SPOOKHILL OUTLET STRUCTURE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____

SPOOKHILL OUTLET

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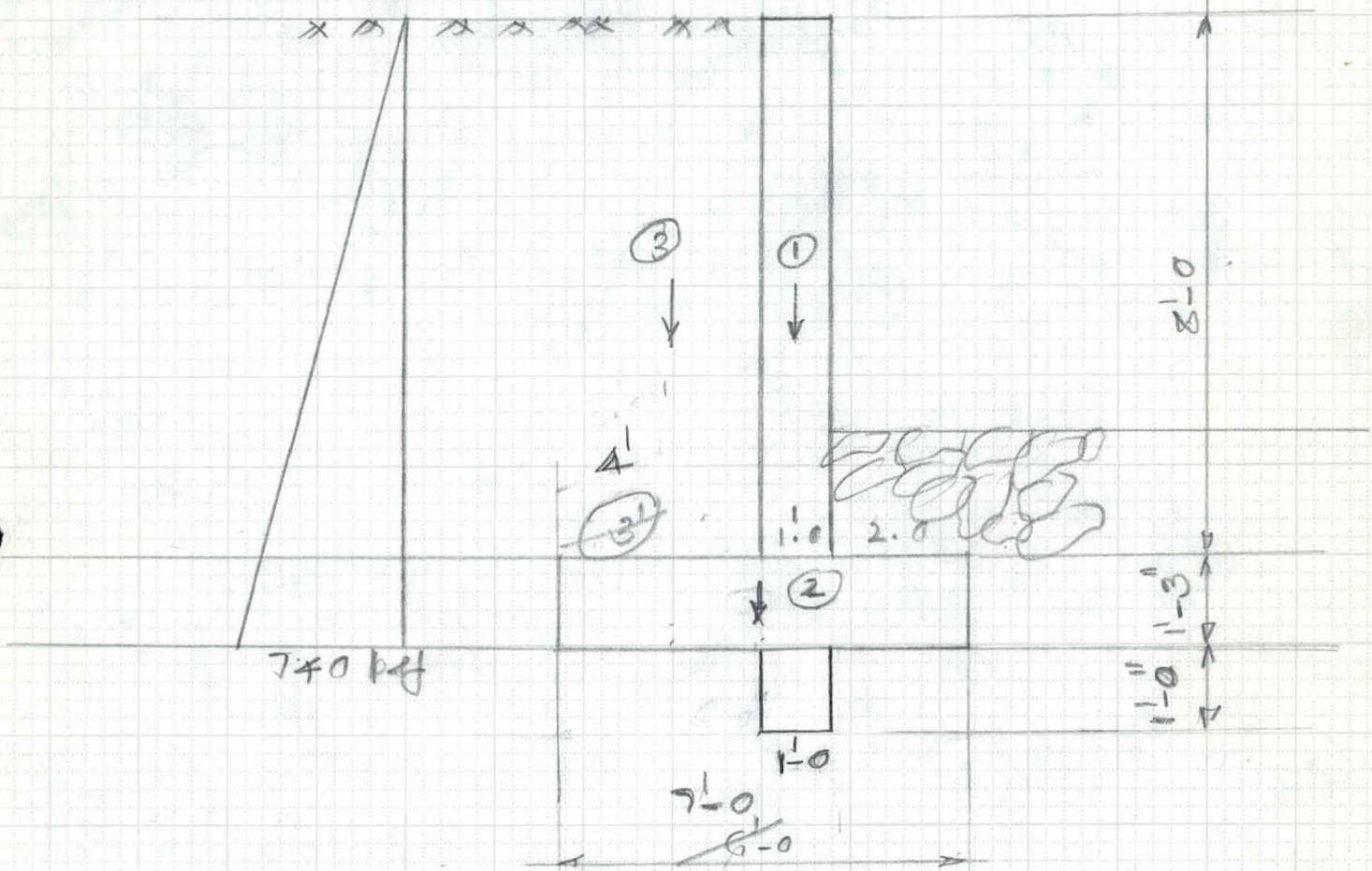
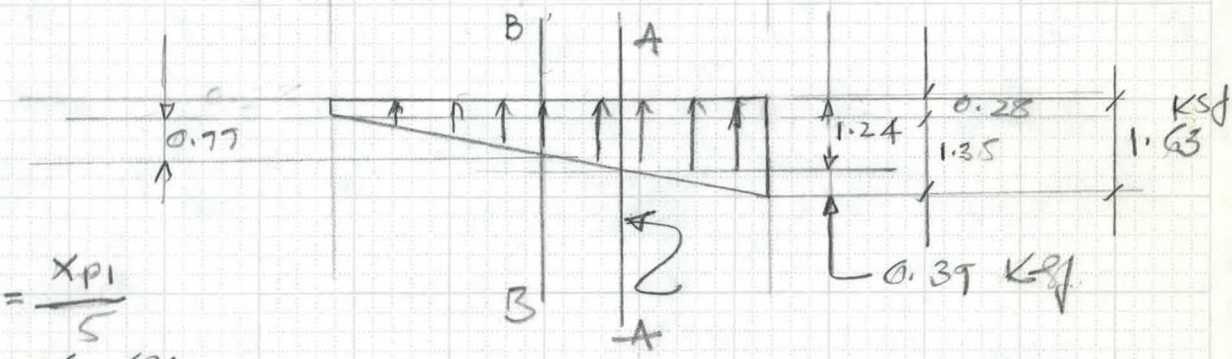
DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Case 1

Submerged Backfill





$$\frac{1.35}{7.0} = \frac{x_{p1}}{5}$$

$x_{p1} = 0.96$ KSF

$(0.96 + 0.28) = 1.24$ KSF

$(1.63 - 1.24) = 0.39$

$$\frac{x_{p2}}{4.0} = \frac{1.35}{7.0}, \quad x_{p2} = 0.77$$

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1) Using Submerged Conditions:

wt of wet soil = 130 pcf

wt. of water = 62.4

wt. of Submerged Soil = 67.6

As per SCS Standards when $\frac{t}{H} < 0.085$, $K = 1 - \sin\phi = 0.45$

using $K = 0.45$

$P_r = wKh = (67.6 \times 0.45 \times h) = 30.4$ pcf

water pr = 62.4

92.8

use 93 pcf

$pr = (92.8 \times 9.25) = 860$ pcf

$P = \left(\frac{860}{2} \times 9.25\right) = 4.0^K$

$M_{O.T} = 4.0 \times 9.25/3 = 12.3$ kft

Stabilizing Moment

$w_1 = (8.0 \times 1.0 \times 0.15) = 1.20^K$

$w_2 = (6.0 \times 1.25 \times 0.15) = 1.13$

$w_3 (Soil) = (3.0 \times 8.0 \times 0.13) = 3.12$

5.45^K

$M_{STB} = (1.2 \times 2.5) + (1.13 \times 3.0) + (3.12 \times 4.5) = 20.43$

$F.S = \left(\frac{20.43}{12.3}\right) = 1.66$

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Check Sliding:

Sliding force = P = 4.0 K

Frictional force = μN = 0.4 × 5.45 = 2.18 K

< 4.0 K

∴ use a Key &
Increase Heel to 4'-0 to
get some additional wt.

Try Footing width = 7'-0

Stabilizing Moment:

W_1	= 1.20 K
W_2 = (7.0 × 1.25 × 0.15)	= 1.31
W_3 = (4.0 × 8.0 × 0.13)	= 4.16
	6.67 K

M_{STB} = (1.2 × 2.5) + (1.31 × 7.0/2) + (4.16 × 5.0)

= 28.4 K'

F.S = (28.4 / 12.3) = 2.3

Sliding Check:

Frictional Force = μN = 0.4 × 6.67 = 2.7 K

Sliding Force P = 4.0 > 2.7 K

Still need a Key for the Base Slab

Footing pressure: 7' wide

$M_{SIB} = 28.4^{kft}$, $N = 6.67^{k}$

$M_{OT} = 12.3$

X_R = Dist. of Resultant $= \frac{(28.4 - 12.3)}{6.67}$

$= 2.41'$

$b/3 = \frac{7.0}{3} = 2.33$, within Mid Third

$e = (b/2 - X_R) = (3.5 - 2.41) = 1.09'$

$< \frac{b}{6} = 1.17'$

$P_r = \frac{6.67}{7 \times 1}\left(1 \pm \frac{6 \times 1.09}{7}\right)$

$= 0.953\,(1 \pm 0.93)$

$P_r(max) = 1.84^{ksf}$ $P_r(Min) = 0.07$

Toe Design:

a) UDL : $(1.24 \times 2) = 2.48^{k}$

b) Triangular: $\left(\frac{0.39}{2} \times 2.0\right) = 0.39^{k}$

Neglecting the footing wt.

$M_{A-A} = \left(2.48 \times \frac{2}{2}\right) + \left(0.39 \times \frac{2}{3} \times 2\right) = 3.0^{kft}$

$M_u = (3.0 \times 1.8) = 5.4^{kft}$

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Toe Steel:

$M_u = 3.9$ k/ft

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{5.4 \times 12}{0.9 \times 4.0 \times 12 \times 11.5^2} = 0.0113$$

from Table 9-2, Read $w = 0.012$

$$\rho = \frac{w f'_c}{f_y} = \frac{0.012 \times 4.0}{40} = 0.0012$$

Gr. 40 is used for design though Gr. 60 is actually used.

$A_s = 0.0012 \times 12 \times 11.5 = 0.17 \text{ in}^2$

$\rho_{min} = 200/f_y = 200/40000 = 0.005$

(Grade 60) $A_s = (0.005 \times 12 \times 11.5) = 0.46 \text{ in}^2$

Reqd Reinf: $1.33(0.17) = 0.23 \text{ in}^2$

use #4 @ 9", $A_s = 0.27$

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Heel Design

unif: $(0.28 \times 4.0) = 1.12^{K}$

Triangular: $\left(\frac{0.77}{2} \times 4.0\right) = 1.54^{K}$

Soil wt: $(8 \times 1)\,0.13 = 1.04^{K/ft}$

Conc. wt: $(1.25 \times 0.15) = 0.19^{K/ft}$

$$M_{BB} = \left(1.04 \times 4 \times \frac{4}{2}\right) + \left(0.19 \times 4 \times \frac{4}{2}\right) - \left(1.12 \times \frac{4}{2}\right) - \left(1.54 \times \frac{1}{3} \times 4\right)$$

$= 5.55^{K\,ft}$

$M_u = 1.8(5.55) = 9.99^{K\,ft}$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{9.99 \times 12}{0.9 \times 4.0 \times 12 \times 12.5^2}\right) = 0.018$$

$d = (15 - 2 - 0.5) = 12.5''$

from Table 9-2, $\omega = 0.017$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.017 \times 4.0}{40}\right) = 0.0017$$

say 0.002

GR. 40 is used for Design, though G. 60 is used for Const'n

$A_s = 0.002 \times 12 \times 12.5 = 0.30\ in^2$

$$\rho_{min} = \frac{200}{f_y} = 0.005$$

$A_s = 0.005 \times 12 \times 12.5 = 0.75\ in^2$

or $1.33\,A_s = 1.33 \times 0.3 = 0.4\ in^2$

use #5 @ 9", $A_s = 0.41$

Stem Design:

$P_r = wKh = (93 \times 8) = 744$ lbs

$M_{stem} = \left(\frac{0.744}{2} \times 8.0\right)\frac{8}{3} = 7.94$ kft

$M_u = (6.94 \times 1.8) = 14.2$ kft

$d = (12 - 2 - 0.5) = 9.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{14.2 \times 12}{0.9 \times 4.0 \times 12 \times 9.5^2}\right) = 0.044$

from Table 9-2, $\omega = 0.043$

$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.043 \times 4.0}{40}\right) = 0.0043$

$A_s = (0.0043 \times 12 \times 9.5) = 0.49$ in^2

$A_{s\,min} = (0.005 \times 12 \times 9.5) = 0.57$ in^2

or $1.33\, A_s = 1.33 \times 0.49 = 0.65$

use #5 @ 6", $A_s = 0.62$

Stem Design:

Check using 10" wall thickness:

VOID

$M_u = (6.83 \times 1.3) = 8.9$ kft

$d = (10 - 2 - 0.5) = 7.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{(8.9 \times 12)}{0.9 \times 3.0 \times 12 \times 7.5^2} = 0.059$$

Read $\omega = 0.061$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{(0.061 \times 3.0)}{60} = 0.0031$$

$\rho_{min} = (0.0033 \times 12 \times 7.5) = 0.30 \text{ in}^2$

$\rho = (0.0031 \times 12 \times 7.5) = 0.28 \text{ in}^2$

#5 @ 12" used before is still ok

10" Stem wall is ok, but

Better to use 12" wall to have some

Factor of Safety against overturning

and Sliding.

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DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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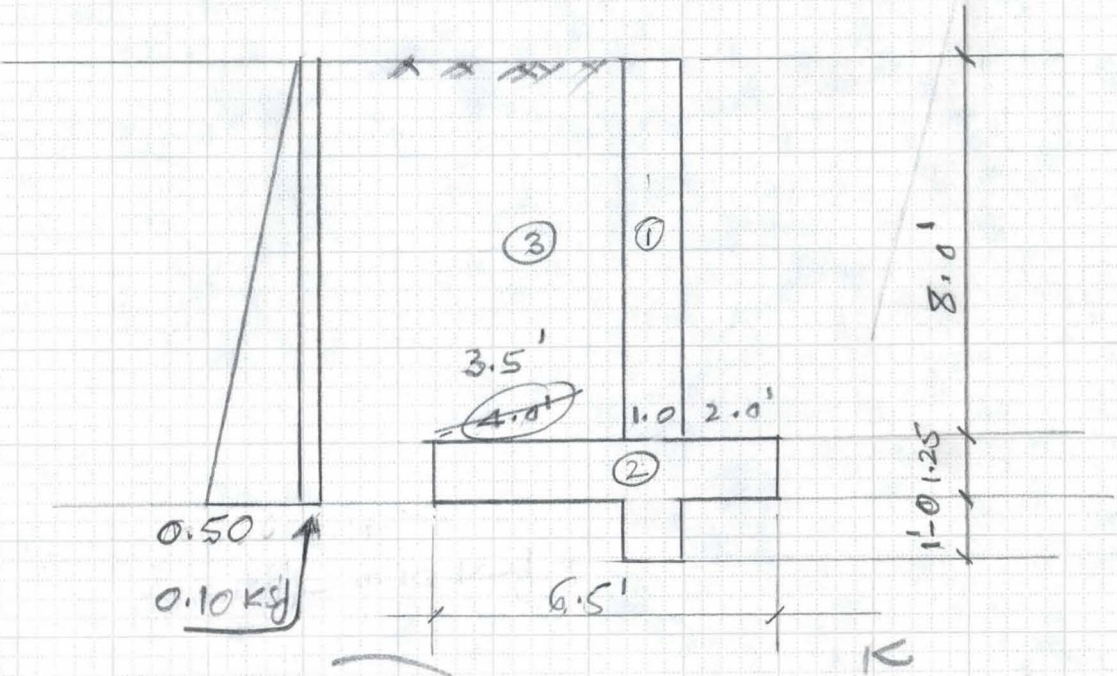
Case 2

Dry Backfill & 2' Surcharge

$P_{r_1} = wKh = (0.12 \times 0.45 \times 9.25) = 0.5$ ksf

Using Surcharge = 2'

$P_{r_2} = (0.12 \times 0.45 \times 2) = 0.108$ ksf, say 0.1 ksf



$P_1 = \left(\frac{0.50}{2} \times 9.25\right) = 2.31$ K

$P_2 = (0.1 \times 9.25) = 0.93$

$M_{OT} = \left(2.31 \times \frac{9.25}{3}\right) + \left(0.93 \times \frac{9.25}{2}\right) = 11.42$ kft

M_{STB}:

$W_1 = (1.0 \times 8.0 \times 0.15) = 1.20$ K

$W_2 = (6.5 \times 1.25 \times 0.15) = 1.22$

$W_3 = (3.5 \times 8.0 \times 0.12) = 3.36$

5.78

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$M_{STB} = (1.20 \times 2.5) + (1.22 \times \frac{6.5}{2}) + (3.36 \times 4.75)$

$= 22.93$ kft

$F.S = (22.93 / 11.4) = 2.0$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 5.78 = 2.3^K$

Sliding Force $= (2.3 + 0.93) = 3.2$

> 2.3 ∴ Use a Base slab Key.

Check Stem Moment:

$Pr_1 = (0.12 \times 0.45 \times 8) = 0.432$ ksf

$Pr_2 = 0.1$ ksf

$P_1 = (\frac{0.432}{2} \times 8) = 1.73^K$

$P_2 = (0.10 \times 8) = 0.8^K$

$M_{Stem} = (1.73 \times \frac{8}{3}) + (0.8 \times \frac{8}{2}) = 7.81$ kft

< 7.94 kft (Used for Design under Submerged Cond.)

Temp. Steel

As per SCS Requirements $\rho_t = 0.003$ (Exp. Face)

$\rho_t = 0.002$ (Non Exp. face)

$As_1 = 0.003 \times 12 \times 12 = 0.43$ use #6 @ 12

$As_2 = 0.002 \times 12 \times 12 = 0.29$ use #5 @ 12

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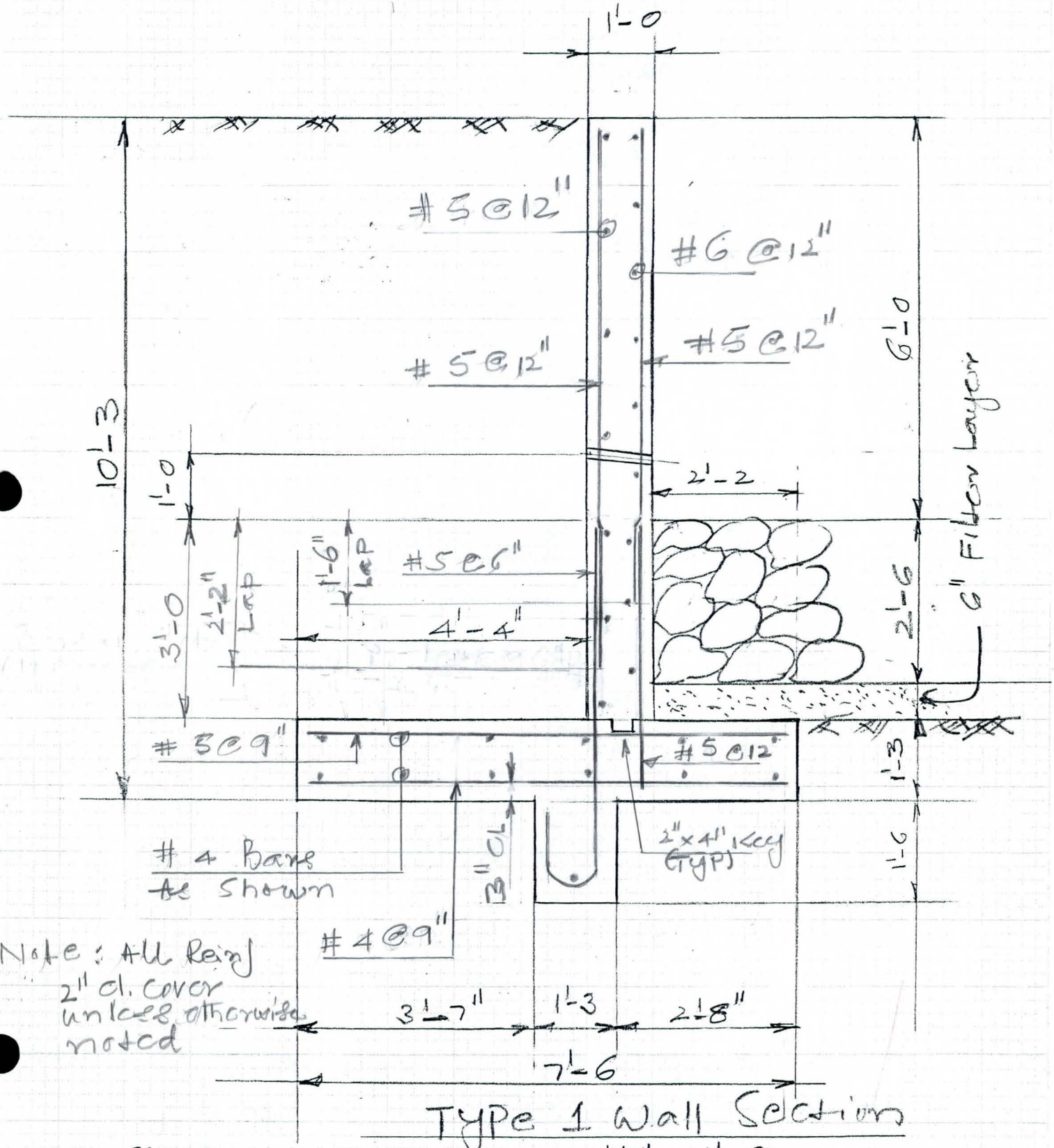
DETAIL 6' Wall Section COMPUTED KVH DATE 8/92

Type 1 Wall CHECKED BY CCW DATE 10/92



Note: All Reinf 2" cl. cover unless otherwise noted

Type 1 Wall Section

1/2" = 1'-0

Stat. 440 To 722.3

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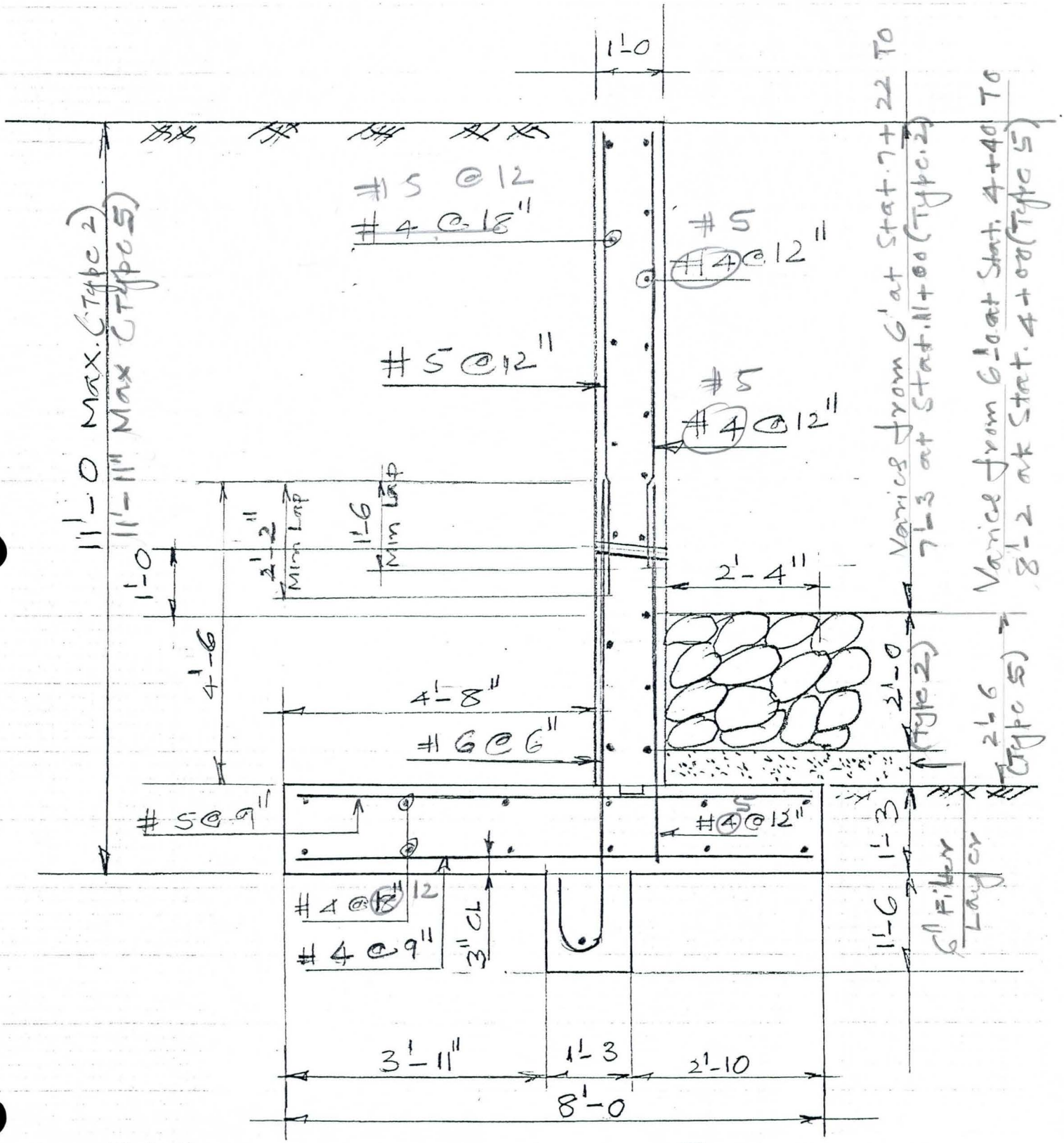
DETAIL 7'-3 wall Section COMPUTED KVH DATE 8/92

Type 2 wall CHECKED BY CLW DATE 10/92



Type-2 AND TYPE-5 WALL SECTIONS

Scale 1/2" = 1'-0

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DETAIL @ Transition COMPUTED KVH DATE 7/92

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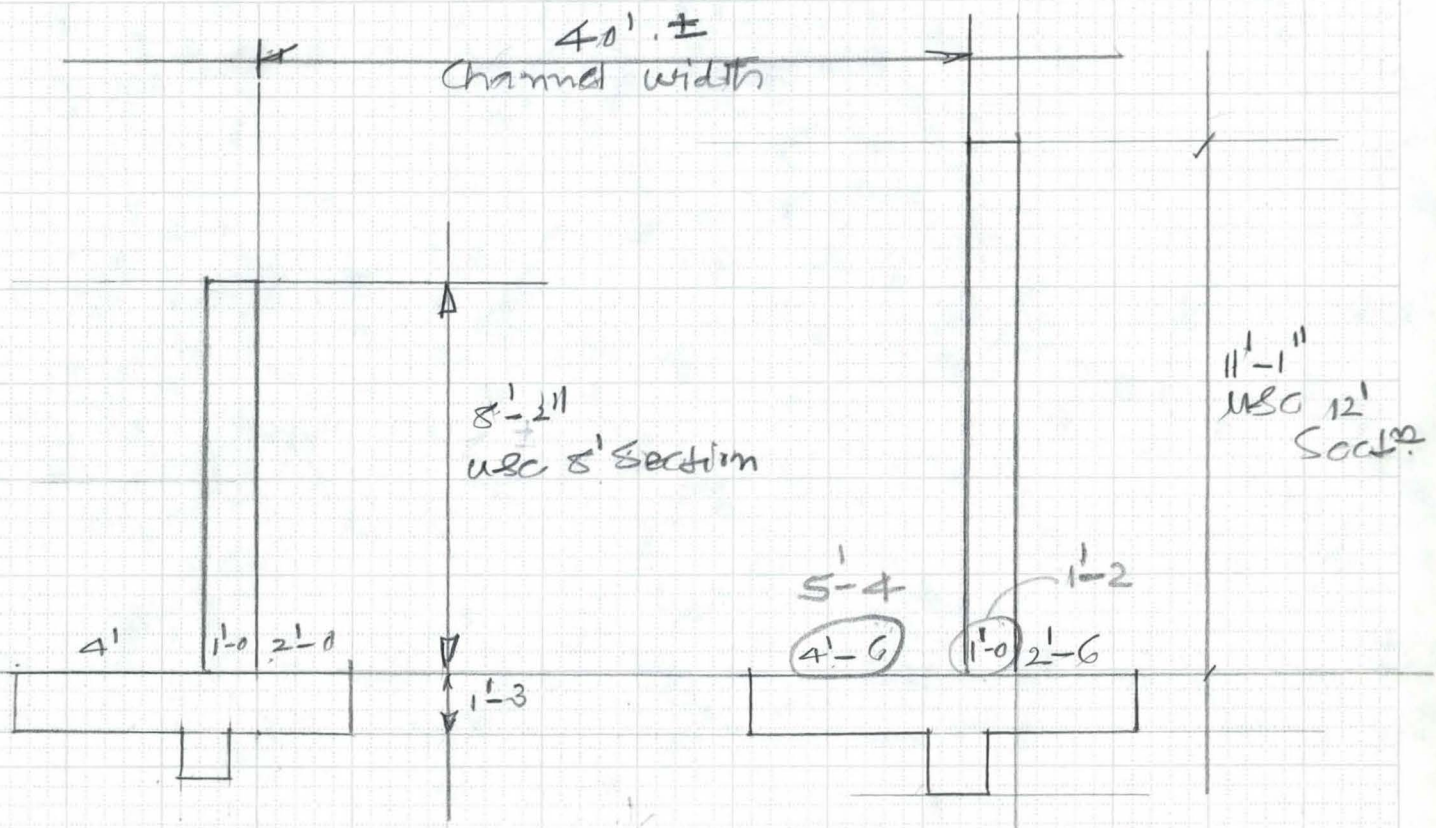


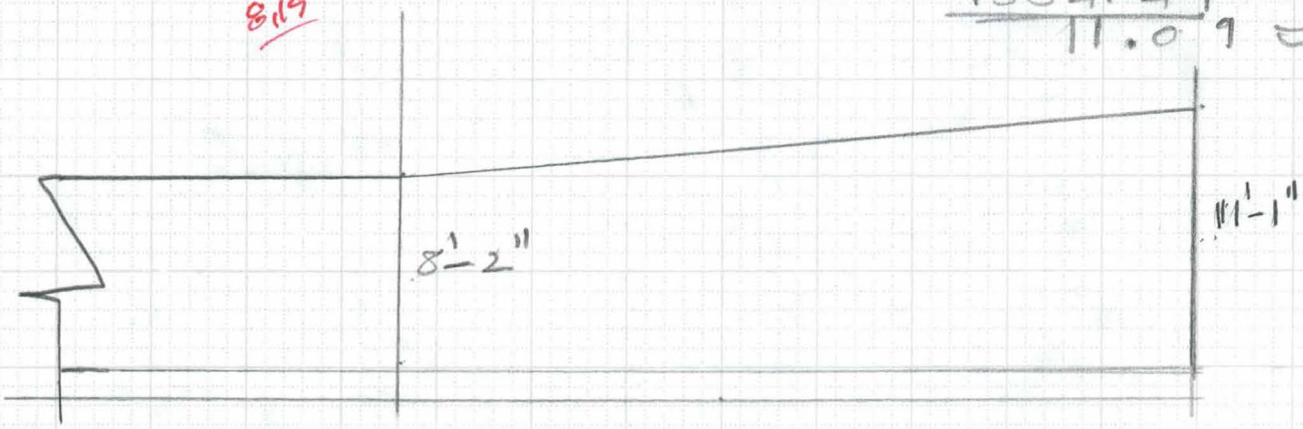
Section at outlet

1/4" = 1'-0

1342.10
1333.91
18.19 ≈ 8'-2

8.19

1345.58
1334.49
11.09 ≈ 11'-1



Elevation View
Transition from High Wall to Regular Sect^n

1/8" = 1'-0

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DETAIL 12' High Wall COMPUTED KVH DATE 7/92

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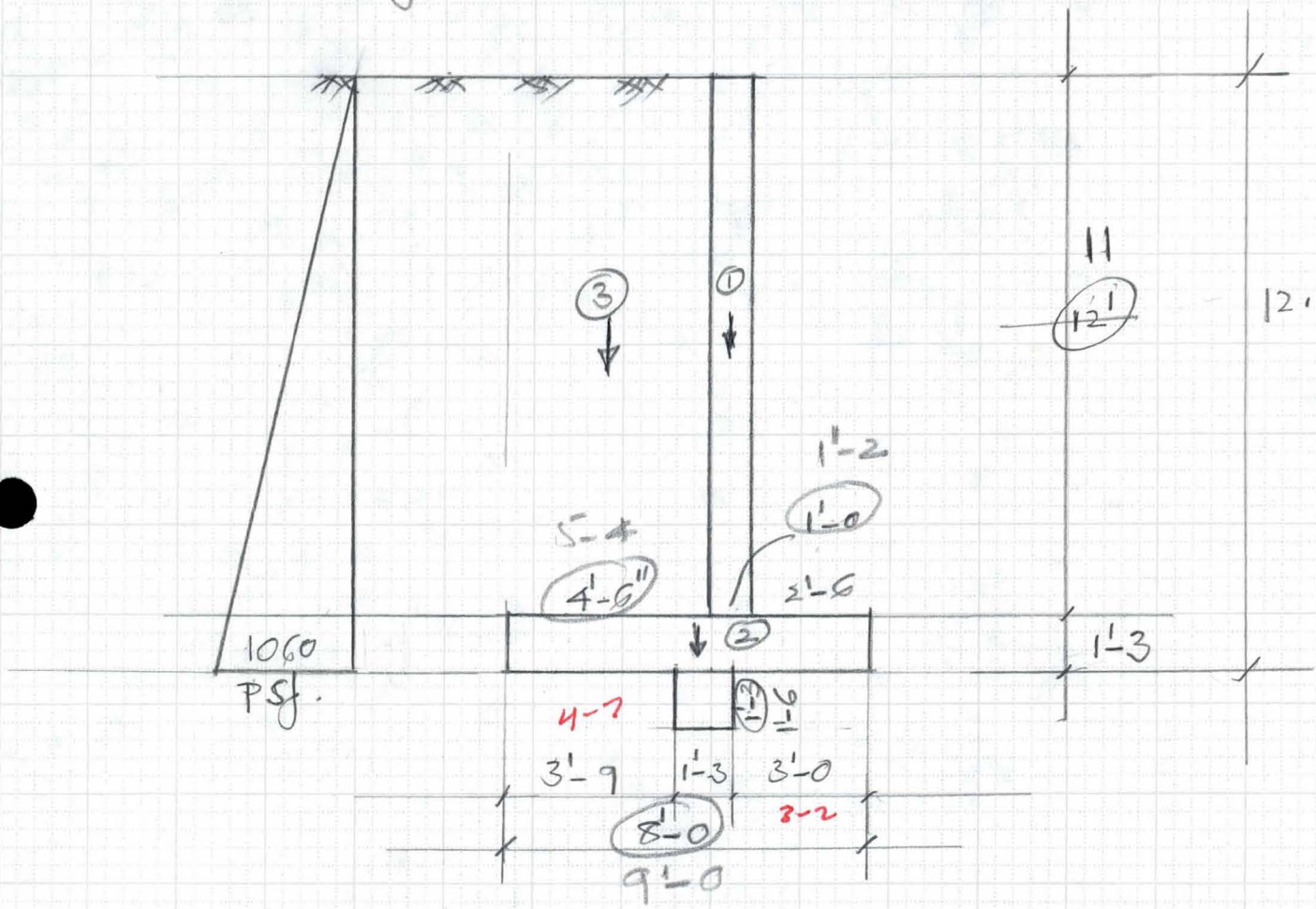
Case 1

Submerged Condition



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DETAIL 12' High Wall COMPUTED KVH DATE 7/92

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(Case check of footing only)

Check for Submerged Condition

Footing width = 8'

Using Equt fluid pr. of 93 psf

$pr = wKh = (93 \times 13.25) = 1139$ psf (1232)

$P = \left(\frac{1139}{2} \times 12.25\right) = 6.98^K$ (1232, 7.55)

$M_{OT} = \left(6.98 \times \frac{12.25}{3}\right) = 28.5^{K'}$ (7.55, 30.8)

Stabilizing Moment:

$w_1 = (11.0 \times 1.0 \times 0.15) = 1.65^K$

$w_2 = (8.75 \times 1.25 \times 0.15) = 1.64$

$w_3 = (5.25 \times 11 \times 0.13) = 7.51$

10.80^K

$M_{STB} = (1.65 \times 3) + (1.64 \times 4.37) + (7.51 \times 6.12) = 58.1^{K'}$

$FS = \left(\frac{58.1}{28.5}\right) = 2.0$ (30.8) 1.9 ok

Sliding Check:

Frictional Force $= \mu N = (0.4 \times 10.8) = 4.32^K$

Sliding Force $= 6.98^K > 4.32^K$

use a Key for Base Slab.

However Sliding force of 6.98^K is very high since 80 psf Equiv. fluid pr is used. wall will not slide because of Grouted Riprap on the inside of the channel wall. Also use weep Holes to keep the water pr. to a minimum.

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DETAIL 12' Retaining wall COMPUTED KVH DATE 9/92

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Check Footing Pressure: (8' footing width) 8'-9

$M_{STB} = 58.1$, $M_{OT} = 28.5^{K/ft}$, $N = 10.8^{K}$

x_R = Dist. of Resultant $= (58.1 - 28.5)/10.8 = 2.74'$

$b/3 = 8.75/3 = 2.92'$

$e = (b/2 - x_R) = (4.37 - 2.74) = 1.64'$

$b/6 = 1.46$ $\quad e > \frac{b}{6}$ ∴ Resultant outside the middle Third.

$\frac{L'}{3} = (\frac{L}{2} - e)$

$L' = 3(\frac{L}{2} - e) = 3(4.37 - 1.64) = 8.19'$

$q_{max} = \frac{2P}{BL'} = \left(\frac{2 \times 10.8}{1 \times 8.19}\right) = 2.64$ KSF

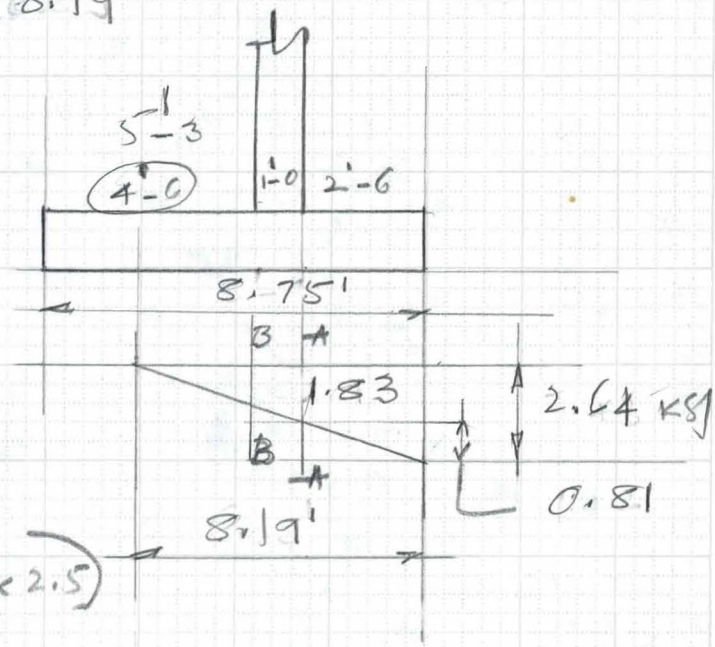
Toe Design

$\frac{2.64}{8.19} = \frac{q_1}{5.69}$

$q_1 = 1.83$ KSF

$P_1 = (1.83 \times 2.5) = 4.58^{K}$

$P_2 = (\frac{0.81}{2} \times 2.5) = 1.01^{K}$



Neglecting footing wt:

$M_{AA} = (4.58 \times \frac{2.5}{2}) + (1.01 \times \frac{2}{3} \times 2.5)$

$= 7.42$

$M_u = 1.8(7.4) = 13.3^{K/ft}$

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DETAIL 12' Retaining Wall COMPUTED KVH DATE 7/92

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Toe Design (Contd) (8'-9" Footing width)

$M_u = 13.3$

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{13.3 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.037$$

Read $\omega = 0.036$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.036 \times 4.0}{40.0}\right) = 0.0036$$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{40{,}000} = 0.005$$

$A_s = (0.0036 \times 12 \times 11.5) = 0.49 \text{ sq}''$

$A_s(min) = (0.005 \times 12 \times 11.5) = 0.69$

or $1.33 A_s = (1.33 \times 0.49) = 0.65$

Since wall th. varies, use #6 @ 9", $A_s = 0.59$

Heel Design:

Neglecting upward Soil pr. on the Heel:

Soil wt $= (11 \times 0.13) = 1.43$ kip

Conc. Ftg $= (1.25 \times 0.15) = 0.19$

$$M_{BB} = \left(1.43 \times \frac{5.25^2}{2}\right) + \left(0.19 \times \frac{5.25^2}{2}\right) = 22.32 \text{ kft}$$

$M_u = 1.8 (22.32) = 40.2$ kft

$d = (15 - 2 - 0.5) = 12.5''$ or

$d = (15 - 3 - 0.5) = 11.5''$ with 1" Clearance to Standard Key

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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8' Footing width

$$\frac{M_u}{\phi f'_c b d^2} = \frac{40.2 \times 12}{0.9 \times 4.0 \times 12 \times 11.5^2} = 0.084$$

Read $\omega = 0.079$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.079 \times 4.0}{40} = 0.00079$$

$$\rho_{min} = \frac{200}{f_y} = 0.005$$

Grade 40 is used for Design, though Gr. 60 is used for Const.

$$A_s = 0.00079 \times 12 \times 11.5 = 1.09 \text{ in}^2$$

#7 @ 6" $A_s = 1.20$ OR

#7 @ 9" $A_s = 0.80$

Try 9'-0 Footing width to have a Little more F.S. in Sliding & reduce Soil. pr a Little

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DETAIL 12' High wall COMPUTED KVH DATE 7/92
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Try Footing width = 9'-0

Using Equiv. Fluid pr = 80 pcf

$P_r = wKh = (93 \times 12.25) = 1139$ pcf

$P = \left(\frac{1139}{2} \times 12.25\right) = 6.98^K$

$M_{OT} = \left(6.98 \times \frac{12.25}{3}\right) = 28.5^{K'}$

Stabilizing Mom:

$W_1 = (1.0 \times 11.0 \times 0.15) = 1.65$

$W_2 = (8.75 \times 1.25 \times 0.15) = 1.64$

$W_3 = (5.25 \times 11.0 \times 0.13) = 7.54$

10.84

$M_{STB} = (1.65 \times 3.0) + \left(1.64 \times \frac{8.75}{2}\right) + 7.50\left(3.5 + \frac{5.25}{2}\right)$

$= 58.0^{K'}$

$F.S = \frac{58.0}{28.50} = 2.0$

Sliding Check

Frictional force $= \mu N = 0.4 \times 10.84 = 4.34^K$

with $\mu = 0.5$, $0.5 \times 10.84 = 5.42^K$

Sliding force $= 6.98^K > 5.42^K$

Use a Base Slab Key (1'-3") x (1'-6")

Actually Sliding force will not be as high as 6.98K because of water pr on Channel side, under submerged condition

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

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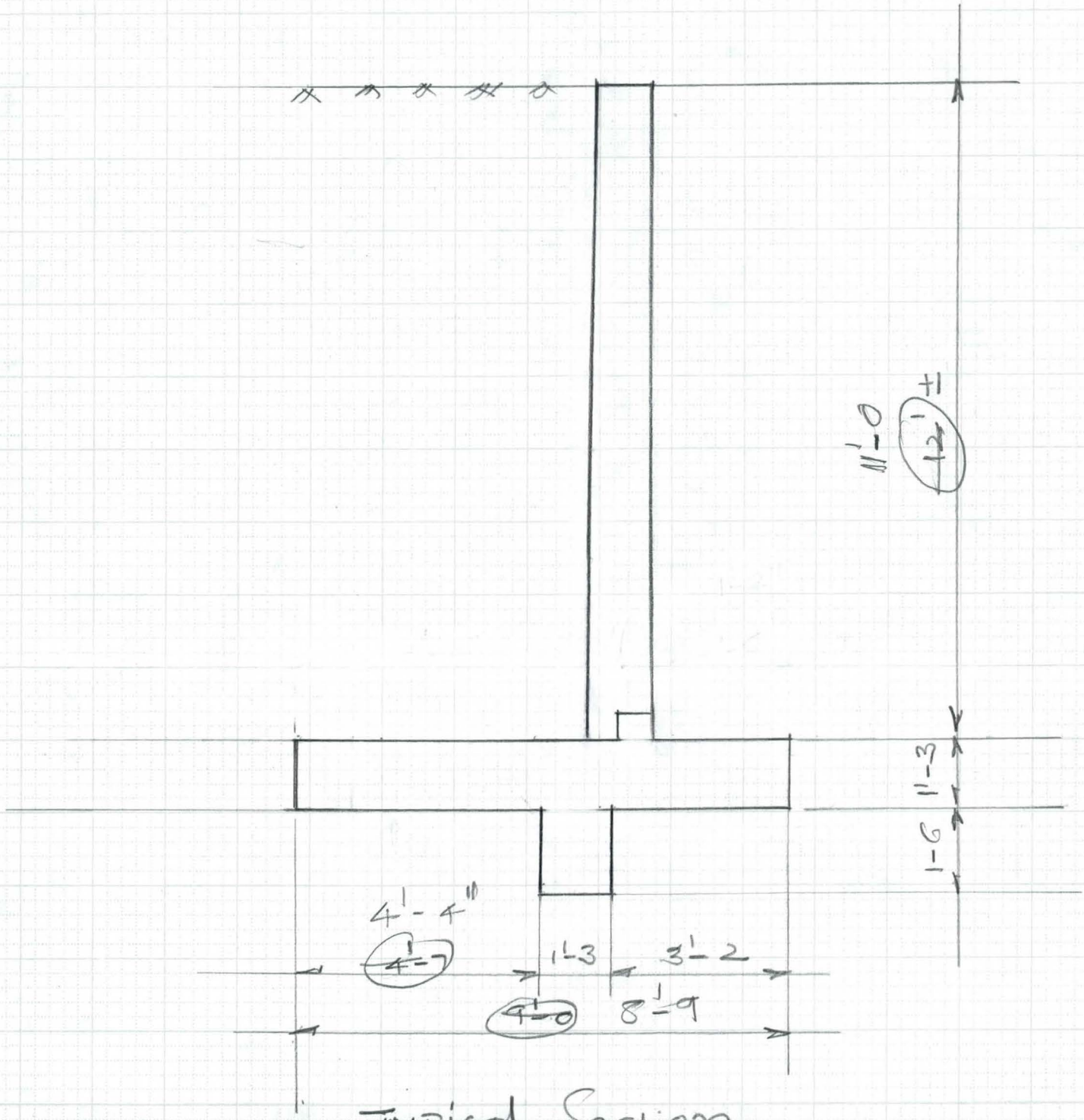

Typical Section

Scale 1/2" = 1'-0

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

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Checking Footing for (8'-9 footing width)

$M_{STB} = 58.1$, $M_{OT} = 28.5$, $N = 10.8^K$

$x_R = (58.1 - 28.5)/10.8 = 2.74'$

$e = \left(\frac{8.75}{2} - 2.74\right) = 1.64$,

$b/6 = \frac{8.75}{6} = 1.46$ $e > b/6$ ∴ 1K

$$P_{r\,max} = \frac{10.8}{8.75}\left(1 \pm \frac{6 \times 1.64}{8.75}\right)$$

$$= 1.23\,(1 \pm 1.12)$$

$P_r(max) = 2.61$ ksf, $P_r(Min) = -0.31$ ksf

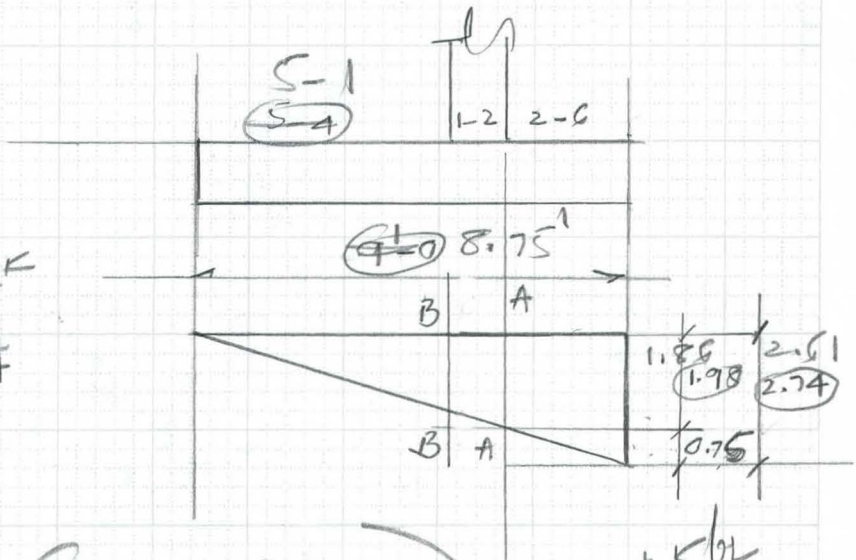
Toe Design:

$$\frac{2.61}{8.75} = \frac{P_{r_1}}{6.25}$$

$P_{r_1} = 1.86$ ksf

$P_1 = (1.86 \times 2.5) = 4.65^K$

$P_2 = \left(\frac{0.75}{2} \times 2.5\right) = 0.94$



Neglecting ftg wt:

$$M_{AA} = \left(4.65 \times \frac{2.5}{2}\right) + \left(0.94 \times \frac{2}{3} \times 2.5\right) = 7.4^{K'}$$

$M_u = (7.4 \times 1.8) = 13.32^{K'}$

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92
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8'-9" Footing width (Contd)

$M_u = 13.32$ $d = (15-3-0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{13.32 \times 12}{0.9 \times 4.0 \times 12 \times 11.5^2} = 0.028$$

Read $\omega = 0.03$ from Table 9-2

ρ_{min} Controlling, use #6 @ 9"

Heel Design:

$$\frac{2.61}{8.75} = \frac{p_r}{5.08}$$ $p_r = 1.52$ ksf

$P = \left(\frac{1.52}{2} \times 5.08\right) = 3.86^k$

Soil wt $= (11.0 \times 0.113) = 1.43$ k/ft

Conc. ftg $= (1.25 \times 0.15) = 0.19$

$$M_{BB} = \left(1.43 \times \frac{5.08^2}{2}\right) + \left(0.19 \times \frac{5.08^2}{2}\right) - 3.86 \times \frac{5.08}{3}$$

$= 14.4$ k-ft

$M_u = 1.8(14.4) = 26.0$ k-ft

$d = (15-3-0.5) = 11.5$ with 1" Cl to Standard Key

$$\frac{M_u}{\phi f'_c b d^2} = \frac{26 \times 12}{0.9 \times 4.0 \times 12 \times 11.5^2} = 0.055$$

Read $\omega = 0.053$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.053 \times 4}{40} = 0.0053$$

$A_s = (0.0053 \times 12 \times 11.5) = 0.73$ in^2

#6 @ 9", $A_s = 0.59$, #7 @ 9", $A_s = 0.80$

At the wall ht. varies, use #7 @ 9"

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

CHECKED BY CLW DATE 10/92

Stem Design

$P_r = wh = (93 \times 11) = 1023$ psf

$M_{om} = \left(\frac{1.023 \times 11}{2}\right)\frac{11}{3} = 20.63$ kft

$M_u = (20.63 \times 1.8) = 37.1$ kft

$d = (14 - 2 - 0.5) = 11.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{37.1 \times 12}{0.9 \times 4.0 \times 12 \times 11.5^2}\right) = 0.078$

from Table 9-2, $w = 0.074$

$\rho = \frac{w f'_c}{f_y} = \frac{(0.074 \times 4.0)}{40} = 0.0074$

$A_s = (0.0074 \times 12 \times 11.5) = 1.02 \text{ in}^2$

6 @ 6" $A_s = 0.88$

At the wall ht. varies use # 7 @ 6", $A_s = 1.20$

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(3)

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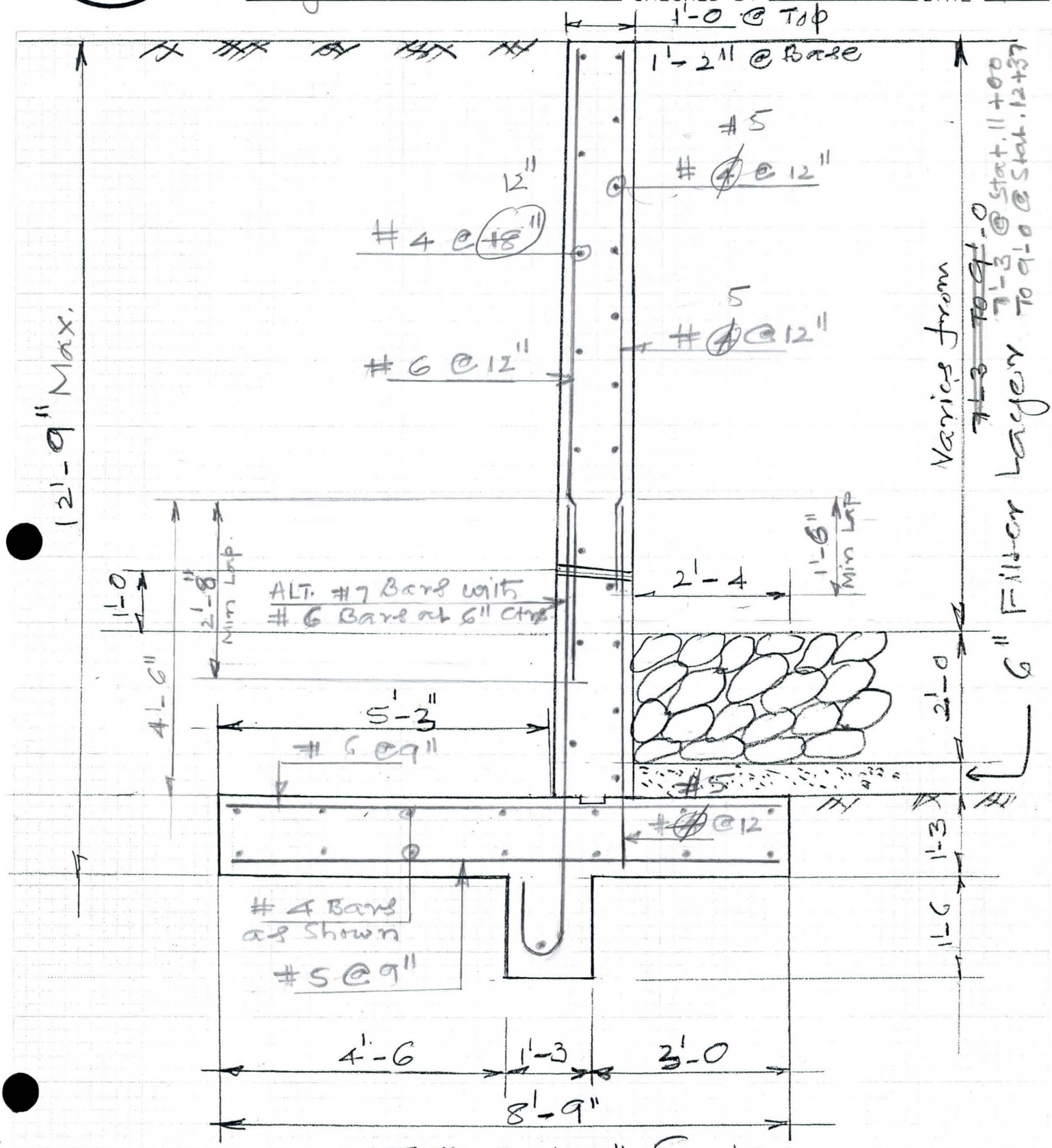
PROJECT Shook Hill Outlet PAGE 21(B) OF

DETAIL 9'-0 Wall Sect COMPUTED KVH DATE 8/92

Type 3 Wall CHECKED BY CWC DATE 10/92



Type 3 Wall Section

Stat. 1100 TO 1237.6

1/2" = 1'-0

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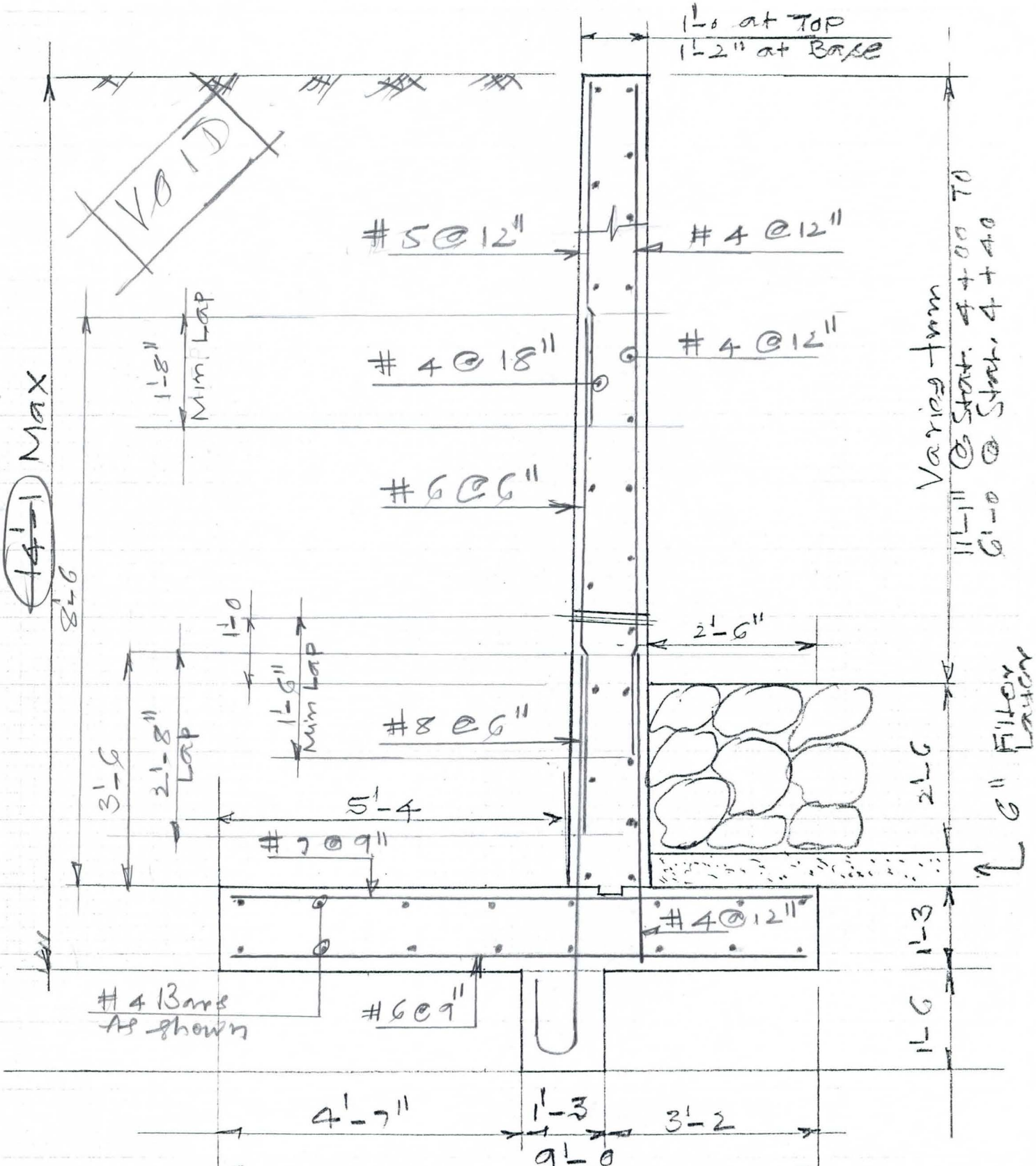
PROJECT Spook Hill PAGE 21(C) OF

DETAIL Type 4 wall COMPUTED KNH DATE 8/92

CHECKED BY CLW DATE 10/92



Type 4 Wall Section

½" = 1'-0 Stat. 4+00 To 4+40

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DETAIL Type 1 wall COMPUTED RVH DATE 8/92

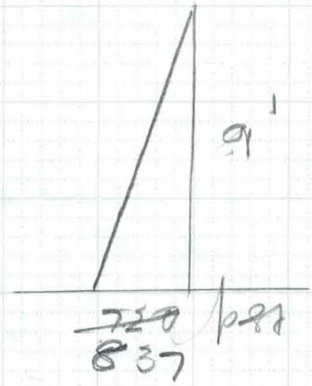
Reinf Check CHECKED BY CLCO DATE 10/92

Type 1 wall:

Ht = (6 + 3) = 9'

pr @ 93 pcf Saturated pr.

(93 × 9) = 837 pcf



$P = \left(\frac{837}{2} \times 9\right) = 3.77^{K}$

$M = 3.77 \left(\frac{9}{3}\right) = 11.31$

$d = (12 - 2 - 0.5) = 9.5$ $\quad A_s = \frac{11.31 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.68$

use #5 @ 6", $A_s = 0.62$

Bar cut off @ (9' − 2) − 1' = 1'−1" say 1' from Bott

pr = (93 × 8) = 744

$P = \left(\frac{744}{2} \times 8\right) = 2.98^{K}$

$M = \left(2.98 \times \frac{8}{3}\right) = 7.95$ $\quad A_s = \frac{7.95 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.48 \text{ in}^2$

Bars cannot be cut off at 2'-2' from Bottom for #5 @ 12"

Bar Extension, $12 d_b = 12 \times 5/8 = 7.5"$

$d_{eff} = 9.5"$

Min 12" $= 12"$

Try Bar Cut off at 3'-0 from Base

Check Min. at (3 − 1) − 1.0 = 2.0' from Base

Check Reinf @ (9 − 2) = 7' Height

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DETAIL Type 1. wall COMPUTED KVH DATE 8/92

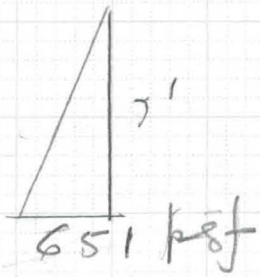
Reinf. Check CHECKED BY CLW DATE 10/92

$Ht = 7'$

$p_v = (.93 \times 7) = .651$

$P = \left(\frac{0.651}{2} \times 7.0\right) = 2.28^K$

$M = (2.28 \times 7/3) = 5.32^{K'}$



$A_s = \left(\frac{5.32 \times 12}{24 \times 0.88 \times 9.5}\right)$

$= 0.32$

#5 @ 12" Bar Cutoff at 3' from Base is ok

Shear Check:

$V = 3.77^K$

$b = 12, \; d = 9.5$

$v = \left(\frac{3.77 \times 1000}{12 \times 9.5}\right) = 33$ psi < 55 ok

$\therefore$ ok

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DETAIL Type 2 wall COMPUTED KVH DATE 8/92

Reinf. Check CHECKED BY CDW DATE 10/92

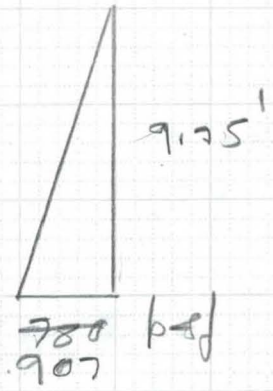
Type 2 wall

Ht = 9'-9

$p_r = (93 \times 9.75) = 907$ psf

$P = \left(\frac{0.907}{2} \times 9.75\right) = 4.42^K$

$M = \left(4.42 \times \frac{9.75}{3}\right) = 14.4$ kft



$A_s = \left(\frac{14.4 \times 12}{24 \times 0.88 \times 9.5}\right)$

$= 0.86$ "

use #6 @ 6", $A_s = 0.88$

Try Bar Cutoff at 3' from Base

Check Mom at $(9.75 - 2.0) = 7.75'$

$P_r = (93 \times 7.75) = 721$

$P = \left(\frac{721}{2} \times 7.75\right) = 2.8^K$

$M = \left(2.8 \times \frac{9.75}{3}\right) = 9.1$ kft, $A_s = \frac{9.1 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.54 \text{ in}^2$

Try Bar Cut off at 3'-6 from Base

$P_r = (93 \times 7.25) = 674$

$P = \frac{0.674}{2} \times 7.25 = 2.44^K$

$M = \left(2.44 \times \frac{7.25}{3}\right) = 5.9$

$A_s = \frac{5.9 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.35$

∴ Use #5 @ 12" at 3'-6 from Base

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DETAIL Type 3 wall COMPUTED KNH DATE 8/92

Reinf. Check CHECKED BY CWW DATE 10/92

Type 3 wall

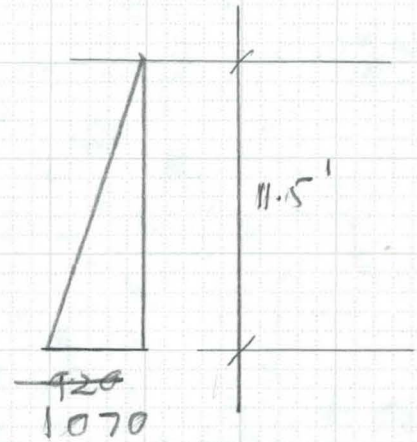
Ht = 11'-6"

$p_r = 93(11.5) = 1070$

$P = \left(\frac{1.070}{2} \times 11.5\right) = 6.15^K$

$M = \left(6.15 \times \frac{11.5}{3}\right) = 23.6^{K'}$

$d_{eff} = (14 - 2.5) = 11.5''$



Alt Bars #7 & #6

#7 @ 12 = 1.20
#6 @ 12 = 0.88 } 1.04

$A_s = \left(\frac{23.6 \times 12}{24 \times 0.88 \times 11.5}\right) = 1.17$

Alt #7 Bars with #6 Bars

$A_s = 1.04$

Bar Cut off

$12 d_b = 12 \times 7/8 = 10.5''$

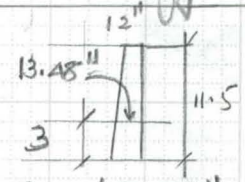
$d_{eff} = 11.5$

Min 12" = 12"

Use 12" Min beyond the actual Bar Cut off

Try at (4-0) - 1' = 3'-0"

Ht = (11.5 - 3.0) = 8.5'



$\left(12 + \frac{8.5}{11.5} \times 2''\right) = 13.48''$

$d_{eff} = 13.48 - 2.5 = 10.98''$

$p_r = (8.5 \times 93 \text{ psf}) = 791 \text{ psf}$

$P = \left(\frac{0.791}{2} \times 8.5\right) = 3.36$

$M = \left(3.36 \times \frac{8.5}{3}\right) = 9.5^{K'}$

$A_s = \frac{9.5 \times 12}{24 \times 0.88 \times 10.98}$

$= 0.49$

#6 @ 12, $A_s = 0.44$

Use Bar Cut off at 4'-6 & use #6 @ 12 at top

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PROJECT Spook Hill Outlet PAGE 26 OF

DETAIL Type 4 wall COMPUTED KVH DATE 8/92

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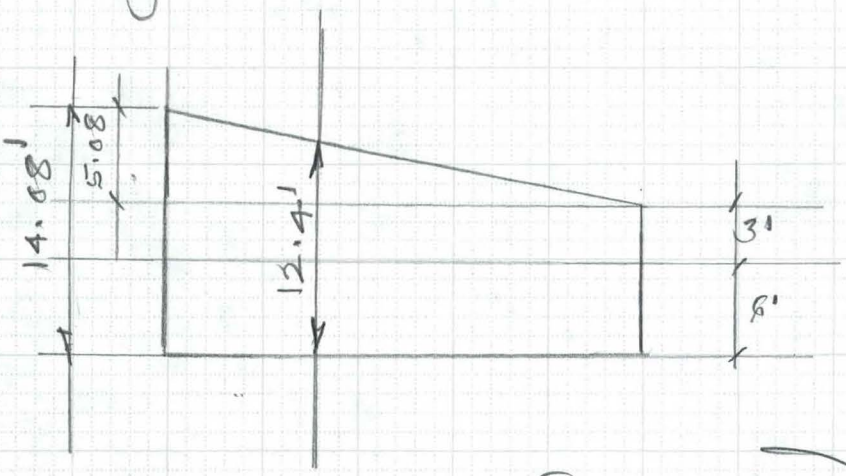
Type 4 wall



$Ht @ C.G_r = (9 + \frac{2}{3} \times 5.08) = 12.4'$

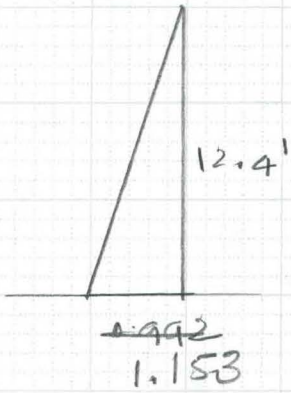
1) Design $Ht = 12.4'$

$P_r = (93 \times 12.4) = 1153$

$P = (\frac{1.153}{2} \times 12.4) = 7.15^k$

$M = 7.15 \times \frac{12.4}{3} = 29.6$ k/ft

$d_{eff} = (14 - 2.5) = 11.5''$



$A_s = \frac{29.6 \times 12}{24 \times 0.88 \times 11.5} = 1.46$

use #8 @ 6", $A_s = 1.58$

Shear Check:

$V_{max} = 6.15^k$

$v = \frac{7.15}{12 \times 11.5}$

$= 51.8$ psi

Allow $S_h = 0.95\sqrt{4000} = 60$ psi ∴ OK

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PROJECT Spook Hill PAGE 29 OF

DETAIL Type 4 wall COMPUTED RVH DATE 9/92

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b) Check Bar Cut off @ 4'-0

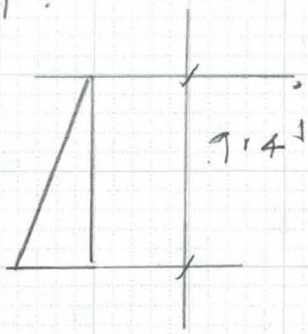
Check at (4 - 1.0) = 3' from Bott.

$Ht = (12.4 - 3.0) = 9.4'$

$pr = (93 \times 9.4) = 874$ psf

$P = \left(\frac{0.874}{2} \times 9.4\right) = 4.11^{K}$

$M = \left(4.11 \times \frac{9.4}{3}\right) = 12.9^{K'}$



$d_{eff} = (14 - 2 - 0.5 - 0.5) = 11.0$

$A_s = \frac{12.9 \times 12}{24 \times 0.88 \times 11} = 0.67$

Use #6 @ 6" & Bar Cutoff at 3'-6

c) Check Bar Cutoff at 7'-0

Check at (7 - 1.0) = 6' from Bottom

$Ht = (12.4 - 6.0) = 6.4'$

$pr = (93 \times 6.4) = 595$

$P = \left(\frac{595}{2} \times 6.4\right) = 1.90^{K}$

$M = 1.90 \times \frac{6.4}{3} = 4.1^{K'}$

$A_s = \frac{4.1 \times 12}{24 \times 0.88 \times 10.5} = 0.22$

Use min #5 @ 12

$d_{eff} = (14 - 2.0 - 0.5 - 1.0)$
$= 10.5$

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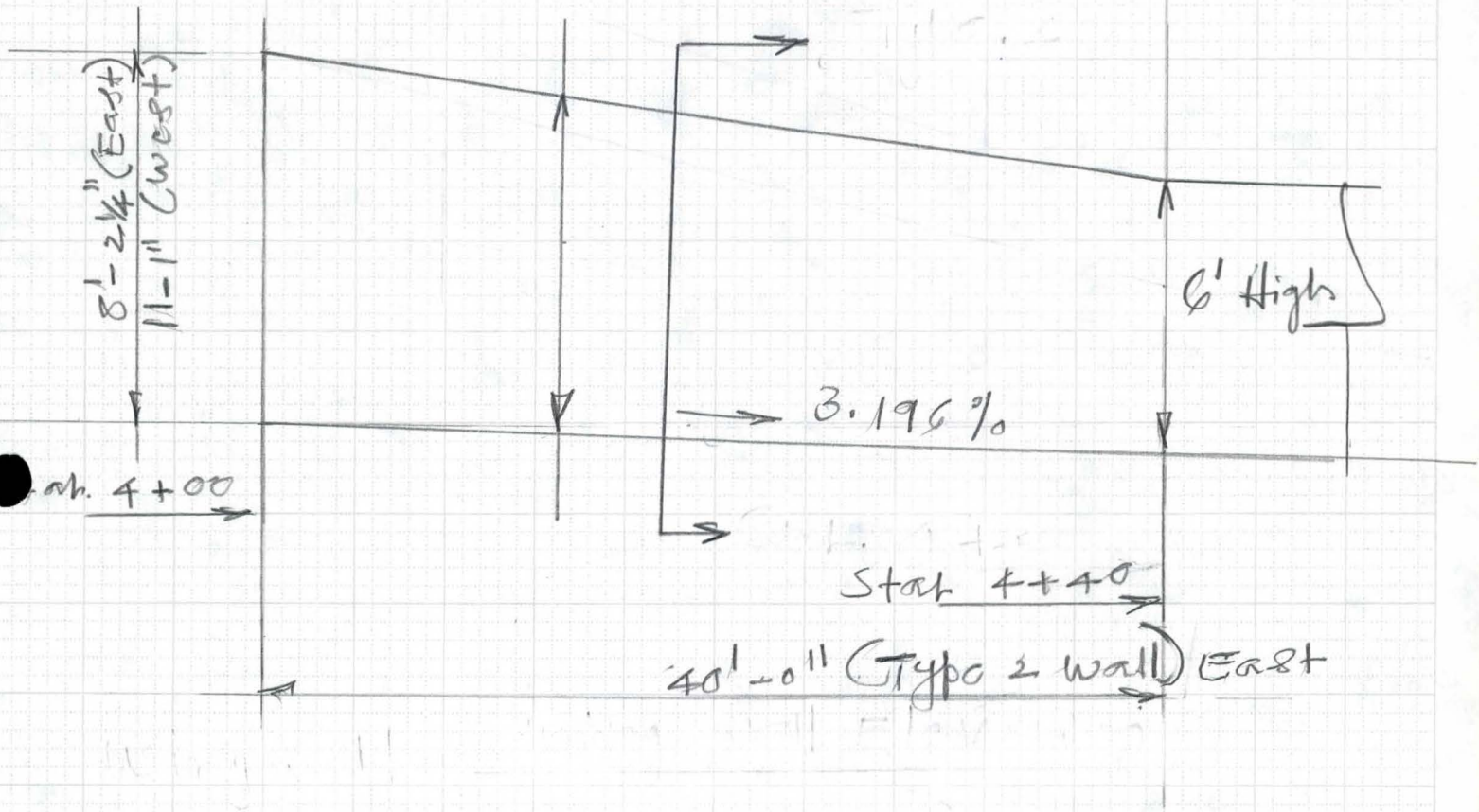
PROJECT Spook Hill outlet PAGE 28 OF

DETAIL East wing wall COMPUTED KVH DATE Aug 92

CHECKED BY [illegible] DATE 10/92

East & west wing walls

3.196 %, $3.196 \times \frac{40}{100} = 1.28'$



East (8'-2) - 6 = 2'-2

Design Ht = 6' + 2/3 (2.17) = 7'-6"

∴ use Type 2 Wall Detail - East wing

West (11-1) - 6 = 5.08', Design Ht = 6 + 2/3 (5.08) = 9.4'

use Type 4 wall Detail with 9'-0 Footing width

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL West Wingwall COMPUTED KVH DATE 8/92

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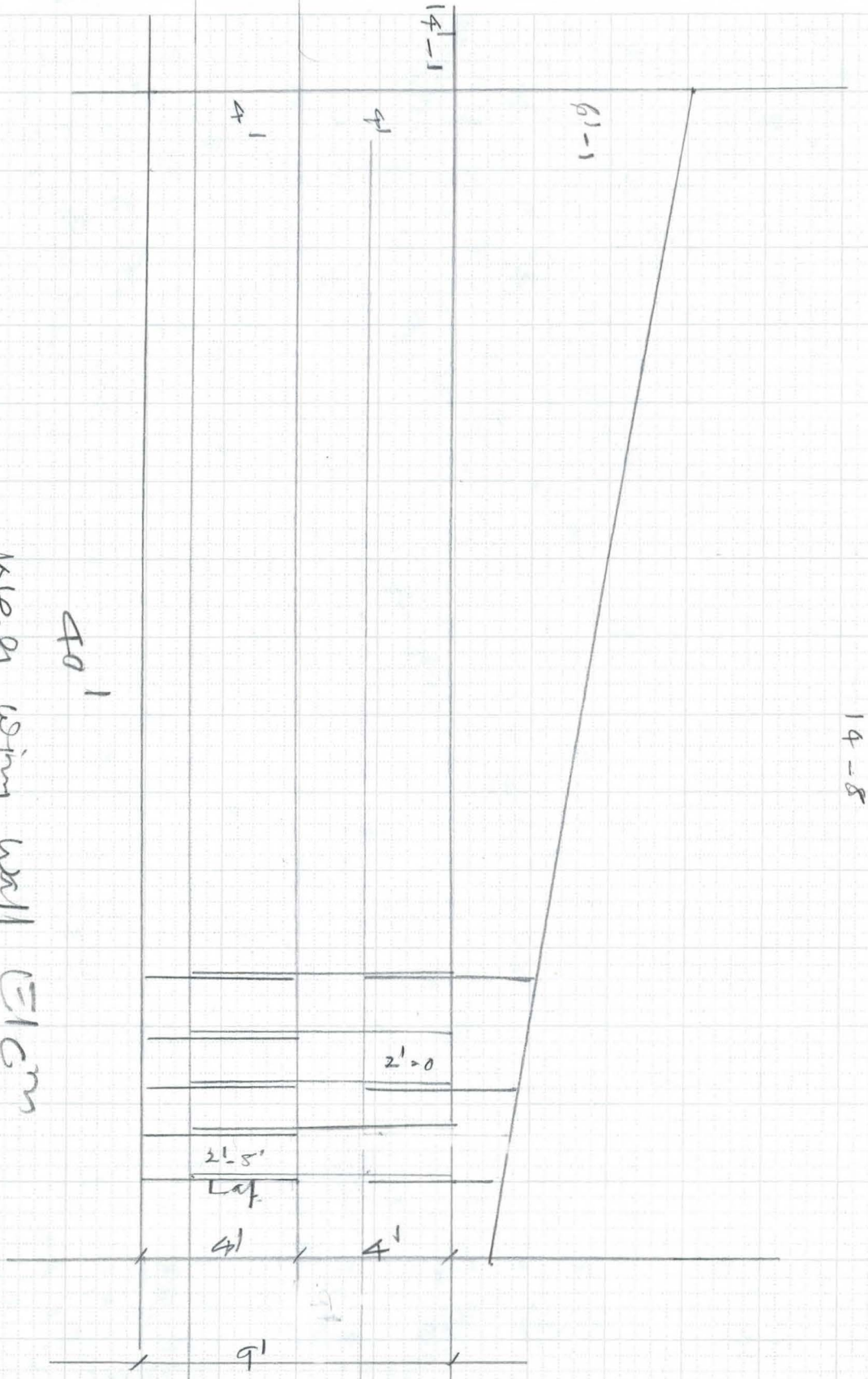

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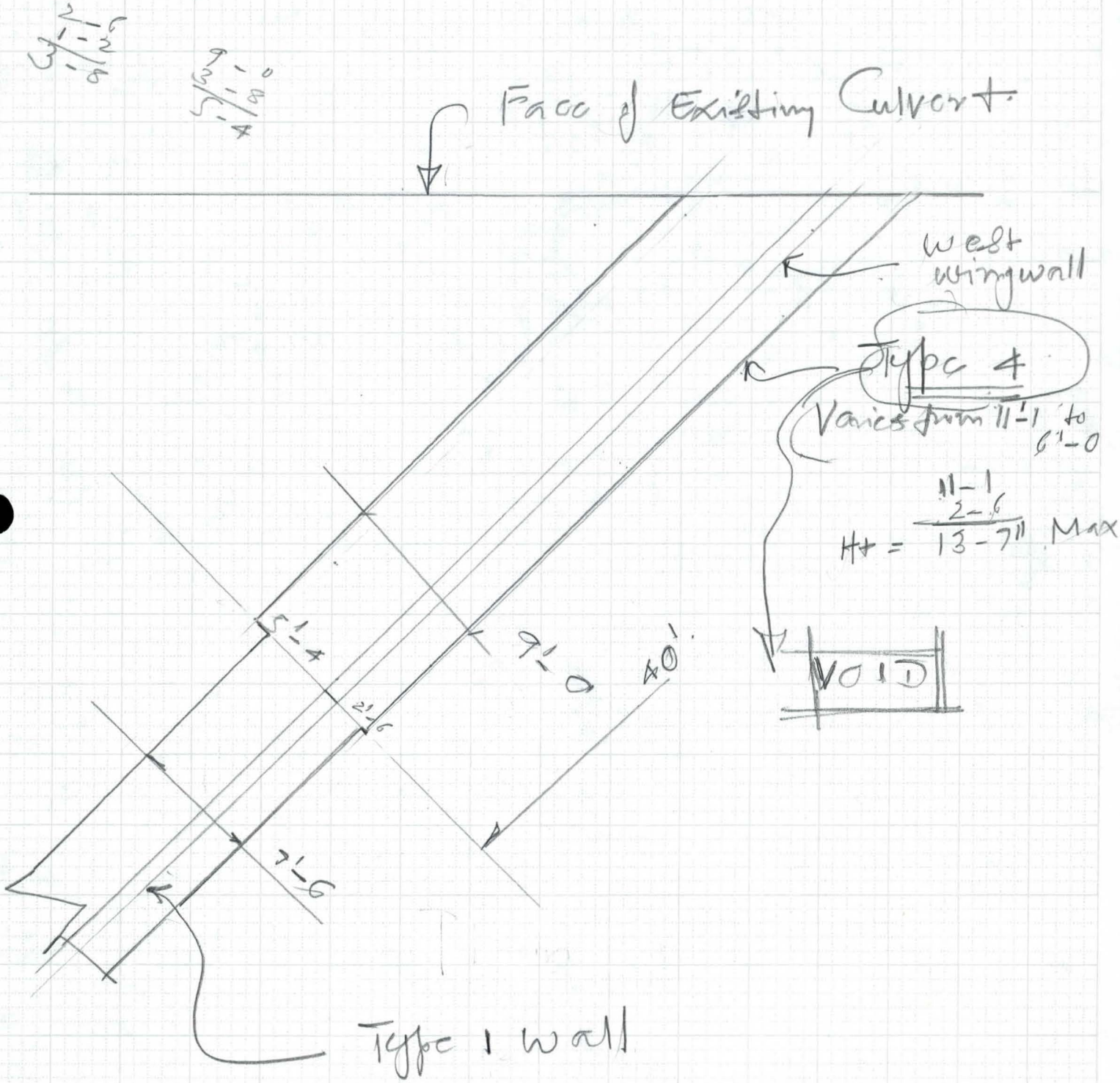
DETAIL Plan West Wing COMPUTED KVH DATE 8/92

CHECKED BY CWW DATE 10/92



Plan West Wing Wall

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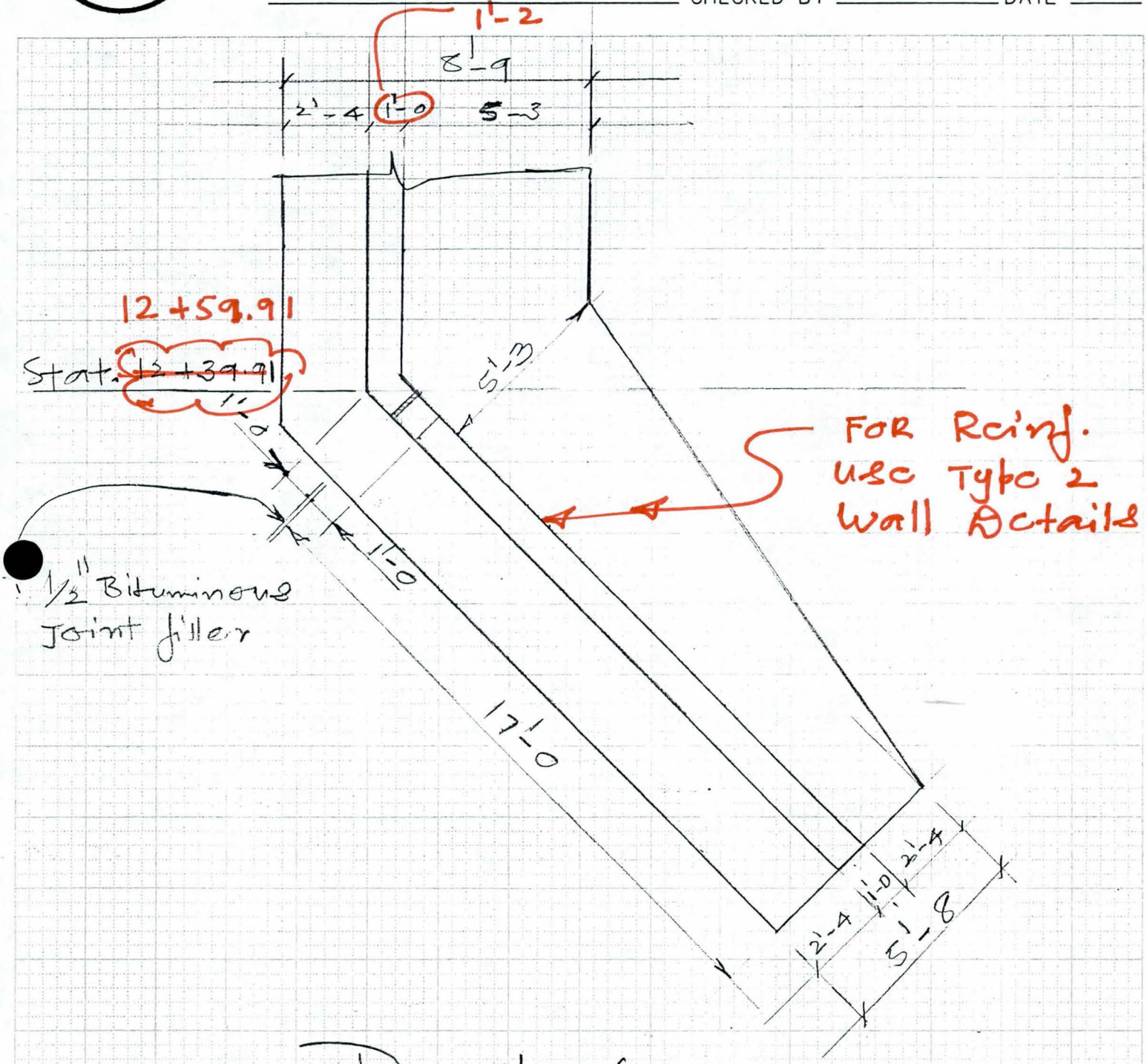
DETAIL Wing wall Detail COMPUTED KVH DATE 5/93

CHECKED BY DATE



Detail - 1

Scale 1/4" = 1'-0

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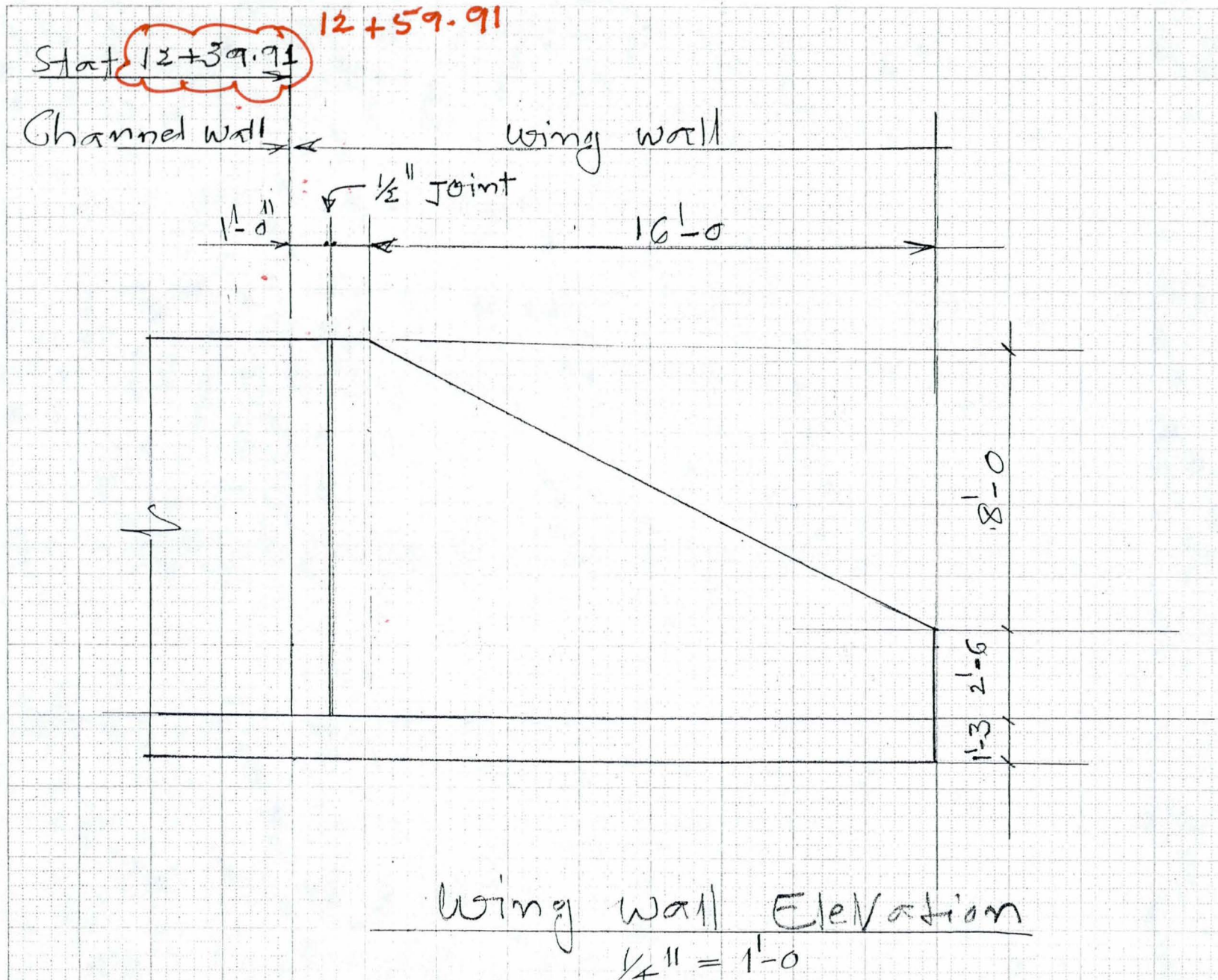
PROJECT Sporkhill PAGE 30 (C) OF

DETAIL Wing Wall COMPUTED KWH DATE 5/93

CHECKED BY DATE



Wing wall Elevation

¼" = 1'-0

30(D)

TABLE 9-2. Moment Strength $M_u/\varphi f'_c bd^2$ or $M_n/f'_c bd^2$ of Rectangular Sections with Tension Reinforcement Only*

ω	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
0.0	0	.0010	.0020	.0030	.0040	.0050	.0060	.0070	.0080	.0090
0.01	.0099	.0109	.0119	.0129	.0139	.0149	.0159	.0168	.0178	.0188
0.02	.0197	.0207	.0217	.0226	.0236	.0246	.0256	.0266	.0275	.0285
0.03	.0295	.0304	.0314	.0324	.0333	.0343	.0352	.0362	.0372	.0381
0.04	.0391	.0400	.0410	.0420	.0429	.0438	.0448	.0457	.0467	.0476
0.05	.0485	.0495	.0504	.0513	.0523	.0532	.0541	.0551	.0560	.0569
0.06	.0579	.0588	.0597	.0607	.0616	.0625	.0634	.0643	.0653	.0662
0.07	.0671	.0680	.0689	.0699	.0708	.0717	.0726	.0735	.0744	.0753
0.08	.0762	.0771	.0780	.0789	.0798	.0807	.0816	.0825	.0834	.0843
0.09	.0852	.0861	.0870	.0879	.0888	.0897	.0906	.0915	.0923	.0932
0.10	.0941	.0950	.0959	.0967	.0976	.0985	.0994	.1002	.1011	.1020
0.11	.1029	.1037	.1046	.1055	.1063	.1072	.1081	.1089	.1098	.1106
0.12	.1115	.1124	.1133	.1141	.1149	.1158	.1166	.1175	.1183	.1192
0.13	.1200	.1209	.1217	.1226	.1234	.1243	.1251	.1259	.1268	.1276
0.14	.1284	.1293	.1301	.1309	.1318	.1326	.1334	.1342	.1351	.1359
0.15	.1367	.1375	.1384	.1392	.1400	.1408	.1416	.1425	.1433	.1441
0.16	.1449	.1457	.1465	.1473	.1481	.1489	.1497	.1506	.1514	.1522
0.17	.1529	.1537	.1545	.1553	.1561	.1569	.1577	.1585	.1593	.1601
0.18	.1609	.1617	.1624	.1632	.1640	.1648	.1656	.1664	.1671	.1679
0.19	.1687	.1695	.1703	.1710	.1718	.1726	.1733	.1741	.1749	.1756
0.20	.1764	.1772	.1779	.1787	.1794	.1802	.1810	.1817	.1825	.1832
0.21	.1840	.1847	.1855	.1862	.1870	.1877	.1885	.1892	.1900	.1907
0.22	.1914	.1922	.1929	.1937	.1944	.1951	.1959	.1966	.1973	.1981
0.23	.1988	.1995	.2002	.2010	.2017	.2024	.2031	.2039	.2046	.2053
0.24	.2060	.2067	.2075	.2082	.2089	.2096	.2103	.2110	.2117	.2124
0.25	.2131	.2138	.2145	.2152	.2159	.2166	.2173	.2180	.2187	.2194
0.26	.2201	.2208	.2215	.2222	.2229	.2236	.2243	.2249	.2256	.2263
0.27	.2270	.2277	.2284	.2290	.2297	.2304	.2311	.2317	.2324	.2331
0.28	.2337	.2344	.2351	.2357	.2364	.2371	.2377	.2384	.2391	.2397
0.29	.2404	.2410	.2417	.2423	.2430	.2437	.2443	.2450	.2456	.2463
0.30	.2469	.2475	.2482	.2488	.2495	.2501	.2508	.2514	.2520	.2527
0.31	.2533	.2539	.2546	.2552	.2558	.2565	.2571	.2577	.2583	.2590
0.32	.2596	.2602	.2608	.2614	.2621	.2627	.2633	.2639	.2645	.2651
0.33	.2657	.2664	.2670	.2676	.2682	.2688	.2694	.2700	.2706	.2712
0.34	.2718	.2724	.2730	.2736	.2742	.2748	.2754	.2760	.2766	.2771
0.35	.2777	.2783	.2789	.2795	.2801	.2807	.2812	.2818	.2824	.2830
0.36	.2835	.2841	.2847	.2853	.2858	.2864	.2870	.2875	.2881	.2887
0.37	.2892	.2898	.2904	.2909	.2915	.2920	.2926	.2931	.2937	.2943
0.38	.2948	.2954	.2959	.2965	.2970	.2975	.2981	.2986	.2992	.2997
0.39	.3003	.3008	.3013	.3019	.3024	.3029	.3035	.3040	.3045	.3051

See Examp on P. 9-20

*$M_n/f'_c bd^2 = A_s f_y (d-a/2) f'_c bd^2 = \omega(1-0.59\omega)$, where $\omega = \rho f_y/f'_c$ and $a = A_s f_y/0.85 f'_c b$.

Design: Using factored moment M_u enter table with $M_u/\varphi f'_c bd^2$; find ω and compute steel percentage ρ from $\rho = \omega f'_c/f'_y$.

Investigation: Enter table with ω from $\omega = \rho f_y/f'_c$; find value of $M_n/f'_c bd^2$ and solve for nominal moment strength, M_n.

Read $\frac{M_u}{\varphi f'_c b d^2}$ Vertically Down & Read ω Horizontally to the Left

FLEX. CRACKS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 31 OF

DETAIL Concrete Qty COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 10/93

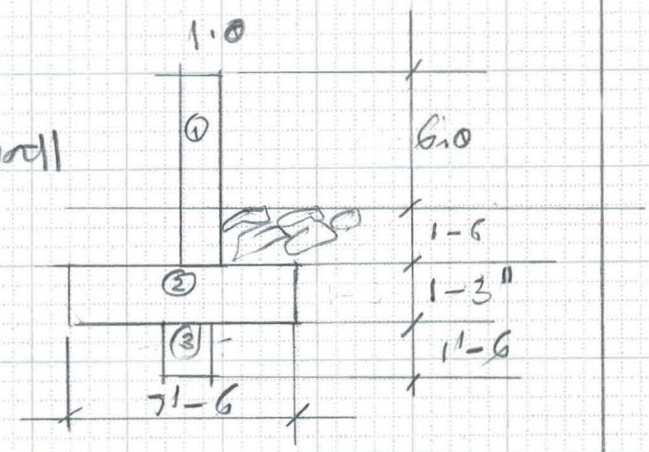
Concrete Qty.

1.) (3+93) To (6+50) (LT) L = 257'

(4+34) To (6+50) (RT) L = 216

L = (257 + 216) = 473'

Type 1. wall



$A_1 = (1.0 \times 7.5) = 7.50$

$A_2 = (1.25 \times 7.5) = 9.38$

$A_3 = (1.25 \times 1.5) = 1.88$

18.76 Sq ft

$Q_1 = (18.75 \times 473)/27 =$ 328.6 CY

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PROJECT Spook Hill PAGE 32 OF
DETAIL Concrete Qty's COMPUTED KVH DATE 7/93
CHECKED BY CGW DATE 10/93

2) Sta 6+50 TO 6+60

L = 10'

$A_1 = (1.0)\left(\frac{7.5+8.67}{2}\right) = 8.09$

$A_2 = 8 \times 1.25 \times = 10.00$

$A_3 = (1.25 \times 1.5) = 1.88$

19.97 sqft

$Q_2 = (19.97 \times 10)/27 \times 2$ 2 Sides = 14.8 CY

3) Sta. (6+60) TO (8+50)

L = 190'

$A_1 = 8.67 \times 1.0 = 8.67$

$A_2 = 8.00 \times 1.25 = 10.00$

$A_3 = 1.25 \times 1.5 = 1.88$

20.55

$Q_3 = [(20.55 \times 190)/27]\,2$ 2 Sides = 289.2

4) Sta (8+50) TO (8+60)

L = 10'

$A_1 = 1.0 \times \left(\frac{8.67+9.83}{2}\right) = 9.25$ sqft

$A_2 = (8 \times 1.25) = 10.00$

$A_3 = (1.25 \times 1.5) = 1.88$

21.13 sqft

$Q_4 = \frac{(21.13 \times 10)\,2}{27}$ = 15.7 CY

319.7

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 33 OF

DETAIL Concrete Qty's COMPUTED KNH DATE 9/93

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5) Stat. (8+60) To (10+50)

L = 190 $H_1 = (8.33 + 1.5) = 9.83'$

$A_1 = (1.0 \times 9.83) = 9.83$

$A_2 = (8.0 \times 1.25) = 10.00$

$A_3 = (1.25 \times 1.5) = 1.88$

21.71

$Q_5 = \frac{(21.71 \times 190)}{27}^2 = 305.6$ CY

6) Stat. (10+50) To (10+60)

L = 10' $H_1 = (8.33 + 1.5) = 9.83$

$H_2 = (9.5 + 1.5) = 11.00$

$A_1 = \frac{(9.83 + 11.0)}{2} 1.15$ wall thickness $= 12.19$

$A_2 = (8.75 \times 1.25) = 10.94$

$A_3 = (1.25 \times 1.5) = 1.88$

25.01

$Q_6 = (25.01 \times 10/27)^2 = 18.5$

324.1

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PROJECT Spook Hill PAGE 34 OF ____

DETAIL Concrete Qty's COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 10/93

7) Stat (10+60) To (12+39.91)

L = 180' Ht = (9.5 + 1.5) = 11.0'

A_1 = (1.17 x 11) = 12.87

A_2 = (8.75 x 1.25) = 10.94

A_3 = (1.25 x 1.5) = 1.88

25.69

Q_7 = (25.69 x 180)²/27 = 342.5 CY

8) Stat. (12+39.91) To (12+59.91)

L = 20' Ht = 11.0 Ht = 9 + 1.5 = 10.5

Ht Av = 10.75

A_1 = 10.75 x 1.17 = 12.58

A_2 = 1.25 x 8.75 = 10.94

A_3 = 1.25 x 1.5 = 1.88

25.4

Q_8 = (25.4 x 20)²/27 = 37.6

9) Wing wall @ the End

L = 17' Ht = (2.5 + 10.5)/2 = 6.5'

A_1 = (1.0 x 6.5) = 6.50

A_2 = 1.25 x (8.75 + 5.67)/2 = 9.01

A_3 = (1.25 x 1.5) = 1.88

17.39

Q_9 = (17.39 x 17)²/27 = 21.9

402.0 CY

Total (over All) = (328.6 + 319.7 + 324.1 + 402.) = 1374.4 CY

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

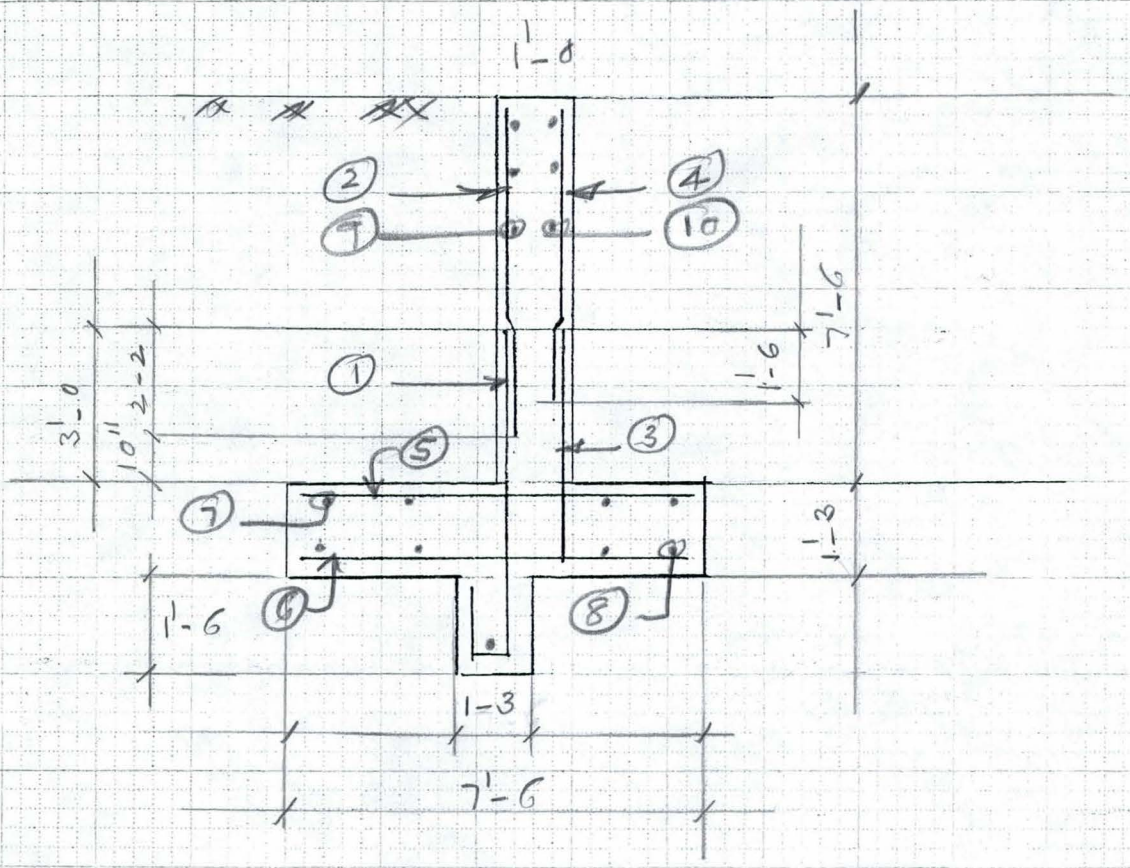
PROJECT Spook Hill PAGE 35 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY Cug DATE 10/93

Reinforcing Steel

Stat (3+93) To (6+50)



Type 1 wall

(NTS)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

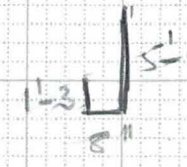
PROJECT Spook Hill PAGE 36 OF

DETAIL Reinf Steel COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 10/93

Reinf. Steel:

Typ c. 1 wall Sta (3+93) To (6+50)
(4+34) To (6+50)

① 

L = 7'-5 #5 @ 6

L = (257 + 216) = 473

No# = (473 x 12/6) = 946 Spl, 947 Bars

Wt = (6.417) 1.043 = 7.736 lbs
#5 Bar

Tot. Wt = (7.736) 947 = 7326

② #5 @ 12, L = 6-6

Wt = (1.043) 6.5 = 6.78 lbs

No# = 473 x 12/12 = 473 Sp - 474

Tot. Wt = (474) 6.78 = 3214

③ #5 @ 12, @ 1.043 lbs L = 4.0'

Wt = (1.043)(4) = 4.172 lbs

No# = 474

Tot. Wt = (4.172)(474) = 1978

④ #5 @ 12, L = 5-10

Wt = (5.83) 1.043 = 6.08 lbs/Bar

No# = 474,

Tot. Wt = (474) 6.08 = 2882

15400 lbs

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DETAIL Reinf Steel COMPUTED KVH DATE 7/93

CHECKED BY CCW DATE 10/93

(5) #5 @ 9", L = 7-2"

wt = (1.043) 7.17 = 7.48 lbs/ft

No. = 473 × 12/9 = 630 sp = 631 Bars

Tot. wt = (631 × 7.48) = 4720 lbs

(6) #4 @ 9" L = 7.17'

wt = (0.668) 7.17 = 4.79 lbs

#4 Bar

No. = 631, Tot. wt = (631 × 4.79) = 3022

(7) & #5 Bars No. = (8 × 2) + 1 = 17

(8) Top & Bot Key

No. (feeding) = 17

(9) #5 Bars, 7 × 12/12 = 7 Spaces, 8 Bars

Total = 17 + 8 = 25 Bars

Tot. Length = (473) 25 = 11825 ft

Tot. wt = 1.043 (11825) = 12333

Laps with 30' Length, 473/30 ≈ 16

16 Laps of 1.5, 16 × 1.5 = 24 ft

Tot. Length = 25 × 24 = 600 L.ft
Bars

wt = (1.043) 600 = 623

(10) #6 @ 12" @ 1.502 lbs/ft

No. = 8, Tot. Length = (473) 8 = 3784

wt = (3784) 1.502 = 5684

Splice Length = (1.5 × 8) 16 = 192'

wt = 192 × 1.502 = 288 — 288

26670

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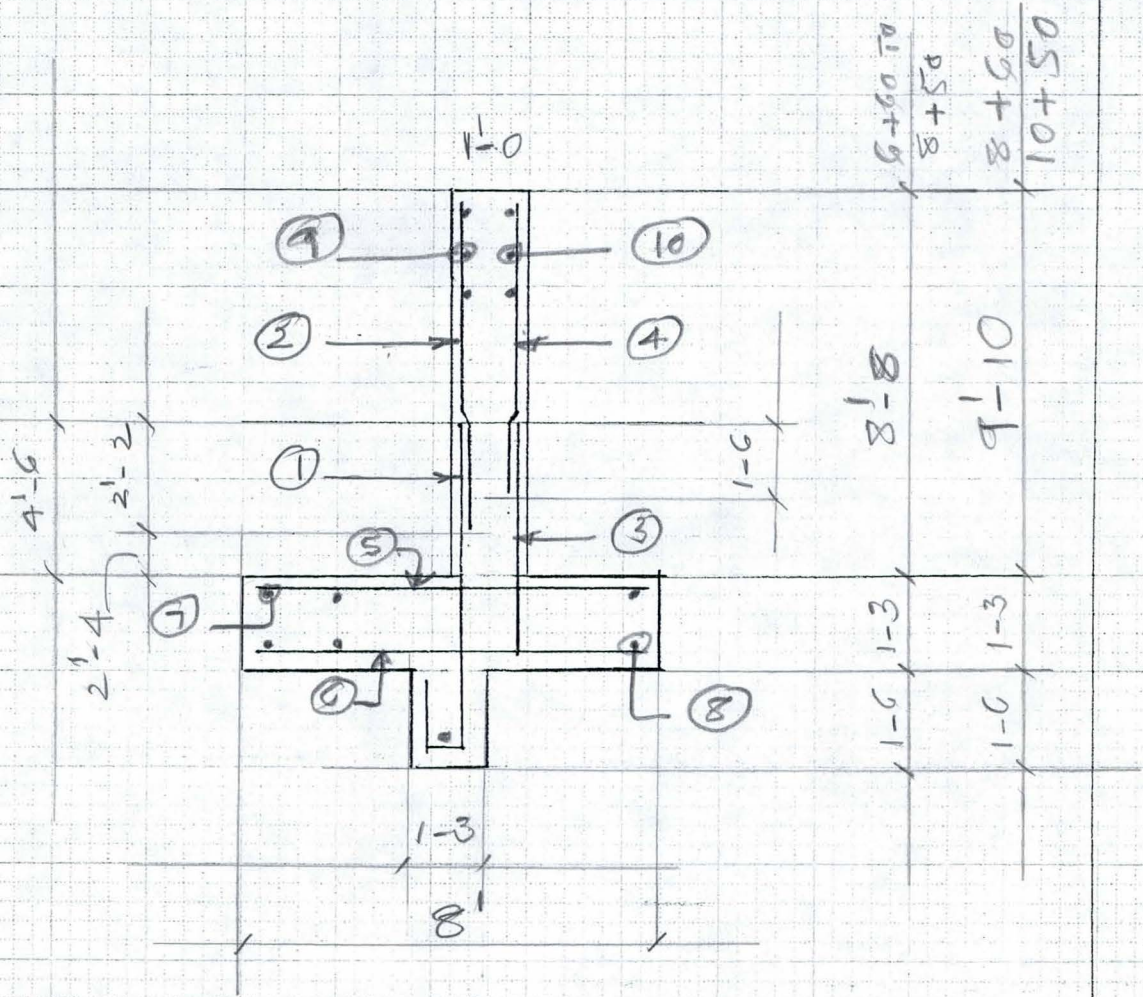
DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY LAK DATE 10/93

Start (6+60) To 8+50

(8+60) To (10+50)



Typo 2 wall

NTS

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PROJECT Spook Hill PAGE 39 OF
DETAIL Reinf. Steel COMPUTED KVH DATE 7/93
CHECKED BY CCW DATE 10/93

Stat. (6+60) To (8+50)

L = 190' #5 @6", @ 1.502 lbs/ft

① 1'-3" | 7' 8" L = 8'-11"
Nos = 190 x 12 / 6 = 380 - 381
wt = (8.917 x 1.502) = 13.393 lbs
Tot. wt = (381 x 13.393) 2 = 10205 lbs
2 walls

② #5 @12" L = 6-2
(1.043) 6.157 = 6.432 lbs/Bar
Nos = 190 x 12/12 = 190 - 191 Bars
Tot. wt = (6.432) 191 x 2 = 2457

③ #5 @12" L = 5-6
wt = (1.043) (5.5) = 5.737 lbs/Bar
Nos = 191, wt = (5.737) 191 x 2 = 2192
2 walls

④ #5 @12, L = 5-6
Wt = (5.5 x 1.043) = 5.737 lbs
Wt = 5.737 x 191 x 2 = 2192

⑤ #5 @9", L = 7.67'
wt = (7.67 x 1.043) = 8.0 lbs
Nos = 190 x 12 / 9 = 253 - 254 Bars
wt = (8.0 x 254) 2 = 4064

21110 lbs

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DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 10/93

(6) #4 @ 9" @ 0.668 lbs/ft

L = 7.67, wt = (7.67 x 0.668) = 5.123

Nos = 190 x 12/9 = 253 - 254

wt = (5.123 x 254) 2 = 2602 lbs

↑ 2 sides

(7) Top 9 Bars
(8) Bot. 9 Bars
(9) Wall 10 Bars

} Total (28 #5 + 1 Key)

(29 x 190 x 1.043) 2 = 11494

Laps @ 30', 190/30 = 7 Sps - 6 Laps

Lap Length 1'-6 = (29 x 1.5 x 6) = 261

Wt = (1.043)(261) 2 = 545

(10) #6 @ 12, No's = 10

(10 x 190 x 1.502) 2 = 5708

↑ 2 walls

Lap: (10 x 1.5 x 6) = 90 Lft

wt = (1.502 x 90) 2 = 270

↑ 2 walls

20619

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DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY Cbw DATE 10/93

Star (8+60) To (10+50)

L = 190' #6 @6"

1-31 | 7' 8

L = 8.917, (8.917 x 1.502) = 13.393

No. = 190x12/6 = 380 - 381

Tot. wt = (13.393 x 381) 2 = 10205 lbs

(2) #5 @12, L = 7-4

(1.043) 7.33 = 7.645 2 walls

Tot. Wt = (7.645) 191 x 2 = 2920

(3) Same as on Page 9 = 2192

(4) #5 @12", L = 6-8

wt = (6.667 x 1.043) = 6.954 lbs

Tot. wt = (6.954 x 191) 2 = 2656

(5) #5 @9" Same as on P. 9 4064

(6) #4 @9" Same as on p. 9 2602

(7) Tot 9 Bars
(8) Bott. 9 Bars
(9) Wall 11 Bars

(29 #5 + 1 Key) = 30 #5

(30 x 190 x 1.043) 2 = 11890

Laps: (30 x 1.5 x 7) = 315'

Wt = (1.043 x 315) 2 = 657

(10) #6 @12, No. = 11, (11 x 190 x 1.502) 2 = 6278

Lap: (11 x 1.5 x 7) = 116 = 349

Wt = (116 x 1.502) 2 =

43813

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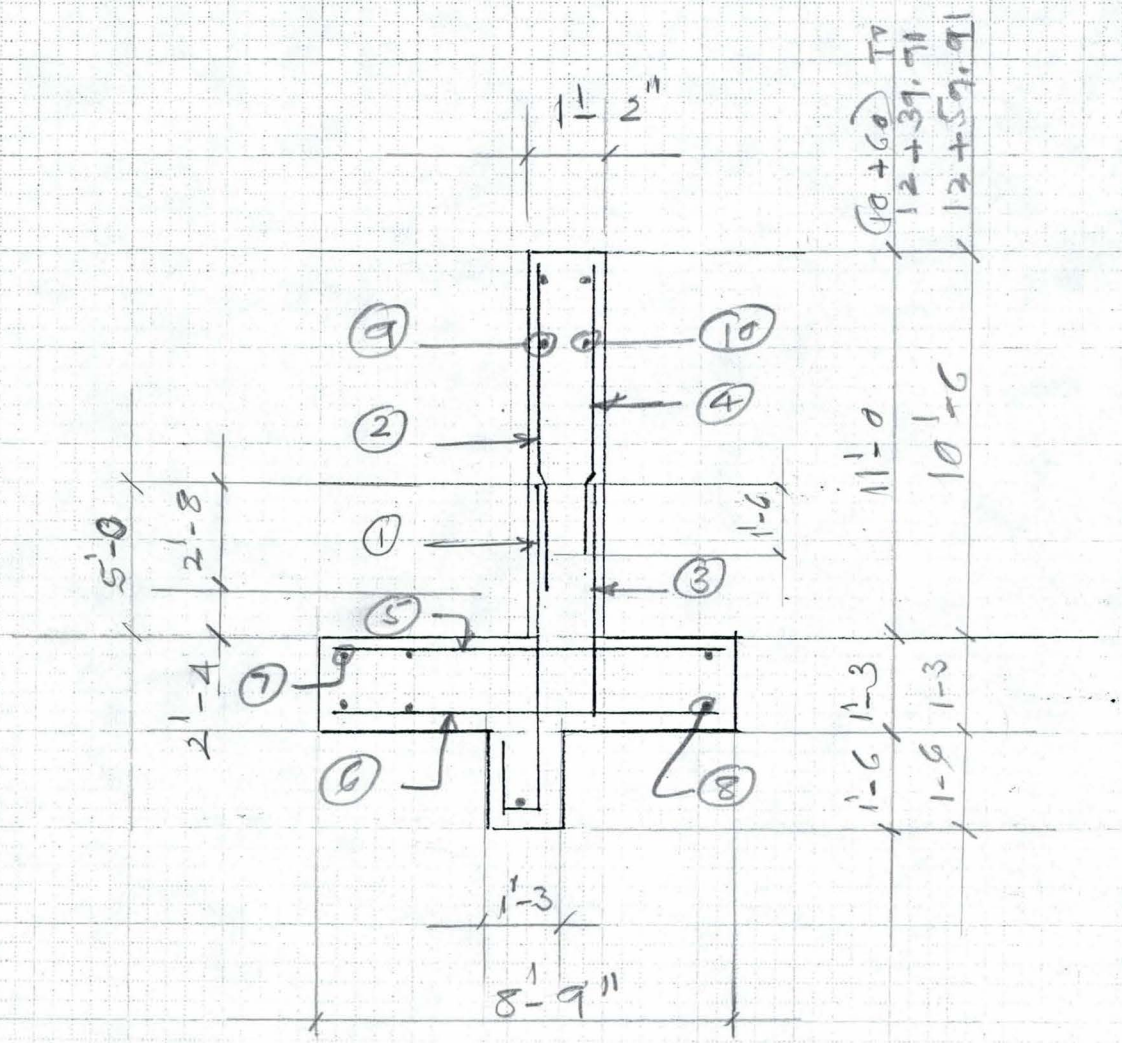
DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY Clay DATE 10/93

Stat. (10+60) To (12+39.91)



Type C-3 Wall

NTS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 43 OF

DETAIL Reinf Steel COMPUTED KNH DATE 7/93

CHECKED BY CGW DATE 10/93

Stair (10+60) To (12+39.91)

L = 180' #7 @ 6" @ 2.044 lbs/ft

(1) 7'-6 / 1'-3 / 8'-1

L = 9.42', (9.42 x 2.044) = 19.254

No. = 180 x 12/6 = 360 - 361

Tot. wt = [(19.254) 361] 2 = 13901 lbs

(2) L = 8'-6 #6 @ 12", @ 1.502 lbs/ft

wt = (8.5 x 1.502) = 12.767

No. = 180 x 12/12 = 180 - 181

Tot. wt = (181 x 12.767) 2 = 4622

(3) L = 6'-0 #5 @ 12", (1.043 x 6) = 6.258

No. = 181, Tot. wt = (6.258 x 181) 2 = 2265

(4) L = 7'-4, #5 @ 12, (1.043 x 7.33) = 7.645

No. = 181, Tot. wt = (7.645 x 181) 2 = 2768

2 walls

(5) #6 @ 9", L = 8'-5, (1.502 x 8.417) = 12.642

No. = 180 x 12/9 = 240 - 241

Total wt = [(241) 12.642] 2 = 6093

(6) #5 @ 9", L = 8'-5, (1.043 x 8.417) = 8.779

No. = 241,

Total wt = (8.779 x 241) 2 = 4231

33880 lbs

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DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY GGW DATE 10/93

Stat (10+60) To (12+39.91) Cont'd

(7) 9 #5 Bars Top of footing

(8) 9 #5 Bott. of footing

(9) 12 #5 Back face of wall

Total Bars = 9+9+12+1 = 31
for Key

(31 x 180 x 1.043) 2 = 11640 lbs

Lap @ 30', (180/30) = 6 spls - 5 Laps

Lap 1'-6" (31 x 1.5 x 5) = 232'

[@ 1.043 x 232] 2 = 484
2 walls

(10) #6 @ 12, (12 x 180 x 1.502) 2 = 6489

Lap: (12 x 1.5 x 5) = 90'
No. of Bars — No. of Laps

(@ 1.502 x 90) 2 = 270
2 walls.

18883 lbs

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PROJECT Spook Hill PAGE 45 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 8/93

Stat. (12 + 39.91) To (12 + 59.91)

use the same steel as from Stat (10+50) To (12 + 39.91)
use Increased Lap for wall Steel.

By proportioning as per Length

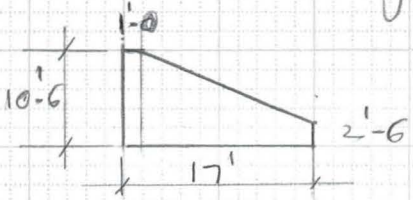
L_1 (previous) = 180'
L_2 (Now) = 20'

wt. of Steel = 33880 lbs (P. 13)
— " — 18883 (P. 14)
52763

wt of Reinf = (52763 × 20/180) = 5863 lbs

wing walls @ Stat. 12 + 59.91

Using wall Type 2 Reinf.



Av. Ht of wall = $\frac{(2.5 + 10.5)}{2}$
= 6.5'

use $\frac{2}{3}$ Ht because of Bars of varying Length & different Splices.

Ht = $\frac{2}{3}$ (10.5) = 7'

From P. 9 = 21110 lbs
— " — P. 10 = 20619
For (190×2)' → 41729

By proportioning for 17×2 = $\frac{41729 \times 34}{380}$
= 3734 lbs

By proportioning for Heights = (3734 × 7/8.67) wall Ht for Type 2 = 3015

8878

Star (6+50) To (6+60)

L = 10' x 2 = 20'

using the same steel as Type. 2

Total Steel = (21110 + 20619) = 41729 lbs

P. 9 P. 10

By proportioning = $\frac{41729 \times (2 \times 10)}{(190 \times 2)}$ = 2196 lbs

Star (8+50) To (8+60)

Same as Above using Type. 2 wall = 2196

Star (10+50) To (10+60)

L = 10 x 2 = 20'

using Type 3 Wall

Total Steel = (33880 + 18883) = 52763

P. 13 P. 14

By Proportioning = $\frac{(52763)(2 \times 10)}{(180 \times 2)}$ = 2931

7323

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PROJECT Spook Hill PAGE 47 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY CGW DATE 10/93

SUMMARY

	lbs
Stat. (3+93) To (6+50) 15400 + 26670 = (Page 6, P.7)	42070
Stat (6+60) To (8+50) & (8+60) To (10+50) (21110 + 20619 + 43813) = (P.9, P.10, P.11)	85542
Stat (10+60) To (12+39.91) (33880 + 18883) = (P.13, P.14)	52763
Stat. (12+39.91) To (12+59.91) Page 15 =	5863
Wing walls @ Stat. (12+59.91) Page 15 =	3015
Stat. (6+50) To (6+60) Page 16	2196
Stat. (8+50) To (8+60) Page 16	2196
Stat. (10+50) To (10+60) Page 16	2931
	196576 lbs

Total Steel = 196.6 K

= 98.3 Tons

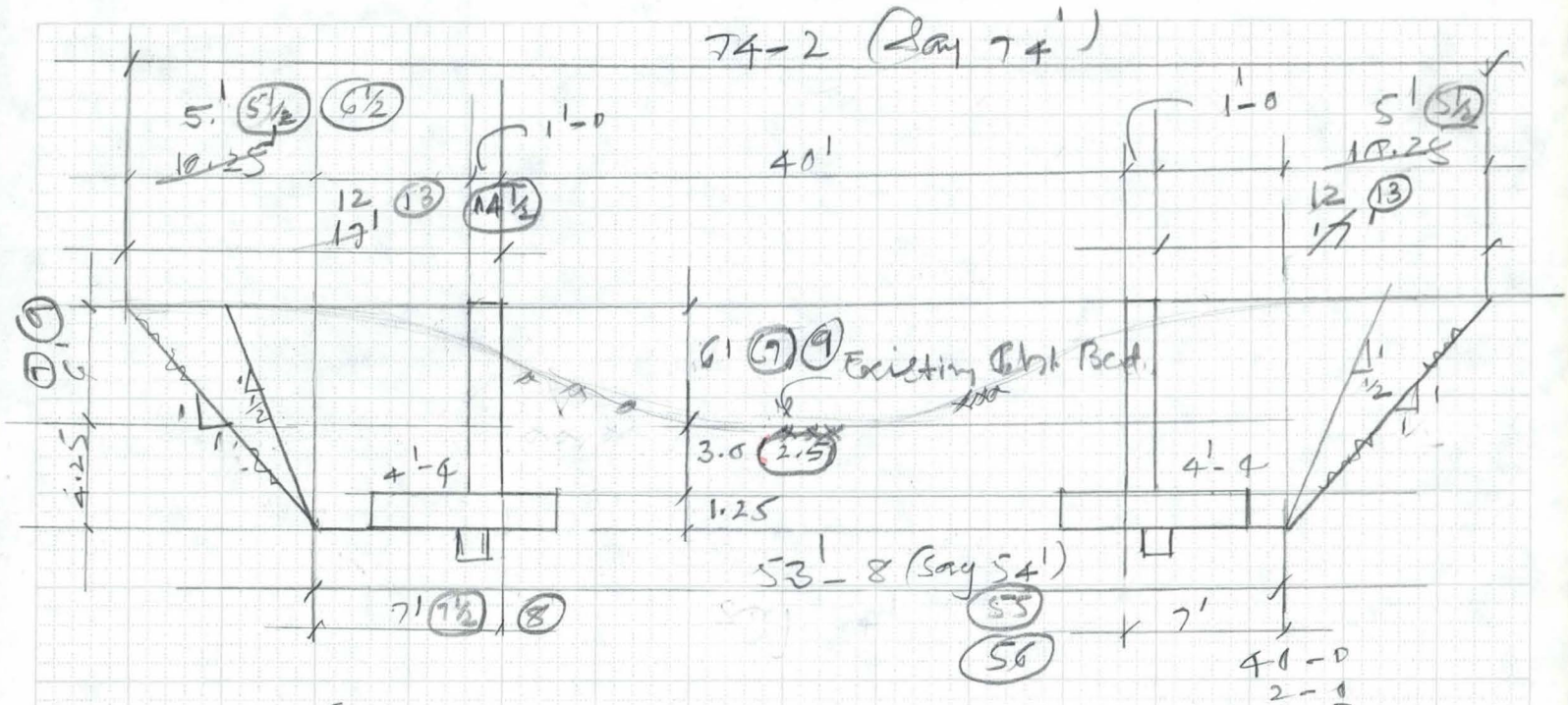
(I)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 48 OF ____

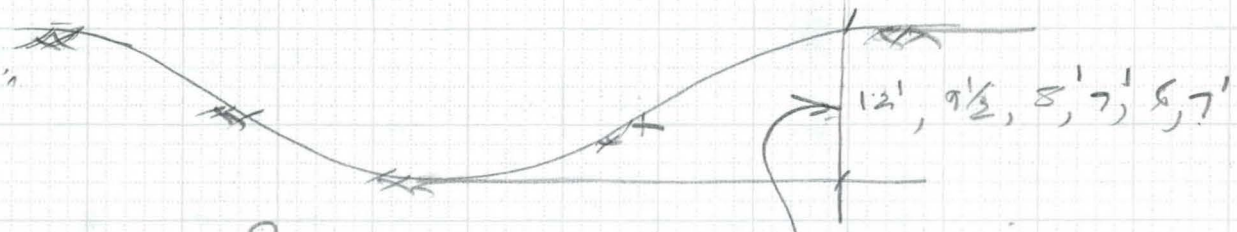
DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY CW DATE 10/92



Stat. 4+40 To 7+22

40-0
2-1
8-8
3-1
53-8
20-6
74'-2



From Stream Bed to Top of Bank (From Topo Sheet)

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 49 OF ____
DETAIL Quantities COMPUTED KVH DATE 9/92
Excavation CHECKED BY CLW DATE 10/92

I Excavation (Stat 4+40 To 7+22)

1) Between Chl. walls: L = 282
(40 x 4.25 x 282)/27 = 1776 cy

2) wall & Footings
A = ½ (7 + 12) 10.25 = 97.4
Qty = (97.4 x 282)/27 = 1017 (2) = 2034
Both Sides

3) Key Trench: (1.25 x 1.5) 282/27 = 20 (2) = 40

II Stat 7+22 To 11+00 L = 378'
Same as previous Cross Section
Except Ht = 7'

1) Between Chl. walls
(40 x 3.75 x 378)/27 = 2100 — 2100

2) Wall & Footings
A = ½ (7.5 + 13) 11.25 = 115.3
Qty = (115.3 x 378)/27 = 1614 (2) — 3228
2 Sides

3) Key Trench: 1.25 x 1.5 x 378/27 = 26 (2) — 52

III Stat 11+00 To 12+37 L = 137'

1) Bot^n Channel walls
(40 x 3.75 x 137)/27 = 761

2) Wall & Footings
A = ½ (8 + 14.5) 12.75 = 143.4
Qty = (143.4 x 137)/27 = 727 x 2 = 1454

3) Key Trench: 1.25 x 1.5 x 137/27 = 10 (2) = 20

11465 cy

(K)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Quantities COMPUTED KVH DATE 9/92

Excavation CHECKED BY CWG DATE 10/92

IV East wing: 11465 CY

By proportioning for 40' & using Quantities of I

1) $(1776 \times \frac{40}{282}) = 252$

6.0 8.17
4.25 4.25
10.25 12.42

2) $(2034 \times \frac{40}{282})\ (\frac{12.42}{10.25}) = 350$

3) $40 \times \frac{40}{252} = 6$

V West wing:

By proportioning for 40' & using Quantities of III

1) $761 \times \frac{40}{137} = 222$

9.0 11.00
3.75 3.75
12.75 14.75

2) $(1454 \times \frac{40}{137})\ \frac{14.75}{12.75} = 491$

3) $(20 \times \frac{40}{137}) = 6$

Total Exc^n 12792 CY

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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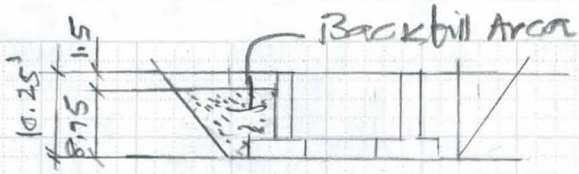
DETAIL Quantities COMPUTED KVH DATE 9/92

Backfill CHECKED BY CCW DATE 10/92

Backfill.



I) Stat. 4+40 To 7+22, L = 282

A = ½ (7+12) 8.75 = 83.1

wall = (1.00 × 9) = 9
ftg = 4.33 × 1.25 = 5.4 } 14.4

Net Area = 68.7

Qty = [(68.7 × 282)/27] 2 = 1435 CY
(both sides)

II) Stat. 7+22 To 11+00, L = 378

A = ½ (7.5+13) 9.75 = 99.9

wall = 1.0 × 10 = 10
ftg = 4.67 × 1.25 = 5.8 } = 15.8

Net 84.1

Qty = [(84.1 × 378)/27] 2 = 2354 CY

III) Stat. 11+00 to 12+37, L = 137

A = ½ (8+14.5) 11.25 = 126.6

wall = (1.08 × 11.5) = 12.4
Ftg = 5.25 × 1.25 = 6.6 } = 19.0

Net = 107.6

Qty = [107.6 × 137/27] 2 = 1092

IV) East wing: By propr. Qtys of I, L = 40

[1435 × 40/282] 8.75/10.92 = 163

V) West wing: By Propn Qtys of III L = 40

[1092 × 40/137] 11.25/13.25 = 270

Total Back Fill 5314 CY

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(M)

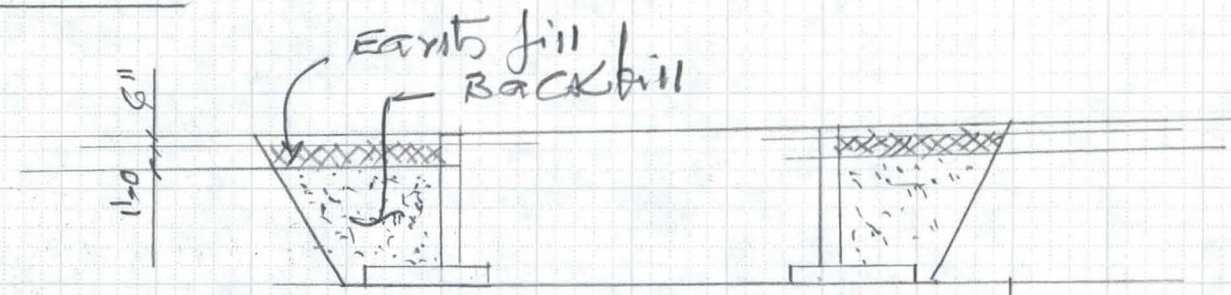
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 52 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Earth Fill CHECKED BY CCW DATE 10/92

Earth Fill



1) Stat 4+40 To 7+22, L = 282
Fill width = 12 ±
Qty = $\left(\frac{12 \times 1.0 \times 282}{27}\right) 2$ ← 2 Sides = 251 CY

2) L = 378 Fill width = 13 ±
Qty = $\left(\frac{13 \times 1.0 \times 378}{27}\right) 2$ = 364

3) L = 137, width = 14.5 ±
Qty = $\left(\frac{14.5 \times 1.0 \times 137}{27}\right) 2$ = 147

5) East & West Approaches
width = 16.0 (Average) L = 40
Qty = $\left(\frac{16 \times 1.0 \times 40}{27}\right) 2$ = 48

Total Earth Fill 810 CY

6910-153 4-90

(A)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 31 OF

DETAIL Concrete Qty's COMPUTED KVH DATE 9/92

CHECKED BY DATE

VOID See Revised Concrete & Steel Qty's

Concrete

Type 1 Start (4+40) To 7+22

L = 282'

A = (1.0 x 9) + (6.5 x 1.25) + (1.5 x 1.25) = 20.3

Qty = (20.3 x 282 / 27) = 212

Type 2 Start (7+22) To (11+00)

L = 378'

Av. wall Ht = (8.5 + 9.75)/2 = 9.125

A = (9.125 x 1.0) + (8 x 1.25) + (1.5 x 1.25) = 21.0

Qty = (21 x 378)/27 = 294

Type 3 Start 11+00 to 12+37

L = 137

Av. wall Ht = (9.75 + 11.5)/2 = 10.63

A = (10.63 x 1.08) + (1.25 x 8.75) + (1.5 x 1.25)
= 24.29

Qty = (24.29 x 137)/27 = 123

Type 4 Start (4+00) To (4+40)

L = 40'

Av. Ht = (9 + 14.08)/2 = 11.54

A = (11.54 x 1.08) + (9.0 x 1.25) + (1.5 x 1.25)
= 25.6

Qty = (25.6 x 40)/27 = 38

Type 5 L = 40 Av. Ht = (9 + 11.17)/2 = 10.08

A = (10.08 x 1.08) + (8.0 x 1.25) + (1.5 x 1.25)
= 22.8

Qty = (22.8 x 40)/27 = 34

Total Conc 701 x 2 (Both sides) = 701

1402 CY

6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 32 OF

DETAIL Grout COMPUTED KVH DATE 9/92

CHECKED BY CGW DATE 10/92

Grouted Rip-Rap

1) $L = (282 + 40) = 322'$

$Qty = (3.0 \times 40 \times 322)/27 =$ 1431 CY

2.5 1193

2) $L = (378 + 137) = 515'$

$Qty = (2.5 \times 40 \times 515)/27 =$ 1526 1908 CY

2.0

3339 CY

2715

3) Filter Material

$\frac{6}{12} \times 40 \times (322 + 515)/27 =$ 620 CY

(c)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 33 OF

DETAIL Bldg 8 - Reinf. St COMPUTED KVH DATE 9/92

CHECKED BY CLW DATE 10/92

Reinf Steel

Type 1. wall, L = 282'

1) Dowels 1.0 5.5 #5 @ 6"

Nos = $\frac{282 \times 12}{6}$ = 564

L = (564 × 6.5) = 3666

Wt = (3666 × 1.043) = 3824 lbs

2) Back face #5 @ 12, L = (9 - 2" - 10") = 8'

Nos. $\frac{282 \times 12}{12}$ = 282

L = (282 × 8) = 2256

Wt = (2256 × 1.043) = 2353

3) a) Front face #4 @ 12, L = 3 + (1' - 0) = 4'

Wt = (282 × 4) 0.668 = 754

b) f. face #4 @ 12, L = 7.33'

Wt = (282 × 7.33) 0.668 = 1381

4) Long. Steel No = 16 #4

L = 282, Splices 10 × 1.5 = 15'

Total L = (282 + 15) = 297

Wt = (297 × 16) 0.668 = 3174

5) Footing Steel:

a) Top: #5 @ 9", Nos. $\frac{282 \times 12}{9"}$ = 376

Wt = (376 × 7.17) 1.043 = 2812

b) Bott: #4 @ 9"

Wt = (376 × 7.17) 0.668 = 1801

c) Longt. Bars: Nos = 13, L = 297

Wt = (297 × 13) 0.668 = 2579

18678 lbs

6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 34 OF

DETAIL Qty & Steel COMPUTED KWH DATE 9/92

CHECKED BY CWW DATE 10/92

Type 2 wall

L = 378'

1) Dowels #6 @6" L = (7+1) = 8.0

1.0 ft 7'

No# = $\frac{378 \times 12}{6}$ = 756

wt = (756 x 8.0) 1.502 = 9084 lbs

2) Back face #5 @12, Av. L = $\frac{(6+7.25)}{2}$ = 6.625

No# = $\frac{378 \times 12}{12}$ = 378

wt = (378 x 6.625) 1.043 = 2612

3) a) Fi face #4 @12, L = 5.5

wt = (378 x 5.5) 0.668 = 1389

b) J. face (Tot) Av. L = 6.625

wt = (378 x 6.625) 0.668 = 1673

4) Longl Bars, L = 378 + (13 x 1.5) = 398'
spliced

No# = 17, wt = (17 x 398) 0.668 = 4520

5) Footings: a) Top #5 @9", L = 7.67

No# = $\frac{378 \times 12}{9}$ = 504,

wt = 504 x 7.67 x 1.043 = 4032

b) Bott. Steel #4 @9"

wt = (504 x 7.67 x 0.668) = 2,582

c) Longl Steel: #4 @18" No# = 12

L = (398 x 12 x 0.668) = 3190

29082

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 35 OF

DETAIL Qty's - Steel COMPUTED KVH DATE 9/92

CHECKED BY CCole DATE 10/92

Reinf. Steel

Type 3 Wall L = 137'

1) Dowels #6 @ 12 & #7 @ 12" Av. 6" Stg

L = 8.0, $\frac{132 \times 12}{12} = 137$ lbs

1.0 wt #6 Bars: (137 × 8.0 × 1.502) = 1646

wt #7: (137 × 8.0 × 2.044) = 2240

2) Back face #5 @ 12", Av. L = $\frac{(7.75 + 9.5)}{2}$ = 8.625'

Nos = 137

wt = (137 × 8.625) 1.043 = 1232

3) Front face: #4 @ 12" L = 5.5'

wt = (137 × 5.5) 0.668 = 503

front of Top: Av. L = $\frac{(6.58 + 8.33)}{2}$ = 7.5'

wt = (137 × 7.5) 0.668 = 686

4) Longit Bars: L = 137 + (5 × 1.5) = 145'
(splices)

Nos = 19, (145 × 19) 0.668 = 1840

5) a) Footing #6 @ 9" Top Nos = $\frac{137 \times 12}{9}$ = 183

wt = (183 × 8.42) 1.502 = 2314

b) Ftg - Bottom #5 @ 9",

wt = (183 × 8.42) 1.043 = 1607

c) Longit Steel #4 Bars = 15

wt = (145 × 15) 0.668 = 1453

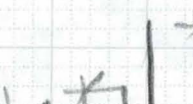
13521 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 36 OF
DETAIL Quys - Steel COMPUTED KVH DATE 9/92
CHECKED BY CWW DATE 10/92

Type. 4 wall

1) L = 40' Dowels # 8 @ 6" L = 7.0'



No = $\frac{40 \times 12}{6}$ = 80

Wt = (80 × 7.0 × 2.67) = 1495 lbs

2) a) Back face # 6 @ 6, L = 7.67

Wt = (80 × 7.67 × 1.502) = 922

b) Back face # 5 @ 12, L = $\left(\frac{11.08}{2} + 1.67\right)$ = 7.21

No = $\frac{40 \times 12}{12}$ = 40

Wt = (40 × 7.21 × 1.043) = 301

3) a) Front f. # 4 @ 12, L = 4.0

Wt = 40 × 4 × 0.668 = 107

b) front f (top) Av. L = $\left(\frac{6 + 11.08}{2}\right) + 1.5$ = 10.04

Wt = 40 × 10.04 × 0.668 = 268

4) Long. Steel: No = 22 + 4 = 26, L = 40

Wt = 26 × 40 × 0.668 = 695

5) a) Footing # 7 @ 9", L = 8.67, No = $\frac{40 \times 12}{9}$ = 54

Wt = 54 × 8.67 × 2.044 = 957

b) # 6 @ 9", Wt = 54 × 8.67 × 1.502 = 703

c) Long. Steel # 4 Bars = 17

Wt = 17 × 40 × 0.668 = 454

5902 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 37 OF

DETAIL Bridge - Steel COMPUTED KVH DATE 9/92

CHECKED BY CCW DATE 10/92

Typ. 5 wall

1) L = 40', Dowels #6 @ 6, L = 8.

No = 40 x 12/6 = 80

1.0 7.0

Wt = 80 x 8 x 1.502 = 961

2) Backface #5 @ 12, Av. L = $\frac{(4.5+6.67)}{2}$ + 2.17 = 7.8'

Wt = 7.8 x 40 x 1.043 = 325

3) Frface a) #4 @ 12, L = 5.5

Wt = 5.5 x 40 x 0.668 = 147

b) Av. L = $\frac{(4.5+6.67)}{2}$ + 1.5 = 7.1

Wt = 7.1 x 40 x 0.668 = 190

4) Long. Bars: No. = 17, L = 40

Wt = 17 x 40 x 0.668 = 454

5) a) Footing #5 @ 9", No. = $\frac{40 \times 12}{9}$ = 54

L = 7.67, Wt = 7.67 x 54 x 1.043 = 432

b) #4 @ 9, Wt = 7.67 x 54 x 0.668 = 277

c) Long. Bars No. = 13, L = 40

Wt = 13 x 40 x 0.668 = 347

3133

Total Reinf:

(18678 + 29082 + 13521) 2

+ (5902 + 3133) = 131597 lb.

(H)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 38 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY CCW DATE 10/92

Summary of Qtys:

1) Concrete	1402 CY
2) Reinf. Steel	131597 lbs
3) Grouted Rip rap	~~3339~~ 2719 CY
4) Filter Material	620 CY
5) Excavation	12992 CY
6) Backfill	5314 CY
7) Earth Fill	810 CY

VOID

See Revised Concrete & Steel Qtys

** TX CONFIRMATION REPORT ** AS OF MAY 18 '93 13:54 PAGE.01

FLOOD CONTROL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	STATUS
01	5/18	13:53	602 640 5137	G3--SR	01"29	02/ 00	INC

** TX CONFIRMATION REPORT ** AS OF MAY 18 '93 13:54 PAGE.01

FLOOD CONTROL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	STATUS
01	5/18	13:53	602 640 5137	G3--SR	01"29	02/ 00	INC

Fax Cover Sheet

FLOOD CONTROL DISTRICT
Of
Maricopa County

2801 West Durango Street ▪ Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TDD (602) 506-5897

To: John Harrington

Company or Dept: SCS Fax # 640-5137

From: Kumar Hanumaiah

Number of Pages Being Sent Including Cover Sheet: 2

If there are any problems, please call (602) 506-1501.

Comments: John: Temperature Steel as previously shown # 4 @ 12" front face and # 4 @ 18" back face appears to be o.k. If you prefer a little more steel, we can increase the Bar size from # 4 to # 5 Bars but keep the same spacing as before.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL Temp. Steel COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____

Tempr. Steel

As per ACI:

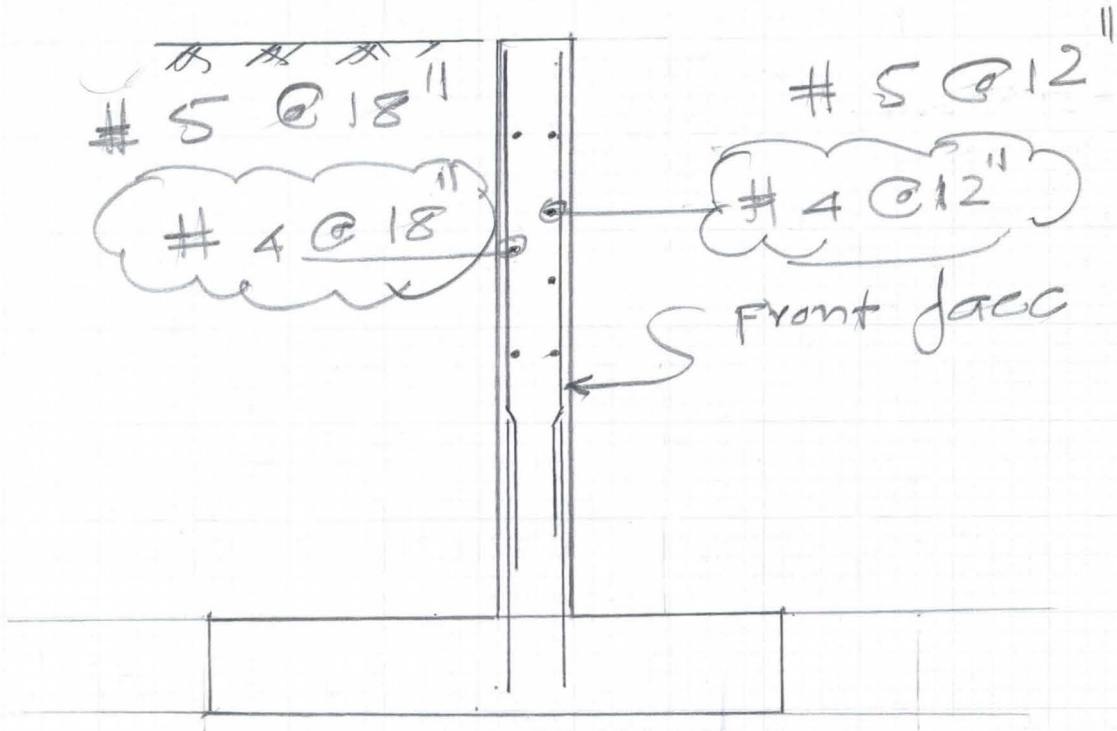
$$\frac{\text{Reinf Steel Area}}{\text{Gross Conc. Area}} = 0.002$$

$$\frac{A_s}{12 \times 12} = 0.002, \quad A_s = 0.29 \text{ sq}''$$

12" wall

$\frac{1}{3}(0.29) \approx 0.1$ (Back face)

$\frac{2}{3}(0.29) \approx 0.2$ (Front face)



Front face, #4 @ 12" $A_s = 0.20$

Back face, #4 @ 18" $A_s = 0.13$

$0.33 > 0.29$

2. The drawings indicate vertical expansion joint spacings at 90 foot intervals along the reinforced concrete channel walls. Assuming a joint sealant with 50% compression recovery capacity, our calculations indicate a joint opening of 1.75 inch to 2 inches will be required to maintain the integrity of the sealant. A c ... th, as shown on the ... ch joint opening wil ... ceptable level but ... placement and ma ... spacing between jo

FAX
640-5137
John HARRINGTON

3. ... upporting the se ... ect to unknown te ... er at the wall to ... ondition could re ... lls near the wall jo ... k cover to re ... at the worst, or ... fect the pe

A ... xerted on the connection to the existing box culvert wing wall. A monol ... connection at this point will result in trans ... wall and could ... We believe an ex ... allow for the f ... a preferred optio ... wall could be us ... old and new secti ... monolithic conne ... entation inclu

640-5143
FAX 640-5137
John Harrington

B. CONS

We h ... and spec ... lt with inco spec ... sed in detail with John Harrington ... t reached as to the change or correction needed. Since this job will be followed up with a final review of the revised drawings and specifications, a detailed list of the comments here is dispensed with.

C. LANDSCAPE ARCHITECTURE

The design report has not addressed landscape treatment. As with previous work in the watershed,

2. The drawings indicate vertical expansion joint spacings at 90 foot intervals along the reinforced concrete channel walls. Assuming a joint sealant with 50% compression recovery capacity, our calculations indicate a joint opening of 1.75 inch to 2 inches will be required to maintain the integrity of the sealant. A one inch expansion joint opening width, as shown on the drawings is not acceptable. A 2 inch joint opening will reduce the sealant strain to an acceptable level but will pose construction problems for placement and maintenance. We recommend reducing the spacing between joints to 45 feet.

3. The continuous monolithic footing supporting the segmented channel wall sections is subject to unknown temperature and shrinkage stress transfer at the wall to footing connection. A high stress condition could result in localized cracking in the walls near the wall joints. However, with the soil and rock cover to reduce thermal effects, we anticipate, at the worst, only minor cracking that should not affect the performance of the structure.

A greater concern will be the forces exerted on the connection to the existing box culvert wing wall. A monolithic connection at this point will result in transfer of stress into the existing wing wall and could result in spalling of the concrete. We believe an expansion-contraction joint designed to allow for the full movement from thermal effects is a preferred option. A steel plate on each side of the wall could be used to maintain alignment between the old and new section. If the decision is to go with a monolithic connection, we recommend the design documentation include supporting analysis.

B. CONSTRUCTION DRAWINGS AND SPECIFICATIONS

We had numerous comments on the drawings and specifications. Most of our comments dealt with inconsistencies between the drawings and specifications. All comments were discussed in detail with John Harrington and general agreement reached as to the change or correction needed. Since this job will be followed up with a final review of the revised drawings and specifications, a detailed list of the comments here is dispensed with.

C. LANDSCAPE ARCHITECTURE

The design report has not addressed landscape treatment. As with previous work in the watershed,

Design Review Report
WNTC Portland, OR
May 10, 1993

Job:	Spookhill Outlet Channel and Sediment Basin
Watershed:	Apache Junction Gilbert Watershed
Location:	Maricopa County, Arizona
Authority:	PL 566
Phase:	Final Design

Summary: The hydraulic design is satisfactory. In general the structural design is adequate with exception of temperature and shrinkage steel and joint spacing. Numerous inconsistencies between the drawings and specifications were noted for correction. Landscape treatment has not been addressed.

Description of Job: The job consists of a grouted rock lined channel with reinforced concrete side walls beginning at the Bush Highway box culvert and proceeding downstream a distance of approximately 900 feet where it discharges into an existing sediment basin. Portions of the sediment basin side slopes and outlet weir are being rebuilt. Out flow from the sediment basin discharges into the Salt River. The channel is designed for a discharge of 2650 cfs.

The design and construction drawings were prepared by the Maricopa Flood Control District. The estimated cost for this project is $750,000.

Review Comments:

A. DESIGN - The hydraulic design is satisfactory. In general the structural loading and analysis appears satisfactory. The design for temperature and shrinkage (T&S) steel will need to be revised to meet SCS criteria. We also are concerned about the expansion joint spacing in the channel walls and the connection to the existing wing walls at the culvert. These items are discussed below.

1. The design indicates T&S steel ratios less than SCS criteria. We understand that the Flood Control District has been advised of SCS criteria and will be revising the drawings as necessary.

** TX CONFIRMATION REPORT ** AS OF MAY 17 '93 8:54 PAGE.01

FLOOD CONTROL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	STATUS
01	5/17	08:50	602 640 5137	G3--S	03"14	05	OK

** TX CONFIRMATION REPORT ** AS OF MAY 17 '93 8:54 PAGE.01

FLOOD CONTROL

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	STATUS
01	5/17	08:50	602 640 5137	G3--S	03"14	05	OK

Fax Cover Sheet

FLOOD CONTROL DISTRICT
Of
Maricopa County

2801 West Durango Street ▪ Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TDD (602) 506-5897

To: John Harrington

Company or Dept: SCS Fax # 640-5137

From: Kumar

Number of Pages Being Sent Including Cover Sheet: 5

If there are any problems, please call (602) 506-1501.

Comments: Spacing of Expansion Joint

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ___ OF ___

DETAIL ___ COMPUTED KVH DATE 5/9

___ CHECKED BY ___ DATE ___

Coeff of Thermal Exp^n = 0.000006 /deg
page 60

Temp. Range (page 25) 30°F to 40°F
Range = 70°

Expansion = $\left(\frac{90'}{2} \times 12\right) 70° \times 0.000006$
= 0.23" say 1/4"

∴ 1/2" Exp. Jt. is ok.
SCS is using about 1" Joint. Scalar
use 1" Jt. as shown but 90' Jt.
spacing is recommended to avoid
future maintaince problems.

AASHTO

Part B
ANALYSIS

8.4 GENERAL

All members of continuous and rigid frame structures shall be designed for the maximum effects of the loads specified in Articles 3.2 through 3.22 as determined by the theory of elastic analysis.

8.5 EXPANSION AND CONTRACTION

8.5.1 In general, provision for temperature changes shall be made in simple spans when the span length exceeds 40 feet.

8.5.2 In continuous bridges, the design shall provide for thermal stresses or for the accommodation of thermal movement with rockers, sliding plates, elastomeric pads, or other means.

8.5.3 The coefficient of thermal expansion and contraction for normal weight concrete may be taken as 0.000006 per deg. F.

8.5.4 The coefficient of shrinkage for normal weight concrete may be taken as 0.0002.

8.5.5 Thermal and shrinkage coefficients for lightweight concrete shall be determined for the type of lightweight aggregate used.

8.6 STIFFNESS

8.6.1 Any reasonable assumptions may be adopted for computing the relative flexural and torsional stiffnesses of continuous and rigid frame members. The assumptions made shall be consistent throughout the analysis.

8.6.2 The effect of haunches shall be considered both in determining moments and in design of members.

8.7 MODULUS OF ELASTICITY AND POISSON'S RATIO

8.7.1 The modulus of elasticity, E_c, for concrete may be taken as $w_c^{1.5}\ 33\sqrt{f_c'}$ in psi for values of w_c between 90 and 155 pounds per cubic foot. For normal weight concrete (w_c = 145 pcf), E_c may be considered as $57{,}000\sqrt{f_c'}$.

8.7.2 The modulus of elasticity E_s for nonprestressed steel reinforcement may be taken as 29,000,000 psi.

8.7.3 Poisson's ratio may be assumed as 0.2.

8.8 SPAN LENGTH

8.8.1 The span length of members that are not built integrally with their supports shall be considered the clear span plus the depth of the member but need not exceed the distance between centers of supports.

8.8.2 In analysis of continuous and rigid frame members distances to the geometric centers of members shall be used in the determination of moments. Moments at faces of support may be used for member design. When fillets making an angle of 45 degrees or more with the axis of a continuous or restrained member are built monolithic with the member and support, the face of support shall be considered at a section where the combined depth of the member and fillet is at least one and onehalf times the thickness of the member. No portion of a fillet shall be considered as adding to the effective depth.

8.8.3 The effective span length of slabs shall be as specified in Article 3.24.1.

8.9 CONTROL OF DEFLECTIONS

8.9.1 General

Flexural members of bridge structures shall be designed to have adequate stiffness to limit deflections or any deformations that may adversely affect the strength or serviceability of the structure at service load.

8.9.2 Superstructure Depth Limitations

The minimum depths stipulated in Table 8.9.2 are recommended unless computation of deflection indicates that lesser depths may be used without adverse effects.

AASHTO

Skew Angle of Wind	Trusses Lateral Load	Trusses Longitudinal Load	Girders Lateral Load	Girders Longitudinal Load
Degrees	PSF	PSF	PSF	PSF
0	75	0	50	0
15	70	12	44	6
30	65	28	41	12
45	47	41	33	16
60	24	50	17	19

The loads listed above shall be used in Group II and Group V loadings as given in Article 3.22.

3.15.2.1.2 For Group III and Group VI loadings, these loads may be reduced by 70 percent and a load per linear foot added as a wind load on a moving live load, as given in the following table:

Skew Angle of Wind	Lateral Load	Longitudinal Load
Degrees	lb./ft.	lb./ft.
0	100	0
15	88	12
30	82	24
45	66	32
60	34	38

This load shall be applied at a point 6 feet above the deck.

3.15.2.1.3 For the usual girder and slab bridges having maximum span lengths of 125 feet the following wind loading may be used in lieu of the more precise loading specified above:

W (wind load on structure)
50 pounds per square foot, transverse;
12 pounds per square foot, longitudinal;
Both forces shall be applied simultaneously.

WL (wind load on live load)
100 pounds per linear foot, transverse;
40 pounds per linear foot, longitudinal;
Both forces shall be applied simultaneously.

3.15.2.2 Forces Applied Directly to the Substructure

The transverse and longitudinal forces to be applied directly to the substructure for a 100-mile per hour wind shall be calculated from an assumed wind force of 40 pounds per square foot. For wind directions assumed skewed to the substructure this force shall be resolved into components perpendicular to the end and front elevations of the substructure. The component perpendicular to the end elevation shall act on the exposed substructure area as seen in end elevation and the component perpendicular to the front elevation shall act on the exposed areas and shall be applied simultaneously with the wind loads from the superstructure. The above loads are for Group II and Group V loadings and may be reduced by 70 percent for Group III and Group VI loadings, as indicated in Article 3.22.

3.15.3 Overturning Forces

The effect of forces tending to overturn structures shall be calculated under Groups II, III, V, and VI of Article 3.22 assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck and sidewalk plan area for Group II and Group V combinations and 6 pounds per square foot for Group III and Group VI combinations.

3.16 THERMAL FORCES

Provision shall be made for stresses or movements resulting from variations in temperature. The rise and fall in temperature shall be fixed for the locality in which the structure is to be constructed and shall be computed from an assumed temperature at the time of erection. Due consideration shall be given to the lag between air temperature and the interior temperature of massive concrete members or structures.

The range of temperature shall generally be as follows:

Metal Structures
Moderate climate, from 0 to 120°F.
Cold climate, from −30 to 120°F.

Concrete Structures	Temperature Rise	Temperature Fall
Moderate climate	30°F	40°F
Cold climate	35°F	45°F

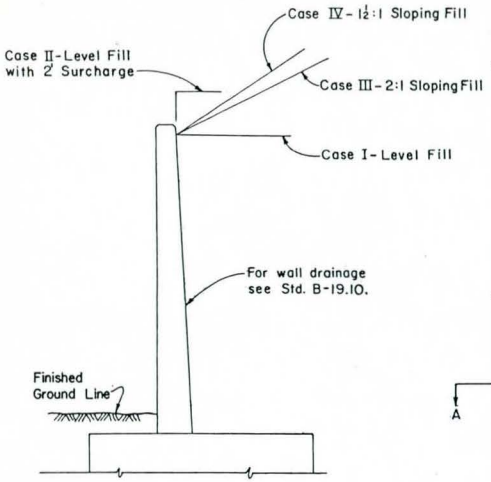
3.17 UPLIFT

3.17.1 Provision shall be made for adequate attachment of the superstructure to the substructure by ensuring that the calculated uplift at any support is resisted by tension members engaging a mass of masonry equal to the largest force obtained under one of the following conditions:

ADOT Standard

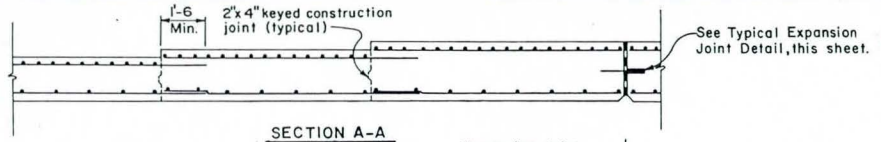
DESIGN	DHY	8-75
DRAWN	GFB	8-75
CHECKED	NAB	3-75

NO	DESCRIPTION OF REVISIONS	MADE BY	DATE
1	Change Notes & Sr bars	WEB	12-82
2	Add bar in F.F.	C.H	5-85
3	Changed Reinf. Note	C.H	10-86
4	Removed Drainage from Typ. Sect.	J.M	3-88
5			
6			

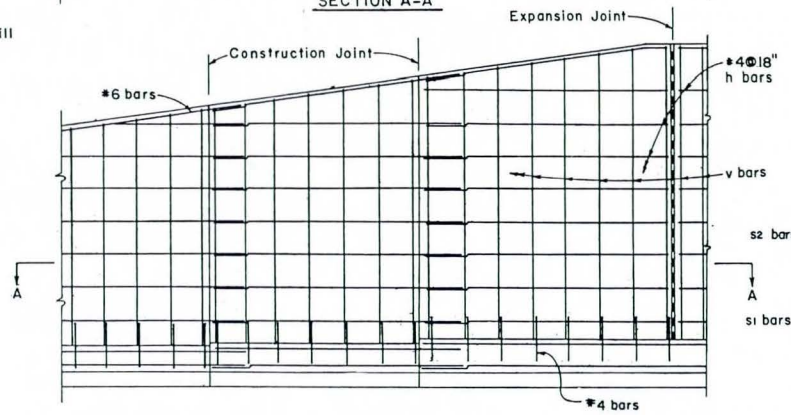


TYPICAL SECTION

Showing Design Cases & Drainage

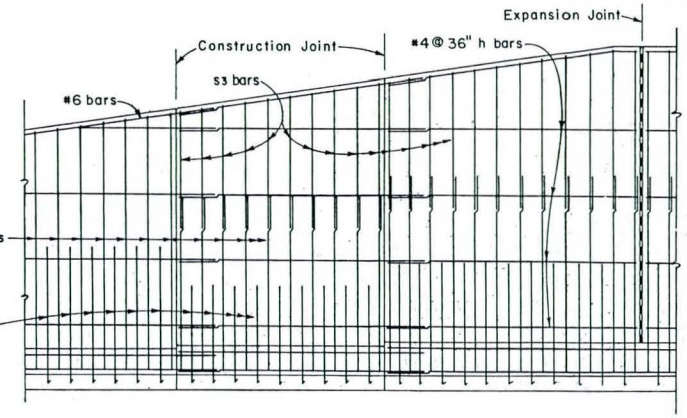


SECTION A-A



TYPICAL ELEVATION

Outside Face Reinforcing



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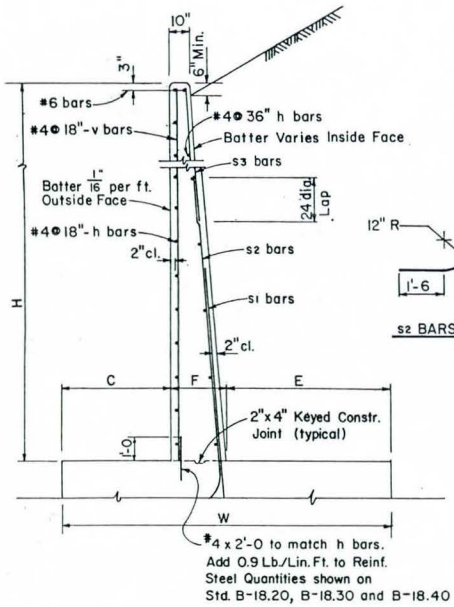
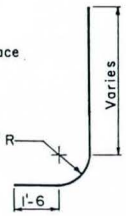
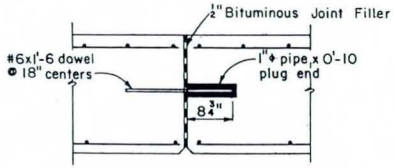


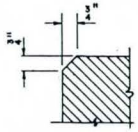
TYPICAL STEM DETAIL



s2 BARS



TYPICAL EXPANSION JOINT DETAIL



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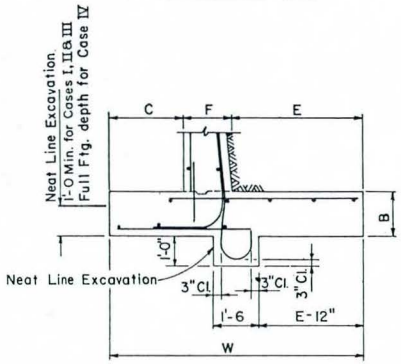
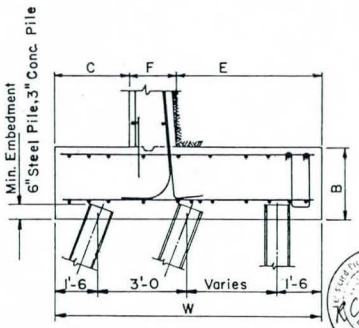


SPREAD FOOTING DETAIL

See Footing Steel Detail on B-18.20



PILE FOOTING DETAIL

See Footing Steel Detail on B-18.30 or B-18.40

GENERAL NOTES

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction.

Design - AASHTO Std. Specs. for Highway Bridges 1977.

Dead Load - Weight of backfill = 120 P.C.F.
Angle of Internal Friction = 33° 15'.

Stresses - Class S Concrete f'_c = 3000 P.S.I.

All Concrete shall be Class S.

Reinforcing Steel shall conform to A.S.T.M. Spec. A-615

Bar sizes #6 and smaller shall be Gr. 40 or Gr. 60; f_s = 20,000 P.S.I.

Bar sizes #7 and larger shall be Grade 60, f_s = 24,000 P.S.I.

All Reinforcing Steel shall have 2" clear cover unless noted otherwise.

JOINT NOTE

All Retaining Walls shall have Construction Joints spaced at not more than 30'-0 apart or as shown. Reinforcing Steel shall project through the joint.

Expansion Joints shall be provided at intervals not exceeding 90'-0.

Footings may be continuous with no joint.

BATTERED PILE NOTE

Batter Piles 3:12 for Cases I & II, 4:12 for Cases III & IV.

DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION
R.C. Brechler		7-88
APPROVED FOR DISTRIBUTION F. E. Hadlin	CANTILEVER RETAINING WALL DETAILS	STANDARD NO. B-18.10

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
201 E. Indianola Ave.
Suite 200
Phoenix, AZ 85012

ARIZONA FACSIMILE MACHINE TRANSMITTAL

Date: May 17, 1993

No. of Pages: Transmittal Sheet and 2 Pages

To: Kumar Hanumaiah
Structural Engineering - FCDMC

Telephone Number:

Facsimile Number: 506-4601

From: John Harrington
Soil Cons. Service

If there are problems with this transmission, please call 640-5143 and speak with John Harrington.

Comments:

Kumar - We have been using more conservative ACI code for joint design because of widespread failure of joints on our mutual EMF Rend 4 project near Williams AFB. The subsequent repair cost over $100,000. We believe the temp range year round is greater than 70°. Also, ACI recommends a factor of safety of 4 for joint design (based on ±25% movement)

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Az
LMS 5/93
Joints

Spookhill Outlet

Joint spacing 90'

T_H = temp. of Concrete (high)
T_L = " " " (Low)

$\Delta T = 110°$ $T_H = 145°$ $T_L = 35°$

$C_t = 6 \times 10^{-6}$

Extreme Movement = (90)(12)(110°)(.000006) = 0.71"

SCS has measured summer day time temperatures in concrete slabs in EMF Reach 4 above 130°. Winter extremes can easily drop slab temp's to 35°.

SCS had total failure of original EMF Reach 4 joints @ 3/4" wide, 100' spacing.

Extreme Placement temperatures (Concrete)

High 100°
Low 50°

Maximum joint movement from placement temp's

Joint compression:

145° − 50° = 95°

Joint extension:

100° − 35° = 65°

Joint Compression Controls

$\Delta T = 95°$

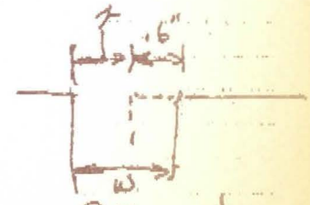
∴ Movement = (90)(12)(95)(.000006) = 0.6"

Rev. 5/18/93 JMC

~~Joint width~~ $\frac{\Delta w}{w} = \frac{0.6}{0.5} = .6 =$

= ~~1.8"~~ .6

= ~~1.75" joint OK for 50% compression joint material~~



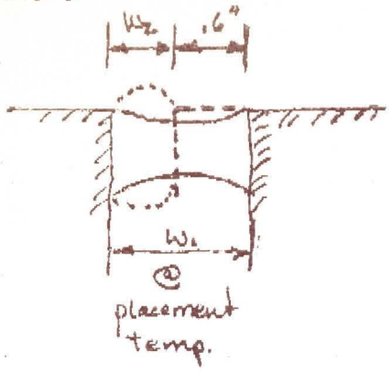
@ Placement

$\frac{\Delta w}{w}$ = 50% for typ. Sealant

Az Spookhill Outlet

LMS 5/93

Joints Rev. 5/17/93 [illegible] 2 2



Joint closure = 0.6 inch for 95° temp diff.

% closure = $\frac{\Delta W}{W_1}$ $\Delta W = 0.6$

$.50 = \frac{.6}{W_1}$

$W_1 = 1.2''$

S.F. = 1.5

$\therefore W_1 = 1.8''$ <u>1.75" OK</u>

ACI recommends safety factor of 4 for joints designed to move ±25%. We are specifying a material that allows ±50% movement of joint width, so a reduction of safety factor from 4 to 2 is justifiable. In the case of slabs on grade, subgrade drag theory, etc, could justify further reduction of S.F., to say 1.5.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL ____ COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____

Coeff of Thermal Exp^n = 0.000006
page 60

Temp. Range (page 25) 30°F to 40°F
Range = 70°

Expansion = $\left(\frac{90'}{2} \times 12\right) 70° \times 0.000006$
= 0.23" say 1/4"

∴ 1/2" Exp. Jt. is ok.
SCS is using about 1" Joint. Scalar
use 1" Jt. as shown but 90' Jt.
spacing is recommended to avoid
future maintainance problems.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ___ OF ___

DETAIL ___ COMPUTED KVH DATE 5/9

___ CHECKED BY ___ DATE ___

Coeff of Thermal Expn = 0.000006
page 60

Temp. Range (page 25) 30°F to 40°F
Range = 70°

Expansion = $\left(\frac{90'}{2} \times 12\right) 70° \times 0.000006$
= 0.23" say 1/4"

∴ 1/2" Exp. Jt. is ok.
SCS is using about 1" Joint. Scalon
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spacing is recommended to avoid
future maintaince problems.

Skew Angle of Wind	Trusses Lateral Load	Trusses Longitudinal Load	Girders Lateral Load	Girders Longitudinal Load
Degrees	PSF	PSF	PSF	PSF
0	75	0	50	0
15	70	12	44	6
30	65	28	41	12
45	47	41	33	16
60	24	50	17	19

The loads listed above shall be used in Group II and Group V loadings as given in Article 3.22.

3.15.2.1.2 For Group III and Group VI loadings, these loads may be reduced by 70 percent and a load per linear foot added as a wind load on a moving live load, as given in the following table:

Skew Angle of Wind	Lateral Load	Longitudinal Load
Degrees	lb./ft.	lb./ft.
0	100	0
15	88	12
30	82	24
45	66	32
60	34	38

This load shall be applied at a point 6 feet above the deck.

3.15.2.1.3 For the usual girder and slab bridges having maximum span lengths of 125 feet the following wind loading may be used in lieu of the more precise loading specified above:

W (wind load on structure)
50 pounds per square foot, transverse;
12 pounds per square foot, longitudinal;
Both forces shall be applied simultaneously.

WL (wind load on live load)
100 pounds per linear foot, transverse;
40 pounds per linear foot, longitudinal;
Both forces shall be applied simultaneously.

3.15.2.2 Forces Applied Directly to the Substructure

The transverse and longitudinal forces to be applied directly to the substructure for a 100-mile per hour wind shall be calculated from an assumed wind force of 40 pounds per square foot. For wind directions assumed skewed to the substructure this force shall be resolved into components perpendicular to the end and front elevations of the substructure. The component perpendicular to the end elevation shall act on the exposed substructure area as seen in end elevation and the component perpendicular to the front elevation shall act on the exposed areas and shall be applied simultaneously with the wind loads from the superstructure. The above loads are for Group II and Group V loadings and may be reduced by 70 percent for Group III and Group VI loadings, as indicated in Article 3.22.

3.15.3 Overturning Forces

The effect of forces tending to overturn structures shall be calculated under Groups II, III, V, and VI of Article 3.22 assuming that the wind direction is at right angles to the longitudinal axis of the structure. In addition, an upward force shall be applied at the windward quarter point of the transverse superstructure width. This force shall be 20 pounds per square foot of deck and sidewalk plan area for Group II and Group V combinations and 6 pounds per square foot for Group III and Group VI combinations.

3.16 THERMAL FORCES

Provision shall be made for stresses or movements resulting from variations in temperature. The rise and fall in temperature shall be fixed for the locality in which the structure is to be constructed and shall be computed from an assumed temperature at the time of erection. Due consideration shall be given to the lag between air temperature and the interior temperature of massive concrete members or structures.

The range of temperature shall generally be as follows:

Metal Structures
Moderate climate, from 0 to 120°F.
Cold climate, from −30 to 120°F.

Concrete Structures	Temperature Rise	Temperature Fall
Moderate climate	30°F	40°F
Cold climate	35°F	45°F

3.17 UPLIFT

3.17.1 Provision shall be made for adequate attachment of the superstructure to the substructure by ensuring that the calculated uplift at any support is resisted by tension members engaging a mass of masonry equal to the largest force obtained under one of the following conditions:

Part B
ANALYSIS

8.4 GENERAL

All members of continuous and rigid frame structures shall be designed for the maximum effects of the loads specified in Articles 3.2 through 3.22 as determined by the theory of elastic analysis.

8.5 EXPANSION AND CONTRACTION

8.5.1 In general, provision for temperature changes shall be made in simple spans when the span length exceeds 40 feet.

8.5.2 In continuous bridges, the design shall provide for thermal stresses or for the accommodation of thermal movement with rockers, sliding plates, elastomeric pads, or other means.

8.5.3 The coefficient of thermal expansion and contraction for normal weight concrete may be taken as 0.000006 per deg. F.

8.5.4 The coefficient of shrinkage for normal weight concrete may be taken as 0.0002.

8.5.5 Thermal and shrinkage coefficients for lightweight concrete shall be determined for the type of lightweight aggregate used.

8.6 STIFFNESS

8.6.1 Any reasonable assumptions may be adopted for computing the relative flexural and torsional stiffnesses of continuous and rigid frame members. The assumptions made shall be consistent throughout the analysis.

8.6.2 The effect of haunches shall be considered both in determining moments and in design of members.

8.7 MODULUS OF ELASTICITY AND POISSON'S RATIO

8.7.1 The modulus of elasticity, E_c, for concrete may be taken as $w_c^{1.5}\ 33\sqrt{f_c'}$ in psi for values of w_c between 90 and 155 pounds per cubic foot. For normal weight concrete (w_c = 145 pcf), E_c may be considered as $57{,}000\sqrt{f_c'}$.

8.7.2 The modulus of elasticity E_s for nonprestressed steel reinforcement may be taken as 29,000,000 psi.

8.7.3 Poisson's ratio may be assumed as 0.2.

8.8 SPAN LENGTH

8.8.1 The span length of members that are not built integrally with their supports shall be considered the clear span plus the depth of the member but need not exceed the distance between centers of supports.

8.8.2 In analysis of continuous and rigid frame members distances to the geometric centers of members shall be used in the determination of moments. Moments at faces of support may be used for member design. When fillets making an angle of 45 degrees or more with the axis of a continuous or restrained member are built monolithic with the member and support, the face of support shall be considered at a section where the combined depth of the member and fillet is at least one and onehalf times the thickness of the member. No portion of a fillet shall be considered as adding to the effective depth.

8.8.3 The effective span length of slabs shall be as specified in Article 3.24.1.

8.9 CONTROL OF DEFLECTIONS

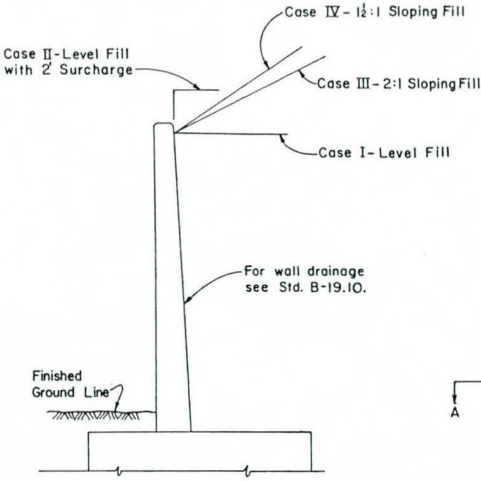
8.9.1 General

Flexural members of bridge structures shall be designed to have adequate stiffness to limit deflections or any deformations that may adversely affect the strength or serviceability of the structure at service load.

8.9.2 Superstructure Depth Limitations

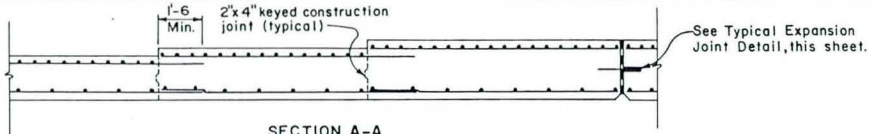
The minimum depths stipulated in Table 8.9.2 are recommended unless computation of deflection indicates that lesser depths may be used without adverse effects.

DESIGN	DHY	8-72	NO.	DESCRIPTION OF REVISIONS	MADE BY	DATE	NO.	DESCRIPTION OF REVISIONS	MADE BY	DATE
DRAWN	GFB	8-73	①	Change Notes & Si bars	WEB	12-82	④	Removed Drainage from Typ. Sect.	JM	3-88
CHECKED	NAB	3-73	②	Add bar in F.F.	C.H	5-85	⑤			
			③	Changed Reinf. Note	C.H	10-86	⑥			

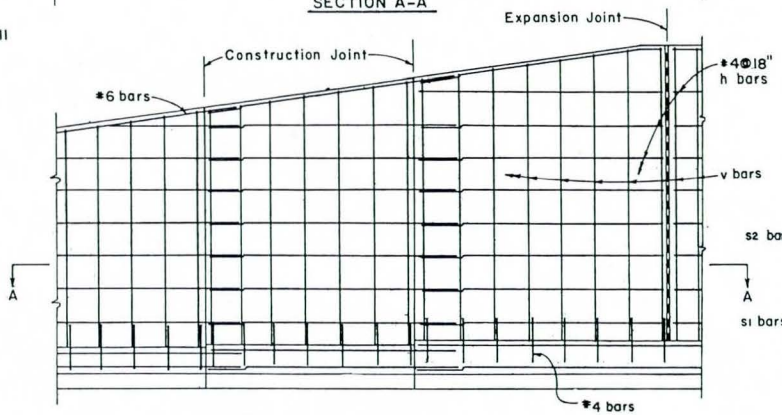


TYPICAL SECTION

Showing Design Cases & Drainage



SECTION A-A



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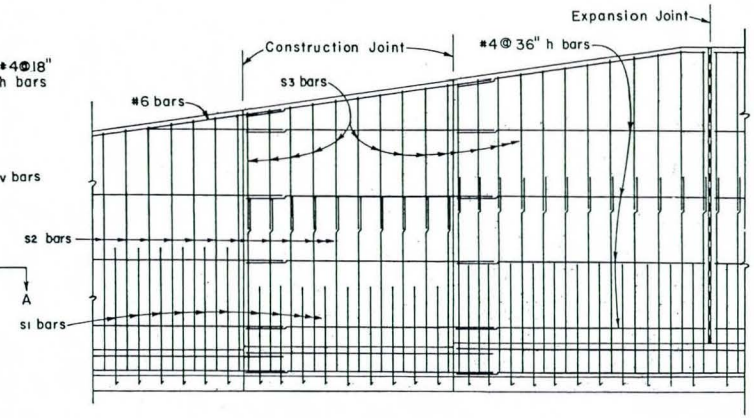

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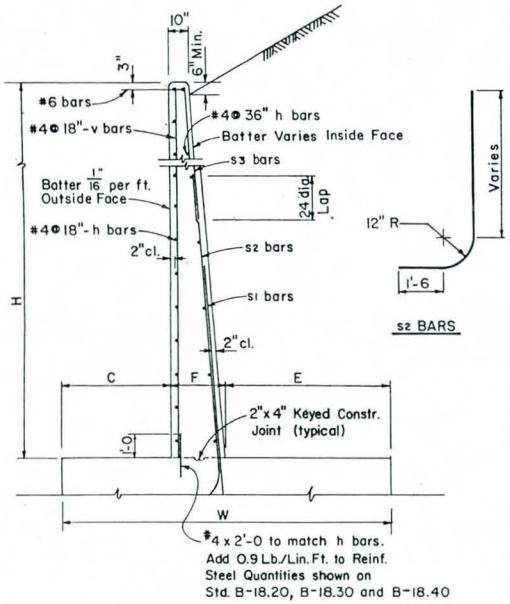

TYPICAL STEM DETAIL

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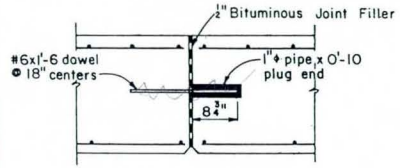
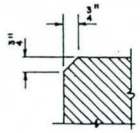


TYPICAL EXPANSION JOINT DETAIL



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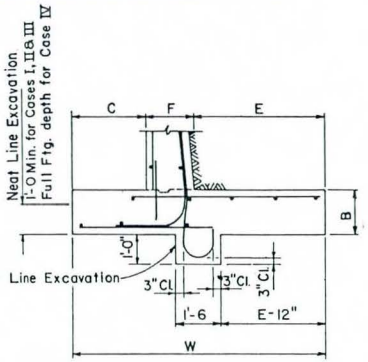

SPREAD FOOTING DETAIL

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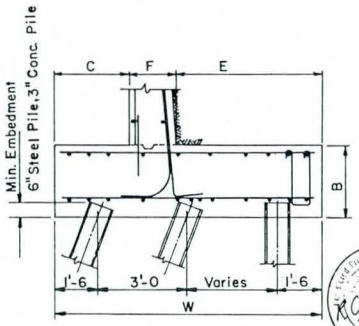

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R.C. Brechler		7-88
APPROVED FOR DISTRIBUTION	CANTILEVER RETAINING WALL DETAILS	STANDARD NO.
		B-18.10

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Temp. Steel COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____

$$\frac{t}{H} \leq 0.085$$

1) $H_1 = (8'-9) - (1-3) = 7'-6''$

$$\frac{t}{H_1} = \left(\frac{1.0}{7.5}\right) = 0.13 > 0.085$$

2) $H_2 = (9'-10)$,

$$\frac{t}{H_2} = \frac{1.0}{9.83} = 0.10 > 0.085$$

3) $H_3 = 11'.0$, $t = 1'-2$

$$\frac{t}{H_3} = \frac{1.17}{11.0} = 0.11 > 0.085$$

<u>Temperature Steel</u>

Coeff = 0.002 (As per ACI)

1) $b = 12$, $d = 12$, $As_1 = (0.002 \times 12 \times 12) = 0.29$

2) $b = 12$, $d = 14$ $As_2 = (0.002 \times 12 \times 14) = 0.34$

#4 @ 18", $A_s = 0.13$

#4 @ 12 $A_s = 0.20$

0.33

6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sprook Hill PAGE ___ OF ___

DETAIL Temp. Steel COMPUTED KVH DATE 5/93

CHECKED BY ___ DATE ___

Wall Thickness ; $t = 12$

$A_s = (0.002 \times 12 \times 12) = 0.29 \text{ in}^2$ (unexp. joints)

$A_s = (0.003 \times 12 \times 12) = 0.43$ $\underline{\#5 @ 12''}$

$\#6 @ 12$, $\underline{A_s = 0.44}$

Wall Thickness: $t = 14''$

$A_s = (0.002 \times 12 \times 14) = 0.31$, $\#5 @ 12''$

$A_s = (0.003 \times 12 \times 14) = 0.5$ $\#6 @ 12$, $A_s = 0.44$

A_s (Reqd) $= 0.5$,

A_s (used) $= 0.44$ say ok

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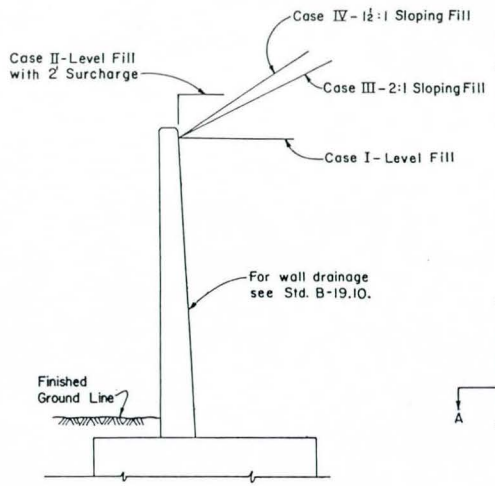
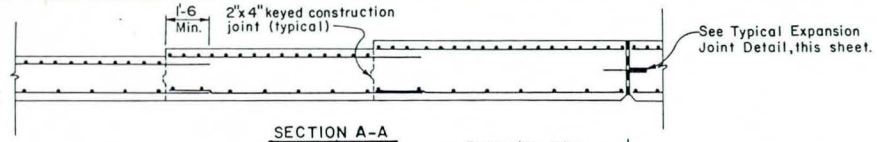
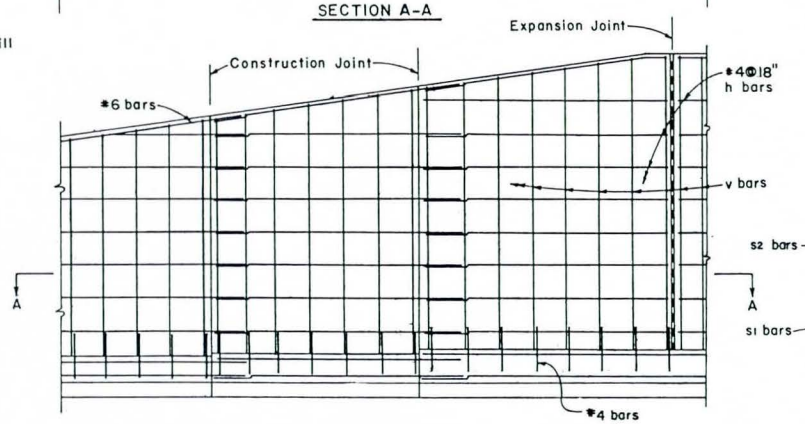


TYPICAL SECTION

Showing Design Cases & Drainage



SECTION A-A



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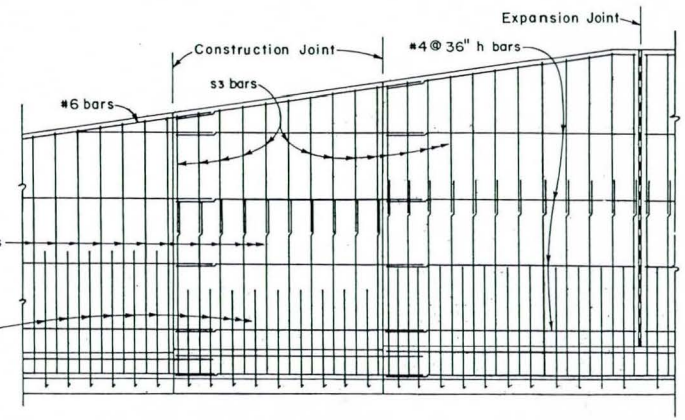

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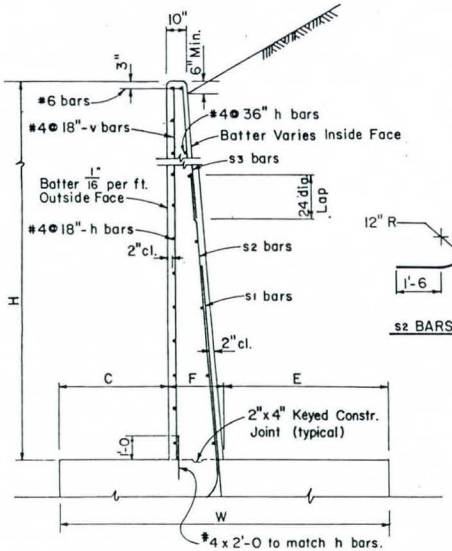
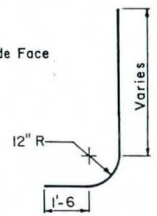
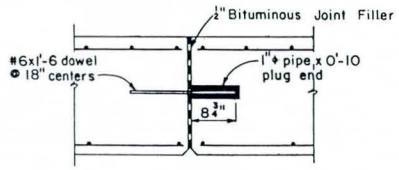


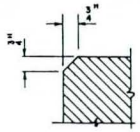
TYPICAL STEM DETAIL



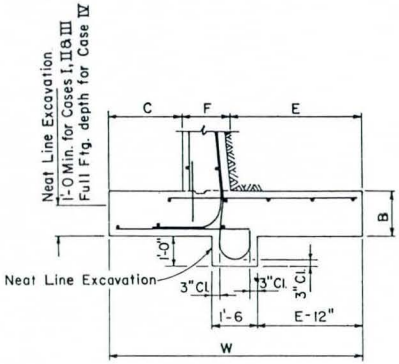
S2 BARS



TYPICAL EXPANSION JOINT DETAIL

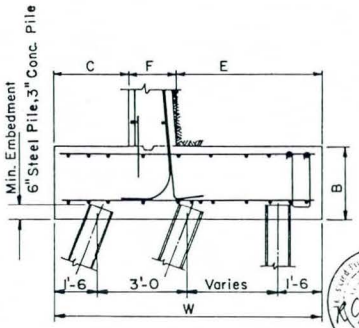


Chamfer all exposed corners thus unless otherwise noted.



SPREAD FOOTING DETAIL

See Footing Steel Detail on B-18.20



PILE FOOTING DETAIL

See Footing Steel Detail on B-18.30 or B-18.40

GENERAL NOTES

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction.

Design - AASHTO Std. Specs. for Highway Bridges 1977.

Dead Load - Weight of backfill = 120 P.C.F.
Angle of Internal Friction = 33° 15'.

Stresses - Class S Concrete f'_c = 3000 P.S.I.

All Concrete shall be Class S.

Reinforcing Steel shall conform to A.S.T.M. Spec. A-615

Bar sizes #6 and smaller shall be Gr. 40 or Gr. 60; f_s = 20,000 P.S.I.

Bar sizes #7 and larger shall be Grade 60, f_s = 24,000 P.S.I.

All Reinforcing Steel shall have 2" clear cover unless noted otherwise.

JOINT NOTE

All Retaining Walls shall have Construction Joints spaced at not more than 30'-0 apart or as shown. Reinforcing Steel shall project through the joint.

Expansion Joints shall be provided at intervals not exceeding 90'-0.

Footings may be continuous with no joint.

BATTERED PILE NOTE

Batter Piles 3:12 for Cases I & II, 4:12 for Cases III & IV.

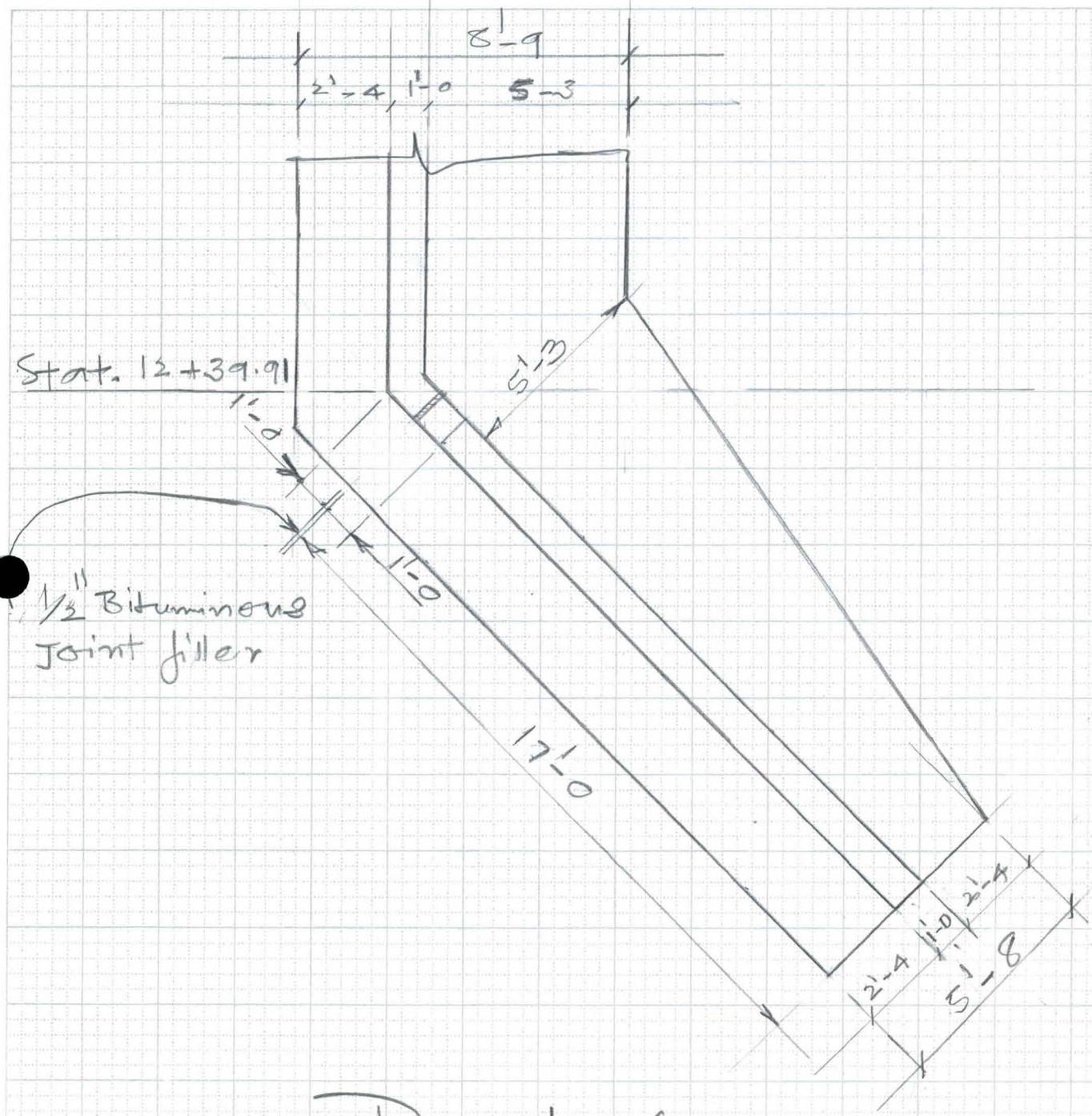
DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION 7-88
APPROVED FOR DISTRIBUTION	CANTILEVER RETAINING WALL DETAILS	STANDARD NO. B-18.10

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Wing wall Detail COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____



Detail - 1

Scale 1/4" = 1'-0

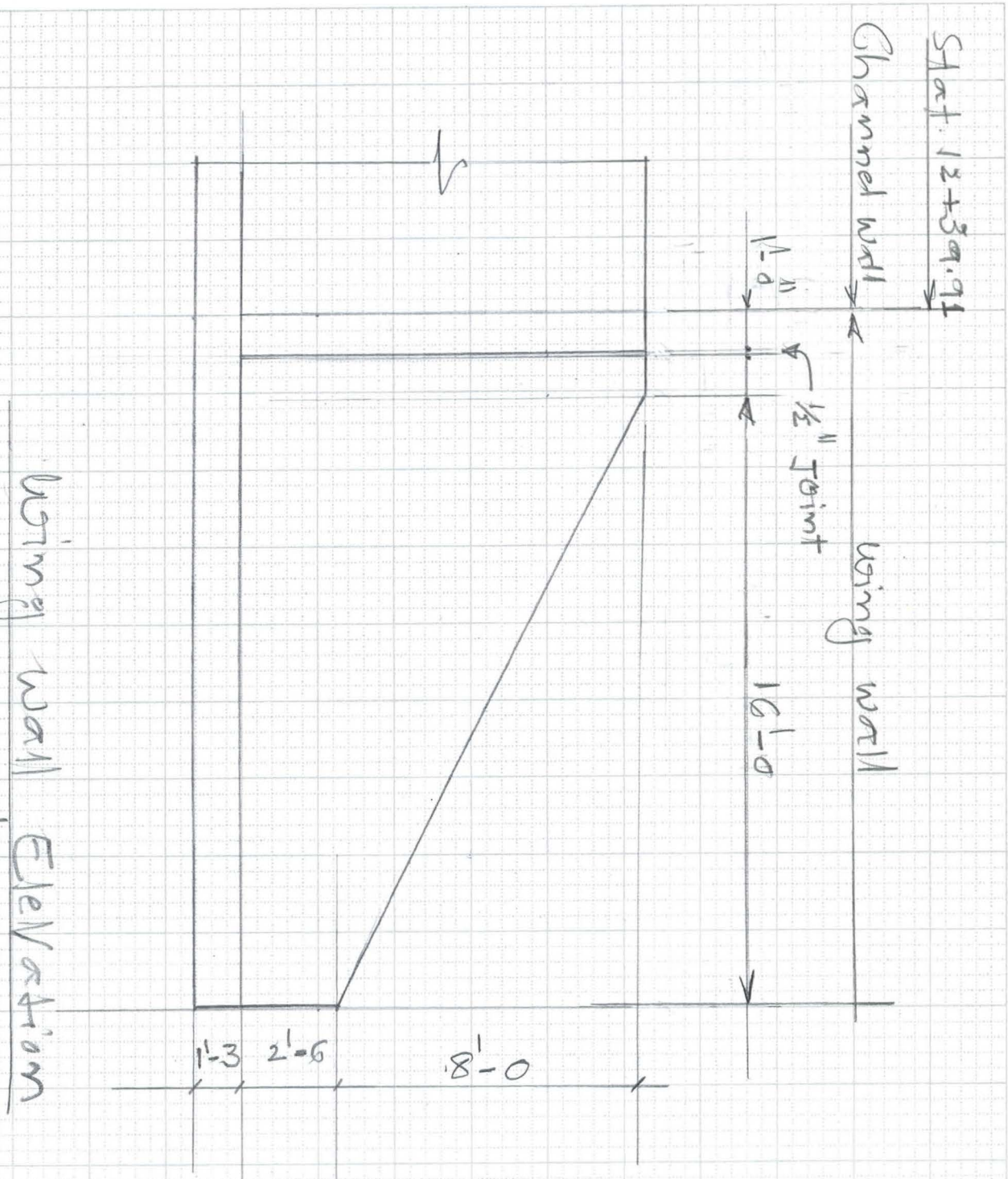
6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill PAGE ____ OF ____

DETAIL Wing Wall COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____



6910-153 4-90

COMPUTATION SHEET

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE ARIZONA PROJECT SPOOKHILL OUTLET

BY JMH DATE 4-14-93 CHECKED BY DATE JOB NO.

SUBJECT STRUCTURAL REVIEW SHEET 1 OF

The WNTC Nov. 20, 1992 Preliminary Design Review recommended additional documentation for soil loadings of walls. Soil Test pits revealed ML-CL, ML, SM-SP and SM soils from the surface to 4' depth.

SOIL MECH. Spook Hill FRS & Floodway, March 6, 1975

Documentation from Spookhill Soil Mechanics in the mid 1970's indicated borrow materials of non-plastic SM or SC's with moderate plasticity. The angle of internal friction of the non-plastic SM was reported at 33°. Max γ_d using ASTM 698 Method A was typically 128 lb/ft³. Opt. Moisture ranged 9-11%. One GM sample γ_d = 110 #/ft³ @ 18%. Shear tests run were defined as quick consolidated direct shear. Cohesion in all samples was ϕ. Shears tests were run at 100% saturation. and 95% of Std. P.

γ_d (1 test)

SPOOKHILL FILL DENSITY & MOISTURE DETERMINATIONS 1978

From density test data during 1978 construction of Spookhill Sediment basin γ_d = 127.6, 126.5, 129.2, 126.6, 126.5, 126.0 w/ opt. moisture running 9 to 10%

COMPUTATION SHEET

SCS-ENG-[illegible]

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE | PROJECT

BY | DATE | CHECKED BY | DATE | JOB NO.

SUBJECT | SHEET 2 OF

Using 95% of standard & 9% moisture

& $127 = \gamma_d$

$\gamma_m = 0.95(127)(1+0.09) = 131.5 \ lb/ft^3$

Designer (FCOMC) use 130 which is reasonable.

For K value, from 1975 test data,

coefficient of internal friction $\phi = 33°$

USING Figure 44, (TR 74)

$K_o = 1 - \sin\phi$

$K_o = 1 - 0.55$

$K_o = 0.45$

FCOMC designer used $K = 0.33$

Change to 0.45 for design loadings

Lee

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 1 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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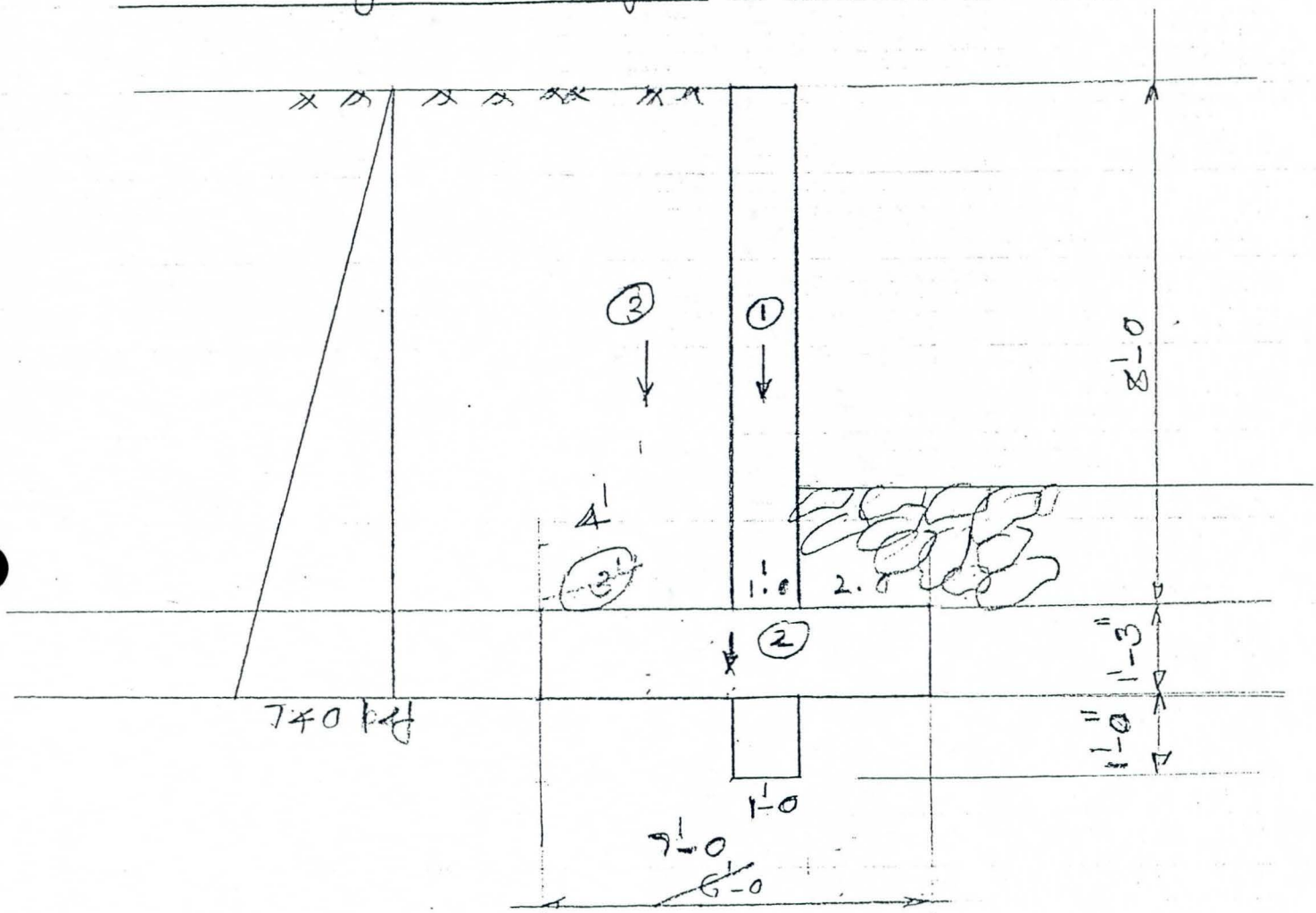
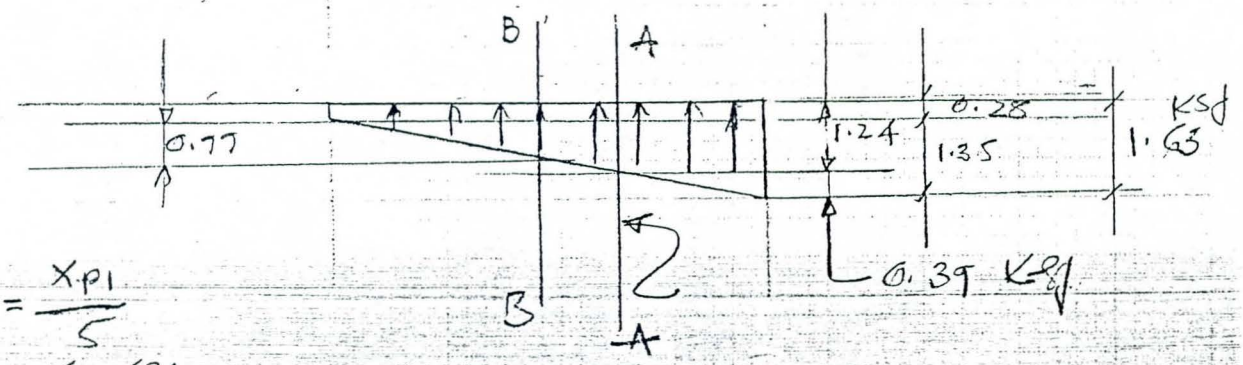
Case 1

Submerged Backfill





$$\frac{1.35}{7.0} = \frac{X_{p1}}{5}$$

$X_{p1} = 0.96$ Ksf

$(0.96 + 0.28) = 1.24$ Ksf

$(1.63 - 1.24) = 0.39$

$$\frac{X_{p2}}{4.0} = \frac{1.35}{7.0}, \quad X_{p2} = 0.77$$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 2 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/9.

CHECKED BY DATE

1) Using Submerged Condition:

Wt of wet soil = 130 pcf

Wt. of Water = 62.4

Wt. of Submerged Soil = 67.6

Using K = ~~0.33~~ 0.45

$P_r = wKh = (67.6 \times \cancel{0.33}\ 0.45 \times h) = 22.3\ h$ pcf

water pr = 62.4

~~84.7~~ 92.8

use 80 to 85 pcf

$p_r = (\cancel{84}\ 93 \times 9.25) = \cancel{740}\ 860$ pcf

$P = (\frac{\cancel{740}\ 860}{2} \times 9.25) = \cancel{3.43}\ 4.0$ K

$M_{O.T} = \cancel{3.43}\ 4.0 \times 9.25/3 = \cancel{10.6}\ 12.3$ Kft

Stabilizing Moment

$w_1 = (8.0 \times 1.0 \times 0.15) = 1.20$ K

$w_2 = (6.0 \times 1.25 \times 0.15) = 1.13$

$w_3 (Soil) = (3.0 \times 8.0 \times 0.13) = 3.12$

5.45 K

$M_{stB} = (1.2 \times 2.5) + (1.13 \times 3.0) + (3.12 \times 4.5) = 20.43$

$F.S = (\frac{20.43}{\cancel{10.6}\ 12.3}) = \cancel{1.93}\ 1.66$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 3 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Check Sliding:

Sliding force = P = ~~3.43~~ 4 K

Frictional force = μN = 0.4 × 5.45 = 2.18 K

< ~~3.43~~ 4 K

∴ use a Key &
Increase Heel to 4'-0 to
get some additional wt.
Has Grout in between walls.

Try Footing width = 7'-0

Stabilizing Moment:

W_1 = 1.20 K

W_2 = (7.0 × 1.25 × 0.15) = 1.31

W_3 = (4.0 × 8.0 × 0.13) = 4.16

6.67 K

MSTB = (1.2 × 2.5) + (1.31 × 7.0/2) + (4.16 × 5.0)

= 28.4 K'

F.S = (28.4 / ~~10.6~~ 12.3) = ~~2.7~~ 2.3

Sliding Check:

Frictional Force = μN = 0.4 × 6.67 = 2.7 K

Sliding Force P = ~~3.43~~ 4 > 2.7 K

Still need a Key for the Base Slab

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 4 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY DATE

Footing pressure: 7' wide

$M_{STB} = 28.4^{kft}$, $N = 6.67^{k}$

$M_{OT} = \cancel{10.6}$ 12.3,

X_R = Dist. of Resultant $= \dfrac{(28.4 - \cancel{10.6}\ 12.3)}{6.67}$

$= \cancel{2.67}$ 2.41 '

$b/3 = \dfrac{7.0}{3} = 2.33$, units in Mid Third

$e = (b/2 - X_R) = (3.5 - \cancel{2.67}\ 2.41) = \cancel{0.83}$ 1.09 '

$< \frac{b}{3} = 1.17'$

$P_r = \dfrac{6.67}{7 \times 1}\left(1 \pm \dfrac{6 \times \cancel{0.83}\ 1.09}{7}\right)$

$= 0.953\left(1 \pm \cancel{0.71}\ .93\right)$

P_r (max) $= 1.63$ ksf for (Min) $= 0.28$

Toe Design:

a) UDL : $(1.24 \times 2) = 2.48^{k}$

b) triangular: $\left(\dfrac{0.39}{2} \times 2.0\right) = 0.39^{k}$

Neglecting the footing wt

$M_{AA} = \left(2.48 \times \dfrac{2}{2}\right) + \left(0.39 \times \frac{2}{3} \times 2\right) = 3.0^{kft}$

$M_u = (3.0 \times 1.3) = \cancel{3.9}$ 1.8 kft 5.4

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 5 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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Toe Steel:

$M_u = 3.9$ kft 5.4

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{3.9 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.011$$ 5.4 0.0113

From Table 9-2, Read $\omega = 0.012$

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.012 \times 3.0}{60} = 0.0006$$ 4/40 .0012

Say 0.001

$A_s = 0.001 \times 12 \times 11.5 = 0.14 \text{ in}^2$ 0.166

$\rho_{min} = 200/f_y = 200/60000 = 0.0033$

(Grade 60) $A_s = (0.0033 \times 12 \times 11.5) = 0.46 \text{ in}^2$

Reqd Reinf: $1.33(0.14) = 0.19 \text{ in}^2$

Use #4 @ 9'', $A_s = 0.27$

SCS table

$A_s = 0.14$

$= 2''$ +

Q_{shr}

$.001(12)12 = 0.18$ ok

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 6 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

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Heel Design

unif: $(0.28 \times 4.0) = 1.12^{K}$

Triangular: $\left(\frac{0.77}{2} \times 4.0\right) = 1.54^{K}$

Soil wt: $(8 \times 1)\,0.13 = 1.04\ K/ft$

Conc. wt: $(1.25 \times 0.15) = 0.19\ K/ft$

$$M_{BB} = \left(1.04 \times 4 \times \frac{4}{2}\right) + \left(0.19 \times 4 \times \frac{4}{2}\right) - \left(1.12 \times \frac{4}{2}\right) - \left(1.54 \times \frac{1}{3} \times 4\right)$$

$$= 5.55\ ^{K'}$$

$$M_u = \cancel{1.3}\,1.6\,(5.55) = \cancel{7.22}\ 9.99\ K'$$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{7.22 \times 12}{0.9 \times 3.0 \times 12 \times 12.5^2}\right) = 0.017$$

$d = (15 - 2 - 0.5)$
$= 12.5''$

from Table 9-2, $\omega = 0.018$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.018 \times 3.0}{60}\right) = 0.001$$

SCS $A_s = 0.24$

$$A_s = 0.001 \times 12 \times 12.5 = 0.15\ in^2$$

ok

$$\rho_{min} = \frac{200}{f_y} = 0.0033,$$

$$A_s = 0.0033 \times 12 \times 12.5 = 0.5\ in^2$$

or $1.33\,A_s = 1.33 \times 0.15 = 0.2\ in^2$

use #5 @ 9", $A_s = 0.41$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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Stem Design:

$P_r = wKh = (\cancel{80} \times 8) = 640$ lbs (93, 744)

$M_{stem} = \left(\frac{0.64}{2} \times 8.0\right)\frac{8}{3} = 6.83$ kft (.74, 7.9)

$M_u = (\cancel{6.83} \times 1.3) = \cancel{8.9}$ kft (7.9, 1.8, 14.2)

$d = (12 - 2 - 0.5) = 9.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{\cancel{8.9} \times 12}{0.9 \times \cancel{3.0} \times 12 \times 9.5^2}\right) = \cancel{0.037}$ (14.2, 0.044)

from Table 9-2, $\omega = 0.038$

$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.0\cancel{38} \times \cancel{3.0}}{\cancel{60}}\right) = 0.0019$ (.044, 4, 40)

$A_s = (\cancel{0.0019} \times 12 \times 9.5) = 0.21\ in^2$ (.0044, 0.50)

$A_{s\,min} = (0.0033 \times 12 \times 9.5) = 0.38\ in^2$

$1.33\ A_s = 1.33 \times \cancel{0.21} = 0.28$ (.15, 0.66)

Use #5 @ 8", $A_s = 0.47$ (#6 @ 5", 0.66)

For 9' Wall #5 @ 6", $A_s = 0.62$

SCS Table ES-220
$M_u = 14.2$
$d = 9.5''$
$A_s = 0.46$ sq in/ft
#5 @ 6" = 0.61
OK $\frac{.61}{12(9.5)} = 0.00535$
OK ?
$\rho_{shrinkage} = .005$

OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL COMPUTED KVH DATE 8/92

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Stem Design:

Check using 10" wall thickness:

$M_u = (6.63 \times 1.3) = 8.9$ kft

$d = (10 - 2 - 0.5) = 7.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{(8.9 \times 12)}{0.9 \times 3.0 \times 12 \times 7.5^2} = 0.059$$

Read $\omega = 0.061$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{(0.061 \times 3.0)}{60} = 0.0031$$

$A_{min} = (0.0033 \times 12 \times 7.5) = 0.30 \text{ in}^2$

$A_s = (0.0031 \times 12 \times 7.5) = 0.28 \text{ in}^2$

#5 @ 12" used before is still ok

10" Stem wall is ok, but

Better to use 12" wall to have some

Factor of Safety against overturning

and Sliding.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill out Lot PAGE 9 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

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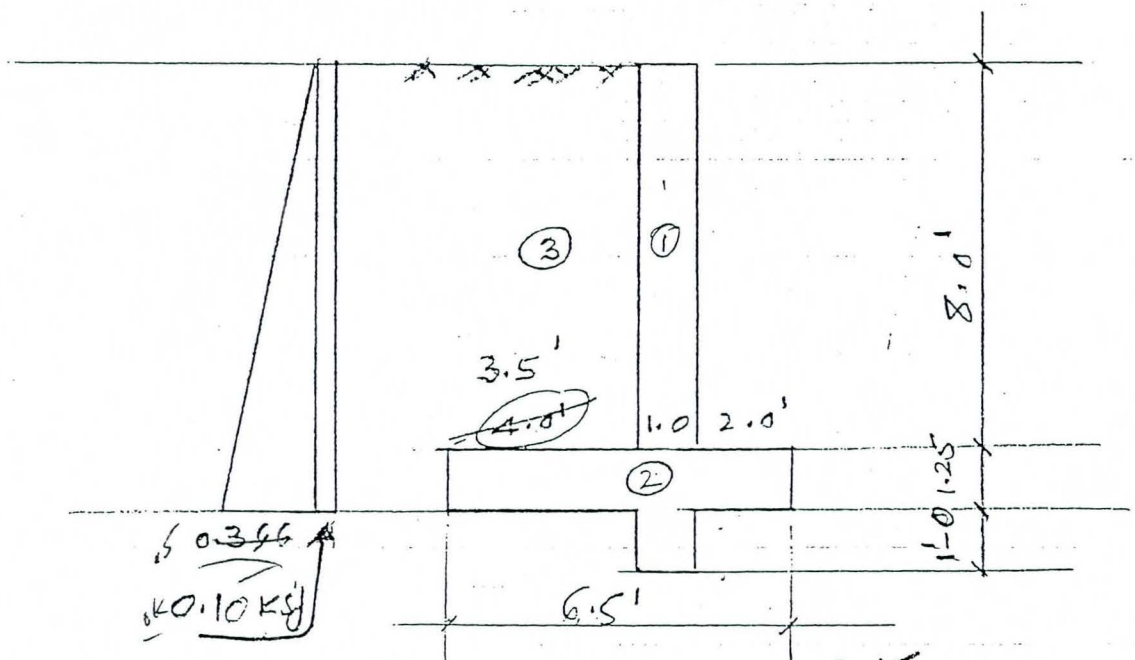
Case 2

Dry Backfill & 2' Surcharge

$P_{H_1} = \omega K h = (0.12 \times \cancel{0.33}\ 0.45 \times 9.25) = \cancel{0.366}\ 0.5$ kef

Using Surcharge = 2'

$P_{H_2} = (0.12 \times \cancel{0.33}\ 0.45 \times 2) = \cancel{0.079}\ 0.108$ kef, say 0.1 kef



$P_1 = \left(\frac{\cancel{0.366}\ 0.5}{2} \times 9.25\right) = \cancel{1.7}\ 2.3$ K

$P_2 = (0.1 \times 9.25) = 0.93$

$M_{OT} = \left(\cancel{1.7}\ 2.3 \times \frac{9.25}{3}\right) + \left(0.93 \times \frac{9.25}{2}\right) = \cancel{9.54}\ 11.4$ kft

M_{STB}:

$w_1 = (1.0 \times 8.0 \times 0.15) = 1.20$ K

$w_2 = (6.5 \times 1.25 \times 0.15) = 1.22$

$w_3 = (3.5 \times 8.0 \times 0.12) = 3.36$

5.78

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Retaining wall COMPUTED KVH DATE 8/92

8'-0 High Sect^n CHECKED BY DATE

$M_{STB} = (1.20 \times 2.5) + (1.22 \times \frac{6.5}{2}) + (3.06 \times 4.75)$

$= 22.93$ kft

$F.S = (22.93 / \cancel{9.54}) = \cancel{2.4}$ 11.4 2.0

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 5.78 = 2.3$ K

Sliding Force $= (\cancel{1.7} + 0.93) = \cancel{2.63}$ 2.3 3.2 K

> 2.3 ∴ Use a Base Slab Key

Check Stem Moment:

$P_{v_1} = (0.12 \times \cancel{0.33} \times 8) = \cancel{0.317}$ 0.45 0.432 Kip

$P_{v_2} = 0.1$ Kip

$P_1 = (\frac{\cancel{0.317}}{2} \times 8) = \cancel{1.27}$ 0.432 1.73 K

$P_2 = (0.10 \times 8) = 0.8$ K

$M_{Stem} = (\cancel{1.27} \times \frac{8}{3}) + (0.8 \times \frac{8}{2}) = \cancel{6.59}$ 1.73 7.81 kft

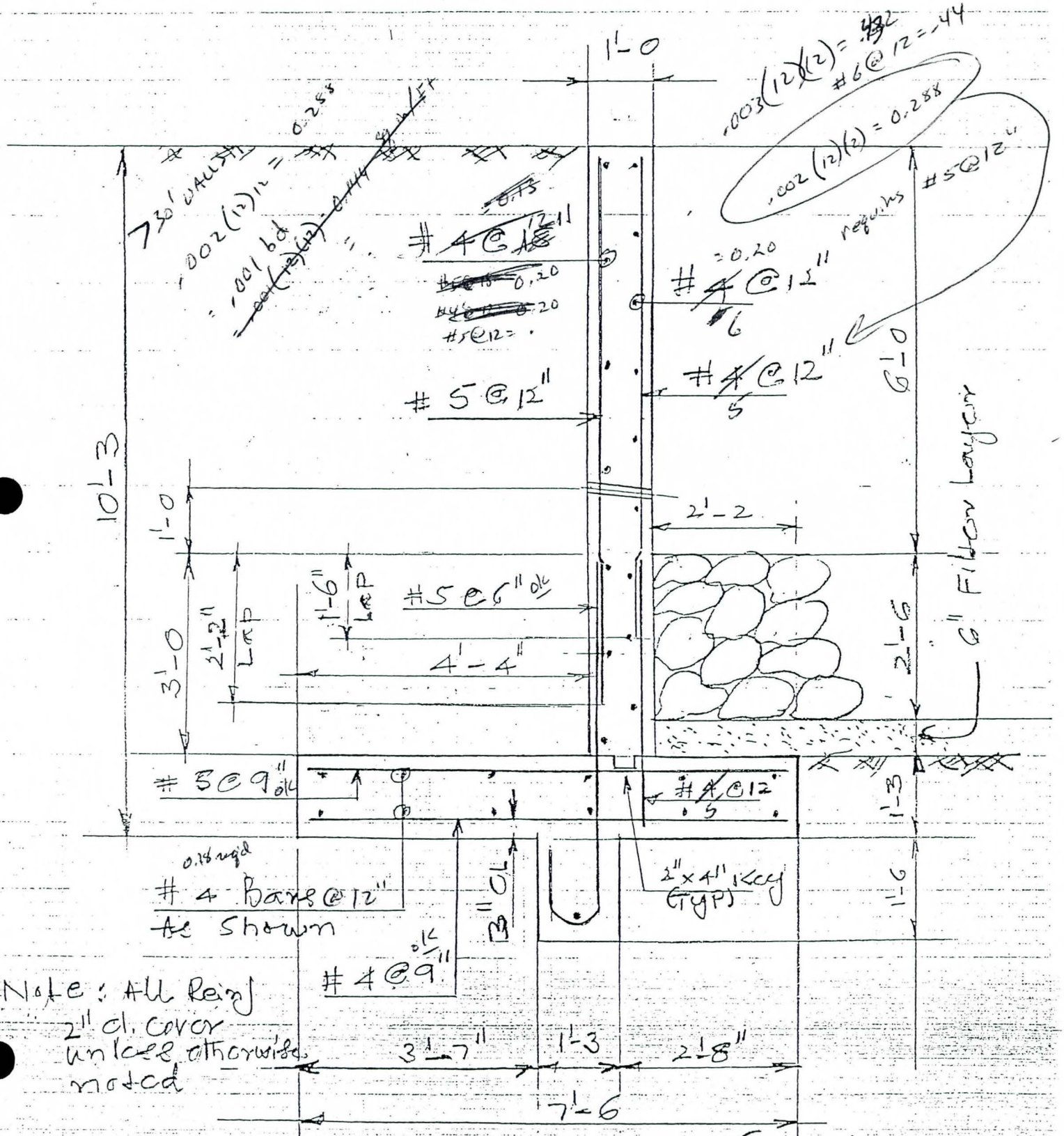
$< \cancel{6.83}$ 7.9 kft (Used for Design under Submerged Cond.)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 10(B) OF

DETAIL 6' Wall Section COMPUTED KVH DATE 8/72

Type 1 Wall CHECKED BY DATE



Type 1 Wall Section

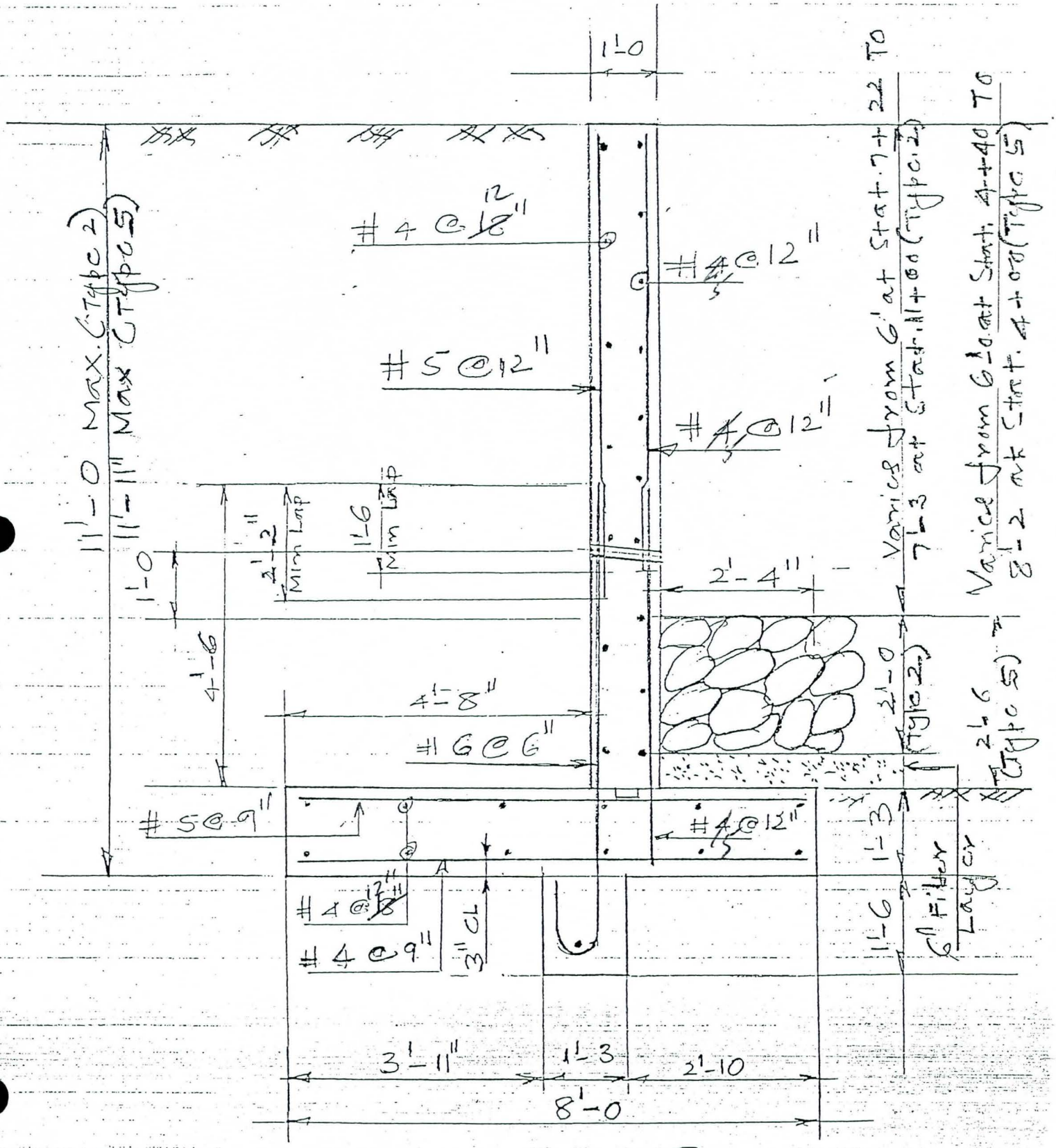
Stat. 440 To 722.3 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 10(C) OF

DETAIL 7'-3 wall Section COMPUTED KVH DATE 8/92

Type 2 wall CHECKED BY DATE



Type-2 AND TYPE-5 WALL SECTION

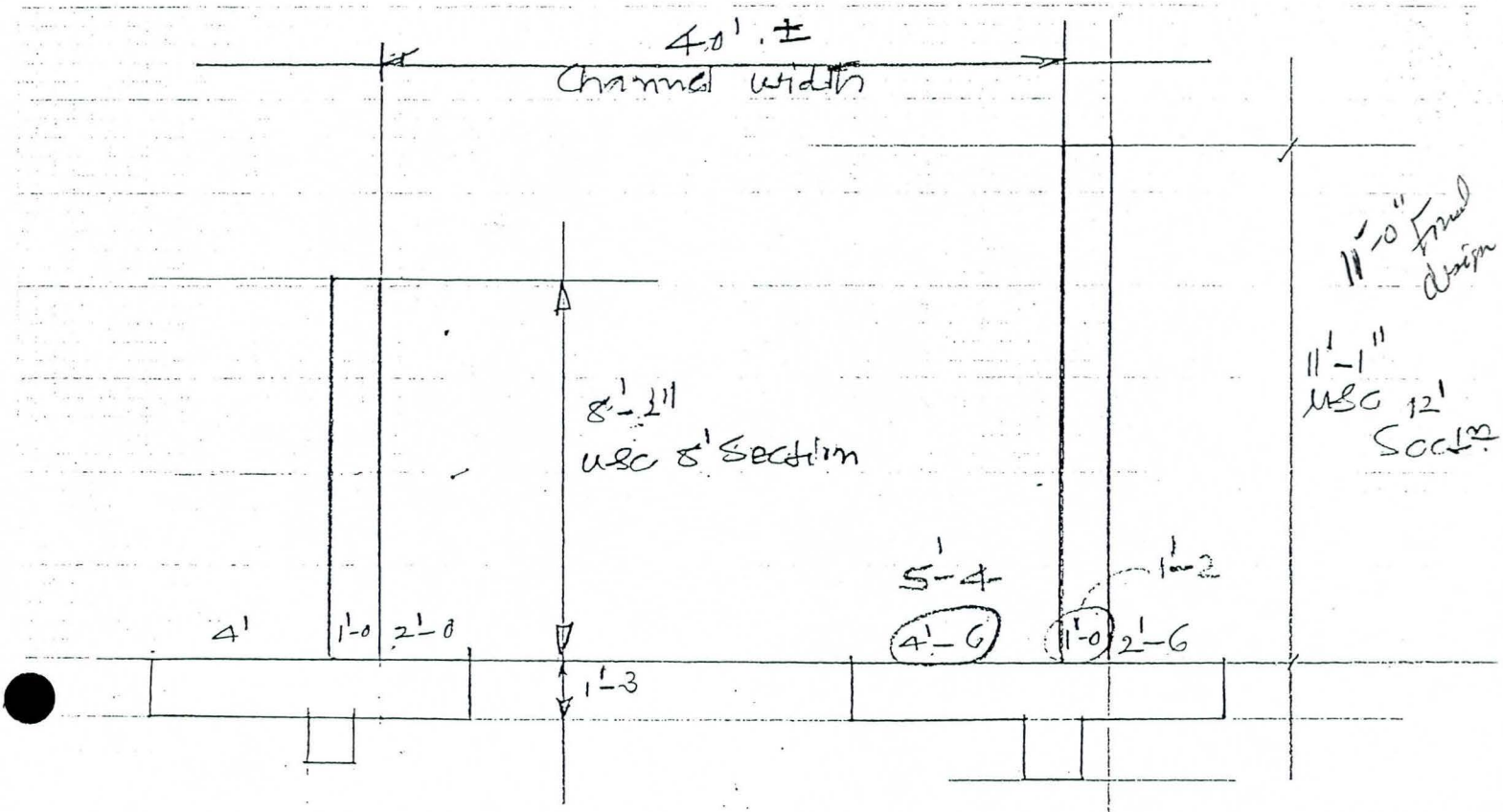
Scale 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 11 OF

DETAIL @ Transition COMPUTED KVH DATE 7/92

CHECKED BY DATE

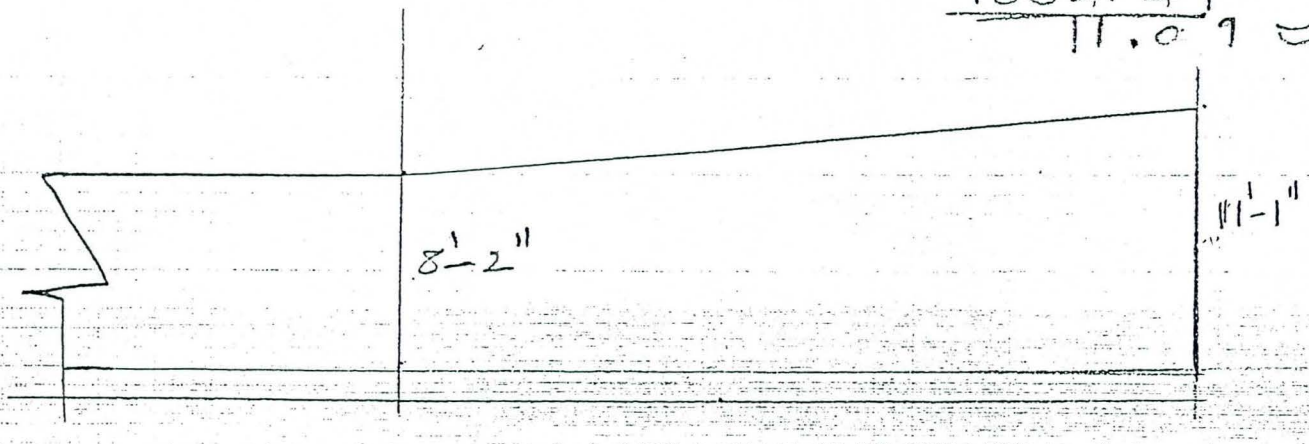


Section at outlet

1/4" = 1'-0

1342.10
1333.91
18.19 ≈ 8'-2

1345.58
1334.47
11.07 ≈ 11'-1



Elevation View
Transition from High Wall to Regular Se

1/8" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

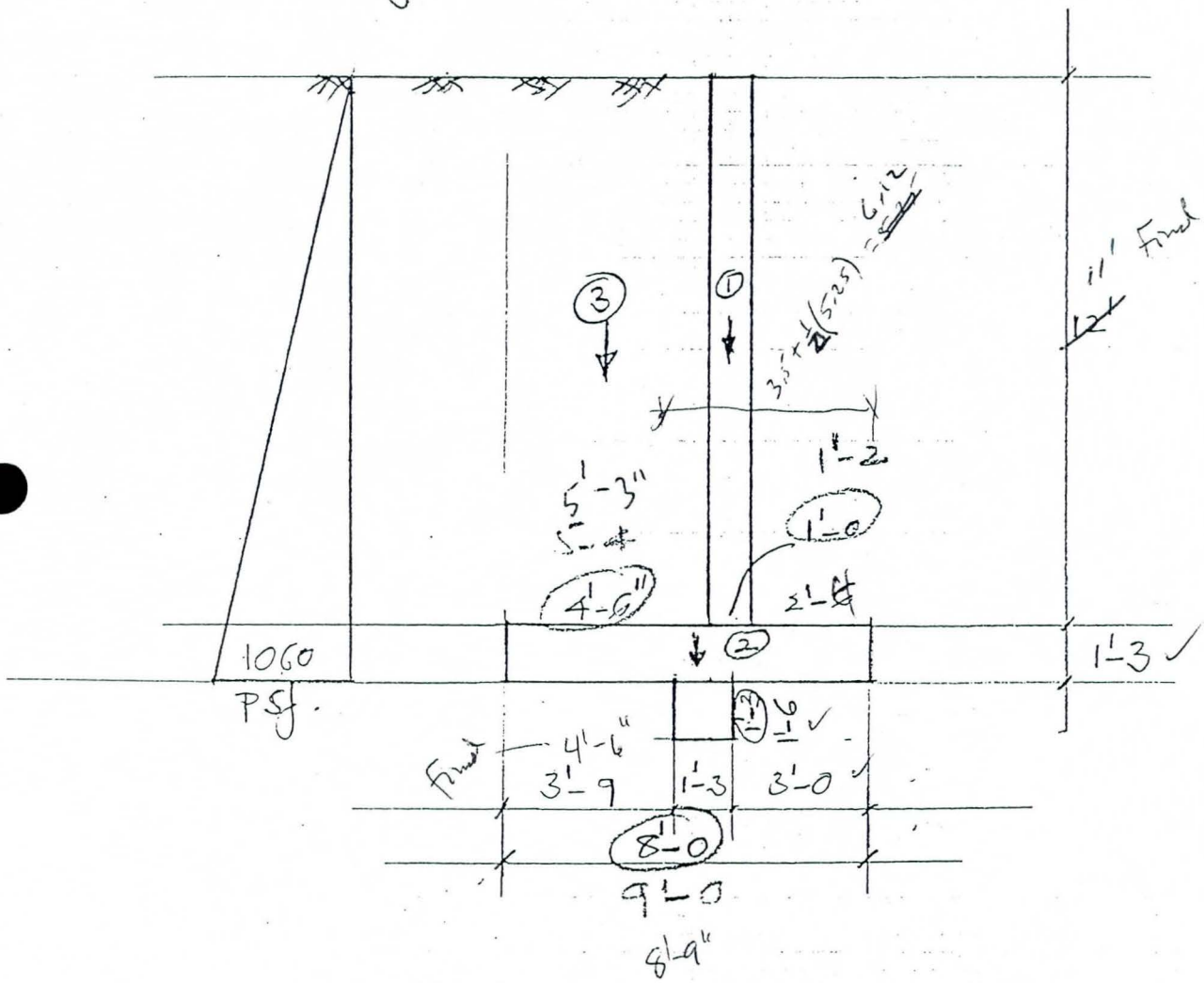
PROJECT Spook Hill outlot PAGE 12 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Case 1

Submerged Condition



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 13 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

Check for Submerged Condition

Footing width = 8'

Using Equt fluid pr. of ~~80~~ 93 pcf

$pr = wkh = (\cancel{80}\ 93 \times \cancel{13.25}\ 12.25) = \cancel{1060}\ 1139$ psf

$P = \left(\frac{\cancel{1060}\ 1139}{2} \times \cancel{13.25}\ 12.25\right) = \cancel{7.03}\ 6.98$ K

$M_{OT} = \left(\cancel{7.03}\ 6.98 \times \frac{\cancel{13.25}\ 12.25}{3}\right) = \cancel{31.1}\ 28.5$ K'

Stabilizing Moment:

$w_1 = (\cancel{14.0}\ 1.0 \times 1.0 \times 0.15) = \cancel{1.8}\ 1.65$ K

$w_2 = (8.75 \times 1.25 \times 0.15) = \cancel{1.51}\ 1.64$

$w_3 = (\cancel{4.5}\ 5.25 \times \cancel{12}\ 11 \times 0.13) = \cancel{7.02}\ 7.51$

$\cancel{10.32}$ K

$M_{STB} = (\cancel{1.8}\ 1.65 \times 3) + (\cancel{1.5}\ 1.64 \times \cancel{4.0}\ 4.37) + (\cancel{7.02}\ 7.51 \times \cancel{5.75}\ 10.8) = \cancel{51.8}\ 58.1$ K'

$FS = \frac{\cancel{51.8}\ 58.1}{\cancel{31.1}\ 28.5} = \cancel{1.7}\ 2.0$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times \cancel{10.32}\ 10.8 = \cancel{4.13}\ 4.32$ K

Sliding Force $= \cancel{7.03}\ 6.98$ K $> \cancel{4.13}\ 4.32$ K

Use a Key for Base Slab.

However Sliding force of 7.03 K is very high since 80 pcf Equiv. fluid pr is used. wall will not slide because of Grouted Riprap on the inside of the channel wall. Also use weep holes to keep the water pr. to a minimum

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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Check Footing Pressure: (8' footing width) 8'-9"

$M_{STB} = \cancel{51.8}\ 58.1$, $M_{OT} = \cancel{31.1}\ 28.5$ Kft, $N = \cancel{10.32}\ 10.8$ K

x_R = Dist. of Resultant $= (\cancel{51.8} - 31.1)/\cancel{10.32}\ 10.8 = \cancel{2.01}\ 2.74'$

$b/3 = \cancel{8.00}\ 8.75/3 = \cancel{2.67}\ 2.92'$

$e = (b/2 - x_R) = (\cancel{4.00} - \cancel{2.01}) = \cancel{1.99}\ 1.64'$

$b/6 = \cancel{1.33}\ 1.46$ $\quad e > \frac{b}{6}$ ∴ Resultant outside the middle Third.

$\frac{L'}{3} = \left(\frac{L}{2} - e\right)$

$L' = 3\left(\frac{L}{2} - e\right) = 3(\cancel{4} - \cancel{1.99}) = \cancel{6.03}\ 8.19$

$q_{max} = \frac{2P}{BL'} = \left(\frac{2 \times \cancel{10.32}\ 10.8}{1 \times \cancel{6.03}\ 8.19}\right) = \cancel{3.43}\ 2.64$ KSf

Note: 3/4 grouted rock true overturning moment is based on 9½' wall height not 11'

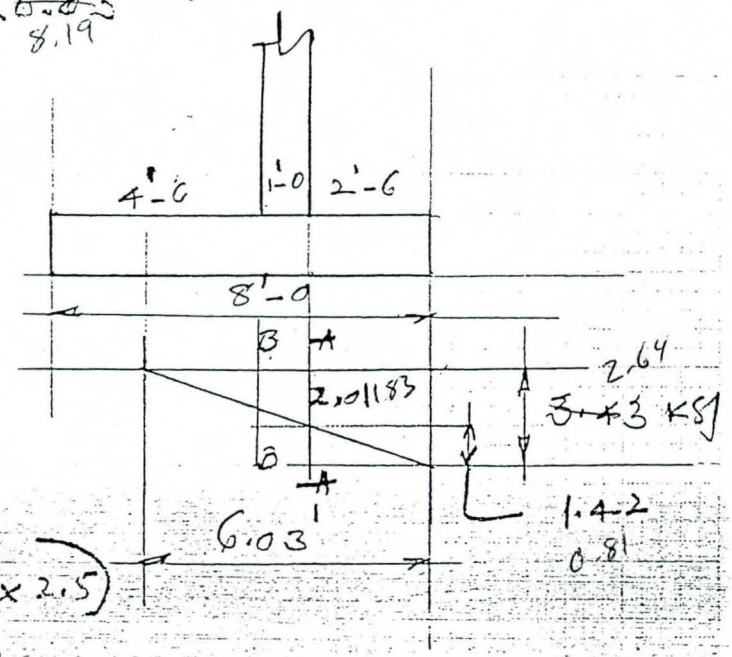
Toe Design

$\frac{\cancel{3.43}\ 2.64}{\cancel{6.03}\ 8.19} = \frac{q_1}{\cancel{3.43}\ 5.69}$

$q_1 = \cancel{2.01}\ 1.83$ KSf

$P_1 = (\cancel{2.01}\ 1.83 \times 2.5) = \cancel{5.03}\ 4.58$ K

$P_2 = \left(\frac{\cancel{1.42}\ 0.81}{2} \times 2.5\right) = \cancel{1.78}\ 1.01$ K



Neglecting footing wt:

$M_{AA} = (\cancel{5.03}\ 4.58 \times \frac{2.5}{2}) + (\cancel{1.78}\ 1.01 \times \frac{2}{3} \times 2.5)$

$= \cancel{9.3}\ 7.42$ Kft

$M_u = 1.3(\cancel{9.3}) = 12.1$ Kft

$1.8(7.4) = 13.3$

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DETAIL 12.1 Retaining wall COMPUTED KVH DATE 7/92

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Toe Design (Cont'd) (8' Footing width)

$M_u = \cancel{12.1}\ 13.3$

SCS table $A_s = 0.35$ $A_{s\,Rqm} \rightarrow 2''$ ok

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{12.1 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.034$$

Read $\omega = 0.035$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{(0.034 \times 3.0)}{60} = 0.0017$$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{60\,000} = 0.0033$$

$A_s = (0.0017 \times 12 \times 11.5) = 0.24\ sq''$

$A_s(min) = (0.0033 \times 12 \times 11.5) = 0.46$

or $1.33\ A_s = (1.33 \times 0.24) = 0.32$

Since wall th. varies, use #6 @ 9" $A_s = 0.59$

Heel Design:

Neglecting upward soil pr. on the heel:

Soil wt $= (\cancel{12}^{11} \times 0.13) = \cancel{1.56}\ 1.43$ kip

Conc. Ftg $= (1.25 \times 0.15) = 0.19$

$M_{BB} = (\cancel{1.56}\ 1.43 \times \frac{\cancel{4.5}\ 5.25^2}{2}) + (0.19 \times \frac{\cancel{4.5}\ 5.25^2}{2}) = \cancel{17.72}\ 22.3$ kip

$M_u = \cancel{1.3}\ 1.8\ (\cancel{17.72}\ 22.3) = \cancel{23.04}\ 40.2$ kip

$d = (15 - 2 - 0.5) = 12.5''$ or $\cancel{34.9}$

$d = (15 - 3 - 0.5) = 11.5''$ with 1" clearance to standard ke

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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8' Footing width → 40.2

$$\frac{M_u}{\phi f'_c b d^2} = \frac{23.04 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.065$$

SCS A_s = 1.1

Read $\omega = 0.068$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.068 \times 3.0}{60.0} = 0.0034$$

alternate

$$\rho_{min} = \frac{200}{f_y} = 0.0033$$

#7's = 1.2

#7's @ 6"

$$A_s = (0.0034 \times 12 \times 11.5) = 0.47 \text{ in}^2$$

#6 @ 9", $A_s = 0.59$ OR

#7 @ 9" $A_s = 0.80$

Try 9'-0 Footing width to have a Little more F.S. in Sliding & reduce Soil. pr a Little

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DETAIL 12' High wall COMPUTED KVH DATE 7/92
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Try Footing width = 9'-0 (8.75)

Using Equiv. Fluid pr = 80 pcf

$P_r = wKh = (80 \times 13.25) = 1060$ pcf

$P = \left(\frac{1060}{2} \times 13.25\right) = 7.03^K$

$M_{OT} = \left(7.03 \times \frac{13.25}{3}\right) = 31.1$ K'

Stabilizing Moments:

$W_1 = (1.0 \times 12.0 \times 0.15) = 1.80^K$

$W_2 = (9.0 \times 1.25 \times 0.15) = 1.69$

$W_3 = (5.5 \times 12.0 \times 0.13) = 8.58$

12.07^K

$M_{STB} = (1.8 \times 3.0) + (1.69 \times 4.5) + 8.58\left(3.5 + \frac{5.5}{2}\right)$

$= 66.63$ K'

$F.S = \frac{66.63}{31.10} = 2.14$

Sliding Check

Frictional force $= \mu N = 0.4 \times 12.07 = 4.8^K$

with $\mu = 0.5$, $0.5 \times 12.07 = 6.1^K$

Sliding force $= 7.03^K > 6.1^K$

Use a Base Slab Key (1'-3) x (1'-6)

Actually Sliding force will not be as high as 7.03K, because of water pr on Channel side, under submerged condition

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

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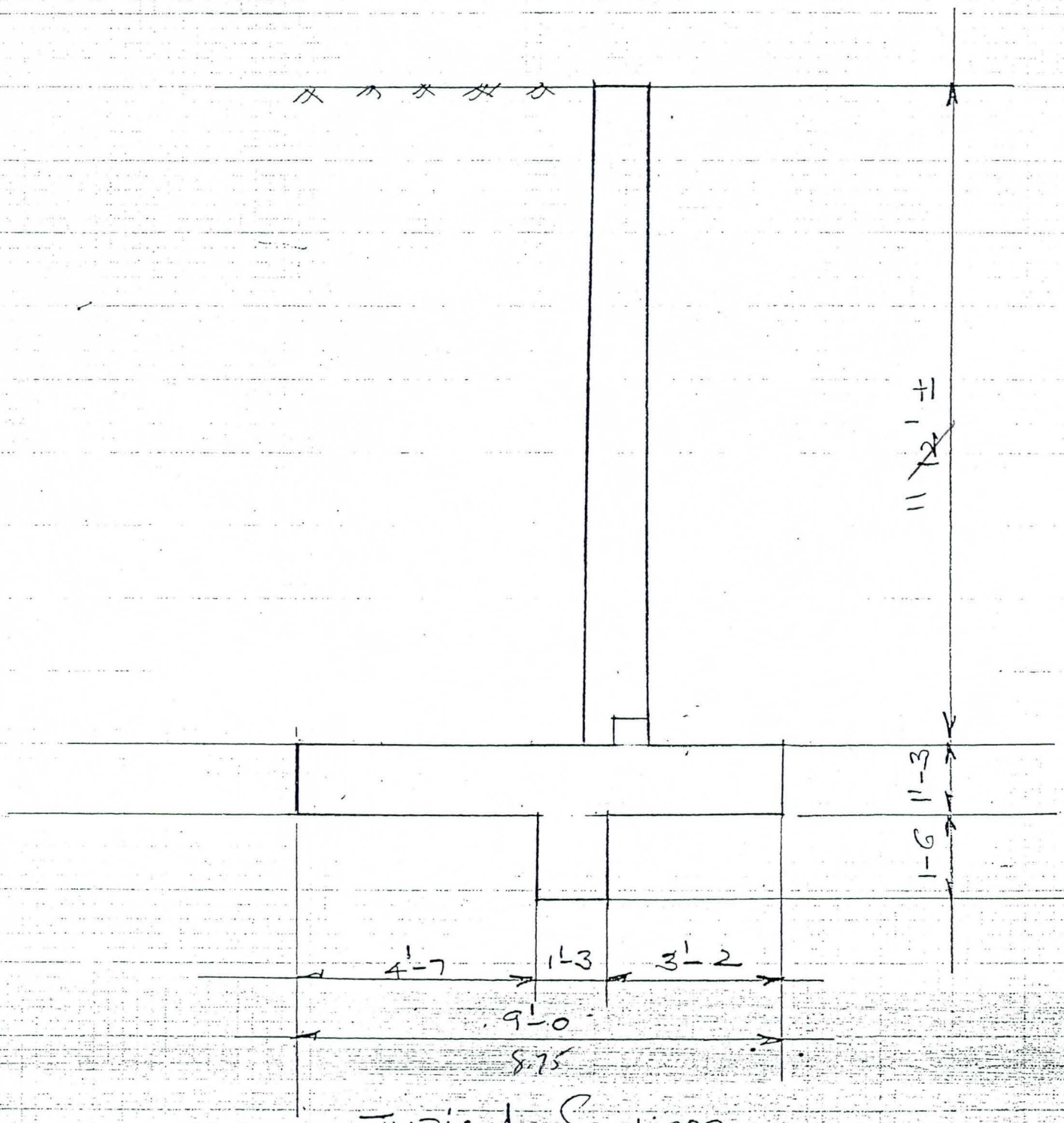

Typical Section

Scale 1/2" = 1'-0

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

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Checking Footing for (9'-0 (8.75) footing width)

$M_{STB} = 66.63^{58.1}$, $M_{OT} = 31.1^{28.5}$, $N = 12.07^{10.8}$ K

$x_R = (66.63 - 31.1)/12.07^{10.8} = 2.94'$ (2.74)

$e = (4.5 - 2.94) = 1.56^{1.64}$,

$b/6 = \frac{9.0}{6} = 1.5$ (1.46) $e > b/6$ ∴ ok

$P_{r\,max} = \frac{12.07^{10.8}}{9 \times 1}\left(1 \pm \frac{6 \times 1.56^{1.64}}{9}\right)$ (8.75)

$= 1.34^{1.23}(1 \pm 1.04^{1.09})$

$p_r(max) = 2.94$ (2.85) Ksf, $p_r(Min) = -0.05$ (-0.11) Ksf

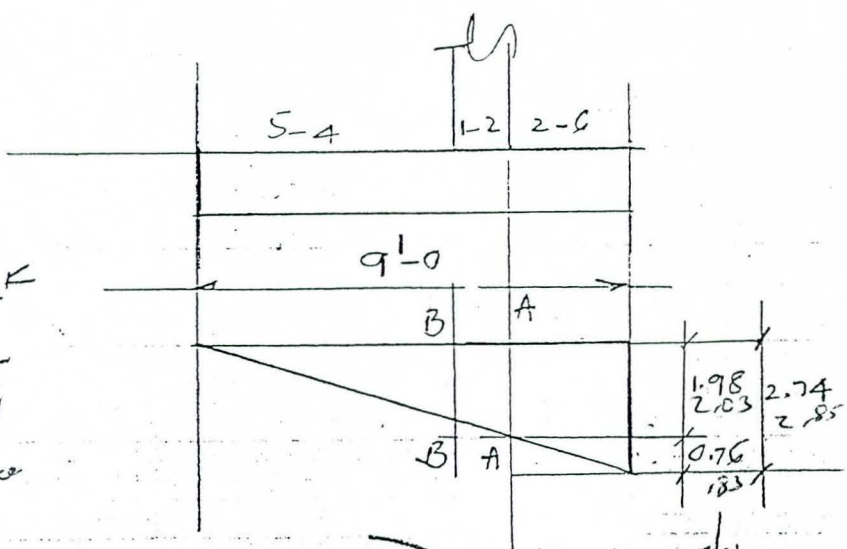
Toe Design:

$\frac{2.94^{2.85}}{9^{8.75}} = \frac{p_{r_1}}{6.5^{6.25}}$

$p_{r_1} = 1.98$ Ksf

$P_1 = (1.98^{2.03} \times 2.5) = 4.95^{5.09}$ K

$P_2 = (\frac{0.76^{.83}}{2} \times 2.5) = 0.95^{1.04}$



Neglecting ftg wt: Close

$M_{AA} = (4.95 \times \frac{2.5}{2}) + (0.95 \times \frac{2}{3} \times 2.5) = 7.8$ Kft

$M_u = (7.8 \times 1.3) = 10.14$ Kft

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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9' Footing width (Contd)

$M_u = 10.14$, $d = (15-3-0.5) = 11.5''$ $A_s = 0.29$ = #5 @ 12 (.31)

$$\frac{M_u}{\phi f'_c b d^2} = \frac{10.14 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.029$$ Rebar: 2''+

Read $\omega = 0.03$ from Table 9-2 ok

ρ_{min} Controlling, use #6 @ 9'' = 0.59

Heel Design:

$\frac{2.74}{9} = \frac{pv}{5.33}$ (2.85, 5.25) $pv = 1.62$ ksf (1.71)

$TP = \left(\frac{1.62}{2} \times 5.33\right) = 4.32$ K (4.49)

↓ Soil wt $= (12.0 \times 0.13) = 1.56$ K/ft (1.43)

↓ Conc. ftg $= (1.25 \times 0.15) = 0.19$

$$M_{BB} = \left(1.56 \times \frac{5.33^2}{2}\right) + \left(0.19 \times \frac{5.33^2}{2}\right) - 4.32 \times \frac{5.33}{3}$$

$= 17.2$ k'ft (14.5)

$M_u = 1.3(17.2) = 22.4$ (26)

$d = (15-3-0.5) = 11.5$ with 1'' Cl to Standard Key

$$\frac{M_u}{\phi f'_c b d^2} = \frac{22.4 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.063$$ SCS 0.756 in/ft

Read $\omega = 0.066$ from Table 9-2

$\rho = \frac{\omega f'_c}{f_y} = \frac{0.066 \times 3.0}{60} = 0.033$

$A_s = (0.033 \times 12 \times 11.5) = 0.46$ in^2 ok

#6 @ 9'', $A_s = 0.59$, #7 @ 9'', $A_s = 0.80$

As the wall will vary use #7 @ 9''

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DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

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Stem Design

$P_r = wKh = (80 \times 12) = 960$ psf (93, 11, 1023)

$Mom = \left(\frac{0.96}{2} \times 12\right)\frac{12}{3} = 23.04$ kft (24.5)

$M_u = (23.04 \times 1.3) = 29.95$ kft (1.8) 44 k-ft. SCS 1.24 sq. in.

$d = (14 - 2 - 0.5) = 11.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{29.95 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2}\right) = 0.084$

from Table 9-2, $w = 0.089$

$\rho = \frac{w f'_c}{f_y} = \left(\frac{0.089 \times 3.0}{60}\right) = 0.0045$

$A_s = (0.0045 \times 12 \times 11.5) = 0.62 \text{ in}^2$

6 @ 6" $A_s = 0.88$

At the wall ht. varies use # 7 @ 6", $A_s = 1.20$

OK

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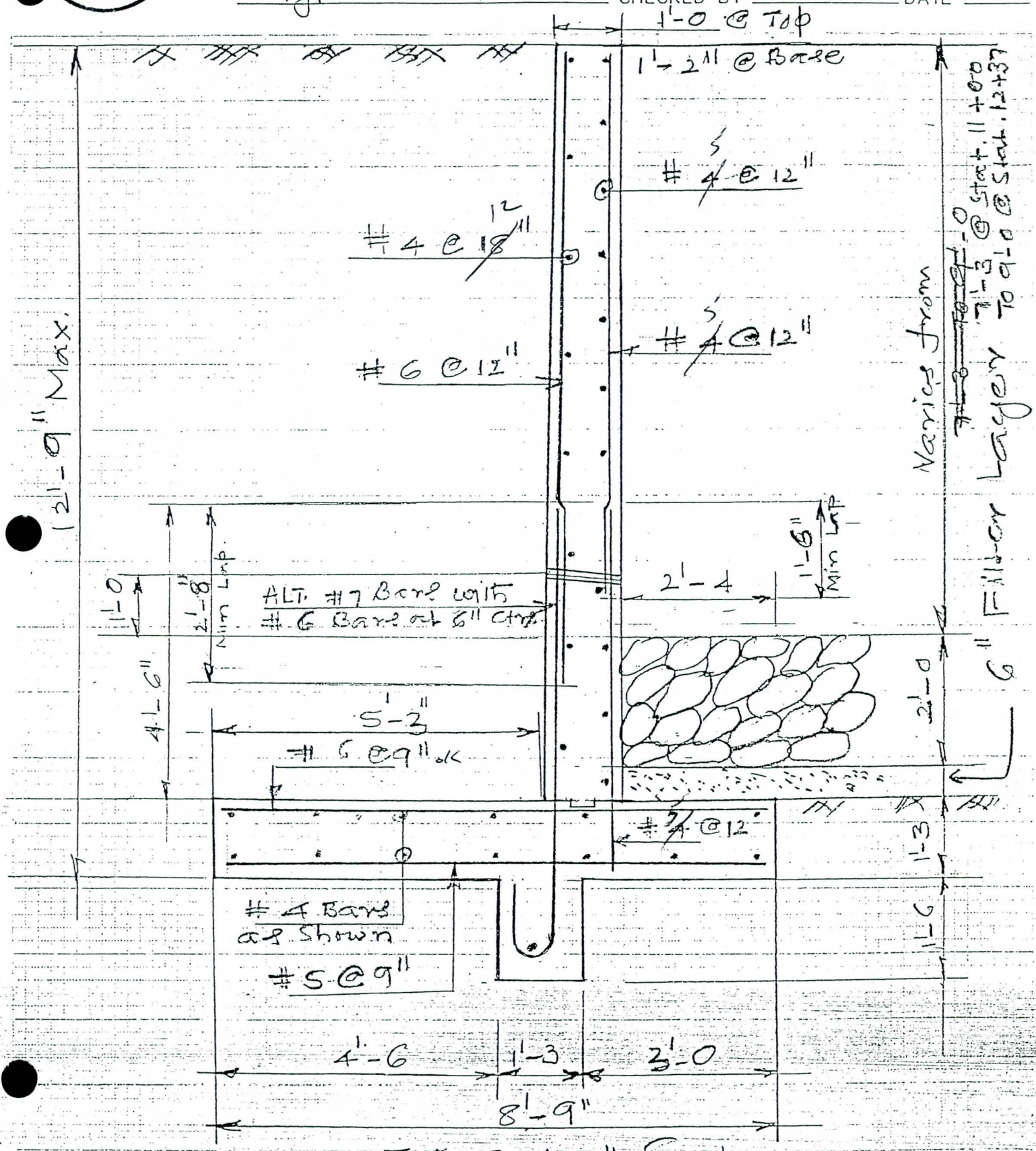
DETAIL 9'-0 Wall Sect. COMPUTED KVH DATE 8/92

Type 3 Wall CHECKED BY DATE



Type 3 Wall Section

Stat. 1100 To 1237.6 1/2" = 1'-0

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DETAIL Type 4 wall COMPUTED KVH DATE 8/92

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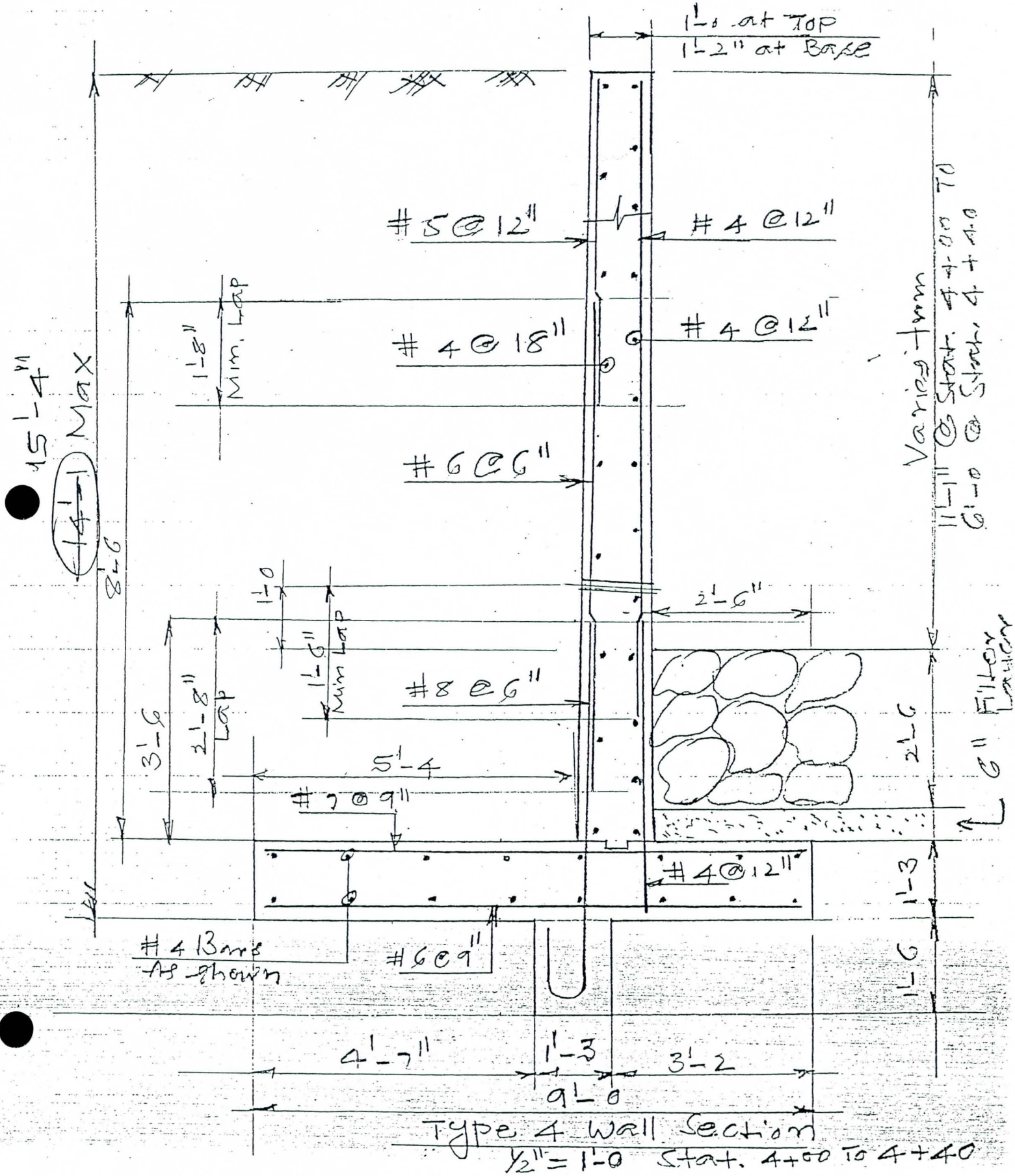

Type 4 Wall Section

1/2" = 1'-0 Stat. 4+00 To 4+40

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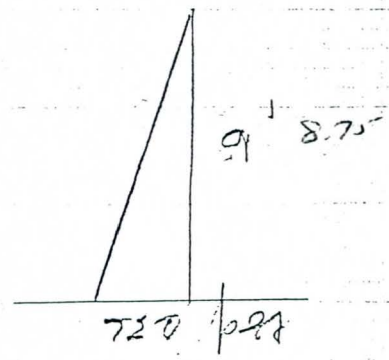
PROJECT Spook Hill Out Lot PAGE 22 OF
DETAIL Type 1 wall COMPUTED KVH DATE 8/92
Reinf Check CHECKED BY DATE

Type 1 wall:

$Ht = (6+3) = 9'$ 8.75

pr @ 80 pcf 93 Saturated pr.

$(80 \times 9) = 720$ pcf 814



$P = \left(\frac{0.720}{2} \times 9\right) = 3.24^k$ 3.54 (0.814)

$M = 3.24 \left(\frac{9}{3}\right) = 9.72$ 10.38

$d = (12 - 2 - 0.5) = 9.5$

$A_s = \frac{9.72 \times 12}{24 \times 0.88 \times 9.5} = 0.58$ ($A_s = 0.34$)

use #5 @ 6", $A_s = 0.62$

Bar Cut off @ $(6' - 2) - 1' = 1'-1''$ say 1' from Bot

$pr = (80 \times 8) = 640$

$P = \left(\frac{640}{2} \times 8\right) = 2.56^k$

$M = \left(2.56 \times \frac{8}{3}\right) = 6.83$, $A_s = \frac{6.83 \times 12}{24 \times 0.88 \times 9.5} = 0.41 \text{ in}^2$

Bars Continued to cutoff at 2-2' from Bottom for #5 @ 12"

Bar Extension, $12 d_b = 12 \times 5/8 = 7.5''$
$d_{eff} = 9.5''$
Min 12" $= 12''$

Try Bar Cut off at 3'-0 from Base
Check Mom. at $(3-1) - 1.0 = 2.0'$ from Base
Check Reinf @ $(9-2) = 7'$ Height

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DETAIL Typo 1. wall COMPUTED KVH DATE 8/92

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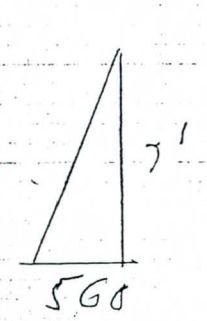
$Ht = 7'$

$pr = (80 \times 7) = 560$

$P = \left(\frac{0.560}{2} \times 7.0\right) = 1.96$

$M = 1.96 \times 7/3 = 4.6^{k'}$



$A_s = \frac{4.6 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.28$

#5 @ 12" Bar Cutoff at 3' from Base is ok

Shear Check:

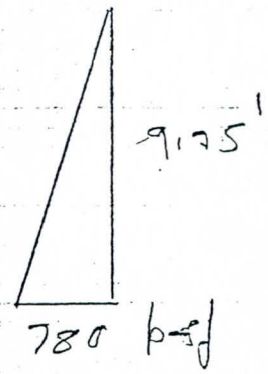
$V = 2.56^k$

$b = 12, \; d = 9.5$

$v = \frac{2.56 \times 1000}{12 \times 9.5} = 22 \text{ psi}$

$\therefore$ ok

Type 2 wall



Ht = 9'-9

$pr = (80 \times 9.75) = 780$

$P = \left(\frac{0.780}{2} \times 9.75\right) = 3.80^K$

$M = \left(3.80 \times \frac{9.75}{3}\right) = 12.4$ kft

$As = \left(\frac{12.4 \times 12}{24 \times 0.88 \times 7.5}\right)$

$= 0.74$

use #6 @ 6", As = 0.88

Try Bar Cutoff at 3' from Base

Check Mom at (9.75 - 2.0) = 7.75'

$Pr = (80 \times 7.75) = 620$

$P = \left(\frac{0.620}{2} \times 7.75\right) = 2.4^K$

$M = \left(2.4 \times \frac{9.75}{3}\right) = 7.8$ kft, $As = \frac{7.8 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.47 \text{ in}^2$

Try Bar Cut off at 3'-6 from Base

$Pr = (80 \times 7.25) = 580$

$P = \frac{0.580}{2} \times 7.25 = 2.10^K$

$M = \left(2.10 \times \frac{7.25}{3}\right) = 5.08$

$As = \frac{5.08 \times 12}{24 \times 0.88 \times 9.5}$

$= 0.30$

∴ Use #5 @ 12" at 3'-6 from Base

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DETAIL Type 3 wall COMPUTED KNH DATE 8/92

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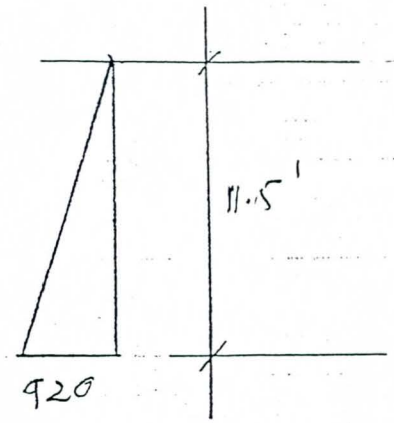
Type 3 wall

Ht = 11'-6"



$p_r = 80(11.5) = 920$

$P = \left(\frac{0.920}{2} \times 11.5\right) = 5.29^{K}$

$M = \left(5.29 \times \frac{11.5}{3}\right) = 20.3^{K'}$

$d_{eff} = (14 - 2.5) = 11.5''$

Alt Bars #7 & #6

#7 @ 12 = 1.20
#6 @ 12 = 0.88 } 1.04

$A_s = \left(\frac{20.3 \times 12}{24 \times 0.88 \times 11.5}\right) = 1.0$

Alt #7 Bars with #6 Bars

$A_s = 1.04$

Bar Cut off

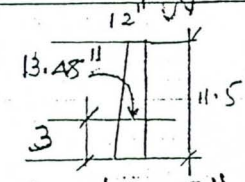
$12 d_b = 12 \times 7/8 = 10.5''$

$d_{eff} = 11.5$

Min 12" = 12"

Use 12" Min beyond the actual Bar Cutoff

Try at (4-0) - 1' = 3'-0"



$\left(13 + \frac{8.5}{11.5} \times 2''\right)$
= 13.48"
d_{eff} = 13.48 - 2.5 = 10.98"

Ht = (11.5 - 3.0) = 8.5'

$p_r = (8.5 \times 80\ psf) = 680\ psf$

$P = \left(\frac{0.68}{2} \times 8.5\right) = 2.89^{K}$

$M = 2.89 \times \frac{8.5}{3} = 8.2^{K'}$

$A_s = \frac{8.2 \times 12}{24 \times 0.88 \times 10.98}$

$= 0.42$

#6 @ 12, $A_s = 0.44$

Use Bar Cutoff at 4'-6 & use #6 @ 12 at top

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DETAIL Type 4 wall COMPUTED KVH DATE 8/92

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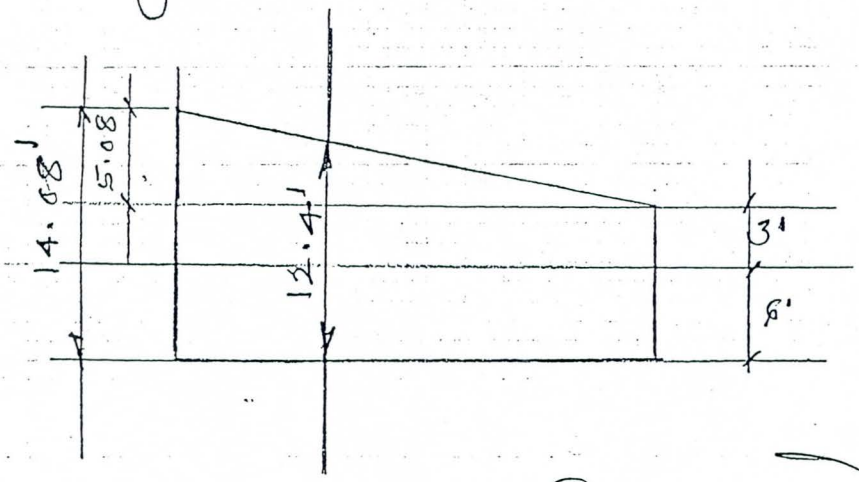
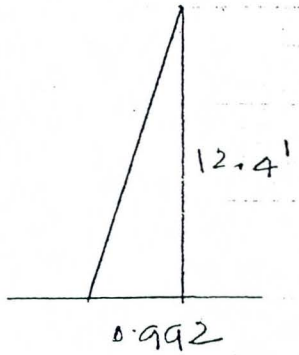
Type 4 wall



Ht @ C.G. $= \left(6 + \frac{2}{3} \times 5.08\right) = 12.4'$

1) Design Ht $= 12.4'$



$P_r = (50 \times 12.4) = 992$

$P = \frac{0.992}{2} \times 12.4 = 6.15^{k}$

$M = 6.15 \times \frac{12.4}{3} = 25.4^{k'}$

$d_{req} = (14 - 2.5) = 11.5''$

$A_s = \frac{25.4 \times 12}{24 \times 0.88 \times 11.5} = 1.25$

use #8 @ 6", $A_s = 1.58$

Shear Check:

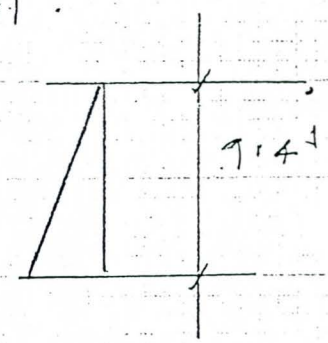
$V_{max} = 6.15^{k}$ $\quad v = \frac{6.15}{12 \times 11.5}$

$= 44.6$ psi

Allow $S_h = 0.95\sqrt{4000} = 60$ psi $\therefore$ OK

b) Check Bar Cut off @ 4'-0

Check at (4 - 1.0) = 3' from Bott.



$Ht = (12.4 - 3.0) = 9.4'$

$pr = (8.0 \times 9.4) = 752$ psf

$P = \left(\frac{0.752}{2} \times 9.4\right) = 3.53^{k}$

$M = \left(3.53 \times \frac{9.4}{3}\right) = 11.1$ k/ft

$d_{eff} = (14 - 2 - 0.5 - 0.5) = 11.0$

$A_s = \frac{11.1 \times 12}{24 \times 0.88 \times 11} = 0.57$

use #6 @ 6" & Bar Cutoff at 3'-6

c) Check Bar Cutoff at 7'-0

Check at (7 - 1.0) = 6' from Bottom

$Ht = (12.4 - 6.0) = 6.4'$

$pr = 80 \times 6.4 = 512$

$P = \frac{0.512}{2} \times 6.4 = 1.64^{k}$

$M = 1.64 \times \frac{6.4}{3} = 3.5$ k/ft

$A_s = \frac{3.5 \times 12}{24 \times 0.88 \times 10.5} = 0.19$

use min #5 @ 12

$d_{eff} = (14 - 2.0 - 0.5 - 1.0)$
$= 10.5$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

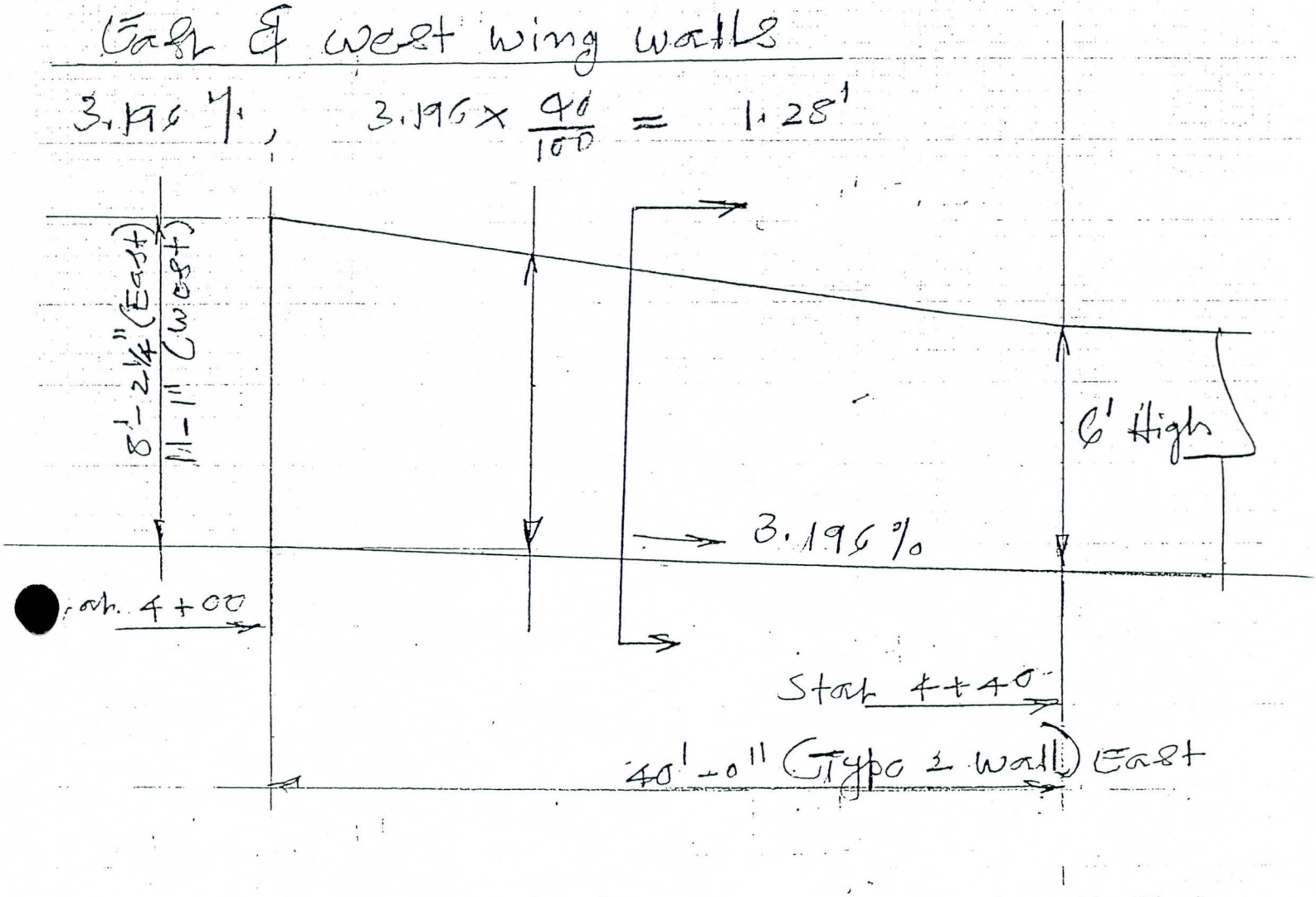
PROJECT Spook Hill outlet PAGE 28 OF

DETAIL East wing wall COMPUTED KVH DATE Aug 9

CHECKED BY DATE

East & west wing walls

3.196 %, $3.196 \times \frac{40}{100} = 1.28'$



East (8'-2) - 6 = 2'-2

Design Ht = 6' + 2/3 (2.17) = 7'-6"

∴ Use Type 2 Wall Detail - East wing

West (11'-1) - 6 = 5.08', Design Ht = 6 + 2/3 (5.08) = 9.4'

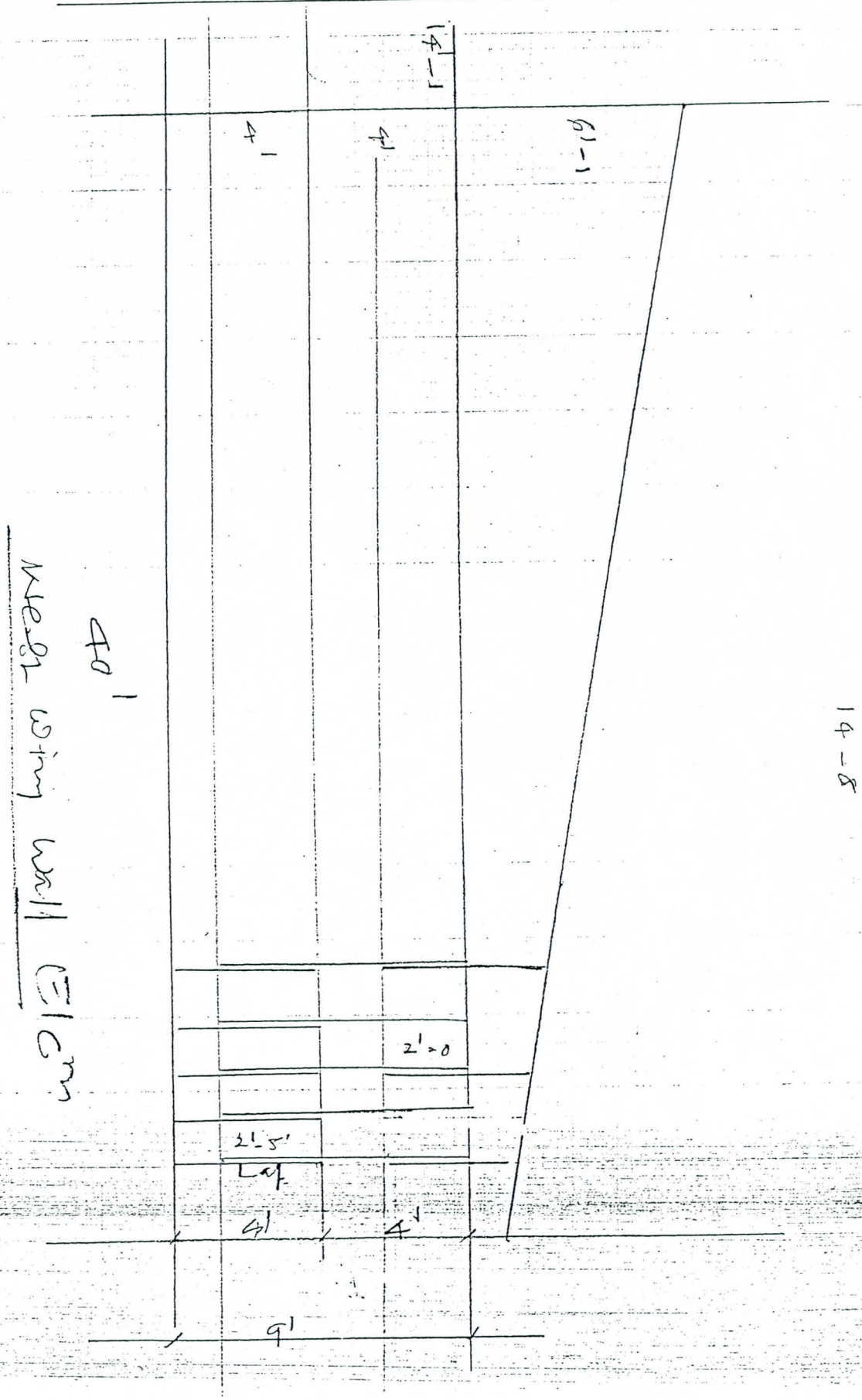
Use Type 4 wall Detail with 9'-0 Footing width

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL West Wingwall COMPUTED KVH DATE 9/92

CHECKED BY DATE

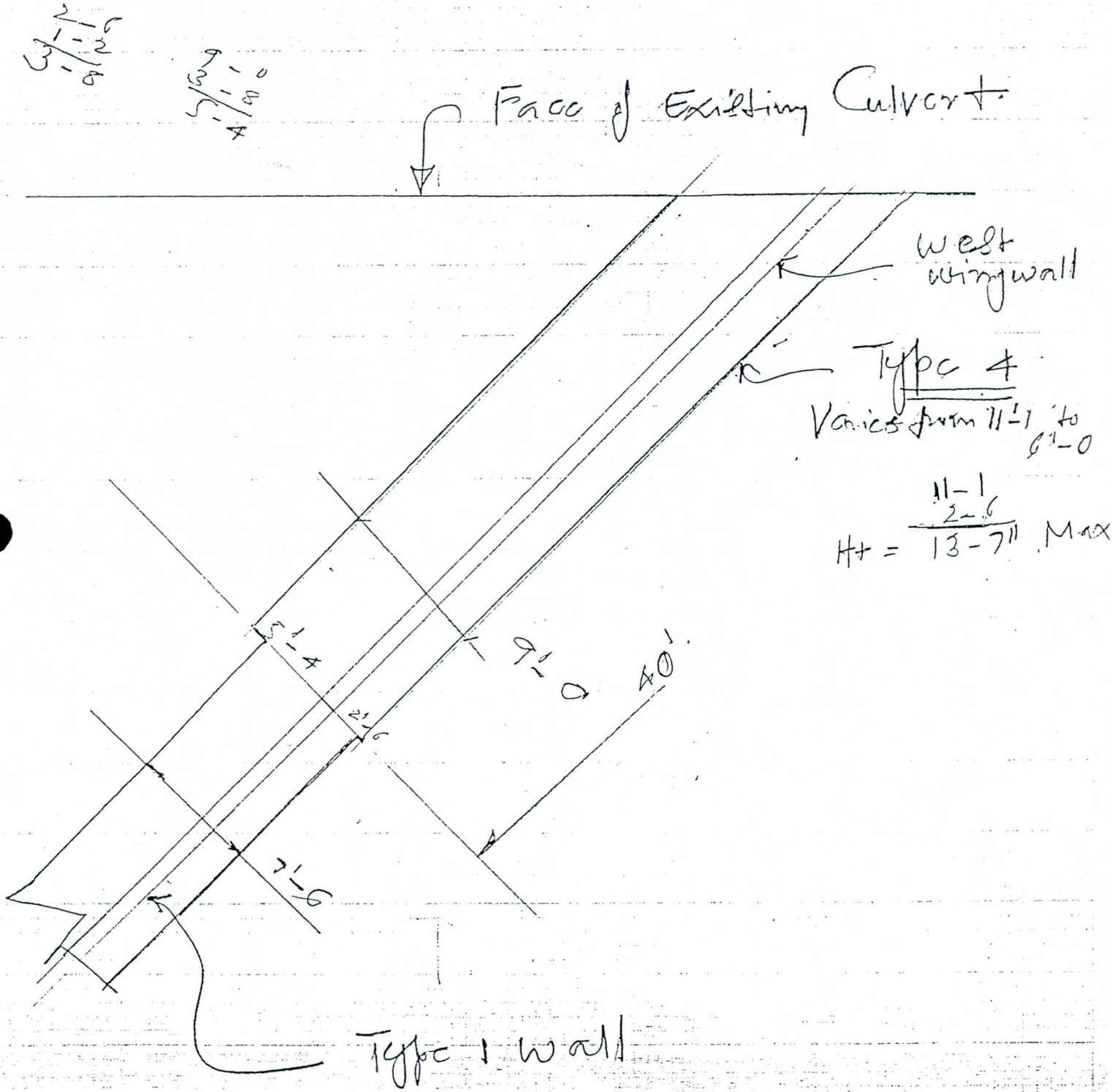


FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Shook Hill Outlet PAGE 30 OF

DETAIL Plan West wing COMPUTED KVH DATE 8/92

CHECKED BY DATE



Plan West wing wall

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill PAGE ____ OF ____

DETAIL Wing Wall COMPUTED KVH DATE 5/93

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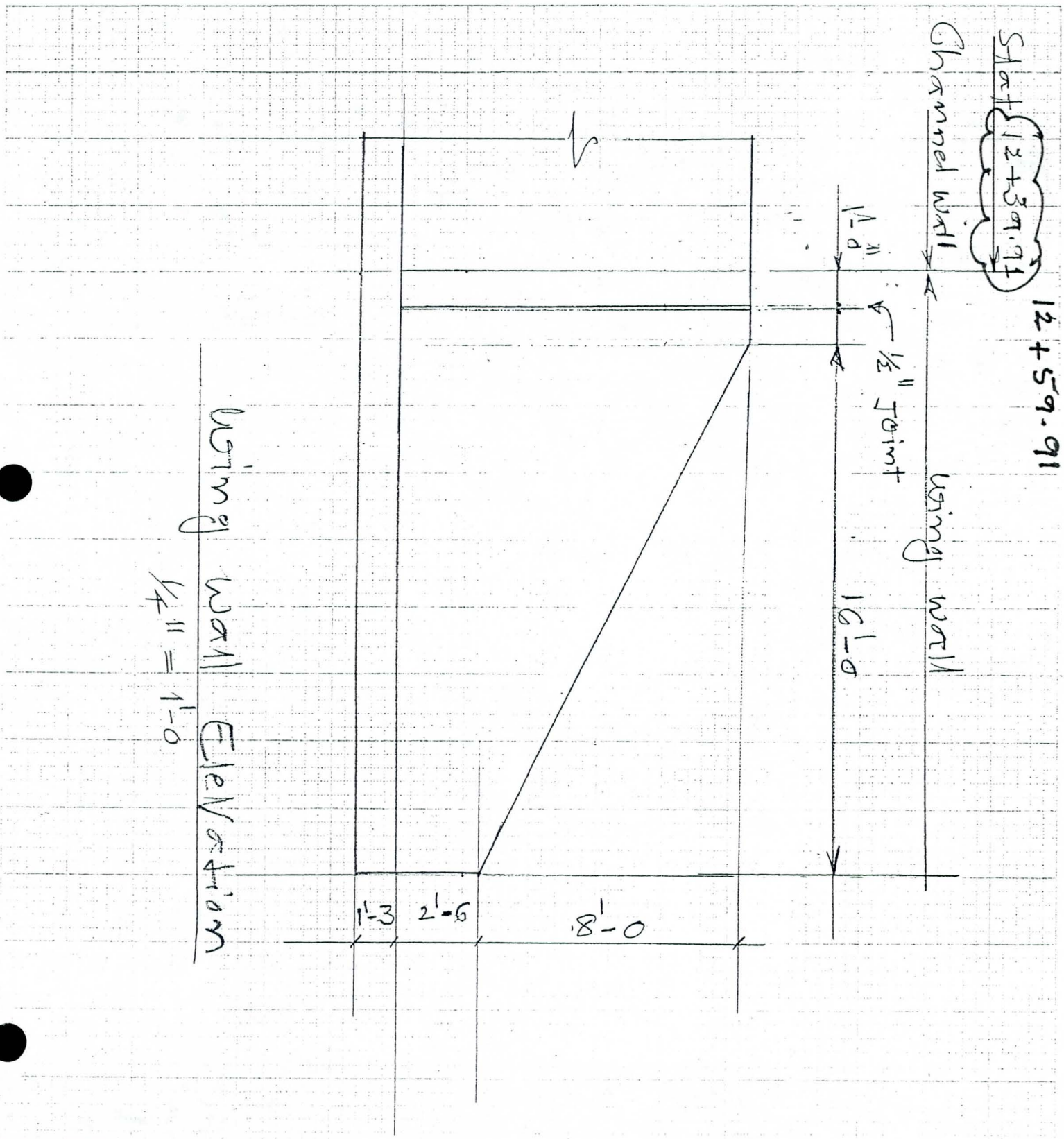
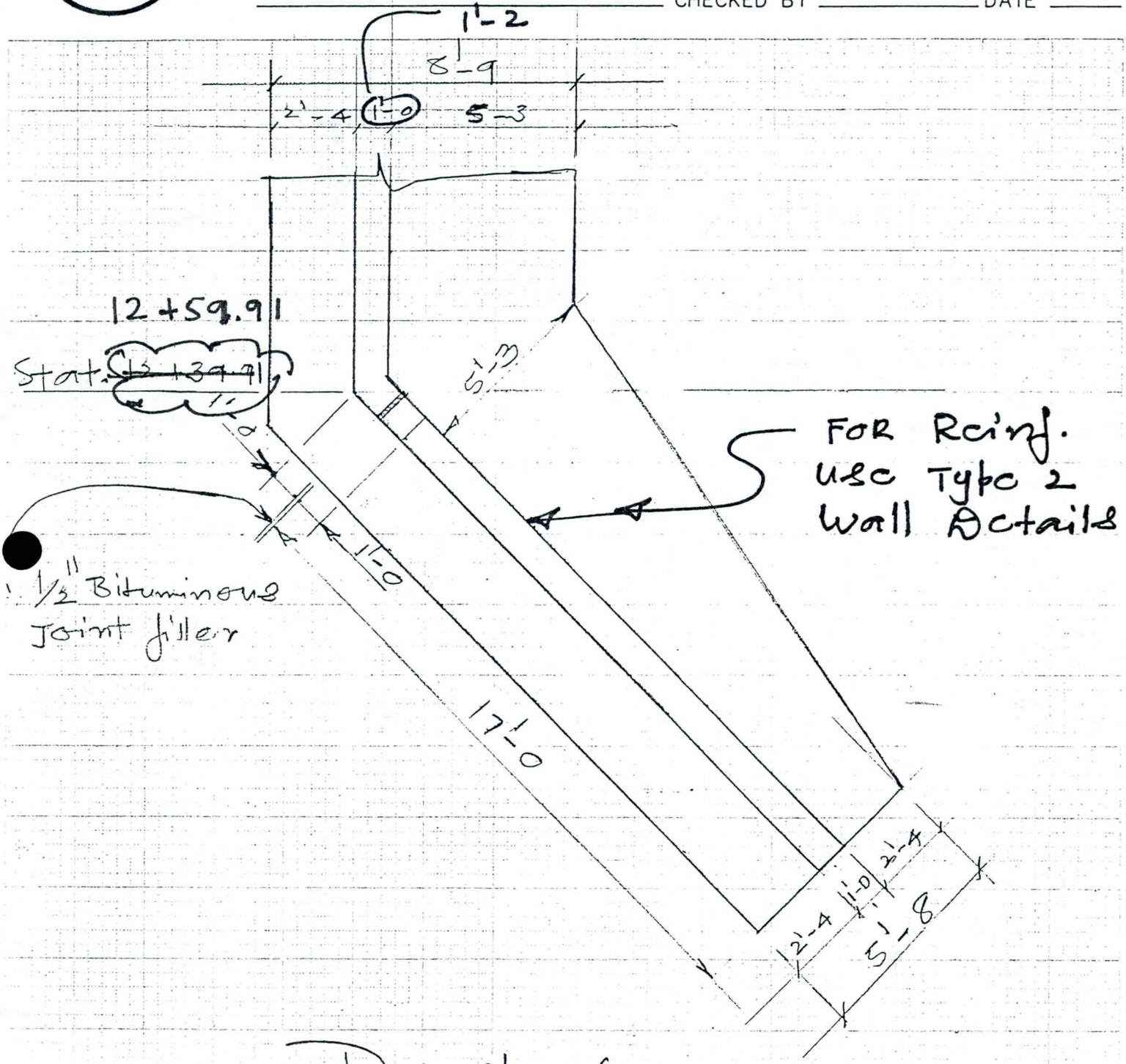


FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Wing wall Detail COMPUTED KVH DATE 5/93

CHECKED BY ____ DATE ____



Detail - 1

Scale 1/4" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Reinf. Steel COMPUTED KVH DATE ____

CHECKED BY ____ DATE ____

Comparision of Steel Between old & New

Previous Steel: Stat. (3+93) To (6+50)

(7) & (8) #4 @ 18"

Nos $7 \times 12 / 18 = 5$ Sp – 6 Bars

Top & Bott. = $6 \times 2 = 12$ #4 + 1 Key = 15

(9) #4 @ 18, Nos = $\frac{7 \times 12}{18} = 5$ Sp – 6 Bars

(10) #4 @ 12" Nos = $\frac{7 \times 12}{12} = 7$ Sp – 8 Bars

Total No. of Bars = (15 + 6 + 8) = 29

Tot. Length = (29 × 473) = 13717 ft

#4 @ (0.668 × 13717) = 9163 lbs

Laps = $\frac{473}{30} = 16$

16 Laps @ 1-6 = 16 × 1.5 = 24

Tot. Length = (29 × 24) = 696 Lft

#4 @ (0.668 × 696) = 465

9628

Steel Now

from 1.7, (12333 + 623 + 5684 + 288) = 18928

Diff = (18928 − 9628) = 9300 lbs

Stat (6+60) To (8+50)
(8+60) To (10+50)
(10+60) To (12+39)

10000
10000
10000
39300

Say 40,000 lbs mrc

MESSAGE DISPLAY FOR KUMAR HANUMAIAH

To: EOM
EAR
KVH

From: Kumar Hanumaiah:TALOS
Postmark: 07/27/93 01:26PM
Status:

Host: TALOS
Delivered: 07/27/93 01:26PM

Subject: Spookhill Outlet Channel

Message:
I gave you a set of Plans of the above referenced project.The design has already been checked by Wainwright and reviewed by scs and we provided a little more reinforcing steel than what is actually required by design as per scs request.Now what I need from you is just the quantities of concrete and reinforcing steel.As you can see from sheet 11 of drawing set,there are 8 stationings and three differant wall types in the table. Keep the quantities of concrete and steel seperate between each stations and a total summary sheet at the end,so that quantities can be checked easily.Let me have these quantities by Monday,August 2, or earlier if you can , so that I can give the final quantities to Besian as soon as possible.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 1 OF

DETAIL Concrete Qty COMPUTED KWH DATE 7/93

CHECKED BY DATE

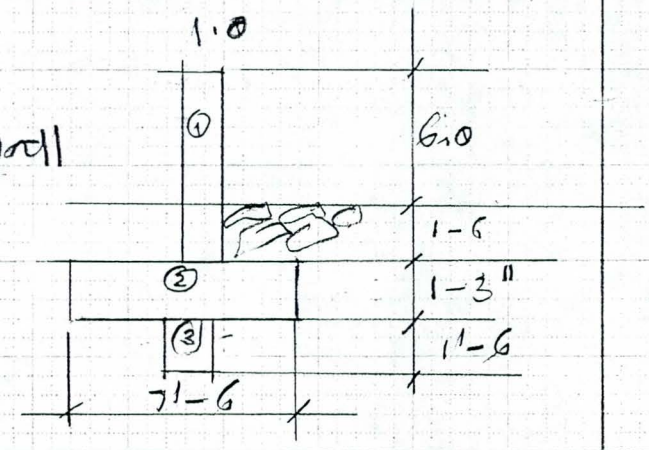
Concrete Qty:

1.) (3+93) To (6+50) (LT) L = 257'

(4+34) To (6+50) (RT) L = 216

L = (257 + 216) = 473'

Type 1. wall



A_1 = (1.0 x 7.5) = 7.50

A_2 = (1.25 x 7.5) = 9.38

A_3 = (1.25 x 1.5) = 1.88

18.76 Sq ft

Q1 = (18.75 x 473) / 27 = 328.6 CY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 2 OF

DETAIL Concrete Hyd COMPUTED KVH DATE 7/93

CHECKED BY DATE

2) Sta 6+50 TO 6+60

$L = 10'$

$A_1 = (1.0)\left(\frac{9.5+8.67}{2}\right) = 8.09$

$A_2 = 8 \times 1.25 \times = 10.00$

$A_3 = (1.25 \times 1.5) = 1.88$

19.97 sqft

$Q_2 = (19.97 \times 10)/27 \; 2$ = CY

2 Sides 14.8

3) Sta. (6+60) TO (8+50)

$L = 190'$

$A_1 = 8.67 \times 1.0 = 8.67$

$A_2 = 8.00 \times 1.25 = 10.00$

$A_3 = 1.25 \times 1.5 = 1.88$

20.55

$Q_3 = \left[(20.55 \times 190)/27\right] 2$ = 289.2

2 Sides

4) Sta (8+50) TO (8+60)

$L = 10'$

$A_1 = 1.0 \times \left(\frac{8.67+9.83}{2}\right) = 9.25$ sqft

$A_2 = (8 \times 1.25) = 10.00$

$A_3 = (1.25 \times 1.5) = 1.88$

21.13 sqft

$Q_4 = \frac{(21.13 \times 10)\,2}{27}$ = CY 15.7

319.7

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 3 OF

DETAIL Concrete Qty COMPUTED KNH DATE 7/93

CHECKED BY DATE

5) Stat. (8+60) To (10+50)

L = 190 Ht = (8.33 + 1.5) = 9.83'

A_1 = (1.0 × 9.83) = 9.83

A_2 = (8.0 × 1.25) = 10.00

A_3 = (1.25 × 1.5) = 1.88

21.71

$Q_5 = \frac{(21.71 \times 190)}{27}^2$ = 305.6 CY

6) Stat. (10+50) To (10+60)

L = 10' H_1 = (8.33 + 1.5) = 9.83

H_2 = (9.5 + 1.5) = 11.00

$A_1 = \frac{(9.83 + 11.0)}{2} 1.17$ (.5 wall thickness) = 12.19

A_2 = (8.75 × 1.25) = 10.94

A_3 = (1.25 × 1.5) = 1.88

25.01

$Q_6 = (25.01 \times 10/27)^2$ = 18.5

324.1

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 4 OF

DETAIL Concrete Qty-2 COMPUTED KVH DATE 7/93

CHECKED BY DATE

7) Stat (10+60) To (12+39.91)

L = 180' Ht = (9.5 + 1.5) = 11.0'

A_1 = (1.17 x 11) = 12.87

A_2 = (8.75 x 1.25) = 10.94

A_3 = (1.25 x 1.5) = 1.88

25.69

Q_7 = (25.69 x 180)2/27 = 342.5 cy

8) Stat. (12+39.91) To (12+59.91)

L = 20' Ht = 11.0 Ht = 9 + 1.5 = 10.5

Ht Av = 10.75

A_1 = 10.75 x 1.17 = 12.58

A_2 = 1.25 x 8.75 = 10.94

A_3 = 1.25 x 1.5 = 1.88

25.4

Q_8 = (25.4 x 20)2/27 = 37.6

9) Wing wall @ the End

L = 17' Ht = (2.5 + 10.5)/2 = 6.5'

A_1 = (1.0 x 6.5) = 6.50

A_2 = 1.25 x ((8.75 + 5.67)/2) = 9.01

A_3 = (1.25 x 1.5) = 1.88

17.39

Q_9 = (17.39 x 17)2/27 = 21.9

402. cy

Total (over All) = (328.6 + 319.7 + 324.1 + 402.) = 1374.4 cy

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

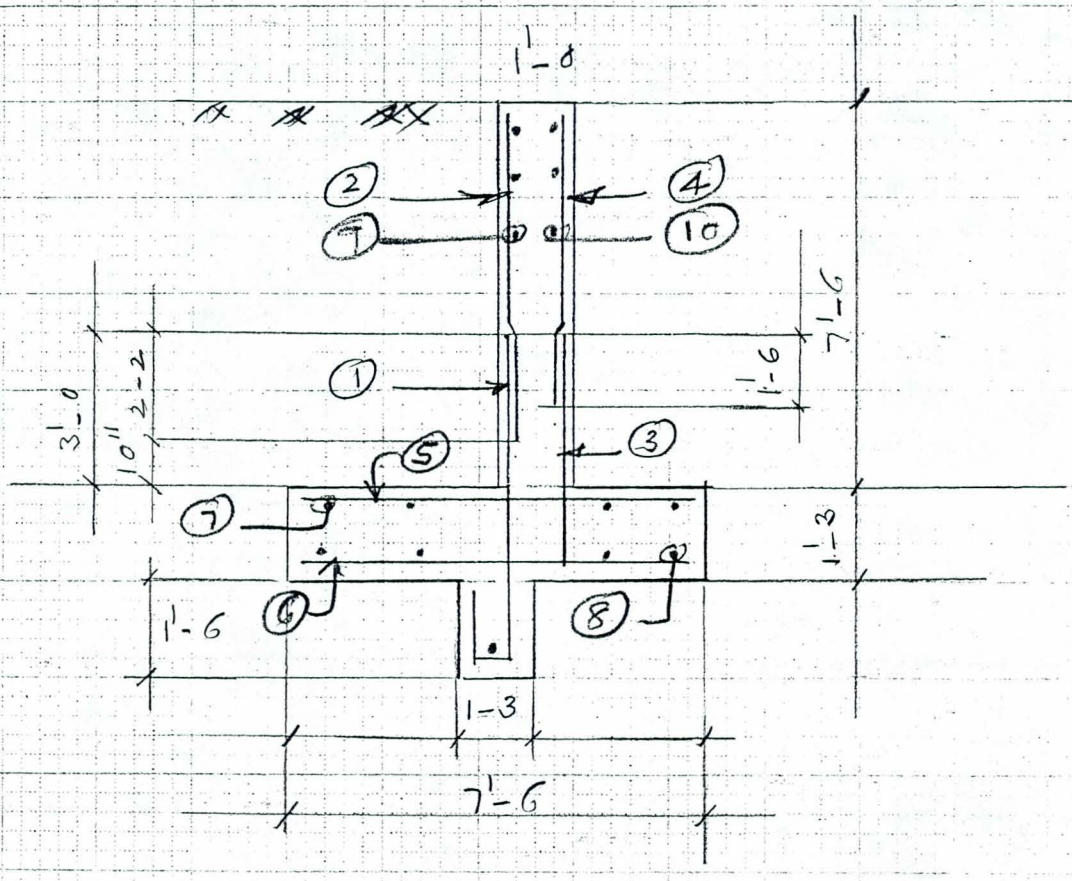
PROJECT Spook Hill PAGE 5 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Reinforcing Steel

Sta (3+93) To (6+50)



Type 1 wall

(NTS)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 6 OF

DETAIL Reinf Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Reinf. Steel:

Typ. 1 wall Sta (3+93) To (6+50)
(4+34) To (6+50)

①

L = 7'-5 #5 @ 6

L = (257 + 216) = 473

Nos = (473 × 12/6) = 946 Spl, 947 Bars

Wt = (6.417) 1.043 = 7.736 lbs
#5 Bar

Tot. Wt = (7.736) 947 = 7326

② #5 @ 12, L = 6-6

Wt = (1.043) 6.5 = 6.78 lbs

Nos = 473 × 12/12 = 473 Sp - 474

Tot. Wt = (474) 6.78 = 3214

③ #5 @ 12, @ 1.043 lbs L = 4.0'

Wt = (1.043)(4) = 4.172 lbs

Nos = 474

Tot. Wt = (4.172)(474) = 1978

④ #5 @ 12, L = 5-10

Wt = (5.83) 1.043 = 6.08 lbs/Bar

Nos = 474,

Tot. Wt = (474) 6.08 = 2882

15400 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 7 OF

DETAIL Reinf Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

(5) #5 @ 9", L = 7-2"

wt = (1.043) 7.17 = 7.48 lbs/lin ft

No. = 473 x 12/9 = 630 sp = 631 Bars

Tot. wt = (631 x 7.48) = 4720 lbs

(6) # 4 @ 9" L = 7.17'

wt = (0.668) 7.17 = 4.79 lbs

4 Bar

No. = 631, Tot. wt = (631 x 4.79) = 3022

(7) & # 5 Bars No. = (8 x 2) + 1 = 17

(8) Top & Bot Key

No. (floating) = 17

(9) #5 Bars, 7 x 12/12 = 7 Spgs, 8 Bars

Total = 17 + 8 = 25 Bars

Tot. Length = (473) 25 = 11825 ft

Tot. wt = 1.043 (11825) = 12333

Laps with 30' Length, 473/30 ≈ 16

16 Laps of 1.5, 16 x 1.5 = 24 ft

Tot. Length = 25 x 24 = 600 Lin ft
Bars

wt = (1.043) 600 = 623

(10) #6 @ 12" @ 1.502 lbs/ft

No. = 8, Tot. Length = (473) 8 = 3784

Wt = (3784) 1.502 = 5684

Splice Length = (1.5 x 8) 16 = 192'

Wt = 192 x 1.502 = 288 — 288

26670

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

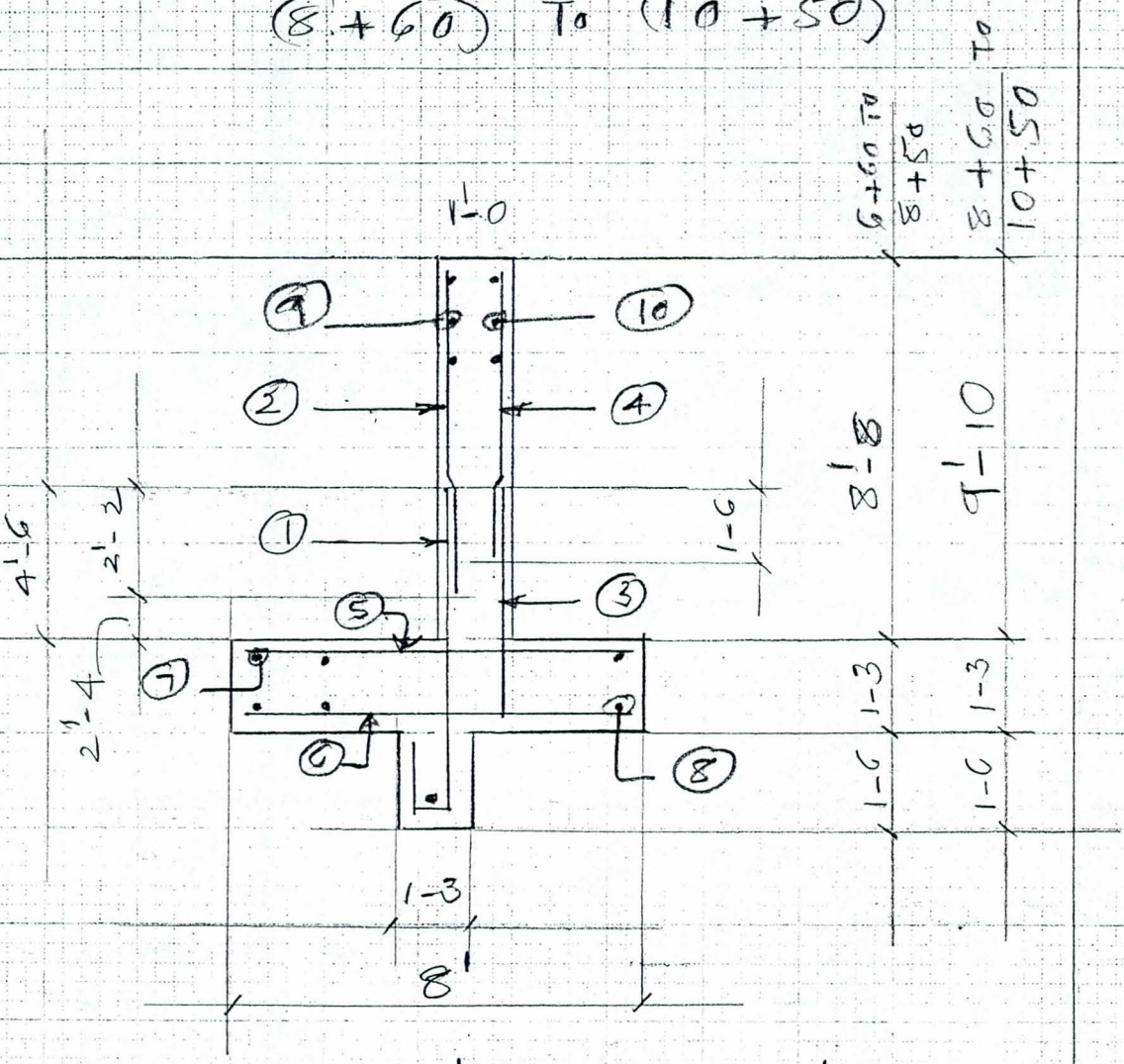
PROJECT Spook Hill PAGE 8 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Start (6+60) To 8+50

(8+60) To (10+50)



Typical 2 Wall

NTS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 9 OF

DETAIL Reinf. Steel COMPUTED KNH DATE 7/93

CHECKED BY DATE

Stat. (6+60) To (8+50)

L = 190' #6 @6" @ 1.502 lbs/ft

① 1'-3 | 7' 8" L = 8'-11"

Nos = 190 × 12 / 6 = 380-381

wt = (8.917 × 1.502) = 13.393 lbs

Tot. wt = (381 × 13.393) 2 = 10205

2 walls

② #5 @12" L = 6-2

(1.043) 6.167 = 6.432 lbs/Bar

Nos = 190 × 12/12 = 190 – 191 Bars

Tot. wt = (6.432) 191 × 2 = 2457

③ #5 @12" L = 5-6

wt = (1.043) (5.5) = 5.737 lbs/Bar

Nos = 191, wt = (5.737) 191 × 2 = 2192

2 walls

④ #5 @12, L = 5-6

Wt = (5.5 × 1.043) = 5.737 lbs

Wt = 5.737 × 191 × 2 = 2192

⑤ #5 @9", L = 9.67'

wt = 9.67 × 1.043 = 8.0 lbs

Nos = 190 × 12 / 9 = 253 – 254 Bars

wt = (8.0 × 254) 2 = 4064

21110 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 10 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

(6) #4 @ 9" @ 0.668 lbs/ft

L = 7.67, Wt. = (7.67 x 0.668) = 5.123

No. = 190 x 12/9 = 253 - 254 lbs

Wt = (5.123 x 254) 2 = 2602

2 sides

(7) Top 9 Bars
(8) Bot. 9 Bars
(9) Wall 10 Bars

Total (28 #5 + 1 Key)

(29 x 190 x 1.043) 2 = 11494

Laps @ 30', 190/30 = 7 Spls - 6 Laps

Lap Length 1'-6 = (29 x 1.5 x 6) = 261

Wt = (1.043)(261) 2 = 545

(10) #6 @ 12, No. = 10

(10 x 190 x 1.502) 2 = 5708

2 walls

Lap: (10 x 1.5 x 6) = 90 Lift

Wt = (1.502 x 90) 2 = 270

2 walls

20619

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 11 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Star (8+60) To (10+50)

L = 190' #6 @ 6"

L = 8.917, (8.917 x 1.502) = 13.393

1-31 | 7'
8

No. = $\frac{190 \times 12}{6}$ = 380 - 381

Tot. wt = (13.393 x 381) 2 = 10205 lbs

(2) #5 @ 12, L = 7-4

(1.043) 7.33 = 7.645 ← 2 walls

Tot. Wt = (7.645) 191 x 2 = 2920

(3) Same as on Page 9 = 2192

(4) #5 @ 12", L = 6-8

wt = (6.667 x 1.043) = 6.954 lbs

Tot. wt = (6.954 x 191) 2 = 2656

(5) #5 @ 9" Same as on P. 9 4064

(6) #4 @ 9" Same as on p. 9 2602

(7) Top 9 Bars } (29 #5 + 1) = 30 #5
(8) Bott. 9 Bars } Key
(9) Wall 11 Bars

(30 x 190 x 1.043) 2 = 11890

Laps: (30 x 1.5 x 7) = 315'

Wt = (1.043 x 315) 2 = 657

(10) #6 @ 12, No. = 11, (11 x 190 x 1.502) 2 = 6278

Lap: (11 x 1.5 x 7) = 116 = 349

wt = (116 x 1.502) 2 =

43813

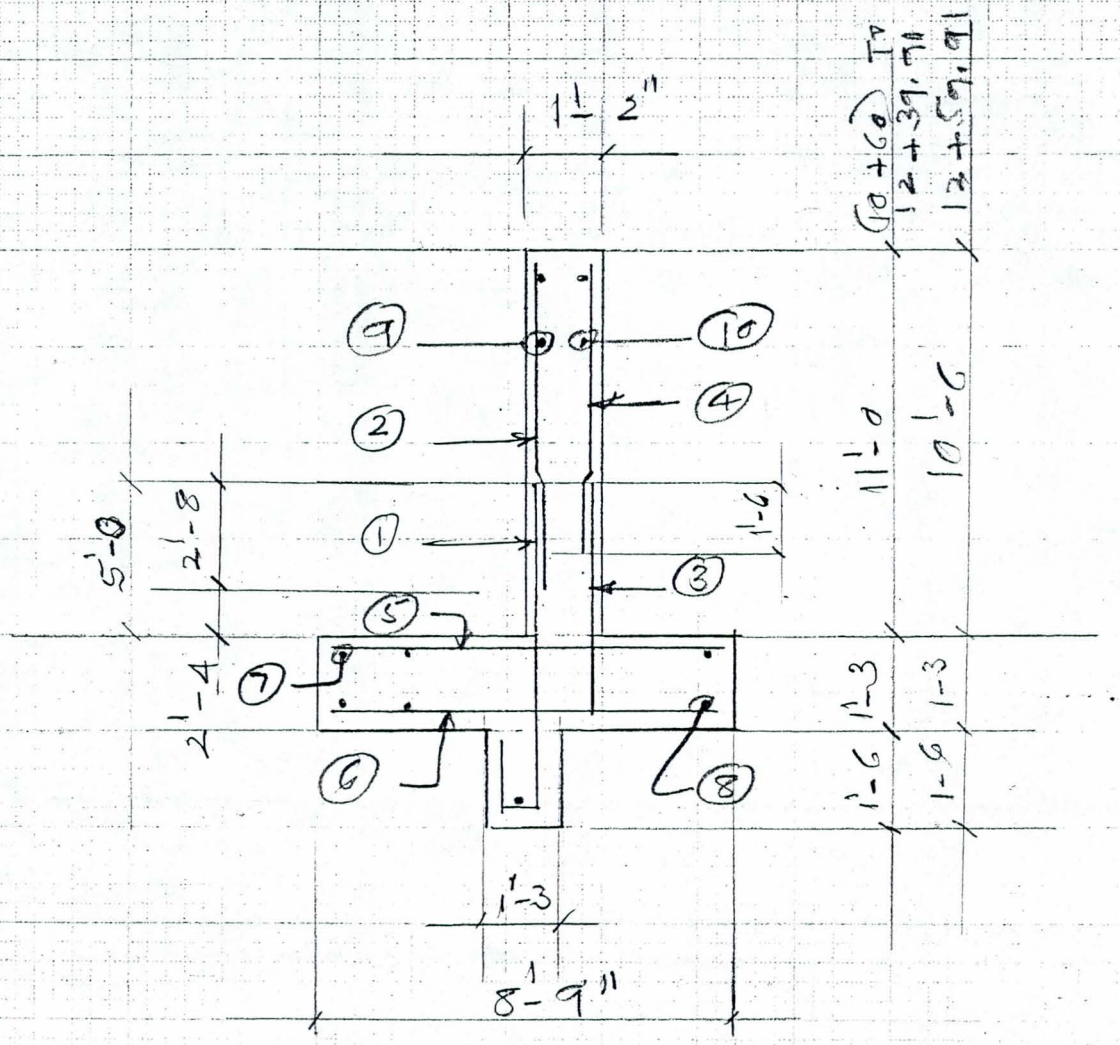
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 12 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Stat. (10+60) To (12+39.91)



Type-3 Wall

NTS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 13 OF

DETAIL Retaining Wall COMPUTED KVH DATE 7/93

CHECKED BY DATE

Start (10+60) To (12+39.91)

L = 180' #7 @ 6" @ 2.044 lbs/ft

(1) 7'-6 / 1'-3 / 8" L = 9.42', (9.42 x 2.044) = 19.254

No# = 180 x 12/6 = 360 - 361

Tot wt = [(19.254) 361] 2 = 13901 lbs

(2) L = 8'-6 #6 @ 12", @ 1.502 lbs/ft

wt = (8.5 x 1.502) = 12.767

No# = 180 x 12/12 = 180 - 181

Tot. wt = (181 x 12.767) 2 = 4622

(3) L = 6'-0 #5 @ 12", (1.043 x 6) = 6.258

No# = 181, Tot. wt = (6.258 x 181) 2 = 2265

(4) L = 7'-4, #5 @ 12, (1.043 x 7.33) = 7.645

No# = 181, Tot. wt = (7.645 x 181) 2 = 2768

2 walls

(5) #6 @ 9", L = 8'-5, (1.502 x 8.417) = 12.642

No# = 180 x 12/9 = 240 - 241

Total wt = [(241) 12.642] 2 = 6093

(6) #5 @ 9", L = 8'-5, (1.043 x 8.417) = 8.779

No# = 241,

Total wt = (8.779 x 241) 2 = 4231

33880 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 14 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Stat (10+60) To (12+39.91) Cont'd

(7) 9 #5 Bars Top of footing

(8) 9 #5 Bott. of footing

(9) 12 #5 back face of wall

Total Bars = 9+9+12+1 = 31
for key

(31 x 180 x 1.043) 2 = 11640 lbs

Lap @ 30', (180/30) = 6 sets - 5 Laps

Lap 1'-6" (31 x 1.5 x 5) = 232'

[@ 1.043 x 232] 2 = 484
2 walls

(10) #6 @ 12, (12 x 180 x 1.502) 2 = 6489

Lap: (12 x 1.5 x 5) = 90'
No. of Bars — No. of Laps

(@ 1.502 x 90) 2 = 270
2 walls.

18883 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 15 OF ____

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY ____ DATE ____

Stat. (12 + 39.91) To (12 + 59.91)

Use the same steel as from Stat (10+60) To (12 + 39.91)
Use Increased Lengths for wall steel.

By proportioning as per Lengths

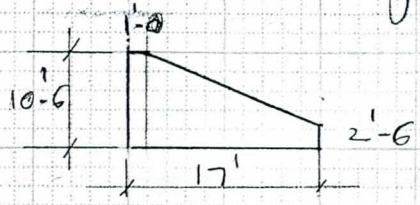
L_1 (previous) = 180'
L_2 (Now) = 20'

Wt. of Steel = 33880 lbs (P. 13)
— " — 18883 (P. 14)
52763

Wt of Reinf = (52763 × 20/180) = 5863 lbs

Wing walls @ Stat. 12 + 59.91

Using wall Type 2 Reinf.



Av. Ht. of wall = $\frac{(2.5 + 10.5)}{2}$
= 6.5'

use $\frac{2}{3}$ Ht because of Bars of Varying Lengths & different Splices.

Ht = $\frac{2}{3}$ (10.5) = 7'

From P. 9 = 21110 lbs
— " — P. 10 = 20619
For (19 × 2)' → 41729

By proportioning for 17 × 2 = $\frac{41729 \times 34}{380}$
= 3734 lbs

By proportioning for Heights = (3734 × $\frac{7}{8.67}$) wall Ht for Type 2 = 3015

8878

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 16 OF

DETAIL Reinf Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

Start (6+50) to (6+60)

L = 10' x 2 = 20'

using the same steel as Type. 2

Total Steel = (21110 + 20619) = 41729 lbs

p. 9 p. 10

By proportioning = $\frac{41729 \times (2 \times 10)}{(190 \times 2)}$ = 2196 lbs

Start (8+50) to (8+60)

Same as above using Type. 2 wall = 2196

Start (10+50) to (10+60)

L = 10 x 2 = 20'

using Type 3 wall

Total Steel = (33880 + 18883) = 52763

p. 13 p. 14

By Proportioning = $\frac{(52763)(2 \times 10)}{(180 \times 2)}$ = 2931

7323

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 17 OF

DETAIL Reinf. Steel COMPUTED KVH DATE 7/93

CHECKED BY DATE

SUMMARY

		lbs
Stat. (3+93) To (6+50)		
15400 + 26670 =		42070
Page 6 P.7		
Stat (6+60) To (8+50) &		
(8+60) To (10+50)		
(21110 + 20619 + 43813) =		85542
P.9 P.10 P.11		
Stat (10+60) To (12+39.91)		52763
(33880 + 18883) =		
P.13 P.14		
Stat. (12+39.91) To (12+59.91)		
Page 15 =		5863
Wing walls @ Stat. (12+59.91)		
Page 15 =		3015
Stat. (6+50) To (6+60)	Page 16	2196
Stat. (8+50) To (8+60)	page 16	2196
Stat. (10+50) To (10+60)	page 16	2931
		196576 lbs

Total Steel = 196.6 K

= 98.3 Tons

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____

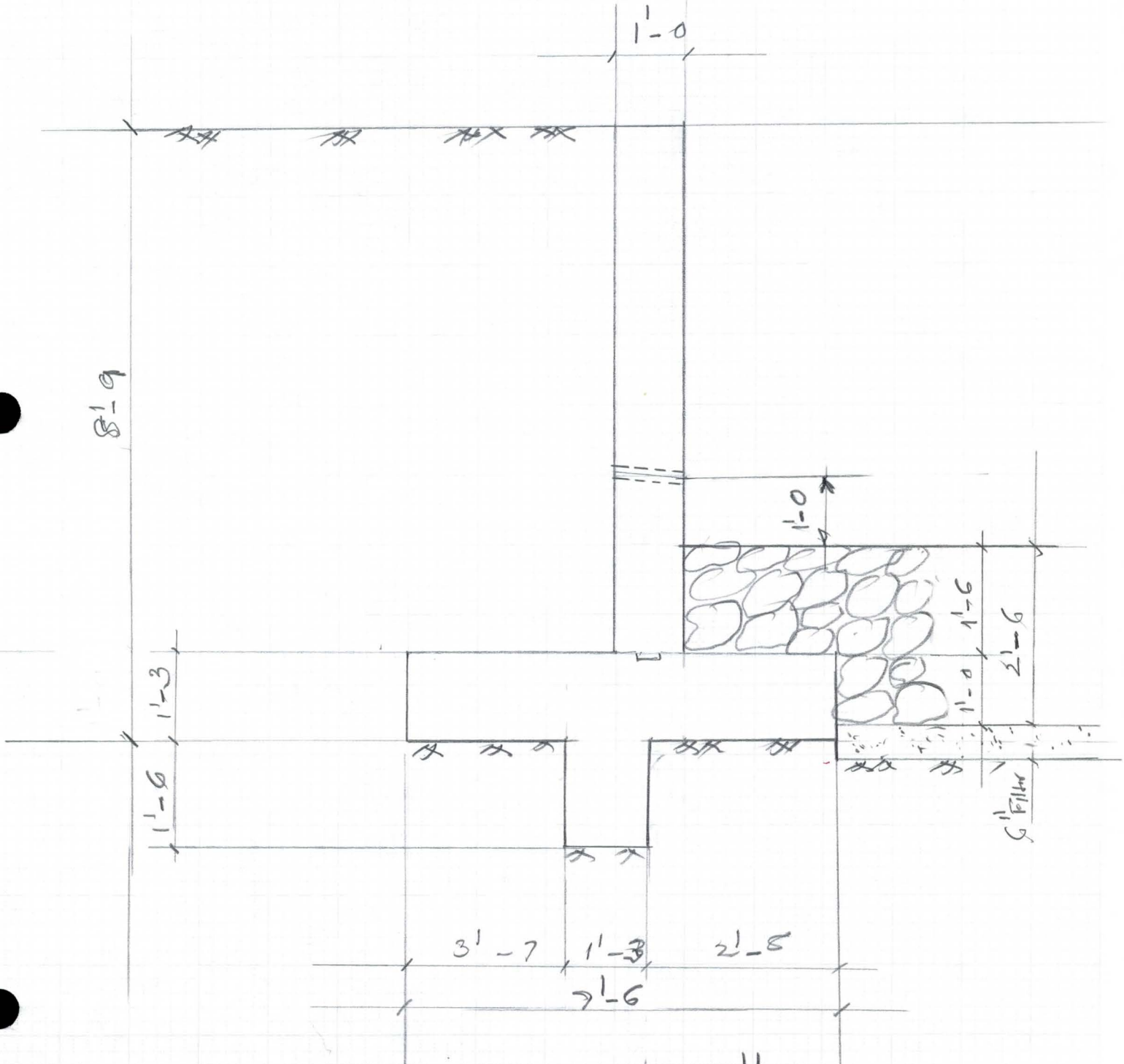
SPOOKHILL OUTLET

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL ____ COMPUTED KVH DATE Oct 92

____ CHECKED BY ____ DATE ____



Type 1 wall

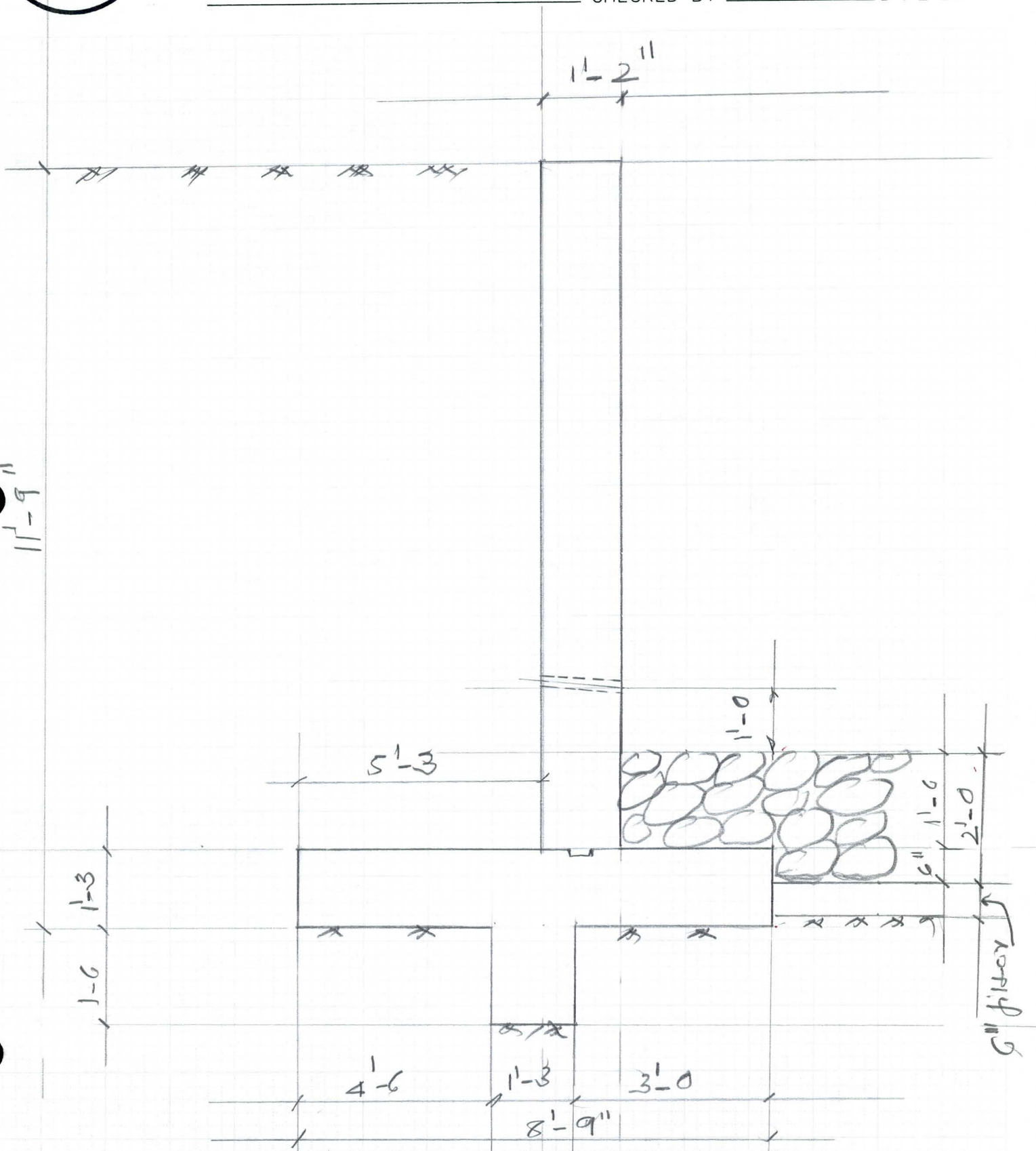
1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

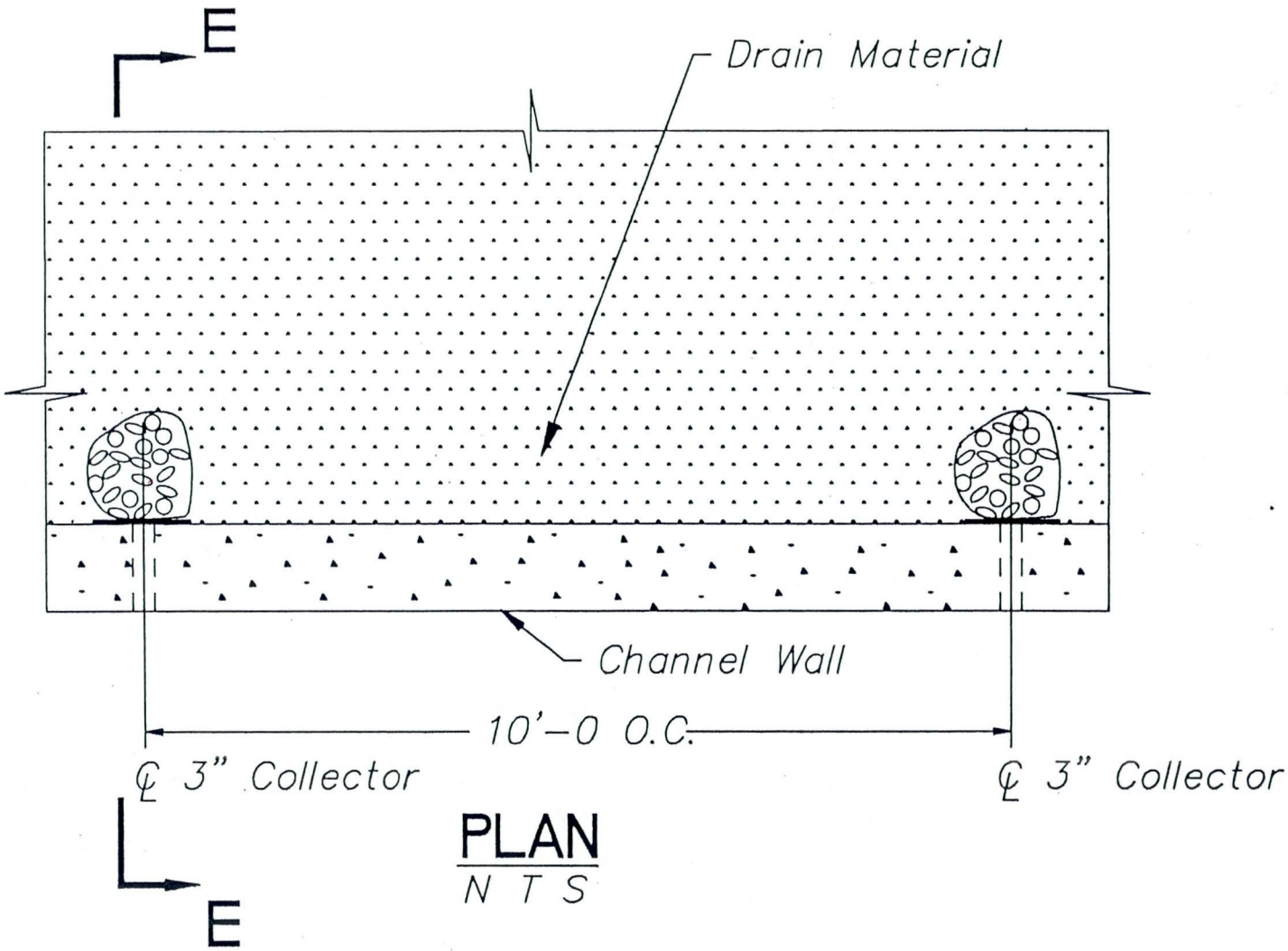
DETAIL ____ COMPUTED KVH DATE 10/92

CHECKED BY ____ DATE ____



Teppo 3 wall

1/2" = 1'-0



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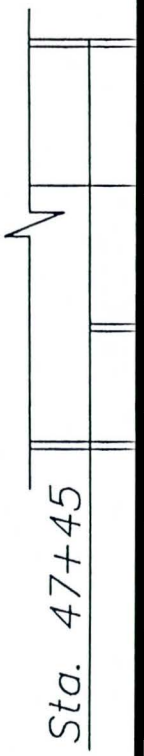
N T S

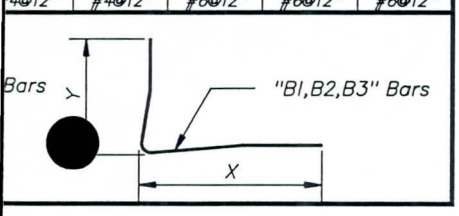


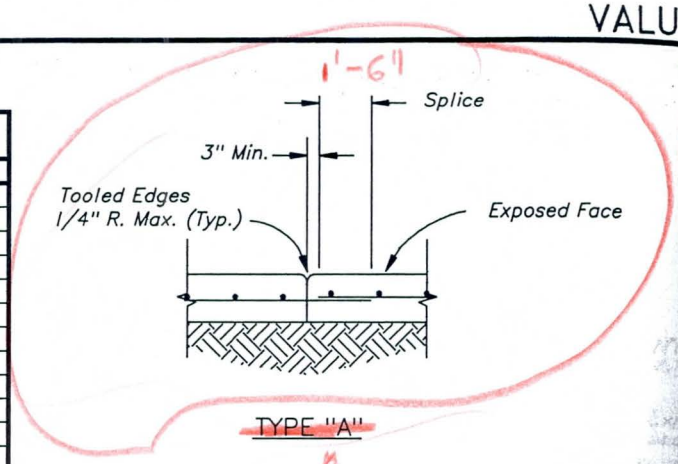
8"x8" No. 4 Mesh

Coarse Aggregate F

8"x8" No. 4 Mesh Galvanized
wire cloth, 16 gu e min.

ALL [redacted] EDULE				
D–D	E–E	F–F	G–G	H–H
'–10"	13'–3"	17'–8"	22'–0"	22'–6"
–	–	10'–0"	10'–0"	10'–0"
'–6"	10'–0"	16'–1"	20'–6"	24'–9"
'–0"	7'–0"	11'–0"	14'–0"	18'–0"
'–0"	1'–2"	1'–7"	2'–0"	2'–3"
'–0"	1'–3"	1'–8"	2'–2"	2'–5"
5@12"	#5@12"	#5@12"	#7@9"	#7@9"
'–3"	9'–6"	13'–6"	7'–9"	5'–6"
'–0"	7'–0"	10'–0"	12'–6"	14'–9"
5@12"	#6@12"	#7@12"	#7@9"	#7@9"
'–9"	3'–0"	9'–6"	11'–3"	13'–0"
'–0"	8'–6"	13'–9"	5'–6"	11'–3"
–	#6@12"	#8@12"	#7@9"	#8@9"
–	5'–9"	6'–3"	4'–9"	9'–0"
–	4'–0"	6'–6"	8'–6"	7'–3"
5@12"	#5@12"	#5@12"	#5@9"	#5@9"
'–1"	1'–1"	1'–1"	1'–1"	1'–1"
–	–	–	#6@9"	#7@9"
–	–	–	13'–6"	9'–5"
–	–	–	1'–5"	1'–11"
–	#5@12"	#5@12"	#5@9"	#5@9"
–	1'–1"	1'–1"	1'–1"	1'–1"
–	–	–	#5@9"	#5@9"
–	–	–	13'–0"	12'–0"
–	–	–	1'–1"	1'–1"
4@12"	#4@12"	#6@12"	#6@12"	#6@12"





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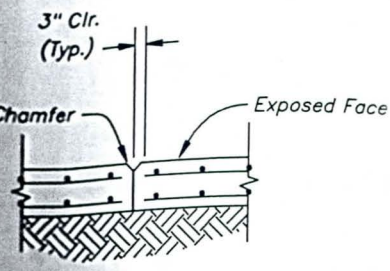
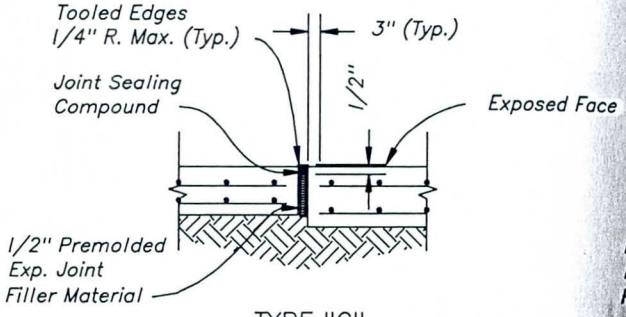
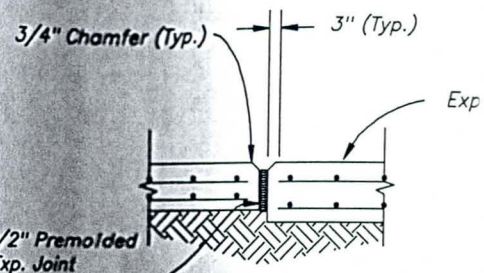


TYPE "B"

CONSTRUCTION JOINTS
NOT TO SCALE

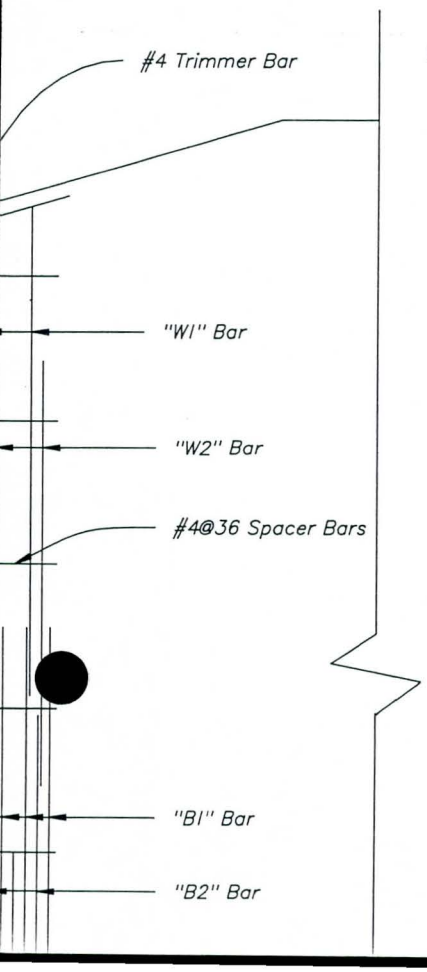


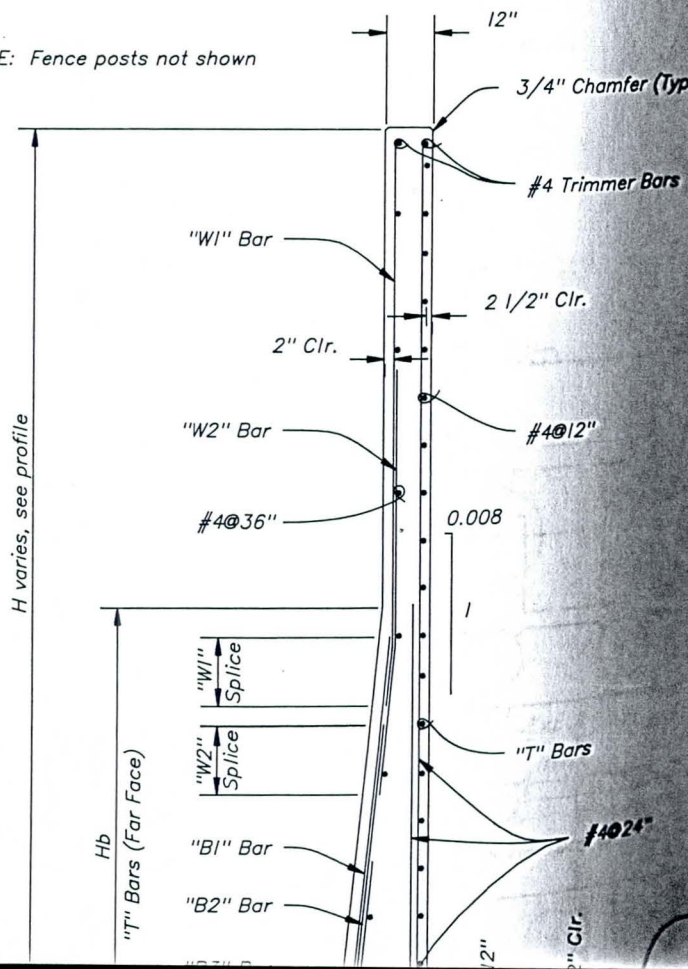
TYPE "C"

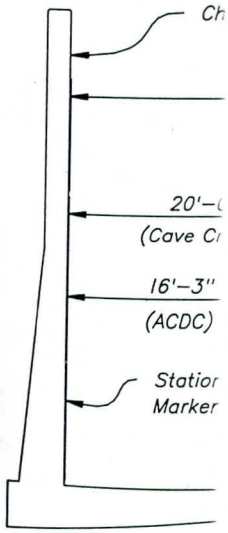


TYPE "D"

EXPANSION JOINTS
NOT TO SCALE







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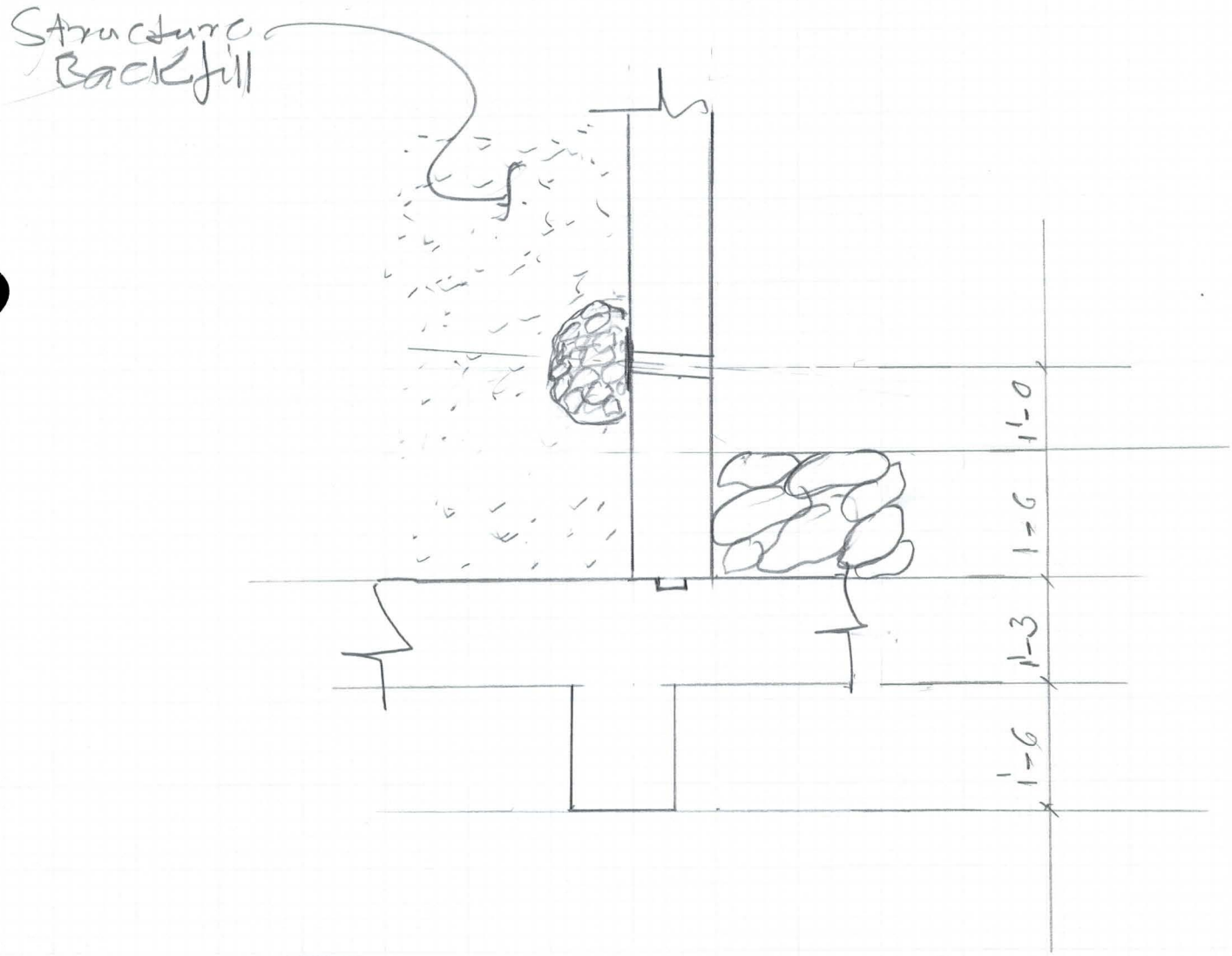
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

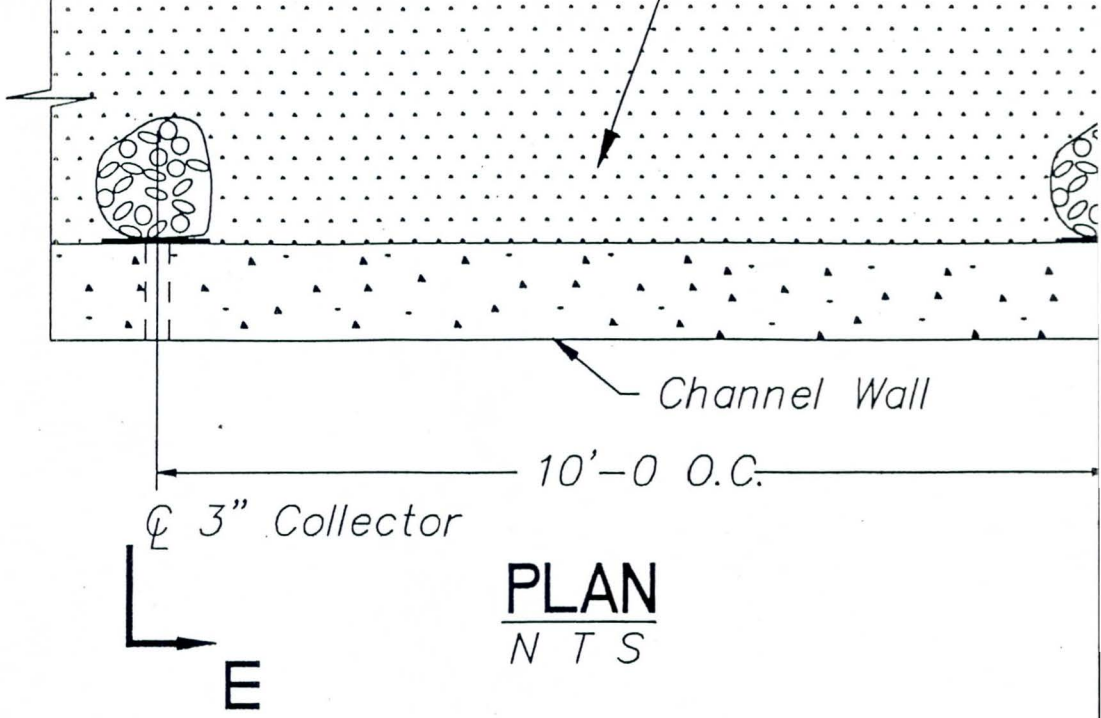
DETAIL Weep Hole Det COMPUTED KVH DATE 9/92

CHECKED BY CCW DATE 10/92



TYP. DRAIN DETAIL (1)

NTS



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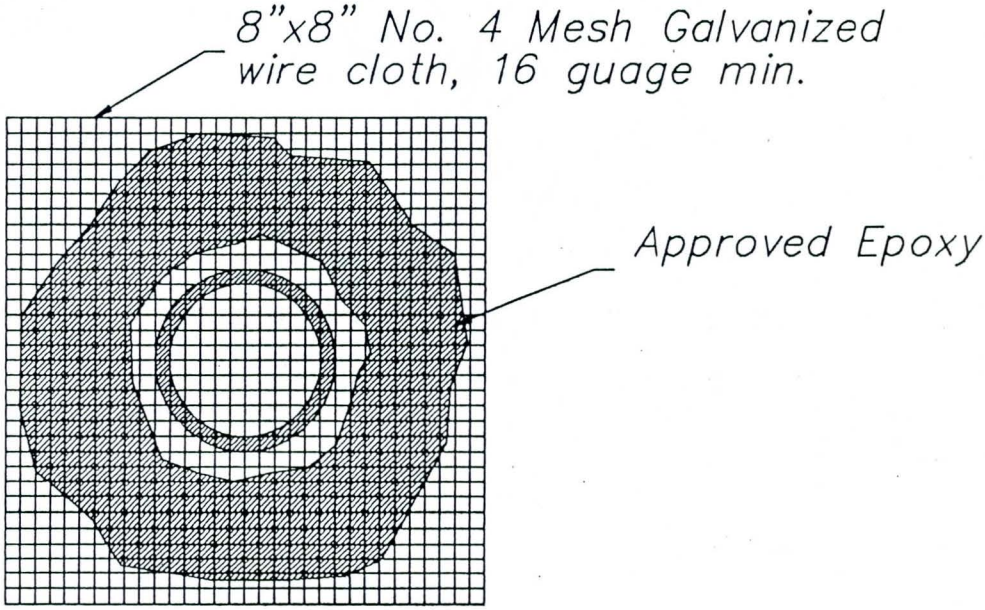

MESH INSTALLATION DETAIL

N T S

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WEST NATIONAL TECHNICAL CENTER
Engineering Staff
Portland, Oregon
November 20, 1992

DESIGN REVIEW REPORT

Project: Buckhorn Mesa Watershed
Job: Spook Hill Floodway Outlet
Location: Maricopa County, AZ
Authority: PL566
Stage: Preliminary Design

SCS Comments

BKH

Summary:

Description of Job:

This job consists of the upgradin[illegible] outlet works for the Spook Hill Floodway to the capability of passing the 100 year frequency storm and attendant sediment. The works has approximately 550 feet of composite reinforced concrete and grouted rock riprap channel from Bush Highway to the existing sediment basin. The sediment basin dikes will be raised to pass the increased flow and to accommodate the backwater in the outlet channel.

Purpose of Review:

The purpose of this review is to determine compliance with SCS standards and criteria, and sound engineering practices.

Scope of Review:

The following material was reviewed:

1. Preliminary design calculations.
   a. Narrative.
   b. Hydraulic and Sediment Transport Analysis.
   c. Structural Design.
   d. Miscellaneous.
2. Preliminary construction drawings.
3. Specifications.

Basis for Review:

The following references were used in review of the job:

1. TR 25 Design of Open Channels
2. Handbook of Hydraulics, King & Brater, 5th ed.
3. Engineering Design Standards - Far West States.
4. NEH Section 5, Hydraulics.
5. Hydraulic Charts for the Selection of Highway Culverts, Hydraulic Engineering Circular No. 5, BPR (USDI).
6. Capacity Charts for the Hydraulic Design of Highway Culverts, Hydraulic Engineering Circular No. 10, BPR (USDI).
7. NEH Section 6 Structural Design.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WEST NATIONAL TECHNICAL CENTER
Engineering Staff
Portland, Oregon
November 20, 1992

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Project: Buckhorn Mesa Watershed
Job: Spook Hill Floodway Outlet
Location: Maricopa County, AZ
Authority: PL566
Stage: Preliminary Design

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Description of Job:

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6. Capacity Charts for the Hydraulic Design of Highway Culverts, Hydraulic Engineering Circular No. 10, BPR (USDI).
7. NEH Section 6 Structural Design.

8. NEH Section 11 Drop Structures.
9. National Engineering Manual.

Review Comments:

Preliminary Design Calculations.

1. HYDRAULICS AND SEDIMENT TRANSPORT ANALYSIS

a. At low water surface in the sediment basin and design flow in the channel a jump will form well into the sediment basin. It is recommended that the stability of the sediment basin under the above condition be addressed. It is suggested a grouted rock riprap hydraulic jump energy dissipator basin or plunge pool be designed for the end of the channel. Examples of design of these type of dissipators are available in the SCS Arizona projects. Pass Mountain Floodway drop structures were designed as jump basins and the outlet of the Signal Butte Floodway was designed as a plunge pool.

The explanation given in the narrative appears acceptable. Any hydraulic jump that can occur will be during high flows at which time the basin will be full and the jump will form in the channel. At low basin water surface flows should be around critical or less and scour will depend upon velocities. A cutoff wall is acceptable at or near the depth proposed be the anticipation of rock in that location to tie it into appears unrrealistic and is not supported by the Geology. The drawings show existing ground about 1.5 feet above the proposed invert and TH 2403 shows no rock at it's limit of 6.0 feet.

c. It appears that the wall height at the end of the channel is sufficient to include the effects of backwater from the sediment basin. It is recommended that documentation of the adequacy of the wall height be included.

Page 11 of 19 of the narrative provides a summary table for the hydraulic properties of the channel. The properties appear to be based on unimpeded flow and does not reflect the location of the sequent depth of the jump formed at maximum discharge. It is suggested that this location be documented to show that the sequent depth will occur in the channel and not in the sediment basin.

d. It does not appear to be documented that the basin will accommodate the 100 year frequency sediment accumulation. It is recommended that the narrative include reasoning for assuming that sufficient capacity is available to accommodate the 100 year frequency sediment amount.

e. No cost comparisons were included in the documentation supporting the statement in the narrative that Alternative number 2 is the least cost. It is recommended that this support be included in the documentation and that it include maintenance and

replacement costs during the life of the project as well as initial cost.

e. Minor comments, suggestions, and editorial comments are redlined on the preliminary design calculations.

4. Structural Design.

a. Narrative. The retaining walls are designed in accordance with AASHTO requirements for live loads. It is recommended that SCS requirements be used where exceeding AASHTO requirements.

b. Narrative. Because expansion joints are on 90 foot intervals the longitudinal steel should meet temperature steel requirements of 0.03 sq in for exposed face and 0.02 sq in for unexposed face.

c. No Soils Mechanics test information is available giving the unit weights, shear strengths and other pertinent structural values for the design of the retaining wall. Values used are based on AASHTO recommendations for typical highway wall design. The specifications do not identify the backfill material by type nor do the drawings show the borrow area. A saturated unit weight of 130 pcf is assumed and a coefficient of lateral pressure of .33. The coefficient corresponds to that of clean sand or gravel. A likely material in the borrow area appears to be SM or SC. At best this material can be expected to be classified as soil type 2 in figure 46 of TR 74. The moist unit weight for this material is expected to be about 100 pcf. This would lead to a minimum value of around .4 for the coefficient or an increase of about 20 percent in the lateral pressure of the soil although something less in the total pressures. Recommend the following actions:

(1) Identify the borrow material and verify their availability.
(2) Correlate unit weights, shear values and other pertinent information for this material with similar material from Spook Hill Dam or other jobs in the vicinity.
(3) Use the correlated values in design or check of the proposed design.

d. Design does not meet provisions of TR 67 as follows:
(1) 60 ksi used for design of Service Hydraulic Structure instead of 40 ksi.
(2) Rho less than rho shy.
(3) Minimum steel less than 0.002bd in the exposed faces and less than 0.001bd in the greater thickness in the unexposed faces..
(4) Load factor of 1.3 used instead of 1.8.

e. NEH Section 11 not met for factor of safety in sliding. Used 1.0 instead of 1.5.

Preliminary Construction Drawings.

1. No comments yet

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ___ OF ___

DETAIL ___ COMPUTED KVH DATE 11/92

CHECKED BY ___ DATE ___

Table of Wall Types and Heights

Station.	~~West Wall~~ LT		~~East Wall~~ RT	
	Wall Ht	Wall Type	Wall Ht.	Wall Type
3+93 To 6+50	6'-0	Type. 1	6'-0	Type. 1
6+50 To 6+60	6'-0 To 6'-3"	Type. 2	6'-0 To 6'-5"	Type. 2
6+60 To 7+60	6'-3"	Type. 2	6'-5"	Type. 2
7+60 To 7+70	6'-3	Type. 2	6'-5" To 6'-10"	Type. 2
7+70 To 8+70	6'-3	Type. 2	6'-10	Type. 2
8+70 To 8+80	6'-3	Type. 2	6'-10 To 7-3	Type. 2
8+80 To 10+97	6'-3	Type. 2	7'-3	Type. 2
10+97 To 11+48	6'-3 To 7'-3	Type. 2	7'-3	Type. 2
11+48 To 12+37	~~6'-3~~ 7'-3 To 9'-0	Type. 3	7'-3 To 9'-0	Type. 3
12+57	9'-0	Type 3	9'-0	Type-3

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ___ OF ___

DETAIL ___ COMPUTED K VH DATE 11/92

CHECKED BY ___ DATE ___

Table of Wall Types and Heights

Station.	~~West~~ LT Wall		~~East~~ RT Wall	
	Wall Ht	Wall Type	Wall Ht.	Wall Type
3+93 To 6+50	6'-0 ✓	Type. 1	6'-0	Type. 1
6+50 To 6+60	6'-0 To 6'-3" ✓	Type. 2	6'-0 To 6'-5" ✓	Type. 2
6+60 To 7+60	6'-3"	Type. 2	6'-5" ✓	Type. 2
7+60 To 7+70	6'-3	Type. 2	6'-5" To 6'-10" ✓	Type. 2
7+70 To 8+70	6'-3	Type. 2	6'-10 ✓	Type. 2
8+70 To 8+80	6'-3	Type. 2	6'-10 To 7-3 ✓	Type. 2
8+80 To 10+97	6'-3	Type. 2	7'-3 ✓	Type. 2
10+97 To 11+48	6'-3 To 7'-3	Type. 2	7'-3 ✓	Type. 2
11+48 To 12+37	~~6'-3~~ 7'-3 To 9'-0	Type. 3	7'-3 To 9'-0 ✓	Type. 3
12+57	9'-0	Type 3	9'-0	Type-3

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE ___ OF ___

DETAIL ___ COMPUTED K Vt DATE 11/92

CHECKED BY ___ DATE ___

Table of Wall Types and Heights

Station	West Wall		East wall	
	Wall Ht	Wall Type	Wall Ht.	Wall Type
3+93 To 6+50	6'-0	Type. 1	6'-0	Type. 1
6+50 To 6+60	6'-0 To 6'-3"	Type. 2	6'-0 To 6'-5"	Type. 2
6+60 To 7+60	6'-3"	Type. 2	6'-5"	Type. 2
7+60 To 7+70	6'-3	Type. 2	6'-5" To 6'-10"	Type. 2
7+70 To 8+70	6'-3	Type. 2	6'-10	Type. 2
8+70 To 8+80	6'-3	Type. 2	6'-10 To 7-3	Type. 2
8+80 To 10+97	6'-3	Type. 2	7'-3	Type. 2
10+97 To 11+48	6'-3	Type. 2	7'-3	Type. 2
11+48 To 12+37	6'-3 To 9'-0	Type. 3	7'-3 To 9'-0	Type. 3

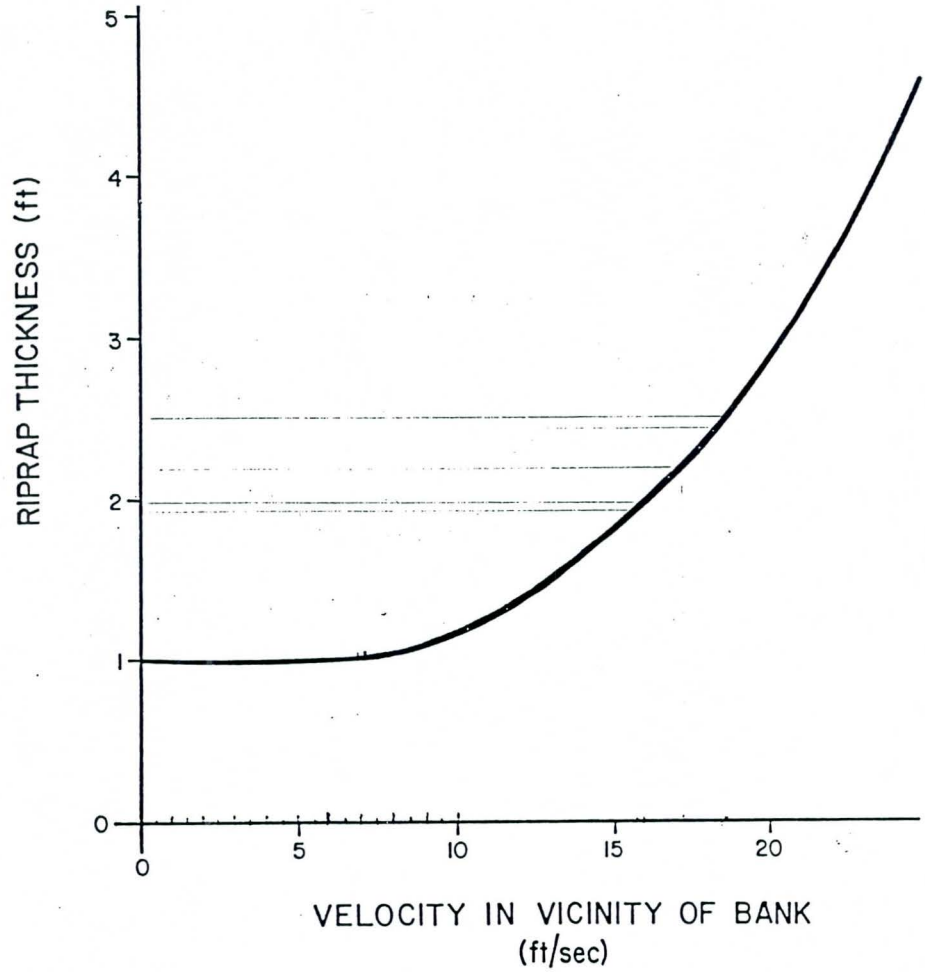


Figure 57. Required blanket thickness as a function of flow velocity.

STA.	VELOCTY	RIPRAP THICKNESS (ft)	
400	18.40	2.40	
500	17.22	2.20	USE 2.50'
650	18.55	2.52	
722.33	16.02	2.00	
850	15.73	1.94	
979.98	15.85	1.97	USE 2.00'
1100	15.86	1.97	
1237	15.83	1.96	

GROUTED ROCK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 2 OF

DETAIL COMPUTED BKH DATE 8-92

CHECKED BY STF DATE 9-92

11-92

WALL Depth

STA	Channel Invert	Channel Wall Elev. Inside	Channel Wall Elev. Outside	Depth of Wall Inside	Depth of Wall Outside
319					
400	34.49	40.49	40.49	6'-0"	6'-00"
650	26.50	32.50	32.50	6'-0"	6'-00"
722.33 PC	25.08	31.25	31.25	6'-2"	6'-2"
850	22.59	28.83	29.33	6'-3"	6'-8.88"
979.98 PI	20.04	26.29	27.29	6'-3"	7'-3"
1097.11	17.75	24.00	24.55	6'-3"	6'-9.6"
1100	17.69	24.00	24.44	6'-3.72"	6'-9"
1118.98	17.32	24.00	24.00	6'-8.16"	6'-8.16"
1237.60 PT	15.00	24.00	24.00	9'-0"	9'-00

3.19%

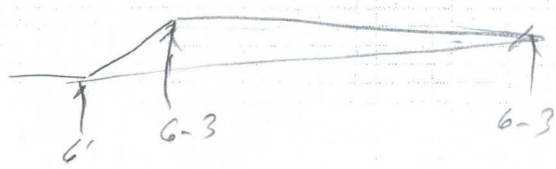
1.95 70 %

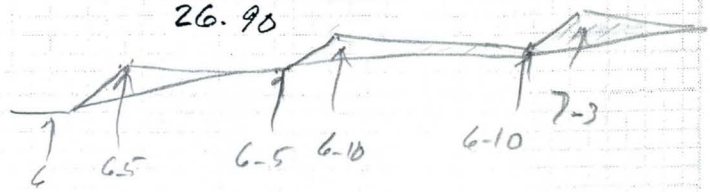
FINALL

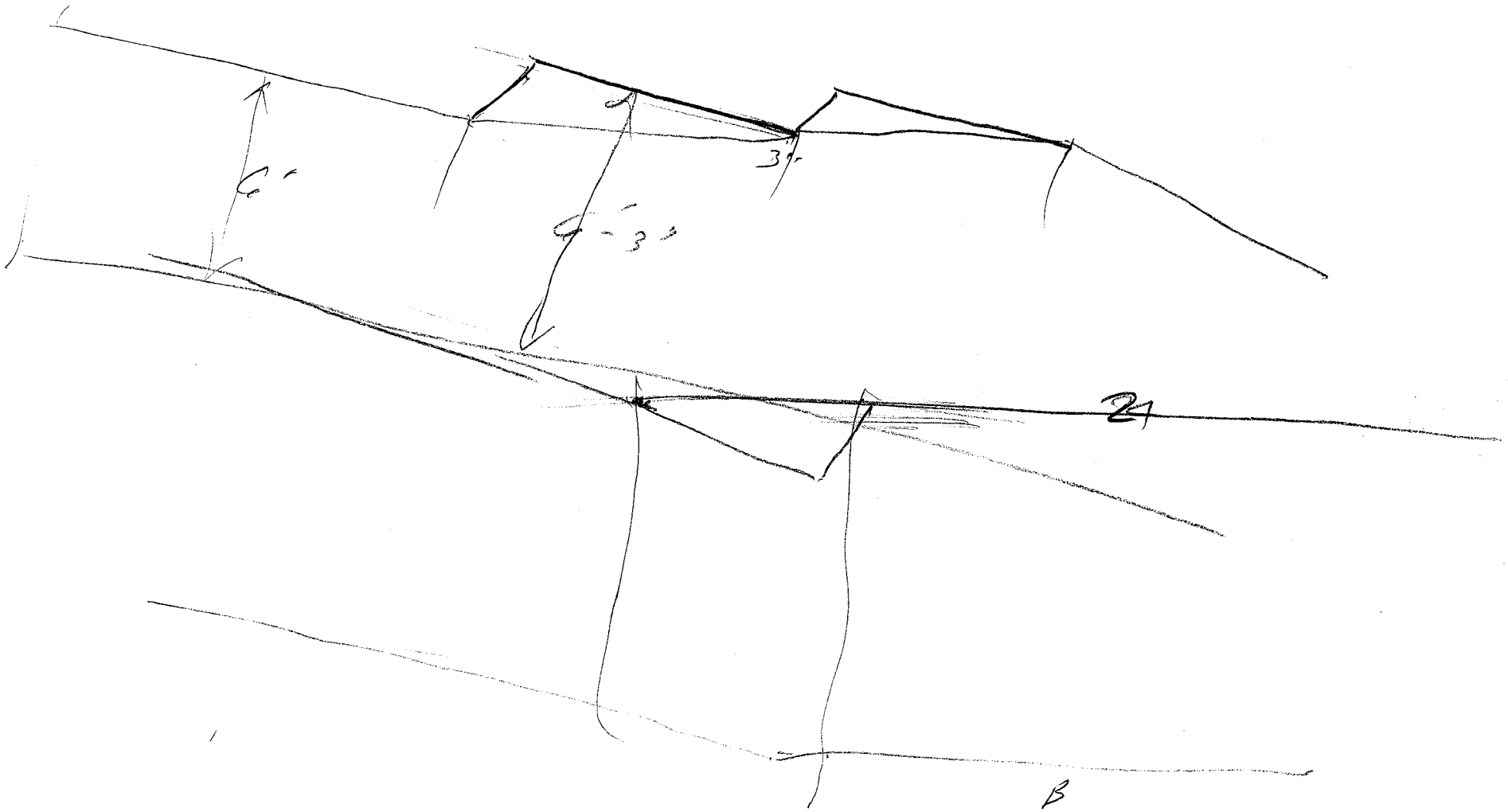
121, Fig 1.7

STA	Inv. el.	Lt Wall Depth	Lt Wall Elev.	RT Wall Depth	RT Wall Elev.
650	26.50	6'-0"	32.50G	6'-0"	32.50 G
660	26.30	6'-3"	32.55G	6'-5"	32.72 G
760	24.35	"	30.60	6'-5"	30.76 G
770	24.15	"	30.40	6'-10"	30.98G
870	22.19	"	28.44	6'-10"	29.03G
880	22.00	"	28.25	7'-3"	29.25 G
1097.11	17.75	"	24.00	"	25.00
1148.27	16.75	6'-3"	24.00G	7'-3"	24.00 G
1000	19.65		25.90		26.90

12—






6"
6" - 3"
3"
21
B

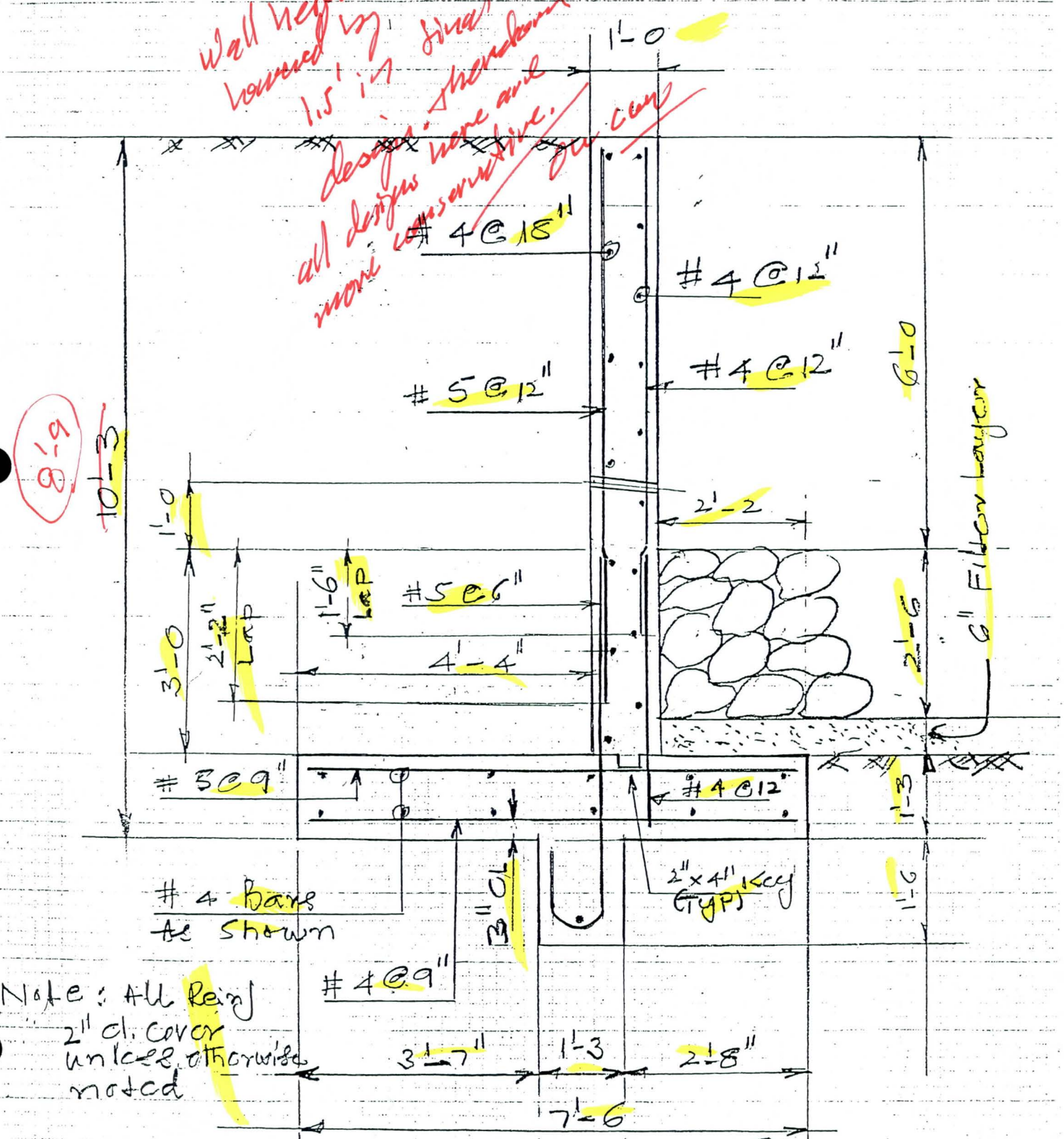
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 6' Wall Section COMPUTED KVH DATE 8/92

Type 1 Wall CHECKED BY CGW DATE 10/92

Wall height bounded by 1.5:1 final design. Therefore all designs here are more conservative. You can



Note: All Reinf 2" cl. cover unless otherwise noted

Type 1 Wall Section

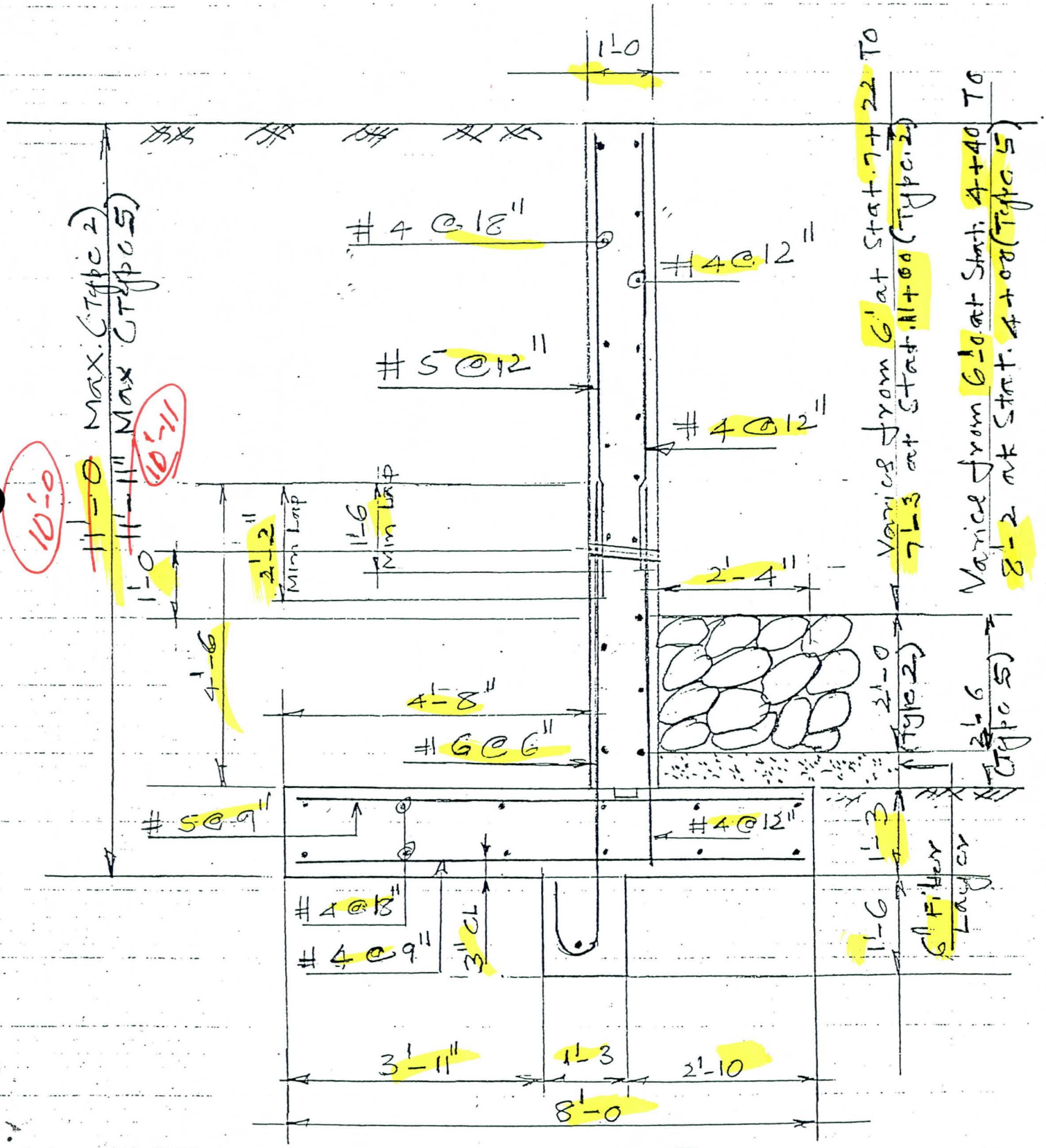
Stat. 440 TO 722.3 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 7'-3 Wall Section COMPUTED KVH DATE 8/92

Type 2 Wall CHECKED BY CGW DATE 10/92



TYPE-2 AND TYPE-5 WALL SECTION

Scale 1/2" = 1'-0

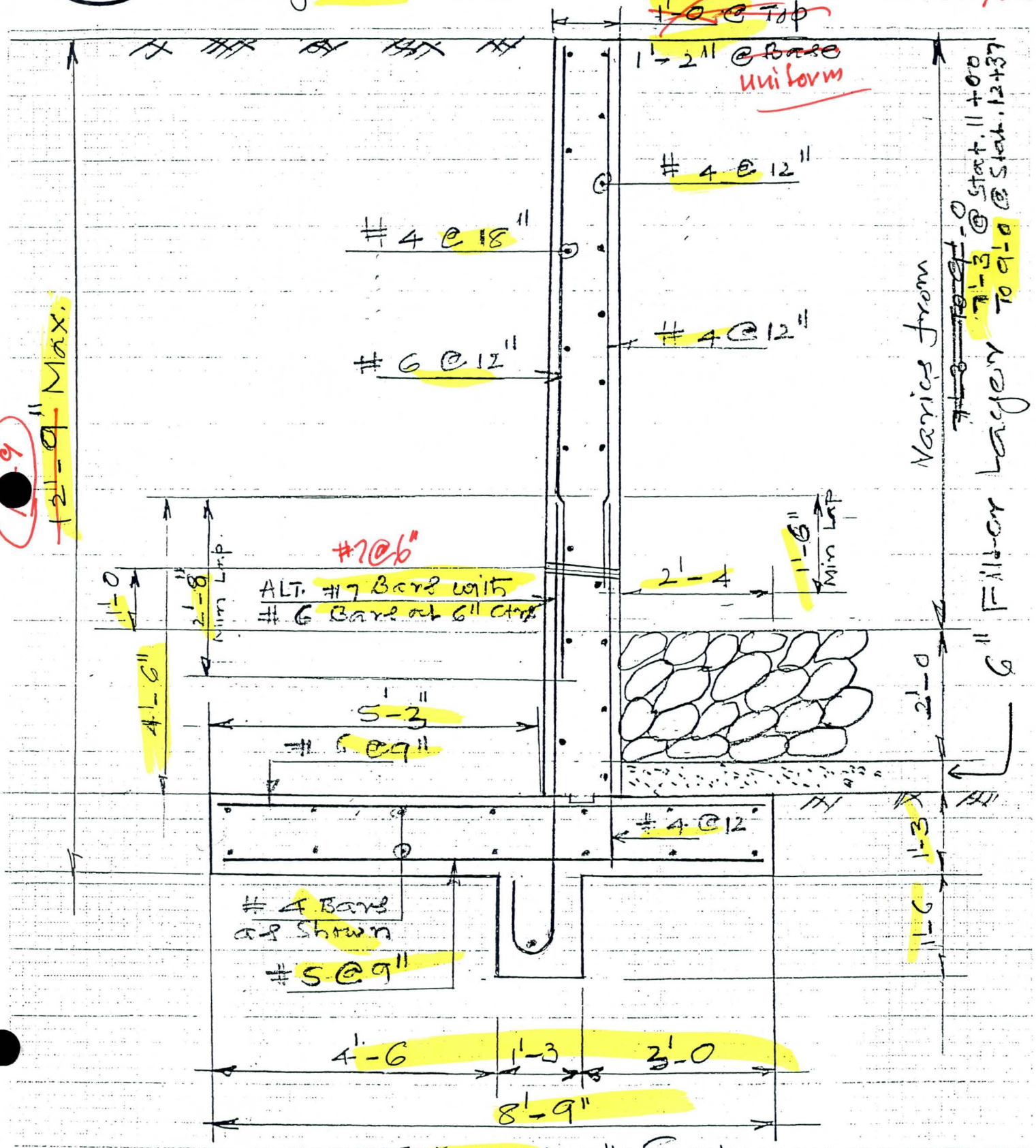
(3)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 9'-0 Wall Sect. COMPUTED KVH DATE 8/92

Type 3 Wall CHECKED BY CGW DATE 10/92



Type 3 Wall Section

Stat. 1100 To 1237.6 1/2" = 1'-0

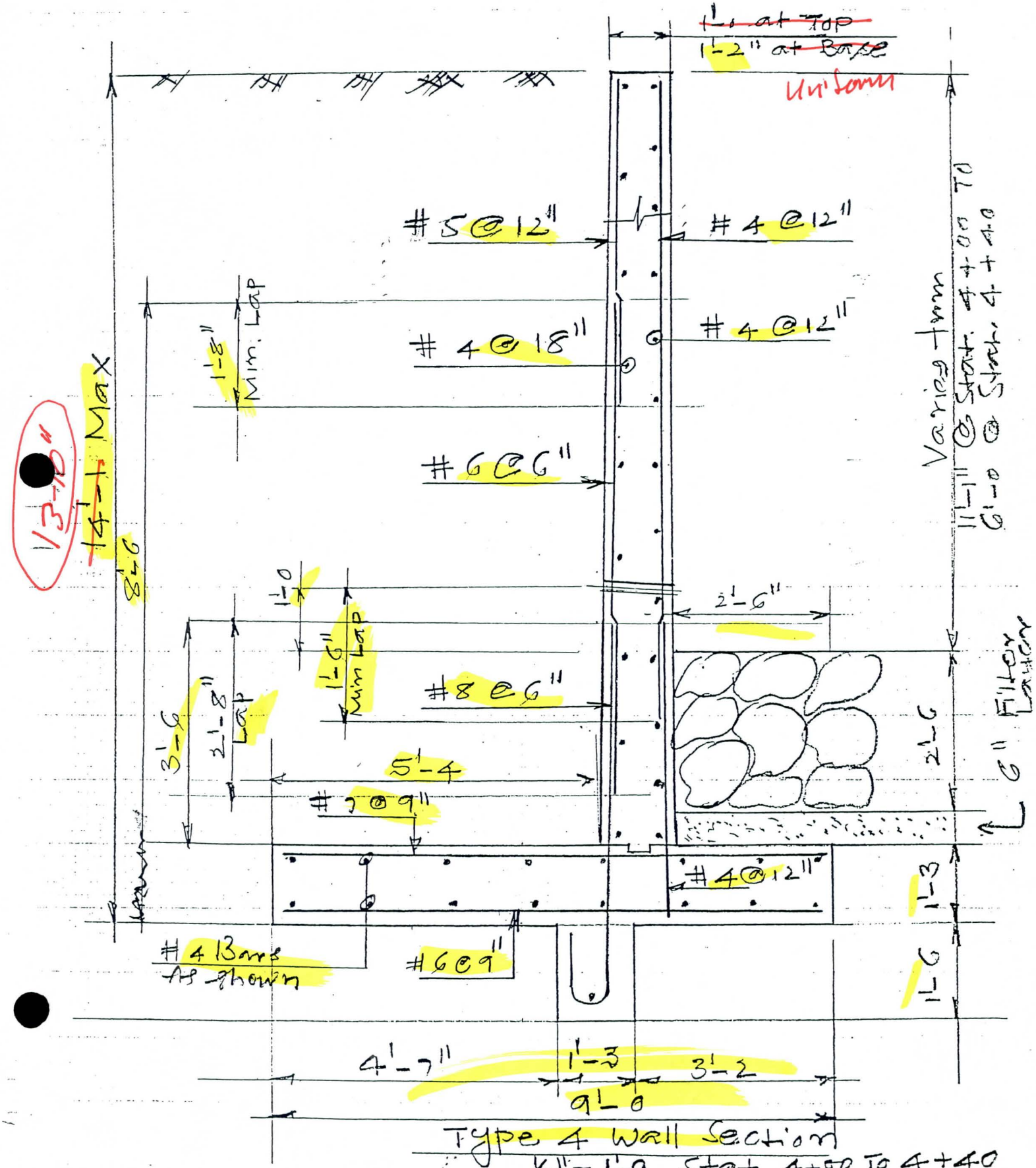
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

(4)

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Type 4 wall COMPUTED KVH DATE 8/92

CHECKED BY CCW DATE 10/92



Type 4 Wall Section

½" = 1'-0 Stat. 4+00 To 4+40

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

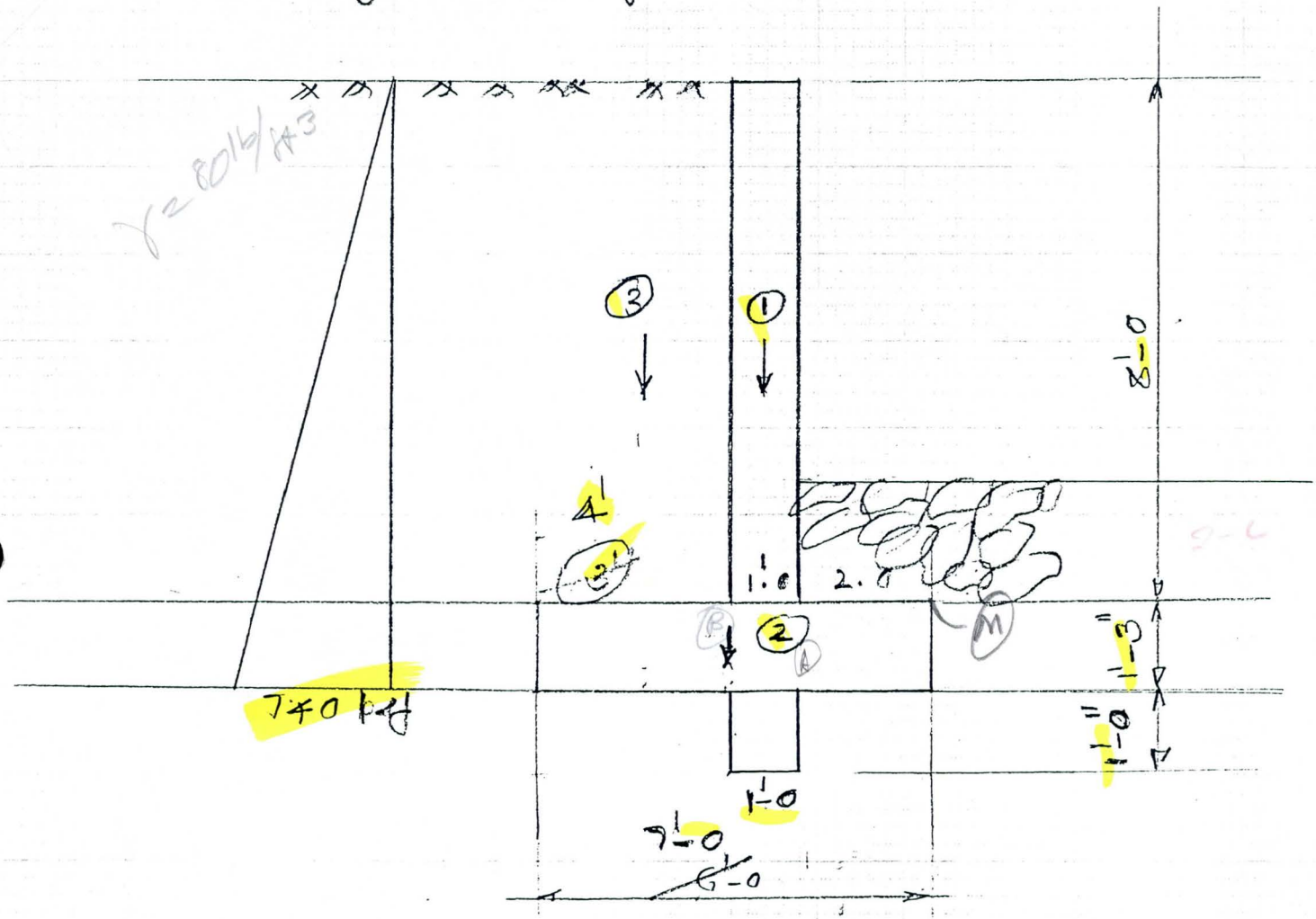
PROJECT Spook Hill Outlet PAGE 1 OF

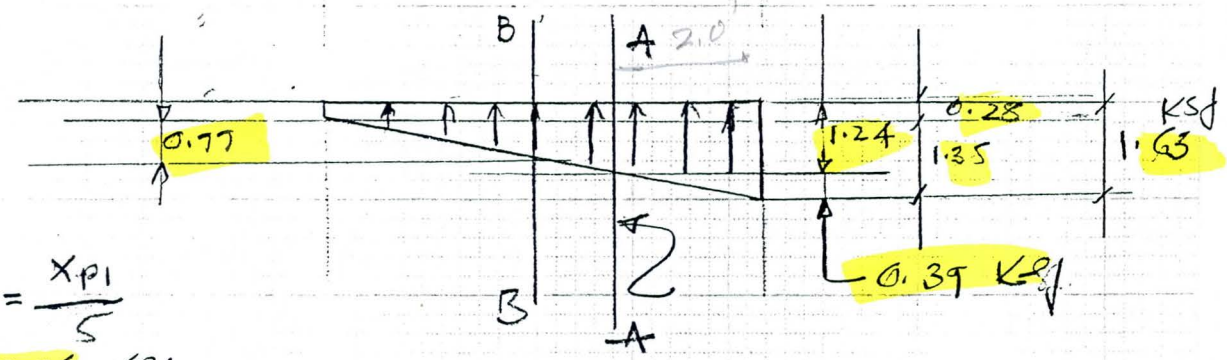
DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Case 1

Submerged Backfill





$$\frac{1.35}{7.0} = \frac{x_{p1}}{5}$$

$x_{p1} = 0.96$ ksf

$(0.96 + 0.28) = 1.24$ ksf

$(1.63 - 1.24) = 0.39$

$$\frac{x_{p2}}{4.0} = \frac{1.35}{7.0}, \quad x_{p2} = 0.77$$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 2 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/9

CHECKED BY CGW DATE 10/92

1) Using Submerged Conditions:

wt of wet soil = 130 pcf

Wt. of Water = 62.4

Wt. of Submerged Soil = 67.6

Using K = 0.33

$P_r = wKh = (67.6 \times 0.33 \times h) = 22.3$ pcf

water pr = 62.4

84.7

use 80 to 85 pcf.

8' wall

$p_r = (80 \times 9.25) = 740$ pcf

$P = \left(\frac{740}{2} \times 9.25\right) = 3.43^K$

$M_{O.T} = 3.43 \times 9.25/3 = 10.6$ Kft

Stabilizing Moment

$w_1 = (8.0 \times 1.0 \times 0.15) = 1.20^K$

$w_2 = (6.0 \times 1.25 \times 0.15) = 1.13$

$w_3(\text{Soil}) = (3.0 \times 8.0 \times 0.13) = 3.12$

5.45^K

@ load TOE

3 3.4

$M_{STB} = (1.2 \times 2.5) + (1.13 \times 3.0) + (3.12 \times 4.5) = 20.43$

$F.S = \left(\frac{20.43}{10.6}\right) = 1.93 \approx 2$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 3 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Check Sliding:

Sliding force = P = 3.43 K

Frictional force = μN = 0.4 × 5.45 = 2.18 K < 3.43 K

∴ use a Key &
Increase Heel to 4'-0 to get some additional wt.

Try Footing width = 7'-0

Stabilizing Moment:

w_1 (7.0 × 1.0 × .15) = = 1.20 K

w_2 = (7.0 × 1.25 × 0.15) = 1.31

w_3 = (4.0 × 8.0 × 0.13) = 4.16

6.67 K

M_{STB} = (1.2 × 2.5) + (1.31 × 7.0/2) + (4.16 × 5.0)
= 28.4 K'

F.S = (28.4 / 10.6) = 2.7 OK

Sliding Check:

Frictional Force = μN = 0.4 × 6.67 = 2.7 K

Sliding Force P = 3.43 > 2.7 K

Still need a Key for the Base Slab

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Shook Hill outlet PAGE 4 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY CWD DATE 10/92

Mid third = L/6 = 7/6 = 1.17'

Footing pressure: 7' wide

$M_{STB} = 28.4^{kft}$, $N = 6.67^{k}$

$M_{OT} = 10.6$,

X_R = Dist. of Resultant $= \frac{(28.4 - 10.6)}{6.67}$

$= 2.67'$

$b/3 = \frac{7.0}{3} = 2.33$, within Mid Third

$e = (b/2 - X_R) = (3.5 - 2.67) = 0.83'$

$< \frac{b}{6} = 1.17'$

$P_r = \frac{6.67}{7 \times 1}\left(1 \pm \frac{6 \times 0.83}{7}\right) = \left(\frac{W}{BL}\right)\left(1 \pm \frac{6e}{L}\right)$

$= 0.953\,(1 \pm 0.71)$

$P_r(max) = 1.63^{ksf}$ $P_r(Min) = 0.28$ 0.24 ksi OK

Toe Design:

a) UDL : $(1.24 \times 2) = 2.48^{k}$

b) triangular: $\left(\frac{0.39}{2} \times 2.0\right) = 0.39^{k}$

Neglecting the footing wt. OK cons

$M_{AA} = \left(2.48 \times \frac{2}{2}\right) + \left(0.39 \times \frac{2}{3} \times 2\right) = 3.0^{kft}$

$M_u = (3.0 \times 1.3) = 3.9^{kft}$

S.F.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 5 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Toe Steel:

$M_u = 3.9$ k/ft

$d = (15 - 3 - 0.5) = 11.5''$

$M = A_s f_y (d - a/2)$

$a = \frac{A_s f_y}{.85 f'_c b}$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{3.9 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.011$$

from Table 9-2, Read $\omega = 0.012$

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.012 \times 3.0}{60} = 0.0006$$

say 0.001

$A_s = 0.001 \times 12 \times 11.5 = 0.14$ in^2

u check: $A_s = M/f_y jd = \frac{(30)(12'')}{(24)(.9)(11.5)}$

$A_s = .142$ in^2 OK

$\rho_{min} = 200/f_y = 200/60000 = 0.0033$

(Grade 60) $A_s = (0.0033 \times 12 \times 11.5) = 0.46$ in^2

Reqd Reinf: $1.33(0.14) = 0.19$ in^2

use #4 @ 9", $A_s = 0.27$

$M = \frac{(.27 in^2)(60 k/in^2)}{(12 in/ft)}\left(11.5 in - \frac{0.53 in}{2}\right)$

$a = \frac{(.27 in^2)(60 k/in^2)}{(.85)(3 k/in^2)(12 in)}$

$a = 0.53$ in

$M = 15$ k-1 > 3.9 k-1 OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sprook Hill outlet PAGE 6 OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

CHECKED BY CWW DATE 10/92

Heel Design

unif: $(0.28 \times 4.0) = 1.12^{K}$

Triangular: $\left(\frac{0.77}{2} \times 4.0\right) = 1.54^{K}$

Soil wt: $(8 \times 1)\,0.13 = 1.04\ K/ft$

Conc. wt: $(1.25 \times 0.15) = 0.19\ K/ft$

$$M_{BB} = \left(1.04 \times 4 \times \frac{4}{2}\right) + \left(0.19 \times 4 \times \frac{4}{2}\right) - \left(1.12 \times \frac{4}{2}\right) - \left(1.54 \times \frac{1}{3} \times 4\right)$$

$= 5.55\ kft$

$M_u = 1.3(5.55) = 7.22\ kft$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{7.22 \times 12}{0.9 \times 3.0 \times 12 \times 12.5^2}\right) = 0.017$$

$d = (15 - 2 - 0.5)$

$= 12.5''$

from Table 9-2, $\omega = 0.018$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.018 \times 3.0}{60}\right) = 0.001$$

$A_s = 0.001 \times 12 \times 12.5 = 0.15\ in^2$

$$\rho_{min} = \frac{200}{f_y} = 0.0033$$

$A_s = 0.0033 \times 12 \times 12.5 = 0.5\ in^2$

or $1.33\,A_s = 1.33 \times 0.15 = 0.2\ in^2$

use #5 @ 9", $A_s = 0.41$

$a = \frac{(0.41)(60)}{(1.85)(3)(12)} = 0.86$

$M_n = \frac{(.41)(60)}{(12)}\left(12.5 - \frac{0.86}{2}\right)$

$M_n = 24.8^{1-k} > 7.22$ OK

W.S. Check

$A_s = M / f_s j d = \frac{(9.84)(12'')}{(24)(.9)(12.5)}$

$M = .44 \approx .41$ ∴ OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 7 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Stem Design:

$P_r = wKh = (80 \times 8) = 640$ lbs

$M_{stem} = \left(\frac{0.64}{2} \times 8.0\right)\frac{8}{3} = 6.83$ kft

$M_u = (6.83 \times 1.3) = 8.9$ kft

$d = (12 - 2 - 0.5) = 9.5''$

$\frac{M_u}{\phi f_c b d^2} = \left(\frac{8.9 \times 12}{0.9 \times 3.0 \times 12 \times 9.5^2}\right) = 0.037$

from Table 9-2, $\omega = 0.038$

$\rho = \frac{\omega f_c}{f_y} = \left(\frac{0.038 \times 3.0}{60}\right) = 0.0019$

$A_s = (0.0019 \times 12 \times 9.5) = 0.21$ in^2

$A_{s\,min} = (0.0033 \times 12 \times 9.5) = 0.38$ in^2

#5 @ 8", $A_s = 0.47$

or $1.33\,A_s = 1.33 \times 0.21 = 0.28$

use #5 @ 8", $A_s = 0.47$

For 9' wall #5 @ 6", $A_s = 0.62$

(?) ok

check

$A_s = M/f_s jd = \frac{(6.83)(12'')}{(24)(.9)(9.5)}$

$A_s = 0.40 < 0.47$ in² ok

9' wall

$A_s = \frac{(6.83)(12'')}{(24)(.9)(6.5'')}$

$A_s = .58$ in² < 0.62 in² ok

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 8 OF

DETAIL COMPUTED KVH DATE 8/92

CHECKED BY CGW DATE 10/92

Stem Design:

Check using 10" wall thickness:

$M_u = (6.83 \times 1.3) = 8.9$ k-ft

$d = (10 - 2 - 0.5) = 7.5''$

$\frac{M_u}{\phi f'_c b d^2} = \frac{8.9 \times 12}{0.9 \times 3.0 \times 12 \times 7.5^2} = 0.059$

Read $\omega = 0.061$ from Table 9-2

$f = \frac{\omega f'_c}{f_y} = \frac{0.061 \times 3.0}{60} = 0.0031$

$f_{min} = (0.0033 \times 12 \times 7.5) = 0.30 \text{ in}^2$

$f = (0.0031 \times 12 \times 7.5) = 0.28 \text{ in}^2$

NG ~~#5 @ 12"~~ 9" used before is still ok

10" Stem wall is ok, but

Better to use 12" wall to have some

Factor of Safety against overturning

and Sliding. OK

W.S.

$A_s = M/f_s jd = \frac{(6.83)(12)}{(24)(0.9)(7.5)}$

$A_s = .50$

#5@7"

#5@9 $a = \frac{(.41)(60)}{(.85)(3)(12)} = .80$

$M_u = \frac{(.41)(60)}{(12)}(7.5 - \frac{.80}{2})$

$M_u = 14.6$ k-ft OK

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill out Lot PAGE 9 OF

DETAIL Retaining Wall COMPUTED KVH DATE 8/92

CHECKED BY LGW DATE 10/92

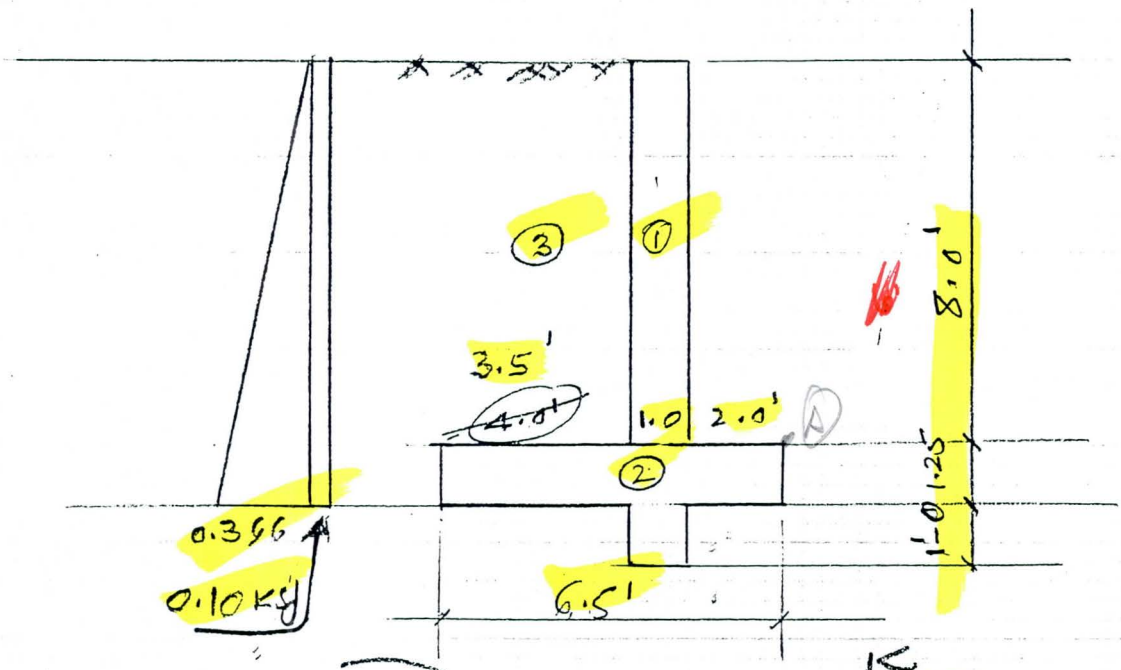
Case 2

Dry Backfill & 2' Surcharge

$P_{r_1} = wKh = (0.12 \times 0.33 \times 9.25) = 0.366$ ksf

Using Surcharge = 2'

$P_{r_2} = (0.12 \times 0.33 \times 2) = 0.079$ ksf, say 0.1 ksf



$P_1 = \left(\frac{0.366}{2} \times 9.25\right) = 1.7^{K}$

$P_2 = (0.1 \times 9.25) = 0.93$

$M_{OT} = \left(1.7 \times \frac{9.25}{3}\right) + \left(0.93 \times \frac{9.25}{2}\right) = 9.54$ kft

M_{STB}:

$w_1 = (1.0 \times 8.0 \times 0.15) = 1.20^{K}$

$w_2 = (6.5 \times 1.25 \times 0.15) = 1.22$

$w_3 = (3.5 \times 8.0 \times 0.12) = 3.36$

5.78

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 10(A) OF

DETAIL Retaining wall COMPUTED KVH DATE 8/92

8'-0 High Sect^n CHECKED BY CWW DATE 10/92

$$M_{STB} = (1.20 \times 2.5) + (1.22 \times \frac{6.5}{2}) + (3.36 \times 4.75)$$

$$= 22.93 \text{ kft}$$

$$F.S = (22.93 / 9.54) = 2.4$$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 5.78 = 2.3^K$

Sliding Force $= (1.7 + 0.93) = 2.63^K$

> 2.3 ∴ Use a Base Slab Key

Check Stem Moment:

$pr_1 = (0.12 \times 0.33 \times 8) = 0.317$ ksf

$pr_2 = 0.1$ ksf

$P_1 = (\frac{0.317}{2} \times 8) = 1.27^K$

$P_2 = (0.10 \times 8) = 0.8^K$

$$M_{Stem} = (1.27 \times \frac{8}{3}) + (0.8 \times \frac{8}{2}) = 6.59 \text{ kft}$$

< 6.83 kft (Used for Design under Submerged Cond.)

P.7

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 31A OF ____

DETAIL Concrete COMPUTED CGW DATE 11/92

Quantities Check CHECKED BY ____ DATE ____

Type I — Sta 4+40 to Sta 7+22.3 = 282.3'

Description	height	Width	Length	Cu ft	Qty	cu yd
Wall	7.5'	1.0'	(2)(282.3)	4234.5	1	156.8
Footing	1.25'	7.5'	(2)(282.3')	5293.1	1	196.0
Key	1.5'	1.25'	(2)(282.3')	1058.6	1	39.2
Type I						392.0 cy
Type 2	Sta 7+22.3 to Sta 11+00 = 377.7'					
Wall	$\left(\frac{8.75+7.50}{2}\right)$	1.0	(2)(377.7)	6137.6	1	227.3
Footing	1.25'	8.0	(2)377.7	7554.0	1	279.8
Key	1.50	1.25	(2)(377.7)	1416.3	1	52.5
Type 2						559.6 cy
Type 3	Sta 11+00 to Sta 12+37.6 = 137.6'					
Wall	$\left(\frac{10.50+8.75}{2}\right)$	1.17	(2)(137.6)	3099.1	1	114.8
Footing	1.25	8.75	(2)(137.6)	3010.0	1	111.5
Key	1.50	1.25	(2)(137.6)	516.0	1	19.1
Type 3						245.4 cy
Type 4	Sta 4+00 to Sta 4+40 = 40'					
Wall	$\left(\frac{12.58+7.50}{2}\right)$	1.17	40	469.9	1	17.4
Footing	1.25	9.0	40	450.0	1	16.7
Key	1.50	1.25	40	75.0	1	2.8
Type 4						36.9
Type 5	Sta 4+00 to Sta 4+40 = 40'					
Wall	(9.67+7.5)/(2)	1.0	40	343.4	1	12.7
Footing	1.25	8.0	40'	400.0	1	14.8
Key	1.50	1.25	40'	75.0	1	2.8
Type 5						30.3
Concrete Total						1264.2 cy

6910-153 4-90

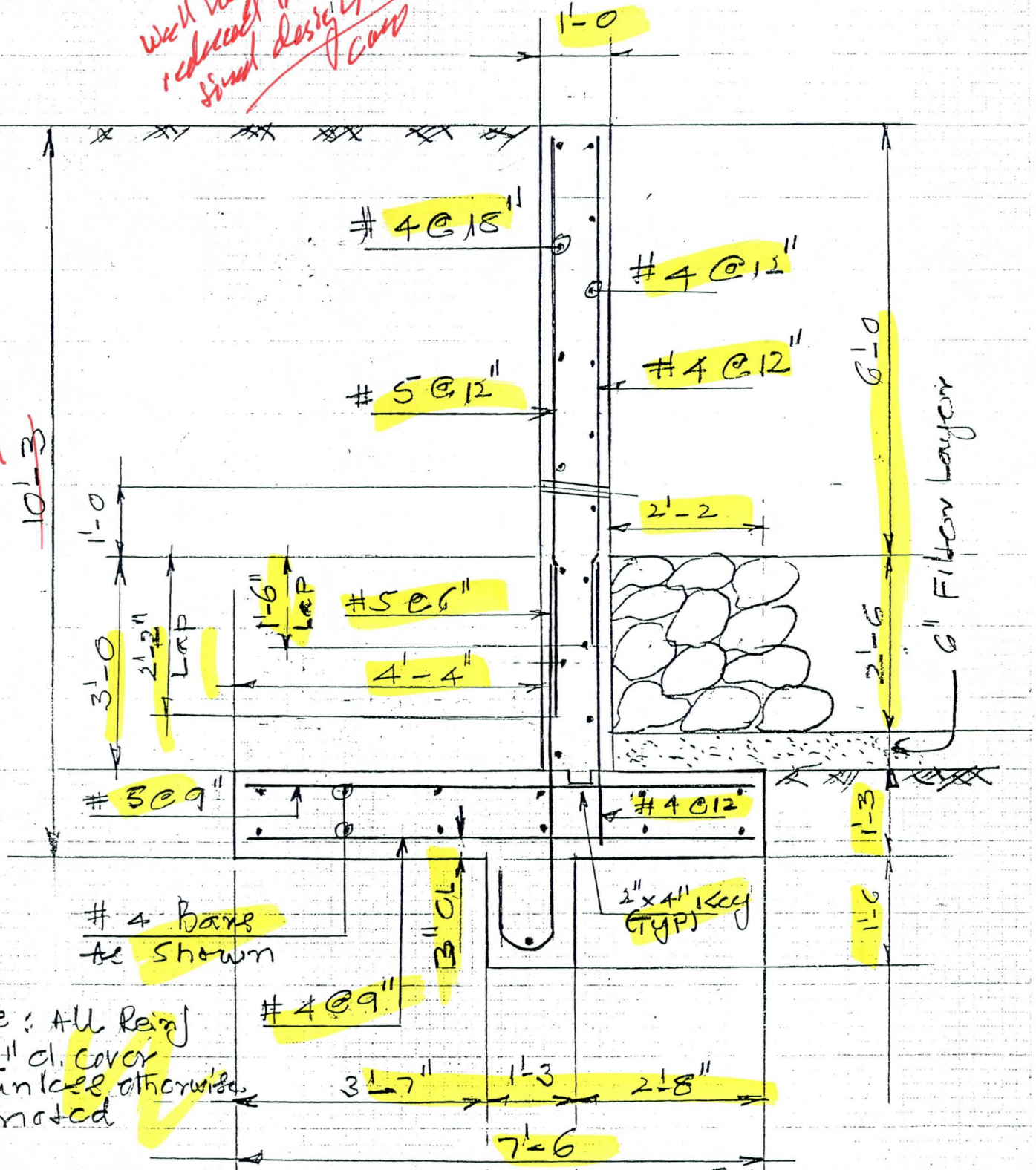
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 10(B) OF

DETAIL 6' Wall Section COMPUTED KVH DATE 8/92

Type 1 Wall CHECKED BY CCW DATE 10/92

Wall height reduced 1.5' since design. CCW



Type 1 Wall Section

Stat. 440 TO 722.3 1/2" = 1'-0

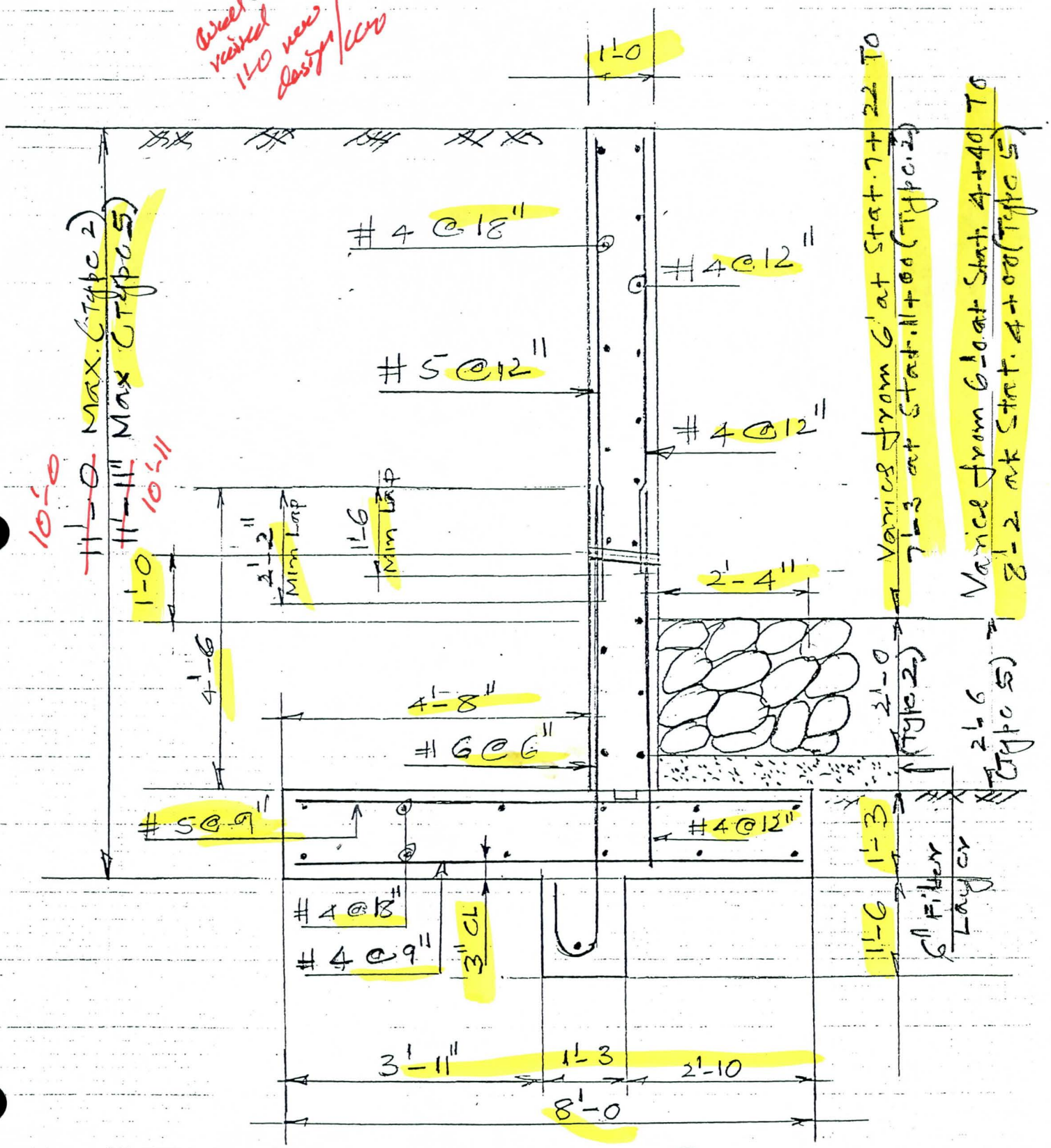
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 10(C) OF

DETAIL 7'-3 wall Section COMPUTED KVH DATE 8/92

Type 2 wall CHECKED BY CGW DATE 10/92

wall raised 1'-0 new design/CGW



TYPE-2 AND TYPE-5 WALL SECTION

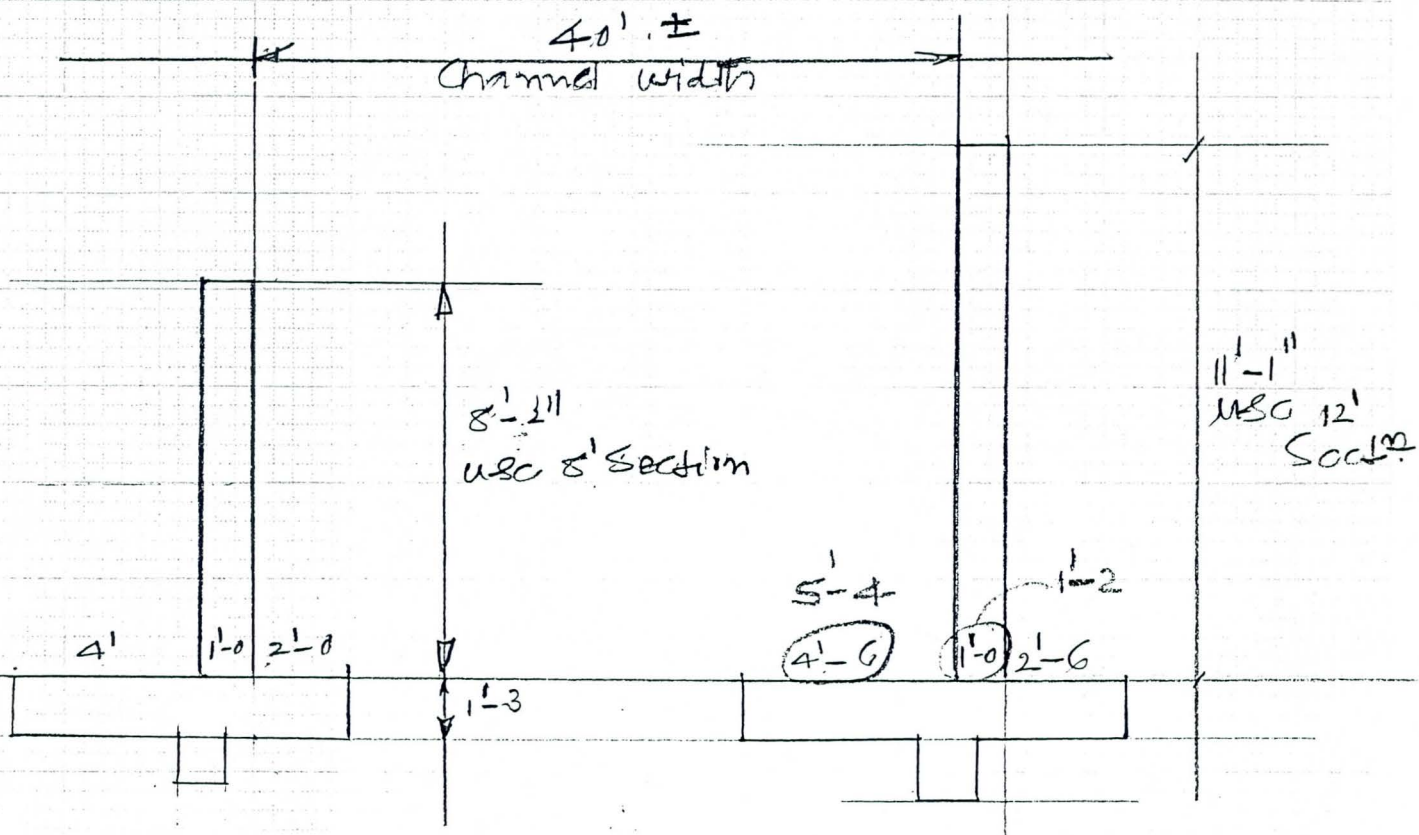
Scale 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 11 OF

DETAIL @ Transition COMPUTED KVH DATE 7/92

CHECKED BY CGW DATE 10/92



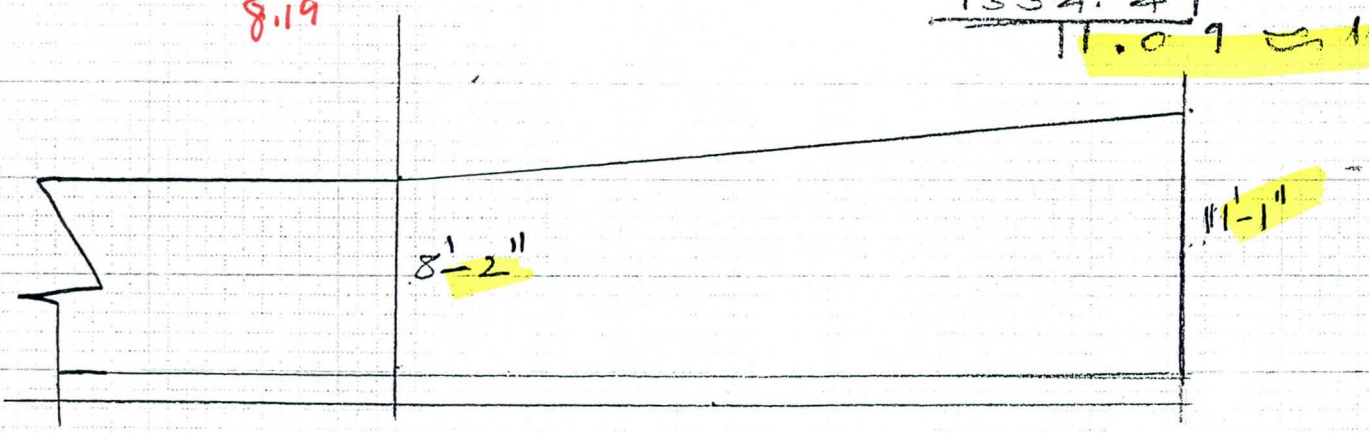
Section at outlet

1/4" = 1'-0

1342.10
1333.91
18.19 ≅ 8'-2

8.19

1345.58
1334.49
11.09 ≅ 11'-1



Elevation View
Transition from High wall to Regular Sec

1/8" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

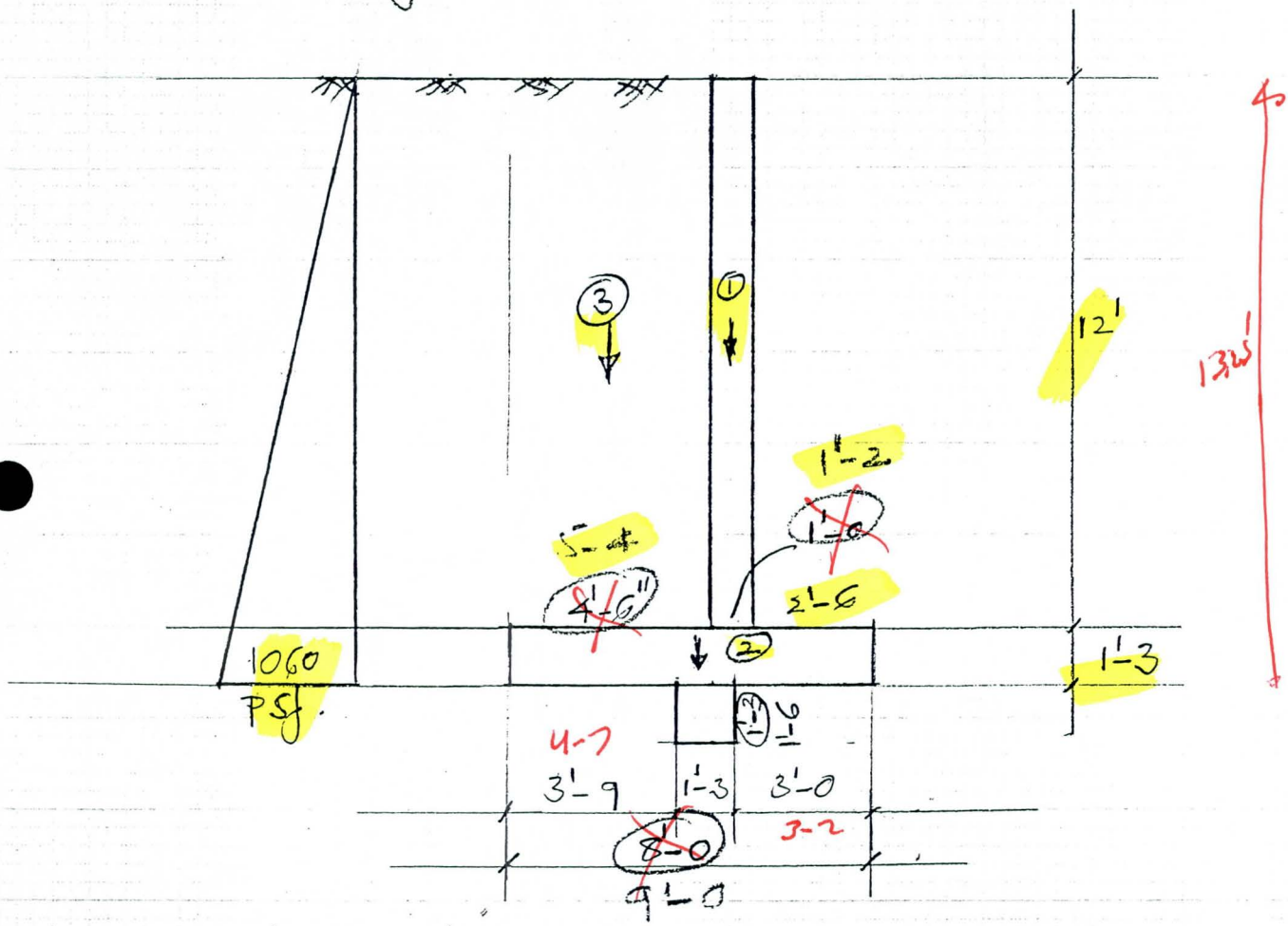
PROJECT Spook Hill outlet PAGE 12 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

CHECKED BY CAW DATE 10/92

Case 1

Submerged Condition



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 13 OF

DETAIL 12' High Wall COMPUTED KVH DATE 7/92

CHECKED BY CLW DATE 10/92

9' footing used

Check for Submerged Condition

Footing width = 8'

Using Equt fluid pr. of 80 pcf

$pr = wkh = (8.0 \times 13.25) = 1060$ psf

$P = (\frac{1060}{2} \times 13.25) = 7.03^K$

$M_{OT} = (7.03 \times \frac{13.25}{3}) = 31.1$ K'

Stabilizing Moment:

$w_1 = (12.0 \times 1.0 \times 0.15) = 1.8^K$

$w_2 = (8.0 \times 1.25 \times 0.15) = 1.5$

$w_3 = (4.5 \times 12 \times 0.13) = 7.02$

10.32^K

$M_{STB} = (1.8 \times 3) + (1.5 \times 4.0) + (7.02 \times 5.75) = 51.8$ K'

$FS = (\frac{51.8}{31.1}) = 1.7$

Sliding Check:

Frictional Force $= \mu N = 0.4 \times 10.32 = 4.13^K$

Sliding Force $= 7.03^K > 4.13^K$

Use a Key for Base Slab.

However Sliding force of 7.03^K is very high since 80 pcf Equiv. fluid pr is used. wall will not slide because of Grouted Riprap on the inside of the channel wall. Also use weep holes to keep the water pr. to a minimum.

Check Footing Pressure: (8' footing width)

$M_{STB} = 51.8^{K\,ft}$, $M_{OT} = 31.1^{K\,ft}$, $N = 10.32^{K}$

x_R = Dist. of Resultant $= (51.8 - 31.1)/10.32 = 2.01'$

$b/3 = 8.0/3 = 2.67'$

$e = (b/2 - x_R) = (4.0 - 2.01) = 1.99'$

$b/6 = 1.33$ $\quad e > \frac{b}{6}$ ∴ Resultant outside the middle Third.

$\frac{L'}{3} = (\frac{L}{2} - e)$

$L' = 3(\frac{L}{2} - e) = 3(4 - 1.99) = 6.03$

$q_{max} = \frac{2P}{BL'} = \left(\frac{2 \times 10.32}{1 \times 6.03}\right) = 3.43$ KSF

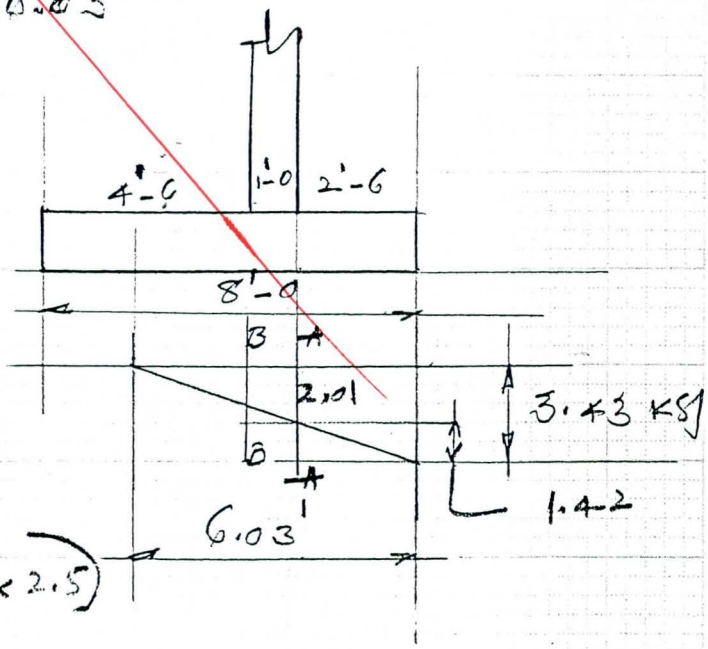
Toe Design

$\frac{3.43}{6.03} = \frac{q_1}{3.53}$

$q_1 = 2.01$ KSF

$P_1 = (2.01 \times 2.5) = 5.03^{K}$

$P_2 = (\frac{1.42}{2} \times 2.5) = 1.78^{K}$



Neglecting footing wt:

$M_{AA} = (5.03 \times \frac{2.5}{2}) + (1.78 \times \frac{2}{3} \times 2.5)$

$= 9.3^{K\,ft}$

$M_u = 1.3(9.3) = 12.1^{K\,ft}$

Toe Design (Cont'd) (8' Footing width)

9' footing used

$M_u = 12.1$

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{12.1 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.034$$

Read $\omega = 0.035$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.034 \times 3.0}{60}\right) = 0.0017$$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{60\,000} = 0.0033$$

$A_s = (0.0017 \times 12 \times 11.5) = 0.24\ sq''$

$A_s(min) = (0.0033 \times 12 \times 11.5) = 0.46$

or $1.33\ A_s = (1.33 \times 0.24) = 0.32$

Since wall th. varies, use #6 @ 9" $A_s = 0.59$

Heel Design:

Neglecting upward soil pr. on the heel:

Soil wt $= (12 \times 0.13) = 1.56$ kip

Conc. Ftg $= (1.25 \times 0.15) = 0.19$

$M_{BB} = \left(1.56 \times \frac{4.5^2}{2}\right) + \left(0.19 \times \frac{4.5^2}{2}\right) = 17.72$ kip

$M_u = 1.3\,(17.72) = 23.04$ kip

$d = (15 - 2 - 0.5) = 12.5''$ or

$d = (15 - 3 - 0.5) = 11.5''$ with 1" clearance to standard ke

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 16 OF

DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

CHECKED BY DATE

8' Footing width

$$\frac{M_u}{\phi f'_c b d^2} = \frac{23.04 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.065$$

Read $\omega = 0.068$ from Table 9-2

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.068 \times 3.0}{60.0} = 0.0034$$

$$\rho_{min} = \frac{200}{f_y} = 0.0033$$

$$A_s = (0.0034 \times 12 \times 11.5) = 0.47 \text{ in}^2$$

#6 @ 9", $A_s = 0.59$ OR

#7 @ 9" $A_s = 0.80$

Try 9'-0 Footing width to have a Little more F.S. in Sliding & reduce Soil. pr a Little

Try Footing width = 9'-0

Using Equiv. Fluid pr = 80 pcf

$Pr = wKh = (80 \times 13.25) = 1060$ psf

$P = \left(\frac{1060}{2} \times 13.25\right) = 7.03^K$ — sliding force

$M_{OT} = \left(7.03 \times \frac{13.25}{3}\right) = 31.1$ K'

Stabilizing Mom:

$W_1 = (1.0 \times 12.0 \times 0.15) = 1.80^K$

$W_2 = (9.0 \times 1.25 \times 0.15) = 1.69$

$W_3 = (5.5 \times 12.0 \times 0.13) = 8.58$

12.07^K

$M_{STB} = (1.8 \times 3.0) + (1.69 \times 4.5) + 8.58\left(3.5 + \frac{5.5}{2}\right)$

5.4 7.6 57.63

$= 66.63$ K'

$F.S = \frac{66.63}{31.10} = 2.14$ OK

Sliding Check

Frictional force $= \mu N = 0.4 \times 12.07 = 4.8^K$

with $\mu = 0.5$, $\therefore 0.5 \times 12.07 = 6.1^K$

Sliding force $= 7.03^K > 6.1^K$

USC a Base Slab Key (1'-3) x (1'-6)

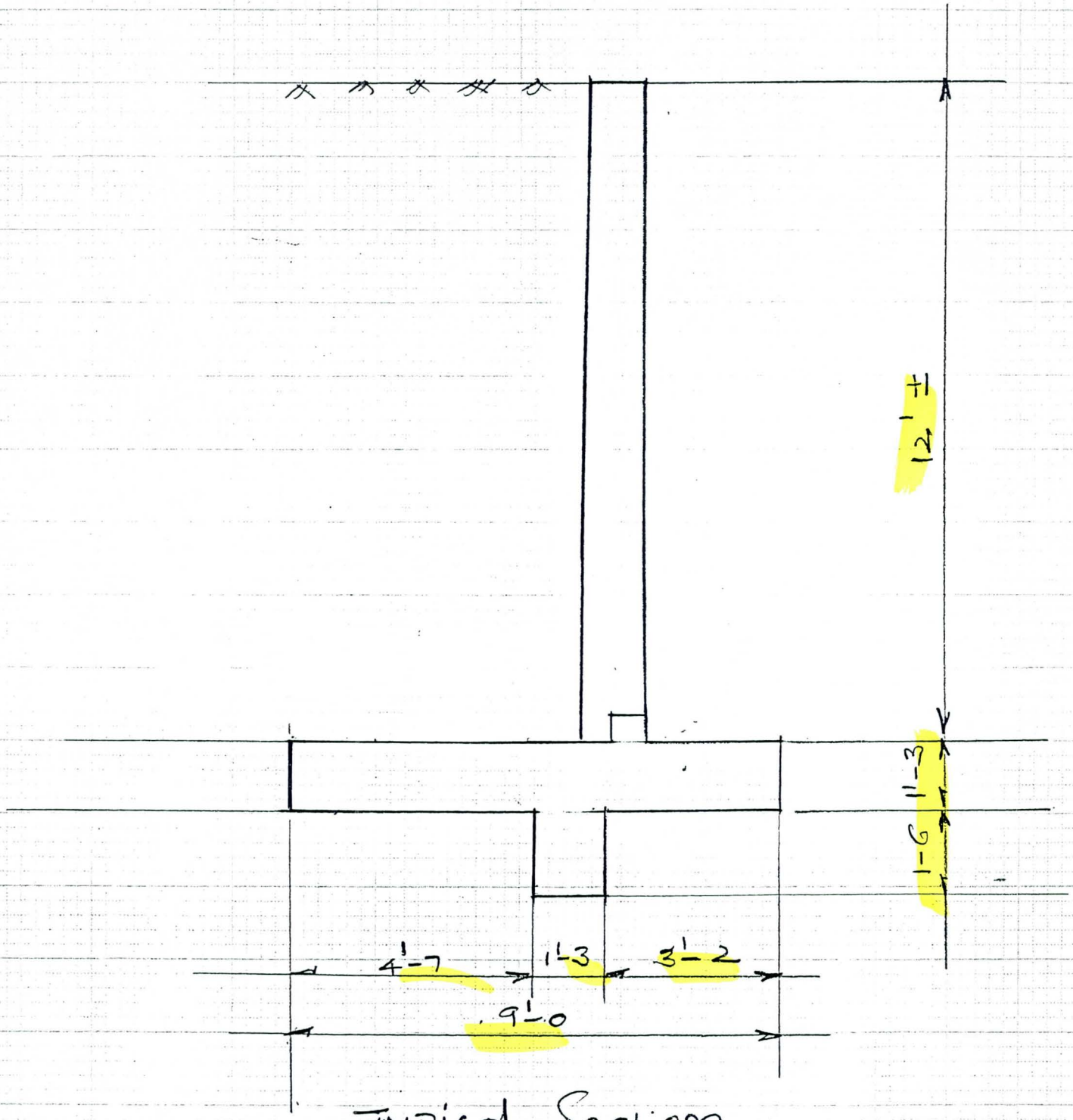
Actually Sliding force will not be as high as 7.03K, because of water pr on Channel side, under Submerged Condition

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 18 OF

DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY CGW DATE 10/92



Typical Section

Scale 1/2" = 1'-0

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DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY CLW DATE 10/92

Checking Footing for (9'-0 footing width)

$M_{STB} = 66.63$, $M_{OT} = 31.1$, $N = 12.07^K$

$x_R = (66.63 - 31.1)/12.07 = 2.94'$

$e = (4.5 - 2.94) = 1.56$,

$b/6 = \frac{9.0}{6} = 1.5$ $e > b/6$ $\therefore$ ok

$P_{r\,max} = \frac{12.07}{9 \times 1}\left(1 \pm \frac{6 \times 1.56}{9}\right)$

$= 1.34\,(1 \pm 1.04)$

$P_{r(max)} = 2.74$ ksf ok conservative $P_{r(min)} = -0.05$ ksf $= 0.0$

$P = \frac{2R}{L} = \frac{(2)(12.07)}{9} = 2.68$

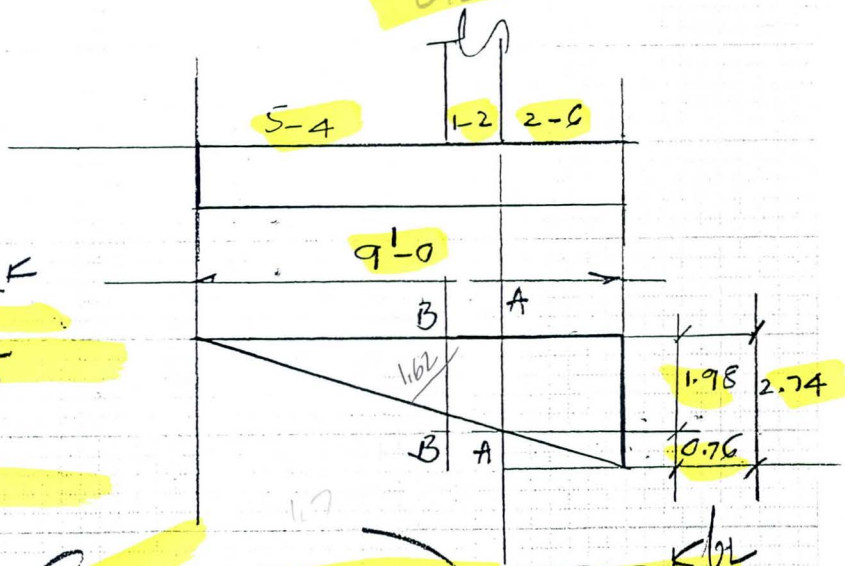
Toe Design:

$\frac{2.74}{9} = \frac{P_{r_1}}{6.5}$

$P_{r_1} = 1.98$ ksf

$P_1 = (1.98 \times 2.5) = 4.95^K$

$P_2 = \left(\frac{0.76}{2} \times 2.5\right) = 0.95$



Neglecting ftg wt:

$M_{AA} = \left(4.95 \times \frac{2.5}{2}\right) + \left(0.95 \times \frac{2}{3} \times 2.5\right) = 7.8^{K'}$

$M_u = (7.8 \times 1.3) = 10.14^{K'}$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 20 OF

DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92

CHECKED BY CGW DATE 10/92

$A_s = \frac{(7.8)(12)}{(24)(1.9)(11.5)}$

$A_s = 0.38$

$\times 1.69 = 0.59$ OK

9' Footing width (Contd)

$M_u = 10.14$, $d = (15-3-0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{10.14 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.029$$

Read $\omega = 0.03$ from Table 9-2

ρ_{min} Controlling, use #6 @ 9''

Heel Design:

$\frac{2.74}{9} = \frac{p_v}{5.33}$ $p_v = 1.62$ KSF

$P = \left(\frac{1.62}{2} \times 5.33\right) = 4.32^K$

Soil wt $= (12.0 \times 0.13) = 1.56$ K/ft

Conc. ftg $= (1.25 \times 0.15) = 0.19$

$M_{BB} = \left(1.56 \times \frac{5.33^2}{2}\right) + \left(0.19 \times \frac{5.33^2}{2}\right) - 4.32 \times \frac{5.33}{3}$

22.2 2.7 24.9

$= 17.2$ kft 24.9

$M_u = 1.3(17.2) = 22.4$ kft 32.4

$A_s = \frac{(24.9)(12)}{(24)(1.9)(11.5)}$

$A_s = 1.20$ in²

$d = (15-3-0.5) = 11.5$ with 1'' Cl to Standard Key

$$\frac{M_u}{\phi f'_c b d^2} = \frac{22.4 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = 0.063$$

Read $\omega = 0.066$ from Table 9-2

$a = \frac{(1.20)(60)}{(1.85)(3)(12)} = 1.56$

$M_n = \frac{(1.20)(60)}{(12)}\left(11.5 - \frac{1.56}{2}\right)$

$M_n = 42.0$ ft²

≥ 32.4

$$\rho = \frac{\omega f'_c}{f_y} = \frac{0.066 \times 3.0}{60} = 0.033$$

OK

$A_s = (0.033 \times 12 \times 11.5) = 0.46$ in²

#6 @ 9'', $A_s = 0.59$, #7 @ 9'', $A_s = 0.80$

$A_s = 0.80$

At the wall ht. varies, use #7 @ 9''

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 21(A) OF
DETAIL 12' Retaining wall COMPUTED KVH DATE 7/92
CHECKED BY CGW DATE 10/92

Stem Design

$P_r = wh = (80 \times 12) = 960$ psf

$M_{om} = \left(\frac{0.96}{2} \times 12\right)\frac{12}{3} = 23.04$ kft

$M_u = (23.04 \times 1.3) = 29.95$ kft

$d = (14 - 2 - 0.5) = 11.5''$

$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{29.95 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2}\right) = 0.084$

from Table 9-2, $w = 0.089$

$\rho = \frac{w f'_c}{f_y} = \left(\frac{0.089 \times 3.0}{60}\right) = 0.0045$

$A_s = (0.0045 \times 12 \times 11.5) = 0.62 \text{ in}^2$

#6 @ 6" $A_s = 0.88$

As the wall ht. varies use #7 @ 6", $A_s = 1.20$ OK

$a = \frac{(1.20)(60)}{(3.5)(.36)} = (1.96)(1.20) = 2.31$

$M_n = \frac{(1.20)(60)}{(12)}\left(11.5 - \frac{2.31}{2}\right)$

$M_n = 60 > 29.95$

OK

ws

$A_s = \frac{(23.0)(12)}{(24)(.9)(11.5)}$

$A_s = 1.11$

#7 @ 6 ok

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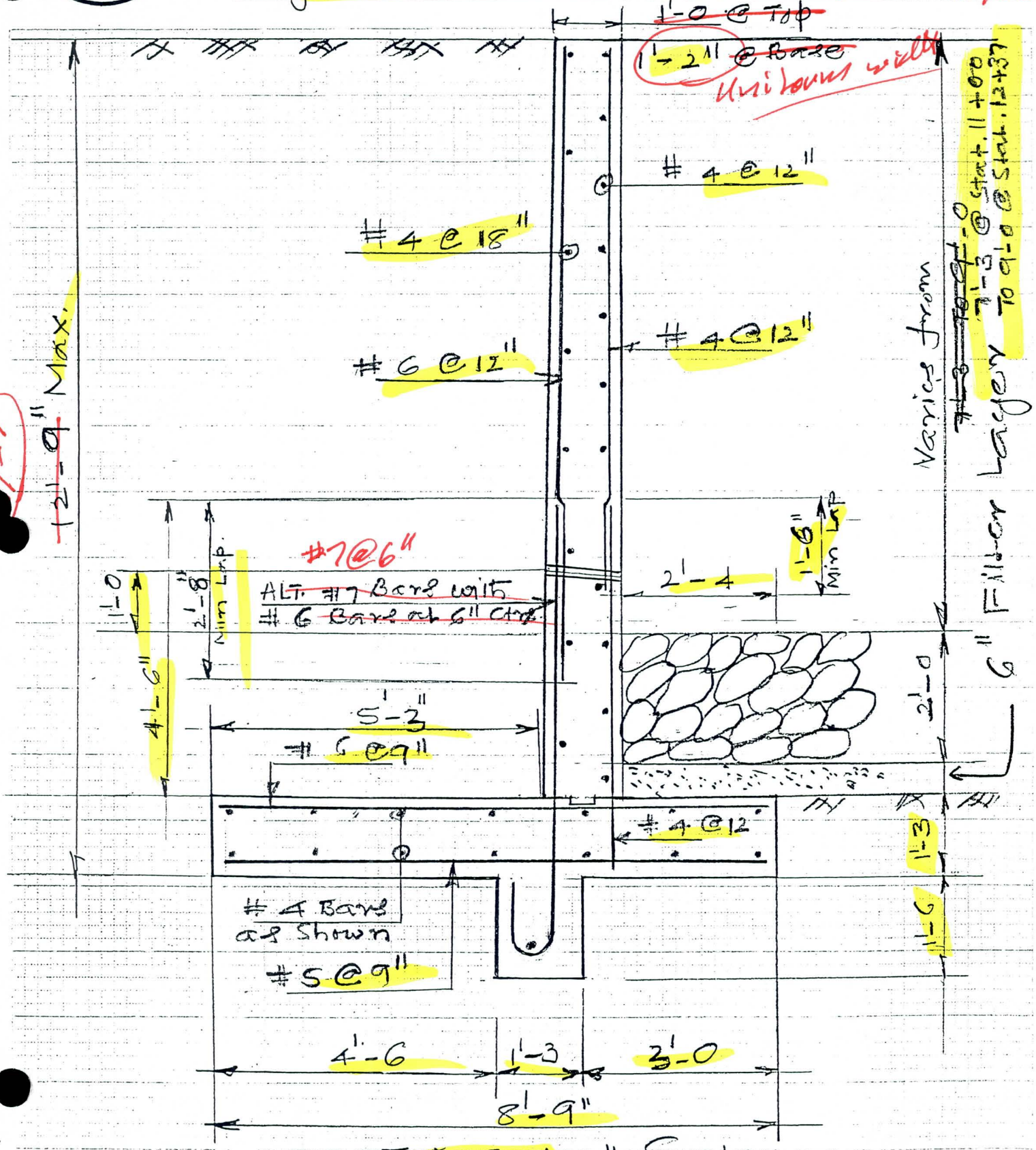
PROJECT Spook Hill Outlet PAGE 21(B) OF

DETAIL 9'-0 Wall Sect COMPUTED KVH DATE 8/92

Type 3 Wall CHECKED BY CGW DATE 10/92



Type 3 Wall Section

1/2" = 1'-0

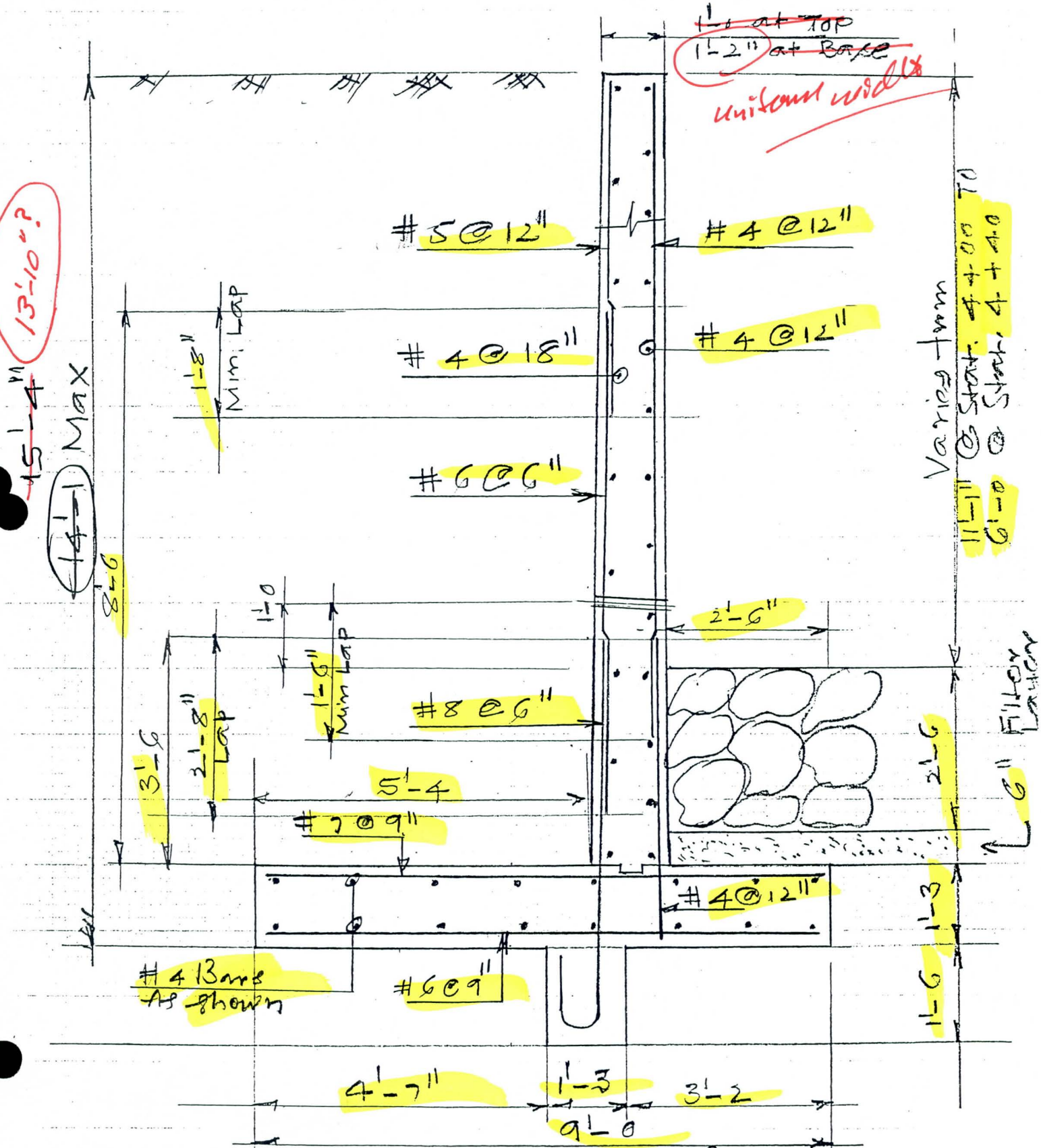
Stat. 1100 To 1237.6

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 21(C) OF

DETAIL Type 4 wall COMPUTED KVH DATE 8/92

CHECKED BY CLW DATE 10/92



Type 4 Wall Section

1/2" = 1'-0 Stat. 4+00 To 4+40

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 22 OF

DETAIL Type 1 wall COMPUTED KVH DATE 8/92

Reinf Check CHECKED BY CGW DATE 10/92

Wall height reduced to 7.5'

Type 1 wall:

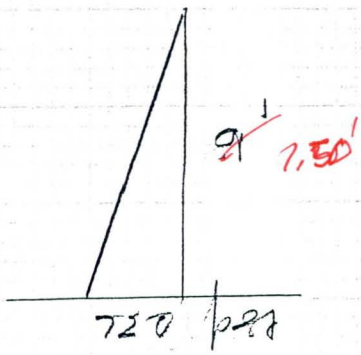
Ht = (6+3) = ~~9'~~ 7.50'

pr @ 80 pcf Saturated pr.

(80 × ~~9~~ 7.5) = ~~720~~ 600 pcf

P = (~~0.720~~ 0.600 / 2 × ~~9~~ 7.5) = ~~3.24~~ 2.25 K

M = ~~3.24~~ 2.25 (~~9~~ 7.5 / 3) = ~~9.72~~ 5.63



d = (12 − 2 − 0.5) = 9.5

$A_s = \frac{\cancel{9.72}\ 5.63 \times 12}{24 \times 0.88 \times 9.5}$

= ~~0.58~~ 0.33 OK

Use #5 @ 6", A_s = 0.62 > 0.33

Bar Cut off @ (24" − 2) − 1' = 1'−1" say 1' from Bot

pr = (80 × ~~8~~ 6.5) = 640

P = (640/2 × 8) = 2.56 K

M = (2.56 × 8/3) = 6.83, not used

$A_s = \frac{6.83 \times 12}{24 \times 0.88 \times 9.5}$

= 0.41 in²

Bars Cannot be cut off at 2'-2' from Bottom for #5 @ 12"

Bar Extension, 12 db = 12 × 5/8 = 7.5"

d = = 9.5"

Min 12" = 12"

Try Bar Cut off at 3'-0 from Base

Check Min. at (3 − 1) − 1.0 = 2.0' from Base

Check Reinf @ (~~9~~ 7.5 − 2) = ~~7'~~ 5.5' ~~Height~~

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sbook Hill Culvert PAGE 23 OF

DETAIL Type 1. wall COMPUTED KVH DATE 8/92

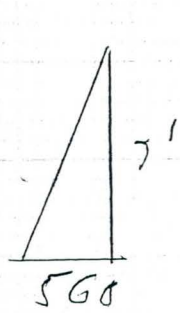
CHECKED BY CGW DATE 10/92

$Ht = \cancel{7}\ 5.5$

$pw = (80 \times \cancel{7}\ 5.5) = \cancel{560}\ 440$

$P = \left(\frac{\cancel{0.560}\ 0.44}{2} \times \cancel{7.0}\ 5.5\right) = \cancel{1.96}\ 1.21$

$M = \cancel{1.96}\ 1.21 \times \cancel{7}\ 5.5/3 = \cancel{4.6}\ 2.2$ k/ft



$As = \frac{\cancel{4.6}\ 2.2 \times 12}{24 \times 0.88 \times 9.5}$

$= \cancel{0.28}\ 0.13 < 0.31$ ok

#5 @ 12" Bar Cutoff at 3' from Base is ok

Shear Check:

$V = \cancel{2.56}\ 2.25$ k at bott

$b = 12,\ d = 9.5$

$v = \frac{\cancel{2.56}\ 2.25 \times 1000}{12 \times 9.5} = \cancel{22}\ 20$ psi < 55

∴ ok

$v_{c\,allow} = \sqrt{f'c} = \sqrt{3000} = 55$

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Skook Hill outlet PAGE 24 OF

DETAIL Type 2 wall COMPUTED KVH DATE 8/92

Type 5 wall CHECKED BY CGW DATE 10/92

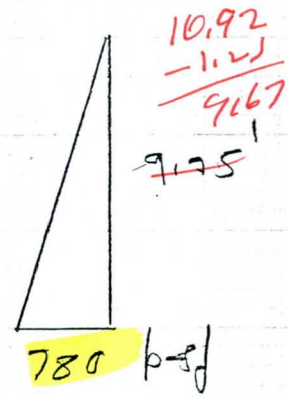
Type 2 wall + 5 wall

Ht = 9'-9 ok actual max 9'-8

$P_r = (80 \times 9.75) = 780$

$P = \left(\frac{0.780}{2} \times 9.75\right) = 3.80^K$

$M = \left(3.80 \times \frac{9.75}{3}\right) = 12.4^{K'}$



$A_s = \left(\frac{12.4 \times 12}{24 \times 0.88 \times 9.5}\right)$

$= 0.74$

use #6 @ 6", $A_s = 0.88$

Try Bar Cut off at 3' from Base

Check Mom at (9.75 - 2.0) = 7.75'

not used

$P_r = (80 \times 7.75) = 620$

$P = \left(\frac{0.620}{2} \times 7.75\right) = 2.4^K$

$M = \left(2.4 \times \frac{9.75}{3}\right) = 7.8^{K'}$, $A_s = \frac{7.8 \times 12}{2.4 \times 0.88 \times 9.5}$

$= 0.47 \text{ in}^2$

Try Bar Cut off at 3'-6 from Base

$P_r = (80 \times \cancel{7.25}\ 6.25) = \cancel{580}\ 500$

$P = \frac{\cancel{0.580}\ .50}{2} \times \cancel{7.25}\ 6.25 = \cancel{2.10}\ 1.56^K$

$M = \left(\cancel{2.10}\ 1.56 \times \frac{\cancel{7.25}\ 6.25}{3}\right) = \cancel{5.08}\ 3.25$

$A_s = \frac{\cancel{5.08}\ 3.25 \times 12}{24 \times 0.88 \times 9.5}$

$= \cancel{0.30}\ 0.19\ 2.31$

∴ Use #5 @ 12" at 3'-6 from Base ok

actual use from base
∴ 9.75 - 3.5 = 6.25'

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Type 3 wall COMPUTED KNH DATE 8/92
CHECKED BY CLW DATE 10/92

Type 3 wall

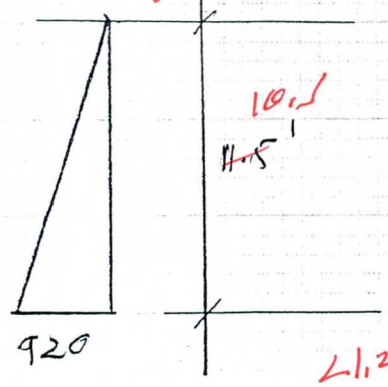
Ht = ~~11'-6"~~ 10.5'

$p_H = 80(\cancel{11.5}\ 10.5) = \cancel{920}\ 840$

$P = \left(\frac{\cancel{0.920}\ 840}{2} \times \cancel{11.5}\ 10.5\right) = \cancel{5.29}\ 4.41$ K

$M = \left(\cancel{5.29}\ 4.41 \times \frac{\cancel{11.5}\ 10.5}{3}\right) = \cancel{20.3}\ 15.4$ K'

11-9
-1-3
10.5



d eff = (14 − 2.5) = 11.5"

Alt Bars #7 & #6
#7 @ 12 = 1.20
#6 @ 12 = 0.88 } 1.04

$A_s = \left(\frac{\cancel{20.3}\ 15.4 \times 12}{24 \times 0.85 \times 11.5}\right) = \cancel{1.0}\ 0.76$ ∠1.20

Alt #7 Bars with #6 Bars
#7 @ 6" used = 1.20 A_s = 1.04 ok

Bar Cut off

12 d_b = 12 × 7/8 = 10.5"
d eff = = 11.5
Min 12" = 12"

Use 12" Min beyond the actual Bar Cutoff

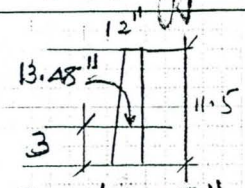
Try at ~~(4-0)~~ 5-0 − 1' = ~~3'-0"~~ 4'-0"

Ht = (~~11.5~~ 10.5 − ~~3.0~~ 4.0) = ~~8.5'~~ 6.5'

p_H = (~~8.5~~ 6.5 × 80 psf) = ~~680 psf~~ 520

$P = \left(\frac{\cancel{0.68}\ 0.52}{2} \times \cancel{8.5}\ 6.5\right) = \cancel{2.89}\ 1.69$ K

$M = \cancel{2.89}\ 1.69 \times \frac{\cancel{8.5}\ 6.5}{3} = \cancel{8.2}\ 3.7$ K'



$\left(12 + \frac{8.5}{11.5} \times 2''\right)$
= 13.48"
d eff = 13.48 − 2.5 = 10.98"

$A_s = \frac{\cancel{8.2}\ 3.7 \times 12}{24 \times 0.85 \times 10.98}$
= ~~0.42~~ 0.19 < 0.44

Use #5 @ 12 As = 0.31 ok OK
#6 @ 12, A_s = 0.44

Use Bar Cutoff at 4'-6 & use #6 @ 12 at top

5'-0

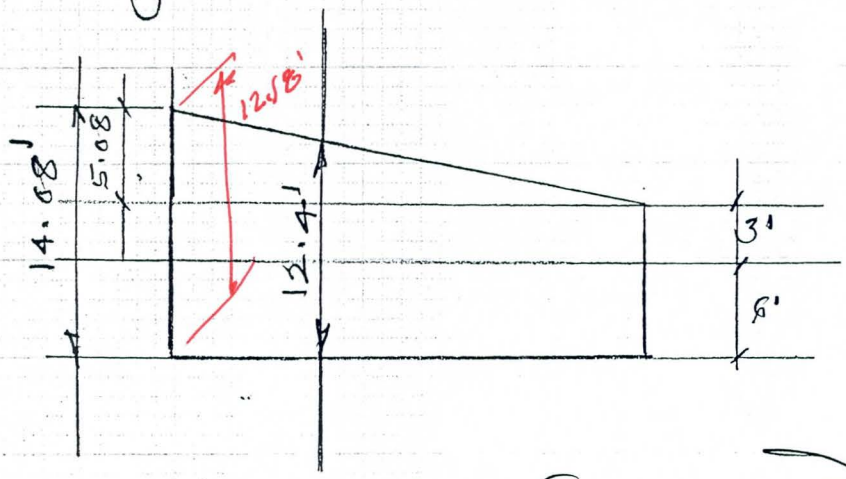
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 26 OF

DETAIL COMPUTED KVH DATE 8/92

Type 4 wall CHECKED BY CLW DATE 10/92

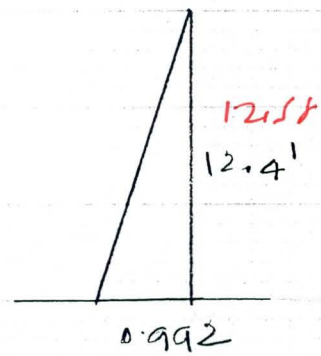
Type 4 wall



13.83
13-10 max
— 1.25
12.58 max wall

$Ht @ C.G_r = (9 + \frac{2}{3} \times 5.08) = 12.4'$

) Design $Ht = 12.4'$ use ok



$P_r = (80 \times 12.4) = 992$

$P = \frac{0.992}{2} \times 12.4 = 6.15^K$

$M = 6.15 \times \frac{12.4}{3} = 25.4^{K/ft}$

$d_{eff} = (14 - 2.5) = 11.5''$

$A_s = \frac{25.4 \times 12}{24 \times 0.88 \times 11.5} = 1.25$

use #8 @ 6", $A_s = 1.58$

Shear Check:

$V_{max} = 6.15^K$ $\quad v = \frac{6.15}{12 \times 11.5}$

$= 44.6$ psi < 60 ok

Allow $S_h = 0.95\sqrt{4000} = 60$ psi ∴ ok

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL Type 4 wall COMPUTED KVH DATE 9/92

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b) Check Bar Cut off @ 4'-0 (3'-6)

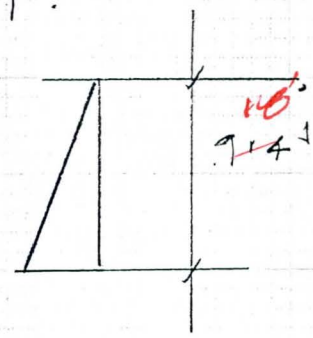
Check at (4 − 1.0) = 3' (2'-0) from Butt.

Ht = (12.4 − 3.0) = 9.4' (12.6, 3.0, 10.6)

pr = (8.0 × 9.4) = 75.2 psf (10.6, 8.00)

P = (0.752 / 2 × 9.4) = 3.53 K (4.50, 10.6)

M = (3.53 × 9.4 / 3) = 11.1 K' (4.50, 10.6, 15.9)



dcff = (14 − 2 − 0.5 − 0.5) = 11.0

As = (11.1 × 12) / (24 × 0.88 × 11) = 0.57 (15.9, 0.82, <0.88)

close enough def. of 4'-0

Use #6 @ 6" & Bar Cutoff at 3'-6

c) Check Bar Cutoff at 7'-0 (9'-6)

Check at (7 − 1.0) = 6' (7.5, 1.5) from Bottom

Ht = (12.4 − 6.0) = 6.4' (7.5, 4.9)

pr = 80 × 6.4 = 512 (4.9, 392)

P = 0.512 / 2 × 6.4 = 1.64 K (392, 4.9, 0.96)

M = 1.64 × 6.4 / 3 = 3.15 K' (0.96, 4.9, 1.54)

As = (3.15 × 12) / (24 × 0.88 × 10.5) = 0.19 (1.6, 0.04)

OK

Use min #5 @ 12

dcff = (14 − 2.0 − 0.5 − 1.0)
= 10.5

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

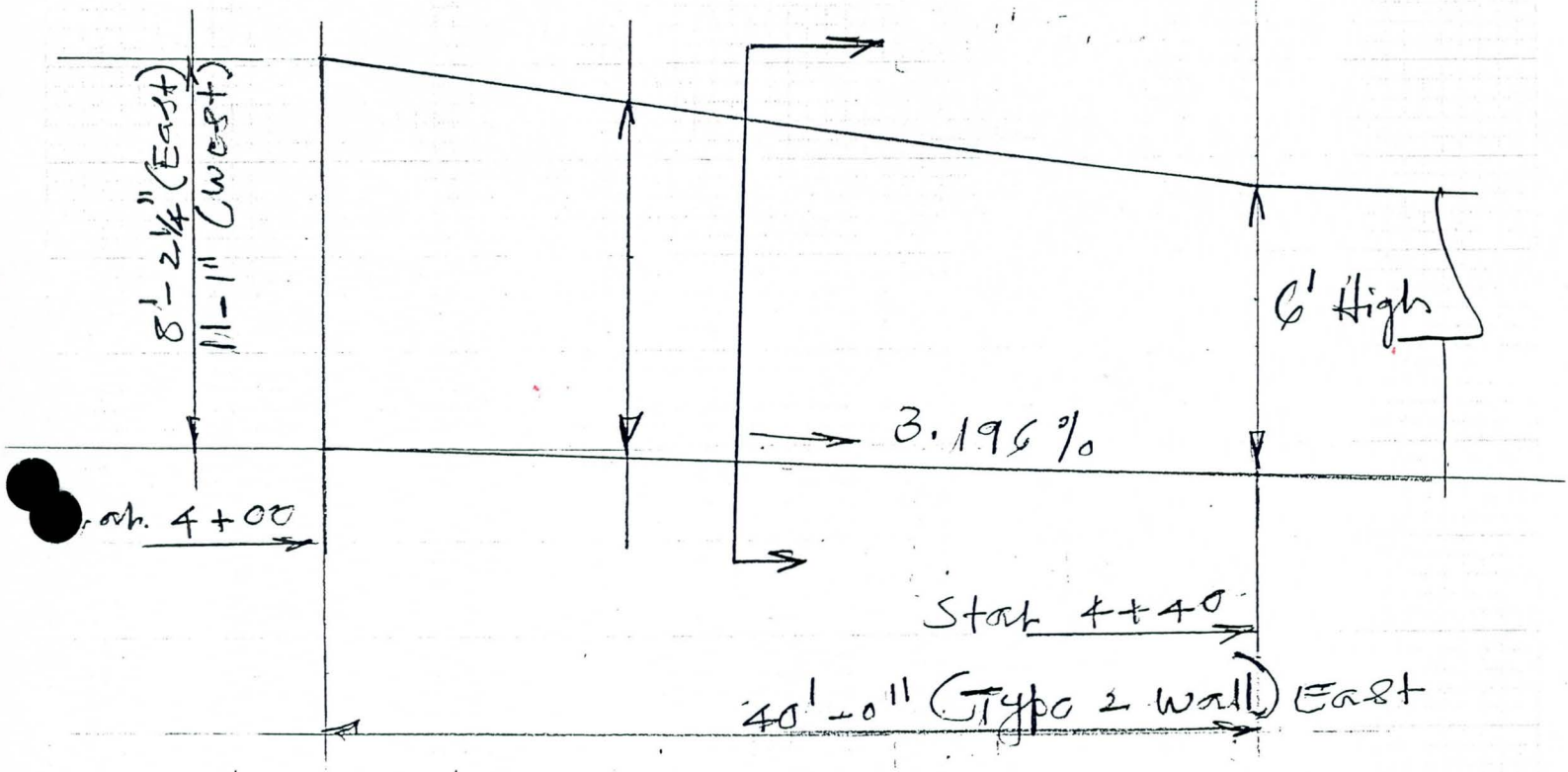
PROJECT Spook Hill outlet PAGE 28 OF ____

DETAIL East wing wall COMPUTED KVH DATE Aug 92

CHECKED BY ____ DATE ____

East & west wing walls

3.196 %, $3.196 \times \frac{40}{100} = 1.28'$



East (8'-2) - 6 = 2'-2

Design Ht = 6' + 2/3 (2.17) = 7'-6"

∴ Use Type 2 Wall Detail - East wing

West (11'-1) - 6 = 5.08', Design Ht = 6 + 2/3 (5.08) = 9.4'

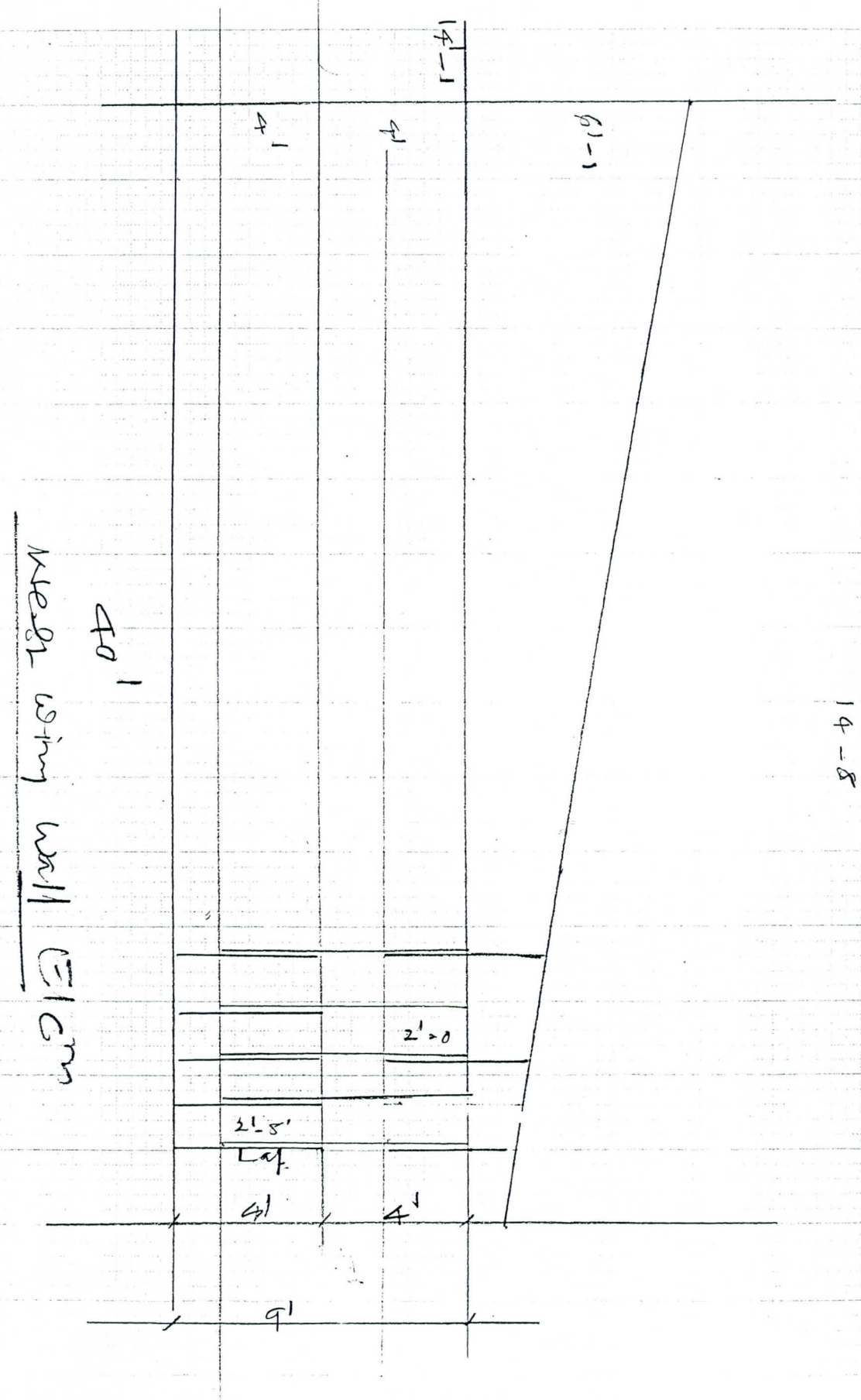
use Type 4 wall Detail with 9'-0 Footing width

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 29 OF

DETAIL West Wingwall COMPUTED KVH DATE 9/92

CHECKED BY DATE



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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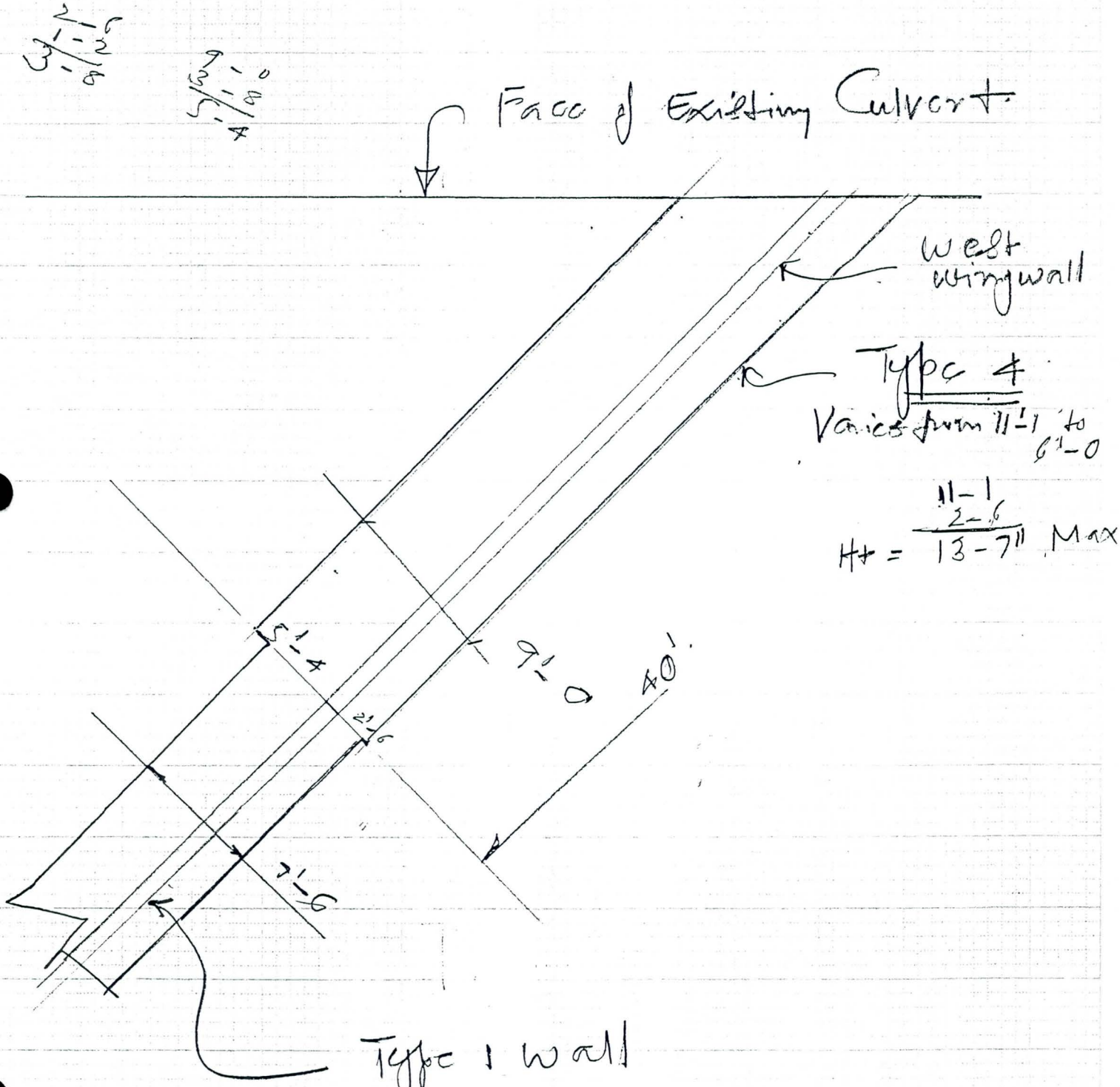
DETAIL Plan West wing COMPUTED KVH DATE 8/92

CHECKED BY DATE



Plan West wing wall

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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DETAIL Concrete Qty's COMPUTED KVH DATE 9/92

CHECKED BY DATE

Concrete

Type 1 Start (4+40) To 7+22

L = 282'

A = (1.0 x 9) + (6.5 x 1.25) + (1.5 x 1.25) = 20.3

Qty = (20.3 x 282 / 27) = 212

Type 2 Start (7+22) To (11+00)

L = 378'

Av. Wall Ht = (8.5 + 9.75)/2 = 9.125

A = (9.125 x 1.0) + (8 x 1.25) + (1.5 x 1.25) = 21.0

Qty = (21 x 378)/27 = 294

Type 3 Start 11+00 to 12+37

L = 137

Av. Wall Ht = (9.75 + 11.5)/2 = 10.63

A = (10.63 x 1.08) + (1.25 x 8.75) + (1.5 x 1.25)

= 24.29

Qty = (24.29 x 137)/27 = 123

Type 4 Start (4+00) To (4+40)

L = 40'

Av. Ht = (9 + 14.08)/2 = 11.54

A = (11.54 x 1.08) + (9.0 x 1.25) + (1.5 x 1.25)

= 25.6

Qty = (25.6 x 40)/27 = 38

Type 5 L = 40 Av. Ht = (9 + 11.17)/2 = 10.08 1330

A = (10.08 x 1.08) + (8.0 x 1.25) + (1.5 x 1.25)

= 22.8

Qty = (22.8 x 40)/27 = 34

701

Total Conc 701 x 2 (both sides) 1402 CY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 32 OF

DETAIL Grout COMPUTED KVH DATE 9/92

CHECKED BY DATE

Grouted Rip-Rap

1) $L = (282 + 40) = 322'$

$Qty = (\cancel{3}\ 2.5 \times 40 \times 322)/27 =$ ~~1431~~ 1193 CY

2) $L = (378 + 137) = 515'$

$Qty = (\cancel{2.5}\ 2.0 \times 40 \times 515)/27 =$ ~~1908~~ 1526 CY

~~3339~~ 2719 CY

3) Filter Material

$\frac{6}{12} \times 40 \times (322 + 515)/27 =$ 620 CY

(c)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 33 OF

DETAIL Retg. Wall – Reinf. St COMPUTED KVH DATE 9/92

CHECKED BY DATE

Reinf Steel

Typ. 1. wall L = 282'

1) Dowels 1.0 5.5 #5 @ 6"

Nos = $\frac{282 \times 12}{6}$ = 564

L = (564 × 6.5) = 3666

Wt = (3666 × 1.043) = 3824 lbs

2) Back face #5 @ 12, L = (9 − 2" − 10") = 8'

Nos. $282 \times \frac{12}{12}$ = 282

L = (282 × 8) = 2256

Wt = (2256 × 1.043) = 2353

3) a) Front face #4 @ 12, L = 3 + (1'-0") = 4'

Wt = (282 × 4) 0.668 = 754

b) f. face #4 @ 12, L = 7.33'

Wt = (282 × 7.33) 0.668 = 1381

4) Long. Steel No. = 16 #4

L = 282 Splices 10 × 1.5 = 15'

Total L = (282 + 15) = 297

Wt = (297 × 16) 0.668 = 3174

5) Footing Steel:

a) Top: #5 @ 9", Nos. $\frac{282 \times 12}{9"}$ = 376

Wt = (376 × 7.17) 1.043 = 2812

b) Bott: #4 @ 9"

Wt = (376 × 7.17) 0.668 = 1801

c) Longl. Bars: Nos = 13, L = 297

Wt = (297 × 13) 0.668 = 2579

18678 lbs

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 34 OF

DETAIL Qty's Steel COMPUTED KWH DATE 9/92

CHECKED BY DATE

Type 2 wall

L = 378'

1) Dowels #6 @ 6" L = (7+1) = 8.0

1.0 ft 7'

Nos = 378×12 / 6 = 756

wt = (756 × 8.0) 1.502 = 9084 lbs

2) Back face #5 @ 12, Av. L = (6+7.25)/2 = 6.625

Nos = 378×12 / 12 = 378

wt = (378 × 6.625) 1.043 = 2612

3) a) Ft face #4 @ 12, L = 5.5

wt = (378 × 5.5) 0.668 = 1389

b) ft. face (top) Av. L = 6.625

wt = (378 × 6.625) 0.668 = 1673

4) Longit Bars, L = 378 + (13 × 1.5) = 398'
spliced

Nos = 17, wt = (17 × 398) 0.668 = 4520

5) Footings: a) Top #5 @ 9", L = 7.67

Nos = 378×12 / 9 = 504,

wt = 504 × 7.67 × 1.043 = 4032

b) Bott. Steel #4 @ 9"

wt = (504 × 7.67 × 0.668) = 2,582

c) Longit Steel: #4 @ 18" Nos = ~~12~~ 13

L = (398 × ~~12~~ 13 × 0.668) = 3190

29082

Double

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Shook Hill PAGE 35 OF

DETAIL Qty's - Steel COMPUTED KVH DATE 9/92

CHECKED BY DATE

Reinf. Steel

Type 3 Wall L = 137'

1) Dowels #6 @ 12 & #7 @ 12" Ht. 6" 8 pg

1.0 L = 8.0, $\frac{132 \times 12}{12} = 137$ lbs

~~wt #6 Bars: (137 × 8.0 × 1.502) = 1645~~

wt #7: (137 × 8.0 × 2.044)(2) = 2240

+2240

2) Back face #5 @ 12", Av. L = $\frac{7.75 + 9.5}{2}$ = 8.625'

Nos = 137

wt = (137 × 8.625) 1.043 = 1232

3) Front face: #4 @ 12" L = 5.5'

wt = (137 × 5.5) 0.668 = ~~503~~ 550

front of Top: Av. L = $\frac{(6.58 + 8.33)}{2}$ = 7.5'

wt = (137 × 7.5) 0.668 = 686

4) Longit Bars: L = 137 + (5 × 1.5) = 145'
(5 splices)

Nos = 19, (145 × 19) 0.668 = 1840

5) a) Footing #6 @ 9" Top Nos = $\frac{137 \times 12}{9}$ = 183

wt = (183 × 8.42) 1.502 = 2314

b) Ftg - Bottom #5 @ 9",

wt = (183 × 8.42) 1.043 = 1609

c) Longit Steel #4 Bars = 15

wt = (145 × 15) 0.668 = 1453

~~13521~~ lb

14162

double

(F)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

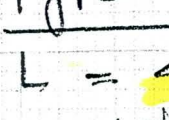
PROJECT Spook Hill PAGE 36 OF

DETAIL Quys - Steel COMPUTED KVH DATE 9/92

CHECKED BY DATE

Typ. 4 wall

1) L = 40' Dowels #8 @ 6" L = 7.0'



No = $\frac{40 \times 12}{6}$ = 80

wt = (80 × 7.0 × 2.67) = 1495 lbs

2) a) Back face #6 @ 6, L = 7.67

wt = (80 × 7.67 × 1.502) = 922

b) Back face #5 @ 12, L = $\left(\frac{11.08}{2} + 1.67\right)$ = 7.21

No = $\frac{40 \times 12}{12}$ = 40

wt = (40 × 7.21 × 1.043) = 301

3) a) Front f. #4 @ 12, L = ~~4.0~~ 5.0

wt = 40 × ~~4~~ 5.0 × 0.668 = ~~107~~ 133

b) front f (top) Av. L = $\left(\frac{6 + 11.08}{2}\right) + 1.5$ = 10.04

wt = 40 × 10.04 × 0.668 = 268

4) Long. Steel: No = 22 + 4 = 26, L = 40

wt = 26 × 40 × 0.668 = 695

5) a) Footing #7 @ 9", L = 8.67, No = $\frac{40 \times 12}{9}$ = 54

wt = 54 × 8.67 × 2.044 = 957

b) #6 @ 9", wt = 54 × 8.67 × 1.502 = 703

c) Long. Steel #4 Bars = 17

wt = 17 × 40 × 0.668 = 454

5902 lbs

one

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 37 OF

DETAIL Bridge - Steel COMPUTED KVH DATE 9/92

CHECKED BY DATE

Type 5 wall

type 2 $\frac{29082}{278} \times 40 = 3078$ OK

1) L = 40', Dowels #6 @ 6, L = 8.

1.0 ft 7.0

No = 40 x 12/6 = 80

Wt = 80 x 8 x 1.502 = 961

2) Backface #5 @ 12, Av. L = $\left(\frac{4.5+6.69}{2}\right) + 2.19 = 7.8'$

Wt = 7.8 x 40 x 1.043 = 325

3) Faface a) #4 @ 12, L = 5.5

Wt = 5.5 x 40 x 0.668 = 147

b) Av. L = $\left(\frac{4.5+6.69}{2}\right) + 1.5 = 7.1$

Wt = 7.1 x 40 x 0.668 = 190

4) Long. Bars: No = 17, L = 40

Wt = 17 x 40 x 0.668 = 454

5) a) Footing #5 @ 9", No = $\frac{40 \times 12}{9} = 54$

L = 7.67, Wt = 7.67 x 54 x 1.043 = 432

b) #4 @ 9, Wt = 7.67 x 54 x 0.668 = 277

c) Long. Bars No = 13, L = 40

Wt = 13 x 40 x 0.668 = 347

3133

Total Reinf:

(8678 + 29082 + ~~13521~~ 14162) 2

+ (5902 + 3133) = ~~131597~~ No

OK 132,879

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 38 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY DATE

Summary of Qtys:

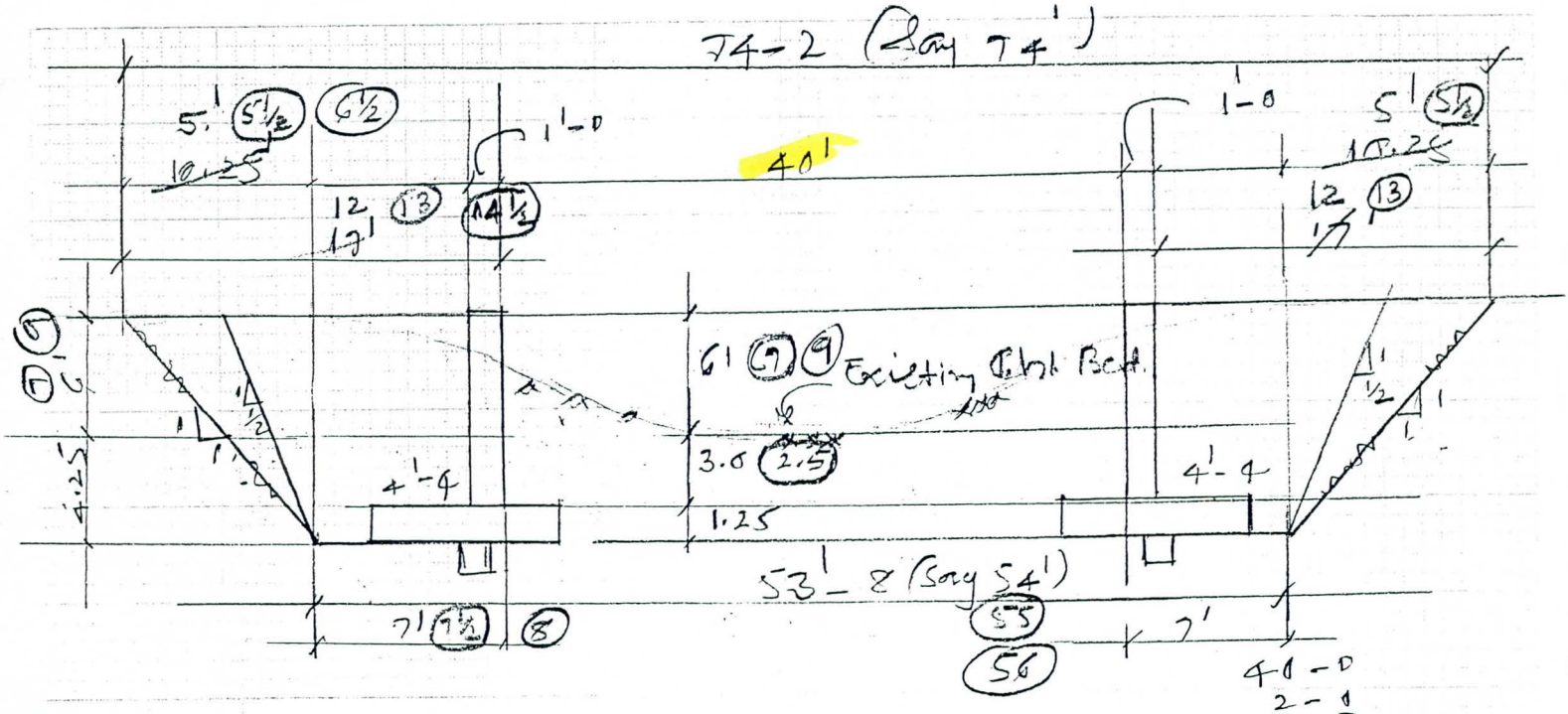
1)	Concrete	~~1402~~ 1264 CY
2)	Reinf. Steel	131597 lbs
3)	Grouted Rip rap	~~3339~~ 2719 CY
4)	Filter Material	620 CY
5)	Excavation	12992 CY
6)	Backfill	5314 CY
7)	Earth Fill	810 CY

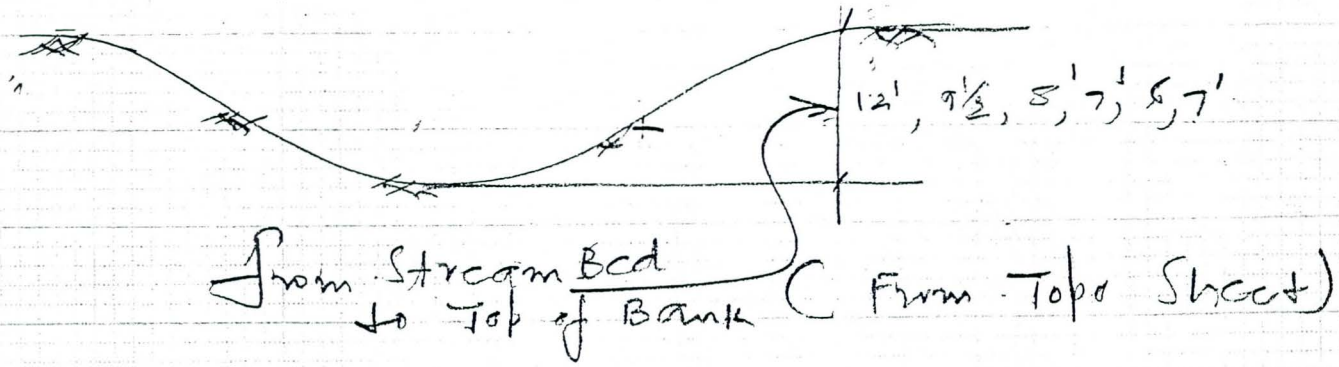
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 39 OF ____

DETAIL Quantities COMPUTED KVH DATE 9/92

CHECKED BY ____ DATE ____





FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 40 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Excavation CHECKED BY DATE

I Excavation (Stat 4+40 To 7+22)

1) Between Chl. walls: L = 282

(40 x 4.25 x 282)/27 = 1776 cy

2) wall & Footings

A = ½ (7 + 12) 10.25 = 97.4

Qty = (97.4 x 282)/27 = 1017 (2) = 2034

Both Sides

3) Key Trench: (1.25 x 1.5) 282/27 = 20 (2) = 40

II Stat. 7+22 To 11+00 L = 378'

Same as previous Cross Section

Except Ht = 7'

1) Between Chl. walls

(40 x 3.75 x 378)/27 = 2100 — 2100

2) Wall & Footings

A = ½ (7.5 + 13) 11.25 = 115.3

Qty = (115.3 x 378)/27 = 1614 (2) — 3228

2 Sides

3) Key Trench: 1.25 x 1.5 x 378/27 = 26 (2) — 52

III Stat 11+00 To 12+37 L = 137'

1) Bot^m Channel walls

(40 x 3.75 x 137)/27 = 761

2) wall & Footings

A = ½ (8 + 14.5) 12.75 = 143.4

Qty = (143.4 x 137)/27 = 727 x 2 = 1454

3) Key Trench: 1.25 x 1.5 x 137/27 = 10 (2) = 20

1465 cy

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 41 OF

DETAIL Quantities COMPUTED KNH DATE 9/92

Excavation CHECKED BY DATE

IV	East wing:		11465 CY
	By proportioning for 40' & using Quantities of I		
	1) $(1776 \times \frac{40}{282})$	=	252
6.0, 4.25, 10.25 / 8.17, 4.25, 12.42	2) $(2034 \times \frac{40}{282})\ \frac{(12.42)}{10.25}$	=	350
	3) $40 \times \frac{40}{282}$	=	6
V	West wing:		
	By proportioning for 40' & using Quantities of III		
	1) $761 \times \frac{40}{137}$	=	222
9.0, 3.75, 12.75 / 11.00, 3.75, 14.75	2) $(1454 \times \frac{40}{137})\ \frac{14.75}{12.75}$	=	491
	3) $(50 \times \frac{40}{137})$	=	6
	Total Excn		12792 CY

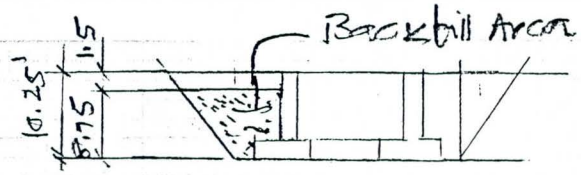
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outLet PAGE 42 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Backfill CHECKED BY DATE

Backfill.



I) Stat 4+40 To 7+22, L = 282

A = ½ (7+12) 8.75 = 83.1

wall = (1.0 × 9) = 9
ftg = 4.33 × 1.25 = 5.4 } 14.4

Net Area = 68.7

Qty = [(68.7 × 282)/27] 2 = 1435 CY
(both sides)

II) Stat. 7+22 To 11+00, L = 378

A = ½ (7.5+13) 9.75 = 99.9

wall = 1.0 × 10 = 10
ftg = 4.67 × 1.25 = 5.8 } = 15.8

Net 84.1

Qty = [(84.1 × 378)/27] 2 = 2354 CY

III) Stat. 11+00 to 12+37, L = 137

A = ½ (8+14.5) 11.25 = 126.6

wall = (1.08 × 11.5) = 12.4
Ftg = 5.25 × 1.25 = 6.6 } = 19.0

Net = 107.6

Qty = [107.6 × 137/27] 2 = 1092

IV) East wing: By prop'n Qtys of I, L = 40

[1435 × 40/282] 8.75/10.92 = 163

IV) West wing: By prop'n Qtys of III L = 40

[1092 × 40/137] 11.25/13.25 = 270

Total Back Fill 5314 CY

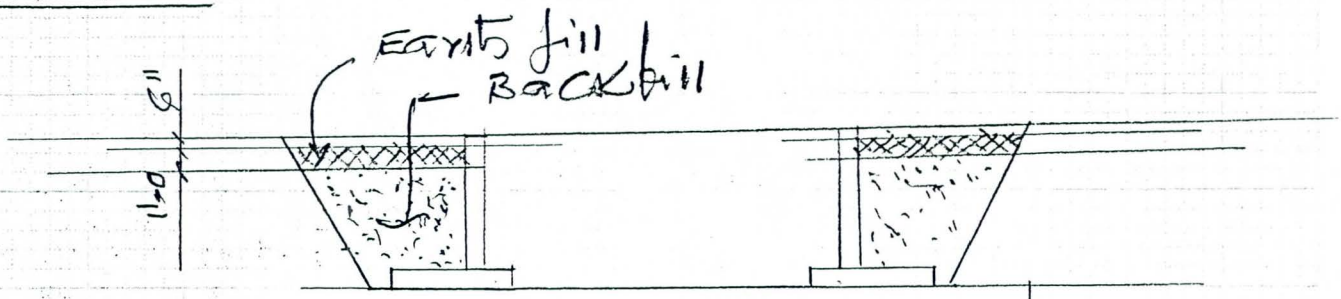
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 43 OF

DETAIL Quantities COMPUTED KVH DATE 9/92

Earth Fill CHECKED BY DATE

Earth Fill



1) Sta 4+40 To 7+22, L = 282
Fill width = 12 ±
Qty = $\left(\frac{12 \times 1.0 \times 282}{27}\right) 2$ ← 2 Sides = 251 CY

2) L = 378 Fill width = 13 ±
Qty = $\left(\frac{13 \times 1.0 \times 378}{27}\right) 2$ = 364

3) L = 137, width = 14.5 ±
Qty = $\left(\frac{14.5 \times 1.0 \times 137}{27}\right) 2$ = 147

5) East & West Approaches.
height = 16.0 (Average) L = 40
Qty = $\left(\frac{16 \times 1.0 \times 40}{27}\right) 2$ = 48

Total Earth Fill 810 CY

STRUCTURAL DESIGN:

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi.Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ___ OF ___

DETAIL _____ COMPUTED _____ DATE _____

_____ CHECKED BY _____ DATE _____

STA		Channel Invert	Channel Wall Elev.		Depth of the Wall		
319		CULVED	Inside	Outside	Inside	Outside	
400		34.49	40.49	40.49	6'-0"	6'-00"	6'
650	13.76%	26.50	32.50	32.50	6'-0"	6'-00"	
722.33 PC		25.08	31.25	31.25	6'-2"	6'-2"	
850		22.59	28.83	29.33	6'-3"	6'-8.88"	7'-3
979.98 PI	19.57%	20.04	26.29	27.29	6'-3"	7'-3"	
1096.94		17.75	24.00	24.55	6'-3"	6'-9.6"	
1100		17.69	24.00	24.44	6'-3.72"	6'-9"	
1118.98		17.32	24.00	24.00	6'-8.16"	6'-8.16"	9'
1237.60		15.00	24.00	24.00	9'-0"	9'-00	

Type ① L = 322'

Type ② L = 378'

Type (3) L = 137'

121, Fig 1.7

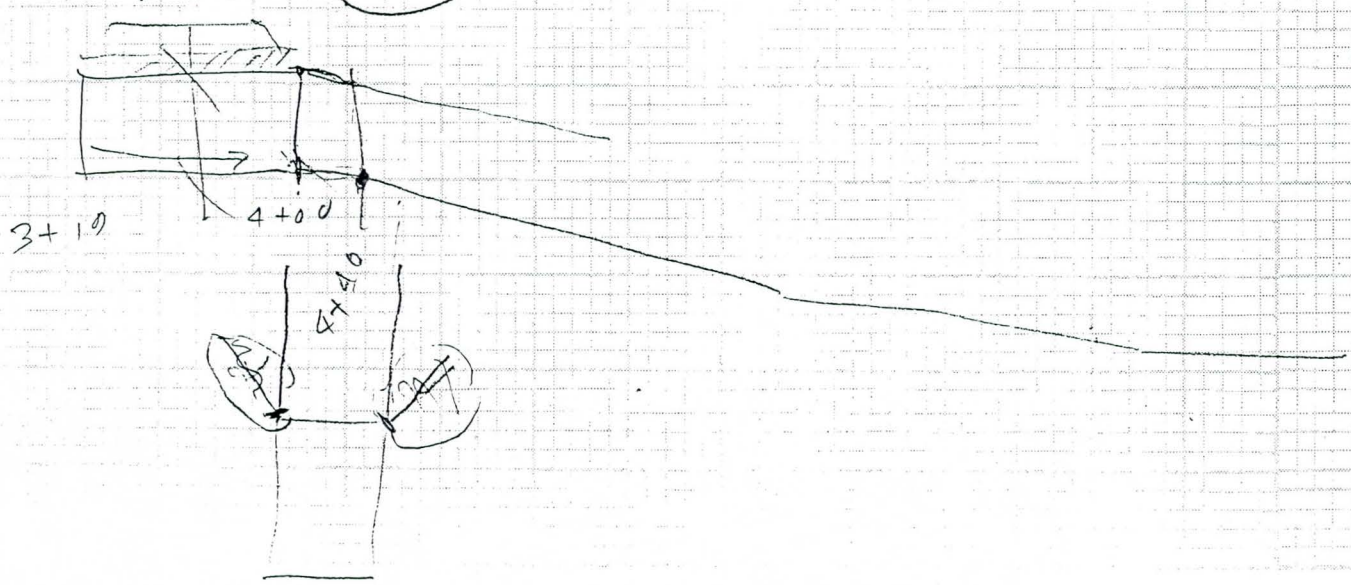
650
400
250

1100
650
450

1237
1100
137

650
400
250

1100
650
250



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 1 OF 4 5

DETAIL Wall detail Dimentions Steel length & Concrete Areas COMPUTED Edgar Q Moreno DATE 8/2/93

CHECKED BY EDM DATE

#5
① 5.66
② 6.33
④ 5.75
⑤ 8.0x1.33 = 10.66
⑦ 10x1 = 18
⑨ 9x1 = 9
55.4 ft

W = 1.043x55.4 = 57.78
⑩ 1.043
58.82

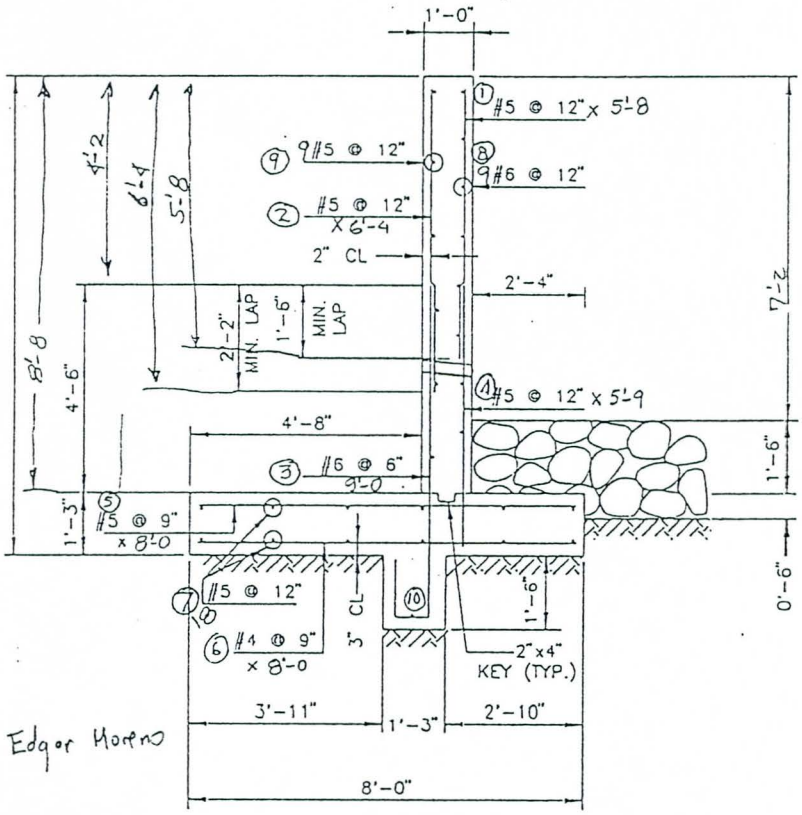
#6
③ 9.0x2 = 18
⑧ 9x1 = 9
27 ft

W = 1.502x27 = 40.55 lb

#4
⑥ 8.0x1.33 = 10.66 ft
W = .668x10.66 = 7.12

W = 106.493

A = 8.66 + 10 + 1.875
= 20.54 ft²



Edgar Moreno

TYPE 2

#5
① 4.50
② 5.16
④ 5.75
⑤ 8.0x1.333 = 10.66
⑦ 18x1 = 18
⑨ 8x1 = 8
52.07 ft

W = 1.043x52.07 = 54.31 lb
⑩ 1 = 1 + 1.043
55.35

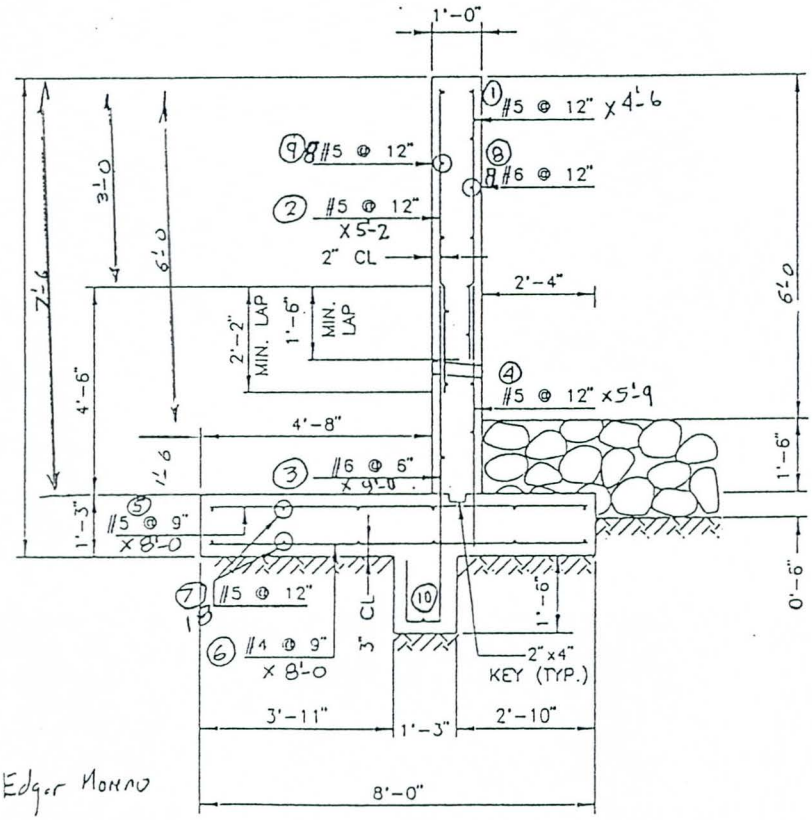
#6
③ 9.0x2 = 18
⑧ 8x1 = 8
26 ft

W = 1.502x26 = 39.05

#4
⑥ 8.0x1.33 = 10.66 ft
W = .668x10.66 = 7.12

TW = 99.28 lb/f

A = 7.5 + 8x1.25 + 1.875
= 19.37 ft²



Edgar Moreno

TYPE 2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookmill Outlet Channel PAGE 2 OF 45

DETAIL Wall Detail Dimentions Steel length COMPUTED Edgar O. Moreno DATE 8/2/93

CHECKED BY EOM DATE

#5

① 7.00
④ 6.25
⑥ 8.75x1.33 = 11.66
⑦ 1.00x20 = 20.0
⑨ 1.00x11 = 11.0
⑩ 1.00x1 = 1.0

56.91 ft

W = 1.043x59.91 = 59.357 lb

#6

② 8.166
⑤ 8.75x1.33 = 11.66
③ 1.00x11 = 11

30.83

W = 1.502x30.83 = 46.30 lb

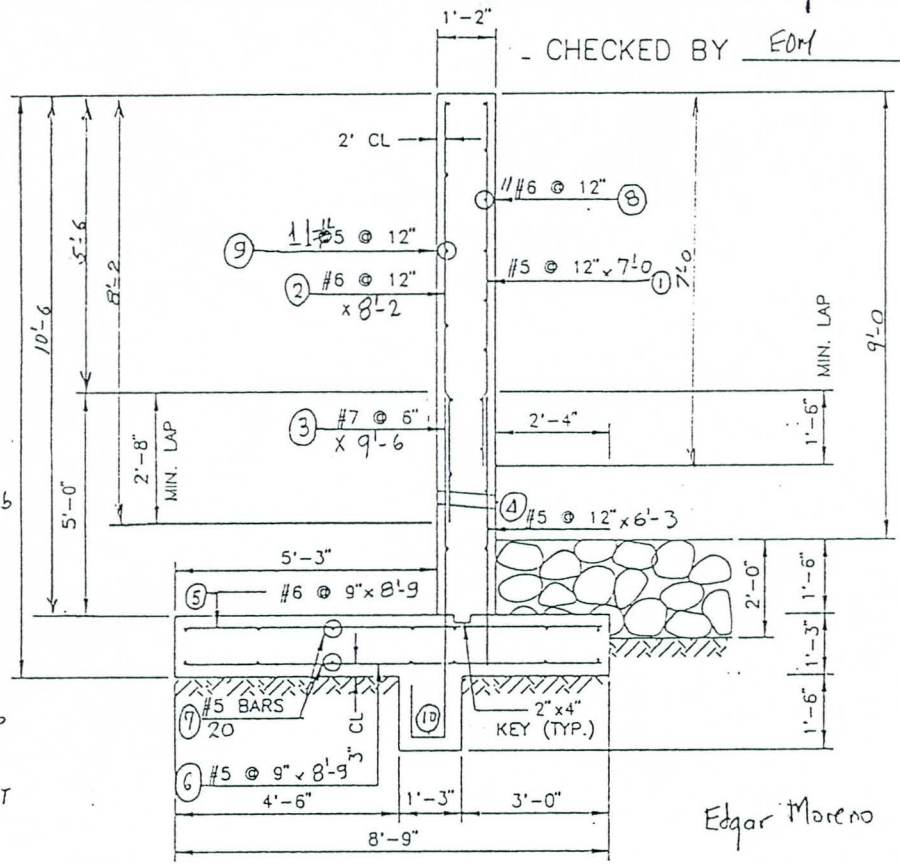
#7

③ 9.5x2 = 19

19 ft

W = 2.044x19 = 38.836 lb

W = 144.50 lb/FT



TYPE 3

Edgar Moreno

A = 1.166x10.5 + 10.9375 + 1.875
= 25.06 FT²

#5

① 6.33
④ 6.25
⑥ 8.75x1.33 = 11.666
⑦ 1.0x18 = 18
⑨ 1.0x10 = 10
⑩ 1.0x1 = 1

53.24 ft

W = 1.043x53.24 = 55.53 lb

#6

② 7.5
⑤ 8.75x1.33 = 11.666
③ 1.0x10 = 10.0

21.666 ft

W = 1.502x21.66 = 32.54 lb

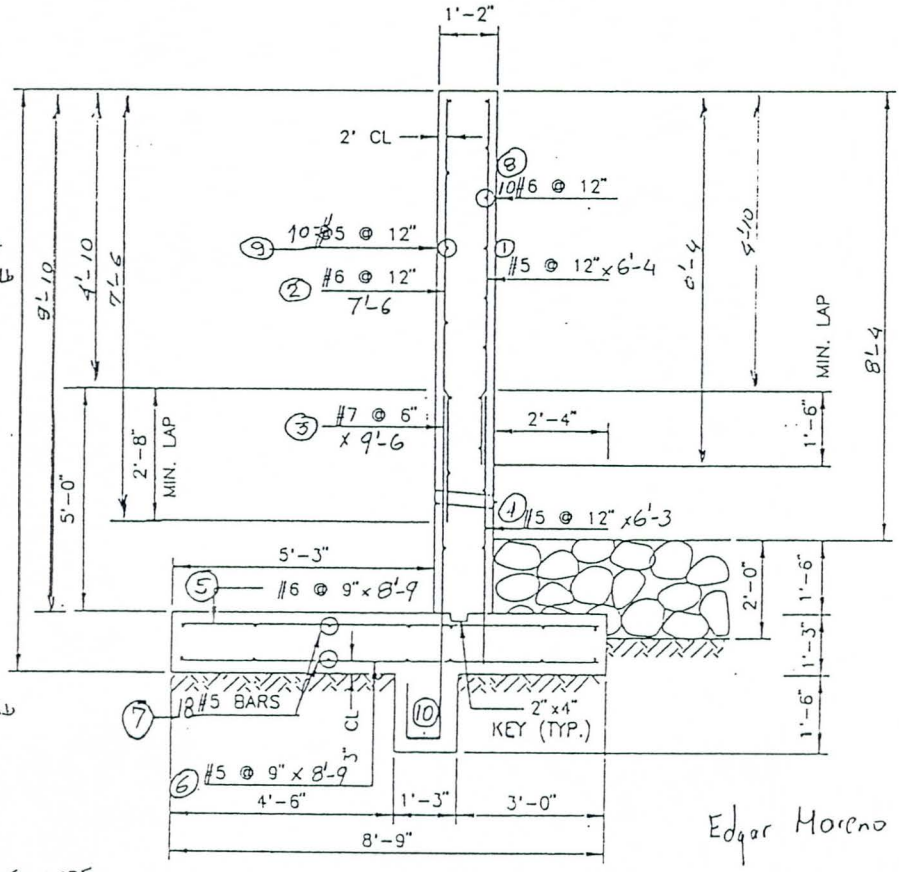
#7

③ 9.5x2 = 19.0

19.0 ft

W = 2.044x19 = 38.836 lb

W = 126.91 lb/FT



TYPE 3

Edgar Moreno

A = 1.166x9.833 + 10.9375 + 1.875
= 24.28 FT²

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 3 OF 45

DETAIL Wall Detail & Steel length & Areas for Concrete COMPUTED Edgar O. Moreno DATE 8/2/93

CHECKED BY E.O.M DATE

#5

① 7.50
④ 6.25
⑥ 8.75 x 1.33 = 11.66
⑦ 1.00 x 20 = 20.00
⑨ 1.00 x 12 = 12.00
⑩ 1.00 x 1 = 1.00
58.41 FT

W = 1.043 x 58.41 = 60.92 Lb

#6

② 8.66
⑤ 8.75 x 1.33 = 11.66
⑧ 1.00 x 12 = 12.00
32.32 FT

W = 1.502 x 32.32 = 48.54 Lb

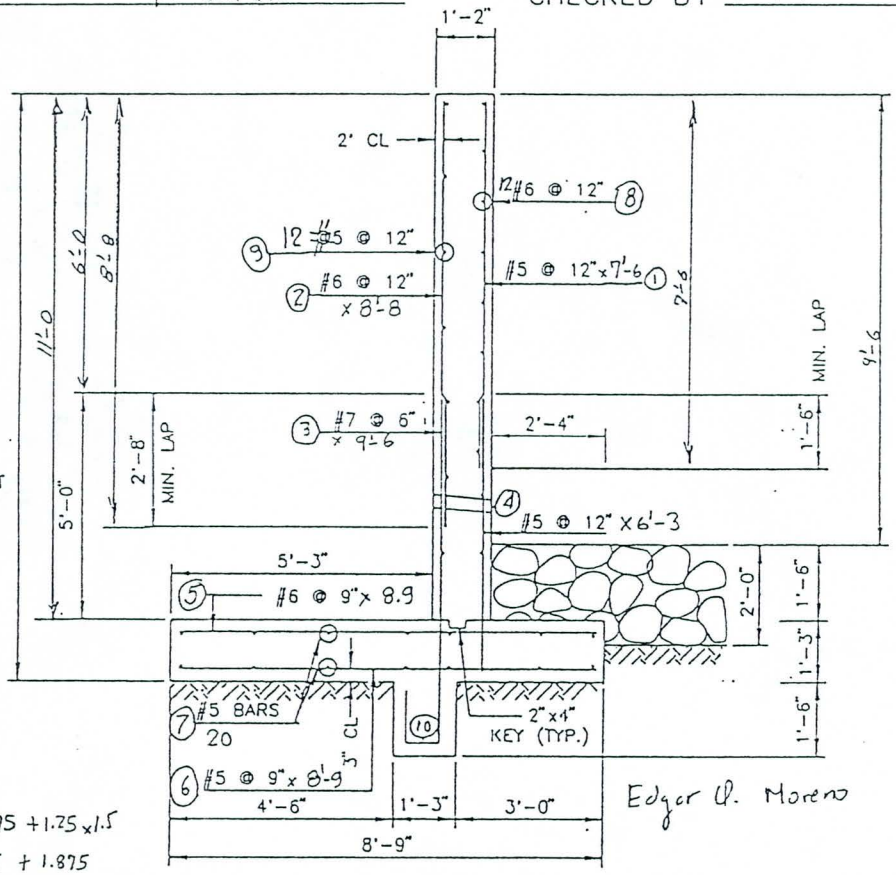
#7

③ 9.5 x 2 = 19 ft
19 FT

W = 2.046 x 19 = 38.83 Lb

W = 148.30 Lb/FT

A = 1.166 x 11 + 1.25 x 8.75 + 1.25 x 1.5
= 12.83 + 10.9375 + 1.875
= 25.64 FT²



TYPE 3

Edgar O. Moreno

#5

① 6.833
② 7.500
④ 5.750
⑤ 8.0 x 1.33 = 10.66
⑦ 18 x L = 18
⑨ 10 x 1 = 10
58.743

W = 1.043 x 58.743 = 61.26
⑩ 1 x 1.043 = 1.043
62.3 Lb

#6

③ 9.0 x 2 = 18.0
⑧ 10 x L = 10
28.0

W = 1.502 x 28 = 42.056 Lb

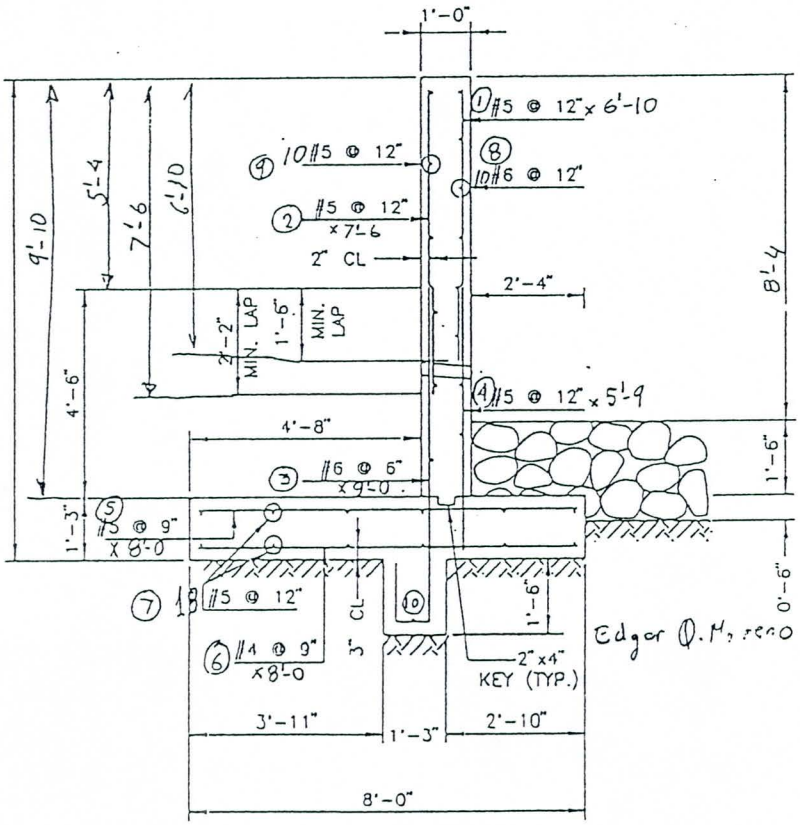
#4

⑥ 8.0 x 1.33 = 10.66 FT

W = .668 x 10.66 = 7.121

TW = 111.479 Lb

A = 9.833 + 10 + 1.875
= 21.708 FT²



TYPE 2

Edgar O. Moreno

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE 4 OF 45

DETAIL Wall detail Dimentions, Steel length & Concrete Areas & Volumes COMPUTED Edgar O. Moreno DATE 8/2/93

CHECKED BY EOM DATE

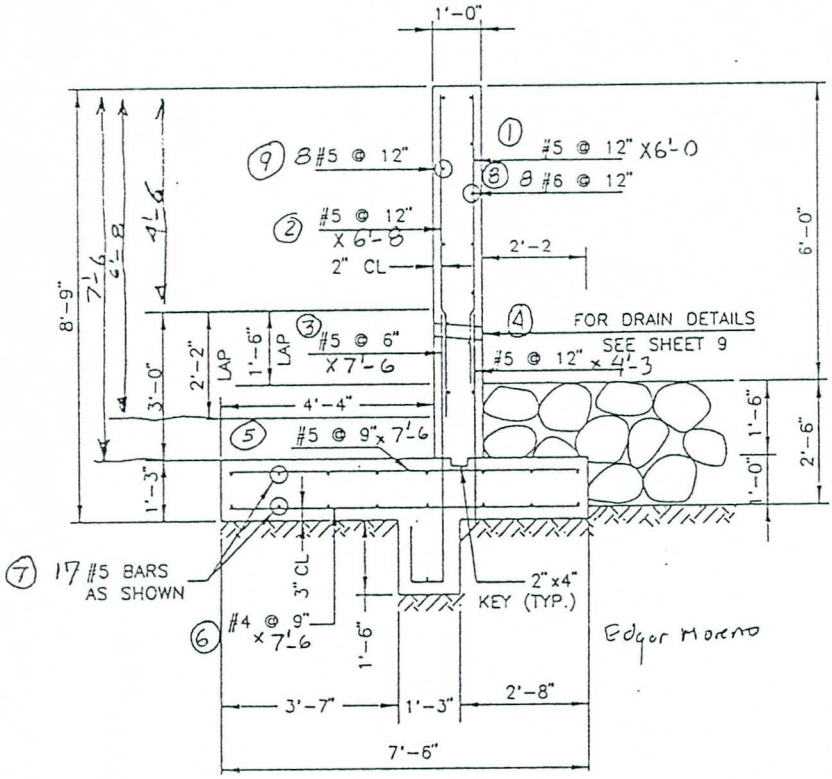
#5
① 6.0
② 6.66
③ 7.5×2 = 15.0
④ 4.25
⑤ 7.5×1.33 = 10.0
⑦ 17×1.0 = 17
⑨ 8×1 = 8
66.916 FT
W = 1.043×66.916 = 69.79 Lb

#6
⑨ 8×1.0 = 8
W = 1.502×8 = 12.016

#4
⑤ ×1.333 = 10.0
W = .668×10 = 6.68

W = 88.486 Lb/FT

A = 8.75 + 9.375 + 1.875
A = 20.0



Edgar Moreno

TYPE 1

THEORETICAL WALLS STEEL & CONCRETE QUANTITIES

STATION	CHANNEL WALL		WALL	STEEL		Concrete	
	WALL HEIGHT	WALL TYPE	FT LENGTH	Lb PER FOOT	Lb TOTAL	FT² AREA/FOOT	CY Total
3 + 93 TO 6 + 50	6'-0"	TYPE 1	467	88.48	41320.	20.	345.92
6 + 50 TO 6 + 60	6'-0" TO 7'-2"	TYPE 2	20	102.88	2058.	19.955	14.78
6 + 60 TO 8 + 50	7'-2"	TYPE 2	380	106.49	40466.	20.54	289.08
8 + 50 TO 8 + 60	7'-2" 8'-4"	TYPE 2	20	108.98	2180.	21.124	15.64
8 + 60 TO 10 + 50	8'-4"	TYPE 2	380	111.479	42362.	21.708	305.52
10 + 50 TO 10 + 60	8'-4" 9'-6"	TYPE 3	20	137.605	2752	24.96	18.48
10 + 60 TO 12 + 39.91	9'-6"	TYPE 3	359.8	148.30	53358.	25.64	341.67
12 + 39.91 TO 12 + 59.91	9'-6" TO 9'-0"	TYPE 3	20	146.40	2928	25.35	18.77
			TOTAL	Lb.	187424.		1349.86 CY

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spookhill Outlet Channel PAGE ~~4~~ 5 OF 5

DETAIL Wall total Quantities COMPUTED Edgar Horan DATE 8/2/93

CHECKED BY E.O.M DATE

TRANSITION	Type	length	S-W/F	S-TOTAL lb	C-FT2	C-CY
STATION 4+33.84 TO 4+43.10	1	6.16	88.48	545	20	4.56
WING WALLS	2	34	75.37	2562.58	17.63	22.20
Previous totals				187424.		1349.86
	TOTAL			190531.58 lb		1376.62 cy

196576 lbs

1374 CY

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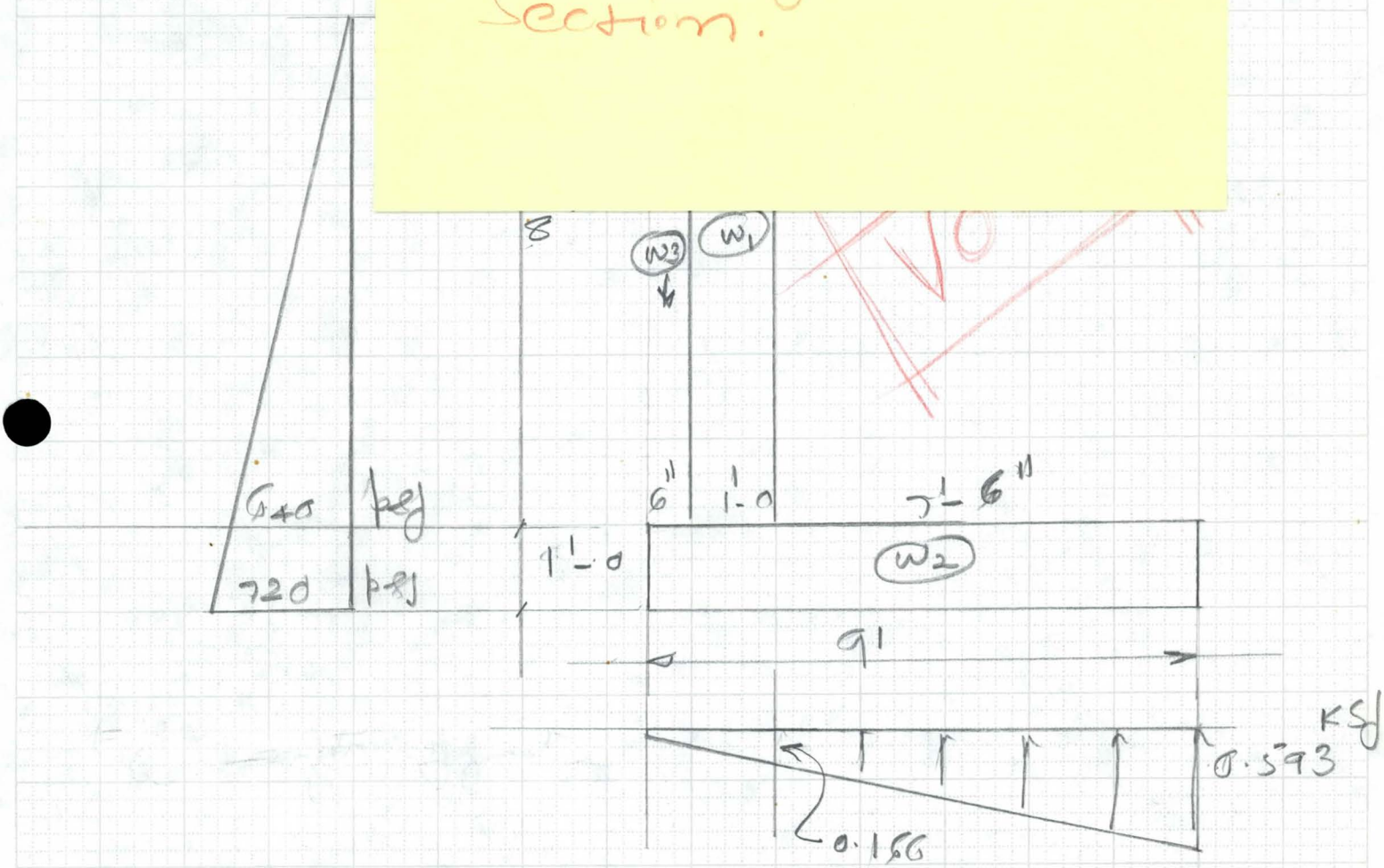
Preliminary Section
This Section is Changed to a Regular Ret. wall Section.

A) Effecti
Subm



Eff. Length of footing = 0.8b = 0.8 x 9 = 7.2'
Say 7' to 9'

Using Submerged pr Condition = 80 pcf

pr_1 = 80 x 8 = 640 pcf

pr_2 = 80 x 9 = 720 pcf

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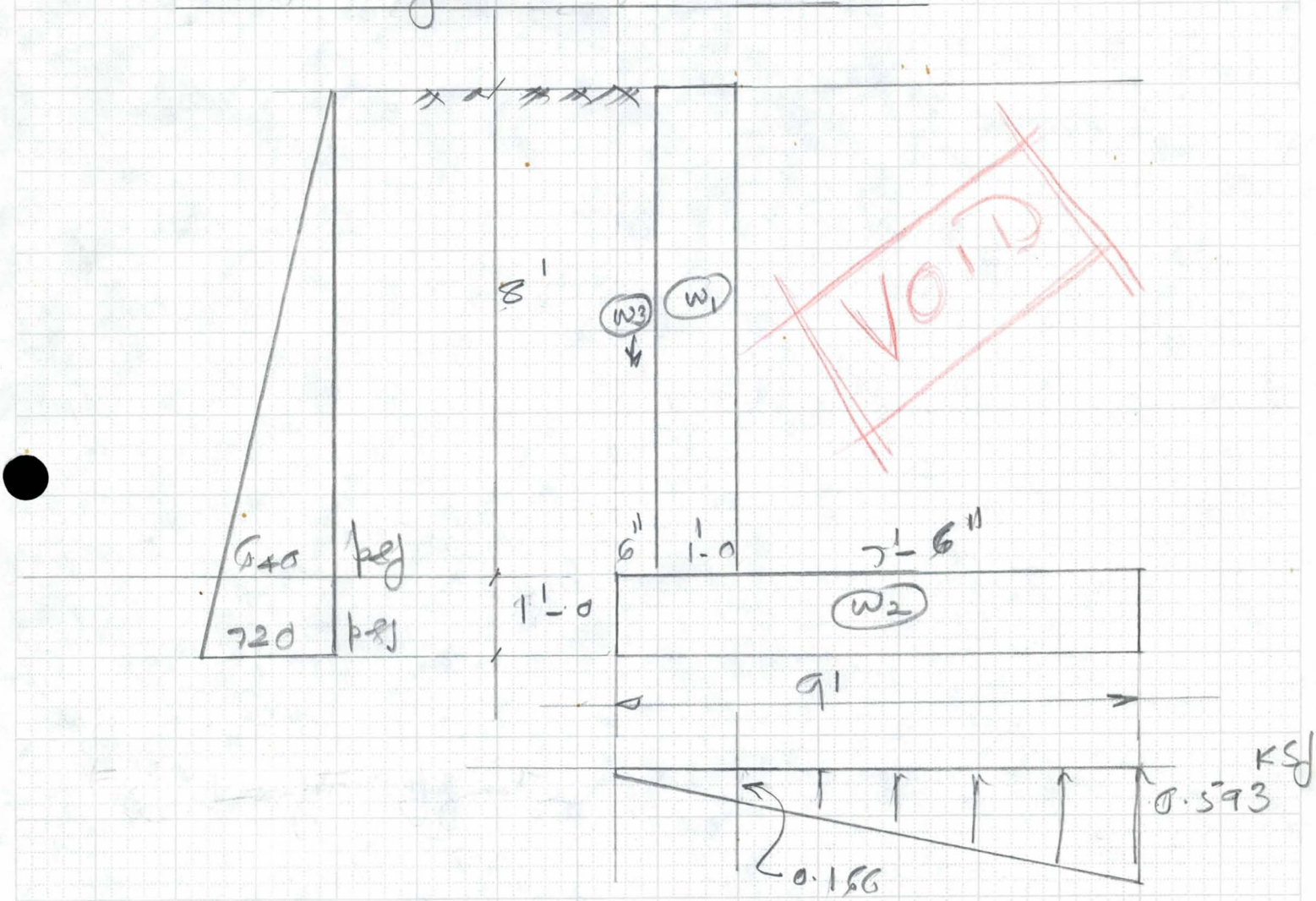
A) Effective width of Footing = 9'

Submerged Soil Condition



Eff. Length of footing = 0.8b = 0.8 x 9 = 7.2'

Say 7' to 9'

Using Submerged pr Conditions = 80 psf

pr_1 = 80 x 8 = 640 psf

pr_2 = 80 x 9 = 720 psf

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$P_1 = \left(\frac{720}{2} \times 9\right) = 3.24^K$

$M_{OT} = (3.24 \times 9/3) = 9.72^{Kft}$

M_{STB}:

$W_1 = (1.0 \times 8.0 \times 0.15) = 1.20^K$

$W_2 = (9.0 \times 1.0 \times 0.15) = 1.35$

$W_3 = (0.5 \times 8.0 \times 0.12) = 0.48$

3.03^K

$M_{STB} = (1.2 \times 8.0) + (1.35 \times 4.5) + (0.48 \times 8.75)$

$= 19.9^{Kft}$

$FS = 19.9 / 9.72 = 2.05$

$X_R = (19.9 - 9.72)/3.03 = 3.36'$

$e = \left(\frac{9}{2} - 3.36\right) = 1.14,$

$b/6 = 9/6 = 1.5 \quad e = 1.14 < b/6$

$\therefore$ Resultant within middthird

$p_r = \frac{3.03}{9 \times 1}\left(1 \pm \frac{6 \times 1.14}{9}\right)$

$p_r(Max) = 0.337(1 + 0.76) = 0.593$ ksf

$p_r(Min) = 0.08$

$(0.593 - 0.08) = 0.513, \quad \left(0.513 \times \frac{1.5}{9}\right) = 0.086$

$p_r = (0.08 + 0.086) = 0.166$

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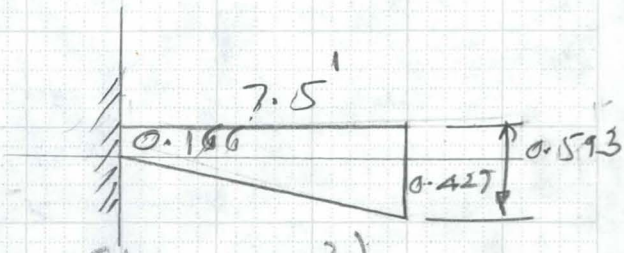
Toe Design:



$$M = \left(0.166 \times \frac{7.5^2}{2}\right) + \left(\frac{0.427}{2} \times 7.5 \times \frac{2}{3} \times 7.5\right) - \left(0.15 \times \frac{7.5^2}{2}\right)$$

wt. of Footing

$$= (4.7 + 8.0 - 4.2) = 8.5^{\text{kh}}$$

$$M_u = 1.3(8.5) = 11.1^{\text{kh}}, \quad d = (12 - 3.5)$$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{11.1 \times 12}{0.9 \times 3.0 \times 12 \times 8.5^2}\right) = 0.057$$

Read $\omega = 0.06$ from Table 9-2

$$\rho = \omega f'_c / f_y = \left(0.06 \times \frac{3.0}{60.0}\right) = 0.0033$$

$$A_s = (0.0033 \times 12 \times 8.5)$$

$$= 0.34 \text{ sq}''$$

(Gr 60) #6 @ 12" $A_s = 0.44$

Using Grade 40, $\rho = \left(\frac{0.06 \times 3.0}{40}\right) = 0.0045$

$$\rho_{min} = \frac{200}{f_y} = \frac{200}{40\,000} = 0.005; \quad A_s = 0.005 \times 12 \times 8.5$$

$$= 0.51 \text{ sq}''$$

(Gr. 40) #7 @ 12", $A_s = 0.60$

Stem Design:

$$P = \left(\frac{0.64}{2} \times 8.0\right) = 2.56^{K}$$

$$M = (2.56 \times 8/3) = 6.83^{kft}$$

$$M_u = (6.83)\,1.3 = 8.9^{kft}$$

$$\left(\frac{M_u}{\phi f'_c b d^2}\right) = \left(\frac{8.9 \times 12}{0.9 \times 3.0 \times 12 \times 9.5^2}\right) = 0.037$$

$d = (12 - 2.5) = 9.5$ Read $\omega = 0.038$ from Table 9.2

Using Gr. 60, $\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.038 \times 3.0}{60.0}\right) = 0.002$

Using Gr. 40 $\rho = \left(0.038 \times \frac{3}{40}\right) = 0.003$

$$\rho_{min} = \left(\frac{200}{60000}\right) = 0.0033$$

$$A_s = (0.0033 \times 12 \times 9.5) = 0.38 \text{ sq}''$$

Gr. 60 #6 @ 12", $A_s = 0.44$

Grade 40 $\rho_{min} = \frac{200}{40000} = 0.005$

$$A_s = (0.005 \times 12 \times 9.5) = 0.57 \text{ sq}''$$

Gr. 40 #7 @ 12", $A_s = 0.60$

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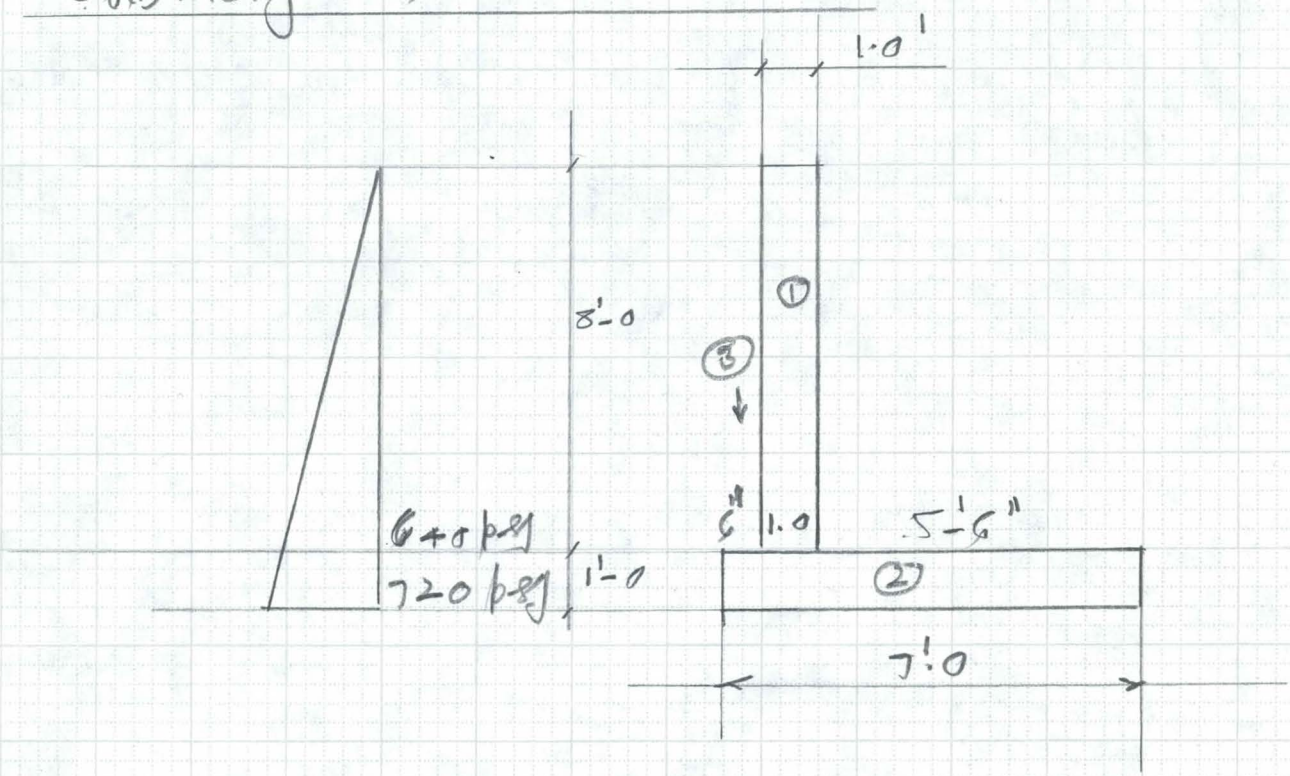
B) Effective weight of Footing 0.8 lb

0.8 × 9 = 7.2, say 7'

Submerged Soil Conditions:



$M_{O.T} \doteq 9.72^{k\text{-}ft}$

M_{STB}:

$W_1 = (1.0 \times 8.0 \times 0.15) = 1.20$

$W_2 = (7.0 \times 1.0 \times 0.15) = 1.05$

$W_3 = (0.5 \times 8.0 \times 0.12) = 0.48$

2.73^{k}

$M_{STB} = (1.2 \times 6.0) + (1.05 \times 3.5) + (0.48 \times 6.75) = 14.12^{k\text{-}ft}$

$FS = \frac{14.12}{9.72} = 1.5$ OK

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$x_R = (14.12 - 9.72)/2.73 = 1.61'$

$e = (7.0/2 - 1.61) = 1.89$

$\frac{b}{6} = \left(\frac{7.00}{6}\right) = 1.17$

$e = 1.89 > \frac{b}{6}$ ∴ Triangular Distn.

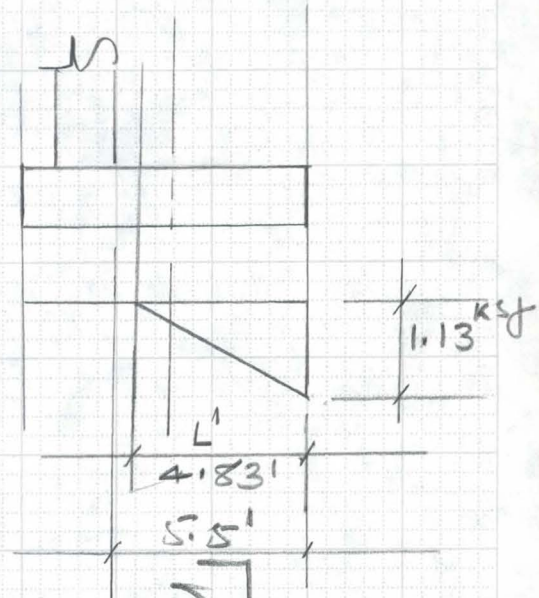
$\frac{L'}{3} = \left(\frac{L}{2} - e\right)$

$L' = 3\left(\frac{L}{2} - e\right) = 3\left(\frac{7}{2} - 1.89\right)$

$= 4.83$

$q_{max} = \frac{2P}{BL'} = \left(\frac{2 \times 2.73}{1 \times 4.83}\right)$

$= 1.13$ ksf



Toe Design:

$M = \left(\frac{1.13}{2} \times 4.83\right)\left[\frac{2}{3}(4.83) + (5.5 - 4.83)\right]$

$= 2.73\,(3.89) = 10.6$ kft

$M_u = 1.3\,(10.6) = 13.8$ kft

$\frac{M_u}{\phi f'_c b d^2} = \frac{13.8 \times 12}{0.9 \times 3.0 \times 12 \times 8.5^2} = 0.071$

Read $\omega = 0.075$ from Table 9-2

Using Gr. 40; $\rho = \frac{\omega f'_c}{f_y} = \frac{0.075 \times 3.0}{40.0}$

$= 0.0057$

$A_s = 0.0057 \times 12 \times 8.5 = 0.58$

(Gr. 40) #7 @ 12" $A_s = 0.60$

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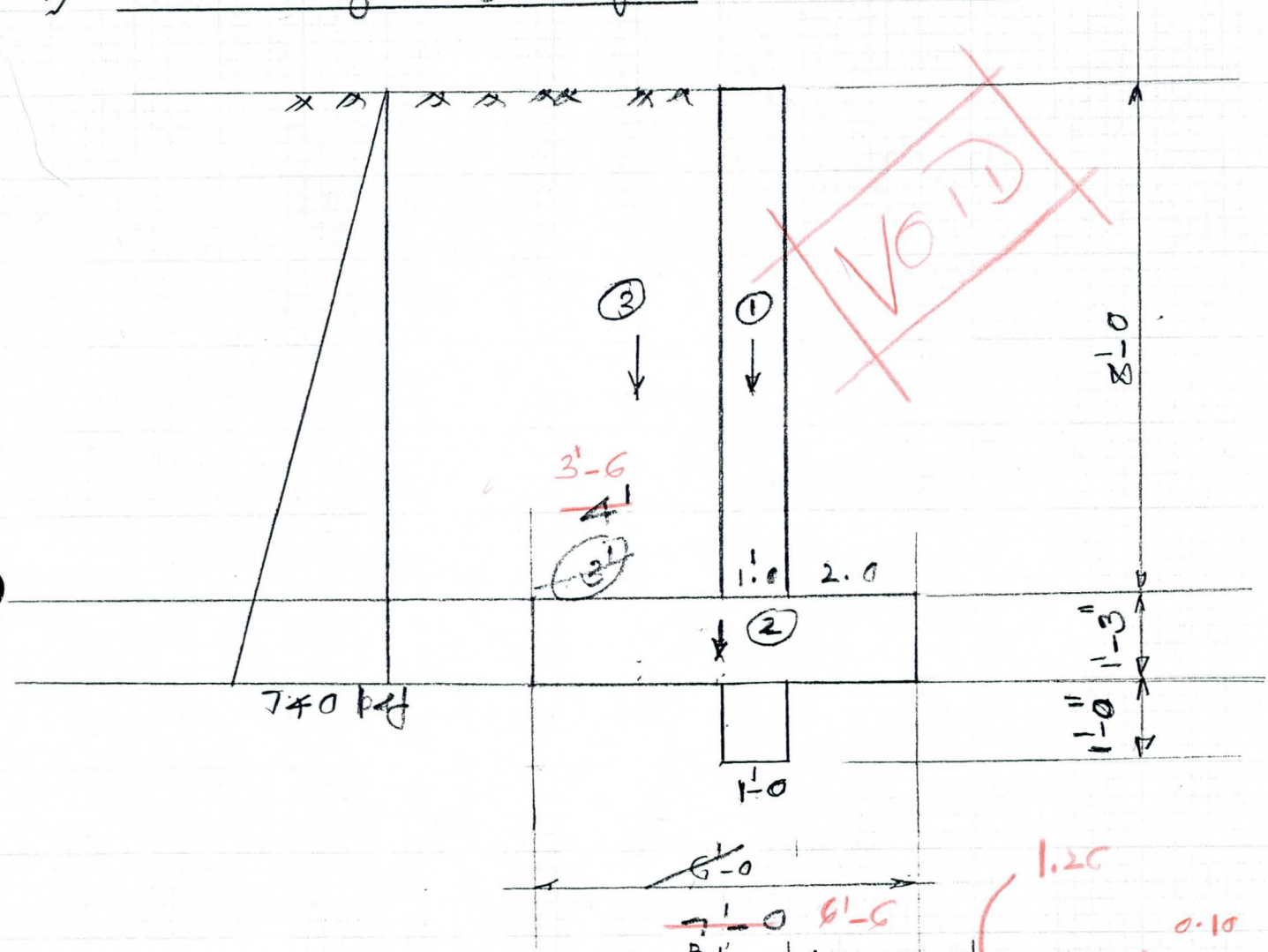
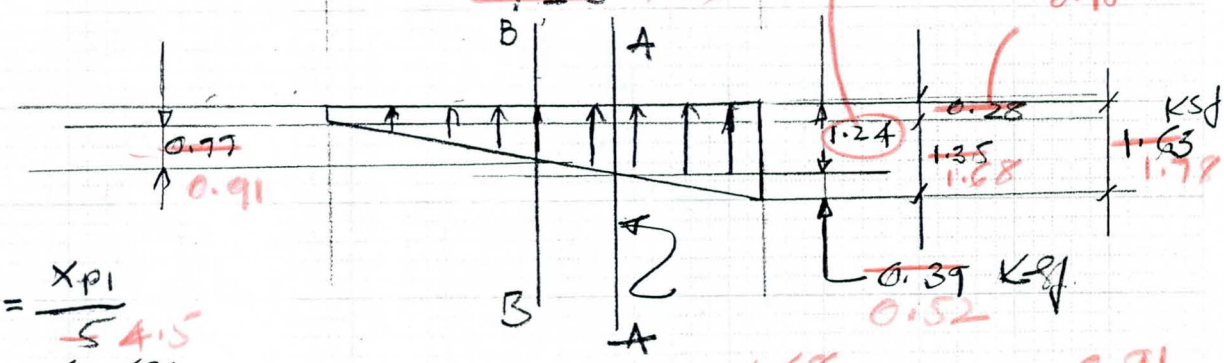
1) Submerged Backfill





$$\frac{1.35}{7.0} = \frac{X_{p1}}{5}$$ (1.68, 6.5, 4.5)

$X_{p1} = 0.96$ Ksf (1.16)

$(0.96 + 0.28) = 1.24$ Ksf (1.26, 0.1)

$(1.63 - 1.24) = 0.39$ (1.98 − 1.26 = 0.52)

$$\frac{X_{p2}}{4.0} = \frac{1.35}{7.0}, \quad X_{p2} = 0.77$$ (1.68, 0.91, 3.5, 6.5)

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1) Using Submerged Condition:

wt of wet soil = 130 pcf

wt. of water = 62.4

wt. of Submerged Soil = 67.6

using K = 0.33

$P_r = wKh = (67.6 \times 0.33 \times h) = 22.3$ pcf

water pr $= \frac{62.4}{84.7}$

use 80 to 85 pcf.

$p_r = (80 \times 9.25) = 740$ pcf

$P = (\frac{740}{2} \times 9.25) = 3.43^K$

$M_{O.T} = 3.43 \times 9.25/3 = 10.6$ Kft

Stabilizing Moment

$w_1 = (8.0 \times 1.0 \times 0.15) = 1.20^K$

$w_2 = (6.0 \times 1.25 \times 0.15) = 1.13$

w_3 (Soil) $= (3.0 \times 8.0 \times 0.13) = 3.12$

5.45^K

$M_{STB} = (1.2 \times 2.5) + (1.13 \times 3.0) + (3.12 \times 4.5) = 20.43$

$F.S = (\frac{20.43}{10.6}) = 1.93$

Check Sliding:

Sliding force = P = 3.43 K

Frictional force = μN = 0.4 × 5.45 = 2.18 K

< 3.43 K

∴ use a Key &
Increase Heel to 4'-0 to
get some additional wt.

Try Footing width = 7'-0

Stabilizing Moment:

W_1 = 1.20 K

W_2 = (~~7.0~~ 6.5 × 1.25 × 0.15) = ~~1.31~~ 1.22

W_3 = (~~4.0~~ 3.5 × 6.0 × 0.13) = ~~4.16~~ 3.64

~~6.67~~ 6.06 K

M_{STB} = (1.2 × 2.5) + (~~1.31~~ 1.22 × ~~7.0~~ 6.5 / 2) + (~~4.16~~ 3.64 × ~~5.0~~ 4.75)

= ~~28.4~~ 24.26 k'

F.S = (~~28.4~~ 24.26 / 10.6) = ~~2.7~~ 2.3

Sliding Check:

Frictional Force = μN = 0.4 × ~~6.67~~ 6.06 = ~~2.7~~ 2.4 K

Sliding Force P = 3.43 > ~~2.7~~ 2.4 K

Still need a Key for the Base Slab

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Footing pressure: ~~7'~~ 6.5' wide

M_{SIB} = ~~28.4~~ 24.3 kft, N = ~~6.67~~ 6.06 K

M_{OT} = 10.6,

X_R = Dist. of Resultant = $\frac{(\cancel{28.4} \; 24.3 - 10.6)}{\cancel{6.67} \; 6.06}$

= ~~2.67'~~ 2.26

$b/3 = \frac{\cancel{7.0} \; 6.5}{3} = \cancel{2.33} \; 2.17$, within Mid Third

$e = (b/2 - X_R) = (\cancel{3.5} \; 3.25 - \cancel{2.67} \; 2.26) = \cancel{0.83} \; 0.99'$

$< \frac{b}{6} = \cancel{1.17'} \; 1.08$

$P_r = \frac{\cancel{6.67} \; 6.06}{7 \times 1} \left(1 \pm \frac{6 \times \cancel{0.83} \; 0.99}{\cancel{7} \; 6.5}\right)$

$= \cancel{0.953} \; 0.933 \left(1 \pm \cancel{0.91} \; 0.91\right)$

$P_r(max) = \cancel{1.63} \; 1.78$ ksf $\quad P_r(Min) = \cancel{0.28} \; 0.084$ ≈ any 0.10

Toe Design:

a) UDL : $(\cancel{1.24} \; 1.26 \times 2) = \cancel{2.48} \; 2.52$ K

b) Triangular: $\left(\frac{\cancel{0.39} \; 0.52}{2} \times 2.0\right) = \cancel{0.39} \; 0.52$ K

Neglecting the footing wt.

$M_{AA} = (\cancel{2.48} \; 2.52 \times \frac{2}{2}) + (\cancel{0.39} \; 0.52 \times \frac{2}{3} \times 2) = \cancel{3.0} \; 3.21$ kft

$M_u = (\cancel{3.0} \; 3.21 \times 1.3) = \cancel{3.9} \; 4.2$ kft

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Toe Steel:

$M_u = \cancel{3.9}\ 4.2$ k/ft

$d = (15 - 3 - 0.5) = 11.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \frac{\cancel{3.9}\ 4.2 \times 12}{0.9 \times 3.0 \times 12 \times 11.5^2} = \cancel{0.011}\ 0.012$$

from Table 9-2, Read $\omega = \cancel{0.012}\ 0.013$

$$\rho = \frac{\omega f'_c}{f_y} = \frac{\cancel{0.012}\ 0.013 \times 3.0}{60} = 0.0006$$

say 0.001

$A_s = 0.001 \times 12 \times 11.5 = 0.14\ in^2$

$\rho_{min} = 200/f_y = 200/60000 = 0.0033$

(Grade 60) $A_s = (0.0033 \times 12 \times 11.5) = 0.46\ in^2$

Reqd Reinf: $1.33(0.14) = 0.19\ in^2$

use #5 @ 12", $A_s = 0.31$

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Heel Design

unif: $(\cancel{0.28}\ 0.10 \times \cancel{4.0}\ 3.5) = \cancel{1.12}\ 0.35^K$

Triangular: $\left(\frac{\cancel{0.77}\ 0.91}{2} \times \cancel{4.0}\ 3.5\right) = \cancel{1.54}\ 1.60^K$

Soil wt: $(8 \times 1)\ 0.13 = 1.04^K/ft$

Conc. wt: $(1.25 \times 0.15) = 0.19\ K/ft$

$$M_{BB} = \left(1.04 \times \cancel{4}\ 3.5 \times \frac{\cancel{4}\ 3.5}{2}\right) + \left(0.19 \times \cancel{4}\ 3.5 \times \frac{\cancel{4}\ 3.5}{2}\right) - \left(\cancel{1.12}\ 0.35 \times \frac{\cancel{4}\ 3.5}{2}\right) - \left(\cancel{1.54}\ 1.60 \times \frac{1}{3} \times \cancel{4}\ 3.5\right)$$

$$= \cancel{5.55}\ 5.06\ ft$$

$$M_u = 1.3(\cancel{5.55}\ 5.06) = \cancel{7.22}\ 6.6\ ft$$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{\cancel{7.22}\ 6.6 \times 12}{0.9 \times 3.0 \times 12 \times 12.5^2}\right) = \cancel{0.017}\ 0.016$$

$d = (15 - 2 - 0.5)$
$= 12.5''$

from Table 9-2, $\omega = \cancel{0.018}\ 0.017$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{\cancel{0.018}\ 0.017 \times 3.0}{60}\right) = 0.001$$

$$A_s = 0.001 \times 12 \times 12.5 = 0.15\ in^2$$

$$\rho_{min} = \frac{200}{f_y} = 0.0033,$$

$$A_s = 0.0033 \times 12 \times 12.5 = 0.5\ in^2$$

or $1.33\ A_s = 1.33 \times 0.15 = 0.2\ in^2$

use #5 @ 12", $A_s = 0.31$

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Stem Design:

$P_r = wKh = (80 \times 8) = 640$ lbs

$M_{stem} = \left(\frac{0.64}{2} \times 8.0\right)\frac{8}{3} = 6.83$ kft

$M_u = (6.83 \times 1.3) = 8.9$ kft

$d = (12 - 2 - 0.5) = 9.5''$

$$\frac{M_u}{\phi f'_c b d^2} = \left(\frac{8.9 \times 12}{0.9 \times 3.0 \times 12 \times 9.5^2}\right) = 0.037$$

from Table 9-2, $\omega = 0.038$

$$\rho = \frac{\omega f'_c}{f_y} = \left(\frac{0.038 \times 3.0}{60}\right) = 0.0019$$

$A_s = (0.0019 \times 12 \times 9.5) = 0.21 \text{ in}^2$

$A_{s\,min} = (0.0033 \times 12 \times 9.5) = 0.38 \text{ in}^2$

or $1.33 A_s = 1.33 \times 0.21 = 0.28$

use #5 @ 12", $A_s = 0.31$

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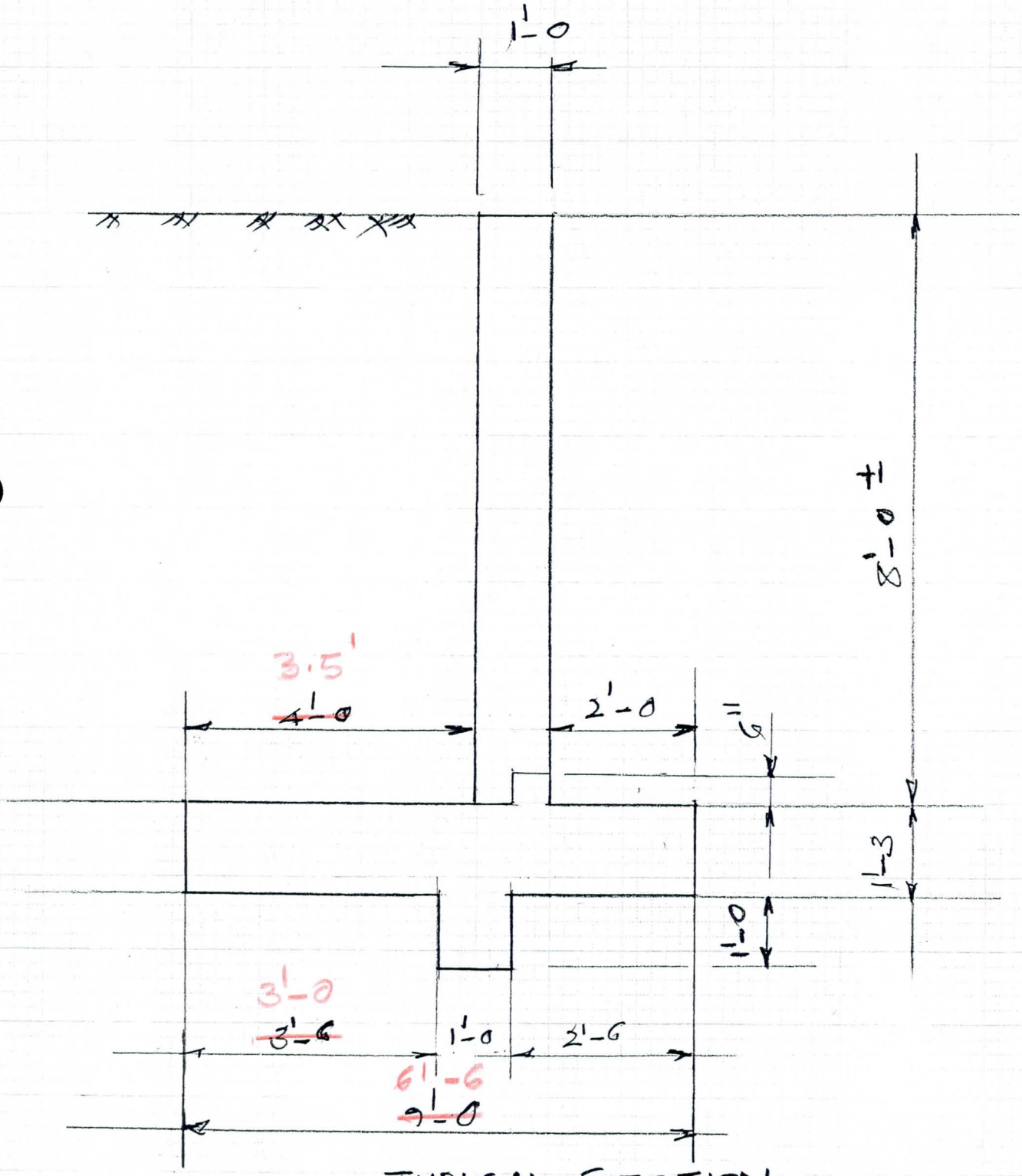

TYPICAL SECTION

Scale 1/2" = 1'-0

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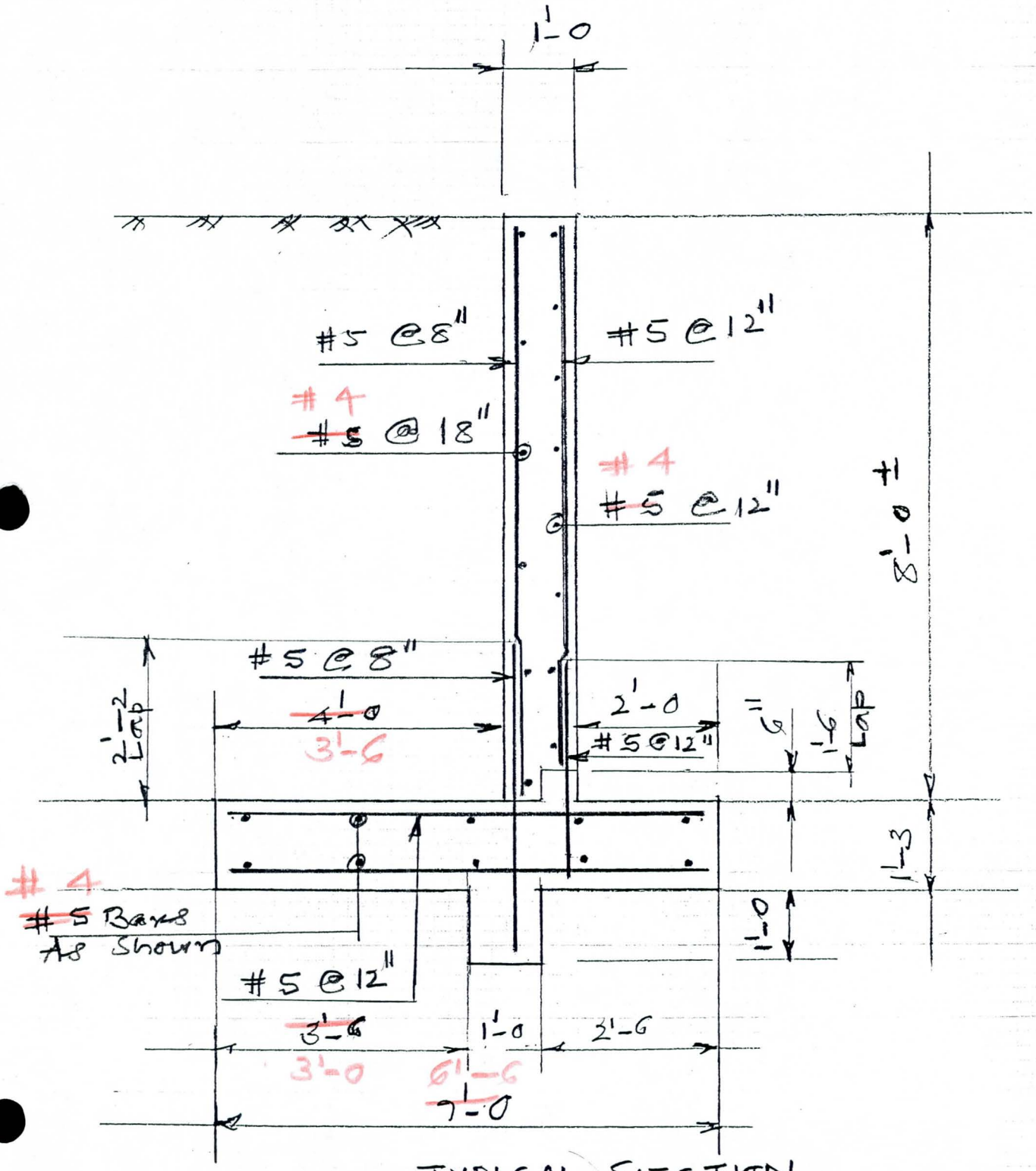

TYPICAL SECTION

Scale ½" = 1'-0

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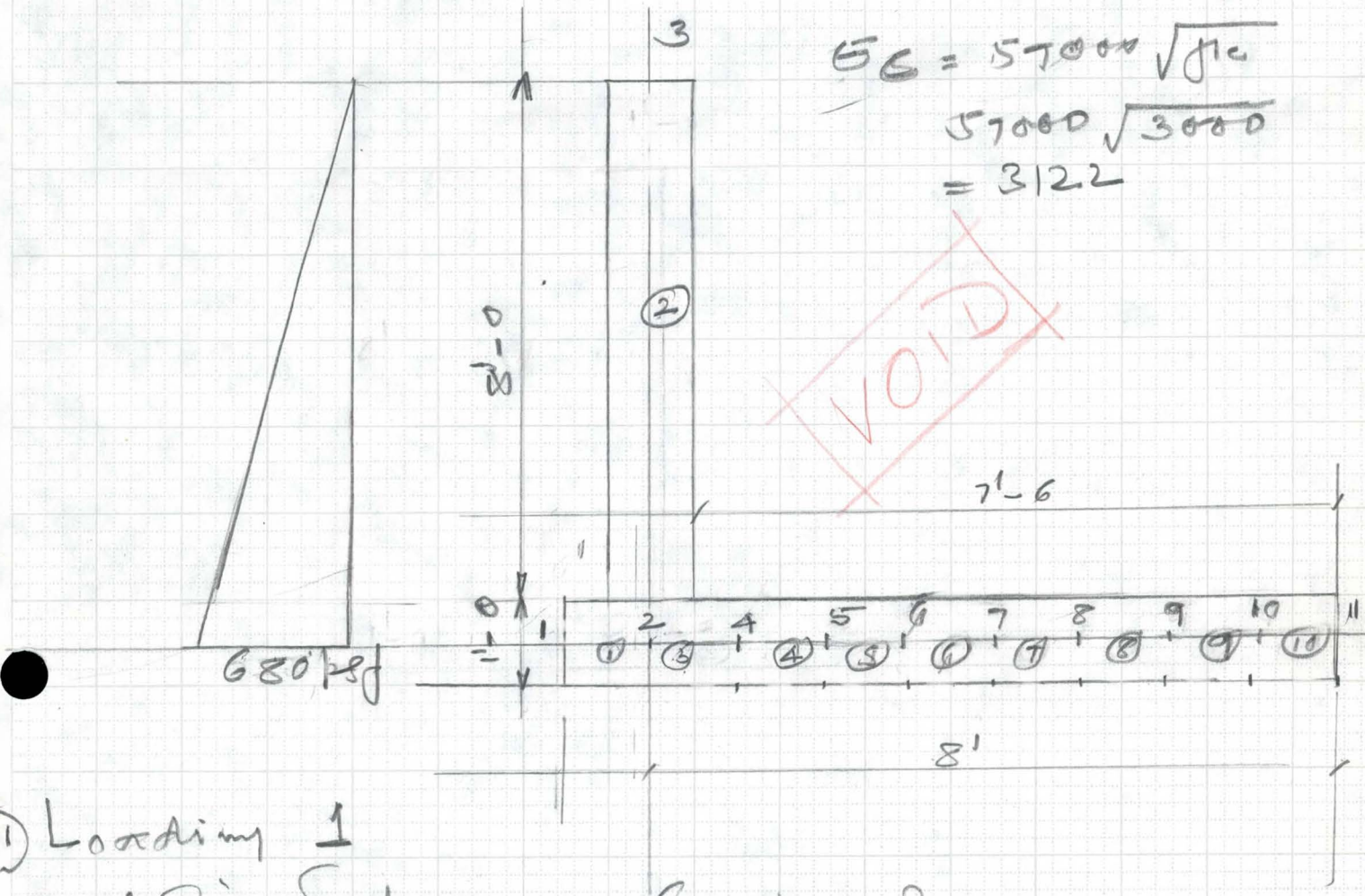
$E_c = 57000\sqrt{f'_c}$

$57000\sqrt{3000}$

$= 3122$



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1) Loading 1

Using Submerged Conditions:

Wt. of wet soil = 120.0

Wt. of water = 62.4

57.6 — wt. of submerged soil

$p_r = wKh$

$K = 0.3$ Level surface, $p_r = 36$ psf

$K = 0.36$, 1:2 Slope 1:2, $p_r = 43$ psf

p_r (Submerged Soil) = $(57.6 \times 0.3) = 17.3$ psf

p_r (Water) $= 62.4$

79.7

Use Equivalent $p_r = 80$ psf

$p_r = (80 \times 8.5) = 680$ psf

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DETAIL Stand III COMPUTED KVH DATE 5/92

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Using K Subgrade Reaction = 100 pci

$100 \times 12 \times 12 \times 12 / 1000 = 172$ KCJ

Spring Constants:

Support 1 & 11 = $(0.5 \times 1 \times 172) = 86$

2 Thru 10 = $(1 \times 1 \times 172) = 172$

2) Loading 2

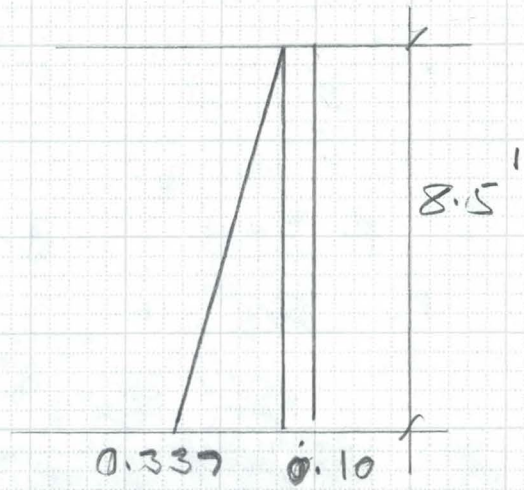
Dry Soil Condition:

$p_{v_1} = (0.120 \times 0.33 \times 8.5) = 0.337$

Surcharge = 2'

$p_v = (0.12 \times 0.33 \times 2) = 0.08$

Say 0.10



6910-153 4-90

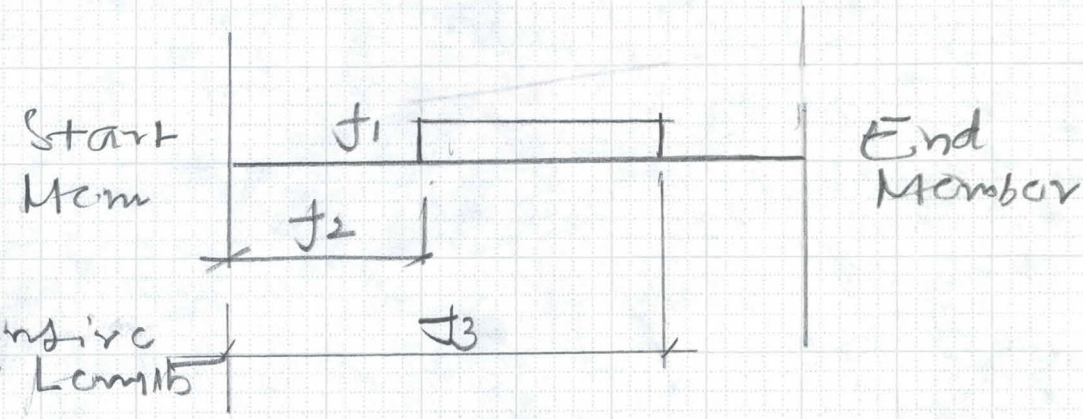
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE 3 OF

DETAIL COMPUTED KVH DATE 5/92

CHECKED BY DATE

① uniform Load (UNI)

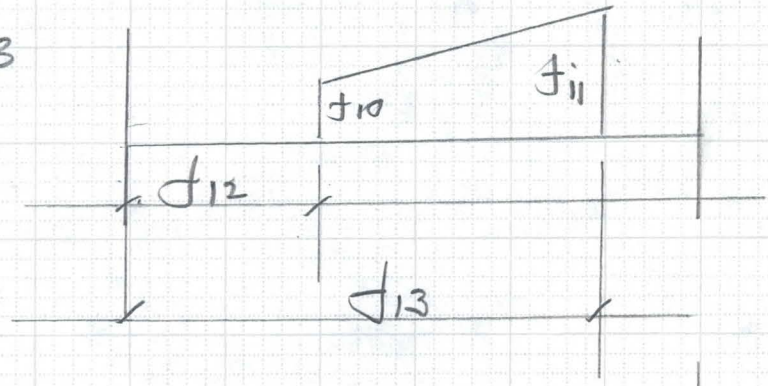


UNI f_1, f_2, f_3

UNI f_1 for the entire Member Length

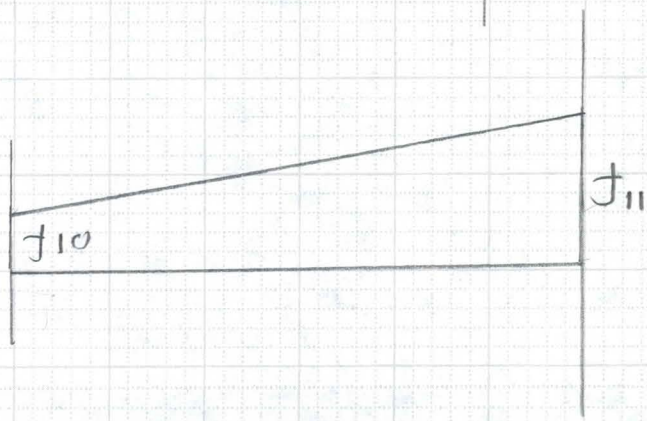
2) Trapezoidal Load (TRAP)

TRAP $f_{10}, f_{11}, f_{12}, f_{13}$



③

TRAP f_{10}, f_{11}



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Retaining wall PAGE 4 OF

DETAIL Stand III COMPUTED KVH DATE 5/92

Spook Hill CHECKED BY DATE

1 Stand plane

2 ~~Unit~~ Kip feet

3 Joint Coordinates

4	1	0.0	0.0
5	2	1.0	0.0
6	3	1.0	8.5
7	4	2.0	0.0
8	5	3.0	0.0
9	6	4.0	0.0
10	7	5.0	0.0
11	8	6.0	0.0
12	9	7.0	0.0
13	10	8.0	0.0
14	11	9.0	0.0

15 Member Incidence

16	1	1	2
17	2	2	3
18	3	2	4
19	4	4	5
20	5	5	6
21	6	6	7
22	7	7	8
23	8	8	9
24	9	9	10
25	10	10	11

26 Member Property

27 1 TO 10 Prismatic YD 1.0 ZD 1.0

28 ~~2 Thru 10 Prismatic YD 1.0 ZD 1.0~~

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Retaining wall PAGE 5 OF

DETAIL Staad III COMPUTED KVH DATE 5/92

Spook Hill CHECKED BY DATE

```
29  Unit Inches
30  Constant
31  E 3122.0 ALL
32  Unit Ft.
33  Constant
34  Density 0.150 ALL
35  Support
36  1  Fixed But Mz KFY 86.0
37  2 Thru 10  Fixed But Mz  KFY 172.0
38  11  Fixed  But Mz  KFY 86.0
39  Loading 1  Submerged Soil Condition
40  Member Load
41  2 TRAP Gx 0.680  0.001  0.0  8.5
42  Loading 2  Dry Soil Condition
43  Member Load
44  2  UNI  Gx  0.10
45  2  TRAP Gx  0.337  0.001  0.0  8.5
46  Selfweight Y -1.0
```

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

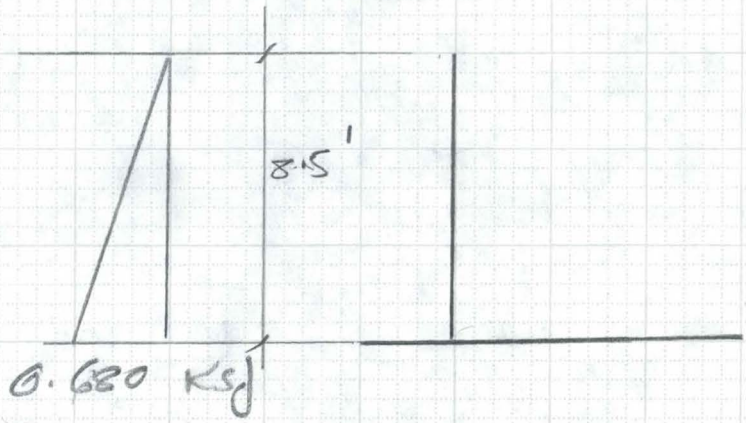
PROJECT Retaining wall PAGE 8 OF

DETAIL Spark Hill COMPUTED KVH DATE 6/92

Check Staad III output CHECKED BY DATE

Check Staad III output:

Stem Moment: (Loading Condition 1)



Using 80 pcf. Equivt P_v

$P_v = (80 \times 8.5) = 680$ psf

$P = \left(\frac{0.68}{2} \times 8.5\right) = 2.89^{k}$

$M = \left(2.89 \times \frac{8.5}{3}\right) = 8.2^{k'}$

≈ 8.21 (From Staad III output)

∴ Wall Mom. Checks ok

Check Toe Moment:

From Hand Calculations, Page 3, $M = 8.5^{k'}$

From Staad III output Member 3 @ J+.2 = 7.61

Pretty Close ∴ Say ok

6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

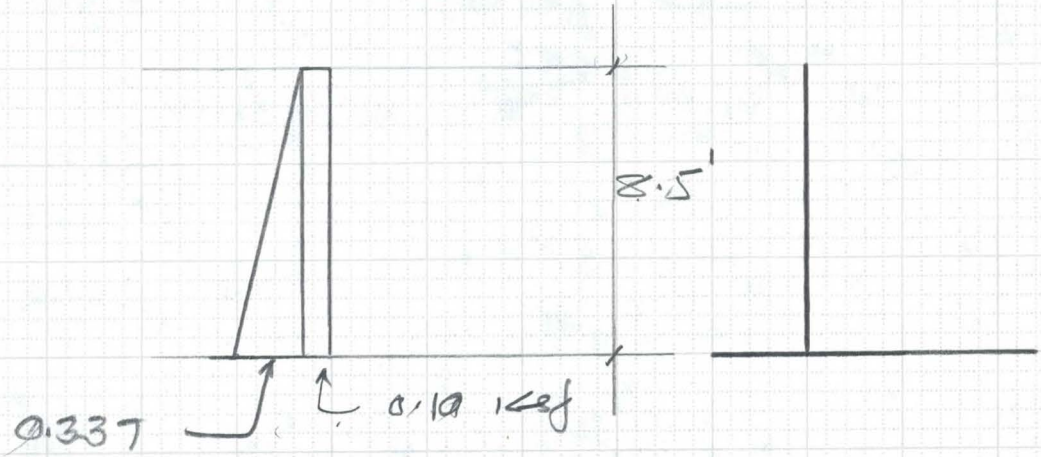
PROJECT Retaining wall PAGE 7 OF

DETAIL Spook Hill COMPUTED KVH DATE 6/92

Check Stand III output CHECKED BY DATE

Check Stand III output:

Stem Mom: Loading Condition 2



$P_1 = (0.10 \times 8.5) = 0.85^k$

$P_2 = \left(\frac{0.337}{2} \times 8.5\right) = 1.43^k$

$M = \left(0.85 \times \frac{8.5}{2}\right) + \left(1.43 \times \frac{8.5}{3}\right)$

$= (3.61 + 4.05) = 7.66$ k-ft

From Stand III output Memb 2 @ Ft. 2 = 7.7 k-ft

Almost Equal ∴ ok

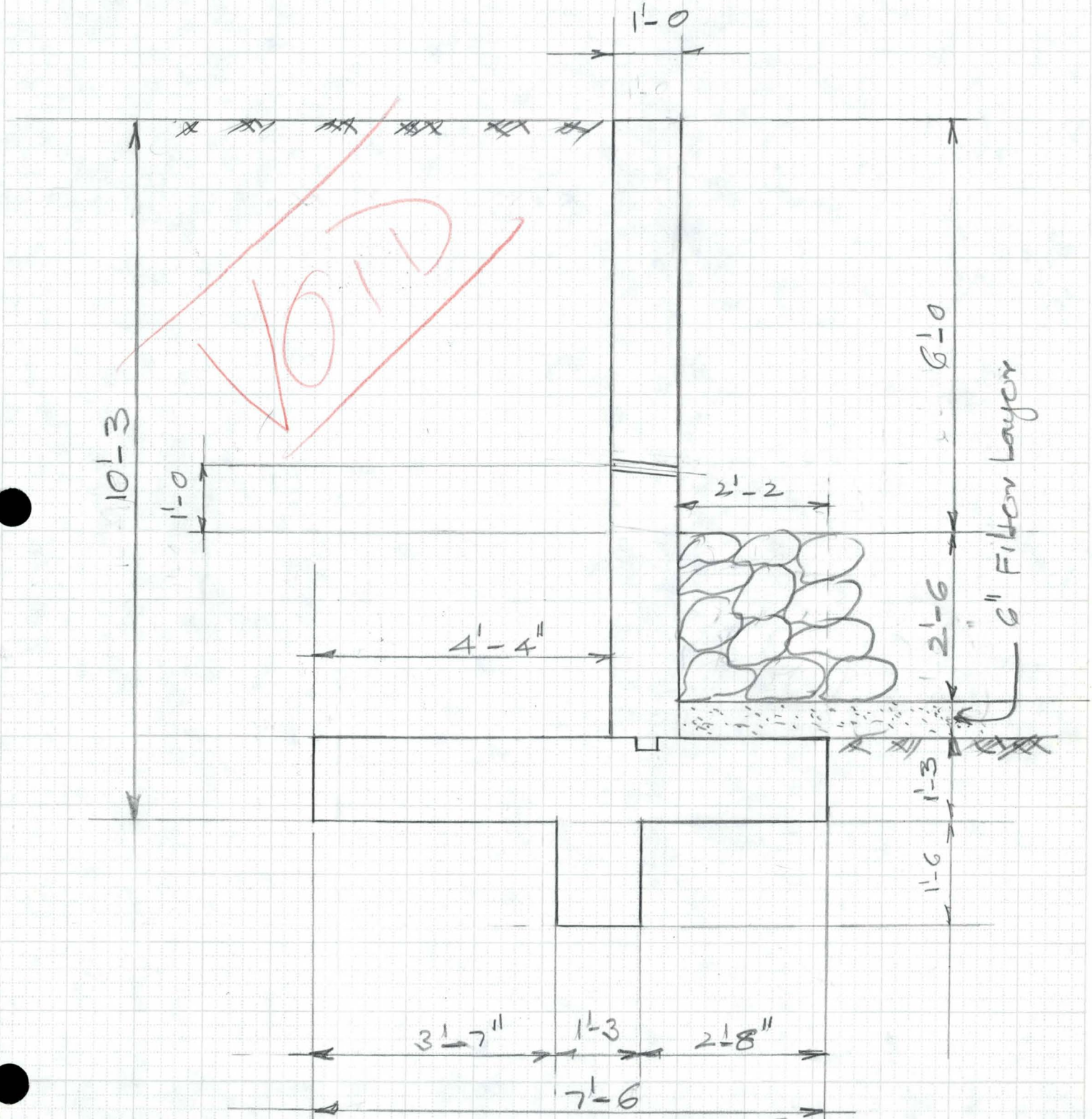
6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE ____ OF ____

DETAIL 6' Wall Section COMPUTED KVH DATE 8/92

CHECKED BY ____ DATE ____



Type 1 Wall Section

Stat. 440 To 722.3

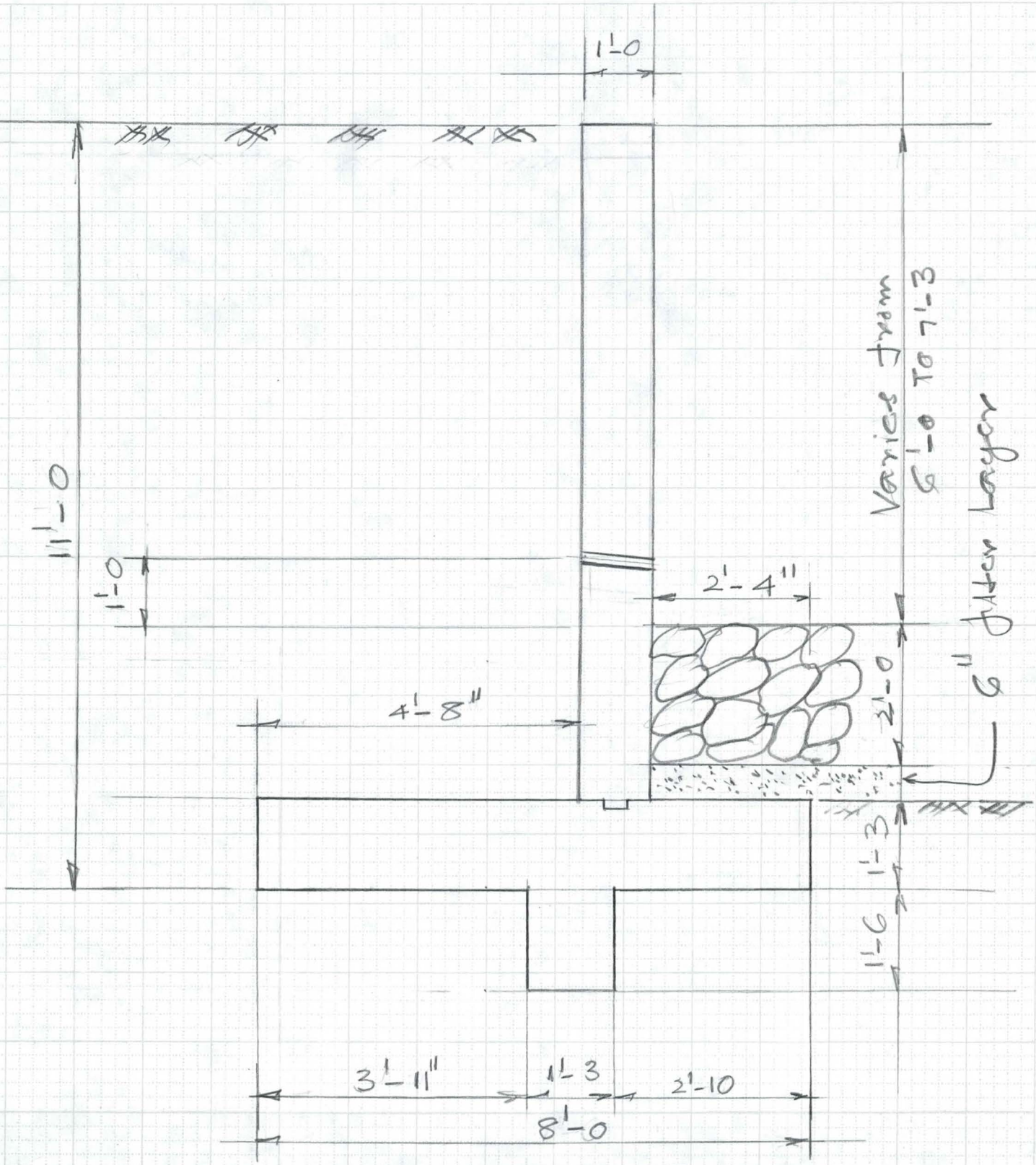
1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 7'-3 Wall Section COMPUTED KVH DATE 8/92

CHECKED BY ____ DATE ____



Type 2 Wall Section

1/2" = 1'-0

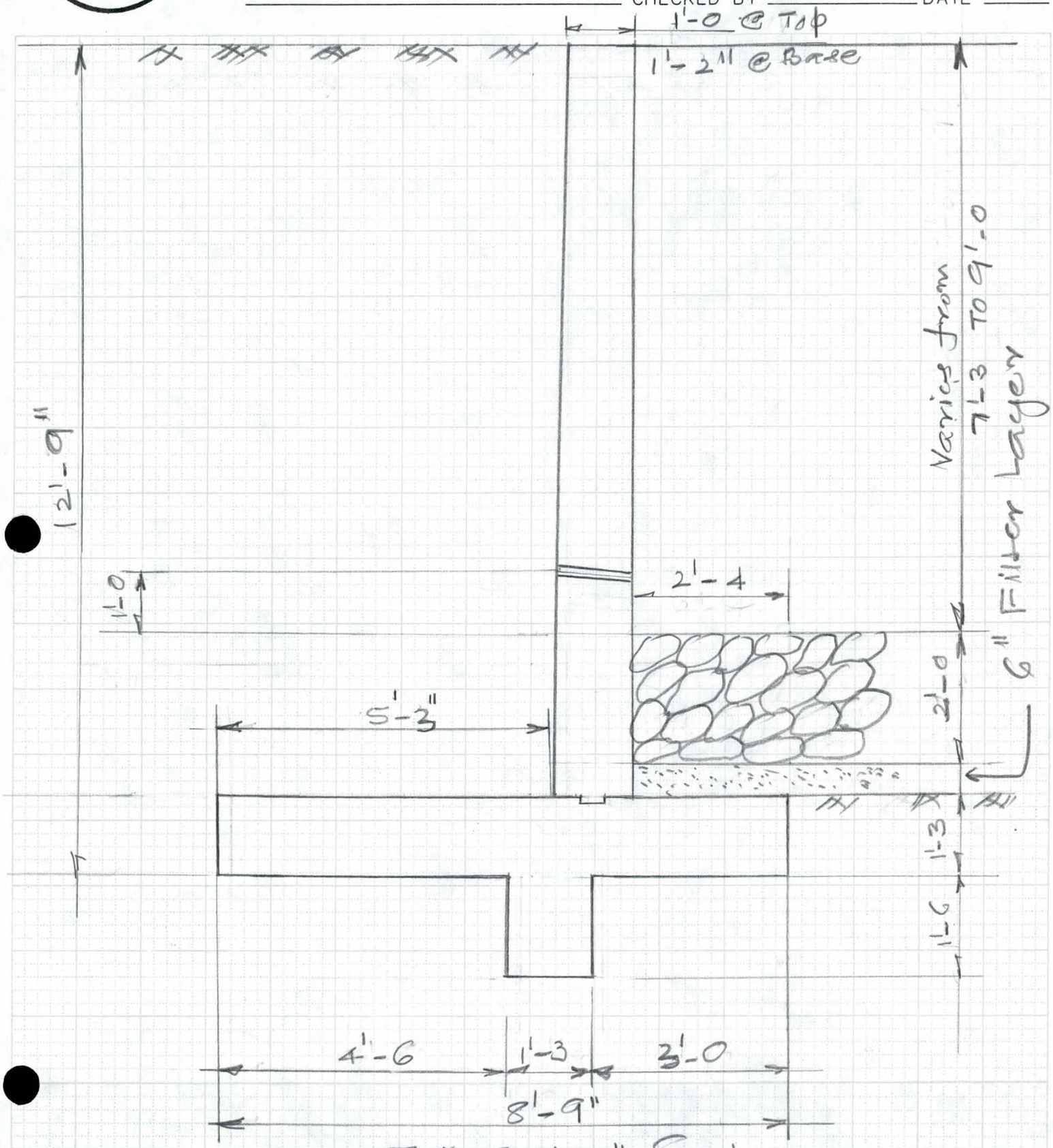
Stat. 722.3 To 1100

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Shook Hill Outlet PAGE ____ OF ____

DETAIL 9'-0 Wall Sect COMPUTED KVH DATE 8/92

CHECKED BY ____ DATE ____



Type 3 Wall Section

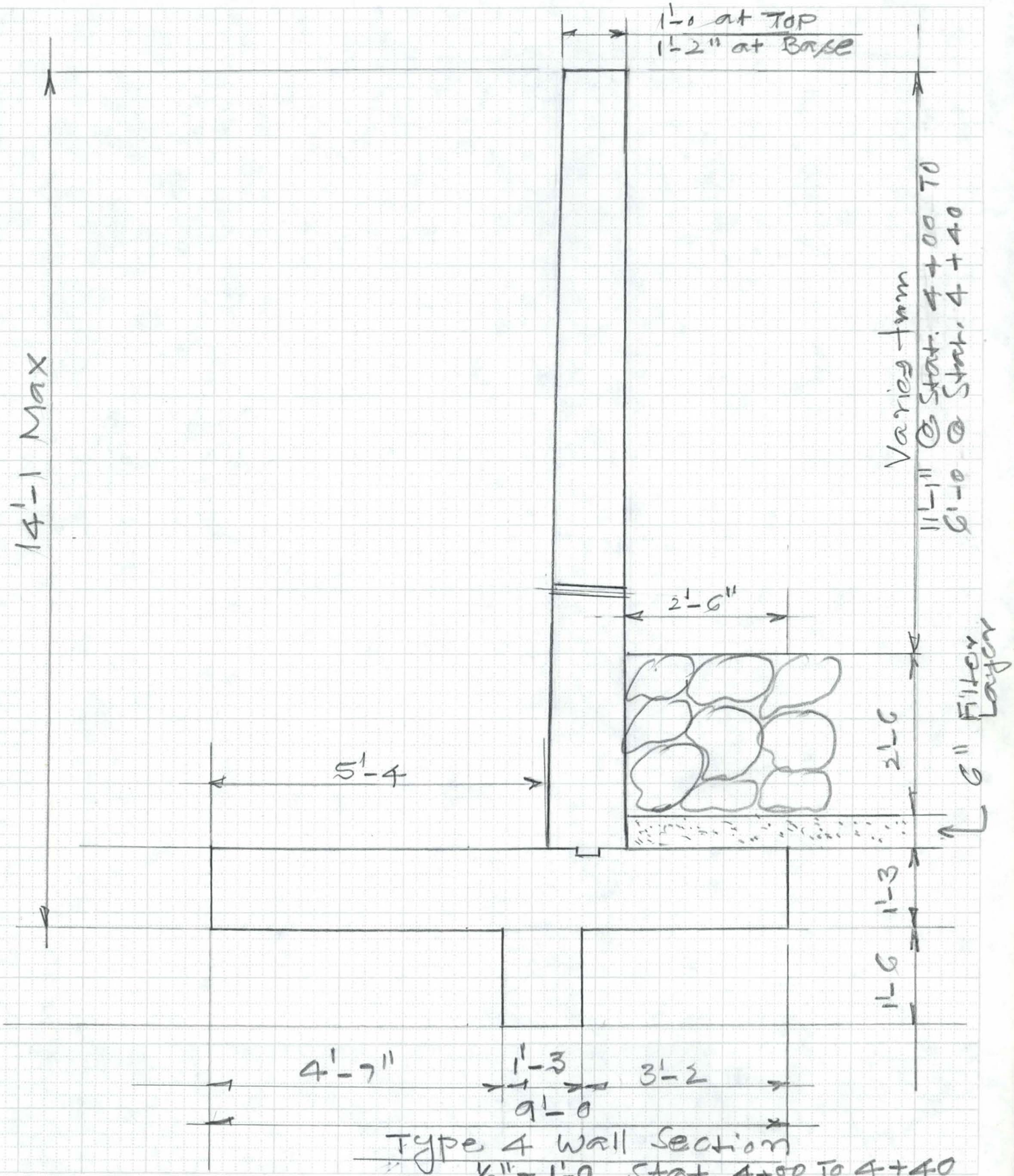
Stat. 1100 To 1237.6 ½" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Type 4 wall COMPUTED KNH DATE 8/92

CHECKED BY ____ DATE ____



Type 4 Wall Section

½" = 1'-0 Stat. 4+00 To 4+40

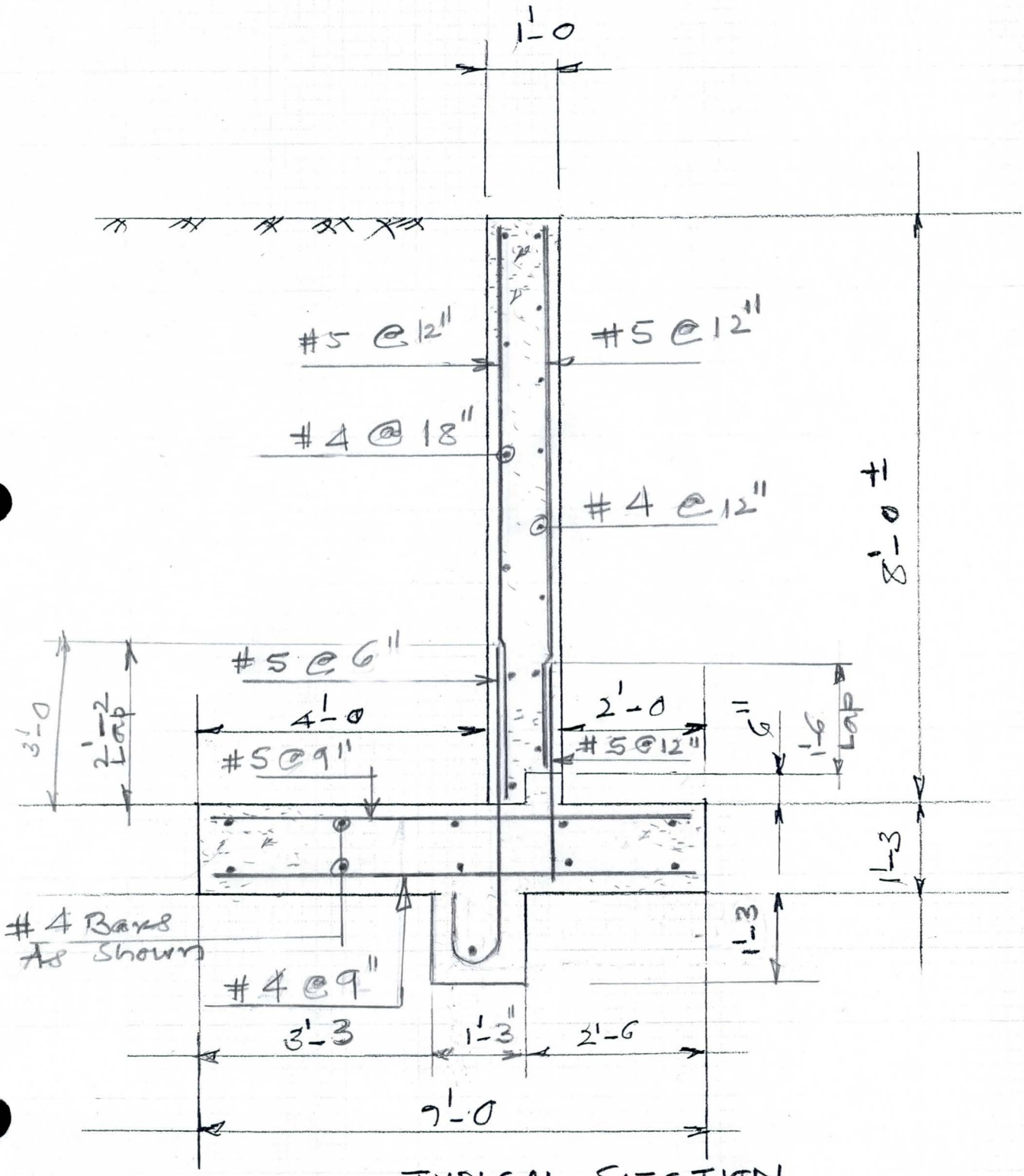
6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE 8(B) OF 10

DETAIL Retaining wall COMPUTED KVH DATE 6/92

8'-0 High Sect^n CHECKED BY _____ DATE _____



TYPICAL SECTION

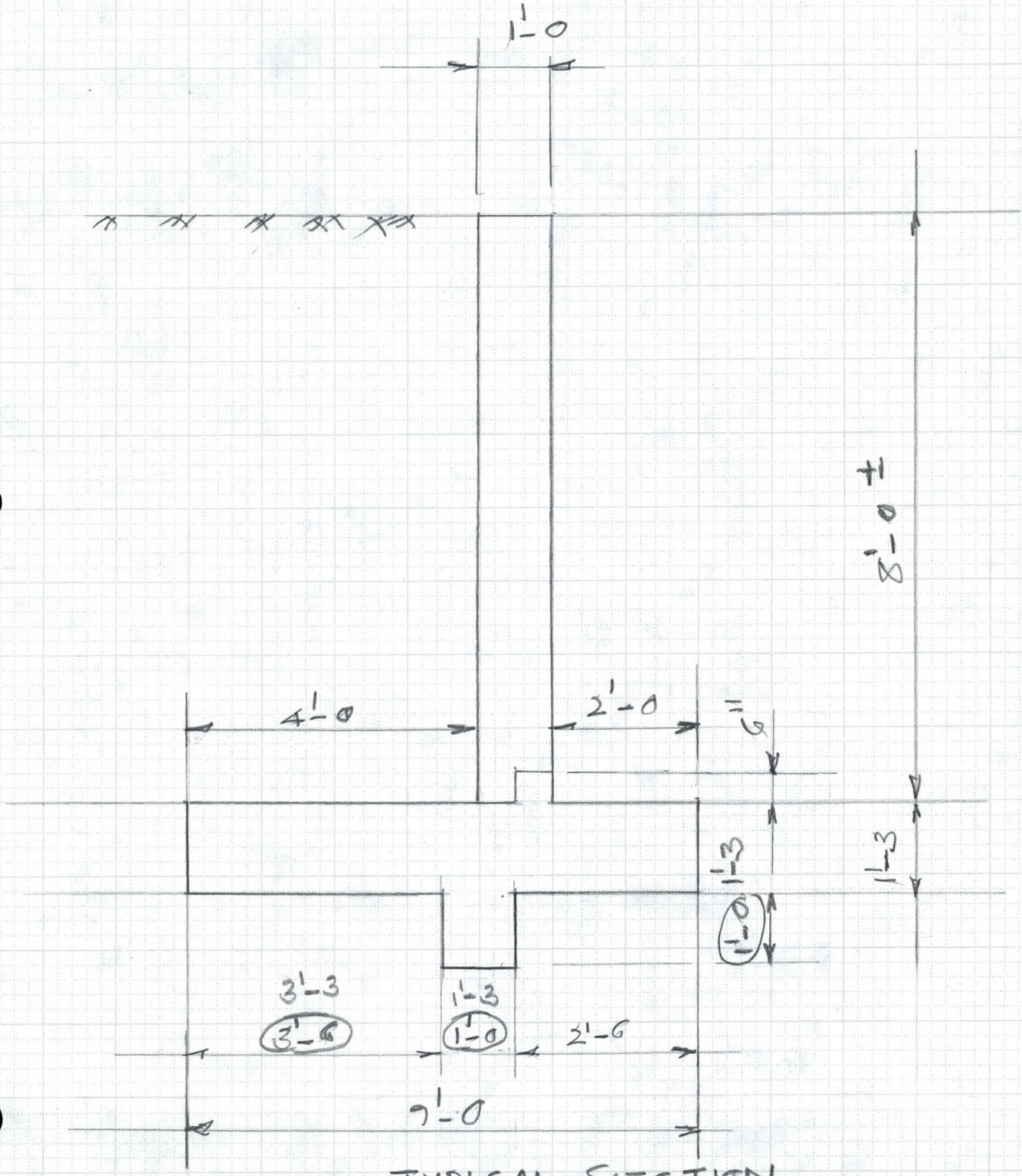
Scale 1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ___ OF 10

DETAIL Retaining wall COMPUTED KVH DATE 6/92

8'-0 High Sect^n CHECKED BY ___ DATE ___



TYPICAL SECTION

Scale 1/2" = 1'-0

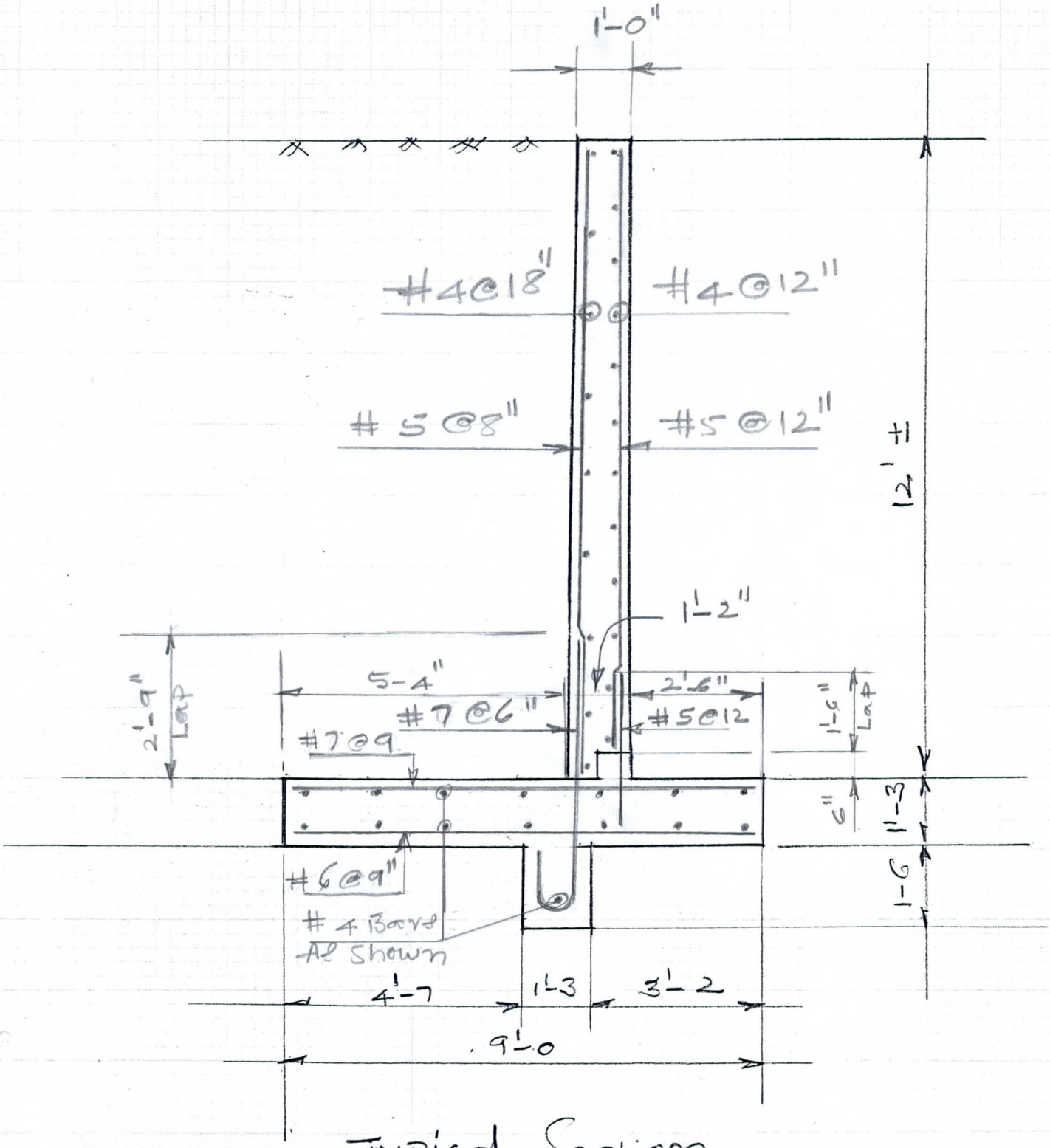
6910-153 4-90

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE 18 OF 22

DETAIL 12' High wall COMPUTED KVH DATE 7/92

CHECKED BY DATE



Typical Section

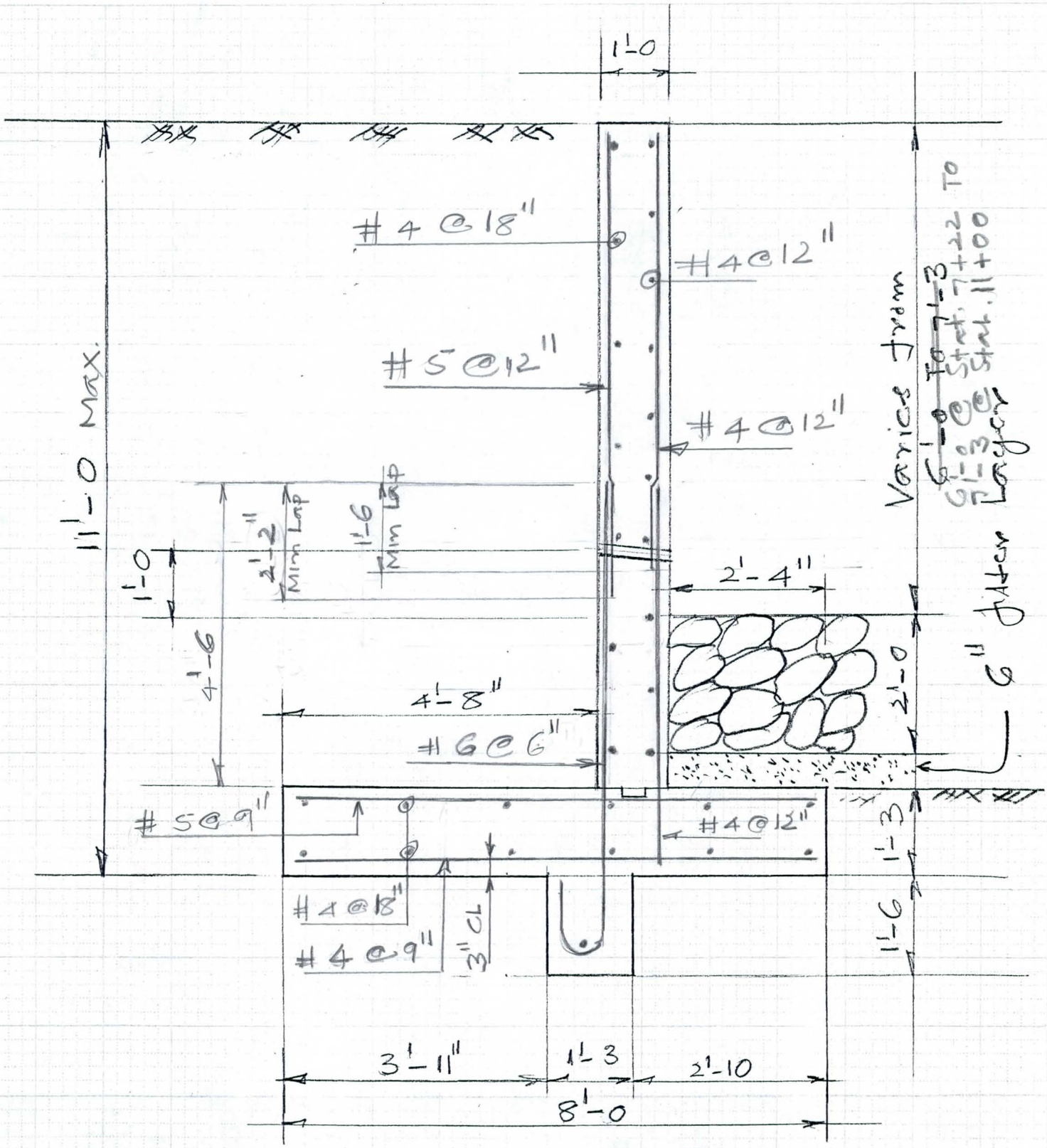
Scale 3/8" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 7'-3 Wall Section COMPUTED KVH DATE 8/92

Type 2 Wall CHECKED BY ____ DATE ____



Type 2 Wall Section

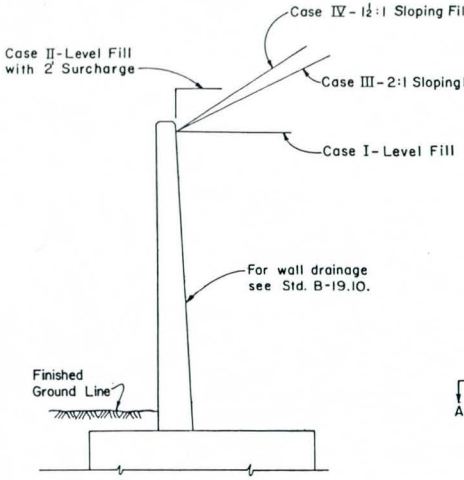
1/2" = 1'-0

Stat. 722.3 To 1100

Construction Jt. P-23

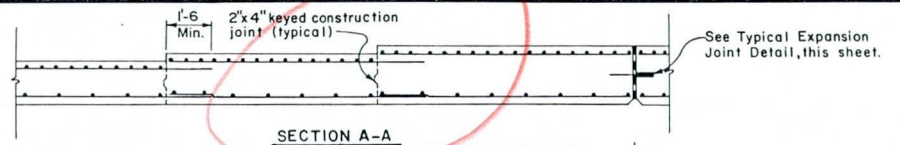
DESIGN	DHY	9-72
DRAWN	GFB	8-73
CHECKED	NAB	3-73

NO	DESCRIPTION OF REVISIONS	MADE BY	DATE
1	Change Notes & Si bars	WEB	12-82
2	Add bar in F.F.	CH	5-85
3	Changed Reinf. Note	CH	10-86
4	Removed Drainage from Typ. Sect.	JM	3-88
5			
6			

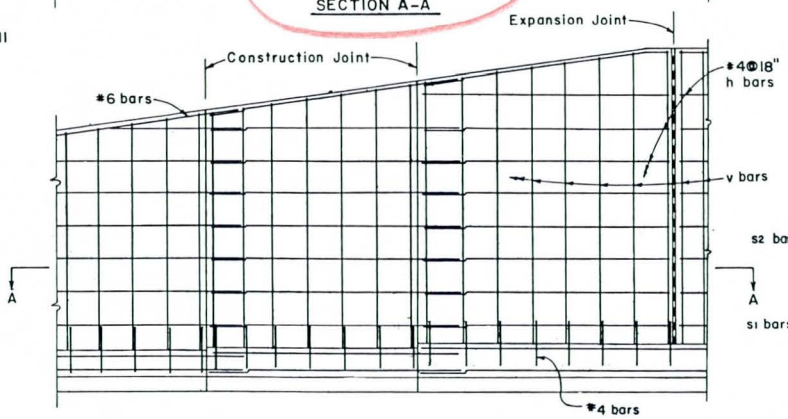


TYPICAL SECTION

Showing Design Cases & Drainage

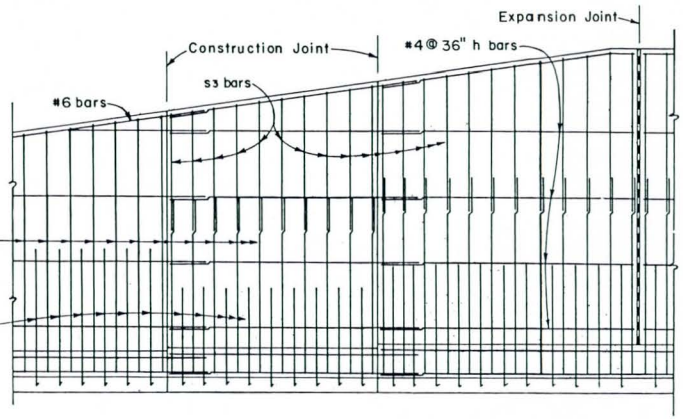


SECTION A-A



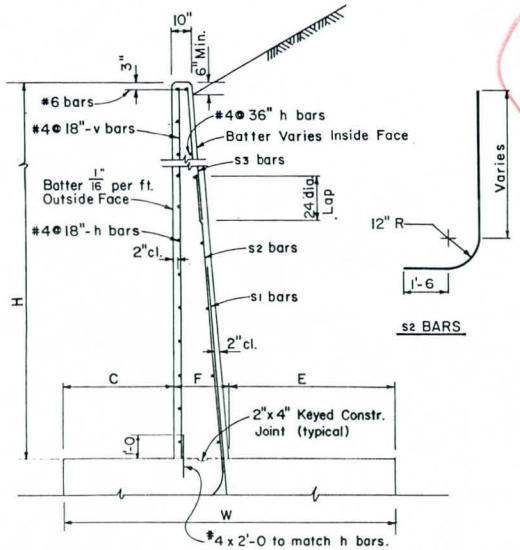
TYPICAL ELEVATION

Outside Face Reinforcing



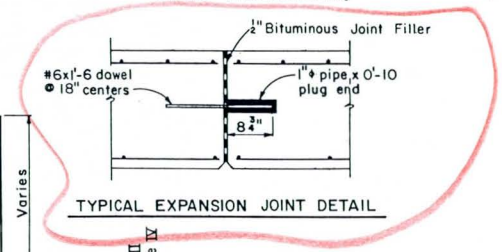
TYPICAL ELEVATION

Inside Face Reinforcing

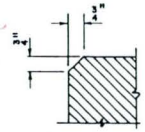


*4 x 2'-0 to match h bars. Add 0.9 Lb./Lin. Ft. to Reinf. Steel Quantities shown on Std. B-18.20, B-18.30 and B-18.40

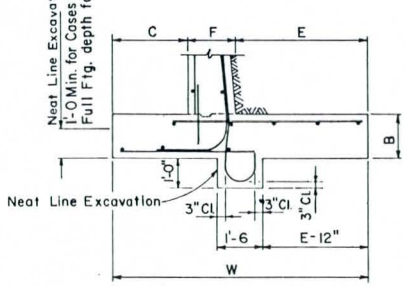
TYPICAL STEM DETAIL



TYPICAL EXPANSION JOINT DETAIL

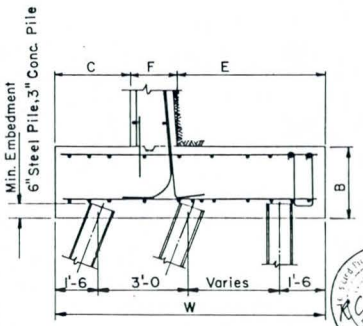


Chamfer all exposed corners thus unless otherwise noted.



SPREAD FOOTING DETAIL

See Footing Steel Detail on B-18.20



PILE FOOTING DETAIL

See Footing Steel Detail on B-18.30 or B-18.40

GENERAL NOTES

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction.

Design - AASHTO Std. Specs. for Highway Bridges 1977.

Dead Load - Weight of backfill = 120 P.C.F.
Angle of Internal Friction = 33° 15'.

Stresses - Class S Concrete f'_c = 3000 P.S.I.

All Concrete shall be Class S.

Reinforcing Steel shall conform to A.S.T.M. Spec. A-615

Bar sizes #6 and smaller shall be Gr. 40 or Gr. 60; f_s = 20,000 P.S.I.

Bar sizes #7 and larger shall be Grade 60, f_s = 24,000 P.S.I.

All Reinforcing Steel shall have 2" clear cover unless noted otherwise.

JOINT NOTE

All Retaining Walls shall have Construction Joints spaced at not more than 30'-0 apart or as shown. Reinforcing Steel shall project through the joint.

Expansion Joints shall be provided at intervals not exceeding 90'-0.

Footings may be continuous with no joint.

BATTERED PILE NOTE

Batter Piles 3:12 for Cases I & II, 4:12 for Cases III & IV.

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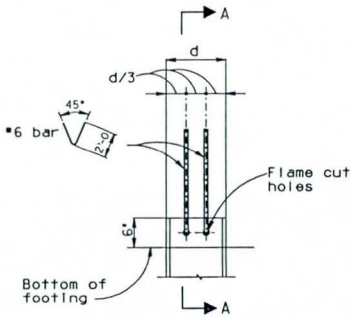
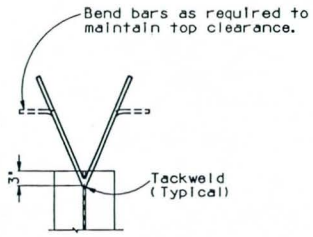
R.C. Brechler		7-88
APPROVED FOR DISTRIBUTION F. E. Hendrix	CANTILEVER RETAINING WALL DETAILS	STANDARD NO. B-18.10

P-24

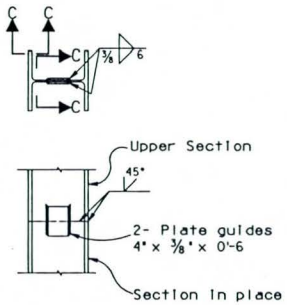


ELEVATION

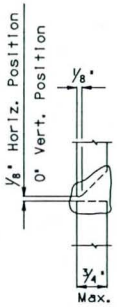


SECTION A-A

PILE ANCHOR DETAIL



PILE SPLICE DETAIL



SECTION C-C

GENERAL NOTES:

Construction - Arizona Department of Transportation Standard Specifications for Road and Bridge Construction.

Structural Steel shall conform to ASTM Specification A36.

All welding shall conform to the requirements of the American Welding Society, Structural Welding Code, D1.1, 1980, revised to date, and as modified by the AASHTO Standard Specifications for Welding of Structural Steel Highway Bridges, 1981, revised to date.

Roadway Drains shall conform to ASTM Specifications A53, Type S, grade "B". Galvanize after fabrication in accordance with ASTM Specifications A123.

Reinforcing Steel shall conform to ASTM Spec. A615. Bars shall be grade 40 or Grade 60, fs= 20,000 psi.

PILE SPLICE NOTE:

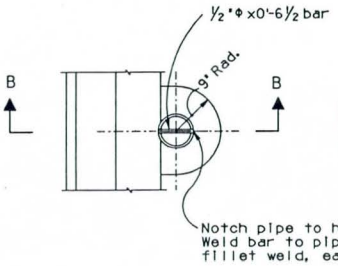
When piling is to be spliced for further driving, upper section shall be lowered on section in place and tapped lightly with hammer to full bearing before butt welds are made. When piling is to be extended without further driving, omit guide plates and make butt welds continuous across web.

PILE POINT NOTE: (Only when required).

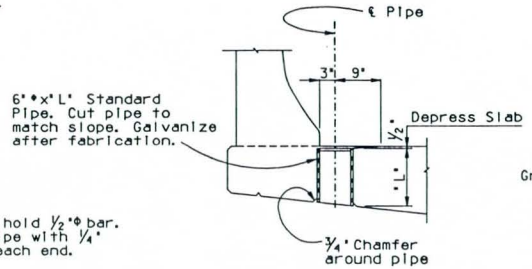
Manufactured pile points shall be attached by means of a single bevel groove weld across the full width of each exterior face of the flanges of the pile.

The flanges of the pile shall be prepared by flame cutting a 45 degree bevel at the bottom edge of each exterior face of flanges. 45 degrees bevel size shall be 1/2 the flange thickness.

Groove welds shall be 5/16" for all HP piles 8" thru 14", HP14x117 shall be 7/16".

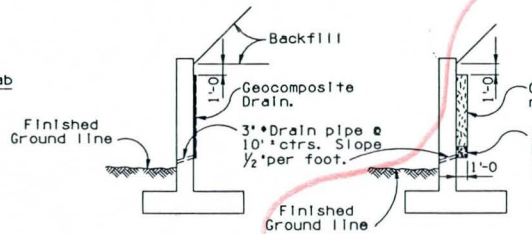


PLAN



SECTION B-B

DECK DRAIN DETAIL

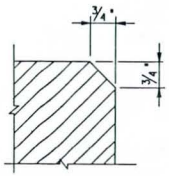


ALTERNATE A

ALTERNATE B

WALL DRAINAGE

Typ weep Hole Detail



Chamfer all exposed corners thus unless otherwise noted. This note applicable to all sheets pertaining to the structure.

CHAMFER DETAIL

REDUCED SIZE DO NOT SCALE

	DESIGN APPROVED	ARIZONA DEPARTMENT OF TRANSPORTATION HIGHWAYS DIVISION STANDARD DRAWINGS	REVISION 7-88
	APPROVED FOR DISTRIBUTION	MISCELLANEOUS DETAILS FOR BRIDGES	STANDARD NO. B-19.10

CADD FILENAME= IFA
VIEW NAME=

REWALL8

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

WEIGHT DENSITY OF SOIL	=	120.00
K FACTOR FOR LATERAL SOIL PRESSURE	=	0.67
ELEVATION OF TOP OF WALL	=	9.25
ELEVATION OF SOIL AT RETAINED SIDE	=	9.25
ELEVATION OF SOIL AT OTHER SIDE	=	1.25
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	0.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.25
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	1.50
FACTOR OF SAFETY AGAINST OVERTURN	=	1.50
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

(1) a) Submerged Soil

Eqvt. Fluid Pr = 80 pcf

120 x 0.66 = 80 pcf

b) Bottom Slab = 1.25

c) No Surcharge.

Spook Hill Retaining wall

Do some Splice Calculations

THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	2048.04
FACTOR OF SAFETY AGAINST SLIDING	=	1.55
FACTOR OF SAFETY AGAINST OVERTURN	=	1.84
MAXIMUM BENDING MOMENT	=	6819.84
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.45
	USE # 4@ 5	

→ Does not agree with printout sketch.

→ 6830 Hand Comp's checks ok.

REWALL8

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

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ELEVATION OF SOIL AT OTHER SIDE	=	1.25
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	0.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.25
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	1.50
FACTOR OF SAFETY AGAINST OVERTURN	=	1.50
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

(1) a) Submerged Soil

Eqvt. Fluid Pr = 80 pcf

120 x 0.66 = 80 pcf

b) Bottom Slab = 1.25

c) No Surcharge.

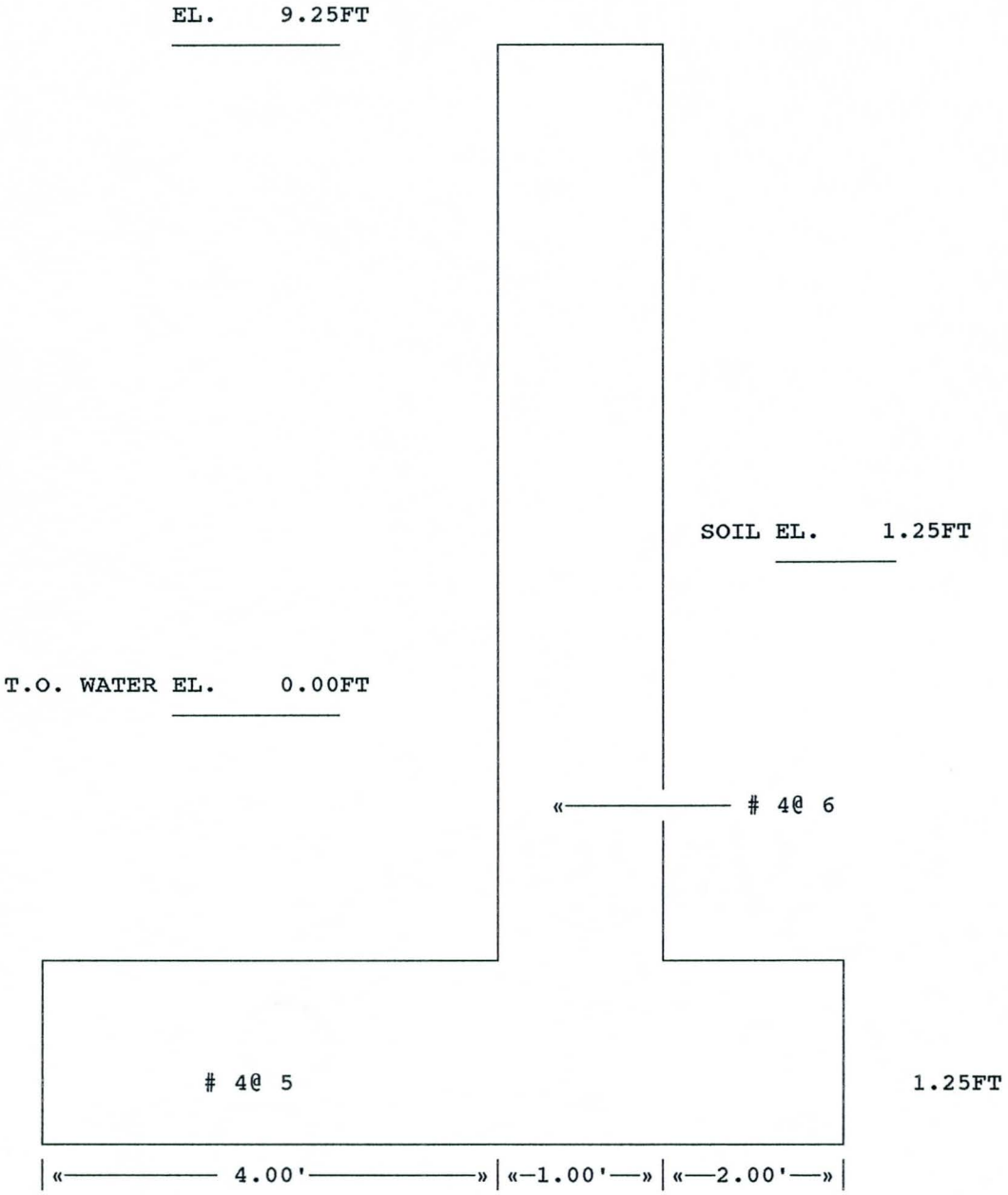
THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	2048.04
FACTOR OF SAFETY AGAINST SLIDING	=	1.55
FACTOR OF SAFETY AGAINST OVERTURN	=	1.84
MAXIMUM BENDING MOMENT	=	6819.84
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.45
	USE # 4@ 5	

→ Does not agree with printout sketch.

→ 6830 Hand Comp's checks ok.



NOTE: THE ABOVE SKETCH IS NOT DRAWN TO SCALE.

1

REWALL8A

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

(2) a) Dry Soil
Eq Wt pr = 36 pcf
Surch. = 2'
b) Bottom Slab = 1.25'
c) Surcharge = 2.0

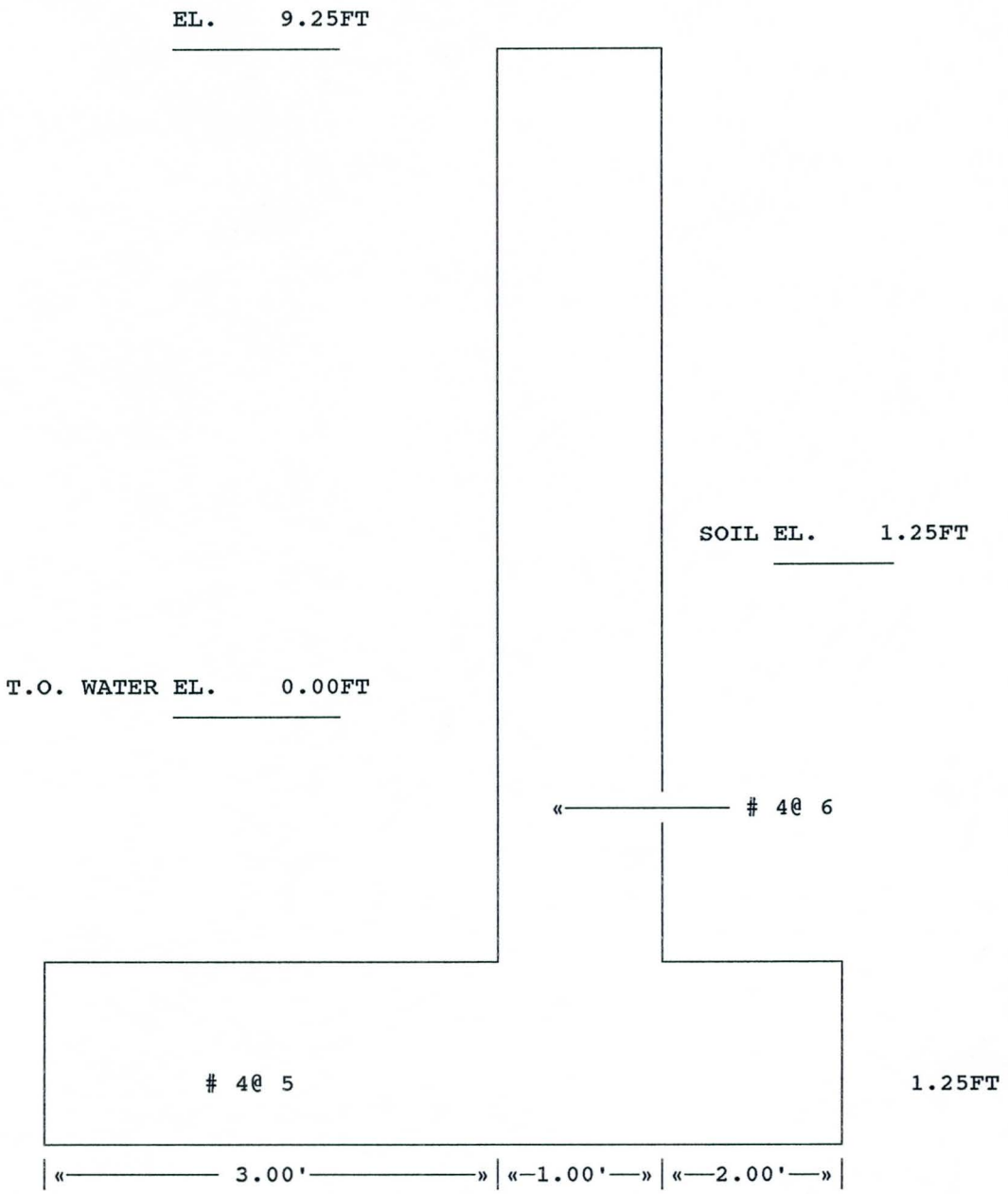
WEIGHT DENSITY OF SOIL	=	120.00
K FACTOR FOR LATERAL SOIL PRESSURE	=	0.33
ELEVATION OF TOP OF WALL	=	9.25
ELEVATION OF SOIL AT RETAINED SIDE	=	9.25
ELEVATION OF SOIL AT OTHER SIDE	=	1.25
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	2.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.25
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	2.00
FACTOR OF SAFETY AGAINST OVERTURN	=	2.00
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	1620.66
FACTOR OF SAFETY AGAINST SLIDING	=	2.47
FACTOR OF SAFETY AGAINST OVERTURN	=	2.63
MAXIMUM BENDING MOMENT	=	5913.60
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.45
	USE # 4@ 5	

5590 lb-ft. (Hand Calculations) ok, since surcharge used was a little higher than 2'



NOTE: THE ABOVE SKETCH IS NOT DRAWN TO SCALE.

1

REWALL 8B

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

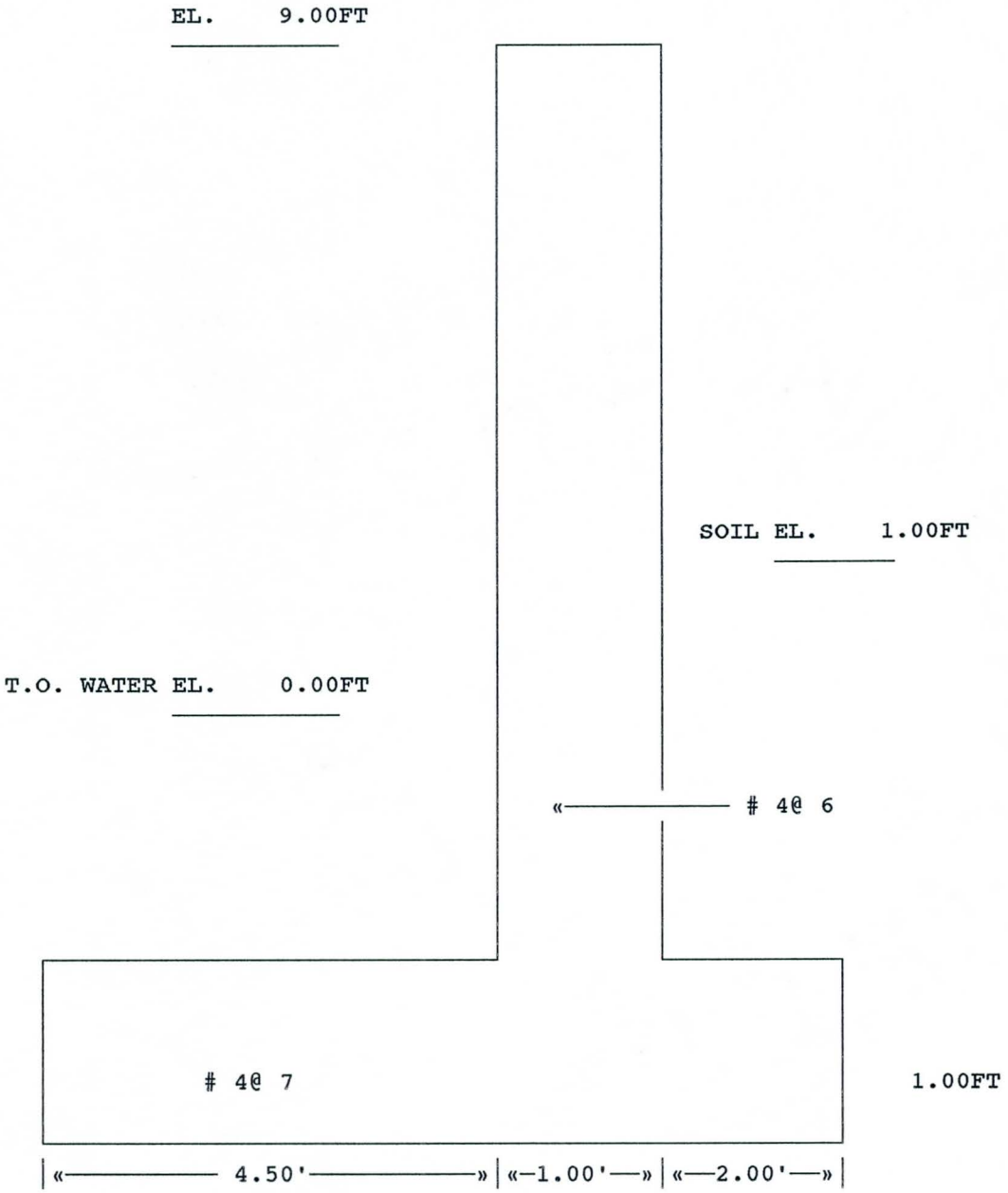
WEIGHT DENSITY OF SOIL	=	120.00
K FACTOR FOR LATERAL SOIL PRESSURE	=	0.67
ELEVATION OF TOP OF WALL	=	9.00
ELEVATION OF SOIL AT RETAINED SIDE	=	9.00
ELEVATION OF SOIL AT OTHER SIDE	=	1.00
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	0.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.00
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	2.00
FACTOR OF SAFETY AGAINST OVERTURN	=	2.00
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

(3) a) Submerged Soil
b) Bottom Slab = 1.0'
c) No Surcharge

THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	4.50
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	1395.35
FACTOR OF SAFETY AGAINST SLIDING	=	2.07
FACTOR OF SAFETY AGAINST OVERTURN	=	3.06
MAXIMUM BENDING MOMENT	=	6860.80
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.33
	USE # 4@ 7	



NOTE: THE ABOVE SKETCH IS NOT DRAWN TO SCALE.

1

work out Splice
Calculations

REWALL8C

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

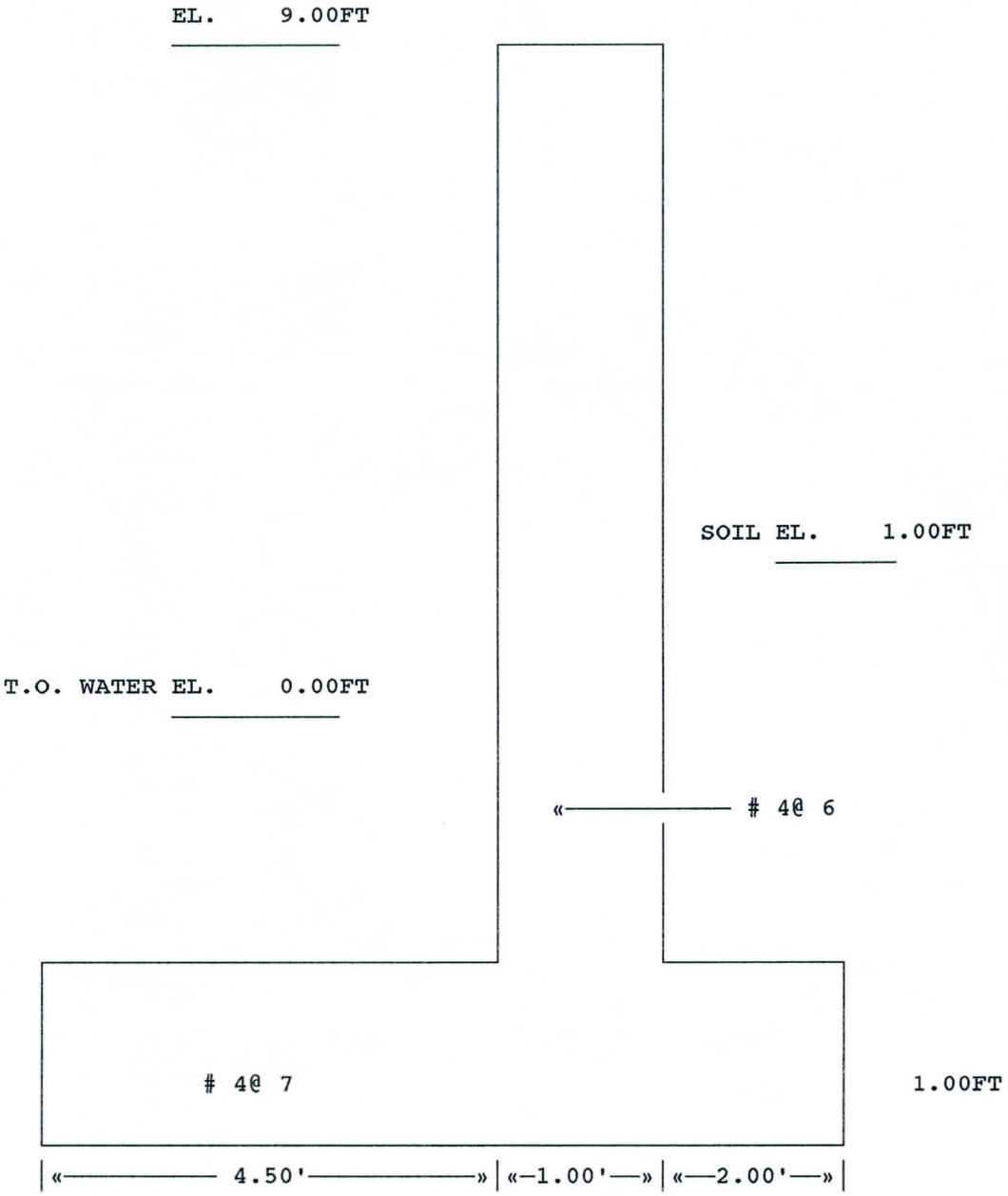
(4) a) Dry Soil
b) Bottom Slab = 1.0
c) Surcharge = 2.0'

WEIGHT DENSITY OF SOIL	=	120.00
K FACTOR FOR LATERAL SOIL PRESSURE	=	0.33
ELEVATION OF TOP OF WALL	=	9.00
ELEVATION OF SOIL AT RETAINED SIDE	=	9.00
ELEVATION OF SOIL AT OTHER SIDE	=	1.00
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	2.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.00
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	2.00
FACTOR OF SAFETY AGAINST OVERTURN	=	2.00
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	1485.40
FACTOR OF SAFETY AGAINST SLIDING	=	2.48
FACTOR OF SAFETY AGAINST OVERTURN	=	2.73
MAXIMUM BENDING MOMENT	=	5913.60
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.33
	USE # 4@ 7	



NOTE: THE ABOVE SKETCH IS NOT DRAWN TO SCALE.

1

REWALL 8D

(5) a) Dry Soil
b) Bott Slab = 1.25'
c) No Surcharge.

PROGRAM: REWALL - PROPRIETARY TO RESEARCH ENGINEERS

OUTPUT REPORT FOR RETAINING WALL DESIGN

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

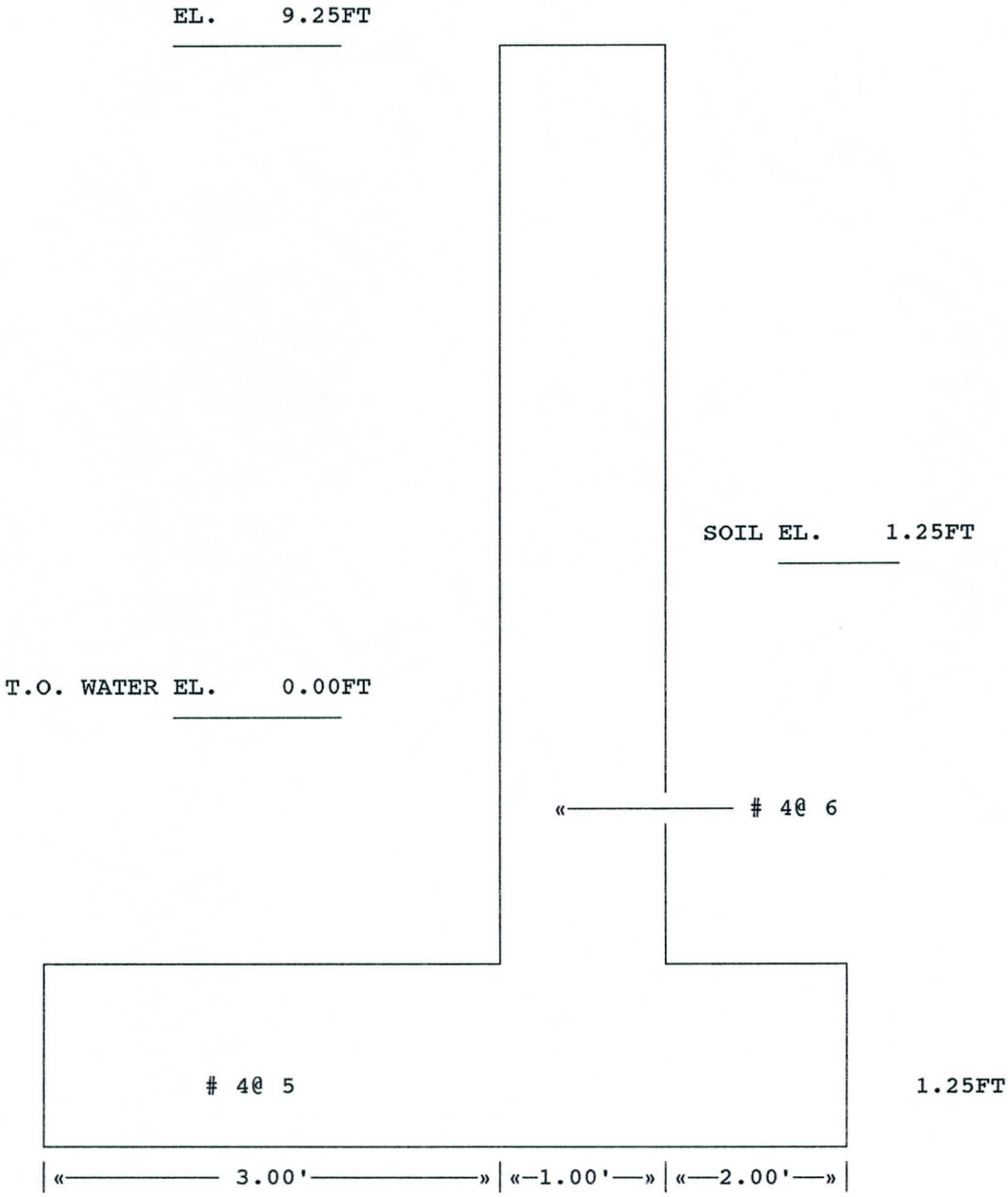
FOLLOWING ARE THE USER-PROVIDED DESIGN PARAMETERS :

WEIGHT DENSITY OF SOIL	=	120.00
K FACTOR FOR LATERAL SOIL PRESSURE	=	0.33
ELEVATION OF TOP OF WALL	=	9.25
ELEVATION OF SOIL AT RETAINED SIDE	=	9.25
ELEVATION OF SOIL AT OTHER SIDE	=	1.25
ELEVATION OF WATER TABLE	=	0.00
DEPTH OF SURCHARGE	=	0.00
THICKNESS OF WALL AT BOTTOM	=	1.00
THICKNESS OF WALL AT TOP	=	1.00
THICKNESS OF BOTTM SLAB	=	1.25
MINIMUM DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
ALLOWABLE SOIL PRESSURE	=	4000.00
FACTOR OF SAFETY AGAINST SLIDING	=	2.00
FACTOR OF SAFETY AGAINST OVERTURN	=	2.00
CONCRETE YIELD STRENGTH PSI	=	2999.98
REINF STEEL YIELD STRENGTH PSI	=	59999.61
CLEARANCE FOR REINF STEEL BOTT SLAB	=	0.250
CLEARANCE FOR REINF STEEL WALL SLAB	=	0.167

THE FOLLOWING IS THE RESULTS OF CALCULATIONS

ALL UNITS ARE POUN FEET UNLESS OTHERWISE NOTED

FINAL DIMENSION OF HEEL	=	3.00
FIXED DIMENSION OF TOE	=	2.00
MAXIMUM SOIL PRESSURE	=	1115.95
FACTOR OF SAFETY AGAINST SLIDING	=	3.13
FACTOR OF SAFETY AGAINST OVERTURN	=	3.71
MAXIMUM BENDING MOMENT	=	3379.20
REINF STEEL FOR WALL IN SQ.IN/FT	=	0.37
	USE # 4@ 6	
REINF STEEL FOR SLAB IN SQ.IN/FT	=	0.45
	USE # 4@ 5	



NOTE: THE ABOVE SKETCH IS NOT DRAWN TO SCALE.

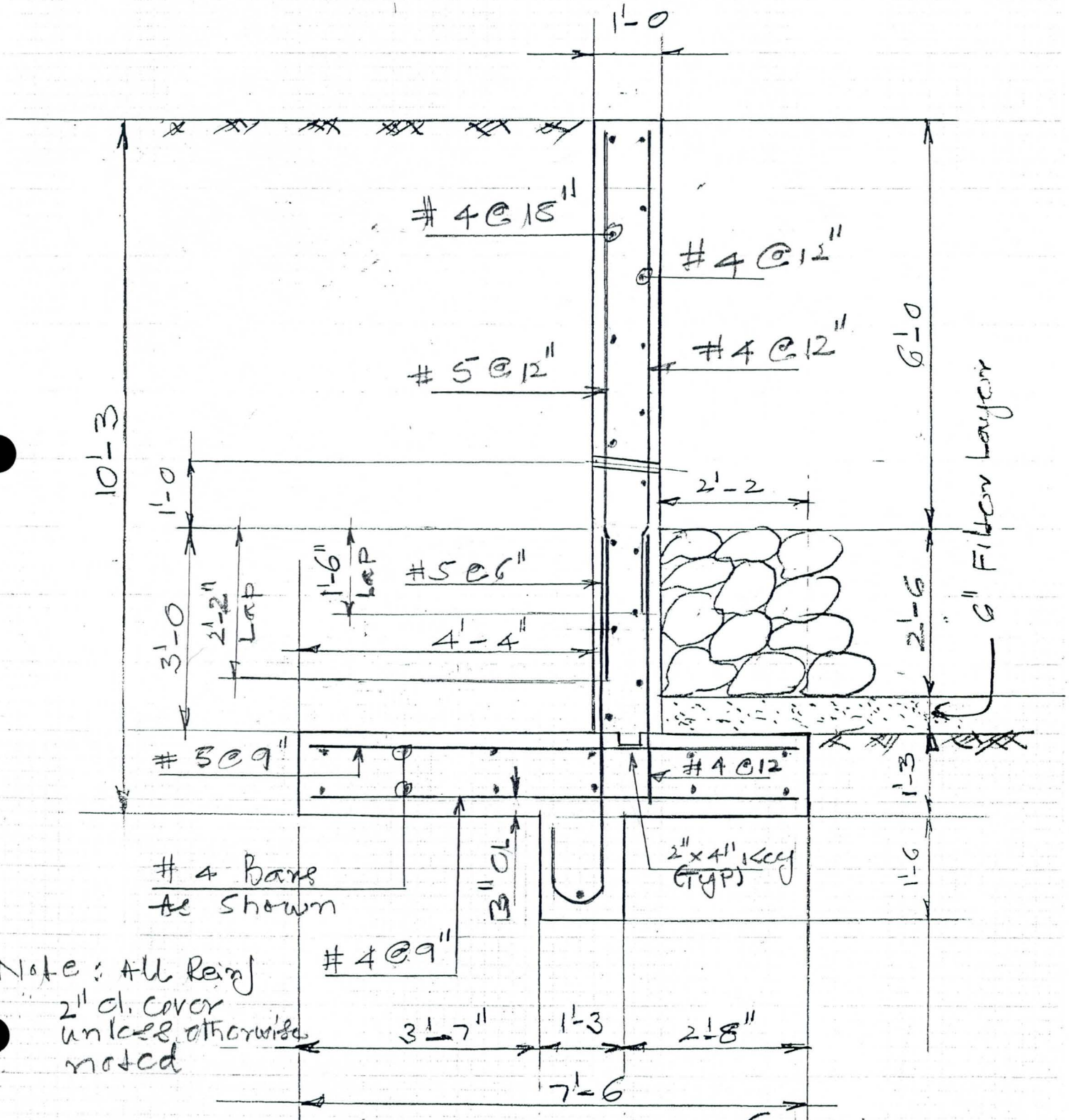
1

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill outlet PAGE ____ OF ____

DETAIL 6' Wall Section COMPUTED KVH DATE 8/12

Type 1 Wall CHECKED BY ____ DATE ____



Note: All Reinf 2" cl. cover unless otherwise noted

Type 1 Wall Section

Stat. 440 TO 722.3

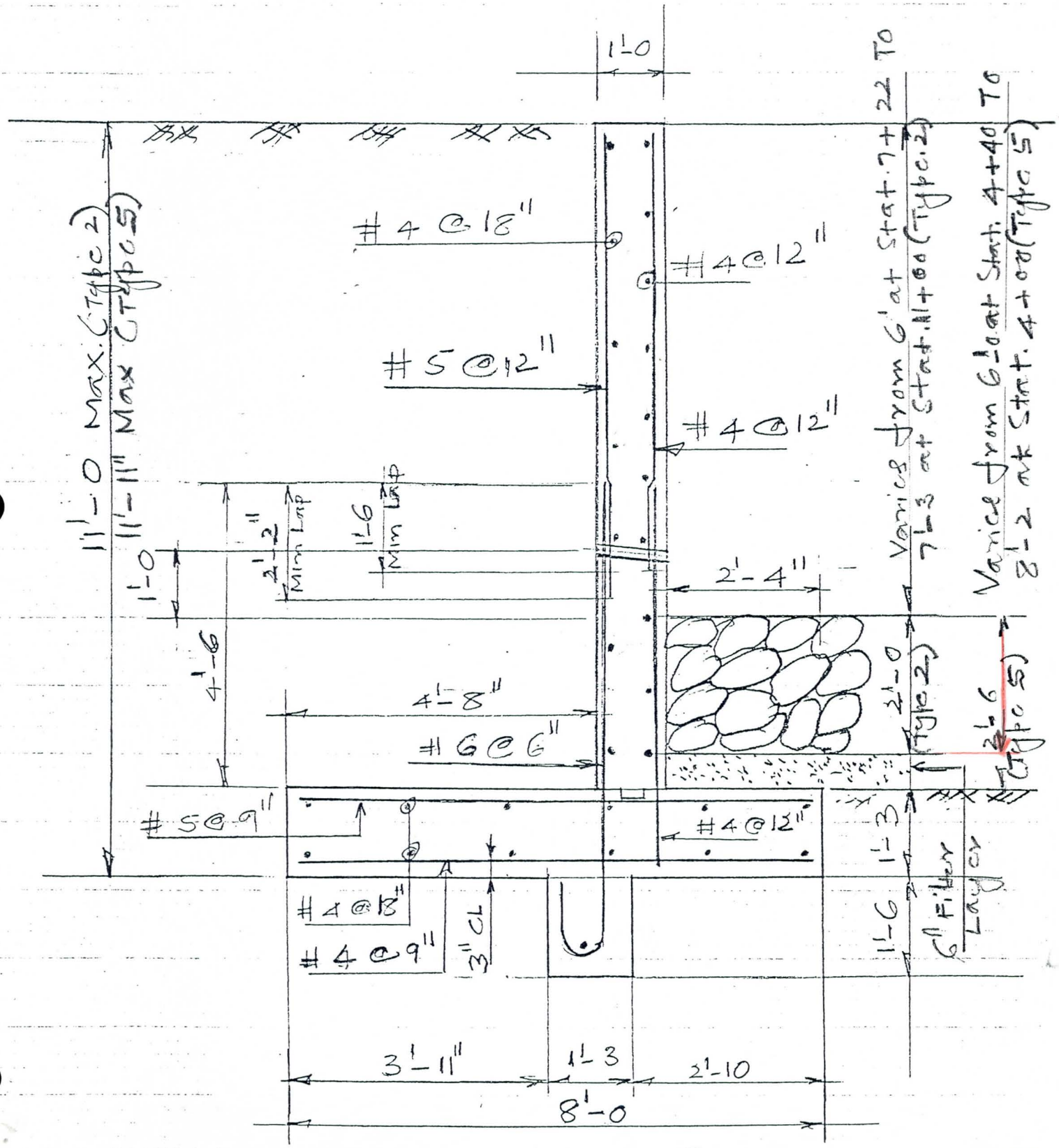
1/2" = 1'-0

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Spook Hill Outlet PAGE ____ OF ____

DETAIL 7'-3 Wall Section COMPUTED KVH DATE 8/92

Type 2 Wall CHECKED BY ____ DATE ____



TYPE-2 AND TYPE-5 WALL SECTIONS

Scale 1/2" = 1'-0

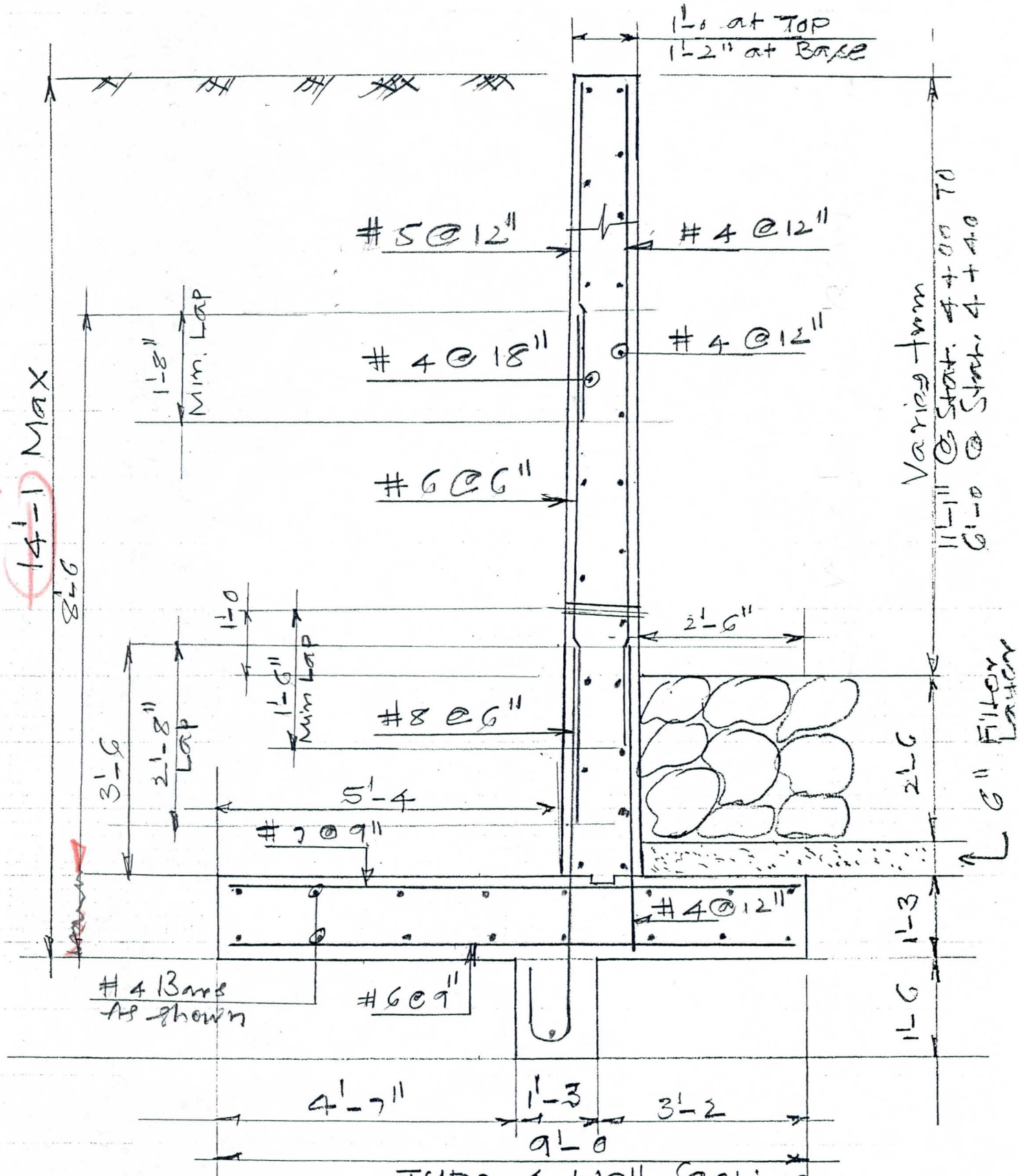
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

(4)

PROJECT Spook Hill PAGE ____ OF ____

DETAIL Type 4 wall COMPUTED KNH DATE 8/92

CHECKED BY ____ DATE ____



Type 4 Wall Section

1/2" = 1'-0 Stat. 4+00 To 4+40

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ___ OF ___

DETAIL _____ COMPUTED _____ DATE _____

_____ CHECKED BY _____ DATE _____

STA		Channel Invert	Channel Wall Elev. Inside	Channel Wall Elev. Outside	Depth of the Wall Inside	Depth of the Wall Outside	
319		COLVIED					
400		34.49	40.49	40.49	6'-0"	6'-00"	6'
650	3.1961%	26.50	32.50	32.50	6'-0"	6'-00"	
722.33 PC		25.08	31.25	31.25	6'-2"	6'-2"	
850		22.59	28.83	29.33	6'-3"	6'-8.88"	7.3
979.98 PI	1.9570%	20.04	26.29	27.29	6'-3"	7'-3"	
1096.94		17.75	24.00	24.55	6'-3"	6'-9.6"	
1100		17.69	24.00	24.44	6'-3.72"	6'-9"	
1118.98		17.32	24.00	24.00	6'-8.16"	6'-8.16"	9'
1237.60		15.00	24.00	24.00	9'-0"	9'-00	

Type ① L = 322'

Type ② L = 378'

Type (3) L = 137'

121, Fig 1.7

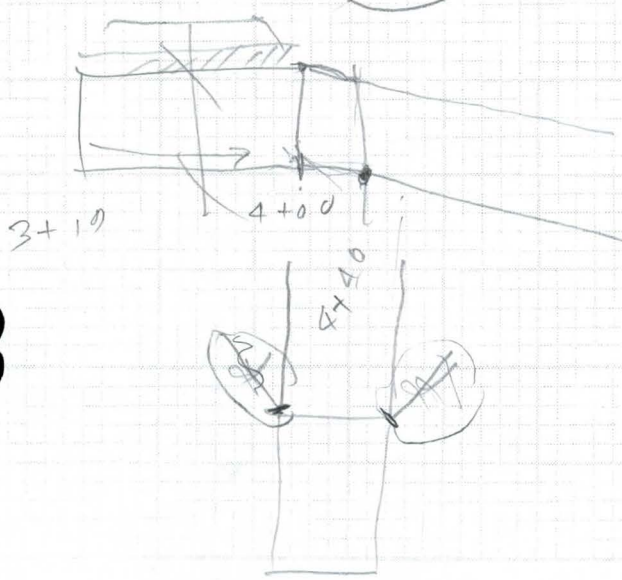
650
400
250

1100
650
450

1237
1100
137

850
650
200

1100
850
250



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT Sherkhill outlet PAGE ____ OF ____

DETAIL Type 4 wall COMPUTED KVH DATE 8/92

CHECKED BY ____ DATE ____

1) Concrete: 1402 cy @ $150 = $210,000
2) Reinf St. 131597 lbs @ 0.50 = 66000
3) Excn 12772 cy @ $3/- = 38000
4) Str. Backfill 5314 @ $12/- = 64000
5) Fill 810 cy @ $2/- = 1500
6) Grouted Riprap
7) Fill Material

$379,500

Say $500,000

6910-153 4-90

MATERIAL SPECIFICATION

521. AGGREGATES FOR DRAINFILL AND FILTERS

1. SCOPE

This specification covers the quality of mineral agregates for the construction of drainfill and filters.

2. QUALITY

Drainfill and filter aggregates shall be sand, gravel or crushed stone or mixtures thereof. They shall be composed of clean, hard, durable mineral particles free from organic matter, clayballs, soft particles or other substances that would interfere with their free-draining properties.

Aggregates of crushed limestone shall be thoroughly washed and screened. Coarse aggregate containing crushed limestone shall have not more than 3 percent by weight of particles finer than the No. 4 sieve. Crushed limestone shall not be used for fine aggregates except in combination with other materials such that not more than 5 percent of the portion finer than the No. 4 sieve shall be crushed limestone.

Aggregates shall be tested for soundness according to ASTM Method C 88, and shall have a weighted average loss in five cycles of not more than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

3. GRADING

Drainfill and filter aggregates shall conform to the specified grading limits after being placed in the work, and after being compacted if compaction is specified. Grading shall be determined by ASTM Method C 136, but the percentage of material finer than a No. 200 sieve shall be not more than 5 percent when determined by ASTM Method C 117.

4. STORING AND HANDLING

Drainfill and filter aggregtes shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other materials.

Material Specs
For FCD

MATERIAL SPECIFICATION

521. AGGREGATES FOR DRAINFILL AND FILTERS

1. SCOPE

This specification covers the quality of mineral agregates for the construction of drainfill and filters.

2. QUALITY

Drainfill and filter aggregates shall be sand, gravel or crushed stone or mixtures thereof. They shall be composed of clean, hard, durable mineral particles free from organic matter, clayballs, soft particles or other substances that would interfere with their free-draining properties.

Aggregates of crushed limestone shall be thoroughly washed and screened. Coarse aggregate containing crushed limestone shall have not more than 3 percent by weight of particles finer than the No. 4 sieve. Crushed limestone shall not be used for fine aggregates except in combination with other materials such that not more than 5 percent of the portion finer than the No. 4 sieve shall be crushed limestone.

Aggregates shall be tested for soundness according to ASTM Method C 88, and shall have a weighted average loss in five cycles of not more than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

3. GRADING

Drainfill and filter aggregates shall conform to the specified grading limits after being placed in the work, and after being compacted if compaction is specified. Grading shall be determined by ASTM Method C 136, but the percentage of material finer than a No. 200 sieve shall be not more than 5 percent when determined by ASTM Method C 117.

4. STORING AND HANDLING

Drainfill and filter aggregtes shall be stored and handled by methods that prevent segregation of particle sizes or contamination by mixing with other materials.

MATERIAL SPECIFICATION

522. AGGREGATE FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of fine aggregate and coarse aggregate for use in the manufacture of portland cement concrete.

2. QUALITY

Aggregate shall conform to the requirements of ASTM Specification C-33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

3. REACTIVITY WITH ALKALIES

The potential reactivity of aggregates with the alkalies in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C 289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C 33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

a. Applicable test results of mortar bar tests, made according to ASTM Method C 227, are available which indicate an expansion of less than 0.10 percent at six months in mortar bars made with cement containing not less than 0.8 percent alkalies expressed as sodium oxide; or

b. Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 percent alkalies expressed as sodium oxide.

4. STORING AND HANDLING

Aggregate of each class and size shall be stored and handled by methods that prevent segregation of particles sizes or contamination by intermixing with other materials.

MATERIAL SPECIFICATION

523. ROCK FOR RIPRAP

1. SCOPE

This specification covers the quality of rock to be used in the construction of rock riprap.

2. QUALITY

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Except as provided below, the rock shall have the following properties:

a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.

b. Absorption not more than 2 percent.

c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 ± 300 grams of rock fragments, reasonably uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

MATERIAL SPECIFICATION

531. PORTLAND CEMENT

1. SCOPE

This specification covers the quality of portland cements.

2. QUALITY

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specified types of cement, except that, when Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited in the specifications.

If air-entraining cement is to be used, the Contractor shall furnish the manufacturer's written statement giving the source, amount and brand name of the air-entraining addition.

3. STORAGE AT THE CONSTRUCTION SITE

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agencies. Cement that is partially hydrated or otherwise damaged will be rejected.

MATERIAL SPECIFICATION

532. AIR-ENTRAINING ADMIXTURES (FOR CONCRETE)

1. SCOPE

This specification covers the quality of air-entraining admixtures for concrete.

2. QUALITY

Air-entraining admixtures shall conform to the requirements of ASTM Specification C 260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

MATERIAL SPECIFICATION

533. WATER-REDUCING AND SET-RETARDING ADMIXTURES FOR PORTLAND CEMENT CONCRETE

1. SCOPE

This specification covers the quality of water-reducing and set-retarding admixtures for portland cement concrete.

2. QUALITY

Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C 494, except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

3. TYPES

Admixtures shall be Type A, Water-Reducing or Type D, Water-Reducing and Retarding , as defined in ASTM Specification C 494.

4. PERFORMANCE IN THE JOB MIX

When added in the manner and amount recommended by the manufacturer to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 percent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C 494, shall be from 1 to 3 hours longer with the admixture than without.

MATERIAL SPECIFICATION

534. CURING COMPOUND (FOR CONCRETE)

1. SCOPE

This specification covers the quality of liquid membrane-forming compounds suitable for spraying on concrete surfaces to retard the loss of water during the curing process.

2. QUALITY

The curing compound shall meet the requirements of ASTM Specification C 309.

Unless otherwise specified the compound shall be Type 2.

3. DELIVERY AND STORAGE

All curing compound shall be delivered to the site of the work in the original container bearing the name of the manufacturer and the brand name. The compound shall be stored in a manner to prevent damage to the containers and to protect water-emulsion types from freezing.

MATERIAL SPECIFICATION

535. PREFORMED EXPANSION JOINT FILLER

1. SCOPE

This specification covers the quality of preformed expansion joint fillers for concrete.

2. QUALITY

Preformed expansion joint filler shall conform to the requirements of ASTM Specification D 1752, Type I, Type II or Type III, unless bituminous type is specified. Bituminous type preformed expansion joint filler shall conform to the requirements of ASTM Specification D 994, or D 1751.

MATERIAL SPECIFICATION

536. SEALING COMPOUND FOR JOINTS IN CONCRETE AND CONCRETE PIPE

1. SCOPE

This specification covers the quality of sealing compound for filling joints in concrete pipe and concrete structures.

2. TYPE

The compound shall be a cold-application mastic, single component or multiple component type.

The single component type shall be a ready-mixed nondrying compound furnished in troweling consistency or in preformed rope or strip form.

The multiple component type shall be composed of two or more substances that are to be mixed prior to application.

3. QUALITY

Sealing compound shall conform to the requirements of one of the following specifications:

ASTM Specification D 1850; Concrete Joint Sealer, Cold-Application Type. Penetration, determined as specified in ASTM D 1850, shall be not greater than 120.

Federal Specification SS-S-210A; Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.

ASTM Specification D-1190 concrete joint sealer, hot poured elastic type.

Federal Specification TT-S-227; Sealing Compound: Elastomeric Type Multi-Component (for Caulking, Sealing, and Glazing in Buildings and other Structures), Type II.

The compound shall be capable of being applied at a temperature of 70°F and shall be of such nature that it will adhere to dry, dust free concrete when applied either directly or over a suitable primer. After curing it shall be a resilient, adhesive material that is capable of filling joints and firm enough to prevent the entry of subsequently placed concrete or of earth during the bedding, cradling, or backfilling operations.

4. COMPOSITION AND PROPERTIES

The compound, if used for pipe having rubber gaskets, shall have a composition such that it will not cause deterioration of the rubber gaskets.

MATERIAL SPECIFICATION

537. NON-METALLIC WATERSTOPS

1. SCOPE

This specification covers non-metallic waterstops for use in joints of concrete structures.

2. CLASSIFICATION

a. Classes. Non-metallic waterstops shall be of the following classes, as specified:

Class I shall be made of either natural or synthetic rubber.

Class II shall be made of vinyl chloride polymer or copolymer.

b. Types. Non-metallic waterstops may be either split or solid and shall conform to the following types, as specified (see Figure 1):

Type A shall have ribbed anchor flanges and a smooth web. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type B shall have ribbed anchor flanges and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the web thickness and (2) the inside diameter (D) specified in the contract. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type C shall have a single, circular, bulb-type anchor flange at each edge and a smooth web.

Type D shall have a single, circular, bulb-type anchor flange at each edge and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half the thickness of the web and (2) the inside diameter (D) specified in the contract.

Type E shall have ribbed anchor flanges and a web molded or extruded in the form of a round or U-shaped bulb of the dimensions specified in the contract. The web bulb shall be connected at the open end of the "U" by a thin membrane (having a thickness of not less than 1/64-inch or more than 1/5 the web thickness) designed to: (1) prevent infiltration of wet concrete into the bulb and (2) tear when expansion of the joint occurs. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges. Auxiliary positioning or nailing flanges may be provided so long as they do not interfere with the functioning of the web bulb.

Type F shall have ribbed anchor flanges with at least two extra heavy ribs (designed to resist displacement of the waterstop during placement of concrete) on each flange and a smooth web having a positioning or nailing flange attached at the center.

Type G shall be of special design conforming to the details shown on the drawings.

c. Sizes. Waterstops of Types A through F shall be of the sizes listed herein, as specified (see Table 1). Type G waterstops shall have the dimensions shown on the drawings.

3. PHYSICAL REQUIREMENTS

The extruded or molded materials shall exhibit the properties specified herein when tested by the methods specified in Section 4 of this specification.

a. Class I Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.2.

(3) The tensile strength shall be not less than 2500 pounds per square inch.

(4) The ultimate elongation shall be not less than 450 percent.

(5) The compression set shall be not more than 30 percent.

(6) The water absorption (by weight) shall be not more than 5 percent.

(7) The decrease in tensile strength and ultimate elongation after aging shall be not more than 20 percent.

(8) There shall be no sign of failure due to brittleness at a temperature of minus 35°F.

b. Class II Waterstops

(1) The hardness (Shore A durometer) shall be not less than 60.

(2) The specific gravity shall be not more than 1.4.

(3) The tensile strength shall be not less than 1400 pounds per square inch.

(4) The ultimate elongation of the web shall be not less than 280 percent and that of the flanges shall be not less than 200 percent.

(5) There shall be no sign of failure due to flange brittleness at a temperature of 0°F nor of web brittleness at a temperature of minus 35°F.

(6) The decrease in either tensile strength or ultimate elongation after accelerated extraction shall be not greater than 15 percent.

(7) As a result of the effects of alkalies:

(a) After immersion for 7 days, the sample shall exhibit no loss of weight and not more than 0.25 percent increase in weight, and the hardness (Shore A) of the treated sample shall differ from that of the untreated sample by not more than plus 5 points or minus 5 points.

(b) After immersion for 30 days, the sample shall exhibit no loss of weight and not more than 0.40 percent increase in weight, and the dimensions of the treated sample shall not differ from those of the untreated sample by more than one percent.

4. TEST METHODS

Testing shall be done by the methods cited herein. All cited test methods are included in Federal Test Method Standard No. 601.

a. Hardness shall be determined by Method 3021.

b. Specific gravity shall be determined by Method 14011.

c. Tensile strength shall be determined by Method 4111.

d. Ultimate elongation shall be determined by Method 4121.

e. Compression set shall be determined by Method 3311.

f. Water absorption shall be determined by Method 6631.

g. Tensile strength and ultimate elongation after aging shall be determined by Method 7111.

h. Brittleness shall be determined by Method 5311-1.

i. Accelerated extraction shall be accomplished by Method 6111 under the following conditions:

(1) Samples shall be not less than 1/16-inch nor more than 1/8-inch in thickness;

(2) The immersion medium shall be a solution made by dissolving 5 grams of chemically pure sodium hydroxide and 5 grams of chemically pure potassium hydroxide in one liter of distilled water;

(3) The samples shall be immersed in the medium for 14 days at a temperature of 145° ± 5°F;

(4) During the immersion period, air shall be gently bubbled through the medium from a 1/4-inch glass tube at a rate of about one bubble per second;

(5) Fresh medium shall be substituted every day;

(6) Samples need not be dipped in acetone.

j. The effects of alkalies shall be determined by Method 6251 under the following conditions:

(1) Sample shall be not more than 1/4-inch in thickness;

(2) The immersion medium shall be as described in (i), above;

(3) Fresh medium shall be substituted every 7 days.

(4) The samples shall be immersed in the medium for a period of 30 days;

(5) Samples need not be dipped in acetone.

5. CONDITION

Waterstops shall be extruded or molded in such a manner that the material is dense and homogeneous throughout and free from voids, tears, thins, indentations, or other imperfections. Unless otherwise specified, waterstops shall be symmetrical in shape and uniform in dimensions and shall be furnished in continuous strips at least 50 feet long. Factory splices shall have a tensile strength equal to at least one-half that of the unspliced section.

6. PACKAGING AND STORING

Waterstops shall be packaged and stored by methods that will protect them from prolonged exposure to direct sunlight or excessive heat.

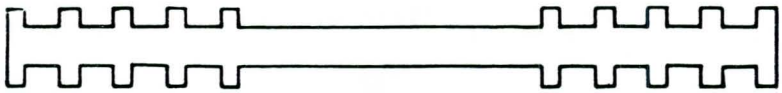
TABLE 1. SIZES OF WATERSTOPS

Size Designation	Web Thickness (T) (Inches)	Width (W) (Inches)
1	1/16	5 1/4
2	3/32	3 3/4
3	3/32	4
4	3/32	5 1/4
5	3/32	6
6	1/8	4
7	1/8	5 1/4
8	1/8	6
9	5/32	4
10	5/32	4 1/2
11	5/32	9
12	3/16	4
13	3/16	5
14	3/16	6
15	3/16	9
16	1/4	6
17	1/4	9
18	3/8	5
19	3/8	6
20	3/8	9
21	1/2	6
22	1/2	9
23	1/2	12

FIGURE 1

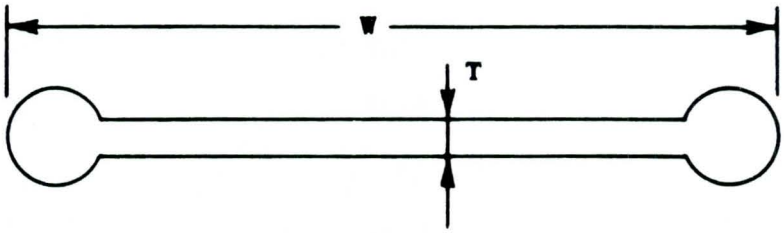
TYPES OF NON-METALLIC WATERSTOPS

TYPE A



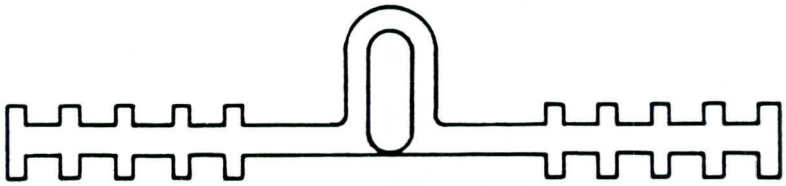
TYPE B

TYPE C

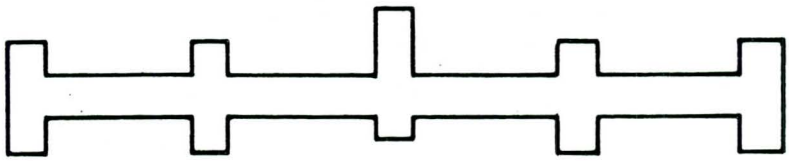


TYPE D

TYPE E



TYPE F



MATERIAL SPECIFICATION

538. METAL WATERSTOPS

1. SCOPE

This specification covers the quality of materials for metal waterstops.

2. MATERIALS

Metal waterstops shall be made of copper or galvanized steel as specified. Waterstops that require forming of the metal involving sharp bends shall be made of copper which shall be soft enough to stand being bent cold through 180 degrees at an inside radius equal to its thickness without cracking.

3. QUALITY

Metal for waterstops shall conform to the requirements of the applicable ASTM standard specifications below:

Copper - ASTM Specification B 152

Zinc-coated (Galvanized) steel - ASTM Specification A 526

MATERIAL SPECIFICATION

539. STEEL REINFORCEMENT (FOR CONCRETE)

1. SCOPE

This specification covers the quality of steel reinforcement for reinforced concrete.

2. QUALITY

All reinforcement shall be free from rust, oil grease, paint or other deleterious matter.

Steel bars for concrete reinforcement requiring bends shall be deformed billet-steel bars conforming to ASTM Specification A 615, Grade 40 or Grade 60.

Straight steel bars shall be deformed bars conforming to one of the following specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 615.

Rail-Steel Deformed Bars for Concrete Reinforcement (Grade 50 or Grade 60) - ASTM Designation A 616.

Axle-Steel Deformed Bars for Concrete Reinforcement (Grade 40 or Grade 60) - ASTM Designation A 617.

Fabricated steel bar mats shall conform to the requirements of ASTM Specification A 184.

Welded steel wire fabric reinforcement shall conform to the requirements of ASTM Specification A 185.

Welded deformed steel wire fabric for concrete reinforcement shall conform to the requirements of ASTM Specification A 497.

Cold-drawn steel wire reinforcement shall conform to the requirements of ASTM Specification A 82.

Deformed steel wire for concrete reinforcement shall conform to the requirements of ASTM Specification A 496.

3. DIMENSIONS OF WELDED WIRE FABRIC

Gauges, spacing and arrangement of wires in welded steel wire fabric shall be as defined in ACI Standard 315 of the American Concrete Institute for the specified style designations.

4. STORAGE

Steel reinforcement stored at the site of the work shall be stored above the ground surface on platforms, skids or other supports and shall be protected from mechanical injury and corrosion.

• Flood Control Dist. Review (Checker) should sign on "Checked By:" and add the "Date", Prior to Sending this Job to SCS for final approval.

APACHE JUNCTION GILBERT WATERSHED
WATERSHED PROTECTION AND FLOOD PREVENTION PROJECT
MARICOPA COUNTY ARIZONA

SPOOKHILL OUTLET DESIGN

Revised date March-93
REVISED: 6-17-92

REVISED: SEPTEMBER 1992

REVISED: DECEMBER 1992

PRIOR TO FINALIZATION:

1) • New Date: ? (Robb) — Need Page No on Ind. 18

2) • Need Page No. for Index. (Robb)

3) • Page 18; should be reviewed by structur people. (Kumar)

4) Appendix "C" needs to be revised and replaced by Kumar

5) Kumar needs to provide calculation, ~~and~~ documentation and drawings for the Retaining walls at the End of Channel and spillway.

6) Kumar needs to review the spec. to see that it meets the structural criteria + Requirements.

7) Kumar needs to make a decision, either he wants to paint the channel retaining wall or he does not want to, If he needs the paint, we should mention that in Spec.

8) When the plans are finalized, Reviewer or Kumar should finalize the cost estimate accordingly.

COPY TO KER FILE 2/13/82

SPOOKHILL SEDIMENT BASIN

INDEX

TRAVERSE from Spookhill Fwy to Spookhill Sediment Basin pp 5-8

Sediment Basin Dike LAYOUT p. 10

Sediment Basin x-Sections pp 12-31

x-Sections upstream of Bush HIGHWAY Bridge pp 32-

TRAVERSE of BM's

SPOOKHILL OUTLET

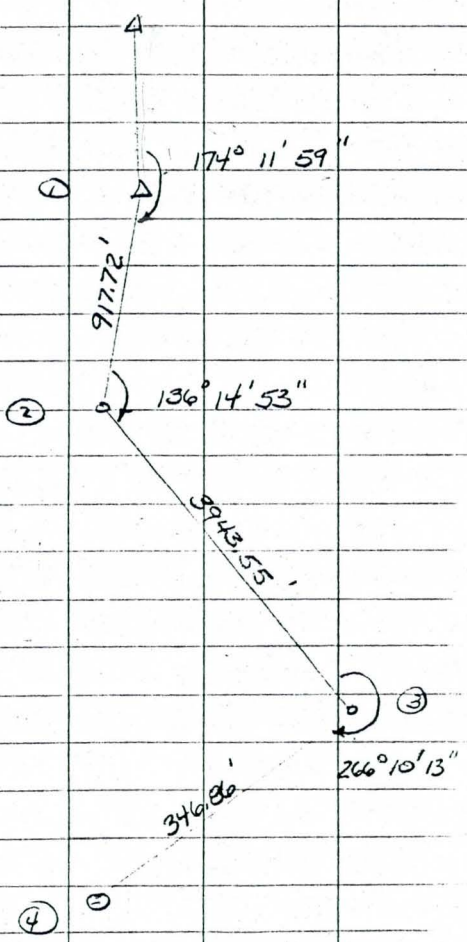
D. Clough
A. Rutledge
G. Mason

Feb 1990

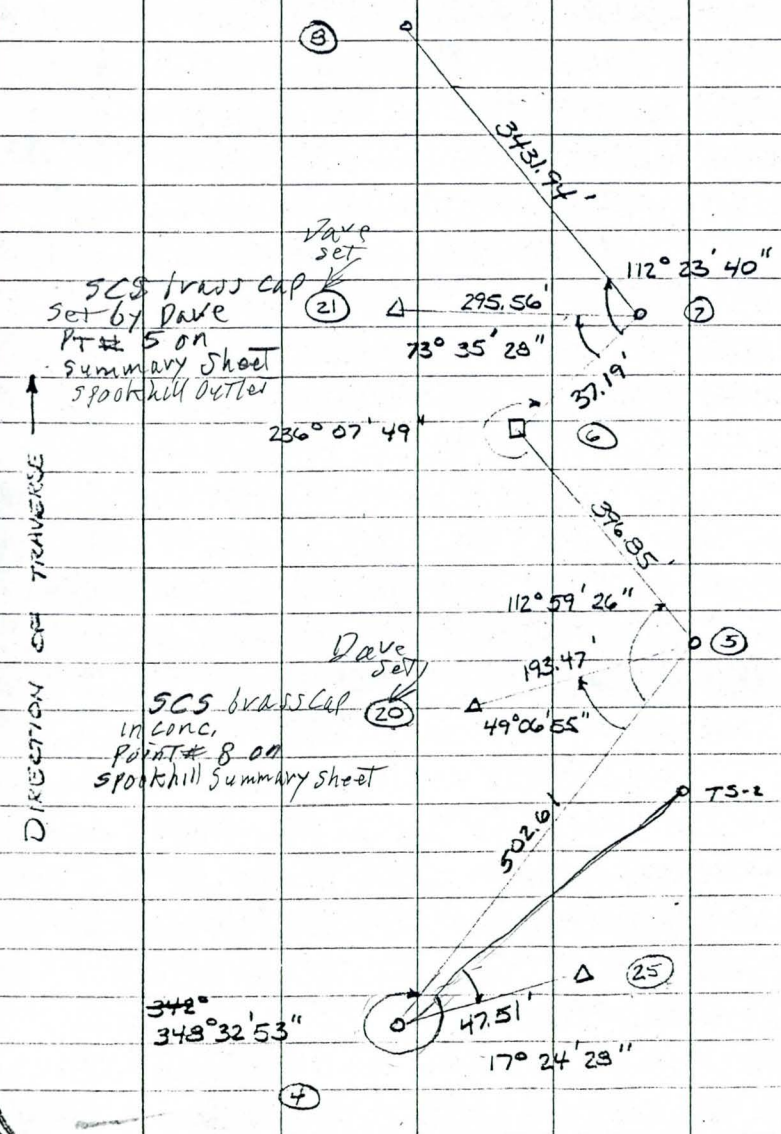
Clear, calm, 55°

Sta.	B.S	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
					Rebar in Conc @ sta 205+00, 75' Lt Fwy ℄
					Rebar in Conc @ sta 208+20, 75' Lt Fwy ℄
					Spindle in ground, TS-1
					Hub & Tack, TS-2
					Aluminum Cap on Rebar, Aerial Marker Reads: WP 80017 SRWW 1987

Circled numbers are filed on data tape: "Design"
File: "BM"



Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.



2/90

TS-4 Spindle in ground = TS-1

Alum Cap on Rebar, Aerial Marker, Roads
{ WPP 80018
SRWW
1987 }

Sec Corner T2N R6E R7E
{ S13 S18
S24 S19 }

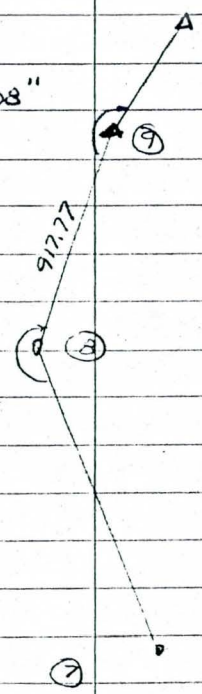
TS-3 H&T

H&T (Backsight)

Brass cap ADOT Top of bridge

Sta.	S.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
					Rebar in Conc @ sta 205+00, 75' Lt Fwy ℄
	185° 48' 08"				Rebar in Conc @ sta 208+20, 75' Lt Fwy ℄ (Closing station)
	222° 31' 12"				TS-4 Spindle in ground, (TS-1)
					Alum. Cap WPP 80018 SRWW 1987 BACKSIGHT

DIRECTION OF TRAVERSE →

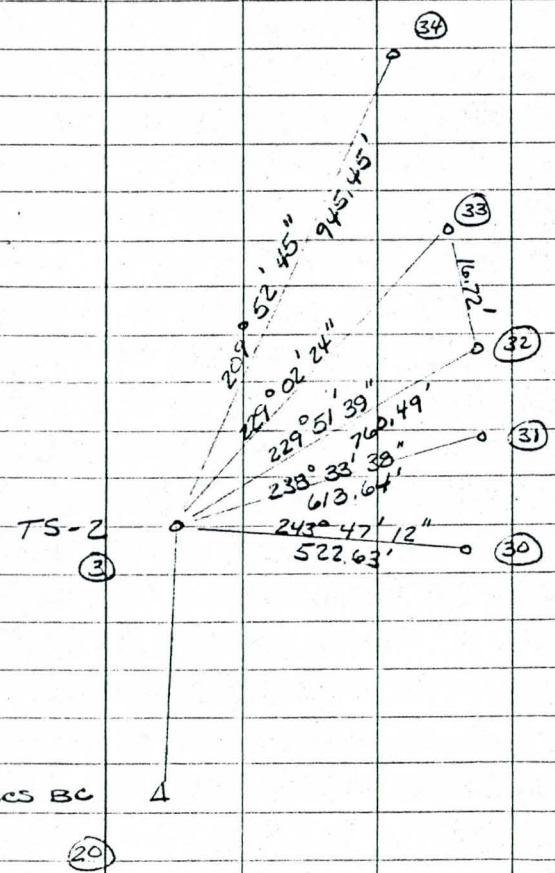


Radial Traverse of
Bill's & Spoon Hill Sediment Basin

D. Clough
B. Covey

Feb 1990

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.



(34) Alum. Cap on rebar, aerial marker, reads: WP 80009, SRWW, 1987. Top of Dike

(33) Rebar in conc, SCS const. BM, Station unknown

(32) Rebar in conc, SCS const. BM, Station unknown
Witness post reads: 14+?? elev = 1321.75

(31) Rebar in conc, SCS const. BM, Station unknown

(30) Rebar in conc, SCS const. BM, 11+61.85
Post reads: elev = 1329.49

LAYOUT OF DIKE @
SPOOKHILL SEDIMENT BASIN

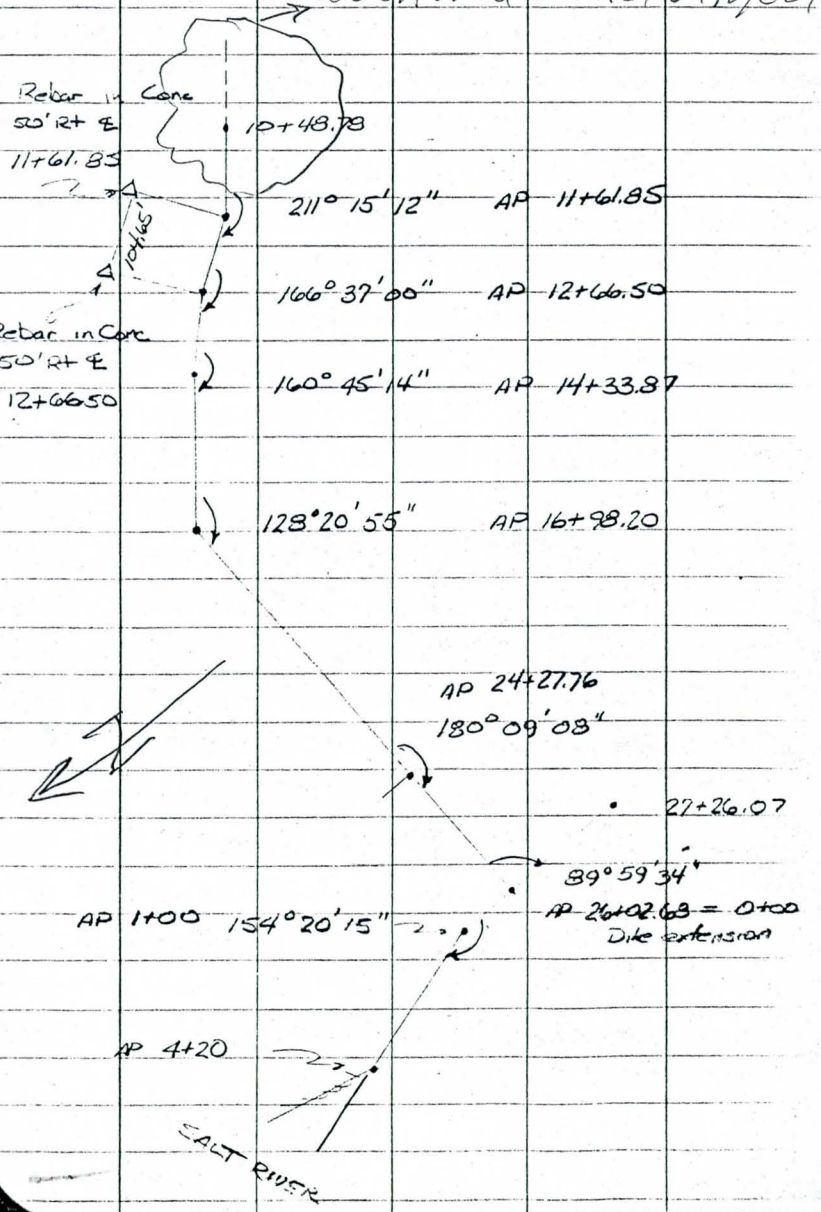
D. Clough III π
B. Covey δ π
G. Mason π

APRIL 17, 1990
clear, calm, 75°

10

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.

additional sketch on page 27



STATIONS & ANGLE TAKEN FROM
Survey notes on Sediment Basin Layout
done 3/77 by SCS

Control for X-Sections
is ℄ Right Dike

SPOOK HILL SEDIMENT BASIN

X- Sections

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
11+61.85 R-BAR IN CONCRETE.	13.22	1342.72	~~13.22~~	1329.50	elev of BK 0.01'
11+00					
11+50					

G. MASON ⊥ π
S. Carey ∞
D. Clough ϕ

APRIL 19, 1990

Clear, breezy, 80°

A ℄ L,

29 29 31 33 34 38 39 39 29 28 27 27 28 29 28
80 44 19 16 1 0 6 23 47 50 57 57 66 73
13 10 8 8 4 3 3 13 14 15 15 14 17 15

34 37 37 36 36 30 28 27 27
127 120 117 108 95 91 84 82 75
8 4 5 7 6 4 6 12 14 14 15 3

34 34 34
200 176 145
8 2 7 9 7 8

28 28 29 36 38
100 52 34 16 3 0
14 3 14 0 13 5 5 9 4 5

27 27 26 26
11 35 39 48
15 0 15 5 16 1 16 2

36 36 35 35 36 36 26 27
103 93 91 80 78 73 60 51
6 0 6 1 7 0 7 1 6 5 6 5 15 8 15 2

34 32 33 33
180 140 125 110
9 4 9 8 9 5 9 5

Cked - TSR 5/90

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		1349.87		
9+97				

44^{5} / 5^{4} / 4

41^{3} / 8^{6} / 80

N. EDGE ROAD.

45^{2} / 4^{7} / 40

46^{2} / 3^{7} / 51

42^{0} / 7^{9} / 57

31^{6} / 18^{3} / 73

31^{8} / 18^{1} / 110

32^{9} / 17^{0} / 113

36^{1} / 13^{8} / 130

38^{2} / 11^{7} / 147

39^{1} / 10^{8} / 174

40^{2} / 9^{7} / 200

Cked 5/10/258

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		1349.07		
9+89				
T.B.M.			3.50	1345.57

45^{3}	46^{5}	43^{5}	44^{5}	41^{8}
4^{6}	3^{4}	6^{4}	5^{4}	8^{1}
56	53	40	42	
		Edge of Road		Road Edge
		44^{4}		
		5^{5}		
		67		

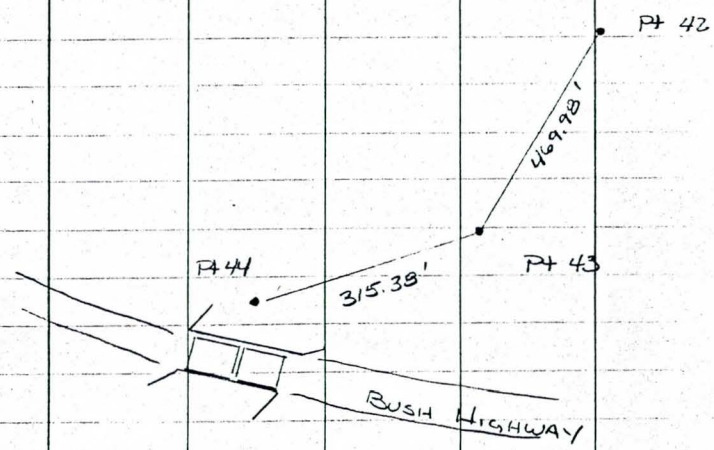
39^{7}	38^{7}	34^{2}	34^{0}	31^{7}
10^{2}	11^{2}	15^{7}	15^{9}	18^{2}
67	75	75	93	98
				BOTTOM GRADE

31^{7}	33^{3}	36^{2}	38^{3}	40^{3}
8^{2}	16^{6}	13^{7}	11^{6}	9^{6}
109	114	137	186	198
			R-R	

2. HWY B.C. ON S. SIDE OF BRIDGE AT PUSH AND SEDIMENT BASIN.

Cked 5/19/89

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.



North ←

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
TBM	10.88	1353.47		1342.59
Pt 44				
-50'				
TP	17.24	1356.84	13.87	1339.60
~~DC~~ -100 PT				

D. Clough ⊼ ⊡
L. Moltor ⊘ ∝
B. Covey ⊘

June 5, 1990

Clear, calm, 105°

33

Aluminum cap, metal marker, WP 80017

42.6	38.9	37.1	37.4	37.9	39.2	40.9	41.7
10.9	14.6	16.4	16.1	15.6	14.3	12.6	11.8
20	19	9	℄	6	11	19	27
WINGWALL							USFS FENCE

48.6	48.1	48.6	42.3	44.6	48.0
4.9	5.4	4.9	11.2	8.9	5.5
45	36	31	45	62	75

E. edge of Bush Hwy.

41.4	41.2	39.7	38.7	39.1	37.9	41.4	46.3	45.9	44.5
12.1	12.3	13.8	14.8	14.4	15.6	12.1	7.2	7.6	8.0
23	19	17	10	℄	14	18	34	47	74
								5r	

50.6	49.9	50.7	43.0	49.8
2.9	3.6	2.8	10.5	3.7
51	45	42	83	19

Spindle ⊘ ℄

5/5/90

34

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
		1356.84		
-100				
TBM			16.56	1340.28
T				

43.5	42.7	41.5	40.4	39.6	39.3	42.7	44.2	49.0	
13.3 ~~13.5~~	14.1	15.3	16.4	17.2 ℄	17.5	14.1	12.6	7.8	
33	21	17	3		10	17	24	32	
625 51.7	52.4	51.8	45.6		50.1	47.0	46.9	45.7	49.9
-3 5.1	4.2	5.0	11.2		6.7	9.8	9.9	11.1	6.9
64 ~~64~~ 57	56	51	39		53	92	106	108	125

℄ SPINDLE

4-19-90

	Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
11+ A-BM CON	12+00					
11						
	BM 11+61.85					
	~~12+66.50~~	~~13.22~~		13.22		
	12+66.50					
						ELEV. OK 1320.00
11	12+66.50 A-BM IN CONCRETE.	11.60	1337.50		1325.90	
	13+00					

L

26.5 / 14.4 / 16.2 / 75
25.1 / 12.7 / 12.6 / 69
25.3 / 13.3 / 12.5 / 60
26.4 / 14.8 / 16.3 / 56
26.5 / 14.4 / 16.2 / 26
26.3 / 14.2 / 12.5 / 17
36.8 / 24.2 / 5.9 / 4 D

32.6 / 20.2 / 10.1 / 81
32.6 / 20.2 / 10.1 / 96
29.3 / 17.4 / 12.4 / 103
29.3 / 17.4 / 13.4 / 125 F
29.3 / 12.0 / 17.5 / 175

R

36.8 / 24.2 / 5.9 / 3
36.1 / 29.7 / 6.6 / 10
28.5 / 16.5 / 14.2 / 21
27.7 / 15.8 / 15.0 / 57 F
28.3 / 16.1 / 14.5 / 86

25.5 / 12.6 / 17.2 / 60
25.3 / 13.4 / 12.4 / 40
24.6 / 12.7 / 18.1 / 18
34.1 / 24.3 / 8.6 / 12
34.8 / 22.1 / 7.9 / 9

35.0 / 23.1 / 7 / 0
34.2 / 22.7 / 8.1 / 4
26.2 / 14.7 / 16.1 / 20
25.7 / 13.7 / 17.1 / 71 F
26.9 / 15.8 / 15.8 / 110

18.1 / 18.6 / 18.2 / 12.7 / 12.3 / 15.2 / 14.8 / 15.4
81 / 83 / 90 / 92 / 111 / 117 / 136 / 180
24.7 / 24.1 / 24.5 / 30.0 / 30.4 / 27.5 / 27.2 F / 27.7

24.0 / 12.5 / 79
24.7 / 12.8 / 78
25.0 / 12.5 / 60
24.5 / 13.0 / 26
32.7 / 4.8 / 13
32.7 / 4.8 / 10
34.2 / 3.3 / 7
34.3 / 3.2 / 0

33.8 / 4.0 / 7
26.0 / 11.5 / 22
24.5 / 13.0 / 56
25.5 / 12.0 / 93 F
24.9 / 12.6 / 150

24.3 / 13.2 / 91
29.5 / 8.1 / 95
29.7 / 7.8 / 108
26.9 / 10.6 / 114
27.2 / 10.3 / 134 F
27.3 / 10.2 / 153

28.1 / 9.4 / 167
26.3 / 11.2 / 185

ecked - RSD 5/90

4-19-90

STA.	BS	H.I.	F.S.		
		1337.5			
13+50			~~11.60~~		
14+33.87 R-BAR IN CONCRETE	13.93	1335.71		1321.78	F.10 O.K. WITH .03' ESD
14+00					
15+00			13.93		

30.1 28.7 7.4 12 | 33.0 31.4 4.5 7 L

33.1 31.3 4.4 0 | 32.5 30.7 5.0 8 | 24.1 22.3 13.4 23 R | 22.9 21.4 14.6 75

30.7 28.9 6.8 15 | 23.9 22.4 13.6 27 | 24.1 22.3 13.4 38 | 23.8 22.0 12.7 60 | 23.7 21.9 13.8 80 | 23.0 21.2 14.5 87 | 23.8 22.0 13.7 95

29.7 27.9 7.8 97 | 29.4 27.6 8.1 108 | 26.1 24.3 11.4 115 | 25.2 23.4 12.3 119 | 26.0 24.2 11.5 134 F | 26.1 24.3 11.4 155 | 25.1 23.3 11.9 185

22.5 21.7 12.2 80 | 23.0 21.2 12.7 77 | 23.2 21.4 12.5 60 | 23.3 21.5 12.4 75 | 30.1 27.9 5.6 13 | 31.6 29.1 4.1 10 | 31.4 29.3 4.3 6 | 31.7 29.6 4.0 0 BEGIN ROCK

31.1 29.0 4.6 6 | 22.7 21.0 13.9 24 | 22.0 20.3 13.7 100

23.1 21.4 7.6 92 | 30.1 28.3 5.4 99 | 30.0 28.2 5.2 112 | 25.6 23.7 10.4 121 | 25.1 23.2 10.6 135 F | 25.0 23.1 10.7 157 | 24.5 22.6 11.2 200

21.7 20.1 8.9 29 | 27.6 25.8 6.7 16 | 26.9 25.2 7.3 13 | 29.3 27.5 6.4 8

29.4 27.6 6.7 0 | 28.8 27.0 6.9 8 | 19.5 17.8 16.2 22 | 19.6 17.8 16.1 91

21.8 20.1 13.9 37 | 22.0 20.3 13.7 60 | 21.8 20.1 7.7 77 | 28.0 26.2 7.7 85 | 28.0 26.2 2.7 103 | 24.2 22.4 11.5 112 | 23.6 21.8 12.1 118 | 24.1 22.3 11.6 129 F | 23.6 21.8 12.1 179

Ckd 5/14/90

STA	BS	HI	F.S.		
WIP8000B ALUM CAP	4.73	1330.77		1326.04	
15+50					
16+00					
16+98.20					

15+50

27.3 27.1 21.0 21.2 20.8 27.8 25.9 28.5 28.4 27.9 19.4 19.8

37 98 96 99 32 49 23 24 27 114 110

125 88 77 60 30 18 13 9 0 7 20 60

23.1 23.5 22.2 21.8 22.4

73 86 89 84

113 149 126 149 155 185

F

16+00

20.6 27.5

32 33

10.2 23

27.3 26.8 19.5 19.2

35 42 11.3 11.6

0 5 20 70

20.8 20.4 26.4 25.8 21.4 22.0 21.6 23.8

10.1 10.4 44 49 94 88 92 79

60 89 97 113 121 135 190 205

F

25.4

19.2 19.8 19.5 28.0 27.0 26.3 26.6 18.6 18.5

54 10.9 11.0 11.3 28 38 46 42 12.2 12.3

130 121 80 30 13 8 0 3 19 50

24.8

21.6 21.2 21.6 21.5 22.8

92 98 92 93 81

150 157 181 178 215 230

161 F

Ckd 5/90 ESJ

4-25-90
CLEAR-WARM 78°

STA.	B.S.	H.I.	F.S.		
		1328.12 ~~1326.04~~			
WP80008 ALUM.CAP	2.08	~~1323.96~~		1326.04	
19+00					
20+00					

L

17.6	17.6									
36.7	36.3	17.6	24.7	23.7	23.2	23.7	19.6	17.9	16.9	16.7
10.5	10.5	10.5	3.4	4.4	4.9	4.4	8.5	10.2	11.2	11.4
90	56	26	13	1	0	6	13	21	52	85

17.7	21.0	21.1	21.2	21.2	22.6
10.4	7.1	7.0	6.9	6.9	5.5
103	126	150	159	189	196

F

23.4
1.1
250

16.7	23.2
.7	4.9
25	11

R

23.1	22.9	17.3	16.8	17.1
5.0	5.2	10.8	11.3	11.0
0	15	25	43	58

16.2	16.2	17.3	23.1	23.7
11.9	11.9	10.8	5.0	4.4
64	90	121	140	150

23.5	22.4	21.9	23.5	24.5
4.6	5.7	5.2	4.6	3.6
160	163	190	195	250

cked 5/90 ~~652~~

4-25-90
CLEAR-WARM 78°

STA.	B.S.	H.I.	F.S.		
		1328.12 ~~1326.04~~			
WP80008 ALUM. CAP	2.08	~~1323.96~~		1326.04	
19+00					
20+00					

L

17^{6} 17^{6}
36^{7} 36^{3}
10^{5} 10^{5}
90 56

17^{6} 24^{7}
10^{5} 7^{4}
26 13

23^{7} 23^{2}
4^{4} 4^{9}
1 0

23^{7} 19^{6}
4^{4} 8^{5}
6 13

17^{9} 16^{9}
10^{2} 11^{2}
21 52

16^{7}
11^{4}
85

R

17^{7} 21^{0} 21^{1} 21^{2} 21^{2} 22^{6}
10^{4} 7^{1} 7^{0} 6^{9} 6^{9} 5^{5}
103 126 150 159 189 196

F

23^{4}
7^{1}
250

16^{7} 23^{2}
7 4^{9}
25 11

23^{1} 22^{9} 17^{3} 16^{8} 17^{1}
5^{0} 5^{2} 10^{8} 11^{3} 11^{0}
0 15 25 43 58

16^{2} 16^{2} 17^{3} 23^{1} 23^{7}
11^{9} 11^{9} 10^{8} 5^{0} 4^{9}
64 90 121 140 150

23^{5} 22^{4} 21^{7} 23^{5} 24^{5}
4^{6} 5^{7} 5^{2} 4^{6} 3^{6}
160 163 190 195 250

ckd 5/90 ~~652~~

4-19-90

STA	B.S.	H.I.	F.S.		
		1330.77			
18+00			4.73		

L

19.0	18.6	18.2	26.0	
11.8	12.2	12.1	4.8	
108	70	23	10	

R

25.0	25.3	19.4	17.1	
5.8	5.6	11.7	13.7	
0	17	28	50	

22.8	22.4	20.8	20.6	21.3	22.9	23.0	
5.0	8.4	10.0	10.2	9.5	7.9	7.8	
107	128	195	161	191	198	216	
116			F				

Chkd 5/90 ESJ

STA.	B.S.	H.I.	F.S.	
TBW	5.13	1326.74	~~5.13~~	1321.61
23+00				

D. Clough ∅
B. Covey ∞
G. Macon ⊤ ⊠

APRIL 26, 1990

Clear, calm, 80°

2" Hub top of left bank, sta. 23+85±
Elev = 1321.61, p. 18

L

13.8	13.9	14.4	15.7	15.9	22.2	21.7	22.0	15.9	16.5	16.7
12.9	12.8	12.3	11.0	10.8	4.5	5.0	4.7	10.8	10.2	10.0
70	38	28	23	21	11	℄	9	22	59	100

14.1	21.7	22.3	20.6 ~~26.~~	21.2	19.8
12.6	5.0	4.4	6.1	5.5	6.9
109	134	~~165~~ 155	159 F	185	192

21.2	21.9
5.5	4.8
198	220

Cked 5/90 CSJ

STA.	B.S.	H.I.	F.S.	
21+00				
22+00				
TBM	5.64		6.51	1321.61
BM	1		1.23	

4-25-90

18

L R

$\frac{15^2}{12^9}$ 105 | $\frac{14^9}{13^2}$ 90 | $\frac{15^4}{12^7}$ 41 | $\frac{15^5}{12^6}$ 26 | $\frac{21^5}{6^6}$ 12 | $\frac{21^9}{6^2}$ 0 | $\frac{21^8}{6^3}$ 5 | $\frac{16^1}{12^0}$ 17 | $\frac{16^7}{11^4}$ 52

$\frac{16^1}{12^0}$ 109 | $\frac{20^9}{7^2}$ 123 | $\frac{23^0}{5^1}$ 134 | $\frac{22^9}{5^2}$ 158 | $\frac{21^7}{6^4}$ 157 | 160 F

$\frac{21^7}{6^4}$ 162 | $\frac{21^9}{6^2}$ 186 | $\frac{22^8}{5^3}$ 250

$\frac{15^9}{12^2}$ 20 | $\frac{19^8}{8^3}$ 12^2 12 | $\frac{20.0}{8^1}$ 8 | $\frac{21^6}{6^5}$ 8^1 5 | 0 | $\frac{22^0}{6^1}$ 8 | $\frac{15^7}{12^4}$ 19 | $\frac{16^2}{11^9}$ 51

$\frac{15^9}{12^2}$ 23 | $\frac{14^5}{13^6}$ 27 | $\frac{14^5}{13^6}$ 66 | $\frac{14^5}{13^6}$ 100 | $\frac{19^3}{8^8}$ 118

$\frac{23^0}{7}$ 133 | $\frac{23^3}{4^8}$ 159 F | $\frac{21^9}{6^2}$ 162 | $\frac{21^5}{6^6}$ 184 | $\frac{22^0}{6^1}$ 250

2" Hub in ground, top edge of left bank, sta. 23+85 ±
Close @ Alum Cap

Cked 5/90 [illegible]

APRIL 26 90

STA.	B.S.	H.I.	F.S.	
T.B.M.	5.10	1326.71		1321.61
23+77.76	TOP RIGHT SHOLDER OF WEIR			

2" HUB TOP OF LEFT BANK, STA. 23+85±
ELEV. 1321.61 p.18

L					R					
21.7					22.1	21.8	14.8	13.9	14.5	17.0
5.0					4.6	4.9	11.9	12.8	12.2	9.7
10					4	45	62	82	91	100
15.5	14.7	13.5	14.0	15.1						
11.2	12.0	13.2	12.7	11.6						
23	33	63	90	105						
21.0	21.3	19.6	20.5	21.0						
5.7	5.4	7.1	6.2	5.7						
128	158	167	179	200						
	F									

ctd 5/90 EJS

4-26-90

STA.	B.S.	H.I.	F.S.	
		1326.71	~~5.10~~	
24+40	RIGHT	TOE OF	WEIR	
	4.74	1326.35		1321.61
25+08	CENTER	OF	WEIR.	

L

14.6 14.0 13.4 13.8 16.3 17.2

12¹ 12⁷ 13³ 12⁸ 10⁴ 9⁵

94 90 67 45 21 9

15.5 20.9 21.2 20.0 20.7 20.6

11² 5⁸ 5⁵ 6⁷ 6⁰ 6¹

107 177 158 166 174 200

Fence

17.1 15.4 16.4

12³ 11⁰ 10⁰

31 19 9

13.9 14.2 15.4 15.7

12⁵ 12² 11⁰ 10⁷

60 79 86 104

19.8 20.2 22.2 21.0 21.3

6⁶ 6² 4² 5⁴ 5¹

177 158 159 176 200

F=?

fence

R

17.5 17.9 17.4 16.0 14.2 14.1

9² 8⁸ 9³ 10⁷ 12⁵ 12⁶

℄ 12 36 52 68 100

17.8 16.8 16.4 14.3 14.2

8⁶ 9⁶ 10⁰ 12¹ 12²

℄ 14 31 44 81 100

ckd 5/90 CSB

4-26-90

22

STA	B.S.	H.I.	F.S.
		1324.35	
25+86	LEFT TOE OF WEIR. ALL SHOTS EX. ℄ 22'L FALL ON ~~SHOLDER~~ TOE OF EXTITION DIKE.		
26+07.68	RIGHT side is the West Side of DIKE		
26+28			
26+88			
~~27+29.5~~	27+26.07		

	L						R	
	22.3	21.8	17.4	16.4	16.9	17.5		17.9
	4 1	4 6	9 0	10 0	9 5	8 9		8 6
	158	102	87	27	22	℄		100
F								
	23.0							
	3 4							
	200							

	17.5	21.3	21.5	21.4	16.7
	8 9	5 1	4 9	5 0	9 7
	17	6	℄	8	29

	15.1	16.4	18.5	21.2	21.4	21.4	17.0
	11 5	10 0	7 9	5 2	5 0	5 0	9 4
	34	19	9	3	℄	10	30

	17.9	15.9	21.3	22.0	22.2	21.9	18.2
	11 5	10 5	5 1	4 4	4 2	4 5	8 2
	35	22	6	℄	3	11	22

	20.2	22.2	22.3	19.5	18.6
	6 2	4 2	4 1	6 9	7 8
	42	℄	9	23	32

Ckd 5/90

4-26-90

STA	B.S.	H.I.	F.S.		L	R
		1326.35				
0+50	DYKE	EXTITION.			16.1 21.5 21.6 21.5 16.0 10³/31 4⁹/8 4⁸/℄ 4⁹/7 10⁴/17 —	
		RIGHT SIDE OF Dike is the EAST Side				
AP 1+00					15.8 17.5 21.5 21.9 22.0 15.6 14.2 14.0 15.7 18.2 10⁶/50 8⁹/24 4⁹/10 4⁵/℄ 4⁴/3 10⁸/23 12²/80 12⁴/137 10⁷/146 8²/152	
1+40					15.4 18.3 21.7 21.8 21.6 19.2 17.0 15.8 15.9 15.7 18.8 11⁰/46 8¹/18 4⁷/5 4⁶/℄ 4⁸/5 7²/12 9⁴/22 10⁶/38 16⁵/83 10⁷/161 7⁶/171	
1+50					15.4 18.6 21.5 21.8 21.5 17.0 15.4 15.9 22.4 11⁰/47 7⁸/16 4⁹/6 4⁶/℄ 4⁹/6 9⁴/18 11⁰/44 10⁵/59 4⁰/74	
TBM	4.11		4.50	1321.85	COTTON SPINDLE AT STA 1+00 DYKE EXTITION	
			4.35	1321.65	5" HUB TOP OF LEFT BANK, STA. 23+85± ELEV. 1321.61 P.18	

Cked 5/90 CSB

STA.	B.S.	HI	F.S.	
T.B.M.		1326.50	~~4.65~~	1321.85
	4.65			
2+00				
TOP OF 8" P.V.C. AT ELBOW +60' TO TOP OF 8" P.V.C. AT BRUSH LINE				
TBM	4.61	1326.46	~~4.61~~	1321.85
3+00				
3+65				

L R

COTTON SPINDLE AT STA. 1+00 DYKE EXTENSION

15.3 16.4 18.3 21.4 21.6 21.7 17.3 15.9 16.7 20.5
~~15.2~~ ~~16.3~~ ~~18.2~~ ~~21.3~~ ~~21.5~~ ~~21.6~~ ~~17.2~~ ~~15.8~~ ~~16.6~~ ~~20.4~~

11' 10' 8' 5' 4' 4' 9' 10' 9' 6'
38 31 15 5 ℄ 4 16 35 66 77

~~22.5~~ 22.4
3' ~~20.3~~ 20.4
6'
+60

COTTON SPINDLE AT STA. 1+00 DYKE EXTENSION

15.3 18.0 21.5 21.7 21.4 17.3 16.8 17.5 22.4 13.4 20.0
11' 8' 5' 4' 5' 9' 9' 9' 4' 3' 6'
35 16 6 ℄ 6 19 39 53 61 66 75

15.0 17.6 21.8 22.0 21.8 19.0 17.9 18.0 23.1
11' 8' 4' 4' 4' 7' 8' 8' 3'
42 23 7 ℄ 5 12 23 30 40

Road Rand to Top of Dike from Gravel ~~yard~~ yard } @ STA 3+65

Cked 5/90 RSJ

4-26-90

STA	B.S.	H.I.	F.S.	
4+00 TBM	2.73 ~~2.84~~		2.34 ~~2.73~~	1323.62
			4.50	1321.85
T.B.M.	S-W EDGE OF CONCRETE BLOCK HEAD WALL ON RIGHT SIDE OF DIKE STA. 4+30 ±			
TBM	4.63	1328.25 ~~1326.18~~	~~4.63~~	1323.62
4+50				
~~T.B.M.~~			~~4.6~~	

	L						R			
	21.8	22.6	20.9	22.1	22.0	22.0	19.5	18.5	22.4	19.4
	4.7	3.9	5.6	4.4	4.5	4.5	7.0	8.0	4.1	7.1
	48	30	14	6	4	6	15	37	55	63

Close @ Spindle @ 1+00 Dike Ex.

?

S.W. edge of concrete block headwall on right side of dike @ sta ≐ 4+30

~~elev = 1321.85, p. 23~~

	L						R			
	24.1	20.6	10.9	20.3	24.2	23.9	22.0	19.1	18.8	13.8	19.2
	~~22.4~~	~~18.9~~ 4.8,	~~17.5~~	~~18.4~~	~~21.4~~	~~21~~	~~20.3~~	~~21~~	~~17.1~~	~~12.1~~	~~17.5~~
	4.1	7.6	9.2	7.9	4.0	4.3	6.2	9.1	9.4	14.7	9.0
	39	33	24	14	16	℄	23	42	65	64	74

OLD DRAINAGE DITCH 12' WIDE

RIVER BANK

ckd 5/10 TSD

D. Clough
B. Covey
G. Mason

April 27, 1990

Clear, calm, 30°

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.	
					℄ D.S. Headwall
9+81			107'		x-Section
9+91					x-Section
10+18.3	113°				
10+48.73	180°				
11+00			N		

STA	B.S.	H.I.	F.S.	
Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Plumb Bob
		~~326.73~~		
4+80		1328.25		
5+05				
5+08				
T.B.M.			4.63	~~1321.35~~

25.4 20.2 19.7 25.3 23.8 23.3 22.1 20.8 16.9 12.9

~~3.7~~ ~~18.5~~ ~~19.0~~ ~~23.6~~ ~~22.1~~ ~~21.6~~ ~~20.1~~ ~~19.1~~ ~~15.2~~ ~~11.2~~

8.9 8.5 2.9 4.4 4.9 6.1 7.4 11.3 15.3

100 85 64 54 46 16 ℄ 23 39 44

OLD DRAINAGE DITCH 12' WIDE

RIVER BANK

18.0

~~10.5~~

10.2

℄

RIVER BANK

~~10.1~~ 12.1

16'

℄

EDGE OF WATER

S.W. EDGE OF CONCRETE BLOCK HEADWALL STA. 7+30± RIGHT SIDE OF DYKE.

ckd 5/90 TSD

4/27/90

Sta.	B.S.	H.I.	F.S. or Grade Rod	Elev. or Planned Elev.
BM	3.50	1349.87		1346.37
10+52 ~~10+40~~				

L R

Nz Hwy Int SE. on U.S. edge of bridge @ Both Hwy in the southwest basin

30^{2}	30^{0}	38^{3}	40^{5}	41^{4}	40^{6}	40^{1}	35^{9}	34^{4}
19^{7}	19^{9}	11^{6}	9^{4}	8^{5}	9^{3}	9^{8}	14^{9}	15^{5}
49	41	20	15	10	6	11	21	~~50~~ 45
		END ROCK		BEGIN ROCK				

29^{0}	28^{3}	28^{2}	29^{0}	30^{2}	28^{9}
20^{9}	21^{6}	21^{7}	20^{9}	19^{7}	21^{0}
58	58	62	62	84	89

29^{1}	37^{8}	38^{2}	38^{3}	36^{3}
68^{8}	12^{1}	11^{7}	11^{6}	13^{6}
97	113	120	134	139

37^{4}	37^{1}	36^{8}	36^{9}
116^{5}	12^{9}	13^{1}	13^{0}
154	164	180	200
	F		

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

STATE AZ		PROJECT Spookhill Outlet Sediment Basin		
BY TJJ	DATE	CHECKED BY	DATE	JOB NO.
SUBJECT Check on Control Monu. 1977 EL. VS- 1990 Survey				SHEET ____ OF ____

9/77 survey ↓

Forward Monu.

29.485 11+61.85 - 1329.50 cks with 0.01' of whats on POST - Monu. elev = 1329.49

25.880 12+66.5 - 1325.90 - Monument elev - 1325.88 within 0.02' ok
Back monu.

22.747 14+33.87 - 1321.78 - Back rebar - Mon elev = 1321.75

WP90008 - 1326.04 - ?
Alum Cap

A~~RO~~ Highway 1346.37 - ?
BC. on Bridge

Need To call FCDMC - To get copy of contract work done To sediment basin as result of 1980 Flood damage) I called Bob Payette on 5/29/90 & he said Paul would get back To me.

• Flood Control Dist. Review (Checker) should sign on "Checked By:" and add the "Date", Prior to sending this Job to SCS for final approval.

APACHE JUNCTION GILBERT WATERSHED
WATERSHED PROTECTION AND FLOOD PREVENTION PROJECT
MARICOPA COUNTY ARIZONA

SPOOKHILL OUTLET DESIGN

REVISED: 6-17-92

REVISED: SEPTEMBER 1992

REVISED: DECEMBER 1992

Page 18

PRIOR TO FINALIZATION:

1) • New Date! ? (Robb) — Need Page No. on Ind.

2) • Need Page No. for Index. (Robb)

3) • Page 18; should be reviewed by structur people. (Kumar)

4) Appendix "C" needs to be revised and replaced by Kumar

5) Kumar needs to provide calculations, ~~and~~ documentations, and drawings for the Retaining walls at the End of Channel and spillway.

6) Kumar needs to review the spec. to see that it meets The structural criteria + Requirements.

7) Kumar needs to make a decision, either he wants to paint the channel retaining wall or he does not want to, If he needs the paint, we should mention that in Spec.

8) When the plans are finalized, Reviewer or Kumar should Finalize the cost estimate accordingly.

26. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 5, Concrete

(1) This item consists of furnishing, forming and placing all concrete to construct the outlet channel and headwalls as shown on the drawings.

(2) In Section 2, MATERIALS, the materials shall be as follows:

(a) Portland Cement shall be Type II or IIA.

(b) The joint sealing compound shall be Type S. Grade NS, use T or NT, low modules silicone conforming to the requirements of ASTM C 920 and shall tolerate submergence by intermittent flood flows. The sealant shall have the capability to withstand without failure an increase of 50 percent and decrease of 50 percent of the joint width as measured at the time of application when tested in accordance with ASTM C 719. The elongation shall be a minimum of 800 percent without failure when tested in accordance with ASTM D 412, and 500 percent without adhesion failure when tested in accordance with ASTM D 3583 (modified).

The sealant material shall show no evidence of failure from accelerated weathering per ASTM C 793 after 5000 hours.

not shown on drawing!

(c) Backer rod shall be closed cell, non-gassing, expanded polyethylene polyurethane or polyvinyl chloride polypropylene flexible foam compatible with the sealant. The rod shall be sized to fit tightly, installed in accordance with the manufacturer's recommendations, and as shown on the drawing.

(3) Section 3, CLASSES OF CONCRETE, Method 1 shall apply and the concrete shall be Class 4000.

(4) Coarse aggregate shall be size No. 57 in accordance with ASTM C 33.

(5) In Section 18, REMOVAL OF FORMS, Method 1 shall apply.

(6) Pozzolan shall be used as a partial substitute for portland cement.

(7) In Section 15, CONSTRUCTION JOINTS, Method 1 shall apply.

? (8) Sealant installation and cleaning shall be in accordance with Construction Specification 400, Section 3, JOINT SEALANT FOR CONCRETE LINED FLOODWAYS.

out ~~(9)~~ All plant roots will be removed from joints and a soil sterilant equal or equivalent to Pramitol shall be applied per manufacturers recommendation.

(10) In Section 25, MEASUREMENT AND PAYMENT, payment will include compensation for Subsidiary Items: Water; Removal of Water; Channel Excavation; ~~Borrow Excavation,~~ Common; Earthfill; and Surveys.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____

8388

3+93

Sta.	Invert Elev.	Channel Wall			
		Depth	Elev.		
650	26.50	6'-0"	32.50		
660	26.30	7'-2"	33.47		
850	22.59	7'-2"	29.76		
860	22.39	8'-4"	30.72		
1050	18.67	8'-4"	27.00		
1060	18.48	9'-6"	27.98		
1237.61	15.00	9'-6"	24.50		
1257.61	15.00	9'-0"	24.00		

3+93 ~~36.49~~ 34.69

BY SCS Tom Joyce DATE: 11-30-92
Time: 2:50 PM

- Max. Wet. W 130 - 140 lb/CF
  95% Compaction 123 - 133

- Dry W 126 - 129

- Optimum Moisture 10 - 12.5%

6. STRUCTURAL DESIGN

?

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi. Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

?

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

All walls shall have construction joints spaced at intervals of 30 feet minimum and 50 feet maximum. Expansion joints shall be provided at intervals not exceeding 90'-0 and as per details shown on drawings. Appendix C provides design calculations for retaining walls.

You have no details provided for this in Plans.

7. O&M ROAD DESIGN

The O&M road will be built on both sides of the channel. To protect the O&M road from future erosion, the project consists of protecting the maintenance road from erosion by applying a gravel cover. Gravel road surfacing will be compacted to approximately 4 inches thick. The gradation for the gravel road surfacing was based on the Maricopa Association of Governments (MAG) specification for aggregated base.

8. ENVIRONMENTAL CONSIDERATIONS

The gravel road surfacing on the maintenance roads will reduce dust produced by vehicles. The gravel road surfacing will have a positive impact on the visual aspects of the channel.

Water will be used to abate dust generated by construction. No negative impact on the conservation of biological or water resources is anticipated by construction of the proposed channel and sediment basin.

STRUCTURAL DESIGN:

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi.Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT _____ PAGE ___ OF ___

DETAIL _____ COMPUTED _____ DATE _____

_____ CHECKED BY _____ DATE _____

STA		Channel Invert	Channel Wall Elev.		Depth of the Wall			
319		CULVERT	Inside	Outside	Inside	Outside		
400		34.49	40.49	40.49	6'-0"	6'-00"	6'	Type ① L = 322'
650	3.96%	26.50	32.50	32.50	6'-0"	6'-00"		
722.33 PC		25.08	31.25	31.25	6'-2"	6'-2"		
850		22.59	28.83	29.33	6'-3"	6'-8.88"	7'-3	
979.98 PI	1.95%	20.04	26.29	27.29	6'-3"	7'-3"		Type ② L = 378'
1096.94		17.75	24.00	24.55	6'-3"	6'-9.6"		
1100		17.69	24.00	24.44	6'-3.72"	6'-9"		
1118.98		17.32	24.00	24.00	6'-8.16"	6'-8.16"	9'	Type (3) L = 137'
1237.60		15.00	24.00	24.00	9'-0"	9'-00		

121, Fig 1.7

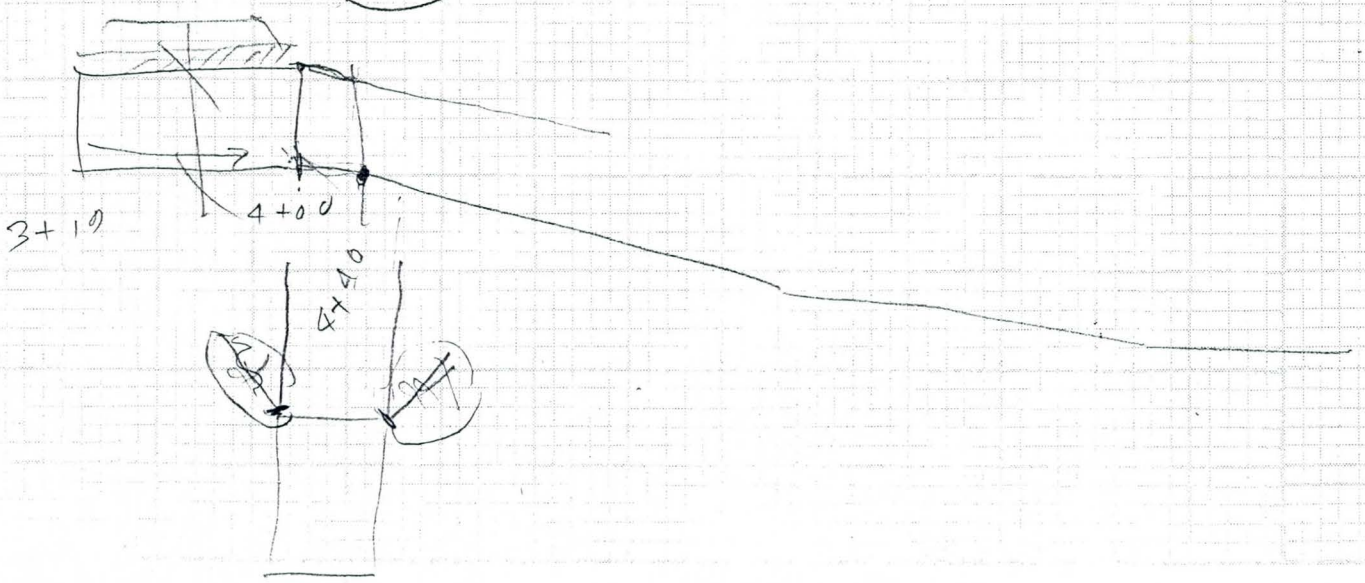
650
400
250

1100
650
450

1237
1100
137

650
400
250

1100
850
250



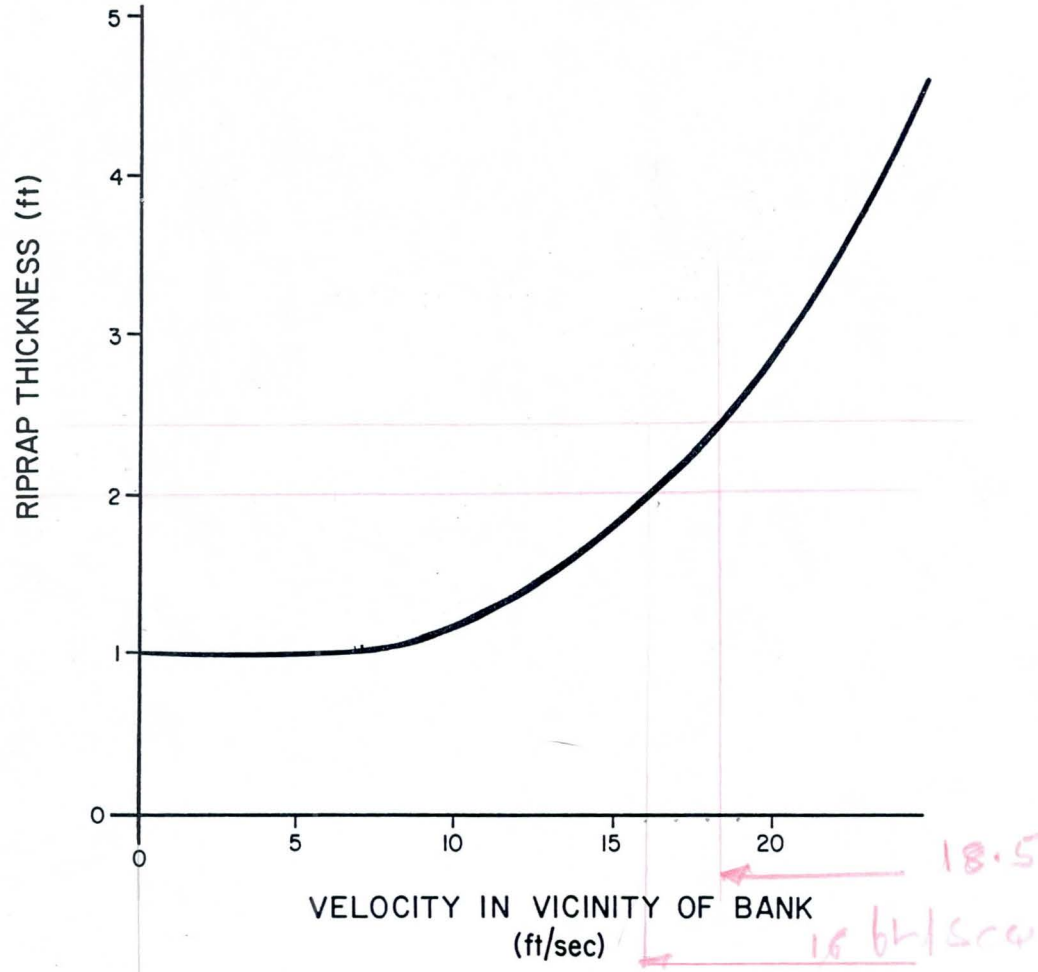


Figure 57. Required blanket thickness as a function of flow velocity.

Rock Grading: Table 6 provides guidelines for rock gradation in grouted riprap installations. Six size classes are listed.

Rock Quality: Rock used in grouted rock slope-protection is usually the same as that used in ordinary rock slope-protection. However, the specifications for specific gravity and hardness may be lowered if necessary as the rocks are protected by the surrounding grout.

In addition, the rock used in grouted riprap installations should be free of fines in order that penetration of grout may be achieved.

Grout Quality and Characteristics: Grout should consist of good strength concrete using a maximum aggregate size of 3/4 in and a slump of 3 to 4 in (7.6 to 10.2 cm). Sand mixes may be used where roughness of the grout surface is unnecessary, provided sufficient cement is added to give good strength and workability.

The volume of grout required will be that necessary to provide penetration to the depths shown in table 6.

The finished grout should leave face stones exposed for one-fourth to one-third their depth and the surface of the grout should expose a matrix of coarse aggregate.

SPKHL2F.OUT

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*-----------------------------------*
          S U M P O                ñ
                                   ñ
ñ   Interactive Summary Printout   ñ
ñ   for MS/PC-DOS micro computers  ñ
ñ            May 1991              ñ
*-----------------------------------*
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NOTE - Asterisk (*) at left of profile number indicates message in summary of errors list

8-10-92

Summary Printout

	SECNO	Q	CWSEL	CRIWS	EG	VCH	DEPTH	AREA	TOPWID	XLCH	ELMIN	10K*S
*	319.00	2653.00	41.97	41.97	44.56	12.92	5.17	205.33	40.00	.00	36.80	47.92
*	400.00	2653.00	38.13	39.66	43.39	18.40	3.64	144.15	40.00	81.00	34.49	498.55
	500.00	2653.00	35.14	36.43	39.74	17.22	3.85	154.10	40.00	100.00	31.29	252.94
	650.00	2653.00	30.08	31.63	35.42	18.55	3.58	143.04	40.00	150.00	26.50	319.24
	722.33	2653.00	29.21	30.22	33.20	16.02	4.13	165.56	40.00	72.33	25.08	202.36
	850.00	2653.00	26.80	27.72	30.64	15.73	4.22	168.67	40.00	127.67	22.58	190.99
	979.98	2653.00	24.22	25.17	28.13	15.85	4.18	167.36	40.00	129.98	20.04	195.67
	100.00	2653.00	21.87	22.82	25.77	15.86	4.18	167.25	40.00	120.02	17.69	196.09
	1237.60	2653.00	19.19	20.13	23.08	15.83	4.19	167.62	40.00	137.62	15.00	194.74

SUMMARY TABLE

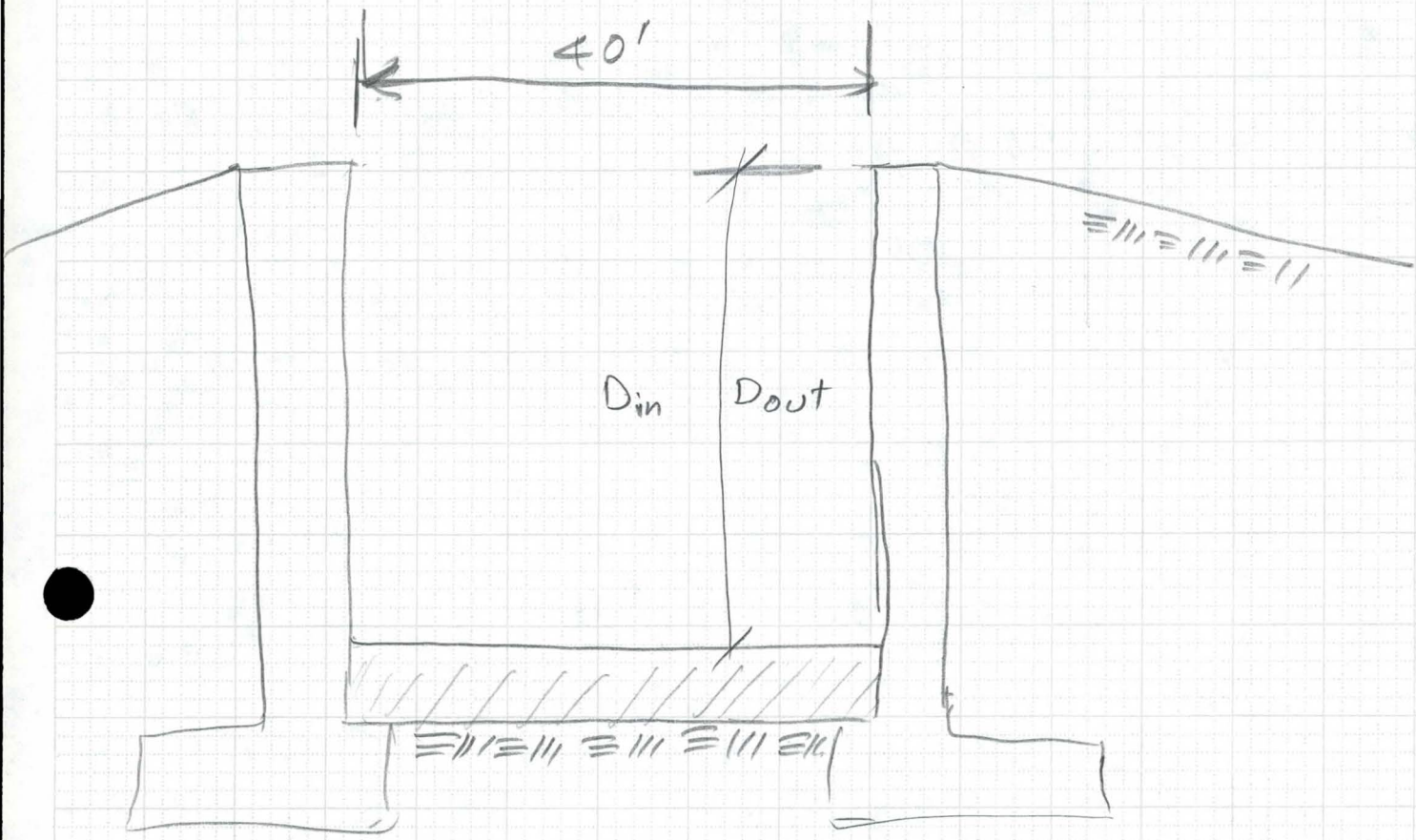
	STA	Water DEPTH	FB	SUPER ELEVATION	Min. CHANNEL DEPTH	USE Channel depi in	OUTside
	319	5.17	1.94	Φ	7.11		
	400	3.64	2.22	Φ	5.86	6'-0"	
	500	3.85	2.11	Φ	5.96	6'-0"	
	650	3.58	2.23	Φ	5.81	6'-0"	
PC	722.33	4.13	2.03	Φ	6.16	6'-2"	6'-2"
	850	4.22	2.02	0.5	6.74	6'-3"	6'-9"
PI	979.98	4.18	2.02	1.00	7.20	6'-3"	7'-3"
	1100	4.18	2.02	0.53	6.73	6'-3"	6'-9"
PT	1237.60	4.19	2.02	Φ	6.21	6'-3"	6'-3"

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

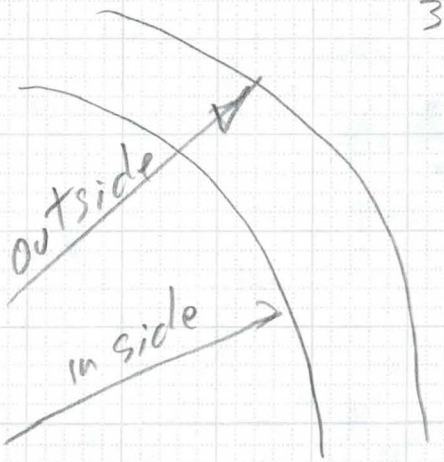
PROJECT _____ PAGE ____ OF ____

DETAIL _____ COMPUTED _____ DATE ____

_____ CHECKED BY _____ DATE ____



Sta.	D	
319	6'	
	6'-2"	6-2"
	6'-3"	6-9"
	6-3	7-3"



STRUCTURAL DESIGN:

Channel walls are basically designed as cantilever retaining walls of varying heights, with grouted riprap section between the channel walls. AASHTO standard specifications for highway bridges with applicable live loads is used for design.

Concrete used is Class AA, compressive strength 4000 psi.Reinforcing steel shall conform to ASTM specifications A615 Grade 60.

Existing wing walls, footings, apron and cutoff walls to be removed before the new channel construction. Dowels from existing box to remain in place and to be doweled into the new wing wall.

United States Department of Agriculture
Soil Conservation Service
P.O. Box 2890
Washington, D.C.
20013

December 30, 1980

NATIONAL ENGINEERING HANDBOOK NOTICE 6-4

This handbook notice updates the working stress design method of reinforced concrete design contained in National Engineering Handbook Section 6, "Structural Design."

The revision sets the ACI Code (318-77), Appendix B - Alternate Design Method as the basic reference. The revision includes items concerning increasing the thickness computation limit for temperature and shrinkage steel to 32 inches, establishes development lengths and splice lengths based on the design yield strength, defines lap splice length classes, maintains flexural bond stress requirements, and provides flexural crack control requirements.

The following sheets should be removed from current copies of NEH-6:

1. Table of Contents and List of Standard Drawings, dated 9-64
2. Nomenclature - Section 6, three pages
3. Pages 6.4-1 through 6.4-4
4. ES-160, three sheets

and the enclosed material should be inserted. This material consists of:

1. Revised Table of Contents and List of Standard Drawings
2. Revised Nomenclature - Section 6, four pages
3. Revised pages 6.4-1 through 6.4-4
4. Revised ES-160, three sheets
5. ES-227, sheet 3 of 3.

NEIL F. BOGNER
Director of Engineering

Enclosure

DIST: NEH 6-4

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Drawing Sizes and Title Blocks - - - - - - - - - - - - -	ES-16	6.4-10
Fixed Ended Beam Moments for Concentrated Load, Uniformly Distributed Load, and Hydrostatic Load on Prismatic Beams - - - - - - - - - - - - - - -	ES-17	6.3-2
Reinforced Concrete - Typical Bar Types - - - - - - - -	ES-18	6.4-10
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Revised 12-80

A = effective tension area of concrete per bar;
= area;
= coefficient.

A_b = area of individual reinforcing bar.

a = height of vertical slab fixed on three edges;
= distance from end of beam to concentrated load;
= ratio of distance from end of beam to start of partial uniform load to total beam span.

b = width of compression face of member;
= breadth or width of vertical slab fixed on three edges.

b_c = breadth of conduit.

b_d = breadth or width of ditch or trench at top of conduit.

C = coefficient $[k(1 - k)] \div 2$ (see ES-1);
= ratio of load intensities, $q_2 \div q_1$, (see ES-3);
= ratio of stiffnesses, $K_s \div K_w$, (see ES-28 and ES-29).

C_c = coefficient (see page 6.2-22 and ES-22).

C_d = coefficient (see page 6.2-18 and ES-15).

D = nominal diameter of bar
= $k(1 - k^2)$ (see ES-3).

d = effective depth of section;
= distance between two concentrated loads (see ES-25).

d_b = nominal diameter of bar.

d_c = thickness of concrete cover to center of bar closest to extreme fiber.

E = $3 \div (1 + k)$ (see ES-3).

e = 2.7183 = base of Naperian logarithms;
= eccentricity;
= moment arm.

f_c = compressive stress in concrete.

f'_c = compressive strength of concrete.

f_s = stress in reinforcement.

f'_s = stress in compressive flexural reinforcement.

f_t = tensile stress in plain concrete.

f_y = yield strength of reinforcement.

H = height of wall;

= vertical distance from top of fill to top of conduit;

= vertical distance between center lines of top and bottom of conduit (see ES-28 and ES-29);

= horizontal component of force.

H_c = vertical distance from top of fill to top of conduit.

H_e = height of equal settlement.

h = vertical dimension or distance (see ES-4);

= vertical inside dimension of conduit (see ES-28 and ES-29).

i = angle of surcharge between fill slope and horizontal.

j = ratio used in reinforced concrete relations.

K = ratio of active lateral pressure to vertical pressure;

= a shape factor coefficient for wind loads.

K_s = stiffness of slab (see ES-28 and ES-29).

K_w = stiffness of wall (see ES-28 and ES-29).

k = radius of gyration;

= ratio of distance from end of beam to a point on the beam to total span length.

L = distance between center lines of vertical walls of rectangular conduit (see ES-28 and ES-29).

ℓ = horizontal inside dimension of conduit (see ES-28 and ES-29);

= length of beam.

ℓ_d = development length.

M = moment.

M_{ab} = moment at end "a" of member "ab."

M^F_{ab} = fixed end moment at end "a" of member "ab."

M^S_c = simple beam moment at point "c."

$M_{k\ell}$ = moment at distance $k\ell$ from end of beam.

M_x = $M_{k\ell}$ where $x = k\ell$.

m = (see ES-29).

N = direct force.

n = modular ratio of steel to concrete;

= (see ES-29).

P = resultant active force per foot of wall (see page 6.2-4);

= concentrated load.

P_H = horizontal component of P.

P_V = vertical component of P.

P_p = resultant passive force per foot of wall (see page 6.2-15).

p = intensity of pressure at a point;
= (see ES-28).

p_n = normal unit pressure on inclined surface.

psf = pounds per square foot.

psi = pounds per square inch.

q = intensity of load on a beam;
= (see ES-28).

R = resultant of a system of forces on loads;
= reaction.

R_A = reaction at end "A" of beam.

R_A^F = reaction at end "A" of fixed ended beam.

R_A^S = simple beam reaction at end "A."

S = shear.

U_A^F = algebraic sum of fixed end moments at joint "A."

u = bond stress.

V = vertical component of force;
= wind velocity;
= shear.

v = shear stress in concrete.

v_c = allowable shear stress taken by concrete.

V_A = shear at end "A" of structural member.

V_A^F = shear at end "A" of fixed ended member.

V_A^S = shear at end "A" of simply supported member.

$V_{k\ell}$ = shear at distance $k\ell$ from end of member.

W = total load on a beam.

W_c = total load per unit of length on a conduit.

w = specific weight of soil per unit volume;
= weight of equivalent fluid per unit volume.

x = coordinate length (usually horizontal).

y = coordinate length (usually vertical).

Z = factor associated with flexural crack width;
= angle of friction between soil and back of wall.

z = ratio of lengths or distances.

α = $(2K') \div b_d$ (see page 6.2-17).

γ = unit weight of backfill (see ES-15 and ES-22).

δ = settlement deflection ratio (see ES-22).

θ = angle between horizontal and inclined surface;

= angle between horizontal and back face of wall.

μ = tangent of angle of internal friction in backfill.

μ' = tangent of angle of friction between fill material and the sides of the ditch or trench.

ρ = projection ratio.

ρ_t = steel ratio for temperature and shrinkage reinforcement.

Σ = summation sign -- sum of.

Σo = perimeter of tensile reinforcement.

ϕ = angle of internal friction of a soil.

Additional symbols and notations used in reinforced concrete design discussions conform to those given in the "Reinforced Concrete Design Handbook" of the American Concrete Institute.

4. Reinforced Concrete

4.1 Classes of Reinforced Concrete. The class of concrete to be used in any specific job should be based on a study of the job requirements as to strength and durability. Many factors affect the quality of concrete; the best materials and design do not produce excellent concrete without high quality methods of construction.

Nine classes of concrete are presently established. They cover the various conditions of design and construction encountered by the Soil Conservation Service. For Class 5000, Class 4000, Class 3000, and Class 2500 concrete the Contractor is responsible for the design of the concrete mix. For Class 5000X, Class 4000X, Class 3000X, Class 3000M, and Class 2500X concrete the Engineer is responsible for the design of the concrete mix. The following is a general guide to these concrete classes and their use.

Class 5000 or 5000X concrete -- for special structures, for precast or prestressed construction, for extreme exposure conditions.

Class 4000 or 4000X concrete -- for standard types and sizes of structures, for moderate exposure conditions.

Class 3000 or 3000X concrete -- for small simple structures, for mass foundations.

Class 3000M -- for minor concrete structures in which the quantity of concrete is less than 5 yards and where the location of the concrete will permit easy maintenance or replacement.

Class 2500 or 2500X concrete -- for small structures built by the farmer or unskilled labor, for plain concrete construction.

Guide Construction Specifications 31. Concrete, 32. Concrete for Minor Structures, and 34. Steel Reinforcement (NEH Section 20) state the technical and workmanship requirements for the operations required in reinforced concrete construction. These specifications include such items as:

Air Content and Consistency
Design of Concrete Mix
Inspection and Testing
Mixing, Conveying, Placing, Consolidating and Curing Concrete
Preparation and Removal of Forms
Fabrication and Placing of Reinforcement.

Guide Material Specifications 531. Portland Cement, 522. Aggregate for Portland Cement Concrete, and 539. Steel Reinforcement (NEH Section 20) state the quality of materials to be incorporated in the construction.

4.2 Design Codes and Criteria:

4.2.1 General Code to be Used. The American Concrete Institute Standard "Building Code Requirements for Reinforced Concrete" (ACI 318-77), Appendix B - Alternate Design Method is used as the design code for working stress design except as modified in 4.2.2.

4.2.2 Other Design Criteria

(a) The allowable extreme fiber unit stress in compression in flexural members is: $f_c = 0.40\ f'_c$.

(b) The allowable tensile unit stress in reinforcement is: f_s = 20000 psi. The design yield strength is: f_y = 40000 psi.

(c) Members subjected to bending and direct compressive force, in which the eccentricity (e = M/N) is not less than that causing balanced working stresses, are designed on the basis of recognized theory of cracked sections. The tensile steel may be stressed to its allowable value; the concrete stress may not exceed its allowable value.

(d) In doubly reinforced flexural members, the modular ratio, E_s/E_c is used to transform compression reinforcement for stress computations.

(e) The minimum clear concrete cover over reinforcement is two inches, except when concrete is deposited on or against earth, the minimum clear concrete cover is three inches. However, in structural design of slabs or beams without web reinforcement, the distance from the surface of the concrete to the centerline of the nearest reinforcing steel may be taken as 2-1/2 or 3-1/2 inches, as the case may be, to simplify the determination of the effective depth, for all bars one inch or less in diameter.

Consideration should be given to increasing the cover when a concrete surface is exposed to high velocities and the water carries abrasive materials.

(f) Reinforcing steel is required in both faces and in both (orthogonal) directions in all concrete slabs and walls, except that only one grid of reinforcing is required in concrete linings of trapezoidal channels. This steel serves either as principal reinforcement or as temperature and shrinkage reinforcement. The minimum steel areas for slabs and walls having thickness equal to or less than 32 inches, in each face and in each direction, expressed as the ratio, ρ_t, of reinforcement area, A_s, to gross concrete area, bt, are as follows:

1. The steel in the direction in which the distance between expansion or contraction joints does not exceed thirty feet,

   ρ_t = 0.002 in an exposed face

   ρ_t = 0.001 in an unexposed face.

2. The steel in the direction in which the distance between expansion or contraction joints exceeds thirty feet,

ρ_t = 0.003 in an exposed face

ρ_t = 0.002 in an unexposed face.

The minimum steel areas for slabs and walls having thicknesses greater than 32 inches are computed as though the thickness were 32 inches.

When expansion or contraction in a member is restrained along any line, the concept of equivalent distance between expansion or contraction joints should be used to determine the required steel ratio, ρ_t. The equivalent distance is taken as double the perpendicular distance from the line of restraint to the far edge or line of support of the member.

When the surface of a wall or slab will be exposed for a considerable period during construction, the steel provided should satisfy requirements for an exposed face.

(g) Where a single grid of reinforcement is used, as permitted above, the steel ratio, ρ_t, is the sum of that listed for both faces.

(h) Splices and development lengths for temperature and shrinkage reinforcement are designed for the design yield strength, f_y.

(i) The maximum spacing of principal steel is twice the thickness of the wall or slab, but not more than 18 inches. The maximum spacing of temperature steel is three times the thickness of the wall or slab, but not more than 18 inches.

(j) Where principal steel is required in only one direction, it is ordinarily placed nearer the concrete surface than the temperature steel. Where principal steel is required in both directions, the steel which carries the larger moment is, ordinarily placed nearer the concrete surface. Where principal steel is required in neither direction, the temperature steel parallel to the longer dimension of the slab or wall is ordinarily placed nearer the concrete surface.

(k) The clear distance between parallel bars in a layer is not less than the bar diameter, 1-1/3 times the maximum size of the coarse aggregate, nor 1 inch. Where parallel reinforcement is placed in two or more layers, bars in the upper layers are placed directly above bars in the bottom layer. The clear distance between layers is not less than 1 inch. The clear distance between bars also applies to the clear distance between a contact lap splice and adjacent splices or bars.

(ℓ) The calculated tension or compression in any bar at any section must be developed on each side of that section by proper embedment length, end anchorage, or hooks. Hooks may be used in developing bars in tension. Hooks are not effective in developing bars in compression.

(m) The development lengths, for design yield strength f_y = 40 ksi, for bars #11 and smaller, are given as follows.

For tension top bars, the development length, ℓ_d, is the larger of $1.4(1600\ A_b/\ \sqrt{f'_c})$ or $1.4(16\ d_b)$ but not less than 12 inches.

For all other tension bars, the development length, ℓ_d, is the larger of $(1600\ A_b/\ \sqrt{f'_c})$ or $(16\ d_b)$ but not less than 12 inches.

Top bars are defined as horizontal bars so placed that more than 12 inches of concrete is cast in the member below the bars. Tension bars spaced laterally not less than 6 inches on centers, and bars with at least 3 inches clear from face of member to first bar, may use 0.8 the development length given above but not less than 12 inches.

For compression bars, the development length, ℓ_d, is the larger of $(800\ d_b/\ \sqrt{f'_c})$ or $(12\ d_b)$ but not less than 8 inches.

In the above relations: A_b is the area of an individual bar in square inches, and d_b is the nominal diameter of a bar in inches.

(n) Splices should be made at or close to points of inflection if it is practical to do so. Lap splices shall not be used for bars larger than #11. Bars in a noncontact splice shall not be farther apart than 1/5 the required length of lap nor 6 inches. Lap splices are designed for the design yield strength f_y = 40 ksi.

(o) Three classes of tension lap splices are established. The minimum length of lap is determined as a multiplier for the class times the development length, ℓ_d, but not less than 30 bar diameters. The classes and minimum lengths are:

Class A splice . . . . . 1.0 ℓ_d

Class B splice . . . . . 1.3 ℓ_d

Class C splice . . . . . 1.7 ℓ_d.

The splice class required depends upon the stress level in the reinforcement to be spliced and the portion of the total reinforcement to be spliced at the cross section.

If the area of tensile steel provided at the splice location is equal to or more than twice that required by analysis (low tensile stress in the reinforcement) and not more than 75 percent of the bars are to be lap spliced within the required lap splice length, a Class A splice may be used. If more than 75 percent of the bars are to be lap spliced within the required lap splice length, a Class B splice is required.

If the area of tensile steel provided at the splice location is less than twice that required by analysis (high tensile stress in reinforcement) and not more than 50 percent of the bars are to be lap spliced within the required lap splice length, a Class B splice may be used. If more than 50 percent of the bars are to be lap spliced within the required lap splice length, a Class C splice is required.

(p) The minimum length for compressive lap splices is the larger of 24 bar diameters or 12 inches. For $f'_c < 3000$ psi, the lap length is increased by 1/3.

(q) Critical sections for development of reinforcement are at points of maximum stress and at points where adjacent reinforcement terminates.

Except at supports of simple spans and at the free end of cantilevers, every reinforcing bar is extended beyond the point at which it is no longer needed to resist flexural stress, for a distance equal to the effective depth of the member or 12 bar diameters, whichever is greater.

Continuing reinforcement has an embedment length not less than the development length, ℓ_d, beyond the point where bent or terminated tension reinforcement is no longer needed to resist flexural stress.

At least 1/3 the positive moment reinforcement in simple spans and 1/4 the positive moment reinforcement in continuous spans extends along the same face of the span into the support at least 6 inches.

At least 1/3 the negative moment reinforcement at a support extends beyond the extreme position of the point of inflection a distance not less than the effective depth of the member, 12 bar diameters, or 1/16 the clear span, whichever is greater.

(r) Sufficient longitudinal tension steel perimeter is provided at every section so that flexural bond stresses do not exceed allowable values. Critical sections for flexural bond stresses occur where the rate of change of moment is greatest or where the steel perimeter is least, or both. For simple spans, critical sections are at the faces of supports. For continuous spans: for negative steel, critical sections are located at faces of supports and at locations where bars terminate; for positive steel, critical sections are at points of inflection.

(s) To aid in the control of flexural cracking in beams and one-way slabs, cross sections at both maximum positive and maximum negative moment locations are proportioned so that the quantity, Z, given by

$$\boxed{Z = f_s \sqrt[3]{d_c A}} \leq 130$$

does not exceed 130. In the relation: f_s is the calculated stress in the reinforcement in ksi (in lieu of calculations, the value of f_s may be taken as the allowable stress), d_c is the thickness of concrete cover in inches measured from the extreme tension fiber to the center of the longitudinal bar located closest to the extreme fiber, and A is the effective tension area of concrete per bar in square inches. A is determined as the tension area of concrete surrounding the flexural tension reinforcement and having the same centroid as the reinforcement, divided by the number of bars.

4.2.3 State and other Local Codes. State and local codes may not be satisfied by the above mentioned code or design criteria. The local design engineer should be familiar with the state and local codes and it should be his responsibility to see that these codes are met.

4.3 Design Procedures

4.3.1 Reference Materials. Procedures for design may be found in several manuals and textbooks, among which are:

"Reinforced Concrete Design" by Sutherland and Reese

"Reinforced Concrete Structures" by Peabody

"Reinforced Concrete Fundamentals" by Ferguson

"Theory and Practice of Reinforced Concrete" by Dunham

"Design of Concrete Structures" by Winter, et al

"Reinforced Concrete Design" by Wang and Salmon

Various design handbooks by ACI

Various publications of the Portland Cement Association

"CRSI handbook" by Concrete Reinforcing Steel Institute.

Numerous computation aids have been developed to simplify and speed up design work by eliminating the need of solving various design formulas. These aids follow, and their use is illustrated by 4.3.2.

STRUCTURAL DESIGN: REINFORCED CONCRETE DESIGN
WORKING STRESS DESIGN
ALLOWABLE STRESSES

ALLOWABLE WORKING STRESSES IN CONCRETE

Description (Stresses in psi)		Class of Concrete				
		Any	5000	4000	3000	2500
Compressive strength	f_c'	f_c'	5000	4000	3000	2500
Modular ratio, for concrete weighing 145 pcf *	n	$\frac{503.3}{\sqrt{f_c'}}$	7	8	9	10
Flexure:						
Extreme fiber stress in compression	f_c	$0.40f_c'$	2000	1600	1200	1000
Extreme fiber stress in tension in plain concrete	f_t	$1.6\sqrt{f_c'}$	113	102	88	80
Shear (computed as V/bd as a measure of diagonal tension):						
Beams - shear at a distance [d] from the face of the support:						
Beams with no web reinforcement	v_c	$1.1\sqrt{f_c'}$	78	70	60	55
Beams with properly designed web reinforcement	v	$5.0\sqrt{f_c'}$	354	316	274	250
Slabs and Footings - peripheral shear at a distance [d/2] from the periphery of the area of the concentrated load or reaction with no web reinforcement	v_c	$2.0\sqrt{f_c'}$	141	126	110	100
Flexural Bond (deformed bars, sizes ≤ #11):						
Tension top bars	u	$3.4\sqrt{f_c'}/D \leq 350$				
All other tension bars	u	$4.8\sqrt{f_c'}/D \leq 500$				
		(D = nominal diameter of bar, inches)				

* n is taken to nearest whole number

ALLOWABLE WORKING STRESSES IN REINFORCEMENT

Description (Stresses in psi)		Grade of Steel
		40, 50, or 60
In tension:	f_s	20000
In compression:		
flexural members	f_s'	20000
columns	f_s	16000

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN SECTION	STANDARD DWG. NO. ES-160 SHEET 1 OF 3 DATE 7-64

Revised 8-80

STRUCTURAL DESIGN: REINFORCED CONCRETE DESIGN
WORKING STRESS DESIGN
ALLOWABLE BOND STRESSES

Allowable Flexural Bond Stress, psi										
Description	Class of Concrete	Bar Size								
		#3	#4	#5	#6	#7	#8	#9	#10	#11
Tension Top Bars	5000	350	350	350	321	275	241	214	192	175
	4000	350	350	342	287	246	215	191	172	156
	3000	350	350	298	248	213	186	165	149	135
	2500	350	340	272	227	194	170	151	136	124
All Other Tension Bars	5000	500	500	500	454	389	340	302	272	247
	4000	500	500	487	405	347	304	270	243	221
	3000	500	500	422	351	301	263	234	211	192
	2500	500	480	384	320	274	240	213	192	174

Flexural Bond Stress

$$u = \frac{V}{\Sigma o j d}$$

V = total shear at the section under investigation, lbs.

Σo = sum of perimeters of the longitudinal tension bars at the section, inches, if all bars are the same size; for mixed sizes, substitute $4\ A_s/D$, where A_s is total longitudinal tension steel area and D is the largest bar diameter.

j = ratio of distance between resultant compression and tension forces to the depth, d. Usually taken as 7/8 for these computations.

d = effective depth, inches.

Flexural bond stress is not considered in compression.

STRUCTURAL DESIGN: REINFORCED CONCRETE DESIGN
WORKING STRESS DESIGN
DEVELOPMENT LENGTHS

Development Length, inches										
Description	Class of Concrete	Bar Size								
		#3	#4	#5	#6	#7	#8	#9	#10	#11
Tension Top Bars	5000	12	12	14	17	20	25	32	40	49
	4000	12	12	14	17	21	28	35	45	55
	3000	12	12	14	18	25	32	41	52	64
	2500	12	12	14	20	27	36	45	57	70
All Other Tension Bars	5000	12	12	12	12	14	18	23	29	35
	4000	12	12	12	12	15	20	25	32	40
	3000	12	12	12	13	18	23	29	37	46
	2500	12	12	12	14	19	25	32	41	50
All Compression Bars	5000	8	8	8	9	11	12	14	16	17
	4000	8	8	8	10	11	13	15	16	18
	3000	8	8	9	11	13	15	16	18	20
	2500	8	8	10	12	14	16	18	20	22

Notes:

(a) Development lengths are given for design yield strength. $f_y = 40$ ksi

(b) Tension bars spaced laterally not less than 6 inches on center, and bars with at least 3 inches clear from face of member to first bar may use 0.8 development lengths shown but not less than 12 inches.

(c) See ES-227, sheet 3 of 3 for lapped splice lengths.

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - DESIGN SECTION	STANDARD DWG. NO. ES-160 SHEET 3 OF 3 DATE 7-64

Revised 8-80

STRUCTURAL DESIGN: Reinforced Concrete Design
Strength Design
Lap Splices in Reinforcement

Lapped Splice Lengths, inches												
Grade of Steel	Description	Class of Concrete	Class of Splice	Bar Size								
				#3	#4	#5	#6	#7	#8	#9	#10	#11
40	Tension Top Bars	6000	A	12	15	19	23	27	30	34	38	46
			B	16	16	19	23	27	30	38	48	59
			C	21	21	24	29	34	39	50	63	77
		5000	A	12	15	19	23	27	30	34	41	50
			B	16	16	19	23	27	33	42	53	65
			C	21	21	24	29	34	43	54	69	85
		4000	A	12	15	19	23	27	30	36	45	56
			B	16	16	19	23	28	37	47	59	72
			C	21	21	24	29	37	48	61	77	95
		3000	A	12	15	19	23	27	33	41	52	64
			B	16	16	19	24	32	43	54	68	83
			C	21	21	24	31	42	55	70	89	109
		2500	A	12	15	19	23	27	36	45	57	70
			B	16	16	19	26	35	47	59	74	91
			C	21	21	24	34	46	61	77	97	119
	All Other Tension Bars	6000	A	12	15	19	23	27	30	34	38	42
			B	16	16	19	23	27	30	34	38	42
			C	21	21	21	23	27	30	36	45	55
		5000	A	12	15	19	23	27	30	34	38	42
			B	16	16	19	23	27	30	34	38	46
			C	21	21	21	23	27	31	39	49	61
		4000	A	12	15	19	23	27	30	34	38	42
			B	16	16	19	23	27	30	34	42	52
			C	21	21	21	23	27	34	44	55	68
		3000	A	12	15	19	23	27	30	34	38	46
			B	16	16	19	23	27	31	38	49	60
			C	21	21	21	23	30	40	50	64	78
		2500	A	12	15	19	23	27	30	34	41	50
			B	16	16	19	23	27	33	42	53	65
			C	21	21	21	24	33	44	55	70	85
	All Compression Bars	6000		12	12	15	18	21	24	27	30	33
		5000		12	12	15	18	21	24	27	30	33
		4000		12	12	15	18	21	24	27	30	33
		3000		12	12	15	18	21	24	27	30	33
		2500		16	16	20	24	28	32	36	40	44

Tension bars spaced laterally not less than 6 inches on center, and bars with at least 3 inches clear from face of member to first bar may use 0.8 lap lengths shown but not less than 12 inches.