CONNECTICUT RIVER FLOOD CONTROL PROJECT

CLAREMONT DAM

SUGAR RIVER, NEW HAMPSHIRE

ANALYSIS OF DESIGN

APPENDIX B

WAR DEPARTMENT CORPS OF ENGINEERS U. S. ARMY
U. S. ENGINEER OFFICE PROVIDENCE, R. I.

JANUARY 1945

CLAREMONT DAM

ANALYSIS OF DESIGN

APPENDIX B

STRUCTURAL DESIGN COMPUTATIONS

CLAREMONT DAM

ANALYSIS OF DESIGN

APPENDIX B - COMPUTATIONS

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Subject: Claremont Dam.
Computation: Intake Structure
Computed by: H. E. W. Checked by: A.L.K. Date: 24-Aug-44

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The approach channel walls and base slab are provided with gravel drains that will prevent hydrostatic head on the channel walls and base slab. The channel walls will be 1'-0" thick and will be anchored to the sidewalls with 1"ϕ anchors. The base slab will be 2'-0" thick and will be anchored to the base slab with 1"ϕ anchor bars Reinforcing steel will be provided for temperature changes.

Sidewalls $A_s = 12 \times 12 \times .0025 = .36$ □" Use 3/4"ϕ at 18"cc both ways

Base slab $A_s = 12 \times 24 \times .0025 = .72$ Use 3/4"ϕ @ 12"cc both ways top and bottom.

Design constants to be used throughout design

$f_s = 18000$ #/□" except where noted $n = 12$ $f_c' = 3000$ #/□"
when $f_c = 800$ #/□" $k = 0.348$ $j = 0.884$ $K = 123$
when $f_c = 900$ #/□" $k = 0.375$ $j = 0.875$ $K = 147$

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Page 2

Subject: Claremont Dam

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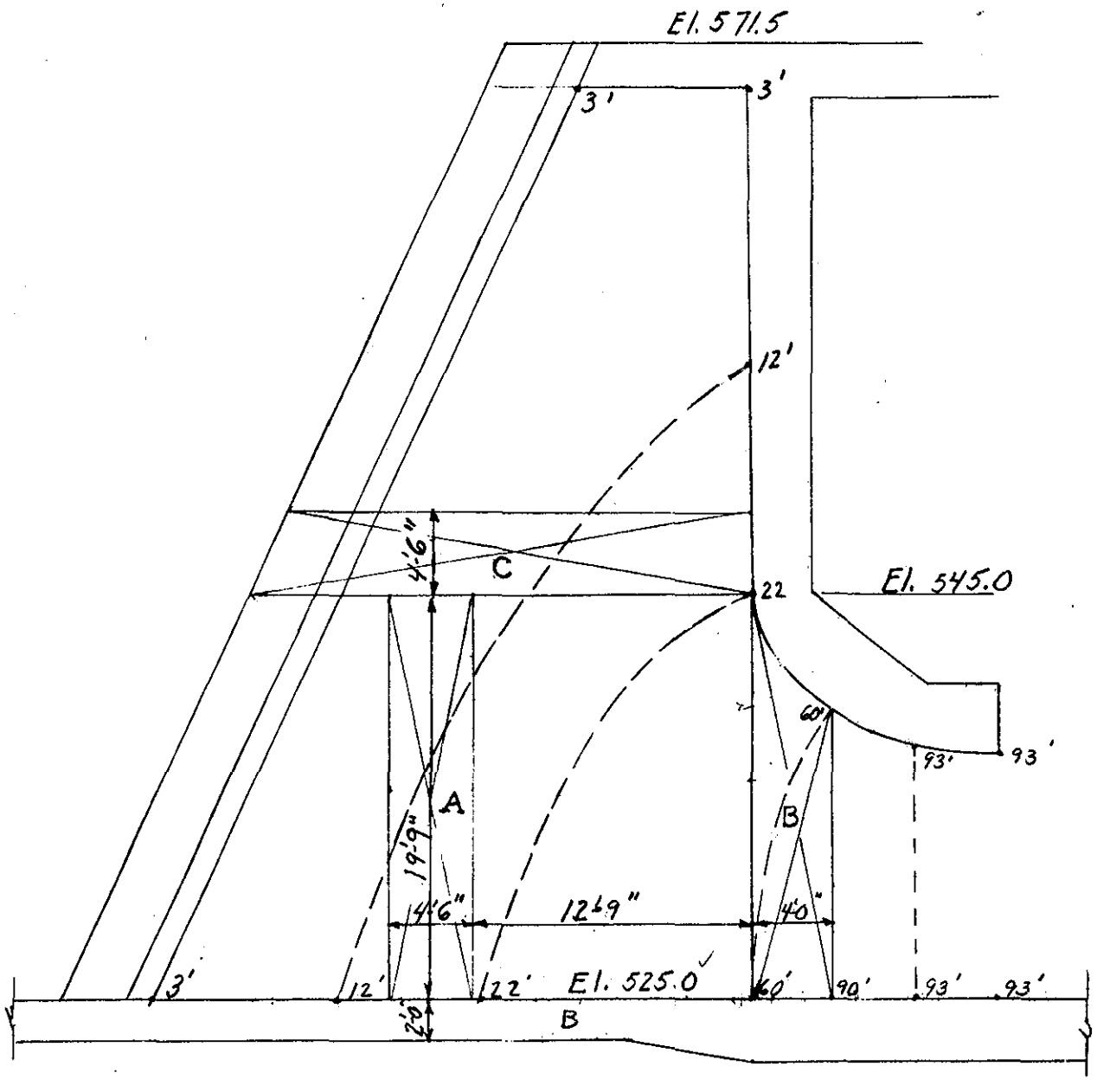
Center Piers



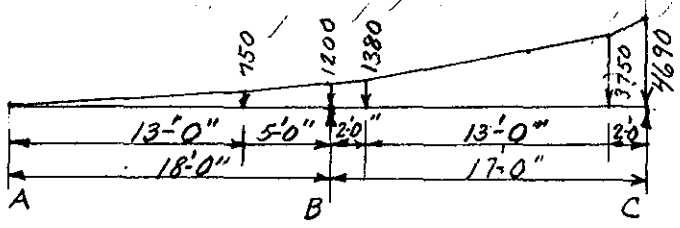
Figures denote differential hydrostatic pressures

INTAKE STRUCTURE - CENTER PIER

Center Piers cont.

Section of Pier below El. 545.0 will be designed horizontally supported at vertical beams A and B. Reaction from beam A on beam C will be taken by cantilever action in the beam.

Horiz. Sect. above base slab



Fixed End Moments

Cantilever AB

$M_B = 750 \times 13 \times .5 \times 9.34 = 45{,}530^{'\#}$

$750 \times 5 \times 2.5 = 9380$

$45 \times 5 \times .5 \times 1.67 = 1900$

$56810^{'\#}$

Member BC

$$M_B^F = \frac{1}{12} \times 1200 \times 17^2 + \frac{.88 \times (10 - 15 \times .88 + 6 \times .88^2)}{15} \times 2550 \times 15 \times .5 \times 17 + \frac{.12^2(4 - 3 \times .12)}{12} \times 2550 \times 2 \times 17$$

$$+ \frac{.12^2(5 - 3 \times .12)}{30} \times 940 \times 2 \times .5 \times 17 = 56{,}980^{'\#}$$

$$M_C^F = \frac{1}{12} \times 1200 \times 17^2 + \frac{.88^2(5 - 4 \times .88)}{10} \times 2550 \times 15 \times .5 \times 17 + \frac{.12(6 - 8 \times .12 + 3 \times .12^2)}{12} \times 5100 \times 17$$

$$+ \frac{.12(10 - 10 \times .12 + 3 \times .12^2)}{30} \times 940 \times 2 \times .5 \times 17 = 71{,}120^{'\#}$$

Mom. Dist.

-56.8	57.0	-71.1
	-0.2	0
0	0	-0.1
0	0	0
56.8		71.2

Cantilever AB

$V_B = 750 \times 13 \times .5 + 750 \times 5 + 450 \times 5 \times .5$

$= 9750^{\#}$

Member BC

$V_B = 1200 \times 17 \times .5 + 2550 \times 15 \times .5 \times .41 - \frac{17000}{17}$

$+ 2550 \times 2 \times .06 + 940 \times 1 \times .04 = 18530^{\#}$

$V_C = 1200 \times 17 \times .5 + 2550 \times 15 \times .5 \times .59 + 850 + 2550 \times 2 \times .94 + 940 \times .96$

$= 28{,}030^{\#}$

$x_0 = 9.3'$ from B

$+M = 18530 \times 9.3 - 56{,}800 - 1200 \times \frac{9.3^2}{2} - 1580 \times \frac{9.3^2}{6} = 40860^{'\#}$

$-A_s$ at B $= \frac{56800 \times 12}{18000 \times .88 \times 44} = .98^{\square''}$

Use 1"ϕ @ 9" cc

$-A_s$ at C $= \frac{71{,}200 \times 12}{18000 \times .88 \times 56} = .97^{\square''}$

$u_0 = \frac{28{,}030}{42 \times .88 \times 56} = 136^{\#}/\square''$ OK

$v = \frac{28{,}030}{12 \times .88 \times 56} = 48^{\#}/\square''$ OK

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Project: Claremont Dam

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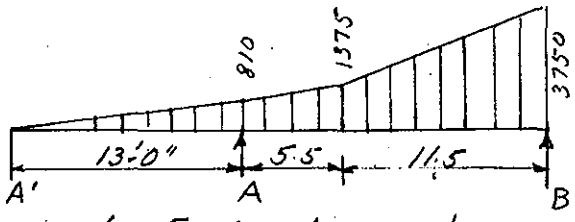
Center Piers (cont.)

Horiz. Section 10' Above Base at El 535.0



Loading

$60 \times 62.5 = 3750$ #/'

$22 \times 62.5 = 1375$ #/'

$13 \times 62.5 = 810$ #/'

Fixed End Moments

Cantilever Beam

$M_A^F = 810 \times \frac{13^2}{3} \times .5 = 22{,}800$ '#

Beam AB

$$M_{AB}^F = \frac{1}{12} \times 810 \times 17^2 + \frac{.32(10 - 15 \times .32 + 6 \times .32^2)}{15} \times 565 \times \frac{5.5}{2} \times 17 +$$

$$\frac{.68^2(4 - 3 \times .68)}{12} \times 565 \times 11.5 \times 17 + \frac{.68^2(5 - 3 \times .68)}{30} \times 2375 \times \frac{11.5}{2} \times 17$$

$$= 41{,}700 \text{ '#}$$

$$M_{BA}^F = \frac{1}{12} \times 810 \times 17^2 + \frac{.32^2(5 - 4 \times .32)}{10} \times 565 \times \frac{5.5}{2} \times 17 + \frac{.68(6 - 8 \times .68 + 3 \times .68^2)}{12} \times 565 \times 11.5 \times 17$$

$$+ \frac{.68(10 - 10 \times .68 + 3 \times .68^2)}{30} \times 2375 \times \frac{11.5}{2} \times 17 = 61{,}540 \text{ '#}$$

Mom Dist.

-22.8	+41.7	-61.5
	-18.9	0
0	0	-9.5
0	0	0
	+22.8	-71.0

Cantilever Beam

V_A $810 \times 13 \times .5 = 5270$ #

Member AB

$$V_A = 810 \times 17 \times .5 + 565 \times \frac{5.5}{2} \times .785 - \frac{48{,}200}{17}$$

$$+ 565 \times 11.5 \times .339 + 2375 \times \frac{11.5}{2} \times .225 = 10550 \text{ #}$$

$$V_B = 810 \times 17 \times .5 + 565 \times \frac{5.5}{2} \times .215 + \frac{48{,}200}{17} + 565 \times 11.5 \times .661$$

$$+ 2375 \times \frac{11.5}{2} \times .775 = 24{,}930 \text{ #}$$

$x_0 = 7.1'$ from A

$$+M = 10{,}550 \times 7.1 - 810 \times \frac{7.1^2}{2} - 565 \times \frac{5.5}{2} \times 3.43 - 565 \times \frac{1.6^2}{2} - 3300 \times \frac{1.6^2}{6}$$

$$- 22{,}800 = 24{,}230 \text{ '#}$$

$-A_s$ at B $= \frac{71{,}000 \times 12}{18{,}000 \times .88 \times 56} = .96$ □" 1"φ @ 9"cc req'd

$-A_s$ at A $= \frac{22{,}800 \times 12}{18000 \times .88 \times 38} = .45$ □" Use 1"φ @ 1'-6"cc

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Computation: Intake Structure

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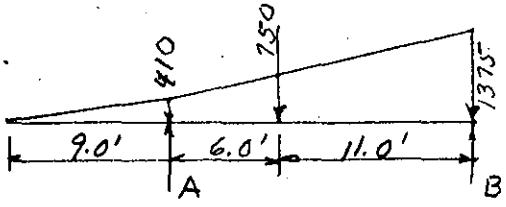
Center Piers (cont.)

Section at El. 545.0



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$22 \times 62.5 = 1375$ #/'

$12 \times 62.5 = 750$ #/'

625

$\frac{625}{11} = \frac{x}{17}$

F.E.M.

Cantilever Beam $= 410 \times 9 \times .5 \times 3 = 5540$ '#

Beam AB

$M^F_{AB} = \frac{1}{12} \times 410 \times 17^2 + \frac{1}{15} \times 965 \times \frac{17^2}{2} = 19{,}170$ '#

$M^F_{BA} = \frac{1}{12} \times 410 \times 17^2 + \frac{1}{10} \times 965 \times \frac{17^2}{2} = 23{,}820$ '#

Mom. Dist.

-5.5	+19.2	-23.8
	-13.7	0
0	0	-6.9
0	0	0
5.5		30.7

Cantilever Beam

$V_A = 410 \times 9 \times .5 = 1850$ #

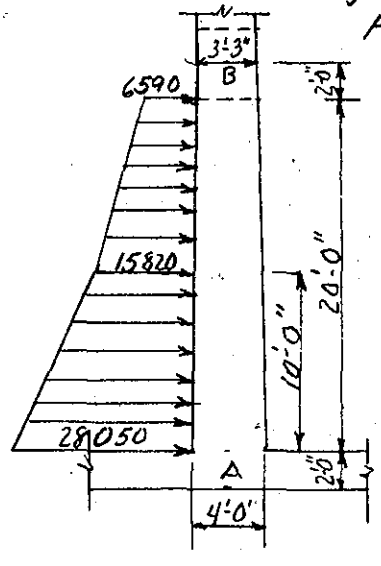
Member AB

$V_A = 410 \times 17 \times .5 + 965 \times \frac{17}{6} - \frac{25{,}200}{17} = 4740$ #

$V_B = 410 \times 17 \times .5 + 965 \times \frac{17}{3} + \frac{25{,}200}{17} = 10{,}440$ #

Vertical Beam A

Beam will be designed simply supported. Neg. steel equal to 75% pos. steel will be provided at supports



$H_A = 6590 \times 20 \times .52 + 9230 \times 10 \times .5 \times .377 + 9230 \times 10 \times .74 + 12{,}230 \times 10 \times .5 \times .81 = 203{,}770$ #

$H_B = 6590 \times 20 \times .48 + 9230 \times 10 \times .5 \times .623 + 9230 \times 10 \times .26 + 12{,}230 \times 10 \times .5 \times .19 = 127{,}630$ #

$x_0 = 12.95$ from B

$M = 127630 \times 12.95 - 6590 \times \frac{12.95^2}{2} - 9230 \times 10 \times .5 \times 4.28 - 9230 \times \frac{.95^2}{2} - 1160 \times \frac{.95^2}{6} = 896800$ '#

reqd $d = \sqrt{\frac{896.800 \times 12}{54 \times 123}} = 40.2'' < 40.5''$ OK

At base $v = \frac{203770}{54 \times .88 \times 44} = 97$ #/□''

Center Piers (cont.)

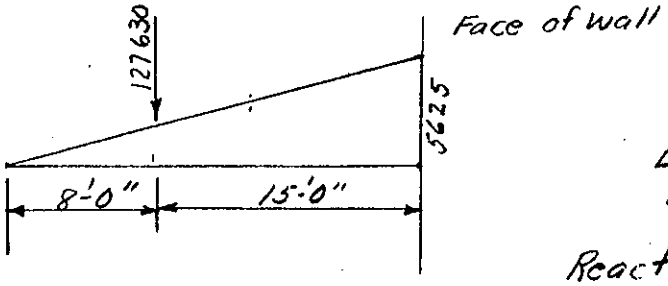
Vertical Beam A (cont.)

At top $v = \frac{127,630}{54 \times .88 \times 36} = 75$ #/□" OK

$A_s = \frac{896800 \times 12}{18000 \times .88 \times 40.5} = 16.8$ □" Use 11-1¼"□ @ 6" cc $A_s = 17.2$ □"

$u_0 = \frac{203,770}{55 \times .88 \times 44} = 95$ #/□"

Cantilever Beam C



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20 × 62.5 × 4.5 = 5625 #/'

12 × 62.5 × 4.5 = 3375 #/'

Load will vary uniformly from 5625 to 0 at outer end

Reaction = 127,630 + 5625 × 23 × .5 = 192,320#

$M = 127,630 \times 15 + 5625 \times 23 \times .5 \times 7.67 = 2,410,620$ '#

req'd $d = \sqrt{\frac{2410620 \times 12}{54 \times 147}} = 60.3" > 48.5$ compression steel req'd

$v = \frac{192,320}{54 \times .88 \times 48.5} = 84$ #/□" OK

Use 3 layers of steel 6" cc then d = 42.5"

$-A_s = \frac{2410620 \times 12}{18000 \times .88 \times 42.5} = 43.0$ □" req. 28-1¼"□ Use 30-1¼"□

$u_0 = \frac{192,320}{150 \times .88 \times 42.5} = 34$ #/□" OK

Use same reinf. both faces

then resist $M = Kbd^2 + \frac{n-1}{n} A_s' f_s' (d-d')$

$A_s' = 46.9$ □" $d-d' = 42.5 - 10.5 = 32$ $f_s' = 12 \times 900 = 10,800$ #/□"

$M = 147 \times 54 \times 42.5^2 + \frac{11}{12} \times 10,800 \times 46.9 \times 32 = 29,195,930$ '# $= 2,433,000$ '# OK

Subject Claremont Dam
Computation Intake Structure
Computed by H. E. W. **Checked by** **Date** 28 Aug 44

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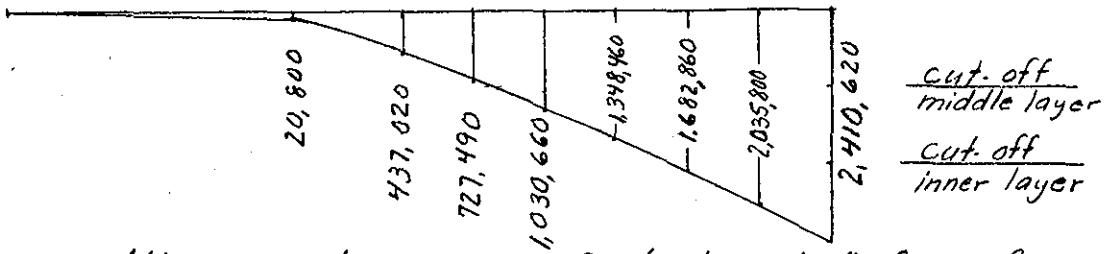
Center Pier (cont.)
Cantilever Beam C (cont.)
Bending Mom Diagram.



Try cutting inside layer of steel 4'-0" from face of wall (Theo.)

$-A_s = \frac{1,682860 \times 12}{18000 \times .88 \times 42} = 30.4^{\square''} < 31.25^{\square''}$ OK

compression steel still req'd

$A_s' = 31.25$, $d-d' = 42 - 7\frac{1}{2} = 34.5$ $f_s' = 10,800$ #/□"

resist. $M = 147 \times 54 \times 42^2 + \frac{11}{12} \times 10800 \times 31.25 \times 34.5$

$M = 2,056,340'^{\#} > 1,682,860'^{\#}$ OK

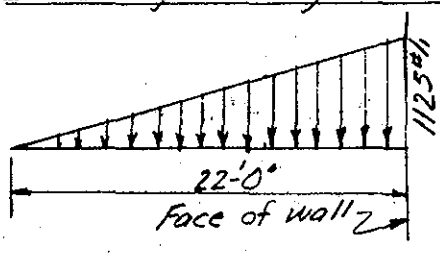
Stop inner layer of steel 8'-3" from face of wall

Try cutting middle layer of steel 10' from wall (Theoretical)

$-A_s = \frac{727490 \times 12}{18000 \times .88 \times 39.5} = 14.0^{\square''} < 15.6^{\square''}$ OK

Stop middle layer 14'-0" from face of wall

Horizontal Section at El. 549.25
Loading Diagram



End shear: $1125 \times \frac{22}{2} = 12375^{\#}$

Mom $= 1125 \times \frac{22^2}{6} = 90,750'^{\#}$

req'd $d = \sqrt{\frac{90,750}{147}} = 248" < 48"$

$v = \frac{12375}{12 \times .88 \times 48} = 24$ #/□" OK

$A_s = \frac{90,750 \times 12}{18,000 \times .88 \times 48} = 1.20^{\square''}$ Use 1"□ @ 8" c.c.

$u_0 = \frac{12375}{6.0 \times .88 \times 48} = 49$ #/□"

Stop 50% steel 8'-6" from face of wall

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Computation: Intake Structure
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Center Pier (cont.)
Horiz. Section at El. 556.0

Mom at face of wall = $12 \times 62.5 \times \frac{19^2}{6} = 45130^{\text{lb}}$

V at face of wall = $12 \times 62.5 \times \frac{19}{2} = 7,130^{\text{lb}}$

void

$A_s = \frac{45,130 \times 12}{18,000 \times .88 \times 44.5} = .77^{\square''}$ Use 7/8"ϕ @ 9" cc
Stop 50% steel 7'-0" from face

Use 7/8"ϕ @ 18" cc above El. 562.5

Design of Base Slab

Head on top of slab at Sta. 15 + 79.5 = 105 - 60 = 45 ft.

Wt. water = 45 × 62.5 = 2810
" slab = 2 × 150 = 300
3110 #/□'

Uplift (max. = 50% head) = $105 \times \frac{1}{2} \times 62.5 = 3280$ #/□'

net pressure = 170 #/□' uplift.

$M = \frac{1}{10} \times 170 \times 11^2 = 2060^{\text{lb}}$ (Mom. negligable)

Use 7/8"ϕ @ 1'-0" cc Top & Bot.

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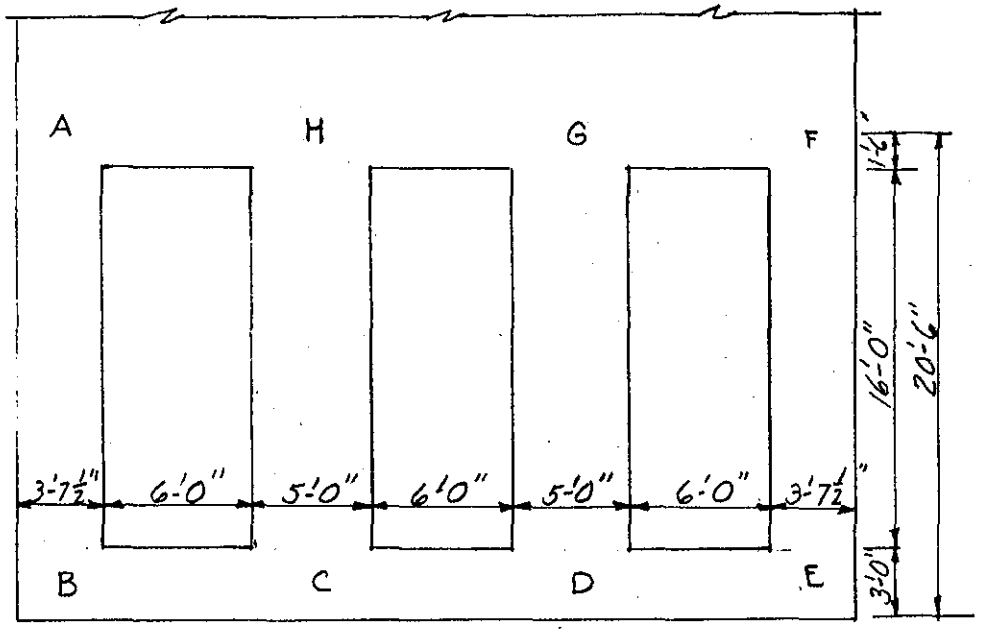
Center Piers (cont)

Design of Beam B

Design member as part of a frame

Consider members fixed at points A, H, G & F



Member	d	d^3	L	d^3/L	K
AB	3.62	47.4	19.0	2.49	1.0
BC	3.00	27.0	10.31	2.62	1.1
CD	3.00	27.0	11.0	2.45	1.0
DE	3.00	27.0	10.31	2.62	1.1
CH	5.00	125.0	19.0	6.58	2.7
DG	5.00	125.0	19.0	6.58	2.7
EF	3.62	47.4	19.0	2.49	1.0

Case I - End gates closed center gate open

Fixed End Moments

Members AB, BC, DE + EF F.E.M = 0

Member CD - EI 630 - 75 = EI 555

Downward thrust = 30x62.5 + 3x 150 = 2325#
Upward thrust = 108x62.5x.50 = 3375#
Net Pressure 1050# Upward

Subject Claremont Dam

Computation Intake Structure

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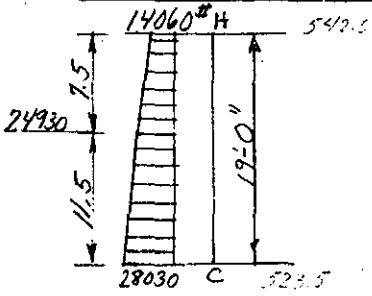
Center Piers (cont.)

Design of Beam B (cont.)

Member CD cont

$M^F = 4 \times \frac{1}{12} \times 1050 \times 11^2 = 42.4^{'K}$

Member CH & DG



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24,930
10,440
14,490

$\frac{2.5}{10} = \frac{x}{14,490} = 3620 + 10440 = 14060^{\#}$

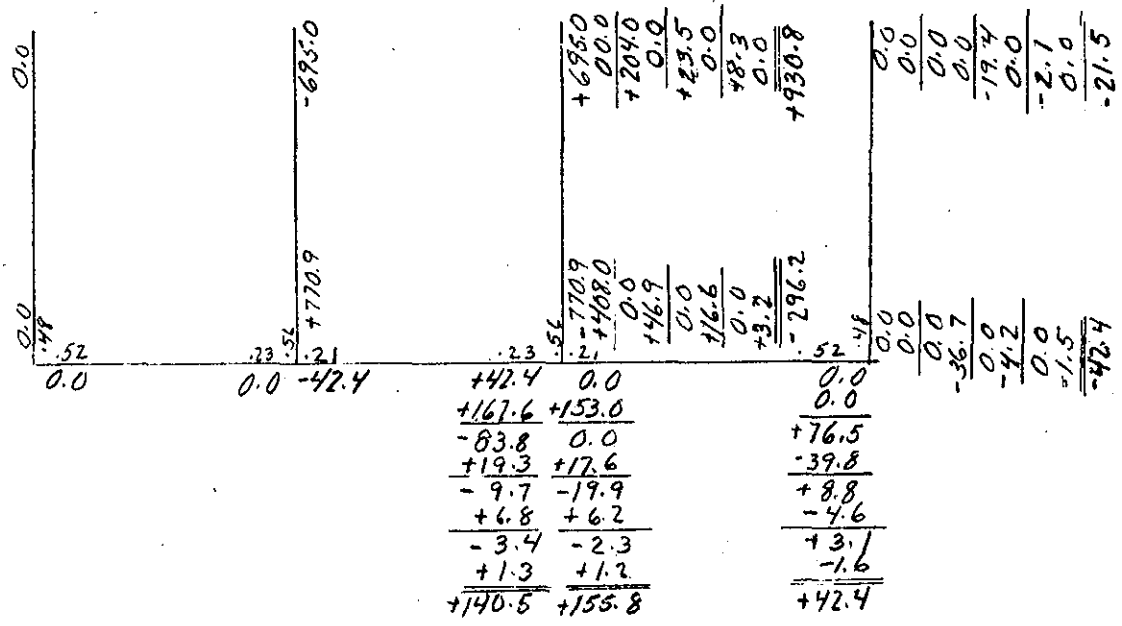
$M^F_{CH} = \frac{1}{12} \times 14.060 \times 19^2 + 10870 \times \frac{7.5}{2} \times 19 \times .395^2 \left(\frac{5 - 4 \times .395}{10}\right)$ (.055)

$+ 10870 \times 11.5 \times 19 \times .605 \left(\frac{6 - 8 \times .605 + 3 \times .605^2}{12}\right) +$

$.605 \left(\frac{10 - 16 \times .605 + 3 \times .605^2}{30}\right) \times 3100 \times \frac{11.5}{2} \times 19 = 770.900^{'K}$

$M^F_{HC} = \frac{1}{12} \times 14060 \times 19^2 + 10870 \times \frac{7.5}{2} \times 19 \times .395 \left(\frac{10 - 15 \times .395 + 6 \times .395^2}{15}\right) + 10870 \times 11.5 \times 19 \times .605^2 \left(\frac{4 - 3 \times .605}{12}\right)$

$+ \frac{.605^2 (5 - 3 \times .605)}{30} \times 3100 \times \frac{11.5}{2} \times 19 = 695.0^{'K}$



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Center Piers (cont.)

Design of Beam B (cont.)

Case II - Center gate closed end gates open

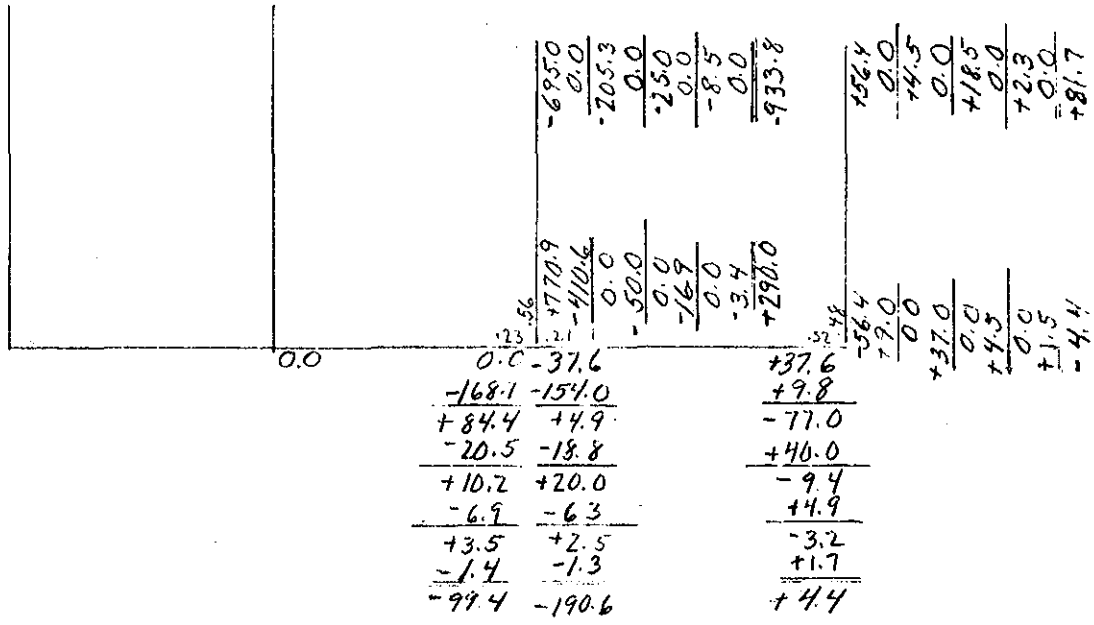
Fixed End Moments - Member AB

Use an average diff. pressure of 60' This would make water at El. 570.0 on inside face. Water pressure on outside face will be 50% of total head or $\frac{1}{2} \times 105 =$ 52.5 ft. which would be equal to water at El 577.5. This will give an unbalanced head inward of 7.5'

$$M^F = 4 \frac{L}{12} \times 7.5 \times 62.5 \times 19^2 = 56.4 \text{ 'K}$$

Member BC

$$M^F = 4 \frac{L}{12} \times 1050 \times 10.31^2 = 37.6 \text{ 'K}$$



Subject: Claremont Dam

Computation: Intake Structure

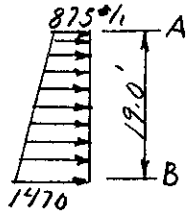
Computed by: H. E. W. Checked by: Date: 16-Sept-44

U. S. GOVERNMENT PRINTING OFFICE 3—10523

Center Piers (cont.)

Beam B (cont.) Case III - Water down in reservoir but ground water to rock surface using 50% head

F.E.M. - Member AB



$P = (570.5 - 542.5)\,31.25 = 875^{\#}$

$P = 875 + 19 \times 31.25 = 1470^{\#}$

$M^F_{AB} = \frac{1}{12} \times 875 \times 19^2 + \frac{1}{15} \times 595 \times \frac{19^2}{2} = 33.5^{'K}$

$M^F_{BA} = \frac{1}{12} \times 875 \times 19^2 + \frac{1}{10} \times 595 \times \frac{19^2}{2} = 37.1^{'K}$

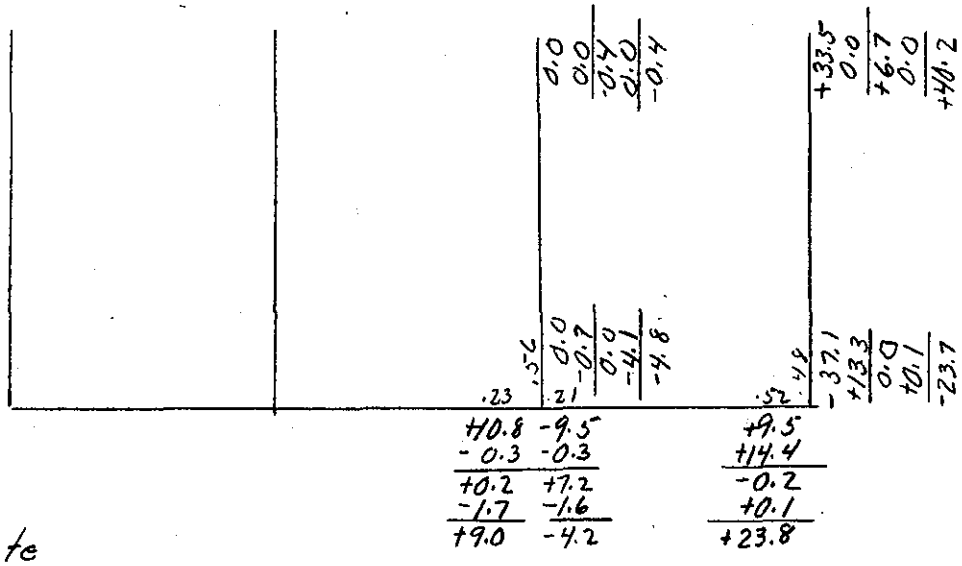
Member BC

Net head $= (570.5 - 522)\,31.25 - 3 \times 150 = 1070^{\#}/_{\square'}$

$M^F = \frac{1}{12} \times 1070 \times 10.31^2 = 9.5^{'K}$

Member CD

$M^F = \frac{1}{12} \times 1070 \times 11^2 = 10.8^{'K}$



Note

Values are for one foot strip multiply each by 4 for section at Beam B

Subject: Claremont Dam
Computation: Intake Structure
Computed by: H. E. W. Checked by: Date: 16-Sept-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of Beam B
Case I

Values of Shear + Max Pos. Mom.

Member CD

$V_C = V_D = 4 \times 1050 \times \frac{11}{2} = 23{,}120^{\#}$

$+M = \frac{1}{8} \times 4200 \times 11^2 - 140{,}500 = -76970$

Member DE

$V_D = V_E = \frac{198{,}200}{10.31} = 19{,}220^{\#}$

Member DG

$V_D = 14060 \times 19 \times .5 + 10870 \times 7.5 \times .5 \times \frac{5}{19} + 10870 \times 11.5 \times \frac{13.25}{19}$
$+ 3100 \times \frac{11.5}{2} \times \frac{15.17}{19.0} - \frac{634{,}600}{19} = 212{,}690^{\#}$

$V_G = 14060 \times 19 \times .5 + 10870 \times 7.5 \times .5 \times \frac{14}{19} + 10870 \times 11.5 \times \frac{5.75}{19}$
$+ 3100 \times 11.5 \times .5 \times \frac{3.83}{19} + \frac{634{,}600}{19} = 238040^{\#}$

$x_0 = 10.8'$ from V_G

$+M = 238040 \times 10.8 - 14060 \times \frac{10.8^2}{2} - 10870 \times \frac{7.5}{2} \times 5.8 - 10870 \times \frac{3.3^2}{2}$
$- 890 \times \frac{3.3^2}{2} \times 1.1 - 930\,800 = 522{,}830'^{\#}$

Member EF

$V_E = V_F = \frac{63{,}900}{19} = 3360^{\#}$

Case II - Values of shear + Max Pos. Mom.

Member CD

$V_C = V_D = 0$

Member DG

Use same values as Case I

Member DE

$V_D = 4 \times 1050 \times 10.31 \times .5 + \frac{195000}{10.31} = 40\,560^{\#}$

$V_E = 4 \times 1050 \times 10.31 \times .5 - \frac{195{,}000}{10.31} = 2740^{\#}$

$+M = -4400 + 2740 \times 6.5 - 4200 \times \frac{6.5^2}{2} = 4450'^{\#}$

Member EF

$V_E = 4 \times 470 \times \frac{19}{2} - \frac{77300}{19} = 13790^{\#}$ $V_F = 1880 \times \frac{19}{2} + \frac{77300}{19} = 21{,}930^{\#}$

$x_0 = \frac{13790}{1880} = 7.3'$ from E

$+M = -4{,}400 + 1880 \times 7.3 - 470 \times \frac{1.2^2}{2} = 8980'^{\#}$

Subject: Claremont Dam

Computation: Intake Structure

Computed by: H.E.W. Checked by: Date: 18-Sept.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Center Piers (cont.)

Case III - Values of Shear & Max Pos. Mom.

Member CD

$V_C = V_D = 4 \times 1070 \times \frac{11}{2} = 23,540^{\#}$

$+M = \frac{1}{8} \times 4280 \times 11^2 - 36000 = 28,740$

Member DE

$V_D = 4 \times 1070 \times \frac{10.31}{2} - \frac{18600}{10.31} = 20,220^{\#}$

$V_E = 4 \times 1070 \times \frac{10.31}{2} + \frac{18600}{10.31} = 23,900^{\#}$

$x = \frac{20,220}{4280} = 4.72'$ from D

$+M = 20,220 \times 4.72 - 4 \times 4200 - 4280 \times \frac{4.72^2}{2} = 30900^{'\#}$

Member EF

$V_E = 4 \times 875 \times \frac{19}{2} + 4 \times 595 \times \frac{19}{2} \times .66 - 4 \times \frac{16,500}{19} = 44720^{\#}$

$V_F = 4 \times 875 \times \frac{19}{2} + 4 \times 595 \times \frac{19}{2} \times .33 + \frac{16,500}{19} = 44,200^{\#}$

$x_0 = 10.6$ from F

$M = 44720 \times 10.6 - 4 \times 40,200 - 4 \times 875 \times \frac{10.6^2}{2} - 4 \times 332 \times \frac{10.6^2}{6} = 46240^{'\#}$

Design of Members

Member AB req'd $= \sqrt{\frac{40,200}{147}} = 16.5'' < 39''$ OK

$v = \frac{44200}{48 \times .88 \times 39} = 27^{\#}/\square''$

At A - As $= \frac{40,200 \times 4 \times 12}{18000 \times .88 \times 39} = 3.12 \square''$ Use 5-7/8"φ @ 1'-0" cc

$u_0 = \frac{44200}{12.57 \times .88 \times 39} = 102^{\#}/\square''$

At B - As Use 5-7/8"φ @ 1'-0" cc

+As $= \frac{46240 \times 12}{18000 \times .88 \times 39} = .90 \square''$ Use 7/8"φ @ 1'-0" cc

Base Slab BCDE

req'd $d = \sqrt{\frac{196,600 \times 12}{48 \times 147}} = 18'' < 31.5''$

$v = \frac{40,560}{48 \times .88 \times 31.5} = 30^{\#}/\square''$

- As at A $= \frac{23,800 \times 4 \times 12}{18000 \times .88 \times 31.5} = 2.28 \square''$ Use 7/8"φ @ 1'-0" cc

Subject: Claremont Dam.

Computation: Intake Structure

Computed by: H.E.W. Checked by: Date: 18- Sept. - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Center Piers (cont.)

Design of Beam B (cont.)

Base slab (cont)

$-As$ at C or D $= \frac{190,600 \times 12}{18000 \times .88 \times 31.5} = 4.6^{\square''}$ use 5-1"□

$u_o = \frac{40560}{20 \times .88 \times 31.5} = 73\ \#/\square''$

$+As = \frac{30960 \times 12}{18000 \times .88 \times 31.5} = .75^{\square''}$ use 7/8"φ @ 1'-0" cc

Member CH & DG

req'd $= \sqrt{\frac{933,800 \times 12}{48 \times 147}} = 40'' < 55.5''$ OK

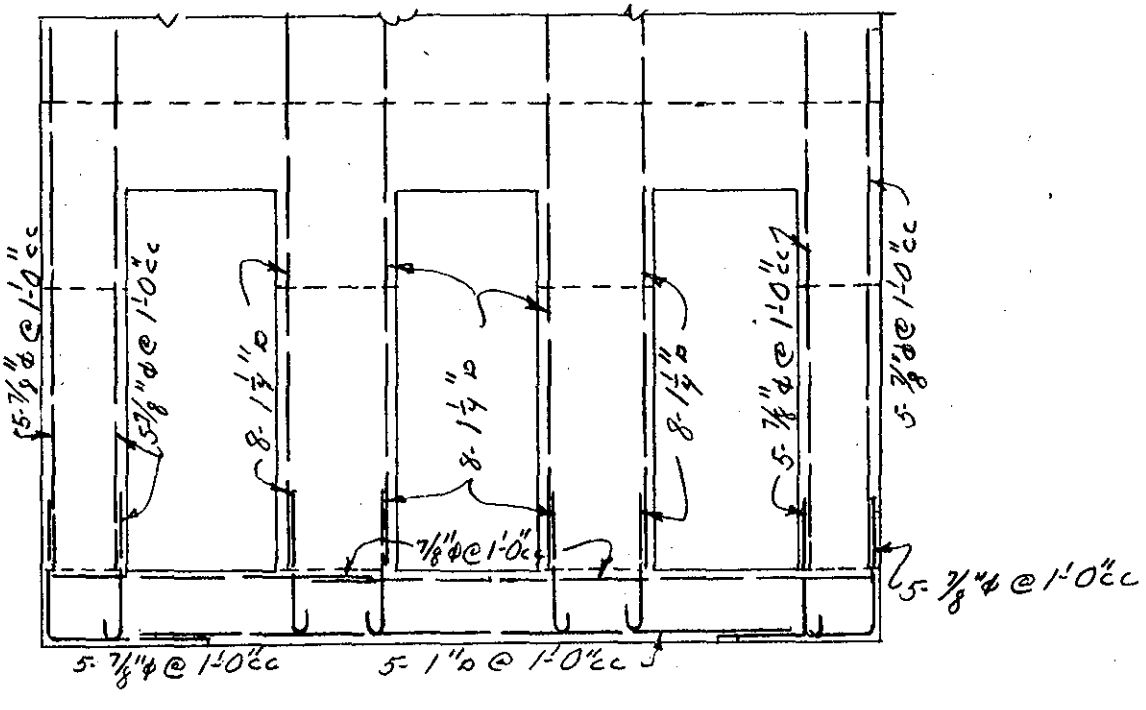
$v = \frac{238040}{48 \times .88 \times 55.5} = 101\ \#/\square''$

reduced shear at face $= 238040 - 14060 \times 1.5 - 1440 \times \frac{1.5}{2} = 215870\#$

$v = \frac{215870}{48 \times .88 \times 55.5} = 92\ \#/\square''$ OK

$-As$ at H or G $= \frac{933,800 \times 12}{18000 \times .88 \times 55.5} = 12.8^{\square''}$ use 8-1 1/4"□

$u_o = \frac{215870}{40 \times .88 \times 55.5} = 110\ \#/\square''$ OK



Subject: Claremont Dam
Computation: Gate Tower
Computed by: H. E. W. Checked by: Date: 21 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

General

The gate tower will be analyzed as a horizontal frame. As many of the individual members of the frame will have a varying moment of inertia, the stiffness, carry-over factors and fixed end moments will be determined by the method of "column analogy" The effect of the corner butresses on the frame has been neglected as they are short an flexible and will be equally loaded. The sections will be loaded with hydrostatic head due to water at spillway elevation. up to elevation 600.5 at which point water to spillway surcharge will increase allowable stresses by more than 50%. Sections above 610.5 will be designed to spillway surcharge elevation with allowable steel stress increased to 27000 #/□"

The following sections will be stress analyzed:

Section at El. 552.0 that will be divided into two parts. Part one from El. 544.75 to El. 549.25, Part two from El. 540.5 to El 544.75 and El. 549.75 to El. 572.0

Section at El. 572.0 that will cover the tower from El. 572.0 to 580.5

Section at El. 580.5 that will cover the tower from El. 580.5 to 600.5

Section at El. 600.5 that will cover the tower from El. 600.5 to 610.5

Section at El. 610.5 that will cover the tower from El. 610.5 to the top.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

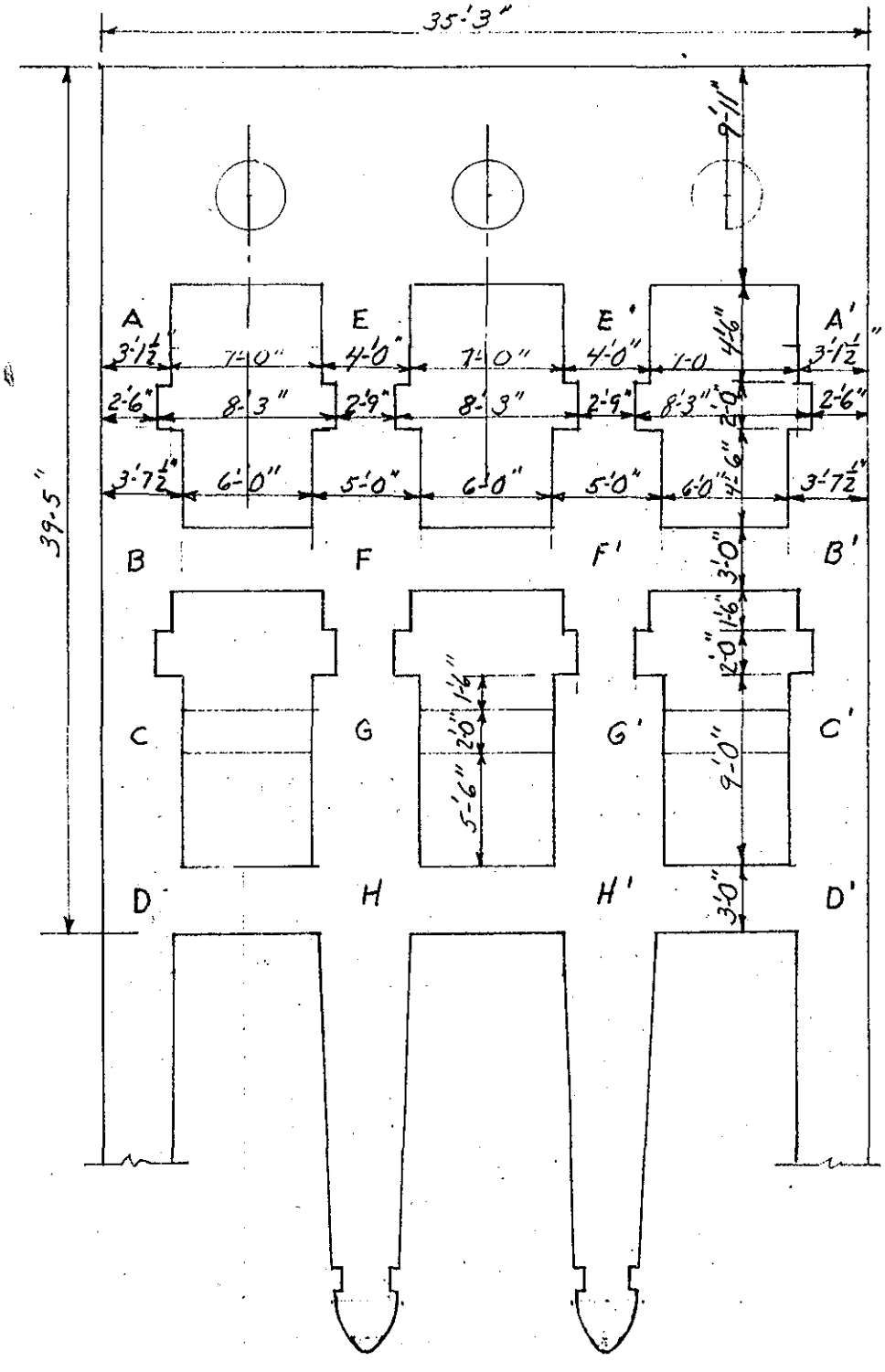
Subject Claremont Dam

Computation Gate Tower Section from El. 540.5 to 572.0

Computed by H.E.W. **Checked by** **Date** 21- Aug.- 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section at El. 552.0



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El 540.5 to El. 572.0

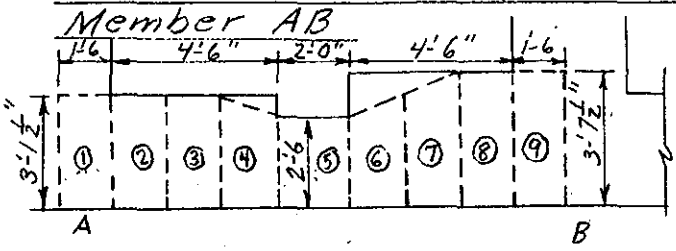
Computed by: H. E. W. Checked by: Date:

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design Assumptions — The section will be designed as a frame with members AB, A'B' EF + E'F' considered fixed at pts A, E E' + A' and the trash rack piers as cantilevers from the frame. The wing walls will have no effect on the frame as they will be securely anchored into rock. The section will be designed for full head at El. 552.0. As a reduction in head is permitted when the tower is 10' or more in rock it is felt that this assumption of loading will give a reasonable design from El. 540.5 to El. 562.5

Co-efficients for Stiffness - Carry over - F.E.M

Member AB



Shaded area will be considered as effective sect. of beam.

Assume beam loaded with 1 kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2 / Ix	m_s	$m_s a$	$m_s ax$
1	1.5	3.12	0.33	0.50	-6.25	-3.12	19.50 (.09)	5.0	2.5	-15.6
2	1.5	3.12	0.33	0.50	-4.75	-2.38	11.31 (.09)	13.2	6.6	-31.4
3	1.5	3.12	0.33	0.50	-3.25	-1.62	5.27 (.09)	19.2	9.6	-31.1
4	1.5	2.81	0.45	0.68	-1.75	-1.19	2.08 (.13)	23.0	15.6	-27.4
5	2.0	2.5	0.64	1.28	0	0	0 (.42)	24.5	31.4	0
6	1.5	2.78	0.47	0.71	+1.75	+1.24	2.17 (.13)	23.0	16.3	+28.5
7	1.5	3.34	0.27	0.41	+3.25	+1.33	4.32 (.08)	19.2	7.9	+25.5
8	1.5	3.62	0.21	0.32	+4.75	+1.52	7.22 (.06)	13.2	4.2	+20.1
9	1.5	3.62	0.21	0.32	+6.25	+2.00	12.50 (.06)	5.0	1.6	+10.0
				5.22		-2.22	65.52		95.7	-21.4
							.92			-40.2
					-0.42		64.60			+18.8
				A	$\bar{x}$		Ix		P	Mx

Stiffness at A

$$\frac{1}{5.22} + \frac{6.58^2}{64.60} = .862$$

Stiffness at B

$$\frac{1}{5.22} + \frac{7.42^2}{64.60} = 1.044$$

F. E. M at A

$$\frac{95.7}{5.22} + \frac{18.8 \times 6.58}{64.60} = 16.4^{1k}$$

F.E.M at B

$$\frac{95.7}{5.22} + \frac{18.8 \times 7.42}{64.60} = 20.5^{1k}$$

$$\text{Carry over at } A = \frac{\frac{1}{5.22} - \frac{6.58 \times 7.42}{64.60}}{.862} = 0.65$$

$$\text{Carry over at } B = \frac{\frac{1}{5.22} - \frac{6.58 \times 7.42}{64.60}}{1.044} = 0.54$$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

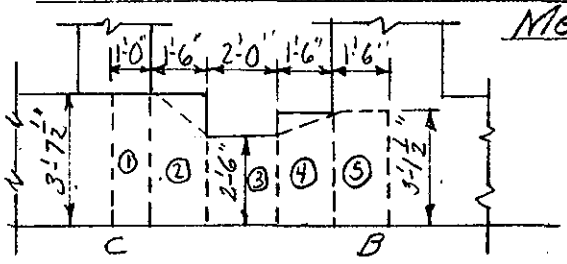
Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to 572.0

Computed by: H. E. W. Checked by: Date: 22-Aug-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Co-eff. for Stiffness – Carry over – F.E.M.



Member BC

Shaded area will be considered as the effective section

Assume beam loaded with 1 kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1	3.62	0.21	0.21	-3.0	-0.63	1.89 .02	1.8	0.4	-1.1
2	1.5	3.06	0.35	0.53	-1.75	-0.93	1.62 .10	5.0	2.7	-4.6
3	2.0	2.50	0.64	1.28	0	0	.42	7.0	9.0	0
4	1.5	2.81	0.45	0.68	1.75	1.19	2.08 .13	5.9	4.0	7.0
5	1.5	3.12	0.33	0.50	3.25	1.63	5.28 .09	2.6	1.3	4.2
				3.20		+1.26	11.63 .49		17.4	+5.5 +6.8
					+0.39		11.14			-1.3
				A	x		Ix		P	Mx

Stiff. at C $= \frac{1}{3.20} + \frac{3.89^2}{11.14} = 1.671$

Stiff. at B $= \frac{1}{3.20} + \frac{3.61^2}{11.14} = 1.483$

Carry over at C $= \dfrac{\frac{1}{3.20} - \frac{3.89 \times 3.61}{11.14}}{1.671} = .57$

Carry over at B $= \dfrac{\frac{1}{3.20} - \frac{3.89 \times 3.61}{11.14}}{1.483} = .64$

F.E.M at C $= \frac{17.4}{3.20} + \frac{-1.3 \times -3.89}{11.14} = 5.89$ 'K

F.E.M at B $= \frac{17.4}{3.20} + \frac{-1.3 \times +3.61}{11.14} = 5.02$ 'K

Member CD

Stiff at C = Stiff. at D $= 4 \times \frac{3.62^3}{\cancel{90}\ 96} = \cancel{2.108}\ 1.977$

"f" for F.E.M = .083 at ea. end

Carry over = 0.50 at ea. end

ubject Claremont Dam

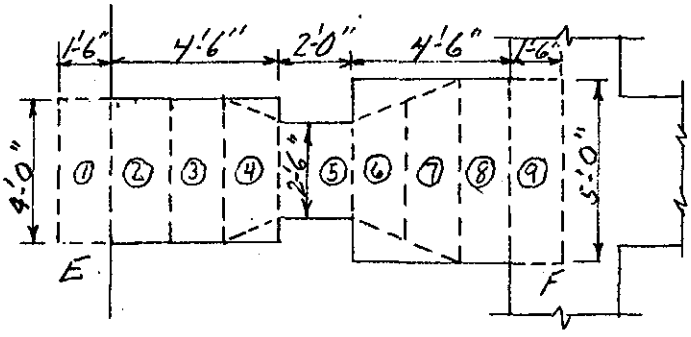
Computation Gate Tower Section from El. 540.5 to El. 572.0

Computed by H.E.W. **Checked by** **Date** 30 - Aug - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Co-efficients for Stiffness - Carry over - F. E. M.

Member EF



Shaded area will be considered as effective Sect. of beam.

Assume beam loaded with 1 kip per ft

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1.5	4.0	0.16	0.24	-6.25	-1.50	9.38 .05	5.0	1.2	-7.5
2	1.5	4.0	0.16	0.24	-4.75	-1.14	5.42 .05	13.2	3.2	-15.0
3	1.5	4.0	0.16	0.24	-3.25	-0.78	2.54 .05	19.2	4.6	-15.0
4	1.5	3.25	0.29	0.44	-1.75	-0.77	1.35 .08	23.0	10.1	-17.7
5	2.0	2.5	0.64	1.28	0	0	0 .42	24.5	31.4	0
6	1.5	3.12	0.33	0.50	1.75	+.88	1.53 .17	23.0	11.5	+20.2
7	1.5	4.37	0.12	0.18	3.25	+.59	1.90 .03	19.2	3.5	+11.3
8	1.5	5.0	0.08	0.12	4.75	+.57	2.71 .02	13.2	1.6	+7.5
9	1.5	5.0	0.08	0.12	6.25	+.75	4.69 .02	5.0	.6	+3.8
				3.36		-1.40	30.41 .59		67.7	-12.4 -28.4
					-.42		29.82			+16.0
				A	$\bar{x}$		I_x		P	M_x

$$\text{Stiffness at } E = \frac{1}{3.36} + \frac{6.58^2}{29.82} = 1.749$$

$$\text{Stiffness at } F = \frac{1}{3.36} + \frac{7.42^2}{29.82} = 2.144$$

$$\text{Carry over at } E = \frac{\frac{1}{3.36} - \frac{6.58 \times 7.42}{29.82}}{1.749} = .77$$

$$\text{Carry over at } F = \frac{\frac{1}{3.36} - \frac{6.58 \times 7.42}{29.82}}{2.144} = .62$$

$$\text{F.E.M at } E = \frac{67.7}{3.36} + \frac{16.0 \times -6.58}{29.82} = 16.61^{1K}$$

$$\text{F.E.M at } F = \frac{67.7}{3.36} + \frac{16.0 \times 7.42}{29.82} = 24.1^{1K}$$

Subject Claremont Dam

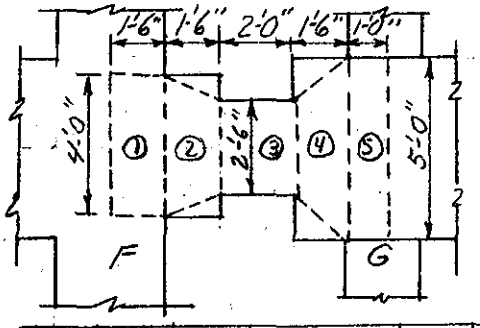
Computation Gate Tower Section from El. 540.5 to 572.0

Computed by H. E. W. **Checked by** **Date** 23-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Co-efficients for Stiffness - Carry over - F.E.M

Member FG



Shaded area will be considered as the effective section

Assume beam loaded with 1 kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	M_s	$M_s a$	$M_s ax$
1	1.5	4.0	0.16	0.24	-3.25	-0.78	2.54 .08	2.6	0.6	-2.0
2	1.5	3.25	0.29	0.44	-1.75	-0.77	1.35 .42	5.9	2.6	-4.5
3	2.0	2.5	0.64	1.28	0	0	0 .05	7.0	9.0	0
4	1.5	3.75	0.19	0.29	+1.75	0.51	0.89 .01	5.0	1.5	+2.5
5	1.0	5.0	0.08	0.08	+3.0	0.24	0.72	1.8	0.1	+0.4
				2.33		-0.80	6.11 .27		13.8	-3.6 -4.7
					-0.34		5.84			+1.1
				A	$\bar{x}$		I_x		P	M_x

Stiffness at F = $\frac{1}{2.33} + \frac{3.66^2}{5.84} = 2.723$

Stiffness at G = $\frac{1}{2.33} + \frac{3.84^2}{5.84} = 2.954$

Carry over at F = $\dfrac{\frac{1}{2.33} - \frac{3.66 \times 3.84}{5.84}}{2.723} = .73$

Carry over at G = $\dfrac{\frac{1}{2.33} - \frac{3.66 \times 3.84}{5.84}}{2.954} = .67$

F.E.M at F = $\frac{13.8}{2.33} + \frac{1.1 \times -3.66}{5.84} = 5.23^{1K}$

F.E.M at G = $\frac{13.8}{2.33} + \frac{1.1 \times 3.84}{5.84} = 6.64^{1K}$

Member GH

Stiffness = $4 \times \frac{5^3}{\cancel{90}\ 96} = \cancel{5.556}\ 5.208$ at far end

"f" for F.E.M = .083 at far end

Carry over = 0.50 at far end

Subject: Claremont Dam
Computation: Gate Tower Section from El. 540.5 to 572.0
Computed by: Checked by: Date:

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Co-efficients for Stiffness - Carry over - F.E.M (cont.)

Members BF & DH

Stiffness = $4 \times \frac{3^3}{124}$ = 0.871 at eq. end

"f" for F.E.M = .083 at eq. end

Carry over = 0.50 " " "

Members FF' & HH'

Stiffness = $4 \times \frac{3^3}{132}$ 0.818 at eq. end

"f" for F.E.M = .083 at eq. end.

Carry over = 0.50 " " "

Design Head

Spillway Elev = 630.0

Sect. " = 552.0

Design head = 78.0

$P = 78.0 \times 62.5 = 4880$ #/□'

Fixed End Moments

Member AB

$M^F_{AB} = 16.4 \times 4.88 = 80.0^{'K}$

$M^F_{BA} = 20.5 \times 4.88 = 100.0^{'K}$

Member BC

$M^F_{BC} = 5.02 \times 4.88 = 24.5^{'K}$

$M^F_{CB} = 5.89 \times 4.88 = 28.7^{'K}$

Member CD & GH

$M^F_{at\ eq.end} = .083 \times 4.88 \times \cancel{7.5}^{9.0\,2} = \cancel{22.8}^{26.0\,'K}$ (error will have little effect & will be neglected)

Member EF

$M^F_{EF} = 16.6 \times 4.88 = 81.0^{'K}$

$M^F_{FE} = 24.1 \times 4.88 = 117.6^{'K}$

Member FG

$M^F_{FG} = 5.23 \times 4.88 = 25.5^{'K}$

$M^F_{GF} = 6.64 \times 4.88 = 32.4^{'K}$

Member BF & DH

$M^F_{at\ eq.end} = .083 \times 4.88 \times 10.31^2 = 43.1^{'K}$

Member FF' & HH'

$M^F_{at\ eq.end} = .083 \times 4.88 \times 11^2 = 49.0^{'K}$

Mom. from Trash Rack Pier

From El. 544.75 to El. 549.25 $M = \frac{2,410,620}{4.5} = 535.7^{'K}$

At El. 552 $M = 90.8^{'K}$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

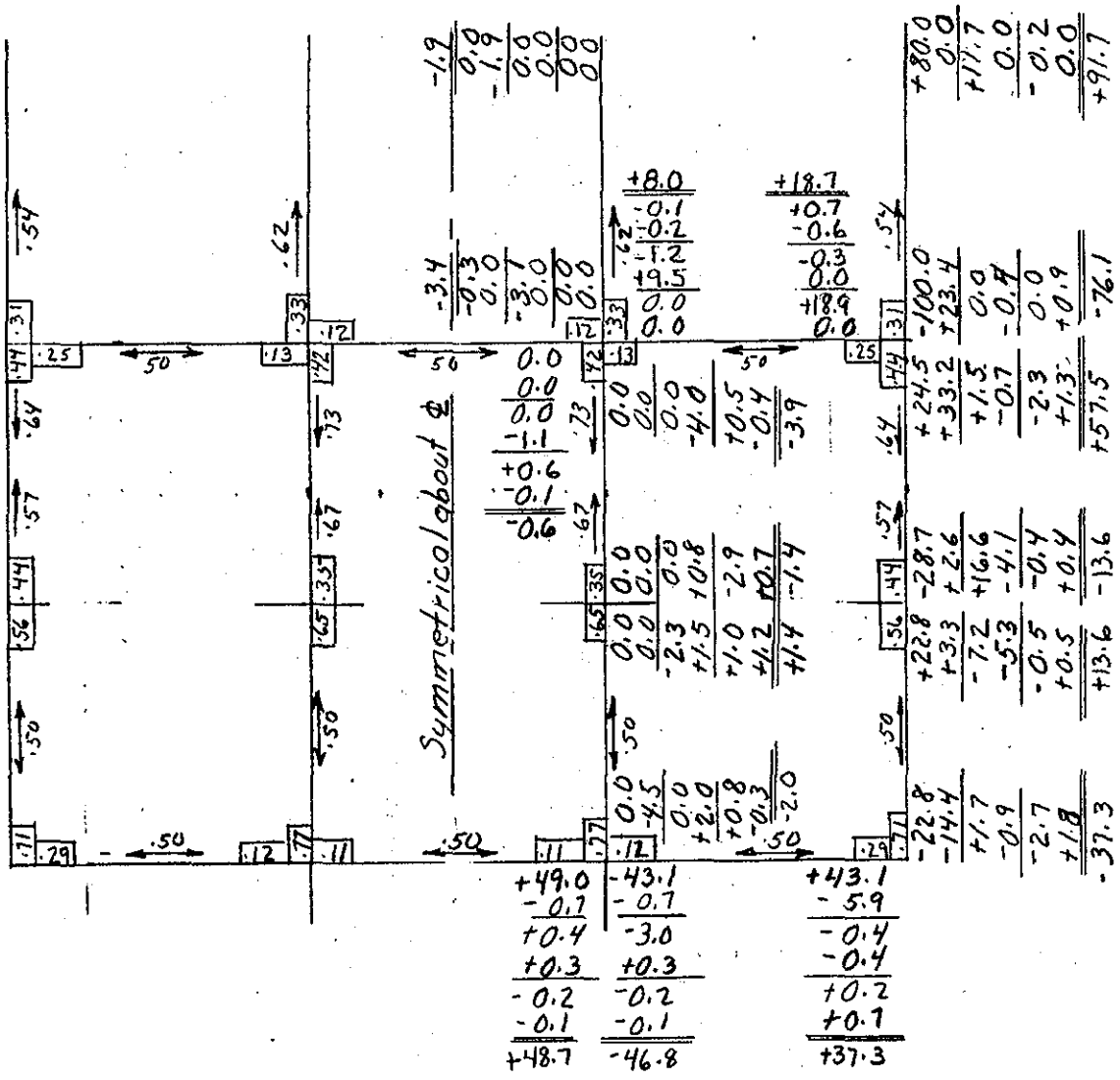
Subject: Claremont Dam

Computation: Gate Tower Section from El. 546.5 to El. 572.0

Computed by: H.E.W. Checked by: Date: 30-Aug-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Case I Gates open outside walls loaded to full head to spillway crest



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

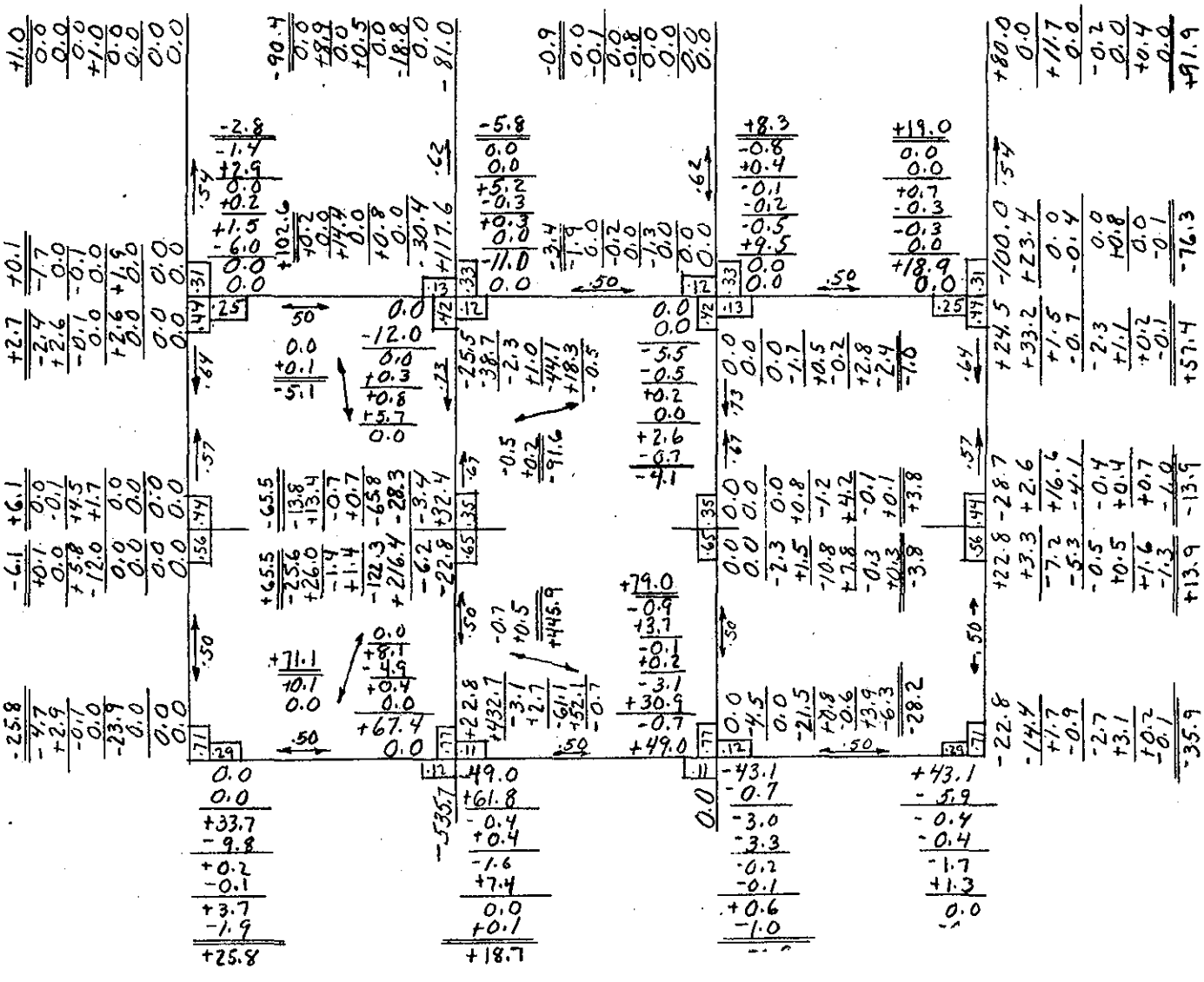
Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to El. 572.0

Computed by: H.E.W. Checked by: Date: 30 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case II - Service Gate in either of the end wells closed the other two remaining open. Use 535.7[K] for mom. from trash rack pier



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

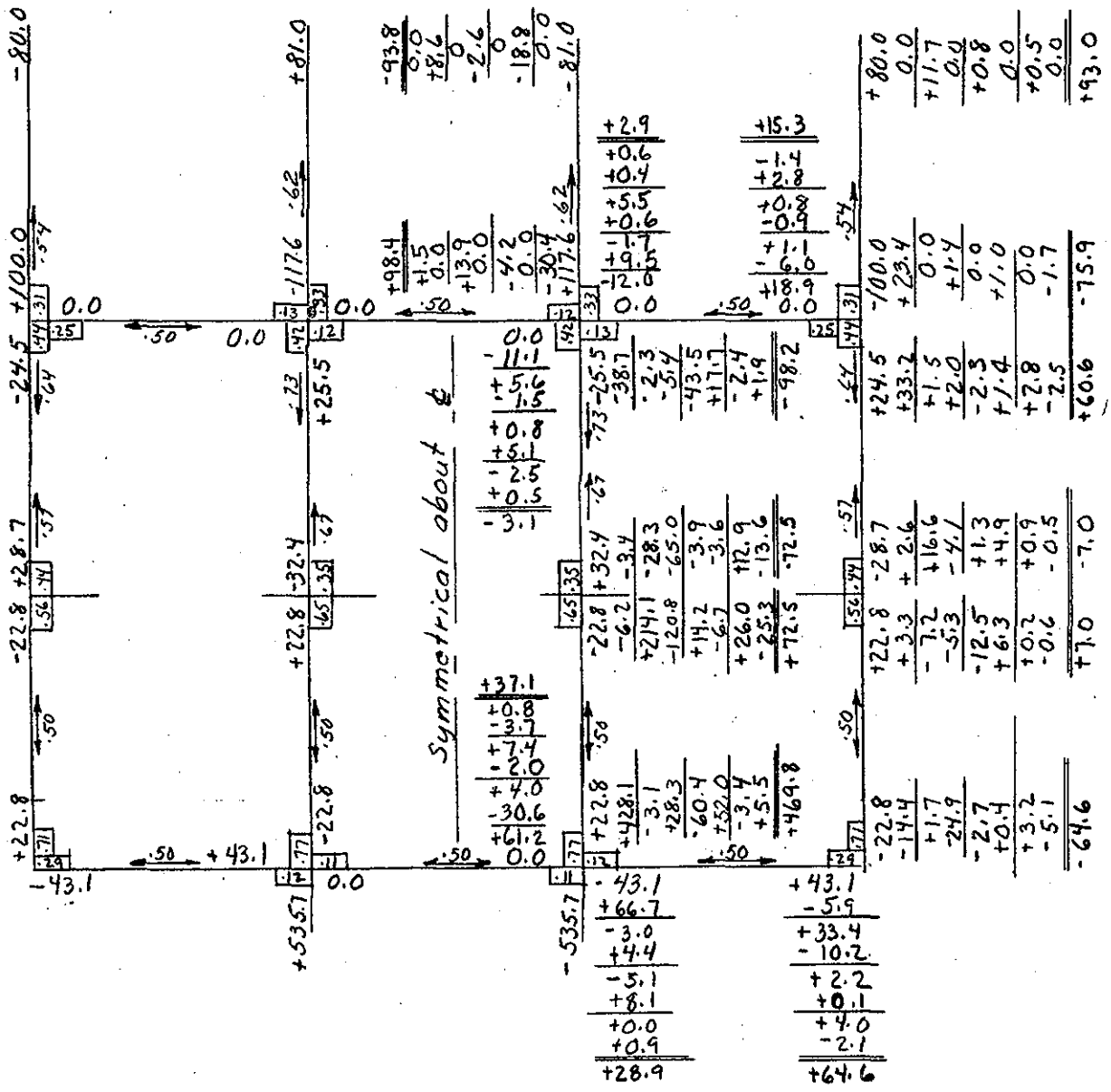
Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to El. 572.0

Computed by: H. E. W. Checked by: Date: 31- Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case III - Middle service gate closed and end service gates open. - Useing 535.7'k for mom. from trash rack pier



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

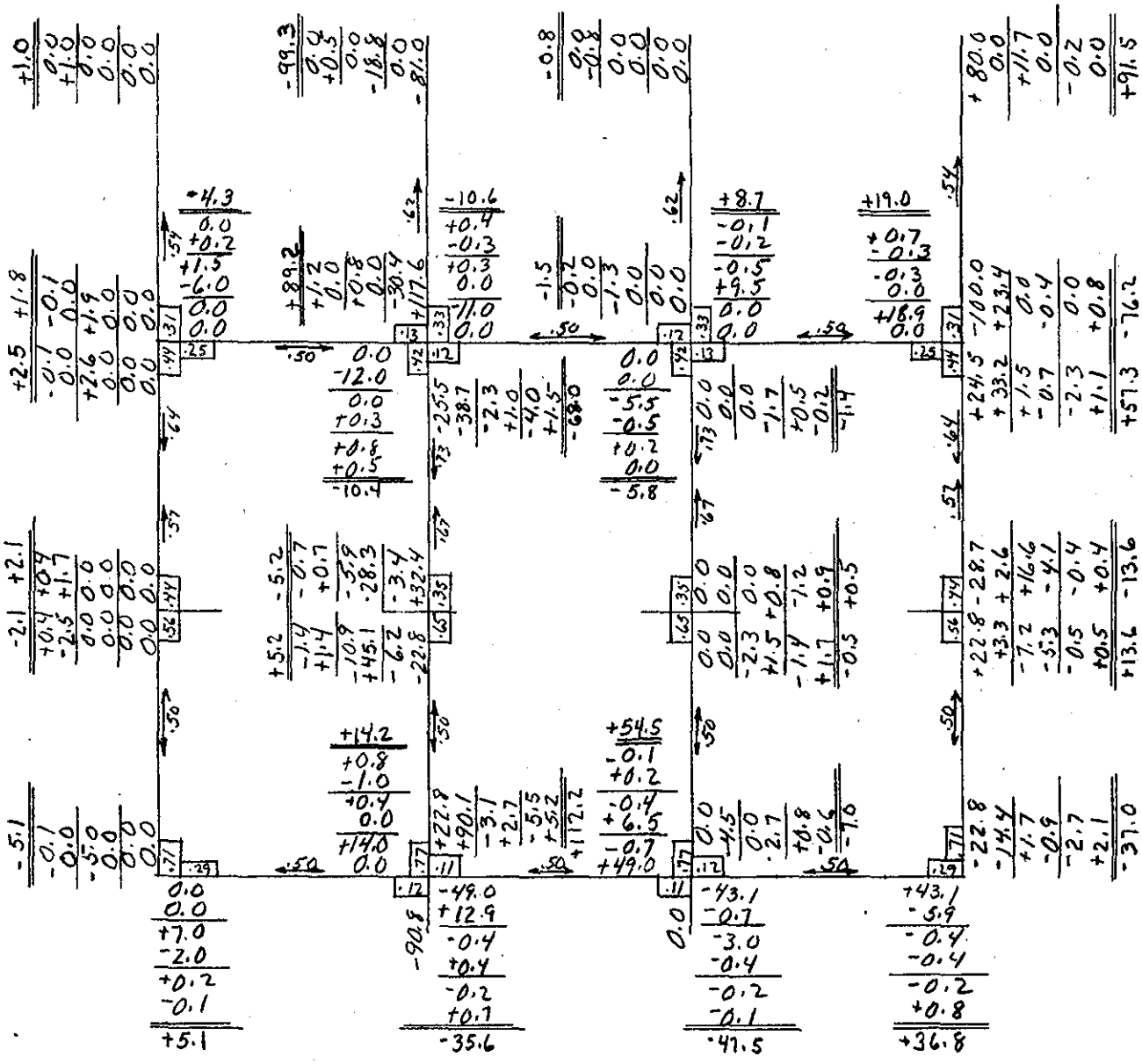
Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to El. 512.0

Computed by: H.E.W. Checked by: Date: 1 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case VII Service gate in either of the end wells closed the other two remaining open Use 90.8'K for mom. from trash rack pier.



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

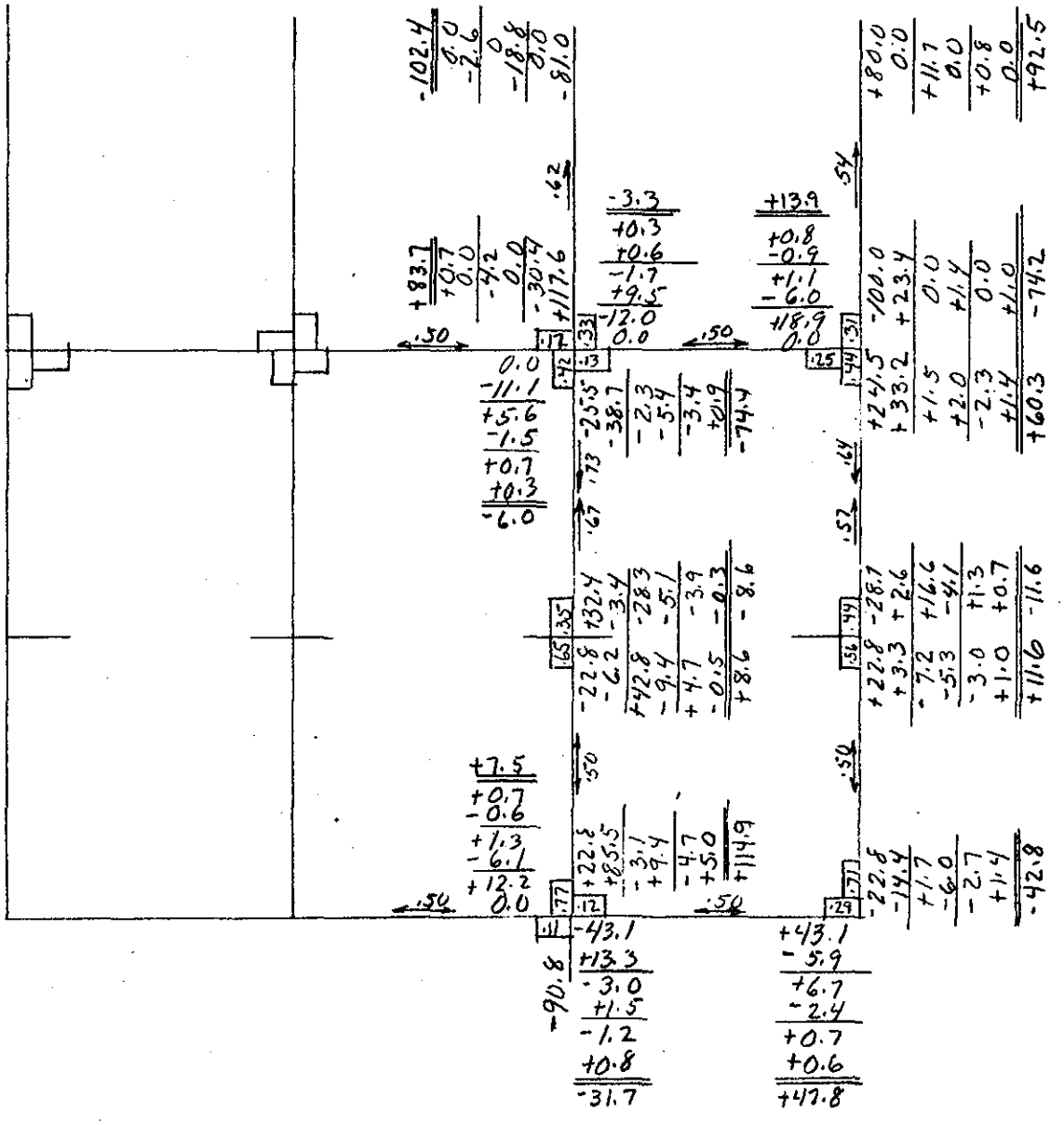
Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to El. 572.0

Computed by: H.E.W. Checked by: Date: 2- Sept - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case VIII Middle service gate closed and end gates open. Useing 90.8'k for mom. from trash rack pier.



Subject: Claremont Dam
Computation: Gate Tower Section from El. 540.5 to 572.0
Computed by: H. E. W. Checked by: Date: 2 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Max. end shears and positive moments
Section A from El. 544.75 to El. 549.25

Member AB & A'B'

$V_A = 4880 \times \frac{14}{2} + \frac{17,100}{14} = 35,380^{\#}$

$x_0 = 6.84'$ from B

$V_B = 4880 \times \frac{14}{2} - \frac{10,600}{14} = 33,400^{\#}$

$+M = 33,400 \times 6.84 - 79,500 - 4880 \times \frac{6.84^2}{2} = 34,800'^{\#}$

Member BC & B'C

$V_B = 4880 \times \frac{7.5}{2} + \frac{52,400}{7.5} = 25,290^{\#}$

$x_0 = 5.18'$ from B

$V_C = 4880 \times \frac{7.5}{2} - \frac{43,500}{7.5} = 12,500^{\#}$

$+M = 25,290 \times 5.18 - 60,600 - 4880 \times \frac{5.18^2}{2} = 5760'^{\#}$

Member CD & C'D'

$V_C = 4880 \times \frac{8}{2} - \frac{22,000}{8} = 16\ 770^{\#}$

$x_0 = 3.44'$ from C

$V_D = 4880 \times \frac{8}{2} + \frac{57,600}{8} = 26,720^{\#}$

$+M = 16770 \times 3.44 - 13,900 - 4880 \times \frac{3.44^2}{2} = 14,920'^{\#}$

Also $+M = 25,800'^{\#}$ at D in Case II

Member EF & E'F'

$V_E = 4880 \times \frac{14}{2} - \frac{4,600}{14} = 33830^{\#}$

$x_0 = 6.93'$ from E

$V_F = 4880 \times \frac{14}{2} + \frac{12,200}{14} = 35030^{\#}$

$+M = 33830 \times 6.93 - 93,800 - 4880 \times \frac{6.93^2}{2} = 23,460'^{\#}$

Use same values for both faces

Member FG & F'G'

$V_F = 4880 \times \frac{7.5}{2} + \frac{170,700}{7.5} = +41060$

$V_G = 4880 \times \frac{7.5}{2} - \frac{109,700}{7.5} = +3670^{\#}$

$+M = 72,500'^{\#}$ at G

Use same values for both faces

Member GH & G'H'

$V_G = 4880 \times \frac{8}{2} - \frac{497,000}{8} = -42,600^{\#}$

$V_H = 4880 \times \frac{8}{2} + \frac{542,800}{8} = 87,370^{\#}$

$+M = 72,500'^{\#}$ at G

Subject: Claremont Dam
Computation: Gate Tower Section from El. 540.5 to 572.0
Computed by: H.E.W. Checked by: Date: 5 Sept. 44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Member BF & F'B'

$V_B = 4880 \times \frac{10.31}{2} + \frac{15,600}{10.31} = 26,670^{\#}$ $\quad x_0 = 5.47'$ from B

$V_F = 4880 \times \frac{10.31}{2} - \frac{15,600}{10.31} = 23,640$

$x_0 =$

$+M = 26,670 \times 5.47 - 57000 - 4880 \times \frac{5.47^2}{2} = 15880'^{\#}$

Member FF'

$V_F = 4880 \times \frac{11}{2} = 26,840^{\#}$

$M = \frac{1}{8} \times 4880 \times 11^2 - 50,600 = 23,210'^{\#}$

Member DH & H'D

$V_D = 4880 \times \frac{10.31}{2} + \frac{94600}{10.31} = 34,330^{\#}$

$V_H = 4880 \times \frac{10.31}{2} + \frac{14900}{10.31} = 26,600^{\#}$

$+M = 28,900'^{\#}$ at H & $27,300'^{\#}$ at D

Member HH'

$V_H = 4880 \times \frac{11}{2} + \frac{99,000}{11} = 35,840^{\#}$

$M = \frac{1}{8} \times 4880 \times 11^2 - 11,600 = 62,210'^{\#}$

Section B from El. 540.5 to El. 544.75 & El. 549.75 to El. 572.0

Member AB

$V_A = 4880 \times \frac{14}{2} + \frac{18,300}{14} = 35470$

$V_B = 33,400$ $\quad +M = 34,800$ (see Section A.

Member BC

Use same values as for Sect. A

Member CD

$V_C = 4880 \times \frac{8}{2} - \frac{23,400}{8} = 16,590^{\#}$ $\quad x_0 = 3.40'$ from C

$V_D = 4880 \times \frac{8}{2} + \frac{31,200}{8} = 23,420^{\#}$

$+M = 16,590 \times 3.40 - 13,600 - 4880 \times \frac{3.40^2}{2} = 14,600'^{\#}$

Member EF

$V_E = 4880 \times \frac{14}{2} + \frac{18,700}{14} = 35,500^{\#}$ $\quad x_0 = 7.27'$ from E

$V_F = 4880 \times \frac{14}{2} - \frac{10,100}{14} = 33,440^{\#}$

$+M = 35,500 \times 7.27 - 102,400 - 4880 \times \frac{7.27^2}{2} = 26,730'^{\#}$

[Use same values for both faces]

Member FG

$V_F = 4880 \times \frac{7.5}{2} + \frac{83,000}{7.5} = 29,370^{\#}$ $\quad x_0 = 1.75'$ from G

$V_G = 4880 \times \frac{7.5}{2} - \frac{73,200}{7.5} = 8540^{\#}$

$M = 8540 \times 1.75 + 5,200 - 4880 \times \frac{1.75^2}{2} = 12,670'^{\#}$

Member GH

$V_G = 4880 \times \frac{8}{2} - \frac{23,400}{8} = 16,600^{\#}$ $\quad x_0 = 3.40'$ from G

$V_H = 4880 \times \frac{8}{2} + \frac{31,200}{8} = 23,420^{\#}$

$+M = 16,600 \times 3.4 - 13,600 - 4880 \times \frac{3.4^2}{2} = 14,630'^{\#}$

Members BF & F'F' - use same values as Section A

Member DH

$V_D = 4880 \times \frac{10.31}{2} + \frac{11,100}{10.31} = 26,230^{\#}$ $\quad x_0 = 5.38'$ from D

$V_H = 4880 \times \frac{10.31}{2} + \frac{10,700}{10.31} = 26,200^{\#}$

$+M = 26,230 \times 5.38 - 42,800 - 4880 \times \frac{5.38^2}{2} = 27,690'^{\#}$

Member HH'

$V_H = 4880 \times \frac{11}{2} + \frac{18,900}{11} = 28,500^{\#}$ - $x_0 = 5.84'$ from H

$M = 28,500 \times 5.84 - 54,500 - 4880 \times \frac{5.84^2}{2} = 28,720'^{\#}$

Design of Section A between El. 549.25 & El. 544.75

Member AB

At pt A values of shear and mom. at face of support.

$V = 35380 - 1.5 \times 4880 = 28060^{\#}$

$M = 93,000 - \frac{1}{3}\left(\frac{35380 + 28060}{2}\right) \times 3 = 61,280'^{\#}$

At pt B values of shear and mom. at face of support

$V = 33,400 - 1.5 \times 4880 = 26080^{\#}$

$M = 79,500 - \frac{1}{3}\left(\frac{33400 + 26080}{2}\right) \times 3 = 49,760'^{\#}$

At end A - req'd $d = \sqrt{\frac{61,280}{147}} = 20.4'' < 33''$ OK

$v = \frac{28060}{12 \times .88 \times 33} = 80^{\#}/\square''$

$A_s = \frac{61,280 \times 12}{18000 \times .88 \times 33} = 1.40\ \square''$ use 1"□ @ 8" cc

Design Section A (cont.)

At end A Member AB (cont.)

$u_0 = \frac{28060}{6.0 \times .88 \times 33} = 160$ #/□"

At end B - $-A_s = \frac{49,760 \times 12}{18000 \times .88 \times 39} = .97$ □" Use 1"φ @ 8"cc

$u_0 = \frac{26080}{4.7 \times .88 \times 39} = 165$ #/□" OK

$+A_s = \frac{34,800 \times 12}{18000 \times .88 \times 25.5} = 1.04$ □" Use 1"φ @ 8"cc

Member BC

At pt B values of shear and mom. at face of support

$V = 25,450 - 4880 \times 1.5 = 18,130$ #

$M = 60,600 - \frac{1}{3}\left(\frac{18130 + 25450}{2}\right) \times 3 = 38,810$ '#

At pt B - $A_s = \frac{38,810 \times 12}{18,000 \times .88 \times 33} = .90$ □" Use 1"φ @ 8"cc

$u_0 = \frac{18130}{4.7 \times .88 \times 33} = 133$ #/□"

At pt C $-A_s = \frac{13,800 \times 12}{18,000 \times .88 \times 39} = .27$ □" Use 1"φ @ 8"cc

$+A_s = \frac{5760 \times 12}{18000 \times .88 \times 25.5} = .11$ □" Use 7/8"φ @ 1'-0"cc

Member CD

At pt D values of shear and mom. at face of support

$V = 26,720 - 1.5 \times 4880 = 19,400$ #

$M = 64,900 - \frac{1}{3}\left(\frac{26720 + 19,400}{2}\right) 3 = 41,840$ '#

At end D - $A_s = \frac{41840 \times 12}{18,000 \times .88 \times 39} = .82$ □" 1"φ @ 8"cc

$u_0 = \frac{19,400}{4.7 \times .88 \times 39} = 120$ #/□"

$+A_s = \frac{14,920 \times 12}{18000 \times .88 \times 39} = .28$ □" Use 7/8"φ @ 1'-0"cc

Member EF

At pt E - Values of shear and mom at face of sup.

$V = 33830 - 1.5 \times 4880 = 26510$ #

$M = 93,800 - \frac{1}{3}\left(\frac{33830 + 26510}{2}\right) \times 3 = 63,630$ '#

Subject: Claremont Dam
Computation: Gate Tower Section from El 540.5 to 572.0
Computed by: H.E.W. Checked by: Date: 6 Sept. 44

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Member EF (cont.)

At pt F - Values of shear and mom. at face of support

$V = 35030 - 1.5 \times 4880 = 27,710^{\#}$

$M = 102,600 - \frac{1}{3}\left(\frac{35030+27710}{2}\right) \times 3 = 71,230^{\#}$

At pt. E - req'd $d = \sqrt{\frac{63630}{147}} = 20.8'' < 43.5''$

$v = \frac{26510}{12 \times .88 \times 43.5} = 58\ \#/\square''$ OK

$-A_s = \frac{63630 \times 12}{18,000 \times .88 \times 43.5} = 1.10\ \square''$ Use 1"φ @ 8" cc

$u_0 = \frac{26510}{4.7 \times .88 \times 43.5} = 147\ \#/\square''$

At pt F $v = \frac{27,710}{12 \times .88 \times 55.5} = 47\ \#/\square''$

$-A_s = \frac{71,230 \times 12}{18000 \times .88 \times 55.5} = .98\ \square''$ Use 1"φ @ 8" cc

$u_0 = \frac{27710}{4.7 \times .88 \times 55.5} = 121\ \#/\square''$

$+A_s = \frac{23,460 \times 12}{18000 \times .88 \times 28.5} = .63\ \square''$ Use 7/8"φ @ 8" cc

Member FG

At pt F - Values of shear and mom. at face of support

$V = 41,060 - 4880 \times 1.5 = 33740^{\#}$

$M = 98,200 - \frac{1}{3}\left(\frac{41,060+33740}{2}\right) \times 3 = 60800^{\#}$

At pt F - $v = \frac{33740}{12 \times .88 \times 43.5} = 73\ \#/\square''$

$-A_s = \frac{60,800 \times 12}{18000 \times .88 \times 43.5} = 1.06\ \square''$ Use 1"φ @ 8" cc

$u_0 = \frac{33740}{4.7 \times .88 \times 43.5} = 187\ \#/\square''$

At pt G $A_s = \frac{72,500 \times 12}{18000 \times .88 \times 55.5} = .99\ \square''$ 1"φ @ 8" cc req'd

Member GH

$V_H = 87,370 - 4880 \times 1.5 = 80050^{\#}$

$M = 471,900 - \frac{1}{3}\left(\frac{87370 \times 80050}{2}\right) \times 3 = 388,190$

At pt H req'd $d = \sqrt{\frac{388190}{147}} = 51.4'' < 55.5''$ OK

$v = \frac{80,050}{12 \times .88 \times 49.5} = 153\ \#/\square''$ Use stirrups

Subject Claremont Dam

Computation Gate Tower Section from El. 540.5 to El. 572.0

Computed by H.E.W. **Checked by** **Date** 7 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Member GH.

At pt. H $-A_s = \frac{388190 \times 12}{18000 \times .88 \times 49.5} = 5.9^{\square''}$ $6 \cdot 1\frac{1}{4}^{\square''}$. OK!

$u_o = \frac{80,050}{9.37 \times .88 \times 49.5} = 196\ ^{\#}/\square''$

Spacing $\frac{7}{8}''\phi$ stirrups

$5.5 \times 80,050 = 440,275^{\#}$ Total shear on 5'-6" strip

$v = \frac{440275}{66 \times .88 \times 49.5} = 153\ ^{\#}/\square''$

$.39 \times 16000 = 63 \times 66 \times s_1$ - $s_1 = 15''$

Use 12" spacing of stirrups for entire length of beam

Member BF

At pt. B. Value of shear and mom at face of support

$V = 26,670 - 4880 \times 1.81 = 17840^{\#}$

$M = 57,000 - \frac{1}{3}\left(\frac{26670 + 17840}{2}\right) 3.62 = 30,150^{\#'}$

At pt F Value of shear and mom. at face of support

$V = 23,640 - 4880 \times 2.5 = 11,440^{\#}$

$M = 41,400 - \frac{1}{3}\left(\frac{23,640 + 11440}{2}\right) 5 = 12,170^{\#'}$

At pt. B - req'd $d = \sqrt{\frac{30,150}{147}} = 14.3'' < 31.5''$

$v = \frac{17840}{12 \times .88 \times 31.5} = 54\ ^{\#}/\square''$

$-A_s = \frac{30,150 \times 12}{18,000 \times .88 \times 31.5} = .72^{\square''}$ use $\frac{7}{8}''\phi$ @ 8" cc

$u_o = \frac{17840}{41 \times .88 \times 31.5} = 157\ ^{\#}/\square''$

At pt. F - $A_s = \frac{12,170 \times 12}{18,000 \times .88 \times 31.5} = .29^{\square''}$

$+A_s = \frac{15880 \times 12}{18000 \times .88 \times 31.5} = 38^{\square''}$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

Member FF'

Values of shear and mom. at face of support

$V = 26,840 - 4880 \times 2.5 = 14,680^{\#}$

$M = 50,600 - \frac{1}{3}\left(\frac{26840 + 14680}{2}\right) \times 5 = 16000^{\#'}$

$-A_s = \frac{16000 \times 12}{18000 \times .88 \times 31.5} = .39^{\square''}$ use $\frac{7}{8}''\phi$ @ 8" cc

Member FF' (cont.)

$u_0 = \frac{14680}{4.1 \times .88 \times 31.5} = 129\ \#/\square''$

$+A_s = \frac{23,210 \times 12}{18000 \times .88 \times 31.5} = .56\ \square''$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

Member DH

At end D - Values of shear & mom. at face of support

$V = 34330 - 4880 \times 1.81 = 25500$

$M = 64,900 - \frac{1}{3}\left(\frac{34330 + 25500}{2}\right) \times 3.62 = 28,800'\#$

At end H - Values of shear & mom. at face of support

$V = 26,600 - 4880 \times 2.5 = 14440\#$

$M = 75,400 - \frac{1}{3}\left(\frac{102,700}{10.31}\right) \times 5.0 = 58,800'\#$

At pt. D - $-A_s = \frac{28800 \times 12}{18,000 \times .88 \times 31.5} = .69\ \square''$ $1\frac{1}{4}''\square$ @ 1'-0" cc

$u_0 = \frac{25,500}{5.0 \times .88 \times 31.5} = 184\ \#/\square''$

At pt H - req'd $d = \sqrt{\frac{58800}{147}} = 20'' < 31.5''$ OK

$-A_s = \frac{58800 \times 12}{18000 \times .88 \times 31.5} = 1.42\ \square''$ Use $1\frac{1}{4}''\square$ @ 1'-0" cc.

$u_0 = \frac{14440}{5.0 \times .88 \times 31.5} = 104\ \#/\square''$

$+A_s = \frac{29,700 \times 12}{18000 \times .88 \times 31.5} = .71\ \square''$ $1''\phi$ @ 1'-0" cc req'd

Member HH

Reduction of shear and mom. at face of support

$V = 35840 - 4880 \times 2.5 = 23,640\#$

$M = 79,300 - \frac{1}{3}\left(\frac{35840 + 23640}{2}\right) \times 5 = 29740'\#$

$-A_s = \frac{29740 \times 12}{18000 \times .88 \times 31.5} = .72\ \square''$ Use $1\frac{1}{4}''\square$ @ 1'-0" cc

$u_0 = \frac{23640}{5.0 \times .88 \times 31.5} = 170\ \#/\square''$

$+A_s = \frac{62,210 \times 12}{18000 \times .88 \times 31.5} = 1.49\ \square''$ Use $1\frac{1}{4}''\square$ @ 1'-0" cc

$v = \frac{23640}{12 \times .88 \times 31.5} = 71\ \#/\square''$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 540.5 to El. 572.0

Computed by H.E.W. **Checked by** **Date** 7- Sept. 44

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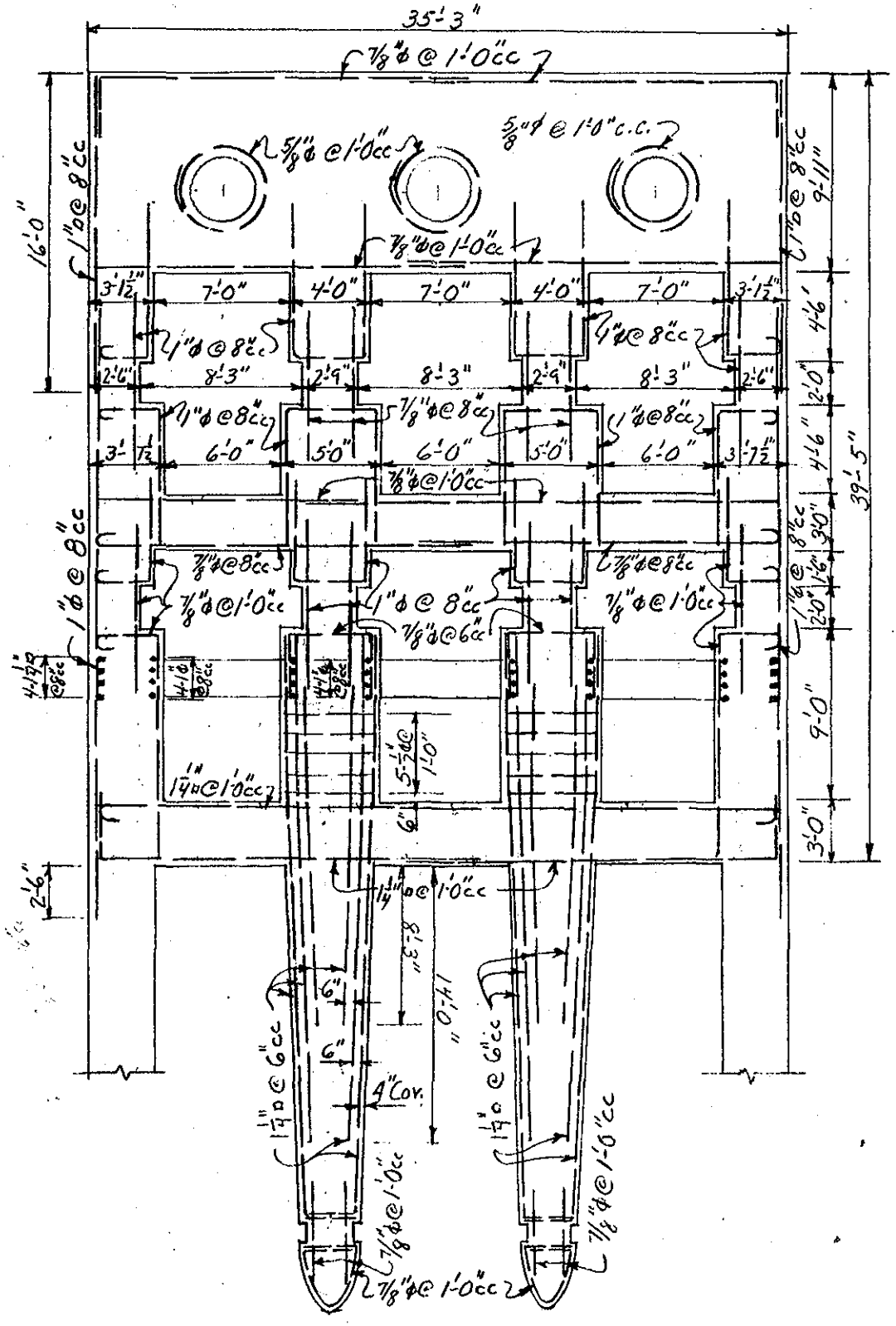
4'-6" Section from El. 544.75 to El. 549.25



Subject: Claremont Dam
Computation: Gate Tower Section from El. 540.5 to El. 572.0
Computed by: H.E.W. Checked by: Date: 9-Sept.-44

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Design of Section B from El. 540.5 to El. 544.75 & El. 549.75 to El. 572.0

Member AB - Use same steel as in Section A
Member BC - Use same steel as in Section A
Member CD

At Pt. D - values of shear and mom. at face of support

$V = 23420 - 4880 \times 1.5 = 16,100$

$M = 42,800 - \frac{1}{3}\left(\frac{23420 + 16,100}{2}\right) \times 3 = 23,040$

At end D - $A_s = \frac{23040 \times 12}{18000 \times .88 \times 39} = .45^{\square''}$ $\frac{7}{8}''\phi$ @ 1'-0" cc

$u_o = \frac{16,100}{2.8 \times .88 \times 39} = 167\ ^{\#}/_{\square''}$

$+A_s$: Use $\frac{7}{8}''\phi$ @ 1'-0" cc

Member EF

At pt E - Values of shear and mom. at face of support

$V = 35500 - 1.5 \times 4880 = 28180^{\#}$

$M = 102,400 - \frac{1}{3}\left(\frac{35500 + 28180}{2}\right) \times 3 = 70560'^{\#}$

At pt F - Values of shear and mom at face of support

$V = 33,440 - 1.5 \times 4880 = 26,120^{\#}$

$M = 89,200 - \frac{1}{3}\left(\frac{33440 + 26120}{2}\right) \times 3 = 59420'^{\#}$

At pt E. $v = \frac{28180}{12 \times .88 \times 43.5} = 61\ ^{\#}/_{\square''}$

$-A_s = \frac{70560 \times 12}{18000 \times .88 \times 43.5} = 1.23^{\square''}$ Use 1"ϕ @ 8" cc

$u_o = \frac{28180}{4.7 \times .88 \times 43.5} = 156\ ^{\#}/_{\square''}$

At pt. F $-A_s = \frac{59,420 \times 12}{18000 \times .88 \times 55.5} = .81^{\square''}$ Use $\frac{7}{8}''\phi$ @ 8" cc

$u_o = \frac{26120}{4.1 \times .88 \times 55.5} = 130\ ^{\#}/_{\square''}$

$+A_s$ $\frac{26,730 \times 12}{18000 \times .88 \times 28.5} = .11^{\square''}$ Use $\frac{7}{8}''\phi$ @ 8" cc.

Member FG

At pt F - Values of shear and mom. at face of support

$V = 29370 - 4880 \times 1.5 = 22050^{\#}$

$M = 74,400 - \frac{1}{3}\left(\frac{29370 - 22050}{2}\right) \times 3 = 48,700'^{\#}$

At pt F - $v = \frac{22050}{12 \times .88 \times 43.5} = 48\ ^{\#}/_{\square''}$ OK

$-A_s = \frac{48,700 \times 12}{18000 \times .88 \times 43.5} = .85^{\square''}$ Use $\frac{7}{8}''\phi$ @ 8" cc

Subject: Claremont Dam.
Computation: Gate Tower Section from El 540.5 to El 572.0
Computed by: H.E.W. Checked by: Date: 11- Sept. 44

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Section B- Member FG (cont)

$u_0 = \frac{22050}{4.1 \times .88 \times 43.5} = 141\ \#/\square''$

At pt G A_s Use $\frac{7}{8}''\phi$ @ 8" cc

Member GH

At pt H - values of shear & mom at face of supports

$V = 23,420 - 4880 \times 1.5 = 16,100^{\#}$

$M = 114,900 - \frac{1}{3}\left(\frac{23420+16100}{2}\right) \times 3 = 95,140'^{\#}$

At pt H $v = \frac{16100}{12 \times .88 \times 55.5} = 27\ \#/\square''$

$-A_s = \frac{95140 \times 12}{18000 \times .88 \times 55.5} = 1.29\ \square''$ Use 1"□ @ 8" cc [El. 549.75-572]
" 1"□ @ 9" cc [El. 540.5-549.75]

$u_0 = \frac{16,100}{6.0 \times .88 \times 55.5} = 55\ \#/\square''$

Members BF & FF' Use same steel as Section A

Member DH

At end D - Values of shear & mom. at face of support

$V = 26,230 - 4880 \times 1.81 = 17400^{\#}$

$M = 42,800 - \frac{1}{3} \times \left(\frac{26230+17400}{2}\right) \times 3.62 = 16,480'^{\#}$

At end H- Values of shear & mom. at face of support

$V = 26200 - 4880 \times 2.5 = 14,000^{\#}$

$M = 47,500 - \frac{1}{3}\left(\frac{26,200+14000}{2}\right) \times 5 = 14,000'^{\#}$

At pt D - $A_s = \frac{16,480 \times 12}{18000 \times .88 \times 31.5} = .40\ \square''$ Try $\frac{7}{8}''\phi$ @ 1'-0" cc

$u_0 = \frac{17400}{2.8 \times .88 \times 31.5} = 224\ \#/\square''$ N.G. Use $\frac{7}{8}''\phi$ @ 8" cc

At pt H - Use $\frac{7}{8}''\phi$ @ 8" cc

$+A_s = \frac{27,690}{18000 \times .88 \times 31.5} = .56\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" cc.

Member H.H'

Values of shear and mom. at face of support

$V = 28,500 - 4880 \times 2.5 = 16,300^{\#}$

$M = 54,500 - \frac{1}{3}\left(\frac{28500+16,300}{2}\right) \times 5 = 17,170'^{\#}$

$-A_s = \frac{17,170 \times 12}{18,000 \times .88 \times 31.5} = .41\ \square''$ Try $\frac{7}{8}''\phi$ @ 8" cc

$u_0 = \frac{16,300}{4.1 \times .88 \times 31.5} = 143\ \#/\square''$ Use $\frac{7}{8}''\phi$ @ 8" cc

$+A_s = \frac{28720 \times 12}{18000 \times .88 \times 31.5} = .69\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" cc

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El. 540.5 to El. 572.0

Computed by: H.E.W. Checked by: Date: 11 Sept. 44

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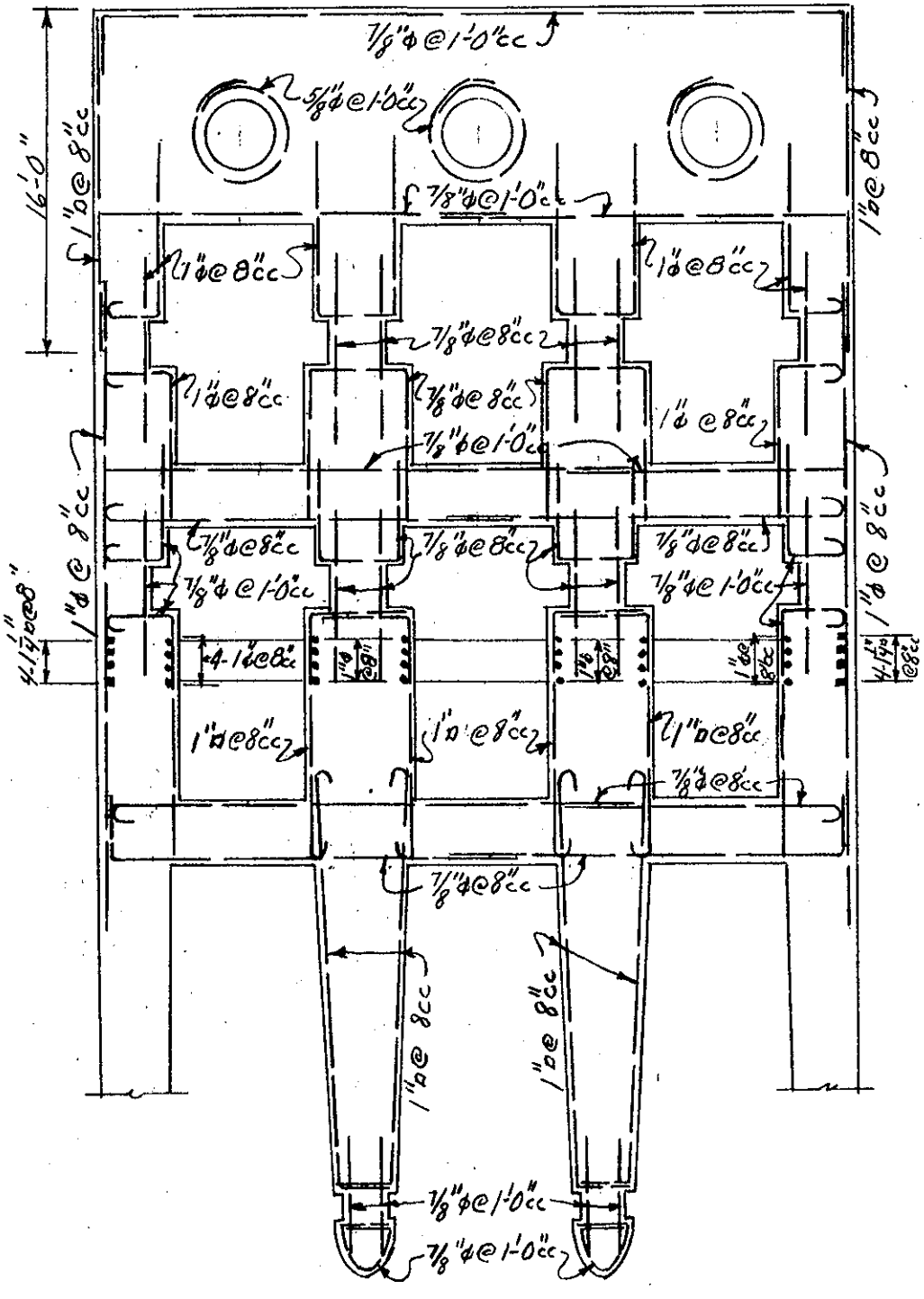
Section from El. 540.5 to El. 544.75 & El. 549.75 to El. 572.0

Note. Dimensions are the same as for section from El. 544.75 to El. 549.25



Subject Claremont Dam

Computation Gate Tower Struts

Computed by H.E.W **Checked by** **Date** 12-Sept-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Vertical Beam in Outside Walls

From Case II - End react. member CD $= 4880 \times 4 - \frac{22000}{8} = 16770^{\#}$

" " " BC $= 4880 \times \frac{7.5}{2} - \frac{43,500}{7.5} = 12500$

Total uniform load $= 29270^{\#/'}$

F.E.M

$M^E = \frac{1}{12} \times 29270 \times 10.67^2 = 277.7^{'K}$

$M^E = \frac{1}{12} \times 29270 \times 10.5^2 = 268.9^{'K}$

$M^E = \frac{1}{12} \times 29270 \times 10.29^2 = 258.3^{'K}$

	29.270 #/'					
	10'-8"		10'-6"		10'-3½"	
		.50	.50	.50	.50	
+	277.7	-277.7	+268.9	-268.9	+258.3	-258.3
	0	+4.4	+4.4	+5.3	+5.3	0
	+2.2	0	+2.7	+2.2	0	+2.7
	0.0	-1.3	-1.4	-1.1	-1.1	0.0
-M	279.9	-274.6	+274.6	-262.5	+262.5	-255.6
V	156.7K	155.7K	154.8K	152.5K	151.4K	150.1K
x_0	→ 5.35'		→ 5.29'		5.13' ←	
+M	139.6'K		134.7'K		129.4'K	
React	156.7	310.5K		303.9K		150.1K

reqd $d = \sqrt{\frac{279,900 \times 12}{36 \times 147}} = 25.2'' < 37''$ OK (Assuming 3'-0" width)

Shear at face: $156,700 - 1.75 \times 29,270 = 105,480$

$v = \frac{105480}{36 \times .88 \times 37} = 90^{\#}/\square''$

Shear at face of strut $= 155,700 - 1.25 \times 29270 = 119,120^{\#}$

$v = \frac{119,120}{24 \times .88 \times 53} = 106^{\#}/\square''$ OK as more than 24" will act

Shear at edge of strut: $155,700 - 2.5 \times 29270 = 82530^{\#}$

$v = \frac{82530}{24 \times .88 \times 37} = 106^{\#}/\square''$ OK as more than 24" will act

Shear at face $= 150,100 - 1.29 \times 29270 = 112,340^{\#}$

$v = \frac{112,340}{36 \times .88 \times 37} = 96^{\#}/\square''$ OK

$-A_s = \frac{279,900 \times 12}{18000 \times .88 \times 37} = 5.75\ \square''$ Use 4-1¼" ⌀ bars

$u_0 = \frac{119,120}{22.5 \times .88 \times 53} = 114^{\#}/\square''$

$+A_s = \frac{139,600 \times 12}{18000 \times .88 \times 37} = 2.86\ \square''$ Use 4-1" ⌀

Project: Claremont Dam

Computation: Gate Tower Struts

Computed by: H. E. W. Checked by: Date: 12 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Vertical Beam in Inside Wall

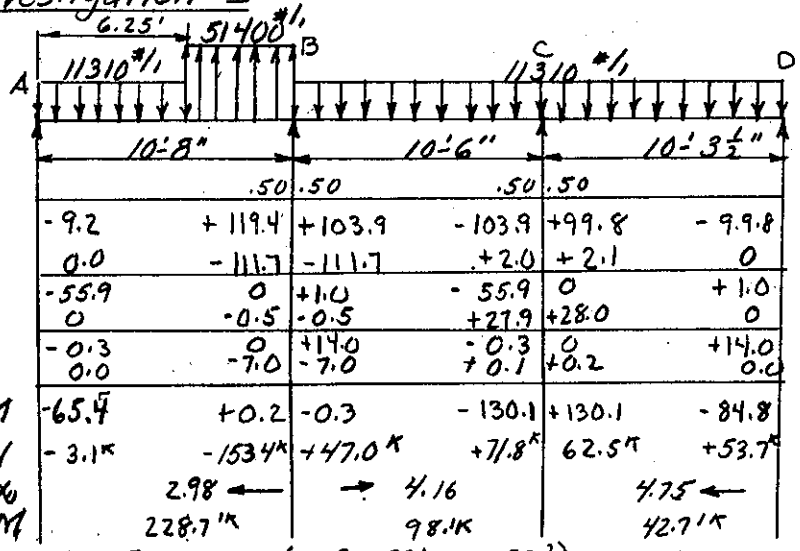
From Case III - Member GH $V_G = 4880 \times 4 - \frac{542,300}{8} = -48,270^{\#}$

Member FG $V_G = 4880 \times \frac{7.5}{2} - \frac{160,700}{7.5} = \frac{-3130}{51400}^{\#}$

From Case VIII Member GH $V_G = 4880 \times 4 - \frac{123,500}{8} = 4080^{\#}$

Member FG $V_G = 4880 \times \frac{7.5}{2} - \frac{83000}{7.5} = \frac{7230}{11,310}^{\#}$

Investigation I



		.50	.50	.50	.50	
	-9.2	+119.4	+103.9	-103.9	+99.8	-99.8
	0.0	-111.7	-111.7	+2.0	+2.1	0
	-55.9	0	+1.0	-55.9	0	+1.0
	0	-0.5	-0.5	+27.9	+28.0	0
	-0.3	0	+14.0	-0.3	0	+14.0
	0.0	-7.0	-7.0	+0.1	+0.2	0.0
M	-65.4	+0.2	-0.3	-130.1	+130.1	-84.8
V	-3.1^K	-153.4^K	+47.0^K	+71.8^K	62.5^K	+53.7^K
x_0		2.98 ←	→ 4.16		4.75 ←	
M		228.7'^K	98.1^K		42.7'^K	

Beam will be investigated for two conditions of loading. First investigation will be for combined loading from Case III + Case VIII. Second investigation will be for a uniform load due to Case VIII

F.E.M $M^F_{AB} = \frac{.586(6-8\times.586+3\times.586^2)}{12} \times 11310 \times 6.25 \times 10.67 - \frac{.414^2(4-3\times.414)}{12} \times 51,400 \times 4.42 \times 10.67$

$= -9.2'^K$

$M^F_{BA} = \frac{.586^2(4-3\times.586)}{12} \times 11310 \times 6.25 \times 10.67 - .414\left(6-\frac{8\times.414+3\times.414^2}{12}\right) \times 51,400 \times 4.42 \times 10.67$

$= -119.4'^K$

$M^F_{BC} = \frac{1}{12} \times 11310 \times 10.5^2 = 103.9'^K$

$M^F_{CD} = \frac{1}{12} \times 11310 \times 10.29^2 = 99.8'^K$

Subject: Claremont Dam
Computation: Gate Tower Struts
Computed by: H. E. W. Checked by: Date: 12-Sept.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Vertical Beam in Inside Wall

Investigation II

F.E.M. Memb. AB $M^F = \frac{1}{12} \times 11310 \times 10.67^2 = 107.3^{'K}$

	A–B		B–C		C–D	
	11310 #/'					
	10'-8"		10'-6"		10'-3½"	
	+107.3	-107.3	+103.9	-103.9	+99.8	-99.8
	0.0	+1.7	+1.7	+2.0	+2.1	0.0
	+0.9	0.0	+1.0	+0.9	0.0	+1.0
	0.0	-0.5	-0.5	-0.5	-0.4	0.0
-M	+108.2	-106.1	+106.1	-101.5	+101.5	-98.8
V	60.5K	60.1K	59.9K	58.8K	58.4	57.9K
x_0	→ 5.35'		→ 5.3'		5.12 ←	
+M	53.6'K		52.5'K		49.4'K	
React.	60.5	120.0K		117.2K		

Design of Beam.

Span AB

req'd $d = \sqrt{\frac{228,700 \times 12}{24 \times 123}} = 30.4'' < 54.5''$

Shear at face of strut = 153,400 − 51,400 × 1.25 = 89,150#

$v = \frac{89,150}{24 \times .88 \times 54.5} = 76$ #/□" OK

$A_s = \frac{228700 \times 12}{18000 \times .88 \times 54.5} = 3.19$ Use 4-1"φ

$u_0 = \frac{89150}{12.6 \times .88 \times 54.5} = 148$ #/□" OK

Span BC & CD

$A_s = \frac{106,100 \times 12}{18000 \times .88 \times 54.5} = 1.48$ □"

Use 4-1"φ both faces

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Struts

Computed by H. E. W **Checked by** **Date** 13-Sept-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of Strut

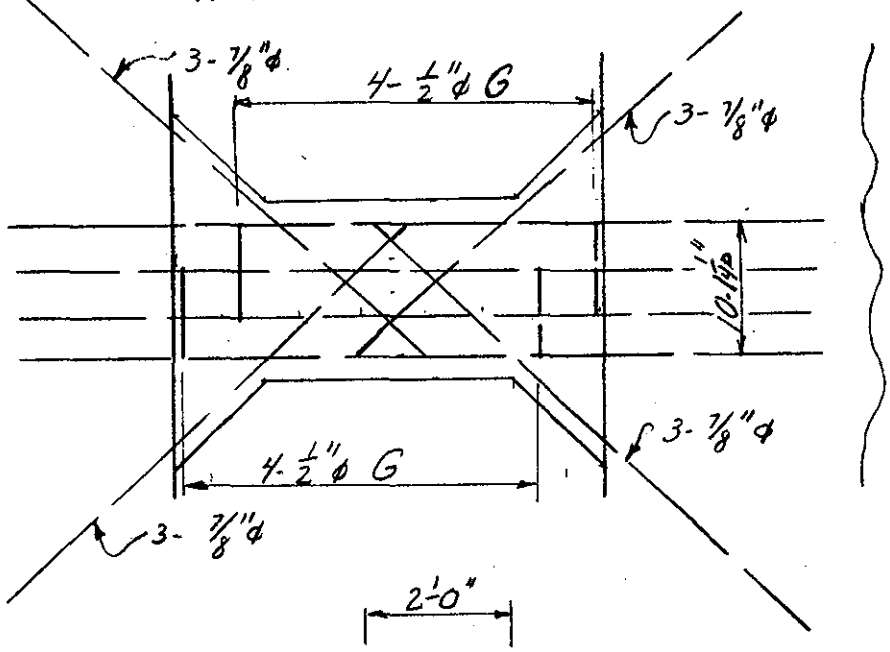
If $p_s = 0.02$ then $A_s = .02 \times 30 \times 24 = 14.4\,\square''$

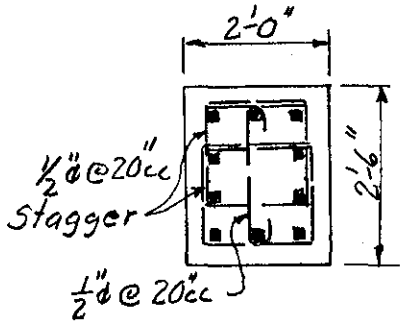
Use 10 - $1\frac{1}{4}''\phi$ bars then $p_s = \frac{15.62}{30 \times 24} = 0.217$

Allowable load $= .80 \times A_g (0.225 f'_c + f_s p_s)$

$P = .80 \times 30 \times 24 (.225 \times 3000 + 16000 \times .0217) = 588{,}670^{\#}$

Actual load will not exceed $310{,}500 + 153{,}400 = 463{,}900^{\#}$





WAR DEPARTMENT

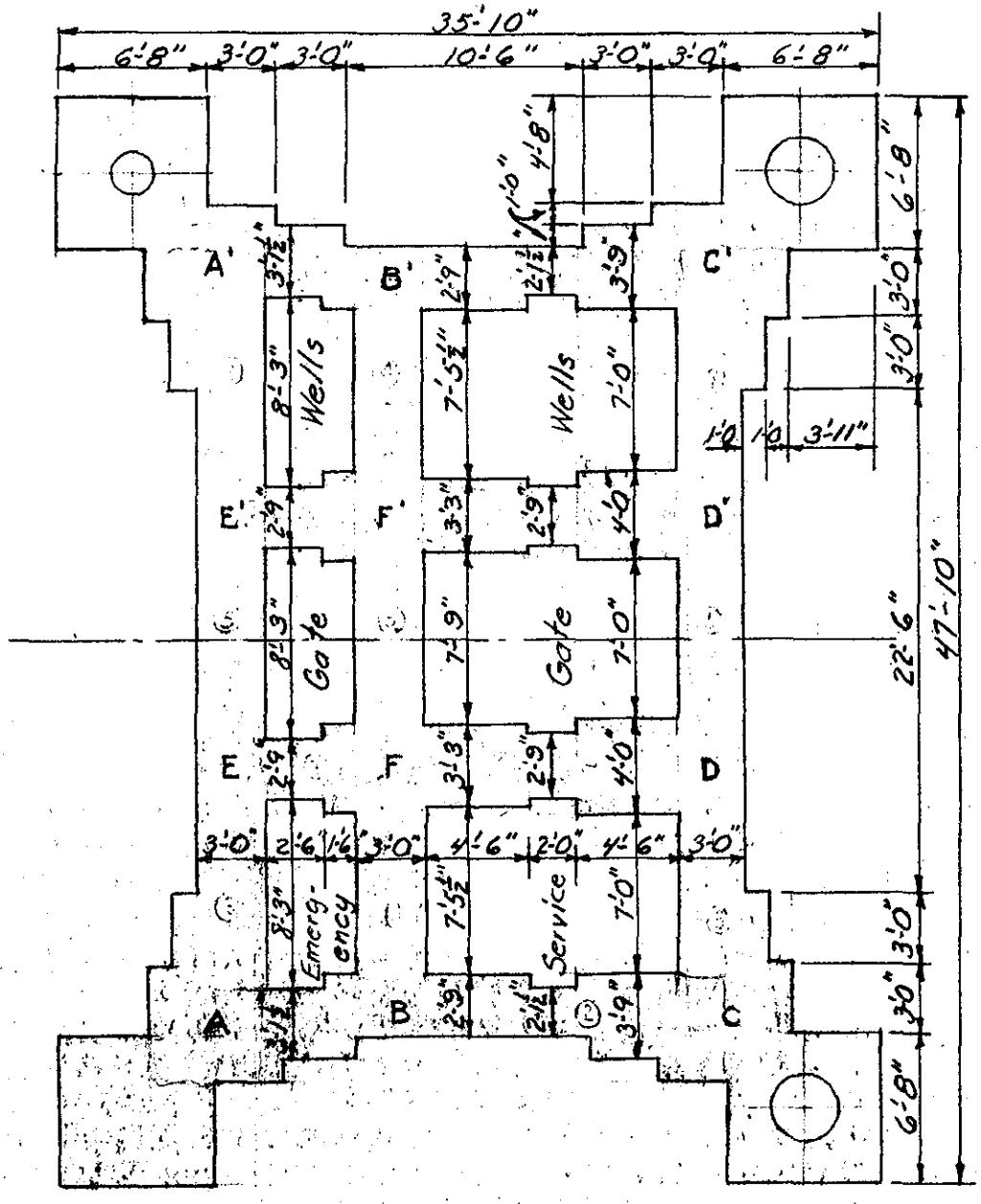
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam.

Computation Gate Tower Section from El. 572.0 to 580.5

Computed by H.E.W. **Checked by** A.L.K. **Date** June - 22, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Horiz. Sect. at El. 572.0

Subject: Claremont Dam

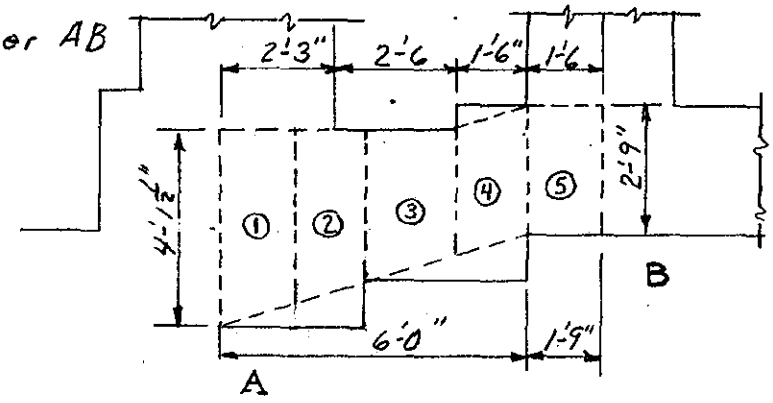
Computation: Gate Tower Section from El. 572.0 to 580.5

Computed by: H.E.W. Checked by: R.L.K. Date: June 23, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Determination of Co-efficients for Fixed End Moments Stiffness and Carry Over Factor

Member AB



Shaded area will be considered as the effective section of the member

Consider member loaded with a uniform load of 1 kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1.5	3.87	0.17	0.26	-3.13	-0.81	2.5	+2.6	+0.7	- 2.1
2	1.5	3.37	0.26	0.39	-1.63	-0.64	1.0	+6.2	+2.4	- 4.0
3	1.75	2.83	0.44	0.77	0	0	i_0= 0.2	+7.5	+5.8	0
4	1.5	2.69	0.51	0.77	+1.63	+1.26	2.1	+6.2	+4.8	+ 7.8
5	1.5	2.75	0.48	0.72	+3.13	+2.25	7.1	+2.6	+1.9	+ 5.9
				2.91		+2.06	+12.9		+15.6	+7.6
					+0.71		1.5			11.1
					+0.71		11.4			-3.5
				A	$\bar{x}$		I_x		P	M_x

Stiffness at A = $\frac{1}{2.91} + \frac{4.59^2}{11.4} = 2.18$

Stiffness at B = $\frac{1}{2.91} + \frac{3.16^2}{11.4} = 1.22$

Carry over at A = $\dfrac{\frac{1}{2.91} - \frac{4.59 \times 3.16}{11.4}}{2.18} = .43$

Carry over at B = $\dfrac{\frac{1}{2.91} - \frac{4.59 \times 3.16}{11.4}}{1.22} = .76$

$M_A = \frac{15.6}{2.91} + \frac{-3.5 \times -4.59}{11.4} = 6.77^{1K}$

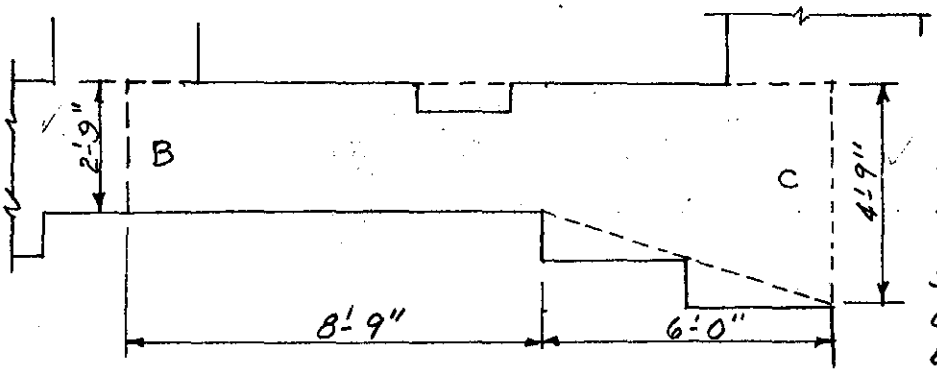
$M_B = \frac{15.6}{2.91} + \frac{-3.5 \times +3.16}{11.4} = 4.39^{1K}$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 572.0 to 580.5
Computed by: H.E.W. Checked by: A.L.K. Date: July 13, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10628

Determination of Co-efficients cont.

Member BC



Shaded area will be considered effective section computation showed that gate guide recess has only a small effect on the coefficients and will be neglected

$\frac{\text{min } d}{\text{max } d} = \frac{2.75}{4.75} = .579$ $\quad a = \frac{6.0}{14.75} = .407$

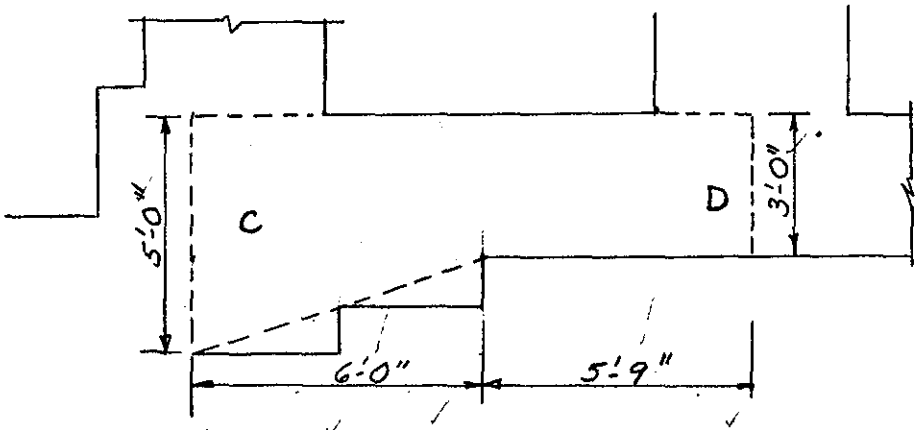
Stiffness $K = 9.5 \times \frac{2.75^3}{177} = 1.11$ haunched end

$K = 4.7 \times \frac{2.75^3}{177} = 0.55$ small end

Carry over factor $C = 0.41$ haunched end
$C = 0.82$ small end

"f" for fixed end mom $f = .126$ haunched end
$f = .065$ small end

Member CD & AE



$\frac{\text{min. } d}{\text{max } d} = \frac{3}{5} = .60$ $\quad a = \frac{6}{11.75} = .511$

Subject: Claremont Dam

Computation: Gate Tower Section from El 572.0 to 580.5

Computed by: H.E.W. Checked by: A.L.K. Date: July 14

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Determination of Co-efficients cont.

Member CD (Cont.)

Stiffness $K = 9.5 \times \frac{3^3}{141} = 1.82$ at C

$K = 4.7 \times \frac{3^3}{141} = 0.90$ at D

Carry over factor $C = .41$ at C

$C = .82$ at D

"f" for f.e.m $f = .124$ at C

$f = .066$ at D

Member BF

Member is of uniform section then:—

Carry over factor = 0.50 at ea. end

f for f.e.m = $\frac{1}{12} = .083$ " " " "

$K = \frac{4 \times 3^2}{125.5} = 0.86$ " " "

Member EE', FF' & DD'

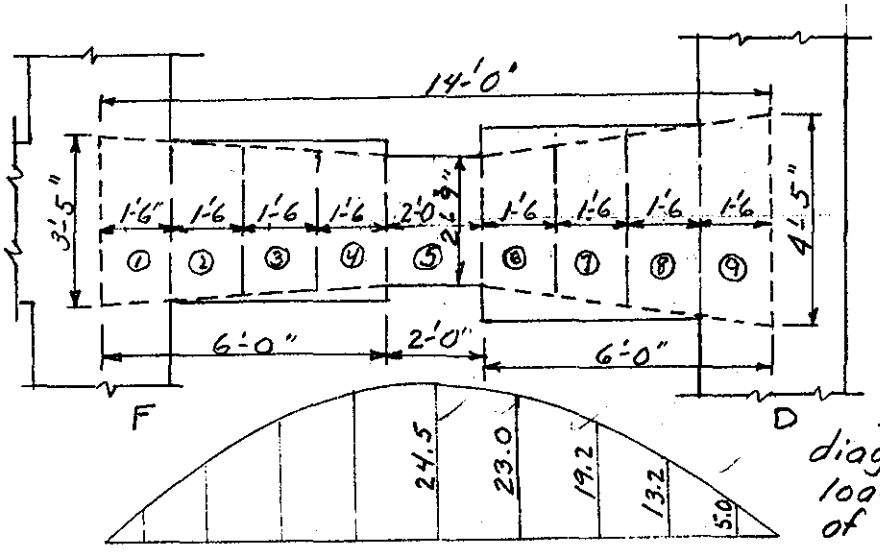
Member is of uniform section then —

carry over factor = 0.50 at ea. end

f for f.e.m = .083 " " "

$K = \frac{4 \times 3^2}{132} = 0.82$ " " "

Member DF



Shaded area within dotted lines will be used as effective area.

Simple bending moment diagram with member loaded with uniform load of 1 K/'

Subject: Claremont Dam
Computation: Gate Tower Section from El 572.0 to 580.5
Computed by: H.E.W. Checked by: A.L.K. Date: July 14

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Determination of Co-efficients cont.
Member 6 (cont.)

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1.5	3.33	0.27	0.41	-6.25	-2.56	+16.0	5.0	+2.1	-13
2	1.5	3.19	0.31	0.47	-4.75	-2.23	+10.6	+13.2	+6.2	-29
3	1.5	3.00	0.37	0.56	-3.25	-1.82	+5.9	+19.2	+10.8	-35
4	1.5	2.83	0.44	0.66	-1.75	-1.16	+2.0	+23.0	+15.2	-27
5	2.0	2.75	0.48	0.96	0	—	$i_0 =$ 0.3	+24.5	+23.5	0
6	1.5	2.96	0.39	0.59	+1.75	+1.03	+1.8	+23.0	+13.6	+24
7	1.5	3.37	0.26	0.39	+3.25	+1.27	+4.1	+19.2	+7.5	+24
8	1.5	3.79	0.18	0.27	+4.75	+1.28	+6.1	+13.2	+3.6	+17
9	1.5	4.21	0.13	0.20	+6.25	+1.25	+7.8	5.0	+1.0	+6
				+4.51		-2.94	+54.8		+83.5	-33
minus corrections							+1.9			-54
					-0.65		52.7			+21
				A	$\bar{x}$		I_x		P	M_x

Stiffness at F = $\frac{1}{4.51} + \frac{6.35^2}{52.7} = 0.987$

Stiffness at D = $\frac{1}{4.51} + \frac{7.65^2}{52.7} = 1.332$

Carry-over Factor at F = $\dfrac{\frac{1}{4.51} - \frac{6.35 \times 7.65}{52.7}}{0.987} = .708$

Carry-over Factor at D = $\dfrac{\frac{1}{4.51} - \frac{6.35 \times 7.65}{52.7}}{1.332} = .525$

$M_F = \frac{83.5}{4.51} + \frac{21}{52.7} \times (-6.35) = 15.98$ 'K

$M_D = \frac{83.5}{4.51} + \frac{21}{52.7} \times (+7.65) = 21.56$ 'K

Subject: Claremont Dam

Computation: Gate Tower Section from El. 572.0 to 580.5

Computed by: H.E.W. Checked by: A.L.K. Date: July 26, 1944

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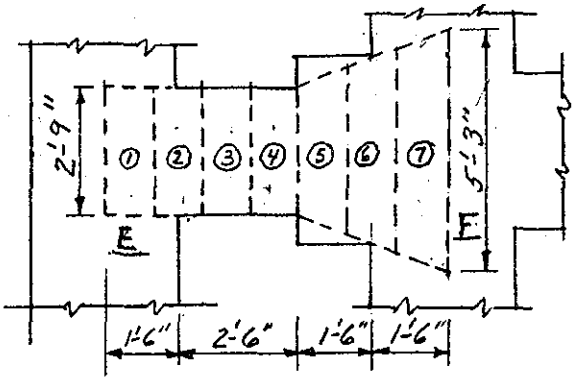
Determination of Co-efficients (cont.)
Member EF



Shaded area will be considered as effective section of beam.

Consider beam to be loaded with a uniform load of 1 kip/ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1	2.75	0.48	0.48	-3	-1.4	4.3	1.6	0.7	-2.2
2	1	2.75	0.48	0.48	-2	-1.0	1.9	4.1	2.0	-4.1
3	1	2.75	0.48	0.48	-1	-0.5	0.5	5.6	2.7	-2.8
4	1	2.75	0.48	0.48	0	—	—	6.1	2.9	—
5	1	3.17	0.31	0.31	+1	0.3	0.3	5.6	1.7	+1.7
6	1	4.00	0.16	0.16	+2	0.3	0.7	4.1	0.7	+1.2
7	1	4.83	0.09	0.09	+3	0.3	0.8	1.6	0.1	+0.5
				2.48		-2.0	8.7		10.8	-5.7
							1.6			-8.3
					-0.81		+7.1			+3.0
				A	$\bar{x}$		$I_{\bar{x}}$		P	M_x

Stiffness at E $= \frac{1}{2.48} + \frac{2.69^2}{7.1} = 1.42$

Stiffness at F $= \frac{1}{2.48} + \frac{4.31^2}{7.1} = 3.02$

Carry-over F at E $= \dfrac{\frac{1}{2.48} - \frac{2.69 \times 4.31}{7.1}}{1.42} = 0.87$

Carry-over F at F $= \dfrac{\frac{1}{2.48} - \frac{2.69 \times 4.31}{7.1}}{3.02} = 0.41$

$M_E = \frac{10.8}{2.48} + \frac{3.0}{7.1}(-2.69) = 3.21$

$M_F = \frac{10.8}{2.48} + \frac{3.0}{7.1}(+4.31) = 6.18$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 572.0 to 580.5
Computed by: H. E. W. Checked by: A. L. K. Date: July 27, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Head = 630.0 - 572.0 = 58.0 ft.
P = 58.0 x 62.5 = 3625 #/□'

Fixed End Moments

Member AB

M^F_{AB} = 3.625 x 6.77 = 24.54 'K
M^F_{BA} = 3.625 x 4.39 = 15.91 'K

Member BC

M^F_{BC} = .065 x 3.625 x 14.75^2 = 51.26 'K
M^F_{CB} = .126 x 3.625 x 14.75^2 = 99.37 'K

Member CD & AE

$M^F_{CD} = M^F_{AE}$ = .124 x 3.625 x 11.75^2 = 62.06 'K

$M^F_{DC} = M^F_{EA}$ = .066 x 3.625 x 11.75^2 = 33.03 'K

Member BF,

Fixed end Mat ea. end = .083 x 3.625 x 10.46^2 = 32.9 'K

Member DD', EE' & FF'

$M^F_{at\ ea.\ end}$ = .083 x 3.625 x 11^2 = 36.41 'K

Member FD

M^F_{FD} = 15.98 x 3.625 = 57.93 'K

M^F_{DF} = 21.56 x 3.625 = 78.16 'K

Member EF

M^F_{EF} = 3.21 x 3.625 = 11.64 'K

M^F_{FE} = 6.18 x 3.625 = 22.40 'K

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project: Claremont Dam

Computation: Gate Tower Section from El. 572.0 to 580.5

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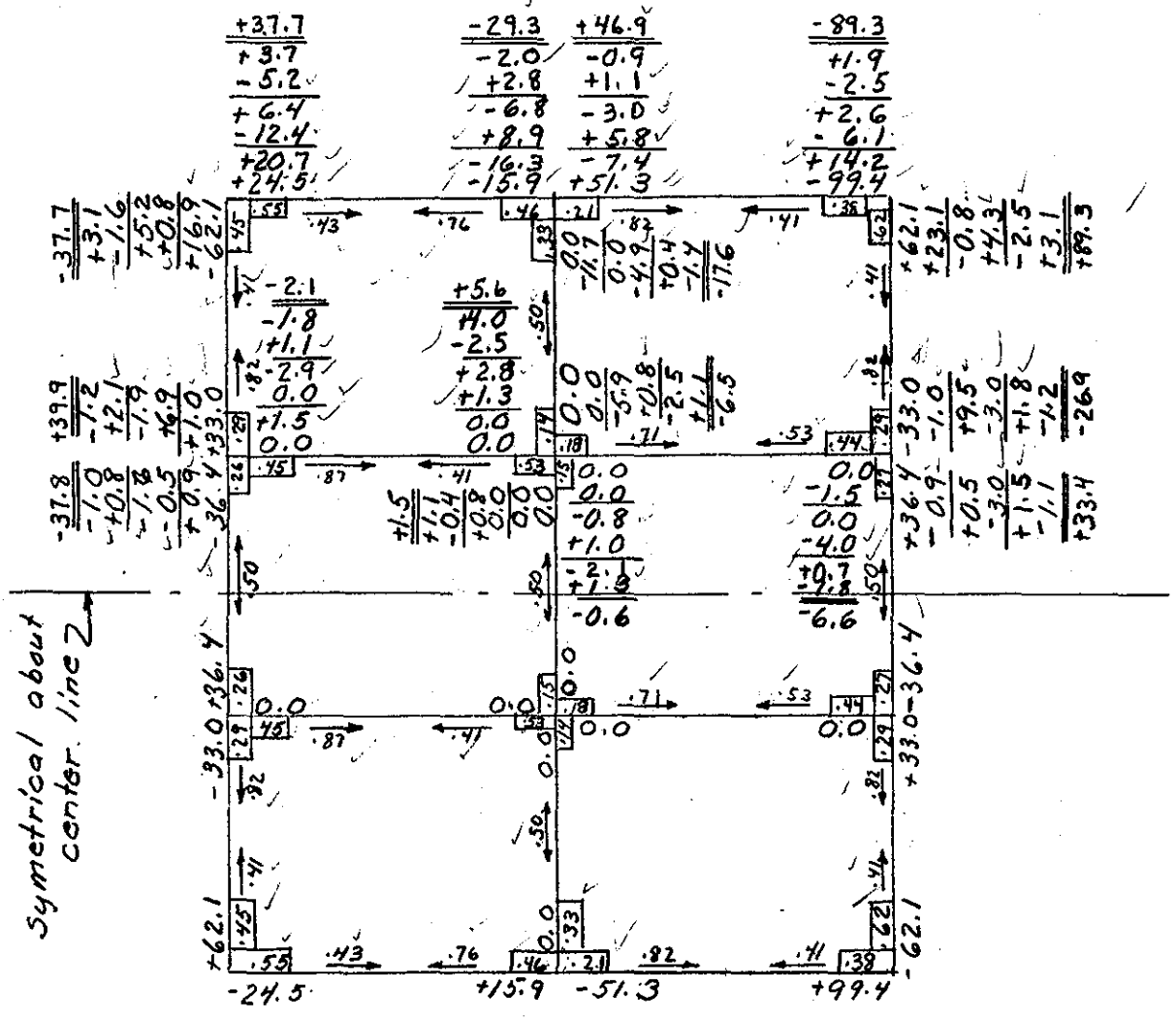
Case I Gates open outside walls loaded to full head to spillway crest



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 572.0 to 580.5

Computed by H. E. W. **Checked by** A. L. K. **Date** July 28

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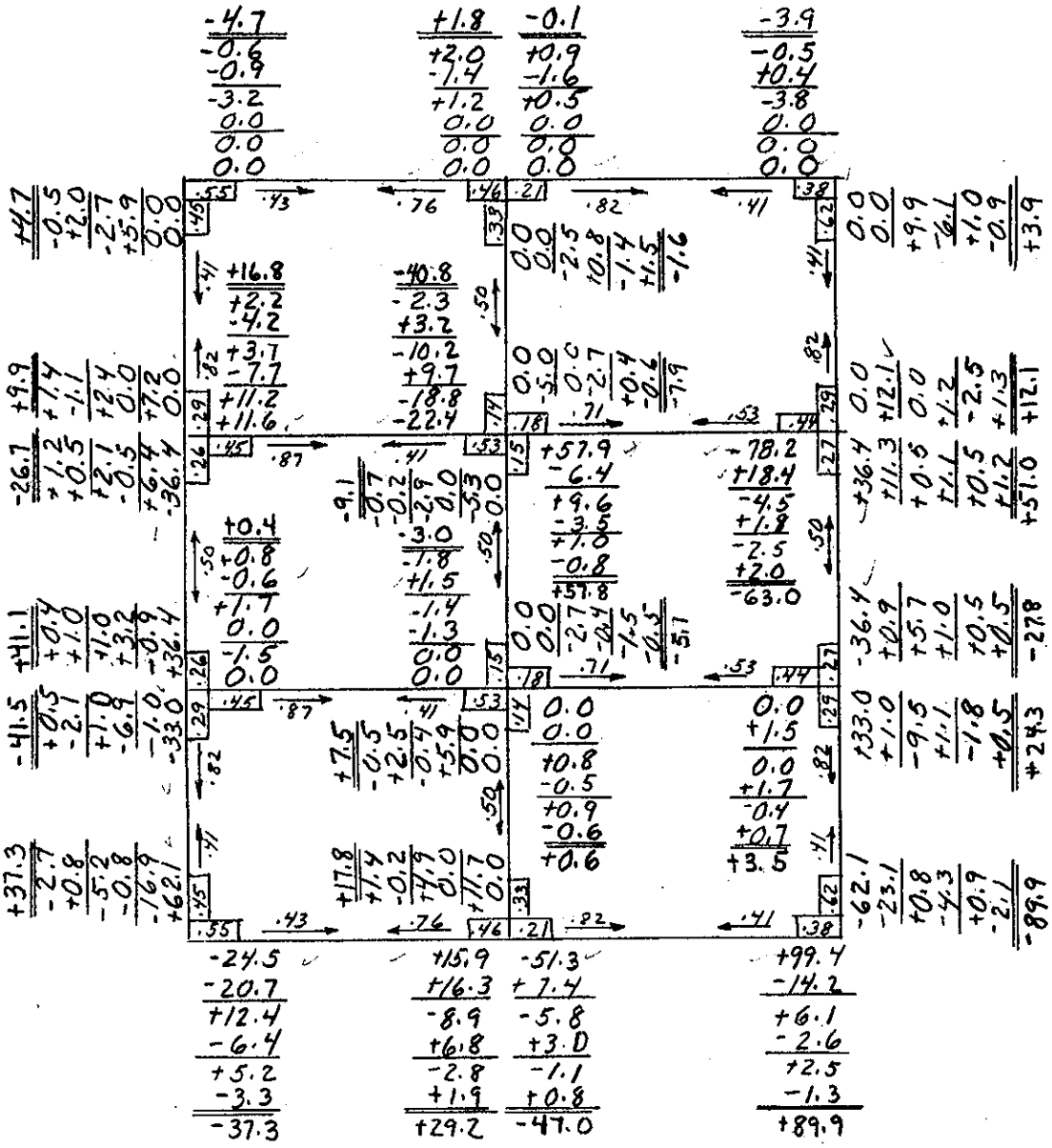
Case II - Service Gate in either of the end walls closed the other two remaining open. Water at spillway crest elevation.



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U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 572.0 to 580.5

Computed by H.E.W. **Checked by** A.L.K. **Date** July 29.

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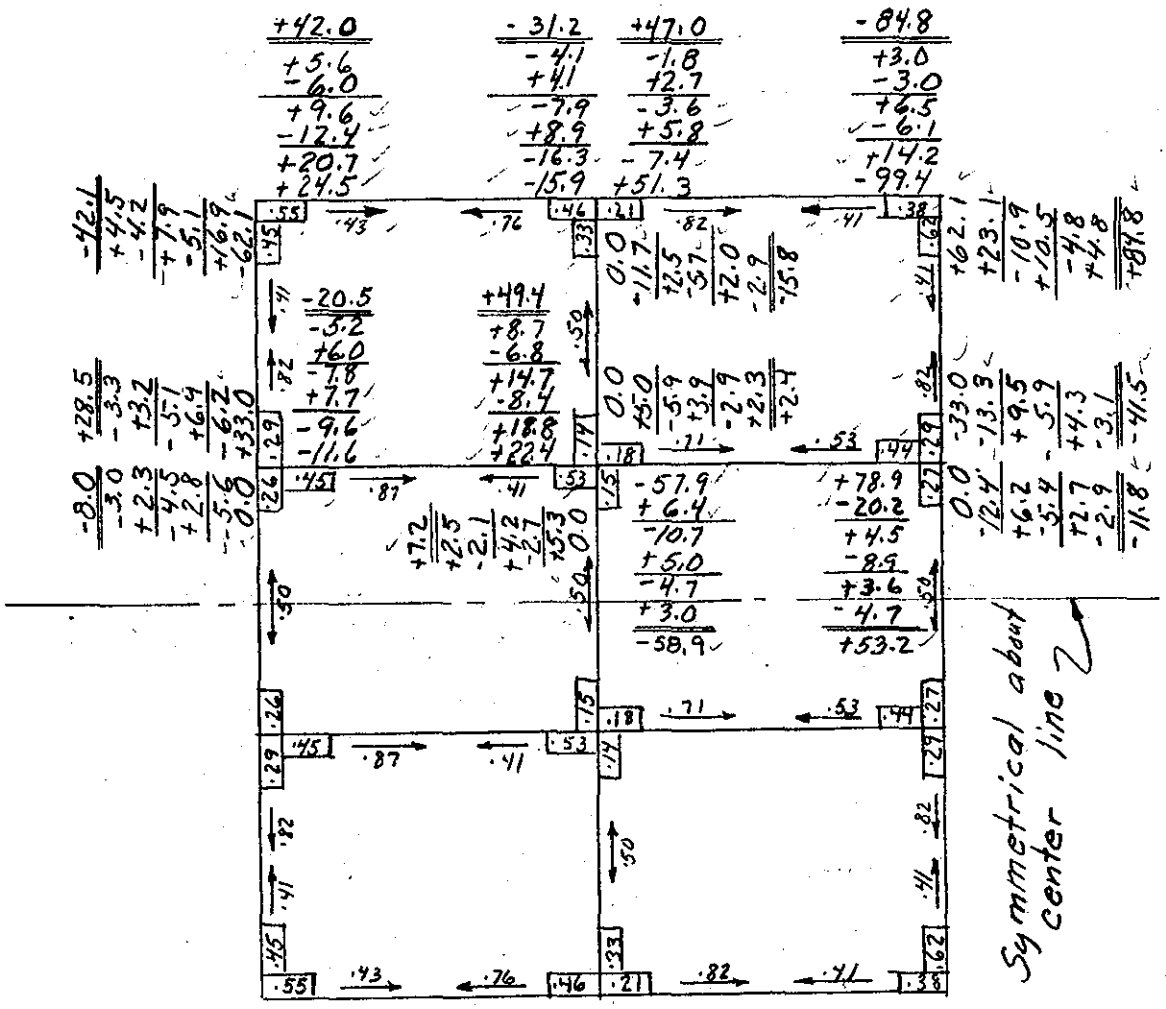
Case III - Middle service gate closed and end service gates open



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 572.0 to 580.5

Computed by H.E.W. **Checked by** A.L.K. **Date** July 31, 1944

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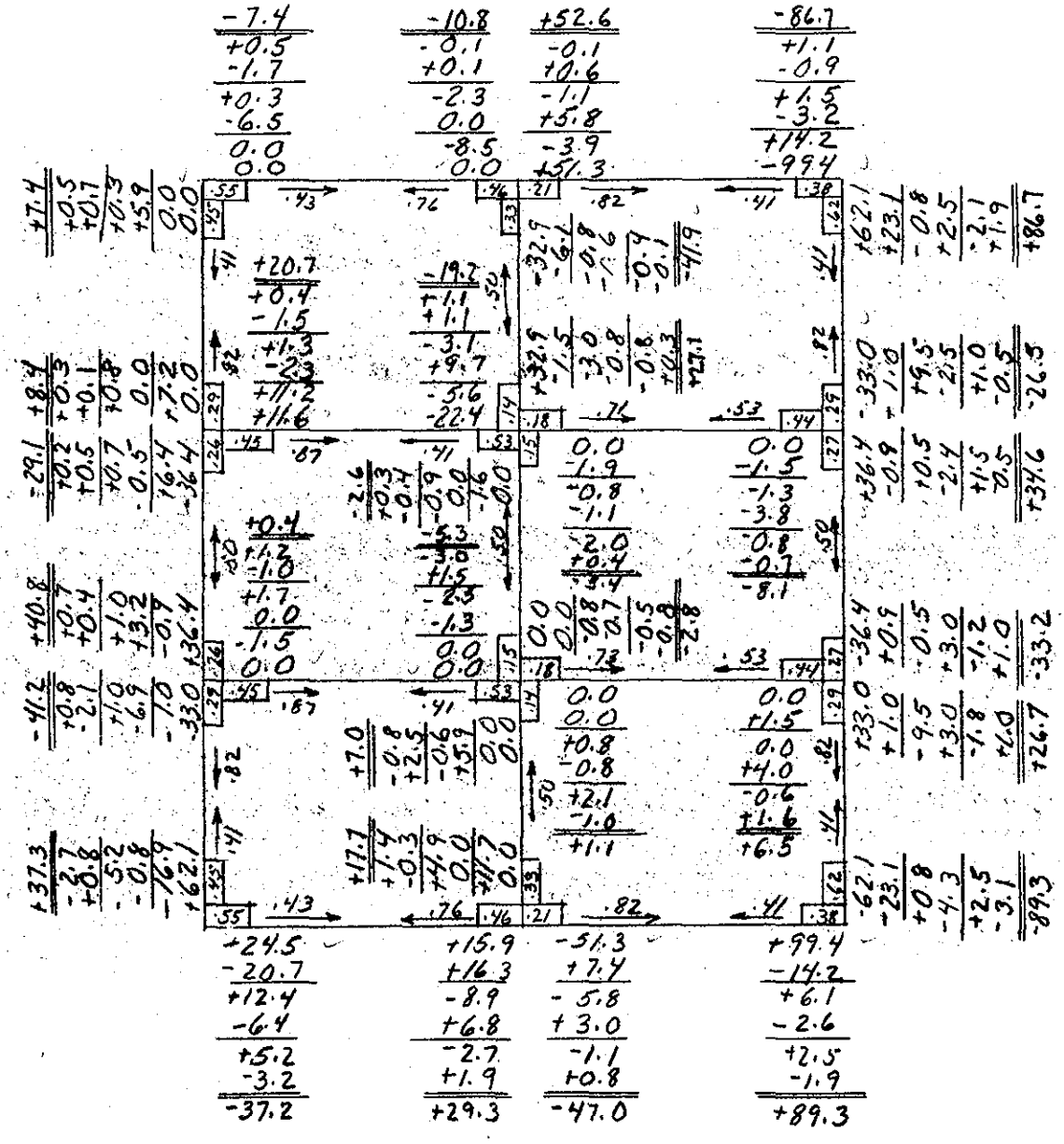
Case IV. Emergency gate down in either of end walls the other two gates remaining open. Water to spillway crest elevation



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El 572.0 to 580.5

Computed by H.E.W. **Checked by** A.L.K. **Date** July 31, 1944

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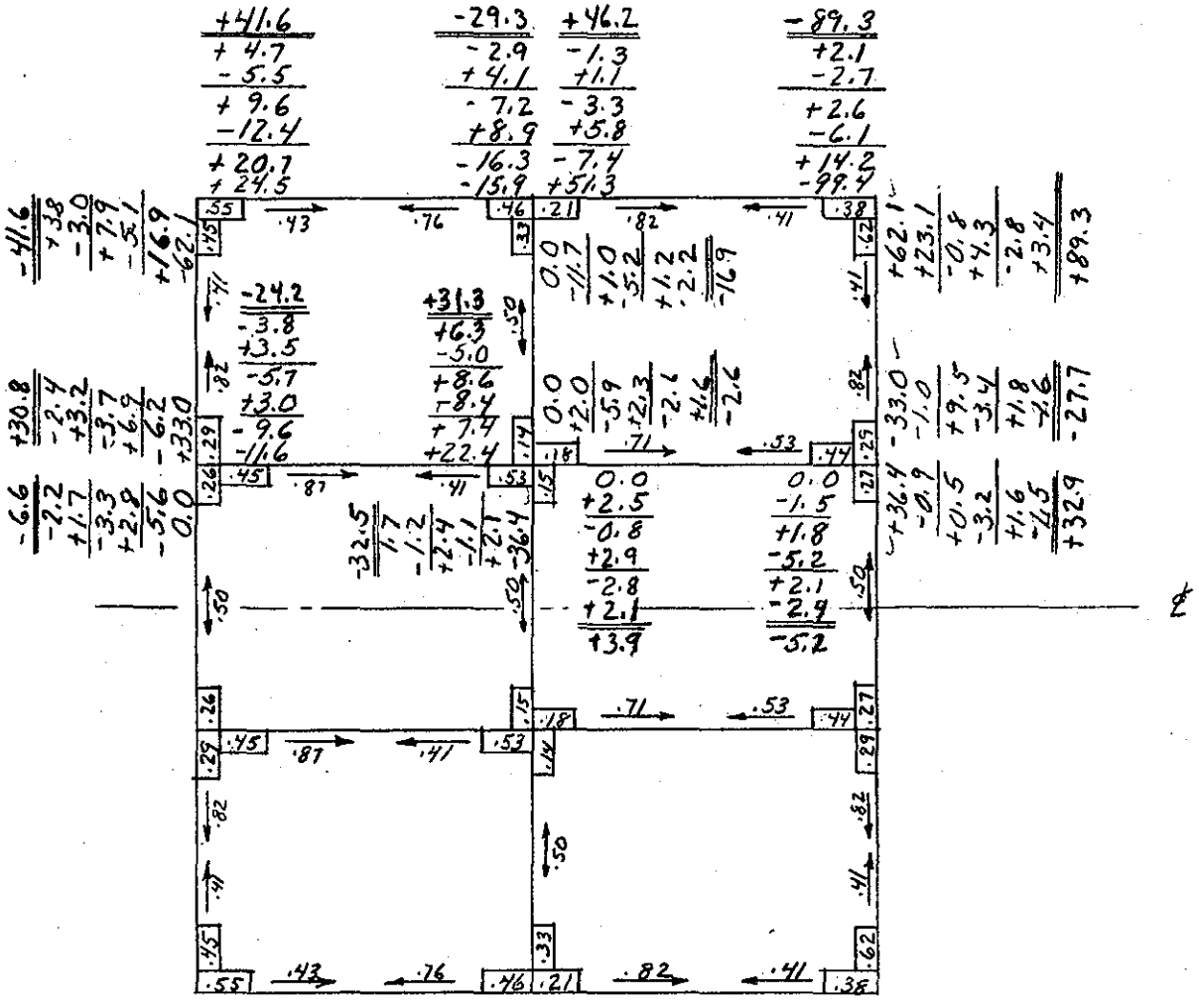
Case V Emergency gate closed in center wall with end gates remaining open. Water to spillway crest elevation.



Subject: Claremont Dam
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U. S. GOVERNMENT PRINTING OFFICE 3—10538

Determination of max. shear and positive moments

Member AB & A'B' (max. values)

$V_A = 3625 \times \frac{7.75}{2} + \frac{12300}{7.75} = 15,440^{\#}$

$V_B = 3625 \times \frac{7.75}{2} - \frac{7,900}{7.75} = 13,030^{\#}$

$x_0 \quad \frac{13030}{3625} = 3.60'$ from B

$Max + M = 13030 \times 3.6 - 29,300 - 3625 \times \frac{3.6^2}{2} = -5880$

Member BC & B'C' (max. values)

$V_B = 3625 \times \frac{14.75}{2} - \frac{34,100}{14.75} = 24,420^{\#}$

$V_C = 3625 \times \frac{14.75}{2} + \frac{43,100}{14.75} = 29,650^{\#}$

$x_0 = \frac{29,650}{3625} = 8.18'$ from C = 6.57' from B

$Max + M = 29,650 \times 8.18 - 89,300 - 3625 \times \frac{8.18^2}{2} = +31,960'^{\#}$

Member CD & C'D' (max values)

$V_C = 3625 \times \frac{11.75}{2} + \frac{65,600}{11.75} = 26,880^{\#}$

$V_D = 3625 \times \frac{11.75}{2} - \frac{43,300}{11.75} = 17,610^{\#}$

$x_0 = \frac{26,880}{3625} = 7.42'$ from C

$Max\ M = 26,880 \times 7.42 - 89,900 - 3625 \times \frac{7.42^2}{2} = 9760'^{\#}$

Member BF & B'F' (max values)

$V_B = 3625 \times \frac{10.46}{2} + \frac{14,800}{10.46} = 20,370'^{\#}$

$V_F = 3625 \times \frac{10.46}{2} - \frac{14,800}{10.46} = 17,550'^{\#}$

$x_0 = \frac{20,370}{3625} = 5.62'$ from B

$Max\ M = 20,370 \times 5.62 - 41,900 - 3625 \times \frac{5.62^2}{2} = 15,330'^{\#}$

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U. S. GOVERNMENT PRINTING OFFICE 3—10528

Member AE & A'E' (max. values)

$V_A = 3625 \times \frac{11.75}{2} + \frac{13,600}{11.75} = 22,460$

$V_E = 3625 \times \frac{11.75}{2} + \frac{2,200}{11.75} = 21,490$

$x_0 = \frac{22,460}{3625} = 6.20'$ from A

$Max + M = 22460 \times 6.2 - 42,100 - 3625 \times \frac{6.2^2}{2} = +27,480^{\prime\#}$

Member EE' (max values)

$V_E = V_{E'} = 3625 \times \frac{11}{2} + \frac{14,400}{11} = 21,250^{\#}$

$Max + M = 21,250 \times 5.87 - 41,100 - 3625 \times \frac{5.87^2}{2} = 21,190^{\prime\#}$

Member FF' (max. values)

$V_F = V_{F'} = 3625 \times \frac{11}{2} = 19,940^{\#}$

$Max + M = 19,940 \times 5.5 - 32,500 - 3625 \times \frac{5.5^2}{2} = 20,530^{\prime\#}$

Member DD' (max. values)

$V_D = V_{D'} = 3625 \times \frac{11}{2} + \frac{23,200}{11} = 22050^{\#}$

$Max + M = 19,940 \times 5.5 - 32,900 - 3625 \times \frac{5.5^2}{2} = 20,930^{\prime\#}$ 21,940

Member EF & E'F' (max. values)

$V_E = 3625 \times 7 \times .5 + \frac{2500}{7} = 12,920$ Case IV

$V_F = 3625 \times 7 \times .5 + \frac{24000}{7} = 16120$ Case II

$x_0 = \frac{12,920}{3625} = 3.56$ from E

$Max\ M = 12,920 \times 3.56 - 20,700 - 3625 \times \frac{3.56^2}{2} = 2330^{\prime\#}$

$V_E = 3625 \times 7 \times .5 - \frac{7100}{7} = 11,680^{\#}$ Case V (1015)

$V_F = 3625 \times 7 \times .5 + \frac{28,900}{7} = 16,820^{\#}$ Case III (4129)

$x_0 = \frac{11,680}{3625} = 3.22'$ from E

$Max\ M = 11,680 \times 3.22 - 24,200 - 3625 \times \frac{3.22^2}{2} = -5400^{\prime\#}$

Subject: Claremont Dam

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Member FD & F'D (max values)

$$V_F = 3625 \times \frac{14}{2} - \frac{5200}{14} = 25010^{\#}$$

$$V_D = 3625 \times \frac{14}{2} + \frac{5200}{14} = 25750^{\#}$$

} Case II

$$x_0 = \frac{25010}{3625} = 6.9' \text{ from } F$$

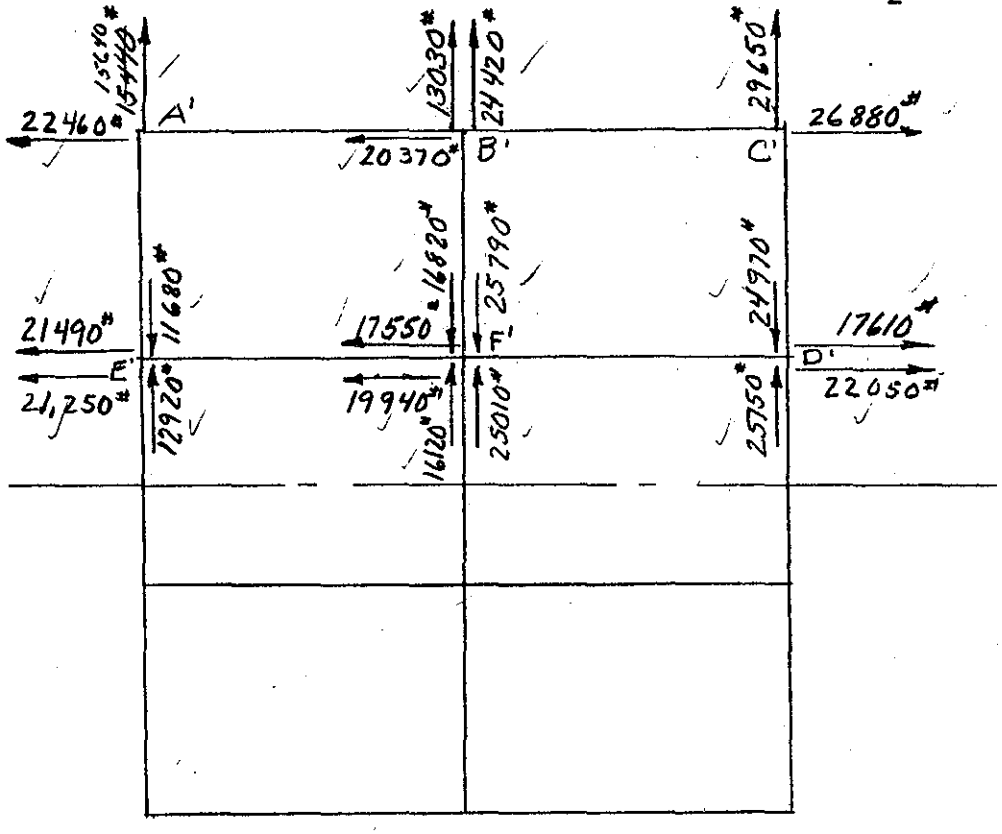
$$\text{Max } M = 25010 \times 6.9 - 57{,}800 - 3625 \times \frac{6.9^2}{2} = 28{,}480'^{\#}$$

$$V_F = 3625 \times \frac{14}{2} + \frac{5700}{14} = 25{,}790^{\#}$$

$$V_D = 3625 \times \frac{14}{2} - \frac{5700}{14} = 24{,}970^{\#}$$

$$x_0 = \frac{25790}{3625} = 7.11' \text{ from } F$$

$$\text{Max } M = 25790 \times 7.11 - 58{,}900 - 3625 \times \frac{7.11^2}{2} = 32{,}840'^{\#}$$



Maximum End Reactions

WAR DEPARTMENT

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Computed by: H.E.W. Checked by: A.L.K. Date: Aug 1, 1944

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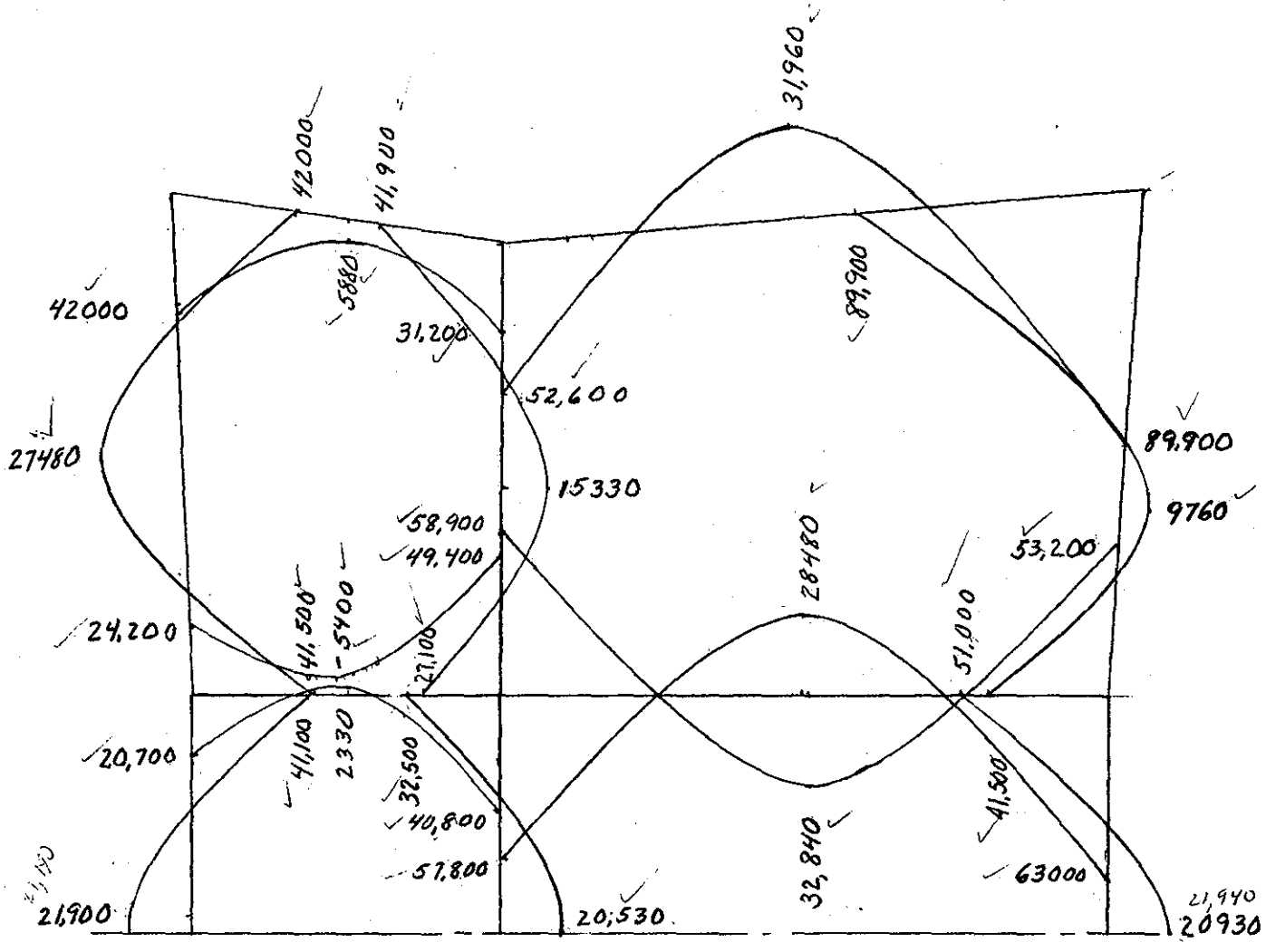

Curve of Max. Moments

Subject: Claremont Dam
Computation: Gate Tower Section from El. 572.0 to 580.5
Computed by: H.E.W. Checked by: A.L.K. Date: Aug. 2, 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10633

Design of Members

Member AB

At pt A values of shear and mom. at face of support

$V = 15640 - 3625 \times 2.25 = 7290^{\#}$

$M = 42000 - \frac{1}{3}\left(\frac{15640 + 7290}{2}\right) \times 4.5 = 24{,}950'^{\#}$

At pt B values of shear and mom at face of support

$V = 13030 - 3625 \times 1.5 = 7590^{\#}$

$M = 31{,}200 - \frac{1}{3}\left(\frac{13030 + 7590}{2}\right) \times 3 = 20{,}890'^{\#}$

At end A reqd $d = \sqrt{\frac{24{,}950}{147}} = 13.1'' < 36''$ OK

$v = \frac{7290}{12 \times .88 \times 36} = 19\ \#/\square''$ OK

$-A_s = \frac{24{,}950 \times 12}{18000 \times .88 \times 36} = .53\ \square''$ Use $\frac{7}{8}''\phi$ at 1'-0" cc

$u_o = \frac{7290}{2.8 \times .88 \times 36} = 82\ \#/\square''$ OK

At end B reqd $d = \sqrt{\frac{20{,}890}{147}} = 12'' < 28.5''$ OK

$v = \frac{7590}{12 \times .88 \times 28.5} = 25\ \#/\square''$ OK

$-A_s = \frac{20{,}890 \times 12}{18{,}000 \times .88 \times 28.5} = .56\ \square'' - \frac{7}{8}''\phi$ @ 1'-0" cc

$u_o = \frac{7590}{2.8 \times .88 \times 28.5} = 108\ \#/\square''$ OK

For steel on inside face use $\frac{3}{4}''\phi$ @ 1'-0" cc

Member BC

At End B - Values of shear and mom. at face of support

$V = 24{,}420 - 1.5 \times 3625 = 18980^{\#}$

$M = 52{,}600 - \frac{1}{3} \times \left(\frac{24{,}420 + 18980}{2}\right) \times 3 = 30{,}900'^{\#}$

At end C - Values of shear and mom. at face of support

$V = 29{,}650 - 3625 \times 2.25 = 21{,}490^{\#}$

$M = 89{,}900 - \frac{1}{3} \times \left(\frac{29650 + 21{,}490}{2}\right) \times 4.5 = 51{,}540'^{\#}$

Subject Claremont Dam

Computation Gate Tower Section from El. 572.0 to 580.5

Computed by H.E.W. **Checked by** A.L.K. **Date** Aug. 2, 1944

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Member BC (cont.)

At end B – req'd $d = \sqrt{\frac{30,900}{147}} = 14.5" < 28.5"$ OK

$v = \frac{18,980}{12 \times .88 \times 28.5} = 63$ #/□" OK

$-A_s = \frac{30,900 \times 12}{18000 \times .88 \times 28.5} = .82$ □" Use 7/8"φ @ 8"cc

$u_0 = \frac{18,980}{4.1 \times .88 \times 28.5} = 184$ #/□"

At end C – req'd $d = \sqrt{\frac{51,540}{147}} = 18.8" < 43.5"$ OK

$v = \frac{21,490}{12 \times .88 \times 43.5} = 47$ #/□" OK

$-A_s = \frac{51,540 \times 12}{18,000 \times .88 \times 43.5} = .90$ □" Us 7/8"φ @ 8"cc

$u_0 = \frac{21,490}{4.1 \times .88 \times 43.5} = 137$ #/□" OK

At pt. max. pos. mom.

req'd $d = \sqrt{\frac{31,960}{123}} = 16.1" < 21"$ OK

$+A_s = \frac{31960 \times 12}{18000 \times .88 \times 21} = 1.15$ □" Use 7/8"φ @ 6"cc

Member CD

At end C – Values of shear and mom. at face of support

$V = 26880 - 3625 \times 2.75 = 16,910$ #

$M = 89,900 - \frac{1}{3}\left(\frac{26880 + 16910}{2}\right) \times 4.75 = 55,230$ '#

At end D – Values of shear and mom. at face of support

$V = 17610 - 3625 \times 2 = 10,360$ #

$M = 41,500 - \frac{1}{3}\left(\frac{17610 + 10360}{2}\right) \times 4 = 22,850$ '#

At end C – req'd $d = \sqrt{\frac{55230}{147}} = 19.4" < 44.5"$

$v = \frac{16910}{12 \times .88 \times 44.5} = 36$ #/□"

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Member CD (cont.)

At end C $-A_s = \frac{55230 \times 12}{18000 \times .88 \times 44.5} = .94^{\square''}$ use $\frac{7}{8}''\phi$ @ 8" cc

$u_o = \frac{16,910}{4.1 \times .88 \times 44.5} = 105\,\#/\square''$

At end D $-$ req'd $d = \sqrt{\frac{22850}{147}} = 12.5'' < 31.5''$ OK

$v = \frac{10360}{12 \times .88 \times 31.5} = 31\,\#/\square''$

$-A_s = \frac{22850 \times 12}{18000 \times .88 \times 31.5} = .55^{\square''}$ use $\frac{3}{4}''\phi$ @ 8" cc

$u_o = \frac{10360}{3.5 \times .88 \times 31.5} = 106\,\#/\square''$

Member DD'

Values of shear and mom. at face of supports

$V = 22050 - 2 \times 3625 = 14,800$

$M = 51,000 - \frac{1}{3}\left(\frac{22050 + 14800}{2}\right) \times 4 = 26430'^{\#}$

$v = \frac{14800}{12 \times .88 \times 31.5} = 45\,\#/\square''$

$-A_s = \frac{26430 \times 12}{18000 \times .88 \times 31.5} = .64^{\square''}$ Use $\frac{3}{4}''\phi$ @ 8" cc

$u_o = \frac{14800}{3.5 \times .88 \times 31.5} = 153\,\#/\square''$

$+A_s = \frac{20,930 \times 12}{18000 \times .88 \times 31.5} = .50^{\square''}$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

Member BF

At end B – Values of shear and mom at face of support

$V = 20,370 - 3625 \times 1.37 = 15,400^{\#}$

$M = 41,900 - \frac{1}{3}\left(\frac{20,370 + 15,400}{2}\right) \times 2.75 = 25510'^{\#}$

At end F – Values of shear and mom. at face of support

$V = 17,550 - 3625 \times 1.62 = 11680^{\#}$

$M = 27,100 - \frac{1}{3}\left(\frac{17,550 + 11680}{2}\right) \times 3.25 = 11,270'^{\#}$

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Member BF (cont.)

At end B - req'd $d = \sqrt{\frac{25510}{147}} = 13.2 < 31.5''$

$v = \frac{15,400}{12 \times .88 \times 31.5} = 46$ #/□"

$-A_s = \frac{25510 \times 12}{18000 \times .88 \times 31.5} = .61$ □" Try 3/4"φ @ 8" cc

$u_0 = \frac{15,400}{3.5 \times .88 \times 31.5} = 159$ #/□"

At end F - $v = \frac{11,680}{12 \times .88 \times 31.5} = 35$ #/□"

$-A_s = \frac{11,270 \times 12}{18,000 \times .88 \times 31.5} = .27$ □" 3/4"φ @ 1'-0" cc

$u_0 = \frac{11680}{2.4 \times .88 \times 31.5} = 176$ #/□"

$+A_s$ at center $= \frac{15330 \times 12}{18,000 \times .88 \times 31.5} = .37$ □" Use 3/4"φ @ 8" cc
(Small spacing used to match steel in FF')

Member FF'

Values of shear and mom. at face of support

$V = 19940 - 3625 \times 3.25 \times .5 = 14070$ #

$M = 32,500 - \frac{1}{3}\left(\frac{19940 + 14070}{2}\right) \times 3.25 = 14080$ '#

req'd $d = \sqrt{\frac{20,530}{123}} = 13.0'' < 31.5$

$v = \frac{14070}{12 \times .88 \times 31.5} = 42$ #/□"

$-A_s = \frac{14080 \times 12}{18000 \times .88 \times 31.5} = .34$ □" Try 3/4"φ @ 1'-0" cc

$u_0 = \frac{14070}{2.4 \times .88 \times 31.5} = 211$ #/□" Too large Use 3/4"φ @ 8" cc
$u_0 = 145$ #/□"

$+A_s = \frac{20,530 \times 12}{18000 \times .88 \times 31.5} = .50$ □" Use 3/4"φ @ 8" cc

Member is subjected to a direct tension of 5770# (case III)
Max possible f_s will not exceed :—

$\frac{5770}{.66} + \frac{20,530 \times 12}{.66 \times .88 \times 31.5} = 19,950$ #/□"

Subject: Claremont Dam

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Computed by: H.E.W. Checked by: A.L.K. Date: Aug. 3, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Member AE

At end A - Values of shear and mom. at face of support

$V = 22460 - 3625 \times 2.13 = 14{,}740^{\#}$

$M = 42000 - \frac{1}{3}\left(\frac{22460 + 14740}{2}\right) \times 4.12 = 16460^{'\#}$

At end E - Values of shear and mom. at face of support.

$V = 21{,}490 - 3625 \times 1.37 = 16520^{\#}$

$M = 41{,}500 - \frac{1}{3}\left(\frac{22460 + 16520}{2}\right) \times 2.75 = 23{,}630^{'\#}$

At end A - req'd $d = \sqrt{\frac{16460}{147}} = 10.6'' < 47''$ OK

$v = \frac{14740}{12 \times .88 \times 47} = 30\ \#/\square''$

$-A_s = \frac{16460 \times 12}{47 \times 18000 \times .88} = .27\ \square''$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{14740}{2.4 \times .88 \times 47} = 148\ \#/\square''$

At end E req'd $d = \sqrt{\frac{23{,}630}{147}} = 12.7'' < 31.5''$

$v = \frac{16520}{12 \times .88 \times 31.5} = 50\ \#/\square''$

$-A_s = \frac{23630 \times 12}{18000 \times .88 \times 31.5} = .57\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

$u_0 = \frac{16520}{3.5 \times .88 \times 31.5} = 170\ \#/\square''$

Pt. of max mom. in center

req'd $d = \sqrt{\frac{27480}{123}} = 15'' < 31.5''$ OK

$+A_s = \frac{27480 \times 12}{18000 \times .88 \times 31.5} = .56\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

Member EE'

Values of shear and mom. at face of support

$V = 21{,}250 - 3625 \times 1.37 = 16280^{\#}$

$M = 41{,}100 - \frac{1}{3}\left(\frac{21{,}250 + 16280}{2}\right) \times 2.75 = 23{,}900$

req'd $d = \sqrt{\frac{21{,}900}{123}} = 13.4'' < 31.5''$

$v = \frac{16280}{12 \times .88 \times 31.5} = 49\ \#/\square''$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 572.0 to 580.5
Computed by: H.E.W. Checked by: A.L.K. Date: Aug 3, 1944

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Member EE' cont.

$-A_s = \frac{23,900 \times 12}{18000 \times .88 \times 31.5} = .58 \square''$ Use 3/4"ϕ @ 8" cc.

$u_o = \frac{16280}{3.5' \times .88 \times 31.5} = 168$ #/□" OK

$+A_s = \frac{21,900 \times 12}{18000 \times .88 \times 31.5} = .53 \square''$ Use ___"ϕ @ ___" cc.

Member EF

Center Gate Well Face

Values of shear and mom. at end E (face of support)

$V = 11,680 - 3625 \times 1.5 = 6240$#

$M = 24,200 - \frac{1}{3}\left(\frac{11,680+6240}{2}\right) \times 3 = 15,240$ '#

Values of shear + mom. at end F (face of support)

$V = 16820 - 3625 \times 1.5 = 11380$#

$M = 49,400 - \frac{1}{3}\left(\frac{16820+11380}{2}\right) \times 3 = 35,300$ '#

At end E req'd $d = \sqrt{\frac{15240}{147}} = 10.2' < 28.5''$ OK

$v = \frac{6240}{12 \times .88 \times 28.5} = 21$ #/□"

$-A_s = \frac{15,240 \times 12}{18000 \times .88 \times 28.5} = .41 \square''$ Use 3/4"ϕ @ 1'-0" cc

$u_o = \frac{6240}{2.4 \times .88 \times 28.5} = 104$ #/□"

At end F req'd $d = \sqrt{\frac{35,300}{147}} = 15.5' < 43.5''$

$v = \frac{11380}{12 \times .88 \times 43.5} = 25$ #/□"

$-A_s = \frac{35,300 \times 12}{18,000 \times .88 \times 43.5} = .62 \square''$ Use 7/8"ϕ @ 1'-0" cc

$u_o = \frac{11380}{4.1 \times .88 \times 43.5} = 73$ #/□"

End Gate Well Face

At end E - Values of shear and mom. at face of support

$V = 12,920 - 3625 \times 1.5 = 7480$#

$M = 20,700 - \frac{1}{3}\left(\frac{12,920+7480}{2}\right) \times 3 = 10,500$ '#

At end F - Values of shear and mom. at face of support

$V = 16,120 - 3625 \times 1.5 = 10680$#

$M = 40,800 - \frac{1}{3}\left(\frac{16120+10680}{2}\right) \times 3 = 27,400$ '#

Member EF cont.

End Gate Well Face

At end E $v = \frac{7480}{12 \times .88 \times 28.5} = 25\ \#/\square''$

$-A_s$ Use $\frac{3}{4}''\phi$ @ 1'-0" c.c.

At end F - Use same values as for opposite face

Member FD

End Gate Well Face

At end F - Values of shear and mom. at face of support

$V = 25{,}010 - 3625 \times 1.5 = 19{,}570\ \#$

$M = 57{,}800 - \frac{1}{3}\left(\frac{25010 + 19570}{2}\right) \times 3 = 35{,}510\ '\#$

At end D - Values of shear and mom at face of support

$V = 25750 - 3625 \times 1.5 = 20310\ \#$

$M = 63{,}000 - \frac{1}{3}\left(\frac{25750 + 20310}{2}\right) \times 3 = 40{,}000\ '\#$

At end F req'd $d = \sqrt{\frac{35{,}510}{147}} = 15.6'' < 34.5$

$v = \frac{19570}{12 \times .88 \times 34.5} = 54\ \#/\square''$ OK

$-A_s = \frac{35{,}510 \times 12}{18000 \times .88 \times 34.5} = .78\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

$u_0 = \frac{19570}{4.1 \times .88 \times 34.5} = 157\ \#/\square''$

At end D $v = \frac{20{,}310}{12 \times .88 \times 43.5} = 44\ \#/\square''$

$-A_s = \frac{40{,}000 \times 12}{18000 \times .88 \times 43.5} = .76\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

$u_0 = \frac{20{,}310}{4.1 \times .88 \times 43.5} = 129\ \#/\square''$

At center req'd $d = \sqrt{\frac{32{,}840}{123}} = 16.4'' < 28.5''$

$+A_s = \frac{32840 \times 12}{18000 \times .88 \times 28.5} = .87\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

Center Gate Well Face -

Use same steel as in opposite face

WAR DEPARTMENT

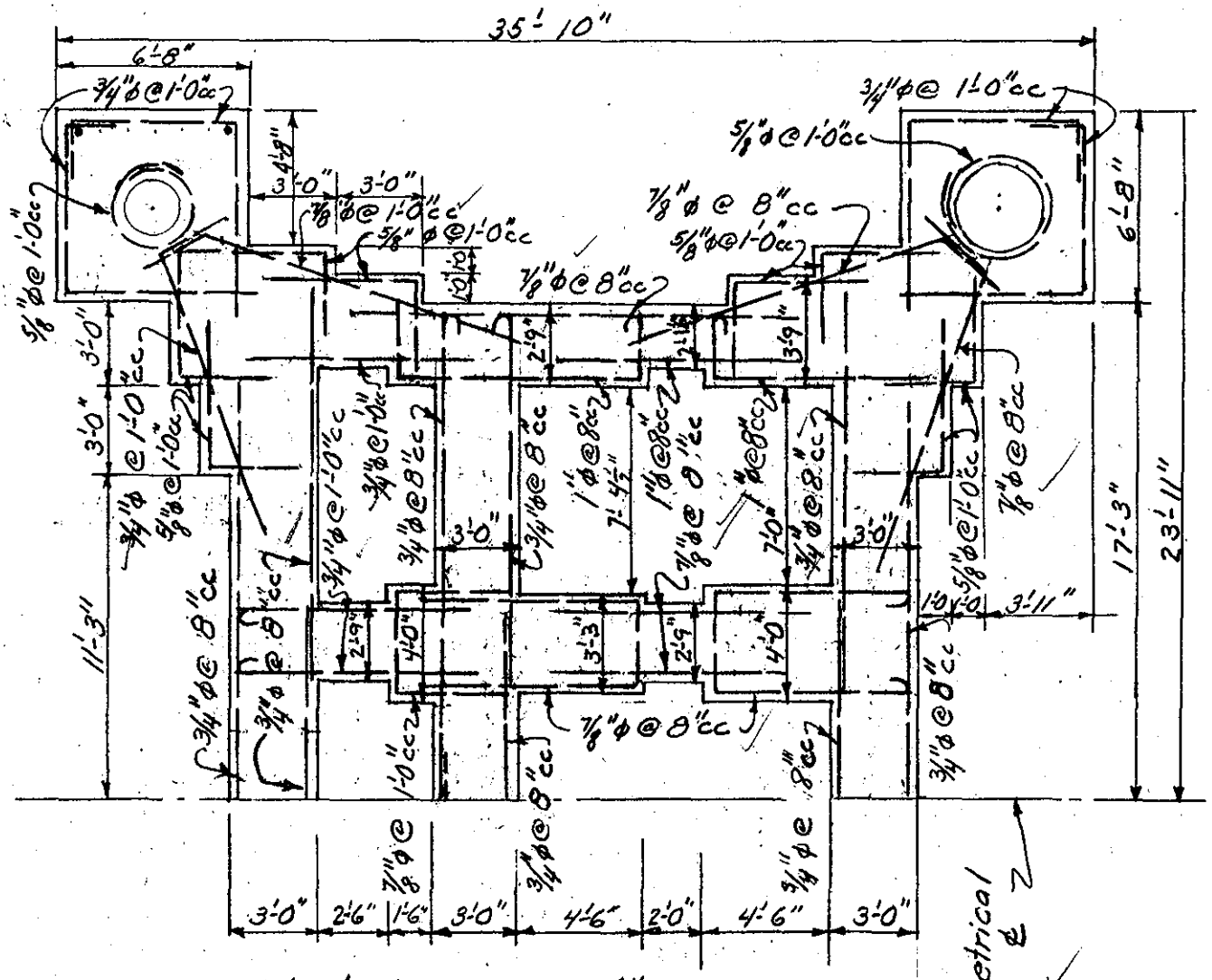
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El. 572.0 to 580.5

Computed by: H.E.W. Checked by: A.L.K. Date: Aug-3-1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528



All steel to have 4" cover

Section from El. 572.0 to 580.5

WAR DEPARTMENT

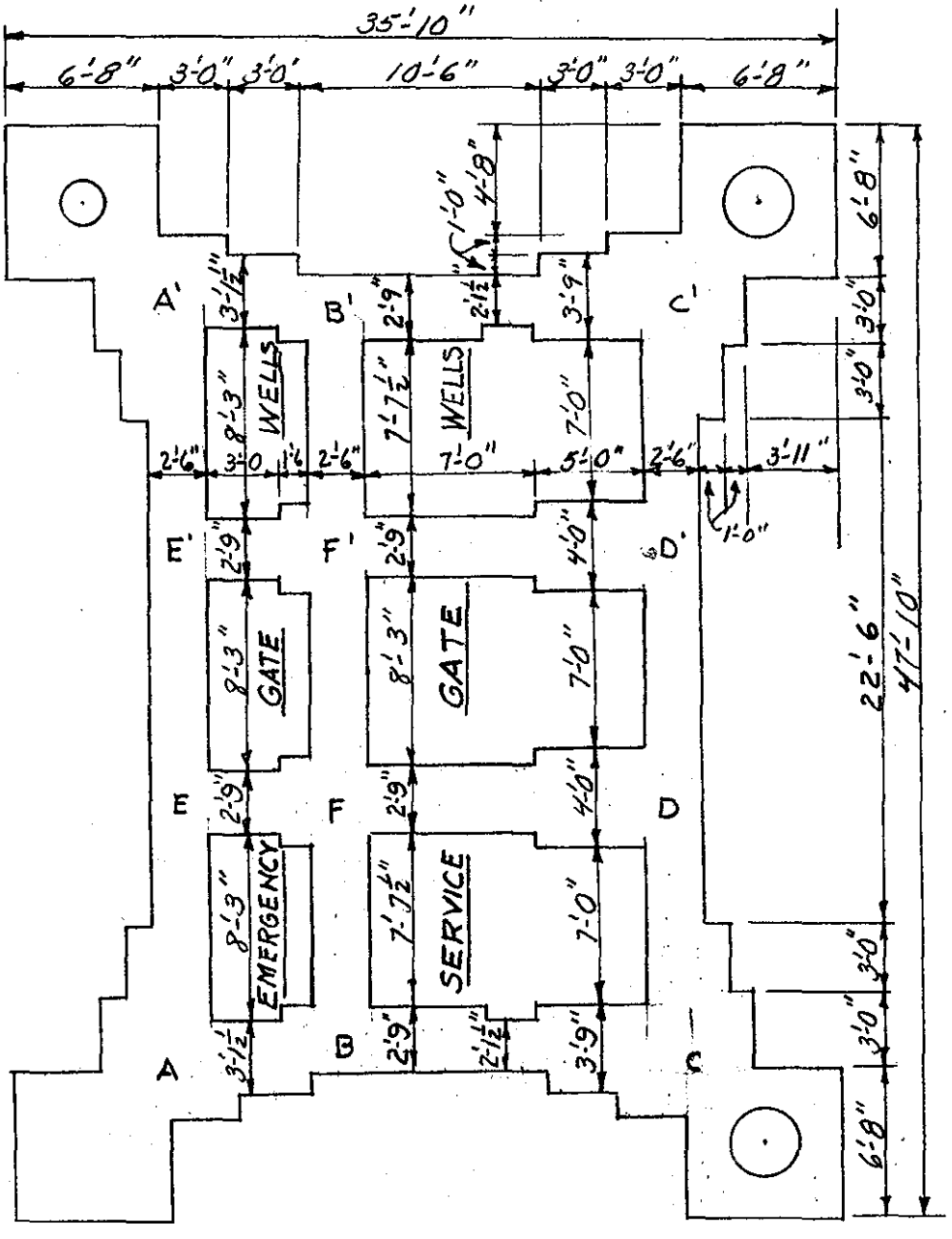
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 580.50 to 600.5

Computed by H.E.W. **Checked by** A.L.K. **Date** Aug. 4, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10538



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El. 580.5 to El. 600.5

Computed by: H.E.W. Checked by: A.L.K. Date: Aug. 4. 1944

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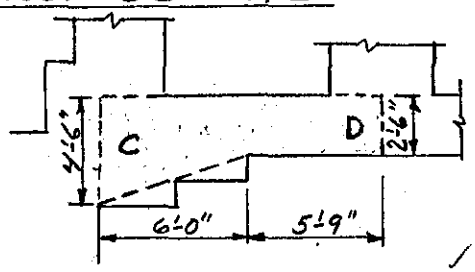
Determination of Co-efficients for Fixed End Moments Stiffness and Carry Over Factor

Members AB, BC and EF will be the same as for the previous section (The changes in length and shape of section are small enough to be neglected)

Member CD & AE



Shaded area will be considered as the effective section

$\frac{min.\ d}{max.\ d} = \frac{2.5}{4.5} = .555$ $a = \frac{6}{11.75} = .511$

Stiffness $K = 10.5 \times \frac{2.5^3}{141} = 1.16$ at C

$K = 4.8 \times \frac{2.5^3}{141} = 0.53$ at D

Carry over factor $C = 0.40$ at C

$C = 0.88$ at D

Fixed end mom. "f" = 0.130 at C

"f" = 0.063 at D

Member FB

Stiffness $K = 4 \times \frac{2.5^3}{124.5} = 0.50$ at eq. end

Carry over $C = 0.50$ at eq. end

F.E.M. $f = 0.083$ " " "

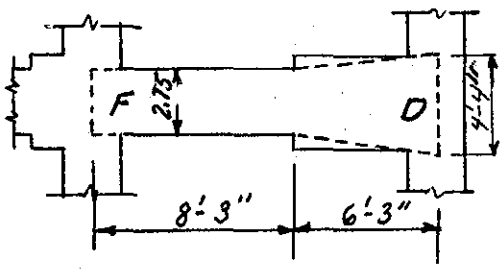
Members EE', FF' and DD'

Stiffness $K = 4 \times \frac{2.5^3}{132} = 0.47$ at eq. end

Carry over $C = 0.50$ at eq. end

F.E.M $f = 0.083$ " " "

Member FD



Shaded area will be considered as the effective section

$\frac{min.\ d}{max\ d} = \frac{2.75}{4.33} = .635$ $a = \frac{6.25}{14.5} = .431$

$M^F_{area.end} = 0.083 \times 3090 \times 11^2 = 31.0$ '"

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

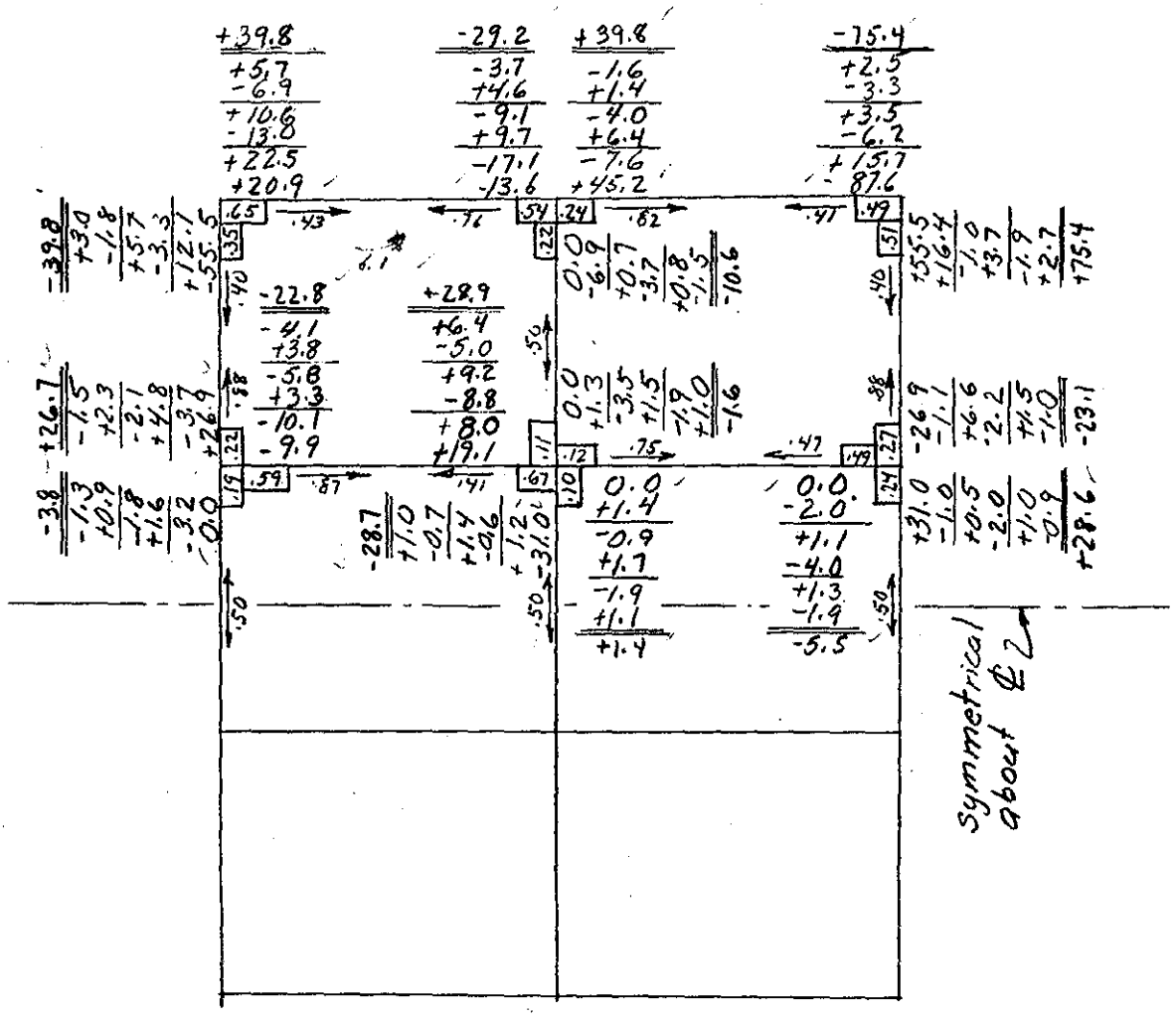
Subject: Claremont Dam

Computation: Gate Tower Section from El. 580.5 to 600.5

Computed by: H.E.W. Checked by: A.L.K. Date: 8-Aug.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case V Emergency gate down in center well. end wells remaining open. Water to spillway crest elevation.



Subject Claremont Dam

Computation Gate Tower Section from El. 580 to 600.5

Computed by H.E.W. **Checked by** A.L.K. **Date** 8 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Maximum Values of Shear and Pos. Moment

Member AB & A'B'

$V_A = 3090 \times \frac{7.5}{2} + \frac{10,600}{7.5} = 13000^{\#}$

$V_B = 3090 \times \frac{7.5}{2} - \frac{7600}{7.5} = 10,580^{\#}$

$x_0 = \frac{10.580}{3090} = 3.42'$ from B

$+M = 10580 \times 3.42 - 29,000 - 3090 \times \frac{3.42^2}{2} = -10890'^{\#}$

Member BC & B'C'

$V_B = 3090 \times \frac{15}{2} - \frac{26.400}{15} = 21,420^{\#}$

$V_C = 3090 \times \frac{15}{2} + \frac{35,800}{15} = 25,560^{\#}$

$x_0 = \frac{25,560}{3090} = 8.27'$ from C

$+M = 8.27 \times 25560 - 76,100 - 3090 \times \frac{8.27^2}{2} = 29,610'^{\#}$

Member CD & C'D'

$V_C = 3090 \times \frac{11.75}{2} + \frac{55,700}{11.75} = 22890$

$V_D = 3090 \times \frac{11.75}{2} - \frac{32.900}{11.75} = 15350$

$x_0 = \frac{22890}{3090} = 7.41'$ from C

$+M = 22890 \times 7.41 - 76,100 - 3090 \times \frac{7.41^2}{2} = 8680'^{\#}$

Member BF & B'F'

$V_B = 3090 \times \frac{10.37}{2} + \frac{9,600}{10.37} = 16,950^{\#}$

$V_F = 3090 \times \frac{10.37}{2} - \frac{9600}{10.37} = 15090^{\#}$

$x_0 = \frac{16,950}{3090} = 5.49'$ from B

$+M = 16950 \times 5.49 - 34,000 - 3090 \times \frac{5.49^2}{2} = 12,490'^{\#}$

Member AE & A'E'

$V_A = 3090 \times \frac{11.75}{2} + \frac{14,900}{11.75} = 19420$

$V_E = 3090 \times \frac{11.75}{2} - \frac{3,200}{11.75} = 17880$

$x_0 = \frac{19,420}{3090} = 6.28'$ from A

$+M = 19420 \times 6.28 - 40,000 - 3090 \times \frac{6.28^2}{2} = 21,030'^{\#}$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 580.5 to 600.5
Computed by: H.E.W. Checked by: A.L.K. Date: 8-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Max. Values of Shear and Pos. Mom. (cont.)

Member EE'

$V_E = V_{E'} = 3090 \times \frac{11}{2} + \frac{9,400}{11} = 17,850^{\#}$

$x_0 = \frac{17,850}{3090} = 5.78'$

$+M = 17850 \times 5.78 - 33,900 - 3090 \times \frac{5.78^2}{2} = 17,650'^{\#}$

Member FF'

$V_F = V_{F'} = 3090 \times \frac{11}{2} = 17000^{\#}$

$+M = \frac{1}{8} \times 3090 \times 121 - 28,700 = 18040'^{\#}$

Member DD'

$V_D = V_{D'} = 3090 \times \frac{11}{2} + \frac{20,500}{11} = 18860^{\#}$

$+M = \frac{1}{8} \times 3090 \times 121 - 28,600 = 18,140'^{\#}$

Member EF & E'F'

$V_E = 3090 \times \frac{7.0}{2} + \frac{1100}{7} = 10,980^{\#}$ Case IV

$V_F = 3090 \times \frac{7.0}{2} + \frac{21000}{7} = 13,815^{\#}$ Case II

$x_0 = \frac{10,980}{3090} = 3.55'$ from E

$+M = 10,980 \times 3.55 - 21,700 - 3090 \times \frac{3.55^2}{2} = -2190'^{\#}$

$V_E = 3090 \times \frac{7.0}{2} - \frac{6,100}{7} = 9940^{\#}$

$V_F = 3090 \times \frac{7.0}{2} + \frac{26,200}{7} = 14560^{\#}$

$x_0 = \frac{9940}{3090} = 3.22'$ from E

$+M = 9940 \times 3.22 - 22,800 - 3090 \times \frac{3.22^2}{2} = -6810'^{\#}$

Member FD & F'D'

$V_F = 3090 \times \frac{14.5}{2} - \frac{6700}{14.5} = 21,940$

$V_D = 3090 \times 14.5 + \frac{6700}{14.5} = 22,860$

} Case II

$\frac{21,940}{3090} = 7.1$ from F

$+M = 21,940 \times 7.1 - 49,200 - 3090 \times \frac{7.1^2}{2} = 28,690'^{\#}$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 580.5 to 600.5
Computed by: H.F.W. Checked by: A.L.K. Date: 8 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10533

Max. Values of Shear and Pos. Mom. (cont.)

Member FD & F'D' (cont.)

$V_F = 3090 \times \frac{14.5}{2} + \frac{5,700}{14.5} = 22790^{\#}$

$V_D = 3090 \times \frac{14.5}{2} - \frac{5700}{14.5} = 22010^{\#}$

$x_0 = \frac{22010}{3090} = 7.12'$ from D

$+M = 22010 \times 7.12 - 46,000 - 3090 \times \frac{7.12^2}{2} = 32,390'^{\#}$

Design of Members

Member AB

At pt A - Values of shear and mom. at face of support

$V = 13000 - 3090 \times 1.75 = 7590^{\#}$

$M = 40000 - \frac{1}{3}\left(\frac{13,000+7590}{2}\right) \times 3.5 = 27,990'^{\#}$

At pt B - Values of shear and mom at face of support

$V = 10,580 - 3090 \times 1.25 = 6720^{\#}$

$M = 31,000 - \frac{1}{3}\left(\frac{10580+6720}{2}\right) 2.5 = 23790'^{\#}$

At end A - req'd $d = \sqrt{\frac{27,990}{147}} = 13.8'' < 36''$ OK

$v = \frac{7590}{12 \times .88 \times 36} = 20^{\#}/\square''$

$-A_s = \frac{27990 \times 12}{18000 \times .88 \times 36} = .59\square''$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

$u_0 = \frac{7590}{2.8 \times .88 \times 28.5} = 86^{\#}/\square''$

At end B - req'd $d = \sqrt{\frac{23790}{147}} = 12.7'' < 28.5''$

$v = \frac{6720}{12 \times .88 \times 28.5} = 22^{\#}/\square''$

$-A_s = \frac{23790 \times 12}{18000 \times .88 \times 28.5} = .63\square''$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

For steel on inside face use $\frac{3}{4}''\phi$ @ 1'-0" cc

Member BC

At pt B - Values of shear and mom. at face of support

$V = 21,420 - 3090 \times 1.25 = 17560$

$M = 46,500 - \frac{1}{3}\left(\frac{21,420+17560}{2}\right) \times 2.5 = 30,260'^{\#}$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 580.5 to 600.5
Computed by: H.E.W. Checked by: A.L.K. Date: 8. Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Member BC (cont.)

At pt C - Values of shear and mom. at face of support

$V = 25560 - 3090 \times 1.75 = 20,150$

$M = 76,100 - \frac{1}{3}\left(\frac{25560 - 20,150}{2}\right) \times 3.5 = 49,460'^{\#}$

Values are nearly the same as for member BC of Section from El. 572.0 to 580.5. so same steel will be used.

Member CD

At end C - Values of shear and mom at face of support

$V = 22890 - 3090 \times 2.75 = 14,390^{\#}$

$M = 76,100 - \frac{1}{3}\left(\frac{22890 + 14390}{2}\right) \times 4.75 = 46,590'^{\#}$

At end D - Values of shear and mom. at face of support

$V = 15350 - 3090 \times 2 = 9170$

$M = 36,300 - \frac{1}{3}\left(\frac{15350 + 9170}{2}\right) \times 4 = 19,950'^{\#}$

At end C - req'd $d = \sqrt{\frac{46,590}{147}} = 17.8'' < 38.5$

$v = \frac{14390}{12 \times .88 \times 38.5} = 35\ ^{\#}/_{\square''}$

$-A_s = \frac{46590 \times 12}{18000 \times .88 \times 38.5} = .92\ ^{\square''}$ Use $\frac{7}{8}''\phi$ @ 8" cc.

$u_o = \frac{14390}{4.1 \times .88 \times 38.5} = 103^{\#}$

At end D - req'd $d = \sqrt{\frac{19,950}{147}} = 11.7'' < 25.5''$

$v = \frac{9170}{12 \times .88 \times 25.5} = 34\ ^{\#}/_{\square''}$

$-A_s = \frac{19,950 \times 12}{18,000 \times .88 \times 25.5} = .60\ ^{\square''}$ Use $\frac{3}{4}''\phi$ @ 8" cc.

$u_o = \frac{9170}{3.5 \times .88 \times 25.5} = 116\ ^{\#}/_{\square''}$

Member DD'

Values of shear and mom. at face of supports

$V = 18,860 - 3090 \times 2 = 12,680^{\#}$

$M = 44000 - \frac{1}{3}\left(\frac{18860 + 12,680}{2}\right) \times 4 = 22970^{\#}$

$+M = 18,140'^{\#}$

req'd $d = \sqrt{\frac{22,970}{147}} = 12.5'' < 25.5''$ OK

Member DD' (cont.)

$v = \frac{12680}{12 \times .88 \times 25.5} = 47$ #/□"

$-A_s = \frac{22970 \times 12}{18000 \times .88 \times 25.5} = .68$ □" Use 3/4"φ @ 8"cc

$u_0 = \frac{12680}{3.5 \times .88 \times 25.5} = 162$ #/□"

$+A_s = \frac{18,180 \times 12}{18000 \times .88 \times 25.5} = .54$ □" Use 3/4"φ @ 8"cc

Member BF

At end B- Values of shear and mom. at face of support

$V = 16950 - 3090 \times 1.37 = 12,730$#

$M = 34000 - \frac{1}{3}\left(\frac{16950 + 12730}{2}\right) \times 2.75 = 20,400$ '#

At end F- Values of shear and mom. at face of support

$V = 15090 - 3090 \times 1.37 = 10860$#

$M = 24,400 - \frac{1}{3}\left(\frac{15090 + 10860}{2}\right) \times 2.75 = 12,500$ '#

At end B- req'd $d = \sqrt{\frac{20,400}{147}} = 11.8" < 25.5"$

$v = \frac{12730}{12 \times .88 \times 25.5} = 47$ #/□" OK

$-A_s = \frac{20,400 \times 12}{18,000 \times .88 \times 25.5} = .61$ □" Use 3/4"φ @ 8"cc

$u_0 = \frac{12730}{3.5 \times .88 \times 25.5} = 162$ #/□"

At end F - $A_s = \frac{12,500 \times 12}{18000 \times .88 \times 25.5} = .37$ □" 3/4"φ @ 8"cc

$+A_s = \frac{12,490 \times 12}{18,000 \times .88 \times 25.5} = .37$ □" Use 3/4"φ @ 1'-0"cc

Member FF

Values of shear and mom. at face of support

$V = 17000 - 3090 \times 1.37 = 12770$#

$M = 28,700 - \frac{1}{3}\left(\frac{17000 + 12,770}{2}\right) \times 2.75 = 15060$ '#

$v = \frac{12770}{12 \times .88 \times 25.5} = 48$ #/□"

$-A_s = \frac{15060 \times 12}{18,000 \times .88 \times 25.5} = .45$ □" Try 3/4"φ @ 1'-0"cc

Member FF' (cont.)

$u_0 = \frac{12770}{2.4 \times .88 \times 25.5} = 231\ \#/\square''$ Too large Use $\frac{3}{4}''\phi$ @ 8" cc

$u_0 = \frac{12770}{3.5 \times .88 \times 25.5} = 163\ \#/\square''$

$+A_s = \frac{18040 \times 12}{18000 \times .88 \times 25.5} = .54\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

Direct tension = 5510#

Including direct tension max. possible "fs" will not exceed

$\frac{5510}{.66} + \frac{18040 \times 12}{.66 \times .88 \times 25.5} = 20,450\ \#/\square''$

Member AE

At end A Values of shear and mom. at face of support

$V = 19420 - 3090 \times 2.13 = 12,830\#$

$M = 40,100 - \frac{1}{3}\left(\frac{19420 + 12830}{2}\right) \times 4.12 = 17,950'\#$

At end E - Values of shear and mom. at face of support

$V = 17880 - 3090 \times 1.37 = 13650\#$

$M = 33,200 - \frac{1}{3}\left(\frac{17880 + 13650}{2}\right) \times 2.75 = 18750'\#$

At end A - req'd $d = \sqrt{\frac{17950}{147}} = 11.1'' < 41''$

$v = \frac{12830}{12 \times .88 \times 41} = 30\ \#/\square''$

$-A_s = \frac{17,950 \times 12}{18,000 \times .88 \times 41} = .33\ \square''$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{12830}{2.4 \times .88 \times 41} = 148\ \#/\square''$

At end E - req'd $d = \sqrt{\frac{18750}{147}} = 11.3'' < 25.5''$

$v = \frac{13650}{12 \times .88 \times 25.5} = 51\ \#/\square''$

$-A_s = \frac{18750 \times 12}{18000 \times .88 \times 25.5} = .56\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

$u_0 = \frac{13650}{3.5 \times .88 \times 25.5} = 173\ \#/\square''$

Pt. of max. pos. mom.

$+A_s = \frac{21,030}{18000 \times .88 \times 25.5} = .52\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

Subject: Claremant Dam

Computation: Gate Tower Section from El. 580.5 to 600.5

Computed by: H.E.W. Checked by: Date: 9-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Member EE'

Values of shear and mom. at face of support

$V = 17\,850 - 3090 \times 1.37 = 13,620^{\#}$

$M = 33,900 - \frac{1}{3}\left(\frac{17850 + 13620}{2}\right) \times 2.75 = 19,490'^{\#}$

req'd $d = \sqrt{\frac{17650}{123}} = 12'' < 25.5''$

$v = \frac{13620}{12 \times .88 \times 25.5} = 51\ \#/\square''$

$-A_s \quad \frac{19490 \times 12}{18000 \times .88 \times 25.5} = .58\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

$u_o = \frac{13620}{3.5 \times .88 \times 25.5} = 174\ \#/\square''$

$+A_s = \frac{17650 \times 12}{18000 \times .88 \times 25.5} = .52\ \square''$ Use $\frac{3}{4}''\phi$ @ 8" cc

Member EF

Center Gate Well Face

At end E - Values of shear and mom. at face of support

$V = 9,940 - 3090 \times 1.25 = 6080^{\#}$

$M = 22,800 - \frac{1}{3}\left(\frac{9940 + 6080}{2}\right) \times 2.5 = 16,120'^{\#}$

At end F Values of shear and mom. at face of support

$V = 14,560 - 3090 \times 1.25 = 10,700^{\#}$

$M = 46,200 - \frac{1}{3}\left(\frac{14560 + 10,700}{2}\right) \times 2.5 = 35670'^{\#}$

At end E. $A_s = \frac{16,120 \times 12}{18,000 \times .88 \times 28.5} = .43\ \square''$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_o = \frac{6080}{2.4 \times .88 \times 28.5} = 101\ \#/\square''$

At end F - req'd $d = \sqrt{\frac{35670}{147}} = 15.6'' < 43.5''$

$v = \frac{10,700}{12 \times .88 \times 43.5} = 23\ \#/\square''$

$-A_s = \frac{35670 \times 12}{18000 \times .88 \times 43.5} = .62\ \square''$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

$u_o = \frac{10,700}{4.1 \times .88 \times 43.5} = 69\ \#/\square''$

Subject: Claremont Dam
Computation: Gate Tower Section from El 580.5 to 600.5
Computed by: H.E.W. Checked by: Date: 10-Aug-44.

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Member EF (cont.)

End Gate Well Face

At end E - Values of shear and mom. at face of support

$V = 10,980 - 3090 \times 1.25 = 7120^{\#}$

$M = 21,700 - \frac{1}{3}\left(\frac{10980+7120}{2}\right) \times 2.5 = 14,160'^{\#}$

At end F - Values of shear and mom. at face of support

$V = 13,820 - 3090 \times 1.25 = 9960^{\#}$

$M = 38,500 - \frac{1}{3}\left(\frac{13,820+9960}{2}\right) \times 2.5 = 28,590'^{\#}$

Use same steel as for opposite face.

Member FD

End Gate Well Face

At end F - Values of shear and mom. at face of support

$V = 21,940 - 3090 \times 1.25 = 18080^{\#}$

$M = 49,200 - \frac{1}{3}\left(\frac{21940+18,080}{2}\right) \times 2.5 = 32,520'^{\#}$

At end D - Values of shear and mom. at face of support

$V = 22860 - 3090 \times 1.25 = 19,000^{\#}$

$M = 55,900 - \frac{1}{3}\left(\frac{22860+19000}{2}\right) \times 2.5 = 38,460'^{\#}$

At end F req'd $d = \sqrt{\frac{32,520}{.147}} = 14.9'' < 28.5''$

$v = \frac{18080}{12 \times .88 \times 28.5} = 60\ \#/\square''$

$-A_s = \frac{32,520 \times 12}{18000 \times .88 \times 28.5} = .87\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

$u_0 = \frac{18080}{4.1 \times .88 \times 28.5} = 175\ \#/\square''$ OK

At end D. $v = \frac{19000}{12 \times .88 \times 43.5} = 41\ \#/\square''$

$-A_s = \frac{38,460 \times 12}{18,000 \times .88 \times 43.5} = 1.67\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

$u_0 = \frac{19000}{4.1 \times .88 \times 43.5} = 122\ \#/\square''$

$+A_s$ at center $= \frac{32,390 \times 12}{18,000 \times .88 \times 28.5} = .86\ \square''$ Use $\frac{7}{8}''\phi$ @ 8" c.c.

Center Gate Well Face

Use same steel as in opposite face

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from 580.5 to 600.5

Computed by H. E. W **Checked by** **Date** 10-Aug.-1944

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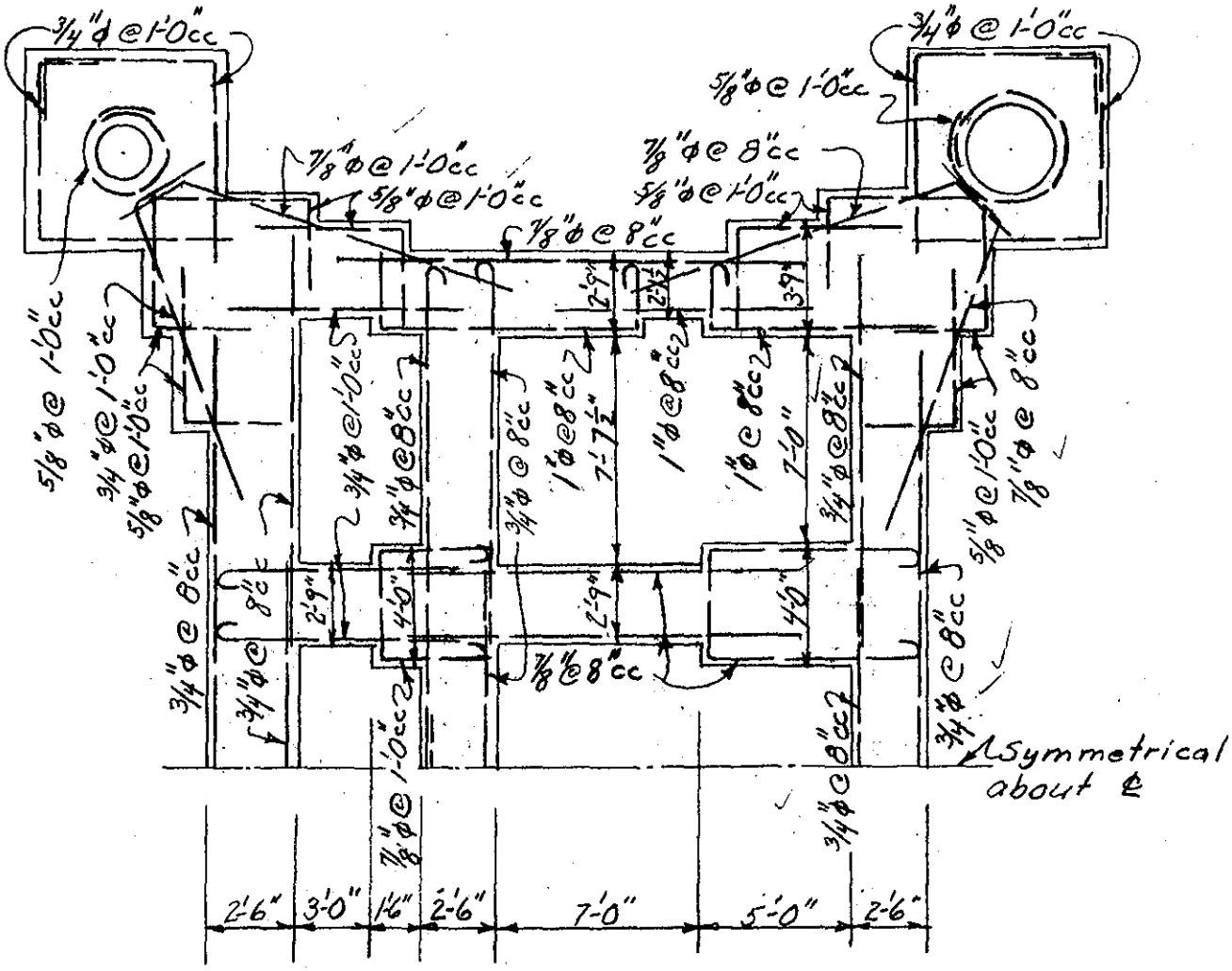


All steel to have 4" cover
Outside dimensions are the same as
Section from El. 572.0 to 580.5

Section from El. 580.5 to 600.5

WAR DEPARTMENT

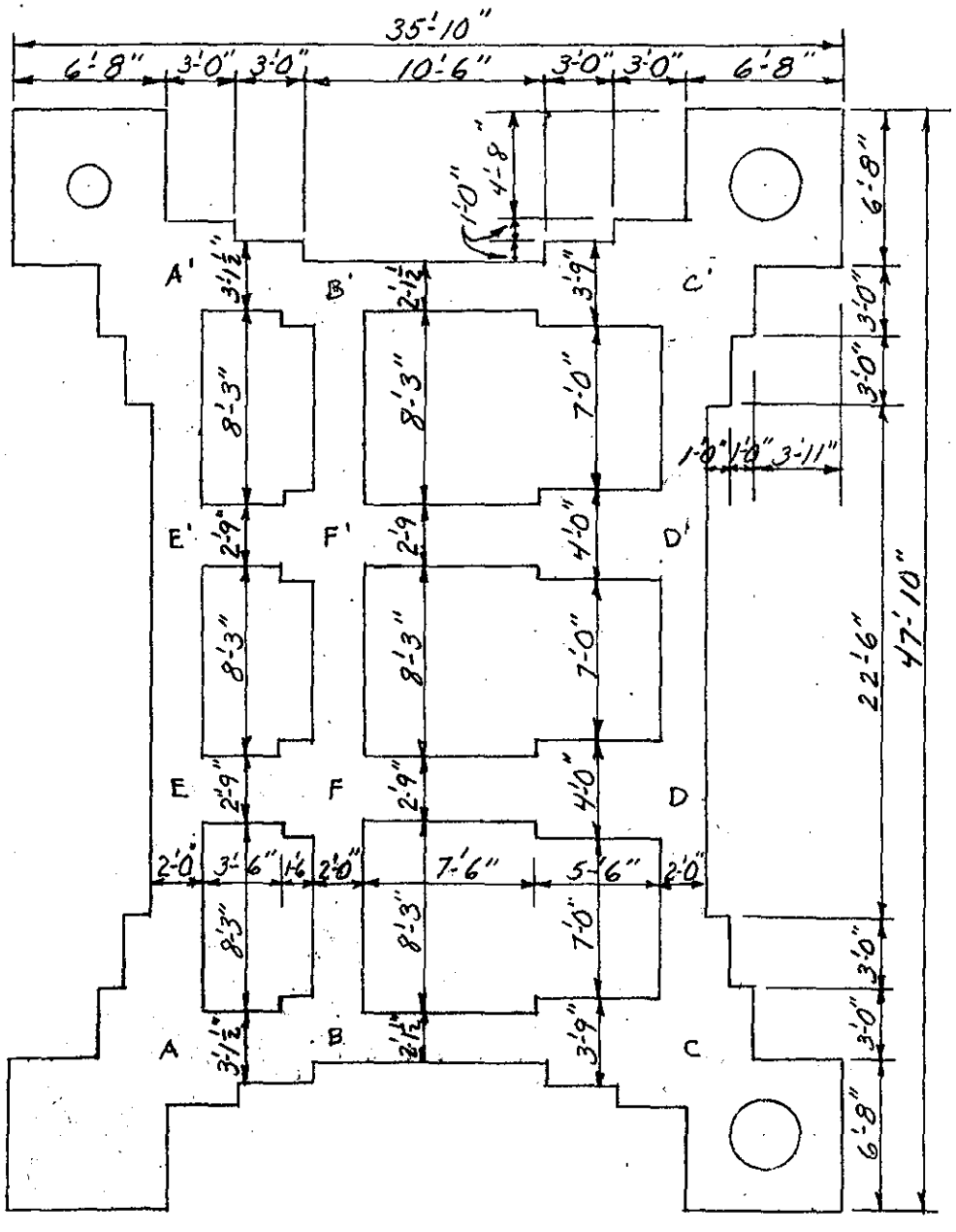
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Section from El. 600.5 to 610.5

Computed by H. E. W. **Checked by** **Date** 10 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Horiz. Sect at El. 600.5

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

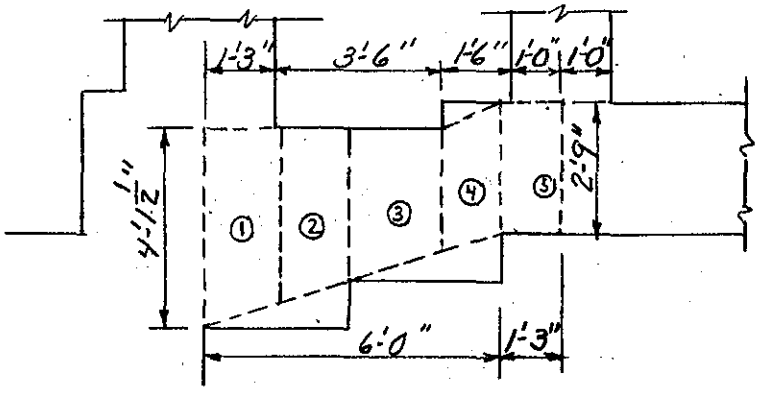
Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H. E. W. Checked by: Date: 10. Aug. - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Coefficients for F.E.M - Stiffness - Carry Over Factor



Shaded area will be considered as the effective section of the member

Consider member loaded with a uniform load of 1 Kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	ax^2	m_s	$m_s a$	$m_s ax$
1	1.5	3.87	0.17	0.26	-3.13	-0.81	2.5	2.44	0.6	-1.9
2	1.5	3.37	0.26	0.39	-1.63	-0.64	1.0	5.58	2.2	-3.6
3	1.25	2.83	0.44	0.77	0	0	0.2	6.55	5.0	0
4	1.25	2.64	0.54	0.68	1.50	+1.02	1.5	5.03	3.4	5.1
5	1.25	2.75	0.48	0.60	2.75	+1.65	4.5	2.08	1.2	3.3
Minus corrections				2.70		1.22	9.7		13.4	+2.9
					+0.45		0.5			6.0
							9.2			-3.1
				A	$\bar{x}$		I_x		P	M_x

$$\text{Stiffness at } A = \frac{1}{2.70} + \frac{4.27^2}{9.2} = 2.35$$

$$\text{Stiffness at } B = \frac{1}{2.70} + \frac{2.98^2}{9.2} = 1.34$$

$$\text{Carry over at } A = \frac{\frac{1}{2.70} - \frac{4.27 \times 2.98}{9.2}}{2.35} = .43$$

$$\text{Carry over at } B = \frac{\frac{1}{2.70} - \frac{4.27 \times 2.98}{9.2}}{1.34} = .75$$

$$M_A = \frac{13.4}{2.70} + \frac{-3.1 \times -4.27}{9.2} = 6.40 \text{ 'K}$$

$$M_B = \frac{13.4}{2.70} + \frac{-3.1 \times +2.98}{9.2} = 3.96 \text{ 'K}$$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

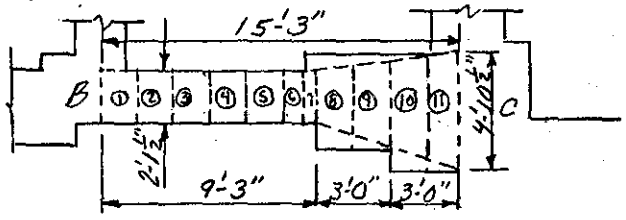
Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 11 Aug. - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Co-efficients for F.E.M. - Stiffness - Carry Over Factor
Member BC



shaded area will be considered as the effective section of the member

Consider member loaded with a uniform load of 1 Kip per ft.

Section	L	d	$\frac{10}{d^3}$	a	x	ax	$10 + ax^2$	m_s	$m_s a$	$m_s ax$
1	1.5	2.12	1.05	1.58	-7.25	-11.5	0.3 83.0	5.44	8.6	-62.3
2	1.5	2.12	1.05	1.58	-5.75	-9.1	0.3 52.2	14.58	23.0	-132.4
3	1.5	2.12	1.05	1.58	-4.25	-6.7	0.3 28.5	21.56	34.1	-144.8
4	1.5	2.12	1.05	1.58	-2.75	-4.3	0.3 11.9	26.25	41.5	-114.1
5	1.5	2.12	1.05	1.58	-1.25	-2.0	0.3 2.5	28.69	45.3	-56.7
6	1.0	2.12	1.05	1.05	0	0	0.1	29.07	30.5	0
7	0.75	2.17	0.98	0.74	0.87	+0.6	0.6	28.29	20.9	+18.2
8	1.5	2.54	0.61	0.92	2.0	+1.8	0.2 3.7	26.25	24.2	+48.3
9	1.5	3.21	0.30	0.45	3.5	+1.6	5.5	21.56	9.7	+34.0
10	1.5	3.88	0.17	0.26	5.0	+1.3	6.5	14.58	2.5	+12.4
11	1.5	4.55	0.11	0.16	6.5	+1.0	6.8	5.44	0.9	+5.7
Minus corrections				11.48	-2.38	-27.3	203.0 65.0		241.2	-391.7 -574.1
							138.0			+182.4
				A	$\bar{x}$		I_x		P	M_x

$$\text{Stiff. at } B = \frac{1}{11.48} + \frac{5.62^2}{138.0} = 0.32$$

$$\text{Stiff. at } C = \frac{1}{11.48} + \frac{9.63^2}{138.0} = 0.76$$

$$\text{Carry-over at } B = \frac{\frac{1}{11.48} - \frac{5.62 \times 9.63}{138.0}}{0.32} = 0.95$$

$$\text{Carry-over at } C = \frac{\frac{1}{11.48} - \frac{5.62 \times 9.63}{138.0}}{0.76} = 0.40$$

$$M_B = \frac{241.2}{11.48} + \frac{(+182.4)(-5.62)}{138} = 13.58 \text{ 'K}$$

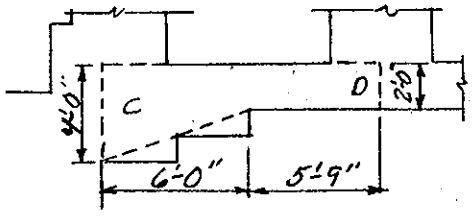
$$M_C = \frac{241.2}{11.48} + \frac{(182.4)(9.63)}{138} = 33.74 \text{ 'K}$$

Subject: Claremont Dam
Computation: Gate Tower Section from El. 600.5 to 610.5
Computed by: H. E. W. Checked by: Date: 14-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Co-efficients for F.E.M. – Stiffness – Carry Over Factor

Member CD & AE



Shaded area will be considered as the effective section

$\frac{min.\,d}{max.\,d} = \frac{2.0}{4.0} = .5 \quad a = \frac{6}{11.75} = .511$

Stiffness $K = 12.5 \times \frac{2^3}{141} = 0.71$ large end
$K = 5.0 \times \frac{2^3}{141} = 0.28$ small end

Carry over $C = 0.38$ large end
" " $C = 0.95$ small end

F.E.M. $f = 0.141$ large end
" $f = 0.059$ small end

Member FB

Stiffness $K = 4 \times \frac{2^3}{128.25} = 0.25$ at eq. end

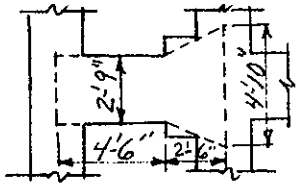
Carry over $C = 0.50$ at eq. end
F.E.M. "f" $= 0.083$ " " "

Members EE' FF' & DD'

Stiffness $K = 4 \times \frac{2^3}{132} = 0.24$ at eq. end

Carry over $C = 0.50$ at eq. end
F.E.M "f" $= 0.083$ at eq. end

Member EF



Shaded area will be considered as the effective section

$\frac{min.\,d}{max\,d} = \frac{2.75}{4.83} = .569 \quad a = \frac{2.5}{7.0} = .357$

Stiffness $K = 8.0 \times \frac{2.75^3}{84} = 1.98$ at large end
$K = 4.65 \times \frac{2.75^3}{84} = 1.15$ " small end

Carry over $C = 0.44$ at large end
" " $C = 0.78$ " small end
F.E.M. $f = 0.125$ at large end
" $f = 0.065$ at small end

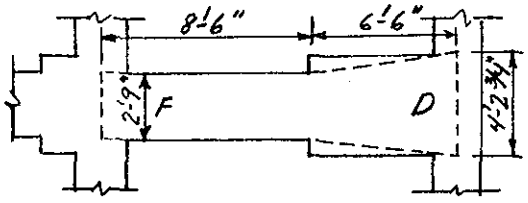
Subject Claremont Dam.
Computation Gate Tower: Section from El. 600.5 to 610.5
Computed by H. E. W. **Checked by** **Date** 14-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Co-efficients for F.E.M. – Stiffness – Carry-over (cont.)

Member FD

Shaded area will be considered as effective section



$\frac{\text{min } d}{\text{max } d} = \frac{2.75}{4.23} = .65 \quad a = \frac{6.5}{15} = .43$

Stiffness $K = 7.6 \times \frac{2.75^3}{180} = 0.88$ large end
" $K = 4.51 \times \frac{2.75^3}{180} = 0.52$ small end

Carry-over $C = 0.43$ at large end
" " $C = 0.74$ at small end

F.E.M. "f" = .115 at large end
" "f" = .071 at small end

Design Head

Spillway Elev = 630.0
Section Elev = 600.5
29.5

$P = 29.5 \times 62.5 = 1840$ #/□'

Water at spillway surcharge elevation will increase the design stresses by 51 % OK

Fixed End Moments

Member AB

$M^F_{AB} = 6.40 \times 1.84 = 11.8^{'K}$
$M^F_{BA} = 3.96 \times 1.84 = 7.3^{'K}$

Member BC

$M^F_{BC} = 13.58 \times 1.84 = 25.0^{'K}$
$M^F_{CB} = 33.74 \times 1.84 = 62.1^{'K}$

Member CD + A.E

$M^F_{CD} = .141 \times 1.84 \times 11.75^2 = 35.8^{'K}$
$M^F_{DC} = .059 \times 1.84 \times 11.75^2 = 15.0^{'K}$

Member BF

$M^F_{BF} = M^F_{FB} = 0.083 \times 1.84 \times 10.69^2 = 17.5^{'K}$

Fixed End Moments (cont.)

Member EE', FF', & DD'

$M^F_{at\ each\ end} = 0.083 \times 1.84 \times 11^2 = 18.5^{1K}$

Member EF

$M^F_{EF} = .065 \times 1.84 \times 49 = 5.9^{1K}$

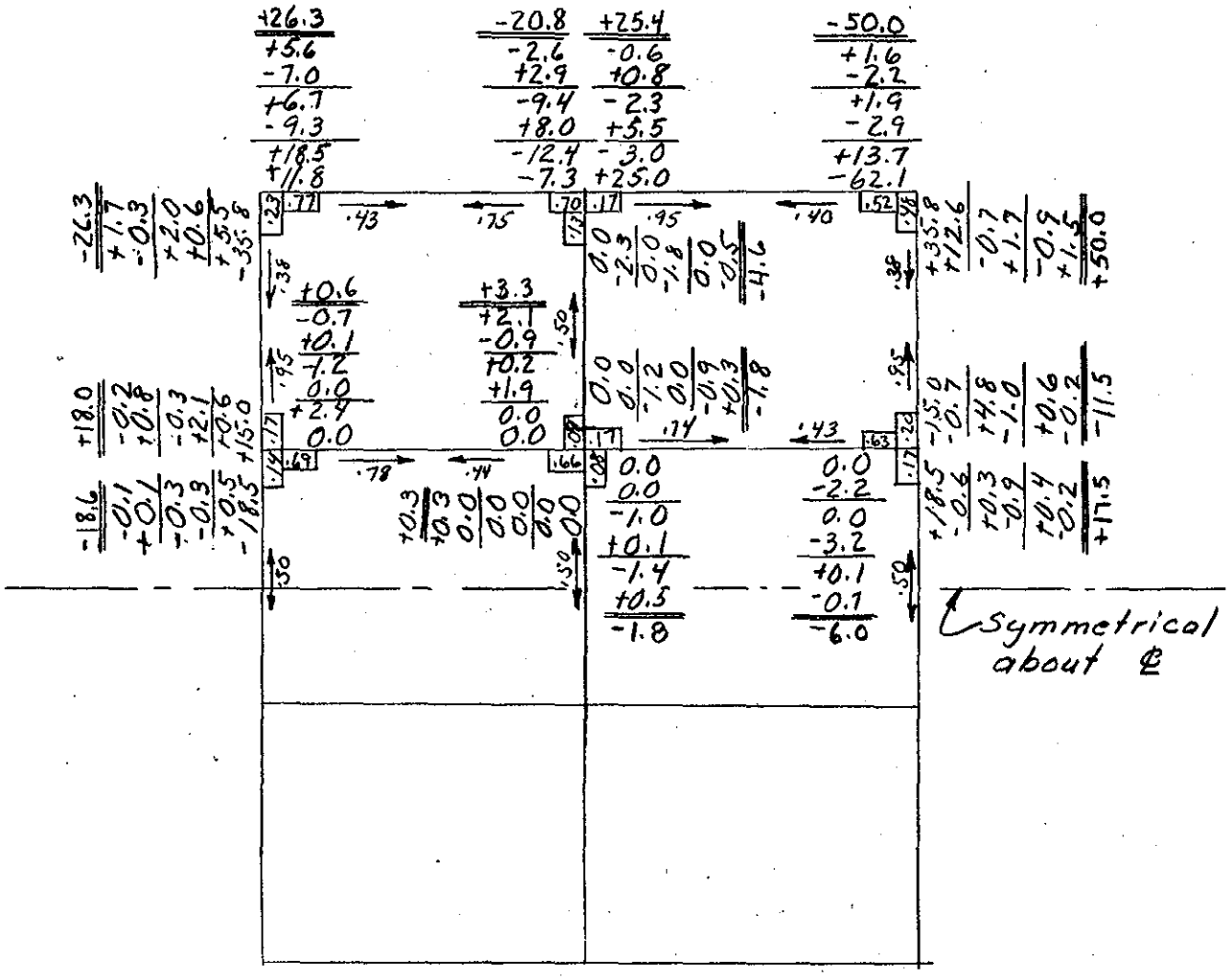
$M^F_{FE} = .125 \times 1.84 \times 49 = 11.3^{1K}$

Member FD

$M^F_{FD} = 0.071 \times 1.84 \times 15^2 = 29.4^{1K}$

$M^F_{DF} = 0.115 \times 1.84 \times 15^2 = 47.6^{1K}$

Case - I Gates open outside walls loaded to full head to spillway crest



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

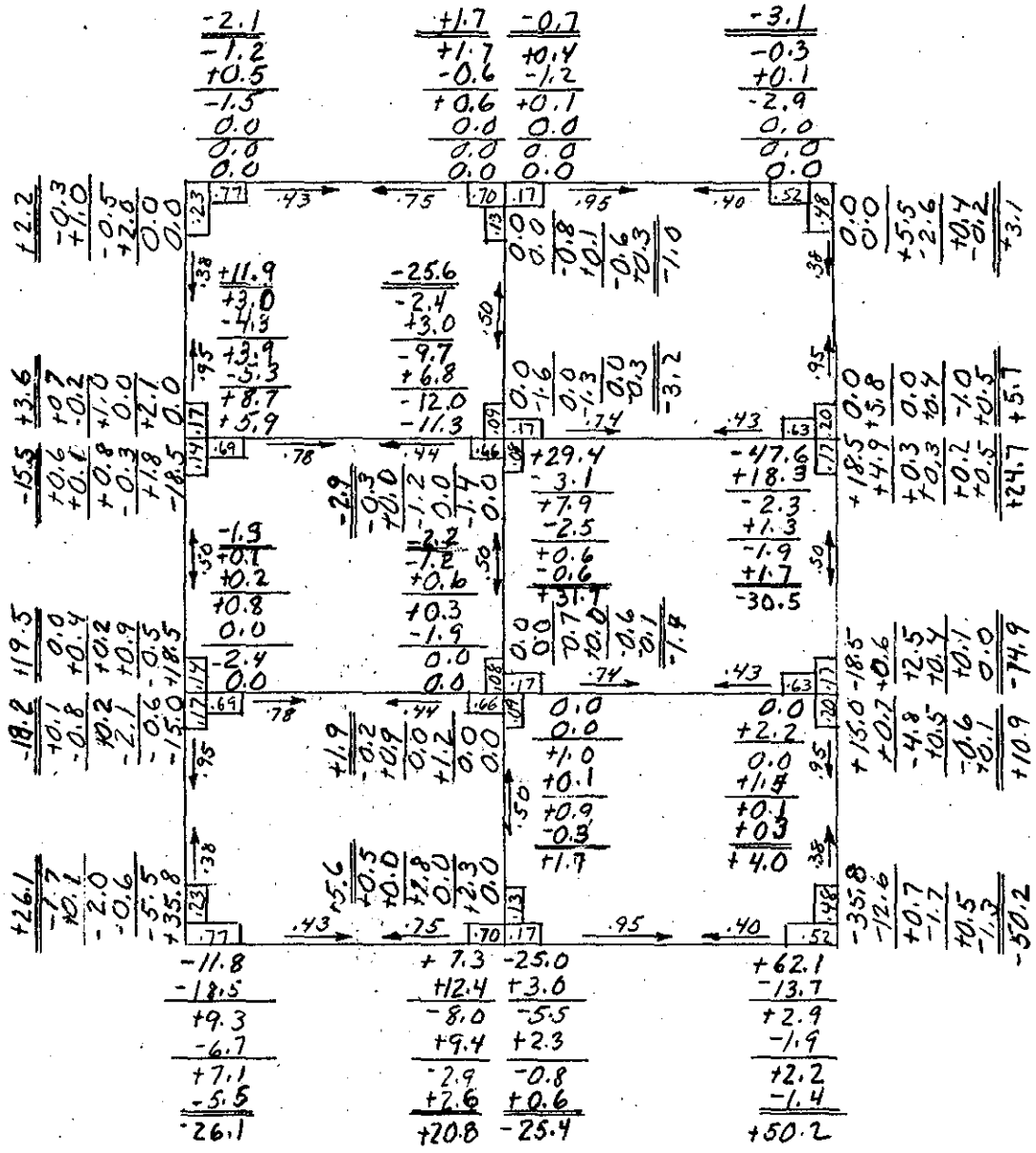
Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H. E. W. Checked by: Date: 15 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case II - Service Gate in either of the end wells closed the other two remaining open. Water at spillway crest elevation



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

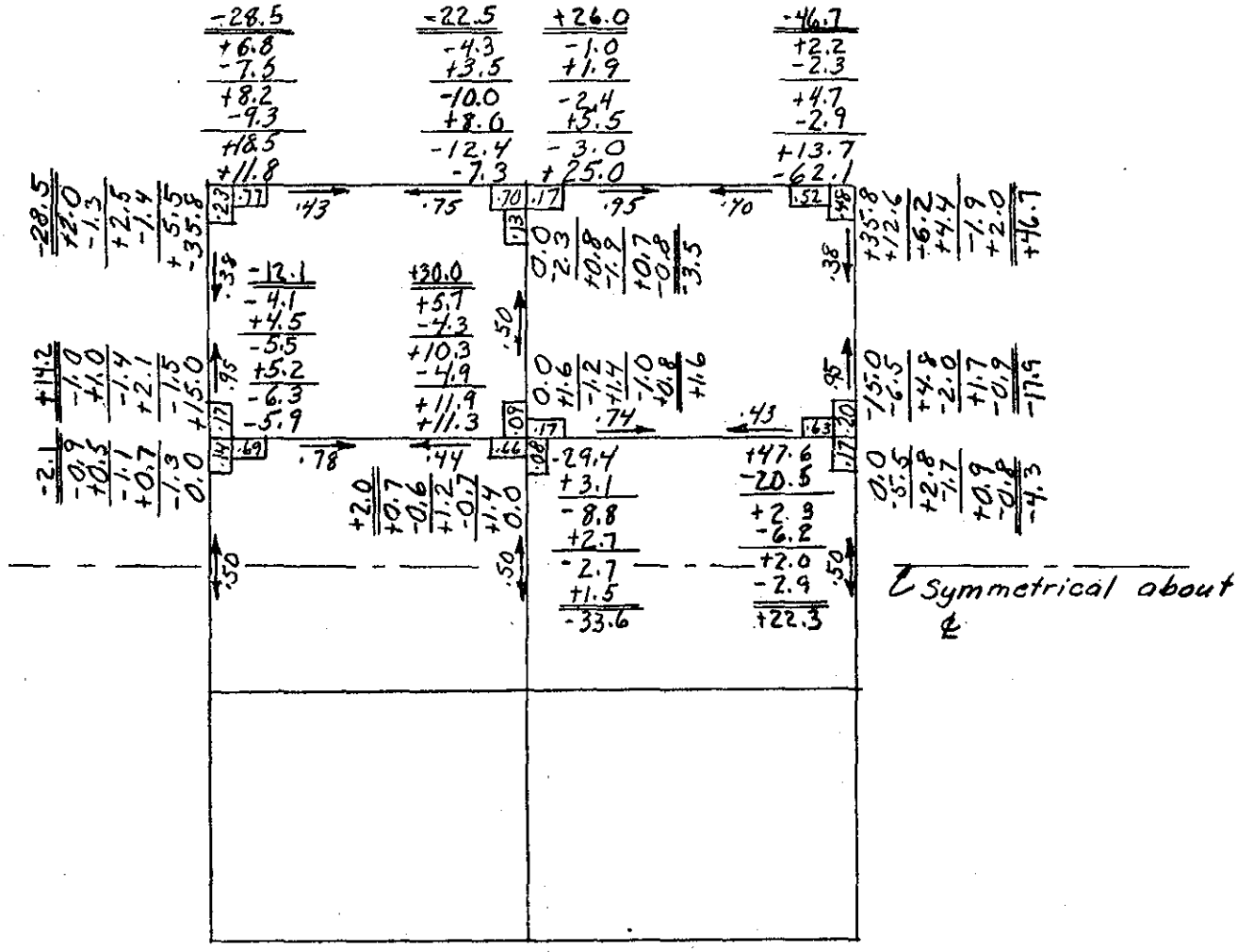
Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 15 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Case - III - Center service gate closed with end service gates open. Water at spillway crest elevation.



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

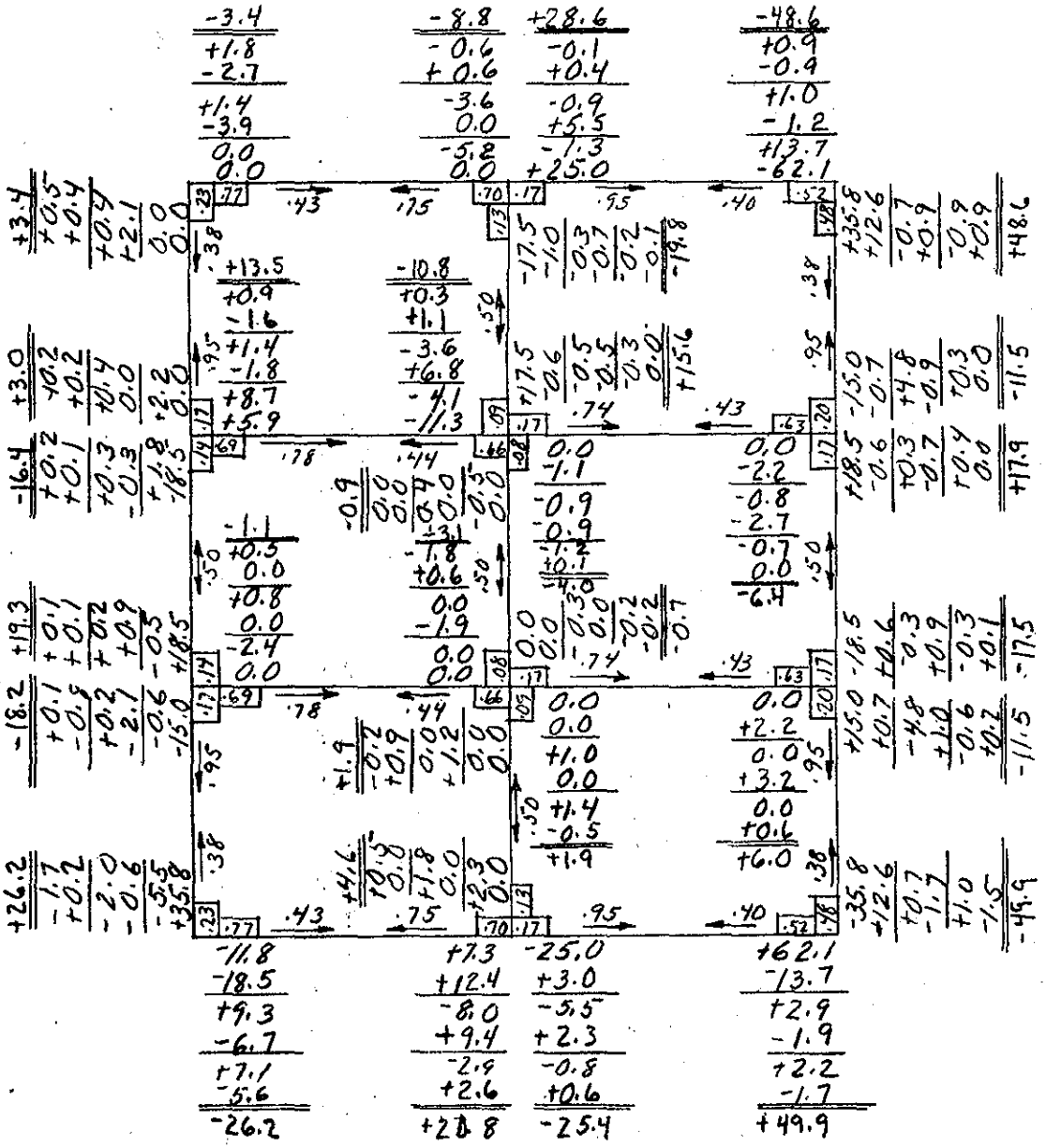
Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H. E. W. Checked by: Date: 15 Aug. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Case IV - Emergency gate down in either of end wells the other two gates remaining open. Water at spillway crest elevation



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

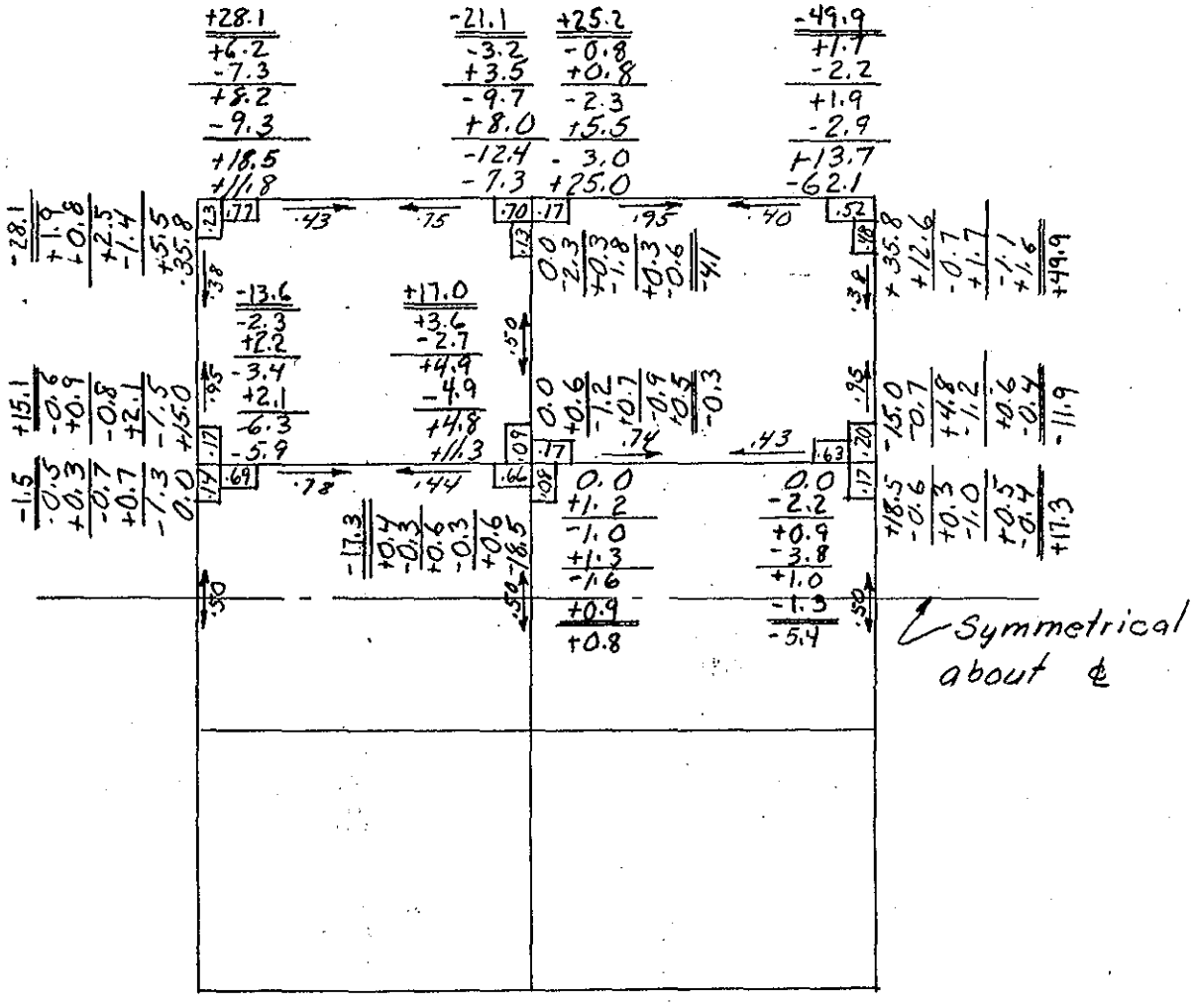
Subject Claremont Dam

Computation Gate Tower Section from El. 600.5 to 610.5

Computed by H.E.W. **Checked by** **Date**

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Case V Emergency gate down in center well, end wells remaining open. Water at spillway crest elevation.



Subject: Claremont Dam
Computation: Gate Tower Section from El. 600.5 to 610.5
Computed by: H.E.W. Checked by: Date: Aug. 16, 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Max. Values of Shear and Pos. Mom.

Member AB + A'B'

$V_A = 1840 \times \frac{7.25}{2} + \frac{7000}{7.25} = 7640^{\#}$

$V_B = 1840 \times \frac{7.25}{2} - \frac{5300}{7.25} = 5940^{\#}$

$x_0 = \frac{5940}{1840} = 3.23$ from B

∴ No pos. mom.

Member BC + B'C'

$V_B = 1840 \times \frac{15.25}{2} - \frac{20,000}{15.25} = 12\,720^{\#}$

$V_C = 1840 \times \frac{15.25}{2} + \frac{24,800}{15.25} = 15,660^{\#}$

(Case III) $x_0 = \frac{12670}{1840} = 6.89'$ from B

$+M = 12670 \times 6.89 - 1840 \times \frac{6.89^2}{2} - 26,000 = 17,620'^{\#}$

Member CD + C'D'

$V_C = 1840 \times \frac{11.75}{2} + \frac{39.300}{11.75} = 13,850^{\#}$

$V_D = 1840 \times \frac{11.75}{2} - \frac{28,800}{11.75} = 8360$

$x_0 = \frac{13850}{1840} = 7.53'$ from C

$+M = 13850 \times 7.53 - 50,200 - 1840 \times \frac{7.53^2}{2} = 1930'^{\#}$

Member BF + B'F'

$V_B = 1840 \times \frac{10.69}{2} + \frac{4,200}{10.69} = 10,230^{\#}$

$V_F = 1840 \times \frac{10.69}{2} - \frac{4.200}{10.69} = 9440^{\#}$

$x_0 = \frac{10,230}{1840} = 5.56'$ from B

$M = 10,230 \times 5.56 - 19,800 - 1840 \times \frac{5.56^2}{2} = 8660'^{\#}$

Member AE + A'E'

$V_A = 1840 \times \frac{11.75}{2} + \frac{14,300}{11.75} = 12030^{\#}$

$V_E = 1840 \times \frac{11.75}{2} - \frac{7900}{11.75} = 10,140^{\#}$

$x_0 = \frac{12030}{1840} = 6.54$

$M = 12030 \times 6.54 - 1840 \times \frac{6.54^2}{2} - 28,500 = 10,830'^{\#}$

Subject: Claremont Dam.

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 16-Aug-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

End Shears & Pos. Mom. (cont.)

Member EE'

$V_E = V_{E'} = 1840 \times \frac{11}{2} + \frac{4000}{11} = 10,480^{\#}$

$x_0 = \frac{10,480}{1840} = 5.7'$

$M = 10,480 \times 5.7 - 19,500 - 1840 \times \frac{5.7^2}{2} = 10,350'^{\#}$

Member FF'

$V_F = 1840 \times \frac{11}{2} = 10,120^{\#}$

$M = \frac{1}{8} \times 1840 \times 11^2 - 17,300 = 10,530'^{\#}$

Member DD'

$V_D = 1840 \times \frac{11}{2} + \frac{9800}{11} = 11,010^{\#}$

$x_0 = \frac{11,010}{1840} = 5.98'$

$M = 11010 \times 5.98 - 24,700 - 1840 \times \frac{5.98^2}{2} = 8,240'^{\#}$

Member EF

$V_E = 1840 \times \frac{7}{2} + \frac{2700}{7} = 6830$ Case IV

$V_F = 1840 \times \frac{7}{2} + \frac{13700}{7} = 8400$ Case II

$x_0 = \frac{6830}{1840} = 3.71'$ from E

$M = 6830 \times 3.71 - 1840 \times \frac{3.71^2}{2} - 13,500 = -820'^{\#}$

$V_E = 1840 \times \frac{7}{2} - \frac{3,400}{7} = 5950^{\#}$ Case V

$V_F = 1840 \times \frac{7}{2} + \frac{17,900}{7} = 8000^{\#}$ Case III

$x_0 = \frac{5950}{1840} = 3.23'$ from E

$M = 5950 \times 3.23 - 1840 \times \frac{3.23^2}{2} - 13,600 = -3980'^{\#}$

Member FD

$V_F = 1840 \times \frac{15}{2} + \frac{11,300}{15} = 14,550^{\#}$

$V_D = 1840 \times \frac{15}{2} - \frac{11,300}{15} = 13,050^{\#}$ } Case III

$x_0 = \frac{14,550}{1840} = 7.9'$ from F

$M = 14,550 \times 7.9 - 33,600 - 1840 \times \frac{7.9^2}{2} = 23,930'^{\#}$

Subject: Claremont Dam.
Computation: Gate Tower Section from El. 600.5 to 610.5
Computed by: H. E. W. Checked by: Date: 16 Aug. 44

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Max. End Shears & Pos. Mom. (cont.)

Member FD cont.

$V_F = 1840 \times \frac{15}{2} + \frac{1200}{15} = 13880^{\#}$

$V_D = 1840 \times \frac{15}{2} - \frac{1200}{15} = 13720^{\#}$

$x_0 = \frac{13,880}{1840} = 7.54'$ from F

$M = 13880 \times 7.54 - 31,700 - 1840 \times \frac{7.54^2}{2} = 20,650'^{\#}$

Design of Members - Member AB

At end A - Value of shear and mom. at face of support

$V = 7640 - 1.25 \times 1840 = 5340^{\#}$

$M = 28,500 - \frac{1}{3}\left(\frac{7640+5340}{2}\right) \times 2.5 = 23,090'^{\#}$

At end B - Value of shear and mom at face of support

$V = 5940 - 1840 = 4100^{\#}$

$M = 22,500 - \frac{1}{3}\left(\frac{5940+4100}{2}\right) \times 2 = 19,150'^{\#}$

At end A

$-A_s = \frac{23090 \times 12}{18000 \times .88 \times 36} = .49^{\square''}$ Use 7/8"ϕ @ 1'-0" cc

$u_0 = \frac{5340}{2.8 \times .88 \times 36} = 60^{\#}/\square''$

At end B

$-A_s = \frac{19,150 \times 12}{18000 \times .88 \times 28.5} = .51^{\square''}$ Use 7/8"ϕ @ 1'-0" cc

For steel on inside face use 3/4"ϕ @ 1'-0" cc

Member BC

At end B - Value of shear and mom. at face of support

$V = 12,720 - 1 \times 1840 = 10880^{\#}$

$M = 28,600 - \frac{1}{3}\left(\frac{12,720+10880}{2}\right) \times 2 = 20,730'^{\#}$

At end C - Value of shear and mom. at face of support

$V = 15,660 - 1840 \times 1.25 = 13,360^{\#}$

$M = 50,200 - \frac{1}{3}\left(\frac{15,660+13,360}{2}\right) \times 2.5 = 38110'^{\#}$

At end B req'd $d = \sqrt{\frac{20,730}{147}} = 11.9'' < 21''$

$v = \frac{10,880}{12 \times .88 \times 21} = 49^{\#}/\square''$

$-A_s = \frac{20,730 \times 12}{18000 \times .88 \times 21} = .75^{\square''}$ Use 7/8"ϕ @ 8" cc

Subject Claremont Dam
Computation Gate Tower Section from El. 600.5 to 610.5
Computed by H.E.W. **Checked by** **Date** 17-Aug.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Member BC (cont.)

End B - $u_o = \frac{10,880}{4.1 \times .88 \times 21} = 144$ #/□"

At end C - $-A_s = \frac{38,110 \times 12}{18,000 \times .88 \times 47.5} = .61$ □" 7/8"φ @ 1'-0" req'd

$u_o = \frac{13360}{2.8 \times .88 \times 47.5} = 114$ #/□"

$+A_s = \frac{17,620 \times 12}{18,000 \times .88 \times 21} = .63$ □" 3/4"φ @ 8" cc req'd

Member CD

At end C - Value of shear and mom at face of support

$V = 13850 - 1840 \times 2.75 = 8790$ #

$M = 50,200 - \frac{1}{3}\left(\frac{13850 + 8790}{2}\right) \times 4.75 = 32,280$ '#

At end D - Value of shear and mom at face of support

$V = 8360 - 1840 \times 2 = 4680$ #

$M = 17,900 - \frac{1}{3}\left(\frac{8360 + 4680}{2}\right) \times 4 = 9210$ '#

At end C - req'd $d = \sqrt{\frac{32,280}{147}} = 14.8" < 34.5"$ OK

$v = \frac{8790}{12 \times .88 \times 34.5} = 24$ #/□"

$-A_s = \frac{32,280 \times 12}{18,000 \times .88 \times 34.5} = .71$ □" Use 7/8"φ @ 8"cc

$u_o = \frac{8790}{4.1 \times .88 \times 34.5} = 71$ #/□"

At end D - $A_s = \frac{9210 \times 12}{18,000 \times .88 \times 19.5} = .36$ □" 3/4"φ @ 1'-0"cc req'd

$u_o = \frac{4680}{2.4 \times .88 \times 19.5} = 114$ #/□"

Member DD

Values of shear and moment at face of support

$V = 11,010 - 1840 \times 2 = 7330$ #

$M = 24,700 - \frac{1}{3}\left(\frac{11,010 + 7330}{2}\right) \times 4 = 12,470$ '#

req'd $d = \sqrt{\frac{12470}{147}} = 9.2" < 19.5"$ OK

$v = \frac{7330}{12 \times .88 \times 19.5} = 36$ #/□"

$-A_s = \frac{12,470 \times 12}{18000 \times .88 \times 19.5} = .49$ □" Use 3/4"φ @ 8"cc

$u_o = \frac{7330}{3.5 \times .88 \times 19.5} = 122$ #/□" OK

Member DD (cont.)

$+A_s = \frac{8240 \times 12}{18000 \times .88 \times 19.5} = .32$ □" Use 3/4"φ @ 1'-0" cc

Member BF.

At end B - Value of shear and mom at face of support

$V = 10,230 - 1840 \times 1.06 = 8280$#

$M = 19,800 - \frac{1}{3}\left(\frac{10,230 + 8280}{2}\right) \times 2.12 = 13,260$'#

At end F - Value of shear and mom. at face of support

$V = 9,440 - 1840 \times 1.38 = 6900$#

$M = 15,600 - \frac{1}{3}\left(\frac{9440 + 6900}{2}\right) \times 2.75 = 8110$'#

At end B. req'd $d = \sqrt{\frac{13,260}{147}} = 9.5" < 19.5"$

$v = \frac{8280}{12 \times .88 \times 19.5} = 40$ #/□"

$-A_s = \frac{13260 \times 12}{18000 \times .88 \times 19.5} = .52$ □" Use 3/4"φ @ 8 cc

$u_0 = \frac{8280}{3.5 \times .88 \times 19.5} = 91$ #/□"

At end F use same steel as at end B

$+A_s = \frac{8660 \times 12}{18,000 \times .88 \times 19.5} = .34$ □" 3/4"φ @ 1'-0" cc req'd

Member FF'

Values of shear and mom. at face of support

$V = 10,120 - 1840 \times 1.38 = 7580$#

$M = 17,300 - \frac{1}{3}\left(\frac{10,120 + 7580}{2}\right) \times 2.75 = 9,200$'#

Use same steel as BF except $+A_s$

use 3/4"φ @ 8" cc to take direct tension

Member AE

At end A - Values of shear and mom. at face of support

$V = 12,030 - 1840 \times 2.2 = 7980$

$M = 28,500 - \frac{1}{3}\left(\frac{12,030 + 7980}{2}\right) \times 4.12 = 14760$

At end E - Values of shear and mom. at face of support

$V = 10,140 - 1840 \times 1.38 = 7600$#

$M = 18,200 - \frac{1}{3}\left(\frac{10140 + 7600}{2}\right) \times 2.75 = 10,070$'#

At end A $v = \frac{7980}{12 \times .88 \times 35} = 22$ #/□"

Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 18-Aug-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Member AE (cont.)

End A (cont.) $-A_s = \frac{14760 \times 12}{18000 \times .88 \times 35} = .32^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{7980}{2.4 \times .88 \times 35} = 106\ \#/\square''$

End E $v = \frac{7600}{12 \times .88 \times 19.5} = 37\ \#/\square''$

$-A_s = \frac{10.070 \times 12}{18,000 \times .88 \times 19.5} = .39^{\square''}$ Try $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{7600}{2.4 \times .88 \times 19.5} = 184\ \#/\square''$ OK

$+A_s$ - Use $\frac{3}{4}''\phi$ @ 1'-0" cc

Member EF

Values of shear and mom. at face of support

$V = 10,480 - 1840 \times 1.38 = 7940\#$

$M = 19,500 - \frac{1}{3}\left(\frac{10,480 + 7940}{2}\right) \times 2.75 = 11,060'\#$

$v = \frac{7940}{12 \times .88 \times 19.5} = 39\ \#/\square''$

$-A_s = \frac{11,060}{18000 \times .88 \times 19.5} = .36^{\square''}$ Try $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{7940}{2.9 \times .88 \times 19.5} = 193\ \#/\square$

$+A_s$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

Member EF

Center Gate Well Face

At end F - Values of shear and mom. at face of support.

$V = 8000 - 1840 \times 1 = 6160\#$

$M = 30,000 - \frac{1}{3}\left(\frac{8000 + 6160}{2}\right) \times 2 = 25,280'\#$

$-A_s = \frac{25,280 \times 12}{18,000 \times .88 \times 43.5} = .44^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_0 = \frac{6160}{2.4 \times .88 \times 43.5} = 67\ \#/\square''$ OK

At end E - Use $\frac{3}{4}''\phi$ @ 1'-0" cc

End Gate Well Face

Use same steel as center gate well face

Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 18 Aug. - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Member FD

End Gate Well Face

At end F - Values of shear and mom. at face of support

$V = 13880 - 1840 \times 1 = 12{,}040^{\#}$

$M = 31{,}700 - \frac{1}{3}\left(\frac{13880 + 12040}{2}\right) \times 2 = 23060'^{\#}$

At end D Values of shear and mom. at face of support

$V = 13720 - 1840 \times 1 = 11860$

$M = 30{,}500 - \frac{1}{3}\left(\frac{13720 + 11860}{2}\right) \times 2 = 21970'^{\#}$

At end F - $A_s = \frac{23060 \times 12}{18{,}000 \times .88 \times 28.5} = .61^{\square''}$ Try $\frac{7}{8}''\phi$ @ 1'-0" cc

$u_o = \frac{12040}{2.8 \times .88 \times 28.5} = 171^{\#}/\square''$ OK

At end D - $A_s = \frac{21970 \times 12}{18000 \times .88 \times 43.5} = .38^{\square''}$ $\frac{3}{4}''\phi$ @ 1'-0" cc req'd

$u_o = \frac{11860}{2.4 \times .88 \times 43.5} = 129^{\#}/\square''$

Center Gate Well Face

Use same steel as in opposite face

$+A_s = \frac{23{,}930 \times 12}{18000 \times .88 \times 28.5} = .63^{\square''}$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El. 600.5 to 610.5

Computed by: H.E.W. Checked by: Date: 18-Aug-44

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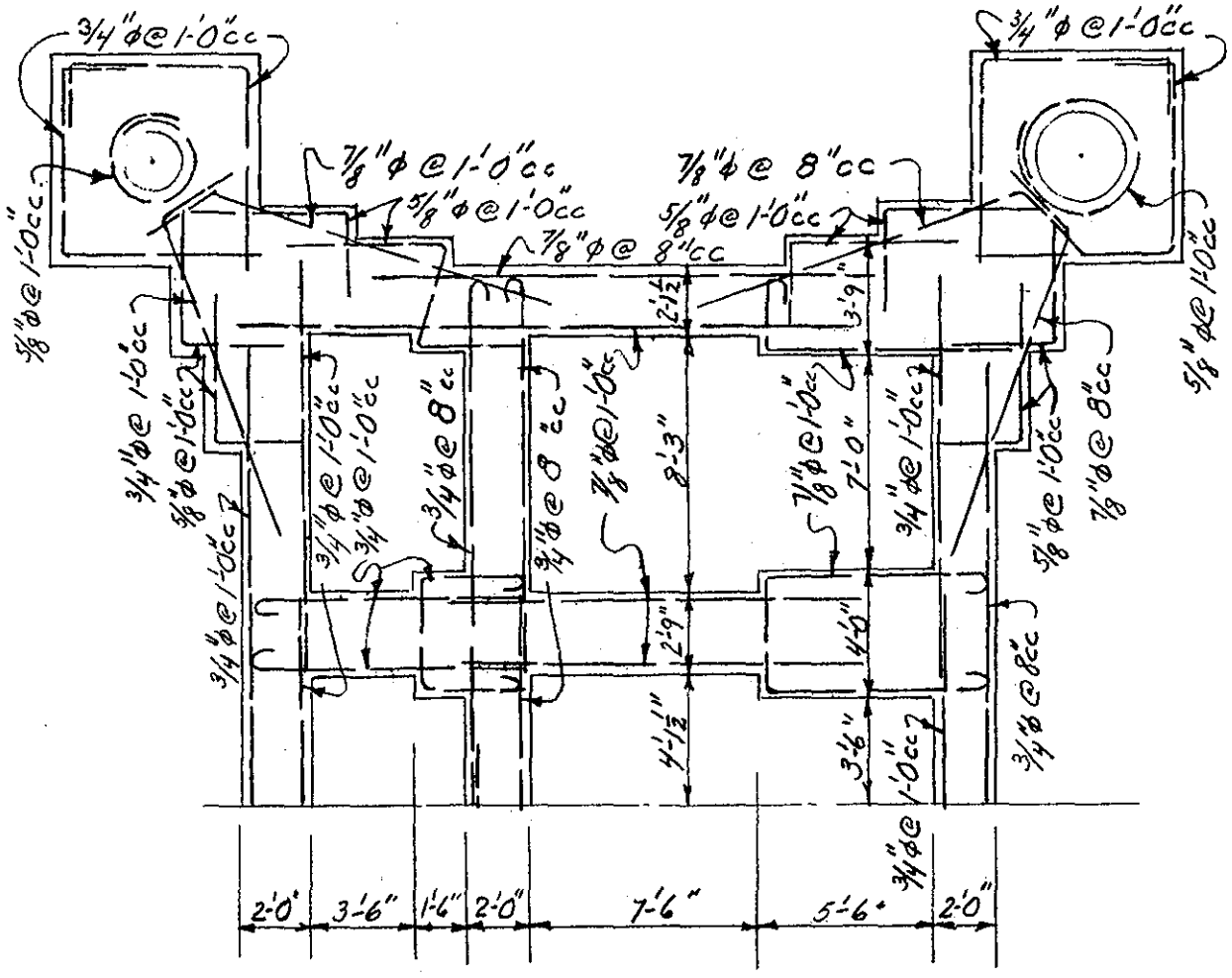

All steel to have 4" cover
Outside dimensions are the same as Section at El. 572.0

Section from El. 600.5 to 610.5

Subject: Claremont Dam
Computation: Gate Tower Section From El. 610.5 to Top
Computed by: H.E.W. Checked by: Date: Aug. 19 - 44

U. S. GOVERNMENT PRINTING OFFICE 3—30528

Horizontal sections from El. 610.5 will be designed to withstand a head of water to spillway surcharge elevation (El. 645.0) A 50% increase in allowable stresses will be used. Because section remains constant above El. 600. all values will be in prop. to those at sect. 600.5.

Head = 645 - 610.5 = 34.5'
P = 34.5 x 62.5 = 2160#

Mult. values found in Sect. at El 600.5 by $\frac{2160}{1840} = 1.17$

Member AB

At end A - V = 5340 x 1.17 = 6250# M = 23090 x 1.17 = 27020'#

$-A_s = \frac{27020 \times 12}{27{,}000 \times .9 \times 36} = .37 \square''$ Use 3/4"φ @ 1'-0" cc

$u_o = \frac{6250}{2.4 \times .9 \times 36} = 80$ #/□"

At end B. V = 4100 x 1.17 = 4800# M = 19150 x 1.17 = 22,400'#

$-A_s = \frac{22{,}400 \times 12}{27{,}000 \times .9 \times 28.5} = .39 \square''$ 3/4"φ @ 1'-0" cc req'd

+As — Use 3/4"φ @ 1'-0" cc

Member BC

At end B - V = 10880 x 1.17 = 12730# M = 20,730 x 1.17 = 24250'#

$-A_s = \frac{24{,}250 \times 12}{27{,}000 \times .9 \times 21} = .57 \square''$ Use 7/8"φ @ 1'-0" cc

$u_o = \frac{12{,}730}{2.8 \times .9 \times 21} = 240$ #/□" OK

At end C - V = 13,360 x 1.17 = 15630# M = 38,110 x 1.17 = 44590'#

$-A_s = \frac{44590 \times 12}{27{,}000 \times .9 \times 47.5} = .46 \square''$ Use 3/4"φ @ 1'-0" cc

$u_o = \frac{15630}{2.4 \times .9 \times 47.5} = 152$ #/□"

+ M at center = 17,620 x 1.17 = 20,620'#

$+A_s = \frac{20{,}620 \times 12}{27{,}000 \times .9 \times 21} = .49 \square''$ Use 7/8"φ @ 1'-0" cc

$\frac{.44}{.49} \times 2160 = 1940$ $\frac{2160 - 1940}{62.5} = 3.5$ ft

Change 7/8"φ @ 1'-0" cc to 3/4"φ @ 1'-0" cc at El. 615.0 on inside face

Subject: Claremont Dam
Computation: Gate Tower Section from El. 610.5 to Top
Computed by: H. E. W. Checked by: Date: Aug. 19, 1944

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Member BC (cont.)

At end B.

$\frac{.44}{.57} \times 2160 = 1670 \qquad \frac{2160-1670}{62.5} = 7.8'$

Change $\frac{7}{8}''\phi$ @ 1'-0" cc to $\frac{3}{4}''\phi$ @ 1'-0" cc at El. 620.5

Member CD

At end C $-V = 8790 \times 1.17 = 10{,}280^{\#}$ $M = 32{,}280 \times 1.17 = 37770'^{\#}$

$-A_s = \frac{37{,}770 \times 12}{27{,}000 \times .9 \times 34.5} = .54^{\square''}$ Use $\frac{7}{8}''\phi$ @ 1'-0" cc

Change $\frac{7}{8}''\phi$ @ 1'-0" cc to $\frac{3}{4}''\phi$ @ 1'-0" cc at El. 620.5

At end D. $\frac{3}{4}''\phi$ @ 1'-0" cc req'd

Member DD

$V = 7330 \times 1.17 = 8580^{\#}$ $-M = 12{,}470 \times 1.17 = 14{,}590'^{\#}$

$-A_s = \frac{14590 \times 12}{27{,}000 \times .9 \times 19.5} = .37^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_o = \frac{8580}{2.4 \times .9 \times 19.5} = 203^{\#/\square''}$ OK

$+M = 8240 \times 1.17 = 9650'^{\#}$

$+A_s$ – Use $\frac{3}{4}''\phi$ @ 1'-0" cc

Member BF

At end B $-V = 8280 \times 1.17 = 9690^{\#}$ $M = 13260 \times 1.17 = 15{,}510'^{\#}$

$-A_s = \frac{15510 \times 12}{27{,}000 \times .9 \times 19.5} = .39^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_o = \frac{9690}{2.4 \times .9 \times 19.5} = 230^{\#/\square''}$ OK

At end F – Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$+A_s$ – " $\frac{3}{4}''\phi$ @ 1'-0" cc

Member FF

$V = 7580 \times 1.17 = 8870^{\#}$ $M = 9200 \times 1.17 = 10{,}760'^{\#}$

$-A_s = \frac{10760 \times 12}{27{,}000 \times .9 \times 19.5} = .27^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

$u_o = \frac{8870}{2.4 \times .9 \times 19.5} = 211^{\#/\square''}$ OK

$+M = 10{,}530 \times 1.17 = 12{,}320'^{\#}$

$+A_s = \frac{12{,}320 \times 12}{27{,}000 \times .9 \times 19.5} = .31^{\square''}$ Use $\frac{3}{4}''\phi$ @ 1'-0" cc

Members AE, & EE & EF

Use $\frac{3}{4}''\phi$ @ 1'-0" cc

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Gate Tower Section from El. 610.5 to Top

Computed by: H.E.W. Checked by: Date: 19-Aug-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Member FD

End Gate Well Face

At end F - $V = 12040 \times 1.17 = 14090^{\#}$ $M = 23060 \times 1.17 = 26980^{\#}$

$- A_s = \frac{26980 \times 12}{27{,}000 \times .9 \times 28.5} = .47^{\square''}$ Use 7/8"φ @ 1'-0" cc

$u_o = \frac{14090}{2.8 \times .9 \times 28.5} = 197^{\#}/\square''$ OK

Change 7/8"φ @ 1'-0" cc to 3/4"φ @ 1'-0" cc at El 615.0

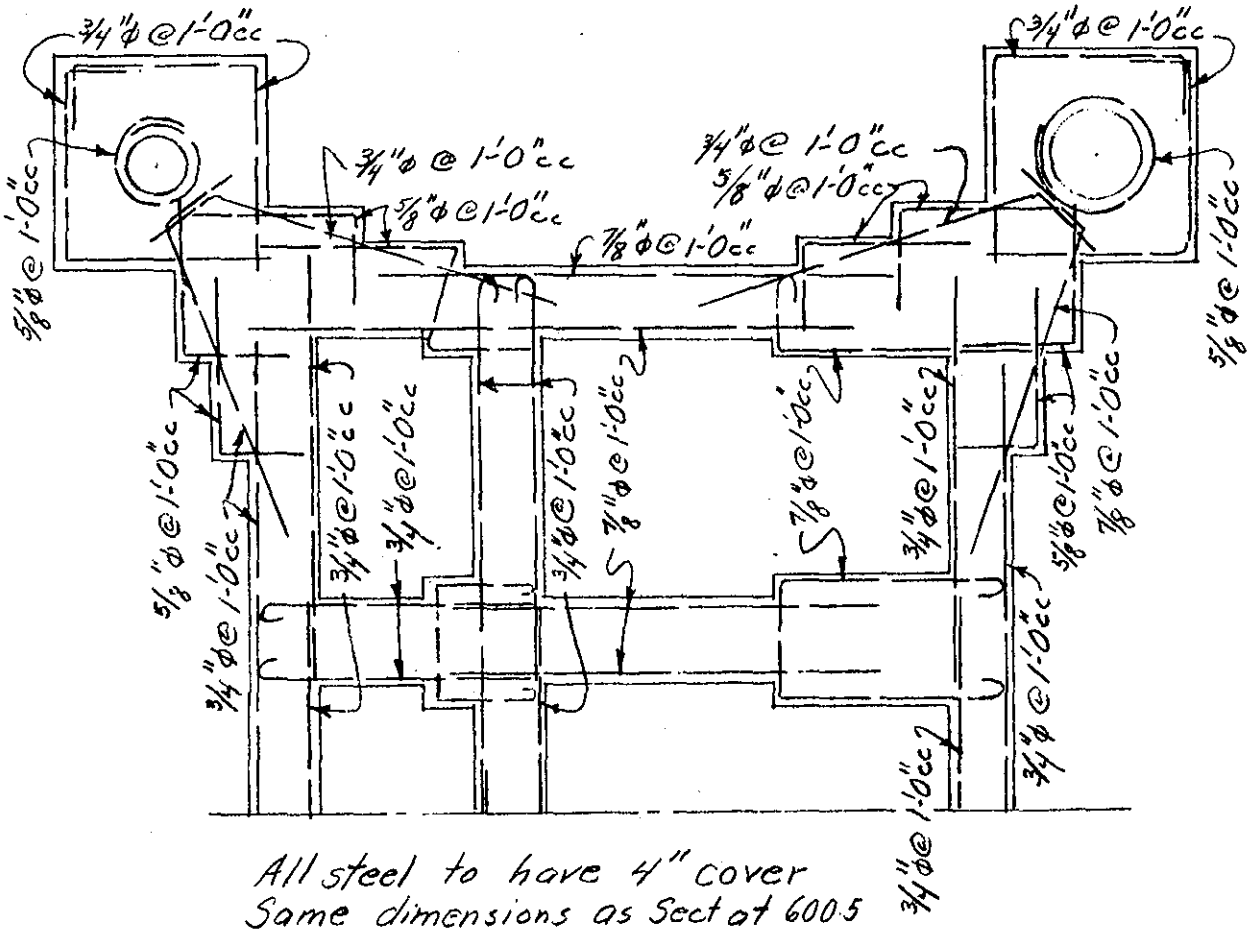
At end D - 3/4"φ @ 1'-0" cc req'd

$+M = 23930 \times 1.17 = 28{,}000^{\prime\#}$

$+ A_s = \frac{28000 \times 12}{27{,}000 \times .9 \times 28.5} = .48^{\square''}$ Use 7/8"φ @ 1'-0" cc

Change 7/8"φ @ 1'-0" cc to 3/4"φ @ 1'-0" cc at El. 615.0

Center - Gate Well Face - Use same steel both faces



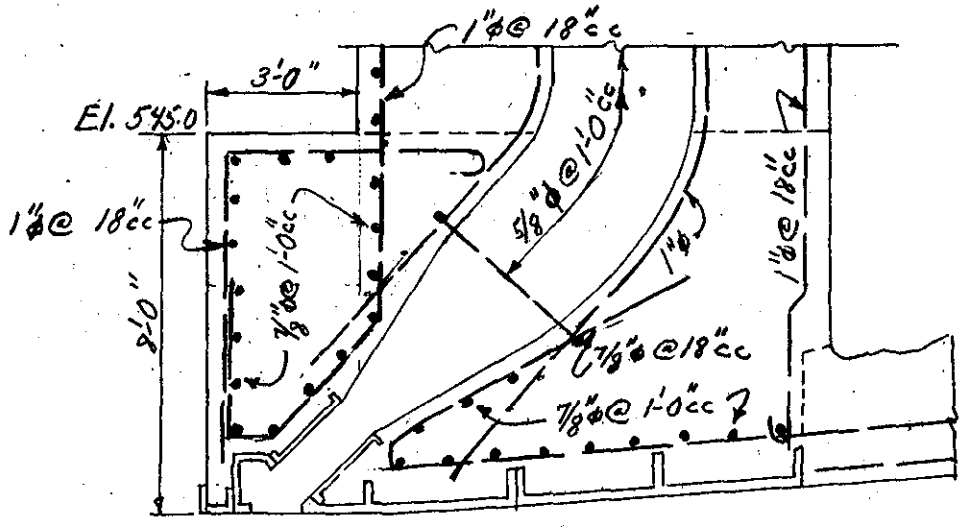
All steel to have 4" cover

Same dimensions as Sect at 600.5

Section at El 610.5

Subject: Claremont Dam
Computation: Gate Tower Air Vent
Computed by: H.E.W. Checked by: Date: 21-Sept.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Vertical load on 3'-7" shelf

Wt. water = (630 - 545) 62.5 x 3.00 = 15,900#
" Conc. (ave) = 7 x 3.00 x 150 = 3200
17100#/'

clear span = 6'-0"

$V = 3 \times 17{,}100 = 51300^{\#}$

$M = \frac{1}{12} \times 17100 \times 36 = 51{,}300'^{\#}$

$A_s = \frac{51{,}300 \times 12}{18000 \times .88 \times 60} = .65^{\square''}$

Horiz. Load on bottom 5'-0" Section

Ave P on sect = (630 - 539.5) x 62.5 = 5660#
Total load on sect = 5660 x 5 = 28300#/'

$V = 3 \times 28{,}300 = 84900^{\#}$

$M = \frac{1}{12} \times 28300 \times 36 = 84{,}900'^{\#}$

req'd $d = \sqrt{\frac{84{,}900 \times 12}{24 \times 12.3}} = 18.5'' < 47.5''$ OK

$A_s = \frac{84{,}900 \times 12}{18000 \times .88 \times 47.5} = 1.35^{\square''}$

WAR DEPARTMENT

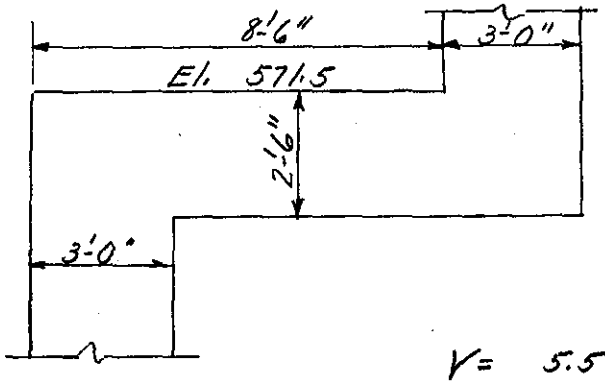
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Gate Tower Raking Platform

Computed by H. E. W. **Checked by** **Date** 21- Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Head = 630 - 571.5 = 58.5'

Wt. water = 58.5 x 62.5 = 3660#

Wt. conc. = 150 x 2.5 = 370

4030#/'

Span = 8'-6"

$V = 5.5 \times 4030 \times .5 = 11{,}080^{\#}$

$M = \frac{1}{12} \times 4030 \times 8.5^2 = 24{,}263^{'\#}$

$v = \frac{11080}{12 \times .88 \times 24.5} = 43^{\#}/\square''$

$A_s = \frac{24263 \times 12}{18000 \times .88 \times 24.5} = .75^{\square''}$ Use 1"ø @ 1'-0" c.c. Top + Bot

$u_o = \frac{11080}{3.1 \times .88 \times 24.5} = 166^{\#}/\square''$

Subject: Claremont Dam
Computation: Investigation for Earthquake
Computed by: H.E.W. Checked by: Date: 13-Sept.-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Earthquake stress will be taken as a horizontal thrust equal to $\frac{1}{10}$ of the gross weight It will be assumed that the vertical walls will each take a proportionate part of the load.

Investigation of walls perpendicular to channel and assuming each wall will take 33% of the load

Elev.	Gross Wt.	Horiz. Thrust by ea. Wall		
655.0	1,427,650	.10 x 1,427650 x .33	=	47.1^K
640.5	2,821,270	.10 x 2,821 270 x .33	=	93.1^K
620.5	4,761 590	.10 x 4 761590 x .33	=	157.1^K
600.5	6,681,760	.10 x 6 681760 x .33	=	220.5^K
580.5	8 890 760	.10 x 8 890 760 x .33	=	293.4^K
572.0	9.827 585	.10 x 9 827 585 x .33	=	324.3^K

Consider wall as a cantilever extending from rock
total height = 113'

Mat El. 572 $= 324{,}300 \times \frac{113}{2} = 18{,}322{,}950^{\prime\#}$

As this loading is of temporary duration allowable stresses may be increased by 50%

$$\text{req'd } d = \sqrt{\frac{18322950 \times 12}{36 \times 147}} = 204'' < 410'' \text{ OK}$$

$$v = \frac{324{,}300}{36 \times .88 \times 410} = 25^{\#/\square''}$$

$$A_s = \frac{18{,}322{,}950 \times 12}{27000 \times 88 \times 410} = 22.5^{\square''} \text{ req } 38\text{-}\tfrac{7}{8}''\phi \text{ or } 29\text{-}1''\phi$$

Use $1''\phi$ @ approx $18''$cc

Mat El. 580.5 $= 293{,}400 \times \frac{104.5}{2} = 15{,}330{,}150^{\prime\#}$

$$A_s = \frac{15{,}330{,}150 \times 12}{27{,}000 \times .88 \times 410} = 18.9^{\square''} \text{ req. } 31\ \tfrac{7}{8}''\phi$$

Use $\frac{7}{8}''\phi$ @ approx $18''$cc

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Investigation for Earthquake

Computed by: H.E.W. Checked by: Date: 14 Sept. - 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Investigation of walls parallel to channel and assuming each wall will take 25% of the load

Horiz. thrust at El. 572.0 = .10 × 9,827,585 × .25 = 245.7^k

Mom = $245{,}700 \times \frac{113}{2}$ = 13,882,000^{'#}

$A_s = \frac{13{,}882{,}000 \times 12}{27{,}000 \times .88 \times 270}$ = 26.0" requires 33-1"ϕ

For total of four walls 132-1"ϕ bars are req'd

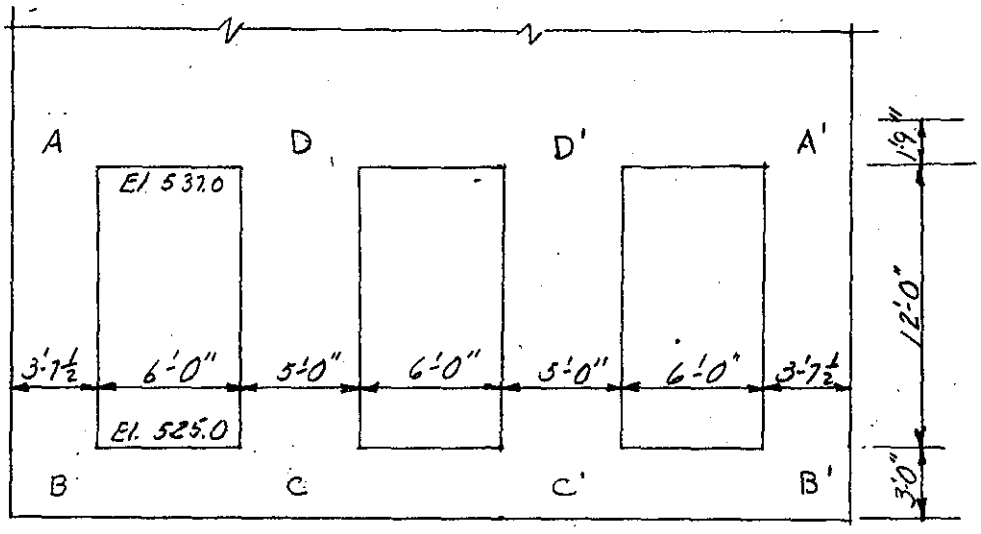
Use 1"ϕ at approx 18" c.c. - Change to 7/8"ϕ at El. 580.5

Subject: Claremont Dam
Computation: Gate Tower - Tunnel Section
Computed by: H.E.W. Checked by: Date: 18 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Load conditions - The max. head on the upstream side of the gates will be 93'. The max head downstream of the gates will be 105'. The section will be designed for the 105' head on center piers and 50% 105' head for sidewalls against rock

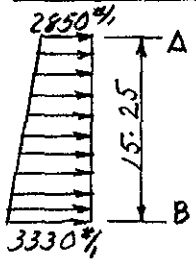
Design Assumptions - The section will be designed as a frame with legs considered fixed at roof slab. Wall sections adjacent to gate slots will be designed to take the gate slot load.



Member	d	d^3	L	d^3/L	K
AB	3.62	47.4	15.25	3.11	1.27
BC	3.00	27.0	10.31	2.62	1.07
CC'	3.00	27.0	11.0	2.45	1.00
DC	(5.00)	125.0	15.25	8.20	3.35

Fixed End Moments

Member AB



$(630 - 538.75) \times 31.25 = 2850$ #/'

$(630 - 524.5) \times 31.25 = 3330$ #/'

$M^F_{AB} = \frac{1}{12} \times 2850 \times 15.25^2 + \frac{1}{15} \times 480 \times \frac{15.25^2}{2} = 59.0$ 'K

$M^F_{BA} = \frac{1}{12} \times 2850 \times 15.25^2 + \frac{1}{10} \times 480 \times \frac{15.25^2}{2} = 60.8$ 'K

Subject: Claremont Dam

Computation: Gate Tower - Tunnel Section

Computed by: H. E. W. Checked by: Date: 18 Sept. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Fixed End Moments (cont.)

Member BC

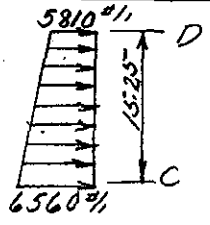
Net loading = $(630 - 522)\,31.25 - 3 \times 150 = 2925$ #/'

$M^F = \frac{1}{12} \times 2925 \times 10.31^2 = 25.9$ 'K

Member CC'

$M^F = \frac{1}{12} \times 2925 \times 11^2 = 29.5$ 'K

Member CD



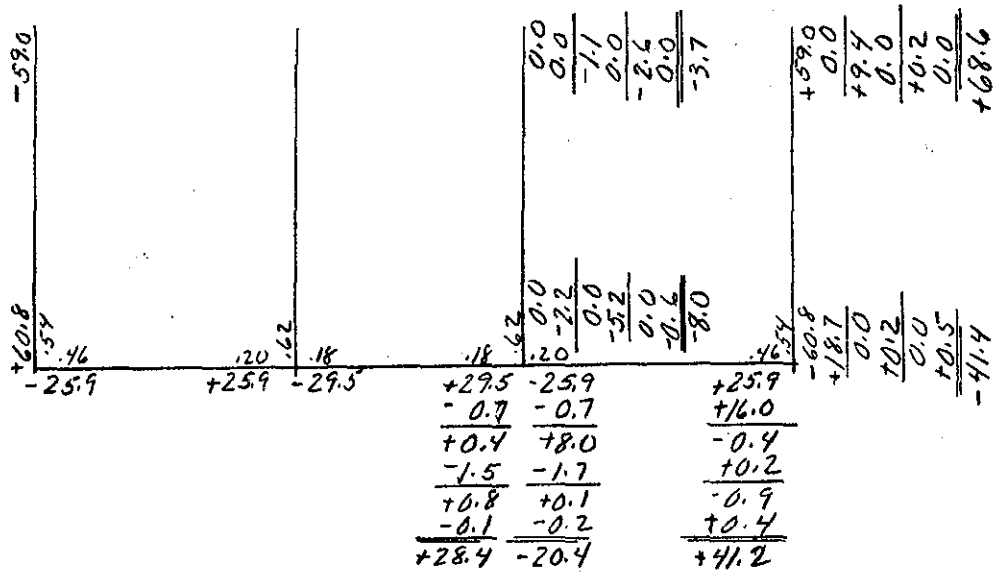
$(630.0 - 537.0)\,62.5 = 5810$ #/'

$(630.0 - 525.0)\,62.5 = 6560$ #/'

$M^F_{CD} = \frac{1}{12} \times 5810 \times 15.25^2 + \frac{1}{10} \times 750 \times \frac{15.25^2}{2} = 121.3$ 'K

$M^F_{DC} = \frac{1}{12} \times 5810 \times 15.25^2 + \frac{1}{15} \times 750 \times \frac{15.25^2}{2} = 118.4$ 'K

Case I - Channels empty walls and base loaded to 50% of head to spillway crest



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

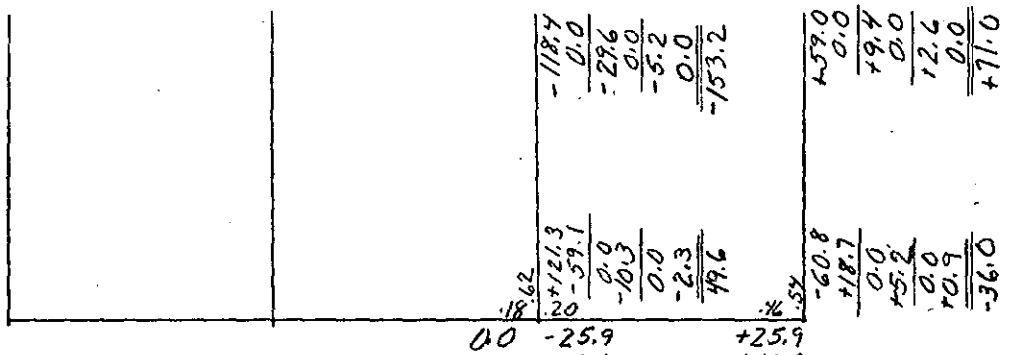
Subject Claremont Dam

Computation Gate Tower - Tunnel Section

Computed by H. E. W. **Checked by** **Date** 19- Sept - 44

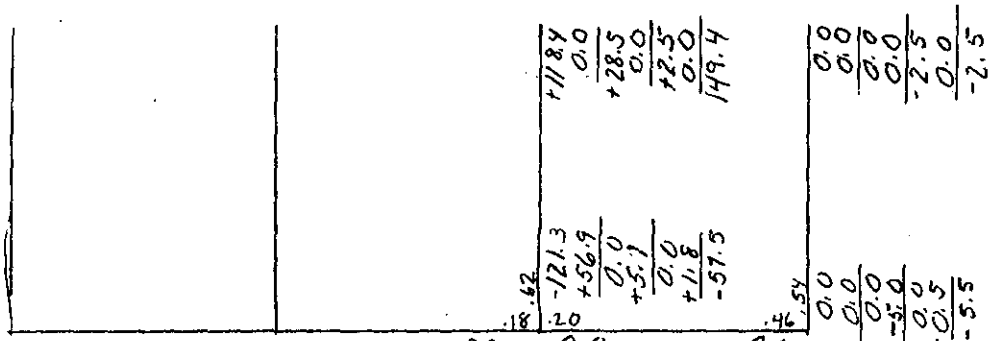
U. S. GOVERNMENT PRINTING OFFICE 3—10523

Case II - End channels empty center channel full



0.0	-25.9	+25.9
-17.2	-19.1	+16.0
+8.6	+8.0	-9.6
-3.0	-3.3	+4.4
+1.5	+2.2	-1.7
-0.7	-0.7	+0.8
-10.8	-38.8	+35.8

Case III End channels full center channel empty



+29.5	0.0	0.0
+16.5	+18.4	0.0
- 8.3	0.0	+9.2
+1.5	+1.7	-4.2
-0.8	-2.1	+0.9
+0.5	+0.6	-0.4
+38.9	+18.6	+5.5

Subject: Claremont Dam.

Computation: Gate Tower - Tunnel Section

Computed by: H.E.W. Checked by: Date: 21 Sept 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of horiz. beam in outside walls at tunnel roof level

Design for a span of 11' where service gate opening and air vent occur together. Load = 25230#/'

Assume beam 4'-0" wide

$M = \frac{1}{12} \times 25230 \times 11^2 = 254400'^{\#}$

$\text{req'd } d = \sqrt{\frac{254400 \times 12}{48 \times 147}} = 20.8'' < 25.5''$

$V = 25230 \times 4.5 = 113000^{\#}$

$A_s = \frac{254400 \times 12}{18000 \times .88 \times 25.5} = 7.6^{\square''}$ Use 6-1 1/8"□ bars

$u_o = \frac{113000}{27 \times .88 \times 25.5} = 187\#/\square''$ O.K.

Design of horiz. beam in dividing walls at tunnel roof level

Assume beam 4'-0" wide

$M = \frac{1}{12} \times 52980 \times 11^2 = 534{,}200'^{\#}$

$\text{req'd } d = \sqrt{\frac{534{,}200 \times 12}{48 \times 147}} = 30'' > 28.5''$ O.K.

$V = 534{,}200 \times 4.5 = 240{,}000^{\#}$

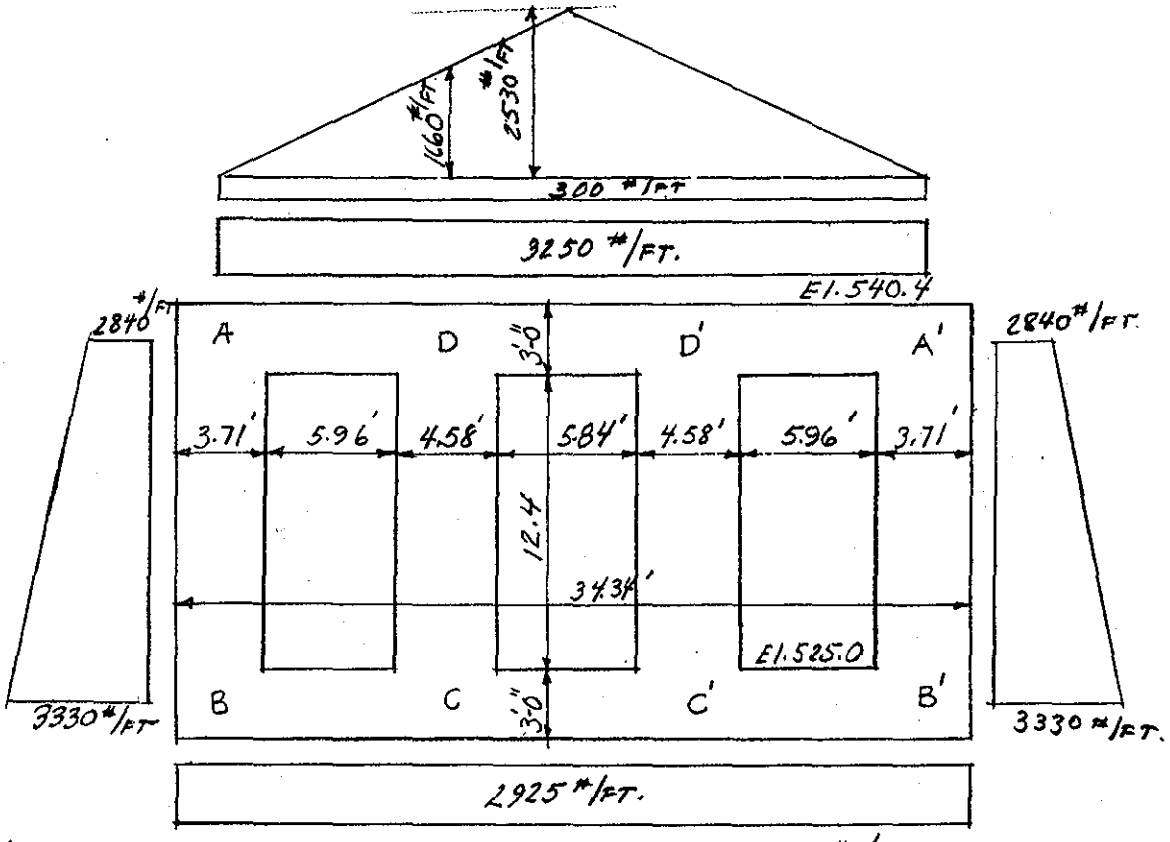
$A_s = \frac{534400 \times 12}{18000 \times .88 \times 28.5} = 14.2^{\square''}$ Use 9-1 1/4"□ @ 6" cc

$A_s = \frac{534400 \times 12}{18000 \times .88 \times 55.5} = 7.3^{\square''}$ Use 9-1"φ @ 6" cc

Subject Claremont Dam
Computation Transition Section of Tunnel
Computed by A.L.K. **Checked by** **Date** 15-Nov-1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section A-A — Section slightly downstream of sta. 16+19.00 the section will be loaded with water pressure due to hydrostatic head plus a triangular rock loading, the rock being assumed to crack at angle of 45° from each side toward the center. The section will be designed as a continuous frame.



Wt of roof 3 X 150 = 450 #/FT
Head of water on roof (630 − 540.4) 31.25 = 2800 #/FT
Wt. of rock 3.71 X 5 X 165 = 300 #/FT. 3250 #/FT
" " " 15.32 X 165 = 2530 #/FT.
Side thrust @ El. 538.9 = (630 − 538.9) 31.25 = 2840 #/FT.
Side thrust @ El. 523.5 = (630 − 523.5) 31.25 = 3330 #/FT
Uplift on base = (630 − 522) 31.25 − 3 X 150 = 2925 #/FT

Note: Dead Load of conduit is assumed to be transmitted to the rock directly from each wall.

Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 15 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section A-A (cont.)

Member	depth	d^3	L	$\frac{d^3}{L}$	K
AB	3.71	51.06	15.40	3.32	1.29
BC	3.00	27.00	10.10	2.68	1.04
CC	3.00	27.00	10.42	2.58	1.00
CD	4.58	96.07	15.40	6.25	2.42
AD	3.00	27.00	10.10	2.68	1.04
DD	3.00	27.00	10.42	2.58	1.00

Fixed End Moments

Member AB

$$M^F_{AB} = \frac{1}{12} \times 2840 \times 15.40^2 + \frac{1}{15} \times 490 \times \frac{15.40^2}{2} = 59.88'^K$$

$$M^F_{BA} = \frac{1}{12} \times 2840 \times 15.40^2 + \frac{1}{10} \times 490 \times \frac{15.40^2}{2} = 61.88'^K$$

Member BC

$$M^F_{BC} = M^F_{CB} = \frac{1}{12} \times 2925 \times 10.10^2 = 24.91'^K$$

Member CC'

$$M^F_{CC'} = M^F_{C'C} = \frac{1}{12} \times 2925 \times 10.42^2 = 26.60'^K$$

Member AD

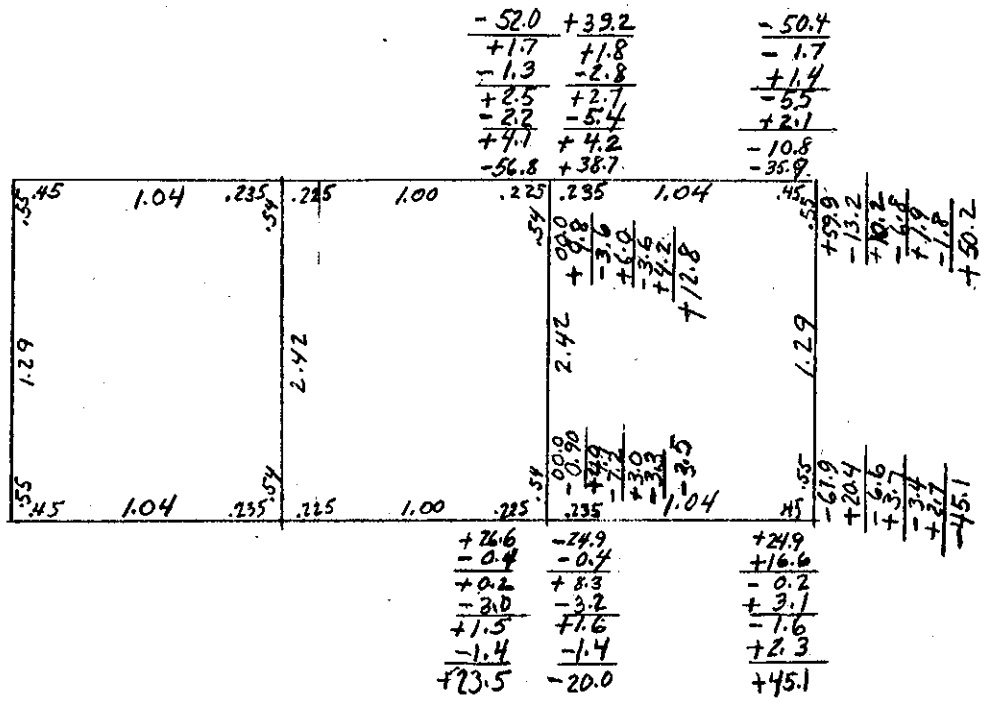
$$M^F_{AD} = \frac{1}{12} \times 3550 \times 10.10^2 + \frac{1}{15} \times 1660 \times \frac{10.10^2}{2} = 35.85'^K$$

$$M^F_{DA} = \frac{1}{12} \times 3550 \times 10.10^2 + \frac{1}{10} \times 1660 \times \frac{10.10^2}{2} = 38.70'^K$$

Member DD'

$$M^F_{DD'} = M^F_{D'D} = \frac{1}{12} \times 5210 \times 10.42^2 + \frac{5}{48} \times \overset{870}{\cancel{1660}} \times \frac{10.42^2}{2} = \overset{52.2}{56.8}'^K$$

Section A-A (cont'd)



End Reactions and Positive Moments

Member AB

$$V_A = 2840 \times 15.40 \times .5 + 490 \times 15.40 \times .5 \times .33 + \frac{5100}{15.40} = 23490^{\#}$$

$$V_B = 2840 \times 15.40 \times .5 + 490 \times 15.40 \times .5 \times .67 - \frac{5100}{15.40} = 24120^{\#}$$

$x_0 = 8.0$ ft. from A

$$+M = 23490 \times 8 - 50200 - 2840 \times \frac{8^2}{2} - \frac{490}{15.40} \times \frac{8^3}{6} = 43600'^{\#}$$

Member BC

$$V_B = 2925 \times 10.10 \times .5 + \frac{25100}{10.10} = 17240^{\#}$$

$$V_C = 2925 \times 10.10 \times .5 - \frac{25100}{10.10} = 12260^{\#}$$

$x_0 = 5.9$ ft. from B

$$+M = 17240 \times 5.9 - 2925 \times \frac{5.9^2}{2} - 45100 = 5900'^{\#}$$

Subject Claremont Dam
Computation Transition Section of Tunnel
Computed by A.L.K. **Checked by** **Date** 16-Nov, 1944.

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Section A-A End Reactions & Pos. Mom cont'd.

Member C-C'

$V_C = V_{C'} = 2925 \times 10.42 \times .5 = 15250^{\#}$

$x_0 = 5.21'$

$+M = 15250 \times 5.21 - 2925 \times \frac{5.21^2}{2} - 23500 = 16300'^{\#}$

Member CD

$V_C = V_D = \frac{9300}{15.4} = 605^{\#}$

Member AD

$V_A = 3550 \times 10.10 \times .5 + 1660 \times 10.10 \times .5 \times .33 + \frac{11200}{10.10} = 21820^{\#}$

$V_D = 3550 \times 10.10 \times .5 + 1660 \times 10.10 \times .5 \times .67 - \frac{11200}{10.10} = 22350^{\#}$

$x_0 = 5.35$ ft from A

$+M = 21820 \times 5.35 - 50400 - 3550 \times \frac{5.35^2}{2} - \frac{1660}{10.10} \times \frac{5.35^3}{6} = 11200'^{\#}$

Member DD'

$V_D = V_{D'} = 5210 \times 10.42 \times .5 + \frac{870 \times 10.42}{4} = 29460^{\#}$

$+M = 29460 \times 5.21 - 5210 \times \frac{5.21^2}{2} - 52{,}000 - \frac{870}{5.21} \times \frac{5.21^3}{6} = 26{,}140'^{\#}$

Design of roof slab A D D'A'

Member DD' req'd $d = \sqrt{\frac{52{,}000}{147}} = 18.8'' < 30.5''$

$v = \frac{29460}{12 \times .88 \times 30.5} = 91.5\ \#/\square''$ OK because shear will reduce at face of support.

reduced V at face of support

$V = 29460 - 5210 \times 2.29 - \frac{870}{5.21} \times \frac{2.29^2}{2} = 17120^{\#}$

reduced M at face of support

$-M = 52000 - \frac{1}{3}\left(\frac{29460 + 17120}{2}\right) 4.58 = 16400'^{\#}$

Member A'D' reduced V at face of support

$V = 21820 - 3550 \times 1.86 - \frac{2530}{15.32} \times \frac{1.86^2}{2} = 14930^{\#}$

reduced M at face of support

$-M = 50400 - \frac{1}{3}\left(\frac{21820 + 14930}{2}\right) \times 3.71 = 27{,}700'^{\#}$

Subject: Claremont Dam
Computation: Transition Section at Tunnel
Computed by: A.L.K. Checked by: Date: 17-Nov., 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section A-A Design of Members cont'd.

$$-A_s = \frac{27{,}700 \times 12}{18000 \times .88 \times 30.5} = .69 \ \square''$$ use 1"ϕ @ 1'-0" cc

$$u_0 = \frac{14950}{3.1 \times .88 \times 30.5} = 180^{\#}/\square''$$

$$+A_s = \frac{26{,}140 \times 12}{18000 \times .88 \times 30.5} = .65 \ \square''$$ use 7/8"ϕ @ 1'-0" cc

Side Walls AB & A'B'

Reduced shear & Mom. at face of support Pt. A

$$V = 23490 - 2840 \times 1.5 - \frac{490}{15.40} \times \frac{1.50^2}{2} = 19{,}200^{\#}$$

$$-M = 50200 - \frac{1}{3}\left(\frac{23490 + 19200}{2}\right) 3.0 = 28{,}860'^{\#}$$

$$-A_s = \frac{28{,}860 \times 12}{18000 \times .88 \times 37.5\,*} = .585 \ \square''$$ use 1"□ @ 1'-0" c.c.

* d = will vary and the min. is 37.5"

$$v = \frac{19200}{12 \times .88 \times 37.5} = 49^{\#}/\square''$$

$$u_0 = \frac{19200}{3.1 \times .88 \times 37.5} = 187^{\#}/\square''$$

Reduced shear & Mom at face of support Pt. B

$$V = 24120 - \left(3330 \times 1.5 - \frac{490}{15.40} \times \frac{1.5^2}{2}\right) = 19160^{\#}$$

$$-M = 45100 - \frac{1}{3}\left(\frac{24120 + 19160}{2}\right) 3.0 = 23{,}460'^{\#}$$

use same steel thru side walls

$$+A_s = \frac{43600 \times 12}{18000 \times .88 \times 37.5} = .885 \ \square''$$ use 1"□ @ 1'-0" cc

Subject: Claremont Dam
Computation: Operating House - Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: Dec. 11, 1944

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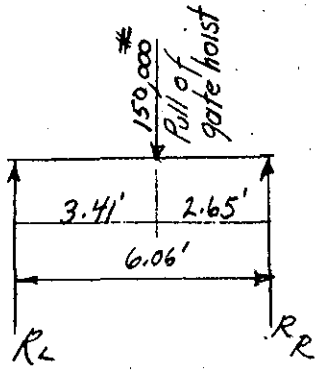


Determination of concentrated loads due to pull of gate hoist.

$$R_L = 150000 \times \frac{2.65}{6.06} = 65{,}500\ \#$$

$$R_R = 150000 \times \frac{3.41}{6.06} = 84500\ \#$$

REACTION FOR GATE HOIST D.L.

$$R_L = \frac{15000 \times 2.65}{6.06} = 6550\ \#$$

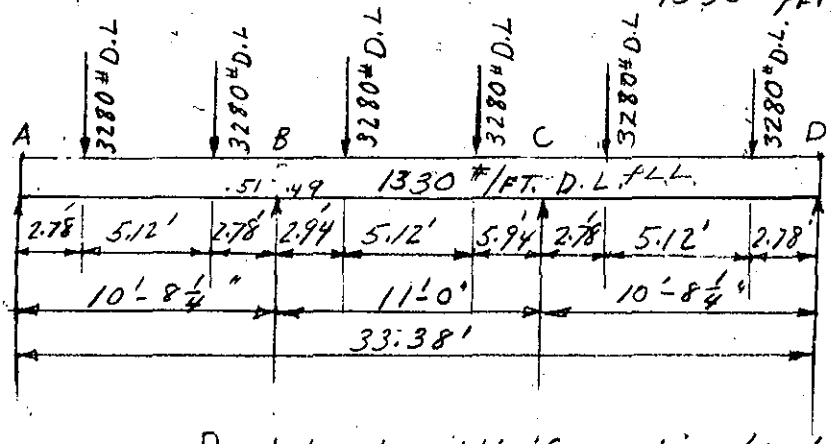
$$R_R = \frac{15000 \times 3.41}{6.06} = 8450\ \#$$

Note. Beams B-1 & B-2 will be designed for gate hoist concentrations plus a uniform Live Load on the floor slabs of 100 #/□'.

Beam B-1

Loadings:

D.L. of beam = 1.67 X 2.16 X 150 = 540 #/FT
" " slab = 3.50 X 125 = 438 #/FT
L.L. of slab = 3.50 X 100 = 350 #/FT
1330 #/FT



Dead Load and Uniform Live Load Diagram

WAR DEPARTMENT

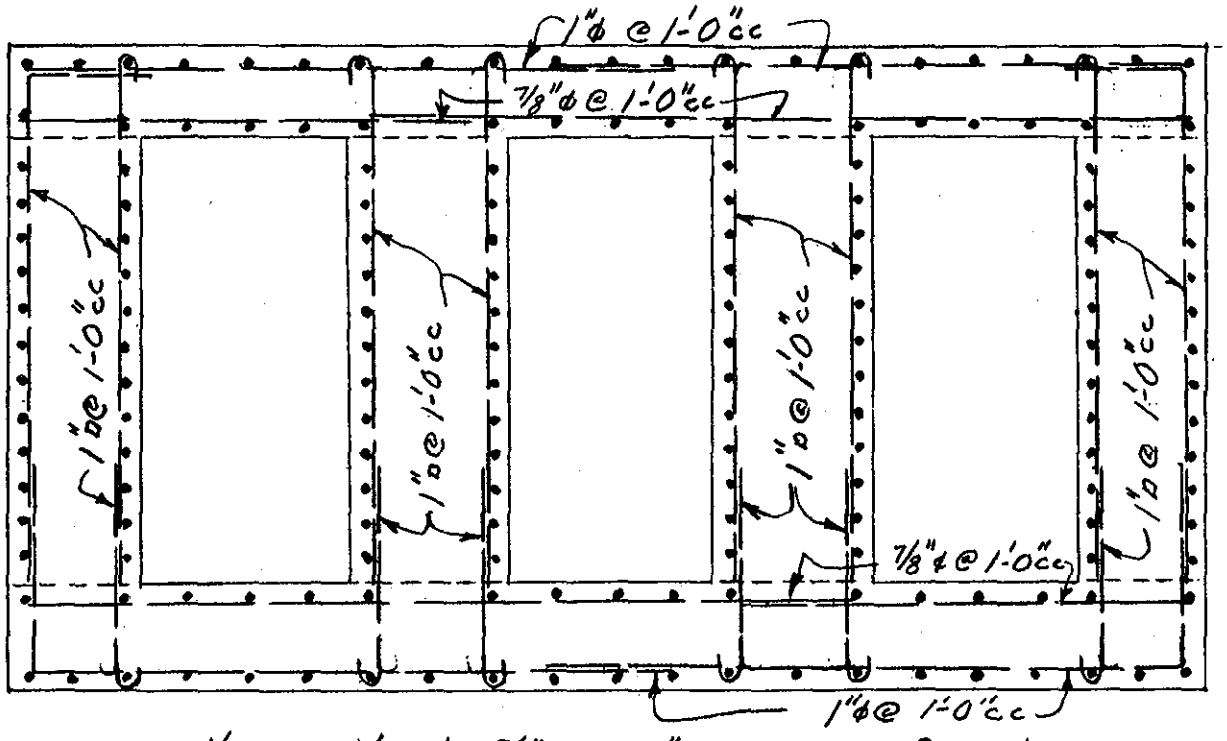
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Transition Section of Tunnel

Computed by: H.E.W. Checked by: Date: 3-Oct-44

U.S. GOVERNMENT PRINTING OFFICE 3—10538



Horiz. steel 7/8"φ @ 18" cc ± in roof and base
" " 7/8"φ @ 12" cc ± in walls

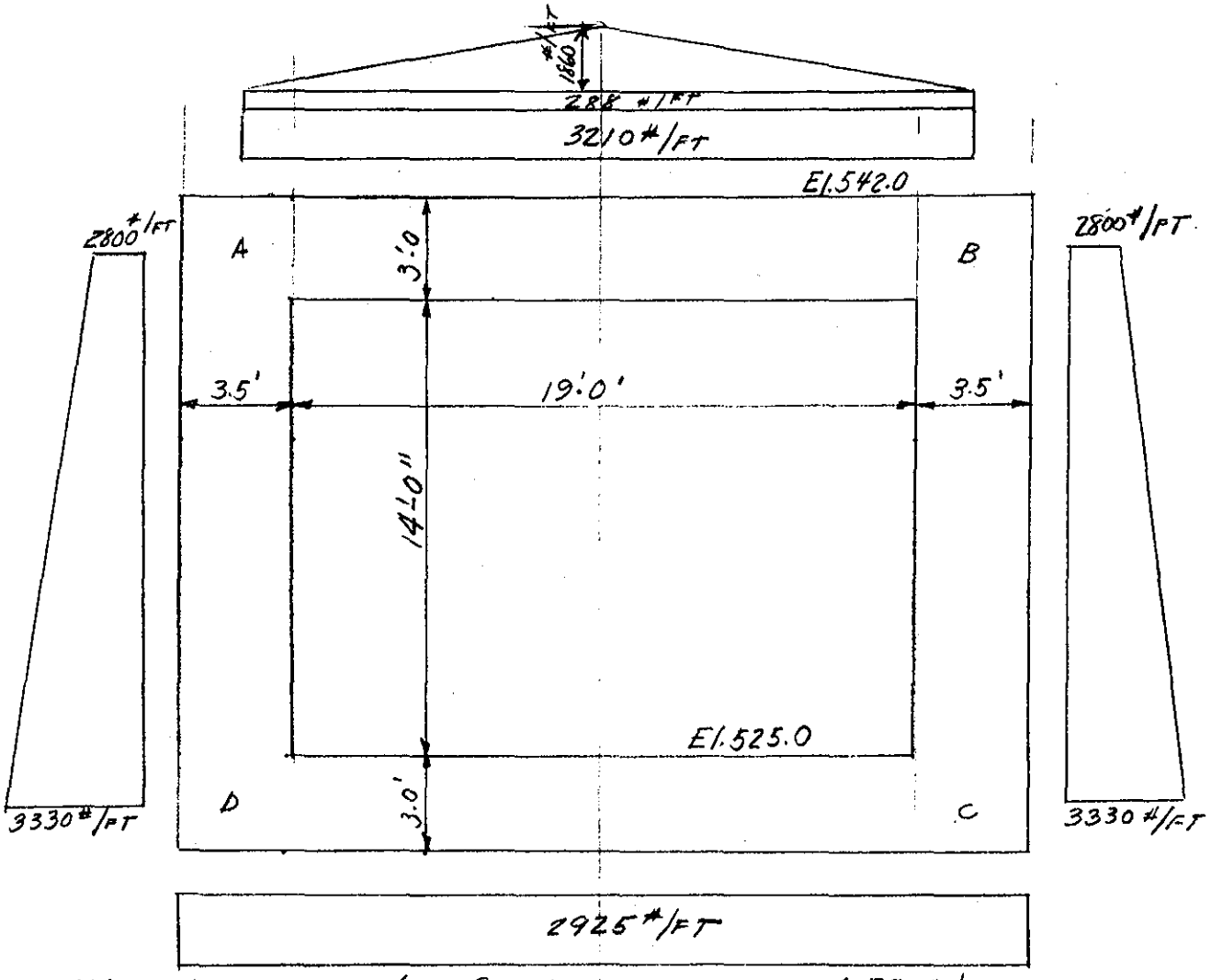
Tunnel Steel from Sta. 16+18 to 16+26

(Dimensions will vary see plans)

Subject Claremont Dam
Computation Transition Section of Tunnel
Computed by A.L.K. **Checked by** **Date** 17 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section B-B (Section at Sta. 16+36.50)



Wt of conc. roof 3x150 = 450 #/FT } 3210 #/FT
Head of water on roof (630 - 542.) 31.25 = 2760 #/FT }
Wt. of rock on roof 3.5 x .5 x 165 = 288 #/FT
" " " 11.25 x 165 = 1860 #/FT
Side thrust @ El. 540.5 = (630-540.5) 31.25 = 2800 #/FT
Side thrust @ El. 523.5 = (630 - 523.5) 31.25 = 3330 #/FT
Uplift on base = (630 - 522) 31.25 - 3 x 150 = 2925 #/FT

Note: Dead Load of conduit is assumed to be transmitted to the rock directly from each wall.

Subject Claremont Dam
Computation Transition Section of Tunnel
Computed by A.L.K. **Checked by** **Date** 17/Nov. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Section B-B cont'd

Member	depth	d^3	L	$\frac{d^3}{L}$	K
AB	3	27	22.5	1.2	1
BC	3.5	42.9	17.0	2.52	2.1
CD	3	27	22.5	1.2	1
DA	3.5	42.9	17.0	2.52	2.1

Fixed End Moments

Member AB

$$M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 3500 \times 22.5^2 + \frac{5}{48} \times 1860 \times \frac{22.5^2}{2} = 196.6 \text{ 'K}$$

Member BC

$$M^F_{BC} = \frac{1}{12} \times 2800 \times 17^2 + \frac{1}{15} \times 530 \times \frac{17^2}{2} = 72.6 \text{ 'K}$$

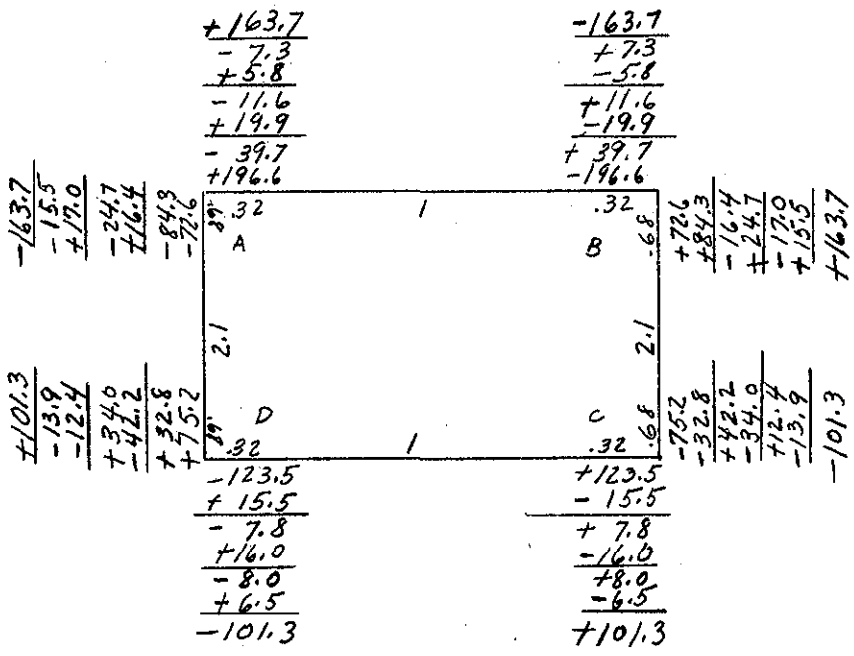
$$M^F_{CB} = \frac{1}{12} \times 2800 \times 17^2 + \frac{1}{10} \times 530 \times \frac{17^2}{2} = 75.2 \text{ 'K}$$

Member CD

$$M^F_{CD} = M^F_{DC} = \frac{1}{12} \times 2925 \times 22.5^2 = 123.5 \text{ 'K}$$

Member DA

$$M^F_{DA} = 75.2 \text{ 'K} \qquad M^F_{AD} = 72.6 \text{ 'K}$$



Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 17 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10536

Section B-B cont'd

End Reactions and Positive moments

Member AB

$V_A = V_B = 3500 \times 22.5 \times .5 + 1860 \times \frac{22.5}{4} = 49550$ #

$X_0 = 11.25'$

$+M = 49{,}550 \times 11.25 - 3500 \times \frac{11.25^2}{2} - 163{,}700 - \frac{1860}{11.25} \times \frac{11.25^3}{6} = 131{,}500$ '#

Member BC & AD

$H_B = 2800 \times 17 \times .5 + 530 \times 17 \times .5 \times .33 + \frac{62400}{17} = 28970$ #

$H_C = 2800 \times 17 \times .5 + 530 \times 17 \times .5 \times .67 - \frac{62400}{17} = 23130$ #

$X_0 = 9.75$ from B

$+M = 28970 \times 9.75 - 163700 - 2800 \times \frac{9.75^2}{2} - \frac{530}{17} \times \frac{9.75^3}{6} = -20{,}020$

No. pos Mom.

Member DC

$V_C = V_D = 2925 \times 22.5 \times .5 = 32900$ #

$X_0 = 11.25$

$+M = 32900 \times 11.25 - 2925 \times \frac{11.25^2}{2} - 101{,}300 = 83{,}700$ '#

Design of Roof slab AB

Reduced Moment & Shear at face of support

reduced $V = 49550 - 3500 \times 1.75 - \frac{1860}{11.25} \times \frac{1.75^2}{2} = 43{,}180$ #

reduced $M = 163700 - \frac{1}{3}\left(\frac{49550 + 43180}{2}\right) 3.5 = 109{,}900$ '#

req'd d for M $= \sqrt{\frac{109{,}900}{147}} = 27.3'' < 30.5$

$V = \frac{43180}{12 \times .88 \times 30.5} = 133.5$ #/□"

req'd d $= \sqrt{\frac{131{,}500}{123}} = 32.7 > 30.5$

Subject: Claremont Dam
Computation: Transition Section at Tunnel
Computed by: A.L.K. Checked by: Date: 18 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

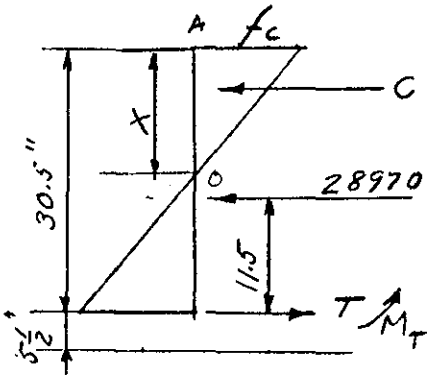
Section B-B cont'd

$$-A_s = \frac{109,900 \times 12}{18000 \times .88 \times 30.5} = 2.73 \ \square'' \qquad \text{use } 1\tfrac{1}{8}''\square @ 5\tfrac{1}{2}'' \text{ c c}$$

$$+A_s = \frac{131,500 \times 12}{18000 \times .88 \times 30.5} = 3.27 \ \square'' \qquad \text{use } 1\tfrac{1}{8}''\square @ 4\tfrac{1}{2}'' \text{ c c}$$

$$u_o = \frac{43,180}{9.8 \times .88 \times 30.5} = 163 \ \#/\square''$$

Investigation of Bending & direct compr. in Member AB



$$M_T = +131,500 \times 12 = 1,580,000$$

$$M_C = 28970 \times 11.5 = 332,000$$

$$1,912,000 \ ''\#$$

① $f_c \times \frac{x}{2} \times 12 - 28970 = T$

② $f_c \times \frac{x}{2} \times 12 \left(30.5 - \frac{x}{3}\right) = 1,912,000$

③ $\frac{f_c}{x} = \frac{\frac{T}{12 \times 3.39}}{30.5 - x}$

$$x^3 + 107.5x^2 + 1340x - 41100 = 0$$

$$x = 13.7''$$

$kd = 13.7 \quad d = 30.5 \quad K = .45 \quad j = .85$

$$f_c \frac{13.7}{2} \times 12 \left(30.5 - \frac{13.7}{3}\right) = 1,912,000$$

$$f_c = \underline{930} \ \#/\square'' \quad \text{OK}$$

Subject: Claremont Dam
Computation: Transition section of Tunnel
Computed by: Checked by: Date: 20/Nov. 1944

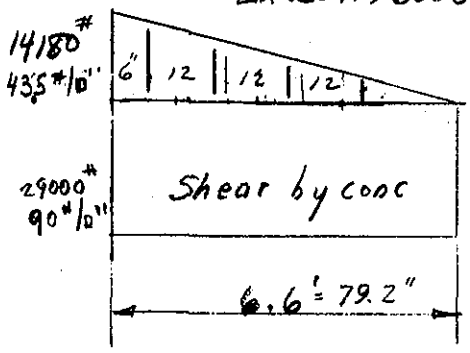
U.S. GOVERNMENT PRINTING OFFICE 3—10538

Section B-B contd

Roof slab Member AB

one $\frac{1}{2}''\phi$ stirrup takes
$2 \times .20 \times 16000 = 6400$ #

Shear taken by concrete
$90 \times 12 \times .88 \times 30.5 = 29000$ #



$A_s = \frac{\frac{1}{2} \times 14,180 \times 6.6 \times 12}{.88 \times 30.5 \times 6400} = 3.3$ Stirrup

4 stirrups

max. spacing $\frac{1}{2} \times 30.5 = 15.25''$
Allowed

Spacing

$6400 = 43.5 \times 12 \times S_1$ $S_1 = 12''$
$6400 = 37.0 \times 12 \times S_2$ $S_2 = 14.5''$
$6400 = 29.0 \times 12 \times S_3$ $S_3 = 18.0''$
$S_4 = 24.7$

use $2 - \frac{1}{2}''\phi$ U stirrups @ 12" cc
$3 - \frac{1}{2}\phi$ U stirup, S @ 15" cc

pt. of inflection

$$49,550\,x - 3500\frac{x^2}{2} - \frac{1860}{11.25}\left(\frac{x^3}{6}\right) - 163,700 = 0$$

$x = 4.25'$

Bending Pt of Positive steel Allow 50% of steel to be bent up

$$M = 1.69 \times 18000 \times .88 \times \frac{30.5}{12} = 68000'\#$$

$$49550\,x - 3500\frac{x^2}{2} - \frac{1860}{11.25}\frac{x^3}{6} - 163700 = 68000$$

$x = 5.9'$

if bars were to be bent up inclination would be almost vertical.

$$u = \frac{27,790}{69 \times .88 \times 30.5} = 150\ \#/\square''$$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Transition Section of Tunnel

Computed by: A.L.K. Checked by: Date: 22 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10538

Vousoir No	Intensity of Vert. Load	Horiz. Proj of Vous Extrados	Vert Load	Vertical + wt of vousoir	Intensity of Horiz. Load	Vert Proj of Vous. Extrados	Total Horiz. Load
1	4580	1.6	7330	8050	0	0	0
2	4244	1.6	6790	7510	0	0	0
3	3980	1.6	6360	7080	0	0	0
4	3720	1.6	5960	6680	0	0	0
5	3490	1.54	5470	6260	2760	1.20	3310
6	3520	1.33	4680	5470	2800	1.50	4200
7	3660	1.16	4250	5040	2860	1.75	5000
8	0	0	0	895	2930	1.88	5500
9	0	0	0	895	2990	1.88	5620
10	0	0	0	895	3050	1.88	5740
11	0	0	0	895	3110	1.88	5850
12	0	0	0	895	3170	1.88	5960
13	-3180	.96	-3050	-2260	3250	1.75	5700
14	-3310	1.29	-4270	-3480	3300	1.62	5350
15	-3350	1.50	-5020	-4230	3350	1.33	4460
16	-3380	1.67	-5640	-4890	0	0	0
17	-3380	1.67	-5640	-4890	0	0	0
18	-3380	1.67	-5640	-4890	0	0	0
19	-3380	1.67	-5640	-4890	0	0	0
				+21035			

21040# is equal to bearing pressure and will be assumed prop. distributed between vousoirs 13-19

Adj value for Vous # 13 = $-2260 - \frac{.96}{10.43} \times 21{,}040 = -4190$ #

" " " " # 14 = $-3480 - \frac{1.29}{10.43} \times 21{,}040 = -6080$ #

" " " " # 15 = $-4230 - \frac{1.50}{10.43} \times 21040 = -7260$ #

" " " " # 16 = $-4890 - \frac{1.67}{10.43} \times 21040 = -8250$ #

" " " " # 17, # 18, # 19 = -8250 #

WAR DEPARTMENT

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

Subject: Claremont Dam

Computation: Transition section of Tunnel

Computed by: A.L.K. Checked by: _____ Date: _____

	Given				Derived				Vertical load			Horiz. Load			Contilever M					Final Moment				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No	ds	d	x	y_1	a	ay_1	y	ay^2	V	ΣV	x_n-x_{n-1}	h	Σh	y_n-y_{n-1}	Vert.	Horiz	m	ma	may	m+M	Hxy	Mom.	Thrust	Shear
1	1.6	3.00	-.8	0	.0593	0	+8.76	4.55	8050	+8.05	-1.60	0	0	0	-1.61	0	-1.61	-0.09	-0.8	+318.4	-232.0	+86.4	26.5	4.0
2	1.6	3.00	-2.40	0	.0593	0	+8.76	4.55	7510	+15.56	-1.60	0	0	0	-14.51	0	-14.51	-0.86	-7.6	+305.5	-232.0	+73.5	26.5	12.0
3	1.6	3.00	-4.00	0	.0593	0	+8.76	4.55	7080	+22.64	-1.60	0	0	0	-39.41	0	-39.41	-2.33	-20.4	+280.6	-232.0	+58.6	26.5	19.2
4	1.6	3.00	-5.6	0	.0593	0	+8.76	4.55	6680	+29.32	-1.48	0	0	-0.5	-75.71	0	-75.71	-4.45	-39.0	+244.9	-232.0	+12.9	26.5	26.0
5	1.75	3.00	-7.08	-.5	.0648	+0.324	+8.26	4.44	6260	+35.58	-1.29	3.31	3.31	-1.25	-119.11	0	-119.11	-7.71	-63.5	+200.9	-219.0	-18.1	40.0	9.5
6	1.75	3.00	-8.37	-1.75	.0648	-.1130	+7.01	3.18	5470	+41.05	-1.13	4.20	7.51	-1.50	-164.91	-4.15	-169.06	-10.95	-77.0	+150.9	-186.0	-35.1	43.0	9.3
7	1.75	3.00	-9.50	-3.25	.0648	-.2100	+5.51	1.97	5040	+46.09	-0.46	5.00	12.51	-1.63	-211.31	-15.45	-226.76	-14.70	-81.0	+93.2	-146.0	-52.8	46.0	8.5
8	1.88	3.17	-9.96	-4.88	.0590	-.2880	+3.88	0.88	0.895	+46.99	0	5.50	18.01	-1.88	-232.51	-35.85	-268.36	-15.80	-61.5	+51.6	-103.0	-51.4	46.8	11.0
9	1.88	3.17	-9.96	-6.76	.0590	-.4000	+2.00	0.24	0.895	+47.89	0	5.62	23.63	-1.88	-232.51	-69.85	-302.36	-17.80	-35.6	+17.6	-53.0	-35.4	47.8	5.5
10	1.88	3.17	-9.96	-8.64	.0590	-.5100	+0.12	0.01	0.895	+48.79	0	5.74	29.47	-1.88	-232.51	-114.35	-346.86	-20.40	-24.5	-26.9	-3.2	-30.1	48.5	0.0
11	1.88	3.17	-9.96	-10.52	.0590	-.6210	-1.76	0.18	0.895	+49.69	0	5.85	35.32	-1.88	-232.51	-169.75	-402.26	-23.70	+41.7	-82.3	+46.6	-35.7	49.5	6.0
12	1.88	3.17	-9.96	-12.40	.0590	-.7310	-3.67	0.78	0.895	+50.59	+0.38	5.96	41.28	-1.76	-232.51	-236.15	-468.66	-27.60	+100.4	-148.7	+96.4	-52.3	50.5	11.8
13	1.75	3.0	-9.58	-14.16	.0648	-.9160	-5.40	1.89	-4.190	+46.40	+1.00	5.70	46.98	-1.42	-213.31	-308.75	-521.96	-33.80	+183.0	-202.0	+143.0	-59.0	51.3	8.5
14	1.75	3.0	-8.58	-15.58	.0648	-1.000	-6.82	3.01	-6.080	+40.32	+1.21	5.35	52.33	-1.42	-166.91	-375.35	-542.26	-35.10	+239.0	-222.3	+180.5	-41.8	49.0	9.0
15	1.75	3.0	-7.37	-17.00	.0648	-1.100	-8.24	4.41	-7.260	+33.06	+1.52	4.46	56.79	-0.50	-118.21	-449.45	-567.66	-36.80	+303.0	-247.7	+218.0	-29.7	46.3	8.5
16	1.67	3.0	-5.85	-17.50	.0619	-1.081	-8.74	4.70	-8.250	+24.81	+1.67	0	56.79	0	-67.81	-477.85	-545.66	-33.80	+296.0	-225.7	+231.5	+6.2	30.3	29.0
17	1.67	3.0	-4.18	-17.50	.0619	-1.081	-8.74	4.70	-8.250	+16.56	+1.67	0	56.79	0	-25.50	-477.85	-503.35	-31.10	+272.0	-183.4	+231.5	+48.1	30.3	21.0
18	1.67	3.0	-2.51	-17.50	.0619	-1.081	-8.74	4.70	-8.250	+8.31	+1.67	0	56.79	0	+2.1	-477.85	-475.75	-29.40	+257.0	-155.8	+231.5	+75.7	30.3	12.8
19	1.67	3.0	-.84	-17.50	.0619	-1.081	-8.74	4.70	-8.250	0	0	0	56.79	—	+16.0	-477.85	-461.85	-28.61	+250.0	-141.9	+231.5	+89.6	30.3	4.5
					1.169	-10.245		57.99										-374.00	+1531.2					

$$\frac{\Sigma ay'}{\Sigma a} = \frac{10.245}{1.169} = -8.76'$$

$$M = -\frac{\Sigma ma}{\Sigma a} = -\frac{-374.00}{1.169} = +320'^{K}$$

$$H = -\frac{\Sigma may}{\Sigma ay^2} = -\frac{1531.2}{57.99} = -26.5^{K}$$

Mom. at crown $= m + M + Hy = 0 + 320 - 26.5 \times 8.76 = +89.0'^{K}$

Mom at invert $= -458.0 + 320 + (-26.5 \times -8.74) = +93.0'^{K}$

Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 27/Nov/1944

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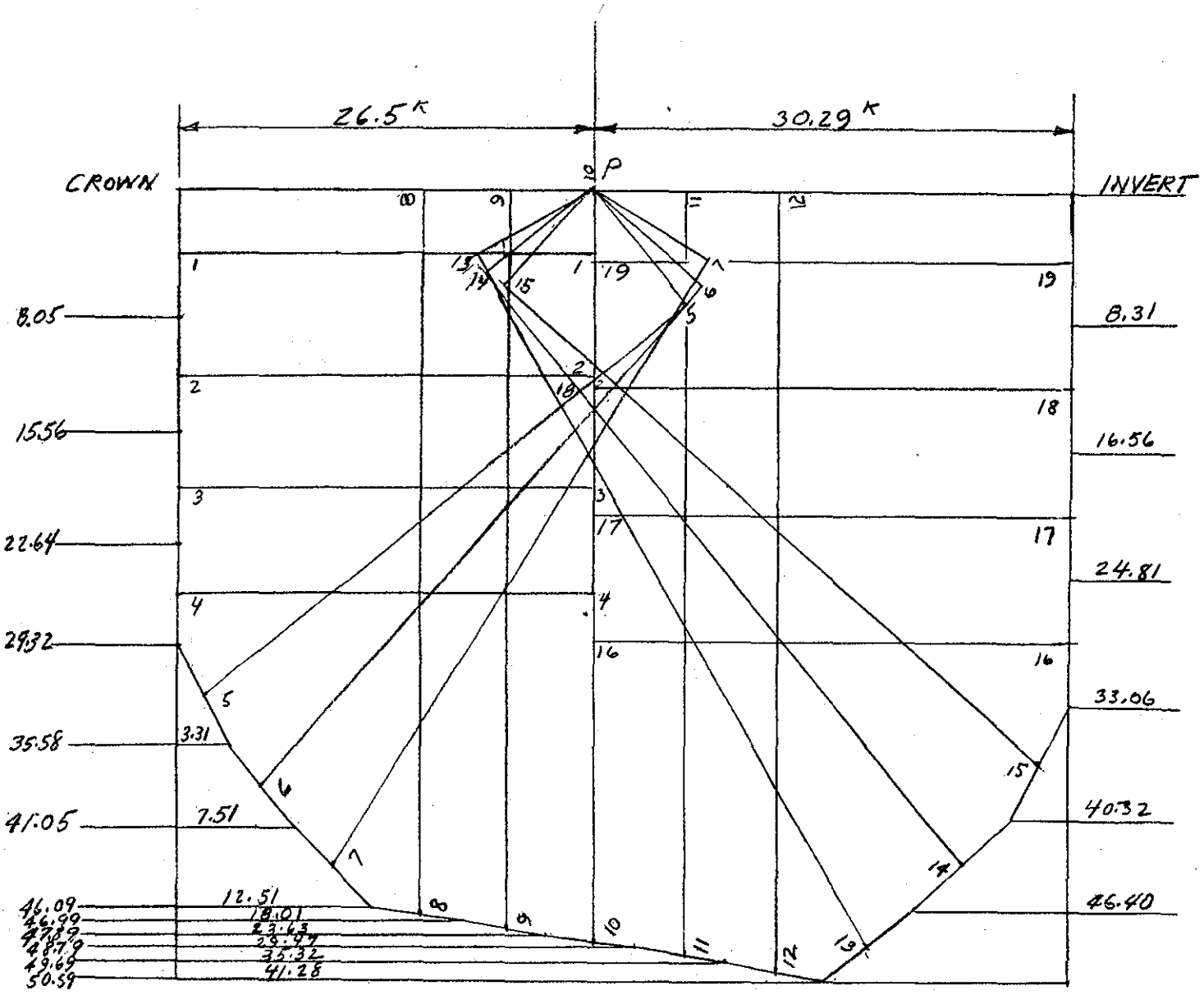

FORCE Diagram

Temperature changes

It will be assumed that there will be 30° rise and fall in the temp

$$H = \frac{E b e' L}{12 \Sigma a y^2} = \frac{3000 \times 144 \times 30 \times .000006 \times 1 \times 9.96}{12 \times 57.99} = 1.11$$

Mom at any pt = ± 1.11 y

Subject: Claremont Dam
Computation: Transition section of Tunnel
Computed by: A.L.K. Checked by: Date: 28 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of section
Basedon Port. cement Ass. pamphlet of Conc culvert and conduits

Section at Crown

$M = 89 + 1.11 \times 8.76 = 98.74$ 'k.
Thrust $N = 26.5 + 1.11 = 27.61$ k

$b = 12 \quad d = 31.5'' \quad d'' = 13.5''$

$M_s = 98{,}740 + \frac{13.5}{12}(27{,}610) = 129{,}740$ '#

$d = \sqrt{\frac{12 \times 129{,}740}{123 \times 12}} = 32.3'' > 31.5''$ OK. because of severe loading assumptions.

$A_s = \frac{12 \times 129{,}740}{18000 \times .88 \times 31.5} - \frac{27{,}610}{18000} = 1.59 \square''$ use 1"ϕ@6"cc

Section at invert.

$M = 93 + 1.11 \times 8.74 = 102.7$ 'k.

Thrust $N = 30.3 + 1.11 = 31.41$ k

$b = 12'' \quad d = 31.5'' \quad d'' = 13.5''$

$M_s = 102{,}700 + \frac{13.5}{12} \times 31{,}410 = 138{,}000$ '#

$d = \sqrt{\frac{138000}{123}} = 33.4'' > 31.5''$

$A_s = \frac{12 \times 138{,}000}{18000 \times .88 \times 31.5} - \frac{31410}{18000} = 1.58 \square''$ use 1"ϕ@6"cc

Subject: Claremont Dam
Computation: Transition section of Tunnel
Computed by: A. L. K. Checked by: Date: 28 Nov. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design section of invert (cont)

$M = 102.7^{'k}$ $b = 12$
$N = 31.41^{k}$ $d = 31.5''$ $d'' = 13.5''$

$$e = \frac{12 \times 102.7}{31.41} + 13.5 = 52.6$$

$$\frac{e}{d} = \frac{52.6}{31.5} = 1.67 \qquad i = 2.11$$

$j = .88$

$$m = q = \frac{12 \times 1.58 \times 2.11}{12 \times 31.5} = .106$$

$k = .37$

$$f_s = \frac{31410 \times 1.67}{.877 \times 1.58 \times 2.11} = 17900\ \#/\square''$$

$$f_c = \frac{17900 \times .37}{12 \times .63} = 877\ \#/\square''$$

Section @ Vousoir No. 13

$M = 59.0 + 1.11 \times 5.4 = 65^{'k}$

$N = 51.3 + 1.11 \times .34 = 51.68^{k}$

$d = 31.5''$ $d'' = 13.5''$ $b = 12''$

$$M_k = 65{,}000 + \frac{13.5}{12} \times 51{,}680 = 123000^{'\#}$$

$$d = \sqrt{\frac{12 \times 123000}{12 \times 123}} = 31.6'' > 31.5''\ \text{ok.}$$

$$A_s = \frac{12 \times 123000}{18000 \times .88 \times 31.5} - \frac{51680}{18000} = .08\ \square''$$

Use Min Transverse steel of 1"φ @ 1'-0" cc both faces.

Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 29/Nov.1944

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Design of sections cont'd.

Unit Shear

$$v = \frac{29000}{12 \times .88 \times 31.5} = 87.4 \ \#/\square''$$

Unit Bond

$$u = \frac{29000}{6.3 \times .88 \times 31.5} = 16.6 \ \#/\square''$$

Vousoir No. 7

$$M = 52.8 + 1.11 \times 5.51 = 58.91 \ ^{'K}$$

$$N = 46 + 1.11 \times 1.36 = 46.4 \ ^{K}$$

$$d = 31.5'' \quad d'' = 13.5'' \quad b = 12''$$

$$M_s = 58910 + 46,400 \times \frac{13.5}{12} = 110,010 \ ^{'\#}$$

$$d = \sqrt{\frac{12 \times 110,010}{123 \times 12}} = 29.9 < 31.5''$$

$$A_s = \frac{12 \times 110,010}{18000 \times .88 \times 31.5} - \frac{46400}{18000} = .08 \ \square''$$

use Min Transverse steel of 1"ϕ @ 1'-0" cc both faces

WAR DEPARTMENT

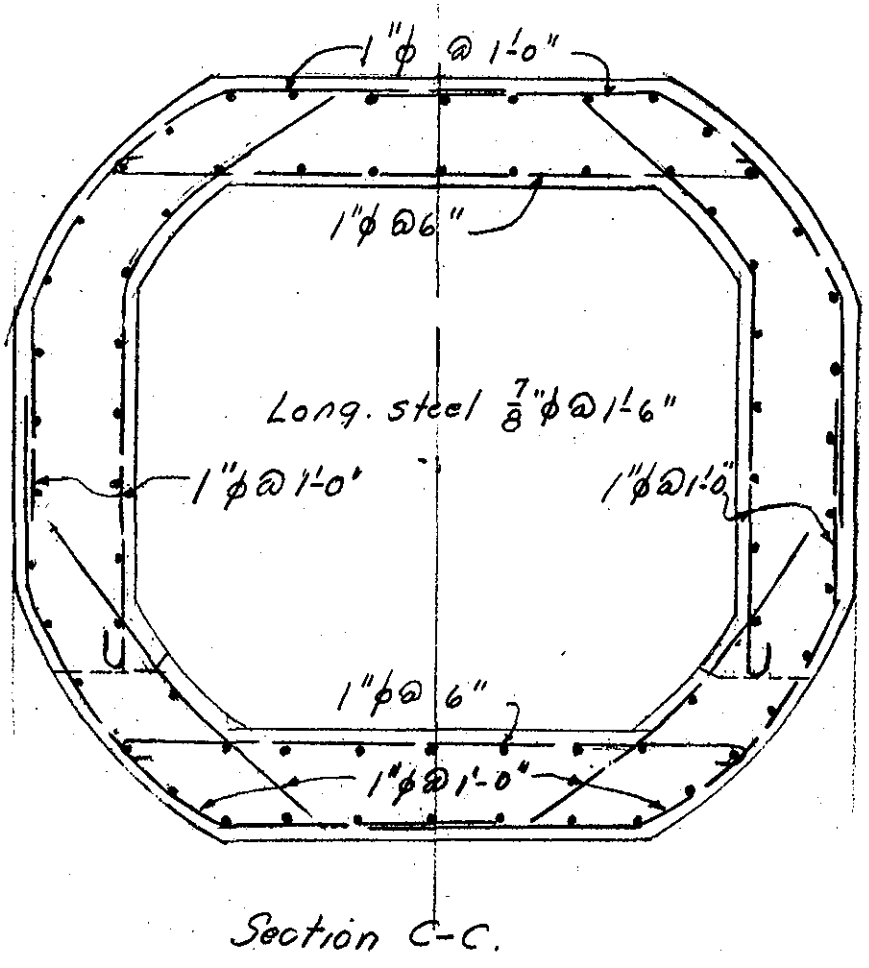
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: TRANSITION Section of TUNNEL

Computed by: A.L.K. Checked by: Date: 5 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Section C-C.

(Steel from Sta. 16+42.5 to Sta 16+48.5)

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

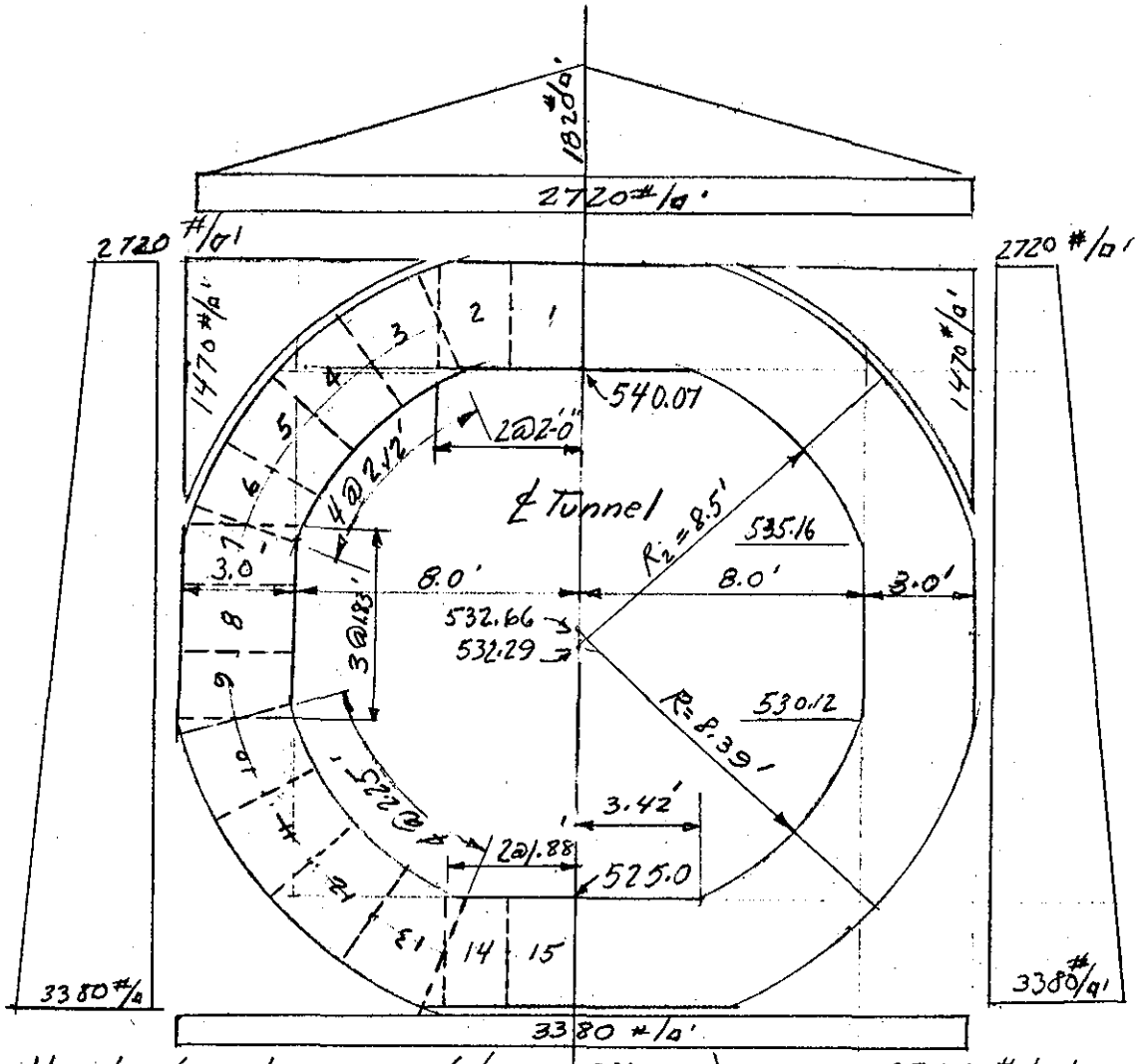
Subject Claremont Dam

Computation TRANSITION SECTION OF TUNNEL

Computed by A.L.K. **Checked by** **Date** 20 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section D-D @ station 16+48.5



Head of water on roof $(630-543.07)31.25 = 2720$ #/□'

Wt of rock on roof $11 \times 165 = 1820$ #/□'

Side thrust at El. 543.07 $= 2720$ #/□'

Side thrust at El. 522 - $(630-522)31.25 = 3380$ #/□'

Uplift at El. 522 on base $= 3380$ #/□'

Vertical load on curved sidewall $= 7.5(31.25+165) = 1470$ #/□'

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation TRANSITION SECTION OF TUNNEL

Computed by A.L.K. **Checked by** **Date** 30 Nov 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Vousoir No	Intensity of Vert. Load	Horiz. Proj. Vous. Extrados	Vertical Load	Vertical Load + wt of Vousoir	Intensity of Horiz. Load	Vertical Proj. of Vous. Extrad.	Total Horiz. Load
1	4370	2.0	8740	9640	0	0	0
2	4050	2.0	8100	9000	0	0	0
3	3762	2.12	8000	8955	2740	1.12	3070
4	3670	1.83	6720	7680	2790	1.62	4530
5	3750	1.42	5330	6290	2840	1.96	5560
6	3950	.92	3630	4590	2910	2.12	6170
7	0	0	0	825	2980	1.83	5450
8	0	0	0	825	3040	1.83	5560
9	0	0	0	825	3100	1.83	5660
10	−3380	.92	−3110	−2100	3180	2.37	7550
11	−3380	1.50	−5070	−4060	3250	2.12	6900
12	−3380	1.92	−6500	−5490	3310	1.83	6060
13	−3380	2.25	−7630	−6620	3360	1.25	4200
14	−3380	1.88	−6360	−5520	0	0	0
15	−3380	1.88	−6360	−5520	0	0	0
				+19320			

19320# is equal to bearing pressure and will be assumed prop. distributed between vousoirs 10-15

Adj. value for Vous. #10 $= -2100 - \frac{.92}{10.35} \times 19320 = -3820$

" " " " #11 $= -4060 - \frac{1.50}{10.35} \times 19320 = -6870$

" " " " #12 $= -5490 - \frac{1.92}{10.35} \times 19320 = -9070$

" " " " #13 $= -6620 - \frac{2.25}{10.35} \times 19320 = -10830$

" " " " #14 $= -5520 - \frac{1.88}{10.35} \times 19320 = -9030$

" " " " #15 $= -5520 - \frac{1.88}{10.35} \times 19320 = -9030$

WAR DEPARTMENT
U.S. ENGINEER OFFICE PROVIDENCE

Subject: Claremont Dam
Computation: Transition section of Tunnel
Computed by: A.L.K. Checked by: Date: 30 Nov 1944

	Given				Derived				Vertical load			Horiz. Load			Cantilever M					Final Moment.				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No.	ds	d	x	y.	a	ay.	y	ay²	V	ΣV	$x_n - x_{n-1}$	h	Σh	$y_n - y_{n-1}$	Vert.	Horiz	m	ma	may	m+M	Hxy	Mom	Thrust	Shear
1	2.00	3.0	-1.00	0	.0740	0	+8.94	5.90	9.640	+9.64	-2.00	0	0	0	-2.41	0	-2.41	-0.18	-1.60	+307.3	-250.0	+57.3	27.99	4.82
2	2.00	3.0	-3.00	0	.0740	0	+8.94	5.90	9.000	+18.64	-1.92	0	0	-0.50	-21.69	0	-21.69	-1.60	-14.30	+288.2	-250.0	+38.2	27.99	14.14
3	2.12	3.0	-4.92	-.46	.0785	-.036	+8.48	5.64	8.955	+27.60	-1.70	3.070	3.07	-1.25	-57.49	0	-57.49	-4.51	-38.30	+252.2	-237.0	+15.2	34.50	7.00
4	2.12	3.0	-6.62	-1.71	.0785	-.134	+7.23	4.10	7.680	+35.28	-1.46	4.530	7.60	-1.54	-104.49	-3.84	-108.33	-8.50	-61.50	+201.4	-202.0	-0.6	38.16	7.50
5	2.12	3.0	-8.08	-3.25	.0785	-.255	+5.69	2.54	6.290	+41.57	-1.04	5.560	13.16	-1.83	-155.99	-15.24	-171.23	-13.40	-76.20	+138.5	-159.0	-20.5	41.50	8.00
6	2.12	3.0	-9.12	-5.08	.0785	-.399	+3.86	1.17	4.590	+46.16	-0.38	6.170	19.33	-1.82	-199.09	-39.24	-238.33	-18.70	-72.20	+71.4	-108.0	-36.6	45.33	6.00
7	1.83	3.0	-9.50	-6.90	.0678	-.468	+2.04	0.28	.825	+46.99	0	5.450	24.78	-1.83	-216.59	-74.44	-291.03	-19.70	-40.20	+18.7	-57.0	-38.3	46.50	6.16
8	1.83	3.0	-9.50	-8.73	.0678	-.592	+0.21	0.003	.825	+47.82	0	5.560	30.34	-1.83	-216.59	-119.64	-336.23	-22.80	-4.80	-26.5	-5.9	-32.4	47.33	0.67
9	1.83	3.0	-9.50	-10.56	.0678	-.716	-1.62	0.18	.825	+48.65	+0.38	5.660	36.00	-1.94	-216.59	-175.14	-391.73	-26.50	+43.00	-82.0	+45.5	-36.5	48.33	5.00
10	2.25	3.0	-9.12	-12.50	.0833	-1.041	-3.56	1.06	-3.820	+44.33	+1.12	7.550	43.55	-1.96	-198.09	-245.14	-443.23	-36.80	+131.00	-133.5	+99.5	-34.0	48.00	4.83
11	2.25	3.0	-8.12	-14.46	.0833	-1.205	-5.52	2.54	-6.870	+37.96	+1.50	6.990	50.54	-1.74	-148.09	-330.64	-478.73	-39.80	+220.00	-169.0	+154.5	-14.5	45.16	7.00
12	2.25	3.0	-6.62	-16.20	.0833	-1.350	-7.26	4.40	-9.070	+28.89	+1.87	6.060	56.60	-1.34	-91.09	-418.64	-509.73	-42.30	+307.00	-200.0	+203.0	+3.0	41.67	6.67
13	2.25	3.0	-4.75	-17.54	.0833	-1.461	-8.60	6.15	-10.830	+18.06	+1.93	4.200	60.80	-0.53	-43.09	-493.14	-536.23	-44.60	+384.00	-226.5	+240.5	+14.0	38.67	5.00
14	1.88	3.0	-2.82	-18.07	.0696	-1.258	-9.13	5.80	-9.030	+9.03	+1.88	0	60.80	0	-8.19	-525.34	-533.53	-37.00	+337.00	-223.8	+255.0	+31.2	32.81	13.67
15	1.88	3.0	-0.94	-18.07	.0696	-1.258	-9.13	5.80	-9.030	0	—	0	60.80	—	+8.81	-525.34	-516.53	-36.00	+328.00	-206.8	+255.0	+48.2	32.81	4.50
					1.1378	+0.173		51.463										-352.39	+1440.9					

$$\Sigma \frac{ay'}{a} = -8.94'$$

$$M = -\frac{\Sigma ma}{\Sigma a} = -\frac{-352.39}{1.1378} = +309.7'^{k}$$

$$H = \frac{\Sigma may}{\Sigma ay^2} = -\frac{1440.9}{51.463} = -27.99^{k}$$

Mom at crown $= m + M + Hy = 0 + 309.7 - 27.99 \times 8.94 = +59.7'^{k}$

Mom at invert $= -500 + 309.7 + (-27.99 \times -9.13) = +64.7'^{k}$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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Subject Claremont Dam

Computation Transition Section of Tunnel

Computed by A.Y.K **Checked by** **Date** 2 / Dec 1944

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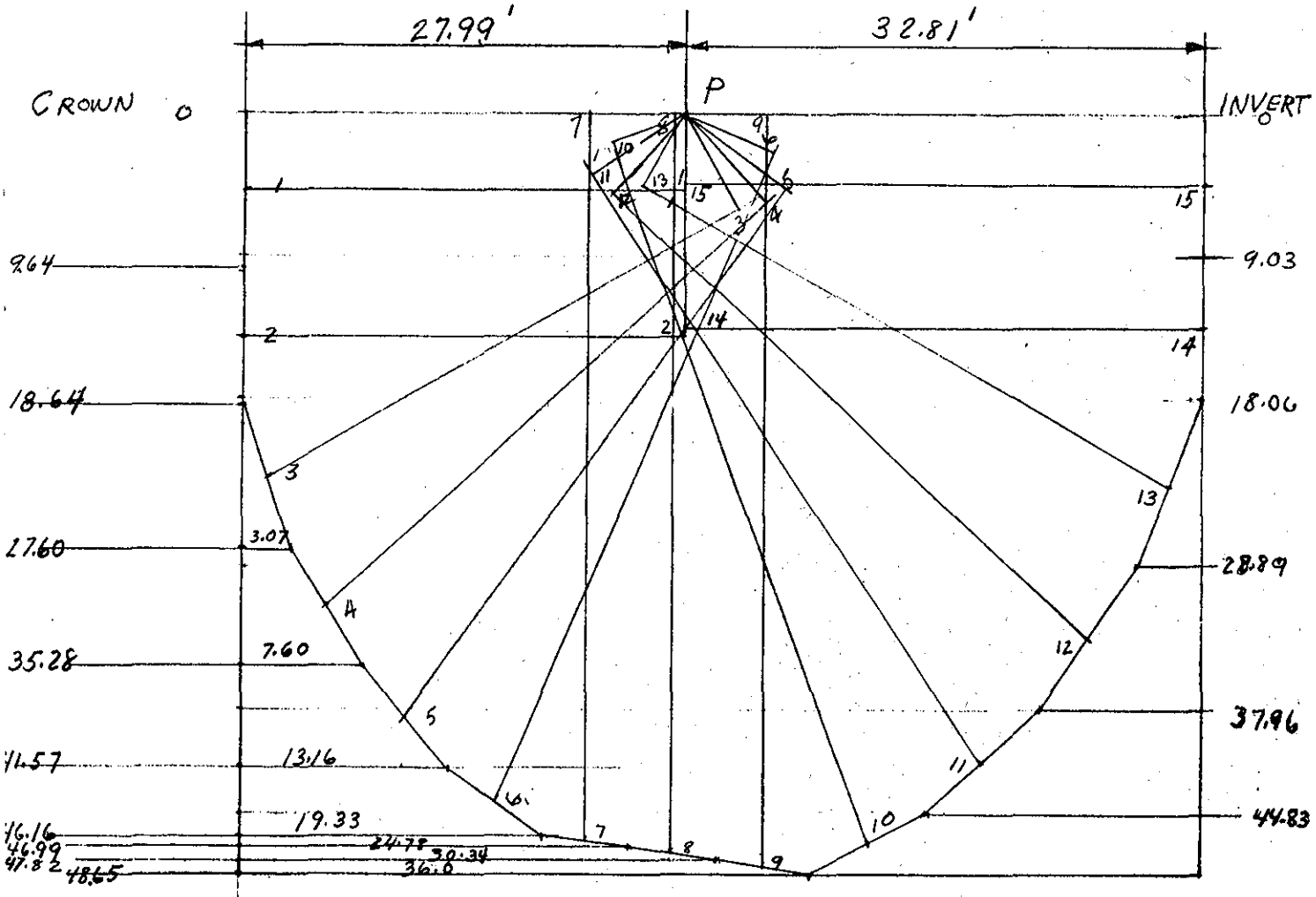


Force diagram

Temperature changes, for a 30° rise and fall in the temp.

$$H = \frac{Ebe'L}{12\Sigma ay^2} = \frac{3000 \times 144 \times 30 \times .000006 \times 1 \times 9.5}{12 \times 51.46} = 1.2$$

Mom. at any pt = 1.2y

Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 4-Dec. 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Design of section

Section at Crown

$M = 59.7 + 1.2 \times 8.94 = 70.4$ 'k

Thrust $N = 27.99 + 1.2 = 29.19$ k

$b = 12''$ $d = 31.5''$ $d'' = 13.5''$

$M_s = 70{,}400 + \frac{13.5}{12} \times 29{,}190 = 103{,}100$ '#

$d = \sqrt{\frac{12 \times 103100}{123 \times 12}} = 28.9'' < 31.5''$ ok

$A_s = \frac{12 \times 103{,}600}{18000 \times .88 \times 31.5} - \frac{29{,}190}{18{,}000} = .86$ □" use 1"φ @ 9"

Section at invert

$M = 64.7 + 1.2 \times 9.13 = 75.65$ 'k
Thrust $N = 32{,}814 + 1.2 = 34.01$ k

$M_s = 75{,}650 + \frac{13.5}{12} \times 34{,}010 = 113{,}850$ '#

$d = \sqrt{\frac{12 \times 113{,}850}{12 \times 123}} = 30.2'' < 31.5''$

$A_s = \frac{113{,}850 \times 12}{18000 \times .88 \times 31.5} - \frac{34010}{18000} = .84$ □"
use 1"φ @ 9"

Vousoir No 9

$M = 36.5 + 1.2 \times 1.62 = 38.34$ 'k
$N = 48.33 + 1.2 \times \frac{5}{48.5} = 48.46$ k

$M_s = 38340 + \frac{13.5}{12} \times 48{,}460 = 90840$ '#

$d = \sqrt{\frac{90840}{123}} = 27.1'' < 31.5''$

$A_s = \frac{90840 \times 12}{18000 \times .88 \times 31.5} - \frac{48460}{18000} = -.42$ use Min steel of 1"φ @ 1'-0" both faces

Subject: Claremont Dam
Computation: Transition Section of Tunnel
Computed by: A.L.K. Checked by: Date: 5 Dec 1944

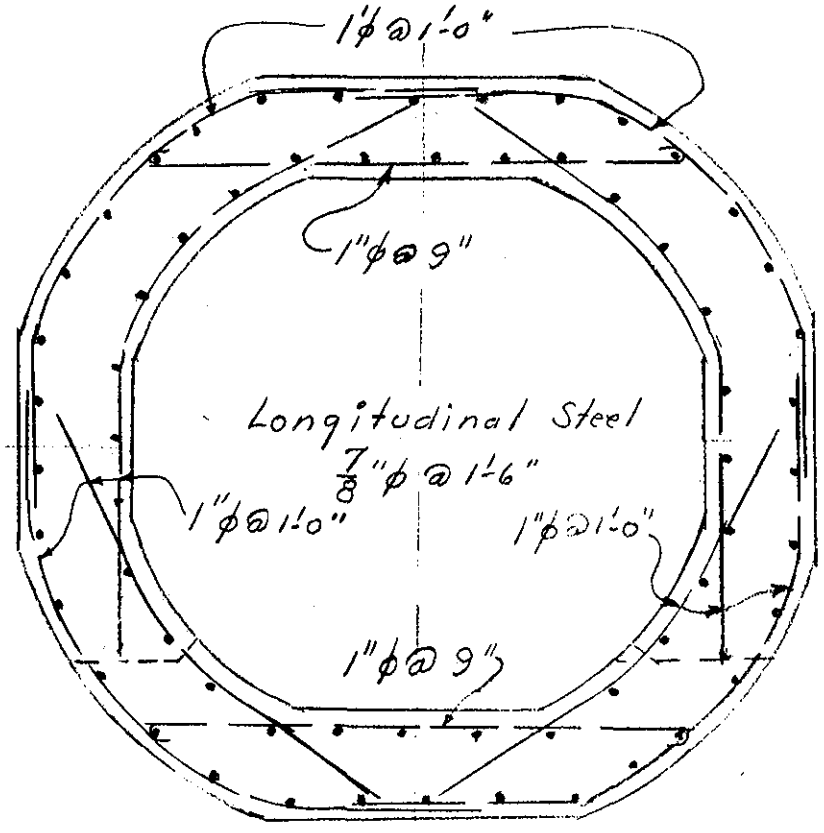
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of sections cont'd.

Max Unit Shear

$$v = \frac{14,140}{12 \times .88 \times 31.5} = 42.3 \#/\square''$$

$$u = \frac{14,140}{4.2 \times .88 \times 31.5} = 122 \#/\square''$$



Section D-D

Steel from Sta 16+48.5 to 16+57.5
" " Sta 16+57.5 to 16+66.0 1"φ @ 1'-0" for trans steel both faces

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

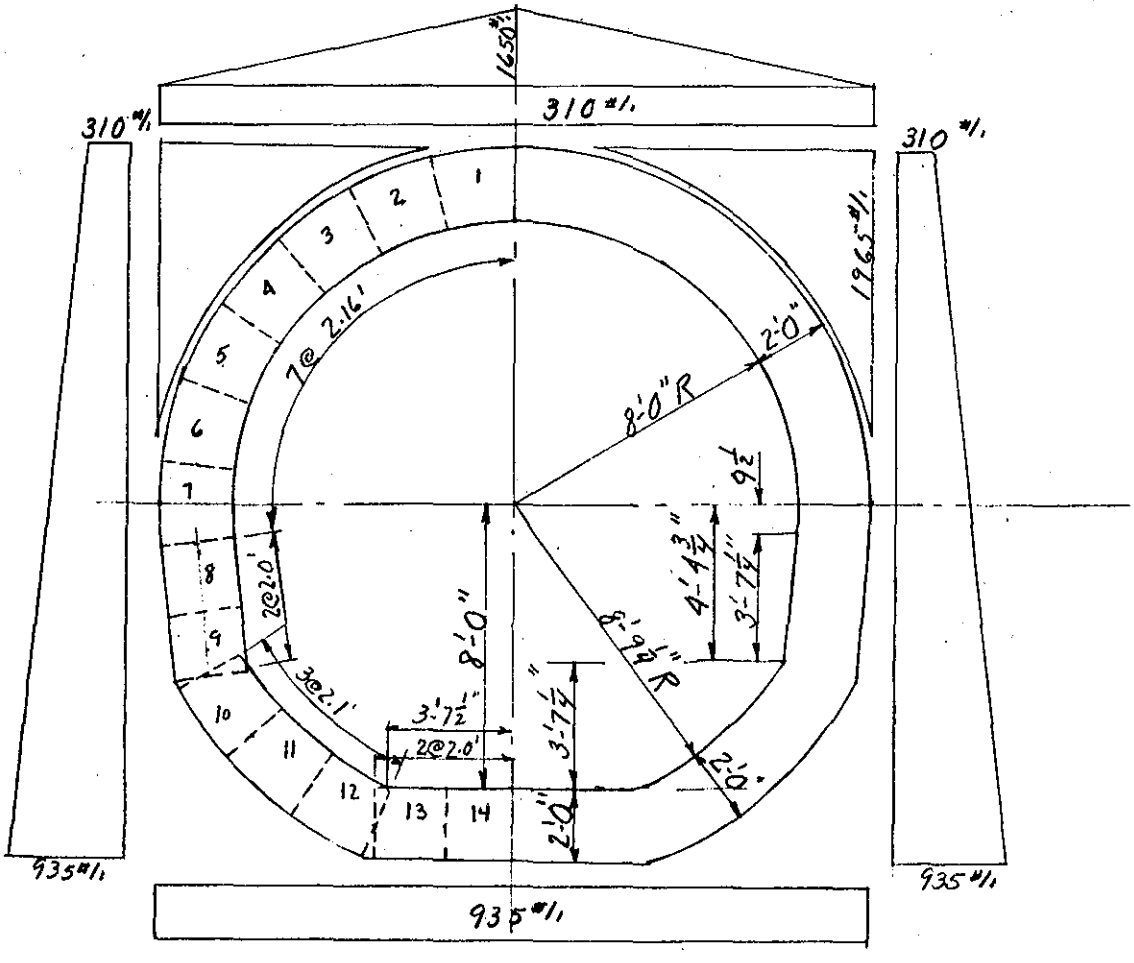
Subject Claremont Dam

Computation Outlet Portal

Computed by H.E.W. **Checked by** **Date** 11-Oct.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

A section at Sta. 25+35 will be analyzed for a loading of rock on roof and ground water assumed to be at El. 550.0



Loading

Wt. rock on roof crown = 10 × 165 = 1650 #/'

" water on roof crown = 10 × 31.25 = 310 #/'

Side thrust at El. 540 = 310 #/'

" at El 520 = 30 × 31.25 = 935 #/'

Uplift on base = 935 #/'

rock and water load on sloped surface of roof

10 × 31.5 + 10 × 165 = 1965 #/'

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Outlet Portal

Computed by: H.E.W. Checked by: Date: 11 Oct. 44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Vousoir No	Intensity of Vert. Load.	Horiz. Proj of Vous. Extrados	Vert. Load V	Vert. Load + weight Vousoir	Intensity of Horiz. Load	Vert. Proj of Vous. Extrados	Total Horiz Load h
1	1810	2.25	4070#	5720	315#	.35	110
2	1550	2.20	3410	4060	330#	.75	250
3	1400	2.00	2800	3450	370	1.40	520
4	1410	1.60	2260	2910	415	1.75	730
5	1570	1.15	1810	2460	475	2.00	950
6	1840	0.70	1290	1940	540	2.30	1240
7	2215	0.10	+220	870	610	2.25	1370
8	-680	0.25	-170	+430	740	2.00	1480
9	-740	0.25	-180	+420	815	2.00	1630
10	-815	1.50	-1220	-590	870	2.10	1830
11	-870	1.70	-1480	-850	915	1.50	1370
12	-915	2.20	-2010	-1380	935	1.25	1170
13	-935	2.00	-1870	-1270	0	0	0
14	-935	2.00	-1870	-1270	0	0	0
				+16900#			

16900# is equal to bearing pressure and will be assumed prop. distributed between vousoirs 10-14

Adj value Vousoir No 10 $= -590 - \frac{1.50}{9.40} \times 16{,}900 = -3290$

" " " No 11 $= -850 - \frac{1.70}{9.40} \times 16900 = -3910$

" " " No 12 $= -1380 - \frac{2.20}{9.40} \times 16900 \quad -5340$

" " " No 13 $= -1270 - \frac{2.00}{9.40} \times 16900 \quad -4860$

" " " No 14 $= \quad -4860$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Outlet Portal

Computed by H E W. Checked by Date 12 Oct. 44

	Given				Derived				Vertical Load			Horiz. Load			Cantilever M					Final Moment				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No	ds	d	x	y_1	a	ay_1	y	ay^2	v	Σv	$x_n - x_{n-1}$	h	Σh	$y_n - y_{n-1}$	Vert	Horiz	m	ma	may	m+M	Hxy	Mom.	Thrust	Shear
1	2.16	2.00	-1.12	-0.05	0.270	-0.01	+9.31	23.40	5.72	+5.72	-1.98	0.11	0.11	-0.45	-1.41	-0.01	-1.42	-0.4	-3.7	+79.0	-45.3	+33.7	5.4	1.5
2	2.16	2.00	-3.10	-0.50	0.270	-0.14	+8.86	21.19	4.06	+9.78	-1.95	0.25	0.36	-1.00	-12.73	-0.06	-12.79	-3.5	-31.0	+69.9	-43.1	+26.8	8.3	3.4
3	2.16	2.00	-5.05	-1.50	0.270	-0.41	+7.86	16.68	3.45	+13.23	-1.65	0.52	0.88	-1.45	-31.80	-0.42	-32.22	-8.7	-68.4	+50.5	-38.3	+12.2	11.1	5.3
4	2.16	2.00	-6.70	-2.95	0.270	-0.80	+6.41	11.09	2.91	+16.14	-1.25	0.73	1.61	-1.75	-53.63	-1.70	-55.33	-14.9	-95.5	+27.4	-31.2	-3.8	12.9	8.1
5	2.16	2.00	-7.95	-4.70	0.270	-1.27	+4.66	5.86	2.46	+18.60	-0.80	0.95	2.56	-2.00	-73.81	-4.52	-78.33	-21.1	-98.3	+4.4	-22.7	-18.3	16.2	6.8
6	2.16	2.00	-8.75	-6.70	0.270	-1.81	+2.66	1.91	1.94	+20.54	-0.25	1.24	3.80	-1.95	-88.69	-9.64	-98.33	-26.5	-70.5	-15.6	-13.0	-28.6	18.7	6.3
7	2.16	2.00	-9.00	-8.65	0.270	-2.34	+0.71	0.14	0.87	+21.41	+0.15	1.37	5.17	-2.15	-93.83	-17.05	-110.88	-29.9	-21.2	-28.2	-3.5	-31.7	20.2	5.8
8	2.00	2.00	-8.85	-10.80	0.250	-2.70	-1.44	0.52	0.43	+21.84	+0.15	1.48	6.65	-2.00	-90.62	-28.17	-118.79	-29.7	+42.8	-36.1	+7.0	-29.1	20.9	5.6
9	2.00	2.00	-8.70	-12.80	0.250	-3.20	-3.44	2.96	0.42	+22.26	+0.70	1.63	8.28	-1.85	-87.34	-41.47	-128.81	-32.2	+110.8	-46.1	+16.8	-29.3	21.5	5.5
10	2.10	2.00	-8.00	-14.65	0.263	-3.85	-5.29	7.36	-3.29	+18.97	+1.40	1.83	10.11	-1.65	-71.76	-56.79	-128.55	-33.8	+178.8	-45.9	+25.8	-20.1	20.5	4.8
11	2.10	2.00	-6.60	-16.30	0.263	-4.29	-6.94	12.67	-3.91	+15.06	+1.80	1.37	11.48	-1.20	-45.20	-73.47	-118.67	-31.2	+216.5	-36.0	+33.8	-2.2	17.8	4.2
12	2.10	2.00	-4.80	-17.50	0.263	-4.60	-8.14	17.43	-5.34	+9.72	+1.80	1.17	12.65	-0.50	-18.09	-87.25	-105.34	-27.7	+225.5	-22.6	+39.6	+17.0	7.8	12.5
13	2.00	2.00	-3.00	-18.00	0.250	-4.50	-8.64	18.66	-4.86	+4.86	+2.00	0	12.65	0	-0.59	-93.57	-94.16	-23.5	+203.0	-11.5	+42.1	+30.6	7.8	7.4
14	2.00	2.00	-1.00	-18.00	0.250	-4.50	-8.64	18.66	-4.86	—	—	0	12.65	—	+9.13	-93.57	-84.44	-21.1	+182.3	-1.7	+42.1	+40.4	7.8	2.5
					3.679	-34.42		158.53										-304.2	+771.1					

$$\frac{\Sigma ay_1}{\Sigma a} = \frac{-34.42}{3.679} = -9.36$$

$$M = -\frac{\Sigma ma}{\Sigma a} = -\frac{-304.2}{3.679} = +82.7$$

$$H = \frac{\Sigma may}{\Sigma ay^2} = -\frac{+771.1}{158.53} = -4.87$$

Mom. at crown $= m + M + Hy = 0 + 82.7 - 4.87 \times 9.36 = 37.1$

Mom. at invert $= -80.0 + 82.7 - 4.87 \times -8.64 = 44.8$

Subject Claremont Dam.
Computation Outlet Portal
Computed by H.E.W. **Checked by** **Date** 13 Oct. 44

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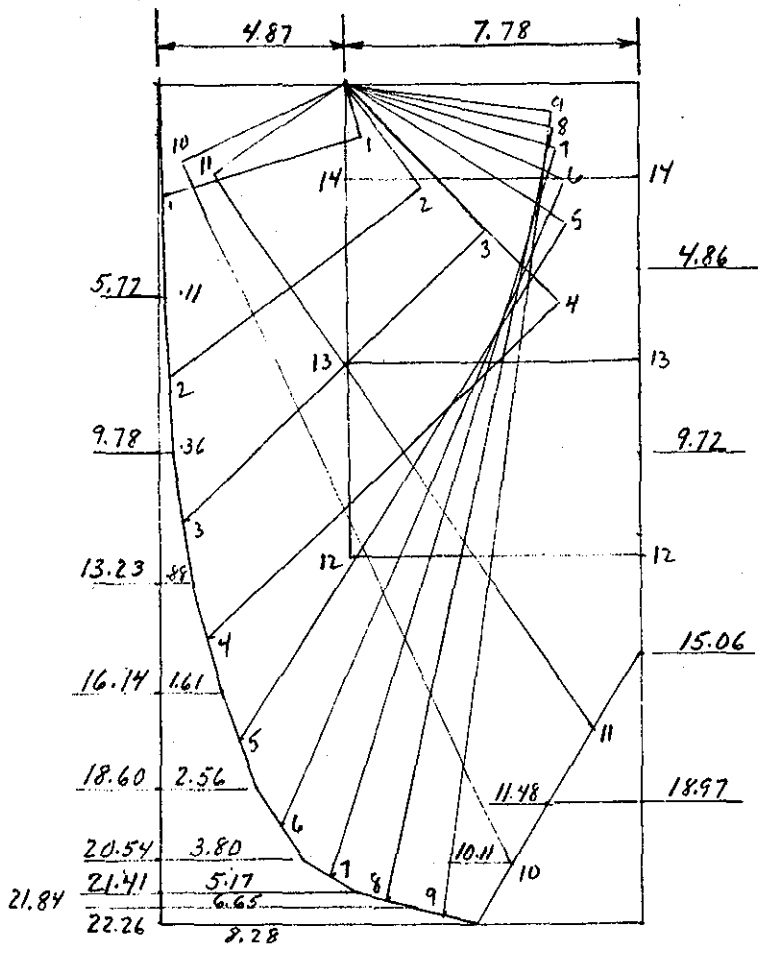

Force Diagram

Temperature Changes

It will be assumed that there will be a 30° rise and fall in the temp.

$$H = \frac{Ebe'L}{12\,\Sigma ay^2} = \frac{3000 \times 144 \times 30 \times .000006 \times 1 \times 9}{12 \times 158.53} = .368$$

Mom. at any pt = $\pm$ 0.368y

Subject: Claremont Dam
Computation: Outlet Portal
Computed by: H.E.W. Checked by: Date: 14-Oct.-44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Design of Section

Section at Crown

$M = 37.1 + .368 \times 936 = 40.5^K$

Thrust $N = 5.4 + .4 = 5.8^K$

$b = 12''$ $d = 19.5''$ $d'' = 7.5''$ $e = \frac{40,500 \times 12}{5,800} + 7.5 = 91.5''$

$\frac{e}{d} = \frac{91.5}{19.5} = 4.69$ Try $1''\phi$ @ $6''$ cc $= 1.58$

Assume $j = .88$ then from Table 10 $i = 1.23$

$m = q = \frac{12 \times 1.58 \times 1.23}{12 \times 19.5} = .10$

From Table 11 $k = .360$ then actual $j = .88$
and $i = 1.23$

$f_s = \frac{5800 \times 4.69}{.88 \times 1.58 \times 1.23} = 15,900$ #/□"

$f_c = \frac{15,900}{12} \times \frac{.36}{.64} = 745$ #/□"

Use $1''\phi$ @ $6''$ cc

Section at Vousoir No. 7

$M = 31.7 + .368 \times .71 = 32.0^{'K}$

$N = 20.2 + .368 \times .6 = 20.4^K$

$b = 12''$ $d = 19.5''$ $d = 7.5''$ $e = \frac{32000 \times 12}{20,400} + 7.5 = 26.3''$

$\frac{e}{d} = \frac{26.3}{19.5} = 1.35$ Assume $1''\phi$ @ $1'-0''$ cc $A_s = .79$

Assume $j = .86$ then $i = 2.75$

$m = q = \frac{12 \times .79 \times 2.75}{12 \times 19.5} = .111$

From Table 11 $k = .372$ then $j = .876$ and $i = 2.855$

$f_s = \frac{20,400 \times 1.35}{.876 \times .79 \times 2.855} = 14000$ #/□"

$f_c = \frac{14000}{12} \times \frac{.372}{.628} = 690$ #/□"

Subject Claremont Dam

Computation Outlet Portal

Computed by H.E.W. **Checked by** **Date** 14 Oct. 44

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Section at Invert

$M = 44.8 + 3.68 \times 8.64 = 48^K$

$N = 7.8 + .4 = 8.2^K$

$b = 12''$ $d = 19.5''$ $d' = 7.5''$ $e = \frac{48000 \times 12}{8,200} + 7.5 = 77.5''$

$\frac{e}{d} = \frac{77.5}{19.5} = 3.97$ Try 1"⊄ @ 6" cc $A_s = 1.58$

Assume $j = .88$ then $i = 1.28$

$m = q = \frac{12 \times 1.58 \times 1.28}{12 \times 19.5} = .104$

From Table 11 $k = .365$ $j = .878$ then $i = 1.28$

f_s $\frac{8200 \times 3.97}{.878 \times 1.58 \times 1.28} = 19000$ #/□"

f_c $\frac{19000}{12} \times \frac{.365}{.635} = 910$ #/□"

} OK as loading assumptions are severe

Investigation for shear

$v = \frac{12,500}{12 \times .88 \times 19.5} = 60$ #/□"

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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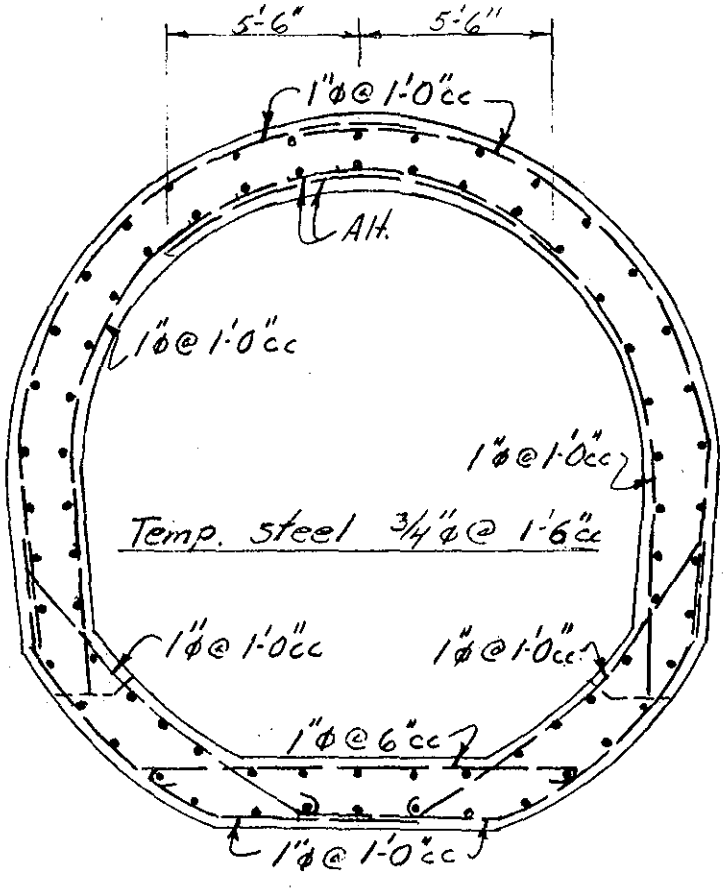
Subject: Claremont Dam

Computation: Outlet Portal

Computed by: H.E.W. Checked by: Date: 14 Oct. 44

U. S. GOVERNMENT PRINTING OFFICE 2—10528



Typical Section Thru Outlet Transition

Subject: Claremont Dam
Computation: Operating House - Equipment Loads
Computed by: H.E.W. Checked by: Date: 9-Aug-44

U.S. GOVERNMENT PRINTING OFFICE 3—10528

The following equipment loads furnished by the Mechanical Section will be used in the design of the superstructure and floors of the Operating House.

Weight of service gate hoists -	15000#
Capacity of service gate hoists -	150000#
Capacity of traveling crane	120,000#
Weight of service gates	20,000#
Weight of emergency gate	20,000#
Weight of standby unit	4500#
Maximum Stationary Wheel load of Crane -	74000#
Maximum mobile wheel load of crane -	41000#
Center to center dist. between truck wheels -	12'-9"
Weight of crane trolley	25000#
90# A.S.C.E. rail	
El. top of crane rail	671.5

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM

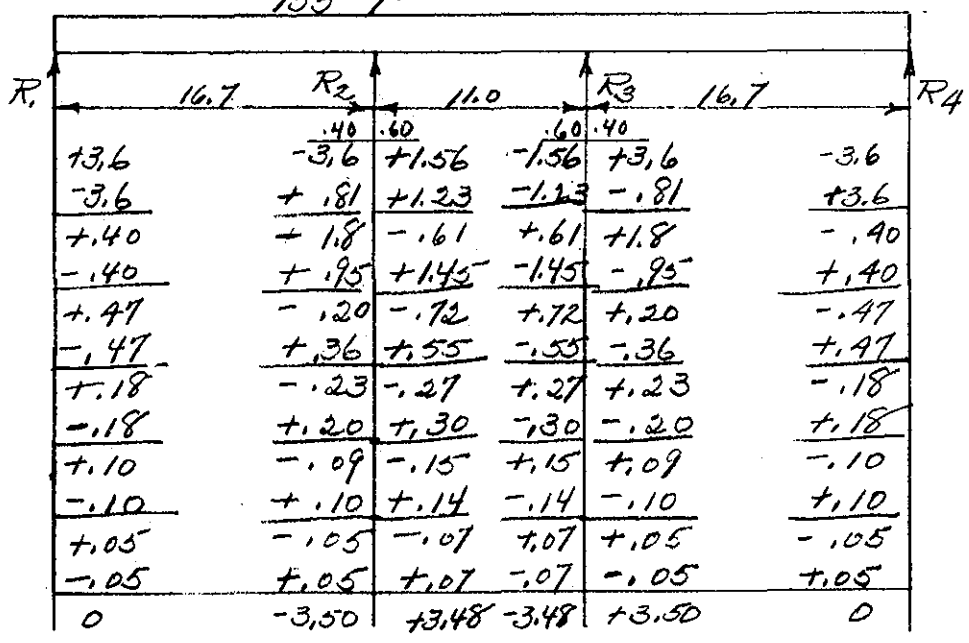
Computation: OPERATING HOUSE - ROOF SLAB

Computed by: D. M. Checked by: Date: 9 AUG. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

DL. 6" slab 80#/□'; 4" cinder concrete 30#/□', Roofing 5#/□ L.L = 40#/□

155#/'



+3.6	-3.6	+1.56	-1.56	+3.6	-3.6
-3.6	+.81	+1.23	-1.23	-.81	+3.6
+.40	-1.8	-.61	+.61	+1.8	-.40
-.40	+.95	+1.45	-1.45	-.95	+.40
+.47	-.20	-.72	+.72	+.20	-.47
-.47	+.36	+.55	-.55	-.36	+.47
+.18	-.23	-.27	+.27	+.23	-.18
-.18	+.20	+.30	-.30	-.20	+.18
+.10	-.09	-.15	+.15	+.09	-.10
-.10	+.10	+.14	-.14	-.10	+.10
+.05	-.05	-.07	+.07	+.05	-.05
-.05	+.05	+.07	-.07	-.05	+.05
0	-3.50	+3.48	-3.48	+3.50	0

$155 \times 16.7 \times 16.7/12 = 3.60$

$155 \times 11 \times 11/12 = 1.56$

$11 \times 2.04/27.7 = 0.81$ $\quad$ $.5 \times 11/27.7 = .20$

$16.7 \times 2.04/27.7 = 1.23$ $\quad$ $.5 \times 16.7/27.7 = .30$

$11 \times 2.41/27.7 = .95$ $\quad$ $.24 \times 11/27.7 = 0.10$

$16.7 \times 2.41/27.7 = 1.45$ $\quad$ $.24 \times 16.7/27.7 = 0.14$

$.92 \times 11/27.7 = .36$ $\quad$ $.12 \times 11/27.7 = 0.05$

$.92 \times 16.7/27.7 = .55$ $\quad$ $.12 \times 16.7/27.7 = 0.07$

Moments at R_2

$16.7 R_1 - 155 \times 16.7^2/2 + 3500 = 0$ $\quad$ $R_1 = 1080\# = R_4$

Moments at R_3

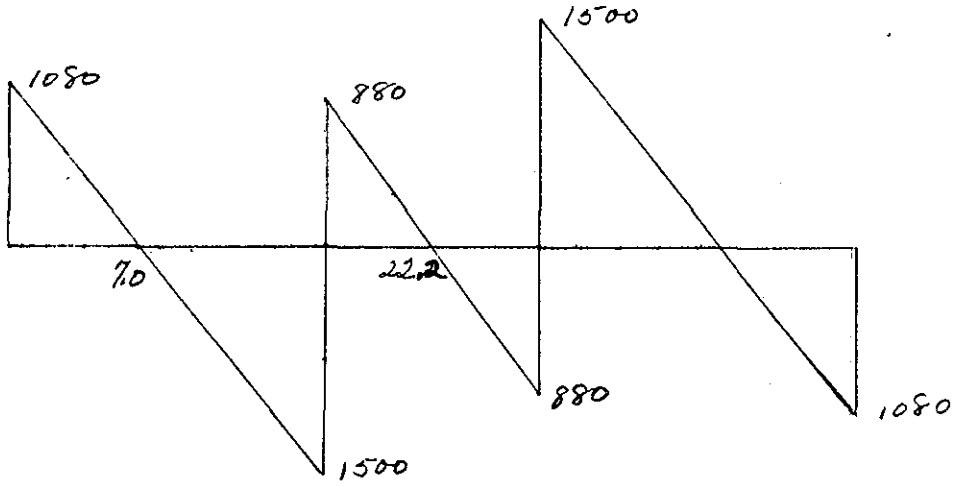
$1080 \times 27.7 + 11 R_2 - 155 \times 27.7^2/2 + 3500 = 0$ $\quad$ $R_2 = 2380 = R_3$

Subject CLAREMONT DAM
Computation OPERATING HOUSE - ROOF SLAB
Computed by D.M. **Checked by** **Date** 9 AUG. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10638

Cont. from P. 1

Shear



$M_{7.0} = 1080 \times 7 - 155 \times 49/2 = 3770'^{\#}$

$M_{22.2} = 1080 \times 22.2 + 2380 \times 5.5 - 155 \times 22.2^2/2 = -1100'^{\#}$

req. $d = \sqrt{\frac{M \times 12}{12 \times K}} = \sqrt{3770/123} = \sqrt{30.6} = 5.5''$

Make slab 7" thick

$v = \frac{V}{bjd} = \frac{1500}{12 \times 5.7 \times .884} = 25^{\#}/\square''$

$A_s = \frac{M \times 12}{f_s jd} = \frac{3770 \times 12}{18000 \times .884 \times 5.7} = 0.50 \square''$

Use $\frac{5}{8}''\phi$ 7" c.c.

$u_0 = \frac{V}{\Sigma O \times jd} = \frac{1500}{1.96 \times 1.7 \times .884 \times 5.7} = 90^{\#}/\square''$

$A_t = .0025 \times 7.0 \times 12 = 0.21 \square''$ Use $\frac{1}{2}''\phi$ 12" C.C.

Bend Points

Design O.K. for $163^{\#}/\square$ actual load

$1500x - 155\frac{x^2}{2} - 3500 = 0 \quad x = 2.7'$

$880x - 77.5x^2 - 3500 = 0 \quad x = a\sqrt{-1}$

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

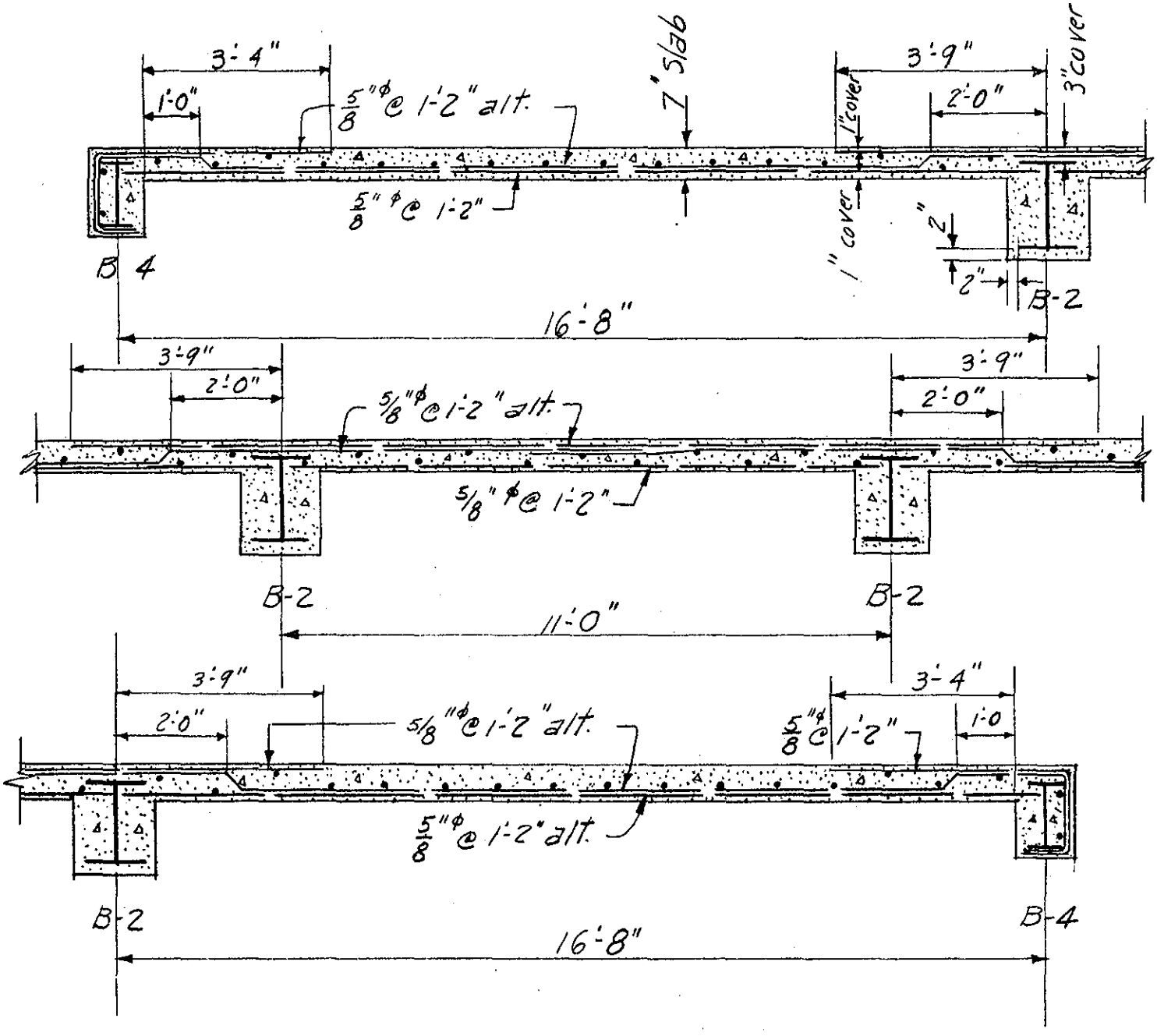
Page 158

Subject CLAREMONT DAM

Computation OPERATING HOUSE

Computed by D. M. & E. H. Checked by Date 29 AUG. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10535



ROOF SLAB

SCALE 3/8" = 1'-0"

WAR DEPARTMENT

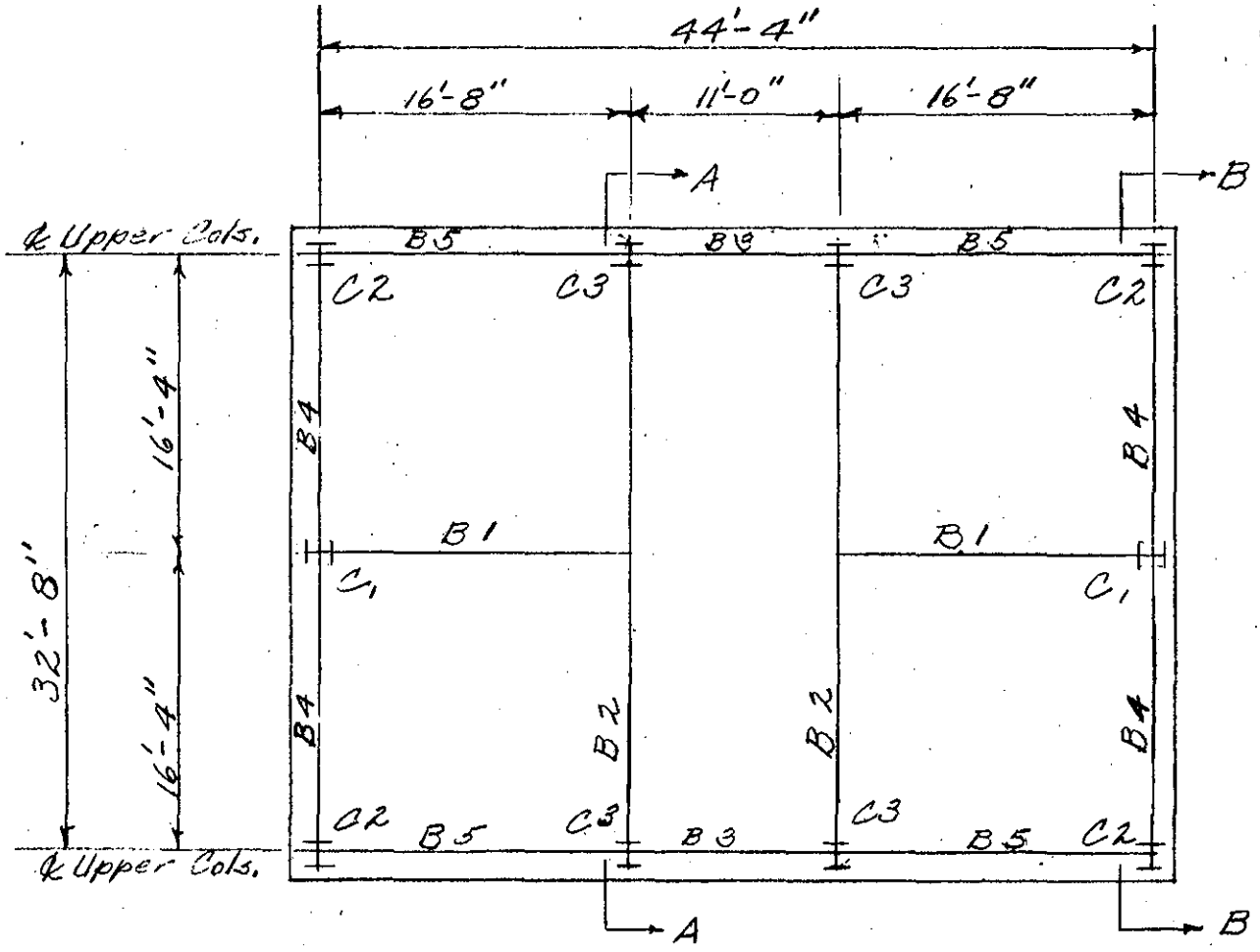
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject CLAREMONT DAM

Computation OPERATING HOUSE - Roof Beams

Computed by D. M. **Checked by** N.E.W. **Date** 8 AUG. 1944.

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Roof is to Consist of 1. Flat Concrete Slab 2. 4" Cinder Concrete 3. 4 Ply Tar + Gravel Roof.

Dead Load

7" Concrete Slab 150 #/cu.'	88 #/□'
4" Cinder Concrete @ 90 #/cu'	30 #/□'
4 Ply Tar + Gravel Roof	5 #/□'
Total	123 #/□'

Live Load - 40 #/□'

Wind Load - 20 #/□'

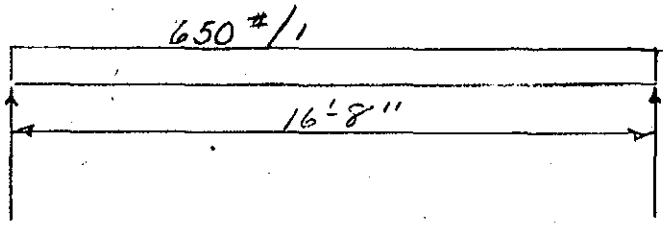
Project CLAREMONT DAM

Computation OPERATING HOUSE - Roof Beams

Computed by D. M. Checked by H.P.W. Date 10 AUG. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

B-5



Parapet Wall = 510#
Concrete around Beam + Beam = 140#
Total 650#

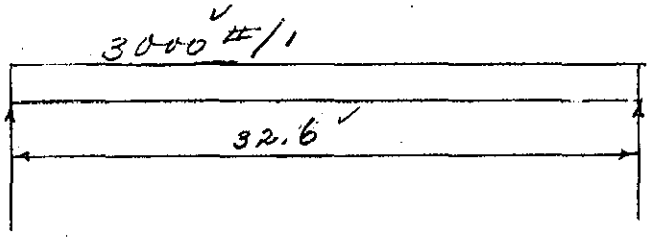
$$S = \frac{M}{f} = \frac{650 \times 16.7 \times 16.7 \times 12}{8 \times 20000} = 13.60$$

Try 8" WF 21# S = 18.0 I = 73.8

$$d = \frac{5}{384}\frac{wl^4}{EI} = \frac{5 \times 650 \times 16.7 \times 16.7^3 \times 12^3}{384 \times 30000000 \times 73.8} = 0.55 < .56, \text{ OK}$$

B5 Use 8" WF 21 #/'
B1 + B3 Use 8" WF 17 #/'

B-2



2380 x 16 3/15 = 2500 R_2 P Corr. Reaction
Wt Bm + Fireproofing = 500 D.L. B2
3000

Subject CLAREMONT DAM

Computation OPERATING HOUSE - Roof Beams

Computed by D. M. Checked by H.C.M. Date 10 AUG. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

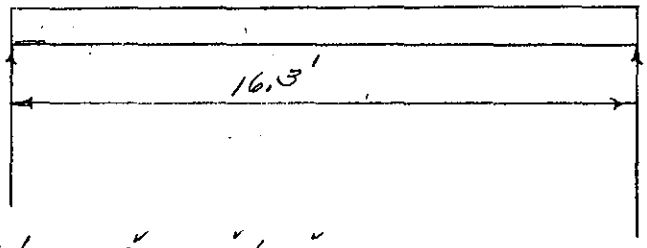
$$S = \frac{M}{f} = \frac{3000 \times 32.6 \times 32.6 \times 12}{8 \times 20000} = 240$$

Try 24" WF 100 $S = 278.9$ $I = 2987.3$

$$d = \frac{3000 \times 32.6 \times 32.6^3 \times 12^3 \times 5}{384 \times 30000000 \times \cancel{3315}\ 2987} = 0.\cancel{77}\ 85'' < 1.09'' \text{ OK}$$

Use 24" WF 100# B2

B4



$R_L = 1850 \times \frac{16.3}{2} = 15080^{\#}$

Load/1 $1080 \times 16.3/153$ = 1140

Parapet ~~700~~ 510

Beam + Concrete around Beam ~~250~~ 200

~~2090~~ 1850 #/1

$$S = \frac{M}{f} = \frac{\cancel{2100}\ 1850 \times 16.3 \times 16.3 \times 12}{8 \times 20000} = \cancel{42.0}\ 37.0$$

Try 14" WF 34 $S = 48.5$ $I = 339.2$

$$d = \frac{5 \times \cancel{2100}\ 1850 \times 16.3 \times 16.3^3 \times 12^3}{384 \times 30000000 \times 339.2} = 0.33''\ \text{O.K.}$$

Use 14" WF 34# B4

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

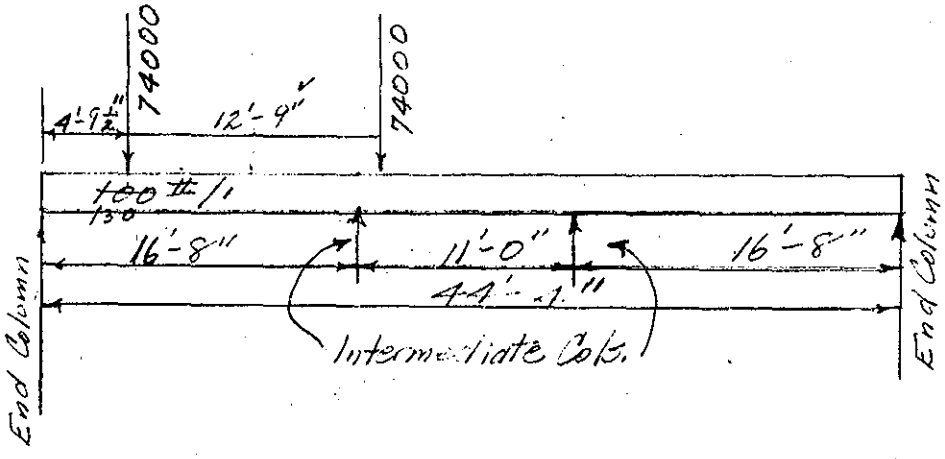
Project: CLARKEMONT DAM

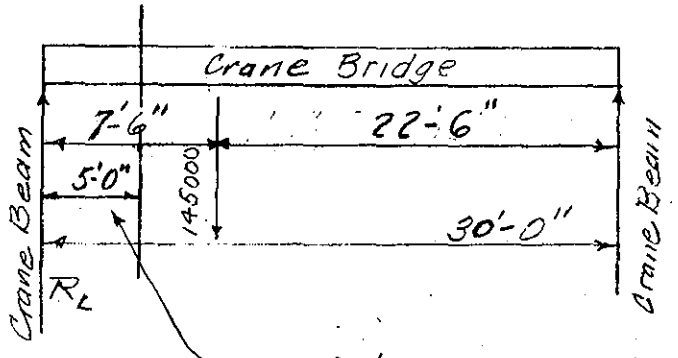
Computation: OPERATING HOUSE - Crane Beams

Computed by: D.M. Checked by: W.2.W. Date: 12 AUG 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10598

Max. Moment Position of Crane for 60 Ton Load





Wgt. of Trolley	25000
Load	120000
Max Wheel Load	80000
Deduct 2.5 x 72000/30	6000
Corr. Max Wheel Load	74000

Manufacturers max wheel load = 80,000# when located 5'-0" from crane rail
Reduced wheel load when load located at center of Emergency Well

Assume

1. Crane Beam	~~70~~ 100 #/'
2. Crane Rail	30 #/'
Total	~~100~~ 130 #/'

$$M = 74000 \times \frac{11.9}{16.7} \times 4.8 + \cancel{100}\,130 \times \frac{16.7}{2} \times 4.8 = \cancel{257000}\ 258\,300''\#$$

$$S = \frac{M}{f} = \frac{\cancel{257000}\ 258\,300 \times 12}{19400} = 160 \qquad \frac{b}{6} = \frac{16.7 \times 12}{12} = 16.7$$

Allow. f = 19400 #/□"

Try 24" WF 100 #

Subject: CLAREMONT DAM

Computation: OPERATING HOUSE - Crane Beams

Computed by: D.M. Checked by: H.P.W. Date: 21 Aug 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Max. f for 25000# Mobile Load

Corrected Max. Wheel Load

$$80000 - (60000 - 12500) \times \frac{25}{30} = 41000^{\#}$$

Max. f occurs when

1. Max Wheel Load	= 41000#	One Wheel	
2 Impact Load	= 10000#	One Wheel	25%
3 Lateral Load	= 1250#	One Wheel	0.05% lifted load

Bending Moment

Beam $150 \times 16.7 \times 16.7/8 = 5300^{\prime\#}$

Wheel Load + Impact $51000 \times 16.7/4 = 213000^{\prime\#}$

B.M. Lateral Load $1250 \times 16.7/4 = 5200^{\prime\#}$

~~Try 21" WF 112~~

S_x Corrected for deduction of 2 - $\frac{7}{8}$" holes

$$I_y = \overset{2987.3}{2620.6} - 2 \times \overset{0.775}{0.875} \times 0.875 \times \overset{11.61^2}{\cancel{10.067}}\,2 = \overset{2804}{\cancel{2467}}$$

$$\text{C.G. Change} = (2 \times 0.875 \times \overset{.775}{\cancel{0.865}} \times \overset{11.61}{10.07}) / [\overset{29.43}{32.93} - (2 \times 0.875 \times \overset{.775}{\cancel{0.865}})] = \overset{.56}{\cancel{0.48}}''$$

$$\text{Corrected } I_0 = \overset{2804}{\cancel{2467}} - \overset{29.43}{31.42} \times \overset{.56^2}{0.48^2} = \cancel{2460}\ 2795$$

$$\text{Corrected } S_y = \overset{27.95}{\cancel{2460}} / \overset{12.56}{\cancel{10.98}} = \overset{222}{\cancel{224}}$$

$$S_y = I_y / y = \overset{17.0}{\cancel{22.3}} - (2 \times \overset{.775}{\cancel{0.865}} \times 0.875 \times 4^2) / \underset{6}{\cancel{6.5}} = \overset{13.4}{\cancel{18.6}}$$

$$f = \frac{218000 \times 12}{\underset{222}{\cancel{224}}} + \frac{5200 \times 12}{\underset{13.4}{\cancel{18.6}}} = \overset{11,810}{\cancel{11700}} + \overset{4700}{3400} = \overset{16,500}{\cancel{15400}}\ \#/\square''$$

<u>Use 24" WF 100#</u> 12" flange required for rail connection

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM

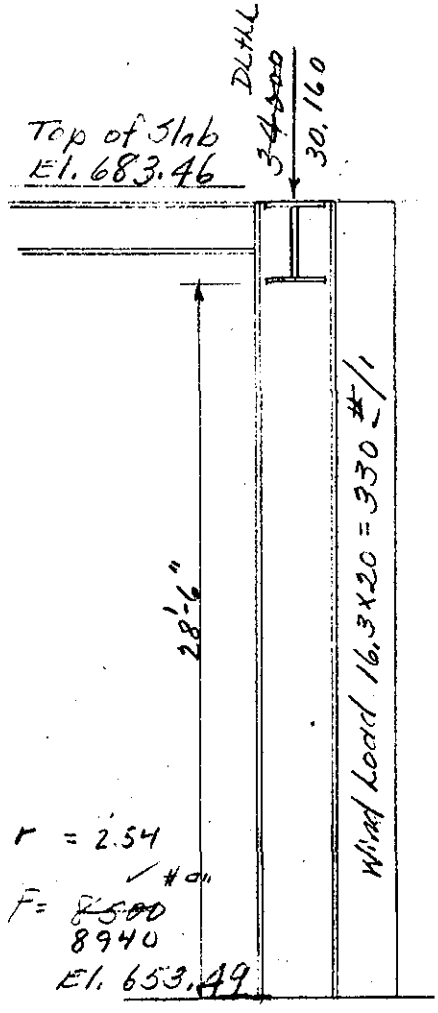
Computation: CONTACTING HOUSE - Steel Columns

Computed by: D. M. Checked by: N.E.M. Date: 16 AUG 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

C1

Wind Load 20#/□'
Assume Column supported over entire length.
During construction column may be unsupported and be loaded with roof slab + live load.



Try 10" WF @ 49#
S = 54.6 A = 14.4 r = 2.54

$\frac{L}{r} = \frac{\cancel{360}\ 342}{2.54} = \cancel{142}\ 135$ ✓ Allowable F = ~~8500~~ 8940 ✓ #□"

$F = \frac{\cancel{34000}\ 30,160}{14.4} + \frac{330 \times \cancel{30.0}\ 28.5 \times \cancel{30.0}\ 28.5 \times 12}{54.6 \times 8}$

$= \cancel{2360}\ 2090 + \cancel{8100}\ 7360 = \cancel{10500}\ 9450$ #/□"

O.K Use 10" WF @ 49#

Subject CLAREMONT DAM

Computation OPERATING HOUSE - Steel Columns

Computed by D.M. **Checked by** H.E.W. **Date** 17 AUG 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

C-3

D.L. B-3 and B-5

$(5.5+8.3) \times 650 = 9000^{\#}$

D.L B2

$\left(\frac{123}{163} \times 2500\right) \times 16.0 + 16.0 \times 450 = 37400^{\#}$

L.L. B2

$16.0 \times 40 \times 2500/163 = 9800$

Lateral Thrust 20000# Mobile Crane Load

$20000 \times .05 \times (1 + 3.9/16.7) = 1300^{\#}$

Vertical Load on Column 25000# Mobile Crane Load

$51000 \times (1 + 3.9/16.7) = 63000^{\#}$

Load on Column 60T Crane Load

$74000 \times 10.1/11 + 74000 \times 4.8/16.7 = 90000^{\#}$

Subject: Clarkemont Dam

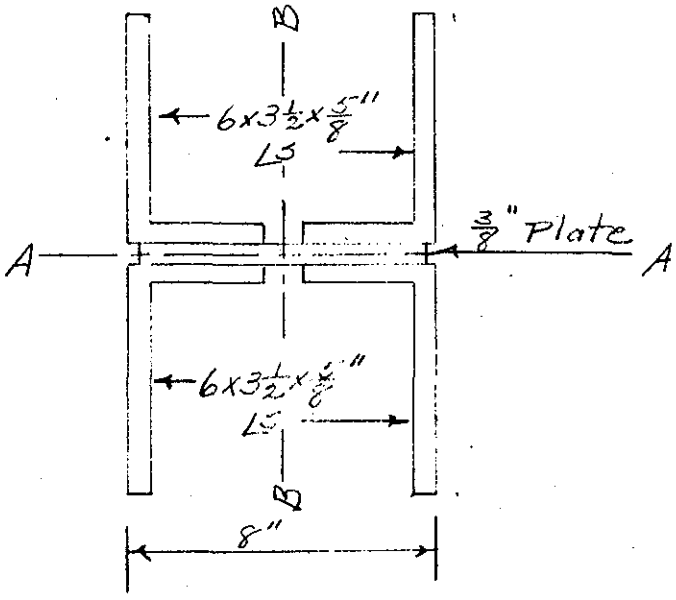
Computation: Overhang Loads - Steel Columns

Computed by: D.M. Checked by: H.C.M. Date: 29 Aug 1941

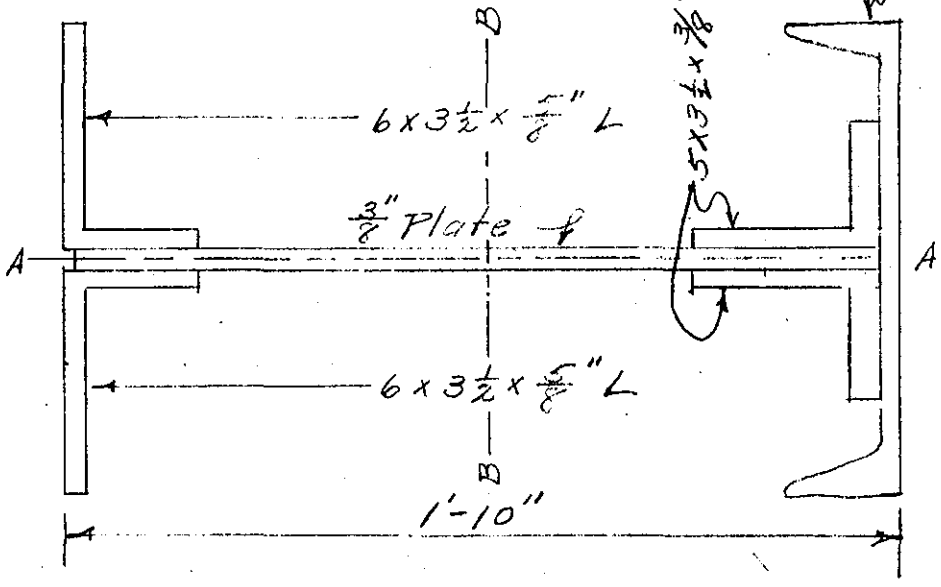
U. S. GOVERNMENT PRINTING OFFICE 3—10528

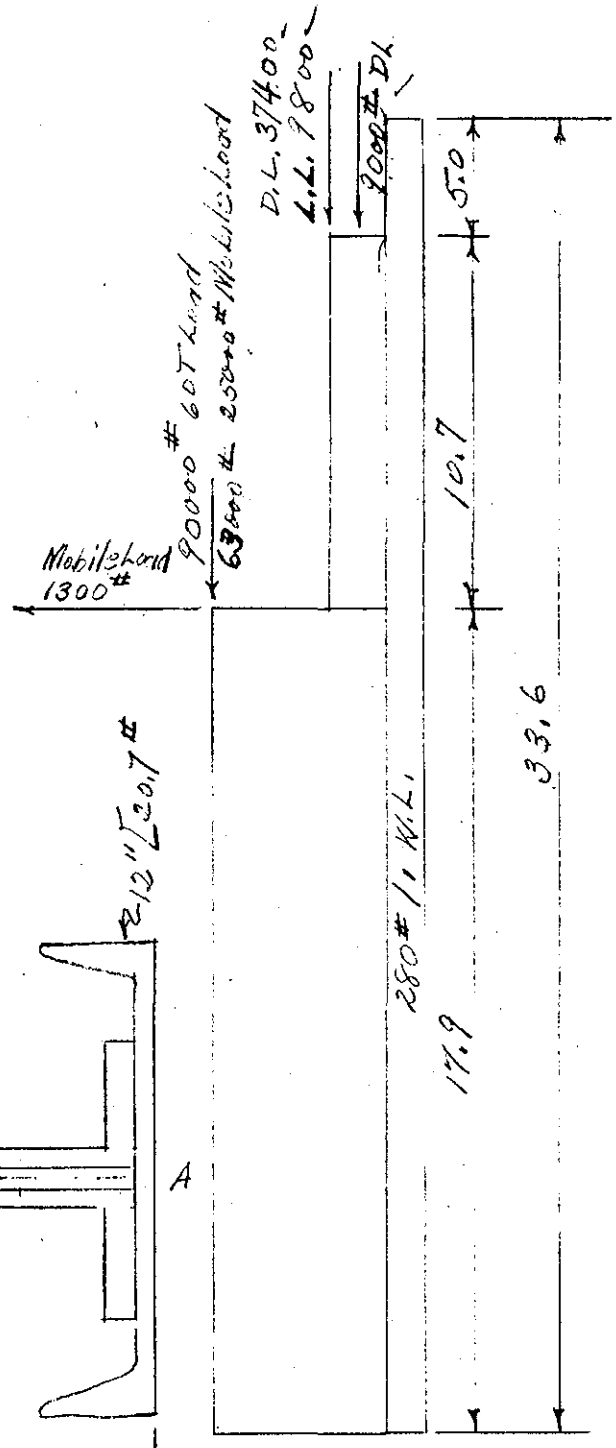
C-3 (cont.)

Top Section



Bottom Section





Subject: CLAREMONT DAM
Computation: OPERATING HOUSE - Steel Columns
Computed by: D.M. Checked by: H.E.N. Date: 25 AUG 1944

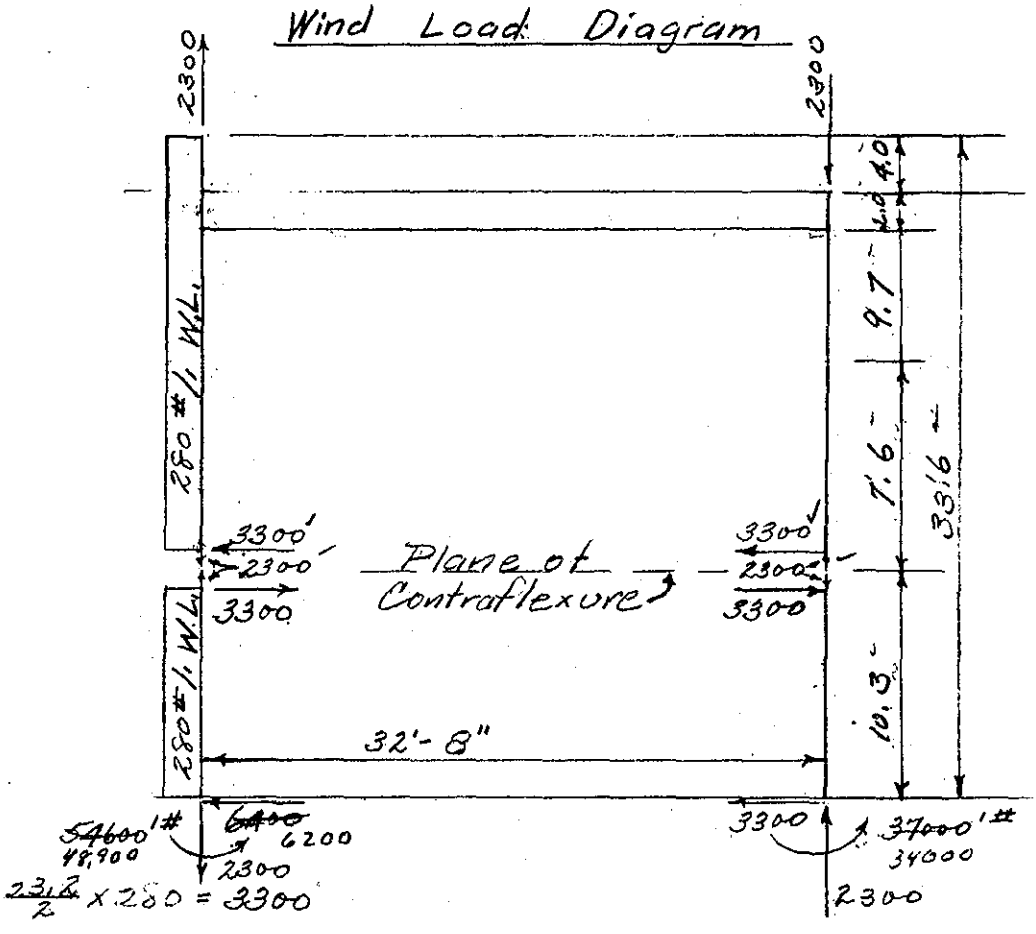
U. S. GOVERNMENT PRINTING OFFICE 3—10532

C-3 (cont.)

Assumptions

Point of contraflexure $\frac{3}{8}$ distance, column base to bottom of roof beam.
H. Reactions at points of contraflexure are equal
Columns fixed top + bottom.

Wind Load Diagram



$\frac{23.2}{2} \times 280 = 3300$

$280 \times 23.2 \times 11.6 = 32.7R \ldots \quad R = 2300$

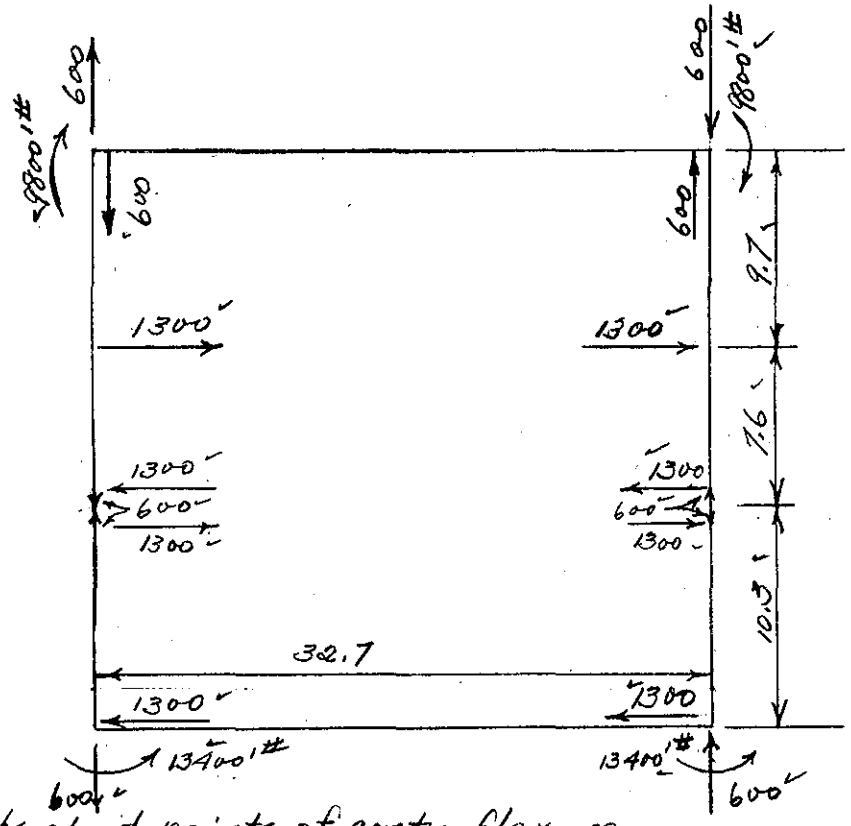
~~B.M. = 18.3 × 3300 = 60000 '#~~
B.M at top of leeward col. = $17.3 \times 3300 = 57,100$ '#
B.M at bot. of leeward col = $10.3 \times 3300 = 34000$ '#
B.M at bot of windward col. = $10.3 \times 3300 + 280 \times \frac{10.3^2}{2} = 48,900$ '#
H at base = $3300 + 280 \times 10.3 = 6200$ #

Subject: CLAREMONT DAM
Computation: OPERATING HOUSE - Steel Columns
Computed by: D.M. Checked by: HEW Date: 25 Aug. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10538

C-3 (cont)

Lateral thrust of Crane



Moments about points of contraflexure

$2600 \times 7.6 = 32.7\, V_1 \qquad V_1 = V_2 = 600^{\#}$

Mom. at roof beam = $1300 \times 17.3 - 1300 \times 9.7 = 9800'^{\#}$
" at base = $1300 \times 10.3 = 13{,}400'^{\#}$

C-3 (cont.)

Top Portion

For design of step columns, Civil Engineering Handbook by Urquhart used

$$f = \frac{P}{A} + \frac{M}{S}$$

$$24000 = 4000 + \frac{840000 + 187000}{S}$$

$$S = 56 \text{ App.}$$

$$\frac{I}{4} = 56 \quad I = 224 \quad \text{App.}$$

Try $\frac{3}{8}$" Web + 4 - 6 x $3\frac{1}{2}$ x $\frac{5}{8}$" LS

$$I_{A/B} = 4 \times 5.1 + 4 \times 5.55 \times 3.12^2 + \frac{3}{8} \times 7.5^3/12$$

$$= 20.4 + 216 + 13.1 = 249.5$$

$$I_{B/A} = 4 \times 20.1 + 4 \times 5.55 \times 2.32^2 + 0.03 =$$

$$80.4 + 119.5 + 0.03 = 200$$

Area of Section

$$4 \times 5.55 = 22.2$$

$$7.5 \times \frac{3}{8} = 2.8$$

$$25.0$$

$$S_B = \frac{249.5}{4} = 62.4$$

$$r = \sqrt{\frac{200}{25.0}} = 2.82 \qquad \frac{l}{r} = \frac{120}{2.82} = 42.6$$

$$f = 16100 \text{ Allow.}$$

Allow. f with wind = 16,100 x 1.33 = 21,400 #/□"

f due to direct load 56200/25.0 = 2250

f due to eccentric load 47200 x 4/62.4 = 3000

f due to Crane thrust 9800 x 12/62.4 = 1900

Total 7150 #/□"

f due to Wind load 57,100 60,000 x 12/62.4 = 11000 7100 18150 18100 #/□"

Use $\frac{3}{8}$" Web + 4 - 6 x $3\frac{1}{2}$ x $\frac{5}{8}$" LS Column above Crane Beam

Subject: CLAREMONT DAM
Computation: OPERATING HOUSE - Steel Columns
Computed by: D.M. Checked by: H.R.N. Date: 18 Aug 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

C-3 (cont.)

Bottom Portion

Try $\frac{3}{8}$" web, 2-6x3½x$\frac{5}{8}$" LS, 2-5x3½x$\frac{3}{8}$" LS

and 12"[20.7# A = 30.7

C.G.

$$\frac{2 \times 5.55 \times 0.88 + 20 \times \frac{3}{8} \times 10 + 2 \times 3.05 \times 20.14 + 6.03 \times 21.3}{11.10 + 7.5 + 6.10 + 6.03} = \frac{11.0}{10.94}$$

I_B =
$2 \times 5.1 + 2 \times 5.55 \times 10.06^2$ = 1,120
$2 \times 7.8 + 2 \times 3.05 \times 9.17^2$ = 520
$3.9 + 6.03 \times 10.36^2$ = 640
$\frac{3}{8} \times 21.5^3/12$ = 310
2590

I_A =
$2 \times 20.1 + 2 \times 5.55 \times 2.32^2$ = 100.0
$2 \times 3.2 + 2 \times 3.05 \times 1.05^2$ = 13.1
128.1
241.2

$r = 2.80$

$\frac{l}{r} = \frac{186}{2.80} = 66.5$

Allow. f = 14800 for column

$SB = \frac{2590}{10.94} = 235$

Assume acting on flange under crane rail
92000# Crane + Beam
47200 x 8/22 17200# B2 Load
9000 x 4/22 1600# B3 Load
111000# Total

Assume acting at back of other flange
47200 x 14/22 = 30000
9000 x 18/22 = 7000
37000# Total

At base
f due to direct load 148000/30.7 = 4800
f due to eccentric load 74000 x 11/235 = 3500
f due to Crane thrust 13400 x 12/235 = 700
9000#/□"

O.K. for wind

Use $\frac{3}{8}$" web, 2-6x3½x$\frac{5}{8}$" LS, 2-5x3½x$\frac{3}{8}$" LS and 12"[20.7#

Allow. f under crane rail = 16200

$\frac{l}{r} = \frac{186}{4.61} = 40.4$

Actual = 92000/6.03
= ~~6000#/□"~~
15,200#/□"

Subject: CLAREMONT DAM
Computation: OPERATING HOUSE - Steel Columns
Computed by: D.M. Checked by: K.P.W. Date: 17 AUG. 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528

C-2

D.L. B3

$8.3 \times 650 = 5400^{\#}$

DL B4

$\frac{123}{163} \times 1140 \times 8.15 + 800 \times 8.15 = 1350^{\#}$

LL B4

$40/163 \times 1140 \times 8.15 = 2300^{\#}$

Lateral Thrust 1300 # Mobile Crane Load

Vertical Load on Column 25000 # Mobile Crane Load

$51000 \times (1 + 3.9/16.7) = 63000^{\#}$

Load on Column 60 T Crane Load

$74000 \times 11.9/16.7 = 53000^{\#}$

Subject CLAREMONT DAM

Computation OPERATING HOUSE - Steel Columns

Computed by D.M. **Checked by** H.E.M. **Date** 18 AUG 1944

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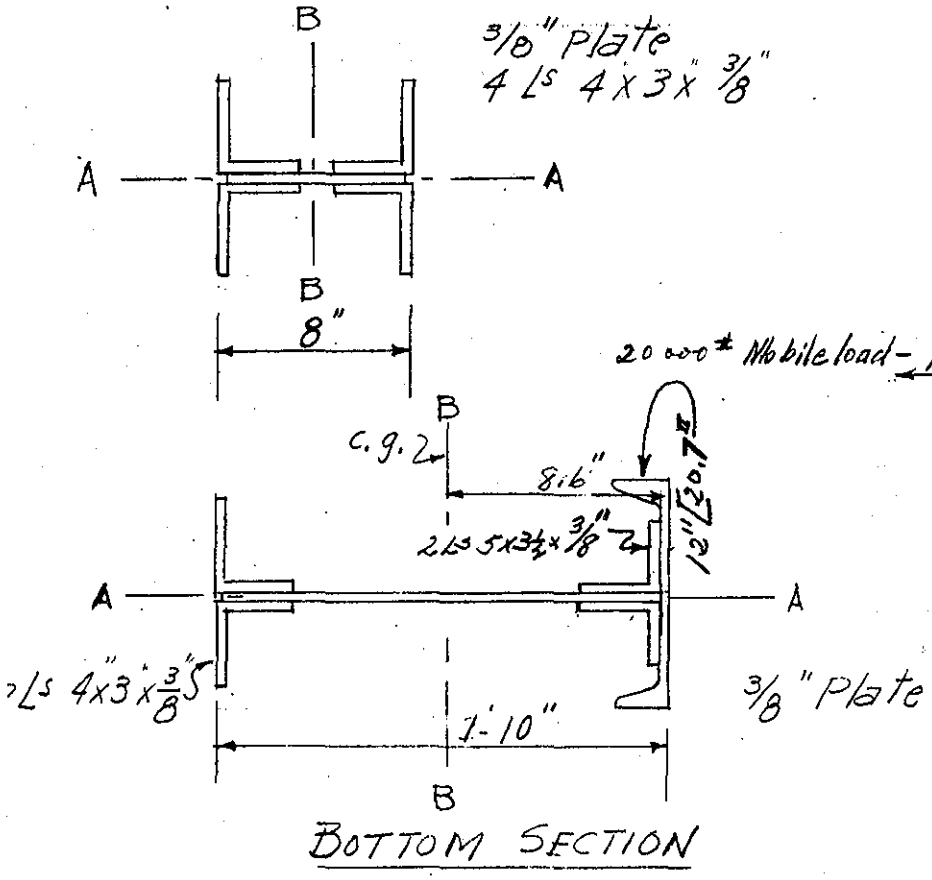
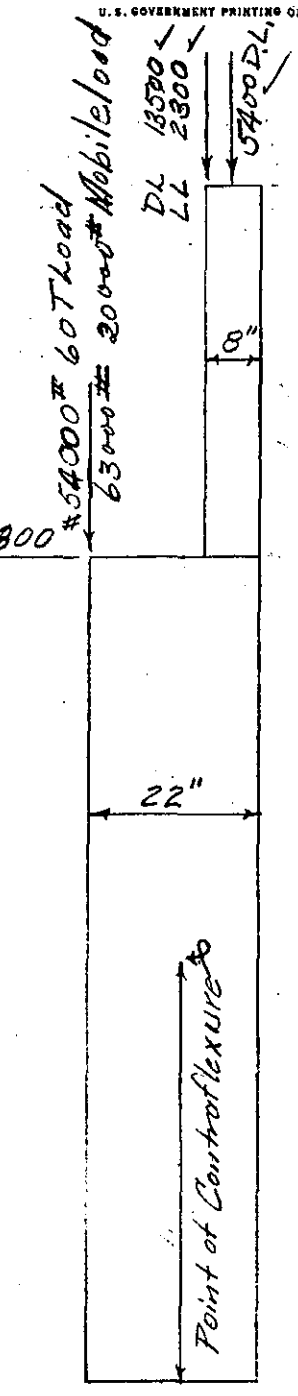
C-2 (cont.)

Top Section



BOTTOM SECTION



Project CLAREMONT DAM

Computation OPERATING HOUSE - Steel Columns

Computed by D.M.T.E.H. Checked by H.P.W. Date 28 AUG. 1944

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C-2 (cont.)

Top Section

Try $\frac{3}{8}$" Web + 4-4x3x$\frac{3}{8}$" Ls

Area of Section

$8 \times \frac{3}{8} = 3.00$

$4 \times 2.48 = 9.92$

12.92

$I_A = 4 \times 4.0 + 4 \times 2.48 \times 1.47^2 + 0.03 = 37.4$

$R_A = \sqrt{37.4/12.92} = 1.70$

$I_B = 4 \times 1.9 + 4 \times 2.48 \times 3.22^2 + \frac{3}{8} \times 7.5^3/12 = 123.6$

f due to direct load $21200/12.92 = 1600$

f due to ecc. load $158 \times 4/30.9 = 2100$

f due to crane thrust $\cancel{10000}$ 9800 $\times 12/30.9 = 3800$

Total 7500 #/□"

$l/r = 10 \times 12/1.7 = 71$ Allow. f = 14600 #/□"

Use $\frac{3}{8}$" Web + 4-4x3x$\frac{3}{8}$" Ls

Subject: CLAREMONT DAM
Computation: OPERATING HOUSE - Steel Columns
Computed by: D. M. Checked by: H.P.W. Date: 28 Aug 1944

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C-2 (cont.)

B: Hom portion

Try $\frac{3}{8}$" web, 2 - 4 x 3 x $\frac{3}{8}$" Ls , 2 - 5 x $3\frac{1}{2}$ x $\frac{3}{8}$" Ls

and 12" [20.7# A = 24.6

C.G.

$$\frac{2 \times 2.48 \times 0.78 + 20 \times \frac{3}{8} \times 10 + 2 \times 3.05 \times 24.14 + 6.03 \times 21.3}{4.96 + 7.5 + 6.10 + 6.03} = 13.4''$$

I_B = 2 x 1.9 + 2 x 2.48 x 12.62² = 795
2 x 7.8 + 2 x 3.05 x 6.7² = 290
3.9 + 6.03 x 7.85² = 374
$\frac{3}{8}$ x 21.3³/12 + $\frac{3}{8}$ x 21.5 x 2.4² = 356
1815

S_C = 211
S_T = 135

$\sqrt{\frac{I}{A}}$ = ~~2.48~~ 2.53

I 2 x 4.0 + 2 x 2.48 x 1.47² = ~~10.7~~ 18.7
2 x 3.2 + 2 x 3.05 x 1.05² = 13.1
128.1
159.9

$\frac{l}{r} = \frac{186}{\cancel{2.48}\ 2.53} = \cancel{75.0}\ 73.0$

Allow. f = ~~14300~~ 14,400

Assume acting at back of column flange under crane rail
63000# Crane + Crane beam load
8/22 x 15800 = 5800
4/22 x 5400 = 1000
70000#

Assume acting at back of other flange of column
14/22 x 15800 = 10000
18/22 x 5400 = 4400
14400

At base
f due to direct load 85000 / 24.6 = 3500
f due to eccentric load (70000 x 8.6 - 14400 x 13.4)/211 = 2200
f due to crane thrust 13400 x 12 / 211 = 800
6500# ✓

Use 3/8" web, 2 - 4 x 3 x 3/8" Ls, 2 - 5 x $3\frac{1}{2}$ x 3/8" Ls and 12" [20.7#

f under crane rail O.K.

WAR DEPARTMENT

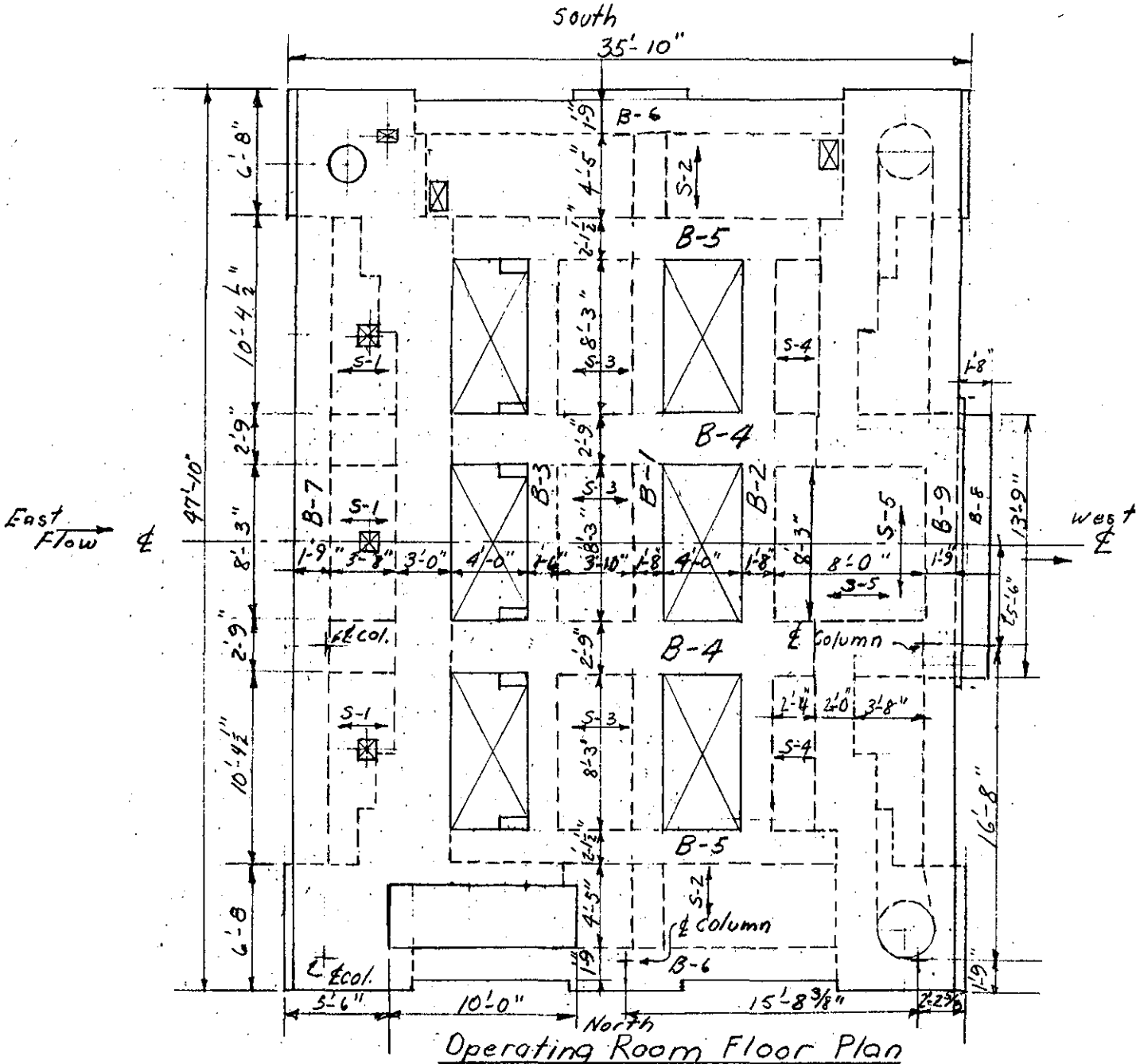
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Operating House - Floor Slabs - El. 650.5

Computed by A.L.K. **Checked by** **Date** 9 Dec. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Operating Room Floor Plan

Floor El. 650.5

Subject: Claremont Dam

Computation: Operating House - Floor Slabs El. 650.5

Computed by: A.L.K. Checked by: Date: 9 Dec., 1944

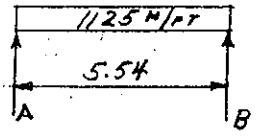
U. S. GOVERNMENT PRINTING OFFICE 3—10528

The various loads to be carried by this structure are as follows. This data was obtained from the mechanical section of the U. S. Engineer Office.

EQUIPMENT	WT.
Gate Hoist	15,000 #
PULL OF GATE HOIST	150,000 #
GATE	20,000 #
STAND BY UNIT	4500 #
CRANE	120,000 #

Operating Room floor slab will be designed for uniform Live load of 1000 #/□'

Slab-S-1 D.L. 10" slab = 125 #/FT. eff span = 5.54'
L.L. = 1000 #/FT.
11.25 #/FT



$+M = \frac{1}{10} \times 1125 \times 5.54^2 = 3440$ '#

req'd $d = \sqrt{\frac{3440}{123}} = 5.3" < 7.7"$

$R_A = R_B = 1125 \times \frac{5.54}{2} = 3120$ #

$V = \frac{3120}{12 \times .88 \times 7.7} = 38$ #/□"

$+A_s = \frac{3440 \times 12}{18000 \times .88 \times 7.7} = .34$ □" use $\frac{5}{8}$"ϕ @ 9" c.c. top & bott.

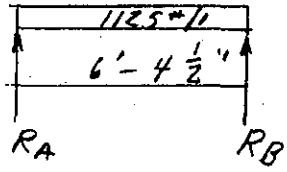
$u = \frac{3120}{2.6 \times .88 \times 7.81} = 174$ #/□"

Subject Claremont Dam
Computation Operating House Floor Slabs El. 650.5
Computed by A.L.K. **Checked by** **Date** 11 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Slab S-2 10" slab effective span $6'-4\frac{1}{2}''$

D.L. + L.L. = 1125 #/FT



$R_A = R_B = 1125 \times \frac{6.37}{2} = 3580$ #

$M = \frac{1}{10} \times 1125 \times 6.37^2 = 4570$ '#

Req'd $d = \sqrt{\frac{4570}{123}} = 6.1'' < 7.06''$

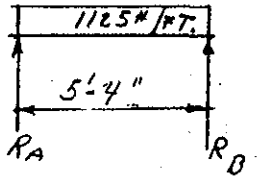
$v = \frac{3580}{12 \times .88 \times 7.06} = 48$ #/□"

$+A_s = \frac{4570 \times 12}{18000 \times .88 \times 7.06} = .49$ □" use $\frac{5}{8}$"ϕ @ 8"cc top & bott.

$u = \frac{3580}{2.9 \times .88 \times 7.56} = 186$ #/□"

Slab S-3 10" slab effective span 5'-4"

D.L. + L.L. = 1125 #/FT.



$R_A = R_B = 1125 \times \frac{5.33}{2} = 3000$ #

$M = \frac{1}{8} \times 1125 \times 5.33^2 = 4000$ '#

Req'd $d = \sqrt{\frac{4000}{123}} = 5.7'' < 7.7''$

$v = \frac{3000}{12 \times .88 \times 7.7} = 37$ #/□"

$A_s = \frac{4000 \times 12}{18000 \times .88 \times 7.7} = .39$ □" $\frac{5}{8}$"ϕ @ 9"cc top & bott.

$u = \frac{3000}{2.6 \times .88 \times 7.81} = 168$ #/□"

Project: Claremont Dam

Computation: Operating House - Floor Slabs El. 650.5

Computed by: A.L.K. Checked by: Date: Dec. 11, 1944

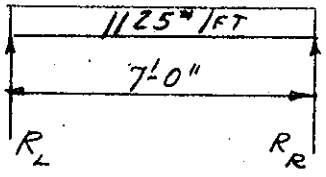
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Slab S-5 10" slab Shortspan 7'-0"
Long span 8'-0

Live load + D.L. = 1125 #/FT

$w_S = \left(\frac{8}{7} - .5\right) 1125 = 720$ #/FT

$w_L = \left(1.5 - \frac{8}{7}\right) 1125 = 405$ #/FT



$M_S = \frac{720 \times 7^2}{12} = 2940$ '#

$M_L = \frac{405 \times 8^2}{12} = 2160$ '#

d_s req'd $= \sqrt{\frac{2940}{123}} = 4.9" < 7.06"$

$v = \frac{2520}{12 \times .875 \times 7.7} = 31$ #/□"

7'-0" span $A_s = \frac{2940 \times 12}{18000 \times .88 \times 7.06} = .313$ □" use $\frac{5}{8}$"φ @ 11" cc top & bott.

$u = \frac{2520}{2.2 \times .88 \times 7.56} = 173$ #/□"

8'-0" span $A_s = \frac{2160 \times 12}{18000 \times .88 \times 7.7} = .21$ □" use $\frac{5}{8}$"φ @ 12" cc top & bott.

Slab S-4 10" slab Eff. span 4'-1"

Live load + D.L. = 1125 #/FT.

$M = \frac{1}{10} \times 1125 \times 4.08^2 = 1865$ #/□'

$R_A = R_B = 1125 \times \frac{4.08}{2} = 2290$ #

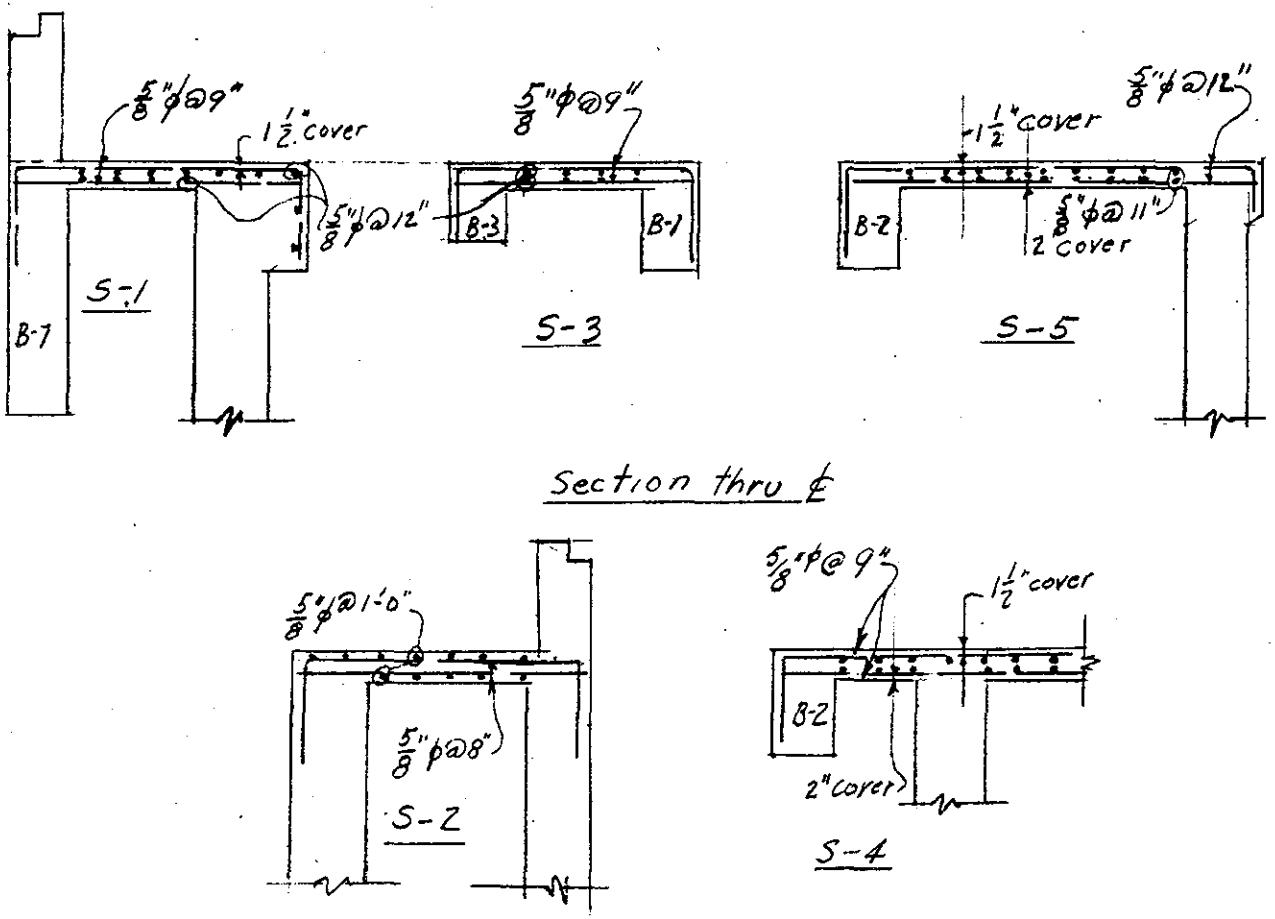
$v = \frac{2290}{12 \times .88 \times 7.7} = 28$ #/□"

$A_s = \frac{1865 \times 12}{18000 \times .88 \times 7.7} = .18$ □" use 5/8" @ 9" top & bott.

$u = \frac{2290}{2.0 \times .88 \times 7.81} = 167$ #/□"

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

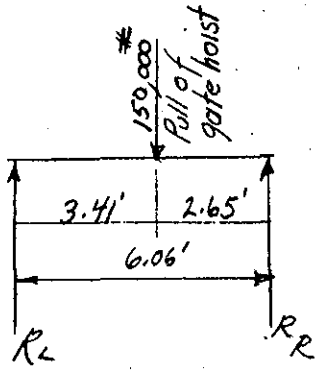
Subject: Claremont Dam
Computation: Operating House - Floor Slabs El. 650.5
Computed by: A.L.K. Checked by: Date: 12 Dec. 1944
Page: 179



U. S. GOVERNMENT PRINTING OFFICE 3—10528

Subject: Claremont Dam
Computation: Operating House - Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: Dec. 11, 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528



Determination of concentrated loads due to pull of gate hoist.

$$R_L = 150000 \times \frac{2.65}{6.06} = 65{,}500\ \#$$

$$R_R = 150000 \times \frac{3.41}{6.06} = 84500\ \#$$

REACTION FOR GATE HOIST D.L.

$$R_L = \frac{15000 \times 2.65}{6.06} = 6550\ \#$$

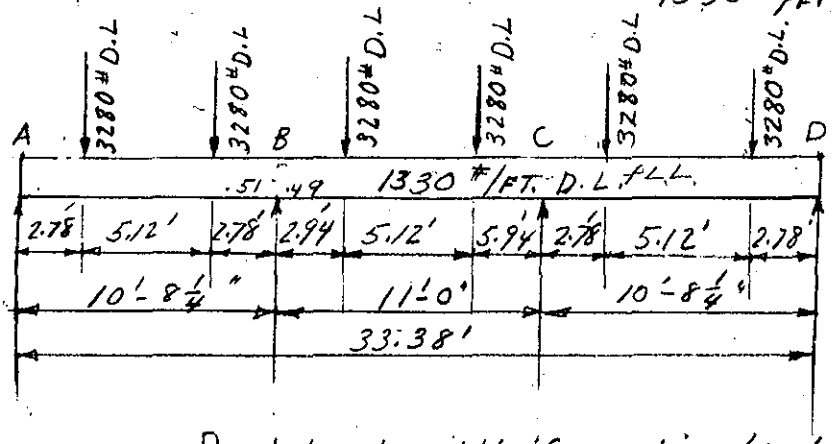
$$R_R = \frac{15000 \times 3.41}{6.06} = 8450\ \#$$

Note. Beams B-1 & B-2 will be designed for gate hoist concentrations plus a uniform Live Load on the floor slabs of 100 #/□'.

Beam B-1

Loadings:

D.L. of beam = 1.67 X 2.16 X 150 = 540 #/FT
" " slab = 3.50 X 125 = 438 #/FT
L.L. of slab = 3.50 X 100 = 350 #/FT
1330 #/FT



Dead Load and Uniform Live Load Diagram

Subject: Claremont Dam
Computation: Operating House - Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 13 Dec. 1944

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Beam B-1 cont'd

$$M^F_{AB} = M^F_{BA} = \frac{3280 \times 2.78 \times 7.9^2}{10.69^2} + \frac{3280 \times 7.9 \times 2.78^2}{10.69^2} + \frac{1}{12} \times 1330 \times 10.69^2 = 19.41^{1k}$$

(5.0, 1.76, 12.85, 19.4)

$$M^F_{BC} = M^F_{CB} = \frac{3280 \times 2.94 \times 8.06^2}{11^2} + \frac{3280 \times 8.06 \times 2.94^2}{11^2} + \frac{1}{12} \times 1330 \times 11^2 = 20.5^{1k}$$

(5.18, 1.88, 12.4)

3280 3280 3280 3280 3280 3280

.51 .49 1330#/ft. .49 .51

	A		B		C	D
	+19.4	-19.4	+20.5	-20.5	+19.4	-19.4
	-19.4	-0.6	-0.5	+0.5	+0.6	+19.4
	-0.3	-9.7	+0.3	-0.3	+9.5	+0.3
	+0.3	+4.8	+4.6	-4.6	-4.8	-0.3
	+2.4	+0.2	-2.3	+2.3	-0.2	-2.4
	-2.4	+1.1	+1.0	-1.0	-1.1	+2.4
-M	0	-23.6	+23.6	-23.6	+23.6	0
-V	8170	12590	10600	10600	12590	8170
X_0	→ 3.68		5.5'		3.68' ←	
+M	18,100'#		5400'#		18100'#	

$$V_A = 3280 + 1330 \times \frac{10.69}{2} - \frac{23600}{10.69} = 8170^{\#}$$

$$V_B = 3280 + 1330 \times \frac{10.69}{2} + \frac{23600}{10.69} = 12590^{\#}$$

$$X_0 = 3.68$$

$$+M = 8170 \times 3.68 - 1330 \times \frac{3.68^2}{2} - 3280 \times .9 = 18{,}100'^{\#}$$

$$V_B = V_C = 3280 + 1330 \times \frac{11}{2} = 10600^{\#}$$

$$x_0 = 5.5'$$

$$+M = 10600 \times 5.5 - 1330 \times \frac{5.5^2}{2} - 3280 \times 2.56 - 23600 = 5400'^{\#}$$

Subject Claremont Dam
Computation Operating House - Floor Beams El. 650.5
Computed by A.L.R. **Checked by** **Date** 14 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-1 cont'd

MAX. GATE LOAD CONCENTRATIONS

Fixed end Moments

$$M^F_{AB} = M^F_{BA} = \frac{32750 \times 7.78 \times 7.9^2}{10.69^2} + \frac{32750 \times 7.9 \times 2.78^2}{10.69^2} = 67.6\ ^{'K}$$

$$M^F_{BC} = M^F_{CB} = \frac{32750 \times 2.94 \times 8.06^2}{11^2} + \frac{32750 \times 8.06 \times 2.94^2}{11^2} = 70.7\ ^{'K}$$

CASE I

32750# 32750# 32750# 32750#

	A	B (.51)	C (.49)	C (.49)	D (.51)	D
	+67.6	-67.6	+70.7	-70.7	0	0
	-67.6	-1.6	-1.5	+34.6	+36.1	0
	-0.8	-33.8	+17.3	-0.8	0	+18.1
	+0.8	+8.4	+8.1	+0.4	+0.4	-18.1
	+4.2	+0.4	+0.2	+4.2	-9.2	+0.2
	-4.2	-0.3	-0.3	+2.4	+2.6	-0.2
-M	0	-94.5	+94.5	-29.9	+29.9	0
V	23900	41600	38640	26860	2800	-2800
X_0	→ 2.78		2.94 ←		No Pos Moment.	
+M	66500 '#		54500 '#			

$$V_A = 32750 - \frac{94500}{10.69} = 23900\ ^{\#}$$

$$V_B = 32750 + \frac{94500}{10.69} = 41600\ ^{\#}$$

$X_0 = 2.78'$

$+M = 23900 \times 2.78 = 66500\ ^{'\#}$

$$V_{BC} = 32750 + \frac{64600}{11} = 38640\ ^{\#}$$

$$V_{CB} = 32750 - \frac{64600}{11} = 26860\ ^{\#}$$

$X_0 = 2.94$

$+M = 26860 \times 2.94 - 29900 = 54500\ ^{'\#}$

$$V_C = \frac{29900}{10.69} = 2800 \qquad V_D = -\frac{29900}{10.69} = -2800\ ^{\#}$$

+M = No Pos Mom

Subject Claremont Dam
Computation Operating House - Floor Beams El. 650.5
Computed by A.L.K. **Checked by** **Date** 14 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-1 cont'd

CASE II

32750# 32750# 32750# 32750#

	A	.51 B	.49	.49 C	.51	D
	+67.6	−67.6	0	0	+67.6	−67.6
	−67.6	+34.4	+33.2	−33.2	+34.4	+67.6
	+17.2	−33.8	−16.6	+16.6	+33.8	−17.2
	−17.2	+25.7	+24.7	−24.7	−25.7	+17.2
	+12.9	−8.6	−12.4	+12.4	+8.6	−12.9
	−12.9	+10.7	+10.3	−10.3	−10.7	+12.9
−M	0	−39.2	+39.2	−39.2	+39.2	0
V	+29080	36420	0	0	36420	29080
X_0	→ 2.78'		0		2.78' ←	
+M	+81000'#		0		81000'#	

$$V_A = 32750 - \frac{39200}{10.69} = 29080^{\#}$$

$$V_B = 32750 + \frac{39200}{10.69} = 36420^{\#}$$

$$X_0 = 2.78'$$

$$+M = 29080 \times 2.78 = 81000'^{\#}$$

CASE III

32750 32750

	A		B		C	D
	0	0	+70.7	−70.7	0	0
	0	−36.0	−34.7	+34.7	+36.0	0
	−18.0	0	+17.4	−17.4	0	+18.0
	+18.0	−8.9	−8.5	+8.5	+8.9	−18.0
	−4.5	+9.0	+4.3	−4.3	−9.0	+4.5
	+4.5	−6.8	−6.5	+6.5	+6.8	−4.5
−M	0	−42.7	+42.7	−42.7	+42.7	0
V	−4470	+4470	32750	32750	4470	−4470
X_0	No Pos		$X_0 = 2.94$		No Pos	
+M	Mom.		+53,300'#		Moment	

$$V_A = -\frac{42,700}{10.69} = -4470^{\#}$$

$$V_B = +\frac{42700}{10.69} = 4470^{\#}$$

Subject: Claremont Dam
Computation: Operating House – Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 14 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-1 cont'd

CASE IV

32750 32750 32750 32750 32750 32750

0 .51 .49 .49 .51 0

	A		B		C	D
	+67.6	-67.6	+70.7	-70.7	+67.6	-67.6
	-67.6	-1.9	-1.2	+1.2	+1.9	+67.6
	-1.0	-33.8	+0.6	-0.6	+33.8	+1.0
	+1.0	+16.9	+16.3	-16.3	-16.9	-1.0
	+8.5	+0.5	-8.2	+8.2	-0.5	-8.5
	-8.5	+3.9	+3.8	-3.8	-3.9	+8.5
-M	0	-82.0	+82.0	-82.0	+82.0	0
V	25060	40440	32750	32750	40440	25060
X_0	→ 2.78'		2.94'		2.78 ←	
+M	69600'#		14000'#		69600'#	

$$V_A = 32750 - \frac{82000}{10.69} = 25060^{\#}$$

$$V_B = 32750 + \frac{82000}{10.69} = 40440^{\#}$$

$$X_0 = 2.78'$$

$$+M = 25060 \times 2.78 = 69{,}600'^{\#}$$

$$V_B = V_C = 32750^{\#}$$
$$X_0 = 2.94$$

$$+M = 32750 \times 2.94 - 82000 = 14000'^{\#}$$

CASE V

32750# 32750#

	+67.6	-67.6	0	0	0	0
	-67.6	+34.4	+33.2	0	0	0
	0	-33.8	0	+16.6	0	0
	0	+17.2	+16.6	-8.1	-8.5	0
	+8.6	0	-4.1	-8.3	0	-4.3
	-8.6	+2.1	+2.0	+4.1	+4.2	+4.3
-M	0	-47.7	+47.7	+4.3	-4.3	0
V	28280	37220	0	0	0	0
X_0	→ 2.78'		No pos M.o.M.		No. pos. Mom.	
+M	78500'#					

$$V_A = 32750 - \frac{47700}{10.69} = 28280^{\#}$$

$$V_B = 32750 + \frac{47700}{10.69} = 37220^{\#}$$

$$X_0 = 2.78'$$

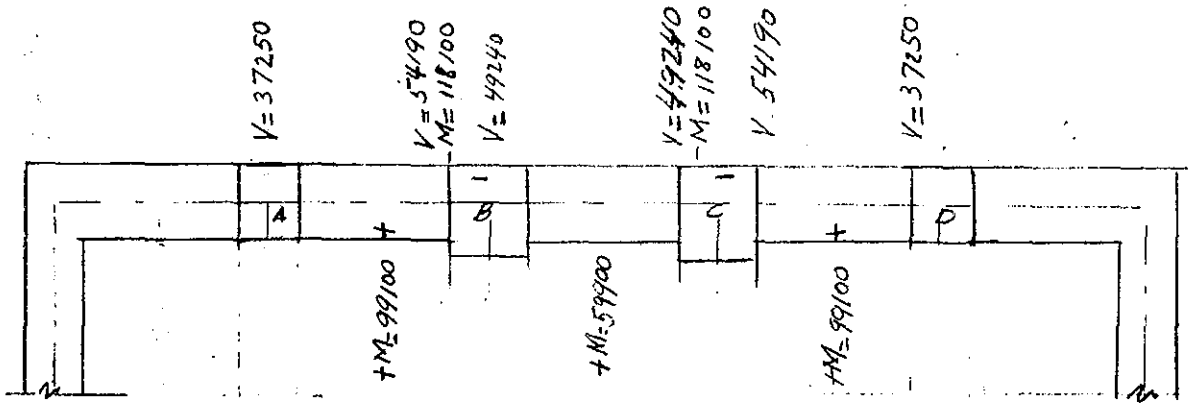
$$+M = 28220 \times 2.78 = 78500'^{\#}$$

Project: Claremont Dam
Computation: Operating House-Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 14 Dec 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-1 cont'd.

Design of members



Beam B-1 - 1'-8" wide by 3'-0" deep

$d_{req'd\ -M} = \sqrt{\frac{118100 \times 12}{147 \times 20}} = 21.9'' < 33.4$ $\quad d_{req'd\ +M} = \sqrt{\frac{99100 \times 12}{123 \times 20}} = 21.9'' < 33.5''$

$V = \frac{54190}{20 \times .88 \times 33.4} = 92\ \#/\square''$

$-A_s = \frac{118100 \times 12}{18000 \times .88 \times 33.4} = 2.66\square''$ use 3-1 □ } top

$u = \frac{54190}{120 \times .88 \times 33.4} = 155\ \#/\square''$

$+A_s = \frac{99100 \times 12}{18000 \times .88 \times 33.5} = 2.24\ \square''$ use 3-1" ϕ bott.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Operating House - Floor Beams El. 650.5

Computed by: A.L.K. Checked by: Date: 15 Dec 1944

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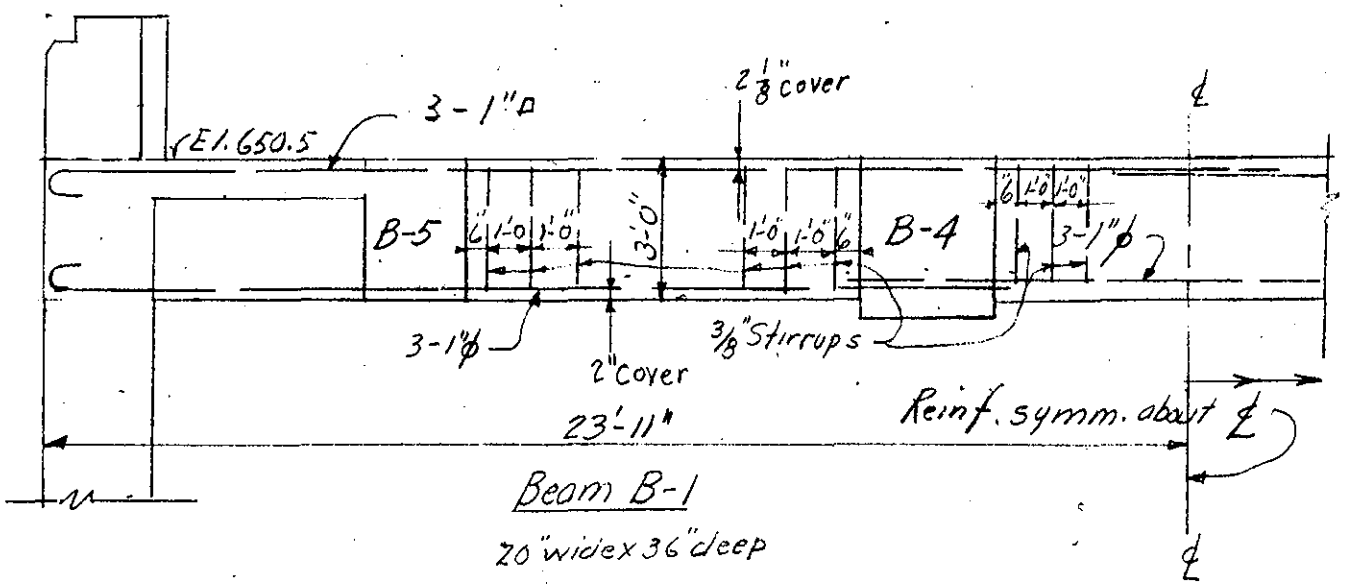
Beam B-1 cont'd



Beam B-1

20" wide x 36" deep

Subject: Claremont Dam

Computation: Operating House - Floor Beams El. 650.5

Computed by: A.L.K. Checked by: Date: 15 Dec 1944

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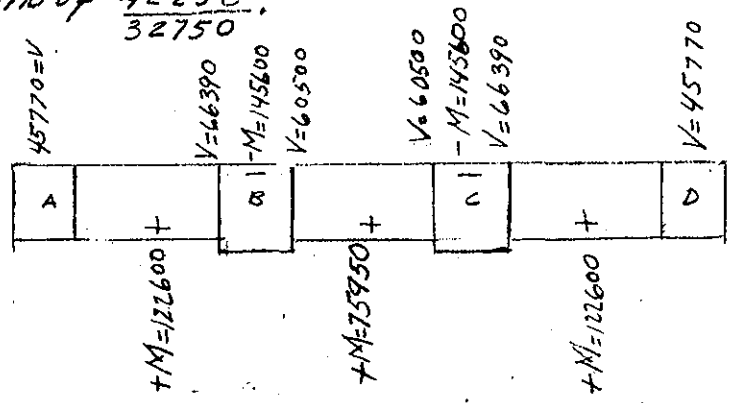
Beam B-2

Beam B-2 supports aproximately the same slab dead Load and uniform liveload as Beam B-1 and will be designed for these values plus the adjusted values of the gate concentrations of Beam B-1 in the ratio of $\frac{42250}{32750}$.



Beam B-2 1'-8" wide x 3'-0" deep

$$V_A = V_D = 29080 \times \frac{42250}{32750} + 8170 = 45770^{\#}$$

$$V_B = V_C = 41600 \times \frac{42250}{32750} + 12590 = 66390^{\#}$$

$$-M_B = -M_C = -94500 \times \frac{42250}{32750} - 23600 = 145600'^{\#}$$

$$+M_{AB} = +M_{CD} = 81000 \times \frac{42250}{32750} + 18100 = 122,600'^{\#}$$

$$V_B = V_C = 38640 \times \frac{42250}{32750} + 10600 = 60500^{\#}$$

$$-M_B - M_C = 145600'^{\#}$$

$$+M = 54500 \times \frac{42250}{32750} + 5450 = 75950'^{\#}$$

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
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Beam B-2 cont'd.

$$d\ req'd_{-M} = \sqrt{\frac{145600 \times 12}{147 \times 20}} = 24.4'' < 33.4''$$

$$d\ req'd_{+M} = \sqrt{\frac{122\,600 \times 12}{123 \times .20}} = 24.4'' < 33.5$$

Reduction of shear

$$V_B = V_C = 66390 - 1330 \times 1.37 = 64570^{\#}$$

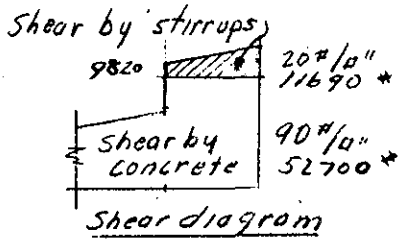
$$v = \frac{64570}{20 \times .88 \times 33.4} = 110\ \#/\square''\ \text{use stirrups}$$

$$-A_s = \frac{145600 \times 12}{18000 \times .88 \times 33.4} = 3.3\ \square''\ \text{use } 3\text{-}1\tfrac{1}{8}\square''\ \text{top}$$

$$u = \frac{64570}{16 \times .88 \times 33.4} = 138\ \#/\square''$$

$$+A_s = \frac{122600 \times 12}{18000 \times .88 \times 33.5} = 2.78 \quad \text{use } 4\text{-}1''\phi\ \text{bott.}$$

Stirrups Required



Shear diagram

$$\frac{90}{110} \times 64390 = 52700^{\#}$$

use $\frac{3}{8}''\phi$ Stirrups One stirrups takes $2 \times .11 \times 16000 = 3500^{\#}$

$$No\ req'd = \frac{\frac{11690 + 9820}{2} \times 1.41 \times 12}{3500 \times .875 \times 33.4} = 1.78 \quad \text{2-Stirrups}$$

Spacing: $.22 \times 16000 = 20 \times 20 \times S_1 \quad S_1 = 8.75''$
$.22 \times 16000 = 18.8 \times 20 \times S_2 \quad S_2 = 9.35''$
use 3 stirrups at 8" cc

Subject Claremont Dam

Computation Opererating House Floor Beams El. 640.5

Computed by A.L.K. **Checked by** **Date** 16 Dec 1944

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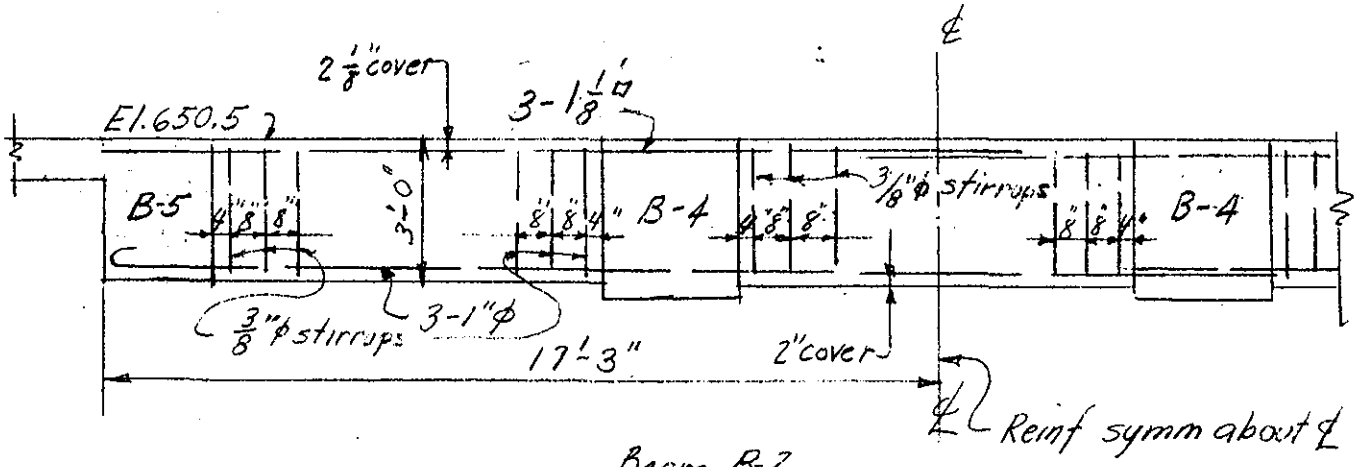
Beam B-2 cont'd.



Beam B-2

20" wide x 36" deep

Subject: Claremont Dam

Computation: Operating House Floor Beams El. 650.5

Computed by: A.L.K. Checked by: Date: 16 Dec 1944

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Beam B-3 assume 1'-6" wide by 2'-0" deep beam.

Beam B-3 will be designed for two conditions of gateloading in addition to dead loads of slab and beam. plus uniform live load of 100 #/□' on slab

CASE I Gate on span AB

CASE II Gate on span BC

Dead loadings

D.L. of beam = 1.5 X 1.16 X 150 = 261 #/FT.

DL of slab = 3.42 X 125 = 427 #/FT

DL of cover PL = 2.0 X 15 = 30 #/FT

718 #/FT.

Fixed End Moments

$M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 720 \times 10.69^2 = 6.9$ '#

$M^F_{BC} = M^F_{CB} = \frac{1}{12} \times 720 \times 11^2 = 7.3$ '#.

	A		B	720#/FT.	C	D
	0	.51	.49	.49	.51	0
	+6.9	-6.9	+7.3	-7.3	+6.9	-6.9
	-6.9	-0.2	-0.2			+6.9
	-0.1	-3.5	+0.1			
	+0.1	+1.7	+1.7			
	+0.9	+0.05	-0.9			
	-0.9	+.43	+0.42			
-M	0	-8.42	+8.42	-8.42	+8.42	0
V	3060	4640	3960	3960	4640	3060
X_0	→ 4.25		5.5'		4.25 ←	
+M	6500' #		2530' #		6500' #	

$V_A = \frac{720 \times 10.69}{2} - \frac{8420}{10.69} = 3060$

$V_B = \frac{720 \times 10.69}{2} + \frac{8420}{10.69} = 4640$

$+M = 3060 \times 4.25 - 720 \times \frac{4.25^2}{2} = 6500$ '#

$V_B = V_C = 720 \times \frac{11}{2} = 3960$ #

$+M = 3960 \times 5.5 - 720 \times \frac{5.5^2}{2} - 8420 = 2530$ '#.

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U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-3 cont'd.

Case I Gate load concentration 20000# span AB
Fixed End $M = \frac{1}{8} \times 20000 \times 10.69 = 26.7$ 'K

20000

	A	.51	B .49	.49	C .51	D
	5'-4 1/8"	5'-4 1/8"				
	+26.7	-26.7	0	0	0	0
	-26.7	+13.6	+13.1	0	0	0
	+6.8	-13.4	0	+6.6	0	0
	-6.8	+6.9	+6.5	-3.4	-3.2	0
	+3.5	-3.4	-1.7	+3.3	0	-1.6
	-3.5	+2.6	+2.5	-1.7	-1.6	+1.6
-M	0	-20.4	+20.4	+4.8	-4.8	0
V	8100	11900	2290	-2290	-450	450
X_0	5.35'		-		-	
+M	43400'#		-		-	

$$V_A = 10000 - \frac{20400}{10.69} = 8100\ \#$$

$$V_B = 10000 + \frac{20400}{10.69} = 11900\ \# \qquad X_0 = 5.35'$$

$$+M = 8100 \times 5.35 = 43400'\#$$

$$V_B = \frac{25200}{11} = 2290 \qquad V_C = -2290$$

$$V_C = -\frac{4800}{10.69} = -450 \qquad V_D = 450\ \#$$

Case II Fixed end $M = \frac{1}{8} \times 20000 \times 11 = 27.5$ 'K

*20000

	A 0	.51	B .49	.49	C .51	D 0
			5'-6"	5'-6"		
	0	0	+27.5	-27.5	0	0
	0	-14.0	-13.5			
	-7.0	0	+6.3			
	+7.0	-3.2	-3.1			
	-1.6	+3.5	+1.6			
	+1.6	-2.6	-2.5			
-M	0	-16.3	+16.3	-16.3	+16.3	0
V	-1530	+1530	10000	10000	+1530	-1530
X_0	-		5.5'		-	
+M	-		55000'#		-	

Subject Claremont Dam

Computation Operating House Floor Beams El. 650.5

Computed by A.L.K. **Checked by** **Date** 18 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-3 cont'd

Uniform live load on slab = 100 × 5.42 = 542 #/FT

Fixed End Mom AB = $\frac{1}{12} \times 542 \times 10.69^2 = 5.15$ 'K

Fixed End Mom BC = $\frac{1}{12} \times 542 \times 11^2 = 5.45$ 'K

	542 #/FT					
	A	B	C		D	
	0	.51	.49	.49	.51	0
	+5.15	−5.15	+5.45	−5.45	+5.15	−5.15
	−5.15	−0.15	−0.15	+0.15	+0.15	+5.15
	−0.08	−2.58	+0.08	−0.08	+2.58	+0.08
	+0.08	+1.25	+1.25	−1.25	−1.25	−0.08
	−0.64	+0.04	−0.63	+0.63	−0.04	−0.63
	+0.64	+0.30	+0.30	−0.30	−0.30	+0.63
−M	0	−6.29	+6.30	−6.30	+6.30	0
V	2300	3480	2980	2980	3480	2300
X_0	→ 4.25		5.5		4.25 ←	
+M	4910 '#		1900 '#		4910 '#	

$$V_A = \frac{542 \times 10.69}{2} - \frac{6290}{10.69} = 2300\ \#$$

$$V_B = \frac{542 \times 11}{2} + \frac{6290}{10.69} = 3480\ \# \qquad X_0 = 4.25'$$

$$+M = 2300 \times 4.25 - 542 \times \frac{4.25^2}{2} = 4910\ '\#$$

$$V_B = V_C = 542 \times \frac{11}{2} = 2980\ \#$$

$$+M = 2980 \times 5.5 - 542 \times \frac{5.5^2}{2} - 6300 = 1900\ '\#$$

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Computed by: A.L.K. Checked by: Date: 18 Dec 1944

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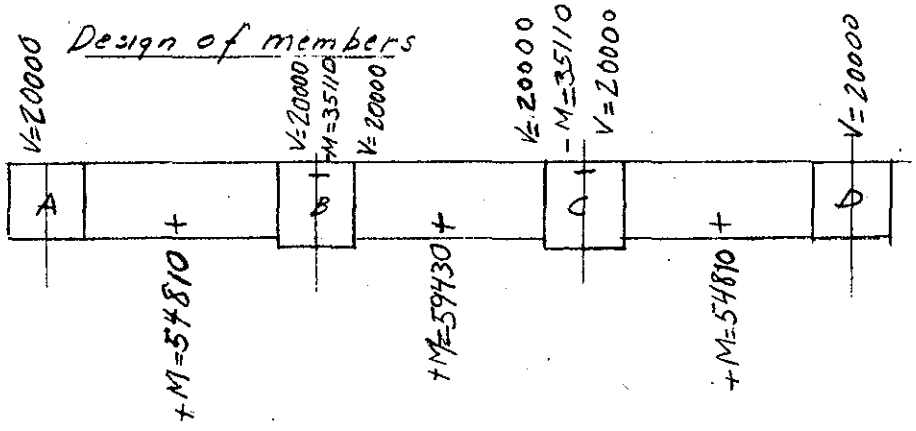
Beam B-3 Cont'd

Design of members



Beam B-3 1'-6" wide x 2'-0" deep

$$d_{req'd\,-M} = \sqrt{\frac{35110 \times 12}{147 \times 20}} = 11.9'' < 21.4''$$

$$d_{req'd\,+M} = \sqrt{\frac{59400 \times 12}{123 \times 20}} \quad 17'' < 21.5''$$

$$v = \frac{20000}{20 \times .88 \times 21.4} = 53\ \#/\square$$

$$+A_s = \frac{59400 \times 12}{18000 \times .88 \times 21.5} = 2.09\ \square'' \quad \text{use } 3\text{-}1''\phi$$

$$-A_s = \frac{35110 \times 12}{18000 \times .88 \times 21.4} = 1.24\ \square'' \quad \text{use } 3\text{-}\tfrac{7}{8}''\phi$$

$$u = \frac{20{,}000}{8.4 \times .88 \times 21.4} = 126\ \#/\square''$$

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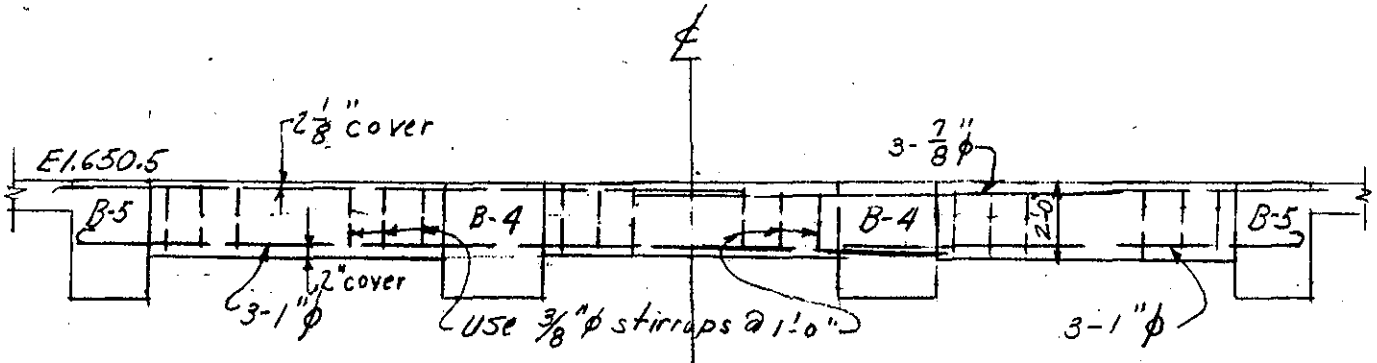
Project Claremont Dam

Computation Operating House Floor Beams El. 650.5

Computed by A.L.K. **Checked by** **Date** 26 Dec., 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-3 Cont'd.



Beam B-3 1'-6" wide by 2'-0" deep

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U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Operating House Floor Beams El. 650.5

Computed by: H.L.K. Checked by: Date: 19 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-6 1'-9" wide x 11'-0" deep

Loads superstructure (brick)

Walls	15.58 x 1.37 x 120	=	2550
"	14.45 x 1.04 x 120	=	1810
"	4.63 x .33 x 120	=	185
Coping	2.15 x .75 x 150	=	240
Curbing	2.98 x 1.5 x 150	=	670
			5455 #/FT Say 5460 #/FT

Pilaster

walls (pilaster)	30. x .5 x 120	=	1800
Curbing	2.98 x .5 x 150	=	224
bracket	11 x .5 x 150	=	825
			2849 Say 2850 #/FT

Floor Loads

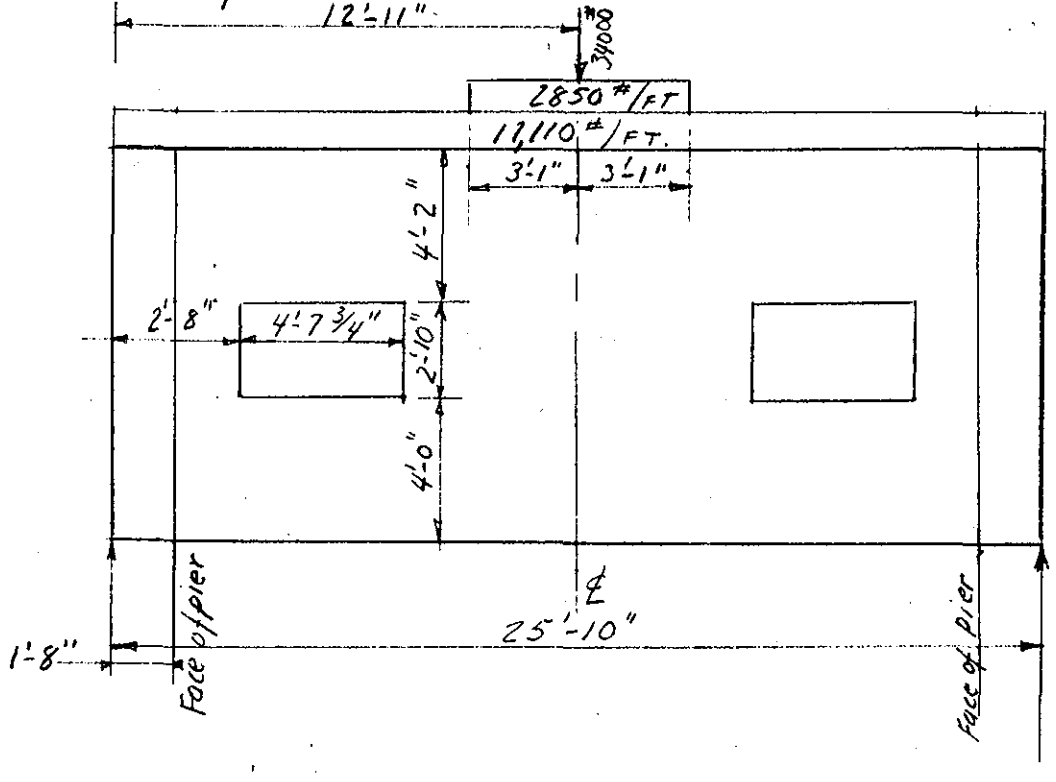
Operating floor L.L + D.L. 1125 x 2.2 = 2480 #/FT

Basement floor L.L + D.L 250 x 2.2 = 275 #/FT

Max D.L. + L.L. Reaction from col. = 34000 #

Beam D.L. 11 x 1.75 x 150 = 2890 #/FT.

Total uniform Dead load + Live load. = 5460 + 2890 + 2480 + 280 = 11,110 #/FT



Subject: Claremont Dam

Computation: Operating House Floor Beams El. 650.5

Computed by: A.L.K. Checked by: Date: 20 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-6 cont'd.

$R_L = 11{,}110 \times 12.92 = 144000$
$= 34000 \times .5 = 17000$
$= 2850 \times .5 = 1425$
$R_L = 162{,}430$ #

$R_R = 11{,}110 \times 12.9 = 144000$
$= 34{,}000 \times .5 = 17000$
$= 2850 \times .5 = 1425$
$R_R = 162{,}430$ #

$X_0 = 12.92'$

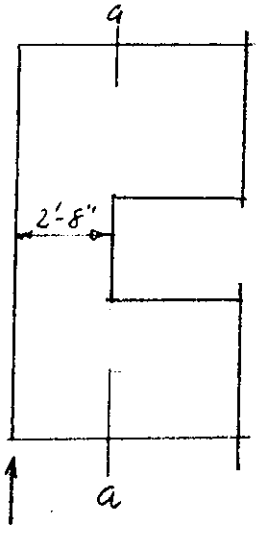
$+M = 162{,}430 \times 12.92 - 11{,}110 \times \frac{12.92^2}{2} - 2850 \times \frac{3.08^2}{2} = 1{,}055{,}100$ '#

$d \text{ req'd} = \sqrt{\frac{1{,}055{,}100 \times 12}{123 \times 21}} = 70'' < 125.94''$

$v = \frac{162{,}430}{21 \times .875 \times 127.3} = 69.4$ #/□"

$+A_s = \frac{1{,}055{,}100 \times 12}{18000 \times .88 \times 127.3} = 6.3$ □" $-A_s = 4.72$ □"

$a = \frac{162430}{28 \times .875 \times 127.3} = 52$ #/□"



Value of shear @ a-a Left side of rightside

$V_{a-a} = 162{,}430 - 11{,}110 \times 2.67 = 132{,}830$ #

Shear of top member $132{,}830 \times .51 = 67700$ #
" of both. " $132{,}830 \times .49 = 65130$ #

$v = \frac{67{,}700}{21 \times .875 \times 45.3} = 81.5$ #/□"

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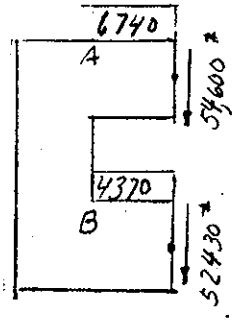
Beam B-6 cont'd Assume pt. of inflection at center of opening



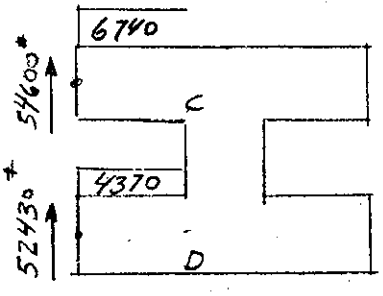
Shear at pt. of inflection = 162430 − 11,110 × 4.99 = 107030#
Value in top member = .51 × 107,030 = 54,600 #
" " bott member = .49 × 107,030 = 52,430 #

Uniform load on top member 8350 × .51 + 2480 = 6740 #/FT
" " bott. " 8350 × .49 + 280 = 4370 #/FT

Mom. at pt. A = 54600 × 2.32 + 6740 × $\frac{2.32^2}{2}$ = 144,650 '#
Mom. at pt. B = 52430 × 2.32 + 4370 × $\frac{2.32^2}{2}$ = 133,100 '

req'd $d = \sqrt{\frac{144,650 \times 12}{21 \times 123}}$ = 25.7" < 45.3"

req'd $d = \sqrt{\frac{133,100 \times 12}{21 \times 123}}$ = 24.9" < 44.75"



Mom. at C = 54600 × 2.32 − 6740 × $\frac{2.32^2}{2}$ = 118,350 '#

Mom. at D = 52430 × 2.32 − 4370 × $\frac{2.32^2}{2}$ = 109,900 '#

Design of Beam

at A $A_s = \frac{144,650 \times 12}{18000 \times .88 \times 45.3}$ = 2.42 □" 3-1"□ ok

at B $A_s = \frac{133,100 \times 12}{18000 \times .88 \times 44.75}$ = 2.25 □" use 3-1"φ

at C $\frac{118350 \times 12}{18000 \times .88 \times 44.75}$ = 2.0 □" use 3-1"φ

at D $\frac{109,900 \times 12}{18000 \times .88 \times 41.94}$ = 1.98 □" 3-1"φ req'd

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
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Beam B-6 cont'd.

$$u_B = \frac{65130}{9.3 \times .88 \times 44.75} = 178\ \#/\square''$$

$$u_C = \frac{54600 - 6740 \times 2.32}{9.3 \times .88 \times 44.75} = 106\ \#/\square''$$

$$+M_{7.31' \text{ from } R_L \text{ or } R_R} = 162{,}430 \times 7.31 - 11{,}110 \times \frac{7.31^2}{2} = 893{,}000'\#$$

$$+A_s = \frac{893000 \times 12}{18000 \times .88 \times 125.94} = 5.4\ \square''$$

Total $A_s = 5.4 + 1.98 = 7.4\ \square''$ use 8-1"□ bott

$-A_s = 5.55\ \square''$ use 6-1"□ top

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Computation: Operating House Floor Beams El. 650.5
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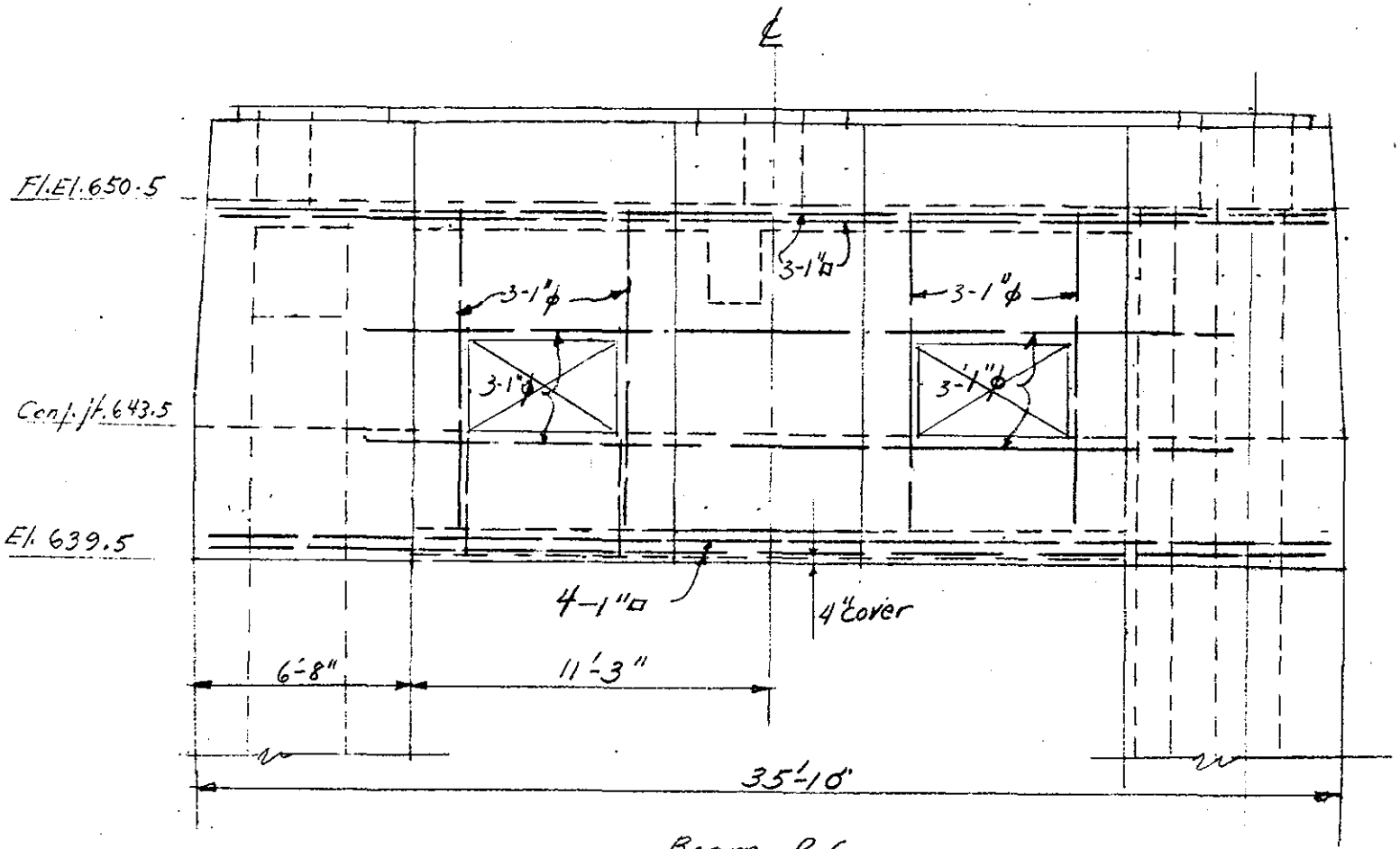
Beam B-6 cont'd



Beam - B-6
1'-9" wide x 11'-0" deep
Steel horiz. and vert. = 3/4"φ @ 1'-0" both faces

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Subject Claremont Dam
Computation Operating House - Floor Beams El. 650.5
Computed by A.L.K. **Checked by** **Date** 28 Dec 1944

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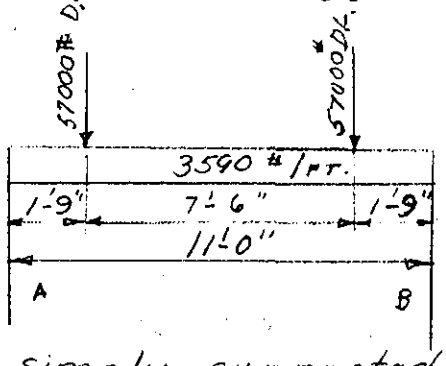
Beam B-8

Beam B-8 will be designed for 250 #/□ on the floor plus dead load of slab, beam and bridge Loads.

Dead loads on beam.

Dead load concentr. of bridge = 57000 #
Concrete beam: 3.42 × 7.0 × 150 = 3590 #/FT.

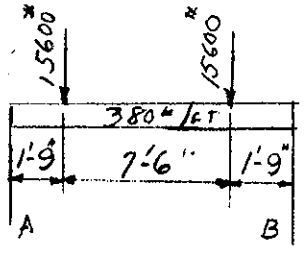


$R_{A_{DL}} = R_{B_{DL}} = 3590 \times \frac{11}{2} + 57000 = 76700^{\#}$

Assume simply supported

$M_{DL} = 76700 \times 5.5 - 57000 \times 3.75 - 3590 \times \frac{5.5^2}{2} = 142{,}800'^{\#}$ D.L. M

Live loads on B-8



Uniform L.L 250 × 1.5 = 380 #/FT.
L.L. concentr. of bridge = 15600 #

$R_A = R_B = 380 \times 5.5 + 15600 = 17690^{\#}$

$M_{LL} = 17600 \times 5.5 - 380 \times \frac{5.5^2}{2} - 15600 \times 3.75 = 32450'^{\#}$

$M_{LL} + M_{DL} = 175250'^{\#}$ $\qquad V_{LL} + V_{DL} = 94390^{\#}$

$d\ req'd = \sqrt{\frac{175250 \times 12}{123 \times 41}} = 20.4 < 80.5$

$V = \frac{94390}{41 \times .88 \times 80.5} = 32.4\ ^{\#}/\square''$

$+A_s = \frac{175250 \times 12}{18000 \times .88 \times 80.5} = 1.65\ \square''$ use 3-$\frac{7}{8}$"ϕ bott.

$u = \frac{94390}{8.7 \times .88 \times 80.5} = 153\ ^{\#}/\square''$ use $\frac{7}{8}$"ϕ min steel. top

Subject Claremont Dam

Computation Operating House - Floor Beams El. 650.5

Computed by ..... **Checked by** ..... **Date** 28 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-9

Beam B-9 will be designed for uniform live load on slab of 750 #/□' plus dead loads of slab, beam and superstructure.

Dead loads on beam

Superstructure D.L.

Brickwall 1.37 X 30.0 X 120 = 4940

conc. curbing 2.94 X 1.5 X 150 = 660

5600 #/FT applied from ends of beam up to 7'-8" from ℄

10" slab S-1 1.83 X 125 = 229 #/FT.

" " S-5 4.0 X 125 = 600 #/FT.

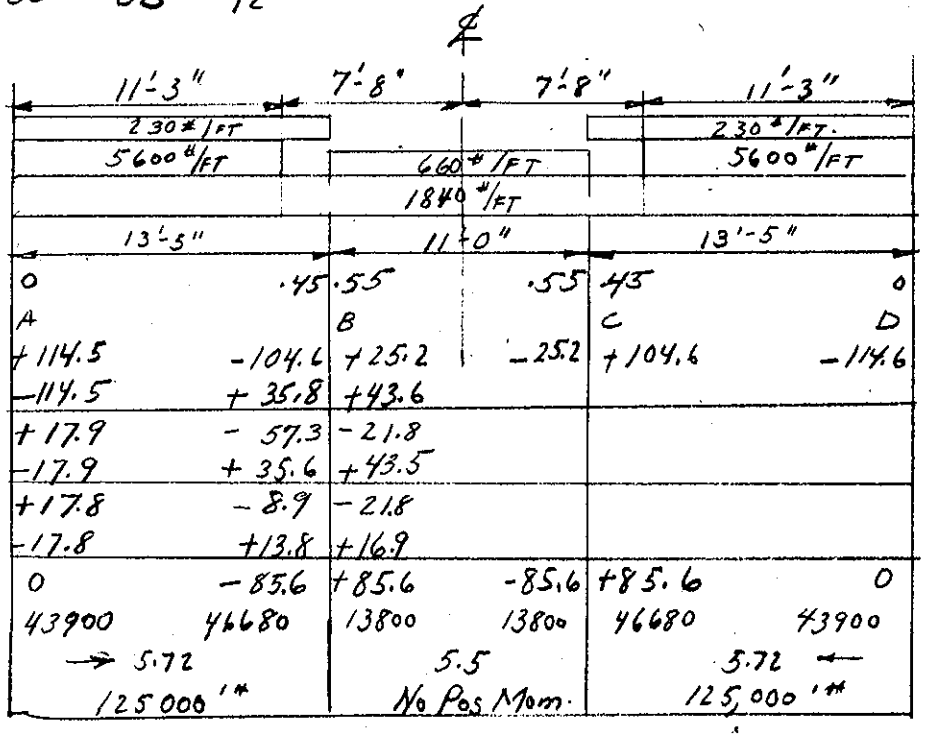
Conc. beam 1.75 X 7 X 150 = 1840 #/FT applied over entire beam

Fixed end Moments

$$M^F_{AB} = \frac{2070 \times 13.42^2}{12} + \frac{.84(6 - 8 \times .84 + 3 \times .84^2)}{12} \times 5600 \times 11.25 \times 13.42 = 114.5 \text{ 'K.}$$

$$M^F_{BA} = \frac{2070 \times 13.42^2}{12} + \frac{.84^2(4 - 3 \times .84)}{12} \times 5600 \times 11.25 \times 13.42 = 104.6 \text{ 'K.}$$

$$M^F_{BC} = M^F_{CB} = \frac{2500 \times 11^2}{12} = 25.2 \text{ 'K}$$



Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 28 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-9 cont'd.

$$V_A = 2070 \times \frac{13.42}{2} + 5600 \times 11.25 \times \frac{7.79}{13.42} - \frac{85600}{13.42} = 43900^{\#}$$

$$V_B = 2070 \times \frac{13.42}{2} + 5600 \times 11.25 \times \frac{5.63}{13.42} + \frac{85600}{13.42} = 46680^{\#}$$

$$X_0 = 5.72'$$

$$+M = 43900 \times 5.72 - \frac{2670 \times 5.72^2}{2} = 125{,}000'^{\#}$$

$$V_B = V_C = 2500 \times \frac{11}{2} = 13800^{\#}$$

$$X_0 = 5.5'$$

$$+M = 13800 \times 5.5 - \frac{2500 \times 5.5^2}{2} - 85600 = \text{No Pos. Mom.}$$

Subject Claremont Dam

Computation Operating House Floor Beams El. 650.5

Computed by A.L.K. **Checked by** **Date** 27 Dec. 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-9 cont'd Live loads on beam

L.L. from slab S-5

$w_s = \left(\frac{8.25}{8} - .5\right) 750 = 400\ \#/\square'$

Live load from slab S-1 $750 \times 1.83 = 1370\ \#/FT$. $w_l = \left(1.5 - \frac{8.25}{8}\right) 750 = 350\ \#/\square'$

Live " " " S-5 $400 \times 6.08 = 2430\ \#/FT$

Fixed End Mom: $M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 1370 \times 13.42^2 = 20.60\ 'K$

$M^F_{BC} = M^F_{CB} = \frac{1}{12} \times 2430 \times 11^2 = 24.50\ 'K$

	1370 #/FT		2430 #/FT		1370 #/FT	
	A	13'-5"	B	11'-0" (℄ of Beam)	C	13'-5" D
	0	.45	.55	.55	.45	0
	+20.6	-20.6	+24.5	-24.5	+20.6	-20.6
	-20.6	-1.7	-2.2			
	-0.9	-10.3	+1.1			
	+0.9	+4.1	+5.1			
	+2.1	+0.5	-2.6			
	-2.1	+0.9	+1.2			
-M	0	-27.1	+27.1	-27.1	+27.1	0
V	7370	11390	13370	13390	11390	7370
X_o	→	5.38'		5.5'		5.38' ←
+M		19850 '#		9200 '#		19850 '#

$V_A = 1370 \times \frac{13.42}{2} - \frac{27100}{13.42} = 7370\ \#$

$V_B = 1370 \times \frac{13.42}{2} + \frac{27100}{13.42} = 11390$

$X_o = 5.38'$

$+M = 7370 \times 5.38 - 1370 \times \frac{5.38^2}{2} = 19850\ '\#$

$V_B = V_C = 2430 \times \frac{11}{2} = 13390\ \#$

$X_o = 5.5'$

$+M = 13390 \times 5.5 - 2430 \times \frac{5.5^2}{2} - 27100 = 9200\ '\#$

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 28 Dec 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-9 cont'd

Total D.L. + L.L. Moments

$M_{BA} = -85600 - 27,100 = -112,700'^{\#}$

$M_{BC} = -112,700'^{\#}$

$+M_{AB} = 125000 + 19850 = 144,850'^{\#}$

Total D.L. + L.L. Shears

$V_{AB} = 43900 + 7370 = 51270^{\#}$

$V_{BA} = 46680 + 11390 = 58070^{\#}$

$V_{BC} = 13390 + 13800 = 27190^{\#}$

$V_{CB} = 27190^{\#}$

Design of beam

req'd $d = \sqrt{\dfrac{112\,700 \times 12}{147 \times 21}} = 20.8'' < 81.5''$

$v = \dfrac{58070}{21 \times .88 \times 81.5} = 39\ \#/\square''$

$-A_s = \dfrac{112\,700 \times 12}{18000 \times .88 \times 81.5} = 1.05\ \square''$ use 3 - $\frac{3}{4}''\phi$ top

$u = \dfrac{58070}{7.2 \times .88 \times 81.5} = 113\ \#/\square''$

$+A_s = \dfrac{144,850 \times 12}{18000 \times .88 \times 79.5} = 1.41\ \square''$ use 3 - $\frac{7}{8}''\phi$ bott.

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam
Computation: Operating House - Floor Beams - El. 650.5
Computed by: A.L.K. Checked by: Date: 11 Dec. 1944
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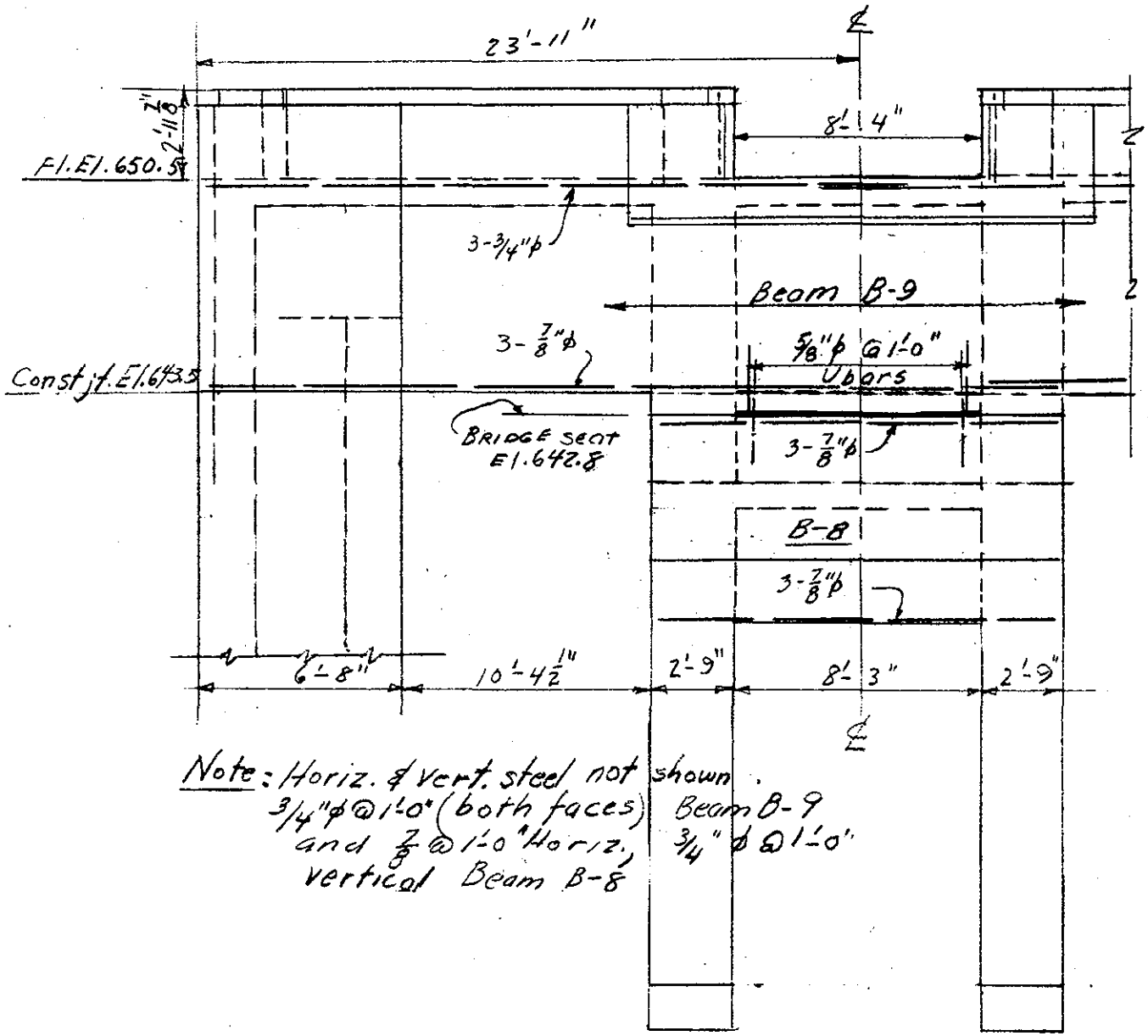


Note: Horiz. & vert. steel not shown.
3/4"ϕ @ 1'-0" (both faces) Beam B-9
and 7/8 @ 1'-0" Horiz. 3/4" ϕ @ 1'-0"
vertical Beam B-8

U. S. GOVERNMENT PRINTING OFFICE 3—10428

Subject: Claremont Dam
Computation: Operating House Floor Beams El 650.5
Computed by: A.L.K. Checked by: Date: 2 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

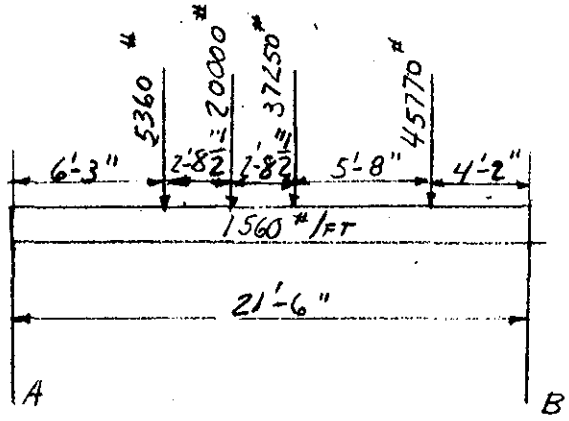
Beam B-5

Beam B-5 will be designed for gate hoist concentrations plus a uniform Live load on the slab of 100#/□' and an emergency gate placed between B-3 and B-1

Loadings

D.L. of beam = 2.12 x 2.16 x 150 = 690
D.L. of slab = 4.33 x 125 = 540
L.L. on slab = 3.27 x 100 = 330
1560 #/FT

Reaction from B-1 = 37250#
" " B-2 = 45770#
" " B-3 = 5360#



$$R_A = 1560 \times \frac{21.5}{2} + \frac{5360 \times 15.25}{21.5} + \frac{20000 \times 12.54}{21.5} + \frac{37250 \times 9.83}{21.5} + \frac{45770 \times 4.16}{21.5} = 58160^{\#}$$

$$R_B = 1560 \times \frac{21.5}{2} + \frac{5360 \times 6.25}{21.5} + \frac{20000 \times 9.04}{21.5} + \frac{37250 \times 11.83}{21.5} + \frac{45770 \times 17.34}{21.5} = 83750^{\#}$$

$x_0 = 9.83'$ from B

$$+M = 83750 \times 9.83 - 45770 \times 5.67 - \frac{1560 \times 9.83^2}{2} = 486{,}600'^{\#}$$

req'd $d = \sqrt{\frac{486{,}600 \times 12}{123 \times 25.5}} = 43.1'' > 33.5''$

Try Beam 25.5" x 39"

Beam will act as a Tee Beam.

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A. L. K. Checked by: Date: 3 Jan. 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-5 cont'd

$b = 57''$ $\frac{t}{d} = \frac{10}{35.5} = .282$ $K = 122.5$

req'd $d = \sqrt{\frac{486,600 \times 12}{122.5 \times 57}} = 28'' < 34.50''$ (d) for 2 layers of steel

$v = \frac{83750}{25.5 \times .88 \times 34.50} = 108$ #/□"

Reduced $V = 83,750 - 1560 \times 1 = 82,190$#

$v = \frac{82190}{25.5 \times .88 \times 34.5} = 105$ #/□" use stirrups

$+A_s = \frac{486600 \times 12}{18000 \times .88 \times 34.5} = 10.7$ □"

use { 5-1 1/8" □ bot. layer
{ 5-1" □ top layer

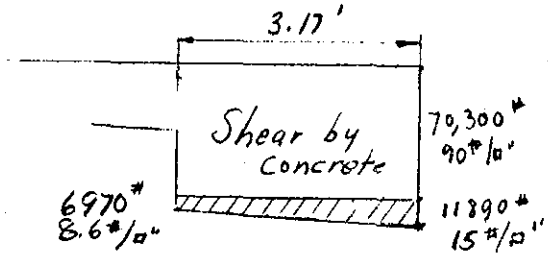
Bending Pts. for top layer of steel Right side

$M = 5 \times 20000 \times .88 \times \frac{36.5}{12} = 268,000$ '#

$83750x - 1560\frac{x^2}{2} = 268000$ '# $x = 3.0'$

Run steel through because bending pt. is too close to support.

$-A_s = 8.0$ □" 5-1 1/4" □



Stirrups Req'd

1/2" ϕ carries $2 \times .2 \times 16000 = 6400$#

$\frac{90}{105} \times 82190 = 70,300$#

Right side

No. of stirrups $= \frac{\frac{11890 + 6970}{2} \times 3.17}{6400 \times .875 \times 36.37} = .146$

use 4-1/2" ϕ ties @ 1'-0" @ each end. of beam

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 15 Jan. 1945

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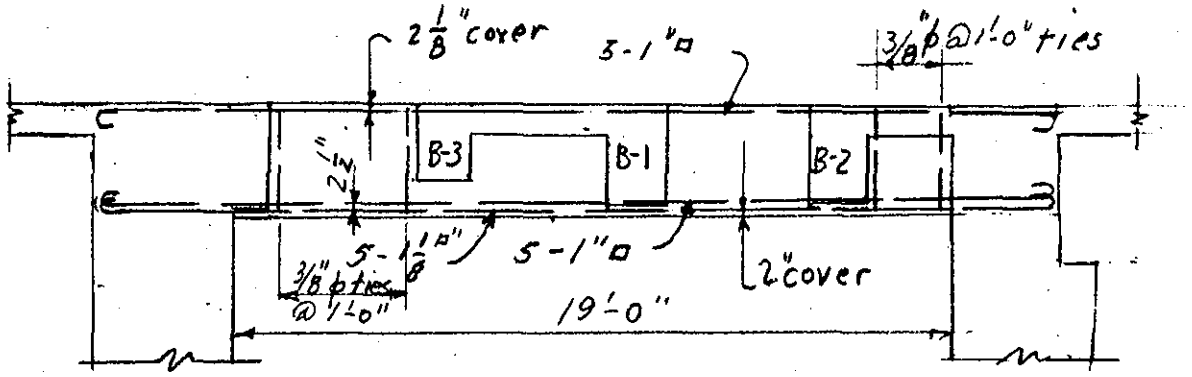
Beam B-5 cont'd.



Beam B-5 2'-1 1/2" x 3'-3" deep

Project: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 26 Dec 1944

U.S. GOVERNMENT PRINTING OFFICE 3—10526

Beam B-4

Dead loads from column and pilaster at entrance (west side)

Entrance Lintel	6.12 X .67 X 150 =	614
" "	1.25 X 1.25 X 150 =	235
" " Conc. Beam	$\frac{11.75}{12}$ X 1.07 X 150 =	157
" " Brick	$\frac{4}{12}$ X 4.28 X 120 =	129
		1135 #/FT

Lintel Load on Pilaster $\frac{1135 \times 15.33}{2}$ = 8700

Wt of Pilaster	3.5 X .67 X 20.44 X 150	= 7200
Wt of door into pilaster		= 600
Wt of brick at "	1.04 X 3.5 X 20.44 X 120	= 8950
Concentrated D.L. into B-4 applied 5'-11" from ℄		25450 #

Wt of brick around column	1.5 X 1.71 X 18.48 X 120 =	5700
" " " " "	$\frac{4}{12}$ X 1.71 X 14.43 X 120 =	990
		6690 #

Concentrated D.L. into B-4 applied 5'-6" from ℄ = 6690 #

Concentrated D.L. into B-4 from column applied 5'-6" from ℄ = 65200 # Approx.

Live loads from columns (west side)

Wind Load	5200 #
Roof Live load	13400 #
Crane load	72000 #
Total concentr. Load	90600 # Approx.

this load occurs when crane is operating on either of the two outer service gate wells.

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 2 Jan 1945

U.S. GOVERNMENT PRINTING OFFICE 3—10526

Beam B-4 cont'd

D.L. on cantilever (East side)

- Concentrated D.L. into B-4 from column = 50,000# Approx.
  (applied 5'-6" from ℄ of tower)

  concentrated D.L. into B-4 from brick around column 6690#
  (applied 5'-6" from ℄ of tower)

Unif D.L of B-4 = 3.25 x 2.75 x 150 = 1340 #/ft.

Live load on cantilever from column (east side)

Wind load	2600
Roof Live load	13500
Crane load	82000
Total conc. Load	98,100 # Approx.

this load occurs when crane is operating on either of the two outer emergency gates.

Concentrations from Beams

D.L. + L.L Reactions	from	B-1	= 98430 #
" "	"	B-2	= 126890 #
" "	"	B-3	= 40000 #
Dead Load Reactions	from	B-7	= 110,400 #
		B-8	= 76700 #
		B-9	= 60400 #
Live load Reactions	from	B-7	= 20,900#
" " "	"	B-8	= 17690 #
" " "	"	B-9	= 24780 #

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Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: A.L.K. Checked by: Date: 4 Jan 1945
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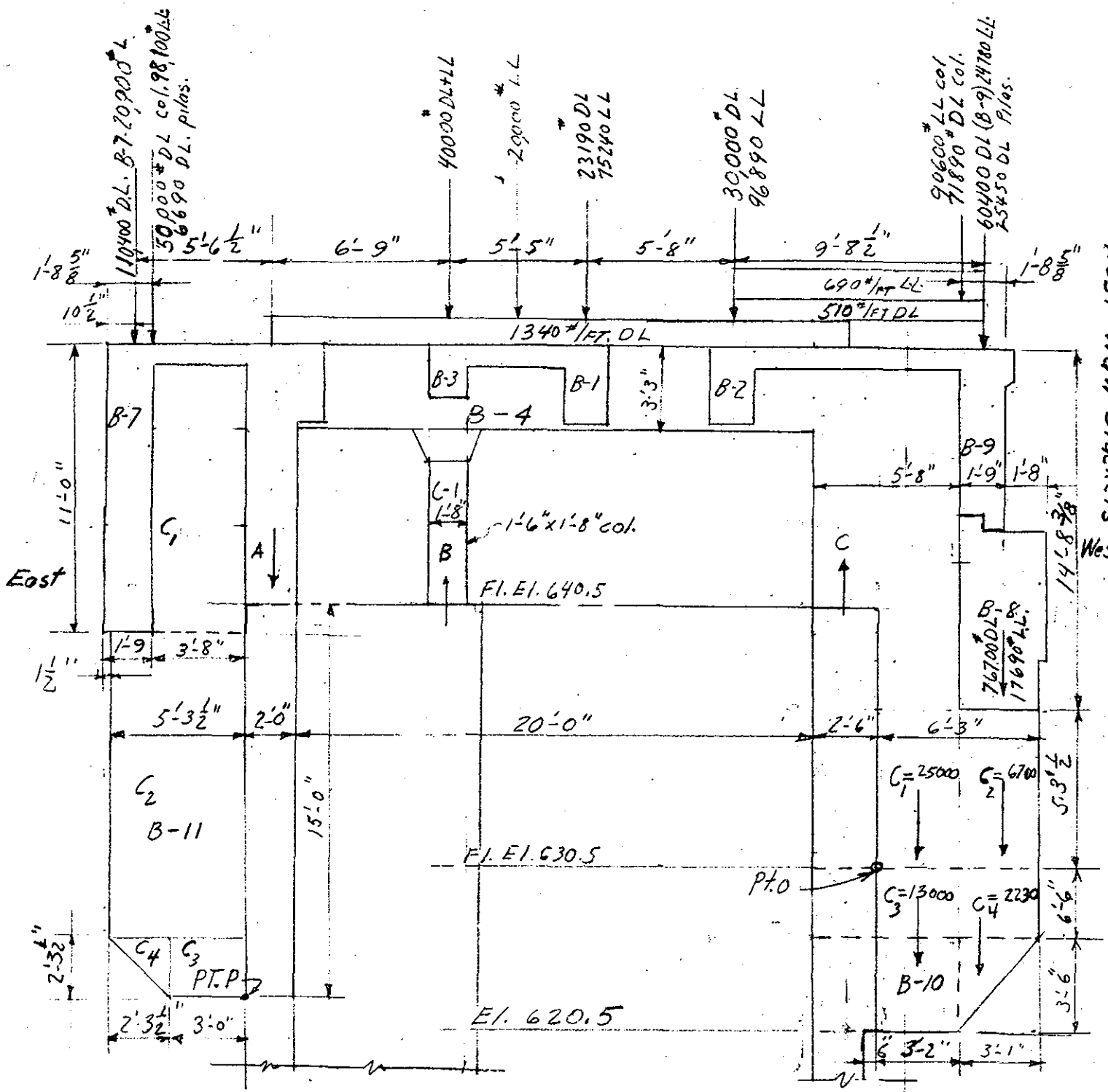
Beam B-4 cont'd

Diagram showing loadings on Beam B-4 and East & West Wall Brackets



Beam B-4 cont'd

CASE I Beam B-4 will be designed for Dead Load and and Live Load concentrations from B-1 & B-2 and Emergency gate between B-1 & B-3

Fixed end Moments

$$M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 1340 \times 6.75^2 = 5.1^{'k}$$

$$M^F_{BC} = \frac{20000 \times 2.71 \times 12.79^2}{15.5^2} + \frac{98430 \times 5.41 \times 10.09^2}{15.5^2} + \frac{1}{12} \times 1340 \times 15.5^2$$

$$+ \frac{126890 \times 11.08 \times 4.42^2}{15.5^2} + \frac{.285^2(4-.855)}{12} \times 1200 \times 4.42 \times 15.5 =$$

$$= 405.4^{'k}$$

$$M^F_{CB} = \frac{20000 \times 12.79 \times 2.71^2}{15.5^2} + \frac{98430 \times 10.09 \times 5.41^2}{15.5^2} + \frac{1}{12} \times 1340 \times 15.5^2$$

$$+ \frac{126,890 \times 4.42 \times 11.08^2}{15.5^2} + \frac{.285(6-8 \times .285 + 3 \times .285^2)}{12} \times 1200 \times 4.42 \times 15.5 =$$

$$= 449.8^{'k}$$

Stiff factors $AB \ \frac{1}{6.75} = .148$

$BC = \frac{1}{15.5} = .0645$

	A 1.0	.70 B 30		1.0 C	
fixed	6.75'		15.5'		fixed.
	+5.1	-5.1	+405.4	-449.8	
	0	-280.0	-120.3	0	
	-140.0	0	0	-60.2	
	0	0	0	0	
−M	-134.9	-285.1	+285.1	-510.0	
V	-57580#	66,620#	112,660#	157740#	
x_0			→ 5.42		
+M	134,900'#		251,100'#		

$$V_A = 1340 \times \frac{6.75}{2} - \frac{420000}{6.75} = -57,580^{\#} \qquad V_B = 1340 \times \frac{6.75}{2} + \frac{420000}{6.75} = 66620^{\#}$$

$$V_B = 1340 \times \frac{15.5}{2} + 20,000 \times \frac{12.79}{15.5} + 98430 \times \frac{10.09}{15.5} + 126890 \times \frac{4.42}{15.52} +$$

$$+ 1200 \times 4.42 \times \frac{2.21}{15.5} - \frac{224,900}{15.5} = 112,660^{\#}$$

Subject: Claremont Dam

Computation: Operating House Floor Beam El. 650.5

Computed by: A.L.K. Checked by: Date: 10 Jan 1945

U.S. GOVERNMENT PRINTING OFFICE 3—10638

Beam B-4 cont'd CASE I

$$V_C = 1340 \times \frac{15.5}{2} + 20000 \times \frac{2.71}{15.55} + 98430 \times \frac{5.41}{15.5} + 126890 \times \frac{11.08}{15.5} +$$

$$+ 1200 \times 4.42 \times \frac{13.29}{15.5} + \frac{224,900}{15.5} = 157,740^{\#}$$

$x_0 = 5.42$

$$+M = 112,600 \times 5.42 - 1340 \times \frac{5.42^2}{2} - 20000 \times 2.71 - 285,100 = 251,100^{'\#}$$

Reduction of M @ face of wall at pt C

$$V = 157740 - 2540 \times 1.25 = 154,560$$

$$M = 510,000 - \left(\frac{157740 + 154,560}{2}\right) \times 2.5 \times .33 = 397,000^{'\#}$$

$$d_{req'd\ -M} = \sqrt{\frac{397,000 \times 12}{33 \times 147}} = 31.4'' < 35.13''$$

$$d_{req'd\ +M} = \sqrt{\frac{251,100 \times 12}{123 \times 33}} = 27.1 < 36.5$$

$$+v = \frac{154,560}{33 \times .88 \times 35.13} = 152\ \#/\square'' \quad \text{Stirrups}$$

$$v = \frac{112,600}{33 \times .88 \times 35.13} = 110\ \#/\square'' \quad \text{Stirrups}$$

$$-A_s = \frac{397,000 \times 12}{18000 \times .88 \times 35.13} = 8.6\ \square'' \quad \text{use } 6-1\tfrac{1}{4}''\square \text{ top}$$

$$+A_s = \frac{251,100 \times 12}{18000 \times .88 \times 36.5} = 5.3\ \square'' \quad \text{use } 6-1''\square \text{ bott.}$$

$$u = \frac{154,560}{30 \times .88 \times 35.13} = 166\ \#/\square''$$

Subject: Claremont Dam
Computation: Operating House Floor Beams El. 650.5
Computed by: AL.K Checked by: Date: 6 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10038

B-4 cont'd Case II

CASE II Dead Loads from B-1 & B-2 and Max. column LOAD (west side)

Fixed End Moments

$M^F_{BC} = M^F_{CB} = 5.1$ 'K

$$M^F_{CD} = \frac{23190 \times 5.42 \times \overset{53.0}{10.09}^2}{15.5^2} + \frac{1}{12} \times 1340 \times \overset{26.8}{15.5}^2 + \frac{30000 \times 11.08 \times \overset{27.0}{4.42}^2}{15.5^2} + \cdot 285 \overset{1.8}{\left(\frac{3.145}{12}\right)} \times 1200 \times 4.42 \times 15.5 = 108.6 \text{ 'K}$$

$$M^F_{DC} = \frac{23190 \times \overset{28.2}{10.09} \times 5.42^2}{15.5^2} + \frac{1}{12} \times 1340 \times \overset{26.8}{15.5}^2 + \frac{30000 \times \overset{27.8}{4.42} \times 11.08^2}{15.5^2} + \cdot 285 \times \frac{4.136}{12} \times 1200 \times \overset{7.2}{4.42} \times 15.5 = 130.0 \text{ 'K}$$

	A .00	.70	B .30	1.00 C	
fixed	+5.1	-5.1	+108.6	-130.0	fixed
	0	-72.5	-31.0	0	
	-36.3	0	0	-15.5	
	0	0	0	0	
-M	-31.2	-77.6	+77.6	-145.5	
V	-11580#	20600#	25160#	42160#	

$V_A = 1340 \times \frac{6.75}{2} - \frac{108,800}{6.75} = -11580$ $V_B = 1340 \times \frac{6.75}{2} + \frac{108,800}{6.75} = 20600$

$$V_B = 1340 \times \frac{15.5}{2} + 23190 \times \frac{10.09}{15.5} + 30000 \times \frac{4.42}{15.5} + 1200 \times 4.41 \times \frac{2.21}{15.5} - \frac{67,900}{15.5} = 25160\#$$

$$V_C = 1340 \times \frac{15.5}{2} + 23190 \times \frac{5.41}{15.5} + 30000 \times \frac{11.08}{15.5} + 1200 \times 4.41 \times \frac{13.3}{15.5} + \frac{67900}{15.5} = 42940$$

Project: Claremont Dam
Computation: Operating House Floor Beams #1,650.5
Computed by: A.L.K. Checked by: Date: 12 Jan 1945

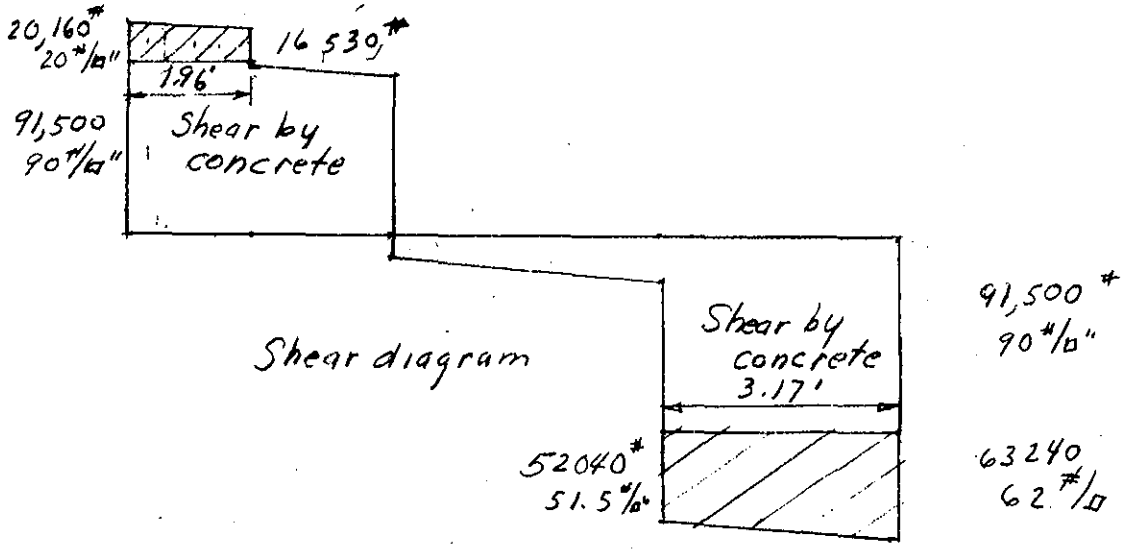
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-4 cont'd.

Stirrups Req'd.

use $\frac{1}{2}$"ϕ Stirrups one stirrup takes $2 \times .20 \times 16000 = 6400$ #

$\frac{90}{110} \times 111{,}600 = 91500$ # $\frac{90}{152} \times 154{,}740 = 91500$ #



Left side

No. of stirrup = $\dfrac{\frac{20160+16530}{2} \times 1.96 \times 12}{6400 \times .875 \times 35.13} = 2.2$ (3 stirrups)

Spacing .40×16000 = 20×33×S_1 9.7"
9920 = 16×33×S_2 18.8" Space @ 4", 12", 12")

Right side use $\frac{5}{8}$"ϕ stirrups

No. of stirrups = $\dfrac{\frac{63240+52{,}040}{2} \times 3.17 \times 12}{9920 \times .875 \times 35.13} = 7.2$ (8 stirrups)

Spacing .62×16000 = 62×33×S_1 S_1 = 4.85"
9920 = 60.6×33×S_2 S_2 = 4.95"
9920 = 59.1×33×S_3 S_3 = 5.1"
9920 = 57.7×33×S_4 S_4 = 5.2"
9920 = 56.3×33×S_5 S_5 = 5.4"
9920 = 54.8×33×S_6 S_6 = 5.4"
9920 = 53.3×33×S_7 S_7 = 5.7"
Spacing @ $2\frac{1}{2}$, 7 @ $5\frac{1}{2}$" cc

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Computed by: A.L.K. Checked by: Date: 8 Jan 1945

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Beam B-10 West side cantilever bracket will be designed to support concrete column which supports Max. D.L. + L.L. on west side.

Moments about Pt. O. of column loads :-

Loads	Moments
$C_1 = 3.16 \times 2.75 \times 19.16 \times 150 = 25000$	$25000 \times 1.58 = 29500$
$C_2 = 5.3 \times 2.75 \times 3.08 \times 150 = 6700$	$6700 \times 4.71 = 31600$
DL+LL column (steel) $= 162490$	$162490 \times 3.20 = 520000$
DL+LL B-9 and Pilaster $= 110630$	$110630 \times 4.05 = 446000$
DL+LL B-8 $= 94390$	$94390 \times 4.87 = 458000$
Slab DL+LL $1200 \times 4.03 = 4830$	$4830 \times 2.02 = 9750$
404040	1,494,850

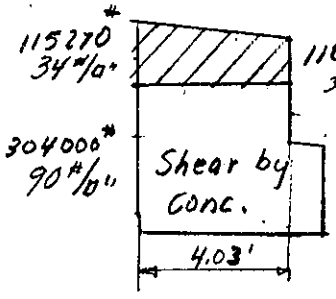
$C_3 = 10 \times 2.75 \times 3.16 \times 150 = 13000$	$13000 \times 1.58 = 20500$
$C_4 = 3.08 \times \frac{3.5}{2} \times 2.75 \times 150 = 2230$	$2230 \times 4.18 = 9350$
$\Sigma V = 419270$	1524700
	145,500
	1,379,200 ′#

$$d \text{ req'd} = \sqrt{\frac{1,379,200 \times 12}{123 \times 33}} = 64.0'' > 116''$$

$$v = \frac{419270}{33 \times .88 \times 116} = 124\#/\square'' \text{ use stirrups}$$

$$A_s = \frac{1,670,200 \times 12}{18000 \times .88 \times 116} = 9.0 \ \square'' \text{ use } 6 - 1\tfrac{1}{4}''\square$$

$$u = \frac{419270}{30 \times .88 \times 116} = 137\#/\square''$$



$\frac{90}{124} \times 419270 = 304,000\#$ use $\frac{5}{8}''\phi$ Stirrups

No. of Stirrups $= \dfrac{112860 \times 4.03 \times 12}{9920 \times .875 \times 116} = 5.4$

Spacing $9920 = 34 \times 33 \times S_1 : S_1 = 8.85''$ use $6 - \frac{5}{8}''\phi$ Stirrups
$9920 = 33.8 \times 33 \times S_2 : S_2 = 8.9''$
$9920 = 33.5 \times 33 \times S_3 : S_3 \ 9.0''$
$9920 = 33.2 \times 33 \times S_4 : S_4 \ 9.0''$
$9920 = 33.0 \times 33 \times S_5 : S_5 = 9.0''$

Space @ $4\frac{1}{2}''$, 5" @ 9".

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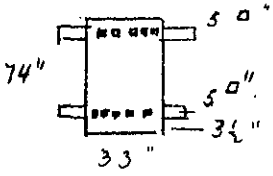
Column on bracket (west side)

Resultant Load 3.7' from Pt. O

Assume column 33" X 74" & $A_s = 10 \square''$

External Moment from B-4 @ Pt C = 145,500'# (CASE II) and DL+LL on bracket column



$33 \times 74 = 2440 \times \frac{74^2}{12} = 4,110,000$

$11 \times 10 = 110 \times 33.5^2 = 112,000$

Trans. Area 2550 Trans I 1,222,000

$f_{c_1} = \frac{404,000}{2550} \pm \frac{404,000 \times 22.4 \times 37}{1,222,000} \mp \frac{145,500 \times 12 \times 37}{1,222,000} = 250\ \#/\square''$

$f_{c_2} = 68\ \#/\square''$

$R^2 = \frac{1,222,000}{2550} = 478 \qquad R = 21.8''$

$$\text{Allowable } f_c = \frac{.18 \times 3000 + .8 \times 16000 \times .004}{1 + 11 \times .004} \left[\frac{1 + \frac{22.4 \times 37}{21.8^2}}{1 + \frac{.8 \times 22.4 \times 37}{21.8^2}} \right]$$

$f_c = 650\ \#/\square''$ use $A_s = 10 - 1''\square$

External Moment from B-4 @ Pt C = 504,800'# (CASE I) and Dead Loads on bracket column

LOADS		MOMENTS
$C_1 = 4.41 \times 2.75 \times 10 \times 150 =$	18200	$\times$ 2.2 = 40000
D.L. column =	71890	$\times$ 4.45 = 320000
D.L. B-9 & Pilas. =	85850	$\times$ 5.30 = 455000
Slab DL 510 X 4.03 =	2060	$\times$ 3.27 = 6750
D.L. B-8 =	76700	$\times$ 6.12 = 470 000
$\Sigma V =$	254700	$\Sigma M = 1,291,750$

$X_0 = \frac{1,291,800}{254,700} = 5.1'$

$e = 61 - 37 = 24''$

$f_c = \frac{254,700}{2550} \pm \frac{254,700 \times 24 \times 37}{1,222,000} \mp \frac{510,000 \times 12 \times 37}{1,222,000} =$

$f_c = 100 \pm 185 \mp 184 = 100\ \#/\square''$

$= 100\ \#/\square''$

Subject Claremont Dam
Computation Operating House Floor Beams El. 650.5
Computed by A.L.K. **Checked by** **Date** 10 Jan 1945

U.S. GOVERNMENT PRINTING OFFICE 3—10598

Beam B-7

Beam B-7 will be designed for uniform live load on slab of 750#/□' plus dead load of slab, beam, and superstructure.

Dead Loads on beam

Superstructure

brick walls	3.63 × .33 × 120 =	150
" "	1.00 × .33 × 120 =	40
" "	12.27 × 1.04 × 120 =	1530
" "	15.75 × 1.37 × 120 =	2530
coping	2.15 × .75 × 150 =	240
curbing (conc)	2.77 × 1.5 × 150 =	630
beam "	× 1.75 × 150 =	2900
10" slab	1.83 × 125 =	230
		8250 #/FT

$M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 8250 \times 13.42^2 = 124^{'k}$

$M^F_{BC} = M^F_{CB} = \frac{1}{12} \times 8250 \times 11^2 = 83.3^{'k}$

$K_{BA} = \frac{1}{13.42} = .075 \quad K_{BC} = \frac{1}{11} = .091$

	A		B		C		D
	0	13'-5" .45	.55	11'-0" .55	.45	13'-5"	0
			37'-10"				
	+124.0	−124.0	+83.3	−83.3	+124.0		−124.0
	−124.0	+18.3	+22.4				
	+6.1	−62.0	−11.2				
	−6.1	+33.0	+40.2				
	+16.5	−3.2	−20.1				
	−16.5	+10.5	+12.8				
−M	0	−127.4	+127.4	−127.4	+127.4		0
V	46000	65000	45400	45400	65000		46000
Xo	→ 5.57		→ 5.5		5.57 ←		
+M	128,000 '#		No. Pos. M		128,000		

$V_A = 8250 \times \frac{13.42}{2} - \frac{127400}{13.42} = 46000$ #

$V_B = 8250 \times \frac{13.42}{2} + \frac{127400}{13.42} = 65,000$ #

$+M = 46000 \times 5.57 - 8250 \times \frac{5.57^2}{2} = 128,000$ '#

Subject: Claremont Dam
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Computed by: A.L.K. Checked by: Date: 12 Jan 1945

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Beam B-7 cont'd

$V_B = V_C = 8250 \times \frac{11}{2} = 45400^{\#}$

$+M = 45400 \times 5.5 - 8250 \times \frac{5.5^2}{2} - 127500 = -2500$

Live load on beam

slab L.L. $2.08 \times 750 = 1560$ #/FT

Final L.L. Mom & shears are in the ratio of $\frac{1560}{8250}$ times D. Load Mom'ts & shears

	A		B - 1560 #/FT.		C	D
	0	.45	.55	.55	.45	0
−M	0	−24.1	+24.1	−24.1	+24.1	0
V	8700	12300	8600	8600	12300	8700
+M	24,200		No. Pos. M.		24,200	

Total D.L. + L.L. Moments

$M_{BA} = -24{,}100 - 127{,}400 = -151{,}500'^{\#}$

$M_{BC} = -151500'^{\#}$

$+M_{AB} = 128000 + 24{,}200 = 152{,}200'^{\#}$

Total D.L. + L.L. Shears

$V_{AB} = 54700^{\#}$ $V_{BA} = 77300^{\#}$

$V_{BC} = 54000^{\#}$ $V_{CB} = 54000^{\#}$

Design of Beam

req'd $d_{+M} = \sqrt{\frac{152200 \times 12}{123 \times 21}} = 26.6'' < 128.5''$

$v = \frac{77300}{21 \times .88 \times 128.5} = 32$ #/□"

$+A_s = \frac{152{,}200 \times 12}{18000 \times .88 \times 128.5} = .90$ □" use 3-$\frac{3}{4}$"ϕ bot.

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Beam B-7 cont'd.

$$A_s = \frac{151,500 \times 12}{18000 \times .88 \times 129.87} = .64 \ \square'' \text{ use } 3-\tfrac{3}{4}''\phi \text{ top}$$

$$u = \frac{77300}{7.2 \times .88 \times 129.87} = 94 \#/\square''$$

Beam B-11 East side cantilever bracket will be designed to support concrete column which supports Max D.L.+L.L. on east side.

Loads		Moments about Pt. P
$C_1 = 3.67 \times 2.75 \times 11 \times 150 =$	16700 ×	1.83 = 30500
D.L.+L.L. column (steel) =	154,790 ×	3.70 = 571000
D.L.+L.L. B-7 =	131,400 ×	4.55 = 498000
$C_2 = 5.29 \times 2.75 \times 11.58 \times 150 =$	25300 ×	2.64 = 66000
$C_3 = 2.29 \times \frac{2.42}{2} \times 2.75 \times 150 =$	1330 ×	3.76 = 5000
$C_4 = 3 \times 2.42 \times 2.75 \times 150 =$	3000 ×	1.5 = 4500
$\Sigma V =$	332520 #	1,175,000
		31,200
		ΣM 1,206,200 '#

$$d \text{ req'd} = \sqrt{\frac{1,206200 \times 12}{123 \times 23}} = 71.5'' < 164.5$$

$$v = \frac{332,520}{33 \times .88 \times 164.5} = 69.8 \#/\square''$$

$$A_s = \frac{1,206,200 \times 12}{18000 \times .88 \times 164.5} = 5.60 \ \square'' \quad \text{use } 6-1''\square$$

$$u = \frac{332,520}{24 \times .88 \times 164.5} = 96 \#/\square''$$

Column on bracket (east side)

Assume effective column section 33" x 89" & $A_s = 10 \ \square''$

External Mom. from B-4 @ Pt A = 31,200'# (CASE II) and D.L.+LL on Bracket column

$M = 31,200 + 1,099,000 = 1,130,200'\#$

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Column on bracket (east side) cont'd.

DL+LL on column

C_1 =	16700	× 1.5 =	25000
D.L+LL B-7	131,400	× 34.0 =	4,470,000
D.L+L.L col.	154,790	× 23.88 =	3,690,000
	302,890 #		8,185,000 '#
			31,200
			8,216,200 '#

Moments about ℄ of column.

$$e = \frac{8,216,200}{302890} = 27.1''$$

According to A.C.I Bldg Code Par. 1109 $\frac{e}{t} = \frac{27.1}{89} = .305$

$33 \times 89 = 2930 \times \frac{89^2}{12} = 1,935,000$
$11 \times 10 = 110 \times 4/2 = 185000$
TRANS. A 3040 □" $I = 2,120,000$ in^4

$$R = \sqrt{\frac{2,120,000}{3040}} = 26.4$$

$$D = \frac{89^2}{2 \times 697} = 5.7$$

$$fc = \frac{302890}{3040}\left[\frac{1 + 5.7 \times \frac{27.1}{89}}{1 + 11 \times .0034}\right] = 262\ \#/\square''$$

use 5-1"□ each face

External M from B-4 at Pt. A = 134,900 '# (CASE I) and D.L. on BRACKET.

DL. on column

C_1 =	16700 × 1.5 =		25100
D.L. col.	56690 × 23.88 =		1352000
D.L. B-7	110,400 × 34.00 =		3760000
	183,790 #		5137100 '#
			134,900
			5,272,000 '#

Moments about ℄ of column.

$$e = \frac{5,272,000}{183,790} = 28.7''$$

$$\frac{e}{t} = \frac{28.7}{89.0} = .324$$

$$fc = \frac{183890}{3040}\left[\frac{1 + 5.7 \times \frac{28.7}{89}}{1 + 11 \times .0034}\right] = 165\ \#/\square''$$

use 5-1"□ each face.

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Operating House Floor Beams El. 650.5

Computed by A. L. K. **Checked by** **Date** 15 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Column supporting B-4

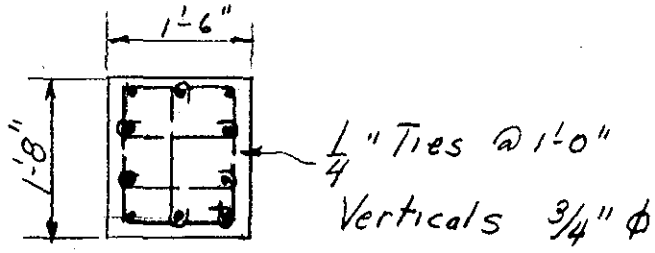
assume 18" x 20" $A_s = 3.52$ □" 10 - 3/4" ϕ

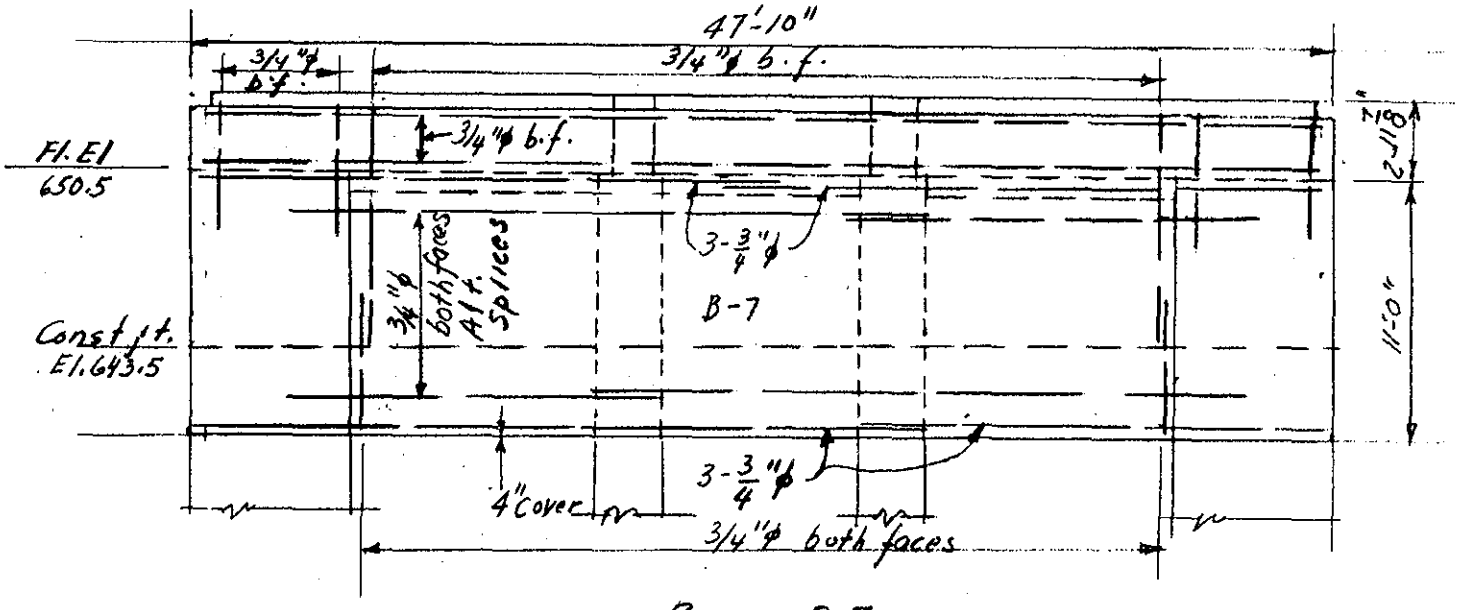
A_g 360 □" $f'_c = 3000$ #/□"

ACI Bldg code (1941) Par 1103 $P = A_g(.225 f'_c + f_s p_g)$

$P = 8 \times 360 (.225 \times 3000 + 16000 \times .0122) = 250{,}000$# Allowable

$P_1 = 40000 + 179{,}300 = 219{,}300$ # Actual.





Beam B-7

11'-0" deep x 1'-9" wide

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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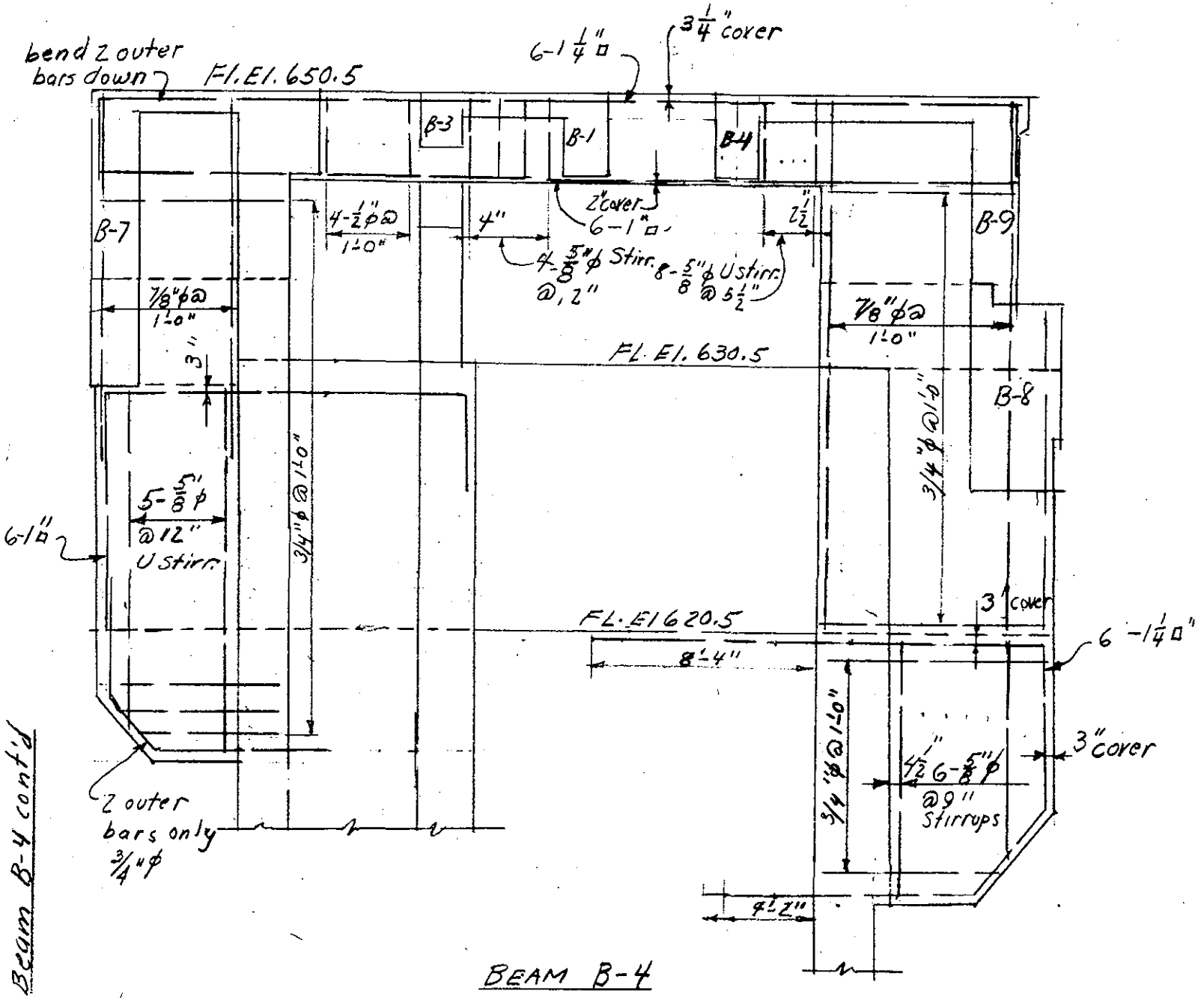


Beam B-4 cont'd

BEAM B-4

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

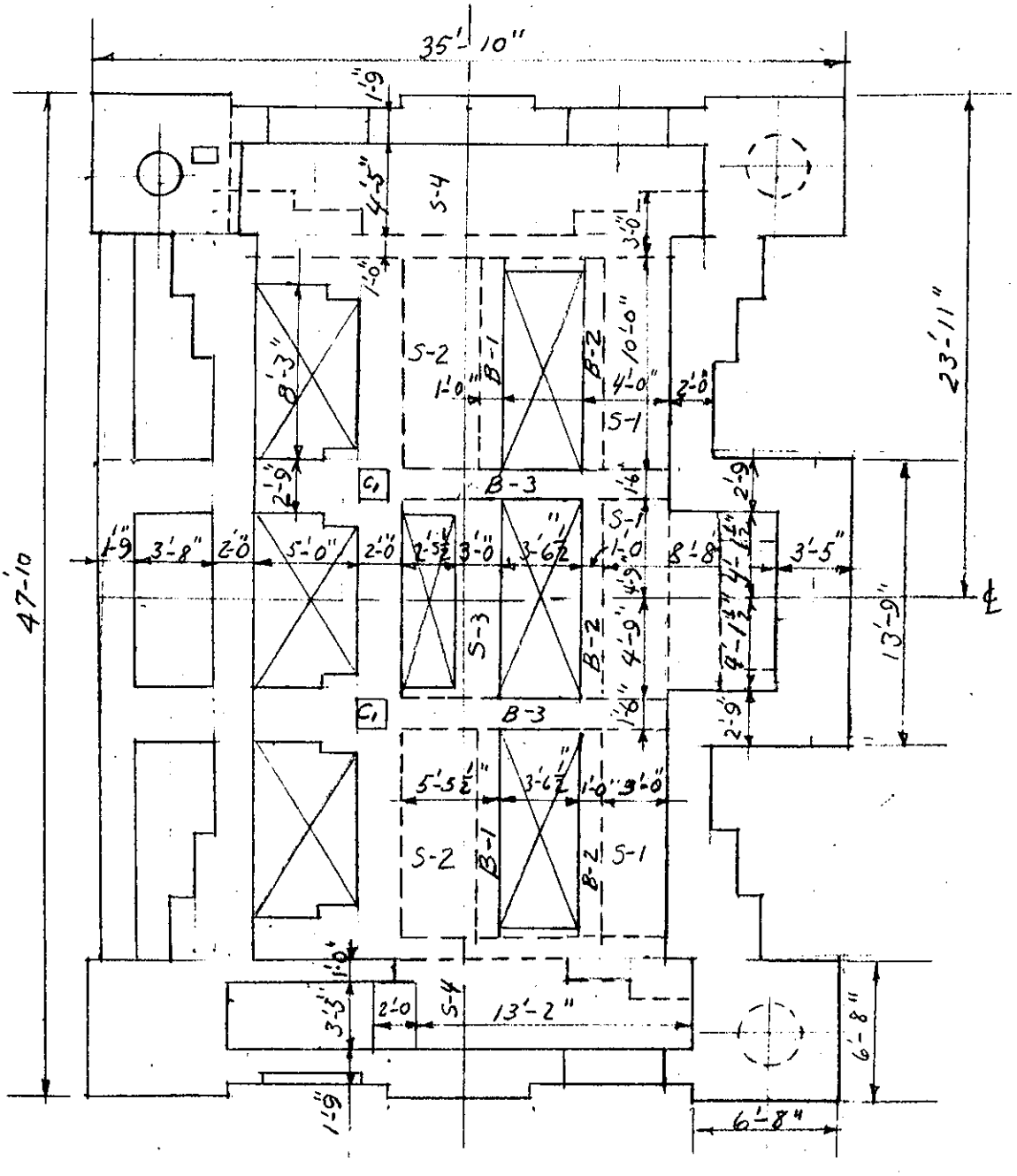
Subject Claremont Dam

Computation Operating House - Basement Floor El. 640.5

Computed by A.L.K. **Checked by** **Date** 15 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

The basement floor @ 640.5 will be designed for Live load of 250 #/□' on the floor, because there is no possibility of heavy equipment loading on this level.



Upper Basement floor Plan
El. 640.5

Subject: Claremont Dam

Computation: Operating House - Basement Floor El 640.5

Computed by: A.L.K. Checked by: Date: 15 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

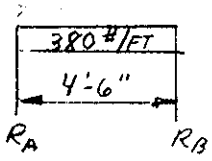
Slab S-1

Loadings

10" slab D.L. 125

Live load 250

375 #/FT SAY 380 #/FT.



$+M = \frac{1}{8} \times 380 \times 4.5^2 = 962'\#$

$R_A = R_B = 380 \times \frac{4.5}{2} = 855\#$

$v = \frac{855}{12 \times .875 \times 8.25} = 9.9\#/\square''$

$+A_s = \frac{962 \times 12}{18000 \times .884 \times 7.75} = .093$ use $\frac{5}{8}''\phi$ @ 12" top & bott.

$u = \frac{855}{12 \times .884 \times 8.25} = 59\#/\square''$ temp $\frac{1}{2}''\phi$ @ 1'-0"

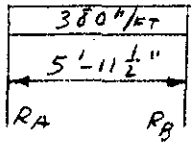
Slab S-2

Loadings

10" slab D.L. 125

Live load 250

375 #/FT 380 #/FT.



$+M = \frac{1}{8} \times 380 \times 5.96^2 = 1690'\#$

$R_A = R_B = 380 \times \frac{5.92}{2} = 1121\#$

d req. $d = \sqrt{\frac{1690}{123}} = 3.7'' < 7.69''$

$v = \frac{1121}{12 \times .884 \times 8.25} = 12.8\#/\square''$

$+A_s = \frac{1690 \times 12}{18000 \times .884 \times 7.75} = .166'\square''$ use $\frac{5}{8}''\phi$ @ 12" top & bott.

$u = \frac{1121}{12 \times .884 \times 8.25} = 72\#/\square''$

Subject Claremont Dam

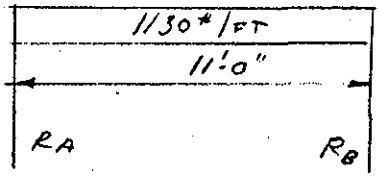
Computation Operating House Basement Floor El 640.5

Computed by H.L.K. **Checked by** **Date** 15 Jan 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Slab 5-3

Assume 10" slab 3 ft wide D.L. = 375
Live load 250×3 = 750
1125 #/FT
SAY 1130 #/FT.



$R_A = R_B = 1130 \times \frac{11}{2} = 6200$ #

$+M = \frac{1}{8} \times 1130 \times 11^2 = 17100$ '#

$d = \sqrt{\frac{17100 \times 12}{123 \times 36}} = 6.8'' < 7.06$

$v = \frac{6200}{36 \times .875 \times 7.87} = 25$ #/□"

$A_s = \frac{17100 \times 12}{18000 \times .884 \times 7.06} = 1.83$ □" $\left\{ \begin{array}{l} 6 - \frac{5}{8}'' \phi \text{ top} \\ 6 - \frac{5}{8}'' \phi \text{ bott.} \end{array} \right.$

$u = \frac{6200}{12 \times .875 \times 7.87} = 75$ #/□"

Subject: Claremont Dam
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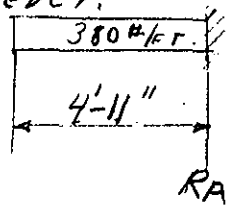
U.S. GOVERNMENT PRINTING OFFICE 3—10528

Slab S-4

Loadings 10" slab 125
Live load 250
375 Say 380 #/FT

For construction purposes slab will be designed as a cantilever.



$M = 380 \times \frac{4.92^2}{2} = 4560$ '#

$R_A = 380 \times \frac{4.92}{2} = 930$ #

$V = \frac{930}{12 \times .88 \times 7.67} = 11.4$ #/□"

$A_s = \frac{4560 \times 12}{18000 \times .88 \times 7.67} = .452$ □" use 5/8"@ 8" cc top & bott

$u = \frac{930}{2.9 \times .88 \times 7.67} = 47.5$ #/□" temp 5/8"φ@1'-0"

Subject Claremont Dam

Computation Operating House - Basement Floor El. 640.5

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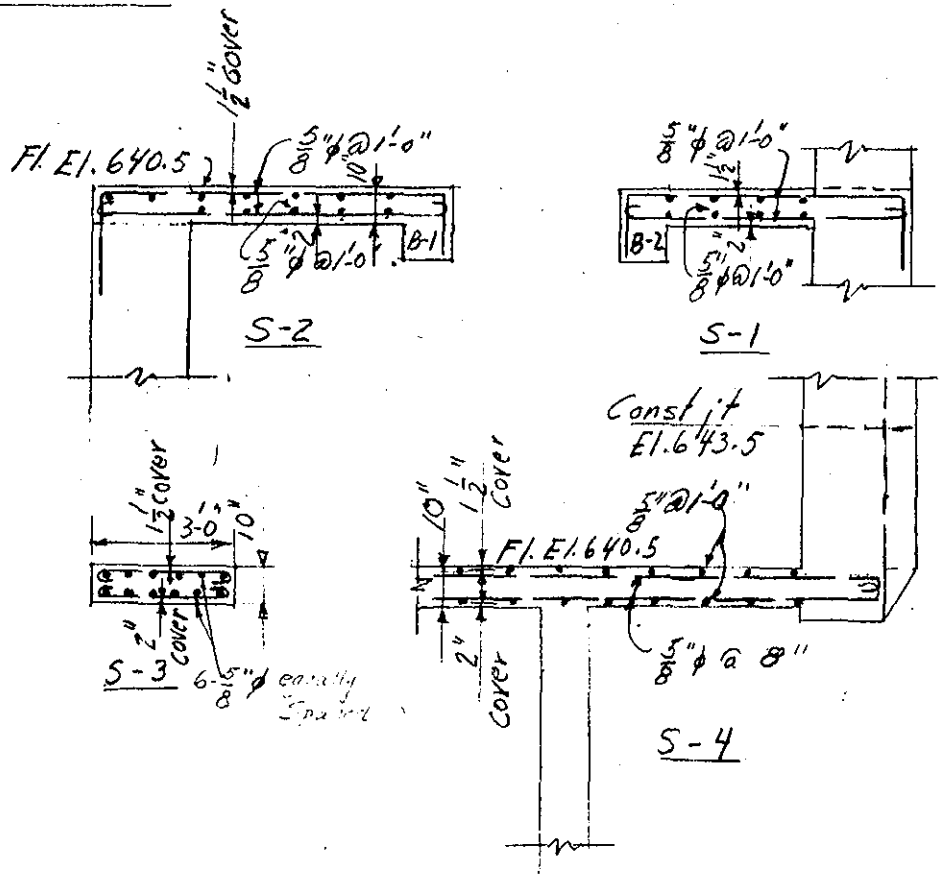
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Slabs cont'd



Project: Claremont Dam
Computation: Operating House - Basement Floor El. 640.5
Computed by: A.L.K. Checked by: Date: 16 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

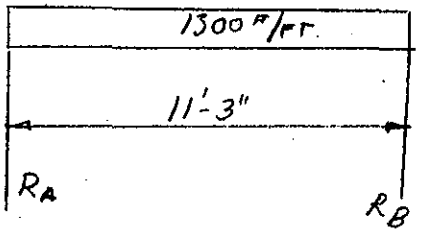
Beam B-1

Assume beam 1'-6" deep by 1'-0" wide

Design loadings

Floor D.L. 10" slab	3.18 X 125 =	398
Floor L.L.	3.18 X 250 =	795
D.L. of Beam	.67 X 1 X 150 =	100
		1293

Say 1300 #/FT.



$+M = \frac{1}{8} \times 1300 \times 11.25^2 = 20600'\#$

$R_A = R_B = 1300 \times \frac{11.25}{2} = 7320\#$

$d \text{ req'd} = \sqrt{\frac{20600}{123}} = 12.9'' < 15.62''$

$v = \frac{7320}{12 \times .875 \times 15.5} = 45 \#/\square''$

$+A_s = \frac{20600 \times 12}{18000 \times .88 \times 15.62} = 1.0 \square''$ use $\begin{cases} 2\text{-}\ 7/8''\phi \text{ bott.} \\ 2\text{-}\ 3/4''\phi \text{ top} \end{cases}$

$u = \frac{7320}{4.8 \times .875 \times 15.5} = 112 \#/\square''$

Subject: Claremont Dam
Computation: Operating House - Basement Floor El. 640.5
Computed by: A.L.K. Checked by: Date: 16 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10523

Beam B-2

Assume 1'-6" deep by 1'-0" wide

Design loadings

Floor D.L. 10" slab	2.5 X 125 =	312
Floor L.L	2.5 X 250 =	625
D.L. of Beam .67 X 1 X 150	=	100
		1037 Say 1040 #/FT

$M^F_{AB} = M^F_{BA} = \frac{1}{12} \times 1040 \times 11.25^2 = 10.95'^K$

$M^F_{BC} = M^F_{CB} = \frac{1}{12} \times 1040 \times 11^2 = 10.50'^K$

	1040 #/FT.					
	0	11'-3" .495	.505	11'-0" .505	.495	11'-3" 0
	A	B		C		D
	+10.95	-10.95	+10.50	-10.50	+10.95	-10.95
	-10.95	+0.22	+0.23			
	+0.11	-5.48	-0.12			
	-0.11	+2.77	+2.83			
	+1.39	-0.06	-1.44			
	-1.39	+0.74	+0.76			
-M	0	-12.76	+12.76	-12.76	+12.76	0
V	4720#	6980#	5720#	5720#	6980#	4720#
x_o	→ 4.54'		5.5'		4.54 ←	
+M	10700'#		2940'#		10700'#	

$V_A = 1040 \times \frac{11.25}{2} - \frac{12760}{11.25} = 4720\#$ $\qquad x_o = 4.54$

$V_B = 1040 \times \frac{11.25}{2} + \frac{12760}{11.25} = 6980\#$

$+M = 4720 \times 4.54 - 1040 \times \frac{4.54^2}{2} = 10700'^\#$

$V_B = V_C = 1040 \times \frac{11}{2} = 5720\#$ $\qquad x_o = 5.5'$

$+M = 5720 \times 5.5 - 1040 \times \frac{5.5^2}{2} - 12{,}760 = 2940'^\#$

Req'd $d_{-M} = \sqrt{\frac{12760}{147}} = 9.3'' < 15.37''$

Req'd $d_{+M} = \sqrt{\frac{10700}{123}} = 9.35'' < 15.5''$

$-A_s = \frac{12760 \times 12}{18000 \times .875 \times 15.56} = .63 \square''$ use $3 - \frac{5}{8}''\phi$

Subject: Claremont Dam
Computation: Operating House - Basement Floor El. 640.5
Computed by: A.L.K. Checked by: Date: 16 Jan 1945

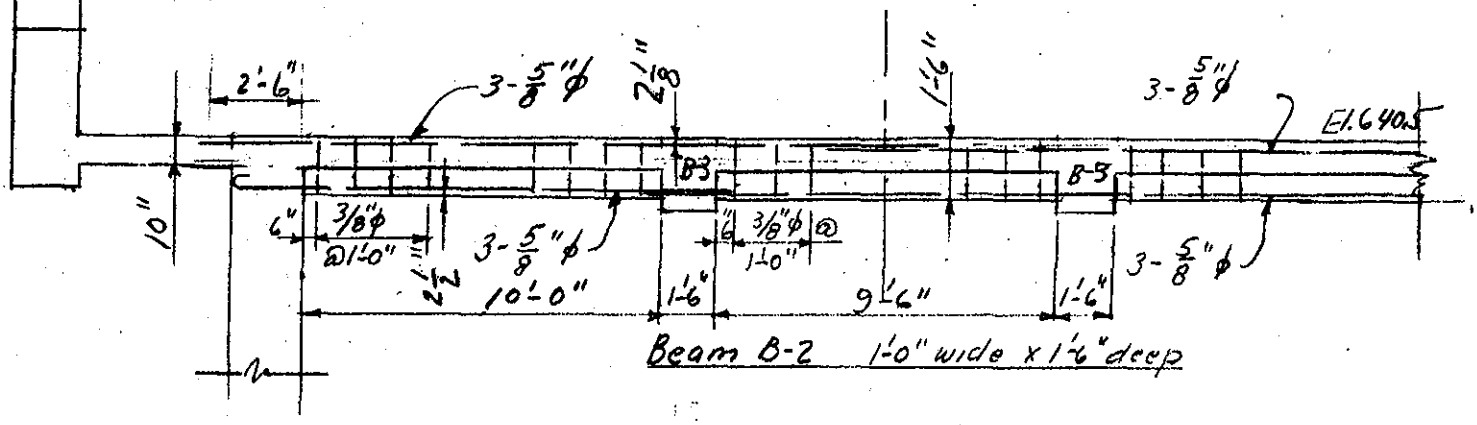
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-2 cont'd

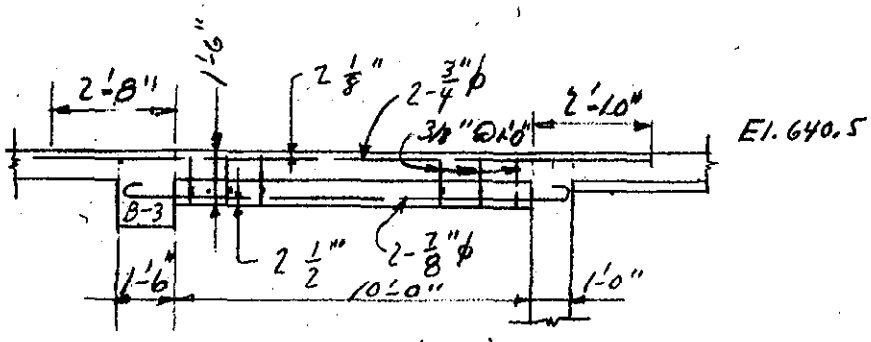
$$+A_s = \frac{10700 \times 12}{18000 \times .88 \times 15.5} = .521 \square'' \quad \text{use } 3-\tfrac{5}{8}''\phi$$

$$v = \frac{6980}{12 \times .875 \times 15.56} = 43\ ^{\#}/\square''$$

$$u = \frac{6980}{6 \times .875 \times 15.56} = 87\ ^{\#}/\square''$$



Beam B-2 1'-0" wide x 1'-6" deep



Beam B-1 1'-0" wide x 1'-6" deep

Subject: Claremont Dam
Computation: Operating House - Basement Floor El 640.5
Computed by: A.L.K. Checked by: Date: 17 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-3

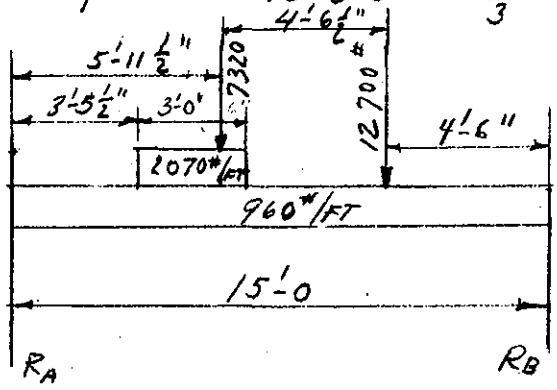
Assume 1'-6" wide x 1'-9" deep

Design loadings

D.L. of beam 1.5x1.75x150 = 394
L.L. on beam 1.5x1.5x250 = 564
958 #/FT say 960 #/FT Uniform DL+LL

Reaction from B-1 = 7320#
" " B-2 = 12700#

LL+DL Load from slab S-3 = $\frac{6200}{3}$ = 2070 #/FT



$R_A = 960 \times \frac{15}{2} + 7230 \times \frac{9.04}{15.0} + 12700 \times \frac{4.5}{15.0} + 2070 \times 3 \times \frac{10.04}{15.0} = 19520^{\#}$

$R_B = 960 \times \frac{15}{2} + 7230 \times \frac{5.96}{15.0} + 12700 \times \frac{10.5}{15.0} + 2070 \times 3 \times \frac{4.96}{15.0} = 21000^{\#}$

$X_0 = 8.65$ from R_B

$+M = 21000 \times 8.65 - 12700 \times 4.15 - 960 \times \frac{8.65^2}{2} - 2070 \times \frac{.11^2}{2} = 93{,}500'^{\#}$

$d_{req} = \sqrt{\frac{93500 \times 12}{123 \times 18}} = 22.4 > 18.5''$ make beam 18"x26" deep

$v = \frac{21000}{18 \times .875 \times 22.62} = 59\ \#/\square''$

$+A_s = \frac{93500 \times 12}{18000 \times .88 \times 23.5} = 3.0\ \square'$ use 3-1"□ bott
3-1"φ top

$u = \frac{21000}{942 \times .875 \times 22.62} = 112\ \#/\square''$

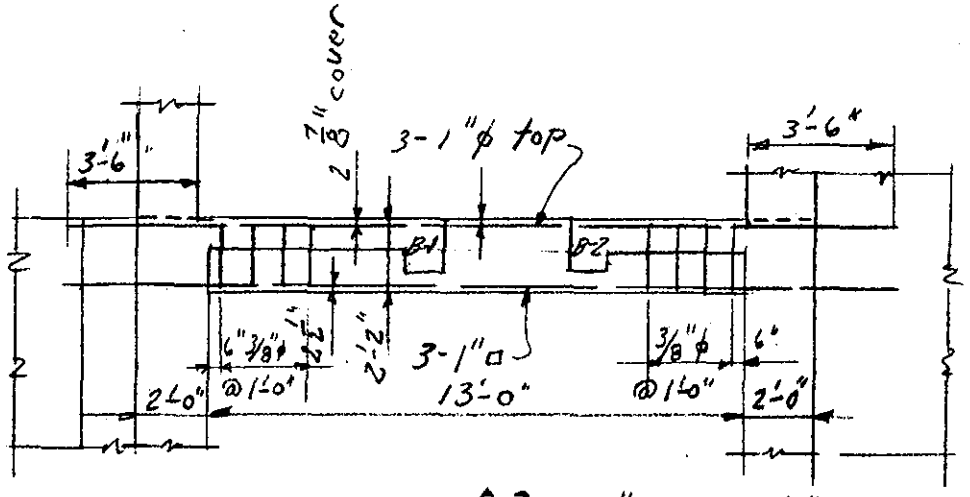
Subject Claremont Dam

Computation Operating House - Basement Floor El 640.5

Computed by A.L.K **Checked by** **Date** 17 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10628

B-3 cont'd



Beam B-3 18" wide x 26" deep

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

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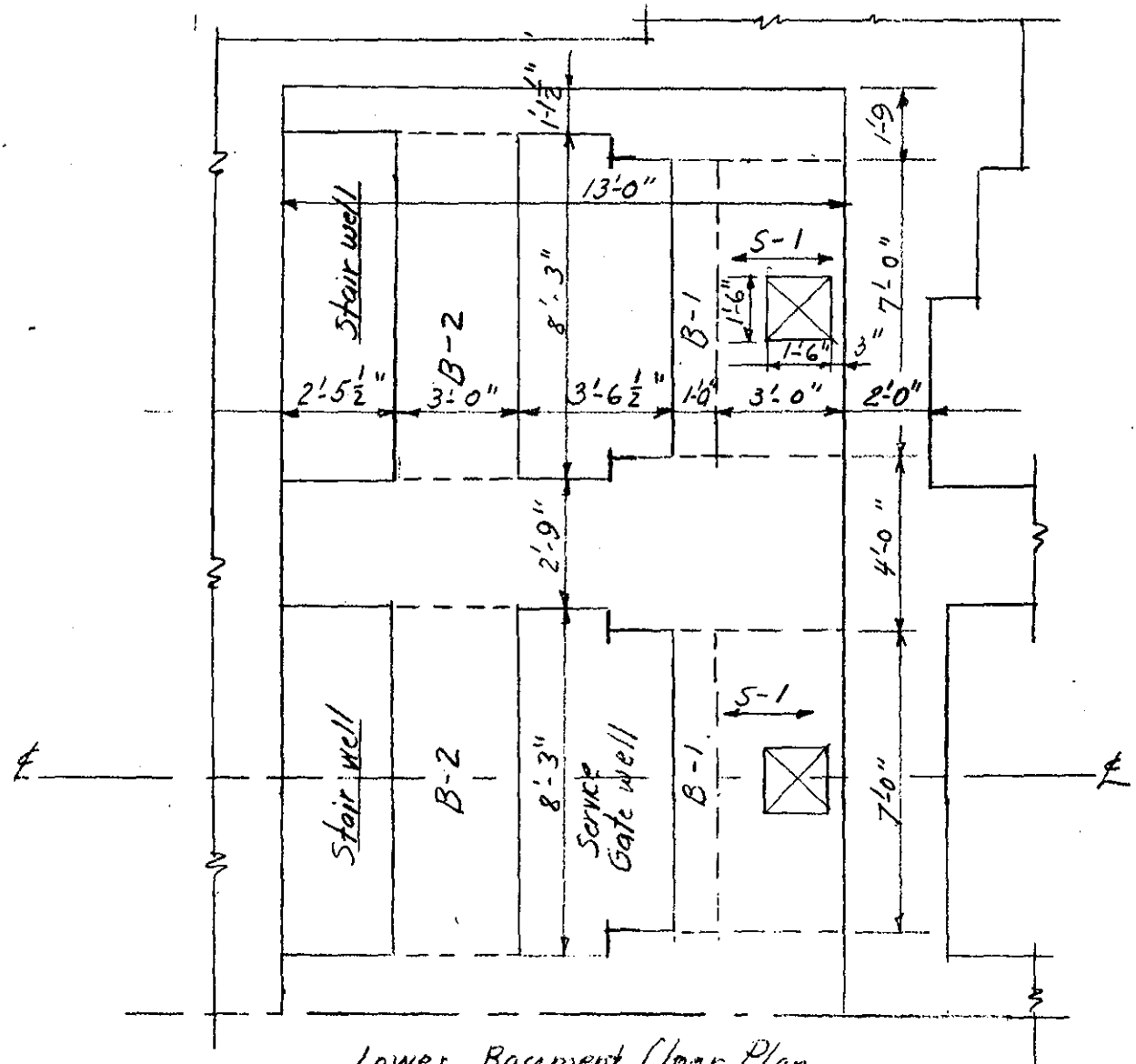
Subject: Claremont Dam

Computation: Operating House - Basement Floor El. 630.5

Computed by: A.L.K. Checked by: Date: 22 Jan. 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Lower Basement Floor Plan
El. 630.5

Subject Claremont Dam
Computation Operating House - Basement Floor El. 630.5
Computed by A.L.R. **Checked by** **Date** 18 Jan 1945

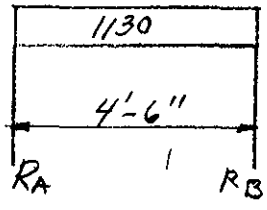
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Basement floor slab @ El. 630.5 will be designed for uniform live load of 1000#/□'

Slab - S-1

Design loadings

D.L. 10" slab = 125
L.L on slab 1000
1125 #/FT 1130#/FT



$+M = \frac{1}{8} \times 1130 \times 4.5^2 = 2870$ '#

$R_A = R_B = 1130 \times \frac{4.5}{2} = 2540$ #

$v = \frac{2540}{12 \times .875 \times 7.37} = 33$ #/□"

$d_{req'd} = \sqrt{\frac{2870}{123}} = 4.84" < 7.69"$

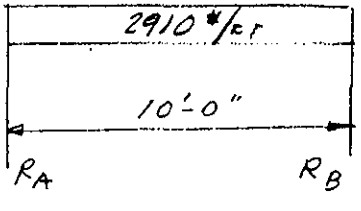
$+A_s = \frac{2870 \times 12}{18000 \times .88 \times 7.69} = .284$ □" use $\frac{5}{8}$"φ @ 12" {top bot.

$u = \frac{2540}{2 \times .875 \times 7.37} = 197$ #/□" temp $\frac{5}{8}$"φ @ 1'-0"

Beam B-1 assume 1'-0" wide 1'-6" deep

Design loadings

D.L. of 10" slab 2.5 x 125 = 310
Floor L.L. 2.5 x 1000 = 2500
D.L. of beam .67 x 150 = 100
2910 #/FT



$+M = \frac{1}{8} \times 2910 \times 10^2 = 36400$ '#

$R_A = R_B = 2910 \times \frac{10}{2} = 14550$ #

$d_{req'd} = \sqrt{\frac{36400}{123}} = 17.2" < 15.5"$

$v = \frac{14550}{18 \times .875 \times 15.38} = 60$ #/□"

make

$d_{req'd} \sqrt{\frac{36400 \times 12}{123 \times 18}} = 14.1" < 15.5"$

Subject: Claremont Dam
Computation: Operating House - Basement Floor El. 630.5
Computed by: A.L.K. Checked by: Date: 18 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-1 cont'd

$$A_s = \frac{36400 \times 12}{18000 \times .88 \times 15.5} = 1.78 \square''$$

use $\begin{cases} 3-\frac{7}{8}''\phi \text{ bott} \\ 3-\frac{7}{8}''\phi \text{ top} \end{cases}$

$$u = \frac{14550}{8.4 \times .875 \times 15.38} = 129\,\#/\square''$$

Beam B-2

Design loadings assume 14" slab

D.L.	14" slab	1.16 × 150	= 174
L.L.	1000 #/□'		= 1000
			1174 Say 1180 #/FT

$$M^F_{AB} = M^F_{BA} = \frac{1180 \times 10.69^2}{12} = 11.2'^K$$

$$M^F_{BC} = M^F_{CB} = \frac{1180 \times 11^2}{12} = 11.9'^K.$$

$$M^F_{CD} = M^F_{DC} = 11.2'^K$$

	1180 #/FT						
	0	10'-8 1/4"	.51	.49	11'-0"	.49 .51	10'-8 1/4"	0
	A			B		C		D
	+11.2		-11.2	+11.9		-11.9	+11.2	-11.2
	-11.2		-0.4	-0.3				+11.2
	-0.2		-5.6	+0.2				
	+0.2		+3.8	+1.6				
	+1.9		+0.1	-0.8				
	-1.9		+0.4	+0.3				
-M	0		-12.9	+12.9		-12.9	+12.9	0
V	5090#		7510#	6500#		6500#	7510	5090
Xo	→ 4.3'			5.5'			4.3 ←	
+M	10900'#			4800'#			10900'#	

$$V_A = 1180 \times \frac{10.69}{2} - \frac{12900}{10.69} = 5090\#$$

$$V_B = 1180 \times \frac{10.69}{2} + \frac{12900}{10.69} = 7510\#$$

$$+M = 5090 \times 4.3 - 1180 \times \frac{4.3^2}{2} = 10900'\#$$

Subject: Claremont Dam
Computation: Operating House - Basement Floor El. 630.5
Computed by: A.L.K. Checked by: Date: 18 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Beam B-2 cont'd

$V_B = V_C = 1180 \times \frac{11}{2} = 6500$

$+M = 6500 \times 5.5 - 1180 \times \frac{5.5^2}{2} - 12900 = 4800$ '#

$d_{req'd\ +M} = \sqrt{\frac{10900}{123}} = 9.45'' < 11.62''$

$d_{req'd\ -M} = \sqrt{\frac{12,900}{147}} = 9.4'' < 12.13''$

$v = \frac{7510}{12 \times .875 \times 12.13} = 59^{\#}/\square''$

$-A_s = \frac{12900 \times 12}{18000 \times .875 \times 12.13} = .81\ \square''$ use $\frac{3}{4}''\phi$ @ 6" top

$+A_s = \frac{10900 \times 12}{18000 \times .88 \times 11.62} = .71\ \square''$ use $\frac{3}{4}''\phi$ @ 7" bott

$u = \frac{7510}{4.7 \times .88 \times 12.13} = 150^{\#}/\square''$

WAR DEPARTMENT

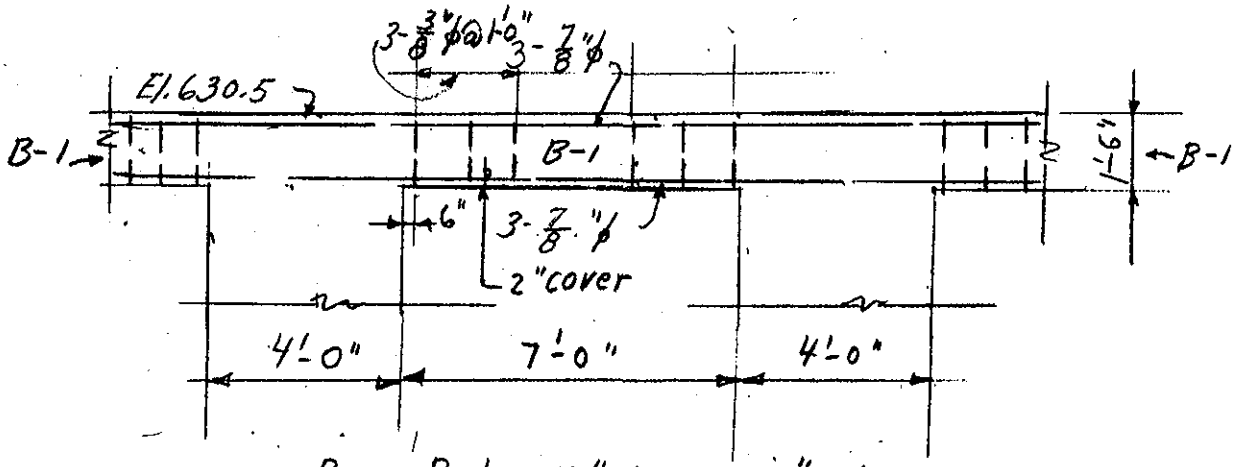
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

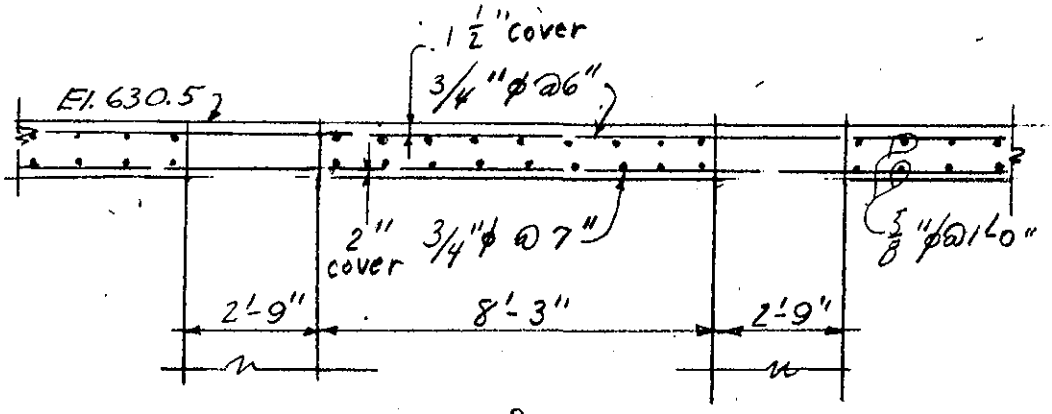
Computation: Operating House Basement Floor El. 630.5

Computed by: A. L. K. Checked by: Date: 22 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528



Beam B-1 18" deep x 12" wide



Beam B-2 36" wide x 14" deep

Subject Claremont Dam.
Computation Operating House Concrete Stairway
Computed by A.L.K. **Checked by** **Date** 19 Jan 1945

U.S. GOVERNMENT PRINTING OFFICE 3—10528

Stairway from operating floor to Basement floor

Assume 8" slab

Stairs $.67 \times .75 \times \frac{1}{2} \times \frac{14}{10.5} \times 150 = 50.5$

Slab $.67 \times \frac{14.5}{10.5} \times 150 = 139.0$

D.L. 189.5

L.L 75.0

D.L.+L.L. 264.5 #/FT say 265 #/FT

Effective span 9'-0"

$R_R = R_L = 265 \times 9 \times .5 = 1195$ #/FT width of stair

$+M = \frac{265 \times 9^2}{8} = 2690$ '#

$d = \sqrt{\frac{2690}{123}} = 4.7" < 5.69"$

$v = \frac{1195}{12 \times .875 \times 6.19} = 18.5$ #/□"

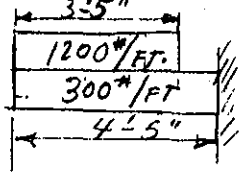
$A_s = \frac{2690 \times 12}{18000 \times .88 \times 5.69} = .36$ □" use $\frac{5}{8}$"ϕ @ 9" bott

$\frac{5}{8}$"ϕ @ 10 top

$u = \frac{1195}{2.4 \times .875 \times 6.19} = 92$ #/□"

Assume 12" deep by 24" wide beam in slab to take stairway reaction.

D.L. of 12" Beam $150 \times 2 = 300$ #/FT



$M = 300 \times \frac{4.42^2}{2} + 1200 \times 3.42 \times 2.71 = 14080$ '#

$V = 300 \times 4.42 + 1200 \times 3.42 = 5430$ #

Subject Claremont Dam
Computation Operating House Concrete Stairway
Computed by A.L.K. **Checked by** **Date** 19 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528

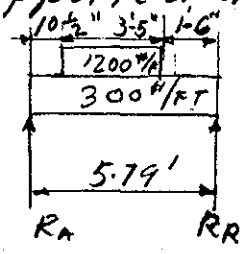
Beam supporting stairway at basement floor cont'd

$$d_{req'd} = \sqrt{\frac{14080 \times 12}{24 \times 123}} = 7.55'' < 9.5''$$

$$A_s = \frac{14080 \times 12}{18000 \times .875 \times 9.5} = 1.13 \square''$$ use 3-3/4"ϕ top

$$v = \frac{5430}{24 \times .875 \times 9.5} = 27\#/\square''$$

after construction above beam will act as a beam supported at ends.



$$R_A = 300 \times \frac{5.79}{2} + 1200 \times 3.42 \times \frac{3.21}{5.79} = 3160^{\#}$$

$$R_B = 300 \times \frac{5.79}{2} + 1200 \times 3.42 \times \frac{2.58}{5.79} = 2700^{\#}$$

$$2700 - 300x - 1200(x - 1.5) = 0$$
$$x = 3.0 \text{ ft.}$$

$$+M = 2700 \times 3 - 300 \times \frac{3^2}{2} - 1200 \times \frac{1.5^2}{2} = 5400'^{\#}$$

$$d_{req'd} = \sqrt{\frac{5400 \times 12}{24 \times 123}} = 4.68'' = 9.75''$$

$$v = \frac{3160}{24 \times .875 \times 9.75} = 15.5\#/\square''$$

$$+A_s = \frac{5400 \times 12}{18000 \times .88 \times 9.75} = .42 \square''$$ use 3-5/8"ϕ bott

WAR DEPARTMENT

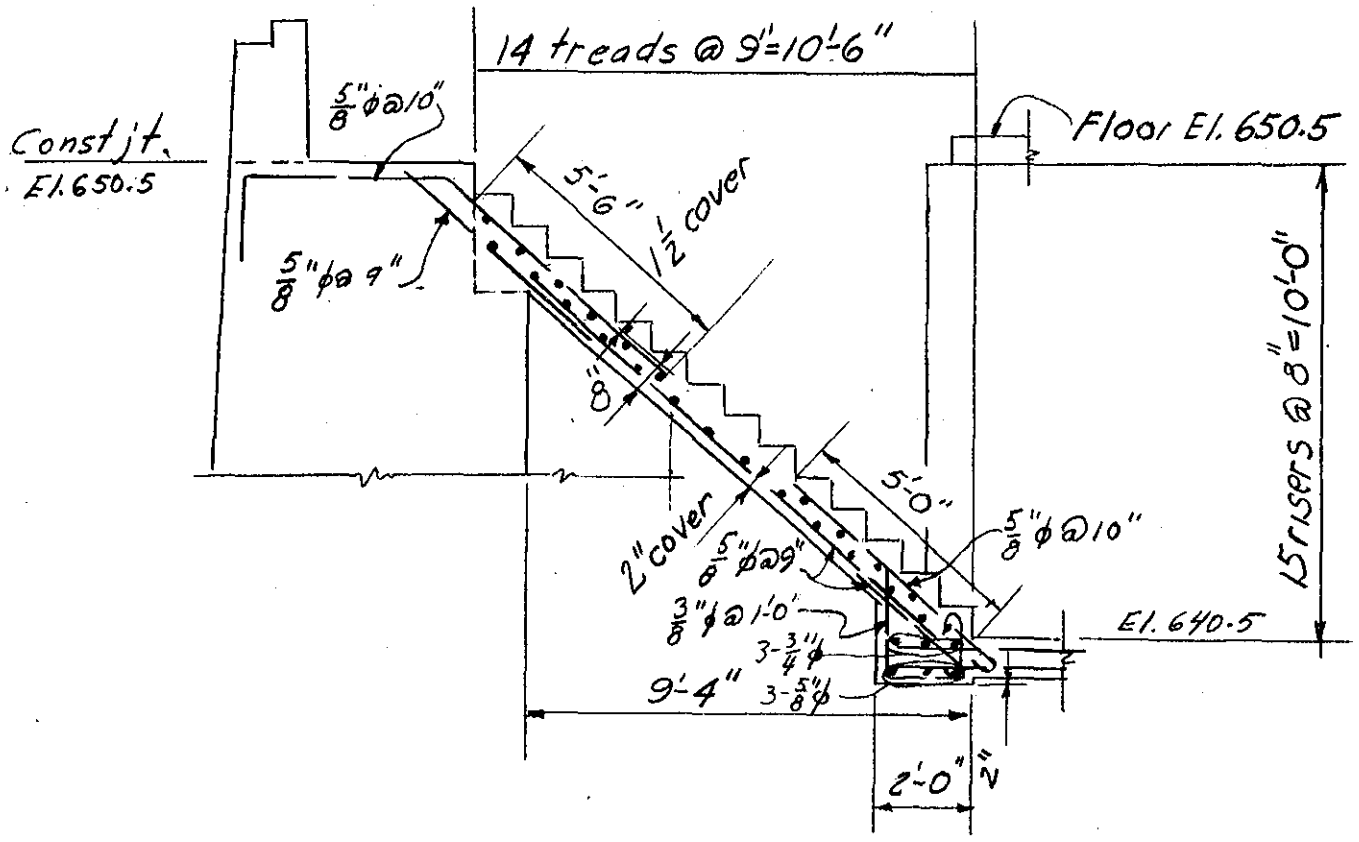
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject Claremont Dam

Computation Operating House Concrete Stairway

Computed by A.L.K. **Checked by** **Date** 19 Jan 1945

U. S. GOVERNMENT PRINTING OFFICE 3—10528



WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: Claremont Dam

Computation: Spillway Retaining Wall

Computed by: H.E.W. Checked by: Date: 16-Oct-44

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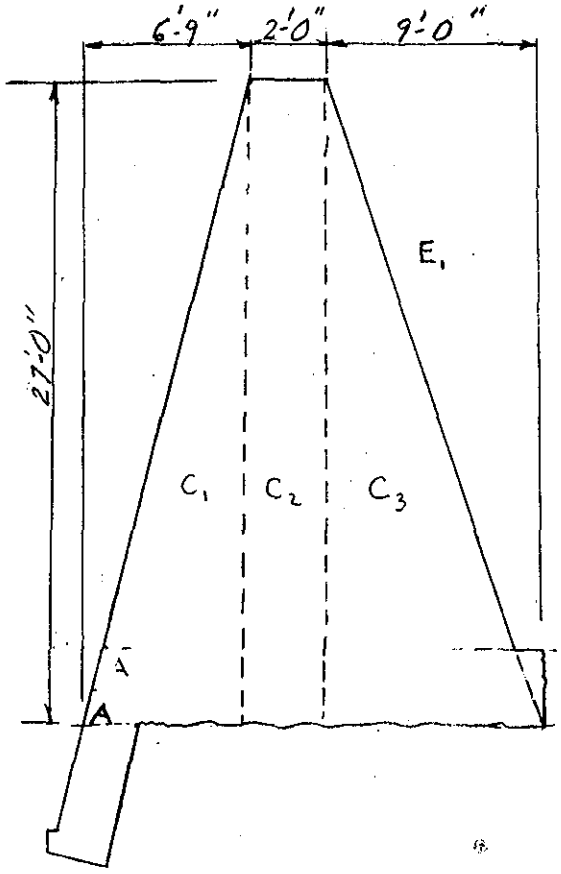


Maximum loading condition on wall will occur with water down and wall loaded only with back fill. Gravel drains are provided at the rear of wall so earth will be considered dry.

Force	↓	↑	→	←	Arm	↻	↺
C_1 27×6.75×.5×150	13,670				4.38	59870	
C_2 27×2×150	8100				7.75	62780	
C_3 27×9.00×.5×150	18230				10.75	195,920	
E_1 27×9.00×.5×100	12150				13.75	167,060	
Per. $27^2 \times 35 \times .5$				12,760	9.00		114840
	52150					485630	114840

$\Sigma = 370,190$

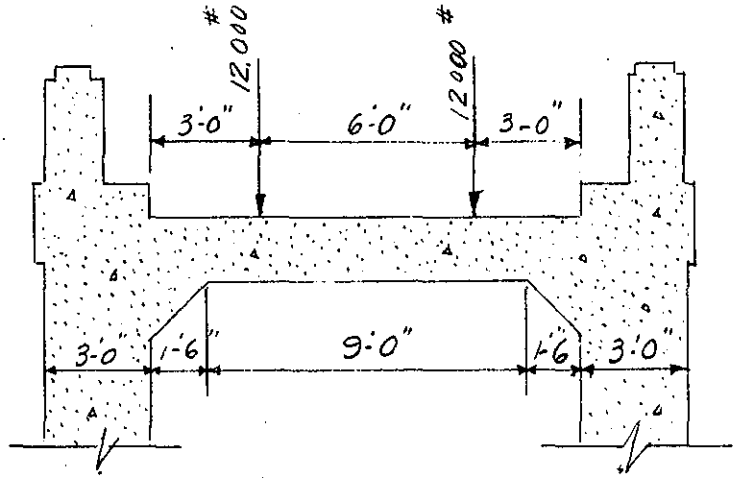
$$\frac{\Sigma M}{\Sigma V} = \frac{370,790}{52,150} = 7.11 \qquad e = 1.77'$$

$$\text{Bear } P = \frac{P}{b}\left(1 \pm \frac{6e}{b}\right) = \frac{52150}{17.75}\left(1 \pm \frac{6 \times 1.77}{17.75}\right) = \begin{matrix} 4696^{\#} \\ 1180^{\#} \end{matrix}$$

Subject: CLAREMONT DAM
Computation: SERVICE BRIDGE ABUTMENT
Computed by: E. J. H. Checked by: Date: 20 SEPT. 1944

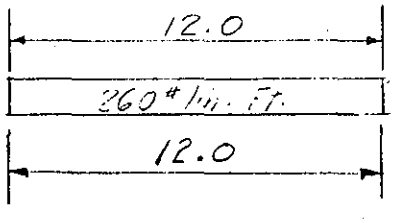
U. S. GOVERNMENT PRINTING OFFICE 3—10528

FLOOR SLAB



Load distribution = .4 S + 3.75 S = span length
= .4 x 12 + 3.75 = 8.55 Ft.

DEAD LOAD MOMENT
Assume slab 1'-9" thick



$R_L = 1560^{\#}$

$M = \frac{260 \times 12 \times 15}{8} = 5850'^{\#}$

LIVE LOAD MOMENT $= +.25 \frac{P}{E} S$

P = wheel load, E = slab distribution S = span length

$= \frac{.25 \times 12000 \times 12}{8.5} = 4250'^{\#}$

IMPACT $= \frac{50}{L+125} = 37\%$ Maximum allowable = 30%

Subject CLAREMONT DAM
Computation SERVICE BRIDGE ABUTMENT
Computed by E.J.H. **Checked by** **Date** 21 SEPT. 1944

U. S. GOVERNMENT PRINTING OFFICE 3—10528

TOTAL MOMENT=

Dead load = 5850 '#
Live load = 4250 '#
Impact
30% x 5300 = 1275 '#
10375 '#

$d = \sqrt{\frac{M \times 12}{12 \times K}}$ $\sqrt{\frac{10375}{123}} = \sqrt{104} = 9.2''$

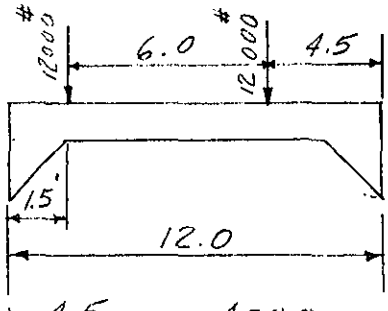
Make slab 12" thick

$A_s = \frac{10375 \times 12}{7/8 \times 18000 \times 9.5} = .82$

Use 3/4"ϕ @ 6" Bend up every other bar

SHEAR

Position of wheel load for max. shear



$R_L = 12000 \times \frac{4.5}{12} = 4500$

$12000 \times \frac{10.5}{12} = 10500$

15000 ÷ 8.5 = 1770 #

TOTAL R_L = 1560 D.L
1770 L.L
530
3860 #

Shear = $\frac{V}{bjd} = \frac{3860}{12 \times \frac{7}{8} \times 9.5} = 39$ #□"

Subject CLAREMONT DAM
Computation SERVICE BRIDGE ABUTMENT
Computed by E. J. H. **Checked by** **Date** 21 SEPT. 1944

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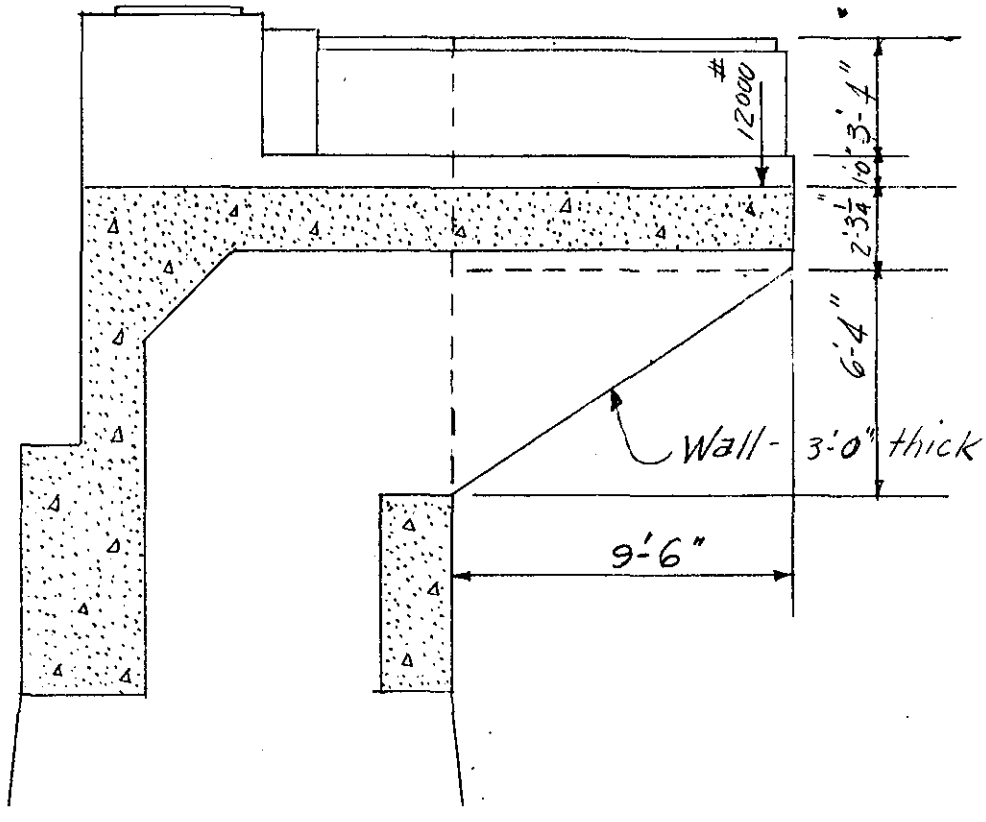
$$\text{BOND} = \frac{3860}{2.36 \times 2 \times \frac{7}{8} \times 9.5} = \#0''$$

SIDE WALL CANTILEVER



Reaction at cantilever support

Slab = 150 x 1.08 x 6 x 9.5	=	9200
Wall = 9.5 x 6.33 x 3 ÷ 2 x 150	=	13600
3.27 x 3 x 9.5 x 150	=	14000
3.33 x 1 x 9.5 x 150	=	4500
Dead load reaction		41300 #

Dead load moment

9200 x 4.75	=	43600 '#
13600 x 3.17	=	43000
14000 x 4.75	=	66000
4500 x 4.75	=	21400
		174000 '#

Subject: CLAREMONT DAM
Computation: SERVICE BRIDGE ABUTMENT
Computed by: E. J. H. Checked by: Date: 22 SEPT. 1944

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Dead load moment (from Page 3) 174,000 '#
Live load moment
12000 x 9.5 = 114,000 '#

Impact moment
3600 x 9.5 = 34 200 '#

TOTAL MOMENT 322,200 '#

Effective depth = $\sqrt{\frac{M \times 12}{147 \times 36}} = \sqrt{\frac{322{,}000 \times 12}{147 \times 36}} = \sqrt{1960} = 27''$

Depth of cantilever is 8'-7" = 103" O.K.

$v = \frac{V}{bjd} = \frac{56900}{36 \times \frac{7}{8} \times 100} = 18^{\#}{}^{\square''}$ O.K

$A_s = \frac{322{,}000 \times 12}{\frac{7}{8} \times 18{,}000 \times 100}$ 2.44 □" Use 4-$\frac{7}{8}$"ϕ in top of cantilever.

Temperature steel 36 x 12 x .0025 = 1.08
Use 7/8"ϕ @ 1'-0" horizontally
7/8"ϕ @ 1'-6" vertically.

Subject: CLAREMONT DAM
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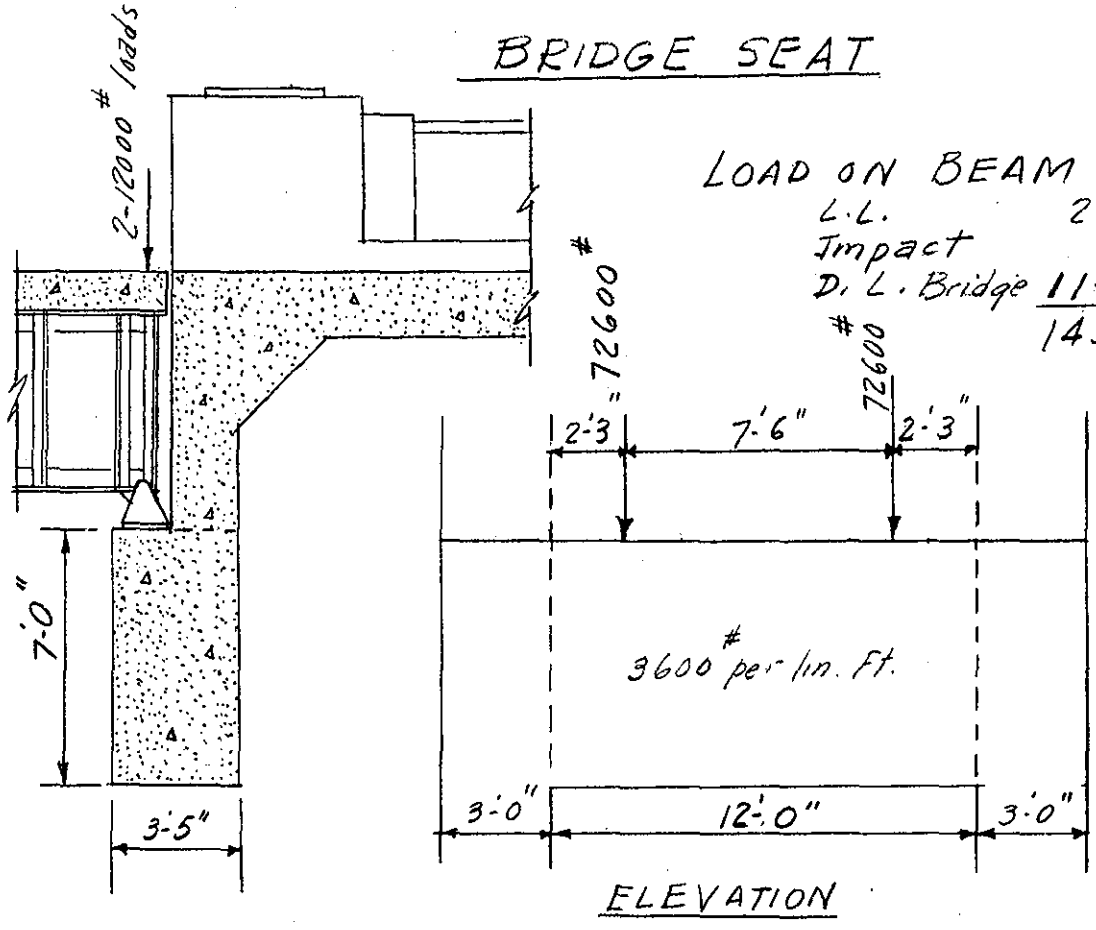
BRIDGE SEAT



ELEVATION

LOAD ON BEAM

L.L.	24000 #
Impact	7200
D.L. Bridge	114000
	145200

D.L. Beam = 7 x 3.42 x 150 = 3600 #/ft.

Reactions = 12,000 L.L.
3600 Impact
57,000 D.L. Bridge
21,600 D.L. Beam
93,600 #

Live load moment =
12000 x 3.75 = 45000 '#

Impact moment =
3600 x 3.75 = 13500

Dead load moment =
57000 x 3.75 = 214000
3600 x 2.3 x 1.15 = 9500 204500
263,000

Subject: CLAREMONT DAM
Computation: SERVICE BRIDGE ABUTMENT
Computed by: E.J.H. Checked by: Date: 22 SEPT. 1944

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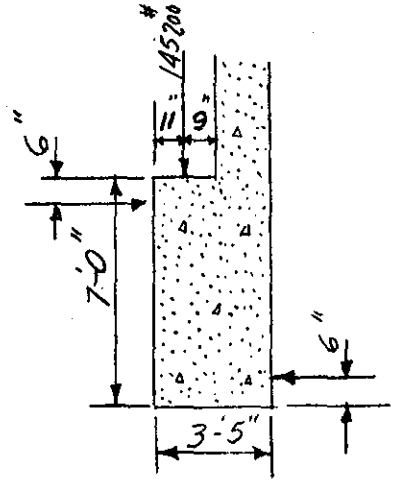
Effective depth $= \sqrt{\frac{M \times 12}{147 \times 41}} = \sqrt{\frac{263{,}000 \times 12}{147 \times 41}} = 23''$

Depth will be kept at 7'-0" as shown.

$v = \frac{93600}{41 \times \frac{7}{8} \times 80}$ 33 #□" O.K

$As = \frac{263{,}000 \times 12}{\frac{7}{8} \times 18{,}000 \times 80} = 2.5$ □" Use 4-7/8"φ in bottom

ECCENTRIC LOAD ON BEAM



3'-5" ÷ 2 = 20½"
11
9½" eccentricity

145,200 × .79 = 115,000 '#

Horizontal force = 115,000 ÷ 6 = 19,200 #

Steel in top of beam

M = 145200 × 9 = 1,310,000 "#

$As = \frac{1{,}310{,}000}{\frac{7}{8} \times 18{,}000 \times 80} = 1.04$

Vertical steel that is being used throughout structure will be sufficient 7/8"φ @ 1'-6"

Steel in side of beam =
$\frac{19200 \times 12}{4} = 57600$ '#

$As = \frac{57600 \times 12}{7/8 \times 18{,}000 \times 37} = 1.2$

Horizontal steel is adequate - 7/8"φ @ 1'-0"

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM

Computation: SERVICE BRIDGE ABUTMENT

Computed by: E.J.H. Checked by: Date: 26 SEPT. 1944

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PRESSURE ON FOOTING

CONCRETE

23 x 7 x 3 x 2 x 150	145000 #
$\frac{(19 \times 3) + (12 \times 3)}{2} \times 36 \times 2 \times 150$	500,000
7 x 3 x 12 x 2 x 150	75500
8 x 3 x 16 x 2 x 150	115,000
1 x 12 x 20 x 150	36,000
3.42 x 7 x 12 x 150	43,000
2.0 x 5.58 x 12 x 150	20,000
1.75 x 4 x 12 x 4 x 150	50,500
2.75 x 1.38 x 12 x 150	6800
1.75 x 7 x 12 x 150	22000
1.5 x 1.5 x 16 x 150	5400
3.17 x 1 x .24 x 2 x 150	23000
3.33 x 1.5 x 18 x 2 x 150	27000
4 x 3 x 6 x 2 x 150	21600
TOTAL WT. OF CONCRETE	1,090,800

EARTH

Structure considered as a hollow bin all earth within side walls included

12 x 16 x 45 x 125 = 1,100,000 #

Dead load of bridge = 114 000

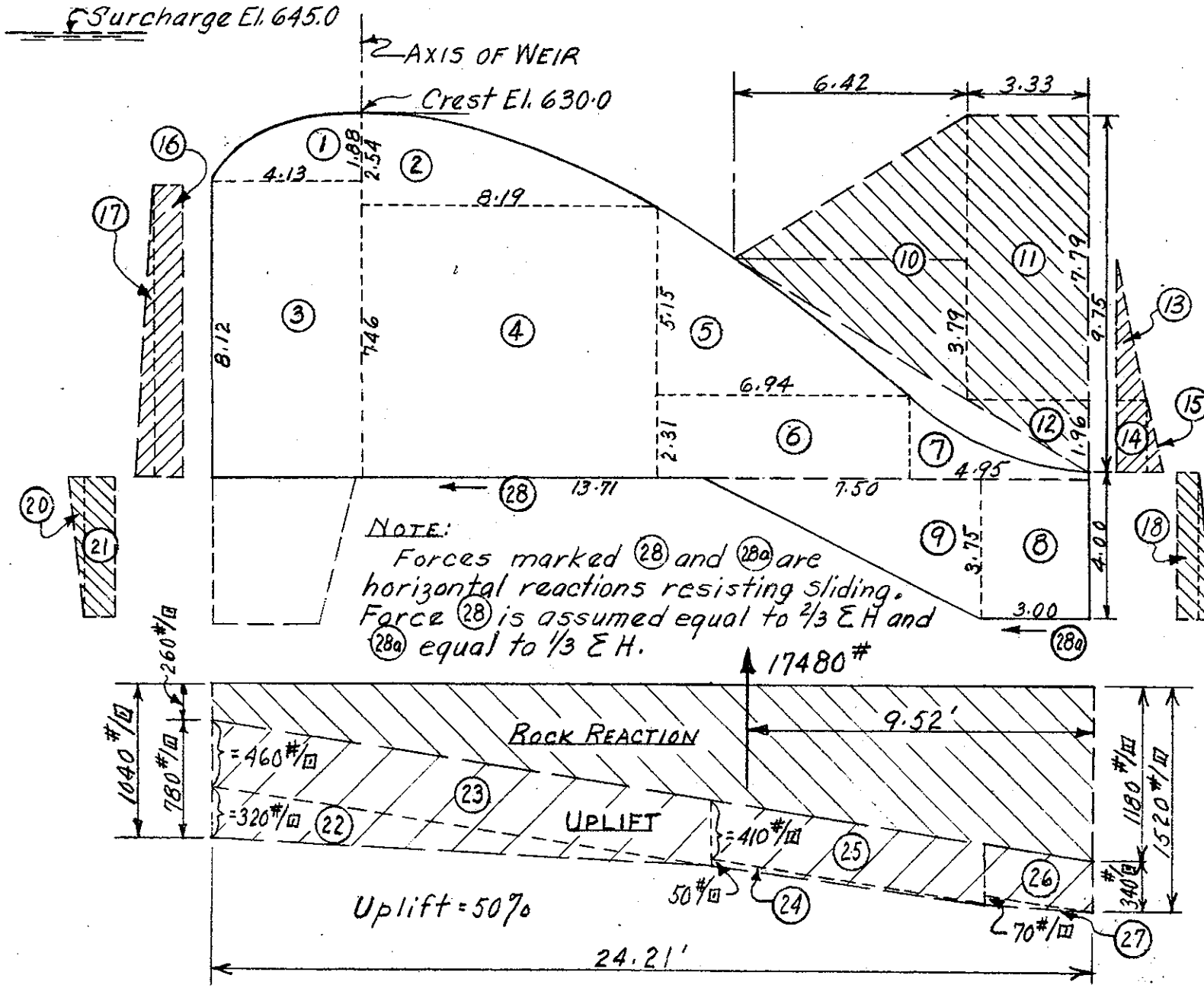
2,304,800 #

Area of Footings = 23 x 7 x 2 = 320 □'

2304800 ÷ 320 = 7200 # □" O.K.

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM
Computation: STABILITY OF SPILLWAY WEIR ~ UPLIFT 50%
Computed by: C.L.M. Checked by: Date: Page: 250 / 45



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WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM

Computation: STABILITY OF SPILLWAY WEIR ~Uplift 50%

Computed by: C.L.M. Checked by: A.W.G. Date: 1-45

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Moments about toe "T"

No.		Forces Vert.	Forces Horiz.	Arm	M + ↷	M − ↶	Type
1	150×4.13×1.88×.75	+870		21.70		-18,900	Concrete
2	150×8.19×2.54×.67	+2080		17.00		35,300	"
3	150×4.13×8.12	+5030		22.14		111,400	"
5	150×8.19×7.46	+9160		15.99		146,600	"
5	150×6.94×5.15×.55	+2950		9.50		28,100	"
6	150×6.94×2.31	+2400		8.42		20,200	"
7	150×4.95×2.31×.40	+ 690		3.95		2,700	"
8	150×3.00×3.75	+1690		1.50		2,500	"
9	150×7.50×3.75×.5	+2110		5.50		11,600	"
10	62.5×7.79×6.42×.5	+1570		5.47		8,600	Water
11	62.5×7.79×3.33	+1620		1.67		2,700	"
12	62.5×3.33×1.96×.5	+ 200		1.11		200	"
13	62.5×7.79×3.79×.5		-920	7.22		6,600	"
14	62.5×7.79×1.96		-960	4.98		4,800	"
15	62.5×1.96×1.96×.5		-120	4.65		600	"
16	62.5×17.0×8.00		+8500	7.75	65,900		"
17	62.5×8.0×8.0×.5		+2000	6.42	12,800		"
18	62.5×7.0×4.0		-1750	2.00		3,500	"
19	62.5×4.0×4.0×.5		- 500	1.33		700	"
20	62.5×1.6×3.75×.50		+ 90	2.50	400		"
21	62.5×13.2×3.75×.50		+1540	1.88	2900		"
			7880				
22	320×13.71×.5	-2190		19.64	43,000		Uplift
23	460×13.71	-6310		17.36	109,500		"
24	50×7.5×.5	- 190		8.00	1,500		"
25	410×7.5	-3080		6.75	20,800		"
26	340×3.0	-1020		1.50	1,500		"
27	70×3.0×.5	- 100		2.00	200		"
		+17,480			258,500		
28	2/3 ΣH = 7900×2/3		5300	3.75		19,900	
						424,900	
						258,500	
		ΣV = 17,480	ΣH = 7880			ΣM 166,400	

Subject: CLAREMONT DAM
Computation: STABILITY OF SPILLWAY WEIR - UPLIFT 50%
Computed by: C.L.M. Checked by: A.W.G. Date: 1-45

U. S. GOVERNMENT PRINTING OFFICE 3—10528

$$\text{Sliding factor} = \frac{\Sigma H}{\Sigma V} = \frac{7880}{17{,}480} = 0.45$$

$$\text{Factor of safety against overturning} = \frac{425{,}000}{259{,}000} = 1.64$$

$$\frac{\Sigma M}{\Sigma V} = \frac{166{,}400}{17{,}480} = 9.52' \text{ from toe} \qquad \tfrac{1}{3}\text{ pt.} = 8.07$$

$$e = \frac{24.21}{2} - 9.52 = 2.59$$

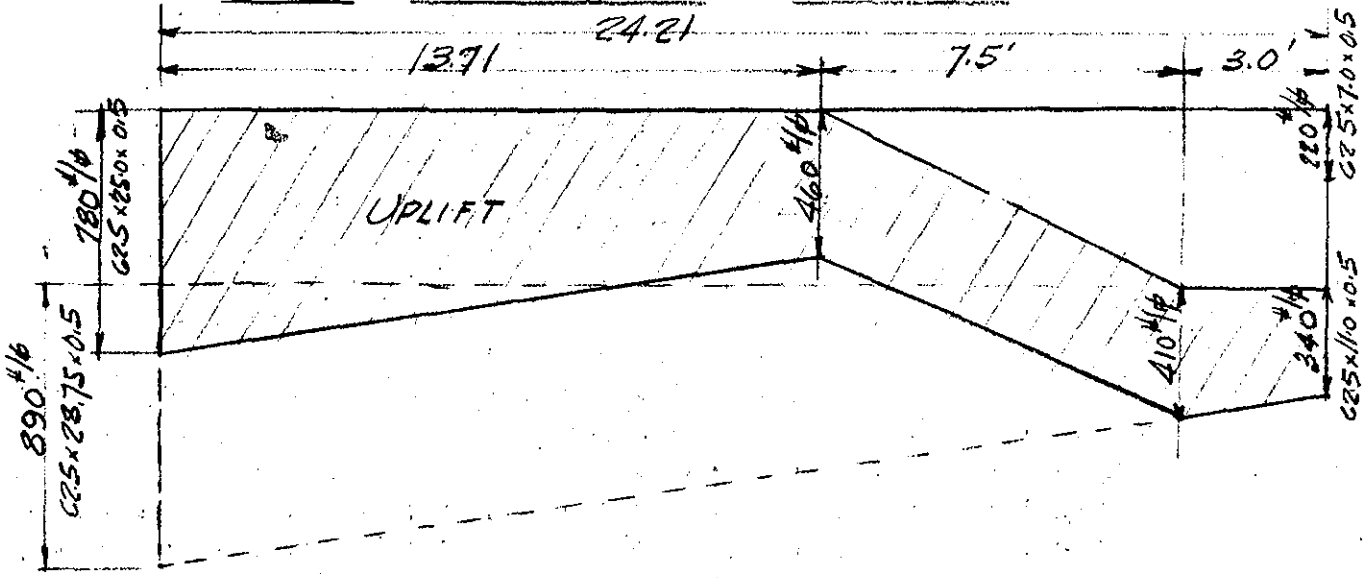
Rock Reaction:

$$P \text{ at Toe} = \frac{17{,}480}{24.21}\left(1 + \frac{6 \times 2.59}{24.21}\right) = 720 \times 1.64 = 1180\ \#/\square'$$

$$P \text{ at Heel} = 720 \times .36 = 260\ \#/\square'$$

$$\text{Uplift at Heel} = 62.5 \times 25 \times .50 = 780\ \#/\square'$$

UPLIFT DISTRIBUTION DIAGRAM

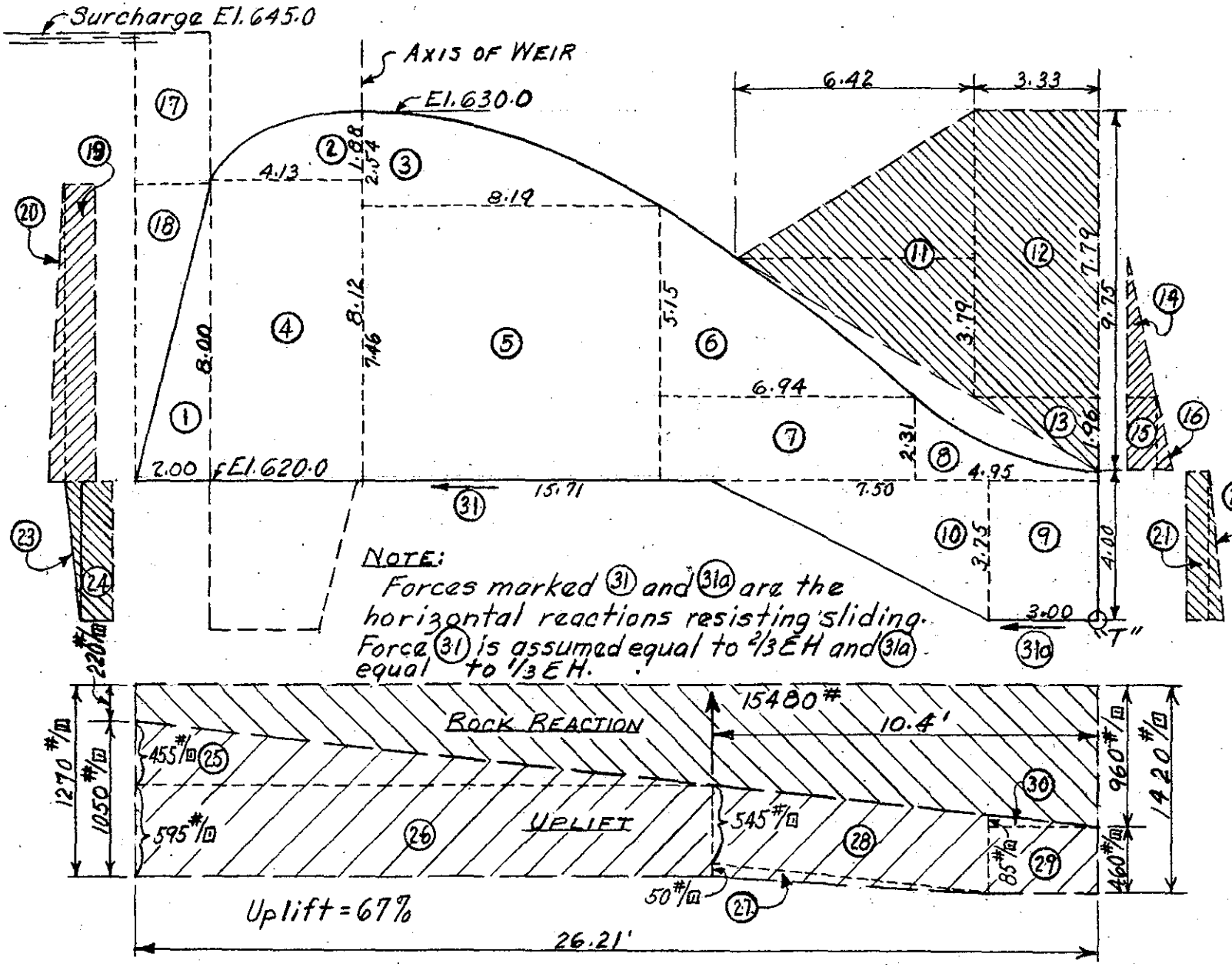


$$220 + 560 \times \frac{10.5}{24.21} = 460$$

$$340 + 550 \times \frac{3.0}{24.21} = 410$$

WAR DEPARTMENT
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Subject: CLAREMONT DAM
Computation: STABILITY OF SPILLWAY WEIR ~ UPLIFT 67%
Computed by: C.L.M. Checked by: A.W.G. Date: 1-4-5
Page 253



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WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

CLAREMONT DAM

Computation STABILITY OF SPILLWAY WEIR ~ UPLIFT 67%

Computed by C. L. M. Checked by A.W.G. Date 1-45

U. S. GOVERNMENT PRINTING OFFICE 3—10528

Moments about toe "T"

No.		Forces Vert.	Forces Horiz.	Arm	Moments + ↷	Moments − ↶	Type
1	150×8.00×2.0×.5	+1200		24.88		29,800	Concrete
2	150×4.13×1.88×.75	+ 870		21.70		18,900	"
3	150×8.19×2.54×.67	+2080		17.00		35,300	"
4	150×4.13×8.12	+5030		22.14		111,400	"
5	150×8.19×7.46	+9160		15.99		146,600	"
6	150×6.94×5.15×.55	+2950		9.50		28,100	"
7	150×6.94×2.31	+2400		8.42		20,200	"
8	150×4.95×2.31×.40	+ 690		3.95		2,700	"
9	150×3.00×3.75	+1690		1.50		2,500	"
10	150×7.50×3.75×.5	+2110		5.50		11,600	"
11	62.5×7.79×6.42×.5	+1570		5.47		8,600	Water
12	62.5×7.79×3.33	+1620		1.67		2,700	"
13	62.5×3.33×1.96×.5	+ 200		1.11		200	"
14	62.5×7.79×3.79×.5		-920	7.22		6,600	"
15	62.5×7.79×1.96		-960	4.98		4,800	"
16	62.5×1.96×1.96×.5		-120	4.65		600	"
17	62.5×17.0×2.00	+2120		25.21		53,400	Water
18	62.5×8.0×2.00×.5	+ 500		25.54		12,800	"
19	62.5×17.0×8.00		+8500	7.75	65,900		"
20	62.5×8.0×8.0×.5		+2000	6.42	12,800		"
21	62.5×7.0×4.0		-1750	2.00		3,500	Water
22	62.5×4.0×4.0×.5		- 500	1.33		700	"
23	62.5×1.10×3.75×.5×.67		+ 190	2.50	400		"
24	62.5×13.1×3.75×.67		+2060	1.88	3,900		"
			+ 8380				
25	455×15.71×.5	-3570		20.98	74,900		Uplift
26	595×15.71	-9350		18.36	171,800		"
27	50×7.5×.5	- 190		8.00	1,500		"
28	545×7.5	-4090		6.75	27,600		"
29	460×3.0	-1380		1.50	2,100		"
30	85×3.0×.5	- 130		2.00	300		"
		+15480			361,200		
31	2/3 ΣH = 8400×2/3		5600	3.75		21,000	Shear Resistance

ΣV = 15480 ΣH = 8400

522,000
-361,200
ΣM = 160,800

WAR DEPARTMENT

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

Project CLAREMONT M

Computation STABILITY OF SPILLWAY WEIR ~ UPLIFT 67%

Computed by C. L. M. Checked by A.W.G Date 1-45

U. S. GOVERNMENT PRINTING OFFICE 3—10528

$$\text{Slid. Factor} = \frac{\Sigma H}{\Sigma V} = \frac{8400}{15480} = 0.54$$

$$\text{Fact Safety against overturning} = \frac{522,000}{361,000} = 1.45$$

$$\frac{\Sigma M}{\Sigma V}\ \frac{160,800}{15,480} = 10.40' \text{ from toe; Third point} = \frac{26.21}{3} = 8.74'$$

$$e = \frac{21}{} - 10.40 = 2.71'$$

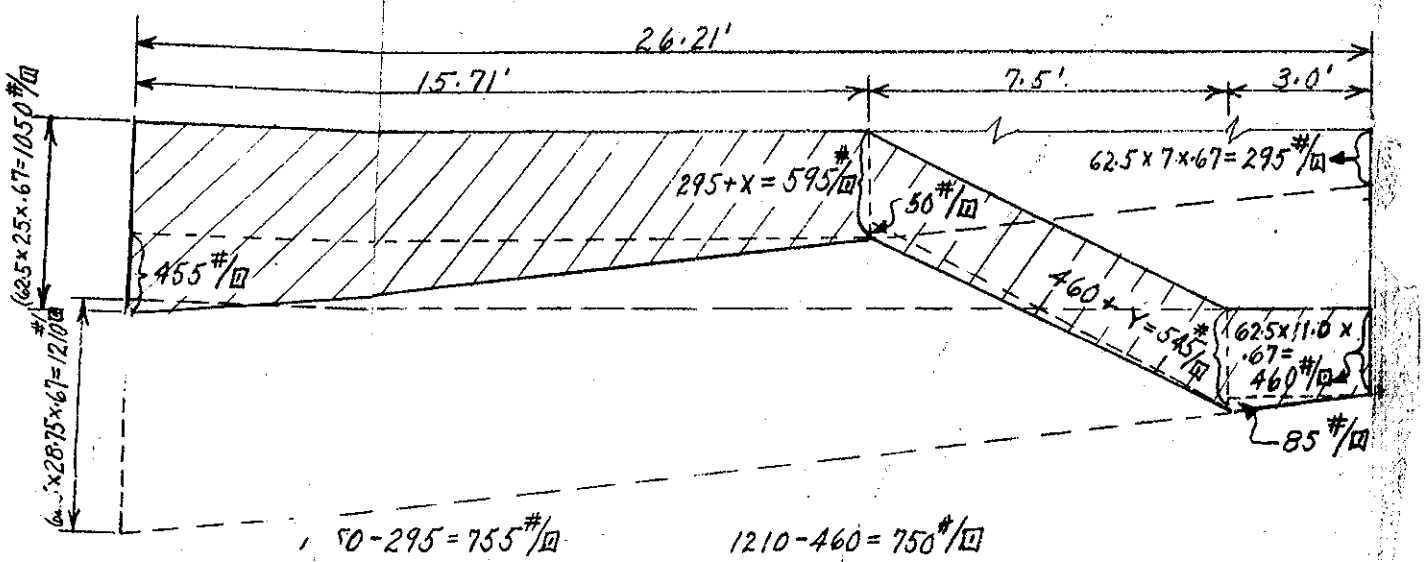
Rock reaction:

$$P.\ @\ \text{Toe} = \frac{15480}{26.21}\left[1 + \frac{(6 \times 2.71)}{26.21}\right] = 590 \times 1.62 = 960\ \#/\square$$

$$P.\ @\ \text{Heel} = 590 \times .38 = 220\ \#/\square$$

$$\text{Uplift} \quad '' \quad = 62.5 \times 25 \times .67 = 1050\ \#/\square$$

UPLIFT DISTRIBUTION DIAGRAM.



$$1210 - 460 = 750\ \#/\square$$

$$750 : 26.21 = Y : 3$$

$$85 = Y$$

$$50 - 295 = 755\ \#/\square$$

$$755 : \ .21 = X : 10.5$$

$$0 = X$$