U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
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ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDED-D

29 August 1966

SUBJECT: Water Resources Development Project - Point Judith, Rhode Island - Design Memorandum No. 5 - Breachway Structure and Walls

TO: Chief of Engineers
ATTN: ENGCW-E

There is submitted herewith, for review and approval, Design Memorandum No. 5 - Breachway Structure and Walls, for the Water Resources Development Project, Point Judith, Rhode Island, in accordance with EM 1110-2-1150.

FOR THE DIVISION ENGINEER:

JOHN Wm. LESLIE
Chief, Engineering Division

Incl (10 cys)
Des Memo No. 5

WATER RESOURCES DEVELOPMENT PROJECT

POINT JUDITH
RHODE ISLAND

DESIGN MEMORANDUM NO. 5

BREACHWAY STRUCTURE AND WALLS

INDEX TO DESIGN MEMORANDA

No.	Title	Date Submitted	Date Approved
1	Hydrology and Hydraulics	1 Jul '65	5 Aug '65
2	General Design (including Site Geology and Embankments and Foundations)	22 Jul '66	
3	Concrete Materials	30 Sep '65	2 Nov '65
4	Real Estate		
5	Breachway Structure and Walls	29 Aug '66	

WATER RESOURCES DEVELOPMENT PROJECT

POINT JUDITH
RHODE ISLAND

DESIGN MEMORANDUM NO. 5

BREACHWAY STRUCTURE AND WALLS

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WATER RESOURCES DEVELOPMENT PROJECT

POINT JUDITH
RHODE ISLAND

DESIGN MEMORANDUM NO. 5

BREACHWAY STRUCTURE AND WALLS

A. PERTINENT DATA

1. Purpose — Water Resources Development, consisting of Hurricane Protection, Beach Erosion Control, and Navigation Improvement.

2. Location

State	Rhode Island
County	Washington
Towns	Narragansett & South Kingstown
Villages	Galilee & Jerusalem
Ocean	Block Island Sound, Atlantic

3. Structures

a. Breachway

Type	Concrete Gravity
Number	1
Location	Across Existing Navigation Channel
Top Elevation	Varies
Length (incl. Navigation Opening)	350 feet
Width	Varies
Navigation Opening (Ungated)	150 feet
Sill Elevation	-24.5 msl

b. Fender System

Type	Concrete and Treated Timber and Wood Piling
Length	200 feet each side of channel
Elevation	6.0 feet msl
Width	5 feet, six inches

3. Structures (Cont'd)

c. Bulkhead

Type	Prestressed Concrete Sheet Piling
Length	1,950 feet
Top Elevation	22.0 feet msl
Bottom Elevation	-1.5 feet msl
Pile Section	8 inches thick by 4 feet wide

WATER RESOURCES DEVELOPMENT PROJECT

POINT JUDITH
RHODE ISLAND

DESIGN MEMORANDUM NO. 5

BREACHWAY STRUCTURE AND WALLS

B. INTRODUCTION

1. PURPOSE

The purpose of this design memorandum is to present for review and approval the basic structural design criteria for the structures in the Point Judith Water Resources Development Project. Basic criteria, typical design computations and other pertinent data are presented.

C. HYDROLOGY AND HYDRAULICS

2. GENERAL

Approved Design Memorandum No. 1 contains the basic hydrologic and hydraulic design criteria for the project.

D. GEOLOGY

3. GENERAL

Design Memorandum No. 2, "General Design", contains the detailed geological studies for the project.

E. FOUNDATIONS

4. GENERAL

Design Memorandum No. 2, "General Design", contains the details on the foundation conditions at the project site.

Additional foundation explorations have recently been completed at the location of the breachway structure to determine the extent of the underlying organic silts originally encountered during the preliminary exploration program. Preliminary analysis of the data indicate that the organic material is not as extensive as originally indicated which may lead to a reduction in the number and lengths of piles required. Changes in pile requirements will be reflected in the contract plans and specifications.

F. CONCRETE

5. CONCRETE MATERIALS

Concrete Materials are discussed in detail in approved Design Memorandum No. 3, "Concrete Materials".

The concrete aggregates will be obtained from an approved commercial source because of the relatively small quantity of concrete required. Type II portland cement, the equivalent Type IS (MS) portland blast furnace slag cement, and Type III portland cement with a maximum of 8% tricalcium aluminate will be specified.

G. STRUCTURAL DESIGN

6. PURPOSE AND SCOPE

This section represents the design criteria, basic data, assumptions and procedure used in the design of the Breaching Structure, the "I" Wall and the Catwalk for the Breachway Control Structure.

7. DESIGN CRITERIA

a. General. All working stresses conform to those specified in the Engineering Manual EM 1110-1-2101, "Working Stresses for Structural Design", dated 1 November 1963. General loading conditions, design assumptions and other design criteria are based on the following applicable parts in the Engineering Manual for Civil Works issued by the Office of the Chief of Engineers; Standard Practice for Concrete (EM 1110-2-2000, December 1965); Retaining Walls (EM 1110-2-2502, 29 May 1961). Accepted engineering practice has been employed in cases where the Engineering Manual for Civil Works does not apply. Design of the concrete sheet piling conforms to the ACI-ASCE Tentative Recommendations for Prestressed Concrete.

b. Concrete.

(1) Concrete working stresses are in general accord with ACI Standard Building Code Requirements for reinforced concrete using concrete with a minimum ultimate compressive strength of 3000 lbs per square inch except for prestressed concrete piling which will have a working stress of 5000 lbs per square inch.

(2) 3000 lb. Concrete

Flexure (extreme fiber stresses in comp.) P.S.I.	
All concrete	1,050

(3) 5000 lb. Prestressed Concrete Piling

Temporary Stresses (lbs. per square inch)

Max. fiber stresses in pretensioned compression	2,400
Max. fiber stresses in tension	190

Stresses at Design Loads

Max. fiber stresses in compression	2,000
Max. fiber stresses in tensions (live load only)	210

c. Reinforcement.

(1) Reinforcement rods except piling

(a) Grade and Working Stresses. All reinforcement in the structures, including temperature and shrinkage reinforcement is designed for the working stresses of new billet steel, intermediate grade, deformed bars which is 20,000 p.s.i. in flexual tension. The reinforcement shall conform to the requirements of Federal Specification QQ-1-632, Type II, Grade C and to ASTM A-305 56T.

(b) Spacing. The clear distance between parallel bars will not be less than 1-1/2 times the diameter of round bars except that in no case will the clear distance between parallel bars be less than 1 inch, or 1-1/2 times the maximum size of the coarse aggregate.

(c) Minimum Cover for Reinforcement.

Item	Minimum Cover (inches)
Concrete except prestressed piling	3"
Prestressed piling	2"

(d) Splices. All splices will be in accordance with the ACI Building Code and as set forth in Table 14c of Reinforced Concrete Design Handbook ACI Publication SP-3.

(e) Temperature and Shrinkage Reinforcement. Temperature and shrinkage reinforcement will be provided where the main reinforcement extends in only one direction. Such reinforcement will provide for a ratio of steel area to concrete area (bd) of 0.002 with a minimum of .0012 in each face.

(2) Reinforcement Strands in Prestressed Piling - Grade and Working Stresses. Reinforcement strands shall be stress relieved and conform to ASTM 416-64 having an allowable ultimate working strength of 250,000 p.s.i.

d. Wood Bearing Piles and Breachway Piling. Bearing piles supporting the breachway structures and the piling in the Breachway Control Structure will be dense close-grained Southern Yellow Pine or Pacific Coast Douglas Fir conforming to the requirements of Federal Specification MM-P-371a for "Piles; Wood", Type I, Class C, rough peeled. The minimum tip diameter of any length of pile will be 8 inches. Bearing piles will be untreated and will be driven to obtain a minimum bearing capacity of 30 tons. Piling in the Breachway Control Structure will be driven to approximate elevation -62.0 M.S.L.

e. Wood Framing. Structural timber framing in the Breachway Control Structure will be treated Douglas Fir, 1450 fiber stress, No. 1 grade.

8. BASIC DATA AND ASSUMPTIONS

a. Loads.

(1) Dead Loads. The following unit weight for materials were used:

	(Unit Weight - lbs./cubic foot)			
Material	Dry	Saturated	Moist	Submerged
Rock Fill	120 p.c.f.	140 p.c.f.	--- - - -	75 p.c.f.
Sand Fill	--- - - -	110 p.c.f.	100 p.c.f.	-- - - -
Concrete	150 p.c.f.	--- - - -	--- - - -	-- - - -

(2) Live Loads. The following live loads have been used:

Water	64.5	lbs per cubic foot
Wind	50	lbs per square foot, if applicable
Catwalk	100	lbs per square foot

b. External Water Pressure. Uplift pressure has been assumed as a uniform pressure equal to the full head available over the entire base area.

c. Earth Pressure. Earth pressures are determined in general accordance with EM 1110-2-2502, Retaining Walls.

d. Earthquake Forces. Earthquake forces were investigated using .05g and found to be negligible.

e. Ice Pressure. Ice pressure is not a factor.

f. Wave Pressures. Wave pressures are determined in accordance with Technical Report No. 4, Shore Protection and Planning, prepared by the Beach Erosion Board. With the exception of one monolith in the Breaching Structure where broken waves will occur, all other structures are affected by the clapotis condition. No breaking wave conditions will occur.

g. Location of Resultant and Sliding. Inasmuch as the Breaching Structure is founded on piles, the location of the resultant is unimportant. The pile foundations are designed to resist the horizontal and vertical loading with uplift held to less than 10 kips per pile.

h. Allowable Pile Bearing. The maximum pile bearing value used for the design of the wood bearing piles is 30 tons under normal conditions. Under storm conditions, an allowable increase of 50% has been assumed. Contract documents will require pile load tests to confirm the assumed design bearing value.

9. BREACHING STRUCTURE

a. General. The Breaching Structure consists of four mass concrete monoliths on each side of the 150-foot clear channel opening. The first two monoliths from the channel will be 20 feet in length and the last two 30 feet in length. The bottom portion of all monoliths will be made by placing tremie concrete between two sheet pile walls. The upper portion of the monoliths will be formed, mass concrete with a face batter of 1 to 4.

b. Loading Conditions. The monoliths were investigated for the following conditions of loading:

(1) Condition I. - Dead load of structure, water surrounding structure to Elevation +1.5 and 100% uplift over entire base.

(2) Condition II. - Storm Condition - Dead load of structure, water to the still water level surrounding the structure plus maximum wave loads on the ocean side. Uplift taken as uniform to the stillwater level.

c. Foundation Design. The wood piling has been so arranged as to virtually eliminate tension in the piles under all conditions of loading. The design arrangement is such that the maximum compression loading is 79 kips, and the maximum tension loading is 6 kips.

10. FENDER SYSTEM AND WALKWAY

The design of the catwalk will follow customary timber design using a 100 lb. per square foot live load. A wooden handrail will be provided on each side of the catwalk.

11. PRECAST CONCRETE SHEET PILE WALL

A prestressed concrete sheet pile wall will be utilized with the top protruding 3 feet above the sandberm. On the ocean side, the maximum water loading is assumed to the top of the wall, and as there is some question as to where ground water may occur on the backside, it has been analyzed by a Mathatron Computer program for a condition where there is no water on the backside and also for a condition where the water is to the ground surface. The true water condition will be somewhere between these extremes. Piling moments and critical depths were designed based on the maximum values obtained from either condition. The selected piling will have a minimum penetration of 20 feet and will be made up of sections 8 inches thick by 4'-0" wide.

12. MISCELLANEOUS STRUCTURES

Concrete, wood stairways and drainage structures indicated in Design Memorandum No. 2, "General Design", are routine structures. Computations are not included in the Appendix for these structures as they are minor in character and design will be accomplished in accordance with standard practice.

13. COST ESTIMATE

The total estimated project cost has not materially changed from that contained in Design Memorandum No. 2, "General Design". An additional item, "Obstruction Lighting", has been added to the project since the submission of the General Design Memorandum. The summary of the cost estimate is given in the following table.

TABLE I

DETAILED COST ESTIMATE
(June 1966 Base)

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
1	Prep. of Site			L.S.	$ 20,000
2	Stripping	16,000	C.Y.	$0.75	12,000
3	Excav., Unclass.	63,000	" "	0.75	47,250
4	Excav., Structures	27,000	" "	0.75	20,250
5	Comp. Earth Fill	38,000	" "	0.60	22,800
6	Sand Fill	743,000	" "	0.12	89,160
7	Sand Borrow	505,000	" "	2.00	1,010,000
8	Gravel Fill	5,000	" "	1.50	7,500
9	Gravel Bedding	44,300	" "	1.50	66,450
10	Comp. Gravel Fill	3,500	" "	1.70	5,950
11	Rock Armor (1-2 tons)	49,000	Tons	6.80	333,200
12	Rock Armor (2-3 tons)	36,000	"	7.10	255,600
13	Rock Armor (1-5 tons)	925	"	7.95	7,355
14	Rock Armor (3-6 tons)	2,700	"	7.80	21,060
15	Rock Armor (4-6 tons)	4,200	"	8.00	33,600
16	Rock Bedding	61,200	"	6.70	410,040
17	Rock Prot.(50-500#)	40,000	"	7.50	300,000
18	Groins				
	200# Chinking	400	"	7.125	2,850
	600# Chinking	400	"	7.125	2,850
	1,000# Chinking	1,350	"	7.50	10,125
19	Drainage Modification		L.S.	Job	11,000
20	Sand Fence	7,700	L.F.	1.00	7,700
21	Cofferdam		L.S.	Job	125,000
22	Fender System		L.S.	Job	45,000
23	Precast Conc. Pile Wall, 24 feet	1,950	L.S.	144.00	280,800
24	Precase Conc. Pile Wall, 13 feet	600	L.S.	78.00	46,800
25	Dredging, Hydraulic	276,000	C.Y.	1.15	317,400
26	Mob. & Demob. Hyd Dredge		L.S.	Job	25,000
27	Dredging, Scow	370,000	C.Y.	1.45	536,500
28	Mob. & Demob. Scow Dredge		L.S.	Job	25,000
29	Reshape Groins	1	L.S.	Job	20,000
30	Wood Bearing Piles, 50'	560	Each	120.00	67,200
31	Seeding, Beach Grass	80,000	S.Y.	0.50	40,000
32	Navigation Aids	1	L.S.	Job	13,000
33	Utility Modifications		L.S.	Job	5,050
34	Concrete Tremie	5,300	C.Y.	32.50	172,250
35	Concrete Mass	3,100	C.Y.	40.00	124,000

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
36	Concrete Misc.	100	C.Y.	$90.00	$ 9,000
37	Stairs, Wood		L.S.	Job	7,000
38	Obstruction Lighting		L.S.	Job	2,100
					$4,557,850
	Contingencies, 15%±				682,150
					$5,240,000
	Engineering & Design, 8.5%±				447,000
					$5,687,000
	Supervision & Administration, 7.5%±				428,000
					$6,115,000
	Lands and Damages				985,000
	TOTAL ESTIMATED PROJECT COST				$7,100,000

APPENDIX A

STRUCTURAL COMPUTATIONS

POINT JUDITH STRUCTURAL COMPUTATIONS

Title	Page No.
Plan Breachway Control Structure	1
Wave Forces	2 - 5
Monolith A	6 - 11
Monolith B	12 - 16
Monolith C	17 - 21
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Fender System and Walkway	25 - 26
Cantilever Sheet Pile Wall	27 - 29

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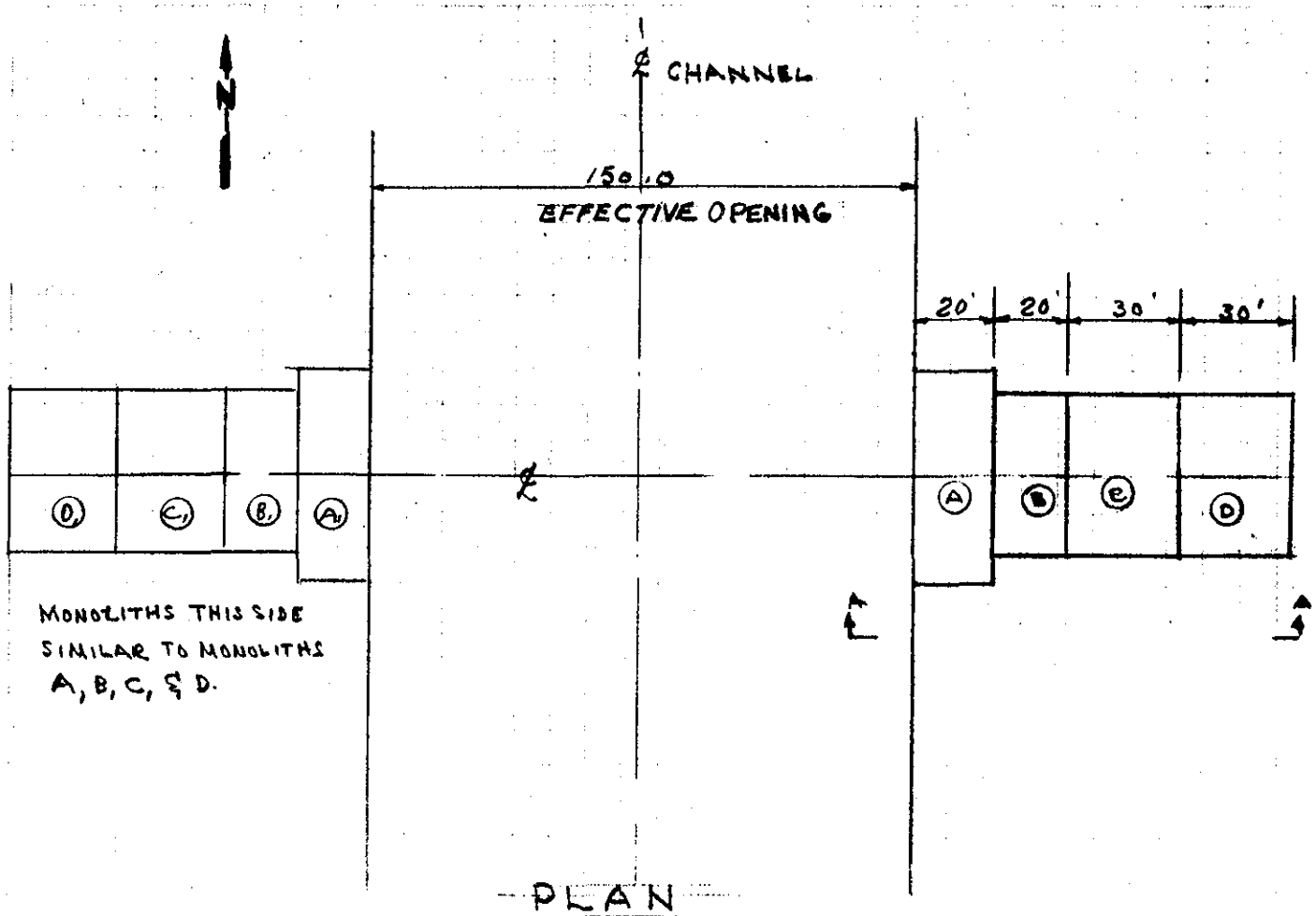
27 Sept 49

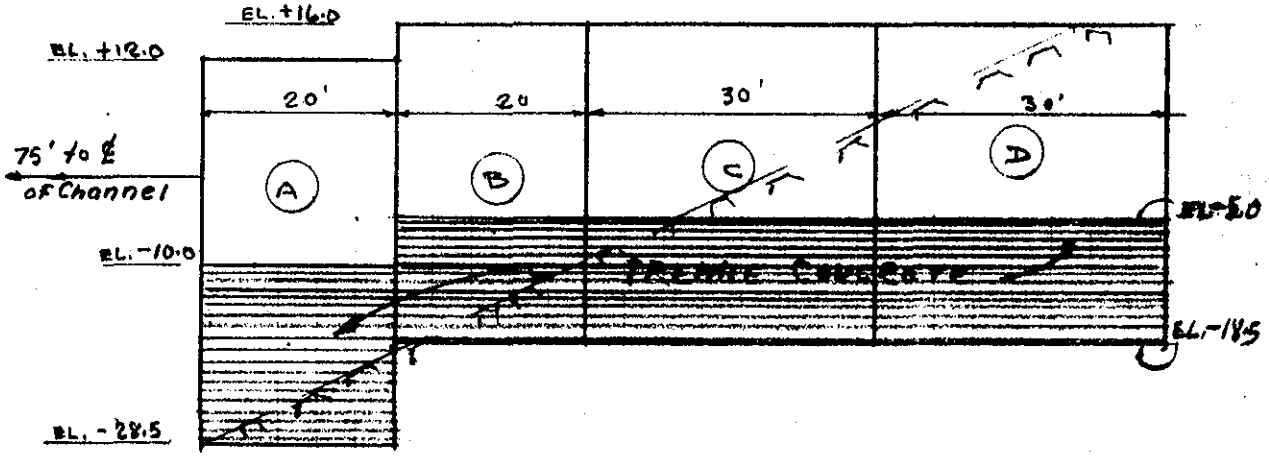
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

PAGE DM1

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Eym CHECKED BY DATE AUGUST 1966



PLAN
1" = 50'
BREACHWAY CONTROL STRUCTURES



A-A
1" = 20'

NED FORM 273
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT: PT. JUDITH – BREACHWAY ABUT.

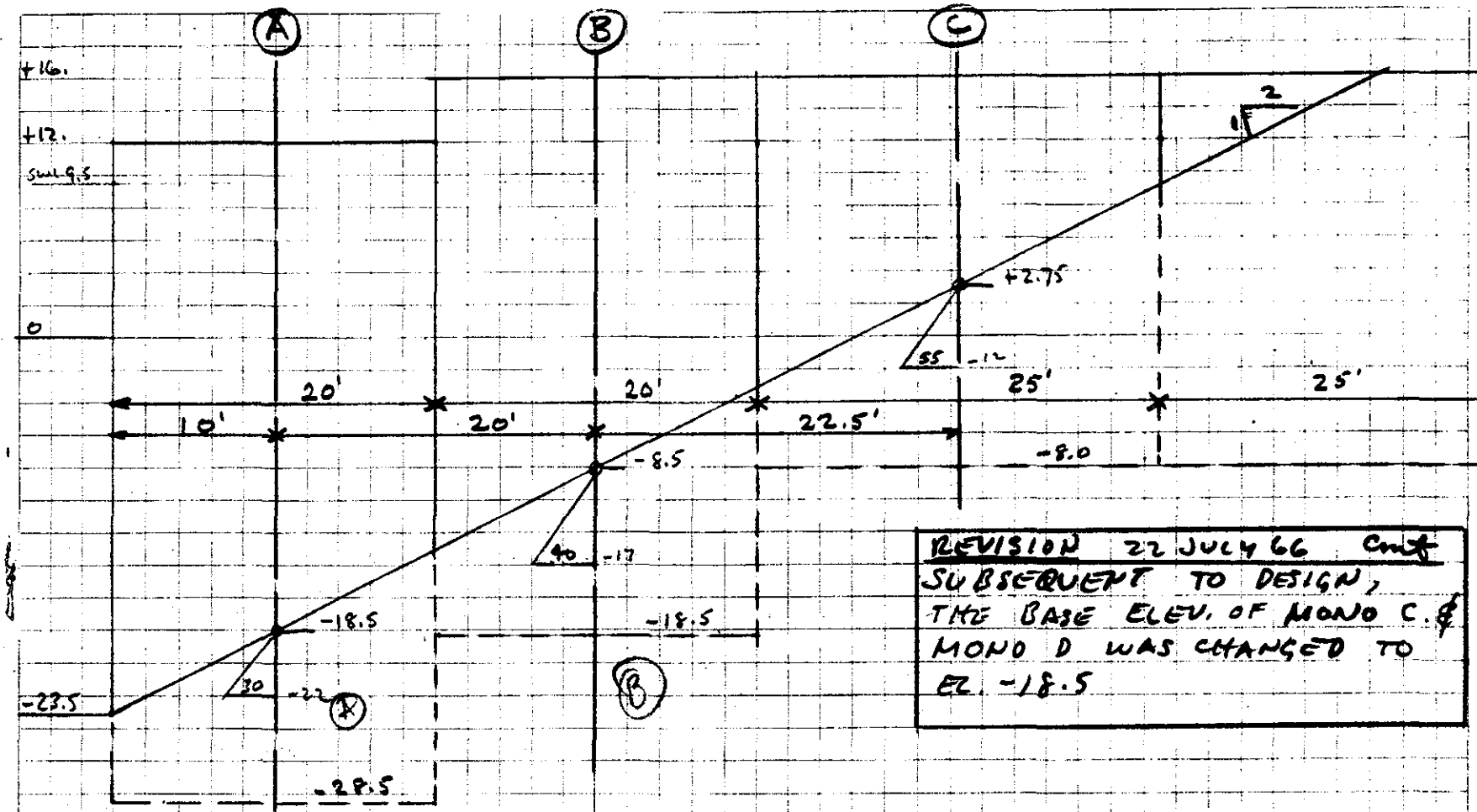
COMPUTATION: Wave Forces

COMPUTED BY: Cmt

CHECKED BY:

DATE: 12/10/65

PAGE DM-2



REVISION 22 JULY 66 Cmt
SUBSEQUENT TO DESIGN, THE BASE ELEV. OF MONO C & MONO D WAS CHANGED TO EL. -18.5

	MONO A	MONO B	MONO C
TOP OF STRUCT	+12	+16	+16
BOT " "	-28.5	-18.5	-8.0
BOT OF CHANNEL	-18.5	-8.5	+2.75
HG'T WALL TO CHAN.	30.5'	24.5	13.25'

PERIOD = 12 SECS
H_s = 8 FT
H MAX = 8 × 1.58 = 12.66 FT
d_b MAX = 12.66 × 1.3 = 16.46 FT
NO BREAKING WAVES ON MONO (A) ONLY CLAPOTIS

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
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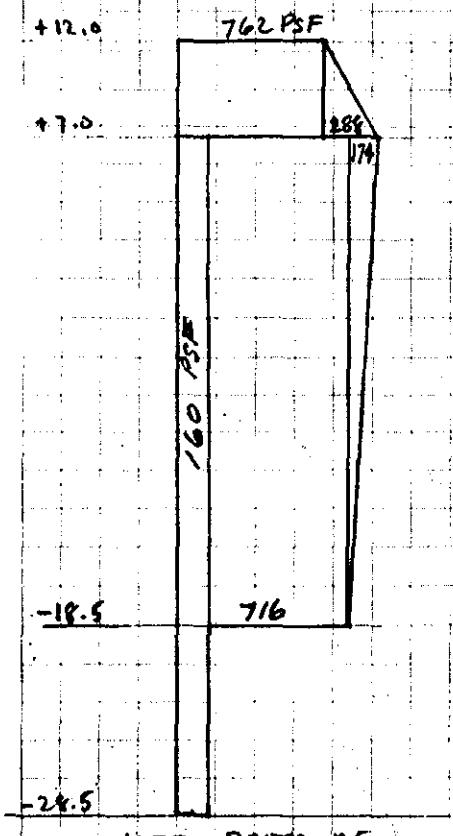
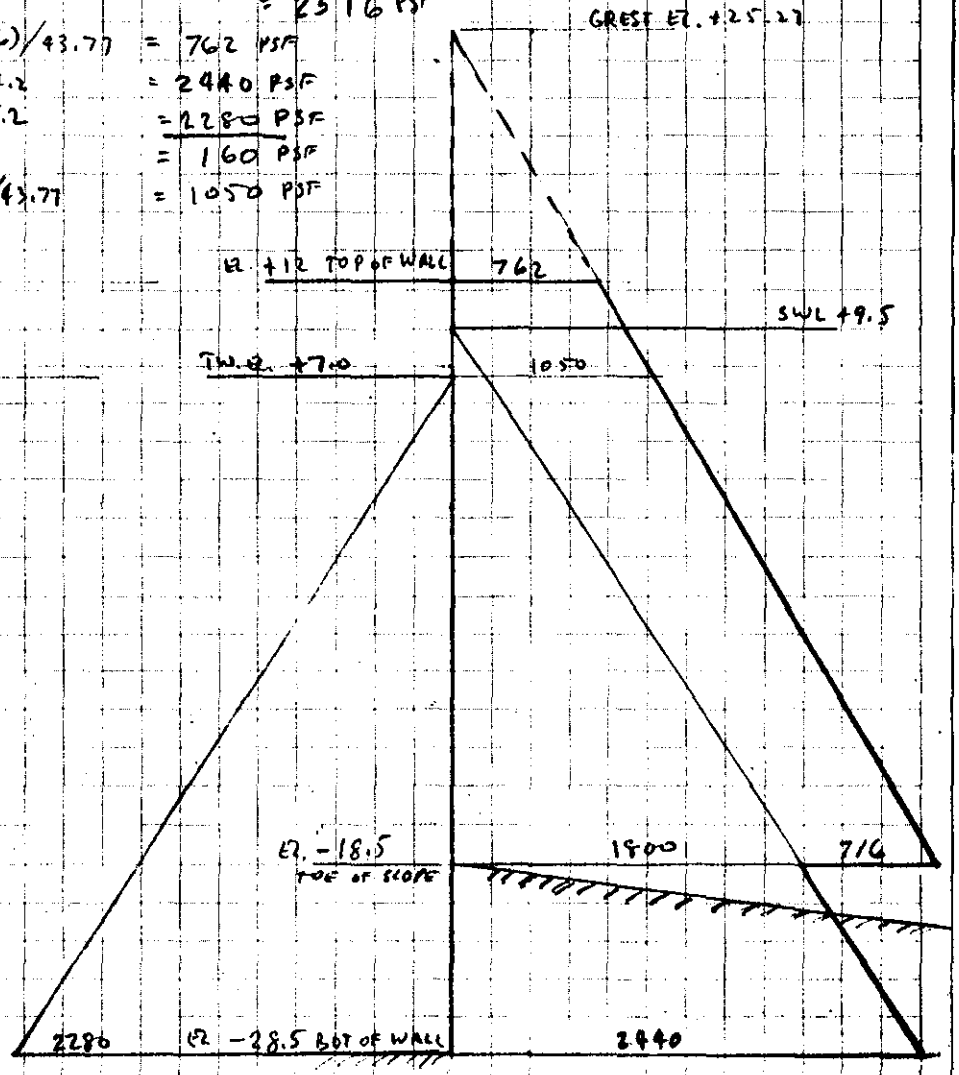
SUBJECT PT. JUDITH - BREACHWAY ABUT.
COMPUTATION WAVE FORCES - CLAPOTIS - MONOLITH (A)
COMPUTED BY Cuff CHECKED BY DATE 12/13/65

SWL = +9.5'
H_{MAX} = 12.66'
d = 9.5 + 18.5 = 28.0' > 16.46 NO BREAKING WAVE
T SEC = 12 SECS
L_o = 5.12 (12)² = 737'
d/Lo = 28/737 = 0.038
d/L = 0.08100
TAN H = 0.4691
COS H = 1.1324
L = 28/.081 = 346'
h_o = 3.14 (12.66)²/346/.4691 = 3.11'
H_{MAX} = + 12.66
SWL = + 9.50
CREST EL. = + 25.27
P_1 = 64.2 (12.66)/1.1324 = 716 PSF
wd = 64.2 (28) = 1800 PSF
P_1 + wd = 2516 PSF

TOP OF WALL P = 13.27 (2516)/43.77 = 762 PSF
BOT OF WALL P = 9.5 + 28.5) 64.2 = 2440 PSF
TW. P @ BOT OF WALL = 7 + 28.5) 64.2 = 2280 PSF
Δ P @ BOT = 160 PSF
P @ EL. 7 = 18.27 (2516)/43.77 = 1050 PSF



NET PRESSURE
PSF



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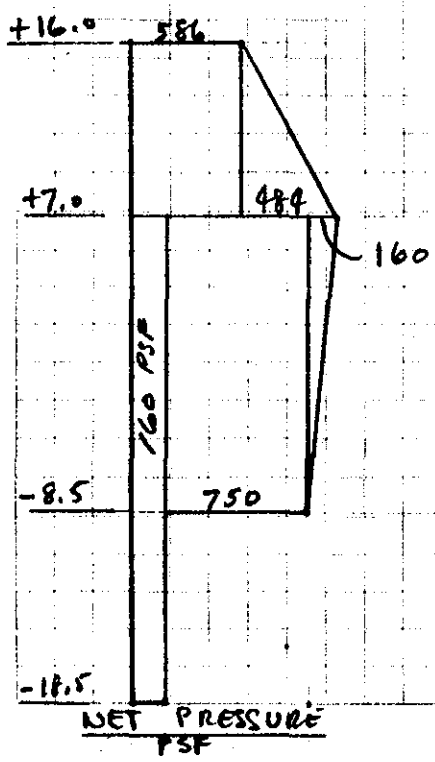
27 Sept 49

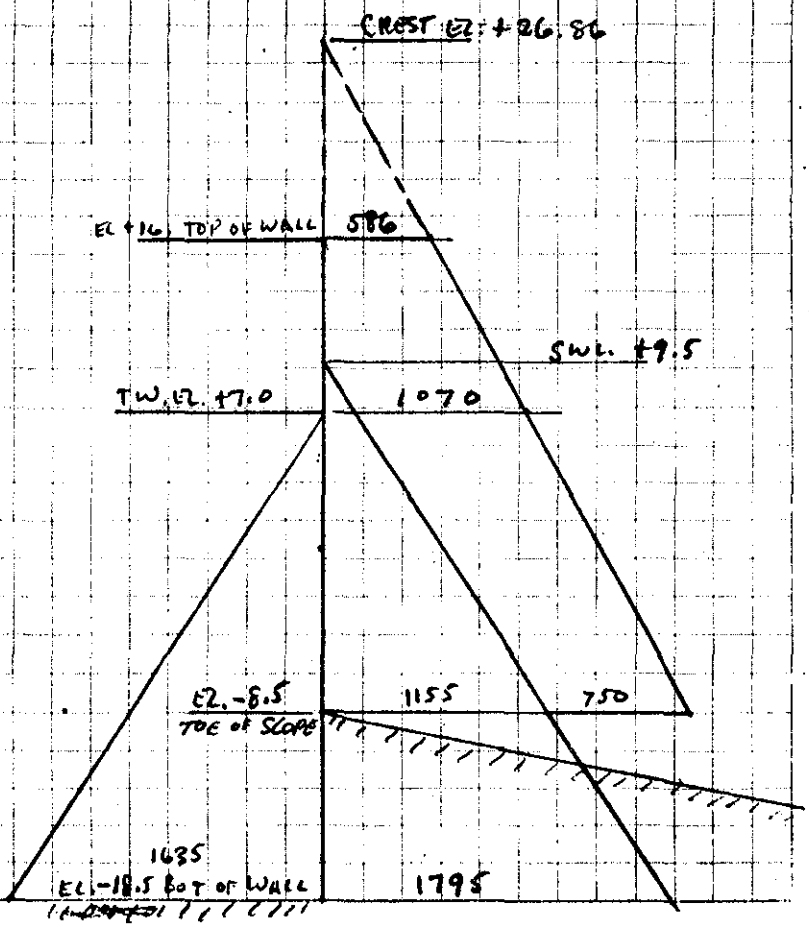
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

PAGE DM-4

SUBJECT: PT. JUDITH – BREACHWAY ABUT – MONOLITH (B)
COMPUTATION: WAVE FORCES – CLAPOTIS
COMPUTED BY: Cmf CHECKED BY: DATE: 12/13/65

SWL = +9.5
H_{max} = 8.0 × 1.58 = 12.66'
d = 9.5 + 8.5 = 18.0' > 16.86' NO BREAKING WAVE
T sec = 12 SEC
L_o = 737'
d/L_o = 18/737 = .0244
d/L = .06395
TANH = .3810
COSH = 1.0818
L = 18/.06395 = 282'
h_o = 3.14(12.66)²/282/.381 = 4.7'
H = 12.66
SWL = 9.5
CREST EL = 26.86
P_1 = 64.2(12.66)/1.0818 = 750 PSF
wd = 64.2 (18) = 1155 PSF
P_1 + wd = 1905 PSF
TOP OF WALL P = 19.86(1905)/35.36 = 586
P @ EL +7 = 19.86(1905)/35.36 = 1070





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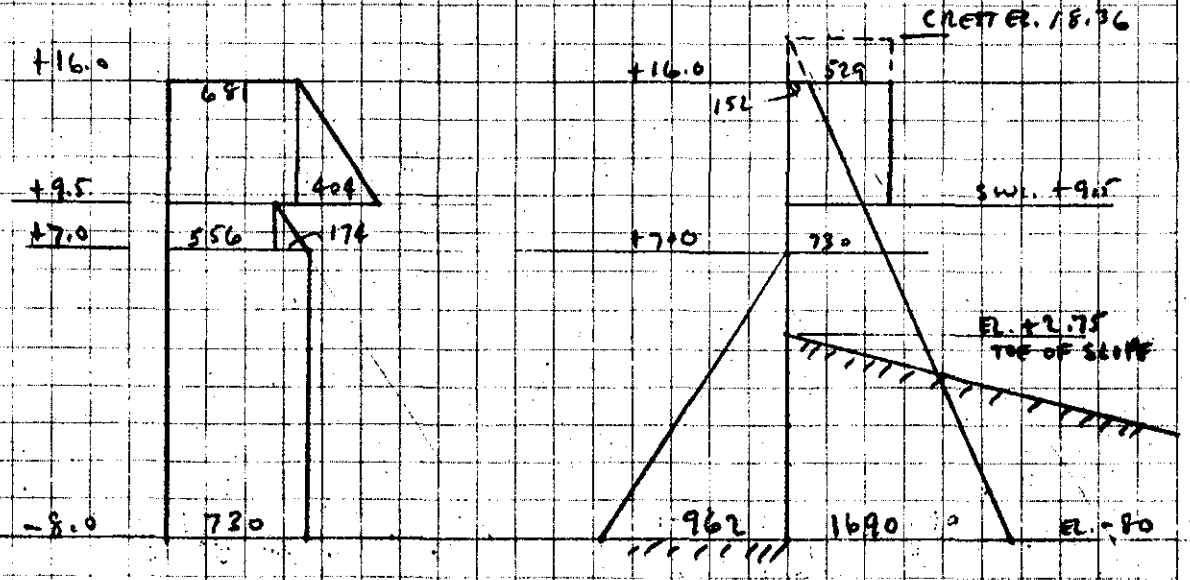
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

PAGE DIV-5

SUBJECT Pt. JUDITH - BREACHWAY ABUT.
COMPUTATION WAVE FORCES - MONOLITH C - BROKEN WAVE
COMPUTED BY Cmt CHECKED BY DATE 12/13/65

SWL = = +9.5
HMAX = = 12.66
d = 9.5-2.75 = 6.75' < 16.46 WAVE WILL BE BROKEN WAVE
T = = 12 SEC.
Lo = = 737'
d_b = 12.66 x 1.3 = 16.46
h_c = 12.66 x .7 = 8.86'
SWL = = 9.5
CREST EL. = = 18.36'
ELB = = -8.0
d_s = = 26.36'
h_c COMP = 16.0 - 9.5 = 6.5'
P_m PSF = 64.2 (16.46)/2 = 529 PSF
@ BOT P = 26.36 (64.2) = 1690 } 728
TW P = 15.00 (64.2) = 962
TOP OF WALL = 2.36 (64.2) = 152
+ 529
681
P @ EL. 7 = 11.34 (64.2) = 730
P @ 9.5 = 8.86 (64.2) = 556



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Fagan CHECKED BY DATE MAY 1966

MONOLITH "A"

— CONDITION —

CASE I: DEAD LOAD. WATER AT EL. +1.5 100% UPLIFT OVER BASE

CASE II STORM CONDITION - EL. WATER +9.5. 100% " " "

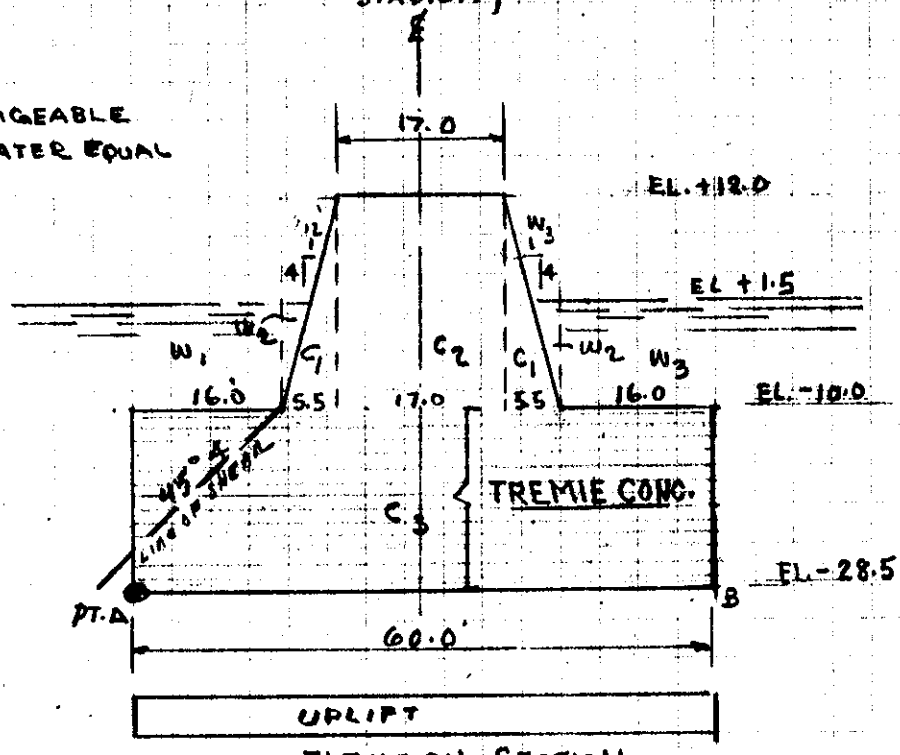
(NOTE: SEE C.H.I.T'S COMPUTATIONS OF WAVE NET FORCES WHICH ARE USED IN THIS ANALYSIS PER MONOLITH)

(CHECK EARTHQUAKE FORCES)

CASE I

— STABILITY —

ROCKFILL NEGLIGEABLE
LAT. PRESS. OF WATER EQUAL AND CANCELS.



ELEVATION - SECTION
1" = 20'

STABILITY PER FOOT OF MONOLITH

ITEM	FACTORS	↓	↑	→	←	ARM	↻ M	↺ M
2(C1)	0.15 X 5.5 X 22 X 2 X 0.5	18.15				30	544.50	
C2	0.15 X 17 X 22	56.10				30	1683.00	
C3	0.15 X 60 X 18.5	166.30				30	4989.00	
W1 & W3	0.064 X 11.5 X 16 X 2	23.50				30	705.00	
2(W2)	0.064 X 2.87 X 11.5 X 0.5	1.06				30	31.80	
UPLIFT	0.064 X 30 X 60		115.30			30		3459.00
		265.11	115.30				7953.30	3459.00
		ΣV = 149.81					ΣM = 4494.3	

X = ΣM ÷ ΣV = 4494.3 ÷ 149.81 = 30.00 e = 0

S.B.P. = ΣV ÷ Area = 149.81 ÷ 60 X 1 = 2.50 ksf

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Eym CHECKED BY DATE MAY 1966

MONOLITH "A"

CASE II – STORM CONDITION (WATER EL. +9.5)

ITEM	FACTORS	↓	↑	→	←	ARM	↷ M	↶ M
CONCRETE	AS COMPUTED PAGE II	240.55				30.00	7216.5	
W_1 & W_3	0.064 × 19.5 × 16 × 2	40.00				30.00	1200.0	
W_2 (2)	0.064 × 4.87 × 19.50 × 2 × 0.5	6.08				30.00	182.4	
F_{160}	0.16 × 35.5				5.68	17.75		100.8
F_{762}	0.762 × 5				3.81	38.00		144.8
F_{288}	0.288 × 5 × 0.5				0.72	37.17		26.7
F_{174}	0.174 × 25.5 × 0.5				2.22	27.00		59.9
F_{716}	0.716 × 25.5				18.26	22.75		415.4
UPLIFT	0.064 × 60 × 1 × 38		146.00			30.00		4380.0
		286.63	146.00		30.69		8598.9	5127.6
	ΣV	140.63		ΣH = 30.69			ΣM = 3471.3	

$x = \Sigma M \div \Sigma V = 3471.3 \div 140.63 = 24.7$ $\quad e = 5.3'$

SOIL BEARING PRESSURE:

$$P_A = \frac{140.63}{60}\left(1 + \frac{6(5.3)}{60}\right) = 2.34\,(1 + .53) = 3.58 \text{ KSF @ A}$$
$$2.34\,(0.47) = 1.10 \text{ KSF @ B}$$

NOTE: THE SOIL BEARING PRESSURES EXCEED THE CONDITION OF ORGANIC SILT AND VERY POOR MATERIAL FOR A DEPTH OF 15'± BELOW TREMIE CONCRETE PER SOILS LAB, AND WOOD PILES WILL BE USED. SOILS LAB SUGGESTS PILES TO BE DRIVEN TO EL -63.5± WHERE IT IS EXPECTED PILE RESISTANCE WILL BE SATISFACTORY.

CHECK FOR EARTHQUAKE FORCES:

WT OF CONCRETE = 240.55 $\quad \alpha = 0.05 \quad h = 40.5$

$P_{e,c} = W_c = 240.55 \times 0.05 = 12.05 \quad y = 38'$

$M_e = 12.05 \times 20.25 = 244.10$

WATER

$$C_e = \frac{51}{\sqrt{1 - 0.72\left(\frac{h}{100 t_e}\right)^2}} = \frac{51}{\left(1 - 0.72\left(\frac{40.5}{100}\right)^2\right)} = 52$$

$P_{e_2} = \frac{2}{3} C_e \times y (\gamma h)^{1/2} = 0.67\,(52)\,(0.05)\,38\,(.08 \times 40.5)^{1/2} = 2.53$

$M_e = .4y\,P_{e_2} = 2.53\,(.4)\,38 = 93.7$

$TM = 244.1 + 93.7 = 337.8$

$e = \frac{337.8}{240.55} = 1.34'$ TOWARD A Resultant well within the structure.

SUBJECT POINT JUDITH

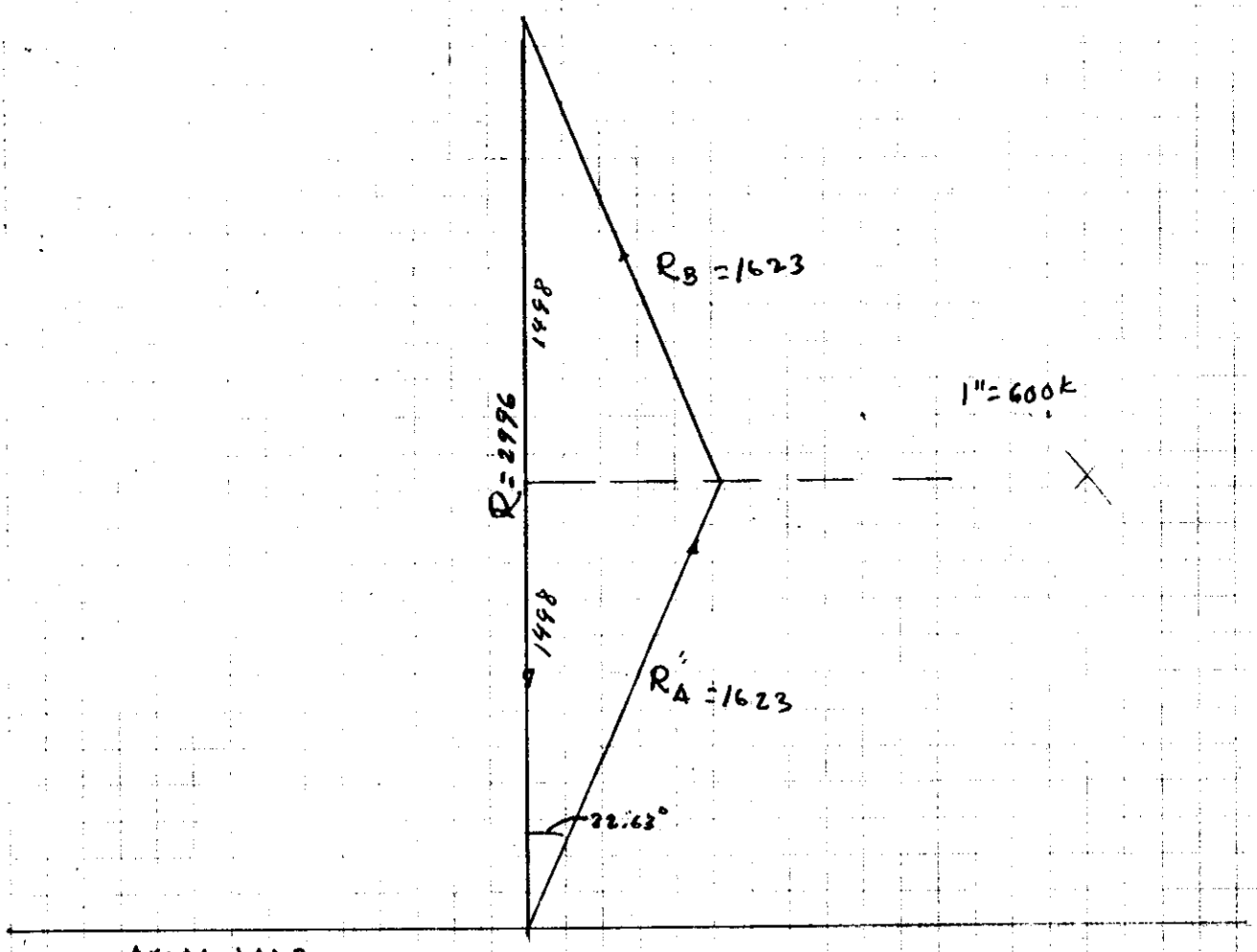
COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Efm CHECKED BY DATE MAY 1966

MONOLITH "A" NOTE; EARTHQUAKE FORCE NOT CONSIDERED CRITICAL

CASE I

R = 149.81 x 20 = 2996.20 TOTAL



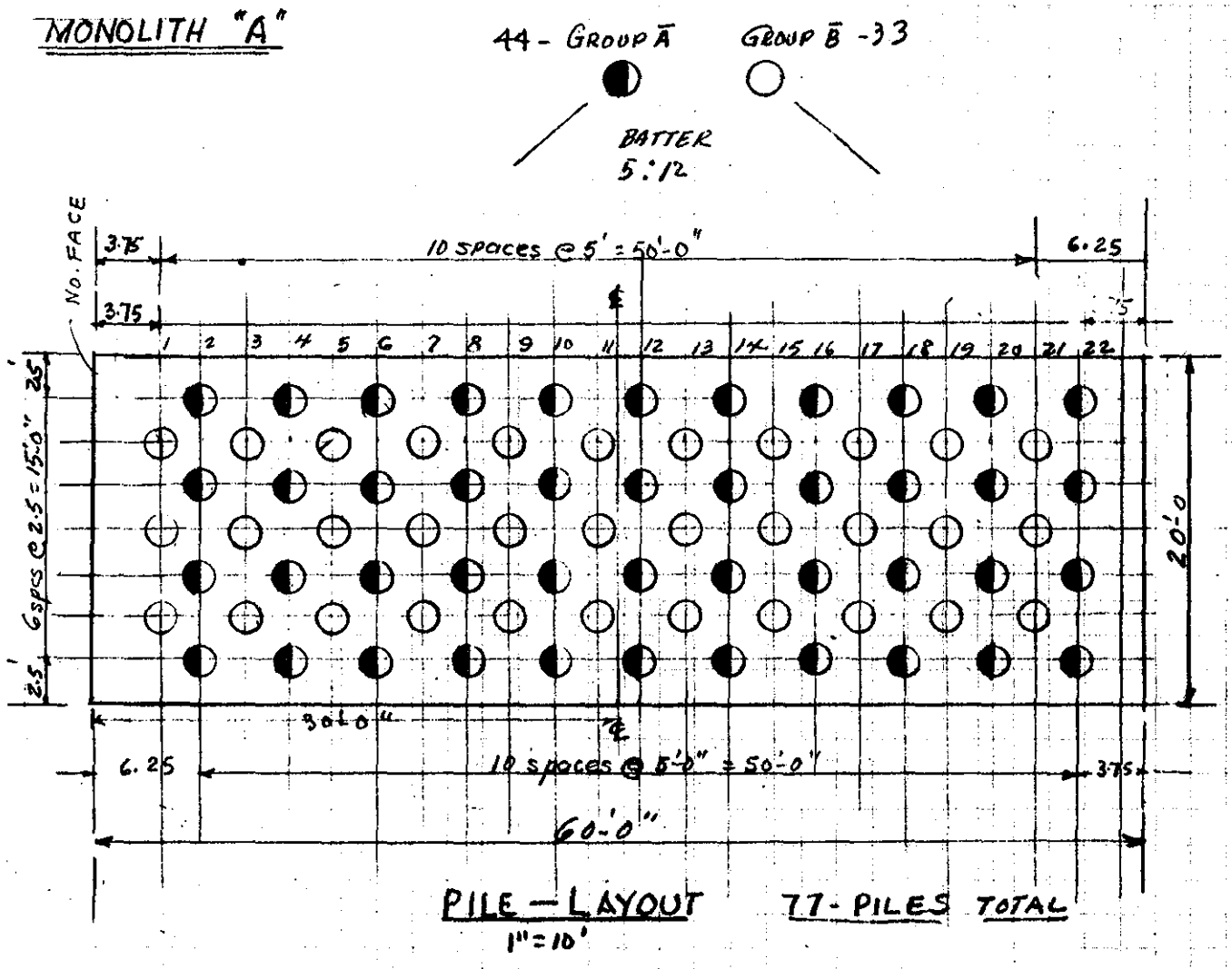
AXIAL LOAD

R_A = 1623/44 = +37 < 60k

R_B = 1623/33 = +49 < 60k ALLOW PER SOILS LAB

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Efm CHECKED BY DATE MAY 1966

MONOLITH "A"



PILE — LAYOUT 77 - PILES TOTAL
1" = 10'

CHECK CASE II — PILING —

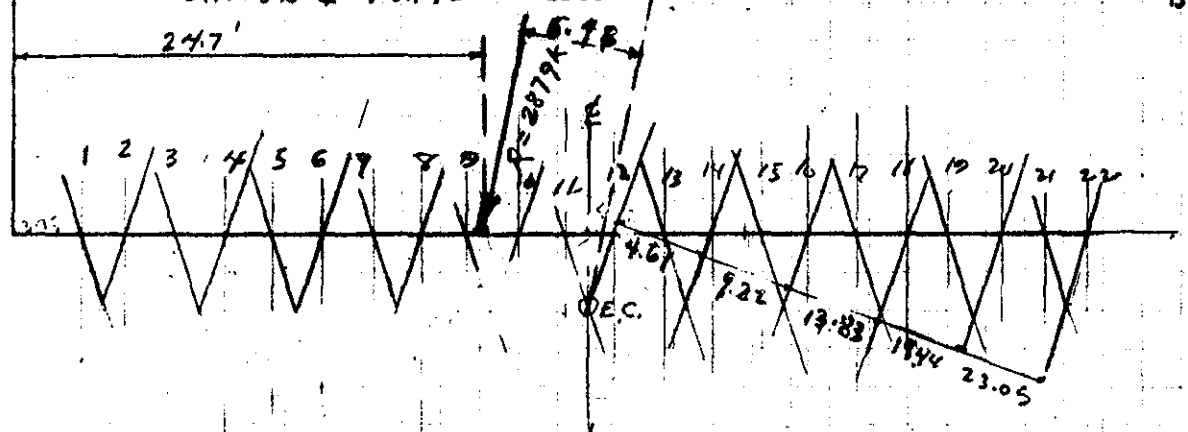
$R = (\overline{140.63}^2 + \overline{30.69}^2)^{1/2} = 143.93$

$\theta = \tan^{-1}(30.69 \div 140.63) = .2183$
$= 12^\circ - 18' - 38''$

R — TOTAL FOR MONOLITH A = 20 × 143.93 2878.60 K

BATTER 4 on 12 = 22.63°

see MOM Below.



M = 2878.6 X 5.48 = 13,595.28 1K

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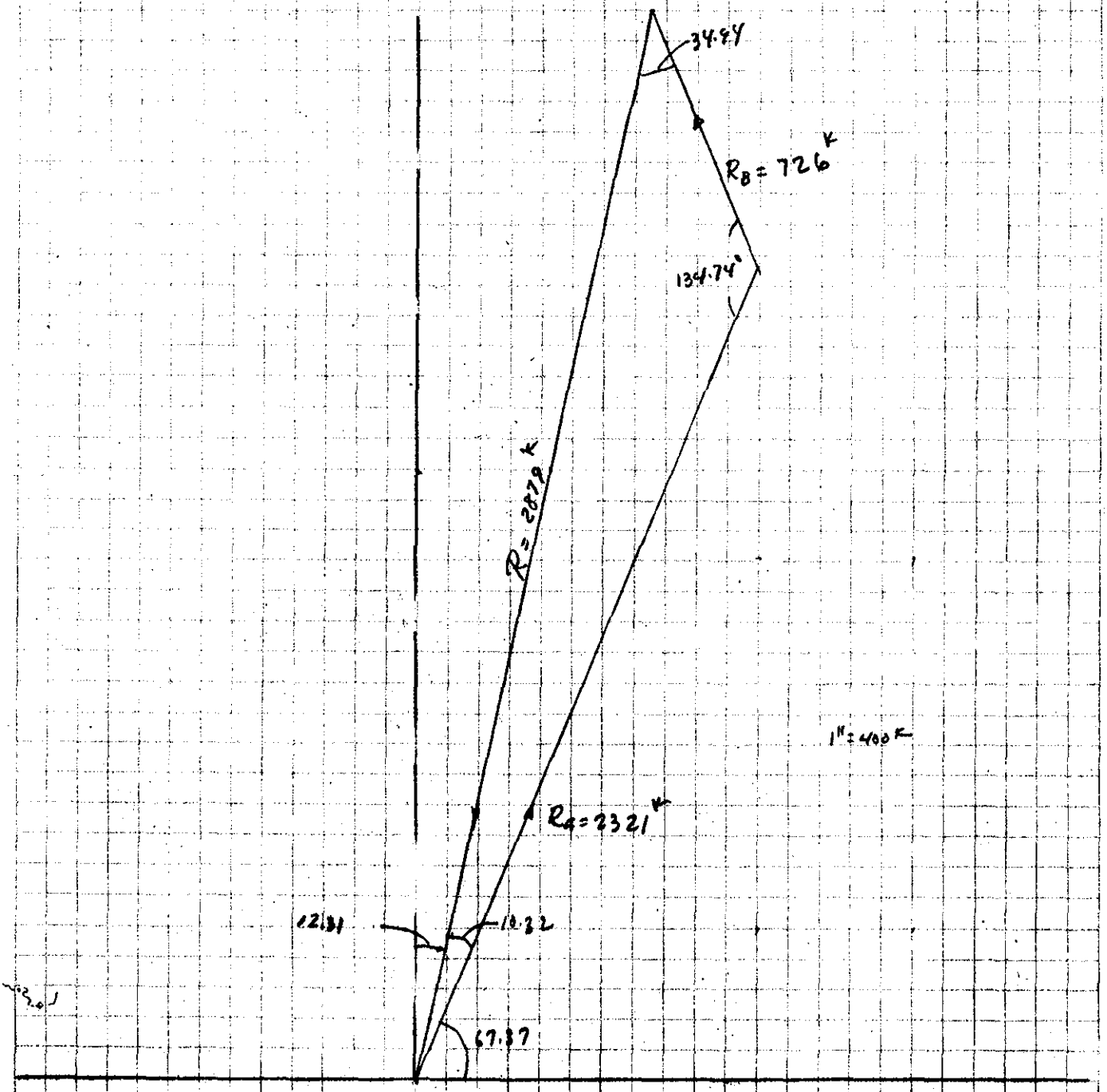
NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY EJM CHECKED BY DATE MAY 1966

MONOLITH "A"



SUBJECT POINT JUDITH

COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Sjm CHECKED BY DATE MAY 1966

MONOLITH "A"

$$I = 2\left[\overline{4.61}^2 + \overline{9.22}^2 + \overline{13.83}^2 + \overline{18.44}^2 + \overline{23.05}^2\right] = 2337.72$$

GROUP "A" $4 \times 2337.72 = 9350.88$
GROUP "B" $3 \times 2337.72 = 7013.16$
$16{,}364.04$ pile-ft²

PER SOIL LAB : ALLOWABLE LOAD ON PILE = 30T = 60k/pile
NOTE: FOR STORM DESIGN ADD 50%
OR 60k × 1.50 = 90k/pile ALLOWABLE - STORM DESIGN

+ = COMPRESSION
− = TENSION

GROUP "A"

PILE	FACTOR			AXIAL LOAD	
2	2321/44	+	18,595.8 / 16,364 (23.05)	= 53 + 26 = +79 < 90	ok
4	53	+	1.14 (18.44)	= 53 + 21 = +74	
6	53	+	1.14 (13.83)	= 53 + 16 = +69	
8	53	+	1.14 (9.22)	= 53 + 11 = +64	
10	53	+	1.14 (4.61)	= 53 + 5 = +58	
12	53	+	0	= 53 + 0 = +53	
14	53	−	5	= 53 − 5 = +48	
16	53	−	11	= +42	
18	53	−	16	= +36	
20	53	−	21	= +32	
22	53	−	26	= +27	

GROUP B

1	726/33	+	1.14 (23.05)	= +48	
3	22	+	21	= +43	
5	22	+	16	= +38	
7	22	+	11	= +33	
9	22	+	5	= +27	
11	22	+	0	= +22	
13	22	−	5	= +17	
15	22	−	11	= +11	
17	22	−	16	= +6	
19	22	−	21	= +1	
21	22	−	26	= −6	ok allow −18k/pile PER SOILS LAB

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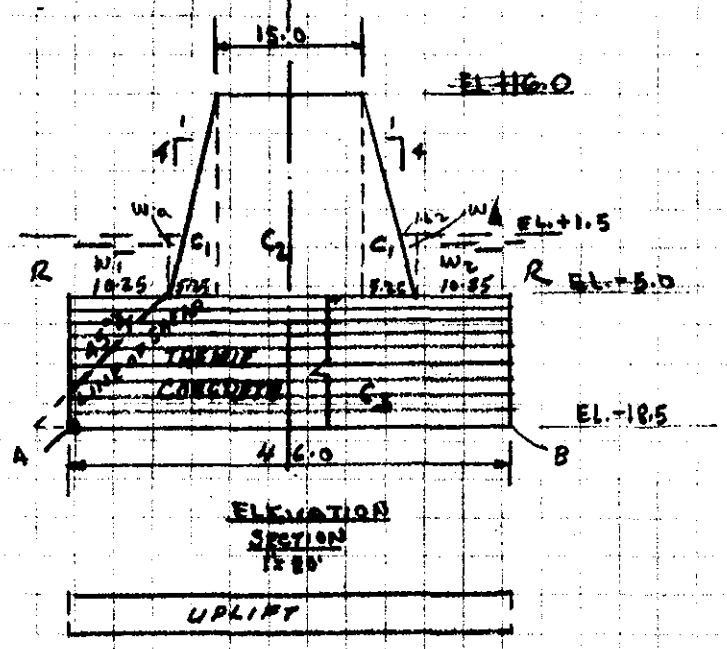
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Elm CHECKED BY DATE MAY, 1966

MONOLITH "B"

CASE I - DEAD LOAD, WATER @ EL +1.5, 100% UPLIFT OVER BASE (AT. PRESS OF WATER EQUAL.: CANCEL)

CASE II - STORM CONDITION: WATER @ EL +9.5, 100% UPLIFT OVER BASE



ROCK FILL NEGLECTED

ITEM	FACTORS	↓	↑	→	←	ARM	↷ MA	↶
C_1 (2)	0.15 x 5.25 x 21 x 0.5 x 2	16.54				23.00	380.42	
C_2	0.15 x 15 x 21	47.85				23.00	1086.75	
C_3	0.15 x 46 x 13.5	93.15				23.00	2142.45	
$W_1 + W_2$	0.064 x 1.62 x 6.5 x 0.5 x 2	0.67				23.00	15.41	
$W_1 + W_2$	0.064 x 10.25 x 6.5 x 2	8.52				23.00	196.10	
UPLIFT	0.064 x 46 x 20		58.88			23.00		1354.24
		166.13	58.88				3826.13	1354.24

$\Sigma V = 107.25$ $\Sigma M = 2466.89$

$X = \Sigma M \div \Sigma V = 2466.89 \div 107.25 = 23.00$

S.B.P. = $\frac{107.25}{46}$ = 2.33 KSF

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SUBJECT POINT JUDITH

COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Exm CHECKED BY DATE MAY 1966

MONOLITH "B" CASE II – STORM CONDITION
WATER EL + 9.5

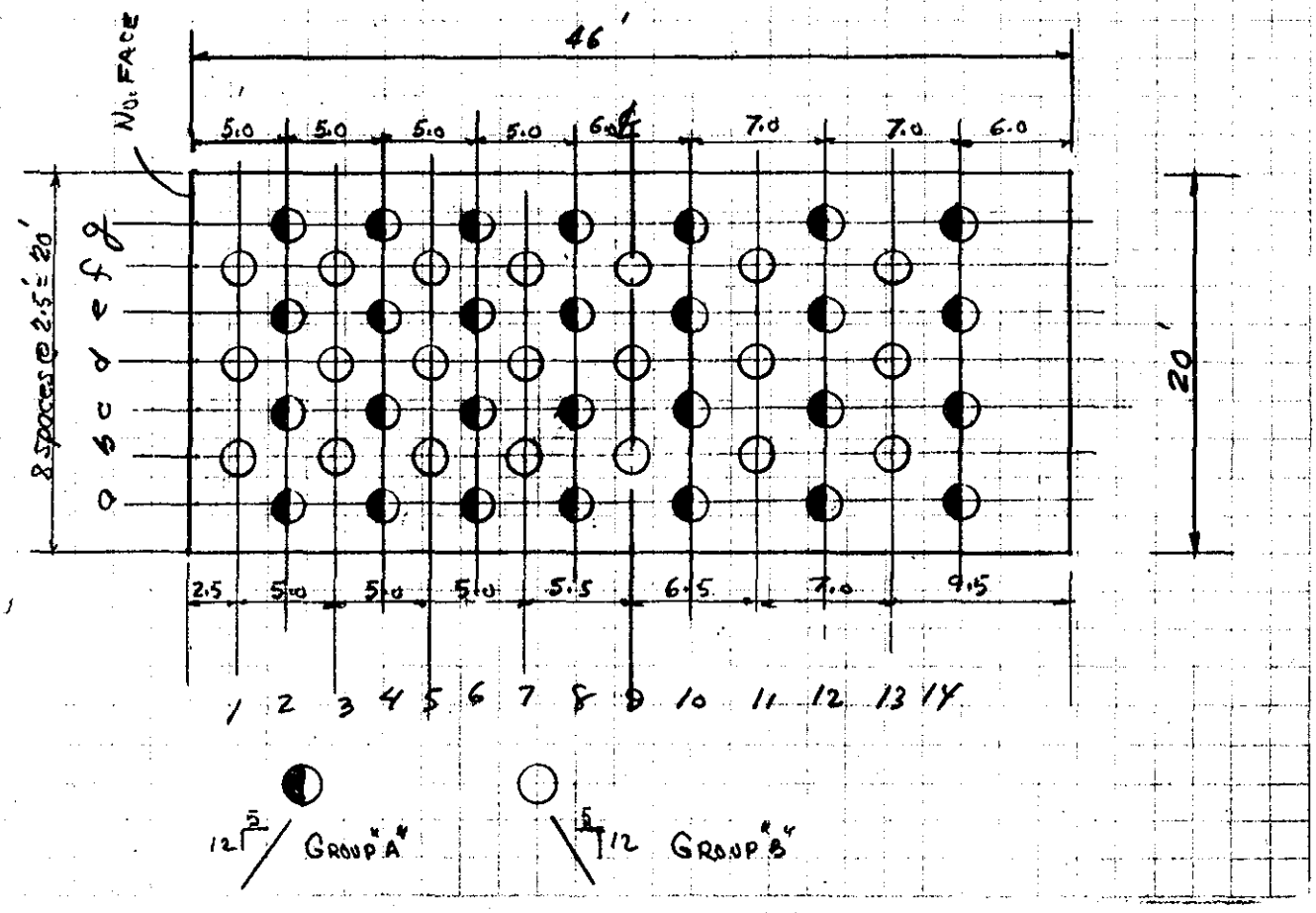
ITEM	FACTORS	↓	↑	→	←	ARM	↶ MA	↷
CONCRETE COMPUTED IN CASE I		156.94				23.00	3609.62	
$w_a + w_b$	0.064 × 3.62 + 14.5 × 0.5 × 2	3.36				23.00	77.28	
$w_1 + w_2$	0.064 × 10.25 × 14.5 × 2	19.02				23.00	437.46	
F_{160}	0.160 × 25.5				4.08	12.75		52.02
F_{160}	0.160 × 15.5 × 0.5				1.24	20.34		25.22
F_{586}	0.586 × 9				5.27	30.00		158.10
F_{750}	0.750 × 15.5				11.62	17.75		206.25
F_{484}	0.484 × 9 × 0.5				2.18	28.50		62.13
UPLIFT	0.064 × 46 × 28		82.43			23.00		1895.89
		179.32	82.43		24.39		4124.36	2399.61

$\Sigma V = 96.89$ $\Sigma H = 24.39$ $\Sigma M = 1724.75$

$X = \Sigma M \div \Sigma V = 1724.75 \div 96.89 = 17.80 > \frac{46}{3} = 15.33$ $e = 5.20$

SOIL BEARING PRESSURE $= 96.89/46 \left(1 \pm \frac{6(5.20)}{46}\right) = 2.11\,(1 \pm 0.68) = 3.54$ ksf @ "A"
0.06 ksf @ "B"

$p = P/A \left(1 \pm \frac{6e}{L}\right)$



SUBJECT POINT JUDITH

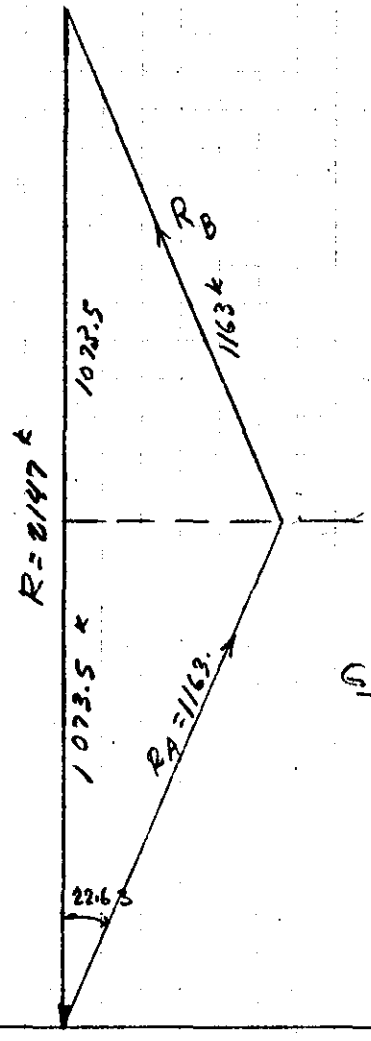
COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Ejm CHECKED BY DATE MAY 1966

MONOLITH "B" CASE I

R = 107.35 K

TOTAL R = 107.35 x 20 = 2147 K



AXIAL LOAD / PILE

GROUP A

1163 ÷ 28 = 36 K < 60 K/pile

GROUP B

1163 ÷ 21 = 55 < 60 K/pile

SUBJECT POINT JUDITH

COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Efm CHECKED BY DATE MAY 1966

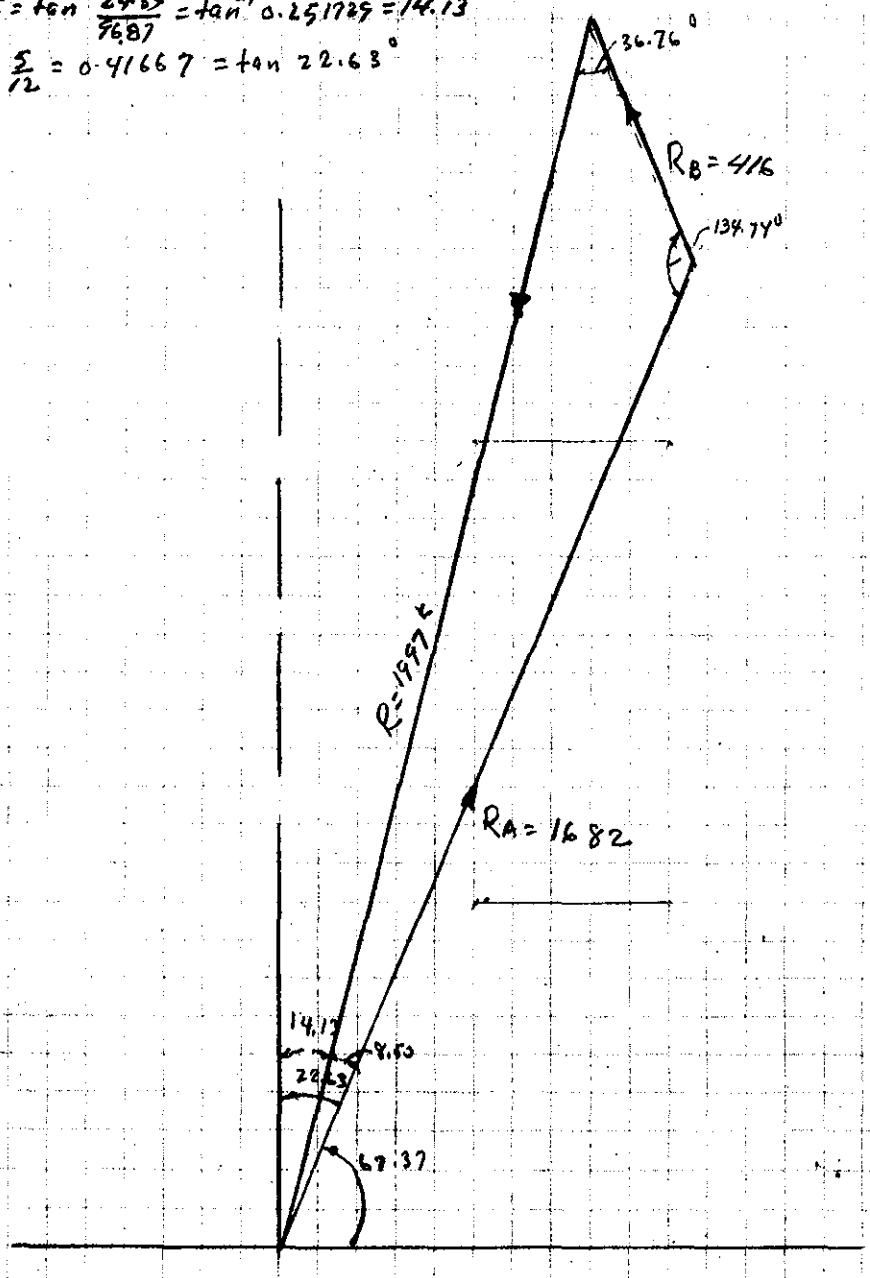
MONOLITH "B" CASE II

$R = (\overline{96.87}^2 + \overline{24.39}^2)^{1/2} = 99.87$

TOTAL $R = 99.87 \times 20 = 1997.40$

$\theta = \tan^{-1}\frac{24}{96} = \tan^{-1}\frac{24.39}{96.87} = \tan^{-1} 0.251729 = 14.13^\circ$

Batter $\measuredangle = \frac{5}{12} = 0.41667 = \tan 22.63^\circ$



SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
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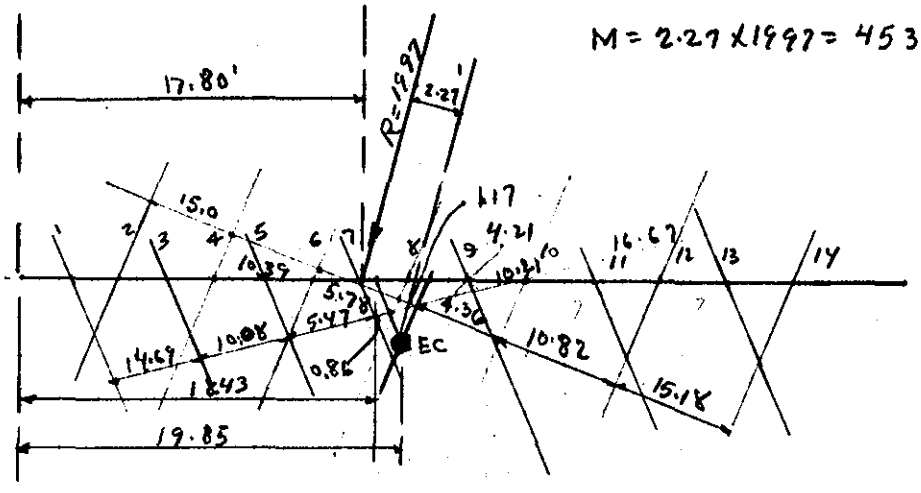
MONOLITH "B" CASE II

ALLOW. PER PILE 60k/pile SOILS LAB
ALLOW. STORM DESIGN ADD 50%
∴ 60 × 1.5 = 90k/pile ALLO. STORM DESIGN

CENTROID OF PILES Each pile as Unity = 1

"A" $\frac{5+10+15+20+26+33+40}{7} = 21.28$

"B" $\frac{2.5+7.5+12.5+17.5+23+29.5+36.5}{7} = 18.43$



M = 2.27 × 1997 = 4533.19 ^1k

$I_A = (\overline{1.17}^2 + \overline{4.36}^2 + \overline{10.82}^2 + \overline{15.18}^2 + \overline{5.78}^2 + \overline{10.39}^2 + \overline{15.00}^2) = 746.51$

$I_B = (\overline{0.86}^2 + \overline{5.47}^2 + \overline{10.08}^2 + \overline{14.69}^2 + \overline{4.21}^2 + \overline{10.21}^2 + \overline{16.67}^2) = 690.07$

GROUP A 746.51 × 4 = 2986.04
" B 690.07 × 3 = 2070.21
5056.25 pile-ft²

GROUP A

PILE	FACTOR	AXIAL LOAD
2	$1682/28 + \frac{4533(18)}{5056.25} =$	60 + 13 = +73 < 90^k/pile
4	60 + .9 (10.39) =	60 + 9 = +69
6	60 + .9 (5.78) =	60 + 5 = +65
8	60 + .9 (1.17) =	60 + 1 = +60
10	60 + .9 (4.36) =	60 − 4 = +56
12	60 − .9 (10.82) =	60 − 10 = +50
14	60 − .9 (15.18) =	60 − 14 = +46

GROUP "B"

PILE	FACTORS	AXIAL LOAD
1	416/21 + .9 (14.69) =	20 + 13 = +33
3	20 + .9 (10.08) =	20 + 9 = +29
5	20 + .9 (5.47) =	20 + 5 = +25
7	20 + .9 (.86) =	20 + 1 = +21
9	20 − .9 (4.21) =	20 − 4 = +16
11	20 − .9 (10.21) =	20 − 9 = +11
13	20 − .9 (16.67) =	20 − 15 = +5

SIGN SIGNIFICANCE: + = COMPRESSION, − = TENSION

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SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
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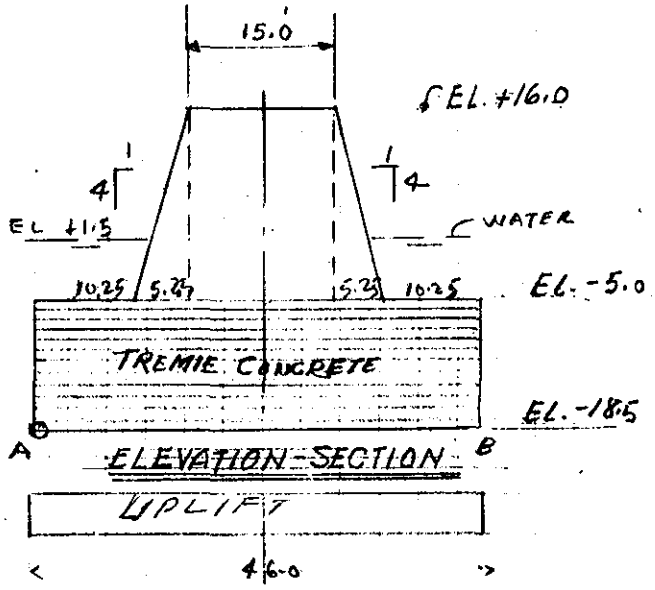
MONOLITH "C"

CASE I - DEAD LOAD . WATER @ EL +1.5 100% UPLIFT OVER BASE
CASE II - STORM CONDITION. WATER @ EL. +9.5
— EARTHQUAKE NOT CRITICAL —

ROCK SLOPE FILL
USE 8' height AVE.
{4' Submerged
{4' open

145 pcf
64
81 pcf submerged

LAT FORCES OF WATER ARE EQUAL ∴ CANCEL



CASE I

ITEM	FACTORS	↓	↑	→	←	ARM	↷ MA	↶
CONCRETE	SAME AS MONOLITH B	156.94				23.00	3609.62	
Rock.	0.081 x 4 x 10.25 x 2	6.66				23.00	153.18	
"	0.081 x 4 x 1 x 0.5 x 2	0.32				23.00	7.36	
Rock	0.145 x 4 x 10.25 x 2	11.89				23.00	273.47	
"	0.145 x 1.5 x 4 x 2	1.74				23.00	40.02	
WATER	SAME AS MON. B	9.19				23.00	211.51	
UPLIFT	" " " "		58.88			23.00		1354.2y
		186.74	58.88				4295.16	1354.2y
		ΣV = 127.86		ΣH = 0			2940.92	

$X = \Sigma M \div \Sigma V = 2940.92 \div 127.86 = 23 \qquad e = 0$

SOIL BEARING PRESSURE $= p = \frac{P}{E_x}\left(1 \pm \frac{6e}{L}\right) = \frac{127.86}{46} = 2.78$ ksf > 1.5

USE PILES

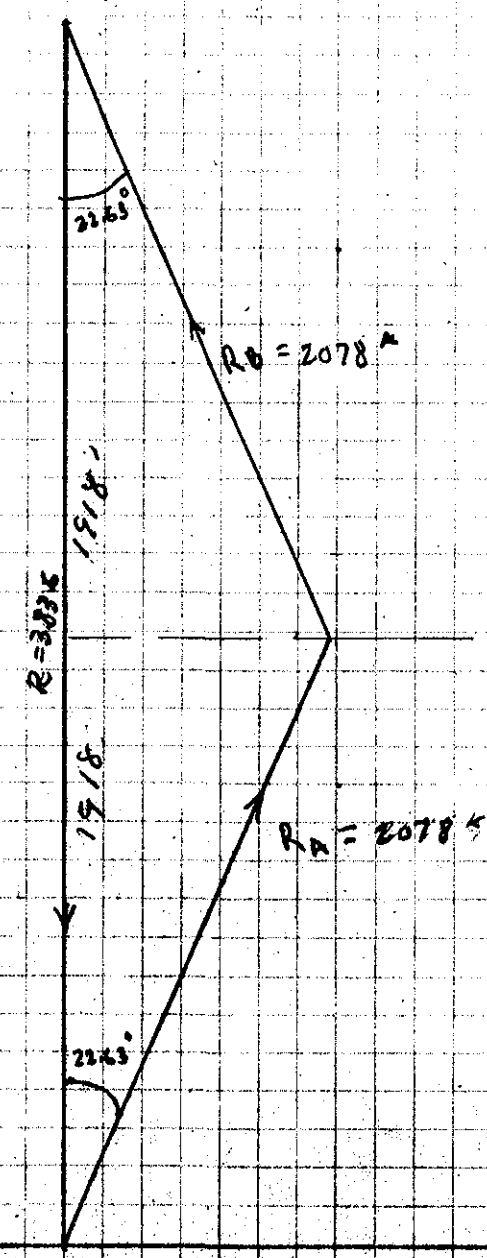
SUBJECT POINT JUDITH

COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Ejm CHECKED BY DATE MAY 1966

MONOLITHIC CASE I

R = 127.86 x 30 = 3836 K



SCALE
1" = 600 K

GROUP A

$\frac{2078}{42} = 49 < 60^K$ ok

GROUP B

$\frac{2078}{35} = 59 < 60^K$ ok

SUBJECT: POINT JUDITH
COMPUTATION: BREACHWAY CONTROL STRUCTURE
COMPUTED BY: EJM CHECKED BY: DATE: MAY 1965

MONOLITH "C" CASE II: STORM CONDITION, WATER @ EL. +9.5

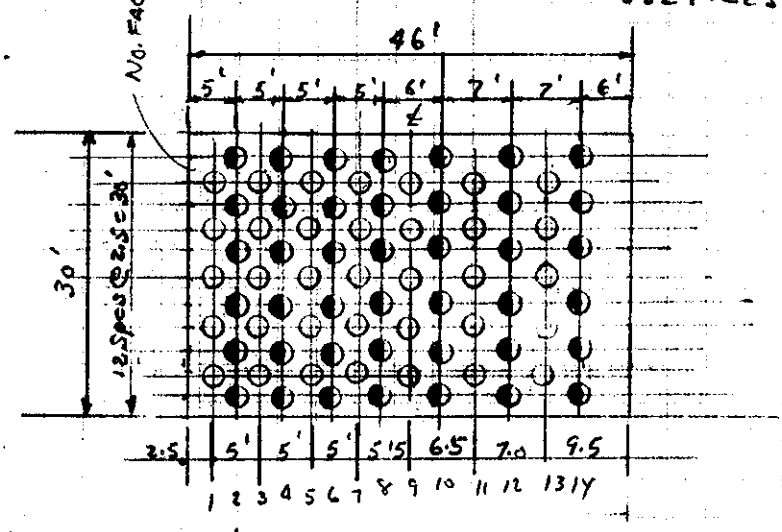
ITEM	FACTORS	↓	↑	→	←	ARM	↷ Mo	↶
CONCRETE	SAME AS CASE I	156.94				23.00	3609.62	
Rock	0.061 × 8 × 10.25 × 2	10.05				23.00	231.15	
"	0.061 × 2 × 0.5 × 8 × 2	0.98				23.00	22.54	
WATER	SAME AS CASE II-MONO B	22.38				23.00	514.74	
F 681	0.681 × 6.5				4.43	31.25		138.30
F 404	0.404 × 6.5 × 0.5				1.31	30.05		39.40
F 556	0.556 × 2.5				1.39	26.75		37.10
F 174	0.174 × 2.5 × 0.5				0.22	26.33		5.80
F 730	0.730 × 15				10.95	17.00		186.20
UPLIFT	SAME AS MONO. B		82.43			23.00		1895.89
		190.35	82.43		18.30		4378.05	2302.69

$\Sigma V = 107.92$ $\Sigma H = 18.30$ $\Sigma M = 2075.26$

$x = \Sigma M \div \Sigma V = 2075.36 \div 107.92 = 19.23 > \frac{46}{3} = 15.33$ $e = 3.77$

SOIL BEARING PRESSURE $= \frac{107.92}{46}\left(1 \pm \frac{6(3.77)}{46}\right) = 2.35(1 \pm 0.49) = \begin{cases} 3.50 \\ 1.20 \end{cases}$

SBP $\begin{cases} 3.50 \text{ ksf @ } P \\ 1.29 \text{ ksf @ } B \end{cases} > 1.5$ ksf ALLOW. USE PILES.



LAYOUT OF PILES
SIMILAR TO MONOLITH B

SUBJECT POINT JUDITH

COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Exm CHECKED BY DATE MAY 1966

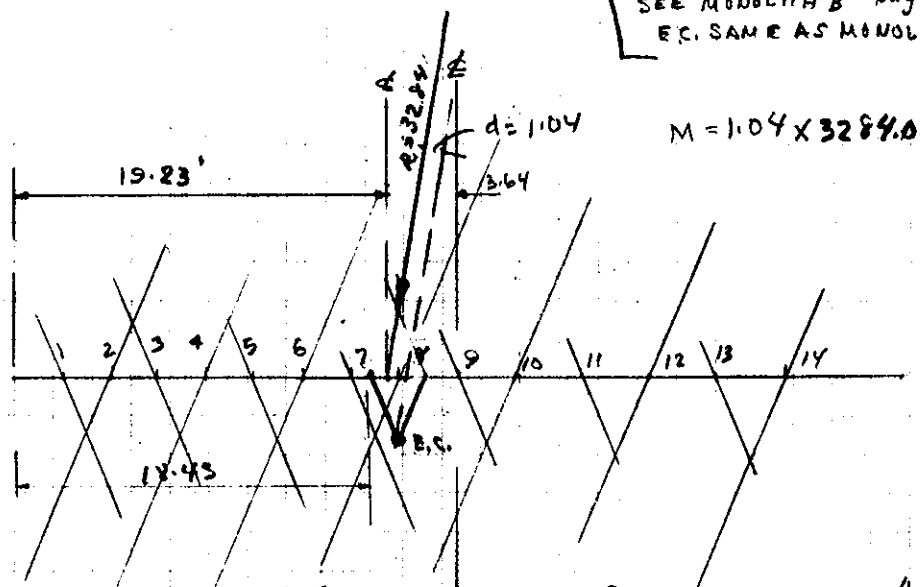
MONOLITH "C" CASE II

$R = (\overline{107.92}^2 + \overline{18.30}^2)^{1/2} = 109.46$ TOTAL R FOR MONOLITH "C" = 109.46 X 3000 = 328.38 K

$\theta = \tan^{-1} \Sigma H \div \Sigma V = \tan^{-1} 18.30 \div 107.92 = 0.16957 = 9.67$

Batter Piles 4 $= \tan 5/12 = 0.41667 = 22.63°$

[CENTROID OF PILES SEE MONOLITH "B" page 4, E.C. SAME AS MONOLITH B]



M = 1.04 X 3284.0 = 3415.1 K

DISTANCES FROM E.C. TO RESPECTIVE PILES SAME AS MONOLITH "B"

GROUP A 746.51 X 6 = 4479.06

GROUP B 690.07 X 5 = 3450.35

7929.41 pile-ft²

GROUP "A"

PILE	FACTORS	AXIAL LOAD
2	$\frac{3471}{42} + \frac{3415(15)}{7929.41}$ = 59 + 6	= +65 < 90
4	59 + .43(10.39) = 59 + 4	= +63
6	59 + .43(5.78) = 59 + 2	= +61
8	59 + .43(1.17) = 59 + 0	= +59
10	59 − .43(4.36) = 59 − 2	= +57
12	59 − .43(10.82) = 59 − 5	= +54
14	59 − .43(15.18) = 59 − 7	= +52

+ = COMPRESSION
− = TENSION

GROUP "B"

1	1027/35 + .43(14.69) = 30 + 6	= +36
3	30 + .43(10.08) = 30 + 4	= +34
5	30 + .43(5.47) = 30 + 2	= +32
7	30 + .43(0.86) = 30 + 0	= +30
9	30 − .43(4.21) = 30 − 2	= +28
11	30 − .43(10.21) = 30 − 4	= +26
13	30 − .43(16.67) = 30 − 7	= +23

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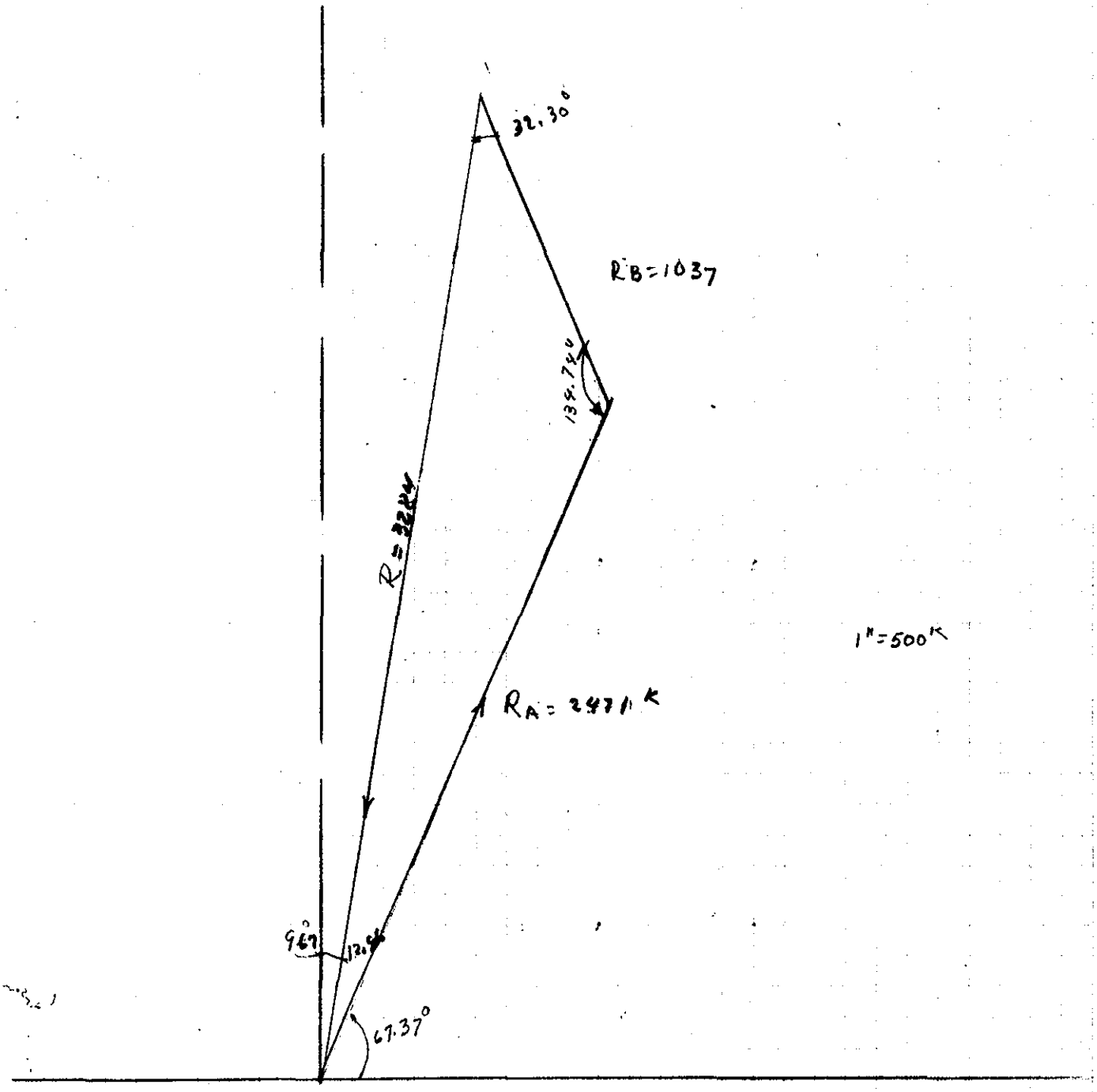
MONOLITH "C" CASE II
FORCE POLYGON



NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

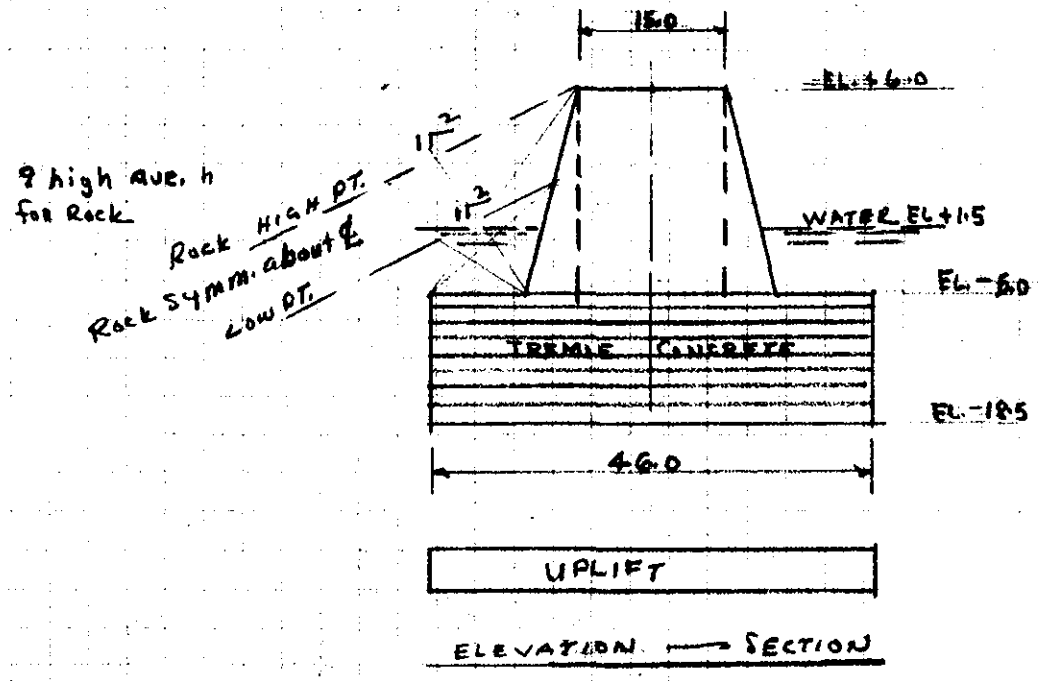
SUBJECT POINT JUDITH
COMPUTATION BREAKWATER CONTROL STRUCTURE
COMPUTED BY Efm CHECKED BY DATE MAY 1966

MONOLITH "D"

CASE I - DEAD LOAD . WATER @ EL. +1.5
100% UPLIFT OVER BASE

CASE II . STORM CONDITION
WATER @ EL. +9.5
100% UPLIFT OVER BASE

CASE I



ITEM	FACTORS	↓	↑	→	←	ARM	→ MA	↺
CONCRETE	- SAME AS MONOLITH C	156.94				23.00	3609.62	
WATER	" " " "	9.19				23.00	211.37	
Rock	Submerged 0.061 X 6 X 0.25 X 2	7.49				23.00	172.27	
Rock	OPEN 0.125 X 8 X 0.25 X 2	7.80				23.00	179.40	
UPLIFT	SAME AS MONOLITH "C"		58.88			23.00		1354.2 y
		181.42	58.88				4172.66	1354.2 y
		ΣV =	122.5 y				ΣM = 2818.42	

$x = \Sigma M \div \Sigma V = 2818.42 \div 122.5y = 23.00 = 23.0 \quad e = 0$

S.B.P. $\frac{122.5y}{46} = 2.66$ ksf > 1.50 ksf ALLOW. USE PILING.

SUBJECT POINT JUDITH

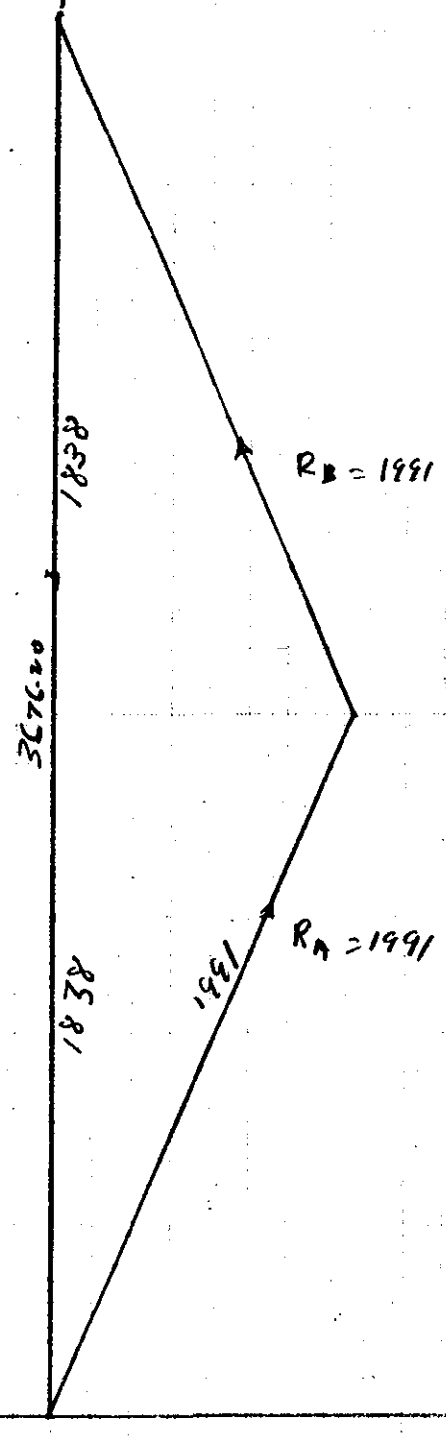
COMPUTATION BREACHWAY CONTROL STRUCTURE

COMPUTED BY Ejm CHECKED BY DATE MAY 1966

MONOLITH "D"
CASE I

R = 122.58 x 30 = 3676.2 K

FORCE POLYGON



Group A

$P = \frac{1991}{42} = 47^k$/pile AVE

GROUP B

$P = \frac{1991}{35} = 57^k$/pile AVE

ALLOW 60

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT POINT JUDITH
COMPUTATION BREACHWAY CONTROL STRUCTURE
COMPUTED BY Eqm CHECKED BY DATE MAY 1966

MONOLITH D
CASE II STORM CONDITION
WATER EL +9.6

ITEM	FACTORS	↓	↑	→	←	ARM	↷ MA ↶	
CONCRETE	SAME AS CASE I	156.94				23.00	3609.62	
WATER	(SEE MONOLITH C)	22.38				23.00	514.74	
Rock	0.06 X 8 X 10.25 X 2 (CASE II)	11.24				22.00	258.52	
UPLIFT	SAME AS MONO "C" CASE II		82.43			23.00		1895.89
WAVE FORCES	- USE SAME AS IN C							
F681, F404, F556, F174, F730					18.30	22.23		406.80
		190.56	82.43		18.30		4382.88	2302.69
		ΣU	108.13		ΣH = 18.30		ΣM = 2080.19	

$x = \Sigma M \div \Sigma U = 2080.19 \div 108.13 = 19.23$

NOTE - THIS MONOLITH 'D' IS SIMILAR TO MONOLITH 'C'
PLACE PILING AS SHOWN ON MONOLITH C
PAGE 2

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

PAGE DM-25
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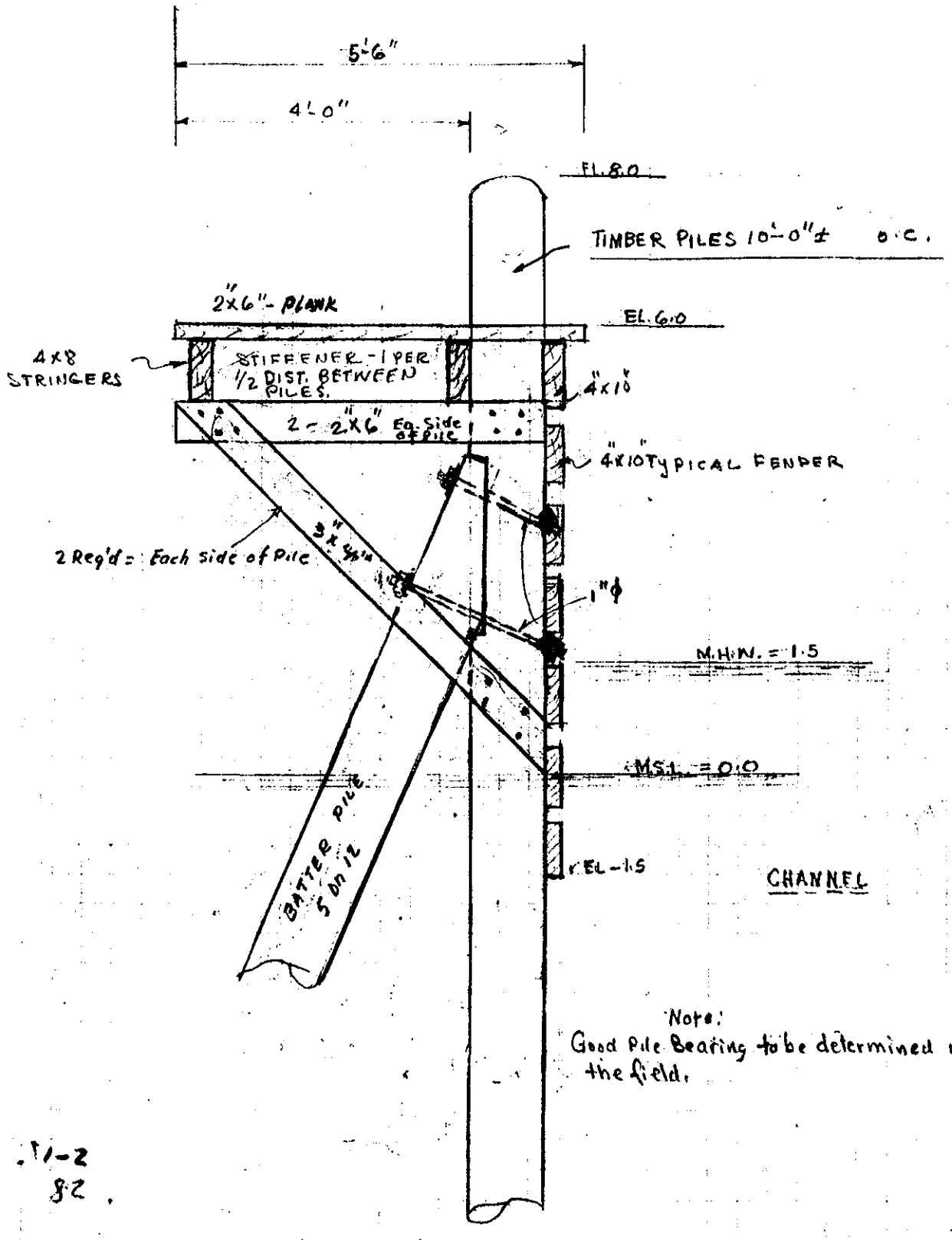
SUBJECT POINT JUDITH
COMPUTATION BREAKWATER FENDER SYSTEM & WALKWAY
COMPUTED BY Efm CHECKED BY DATE MARCH 1966



Note:
Good Pile Bearing to be determined in the field.

11-2
82

X-SECTION

SUBJECT: POINT JUDITH

COMPUTATION: BREACHWAY CONTROL STRUCTURE

COMPUTED BY: [illegible] CHECKED BY: DATE: MARCH 1966

WOOD = USE DOUGLAS FIR — 4.6. 100 psf
2 x 6 (1 5/8 x 5 5/8)

1. PLANKING

WT. PLANK 1 BM x 4 = 4#
L.L. = 100
104

$\frac{wL^2}{8} = M = \frac{104 \times (4)^2}{8} = 216'^{\#}$

$f = \frac{216 \times 12}{2.54} = 972$ psi < 1500

2. JOIST 4 x 8 (3 5/8 x 7 1/2) Span 10' S = 33.98 wt = 11#/'

$w = \frac{104 \times 4}{2} = 208 + 11 = 219$ say 220

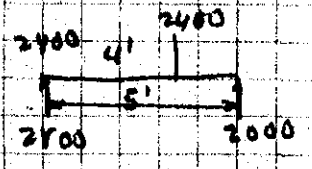
$M = \frac{wL^2}{8} = \frac{220\,(10)^2}{8} = 3000'^{\#}$

$f = \frac{3000 \times 12}{33.98} = 1062 < 1500$ psi

— DEFLECTION —

$\frac{5wL^4}{384EI} = \Delta_{MAX} = \frac{5\,(2400)(1000)}{384\,(1{,}200{,}000)\,(123.49)} = 0.0002$

3. GIRDER 4 x 6 (3 5/8 x 5 5/8) 2 BM/' x 4 = 8#/' S = 19.12



$M_1 = 2(2400) - 2(2400) + 800$
$M_2 = \frac{8 \times 5^2}{8} = 25$
825

$f = \frac{825 \times 12}{19.12} = 534 < 1500$

DIAGONAL 4 x 6

$R = \frac{2400}{.707} = 4000^{\#}$ APPROX

$f_c = \frac{P}{A} = \frac{4000}{20.39} = 196 < 275$ psi

2 - 3 x 4 $f_c = \frac{4000}{2(7.5)} = 267 < 275$ psi

SUBJECT Pt. Judith R.I.
COMPUTATION Sheet Pile Wall
COMPUTED BY H.E.W CHECKED BY DATE July 66

CANTILEVER SHEET PILE WALL PT. JUDITH R.I.

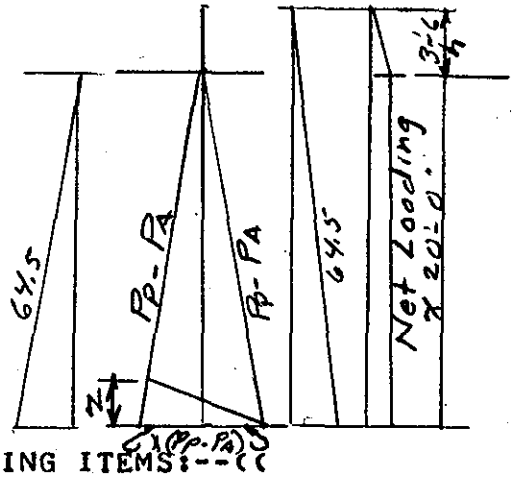
DESCRIPTION:---THIS PROGRAM FINDS THE MINIMUM PENETRATION. OR GIVEN THE PENETRATION FINDS THE PASSIVE P, MAX. M, AND S OF SHEET PILING

LOADING:----TRIANGULAR WATER LOAD TO TOP OF WALL ON ONE SIDE PLUS A CONCENTRATED LOAD. WATER ON OTHER SIDE ASSUMED AT A LOWER ELEV. GRADE IS THE SAME ON BOTH SIDES.

INSTRUCTIONS:----CONTROL & PROGRAM MODE @ AUTO OUTBOARD READER OFF

FIND MINIMUM PENETRATION.

H=EXPOSED HEIGHT OF WALL =3.5 $\gamma sat = 110$
P=CONCENTRATED LOAD =0 $K_a = .4$
Y=DIST OF CONC. LD. TO GR=0 $K_p = 1.6$
PP=PASSIVE PRESSURE (SUB E)=72.8 (45.5x1.6)
PA=ACTIVE " (SUB E)=18.2 (.4x45.5)
W=WEIGHT OF WATER =64.5
Q=DIFFERENTIAL HEAD =3.5
X=ASSUME X=2H =20.0



DEPTH OF PENETRATION(FT) = 16.29
" " Z = 3.56

GIVEN A DEPTH OF PENETRATION --- ENTER FOLLOWING ITEMS:---(
X=DEPTH OF PENETRATION =20.0
PP (ASSUME MAX) =80

PP = PASSIVE PRESSURE 59.90
Z = 4.11

FIND XO AND MAX. MOMENT IN THE SHEETING--- ENTER FNLLOWING ITEMS:--

ASSUMED XO (.33H)= 10.0
XO= (FEET) = 12.35
M FT LBS = 9461.67

Basic Formula

$$Z = \frac{(P_P - P_A)x^2 - wh^2 - 2wh(x)}{2(P_P - P_A)x}$$

$$M = \frac{wh^2}{2}\left(h + x - \frac{2h}{3}\right) + wh\left(\frac{x}{2}\right)^2 + Z^2\frac{(P_P - P_A)x}{3} - (P_P - P_A)\frac{x^3}{6}$$

It is unlikely that the ground water on the landside will reach as high as the ground surface. The following sheet assumes the sheeting acts as a complete cut-off with no ground water on landside.

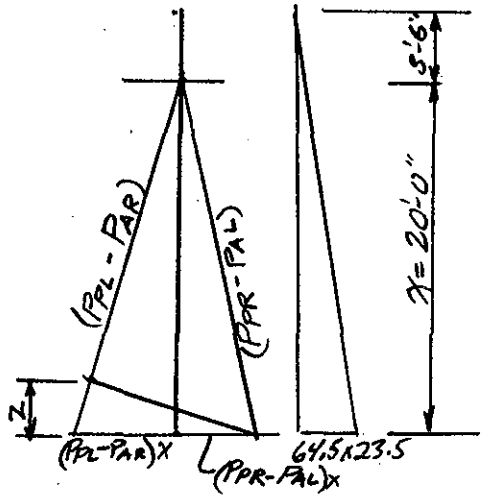
NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U. S. ARMY

SUBJECT Pt. Judith R.I.
COMPUTATION Sheet Pile Wall
COMPUTED BY H.E.W CHECKED BY DATE July 66

```
DESCRIPTION:----THIS PROGRAM FINDS MINIMUM PENETRATION AND MAX MOMENT
              OR GIVEN PENETRATION FINDS PPR AND MAX. MOMENT
LOADING:      TRIANGULAR WATER LOAD @ WATERSIDE (TOP TO BOT OF WALL) NO
              WATERLANDSIDE,CONCENTRATED WATER LOAD DUE TO WAVE FORCES
              @ EXPOSED FACE, GRADE SAME BOTH SIDES.
INSTRUCTIONS:--1.CLEAR RESET MEMORY ((=
               2.CONTROL & PROGRAM MODE @ AUTO
               3.ALL UNITS POUND FEET
TO FIND MINIMUM PENETRATION
ENTER FOLLOWING ITEMS:-----
    H=EXPOSED HEIGHT OF WALL  =3.5
    P=WAVE FORCE AS CONCENTRATED LD=0
    Y=DISTANCE OF WAVE FORCE FROM GRADE=0
  PPR=PASSIVE PRESSURE RS=72.8  (45.5x1.6)
  PPL=   "          "   LS=176.0  (110 x 1.6)
  PAR=ACTIVE        "    RS=18.2
  PAL=   "          "    LS=44.0
    W=WEIGHT OF WATER    =64.6 ← Should be 64.5
    X=ASSUME X=2H         =12.0
```

γsat = 110
Ka = .4
Kp = 1.6




```
DEPTH OF PENETRATION  (FEET)=        10.95
  "     "Z"                 =         2.65
NEW INSTRUCTIONS:    GIVEN A DEPTH OF PENETRATION FIND THE PASSIVE
   PRESSURE FOR RIVERSIDE AND LANDSIDE (PPL&PPR)
ENTER FOLLOWING ITEMS:----
    X=DEPTH OF PENETRATION=20.0
  PPR (ASSUME MAX.)          60.0


  PPR=PASSIVE PRESSURE  RS=        51.54
  PPL=   "        "     LS=       124.61
          "Z"             =         3.02
NEW INSTRUCTIONS:    FIND XO AND MAX. MOMENT IN THE SHEETING
ENTER THE FOLLOWING ITEM;

  ASSUMED XO  (.33X)     =12.0

    XO=       (FEET)       =       12.33
    M         FT  LBS      =     9464.25
```

Use a 20' penetration and a precast, prestressed concrete sheet pile capable of resisting a moment equal to 9500'#

NED FORM 223
27 Sept 49

NEW ENGLAND DIVISION
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT Pt. Judith R.I.
COMPUTATION Sheet Piling
COMPUTED BY H.E.W CHECKED BY DATE July 66

Length of pile = 23'-6" $M = 9500'^{\#} = 114{,}000'^{\#}$

Try 8"x12" Section $A = 96\ \square''$ $S = 128''^3$ $I = 512''^4$

Stresses $f = \frac{114000}{128} = 890$ psi.

Prestress $P = 890 \times 96 = 85{,}000^{\#}$

For a 4' wide section use $\frac{4 \times 85000}{20{,}160} = 16.8$ Use 18 str.

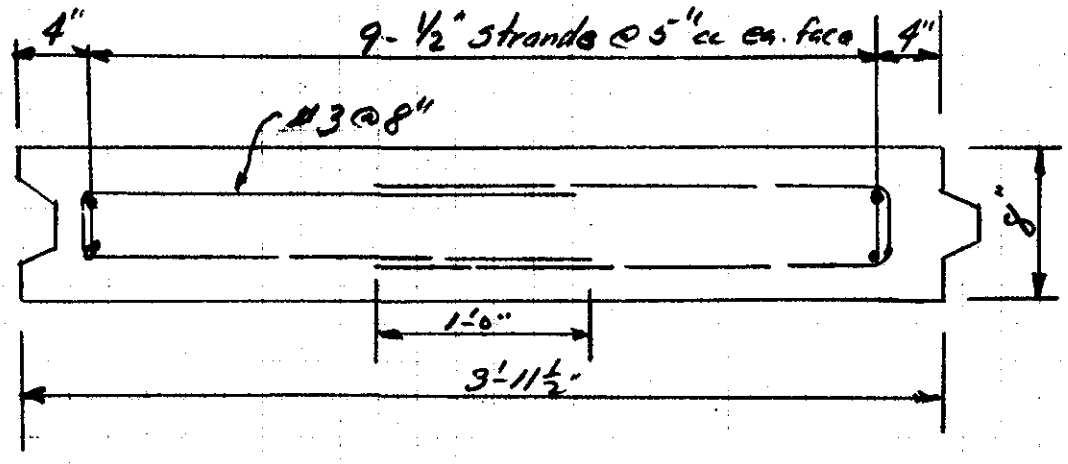
Using 18-½" strands $P_{tension} = 18 \times 25{,}200 = 453{,}000^{\#}$

$P_{release} = .95 \times 453{,}000 = 430{,}000^{\#}$

$P_{final} = .80 \times 453000 = 362{,}000^{\#}$

stresses @ release $f = \frac{430{,}000}{4 \times 96} = 1125$ psi OK

Final $f = \frac{362{,}000}{4 \times 96} = 940$ psi OK



CORPS OF ENGINEERS

U.S. ARMY

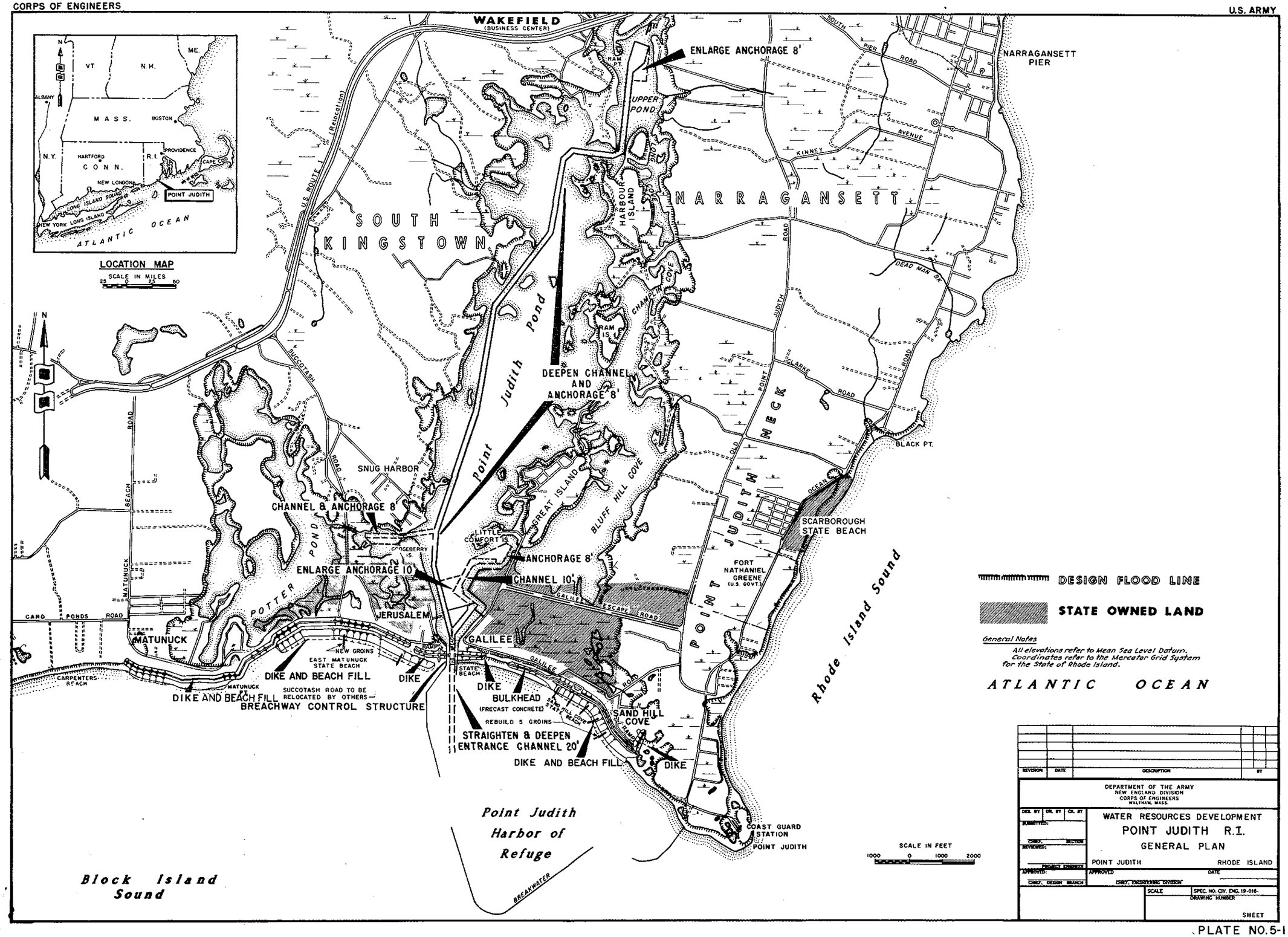


PLATE NO. 5-1

CORPS OF ENGINEERS — U. S. ARMY

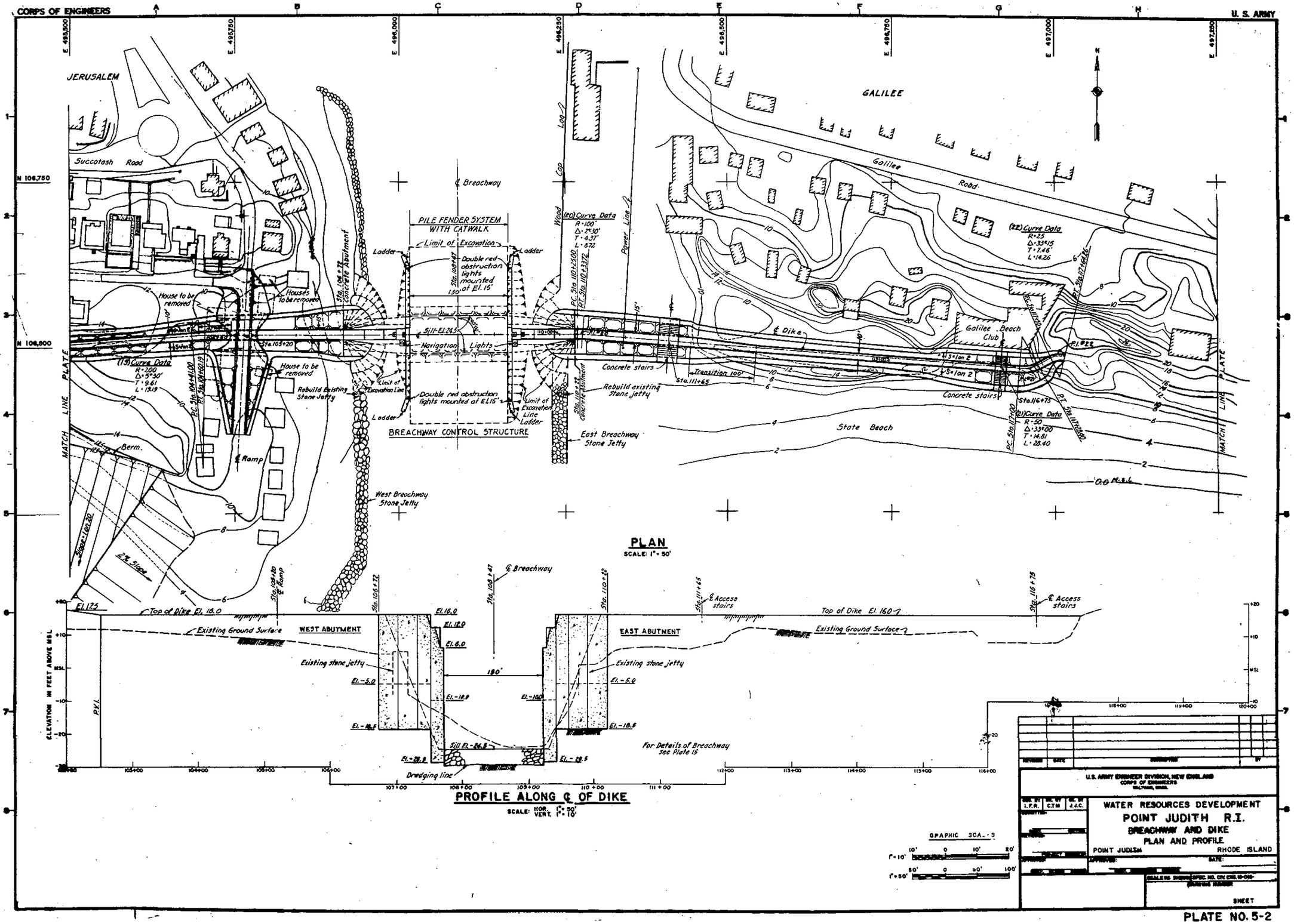
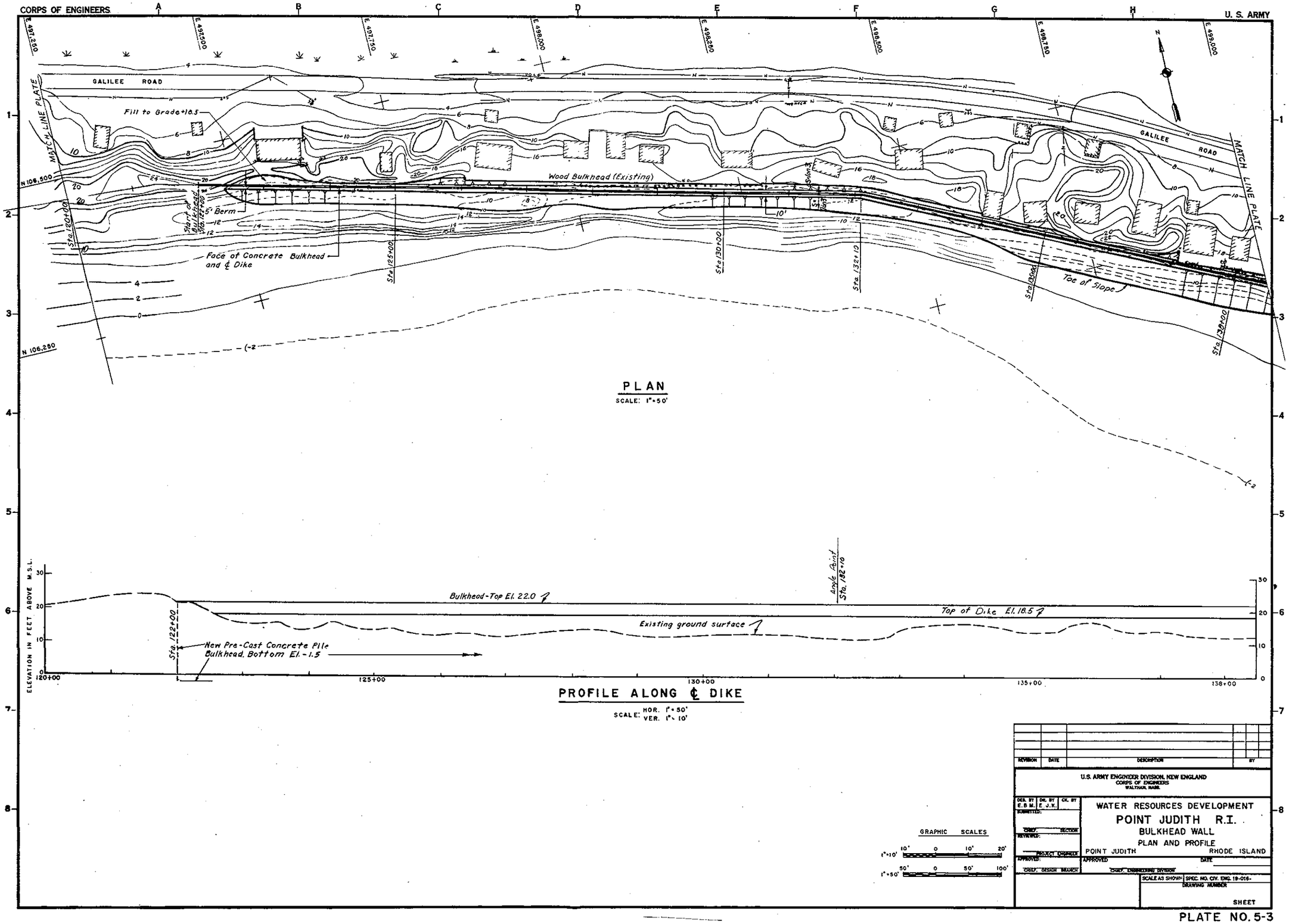


PLATE NO. 5-2

CORPS OF ENGINEERS U. S. ARMY



REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY E.B.M. | DR. BY E.J.K. | CK. BY

SUBMITTED: CHIEF, SECTION

REVIEWED: PROJECT ENGINEER

APPROVED: CHIEF, DESIGN BRANCH

WATER RESOURCES DEVELOPMENT
POINT JUDITH R.I.
BULKHEAD WALL
PLAN AND PROFILE

POINT JUDITH RHODE ISLAND

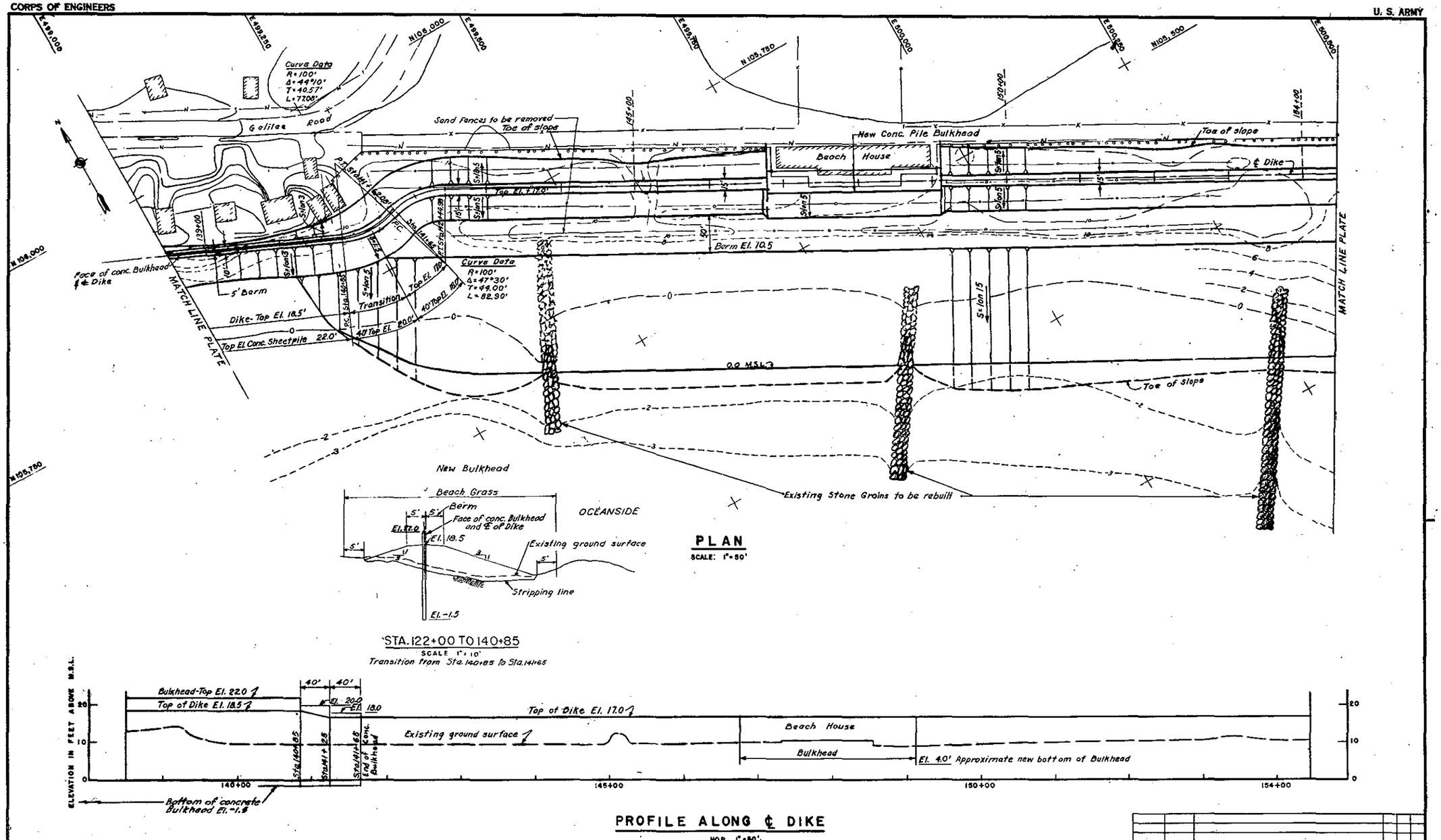
APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO. 5-3

CORPS OF ENGINEERS

U. S. ARMY



GRAPHIC SCALES

1"=10' 10' 0 10' 20'

1"=50' 50' 0 50' 100'

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CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY — DR. BY E.J.K. — CK. BY

SUBMITTED: CHIEF, SECTION

REVIEWED: PROJECT ENGINEER

APPROVED: CHIEF, DESIGN BRANCH

WATER RESOURCES DEVELOPMENT

POINT JUDITH R.I.

BULKHEAD WALL AND DIKE

PLAN, PROFILE AND SECTION

POINT JUDITH RHODE ISLAND

APPROVED: CHIEF, ENGINEERING DIVISION — DATE

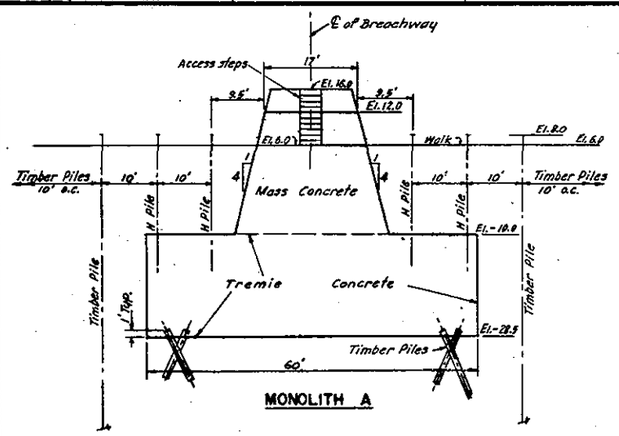
SCALE AS SHOWN — SPEC. NO. CIV. ENG. 19-016-

DRAWING NUMBER

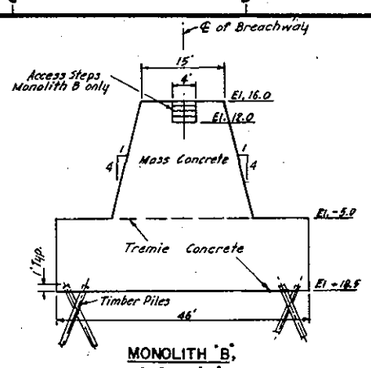
SHEET

PLATE NO. 5-4

CORPS OF ENGINEERS — U. S. ARMY

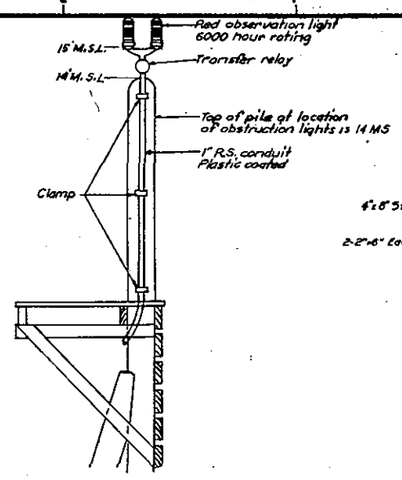


MONOLITH A

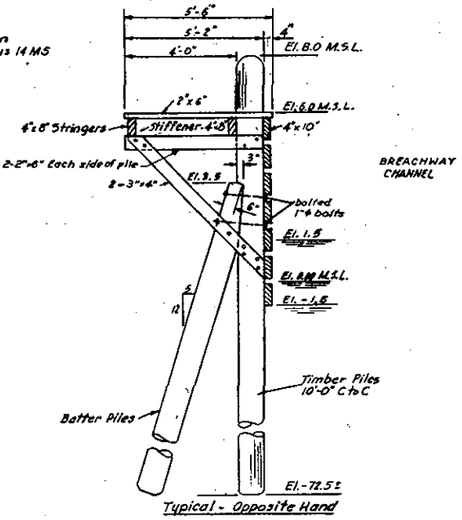


MONOLITH "B", "C" AND "D"

BREACHWAY CONCRETE DETAILS
EAST AND WEST SIDE
SCALE: 1" = 10'

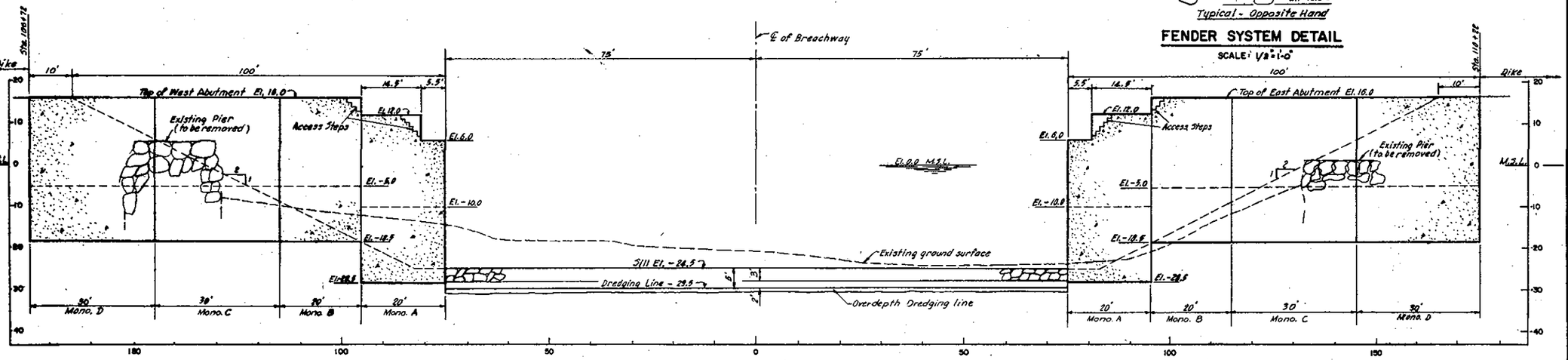


TYPICAL OBSTRUCTION LIGHT MOUNTING DETAIL
SCALE 1/2" = 1'-0"

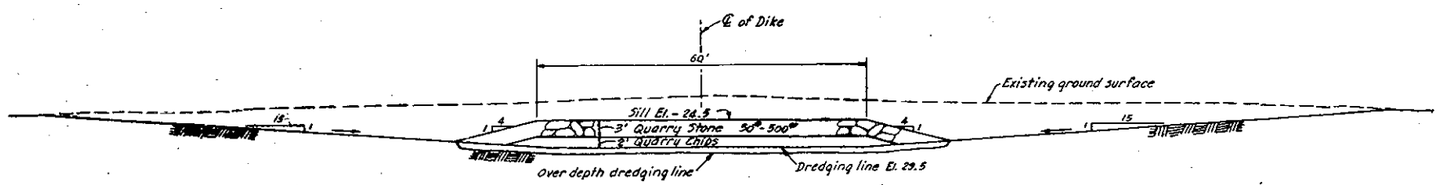


Typical - Opposite Hand

FENDER SYSTEM DETAIL
SCALE: 1/8" = 1'-0"



PROFILE ALONG ℄ BARRIER
SCALE: 1" = 10' HOR. 1" = 10' VERT.



SECTION OF SILL ALONG ℄ OF CHANNEL
SCALE: 1" = 10'

REVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY C.M.D. | CK. BY
SUBMITTED:
CHIEF, SECTION
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APPROVED:
CHIEF, DESIGN BRANCH

WATER RESOURCES DEVELOPMENT
POINT JUDITH R.I.
BREACHWAY
PROFILE AND DETAILS
POINT JUDITH — RHODE ISLAND
APPROVED — DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO. CIV. ENG. 19-016-
DRAWING NUMBER
SHEET

PLATE NO.5-5