSPECTION. SPECIAL INSPECTORS SHALL EXAMINE ITEMS REQUIRING INSPECTION AND OBSERVE WORK FOR CONFORMANCE WITH THE CONTRACT DOCUMENTS. ALL DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE CONTRACTOR FOR CORRECTION. WEEKLY INSPECTION REPORTS ARE TO BE PROVIDED BY THE SPECIAL INSPECTOR TO THE OWNER, THE BUILDING OFFICIAL, THE ENGINEER, AND THE CONTRACTOR.

QUALIFICATION OF SPECIAL INSPECTORS

THE INSPECTION AGENCY SHALL SUBMIT QUALIFICATIONS AND OR CERTIFICATIONS TO THE BUILDING OFFICIAL, OWNER, AND OR OWNERS REPRESENATIVE TO DETERMINE THAT THE AGENCEY MEETS THE APPLICABLE REQUIREMENTS.
-THE AGENCY SHALL BE OBJECTIVE AND COMPETENT.
-THE AGENCY SHALL ALSO DISCLOSE POSSIBLE CONFLICTS OF INTEREST SO THAT OBJECTIVITY CAN BE CONFIRMED.
-THE AGENCY SHALL HAVE ADEQUATE EQUIPMENT TO PERFORM REQUIRED TESTS.
-THE EQUIPMENT SHALL BE PERIODICALLY CALIBRATED.
-THE AGENCY SHALL EMPLOY EXPERIENCED PERSONNNEL EDUCATED IN CONDUCTING, SUPERVISING AND EVALUATING TESTS AND/OR INSPECTIONS.

CARTWRIGHT ENGINEERS
595 S. Riverwoods Pkwy Suite 270
Logan, Utah 84321
T (435) 753-2820 F (435) 753-2851
www.cartwrightengineers.com

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REVISIONS

MARK	DATE	DESCRIPTION
1	4/23/10	ADDENDUM 1
2		
3		
4		
5		

REGISTERED PROFESSIONAL ENGINEER
CARLOS A. CARTWRIGHT
No. 3657
Exp. 3/31/10
STRUCTURAL
STATE OF CALIFORNIA

BEVATRON FIELD ORDER #2, RETAINING WALL

BERKELEY, CALIFORNIA

PROJECT # :108096.2

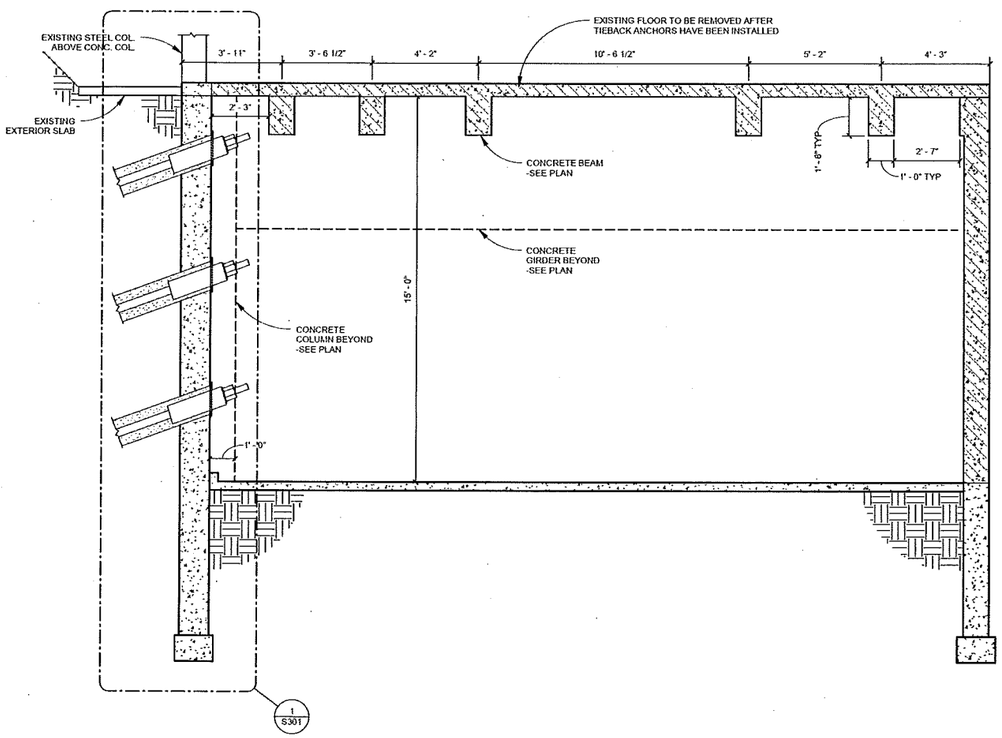
SCALE: As indicated

DATE: APRIL 23, 2010

APPROVALS	
DESIGNED BY:	EBM
DRAWN BY:	BFL
CHECKED BY:	CAC

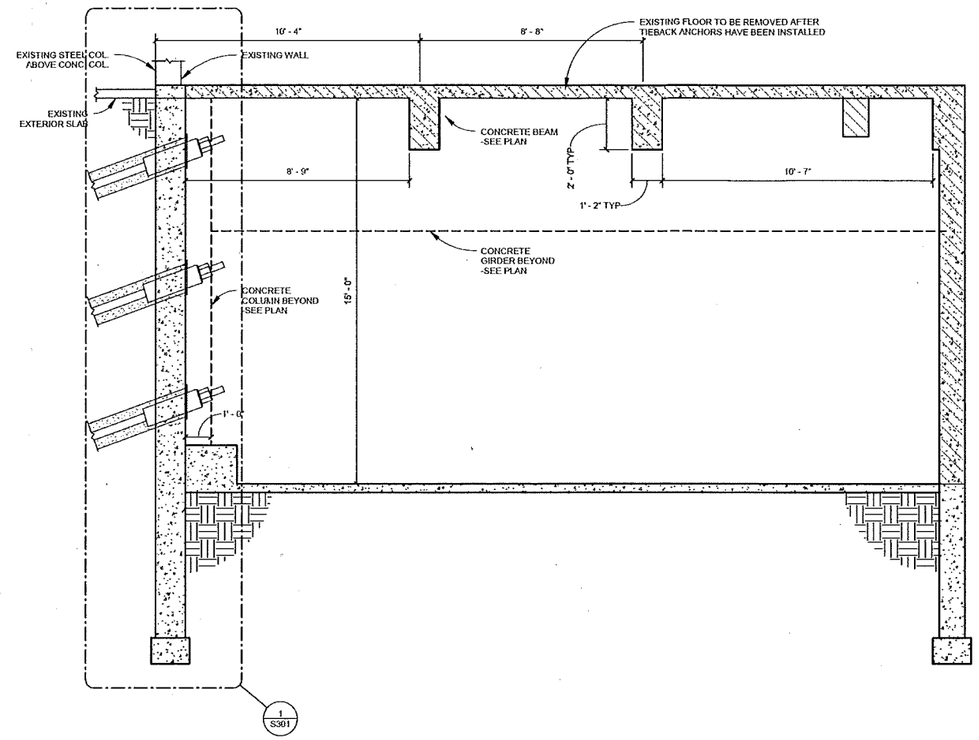
SHEET TITLE
RETAINING WALL PLAN

SHEET NUMBER
S101



SECTION 1

SCALE: 3/8" = 1'-0"



SECTION 2

SCALE: 3/8" = 1'-0"

CARTWRIGHT ENGINEERS

595 S. Riverwoods Prkwy Suite 270
Logan, Utah 84321
T (435) 753-2820 F (435) 753-2851
www.cartwrightengineers.com

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REVISIONS

MARK	DATE	DESCRIPTION
1	4/23/10	ADDENDUM 1
2		
3		
4		
5		

REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER A. CARTWRIGHT
No. 3657
Exp. 9/31/10
STRUCTURAL
STATE OF CALIFORNIA

BEVATRON FIELD ORDER #2, RETAINING WALL

BERKELEY, CALIFORNIA

PROJECT # :108096.2

SCALE: 3/8" = 1'-0"

DATE: APRIL 23, 2010

APPROVALS

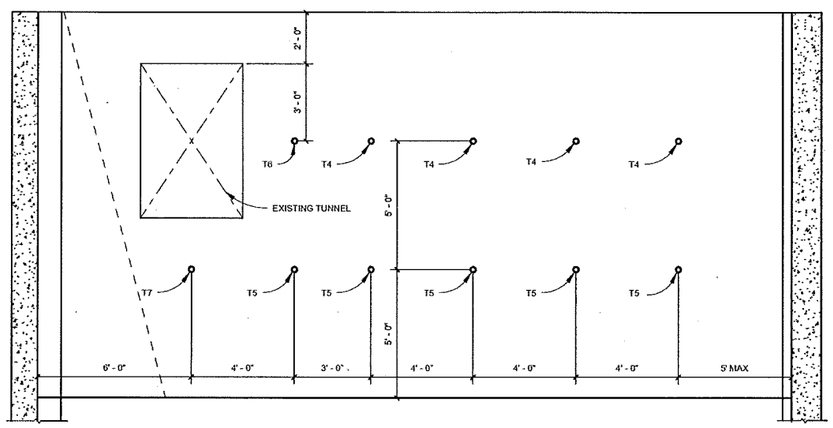
DESIGNED BY:	EBM
DRAWN BY:	BFL
CHECKED BY:	CAC

SHEET TITLE

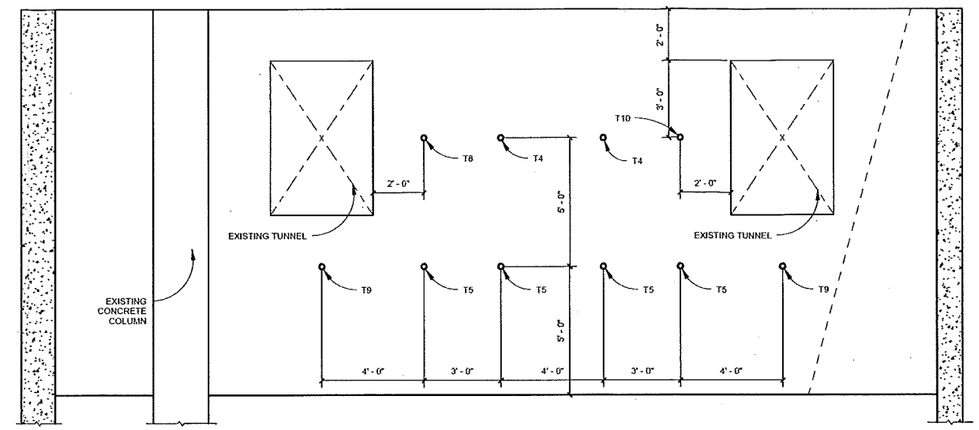
SECTIONS

SHEET NUMBER

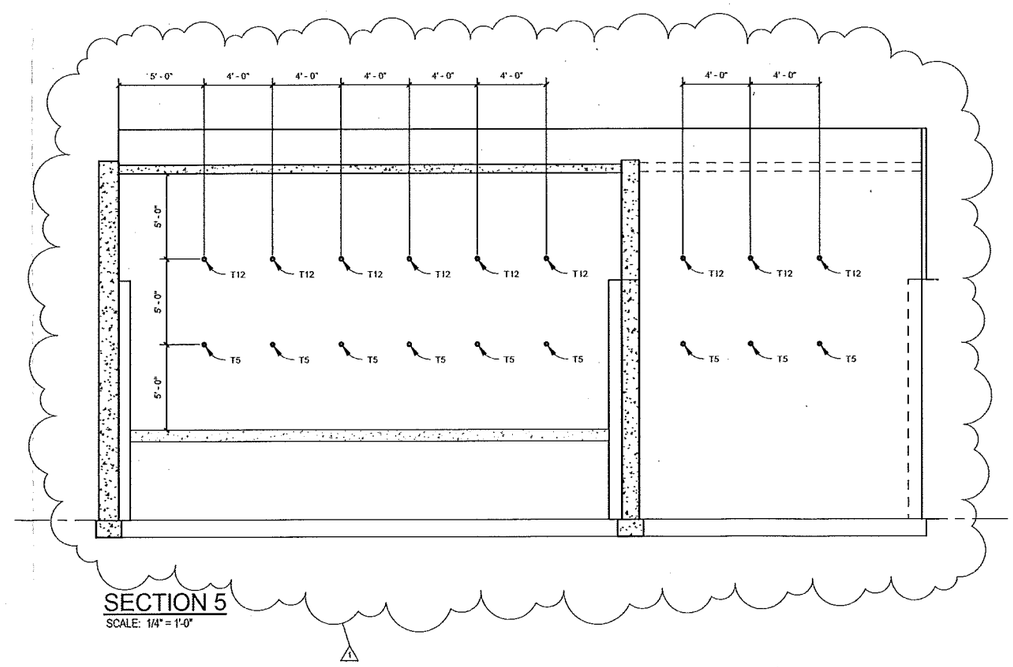
S201



SECTION 3
SCALE: 3/8" = 1'-0"



SECTION 4
SCALE: 3/8" = 1'-0"



SECTION 5
SCALE: 1/4" = 1'-0"

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ENGINEERS
565 S. Riverwoods Pkwy Suite 270
Logan, Utah 84321
T (435) 753-2850 F (435) 753-2851
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REVISIONS

MARK	DATE	DESCRIPTION
1	4/23/10	ADDENDUM 1
2		
3		
4		
5		

REGISTERED PROFESSIONAL ENGINEER
No. 3657
4/23/10
STRUCTURAL
STATE OF CALIFORNIA

BEVATRON FIELD ORDER #2, RETAINING WALL

BERKELEY, CALIFORNIA

PROJECT # :108096.2

SCALE: As indicated

DATE: APRIL 23, 2010

APPROVALS

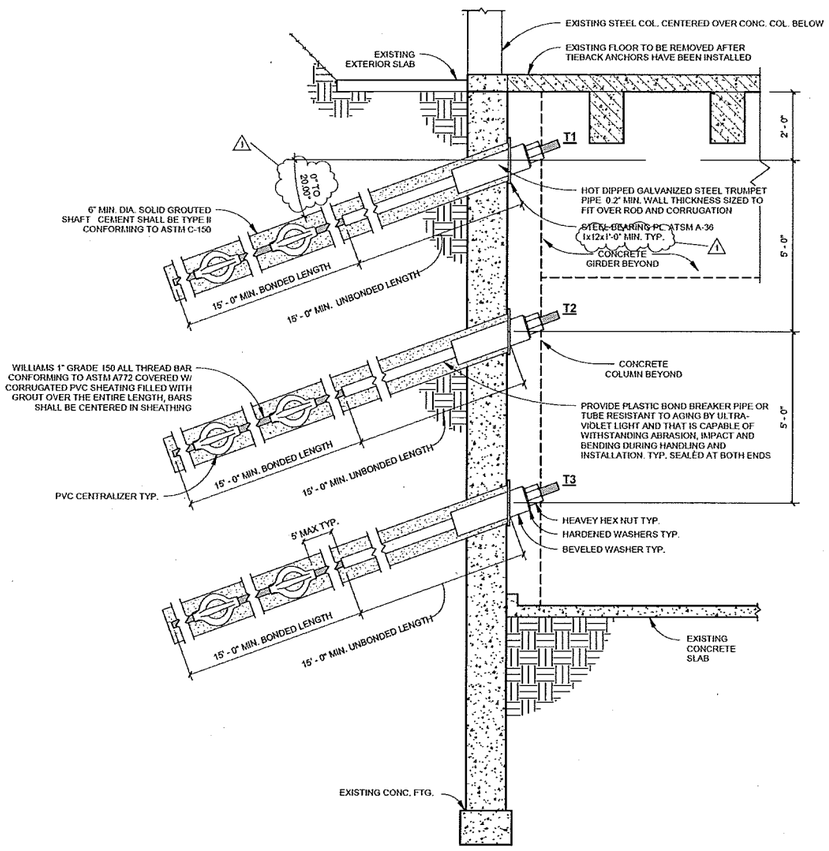
DESIGNED BY:	EBM
DRAWN BY:	MWC
CHECKED BY:	EBM

SHEET TITLE

SECTIONS

SHEET NUMBER

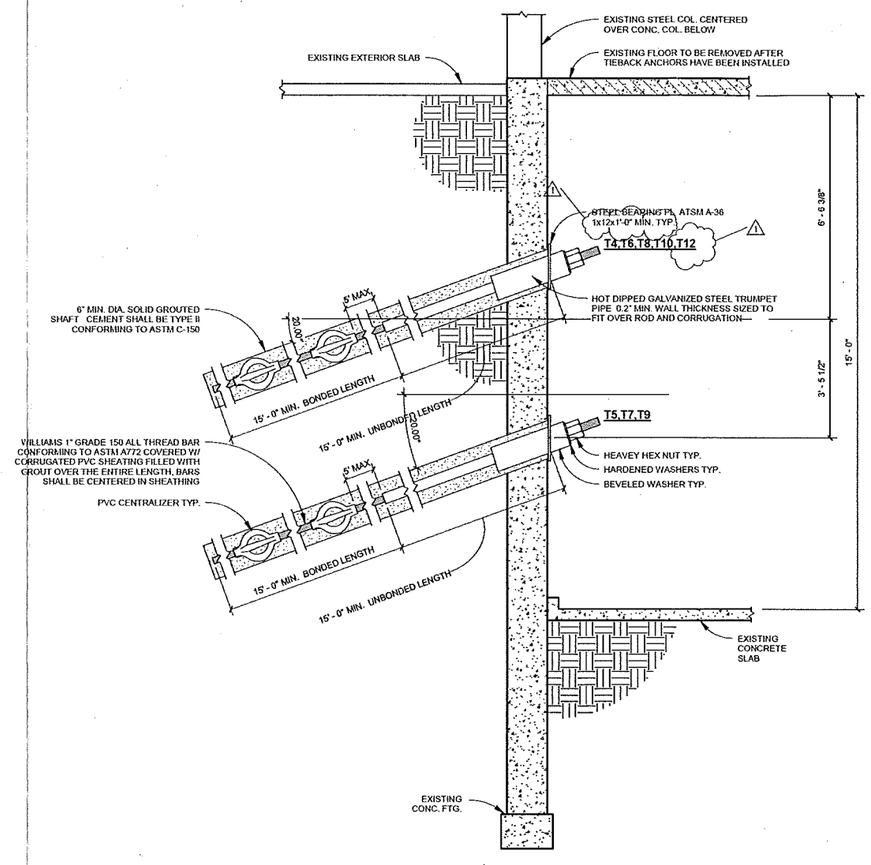
S202



NOTE:
IN THE NORTH ROOM, THE FOURTH T1 TIEBACK FROM THE NORTH WALL, NEAR THE BUILDING COLUMN WILL NEED TO BE DRILLED 4 FEET BELOW THE TOP OF WALL TO AVOID AN EXTERIOR MANHOLE THAT IS APPROXIMATELY 5 FEET DEEP, LOCATED ON THE SLOPE EAST OF THE BUILDING 9 FEET FROM THE BUILDING WALL. THE (2) SOUTHERNMOST T1 TIEBACKS IN THE SAME ROOM MAY BE MOVED TO A MAXIMUM OF 4 FEET BELOW TOP OF WALL TO AVOID THE EXISTING ROOF BEAM.

1 DETAIL
SCALE: 1/2" = 1'-0"

TIE BACK SCHEDULE			
MARK	MIN. LENGTH	DESIGN LOAD	LOCK OFF LOAD
T1	30' - 0"	51.1 Kips	41 Kips
T2	30' - 0"	51.1 Kips	41 Kips
T3	30' - 0"	51.1 Kips	41 Kips
T4	30' - 0"	24 Kips	19.2 Kips
T5	30' - 0"	24 Kips	19.2 Kips
T6	45' - 0"	43.6 Kips	35 Kips
T7	30' - 0"	33 Kips	26 Kips
T8	35' - 0"	43.6 Kips	35 Kips
T9	45' - 0"	43.6 Kips	35 Kips
T10	45' - 0"	43.6 Kips	35 Kips
T12	45' - 0"	24 Kips	19.2 Kips



2 DETAIL
SCALE: 1/2" = 1'-0"

CARTWRIGHT ENGINEERS
595 S. Riverwoods Prkwy Suite 270
Logan, Utah 84321
T (435) 753-2820 F (435) 753-2851
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REVISIONS

MARK	DATE	DESCRIPTION
1	4/23/10	ADDENDUM 1
2		
3		
4		
5		

REGISTERED PROFESSIONAL ENGINEER
Carlos A. Cruzado
No. 3657
Exp. 9/31/10
STRUCTURAL
STATE OF CALIFORNIA

BEVATRON FIELD ORDER #2, RETAINING WALL

BERKELEY, CALIFORNIA

PROJECT # :108096.2

SCALE: As Indicated

DATE: APRIL 23, 2010

APPROVALS	
DESIGNED BY:	EBM
DRAWN BY:	CRA/BFL
CHECKED BY:	CAC

SHEET TITLE
DETAILS

SHEET NUMBER
S301

Cartwright Engineers, 2012, "Bevatron Caisson Locations, Lawrence Berkeley National Laboratory, Berkeley, California," survey data sheet C001 and drawing sheets C101 through C109 dated February, 2012,, Cartwright Project # 111095.

BEVATRON CAISSON LOCATIONS

Number	Northing	Easting	Elevation
408	847.04	2178.53	706.69
409	849.78	2174.00	704.27
411	867.89	2190.47	707.98
412	871.25	2186.03	708.31
413	879.97	2190.65	708.37
414	885.37	2197.32	708.60
415	852.27	2135.80	708.38
416	857.78	2117.08	707.59
419	864.01	2105.61	707.37
420	867.80	2106.37	707.31
421	861.06	2089.53	705.29
422	864.99	2091.39	706.50
424	862.39	2084.60	706.31
429	862.03	2068.92	706.67
433	859.65	2050.36	705.90
435	861.96	2052.85	705.60
438	860.96	2059.73	706.19
439	866.48	2057.27	706.45
441	867.18	2061.24	707.28
442	866.44	2066.67	707.40
444	870.17	2073.97	707.17
446	862.86	2045.86	705.96
448	773.26	2006.31	707.68
450	787.33	2011.23	705.27
451	784.67	2005.41	707.36
452	782.53	1999.26	707.59
702	835.42	2153.88	706.84
703	836.80	2149.99	706.78
704	836.83	2150.03	706.78
705	804.29	2160.24	706.60
706	804.14	2165.02	707.21
707	800.67	2167.69	705.90
708	838.08	2145.28	706.97
709	841.36	2142.73	707.02
710	844.71	2143.35	707.79
713	800.18	2171.24	706.55
714	800.64	2175.15	707.27
716	800.55	2178.62	707.91
717	804.71	2181.32	707.69
718	804.29	2173.96	707.40
719	804.47	2170.24	706.94
720	833.91	2164.24	706.57
721	837.58	2162.34	706.80
722	840.93	2160.45	706.75
723	844.64	2157.21	707.43
724	848.46	2153.98	707.57
726	849.57	2147.32	707.91
727	846.16	2150.11	707.67
728	842.06	2153.26	707.29
729	838.80	2155.98	706.95
730	835.16	2158.42	706.14
731	844.44	2147.63	707.64
732	841.51	2150.09	707.38
733	841.20	2146.81	707.44
737	744.11	2143.70	702.17
738	742.97	2150.97	704.75
740	733.82	2139.91	704.99

Number	Northing	Easting	Elevation
742	736.52	2141.97	704.36
743	724.11	2131.69	705.60
744	722.53	2128.81	704.94
745	720.68	2124.67	705.83
746	719.23	2122.56	707.28
747	718.59	2119.08	707.33
748	716.34	2116.00	707.25
750	715.49	2109.72	705.21
751	715.30	2108.64	705.24
753	714.85	2103.11	706.96
757	709.19	2118.53	709.12
758	711.44	2117.61	707.61
760	714.61	2119.78	707.73
761	710.67	2121.24	708.11
762	714.80	2128.12	708.47
764	716.16	2130.59	707.80
767	853.25	2143.22	705.38
775	853.64	2135.83	707.93
1205	837.18	1982.20	701.55
1206	833.01	1983.57	701.05
1207	829.90	1982.41	701.59
1208	827.45	1978.07	701.14
1209	803.49	1975.93	701.64
1210	807.97	1973.54	700.42
1211	799.46	1972.74	701.65
1212	778.12	1972.69	701.97
1213	774.23	1975.96	702.40
1214	771.10	1977.86	702.09
1215	768.95	1978.36	701.95
1216	769.69	1973.03	702.39
1217	777.03	1976.95	701.71
1225	855.85	2035.83	707.88
1226	850.04	2043.12	708.00
1227	846.24	2037.68	697.34
1228	846.82	2033.98	693.11
1229	851.47	2030.43	699.15
1233	850.63	2007.81	702.02
1234	856.78	2010.12	696.18
1235	875.21	2009.22	702.13
1236	882.09	1999.37	706.26
1237	886.93	1992.12	707.64
1238	869.05	1985.58	706.78
1240	872.47	1989.49	706.00
1242	876.99	1983.90	702.59
1245	880.65	1977.41	704.28
1247	843.75	2009.31	707.36
1248	842.25	2028.80	690.59
1249	845.49	2024.36	689.31
1250	851.69	2014.32	691.23
1251	826.88	2034.55	697.97
1252	835.25	2027.22	698.08
1253	837.01	2029.05	695.02
1254	838.20	2018.54	697.72
1255	861.84	2005.64	694.25
1256	871.61	2016.36	703.15
1257	865.25	1999.98	696.55
1258	850.76	2000.23	702.58

Number	Northing	Easting	Elevation
1261	840.18	2003.72	707.40
1330	762.19	2014.96	704.98
1331	755.02	2010.53	704.32
1332	748.95	2013.22	704.16
1333	748.04	2019.42	704.12
1334	742.04	2015.91	704.37
1335	741.95	2023.99	704.77
1336	735.79	2020.39	704.62
1337	737.38	2014.34	704.70
1338	732.90	2017.32	704.86
1339	735.56	2028.25	703.90
1340	731.17	2025.22	704.23
1341	728.49	2021.37	704.57
1342	724.69	2024.70	703.75
1343	726.57	2031.22	703.72
1344	730.94	2033.50	704.04
1345	720.37	2036.58	703.94
1346	717.48	2033.06	704.81
1347	715.62	2036.95	704.49
1348	717.29	2041.07	703.88
1350	713.73	2047.99	705.55
1351	721.51	2027.89	704.15
1352	726.22	2039.84	704.60
1353	735.90	2032.94	703.51
1354	755.33	2017.91	703.97
1365	708.89	2066.75	703.59
1366	709.59	2059.35	704.12
1367	711.28	2053.21	703.61
1368	717.40	2058.64	705.09
1369	719.40	2051.89	704.80
1370	705.88	2072.90	703.78
1371	706.47	2079.28	704.79
1372	705.97	2086.07	704.16
1373	705.55	2092.93	704.72
1374	767.35	2016.89	705.62
1375	769.51	2013.00	707.42
1376	773.32	2015.88	706.97
1377	775.93	2012.52	706.36
1378	771.58	2000.58	707.28
1390	791.69	1998.34	707.50
1391	791.05	2004.61	707.32
1393	726.45	2044.87	704.47
1394	767.77	2005.36	707.34
1398	714.65	2073.40	705.41
1399	707.89	2086.49	704.24
1400	712.39	2094.72	706.32
1401	712.10	2088.08	705.36
1402	706.00	2094.90	705.00
1403	706.37	2100.43	704.34
1404	706.18	2104.55	704.48
1405	711.33	2103.55	704.46
1406	716.09	2104.15	705.15
1407	708.21	2109.75	705.01
1408	708.43	2113.51	705.37
1409	714.55	2113.16	707.28
1410	711.95	2121.24	706.28
1412	715.61	2120.27	706.96

Number	Northing	Easting	Elevation
1413	717.84	2126.94	707.17
1440	887.20	2004.22	705.99
1441	892.53	2010.65	706.56
1442	899.75	2010.56	707.04
1443	896.67	2017.62	706.43
1444	900.27	2024.56	706.74
1445	904.40	2030.39	706.07
1446	880.27	2034.98	706.23
1447	866.44	2018.27	705.96
1448	882.41	2015.52	701.32
1449	875.90	2011.71	700.90
1450	878.05	2022.94	701.10
1451	885.80	2022.94	701.20
1452	892.49	2035.54	702.24
1454	712.34	2079.59	705.31
1455	726.57	2044.81	704.48
1456	722.42	2045.63	704.16
1458	964.80	2064.06	703.65
1459	965.44	2077.63	702.51
1462	964.70	2103.08	703.70
1463	932.29	2125.22	707.31
1464	932.30	2101.93	706.03
1465	953.06	2101.94	705.54
1466	960.68	2128.00	704.58
1470	855.83	2046.74	706.28
1471	860.89	2042.78	706.35
1472	865.46	2051.30	705.72
1473	859.39	2053.46	705.86
1474	855.11	2052.20	706.33
1475	857.42	2057.78	707.41
1476	862.85	2060.01	705.84
1477	868.61	2059.79	705.64
1478	859.75	2065.51	705.49
1479	863.85	2066.53	704.54
1480	862.95	2074.98	705.62
1481	869.28	2067.46	705.91
1482	871.65	2075.36	705.84
1483	871.23	2081.41	706.10
1484	865.38	2081.35	705.74
1485	871.54	2086.70	705.98
1486	866.39	2088.35	705.27
1487	871.75	2093.31	705.32
1488	865.63	2093.91	705.80
1490	871.01	2099.42	706.37
1491	860.30	2103.79	705.32
1493	862.84	2099.24	706.26
1494	866.11	2103.81	705.35
1495	871.41	2108.28	705.79
1496	869.52	2113.59	705.55
1499	857.24	2027.83	705.20
1500	861.42	2023.34	705.04
1501	851.52	2038.78	705.19
1502	852.53	2151.32	704.66
1503	857.49	2145.92	704.70
1504	851.59	2141.76	705.07
1505	860.45	2141.03	704.75
1506	856.58	2138.29	704.45

Number	Northing	Easting	Elevation
1507	848.90	2133.01	704.17
1508	853.57	2132.60	704.62
1509	859.52	2135.73	705.13
1510	855.69	2128.50	704.85
1511	860.86	2131.60	704.89
1512	857.81	2125.95	705.02
1513	862.88	2128.24	704.81
1514	864.40	2124.52	705.00
1515	857.92	2121.68	705.35
1516	855.60	2119.22	705.36
1517	861.16	2119.48	705.17
1518	861.16	2117.12	704.61
1519	858.15	2112.23	704.98
1520	861.01	2111.79	704.53
1521	864.51	2118.82	705.41
1522	867.62	2118.47	705.15
1523	866.76	2121.96	705.22
1524	854.40	2142.69	704.88
1525	849.10	2139.21	705.51
1526	1030.17	2151.26	700.13
1529	941.98	2029.86	706.89
1530	952.87	2030.17	706.83
1531	956.81	2042.21	704.52
1532	928.71	2031.13	707.06
1533	918.24	2030.61	706.33
1534	905.63	2024.26	704.65
1535	911.32	2024.67	705.06
1536	919.63	2023.90	705.08
1537	927.31	2023.81	706.43
1538	935.63	2022.15	706.24
1539	942.30	2022.82	706.13
1540	948.07	2022.71	706.64
1541	951.94	2019.58	706.28
1542	947.79	2015.09	706.43
1543	945.19	2009.39	705.66
1544	938.50	2009.27	706.63
1545	931.78	2010.07	706.53
1546	923.92	2010.98	702.83
1547	915.83	2010.92	705.00
1548	907.92	2011.26	705.72
1549	899.87	2010.79	705.35
1550	898.15	2003.71	706.17
1551	905.76	2002.55	706.10
1552	913.05	2000.08	705.63
1553	921.18	1997.60	706.98
1554	928.29	1995.60	706.50
1555	935.55	1993.68	706.61
1556	941.27	2002.25	706.03
1557	937.60	2001.39	706.69
1558	930.17	2002.26	706.68
1559	922.00	2005.21	704.63
1560	914.41	2005.23	705.16
1561	901.43	1994.53	705.88
1562	894.58	1990.48	706.13
1563	897.68	1989.65	706.56
1564	897.75	1987.03	706.36
1565	902.88	1991.14	705.72

Number	Northing	Easting	Elevation
1566	902.89	1987.68	705.77
1567	900.17	1988.44	706.56
1570	909.37	1986.09	705.22
1571	917.33	1984.56	705.62
1572	924.32	1982.95	704.96
1573	931.53	1987.27	706.03
1574	927.54	1977.42	705.36
1575	922.86	1976.28	705.90
1576	911.48	1979.57	705.40
1577	901.47	1982.04	706.45
1578	894.71	1982.56	706.32
1579	856.39	1924.08	706.01
1580	834.98	1915.49	706.02
1581	833.93	1918.18	705.46
1583	744.12	2163.71	704.90
1584	740.31	2157.58	705.00
1585	743.48	2155.14	705.17
1586	744.05	2158.97	704.38
1613	877.84	2196.06	708.00
1615	737.77	2160.88	705.28
1616	733.21	2157.04	705.27
1617	729.15	2153.72	705.79
1618	725.46	2149.11	705.91
1619	722.67	2146.27	706.16
1620	718.33	2140.41	706.30
1621	715.95	2137.65	706.20
1622	718.55	2135.47	706.13
1623	721.71	2133.99	706.62
1624	726.05	2143.98	706.26
1625	729.46	2143.70	706.30
1626	728.23	2146.94	706.11
1627	730.88	2149.57	705.61
1628	733.95	2152.30	705.95
1629	736.87	2154.79	705.61
1630	736.28	2150.32	706.42
1631	738.87	2149.09	705.77
1632	735.72	2146.16	706.38
1633	732.62	2143.26	706.53
1634	730.32	2141.30	706.04
1635	725.57	2134.53	705.89
1636	721.42	2129.15	706.27
1637	717.20	2131.72	706.01
1639	721.03	2138.62	706.02
1648	981.97	2144.12	705.52
1649	978.04	2143.87	705.88
1672	975.07	2130.34	703.55
1673	974.87	2101.03	704.84
1676	788.49	1909.96	708.43
1677	812.30	1910.93	707.08
1723	837.02	2011.11	706.08
1724	828.52	2006.64	706.50
1814	838.96	2005.41	701.22
1815	836.53	2012.88	700.91

BRASS CAP MONUMENTS			
5011	947.61	1403.1	673.51
5017	998.17	1805	708.54

1. *THIS DRAWING SHOWS THE LOCATION OF THE CAISSONS THAT WERE UNCOVERED BY EXCAVATION DURING DEMOLITION OF BUILDING 51. MANY OF THESE CAISSONS ARE SHOWN ON SHEET S1, WHICH IS THE FOOTING AND FOUNDATION PLAN FOR BUILDING 51 AND WAS PROVIDED TO US BY LBNL.*

2. *THERE WERE MANY CAISSONS THAT WERE FOUND AND LOCATED THAT WERE NOT SHOWN ON ANY OF THE AS-BUILT DRAWINGS THAT WERE PROVIDED TO US BY LBNL. THEREFORE WE ASSUME THAT THERE MAY BE ADDITIONAL CAISSONS PRESENT THAT WERE NOT FOUND AND LOCATED.*

3. *DURING THE PROCESS OF THE BUILDING SLAB AND TUNNEL REMOVAL AND UTILITY EXCAVATION SEVERAL CAISSONS THAT ARE SHOWN ON THIS DRAWING MAY HAVE BEEN REMOVED OR CUT DOWN TO A LOWER ELEVATION.*

4. *REPRESENTATIVES FROM CLAUSS CONSTRUCTION MARKED THE LOCATIONS OF THE CAISSONS. THESE MARKS WERE THEN SURVEYED BY FORESIGHT SURVEYING. THIS DRAWING IS THE PRODUCT OF THAT SURVEY.*

CLAUSS CONSTRUCTION
DEMOLITION • HAZARDOUS WASTE • EARTHWORK
1-888-463-2291

REVISIONS

MARK	DATE	DESCRIPTION
1	-	-
2	-	-
3	-	-
4	-	-
5	-	-

CARTWRIGHT
ENGINEERS
595 S. Riverwoods Prkwy Suite 270
Logan, Utah 84321
T (435) 753-2850 F (435) 753-2851
www.caceng.com

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BEVATRON CAISSON LOCATIONS
LAWRENCE BERKELEY
NATIONAL LABORATORY
BERKELEY, CALIFORNIA

PROJECT # : 111095

SCALE: NOTED

DATE: FEBRUARY 2012

APPROVALS

DESIGNED BY:

DRAWN BY:

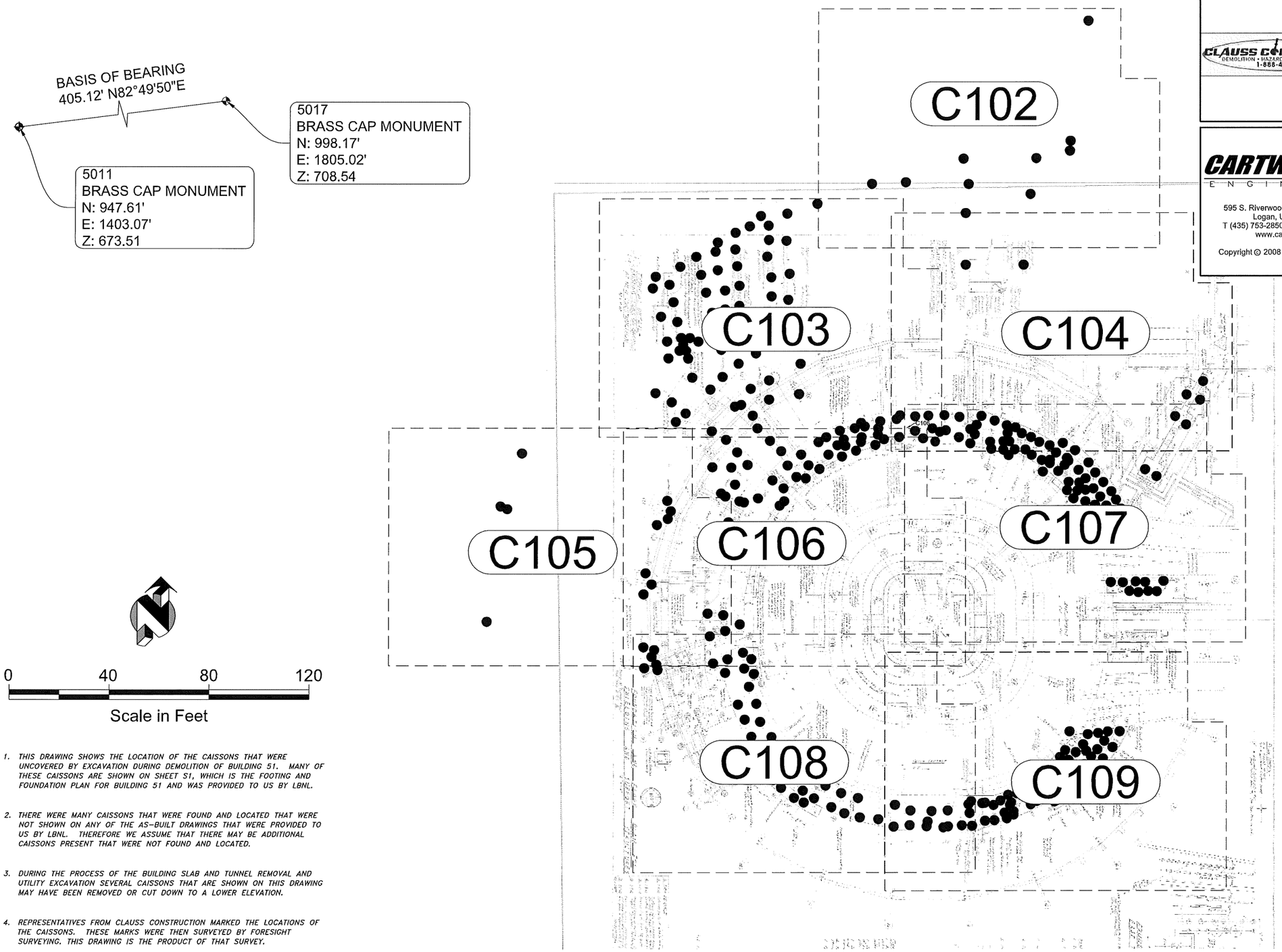
CHECKED BY:

SHEET TITLE

CAISSON POINT
NORTHING, EASTING, ELEVATION

SHEET NUMBER

C001



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BEVATRON CAISSON LOCATIONS
LAWRENCE BERKELEY
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BERKELEY, CALIFORNIA

PROJECT # : 111095

SCALE: NOTED

DATE: FEBRUARY 2012

APPROVALS

DESIGNED BY:	
DRAWN BY:	
CHECKED BY:	

SHEET TITLE

CAISSON LOCATIONS
OVERALL SITE

SHEET NUMBER

C101

0 10 20 30

Scale in Feet

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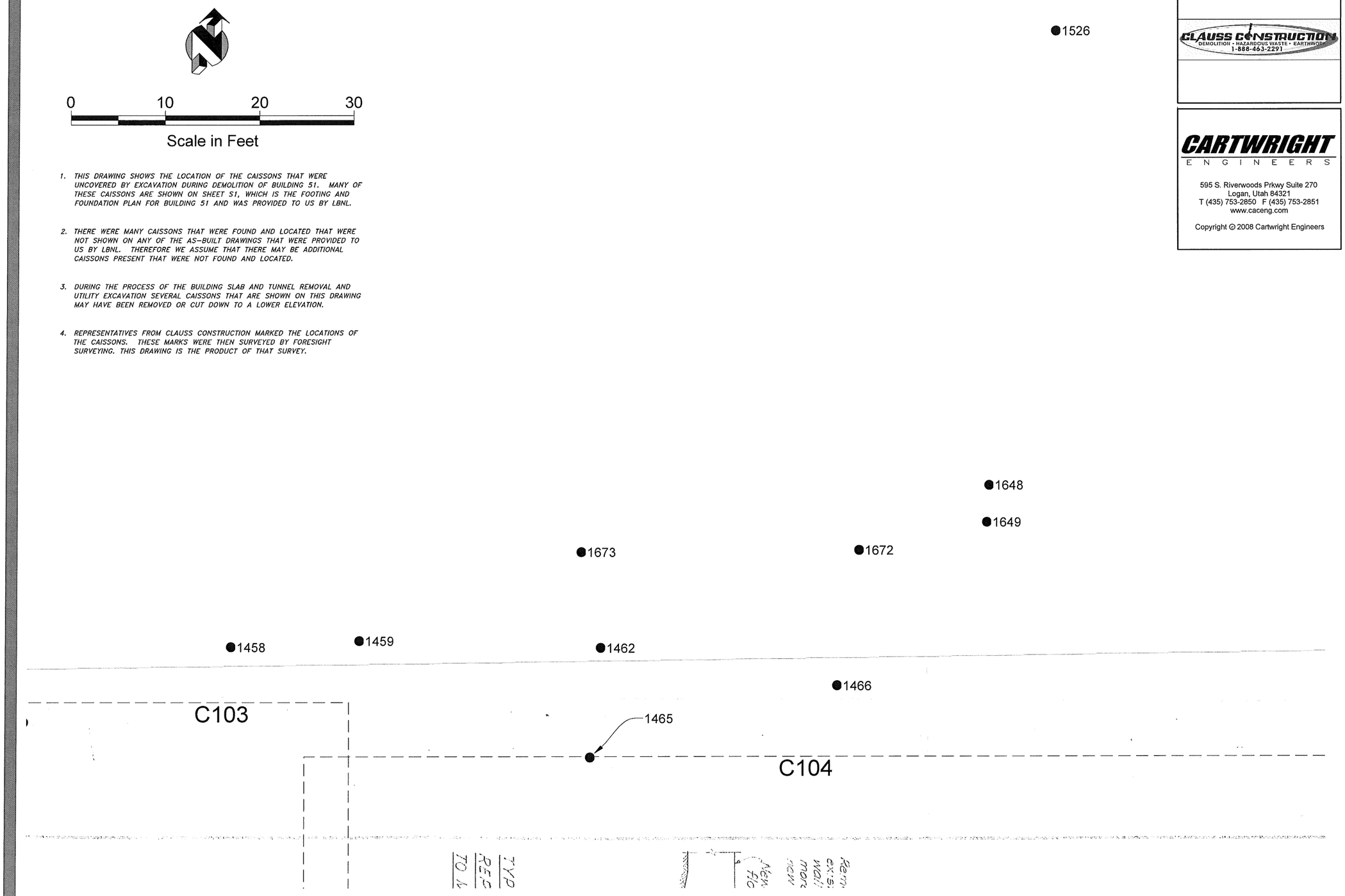

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PROJECT # : 111095

SCALE: NOTED

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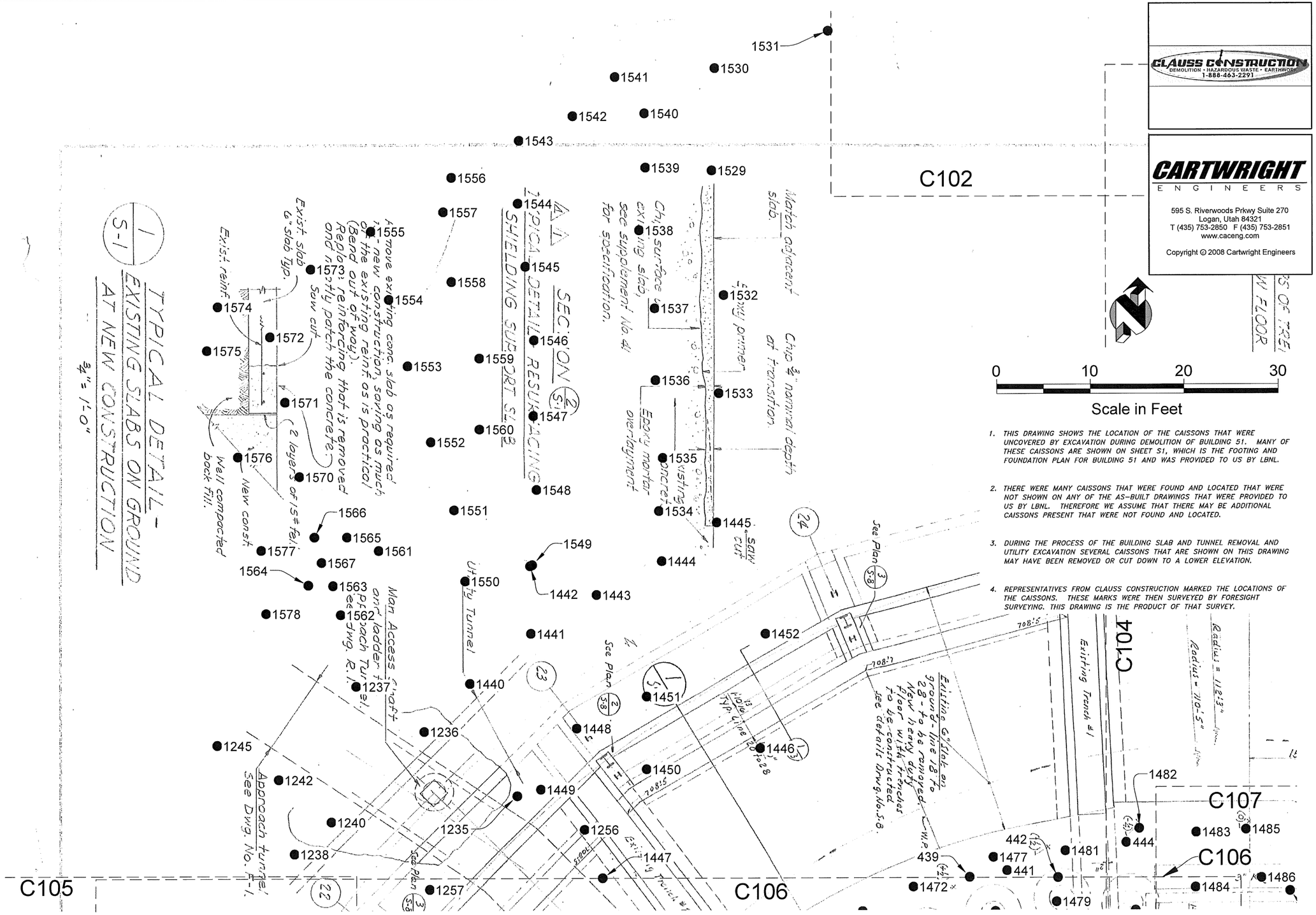
SHEET TITLE

CAISSON LOCATIONS

SHEET NUMBER

C102



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PROJECT # : 111095

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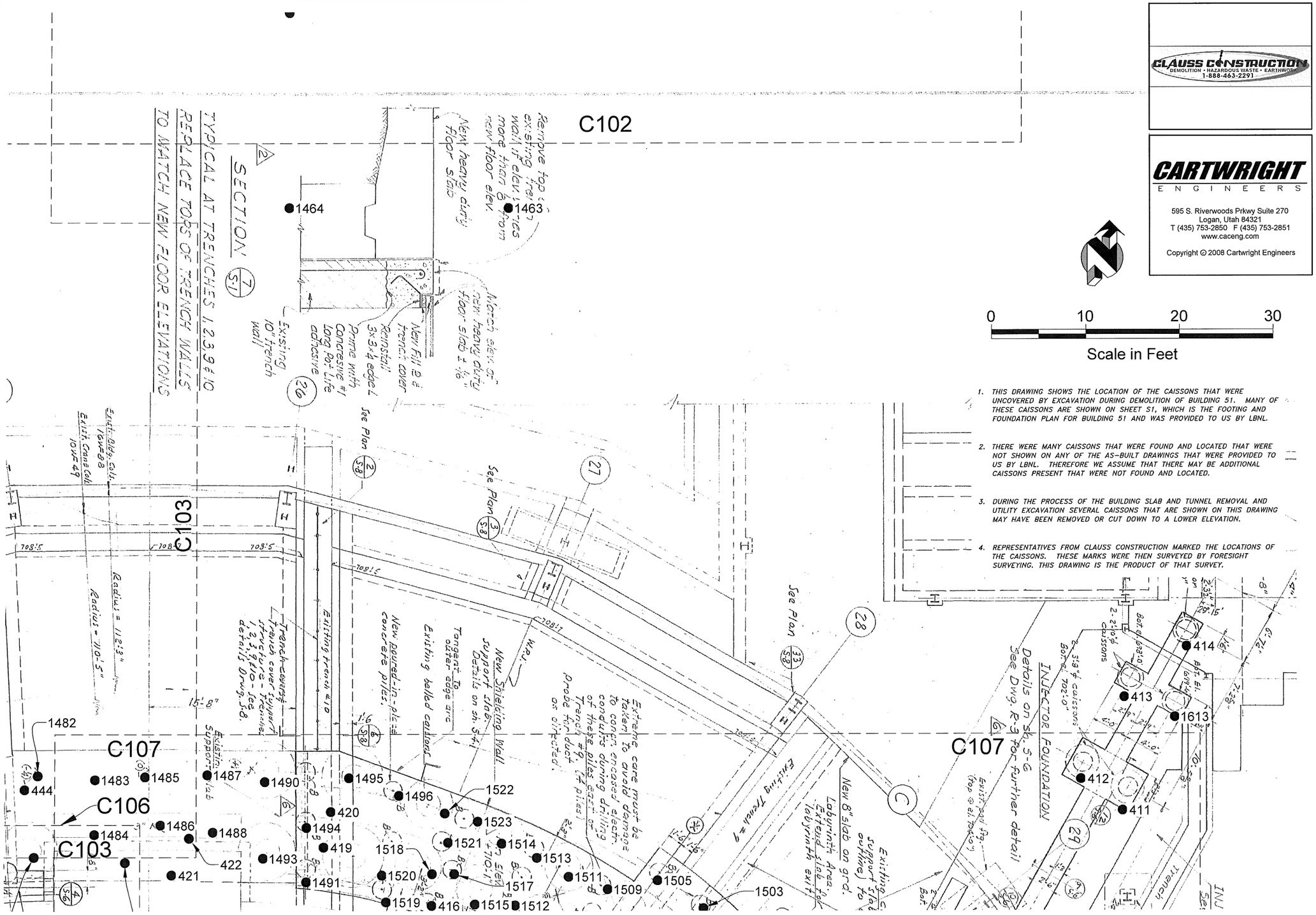
SHEET TITLE
CAISSON LOCATIONS

SHEET NUMBER
C103



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0 10 20 30
Scale in Feet

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LAWRENCE BERKELEY
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PROJECT # : 111095

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SHEET TITLE
CAISSON LOCATIONS

SHEET NUMBER
C104

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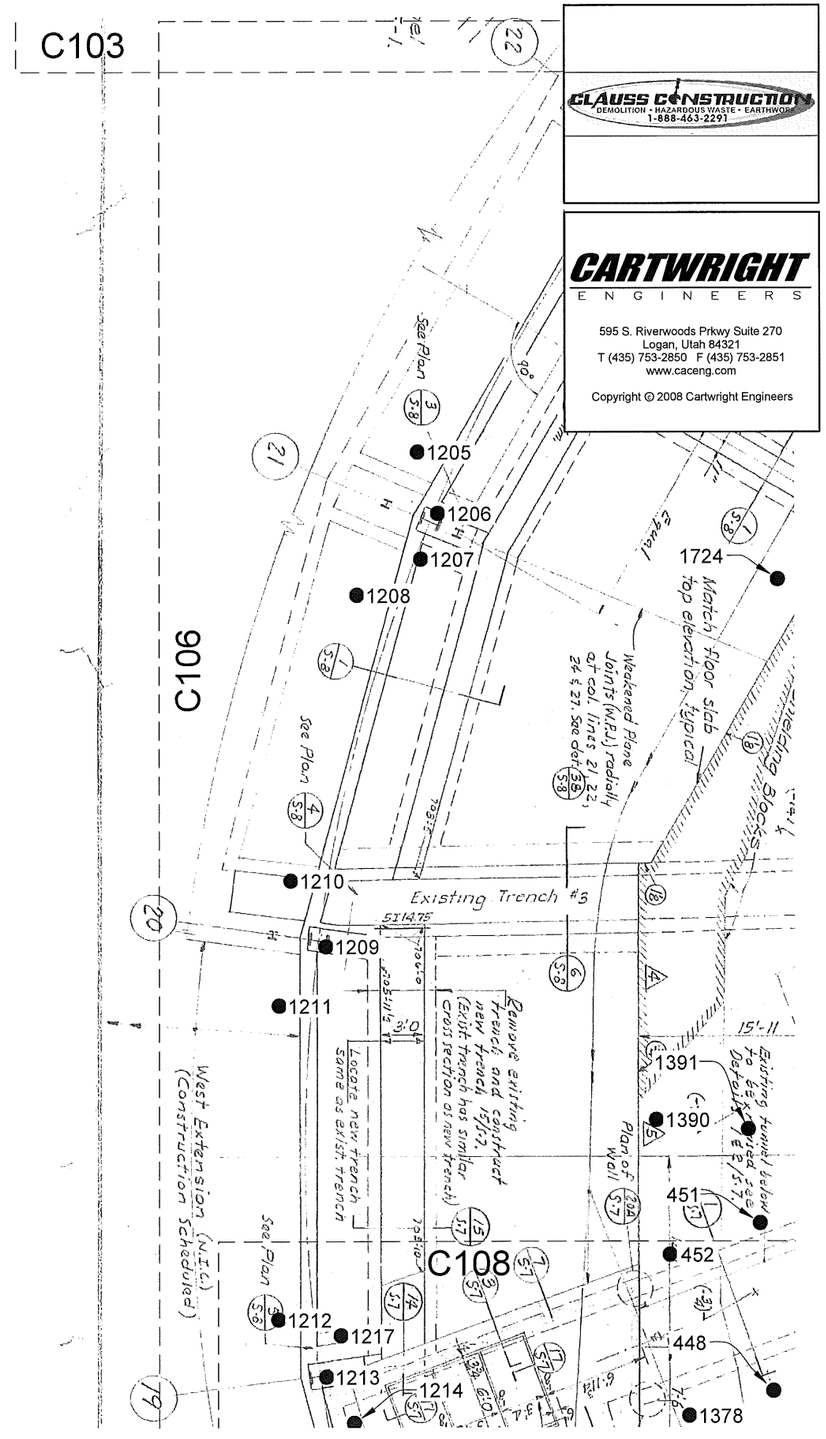

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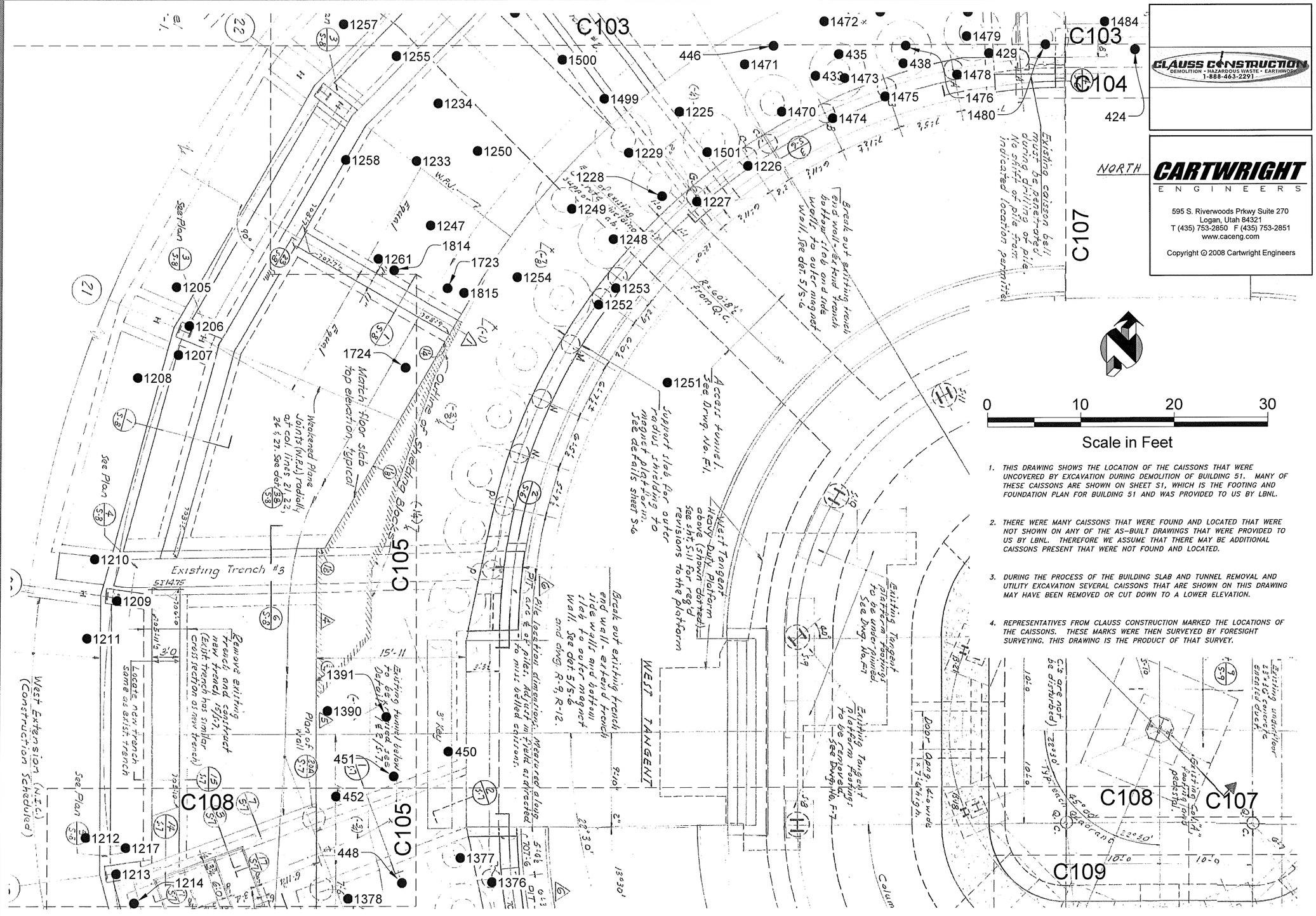
SHEET TITLE
CAISSON LOCATIONS

SHEET NUMBER
C105



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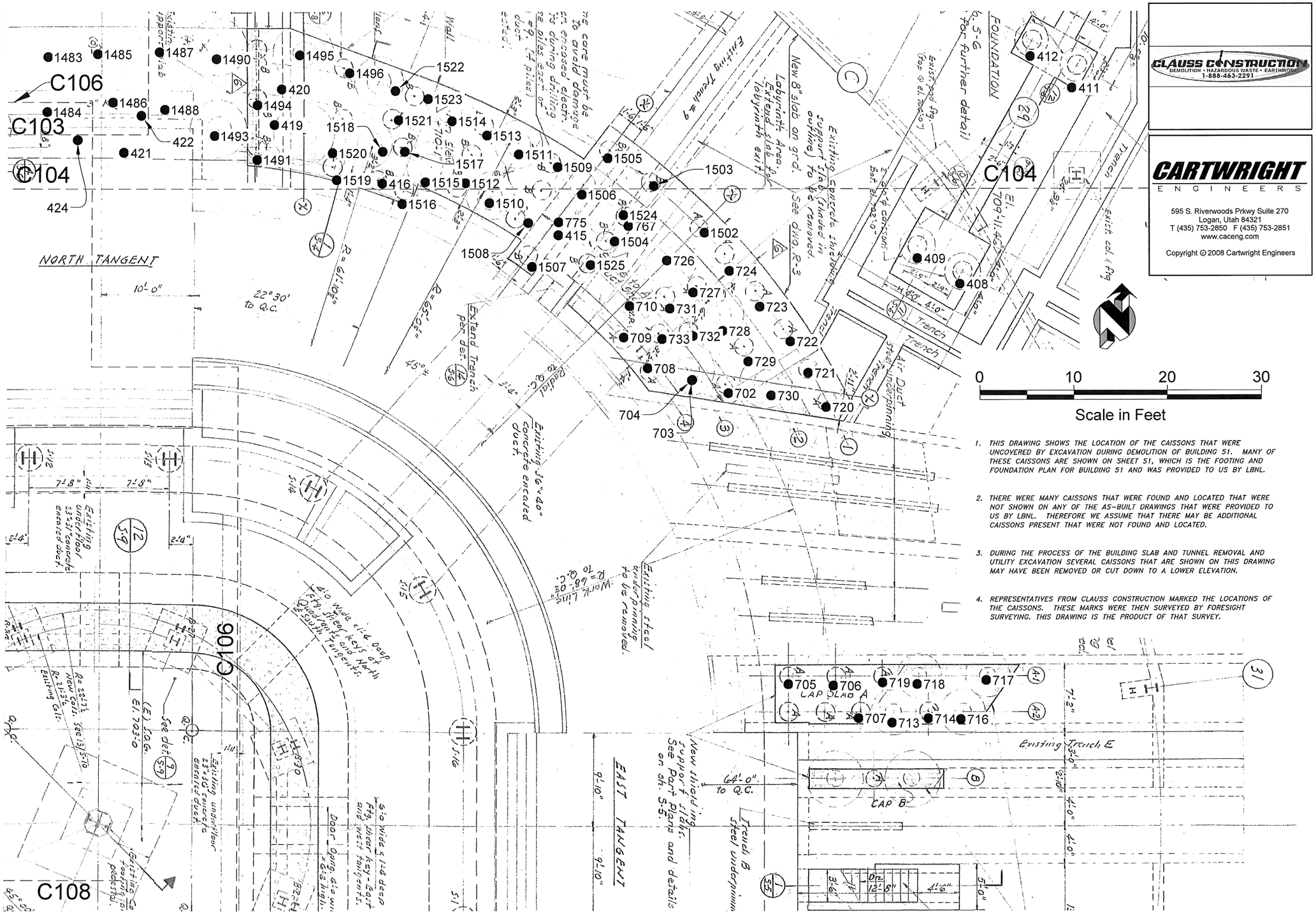
SHEET TITLE

CAISSON LOCATIONS

SHEET NUMBER

C106



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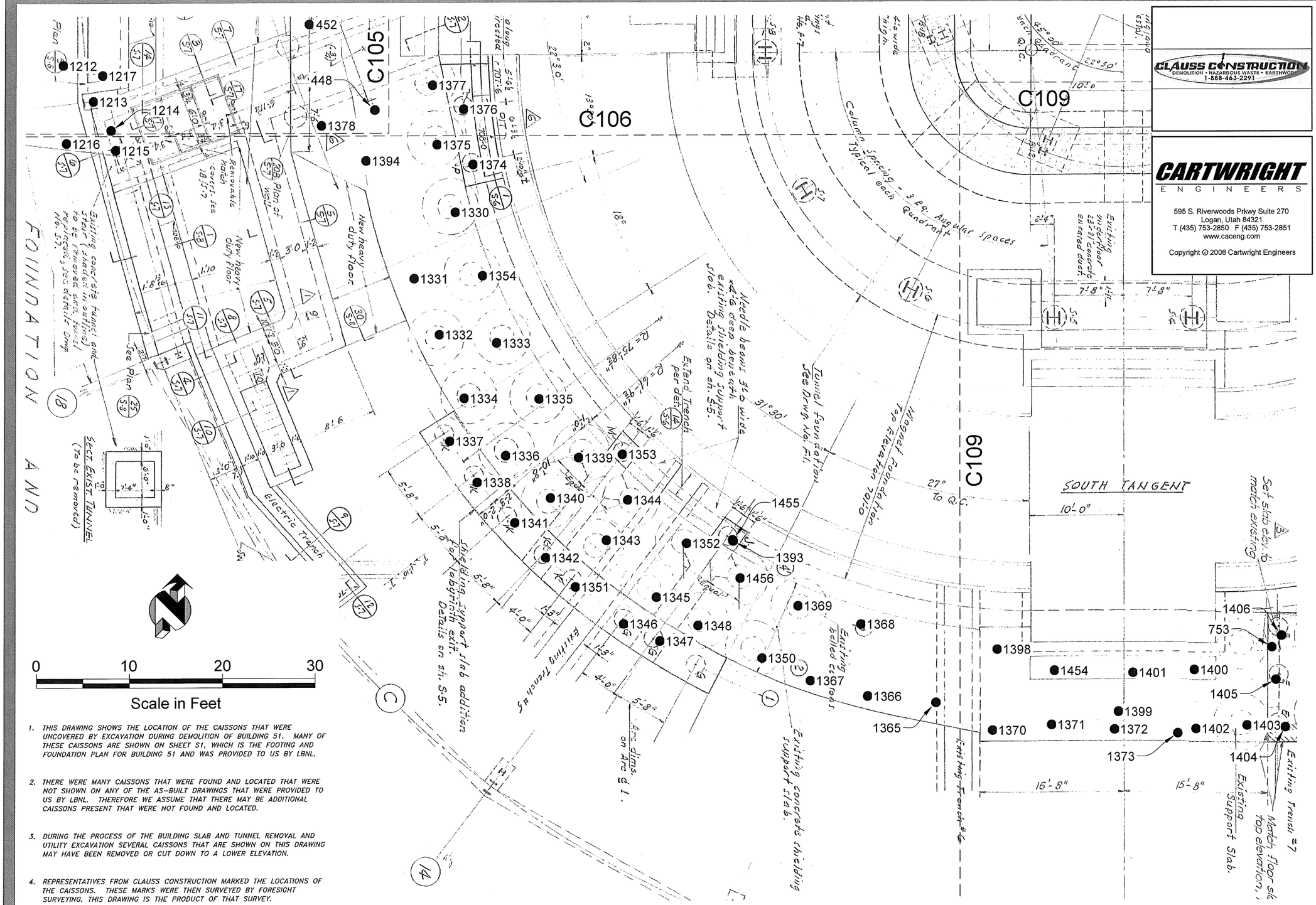
SHEET TITLE

CAISSON LOCATIONS

SHEET NUMBER

C107



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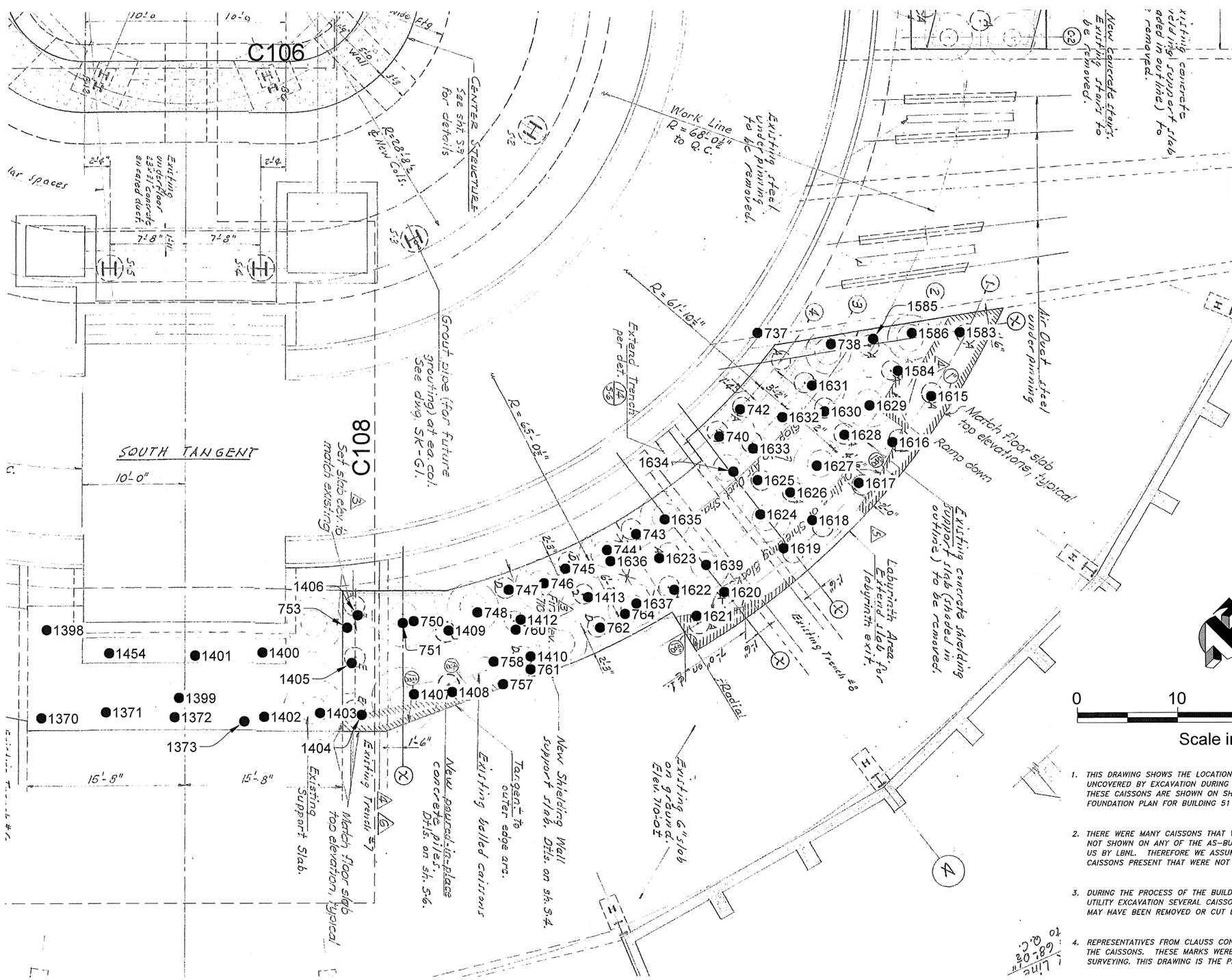
SHEET TITLE

CAISSON LOCATIONS

SHEET NUMBER

C108



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CAISSON LOCATIONS

SHEET NUMBER

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