CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

CONNECTICUT RIVER, MASSACHUSETTS

ANALYSIS OF DESIGN FOR LOCAL PROTECTION WORKS

ITEM C. 4 - HIRED LABOR

WILLIMANSETT DIKE

DECEMBER 1939

CORPS OF ENGINEERS, U. S. ARMY

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

CONNECTICUT RIVER FLOOD CONTROL

ANALYSIS OF DESIGN

WILLIMANSETT DIKE, C.4

CHICOPEE, MASS.

CORPS OF ENGINEERS, U. S. ARMY

UNITED STATES ENGINEER OFFICE, PROVIDENCE, RHODE ISLAND

I. INTRODUCTION

A. AUTHORIZATION AND PAST REPORTS. - The Willimansett Dike (Item C.4) is a part of the Chicopee Dike project, authorized under the Flood Control Act approved June 28, 1938. It is a part of the Connecticut River Flood Control Plan recommended by the District Engineer in "Report of Survey and Comprehensive Plan for Flood Control in the Connecticut River Valley", dated March 20, 1937, approved by the Chief of Engineers November 29, 1937, and published as House Document No. 456, 75th Congress, 2nd session.

B. BRIEF DESCRIPTION OF DIKE AND APPURTENANT STRUCTURES. - The Willimansett Dike (Item C.4) consists of two earth dikes, one 440± feet long between Stations 0+30± and 4+70±, called "Montgomery Street Dike", and the other earth dike 167± feet long between Stations 10+22± and 11+89±, called "Tourtellotte Street Dike". There is also a stop-log gate crossing Prospect Street, near the Willimansett underpass of the Boston and Maine Railroad.

C. ALINEMENT. - The alinement was determined with regard to topography, protection afforded, and economy.

II. GEOLOGICAL INVESTIGATIONS

The upper portion of the foundation is composed largely of fine and medium sand and silt (Classes 4, 6 and 8) with intervening strata of sand and gravel (Classes 5 and 7). The only deep test hole, Bore Hole BH.1, indicates a great thickness of these cohesionless materials beneath the surface. Ground water occurs at an average depth ranging from about 2 to 8 feet.

III. HYDRAULIC DESIGN

A. DESIGN FLOOD. - The design flood on which the grades of the Montgomery Street Dike and the stop-log are based is largely due to Willimansett Brook. A maximum discharge of 1500 c.f.s. has been used, equivalent to almost 400 c.f.s. per square mile of drainage area. The design flood for the Tourtellotte Street Dike is the maximum predicted flood (on the Connecticut River) reduced by the 20 reservoirs included in the Comprehensive Plan. This has a peak discharge at Chicopee of 304,000 c.f.s., about 15 per cent greater than the maximum flood of record.

B. FREEBOARD. - Freeboard for Montgomery Street Dike is 3 feet; for the stop-log structure, 1 foot; and for Tourtellotte Street Dike, 5 feet.

IV. LABORATORY AND FIELD INVESTIGATION OF SOILS

Since this is in the same area and using the same borrow pits, the results of investigations of soils for Chicopee Dike project (Item C.2) are applicable.

V. DESIGN

A. DIKE DESIGN CRITERIA. - The Willimansett Dike has a large section of random material covered on the riverside with a blanket of impervious material. The crest of the dike is at such a grade that overtopping at design flood and by wave action is eliminated. The slopes are such that they are stable under all conditions. Riprap is used at critical points to prevent scour. The general design criteria as detailed in the Analyses of Design, Northampton N.2 and N.3d, are applicable.

B. STRUCTURAL DESIGN. - The Willimansett Dike has one reinforced concrete stop-log structure approximately 7.5 feet high. This has been

designed according to the usual principles as established in other projects (*see Northampton N.2 and N.3d Analysis of Design*).

VI. CONSTRUCTION PROCEDURE AND COSTS

A. FIELD OPERATIONS. - Since this is a small project, it is estimated that work can be started by February 15, 1940 and completed by May 30, 1940. The usual field inspections will be made. Field and laboratory tests of all materials will be made to control the quality of the work.

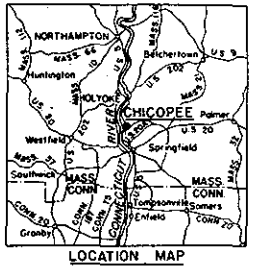
B. SUMMARY OF COSTS. - The total estimated cost of the Willimansett Dike is $18,200, including 10 per cent for contingencies and 15 per cent for engineering and overhead, distributed as follows:

a.	Embankment	$ 9,098
b.	Concrete	2,117
c.	Miscellaneous	6,985
	Total	$18,200

PLATES

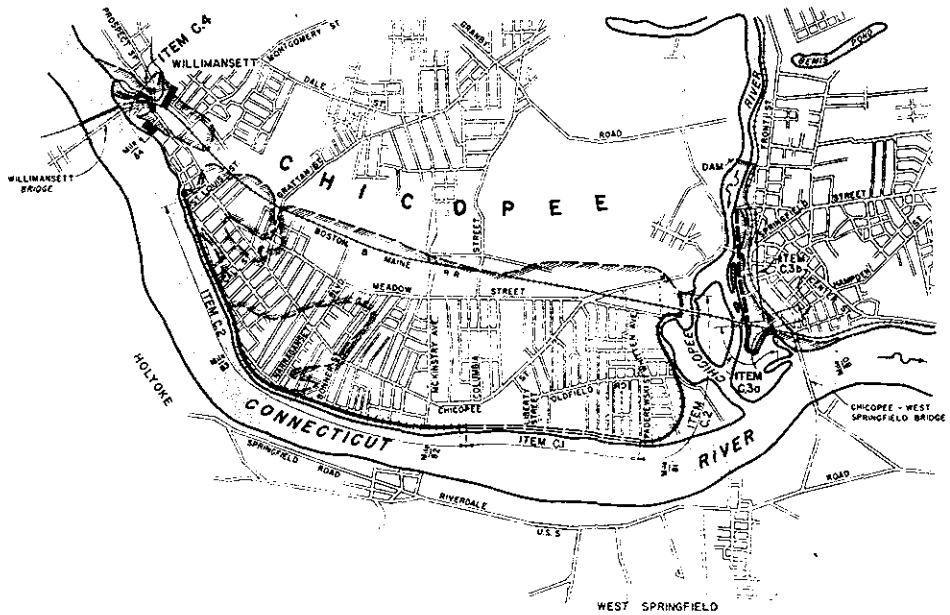
LIST OF PLATES

PLATE NO.		FILE NO.
1	PROJECT LOCATION	CT-4-2014
2	GENERAL PLAN	CT-4-2015
3	EMBANKMENT DETAILS	CT-4-2017



LOCATION MAP

SCALE 1"=8 MILES



VICINITY MAP

SCALE: 1"=1500'

LEGEND

- Item C1 Initial Fiscal Year 1939 Unit, Dike
- Item C2 Fiscal Year 1939 Section, Dike
- Item C3a Fiscal Year 1940 Unit, West of B & M R R South Bank Chicopee River
- Item C3b Future Construction, Fiscal Year 1940 Unit, South Bank Chicopee River
- Item C4 Fiscal Year 1940 Section Willimansett Dike
- Overflow Limits, March 1936 Flood

KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE DIKE

WILLIMANSETT SECTION - H.L.

PROJECT LOCATION AND INDEX

CONNECTICUT RIVER — MASSACHUSETTS

IN 16 SHEETS — SCALE 1 IN = 1500 FT (500' 0 1500' 3000') — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — DEC. 1939

SUBMITTED: Raul P. Nichol, SENIOR ENGINEER, HYD. PUBLIC SECTION

APPROVAL RECOMMENDED: J. J. Burns, LT. COL. CORPS OF ENGS., CHIEF, C. ENGINEERING DIV.

APPROVED: J. H. Dugan, LT. COL. CORPS OF ENGS., DISTRICT ENGINEER

DESIGNED: F. C. Hancock, ENGINEER

DRAWN: H.S.B.; TRACED: W.L.B.; CHECKED: C.O.J.

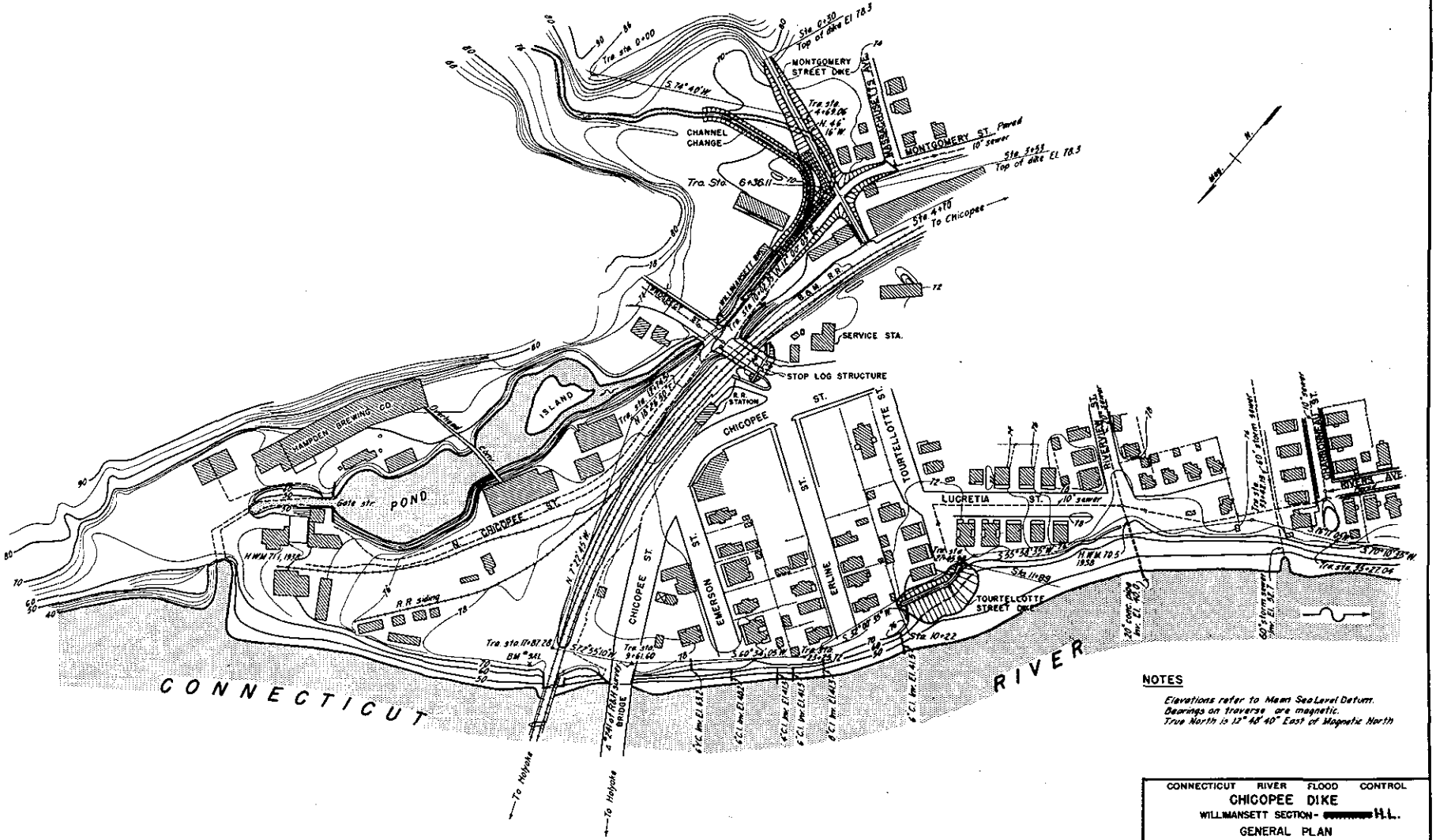
FISCAL YEAR 1940

FILE NO. CT-4-2014

PLATE NO. 1

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTES

Elevations refer to Mean Sea Level Datum.
Bearings on traverse are magnetic.
True North is 12° 48' 40" East of Magnetic North

CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE DIKE

WILLIMANSETT SECTION - [redacted] H.L.

GENERAL PLAN

CONNECTICUT RIVER MASSACHUSETTS

IN 16 SHEETS SCALE: 1 IN. = 100 FT. SHEET NO. 4

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. DEC. 1939

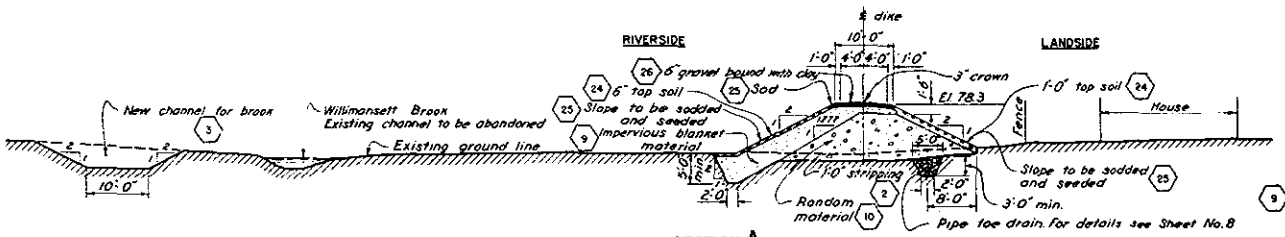
KEY	DATE	REVISION (Indicated by)	REV. BY	CK. BY	AP. BY

FISCAL YEAR 1940
FILE NO. CT-4-206

PLATE NO. 2

C.4

4



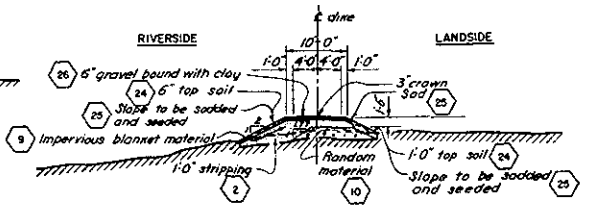
SECTION $\frac{A}{5}$

STA. 1+15±

TYPICAL BETWEEN STA. 0+50± AND STA. 2+29±

MONTGOMERY STREET DIKE

SCALE: 1" = 10'-0"



SECTION $\frac{D}{5}$

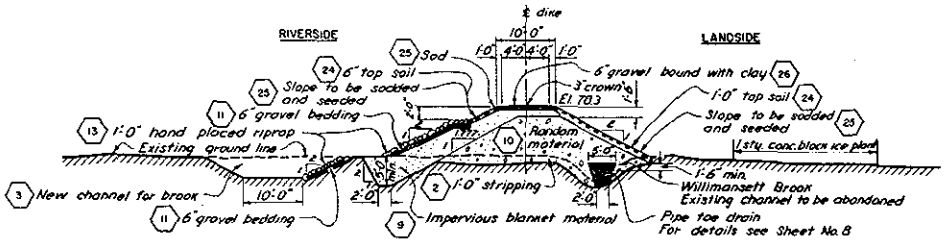
STA. 0+45±

TYPICAL BETWEEN STA. 0+30± AND STA. 0+50±

AND BETWEEN STA. 4+25± AND STA. 4+70±

MONTGOMERY STREET DIKE

SCALE: 1" = 10'-0"



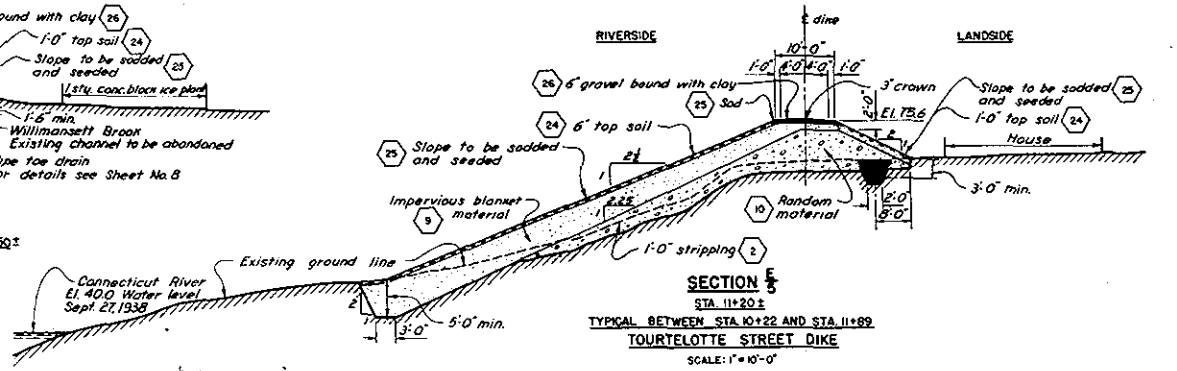
SECTION $\frac{B}{5}$

STA. 3+00±

TYPICAL BETWEEN STA. 2+29± AND STA. 3+50±

MONTGOMERY STREET DIKE

SCALE: 1" = 10'-0"



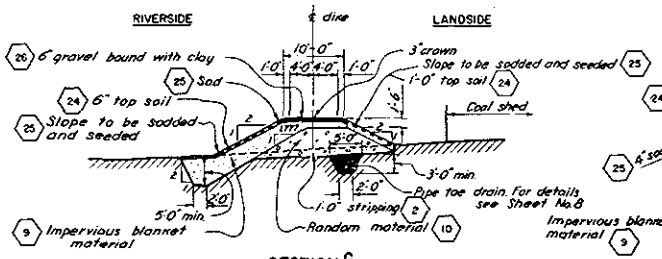
SECTION $\frac{E}{5}$

STA. 11+20±

TYPICAL BETWEEN STA. 10+22 AND STA. 11+89

TOURTELOTTE STREET DIKE

SCALE: 1" = 10'-0"



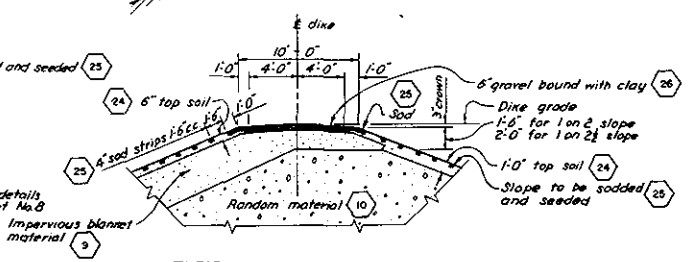
SECTION $\frac{C}{5}$

STA. 4+17±

TYPICAL BETWEEN STA. 3+50± AND STA. 4+25±

MONTGOMERY STREET DIKE

SCALE: 1" = 10'-0"



TYPICAL CROWN SECTION

SCALE: 1" = 5'-0"

5' 0 5' 10'

NOTES:

Elevations refer to Mean Sea Level Datum.

Figures in hexagons indicate item numbers under which payment will be made.

Dike grade is at shoulders of dike crown.

KEY	DATE	REVISION (indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE DIKE

WILLIMANSETT SECTION - [redacted] H.L.

EMBANKMENT DETAILS

CONNECTICUT RIVER — MASSACHUSETTS

IN 16 SHEETS — SCALE: 1" = 10 FT — SHEET NO. 6

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — DEC. 1939

SUBMITTED: Lucius B. Lobdell, Senior Engineer, Head, Design Section

APPROVAL RECOMMENDED: D. B. Burns, Principal Engineer, Chief, Design Section

APPROVED: [illegible], Colonel, Corps of Engineers, District Engineer

DESIGNED: R. C. Hanson, Asst. Engineer

DRAWN: R.A.T.-F.E. TRACED: C.R. CHECKED: C.O.T.

FISCAL YEAR 1940 FILE NO. CT-4-2017

PLATE NO. 3

CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

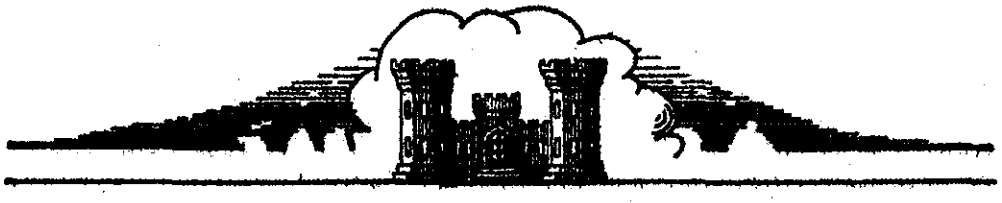
CONNECTICUT RIVER, MASSACHUSETTS

ANALYSIS OF DESIGN FOR LOCAL PROTECTION WORKS

ITEM C. 4 - HIRED LABOR

WILLIMANSETT DIKE

APPENDIX A



DECEMBER 1939

CORPS OF ENGINEERS, U. S. ARMY

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

WAR DEPARTMENT

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

Page 1

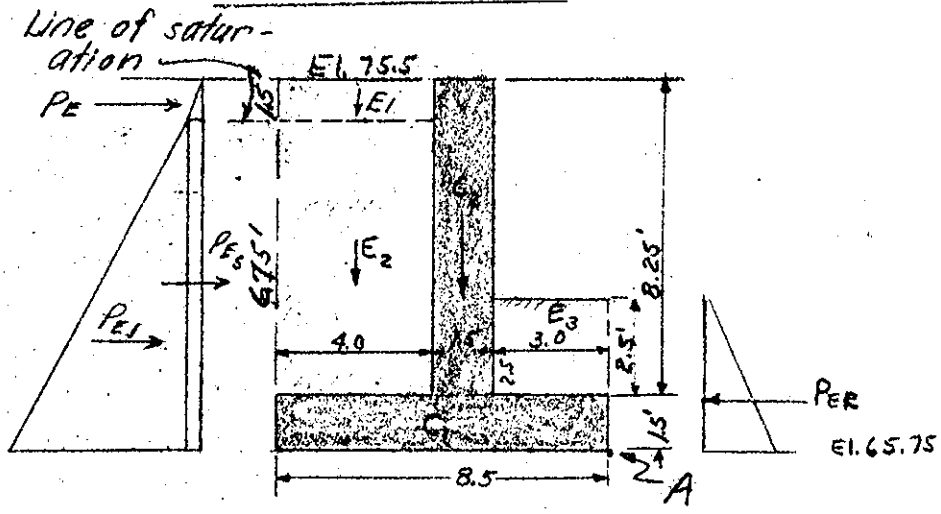
Subject: CHICOPEE DIKE - C4

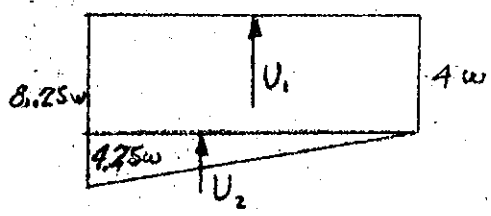
Computation: Prospect Street stop log structure

Computed by: J.H.L. Checked by: [illegible] Date: Nov. 1939

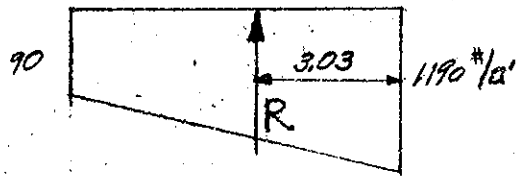
U. S. GOVERNMENT PRINTING OFFICE 3—10528

Maximum section





HYDROSTATIC UPLIFT



BEARING

WAR DEPARTMENT

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

Page 2

:t CHICOPEE DIKE - C4

utation Prospect Street stop log structure

uted by JHL Checked by RSM Date Nov. 1939

U. S. GOVERNMENT PRINTING OFFICE 3—10536

STABILITY - River falling, dike saturated to design grade.

Forces acting		↓	↑	→	←	Arm	Moments abt. A ↻	Moments abt. A ↺
P_E	$35 \times 1.5^2/2$			40		8.75	350	
P_{Es}	$35 \times 3 \times 8.25$			870		4.13	3600	
P_{E1}	$80 \times 8.25^2/2$			2720		2.75	7480	
U_1	$62.5 \times 4.0 \times 8.5$		2120			4.25	9000	
U_2	$62.5 \times 4.25 \times 8.5/2$		1130			5.67	6420	
E_1	$100 \times 4 \times 1.5$	600				6.5		3900
E_2	$125 \times 4 \times 6.75$	3380				6.5		21970
E_3	$125 \times 3 \times 2.5$	940				1.5		1410
C_1	$150 \times 1.5 \times 8.5$	1910				4.25		8120
C_2	$150 \times 1.5 \times 8.25$	1850				3.75		6950
P_{ER}	$80 \times 4^2/2$				640	1.33		850
		8680	3250	8630	640		26850	43,200
	$\Sigma V =$	5430					$\Sigma M =$	16,530
	$\Sigma H =$			2990				

Position of resultant - $\frac{\Sigma M}{\Sigma V} = \frac{16,530}{5,430} = 3.03'$, within middle third.

Bearing - $e = \frac{8.5}{2} - 3.03 = 1.22'$

$$\frac{5430}{8.5}\left(1 \pm \frac{6 \times 1.22}{8.5}\right) = 640(1 \pm .86) = 1190\ \#/\square' \text{ to } 90\ \#/\square'$$

Sliding - Net horizontal force 2990#

Max. allowable horizontal force - active pressure

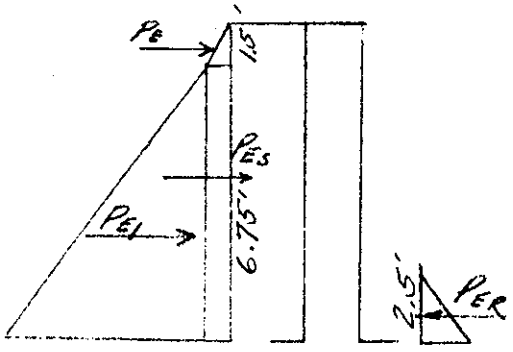
$5430 \times .45 =$ 2440#

passive resistance of soil and resistance of stop log sill is more than ample to balance remaining horizontal pressure.

Project: CHICOPEE - C4
Computation: Prospect Street Stop-log structure
Computed by: JHL Checked by: RSM Date: Nov. 1939

U. S. GOVERNMENT PRINTING OFFICE 3—10528

DESIGN OF STEM



At base of stem

	Force →	Force ←		Moments ↷	Moments ↶
P_E $35 \times \overline{1.5}^2/2$	40		7.25	290	
P_{ES} $35 \times 6.75 \times 1.5$	350		3.38	1200	
P_{EL} $80 \times \overline{6.75}^2/2$	1820		2.25	4100	
P_{ER} $80 \times \overline{2.5}^2/2$		250	.83		210
	2210	250		5590	210
ΣV	1960#		ΣM	5380'#	

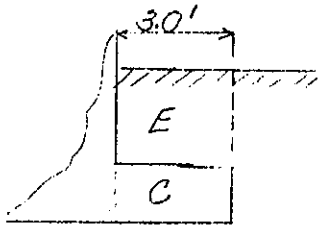
$d = \sqrt{\frac{5380}{123}} = 2.1'' + 3''$ cover $= 5.1''$ req'd., $18''$ supplied

$A_s = 5380 \times 12 / 18000 \times .884 \times 14.5 = .28^{\square''}$ Use $\frac{1}{2}''\square$ @ 1'-0"

$v = 1960/12 \times .884 \times 14.5 = 13\#/\square''$ OK

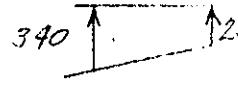
DESIGN OF BASE - Road side

At face of stem



	↓	↑		↷	↶
E $125 \times 3 \times 2.5$	940		1.5	1410	
C $150 \times 3 \times 1.5$	675		1.5	1010	
U 250×3		750	1.5		1120
$90 \times 3/2$		135	1.0		130
B 800×3		2400	1.5		3600
$390 \times 3/2$		590	2.0		1180
	1615	3875		2420	6,030

$\Sigma V = 2260\#$ $\Sigma M = 3610'\#$



$A_s = \frac{3610 \times 12}{18000 \times .884 \times 13.5} = .20^{\square''}$

Use $\frac{1}{2}''\square$ @ 1'-0"

WAR DEPARTMENT

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

Page 4

ect CHICOPEE DIKE - C4

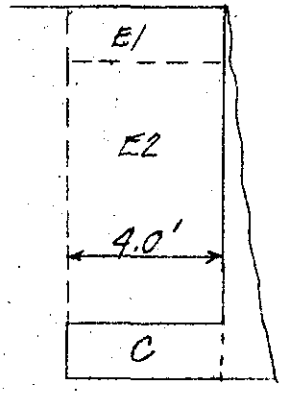
putation Prospect St. Stop log

puted by JHL Checked by R. L. M. Date Nov. 1939

U. S. GOVERNMENT PRINTING OFFICE 3—10528

DESIGN OF BASE - Dike side

At face of stem



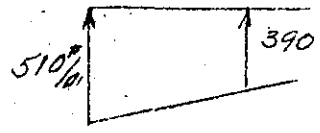
		Force ↓	Force ↑		Moment ↶	Moment ↷
E_1	100×4×1.5=	600		2.0	1200	
E_2	125×4×6.75=	3380		2.0	6760	
C	150×4×1.5	900		2.0	1800	
U	390×4		1560	2.0		3120
	120×4/2		240	2.7		650
B	90×4		360	2.0		720
	520×4/2		1040	1.3		1350
		4880	3200		9760	5840

$\Sigma V = 1680^{\#}$ $\Sigma M = 3920'^{\#}$

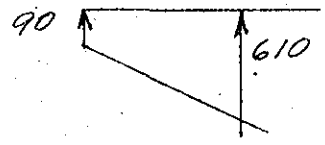
$A_s = \frac{3920 \times 12}{18000 \times .884 \times 13.5} = .22^{\square''}$

Use $\frac{1}{2}$"□ @ 1'-0"

$v = 1680/12 \times .884 \times 13.5 = 12^{\#}/\square''$ OK



Uplift



Bearing

WAR DEPARTMENT

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

Page 5

ject CHICOPEE -C4

nputation Prospect St. Stop log structure

nputed by RSM Checked by J.H.L. Date 11-17-39

U. S. GOVERNMENT PRINTING OFFICE 3—10828

STOP LOGS

$H = 6.4'$, $L = 15.5'$

$w = 6.4 \times 62.5 = 400^{\#}/\square'$

$M = 400 \times \frac{1}{15.5^2} \times 12/8 = 144{,}500$ "# per ft. of depth.

Assume beam. 6"×8"

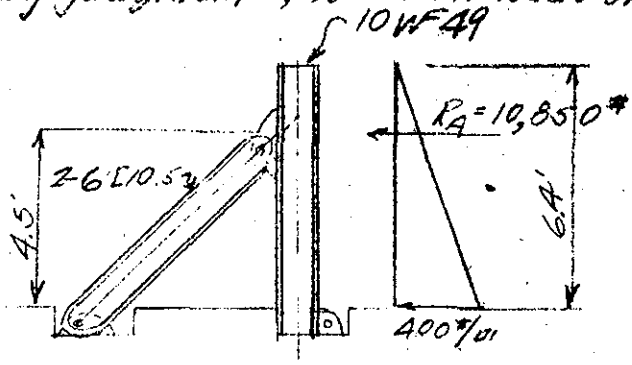
Allowable $M = f_s = 1750 \times 5.5 \times \overline{7.5}^2/6 = 90{,}000$ "#

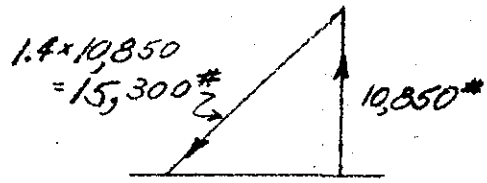
Actual $M = 144{,}500 \times 5.5/12 = 66{,}500$ "#

$V = 400 \times \frac{15.3}{2} \times \frac{5.5}{12} = 1400^{\#}$

Allowable $V = \frac{2}{3} bdv = \frac{2}{3} \times 7.5 \times 5.5 \times 128 = 3520^{\#}$

STOP LOG SUPPORT. - Note: Size of members is determined by judgment, as actual loads are very light.





$R_A = 15.5\left[1.9 \times 62.5 + 1.9 \times 62.5 \times \frac{4.5}{2} + \frac{4.5 \times 62.5 \times 4.5}{2 \times 3}\right. = 10{,}850^{\#}$

Stop log beam Assume 10 WF 49 for f/g. bearing area.

$M = \frac{120+400}{2} \times \overline{4.5}^2 \times 12/8 \text{ (approx.)} \times 15.5 = 122{,}500$ "#

$f_t = 122{,}500 / 54.6 = 2{,}240$ #/□"

$f_c = 10{,}850 / 14.40 = 760$

f_s Total $3{,}000$ #/□"

f_s allowable $= \frac{18000}{1 + \frac{54^2}{18000 \cdot 2.54^2}} = 17{,}800$ #/□" OK

Anchor pin bolt - $\frac{15300}{2 \times 12000} = .64$ □" reqd. Used 1"φ $A_s = .79$ □"