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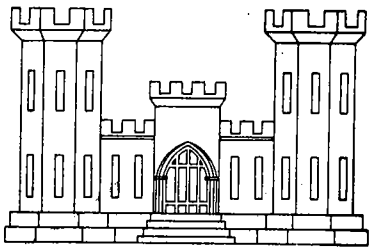
LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

BL-1E, 1B, etc



DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

March 1971

LMVED-TD (NOD 18 Mar 71) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 7 May 71

TO: Chief of Engineers, ATTN: ENGCW-V/ENGCW-E

1. The subject design memorandum is forwarded for review and approval pursuant to para 20a, ER 1110-2-1150. Approval is recommended subject to the following comments.

2. Table of Contents, page vi. Title for Plate 29 should read "I-wall and levee configuration (Sta 664+73.3 to Sta 772+00)."

3. Para 33 b(1), page 13. Plate 61 referred to in this sentence is the stability analysis of an I-wall levee, not an earthen levee. This reference should be corrected.

4. Para 36b, page 17. This paragraph should be expanded to include the design load of the piles in both tension and compression.

5. Para 38, page 18. The third sentence states: "In order to utilize the maximum amount of Pleistocene soils and the minimum amount of Recent deposits, borrowing will be in the deepest portion of the borrow areas and to the maximum depth practicable (approximately el. -80.0)." This should be required in the specifications.

6. Paras 38, 39a, and plates 30, 31, and 32. These paragraphs and plates should cover the method, compaction, and the source of material for raising the levee to compensate for additional settlement (1.5' to 2.0') subsequent to third lift. Proposed compaction of third lift shaping should also be indicated.

7. Paras 55, 56, 57, and 58, page 25. The allowable design loads for the piles, pile load computation results, and the assumptions made in the analysis should be included. For instance, assuming a uniform distribution of loads on the pile arrangements shown for gate monoliths on plates 79 and 80 would not be appropriate since the gate piers and pile arrangements are not symmetrical.

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8. Table 3, page 32. a. The unit price of Z-27 sheet pile ($4.00/s.f.) is considered low and should be checked.

b. The basis for determining the relocations costs should be furnished.

9. Para 67, page 29. The spoil-disposal areas mentioned in the third sentence should be shown on the plates referenced, if not shown elsewhere.

10. Para 70, pages 29 and 30. a. The stated elevation of the Southern Natrual Gas Company high pressure gas lines does not agree with the profile of plate 3.

b. The baseline stations of 711+77.5, 718+34.2, and 765+75.0 for the pipeline crossings on page 30 do not agree with those on plan and profile plate 2. These discrepancies should be reconciled.

11. Para 71c, page 30. The stationing of Louisiana Cement Company conveyor system is given as 716+56.2 in this paragraph as 716+53.25 on plate 2 and as 716+55.25 on plate 74. These stations should be corrected during preparation of plans and specifications.

12. Para 74, page 34. The reported decrease of $4,957,000 should NOT be reflected in the PB-3 but should be retained in the project estimate as additional contingencies.

13. Plate 2. The electrical cables shown on the profile at approximate station 738+64 should be shown on the plan.

14. Plate 3. a. The 24" Southern Natural Gas pipeline at station 823+50 should be shown on the profile.

b. The stationing of the Southern Natural Gas pipelines should be made consistent on the plan and profile.

15. Plate 14. a. The compression indices (C_c) shown on plate 14 do not agree with those on plate 7. These differences should be reconciled.

b. The values of the coefficient of consolidation (C_v) used in establishing the U - t curves should be given.

16. Plate 15. The e-log p curve for the clay strata from el -10 to el -18 should be added to plate 8.

17. Plate 30. The meaning of the term "Recommended" shown on the third lift-shaping section should be explained.

18. Plates 30, 31, and 32. The quantity of fill available for third lift construction should be checked. If sufficient material is not available within the section, other provisions should be indicated.

19. Plates 33, 34, 36, 37, 38, 45, 59, 61. The shallowest failure surfaces intersect the tips of the sheet pile I-walls. This implies that either this is the location of a critical failure surface and that there are no critical failure surfaces at higher elevations, or that some value of shear strength has been assigned the sheet piling. I-wall sections should be analyzed as if the sheet piling was nonexistent. Any sections where this change in concept could cause an appreciable change in the factor of safety should be reanalyzed.

20. Plates 34 and 35. The stability analyses on these two plates should be checked. Our review revealed lower resisting forces on the central block for assumed failure surfaces B1 and B2, than that shown on plate 34 and an apparent error in the direction and location of the crossover at el -70 on plate 35.

21. Plate 56. The differential settlement between the levee and the pile supported T-wall will be significant and could be detrimental to the connecting I-wall. These portions of the I-wall should be constructed in the usual sequence, but the placing of the concrete cap should be delayed until most of the settlement of the levee has taken place. Interim protection can be provided by driving longer sections of sheet piling and allowing them to protrude to approximately el 17.5.

22. Plate 76. The possibility of interference between the piles beneath the inverted T-wall and those beneath the discharge basin should be investigated.

23. Appendix B, Fig. B-5. The actual modulus of subgrade reaction for a clay with shear strength equal to 300 lb/sq ft could be less than 140 lb/sq in instead of 400 lb/sq in as assumed. Axial pile loads should be determined using a conservatively low value for the modulus.

LMVED-TD (NOD 18 Mar 71) 1st Ind 7 May 71
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

24. Minor comments are shown in red on pages 9, 17, 18, and 31 of the text and plates 7, 11, 14, 15, 34, 35, 46, and 53.

FOR THE DIVISION ENGINEER:

Ufmont J. Gumm Jr.

1 Incl (14 cy)
wd 2 cy

for ROBERT I. KAUFMAN
Acting Chief, Engineering Division

CF:
NOD-LMNED-PP

ENGCW-EZ (LMNED-PP, 18 Mar 71) 2nd Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, Office of the Chief of Engineers, Washington, D.C. 20314 18 August 1971

TO: Division Engineer, Lower Mississippi Valley, ATTN: LMVED-TD

1. Approved, subject to the comments of the Division Engineer in the 1st Indorsement and to the following comments.

2. Paragraph 3. The assurances of local cooperation should include additional assurances required by Sections 210 and 305 of Public Law 91-646, approved 2 January 1971. In accepting the additional assurances, it should be ascertained that the local sponsor is vested with adequate legal authority and economic capability to comply therewith.

3. Paragraph 33 and Plate 41. A stability analysis should be made with the vertical face of the active wedge located 130 feet floodside of the levee baseline and the base of the central block at Elevation -50.

4. Paragraph 38, and Plates 16 and 17. From Station 600+00 to Station 770+00 there are large quantities of pervious soils in the lower parts of the Michoud Canal borrow, from about Elevation -60 to Elevation -80. Specifications should state that these materials be placed on the landside zone of the levee.

5. Paragraphs 67 and 74b(4). Paragraph 74b(4) cites several reasons for the increase of $2,508,000 in the estimated cost for land and damages over the cost contained in the project document. One of the reasons is stated as being credit allowance for the area beneath the existing levee. This is not in accord with the statement in paragraph 67 indicating that the acreage under the levee was deducted from the total project requirements for rights-of-way. Table 3 reflects a reduction of $519,000 for 79 acres on which the existing levees are located. This apparent discrepancy should be explained.

6. Plate 34. A stability analysis should be made with the vertical face of the active wedge located 170 feet floodside of the levee base line and the base of the central block at Elevation -25.

7. Plate 42. Consideration should be given to leaving a 40-foot wide berm at Elevation 0.0 on the floodside of the levee.

8. Plate 51. The 1 on 2 dredged slopes should be flattened so that the factor of safety against local failure is at least 1.5. Local failures could lead to overall instability.

ENGCW-EZ (LMNED-PP, 18 Mar 71) 2nd Ind 18 August 1971
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

9. Plate 70. The riprap toe protection on the channel side should be designed in accordance with Method A on Plate 37 of EM 1110-2-1601.

FOR THE CHIEF OF ENGINEERS:

1 Incl
wd

JOSEPH M. CALDWELL
Chief, Engineering Division
Civil Works Directorate

LMVED-TD (NOD 18 Mar 71) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 18 Oct 71

TO: District Engineer, New Orleans, ATTN: LMNED-PP

Referred to note approval subject to comments in previous indorsements.

FOR THE DIVISION ENGINEER:

GEORGE B. DAVIS
Acting Chief, Engineering Division

LMNED-PP (18 Mar 71) 4th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, La. 70160 12 Nov 71

TO: Division Engineer, Lower Mississippi Valley, ATTN: LMVED-TD

1. The proposed disposition of comments presented in the 1st, 2d, and 3d Indorsements of this chain of correspondence follows (paragraph numbers refer to like-numbered paragraphs in the respective indorsements). All elevations contained herein are in feet and refer to mean sea level datum.

a. 1st Ind, para 2. Concur.

b. Para 3. Concur. Plate 61 should be referenced in para 33a(2), page 12.

c. Para 4. Concur. Para 36b should be modified to include the sentence: "The maximum design loads in tension and compression are 16.5 tons and 36 tons, respectively." The pile test loads will be approximately twice the design loads.

d. Para 5. Concur.

e. Para 6. After construction of the third lift, the levee will be maintained to the design grade by local interests and therefore the method, compaction, and source of material are not presented in the subject design memorandum. The amounts of additional settlement subsequent to the third lift were utilized in determining the maintenance costs shown in table 5, page 38. The plans and specifications for the third lift will specify that the levee be compacted in accordance with the standard guide specifications for semicompacted fill.

f. Para 7. Inclosed herewith is a table showing the allowable and computed pile loads for all T-wall and gate monoliths. The assumptions made in the analysis are as shown on figures B-5 and B-6 except that the modulus of subgrade reaction (AK) has been revised to 140 lbs/sq.in. (see incl 2).

g. Para 8a & 8b. Concur. Due to wage and material increases, the unit price for Z-27 and MA-22 sheet pile was increased to $4.50/s.f. This has resulted in a revision to pages 31 thru 38 as shown in incl 3. The pipe relocation costs were determined from the latest tabulation of bids for pipes of similar sizes. The costs for relocating the Southern Natural Gas Co. lines were estimated by owners and verified by NOD.

h. Para 9. All references to spoil-disposal areas in this paragraph should be deleted. No spoil-disposal areas are required.

i. Para 10a & 10b. The elevation of the Southern Natural Gas Co. high pressure gas line as shown on page 29 and plate 3 is in error and should read elevation -6.0. The baseline stations for the pipeline crossings as shown on plate 2 are the correct stations.

j. Para 11. The correct station for the Louisiana Cement Co. conveyor system should be station 716+55 as shown in plan on plate 2. The plans and specifications will indicate the correct station.

k. Para 12. Concur. The reported decrease will be retained in the PB-3 project estimate as additional contingencies.

l. Para 13. Concur.

m. Para 14a & 14b. Concur. The correct station should read 824+06 as shown in plan on plate 2.

n. Para 15a. Concur. The values of the compression indices shown on plate 14 are correct and accordingly the values on plate 7 should agree with those on plate 14.

o. Para 15b. The values of the coefficients of consolidation (C_v) used to develop the U-t curves shown on plate 14 are 7, 4, and $1.0X10^{-4}$ cm^2/sec for strata I, II, III, respectively.

p. Para 16. Sufficient undisturbed samples were not available between elevation -10.0 and -18.0 from boring 3-EU to perform consolidation tests.

q. Para 17. The third lift shaping section shown on plate 30 is the configuration which meets the design criteria and was forwarded to higher authority for approval. The word "Recommended" means the section is recommended for approval.

r. Para 18. The levees were designed such that sufficient material will be available to construct the third lift.

s. Para 19. The levee embankments containing the I-wall sections referred to in this paragraph were analyzed for the change in concept, i.e., considering the sheet piling as nonexistent, and there were no appreciable changes in the factors of safety. We can readily understand and appreciate the value of this type of concept for establishing a conservative design for cursory review. However, we feel that general use of this procedure for final design will result in ultra conservative designs and would prevent the use of I-type walls.

For purposes of maintaining currently approved designs inviolate and establishing mutually acceptable guidelines for future design, we propose a modified approach as follows:

(1) Using the construction (Q) shear strengths and the conventional cantilever I-type wall analysis, determine the minimum sheet pile penetration needed to retain the differential waterhead (F.O.S.=1.0) and the maximum penetration required for design.

(2) Disregard the sheet pile below the minimum penetration and conduct conventional levee stability analyses, deducting the lateral load of the differential head caused by the wedge of water supported by the I-wall, adding, however, the effects of the weight of all other water overlying the active wedges.

(3) The stability of the levee containing the I-type wall will be considered acceptable if the factors of safety for assumed failure surfaces between the minimum tip penetration and the required penetration are above 1.0 and the F.O.S. below the required tip penetration are 1.3 or higher. Further, for subsurface conditions having a soft stratum (low shear strength) overlying a firm stratum (high shear strength), the pile penetration into the firm stratum will be to a sufficient depth to prevent the pile tip from kicking up into the soft stratum.

t. Para 20. Concur. The factors of safety for analyses B1 and B2 on plate 34 should be 2.62 and 1.84, respectively. The cross-over referred to in this comment is in the correct direction and location. However, it should be shown at elevation -60.0 instead of elevation -70.0.

u. Para 21. Concur. The plans and specifications will indicate that placement of the concrete cap should be delayed to allow for levee settlement and the sheet pile will be driven to elevation 17.5 for interim protection.

v. Para 22. Concur. The batter should be changed from 1 on 2 to a batter of 1 on 2.5. The P&S will reflect this change.

w. Para 23. Concur. The pile foundations were reanalyzed using a modulus of subgrade reaction of 140 lbs/sq.in. The new pile loads are shown on the table in incl 2. This resulted in exceeding the allowable pile stress on the protected side vertical pile of Gate No. 2 by 6 percent, which would be tolerable. However, the addition of another vertical pile in the gate bay would provide a better designed monolith since most of the time the loading will be vertical resulting from vehicular traffic. This is tabulated in the table of incl 2. The gate monolith will therefore be revised in the plans and specifications to show this additional pile.

x. Para 24. We concur with the minor comments shown in red.

y. 2d Ind, para 2. The Attorney General of the State of Louisiana in his opinion of 7 April 1971 stated that the local assurers for the project are not now vested with adequate legal authority to comply with the provisions of Section 210 and 305 of P.L. 91-646. Only after passage of a proposed constitutional amendment early next year will the agencies be in a position to provide the additional assurances required by the act.

z. Para 3. A stability analysis was made with the vertical face of the active wedge located 130 feet flood side of the levee baseline and with the base of the central block at elevation -50.0 and the resulting minimum factor of safety is 1.80.

aa. Para 4. Hydraulic fill for construction of the levee from station 772+00 to station 1006+59 will be obtained from the GIWW. If the project "Michoud Canal Enlargement" is constructed coincident with one of the hydraulic fill lifts for the levee, an effort will be made to place the material removed from the Michoud Canal in the levee proper. Inasmuch as the Michoud Canal will be deepened only to elevation -40.0, the pervious soils between elevation -60.0 and elevation -80.0 will not be part of the fill placed in the levee.

bb. Para 5. That part of the statement in para 74b(4) stating that credit was allowed for the area beneath the existing levee is in error. The value of lands under the levee was correctly subtracted in table 3 from the total project requirements.

cc. Para 6. A stability analysis was made with the vertical face of the active wedge located 170 feet flood side of the levee baseline and with the base of the central block at elevation -25.0 and the resulting minimum factor of safety is 3.01.

dd. Para 7. As stated in para laa above, borrow material will not be obtained from the Michoud Canal for construction of the New Orleans East back levee. If the Michoud Canal is used as a borrow area for other projects in the future, the 40-foot wide berm at elevation 0.0 referred to in this paragraph will be complied with.

ee. Para 8. The requirement that slopes of borrow pits be designed to provide a factor of safety of 1.5 is considered too conservative. Slopes designed for a minimum factor of safety of 1.3 against local failure are considered satisfactory. We have not experienced any problems relative to local failure of the 1 on 2 dredged slopes in borrow pits located in

the MR-GO for levees previously constructed and/or under construction, i.e., Chalmette levee and Chalmette levee extension. Inasmuch as the soil conditions in the GIWW are similar to those in the MR-GO and the minimum factor of safety of the 1 on 2 slopes is 1.37 (see GDM, plate 64), it is strongly requested that the borrow pits with 1 on 2 side slopes presented in the GDM be approved. Further, it is requested that side slopes of borrow pits continue to be designed for a minimum factor of safety of 1.3, rather than a factor of safety of 1.5.

ff. Para 9.

(1) The riprap toe protection design, method A on plate 37 of EM 1110-2-1601, does not apply to this project because the water elevation which is tidal normally varies between +2.0 and -1.0 and the toe of riprap protection at -3.0. is therefore below the water level.

(2) The riprap toe protection design for the subject GDM has been changed to agree with the typical section, south bank, plate 2, Mississippi River-Gulf Outlet, General Design Memorandum No. 2, Supplement No. 4.

gg. 3d Ind. No replies required.

2. It is recommended that the proposed disposition of comments presented above be approved.

FOR THE DISTRICT ENGINEER:

JEROME C. BAEHR
Chief, Engineering Division

2 Incl
Added 2 incl (16 cys)
2. Tabulation of pile loads
3. Revised pages

d. New Orleans Sewerage and Water Board pumping station. At station 867+87, a new floodwall will be constructed south of an existing New Orleans Sewerage and Water Board pumping station. The existing floodwall with the top elevation at +16.0 will be replaced with a new T-wall with the top elevation at +23.0. Location and details of this floodwall are shown on plates 3 and 76 through 78.

ENVIRONMENTAL QUALITY

72. Environmental quality.

a. General. The engineering treatment required for preserving and maintaining the environmental quality of the project has been considered during preparation of this memorandum. Specifically, levee erosion protection, corrosion mitigation, and the disposition of dredge waste water are discussed in paragraphs 39a, 40, and 62, respectively. Further, as indicated in paragraphs 65 and 66 and in appendix A, extensive coordination has been accomplished with the appropriate agencies relative to effects of the project on fish and wildlife resources and water quality control during and subsequent to construction.

b. Enhancement. Construction of the protective works covered herein alters the existing terrain only to the extent of raising and strengthening existing work along the same alignment. Essentially all borrow material needed to enlarge the existing levee will come from within adjacent waterways or from a remote location in Lake Pontchartrain. Additional beautification measures beyond those normally associated with levee construction, i.e., grading and sodding, are not warranted. The logic behind this statement is that the adjacent developed area is occupied by industry which precludes the use of public funds for beautification of private vistas and that adjacent area which is not developed as industrially zoned.

ESTIMATE OF COST

73. General. Based on January 1971 price levels, the estimated first cost for the New Orleans East back levee is $15,000,000 This estimate consists of $2,773,000 for lands and damages, $496,000 for relocations, $9,657,000 for levees and floodwalls, which includes work done by local interests, $1,226,000 for engineering and design, and $848,000 for supervision and administration. The detailed estimate of first cost is shown on table 3.

Unit 3

TABLE 3

ESTIMATE OF FIRST COST
(January 1971 price levels)

Cost acct. no.	Item	Estimated quantity	Unit	Unit price	Estimated amount
			$	$	$
	CONSTRUCTION				
11	Levees and floodwalls				
	Levees				
	Levee raising[1]	348	sta.	215.52	75,000
	Levee embankment(barge)	100,500	c.y.	3.50	351,800
	1st lift	2,530,000	c.y.	1.09	2,758,000
	2d lift	1,714,000	c.y.	1.13	1,937,000
	Shapeup	467,500	c.y.	.40	187,000
	Retaining dike (cast)	700,000	c.y.	.30	210,000
	Fertilizing and seeding	251	acre	175.00	43,900
	Clearing and grubbing	360	acre	100.00	36,000
	Foreshore protection				
	Shell	16,930	c.y.	4.00	67,700
	Riprap	70,100	tons	6.50	455,700
	Subtotal				6,122,100
	Contingencies 20%+				1,223,900
	Subtotal, levees				7,346,000
	Floodwalls and gate structures				
	Structure excavation	7 400	c.y.	3.00	22,200
	Structure backfill	4,940	c.y.	3.00	14,800
	Steel sheet piling (MA-22)	9,120	s.f.	4.50	41,000
	Steel sheet piling (Z-27)	196,880	s.f.	4.50	886,000
	12"x12" prestressed conc. piles	17,500	l.f.	8.00	140,000
	Concrete in stabilization slab	90	c.y.	50.00	4,500
	Concrete in T-wall base	660	c.y.	50.00	33,000
	Concrete in walls, columns, and beams	6,260	c.y.	70.00	438,200
	Portland cement	9,630	bbls.	5.50	53,000
	Steel reinforcement	694,520	lbs.	.20	138,900
	Bulb-type waterstops	3,050	l.f.	5.00	15,300
	L-type waterstops	340	l.f.	10.00	3,400
	Expansion joint filler	6,300	s.f.	1.00	6,300
	Structural steel	53,540	lbs.	.90	48,200
	Miscellaneous metalwork	1	job	L.S.	10,000
	Gate seals	300	l.f.	10.00	3,000
	Overhead trolleys	1	job	L.S.	2,400
	Sackrub finish	174,650	s.f.	.30	52,400

[1]Levees raised by local interests from approx. el. +9.5 to approx. el. +11.5 (existing) after project authorization.

TABLE 3 (cont'd)

Cost acct. no.	Item	Estimated quantity	Unit	Unit price	Estimated amount
			$	$	$
	Floodwalls and gate structures (cont'd)				
	Subtotal				1,912,600
	Contingencies 20%				398,400
	Subtotal, floodwalls & gate structures				2,311,000
	Subtotal, levees & floodwalls (Cost acct. 11)				9,657,000
30	Engineering & design 13%(based on actual work required)				1,226,000
31	Supervision & administration 9%) (based on actual work required)				848,000
	Total, levees and floodwalls				11,731,000[2]
01	Land improvements				
	I-wall	34.0	acre	varies	461,600
	Levee	430.0	acre	varies	2,209,000
	Construction easement	59.0	acre	varies	157,000
	Severance	None	-	-	-
	Less existing levee	79.0	acre	varies	-519,000
	Subtotal, lands and improvements				2,308,600
	Contingencies 20%				462,000
	Real estate, hired labor cost (approx. 12 tracts)				300
	Acquisition cost by others (approx. 12 tracts)				2,100
	Total lands and improvements				2,773,000
02	Relocations				
	1 1/2" electric cable	4	each	L.S.	14,000
	8" pipeline	1	each	L.S.	700
	12" pipeline	3	each	L.S.	4,200
	12" high pressure gas line	1	each	L.S.	60,000
	20" high pressure gas line	1	each	L.S.	100,000
	24" high pressure gas line	1	each	L.S.	100,000
	T-type floodwall	130	l.f.	L.S.	30,000
	Modification to N.O.S.&W.B. pumping station floodwall	1	each	L.S.	25,000
	Modification to existing shell ramps	1	each	L.S.	5,000
	Subtotal				338,900
	Contingencies 20%				67,800
	Subtotal				406,700
	Engineering & design 13%(based on actual work rqd)				52,800
	Supervision & administration 9%(based on actual work required)				36,500
	Total, relocations				496,000
	TOTAL PROJECT COST				15,000,000

[2]Includes work done by local interests.

74. Comparison of estimates.

a. GDM versus PB-3. The current estimate of $15,000,000 for the New Orleans East back levee represents a decrease of $4,807,000 over the latest PB-3 effective 1 July 1970. The estimate presented in the PB-3 is based on the estimate included in Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Citrus Back Levee, approved 29 December 1967, and escalated to July 1970 price levels. Table 4 shows a comparison of the project document, PB-3, and general design memorandum estimates. Reasons for the difference between the design memorandum and PB-3 estimates are as follows:

(1) Levees and floodwalls. The net decrease of $2,278,000 is comprised of a decrease of $1,382,000 attributable to the selection of floodwall construction instead of levee along the Michoud Canal and an additional $896,000 decrease reflecting the deletion in this GDM of the U. S. Highway 90 to GIWW reach from the project.

(2) Engineering and design. The increase of $295,000 resulted from recomputing the E&D cost based on an analysis of actual work required rather than applying a percentage to the construction cost.

(3) Supervision and administration. The net increase of $218,000 reflects the added S&A costs as a result of recomputing S&A costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(4) Lands and damages. The net decrease of $3,329,000 is the result of a decrease in land requirements for T-wall in place of levee, a more detailed estimate of levee requirements, the elimination in this GDM of the levee from the GIWW to U. S. Highway 90, and the assignment of credit for area beneath the existing levee.

(5) Relocations. The increase of $287,000 reflects general refinements in the cost estimate based on the more detailed information available during preparation of this memorandum.

TABLE 4

COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff. 1 Jul 70	GDM No. 2 Supp.No. 4	Difference Supp.No.4 - PB-3	Difference Supp. No. 4 - Proj.document
		$	$	$	$	$
11	Levees and floodwalls	4,993,000	11,935,000	9,657,000	-2,278,000	+4,664,000
30	Engineering and design	195,000	931,000	1,226,000	+295,000	+1,031,000
31	Supervision and administration	300,000	630,000	848,000	+218,000	+548,000
	Subtotal	5,488,000	13,496,000	11,731,000	-1,765,000	+6,243,000
01	Lands and damages	265,000	6,102,000	2,773,000	-3,329,000	+2,508,000
02	Relocations	238,000	209,000	496,000	+287,000	+258,000
	Subtotal	503,000	6,311,000	3,269,000	-3,042,000	+2,766,000
	Total	5,991,000	19,807,000	15,000,000	-4,807,000	+9,009,000

b. GDM versus project document. The estimate of $15,000,000 for the New Orleans East back levee also represents an increase of $9,009,000 over the project document estimate. Reasons for the difference between the design memorandum and project document estimates are as follows:

(1) Levees and floodwalls. The increase of $4,664,000 is the result of increasing the height of all levee protection from elevation 16.0 to elevation 17.5, construction of approximately 2 miles of concrete I-wall, eight gate structures, and 130 feet of I-wall in lieu of earth levee, and increasing the contingencies by 5 percent over that presented in the project document.

(2) Engineering and design. The increase of $1,031,000 resulted from recomputing the E&D costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(3) Supervision and administration. The increase of $548,000 resulted from recomputing the S&A costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(4) Lands and damages. The increase of $2,508,000 is the result of an increase in acreage requirements, a 10 percent increase in contingencies, the escalation of land costs due to development in the area subsequent to the preparation of the project document, and credit allowance for the area beneath the existing levee.

(5) Relocations. The increase of $258,000 is due primarily to modifying the floodwall to accommodate the pipe crossings and roads which were constructed since presentation of the project document.

SCHEDULES FOR DESIGN AND CONSTRUCTION

75. Schedules for design and construction. The sequence of contracts and the schedules for design and construction are shown below:

Contracts	Design: Start	Design: Complete	Construction: Advertise	Construction: Award	Construction: Complete	Estimated Construction Cost Includes Contingencies and S&I
Levee raising[1] (interim protection sta. 664+73 to sta. 1006+59)			May 66	Jun 66	Apr 67	$ 75,000
Levee, 1st lift 1971 (Sta. 772+00 to Sta. 876+87)		Dec 71	Dec 71	Jan 72	Jan 73	1,381,000
Concrete floodwall (Sta. 664+73 to Sta. 772+00 and Sta. 874+42 to Sta. 879+32)		Feb 72	Feb 72	Mar 72	Mar 73	3,537,000
Levee, 1st lift (Sta. 876+87 to Sta. 1006+59)		Mar 72	Mar 72	Apr 72	Nov 73	2,088,000
Levee, 2d lift (Sta. 772+00 to Sta. 876+87)		Dec 74	Dec 74	Jan 75	Nov 75	1,097,000
Levee, 2d lift (Sta. 876+87 to Sta. 1006+59)		Oct 75	Oct 75	Nov 75	Oct 76	1,269,000
Levee shapeup & seeding, foreshore protection (Sta. 772+00 to Sta. 876+87)		Oct 77	Oct 77	Nov 77	Sept 78	397,000
Levee shapeup & seeding, foreshore protection (Sta. 876+87 to Sta. 1006+59)		Sept 78	Sept 78	Oct 78	Jun 79	482,000
Total						$10,326,000

[1]Raising 1965 levee by local interests to the existing interim protection levee. See plates 29 through 32.

76. Funds required by fiscal year. To maintain the schedules for design and construction, as shown above, of the New Orleans East back levee, funds[1] will be required by fiscal year as follows:

Funds required by FY	1971	$ 115,350[2]
	1972	4,749,000
	1973	2,019,670
	1974	633,930
	1975	695,880
	1976	1,412,210
Balance to complete		2,213,960
Total		$11,840,000

OPERATION AND MAINTENANCE

77. General. The New Orleans East back levee will be maintained and operated at the expense of local interests as a feature of local cooperation in the hurricane project. A detailed estimate of the annual operation and maintenance costs is shown in table 5. In addition, it is estimated that replacement of the overhead roller gates will be necessary at 30-year intervals. The annual charge for these replacements is $1,140.

TABLE 5

ESTIMATE OF ANNUAL OPERATION AND MAINTENANCE COSTS

Maintenance:	$4,650
I-wall	270
Foreshore protection	700
Overhead roller gates	960
Operation:	
Overhead roller gates	80
Total	$6,660

[1]Includes cost for construction (including contingencies 20%), supervision and administration, engineering and design.

[2]Includes costs for preparation of plans and specifications and credit for work accomplished by local interests.

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
NEW ORLEANS EAST BACK LEVEE

Computed by T.S.T.
Ckd by JGB
Date 20 May 71

NEW ORLEANS EAST BACK LEVEE PROJECT

TYPE OF STRUCTURE	PILE Group	Length	Batter	No. Pile per Row	LOAD CASES 1 P	1 Q	2 P	2 Q	3 P	3 Q	4 P	4 Q	5 P	5 Q	6 P	6 Q	7 P	7 Q	CRITICAL PILE LOAD Case No. P	Case No. Q	Allow. Load P	Allow. Load Q	Comp. Load P	Comp. Load Q	% Load P	% Load Q
OVERHEAD GATES #1, #3 Thru. #5	A	75.5'	1 on 4	6	12.19k	0.35k	18.80k	0.68k	22.07k	0.36k	4.35k	0.28k	-19.88k	-0.54k	10.39k	0.53k	20.26k	0.25k	5	5	40k	3.80k	-19.88k	-0.54k	49.70%	14.11%
	B		1 on 2	6	16.46k	0.95k	14.32k	0.81k	14.25k	0.47k	17.01k	0.36k	52.71k	-0.45k	14.42k	0.64k	7.00k	0.32k	5	2	80k	5.47k	52.71k	0.81k	65.88%	14.85%
	C_A		—	2	-1.77k	0.36k	-8.36k	0.69k	7.46k	0.38k	-6.42k	0.28k	1.67k	-0.55k	-10.66k	0.53k	9.98k	0.27k	6	2	40k	4.34k	-10.66k	0.69k	26.65%	15.86%
	C_B		—	2	47.07k	0.36k	71.48k	0.69k	46.53k	0.38k	41.24k	0.28k	14.61k	-0.55k	58.87k	0.53k	29.63k	0.27k	2	2	80k	2.79k	71.48k	0.69k	89.35%	24.61%
SWING GATE #2	A	75.5'	1 on 4	4	11.42k	0.29k	14.71k	0.46k	22.00k	0.06k	6.58k	0.19k	-15.82k	-0.64k	8.87k	0.31k	16.96k	-0.13k	5	5	40k	3.85k	-15.82k	-0.64k	47.05%	16.71%
	B		1 on 2	4	8.25k	0.36k	10.85k	0.55k	12.50k	0.14k	8.41k	0.25k	49.27k	-0.58k	10.69k	0.38k	12.53k	-0.07k	5	5	80k	3.83k	49.27k	-0.58k	61.61%	15.02%
	C_A		—	1	-0.24k	0.30k	-3.56k	0.46k	18.97k	0.09k	-1.18k	0.20k	6.90k	-0.65k	-3.51k	0.31k	21.50k	-0.10k	7	5	80k	5.82k	21.50k	-0.65k	26.87%	11.19%
	C_B		—	2	33.23k	0.30k	49.59k	0.46k	21.40k	0.09k	25.32k	0.20k	2.51k	-0.65k	37.26k	0.31k	5.97k	-0.10k	2	2	80k	3.82k	49.57k	0.46k	61.97%	12.15%
T-WALL AT AERIAL CROSSING	A	73.3'	1 on 3.5	4	10.41k	-0.10k	4.52k	0.01k	-18.48k	-3.10k	18.23k	3.24k	17.37k	2.12k					3	3	40k	3.86k	-18.48k	-3.10k	46.20%	80.21%
	B		1 on 2.5	4	27.46k	-0.02k	23.97k	0.08k	50.35k	-3.12k	12.43k	3.41k	24.03k	2.28k					3	3	80k	-3.78k	50.35k	-3.12k	62.94%	82.41%
T-WALL AT DERRICK FOUNDATION	A	73.3'	1 on 3.5	5	11.37k	-0.11k	4.95k	0.01k	-20.19k	-3.39k	19.93k	3.54k	19.99k	2.32k					3	3	40k	3.78k	-20.19k	-3.39k	50.48%	89.65%
	B		1 on 2.5	5	30.03k	-0.03k	26.20k	0.08k	55.05k	-3.41k	13.57k	3.74k	26.28k	2.49k					3	3	80k	3.56k	55.05k	-3.41k	68.81%	95.78%
T-WALL AT PUMPING STATION	A	68.8'	1 on 2	3	9.12k	-1.06k	2.89k	-1.10k	2.74k	-0.59k	-1.91k	-0.62k	-19.85k	-0.47k	-32.57k	-0.93k	50.42k	0.73k	6	6	40k	3.20k	-32.57k	-0.93k	81.42%	29.19%
	B		1 on 2.5	4	56.93k	-0.87k	53.61k	-0.93k	40.60k	-0.47k	38.15k	-0.52k	54.36k	-0.38k	52.94k	-0.87k	9.14k	0.86k	1	2	80k	3.63k	56.93k	-0.93k	71.16%	25.53%
	C		1 on 2.5	2	17.27k	-0.96k	12.07k	-1.02k	22.97k	-0.51k	19.01k	-0.56k	56.71k	-0.38k	31.12k	-0.92k	41.44k	0.94k	5	7	80k	4.20k	56.71k	0.94k	70.88%	22.29%
T-WALL AT P.S. Adjacent TO Discharge Line	A	70.2'	1 on 2	6	6.96k	-2.16k	-1.75k	-0.09k	-26.99k	2.28k	49.80k	1.17k	19.90k	1.45k	50.11k	1.60k			3	3	40k	3.46k	-26.99k	2.28k	67.47%	65.80%
	B		1 on 2	8	54.97k	-1.98k	46.27k	0.04k	69.62k	2.40k	23.66k	1.38k	20.34k	1.57k	43.73k	1.87k			3	3	80k	2.88k	69.62k	2.40k	87.03%	83.33%

omit case 5 & 6 in D.M.

- Compression
+ Tension

LEGEND
Group A pile — Floodside Batter Piles
Group Bm Pile — Protectedside middle Row Batter Piles
Group B Pile — Protectedside Batter Piles
Group C_A Pile — Floodside Vertical Piles
Group C_B Pile — Protectedside Vertical Piles

Ind. 2

Fig. B-11A

LMVED-TD (NOD 18 Mar 71) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 9 Dec 71

TO: District Engineer, New Orleans, ATTN: LMNED-PP

1. The actions proposed and information furnished in response to comments in previous indorsements are satisfactory subject to the following comments.

2. Para 1e. It is considered that requiring local interests to provide the 1.5 feet of final levee fill is beyond the scope of normal maintenance. This procedure should be reexamined and the cost estimate revised, if applicable.

3. Para 1s. The proposed modified approach for designing cantilever I-type walls is not concurred in. The sheet pile should be considered nonexistent in analyses of the overall stability of the levee containing the I-wall. Because of the complexity and the many variations of this problem, a meeting will be held in the near future between NOD and LMVD to arrive at mutually acceptable design guidelines.

FOR THE DIVISION ENGINEER:

wd all incl

A. J. DAVIS
Chief, Engineering Division

LMNED-PP (18 Mar 71) 6th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, La. 70160 7 Jan 72

TO: Division Engineer, Lower Mississippi Valley, ATTN: LMVED-TD

1. The proposed disposition of comments presented in the 5th Ind of this chain of correspondence follows (paragraph numbers refer to like-numbered paragraphs in the 5th Ind).

a. Para 2. The design of the ultimate levee section presented in the subject GDM was based on existing (Q) shear strengths. As stated in paragraph 42 of the GDM, additional soils borings, tests, and stability analyses will be made prior to each lift subsequent to the first. It is believed that these analyses will indicate that sufficient gains in shear strength have developed so that the 3d lift can be overbuilt 1.5 - 2.0 feet above net grade to compensate for long-term settlement. The information presented in para 1e of the 4th Ind concerning additional levee fill and its cost being included in maintenance costs, table 5, page 38 of the GDM, is incorrect. The additional material needed for the 1.5 feet of final levee fill was previously provided in the estimated quantities and costs reflected in table 3, page 32 of the GDM.

b. Para 3. A meeting between personnel from LMVD and NOD was held in the New Orleans District on 14 December 1971 to discuss the design of cantilever I-type floodwalls. The I-type floodwalls for the New Orleans East back levee were evaluated considering the design guidelines established at the aforementioned meeting and it was found that the passive resistance along inclined planes on the protected side (I-wall penetration analysis presented in GDM) was less than the resistance developed by assuming shear failure along horizontal planes similar to the conventional "Method of Planes" analysis. Therefore, the tip penetrations presented in the GDM meet the design requirements for stability.

2. It is recommended that the proposed disposition of comments presented above be approved.

FOR THE DISTRICT ENGINEER:

JEROME C. BAEHR
Chief, Engineering Division

LMVED-TD (NOD 18 Mar 71) 7th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 25 Jan 72

TO: District Engineer, New Orleans, ATTN: LMNED-PP

The actions described and information furnished in the 6th Ind are satisfactory.

FOR THE DIVISION ENGINEER:

A. J. DAVIS
Chief, Engineering Division

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LMNED-PP

18 March 1971

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 4, New Orleans East Back Levee

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

1. The subject general design memorandum is submitted herewith for review in accordance with the provisions of ER 1110-2-1150 dated 19 June 1970.

2. Approval of this memorandum is recommended.

1 Incl (16 cys)
GDM No. 2, Supp. No. 4

HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

STATUS OF DESIGN MEMORANDA

Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 6 Mar 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Approved 29 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Approved 10 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Submitted 16 Jul 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex	Approved 19 Sept 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Submitted 18 Mar 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	Scheduled Jun 72

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5A, Orleans Parish Lakefront Levee - East of IHNC	Scheduled Feb 72
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Approved 4 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Scheduled Jun 72
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees	Approved 6 Jun 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee from South Point to GIWW	Scheduled Dec 71
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Approved 12 Aug 69
4	Lake Pontchartrain Barrier Plan, and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC	Scheduled Mar 72
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre Control Structures	Approved 29 Oct 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Scheduled Oct 71
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Sept 71

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Scheduled Dec 71
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled Nov 71
10	Lake Pontchartrain Barrier Plan, Corrosion Protection	Approved 21 May 69
12	Source of Construction Materials	Approved 30 Aug 66
1	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., GDM, Seabrook Lock	Approved 4 Nov 70
2	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., DDM, Seabrook Lock	Scheduled Feb 72

LEGEND

EXISTING IMPROVEMENTS

- Levee
- Seawall
- Location of work covered in this document.
- Portion of U.S. Hwy 90 to serve as part of Barrier Embankment

AUTHORIZED IMPROVEMENTS

- New Levee
- Levee Enlargement
- Control Structure
- Drainage Structure
- Lock
- Floodgate
- Navigation Channel
- Floodwall
- Seawall Strengthening
- Rock Fill

Mandeville
Seawall
190
PASS MANCHAC
LAKE MAUREPAS
LAKE PONTCHARTRAIN CAUSEWAY
LAKE PONTCHARTRAIN
ST. JOHN THE BAPTIST PARISH
ST. CHARLES PARISH
ST. CHARLES PARISH
JEFFERSON PARISH
JEFFERSON PARISH
ORLEANS PARISH
ST. TAMMANY PARISH
ORLEANS PARISH
11
Apple Pie Ridge
90
THE RIGOLETS
N
South Point
10
NEW ORLEANS EAST
New Orleans Lakefront Airport
Seabrook Lock
Seawall
CITRUS
90
WATERWAY
ORLEANS PARISH
ST. BERNARD PARISH
CHEF MENTEUR PASS
GULF INTRACOASTAL
LAKE BORGNE
BONNET CARRÉ SPILLWAY
10
ST CHARLES PARISH
JEFFERSON PARISH
NEW ORLEANS
FLORIDA AVE. BRIDGE
INNER HARBOR NAVIGATION CANAL
47
Bayou Bienvenue
CHALMETTE
EXISTING LOCK
MISSISSIPPI RIVER - GULF OUTLET
61
MISSISSIPPI RIVER
Chalmette
Violet
Bayou Dupre
Verret
Caernarvon
46

SCALE OF MILES
1 0 1 2 3 4 5

LAKE PONTCHARTRAIN
AND VICINITY, LA.
(HURRICANE PROTECTION)

AUTHORIZED PLAN OF PROTECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

NOVEMBER 1965 FILE NO. H-2-23693

REV. DEC. 1970

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

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APPENDIXES

PERTINENT DATA

Location of project		Southeastern Louisiana in Orleans Parish
Hydrologic data		
Temperature:	Maximum monthly	87.1° Fahrenheit
	Minimum monthly	43.0° Fahrenheit
	Average annual	69.7° Fahrenheit
Annual precipitation:	Maximum	85.73 inches
	Minimum	31.07 inches
	Average	60.58 inches
Hydraulic design criteria--tidal		
Design hurricane--Standard Project Hurricane (SPH)		
Frequency		1 in 200 years
Central Pressure Index (CPI)		27.5 inches of mercury
Maximum 5-min. average wind		100 m.p.h.
Levee		
Method of construction		Hydraulic lifts & shapeups
Levee length		4.4 miles
Elevation--varies		17.5[1,2]
Crown width		10 feet
Floodwall		
Type		I-wall & inverted T-wall
Length		2 miles
Elevation--varies		19.0-23.0[1]
Rights-of-way		
Permanent rights-of-way		385 acres
Construction easements		59 acres
Estimated first cost		
Levees and floodwalls		$ 9,517,000
Engineering and design		1,226,000
Supervision and administration		848,000
Relocations		496,000
Lands and damages		2,773,000
Total		$14,860,000

[1]See table 1, Location and type of protective works, for specific reach construction grades.

[2]Elevations herein are in feet referred to mean sea level unless otherwise noted.

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

PROJECT AUTHORIZATION

1. Authority.

a. Public Law. Public Law 298, 89th Congress, 1st Session, approved 27 October 1965, authorized the "Lake Pontchartrain, Louisiana and Vicinity," hurricane protection project, substantially in accordance with the recommendations of the Chief of Engineers in House Document No. 231, 89th Congress, 1st Session, except that the recommendations of the Secretary of the Army in that document shall apply with respect to the Seabrook Lock feature of the project.

b. House Document. The report of the Chief of Engineers dated 4 March 1964 printed in House Document No. 231, 89th Congress, 1st Session, submitted for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers and the concurring report of the Mississippi River Commission for those areas under its jurisdiction. The report of the Board of Engineers for Rivers and Harbors stated: "For protection from hurricane flood levels, the reporting officers find that the most suitable plan would consist of a barrier extending generally along U. S. Highway 90 from the eastern-most levee to high ground east of the Rigolets, together with floodgates and a navigation lock in the Rigolets, and flood and navigation gates in Chef Menteur Pass; construction of a new lakeside levee in St. Charles Parish extending from the Bonnet Carre Spillway guide levee to and along the Jefferson Parish line; extension upward of the existing riprap slope protection along the Jefferson Parish levee; enlargement of the levee landward of the seawall along the 4.1 mile lakefront, and construction of a concrete-capped sheet-pile wall along the levee west of the Inner Harbor Canal in New Orleans; raising the rock dikes and landward gate bay of the planned Seabrook Lock; construction of a new levee lakeward of the Southern Railway extending from the floodwall at New Orleans Airport to South Point; enlargement of the existing levee extending from U. S. Highway 90 to the Gulf Intracoastal Waterway, thence westward along the waterway to the Inner Harbor Canal, together with riprap slopes along the canal; construction of a concrete capped sheet-pile wall along the east levee of the Inner Harbor Canal between the Gulf Intracoastal Waterway and the New Orleans Airport...."

c. BERH recommendation. The report of the Chief of Engineers stated: "...The Board [of Engineers for Rivers and Harbors] recommends authorization for construction essentially as planned by the reporting officers...I concur in the recommendation of the Board of Engineers for Rivers and Harbors."

2. Purpose and scope. This supplement presents the essential data, assumptions, criteria, and computations for developing the plan, design, and cost for the New Orleans East back levee in sufficient detail to provide an adequate basis for preparing plans and specifications for the floodwall and first lift levee construction without additional design analysis.

3. Local cooperation. The conditions of local cooperation pertinent to this supplement and as specified in the report of the Board of Engineers for Rivers and Harbors and concurred in by the report of the Chief of Engineers are as follows: "...That the barrier plan for protection from hurricane floods of the shores of Lake Pontchartrain...be authorized for construction,...Provided that prior to construction of each separable independent feature local interests furnish assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:

"(1) Provide all lands, easements, and rights-of-way, including borrow and spoil disposal areas, necessary for construction of the project;

"(2) Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction works;

"(3) Hold and save the United States free from damages due to the construction works;

"(4) Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (1) and (2) above and a cash contribution presently estimated at $14,384,000 for the barrier plan...to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution, accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;

"(5) For the barrier plan, provide an additional cash contribution equivalent to the estimated capitalized value of operation and maintenance of the Rigolets navigation lock and

channel to be undertaken by the United States, presently estimated at $4,092,000, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier;

"(6) Provide all interior drainage and pumping plants required for reclamation and development of the protected areas;

"(7) Maintain and operate all features of the works in accordance with regulations prescribed by the Secretary of the Army, including levees, floodgates and approach channels, drainage structures, drainage ditches or canals, floodwalls, seawalls, and stoplog structures, but excluding the Rigolets navigation lock and channel and the modified dual purpose Seabrook Lock; and

"(8) Acquire adequate easements or other interest in land to prevent encroachment on existing ponding areas unless substitute storage capacity or equivalent pumping capacity is provided promptly;

"Provided that construction of any of the separable independent features of the plan may be undertaken independently of the others, whenever funds for that purpose are available and the prescribed local cooperation has been provided...."

INVESTIGATIONS

4. Project document investigations. Studies and investigations made in connection with the report on which authorization is based (H.D. No. 231, 89th Congress, 1st Session) consisted of: research of information which was available from previous reports and existing projects in the area; extensive research in the history and records of hurricanes; damage and characteristics of hurricanes; extensive tidal hydraulics investigations involving both office and model studies relating to the ecological impact of the project on Lakes Pontchartrain and Borgne; an economic survey; and preliminary design and cost studies. A public hearing was held in New Orleans on 13 March 1956 to determine the views of local interests.

5. Investigations made subsequent to project authorization. Surveys and studies made subsequent to project authorization for the New Orleans East back levee include:

a. aerial and topographic surveys of the New Orleans East back levee;

b. soils investigations including general and undisturbed type borings and associated laboratory evaluations;

c. detailed design studies for levee and gap closure construction including levee section stability determinations;

d. tidal hydraulic studies required for establishing design grades for protective works based on revised hurricane parameters furnished subsequent to project authorization by the U. S. Weather Bureau;

e. real estate requirements and appraisals;

f. cost estimates for levees, road ramps, and relocations.

6. Planned future investigations. Additional soils borings and tests will be made prior to each levee lift subsequent to the first. Design analyses, utilizing information obtained from the additional borings, will be made and preparation of plans and specifications for each lift will be based on these analyses. Also, bearing pile tests will be conducted to determine the pile lengths for construction.

LOCAL COOPERATION

7. Local cooperation requirements. The conditions of local cooperation as specified by the authorizing laws are quoted in paragraph 3.

8. Status of local cooperation. On 2 November 1965, the Governor of the State of Louisiana designated the State of Louisiana, Department of Public Works, as "...the agency to coordinate the efforts of local interests and to see that the local commitments are carried out promptly...." By State of Louisiana Executive Order dated 17 January 1966, the Board of Levee Commissioners of the Orleans Levee District was designated as the local agency to provide the required local cooperation for all portions of the Lake Pontchartrain, La. and Vicinity project in Orleans, Jefferson, St. Charles, and St. Tammany Parishes. Assurances covering all of the local cooperation required for the Lake Pontchartrain Barrier Plan were requested through the Department of Public Works from the Board of Levee Commissioners of the Orleans Levee District on 21 January 1966, and a satisfactory act of assurances, supported by a resolution of the Board of Levee Commissioners of the Orleans Levee District dated 28 July 1966, were approved and accepted on behalf of the United States on 10 October 1966. The principal officers currently responsible for the fulfillment of the conditions of local cooperation are as follows:

Mr. C. H. Downs, Director
State of Louisiana
Department of Public Works
Baton Rouge, Louisiana 70804

Mr. Edward Lennox, President
Board of Levee Commissioners of the
Orleans Levee District
Room 200, Wild Life and Fisheries Building
418 Royal Street
New Orleans, Louisiana 70130

9. Views of local interests. The Board of Levee Commissioners of the Orleans Levee District represents local interests. The plan presented herein was coordinated in detail with the Board's engineering staff and bears the approval of the Board. The intention and capability of the local sponsor to provide the required non-Federal contribution for the entire Lake Pontchartrain Barrier Plan, presently estimated at $67,162,000, have been amply demonstrated; in fact, considerable work which ultimately will be incorporated into the overall project has already been accomplished by the sponsor.

LOCATION OF PROJECT AND TRIBUTARY AREA

10. Project location. The New Orleans East back levee segment of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project, as shown on plate 1, is located in southeastern Louisiana along the north bank of the GIWW (Gulf Intracoastal Waterway). The project area covered in this memorandum is located in Orleans Parish.

11. Tributary area. The tributary area of Lake Pontchartrain varies in character from flat tidal marsh at or near sea level to upland areas of significant relief with natural ground elevations as high as 250 feet above mean sea level. Runoff from within the project area is disposed of into either Lake Borgne or Lake Pontchartrain, generally by pumping, although some developed areas located on alluvial ridges in St. Charles, St. Bernard, and St. Tammany Parishes are drained by gravity. In addition to runoff from the project area, Lake Pontchartrain receives the runoff of 4,700 square miles located to the north and west of the lake. During major floods on the Mississippi River and its tributaries, floodflows may be diverted from the Mississippi River to Lake Pontchartrain through the Bonnet Carre' Spillway, a controlled overbank floodway constructed under the Flood Control, Mississippi River and Tributaries project.

PROJECT PLAN

12. General. The project, as shown on the flyleaf map, consists of two separate and distinct major features--the Chalmette Area Plan and the Lake Pontchartrain Barrier Plan. This memorandum is concerned only with a segment of the latter, the New Orleans East back levee. The overall Lake Pontchartrain Barrier Plan is described in GDM, Citrus Back Levee, approved 29 December 1967.

13. New Orleans East back levee. This levee is located on the north bank of the GIWW and extends from a junction with the Citrus Back Levee to the west end of the Chef Menteur Pass barrier levee. Under the project plan covered herein, the first 2 miles will consist of floodwall (I-type and inverted T-type) constructed to an elevation of 20.0 feet in an enlarged levee. The remaining 4.4 miles will consist of enlarging and raising the existing earth levee from its elevation of approximately 12 feet to a new net elevation of 17.5 feet and providing foreshore wave-wash protection on the flood side of the levee. The plan also provides for constructing four T-walls and eight gate closures; modifying eight road ramps, eight pipeline and four electric cable crossings, and the floodwall at an existing pumping station. The plan of improvement as described above is shown in general on plates 1 through 4 and is detailed on subsequent plates.

DEPARTURES FROM PROJECT DOCUMENT PLAN

14. Departures from project document plan. The net grades of the protective works presented herein were revised upward in accordance with the results of tidal hydraulic studies utilizing more severe hurricane parameters developed by the U. S. Weather Bureau subsequent to project authorization. Results of these studies relative to the protective works described herein are contained in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I Chalmette," approved 27 October 1966. The revised net grades of the New Orleans East Back Levee are elevation 17.5 for levees and elevation 19.0 for most of the floodwalls except at the existing drainage pumping station where wave runup dictates a net grade of 23.0. The results of similar studies contained in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part III - Lakeshore," approved 25 February 1969, indicate that the entire South Point to GIWW reach will now have to be raised. Therefore, the U. S. Highway 90 to GIWW segment will be deleted from the New Orleans East back levee design and included in the South Point to GIWW design. This means that the structure for the Louisville and Nashville Railroad will also be covered in the South Point to GIWW design memorandum.

HYDROLOGY AND HYDRAULICS

15. General. The Hydrology and Hydraulic Analysis design memorandum for the Lake Pontchartrain Barrier Plan was presented in a series of three separate reports entitled Design Memorandum No. 1 and subtitled Part I - Chalmette, Part II - Barrier, and Part III - Lakeshore, respectively. Part I - Chalmette was approved on 27 October 1966; Part II - Barrier was approved on 18 October 1967; and Part III - Lakeshore was approved on 6 March 1969. These documents present detailed descriptions and analyses of the tidal hydraulic methods and procedures used in tidal hydraulic design of the features for the plan, and include the essential data, assumptions and criteria used, and results of studies which provide the bases for determining surges, routing, wind tides, runup, overtopping, and frequencies. All basic hydraulic information required for design of the New Orleans East back levee is included in Part I - Chalmette.

16. Design elevations. The design hurricane for the New Orleans East back levee is the SPH (Standard Project Hurricane) having a return frequency of once in about 200 years; a central pressure of 27.5 inches of mercury; a maximum 5-minute average wind velocity of 100 m.p.h. 30 feet above the surface at a radius of 30 nautical miles from the center; a forward speed of 11 knots; and progress along a track critical to the area of interest. Detailed information on the design hurricane is presented in "Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I - Chalmette." The design hurricane would produce a maximum wind tide level of 13.0 feet along the New Orleans East back levee. Design elevations for protective structures and pertinent information relative thereto are as follows:

Type structure	Avg. depth	Significant Wave (H_s)	Wave period (T)	Runup	Ultimate or design elev. of protective structures
	ft.	ft.	sec.	ft.	ft.
Levee	12.7	4.9	5.5	4.5	17.5
Floodwall	12.7	4.9	5.5	6.0	19.0
Floodwall at pump station	12.7	4.9	5.5	10.0	23.0

17. Drainage. Inasmuch as an existing system of levees completely encompasses the New Orleans East area, as shown on the flyleaf map, interior drainage is required to prevent flooding of the developed areas as a result of direct rainfall. Local interests have provided the required drainage. Existing pump discharge pipes will be modified to pass through a new floodwall.

The plan presented herein consists of the raising or enlargement of the existing New Orleans East back levee and will not interfere with the existing interior drainage facilities.

GEOLOGY

18. Physiography. The project area is located within the Central Gulf Coastal Plain on the eastern flank of the Mississippi River Deltaic Plain. Physiographic features of the study area include: marshes, natural levees, abandoned distributaries, and many small, shallow ponds. Relief in the area is very slight with a maximum variation of 8 feet between remnant alluvial ridge (Gentilly-Bayou Sauvage Ridge) and the adjacent marshlands. Maximum elevations of 2 are found along the crest of the remnant alluvial ridge which trends east-northeastward through the project area. Minimum elevations of -4 to -6 are found in areas of artificially-drained marshland in the north and west sections of the project area.

19. General geology. For this project, only the geologic history at the close of and since the Pleistocene Epoch is relevant. Near the end of that time, sea level was about 450 feet below its present level and the project area was a flat, highland plain bordering on the northeast of the entrenched Mississippi River. During that period, the exposed Pleistocene surface was subjected to dessication and weathering. Sea level then began to rise and an extensive sand beach was formed which extended in a northeast direction generally parallel to, and to the northwest of the Bayou Sauvage Ridge. When sea level reached its present stand about 5,000 years ago, the Mississippi River began to migrate laterally, back and forth, across the alluvial valley. Sedimentation began in the project area 4,000 to 4,500 years ago when the Mississippi River occupied the Cocodrie Course, and the sand beach was buried beneath finer alluvial sediments. About 3,500 years ago, the river shifted its course to the western part of the delta and occupied the Teche Course until approximately 2,800 years ago. During this period, the project area was subjected to erosion and subsidence. About 2,800 years ago, the Mississippi shifted eastward to the La Loutre or St. Bernard Course and sedimentation again took place in the project area. At this time, Bayou Metairie-Bayou Sauvage, a major distributary of the Mississippi River, coursed through the area and left the remnant alluvial ridge that extends east-northeastward through the project area. The Mississippi abandoned the La Loutre Course about 1,500 years ago and occupied the Lafourche Course to the west. Sedimentation did not occur again in the project area until the river occupied its present course approximately 1,200 years ago. However, no large distributaries flowed into the area and the center of deposition shifted south of the project area. Levees constructed along the Mississippi

River have eliminated seasonal flooding of the lands adjacent to the river and at present no sediments are being introduced into the project area.

20. Subsidence. The project area lies in a region of active subsidence and downwarping which has been occurring since the close of the Pleistocene Epoch. The Pleistocene surface has been downwarped toward the south and west from elevation zero at the Pleistocene outcropping north of Lake Pontchartrain to about elevation -500 near the edge of the continental shelf, about 80 miles south of New Orleans. The overall rate of regional subsidence has been about 0.39 foot per century. In addition, large settlements of the ground surface have occurred in the drained marsh and swampland areas, a result of the shrinking of highly organic soils as the land was reclaimed and the water table lowered.

21. Investigations performed. Sufficient general type and undisturbed borings were made in conjunction with this segment of the project. In addition, borings and geologic information from other sources were available for interpretation of the physiography, subsurface, and foundation conditions of the area.

22. Foundation conditions. The subsurface, as indicated by the boring logs shown on plates 5 and 6, consists of Recent deposits averaging 43-47 feet in thickness except in the vicinity of station 750+00 where the Recent deposits increase in thickness to about 60 feet. Underlying the Recent materials are deposits of Pleistocene age. The Recent consists predominantly of very soft to soft interdistributary clays with lenses and layers of silt, with the exception of the area between stations 664+77.3 and 740+00. The subsurface from stations 664+77.3 to 693+00 consists of fill material of soft to medium clays with large layers and areas of silt, silty sand, and sand underlain by soft alternating intradelta clays and silts with layers and areas of silt, silty sands, and sands. The subsurface between stations 693+00 and 740+00 consists of fill material of soft to medium clays mixed with large layers of silts, silty sands, and sands underlain by abandoned distributary silts, silty sands, and sands. Underlying the interdistributary, intradelta, and abandoned distributary sediment are medium to stiff prodelta clays to the general vicinity of station 960+00. The prodelta clays rest unconformably on the stiff Pleistocene clays between stations 664+77.3 and 850+00 and vary in thickness from 6 feet at station 575+00 to 20 feet at station 850+00. From stations 850+00 to 960+00 the prodelta clays are underlain by a thin stratum of nearshore sands with shells and shell fragments. In the vicinity of station 960+00, the prodelta pinch-out and the interdistributary deposits directly overlie nearshore material. Stiff Pleistocene clays underlie the nearshore deposits for their entire length.

23. Mineral resources. Oil and gas production occur in the general area but not in the immediate vicinity of the project. However, this project will not adversely affect future exploration and production of these natural resources, nor will future exploration and production affect the project.

24. Sources of construction materials. A design memorandum, "Lake Pontchartrain, Louisiana and Vicinity, DM No. 12, Sources of Construction Materials," approved 30 August 1966, has been prepared listing sources of sand, gravel, shell, and rocks.

25. Conclusions. Because of the low shear strengths and compressibility of some of the Recent sediments, stability and settlement will be major problems. Also, the proximity of sand and silt layers to the surface between stations 693+00 and 740+00 may cause seepage and uplift problems.

SOILS AND FOUNDATIONS INVESTIGATION AND DESIGN

26. General. This report covers the soils and foundations investigations and design for the New Orleans East back levee and floodwalls extending from the eastern end of the Citrus back levee along the east bank of the Michoud Canal and along the north bank of the GIWW to the western extremity of the Chef Menteur Pass barrier levee. Soils and foundations coverage for other features of the Lake Pontchartrain Barrier Plan are included or will be included in the various supplements to the design memorandum.

27. Field investigations. Undisturbed borings 5 inches in diameter extending to approximate elevation -95.0 were made at seven locations along the existing levee alignment (stations 697+20 at levee toe, 715+50 at C/L levee, 815+00 at C/L levee, 875+55 at C/L levee and levee toe, 939+44 at C/L levee and levee toe). Logs of the undisturbed borings are shown on plates 7 through 13. Settlement analyses utilizing data from the undisturbed borings are shown on plates 14 and 15. General type core borings, 1 7/8-inch I.D., extending to approximate elevation -60.0 were made at 20 locations along the levee alignment. Logs of the general type borings and related data are shown on plates 5 and 6. Seventeen general type core borings, 1 7/8-inch I.D., extending to elevation -50.0 in the Michoud Canal and to elevation -70.0 in the GIWW were made in the recommended borrow areas adjacent to the levee and floodwall alignment. The logs of the borrow borings and related data are shown on plates 16 and 17. The locations of the borings are shown in plan on plates 2, 3, and 4.

28. Laboratory tests. Visual classifications were made on all samples obtained from the borings. Water content determinations were made on all cohesive soil samples. Unconfined compression

(UC), unconsolidated-undrained (Q), consolidated-undrained (R), and consolidated-drained (S) shear tests, and consolidation (C) tests were performed on representative soil samples from the undisturbed borings. Liquid and plastic limits were determined for tested samples. Results of laboratory tests are shown on plates 18 through 24.

29. Soil conditions. The subsurface along this project consists generally of 10 to 15 feet of artificial levee fill overlying 40 to 60 feet of Recent deposits of clays, silts, and sands which are underlain by a Pleistocene deposit encountered at approximate elevations -40.0 to -60.0. A generalized soil and geologic profile is shown on plates 25 and 26. The subsurface soils above the Pleistocene deposit which directly affect the design of this project consist generally of the following:

a. Station 664+77.3 to station 740+00. This reach is composed of soft clay down to elevation 1.0 underlain by a layer of silty sand to elevation -6.0, which overlies a layer of silt extending down to elevation -10.0, underlain by a soft clay layer with organic matter down to elevation -18.0, which overlies a layer of silt extending down to elevation -26.0, underlain by a fine sand layer down to elevation -36.0, which overlies a layer of medium clay extending down to elevation -50.0 at the top of the Pleistocene formation.

b. Station 740+00 to station 840+00. This reach is composed of soft to medium clay down to elevation -46.0, underlain by a silty sand layer down to elevation -51.0 at the top of the Pleistocene formation.

c. Station 840+00 to station 892+00. This reach is composed of medium clay with areas of soft to stiff clay and silt lenses down to elevation -50.0 at the top of the Pleistocene formation.

d. Station 892+00 to station 1006+59.2. This reach is composed of soft clay with organic matter and silt lenses down to elevation -45.0 at the top of the Pleistocene formation.

30. Water contents of soils. The ranges of water contents for organic clays, clays, silts, and Pleistocene clays are as follows: organic clays, 100 to 600 percent; clays, 30 to 80 percent; silts, 20 to 40 percent; and Pleistocene clays generally less than 45 percent.

31. Design and construction problems. The low shear strength and highly compressible Recent foundation clays, the utilities which cross the existing levee, and the dynamic and static wave forces on the floodwalls produce major design and construction problems outlined as follows:

a. types of protective works

b. stability

c. floodwalls

d. settlement

e. sources of fill material

f. method of construction

g. erosion protection

32. Types of protective works. Floodwalls will be used between station 664+73.3 and station 772+00 where the proximity of the existing plant facilities to the alignment and comparisons of costs to I-type floodwalls preclude the use of a conventional levee. Inverted T-type floodwalls, supported on bearing piles, will be utilized across the discharge pipes at the pumping station located in the vicinity of station 876+87 (see plate 56). I-type floodwalls will tie this T-type floodwall to the levee. A conventional earthen levee will be used along the remainder of the project. The existing earthen levee will be enlarged with hydraulic fill placed in lifts.

33. Stability analyses.

a. First lift hydraulic fill, retaining dikes, and I-wall levees. The slopes and locations of the retaining dikes, the slopes and heights of the hydraulic fill lifts, and the slopes and berm distances of levees with I-type floodwalls were designed (using cross sections representative of existing conditions) for the following conditions:

(1) hurricane floodwater to the elevation of the existing levee on the flood side and natural ground water to elevation zero on the protected side and anticipated failure towards the protected side (see plates 48 and 50)

(2) water at elevation zero on both sides of the levee and anticipated failure toward the adjacent canals, i.e., the GIWW and the Michoud Canal (see plates 33, 34, 35, 41, 42, 43, 44, 47, 49, 51, 52, and 57)

(3) For the stability analyses of levees with I-type floodwalls, the water elevation was considered to be equal to the top of the design hurricane wave on the flood side and equal to elevation zero on the protected side with anticipated

failure toward the protected side (see plates 36, 37, 38, and 59). In the reach between station 664+73.3 and station 755+00, uplift forces could develop in the sand and silt strata which extend and are opened to the Michoud Canal. Because of the close proximity of the levee to the Michoud Canal, the loss in pressure head between the canal and the protected side toe of the levee was considered to be zero. Accordingly, the uplift forces used for design were based on the total head differential between WTL (el. 13.0) on the flood side and ground water (el. 0.0) on the protected side and anticipated failure towards the protected side (see plate 36).

b. Ultimate earthen levee. The slopes and berm distances for the recommended ultimate levee were designed for the following conditions:

(1) water at elevation zero on both sides of the levee and anticipated failure toward the adjacent GIWW (see plates 53, 55, 61, 64, and 65)

(2) water to the WTL (el. 13.0) on the flood side and natural ground water to elevation zero on the protected side and anticipated failure toward the protected side (see plates 54, 58, and 60)

c. Method and criteria used. The stabilities were determined by the method of planes using the design (Q) shear strengths shown on plates 7 through 13 and applying a minimum factor of safety with respect to strength of approximately 1.3.

d. Borrow pit. The minimum distance a borrow pit with 1 on 2 slopes to elevation -100.0 could be located from the levee C/L was determined by applying a minimum factor of safety with respect to strength of approximately 1.5. The stability of the 1 on 2 slopes of the borrow pit was determined by applying a minimum factor of safety with respect to strength of approximately 1.3.

34. I-type floodwall stability.

a. Steel sheet piles. The stability and the required penetrations of the steel sheet piles below the earth surface were determined by the method of planes using the consolidated-drained (S) shear test result, i.e., $c=0$, $\phi_a=23°$. A factor of safety of 1.25 was applied to the friction angle as follows: $\phi_d = \tan^{-1} \frac{\tan \phi \text{ available}}{\text{factor of safety}}$. The developed friction angle was used to determine K_A and K_P values as follows: $K_A = \tan^2 (45° - \frac{\phi d}{2})$; $K_P = \tan^2 (45° + \frac{\phi d}{2})$. Using K_A and K_P values and the effective

unit weights, net horizontal water and earth pressure diagrams were determined for movement toward each side of the sheet pile. The sum of the horizontal forces on the protected side was equated to the sum of the horizontal forces on the flood side for various tip penetrations. At these penetrations, summations of overturning moments were determined. The required depths of penetration were established as those where the summation of moments were equal to zero. These analyses are shown on plates 39, 46, and 62.

b. Application of wave forces. The results of tidal hydraulic analyses indicate that the floodwalls will be subjected to the pressures and forces imparted by broken and breaking waves. In the design of the floodwalls, the wave effect was applied as a line force acting through the centroid of the dynamic wave pressure distribution diagram (see plate 39).

c. Governing design case. Sufficient (Q) stability analyses were performed to confirm that the (S) case governed for design.

35. Inverted T-type floodwall. Inverted T-type floodwalls on bearing piles will be utilized in lieu of I-type floodwalls at overhead utility crossings, gate monoliths, and at the pumping station. The height of the wall above the ground and the magnitude of the dynamic wave force at the pumping station render the use of I-wall unsatisfactory. A steel sheet pile cutoff will be used beneath the T-walls to provide protection against seepage. A diagrammatic presentation of the net pressure on the sheet pile cutoff is shown on plates 40, 46, and 62. The net pressure diagram along the sheet pile cutoff was determined as follows:

a. Method and criteria used. Conventional stability analyses by the method of planes, utilizing a factor of safety of 1.3 incorporated in the soil strength parameters, were performed to determine the stability against rotational failure. The use of a factor of safety of 1.3 is also recommended by Mr. Gregory P. Tschebotarioff in chapter 5 of "Foundation Engineering," edited by G. A. Leonards and dated 1962. The analyses were performed at 1-foot intervals with the active wedge located at the flood side edge of the structure and the passive wedge located at the protected side edge of the structure.

b. Assumption of value for resistance at base of structure. The assumption was made that the value of (R_B) at the bottom of the base of the structure was zero.

c. Driving force-magnitude. For each analysis the net driving force, i.e., $(D_A-D_P)-(R_A+R_B+R_P)$ was determined. The value of D_A included the weight of water between the tail water elevation and the WTL elevation located above the active wedge.

d. Driving force-assumption. The assumption was made that the net driving force above the bottom of the base of the structure was carried by the structure.

e. Pressure diagram derivation. Considering driving (D_A) positive and all resistance (D_P, R_P, R_B, and R_A) negative in the expression $\Sigma D = D_A - (D_P+R_P+R_B+R_A)$ and using the method of planes stability analyses, the ΣD was determined by assuming failure at the bottom of the base of the structure and at each foot in depth thereafter. The value of the algebraic difference in ΣD, between 1-foot intervals, was used to develop the pressure diagram. If the incremental difference were negative, the pressure diagram indicates an available horizontal resistance in excess of that required; and if the incremental difference were positive, the pressure diagram indicates an unbalanced horizontal pressure in excess of the available soil resistance.

f. Results of sheet pile cutoff analysis. The net pressure diagrams presented on plates 40, 46, and 62 indicate that the total available horizontal resistance is in excess of the total horizontal waterload on the sheet pile cutoff. Therefore, no lateral load acting on the sheet pile cutoff is transmitted to or is required to be carried by the bearing piles.

36. Foundations for T-type floodwalls.

a. Design considerations and criteria. Design compression and tension capacities versus tip elevations were developed for 12-inch square concrete piles. The piling is to be used to support the T-type walls. Design data were determined for the (Q) and (S) shear strengths. In compression, a factor of safety of 1.75 was applied to the shear strengths, and a conjugate stress ratio $(K_o) = 1.0$ was used in the (S) case for determining the normal pressure on the pile surface. In tension, a factor of safety of 2.0 was applied to the shear strengths and a conjugate stress ratio $(K_o) = 0.70$ was used in the (S) case. Further, pile design loads versus tip elevations are presented for 14-inch and 16-inch square concrete piles for the (Q) case only, inasmuch as the (Q) case governed for design. The results of pile design loads versus tip elevations analysis and bearing pile subgrade moduli are shown on plate 63. Pertinent data relative to floodwalls (and levees) are shown in table 1. The stabilities of the floodwalls, relative to failure of the soils foundation, were determined using the design (Q) shear strengths. The results of the stability analyses are shown on plates 33, 34, 36, 37, 38, and 45.

TABLE 1

LOCATION AND TYPE OF PROTECTIVE WORKS

Station location	Construction Grades feet m.s.l. Wall	Levee	Sheet Pile Tip Elev. ft.m.s.l. I-wall	T-wall	Base Elev. ft.m.s.l. T-wall
664+73.3 to 697+97.95	20.0	13.0	-5.0	-	-
697+97.95 to 698+27.95	20.0	-	-	-5.0	8.5
698+27.95 to 699+82.5	20.0	13.0	-5.0	-	-
699+82.5 to 700+36.3	20.0	-	-	-5.0	9.5
700+36.3 to 704+65.5	20.0	13.0	-5.0	-	-
704+65.5 to 705+06.5	20.0	-	-	-5.0	8.5
705+06.5 to 708+25.0	20.0	13.0	-5.0	-	-
708+25.0 to 708+55.0	20.0	-	-	-5.0	8.5
708+55.0 to 708+75.5	20.0	13.0	-5.0	-	-
708+75.5 to 709+10.5	20.0	-	-	-5.0	9.5
709+10.5 to 711+21.8	20.0	13.0	-5.0	-	-
711+21.8 to 711+75.5	20.0	-	-	-5.0	9.5
711+75.5 to 716+40.25	20.0	13.0	-5.0	-	-
716+40.25 to 716+70.25	20.0	-	-	-5.0	8.5
716+70.25 to 717+59.8	20.0	13.0	-5.0	-	-
717+59.8 to 718+13.5	20.0	-	-	-5.0	9.5
718+13.5 to 729+06.5	20.0	13.0	-5.0	-	-
729+06.5 to 729+60.3	20.0	-	-	-5.0	9.5
729+60.3 to 737+89.8	20.0	13.0	-5.0	-	-
737+89.8 to 738+43.5	20.0	-	-	-5.0	9.5
738+43.5 to 744+65.5	20.0	13.0	-5.0	-	-
744+65.5 to 745+19.3	20.0	-	-	-5.0	9.5
745+19.3 to 766+41.5	20.0	13.0	-5.0	-	-
766+41.5 to 766+95.3	20.0	-	-	-5.0	10.5
766+95.3 to 771+82.0	20.0	13.0	-5.0	-	-
771+82.0 to 772+00.0	20.0	13.0 to 17.5	-5.0	-	-
772+00.0 to 772+10.0	20.0	17.5	-5.0	-	-
772+10.0 to 874+42.0	-	17.5	-	-	-
874+42.0 to 874+47.0	20.0	17.5	-6.0	-	-
874+47.0 to 874+65.0	20.0	17.5 to 13.0	-6.0	-	-
874+65.0 to 875+62.0	20.0	13.0	-6.0	-	-
875+62.0 to 876+02.0	23.0	-	-	-6.0	2.0
876+02.0 to 877+72.0	23.0	-	-	-33.0	2.0
877+72.0 to 878+12.0	23.0	-	-	-6.0	2.0
878+12.0 to 879+09.0	20.0	13.0	-6.0	-	-
879+09.0 to 879+27.0	20.0	13.0 to 17.5	-6.0	-	-
879+27.0 to 879+32.0	20.0	17.5	-6.0	-	-
879+32.0 to 1006+59.2	-	17.5	-	-	-

b. Test piles. During construction, bearing pile tests will be conducted at two sites (in the vicinity of boring 3-EU and in the vicinity of boring 12-EU) for selecting the pile lengths to be used for construction. Three 12-inch square concrete piles of different lengths will be driven at each site. The elevations of the tips of the test piles will be -55, -60, and -65. The intermediate length pile will be tested in compression. If test results show that the pile can safely carry twice the design load, the pile will be tested in tension. If the intermediate length pile fails before the required capacity is attained in compression, the long pile will be tested in compression and in tension. If the intermediate pile safely carries compression loads significantly in excess of that required, the short pile will be tested in compression and in tension. Pile maximum test loads will be 25 tons in tension and 70 tons in compression. The test piles meeting the above criteria will be left in place.

37. Settlement.

a. General. Estimates of settlement beneath the levee were made based on consolidation test data from the undisturbed borings. Settlement analyses consisted of developing curves of: (1) void ratio (e) and compression index C_c versus depth; (2) load ($\overline{P}$) versus void ratio (e); (3) load ($\overline{P}$) versus settlement (ρ); and (4) percent consolidation ($U_Z\%$) versus time (t) for the strata in which consolidation will occur. A presentation of settlement analyses, applicable to undisturbed borings 2-EUT and 3-EU is shown on plates 14 and 15.

b. Adjustments. The computed settlement was increased by 25 percent to include the effect of possible lateral plastic displacement of the foundation. The determination of 25 percent was based on information contained on plate 70. The quantity of hydraulic fill was increased 20 percent and the quantity of hauled fill was increased 15 percent to compensate for consolidation and shrinkage of the fill. The settlements estimated for levees containing I-type floodwalls indicate that the proposed wall construction grade (el. 20.0) is sufficient to provide protection to ultimate grade (el. 19.0). To reduce differential settlement of the concrete portion of the floodwalls tying into the levees, the concrete capping will be performed subsequent to construction of the levee. Estimated ultimate settlements of the earth levees are shown in table 2.

TABLE 2

SETTLEMENT OF LEVEE

Lift No.	Type	Elevation (ft.m.s.l.) Crown	Base	Settlement (ft) Base
		Stations 664+77.3 to 740+00		
I-wall in Levee		13.0	11.0	Negligible
		Stations 7400 to 840+00		
1	Hyd fill	10.0	10.0	0
2	Hyd fill	9.8	9.8	0.2
3	Shape	17.5	9.5	0.5
	Ultimate	17.5	8.0	2.0
		Stations 840+00 to 892+00		
1	Hyd fill	10.0	10.0	0
2	Hyd fill	9.8	9.8	0.2
3	Shape	17.5	9.5	0.5
	Ultimate	17.5	8.0	2.0
		Stations 892+00 to 1006+59.2		
1	Hyd fill	11.0	11.0	0
2	Hyd fill	10.8	10.8	0.2
3	Shape	17.5	10.5	0.5
	Ultimate	17.5	8.5	2.5

38. Sources of fill materials. The levee will be constructed of hydraulic fill obtained from adjacent borrow areas located in the GIWW and the Michoud Canal. The borrow areas are composed of Recent deposits above elevation -60.0 and Pleistocene deposits below elevation -60.0. In order to utilize the maximum amount of Pleistocene soils and the minimum amount of Recent deposits, borrowing will be in the deepest portion of the borrow areas and to the maximum practicable depth (approximately el. -80.0). Logs of borings taken in these borrow areas are shown on plates 16 and 17. A generalized soil and geologic profile of these areas is shown on plates 27 and 28. The material for construction of the levee to elevation 13.0 in the floodwall areas will be obtained from a borrow area in the bottom of Lake Pontchartrain along the north shore. The borrow material from the lake, consisting of stiff Pleistocene clays, will be transported to the project on

barges. See plates 66 and 67 for the locations and soil boring sections of the borrow area in the lake. See plate 68 for compaction curves of material from the Lake Pontchartrain borrow area.

39. Method of construction.

a. Earthen levee. Construction of the levee will be by conventional successive hydraulic lifts on each side of the existing levee, utilizing adjacent borrow from the GIWW and Michoud Canal, and by shaping of the in-place hydraulic fill (see plates 30, 31, and 32). The waste water from the flood side will be returned through spill boxes directly into the GIWW. The land side waste water will be returned by the contractor, at intermediate points, over the levee and into the GIWW.

b. Earthen levee with I-type floodwall. The levee will be constructed by cast and haul methods utilizing borrow from Lake Pontchartrain. (See plates 29 and 46.) Subsequent to construction of the levee, steel sheet piling will be driven in the existing levee followed by placement of the concrete for the wall.

40. Erosion protection. Due to the short duration of hurricane flood stages and the resistant nature of the clayey soils, no erosion protection is considered necessary on the levee slopes. However, foreshore protection will be provided along the top of the canal bank along the GIWW to provide protection against erosion from boat traffic generated waves. The foreshore protection will consist of a 2-foot layer of riprap on a three-fourths-foot thick shell blanket and extending from elevation 3.0 to -3.0 (see plate 70).

41. Settlement observations. Settlement observations will be made along the floodwalls promptly after construction and yearly thereafter until settlement is essentially complete. Profiles and sections will be taken along the entire alignment during construction of each stage of the levees and berms, and annually after completion of the last stage until settlement is essentially complete. Reference markers will be installed along the structure walls to obtain data relative to vertical and lateral movement.

42. Additional soils borings and tests. Additional soils borings and tests will be made prior to each lift subsequent to the first. Design analyses, utilizing the information obtained from the additional borings, will be made and preparation of plans and specifications for each lift will be based on these analyses. The analyses will be submitted for review either prior to or concurrent with submission of the plans and specifications, as appropriate.

OTHER PLANS CONSIDERED

43. Recommended construction plan. In general, the recommended construction plan consists of two main segments. One segment, next to existing facilities, is to be a floodwall built on a levee enlarged by haul fill. The other segment is an existing levee which will be enlarged by hydraulic lifts and subsequent shapeups.

44. Alternate construction plans adjacent to existing facilities. Existing development along the Michoud Canal is such that the construction of a levee section enlarged to ultimate grade would require relocation of major portions of the $12-$25 million dollar facilities. This analogy results from the fact that the existing levee cannot be extended toward the water due to the absence of available land. Further, a landside extension to satisfy width requirements is restricted by the proximity of the plant facilities mentioned above. These circumstances dictated that some type of floodwall be erected in the vicinity of Michoud Canal. A comparison of ultimate section levee to I-wall differential costs for this reach follows:

Alternate	Total Cost
Levee	$59,468,000
I-wall	$ 2,329,000

Since the cost of T-type floodwall is approximately $350 per linear foot and I-type floodwall costs approximately $150 per linear foot, the I-type wall was used for the entire length in question except in special instances, at gates, existing overhead installations, etc., where only a T-type wall was practical. Of course, the only rational solution at the existing pumping station was to construct an adequate wall system. The alternative of relocating and reconstructing the entire station to accommodate a new levee section was out of the question due to the excessive costs involved.

45. Alternate construction plans for raising levee. For that portion of the project along the GIWW where there is no existing development, the existing levee is to be raised to ultimate grade and section. The alternate of constructing a floodwall in lieu of increasing the levee section was considered. However, as the following preliminary costs show, the levee option is more economical:

Alternate	Total Cost
Levee	$ 6,060,000
I-wall	$ 6,566,000

The method of hydraulically positioning the material needed for raising the levee was more practical than hauling the material for various reasons: (1) access in this reach is limited; and (2) the haul fill would be more costly by virtue of the fact that it would have to be excavated from the lake and then barge transported to the site.

ACCESS ROADS

46. Access roads. Main access to the project area is provided by U. S. Highway 90 and Intracoastal Drive (see plate 1). The floodwall along Michoud Canal can be reached by the use of existing local roads through the industrial plants adjacent to Intracoastal Drive. Access to that portion of the levee between the pumping station and Michoud Canal is by means of an existing shell road extending to the station from the end of Intracoastal Drive. Beyond the pumping station to the end of the project (station 1006+59.2) the top of the existing levee can serve for project vehicular travel. Access for floating plant as required by construction will be by the MR-GO, the GIWW, and the Michoud Canal.

STRUCTURAL DESIGN

47. Criteria for structural design. The structural design presented herein complies with standard engineering practice and criteria set forth in Engineering Manuals for Civil Works construction published by the Office, Chief of Engineers, subject to modifications indicated by engineering judgment and experience to meet local conditions. The floodwall and levee composite design is similar to the design presented in the Citrus Back Levee GDM. (See Lake Pontchartrain, La. & Vicinity, Lake Pontchartrain Barrier Plan, DM No. 2 - General, Citrus Back Levee, dated 21 August 1967 and approved 29 December 1967.)

48. Basic data. Basic data relevant to the design of the protective works are shown in the following table:

		Elevations ft. m.s.l.
a.	Water elevations	
	Wind tide level	13.0
	Landside of floodwall	0.0
b.	Floodwall gross grades	
	I-wall, T-wall, and gates (Sta. 664+77.3 to Sta. 772+00)	20.0
	Levee for I-wall	13.0
	I-wall (Sta. 874+42 to Sta. 875+42 and Sta. 878+32 to Sta. 879+32)	20.0
	T-wall (Sta. 875+42 to Sta. 878+32)	23.0

c. Unit Weights

	Lb. per cu.ft.
Water	62.5
Concrete	150
Steel	490
Earth	See plates 44 through 46

d. Design loads

(1) Earth pressures (lateral)
See figures B-1 through B-3

(2) Windloads 50 p.s.f.

(3) Water loads. See figures B-4 and B-39

(4) Wave characteristics

	Michoud Canal	Existing pumping sta.
(a) Wind speed, U	75 m.p.h.	75 m.p.h.
(b) Fetch length, F	5 miles	5 miles
(c) Significant wave height, H_s	4.94 feet	4.94 feet
(d) Wave period, T	5.45 seconds	5.45 seconds
(e) Depth at toe of levee, d_t	13 feet	12.73 feet
(f) Structural design wave height, H	8.25 feet	6.28 feet
(g) Structural design wave height, H_{10}	6.28 feet	5.2 feet
(h) Wind tide level elevation	13.0	13.0

49. Allowable working stresses. The allowable working stresses for concrete and structural steel are in accordance with those recommended in "Working Stresses for Structural Design," EM 1110-1-2101 dated 1 November 1963 and amendment 1 dated 14 April 1965. The basic minimum 28-day compressive strength for concrete will be 3,000 p.s.i., except for prestressed concrete piling where the minimum will be 5,000 p.s.i. Steel for steel sheet piling will meet the requirements of ASTM A328-69, "Standard Specification for Steel Sheet Piling." For convenient reference, pertinent allowable stresses are tabulated below:

Reinforced concrete

f'c	3,000 p.s.i.
fc	1,050 p.s.i.
v_c (without web reinforcement)	60 p.s.i.
v_c (with web reinforcement)	274 p.s.i.
fs	20,000 p.s.i.
Minimum area steel	0.0025 bd sq.in.
Shrinkage and temperature steel area	0.0020 bt sq.in.

Structural steel (ASTM A-36)

Basic working stress	18,000 p.s.i.

50. Location and alignment. The new floodwall will tie into an existing floodwall (see Citrus Back Levee GDM) at station 664+73.3 and follow an existing levee along the Michoud Canal to station 753+00 then along the GIWW to station 772+00. See plate 2. From station 772+00 to station 1006+59.2 the flood protection will consist of an earth levee except for a short length of I-wall and T-wall in the vicinity of an existing pumping station at station 876+87. See plate 3.

51. Foundation. The results of subsurface exploration, soils tests, and foundation studies are presented in previous paragraphs. Locations of general type borings are shown on plates 2 through 4. The general type boring logs are shown on plates 7 through 10. Undisturbed boring data are shown on plates 11 through 17.

52. I-type floodwall. All of the floodwall between stations 664+73.3 and 772+00 will be concrete I-wall except for four T-wall monoliths and eight gate monoliths. I-wall will also be constructed in the vicinity of an existing pumping station between stations 874+42 and 875+42 and between stations 878+32 and 879+32. The I-wall will consist of sheet piling driven into an enlarged levee section. The upper portion of the sheet piling will be capped with concrete. The sheet piling will be driven to the required depth with 1 foot of the sheet pile extending above the levee crown. The concrete portion of the floodwall will extend from 2 feet below the levee crown to elevation 20.0, the top of the floodwall. See plate 71.

53. I-wall loading cases. In the design of the I-wall, two loading cases were considered:

Case I - Static water to the WTL, elevation 13.0, 1.5 factor of safety in the soil, no dynamic wave force.

Case II - Static water to top of broken wave, 1.25 factor of safety in the soil, dynamic wave load from broken wave.

Since Case II proved to be the most critical, only the computations for this case are shown (see figures B-1 through B-3).

54. Joints. Expansion joints in the I-wall will be spaced 30 feet apart at sheet pile interlocks. Where the I-wall joins the T-wall, the deflection of the I-wall will produce a lateral displacement. To take care of this displacement, a special seal located in a notch in the I-wall has been designed to prevent water from flowing through this joint. See plates 71 and 72 for details.

55. T-type floodwall--vicinity of Michoud Canal. T-walls will be constructed below three aerial crossings and adjacent to a stiff-leg derrick. See plates 73 through 75 for the location and length of each T-wall. These walls were designed assuming the sheet pile cutoff to be impervious and under the following load conditions:

Case I - Water at WTL el. 13.0, no wave, no wind.

Case II - Water at WTL el. 13.0, no wave, wind from flood side. 33 1/3 percent increase in allowable stresses.

Case III - Broken waves to elevation 18.8, wave force, wind from flood side. 33 1/3 percent increase in allowable stresses.

Case IV - No water or wave force, wind from protected side. 33 1/3 percent increase in allowable stresses.

56. T-type floodwall--vicinity of pumping station. The existing floodwall will be removed and a T-type floodwall will be constructed in the vicinity of the pumping station between stations 875+42 and 878+32. See plates 76 through 78. Design computations for the T-wall are shown on figures B-37 through B-56. The new floodwall was designed assuming the sheet pile cutoff to be impervious and for the following load conditions:

Case I - Water at WTL el. 13.0, no wave, no wind, discharge pipes filled with water.

Case II - Water at WTL el. 13.0, no wave, no wind, discharge pipes empty.

Case III - Water at WTL el. 13.0, no wave, wind from flood side, discharge pipes filled with water. 33 1/3 percent increase in allowable stresses.

Case IV - Water at WTL el. 13.0, no wave, wind from flood side, discharge pipes empty. 33 1/3 increase in allowable stresses.

Case V - Broken waves to el. 17.4, wave force, wind from flood side, discharge pipes filled with water. 33 1/3 percent increase in allowable stresses.

Case VI - Broken waves to el. 17.4, wave force, wind from flood side, discharge pipes empty. 33 1/3 percent increase in allowable stresses.

Case VII - No water or wave force, wind from protected side, discharge pipes empty. 33 1/3 percent increase in allowable stresses.

57. T-wall piling. Factors considered in the selection of the type of piling include availability, economy, resistance to decay, resistance to corrosive soil and water conditions, and fitness for driving. In general, the above considerations indicate that 12-inch by 12-inch square, precast, prestressed concrete piles are the most suitable. The prestressed concrete piles will meet the requirements of the Joint AASHO and PCI Committee Standard Specifications for "Square Concrete Prestressed Piles."

58. Gates. Eight gate monoliths will be constructed for access roads in lieu of I-wall between station 664+73.3 and station 772+00. These gates are necessary to provide plant personnel and vehicles with access to the Michoud Canal and the GIWW. Each gate monolith will consist of a steel gate which will be closed by local interests when a hurricane approaches. See figures B-4 through B-36 for design of gate monoliths. The locations and details of these gates are shown on plates 79 through 85. The gate monoliths were designed for the following load conditions:

Case I - Water at WTL el. 13.0, no wave, no wind.

Case II - No water, no wave, no wind, truck loading on edge of slab at protected side.

Case III - No water, no wave, no wind, truck loading on edge of slab at flood side.

Case IV - Water at WTL el. 13.0, no wave, wind from flood side. 33 1/3 percent increase in allowable stresses.

Case V - Broken waves to el. 18.8, wave force, wind from flood side. 33 1/3 percent increase in allowable stresses.

Case VI - No water, no wave, wind from flood side, truck loading on edge of slab at protected side. 33 1/3 percent increase in allowable stresses.

Case VII - No water, no wave, wind from protected side, truck loading on edge of slab at flood side. 33 1/3 percent increase in allowable stresses.

59. Overhead roller gates. Seven overhead roller gates will be constructed. Each such structure will consist of a single leaf steel overhead roller gate, riding on an I-beam suspended from a reinforced concrete beam. The concrete beam will be supported by three concrete columns. Each opening will have a vertical clearance of 16 feet and a horizontal clearance of 20 feet. The concrete beam over the opening will be removable to permit the passage of over-height loads. A gate guide will be provided to restrain the gate against wind forces when the gate is being closed.

Each sill across the gate opening will be sloped 1 inch to prevent the bottom seal of the gate from sliding along the full length of the opening while the gate is being closed. The bottom of the gate will be sloped 1 inch to match the sill slope. The sloping of the sill and gate is designed to eliminate previous gate closing difficulties associated with resistance to sliding the seal over the sill. Design computations for a typical overhead gate are shown on figures B-12 through B-21. Typical plans, elevations, and details of the overhead gates are shown on plates 79 through 82.

60. Swing gate. One swing gate will be constructed at station 708+86. To assure a proper seal, the gate is constructed so that it can be adjusted in either the horizontal or the vertical direction. The side and bottom seals can also be adjusted as alternate or supplemental means to assure that a proper seal is obtained. Plan, elevation, and details are shown on plates 83 through 85.

61. Utility crossings. Details of pipeline crossings through the I-wall are shown on plate 86. Each utility crossing will be so constructed that any anticipated settlement or deflection of the I-wall or any small movements of the pipe will not seriously affect either the wall or pipeline.

62. Corrosion control.

a. General. The major cause of corrosion of iron and steel structures in soil can be attributed to moisture and the nonuniform distribution of oxygen on the surface of these structures. The National Bureau of Standards Monograph No. 58, April 1962, "Corrosion of Steel Pilings in Soils," states that when driven into natural undisturbed soil, steel piling does not corrode at a rate sufficient to significantly affect strength or useful life. The absence of significant corrosion on the piling inspected by the Bureau at 11 different locations is attributable to the probability that there is not enough oxygen available either originally or by replenishment to support corrosion on the underground sections. The conditions at the test sites varied widely and even though the soil properties and characteristics did indicate a corrosive environment at many of the sites, the data obtained indicate that sufficient oxygen is not available a short distance below the ground line, and especially below the water table, to promote corrosion by differential aeration or other causes.

b. Site condition. All of the steel sheet piling being driven for the New Orleans East back levee is located in existing levees 5 or more years old. While soil samples obtained from this area do indicate an environment which may be suspect,

from a corrosion standpoint, it is anticipated that sufficient oxygen will not be available to promote corrosion both below the ground line and below the water table.

c. Stray current considerations. Utility companies in this area have not encountered any corrosion problems on their gas, water, and sewer mains which can be attributed to stray currents. Therefore, stray current corrosion is not anticipated to present a problem at this time. However, since the project area is essentially an industrial area, stray current corrosion must be considered as a possible future problem.

d. Electrical continuity. Except for bonding, no corrosion protection measures are proposed, since all of the piling is to be driven in levees existing more than 5 years. All steel sheet piling shall be bonded together to obtain electrical continuity and provide for installation of cathodic protection if the need arises in the future. The piles shall be bonded together with No. 6 reinforcing bars welded to each of the piles near the top. Flexible jumpers insulated with cross-linked polyethelene shall be welded or brazed to adjacent sheet piles at the monolith joints 3 inches below the bottom of the concrete. See plate 71.

e. Coating. The overhead roller gates, swing gate, trolleys, "I" beams, corner plates, and all ferrous metal components which are not galvanized or stainless steel will be coated with a five-coat vinyl paint system.

SOURCES OF CONSTRUCTION MATERIALS

63. Sources of construction materials. In addition to the information presented in this memorandum relative to borrow area locations and materials, information relative to materials sources is also contained in Design Memorandum No. 12, "Sources of Construction Materials," dated 27 June 1966, approved 30 August 1966.

COORDINATION WITH OTHER AGENCIES

64. General. As previously mentioned, the State of Louisiana, Department of Public Works was appointed project coordinator for the State by the Governor of Louisiana. This agency has functioned to coordinate the needs, desires, and interests of state agencies and the Corps of Engineers. The Orleans Levee District will provide the local cooperation for all features of the project except those features located in St. Bernard Parish. The project plan presented herein is acceptable to both of the above agencies.

65. U. S. Department of the Interior, Fish and Wildlife Service. Extensive coordination with the U. S. Fish and Wildlife Service was accomplished during preauthorization studies and subsequent to authorization of the project. By letter dated 2 April 1968, the Regional Director, U. S. Fish and Wildlife Service, Atlanta, Georgia, was informed of the current layout for the Lake Pontchartrain Barrier Plan feature of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project and requested to furnish views and comments on the entire Lake Pontchartrain Barrier Plan. By letter dated 15 May 1968, the Acting Regional Director states "...We are of the opinion that hurricane control structures in the Rigolets and Chef Menteur tidal passes have little appreciable effect on salinities in Lakes Maurepas, Pontchartrain, and Borgne. Therefore, no adverse effects on fish and wildlife resources in these areas are expected." Any significant modification to the current plan will be forwarded to the Regional Director for further review and comment. Copies of the above letter and the response of the Acting Regional Director are included in appendix A.

66. U. S. Department of the Interior, Federal Water Pollution Control Administration (now Environmental Protection Agency, Federal Water Quality Administration).

a. Review and recommendations. By letter dated 8 April 1968, the Regional Director, Federal Water Pollution Control Administration, was informed of the current layout for the Lake Pontchartrain Barrier Plan feature of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project and requested to furnish views and comments on the entire Lake Pontchartrain Barrier Plan. The Regional Director requested in his letter of response dated 15 May 1968 that consideration be given to the following:

(1) Minimizing water quality degradation during construction.

(2) Minimizing the accidental spillage of petroleum products or other harmful materials and maintenance of sanitary facilities to adequately treat domestic wastes.

(3) Constructing and operating water quality control structures so as to insure that ecological conditions remain unchanged.

b. Project incorporation of recommendations. Provisions relative to water quality degradation during construction, control of accidental spillages, and maintenance of adequate sanitary facilities by construction contractors will be incorporated into the construction plans and specifications. The Seabrook Lock will be operated to provide a desirable salinity regimen in Lake

Pontchartrain to the end that deleterious alterations in the lake ecology will be avoided. The Regional Director has been advised of the action to be taken in connection with his comments. Copies of correspondence with the Regional Director are included in appendix A.

REAL ESTATE REQUIREMENTS

67. General. All rights-of-way required for construction of the New Orleans East back levee will be acquired by the Orleans Levee District and furnished without cost to the United States. There will be no acquisition by the United States. Rights-of-way limits and spoil-disposal areas are shown on plates 2, 3, 4, 29, and 45. The present levee extends an average of 50 feet on either side of the centerline over the entire project length. The acreage under the existing levee was deducted from the total project requirements for rights-of-way. See table 3.

RELOCATIONS

68. General. Under the authorizing law, local interests are responsible for the accomplishment of "...all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction work;..." Included in the required modifications are road ramps, utilities, and drainage rectification work.

69. Road ramps. Shell roads over the existing levee provide each plant with individual access to the Michoud Canal. Since the levee section will be enlarged, these crossings will need to be replaced with new ramps constructed to grades approximating the existing declivities. The locations of the ramp modifications are shown on plate 2. See plate 87 for typical sections through the ramps.

70. Utility modifications. At station 823+50, 1-20" and 1-24" Southern Natural Gas Company high pressure gas lines pass through the existing levee at approximate elevation 7.0. These two lines will be removed from within the levee and will be raised above the top of the new levee. For the remaining modifications, utility services will be interrupted for a minimum period to permit the driving of sheet piling and other project construction activities. As soon as is possible thereafter, the utilities are to be put back in service. The crossings as indicated in the following tabulation will be modified to pass through the floodwall as shown on plate 86. The locations of the listed crossings are shown in plan and profile on plates 2 and 3.

Baseline station	Description	El. at top of pipe ft. m.s.l.
711+77.5	Two 8" pipelines	14.1
718+34.2	One 12" pipeline	14.2
738+64.0	Two 12" pipelines	17.5
	Four 1 1/2" elec. cables	
765+75.0	One 12" H.P. gas line	13.9
876+87	Three 72" pipes	15.0

71. Modifications at existing facilities.

a. General. In the vicinity of Air Products and Chemicals, Inc., plant and Louisiana Cement Company plant, the floodwall will pass below overhead pipelines and an overhead conveyor. These aerial crossings are supported by piling located within the levee section. See plates 2, 73 through 75 for location and detail. It is usually the policy of the New Orleans District to require that utilities or structures which support utilities be removed from the levee proper. However, relocating the existing piling outside the levee system would cause both plants to be shut down while expensive and extensive modifications to the aerial crossings were made. In view of the above and because the type of protection is a floodwall rather than a levee, the existing piling will not be relocated. T-type floodwalls supported on piling, in lieu of I-type floodwalls, will be constructed beneath the aerial pipeline crossings. The aerial pipelines are high enough to allow the sheet pile cutoff to be driven beneath the crossings without interrupting plant operation. The concrete bearing piles will be driven as close as possible to each of the pipeline crossings. The T-walls will be constructed in the locations cited below.

b. Air Products and Chemicals, Inc. At stations 698+12.95 and 708+40 the T-type floodwall will pass below overhead pipelines. Also adjacent to station 704+86, there is a stiffleg derrick foundation supported by piling. This foundation cannot be relocated since the derrick is used to service equipment in this area of the plant. A T-wall will also be constructed in this area for reasons stated in paragraph 4a. Location and details are shown on plates 2 and 73 through 75.

c. Louisiana Cement Company. At station 716+56.2 this floodwall will pass below an overhead conveyor system. Location and details of this floodwall are also shown on plates 2 and 73 through 75.

d. New Orleans Sewerage and Water Board pumping station. At station 867+87, a new floodwall will be constructed south of an existing New Orleans Sewerage and Water Board pumping station. The existing floodwall with the top elevation at +16.0 will be replaced with a new T-wall with the top elevation at +23.0. Location and details of this floodwall are shown on plates 3 and 76 through 78.

ENVIRONMENTAL QUALITY

72. Environmental quality.

a. General. The engineering treatment required for preserving and maintaining the environmental quality of the project has been considered during preparation of this memorandum. Specifically, levee erosion protection, corrosion mitigation, and the disposition of dredge waste water are discussed in paragraphs 39a, 40, and 62, respectively. Further, as indicated in paragraphs 65 and 66 and in appendix A, extensive coordination has been accomplished with the appropriate agencies relative to effects of the project on fish and wildlife resources and water quality control during and subsequent to construction.

b. Enhancement. Construction of the protective works covered herein alters the existing terrain only to the extent of raising and strengthening existing work along the same alignment. Essentially all borrow material needed to enlarge the existing levee will come from within adjacent waterways or from a remote location in Lake Pontchartrain. Additional beautification measures beyond those normally associated with levee construction, i.e., grading and sodding, are not warranted. The logic behind this statement is that the adjacent developed area is occupied by industry which precludes the use of public funds for beautification of private vistas and that adjacent area which is not developed as industrially zoned.

ESTIMATE OF COST

73. General. Based on January 1971 price levels, the estimated first cost for the New Orleans East back levee is $14,860,000. This estimate consists of $2,773,000 for lands and damages, $496,000 for relocations, $9,517,000 for levees and floodwalls, which includes work done by local interests, $1,226,000 for engineering and design, and $848,000 for supervision and administration. The detailed estimate of first cost is shown on table 3.

TABLE 3

ESTIMATE OF FIRST COST
(January 1971 price levels)

Cost acct. no.	Item	Estimated quantity	Unit	Unit price	Estimated amount
			$	$	$
	CONSTRUCTION				
11	Levees and floodwalls				
	Levees				
	Levee raising[1]	348	sta.	215.52	75,000
	Levee embankment(barge)	100,500	c.y.	3.50	351,800
	1st lift	2,530,000	c.y.	1.09	2,758,000
	2d lift	1,714,000	c.y.	1.13	1,937,000
	Shapeup	467,500	c.y.	.40	187,000
	Retaining dike (cast)	700,000	c.y.	.30	210,000
	Fertilizing and seeding	251	acre	175.00	43,900
	Clearing and grubbing	360	acre	100.00	36,000
	Foreshore protection				
	Shell	16,930	c.y.	4.00	67,700
	Riprap	70,100	tons	6.50	455,700
	Subtotal				6,122,100
	Contingencies 20%+				1,223,900
	Subtotal, levees				7,346,000
	Floodwalls and gate structures				
	Structure excavation	7,400	c.y.	3.00	22,200
	Structure backfill	4,940	c.y.	3.00	14,800
	Steel sheet piling (MA-22)	9,120	s.f.	4.00	36,500
	Steel sheet piling (Z-27)	196,880	s.f.	4.00	787,500
	12"x12" prestressed conc. piles	17,500	l.f.	8.00	140,000
	Concrete in stabilization slab	90	c.y.	50.00	4,500
	Concrete in T-wall base	660	c.y.	50.00	33,000
	Concrete in walls, columns, and beams	6,260	c.y.	70.00	438,200
	Portland cement	9,630	bbls.	5.50	53,000
	Steel reinforcement	694,520	lbs.	.20	138,900
	Bulb-type waterstops	3,050	l.f.	5.00	15,300
	L-type waterstops	340	l.f.	10.00	3,400
	Expansion joint filler	6,300	s.f.	1.00	6,300
	Structural steel	53,540	lbs.	.90	48,200
	Miscellaneous metalwork	1	job	L.S.	10,000
	Gate seals	300	l.f.	10.00	3,000
	Overhead trolleys	1	job	L.S.	2,400
	Sackrub finish	174,650	s.f.	.30	52,400

[1]Levees raised by local interests from approx. el. +9.5 to approx. el. +11.5 (existing) after project authorization.

TABLE 3 (cont'd)

Cost acct. no.	Item	Estimated quantity	Unit	Unit price	Estimated amount
			$	$	$
	Floodwalls and gate structures (cont'd)				
	Subtotal				1,809,600
	Contingencies 20%				341,400
	Subtotal, floodwalls & gate structures				2,171,000
	Subtotal, levees & floodwalls (Cost acct. 11)				9,517,000
30	Engineering & design 13%(based on actual work required)				1,226,000
31	Supervision & administration 9%) (based on actual work required)				848,000
	Total, levees and floodwalls				11,591,000[2]
01	Land improvements				
	I-wall	34.0	acre	varies	461,600
	Levee	430.0	acre	varies	2,209,000
	Construction easement	59.0	acre	varies	157,000
	Severance	None	-	-	-
	Less existing levee	79.0	acre	varies	519,000
	Subtotal, lands and improvements				2,308,600
	Contingencies 20%				462,000
	Real estate, hired labor cost (approx. 12 tracts)				300
	Acquisition cost by others (approx. 12 tracts)				2,100
	Total lands and improvements				2,773,000
02	Relocations				
	1 1/2" electric cable	4	each	L.S.	14,000
	8" pipeline	1	each	L.S.	700
	12" pipeline	3	each	L.S.	4,200
	12" high pressure gas line	1	each	L.S.	60,000
	20" high pressure gas line	1	each	L.S.	100,000
	24" high pressure gas line	1	each	L.S.	100,000
	T-type floodwall	130	l.f.	L.S.	30,000
	Modification to N.O.S.&W.B. pumping station floodwall	1	each	L.S.	25,000
	Modification to existing shell ramps	1	each	L.S.	5,000
	Subtotal				338,900
	Contingencies 20%				67,800
	Subtotal				406,700
	Engineering & design 13%(based on actual work rqd)				52,800
	Supervision & administration 9%(based on actual work required)				36,500
	Total, relocations				496,000
	TOTAL PROJECT COST				14,860,000

[2]Includes work done by local interests.

74. Comparison of estimates.

a. GDM versus PB-3. The current estimate of $14,860,000 for the New Orleans East back levee represents a decrease of $4,947,000 over the latest PB-3 effective 1 July 1970. The estimate presented in the PB-3 is based on the estimate included in Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Citrus Back Levee, approved 29 December 1967, and escalated to July 1970 price levels. Table 4 shows a comparison of the project document, PB-3, and general design memorandum estimates. Reasons for the difference between the design memorandum and PB-3 estimates are as follows:

(1) Levees and floodwalls. The net decrease of $2,418,000 is comprised of a decrease of $1,522,000 attributable to the selection of floodwall construction instead of levee along the Michoud Canal and an additional $896,000 decrease reflecting the deletion in this GDM of the U. S. Highway 90 to GIWW reach from the project.

(2) Engineering and design. The increase of $295,000 resulted from recomputing the E&D cost based on an analysis of actual work required rather than applying a percentage to the construction cost.

(3) Supervision and administration. The net increase of $218,000 reflects the added S&A costs as a result of recomputing S&A costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(4) Lands and damages. The net decrease of $3,329,000 is the result of a decrease in land requirements for T-wall in place of levee, a more detailed estimate of levee requirements, the elimination in this GDM of the levee from the GIWW to U. S. Highway 90, and the assignment of credit for area beneath the existing levee.

(5) Relocations. The increase of $287,000 reflects general refinements in the cost estimate based on the more detailed information available during preparation of this memorandum.

TABLE 4

COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff. 1 Jul 70	GDM No. 2 Supp.No. 4	Difference Supp.No.4 - PB-3	Difference Supp. No. 4 - Proj.document
		$	$	$	$	$
11	Levees and floodwalls	4,993,000	11,935,000	9,517,000	-2,418,000	+4,524,000
30	Engineering and design	195,000	931,000	1,226,000	+295,000	+1,031,000
31	Supervision and administration	300,000	630,000	848,000	+218,000	+548,000
	Subtotal	5,488,000	13,496,000	11,591,000	-1,905,000	+6,103,000
01	Lands and damages	265,000	6,102,000	2,773,000	-3,329,000	+2,508,000
02	Relocations	238,000	209,000	496,000	+287,000	+258,000
	Subtotal	503,000	6,311,000	3,269,000	-3,042,000	+2,766,000
	Total	5,991,000	19,807,000	14,860,000	-4,947,000	+8,869,000

b. GDM versus project document. The estimate of $14,860,000 for the New Orleans East back levee also represents an increase of $8,869,000 over the project document estimate. Reasons for the difference between the design memorandum and project document estimates are as follows:

(1) Levees and floodwalls. The increase of $4,524,000 is the result of increasing the height of all levee protection from elevation 16.0 to elevation 17.5, construction of approximately 2 miles of concrete I-wall, eight gate structures, and 130 feet of I-wall in lieu of earth levee, and increasing the contingencies by 5 percent over that presented in the project document.

(2) Engineering and design. The increase of $1,031,000 resulted from recomputing the E&D costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(3) Supervision and administration. The increase of $548,000 resulted from recomputing the S&A costs based on an analysis of actual work required rather than applying a percentage to the construction cost.

(4) Lands and damages. The increase of $2,508,000 is the result of an increase in acreage requirements, a 10 percent increase in contingencies, the escalation of land costs due to development in the area subsequent to the preparation of the project document, and credit allowance for the area beneath the existing levee.

(5) Relocations. The increase of $258,000 is due primarily to modifying the floodwall to accommodate the pipe crossings and roads which were constructed since presentation of the project document.

SCHEDULES FOR DESIGN AND CONSTRUCTION

75. Schedules for design and construction. The sequence of contracts and the schedules for design and construction are shown below:

Contracts	Design: Start	Design: Complete	Construction: Advertise	Construction: Award	Construction: Complete	Estimated Construction Cost Includes Contingencies and S&I
Levee raising[1] (interim protection sta. 664+73 to sta. 1006+59)			May 66	Jun 66	Apr 67	$ 75,000
Levee, 1st lift 1971 (Sta. 772+00 to Sta. 876+87)	Dec 71	Dec 71	Jan 72	Jan 73		1,381,000
Concrete floodwall (Sta. 664+73 to Sta. 772+00 and Sta. 874+42 to Sta. 879+32)	Feb 72	Feb 72	Mar 72	Mar 73		3,434,000
Levee, 1st lift (Sta. 876+87 to Sta. 1006+59)	Mar 72	Mar 72	Apr 72	Nov 73		2,088,000
Levee, 2d lift (Sta. 772+00 to Sta. 876+87)	Dec 74	Dec 74	Jan 75	Nov 75		1,097,000
Levee, 2d lift (Sta. 876+87 to Sta. 1006+59)	Oct 75	Oct 75	Nov 75	Oct 76		1,269,000
Levee shapeup & seeding, foreshore protection (Sta. 772+00 to Sta. 876+87)	Oct 77	Oct 77	Nov 77	Sept 78		397,000
Levee shapeup & seeding, foreshore protection (Sta. 876+87 to Sta. 1006+59)	Sept 78	Sept 78	Oct 78	Jun 79		482,000
Total						$10,223,000

[1]Raising 1965 levee by local interests to the existing interim protection levee. See plates 29 through 32.

76. Funds required by fiscal year. To maintain the schedules for design and construction, as shown above, of the New Orleans East back levee, funds[1] will be required by fiscal year as follows:

Funds required by FY	1971	$ 115,350[2]
	1972	4,646,000
	1973	2,019,670
	1974	633,930
	1975	695,880
	1976	1,412,210
Balance to complete		2,213,960
Total		$ 11,737,000

OPERATION AND MAINTENANCE

77. General. The New Orleans East back levee will be maintained and operated at the expense of local interests as a feature of local cooperation in the hurricane project. A detailed estimate of the annual operation and maintenance costs is shown in table 5. In addition, it is estimated that replacement of the overhead roller gates will be necessary at 30-year intervals. The annual charge for these replacements is $1,140.

TABLE 5

ESTIMATE OF ANNUAL OPERATION AND MAINTENANCE COSTS

Maintenance:	$4,650
I-wall	270
Foreshore protection	700
Overhead roller gates	960
Operation:	
Overhead roller gates	80
Total	$6,660

[1]Includes cost for construction (including contingencies 20%), supervision and administration, engineering and design.

[2]Includes costs for preparation of plans and specifications and credit for work accomplished by local interests.

PROJECT FORMULATION AND EVALUATION

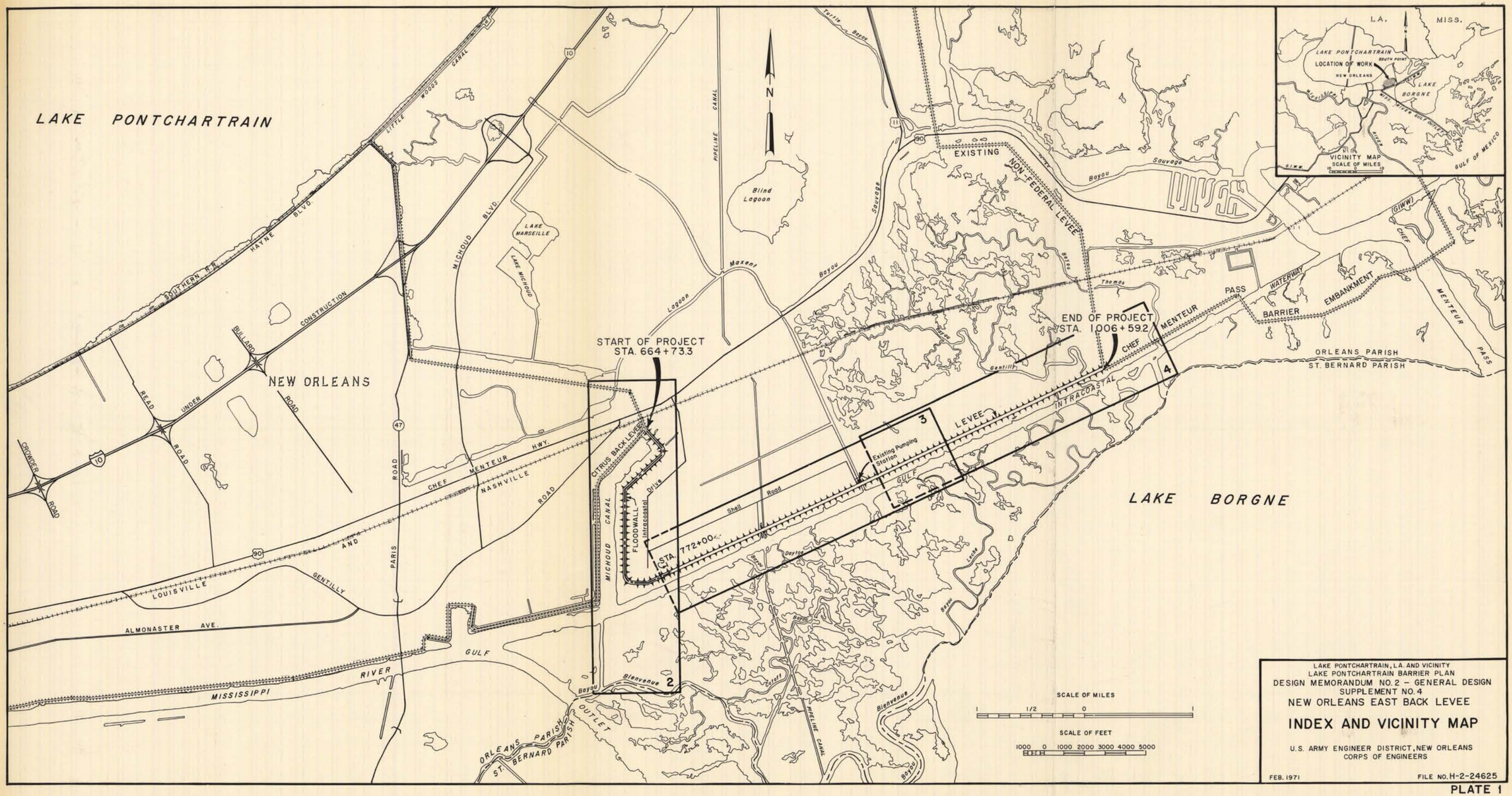
78. Project formulation and evaluation. The New Orleans East back levee is not a separable unit of the Lake Pontchartrain Barrier Plan; therefore, an incremental justification and independent economic analysis is not practicable.

ECONOMICS

79. Economic justification. The current economic analysis for the entire Lake Pontchartrain, Louisiana and Vicinity, hurricane protection project, based on the July 1970 PB-3 costs, indicates a benefit-to-cost ratio of 11.6 to 1. As stated in paragraph 78 above, an independent economic analysis for the project feature presented herein is not practicable. The reduced costs of the New Orleans East back levee protective works presented in this memorandum below that shown in the current PB-3 will not significantly change the approved benefit-to-cost ratio for the entire project.

RECOMMENDATIONS

80. Recommendations. The plan of improvement presented herein for the New Orleans East back levee consists of the construction of a floodwall in an enlarged levee joining the Citrus back levee floodwall and extending for 2 miles along the Michoud Canal to a point near the canal on the north bank of the GIWW and, from this point, the project work is the enlargement and raising of an existing levee for a distance of 4.4 miles to its intersection with the Chef Menteur barrier levee. Eight gates are to be provided in the floodwall to maintain access by existing industries to the adjacent waterways. Additionally, existing utilities and a floodwall at a pumping station will be modified to provide protective continuity in the system. This plan is considered to be the best means of accomplishing the project objectives and is recommended for approval.



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
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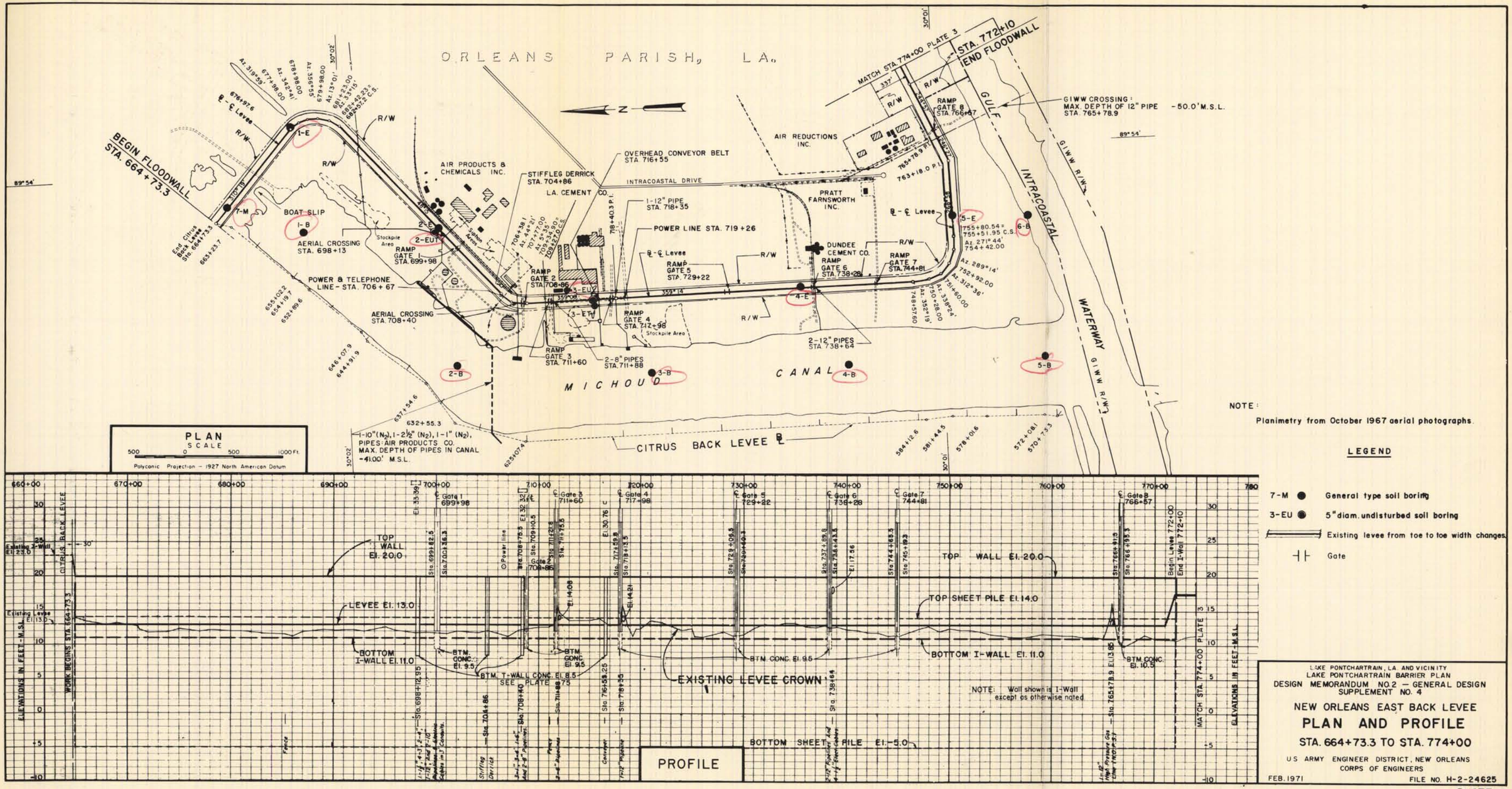
NEW ORLEANS EAST BACK LEVEE

INDEX AND VICINITY MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 1



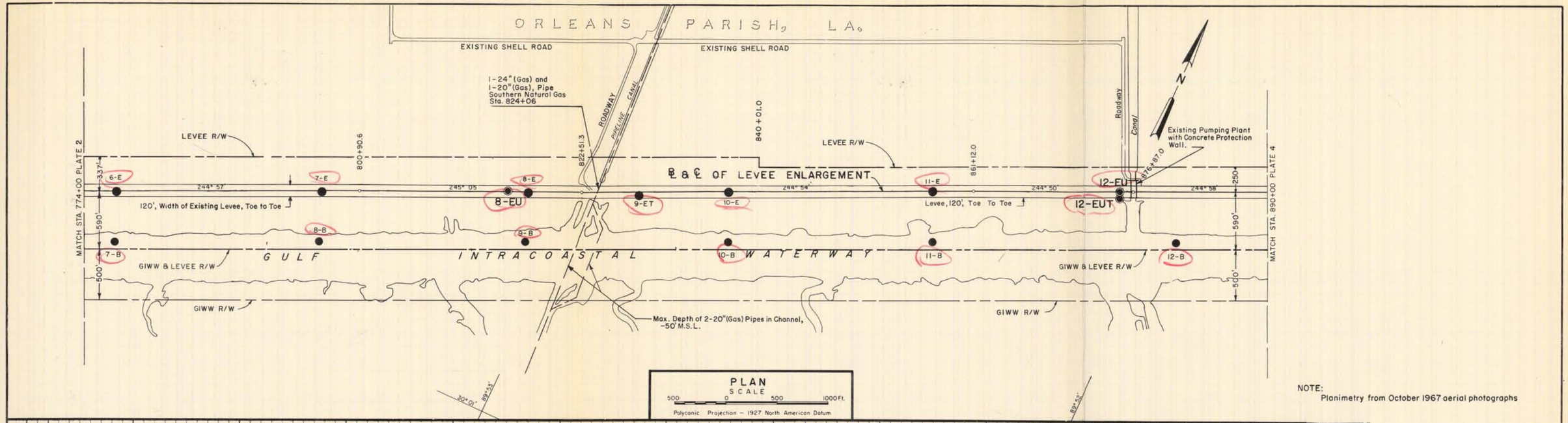
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 — GENERAL DESIGN SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE
PLAN AND PROFILE
STA. 664+73.3 TO STA. 774+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

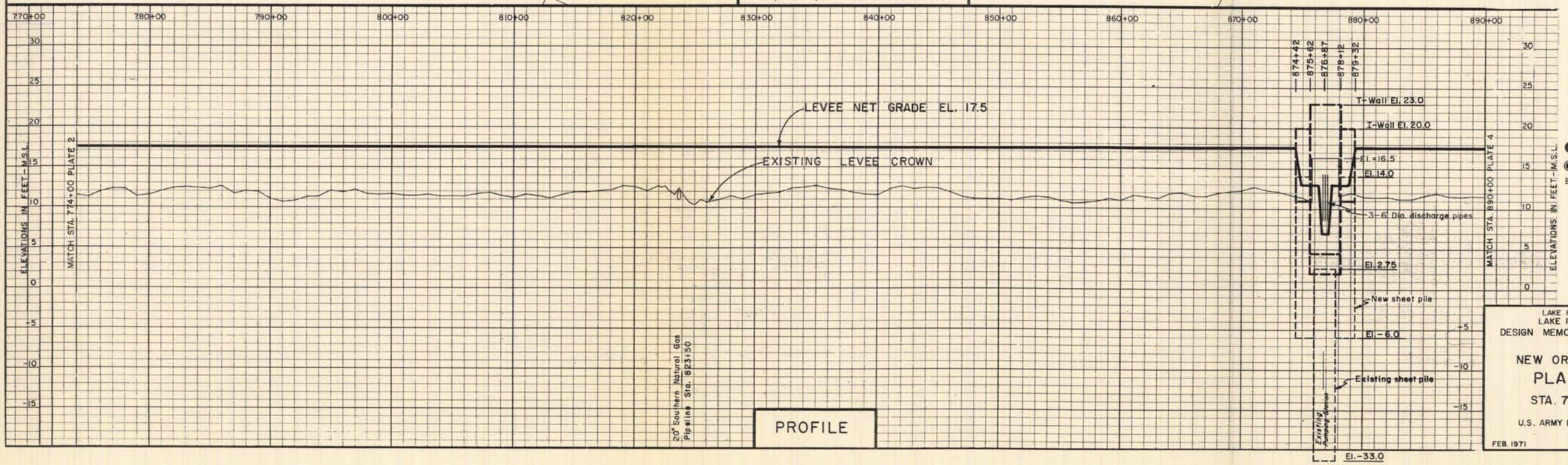
FEB. 1971 FILE NO. H-2-24625

PLATE 2



PLAN
SCALE
500 0 500 1000 Ft.
Polyconic Projection – 1927 North American Datum

NOTE:
Planimetry from October 1967 aerial photographs



PROFILE

LEGEND

- 11-E General type soil boring, baseline
- 12-EU 5" Dia. undisturbed boring
- Existing levee from toe to toe

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 — GENERAL DESIGN
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NEW ORLEANS EAST BACK LEVEE
PLAN AND PROFILE
STA. 774+00 TO STA 890+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
CORPS OF ENGINEERS

FEB. 1971

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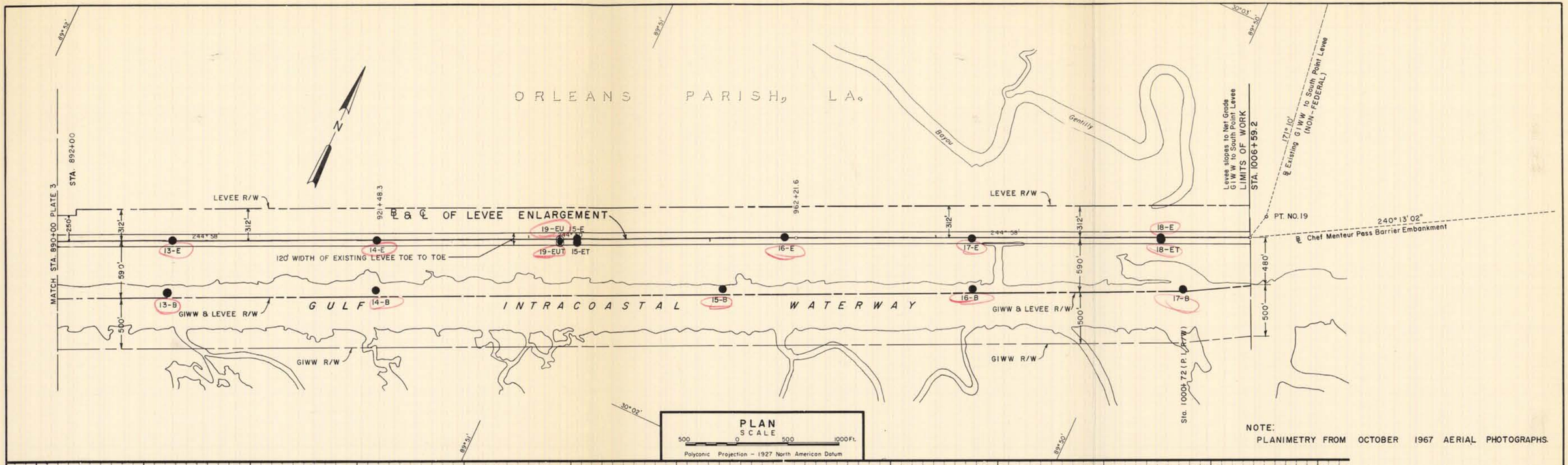
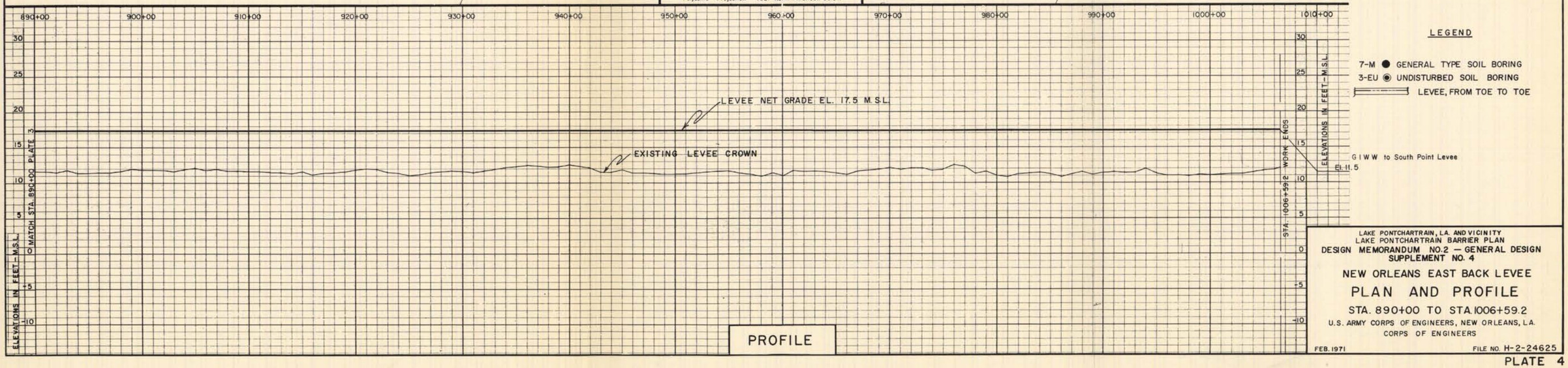
PLATE 3





LEGEND

7-M ● GENERAL TYPE SOIL BORING

3-EU ◉ UNDISTURBED SOIL BORING

LEVEE, FROM TOE TO TOE

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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NEW ORLEANS EAST BACK LEVEE

PLAN AND PROFILE

STA. 890+00 TO STA.1006+59.2

U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS, LA.
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PLATE 4

BORING NO. 7-M
STA. 666+79
C/L LEVEE
10-11 JAN. 66

BORING NO. 1-E
STA. 677+21
C/L LEVEE
29 AUG. 66

BORING NO. 2-E
STA. 697+20
C/L LEVEE
30-31 AUG. 66

BORING NO. 3-ET
STA. 715+50
55 FT. CANAL SIDE C/L LEVEE
30-31 AUG. 66

BORING NO. 4-E
STA. 737+21
C/L LEVEE
31 AUG. 66

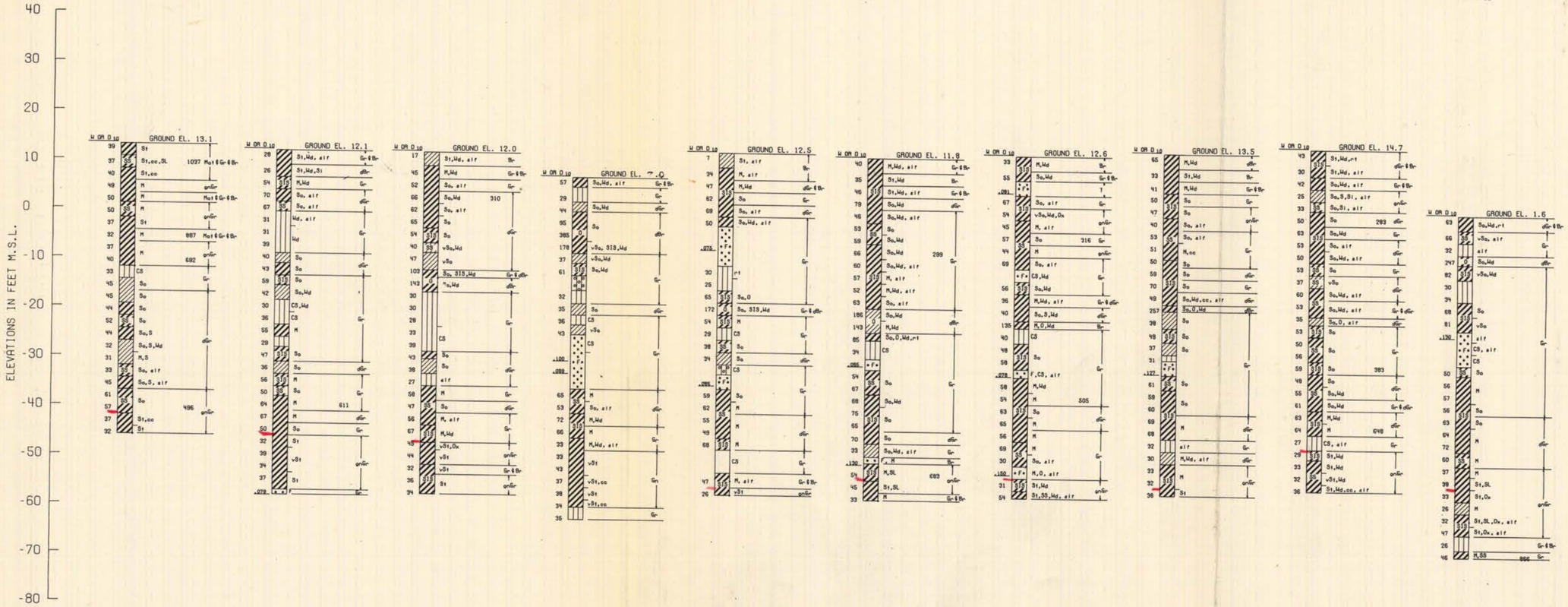
BORING NO. 5-E
STA. 757+20
C/L LEVEE
1 SEPT. 66

BORING NO. 6-E
STA. 777+20
4 FT. CANAL SIDE C/L LEVEE
1-2 SEPT. 66

BORING NO. 7-E
STA. 797+20
4 FT. CANAL SIDE C/L LEVEE
2 SEPT. 66

BORING NO. 8-E
STA. 817+20
4 FT. CANAL SIDE C/L LEVEE
6 SEPT. 66

BORING NO. 9-ET
STA. 828+19
46 FT. CANAL SIDE C/L LEVEE
6-7 SEPT. 66



For general notes see plate 16.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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NEW ORLEANS EAST BACK LEVEE

GENERAL TYPE BORINGS ALONG LEVEE ALIGNMENT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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PLATE 5

BORING NO. 10-E
STA. 837+20
4 FT. CANAL SIDE C/L LEVEE
7 SEPT. 66

BORING NO. 11-E
STA. 857+11
4 FT. CANAL SIDE C/L LEVEE
8 SEPT. 66

BORING NO. 13-E
STA. 901+35
C/L LEVEE
24-25 JULY 67

BORING NO. 14-E
STA. 921+12
C/L LEVEE
24 JULY 67

BORING NO. 15-E
STA. 940+59
C/L LEVEE
20-21 JULY 67

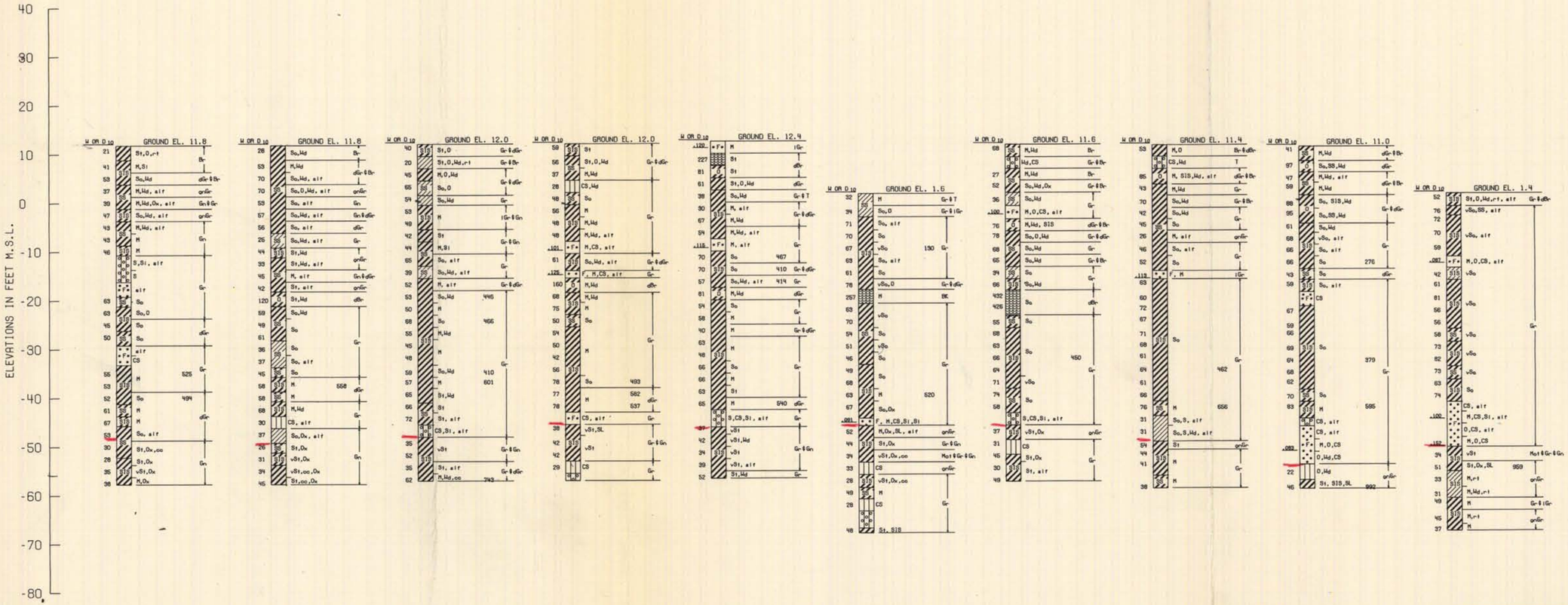
BORING NO. 15-ET
STA. 940+59
32 FT. CANAL SIDE C/L LEVEE
21 JULY 67

BORING NO. 16-E
STA. 961+06
C/L LEVEE
19-20 JULY 67

BORING NO. 17-E
STA. 979+47
4 FT. CANAL SIDE C/L LEVEE
WATER TABLE AT 10.0 FT.
18-19 JULY 67

BORING NO. 18-E
STA. 997+80
4 FT. CANAL SIDE C/L LEVEE
WATER TABLE AT 10.9 FT.
17-18 JULY 67

BORING NO. 18-ET
STA. 997+80
34 FT. LANDSIDE C/L LEVEE
WATER TABLE AT 3.5 FT.
11-12 JULY 67



For general notes see plate 16.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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GENERAL TYPE BORINGS ALONG LEVEE ALIGNMENT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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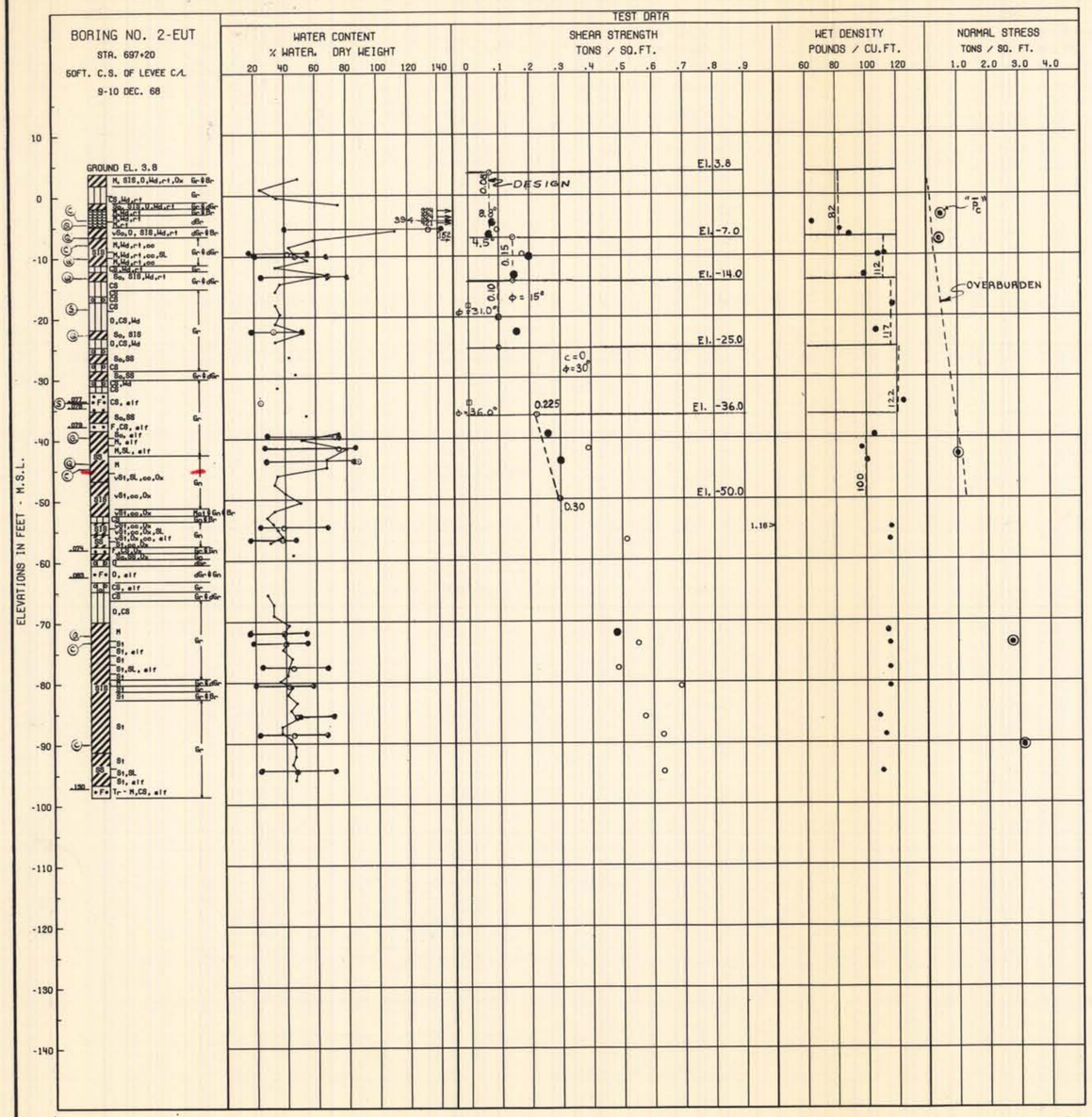
PLATE 6

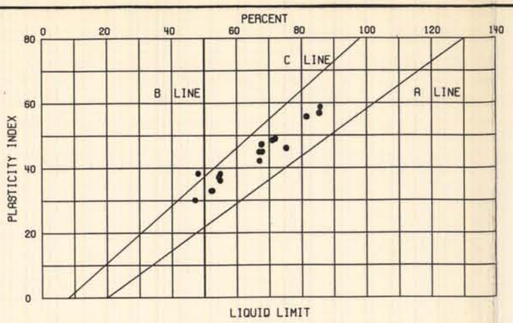
BORING NO. 2-EUT

STA. 697+20

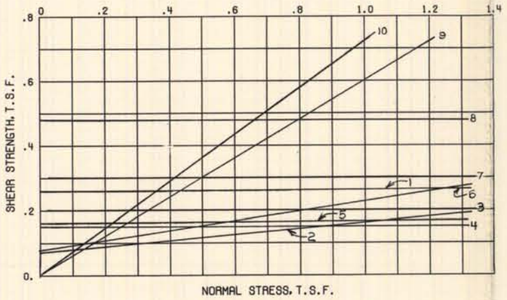
SOFT. C.S. OF LEVEE C/L

9-10 DEC. 68



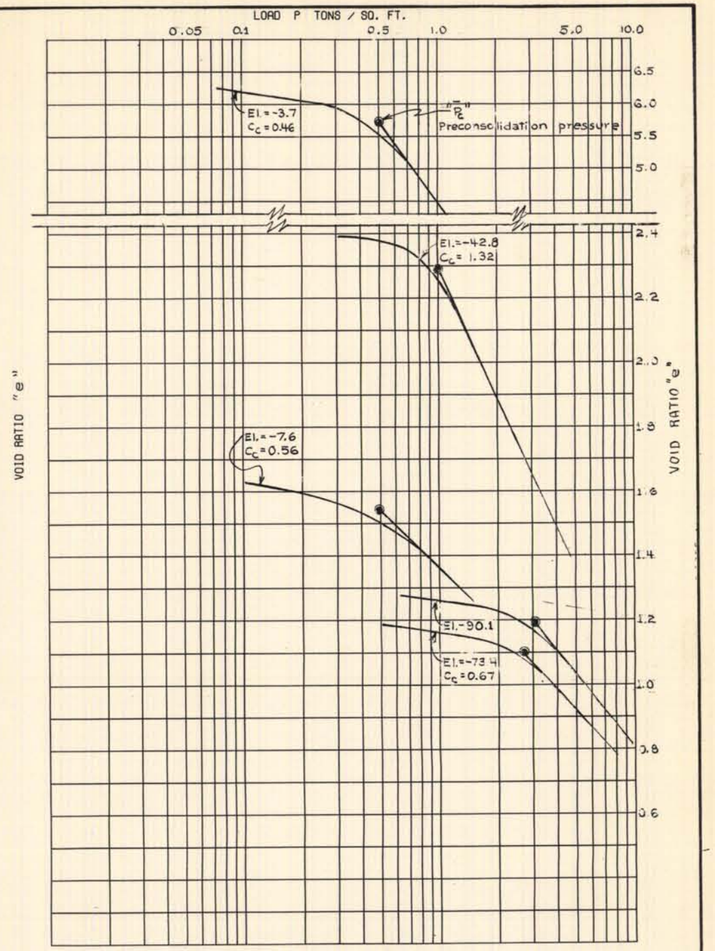


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
	1	- 4.6	Q	8.8°	0.08	CHO
	2	- 6.4		4.5°	0.07	CH
	3	- 10.0			0.20	CH
	4	- 13.1			0.15	CH
	5	- 22.3		0	0.16	CH
	6	- 39.3			0.26	CH
	7	- 43.6			0.30	CH
	8	- 71.8			0.48	CH
	9	- 18.1	S	31.0°	0	ML
	10	- 33.9		36.0°		SP



CONSOLIDATION DATA

NOTES

⊙ - (UC) UNCONFINED COMPRESSION TEST

● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST

▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST

⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST

BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORING SEE PLATE 2

FOR GENERAL NOTES SEE PLATE 8

FOR DETAIL SHEAR STRENGTH DATA SEE PLATE 18

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
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NEW ORLEANS EAST BACK LEVEE

UNDISTURBED BORING 2-EUT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

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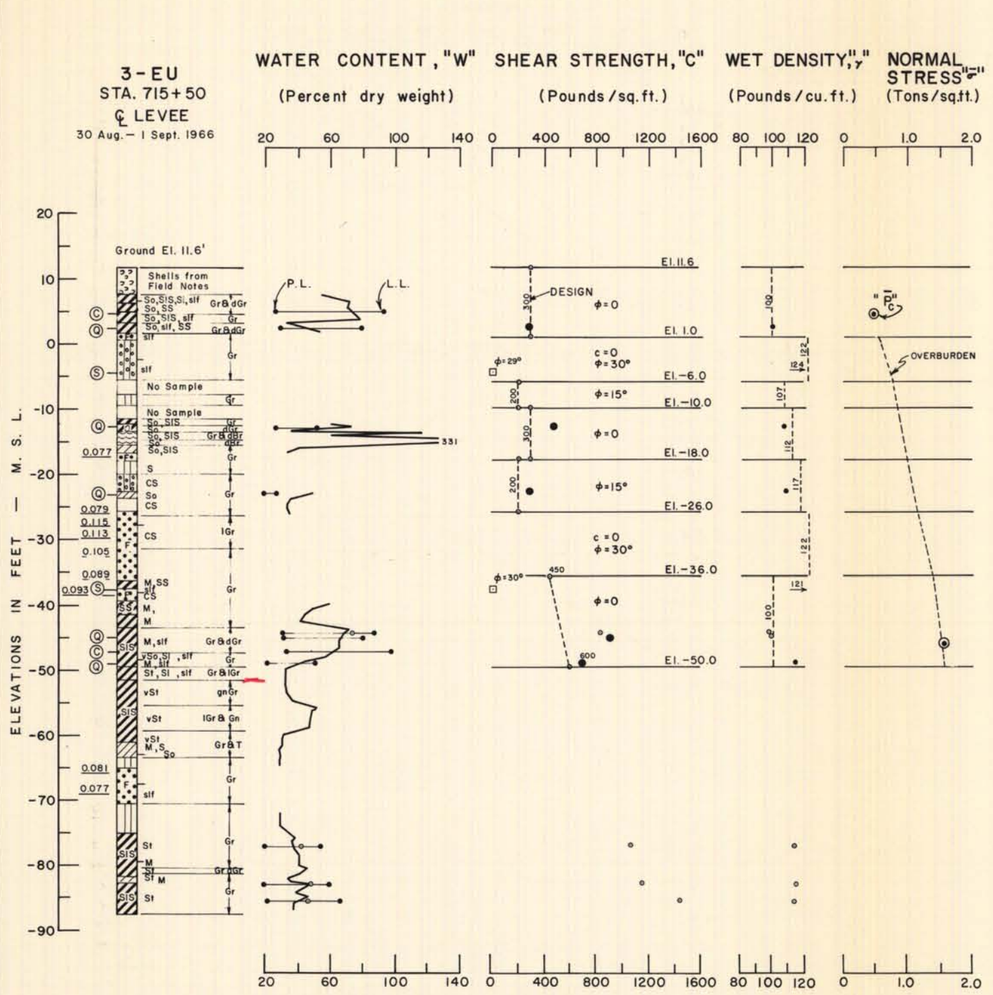
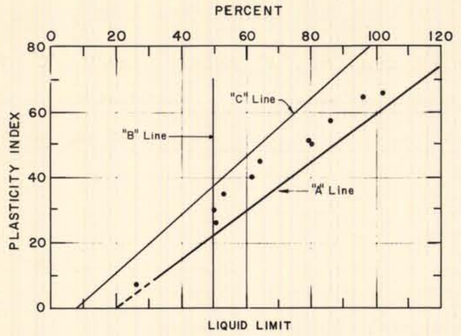
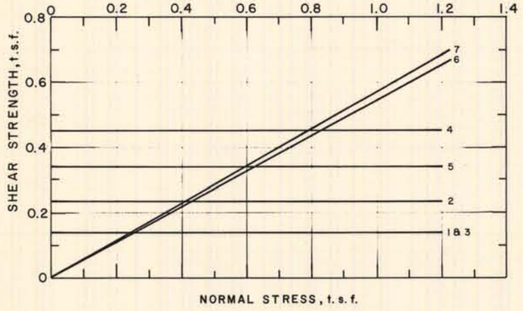
PLATE 7

3-EU
STA. 715+50
℄ LEVEE
30 Aug.– 1 Sept. 1966



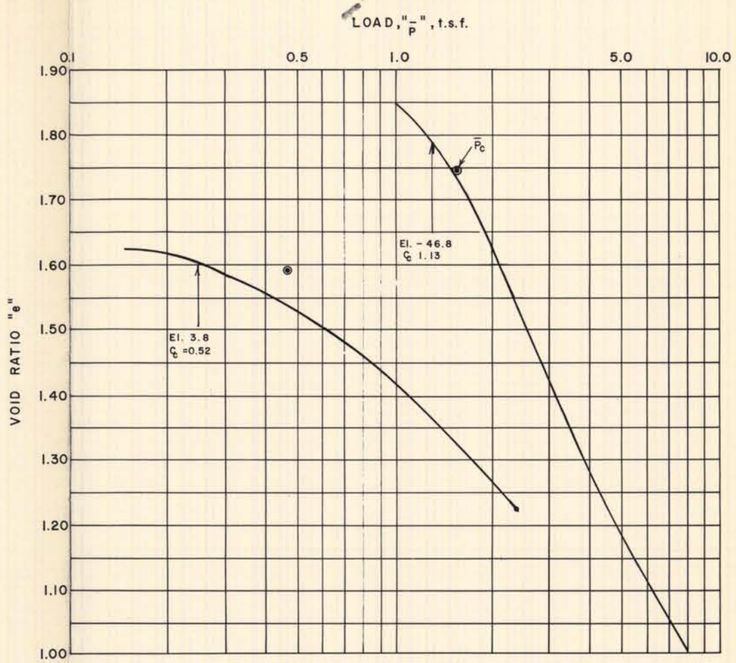


PLASTICITY CHART



ENVELOPE NO.	EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	2.1	Q	0	0.14	CH
2	-13.0			0.23	CH
3	-23.0			0.14	CL
4	-45.2			0.45	CH
5	-49.2		0	0.34	CH
6	-4.4	S	29	0.0	SM
7	-37.6		30	0.0	SP

SHEAR STRENGTH DATA



CONSOLIDATION DATA

GENERAL NOTES

- UC– Unconfined compression shear test
- ● Ⓠ – Unconsolidated undrained triaxial shear test
- ▲ Ⓡ – Consolidated undrained triaxial shear test
- ⊡ Ⓢ – Consolidated drained direct shear test
- Ⓒ – Consolidation test
- W – Natural water content
- L.L.– Liquid limit
- P.L.– Plastic limit
- c – Unit cohesion
- φ – Angle of friction
- γ – Unit weight of soil-water system
- σ̄ – Normal stress
- ◉ $\bar{P}_c$ – Preconsolidation pressure
- e – Void ratio
- C_c – Compression index
- O.B.– Overburden

Borings were taken with a 5 inch diameter steel tube piston type sample.

For detail shear strength data see plate 19
See plate A for soil boring legend

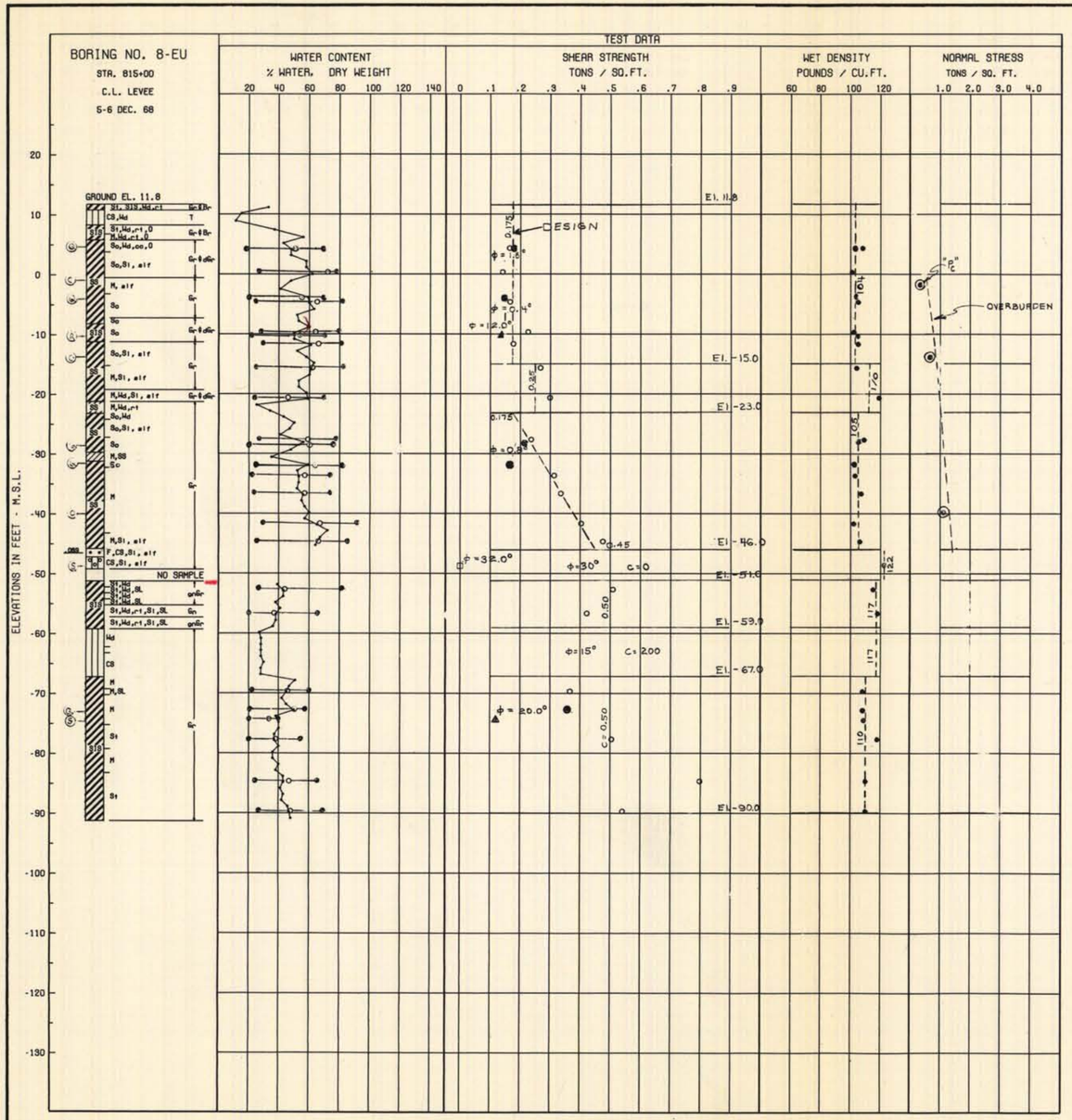
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

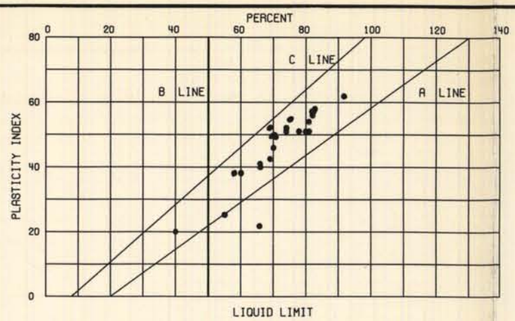
UNDISTURBED BORING 3-EU DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

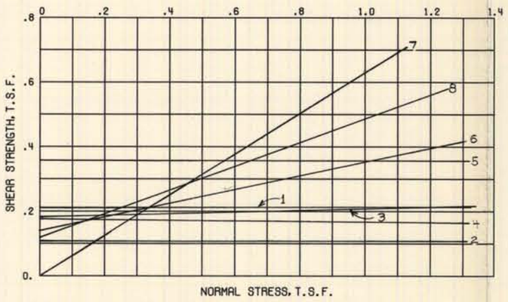
FEB. 1971 FILE NO. H-2-24625

PLATE 8



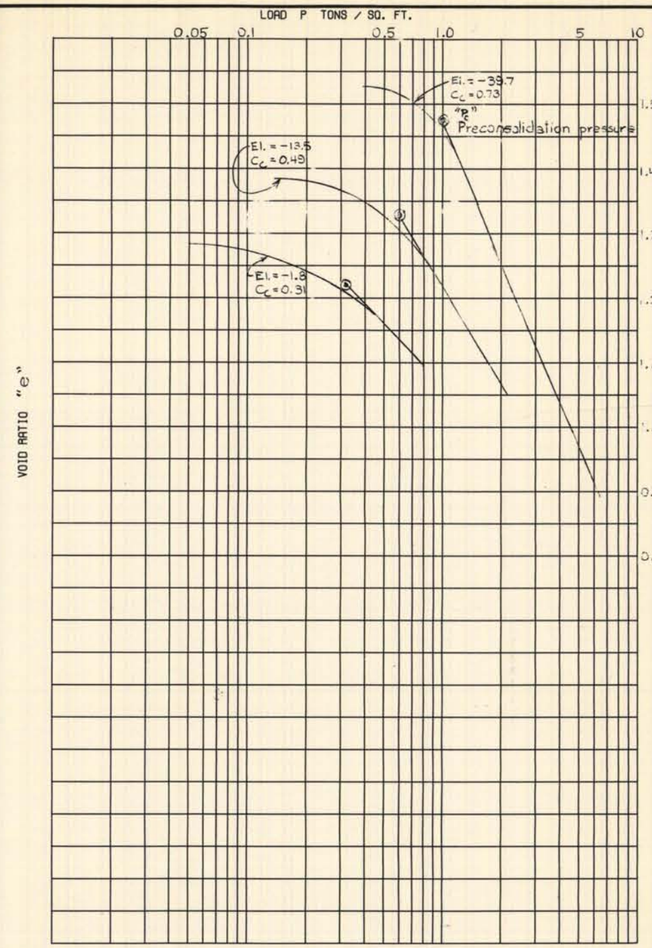


PLASTICITY CHART



SHEAR STRENGTH DATA

BORING NO.	ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
	1	4.5	Q	1.8°	0.185	CH
	2	-4.0	Q	0.4°	0.105	CH
	3	-28.3	Q	0.8°	0.21	CH
	4	-31.8	Q	0	0.17	CH
	5	-72.6	Q	0	0.36	CH
	6	-10.1	R	12.0°	0.14	CH
	7	-48.6	S	32.0°	0	SM
	8	-74.3	S	20.0°	0.12	CL



CONSOLIDATION DATA

NOTES

⊙ - (UC) UNCONFINED COMPRESSION TEST
● - (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
▲ - (R) CONSOLIDATED - UNDRAINED SHEAR TEST
⊡ - (S) CONSOLIDATED - DRAINED SHEAR TEST
BORINGS WERE TAKEN WITH A 5 INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER
FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORINGS SEE PLATE 3
FOR GENERAL NOTES SEE PLATE B
FOR DETAIL SHEAR STRENGTH DATA, SEE PLATE 20

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

UNDISTURBED BORING 8-EU DATA

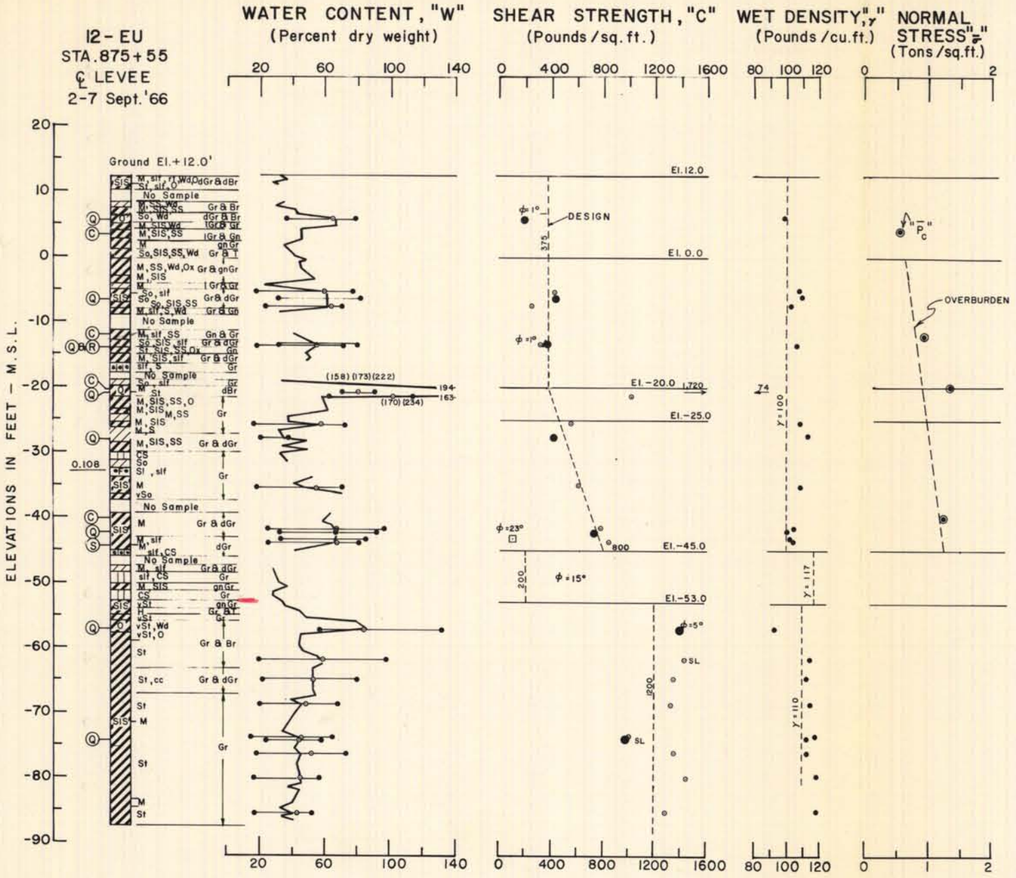
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

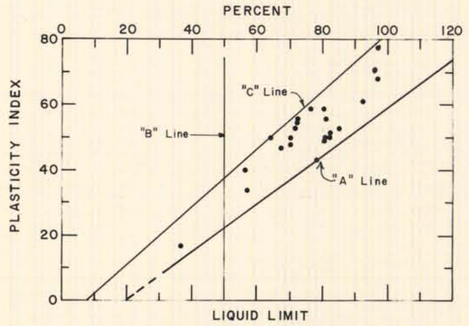
FILE NO. H-2-24625

PLATE 9

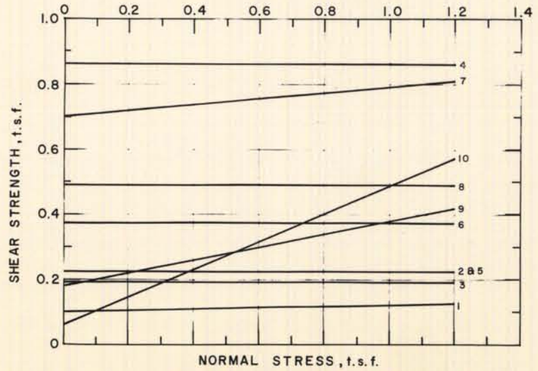
12-EU
STA. 875+55
℄ LEVEE
2-7 Sept. '66



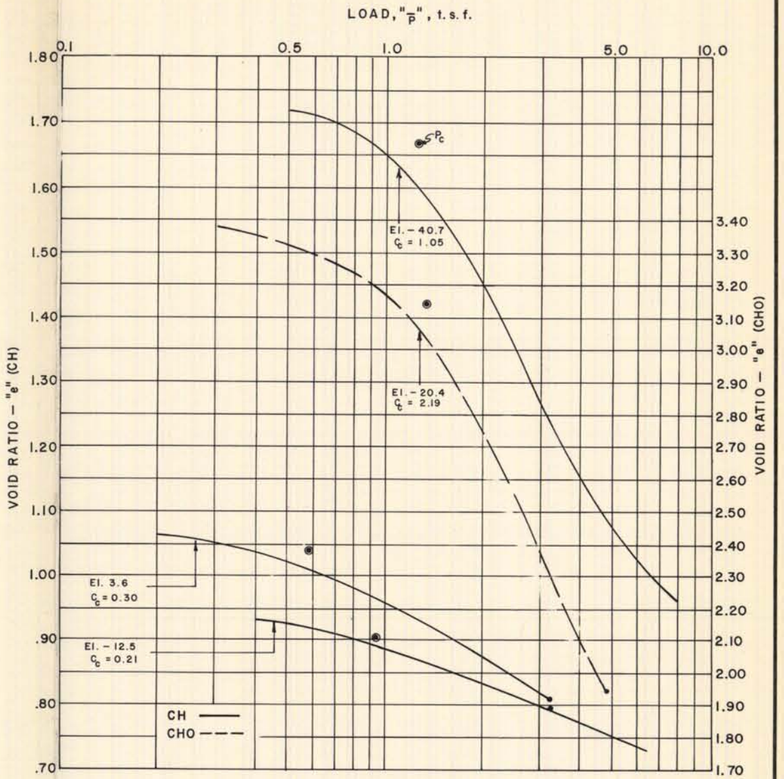
ENVELOPE NO.	EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	+5.5	Q	1.0	0.10	CH
2	−6.6		0	0.22	CH
3	−13.4			0.19	CH
4	−20.9			0.86	CHO
5	−27.9			0.22	CH
6	−42.5		0	0.37	CH
7	−57.4		5.0	0.70	CHO
8	−74.5		0	0.49	CH
9	−13.4	R	11.0	0.18	CH
10	−43.7	S	23.0	0.06	CH



PLASTICITY CHART



SHEAR STRENGTH DATA



CONSOLIDATION DATA

NOTES:
See plate A for soil boring legend
See plate B for general notes
See plate 21 for detail shear strength data

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

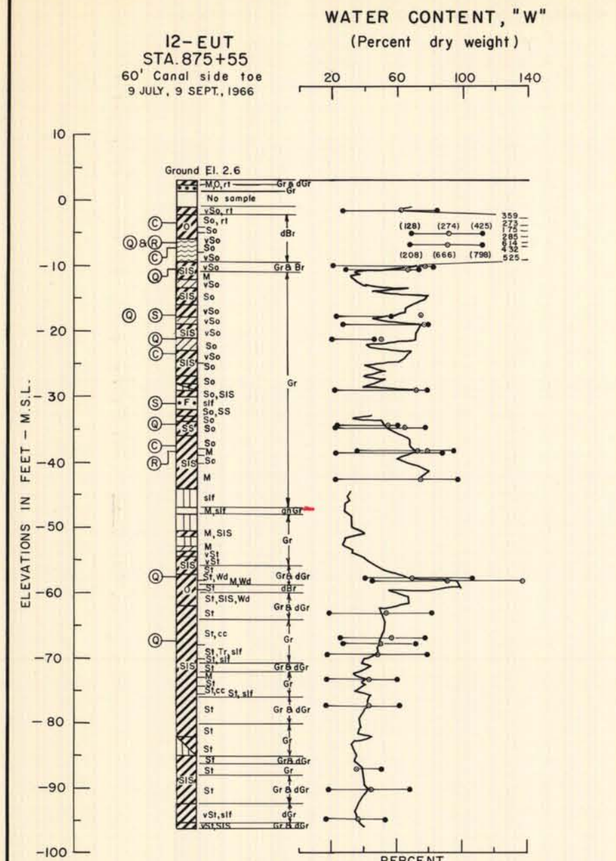
UNDISTURBED BORING 12-EU DATA

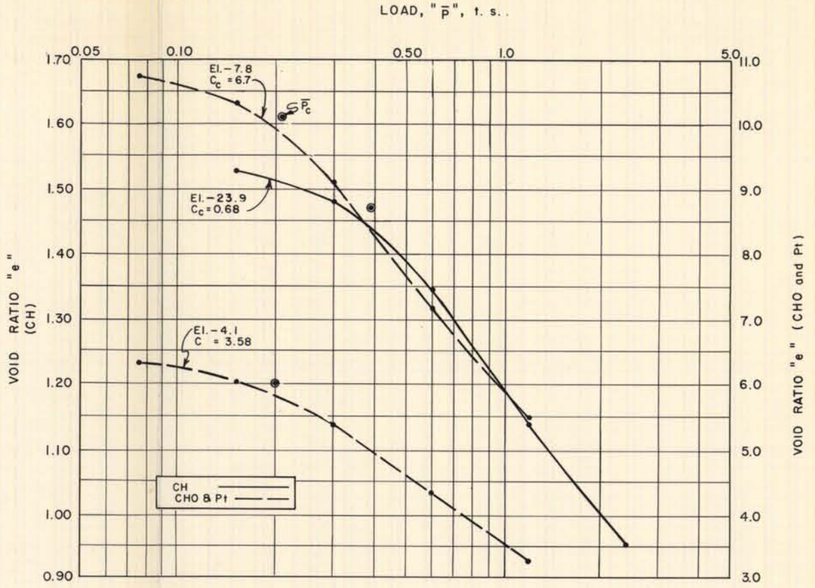
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 10

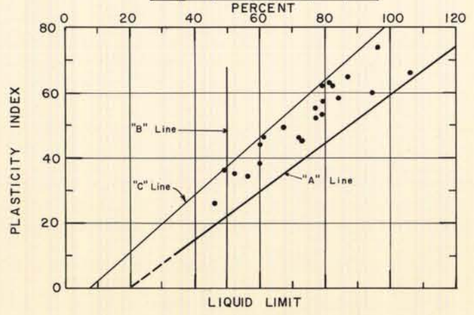
12-EUT
STA. 875+55
60' Canal side toe
9 JULY, 9 SEPT., 1966



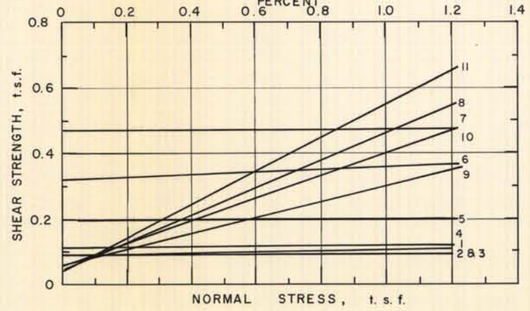


NOTE:

See Plate A for soil boring legend.
See Plate B for general notes.
See Plate 22 for detail shear strength data.



PLASTICITY CHART



ENVELOPE No.	El.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	- 6.9	Q	1	0.09	PT
2	-11.0		0	0.09	CH
3	-18.1		0	0.09	CH
4	-21.8		0	0.11	CL
5	-34.8		0	0.20	CH
6	-58.2		2	0.32	CH
7	-67.9		0	0.47	CH
8	- 6.9	R	23	0.04	PT
9	-38.7		14	0.06	CH
10	-18.1	S	19	0.06	CH
11	-31.8		27	0.04	SP

SHEAR STRENGTH DATA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

UNDISTURBED BORING 12-EUT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

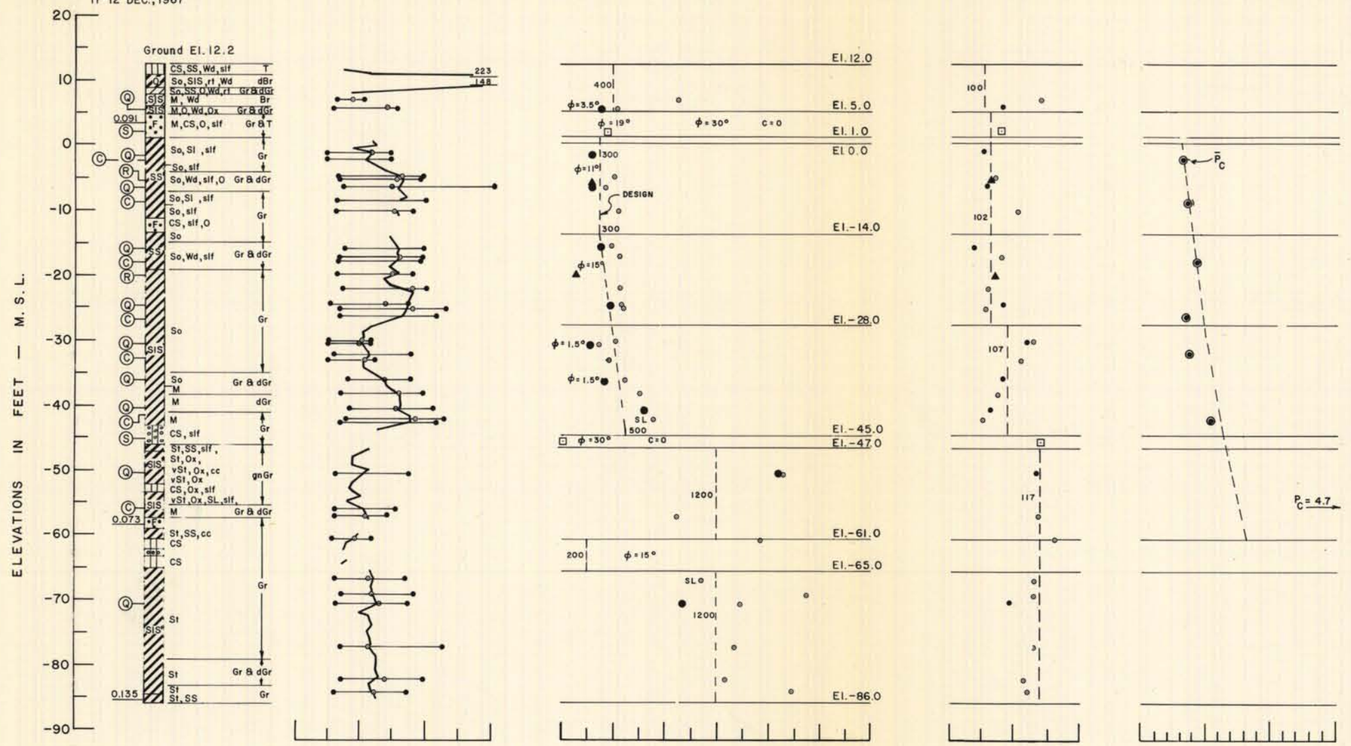
FEB. 1971 FILE NO. H-2-24625

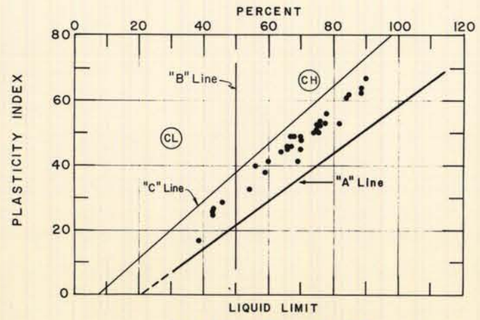
PLATE 11

19-EU

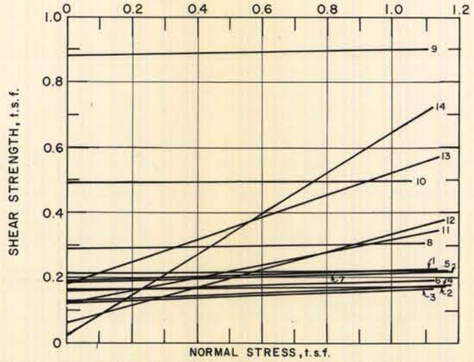
STA. 939+44 on ℄ LEVEE

11-12 DEC., 1967



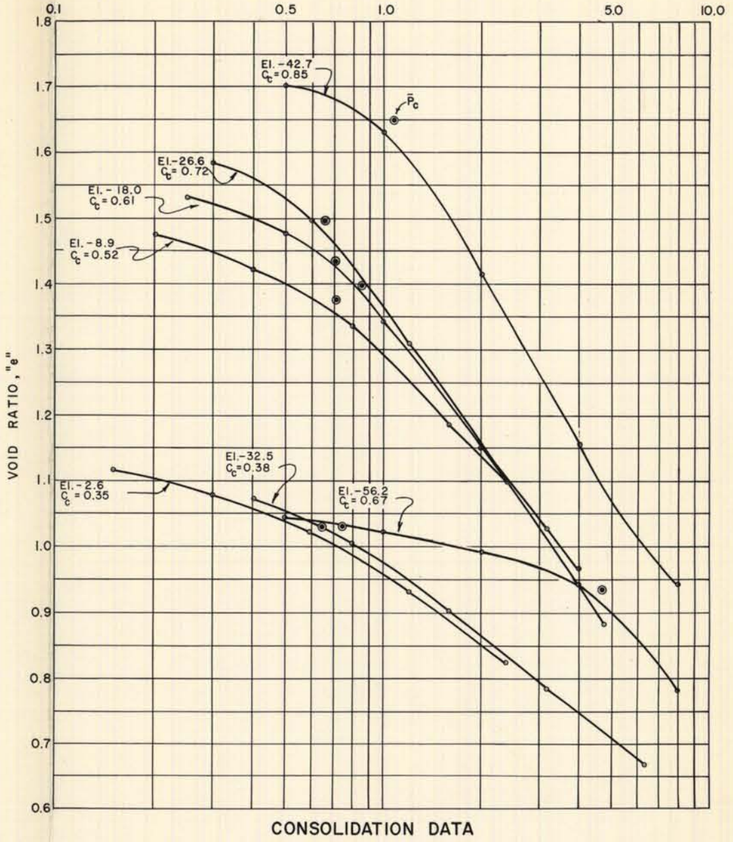


PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	+5.3	Q	1.5	0.188	CH
2	-1.6		2	0.128	CH
3	-6.7		2	0.125	CH
4	-16.1		0	0.165	CH
5	-24.8		0	0.215	CH
6	-30.7		1.5	0.16	CH
7	-36.2		1.5	0.185	CH
8	-40.9		0.5	0.290	CH
9	-50.8		1.0	0.88	CH
10	-70.7		0	0.49	CH
11	-5.7	R	11	0.12	CH
12	-20.1		15	0.06	CH
13	1.9	S	19	0.18	SP
14	-45.8		32	0.02	SM



CONSOLIDATION DATA

Notes:

See plate A for soil boring legend.
For general notes see plate B
For detail shear strength data see plate 23

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

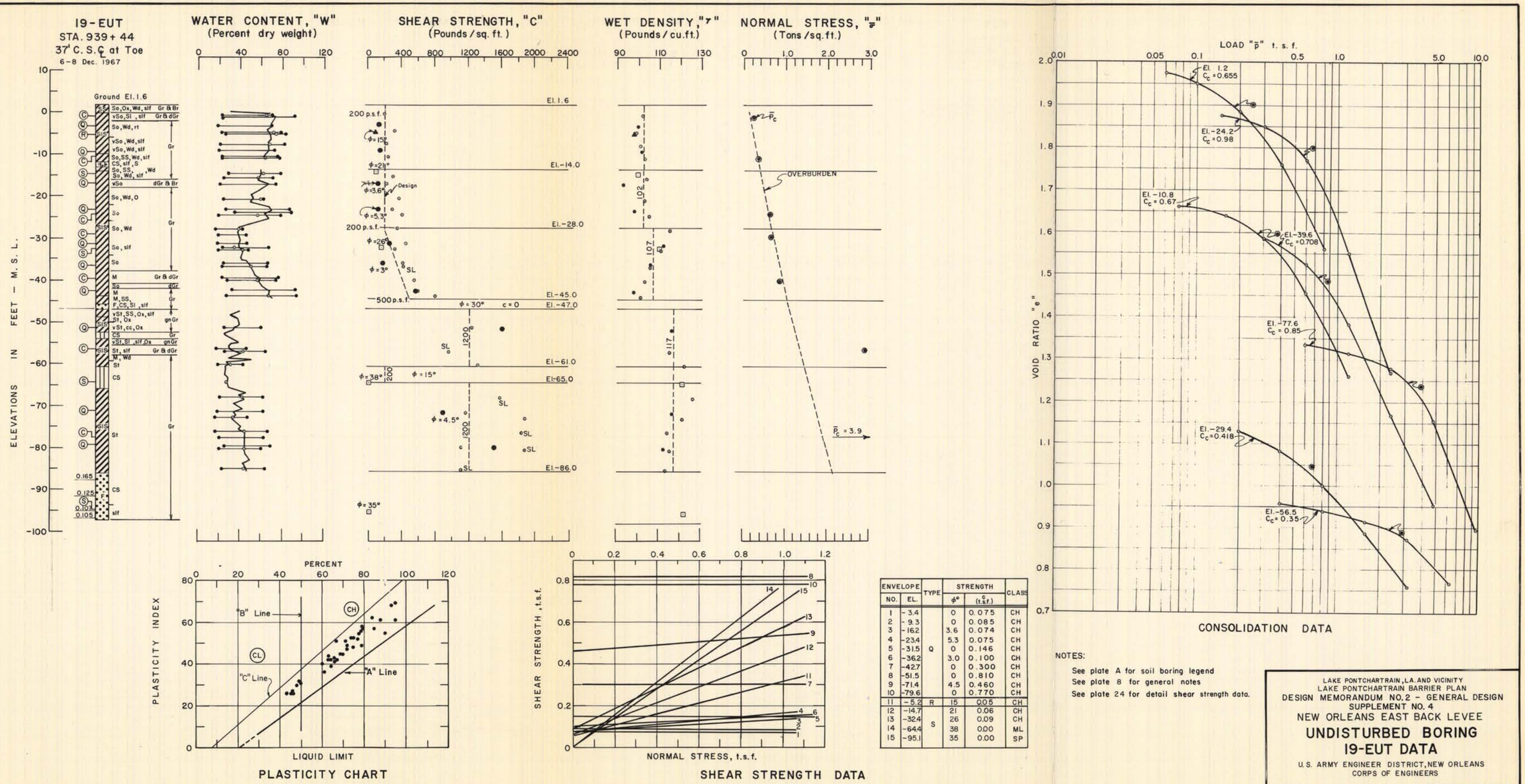
UNDISTURBED BORING 19-EU DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

FILE NO. H-2-24625

PLATE 12



CONSOLIDATION DATA

PLASTICITY CHART

SHEAR STRENGTH DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH φ°	STRENGTH (t.s.f.)	CLASS
1	-3.4	Q	0	0.075	CH
2	-9.3		0	0.085	CH
3	-16.2		3.6	0.074	CH
4	-23.4		5.3	0.075	CH
5	-31.5		0	0.146	CH
6	-36.2		3.0	0.100	CH
7	-42.7		0	0.300	CH
8	-51.5		0	0.810	CH
9	-71.4		4.5	0.460	CH
10	-79.6		0	0.770	CH
11	-5.2	R	15	0.05	CH
12	-14.7	S	21	0.06	CH
13	-32.4		26	0.09	CH
14	-64.4		38	0.00	ML
15	-95.1		35	0.00	SP

NOTES:

See plate A for soil boring legend
See plate 8 for general notes
See plate 24 for detail shear strength data.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

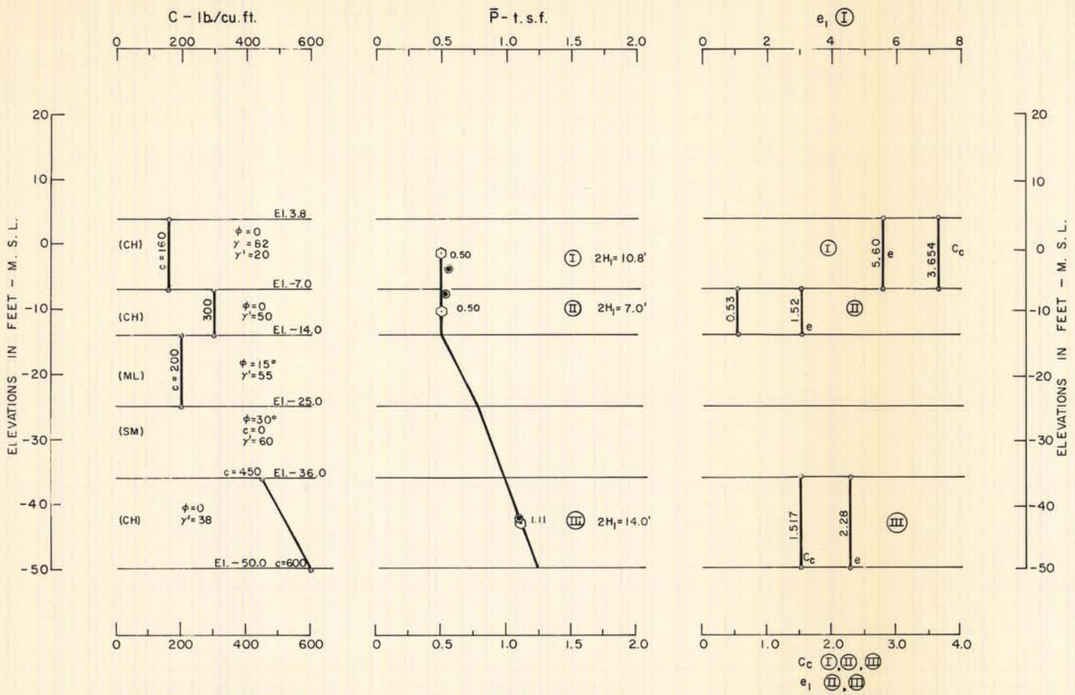
UNDISTURBED BORING 19-EUT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

FILE NO. H-2-24625

PLATE 13

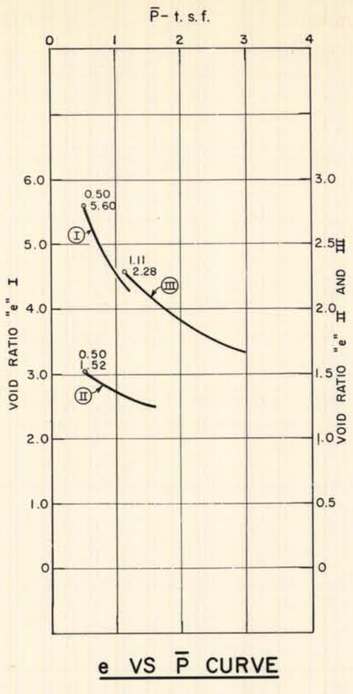


SHEAR STRENGTH VS DEPTH

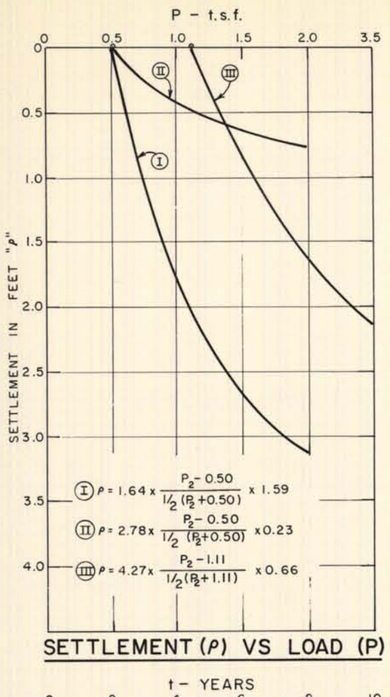
BASED ON DATA FROM UNDISTURBED BORING 2-EUT.

O.B. AND P, VS DEPTH

e_1 AND C_c VS DEPTH

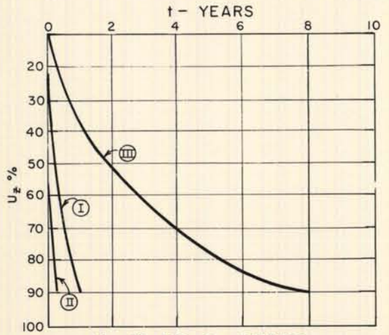


e VS P̄ CURVE



SETTLEMENT (ρ) VS LOAD (P)

NOTE:
For basic settlement equations see plate 15.



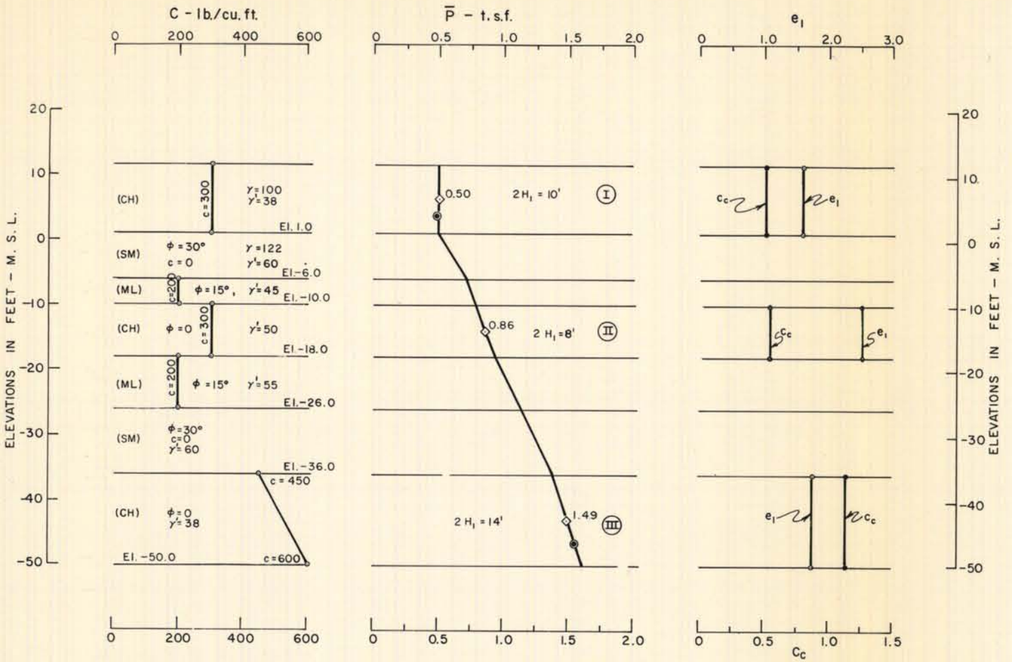
U_z % VS t - YEARS

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

SETTLEMENT ANALYSIS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 14

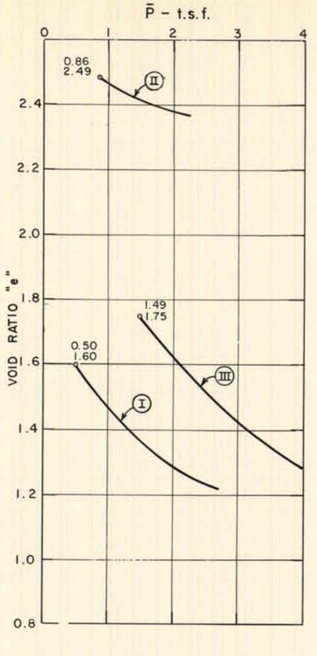


SHEAR STRENGTH VS DEPTH

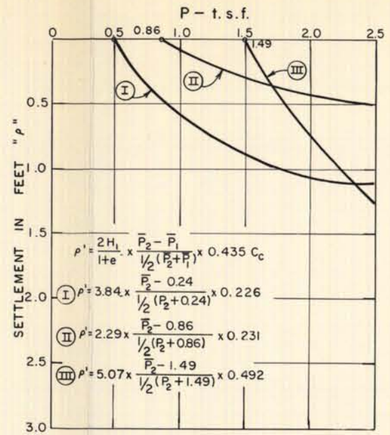
O.B. AND $\bar{P}$, VS DEPTH

e_1 AND C_c VS DEPTH

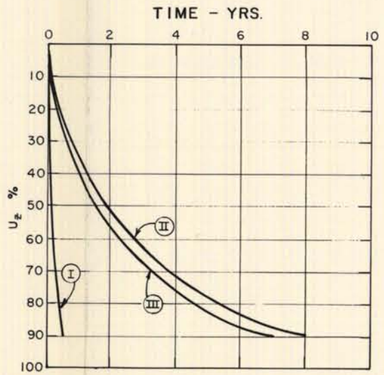
BASED ON DATA FROM UNDISTURBED BORING 3-EUT



e VS $\bar{P}$ CURVE



SETTLEMENT (ρ) VS LOAD (P)



U_z % VS t - YEARS

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

SETTLEMENT ANALYSIS

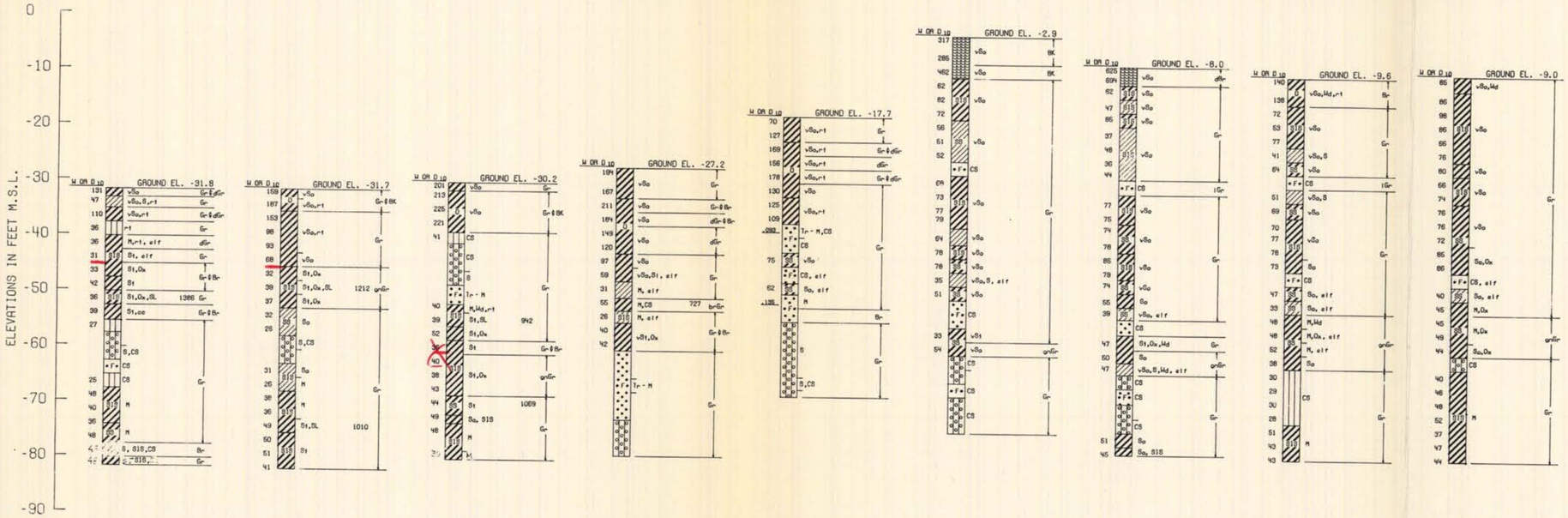
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 15

STATIONING ALONG CITRUS BACK LEVEE

STATIONING ALONG NEW ORLEANS EAST BACK LEVEE

BOR. 1-B	BOR. 2-B	BOR. 3-B	BOR. 4-B	BOR. 5-B	BOR. 6-B	BOR. 7-B	BOR. 8-B	BOR. 9-B
STA. 657+00	STA. 637+00	STA. 612+00	STA. 592+00	STA. 572+00	STA. 757+00	STA. 777+00	STA. 797+00	STA. 817+00
400 FT. C.S. C.L. LEVEE	360 FT. C.S. C.L. LEVEE	500 FT. C.S. C.L. LEVEE	500 FT. C.S. C.L. LEVEE	500 FT. C.S. C.L. LEVEE	750 FT. CANAL SIDE C.L. LEVEE	500 FT. CANAL SIDE C.L. LEVEE	500 FT. CANAL SIDE C.L. LEVEE	500 FT. CANAL SIDE C.L. LEVEE
5 DEC 69	8 DEC 69	8 DEC 69	9 DEC 69	10 DEC 69	21 NOV 69	24 NOV 69	25 NOV 69	25 NOV 69



NOTES:

Borings were made with a 1 7/8" I.D. core barrel sampler.

For locations of borings see plates 2, 3, and 4.

See plate A for boring legend.

PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

BORROW BORINGS ALONG MICHOUD CANAL

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

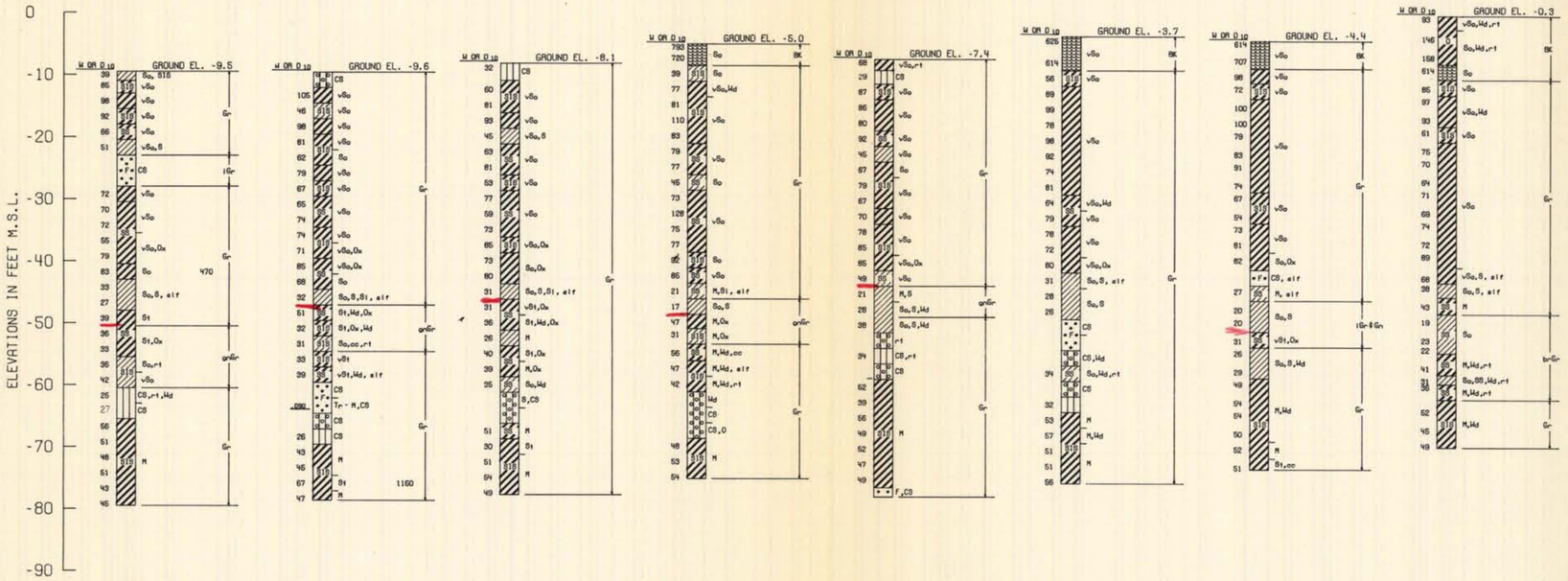
FEB. 1971

FILE NO. H-2-24625

PLATE 16

STATIONING ALONG NEW ORLEANS EAST BACK LEVEE

BOR. 10-B	BOR. 11-B	BOR. 12-B	BOR. 13-B	BOR. 14-B	BOR. 15-B	BOR. 16-B	BOR. 17-B
STA. 837+00	STA. 857+00	STA. 881+00	STA. 901+00	STA. 921+00	STA. 955+00	STA. 979+50	STA. 1000+00
500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. C.L. LEVEE	500 FT. C.S. OF C.L. LEVEE	500 FT. C.S. C.L. LEVEE
26 NOV 69	1 DEC 69	2 DEC 69	2 DEC 69	3 DEC 69	3 DEC 69	4 DEC 69	4 DEC 69



NOTES

Borings were made with a 1 7/8" I.D. core barrel sampler.

For locations of borings see plates 2, 3, and 4.

See plate A for boring legend.

LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

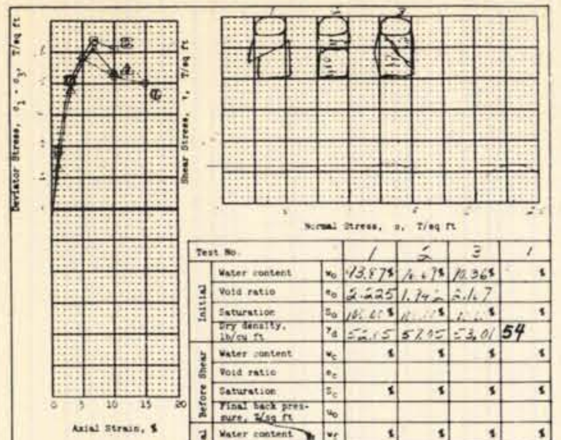
NEW ORLEANS EAST BACK LEVEE

BORROW BORINGS ALONG G.I.W.W.

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

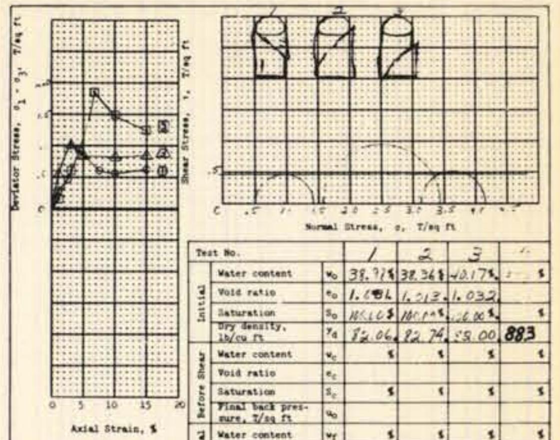
PLATE 17



Test No.			1	2	3	1
Initial	Water content	w_o	13.87%	14.47%	10.36%	%
	Void ratio	e_o	2.225	1.742	2.17	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	52.15	57.05	53.01	54
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.31	1.55	2.66	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.58	1.64	1.61	
Time to failure, min		t_f	11.27	25.07	25.41	
Rate of strain, percent/min			6.58	6.27	6.27	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .30 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

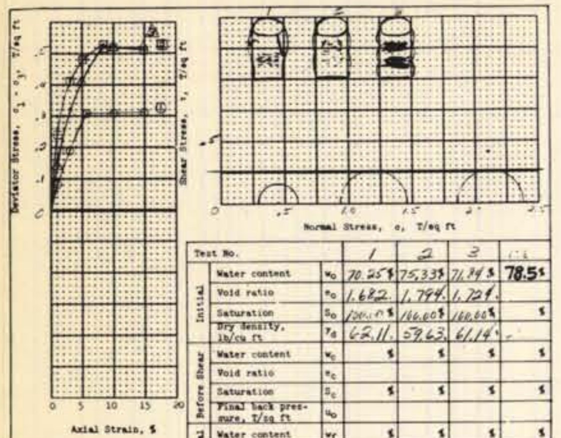
Type of test "Q" | Type of specimen 5" Undisturbed
Classification M(Gn, CH4; lns, lys & ars ML & SP
LL 75 | PL 28 | PI 57 | G_s 2.6166
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 13-A
Depth 47.4 El -43.6 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	4
Initial	Water content	w_o	38.97%	38.36%	40.17%	%
	Void ratio	e_o	1.084	1.013	1.032	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	82.06	82.74	83.00	883
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.52	1.57	3.14	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.92	1.24	1.01	
Time to failure, min		t_f	6.40	10.17	5.67	
Rate of strain, percent/min			0.66	0.66	0.66	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .48 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

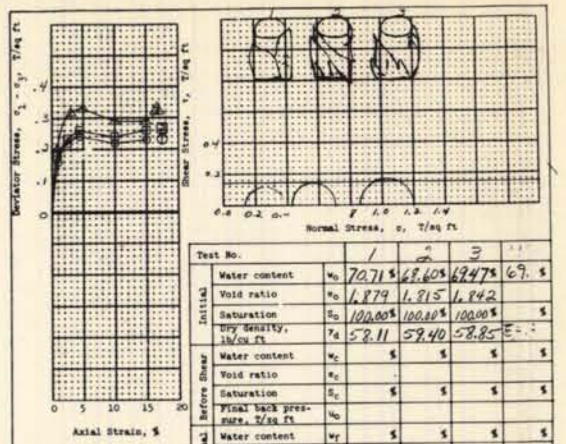
Type of test "Q" | Type of specimen 5" Undistrubed
Classification M(Gr&dGr,CH3; lns, lys & ars ML; few org strks
LL 54 | PL 17 | PI 37 | G_s 2.6707
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 20-A
Depth 75.6 El -71.8 | Date 7 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	70.25%	75.33%	71.84%	78.5%
	Void ratio	e_o	1.682	1.794	1.724	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	62.11	59.63	61.14	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.29	0.93	1.86	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.31	0.53	0.52	
Time to failure, min		t_f	8.92	12.87	12.75	
Rate of strain, percent/min			0.64	0.64	0.64	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .26 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

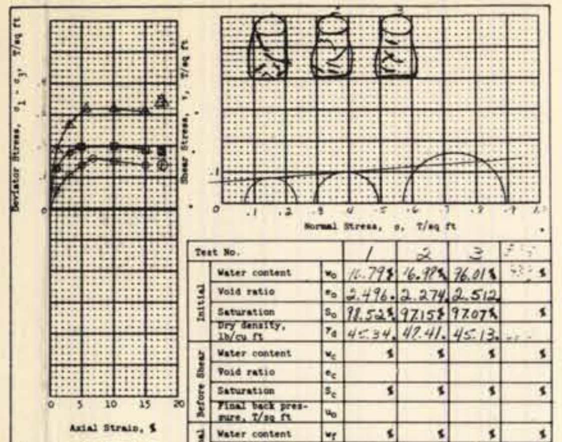
Type of test "Q" | Type of specimen 5" Undisturbed
Classification So(Gr,CH4; lns ML; lns & lys SP; few slf
LL 75 | PL 29 | PI 46 | G_s 2.6682
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 12-A
Depth 43.1 El -39.3 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	70.71%	68.60%	69.47%	69. %
	Void ratio	e_o	1.879	1.815	1.842	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	58.11	59.40	58.85	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.14	0.43	0.26	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.24	0.26	0.33	
Time to failure, min		t_f	6.29	6.32	7.46	
Rate of strain, percent/min			0.65	0.64	0.66	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .15 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

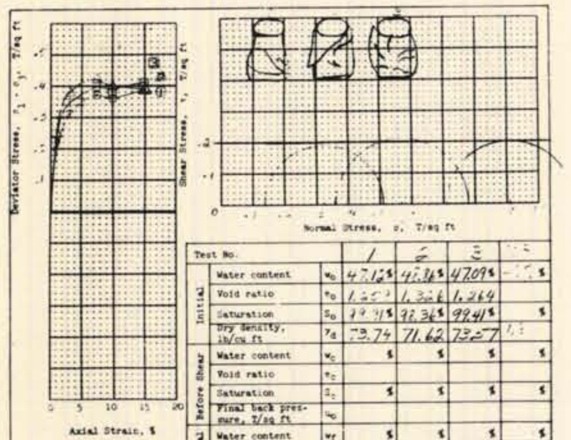
Type of test "Q" | Type of specimen 5" Undisturbed
Classification So(Gr&dGr,CH4; lns & thin lys ML; org ars
LL 81 | PL 25 | PI 56 | G_s 2.6777
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 5-C
Depth 16.9 El -13.1 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	16.79%	16.97%	96.01%	%
	Void ratio	e_o	2.496	2.274	2.512	
	Saturation	S_o	98.52%	97.15%	97.07%	%
	Dry density, lb/cu ft	γ_d	45.34	47.41	45.13	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.29	0.57	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.16	0.20	0.32	
Time to failure, min		t_f	10.15	7.48	8.74	
Rate of strain, percent/min			0.64	0.65	0.65	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 4.5°
tan ϕ = .07870
c = .07 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

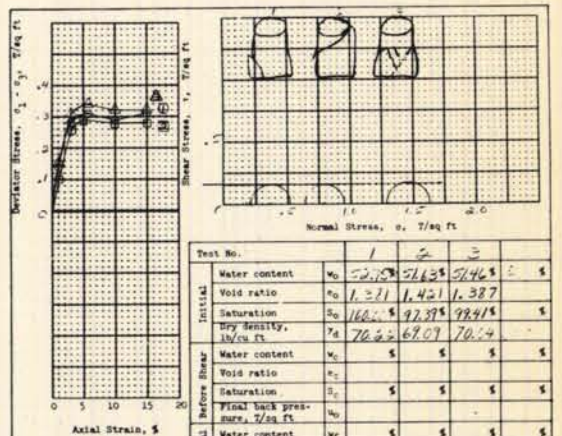
Type of test "Q" | Type of specimen 5" Undisturbed
Classification vSo(dGr &Br,CH4-OA; lns ML; dw; rts & rt; pcs wd
LL 137 | PL 31 | PI 106 | G_s 2.5399
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 3-D
Depth 10.2 El -6.4 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	47.12%	41.84%	47.09%	%
	Void ratio	e_o	1.252	1.326	1.264	
	Saturation	S_o	99.91%	97.36%	99.41%	%
	Dry density, lb/cu ft	γ_d	73.74	71.62	73.57	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.14	0.36	0.71	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.37	0.42	0.40	
Time to failure, min		t_f	11.25	11.40	11.41	
Rate of strain, percent/min			0.65	0.65	0.65	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .20 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

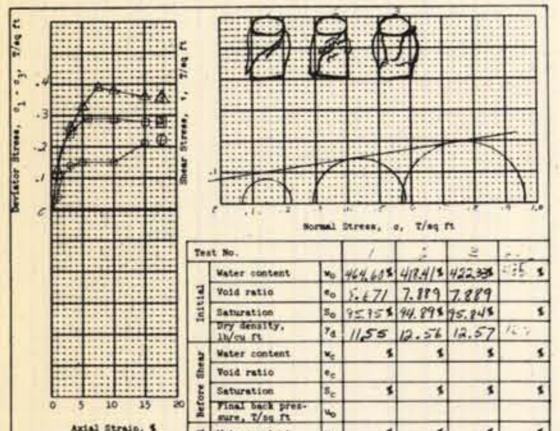
Type of test "Q" | Type of specimen 5" Undisturbed
Classification M(Gr&dGr,CH-; lns ML; rts & rt; cc; org ars
LL 68 | PL 21 | PI 47 | G_s 2.6690
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 4-D
Depth 13.8 El -10.0 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	52.75%	51.63%	51.46%	%
	Void ratio	e_o	1.371	1.421	1.387	
	Saturation	S_o	100.00%	97.39%	99.41%	%
	Dry density, lb/cu ft	γ_d	70.62	69.09	70.14	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.31	0.64	1.27	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.31	0.29	0.34	
Time to failure, min		t_f	7.75	7.47	8.72	
Rate of strain, percent/min			0.65	0.66	0.66	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0°
tan ϕ = 0
c = .16 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

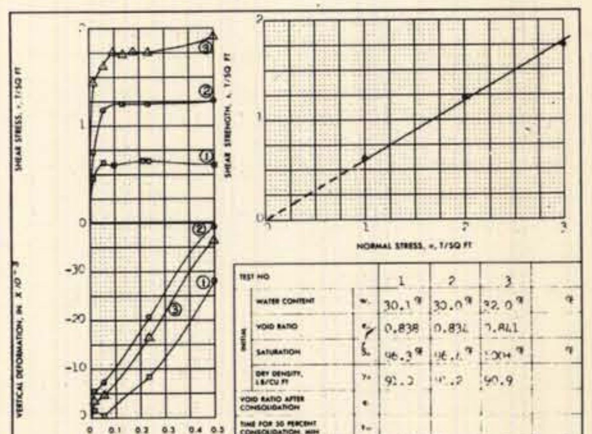
Type of test "Q" | Type of specimen 5" Undisturbed
Classification So(Gr,CH3; lns & alt. thin lys ML
LL 52 | PL 19 | PI 33 | G_s 2.6834
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697 + 20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 7-D2
Depth 26.1 El -22.3 | Date 5 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



Test No.			1	2	3	
Initial	Water content	w_o	464.68%	418.41%	422.33%	%
	Void ratio	e_o	5.671	7.889	7.889	
	Saturation	S_o	95.75%	94.89%	95.84%	%
	Dry density, lb/cu ft	γ_d	11.55	12.56	12.57	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.17	0.29	0.57	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.15	0.29	0.39	
Time to failure, min		t_f	7.57	9.01	11.62	
Rate of strain, percent/min			0.64	0.64	0.64	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.4	1.4	1.4	
Initial height, in.		H_o	3.0	3.0	3.0	

Shear Strength Parameters
ϕ = 8.8°
tan ϕ = .15481
c = .08 T/sq ft
Method of saturation ______
☐ Controlled stress
☒ Controlled strain

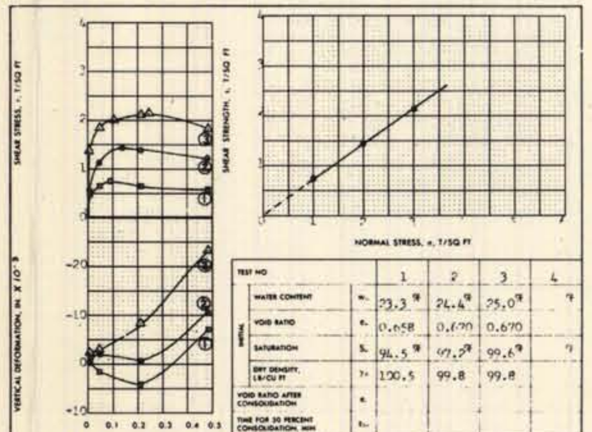
Type of test "Q" | Type of specimen 5" Undisturbed
Classification M(dBr,Pt; rts & rt; tr-soil
LL 394 | PL 195 | PI 199 | G_s 1.7857
Remarks TESTING SECTION NOD
Project LK. PONT., LA. & VIC. - HURR. PROT. 1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 697+20 - 50' C/S of Levee C/L
Boring No. 2-EUT | Sample No. 3-B
Depth 8.4 El -4.6 | Date 4 Ma 69
TRIAXIAL COMPRESSION TEST REPORT GJH



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	30.1%	30.0%	32.0%	%
	VOID RATIO	e_o	0.838	0.834	0.841	
	SATURATION	S_o	96.3%	96.4%	100+%	%
	DRY DENSITY, LB/CU FT	γ_d	91.3	91.2	90.9	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	32.4%	32.1%	30.9%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.61	1.22	1.75	
ACTUAL TIME TO FAILURE, MIN		t_f	360	780	600	
RATE OF STRAIN, IN./MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS
ϕ = 31°
TAN ϕ = 0.601
c = 0 T/SQ FT
☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.560 IN. THICK
CLASSIFICATION SILTY SAND (SM), gray
LL NP | PL NP | PI NP | G_s 2.68
REMARKS
PROJECT LAKE PONTCHARTRAIN, LA. & VICINITY - 1968 NEW ORLEANS EAST BACK LEVEE
AREA GDM #2; SUPP. #4
BORING NO 2-EUT | SAMPLE NO 9-D
EL -18.1 | DATE 15 JANUARY 1969
HWC DIRECT SHEAR TEST REPORT



TEST NO			1	2	3	4
INITIAL	WATER CONTENT	w_o	23.3%	24.4%	25.0%	%
	VOID RATIO	e_o	0.658	0.670	0.670	
	SATURATION	S_o	94.5%	97.2%	99.6%	%
	DRY DENSITY, LB/CU FT	γ_d	100.5	99.8	99.8	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	24.1%	23.3%	23.1%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.74	1.42	2.12	
ACTUAL TIME TO FAILURE, MIN		t_f	630	900	1500	
RATE OF STRAIN, IN./MIN			.00017	.00017	.00017	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS
ϕ = 36°
TAN ϕ = 0.726
c = 0 T/SQ FT
☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.550 IN. THICK
CLASSIFICATION SILTY SAND (SM), gray, contains traces of clay
LL - | PL - | PI - | G_s 2.67
REMARKS Top 3" of sample was CLAY (CH), not used in specimens
PROJECT LAKE PONTCHARTRAIN, LA. & VICINITY - 1968 NEW ORLEANS EAST BACK LEVEE
AREA GDM #2; SUPP. #4
BORING NO 2-EUT | SAMPLE NO 10-D
EL -33.9 | DATE 20 JANUARY 1969
WJH DIRECT SHEAR TEST REPORT

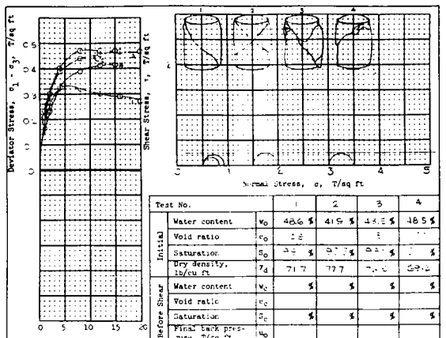
LAKE PONTCHARTRAIN LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 2-EUT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

2



Test No.			1	2	3	4
Initial	Water content	w_o	48.6 %	41.5 %	44.2 %	48.5 %
	Void ratio	e_o	1.28	1.14	1.21	
	Saturation	S_o	102 %	97.7 %	99.7 %	%
	Dry density, lb/cu ft	γ_d	71.7	77.7	75.6	69.6
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_0				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	0.50
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.33	0.47	0.47	0.41
Time to failure, min		t_f	15	50	11	38
Rate of strain, percent/min			0.40	1.50	0.67	0.40
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.28	0.47	0.47	0.41
Initial diameter, in.		D_o	1.4	1.41	1.4	1.41
Initial height, in.		H_o	3.00	3.00	3.00	3.00

Shear Strength Parameters
ϕ = ____ °
tan ϕ = ____
c = 0.42 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

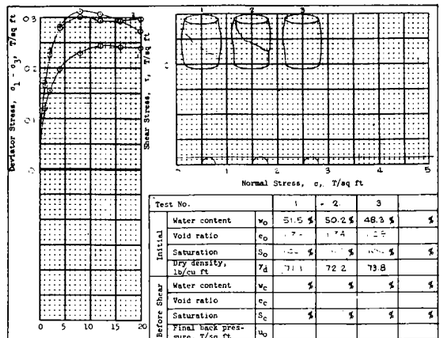
Classification GRAY VERY SILTY CLAY (CH), SOME FINE SAND SEAMS

LL 51 | PL 25 | PI 26 | G_s 2.63

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.
Area
Boring No. 3-EU | Sample No. 2-B
Depth -13.0 | Date 12/2/66
TRIAXIAL COMPRESSION TEST REPORT

3



Test No.			1	2	3	
Initial	Water content	w_o	51.5 %	50.2 %	48.3 %	%
	Void ratio	e_o	1.37	1.34	1.25	
	Saturation	S_o	102 %	100 %	100 %	%
	Dry density, lb/cu ft	γ_d	71.1	72.2	73.8	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_0				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.24	0.80	0.36	
Time to failure, min		t_f	24	12	20	
Rate of strain, percent/min			0.50	0.67	0.40	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.24	0.29	0.30	
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.07	

Shear Strength Parameters
ϕ = 0 °
tan ϕ = 0
c = 0.14 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

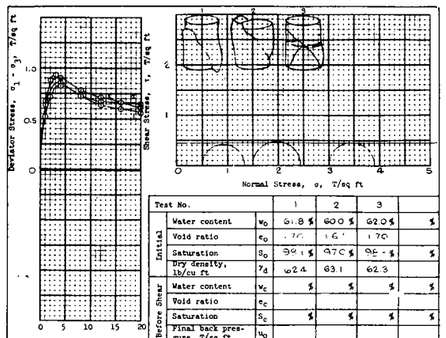
Classification GRAY CLAY (CL-ML), WITH SILT LAMINATIONS

LL 26 | PL 19 | PI 7 | G_s 2.71

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.
Area
Boring No. 3-UE | Sample No. B-D
Depth -23.0 | Date 12/2/66
TRIAXIAL COMPRESSION TEST REPORT

5



Test No.			1	2	3	
Initial	Water content	w_o	61.8 %	60.0 %	62.0 %	%
	Void ratio	e_o	1.70	1.61	1.70	
	Saturation	S_o	99.1 %	97.0 %	98.5 %	%
	Dry density, lb/cu ft	γ_d	62.4	63.1	62.3	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_0				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.83	0.94	0.90	
Time to failure, min		t_f	15	12	18	
Rate of strain, percent/min			0.27	0.25	0.17	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.60	0.66	0.68	
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0 °
tan ϕ = 0
c = 0.49 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

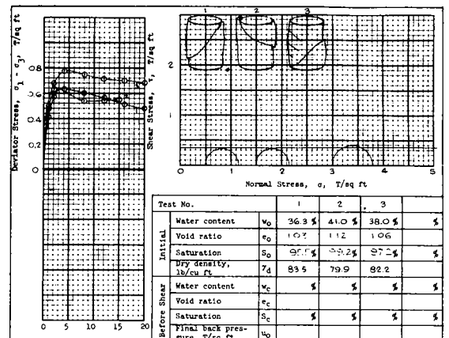
Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH SILT & VERY FINE SAND SEAMS

LL 80 | PL 30 | PI 50 | G_s 2.70

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.
Area
Boring No. 3-EU | Sample No. 14-B
Depth -45.2 | Date 12/3/66
TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	36.3 %	41.0 %	38.0 %	%
	Void ratio	e_o	1.03	1.12	1.06	
	Saturation	S_o	97.5 %	99.2 %	97.5 %	%
	Dry density, lb/cu ft	γ_d	83.5	79.9	82.2	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_0				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.64	0.63	0.78	
Time to failure, min		t_f	15	14	34	
Rate of strain, percent/min			0.28	0.17	0.12	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.52	0.56	0.70	
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters
ϕ = 0 °
tan ϕ = 0
c = 0.34 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

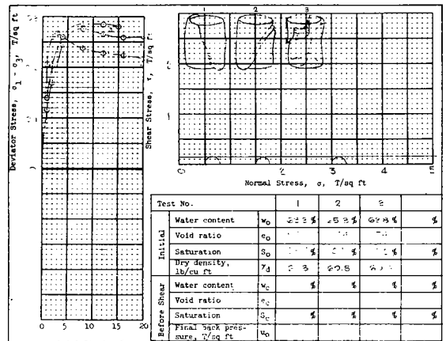
Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH SAND POCKETS & SHELL FRAGMENTS

LL 50 | PL 20 | PI 30 | G_s 2.71

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.
Area
Boring No. 3-EU | Sample No. 15-B
Depth -49.2 | Date 12/5/66
TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3
Initial	Water content	w_o	22.3 %	25.3 %	27.9 %
	Void ratio	e_o			
	Saturation	S_o	%	%	%
	Dry density, lb/cu ft	γ_d	97.8	92.8	
Before Shear	Water content	w_c	%	%	%
	Void ratio	e_c			
	Saturation	S_c	%	%	%
	Final back pressure, T/sq ft	u_0			
Final	Water content	w_f	%	%	%
	Void ratio	e_f			
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$		0.65	0.47	0.45
Time to failure, min		t_f	15	7	9
Rate of strain, percent/min			0.40	0.78	1.2
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$		0.26	0.22	0.28
Initial diameter, in.		D_o	1.4	1.41	1.4
Initial height, in.		H_o	3.00	3.00	3.00

Shear Strength Parameters
ϕ = ____ °
tan ϕ = ____
c = 0.4 T/sq ft

Method of saturation ____

☐ Controlled stress
☐ Controlled strain

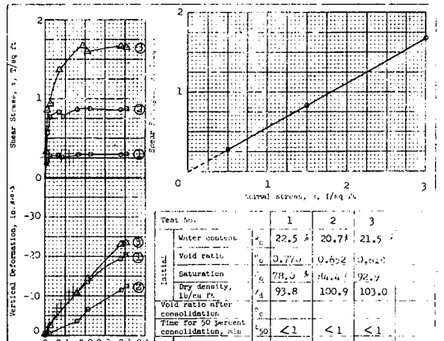
Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY(CH), W/ SAND POCKETS *

LL 78 | PL 28 | PI 51 | G_s 2.67

Remarks * ALL OF SAMPLE REQ'D TO TRIM 3 SPECIMENS SPECIMEN No.1 TRIMMED WITH LONG AXIS PERPENDICULAR TO VERTICAL AXIS OF SAMPLE ALL 3 SPECIMENS REPRESENTATIVE OF CLAY, NOT SAND

Project HURRICANE PROTECTION, N.O. & VIC.
Area
Boring No. 3-EU | Sample No. 2-C
Depth +2 | Date 12/ /66
TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3
Initial	Water content	w_c	22.5 %	20.7 %	21.5 %
	Void ratio	e_o	0.774	0.692	0.712
	Saturation	S_o	78.9 %	84.4 %	92.7
	Dry density, lb/cu ft	γ_d	93.8	100.9	103.0
	Void ratio after consolidation	e_c			
	Time for 50 percent consolidation, min	t_{50}	< 1	< 1	< 1
Final	Water content	w_f	26.7 %	23.8 %	21.9 %
	Void ratio	e_f			
	Saturation	S_f	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0
Maximum shear stress, T/sq ft		τ_{max}	0.28	0.83	1.68
Actual time to failure, min		t_f	600	600	1440
Rate of strain, in./min			.00011	.00011	.00013
Ultimate shear stress, T/sq ft		τ_{ult}	-	-	-

Shear Strength Parameters
ϕ' = 29 °
tan ϕ' = 0.554
c' = 0 T/sq ft

☐ Controlled stress
☒ Controlled strain

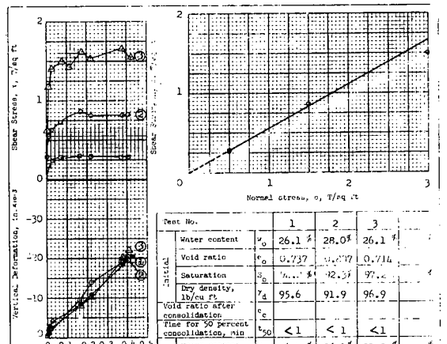
Type of specimen UNDISTURBED | 3.00 in. square | 0.471 in. thick

Classification SILTY SAND(SM), GRAY, with pockets of clay and shells (SC)

LL —— | PL —— | PI —— | G_s 2.66

Remarks
* Shear at 1" Dia

Project HURRICANE PROTECTION
NEW ORLEANS & VICINITY BARRIER PLAN
Area NEW ORLEANS EAST BACK LEVEE
Boring No. 3-EU | Sample No. 4-A
El -4.4 | Date 30 November 1966
CDA DIRECT SHEAR TEST REPORT



Test No.			1	2	3
Initial	Water content	w_c	26.1 %	28.0 %	26.1 %
	Void ratio	e_o	0.737	0.777	0.714
	Saturation	S_o	96.4 %	97.5 %	97.4
	Dry density, lb/cu ft	γ_d	95.6	91.9	96.9
	Void ratio after consolidation	e_c			
	Time for 50 percent consolidation, min	t_{50}	< 1	< 1	< 1
Final	Water content	w_f	26.4 %	26.1 %	23.9 %
	Void ratio	e_f			
	Saturation	S_f	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0
Maximum shear stress, T/sq ft		τ_{max}	0.28	0.86	1.50
Actual time to failure, min		t_f	600	1290	630
Rate of strain, in./min			.00012	.00013	.00012
Ultimate shear stress, T/sq ft		τ_{ult}	0.28	0.82	-

Shear Strength Parameters
ϕ' = 30 °
tan ϕ' = 0.577
c' = 0 T/sq ft

☐ Controlled stress
☒ Controlled strain

Type of specimen UNDISTURBED | 3.00 in. square | 0.471 in. thick

Classification SILTY SAND (SW), gray, w/ clay layers of 4" and 1"

LL —— | PL —— | PI —— | G_s 2.66

Remarks

Project HURRICANE PROTECTION
NEW ORLEANS & VICINITY BARRIER PLAN
Area NEW ORLEANS EAST BACK LEVEE
Boring No. 3-EU | Sample No. 12-C
El -37.6 | Date 30 November 1966
CDA DIRECT SHEAR TEST REPORT

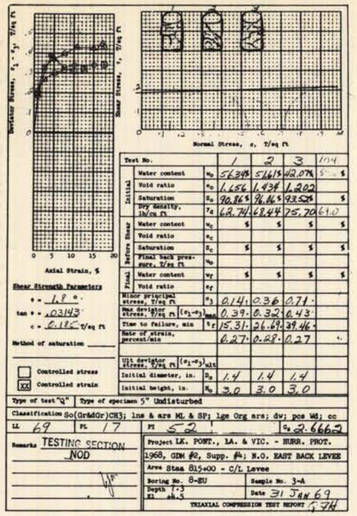
LAKE PONTCHARTRAIN LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 3-EU

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 | FILE NO. H-2-24625

PLATE 19



Test No.		1	2	3	1-U4
Initial	Water content w_o	56.3%	56.8%	58.0%	57.0%
	Void ratio e_o	1.656	1.638	1.702	
	Saturation S_o	90.8%	91.6%	93.5%	
	Dry density, lb/cu ft γ_d	68.74	68.44	67.50	68.10
Before Shear	Water content w_c				
	Void ratio e_c				
	Saturation S_c				
	Final back pressure, T/sq ft σ_b				
Final	Water content w_f				
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.14	0.36	0.71	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.39	0.92	1.43	
	Time to failure, min t_f	15.31	26.69	39.46	
	Rate of strain, percent/min	0.27	0.08	0.27	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o	1.4	1.4	1.4	
	Initial height, in. H_o	3.0	3.0	3.0	

Axial Strain, %

Shear Strength Parameters
ϕ = 1.2°
$\tan\phi$ = .0343
c = 0.12 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

Type of test "Q" | Type of specimen 5" Undisturbed

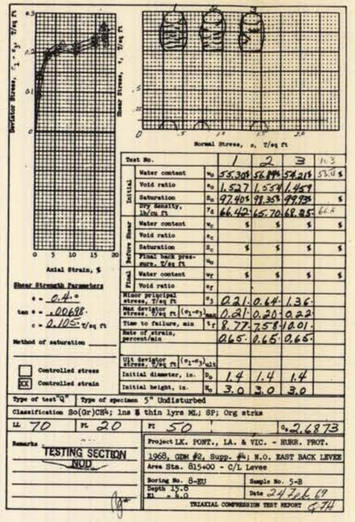
Classification So(Gr&Or)CH); lns & ars ML & SP; lge Org ars; dv; pcs ML; cc

LL 69 PL 17 PI 52 γ_s 2.66G2

Remarks TESTING SECTION NOD

Project LK. PONT., LA. & VIC. - HURR. PROT.
1968, GDM #2, Supp. #4; N.O. EAST BACK LEVEE
Area Sta. 815+00 - C/L Levee
Boring No. 8-EU | Sample No. 3-A
Depth -7.2 to -48.5 | Date 31 JAN 69

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	1-U3
Initial	Water content w_o	56.3%	56.8%	58.2%	57.3%
	Void ratio e_o	1.527	1.558	1.627	
	Saturation S_o	97.4%	98.3%	99.7%	
	Dry density, lb/cu ft γ_d	66.42	65.70	64.85	65.6
Before Shear	Water content w_c				
	Void ratio e_c				
	Saturation S_c				
	Final back pressure, T/sq ft σ_b				
Final	Water content w_f				
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.21	0.44	1.36	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.81	0.20	0.22	
	Time to failure, min t_f	8.77	25.84	0.01	
	Rate of strain, percent/min	0.65	0.65	0.65	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o	1.4	1.4	1.4	
	Initial height, in. H_o	3.0	3.0	3.0	

Axial Strain, %

Shear Strength Parameters
ϕ = 0.4°
$\tan\phi$ = .00698
c = 0.10 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

Type of test "Q" | Type of specimen 5" Undisturbed

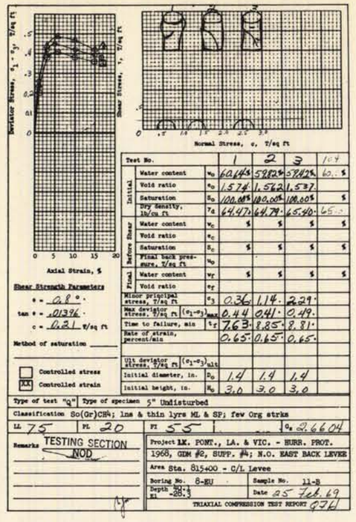
Classification So(Gr)CH); lns & thin lyre ML; SP; Org strks

LL 70 PL 20 PI 50 γ_s 2.6873

Remarks TESTING SECTION NOD

Project LK. PONT., LA. & VIC. - HURR. PROT.
1968, GDM #2, Supp. #4; N.O. EAST BACK LEVEE
Area Sta. 815+00 - C/L Levee
Boring No. 8-EU | Sample No. 5-B
Depth 15.0 to -5.0 | Date 24 JAN 69

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	1-U4
Initial	Water content w_o	60.6%	58.2%	57.8%	58.9%
	Void ratio e_o	1.574	1.562	1.537	
	Saturation S_o	100.0%	100.0%	100.0%	
	Dry density, lb/cu ft γ_d	64.47	64.79	65.40	65.0
Before Shear	Water content w_c				
	Void ratio e_c				
	Saturation S_c				
	Final back pressure, T/sq ft σ_b				
Final	Water content w_f				
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.36	1.14	2.29	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.44	0.41	0.49	
	Time to failure, min t_f	7.63	8.85	9.81	
	Rate of strain, percent/min	0.65	0.65	0.65	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o	1.4	1.4	1.4	
	Initial height, in. H_o	3.0	3.0	3.0	

Axial Strain, %

Shear Strength Parameters
ϕ = 0.8°
$\tan\phi$ = .0139
c = 0.21 T/sq ft

Method of saturation ____

☐ Controlled stress
☒ Controlled strain

Type of test "Q" | Type of specimen 5" Undisturbed

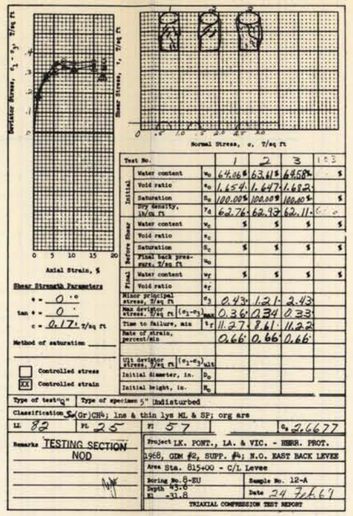
Classification So(Gr)CH); lns & thin lyre ML & SP; few Org strks

LL 75 PL 30 PI 45 γ_s 2.6604

Remarks TESTING SECTION NOD

Project LK. PONT., LA. & VIC. - HURR. PROT.
1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 815+00 - C/L Levee
Boring No. 8-EU | Sample No. 11-B
Depth 30.4 to -25.5 | Date 25 JAN 69

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	1-U3
Initial	Water content w_o	64.0%	63.1%	65.5%	
	Void ratio e_o	1.654	1.647	1.682	
	Saturation S_o	100.0%	100.0%	100.0%	
	Dry density, lb/cu ft γ_d	62.76	62.93	62.11	
Before Shear	Water content w_c				
	Void ratio e_c				
	Saturation S_c				
	Final back pressure, T/sq ft σ_b				
Final	Water content w_f				
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.43	1.21	2.43	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.36	0.31	0.33	
	Time to failure, min t_f	11.27	9.61	11.22	
	Rate of strain, percent/min	0.66	0.66	0.66	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o				
	Initial height, in. H_o				

Axial Strain, %

Shear Strength Parameters
ϕ = 0.1°
$\tan\phi$ = 0
c = 0.17 T/sq ft

Method of saturation ____

☒ Controlled stress
☐ Controlled strain

Type of test "Q" | Type of specimen 5" Undisturbed

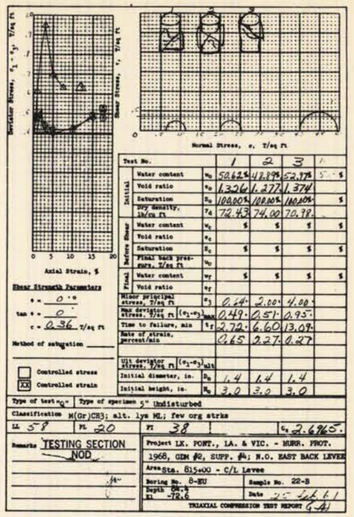
Classification So(Gr)CH); lns & thin lyre ML & SP; org ars

LL 82 PL 25 PI 57 γ_s 2.6677

Remarks TESTING SECTION NOD

Project LK. PONT., LA. & VIC. - HURR. PROT.
1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 815+00 - C/L Levee
Boring No. 8-EU | Sample No. 12-A
Depth 43.0 to -31.8 | Date 24 JAN 69

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	1-U2
Initial	Water content w_o	58.6%	58.9%	59.3%	
	Void ratio e_o	1.526	1.574		
	Saturation S_o	100.0%	100.0%	100.0%	
	Dry density, lb/cu ft γ_d	64.43	64.00	63.78	
Before Shear	Water content w_c				
	Void ratio e_c				
	Saturation S_c				
	Final back pressure, T/sq ft σ_b				
Final	Water content w_f				
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.64	2.08	4.08	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.49	0.61	0.85	
	Time to failure, min t_f	2.72	6.60	13.09	
	Rate of strain, percent/min	0.65	2.27	0.27	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o	1.4	1.4	1.4	
	Initial height, in. H_o	3.0	3.0	3.0	

Axial Strain, %

Shear Strength Parameters
ϕ = 0.1°
$\tan\phi$ = 0
c = 0.36 T/sq ft

Method of saturation ____

☒ Controlled stress
☐ Controlled strain

Type of test "Q" | Type of specimen 5" Undisturbed

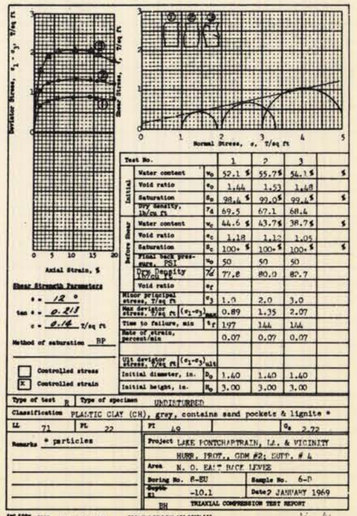
Classification M(Gr)CH); slt. lye ML; few org strks

LL 59 PL 20 PI 38 γ_s 2.6765

Remarks TESTING SECTION NOD

Project LK. PONT., LA. & VIC. - HURR. PROT.
1968, GDM #2, SUPP. #4; N.O. EAST BACK LEVEE
Area Sta. 815+00 - C/L Levee
Boring No. 8-EU | Sample No. 22-B
Depth 64.2 to -78.6 | Date 25 JAN 69

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	52.1%	55.7%	54.1%	
	Void ratio e_o	1.44	1.53	1.48	
	Saturation S_o	98.4%	99.0%	99.4%	
	Dry density, lb/cu ft γ_d	69.5	67.1	68.4	
Before Shear	Water content w_c	44.6%	43.7%	38.7%	
	Void ratio e_c	1.18	1.12	1.05	
	Saturation S_c	100+%	100+%	100+%	
	Final back pressure, psi σ_b	50	50	50	
Final	Dry density, lb/cu ft γ_d	77.8	80.0	80.7	
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	1.0	2.0	3.0	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.89	1.35	2.07	
	Time to failure, min t_f	197	144	144	
	Rate of strain, percent/min	0.07	0.07	0.07	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$				
	Initial diameter, in. D_o	1.40	1.40	1.40	
	Initial height, in. H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters
ϕ = 12°
$\tan\phi$ = 0.213
c = 0.14 T/sq ft

Method of saturation BP

☐ Controlled stress
☒ Controlled strain

Type of test R | Type of specimen UNDISTURBED

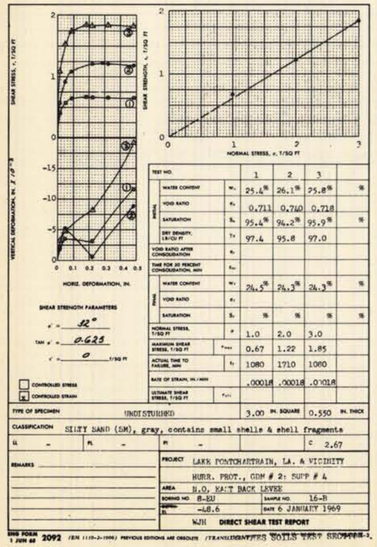
Classification PLASTIC CLAY (CH), gray, contains sand pockets & lignite *

LL 71 PL 22 PI 49 γ_s 2.72

Remarks * particles

Project LAKE PONTCHARTRAIN, LA. & VICINITY
HURR. PROT., GDM #2; SUPP. # 4
Area N. O. EAST BACK LEVEE
Boring No. 6-EU | Sample No. 6-B
Depth -10.1 | Date 2 JANUARY 1969
St

TRIAXIAL COMPRESSION TEST REPORT



TEST NO.		1	2	3	
INITIAL	WATER CONTENT w_o, %	25.1%	26.1%	25.8%	%
	VOID RATIO e_o	0.711	0.740	0.718	
	SATURATION S_o, %	95.4%	94.2%	95.9%	%
	DRY DENSITY, LB/CU FT γ_d	97.4	95.8	97.0	
VOID RATIO AFTER CONSOLIDATION	e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN	t_{50}				
FINAL	WATER CONTENT w_f, %	24.5%	24.3%	24.3%	%
	VOID RATIO e_f				
	SATURATION S_f, %	%	%	%	%
NORMAL STRESS, T/SQ FT	σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT	τ_{max}	0.67	1.22	1.85	
ACTUAL TIME TO FAILURE, MIN	t_f	1080	1710	1080	
RATE OF STRAIN, IN./MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT	τ_{ult}				

SHEAR STRENGTH PARAMETERS
ϕ' = 32°
$\tan\phi'$ = 0.625
c' = 0 T/SQ FT

☐ CONSOLIDATED STRESS
☒ CONSOLIDATED STRAIN

TYPE OF SPECIMEN UNDISTURBED 3.00 IN. SQUARE 0.550 IN. THICK

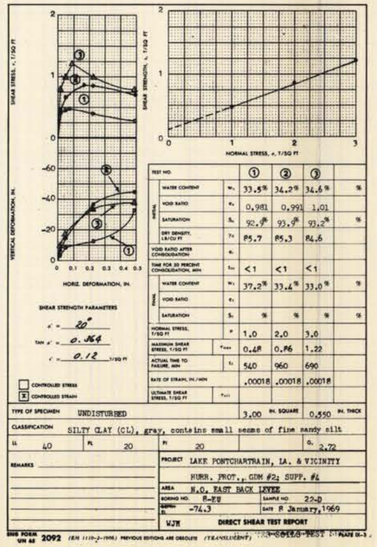
CLASSIFICATION SILTY SAND (SM), gray, contains small shells & shell fragments

LL – PL – PI – γ_s 2.67

REMARKS

PROJECT LAKE PONTCHARTRAIN, LA. & VICINITY
HURR. PROT., GDM # 2: SUPP # 4
AREA N.O. EAST BACK LEVEE
BORING NO. 8-EU | SAMPLE NO. 16-B
DEPTH -48.6 | DATE 6 JANUARY 1969

WJH DIRECT SHEAR TEST REPORT



TEST NO.		①	②	③	
INITIAL	WATER CONTENT w_o, %	33.5%	34.2%	34.6%	%
	VOID RATIO e_o	0.981	0.992	1.01	
	SATURATION S_o, %	92.9%	93.9%	93.2%	%
	DRY DENSITY, LB/CU FT γ_d	85.7	85.3	84.6	
VOID RATIO AFTER CONSOLIDATION	e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN	t_{50}	<1	<1	<1	
FINAL	WATER CONTENT w_f, %	37.2%	33.4%	33.0%	%
	VOID RATIO e_f				
	SATURATION S_f, %	%	%	%	%
NORMAL STRESS, T/SQ FT	σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT	τ_{max}	0.48	0.96	1.22	
ACTUAL TIME TO FAILURE, MIN	t_f	540	960	690	
RATE OF STRAIN, IN./MIN		.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT	τ_{ult}				

SHEAR STRENGTH PARAMETERS
ϕ' = 20°
$\tan\phi'$ = 0.364
c' = 0.12 T/SQ FT

☐ CONSOLIDATED STRESS
☒ CONSOLIDATED STRAIN

TYPE OF SPECIMEN UNDISTURBED 3.00 IN. SQUARE 0.550 IN. THICK

CLASSIFICATION SILTY CLAY (CL), gray, contains small seams of fine sandy silt

LL 40 PL 20 PI 20 γ_s 2.72

REMARKS

PROJECT LAKE PONTCHARTRAIN, LA. & VICINITY
HURR. PROT., GDM #2; SUPP. #4
AREA N.O. EAST BACK LEVEE
BORING NO. 8-EU | SAMPLE NO. 22-B
DEPTH -74.3 | DATE 8 January 1969

WJH DIRECT SHEAR TEST REPORT

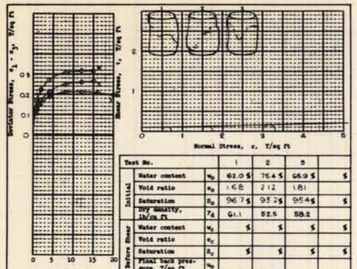
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 8-EU

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 20



Test No.		1	2	3	
Initial	Water content w_o	62.0 %	76.4 %	66.9 %	%
	Void ratio e_o	1.68	2.12	1.81	
	Saturation S_o	96.7 %	95.2 %	95.4 %	%
	Dry density, lb/cu ft γ_d	61.1	52.5	58.2	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.21	0.27	0.86	
Time to failure, min	t_f	25	32	29	
Rate of strain, percent/min		0.40	0.48	0.65	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.21	0.27	0.32	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 10°, tan ϕ = 0.17, c = 0.10 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification DARK GRAY ORGANIC CLAY (CH) WITH ROOTS & WOOD

LL 78 | PL 35 | PI 43 | q_u 2.62

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

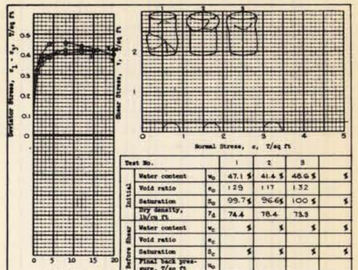
Area ____

Boring No. 12-EU | Sample No. 2-D

Depth 45.5 | Date 12/5/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	47.1 %	41.4 %	46.0 %	%
	Void ratio e_o	1.29	1.17	1.32	
	Saturation S_o	99.7 %	96.6 %	100 %	%
	Dry density, lb/cu ft γ_d	74.4	78.4	73.3	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.42	0.43	0.46	
Time to failure, min	t_f	37	14	16	
Rate of strain, percent/min		0.30	0.64	0.44	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.42	0.42	0.43	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.22 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification LIGHT GRAY & TAN CLAY (CH) INTERMIXED WITH GRAY CLAY *

LL 82 | PL 30 | PI 52 | q_u 2.73

Remarks * AND FEW SAND POCKETS

Project HURRICANE PROTECTION, N.O. & VIC.

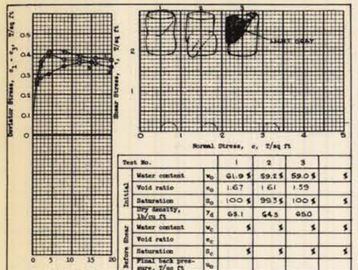
Area ____

Boring No. 12-EU | Sample No. 5-C

Depth -8.0 | Date 12/6/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	61.9 %	59.2 %	59.0 %	%
	Void ratio e_o	1.67	1.61	1.59	
	Saturation S_o	100 %	99.3 %	100 %	%
	Dry density, lb/cu ft γ_d	68.1	64.5	65.0	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.42	0.49	0.56	
Time to failure, min	t_f	16	13	41	
Rate of strain, percent/min		0.39	0.29	0.30	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.38	0.36	0.36	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.19 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH) WITH SAND POCKETS & FEW SHELL FRAGMENTS

LL 80 | PL 30 | PI 50 | q_u 2.70

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

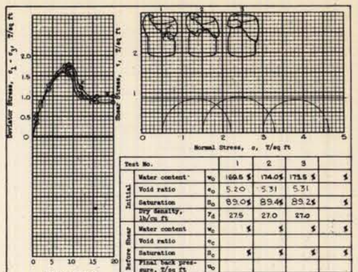
Area ____

Boring No. 12-EU | Sample No. 7-C

Depth ____ | Date 12/6/66

El -13.4

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	188.5 %	174.0 %	173.6 %	%
	Void ratio e_o	5.20	5.31	5.31	
	Saturation S_o	83.0 %	89.4 %	89.2 %	%
	Dry density, lb/cu ft γ_d	27.5	27.0	27.0	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	1.70	1.80	1.63	
Time to failure, min	t_f	16	16	14	
Rate of strain, percent/min		0.58	0.58	0.59	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.86	0.91	0.85	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.86 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification DARK GRAY PEAT (Pt) WITH FIBROUS ORG MAT

LL 222 | PL 156 | PI 64 | q_u 2.73

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

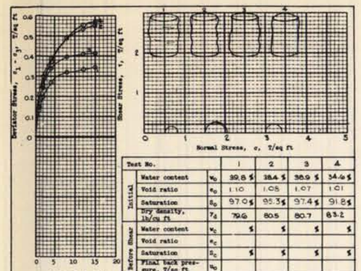
Area ____

Boring No. 12-EU | Sample No. 9-C

Depth -20.9 | Date 12/6/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	4	
Initial	Water content w_o	39.8 %	38.4 %	38.9 %	34.6 %	%
	Void ratio e_o	1.10	1.08	1.07	1.01	
	Saturation S_o	97.0 %	95.5 %	97.4 %	91.8 %	%
	Dry density, lb/cu ft γ_d	79.6	80.5	80.7	83.2	
Before Shear	Water content w_c	%	%	%	%	%
	Void ratio e_c					
	Saturation S_c	%	%	%	%	%
	Final back pressure, T/sq ft u_b					
Final	Water content w_f	%	%	%	%	%
	Void ratio e_f					
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	1.50	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.34	0.55	0.41	0.51	
Time to failure, min	t_f	33	16	14	15	
Rate of strain, percent/min		0.46	0.27	0.96	0.97	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.34	0.55	0.41	0.51	
Initial diameter, in.	D_o	1.41	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.22 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY SILTY CLAY (CL) WITH FINE SAND SEAMS

LL 37 | PL 20 | PI 17 | q_u 2.68

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

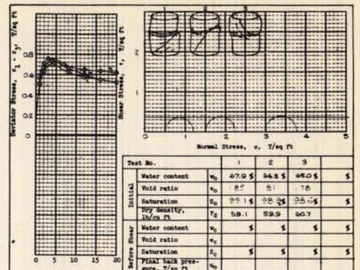
Area ____

Boring No. 12-EU | Sample No. 11-A

Depth -27.9 | Date 12/6/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	67.9 %	64.3 %	65.0 %	%
	Void ratio e_o	1.87	1.81	1.78	
	Saturation S_o	99.1 %	98.2 %	98.6 %	%
	Dry density, lb/cu ft γ_d	59.1	59.9	60.7	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.69	0.79	0.76	
Time to failure, min	t_f	33	15	12	
Rate of strain, percent/min		0.12	0.27	0.26	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.56	0.56	0.64	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.37 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH) WITH SILT SEAMS

LL 92 | PL 31 | PI 61 | q_u 2.70

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

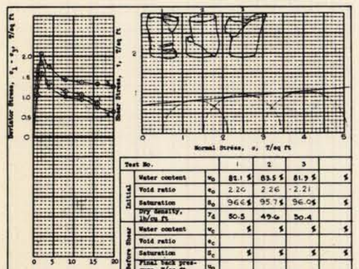
Area ____

Boring No. 12-EU | Sample No. 14-D

Depth -42.5 | Date 11/6 & 12/7/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	81.1 %	83.5 %	81.3 %	%
	Void ratio e_o	2.20	2.26	2.21	
	Saturation S_o	96.6 %	95.7 %	96.0 %	%
	Dry density, lb/cu ft γ_d	50.5	49.6	50.4	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	1.93	1.93	2.08	
Time to failure, min	t_f	9	21	16	
Rate of strain, percent/min		0.19	0.81	0.13	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.90	0.80	1.41	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 30°, tan ϕ = 0.58, c = 0.70 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY ORGANIC CLAY (OH) WITH WOOD FRAGMENTS

LL 131 | PL 75 | PI 56 | q_u 2.59

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

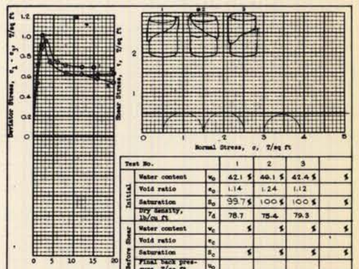
Area ____

Boring No. 12-EU | Sample No. 18-C

Depth -37.4 | Date 12/7/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	42.1 %	40.1 %	42.4 %	%
	Void ratio e_o	1.14	1.24	1.12	
	Saturation S_o	99.7 %	100 %	100 %	%
	Dry density, lb/cu ft γ_d	78.7	75.4	79.3	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.36	1.02	0.91	
Time to failure, min	t_f	11	19	21	
Rate of strain, percent/min		0.25	0.16	0.11	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.68	0.61	0.58	
Initial diameter, in.	D_o	1.41	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0°, tan ϕ = 0, c = 0.60 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH SILT SEAMS

LL 57 | PL 23 | PI 34 | q_u 2.70

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

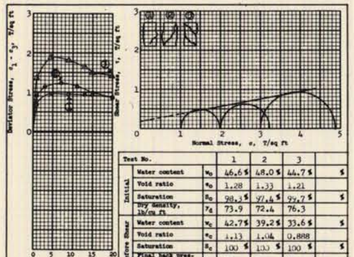
Area ____

Boring No. 12-EU | Sample No. 22-D

Depth -74.5 | Date 12/8/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	46.6 %	48.0 %	44.7 %	%
	Void ratio e_o	1.28	1.33	1.21	
	Saturation S_o	98.5 %	97.4 %	99.7 %	%
	Dry density, lb/cu ft γ_d	73.9	72.4	76.3	
Before Shear	Water content w_c	42.7 %	39.2 %	33.6 %	%
	Void ratio e_c	1.13	1.14	0.898	
	Saturation S_c	100 %	93 %	100 %	%
	Final back pressure, T/sq ft u_b	70	70	60	
Final	Water content w_f	79.2	85.0	89.3	
	Void ratio e_f				
Minor principal stress, T/sq ft	σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.98	1.22	1.89	
Time to failure, min	t_f	96	163	98	
Rate of strain, percent/min		0.05	0.043	0.047	
Ult deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{ult}$	0.93	1.00	1.50	
Initial diameter, in.	D_o	1.38	1.38	1.38	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 11°, tan ϕ = 0.194, c = 0.18 T/sq ft

Method of saturation BP

☐ Controlled stress ☒ Controlled strain

Type of test R | Type of specimen UNDISTURBED

Classification CLAY(CH), gray, contains a sand seam

LL ____ | PL ____ | PI ____ | q_u 2.70 tons/sq ft

Remarks ____

Project HURRICANE PROTECTION

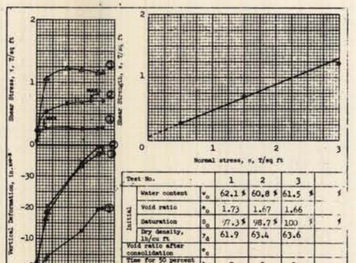
NEW ORLEANS & VICINITY BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EU | Sample No. 7-C

El -13.4 | Date 30 November 1966

JL TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	62.1 %	60.8 %	61.5 %	%
	Void ratio e_o	1.73	1.67	1.66	
	Saturation S_o	97.3 %	98.7 %	100 %	%
	Dry density, lb/cu ft γ_d	61.9	63.4	63.6	
	Void ratio after consolidation e_c				
	Time for 50 percent consolidation, min t_{50}	2	2	2	
Final	Water content w_f	61.6 %	58.9 %	59.0 %	%
	Void ratio e_f				
	Saturation S_f	%	%	%	%
Normal stress, T/sq ft	σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft	τ_{max}	0.27	0.70	1.23	
Actual time to failure, min	t_f	870	4770	2790	
Rate of strain, in./min		.000061	.000072	.00007	
Ultimate shear stress, T/sq ft	τ_{ult}	0.26	0.70	1.15	

Shear Strength Parameters: ϕ' = 23°, c' = 0.026 T/sq ft

Method of saturation ____

☐ Controlled stress ☒ Controlled strain

Type of specimen UNDISTURBED | 3.00 in. square | 0.471 in. thick

Classification CLAY(CH), gray, with pockets of silty sand

LL 85 | PL 32 | PI 53 | q_u 2.71

Remarks ____

Project HURRICANE PROTECTION

NEW ORLEANS & VICINITY BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EU | Sample No. 15-A

El -43.7 | Date 2 December 1966

GDA DIRECT SHEAR TEST REPORT

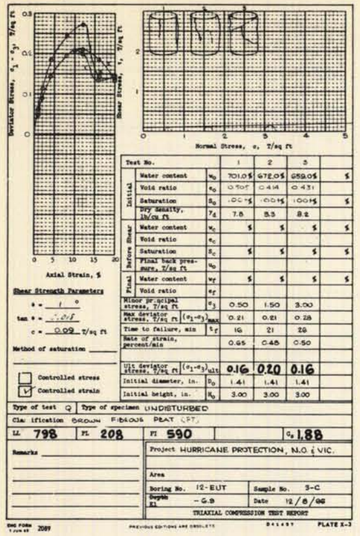
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 12-EU

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 | FILE NO. H-2-24625

PLATE 21



Test No.		1	2	3	
Initial	Water content w_o	701.0 %	672.0 %	689.0 %	%
	Void ratio e_o	0.707	0.414	0.431	
	Saturation S_o	100 %	100 %	100 %	%
	Dry density, lb/cu ft γ_d	7.8	8.3	8.2	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.21	0.21	0.28	
	Time to failure, min t_f	16	21	23	
	Rate of strain, percent/min	0.65	0.45	0.50	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.16	0.20	0.16	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 1 °; $\tan\phi$ = .017; c = 0.09 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification BROWN FIBROUS PEAT (PT)

LL 798 PL 208 PI 590 q_u 1.88

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 3-C

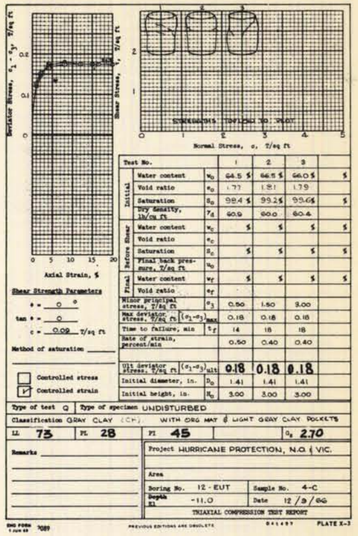
Depth -6.9 Date 12/8/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

14



Test No.		1	2	3	
Initial	Water content w_o	64.5 %	66.5 %	66.0 %	%
	Void ratio e_o	1.77	1.81	1.79	
	Saturation S_o	98.4 %	99.2 %	98.6 %	%
	Dry density, lb/cu ft γ_d	58.2	58.4	58.8	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.18	0.18	0.18	
	Time to failure, min t_f	14	18	18	
	Rate of strain, percent/min	0.50	0.40	0.40	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.18	0.18	0.18	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0 °; $\tan\phi$ = 0; c = 0.09 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CH) WITH ORG MAT & LIGHT GRAY CLAY POCKETS

LL 73 PL 28 PI 45 q_u 2.70

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 4-C

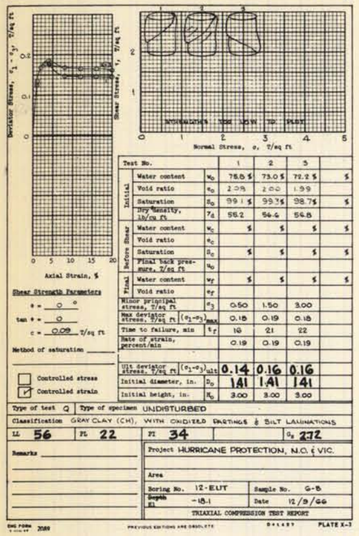
Depth -11.0 Date 12/9/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

15



Test No.		1	2	3	
Initial	Water content w_o	78.6 %	73.0 %	72.2 %	%
	Void ratio e_o	2.08	2.00	1.99	
	Saturation S_o	99.1 %	99.3 %	98.7 %	%
	Dry density, lb/cu ft γ_d	56.2	56.6	56.8	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.18	0.19	0.18	
	Time to failure, min t_f	16	21	22	
	Rate of strain, percent/min	0.19	0.19	0.19	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.14	0.16	0.16	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0 °; $\tan\phi$ = 0; c = 0.09 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH CINDERS PARTINGS & SILT LAMINATIONS

LL 56 PL 22 PI 34 q_u 2.72

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 6-B

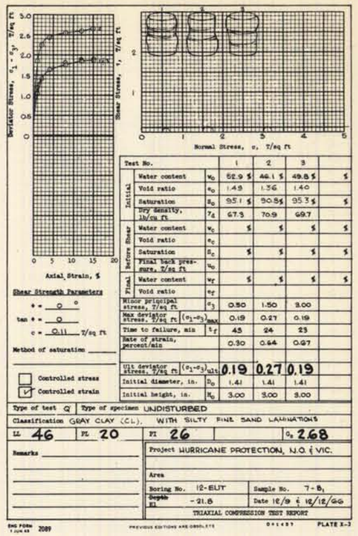
Depth -18.1 Date 12/9/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

16



Test No.		1	2	3	
Initial	Water content w_o	52.9 %	46.1 %	48.8 %	%
	Void ratio e_o	1.48	1.36	1.40	
	Saturation S_o	95.1 %	90.5 %	93.3 %	%
	Dry density, lb/cu ft γ_d	67.5	70.9	69.7	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.19	0.21	0.19	
	Time to failure, min t_f	45	64	53	
	Rate of strain, percent/min	0.30	0.64	0.27	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.19	0.27	0.19	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0 °; $\tan\phi$ = 0; c = 0.11 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CL), WITH SILTY FINE SAND LAMINATIONS

LL 46 PL 20 PI 26 q_u 2.68

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 7-B

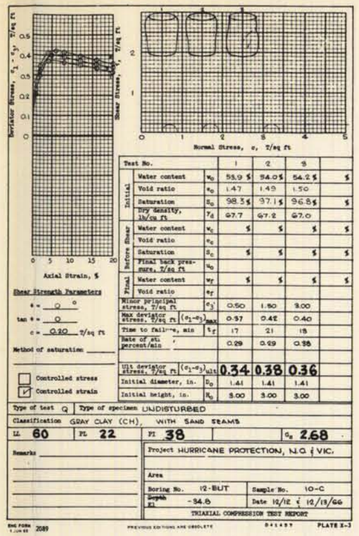
Depth -21.8 Date 12/9 & 12/12/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

17



Test No.		1	2	3	
Initial	Water content w_o	58.9 %	54.0 %	54.2 %	%
	Void ratio e_o	1.47	1.49	1.50	
	Saturation S_o	98.5 %	97.1 %	96.8 %	%
	Dry density, lb/cu ft γ_d	67.7	67.2	67.0	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.57	0.42	0.40	
	Time to failure, min t_f	17	21	15	
	Rate of strain, percent/min	0.29	0.69	0.98	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.34	0.38	0.36	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0 °; $\tan\phi$ = 0; c = 0.30 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH SAND SEAMS

LL 60 PL 22 PI 38 q_u 2.68

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 10-C

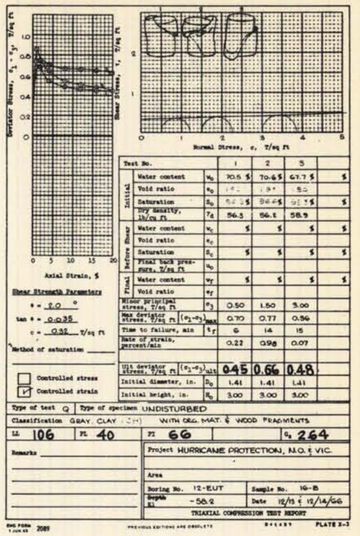
Depth -34.8 Date 12/12 & 12/13/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

18



Test No.		1	2	3	
Initial	Water content w_o	70.5 %	70.6 %	67.7 %	%
	Void ratio e_o	1.92	1.87	1.82	
	Saturation S_o	100 %	99.6 %	97.5 %	%
	Dry density, lb/cu ft γ_d	56.5	56.1	58.9	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.70	0.77	0.56	
	Time to failure, min t_f	6	14	15	
	Rate of strain, percent/min	0.22	0.98	0.07	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.45	0.66	0.48	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 2.0 °; $\tan\phi$ = 0.035; c = 0.35 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CH) WITH ORG MAT. & WOOD FRAGMENTS

LL 106 PL 40 PI 66 q_u 2.64

Remarks ____

Project HURRICANE PROTECTION, N.O. & VIC.

Area ____

Boring No. 12-EUT Sample No. 10-B

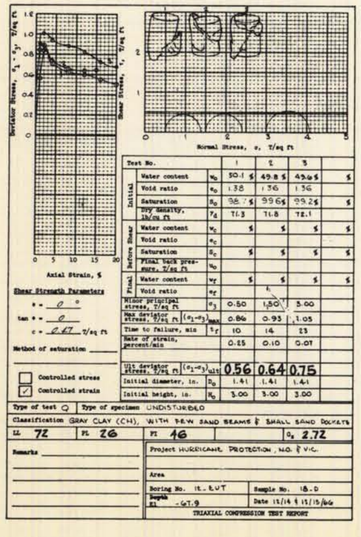
Depth -50.2 Date 12/13 & 12/14/66

El ____

TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 PREVIOUS EDITIONS ARE OBSOLETE DUNN PLATE X-3

19



Test No.		1	2	3	
Initial	Water content w_o	50.1 %	49.8 %	49.6 %	%
	Void ratio e_o	1.38	1.36	1.36	
	Saturation S_o	98.1 %	99.6 %	99.2 %	%
	Dry density, lb/cu ft γ_d	71.3	71.8	72.1	
Before Shear	Water content w_c	%	%	%	%
	Void ratio e_c				
	Saturation S_c	%	%	%	%
	Final back pressure, T/sq ft u_b				
Final	Water content w_f	%	%	%	%
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	0.50	1.50	3.00	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.86	0.93	1.05	
	Time to failure, min t_f	10	14	23	
	Rate of strain, percent/min	0.25	0.10	0.07	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.56	0.64	0.75	
	Initial diameter, in. D_o	1.41	1.41	1.41	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 0 °; $\tan\phi$ = 0.424; c = 0.67 T/sq ft

Method of saturation ____

☐ Controlled stress ☑ Controlled strain

Type of test Q Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), WITH SEW SAND SEAMS & SMALL SAND POCKETS

LL 72 PL 26 PI 46 q_u 2.72

Remarks ____

Project HURRICANE PROTECTION, NO. & VIC.

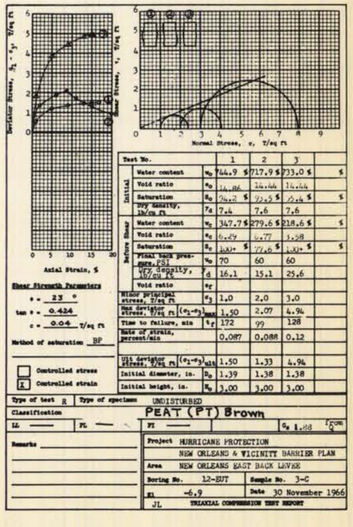
Area ____

Boring No. 12-EUT Sample No. 18-D

Depth -47.9 Date 12/14 & 12/15/66

El ____

TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	44.9 %	47.9 %	48.3 %	%
	Void ratio e_o	1.26	1.34	1.34	
	Saturation S_o	96.2 %	97.6 %	97.5 %	%
	Dry density, lb/cu ft γ_d	74.4	73.1	73.0	
Before Shear	Water content w_c	34.7 %	39.6 %	38.6 %	%
	Void ratio e_c	0.947	1.077	1.038	
	Saturation S_c	100 %	100 %	100 %	%
	Final back pressure, T/sq ft u_b	0.83	0.83	0.83	
Final	Water content w_f	30	30	30	
	Void ratio e_f	0.827	0.827	0.827	
	Minor principal stress, T/sq ft σ_3	1.0	2.0	3.0	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	1.50	2.07	4.94	
	Time to failure, min t_f	172	99	128	
	Rate of strain, percent/min		0.087	0.088	0.12
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	1.50	1.33	4.94	
	Initial diameter, in. D_o	1.39	1.38	1.38	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 23 °; $\tan\phi$ = 0.424; c = 0.04 T/sq ft

Method of saturation BP

☐ Controlled stress ☒ Controlled strain

Type of test R Type of specimen UNDISTURBED

Classification PEAT (PT) Brown

LL ____ PL ____ PI ____ q_u 1.68 from Q

Remarks ____

Project HURRICANE PROTECTION

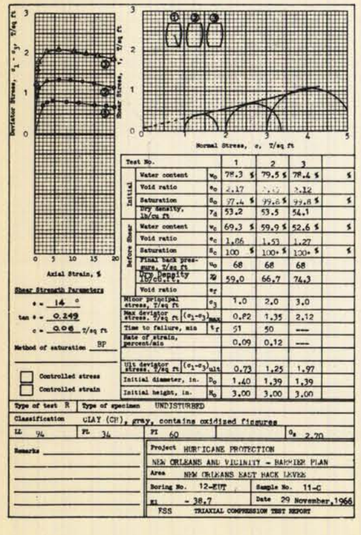
NEW ORLEANS & VICINITY BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EUT Sample No. 3-C

El -6.9 Date 30 November 1966

JL TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	78.3 %	79.5 %	78.4 %	%
	Void ratio e_o	2.17	2.17	2.12	
	Saturation S_o	97.4 %	99.6 %	97.8 %	%
	Dry density, lb/cu ft γ_d	53.2	53.5	54.1	
Before Shear	Water content w_c	69.3 %	59.9 %	52.6 %	%
	Void ratio e_c	1.86	1.51	1.27	
	Saturation S_c	100 %	100 %	100 %	%
	Final back pressure, T/sq ft u_b	68	68	68	
Final	Water content w_f	59.0	66.7	76.3	
	Void ratio e_f				
	Minor principal stress, T/sq ft σ_3	1.0	2.0	3.0	
	Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.82	1.35	2.12	
	Time to failure, min t_f	51	50	---	
	Rate of strain, percent/min	0.09	0.12	---	
	Ult deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{ult}$	0.73	1.25	1.97	
	Initial diameter, in. D_o	1.40	1.39	1.39	
	Initial height, in. H_o	3.00	3.00	3.00	

Shear Strength Parameters: ϕ = 14 °; $\tan\phi$ = 0.249; c = 0.06 T/sq ft

Method of saturation BP

☐ Controlled stress ☐ Controlled strain

Type of test R Type of specimen UNDISTURBED

Classification CLAY (CH), gray, contains oxidized fissures

LL 74 PL 34 PI 40 q_u 2.70

Remarks ____

Project HURRICANE PROTECTION

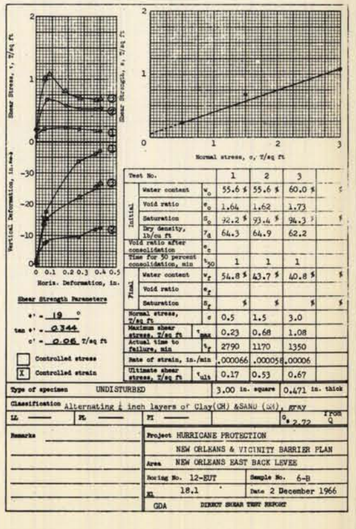
NEW ORLEANS AND VICINITY - BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EUT Sample No. 11-C

El -38.7 Date 29 November 1966

FSS TRIAXIAL COMPRESSION TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	55.6 %	55.6 %	60.0 %	%
	Void ratio e_o	1.64	1.62	1.73	
	Saturation S_o	92.2 %	93.6 %	96.3 %	%
	Dry density, lb/cu ft γ_d	64.3	64.9	62.2	
Final	Void ratio after consolidation e_c				
	Time for 50 percent consolidation, min t_{50}	1	1	1	
	Water content w_f	54.8 %	43.7 %	40.8 %	%
	Void ratio e_f				
	Saturation S_f	%	%	%	%
	Normal stress, T/sq ft σ	0.5	1.5	3.0	
	Maximum shear stress, T/sq ft τ_{max}	0.23	0.68	1.08	
	Actual time to failure, min t_f	2790	1170	1350	
	Rate of strain, in./min	.000066	.000058	.00006	
	Ultimate shear stress, T/sq ft τ_{ult}	0.17	0.53	0.67	

Shear Strength Parameters: ϕ = 19 °; $\tan\phi$ = 0.344; c = 0.06 T/sq ft

☐ Controlled stress ☒ Controlled strain

Type of specimen UNDISTURBED 3.00 in. square 0.471 in. thick

Classification Alternating 4 inch layers of Clay(CH) &SAND (SU), gray

LL ____ PL ____ PI ____ q_u 2.72 from Q

Remarks ____

Project HURRICANE PROTECTION

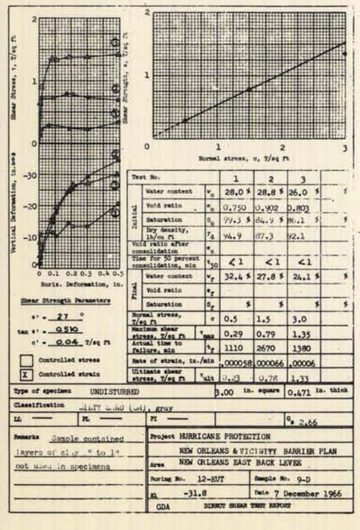
NEW ORLEANS & VICINITY BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EUT Sample No. 6-B

El 18.1 Date 2 December 1966

GDA DIRECT SHEAR TEST REPORT



Test No.		1	2	3	
Initial	Water content w_o	28.0 %	28.8 %	26.0 %	%
	Void ratio e_o	0.750	0.802	0.803	
	Saturation S_o	99.3 %	94.9 %	90.2 %	%
	Dry density, lb/cu ft γ_d	94.9	93.3	92.1	
Final	Void ratio after consolidation e_c				
	Time for 50 percent consolidation, min t_{50}	<1	<1	<1	
	Water content w_f	32.4 %	27.8 %	24.1 %	%
	Void ratio e_f				
	Saturation S_f	%	%	%	%
	Normal stress, T/sq ft σ	0.5	1.5	3.0	
	Maximum shear stress, T/sq ft τ_{max}	0.29	0.79	1.35	
	Actual time to failure, min t_f	1110	2670	1380	
	Rate of strain, in./min	.000058	.000066	.00006	
	Ultimate shear stress, T/sq ft τ_{ult}	0.23	0.78	1.33	

Shear Strength Parameters: ϕ = 27 °; $\tan\phi$ = 0.510; c = 0.04 T/sq ft

☐ Controlled stress ☒ Controlled strain

Type of specimen UNDISTURBED 3.00 in. square 0.471 in. thick

Classification silty clay (CL), gray

LL ____ PL ____ PI ____ q_u 2.66

Remarks Sample contained layers of clay 4 to 1" not used in specimens

Project HURRICANE PROTECTION

NEW ORLEANS & VICINITY BARRIER PLAN

Area NEW ORLEANS EAST BACK LEVEE

Boring No. 12-EUT Sample No. 9-D

El -31.8 Date 7 December 1966

GDA DIRECT SHEAR TEST REPORT

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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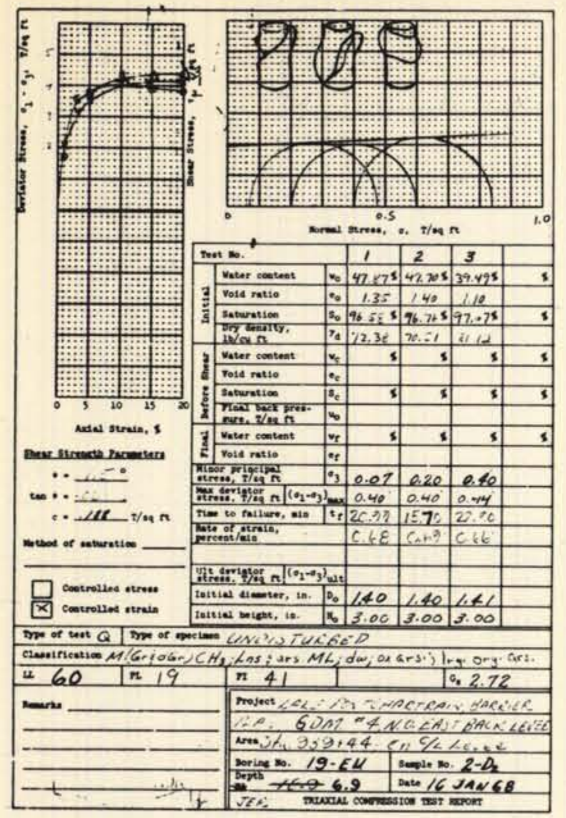
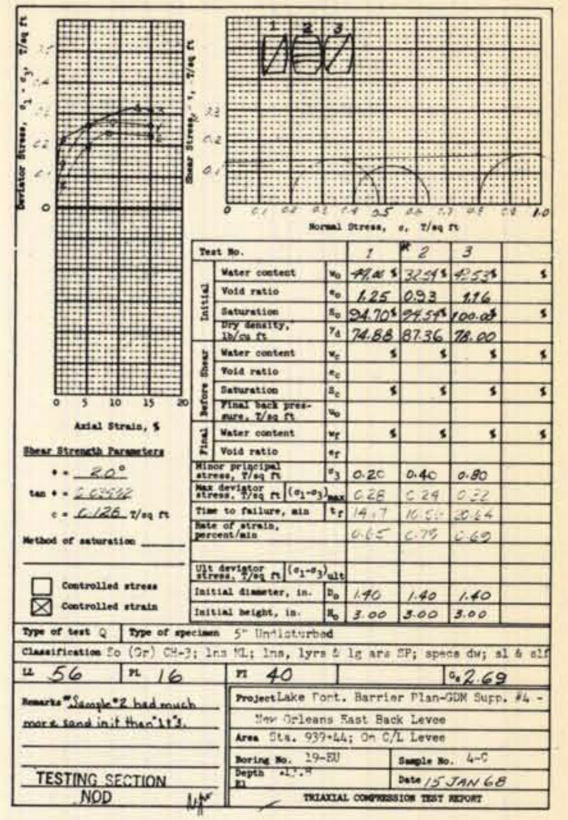
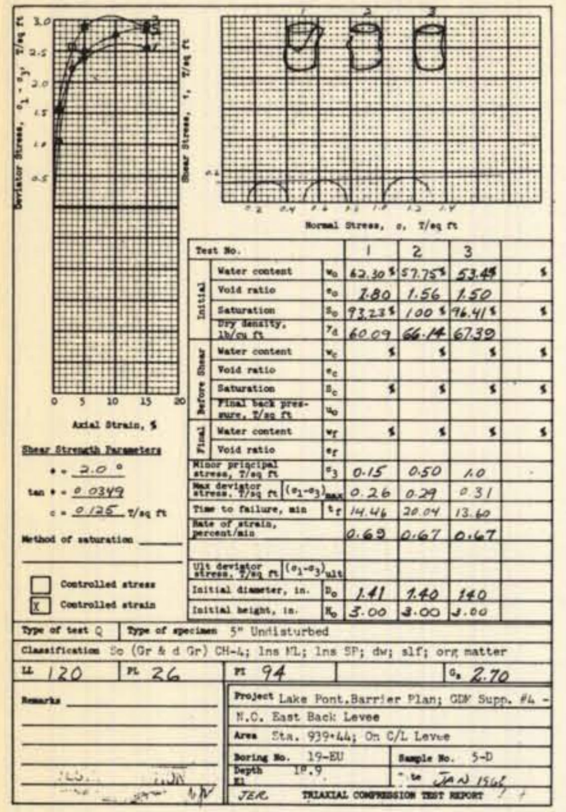
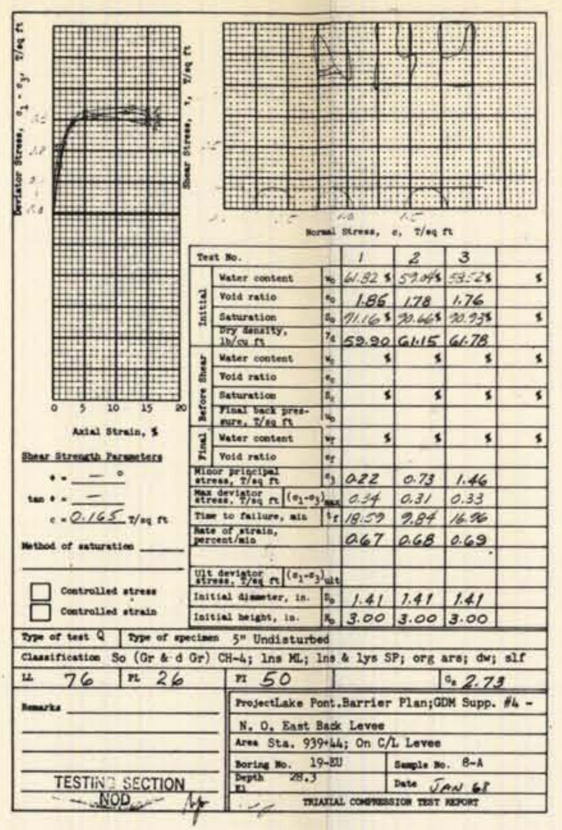
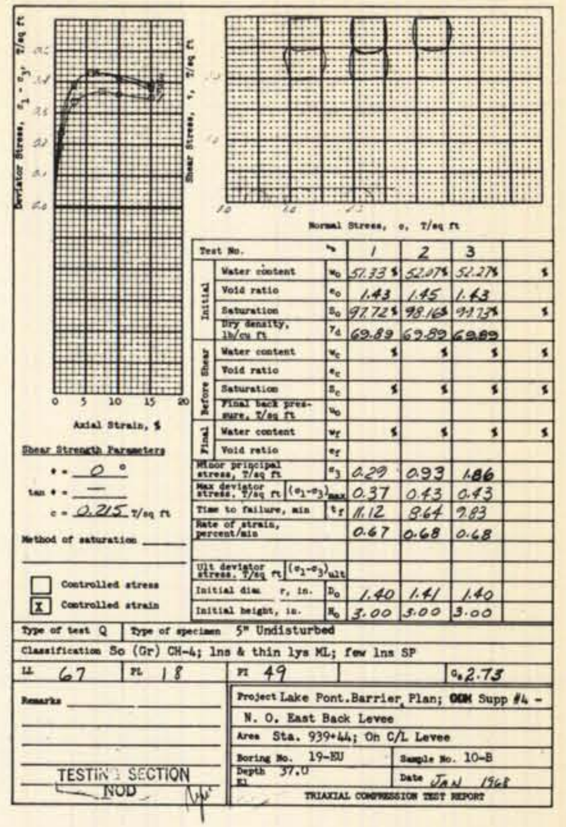
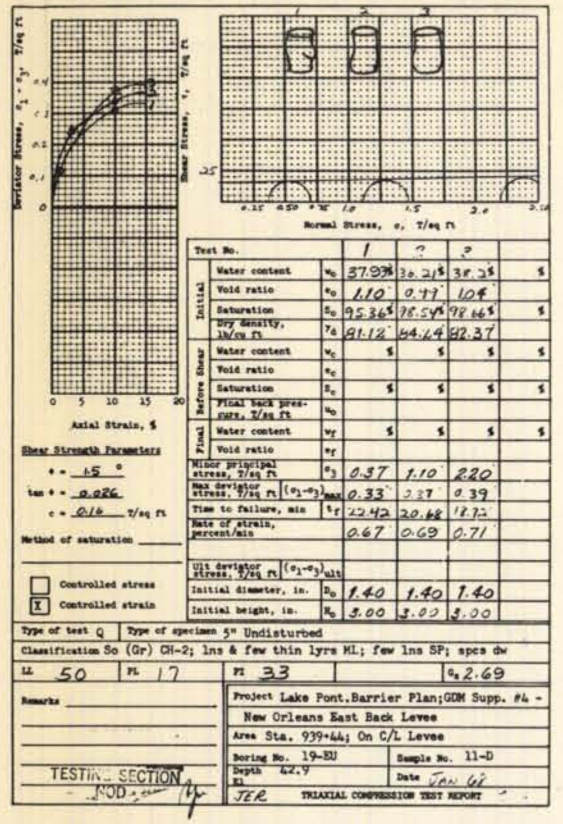
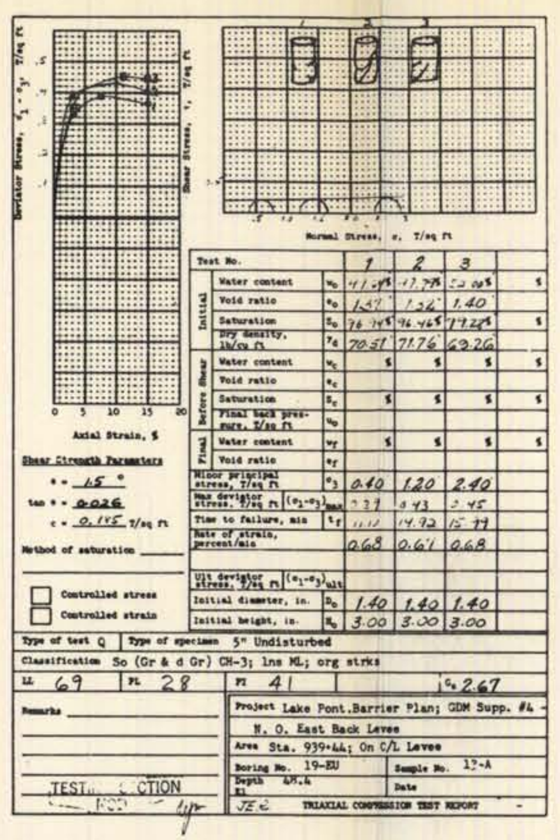
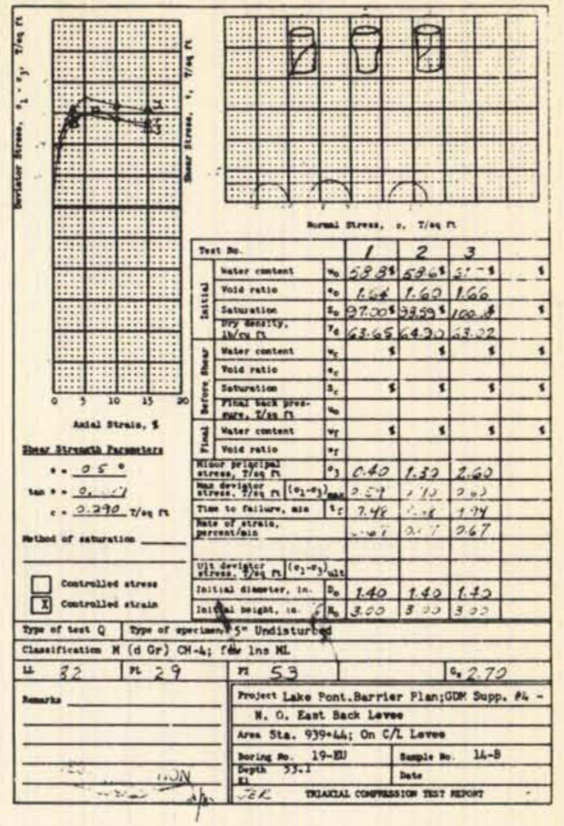
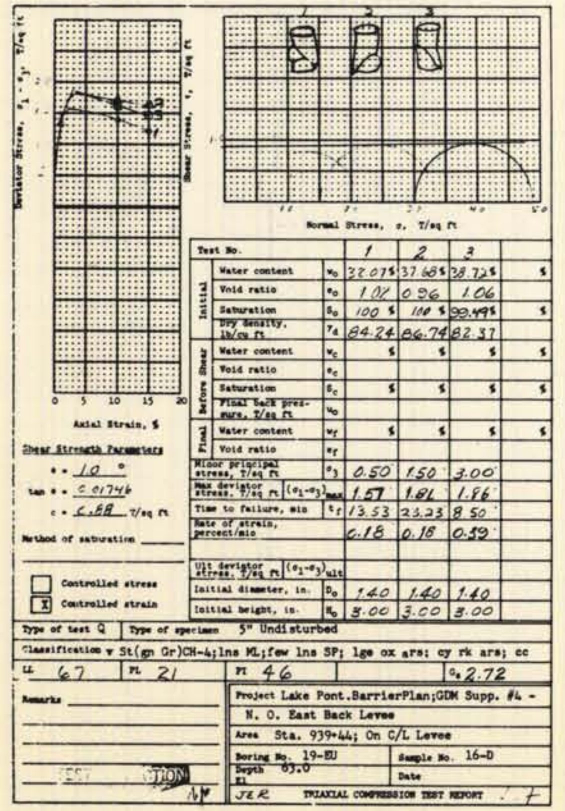
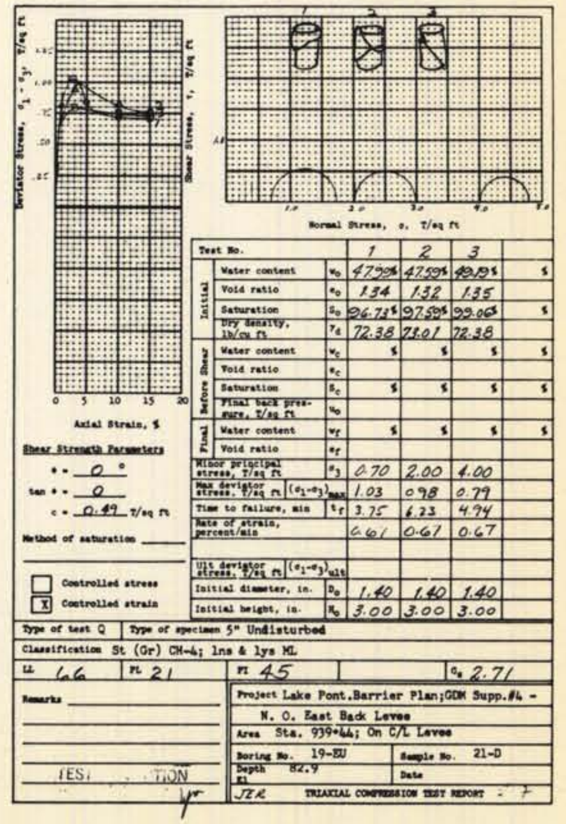
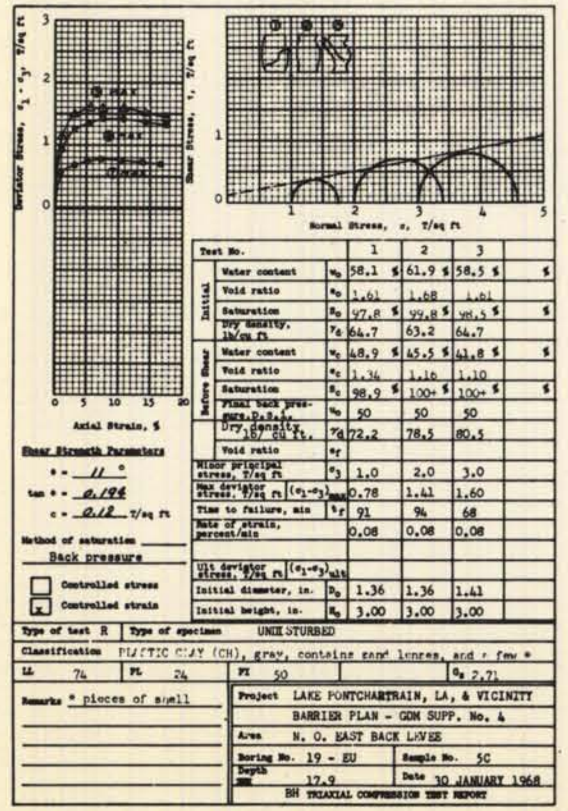
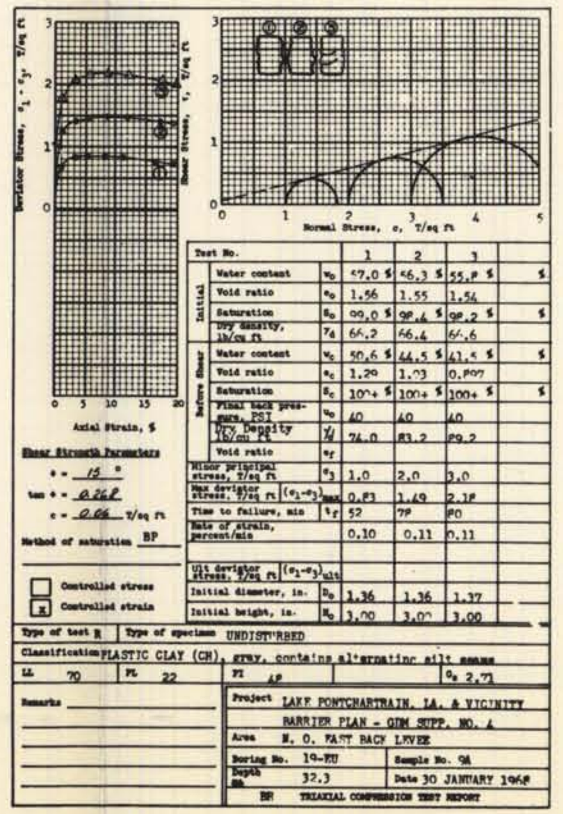
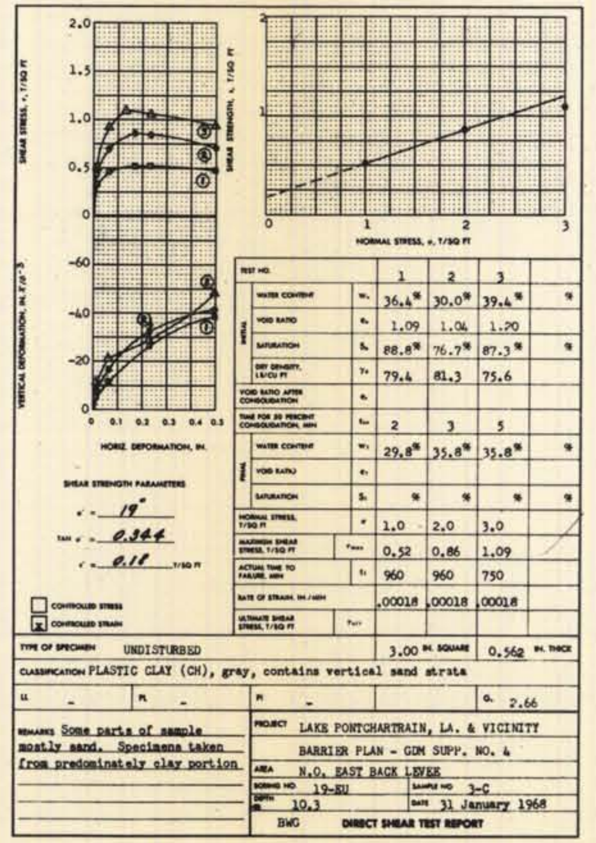
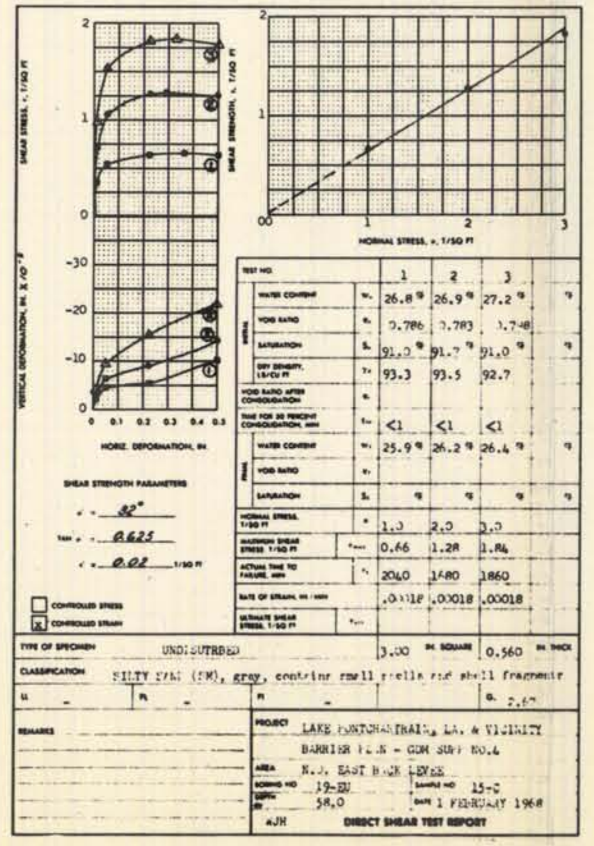
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 12-EUT

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 22

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 19-EU

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

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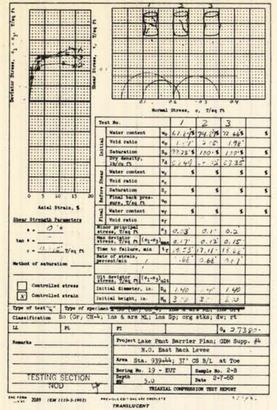

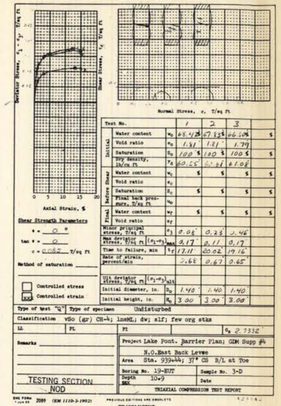

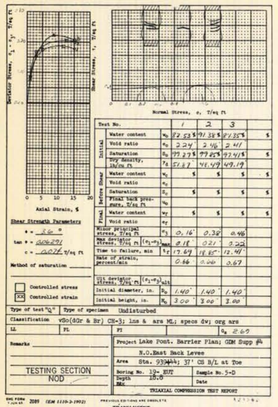

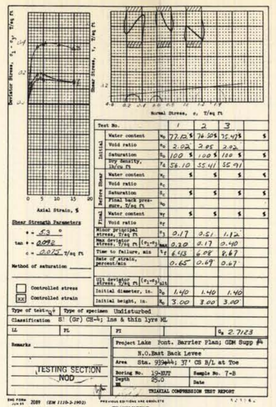

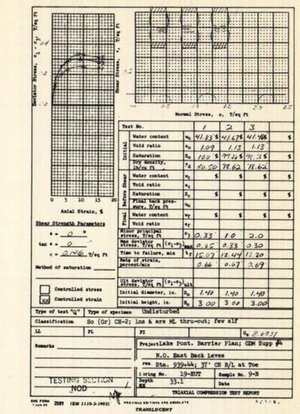

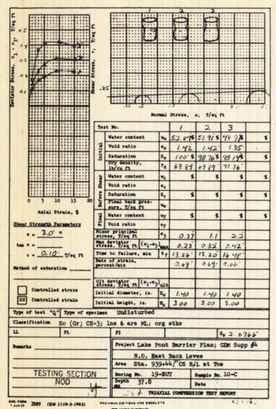

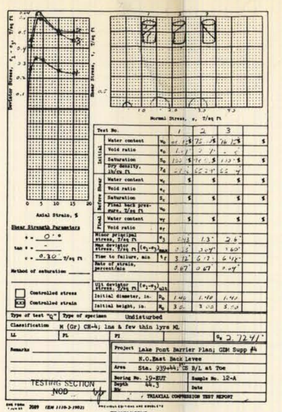

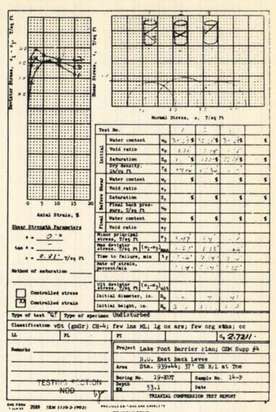

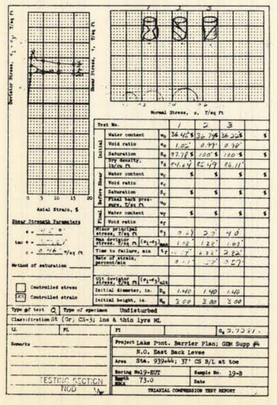

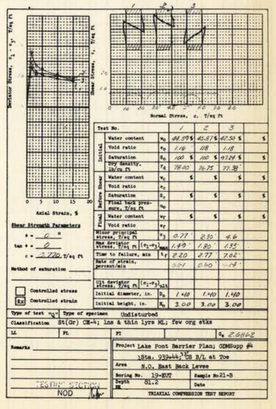

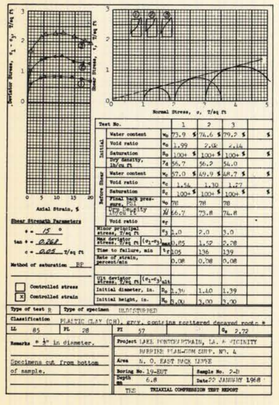

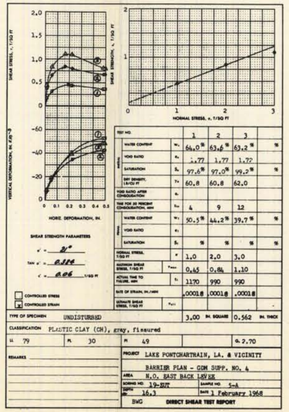

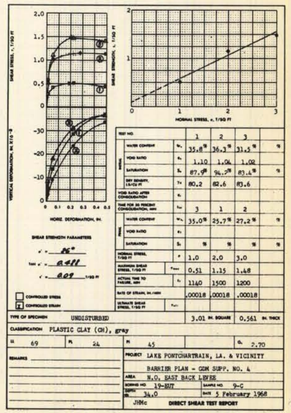

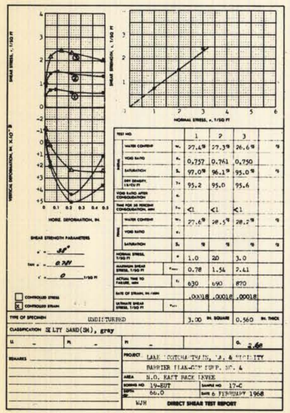

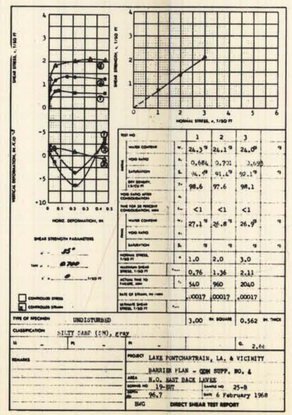

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 19-EUT

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

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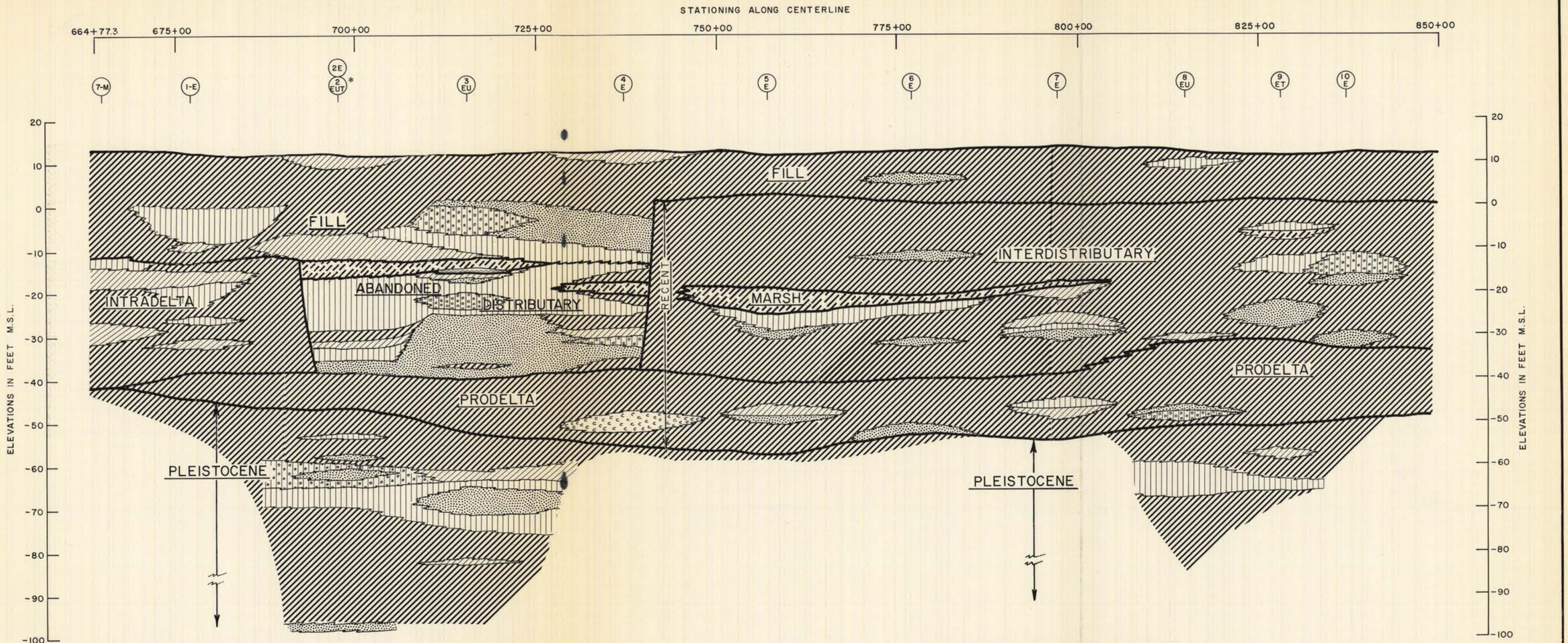
PLATE 24



LEGEND

CH	- fat clay	FILL
CHO	- fat clay w/org. matter	NATURAL LEVEE - soft to stiff clays w/lenses and layers silt
PT	- peat	MARSH - vy. soft clays w/organic matter and peat
CL	- lean clay	INTERDISTRIBUTARY - vy. soft to soft clays w/lenses and layers silt
ML	- silt	INTRADELTA - soft alternating clays and silts w/layers and areas silt, silty sands and sands
SM	- silty sand	ABANDONED DISTRIBUTARY - silts, silty sands, and sands w/lenses and layers clay
SP	- fine sand	PRODELTA - medium to stiff clays
SI	- shells	NEARSHORE - sands w/shell and shell fragments and lenses and layers of clay

NOTES: For general type boring logs see plates 5&6
For undisturbed boring logs see plates 7 through 9.
*2EUT used for profiling below elevation -40' m.s.l.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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NEW ORLEANS EAST BACK LEVEE

SOIL AND GEOLOGIC PROFILE ALONG ℄ OF LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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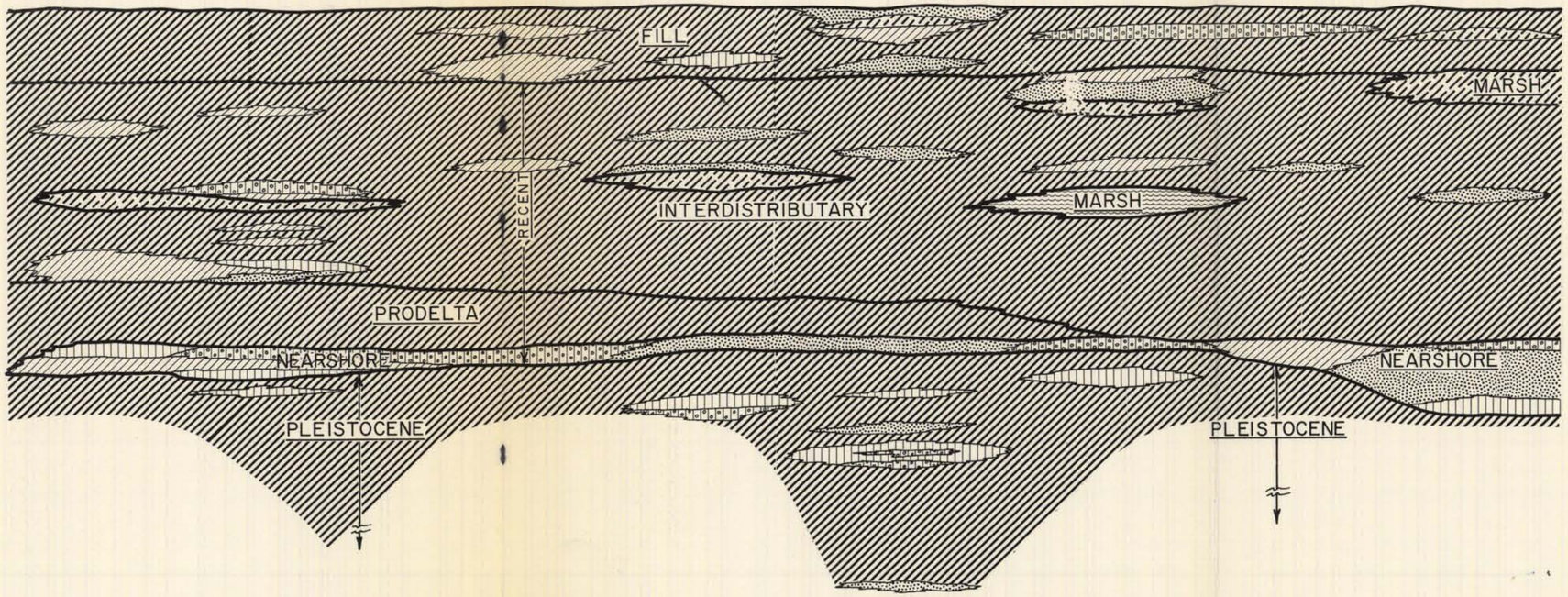
PLATE 25

STATIONING ALONG CENTERLINE

850+00 875+00 900+00 925+00 950+00 975+00 1000+00 1006+59.2

11 E | 12 EU | 13 E | 14 E | 19 EU | 16 E | 17 E | 18 E



ELEVATIONS IN FEET M.S.L.

21 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100

20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100

ELEVATIONS IN FEET M.S.L.

LEGEND

	CH – fat clay	FILL
	CHO – fat clay w/org. matter	NATURAL LEVEE – soft to stiff clays w/lenses and layers silt
	PT – peat	MARSH – vy. soft clays w/organic matter and peat
	CL – lean clay	INTERDISTRIBUTARY – vy. soft to soft clays w/lenses and layers silt
	ML – silt	INTRADELTA – soft alternating clays and silts w/layers and areas silt, silty sands and sands
	SM – silty sand	ABANDONED DISTRIBUTARY – silts, silty sands, and sands w/lenses and layers clay
	SP – fine sand	PRODELTA – medium to stiff clays
	SI – shells	NEARSHORE – sands w/shell and shell fragments and lenses and layers of clay

NOTES: For general type boring logs see plates 5 & 6
For undisturbed boring logs see plates 10 through 13

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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NEW ORLEANS EAST BACK LEVEE

SOIL AND GEOLOGIC PROFILE ALONG ℄ OF LEVEE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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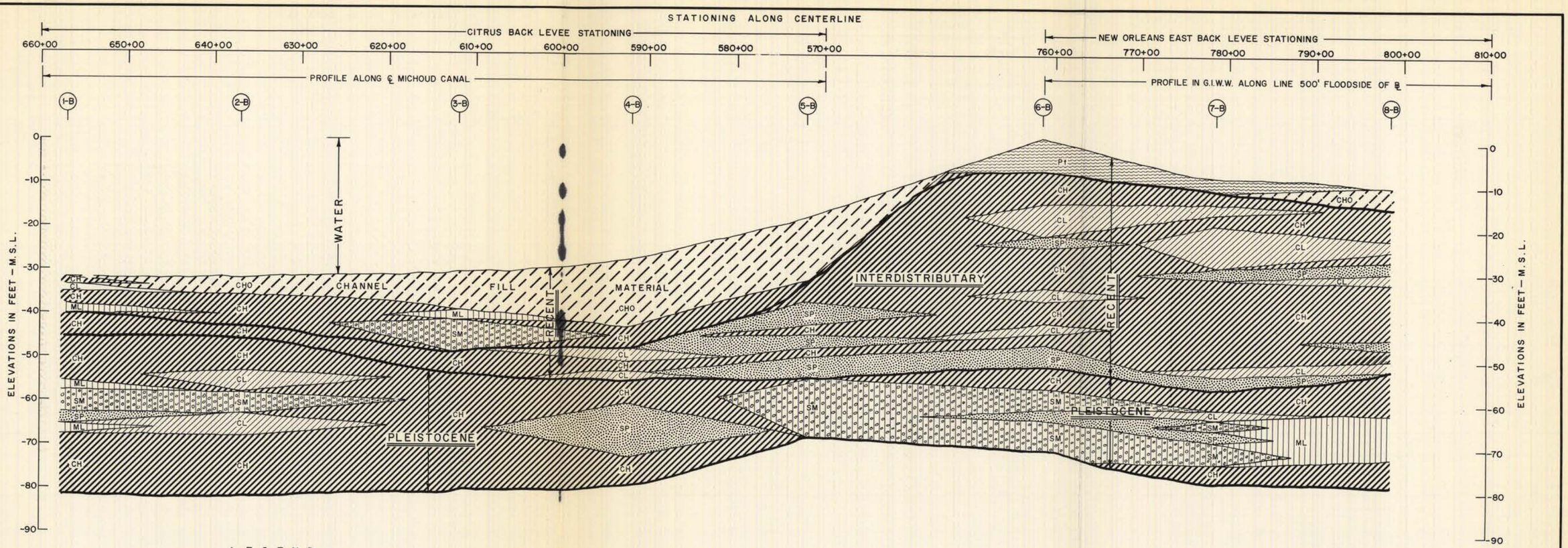
PLATE 26



LEGEND

- (CH) fat clay
- (CHO) fat clay with organic matter and peat
- (Pt) peat
- (ML) silt
- (SM) silty sand
- (SP) fine sand
- (CL) lean clay

NOTES:

CHANNEL FILL MATERIAL.
INTERDISTRIBUTARY – vy. soft to soft clays w/lenses & layers of ML.
REWORKED PLEISTOCENE – med. to stiff clays w/SIS.
PLEISTOCENE – stiff to vy. stiff clays w/SIS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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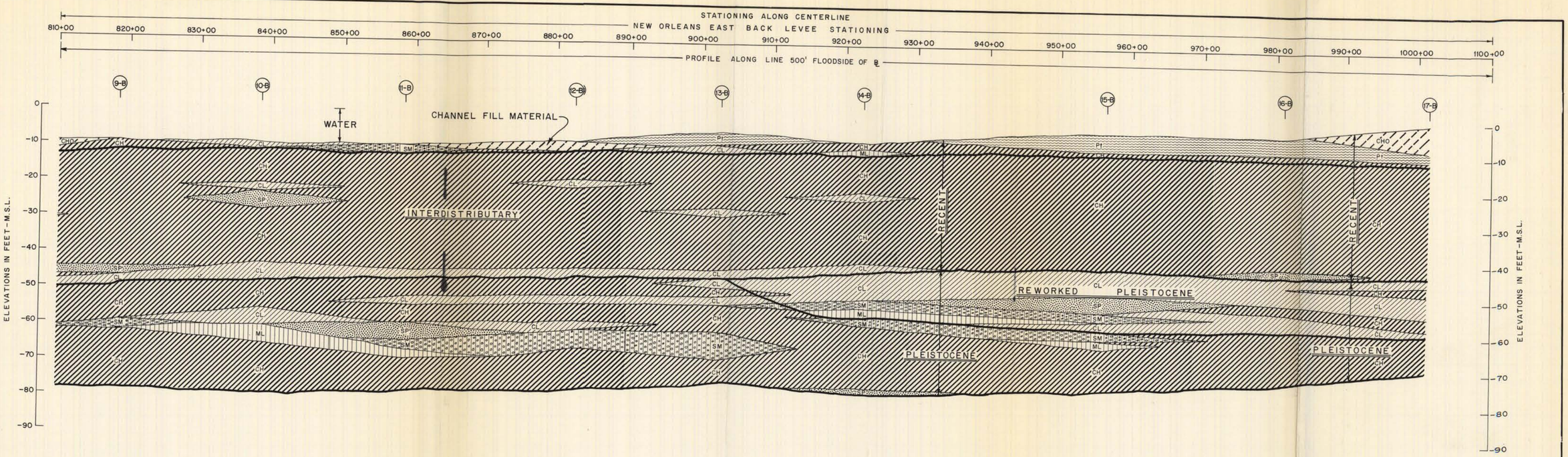
NEW ORLEANS EAST BACK LEVEE

SOIL AND GEOLOGIC PROFILE BORROW BORINGS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 27



NOTE:
For legend see plate 27.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

SOIL AND GEOLOGIC PROFILE BORROW BORINGS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

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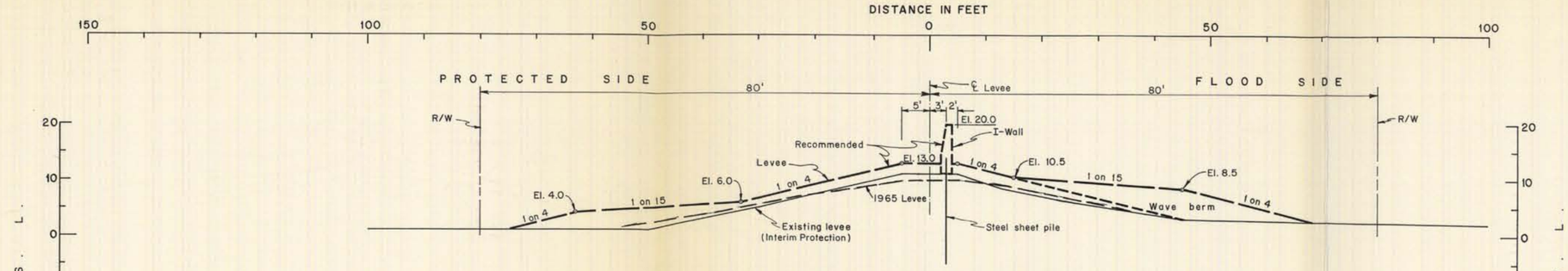
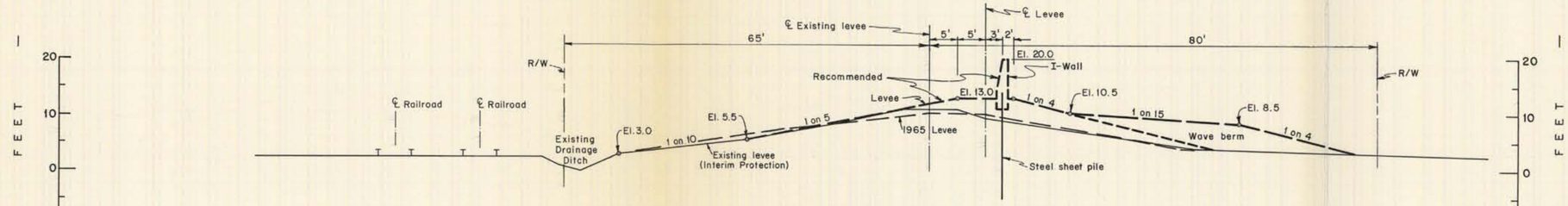
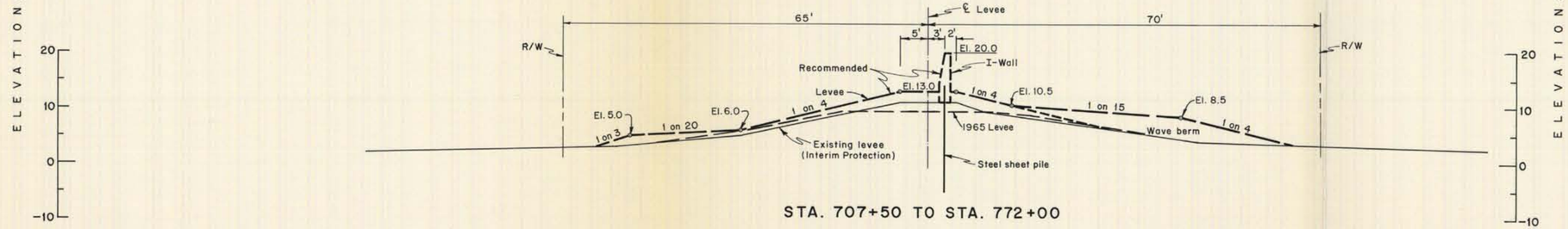
PLATE 28



STA. 664+73.3 TO STA. 690+00



STA. 690+00 TO STA. 707+50



STA. 707+50 TO STA. 772+00

NOTES:

Levee to be constructed to ultimate section in one lift.

Quantity of in place material should be increased by 15% to allow for shrinkage and consolidation of fill.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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NEW ORLEANS EAST BACK LEVEE

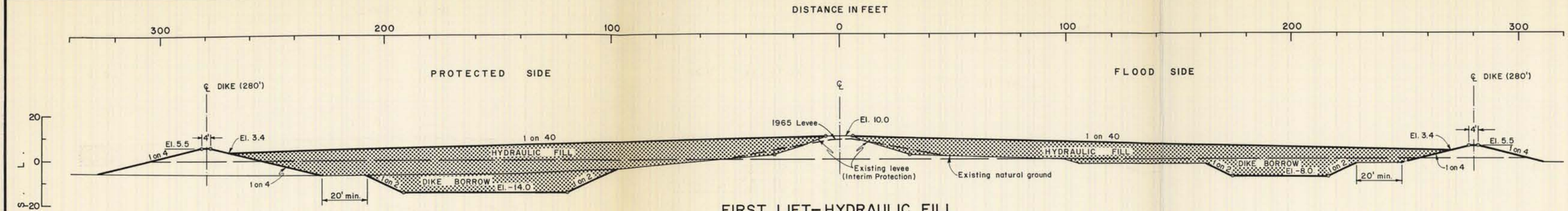
I-WALL & LEVEE CONFIGURATION STA. 664+73.3 TO STA. 772+00

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

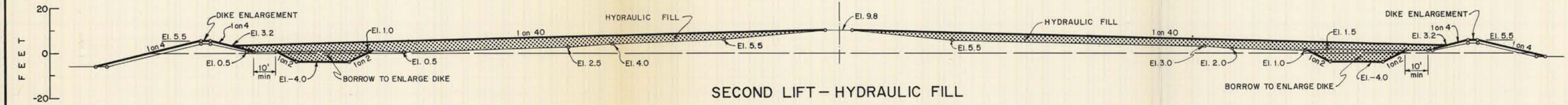
FEB 1971

FILE NO. H-2-24625

PLATE 29

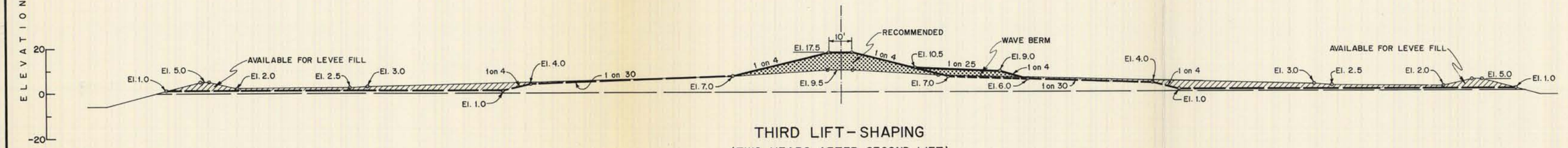


FIRST LIFT- HYDRAULIC FILL



SECOND LIFT - HYDRAULIC FILL

(TWO YEARS AFTER FIRST LIFT)



THIRD LIFT - SHAPING

(TWO YEARS AFTER SECOND LIFT)

NOTE:
HYDRAULIC FILL CONSTRUCTION APPLICABLE TO REACH BETWEEN STATIONS 772+00 AND 840+00

NOTES:

Quantity of in place material should be increased by 20% to allow for shrinkage and consolidation of fill.

Excess fill from nearby sections will be used to complete the third lift where quantity of adjacent fill is not sufficient.

Settlement of fill includes consolidation and lateral spread of foundation. Hydraulic fill to be obtained from bottom of adjacent G I W W

An additional 1.5 feet of settlement of the crown is anticipated subsequent to construction of the third lift. Shaded area is that required to construct each lift.

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NEW ORLEANS EAST BACK LEVEE

LEVEE SECTIONS
STAGE CONSTRUCTION
STA. 772+00 TO STA. 840+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

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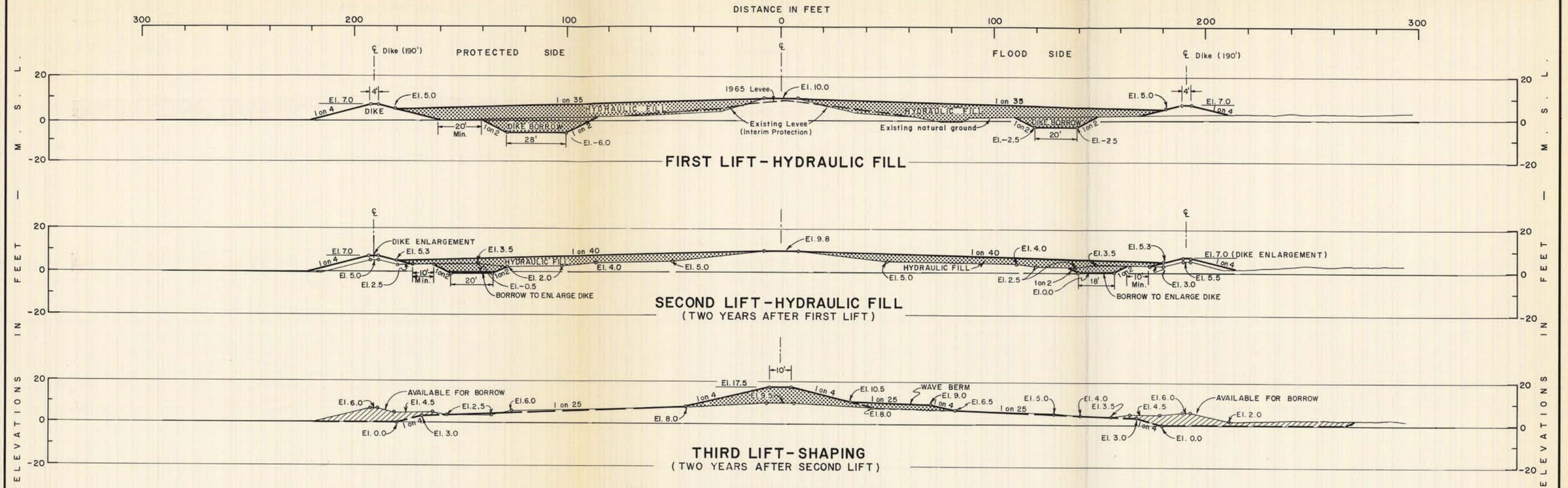
PLATE 30



HYDRAULIC FILL CONSTRUCTION APPLICABLE TO REACH BETWEEN STATIONS 840+00 AND 874+47 AND STATIONS 879+27 AND 892+00.
FOR CONFIGURATION OF FLOODWALL AND LEVEE BETWEEN STATIONS 874+47 AND 879+27 SEE PLAN ON PLATE 56.

NOTES:
Settlement of fill includes consolidation and lateral spread of foundation.
Hydraulic fill to be obtained from bottom of adjacent G I W W
An additional 1.5 feet of settlement of the crown is anticipated subsequent to construction of the third lift. Shaded area is required to construct each lift.
Quantity of in place material should be increased by 20% to allow for shrinkage and consolidation fill.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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LEVEE SECTIONS STAGE CONSTRUCTION STA. 840+00 TO STA. 892+00

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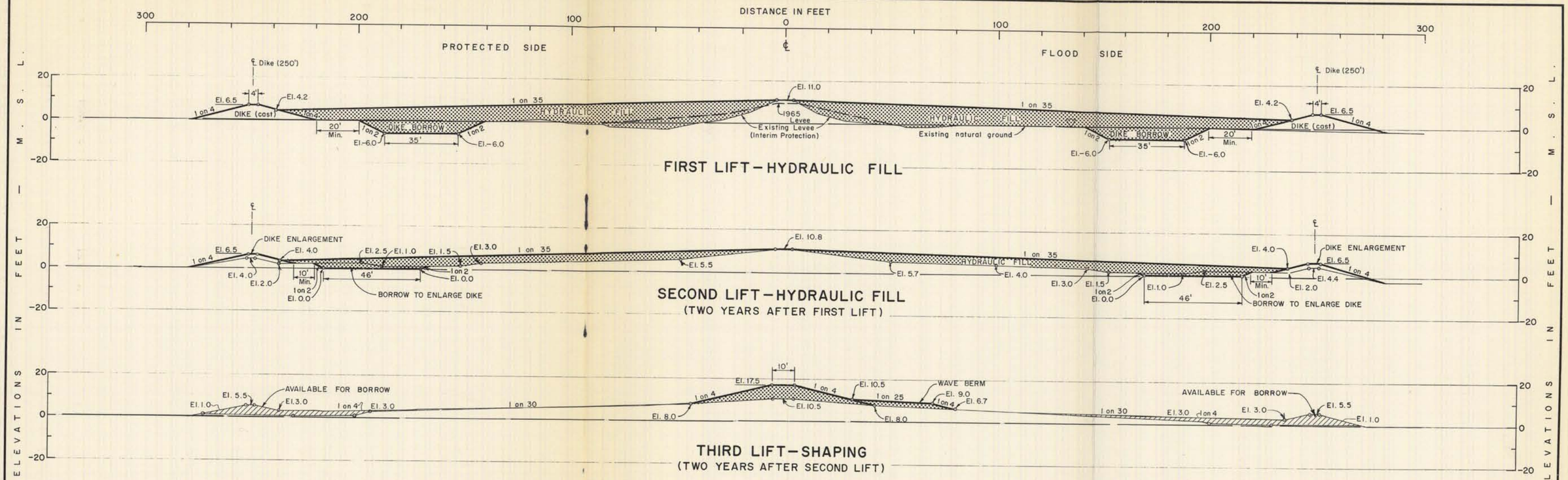
FILE NO. H-2-24625

PLATE 31



NOTES:

Quantity of in place material should be increased by 20% to allow for shrinkage and consolidation of fill.

Settlement of fill includes consolidation and lateral spread of foundation.

Hydraulic fill to be obtained from bottom of adjacent G I W W and Michoud Canal.

An additional 2.0 feet of settlement of the crown is anticipated subsequent to construction of the third lift.

Shaded area is that required to construct each lift.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

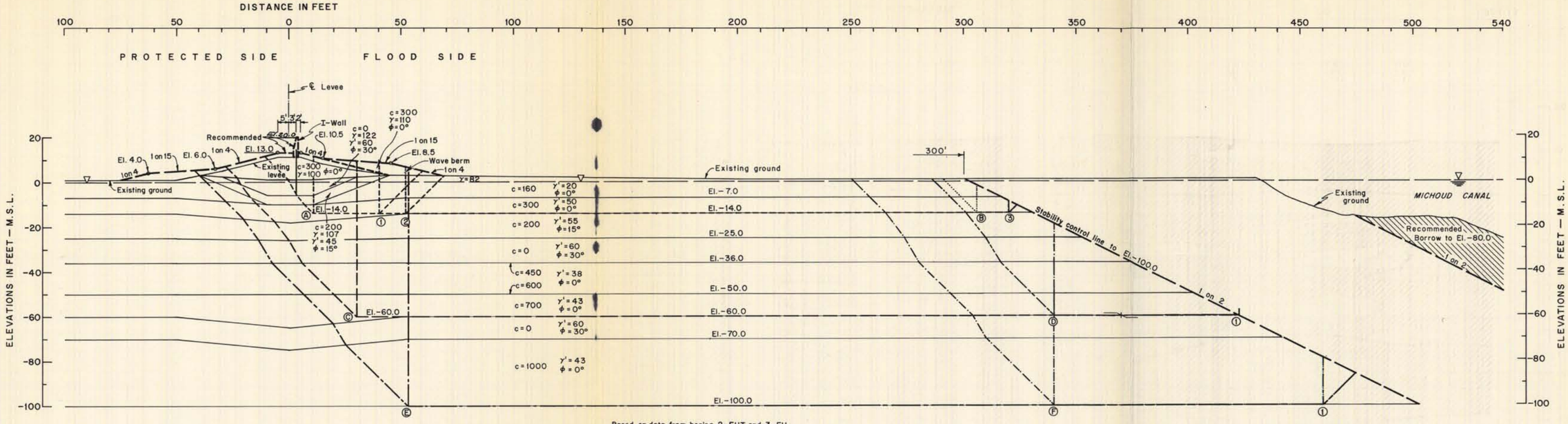
LEVEE SECTIONS STAGE CONSTRUCTION STA. 892+00 TO STA. 1006+59.2

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

FILE NO. H-2-24625

PLATE 32



Based on data from boring 2-EUT and 3-EU.
See plates 7 and 8 respectively.

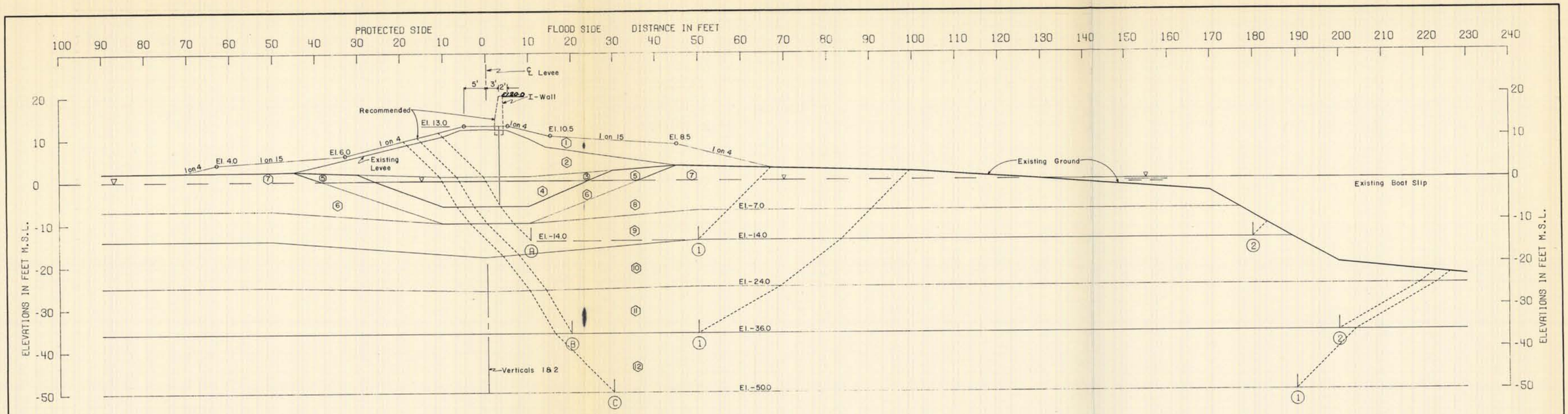
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	ΣR	ΣD	
Ⓐ ①	-14.0	16,853	8,850	8,520	31,535	15,006	34,223	16,529	2.07*
Ⓐ ②	-14.0	16,853	12,450	7,400	31,535	10,375	36,703	21,160	1.73**
Ⓐ ③	-14.0	16,853	88,650	1,800	31,535	375	107,303	31,160	3.44
Ⓑ ③	-14.0	6,760	4,200	1,800	3,515	375	12,760	3,140	4.06
Ⓒ ①	-60.0	76,252	245,416	0	166,347	0	321,668	166,347	1.93
Ⓓ ①	-60.0	51,605	36,931	0	68,156	0	88,536	68,156	1.30
Ⓔ ①	-100.0	154,725	407,000	28,000	345,272	6,321	589,725	338,951	1.74
Ⓕ ①	-100.0	132,264	120,000	28,000	216,872	6,321	280,264	210,551	1.33

*F.S. without wave berm is 1.37.
**F.S. without wave berm is 1.47.

For general notes see plate 34.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
I-WALL LEVEE-FLOOD SIDE
(Q) STABILITY ANALYSIS
STA. 664+73.3 TO STA. 669+00
STA. 671+00 TO STA. 689+00
STA. 724+00 TO STA. 740+00
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625

PLATE 33



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 2-EUT&3-EU DATA PLATES 7 & 8 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
①	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
②	CH	100.0	100.0	300.0	300.0	300.0	300.0	0.
③	SP	122.0	122.0	0.	0.	0.	0.	30.0
④	SP	60.0	60.0	0.	0.	0.	0.	30.0
⑤	ML	107.0	107.0	200.0	200.0	200.0	200.0	15.0
⑥	ML	45.0	45.0	200.0	200.0	200.0	200.0	15.0
⑦	CH	82.0	82.0	160.0	160.0	160.0	160.0	0.
⑧	CH	20.0	20.0	160.0	160.0	160.0	160.0	0.
⑨	CH	50.0	50.0	300.0	300.0	300.0	300.0	0.
⑩	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
⑪	SP	60.0	60.0	0.	0.	0.	0.	30.0
⑫	CH	38.0	38.0	525.0	525.0	600.0	600.0	0.

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓐ	①	-14.00	19722	11850	7879	31710	10299	39452	21411	1.819
Ⓐ	②	-14.00	19722	50789	1989	31710	484	72502	31270	2.318
Ⓑ	①	-36.00	49863	18000	61689	84835	37.22	129553	47713	2.715
Ⓑ	②	-36.00	49863	107895	13743	84835	6309	171502	78525	2.184
Ⓒ	①	-49.90	64420	96000	27647	129059	24140	188068	104919	1.793

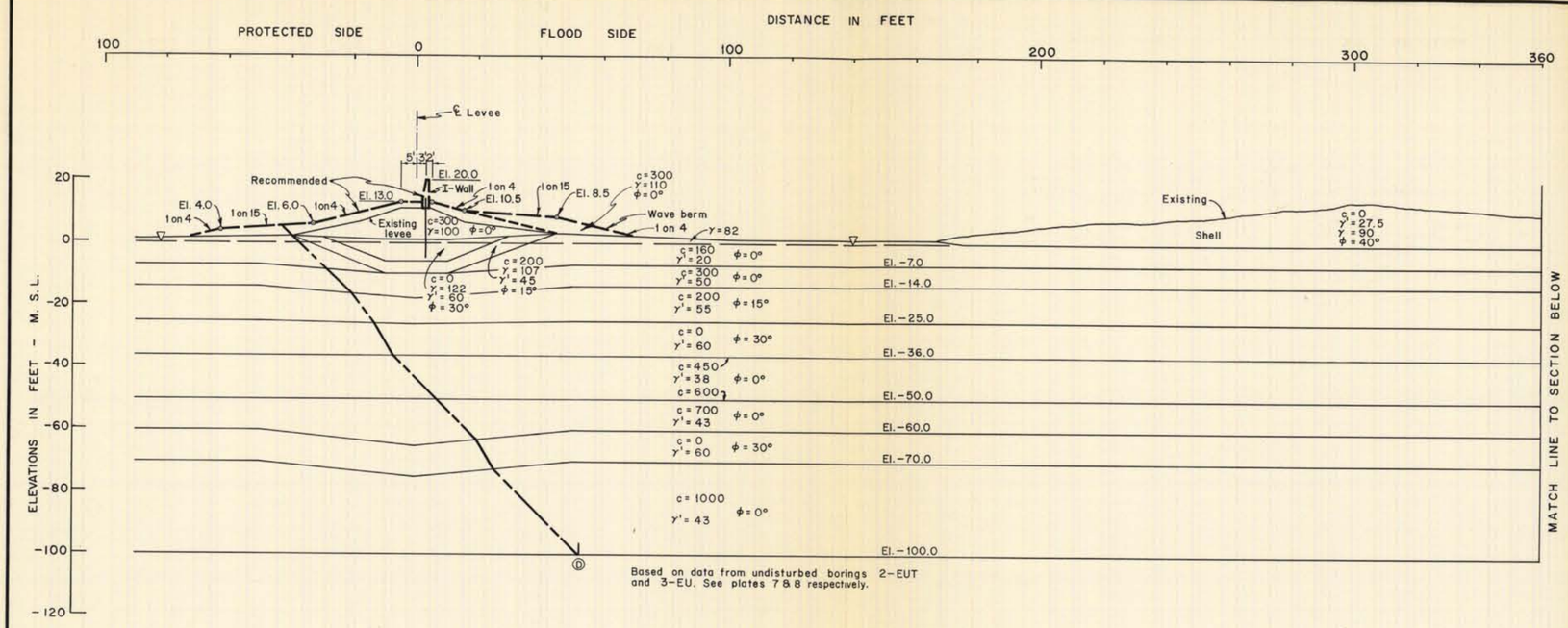
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

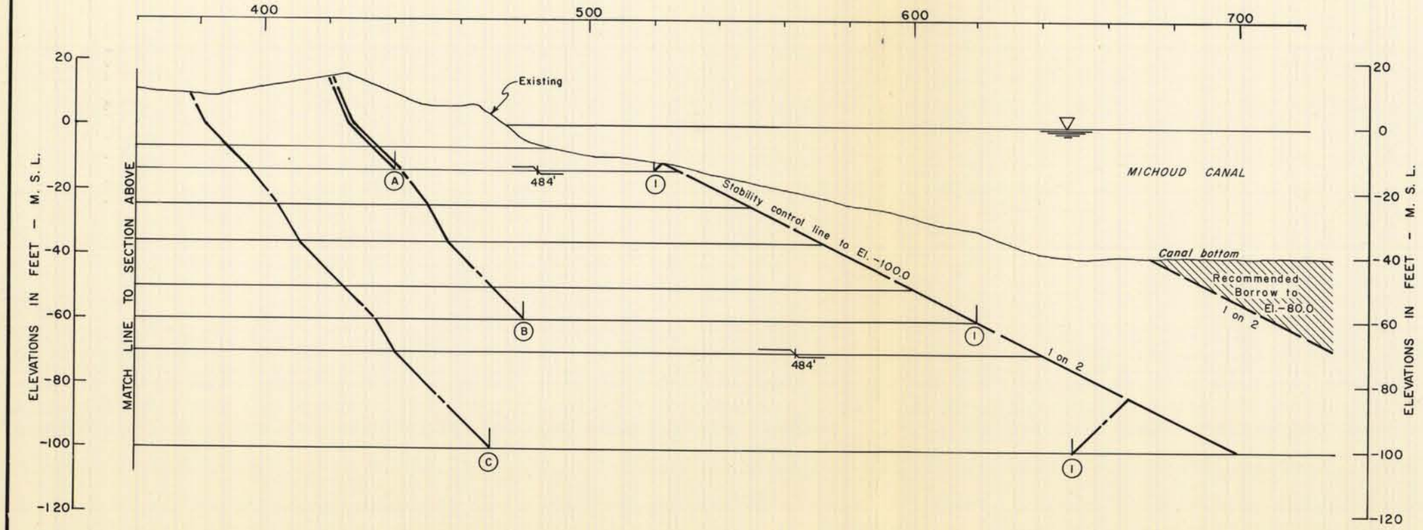
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 — GENERAL DESIGN
SUPPLEMENT NO.4
NEW ORLEANS EAST BACK LEVEE
I-WALL LEVEE
BOAT SLIP CROSSING
(Q) STABILITY ANALYSIS
STA. 669+00 TO STA. 671+00
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 34



Based on data from undisturbed borings 2-EUT and 3-EU. See plates 7 & 8 respectively.



ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A)-(I)	-14.0	9,035	22,858	1,440	10,834	179	33,333	10,655	3.13
(B)-(I)	-60.0	57,268	77,530	0	94,150	0	134,798	94,150	1.43
(C)-(I)	-100.0	139,563	180,000	32,000	258,730	8,869	351,563	249,861	1.41
(D)-(I)	-100.0	153,725	597,000	32,000	345,272	8,869	782,725	336,403	2.33

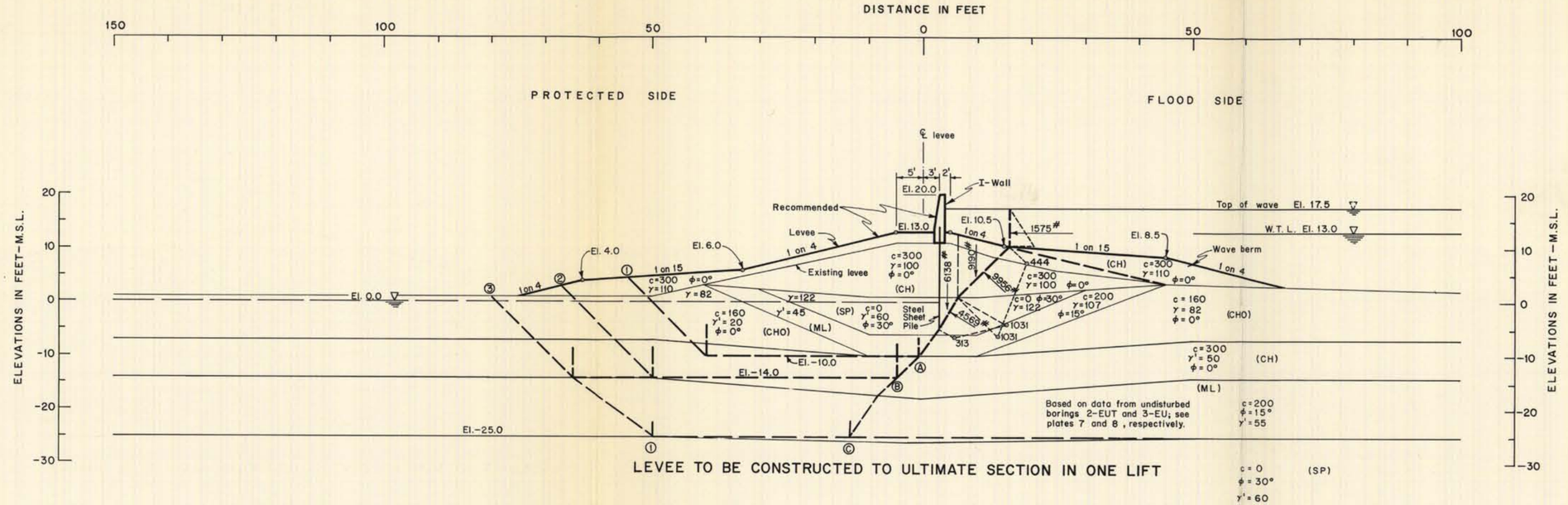
For general notes see plate 34.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LIMIT OF BORROW — FLOOD SIDE (Q) STABILITY ANALYSIS STA. 689+00 TO STA. 724+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625

PLATE 35



LEVEE TO BE CONSTRUCTED TO ULTIMATE SECTION IN ONE LIFT

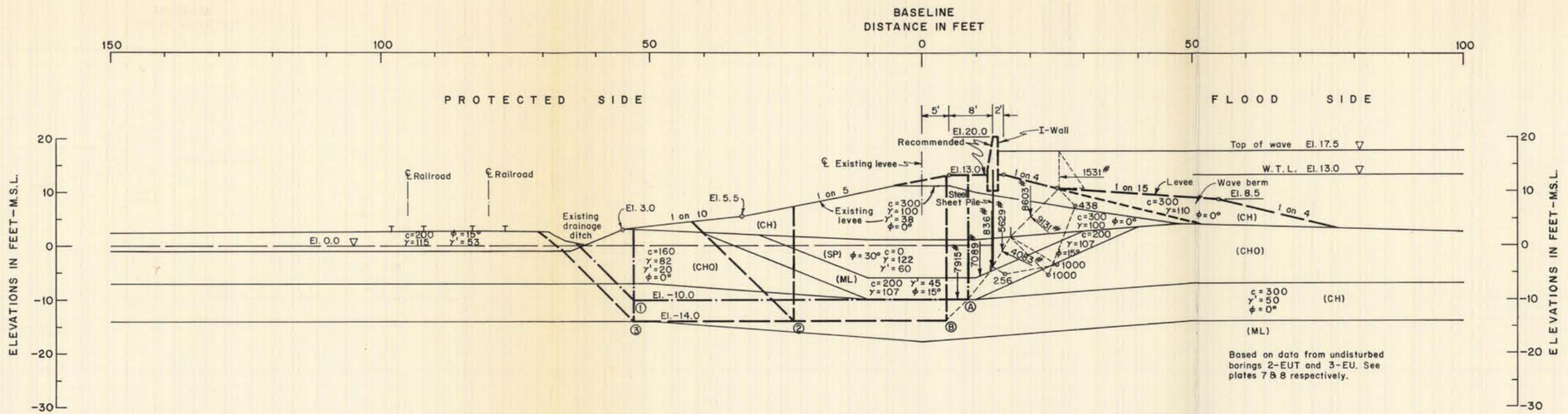
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	ΣR	ΣD	
Ⓐ ①	-10.0	16,186	11,700	6,352	30,125	7,382	34,238	22,743	1.50
Ⓑ ②	-14.0	18,586	13,560	7,960	38,053	9,626	40,106	28,427	1.41
Ⓑ ③	-14.0	18,586	18,060	6,760	38,053	5,259	43,406	32,794	1.32
Ⓒ ①	-25.0*	27,454	17,161	13,386	63,184	20,118	58,001	43,066	1.35

* Uplift applied from El. 13.0 in (ML) stratum.

For general notes see plate 34.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
I-WALL LEVEE-PROTECTED SIDE
(Q) STABILITY ANALYSIS
STA. 664+73.3 TO STA. 690+00
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625



APPLICABLE TO REACH OF I-WALL ADJACENT TO RAILROAD TRACK

LEVEE TO BE CONSTRUCTED TO ULTIMATE SECTION IN ONE LIFT

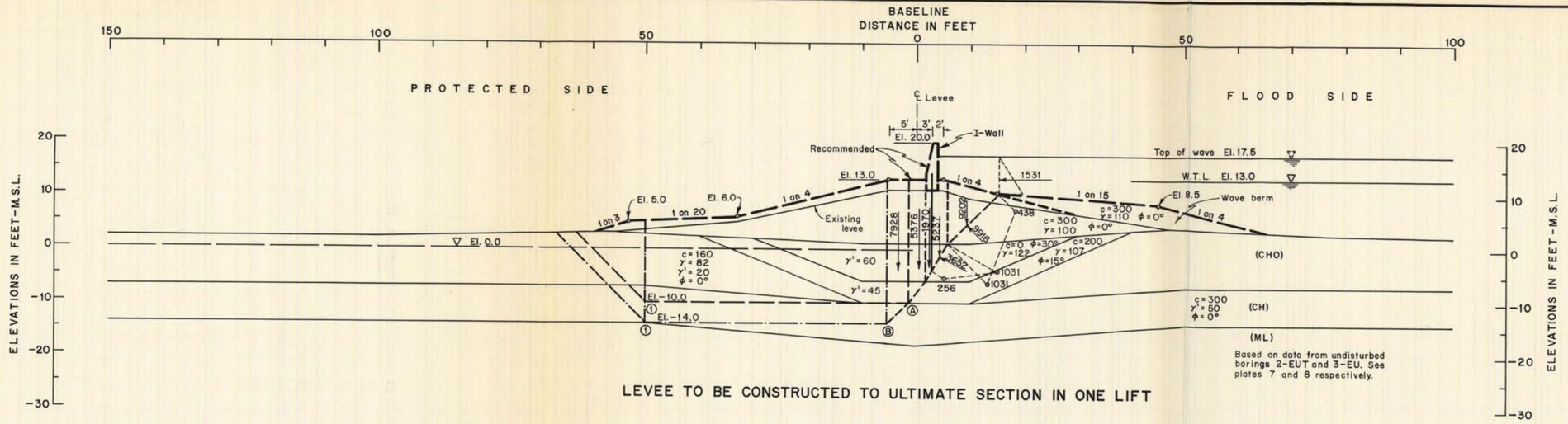
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	ΣR	ΣD	
Ⓐ ①	-10.0	16,304	18,450	4,040	30,533	2,488	38,794	28,045	1.38
Ⓑ ②	-14.0	18,704	8,400	8,020	38,448	12,694	35,124	25,754	1.36
Ⓑ ③	-14.0	18,704	17,250	7,955	38,448	4,980	43,909	33,468	1.31

For general notes see plate 34.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

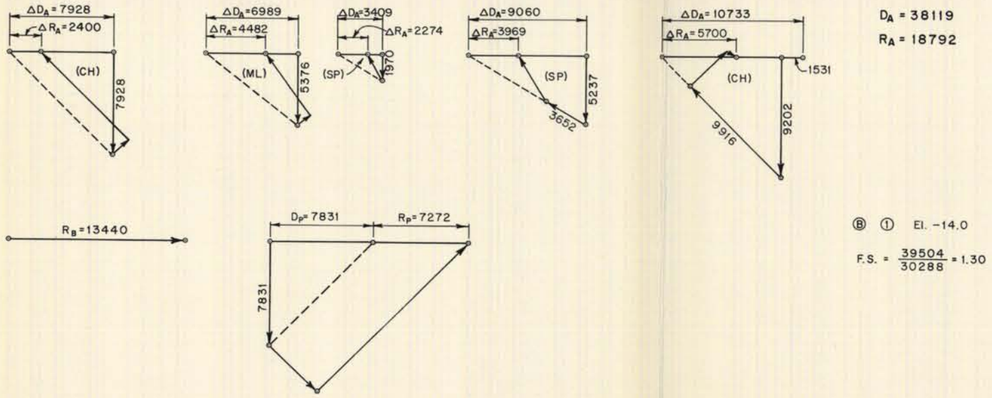
I-WALL LEVEE-PROTECTED SIDE (Q) STABILITY ANALYSIS STA. 690+00 TO STA. 707+50

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625



Based on data from undisturbed borings 2-EUT and 3-EU. See plates 7 and 8 respectively.

LEVEE TO BE CONSTRUCTED TO ULTIMATE SECTION IN ONE LIFT



$D_A = 38119$

$R_A = 18792$

Ⓑ ① El. −14.0

$F.S. = \frac{39504}{30288} = 1.30$

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NUMBER	ELEVATION	R_A	R_B	R_P	D_A	$-D_P$	ΣR	ΣD	
Ⓐ ①	-10.0	16,392	14,610	4,648	30,191	5,245	35,650	24,946	1.43
Ⓑ ①	-14.0	18,792	13,440	7,272	38,119	7,831	39,504	30,288	1.30

For general notes see plate 34.

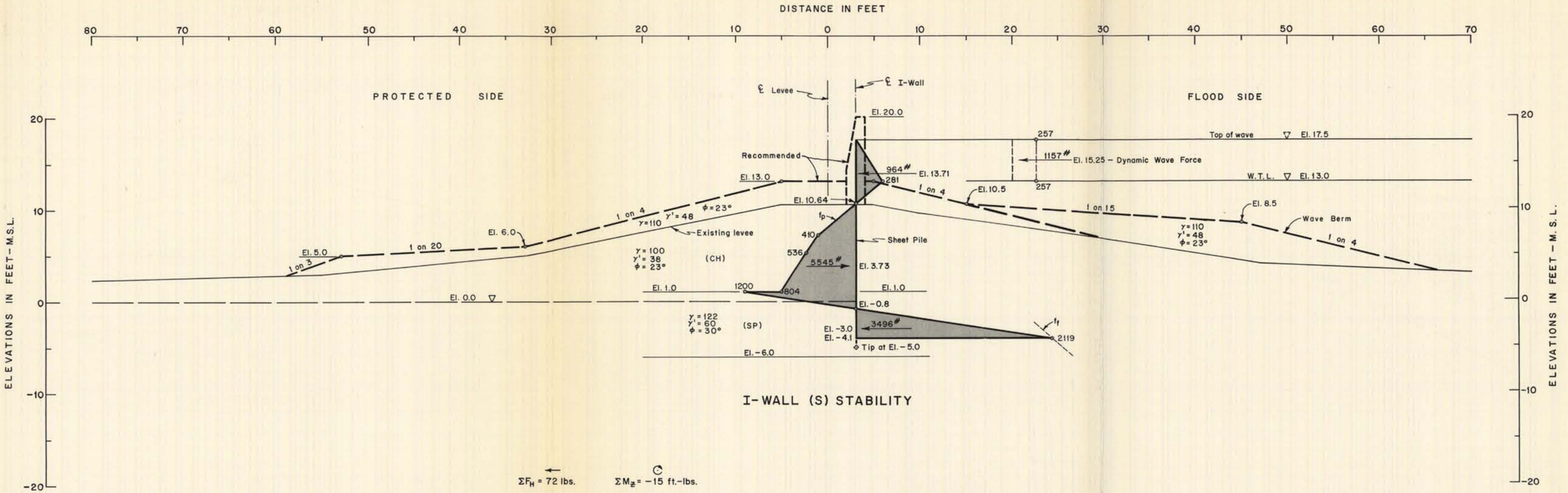
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

I-WALL LEVEE-PROTECTED SIDE (Q) STABILITY ANALYSIS STA. 707+50 TO STA. 740+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 38



I-WALL (S) STABILITY

$\overleftarrow{\Sigma F_H} = 72$ lbs. $\quad \overset{\circlearrowleft}{\Sigma M_{\bar{z}}} = -15$ ft.-lbs.

GENERAL NOTES

Cantilever sheet pile stability by method of planes analysis
(S) – Consolidated–drained shear strength, c = o
(f_ω) – Lateral water pressure
(f'_F) – Net lateral pressure on flood side, soil and water
(f'_P) – Net lateral pressure on protected side, soil and water
γ_ω – Unit weight of water in p.c.f.
γ – Unit weight of soil–water system in p.c.f.
γ' – Submerged unit weight of soil in p.c.f.
c – Unit cohesion in p.s.f.
ΣF_H – Summation of horizontal forces in lbs.
$\Sigma M_{\bar{z}}$ – Summation of moments about tip, in ft. lbs.
$\bar{z}$ – Penetration of sheet pile below levee crown in feet
F.S. – Factor of safety with respect to (S) shear strength, $\phi_d = \tan^{-1}\left(\frac{\tan\phi}{F.S.}\right)$
ϕ – Angle of internal friction in degrees

NOTES:

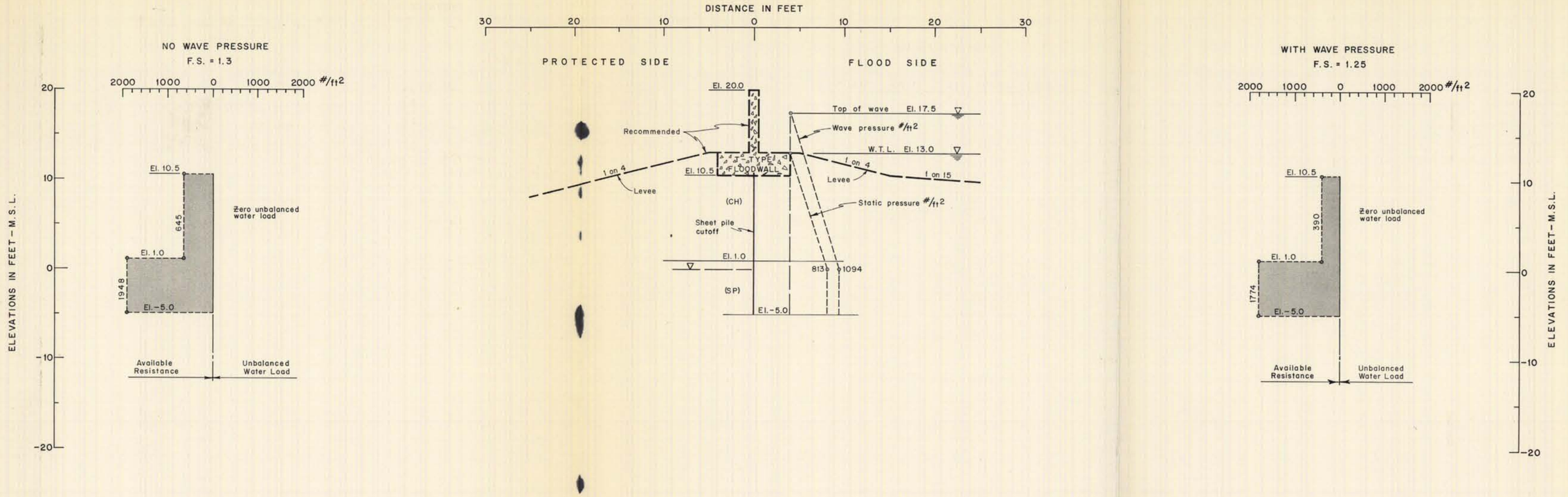
For location in plan see plate 2.
For soil boring data see plates 7 & 8.
(S) case governed for design.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

CANTILEVER SHEET PILE FLOODWALL
(S) STABILITY ANALYSIS
STA. 664+73.3 TO STA. 740+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 39



NOTE:

Sheet pile cutoff analysis applicable to gates and T-type floodwalls located between sta. 690+00 and sta. 740+00.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

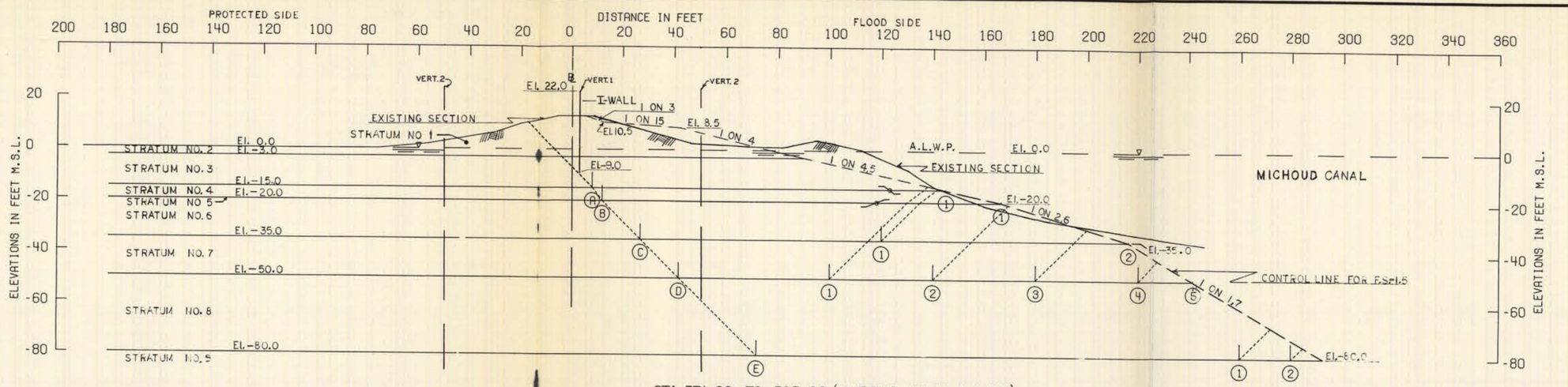
SHEET PILE CUTOFF ANALYSIS STA. 690+00 TO STA. 740+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971

FILE NO. H-2-24625

PLATE 40



STA. 571+60 TO 595+00 (CITRUS BACK LEVEE)

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING DATA PLATES FROM GDM NO. 2, CITRUS BACK LEVEE.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	107.5	107.5	400.0	400.0	400.0	400.0	0.
2	CH	45.0	45.0	400.0	400.0	400.0	400.0	0.
3	CH	40.0	40.0	400.0	250.0	400.0	250.0	0.
4	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
5	CH	0.	0.	0.	0.	467.0	335.0	0.
6	CH	40.0	40.0	567.0	401.0	667.0	467.0	0.
7	CH	40.0	40.0	767.0	534.0	867.0	600.0	0.
8	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.
9	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-15.00	20328	36620	0	32580	0	56948	32580	1.748
Ⓑ ①	-20.00	25925	50928	0	42446	0	76853	42446	1.811
Ⓒ ①	-35.00	40992	44489	15587	76481	11768	101069	64712	1.562
Ⓒ ②	-35.00	40992	89321	0	76481	0	130313	76481	1.704
Ⓓ ①	-50.00	59179	34970	32353	117899	35186	126504	82713	1.529
Ⓓ ②	-50.00	59179	58970	27397	117899	22201	145547	95698	1.521
Ⓓ ③	-50.00	59179	82970	19936	117899	10299	162087	107600	1.506
Ⓓ ④	-50.00	59179	106970	8504	117899	2012	174655	115887	1.507
Ⓓ ⑤	-50.00	59179	120170	0	117899	0	179349	117898	1.521
Ⓔ ①	-80.00	119179	188000	24074	223323	6898	331253	216424	1.531
Ⓔ ②	-80.00	119179	208000	9259	223323	1019	336439	222304	1.513

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

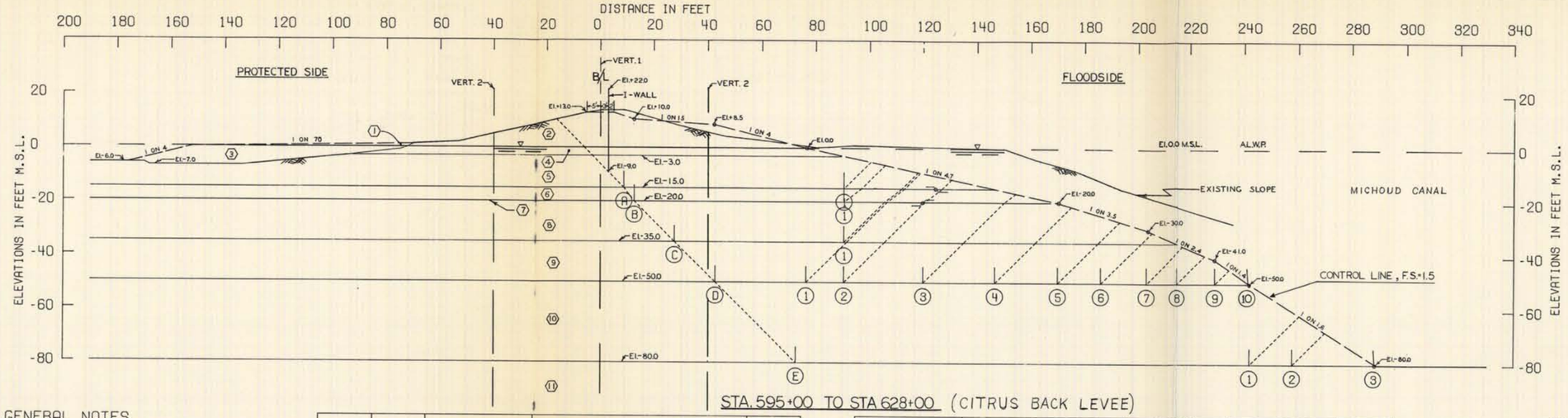
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LIMIT OF BORROW—CITRUS BACK LEVEE
(Q) STABILITY ANALYSIS
FLOOD SIDE STA. 571+60 TO STA. 595+00

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 41



STA. 595+00 TO STA 628+00 (CITRUS BACK LEVEE)

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING DATA PLATES FROM GDM NO. 2, CITRUS BACK LEVEE.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	FILL	102.5	102.5	200.0	200.0	200.0	200.0	0.
2	CH	107.5	107.5	400.0	400.0	400.0	400.0	0.
3	FILL	40.0	40.0	200.0	200.0	200.0	200.0	0.
4	CH	45.0	45.0	400.0	400.0	400.0	400.0	0.
5	CH	40.0	40.0	400.0	250.0	400.0	250.0	0.
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
7	CH	0.	0.	0.	0.	467.0	335.0	0.
8	CH	40.0	40.0	567.0	401.0	667.0	467.0	0.
9	CH	40.0	40.0	767.0	534.0	867.0	600.0	0.
10	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.
11	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-15.00	20041	22305	4944	32506	2372	47292	30134	1.569
(B) (1)	-20.00	25562	27346	9036	42199	4801	61945	37397	1.656
(C) (1)	-35.00	40039	29631	19296	76139	18070	88968	58069	1.532
(D) (1)	-50.00	56874	20196	35198	117467	43612	112268	73854	1.520
(D) (2)	-50.00	56874	28596	33546	117467	38754	119017	78713	1.512
(D) (3)	-50.00	56874	46296	30068	117467	29602	133238	87864	1.516
(D) (4)	-50.00	56874	62256	26819	117467	21012	145949	96454	1.513
(D) (5)	-50.00	56874	76296	22454	117467	13808	155624	103658	1.501
(D) (6)	-50.00	56874	85896	19314	117467	9693	162084	107773	1.504
(D) (7)	-50.00	56874	96096	15009	117467	5618	167979	111848	1.502
(D) (8)	-50.00	56874	103176	11263	117467	3162	171313	114304	1.499
(D) (9)	-50.00	56874	111696	5679	117467	955	174250	116511	1.496
(D) (10)	-50.00	56874	118896	0	117467	0	176207	117461	1.500
(E) (1)	-80.00	116874	169160	36623	222215	16473	322657	205742	1.568
(E) (2)	-80.00	116874	184860	24389	222215	7304	326123	214911	1.517
(E) (3)	-80.00	116874	215160	0	222215	0	332813	222208	1.498

NOTES

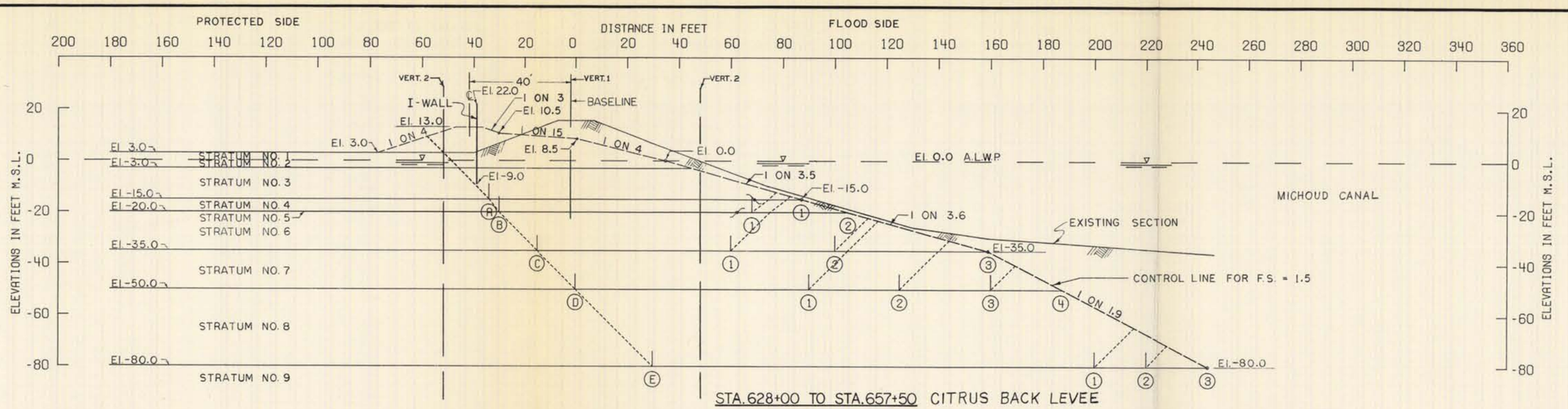
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LIMIT OF BORROW—CITRUS BACK LEVEE
(Q) STABILITY ANALYSIS
FLOOD SIDE STA. 595+00 TO STA. 628+00

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625



STA. 628+00 TO STA. 657+50 CITRUS BACK LEVEE

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING DATA PLATES FROM GDM NO. 2, CITRUS BACK LEVEE.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	107.5	107.5	400.0	400.0	400.0	400.0	0.
2	CH	45.0	45.0	400.0	400.0	400.0	400.0	0.
3	CH	40.0	40.0	400.0	250.0	400.0	250.0	0.
4	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
5	CH	0.	0.	0.	0.	467.0	335.0	0.
6	CH	40.0	40.0	567.0	401.0	667.0	467.0	0.
7	CH	40.0	40.0	767.0	534.0	867.0	600.0	0.
8	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.
9	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(A) (1)	-15.00	16592	37137	0	31572	0	53729	31572	1.702
(B) (1)	-20.00	22212	39035	5099	41460	1783	66346	39677	1.672
(B) (2)	-20.00	22212	49051	0	41460	0	71263	41460	1.719
(C) (1)	-35.00	36981	42575	16075	75495	13188	95631	62306	1.535
(C) (2)	-35.00	36981	61255	10286	75495	4253	108522	71242	1.523
(C) (3)	-35.00	36981	88808	0	75495	0	125789	75495	1.666
(D) (1)	-50.00	58942	60675	25434	116913	18734	145051	98179	1.477
(D) (2)	-50.00	58942	81675	19332	116913	9348	159949	107565	1.487
(D) (3)	-50.00	58942	102675	10127	116913	2742	171744	114171	1.504
(D) (4)	-50.00	58942	118875	0	116913	0	177817	116913	1.521
(E) (1)	-80.00	118942	170000	30689	222337	10776	319631	211561	1.511
(E) (2)	-80.00	118942	190000	16896	222337	3265	325838	219072	1.487
(E) (3)	-80.00	118942	214400	0	222337	0	333342	222337	1.499

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

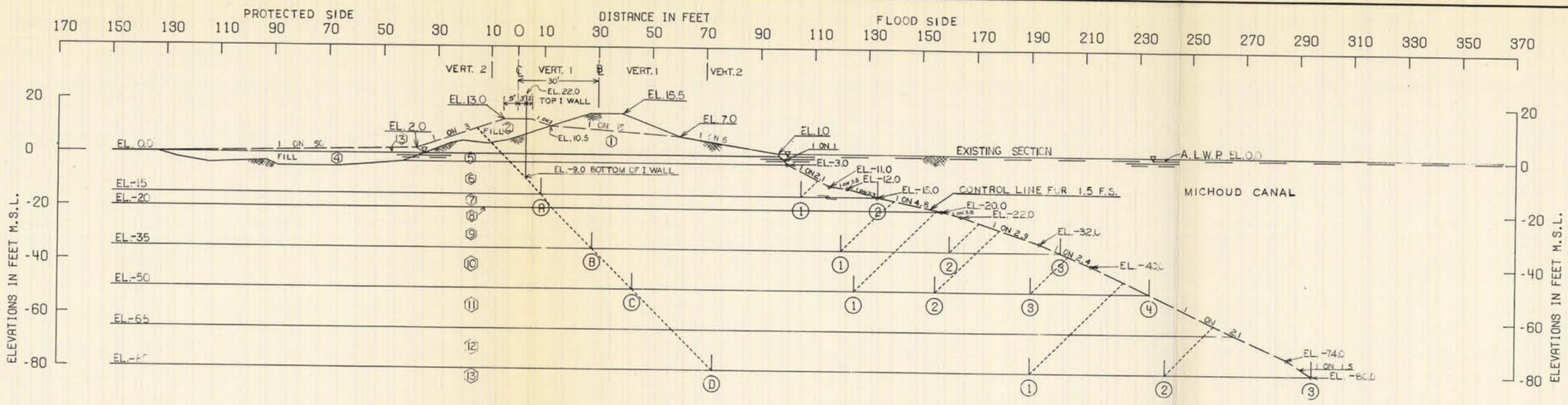
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LIMIT OF BORROW—CITRUS BACK LEVEE
(Q) STABILITY ANALYSIS
FLOOD SIDE STA. 628+00 TO STA. 657+50

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 43



STA. 657+50 TO STA. 664+73.3 CITRUS BACK LEVEE

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS. SEE BORING DATA PLATES FROM GDM NO. 2, CITRUS BACK LEVEE.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	CH	107.5	107.5	400.0	400.0	400.0	400.0	0.
②	FILL	107.5	107.5	400.0	400.0	400.0	400.0	0.
③	FILL	102.5	102.5	200.0	200.0	200.0	200.0	0.
④	FILL	40.0	40.0	200.0	200.0	200.0	200.0	0.
⑤	CH	45.0	45.0	400.0	400.0	400.0	400.0	0.
⑥	CH	40.0	40.0	400.0	250.0	400.0	250.0	0.
⑦	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
⑧	CH	0.	0.	0.	0.	467.0	335.0	0.
⑨	CH	40.0	40.0	567.0	401.0	667.0	467.0	0.
⑩	CH	40.0	40.0	767.0	534.0	867.0	600.0	0.
⑪	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.
⑫	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.
⑬	CH	60.0	60.0	1000.0	1000.0	1000.0	1000.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-15.00	17170	27841	3106	31837	1168	48118	30668	1.569
Ⓐ ②	-15.00	17170	34512	0	31837	0	51682	31836	1.623
Ⓑ ①	-35.00	38554	47354	14283	75373	10097	100191	65275	1.535
Ⓑ ②	-35.00	38554	66034	8780	75373	3182	113368	72190	1.570
Ⓑ ③	-35.00	38554	85181	0	75373	0	123735	75373	1.642
Ⓒ ①	-50.00	60602	51633	28267	116423	24013	140503	92409	1.520
Ⓒ ②	-50.00	60602	69633	22744	116423	14549	152980	101874	1.502
Ⓒ ③	-50.00	60602	90633	14763	116423	5412	165999	111010	1.495
Ⓒ ④	-50.00	60602	117033	0	116423	0	177636	116423	1.526
Ⓓ ①	-80.00	120603	117000	64823	228335	43535	302426	184800	1.637
Ⓓ ②	-80.00	120603	167000	37021	228335	15091	324624	213244	1.522
Ⓓ ③	-80.00	120603	221900	0	228335	0	342583	228335	1.500

NOTES

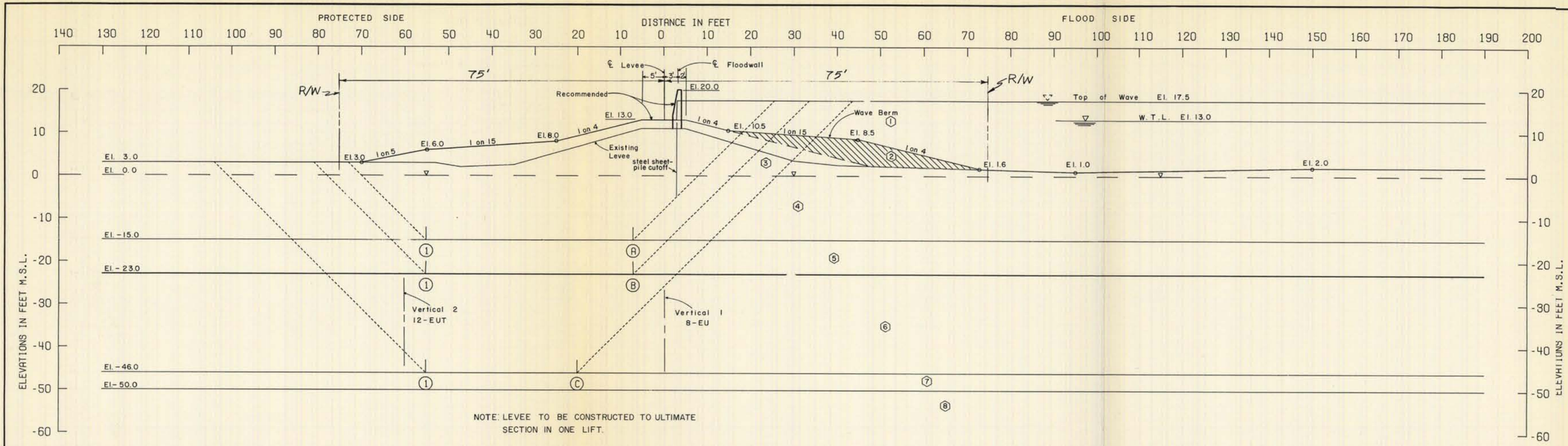
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LIMIT OF BORROW–CITRUS BACK LEVEE
(Q) STABILITY ANALYSIS
FLOOD SIDE STA. 657+50 TO STA. 664+73.3

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625



NOTE: LEVEE TO BE CONSTRUCTED TO ULTIMATE SECTION IN ONE LIFT.

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING 8-EU & 12-EUT DATA PLATES 9 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	W	62.5	62.5	0.	0.	0.	0.	0.
②	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
③	CH	104.0	104.0	350.0	200.0	350.0	200.0	0.
④	CH	42.0	42.0	350.0	200.0	350.0	200.0	0.
⑤	CH	45.0	45.0	500.0	200.0	500.0	200.0	0.
⑥	CH	45.0	45.0	350.0	200.0	350.0	200.0	0.
⑦	CH	42.0	42.0	625.0	400.0	900.0	600.0	0.
⑧	CH	45.0	45.0	1000.0	1000.0	1000.0	1000.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_R	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-15.00	16946	13080	7200	38715	12342	37226	26372	1.412
Ⓑ ①	-23.00	23495	13080	10477	57430	21317	47053	36113	1.303
Ⓒ ①	-46.00	49160	24937	28800	121342	62368	102898	58973	1.745

NOTES

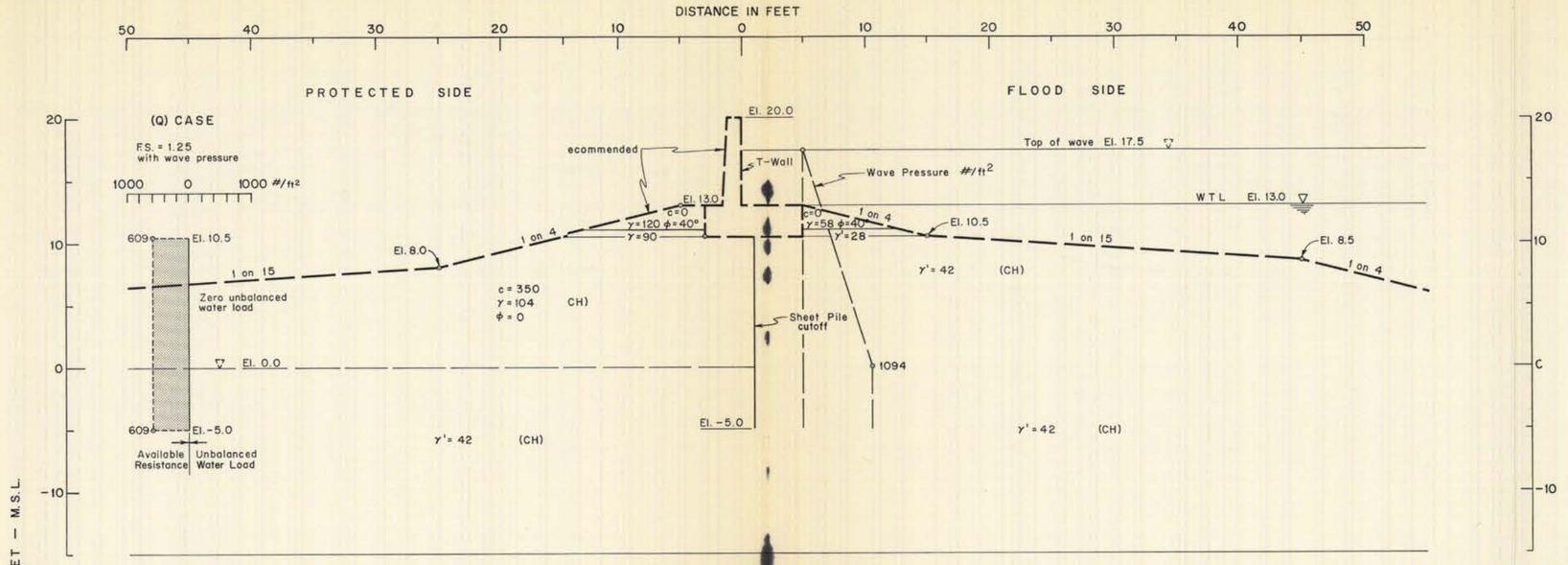
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

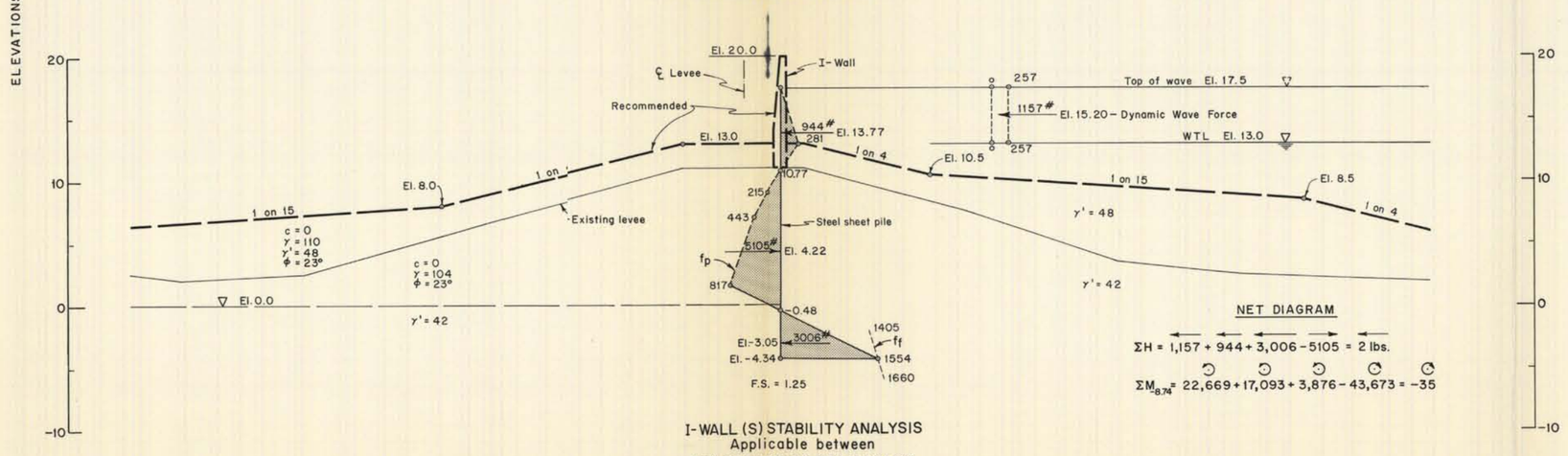
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGI
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

I-WALL LEVEE PROTECTED SIDE (Q) STABILITY ANALYSIS STA. 740+00 TO STA. 772+00

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625



SHEET PILE CUTOFF ANALYSIS
Applicable between
STA.740+00 TO STA.840+00



NET DIAGRAM

$\Sigma H = 1,157 + 944 + 3,006 - 5105 = 2$ lbs.

$\Sigma M_{8.74} = 22,669 + 17,093 + 3,876 - 43,673 = -35$

I-WALL (S) STABILITY ANALYSIS
Applicable between
STA.740+00 TO STA.772+00

NOTES

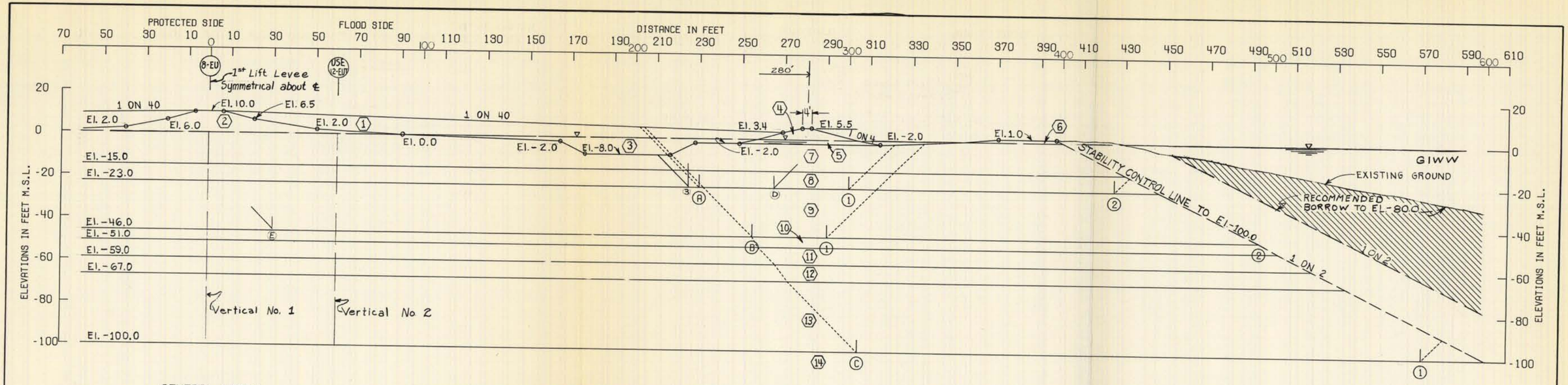
For location in plan see plate 2
For soil boring data see plate 9.
(S) case governed for design.
For general notes see plate 39.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

SHEET PILE CUTOFF ANALYSIS
STA. 740+00 TO STA. 840+00
I-WALL (S) STABILITY ANALYSIS
STA. 740+00 TO STA. 772+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 8-EU & 12-EU DATA PLATES 9 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	50.0	50.0	50.0	50.0	0.
2	CH	104.0	104.0	350.0	200.0	350.0	200.0	0.
3	CH	48.0	48.0	50.0	50.0	50.0	50.0	0.
4	CH	100.0	100.0	150.0	150.0	150.0	150.0	0.
5	CH	38.0	38.0	150.0	150.0	150.0	150.0	0.
6	CH	104.0	104.0	350.0	200.0	350.0	200.0	0.
7	CH	42.0	42.0	350.0	200.0	350.0	200.0	0.
8	CH	48.0	48.0	500.0	200.0	500.0	200.0	0.
9	CH	42.0	42.0	625.0	400.0	900.0	600.0	0.
10	SP	60.0	60.0	0.	0.	0.	0.	30.0
11	CH	55.0	55.0	1000.0	1000.0	1000.0	1000.0	0.
12	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
13	CH	48.0	48.0	1000.0	1000.0	1000.0	1000.0	0.
14	CH	48.0	48.0	1200.0	1200.0	1200.0	1200.0	0.

ASSUMED FAILURE SURFACE NO.		ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A	1	-23.00	7308	14000	8529	25125	10411	29838	14714	2.028
A	2	-23.00	7308	39000	2800	25125	1724	49108	23401	2.099
B	1	-46.00	25803	21100	27210	69777	46284	74114	23493	3.155
B	2	-46.00	25803	127742	0	69777	0	153545	69777	2.201
C	1	-100.00	129533	265000	19999	273057	3597	414533	269460	1.538
D	3	-23.00	10052	8000	6000	22876	5673	24052	17203	1.40
E	1	-46.00	49103	52.000	27,210	97,400	46,284	128,313	51,116	2.51
E	7	-46.00	49103	92,600	0	97400	0	141,703	97,400	1.45

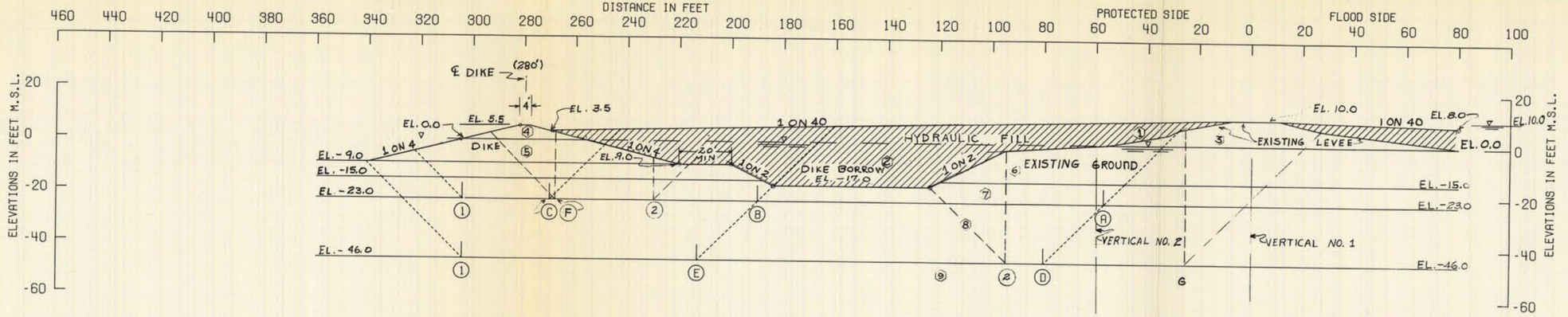
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE - 1ST LIFT - FLOODSIDE
(Q) STABILITY ANALYSIS
STA. 772+00 TO STA. 821+60
STA. 825+20 TO STA. 840+00
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625

PLATE 47



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 8-EU & 12-EUT DATA PLATES 9 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
①	CH	110.0	110.0	50.0	50.0	50.0	50.0	0.
②	CH	48.0	48.0	50.0	50.0	50.0	50.0	0.
③	CH	104.0	104.0	350.0	300.0	350.0	300.0	0.
④	CH	100.0	100.0	150.0	150.0	150.0	150.0	0.
⑤	CH	38.0	38.0	150.0	150.0	150.0	150.0	0.
⑥	CH	42.0	42.0	350.0	200.0	350.0	200.0	0.
⑦	CH	45.0	45.0	500.0	200.0	500.0	200.0	0.
⑧	CH	42.0	42.0	625.0	400.0	900.0	600.0	0.
⑨	SP	60.0	60.0	0.	0.	0.	0.	30.0

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-23.00	15394	49422	6920	38731	8524	71736	30206	2.375
Ⓑ ①	-23.00	4719	22800	6920	29257	8524	34439	20732	1.661
Ⓒ ①	-23.00	8357	6800	6920	20888	8524	22077	12363	1.786
Ⓓ ①	-46.00	33794	152587	24000	94185	35544	210381	58640	3.588
Ⓔ ①	-46.00	23119	56236	24000	77670	35544	103356	42125	2.454
Ⓕ ②	-23.00	9200	7600	5600	21939	4787	22400	16654	1.34
Ⓕ Ⓑ	-23.00	9200	15600	2400	21439	1215	27200	20224	1.34
Ⓒ ②	-46.00	48220	45660	20800	91416	25761	114630	65655	1.74

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

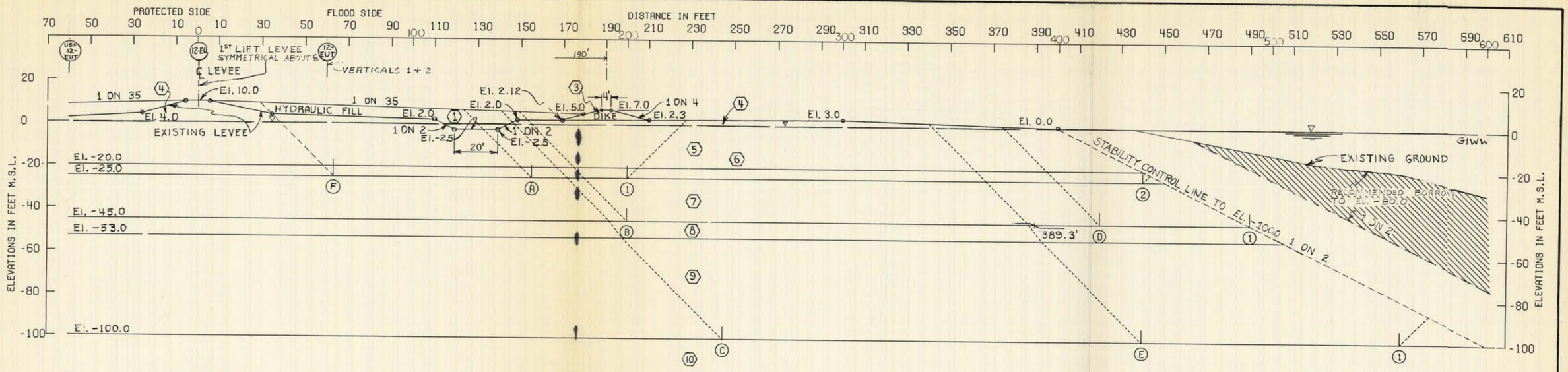
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LEVEE IS SYMMETRICAL ABOUT ℄.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE-1ST LIFT-PROTECTED SIDE
(Q) STABILITY ANALYSIS
STREAM CLOSURE
STA. 821+60 TO STA. 825+20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 48



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING *12-EUT* DATA PLATE 11

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

FOR BANK CUT STABILITY, SEE STABILITY ANALYSIS FOR ULTIMATE SECTION PLATE 55.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	50.0	50.0	50.0	50.0	0.
2	CH	48.0	48.0	50.0	50.0	50.0	50.0	0.
3	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.
4	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.
5	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.
6	CH	38.0	38.0	200.0	200.0	200.0	200.0	0.
7	CH	38.0	38.0	380.0	380.0	560.0	560.0	0.
8	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
9	CH	48.0	48.0	1200.0	1200.0	1200.0	1200.0	0.
10	CH	48.0	48.0	1500.0	1500.0	1500.0	1500.0	0.

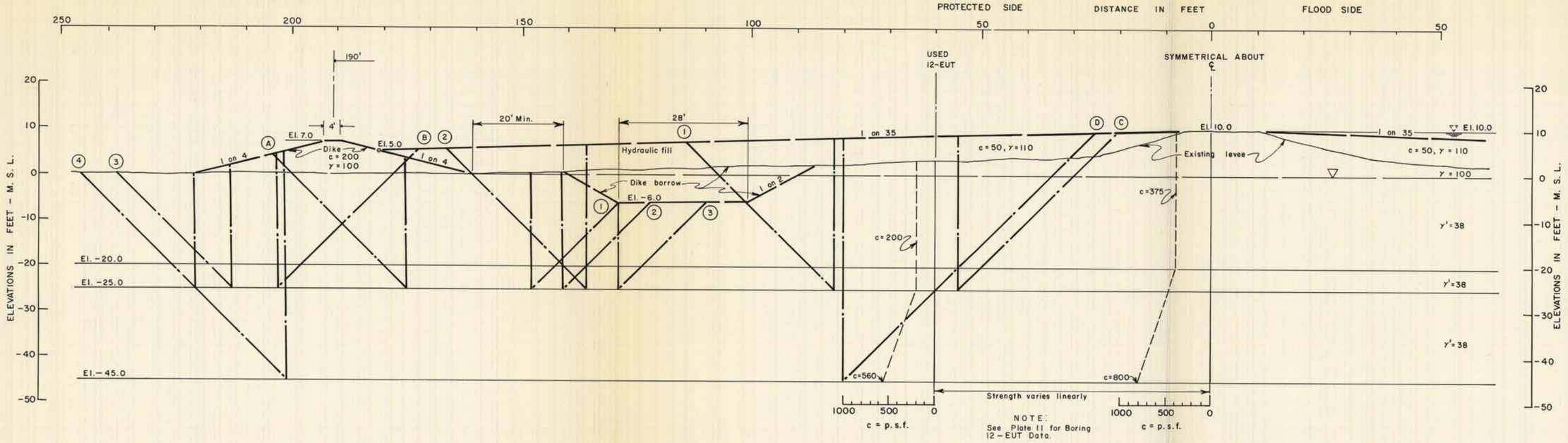
ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-25.00	9911	9000	10974	30993	19306	29886	11687	2.557
(A) (2)	-25.00	9911	57000	1333	30993	315	68245	30677	2.225
(B) (1)	-45.00	26395	149671	0	66715	0	176067	66715	2.639
(C) (1)	-100.00	149754	472500	31999	254751	6396	654254	248355	2.634
(D) (1)	-45.00	25509	26473	0	35647	0	51982	35647	1.458
(E) (1)	-100.00	147624	180000	31999	198081	6396	359624	191684	1.876
(F) (1)	-25.00	14108	23400	10974	38415	19306	48482	19163	2.529

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2- GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE - 1ST LIFT - FLOOD SIDE
(Q) STABILITY ANALYSIS
STA. 840+00 TO STA. 874+47
STA. 879+27 TO STA. 892+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625



NOTE:
See Plate 11 for Boring 12-EUT Data.

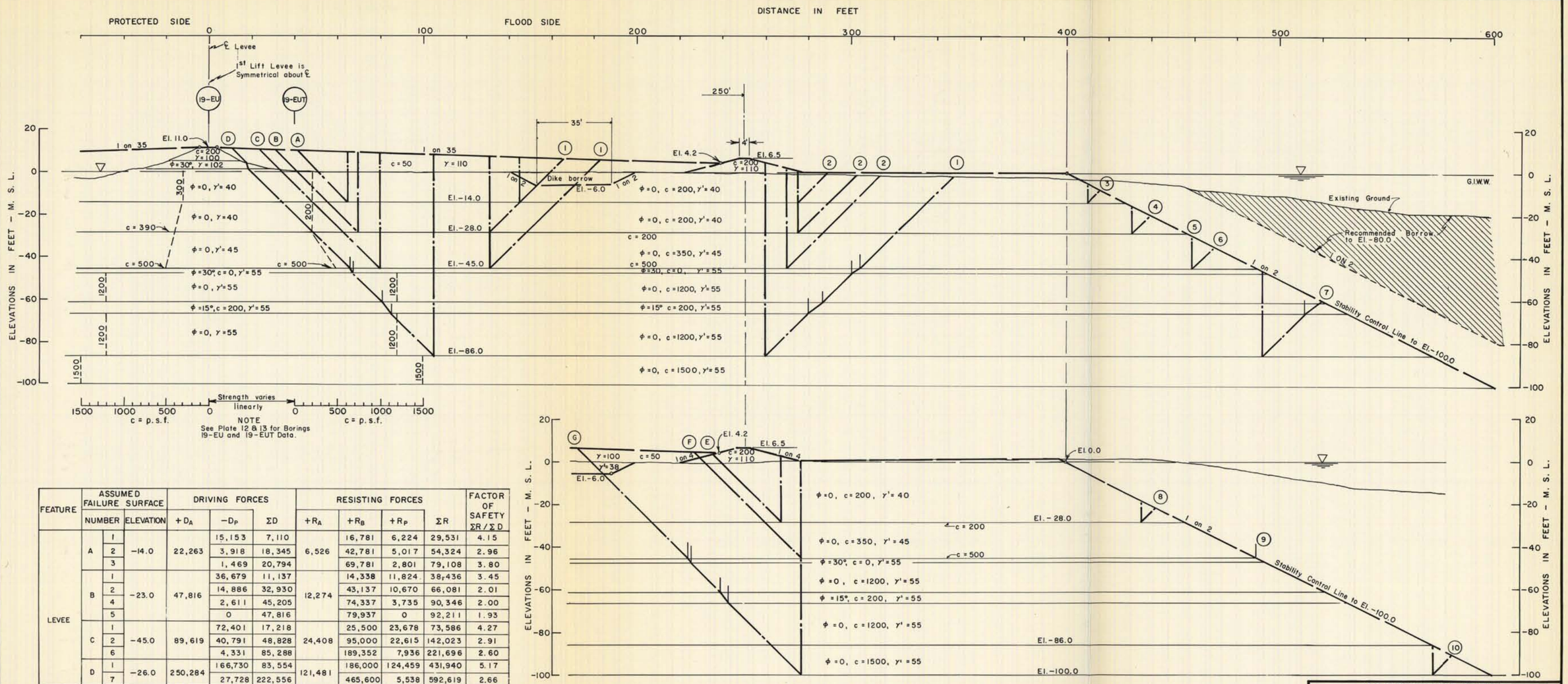
1ST LIFT STABILITY ANALYSIS

FEATURE	ASSUMED FAILURE SURFACE NUMBER		ELEVATION	DRIVING FORCES $+D_A$	$-D_P$	ΣD	RESISTING FORCES $+R_A$	$+R_B$	$+R_P$	ΣR	FACTOR OF SAFETY $\Sigma R/\Sigma D$
PROTECTED SIDE DIKE	A	1	-25.0	27,325	9,823	17,502	11,600	5,400	7,600	24,600	1.41
		2			8,227	19,098		6,800	7,600	26,000	1.36
		3			6,859	20,466		9,200	7,600	28,400	1.39
	B	4	-25.0	25,549	11,871	13,678	11,544	3,600	10,000	25,144	1.83
1ST LIFT	C	1	-25.0	40,102	35,792	4,310	13,910	4,400	8,891	27,201	6.31
		2			29,919	10,183		15,200	10,542	39,652	3.89
		3			12,670	27,432		30,600	10,000	54,510	1.99
	D	4	-45.0	81,845	43,466	38,379	26,669	56,560	25,200	108,429	2.83

For general notes see plate 49.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE-1ST LIFT PROTECTED SIDE
(Q) STABILITY ANALYSIS
STA.840+00 TO STA.874+47
STA. 879+27 TO STA.892+00
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 50



NOTE
See Plate 12 & 13 for Borings 19-EU and 19-EUT Data.

FEATURE	ASSUMED FAILURE SURFACE NUMBER		ASSUMED FAILURE SURFACE ELEVATION	DRIVING FORCES +D_A	DRIVING FORCES −D_P	DRIVING FORCES ΣD	RESISTING FORCES +R_A	RESISTING FORCES +R_B	RESISTING FORCES +R_P	RESISTING FORCES ΣR	FACTOR OF SAFETY ΣR/ΣD
LEVEE	A	1	-14.0	22,263	15,153	7,110	6,526	16,781	6,224	29,531	4.15
		2			3,918	18,345		42,781	5,017	54,324	2.96
		3			1,469	20,794		69,781	2,801	79,108	3.80
	B	1	-23.0	47,816	36,679	11,137	12,274	14,338	11,824	38,436	3.45
		2			14,886	32,930		43,137	10,670	66,081	2.01
		4			2,611	45,205		74,337	3,735	90,346	2.00
		5			0	47,816		79,937	0	92,211	1.93
	C	1	-45.0	89,619	72,401	17,218	24,408	25,500	23,678	73,586	4.27
		2			40,791	48,828		95,000	22,615	142,023	2.91
		6			4,331	85,288		189,352	7,936	221,696	2.60
	D	1	-26.0	250,284	166,730	83,554	121,481	186,000	124,459	431,940	5.17
		7			27,728	222,556		465,600	5,538	592,619	2.66
DIKE	E	8	-28.0	33,630	1,260	32,370	12,800	33,200	2,520	48,520	1.50
	F	9	-45.0	64,303	0	64,303	24,150	96,861	0	121,011	1.88
	G	10	-100.0	279,428	3,465	275,963	159,695	442,500	27,000	629,195	2.28

NOTE:

For general notes see plate 49.

For bank cut stability see stability analysis for ultimate section, plate 64.

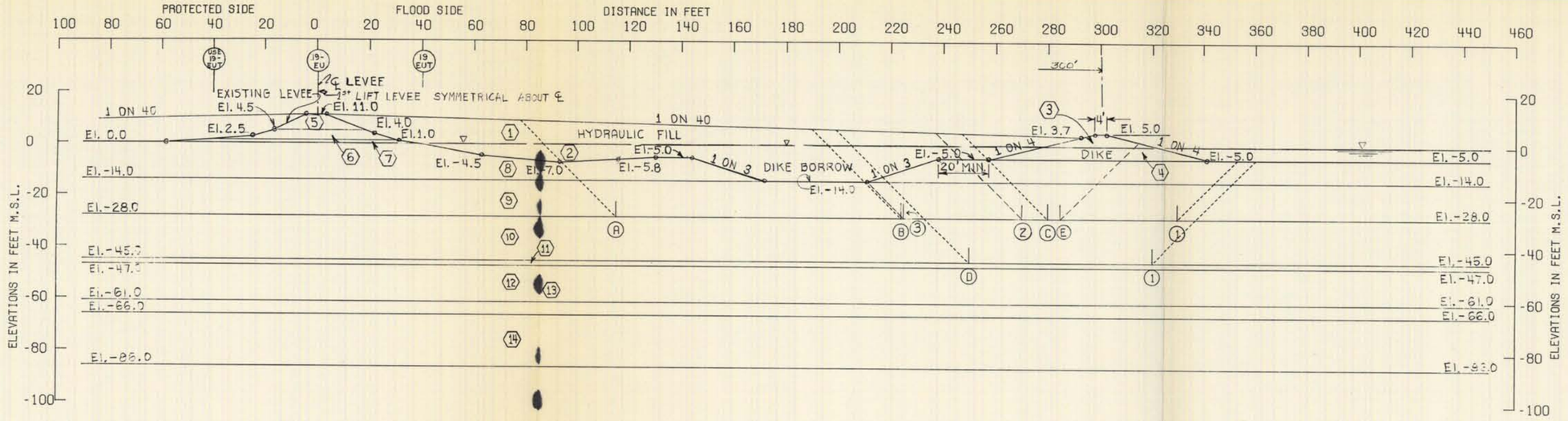
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE
LEVEE-1st LIFT-FLOOD SIDE
(Q) STABILITY ANALYSIS
STA. 892+00 TO STA. 981+22
STA. 982+92 TO STA. 1006+59.2

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 51



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING 12-EUT DATA PLATE 13.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	50.0	50.0	50.0	50.0	0.
2	CH	48.0	48.0	50.0	50.0	50.0	50.0	0.
3	CH	102.0	102.0	150.0	150.0	150.0	150.0	0.
4	CH	40.0	40.0	150.0	150.0	150.0	150.0	0.
5	CH	100.0	100.0	400.0	400.0	400.0	400.0	0.
6	SP	102.0	102.0	0.	0.	0.	0.	30.0
7	CH	102.0	102.0	300.0	300.0	300.0	300.0	0.
8	CH	40.0	40.0	300.0	200.0	300.0	200.0	0.
9	CH	40.0	40.0	345.0	200.0	390.0	200.0	0.
10	CH	45.0	45.0	445.0	350.0	500.0	500.0	0.
11	SP	55.0	55.0	0.	0.	0.	0.	30.0
12	CH	55.0	55.0	800.0	800.0	800.0	800.0	0.
13	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
14	CH	55.0	55.0	1200.0	1200.0	1200.0	1200.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-28.00	10027	43000	9200	47692	11295	62227	36397	1.710
B 1	-28.00	7630	21200	9200	37774	11295	38030	26478	1.436
C 1	-28.00	10185	10000	9200	30975	11295	29385	19680	1.493
D 1	-45.00	20106	35000	21100	72168	35165	76206	37003	2.059
E 2	-28.00	11240	3000	9200	26475	11296	23440	15179	1.54
E 3	-28.00	11240	12000	5600	26475	5223	28840	21252	1.36

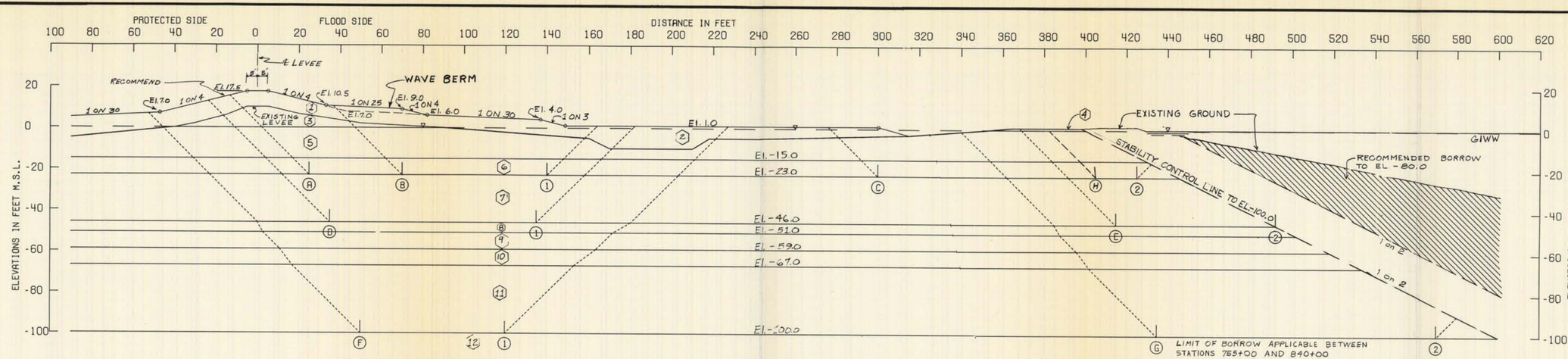
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE-1ST LIFT FLOOD SIDE
(Q) STABILITY ANALYSIS
STREAM CROSSING
STA. 981+22 TO STA. 982+92
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625

PLATE 52



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 8-EU+12-EUT DATA PLATES 9 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
2	CH	48.0	48.0	300.0	300.0	300.0	300.0	0.
3	CH	104.0	104.0	350.0	200.0	350.0	200.0	0.
4	CH	104.0	104.0	350.0	200.0	350.0	200.0	0.
5	CH	42.0	42.0	350.0	200.0	350.0	200.0	0.
6	CH	45.0	45.0	500.0	200.0	500.0	200.0	0.
7	CH	42.0	42.0	625.0	400.0	900.0	600.0	0.
8	SP	60.0	60.0	0.	0.	0.	0.	30.0
9	CH	55.0	55.0	1000.0	1000.0	1000.0	1000.0	0.
10	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
11	CH	48.0	48.0	1000.0	1000.0	1000.0	1000.0	0.
12	CH	48.0	48.0	1200.0	1200.0	1200.0	1200.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-23.00	26144	26062	10773	64223	15427	62980	48795	1.291
(A) (2)	-23.00	26144	83062	2800	64223	1633	112006	62590	1.790
(B) (1)	-23.00	15463	14000	10773	40767	15427	40236	25339	1.588
(B) (2)	-23.00	15463	71000	2800	40767	1633	89263	39134	2.281
(C) (2)	-23.00	10581	25000	2800	14259	1633	38381	12626	3.040
(D) (1)	-46.00	50147	61562	30200	129821	54263	141909	75558	1.878
(D) (2)	-46.00	50147	260921	0	129821	0	311068	129821	2.396
(E) (2)	-46.00	28000	31358	0	45900	0	59358	45900	1.293
(F) (1)	-100.00	156976	70000	155206	372251	251519	382182	120731	3.166
(F) (2)	-100.00	156976	520000	19999	372251	3597	696976	368653	1.891
(G) (2)	-100.00	128740	135000	19999	219587	3597	283740	215990	1.314
(H) (2)	-23.00	96.00	4000	2800	12721	1633	16400	11088	1.48

NOTES

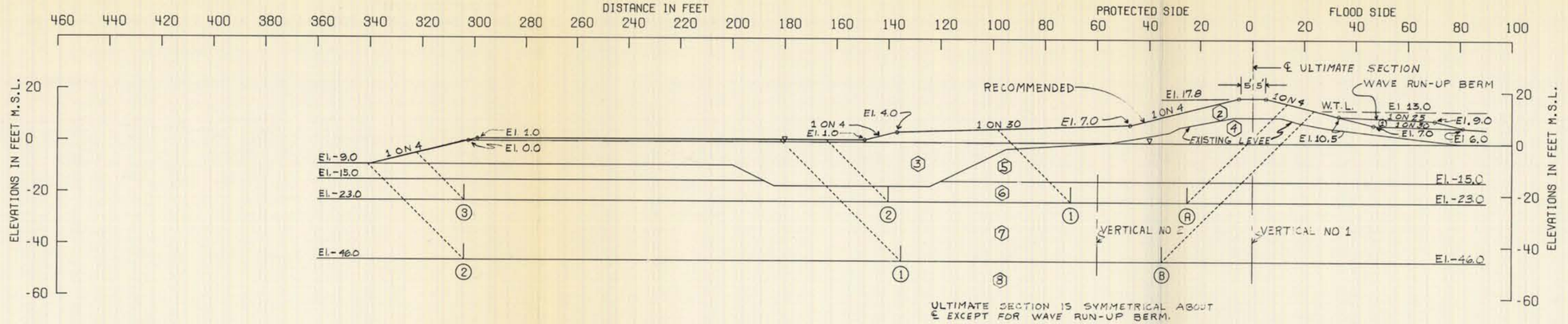
Φ -- ANGLE OF INTERNAL FRICTIEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE OUNDS
R -- HORIZONTAL RESISTING FOR POUNDS
A -- AS A SUBSCRIPT, REFERS TIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TITRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TISIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R}{D_A - D_P}$

LEVEE IS SYMMETRICAL ABOUT EXCEPT FOR WAVE BERM ON FLOODDE.

LAKE PONTCHARTRAIN, LA AINITY
LAKE PONTCHARTRAIN BA PLAN
DESIGN MEMORANDUM NO. 2 -ERAL DESIGN
SUPPLEMENT N(
NEW ORLEANS EAST B LEVEE
LEVEE ULTIMATE SECT·FLOOD SIDE
(Q) STABILITY AYSIS
STA. 772+00 TO ST21+60
STA. 825+20 TO ST40+00
U.S. ARMY ENGINEER DISTRICW ORLEANS
CORPS OF ENGI
FEB. 1971
NO. H-2-24625

PLATE 53



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS. AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING 8EU & 12EUT DATA PLATES 9 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
2	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
3	CH	48.0	48.0	300.0	300.0	300.0	300.0	0.
4	CH	104.0	104.0	350.0	300.0	350.0	300.0	0.
5	CH	42.0	42.0	350.0	200.0	350.0	200.0	0.
6	CH	45.0	45.0	500.0	200.0	500.0	200.0	0.
7	CH	42.0	42.0	625.0	400.0	900.0	600.0	0.
8	SP	60.0	60.0	0.	0.	0.	0.	30.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-23.00	26297	12062	12801	64126	27659	51161	36467	1.403
A 2	-23.00	26297	26062	13200	64126	16334	65560	47792	1.372
A 3	-23.00	26297	58862	8188	64126	9330	93348	54796	1.704
B 1	-46.00	50563	61562	31600	129533	56480	143725	73052	1.967
B 2	-46.00	50563	162962	24000	129533	36730	237525	92803	2.559

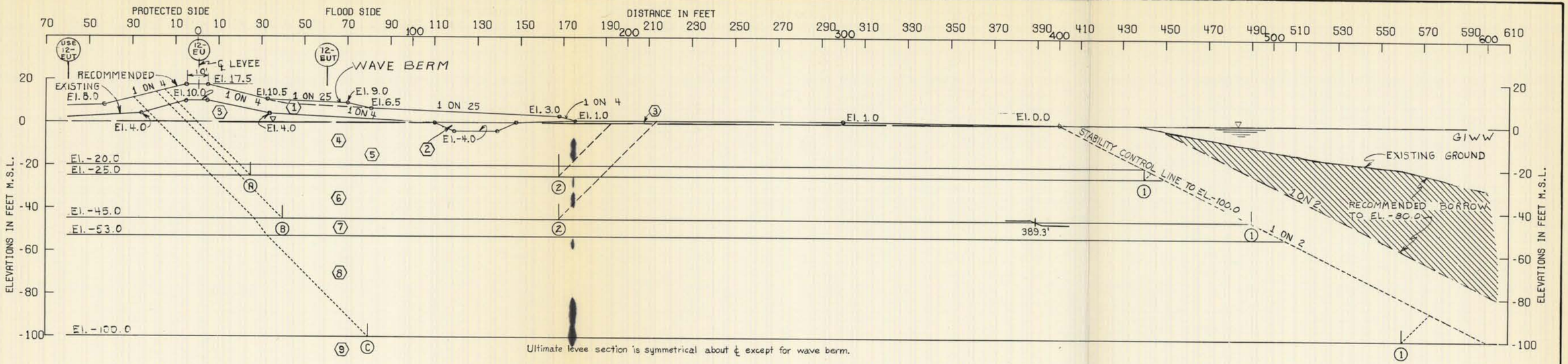
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE-ULTIMATE SECTION PROTECTED SIDE
(Q) STABILITY ANALYSIS-STREAM CLOSURE
STA. 821+60 TO STA. 825+20
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625



Ultimate levee section is symmetrical about ℄ except for wave berm.

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 12-EU+12-EUT DATA PLATES 10 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
1	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
2	CH	48.0	48.0	300.0	300.0	300.0	300.0	0.
3	CH	100.0	100.0	375.0	200.0	375.0	200.0	0.
4	CH	38.0	38.0	375.0	200.0	375.0	200.0	0.
5	CH	38.0	38.0	418.0	200.0	460.0	200.0	0.
6	CH	38.0	38.0	630.0	380.0	800.0	560.0	0.
7	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0
8	CH	48.0	48.0	1200.0	1200.0	1200.0	1200.0	0.
9	CH	48.0	48.0	1500.0	1500.0	1500.0	1500.0	0.

ASSUMED FAILURE SURFACE		RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	ELEV.	R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-25.00	27298	85654	1333	67077	315	114286	66761	1.712
B 1	-45.00	47324	240585	0	118659	0	287909	118659	2.426
C 1	-100.00	172954	576000	31999	347202	6396	780954	340806	2.291
A 2	-25.00	27298	31408	10400	67077	15355	69,106	51,722	1.34
B 2	-45.00	47324	72.562	25600	118,659	43955	145,486	74,704	1.947

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

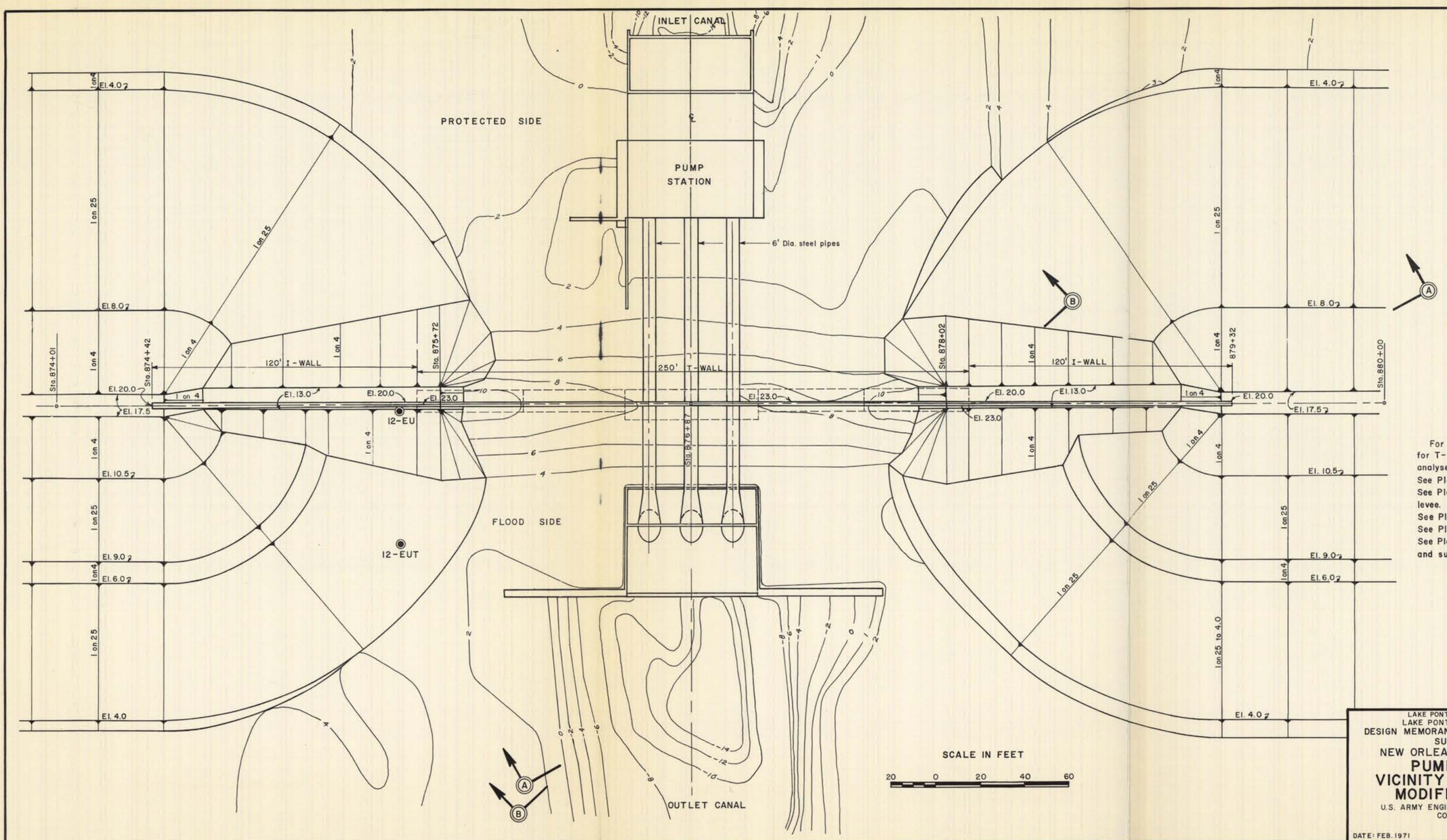
LAKE PONTCHARTRAIN LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE
LEVEE-ULTIMATE SECTION-FLOOD SIDE
(Q) STABILITY ANALYSIS
STA. 840+00 TO STA. 874+47
STA. 879+27 TO STA. 892+00

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

PLATE 55



SCALE IN FEET

20 0 20 40 60

NOTES

For stability analyses: see Plate 62 for T-wall sheet pile cutoff and I-wall (s) analyses.
See Plate 60 & 61 for sec. A-A & B-B.
See Plate 59 for I-wall levee and main levee.
See Plate 57 & 58 for ℄ sections.
See Plates 10 & 11 for soil boring data.
See Plate 63 for T-wall pile capacites and subgrade moduli.

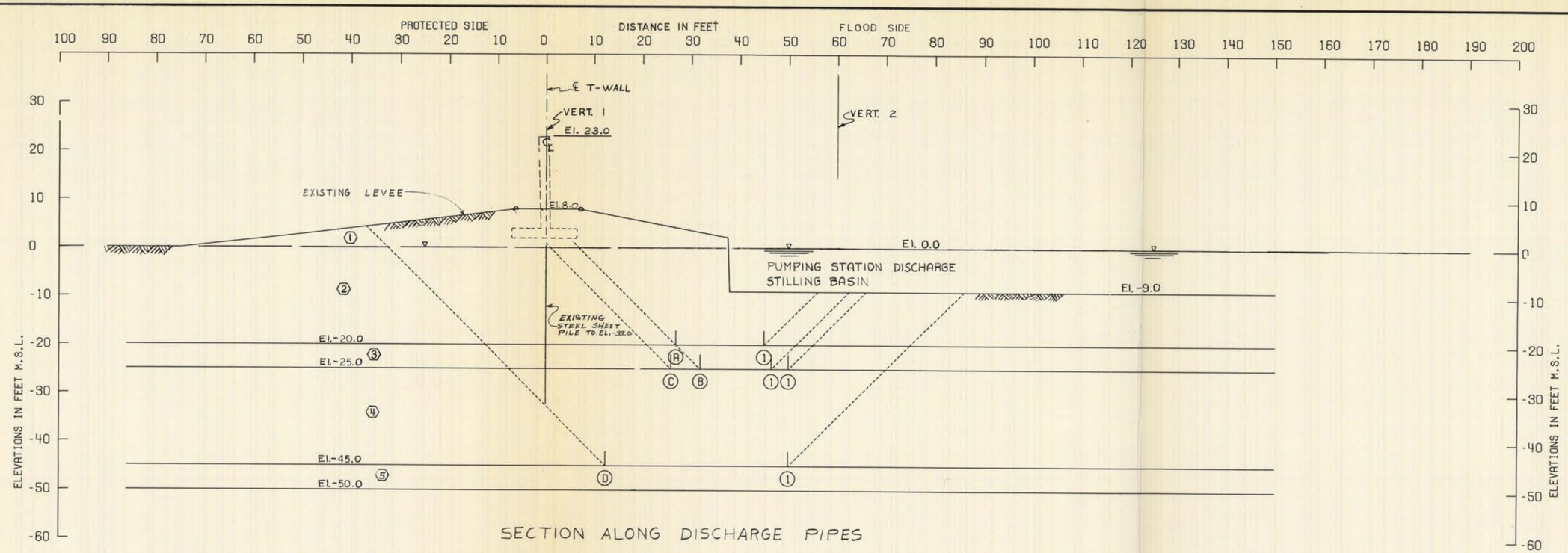
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

PUMPING STATION VICINITY STATION 876+87 MODIFICATION PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971 FILE NO. H-2-24625

PLATE 56



SECTION ALONG DISCHARGE PIPES

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING 12-EU AND 12 EUT DATA PLATES 10 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
①	CH	100.0	100.0	375.0	200.0	375.0	200.0	0.
②	CH	38.0	38.0	375.0	200.0	375.0	200.0	0.
③	CH	38.0	38.0	412.5	200.0	450.0	200.0	0.
④	CH	38.0	38.0	625.0	380.0	800.0	560.0	0.
⑤	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-20.00	18843	4828	4955	23032	2296	28626	20735	1.381
Ⓑ ①	-25.00	21907	4113	6891	29179	4858	32912	24321	1.353
Ⓒ ①	-25.00	22790	6935	6634	31685	4858	36360	26827	1.355
Ⓓ ①	-45.00	43045	24558	21600	71186	24618	89203	46567	1.916

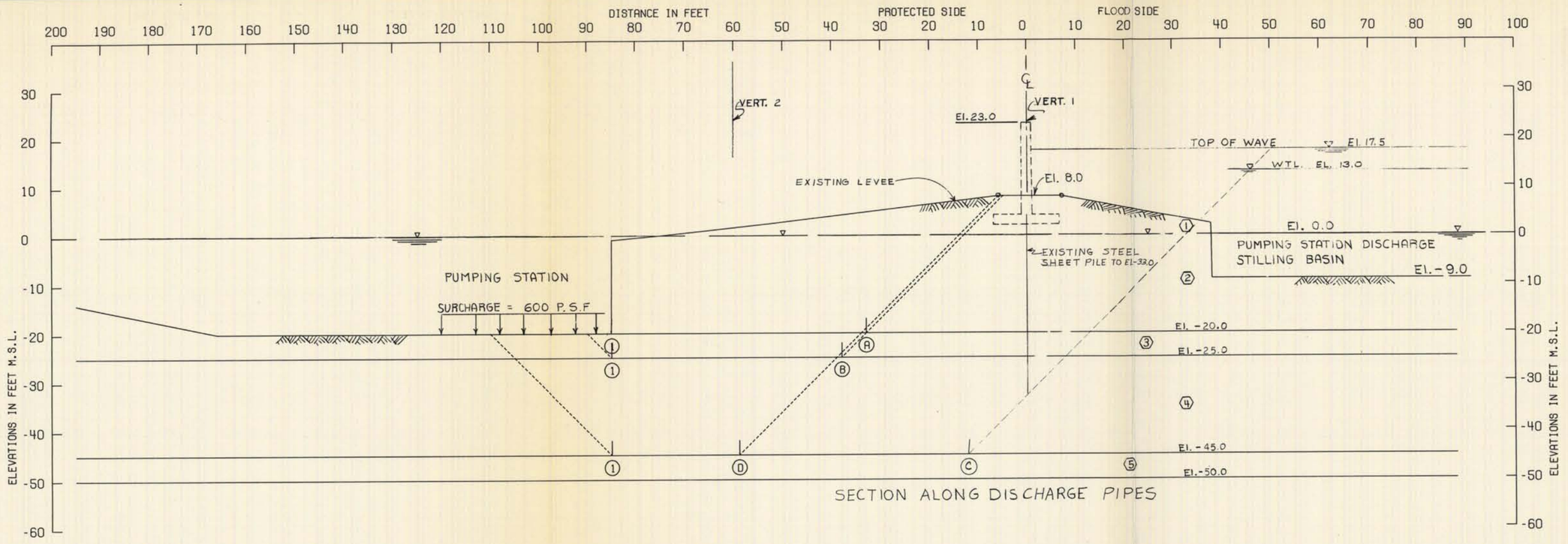
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
FLOODWALL - LEVEE
FLOOD SIDE
(Q) STABILITY ANALYSIS
VICINITY OF PUMPING STATION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625

PLATE 57



SECTION ALONG DISCHARGE PIPES

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORING 12-EU AND 12-EUT DATA PLATES 10 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F.				FRICTION ANGLE DEGREES
				CENTER OF STRATUM		BOTTOM OF STRATUM		
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
①	CH	100.0	100.0	375.0	200.0	375.0	200.0	0.
②	CH	38.0	38.0	375.0	200.0	375.0	200.0	0.
③	CH	38.0	38.0	412.5	200.0	450.0	200.0	0.
④	CH	38.0	38.0	625.0	380.0	800.0	560.0	0.
⑤	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	RESISTING FORCES R_B	RESISTING FORCES R_P	DRIVING FORCES D_A	DRIVING FORCES $-D_P$	SUMMATION OF FORCES RESISTING	SUMMATION OF FORCES DRIVING	FACTOR OF SAFETY
Ⓐ	①	-20.00	17899	11463	39	22489	36	29402	22453	1.310
Ⓑ	①	-25.00	20768	10408	2000	29016	3475	33176	25541	1.300
Ⓒ	①	-45.00	42678	45357	17200	103476	26897	105235	76579	1.374
Ⓓ	①	-45.00	37572	14699	17200	61051	26897	69472	34154	2.034

NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

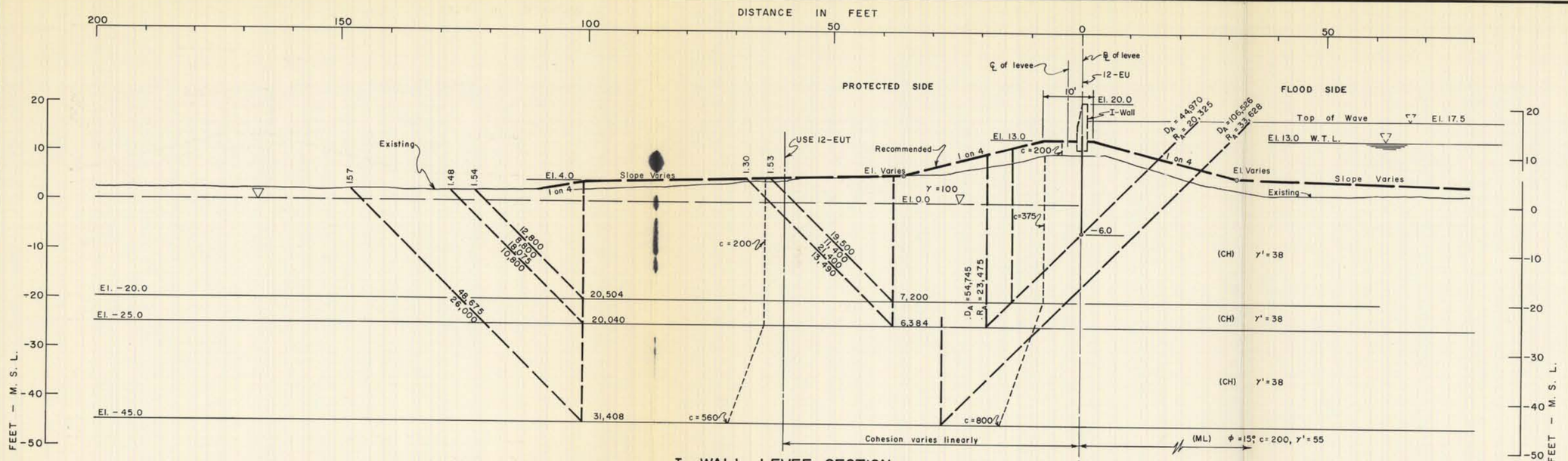
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

FLOODWALL-LEVEE PROTECTED SIDE (Q) STABILITY ANALYSIS VICINITY OF PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

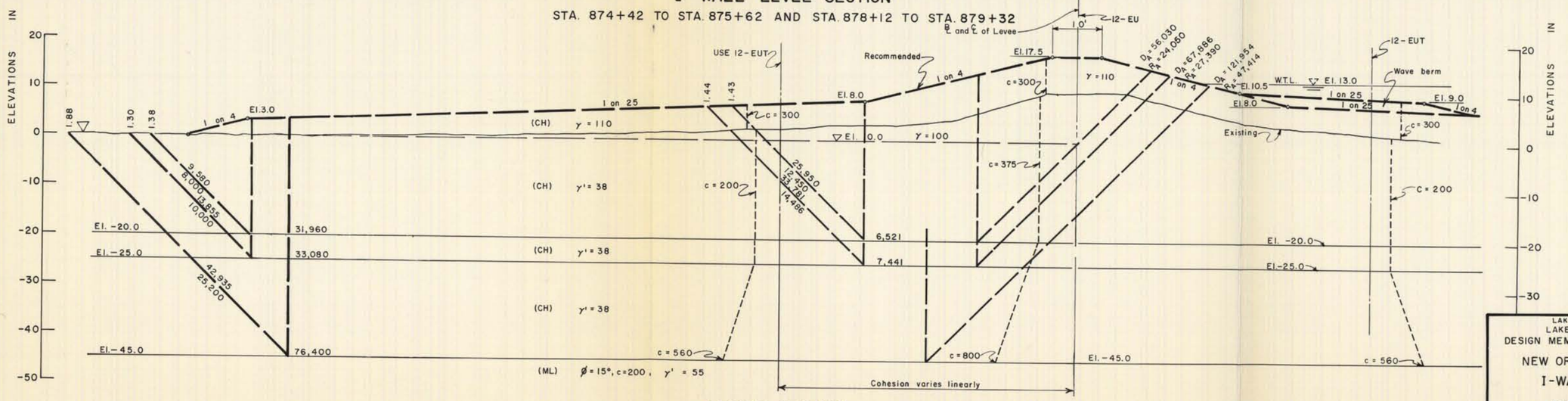
FEB. 1971 FILE NO. H-2-24625

PLATE 58



I-WALL LEVEE SECTION

STA. 874+42 TO STA. 875+62 AND STA. 878+12 TO STA. 879+32



LEVEE SECTION

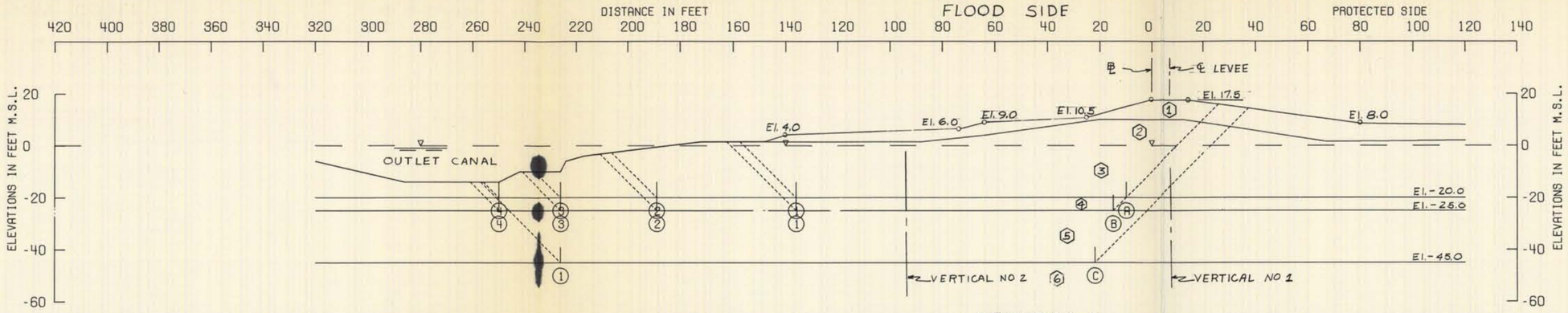
STA. 840+00 TO STA. 874+47 AND STA. 879+27 TO STA. 892+00

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

I-WALL LEVEE AND LEVEE
PROTECTED SIDE
(Q) STABILITY ANALYSIS
VICINITY OF PUMPING STATION

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625



SECTION A-A

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 12-EUT + 12-EU DATA PLATES 10 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.
2	CH	100.0	100.0	375.0	200.0	375.0	200.0	0.
3	CH	38.0	38.0	375.0	200.0	375.0	200.0	0.
4	CH	38.0	38.0	418.0	200.0	460.0	200.0	0.
5	CH	38.0	38.0	630.0	380.0	800.0	560.0	0.
6	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
A 1	-20.00	23792	31374	8600	55642	12738	63766	42903	1.486
A 2	-20.00	23792	41974	6922	55642	6383	72689	49258	1.476
A 3	-20.00	23792	49374	4000	55642	1898	77166	53743	1.436
A 4	-20.00	23792	54174	2400	55642	683	80366	54959	1.462
B 1	-25.00	27569	32313	10600	67183	17762	70482	49420	1.426
B 2	-25.00	27569	42913	8704	67183	10094	79187	57088	1.387
B 3	-25.00	27569	50313	6000	67183	4272	83882	62910	1.333
B 4	-25.00	27569	55113	4400	67183	2297	87082	64885	1.342
C 1	-45.00	49696	120460	19600	122590	21293	189756	101296	1.873

NOTES

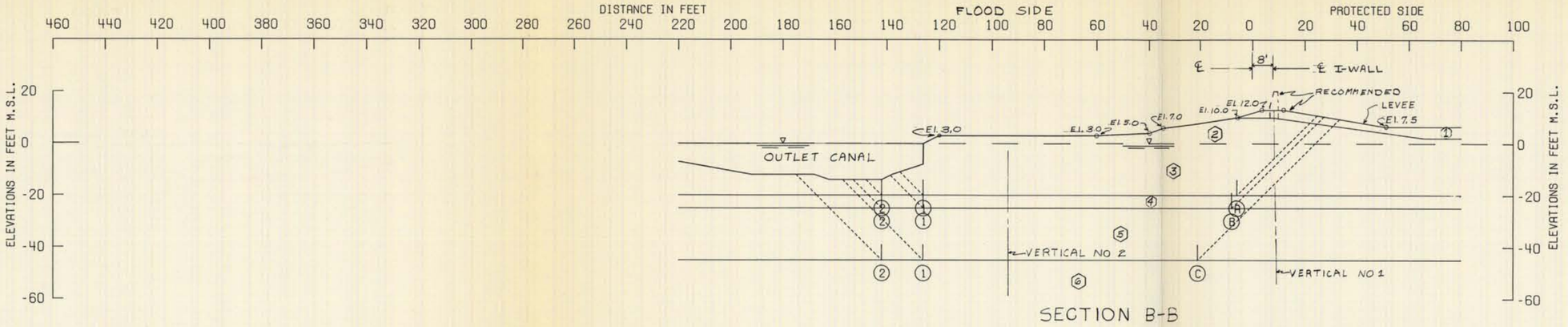
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

FOR LOCATION OF SECTION A-A IN PLAN SEE PLATE 56.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE—FLOOD SIDE
(Q) STABILITY ANALYSIS
SECTION A-A
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 60



SECTION B-B

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 12-EU+12EUT DATA PLATES 10 & 11 RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. 'CENTER OF STRATUM		BOTTOM OF STRATUM		FRICTION ANGLE DEGREES
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	
①	CH	100.0	100.0	200.0	200.0	200.0	200.0	0.
②	CH	100.0	100.0	375.0	200.0	375.0	200.0	0.
③	CH	38.0	38.0	375.0	200.0	375.0	200.0	0.
④	CH	38.0	38.0	418.0	200.0	460.0	200.0	0.
⑤	CH	38.0	38.0	630.0	380.0	800.0	560.0	0.
⑥	ML	55.0	55.0	200.0	200.0	200.0	200.0	15.0

ASSUMED FAILURE SURFACE NO.	ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-20.00	21601	30471	3600	38951	2049	55672	36901	1.509
Ⓐ ②	-20.00	21601	33671	2400	38951	683	57672	38268	1.507
Ⓑ ①	-25.00	25335	32772	5066	48388	4113	63174	44275	1.427
Ⓑ ②	-25.00	25335	35972	4400	48388	2297	65707	46091	1.426
Ⓒ ①	-45.00	47621	65924	19600	93214	20225	133145	72988	1.824
Ⓒ ②	-45.00	47621	74662	20400	93214	18938	142684	74276	1.921

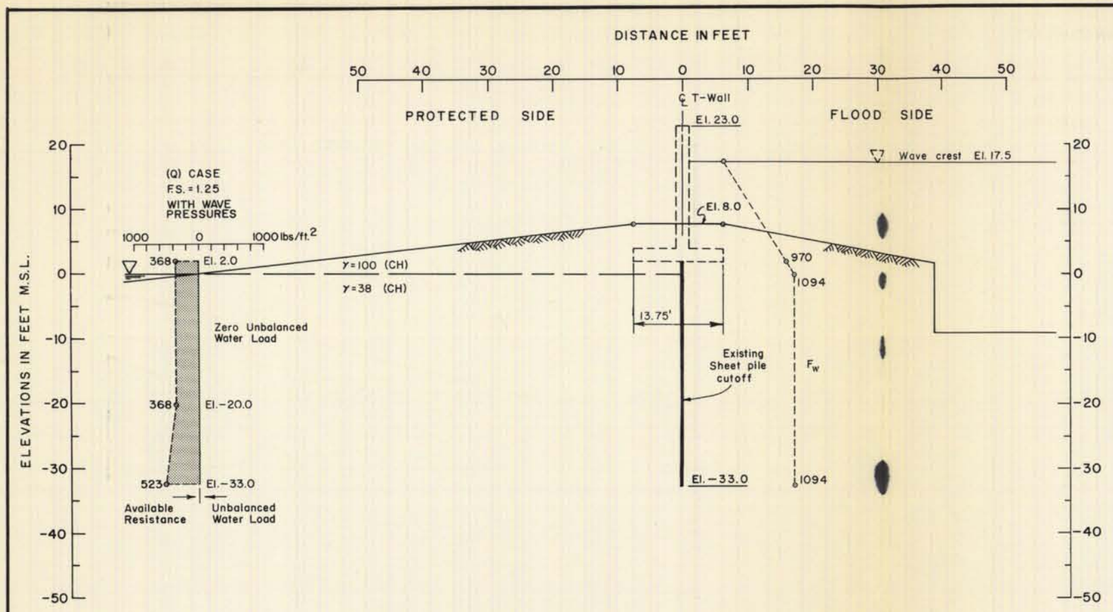
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

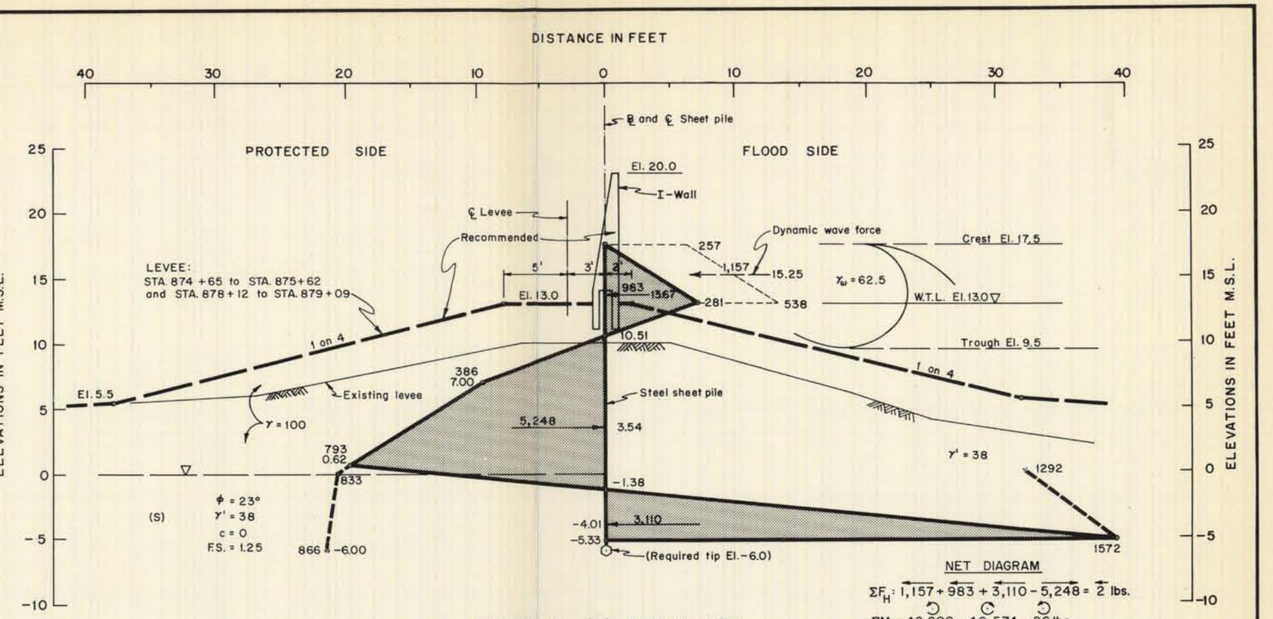
FACTOR OF SAFETY = $\frac{R_A + R_B + \frac{1}{3}P}{D_A - D_i}$

FOR LOCATION OF SECTION B-B IN PLAN SEE PLATE 36

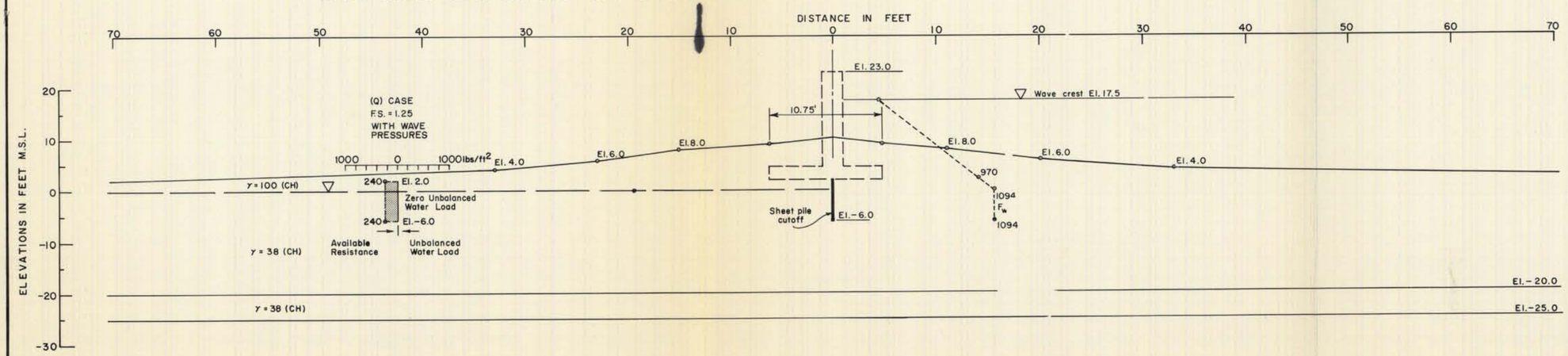
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
I-WALL LEVEE — FLOOD SIDE
(Q) STABILITY ANALYSIS
SECTION B-B
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24625



PUMPING STATION VICINITY OF STATION 876+87
T-WALL SHEET PILE CUTOFF (Q) STABILITY



I-WALL (S) STABILITY
STATION 874+42 TO 875+62 AND STATION 878+12 TO 879+32



PUMPING STATION VICINITY OF STATION 876+00
T-WALL SHEET PILE CUTOFF (Q) STABILITY

GENERAL NOTES

For location plan see plate no. 56.

For soil boring data see plates nos. 10 & 11.

(S) Case governs for design for I-wall

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

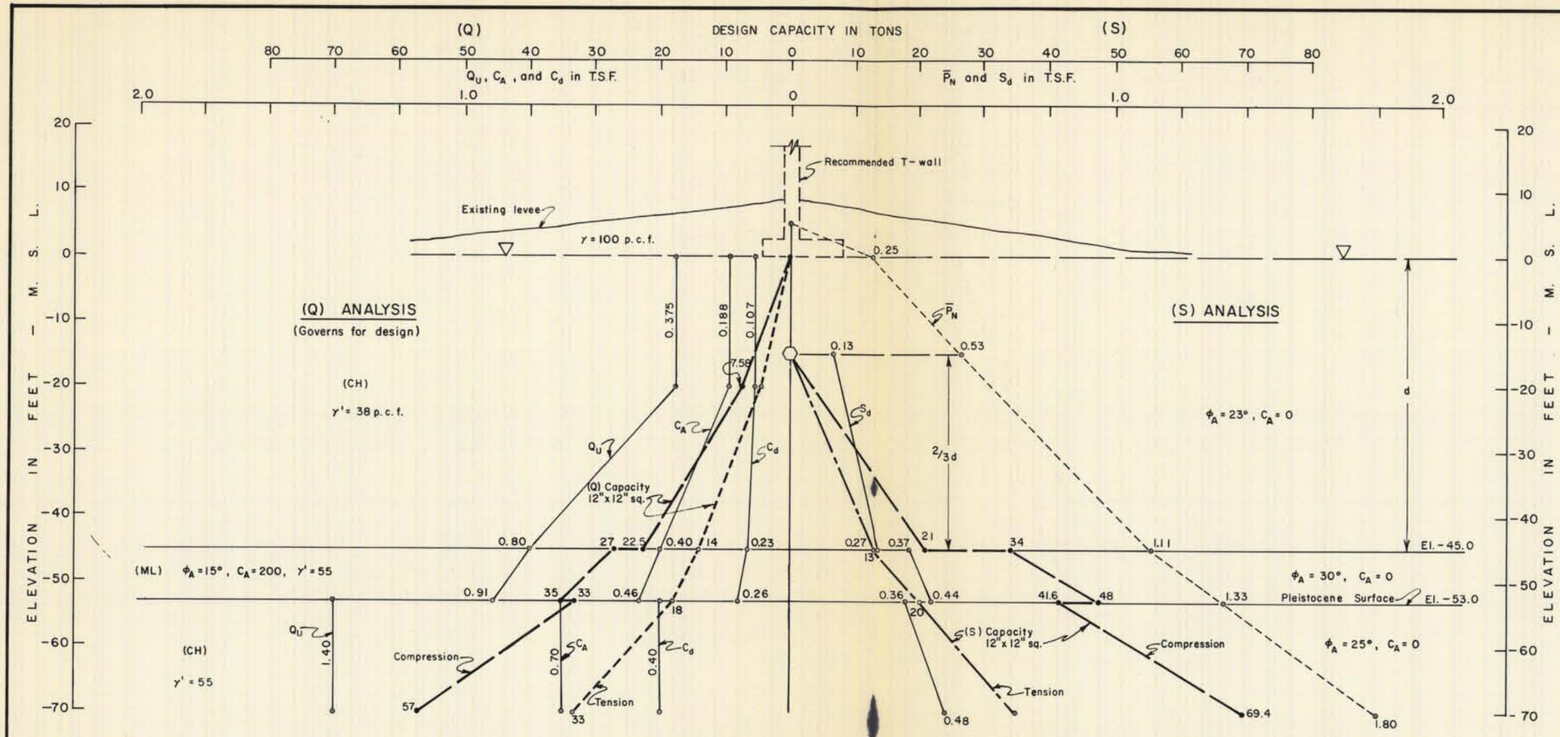
FLOODWALL AT PUMPING STATION VICINITY STA. 876+87

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB 1971

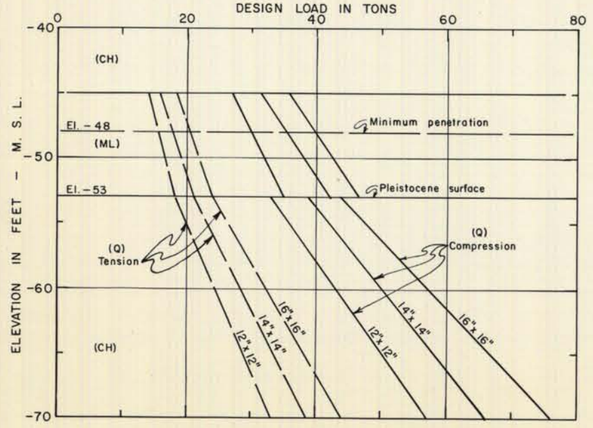
FILE NO. H-2-24625

PLATE 62

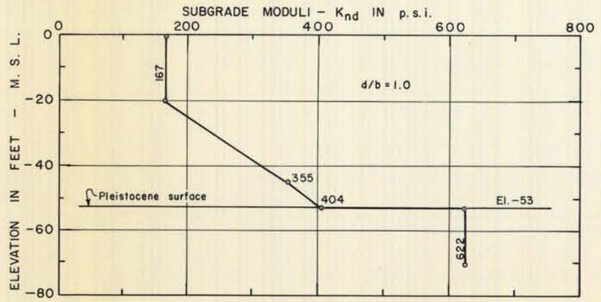


PILE CAPACITY ANALYSES IN VICINITY OF STATION 876+87

APPLICABLE BETWEEN STATION 740+00 AND STATION 880+00



DESIGN LOAD VS TIP ELEVATION



SUBGRADE MODULI VS ELEVATION

GENERAL NOTES

(Q) Case governs for design capacities.

See plate 10 for soil boring data.

Q_U = Unconfined compressive strength.

C_A = Unit cohesion available in p.s.f.

C_d = Unit cohesion developed = C ÷ F.O.S.

S_A = Shear strength = C + $\bar{P}_N$ tan Φ

S_d = Strength developed = S ÷ F.O.S.

$\bar{P}_N$ = Effective normal stress in t.s.f.

γ = Unit weight of soil - water system in p.c.f.

γ' = Submerged unit weight of soil in p.c.f.

Applied factors of safety: 1.75 in compression and 2.0 in tension.

Applied conjucate stress ratios: K = 1.0 in compression and 0.7 in tension.

Subgrade Modulus for cohesive soils: $K_o = 80 \cdot Q_u (p.s.f.) = 0.5555 \cdot Q_u (p.s.i.)$

$K_{nd} = 0.4\ K_o \cdot d/b = 0.2222 \cdot Q_u \cdot d/b$ (p.s.i.) (Design)

(Includes reduction factor for cyclic loading.)

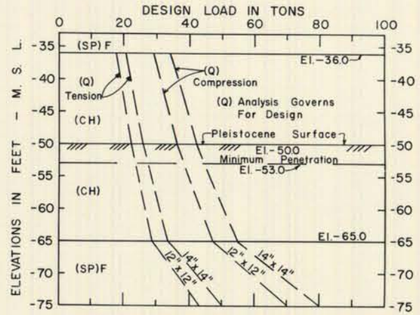
K_o values are those proposed by Karl Terzaghi in "Evaluation of Coefficients of Subgrade Reactions," Geotechnique, London, England, Vol. V, 1955, p.p. 297-326.

d = Projected diameter of pile (inches)

b = Unit conversion factor = 12 inches

Design load is the structure load carried by the pile. The pile capacity curves include the factors of safeties used for design.

T-wall from stations 875+62 to 878+12.



DESIGN LOAD VS TIP ELEVATION

(APPLICABLE BETWEEN STA. 690+00 AND 740+00)

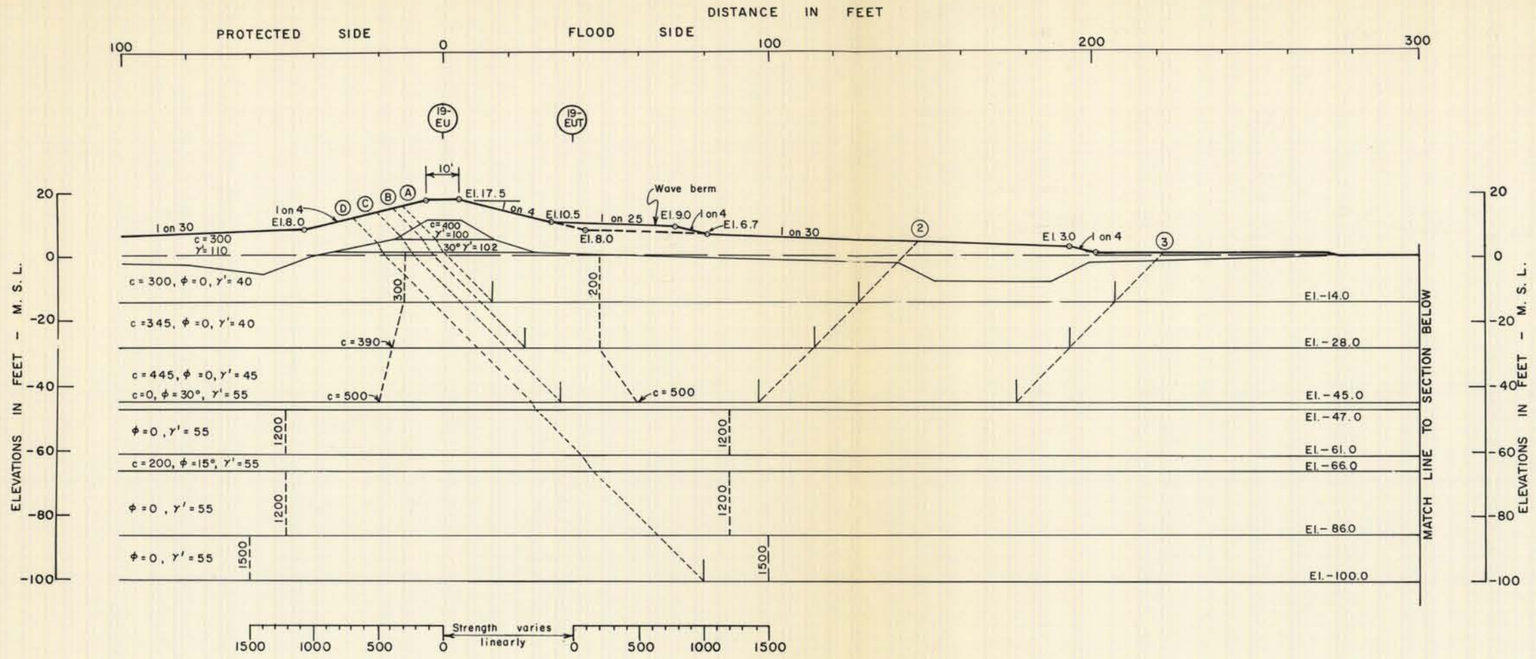
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

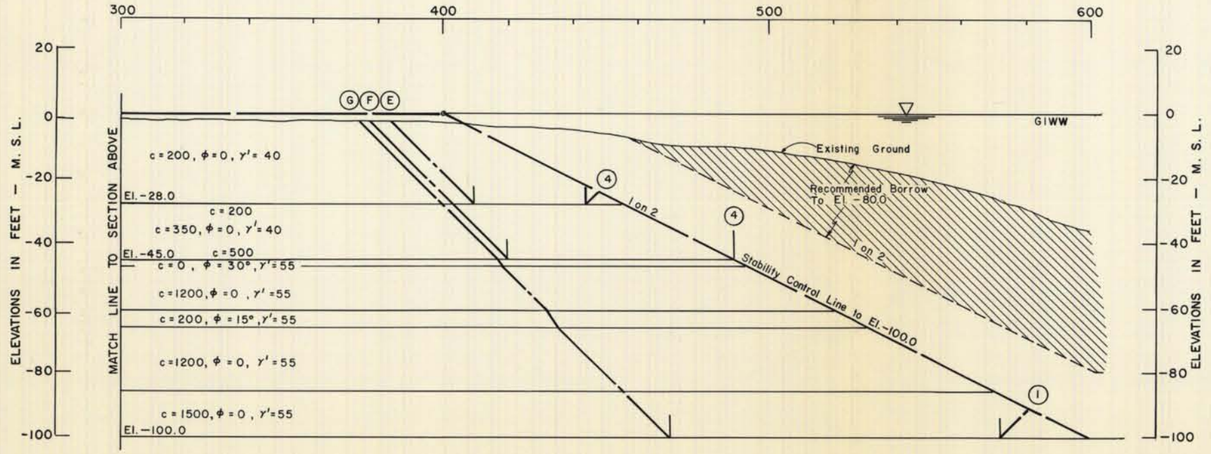
PILE DESIGN LOAD VS TIP EL. AND BEARING PILE SUBGRADE MODULI

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971 FILE NO. H-2-24625

PLATE 63





ASSUMED FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY ΣR / ΣD
NUMBER		ELEVATION	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	
A	1	-14.0	43,767	19,167	24,600	20,356	5,781	10,000	36,137	1.47
	2			12,783	30,984		23,581	8,520	52,457	1.69
	3			5,723	38,044		41,781	6,600	68,737	1.81
B	2	-28.0	76,579	32,934	43,645	27,889	18,334	14,000	60,223	1.38
	3			20,103	56,476		34,134	12,100	74,123	1.31
	4			479	76,100		84,334	1,600	113,823	1.50
C	2	-45.0	124,623	68,167	56,456	39,486	30,500	29,250	99,236	1.76
	3			46,880	77,743		77,000	23,017	139,503	1.79
	4			0	124,623		217,861	0	257,347	2.07
D	1	-100.0	370,153	3,590	366,563	175,819	738,000	28,000	941,819	2.57
E	4	-28.0	12,891	479	12,412	10,423	6,800	1,600	18,823	1.52
F	4	-45.0	34,902	0	34,902	22,351	25,361	0	47,712	1.37
G	1	-100.0	175,216	3,590	171,626	154,182	153,000	28,000	335,182	1.95

For general notes see plate 61.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LEVEE-ULTIMATE SECTION-FLOOD SIDE
(Q) STABILITY ANALYSIS
STA. 892+00 TO STA. 981+22
STA. 982+92 TO STA. 1006+59.2

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
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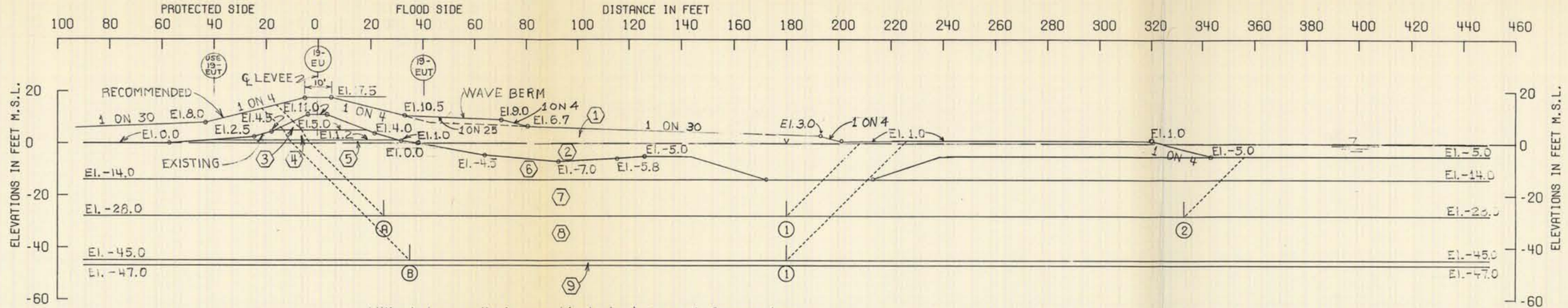
PLATE 64



Ultimate levee section is symmetrical about ℄ except for wave berm.

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS, SEE BORINGS 9-EU & 19-EUT DATA PLATES [illegible] RESPECTIVELY.

SHEAR STRENGTHS BETWEEN VERTICALS 1 AND 2 WERE ASSUMED TO VARY LINEARLY BETWEEN THE VALUES INDICATED FOR THESE LOCATIONS.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F.		C - UNIT COHESION - P.S.F. CENTER OF STRATUM		C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM		FRICTION ANGLE
		VERT. 1	VERT. 2	VERT. 1	VERT. 2	VERT. 1	VERT. 2	DEGREES
1	CH	110.0	110.0	300.0	300.0	300.0	300.0	0.
2	CH	48.0	48.0	300.0	300.0	300.0	300.0	0.
3	CH	100.0	100.0	400.0	400.0	400.0	400.0	0.
4	SP	102.0	102.0	0.	0.	0.	0.	30.0
5	CH	102.0	102.0	300.0	300.0	300.0	300.0	0.
6	CH	40.0	40.0	300.0	200.0	300.0	200.0	0.
7	CH	40.0	40.0	345.0	200.0	390.0	200.0	0.
8	CH	45.0	45.0	445.0	350.0	500.0	500.0	0.
9	SP	55.0	55.0	0.	0.	0.	0.	30.0

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
(A) (1)	-28.00	26979	31534	14600	76452	25003	73113	51449	1.421
(A) (2)	-28.00	26979	62134	9199	76452	11301	98313	65150	1.509
(B) (1)	-45.00	39068	72500	24700	124416	51095	136268	73321	1.859

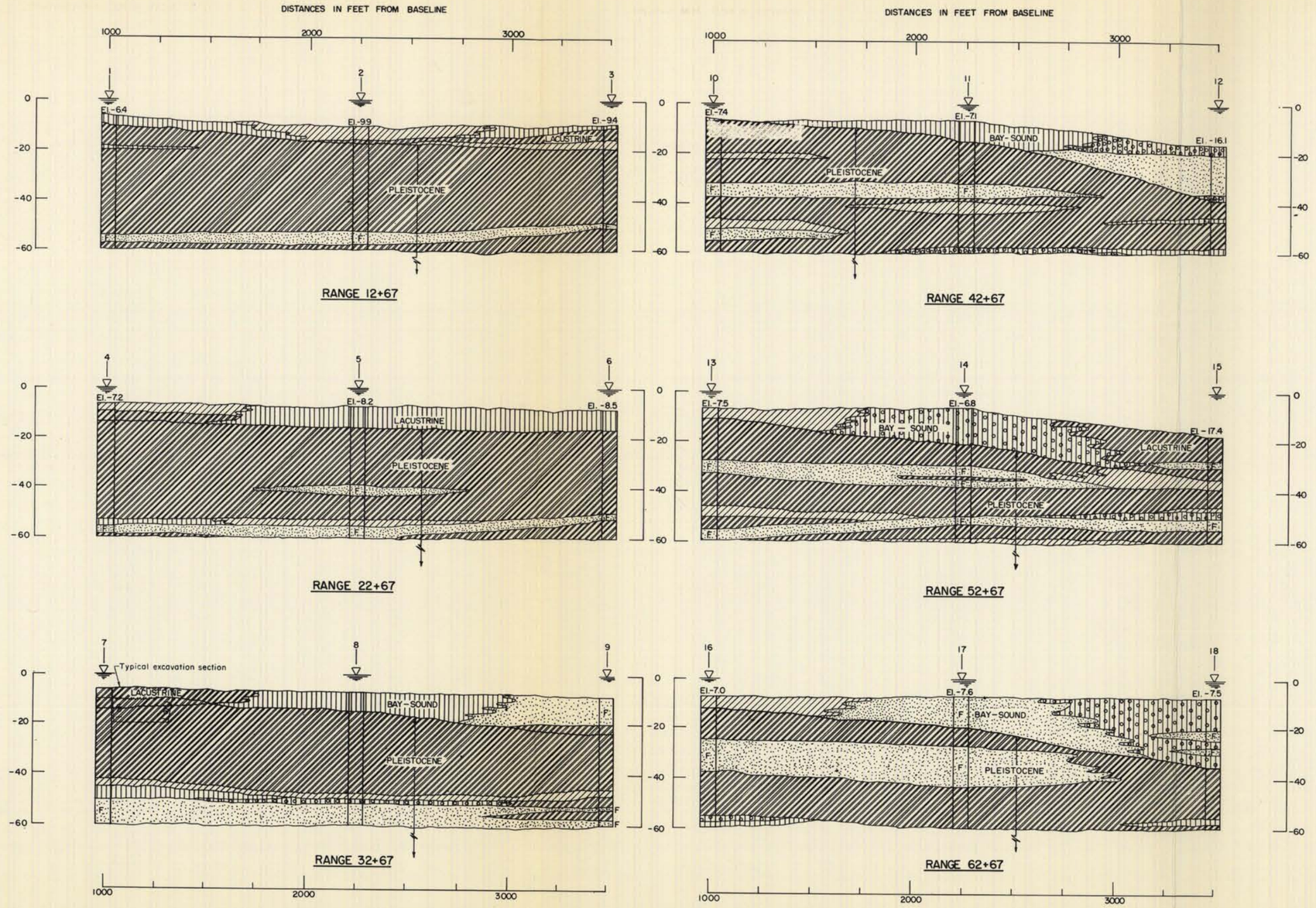
NOTES

Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
LEVEE - ULTIMATE SECTION-FLOOD SIDE
(Q) STABILITY ANALYSIS - STREAM CLOSURE
STA. 981+22 TO STA. 982+92
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEB. 1971 FILE NO. H-2-24625

PLATE 65



SOIL BORING SECTIONS

UNDISTURBED BORING

ELEVATIONS IN FEET --- M.S.L.

B-1U
Sta. 17+67 ± 1625' from B/L
7-8 March, 1968
GND. EL. -8.0

B-3U
Sta. 17+67 ± 2875' from B/L
14-15 March, 1968
GND. EL. -8.0
Composited for Compaction Testing

B-2U
Sta. 37+67 ± 1625' from B/L
1-5 March, 1968
GND. EL. -7.5

B-4U
Sta. 37+67 ± 2875' from B/L
6 March, 1968
GND. EL. -9.0
Composited for Compaction Testing

CH – Fat Clay
CL – Lean Clay
ML – Silt
SM – Silty Sand
SP – Fine Sand

LEGEND (Soil Boring Sections)

RECENT
- Lacustrine – soft to very soft lean clay and fat clay with silty sand and sand, and with shell and shell fragments.
- Bay-Sound – silt, silty sand and sand with shell and shell fragments.

PLEISTOCENE – stiff to very stiff clays with layers and lenses silt and sand

Soil samples taken with 1 7/8 inch I.D. core barrel.
See PLATE A for soil boring legend.
See PLATE 67 for location of borings.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

BORROW DATA

PIT AREA IN LAKE PONTCHARTRAIN
ALONG NORTH SHORE

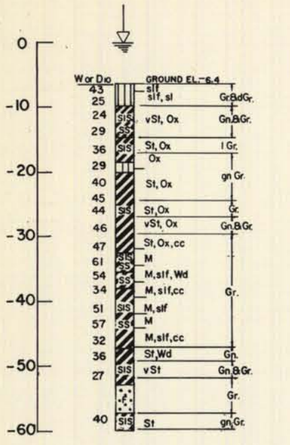
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971
FILE NO. H-2-24625

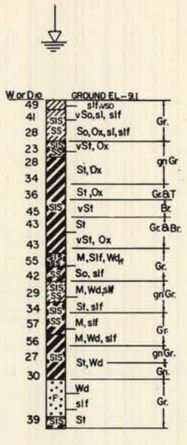
PLATE 66

PLOT NO. 4

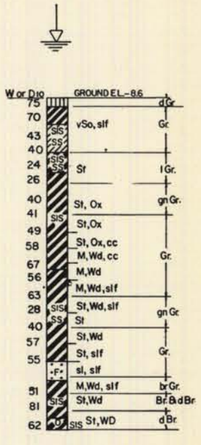
BORING NO. 1
Sta. 12+67 - 1000' Rt. of B/L



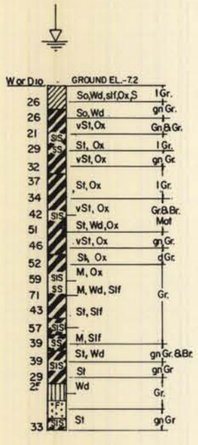
BORING NO. 2
Sta. 12+67 - 2250' Rt. of B/L



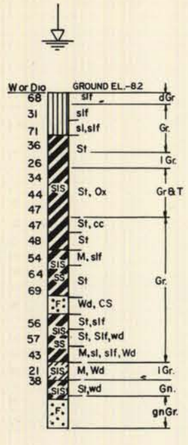
BORING NO. 3
Sta. 12+67 - 3500' Rt. of B/L



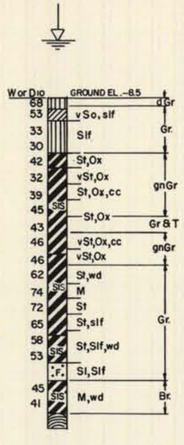
BORING NO. 4
Sta. 22+67 - 1000' Rt. of B/L



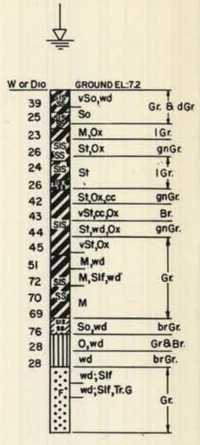
BORING NO. 5
Sta. 22+67 - 2250' Rt. of B/L



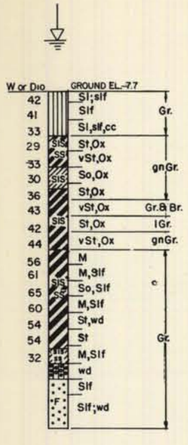
BORING NO. 6
Sta. 22+67 - 3500' Rt. of B/L



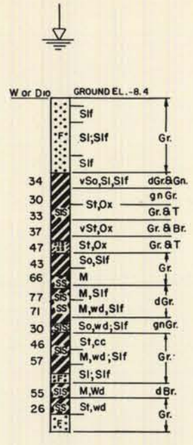
BORING NO. 7
Sta. 32+67 - 1000' Rt. of B/L



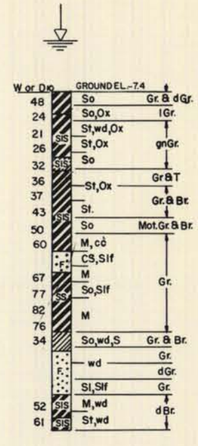
BORING NO. 8
Sta. 32+67 - 2250' Rt. of B/L

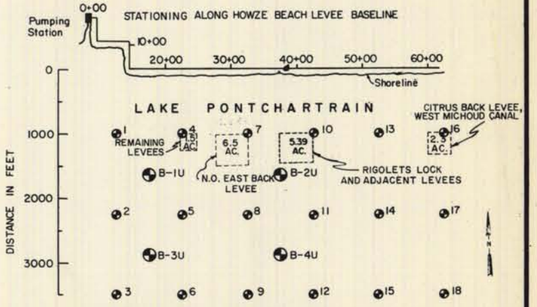


BORING NO. 9
Sta. 32+67 - 3500' Rt. of B/L



BORING NO. 10
Sta. 42+67 - 1000' Rt. of B/L



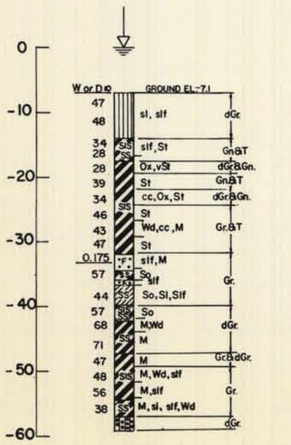


PROSPECTIVE BORROW AREAS
LAKE PONTCHARTRAIN ALONG NORTH SHORE
● INDICATES BORING LOCATIONS

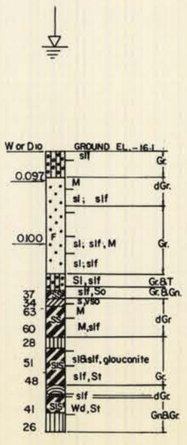
GENERAL NOTES:
FOR SOIL BORING LEGEND SEE PLATE A.
SOIL SAMPLES TAKEN WITH 1⅞" I.D. CORE BARREL SAMPLER.

PLOT NO. 4

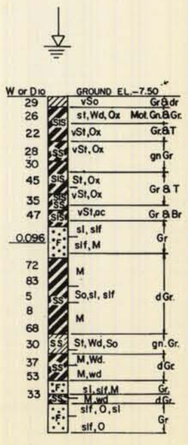
BORING NO. 11
Sta. 42+67 - 2250' Rt. of B/L



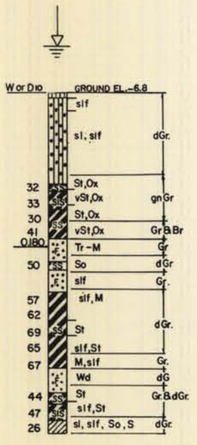
BORING NO. 12
Sta. 42+67 - 3500' Rt. of B/L



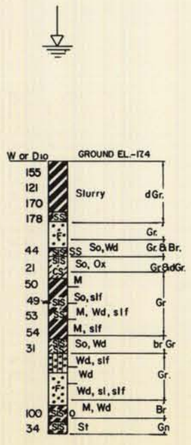
BORING NO. 13
Sta. 52+67 - 1000' Rt. of B/L



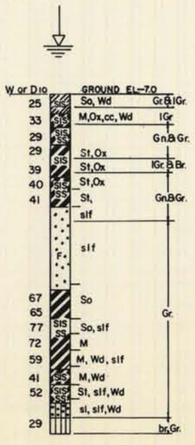
BORING NO. 14
Sta. 52+67 - 2250' Rt. of B/L



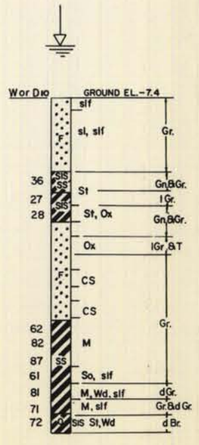
BORING NO. 15
Sta. 52+67 - 3500' Rt. of B/L



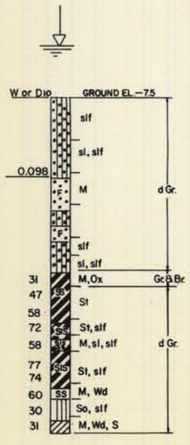
BORING NO. 16
Sta. 62+67 - 1000' Rt. of B/L



BORING NO. 17
Sta. 62+67 - 2250' Rt. of B/L



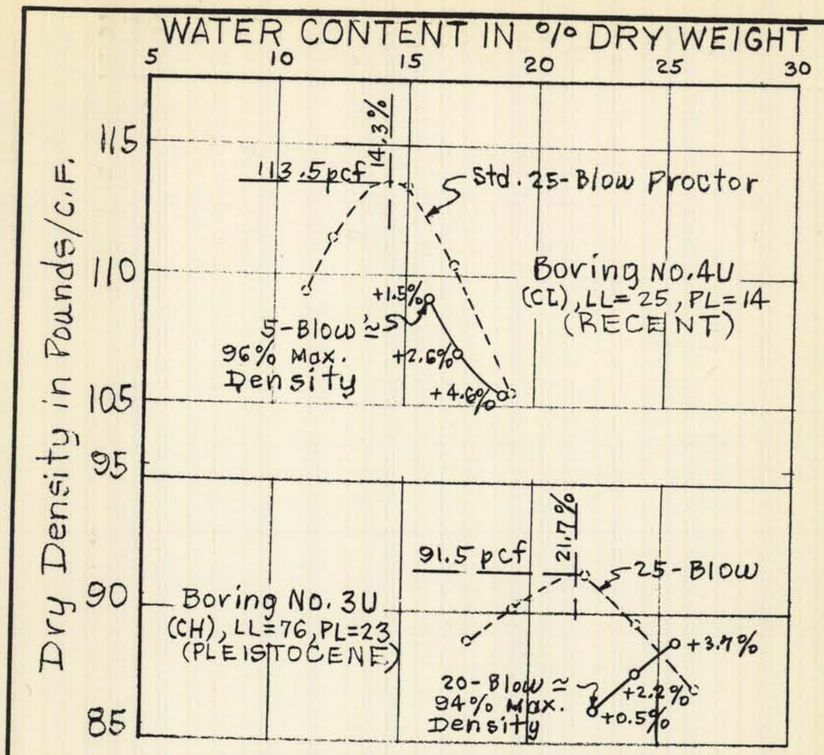
BORING NO. 18
Sta. 62+67 - 3500' Rt. of B/L



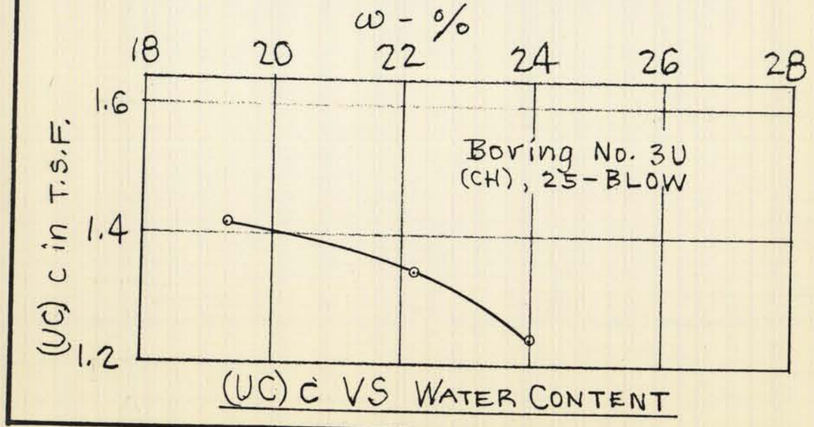
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
BORROW DATA
PIT AREA IN LAKE PONTCHARTRAIN ALONG NORTH SHORE
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971 FILE NO. H-2-24625

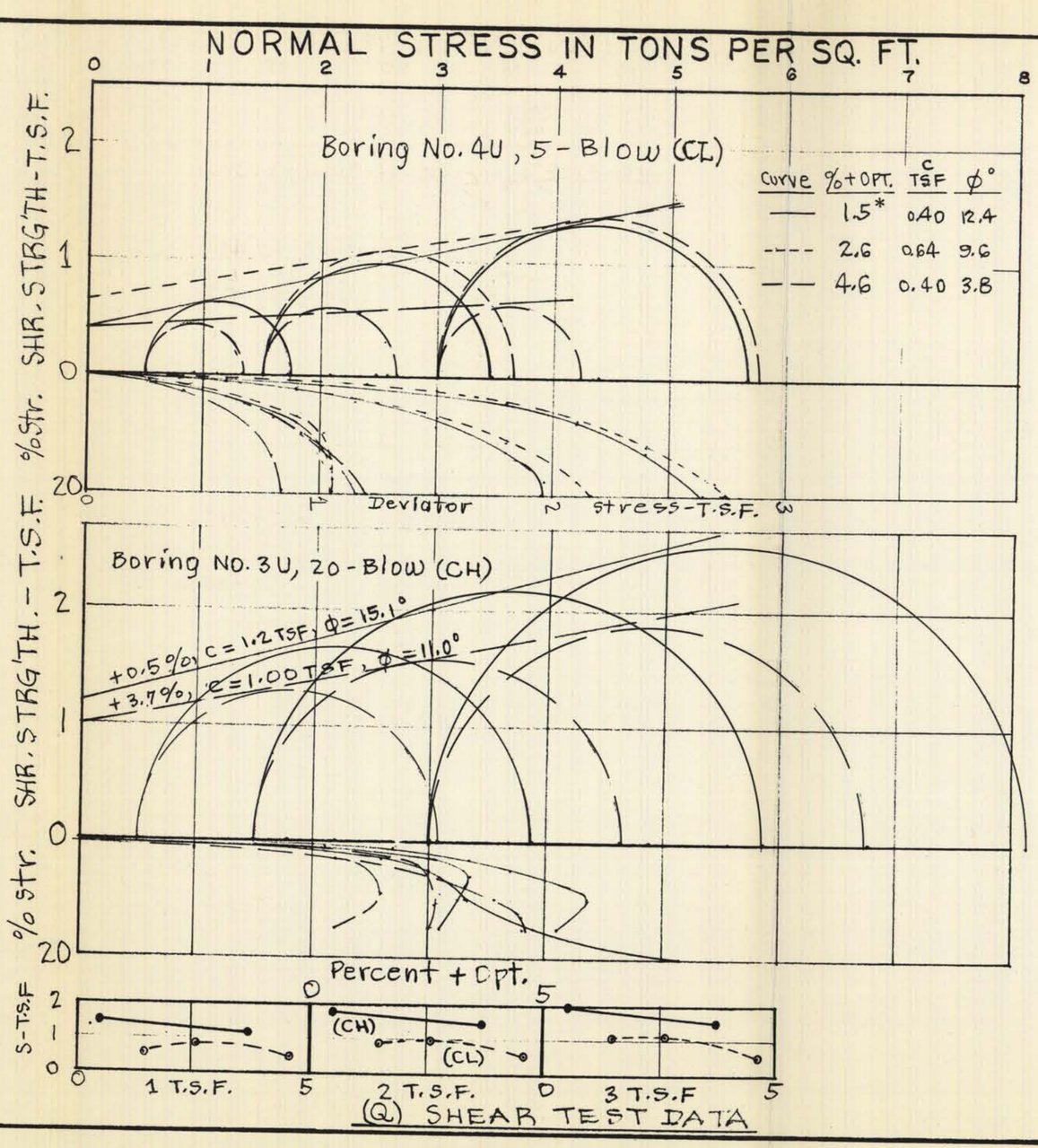
PLATE 67



COMPACTION CURVES



(UC) c VS WATER CONTENT



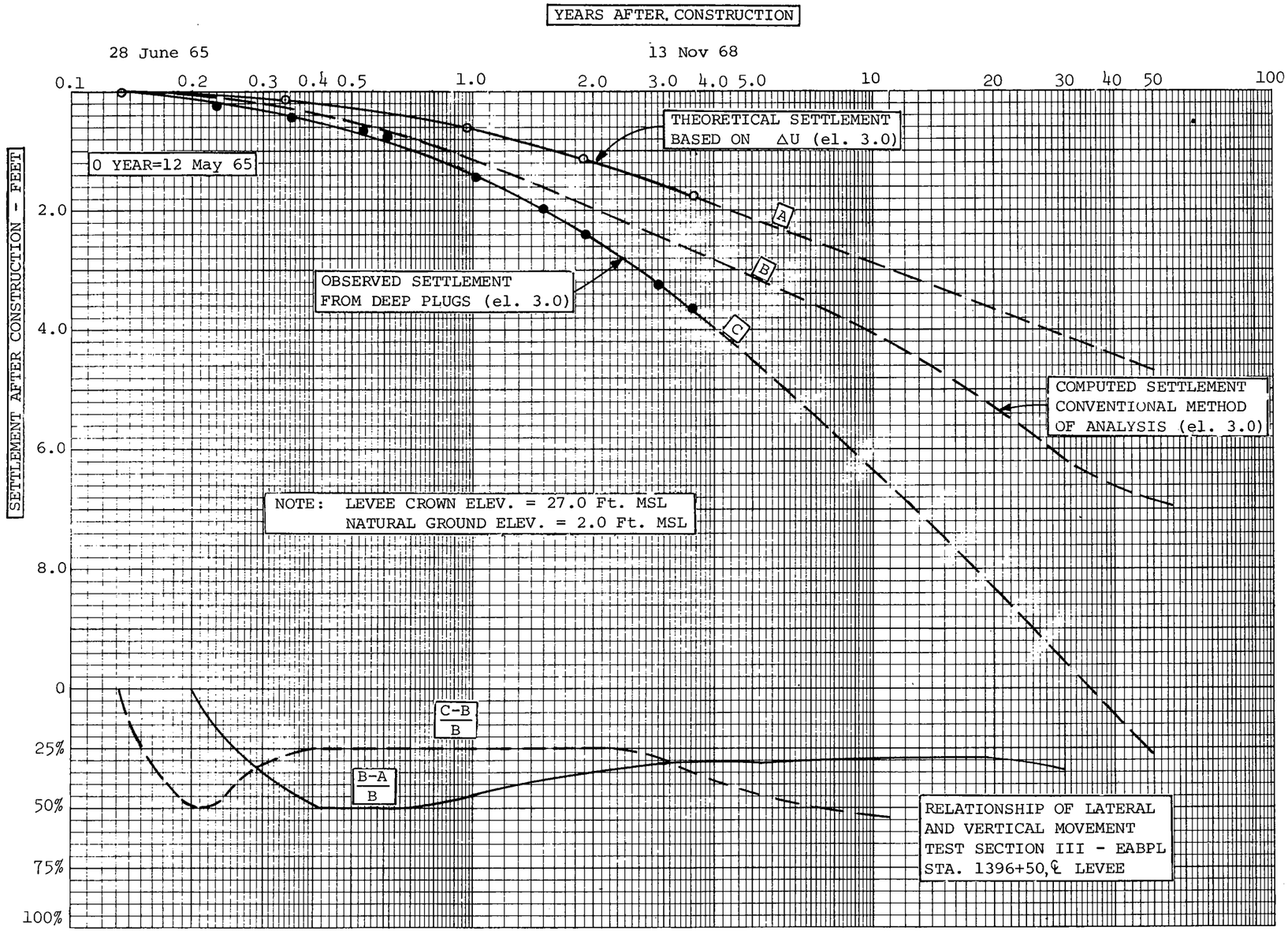
(Q) SHEAR TEST DATA

Note:
For soil boring logs and location of borrow area in Lake Pontchartrain along North Shore see plates 66, 67 & 68.

* These numbers indicate percent above optimum water content.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2-GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
COMPACTION DATA-TYPICAL CLAYS
BORROW AREA IN L. PONTCHARTRAIN
U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS, LA.
CORPS OF ENGINEERS
FEB. 1971
FILE NO. H-2-24265

PLATE 68



TOTAL SETTLEMENT (C) = $\frac{(C-B)}{B}$ (B) + (B); WHERE $\frac{(C-B)}{B}$ B =
ADDITIONAL SETTLEMENT DUE TO LATERAL MOVEMENT OF FOUNDATION

$\frac{(B-A)}{B}$ = PERCENT REDUCTION OF GAIN IN STRENGTH, BASED ON COMPUTED SETTLEMENT, BECAUSE OF LATERAL MOVEMENT OF FOUNDATION

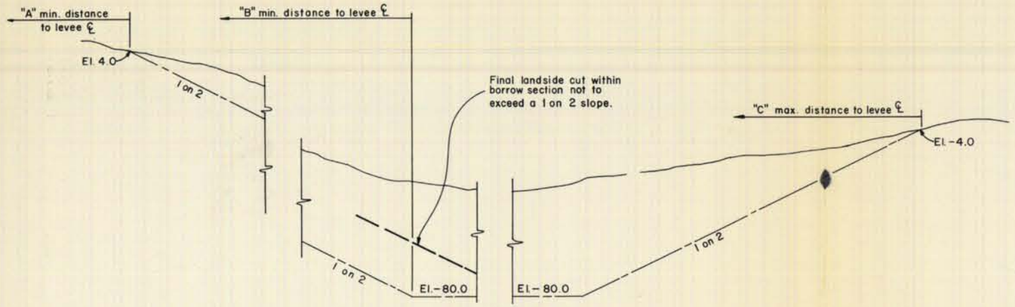
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2-GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

SETTLEMENT AND LATERAL MOVEMENT OF FOUNDATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FEB. 1971 FILE NO. H-2-24625

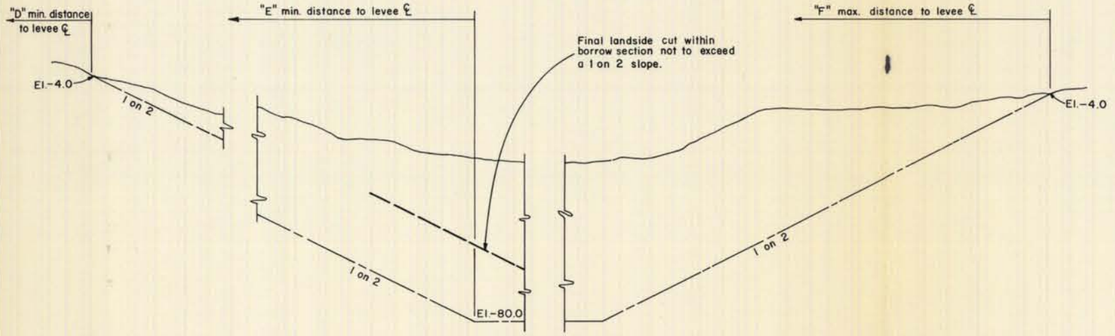
PLATE 69



BORROW SECTION "A"

LOCATED IN THE MICHOUD CANAL

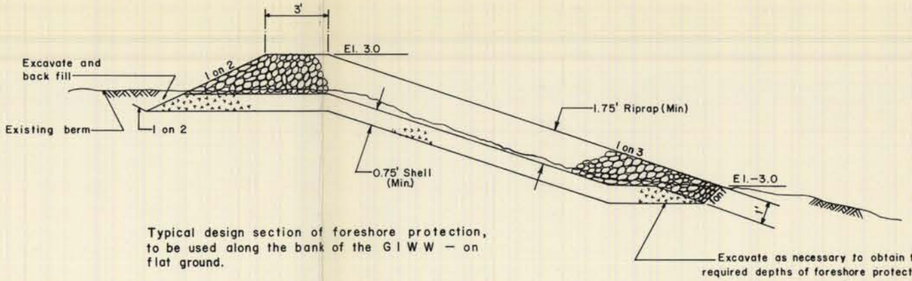
	DISTANCE TO LEVEE ℄		
LEVEE STATIONING	DIST."A"	DIST."B"	DIST."C"
667+73 to 682+00	450'	602'	
682+00 to 690+00	450'	602'	1,250'
690+00 to 709+00	All distances vary continously from the levee ℄ thru this reach		
709+00 to 721+00	600'	752'	1,200'
721+00 to 748+50	600'	752'	1,200'
748+50 to 752+00	All distances vary continously from the levee ℄ thru this reach		



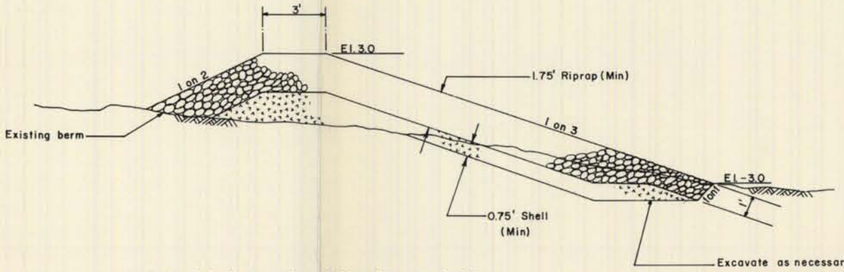
BORROW SECTION "B"

LOCATED IN THE GULF INTRACOASTAL WATERWAY

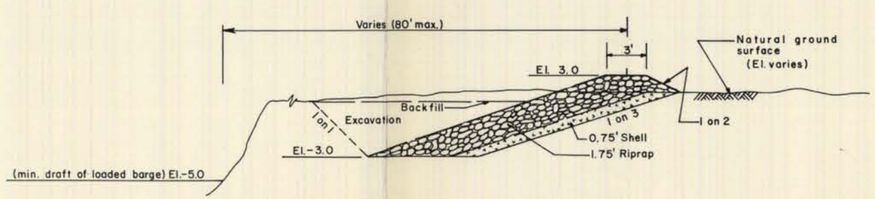
	DISTANCE TO LEVEE ℄		
LEVEE STATIONING	DIST. "D"	DIST."E"	DIST."F"
752+00 to 763+55	All distances vary continously from levee L thru this reach		
763+55 to 772+00	450'	602'	850'
772+00 to 1006+59	450'	602'	850'



Typical design section of foreshore protection, to be used along the bank of the G I W W — on flat ground.



Typical design section of foreshore protection to be used along the bank of the G I W W — on sloping ground.



Typical design section of foreshore protection to be used inland from edge of bank of G I W W, but not to exceed 80' perpendicularly from the edge of bank at El.—5.0 M.S.L.

FORESHORE DESIGN SECTIONS
STA. 755+00 TO STA. 1006+59.2

NOTES:
All sections plotted are not drawn to scale.
All elevations are in feet and refer to M.S.L.

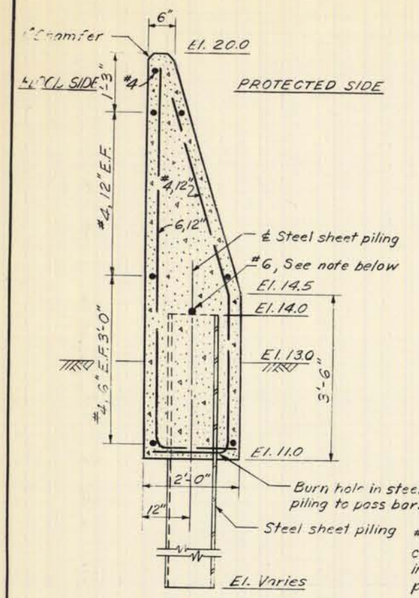
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DESIGN SECTIONS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

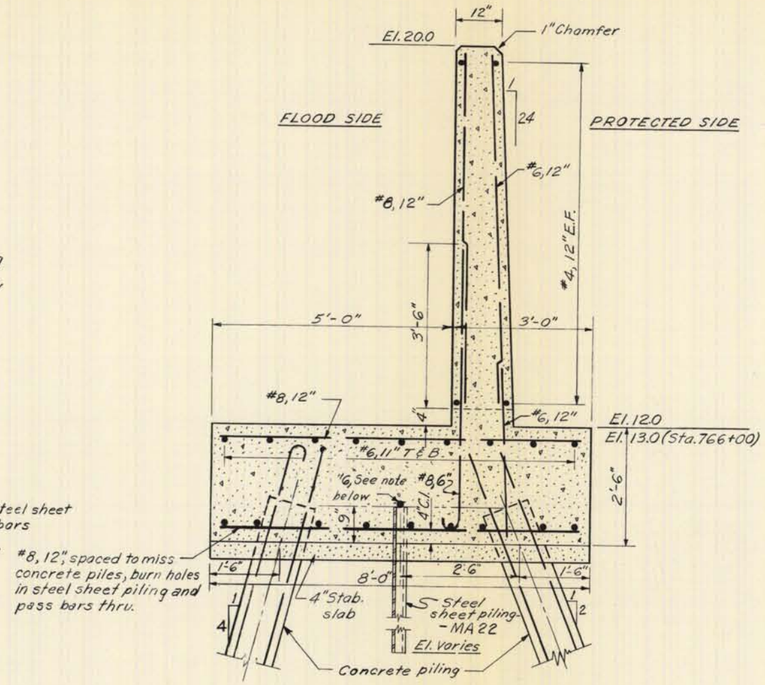
FEB. 1971 FILE NO. H-2-24625

PLATE 70



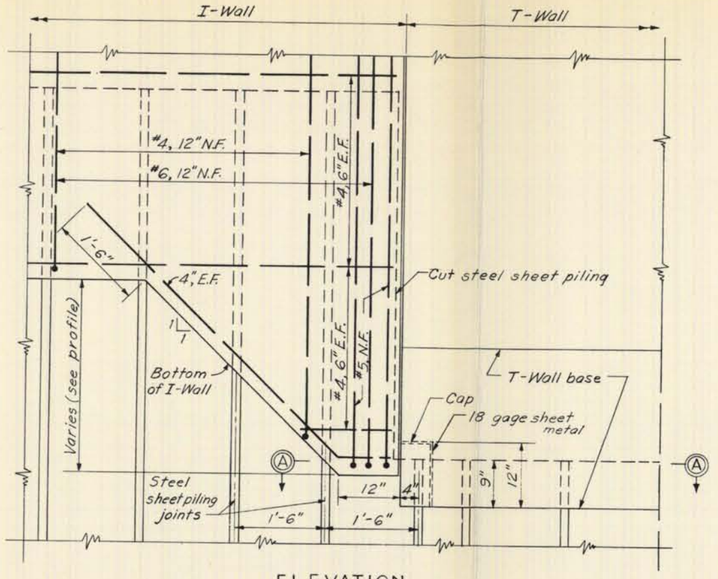
TYPICAL I-WALL SECTION

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



TYPICAL T-WALL SECTION FOR GATE MONOLITH

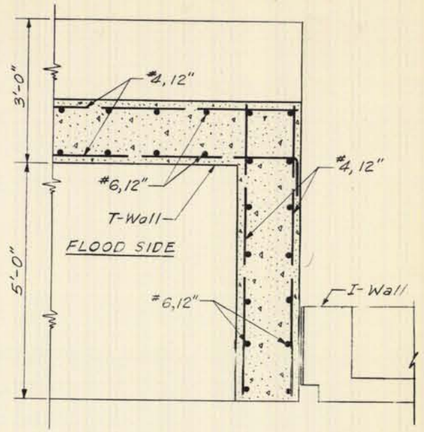
Scale: 3/8"=1'-0"



ELEVATION

TYPICAL DETAIL FOR I-WALL TO T-WALL AT BASE

Scale: 1/2"=1'-0"

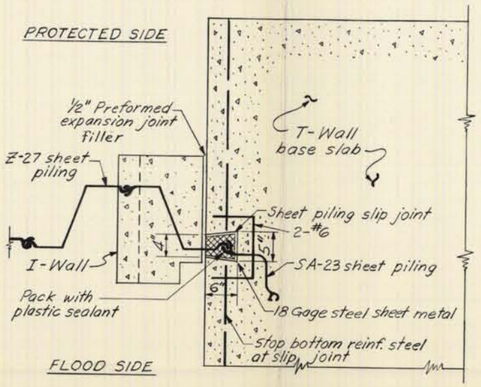


TYPICAL T-WALL CORNER DETAIL

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

Note:
Concrete piling tip El. for gate monoliths at −60.0 ±

Note:
Weld a No.6 reinf. rod to top of each steel sheet pile. Install flexible jumper at all monolith joints. Jumpers shall be insulated No. 1/0 AWG copper, insulated with cross linked polyethylene in an 8" dia. loop. Jumper shall be welded to adjacent steel sheet piles 3 inches below bottom of concrete cap. Welded connections shall be coated with splicing epoxy to obtain a moisture proof connection.



SECTION A-A

Scale: 1/2"=1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

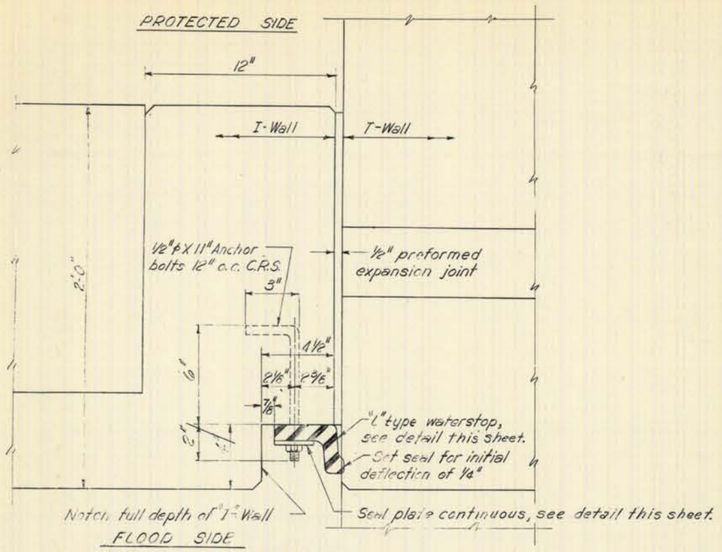
TYPICAL WALL SECTIONS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

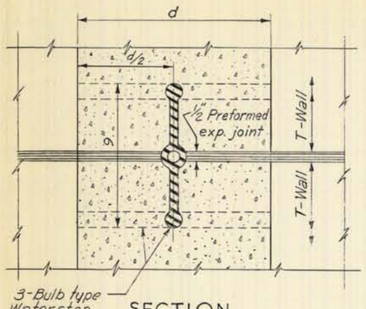
FILE NO. H-2-24625

PLATE 71



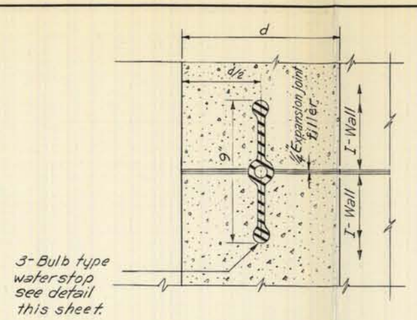
PLAN

Scale: 1 1/2" = 1'-0"



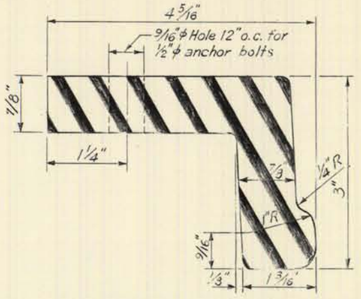
SECTION

Scale: 1 1/2" = 1'-0"



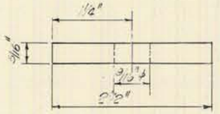
SECTION

Scale: 1 1/2" = 1'-0"



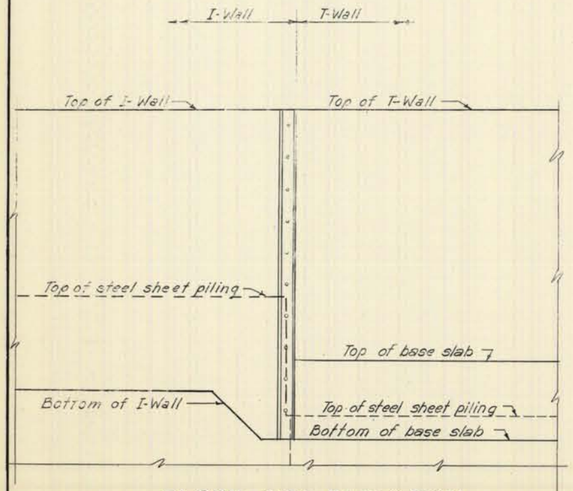
"L"-TYPE WATERSTOP SEAL DETAIL

Scale: Half size



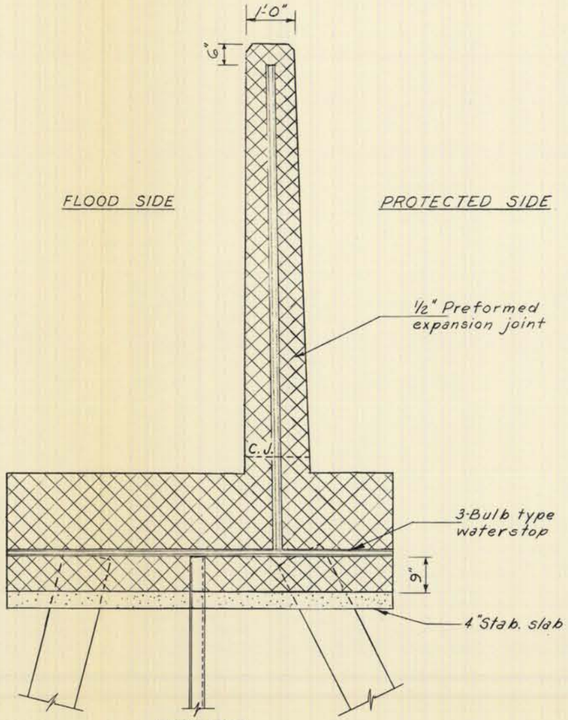
SEAL PLATE

Scale: Half size



FLOOD SIDE ELEVATION

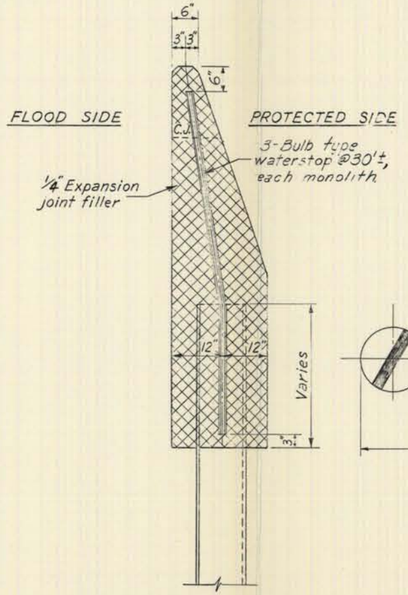
Scale: 1/4" = 1'-0"



SECTION

TYPICAL "T"-WALL JOINT

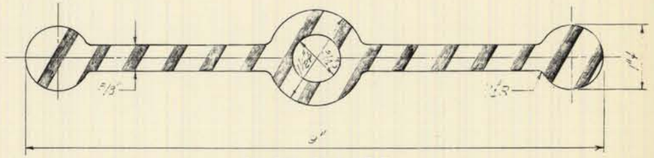
Scale: 3/8" = 1'-0"



SECTION

TYPICAL "I"-WALL JOINT

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



3-BULB TYPE WATERSTOP

Scale: Half size

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

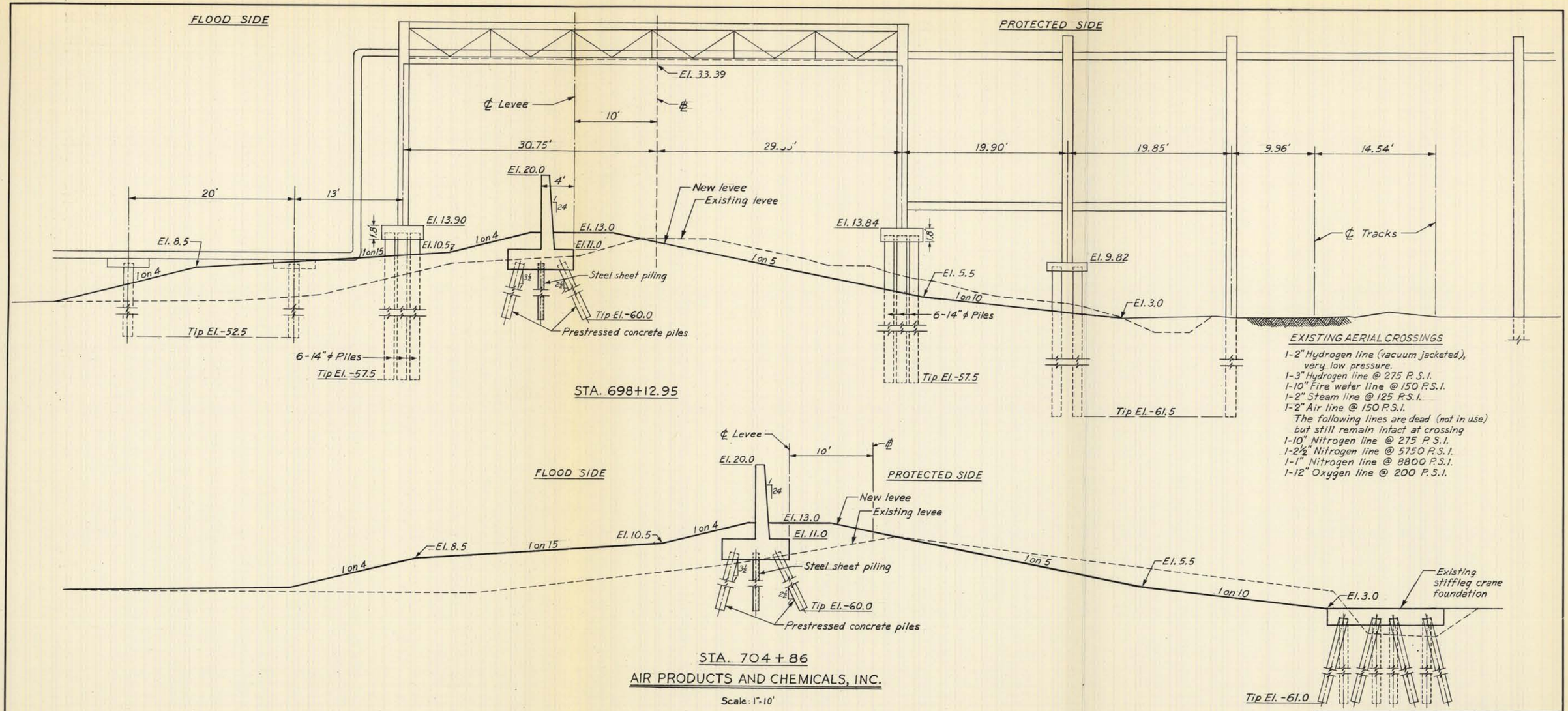
TYPICAL WALL JOINTS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 72



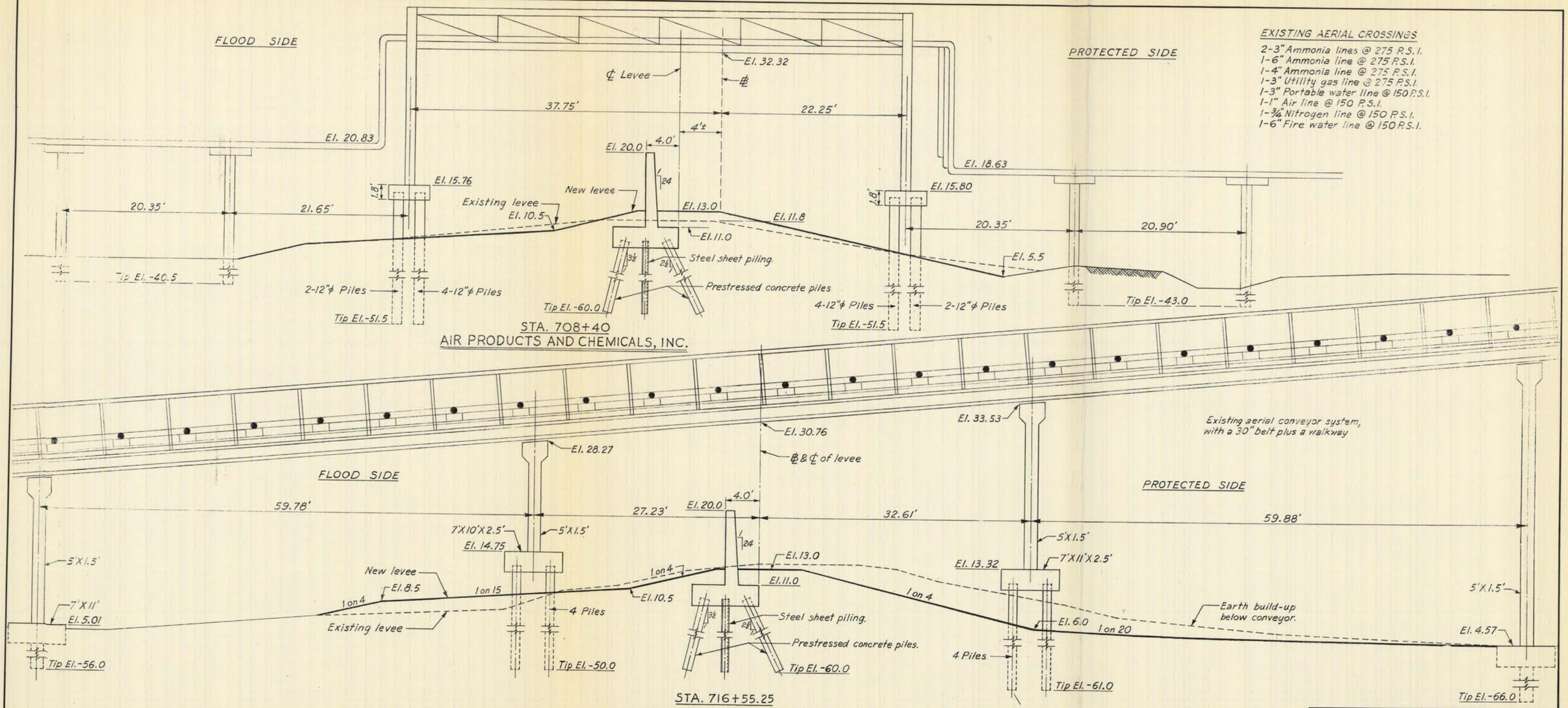
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

LEVEE SECTIONS AT STATIONS 698+12.95 AND 704+86

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971 FILE NO. H-2-24625

PLATE 73



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

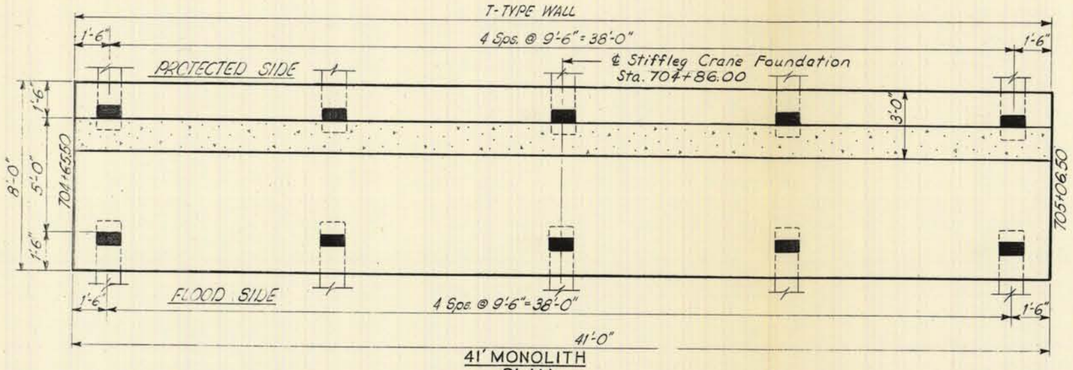
LEVEE SECTIONS AT STATIONS 708+40 AND 716+55.25

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

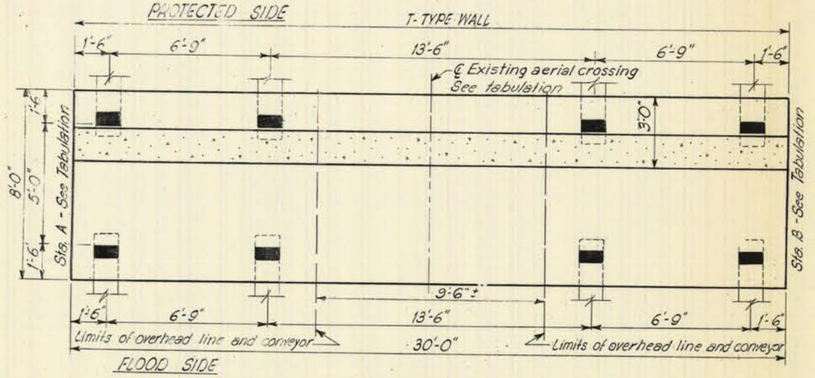
DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 74



41' MONOLITH
PLAN
Scale: 3/16"=1'-0"



30' MONOLITH
PLAN
Scale: 3/16"=1'-0"

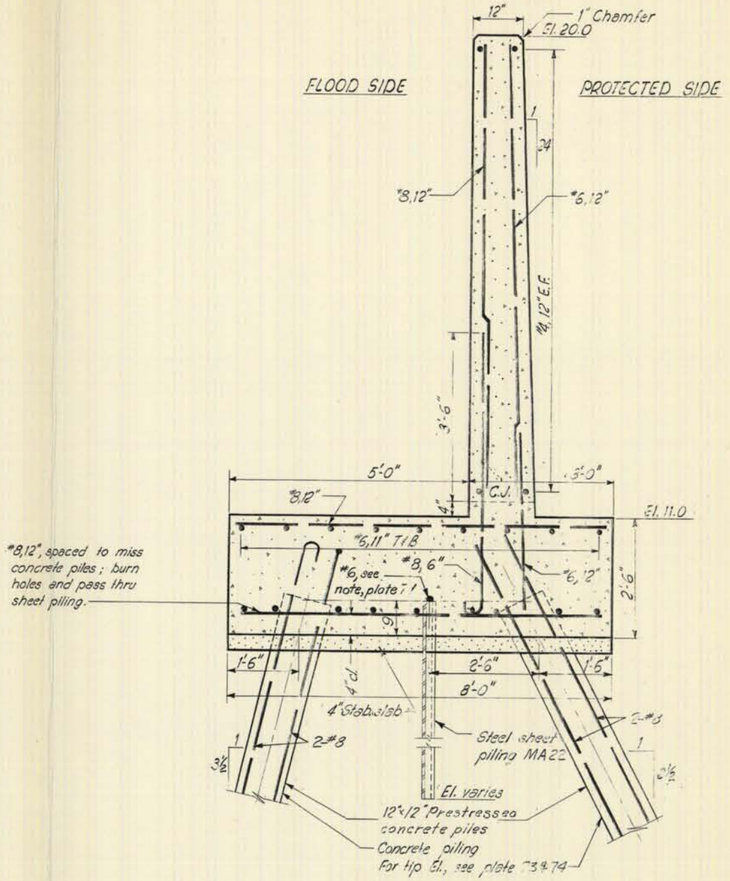
41' Monolith Tabulation		
Station ℄ Stiffleg Crane Foundation	Station A	Station B
704+86.00	704+65.50	705+06.50

30' Monolith Tabulation		
Station ℄ Aerial crossing	Station A	Station B
698+12.95	697+97.95	698+27.95
708+40.00	708+25.00	708+55.00
716+55.25	716+40.25	716+70.25

LEGEND

1 on 2½ Batter (compression pile)

1 on 3½ Batter (tension pile)

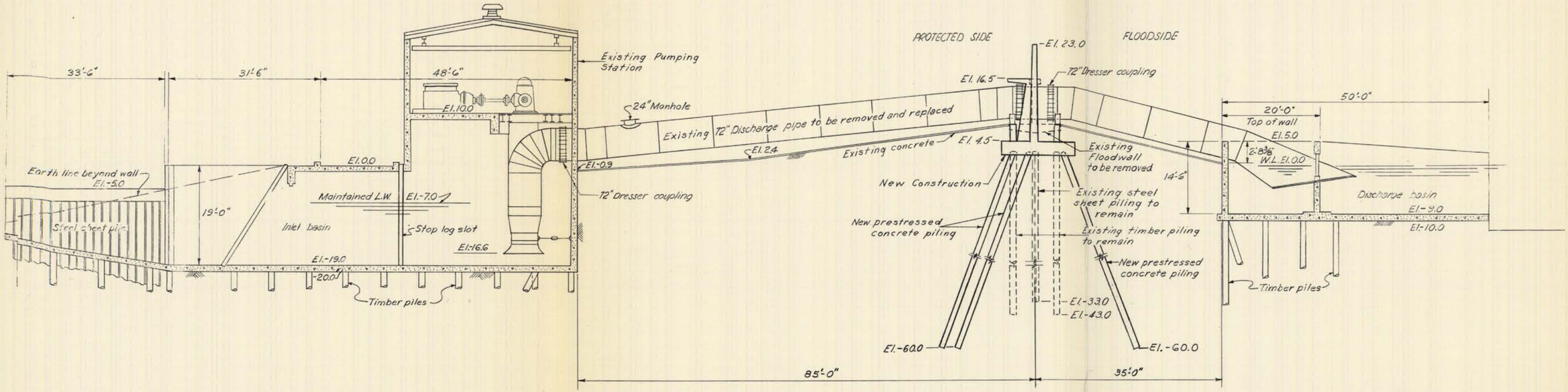


TYPICAL SECTION
Scale: 3/8"=1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
DETAILS OF T-WALL MONOLITHS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971 FILE NO. H-2-24625

PLATE 75



SECTION THRU PUMPING STATION

Scale: 1/16"=1'-0"

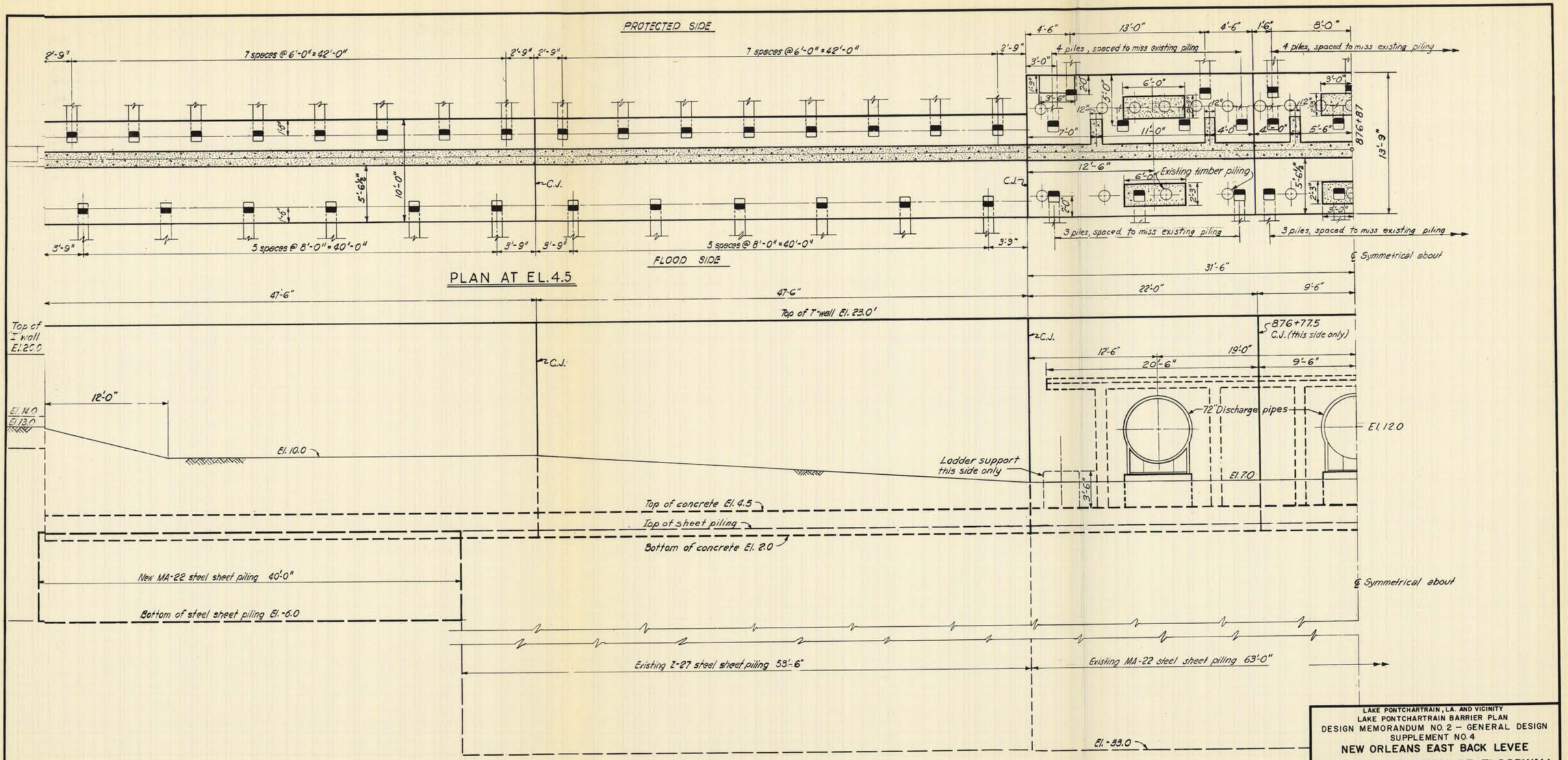
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE
SECTION THRU
EXISTING PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 76



FLOOD SIDE ELEVATION

Scale: 1/8"-1'-0"

(PILING NOT SHOWN)

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

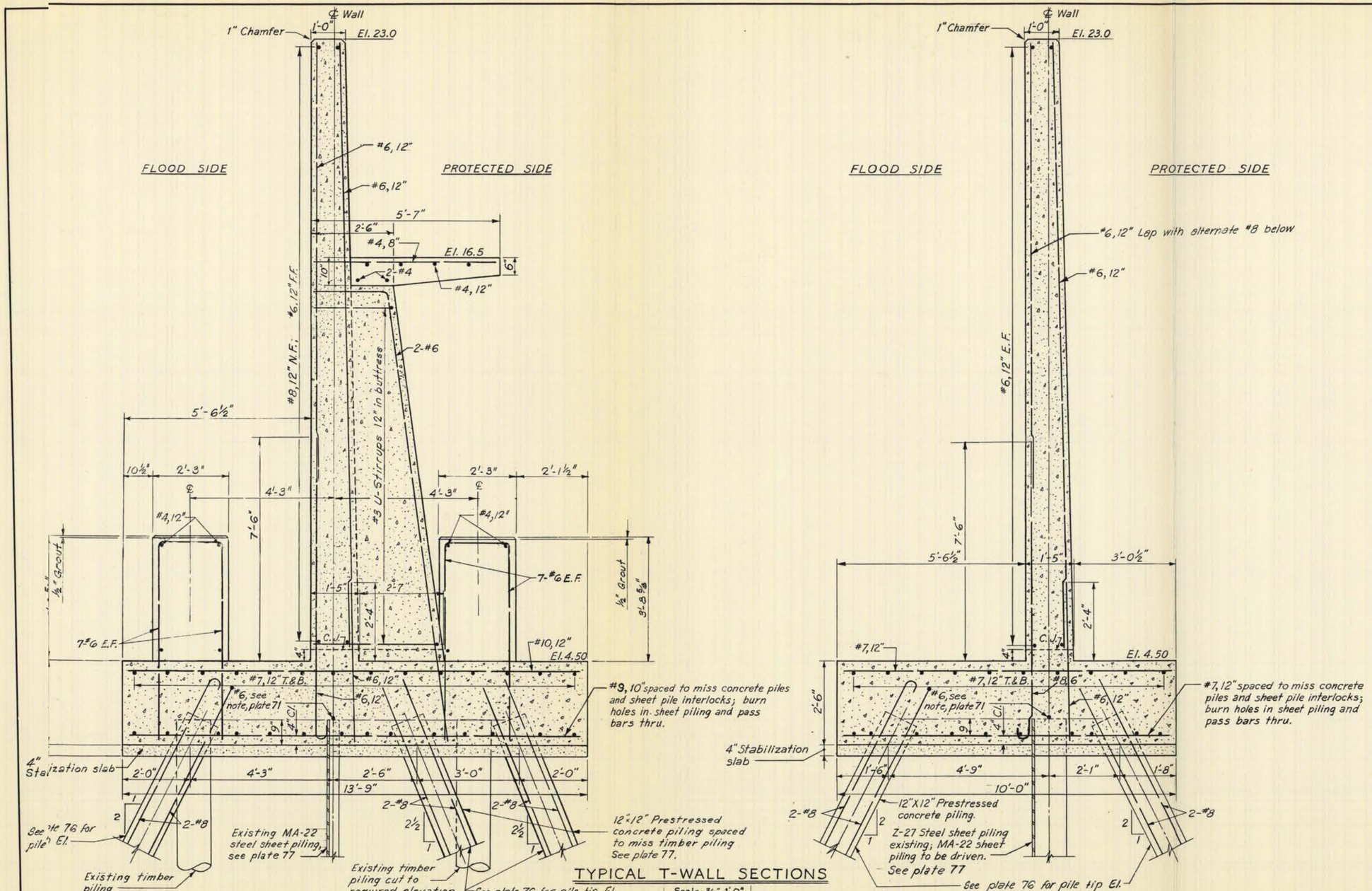
PLAN AND ELEVATION OF FLOODWALL AT EXISTING PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 77



TYPICAL T-WALL SECTIONS

Scale: ⅜"=1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

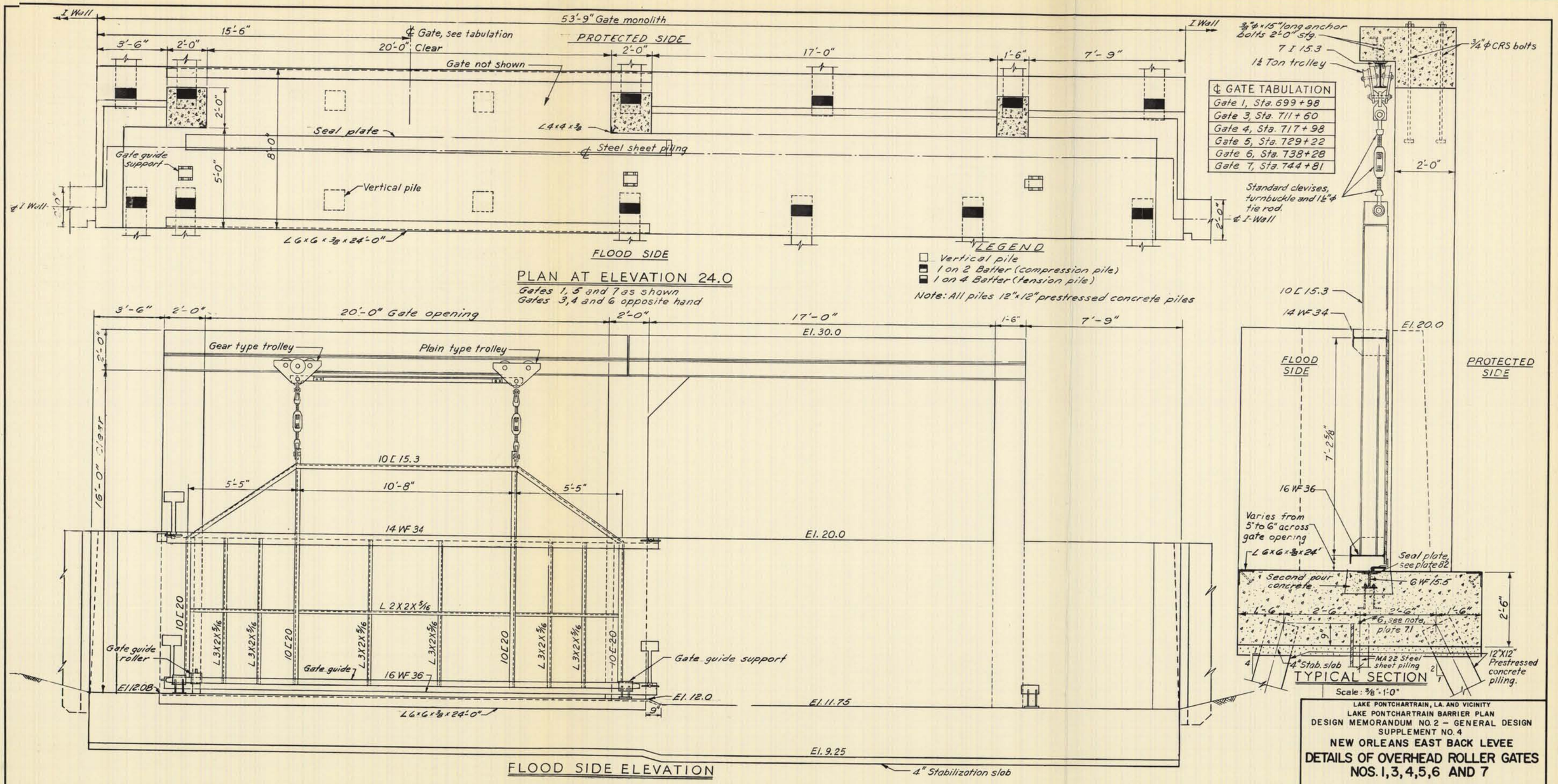
FLOODWALL SECTIONS AT EXISTING PUMPING STATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 78



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

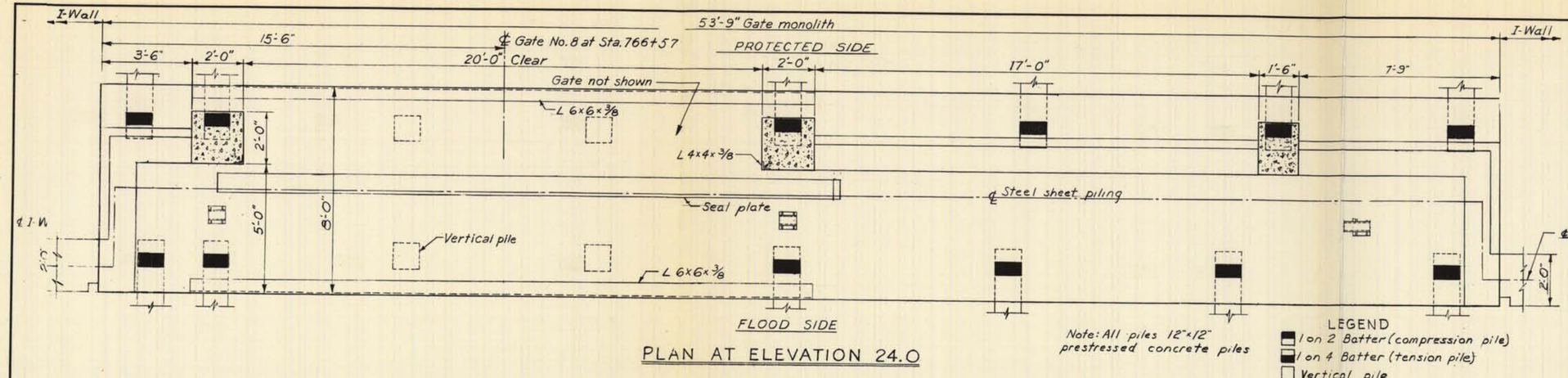
NEW ORLEANS EAST BACK LEVEE
DETAILS OF OVERHEAD ROLLER GATES NOS. 1, 3, 4, 5, 6 AND 7

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

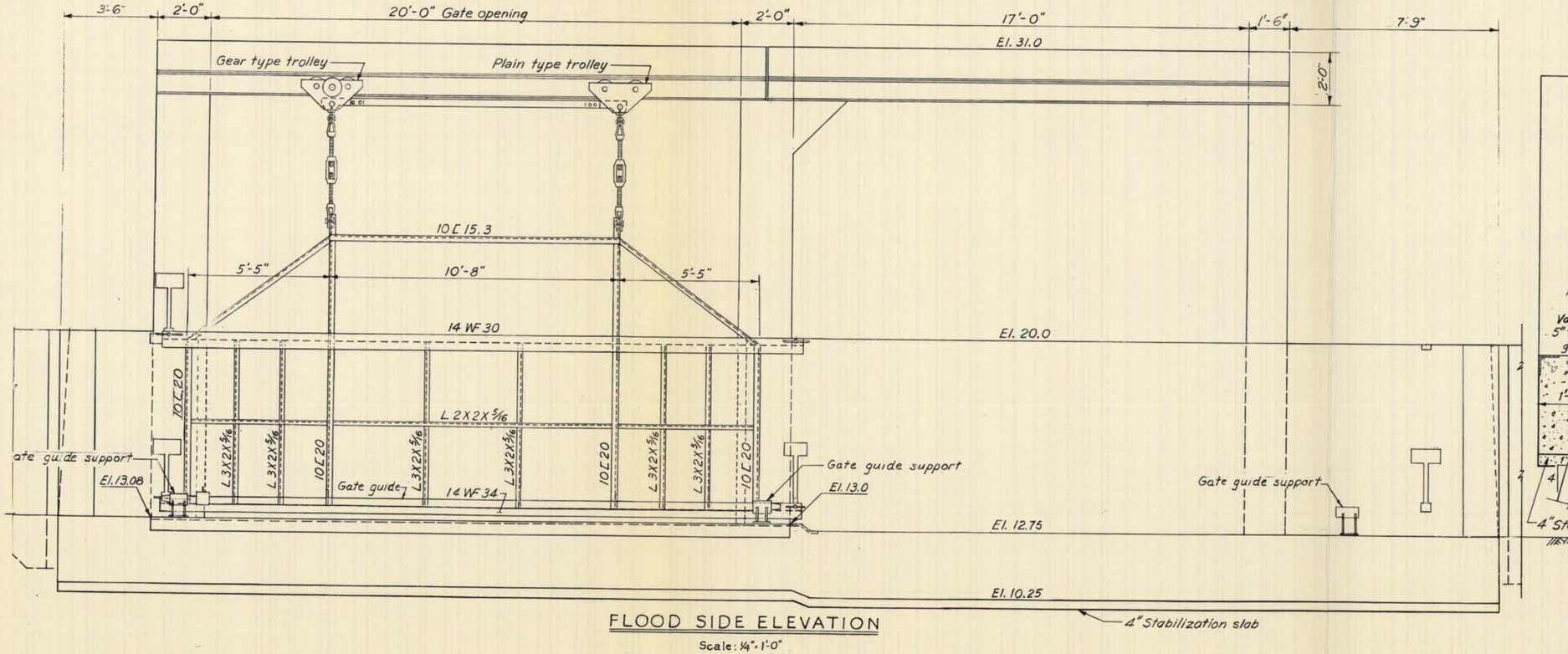
PLATE 79



PLAN AT ELEVATION 24.0

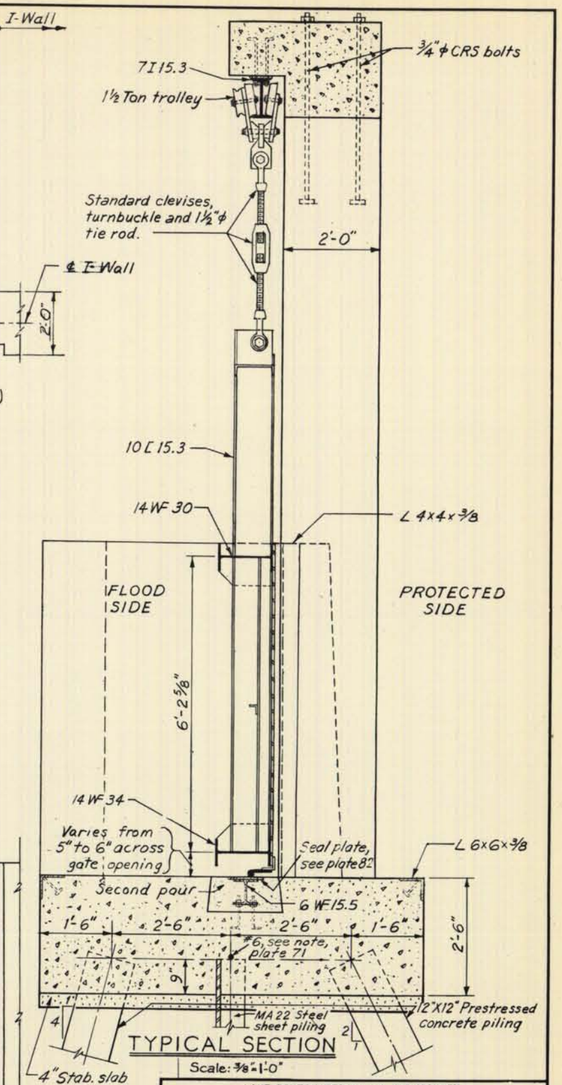
Note: All piles 12"x12" prestressed concrete piles

LEGEND
- 1 on 2 Batter (compression pile)
- 1 on 4 Batter (tension pile)
- Vertical pile



FLOOD SIDE ELEVATION

Scale: 1/4" = 1'-0"



TYPICAL SECTION

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

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

DETAIL OF OVERHEAD ROLLER GATE NO. 8

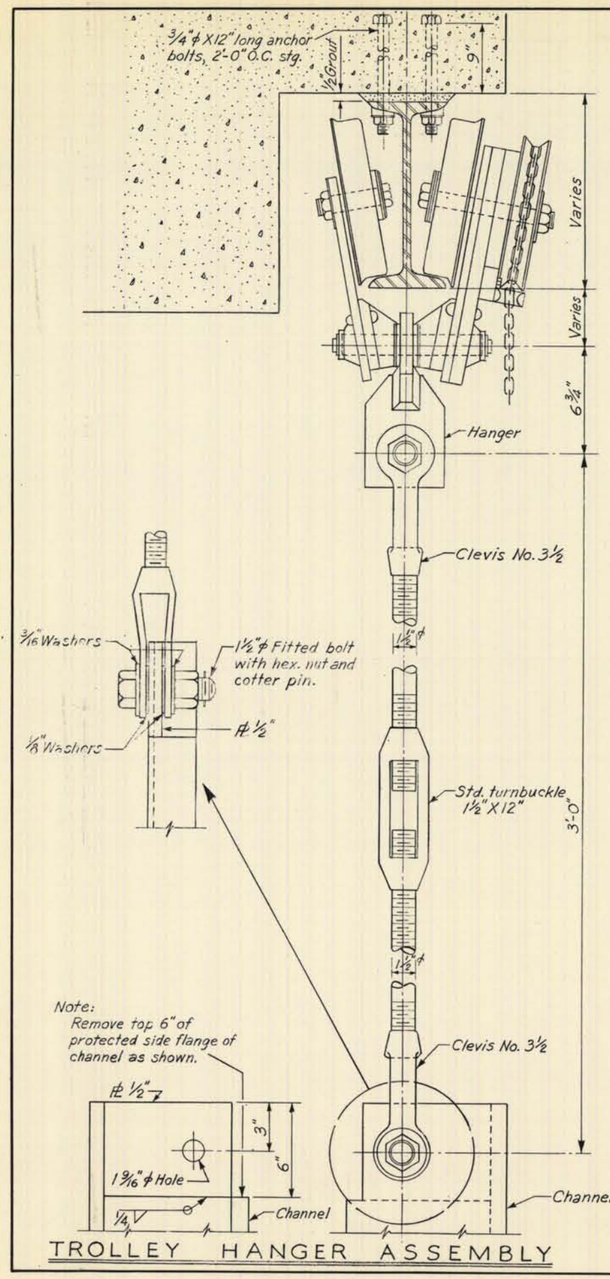
STATION 766+57

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

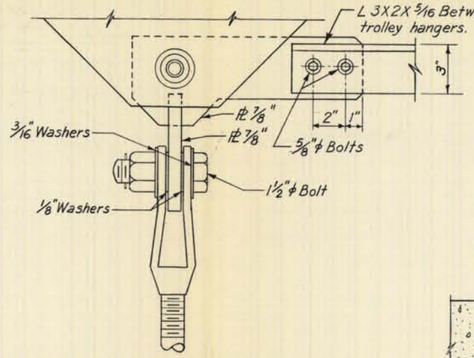
DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 80

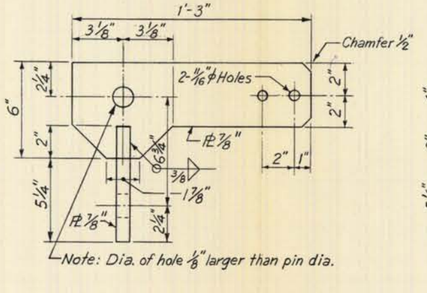


TROLLEY HANGER ASSEMBLY

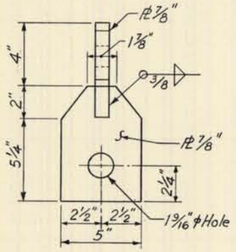


FLOOD SIDE ELEVATION OF HANGER

Scale: 1 1/2" = 1'-0"

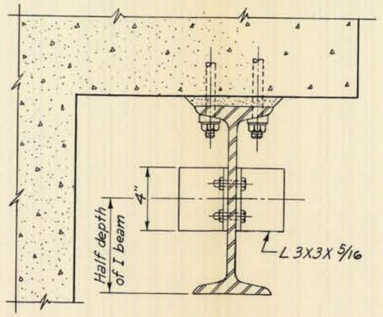


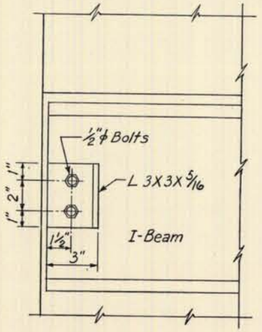
Note: Dia. of hole 1/8" larger than pin dia.



HANGER DETAILS

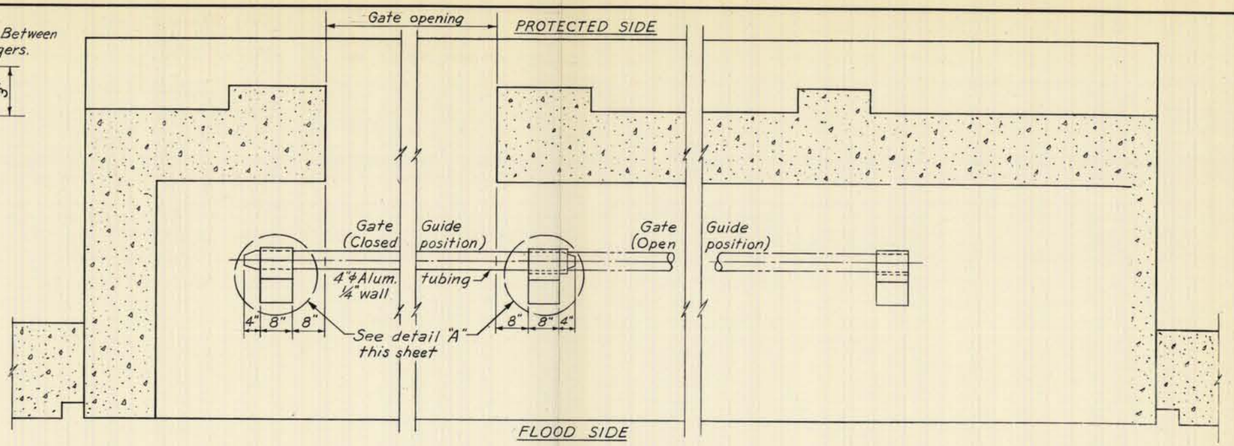
Scale: 3" = 1'-0"





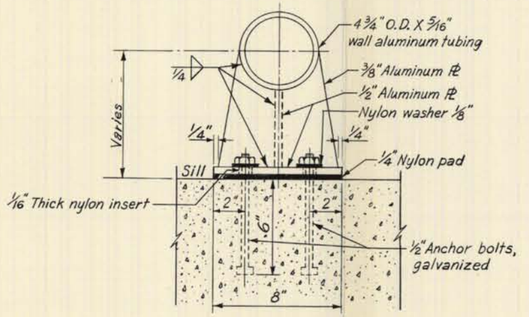
TYPICAL TROLLEY STOP
(STOP AT BOTH ENDS OF I-BEAM)

Scale: 1 1/2" = 1'-0"



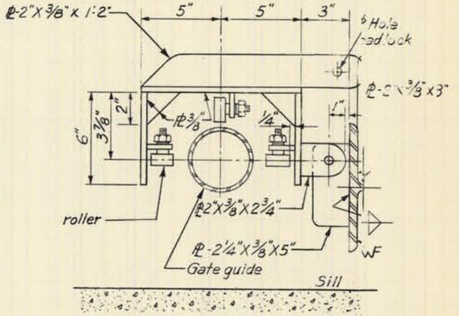
PLAN

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



DETAIL "A"

Scale: 1 1/2" = 1'-0"



SECTION THRU GATE ℄

Scale: 1 1/2" = 1'-0"

LAKE PONTCHARTRAIN, LA & VINITY
LAKE PONTCHARTRAIN & VICINITY PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN SUPPLEMENT
NEW ORLEANS EAST LEVEE

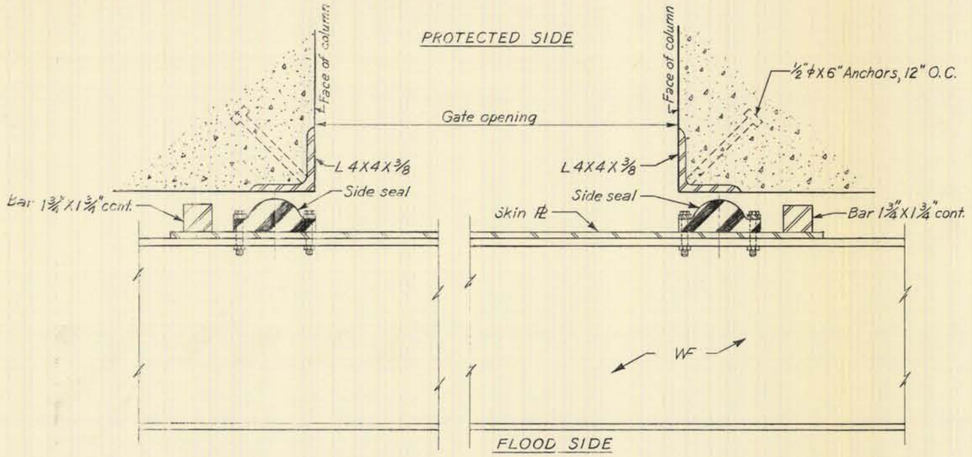
OVERHEAD ROLLER (TROLLEY) AND GATE GUIDE DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

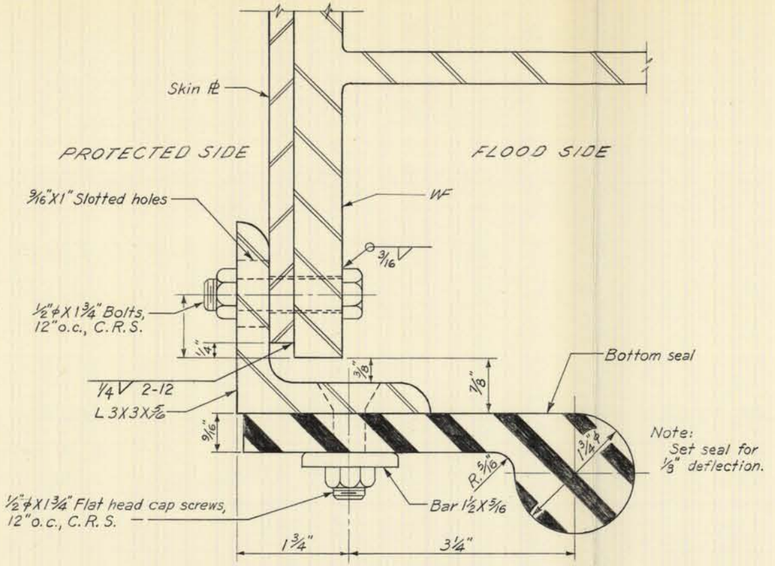
NO. H-2-24625

PLATE 81



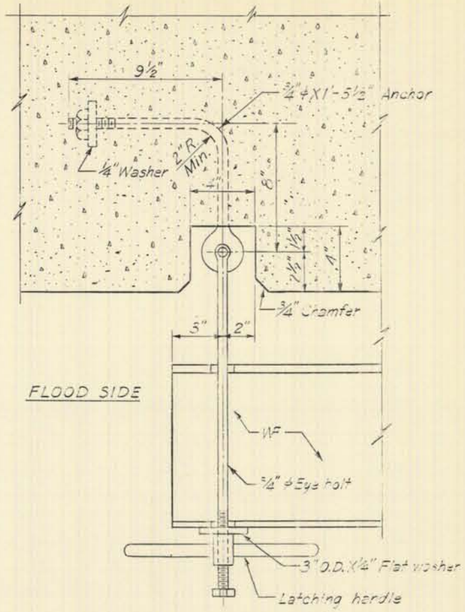
SECTION THRU OVERHEAD ROLLER GATE

Scale: 1½"=1'-0"



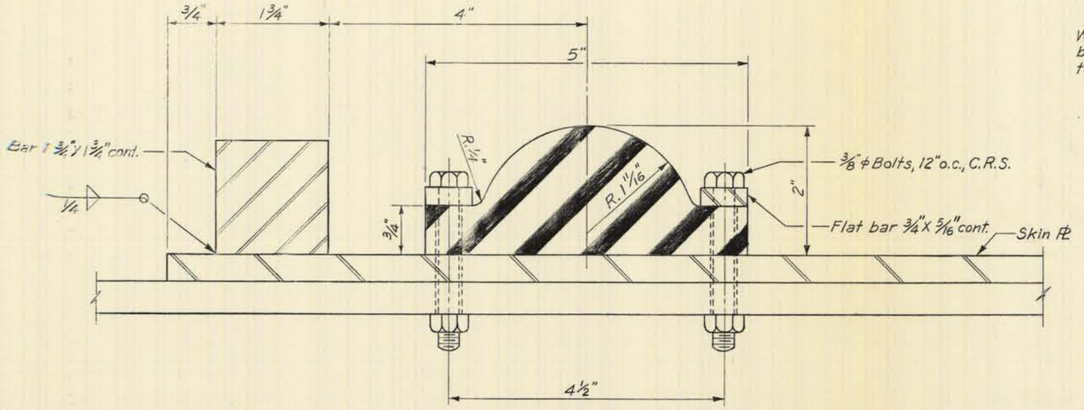
SECTION THRU BOTTOM SEAL

Scale: Half size



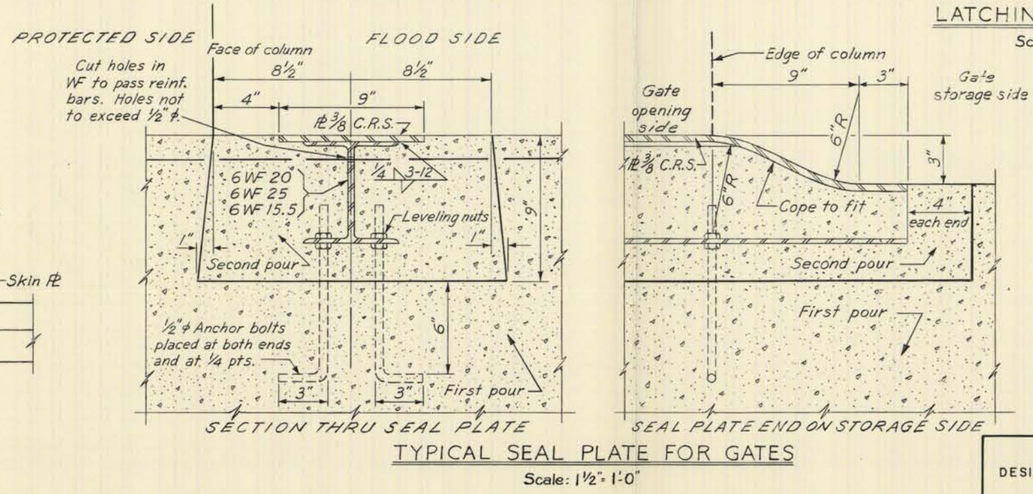
LATCHING ASSEMBLY

Scale: 1½"=1'-0"



TYPICAL SIDE SEAL

Scale: Half size



TYPICAL SEAL PLATE FOR GATES

Scale: 1½"= 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO 4

NEW ORLEANS EAST BACK LEVEE

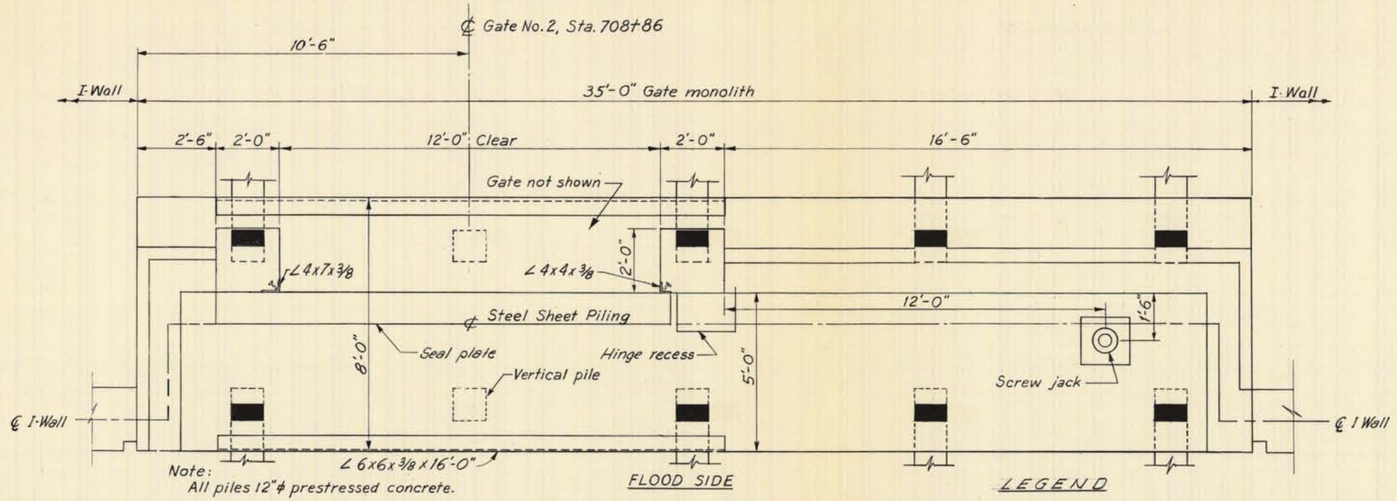
OVERHEAD ROLLER GATE SEAL DETAILS AND LATCHING ASSEMBLY

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

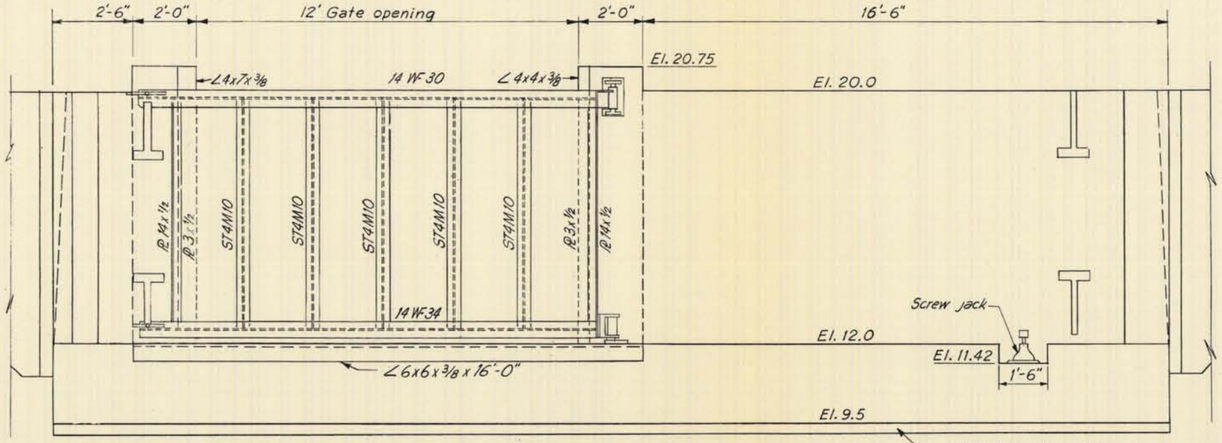
DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 82

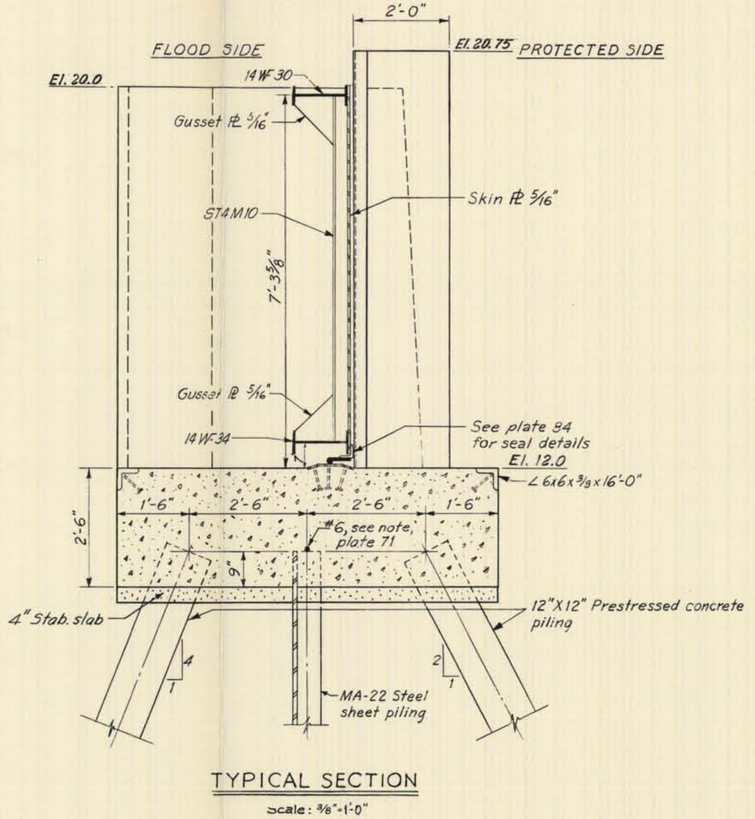


PLAN AT ELEVATION 21.0



FLOOD SIDE ELEVATION

Scale: 1/4"-1'-0"



TYPICAL SECTION

Scale: 3/8"-1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 — GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

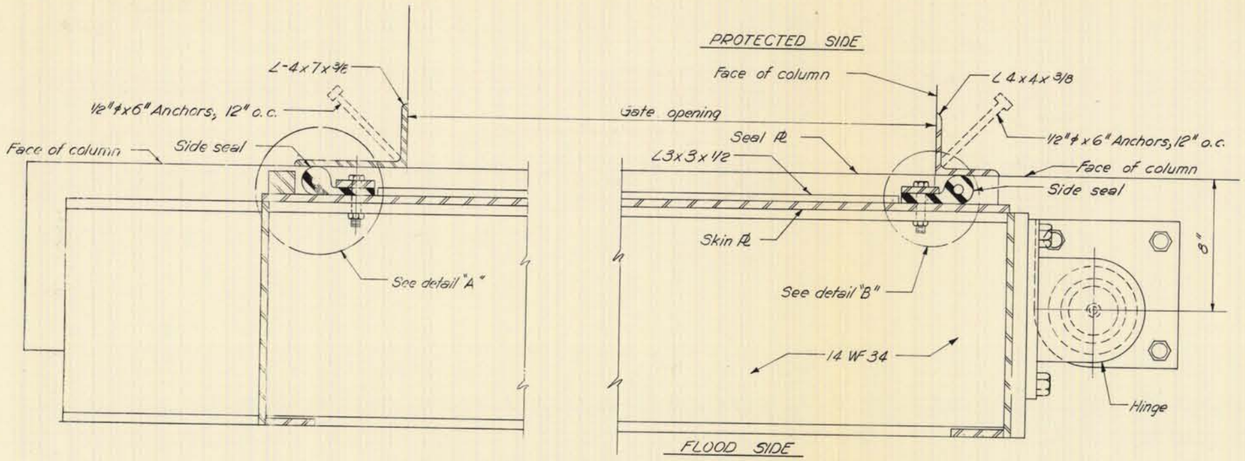
DETAIL OF SWING GATE NO. 2

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

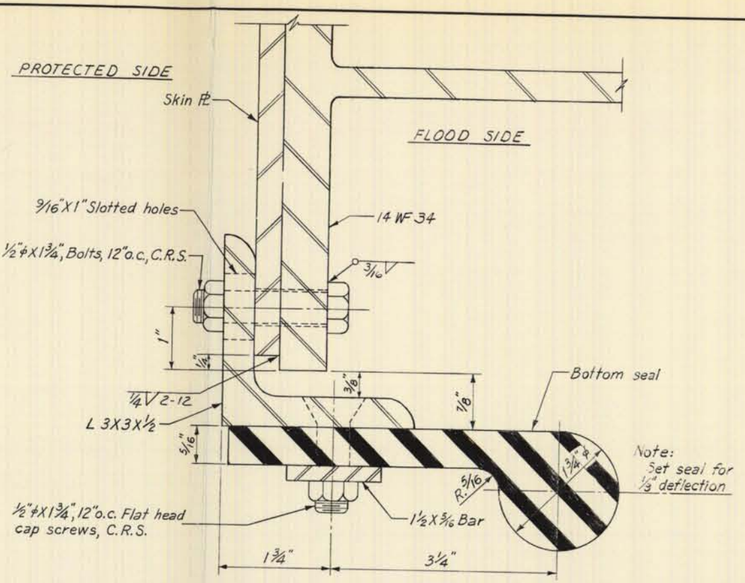
FILE NO. H-2-24625

PLATE 83



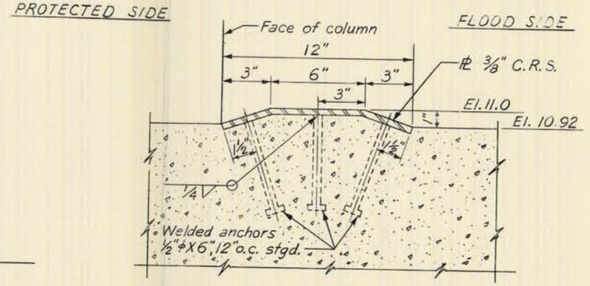
SECTION THRU SWING GATE

Scale: 1½"=1'-0"



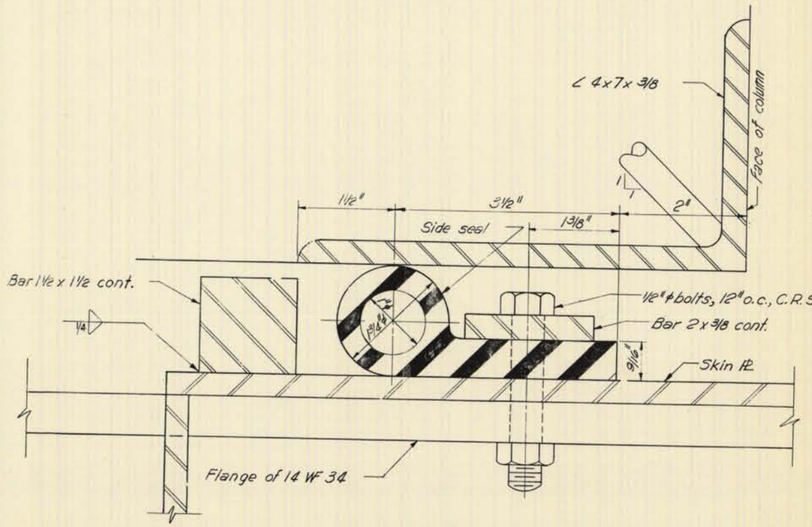
SECTION THRU BOTTOM SEAL

Scale: Half size



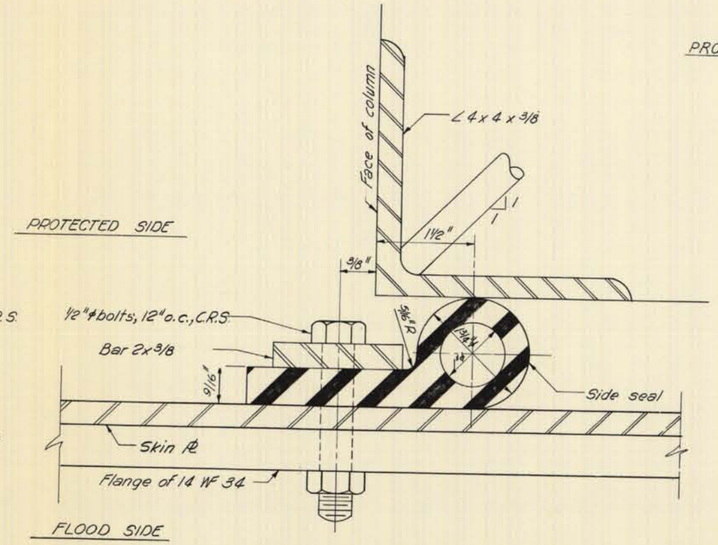
SEAL PLATE DETAIL

Scale: 1½"=1'-0"



DETAIL "A"

Scale: Half size



DETAIL "B"

Scale: Half size

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

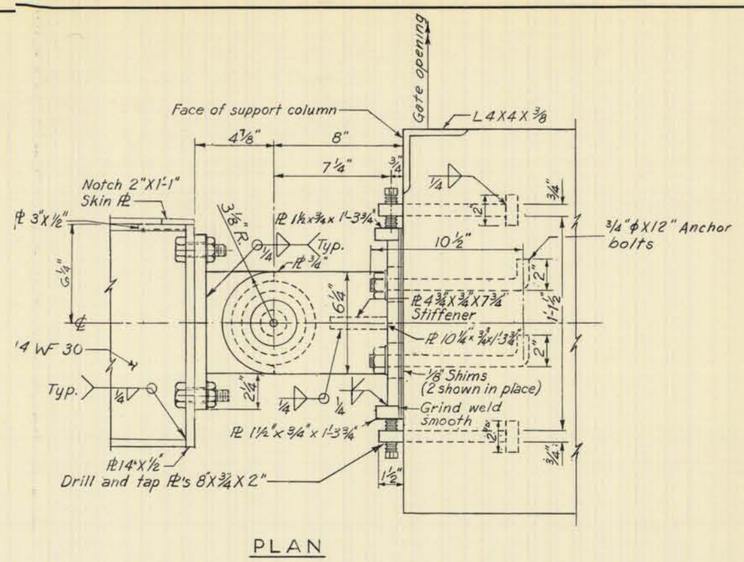
SWING GATE SEAL DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

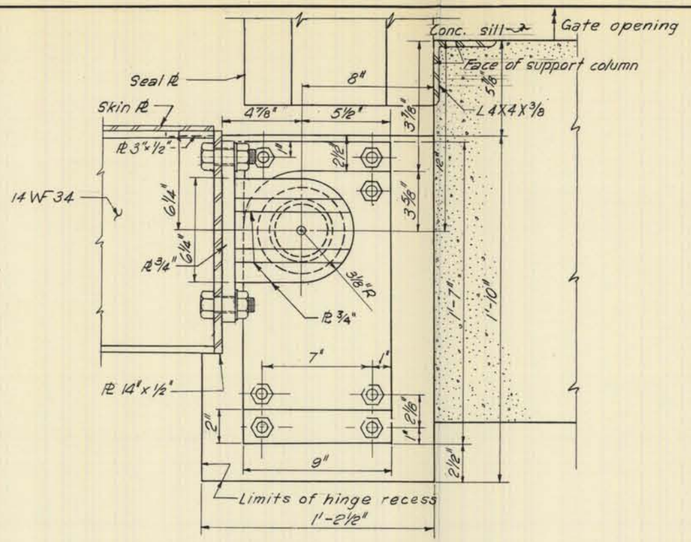
DATE: FEB. 1971

FILE NO. H-2-24625

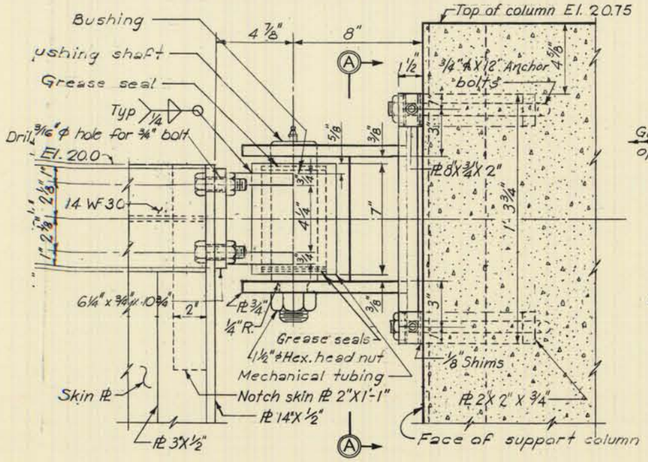
PLATE 84



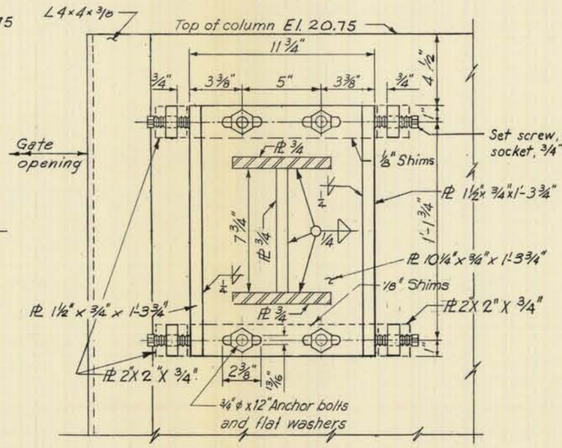
PLAN



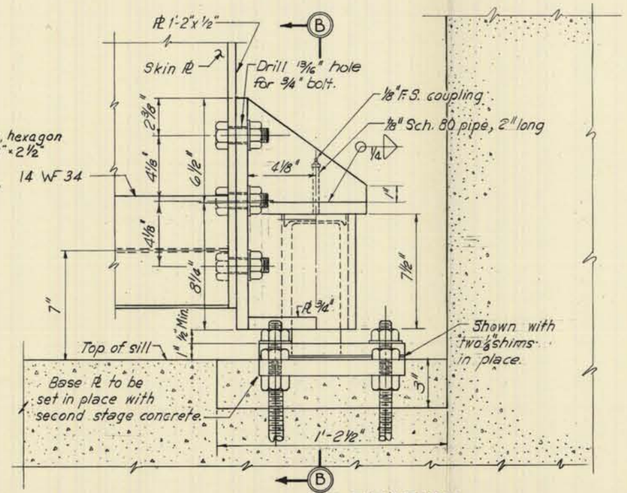
PLAN



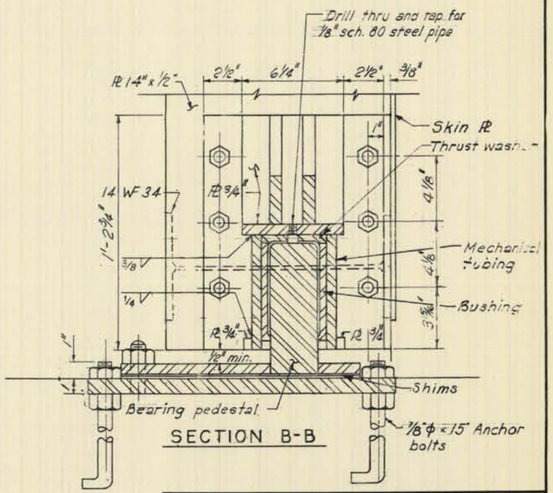
ELEVATION



SECTION A-A



ELEVATION



SECTION B-B

UPPER HINGE

Scale: 1½"=1'-0"

LOWER HINGE

Scale: 1½"=1'-0"

Note:
Bottom gate seal not shown
See plate 84 for details.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

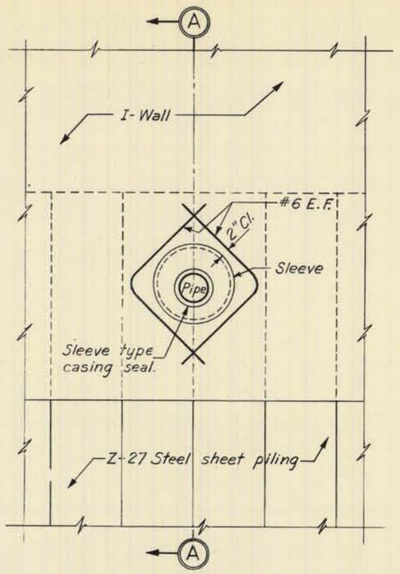
SWING GATE HINGE DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

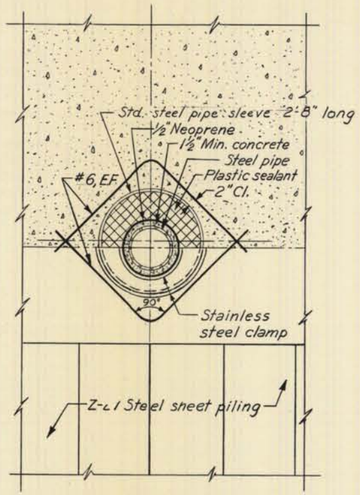
DATE: FEB. 1971

FILE NO. H-2-24625

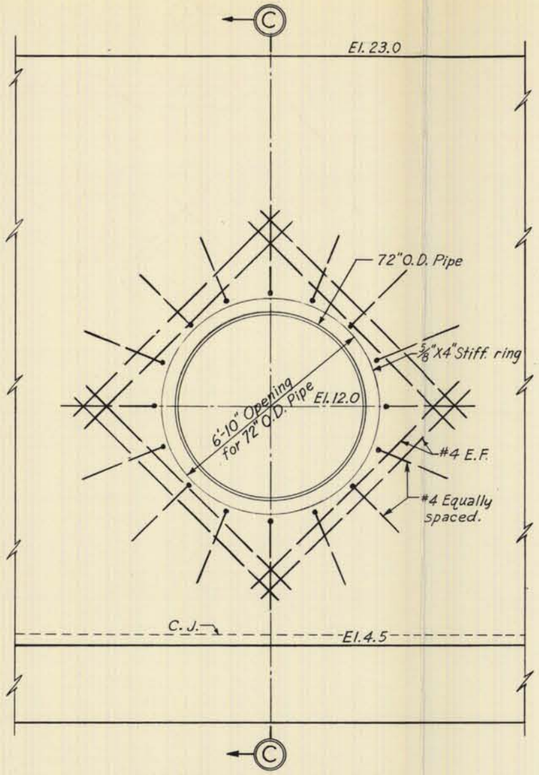
PLATE 85



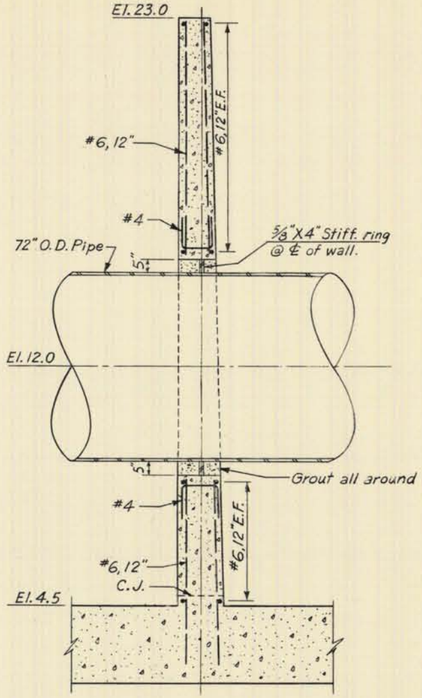
ELEVATION



ELEVATION B-B



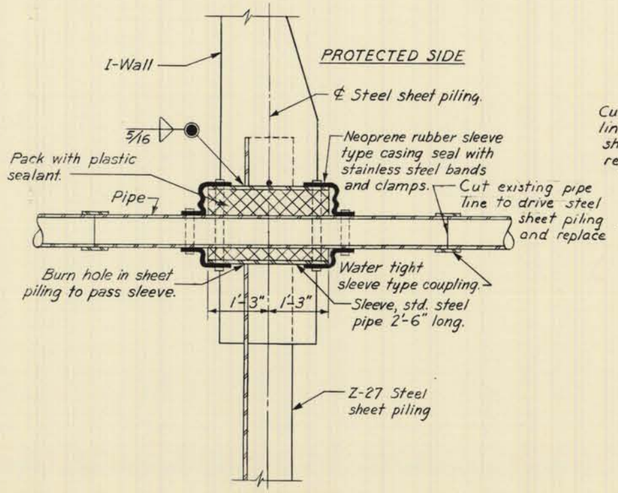
FLOOD SIDE ELEVATION



SECTION C-C

72"ϕ DISCHARGE PIPE THRU T-WALL

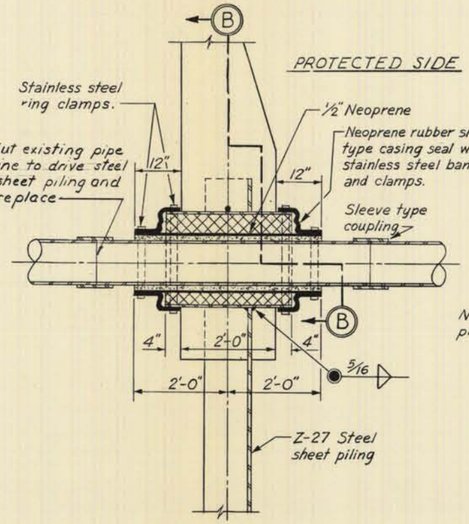
Scale: ¼"=1'-0"



SECTION A-A

TYPICAL PIPE THRU I-WALL

Scale: ⅜"=1'-0"



Note: Alignment of existing pipe not to be modified

SECTION

TYPICAL GAS PIPE THRU I-WALL

Scale: ⅜"=1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

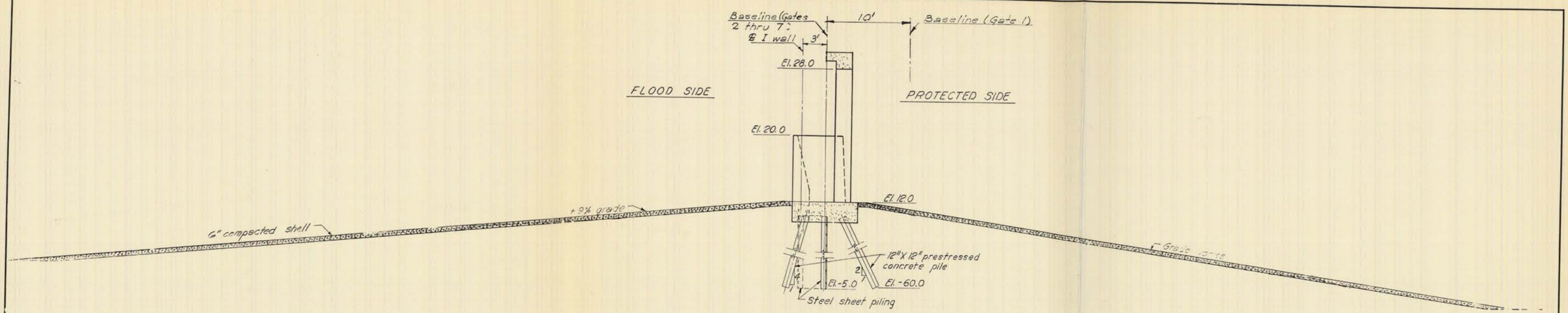
UTILITY CROSSING DETAILS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

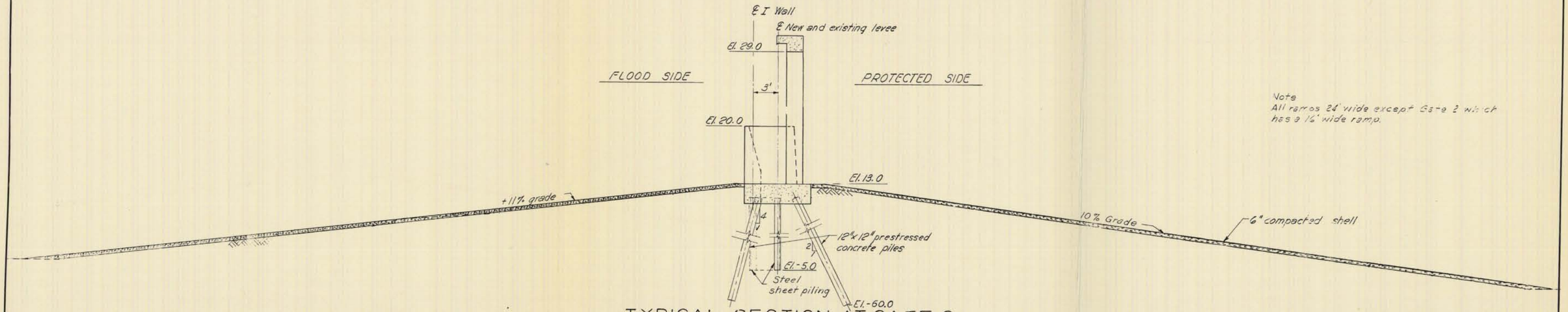
FILE NO. H-2-24625

PLATE 86



TYPICAL SECTION GATES 1 THRU 7

Scale: 1" = 5'-0"



Note
All ramps 24' wide except Gate 2 which has a 16' wide ramp.

TYPICAL SECTION AT GATE 8

Scale: 1" = 10'

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 4

NEW ORLEANS EAST BACK LEVEE

TYPICAL SECTIONS OF GATE RAMPS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: FEB. 1971

FILE NO. H-2-24625

PLATE 87

UNIFIED SOIL CLASSIFICATION

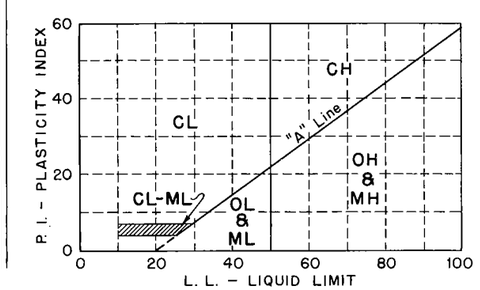
MAJOR DIVISION		TYPE	LETTER SYMBOL	SYMBOL	TYPICAL NAMES
COARSE – GRAINED SOILS More than half of material is larger than No. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size.	CLEAN GRAVEL (Little or No Fines)	GW		GRAVEL, Well Graded, gravel-sand mixtures, little or no fines
			GP		GRAVEL, Poorly Graded, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable Amount of Fines)	GM		SILTY GRAVEL, gravel-sand-silt mixtures
			GC		CLAYEY GRAVEL, gravel-sand-clay mixtures
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SAND (Little or No Fines)	SW		SAND, Well-Graded, gravelly sands
			SP		SAND, Poorly-Graded, gravelly sands
		SANDS WITH FINES (Appreciable Amount of Fines	SM		SILTY SAND, sand-silt mixtures
			SC		CLAYEY SAND, sand-clay mixtures
FINE – GRAINED SOILS More than half the material is smaller than No. 200 sieve size.		SILTS AND CLAYS (Liquid Limit < 50)	ML		SILT & very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
			CL		LEAN CLAY; Sandy Clay; Silty Clay; of low to medium plasticity
			OL		ORGANIC SILTS and organic silty clays of low plasticity
		SILTS AND CLAYS (Liquid Limit > 50)	MH		SILT, fine sandy or silty soil with high plasticity
			CH		FAT CLAY, inorganic clay of high plasticity
			OH		ORGANIC CLAYS of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		PEAT, and other highly organic soil
WOOD			Wd		WOOD
SHELLS			Sl		SHELLS
NO SAMPLE					

NOTE: Soils possessing characteristics of two groups are designated by combinations of group symbols

DESCRIPTIVE SYMBOLS

COLOR	
COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	BK
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH-GRAY	br Gr
GRAYISH-BROWN	gy Br
GREENISH-GRAY	gn Gr
GRAYISH-GREEN	gy Gn
GREEN	Gn
BLUE	Bl
BLUE-GREEN	Bl Gn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS		
CONSISTENCY	COHESION IN LBS./SQ.FT. FROM UNCONFINED COMPRESSION TEST	SYMBOL
VERY SOFT	< 250	vSo
SOFT	250 - 500	So
MEDIUM	500 - 1000	M
STIFF	1000 - 2000	St
VERY STIFF	2000 - 4000	vSt
HARD	> 4000	H



PLASTICITY CHART

For classification of fine - grained soils

MODIFICATIONS	
MODIFICATION	SYMBOL
Traces	Tr-
Fine	F
Medium	M
Coarse	C
Concretions	cc
Rootlets	rt
Lignite fragments	lg
Shale fragments	sh
Sandstone fragments	sds
Shell fragments	slf
Organic matter	O
Clay strata or lenses	CS
Silt strata or lenses	SIS
Sand strata or lenses	SS
Sandy	S
Gravelly	G
Boulders	B
Slickensides	SL
Wood	Wd
Oxidized	Ox

NOTES:

FIGURES TO LEFT OF BORING UNDER COLUMN "W OR D_{10}"

- Are natural water contents in percent dry weight
- When underlined denotes D_{10} size in mm *

FIGURES TO LEFT OF BORING UNDER COLUMNS "LL" AND "PL"

- Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

- ▽ Ground-water surface and date observed
- (C) Denotes location of consolidation test **
- (S) Denotes location of consolidated-drained direct shear test **
- (R) Denotes location of consolidated-undrained triaxial compression test **
- (Q) Denotes location of unconsolidated-undrained triaxial compression test **
- (T) Denotes location of sample subjected to consolidation test and each of the above three types of shear tests **
- FW Denotes free water encountered in boring or sample

FIGURES TO RIGHT OF BORING

- Are values of cohesion in lbs./sq.ft. from unconfined compression tests
- In parenthesis are driving resistances in blows per foot determined with a standard split spoon sampler (1 3/8" I.D., 2" O.D.) and a 140 lb. driving hammer with a 30" drop
- Where underlined with a solid line denotes laboratory permeability in centimeters per second of undisturbed sample
- Where underlined with a dashed line denotes laboratory permeability in centimeters per second of sample remoulded to the estimated natural void ratio

* The D_{10} size of a soil is the grain diameter in millimeters of which 10% of the soil is finer, and 90% coarser than size D_{10}.

**Results of these tests are available for inspection in the U.S. Army Engineer District Office, if these symbols appear beside the boring logs on the drawings.

GENERAL NOTES:

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract.

Ground-water elevations shown on the boring logs represent ground-water surfaces encountered on the dates shown. Absence of water surface data on certain borings implies that no ground-water data is available, but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of these borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM L.M.V.G.G. 5 JUNE 1964
1	9-17-63	IST. PAR. OF GENERAL NOTES REVISED	L. M. V. D. MULTIPLE LETTER, DATED 5 SEPT., 1963

SOIL BORING LEGEND

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-21800

PLATE A

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

APPENDIX A

CORRESPONDENCE RELATIVE TO COORDINATION WITH OTHER AGENCIES

COPY

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LMNED-PP

2 April 1968

Mr. C. Edward Carlson, Regional Director
U. S. Department of the Interior
Fish and Wildlife Service
Peachtree-Seventh Building
Atlanta, Georgia 30323

Dear Mr. Carlson:

Please refer to our letter dated 21 April 1967 requesting your views and comments on the general design memorandum for the Lake Pontchartrain Barrier Plan feature of the "Lake Pontchartrain, La. and Vicinity" project.

Our letter dated 21 April 1967 indicated that your views and comments would be requested for each supplement to the general design memorandum. However, we now feel that your views on the entire Lake Pontchartrain Barrier Plan would be preferable. The layout of the Lake Pontchartrain Barrier Plan, as described in House Document No. 231, 89th Congress, 1st Session, is shown in inclosure 1. The plan, layout of which is shown on inclosure 2, now under consideration is essentially the same as that presented in the House Document, with the following exceptions:

a. Barrier. The Chief of Engineers has approved a change in the alignment of the barrier in the Chef Menteur Pass area to that shown on inclosure 3. The barrier elevation will be 9 feet mean sea level or the elevation of existing U. S. Highway 90, whichever is higher. The remaining structures sites will remain as specified in the House Document, except that consideration is being given to widening the Rigolets Lock from 84 feet to 110 feet. The modification of the width of the Rigolets Lock is not for public release.

b. Seabrook Lock. The Chief of Engineers has approved a change in the controlling elevation of the Seabrook Lock from 13.2 feet to 7.2 feet mean sea level. This change will be effected by lowering the crown of the rock dike which will tie the lock to the levee system. In addition, auxiliary control structures, located on each side of the lock, will be added to provide for passage of flows or salinity control and riparian use when the lock is passing traffic.

c. Levees. Based on revised parameters for the standard project hurricane, as developed by the U. S. Weather Bureau, the levee grades recommended in House Document No. 231 were increased by as much as 1 to 2 feet.

d. St. Charles Parish Levees. The St. Charles Parish Lakefront levee will extend across the Parish Line Canal and tie into the Jefferson Parish Lakefront levee, rather than having a levee extending south approximately 3.5 miles along the west side of the Parish Line Canal to the Illinois Central Railroad. Drainage structures will be provided in the Lakefront levee to allow gravity drainage of the area.

We have received your comments on Seabrook Lock and the Citrus Back Levee, i.e., the levee along the north bank of the Gulf Intracoastal Waterway from the Inner Harbor Navigation Canal to the Michoud Canal, by letters dated 7 June 1967 and 22 June 1967, respectively. Your views, recommendations, and comments on the remainder of the Lake Pontchartrain Barrier Plan are requested.

Because of the urgency of providing protection to the areas vulnerable to hurricane flooding, we are operating on a much compressed planning schedule. Accordingly, it would be very much appreciated if your comments are provided not later than 1 June 1968.

Sincerely yours,

3 Incl
1. Gen map (file H-2-23693) dtd Nov 65
2. Gen map (file H-2-23693) rev May 67
3. Map - barrier alignment (file H-2-24066, plate 2)

THOMAS J. BOWEN
Colonel, CE
District Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

May 15, 1968

District Engineer
U. S. Army, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to your letter of April 2, 1968, (LMNED-PP), requesting our views on the Lake Pontchartrain Barrier Plan feature of the Lake Pontchartrain, Louisiana, and Vicinity project.

The overall barrier plan and its influence on fish and wildlife resources have been discussed in prior Bureau reports, most recently our letter report of June 21, 1967.

As indicated in past reports, we are of the opinion that hurricane control structures in the Rigolets and Chef Menteur tidal passes will have little appreciable effect on salinities in Lakes Maurepas, Pontchartrain, and Borgne. Therefore, no adverse effects on fish and wildlife resources in these areas are expected.

Previous model tests have indicated that acceptable salinity levels for the preservation of fish and wildlife resources in Lake Pontchartrain can be obtained by utilization of the Seabrook Lock facility, which includes an auxiliary control structure on each side of the lock. Use of these auxiliary structures should insure that adequate diversion flows for salinity control and riparian use can be provided. The capability for adjusting salinities as may be required for fish and wildlife would tend to prevent the occurrence of detrimental effects.

New levee construction and levee enlargement works as planned, including the modified St. Charles Parish levee, are not expected to directly affect fish and wildlife resources to any great degree. Indirectly, the levee system will hasten urban and industrial development of additional marshland that now provides moderate quality habitat for wildlife. Your staff has indicated that the Parish Line Canal is no longer classed as a navigable waterway. Blockage of the channel, however, will inconvenience boat owners who now use the canal.

We are pleased with your previous recognition of the need for a salinity surveillance system at the Seabrook Lock upon its completion. This Bureau and the Louisiana Wild Life and Fisheries Commission will be glad to participate in the development and monitoring of such a system.

We appreciate the opportunity to provide these comments at this time. If current plans are modified, we request the opportunity for further review and comment.

A copy of this letter has been sent to the Louisiana Wild Life and Fisheries Commission. Any comments that agency wishes to make will be forwarded to you.

Sincerely yours,

W. L. Towns
Acting Regional Director

C O P Y

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LMNED-PP

8 April 1968

Mr. William C. Galegar, Regional Director
Federal Water Pollution Control Administration
Third Floor--1402 Elm Street
Dallas, Texas 75202

Dear Mr. Galegar:

Please refer to our letter dated 21 April 1967 requesting your views and comments on the general design memorandum for the Lake Pontchartrain Barrier Plan feature of the "Lake Pontchartrain, La. and Vicinity" project.

Our letter dated 21 April 1967 indicated that your views and comments would be requested for each supplement to the general design memorandum. However, we now feel that your views on the entire Lake Pontchartrain Barrier Plan would be preferable. The layout of the Lake Pontchartrain Barrier Plan, as described in House Document No. 231, 89th Congress, 1st Session, is shown in inclosure 1. The plan, layout of which is shown on inclosure 2, now under consideration is essentially the same as that presented in the House Document, with the following exceptions:

a. Barrier. The Chief of Engineers has approved a change in the alignment of the barrier in the Chef Menteur Pass area to that shown on inclosure 3. The barrier elevation will be 9 feet mean sea level or the elevation of existing U. S. Highway 90, whichever is higher. The remaining structures sites will remain as specified in the House Document, except that consideration is being given to widening the Rigolets Lock from 84 feet to 110 feet. The modification of the width of the Rigolets Lock is not for public release.

b. Seabrook Lock. The Chief of Engineers has approved a change in the controlling elevation of the Seabrook Lock from 13.2 feet to 7.2 feet mean sea level. This change will be effected by lowering the crown of the rock dike which will tie the lock to the levee system. In addition, auxiliary control structures, located on each side of the lock, will be added to provide for passage of flows or salinity control and riparian use when the lock is passing traffic.

c. Levees. Based on revised parameters for the standard project hurricane, as developed by the U. S. Weather Bureau, the levee grades recommended in House Document No. 231 were increased by as much as 1 to 2 feet.

d. St. Charles Parish Levees.. The St. Charles Parish Lakefront levee will extend across the Parish Line Canal and tie into the Jefferson Parish Lakefront levee, rather than having a levee extending south approximately 3.5 miles along the west side of the Parish Line Canal to the Illinois Central Railroad. Drainage structures will be provided in the Lakefront levee to allow gravity drainage of the area.

We have received your comments on Seabrook Lock and the Citrus Back Levee, i.e., the levee along the north bank of the Gulf Intracoastal Waterway from the Inner Harbor Navigation Canal to the Michoud Canal, by letter dated 23 June 1967. Your views, recommendations, and comments on the remainder of the Lake Pontchartrain Barrier Plan are requested.

Because of the urgency of providing protection to the areas vulnerable to hurricane flooding, we are operating on a much compressed planning schedule. Accordingly, it would be very much appreciated if your comments are provided not later than 1 June 1968.

Sincerely yours,

3 Incl
1. Gen Map (file H-2-23693) dtd Nov 65
2. Gen map (file H-2-23693) rev May 67
3. Map - barrier alignment (file H-2-24-66, plate 2)

THOMAS J. BOWEN
Colonel, CE
District Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
1402 ELM STREET, 3RD FLOOR
DALLAS, TEXAS 75202

May 15, 1968

Your Ref: LMNED-PP

Colonel Thomas J. Bowen, District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to your letter of April 8, 1968 requesting review and comment on the remainder of the Lake Pontchartrain Barrier Plan.

We have reviewed the information submitted in accordance with Executive Order 11288, Sections 1(3) and 1(7) in regard to water pollution control measures and find as follows:

a. All contractors should perform construction operations in a manner that will reduce turbidity and siltation to the lowest practicable level.

b. All contractors should take precautions to prevent water pollution by accidental spillage of hazardous materials which would result in substantial harm to fish or shellfish. Also, all contractors should provide and maintain sanitation facilities that will adequately treat domestic wastes to conform with Federal and local health regulations.

c. It is desirable that the water quality control structures be constructed and operated so as to prevent changes in the present water quality and to ensure that ecological conditions remain unchanged.

The comments of the Louisiana Stream Control Commission have been incorporated in our review.

Colonel Thomas J. Bowen
C/E, New Orleans, Louisiana

5/15/68

Your cooperation in carrying out the requirements of the Order is appreciated.

Sincerely yours,

for WILLIAM C. GALEGAR
Regional Director

cc: Louisiana Stream Control Commission

C O P Y

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LMNED-PP

15 July 1969

Mr. William C. Galegar, Regional Director
Federal Water Pollution Control Administration
Third Floor - 1402 Elm Street
Dallas, Texas 75202

Dear Mr. Galegar:

Please refer to our letter dated 8 April 1968 requesting your views on the entire Lake Pontchartrain Barrier Plan and your reply dated 15 May 1968. We are now considering a modification to that portion of the current plan located in the vicinity of the Rigolets Pass.

The layout of the Lake Pontchartrain Barrier Plan, provided with our letter of 8 April 1968, and the plan now under consideration are essentially the same; however, two additional schemes for the Rigolets Control Structure and Closure are presently being evaluated. The new schemes are as follows:

a. A control structure with sixteen 50-foot bays and a sill elevation of -30 feet m.s.l. (mean sea level). The structure would be located in the main channel of the Rigolets and constructed inside a cellular sheet pile cofferdam. A closure dam would extend from the east end of the structure thence across the Rigolets. This scheme required no approach channels. (Refer to inclosed layout.)

b. A control structure with twenty-three 50-foot bays and a sill elevation of -20 feet m.s.l. The layout is the same as for the above scheme.

It is requested that you furnish your views and comments on the above schemes at your earliest conveniience.

Sincerely yours,

Incl
Layout

HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
1402 ELM STREET, 3RD FLOOR
DALLAS, TEXAS 75202

August 5, 1969

Your Ref: LMNED-PP

Colonel Herbert R. Haar, Jr.
District Engineer
U. S. Army Engineer District, New Orleans
P. O. Box 60267
New Orleans, Louisiana 70160

Attention: LMNED-PP

Dear Sir:

Reference is made to your letter of July 15, 1969 requesting our comments on the modifications to your Lake Pontchartrain Barrier Plan in the vicinity of the Rigolets Pass.

We have reviewed this modification in regard to water pollution control measures and recommend that the final plans and specifications for the project require the contractors to:

1. Provide and maintain sanitation facilities that will adequately treat domestic wastes to conform with Federal and State health regulations.

2. Perform construction operations in a manner that will reduce turbidity and siltation to the lowest practicable level.

3. Take precautions to prevent water pollution by accidental spillage of hazardous materials which would result in substantial harm to fish or shellfish.

The comments of the Louisiana Stream Control Commission and Louisiana State Department of Health have been incorporated in our review.

Your cooperation in carrying out the requirements of the Order is appreciated.

Sincerely yours,

JERRY T. THORNHILL, Assistant Chief
Federal Activities Coordination

cc: Louisiana Stream Control Commission

Louisiana State Department of Health

C O P Y

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

LMNED-PP

3 July 1969

Mr. C. Edward Carlson, Regional Director
U. S. Department of the Interior
Fish and Wildlife Service
Peachtree-Seventh Building
Atlanta, Georgia 30323

Dear Mr. Carlson:

Please refer to our letter dated 2 April 1968 requesting your views on the entire Lake Pontchartrain Barrier Plan and your reply dated 15 May 1968. We are now considering a modification to that portion of the current plan located in the vicinity of the Rigolets Pass.

The layout of the Lake Pontchartrain Barrier Plan, provided with our letter of 2 April 1968, and the plan now under consideration are essentially the same; however, two additional schemes for the Rigolets Control Structure and Closure are presently being evaluated. The new schemes are as follows:

a. A control structure with sixteen 50-foot bays and a sill elevation of -30 feet m.s.l. (mean sea level). The structure would be located in the main channel of the Rigolets and constructed inside a cellular sheet pile cofferdam. A closure dam would extend from the east end of the structure thence across the Rigolets. This scheme required no approach channels. (Refer to inclosed layout.)

b. A control structure with twenty-three 50-foot bays and a sill elevation of -20 feet m.s.l. The layout is the same as for the above scheme.

It is requested that you furnish your views and comments on the above schemes at your earliest conveniience.

Sincerely yours,

HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

August 21, 1969

District Engineer
U.S. Army, Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

This is in reply to your letter of July 3, 1969, (LMNED-PP), requesting our comments on the two additional schemes you are considering in modifying plans for the Rigolets Control Structure and Closure, a part of the Lake Pontchartrain Barrier Plan. The new schemes described in your letter are as follows:

a. A control structure with sixteen 50-foot bays and a sill elevation of -30 feet mean sea level. The structure would be located in the main channel of the Rigolets and constructed inside a cellular sheet pile cofferdam. A closure dam would extend from the east end of the structure across the Rigolets. This scheme requires no approach channels.

b. A control structure with twenty-three 50-foot bays and a sill elevation of -20 feet m.s.l. The layout is the same as for the above scheme.

The control structure described under "b" above is identical in dimensions to the structure originally planned. The influence of the original structure on fish and wildlife was discussed in prior Bureau reports and most recently in our letter of May 15, 1968. Apparently, the structure described under "a" above is designed to pass approximately the same volume of water as structure "b". Therefore, we are of the opinion that the proposed modifications to the planned structure will have little effect on salinities in adjacent waters and no significant adverse effects on fish and wildlife resources. The proposed location of the structures in the main channel of the Rigolets does not alter our views.

We appreciate the opportunity to provide these comments at this time. If current plans are further modified, we request the opportunity for further review and comment.

A copy of this letter has been sent to the Louisiana Wild Life and Fisheries Commission. Any comments that agency wishes to make will be forwarded to you.

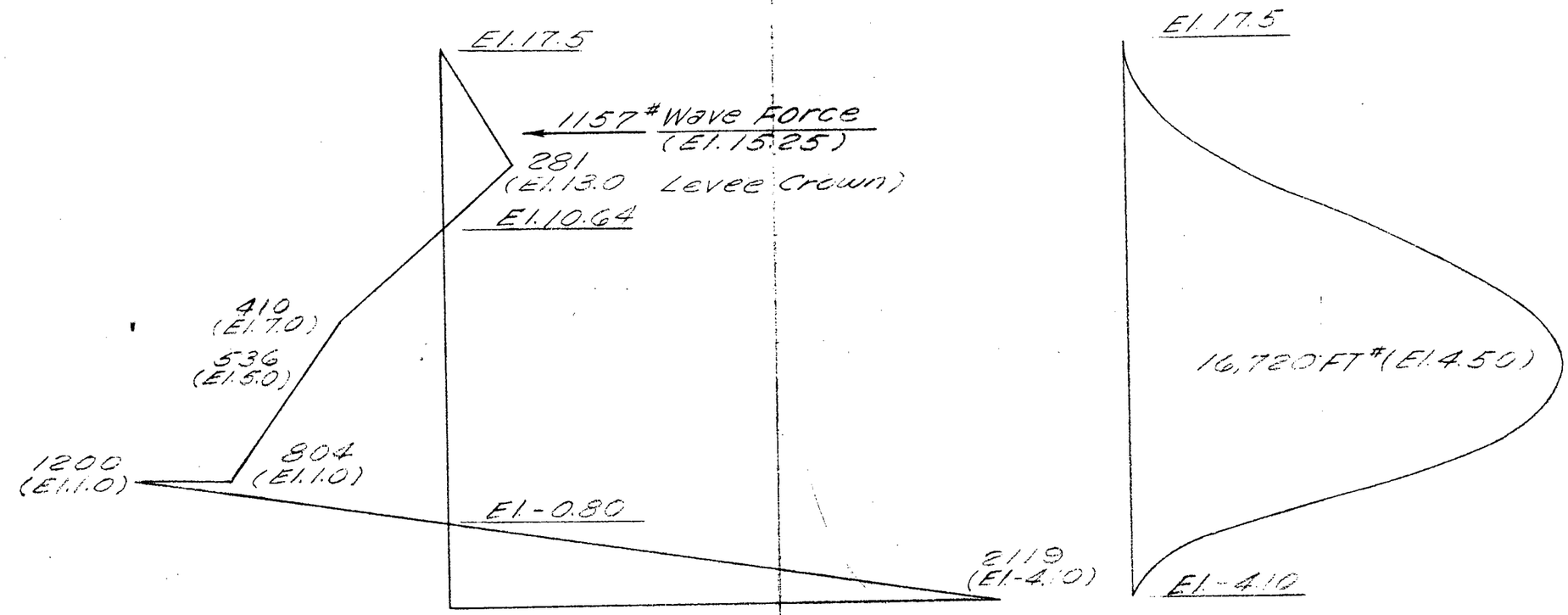
Sincerely yours,

W. L. Towns
Acting Regional Director

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 4
NEW ORLEANS EAST BACK LEVEE

APPENDIX B

STRUCTURAL DESIGN CALCULATIONS



See Plate 39

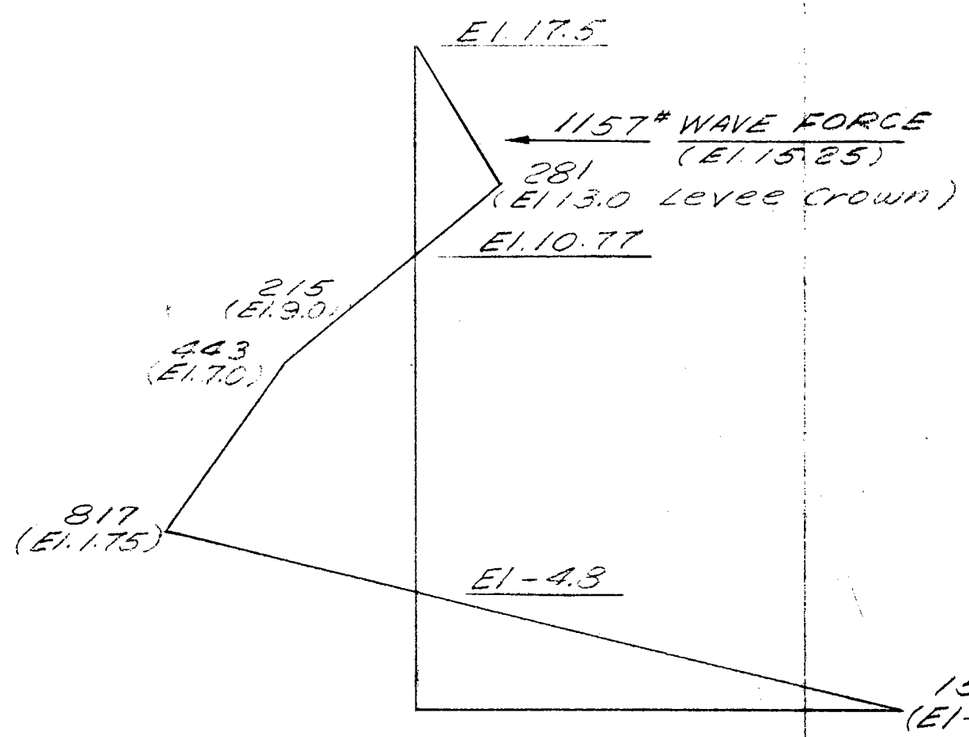
NET PRESSURE DIAGRAM
STATIC + DYNAMIC LOAD
Scale: 1" = 5'
1" = 500 PSF

MOMENT DIAGRAM
STATIC + DYNAMIC LOAD
Scale: 1" = 5', 1" = 5,000 FT#

DEFL. AT TOP OF FLOOD WALL = 4"

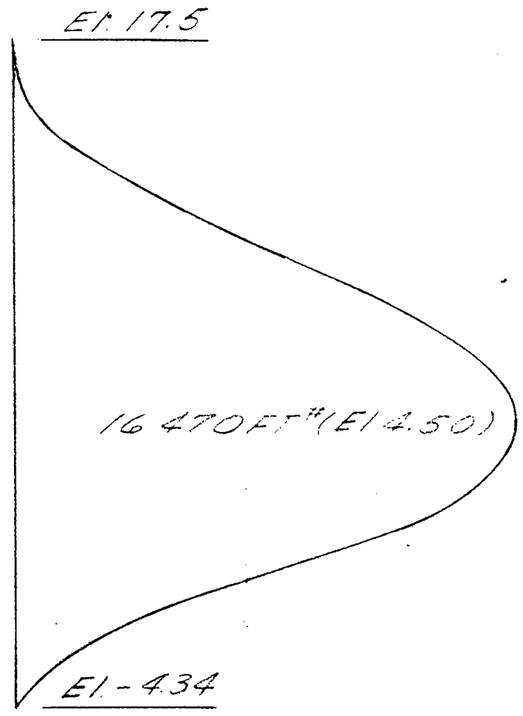
STA. 664+00 TO STA. 766+00

FIG. B-1



See Plate 46

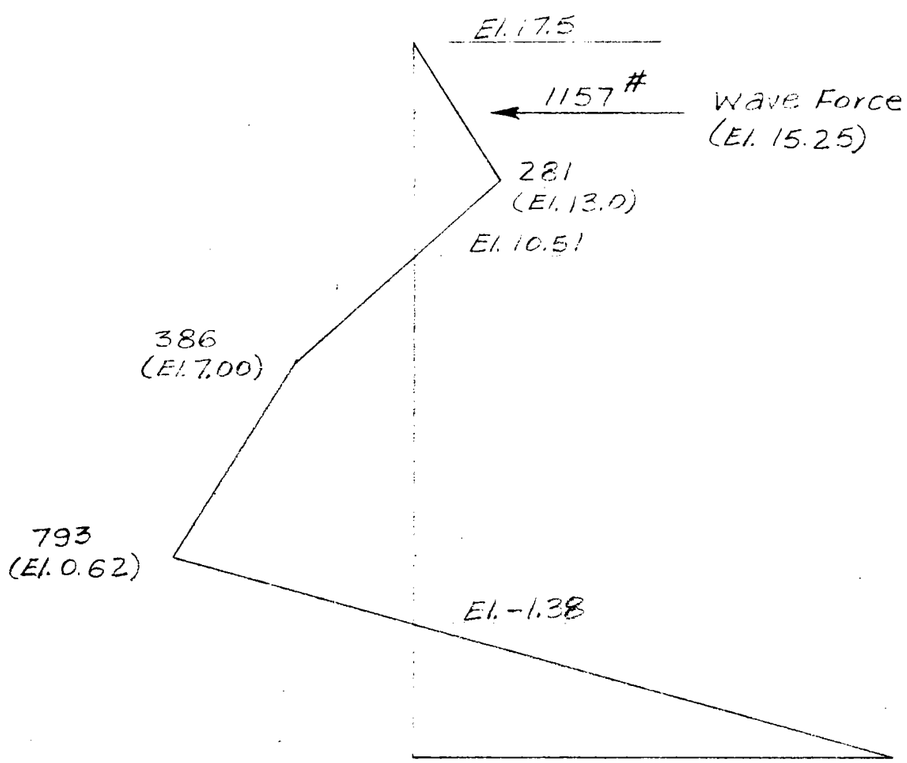
NET PRESSURE DIAGRAM
STATIC + DYNAMIC LOAD
Scale : 1" = 5'
1" = 500psf



MOMENT DIAGRAM
STATIC + DYNAMIC LOAD
Scale : 1" = 5', 1" = 5,000 FT#

DEFL. AT TOP OF FLOOD WALL = 7/32"
STA. 766+00 TO STA 772+00

FIG. B-2

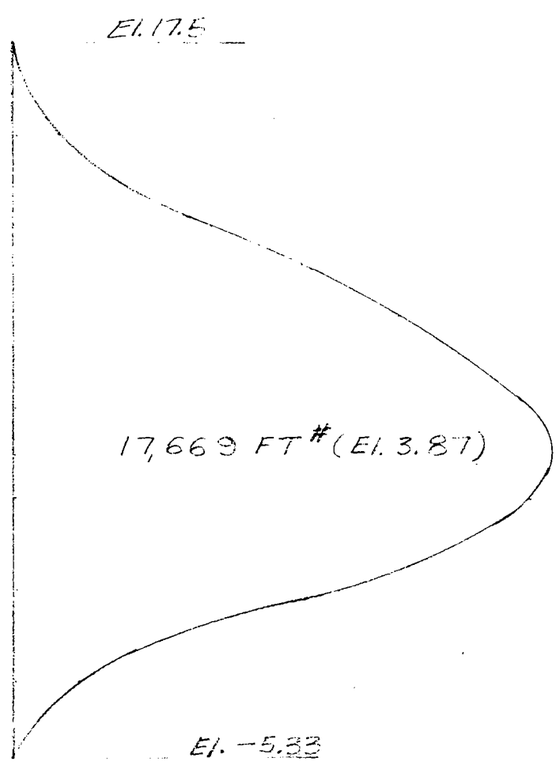


See plate 62

NET PRESSURE DIAGRAM

STATIC + DYNAMIC LOAD

Scale: 1" = 5'
1" = 500 psf



MOMENT DIAGRAM

STATIC + DYNAMIC LOAD

Scale: 1" = 5'
1" = 5,000 FT #

DEFL. AT TOP OF FLOOD WALL = 0.827 "

STA. 874+42 TO 875+62 AND STA. 878+12 TO 879+32

FIG. B-3

LAKE PONT. & VIC. (HURE PROT.)
BARRIER PLAN 3 DM
NEW ORLEANS EAST BACK LEVEE

Sheet 1 of 53
Comp. by T.S.T.
Ckd by J.M.M.
Date Oct 70

DETERMINATION OF WAVE FORCE

Wall seaward of shoreline

$H_1 = 8.25'$ W.T.L. = El. 13.0

Breaking depth $d_b = 0.67 \frac{8.25}{(5.45)^{\frac{1}{3}}} = 8.47'$

Bottom El. = 13.0 - 8.47 = 4.53'

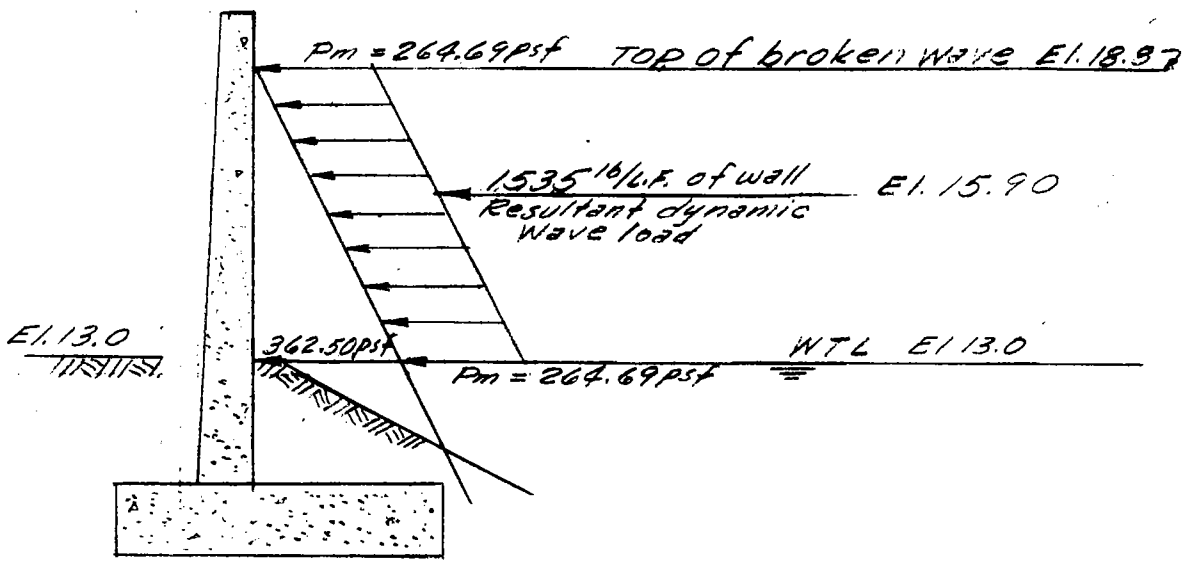
Wave breaks on berm, approx 60' from wall

USE BROKEN WAVE

Reference — U.S. Army Coastal Engineering Research Center, "Shore Protection, Planning and Design," Technical Report No. 4, 3rd ed. 1966.

Height of broken wave = $0.7(H_1) = 0.7(8.25) = 5.775'$

Top of broken wave = 13.0 + 5.8 = El. 18.8



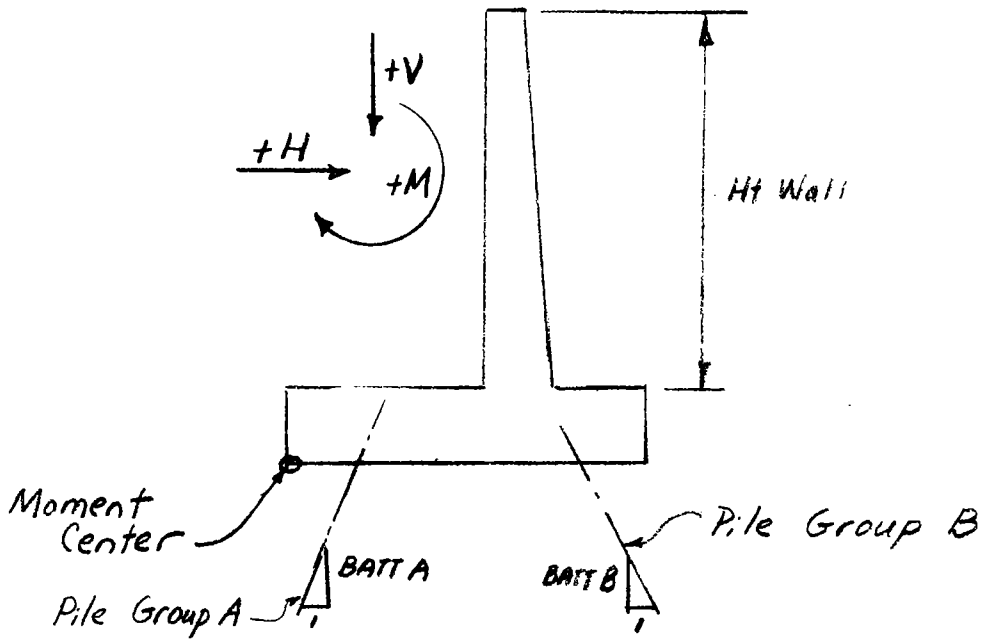
$P_m = \frac{w d_b}{2} = \frac{62.5 \times 8.47}{2} = 264.69 psf$

Resultant dynamic wave load = $P_m \times h_c = 264.69 \times 5.8 = 1535.2$ #/L.F.

FIG. B-4

Batter Pile Foundation

Determine Pile Group by Hrennikoff's Method with Computer Program K29HREN. This program obtains the pile loading when the resultant moment, vertical force, and horizontal force are known.



The following values are known or assumed.

(1.) All piles are 12"×12" prestressed concrete
- (a.) Area = 144 sq. in.
- (b.) Moment of Inertia $AI = 1728\ in^4$; $S = 288$
- (c.) Modulus of Elasticity $E = 4.29 \times 10^6\ lb/in^2$
- (d.) $f_c' = 5000$ psi; $f_c = 1750$ psi
- (e.) Effective prestress after losses = 840 psi (Ref. - Std Prestressed Concrete Piles (10" to 24" square) Design Sheet by Joint Committee of AASHO & PCI)
- (f.) Minimum prestress after losses = 700 psi
- (g.) Tension in precompressed tensile zone = 0

(2.) Modulus of subgrade reaction (AK) = 400 psi

(3.) Allowable pile compression load (PC) = 80 k

(4.) Allowable pile tension load (PT) = 40 k

FIG. B-5

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by JGB
Chkd by TST
Date

Batter Pile Foundation

The following conditions are known or assumed:
(1.) Pile resistance is skin friction, no end bearing
(2.) Pile head is hinged at the base slab

Maximum moment in pile due to transverse load on pile head = $0.5 R Q_A$

Ref. - Journal # 3509 May, 1963 of Soil Mechanics and Foundations Division "Laterally Loaded Piles in a Layered Soil System" by M.T. Davisson and H.L. Gill pg. 72 Fig 5b

where 0.5 = Max. moment coefficient ($\ell_{max} = 5$)

$$R = \sqrt[4]{\frac{EI}{k}} = \sqrt[4]{\frac{4.29\times10^6 \times 1728}{400}} = \sqrt[4]{18.5\times10^6}$$

$R = 65.6''$

Q_A = Max. transverse load on pile head

$M = 0.5 (65.6) Q_A = 32.8 Q_A$

Allowable pile head deflection = y_A

$$y_A = \frac{1.375 R^3 Q_A}{EI}$$

Ref - Journal # 3509 pg 72 Fig 5b

1.375 = Deflection coefficient ($\ell_{max} = 5$)

$$y_A = \frac{1.375 (65.6)^3 Q_A}{4.29\times10^6 (1728)} = 52.4\times10^{-6} Q_A \quad (Q_A \text{ in lb})$$

Program K29HRN obtains the actual axial and transverse loads on the piles by Hrennikoff's method and compares them to the allowables. Allowable transverse loads are computed from the axial loads thusly:

Tension Pile

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} = 1 \qquad f_a = \frac{P}{A} = \frac{P}{144} = 0.00694 P$$

$F_a = F_b = 700 psi$

FIG. B-6

Batter Pile Foundation

Tension Pile cont'd

$$f_b = \frac{M}{S} = \frac{32.8\,Q}{288} = 0.114\,Q \qquad F_b = 700 \text{ psi}$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} = 1$$

$$\frac{0.00694P}{700} + \frac{0.114Q}{700} = 1$$

$$0.114Q = 700 - 0.00694P$$

$$Q = 6140 - 0.0609P$$

$$y = 52.4\times10^{-6}\,Q - 52.4\times10^{-6}(6140 - 0.0609P)$$

$$y = 0.3217 - 3.19\times10^{-6}P$$

Compression Pile

$$f_a = \frac{P}{A} = \frac{P}{144} = 0.00694P$$

$F_a = F_b =$ f_c — eff. prestress after losses

$= 1750 - 840 = 910$ psi

$$f_b = \frac{M}{S} = \frac{32.8\,Q}{288} = 0.114Q$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} = 1$$

$$\frac{0.00694P}{910} + \frac{0.114Q}{910} = 1$$

$$0.114Q = 910 - 0.00694P$$

$$Q = 7982 - 0.0609P$$

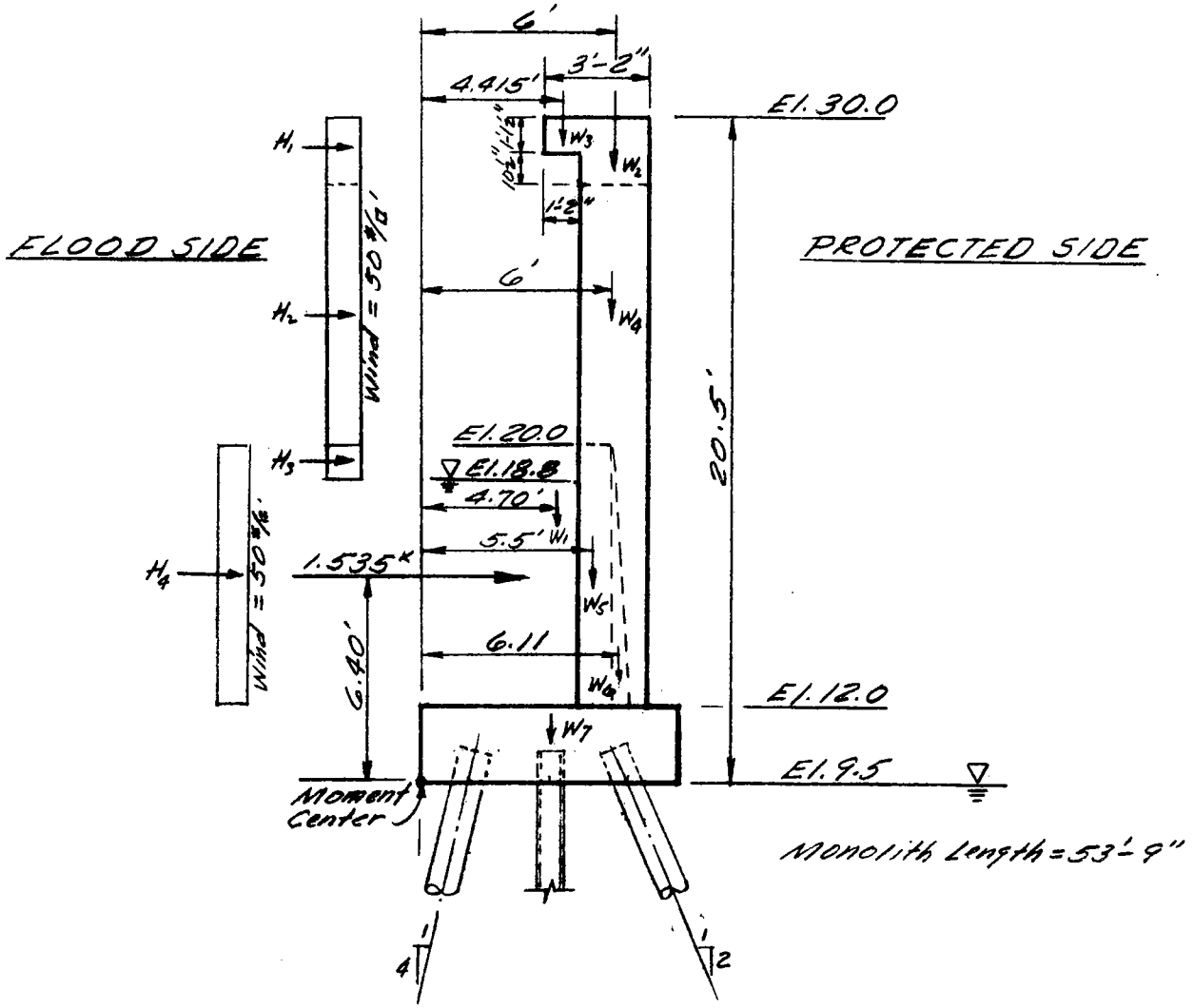
$$y = 52.4\times10^{-6}Q = 52.4\times10^{-6}(7982 - 0.0609P)$$

$$y = 0.4183 - 3.19\times10^{-6}P$$

FIG. B-7

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 5 of 53
Computed by T.S.T.
Ckd by JGB
Date Oct 70



LOAD CASES ON THE GATE MONOLITH

CASE I — Water at El. 13.0 (W.T.L.), no wave, no wind – 100% force used.

CASE II — No water, no wave, no wind, truck loading on edge of slab at protected side — 100% force used.

CASE III — No water, no wave, no wind, truck loading on edge of slab at flood side — 100% force used.

CASE IV — Water at El. 13.0 (W.T.L.), no wave, wind from flood side — 75% force used.

CASE V — Water at El. 18.8, wave force, wind from flood side — 75% force used.

CASE VI — No water, wind from flood side, truck loading on edge of slab at protected side — 75% force used.

CASE VII — No water, wind from protected side, truck loading on edge of slab at flood side — 75% force used.

FIG. B-8

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN G DM
NEW ORLEANS EAST BACK LEVEE

Sheet 6 of 53
Computed by T.S.T.
Ckd by JGB
Date Oct 70

ITEM	COMPUTATION	V	H	$\bar{x}$	M
Gate Wt., W_1	(Included Misc. Wt.)	6.00^K		4.70'	28.20^{1K}
Conc. Bm., W_2	2×2×42.5×0.15	25.50^K		6.00'	153.00^{1K}
Conc. Haunch W_2	½×2×2×2×0.15	0.60^K		6.00'	3.60^{1K}
Conc. Bm., W_3	1.125×1.17×42.5×0.15	8.39^K		4.42'	37.08^{1K}
Conc. Col., W_4	2×2×2×16×0.15	19.20^K		6.00'	115.20^{1K}
Conc. Col., W_4	1×2×1.5×16×0.15	7.20^K		6.00'	43.20^{1K}
Conc. T-Wall, W_5	1×8×38.25×0.15	45.90^K		5.50'	252.45^{1K}
Conc. T-Wall, W_6	½×0.333×8×38.25×0.15	7.64^K		6.11'	46.68^{1K}
Conc. Slab, W_7	8×2.5×53.75×0.15	161.25^K		4.00'	645.00^{1K}
Subtotal W/O uplift		281.68^K			1324.41^{1K}
Water Wt. ↓	1×5×51.09×0.0625	15.97^K		2.50'	39.93^{1K}
Water uplift ↑	-3.5×4×53.75×0.0625	-47.03^K		2.00'	-94.06^{1K}
Water force →	½(3.5)²×53.75×0.0625		20.58^K	1.17'	24.08^{1K}
CASE I (100%) TOTALS		250.62^K	20.58^K		1294.36^{1K}
Truck Loading (H20-S16-44)		32.00^K		8.00'	256.00^{1K}
CASE II (100%) TOTALS		313.68^K	0.00		1580.41^{1K}
Truck Loading (H20-S16-44)		32.00^K	.	——	——
CASE III (100%) TOTALS		313.68^K	0.00		1324.41^{1K}
Water Wt. ↓	1×5×51.09×0.0625	15.97^K		2.50'	39.93^{1K}
Water uplift ↑	-3.5×53.75×4×0.0625	-47.03^K		2.00'	-94.06^{1K}
Water force →	½(3.5)²×53.75×0.0625		20.58^K	1.17'	24.08^{1K}
Wind force, H_1 →	2×42.5×0.05		4.25^K	19.50'	82.88^{1K}
Wind force, H_2 →	5.5×8×0.05		2.20^K	14.50'	31.90^{1K}
Wind force, H_3 →	7×53.75×0.05		18.81^K	7.00'	131.67^{1K}
CASE II (75%) TOTALS		187.97^K	34.38^K		1155.61^{1K}
Water Wt. ↓	6.8×5×51.09×0.0625	108.56^K		2.50'	271.40^{1K}
Water uplift ↑	-9.3×4×53.75×0.0625	-124.97^K		2.00'	-249.94^{1K}
Water force →	½(9.3)²×53.75×0.0625		145.28^K	3.10'	450.37^{1K}
Wave force →	1.535×53.75		82.51^K	6.40'	528.06^{1K}
Wind force, H_1 →	2×42.5×0.05		4.25^K	19.50'	82.88^{1K}
Wind force, H_2 →	8×5.5×0.05		2.20^K	14.50'	31.90^{1K}
Wind force, H_3 →	1.2×53.75×0.05		3.23^K	9.90'	31.98^{1K}
CASE I (75%) TOTALS		199.27^K	178.10^K		1853.30^{1K}

FIG. B-9

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN G D M
NEW ORLEANS EAST BACK LEVEE

Sheet 7 of 53
Computed by T.S.T.
Ckd by JGB
Date Oct 70

ITEM	COMPUTATION	V	H	$\bar{x}$	M
Subtotal W/o uplift		281.68^{K}			1324.41^{1K}
Truck Loading (H20-S16-44)		32.00^{K}		8.00'	256.00^{1K}
Wind force, H_1 →	2 x 42.5 x 0.05		4.25^{K}	19.50'	82.88^{1K}
Wind force, H_2 →	5.5 x 8 x 0.05		2.20^{K}	14.50'	31.90^{1K}
Wind force, H_4 →	8 x 33.75 x 0.05		13.50^{K}	6.50'	87.75^{1K}
CASE II (75%) TOTALS		235.26^{K}	14.96^{K}		1337.21^{1K}
Truck Loading (H20-S16-44)		32.00^{K}		—	—
Wind force, H_1 ←	2 x 42.5 x 0.05		-4.25^{K}	19.50'	-82.88^{1K}
Wind force, H_2 ←	5.5 x 8 x 0.05		-2.20^{K}	14.50'	-31.90^{1K}
Wind force, H_4 ←	8 x 33.75 x 0.05		-13.50^{K}	6.50'	-87.75^{1K}
CASE III (75%) TOTALS		235.26^{K}	-14.96^{K}		841.41^{1K}

FIG. B-10

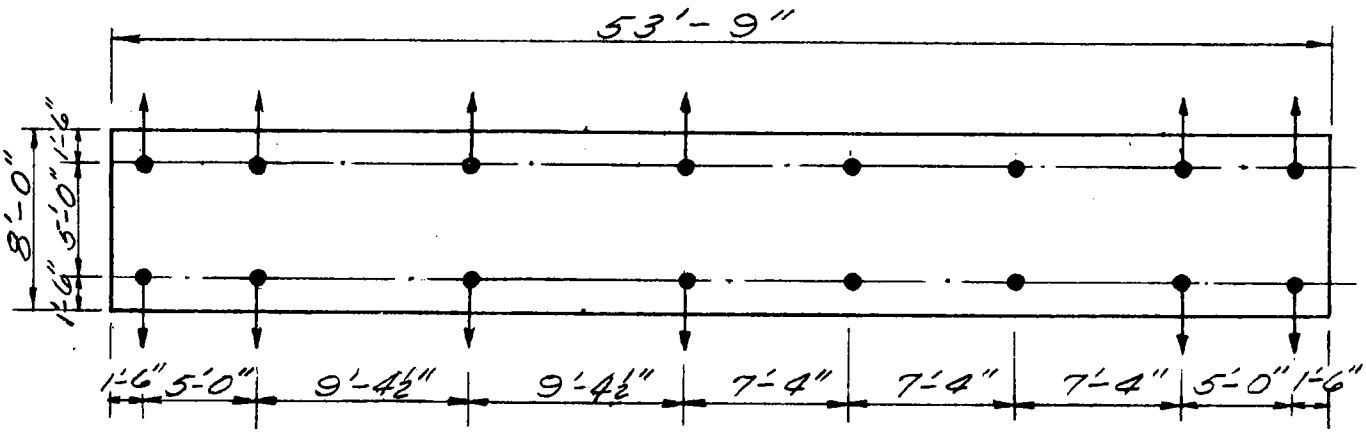
LAKE PONT & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp by T.S.T.
Ckd by J.M.M.
Date Oct 70 JOB

Moments and Forces on Gate Monolith

CASE	AM (MOMENT)	YV (VERT. LOAD)	XH (HOR. LOAD)
I	1294.36^k	250.62^k	20.58^k
II	1580.41^k	313.68^k	0.00^k
III	1324.41^k	313.68^k	0.00^k
IV	1155.61^k	187.97^k	34.38^k
V	1853.30^k	199.27^k	178.10^k
VI	1337.21^k	235.26^k	14.96^k
VII	841.41^k	235.26^k	-14.96^k

No pile spacing greater than 10'-0" o.c.



Pile Spacing in Gate Monolith

FIG. B-11

CASE I - WATER TO 18.5, NO WAVE LOAD, F_b = 18,000psi, F_b = 20,000psi

REACTIONS

62.5 × 6.8 = 425 #/ft² ✓

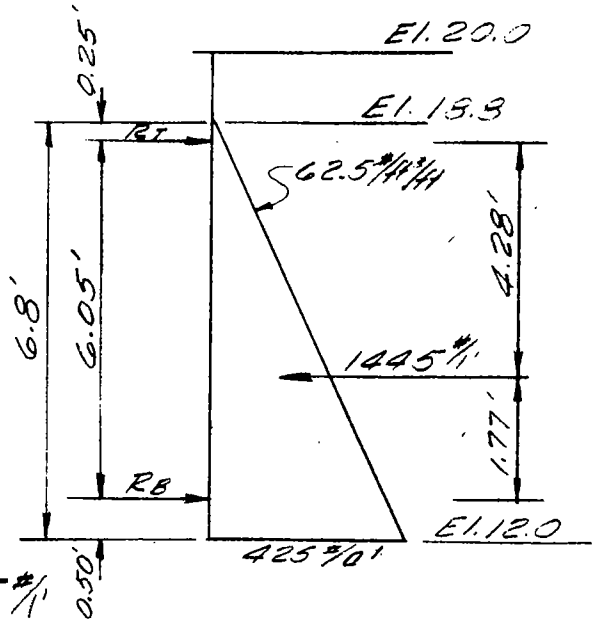
425 × 6.8 × 0.5 = 1445 #/ft ✓

$R_T = \frac{1445 \times 1.77}{6.05}$

= 422.75# ✓

$R_B = \frac{1445 \times 4.28}{6.05}$

= 1022.25# ✓



GIRDER DESIGN

1. TOP Girder

Span = 21.08'; Load = 422.75 #/ft

$Moment = \frac{422.75(21.08)^2}{8}$ = 23,482 ft-lb = 281,784 in-lb. ✓

$S_{req'd} = \frac{281,784}{20,000}$ = 14.09 in³

$S_{req'd} = \frac{281,784}{18,000}$ = 15.65 in³ ✓

2. Bottom Girder

Span = 21.08', Load = 1022.25#

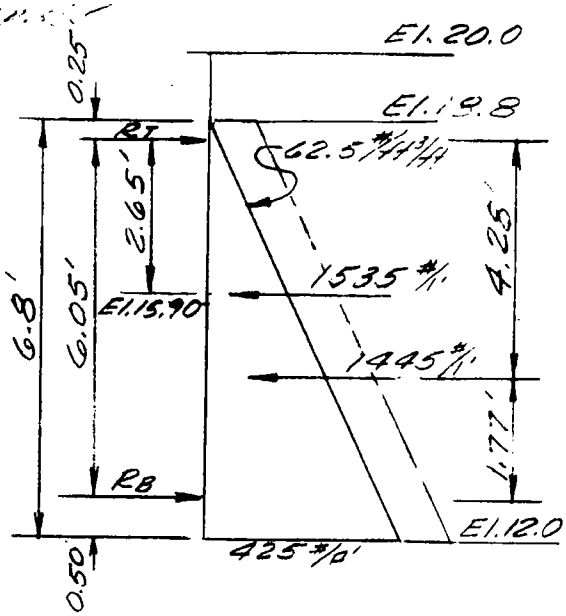
$Moment = \frac{1022.25(21.08)^2}{8}$ = 56,782 ft-lb = 681,384 in-lb

$S_{req'd} = \frac{681,384}{20,000}$ = 34.07 in³ ✓

$S_{req'd} = \frac{681,384}{18,000}$ = 37.85 in³ ✓

FIG. B-12

CASE II — WATER TO 18.8, WITH WAVE LOAD. F_b = 24 [illegible] psi
& F_b = 26.667 psi ✓



REACTIONS

$62.5 \times 6.8 = 425\ \#/ft^2$

$425 \times 6.8 \times 0.5 = 1445\ \#/ft$

$$R_T = \frac{1445 \times 1.77}{6.05} + \frac{1535 \times 3.40}{6.05}$$

$= 1285.40\ \#$ ✓

$$R_B = \frac{1445 \times 4.28}{6.05} + \frac{1535 \times 2.65}{6.05}$$

$= 1694.60\ \#$ ✓

GIRDER DESIGN

1. TOP Girder

Span = 21.08', Load = 1285.40 #/'

$$\text{Moment} = \frac{1285.40(21.08)^2}{8} = 71,399\ ft\text{-}lb = 856,788\ in\text{-}lb$$

$$S_{req'd} = \frac{856,788}{20,000 \times 3/4} = 32.1\ in^3$$ ✓

$$d_{min.} = \frac{21.08 \times 12}{24} = 10.54\ in.$$ ✓

Try 14 WF 34 $S = 48.5\ in^3$; $I = 339.2\ in^4$ ✓

$f_s = 17\,666\ psi < 26,667\ psi$ ✓

$$\Delta = \frac{5WL^3}{384EI}$$

$$= \frac{5 \times 1285.40 \times 21.08 \times (21.08 \times 12)^3}{384 \times 29 \times 10^6 \times 339.2}$$

$= 0.5806" \cong 9/16"$ o.k. ✓

USE 14 WF 34 ✓

FIG. B-13

2. Bottom Girder

Span = 21.08'; Load = 1694.60# ✓

$$\text{Moment} = \frac{1694.60(21.08)^2}{8} = 94,128 \text{ ft-lb} = 1,129,563 \text{ in-lb}$$

$$S_{req'd} = \frac{1,129,563}{26667} = 42.35 \text{ in}^3$$ ✓

Try 16WF36, $S = 56.3 \text{ in}^3$, $I = 446.3 \text{ in}^4$

$f_s = 20,063 \text{ psi} < 26,667 \text{ psi}$ ✓

$$\Delta = \frac{5 \times 1694.60 \times 21.08 (21.08 \times 12)^3}{384 \times 29 \times 10^6 \times 446.3}$$

$= 0.5817'' \cong 19/32''$ ✓

Use 16WF36 ✓

3. Skin Plate

Use 5/16" skin plate

$$I = \frac{12 \times 0.3125^3}{12} = 0.031 \text{ in}^4$$ ✓

$$S = \frac{2 \times 0.031}{0.3125} = 0.20 \text{ in}^3$$ ✓

Load (Maximum) = 62.5 × 6.55 = 409.4 #/ft ✓

$M_{max.} = S \times f = 0.20 \times 20,000 = 4,000 \text{ in-lb}$ ✓

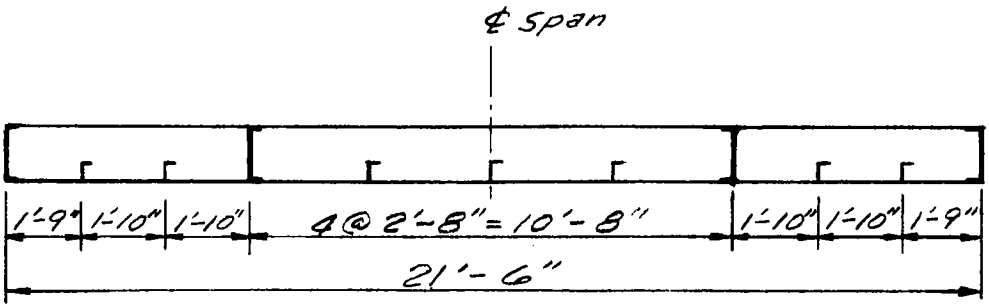
(Int. span) $M = \frac{409.4 \times L^2 \times 12}{12} = 4000 \text{ in-lb}$

$L =$ 3.13 ' ✓

(End Span) $M = \frac{409.4 \times L^2 \times 12}{10} = 4000 \text{ in-lb}$

$L =$ 2.85 ' ✓

FIG. B-14



(Interior) $M = \frac{409.4 \times 2.667^2 \times 12}{12} = 2912$ in-lb ✓

$f_s = \frac{2912}{0.2} = 14560$ psi ✓

(End) $M = \frac{409.4 \times 1.833^2 \times 12}{10} = 1651$ in-lb ✓

$f_s = \frac{1651}{0.2} = 8255$ psi ✓

$62.5 \times 0.25 = 15.63$ #/ft

$62.5 \times 6.80 = 425.0$ #/ft

$R_T = \frac{1445(1.77)}{6.05} = 422.75$ # ✓

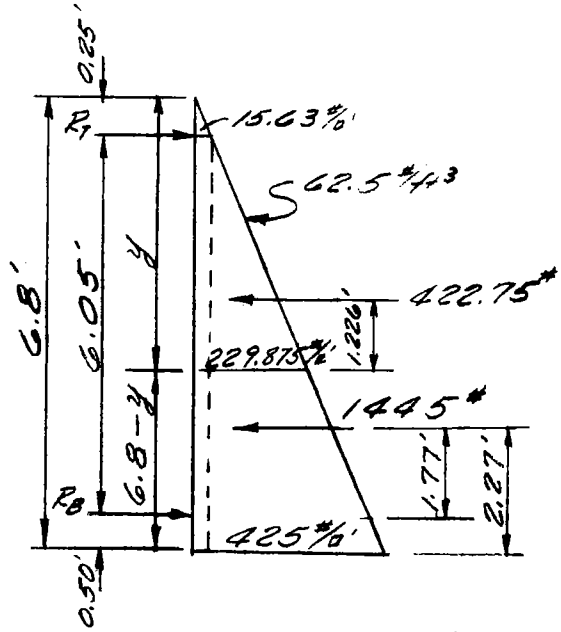
$R_B = \frac{1445(4.28)}{6.05} = 1022.25$ # ✓

Pt. of zero shear

$\frac{62.5 y^2}{2} = 422.75$

$y^2 = \frac{845.50}{62.5} = 13.528$ ✓

$y = 3.678'$ ✓



Allow $f_s = 18{,}000$ #/in² ✓

Max. Moment

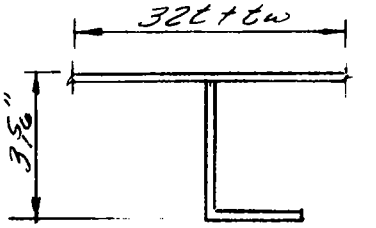
$M_{max.} = 422.75 \times 3.428 - \frac{1}{2} \times 3.678^2 \times 62.5 \times 1.226$

$= 1449.19 - 518.28$

$= \underline{930.91 \text{ ft-lb}}$ ✓

FIG. B-15

PROPERTIES OF 5/16" SKIN PL WITH L 3 x 2 x 5/16



$32(\frac{5}{16}) + \frac{5}{16} = 10.\frac{5}{16}"$

TYPE	AREA	$\bar{y}$	Ay	Ay^2	I_o
PL 10.3125 x 5/16	3.22	0.157	0.506	0.079	—
L 3 x 2 x 5/16	1.47	2.293	3.370	7.727	1.30
	$\Sigma A = 4.69$		$\Sigma Ay = 3.876$	7.806	1.30

$$\bar{y} = \frac{\Sigma Ay}{\Sigma A} = \frac{3.876}{4.69} = 0.826"$$

$$I = I_o + \Sigma Ay^2 - (\Sigma Ay \times \bar{y})$$
$$= 1.30 + 7.806 - (3.876 \times 0.826)$$
$$= 1.30 + 7.806 - 3.202$$
$$= 5.904 \text{ in}^4$$

$$S_{Top} = \frac{I}{C_T} = \frac{5.904}{0.826} = 7.14 \text{ in}^3$$

$$S_{Bott.} = \frac{I}{C_B} = \frac{5.904}{2.487} = 2.37 \text{ in}^3$$

FIG. B-16

Design Vertical Members

Spacing @ 2'-8"

$M = 930.91 \times 2.67 \times 12 = 29{,}826.4$ in-lb ✓

$S_{req'd} = \frac{29826.4}{18{,}000} = 1.66\ in^3$ ✓

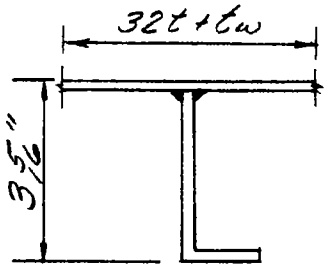
$"d"_{(min)} = \frac{6.05 \times 12}{24} = 3.03$ in. ✓

Use L 3 x 2 x 5/16 ; $S = 2.37\ in^3$; $I = 5.904\ in^4$ Wt. = 5.0 #/'
Plate width = 10.3125 in; $f_s = 12{,}600$ psi

$$\Delta_{Max} = \frac{5h^4m}{768EI}(P_1 + P_2)$$

$$= \frac{5(6.05\times12)^4 \times 2.67\times12}{768(29\times10^6)(5.904)}\left(\frac{15.63+393.75}{144}\right)$$

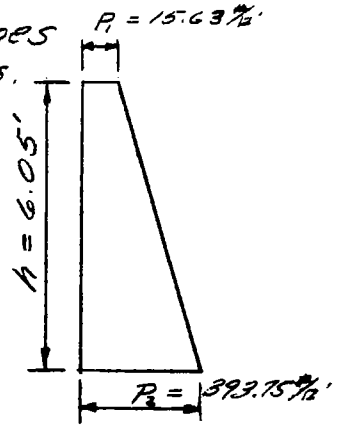
$$= 0.097" \cong \tfrac{1}{8}" \checkmark$$



$32(\frac{5}{16}) + \frac{5}{16} = 10\frac{5}{16}"$

Lateral Support for girders

Top Girder (14WF34) — Support girder flanges at ends and hanger Ls.



1. Interior Span

Span = 10'-8" = 128"

$$L = \frac{12 \times 10^6}{4.58(18\times10^3)}$$

$= 14.55' > 10.67'$ o.k. ✓

FIG. B-17

2. Exterior span

Span = 5'-5"

$L = 14.55' > 5.5$ o.k.

TOP Girder (14WF34)

$L_u = 10'-8"$

$d/A_f = 4.58$

$I_f = \frac{bh^3}{12} = \frac{0.453(6.75)^3}{12} = 11.70 \text{ in}^4$

$A = A_f + \frac{1}{6} A_w$

$= (0.453 \times 6.75) + \frac{1}{6}[14.00 - 2(0.453)] \times 0.28$

$= 3.67 \text{ in}^2$

$r_y = \sqrt{\frac{I}{A}} = \sqrt{\frac{11.70}{3.67}} = 1.785$

$\frac{L}{r_y} = \frac{128}{1.785} = 71.8$

Formula 4

$C_b = 1.00$; $C_c = 126.1$

$K_2 = 1 - \frac{(71.8)^2}{2(126.1)^2 1.00} = 0.839$

$F_b = 0.5 K_2 F_y$

$= 0.5 \times 0.839 \times 36,000$

$= 15,102 \text{ psi}$ | use

Formula 5

$F_b = \frac{10,000000}{128(4.58)} = 17,058 \text{ psi}$

$f_b = 17666 \times 0.75$

$= 13250 \text{ psi} < 15,102 \text{ psi}$ o.k.

FIG. B-18

Bottom Girder (16 WF 36)

$L_u = 10'-8''$

$d/A_f = 5.30$

$I_f = \frac{bh^3}{12} = \frac{0.428(6.992)^3}{12} = 12.19 \text{ in}^4$

$A = A_f + \frac{1}{6} A_w$

$= (0.428 \times 6.992) + \frac{1}{6}[15.85 - 2(0.428)] \times 0.299$

$= 3.74 \text{ in}^2$

$r_y = \sqrt{\frac{12.19}{3.74}} = 1.805$

$\frac{L}{r_y} = \frac{128}{1.805} = 70.91$

Formula 4

$C_b = 1.00$; $C_c = 126.1$

$K_2 = 1 - \frac{(70.91)^2}{2(126.1)^2 1.00} = 0.842$

$F_b = 0.5 K_2 F_y$

$= 0.5 \times 0.842 \times 36000$

$= 15,156 \text{ psi}$

Formula 5

$F_b = \frac{10,000,000}{128(5.30)} = 14,741 \text{ psi}$

$f_b = 20,063 \times 0.75$

$= 15,047 \text{ psi} < 15,156 \text{ psi}$ O.K.

FIG. B-19

LAKE PONT & VIC. (HURR. PROT.) Sheet 17 of 53
BARRIER PLAN GOM Comp by T.S.T.
NEW ORLEANS EAST BACK LEVEE Ckd by J.MM.
Date Oct 70

MEMBER	SIZE	NO	Wt/FT	LENGTH	WEIGHT (Total)	ARM	MOMENT
TOP Girder	14WF34	1	34	24.8	843	7.312	6164.0
Bott. Girder	16WF36	1	36	24.8	892.8	8.251	7366.5
Skin Plate	5/16 x 7.78	1	99.34	21.5	2135.8	0.156	333.2
Vertical Ls	L 3 x 2 x 5/16	7	5.0	7.18	251.3	2.731	686.3
Vertical Ls	10 L 20	4	20	7.18	574.4	5.313	3051.8
Seal Angle	L 3 x 3 x 5/16	1	6.1	22	134.2	0.557	74.7
Bars (Both sides)	1 3/4 x 1 3/4	2	10.413	8.0	166.6	1.188	197.9
Stiffener PL	PL 7/8 x 5/16	4	7.57	1.29	39.1	7.251	283.5
Stiffener PL	PL 9 5/16 x 5/16	4	9.895	1.32	52.2	8.251	430.7
Horizontal L	L 2 x 2 x 5/16	1	3.92	22	86.2	3.923	338.2
					5175.6	3.657	18926.8

FIG. B-20

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 18 of 53
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Date Oct 70

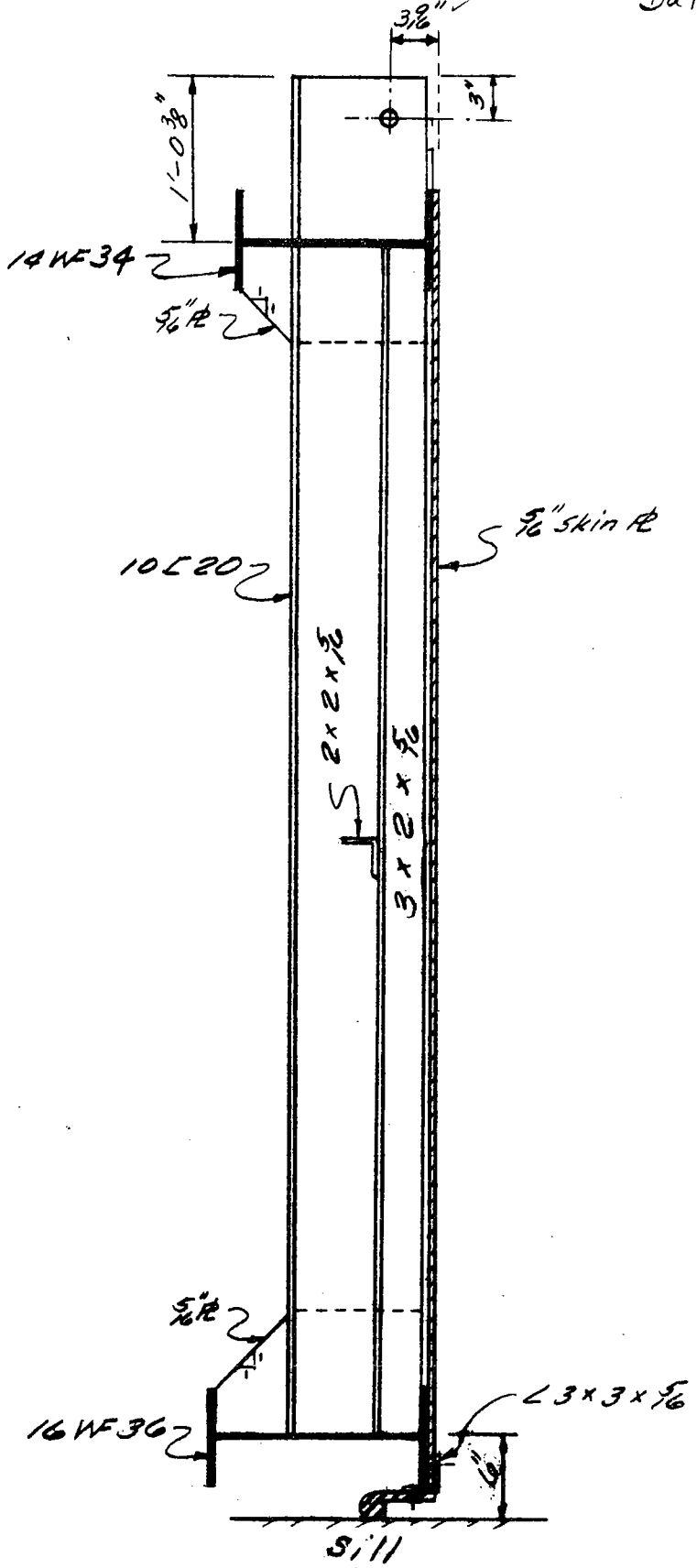
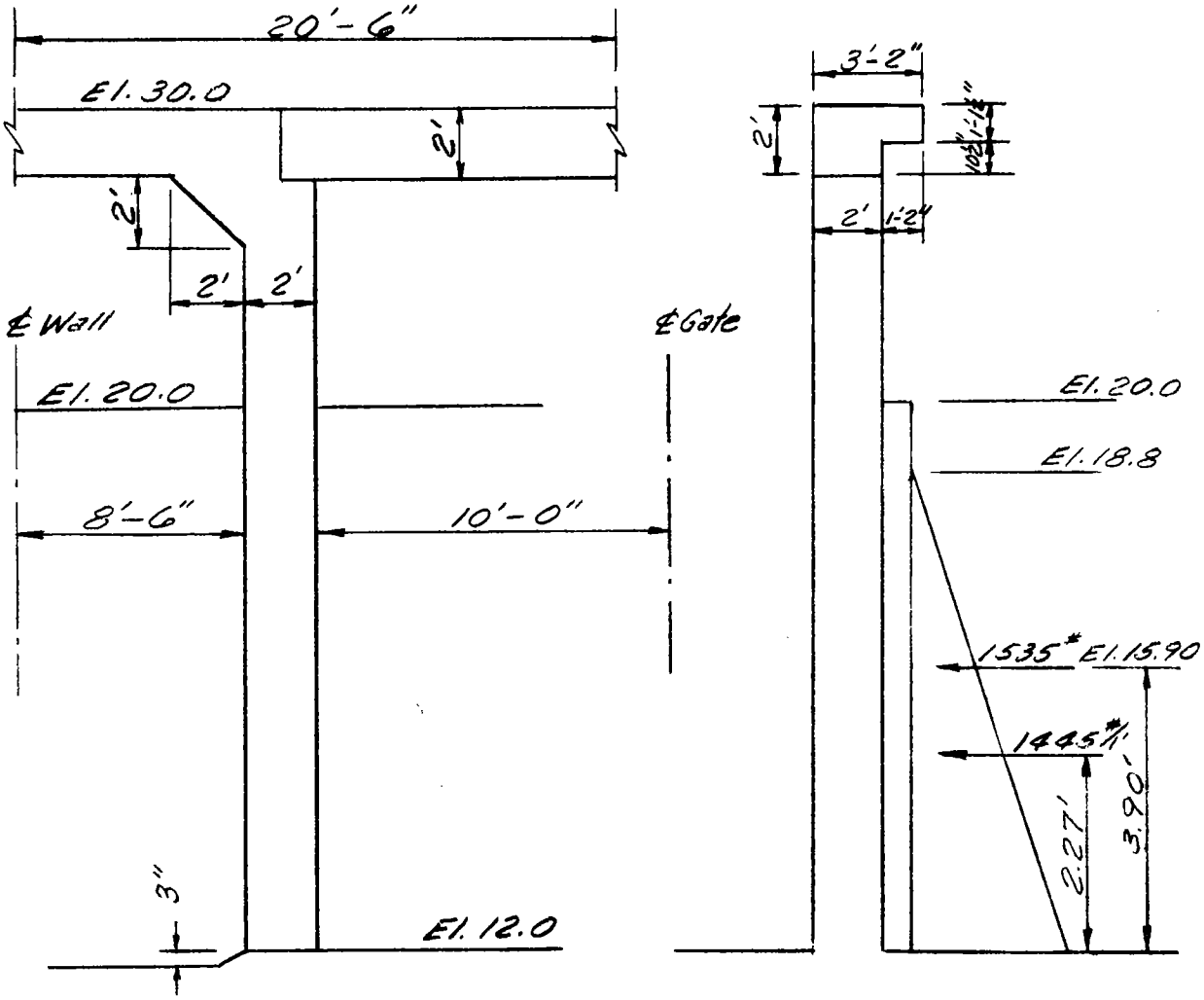


FIG. B-21

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 19 of 53
Comp. by T.S.T.
Ckd by J.M.M.
Date Nov 70



I. Wind, Water and Wave Force

1. Dead Load

Conc. Bm. : 0.80 x 20.5	=	16.40^k
Conc. Haunch : ½ x 2 x 2 x 2 x 0.15	=	0.60^k
Steel Bm. & Trolleys : 0.1 x 20.5	=	2.05^k
Conc. Col. : 2 x 2 x 2 x 16 x 0.15	=	19.20^k
Steel Gate : (Half gate Wt.)	=	2.56^k
Total	=	40.81^k ✓

2. Live Load

1.445#/' x 12	= 17.34 x 2.27	= 39.36'^{k}
Wave force : 1.535 x 12	= 18.42 x 3.90	= 71.84'^{k} ✓
	M_{base}	= 111.20'^{k} ✓

FIG. B-22

2. Live Load (Cont'd)

Wind on col. & Bm. (W.S. El. = 18.8)

$1.2 \times 12 \times 7.4 \times 0.05^{4}/_{12}$	$= 5.33^{1k}$
$2 \times 20.5 \times 17 \times 0.05^{4}/_{12}$	$= 34.85^{1k}$
$2 \times 8.0 \times 12 \times 0.05^{4}/_{12}$	$= 9.60^{1k}$
$12 \times 2 \times 2 \times 14.67 \times 0.05^{4}/_{12}$	$= 1.47^{1k}$
	$M_{base} = 51.25^{1k}$

Ignore Eccentric of Trolley

A. Column Design (Column Size 24" x 24") – Center Col.

$f_y = 40$ KSI ; $f_s = 16$ KSI

$f'_c = 3$ KSI ; $n = 9$

$b = 24"$; $t = 24"$

$M_x = 162.45 \times 0.75 = 121.84^{1k}$

$M_y = 12.38 \times 0.75 = 9.29^{1k}$

$N_x = 40.81 \times 0.75 = 30.61^{k}$

$A_g = 576$ sq. in.

$N' = \frac{30.61}{3 \times 576} = 0.018$

For $g = 0.75$

$\frac{P_b}{f'_c A_g} = 0.20$ (From Table 26)

$\frac{N}{f'_c A_g} < \frac{P}{f'_c A_g}$ Tension Controls (Column Design Region III)

$M'_x = \frac{12 \times 121.84}{3 \times 24 \times 576} = 0.035$

$M'_y = \frac{12 \times 9.29}{3 \times 24 \times 576} = 0.0026$

Assume $P_g = 0.020$

From Diagram 35a for $f'_c = 3$ KSI; $f_y = 4$ KSI; $g = 0.75$

$M_x = 0.040$

FIG. B-23

LAKE PONT. & VIC (HURR PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ck'd by J.M.M.
Date Nov 70

using the approximate solution compute

$\frac{1}{7/8}\left(\frac{M_x'}{M_{x-x}} + \frac{M_y'}{M_{y-y}}\right) = \frac{1}{0.875}\left(\frac{0.0334}{0.040}\right) = 0.954 < 1.0$ o.k. ✓

$A_{st} = 0.02 \times 576 = 11.52^{a}$" ✓

<u>use 7-#8 bars & 5-#10 bars; $A_s = 11.88^{a}$"</u> ✓

For $M_y' = 0.0024$; $N' = 0.016$

$A_{st} = 0.002 \times 576 = 1.156^{a}$" (Req'd)

$A_{st} = 3.95^{a}$" (Provided)

II <u>Water, NO Wind & NO Wave</u>

1. <u>Dead Load</u>

Conc. Bm. : 0.80×20.5	=	16.40^{k}
Conc. Haunch : $\frac{1}{2} \times 2 \times 2 \times 2 \times 0.15$	=	0.60^{k}
Steel Bm & Trolleys : $0.1^{k}/ft \times 20.5$	=	2.05^{k}
Conc. Col. : $2 \times 2 \times 2 \times 16 \times 0.15$	=	19.20^{k}
Steel Gate	=	2.56^{k}
Total	=	40.81^{k} ✓

2. <u>Live Load</u>

$1.5^{k}/ft \times 12 = 18 \times 2.27$ $= 40.86^{k}$ (@ Base)

<u>Column Design</u>

$M_x = 40.86^{k}$; $N = 40.81^{k}$; $A_g = 576$ sq. in.

$N' = \frac{40.81}{3 \times 576} = 0.024$

$M_y = 9.26'^{k}$

For $g = 0.75$

$\frac{P_b}{f'_c A_g} = 0.20$ (From Table 26) ✓

FIG. B-24

LAKE POINT. & VIC (HURR PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

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Date Nov 70

Column Design (Cont'd)

$\frac{N}{f'_c A_g} < \frac{P_b}{f'_c A_g}$ Tension Control (Region III)

$M_x' = \frac{12 \times 40.81}{3 \times 24 \times 576} = 0.012$

$M_y' = \frac{12 \times 12.38}{3 \times 24 \times 576} = 0.0036$

Assume $P_g = 0.020$

From Diagram 350 for $f'_c = 3$KSI, $f_y = 4$KSI, $g = 0.75$

$M_x = 0.043$

$\frac{1}{7/8}\left(\frac{M_x'}{M_{xx}} + \frac{M_y'}{M_{yy}}\right) = \frac{1}{0.875}\left(\frac{0.0156}{0.043}\right) = 0.415 < 1.00$

B. Column Design (column size 24"x18") – End Col.

I Wind, Water & Wave Force

1. Dead Load

Conc. Bm.: 0.80×10.0	=	8.00^K
Steel Bm & Trolley: 0.1×10	=	1.00^K
Conc. Col.: $2 \times 2 \times 1.5 \times 16 \times 0.15$	=	14.40^K
Steel Gate (Half Gate Wt.)	=	2.56^K
	Total =	25.96^K

2. Live Load

Water: $1.445\frac{K}{ft} \times 10$	= 14.45×2.27	=	32.80^K
Waveforce: 1.535×10	= 15.35×3.90	=	59.87^K
		Mbase =	92.67^K

Wind on Col. & Bm. (W.S. El. = 18.8)

$2 \times 10 \times 17 \times 0.05$	=	17.00^K
$2 \times 8 \times 12 \times 0.05$	=	9.60^K
$2 \times 1.2 \times 7.4 \times 0.05$	=	0.89^K
Mbase =		27.49^K

FIG. B-25

LAKE PONT. & VIC. (HURR PROT.)
BARRIER PLAN 3 D M
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd by J.M.M
Date Nov 70

$M_x = 120.16^{IK} \times 0.75 = 90.12^{IK}$

$M_y = 12.38^{IK}$

$N = 25.96^{K} \times 0.75 = 19.47^{K}$

$A_g = 24 \times 18 = 432$ sq. ft.

$N' = \frac{19.47}{3 \times 432} = 0.015$

$g_x = 0.75 \quad g_y = 0.70$

$\frac{P_b}{f'_c A_g} = 0.20$ (From Table 26)

$\frac{N}{f'_c A_g} < \frac{P_b}{f'_c A_g}$ Tension Control (Region III) ✓

$M'_x = \frac{12 \times 90.12}{3 \times 24 \times 432} = 0.035$ ✓

$M'_y = \frac{12 \times 12.38}{3 \times 24 \times 432} = 0.0048$ ✓

From Diagram 35a for $f'_c = 3$ KSI; $f_y = 4$ KSI; $g = 0.70$

Assume $p = 0.020$

$\frac{1}{7/8}\left(\frac{0.0358}{0.040}\right) = 1.02 \cong 1.0$ O.K.

$A_{st} = 0.020 \times 432 = 8.64^{\square"}$ ✓

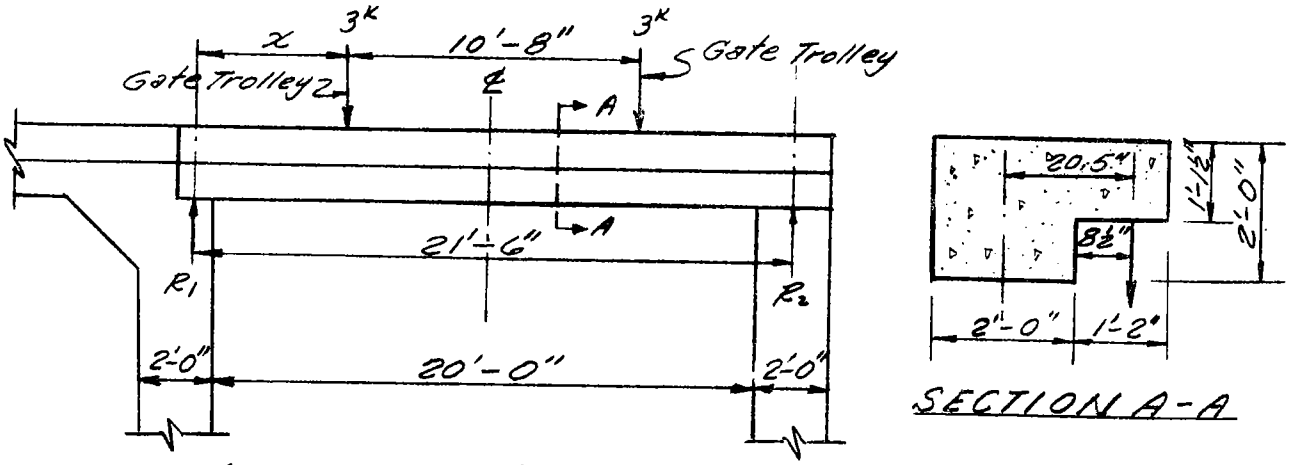
<u>Use 4 - #9 bars & 6 - #8 bars $A_s = 8.74^{\square"}$</u> ✓

<u>Max. Moment for Live Load</u>

$M_{L.L.} = \frac{2.9 \times 22}{4} = 16.13^{IK}$ (When one trolley wheel is @ ℄ span)

FIG. B-26

Concrete Beam Design



$f'_c = 3000$ psi ; $f_s = 20{,}000$ psi ; $n = 9.2$; $f_c = 1050$ psi

Dead Load

Removable Bm: $(2 \times 2 + 1.125 \times 1.167) \times 0.15 = 0.79$ K/L.

Trolley Bm $= 0.02$ K/L.

Total $= 0.81$ K/L. ✓

Max. Moment For Moving Loads (Live Load)

$D = \frac{10.67}{21.5} = 0.496\,L < 0.586\,L$, Therefore

1. Max. Moment occurs at.

$$x = \tfrac{1}{2}\left(L - \frac{P}{2}\right) = 0.5(21.5 - 5.335) = 8.083 \text{ ft.}$$

$$M_{max.} = R_1 x = \frac{3.0(2 \times 21.5 - 2 \times 8.083 - 10.667)}{21.5} \times 8.083$$

$$= 18.23 \text{ 'K} \quad \checkmark$$

2. For Load in same position

$$M_{midspan} = 21.68 \text{ 'K} - 3.0^{K} \times 2.667 = 13.679 \text{ 'K} \quad \checkmark$$

3. For Left Load at Midspan

$$M_{midspan} = 1.50 \times 10.75 = 16.125 \text{ 'K} \quad \checkmark$$

FIG. B-27

LAKE PONT & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd. by J.M.M.
Date NoJ 70

Max. Moment For Dead Load

$$M_L = \frac{0.81 \times (21.5)^2}{8} = 46.80^{'K}$$ ✓

$$M_{8.083} = \frac{0.81 \times 8.083 (21.5 - 8.083)}{2} = 43.92^{'K}$$

Total Max. Moment (Live Load + Dead Load)

$$M_{max.} = 16.13 + 46.80 = 62.93^{'K}$$ ✓

Check Effective Depth

$$K_b d^2 = 12000 M$$

$$d^2 = \frac{12000 \times 62.93}{152 \times 24} = 207.0065 in^2$$

$$d = 14.3877"$$

use $d = 21"$ ✓

Design of Positive Steel

$$A_s = \frac{62.93}{1.44(21)} = 2.08^{2}" \checkmark$$

$$\text{Min } A_s = 0.005 \times 24 \times 21 = 2.51^{2}" \checkmark$$

use 2-#9 & 1-#7 ($A_s = 2.60^{2}"$)

Design of Negative Steel (Occurs during Beam Pickup)

pick up points

$$Pt. = 0.207L = 0.207 \times 23.0 = 4.76' \text{ From End of Bm.}$$

$$R_1 = R_2 = \frac{0.81 \times 23}{2} = 9.315^{K} \checkmark$$

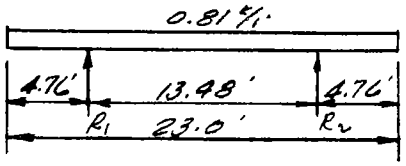


FIG. B-28

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ck'd by J.M.M.
Date Nov 70

$M_{max.} = R_1(\frac{L}{2} - x) - (\frac{1}{2}w)\frac{L}{4}$

$= 9.315(11.5 - 4.76) - (11.5 \times 0.61)\,5.75$

$= 62.78 - 53.56$

$= 9.22'^K$ ✓

Check Effective Depth

$K_b d^2 = 12000 M$

$d^2 = \frac{12000 \times 9.22}{152 \times 24} = 30.3289\ in^2$

$d = 5.51" < 21"$ o.k.

use $d = 21"$ ✓

Reinforcing Req'd

$A_s = \frac{9.22}{1.44 \times 21} = 0.30^{\square"}$ ✓

Min. $A_s = 0.0025 \times 24 \times 21 = 1.26^{\square"}$

use 3-#6 $A_s = 1.32^{\square"}$

FIG. B-29

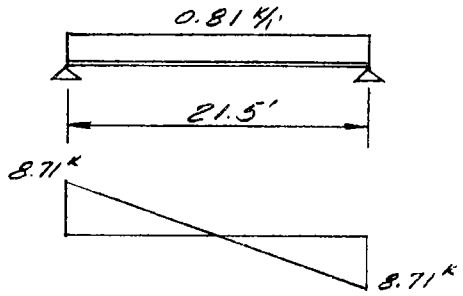
LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GOM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd. by J.M.M.
Date Nov 70

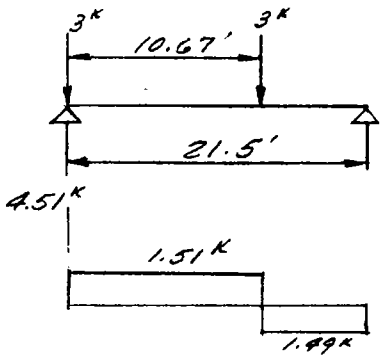
Design of Stirrups

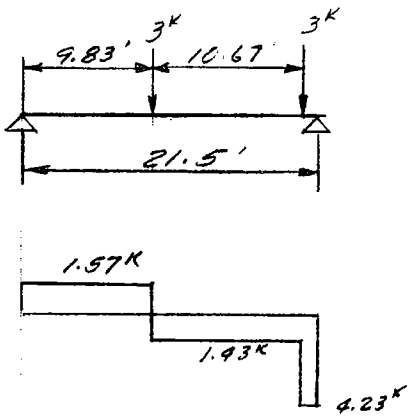
1. For Live Load & Dead Load Without Torsion

(a) Dead Load



(b) Live Load





(c) Influence Diagram for Max. shear Due To D.L. & L.L.

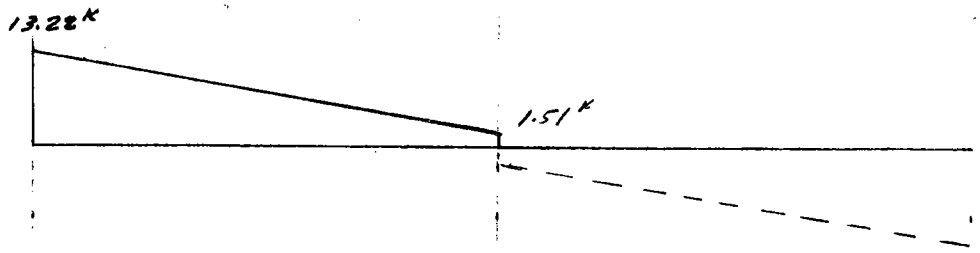


FIG. B-30

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GOM
NEW ORLEANS EAST BACK LEVEE

Comp by T.S.T.
Ckd by J.M.M.
Date Nov 70

Check the Max. Shear stresses.

$$v_{o.o} = \frac{V}{bd} = \frac{13220}{24 \times 21}$$

$$= 26.23 \text{ psi} < 60 \text{ psi} \quad \text{o.k.} \checkmark$$

$$v_{9.03} = \frac{V}{bd} = \frac{1570}{24 \times 21}$$

$$3.12 \text{ psi} < 60 \text{ psi} \quad \text{o.k.} \checkmark$$

FOR TORSION

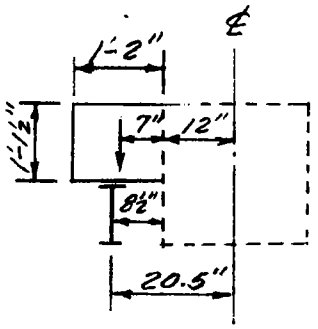
(1.) Torsion At ℄ of Beam

$T_{D.L.} = 1.1667 \times 1.125 \times 0.15 \times 19 + 0.02 \times 20.5$

$= 4.15 \text{"K/Ft.}$ ✓

$T_{L.L.} = 3 \times 20.5$

$= 61.5 \text{"K}$ ✓



(2) Torsion Due To Dead Load

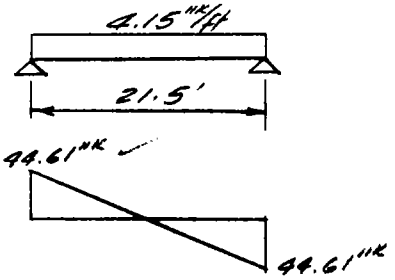
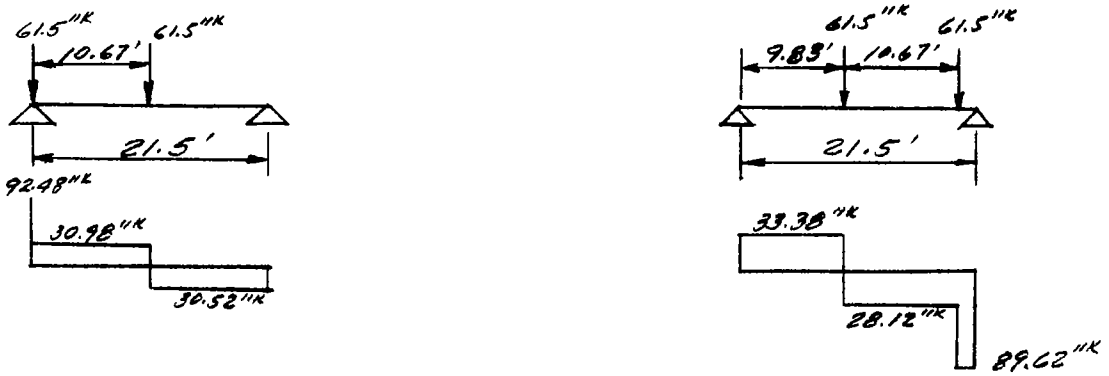
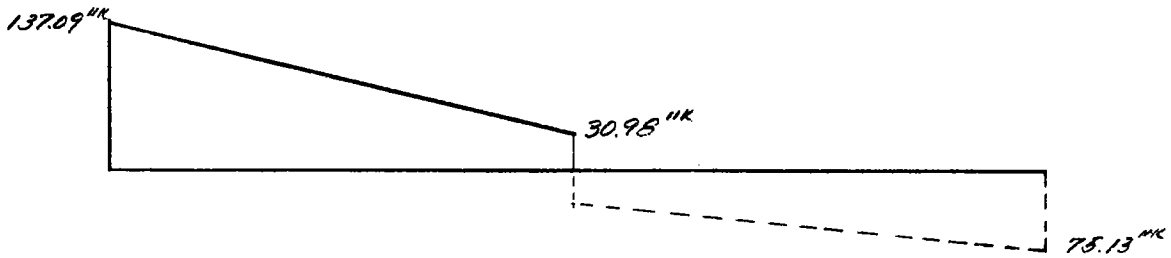


FIG. B-31

(3.) Torsion Due To Live Load



Influence Diagram for Max. Torsion Due To D.L. & L.L.



Max. Shear Stresses

$$v_{o\text{-}o} = \frac{4.8T}{6^3} = \frac{4.8 \times 137090''^{\#}}{(24)^3}$$

$$= 47.60 \text{ psi}$$ ✓

$$v_{9.83} = \frac{4.8T}{6^3} = \frac{4.8 \times 30980''^{\#}}{(24)^3}$$

$$= 10.76 \text{ psi}$$ ✓

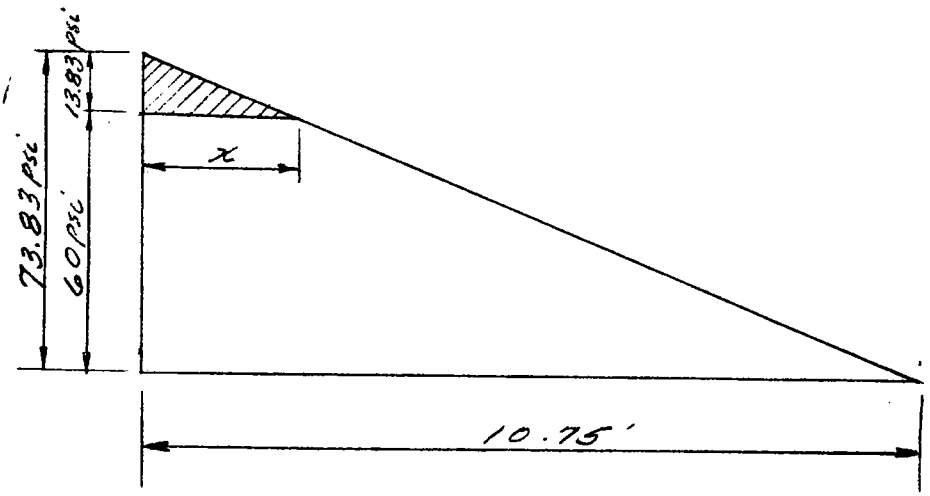
FIG. B-32

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GOM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd by J.M.M.
Date Nov 70

For Shear And Torsion

Max. Shear Stress Influence Diagram (Where The Max. Shear Stress Is Due To Shear & Torsion)



$$\frac{x}{13.83} = \frac{10.75}{73.83}$$

$$x = \frac{13.83 \times 10.75}{73.83}$$

$$= 2.014' = 24.17'' \text{ (Distance Req'd for stirrups)}$$

$v' = 13.83$ psi (stress carried by stirrup)

Use No 4 stirrups, From ACI Handbook :

$$\text{Stirrup spacing} = \frac{A_v f_v}{b v'}$$

$$= \frac{0.4 \times 20{,}000}{24 \times 13.83}$$

$$= 24.10''$$

For Sec. 1206 (a) ACI

$$\text{Spacing} = \frac{d}{2} = \frac{21.0}{2} = 10.5''$$

FIG. B-33

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd by J.M.M.
Date Nov 70

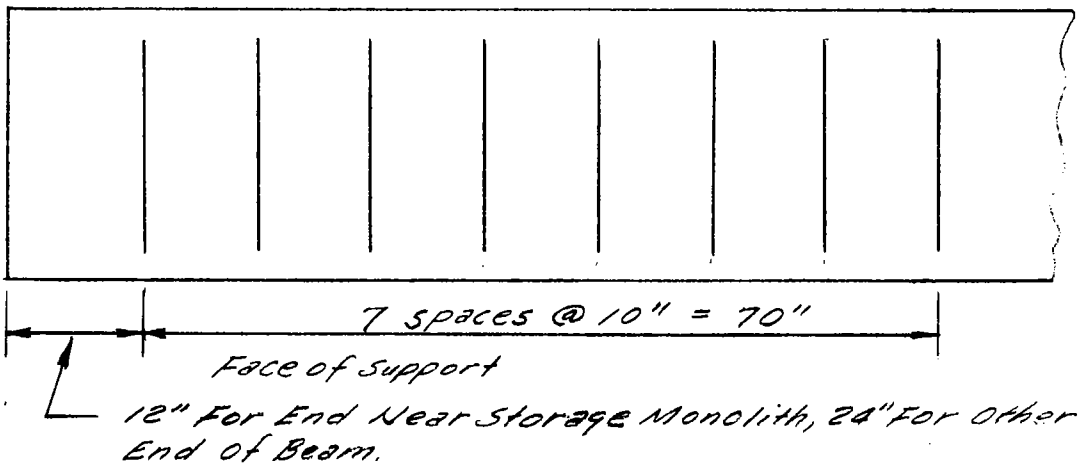
For Sec. 1206 (6)

$0.00156\, Sp = Av$

$$Spacing = \frac{0.40}{0.0015 \times 24}$$

$$= 11.11''$$

Use Max. Spacing = 10.0 in



Design of Transverse Steel (Shrinkage & Temperature)

$A_s = 0.00206t = 0.0020 \times 12 \times 13.5$

$= 0.32''$ per Lin Ft.

Use No 4 Bars At 12" c/c

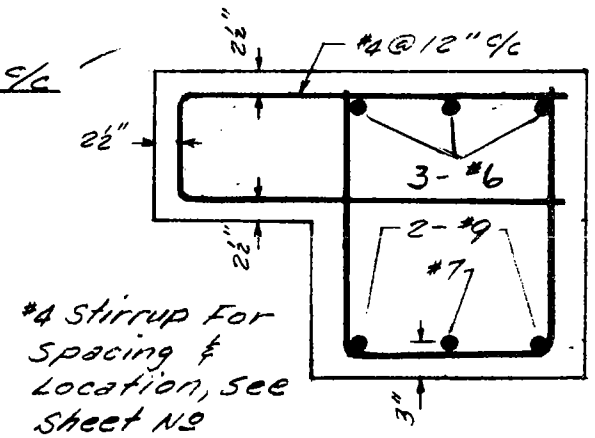
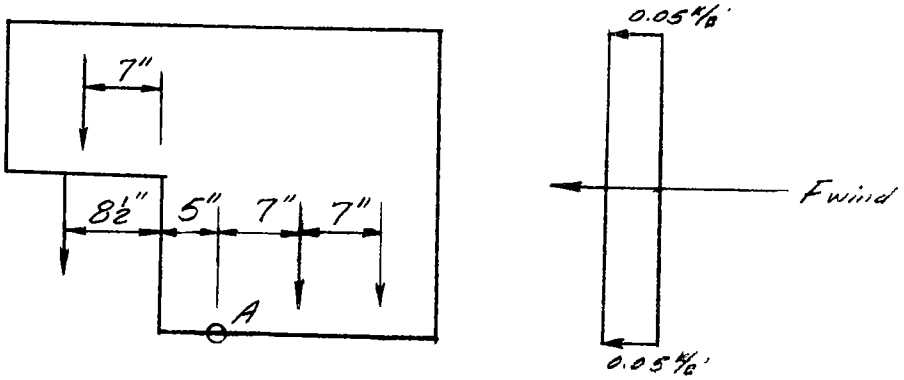


FIG. B-34

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd by J.M.M.
Date Nov 70

Design of Anchor Bolts



Gate: $(3.0 + \frac{10.833}{21.50} \times 3.0) 13.5$ = 60.91 "K

Conc.: $(1.1667 \times 1.125 \times 21.5 \times 0.15 \times \frac{1}{2}) \times 12$ = 25.40 "K

I Beam: $(0.02 \times 21.5 \times \frac{1}{2}) 13.5$ = 2.90 "K

Wind: $(0.05 \times 2.0 \times 21.5 \times \frac{1}{2}) \times 12$ = 12.90 "K

- Conc: $(2.0 \times 2.0 \times 21.5 \times 0.15 \times \frac{1}{2}) \times 7$ = -45.15 "K

ΣM_A = 56.96 "K

Tension On Bolt B:

$14 B = \Sigma M_A$

$B = \frac{56.96}{14.0}$

$= 4.07^K$

$F_t = 0.83(0.40)F_y = 0.83(0.40)(30.0) = 10{,}000$ psi

use QQ-S-766d Class 304

Area Needed $= \frac{4070}{10{,}000} = 0.407$ in²

use ¾" Diam. Bolt.

FIG. B-35

LAKE PONT. & VIC. (HURR. PROT.)
BARRIER PLAN GOM
NEW ORLEANS EAST BACK LEVEE

Comp. by T.S.T.
Ckd by J.M.M.
Date Nov 70

Embedment of Bolts:

Allowable Bond stress:

$$U = \frac{1.7\sqrt{f'c}}{D} = \frac{1.7\sqrt{3000}}{0.75}$$

$$= 124.15 \text{ psi} < 160 \text{ psi}$$

Sum of Perimeters

$$\Sigma_c = \pi D = 3.14159 \times 0.75$$
$$= 2.36"$$

Length of Embedment

$$\frac{P}{\Sigma_c L} = U$$

$$\therefore L = \frac{P}{\Sigma_c U}$$

$$= \frac{4070}{2.36 \times 124.15}$$

$$= 13.89"$$

use $L = 20"$

FIG. B-36

LAKE PONT. VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE
T-Wall at Pumping Station

Sheet 34 of 53
Comp. by J.B.
Chkd by T.F.
Date Nov 70

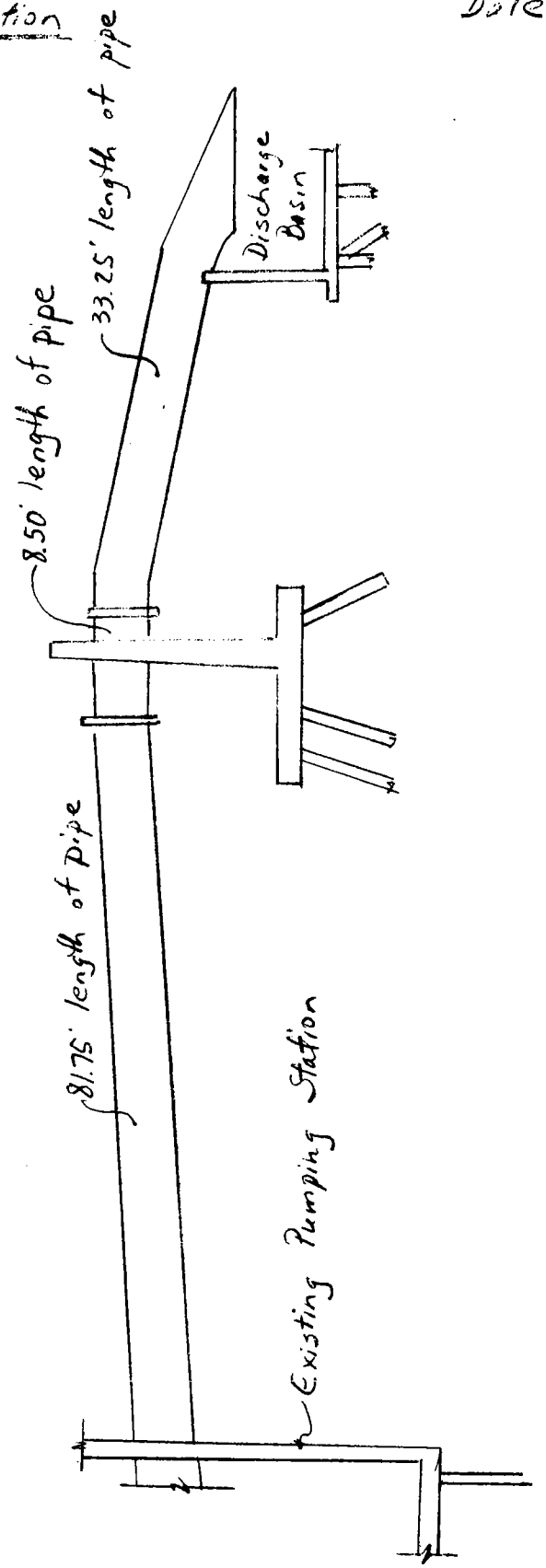


FIG. B-37

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 35 of 53
Comp. by JGB
Chkd by ZBT
Date: NOV 70

T-Wall at Pumping Station

Load Cases

Case I - Water at El. 13.0, no wave, no wind, discharge pipes filled with water - 100% forces used

Case II - Water at El. 13.0, no wave, no wind, discharge pipes empty - 100% forces used.

Case III - Water at El. 13.0, no wave, wind from flood side, discharge pipes filled with water - 75% forces used.

Case IV - Water at El. 13.0, no wave wind from flood side, discharge pipes empty 75% forces used.

Case V - Water at El. 17.4, wave force, wind from flood side, discharge pipes filled with water - 75% forces used.

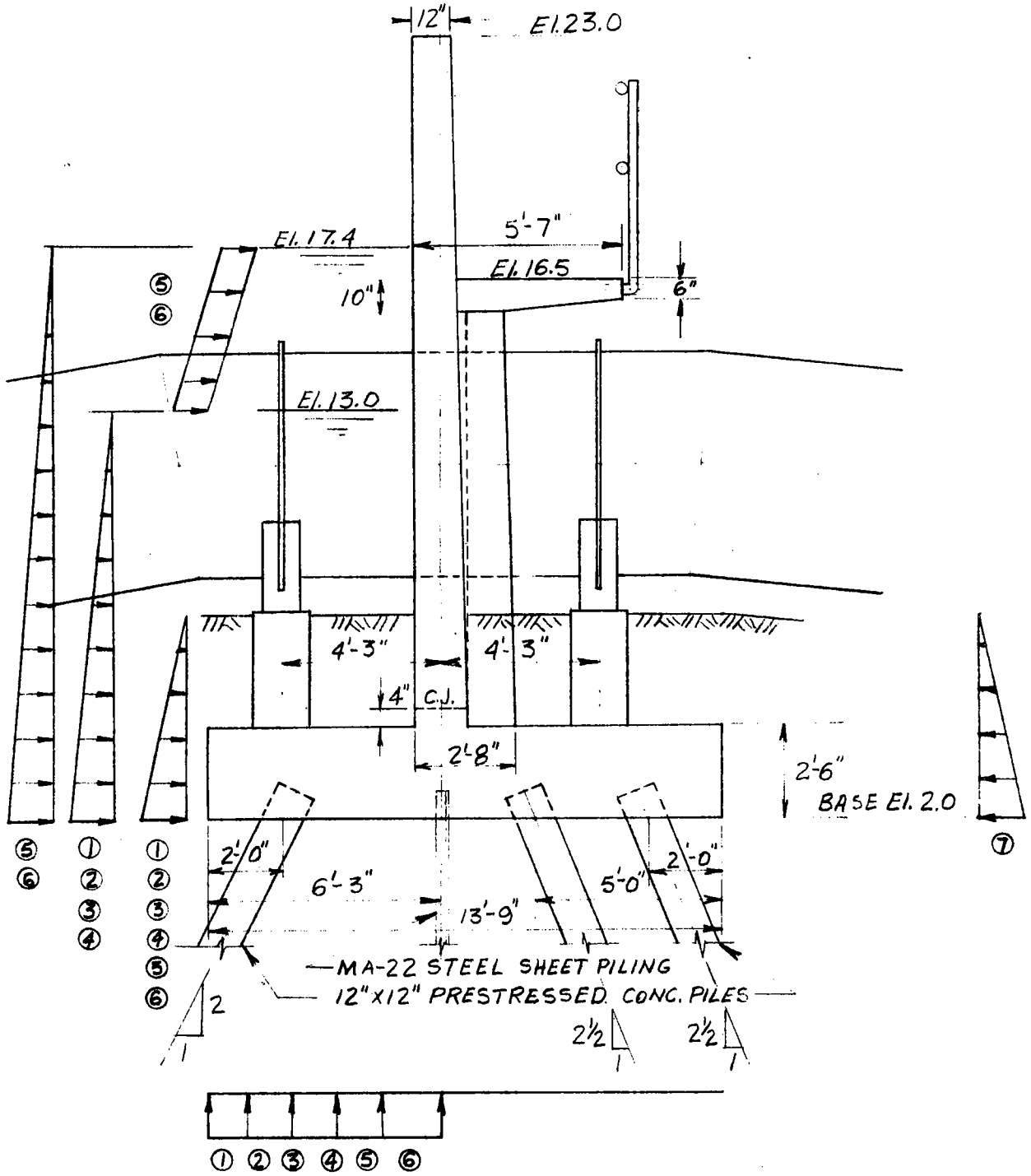
Case VI - Water at El. 17.4, wave force, wind from flood side, discharge pipes empty - 75% forces used.

Case VII - No water or wave force, wind from protected side, discharge pipes empty - 75% forces used.

FIG. B-38

LAKE PONTCHARTRAIN, LA. & VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

BY: TFP
NOV. 70
CKD. BY: TST, JGB



CASE No. ⑪

UPLIFT

FIG. B-39

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

Sheet 37 of 93
BY: TFP
NOV. 70
CKD. BY: DT, JGB

PIPES THRU FLOODWALL

PIPE DATA

1/2 in. Thick
$C = \pi d = 3.142 \times 72 = 226.22$ in.
Wt/ft = 384 #/L.F.
Wt/Pipe = $81.75 \times 0.384 = 31.39^k$
$8.50 \times 0.384 = 3.26$
$33.25 \times 0.384 = 12.77$
47.42^k

WATER IN PIPE

$A = 0.785 d^2 = 0.785 \times 6^2 = 28.26^{\square'}$
wt/water $= 81.75 \times 28.26 \times 0.0625 = 144.39^k$
$= 8.50 \times 28.26 \times 0.0625 = 15.01$
$= 33.25 \times 28.26 \times 0.0625 = 58.73$
218.13^k

PEDESTAL REACTIONS DUE TO WEIGHT OF PIPE

PIPE FILLED WITH WATER

FLOOD SIDE PEDESTAL
1/2 wt. of 8.5' section, No Water = $3.26/2 = 1.63^k$
1/2 wt. of 8.5' section, Water = $15.01/2 = 7.51$
1/2 wt. of 33.25' section, No Water = $12.77 \times 1/2 = 6.39$
1/2 wt. of 33.25' section, Water = $58.73 \times 1/2 = 29.37$
44.90^k

PROTECTED SIDE PEDESTAL
1/2 wt. of 8.5' section, No Water = $3.26/2 = 1.63^k$
1/2 wt. of 8.5' section, Water = $15.01/2 = 7.51$
1/2 wt. of 81.75' section, No Water = $31.39 \times 1/2 = 15.70$
1/2 wt. of 81.75' section, Water = $144.39 \times 1/2 = 72.20$
97.04^k

FIG. B-40

PIPES THRU FLOODWALL

PIPE EMPTY

FLOOD SIDE PEDESTAL

1/2 Wt. of 8.5' Section	= 3.26/2 = 1.63^k
1/2 Wt. of 33.25' Section	= 12.77 x 1/2 = 6.39
	8.02^k

PROTECTED SIDE PEDESTAL

1/2 Wt. of 8.5' Section	= 3.26/2 = 1.63^k
1/2 Wt. of 81.75' Section	= 31.39 x 1/2 = 15.70
	17.33^k

FIG. B-41

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

BY: TFP
NOV. 70
CKD. BY: BT, JGB

PILE LOADINGS CASE I

ITEM	COMPUTATION	H	V	ARM	MOMENT
FOOTING	13.75x2.5x22x0.15	———	113.44	6.88	780.47
STEM	18.5/2 (1+1.42) 22x0.15	———	73.87	6.15	454.30
HOLE	-0.785x6²x1.25x0.15	———	-5.30	6.15	-32.60
BUTTRESS	11.17x1.96x1x0.15x2	———	6.57	7.71	50.66
PEDESTAL	2.25x3.72x6x0.15x2	———	15.07	6.25	94.19
CATWALK	1.35x0.83x18.50x0.15	———	3.11	7.37	22.92
	0.5x3.08x18.50x0.15	———	4.27	9.58	40.91
	½x0.33x3.08x18.50x0.15	———	1.41	9.07	12.79
Soil		———	27.67	6.875	190.23
		①	240.11		1613.87
PEDESTAL LOADS	FLOOD SIDE } PIPE	———	8.02	2.0	16.04
	PROTECTED SIDE } EMPTY	———	17.33	10.5	181.97
	FLOOD SIDE * } PIPE	———	10.74	2.0	21.48
	PROTECTED SIDE } FULL	———	21.03	10.5	220.82
		②	57.12		440.31
WATER UPLIFT	5.54x8.5x22x0.0625	———	64.75	2.77	179.36
	-0.688x6.25x22	———	-94.60	3.13	-296.10
		③	-29.85		-116.74
	SUM ①→③		267.38		1937.44
HORIZONTALS	½x0.0625x 11²x22	83.19	———	3.67	305.31
	½x0.0475x 5²x22x0.75	9.80	———	1.67	16.37
		92.99			321.68

CASE I TOTALS

M	V	H
2259.12 k	267.38 k	92.99 k

* Water Weight in pipe above El. 13.0

FIG. B-42

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

By: TFP
NOV. 70
CKD. BY: DT, JGB

PILE LOADINGS CASE II

ITEM	COMPUTATION		H	V	ARM	MOMENT
DEAD LOAD	TOTALS		①	240 11		1613.37
PEDESTAL LOADS	FLOOD SIDE	PIPE	——	8.02	2.0	16.04
	PROTECTED SIDE	EMPTY	——	17.33	10.5	181.77
			②	25.35		198.31
WATER	5.54(8.5x22x0.0625			64.75	2.77	179.36
Water in pipe	20.13x5.54x0.0625			- 6.97	2.00	- 13.94
UPLIFT	0.688x6.25x22			-94.60	3.13	- 296.10
			③	-36.82		- 130.68
	SUM ①→③			228.64		1681.20
HORIZONTALS	½x0.0625x 11²x22		83.19	——	3.67	305.31
	½x0.0475 x 5²x22x0.75		9.80	——	1.67	16.37
			92.99			321.68

CASE II TOTALS

M	V	H
2002.88^1K	228.64^K	92.99^K

FIG. B-43

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

BY: TFP
NOV. 70
CKD. BY TST, JGB

PILE LOADINGS

CASE III

ITEM	COMPUTATION	H	V	ARM	MOMENT
Σ V	FROM CASE I	———	267.38		1937.44
Σ H	FROM CASE I	92.99	———		321.68
WIND LOAD	0.05X10X22	11.0	———	16.00	176.00
	Total	103.99	267.38		2435.12
	75%	77.99	200.54		1826.34

CASE IV

ITEM	COMPUTATION	H	V	ARM	MOMENT
Σ V	FROM CASE II	———	228.64		1681.20
Σ H	FROM CASE III	103.99	———		497.68
	Total	103.99	228.64		2188.30
	75%	77.99	171.48		1634.15

CASE V

ITEM	COMPUTATION	H	V	ARM	MOMENT
DEAD LOAD	CASE I, ①	———	240.11		1613.97
PIPE (FILLED)		———	44.90	6.25	1107.72
WATER	5.54X12.9X0.0625X22	———	98.27	2.77	272.21
	-0.785X6²X5.54X0.0625	———	- 9.79	2.00	- 19.58
UPLIFT	-0.962X6.25X22	———	-132.28	3.13	- 414.04
			338.25		2560.18
WATER	½X0.0625X15.40²X22	163.05	———	5.13	836.45
WAVE	0.257X4.4X22	24.88	———	13.20	328.42
SOIL	½X0.0475X5.0²X22X.75	9.80	———	1.67	16.37
WIND	0.05X5.6X22	6.16	———	18.20	112.11
	Total	203.89	338.25		3853.53
	75%	152.92	253.69		2890.15

	M	V	H
CASE III	1826.34^{1k}	200.54^{k}	77.99^{k}
CASE IV	1634.15^{1k}	171.48^{k}	77.99^{k}
CASE V	2890.15^{1k}	253.69^{k}	152.92^{k}

FIG. B-44

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

BY: TFP
NOV. 70
CKD. BY: TST JBE

PILE LOADINGS CASE VI

ITEM	COMPUTATION	H	V	ARM	MOMENT
DEAD LOAD	CASE I, ①		240.11		1613.97
PIPE (EMPTY)	CASE I, ②		25.35		198.01
WATER	$5.54 \times 12.9 \times 0.0625 \times 22$		98.27	2.77	272.21
	$-0.785 \times 6^2 \times 5.54 \times 0.0625$		- 9.79	2.00	- 19.58
	$-0.969 \times 6.25 \times 22$		-132.28	3.13	- 414.04
		———	221.66		1650.47
HORIZONTALS	CASE V	203.89	———		1293.35
	Total	203.89	221.66		2943.82
	75%	152.92	166.25		2207.87

CASE VII

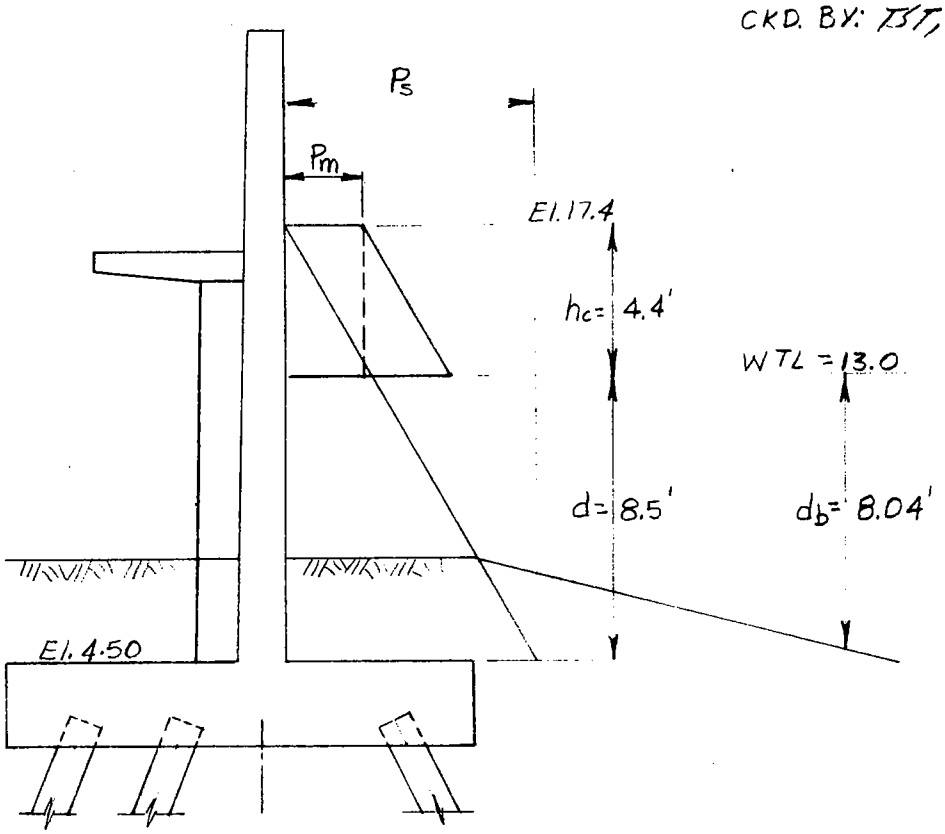
ITEM	COMPUTATION	H	V	ARM	MOMENT
DEAD LOAD	CASE I, ①	———	240.11		1613.87
PIPE(EMPTY)	CASE I, ②	———	25.35		198.01
soil			64.08	6.875	440.55
			329.54		2252.43
WIND	$-0.05 \times 16.0^2 \times 22$	-17.60		13.00	- 228.50
soil	$-\frac{1}{2} \times 0.110 \times 5.0^2 \times 22 \times .75$	-22.69		1.67	- 37.89
	Total	-40.29	329.54		1985.74
	75%	-30.22	247.16		1489.31

	M	V	H
CASE VI	2207.87^{lk}	166.25^{k}	152.92^{k}
CASE VII	1489.31^{lk}	247.16^{k}	-30.22^{k}

FIG. B-45

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE FLOODWALL

Sheet 43 of 53
BY: TFP
NOV. 70
CKD. BY: JST



IMPACT FORCE ON WALL DUE TO WAVE LOADS

$H_s = 4.94'$ $\quad H_{10} = 1.27\, H_s = 6.28$ ft. FROM HYDRAULICS

ASSUME $H_b = H_{10}$

$d_b = 1.28\, H_b = 8.04$

$h_c = 0.7\, H_b = 4.40'$

$d = WTL - GRD = 13.0 - 4.5 = 8.5'$

$P_s = w(d + h_c) = 62.5(8.5 + 4.4) = 826\ \#/ft^2$

$P_m = w\frac{C^2}{2g} = w\frac{d_b}{2} = \frac{62.5 \times 8.04}{2} = 257\ \#/ft^2$

$R = P_m h_c + \frac{1}{2} P_s (h_c + d) = [257 \times 4.4 + \frac{1}{2} \times 826 (4.4 + 8.5)]$

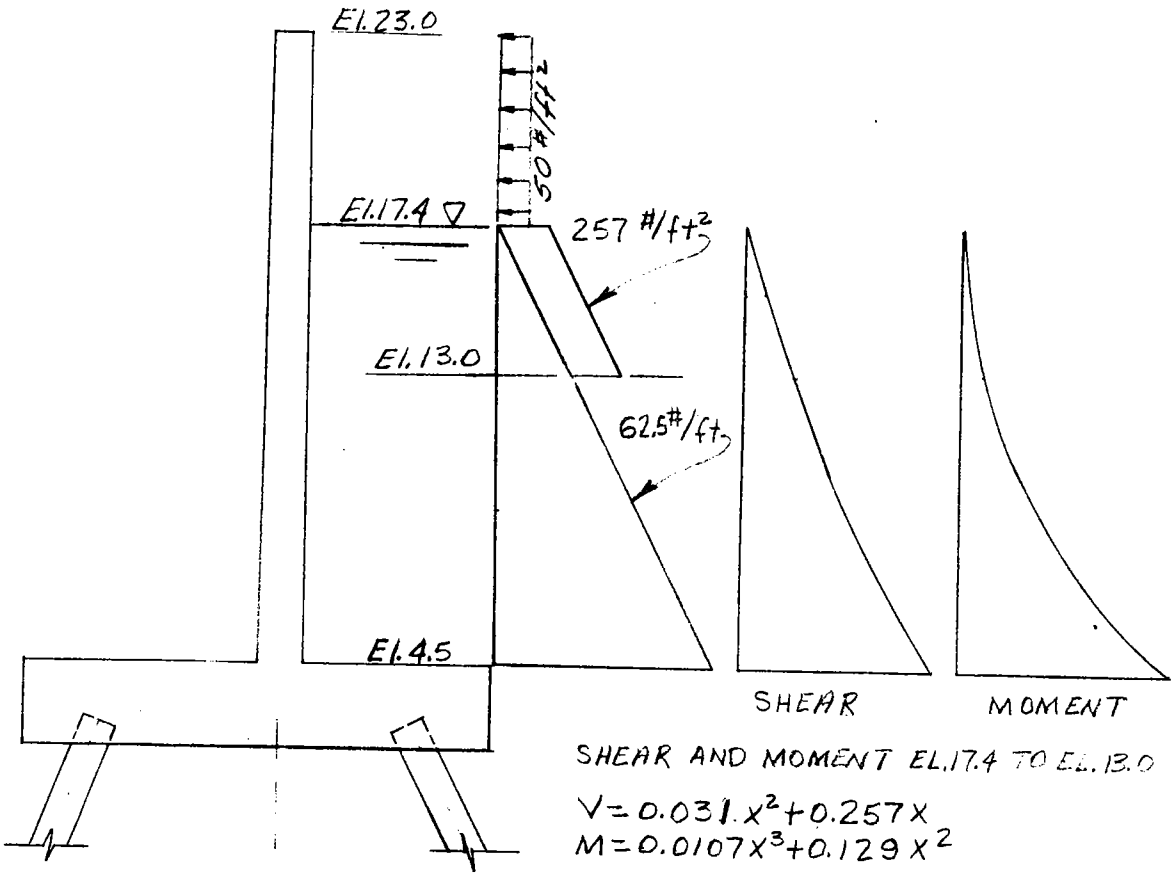
$= 6458.5\ \#/$ Lin. ft.

$z_R = \frac{\Sigma M_{4.5}}{R} = \frac{(1131 \times 10.7) + (5328 \times 4.30)}{6458.5} = 5.42$ ft.

FIG. B-46

NEW ORLEANS EAST BACK LEVEE
INVERTED T-TYPE WALL

BY: TFP
NOV. 70
CKD. BY: TST, JGB



SHEAR AND MOMENT EL.17.4 TO EL.13.0

$V = 0.031x^2 + 0.257x$

$M = 0.0107x^3 + 0.129x^2$

SHEAR AND MOMENT EL.13.0 TO EL.4.5

$V = 0.282x + 0.031x^2 + 1.75$

$M = 0.141x^2 + 0.0107x^3 + 1.75(x + 1.94)$

Wind Force = 0.05 #/ft² × 5.6 = 0.28 K
Wind Moment = 0.28 × 15.7 = 4.40 IK

M_{max} AT BASE OF STEM

$M = 35{,}000$ ft-lbs + 4400 ft-lbs
$= 472{,}800$ in-lbs

V_{max} AT BASE OF STEM

$V = 6736$ lbs

$n = 9.2$ $f_c = 1050$ $f_s = 20{,}000$ $R = 152$ $j = 0.891$

ALLOW 1/3 INCREASE IN ALLOWABLE STRESSES WHEN CONSIDERING THE DYNAMIC EFFECTS OF WAVE LOADING.

STEM DESIGN

$$d = \sqrt{\frac{M}{Rb}} = \sqrt{\frac{472{,}000}{202 \times 12}} = 14.0 \text{ in.}$$

USE $d = 17.0 - 3.0 - 0.5 = 13.5$ in.

FIG. B-47

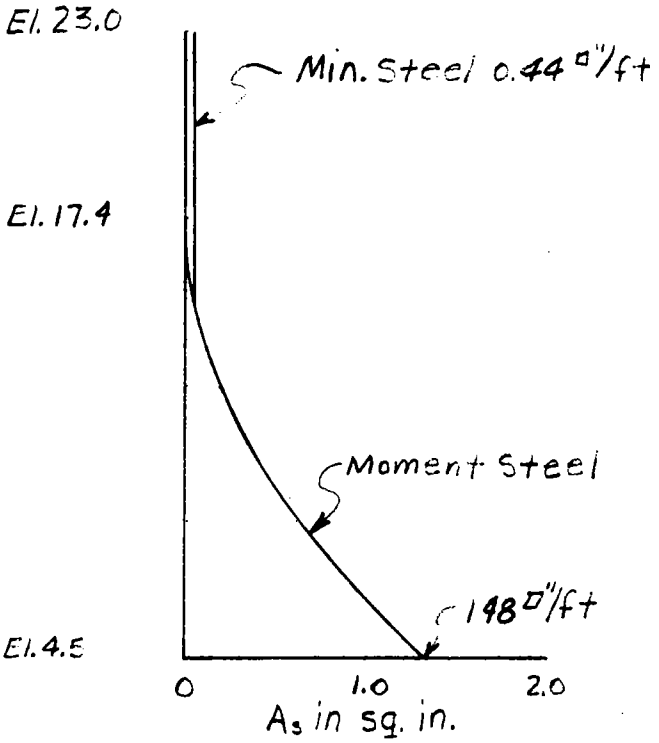
$$A_s = \frac{M}{f_s j d} = \frac{472800}{26{,}600 \times 0.891 \times 13.5} = 1.48\ \square''/ft$$

Use #8 At 6 in. $A_s = 1.58\ \square''/ft$

$$v = \frac{V}{bd} = \frac{6736}{12 \times 13.5} = 42\ psi < 80\ psi \quad O.K.$$

$$u = \frac{V}{\Sigma_o j d} = \frac{6736}{6.3 \times 0.891 \times 13.5} = 89\ psi < 263\ psi \quad O.K.$$

Minimum Steel = 0.0025 bd
= 0.0025 × 12 × 13.5
= 0.405 $\square''/ft$



STEEL REQUIREMENT IN STEM

Temperature steel

$$A_s = 0.0020\ bd$$
$$= 0.0020 \times 12 \times 13.5$$
$$= 0.324\ \square''/ft$$

Use #6 @ 12" ; $A_s = 0.44\ \square''/ft$

FIG. B-48

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Comp. By JGB
Chk'd By TST
Date NOV 70

T-Wall at Pumping Station

Summary of Pile Loadings

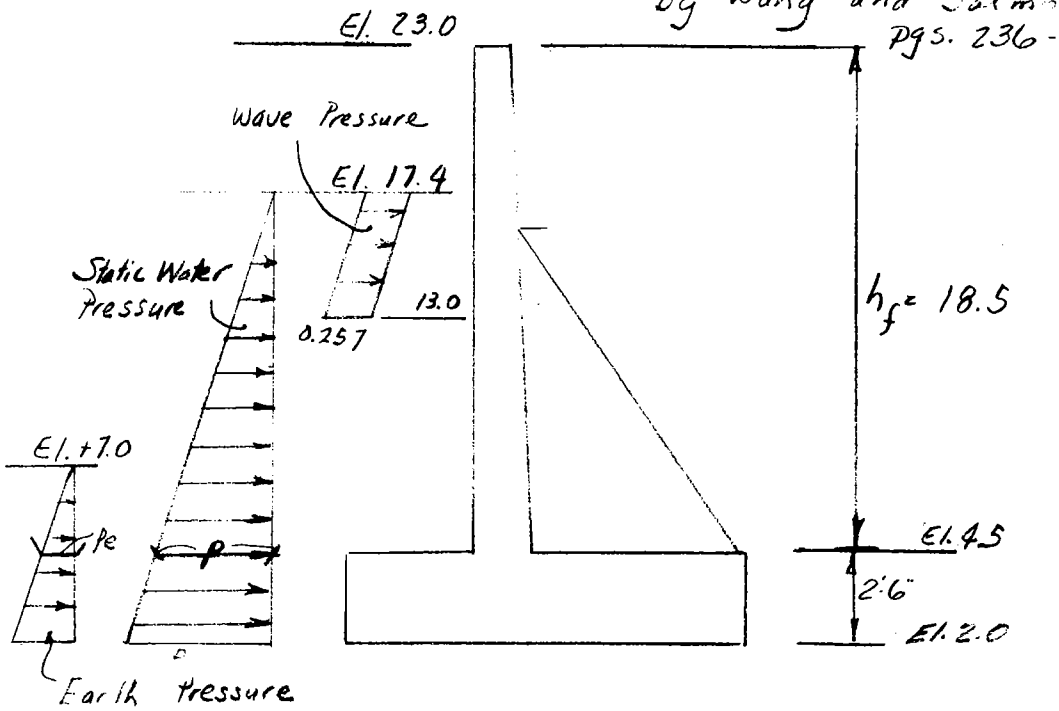
Case	M^{ik}	V^{k}	H^{k}
I	2259.1	267.4	93.0
II	2002.9	228.6	93.0
III	1826.3	200.5	78.0
IV	1634.2	171.5	78.0
V	2890.2	253.7	152.9
VI	2207.9	166.3	152.9
VII	1489.3	247.2	-30.2

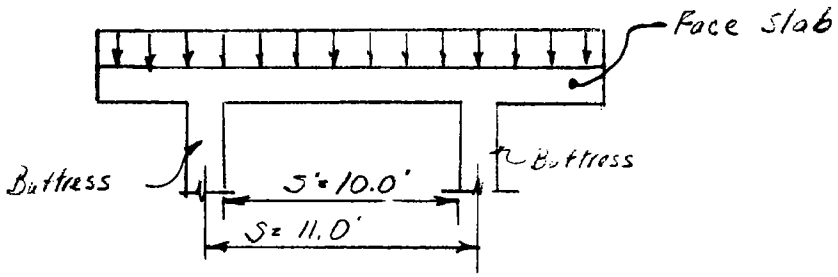
FIG. B-49

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 47 of 53
Comp. by JGB
Ch'k'd By TST
Date Nov 70

T-Wall at Pumping Station Ref.- "Reinforced Concrete Design" by Wang and Salmon Pgs. 236-243





Face Slab

Vertical Bending
Pressure distribution

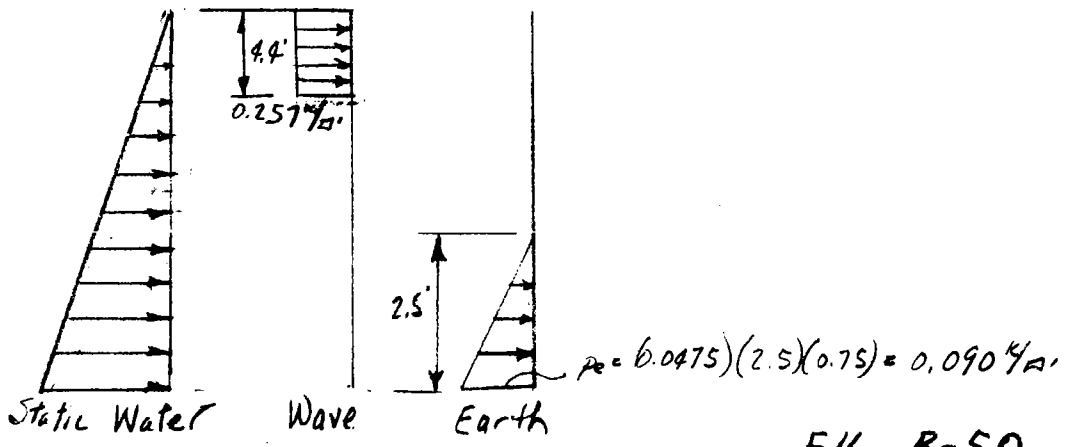


FIG. B-50

Comp. by JGD
Chkd by RST
Date Nov 70

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GLM
NEW ORLEANS EAST BACK LEVEE

T-Wall at Pumping Station
Vertical Bending
Moment at Base

$s'/h_f = 10.0/18.5 = 0.54$

Water Load

without buttresses

$M_{1w} = \frac{1}{6}(0.0625)(12.9)^3 = 22.4^{1k}$

with buttresses

$M'_{1w} = 0.03\, p\, h_f^2 (s'/h_f)$ (Eq. 11.8.1 pg. 238 Design Ref)

$= 0.03(12.9)(0.0625)(12.9)^2(0.54)$

$= 2.17^{1k}$

Wave Load

without buttresses

$M_{1v} = (0.257)(4.4)(10.7) = 12.1^{1k}$

with buttresses

$\frac{M'_{1v}}{M_{1v}} = \frac{M'_{1w}}{M_{1w}}$

$\frac{M'_{1v}}{12.10} = \frac{2.17}{22.4}$

$M'_{1v} = 1.17^{1k}$

Soil Load

without buttresses

$M_{1E} = \frac{1}{2}(0.090)(2.5)\frac{2.5}{3} = 0.094^{1k}$

with buttresses

$\frac{M'_{1E}}{M_{1E}} = \frac{M'_{1w}}{M_{1w}}$

$\frac{M'_{1E}}{0.094} = \frac{2.17}{22.4}$

$M'_{1E} = 0.0091$ – neglect

FIG. B-51

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE
T-Wall at Pumping Station

Comp. by JGB
Chk'd by TST
Date Nov 70

Vertical Bending

Moment at base

$M_1' = M_{1W}' + M_{1V}' = 2.17 + 1.17 = 3.34$ 'k

$d_{req} = \sqrt{\frac{M}{Kb}} = \sqrt{\frac{3,340}{202}} = 4.07$

$d_{prov} = 17 - 3.0 = 14.0$

$A_s = \frac{M}{ad} = \frac{3.34}{(1.92)(14.0)} = 0.12$ □"/'
reqd in front face

Moment above base

$M_2' = 0.25\ M_1' = 0.25(3.34) = 0.84$ 'k

$d_{req} = \sqrt{\frac{M}{Kb}} = \sqrt{\frac{990}{202}} = 2.04$ in

$d_{prov} = 15.75 - 3.0 = 12.75$ in

$A_s = \frac{M}{ad} = \frac{0.84}{(1.92)(12.75)} = 0.03$ □"/'

$\min A_s = 0.0025(12.0)(12.75) = 0.40$ □"
use #6 @ 12" E.F., $A_s = 0.44$

Horizontal Bending

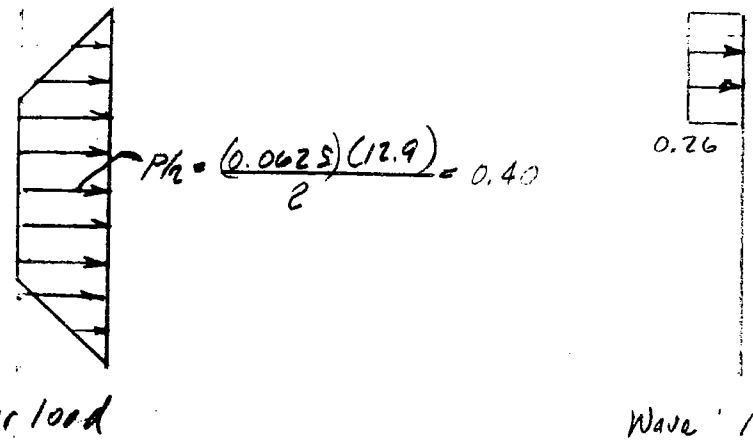


FIG. B-52

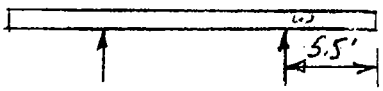
LAKE PONT. VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 50 of 53
Comp. By JGB
Chkd By TST
Date Nov 70

T-Wall at Pumping Station

Horizontal Bending

$w = 0.40 + 0.26 = 0.66$ k/'



$$M = \frac{w\,5.5^2}{2} = \frac{(0.66)\,5.5^2}{2} = 10.0$$

$k = 202$

$$d = \sqrt{\frac{M}{kb}} = \sqrt{\frac{(10,000)(12)}{(202)(12)}} = 7.04 \text{ in}$$

$d_{prov} = 12.0 - 2.5 - 0.75 - 0.50 = 8.25$ in OK

$$A_s = \frac{M}{ad} = \frac{10.0}{(1.92)(8.25)} = 0.63 \text{ □"}$$

use #8 @ 12" $A_s = 0.79$ □", $\Sigma o = 3.1$"

min $A_s = 0.0025(12)(8.25) = 0.25$ □"

Shear

$V = w(5.5)$

$V = 0.66(5.5) = 3.63$

$$v = \frac{V}{bd} = \frac{3,630}{(12.0)(8.25)} = 37 \text{ psi} < 80 \text{ psi OK}$$

No web reinforcement req'd

Bond

$$\mu = \frac{V}{\Sigma o j d} = \frac{3630}{(3.1)(0.875)(8.25)} = 162.2 \text{ psi}$$

$$\text{allw } \mu = \frac{3.4\sqrt{f_c'}}{D}\,1.333 = \frac{3.4\sqrt{3000}}{1.00}\,1.333 = 248 \text{ psi}$$

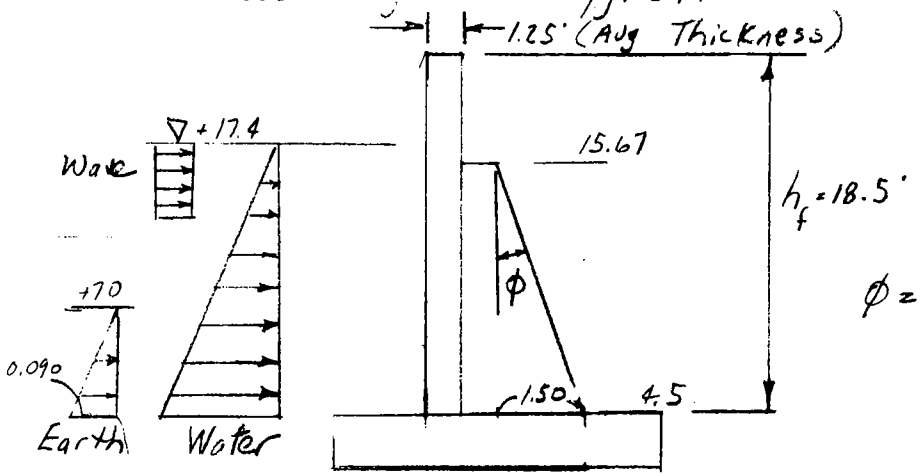
OK

FIG. B-53

LAKE PONT. - VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE
T-Wall at Pumping Station
Buttress Design

Sheet 51 of 53
Comp. by JGB
Chk'd by TST
Date NOV 70

See design sht pg. 241

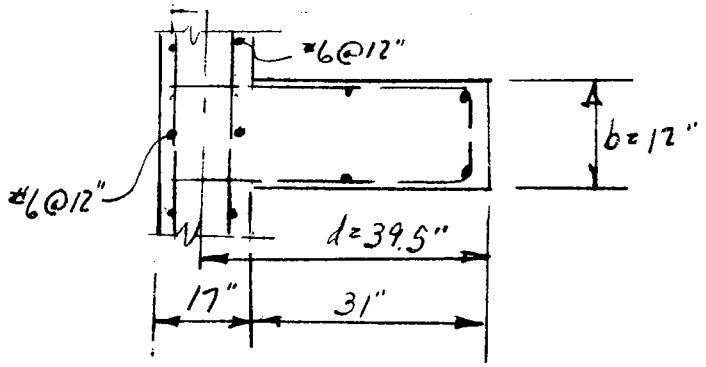


$\phi = \tan^{-1} \frac{1.50}{11.7} = 7°20'$

Load on buttress

Item		Force	Arm	Moment
Static Water	$\frac{1}{2}(0.0625)(12.4)^2 =$	5.20	4.3	22.4
Wave	$(0.257)(4.4) =$	1.13	10.7	12.1
Earth	$\frac{1}{2}(0.090)(2.5) =$	0.11	0.83	0.1
		6.44		34.6

Section thru Buttress @ Base



$d_{req'd} = \sqrt{\frac{M}{Kb}} = \sqrt{\frac{34,600(12)}{(202)(12)}} = 13.1$

$d_{provided} = 39.5"$ OK

$A_s = \frac{M}{ad} = \frac{34.6}{(2.0)(39.5)} = 0.46\ \square"$

2-#6 OK $A_s = 0.88\ \square"$, $2a = 4.7"$

FIG. B-54

LAKE PONT. & VIC (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE
T-Wall at Pumping Station
Buttress Design

Comp. By JGB
Chkd By TST
Date Nov 70

Shear

$V = 6.44^K$

$v = \frac{V}{bd} = \frac{6,440}{(12.0)(39.5)} = 13.6 \text{ psi} < 80 \text{psi}_{allw}$ OK

Bond

$\mu = \frac{V}{\Sigma o j d} = \frac{6,440}{4.7(0.875)(39.5)} = 39.6 \text{ psi}$

$allw\ \mu = 248\ (1.333) = 330 \text{ psi}$

Check section halfway up Buttress
@ El 10.0

Load

Item	Force	Arm	Moment
Static Water $\frac{1}{2}(0.0625)(7.4)^2$ =	1.71	2.47	4.2
Wave	1.13	5.2	5.9
	2.84^K		10.1

$d = 39.5 - 9.0 = 30.5"$

$d_{reqd} = \sqrt{\frac{M}{Kb}} = \sqrt{\frac{10,100(12)}{(202)(12)}} = 7.1 \text{ in.}$

$A_s = \frac{M}{ad} = \frac{10.1}{(1.92)(30.5)} = 0.17 \square"$

2-#6 more than adequate $A_s = 0.88 \square"$ $\Sigma o = 4.7"$

Shear

$V = 2.84$

$v = \frac{V}{bd} = \frac{2,840}{(12.0)(30.5)} = 7.8 \text{psi} < 80 \text{psi}$ allw OK

Bond

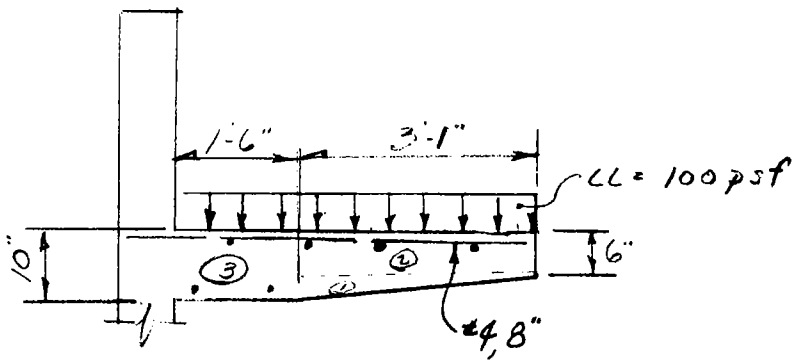
$\mu = \frac{V}{\Sigma o j d} = \frac{2,840}{(4.7)(0.875)(30.5)} = 22.6 \text{psi} < 330 \text{ psi}$ allw OK

FIG. B-55

LAKE PONT & VIC. (HURR. PROT.)
BARRIER PLAN GDM
NEW ORLEANS EAST BACK LEVEE

Sheet 53 of 53
Comp. by JGB
Chk'd by TST
Date: Nov 70

T-Wall at Pumping Station
Walkway Design Live Load = 100 psf



Consider one foot width slab

		Shear (k)	Arm (in)	Moment (in-k)
Dead Load ① Δ	½(0.333)(3.08)(0.15) =	0.077	30.3	2.3
②	(0.50)(3.08)(0.15) =	0.231	36.5	8.4
③	(0.833)(1.50)(0.15) =	0.187	9.0	1.7
Live Load	0.100(4.58) =	0.458	27.5	12.6
		0.953		25.0

$$d = \sqrt{\frac{M}{Kb}} = \sqrt{\frac{25{,}000}{(152)(12)}} = 3.7 \text{ in}$$

$d_{prov} = 10.0 - 2.5 - 0.25 = 7.25$ o/c

$$A_s = \frac{M}{ad} = \frac{25.0/12}{1.44(7.25)} = 0.20 \text{ □"/'}$$

Minimum A_s

$A_s = 0.0025\,bd$
$= 0.0025(12)(7.25) = 0.22$ □"
Use # 4 @ 8" $A_s = 0.30$ □"/' $\Sigma O = 2.4$"

Shear

$$v = \frac{V}{bd} = \frac{953}{(12.0)(7.25)} = 11 \text{ psi} < \text{allw} = 60 \text{ psi, OK}$$

Bond

$$\mu = \frac{V}{\Sigma o j d} = \frac{953}{(2.4)(0.875)(7.25)} = 62.6 \text{ psi} < \text{allw} = 500 \text{ psi, OK}$$

FIG. B-56