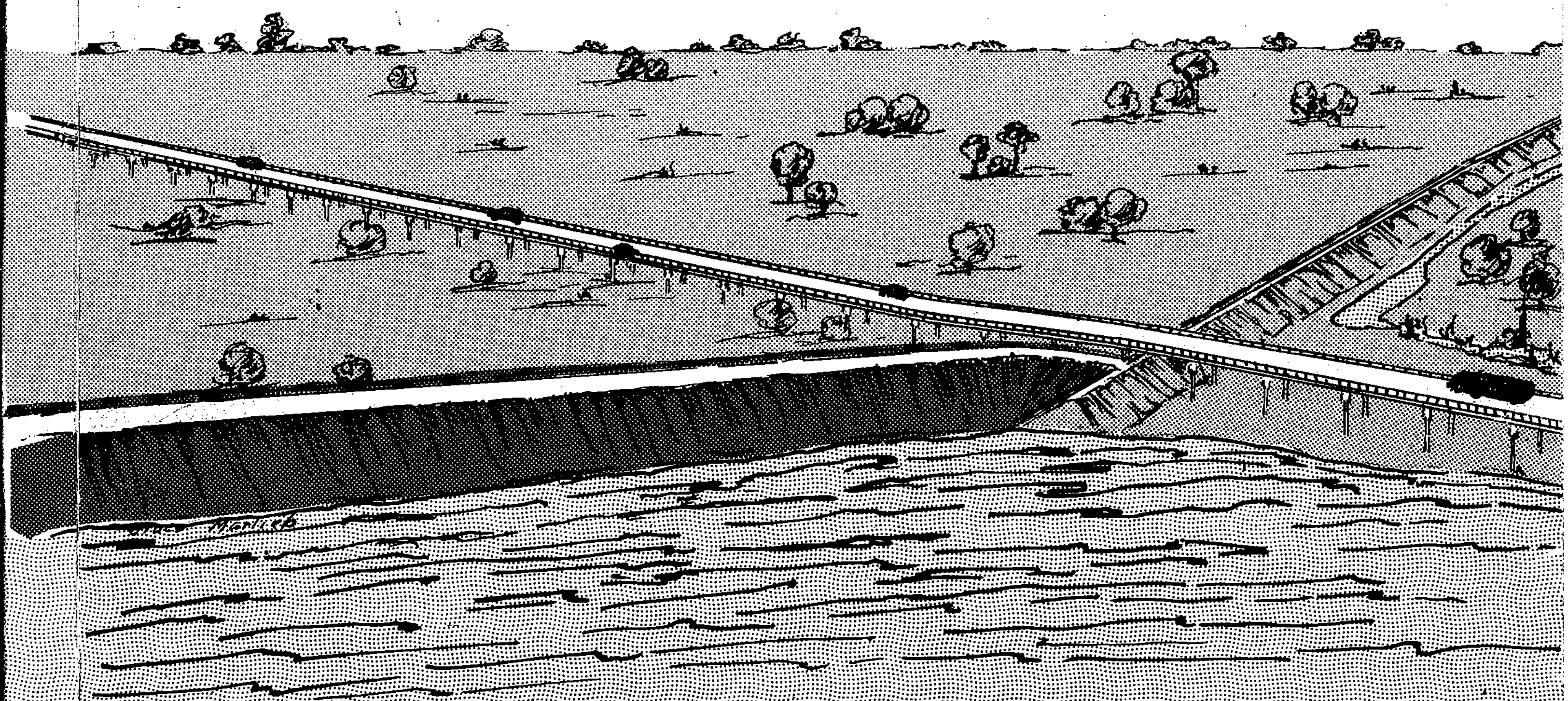
U. S. ARMY, CORPS OF ENGINEERS

ST. CHARLES PARISH LAKEFRONT LEVEE



LAKE PONTCHARTRAIN, LA. and VICINITY

GENERAL DESIGN MEMORANDUM No. 2
SUPPLEMENT No. 6

No 31

Prepared in the Office of the District Engineer
New Orleans District, Corps of Engineers
New Orleans, Louisiana

SEPTEMBER 1969

9481

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

LMNED-PP 30 September 1969

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 6, St. Charles Parish Lakefront 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 1 July 1969.

2. Approval of the subject design memorandum is recommended.

1 Incl (16 cys)
GDM No. 2, Supp. No. 6

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

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

STATUS OF DESIGN MEMORANDA

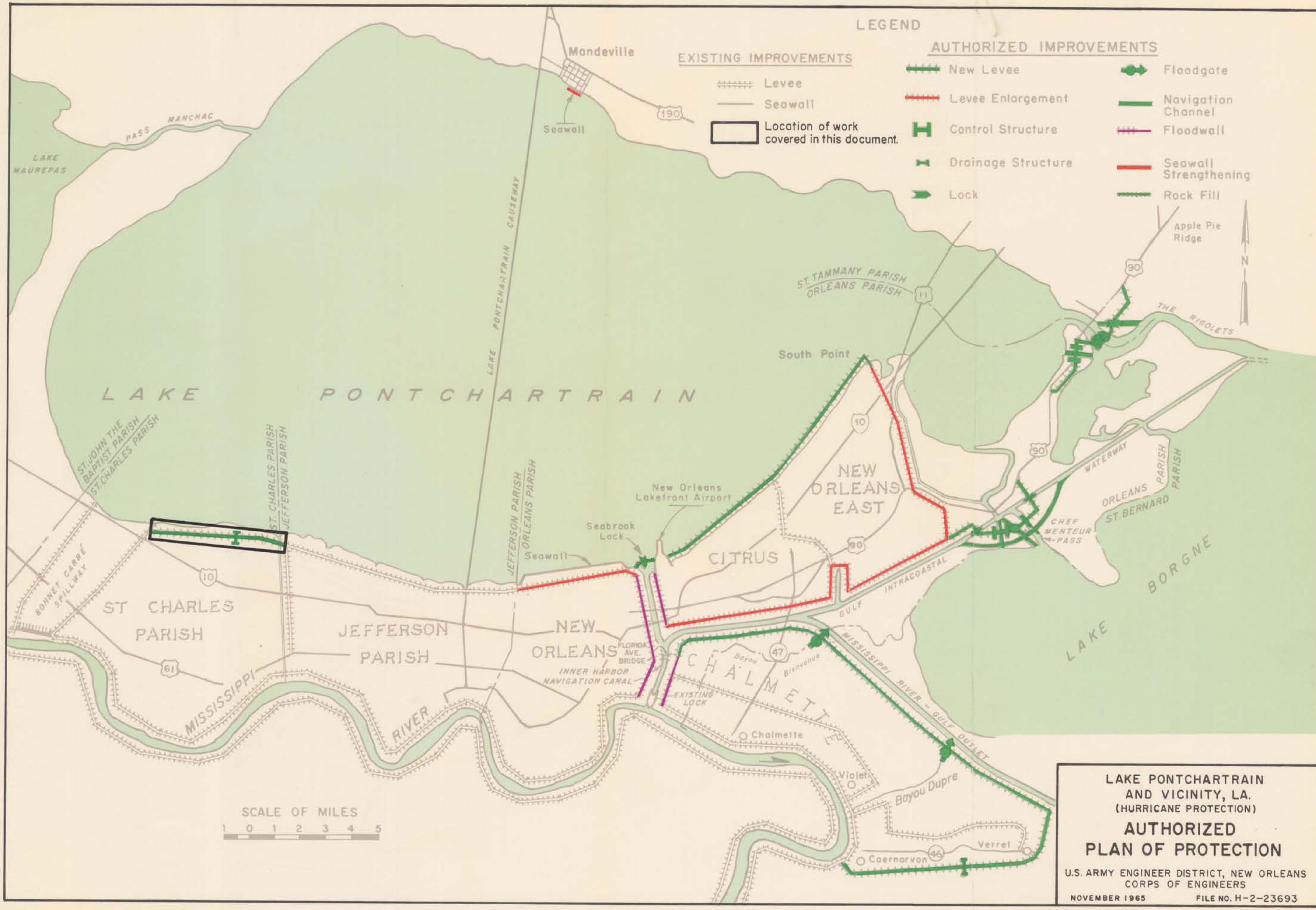
Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 25 Feb 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor 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	Scheduled Dec 69
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	Submitted 17 Jun 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Scheduled Jul 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	Scheduled Jul 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 Aug 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Submitted 30 Sept 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Scheduled Jun 71
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 Sept 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	Not scheduled
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 Jan 71
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Aug 70
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Scheduled Oct 70

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled Aug 70
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	Scheduled Jan 70
2	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., DDM, Seabrook Lock	Scheduled Apr 71


LEGEND
EXISTING IMPROVEMENTS
Levee
Seawall
Location of work covered in this document.
AUTHORIZED IMPROVEMENTS
New Levee
Levee Enlargement
Control Structure
Drainage Structure
Lock
Floodgate
Navigation Channel
Floodwall
Seawall Strengthening
Rock Fill
N
Mandeville
Seawall
190
PASS MANCHAC
LAKE MAUREPAS
LAKE PONTCHARTRAIN
LAKE PONTCHARTRAIN CAUSEWAY
ST. JOHN THE BAPTIST PARISH
ST. CHARLES PARISH
ST. CHARLES PARISH
JEFFERSON PARISH
JEFFERSON PARISH
ORLEANS PARISH
ST. TAMMANY PARISH
ORLEANS PARISH
Apple Pie Ridge
90
11
THE RIGOLETS
South Point
10
90
NEW ORLEANS EAST
New Orleans Lakefront Airport
Seabrook Lock
Seawall
CITRUS
90
WATERWAY
ORLEANS PARISH
ST. BERNARD PARISH
CHEF MENTEUR PASS
LAKE BORGNE
GULF INTRACOASTAL
BONNET CARRE SPILLWAY
ST CHARLES PARISH
10
JEFFERSON PARISH
NEW ORLEANS
FLORIDA AVE. BRIDGE
INNER HARBOR NAVIGATION CANAL
61
MISSISSIPPI RIVER
47
Bayou Bienvenue
CHALMETTE
EXISTING LOCK
MISSISSIPPI RIVER - GULF OUTLET
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. OCT. 1968

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 6
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PLATES (cont'd)

APPENDIXES

PERTINENT DATA

Location of Project	Southeastern Louisiana in St. Charles Parish
Hydrologic Data	
Temperature: Maximum monthly	87.1 degrees Fahrenheit
Minimum monthly	43.0 degrees Fahrenheit
Average annual	69.7 degrees Fahrenheit
Annual precipitation: Maximum	85.73 inches
Minimum	31.07 inches
Average	60.58 inches
Hydraulic design criteria - Interior Drainage	
Assumed value of "n" (channels):	0.030
Hydraulic Design Criteria - Tidal	
Design Hurricane - Standard Project Hurricane (SPH)	
Frequency	1 in 300 years
Central Pressure Index (CPI)	27.6 inches of mercury
Maximum 5-min. average wind	100 m.p.h.
Levee	
Method of construction	Hydraulic fill[1]
Levee length	5.7 miles
Elevation - varies	12.5 - 12.0[2,3]
Crown width	20.0 feet
Rights-of-way	
Permanent rights-of-way	773 acres
Spoil easements	140 acres
Estimated first cost	
Levees and floodwalls	$12,497,000
Engineering and design	1,376,000
Supervision and administration	701,000
Relocations	384,000
Lands and damages	742,000
Total	$15,700,000

[1]Except transition at the Bonnet Carre' Spillway east guide levee which will be constructed of haul material.

[2]Elevation varies:

Elev.	Sta.
12.0	0+00 - 140+00
12.5	140+00 - 298+61.07

[3]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. 6
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PROJECT AUTHORIZATION

1. Authority.

a. 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. The report of the Chief of Engineers dated 4 March 1964 and 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 United States Highway 90 from the easternmost 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 east 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 the New Orleans Airport to South Point; enlargement of the existing levee extending from United States 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. 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 St. Charles Parish lakefront levee in sufficient detail to provide an adequate basis for preparing plans and specifications for the first lift levee construction and the Bayou Piquant drainage structure, without additional design analyses.

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. 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 subsequent to project authorization. Subsequent to project authorization, detailed investigations were undertaken as follows:

a. Aerial and topographic surveys along the St. Charles Parish Lakefront levee alignment between the Bonnet Carre' Spillway east guide levee and the St. Charles-Jefferson Parish Line Canal;

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

c. Detailed design studies for levee, drainage structure, drainage ditch, and closure dam construction, including bank and 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, closure dams, drainage structure, collector ditch, and relocations.

LOCAL COOPERATION

6. Conditions of local cooperation. The conditions of local cooperation as specified by the authorizing law are quoted in paragraph 5.

7. 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, Louisiana 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 assurance, supported by a resolution of the Board of Levee Commissioners of the Orleans Levee District dated 28 July 1966, was 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. Calvin T. Watts, Acting Director
State of Louisiana
Department of Public Works
Baton Rouge, Louisiana 70804

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

8. 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 $57,075,000, 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

9. Project location. The St. Charles Parish lakefront levee feature of the Lake Pontchartrain, Louisiana and Vicinity, hurricane protection project, as shown on plate 1, is located in southeastern Louisiana along the southwest shoreline of Lake Pontchartrain. The project area covered in this memorandum is located in St. Charles Parish.

10. Tributary area. The drainage area that will be inclosed on completion of the St. Charles Parish lakefront levee is approximately 51 square miles. This area is bounded on the west by the Bonnet Carre' Spillway east guide levee, on the south by the Mississippi River, on the east by the St. Charles Parish-Jefferson Parish boundary, and on the north by Lake Pontchartrain. The topography of the area is typical of the Mississippi River delta. The land slopes away from the alluvial ridge of the Mississippi River to adjacent backswamp areas. Next to the river, natural ground is about elevation 10,[1] and the ground slopes gradually

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[1]All elevations used herein are in feet and refer to mean sea level unless otherwise noted.

down to about elevation 2 approximately 1 mile distant from the river and thence to about mean sea level at the lakeshore. Natural ground elevations in the marsh average about 0.5.

PROJECT PLAN

11. Protective works. The plan presented herein covers all of the project works located in St. Charles Parish and provides for construction along the St. Charles Parish lakeshore of approximately 5.7 miles of new earthen levee to net grades of 12.0 between stations 0+00 and 140+00 and 12.5 between stations 140+00 and 298+61.07 (see plate 1). A landside drainage ditch will be provided parallel to and approximately 1000 feet landward of the levee centerline from Bayou LaBranch to the Parish Line Canal and a drainage structure will be constructed in the levee alignment near Bayou Piquant.

DEPARTURES FROM PROJECT DOCUMENT PLAN

12. Departures from project document plan. Extensive changes have been made to the plan presented in the authorizing document. The following changes, which are considered to be within the discretionary authority of the Chief of Engineers, have been incorporated into the plan.

a. 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 III - Lakeshore," approved 25 February 1969. The revised net grades of the St. Charles Parish lakefront levee are: elevation 12.0 from its eastern connection with the Jefferson Parish lakefront levee to approximate station 140+00 and elevation 12.5 westward thereof to its connection with the Bonnet Carre' Spillway east guide levee.

b. Investigations subsequent to project authorization revealed that the Parish Line Canal is no longer a navigable waterway of the State of Louisiana, therefore allowing a closure at the lakeward terminus of the canal and eliminating the need for a lateral return levee. The current estimated total construction cost for the lateral return levee is $2,059,000, compared to $366,000 for effecting a closure; consequently, the latter alternative was selected. A combination flap and vertical lift gate drainage structure will be constructed in the lakefront levee alignment in the vicinity of Bayou Piquant. Runoff which was formerly collected by the Parish Line Canal will be conveyed to the Bayou Piquant Drainage Structure by a drainage ditch as shown on plate 2.

HYDROLOGY AND HYDRAULICS

13. General. The tidal hydraulic analysis and design for the St. Charles Parish lakefront levee are presented in Design Memorandum No. 1, Part III - Lakeshore, which contains descriptions of the methods used in the tidal hydraulic design and covers essential data, criteria, and the results of studies which provide the basis for determining surges, routings, wind tides, runup, overtopping, and frequencies. In Part I - Chalmette, approved 27 October 1966, the climatology and hydrology for the entire Lake Pontchartrain, Louisiana and Vicinity hurricane protection project is presented. The hydraulic design and analysis for the provision of interior drainage restricted by the St. Charles Parish lakefront levee are presented herein as appendix A.

14. Design elevations. The hurricane used in the design of the protective works presented herein is the Standard Project Hurricane (SPH) having a frequency of about once in 300 years, a central pressure index of 27.6 inches of mercury, a maximum 5-minute average wind velocity of 100 miles per hour at 30 feet above the water surface and at a radius of 30 nautical miles from the center, moving on a track critical to the south shore of Lake Pontchartrain at a forward speed of 11 knots. Detailed information on the design hurricane is contained in the design memoranda referred to in paragraph 13. The net grades for the St. Charles Parish lakefront levee, calculated to provide protection from the design hurricane, are as follows:

Location	Net Grade
Sta. 0+00 to Sta. 139+00	12.0
Sta. 139+00 to Sta. 141+00 (transition)	12.0 to 12.5
Sta. 140+00 to Sta. 298+61.07	12.5

GEOLOGY

15. Physiography. The project area is located within the Gulf Coastal Plain. Specifically, the area is located at the western edge of the Pontchartrain Basin between the alluvial ridge of the present Mississippi River and the southwest shoreline of Lake Pontchartrain. Dominant physiographic features of the area are the marshes, the natural levees of the Mississippi River, and Lake Pontchartrain. Relief in the project area is slight

with a maximum of about 12 feet between the natural levee ridge of the present Mississippi River and the marshes adjacent to Lake Pontchartrain. Maximum elevations of 12 feet are found along the natural levee ridges of the present Mississippi River. Minimum elevations of mean sea level or slightly below are found in the marsh area adjacent to Lake Pontchartrain.

16. General geology. Only the geologic history since the end of the Pleistocene period is significant for this project. At that time, with sea level about 450 feet below its present level, the project area was a flat, highland plain on the northeast border of the deeply entrenched Mississippi River. During this period, the upper part of the Pleistocene was desiccated and weathered. About 4,500 to 5,000 years ago, sea level reached its present stand and the Mississippi River began to migrate laterally back and forth across the alluvial valley. Since then, until the Mississippi River began to occupy its present course about 1,200 years ago, the project area has been subjected to an influx of Mississippi River sediments on two separate occasions. Construction of levees along the Mississippi River has eliminated floodwaters from the region and at present no sediments are being introduced into the project area.

17. Subsidence. Progressive subsidence and downwarping have been occurring in the project area since the end of the Pleistocene period. The Pleistocene surface has been downwarped towards the south and west from zero at the Pleistocene outcrop on the north side of Lake Pontchartrain to a depth of about 500 feet at the edge of the continental shelf about 80 miles south of New Orleans. The overall rate of subsidence in the project area has been about 0.39 foot per century.

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

19. Foundation conditions. The subsurface, as shown on plates 6 and 7, consists of Recent deposits varying in thickness from about 50 feet between stations 25+00 and 130+00 to over 100 feet between stations 155+00 and 298+61.07 (the western limit of the project). Underlying the Recent are sediments of Pleistocene (Prairie formation) age. Generally, the Recent consists of a surface layer, 12 to 20 feet thick, of very soft marsh clays with peat and organic matter and have moisture contents averaging about 360 percent. At the western end of the project, the marsh deposits are overlain by a surface veneer of fill material consisting primarily of silts and lean clays. The marsh deposits are underlain

by very soft lacustrine clays, interspersed with lenses and layers of silt and shell fragments, and have moisture contents of about 60 to 80 percent. The lacustrine deposits vary in thickness from about 36 feet between stations 30+00 and 130+00 to at least 60 feet west of station 130+00. From station 20+00 to 141+00, the lacustrine deposits are underlain by stiff to very stiff Pleistocene clays with interspersed lenses of silt.

20. Mineral resources. Oil and gas production are not found in the immediate vicinity of the project. However, further exploration and production of these natural resources may take place in the area, but will not be adversely affected by the project.

21. Conclusions. Because of the low shear strength of the marsh and lacustrine deposits and the high compressibility of some of the sediments, stability and settlement are major problems, particularly west of station 150+00 where the depth to Pleistocene increases considerably. In addition, the lakeside portion of the project levee will be subject to wave attack.

SOILS AND FOUNDATIONS INVESTIGATION AND DESIGN

22. General. This part of the report covers the soils and foundations investigation and design for the St. Charles Parish lakefront levee and Bayou Piquant Drainage Structure. The project is located approximately 500 feet south of the Lake Pontchartrain shore and extends from the Bonnet Carre' Spillway east guide levee to the western terminus of the Jefferson Parish lakefront levee.

23. Field investigations. Undisturbed borings 5 inches in diameter extending to approximate elevation -80.0 were made at four locations along the levee baseline (stations 5+00, 105+00, 205+00, and 296+50). General-type core borings, 1 7/8-inch I.D., extending to approximate elevation -60.0 were made at ten locations along the levee baseline (stations 1+85, 30+00, 55+00, 80+00, 130+00, 155+00, 180+00, 230+00, 255+00, and 280+00). These boring data are shown on plates 8, 10 through 13, and 15 through 18. Twelve general-type core borings, 1 7/8-inch I.D., extending to approximate elevation -70.0 were made in the bottom of Lake Pontchartrain in the recommended borrow area opposite the levee alignment. These boring data are shown on plate 9. The locations of the borings are shown on plates 2 through 4.

24. Laboratory tests. Visual classifications were made for 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 also determined for these test samples. The logs of the undisturbed borings and the results of the undisturbed tests are shown on plates 10 through 13 and 15 through 18.

25. Soil conditions. The subsurface along the project works presented herein consists generally of 12 to 15 feet of peat and highly organic clays overlying 50 to 80 feet of Recent deposits of clays and silts which are underlain by a Pleistocene deposit encountered at approximate elevation -80.0 at the Bonnet Carre' Spillway east guide levee, at elevation -50.0 in the vicinity of Bayou Piquant, and at elevation -70.0 at the Parish Line Canal. In the vicinity of station 200+00, the top of the Pleistocene is at about elevation -100. A generalized soil and geologic profile is shown on plates 6 and 7. That portion of the subsurface soils above the Pleistocene deposit which directly affect the design of this project consist generally of the following:

a. Station 0+00 (east end of project) to station 55+00. The upper subsurface soils in this reach are composed of very soft organic clay down to elevation -2.0 underlain by a layer of very soft peat to elevation -8.0, which overlies a layer of very soft organic clay extending down to elevation -12.0, underlain by a very soft clay layer with organic matter down to elevation -15.0, which overlies a layer of very soft clay with silt lenses extending down to elevation -40.0, underlain by a soft clay layer with silt lenses down to elevation -55.0, and underlain by a medium clay layer with silt and sand lenses down to elevation -70 at the top of the Pleistocene formation.

b. Station 55+00 to station 140+00. The upper subsurface soils in this reach are composed of very soft organic clay down to elevation -2.0, underlain by a layer of very soft peat down to elevation -8.0, which overlies a very soft organic clay layer extending down to elevation -21.0, underlain by a layer of very soft clay with silt lenses down to elevation -30.0, which overlies a soft clay layer with silt lenses extending down to elevation -45.0, and underlain by a layer of medium clay with silt lenses down to elevation 50.0 at the top of the Pleistocene formation.

c. Station 140+00 to station 298+61.07 (west end of the project). The upper subsurface soils in this reach are composed of very soft organic clay down to elevation -2.0, underlain by a layer of very soft peat down to elevation -8.0, which overlies a very soft organic clay layer extending down to elevation -15.0, underlain by a layer of very soft clay with silt lenses down to elevation -40.0, which overlies a soft clay layer extending down to elevation -47.0, and underlain by a layer of medium clay with silt lenses down to elevation -80.0 at the top of the Pleistocene formation.

d. Bonnet Carre' Spillway east guide levee (from 200 feet north to 300 feet south of station 298+61.07). The upper subsurface soils in this reach are composed of a silt layer down to elevation 6.0, underlain by a layer of stiff organic clay down to elevation 3.0 which overlies a soft clay layer with silt lenses extending down to elevation -20.0, and underlain by a layer of medium clay with silt lenses down to elevation -80.0 at the top of the Pleistocene formation.

26. Water contents of soils. The ranges of water contents for the peats, organic clays, clays, and silts are as follows: peat, 300 to 900 percent; organic clays, 150 to 300 percent; clays, 40 to 100 percent; silts, 20 to 40 percent; and the Pleistocene clays about 40 percent or less.

27. Design and construction problems. The low shear strength and highly compressible Recent foundation clays and peats, access to the construction site, numerous existing streams which cross the levee alignment and the potential dynamic and static wave forces all combine to produce major design and construction problems in the following areas of interest:

a. Types of protective and drainage works

b. Location of protective and drainage works

c. Stability

d. Floodwall type

e. Settlement

f. Sources of fill material

g. Methods of construction

h. Erosion protection

28. Types of protective works. A conventional earthen levee will be used along the entire length of the project, except in the vicinity of the Bayou Piquant Drainage Structure where I-type floodwalls will be constructed in the levee (sta. 97+08 to sta. 97+66 and sta. 101+94 to sta. 102+52) with the elevation of the levee decreasing towards the structure until the height of floodwall above ground dictates the use of inverted T-type floodwalls (sta. 97+66 to sta. 99+30 and sta. 100+30 to sta. 101+94) which will tie into the structure. The drainage structure and concrete inverted T-type floodwalls will be supported on bearing piles.

29. Location of protective works. The alignment of the protective works, as shown on plates 2 through 4, was located a sufficient distance from Lake Pontchartrain to assure that the normal retreat of the shoreline will not endanger the stability of the levee within its project life. The drainage structure was located a sufficient distance from Bayou Piquant to provide adequate stability with respect to Bayou Piquant during construction.

30. Design considerations.

a. Method of construction. Several plans for construction of the levee were considered as outlined in paragraphs 46 and 47 of this document. Based on the results of these studies, the plan selected consists of constructing the levee in successive lifts utilizing hydraulic fill from adjacent borrow in Lake Pontchartrain with shapeup following the final lift.

b. Cost estimates. To properly design a levee constructed with successive lifts of hydraulic fill, borings should be made prior to placement of each lift to determine the design (Q) shear strengths for that lift. In order to produce a reliable cost estimate at this time, a method to estimate the proper design shear strengths for each lift had to be devised. Accordingly, design shear strengths for lifts after the first are based on an assumed gain in shear strength based on the consolidated-undrained (R) test trend. These strengths, however, were reduced because of lateral displacement of the levee. These two points are discussed in detail in paragraphs 31a and 32.

31. Stability analyses.

a. Levees. The slopes and berm distances for the recommended levee, using cross sections representative of existing conditions along the levee alignment, were designed to resist the following conditions: project hurricane still water level (elevation 10.0 from stations 0+00 to 140+00 and elevation 10.5 from stations 140+00 to 298+61.07) and assumed failure toward the landside. The stabilities of the first lifts were determined by the method of planes using the design (Q) shear strengths shown on plates 10 through 13 and applying a minimum factor of safety with respect to strength of approximately 1.3. The stabilities of subsequent lifts were determined by the method of planes utilizing an assumed gain in shear strength based on the consolidated-undrained (R) test trend, i.e., $S = C + \overline{P} \tan 13°$, where S = design shear strengths, C = cohesion based on (Q) test, $\overline{P}$ = increase in intergranular pressure in the strata (based on the percent consolidation at the time) due to the overburden, and 13° = friction angle based on the (R) tests.

b. Stream closures. The slope and berm distances for the recommended first lift of the stream closures were designed for water at elevation 0.0 and to resist assumed failure towards the flood side for the construction period. Even though the SPH could occur during construction, it would be more economical to repair the failure, if one should occur, than to build the closure wide enough to provide a factor of safety of 1.3 with the water at elevation -6.0 on the flood side. However, the ultimate stream closure configuration was designed for the most critical design hurricane condition, i.e., water at elevation -6.0 on the lakeside and the prevention of assumed failure towards the lakeside.

32. Lateral displacement of levee foundations. Since each stratum may not develop the total calculated drop in pore pressure and related percent consolidation because of lateral displacement, (which would reduce the effective $\overline{P}$ and consequently reduce the assumed gain in shear strength), only 60 percent of the gain in shear strength, based on the calculated percent consolidation, was used in designing lifts subsequent to the first. The determination of 60 percent was based on data relative to lateral and vertical movement of the foundation of Test Section III - East Atchafalaya Basin Protection Levee, station 1396+50 (see plate 19). The data presented on plate 19 is the only available data and was used in establishing the percent of computed gain in shear strength to be used for design.

33. Levee configuration. The configuration of the ultimate levee section, based on an assumed gain in shear strength, for the reach with the worst soils foundation (station 140+00 to station 298+61.07) and the location of the hydraulic fill retention dikes relative to the centerline of the levee were designed for a minimum factor of safety of 1.3. Even though the foundation soils are slightly better in the reach extending from station 0+00 to station 140+00, the location of the retention dikes and the configuration of the ultimate levee section, which was designed for the worst reach, were used for the entire length of the project because of the uncertainty of determining the gain in shear strength

and the lack of information on the magnitude of lateral movement of the foundation soils. Consequently, in the reach with the better foundation soils, the lifts can be constructed to higher grades; fewer number of lifts will be required to construct the levee to gross grade; and the minimum factors of safety of the ultimate section are more than 1.3. Further, the configuration of the ultimate section was not changed for the reach with the better foundation soils. Should additional boring and testing indicate that the ultimate section can be reduced, only the protected side configuration may be reduced inasmuch as the flood side configuration is based on requirements relative to wave runup. The magnitude of the protected side configuration reduction would be relatively small and the reduction could be accomplished with little difficulty.

34. Levee termination at Bayou Piquant Drainage Structure. The configuration of the levee at the drainage structure is designed for a hurricane condition of flood side water at elevation -6.0 and the prevention of assumed failure towards the flood side channel. The stability of the first lift was determined by the method of planes using the design (Q) shear strength shown on plate 11 and applying a minimum factor of safety with respect to strength of approximately 1.3. For all subsequent lifts, an assumed gain in shear strength was utilized as discussed in paragraphs 31a and 32. The configuration of the levee termination at the structure is shown in plan on plate 47.

35. I-type floodwall stability.

a. The stability and required penetration of the steel sheet pile below the ground surface were determined by the method of planes using the consolidated-drained (S) shear test results, i.e., C = 0, $= \phi_a = 23°$. A factor of safety of 1.25 was applied to the friction angle as follows:

$\phi_d = \tan^{-1}\left(\frac{\tan \phi \text{ available}}{\text{factor of safety}}\right)$. 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 summation of the horizontal forces on the protected side was equated to the summation of the horizontal forces on the flood side for various tip penetrations. At these various tip penetrations, summations of overturning moments were determined. The required depths of penetration were determined as those where the summation of moments was equal to zero. Sufficient (Q) stability analyses were performed to confirm that the (S) case governed for design. The analyses are shown on plate 61.

b. The results of tidal hydraulic analyses indicate that the floodwalls will be subjected to the pressure and forces imparted by broken and breaking waves. In the stability analyses, the wave effect was applied as a line force acting through the centroid of the dynamic wave pressure distribution diagram (see plate 61). The static water pressure diagram resulting from wave action was considered effective only to the top of the impervious clay layer, inasmuch as the period of time the wave will exist is too short to allow water pressures to become effective in the impervious soil layer. The aforementioned analyses were used for design. However, tip penetrations were also determined for the static water pressure diagram, resulting from wave action, effective through the clay fill to the tip of the sheet pile (see plate 62).

36. Inverted T-type floodwall and drainage structure sheet pile cutoff. Inverted T-type floodwalls on bearing piles will be utilized in lieu of I-type floodwalls where the height of the wall above ground and the magnitude of the dynamic wave force render the I-type floodwall impracticable. A steel sheet pile cutoff will be used beneath the T-wall to provide protection against seepage. The drainage structure will be a concrete structure supported on prestressed concrete bearing piles with steel sheet pile cutoff. The analyses of the stability and required penetration of the steel sheet pile cutoff are presented on plate 59.

37. Foundations for structures. Twelve-inch square prestressed concrete piles will be used to support the T-type walls and the drainage structure. Design compression and tension capacities versus tip elevations were developed for treated timber and 12-inch square concrete piles. 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_0) = 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_0) = 0.70 was used in the (S) case. Further, pile design loads versus tip elevations are presented for 16-inch square concrete piles for the (S) case only, inasmuch as the (S) case governed for design. The results of pile design loads versus tip elevations are shown on plate 57. Pertinent data relative to levee and floodwalls are shown in table 1. The stability of the drainage structure, relative to failure of the soils foundation for the hurricane condition with water to elevation 10.5 on the flood side and to elevation -1.5 on the protected side, was determined using the design (Q) shear strengths. The results of the stability analyses are shown on plate 60.

TABLE 1

LOCATION AND TYPE OF PROTECTIVE WORKS

Station	Top Elev. Wall	Top Elev. Levee	Sheet Pile Tip Elev. I-Wall	Sheet Pile Tip Elev. T-Wall or Structure	Elev. of Base T-Wall or Structure
0+00 to 97+08		12.0			
97+08 to 97+66	12.5		-9.0	-	-
97+66 to 98+30	12.5		-	-17.0	-1.0
98+30 to 98+55	12.5		-	-17.0	-4.0
98+55 to 99+05	12.5		-	-17.0	-5.5
99+05 to 99+30	12.5		-	-20.0	-8.5
99+30 to 100+30	12.5		-	-20.0	-9.5
100+30 to 100+55	12.5		-	-20.0	-8.5
100+55 to 101+05	12.5		-	-17.0	-5.5
101+05 to 101+30	12.5		-	-17.0	-4.0
101+30 to 101+94	12.5		-	-17.0	-1.0
101+94 to 102+52	12.5		-9.0	-	-
102+52 to 140+00		12.0			
140+00 to 298+61.07		12.5			

38. Settlement. Estimates of settlement beneath the levee were made based on consolidation test data from undisturbed borings. Settlement analyses consisted of developing curves of: void ratio (e) and compression index (C_c) versus depth; load ($\overline{P}$) versus void ratio (e); load ($\overline{P}$) versus settlement (ρ); and percent consolidation (U_z%) versus time (t) for the strata in which consolidation will occur. The aforementioned curves applicable to boring 10-U are shown on plate 14. Inasmuch as the insitu foundation soils for borings 2-U and 6-U are relatively similar to 10-U, the curves shown on plate 14 were used to determine the settlement from stations 0+00 to 55+00 (boring 2-U) and from stations 55+00 to 140+00 (boring 6-U) with adjustments in the magnitude of settlement being made to compensate for the differences in strata thickness, in void ratios (e) and compression indices (C_c). The computed settlement was increased by 25 percent to include the effect of possible lateral displacement of the foundation and consolidation of the fill. The determination of 25 percent was based on information contained on plate 19. Because the project area foundation soils are considered to be less critical than the Atchafalaya Basin soils, the 25-percent increase in settlement was assumed for both lateral movement of the foundation and consolidation of the fill, rather than only lateral movement of the foundation as indicated on plate 19. The I-type floodwalls

will be constructed 2 feet above net grade to allow for settlement of the underlying foundation. Estimated ultimate settlements, including settlement during construction, of the earth levees are shown in table 2.

TABLE 2

ESTIMATED SETTLEMENT OF LEVEE

Lift No.	Lift Type	Elevation Crown	Elevation Base	Settlement (ft.) Base
		Stations 0+00 to 55+00		
		0	0	0
1	Hyd fill	10.0	-7.7	7.7
2	Hyd fill	13.0	-9.7	9.7
3	Shape	14.0	-14.2	14.2
	Ultimate	12.0	-16.0	16.0
		Stations 55+00 to 140+00		
		0	0	0
1	Hyd fill	10.0	-6.0	6.0
2	Hyd fill	13.0	-8.5	8.5
3	Shape	14.0	-12.5	12.5
	Ultimate	12.0	-14.0	14.0
		Stations 140+00 to 298+61.07		
		0	0	0
1	Hyd fill	7.0	-5.7	5.7
2	Hyd fill	9.5	-7.1	7.1
3	Hyd fill	11.0	-9.8	9.8
4	Hyd fill	12.0	-12.9	12.9
5	Shape	13.5	-15.6	15.6
	Ultimate	12.5	-16.5	16.5

39. Sources of fill material. The levee will be constructed of hydraulic fill material obtained from an adjacent borrow area located in Lake Pontchartrain (see plates 2 through 4). Boring logs and a geologic soil profile of the borrow area are shown on plates 9 and 7, respectively. Shell to be utilized at the structure site is also available from Lake Pontchartrain. Haul material is available from the Bonnet Carre' Spillway to repair damage which may occur to the final levee and to construct the Bonnet Carre' Spillway east guide levee enlargement (see plate 65).

40. Method of construction.

a. Levee, station 0+00 to station 140+00. Construction of the levee by conventional successive hydraulic lift and shapeup methods utilizing adjacent borrow from Lake Pontchartrain will begin at station 0+00 (east end of project) and progress westward to station 140+00. A temporary opening shall be left in the levee at Bayou Piquant to provide for interior drainage prior to construction of the drainage structure. The first levee lift will terminate at station 103+30; however, the flotation channel will be constructed to Bayou Piquant as shown on plate 42. The stream closures will be constructed concurrent with the levee. See plates 39 and 40 for stage construction sections. Scheduling of the second levee lift will be such that the construction at station 90+80 to 101+30 will be coincident with the first lift closure of Bayou Piquant and subsequent to completion of the drainage structure construction (see plate 44).

b. Levee, station 140+00 to station 298+61.07. Construction of the levee by conventional successive hydraulic lift and shapeup methods utilizing adjacent borrow from Lake Pontchartrain will begin at station 298+61.07 (west end of project) and progress eastward to station 140+00. Stream closures will be constructed concurrent with the levee. See plate 41 for stage construction sections.

c. Drainage structure . A flotation channel to elevation -8.0 will be constructed through the structure site under the contract for the first hydraulic lift west of Bayou Piquant (see plate 42). Subsequent to completion of the first lift, the drainage structure excavation and protection dike will be constructed by cast method (see plate 43). If necessary, well points will be installed, as discussed in paragraph 41, and the water will be drawn down to elevation -11.0. The drainage structure, inverted T-type floodwalls, and I-type floodwalls will be constructed in the dry. The drainage structure complex will be scheduled for construction during the 2-year interim between the first and second hydraulic levee lifts.

d. Bayou Piquant closure. The Bayou Piquant closure extends from station 90+80 to station 98+30 (see plate 45). The first lift of the closure will be constructed coincident with construction of the second lift of the adjacent levee. The first and second lifts of the closure will be hydraulic fill constructed to elevation 10.0 and 13.0, respectively. The third lift will consist of shaping the fill material to gross grade (same as adjacent levee configuration).

e. <u>Bonnet Carre' Spillway east guide levee enlargement</u>. The Bonnet Carre' Spillway east guide levee enlargement, to be constructed of haul material from the Bonnet Carre' Spillway, shall extend from 200 feet lakeward to 300 feet landward of station 298+61.07. The enlargement will consist of one lift constructed to a gross grade of 14.0. See plates 5 and 23.

f. Consideration was given to constructing the stream closures with shell cores, however the recommended hydraulic lift method was more economical and practicable.

41. <u>Drainage structure dewatering during construction</u>. In order to construct the Bayou Piquant Drainage Structure in the dry, well points may be required along the top of the excavation. The well points would extend down to elevation -17.0 and will draw the water table down to elevation -11.0, which is 1.5 feet below the bottom of the structure. Calculations for determining the well screen elevations are shown on plate 58. Inasmuch as the organic clay stratum located between the peat stratum and the free water surface is considered impervious, seepage to the well points will be horizontal and will originate from a line source in Bayou Piquant. A plan flow net of seepage from the line source in Bayou Piquant to the well points at the structure excavation is shown on plate 58. In addition to the conventional manual flow net method, an equivalent circular flow net, developed by a computer program based on the mathematical equation for transforming radial flow to flow from a line source, is also shown for comparison purposes and to check the adequacy of the hand-drawn flow net. An approximate value of the equivalent well radius (r_w) is $\frac{4}{\pi}\sqrt{\text{area of rectangle}}$.

42. <u>Erosion protection</u>. Erosion protection will not be provided for damage from hurricane flood stages because of the relatively short duration of hurricane flood stages and the resistant nature of the clayey soils. However, because of the frequency and duration of waves generated in Lake Pontchartrain by other than hurricane winds and because of the proximity of the levee to Lake Pontchartrain, erosion protection will be provided for damage which could occur from waves generated by other than hurricane winds. The erosion protection for the levee will consist of 2 feet of riprap placed on 0.75 foot of shell extending from elevation 6.5 to elevation -2.8 along the lakeside slope of the levee. In addition to the levee slope protection, erosion protection will also be provided on the flood side slopes of stream closures and will extend from elevation 0.0 to the bottom of the streams. Locations of erosion protection are shown on plates 5 and 39 through 41. Further, 2 feet of riprap on 1 foot of shell will be placed 20 feet on each side of the floodwall and will extend from elevation 8.0 at the earth levee to elevation -6.0 at the drainage structure (see plate 47).

43. Settlement instrumentation. Settlement plates will be installed at the centerline of the levee, at the top of bank of the flood side flotation channel (120 feet from the centerline), at the center of the flood side flotation channel (154 feet from the centerline), and at the protected side toe of the flood side retention dike (210 feet from the centerline). The settlement plates, consisting of a 1/4-inch iron plate, 2 feet by 2 feet, and a 1-inch galvanized iron pipe welded in a vertical position to the center of the top surface of the plate, will be located at 500-foot intervals along the levee alignment. Legs, 2 feet in length, will be welded on the corners of the iron plates and driven into the ground to help maintain the galvanized iron pipe in a vertical position. Because of the softness of the peat stratum, extreme difficulty is anticipated in maintaining the galvanized iron pipe in a vertical position. Therefore, the settlement plates will be placed just prior to construction of the second lift, and the height of fill placed during construction of the first lift will be determined to sufficient accuracy by locating the top of the peat stratum with hand-driven 2-inch piston-type borings. Settlement observations for other than the instrumented sections, will be made promptly after each lift construction, 1 year later, and immediately prior to the next lift. Settlement reference markers will be installed along the structure walls to obtain data relative to vertical and lateral movement.

44. Instrumented levee sections. Various measurement devices, to obtain data on pore water pressure, settlement of foundation, lateral movement of foundation, and consolidation of the fill will be installed at two sections along the levee alignment (stations 80+00 and 205+00). The instrumented section at station 80+00 will provide data on that portion of the project having the better soils foundation. The instrumented section at station 205+00 will provide data on that portion of the project with the poorer soils foundation. The measuring devices to be installed are slope indicator wells, open-system piezometers, permanent bench marks, surface reference hubs, deep settlement plugs, and settlement plates. The settlement plates will be installed as discussed in paragraph 43; the surface reference hubs will be installed as soon as practicable after each lift; and all other instruments will be installed as soon as practicable after completion of the first lift. The locations of the instruments are shown in plan and profile on plates 63 and 64.

45. Additional soils borings and tests. The ultimate design sections presented herein are based on an assumed gain in shear strength resulting from the overburden of the levee fill. 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 and the instrumented sections, 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 INVESTIGATED

46. Alternative construction plans considered. In addition to the recommended construction plan of conventional successive hydraulic fill lift and shapeup methods utilizing adjacent borrow material from Lake Pontchartrain, various alternative plans were considered, including: pumping sand from the Mississippi River for the levee core, then topping with hauled material from the Bonnet Carre' Spillway (Plan A); mucking out to elevation -15.0, pumping sand from the Mississippi River for the levee core, then topping with hauled material from the Bonnet Carre' Spillway (Plan B); hauling material from the Bonnet Carre' Spillway for the entire levee (Plan C); and mucking out to elevation -15.0, pumping sand from the Mississippi River for the levee core, then topping with conventional successive hydraulic fill lift and shapeup methods utilizing adjacent borrow material from Lake Pontchartrain (Plan D). Sufficient design analyses were accomplished to determine that the most economical and practicable method of construction is by conventional successive hydraulic fill and shapeup methods utilizing adjacent borrow material from Lake Pontchartrain. In addition to being more costly, the alternative plans were considered less practicable for the following reasons:

a. The height to which the lifts could be constructed would be less than the recommended plan because of the increase in weight of the borrow material from the Bonnet Carre' Spillway (γ= 120 lb./ft^3) and the Mississippi River (γ = 120 lb./ft^3) over that of the borrow material from Lake Pontchartrain (γ = 100 lb./ft^3), thereby increasing the number of lifts and consequently the time required to complete construction. Further, the additional weight would increase the settlement of the foundation and could increase the magnitude of lateral movement in the foundation.

b. Since Bayou Piquant must remain open until after the drainage structure is completed and operating, a bridge would be required across Bayou Piquant to provide access for hauling material from the Bonnet Carre' Spillway to construct the levee east of the drainage structure site. Subsequent to completion of construction of the drainage structure, the bridge would have to be relocated to provide access across the drainage structure approach channel. Because of the poor soils foundation in the area, providing access for hauling equipment across Bayou Piquant and the approach channel would not be practical.

c. Sufficient material is available in the Bonnet Carre' Spillway to construct the levee; however, portions of the borrow area would have to be drained and most of the borrow material would have to be stockpiled and allowed to drain before it could be hauled and placed in the levee. Further, the material would have to be dumped and spread ahead of hauling until the levee base is raised about 3 feet above natural ground surface before hauling equipment could operate over the fill.

47. Alternative construction plans cost comparison. Design sections, based on limited stability analyses, were developed for the reach which has the poorest soils foundation (station 140+00 to station 298+61.07). For the purpose of comparison, costs per linear foot of embankment were determined for the alternative plans and the recommended plan and are presented in table 3.

TABLE 3

COSTS COMPARISON
Recommended Plan vs Alternative Plans

Plan	Cost/lin.ft. $	Costs per lin.ft. above recomm. plan $
Recommended	245	-
(A)	488	243
(B)	457	212
(C)	521	276
(D)	305	60

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

48. Levee.

a. The general location of the St. Charles Parish lakefront levee is shown on plate 1 and the detailed alignment and profile are shown on plates 2 through 4. The levee is approximately 5.7 miles in length and is located on the south shore of Lake Pontchartrain along the St. Charles Parish lakeshore extending from the Bonnet Carre' Spillway east guide levee to the western terminus of the existing Jefferson Parish lakefront levee.

b. The primary source of borrow for levee construction will be the bed of Lake Pontchartrain. Material to be used in the retaining dikes shall be cast from inside the levee foundation area as shown on plates 39 through 41. Haul material to be used in raising and shaping the Bonnet Carre' Spillway east guide levee at the "tie-in" section shall be hauled from the Bonnet Carre' Spillway in the vicinity of U. S. Highway 61.

c. The levee between stations 0+00 and 140+00 will be constructed to final grade in two lifts and one shaping with intervals of approximately 2 years between lifts and approximately 4 years between the final lift and shaping.

d. The levee between stations 140+00 and 298+61.07 will be constructed to final grade in four lifts and one shaping with intervals of approximately 2 years between all lifts and 4 years between the final lift and shaping. The Bonnet Carre' Spillway east guide levee will be enlarged from 200 feet north to 300 feet south of station 298+61.07 in one lift.

49. Floodwalls. I-type floodwall will be constructed in the vicinity of the drainage structure between stations 97+08 and 97+66, and between stations 101+94 and 102+52. T-type floodwall will be constructed between stations 97+66 and 99+30, and stations 100+30 and 101+94. More detailed description and results of the floodwall analyses and the embankments in which they are located are contained in the Soils and Foundations Investigation and Design section of this memorandum.

50. Drainage structure. The Bayou Piquant Drainage Structure will be a reinforced concrete structure supported on prestressed concrete bearing piles with steel sheet pile cutoff. The structure will consist of eight 9- by 5-foot openings with combination flap and vertical lift gates and will be constructed in the levee alignment near Bayou Piquant between stations 99+30 and 100+30. A one-lane bridge will be constructed to provide access across the structure (refer to plates 66 and 67).

ACCESS ROADS

51. Access roads. There are no access roads near the levee rights-of-way and due to the natural ground elevations and poor foundation soils in this area, it is not economical to construct such roads. Levee construction will be performed from floating plant equipment. Following completion of the first lift levee, the access channel for floating plants will not be constructed nearer than approximately 400 feet from the levee toe except for construction of the Bayou Piquant Drainage Structure entrance and outlet channels. Subsequent to the final levee lift and shaping, shell and riprap to be used for slope protection will be hauled and placed utilizing the completed levee for access.

STRUCTURAL DESIGN

52. Criteria for structural design. The structural design 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 criteria and calculations for structural design of the Bayou Piquant Drainage Structure are presented herein as appendix C.

53. Basic design data.

a. Head differentials. The maximum wind tide elevations due to the design hurricane are as follows:

	Stillwater Elevations		
	Flood side	Protected side	Differential
Max. direct head	10.5	-1.58	12.08
Max. reverse head	-7.0	1.45	8.45

b. Wave loads. Wave loads on the structure were calculated in accordance with "Technical Report No. 4 (Third Edition - 1966), Shore Protection, Planning and Design" by the U. S. Army Coastal Engineering Research Center, and these calculations are shown in appendix C, figures C-1 through C-6.

c. Top of walls. The tops of the gate monoliths, T-wall monoliths, and I-wall monoliths are at elevation 12.5, which is 2 feet above the maximum wind tide level. The concrete for the I-wall monoliths will be placed after initial settlement of the levee fill. A precast concrete cap 12 inches high will be bonded to the top of the concrete I-wall with epoxy resin.

d. Unit weights.

Item	Lb. per cu.ft.
Water	62.5
Concrete	150
Steel	490
Saturated riprap	110
Submerged riprap	47.5
Saturated shell	90
Submerged shell	27.5

e. Horizontal loads. (equivalent fluid pressure)

Item	Lb. per cu.ft.
Water	62.5
Saturated riprap	55
Submerged riprap	23.75
Saturated shell	45
Submerged shell	13.75
Earth pressures on I-wall, see plate 72	

f. Design load conditions. The load conditions used for design are as follows:

(1) Case 1. Dead loads only, no backfill or waterloads.

(2) Case 2. Water elevation 10.5 on flood side and -1.58 on protected side, live loads on bridge, full uplift with impervious sheet pile cutoff and net horizontal force on cutoff exerted at bottom of base.

(3) Case 3. Same as case 2 except sheet pile cutoff pervious and no horizontal force exerted on cutoff.

(4) Case 4. Water elevation -7.0 (or at bottom of base) on flood side and elevation 1.45 on protected side, full uplift with impervious sheet pile cutoff, and dead loads on bridge.

(5) Case 5. Same as case 4 except sheet pile cutoff pervious.

(6) Case 6. Same as case 2 plus net pressure from wave loading (increase allowable stresses and pile loads by 1/3).

(7) Case 7. Same as case 3 plus net pressure from wave loading (increase allowable stresses and pile loads by 1/3).

Since cases 6 and 7 include wave loads, they are Group II loadings and allowable stresses will be increased accordingly.

g. Bridge. The drainage structure includes a one-lane bridge designed in accordance with AASHO requirements for an H-10 loading for a single truck and an impact coefficient of 0.3. Refer to paragraph 58.

54. Allowable working stresses. The allowable working stresses for concrete, reinforcing steel, and steel sheet piling comply with the provisions of "Working Stresses for Structural Design,"

EM 1110-1-2101, dated 1 November 1963. Prestressed concrete piling will be specified to have a basic minimum compressive strength of 5,000 p.s.i. and all other structural concrete will have a minimum compressive strength of 3,000 p.s.i. at 28 days. Steel sheet piling will conform to the requirements of ASTM A328-67, "Standard Specifications for Steel Sheet Piling." For convenient reference, pertinent basic allowable stresses are tabulated below:

Reinforced concrete	Stress - p.s.i.
f_c'	3,000
f_c	1,050
v_c (without web reinf.)	60
v_c (with web reinf.)	274
f_c (reinf. steel)	20,000

Minimum tensile reinforcing steel = .0025bd or 0.44 sq.in. per ft.

Shrinkage and temperature reinforcing steel = .002bt or 0.44 sq.in. per ft. in each face.

Modular ratio, n = 9.2

Basic stress steel sheet piling = 18,000 p.s.i.

55. Drainage structure.

a. The Bayou Piquant Drainage Structure will be constructed in a gap to be left open during construction of the new levee embankment. The structure will be located approximately 600 feet west of Bayou Piquant which is one of the principal natural drainage channels for the area. The drainage structure will be constructed during the interval between construction of the first and second lifts of the levee embankment. The drainage structure construction contract will include excavation from elevation -8.0 to elevation -12.0, excavation for the new drainage channel, the shell backfill, and the riprap along the structure (see plates 42, 43, and 66). Earth backfill along the wall and the closure of Bayou Piquant will be included in the contract for the second lift of the levee embankment.

b. The drainage structure will have eight rectangular openings 9 feet by 5 feet with inverts at elevation -5.5 as shown in plan and profile on plate 67. Typical cross sections of the structure monoliths are shown on plates 69 (gate monolith), 70 and 71 (T-wall monoliths), and 72 (I-wall monolith).

c. Because of the relatively large gate openings required in the stems of the gate monoliths, buttresses have been added at each end of these monoliths. The buttresses together with the bridge piers at the center of each of these monoliths, will provide adequate support in bending and shear for the stems. Typical computations for the required areas of reinforcing steel are shown for monolith S-10 in figures C-8 through C-25.

56. Foundations.

a. The results of subsurface explorations, soils tests, and foundation studies are presented in the Soils and Foundations Investigation and Design section of this report. Due to the poor foundation soils in the vicinity of the drainage structure site, the existing material will be removed to elevation -12.0 and backfilled with shell as shown on plates 42 and 43.

b. Prestressed concrete piles 12 inches square by 70 feet long will be used to support the structure monoliths as shown on plate 68. Steel H-piles (12BP53 x 79') were investigated for use on this structure and the initial cost of the steel piles would be approximately $9,000 less than the cost of prestressed concrete piles. However, the concrete piles were selected because of the proximity of the pile heads to the water table in some locations and the consequent susceptibility to corrosion of steel piles in the regions. Allowable pile design loads and moduli of subgrade soil reaction are shown on plate 57. Since the Hrennikoff method of batter pile analysis was used to check the pile loads (determined by the Culman method of graphical analysis) and since only one value of subgrade soil reaction can be used with this method, an average value of 135 p.s.i. was selected. The sheet pile cutoff stability analysis and computation of the unit forces exerted on the bases of the structure monoliths by the sheet pile cutoff are shown on plate 59. Computations for required section of sheet pile for cutoff are shown on figures C-28 and C-29.

c. The I-wall stability analysis is shown on plates 61 and 62, and the I-wall design analysis is shown on plate 72. Since the I-wall had been designed prior to addition of the bridge across the structure, the I-wall was designed with backfill at elevation 6.5. When the bridge was added, the I-wall was shortened and resulted with the minimum final backfill at elevation 7.0. Since this change would reduce the loading on the I-wall, a reanalysis was not made.

57. Gates. The drainage structure will have eight identical combination flap and vertical lift gates which will be used to provide a total possible opening of 360 square feet. The flaps will be made of cast steel conforming to the requirements of ASTM designation A-216-66, grade WCB, "Specification for Carbon Steel Castings Suitable for Fusion Welding for High Temperature Service." The gates will include movable frames with steel vertical stems, bronze seating faces, bronze hinge bolts, bronze bushings, and stainless steel anchor bolts and nuts. The gates will be designed to withstand a 20-foot seating head and have double hinged leaves. The slide frames will be seated on flush-type cast steel thimbles set in the concrete structure. Concrete brackets at the top of the wall will support the gate hoists. The combination flap and lift gates with guides and lifts are shown on plate 73. The gate frames will be approximately 11 by 7 feet. The vertical lift feature is provided to facilitate cleaning and maintenance of the gates without unwatering the structure.

58. Bridge. A one-lane concrete bridge was designed for a single H-10 truck in accordance with AASHO specifications to connect the levees on each end of the drainage structure. The bridge roadway will facilitate emergency floodfighting, normal inspection of the levees, and routine maintenance of the levees and the gates. If a bridge were not built across this structure, it would be necessary to travel approximately 25 miles to go around the structure to get from one side to the other. The bridge will be 4 feet below the top of the wall and will have a concrete curb and pipe handrail along the edge away from the structure wall. Design computations for the bridge are shown on figures C-23 through C-29.

59. Settlement. The maximum anticipated settlement of the levee and I-wall is included in the Soils and Foundation Investigation and Design section of this memorandum. The top elevation of the sheet piling for the I-wall will be adjusted to a gross grade to allow for the anticipated future settlement. The concrete on the I-wall will be placed after initial settlement of the levee fill. The monolith joints of the I-wall and the joints between the I-wall and T-wall monoliths will be designed to slip in order to permit settlement without producing excessive stress concentrations in the concrete.

60. Gate hoists.

a. General. Each of the eight gates, because of their size, will have two stems. Two floor stands for each gate will be mounted on concrete wall brackets and interconnected with a shaft to provide synchronous operation of the stems. Operation will be accomplished by a portable gasoline engine-driven operating unit. The arrangement of the lift equipment is shown on plate 73.

b. Description.

(1) Stem. Gate stems will consist of 3-inch diameter cold-rolled steel with acme screw threads. Stem guides will be provided to allow an unsupported length of 8.5 feet between the top of the gate and the guide.

(2) Floor stand. A commercially manufactured two-speed floor stand with ratios of 6.7:1 (high speed) and 20:1 (low speed) will be selected. Each floor stand will have a stem diameter of 3 inches and an approximate capacity of 38,000 lb. based on operating a 15-inch handle on the low speed shaft with a 40-lb. effort. The two floor stands for each gate will have an interconnecting shaft to provide synchronous operation. One floor stand for each gate will have an input pinion shaft at a right angle to the interconnecting shaft to allow operation from the walkway. The walkway handrail will be removable to provide access to the floor stands.

(3) Portable operating unit. Since the gates will be hoisted for maintenance purposes only and electric power is not available in the immediate vicinity, operation by electric motor is not justifiable. Instead, operation will be accomplished by a portable operating unit consisting of a gasoline engine, reversing transmission, gear reduction drive unit, and overload release clutch. A movable adaptor bracket with a requirement of minimum adjustment for alignment will be provided on the floor stand to mount the portable operating unit. The bracket will swivel out of position to allow hand crank operation in the event of breakdown of the portable unit.

c. Design data.

(1) Hoisting load. The hoisting load will consist of the weight of the gate plus the seal friction. Design conditions for lifting the gates are water elevation 2.0 on the flood side and elevation 0.0 on the protected side.

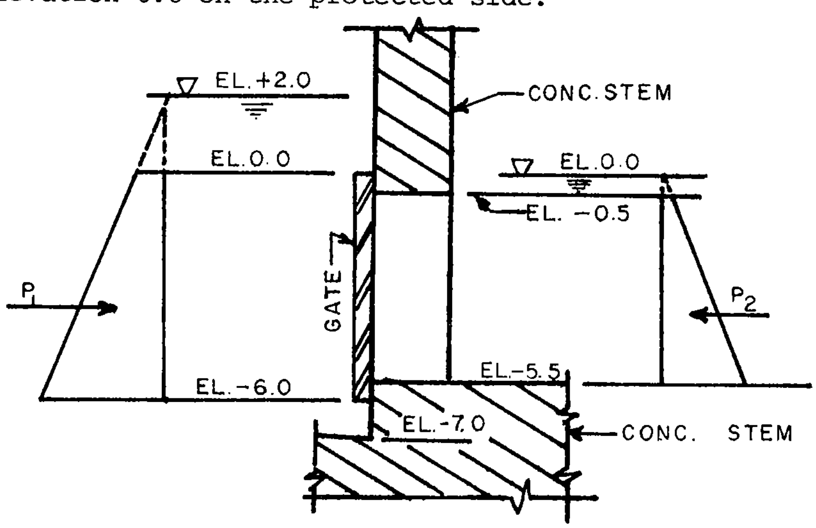


Diagram for Hoisting Load Computations

size of gate = 10 ft. by 6 ft. on flood side
9 ft. by 5 ft. on protected side

weight of gate and stem = 19,000 lb.

coefficient of seal friction = 0.3

water load = $P_1 - P_2$

= [1/2x(2+8)x62.5x6x10] - [1/2x(0.5+5.5)x62.5x5x9]
= 10,300 lb.

seal friction = water load x coefficient of friction
= 10,300 lb. x 0.3
= 3,090 lb. (Round to 3,100 lb.)

total load = weight of gate + seal friction
= 19,000 lb. + 3,100 lb.
= 22,100 lb.

load on each stem = 22,100 lb. ÷ 2
= 11,050 lb. (Round to 11,100 lb)

(2) Floor stand.

capacity = 38,000 lb. (based on operating a 15-inch handle on the low speed shaft with a 40-lb. effort)

ratios = 6.7:1 (high speed)
20:1 (low speed)

$$\text{effort required for each floor stand} = \frac{\text{stem load x 40 lb.}}{\text{38,000 lb.}}$$

$$= \frac{\text{11,100 lb. x 40 lb.}}{\text{38,000 lb.}}$$

$$= \text{11.7 lb.}$$

$$\text{input torque to each floor stand} = \frac{\text{11.7 lb. x 15 in.}}{\text{12 in./ft.}} = \text{14.6 ft.-lb.}$$

(3) Portable operating unit. Since the low speed shafts of two floor stands will be interconnected and coupled to the portable operating unit, the torque required to hoist the gate is:

14.6 ft.-lb. x 2 = 29.2 ft.-lb.

The operating unit will deliver approximately 50 ft-lb. of torque at 100 r.p.m.

(4) Gate operating time. The gate operating time is based on the output speed of the operating unit, the low speed ratio of the floor stand, and the lead of the threaded stem. The stem threads will be single acme with three threads per inch.

$$\text{gate operating time} = \frac{RxTxD}{n}$$

where R = low speed ratio of floor stand
T = turns of stem nut per foot of gate travel
D = gate travel, ft.
n = input r.p.m. to low speed shaft of floor stand

$$\text{gate operating time} = \frac{20x36x8.5}{100}$$

$$= 61.2 \text{ minutes}$$

(5) Wall bracket. The maximum thrust on the concrete wall bracket is computed as follows:

$$F = \frac{Wfi + D.L.}{2}$$

where F = maximum thrust
W = water load on gate = 10,300 lb.
f = coefficient of starting friction = 0.7
i = coefficient for impact = 1.2
D.L. = dead load consisting of gate, stem and floor stand = 19,400 lb.

$$F = \frac{(10{,}300)\times(0.7)\times(1.2) + 19{,}400}{2}$$

$$= 14{,}000 \text{ lb.}$$

(6) Stem. The stems were considered as long columns with calculations relative to buckling as follows:

$$\frac{P}{A} = \frac{\pi^2 E}{(k\ l\ /r)^2} \quad \text{(Eulers Column Formula)}$$

where P = ultimate buckling load
E = modulus of elasticity = 29,500,000 p.s.i.
K = end condition factor = 0.7
l = unsupported length in inches = 102 in.
r = radius of gyration = 0.62 in.
A = area at root of thread = 4.84 sq.in.

$$P = \frac{(3.142)^2\ (29{,}500{,}000)\ (4.84)}{[(0.7)\ (102)/(0.62)]^2}$$

$$P = 107{,}000 \text{ lb.}$$

The following condition must be satisfied to avoid buckling:

P ≥ (floor stand capacity) x 2
107,000 ≥ 76,000
Therefore, the stem is adequate

61. Corrosion control.

a. General. The rate of corrosion of iron or steel structures in water is controlled largely by the concentration of dissolved salts and the amount of dissolved oxygen in the water. Further, corrosion of iron may produce soluble iron salts which easily hydrolyze to produce acid solutions and increase the corrosive effect.

b. Water characteristics. Salt water intrusion into Lake Pontchartrain is via the Rigolets and Chef Menteur Passes and the Mississippi River-Gulf Outlet (MR-GO) via the Inner Harbor Navigation Canal (IHNC), all of which are located eastward of the proposed site. Major fresh water flow into Lake Pontchartrain is from Lake Maurepas, which is west of the site, and the rivers and bayous on the north side of Lake Pontchatrain. Additional fresh water is pumped into the lake from the drainage systems of Jefferson and Orleans Parishes. Records for the period 1962 to 1968 reveal that salinity observations made in the vicinity of the proposed site show chloride concentrations varying from 50 to 6,000 parts per million (p.p.m.). The samples obtained exceeded 1,000 p.p.m. 50 percent of the time. Chloride concentrations in this area of the lake vary according to the volume of fresh water inflow, increasing during periods of drought and decreasing with heavy rain over the basin. Therefore, it is anticipated that the water landside of the gates will be fresh since the structure and connecting levees will eliminate the influx of saline water into the project area. The salinity data obtained for the period 1962 to 1968 are shown in appendix D. The locations of the sampling stations are shown on plate D-1 of appendix D.

c. Corrosion mitigation.

(1) The influx of saline water results in low-resistance water and establishes an environment where ferrous metal components on the lakeside of the gate will be subject to a higher rate of corrosion than those components on the landside. Therefore, in order to provide normal protection against corrosion, a vinyl paint system of 7.5 mils thickness will be used on both sides of the gates and frames. In addition, zinc anodes will be installed on the lakeside of the gates to combat the higher rate of corrosion that will obtain thereon.

(2) The anodes will be high purity zinc, rated 335 ampere-hours per pound at 90 percent efficiency with a solution potential of -1.10 volts relative to a reference half-cell. The system will consist of three 5-lb. condenser type anodes bolted to each gate and designed to provide polarization potential of -0.85 volts. The number and size of the anodes were selected to obtain a 10-year life and insure current distribution to shielded areas of the gate. Since the gates can be raised, inspection and maintenance of both the anodes and the paint coating will be facilitated. Details of the anodes and mounting are shown on plates 73 and 74.

(3) Calculations. Cathodic protection provided for the flap gates and frames will be sacrificial metal type anodes. These anodes will supplement 7.5 mils of vinyl paint and are designed to protect only the lakeside of the gate.

Protection potential: -0.85 volts to a copper sulfate reference electrode

Anode: High purity zinc, condenser type, rated 335 amp. hrs/lb @ 90% eff.

Driving potential: 0.25 volts relative to polarized cathode

Current density: 0.0003 amp/sq.ft. for painted surfaces

Approximate area of gate and frame = 11'x7' = 77 sq.ft.

"I" required = (77)(.0003 amp/sq.ft.) = 0.0231 amperes

$$\text{lbs. of zinc/yr} = \frac{(0.0231)\ (8{,}760\ \text{hrs/yr})}{335\ \text{amp-hr/lb}} = 0.604\ \text{lbs/yr}$$

$$\text{No. of anodes for 10-yr life} = \frac{(0.604\ \text{lbs/yr})\ (10)}{5\ \text{lbs/anode}} = 1.21\ \text{anodes}$$

Use 3 anodes for symmetry and protection of shielded areas between the gate webs.

SOURCES OF CONSTRUCTION MATERIALS

62. 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

63. General. As previously mentioned, the State of Louisiana, Department of Public Works was appointed project coordinator for the State by Governor McKeithen. 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 other than those located in St. Bernard Parish. The project plan presented herein is acceptable to both of the above agencies.

64. 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 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." 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 B.

65. U. S. Department of the Interior, Federal Water Pollution Control Administration.

a. 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 accidential 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. 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 B.

66. State of Louisiana, Department of Public Works. The Chief Engineer, State of Louisiana, Department of Public Works was informed of the proposed plan for the St. Charles Parish lakefront levee feature of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project and requested to furnish views and comments thereon. By letter dated 30 July 1969, the Chief Engineer recommended that the proposed drainage ditch be located a minimum of 1000 feet landward of the levee centerline, and that an additional drainage structure be constructed in the lakefront levee about midway between the proposed Bayou Piquant Drainage Structure and the Bonnet Carre' Spillway east guide levee. By letter dated 7 August 1969, the Chief Engineer was advised that we now propose to locate the collector ditch 1000 feet landward of the levee centerline. The Chief Engineer was also informed that since our detailed hydraulic studies indicate that the proposed Bayou Piquant Drainage Structure will be of sufficient capacity to serve the project needs, an additional drainage structure is not required. Copies of the above correspondence are included in appendix B.

REAL ESTATE REQUIREMENTS

67. General. All rights-of-way for the St. Charles Parish lakefront 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 through 4.

RELOCATIONS

68. General. The authorizing act specifies that local interests, prior to initiation of construction, give assurances to the Secretary of the Army that they will accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities required for construction of the project. The relocations, as shown on plate 3, required for construction of the project feature presented herein are one 16-inch and one 30-inch gas pipeline crossing at approximate levee centerline station 125+00. The estimated cost for these relocations is $384,000, based on initially raising the two pipelines on concrete piles to final grade. Both pipelines are owned by the United Gas Pipeline Company.

ENVIRONMENTAL QUALITY

69. 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 and corrosion mitigation for the Bayou Piquant Drainage Structure are discussed herein in paragraphs 41 and 60b, respectively. Further, as indicated in paragraphs 64 and 65, 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 will alter the existing terrain only to the extent of superimposing a hurricane protection levee with required contiguous features. Essentially all borrow material will be obtained from Lake Pontchartrain. Additional beautification measures beyond those which are normally associated with levee construction; i.e., grading and sodding are not warranted.

ESTIMATE OF COST

70. General. Based on July 1969 price levels, the estimated first cost for the St. Charles Parish lakefront levee is $15,700,000. This estimate consists of $742,000 for lands and damages, $384,000 for relocations, $12,497,000 for levees and floodwalls, $1,376,000 for engineering and design, and $701,000 for supervision and administration. The detailed estimate of first cost is shown on table 4.

71. Comparison of estimates.

a. The current estimate of $15,700,000 for the St. Charles Parish lakefront levee represents an increase of $5,416,000 over the latest PB-3 effective 1 July 1969. 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 1969 price levels. Table 5 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 increase of $4,724,000 is comprised of a decrease of $2,059,000 as a result of eliminating the St. Charles Parish lateral return levee from the authorized plan of protection and an increase of $6,783,000 which reflects the added cost for constructing the protective works to higher net grades which resulted from hydraulic studies utilizing more severe parameters for the SPH furnished by the U. S. Weather Bureau subsequent to project authorization; an additional increase in the height of the protective works above natural ground of approximately 1 foot resulting from releveling by the U. S. Coast and Geodetic Survey which in 1965 disclosed that the ground surfaces in the project area were about 1 foot lower than they were considered to be when the project document cost estimates were prepared; modifications in design cross sections for the levee resulting from the increases in the height of the protective works as described above; enlargement of Bonnet Carre' Spillway east guide levee; inclusion of a vehicular bridge across the drainage structure; inclusion of combination flap and vertical lift gates for the drainage structure in lieu of only flap gates, as authorized.

(2) Engineering and design. The increase of $572,000 reflects the added E&D cost as a result of applying to the increased construction cost an increased percentage based on recent experience of E&D costs for similar-type projects.

(3) Supervision and administration. The net increase of $114,000 reflects the added S&A costs as a result of applying to the increased construction cost a smaller percentage based on recent experience of S&A costs for similar-type projects.

(4) Lands and damages. The net decrease of $149,000 is comprised of a decrease of $205,000 as a result of eliminating the St. Charles Parish lateral return levee from the authorized plan of protection and an increase of $56,000 which reflects the detailed appraisals made during preparation of this memorandum.

(5) Relocations. The increase of $155,000 reflects general refinements in the cost estimate based on the more detailed information available during preparation of this memorandum.

b. The estimate of $15,700,000 for the St. Charles Parish lakefront levee also represents an increase of $10,001,000 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 $7,559,000 is comprised of $4,724,000 as described in paragraph 71a(1) above and $2,835,000 as a result of updating the project document estimate as shown in General Design Memorandum No. 2, Lake Pontchartrain Barrier Plan, Citrus Back Levee and subsequent escalation of the project document estimate to reflect July 1969 price levels and using 20 percent contingencies in the PB-3 estimate in lieu of the 15 percent used in the project document.

(2) Engineering and design. The increase of $1,174,000 is comprised of $572,000 as described in paragraph 71a(2) above and $602,000 which reflects an increased E&D percentage applied to the increased construction cost contained in the current PB-3.

(3) Supervision and administration. The increase of $400,000 is comprised of $114,000 as described in paragraph 71a(3) above and $286,000 which reflects an increased S&A percentage applied to the increased construction cost contained in the current PB-3.

(4) Lands and damages. The increase of $520,000 is comprised of the $149,000 decrease as described in paragraph 71a(4) above and an increase of $669,000 as a result of updating the project document estimate as shown in General Design Memorandum No. 2, Lake Pontchartrain Barrier Plan, Citrus Back Levee, and subsequent escalation of land costs for preparation of the current PB-3.

(5) Relocations. The increase of $348,000 is comprised of $155,000 as described in paragraph 71a(5) above and $193,000 as a result of updating the project document estimate as shown in General Design Memorandum No. 2, Lake Pontchartrain Barrier Plan, Citrus Back Levee, and subsequent escalation of price levels for preparation of the current PB-3.

TABLE 4

LAKE PONTCHARTRAIN BARRIER PLAN
ST. CHARLES PARISH LAKEFRONT LEVEE

ESTIMATE OF FIRST COST
(August 1969 price levels)

Cost acct. No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
				$	$
	CONSTRUCTION				
11	Levees and floodwalls				
	Levee embankment (haul)	4,600	c.y.	1.50	6,900
	Levee embankment (hydraulic)				
	1st lift	6,029,700	c.y.	0.75	4,522,275
	2d lift	1,791,700	c.y.	0.80	1,433,360
	3d lift	910,500	c.y.	0.80	728,400
	4th lift	709,600	c.y.	0.80	567,680
	Shapeup	574,900	c.y.	0.60	344,940
	Seeding	227.4	acre	75.00	17,055
	Retaining dike (cast)	912,000	c.y.	0.40	364,800
	Slope protection (haul)				
	Shell	67,800	c.y.	5.00	339,000
	Riprap	159,800	c.y.	6.50	1,038,700
	Subtotal				9,363,110
	Contingencies 20%±				1,917,890
	Subtotal, levee				11,281,000
	Drainage ditch				
	Excavation	526,000	c.y.	0.25	131,500
	Contingencies 20%±				26,500
	Subtotal, drainage ditch				158,000
	Drainage structure				
	Excavation (hydraulic)	79,400	c.y.	0.80	63,520
	Excavation (structure)	2,000	c.y.	2.00	4,000
	Construction dewatering	1	job	L.S.	100,000
	Earthfill	1,200	c.y.	1.50	1,800
	Shell; dumped	24,750	c.y.	5.00	123,750
	Shell fill & blanket	2,000	c.y.	7.00	14,000
	Riprap	1,700	tons	12.50	21,250
	Steel sheet piling (Z-27)	8,450	s.f.	5.20	43,940
	12x12 prestressed conc. piles x 70'	19,750	l.f.	7.00	138,250
	Concrete; stab slab	92	c.y.	35.00	3,220

TABLE 4 (cont'd)

Cost acct. No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
				$	$
11	Levees and floodwalls (cont'd)				
	Drainage structure (cont'd)				
	Concrete; wall base	720	c.y.	45.00	32,400
	Concrete; wall stem piers & butt	550	c.y.	68.00	37,400
	Concrete; bridge	160	c.y.	90.00	14,400
	Portland cement	1,700	bbls.	5.50	9,350
	Steel reinforcement	135,000	lbs.	0.16	21,600
	Gates, frames, & thimbles	8	ea.	26,000.00	208,000
	Hoist machinery	1	job	L.S.	35,400
	Handrail	600	l.f.	8.00	4,800
	Miscellaneous metals	1	job	L.S.	240
	Bulb-type waterstops	285	l.f.	6.00	1,710
	L-type waterstops	22	l.f.	10.00	220
	1/2" expansion joint filler	950	s.f.	1.00	950
	Cathodic protection	1	job	L.S.	1,600
	Subtotal				881,800
	Contingencies 20%±				176,200
	Subtotal, drainage structure				1,058,000
	Subtotal levees & floodwalls (cost account 11)				12,497,000
30	Engineering & design, 11%±				1,376,000
31	Supervision & administration, 5.6%±				701,000
	Total levees and floodwalls				14,574,000
01	Lands and improvements				
	Campsite	1.0	acre	1,000.00	1,000
	Swampland	102.0	acre	1,000.00	102,000
	Marshland	66.0	acre	750.00	49,500
	Marshland	604.0	acre	600.00	362,400
	Spoil easement	140.0	acre	750.00	105,000
	Improvements	3	camps	L.S.	17,000
	Severance	None			
	Subtotal land and improvements	913 acr.			636,900
	Contingencies 15%±				96,100
	Real estate hired labor cost (approx. 45 tracts)				1,000
	Acquisition cost by others (approx. 45 tracts)				8,000
	Total lands and improvements				742,000

TABLE 4 (cont'd)

Cost acct. No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
				$	$
02	Relocations				
	16" gas pipeline	1	job	L.S.	100,000
	30" gas pipeline	1	job	L.S.	175,000
	Subtotal				275,000
	Contingencies 20%±				55,000
	Subtotal				330,000
	Engineering & design, 11%±				36,000
	Supervision & administration, 5.6%±				18,000
	Total relocations				384,000
	TOTAL PROJECT COST				15,700,000

TABLE 5

ST. CHARLES PARISH LAKEFRONT LEVEE
COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff. 1 Jul 69	GDM No. 2 Supp. No. 3	Difference Supp.No. 6 - PB-3	Difference Supp. No. 6 - Proj.document
11	Levees and floodwalls	$4,938,000	$ 7,773,000	$12,497,000	+$4,724,000	+$ 7,559,000
30	Engineering and design	202,000	804,000	1,376,000	+ 572,000	+ 1,174,000
31	Supervision and administration	301,000	587,000	701,000	+ 114,000	+ 400,000
	Subtotal	$5,441,000	$ 9,164,000	$14,574,000	+$5,410,000	+$ 9,133,000
01	Lands and damages	$ 222,000	$ 891,000	$ 742,000	-$ 149,000	+$ 520,000
02	Relocations	36,000	229,000	384,000	+ 155,000	+ 348,000
	Subtotal	$ 258,000	$ 1,120,000	$ 1,126,000	+$ 6,000	+$ 868,000
	TOTAL	$5,699,000	$10,284,000	$15,700,000	+$5,416,000	+$10,001,000

SCHEDULES FOR DESIGN AND CONSTRUCTION

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

Contracts	Design		Construction			Estimated Construction Cost Includes Contingencies
	Start	Complete	Advertise	Award	Complete	
Levee, 1st lift (Sta. 0+00 to Sta. 140+00)	1967	Jul 70	Jul 70	Aug 70	Aug 73	$ 3,034,000
Levee, 1st lift (Sta. 140+00 to Sta. 298+61.1) and spillway guide levee enlargement		Dec 70	Dec 70	Jan 71	Aug 73	2,864,000
Drainage structure and collector ditch		Jul 73	Jul 73	Aug 73	Nov 74	1,216,000
Levee, 2d lift (Sta. 0+00 to Sta. 298+61.07)		Jul 75	Jul 75	Aug 75	Apr 77	1,726,000
Levee, 3d lift (Sta. 140+00 to Sta. 298+61.07)		Mar 79	Mar 79	Apr 79	Apr 80	877,000
Levee, shapeup & seeding & slope protection (sta. 0+00 to Sta. 140+00)		Mar 81	Mar 81	Apr 81	Apr 82	1,020,000
Levee, 4th lift (Sta. 140+00 to Sta. 298+61.07)		Mar 82	Mar 82	Apr 82	Dec 82	683,000
Levee, shapeup & seeding & slope protection (Sta. 140+00 to Sta. 298+61.07)		Nov 86	Nov 86	Dec 86	Dec 87	1,077,000
TOTAL						$12,497,000

73. Funds required by fiscal year. To maintain the schedules for design and construction, as shown above, of the St. Charles Parish lakefront levee, funds[1] will be required by fiscal year as follows:

Funds required for FY	1970	$ 10,000[2]
	1971	1,569,000
	1972	2,255,000
	1973	2,224,000
	1974	1,077,000
	1975	396,000
Balance to complete		5,687,000
Total		$13,218,000

[1] Includes cost for construction (including contingencies), 5 percent supervision and inspection applied to the construction costs, and preparation of plans and specifications.

[2] Includes only costs for preparation of plans and specifications.

OPERATION AND MAINTENANCE

74. General. As specified in the authorizing act, local interests will be required to maintain and operate the completed flood protective works in accordance with regulations prescribed by the Secretary of the Army. The estimated annual maintenance cost of the St. Charles Parish lakefront levee is $16,000. The estimated annual operation and maintenance cost of the drainage structure is $3,700. In addition, the total estimated annual replacement cost of the drainage structure is $11,000 based on replacement intervals of (a) 10 years for the cathodic protection system, (b) 25 years for the gates, and (c) 50 years for the structure and bridge crossing. The total estimated annual cost to local interests for operation, maintenance, and replacement of the protective works presented herein is, therefore, $30,700.

PROJECT FORMULATION AND EVALUATION

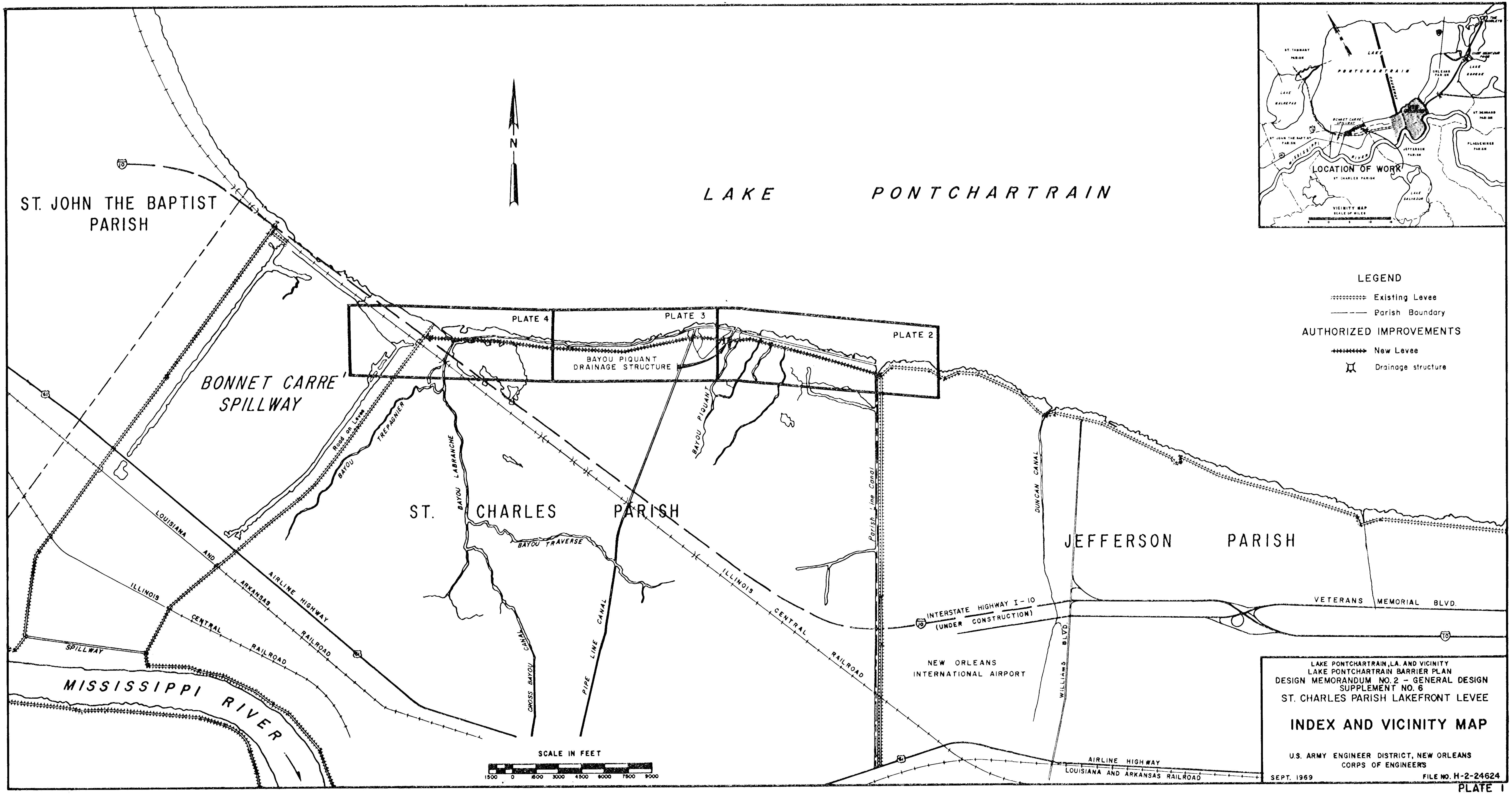
75. Project formulation and evaluation. The St. Charles Parish lakefront levee is not a separable unit of the Lake Pontchartrain Barrier Plan; therefore, an incremental justification and independent economic analysis is not practicable.

ECONOMICS

76. Economic justification. The current economic analysis (LMV Form 23) for the entire Lake Pontchartrain, Louisiana and Vicinity hurricane protection project, based on the July 1969 PB-3 costs, indicates a benefit-to-cost ratio of 12.4 to 1. As stated in paragraph 75 above, an independent economic analysis for the project feature presented herein is not practicable. The additional costs of the St. Charles Parish protective works presented in this memorandum over that shown in the current PB-3 will not significantly change the approved benefit-to-cost ratio for the entire project.

RECOMMENDATIONS

77. Recommendations. The plan of improvement presented herein for the St. Charles Parish lakefront levee consists of a new levee approximately 5.7 miles in length along the St. Charles Parish lakeshore extending from the Bonnet Carre' Spillway east guide levee to the western terminus of the Jefferson Parish lakefront levee. An interior drainage ditch will be provided along the levee alignment from Bayou LaBranch to the Parish Line Canal. A drainage structure equipped with eight 9- by 5-foot combination flap and vertical lift gates will be constructed near the lakeward terminus of Bayou Piquant. 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
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

INDEX AND VICINITY MAP

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 1

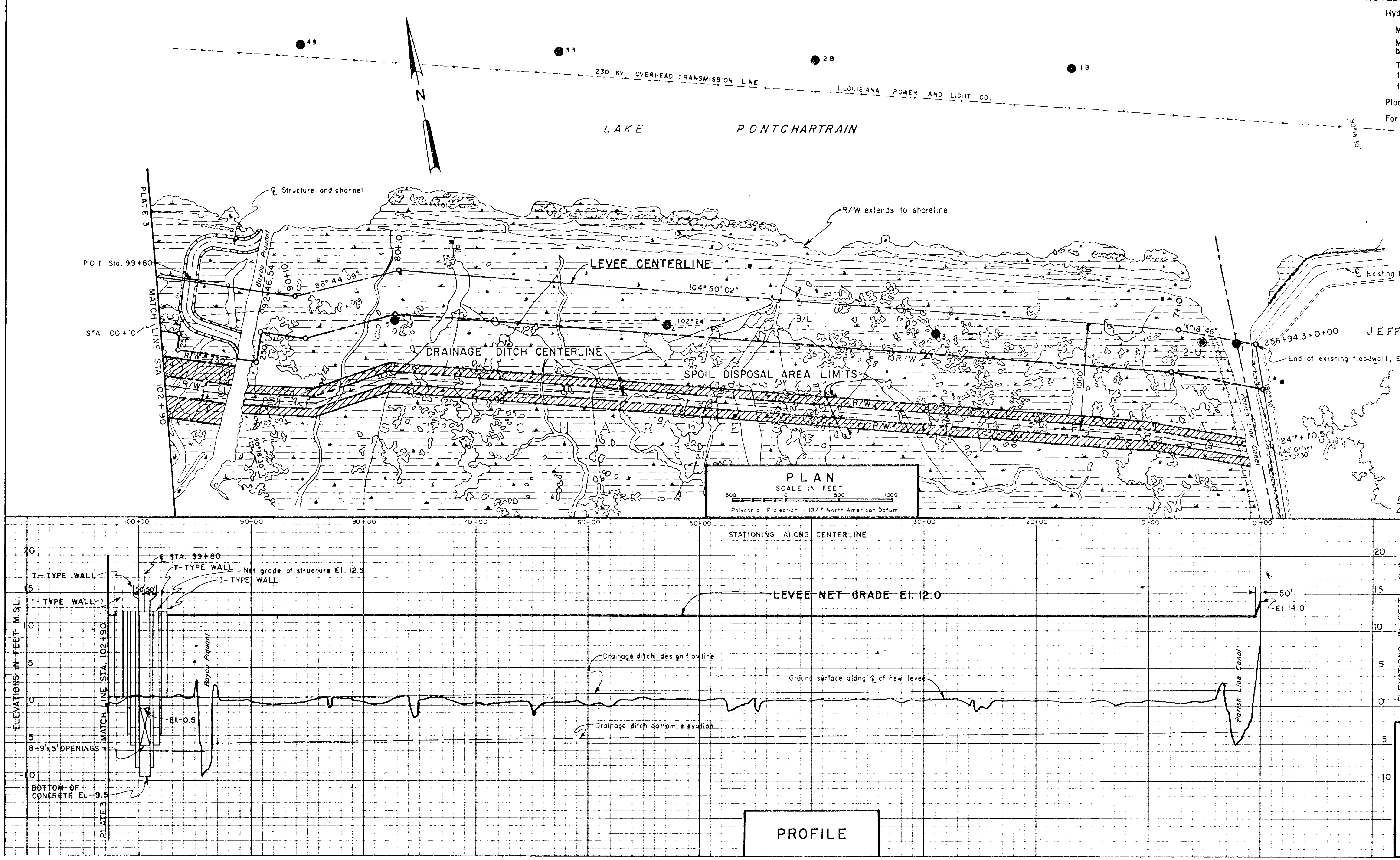
NOTES:

Hydraulic borrow area requirements

- Minimum distance from shore line shall be 2,000 ft.
- Minimum distance from LP&L transmission line shall be 500 ft.
- The borrow area shall be located only on one side of the transmission line at any point along the transmission line.

Planimetry from aerial photographs dated 2 May 1967.

For soil boring logs see plates 8-9



LEGEND

- Parish boundary
- 1 — General type soil boring, baseline
- 2 B — General type soil boring, borrow area
- 2-U — 5" Dia. undisturbed boring
- R/W
- Spoil disposal area

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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PLAN AND PROFILE
STA. 0+00 TO STA. 102+90

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

SEPT. 1969 — FILE NO. H-2-24624

PLATE 2

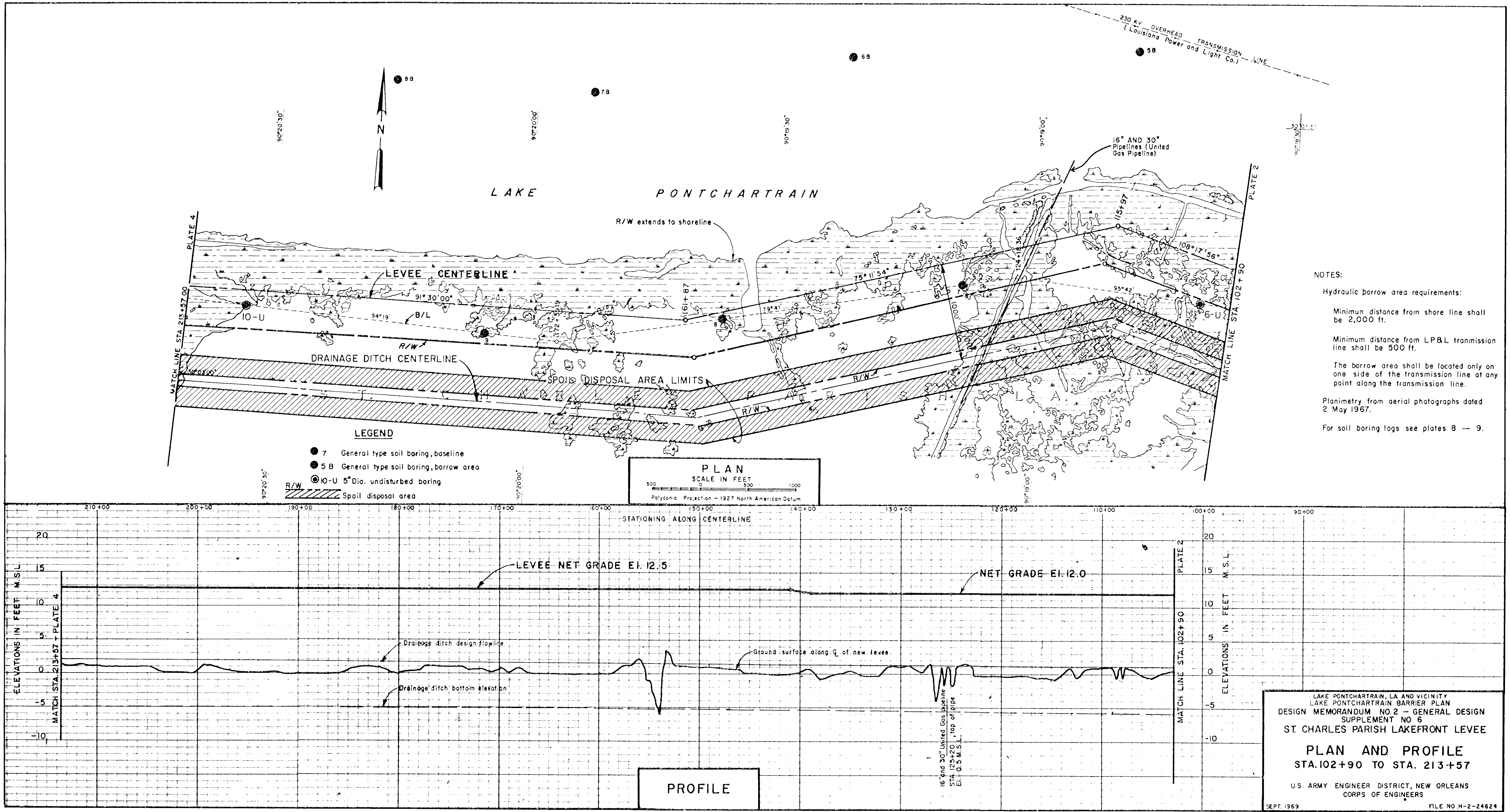
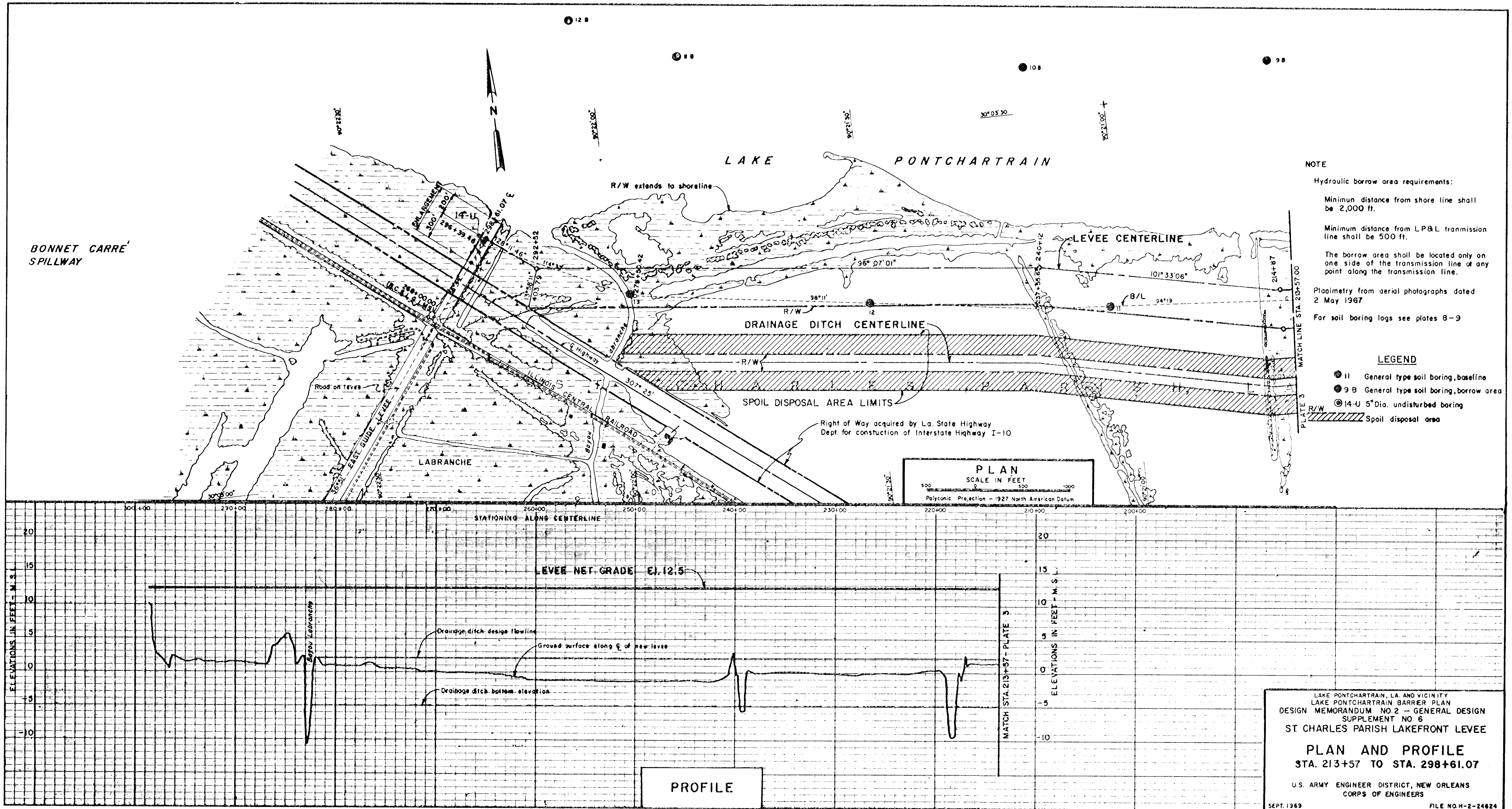

230 KV OVERHEAD TRANSMISSION LINE (Louisiana Power and Light Co.)
N
LAKE PONTCHARTRAIN
16" AND 30" Pipelines (United Gas Pipeline)
R/W extends to shoreline
LEVEE CENTERLINE
91° 30' 00"
94° 19'
B/L
R/W
DRAINAGE DITCH CENTERLINE
SPOIL DISPOSAL AREA LIMITS
75° 11' 54"
79° 41'
108° 17' 56"
95° 42'
161+87
115+97
124+18.36
10-U
6-U
MATCH LINE STA. 213+57.00
MATCH LINE STA. 102+90
PLATE 4
PLATE 2
ST. CHARLES PARISH
LEGEND
7 General type soil boring, baseline
5 B General type soil boring, borrow area
10-U 5" Dia. undisturbed boring
R/W Spoil disposal area
PLAN
SCALE IN FEET
Polyconic Projection – 1927 North American Datum
NOTES:
Hydraulic borrow area requirements:
Minimun distance from shore line shall be 2,000 ft.
Minimum distance from LP&L tranmission line shall be 500 ft.
The borrow area shall be located only on one side of the transmission line at any point along the transmission line.
Planimetry from aerial photographs dated 2 May 1967.
For soil boring logs see plates 8 — 9.
STATIONING ALONG CENTERLINE
ELEVATIONS IN FEET M.S.L.
LEVEE NET GRADE El. 12.5
NET GRADE El. 12.0
Drainage ditch design flowline
Drainage ditch bottom elevation
Ground surface along ℄ of new levee
16" and 30" United Gas Pipeline STA. 125+20, top of pipe El. 0.5 M.S.L.
MATCH STA. 213+57 – PLATE 4
MATCH LINE STA. 102+90 PLATE 2
PROFILE
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO 6
ST. CHARLES PARISH LAKEFRONT LEVEE
PLAN AND PROFILE
STA. 102+90 TO STA. 213+57
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969
FILE NO. H-2-24624

PLATE 3



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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ST CHARLES PARISH LAKEFRONT LEVEE

PLAN AND PROFILE
STA. 213+57 TO STA. 298+61.07

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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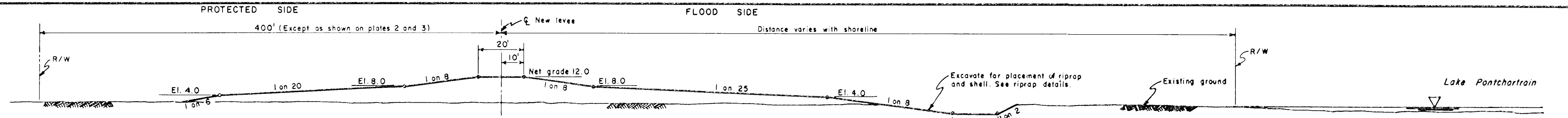
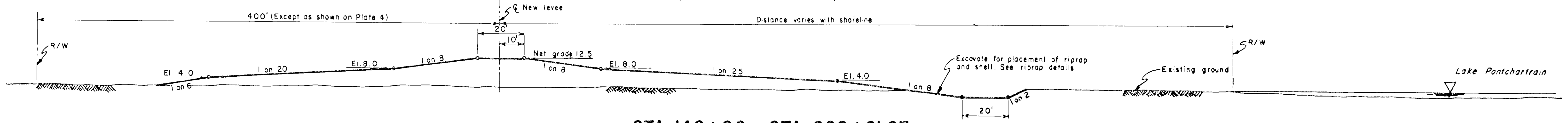
SEPT. 1969 FILE NO. H-2-24624

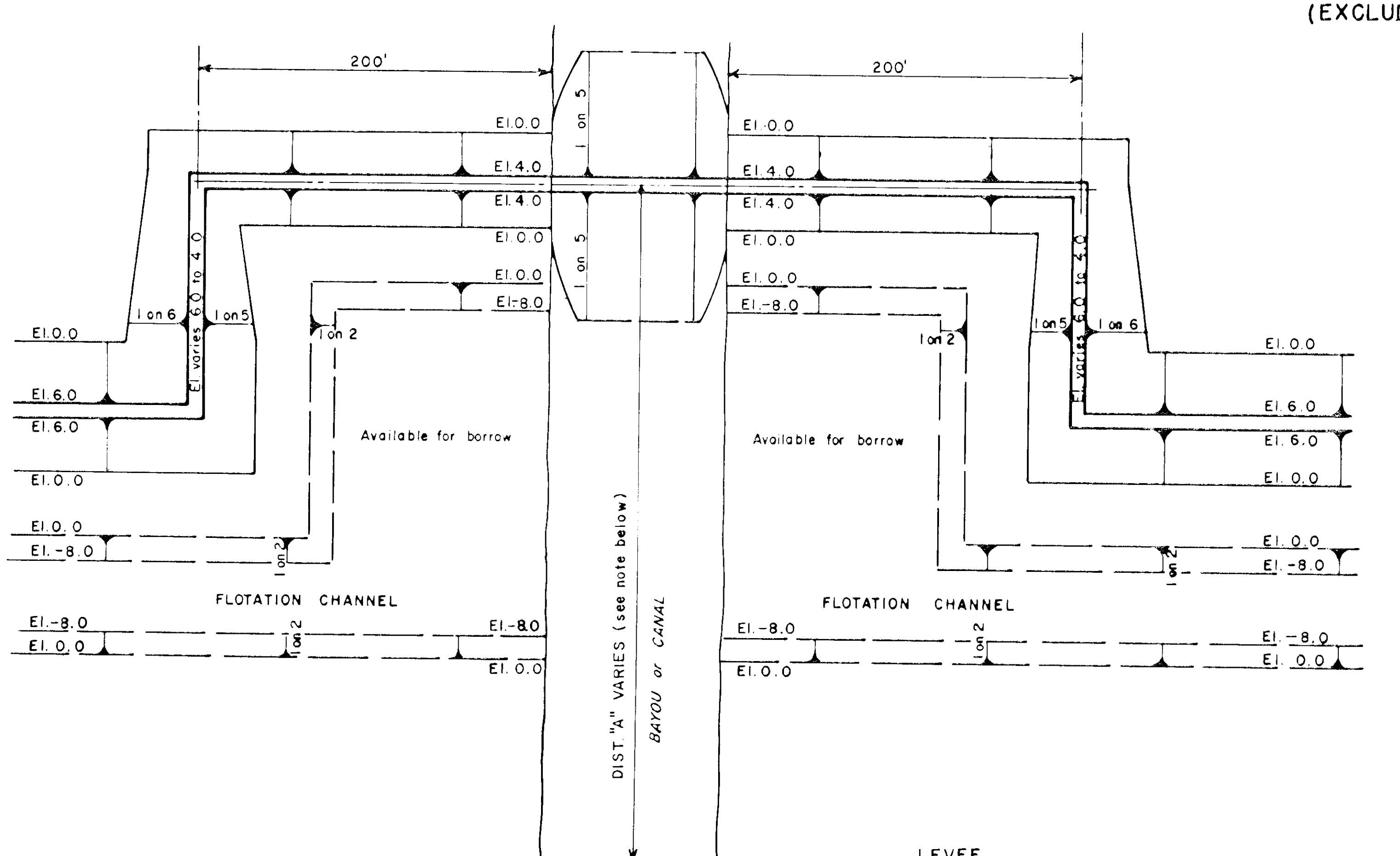
PLATE 4



STA. 0+00 – STA. 140+00
(EXCLUDING CLOSURES)



STA. 140+00 – STA. 298+61.07
(EXCLUDING CLOSURES)

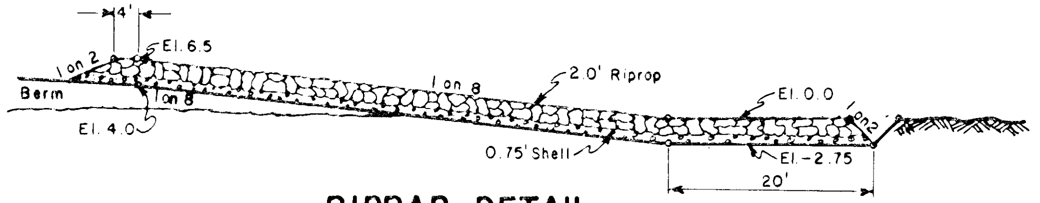


NOTE: CLOSURES

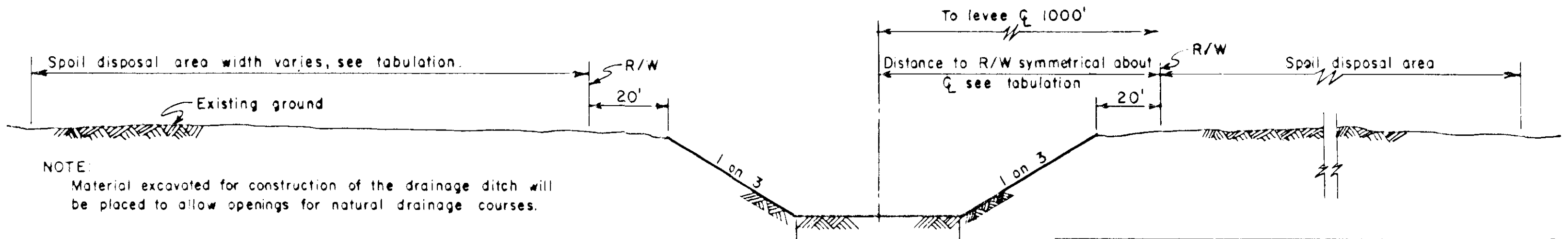
APPROX. ℄ LOCATION	DIST. "A"	BAYOU OR CANAL
STA. 1+90	300'	PARISH LINE CANAL
STA. 93+80	300'	BAYOU PIQUANT
STA. 125+20	300'	CANAL (PIPELINE)
STA. 154+50	380'	CANAL
STA. 218+20	380'	BAYOU
STA. 239+20	380'	CANAL
STA. 282+60	380'	BAYOU LABRANCHE

Bayou Piquant at Sta. 93+80 shall remain open until drainage structure is complete.

HALF-PLAN OF CLOSURE - TYPICAL
(FIRST LIFT)



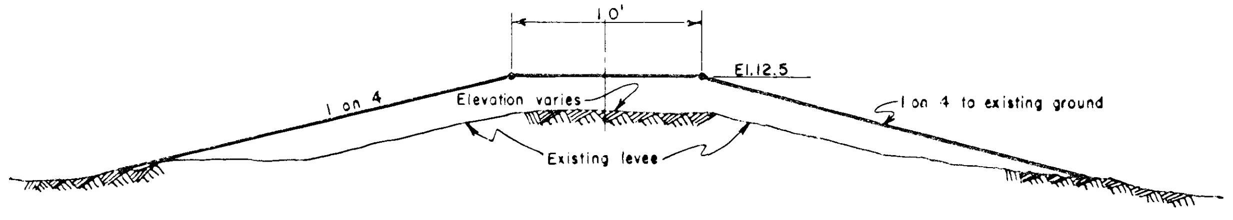
RIPRAP DETAIL



NOTE
Material excavated for construction of the drainage ditch will be placed to allow openings for natural drainage courses.

BOTTOM WIDTH	DEPTH OF FLOW	APPROX. STATIONS ALONG BASELINE	SPOIL DISPOSAL AREA WIDTH
12'	5.8'	2+00 to 94+00	75'
75'	6.8	94+00 to 126+00	200'
75'	6.8'	126+00 to 140+00	110'
75'	6.8'	140+00 to 280+00	110'

LANDSIDE DRAINAGE DITCH DETAIL



BONNET CARRE' SPILLWAY EAST GUIDE LEVEE ENLARGEMENT
(GUIDE LEVEE STATIONS 274+57 TO 279+57)
(PROVIDE 1 ON 20 END SLOPES)

NOTES:
Sections not to scale. All elevations in feet M.S.L.
Smooth transitions will be provided between change in sections.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
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DESIGN SECTIONS AND CLOSURE PLAN

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

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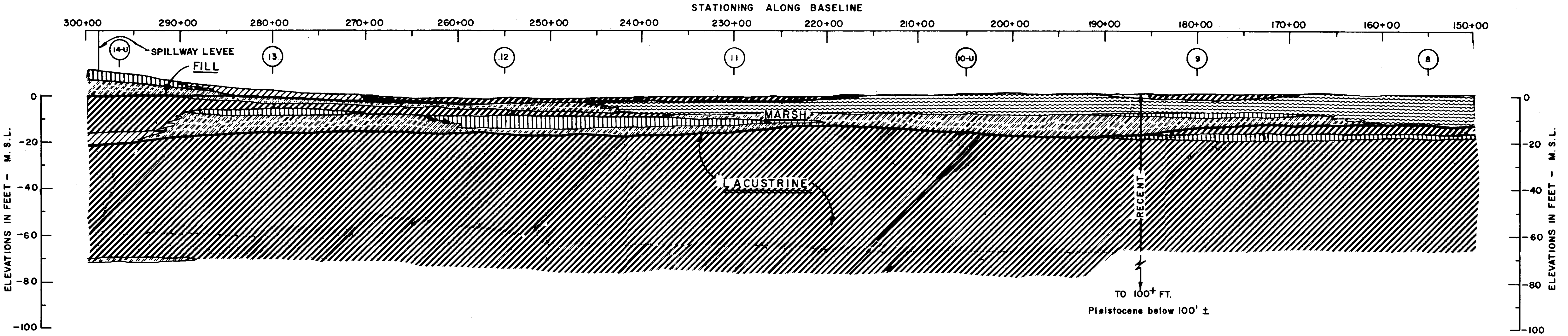
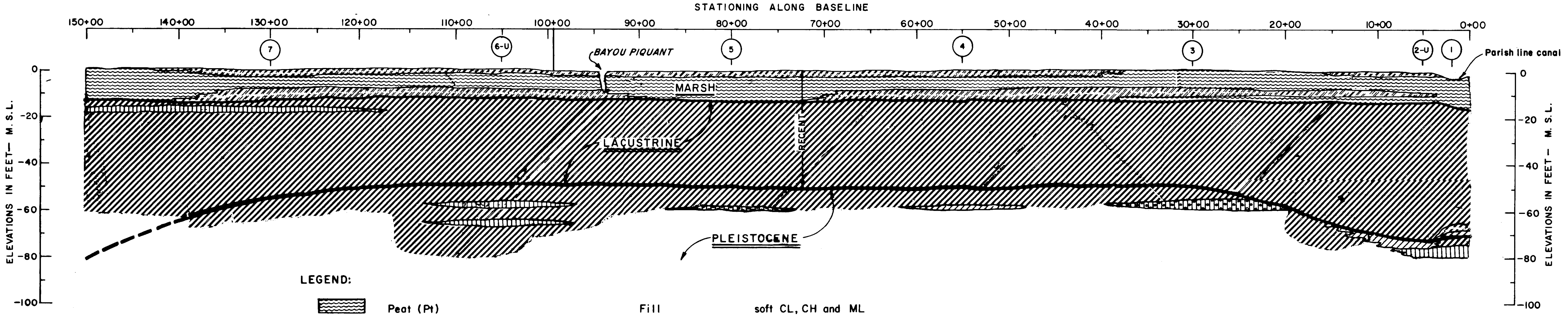
PLATE 5





LEGEND:

Peat (Pt)		Fill	soft CL, CH and ML
Fat clay with organic matter (CHO)		Marsh	vy soft CH with organic matter and peat
Fat clay (CH)		Lacustrine	vy soft to soft CH with SIS; and slf
Lean clay (CL)		Pleistocene	stiff to vy stiff CH with SIS
Silt (ML)			
Silty sand (SM)			
(7) Boring number and location along profile.			

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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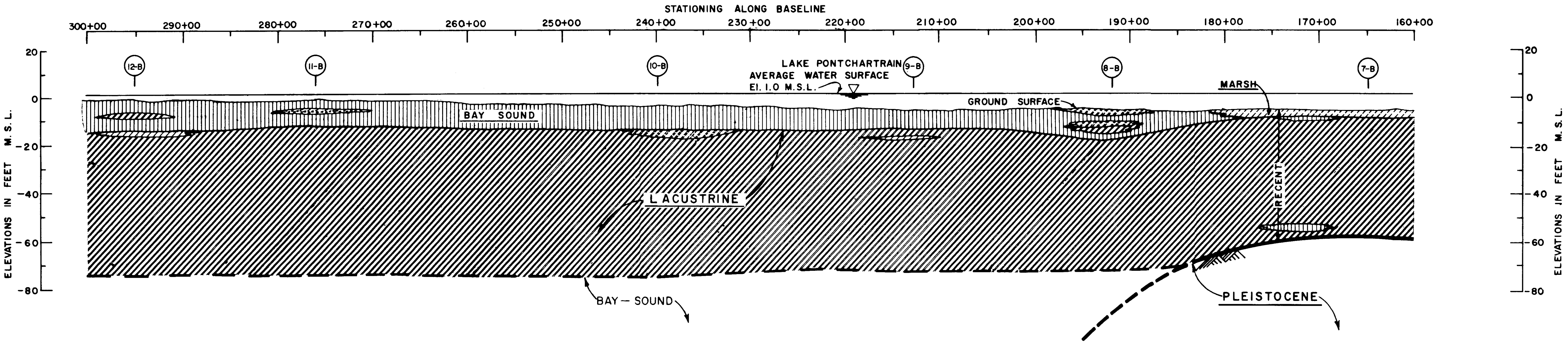
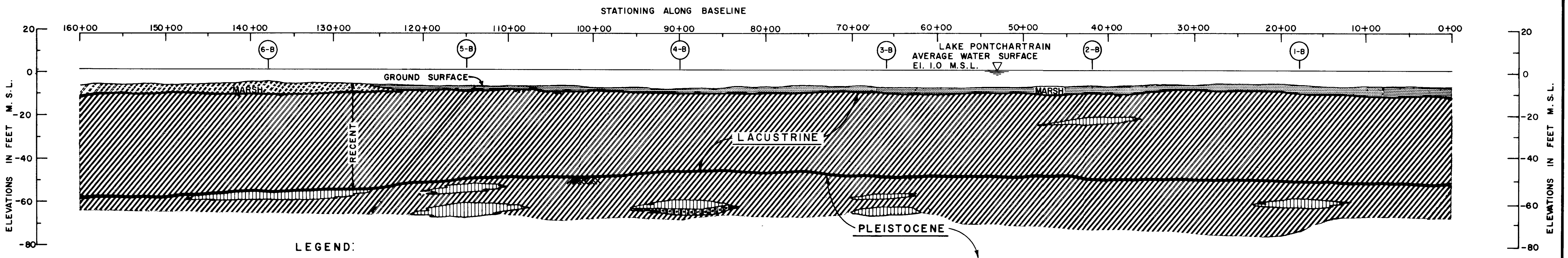
SOIL AND GEOLOGIC PROFILE ALONG LEVEE CENTERLINE

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 6





LEGEND:

- Peat (Pt)
- Fat clay with organic matter (CHO)
- Fat clay (CH)
- Lean clay with organic matter (CLO)
- Lean clay (CL)
- Silt (ML)
- Shells (Sl)
- Silty Sand (SM)
- (7-B) Boring number and location along profile

Marsh	vy soft CH with organic matter and peat
Bay—Sound	silts with CS and sl and slf
Lacustrine	vy soft to soft CH with SIS, and slf
Pleistocene	stiff to vy stiff CH with SIS

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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SOIL AND GEOLOGIC PROFILE
LAKE PONTCHARTRAIN
BORROW AREA

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

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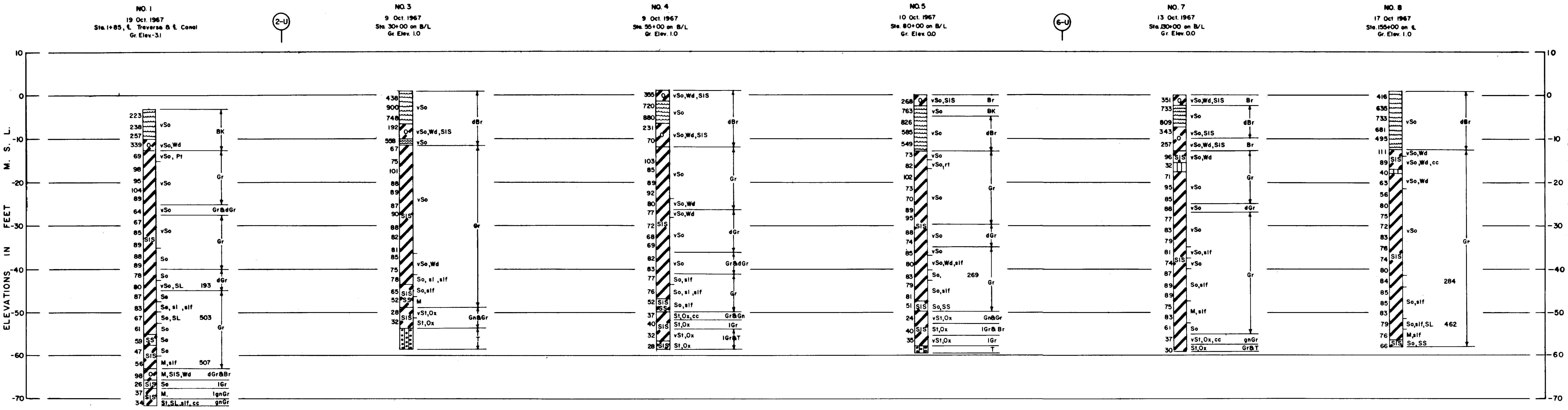
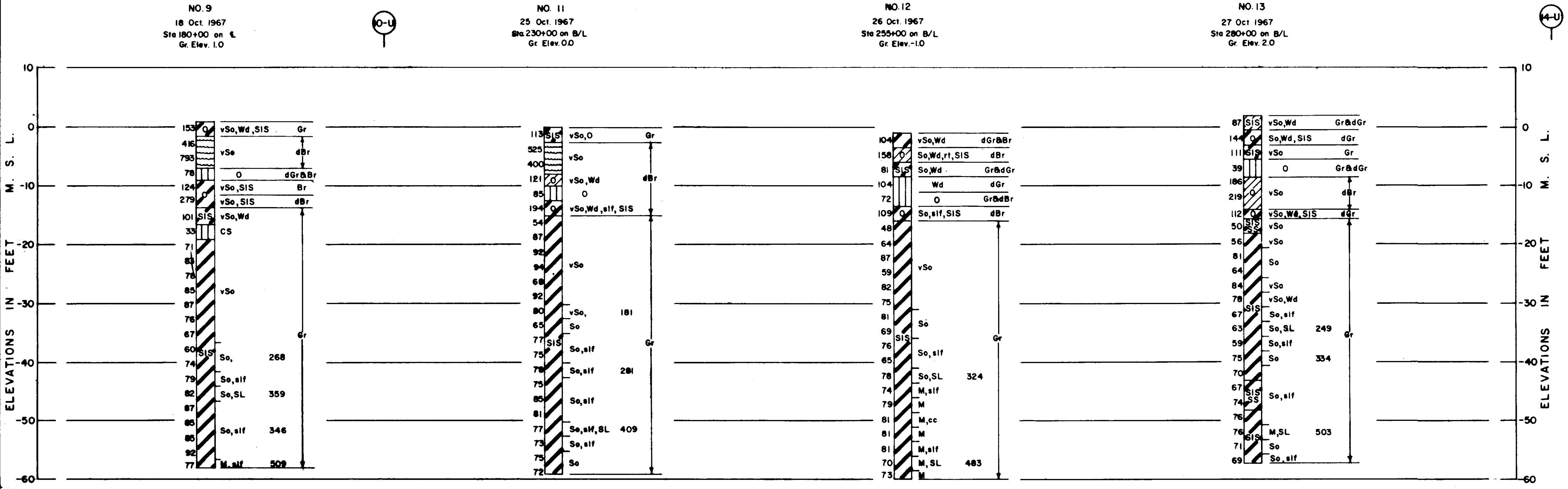
PLATE 7





NOTES:
General type borings were taken with a $1\frac{7}{8}$" I.D. core barrel sampler.
For undisturbed borings, see plates 10 thru 13.
For soil boring legend, see plate A.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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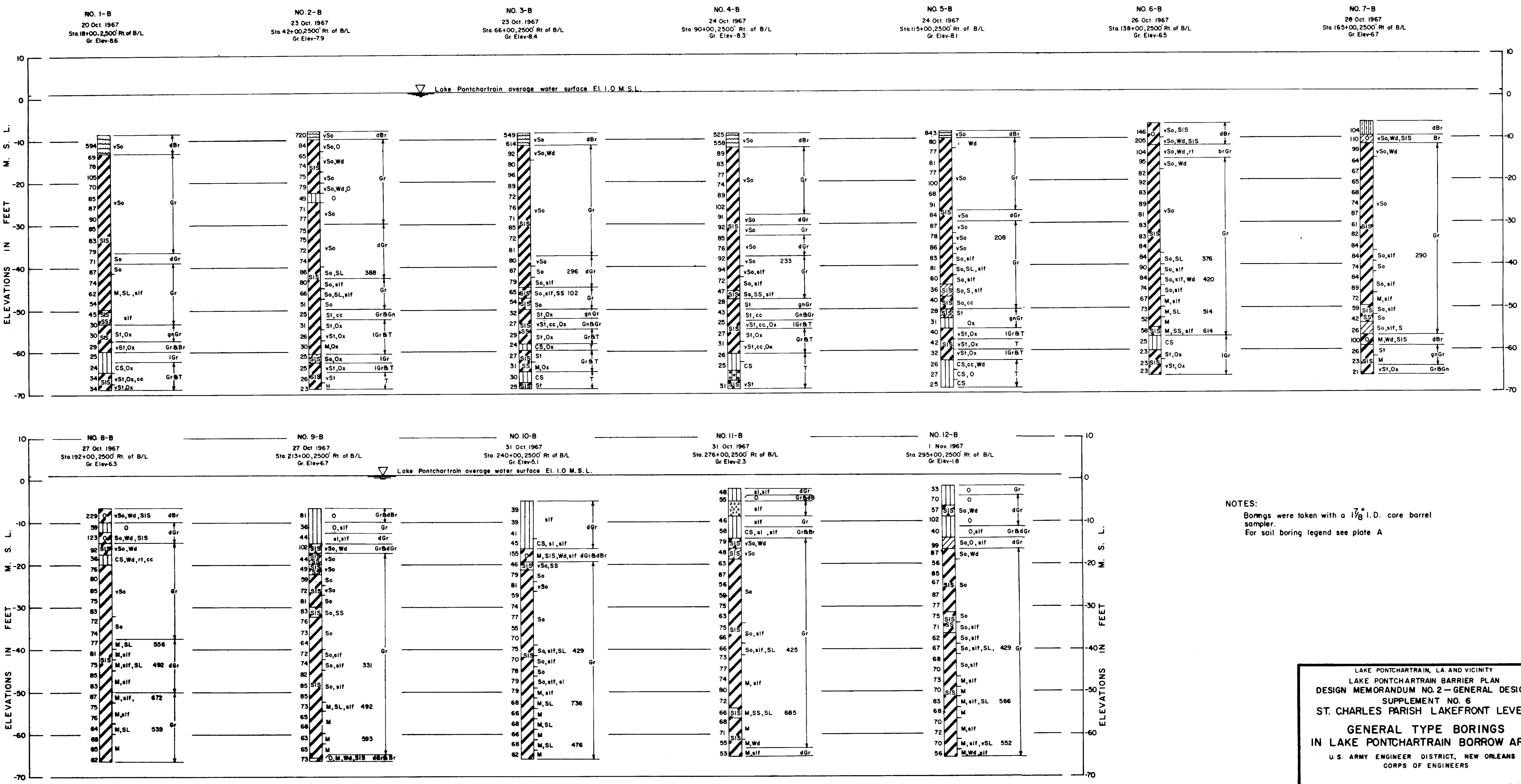
GENERAL TYPE BORINGS ALONG BASELINE

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 8



NOTES:
Borings were taken with a $1\frac{7}{8}$" I.D. core barrel sampler.
For soil boring legend see plate A

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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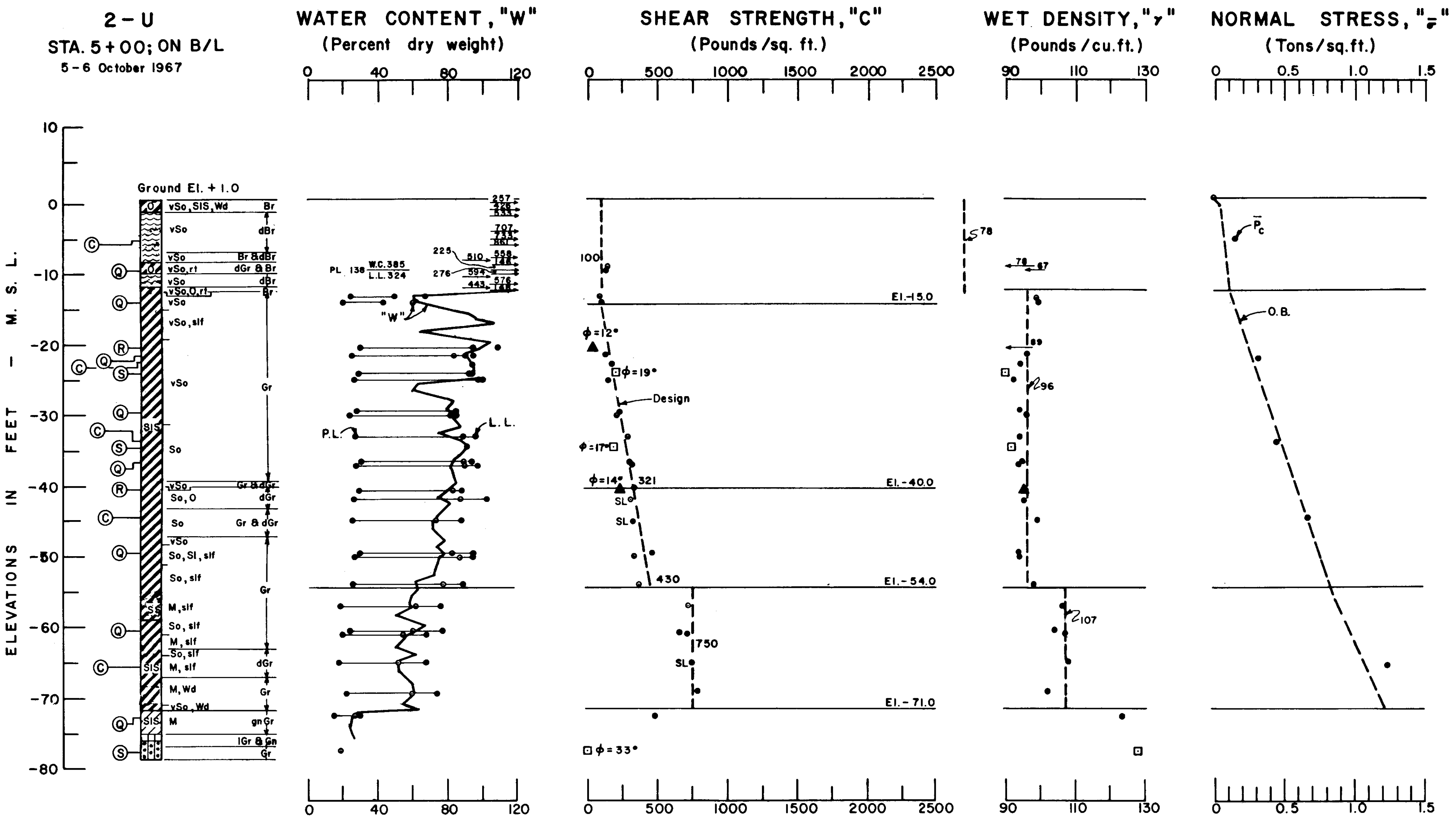
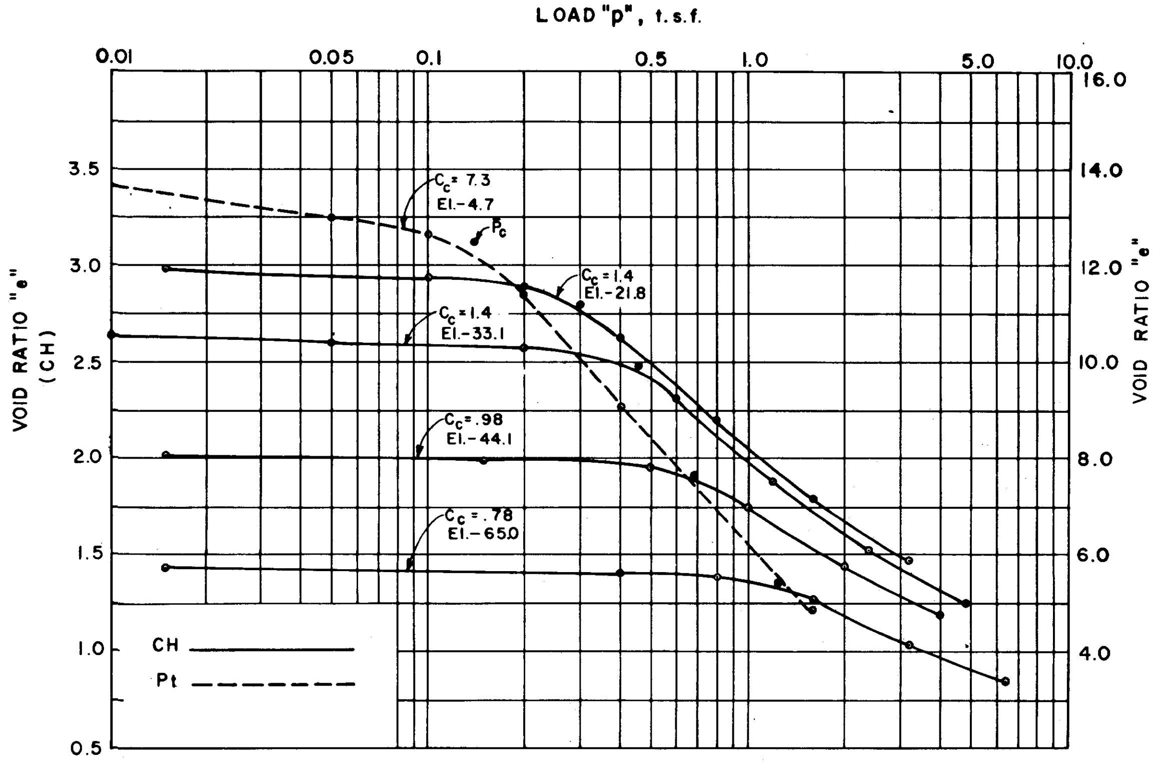
GENERAL TYPE BORINGS IN LAKE PONTCHARTRAIN BORROW AREA

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

SEPT. 1969 — FILE NO. H-2-24624

PLATE 9



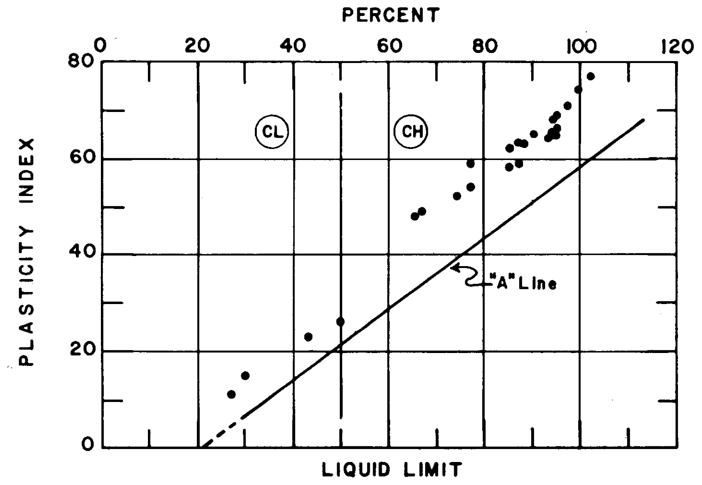


CONSOLIDATION DATA

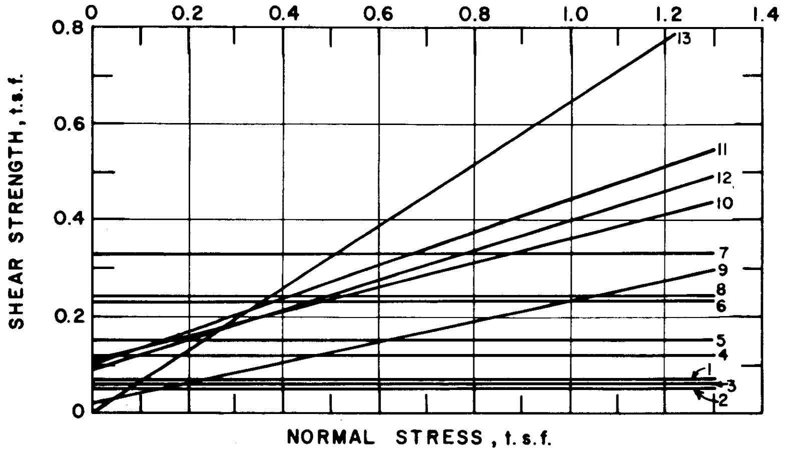
GENERAL NOTES

- ∘ 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.

See plate A for soil boring legend.



PLASTICITY CHART



ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	-9.5	Q	0	0.07	Pt
2	-14.0			0.05	CL
3	-21.4			0.06	CH
4	-29.5			0.12	CH
5	-36.7			0.15	CH
6	-49.6			0.23	CH
7	-60.7			0.33	CH
8	-72.5		0	0.24	CL
9	-20.5	R	12	0.02	CH
10	-40.7		14	0.11	CH
11	-23.9	S	19	0.10	CH
12	-34.5		17	0.09	CH
13	-77.5		33	0.00	ML

SHEAR STRENGTH DATA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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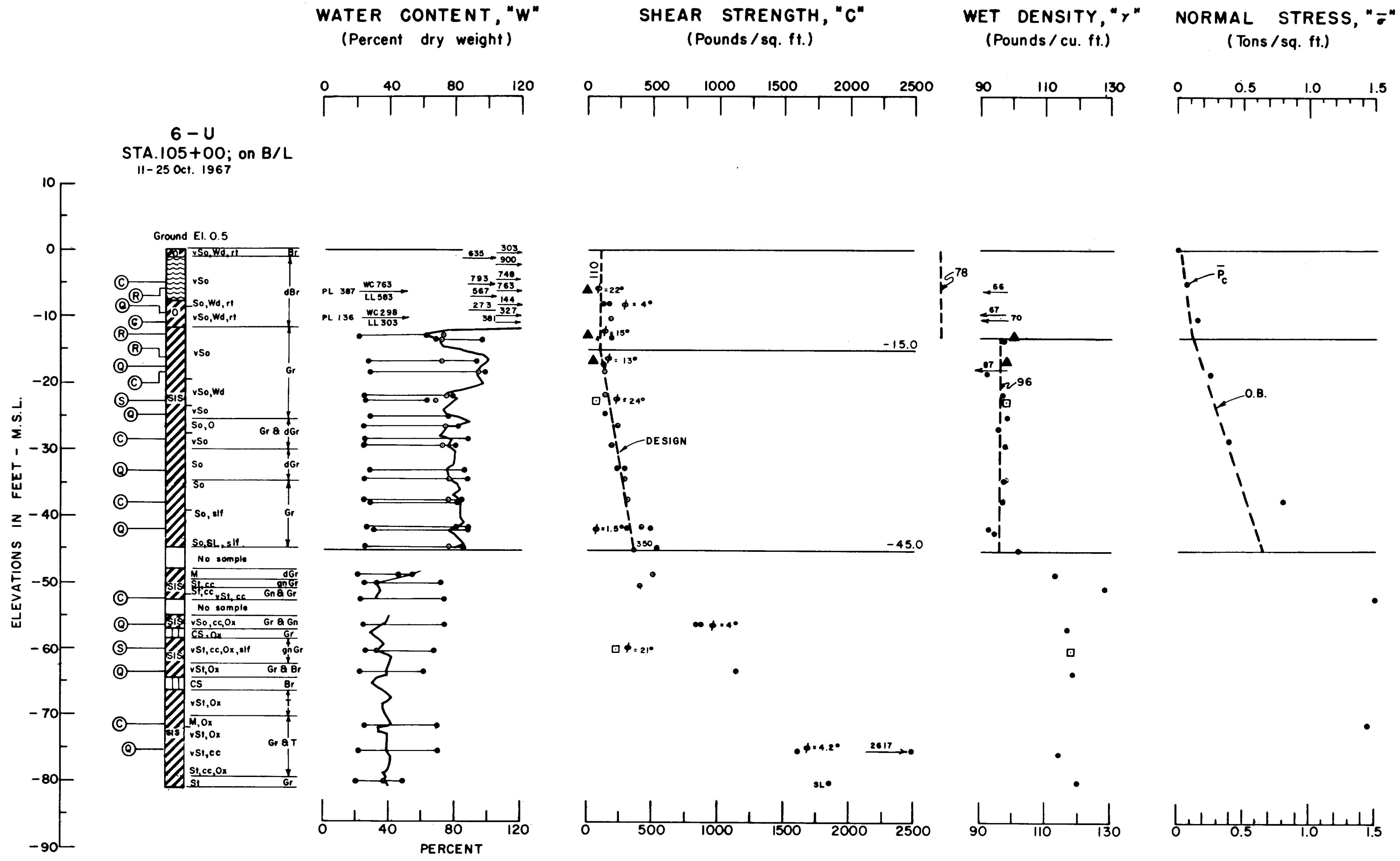
UNDISTURBED BORING 2-U DATA

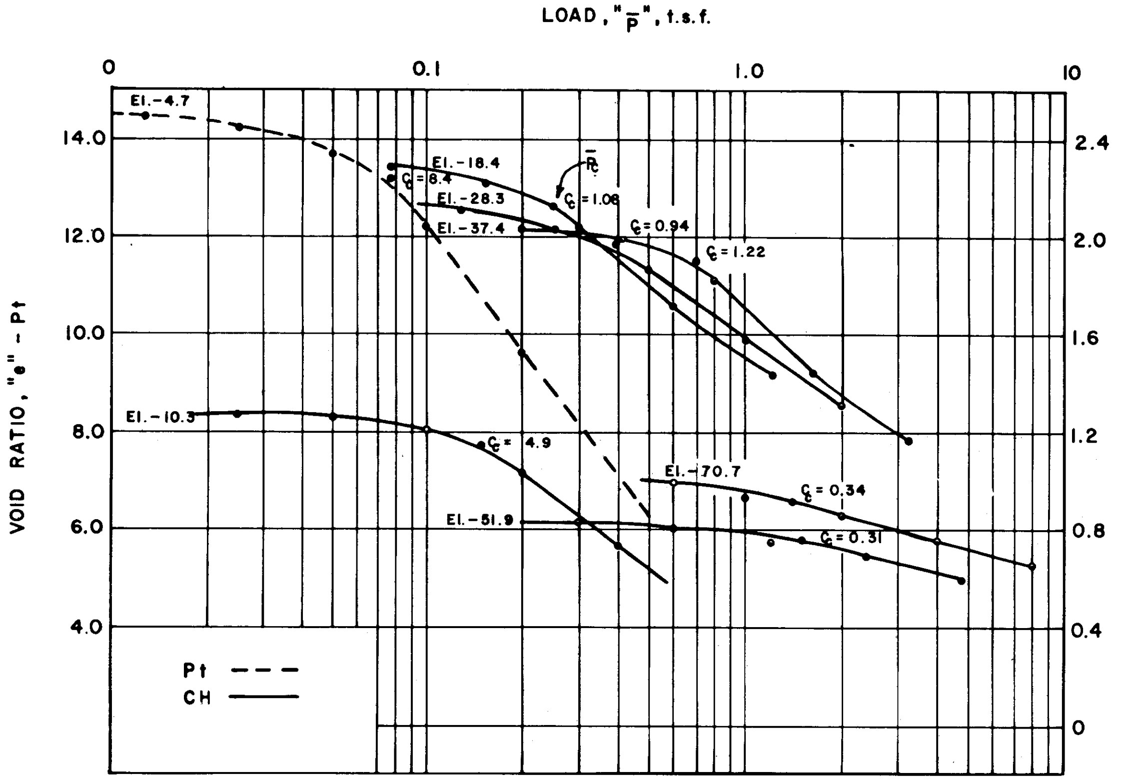
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969

FILE NO. H-2-24624

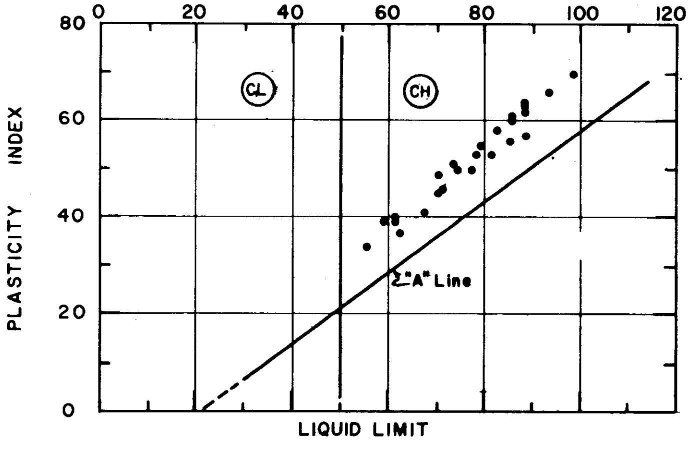
PLATE 10



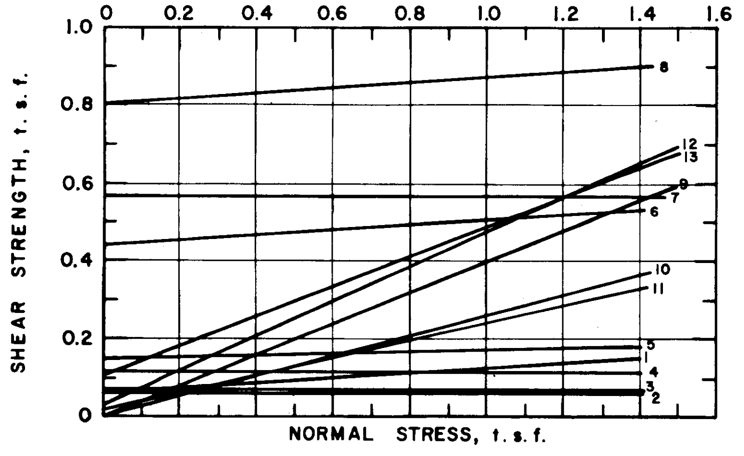


CONSOLIDATION DATA

NOTE:
See plate 10 for general notes.
See plate A for soil boring legend.



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f)	CLASS
1	- 9.2	Q	4.0	0.067	Pt
2	-17.3		0	0.065	CH
3	-24.5		0	0.070	CH
4	-32.6		0	0.120	CH
5	-41.6		1.5	0.150	CH
6	-55.8		4.0	0.440	CH
7	-62.9		0	0.570	CH
8	-74.9		4.2	0.800	CH
9	- 5.6	R	22	0.00	Pt
10	-12.3		15	0.00	CH
11	-16.1		13	0.02	CH
12	-22.2	S	24	0.03	CH
13	-59.8		21	0.11	CH

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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UNDISTURBED BORING
6-U DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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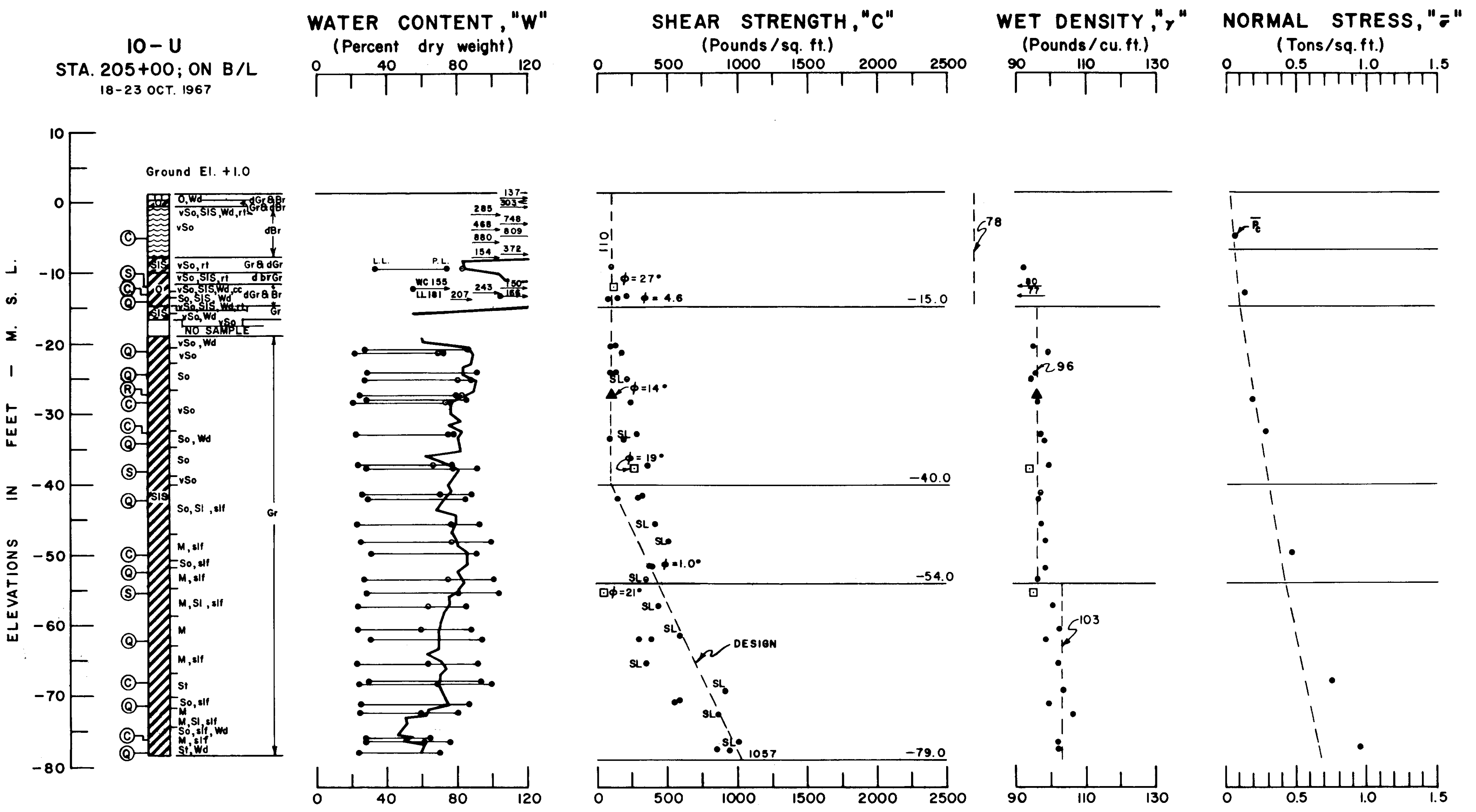
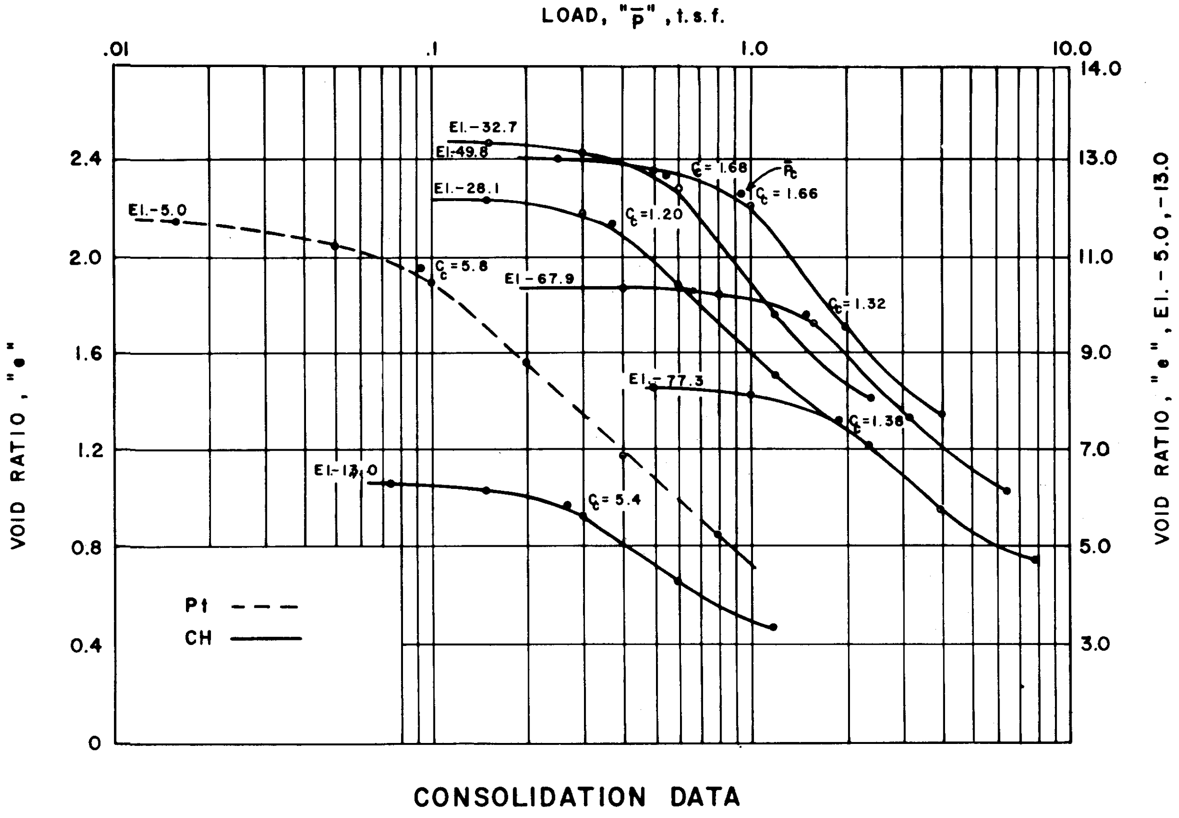
SEPT. 1969

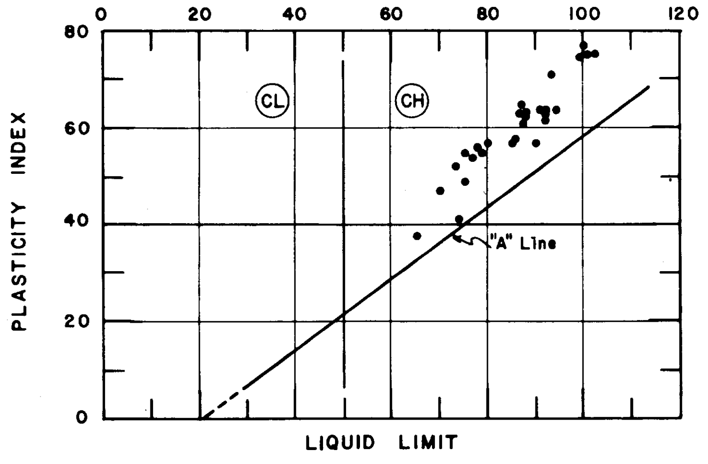
FILE NO. H-2-24624



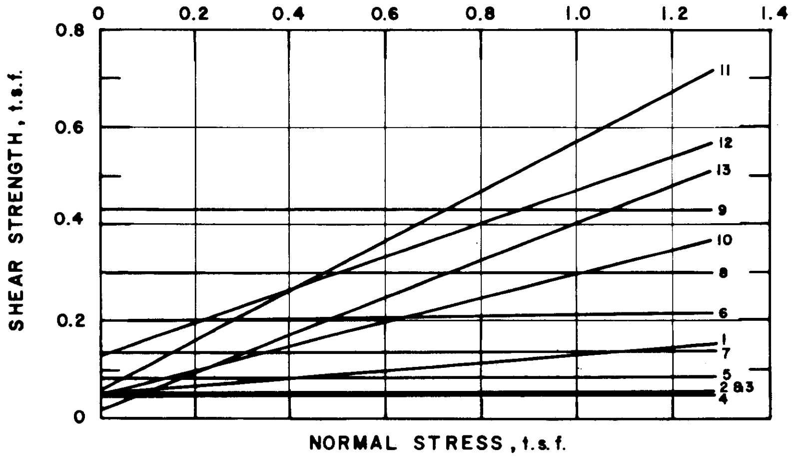


CONSOLIDATION DATA

NOTE:
See plate 10 for general notes.
See plate A for soil boring legend.



PLASTICITY CHART



ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ°	STRENGTH c (t.s.f.)	CLASS
1	-14.1	Q	4.6	0.055	CH
2	-21.0		0	0.057	
3	-24.8		0	0.058	
4	-33.6		0	0.048	
5	-42.0		2.0	0.087	
6	-52.3		1.0	0.200	
7	-62.0		0	0.140	
8	-71.3		0	0.300	
9	-78.0		0	0.430	CH
10	-27.4	R	14	0.05	CH
11	-12.2	S	27	0.06	CH
12	-37.9		19	0.13	CH
13	-55.4		21	0.02	CH

SHEAR STRENGTH DATA

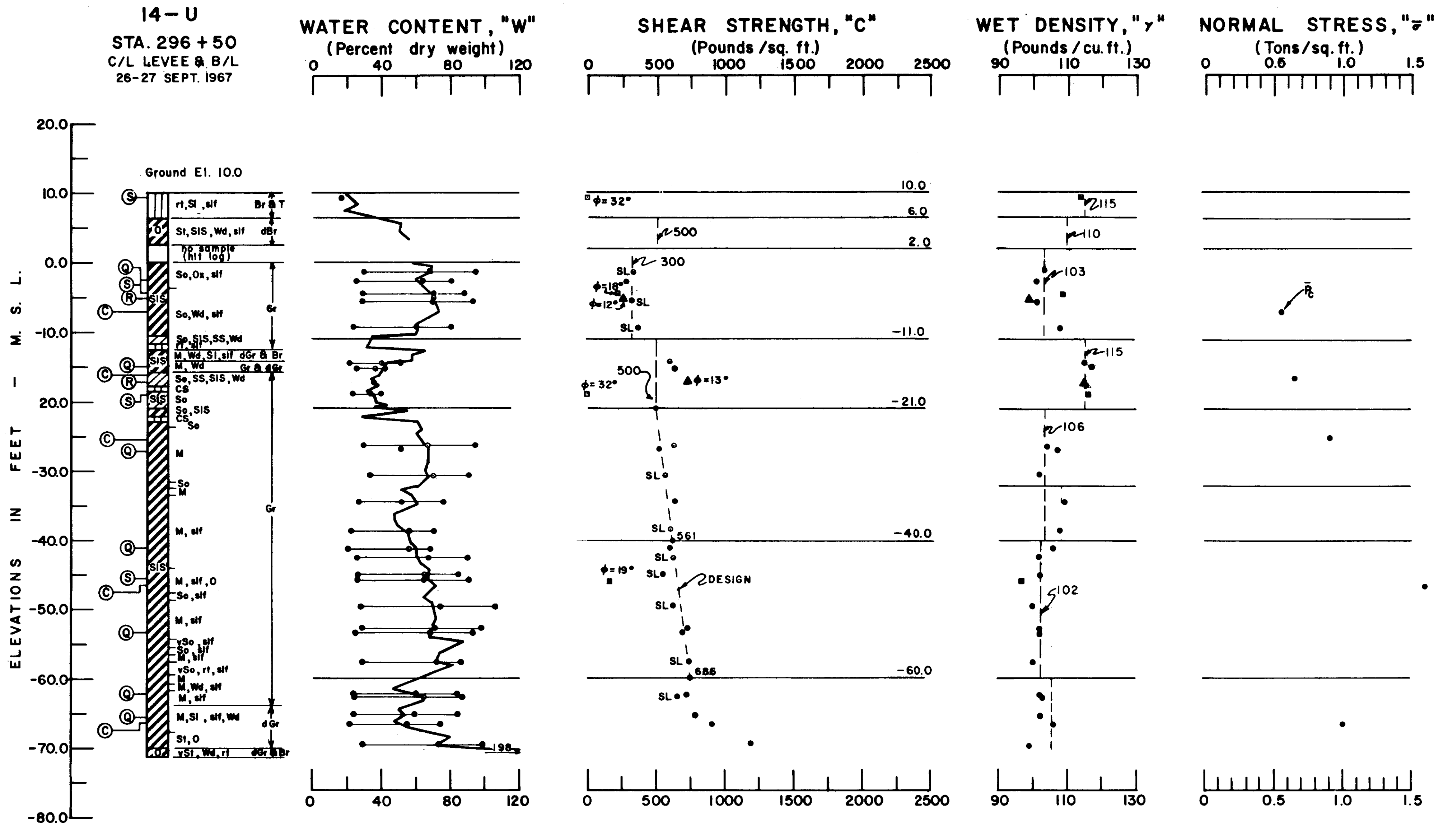
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

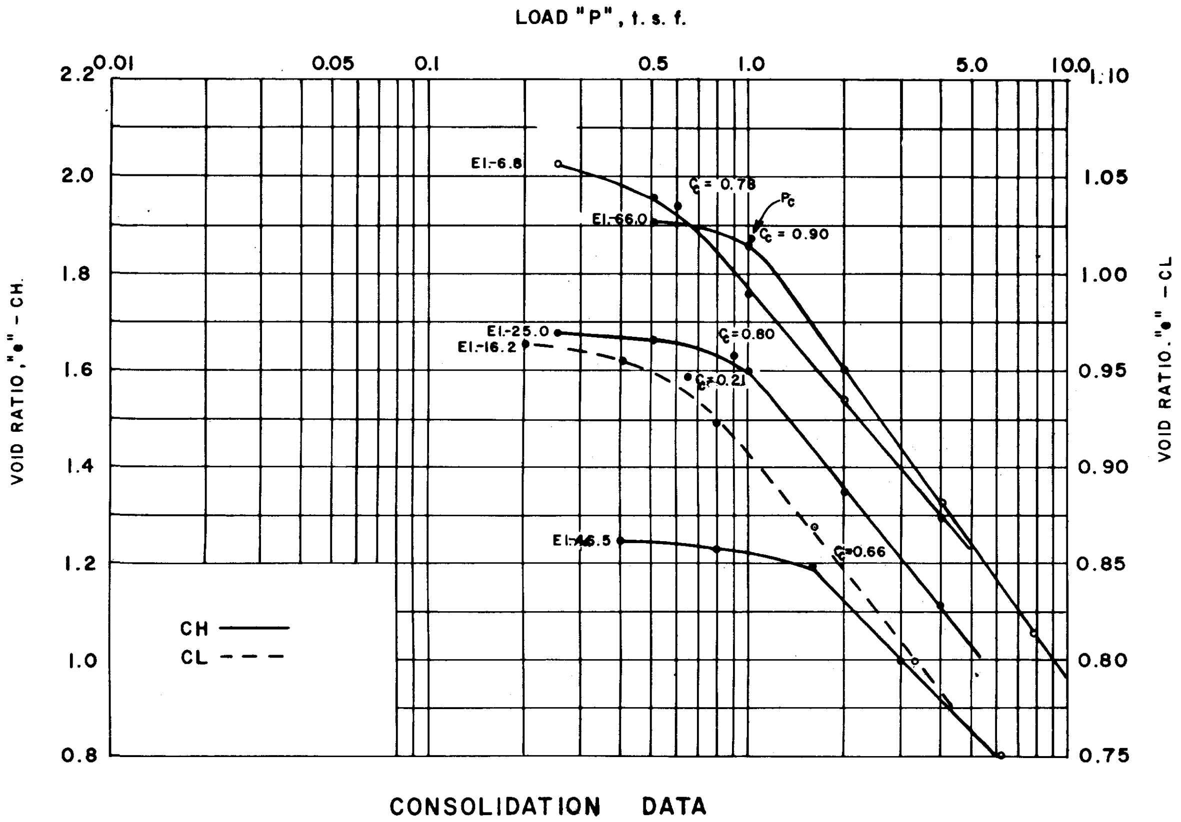
UNDISTURBED BORING 10-U DATA

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

SEPT. 1969

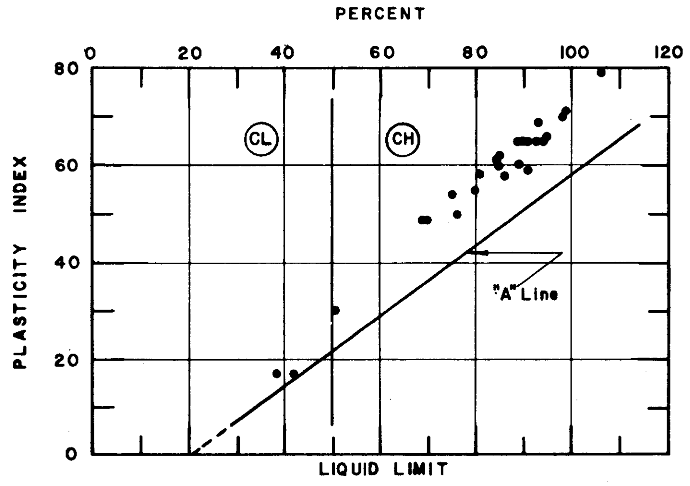
FILE NO. H-2-24624



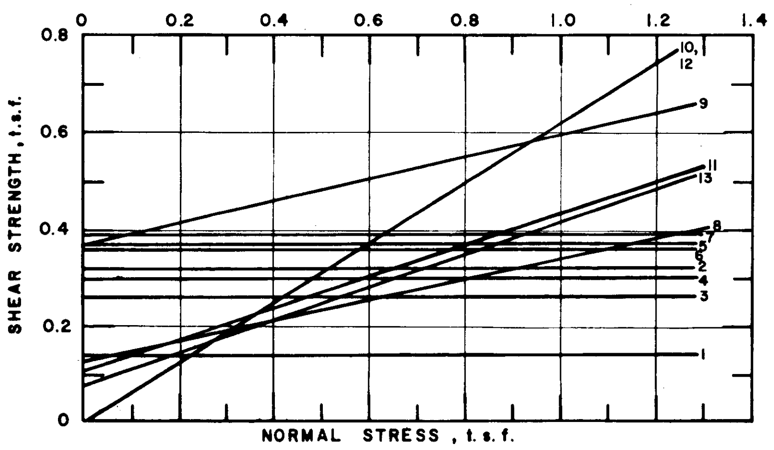


CONSOLIDATION DATA

NOTE:
See plate 10 for general notes.
See plate A for soil boring legend



PLASTICITY CHART



ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ(DEG)	STRENGTH c (t. s. f.)	CLASS
1	- 2.5	Q	0	0.14	CH
2	-14.9			0.32	CL
3	-26.8			0.26	CH
4	-41.1			0.30	CH
5	-52.6			0.37	CH
6	-62.0			0.36	CH
7	-65.1		0	0.39	CH
8	- 5.0	R	12	0.13	CH
9	-17.0		13	0.37	ML
10	+ 9.5	S	32	0.00	CL
11	- 4.2		18	0.11	CH
12	-18.8		32	0.00	CL
13	-45.6		19	0.08	CH

SHEAR STRENGTH DATA

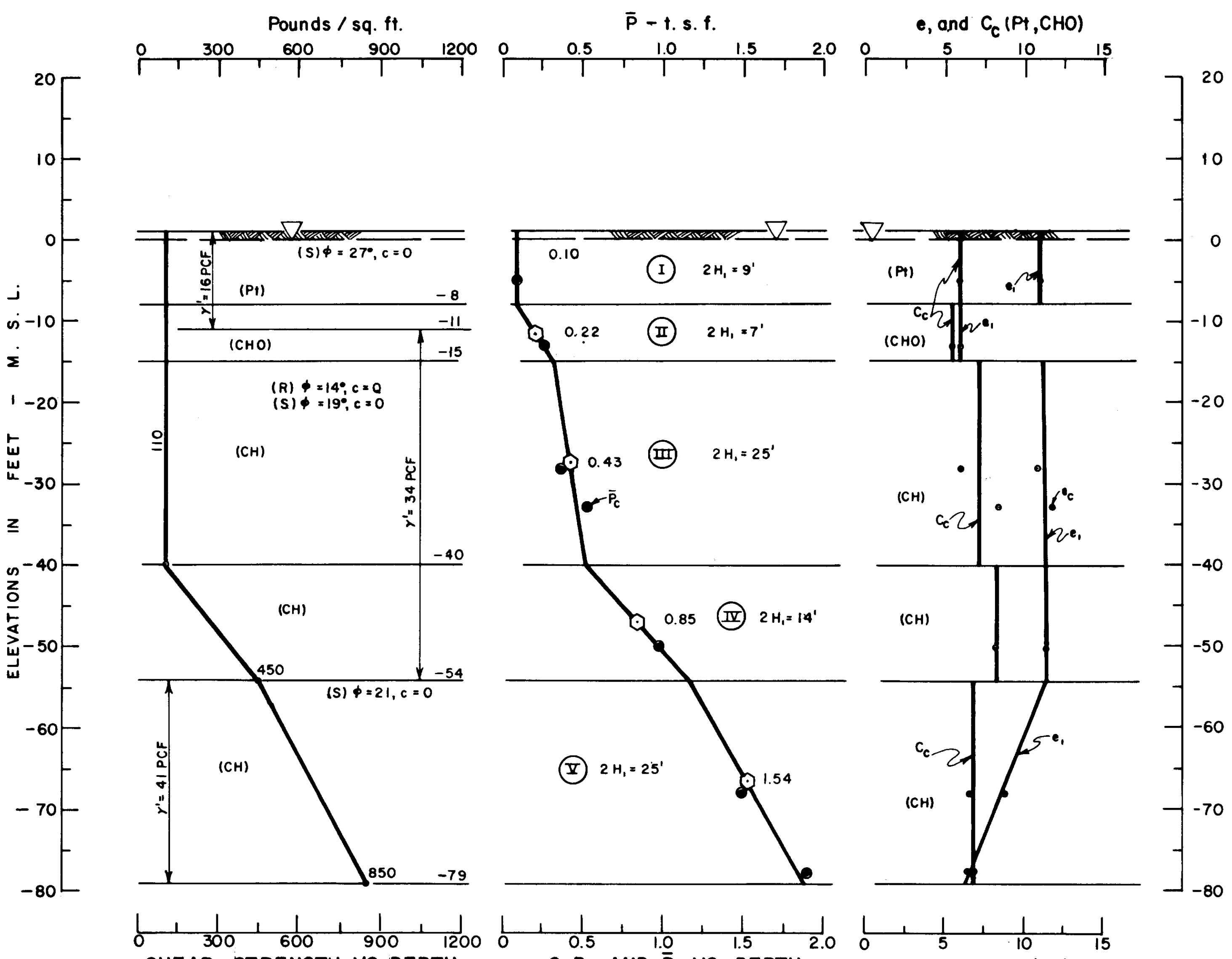
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

UNDISTURBED BORING 14-U DATA

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

SEPT. 1969 FILE NO. H-2-24624

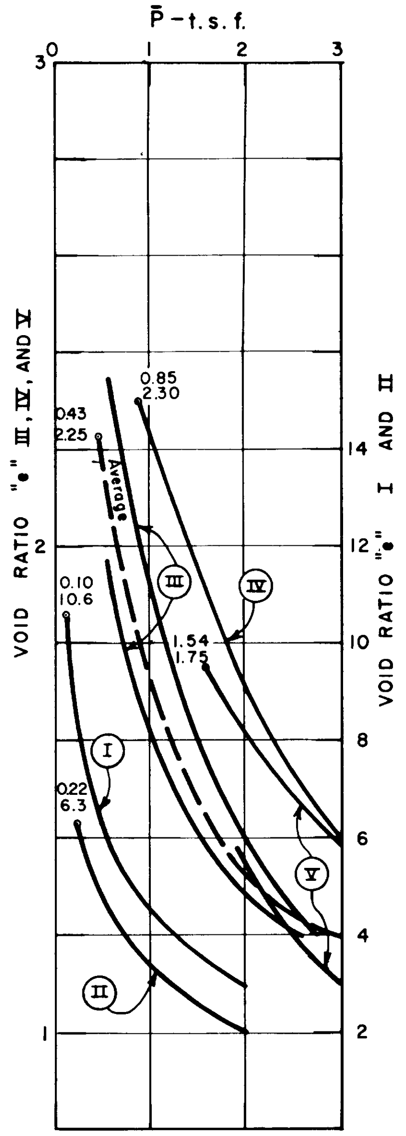
PLATE 13



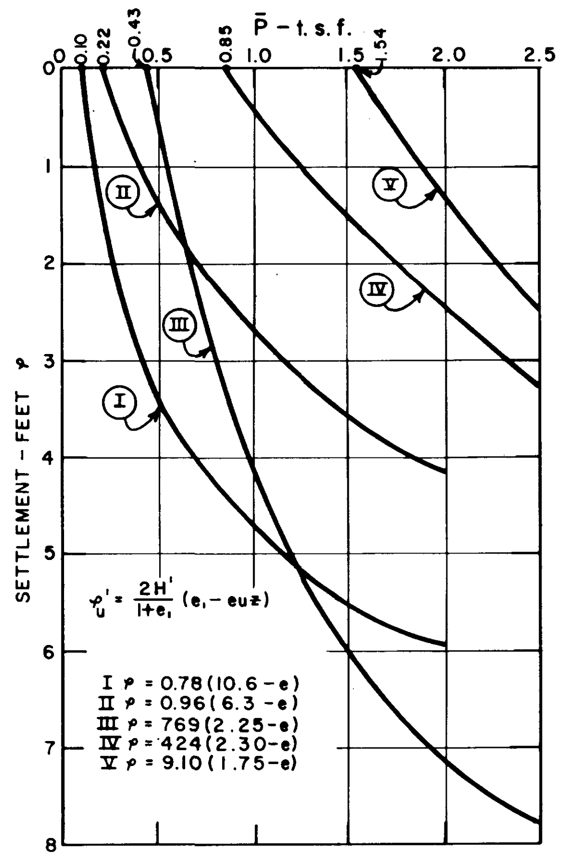
SHEAR STRENGTH VS DEPTH

O.B. AND P̄, VS DEPTH

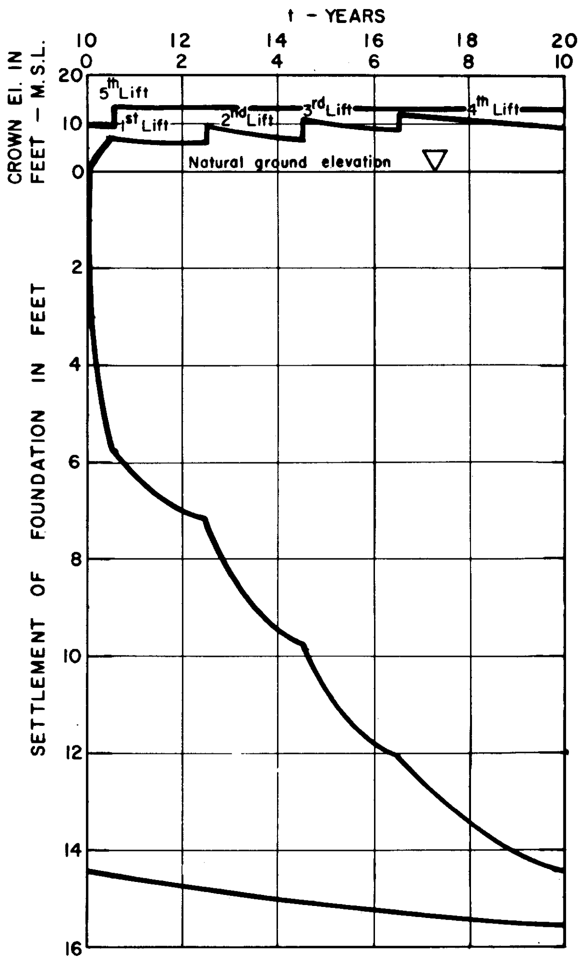
e_1 AND C_c VS DEPTH



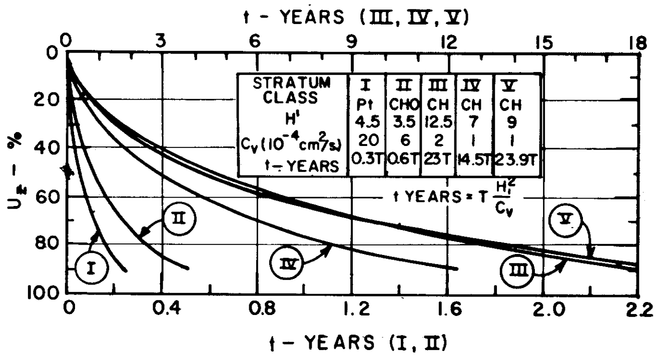
e VS P̄ CURVES



SETTLEMENT VS LOAD

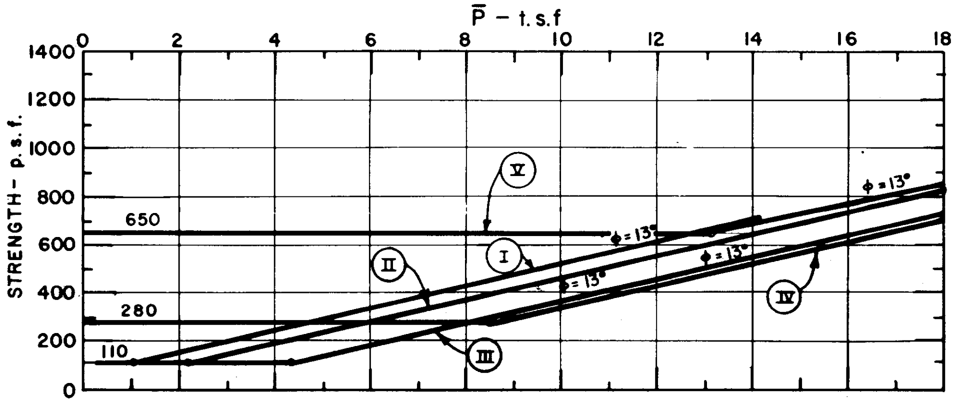


SETTLEMENT VS TIME

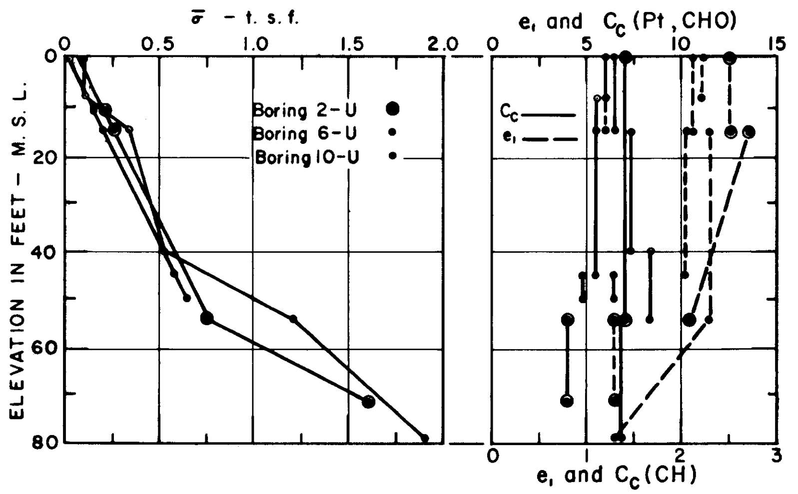


STRATUM CLASS	I	II	III	IV	V
	Pt	CHO	CH	CH	CH
H'	4.5	3.5	12.5	7	9
C_v (10^{-4} cm^2/s)	20	6	2	1	1
t - YEARS	0.3T	0.6T	23T	14.5T	23.9T

$U_{\bar{z}}$ % VS TIME



ENVELOPES OF STRENGTH VS LOAD FOR Q AND R VALUES



O.B. AND P VS DEPTH

e_1 AND C_c VS DEPTH

GENERAL NOTES

- $\bar{P}_c$ Preconsolidation pressure.
- C_c Compression index.
- e Void ratio.
- ρ Settlement.
- C_v Coefficient of consolidation.
- $\bar{P}$ Intergranular pressure.
- t Time in years.
- $U_{\bar{z}}$ Percent consolidation.

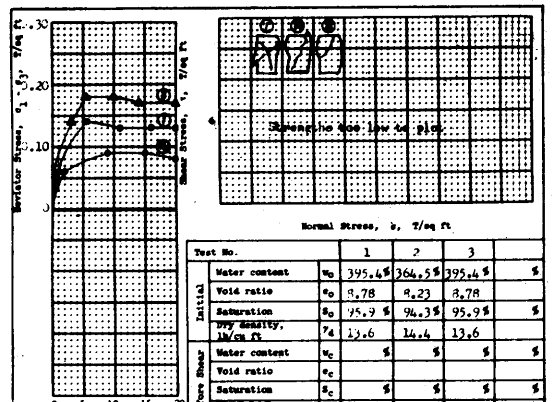
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

CONSOLIDATION DESIGN DATA BORING NO. 10-U

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

SEPT. 1969 FILE NO. H-2-24624

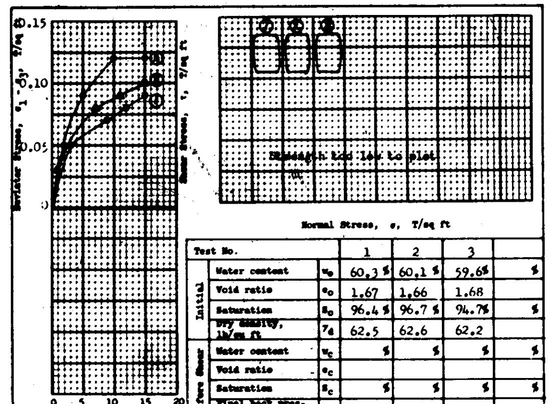
PLATE 14



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.07 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	39.4%	36.5%	39.4%
Void ratio	e_o	0.78	[illegible]	0.78
Saturation	S_o	95.9%	93.8%	95.9%
Dry density, lb/cu ft	γ_d	83.6	84.4	83.6
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.14	0.09	0.18
Time to failure, min	t_f	8	60	24
Rate of strain, percent/min		0.70	0.15	3.22
Initial diameter, in.	D_o	1.38	1.38	1.39
Initial height, in.	H_o	3.00	3.00	3.00

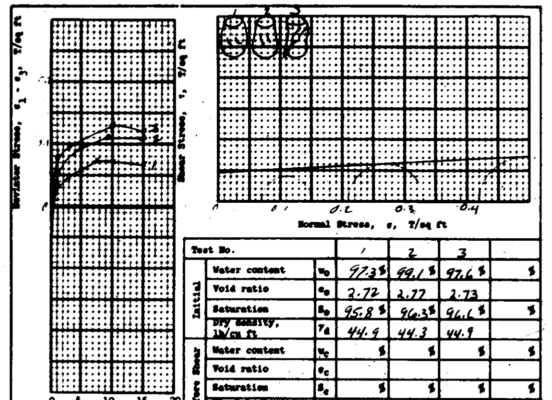
Controlled strain. Type of specimen: UNDISTURBED. Classification: [illegible]. LL 34, PL 13, PI [illegible], G_s 2.73. Project: LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE. Boring No. 2-U; Sample No. 3-C; Depth 10.0; Date 27 November 1967. JHG — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.05 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	60.3%	60.1%	59.6%
Void ratio	e_o	1.67	1.66	1.68
Saturation	S_o	96.4%	96.7%	94.7%
Dry density, lb/cu ft	γ_d	62.5	62.6	62.2
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.09	0.12	0.10
Time to failure, min	t_f	170	16	45
Rate of strain, percent/min		0.09	0.62	0.33
Initial diameter, in.	D_o	1.37	1.37	1.37
Initial height, in.	H_o	3.00	3.00	3.00

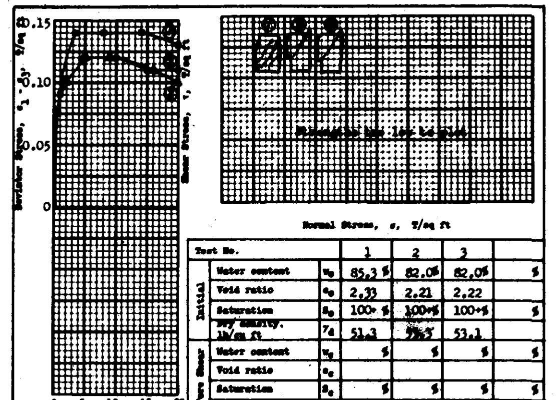
Controlled strain. Type of specimen: UNDISTURBED. Classification: LEAN CLAY (CL), grey, contains 1/8" to 1/4" silt seams. LL 43, PL 20, PI 23, G_s 2.67. Boring No. 2-U; Sample No. 4-D; Depth 14.5; Date 28 November 1967. JHS — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 2.9°; tan φ = 0.051; c = 0.046 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	71.3%	69.1%	71.6%
Void ratio	e_o	2.72	2.72	2.72
Saturation	S_o	95.8%	96.3%	96.6%
Dry density, lb/cu ft	γ_d	44.4	44.3	44.1
Minor principal stress, T/sq ft	σ_3	0.07	0.21	0.42
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.07	0.11	0.12
Time to failure, min	t_f	11.16	13.84	14.73
Rate of strain, percent/min		0.67	0.67	0.67
Initial diameter, in.	D_o	1.4	1.4	1.4
Initial height, in.	H_o	3.0	3.0	3.0

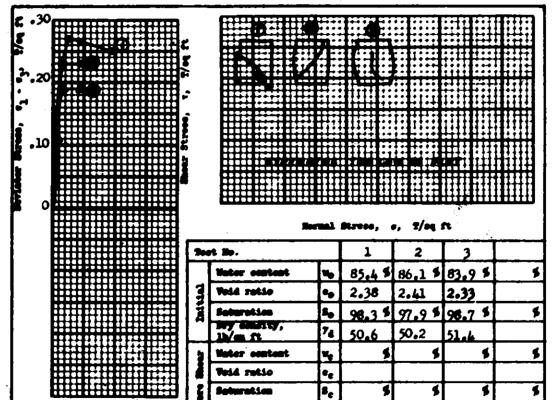
Type of specimen: 5" Undisturbed. Classification: vBo(Gr)CH; lne & lys ML; Sif. LL 93, PL 29, PI 69 (?), G_s 2.69. Area: Sta. 5 + 00 – on base line. Boring No. 2-U; Sample No. 5-B; Depth 17.6. TESTING SECTION NOD — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.06 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	85.3%	82.0%	82.0%
Void ratio	e_o	2.30	2.21	2.22
Saturation	S_o	100+%	100+%	100+%
Dry density, lb/cu ft	γ_d	51.3	[illegible]	53.1
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.14	0.12	0.12
Time to failure, min	t_f	8	24	16
Rate of strain, percent/min		0.42	0.36	0.19
Initial diameter, in.	D_o	1.41	1.41	1.40
Initial height, in.	H_o	3.00	3.00	3.00

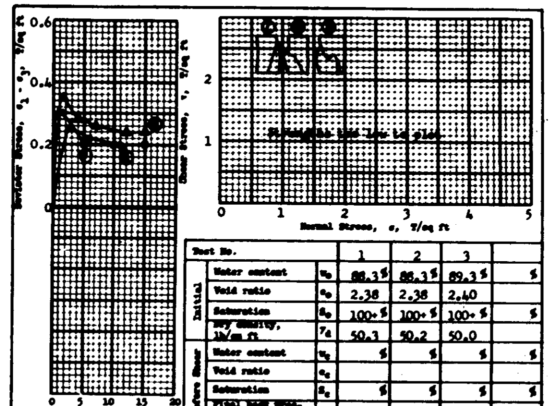
Type of test Q. Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), light gray. G_s 2.74. Boring No. 2-U; Sample No. 6-C; Depth 21.9; Date 28 November 1967. PAM — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.12 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	85.4%	86.1%	83.9%
Void ratio	e_o	2.38	2.41	2.33
Saturation	S_o	98.3%	97.9%	98.7%
Dry density, lb/cu ft	γ_d	50.6	50.2	51.4
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.27	0.23	0.19
Time to failure, min	t_f	4	13	12
Rate of strain, percent/min		0.63	0.12	0.12
Initial diameter, in.	D_o	1.38	1.38	1.38
Initial height, in.	H_o	3.00	3.00	3.00

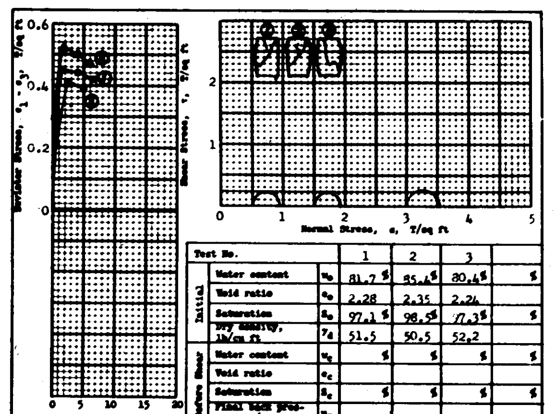
Controlled strain. Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), grey. LL 85, PL 27, PI 58, G_s 2.74. Boring No. 2-U; Sample No. 8C; Depth 30.0; Date 28 NOVEMBER 1967. JHS — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.15 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	88.1%	88.3%	88.0%
Void ratio	e_o	2.38	2.38	2.40
Saturation	S_o	100+%	100+%	100+%
Dry density, lb/cu ft	γ_d	50.3	50.2	50.0
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.30	0.25	0.35
Time to failure, min	t_f	6	13	11
Rate of strain, percent/min		0.19	0.19	0.15
Initial diameter, in.	D_o	1.37	1.37	1.37
Initial height, in.	H_o	3.00	3.00	3.00

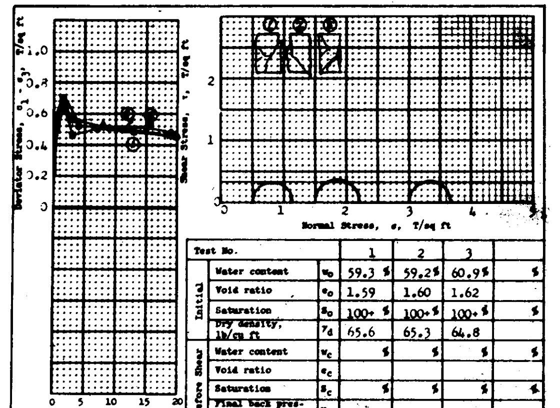
Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), grey, contains vertical cracks. LL 94, PL 29, PI 65, G_s 2.72. Boring No. 2-U; Sample No. 10-B; Depth 37.2; Date 29 November 1967. TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.23 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	81.7%	85.4%	80.4%
Void ratio	e_o	2.26	2.31	2.15
Saturation	S_o	97.4%	98.8%	100+%
Dry density, lb/cu ft	γ_d	51.5	50.5	52.2
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.45	0.41	0.52
Time to failure, min	t_f	47	14	19
Rate of strain, percent/min		0.03	0.16	0.10
Initial diameter, in.	D_o	1.38	1.38	1.40
Initial height, in.	H_o	3.00	3.00	3.00

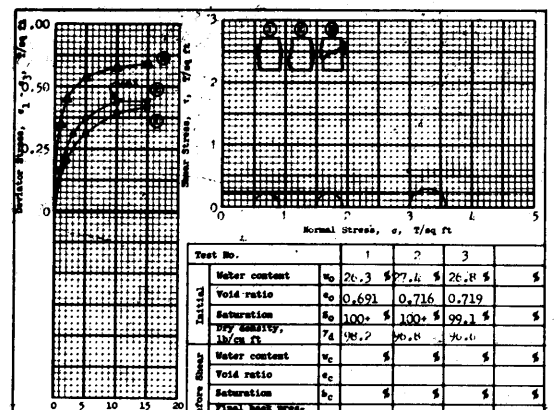
Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), grey, contains scattered shells from 1/32" to 1/4" in dia. LL 95, PL 29, PI 66, G_s 2.71. Boring No. 2-U; Sample No. 13-C; Depth 50.1; Date 29 November 1967. JHG — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.33 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	59.3%	59.2%	60.9%
Void ratio	e_o	1.59	1.60	1.62
Saturation	S_o	100+%	100+%	100+%
Dry density, lb/cu ft	γ_d	65.6	65.3	64.8
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.64	0.70	0.66
Time to failure, min	t_f	13	8	12
Rate of strain, percent/min		0.14	0.19	0.15
Initial diameter, in.	D_o	1.37	1.37	1.36
Initial height, in.	H_o	3.00	3.00	3.00

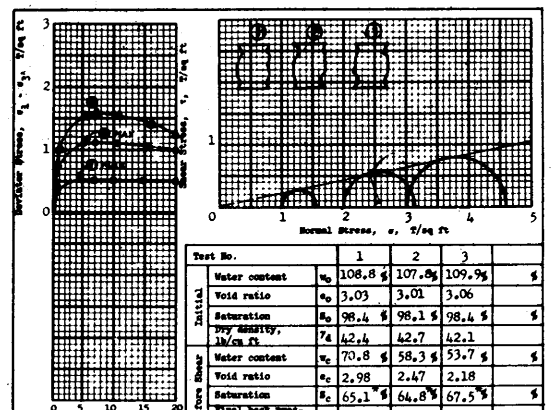
Controlled strain. Type of test Q. Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), gray, contains shells. LL 77, PL 23, PI 54, G_s 2.72. Project: LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE. Boring No. 2-U; Sample No. 16-B; Depth 61.2; Date 29 November 1967. EK — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.24 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	26.3%	27.4%	26.8%
Void ratio	e_o	0.691	0.716	0.719
Saturation	S_o	100+%	100+%	99.1%
Dry density, lb/cu ft	γ_d	98.2	96.8	96.6
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.42	0.44	0.59
Time to failure, min	t_f	55	24	28
Rate of strain, percent/min		0.27	0.62	0.54
Initial diameter, in.	D_o	1.40	1.40	1.40
Initial height, in.	H_o	3.00	3.00	3.00

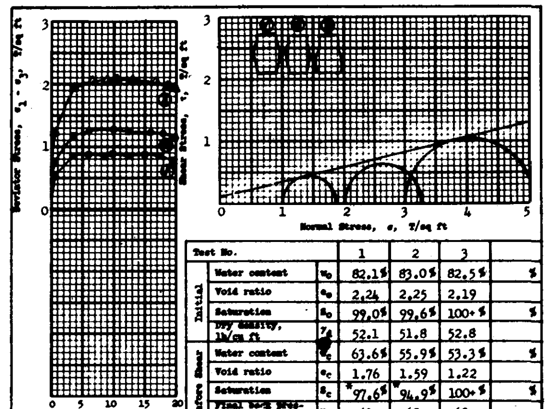
Controlled strain. Type of test Q. Type of specimen: UNDISTURBED. Classification: SILTY CLAY (CL), gray. LL 30, PL 15, PI 15, G_s 2.66. Boring No. 2-; Sample No. 19-B; Depth 73.0; Date 29 Nov. 1967. PAM — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 12°; tan φ = 0.213; c = 0.02 T/sq ft. Method of saturation: Back pressure

Test No.		1	2	3
Initial – Water content	w_o	108.8%	107.8%	109.9%
Void ratio	e_o	3.03	3.01	3.06
Saturation	S_o	98.4%	98.1%	98.4%
Dry density, lb/cu ft	γ_d	42.4	42.7	42.1
Before Shear – Water content	w_c	70.8%	58.3%	53.7%
Void ratio	e_c	2.98	2.47	2.18
Saturation	S_c	65.1*%	64.8*%	67.5*%
Final back pressure, T/sq ft	u_o	70	70	70
Dry density, lb/cu ft	γ_d	43.0	49.3	53.8
Minor principal stress, T/sq ft	σ_3	1.0	2.0	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.53	1.11	1.59
Time to failure, min	t_f	53	57	80
Rate of strain, percent/min		0.09	0.09	0.09
Initial diameter, in.	D_o	1.38	1.38	1.36
Initial height, in.	H_o	3.00	3.00	3.00

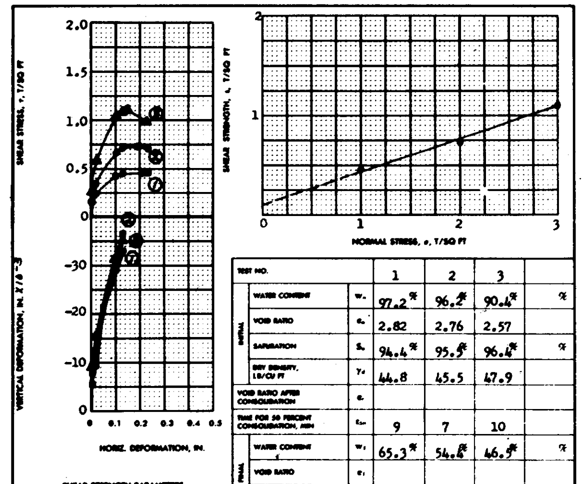
Controlled strain. Type of test R. Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), light gray, homogeneous. LL 95, PL 30, PI 65, G_s 2.74. Remarks: * pore pressure responce indicated 100% saturation. Boring No. 2-U; Sample No. 6B; Depth 21.0'; Date 8 DECEMBER 1967. PJR — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 14°; tan φ = 0.249; c = 0.11 T/sq ft. Method of saturation: BP

Test No.		1	2	3
Initial – Water content	w_o	82.1%	83.0%	82.5%
Void ratio	e_o	2.24	2.25	2.19
Saturation	S_o	99.0%	99.6%	100+%
Dry density, lb/cu ft	γ_d	52.1	51.8	52.8
Before Shear – Water content	w_c	63.6%	55.9%	53.3%
Void ratio	e_c	1.76	1.59	1.22
Saturation	S_c	*97.6%	*94.9%	100+%
Final back pressure, PSI	u_o	60	60	60
Dry density, lb/cu ft	γ_d	61.1	65.1	75.8
Minor principal stress, T/sq ft	σ_3	1.0	2.0	3.0
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.87	1.27	2.07
Time to failure, min	t_f	100	168	175
Rate of strain, percent/min		0.06	0.06	0.06
Initial diameter, in.	D_o	1.40	1.40	1.40
Initial height, in.	H_o	3.00	3.00	3.00

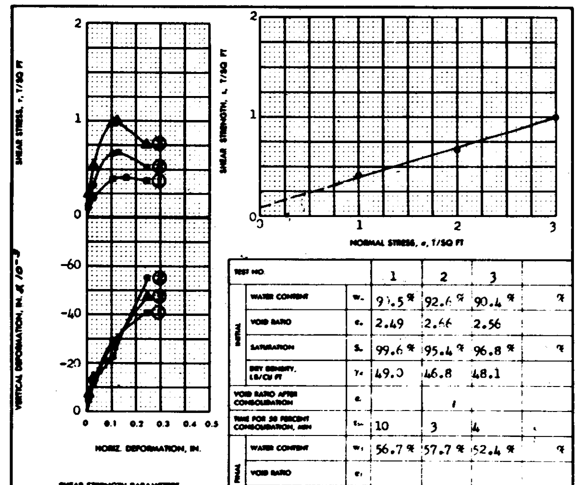
Controlled strain. Type of test R. Type of specimen: UNDISTURBED. Classification: PLASTIC CLAY (CH), gray, homogeneous. LL 87, PL 28, PI 59, G_s 2.70. Remarks: * Pore pressure response indicated 100% saturation. Boring No. 2-U; Sample No. 11-B; Depth 41.2; Date 8 December 1967. JL — TRIAXIAL COMPRESSION TEST REPORT



Shear Strength Parameters: φ = 19°; tan φ = 0.344; c = 0.10 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	97.2%	96.2%	90.4%
Void ratio	e_o	2.82	2.76	2.57
Saturation	S_o	94.4%	95.5%	96.4%
Dry density, lb/cu ft	γ_d	44.8	45.5	47.9
Time for 50 percent consolidation, min	t_{50}	9	7	10
Final – Water content	w_f	65.3%	54.4%	46.5%
Normal stress, T/sq ft	σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft	τ_{max}	0.45	0.73	1.10
Actual time to failure, min	t_f	2400	2220	1860
Rate of strain, in./min		.00009	.00009	.00009

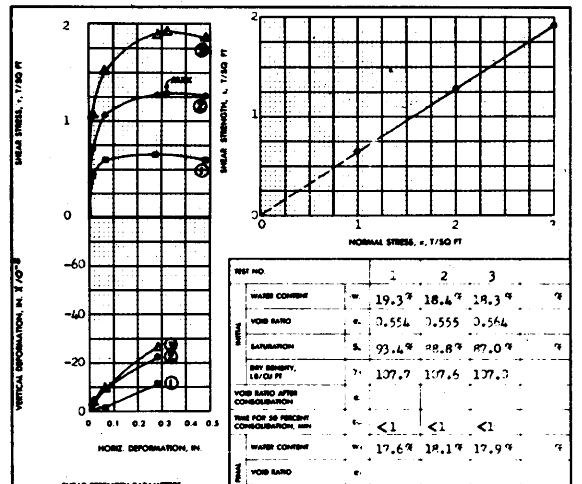
Controlled strain. Type of specimen: UNDISTURBED; ① & ② 3.00, ③ 3.01 in. square; 0.748, 0.626 in. thick. Classification: PLASTIC CLAY (CH), grey, homogeneous. LL 93, PL 29, PI 64, G 2.74. Remarks: Test not carried to 0.5" horiz. deformation due to power failure. Boring No. 2-U; Sample No. 7-A; Depth 24.4; Date 30 November 1967. BWG — DIRECT SHEAR TEST REPORT



Shear Strength Parameters: φ = 17°; tan φ = 0.306; c = 0.09 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	93.5%	92.6%	90.4%
Void ratio	e_o	2.49	2.66	2.56
Saturation	S_o	99.6%	95.4%	96.8%
Dry density, lb/cu ft	γ_d	49.0	46.8	48.1
Time for 50 percent consolidation, min	t_{50}	10	3	4
Final – Water content	w_f	56.7%	57.7%	52.4%
Normal stress, T/sq ft	σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft	τ_{max}	0.41	0.67	1.00
Actual time to failure, min	t_f	1860	1530	1440
Rate of strain, in./min		.0009	.0009	.0009

Controlled strain. Type of specimen: UNDISTURBED; 1&2–3.01, 3–3.00 in. square; 1&2–0.626, 3–0.748 in. thick. Classification: PLASTIC CLAY (CH), gray, homogeneous. LL –, PL –, PI –, G 2.74 From 9C. Remarks: Test not carried to 0.5" horizontal deformation due to power failure. Boring No. 2-U; Sample No. 9-D; Depth 35.0; Date 30 NOVEMBER 1967. WJH — DIRECT SHEAR TEST REPORT



Shear Strength Parameters: φ = 33°; tan φ = 0.649; c = 0 T/sq ft

Test No.		1	2	3
Initial – Water content	w_o	19.3%	18.4%	18.3%
Void ratio	e_o	0.554	0.555	0.564
Saturation	S_o	93.4%	88.8%	87.0%
Dry density, lb/cu ft	γ_d	107.7	107.6	107.0
Time for 50 percent consolidation, min	t_{50}	<1	<1	<1
Final – Water content	w_f	17.6%	18.1%	17.9%
Normal stress, T/sq ft	σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft	τ_{max}	0.65	1.28	1.92
Actual time to failure, min	t_f	1290	1500	1500
Rate of strain, in./min		.00022	.00022	.00022

Controlled strain. Type of specimen: UNDISTURBED; 3.00 in. square; 0.560 in. thick. Classification: Sandy SILT (ML), gray, contains trace of clay. LL –, PL –, PI –, G 2.68. Boring No. 2-U; Sample No. 20-C; Depth 78.0; Date 11 DECEMBER 1967. WJH — DIRECT SHEAR TEST REPORT

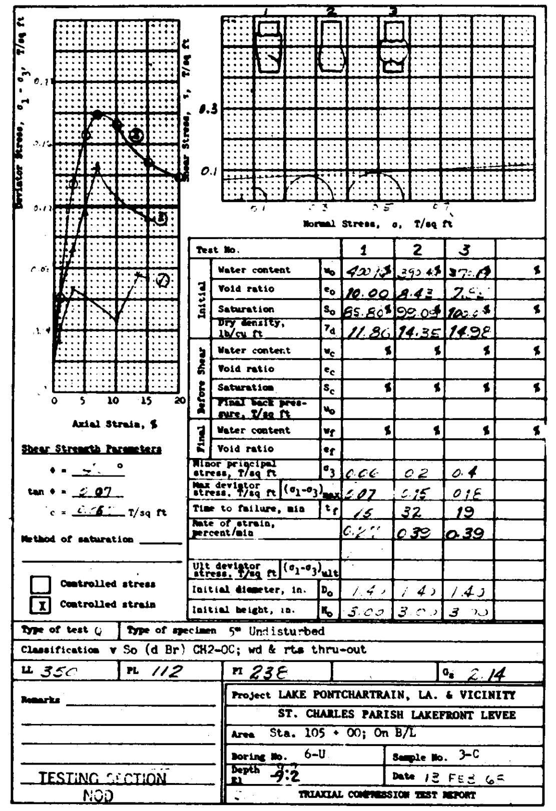
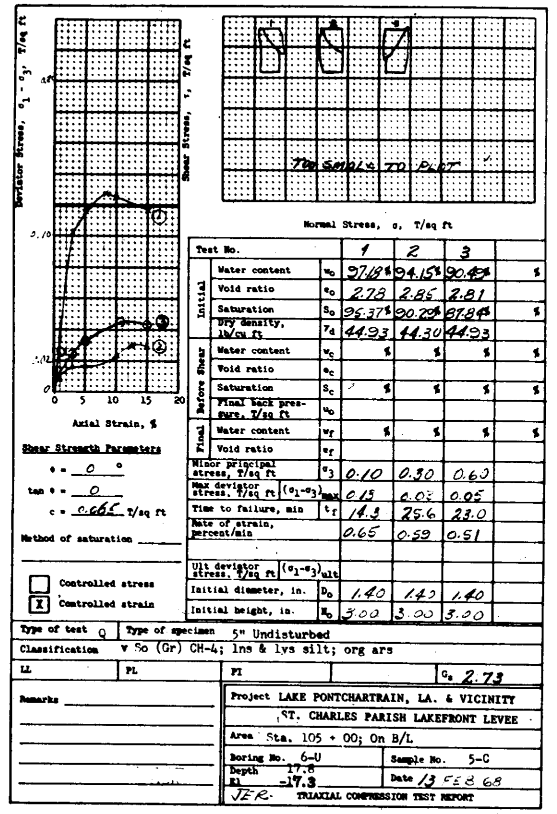
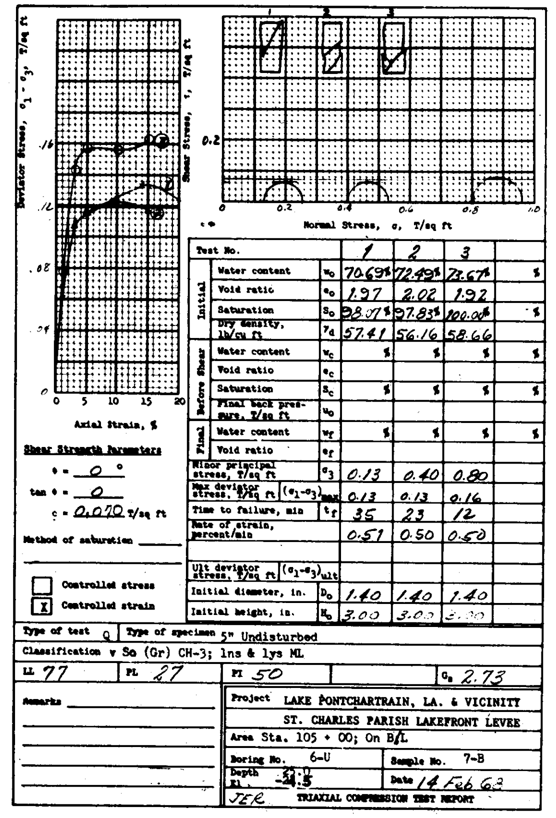
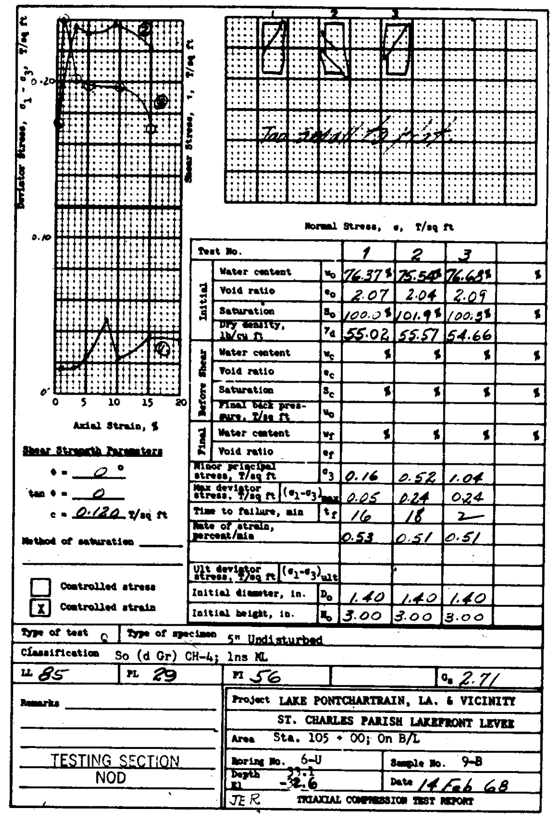
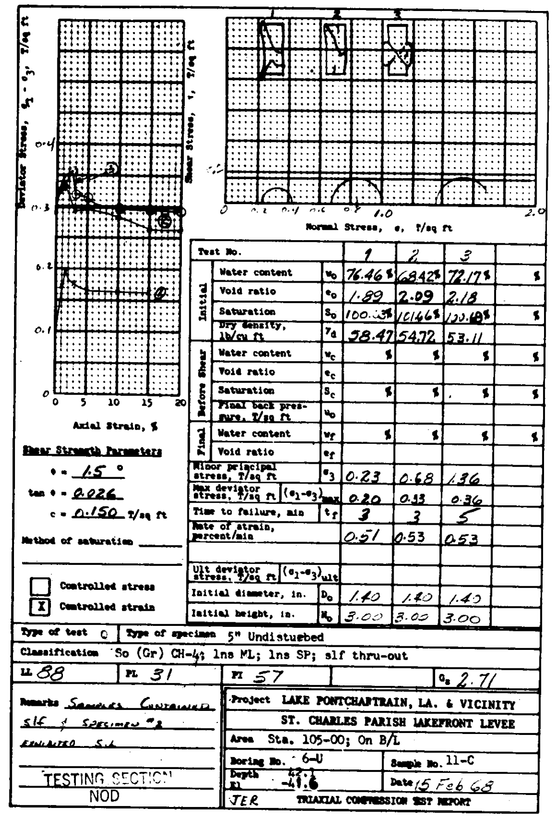
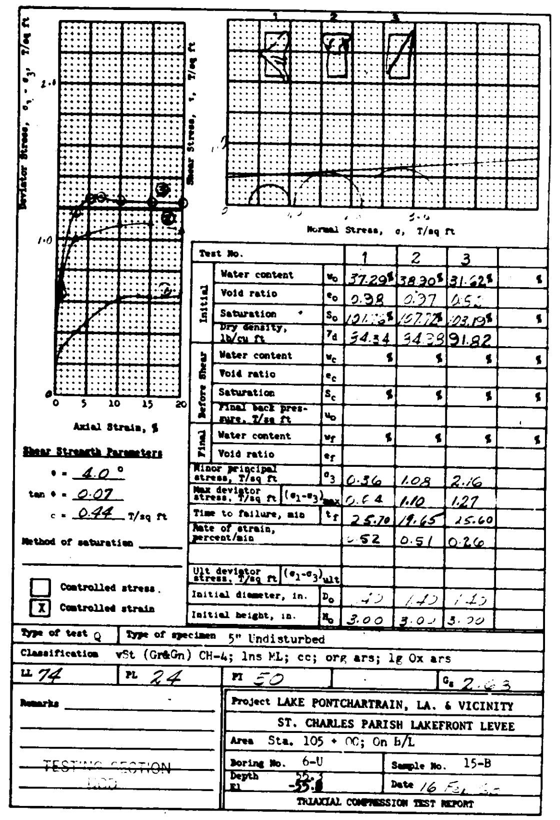
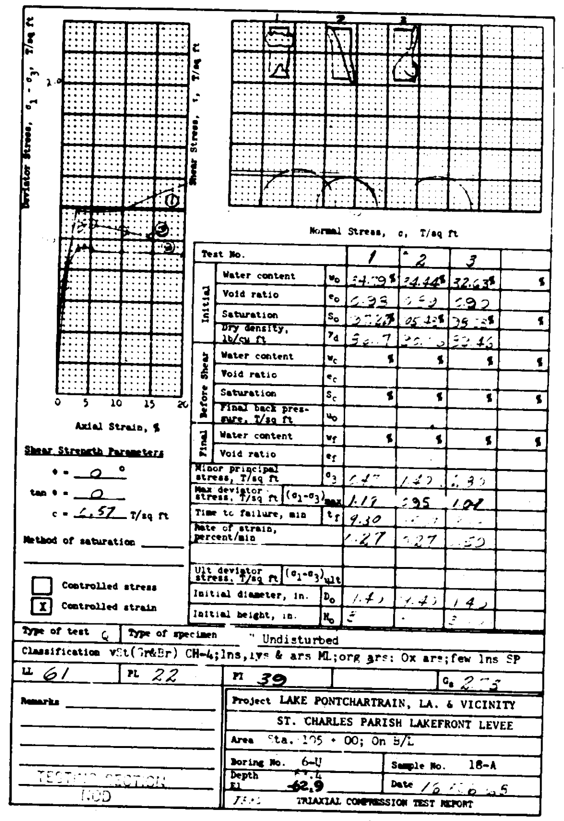
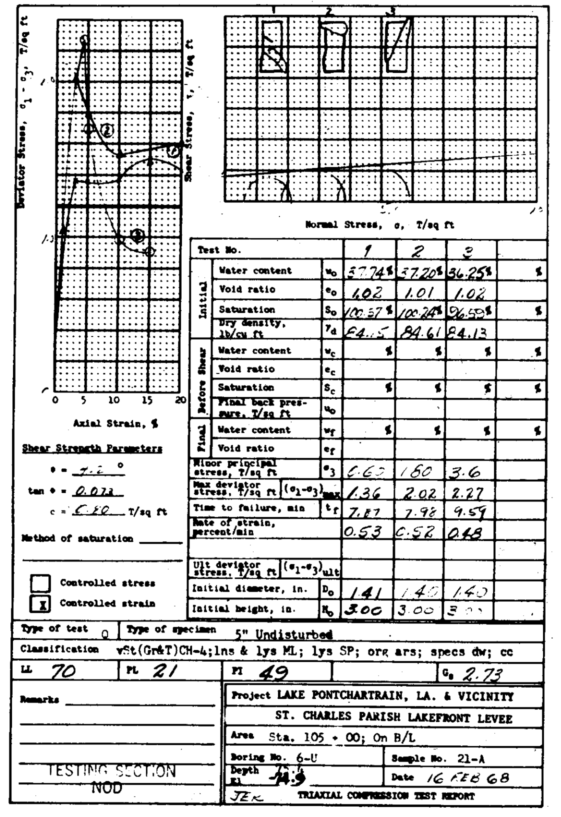
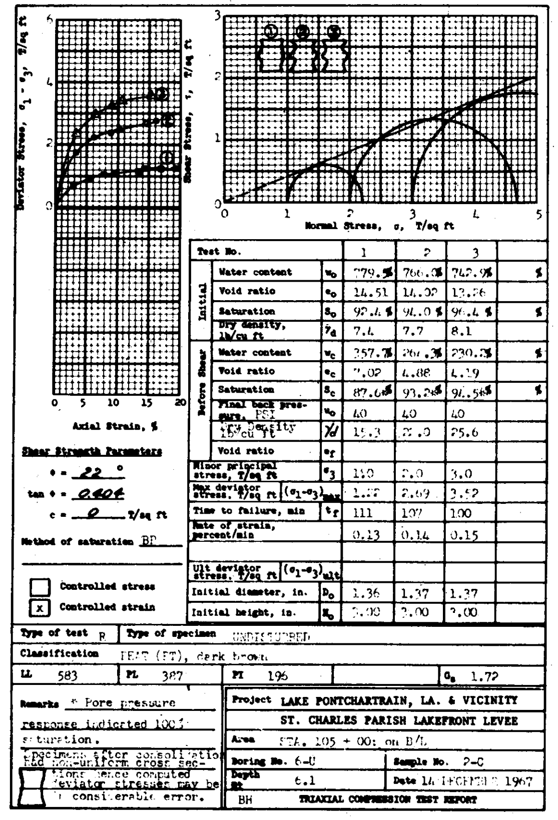
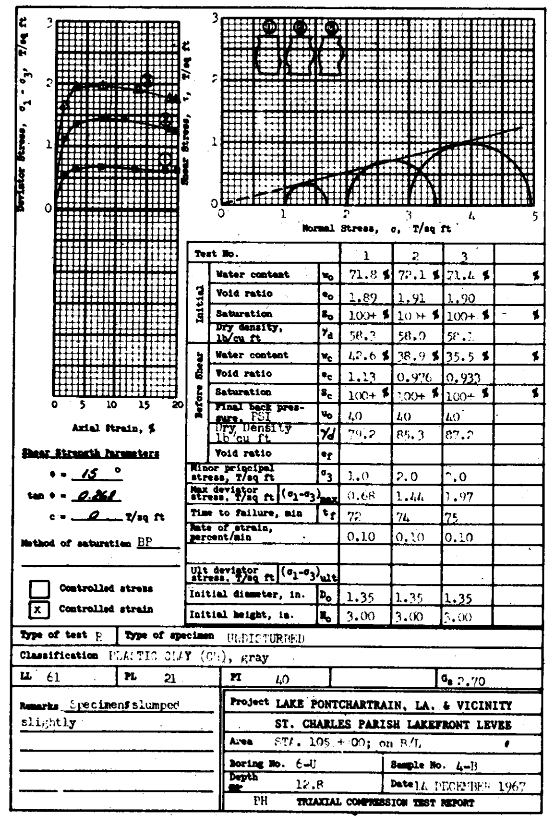
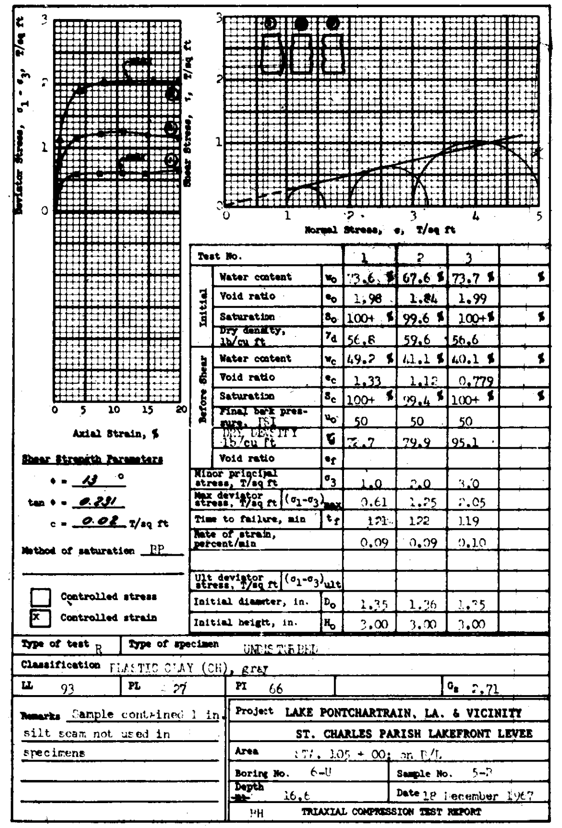
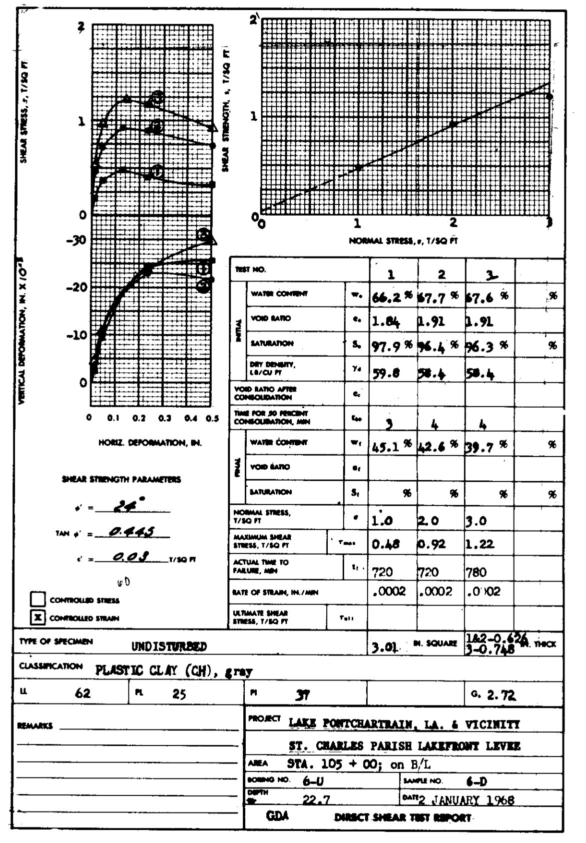
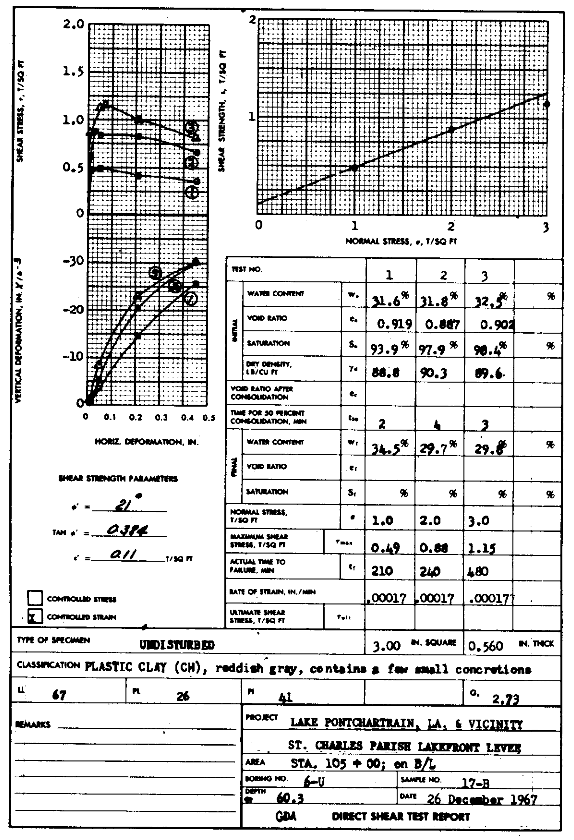
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 2-U

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

SEPT. 1969 — FILE NO. H-2-24624

PLATE 15

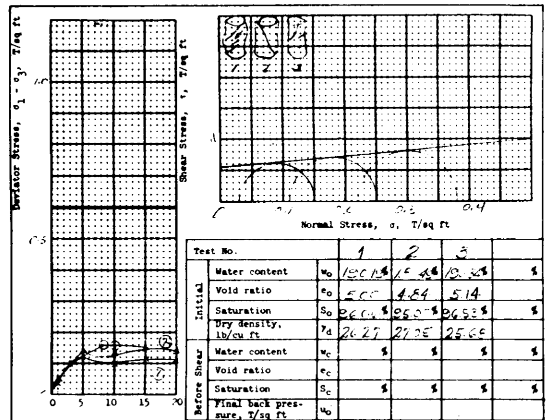
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 6-U

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 16

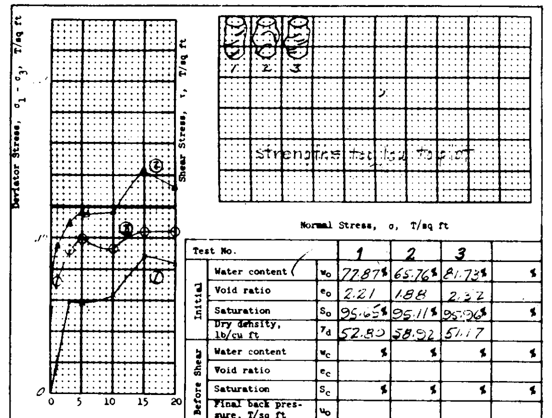


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205+00; On B/L; Boring No. 10-U; Sample No. 4-D; Depth 15.1, El -14.1; Date 20 FEB 68; JEA; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification v So (d Gr&Br) CH3-OB; lns ML; dw; few rt; G_s 2.53

Shear Strength Parameters: φ = 4.0°; tan φ = .07; c = 0.055 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	190.1%	15.4%	19.3%
Void ratio e_o	5.00	4.84	5.14
Saturation S_o	96.0%	95.0%	96.53%
Dry density, lb/cu ft γ_d	26.27	27.25	25.69
Minor principal stress, T/sq ft σ_3	0.05	0.1	0.22
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.12	0.14	0.16
Time to failure, min t_f	10.4	14.4	23.2
Rate of strain, percent/min	0.51	0.37	0.35
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

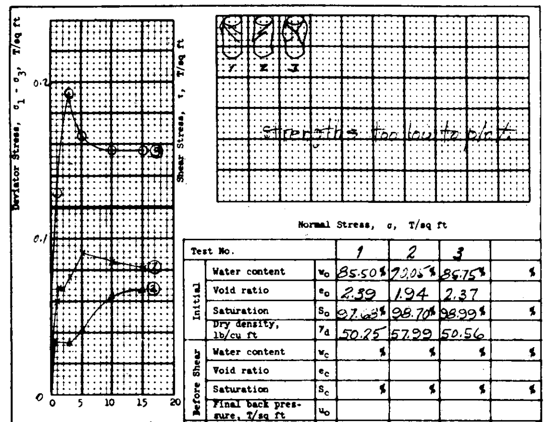


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 6-C; Depth 22.0, El -21.0; Date 19 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification v So (Gr) CH-4; lns & lys ML; org strks; LL 88; PL 27; PI 56; G_s 2.72

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.057 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	77.87%	65.76%	81.73%
Void ratio e_o	2.21	1.88	2.32
Saturation S_o	95.65%	95.11%	95.96%
Dry density, lb/cu ft γ_d	52.80	58.92	51.17
Minor principal stress, T/sq ft σ_3	0.08	0.23	0.46
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.09	0.14	0.11
Time to failure, min t_f	55	47	47
Rate of strain, percent/min	0.29	0.31	0.31
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

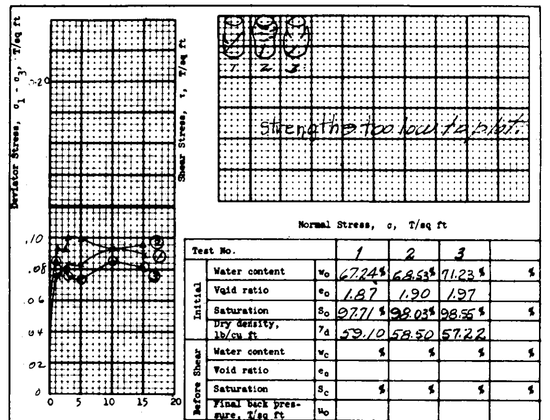


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 7-C; Date 20 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification So (Gr) CH-4; lns & lys ML; few org ars; LL 92; PL 28; PI 64; G_s 2.73

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.058 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	85.50%	92.06%	86.75%
Void ratio e_o	2.39	1.94	2.37
Saturation S_o	97.48%	98.70%	98.99%
Dry density, lb/cu ft γ_d	50.25	57.99	50.56
Minor principal stress, T/sq ft σ_3	0.10	0.30	0.60
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.09	0.27	0.19
Time to failure, min t_f	31	31	3
Rate of strain, percent/min	0.51	0.40	0.40
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

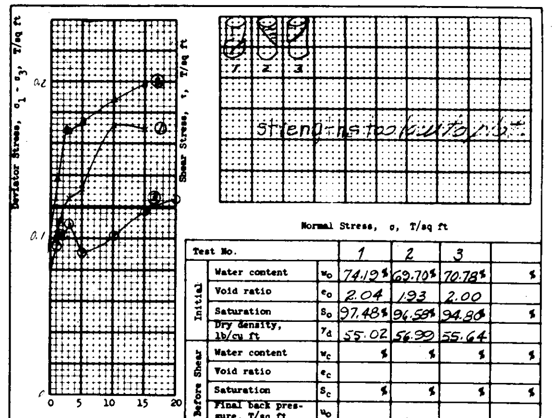


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 9-D; Date 21 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification So (Gr) CH-4; lns & lys ML; dw; org strks; G_s 2.72

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.044 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	67.24%	68.55%	71.23%
Void ratio e_o	1.87	1.90	1.97
Saturation S_o	97.71%	98.01%	98.56%
Dry density, lb/cu ft γ_d	59.10	58.50	57.22
Minor principal stress, T/sq ft σ_3	0.15	0.45	0.90
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.07	0.10	0.09
Time to failure, min t_f	19	19	19
Rate of strain, percent/min	0.52	0.52	0.51
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

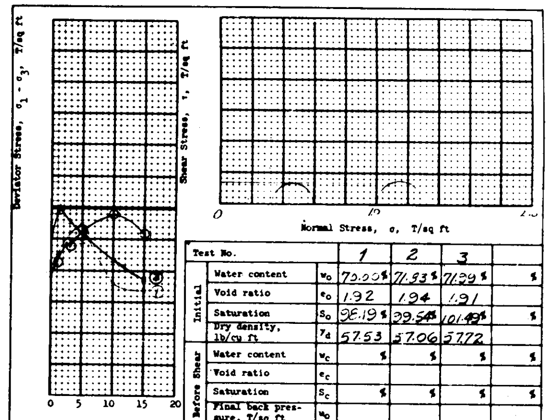


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 11-D; Date 21 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification So (Gr) CH-4; lns & lys ML; Sl; slf; specs dw; LL 85; PL 28; PI 57; G_s 2.68

Shear Strength Parameters: φ = 0°; c = 0.037 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	74.19%	69.70%	70.78%
Void ratio e_o	2.04	1.93	2.00
Saturation S_o	97.48%	96.50%	98.90%
Dry density, lb/cu ft γ_d	55.02	56.90	55.64
Minor principal stress, T/sq ft σ_3	0.21	0.63	1.26
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	[illegible]	0.21	0.13
Time to failure, min t_f	22	24	38
Rate of strain, percent/min	0.52	0.52	0.52
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

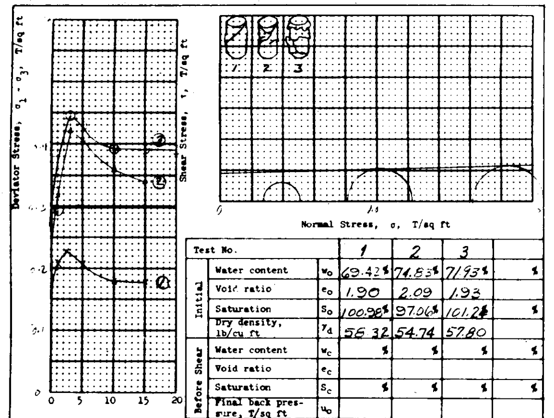


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 16-D; Date 23 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification M (Gr) CH-4; few lns ML; org ars; LL 94; PL 30; PI 64; G_s 2.69

Shear Strength Parameters: φ = 0°; c = 0.14 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	70.05%	71.85%	71.29%
Void ratio e_o	1.92	1.94	1.91
Saturation S_o	98.19%	99.58%	101.4%
Dry density, lb/cu ft γ_d	57.53	57.06	57.72
Minor principal stress, T/sq ft σ_3	0.33	1.00	2.00
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.27	0.30	0.25
Time to failure, min t_f	18.3	53	6.0
Rate of strain, percent/min	0.27	0.28	0.40
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

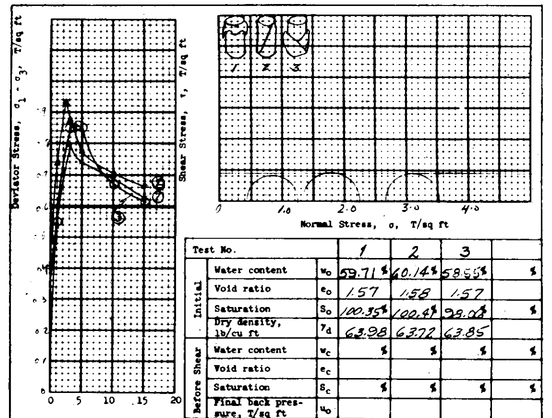


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 14-B; Depth -32.3; Date 21 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification M (Gr) CH-4; lns ML; slf; org ars; LL 90; PL 33; PI 57; G_s 2.71

Shear Strength Parameters: φ = 1.0°; tan φ = 0.017; c = 0.200 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	69.42%	74.85%	71.93%
Void ratio e_o	1.90	2.09	1.92
Saturation S_o	100.98%	97.06%	101.28%
Dry density, lb/cu ft γ_d	56.32	54.74	57.80
Minor principal stress, T/sq ft σ_3	0.27	0.81	1.62
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.23	0.42	0.45
Time to failure, min t_f	4.7	6.3	6.5
Rate of strain, percent/min	0.53	0.40	0.41
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

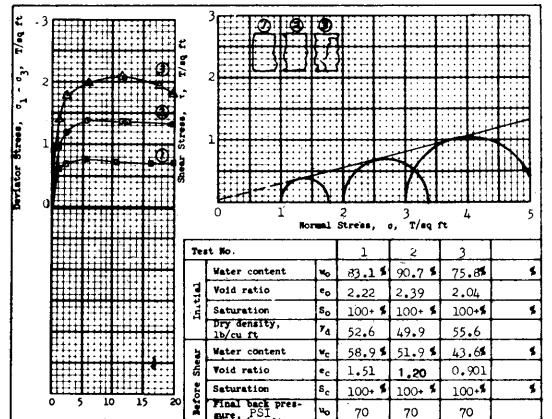


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; On B/L; Boring No. 10-U; Sample No. 20-D; Depth 28.0; Date 26 FEB 68; TESTING SECTION NOD

Type of test Q; Type of specimen 5" Undisturbed; Classification St(Gr)CH-4; lns & thin lys ML; few lys SP; dw; few org ars; LL 70; PL 23; PI 47; G_s 2.63

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.430 T/sq ft; Controlled strain

Test No.	1	2	3
Water content w_o	59.71%	60.16%	58.55%
Void ratio e_o	1.57	1.58	1.57
Saturation S_o	100.35%	100.45%	99.03%
Dry density, lb/cu ft γ_d	63.98	63.72	63.85
Minor principal stress, T/sq ft σ_3	0.44	1.33	2.66
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.80	0.93	0.86
Time to failure, min t_f	8.2	13.4	8.4
Rate of strain, percent/min	0.41	3.00	0.31
Initial diameter, in. D_o	1.40	1.40	1.40
Initial height, in. H_o	3.00	3.00	3.00

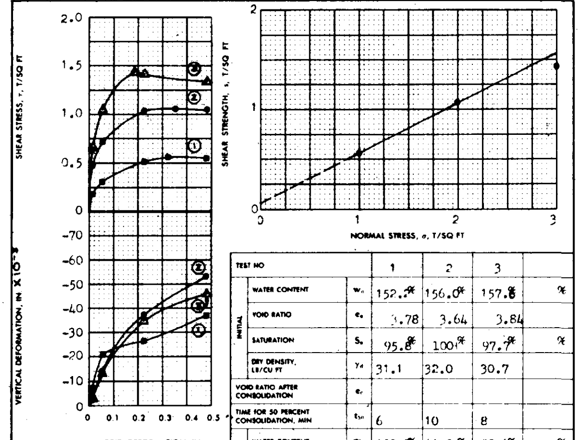


TRIAXIAL COMPRESSION TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area STA. 205 + 00; on B/L; Boring No. 10-U; Sample No. 8-A; Depth 28.4; Date 18 December 1967

Type of test R; Type of specimen UNDISTURBED; Classification PLASTIC CLAY (CH), gray, contains a few thin silty lenses; LL 79; PL 24; PI 55; G_s 2.71

Shear Strength Parameters: φ = 14°; tan φ = 0.249; c = 0.05 T/sq ft; Method of saturation BP; Controlled strain

Test No.	1	2	3
Water content w_o	83.1%	90.7%	75.8%
Void ratio e_o	2.22	2.39	2.04
Saturation S_o	100+%	100+%	100+%
Dry density, lb/cu ft γ_d	52.6	49.9	55.6
Water content w_c	58.9%	51.9%	43.6%
Void ratio e_c	1.51	1.20	0.901
Saturation S_c	100+%	100+%	100+%
Final back pressure, T/sq ft u_o	70	70	70
Final dry density, lb/cu ft	67.4	77.0	89.0
Minor principal stress, T/sq ft σ_3	1.0	2.0	3.0
Max deviator stress, T/sq ft $(\sigma_1-\sigma_3)_{max}$	0.76	1.38	2.08
Time to failure, min t_f	60	57	117
Rate of strain, percent/min	0.09	0.10	0.10
Initial diameter, in. D_o	1.40	1.39	1.40
Initial height, in. H_o	3.00	3.00	3.00

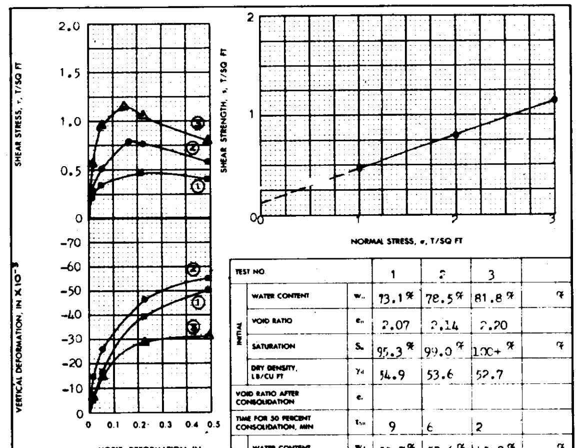


DIRECT SHEAR TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area STA. 205 + 00; on B/L; Boring No. 10-U; Sample No. 4-B; Depth 13.2; Date 28 Dec. 1967; GDA

Type of specimen UNDISTURBED; 3.00 in. square; 0.748 in. thick; Classification PLASTIC CLAY (CH), dark grey, highly organic; LL 181; PL 54; PI 127; G_s 2.38

Shear Strength Parameters: φ' = 27°; tan φ' = 0.510; c' = 0.06 T/sq ft; Controlled strain

Test No.	1	2	3
Initial water content w_o	152.2%	156.0%	157.8%
Void ratio e_o	3.78	3.64	3.84
Saturation S_o	95.8%	100%	97.7%
Dry density, lb/cu ft γ_d	31.1	32.0	30.7
Time for 50 percent consolidation, min t_{50}	6	10	8
Final water content w_f	100.7%	61.0%	59.6%
Normal stress, T/sq ft σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft τ_{max}	0.56	1.06	1.43
Actual time to failure, min t_f	1860	2040	1080
Rate of strain, in./min	.00017	.00018	.00017

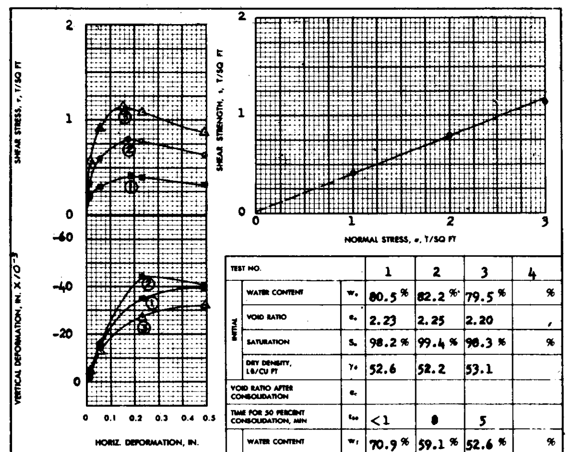


DIRECT SHEAR TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area Sta. 205 + 00; on B/L; Boring No. 10-U; Date 28 Dec 1967; GDA

Type of specimen UNDISTURBED; 3.01 in. square; 0.561 No. 1, 0.626 No. 2&3 in. thick; Classification PLASTIC CLAY (CH), gray, w/pockets of sand; LL 91; PL 27; PI 64; G_s 2.70

Shear Strength Parameters: φ' = 19°; tan φ' = 0.344; c' = 0.13 T/sq ft; Controlled strain

Test No.	1	2	3
Initial water content w_o	73.1%	78.5%	81.8%
Void ratio e_o	2.07	2.14	2.20
Saturation S_o	95.3%	99.0%	100+%
Dry density, lb/cu ft γ_d	54.9	53.6	52.7
Time for 50 percent consolidation, min t_{50}	9	6	2
Final water content w_f	55.7%	52.6%	45.0%
Normal stress, T/sq ft σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft τ_{max}	0.47	0.79	1.15
Actual time to failure, min t_f	1260	960	840
Rate of strain, in./min	.00018	.00018	.00018



DIRECT SHEAR TEST REPORT — Project LAKE PONTCHARTRAIN, LA. & VICINITY, ST. CHARLES PARISH LAKEFRONT LEVEE; Area STA. 205 + 00; on B/L; Boring No. 10-U; Sample No. 15-A; Depth 56.4; Date 3 JANUARY 1967; WJH

Type of specimen UNDISTURBED; 1-3.00, 2&3-3.01 in. square; 1-0.560, 2&3-0.626 in. thick; Classification PLASTIC CLAY (CH), grey, contains shell fragments; LL 103; PL 28; PI 75; G_s 2.72

Shear Strength Parameters: φ' = 21°; tan φ' = 0.384; c' = 0.02 T/sq ft; Controlled strain

Test No.	1	2	3
Initial water content w_o	80.5%	82.2%	79.5%
Void ratio e_o	2.23	2.25	2.20
Saturation S_o	98.2%	99.4%	98.3%
Dry density, lb/cu ft γ_d	52.6	52.2	53.1
Time for 50 percent consolidation, min t_{50}	<1	8	5
Final water content w_f	70.9%	59.1%	52.6%
Normal stress, T/sq ft σ	1.0	2.0	3.0
Maximum shear stress, T/sq ft τ_{max}	0.41	0.79	1.14
Actual time to failure, min t_f	1080	1020	900
Rate of strain, in./min	.00018	.00018	.00018

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

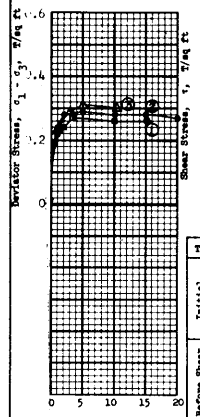
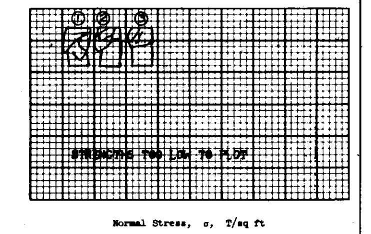
DETAIL SHEAR STRENGTH DATA
BORING 10-U

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

SEPT. 1969 — FILE NO. H-2-24624

PLATE 17

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 3-D

Test No.		1	2	3	
Initial: Water content	w_o	64.8 %	66.6 %	61.6 %	%
Void ratio	e_o	1.75	1.80	1.68	
Saturation	S_o	100+ %	100+ %	99.4 %	%
Dry density, lb/cu ft	γ_d	61.5	60.4	63.2	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.27	0.29	0.31	
Time to failure, min	t_f	34	17	42	
Rate of strain, percent/min		0.10	0.30	0.12	
Initial diameter, in.	D_o	1.40	1.41	1.41	
Initial height, in.	H_o	3.00	3.00	3.00	

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

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

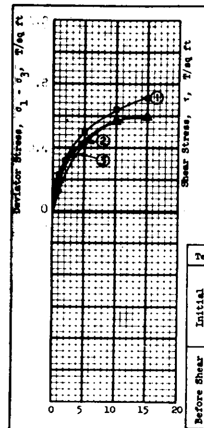
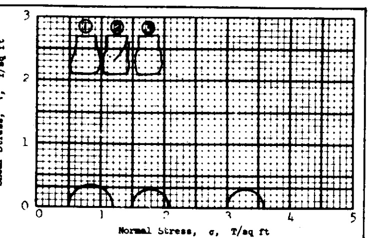
Classification PLASTIC CLAY (CH), gray, contains many small pebbles

LL 80 | PL 25 | PI 55 | G_s 2.71

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 3-D; Depth 12.7; Date 29 NOVEMBER 1967; JMS

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 6-D

Test No.		1	2	3	
Initial: Water content	w_o	36.7 %	36.1 %	36.4 %	%
Void ratio	e_o	0.943	0.973	0.954	
Saturation	S_o	100+ %	100+ %	100+ %	%
Dry density, lb/cu ft	γ_d	86.1	84.8	85.6	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.71	0.59	0.60	
Time to failure, min	t_f	38	54	35	
Rate of strain, percent/min		0.39	0.28	0.43	
Initial diameter, in.	D_o	1.35	1.35	1.35	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.32 T/sq ft

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

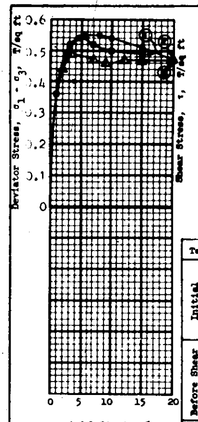
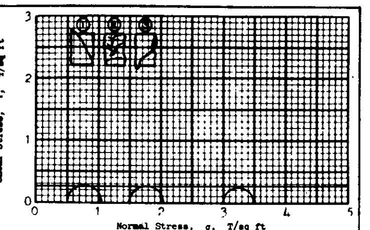
Classification SILTY CLAY (CL), gray, contains roots & spots of clay (CH)

LL 42 | PL 25 | PI 17 | G_s 2.68

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 6-D; Depth 25.1; Date 30 NOVEMBER 1967; EK

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 9-D

Test No.		1	2	3	
Initial: Water content	w_o	49.8 %	50.5 %	53.5 %	%
Void ratio	e_o	1.37	1.39	1.47	
Saturation	S_o	99.2 %	99.2 %	99.4 %	%
Dry density, lb/cu ft	γ_d	71.8	71.4	68.9	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.54	0.55	0.49	
Time to failure, min	t_f	10	29	14	
Rate of strain, percent/min		0.48	0.19	0.24	
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 = 0.26 T/sq ft

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

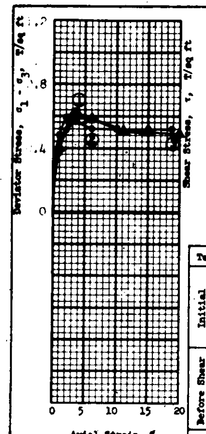
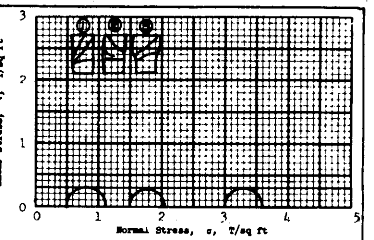
Classification PLASTIC CLAY (CH), gray, slickensided

LL - | PL - | PI - | G_s 2.73 From 9B

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 9-D; Depth 37.0; Date 30 Nov. 1967; FAM

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 13-B

Test No.		1	2	3	
Initial: Water content	w_o	54.9 %	56.4 %	55.5 %	%
Void ratio	e_o	1.39	1.56	1.56	
Saturation	S_o	100+ %	99.1 %	97.5 %	%
Dry density, lb/cu ft	γ_d	71.5	66.7	66.8	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.63	0.56	0.60	
Time to failure, min	t_f	13	15	13	
Rate of strain, percent/min		0.26	0.23	0.30	
Initial diameter, in.	D_o	1.38	1.39	1.40	
Initial height, in.	H_o	3.00	3.00	3.00	

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

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

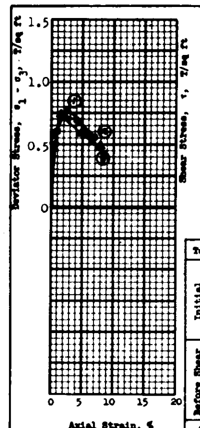
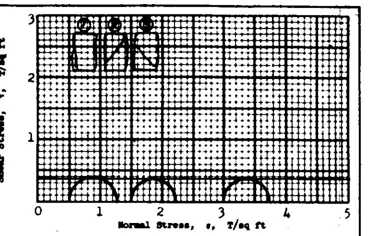
Classification PLASTIC CLAY (CH), grey, contains shells & sand laminations

LL 69 | PL 20 | PI 49 | G_s 2.74

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 13-B; Depth 51.3; Date 1 DECEMBER 1967; EK

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 16-B

Test No.		1	2	3	
Initial: Water content	w_o	73.0 %	67.6 %	68.3 %	%
Void ratio	e_o	1.91	1.80	1.79	
Saturation	S_o	100+ %	100+ %	100+ %	%
Dry density, lb/cu ft	γ_d	58.6	60.9	61.0	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.77	0.73	0.74	
Time to failure, min	t_f	33	13	17	
Rate of strain, percent/min		0.07	0.15	0.11	
Initial diameter, in.	D_o	1.39	1.36	1.38	
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

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

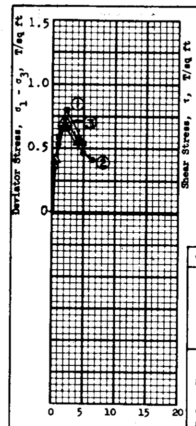
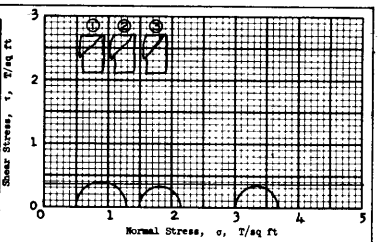
Classification PLASTIC CLAY (CH), gray, contains vertical cracks, fissured

LL 98 | PL 28 | PI 70 | G_s 2.73

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 16-B; Depth 62.8; Date 4 December 1967; EK

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 18-C

Test No.		1	2	3	
Initial: Water content	w_o	60.0 %	60.7 %	60.5 %	%
Void ratio	e_o	1.67	1.68	1.68	
Saturation	S_o	98.1 %	98.6 %	98.3 %	%
Dry density, lb/cu ft	γ_d	63.9	63.5	63.7	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.80	0.65	0.69	
Time to failure, min	t_f	24	10	14	
Rate of strain, percent/min		0.10	0.21	0.11	
Initial diameter, in.	D_o	1.39	1.39	1.39	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.36 T/sq ft

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

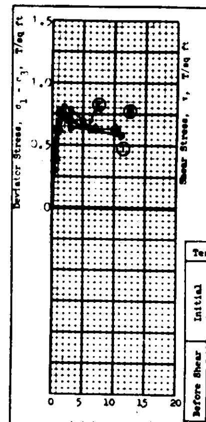
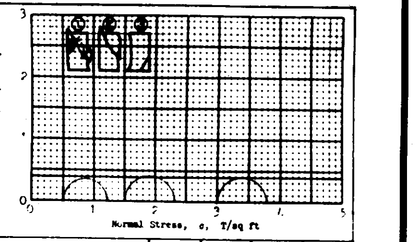
Classification PLASTIC CLAY (CH), gray, contains scattered small shells

LL 84 | PL 23 | PI 61 | G_s 2.73

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 18-C; Depth 72.2; Date 1 DECEMBER 1967; JMS

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 19-D

Test No.		1	2	3	
Initial: Water content	w_o	[illegible] %	59.7 %	59.8 %	%
Void ratio	e_o	[illegible]	1.63	1.64	
Saturation	S_o	[illegible] %	98.9 %	98.4 %	%
Dry density, lb/cu ft	γ_d	[illegible]	[illegible]	[illegible]	
Minor principal stress, T/sq ft	σ_3	0.5	1.5	[illegible]	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	[illegible]	0.83	[illegible]	
Time to failure, min	t_f		15	12	
Rate of strain, percent/min		0.29	0.17	0.14	
Initial diameter, in.	D_o	1.39	1.38	1.39	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: φ = 0°; tan φ = 0; c = 0.39 T/sq ft

Controlled strain (X)

Type of test Q. Type of specimen UNDISTURBED

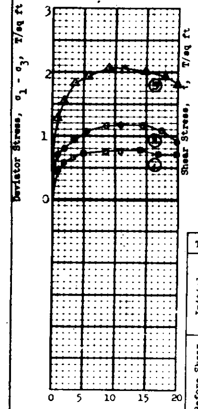
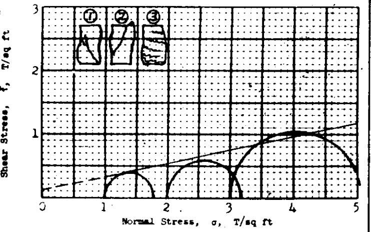
Classification PLASTIC CLAY (CH), gray, contains silt lenses

LL 85 | PL 23 | PI 62 | G_s 2.70

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 19-D; Depth 85.5; Date 1 DEC 1967; KM

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 4-B

Test No.		1	2	3	
Initial: Water content	w_o	69.6 %	73.6 %	71.0 %	%
Void ratio	e_o	1.87	1.96	1.92	
Saturation	S_o	100+ %	100+ %	100+ %	%
Dry density, lb/cu ft	γ_d	58.9	57.2	58.0	
Before Shear: Water content	w_c	55.0 %	54.7 %	47.9 %	%
Void ratio	e_c	1.52	1.43	1.18	
Saturation	S_c	98.0 %	100+ %	100+ %	%
Final back pressure, PSI	u_o	60	60	60	
Dry density lb/cu ft	γ_d	67.2	69.5	77.4	
Void ratio	e_f				
Minor principal stress, T/sq ft	σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	0.78	1.18	2.06	
Time to failure, min	t_f	178	140	114	
Rate of strain, percent/min		0.08	0.08	0.08	
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 = 12°; tan φ = 0.213; c = 0.13 T/sq ft

Method of saturation BP

Controlled strain (X)

Type of test R. Type of specimen UNDISTURBED

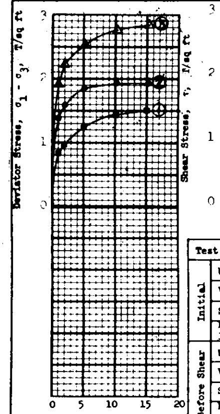
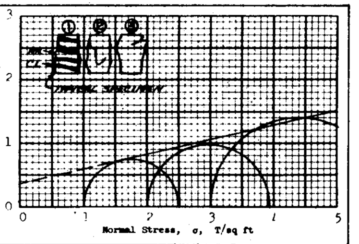
Classification PLASTIC CLAY (CH), gray, homogeneous

LL - | PL - | PI - | G_s 2.71 From 4A

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 4-B; Depth 15.2; Date 11 December 1967; BH

TRIAXIAL COMPRESSION TEST REPORT — Boring 14-U, Sample 7-B

Test No.		1	2	3	
Initial: Water content	w_o	34.7 %	36.0 %	35.5 %	%
Void ratio	e_o	0.964	0.989	0.980	
Saturation	S_o	97.0 %	98.8 %	97.1 %	%
Dry density, lb/cu ft	γ_d	85.2	84.1	84.5	
Before Shear: Water content	w_c	31.4 %	30.7 %	29.5 %	%
Void ratio	e_c	0.919	0.859	0.853	
Saturation	S_c	91.4 %	93.9 %	92.7 %	%
Final back pressure, PSI	u_o	60	60	60	
Dry density lb/cu ft	γ_d	87.2	90.0	90.3	
Minor principal stress, T/sq ft	σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft	$(\sigma_1-\sigma_3)_{max}$	[illegible]	[illegible]	[illegible]	
Time to failure, min	t_f	167	112	167	
Rate of strain, percent/min		0.09	0.09	0.09	
Initial diameter, in.	D_o	1.38	1.38	1.39	
Initial height, in.	H_o	3.00	3.00	3.00	

Shear Strength Parameters: φ = 13°; tan φ = 0.231; c = 0.37 T/sq ft

Method of saturation BP

Controlled strain (X)

Type of test R. Type of specimen UNDISTURBED

Classification Fine sandy SILT (ML), gray, contains horizontal layers of *

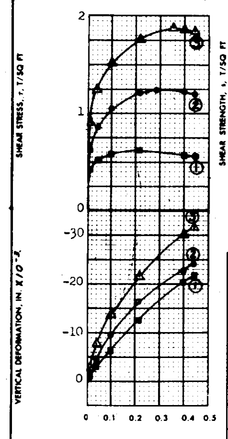
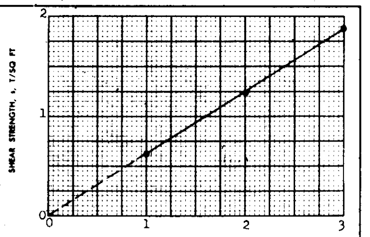
LL - | PL - | PI - | G_s 2.68 From 7A

Remarks: "Pore pressure response indicated 100% saturation. * silty CLAY (CL), 1/8" thick approx. every 1"

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 7-B; Depth 27.2; Date 11 DECEMBER 1967; JH

DIRECT SHEAR TEST REPORT — Boring 14-U, Sample 1-B

TEST NO.		1	2	3	
Initial: Water content	w_o	16.5 %	16.2 %	15.8 %	%
Void ratio	e_o	0.693	0.721	0.718	
Saturation	S_o	63.8 %	60.0 %	59.0 %	%
Dry density, lb/cu ft	γ_d	98.8	97.2	97.4	
Time for 50 percent consolidation, min	t_{50}	2	3	4	
Final: Water content	w_f	24.7 %	24.7 %	23.8 %	%
Normal stress, T/sq ft	σ	1.0	2.0	3.0	
Maximum shear stress, T/sq ft	τ_{max}	0.62	1.24	1.88	
Actual time to failure, min	t_f	1830	2490	2940	
Rate of strain, in./min		.00012	.00012	.00012	

Shear Strength Parameters: φ' = 32°; tan φ' = 0.625; c' = 0 T/sq ft

Controlled strain (X)

Type of specimen UNDISTURBED; 3.00 in. square; 0.560 in. thick

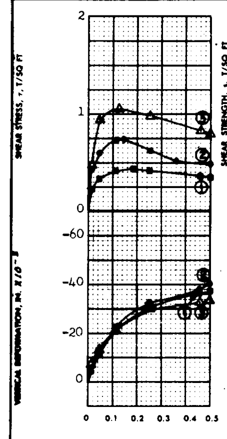
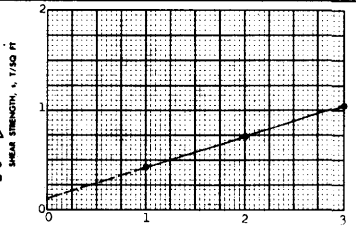
Classification SILTY CLAY (CL), tan, contains rootlets

LL - | PL - | PI - | G_s 2.68

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 1-B; Depth 0.7; Date 4 December, 1967; WJH

DIRECT SHEAR TEST REPORT — Boring 14-U, Sample 4-A

TEST NO.		1	2	3	
Initial: Water content	w_o	68.5 %	69.6 %	70.8 %	%
Void ratio	e_o	1.62	1.64	1.64	
Saturation	S_o	100+ %	100+ %	100+ %	%
Dry density, lb/cu ft	γ_d	64.6	64.0	64.0	
Time for 50 percent consolidation, min	t_{50}	11	6	18	
Final: Water content	w_f	55.5 %	49.5 %	43.8 %	%
Normal stress, T/sq ft	σ	1.0	2.0	3.0	
Maximum shear stress, T/sq ft	τ_{max}	0.43	0.74	1.05	
Actual time to failure, min	t_f	1410	1110	990	
Rate of strain, in./min		.00014	.00014	.00014	

Shear Strength Parameters: φ' = 18°; tan φ' = 0.325; c' = 0.11 T/sq ft

Controlled strain (X)

Type of specimen UNDISTURBED; 3.00 in. square; 0.560 in. thick

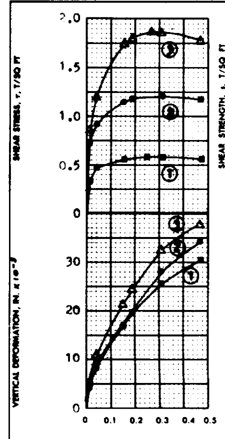
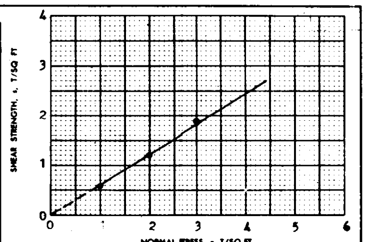
Classification PLASTIC CLAY (CH), grey, contains small shells

LL 89 | PL 29 | PI 60 | G_s 2.71

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 4-A; Depth 14.4; Date 14 DECEMBER 1967; WJH

DIRECT SHEAR TEST REPORT — Boring 14-U, Sample 7-D

TEST NO.		①	②	③	
Initial: Water content	w_o	34.1 %	33.4 %	33.2 %	%
Void ratio	e_o	0.906	0.935	0.900	
Saturation	S_o	100+ %	95.0 %	98.1 %	%
Dry density, lb/cu ft	γ_d	87.1	85.8	87.4	
Void ratio after consolidation	e_c				
Time for 50 percent consolidation, min	t_{50}	<1	<1	<1	
Final: Water content	w_f	32.3 %	29.8 %	29.1 %	%
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}	0.58	1.20	1.87	
Actual time to failure, min	t_f	2280	2820	2400	
Rate of strain, in./min		.00011	.00011	.00011	
Ultimate shear stress, T/sq ft	τ_{ult}				

Shear Strength Parameters: φ' = 32°; tan φ' = 0.625; c' = 0 T/sq ft

Controlled strain (X)

Type of specimen UNDISTURBED; 3.00 in. square; 0.562 in. thick

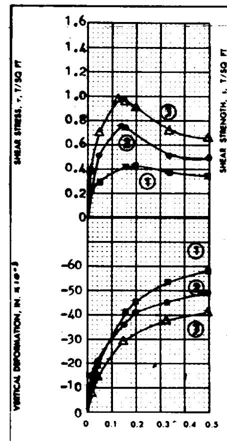
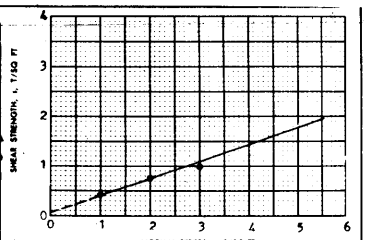
Classification SILTY CLAY (CL), gray

LL 39 | PL 22 | PI 17 | G_s 2.66

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

Boring No. 14-U; Sample No. 7-D; Depth 29.0; Date 4 December, 1967; BMG

DIRECT SHEAR TEST REPORT — Boring 14-U, Sample 14-C

TEST NO.		①	②	③	
Initial: Water content	w_o	64.5 %	68.4 %	60.1 %	%
Void ratio	e_o	1.86	2.00	1.83	
Saturation	S_o	95.0 %	93.7 %	90.0 %	%
Dry density, lb/cu ft	γ_d	59.7	57.0	60.4	
Void ratio after consolidation	e_c				
Time for 50 percent consolidation, min	t_{50}	1	6	12	
Final: Water content	w_f	59.1 %	55.1 %	50.4 %	%
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}	0.43	0.75	0.98	
Actual time to failure, min	t_f	1740	1230	1080	
Rate of strain, in./min		.00012	.00012	.00012	
Ultimate shear stress, T/sq ft	τ_{ult}				

Shear Strength Parameters: φ' = 19; tan φ' = 0.344; c' = 0.08 T/sq ft

Controlled strain (X)

Type of specimen UNDISTURBED; 3.00 in. square; 0.562 in. thick

Classification PLASTIC CLAY (CH), gray, fissured

LL 91 | PL 26 | PI 65 | G_s 2.74

Project LAKE PONTCHARTRAIN, LA. & VICINITY — ST. CHARLES PARISH LAKEFRONT LEVEE

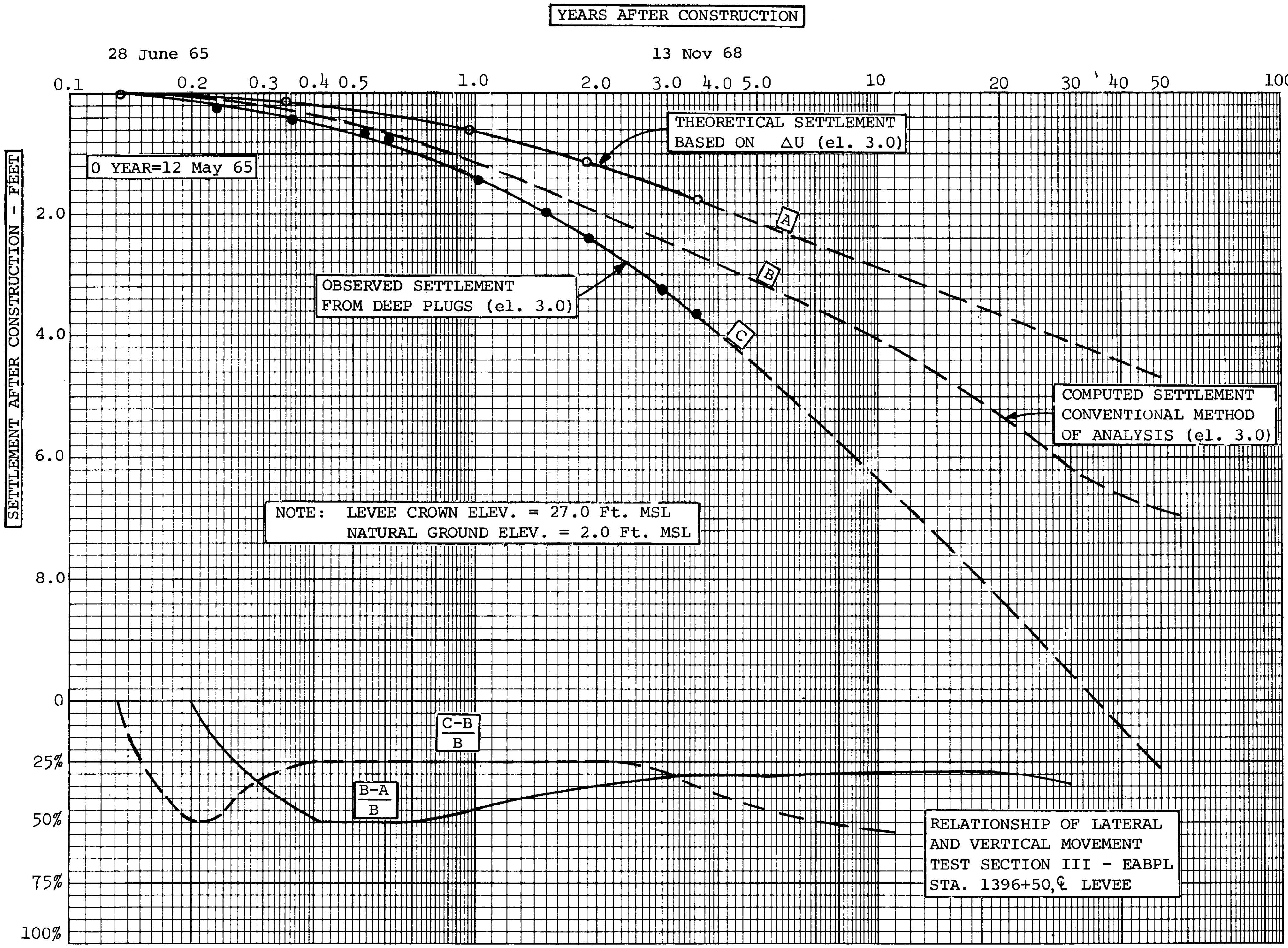
Boring No. 14-U; Sample No. 14-C; Depth 55.8; Date 4 December, 1967; BMG

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

DETAIL SHEAR STRENGTH DATA
BORING 14-U

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

SEPT. 1969 — FILE NO. H-2-24624



TOTAL SETTLEMENT (C) = $\frac{(C-B)}{B}$ (B) + (B); WHERE $\frac{(C-B)}{B}$ B = ADDITIONAL SETTLEMENT DUE TO LATERAL MOVEMENT OF FOUNDATION

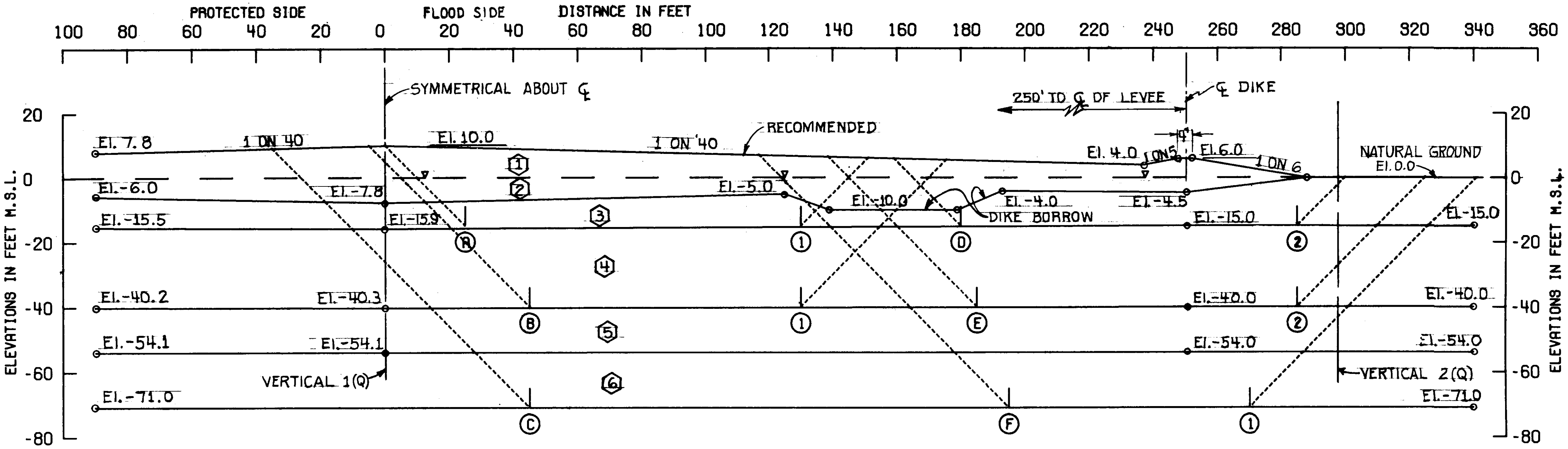
$\frac{(B-A)}{B}$ = PERCENT REDUCTION OF GAIN IN STRENGTH, BASED ON COMPUTED SETTLEMENT, BECAUSE OF LATERAL MOVEMENT OF FOUNDATION

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

SETTLEMENT AND LATERAL MOVEMENT OF FOUNDATION

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

SEPT. 1969 FILE NO. H-2-24624



STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 2	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 1	C - UNIT COHESION - P.S.F. BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	CH	100.0	100.0	50.0	50.0	50.0	50.0	0.
2	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
3	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
4	CH	34.0	34.0	216.0	216.0	321.0	321.0	0.
5	CH	34.0	34.0	380.0	380.0	430.0	430.0	0.
6	CH	45.0	45.0	700.0	700.0	700.0	700.0	0.

ASSUMED FAILURE NO.	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
A 1	-15.00	3410	11550	2843	22864	15442	17804	7422	2.399
A 2	-15.00	3410	28600	3300	22864	1884	35310	20979	1.683
B 1	-40.00	14010	27285	13382	66303	51967	54678	14335	3.814
B 2	-40.00	14010	77040	14100	66303	18489	105150	47813	2.199
C 1	-71.00	48232	157500	48532	152305	73181	254264	79124	3.213
D 2	-15.00	2697	11550	3300	14201	1884	17547	12317	1.425
E 2	-40.00	13481	32100	14100	51241	18489	59681	32751	1.822
F 1	-71.00	48246	52500	48532	127920	73181	149278	54739	2.727

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

GENERAL NOTES

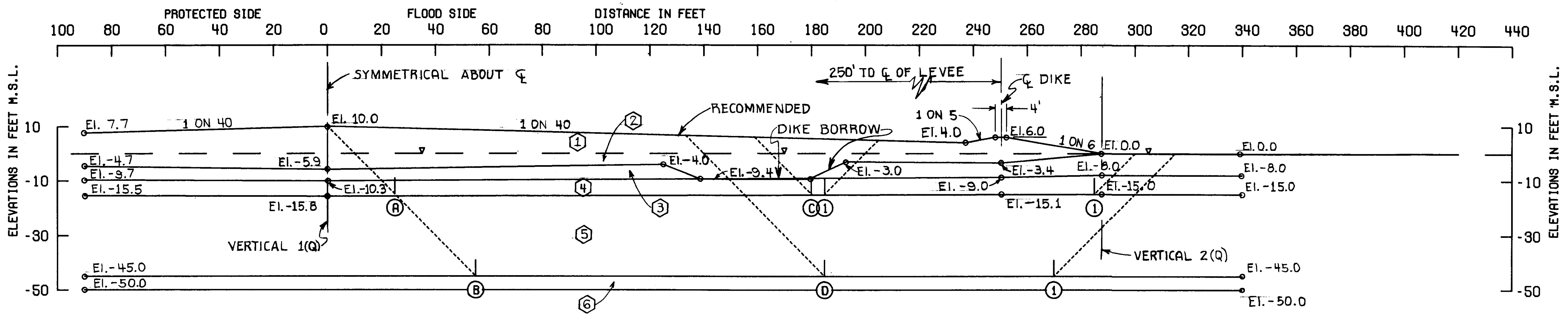
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS. AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U. SEE PLATE 10.

FOR STABILITY ANALYSIS OF PARISH LINE CANAL CLOSURE, 1st LIFT STA. 1+90, SEE PLATE 31.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE (Q) STABILITY - 1st LIFT STA. 0+00 TO STA. 55+00 FLOOD SIDE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U. SEE BORING DATA, PLATE 11

FOR STABILITY ANALYSIS OF BAYOU PIQUANT CLOSURE, 1st LIFT, STA. 93+80, AND CANAL CLOSURE 1st LIFT, STA. 125+20, SEE PLATES 54 AND 32 RESPECTIVELY

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	50.0	50.0	50.0	50.0	0.
2	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
3	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
4	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
5	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
6	CH	46.0	46.0	450.0	450.0	550.0	550.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-15.00	3620	17600	3418	22538	11884	24638	10653	2.313
B 1	-45.00	17538	75250	17400	75192	27282	110188	47910	2.300
C 1	-15.00	2757	11550	3300	14143	1881	17607	12261	1.436
D 1	-45.00	16831	29750	17400	61057	27282	63981	33774	1.894

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

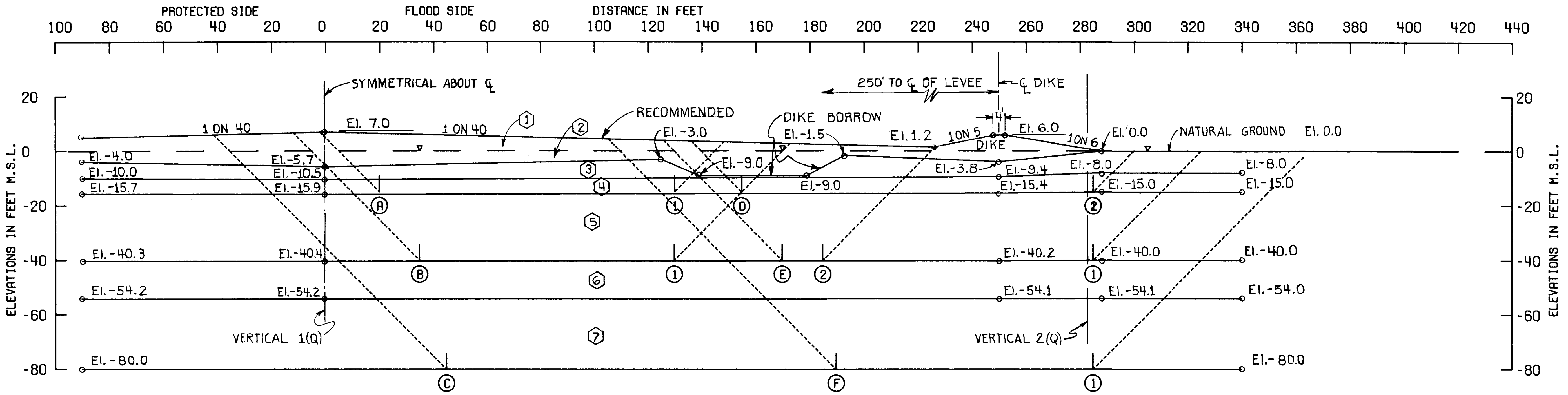
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE (Q) STABILITY-1st LIFT
STA. 55+00 TO STA. 140+00
FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U DATA, PLATE 12.

FOR STABILITY ANALYSIS OF CLOSURES 1st LIFT, STA. 154+50, 218+20, 239+20, AND 282+60, SEE PLATE 32.

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	100.0	100.0	50.0	50.0	50.0	50.0	0.
(2)	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
(3)	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
(4)	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
(5)	CH	34.0	34.0	110.0	110.0	110.0	110.0	0.
(6)	CH	34.0	34.0	280.0	280.0	450.0	450.0	0.
(7)	CH	41.0	41.0	650.0	650.0	850.0	850.0	0.

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-15.00	3338	12100	2668	15734	9602	18107	6132	2.952
(A) (2)	-15.00	3338	29150	3300	15734	1882	35788	13852	2.584
(B) (1)	-40.00	8791	10450	8000	51284	38597	27242	12686	2.147
(B) (2)	-40.00	8791	16500	8628	51284	28453	33920	22830	1.486
(C) (1)	-80.00	50155	204000	49567	153821	93373	303723	60448	5.024
(D) (1)	-15.00	2589	14300	3300	9686	1882	20189	7804	2.587
(E) (1)	-40.00	8117	12650	8800	39441	18487	29567	20953	1.411
(F) (1)	-80.00	50299	80750	49567	131043	93373	180616	37670	4.795

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

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

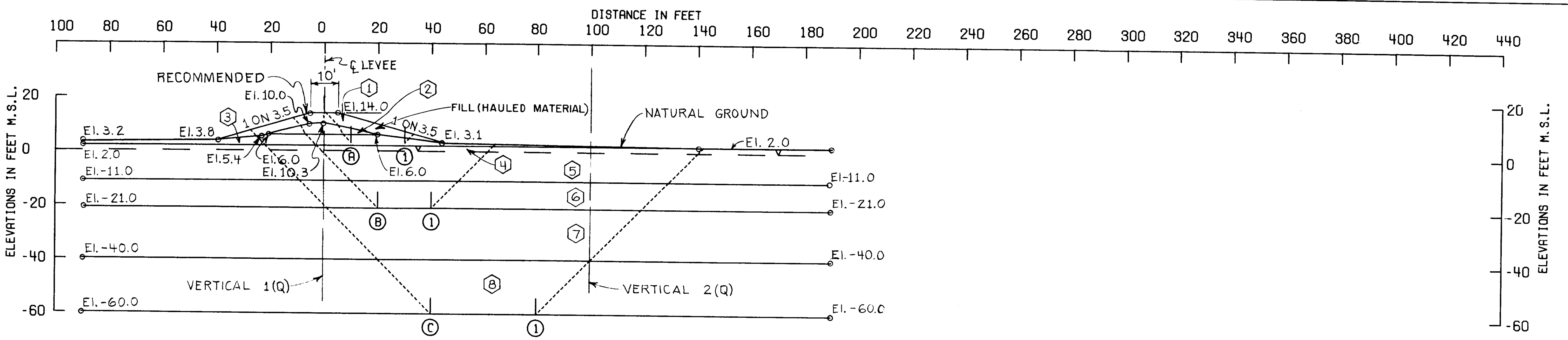
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE (Q) STABILITY - 1st LIFT
STA. 140+00 TO STA. 298+61.07

FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 14-U. SEE BORING DATA, PLATE 13.

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	120.0	120.0	200.0	200.0	200.0	200.0	0.
2	ML	115.0	115.0	0.	0.	0.	0.	32.0
3	CH	110.0	110.0	500.0	500.0	500.0	500.0	0.
4	CH	103.0	103.0	300.0	300.0	300.0	300.0	0.
5	CH	41.0	41.0	300.0	300.0	300.0	300.0	0.
6	CH	53.0	53.0	500.0	500.0	500.0	500.0	0.
7	CH	44.0	44.0	561.0	561.0	622.0	622.0	0.
8	CH	40.0	40.0	686.0	686.0	750.0	750.0	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	3.00	6528	10000	2321	6701	810	18849	5891	3.199
B 1	-21.00	24407	10000	18695	49770	17190	53102	32580	1.630
C 1	-60.00	70645	30000	66558	156987	95346	167203	61640	2.713

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

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

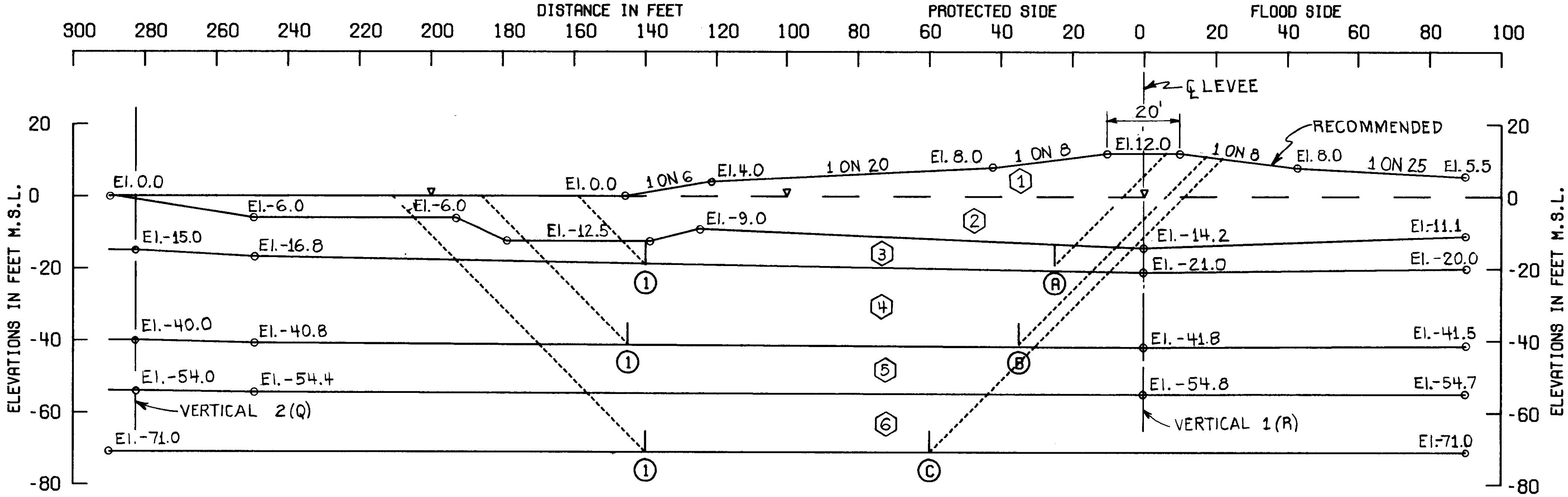
SEE PLATE 25 FOR BORROW DATA.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE (Q) STABILITY- GROSS SEC.
BONNET CARRÉ SPILLWAY
EAST GUIDE LEVEE ENLARGEMENT

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

SEPT. 1969 FILE NO. H-2-24624



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	100.0	100.0	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	309.0	110.0	309.0	110.0	0.
4	CH	34.0	34.0	404.0	216.0	309.0	321.0	0.
5	CH	34.0	34.0	556.0	380.0	606.0	430.0	0.
6	CH	45.0	45.0	868.0	700.0	868.0	700.0	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)	-19.00	15949	30305	8952	35936	6686	55207	29250	1.887
(B) (1)	-41.00	32319	49390	22072	79492	27587	103781	51904	1.999
(C) (1)	-71.00	73907	68843	58038	162084	82665	200788	79418	2.528

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

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

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U. SEE BORING DATA PLATE 10. GAINS IN SHEAR STRENGTHS ARE BASED ON (R) TREND

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

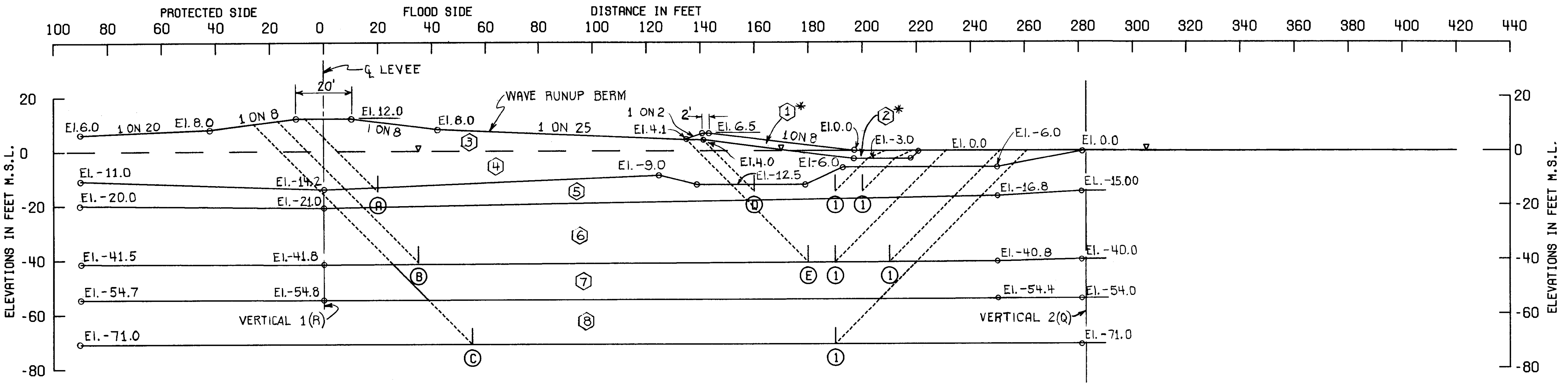
FOR STABILITY ANALYSIS OF PARISH LINE CANAL CLOSURE, ULTIMATE SEC., STA. 1+90. SEE PLATE 33.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2- GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY – ULTIMATE SEC. STA. 0+00 TO STA. 55+00 PROTECTED SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U. SEE BORING DATA, PLATE 10. GAINS IN SHEAR STRENGTHS ARE BASED ON (R) TREND.

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

FOR STABILITY ANALYSIS OF PARISH LINE CANAL, ULTIMATE SEC., STA. 1+90, SEE PLATE 34.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	RR*	58.0	58.0	0.	0.	0.	0.	40.0
3	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
4	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
5	PT	16.0	16.0	309.0	110.0	309.0	110.0	0.
6	CH	34.0	34.0	404.0	216.0	509.0	321.0	0.
7	CH	34.0	34.0	556.0	380.0	606.0	430.0	0.
8	CH	45.0	45.0	868.0	700.0	868.0	700.0	0.

* RIPRAP – 2' RIPRAP ON 0.75' SHELL BLANKET.

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	13642	39933	5529	28857	4527	59105	24329	2.429
B 1	-41.00	32319	67270	19234	79492	25468	118823	54023	2.199
C 1	-71.00	73907	107327	53851	162148	78660	235087	83489	2.816
D 1	-15.00	9489	7279	5402	15378	4188	22170	11189	1.981
E 1	-41.00	23845	11370	18354	49683	24073	53569	25610	2.092

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

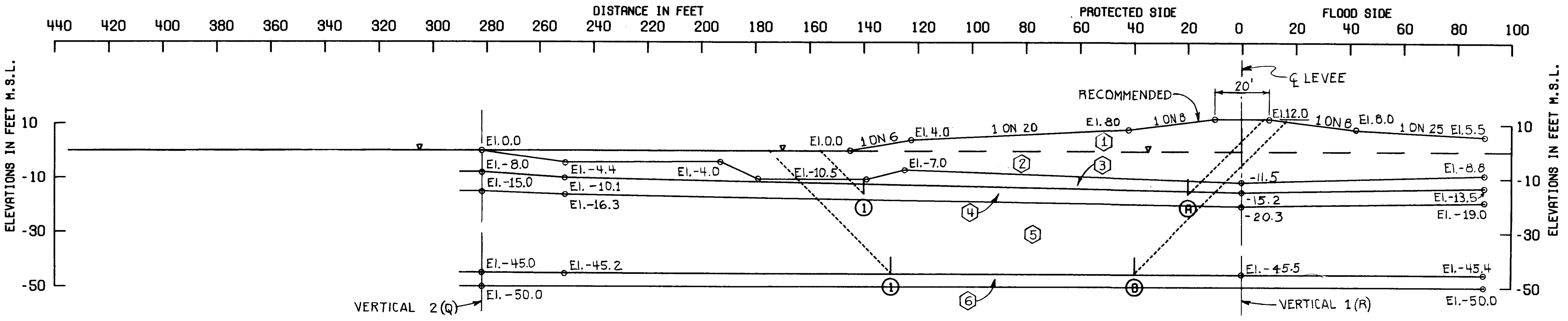
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2- GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY — ULTIMATE SEC. STA. 0+00 TO STA. 55+00 FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON RESULTS OF UNDISTURBED BORING 6-U. SEE BORING DATA, PLATE 11. GAINS IN SHEAR STRENGTHS ARE BASED ON (R) TREND

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

FOR STABILITY ANALYSIS OF BAYOU PIQUANT, ULTIMATE SEC. STA. 93+80, AND CANAL, CLOSURE, ULTIMATE SEC., STA. 125+20. SEE PLATES 35 AND 37, RESPECTIVELY.

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	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	301.0	110.0	301.0	110.0	0.
4	PT	16.0	16.0	301.0	110.0	301.0	110.0	0.
5	CH	34.0	34.0	415.0	235.0	530.0	350.0	0.
6	CH	46.0	46.0	622.0	450.0	722.0	550.0	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)	-16.00	14395	29618	7498	30386	4825	51510	25560	2.015
(B) (1)	-45.00	43780	50361	29649	86609	33814	123791	52795	2.345

NOTES

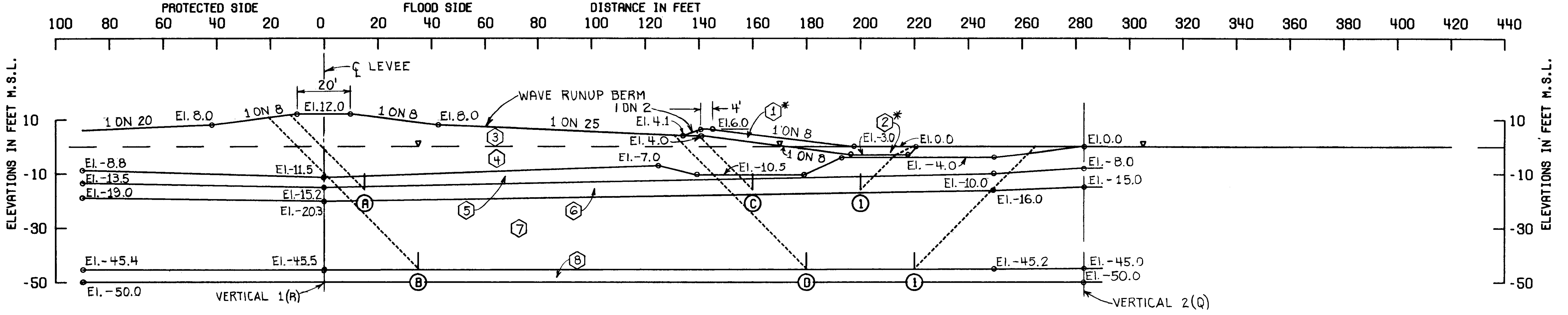
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY — ULTIMATE SEC. STA. 55+00 TO STA. 140+00 PROTECTED SIDE

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969
FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U. SEE BORING DATA PLATE 11. GAINS IN SHEAR STRENGTHS ARE BASED ON (R) TRENDS.

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

FOR STABILITY ANALYSIS OF BAYOU PIQUANT, ULTIMATE SEC., STA. 43+80, AND CANAL CLOSURE, ULTIMATE SEC., STA. 125+20, SEE PLATES 36 AND 38 RESPECTIVELY.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	RR*	58.0	58.0	0.	0.	0.	0.	40.0
3	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
4	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
5	PT	16.0	16.0	301.0	110.0	301.0	110.0	0.
6	PT	16.0	16.0	301.0	110.0	301.0	110.0	0.
7	CH	34.0	34.0	415.0	235.0	530.0	350.0	0.
8	CH	46.0	46.0	622.0	450.0	722.0	550.0	0.

* RIPRAP- 2' RIPRAP ON 0.75' SHELL BLANKET.

ASSUMED FAILURE NO.		ASSUMED SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
			R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-16.00	14395	40769	5313	30387	4145	60477	26242	2.305
B	1	-45.00	36127	82994	19994	87894	27057	139125	60837	2.287
C	1	-16.00	9583	7163	5313	16299	4145	22060	12154	1.815
D	1	-45.00	27075	16094	19994	55787	27057	75910	31027	2.447

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

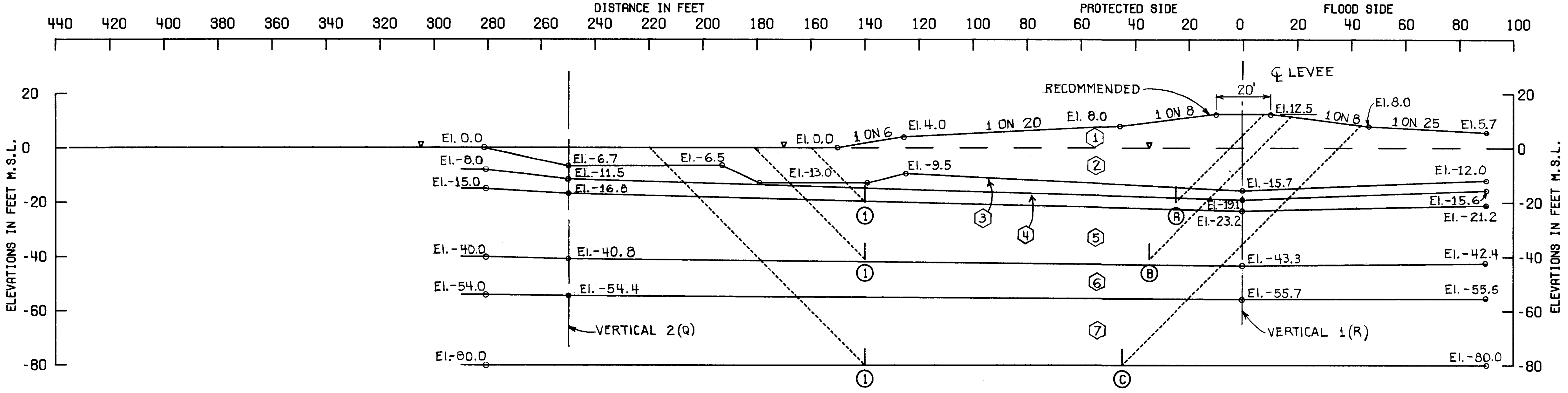
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY — ULTIMATE SEC. STA. 55+00 TO STA. 140+00

FLOOD SIDE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U. SEE BORING DATA PLATE 12. GAINS IN SHEAR STRENGTH ARE BASED ON (R) TREND.

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

FOR STABILITY ANALYSIS OF CLOSURES, ULTIMATE SEC., STA. 154+50, 218+20, 239+20, 282+60, SEE PLATE 37.

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	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	314.0	143.0	314.0	146.0	0.
4	PT	16.0	16.0	314.0	146.0	314.0	146.0	0.
5	CH	34.0	34.0	296.0	148.0	296.0	148.0	0.
6	CH	41.0	41.0	477.0	324.0	647.0	494.0	0.
7	CH	41.0	41.0	802.0	700.0	1002.0	900.0	0.

ASSUMED FAILURE SURFACE NO.	ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-20.00	16634	31229	9540	39506	7886	57403	31620	1.815
(B) (1)	-41.00	28224	25641	18025	82198	28339	71890	53859	1.335
(C) (1)	-80.00	78527	91605	63001	201712	108292	233134	93420	2.496

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

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

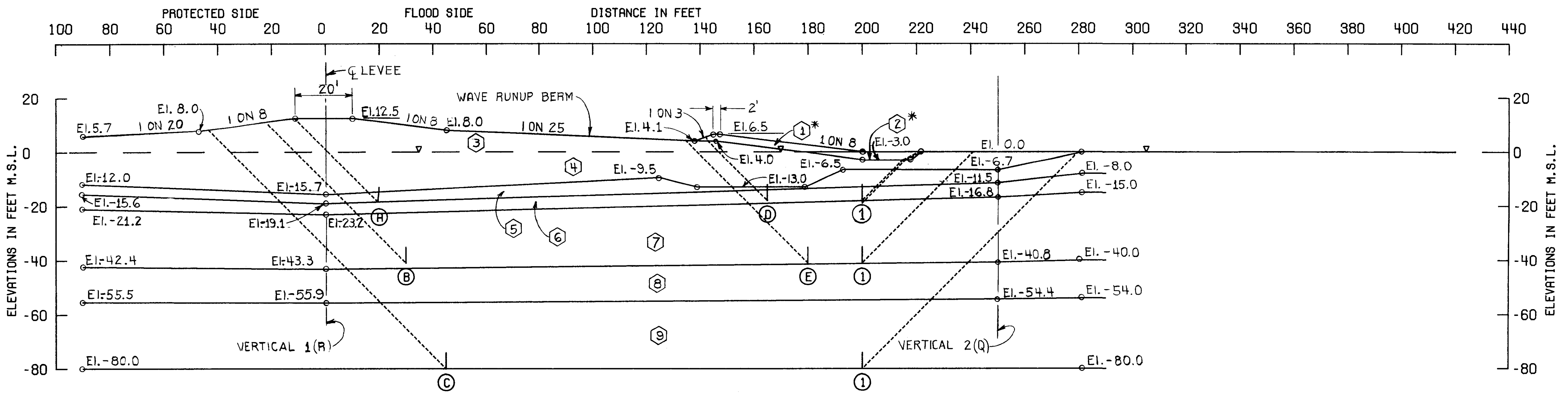
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY – ULTIMATE SEC. STA. 140+00 TO STA. 298+61.07 PROTECTED SIDE

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

SEPT. 1969

FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U. SEE BORING DATA PLATE 12. GAINS IN SHEAR STRENGTHS ARE BASED ON (R) TREND.

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

FOR STABILITY ANALYSIS OF CLOSURES, ULTIMATE SEC., STA. 154+50, 218+20, 239+20 AND 282+60, SEE PLATE 38.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	RR*	58.0	58.0	0.	0.	0.	0.	40.0
3	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
4	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
5	PT	16.0	16.0	314.0	143.0	314.0	146.0	0.
6	PT	16.0	16.0	314.0	146.0	314.0	146.0	0.
7	CH	34.0	34.0	246.0	148.0	296.0	148.0	0.
8	CH	41.0	41.0	477.0	324.0	647.0	494.0	0.
9	CH	41.0	41.0	802.0	700.0	1002.0	908.0	0.

* RIPRAP— 2' RIPRAP ON 0.75' SHELL BLANKET

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	-19.00	16113	43214	7052	37640	6201	66379	31438	2.111
B 1	-41.00	28303	38746	14790	83389	24940	81840	58449	1.400
C 1	-80.00	79144	147563	57665	204029	102675	284372	101354	2.806
D 1	-18.00	10687	6698	6708	18698	5701	24093	12997	1.854
E 1	-41.00	19757	3674	14790	50187	24940	38217	25246	1.514

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
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P -- AS A SUBSCRIPT, REFERS TO PASSIVE WEDGE

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

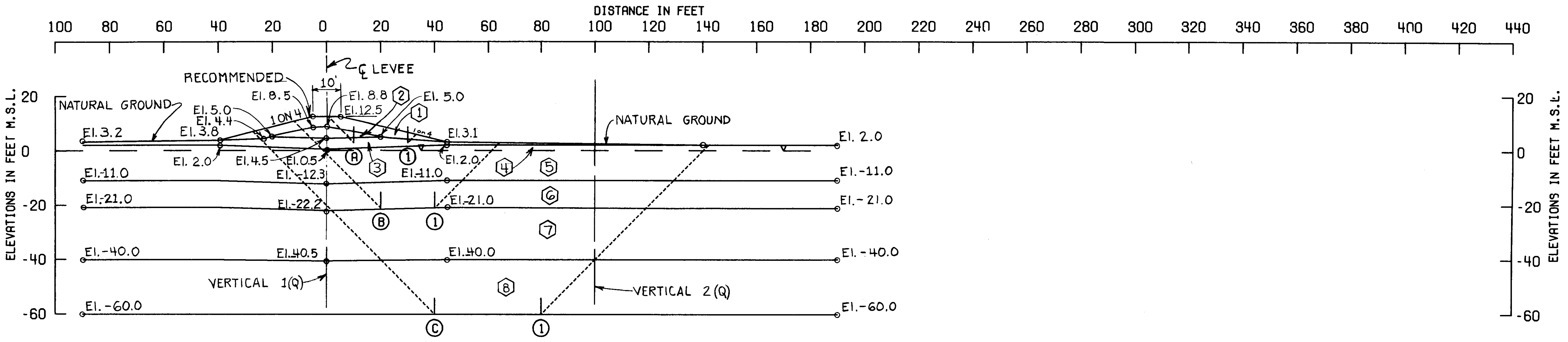
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2- GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE STABILITY — ULTIMATE SEC. STA. 140+00 TO STA. 298+61.07 FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 29



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 14-U. SEE BORING DATA, PLATE 13.

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	120.0	120.0	250.0	250.0	250.0	250.0	0.
2	ML	115.0	115.0	0.	0.	0.	0.	32.0
3	CH	110.0	110.0	500.0	500.0	500.0	500.0	0.
4	CH	103.0	103.0	300.0	300.0	300.0	300.0	0.
5	CH	41.0	41.0	300.0	300.0	300.0	300.0	0.
6	CH	53.0	53.0	500.0	500.0	500.0	500.0	0.
7	CH	44.0	44.0	561.0	561.0	622.0	622.0	0.
8	CH	40.0	40.0	686.0	686.0	750.0	750.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	3.00	5528	10000	2023	4924	631	17551	4293	4.088
B 1	-21.00	23769	10000	18695	45049	17138	52465	27911	1.880
C 1	-60.00	69893	30000	66558	149769	95346	166451	54422	3.058

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

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

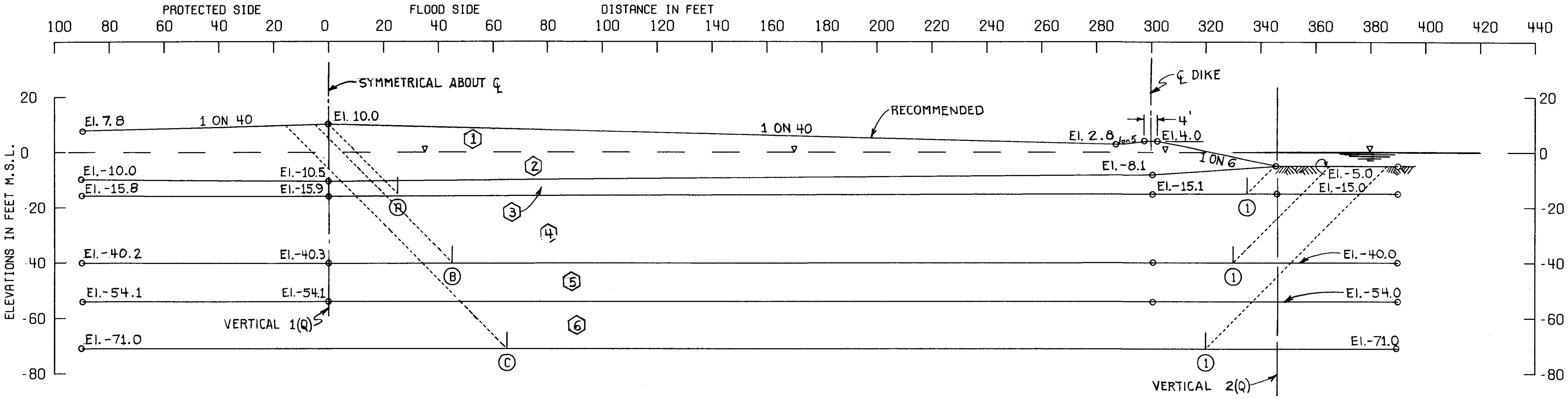
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE (Q) STABILITY - ULTIMATE SEC.
BONNET CARRE SPILLWAY EAST GUIDE LEVEE ENLARGEMENT

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 30



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U. SEE BORING DATA, PLATE 10.

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	50.0	50.0	50.0	50.0	0.
2	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
3	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
4	CH	34.0	34.0	216.0	216.0	321.0	321.0	0.
5	CH	34.0	34.0	380.0	380.0	430.0	430.0	0.
6	CH	45.0	45.0	700.0	700.0	700.0	700.0	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	-15.00	3059	34100	2208	23281	1363	39368	21917	1.796
B	1	-40.00	13663	91485	13000	68458	16604	118148	51853	2.278
C	1	-71.00	47919	178500	47440	154745	67772	273860	86972	3.149

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

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

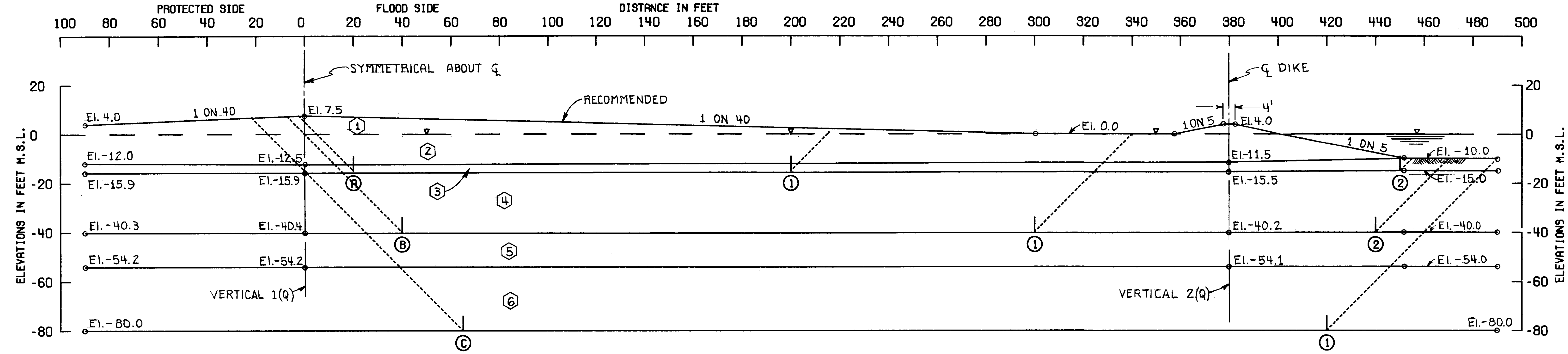
SEE PLATE 5 FOR LOCATION OF DIKE BORROW

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

PARISH LINE CANAL CLOSURE (Q) STABILITY 1st LIFT STA. 1+90 FLOOD SIDE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624

PLATE 31



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U SEE BORING DATA PLATE 12.

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	50.0	50.0	50.0	50.0	0.
2	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
3	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
4	CH	34.0	34.0	110.0	110.0	110.0	110.0	0.
5	CH	34.0	34.0	280.0	280.0	450.0	450.0	0.
6	CH	41.0	41.0	650.0	650.0	850.0	850.0	0.

ASSUMED FAILURE NO.	ASSUMED 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
A 1	-15.00	2546	19800	2071	17775	7854	24417	9921	2.461
A 2	-15.00	2546	47300	1100	17775	215	50946	17560	2.901
B 1	-40.00	8025	28600	7403	58057	26912	44029	31144	1.414
B 2	-40.00	8025	44000	6600	58057	13960	58625	44697	1.312
C 1	-80.00	49335	301750	48234	167493	83404	399319	84088	4.749

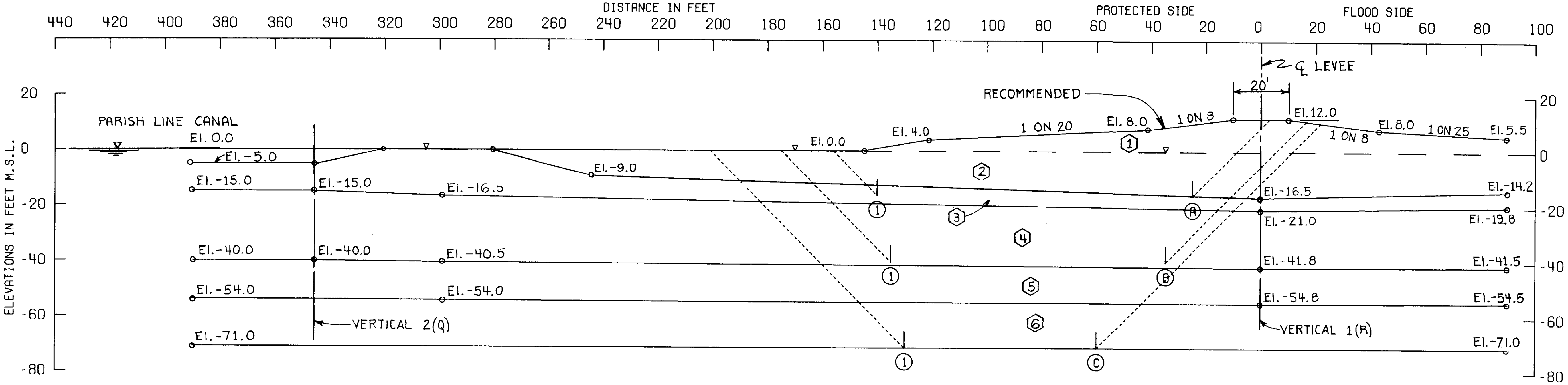
NOTES

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

SEE PLATE 5 FOR LOCATION OF DIKE BORROW.
SEE PLATES 3 AND 4 FOR LOCATIONS OF CLOSURES.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
CLOSURES (Q) STABILITY -1st LIFT
STA. 125+20, 154+50, 218+20, 239+20, 282+60
FLOOD SIDE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969
FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U SEE BORING DATA PLATE 10 GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	309.0	110.0	309.0	110.0	0.
4	CH	34.0	34.0	404.0	216.0	509.0	321.0	0.
5	CH	34.0	34.0	556.0	380.0	606.0	430.0	0.
6	CH	45.0	45.0	867.0	700.0	567.0	700.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
(A) (1)	-16.00	14010	31558	7823	30676	4995	53392	25680	2.079
(B) (1)	-40.00	31474	38361	22723	78452	26753	92559	51699	1.790
(C) (1)	-71.00	73994	57480	61817	163590	85161	193291	78429	2.465

NOTES

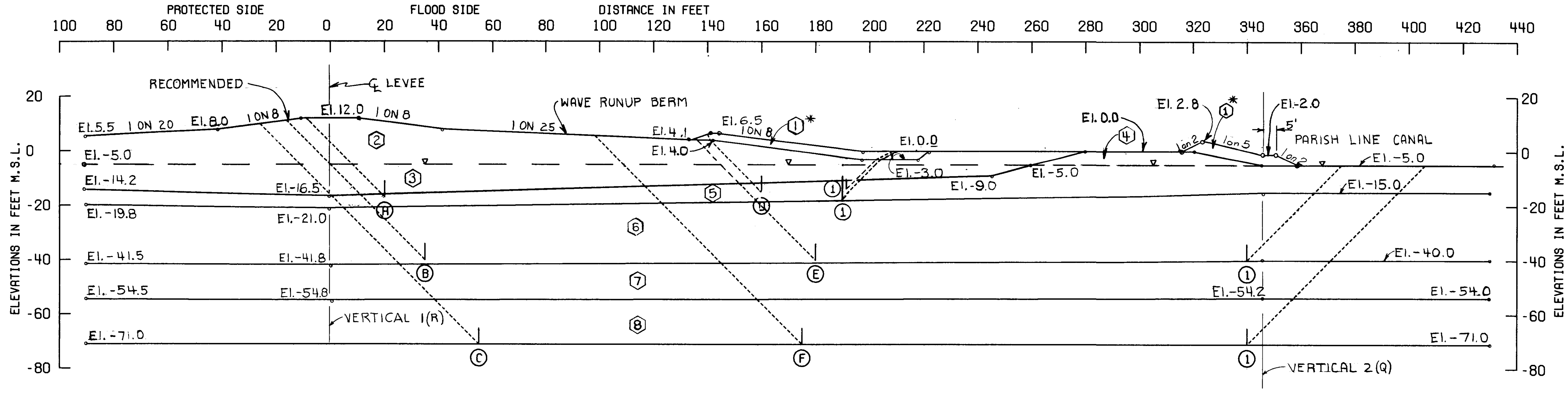
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
∇ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE 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. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

CLOSURE STABILITY— ULTIMATE SEC. STA. 1+90 PROTECTED SIDE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969
FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 2-U. SEE BORING DATA PLATE 10. GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
3	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
4	PT	78.0	78.0	309.0	110.0	309.0	110.0	0.
5	PT	16.0	16.0	309.0	110.0	309.0	110.0	0.
6	CH	34.0	34.0	404.0	216.0	509.0	321.0	0.
7	CH	34.0	34.0	556.0	380.0	606.0	430.0	0.
8	CH	45.0	45.0	867.0	700.0	867.0	700.0	0.

*RIPRAP - 2' RIPRAP ON 0.75' SHELL BLANKET

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	-17.00	14603	42263	8260	36992	10742	65126	26250	2.481
B 1	-40.00	31474	124172	13000	90090	15666	168646	74424	2.266
C 1	-71.00	73955	219927	47440	186550	64843	341323	121706	2.804
D 1	-15.00	9543	6250	7480	19197	9029	23274	10167	2.289
E 1	-40.00	24298	58836	13000	58748	15666	96134	43082	2.231
F 1	-71.00	65569	122548	47440	142397	64843	235557	77553	3.037

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

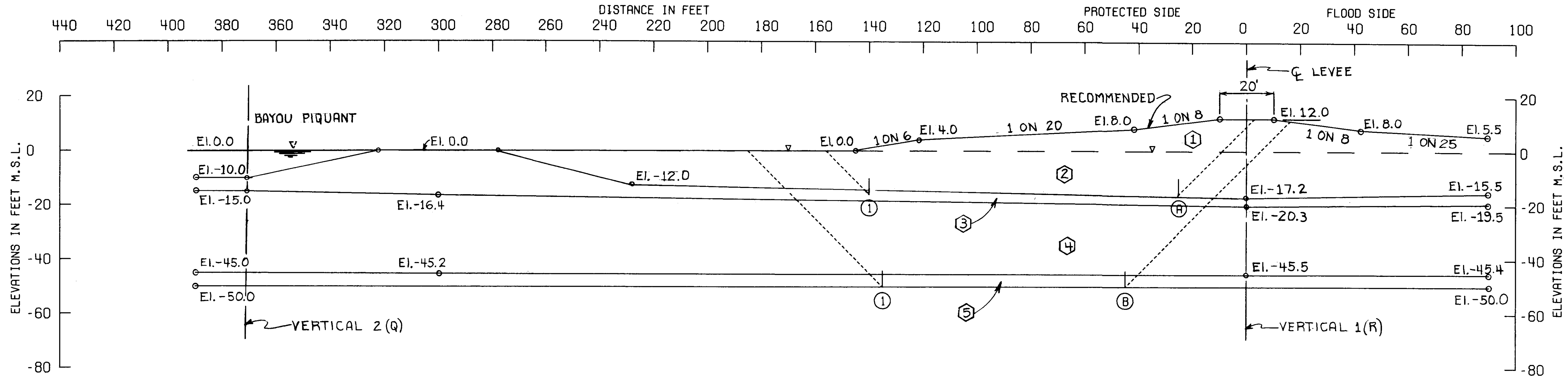
FACTOR OF SAFETY = $\frac{R_A + R_B + R_P}{D_A - D_P}$

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

PARISH LINE CANAL CLOSURE
STABILITY - ULTIMATE SEC. STA. 1+90 - FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U, SEE BORING DATA PLATE 11. GAIN IN SHEAR STRENGTH BASED ON (R) TREND

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	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	298.0	110.0	298.0	110.0	0.
4	CH	34.0	34.0	413.0	235.0	528.0	350.0	0.
5	CH	46.0	46.0	622.8	450.0	722.0	550.0	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)	-17.00	14519	30882	8354	32504	5684	53755	26821	2.004
(B) (1)	-50.00	41509	64726	32353	104412	43119	138588	61293	2.261

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

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

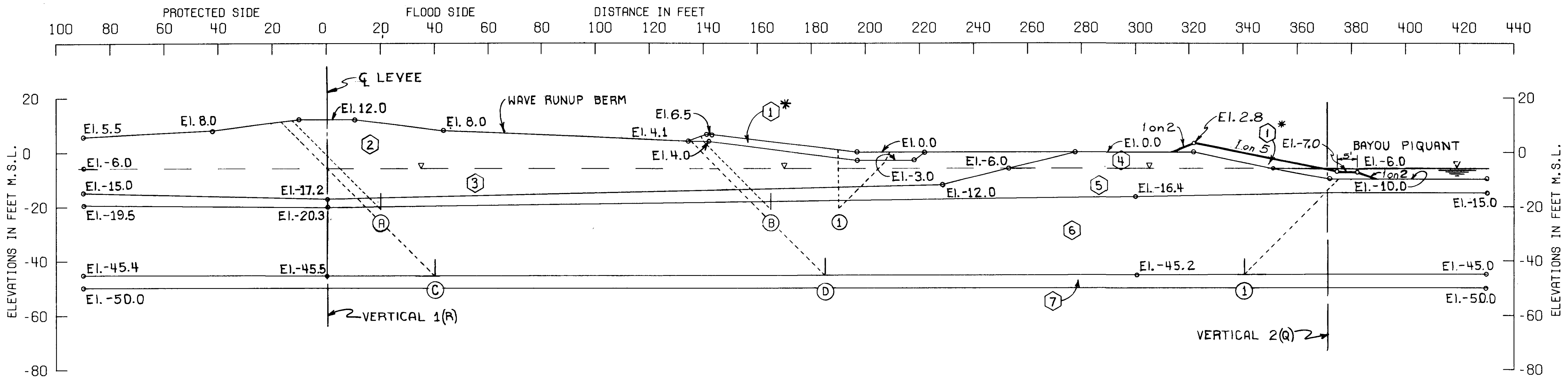
FOR STABILITY ANALYSIS OF BAYOU PIQUANT FIRST LIFT SEE PLATE 54.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6

ST. CHARLES PARISH LAKEFRONT LEVEE
BAYOU PIQUANT CLOSURE STABILITY-
ULTIMATE SEC. STA. 93+80
PROTECTED SIDE

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

SEPT. 1969 FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U SEE BORING DATA PLATE II GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
3	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
4	PT	78.0	78.0	298.0	110.0	298.0	110.0	0.
5	PT	16.0	16.0	298.0	110.0	298.0	110.0	0.
6	CH	34.0	34.0	413.0	235.0	528.0	350.0	0.
7	CH	46.0	46.0	622.0	450.0	722.0	550.0	0.

* RIPRAP 2' RIPRAP ON 0.75' SHELL BLANKET.

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	-21.00	16873	76782	10941	46668	17326	104596	29342	3.564
B	1	-18.50	11264	11065	9276	24529	13211	31606	11317	2.793
C	1	-45.00	35658	137148	15344	107544	18498	188152	89046	2.113
D	1	-45.00	28577	65886	15344	72311	18498	109808	53813	2.041

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

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

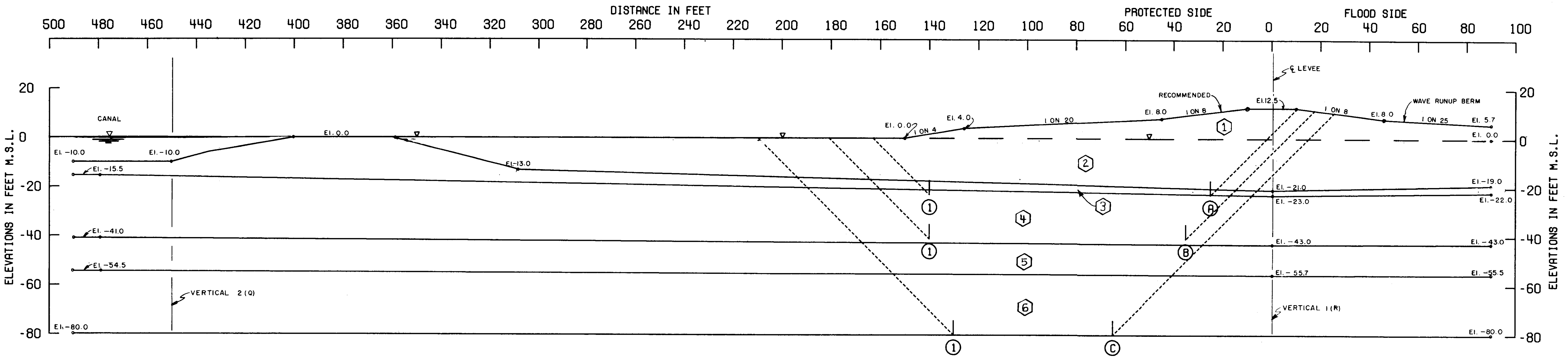
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT CLOSURE STABILITY
ULTIMATE SEC. STA. 93+80
FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 36



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U. SEE BORING DATA PLATE 12. GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	250.0	250.0	250.0	250.0	0.
2	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
3	PT	16.0	16.0	315.0	110.0	315.0	110.0	0.
4	CH	34.0	34.0	296.0	110.0	296.0	110.0	0.
5	CH	34.0	34.0	449.0	280.0	614.0	450.0	0.
6	CH	41.0	41.0	805.0	650.0	1005.0	850.0	0.

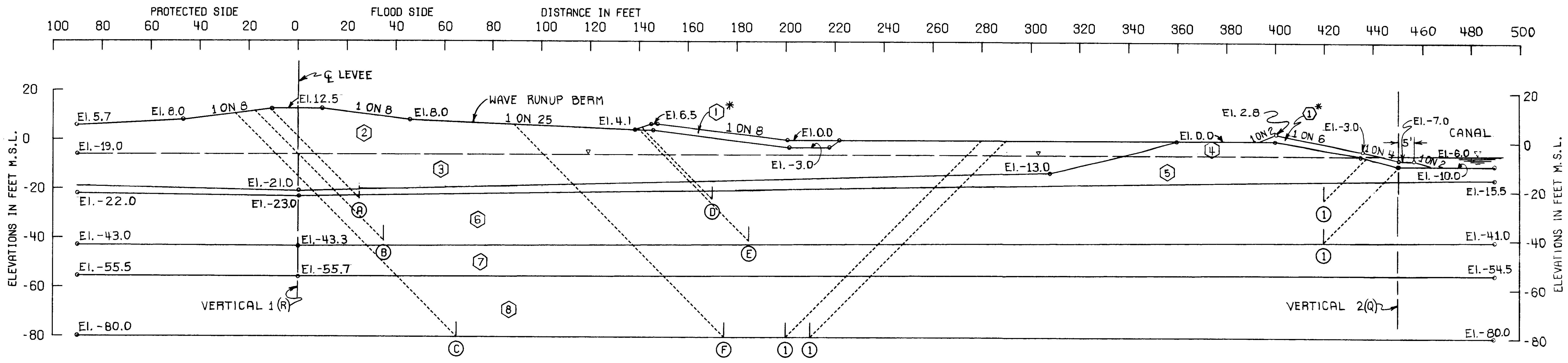
ASSUMED FAILURE NO.	ASSUMED SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-23.00	17999	31902	11499	45186	10514	61401	34672	1.771
B 1	-41.00	27816	27282	19775	85093	30103	74874	54990	1.362
C 1	-80.00	77921	63142	67100	202641	114705	208164	87935	2.367

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. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
CLOSURES STABILITY-ULTIMATE SEC.
STA. 125+20, 154+50, 218+20, 239+20, 282+60 — PROTECTED SIDE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969
FILE NO. H-2-24624



GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 10-U. SEE BORING DATA PLATE 12. GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	RR*	120.0	120.0	0.	0.	0.	0.	40.0
2	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
3	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
4	PT	78.0	78.0	315.0	110.0	315.0	110.0	0.
5	PT	16.0	16.0	315.0	110.0	315.0	110.0	0.
6	CH	34.0	34.0	296.0	110.0	296.0	110.0	0.
7	CH	34.0	34.0	449.0	280.0	619.0	450.0	0.
8	CH	41.0	41.0	805.0	650.0	1005.0	850.0	0.

* RIPRAP - 2' RIPRAP ON 0.75' SHELL BLANKET

ASSUMED FAILURE SURFACE NO.		ASSUMED FAILURE SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
			R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A	1	-24.00	18509	80593	4142	55086	4597	103244	50489	2.045
B	1	-41.00	27816	77757	7193	99246	16123	112766	83123	1.357
C	1	-80.00	77921	129513	63686	231456	139842	271122	91614	2.959
D	1	-24.00	13865	43516	4142	33961	4597	61524	29364	2.095
E	1	-41.00	21415	40177	7193	65117	16123	68786	48994	1.404
F	1	-80.00	71205	32854	63180	184477	139040	167240	45437	3.681

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

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

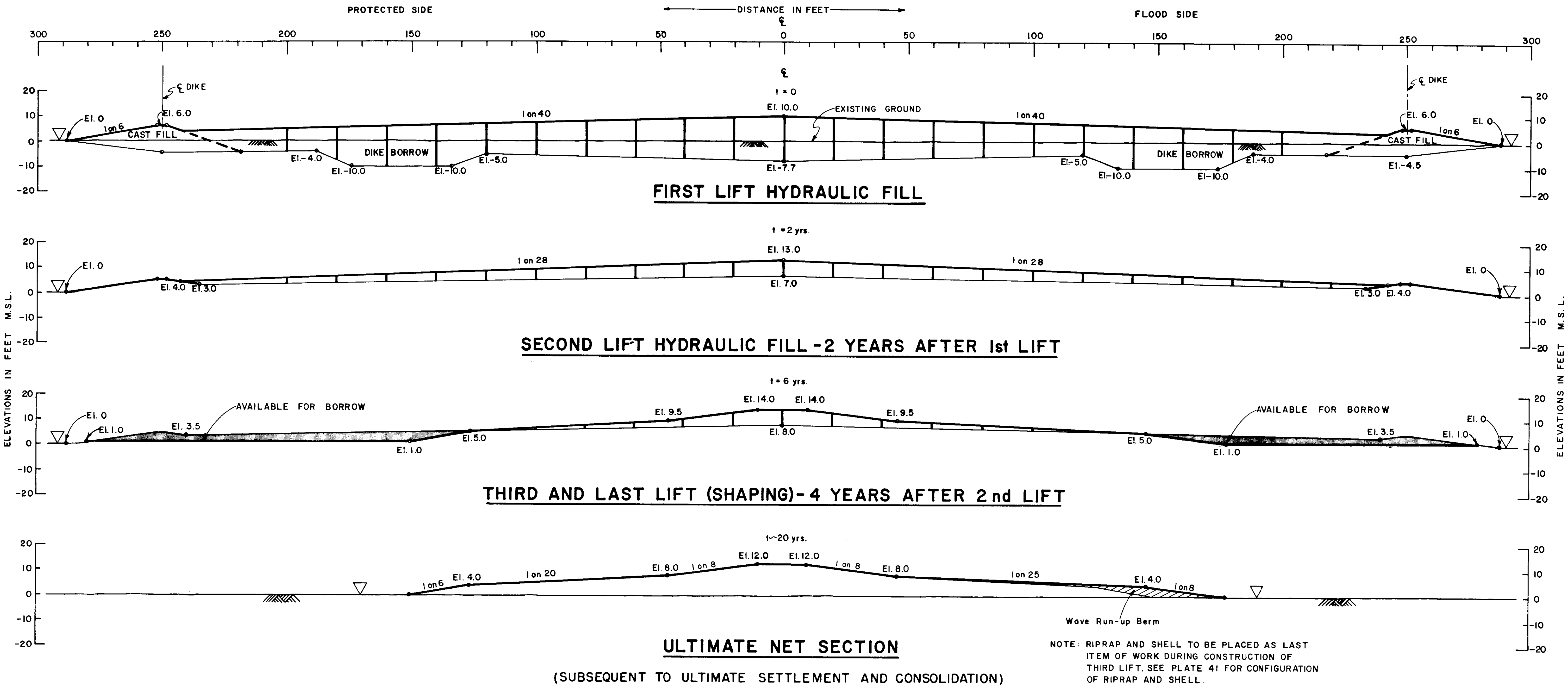
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

CLOSURES STABILITY - ULTIMATE
SEC. STA. 125+20, 154+50, 218+20, 239+20, 282+60
FLOOD SIDE

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 38



NOTE: RIPRAP AND SHELL TO BE PLACED AS LAST ITEM OF WORK DURING CONSTRUCTION OF THIRD LIFT. SEE PLATE 41 FOR CONFIGURATION OF RIPRAP AND SHELL.

NOTE:

SETTLEMENT OF CROWN INCLUDES CONSOLIDATION AND LATERAL SPREAD OF FOUNDATION AND CONSOLIDATION AND SHRINKAGE OF FILL.

HATCHED AREA INDICATES THE QUANTITY OF MATERIAL REQUIRED TO CONSTRUCT EACH LIFT.

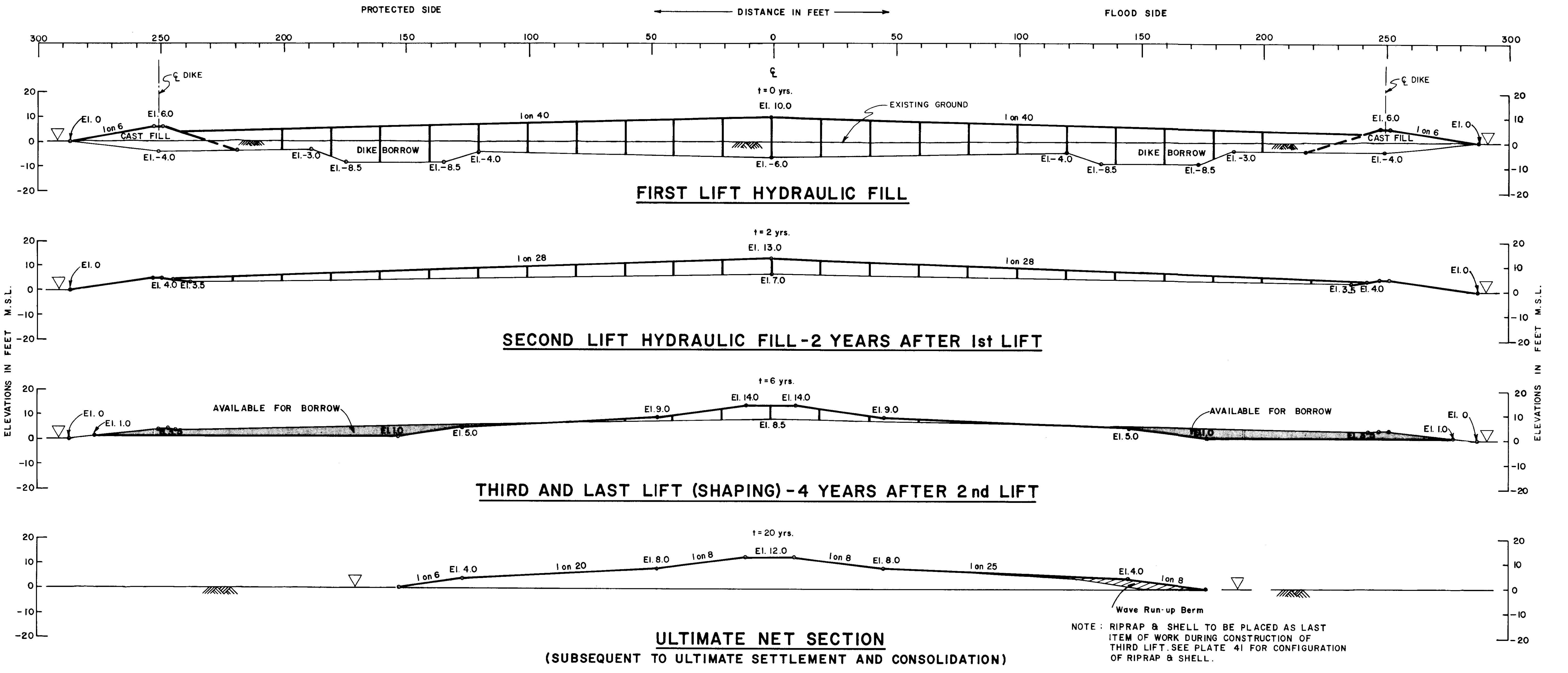
HYDRAULIC FILL TO BE OBTAINED FROM ADJACENT BORROW IN LAKE PONTCHARTRAIN.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE CONFIGURATIONS-STAGE CONSTRUCTION STA. 0+00 TO 55+00

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

SEPT. 1969 FILE NO. H-2-24624



NOTE: RIPRAP & SHELL TO BE PLACED AS LAST ITEM OF WORK DURING CONSTRUCTION OF THIRD LIFT. SEE PLATE 41 FOR CONFIGURATION OF RIPRAP & SHELL.

NOTE:

SETTLEMENT OF CROWN INCLUDES CONSOLIDATION AND LATERAL SPREAD OF FOUNDATION AND CONSOLIDATION AND SHRINKAGE OF FILL.

HATCHED AREA INDICATES THE QUANTITY OF MATERIAL REQUIRED TO CONSTRUCT EACH LIFT.

HYDRAULIC FILL TO BE OBTAINED FROM ADJACENT BORROW IN LAKE PONTCHARTRAIN.

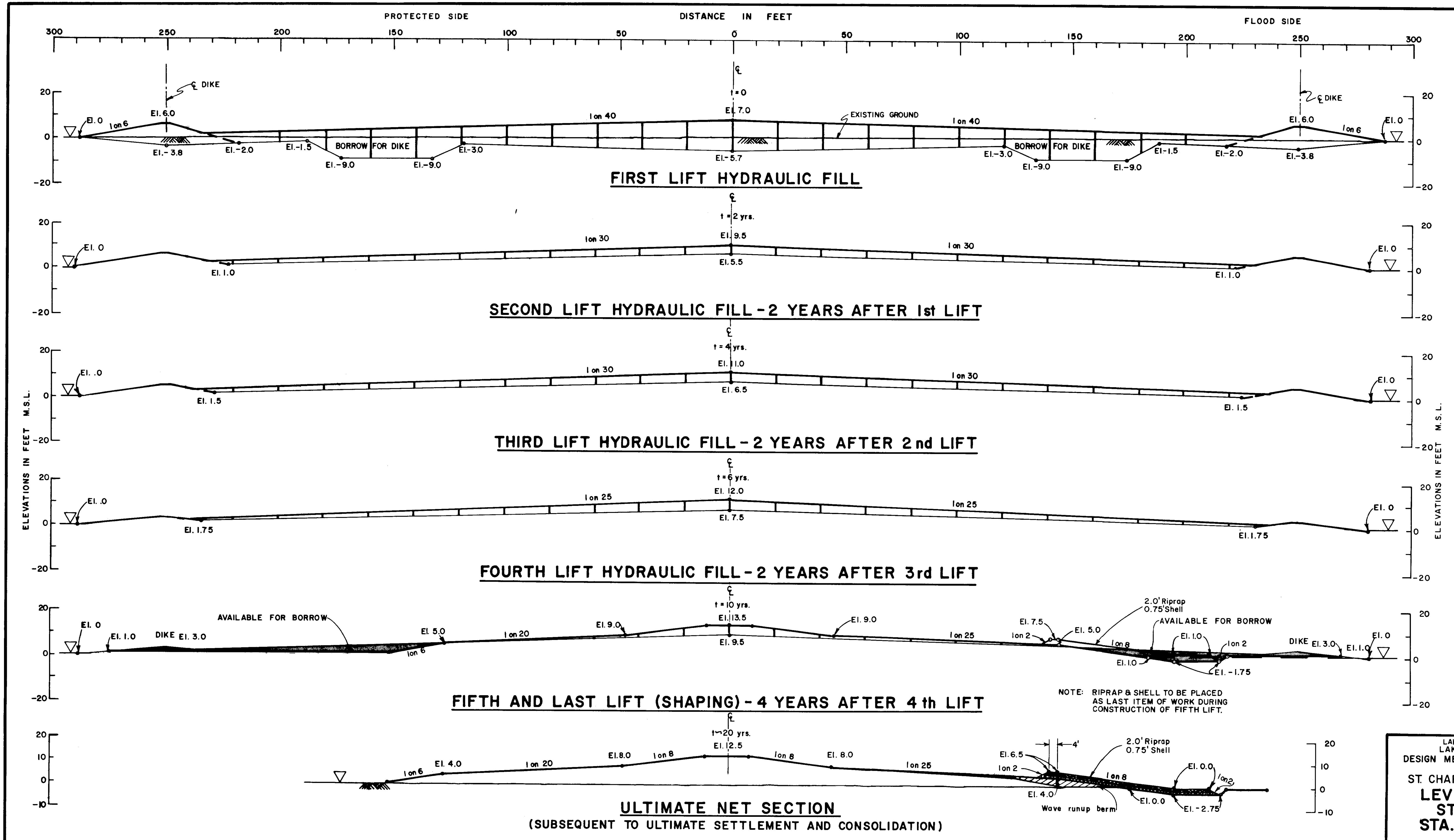
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE CONFIGURATIONS- STAGE CONSTRUCTION STA. 55+00 TO 140+00

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 40



NOTE:

SETTLEMENT OF CROWN INCLUDES CONSOLIDATION AND LATERAL SPREAD OF FOUNDATION AND CONSOLIDATION AND SHRINKAGE OF FILL.

HATCHED AREA INDICATES THE QUANTITY OF MATERIAL REQUIRED TO CONSTRUCT EACH LIFT.

HYDRAULIC FILL TO BE OBTAINED FROM ADJACENT BORROW IN LAKE PONTCHARTRAIN.

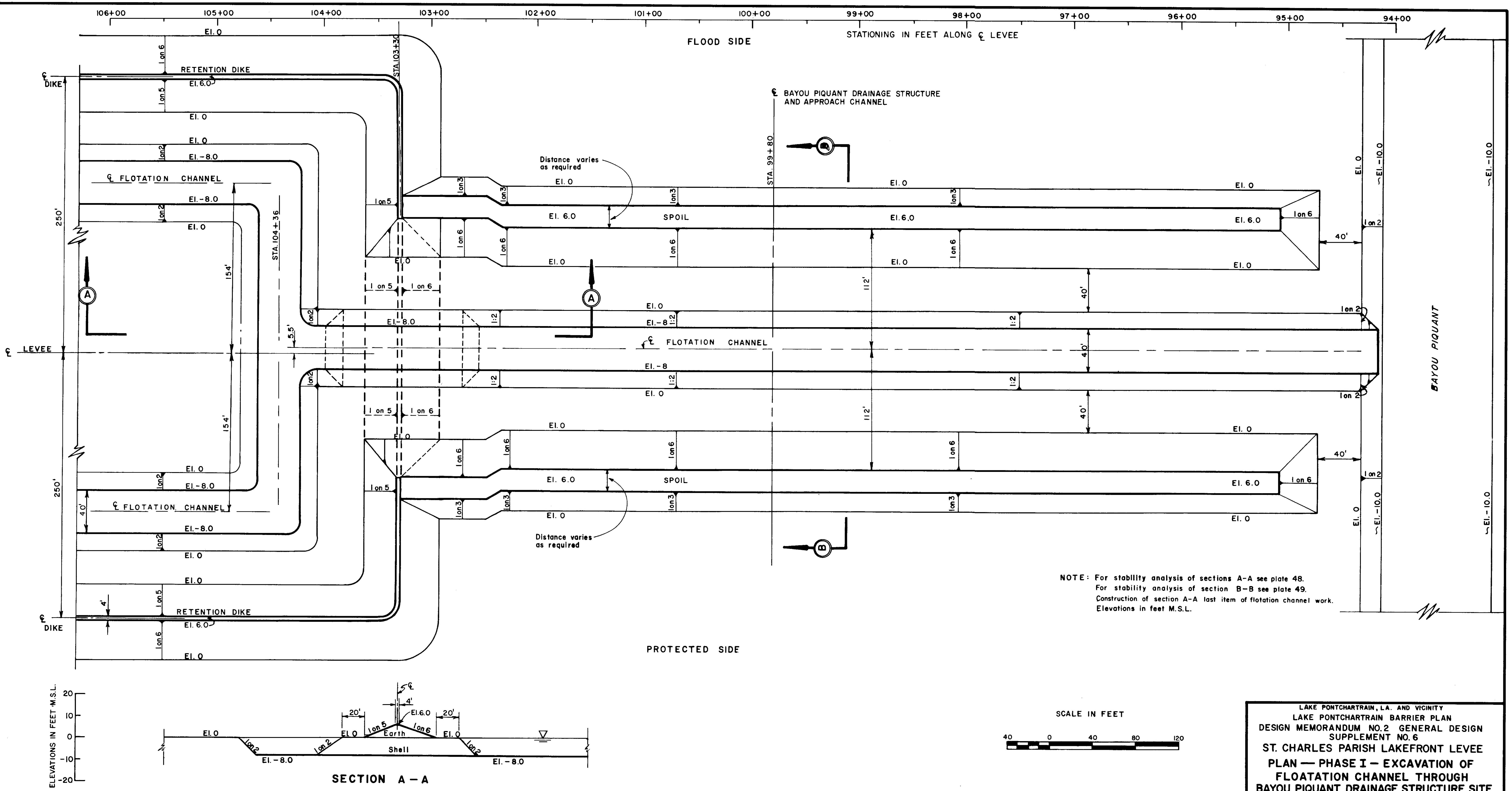
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LEVEE CONFIGURATIONS-STAGE CONSTRUCTION
STA. 140+00 TO 298+61.07

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 41



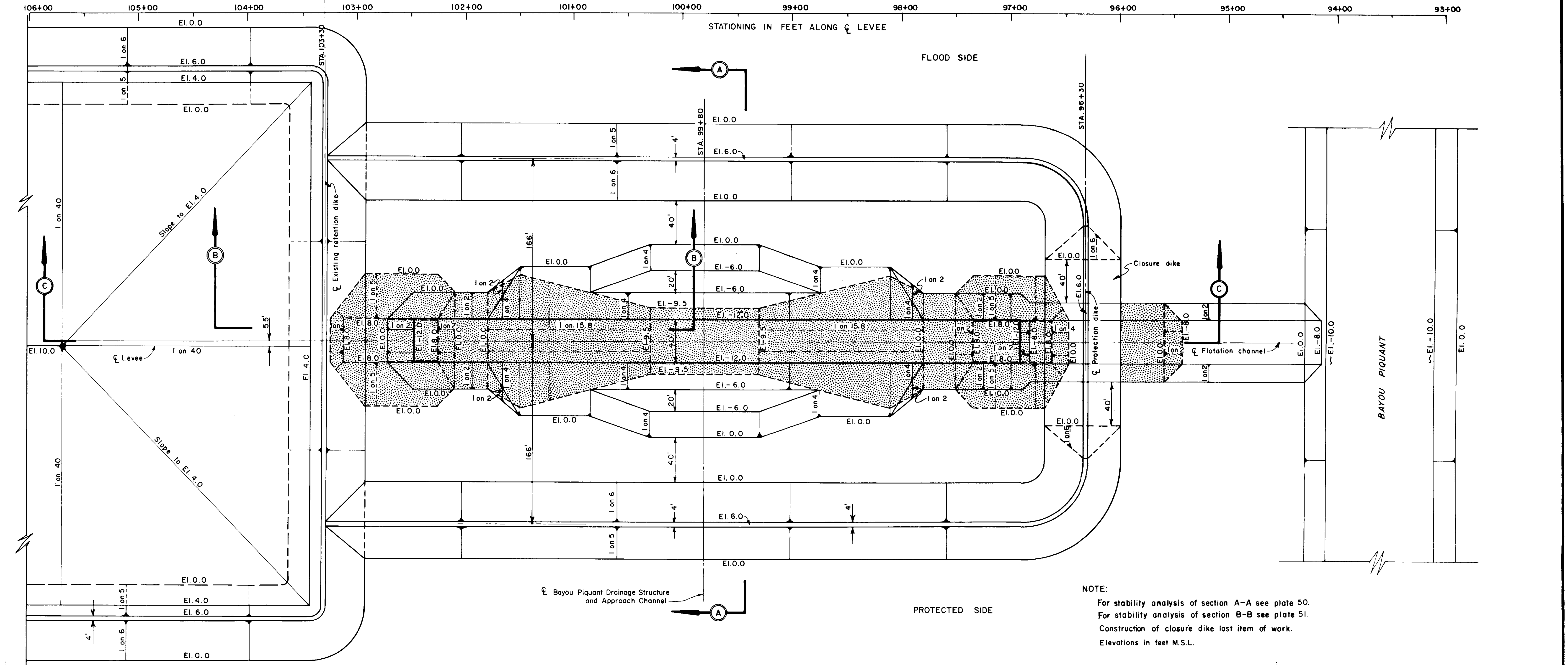
NOTE: For stability analysis of sections A-A see plate 48.
For stability analysis of section B-B see plate 49.
Construction of section A-A last item of flotation channel work.
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

PLAN — PHASE I — EXCAVATION OF FLOATATION CHANNEL THROUGH BAYOU PIQUANT DRAINAGE STRUCTURE SITE

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

SEPT. 1969 FILE NO. H-2-24624



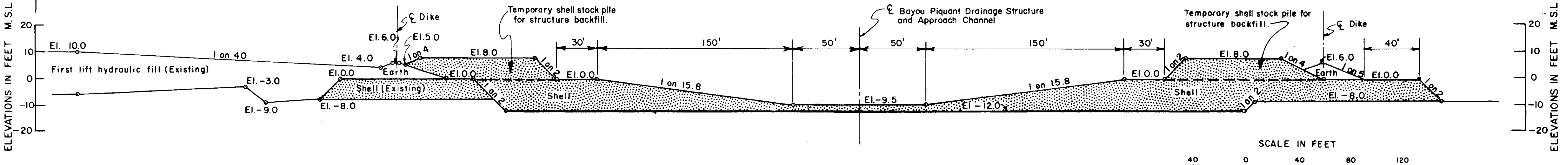
NOTE:

For stability analysis of section A–A see plate 50.

For stability analysis of section B–B see plate 51.

Construction of closure dike last item of work.

Elevations in feet M.S.L.



SECTION C–C

SCALE IN FEET

40 0 40 80 120

LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 GENERAL DESIGN

SUPPLEMENT NO. 6

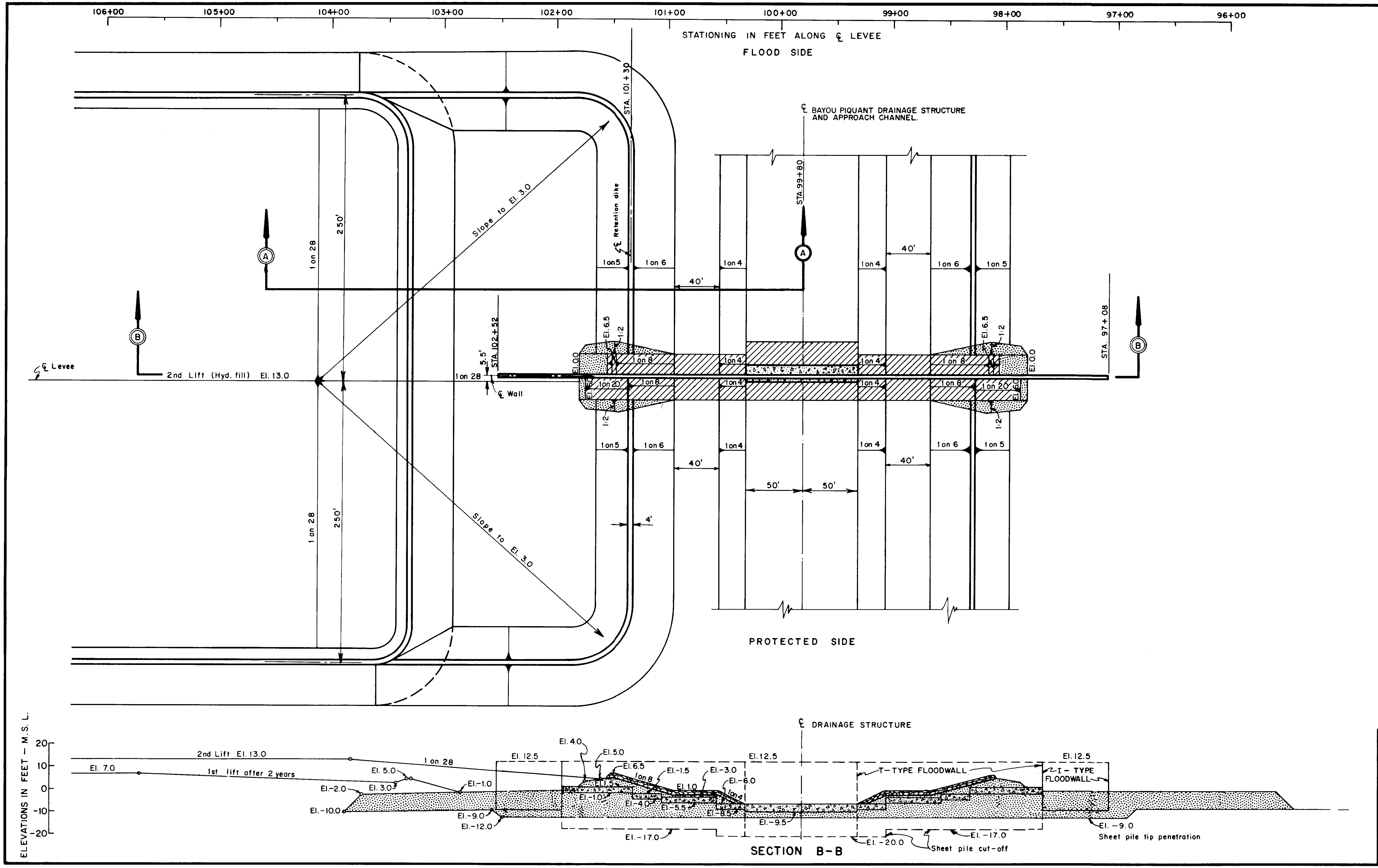
ST. CHARLES PARISH LAKEFRONT LEVEE

PLAN–PHASE II–CONSTRUCTION OF PROTECTION DIKE AND FINAL EXCAVATION BAYOU PIQUANT DRAINAGE STRUCTURE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624



NOTE:
For Stability Analysis of Section A-A see Plate 52.
Elevations in feet M.S.L.

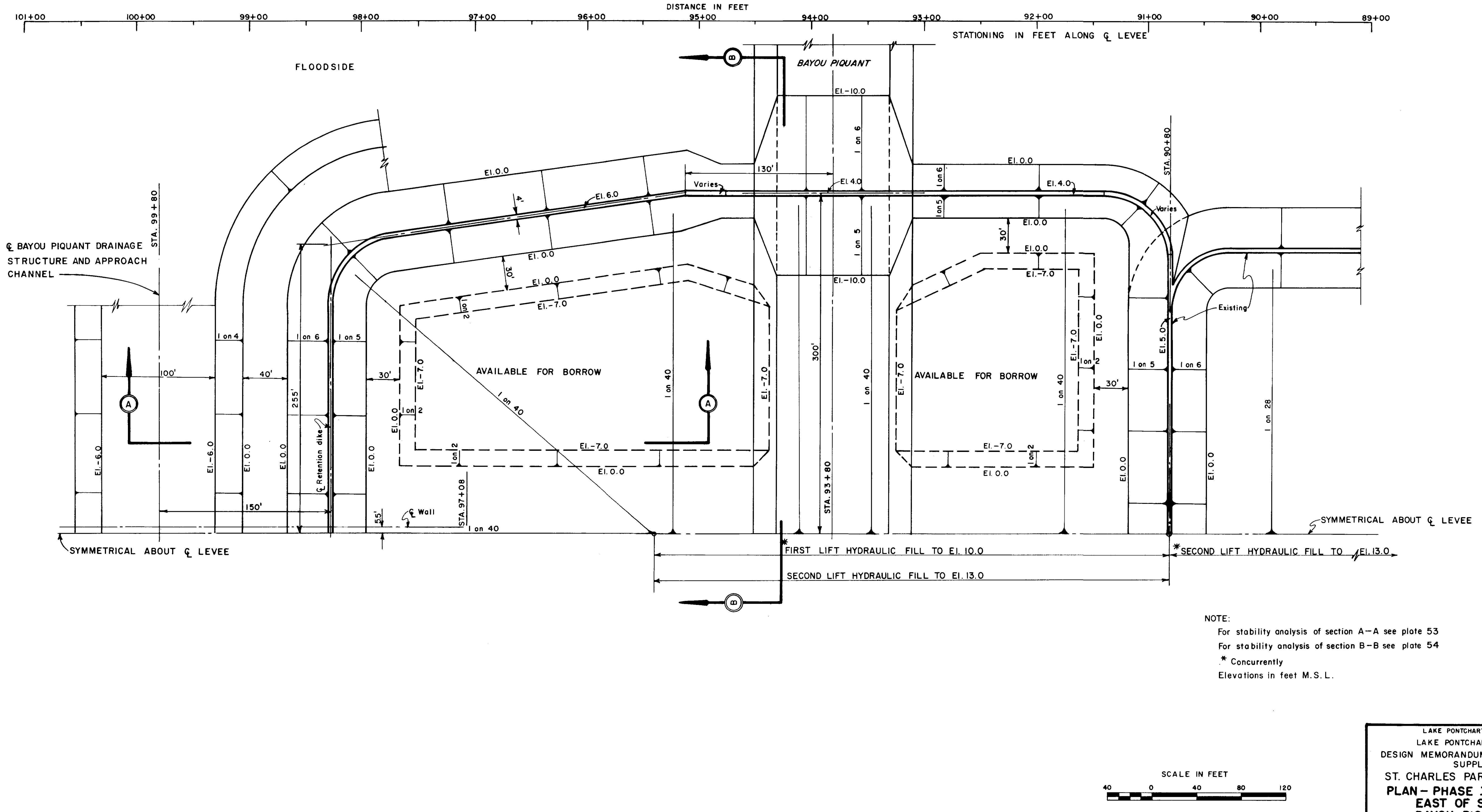
SCALE IN FEET

40 0 40 80 120

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
PLAN-PHASE III - HYDRAULIC FILL
WEST OF BAYOU PIQUANT
DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969

FILE NO. H-2-24624



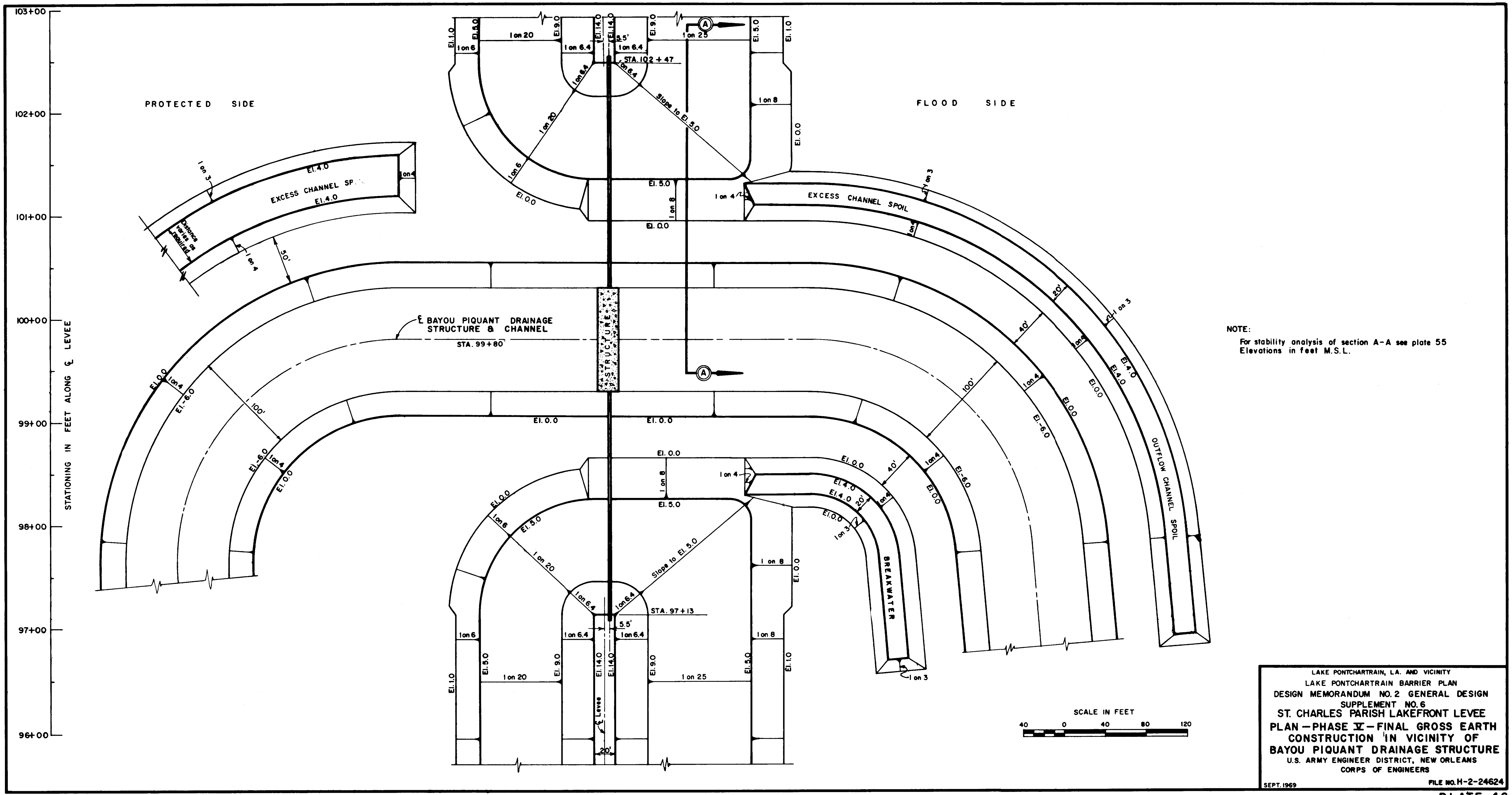
NOTE:
For stability analysis of section A—A see plate 53
For stability analysis of section B—B see plate 54
* Concurrently
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

PLAN – PHASE IV – HYDRAULIC FILL EAST OF STRUCTURE AND BAYOU PIQUANT CLOSURE

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

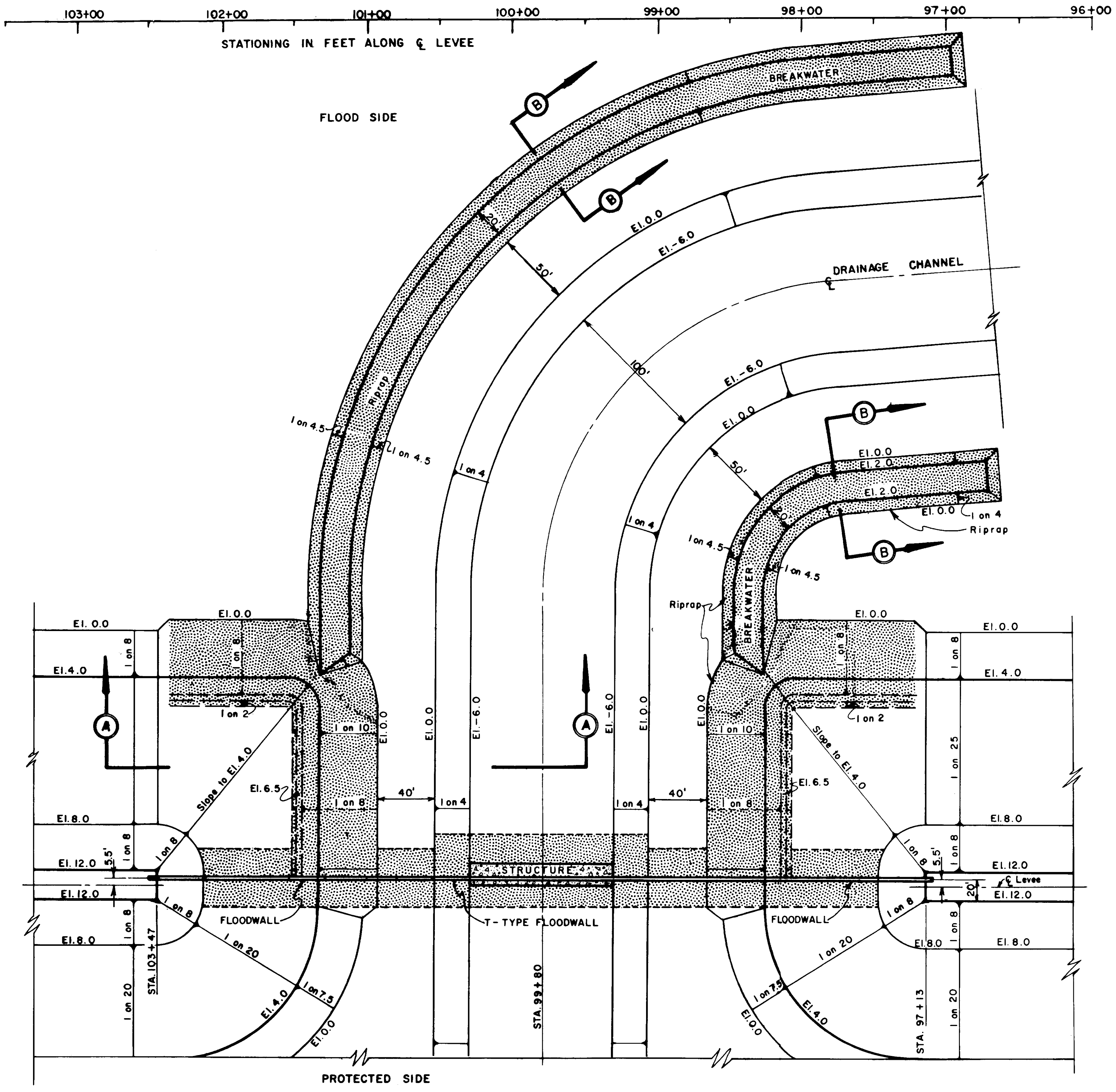
SEPT. 1969 FILE NO. H-2-24624

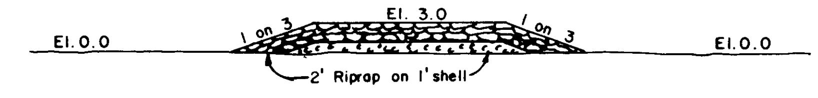


LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
PLAN — PHASE V — FINAL GROSS EARTH CONSTRUCTION IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

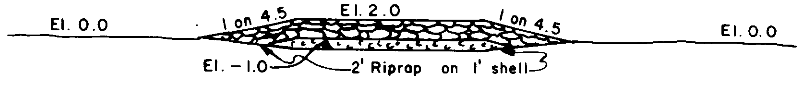
SEPT. 1969 FILE NO. H-2-24624

PLATE 46





SECTION B-B
(CONSTRUCTION CONFIGURATION)

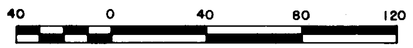


SECTION B-B
(ULTIMATE CONFIGURATION)

NOTE:

For stability analysis of section A-A see plate 56.
Elevations in feet m.s.l.

SCALE IN FEET



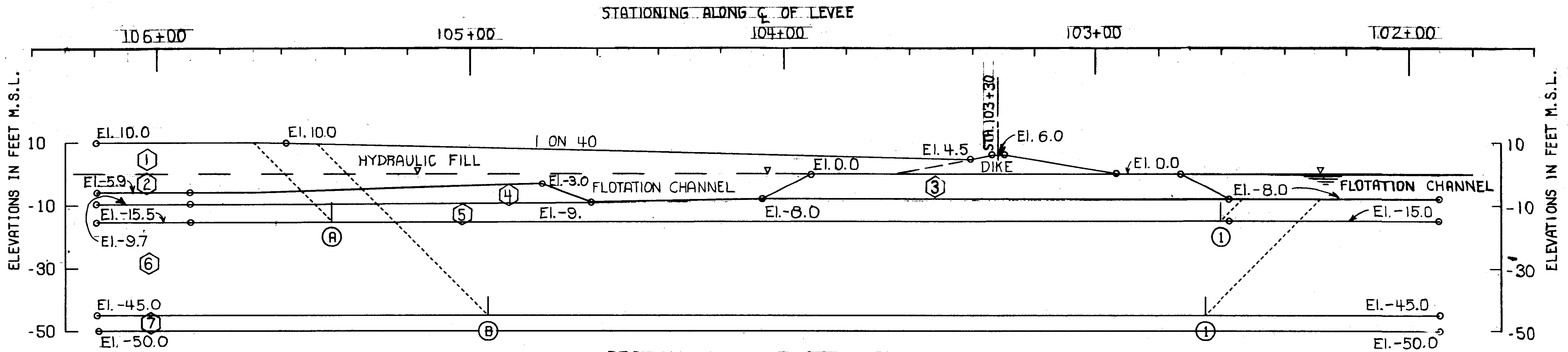
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

PLAN-BAYOU PIQUANT DRAINAGE STRUCTURE SITE (ULTIMATE)

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

SEPT. 1969 FILE NO. H-2-24624

PLATE 47



SECTION A-A PLATE 42

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	50.0	50.0	50.0	50.0	0.
2	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
3	SL	27.5	27.5	0.	0.	0.	0.	40.0
4	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
5	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
6	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
7	CH	46.0	46.0	450.0	450.0	550.0	550.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-15.00	3650	31350	1540	22512	453	36540	22059	1.656
B 1	-45.00	17667	80500	15640	71879	19468	113807	52411	2.171

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

GENERAL NOTES

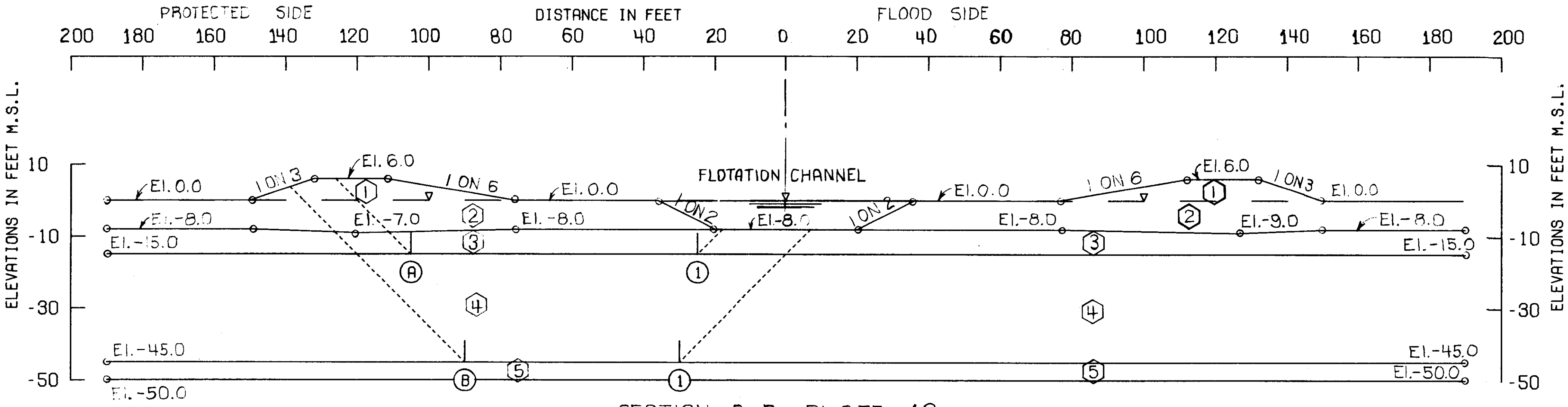
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED *BORING 6-U*, SEE *PLATE 11*.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION B-B PLATE 42

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	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
2	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
3	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
4	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
5	CH	46.0	46.0	450.0	450.0	550.0	550.0	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	4500	8800	1540	9917	491	14840	9426	1.574
(B) (1)	-45.00	18147	21000	15640	42873	19429	54787	23444	2.337

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

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

GENERAL NOTES

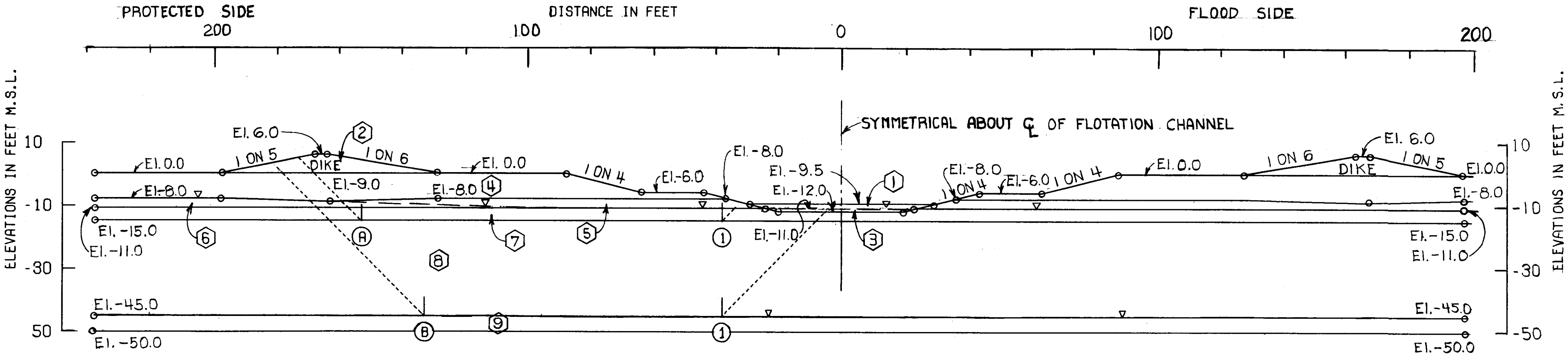
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF *UNDISTURBED BORING* 6-U SEE PLATE 11

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION A-A PLATE 43

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	SL	90.0	90.0	0.	0.	0.	0.	40.0
2	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
3	SL	27.5	27.5	0.	0.	0.	0.	40.0
4	PT	78.0	78.0	110.0	110.0	110.0	110.0	0.
5	PT	78.0	78.0	110.0	110.0	110.0	110.0	0.
6	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
7	PT	34.0	34.0	110.0	110.0	110.0	110.0	0.
8	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
9	CH	46.0	46.0	450.0	450.0	550.0	550.0	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	4299	12650	1320	15278	1401	18269	13876	1.317
B 1	-45.00	18064	33250	15658	64457	23858	66972	40598	1.650

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

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

GENERAL NOTES

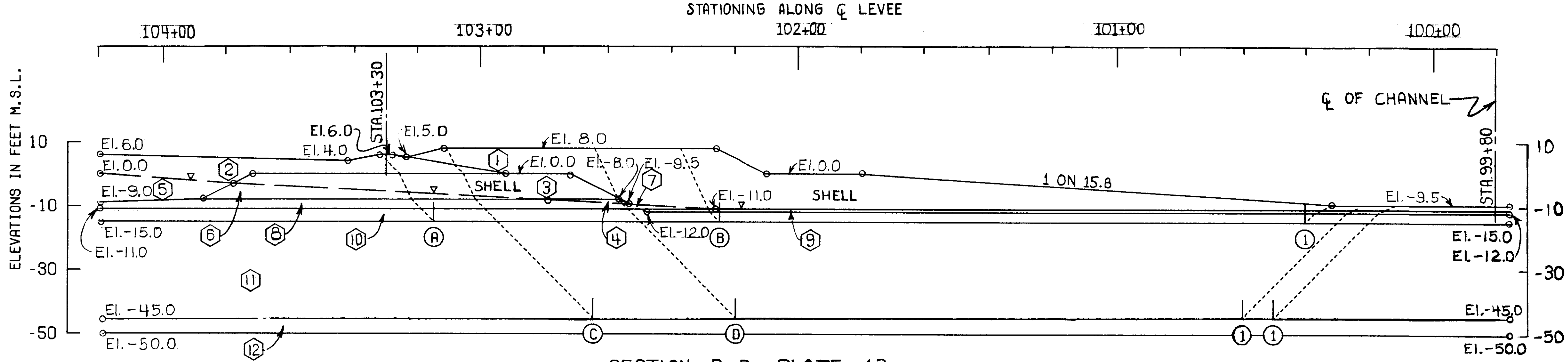
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING G-U, SEE PLATE 11.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION B-B PLATE 43

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	SL	90.0	90.0	0.	0	0.	0.	40.0
2	CH	100.0	100.0	50.0	50.0	50.0	50.0	0.
3	SL	90.0	90.0	0.	0.	0.	0.	40.0
4	PT	78.0	78.0	110.0	110.0	110.0	110.0	0.
5	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
6	SL	27.5	27.5	0.	0.	0.	0.	40.0
7	SL	27.5	27.5	0.	0.	0.	0.	40.0
8	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
9	SL	27.5	27.5	0.	0.	0.	0.	40.0
10	CH	34.0	34.0	110.0	110.0	110.0	110.0	0.
11	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
12	CH	46.0	46.0	450.0	450.0	550.0	550.0	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	7574	30250	1781	17766	1096	39605	16669	2.376
B	1	-15.00	14735	20350	1781	23331	1096	36866	22234	1.658
C	1	-45.00	23753	75250	15658	86312	25236	114661	61075	1.877
D	1	-45.00	24668	56000	15658	91630	26661	96326	64968	1.483

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

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

GENERAL NOTES

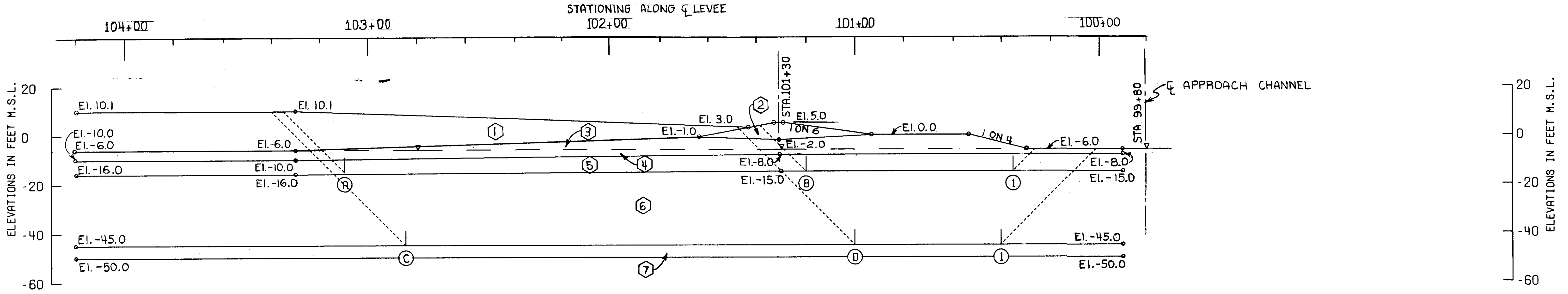
CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U, SEE PLATE 11.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION A-A PLATE 44

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U, SEE PLATE 11.

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	100.0	100.0	75.0	75.0	75.0	75.0	0.
2	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
3	PT	78.0	78.0	110.0	110.0	110.0	110.0	0.
4	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
5	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
6	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
7	CH	46.0	46.0	450.0	450.0	550.0	550.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A I	-15.00	4417	30250	1980	27278	998	36647	26280	1.394
B I	-15.00	4027	9350	1980	12345	998	15357	11347	1.353
C I	-45.00	18277	85750	16080	91174	21423	120107	69750	1.722
D I	-45.00	17958	21000	16080	52332	21423	55038	30908	1.781

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

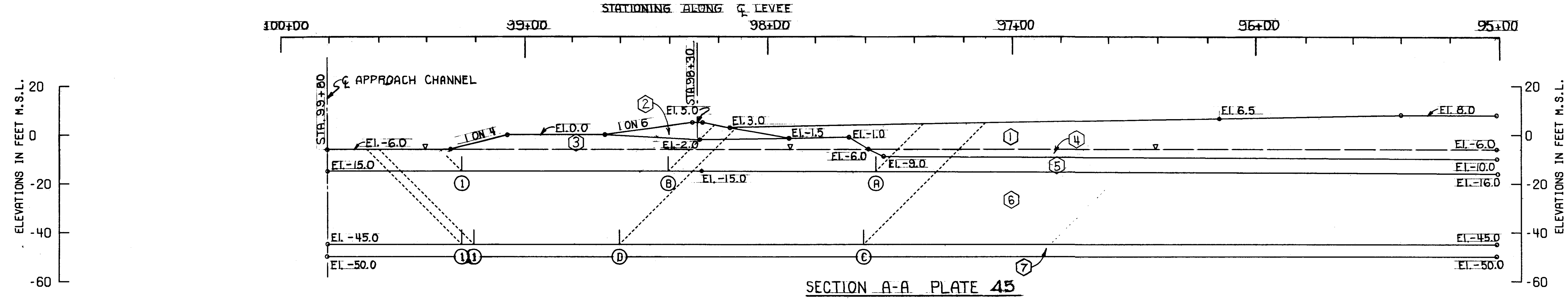
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION A-A PLATE 45

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U SEE PLATE II.

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	50.0	50.0	50.0	50.0	0.
2	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
3	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
4	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
5	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
6	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
7	CH	46.0	46.0	450.0	450.0	550.0	550.0	0.

ASSUMED FAILURE NO.	SURFACE ELEV.	RESISTING FORCES			DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
		R_A	R_B	R_P	D_A	$-D_P$	RESISTING	DRIVING	
A 1	-15.00	2657	18700	1980	15541	891	23337	14650	1.593
B 1	-15.00	3979	9350	1980	12327	891	15309	11436	1.339
C 1	-45.00	16715	57750	16080	68337	20487	90545	47849	1.892
D 1	-45.00	17827	21000	16080	52116	21219	54907	30897	1.777

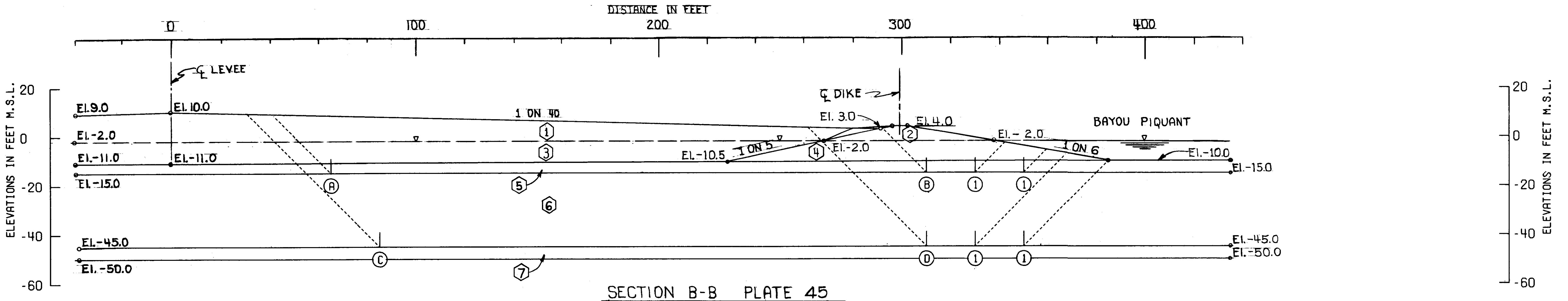
NOTES

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. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969
FILE NO. H-2-24624



SECTION B-B PLATE 45

FIRST LIFT FOR BAYOU PIQUANT CLOSURE

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING G-U. SEE PLATE 11.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	EFFECTIVE UNIT WT. P.C.F. VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	CENTER OF STRATUM VERT. 2	BOTTOM OF STRATUM VERT. 1	BOTTOM OF STRATUM VERT. 2	FRICTION ANGLE DEGREES
1	CH	100.0	100.0	50.0	50.0	50.0	50.0	0.
2	PT	78.0	78.0	100.0	100.0	100.0	100.0	0.
3	CH	38.0	38.0	50.0	50.0	50.0	50.0	0.
4	PT	16.0	16.0	100.0	100.0	100.0	100.0	0.
5	PT	16.0	16.0	110.0	110.0	110.0	110.0	0.
6	CH	34.0	34.0	235.0	235.0	350.0	350.0	0.
7	CH	46.0	46.0	450.0	450.0	550.0	550.0	0.

ASSUMED FAILURE NO.	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	2893	29150	2554	22620	1738	34597	20882	1.657
B 1	-15.00	3821	4400	1984	8333	828	10205	7504	1.360
C 1	-45.00	17016	85750	15800	81427	21884	118566	59543	1.991
D 1	-45.00	17320	14000	15229	43378	19605	46550	23773	1.958

NOTES

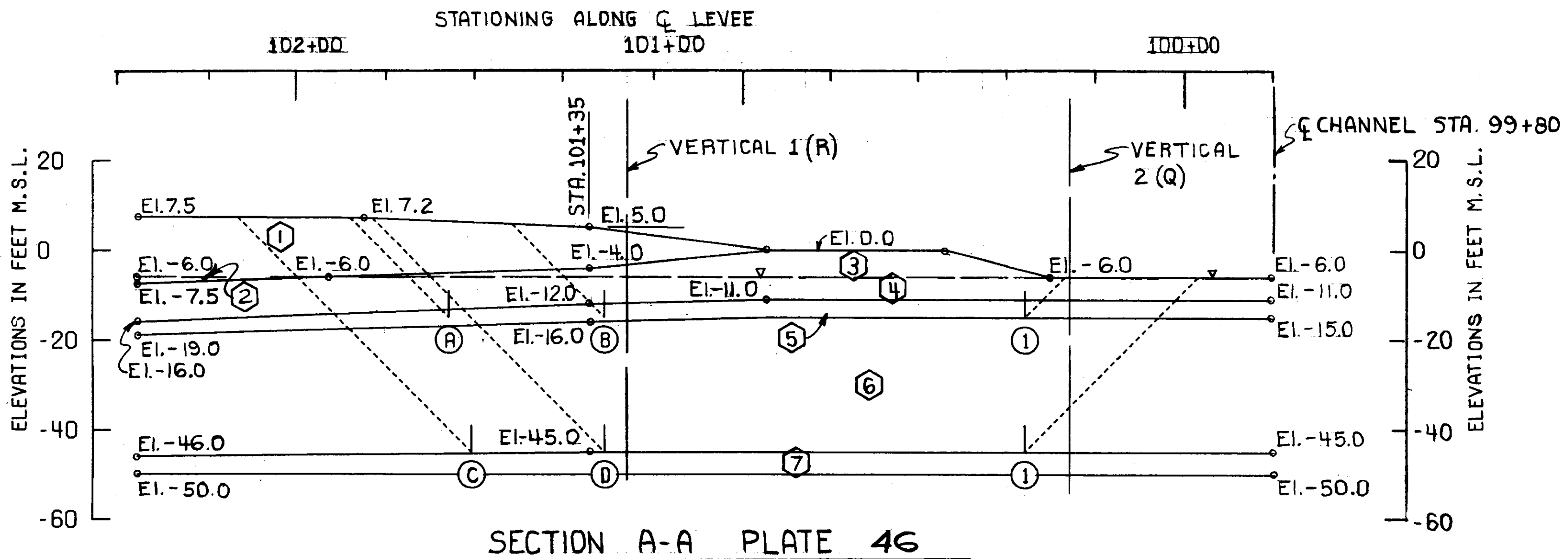
Φ -- ANGLE OF INTERNAL FRICTION, DEGREES
C -- UNIT COHESION, P.S.F.
▽ -- STATIC WATER SURFACE
D -- HORIZONTAL DRIVING FORCE IN POUNDS
R -- HORIZONTAL RESISTING FORCE IN POUNDS
A -- AS A SUBSCRIPT, REFERS TO ACTIVE WEDGE
B -- AS A SUBSCRIPT, REFERS TO CENTRAL BLOCK
P -- AS A SUBSCRIPT, REFERS TO PASSIVE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

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

SEE PLATE 5 FOR LOCATION OF DIKE BORROW

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
(Q) STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624



SECTION A-A PLATE 46

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U, SEE PLATE 11. GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	125.0	125.0	125.0	125.0	0.
2	CH	38.0	38.0	125.0	125.0	125.0	125.0	0.
3	PT	78.0	78.0	215.0	110.0	215.0	110.0	0.
4	PT	16.0	16.0	215.0	110.0	215.0	110.0	0.
5	PT	34.0	34.0	215.0	110.0	215.0	110.0	0.
6	CH	34.0	34.0	340.0	235.0	398.0	235.0	0.
7	CH	46.0	46.0	550.0	450.0	655.0	550.0	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	6645	23607	2075	20287	1142	32326	19145	1.688
B 1	-15.00	7074	15664	2075	16857	1142	24812	15715	1.579
C 1	-45.00	23634	42804	16080	79809	22896	82518	56913	1.450
D 1	-45.00	25712	32391	16080	75451	22896	74183	52554	1.412

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

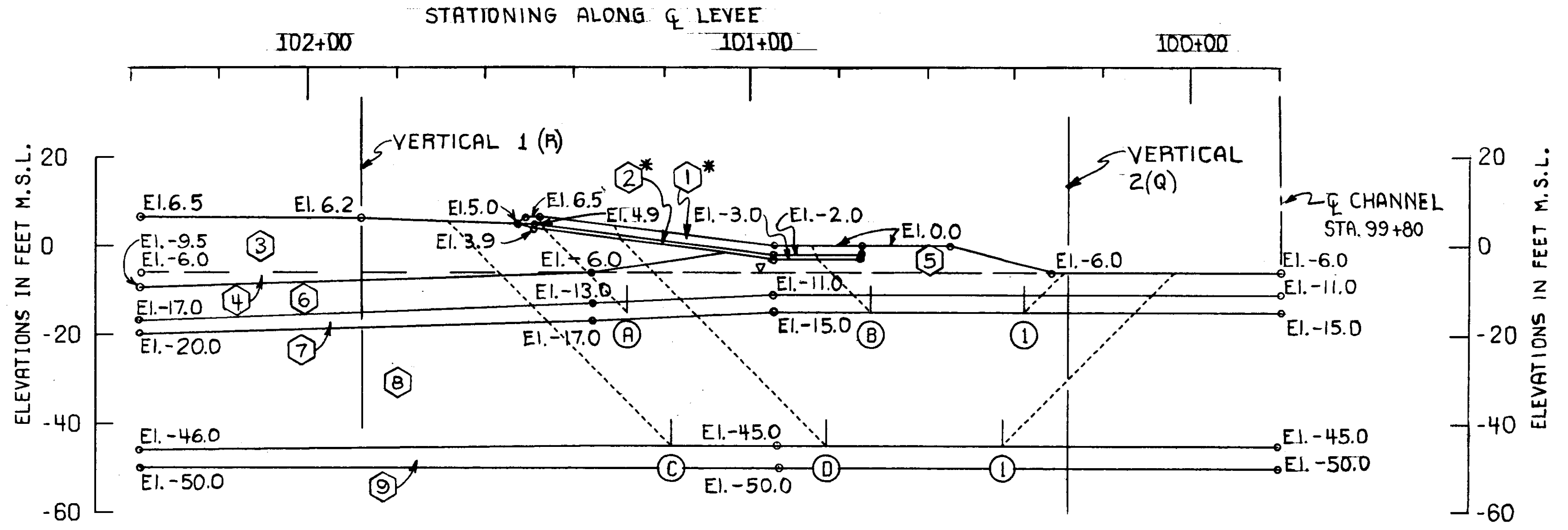
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

SEPT. 1969 FILE NO. H-2-24624



SECTION A-A PLATE 47

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING 6-U SEE PLATE 11 GAIN IN SHEAR STRENGTH BASED ON (R) TREND.

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	*RR	120.0	120.0	0.	0.	0.	0.	40.0
2	*SL	90.0	90.0	0.	0.	0.	0.	40.0
3	CH	100.0	100.0	250.0	250.0	250.0	250.0	0.
4	CH	38.0	38.0	250.0	250.0	250.0	250.0	0.
5	PT	78.0	78.0	235.0	110.0	235.0	110.0	0.
6	PT	16.0	16.0	235.0	110.0	235.0	110.0	0.
7	PT	34.0	34.0	235.0	110.0	235.0	110.0	0.
8	CH	34.0	34.0	260.0	235.0	475.0	350.0	0.
9	CH	46.0	46.0	575.0	450.0	675.0	550.0	0.

* RIPRAP - 2' RIPRAP ON 0.75' SHELL BLANKET

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	9123	15056	2083	18008	1268	26262	16739	1.569
B 1	-15.00	4088	3336	2083	6585	1268	9506	5317	1.788
C 1	-45.00	30043	30352	16081	71310	23949	76475	47360	1.615
D 1	-45.00	25899	15458	16081	53948	23949	57438	29999	1.915

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

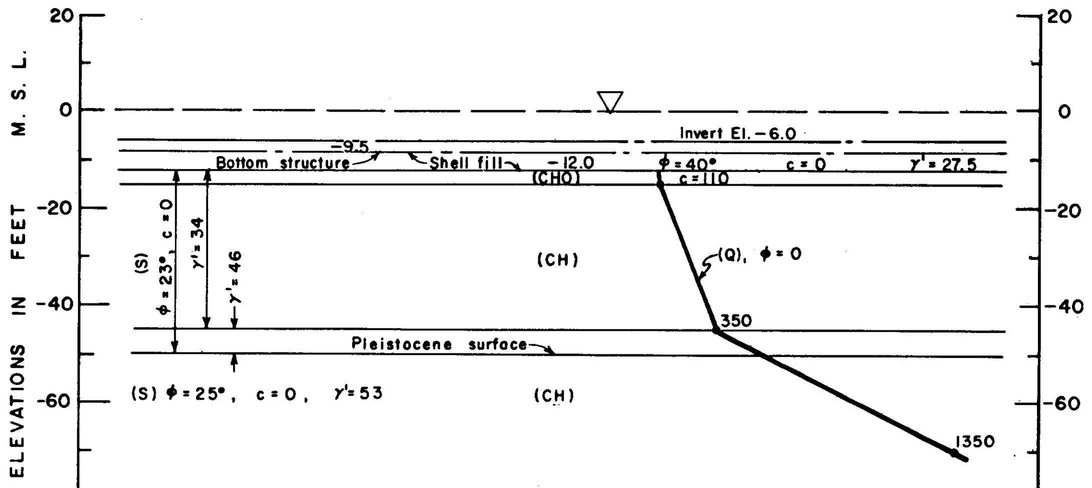
$$\text{FACTOR OF SAFETY} = \frac{R_A + R_B + R_P}{D_A - D_P}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

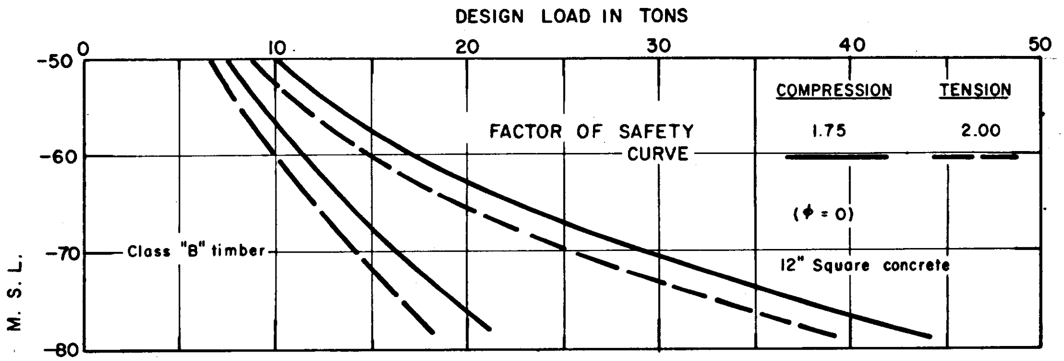
STABILITY ANALYSIS IN VICINITY OF BAYOU PIQUANT DRAINAGE STRUCTURE

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

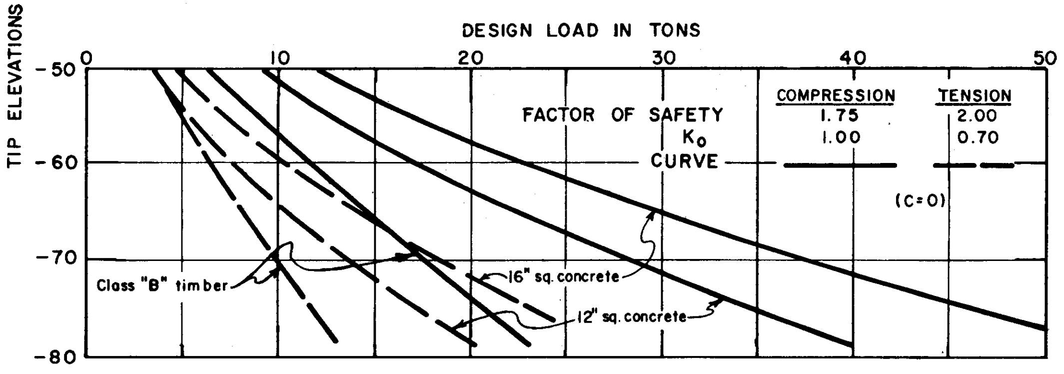
SEPT. 1969 FILE NO. H-2-24624



SOIL PROFILE

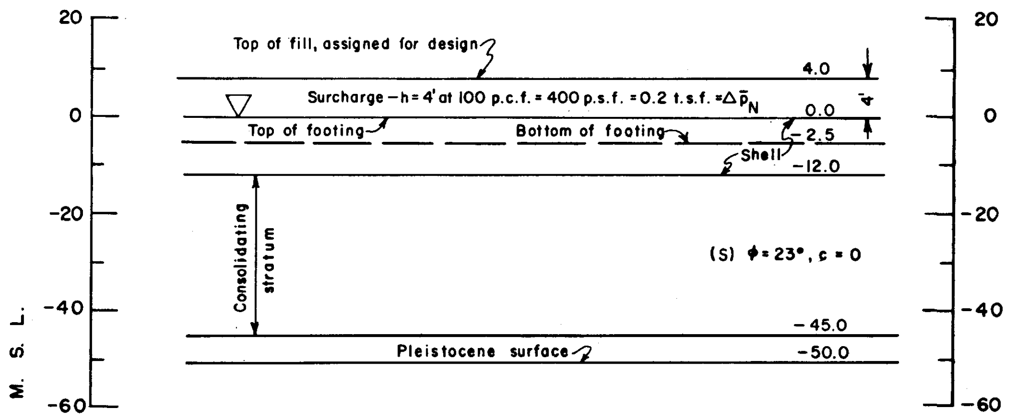


(Q) CASE

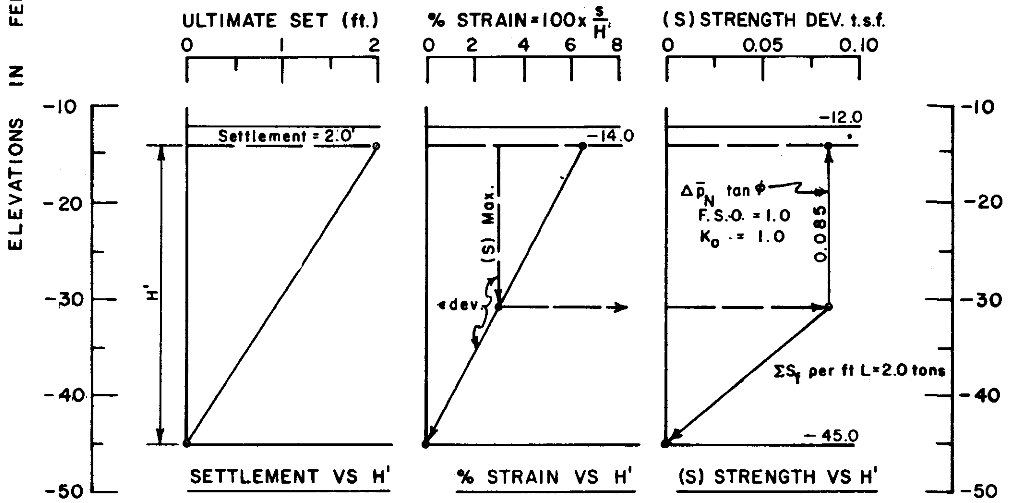


(S) CASE

STRUCTURE PILE DESIGN LOAD VS TIP ELEVATION AND T-WALL 50' EACH SIDE OF STRUCTURE

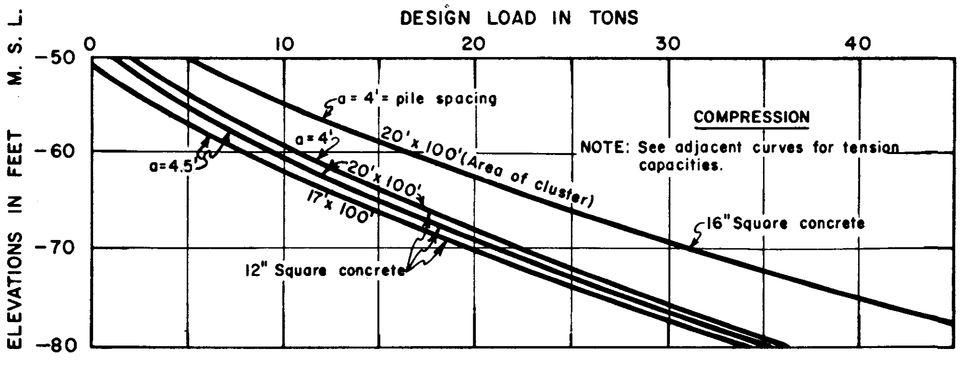


SOIL PROFILE



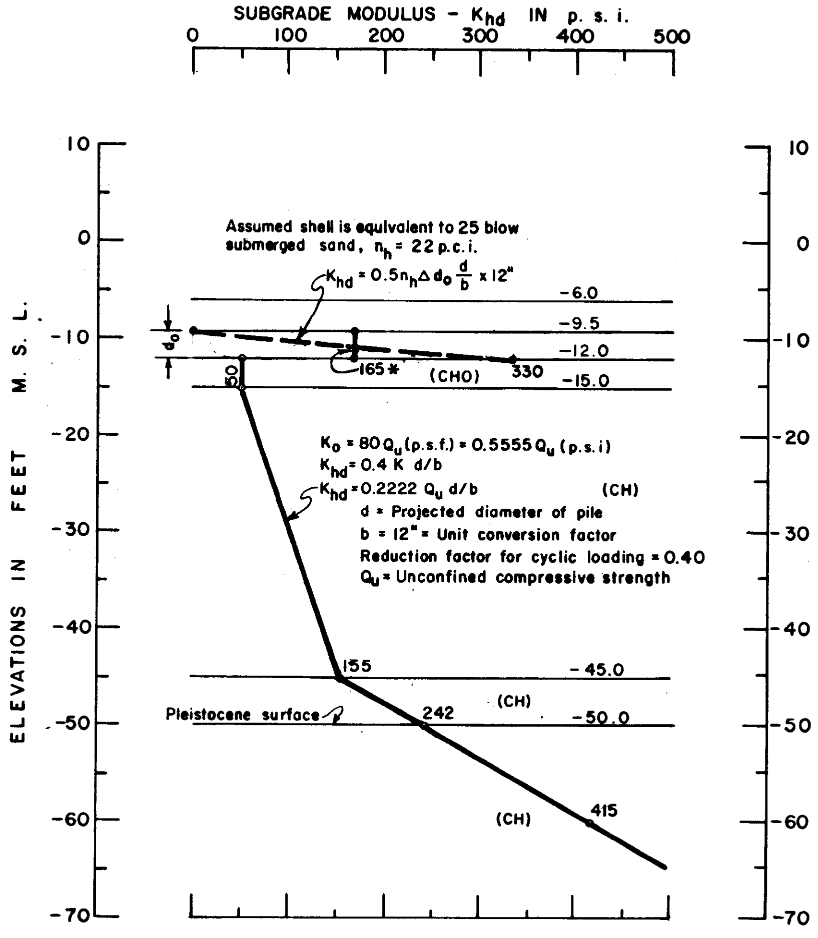
L = Cluster Per., $Q' = \frac{A}{n}\gamma h = 0.2\frac{A}{n}$ (tons), $Q'' = \frac{L}{n}Hs = \frac{L}{n}\Sigma S_f = 2\frac{L}{n}$ (tons)

n = Number piles in cluster, $Q_t = Q + Q' + Q''$



(S) CASE

T-WALL PILE DESIGN LOAD VS TIP ELEVATION (NEGATIVE SKIN FRICTION INCLUDED)



BEARING PILE SUBGRADE MODULI

* For 25' each side of structure use 400 to the top of channel slope. For the remainder of the T-wall use 800 to the top of the riprap.

GENERAL NOTES

K_o and n_h values are those proposed by Karl Terzaghi in "Evaluation of Coefficients of Subgrade Reactions", Geotechnique, London, England, volume V, 1955, pp. 297 − 326.

Q' = The load that acts on each pile due to the weight of the surcharge.

Q" = The load that acts on each pile due to the negative skin friction developed by the settlement of the soil that surrounds the pile cluster, moving downward with reference to the cluster.

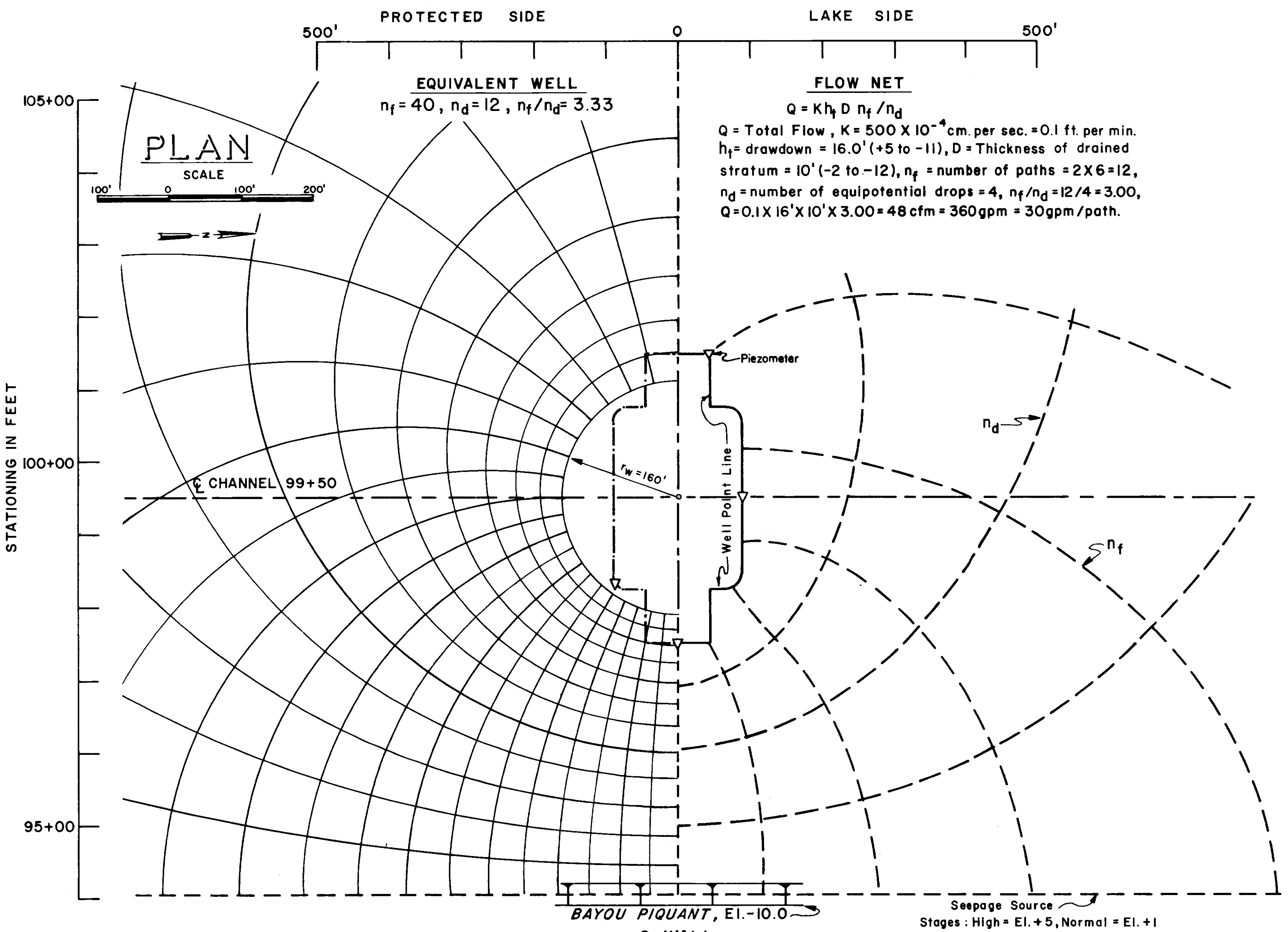
(S) Case governed for design.

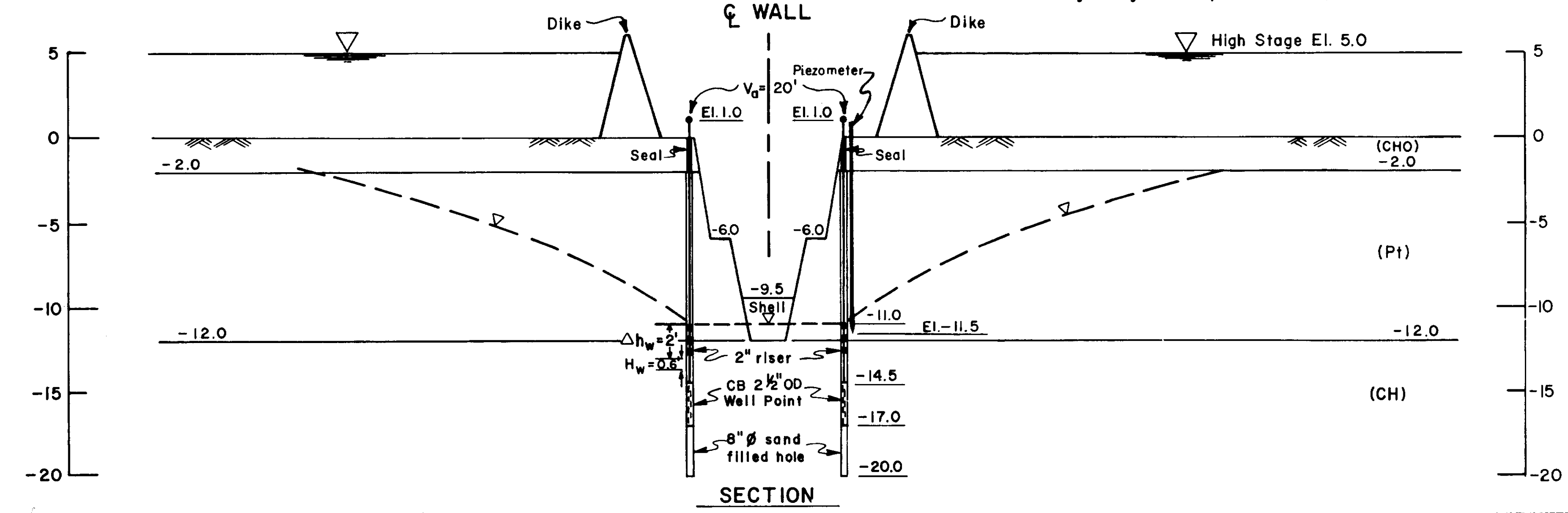
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 − GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

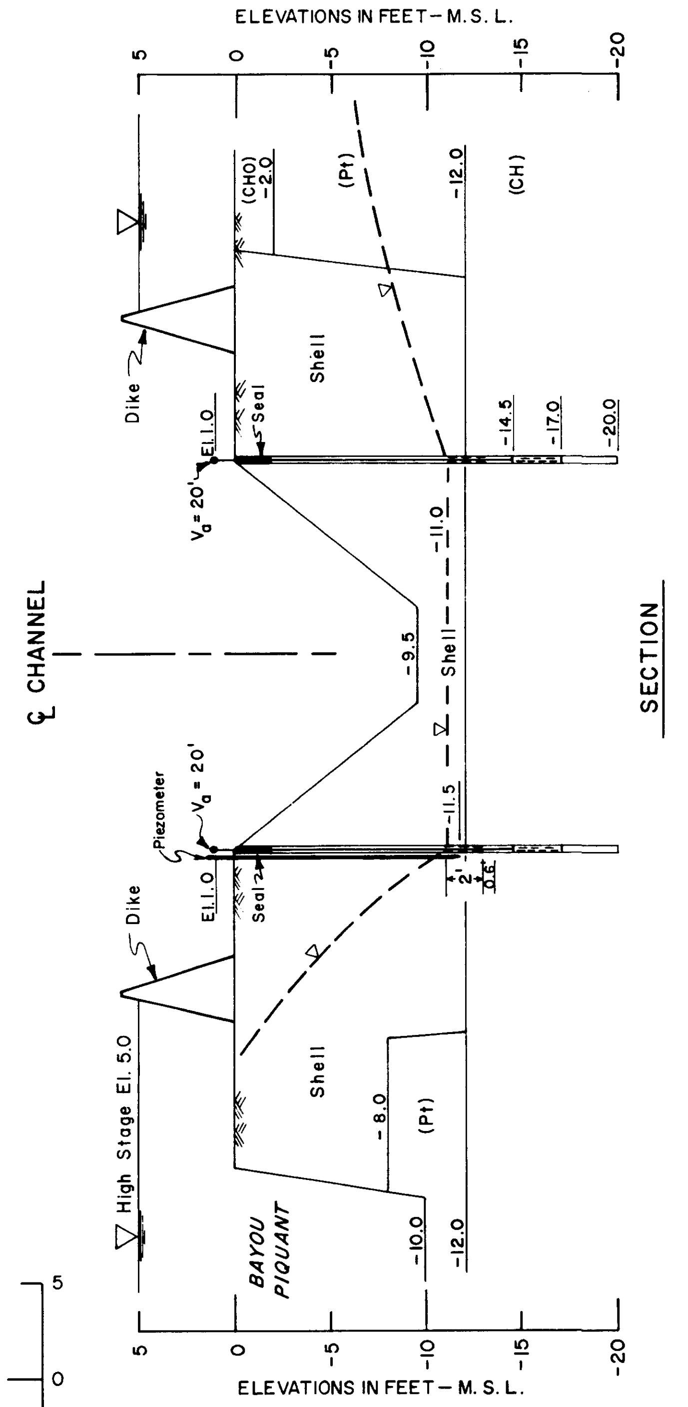
BAYOU PIQUANT DRAINAGE STRUCTURE PILE DESIGN LOAD VS TIP ELEVATION AND SUBGRADE MODULI

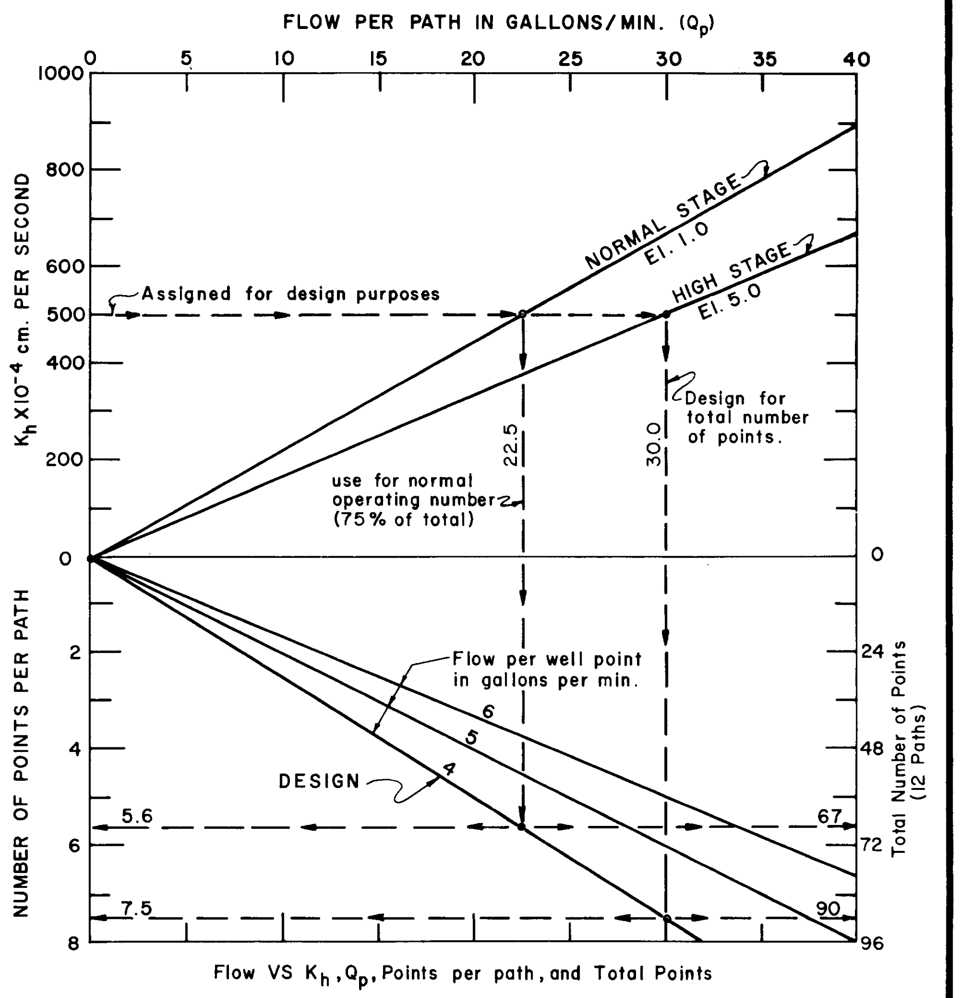
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624









CALCULATIONS FOR DETERMINING THE WELL SCREEN ELEVATION

GIVEN: CB 2.5" OD point with 2" riser pipe, vacuum at pump (V) = 24 feet, head loss in collector (H_c) = 2 ft., intake of pump 2' above collector, style D - Mesh E screen, available vacuum (V_a) in collector at El. 1.0 = 24' - 2' - 2' = 20 ft., fully penetrating wells, gravity flow, points spaced proportionally to flow lines, Q = 4 gpm = 0.533 cfm, 8-in. dia. sanded hole r_w = 0.33-ft., K = 500 X 10^{-4} cm/sec. = 0.10 fpm, Lake stage = El. 5.0, drawdown beneath bottom of excavation to El. -11.0, well spacing a = 6 ft.

SOLUTION: Head loss at well point (Eq. 3-40), $\Delta h_w = \sqrt{\frac{Q_p}{\pi K} \ln \frac{a}{2\pi r_w}} = \sqrt{\frac{0.533}{0.314} \ln \frac{6}{2.09}}$ $= \sqrt{1.87} = 1.4$ ft., well spacing, a = 23 ft., $\Delta h_w = \sqrt{1.7 \ln 11.0} = \sqrt{4} = 2.0$ ft.
Use Δh_w = 2.0 ft., water surface in well = (-11) + (-2) = -13.0.
Head loss in well screen and riser = $H_w = H_e + H_s + H_r + H_v$:
H_e (fig. 3-41a, curve 7) = 0.15 ft., H_s (fig. 3-41b, CB-style D) = 0.30 ft., $H_r + H_v$ (fig. 3-41c, 2" riser) = 0.15 ft., H_w = 0.6 ft., W.S. El. = (-13.0) + (-0.6) = -13.6, Va = 20 ft., V req = 1 + 13.6 = 14.6 ft. < 20 ft. (OK) set top of 30-in. screen at El. -14.5, bot. at El. -17.0, bot. of sanded hole at El. -20.0.

COMPILATION FOR COST ESTIMATING PURPOSES

Install 90 points, 75% of total operating under normal conditions. 1800' of 8-in. Ø drilled hole, 1620' of hole backfilled with concrete sand, 180' of upper 2-ft. of hole sealed with clay, 1395' of 2 in. riser pipe, 90 each CB 2.5-in. OD well points, 1160' of collector pipe, install and read 4 ea. open type piezometer with top at El. 1.0, and tip at El. -11.5.

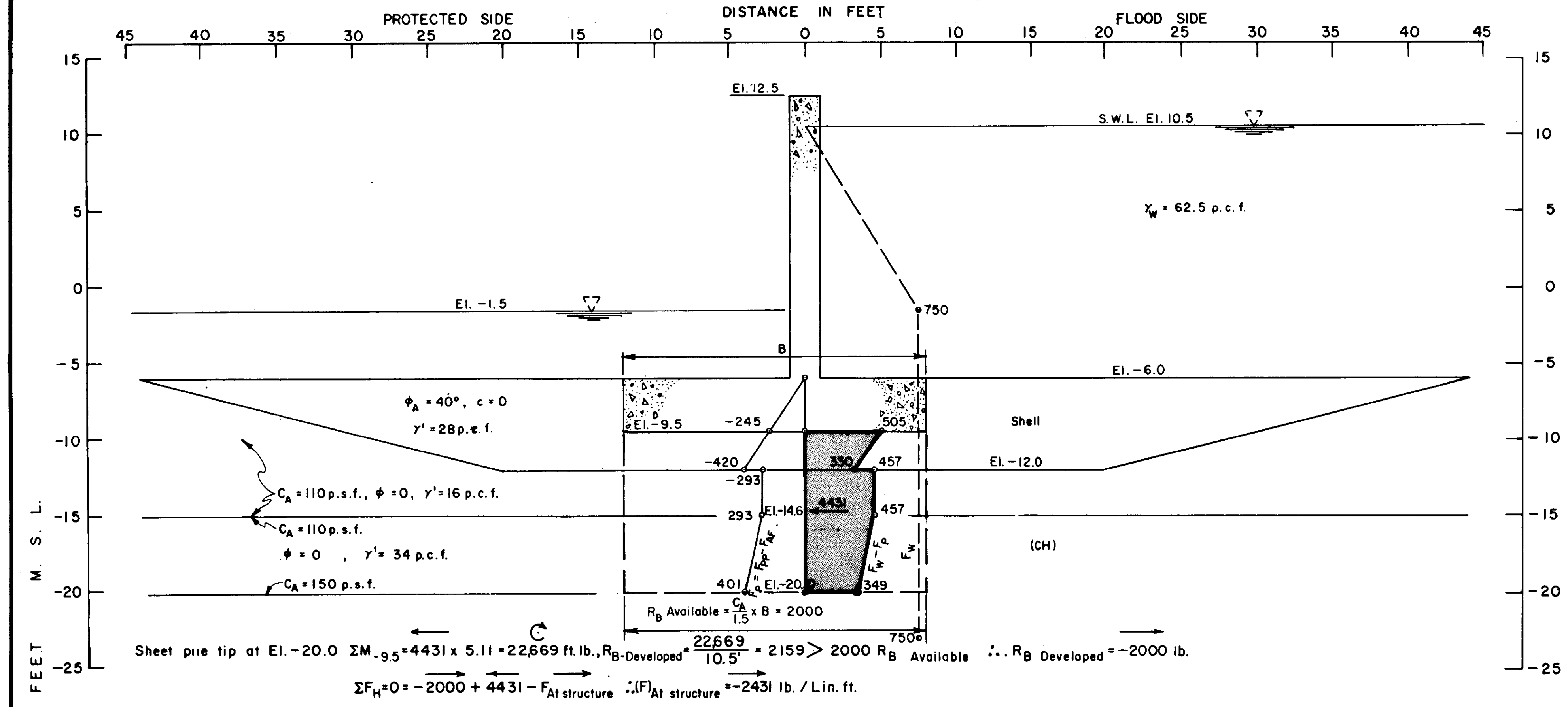
NOTE:
Procedure from Chapter No. 3, "Dewatering", Foundation Engineering Text, Leonards Editor, Authors - Mansur and Kaufman.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

CONSTRUCTION DEWATERING BAYOU PIQUANT DRAINAGE STRUCTURE

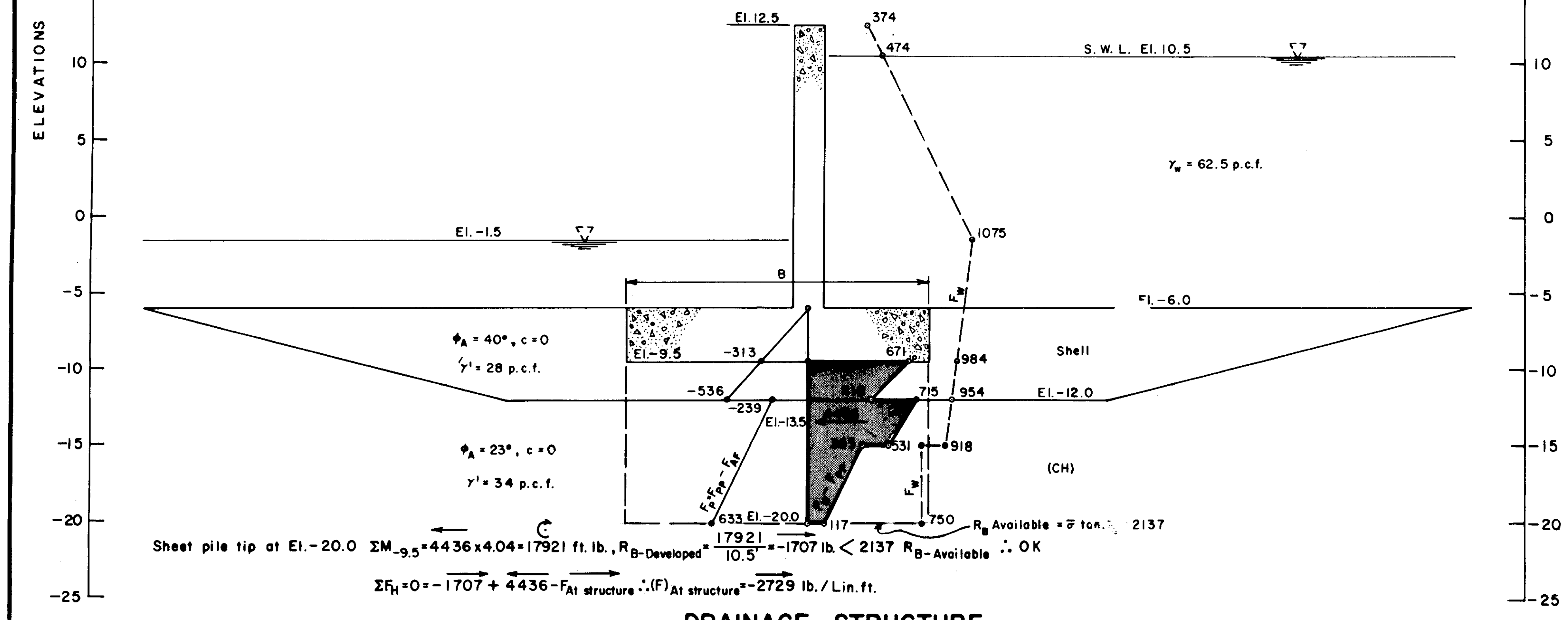
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624



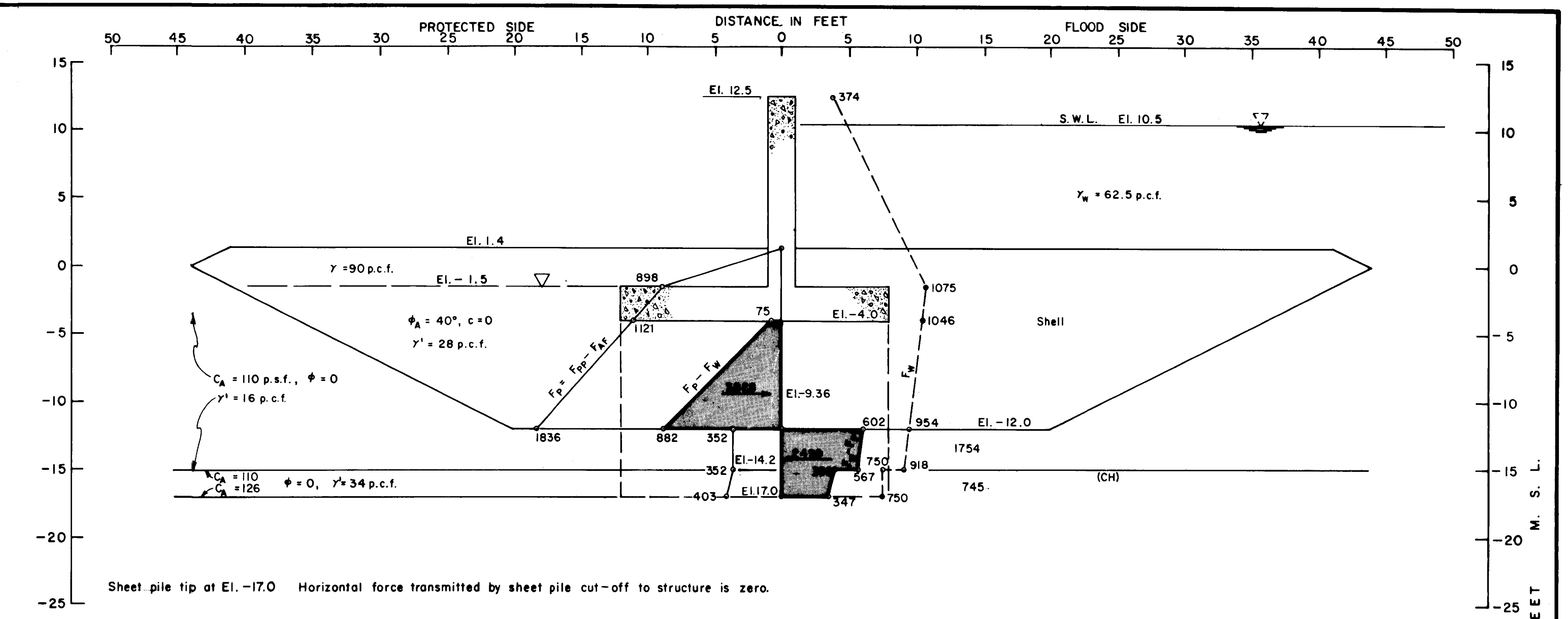
DRAINAGE STRUCTURE

SHEET PILE CUT-OFF (Q) ANALYSIS F.S. 1.50 - WITHOUT WAVE PRESSURE (Q CASE GOVERNS)



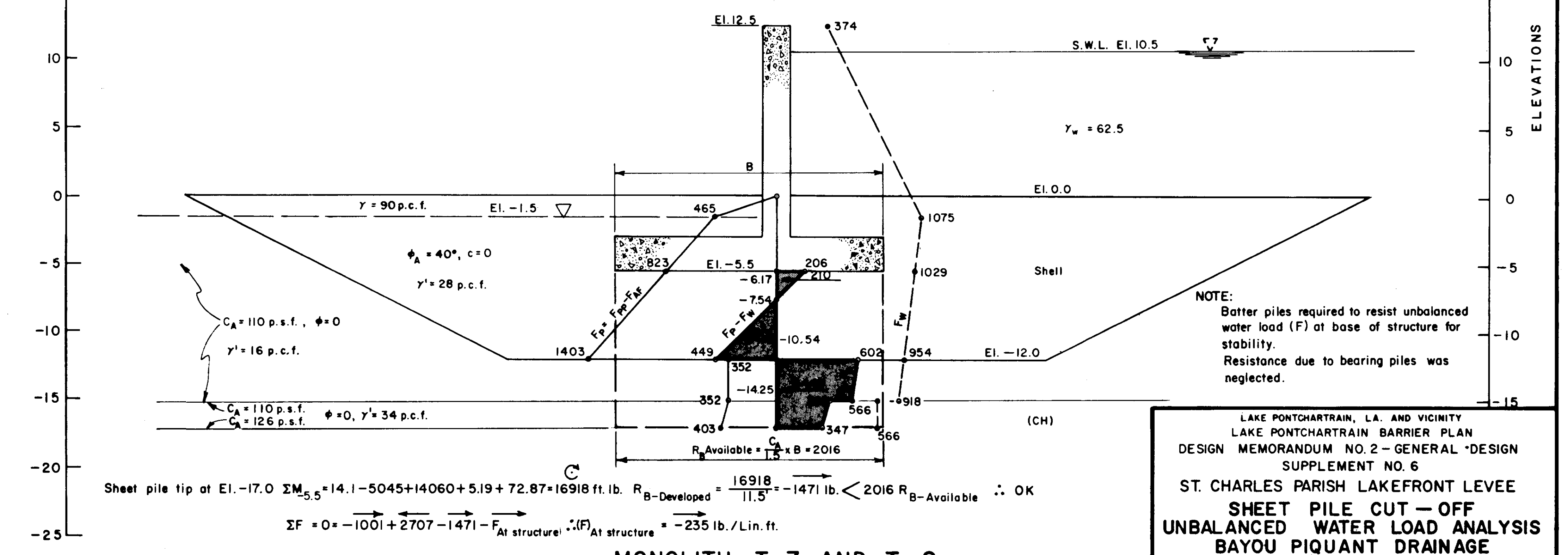
DRAINAGE STRUCTURE

SHEET PILE CUT-OFF (S) ANALYSIS F.S. 1.25 - WITH WAVE PRESSURE (S CASE GOVERNS)



MONOLITH T-6

T-WALL SHEET PILE CUT-OFF (Q) ANALYSIS F.S. = 1.25 WITH WAVE PRESSURE (Q CASE GOVERNS)



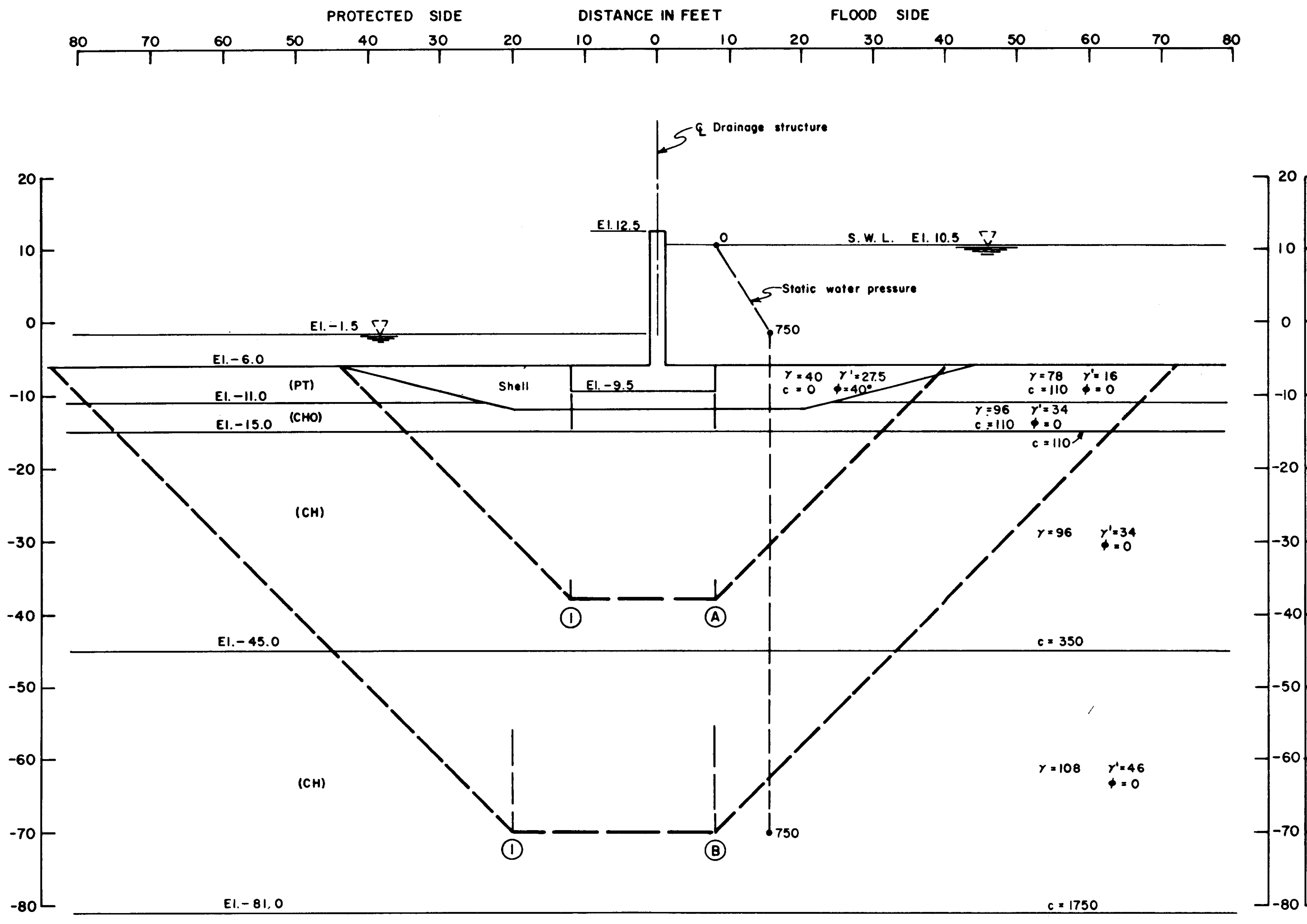
MONOLITH T-7 AND T-8

T-WALL SHEET PILE CUT-OFF (Q) ANALYSIS F.S. = 1.25 WITH WAVE PRESSURE (Q CASE GOVERNS)

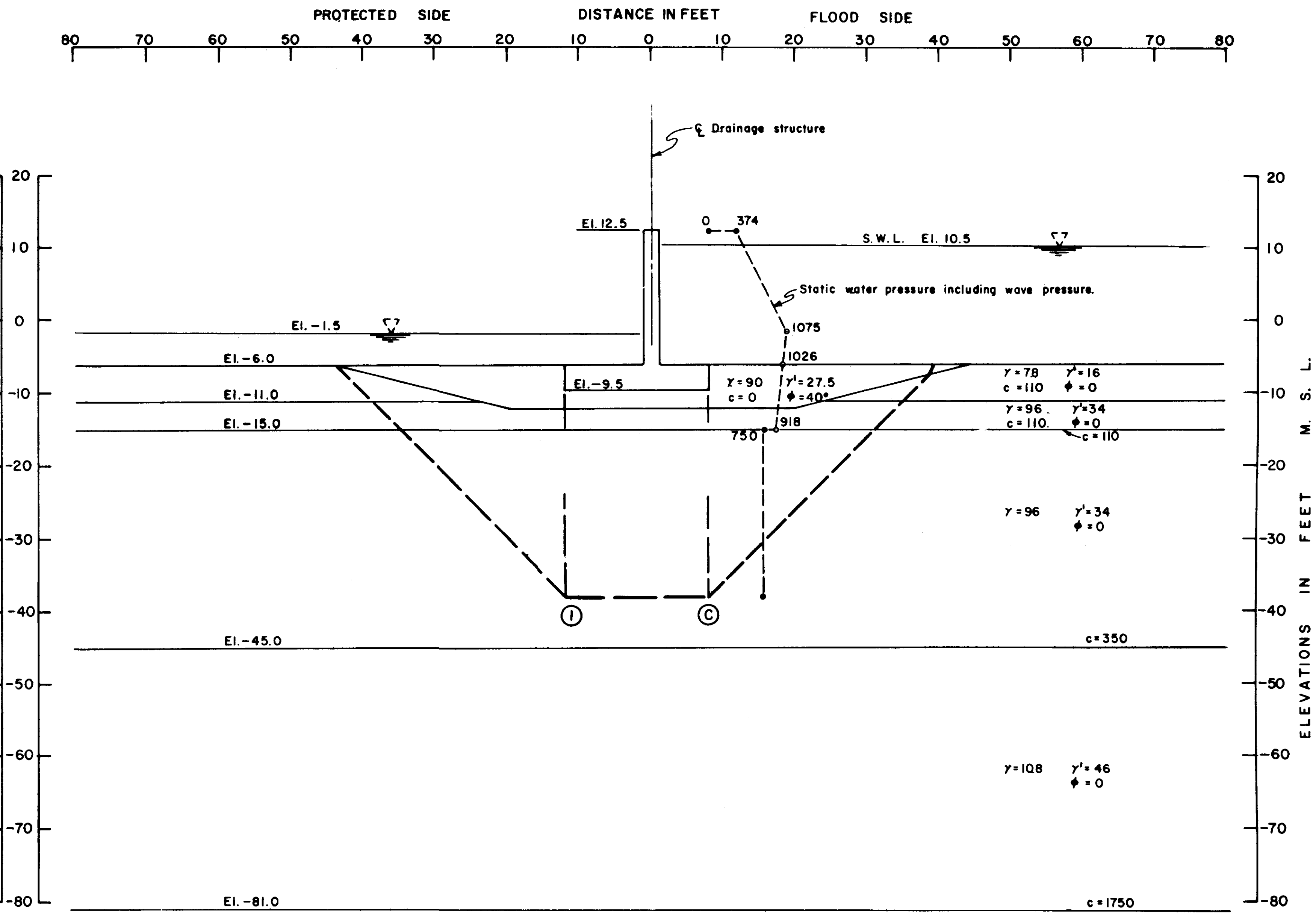
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

SHEET PILE CUT-OFF UNBALANCED WATER LOAD ANALYSIS BAYOU PIQUANT DRAINAGE STRUCTURE AND T-WALL

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624



WITHOUT WAVE FORCE
(MINIMUM F.O.S. = 1.50)



WITH WAVE FORCE
(MINIMUM F.O.S. = 1.25)

ASSUMED FAILURE SURFACE		RESISTING FORCES				DRIVING FORCES		SUMMATION OF FORCES		FACTOR OF SAFETY
NO.	EL.	R_A	R_B	R_P	R_{SIDES}	D_A	$-D_P$	RESISTING	DRIVING	
Ⓐ ①	-38.0	1,259,200	588,000	1,259,200	473,636	4,015,700	1,594,300	3,580,036	2,421,400	1.48
Ⓑ ①	-70.0	5,758,000	3,704,400	5,758,000	1,958,830	11,182,100	6,399,800	17,179,230	4,782,300	3.59
Ⓒ ①	-38.0	1,259,200	588,000	1,259,200	473,636	4,148,900	1,594,300	3,580,036	2,554,600	1.40

GENERAL NOTES

Classification, stratification, shear strengths, and unit weights of the soil were based on the results of undisturbed boring 6-U. See plate 11.

NOTE:

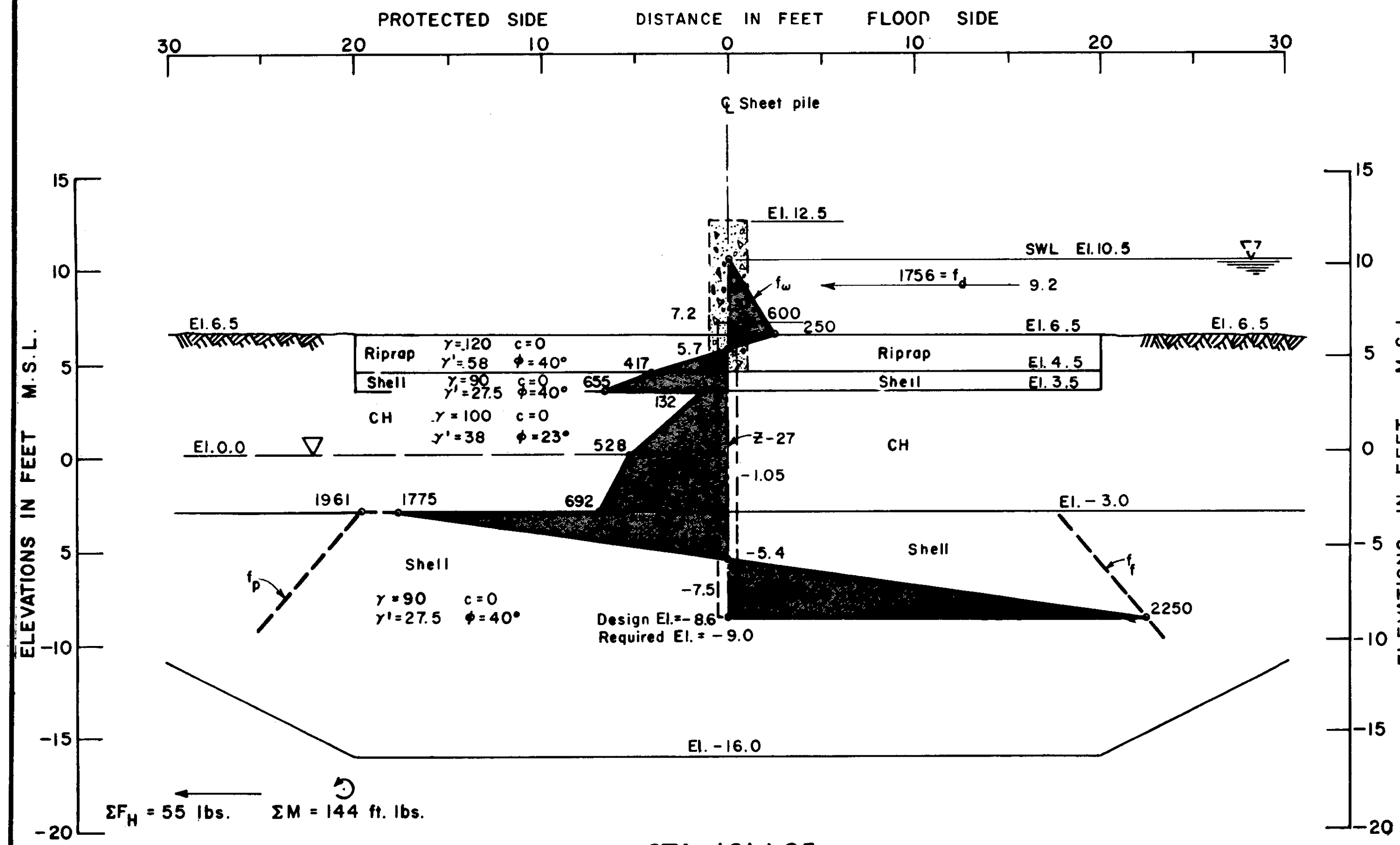
Resistance due to bearing piles was neglected.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

MASS (Q) STABILITY-BAYOU PIQUANT DRAINAGE STRUCTURE

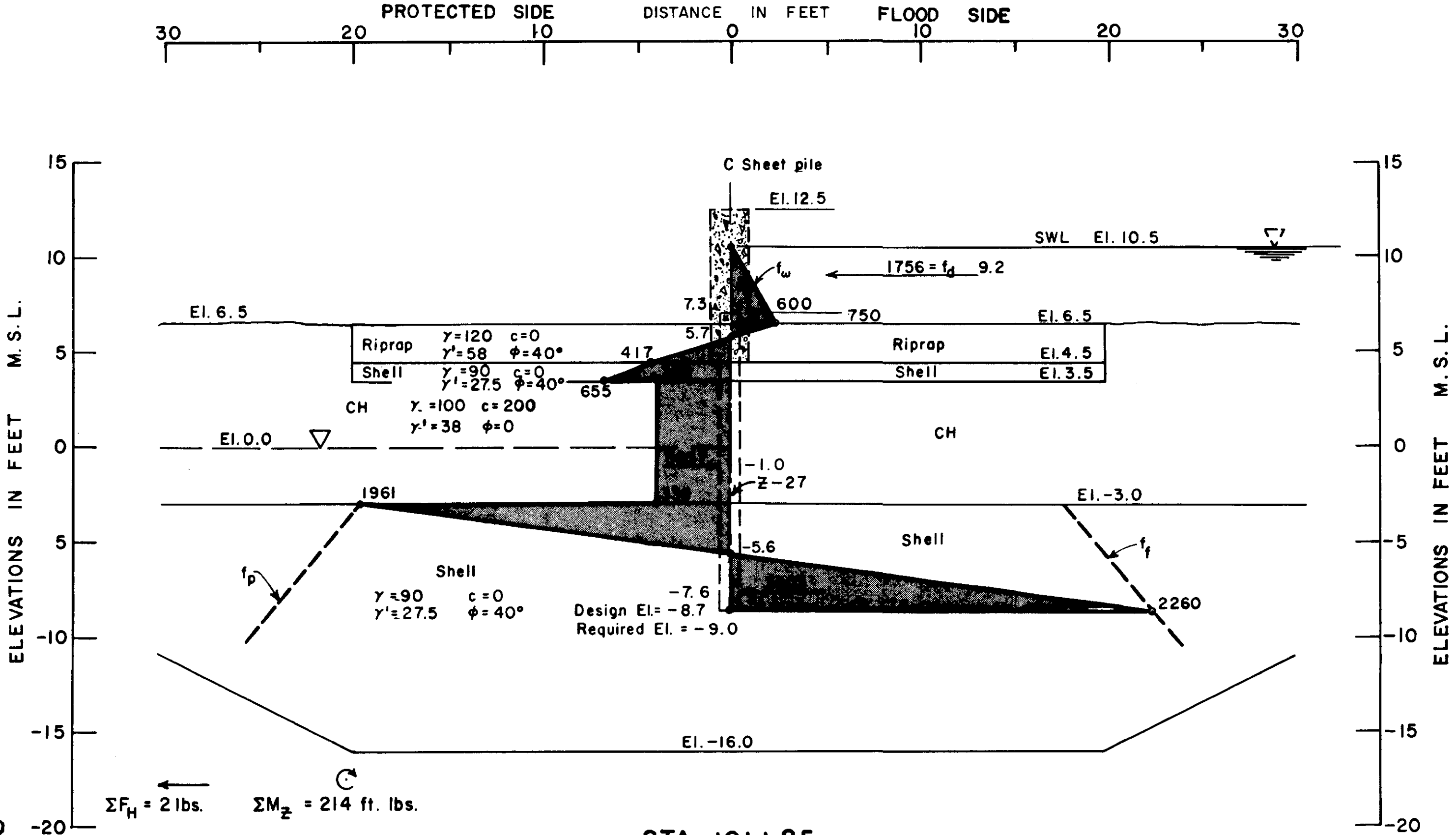
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624



STA. 101+85

(S) CASE - F.S. = 1.25



STA. 101+85

(Q) CASE - F.S. = 1.25

GENERAL NOTES

(S) - Shear strength case governed for design.

Stability analysis by the method of planes with surfaces $45° \pm \frac{\phi_d}{2}$ and F.S.=1.25 applied to the (S) shear strength of the soil.

ϕ_a - Available angle of internal friction in degrees.

ϕ_d - Developed angle of internal friction = $\tan^{-1}(\frac{\tan \phi_a}{F.S.})$.

C_a - Unit cohesion available.

C_d - Unit cohesion developed = $C_a \div$ F.S.

(S) - Consolidated-drained shear strength of soil. For undisturbed shear test data see plates

f_ω - Net lateral water pressure. (Water pressure from waves effective to top of impervious clay layer-applies to plate 61

f_f - Net lateral pressure on floodside = earth + f_ω.

f_p - Net lateral pressure on protected side = earth - f_ω.

ΣF_H - Summation of horizontal forces.

$\Sigma M_{\not z}$ - Summation of moments about the sheet pile tip.

γ, γ' & γ_ω - Unit weights p.c.f..

H - Static water head above levee crown.

$\not z$ - Penetration of tip below crown.

S.W.L. - Still water level = El. 10.5.

f_d - Dynamic wave force.

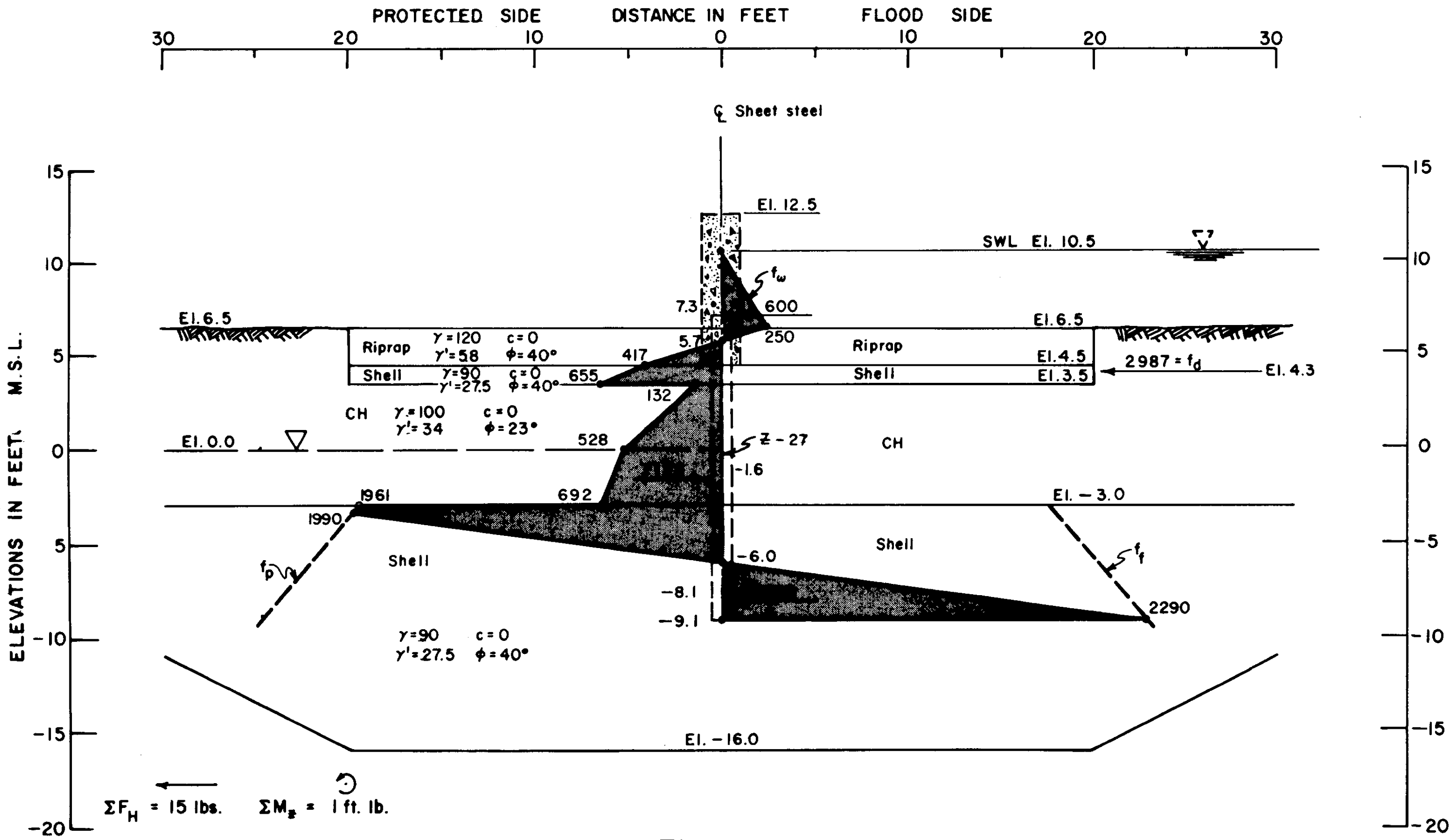
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
CANTILEVER SHEET PILE FLOODWALL
(Q) STABILITY AND (S) STABILITY
BAYOU PIQUANT DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624

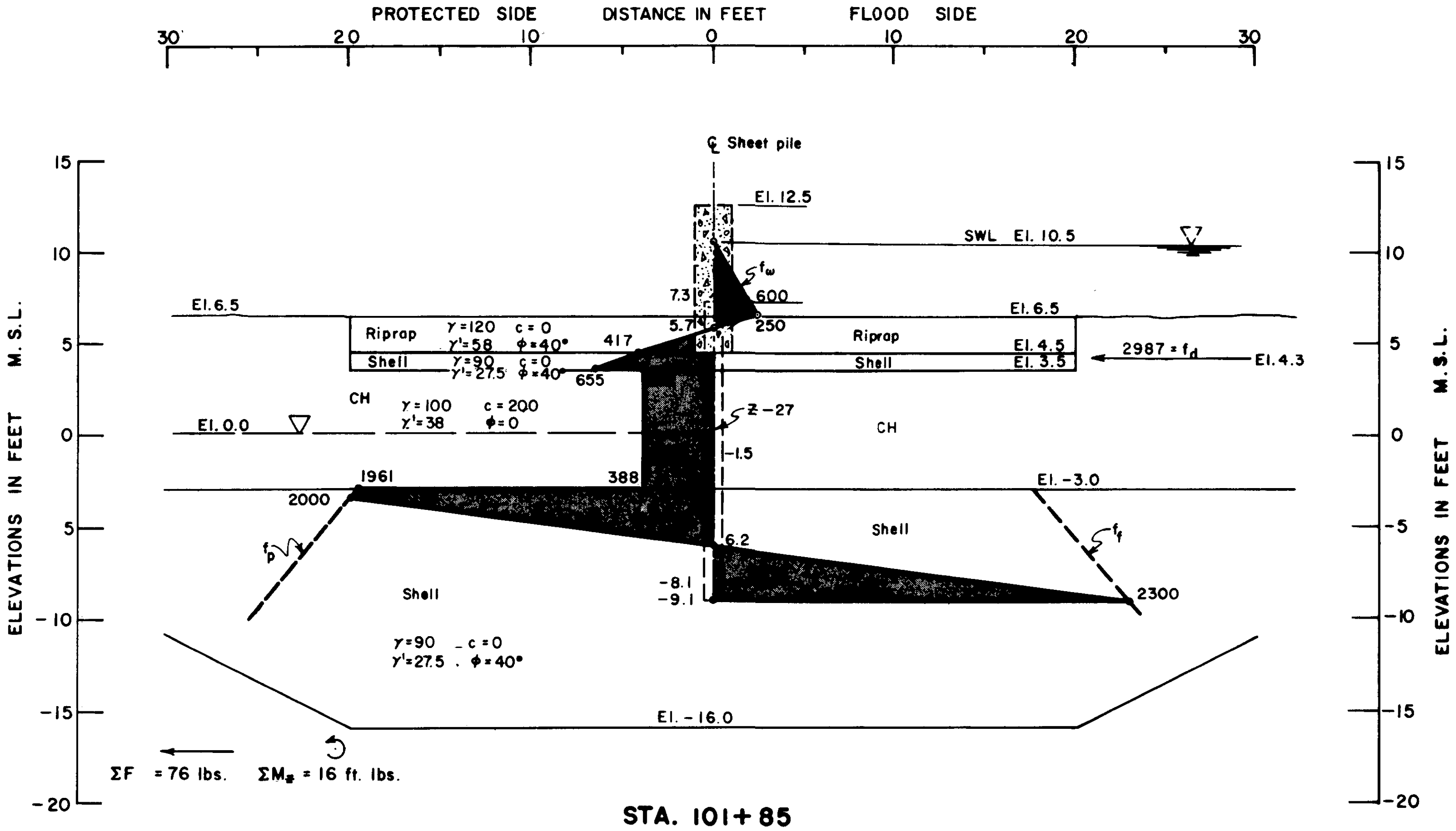
PLATE 61

GENERAL NOTE

Same as plate 61 except that water pressure from waves effective to tip of sheet pile. (Applies to this plate only).



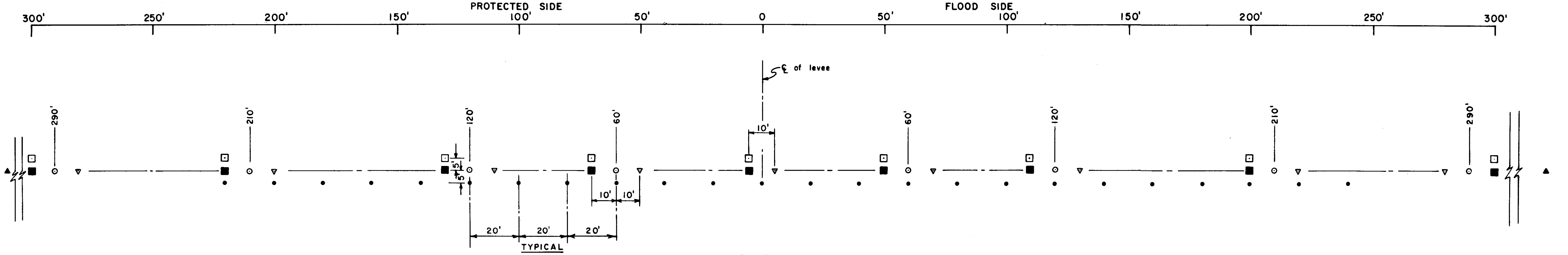
STA. 101+85
(S) CASE - F.S. = 1.25



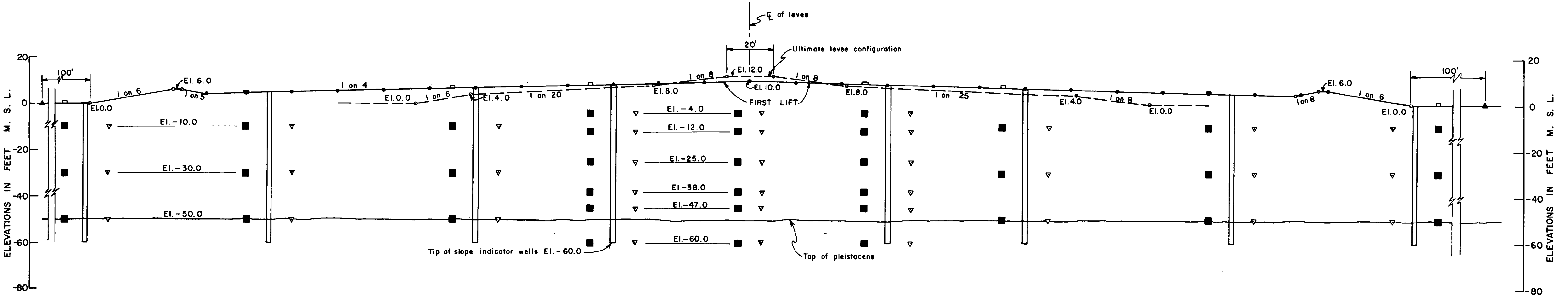
STA. 101+85
(Q) CASE - F.S. = 1.25

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
CANTILEVER SHEET PILE FLOODWALL
(Q) STABILITY AND (S) STABILITY
BAYOU PIQUANT DRAINAGE STRUCTURE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 1969 FILE NO. H-2-24624



PLAN



PROFILE

NOTE: Instruments shall be installed as soon as practicable after completion of the first lift.

LEGEND

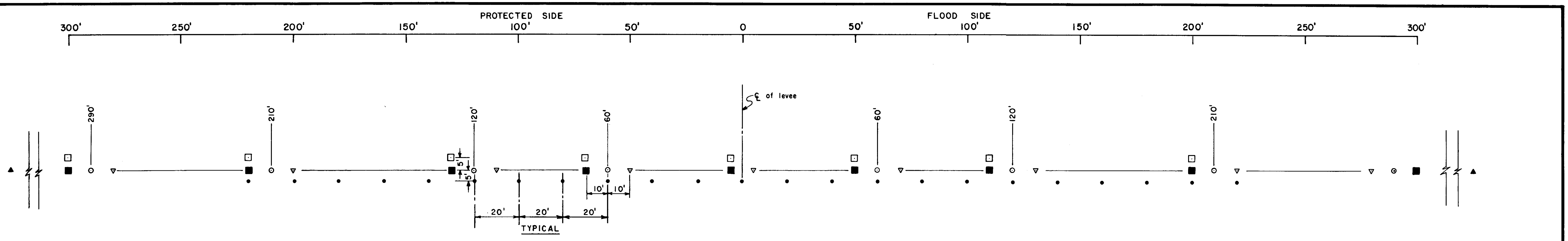
- ⊙ Slope indicator wells
- ▽ Piezometer, open - system
- ▲ Permanent bench marks
- • Surface reference hubs
- ■ Deep settlement plugs
- ⊡ Settlement plates

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

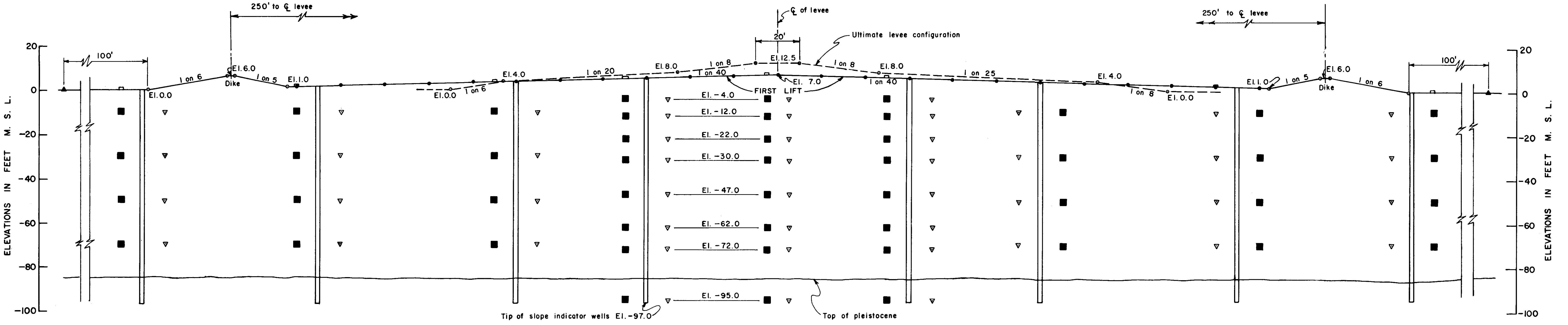
INSTRUMENTED LEVEE SECTION
STA. 80+00

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

SEPT 1969 FILE NO. H-2-24624



PLAN



PROFILE

NOTE: Instruments shall be installed as soon as practicable after completion of the first lift.

LEGEND

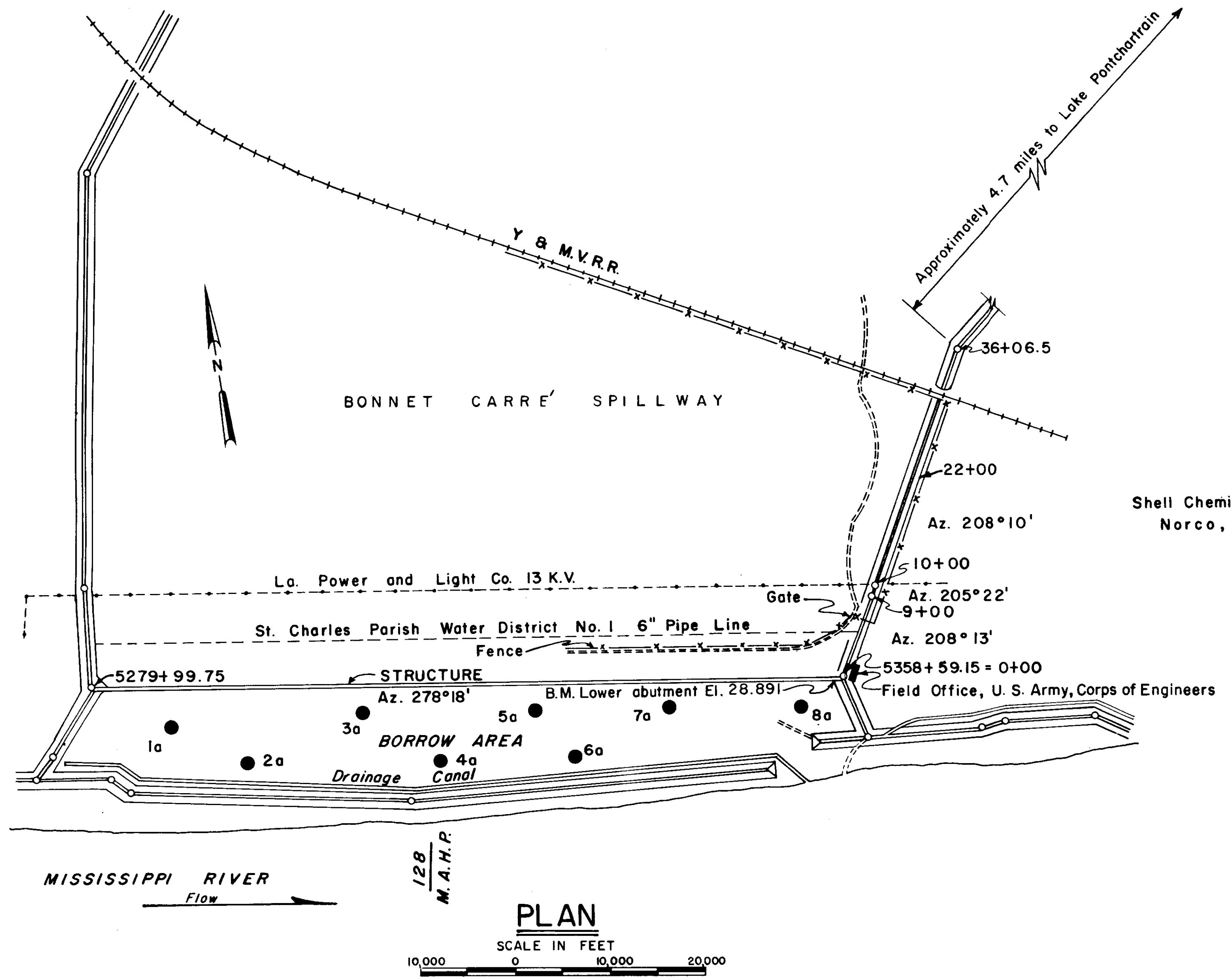
- ⊙ Slope indicator wells
- ▽ Piezometer, open - system
- ▲ Permanent bench marks
- • Surface reference hubs
- ■ Deep settlement plugs
- ⊡ Settlement plates

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

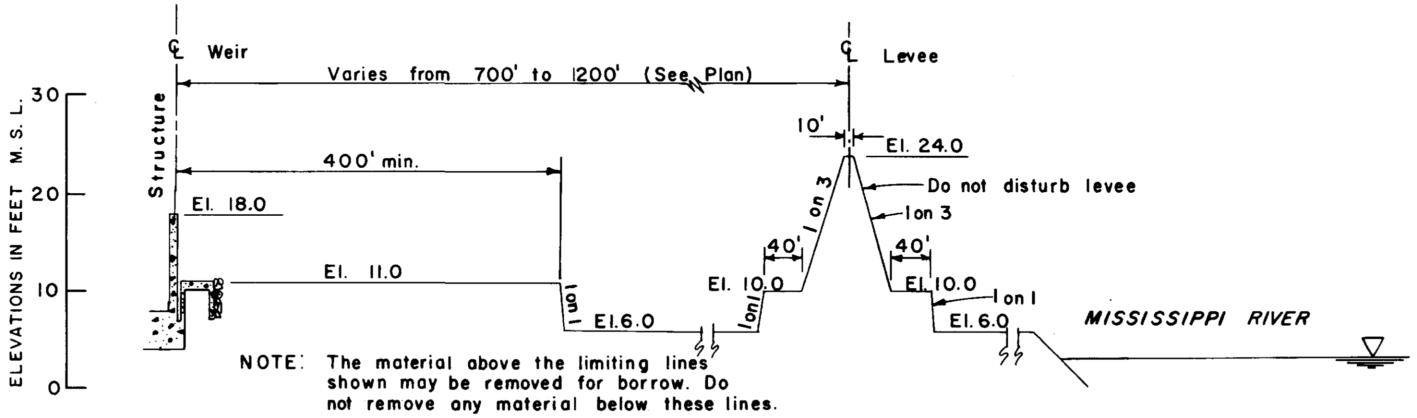
INSTRUMENTED LEVEE SECTION
STA. 205+00

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

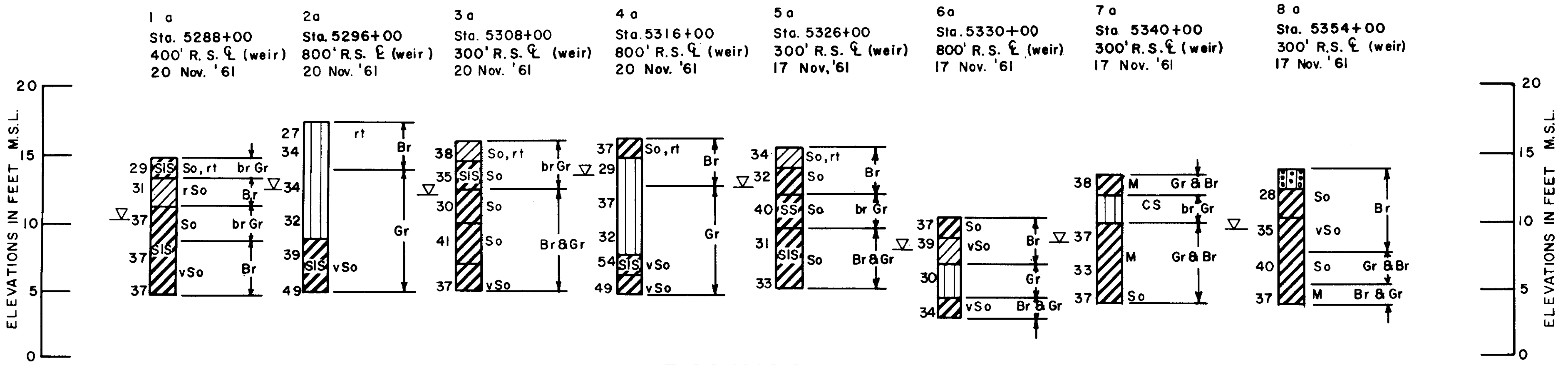
SEPT 1969 FILE NO. H-2-24624



PLAN



TYPICAL SECTION FOR BORROW



BORINGS

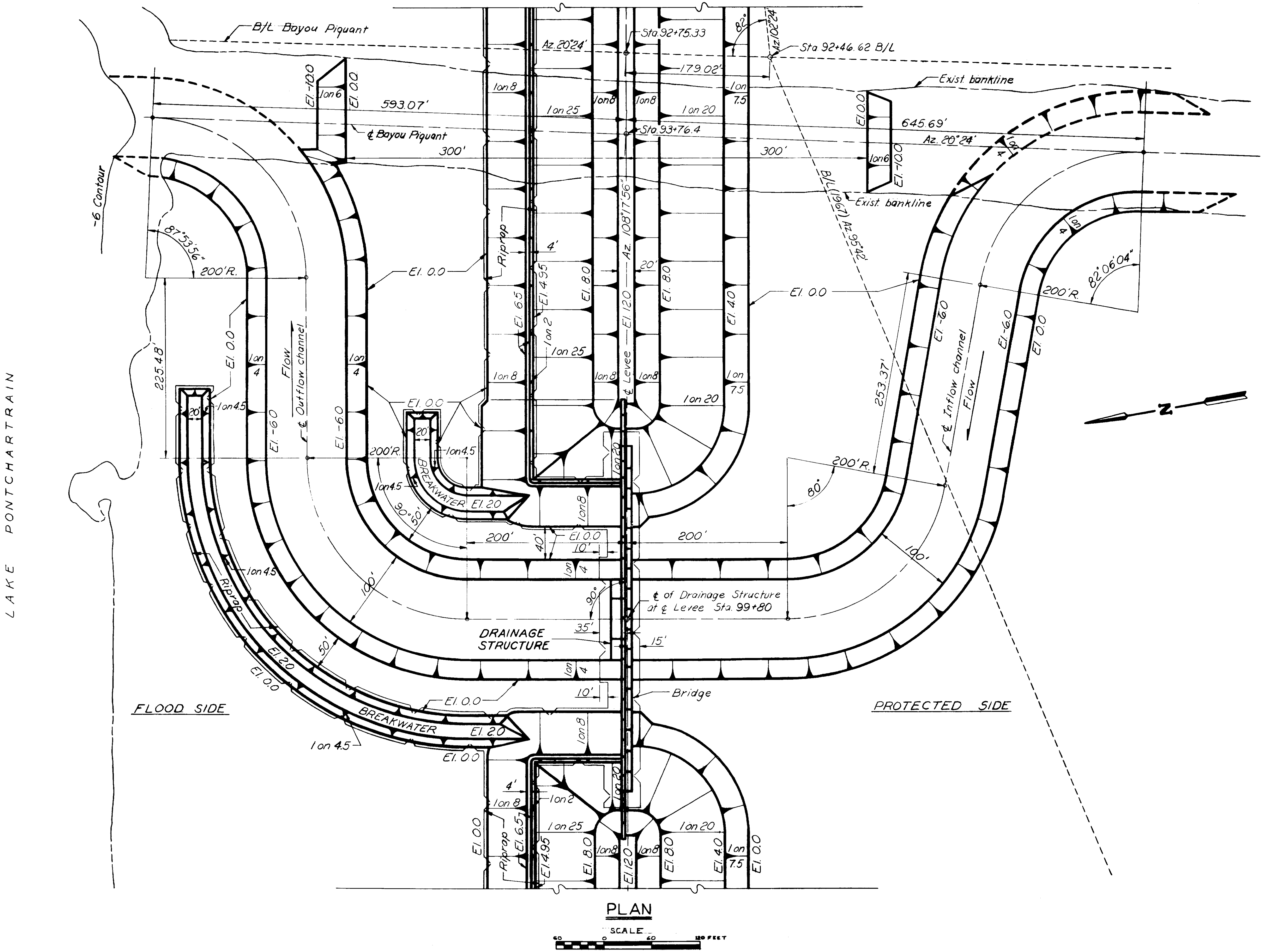
NOTE: Borings 1a to 8a incl.: Soil samples were taken with a 4" dia. post hole auger.
For soil boring legend see plate A.

LAKE PONTCHARTRAIN LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

ADDITIONAL BORROW AREA LOCATION BONNET CARRE' SPILLWAY

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

SEPT. 1969 FILE NO. H-2-24624



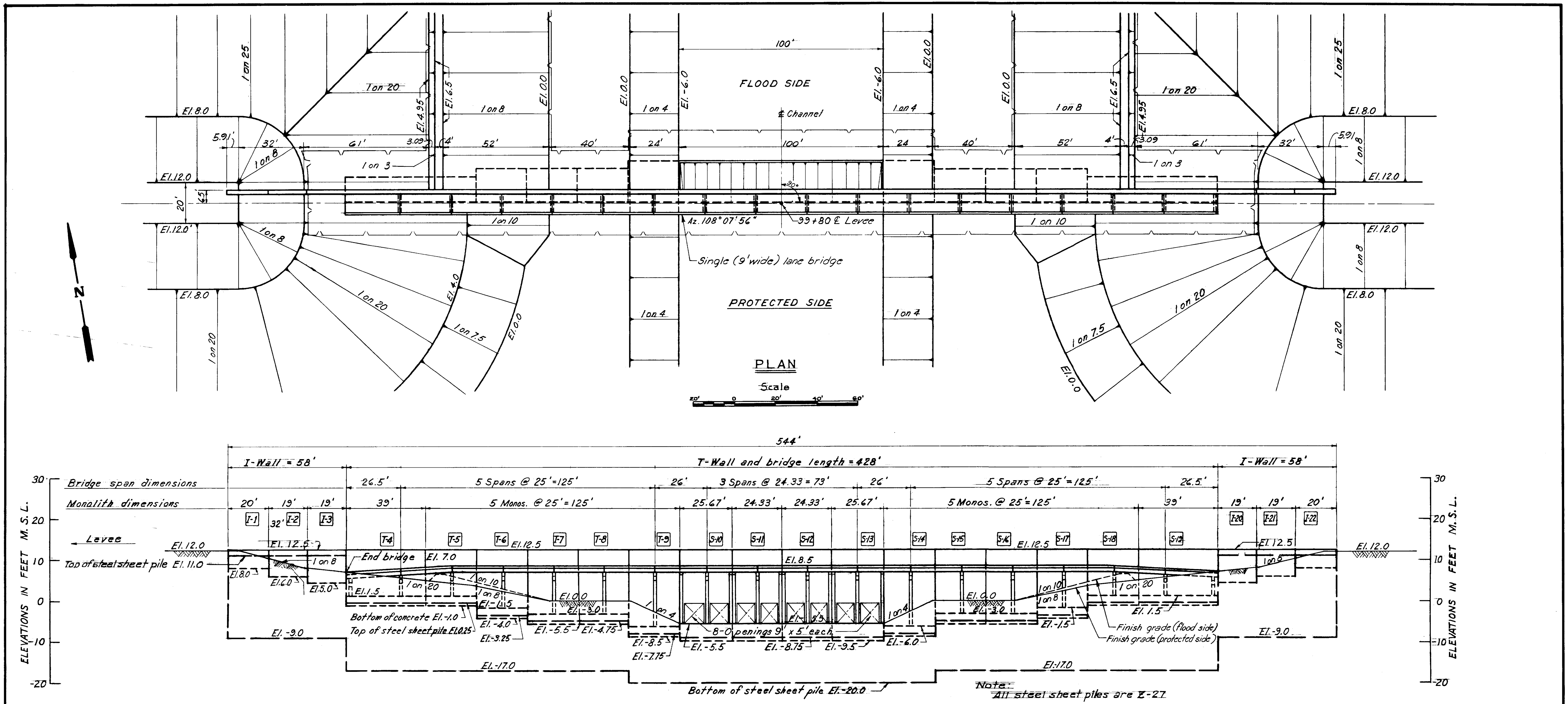
NOTE:
Riprap will be placed on breakwaters and levee slopes with final levee contract. For riprap and shell backfill to be placed with structure contract, see plates 42 and 43.
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT DRAINAGE STRUCTURE-SITE PLAN

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

SEPT. 1969 FILE NO. H-2-24624

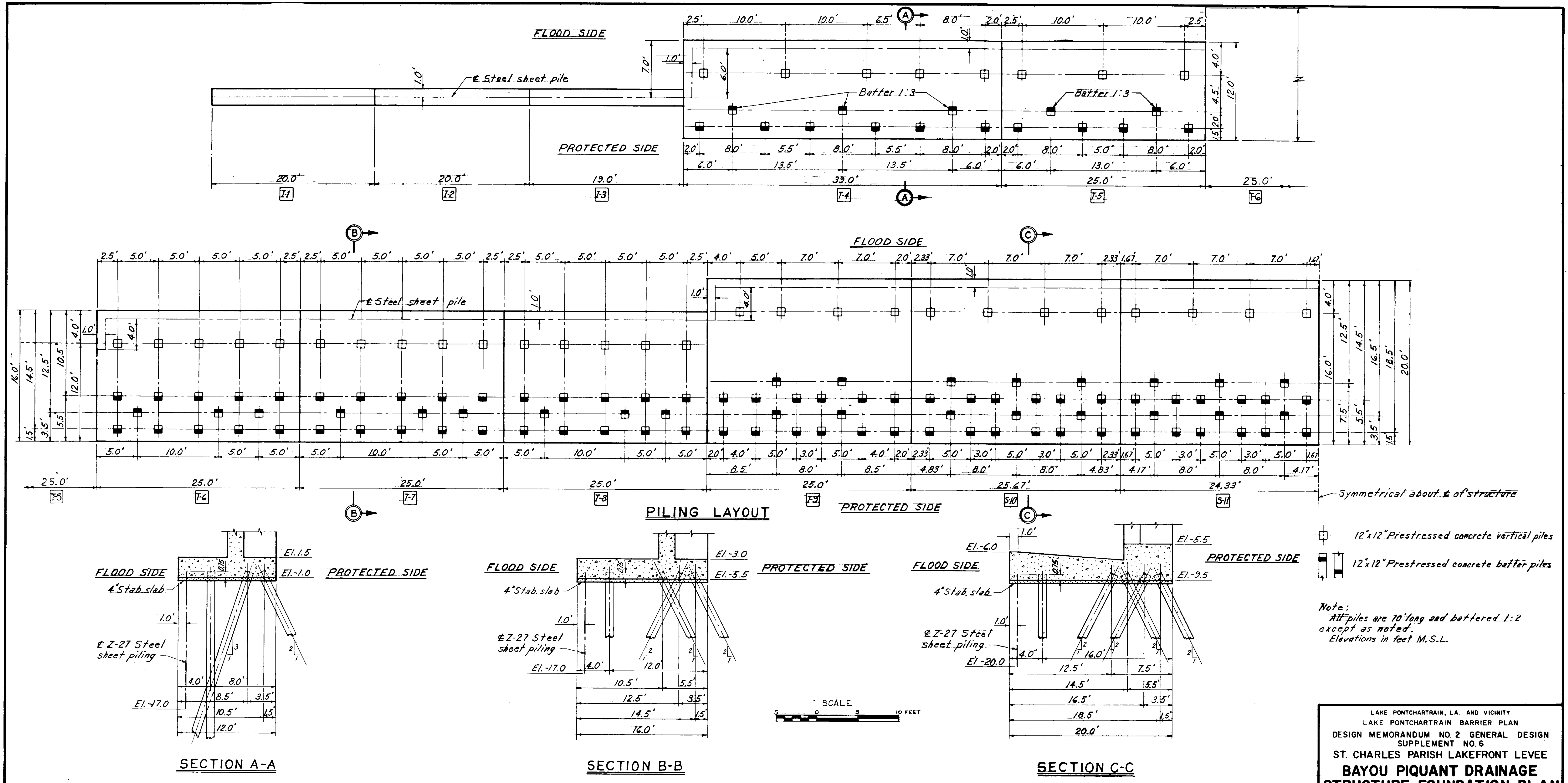


LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT
DRAINAGE STRUCTURE
PLAN AND PROFILE

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

SEPT 1969 FILE NO. H-2-24624



LAKE PONTCHARTRAIN, LA. AND VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6

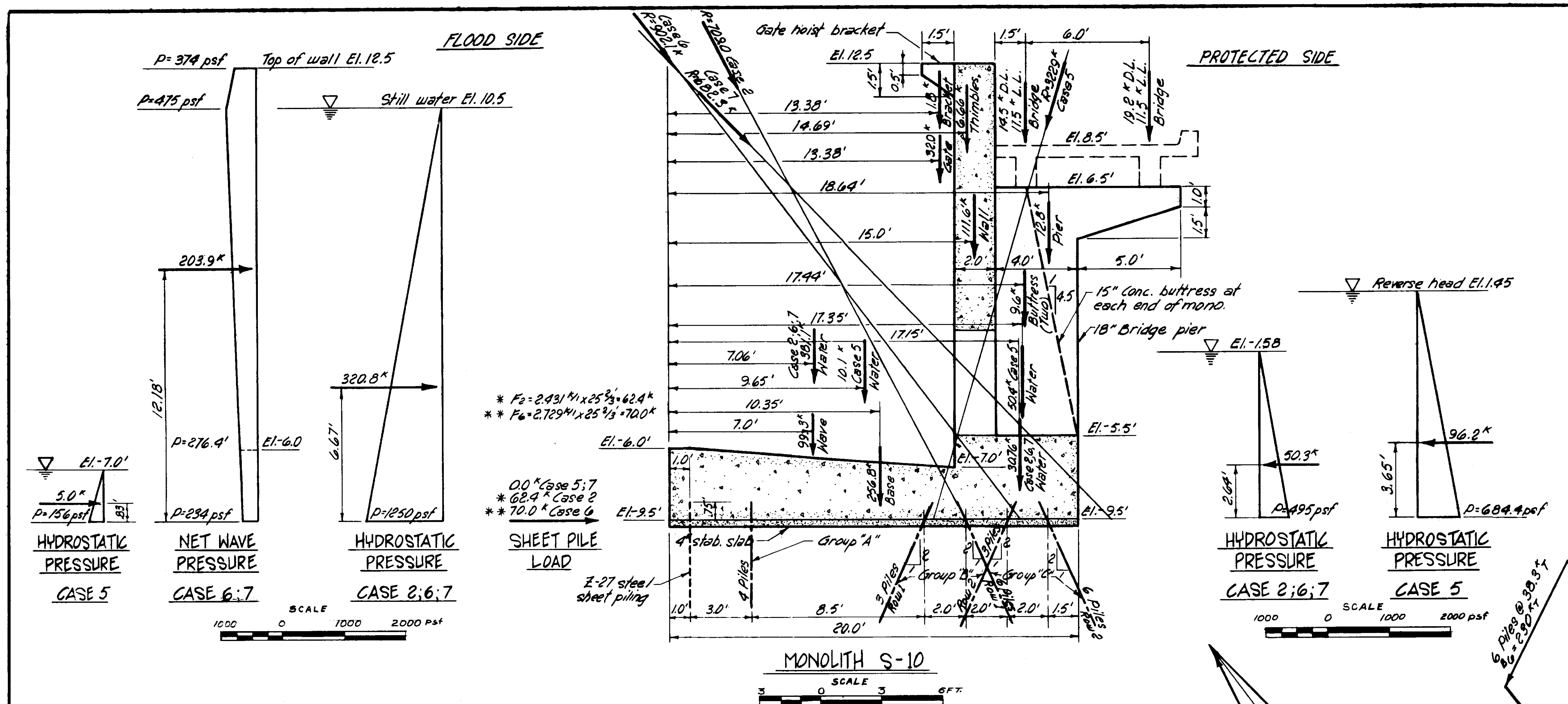
ST. CHARLES PARISH LAKEFRONT LEVEE

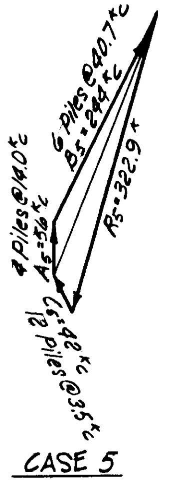
BAYOU PIQUANT DRAINAGE STRUCTURE–FOUNDATION PLAN

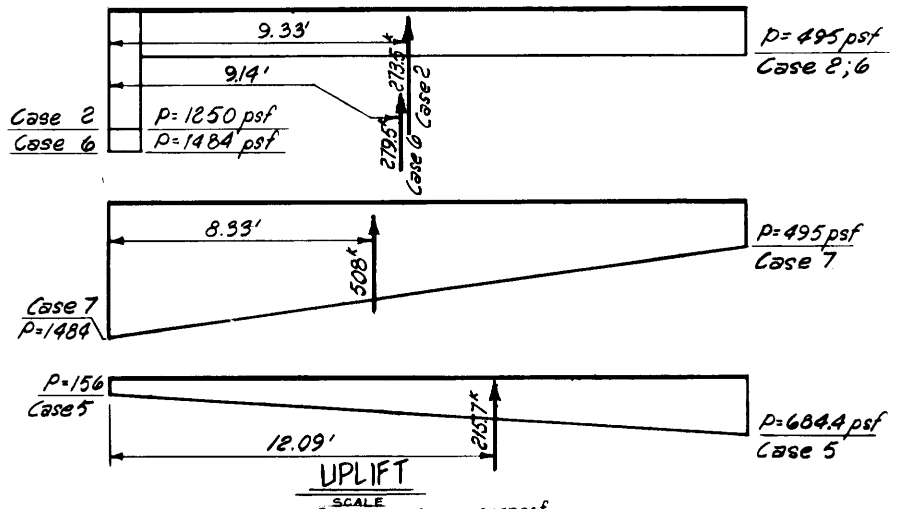
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

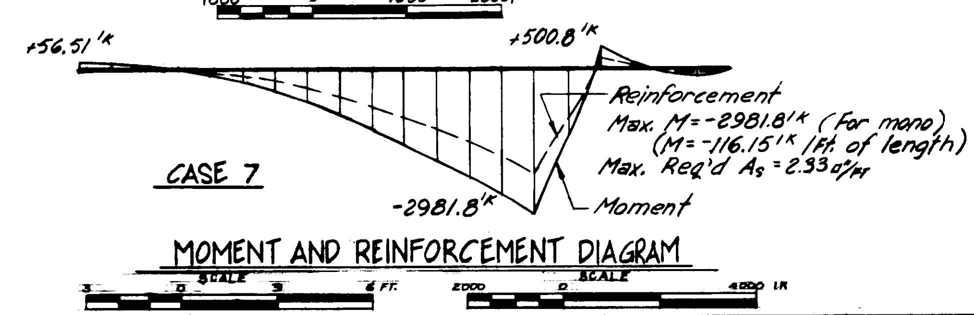
SEPT. 1969 FILE NO. H-2-24624

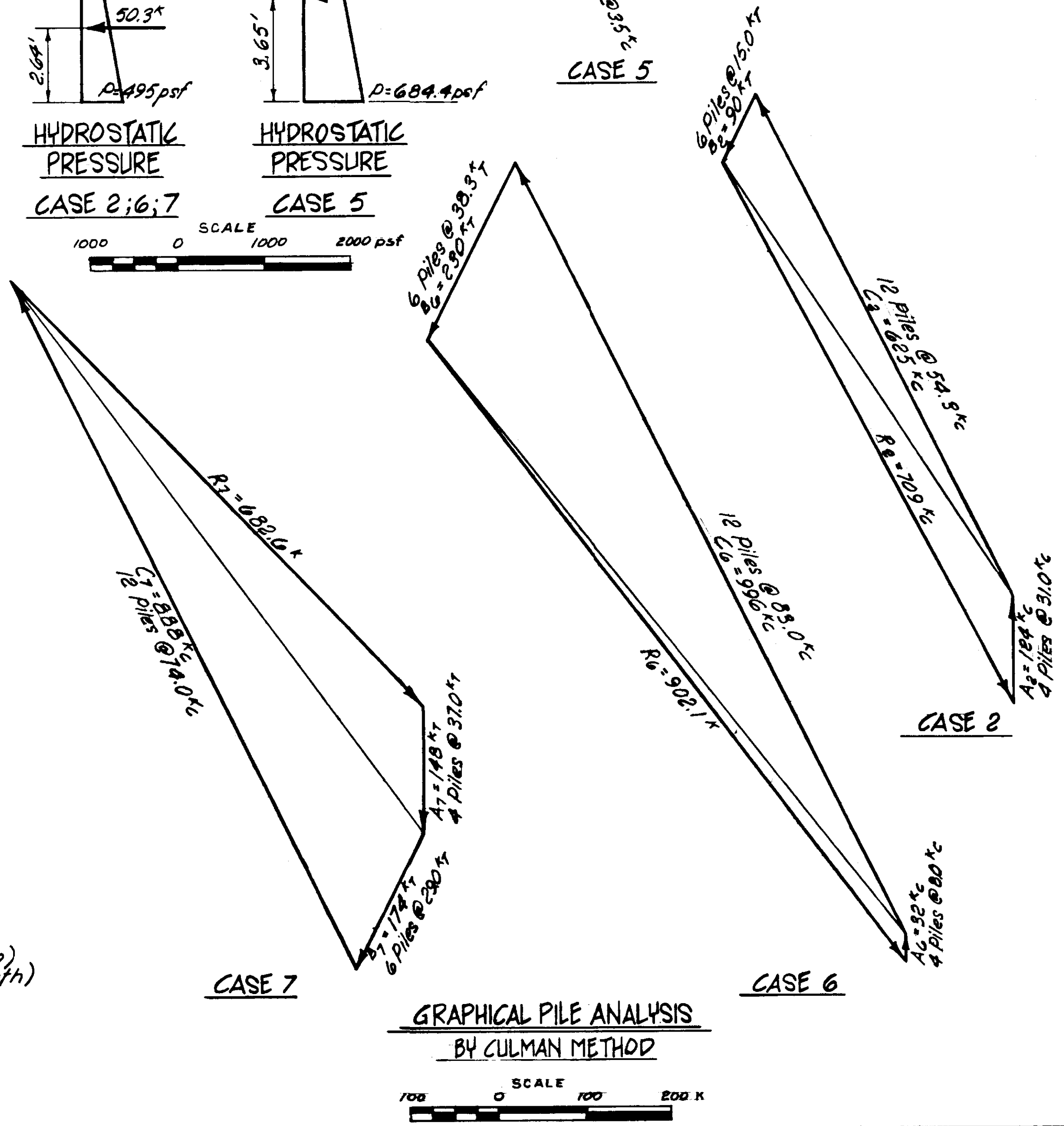
PLATE 68











COMPUTED PILE LOADS BY HRENNIKOFF METHOD					
CASE NO.	GROUP "A"	GROUP "B"		GROUP "C"	
	ROW 1	ROW 1	ROW 2	ROW 1	ROW 2
1	26.7K	32.7K	33.1K	16.7K	17.0K
2	26.1K	-11.7K	-12.4K	55.0K	54.3K
3	-4.2K	-10.0K	-1.6K	42.4K	50.8K
4	-5.3K	31.4K	39.5K	-2.4K	5.7K
5	14.6K	38.0K	40.9K	2.1K	5.1K
6	0.7K	-36.6K	-28.0K	78.7K	87.3K
7	-38.6K	-36.5K	-16.3K	63.3K	83.5K

ALLOWABLE PILE LOADS

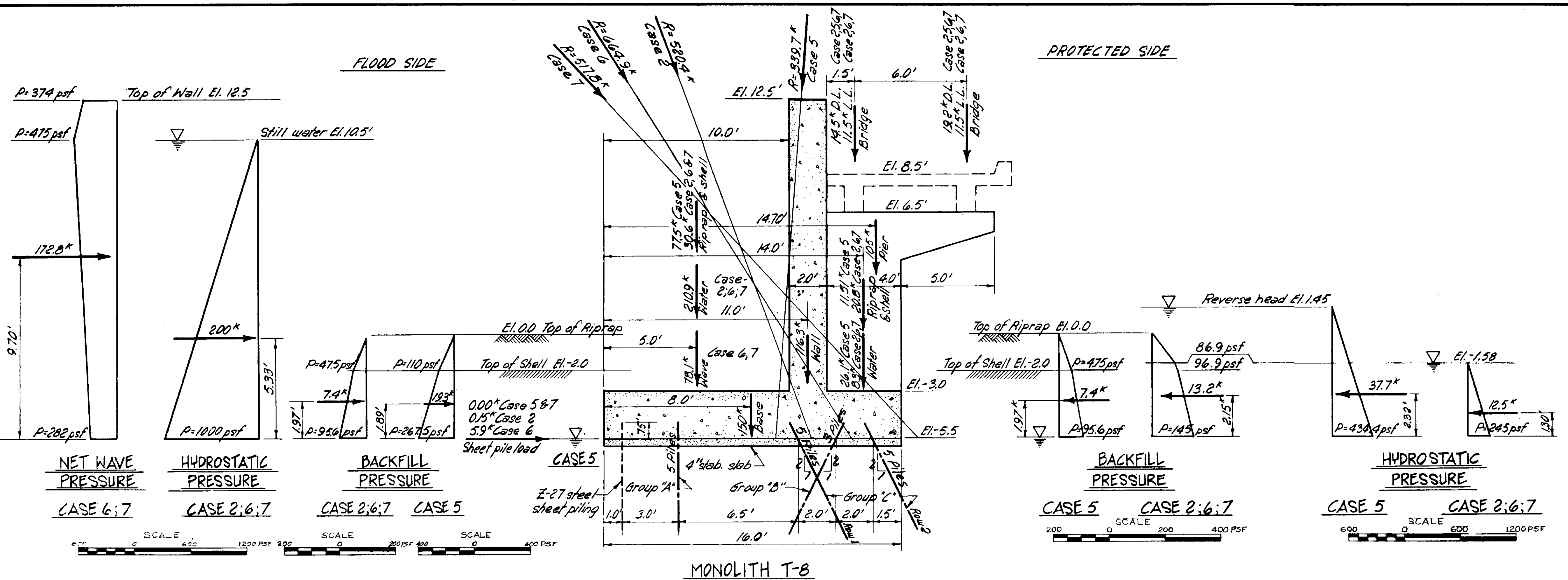
W/o Wave 60KC 29KT
W/ Wave 80KC 38.7KT

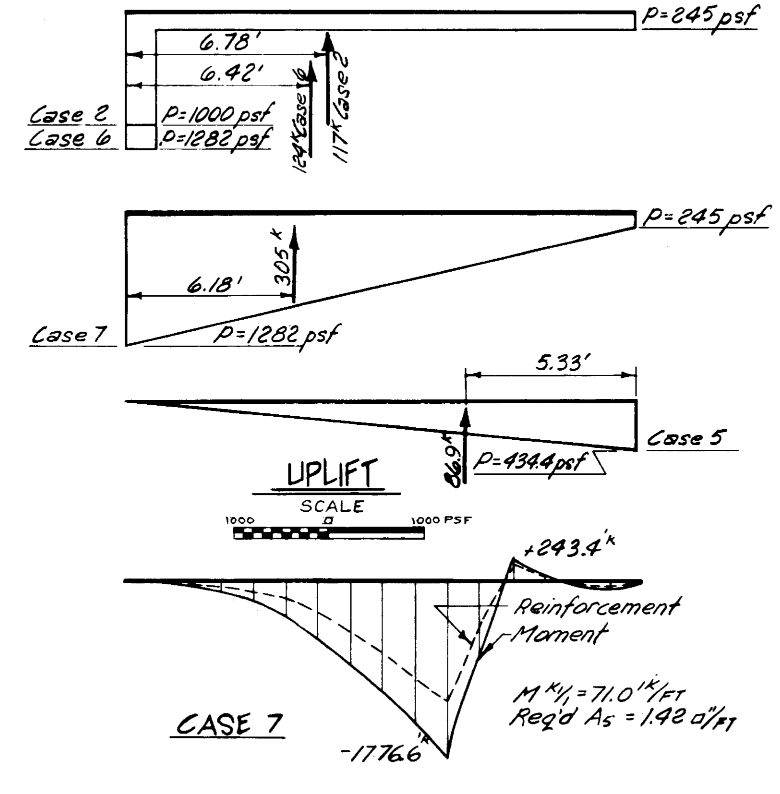
Note:
All prestressed concrete piles are 12"x12"x70' long.
Loads shown are for the full monolith length.
Sheet pile loads computed from unit loads indicated on Plate 59.
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
BAYOU PIQUANT
DRAINAGE STRUCTURE
MONOLITH S-10
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT. 19[illegible] FILE NO. H-2-24624

PLATE 69





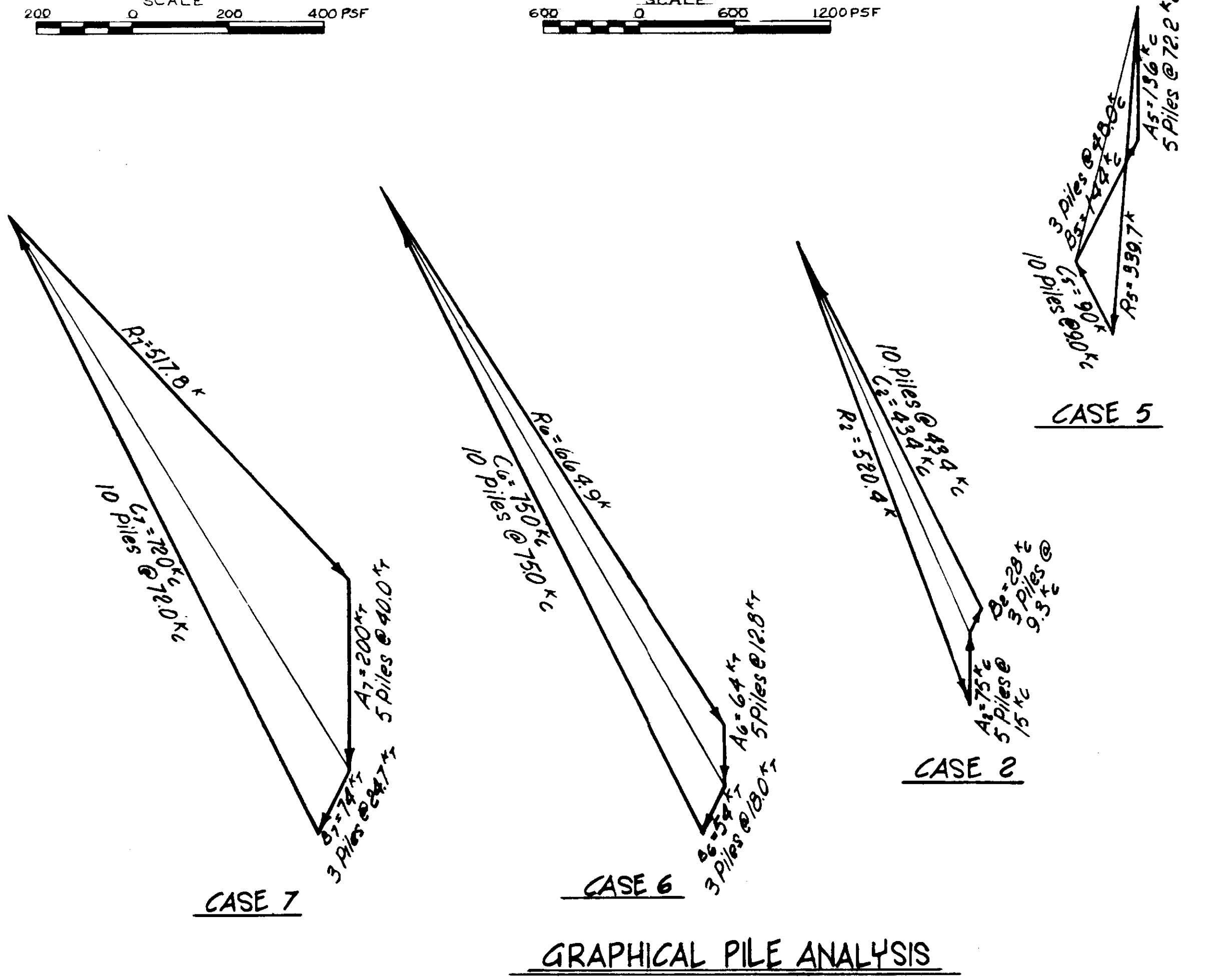
MOMENT AND REINFORCEMENT DIAGRAM

COMPUTED PILE LOADS BY HRENNIKOFF METHOD

CASE NO.	GROUP "A" ROW 1	GROUP "B" ROW 1	GROUP "C" ROW 1	GROUP "C" ROW 2
1	17.1^K	40.6^K	10.2^K	15.6^K
2	16.3^K	8.7^K	40.1^K	45.4^K
3	-2.6^K	2.0^K	35.0^K	46.1^K
4	15.6^K	42.5^K	5.2^K	10.4^K
5	26.5^K	46.4^K	8.1^K	10.0^K
6	-8.9^K	-18.8^K	64.9^K	81.5^K
7	-34.8^K	-26.1^K	57.1^K	82.0^K

ALLOWABLE PILE LOADS

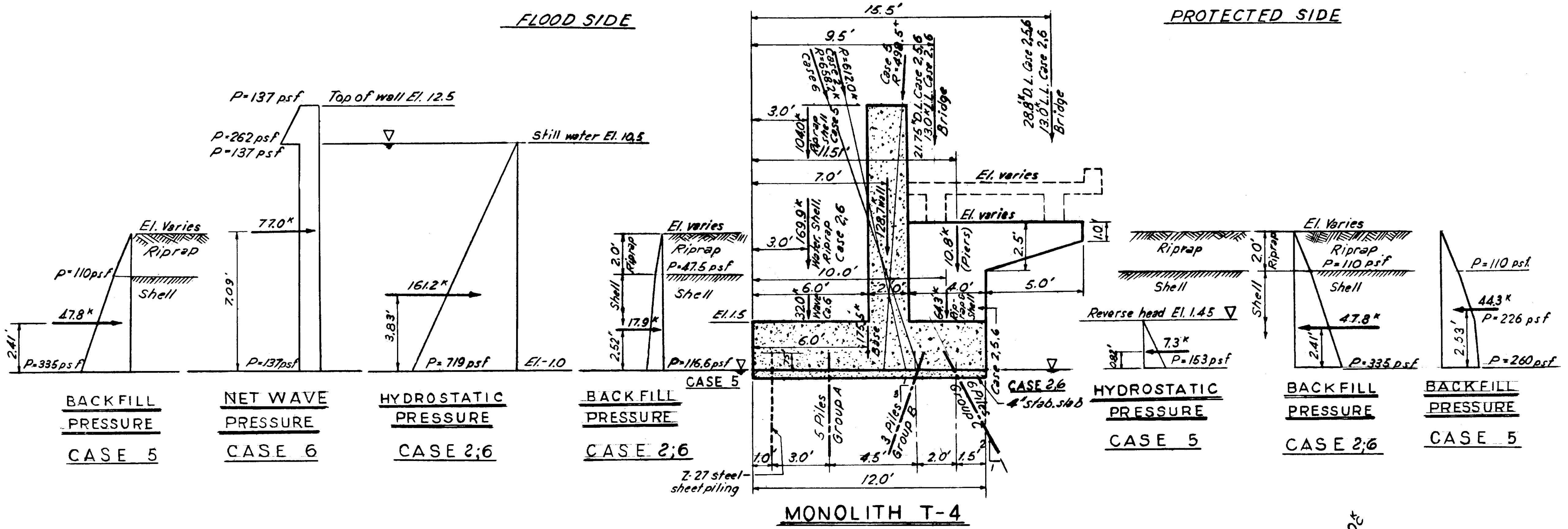
W/o Wave 60^K_C 29^K_T
W/ Wave 80^K_C 38.7^K_T



GRAPHICAL PILE ANALYSIS BY CULMAN METHOD

Note:
All prestressed concrete piles are 12"x12"x70' long.
Loads shown are for the full monolith length.
Elevations in feet M.S.L.

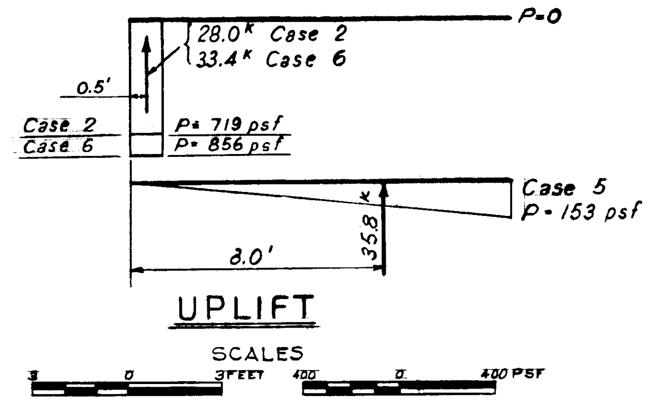
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
BAYOU PIQUANT DRAINAGE STRUCTURE
MONOLITH T-8
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624

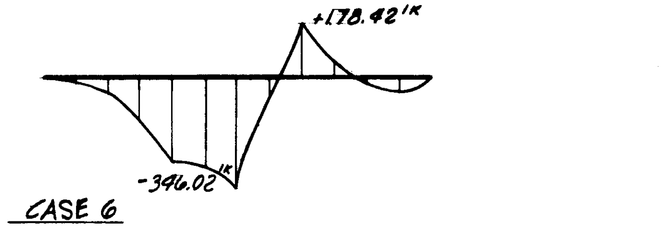


COMPUTED PILE LOADS: HRENNIKOFF METHOD			
CASE NO.	GROUP "A"	GROUP "B"	GROUP "C"
1	25.51	48.57	18.43
2	42.40	27.13	57.49
3	18.12	22.97	56.20
4	41.51	54.95	19.36
5	46.69	55.83	19.63
6	34.27	10.32	79.02
7	5.37	5.37	77.48

ALLOWABLE PILE LOADS

W/o wave	60KC	29KT
W/ wave	80KC	38.7KT

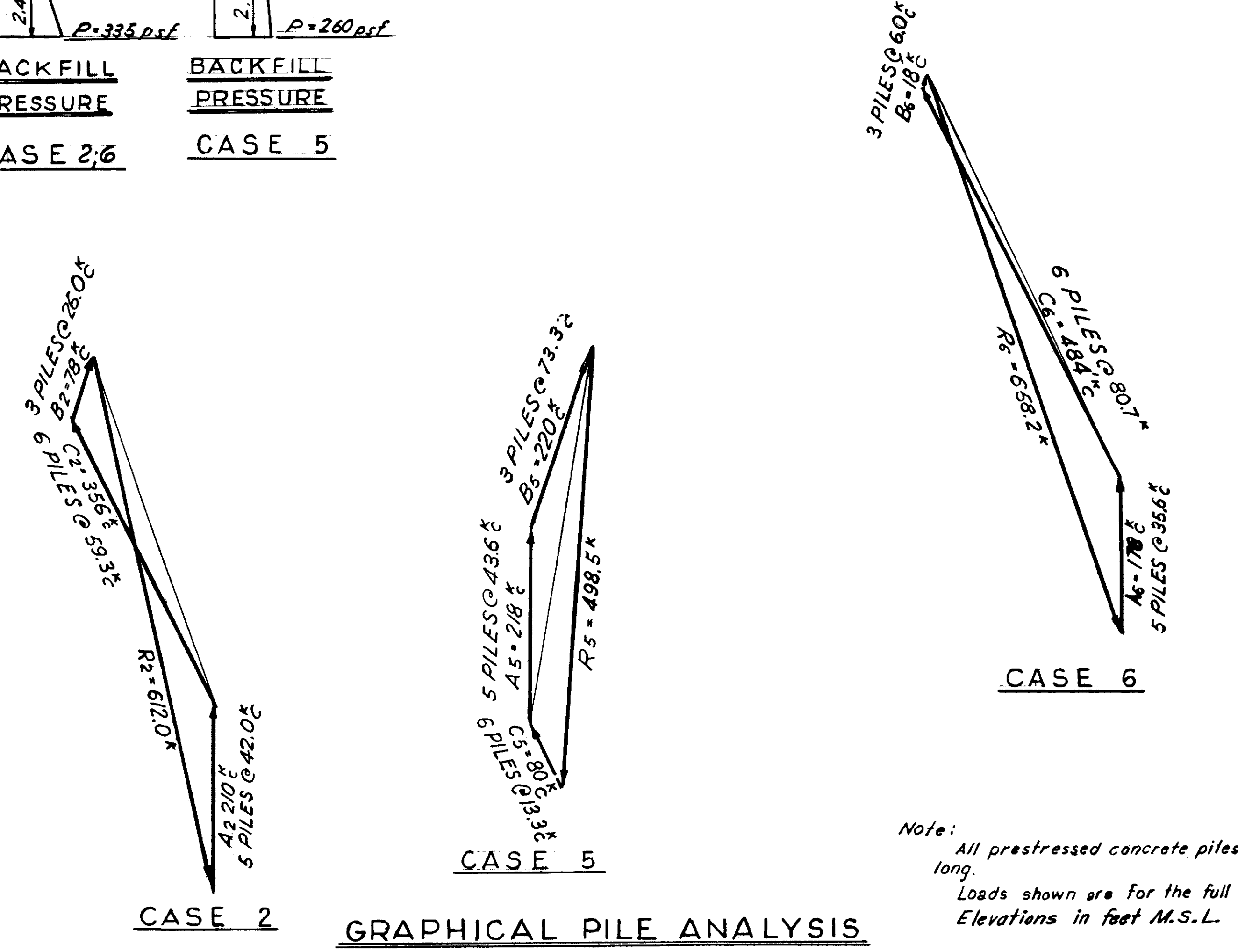




Minimum steel required

MOMENT AND REINFORCEMENT DIAGRAM

SCALES

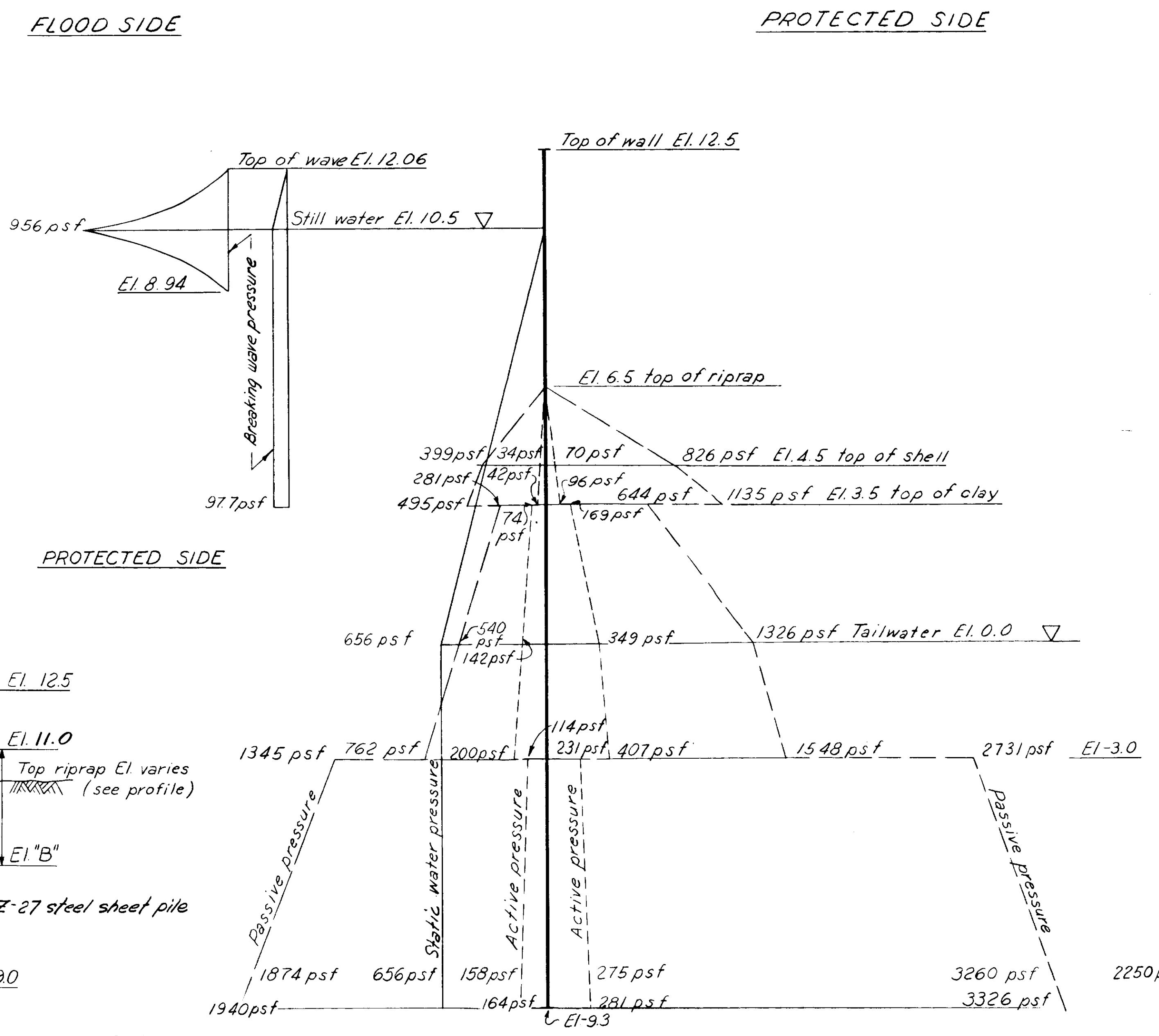


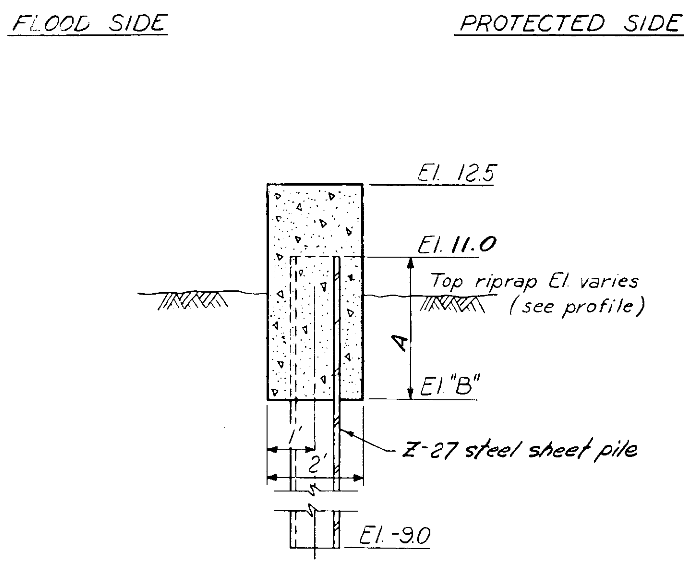
GRAPHICAL PILE ANALYSIS BY CULMAN METHOD

SCALE

Note:
All prestressed concrete piles are 12"x12"x 70' long.
Loads shown are for the full monolith length.
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
BAYOU PIQUANT DRAINAGE STRUCTURE
MONOLITH T-4
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624





COMPLETED I-WALL SECTION

Note: Sheet pile will be initially 2' higher than shown.

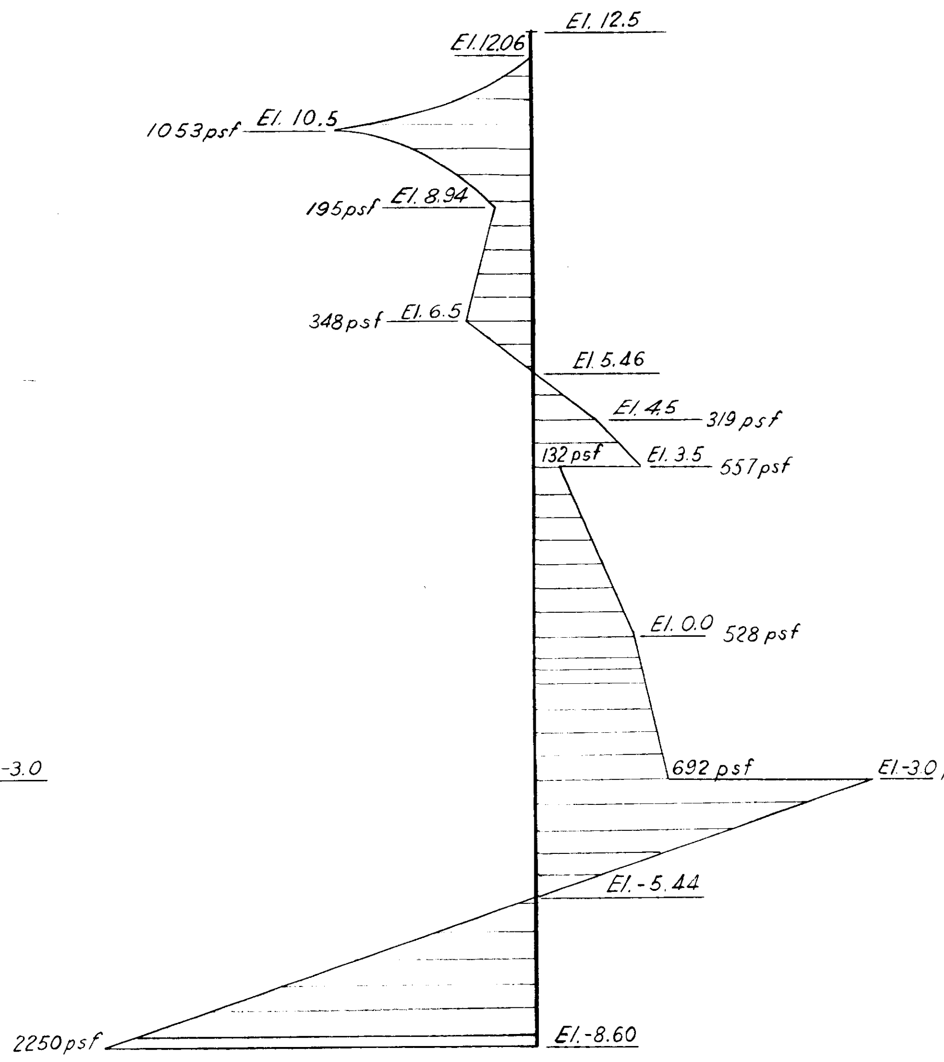
Scale 2 0 2 4 Feet

MONOLITH AND SHEET PILE El		
A	El. "B"	Mono. Nos.
3.0	8.0	I-1 & I-22
5.0	6.0	I-2 & I-21
6.0	5.0	I-3 & I-20

PRESSURE DIAGRAM (F.S.=1.25)

(S) CASE

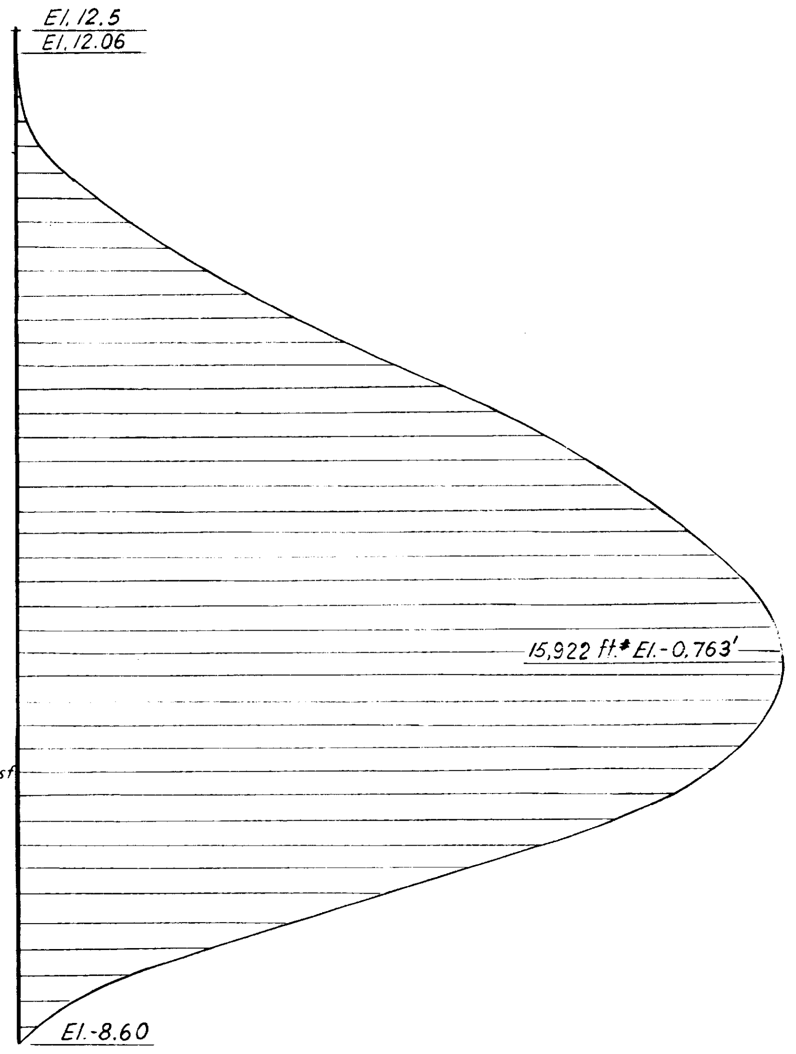
Scales 2 0 2 4 Feet; 500 0 500 1000 psf



NET PRESSURE DIAGRAM (F.S.=1.25)

(S) CASE

Scales 2 0 2 4 Feet; 500 0 500 1000 psf



MOMENT DIAGRAM (F.S.=1.25)

(S) CASE

MAX. DEFLECTION = 0.619"

Scales 2 0 2 4 Feet; 2000 0 2000 2000 Ft#

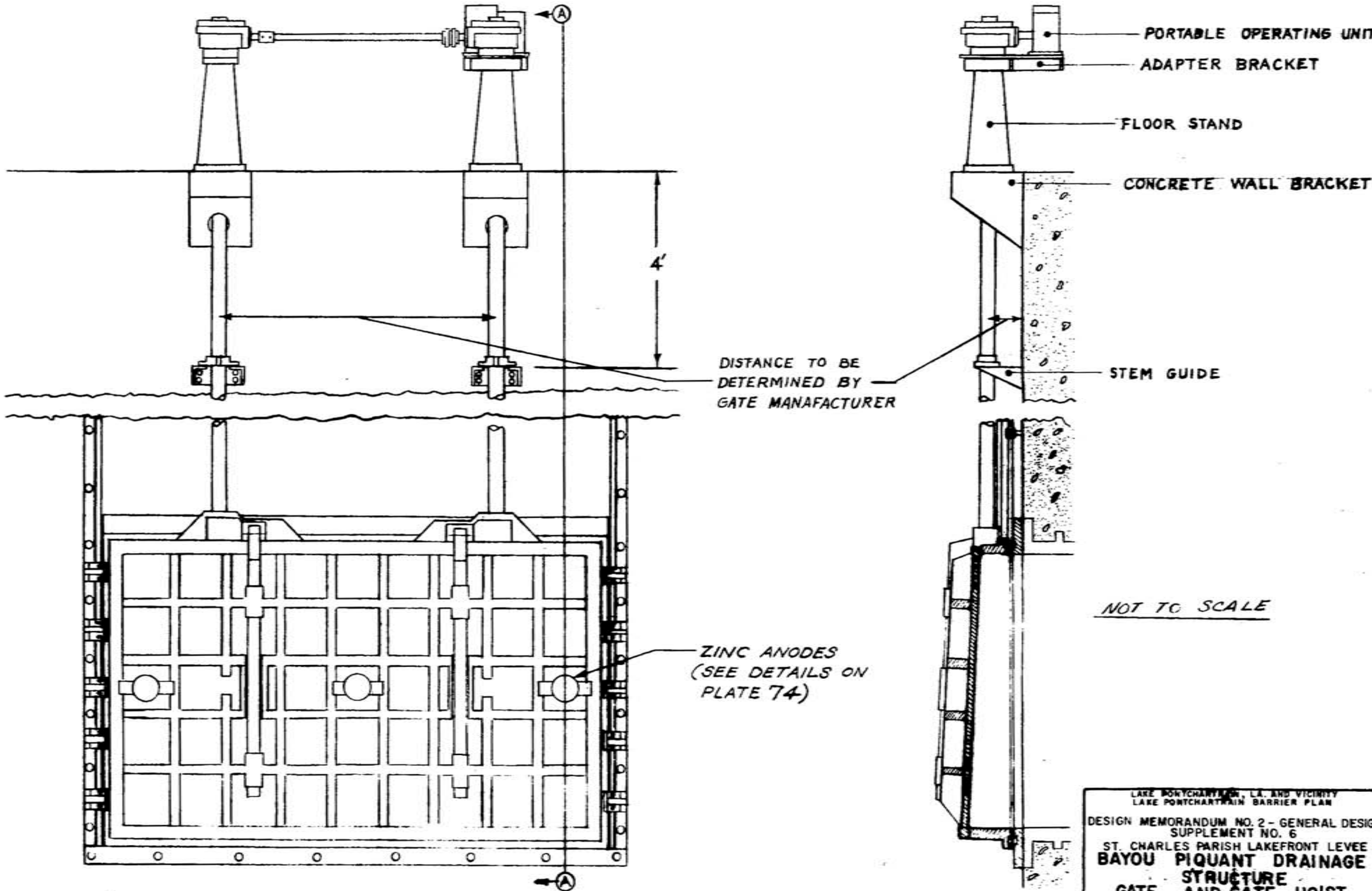
NOTE:
Elevations in feet M.S.L.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT
DRAINAGE STRUCTURE
I-WALL DESIGN ANALYSIS

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

SEPT. 1969 FILE NO. H-2-24624



9'×5' COMBINATION FLAP AND VERTICAL LIFT GATE

SECTION A-A

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

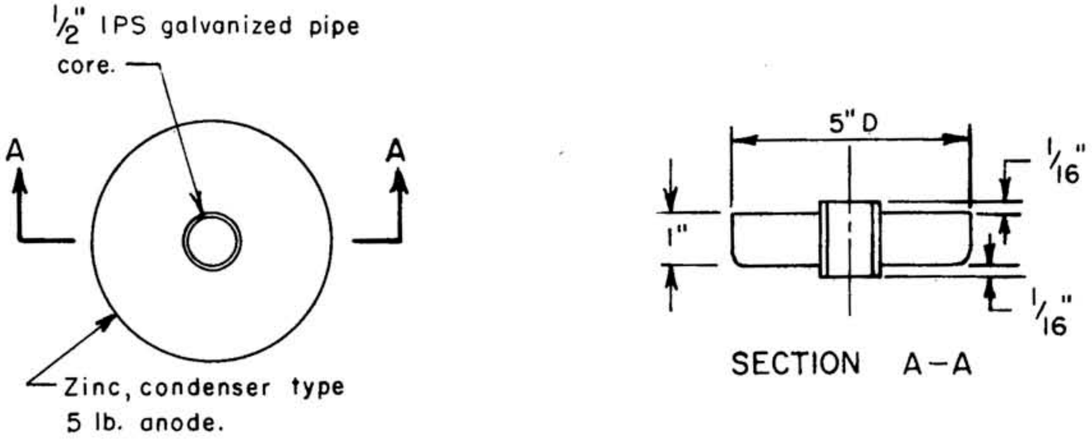
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT DRAINAGE STRUCTURE
GATE AND GATE HOIST

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

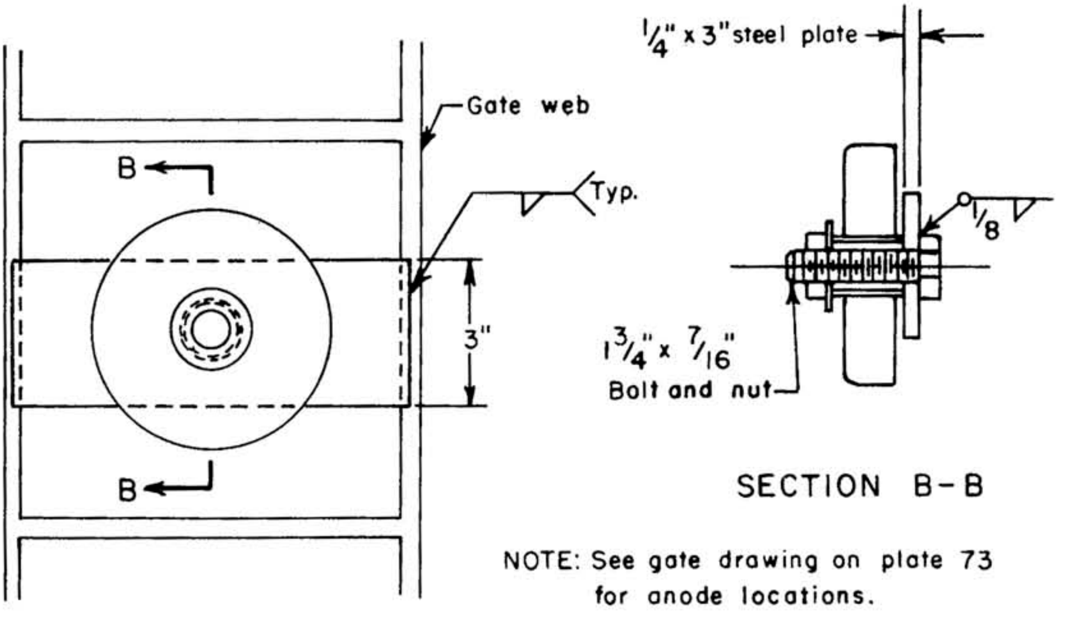
SEPT. 1969 FILE NO. H-2-24624

PLATE 73



ANODE

NO SCALE



NOTE: See gate drawing on plate 73 for anode locations.

ANODE MOUNTING

NO SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

BAYOU PIQUANT DRAINAGE STRUCTURE — ANODE DETAILS

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

SEPT. 1969 FILE NO. H-2-24624

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

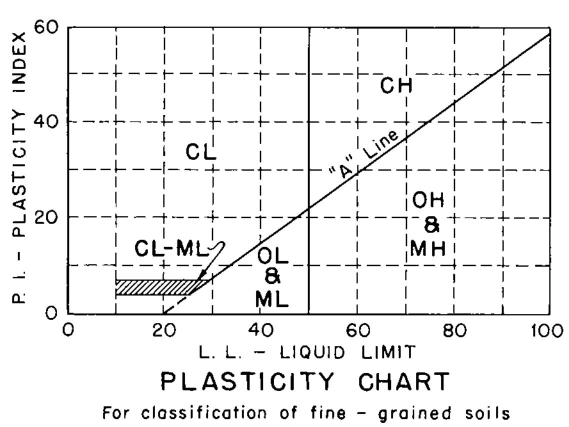
DESCRIPTIVE SYMBOLS

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 ($1\frac{3}{8}$" 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	1ST. 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

APPENDIX A

HYDRAULIC DESIGN AND ANALYSIS
INTERIOR DRAINAGE

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

APPENDIX A

HYDRAULIC DESIGN AND ANALYSIS
INTERIOR DRAINAGE

1. General. The plan of improvement for St. Charles Parish consists of a levee to be constructed along the St. Charles Parish lakefront extending from the Bonnet Carre' Spillway east guide levee to the St. Charles Parish-Jefferson Parish boundary, plus an interior drainage structure to be located near Bayou Piquant. The drainage plan consists of a landside ditch, paralleling the levee, which will move intercepted flows to the drainage structure. The drainage structure will be a wall-type structure with eight gated openings measuring 9 feet by 5 feet.

2. Drainage area. The drainage area that will be inclosed on completion of the St. Charles Parish lakefront levee is approximately 51 square miles. This area is bounded on the west by the Bonnet Carre' Spillway, on the south by the Mississippi River, on the east by the St. Charles Parish-Jefferson Parish boundary, and on the north by Lake Pontchartrain. The topography of the area is typical of the Mississippi River delta. The land slopes away from the alluvial ridge of the Mississippi River to adjacent backswamp areas. Next to the river, natural ground is about elevation 10, and the ground slopes gradually down to about elevation 2 a mile distant from the river. Natural ground elevations average about 0.5 over the remainder of the drainage area.

3. Hydraulic computations. The Manning formula with a roughness coefficient of 0.030 was used to determine friction losses in earthen channels. In the derivation of the rating curve for the drainage structure, an entrance loss of 50 percent of the difference in velocity heads was used. Flows through the structure with submerged outlet and operating under various heads were computed by use of the formula $Q = CA(2gh)^{0.50}$ where

Q = discharge in cubic feet per second (c.f.s.)
C = coefficient of discharge
A = clear structure area in square feet
g = acceleration due to gravity
h = difference in upstream and downstream water levels

The value of "C" was computed to be 0.82. The rating curve derived with the use of the foregoing equation is shown on plate A-1.

4. Infiltration and runoff. Runoff data for the area are not available. In the preparation of synthetic inflows for all storms, an infiltration rate of 0.10 inch per hour was used for the entire area.

5. Synthetic inflow hydrographs. Inflow hydrographs for the design storms for the drainage structure and stilling basin were synthesized with the use of values contained in the U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," published in 1961. Curves showing rainfall-duration-frequencies and distribution of rainfall are shown on plate A-1. Inflow and outflow hydrographs were computed for the area and are shown on plate A-2.

6. Drainage structure.

a. The drainage structure was designed to have sufficient capacity to dispose of inflows from high intensity storms and normal rainfalls without excessive overflow of lands and to provide for prompt evacuation of impounded runoff during periods of normal tides. A storm with a frequency of 25 years and a duration of 24 hours was assumed to occur coincident with a Lake Pontchartrain stage of 0.50. Based on the preceding assumptions, the drainage structure was designed to dispose of inflows from the design storm in accordance with the following criteria:

(1) The sump pool elevation will not exceed 1.50.

(2) Storage equivalent to 3 inches of runoff below the peak sump stage for the structure design storm will be available within 24 hours after the cessation of runoff. This volume of storage is equivalent to about 75 percent of runoff from the 1-year 24-hour storm. Inflow, outflow, and sump pool hydrographs are shown on plate A-2. The storage curve for the sump pool is shown on plate A-3. Additional pertinent data are provided in table A-1.

b. The approach channel will be approximately 1,000 feet long extending from the existing channel of Bayou Piquant to the concrete paved portion of the intake. The invert elevation of the channel will be at -6.0 feet with a bottom width of 100 feet and channel side slopes of 1 on 4. Although velocities in the approach channel are low, a 10-foot section adjacent to the concrete intake will be riprapped to protect the structure from turbulence and eddy conditions.

c. The intake section will have a paved invert at elevation -5.5. The maximum average velocity for the structure design discharge of 2,310 c.f.s. will be about 2.4 feet per second (f.p.s.) at the beginning of the pavement.

d. The eight gates in the structure will be 9 feet wide and 5 feet high and have a sill elevation of -5.5 feet. The maximum average velocity for the structure design discharge will be about 6.5 f.p.s. The operating unit for raising and lowering the gates will be placed at elevation 12.5.

e. For an occurrence of the Standard Project Hurricane along Track C, transposed and rotated to produce critical low water elevations in Lake Pontchartrain, the elevation of -7.0 can be experienced in the vicinity of the drainage structure (see tidal hydrograph, plate A-4). The decline to this extreme low level and subsequent return to normal tidal level would be completed in about 10 hours. Detail flood routings performed in connection with the design of other projects in areas with considerable available sump storage indicate that a high intensity storm of any frequency produces about the same peak sump elevation for a wide range of outlet conditions. Accordingly, the stilling basin has been designed for a discharge of 2,850 c.f.s. with elevations of -7.0 in Lake Pontchartrain and 0.0 at the tailwater of the structure, and with the sump pool at elevation 1.45 (the peak sump elevation produced by the 25-year 24-hour storm occurring with the average water surface elevation of 0.5 on the lakeside of the structure).

f. The outlet channel will extend for a distance of about 1,000 feet to its intersection with the existing channel of Bayou Piquant. The channel will have a bottom width of 100 feet with an invert elevation of -6.0 and side slopes of 1 on 4. The section adjacent to the end sill will be protected with riprap for a distance of about 20 feet. For a discharge of 2,850 c.f.s., this section will limit the average maximum velocity to 4.0 f.p.s. at the downstream end of the riprap. The outlet channel terminates in the existing Bayou Piquant about 1,000 feet below the structure.

g. To reduce the effective wave heights on the drainage structure and, therefore, reduce the design loads, breakwaters will be constructed along both banks of the outlet channel. The breakwaters, which will be protected from erosion by riprap, will be constructed to a net grade of 2.0 with a crown width of 20 feet and side slopes of 1 vertical on 4.5 horizontal. Further, the breakwaters will extend from the lakeside slope of the levee for approximately 200 and 700 feet along the right and left descending banks, respectively, of the drainage structure outlet channel.

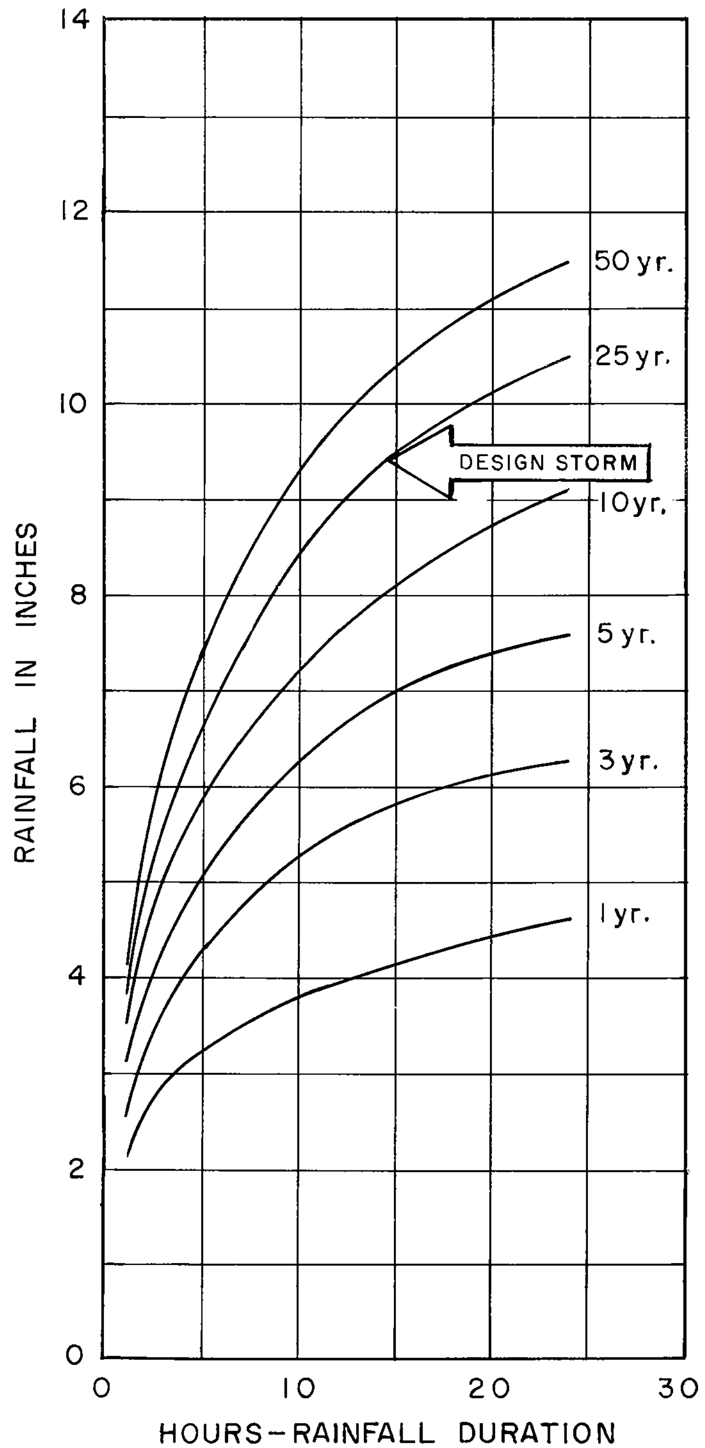
7. Landside drainage ditch. During periods of intensive rainfall, extensive overbank areas are available to convey runoff to the drainage structure and supplement flows in the landside drainage ditch. With the average low tide elevation of 0.2 in Lake Pontchartrain, the drainage ditch has been designed to convey low and moderate flows which are essentially confined by the alluvial ridges or spoil banks of the tributary streams. Design flows from those areas which will be served by gravity drainage were derived with the use of the equation $Q=45M^{0.833}$ where M is the drainage area in square miles. This equation was derived by the U. S. Department of Agriculture, Soil Conservation Service for the Mississippi Delta. Drainage systems based on this criterion have proven adequate over a period of years. Data pertinent to the drainage ditch are tabulated below. All side slopes are 1 vertical on 3 horizontal.

Approximate levee sta.	Drainage area(sq.mi.)	Design discharge (c.f.s.)	Bottom width(ft.)	Depth of flow (ft.)
282+00				
	22.5	600	75.0	6.8
126+00				
	22.0	1,600	75.0	6.8
94+00				
	6.5	220	12.0	5.8
2+00				

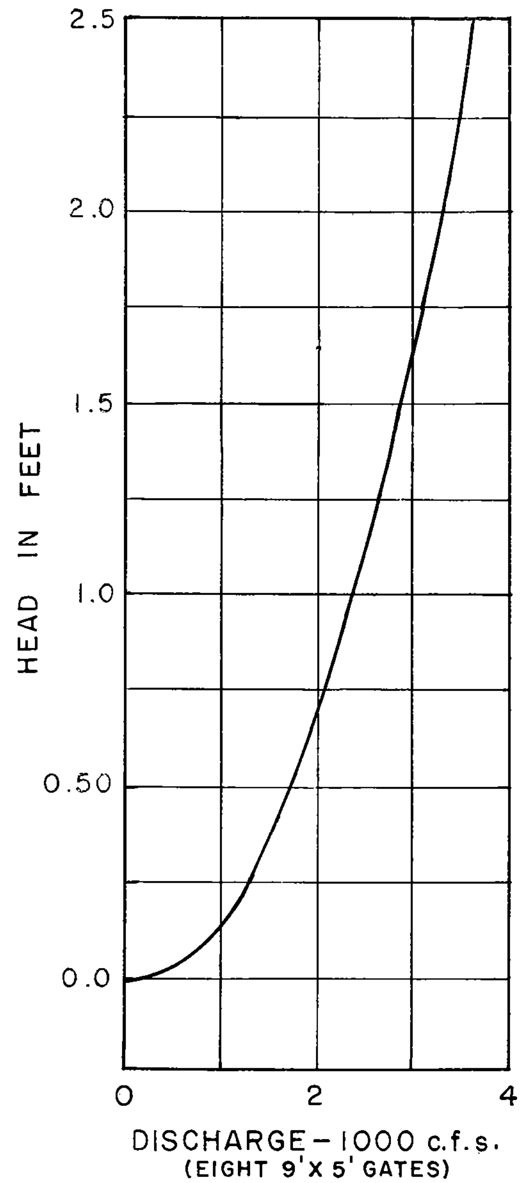
8. Ponding area. The low, poorly drained sump area will remain subject to flooding due to interior runoff after completion of the Federal project. This area, comprising about 12,000 acres, is generally below elevation 1.0. Flooding of this area will occur either from moderate rainfall with the drainage structure closed or from intense local storms with the drainage structure open. Although this area will be benefited by reason of reduced stages from hurricane tides, periodic flooding in the future will require that it be kept free from encroachment. In the future, if the ponding area is impaired, substitute storage capacity or equivalent pumping capacity must be provided by local interests without cost to the United States.

TABLE A-1
PERTINENT DATA

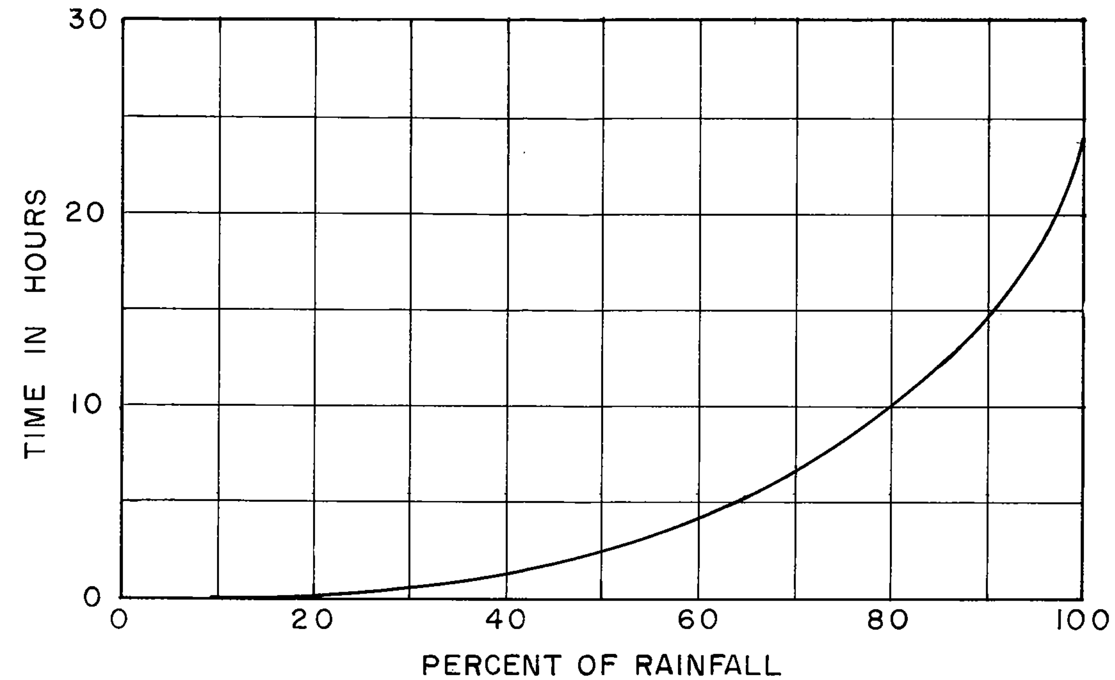
Item	
Maximum rainfall	10.5 inches
Rainfall excess	8.1 inches
Maximum hourly rainfall	3.8 inches
Maximum inflow (structure design storm)	7,910 c.f.s.
Maximum outflow (structure)design storm)	2,310 c.f.s.
Drainage area	51 sq.mi.
Average stage, Lake Pontchartrain	0.5 ft.m.s.l.
Head on structure	0.95 ft.
Structure invert elevation	-5.5 ft.m.s.l.
Maximum stage, Lake Pontchartrain	10.5 ft.m.s.l.
Minimum stage, Lake Pontchartrain	-7.0 ft.m.s.l.
Maximum sump stage	1.45 ft.m.s.l.
Minimum sump stage	-1.58 ft.m.s.l.
Storage below peak sump stage available 24 hours after cessation of runoff	3.0 inches
Duration of ponding above elevation 0.5	250 hours



FREQUENCY CURVES



RATING CURVE



DISTRIBUTION OF RAINFALL

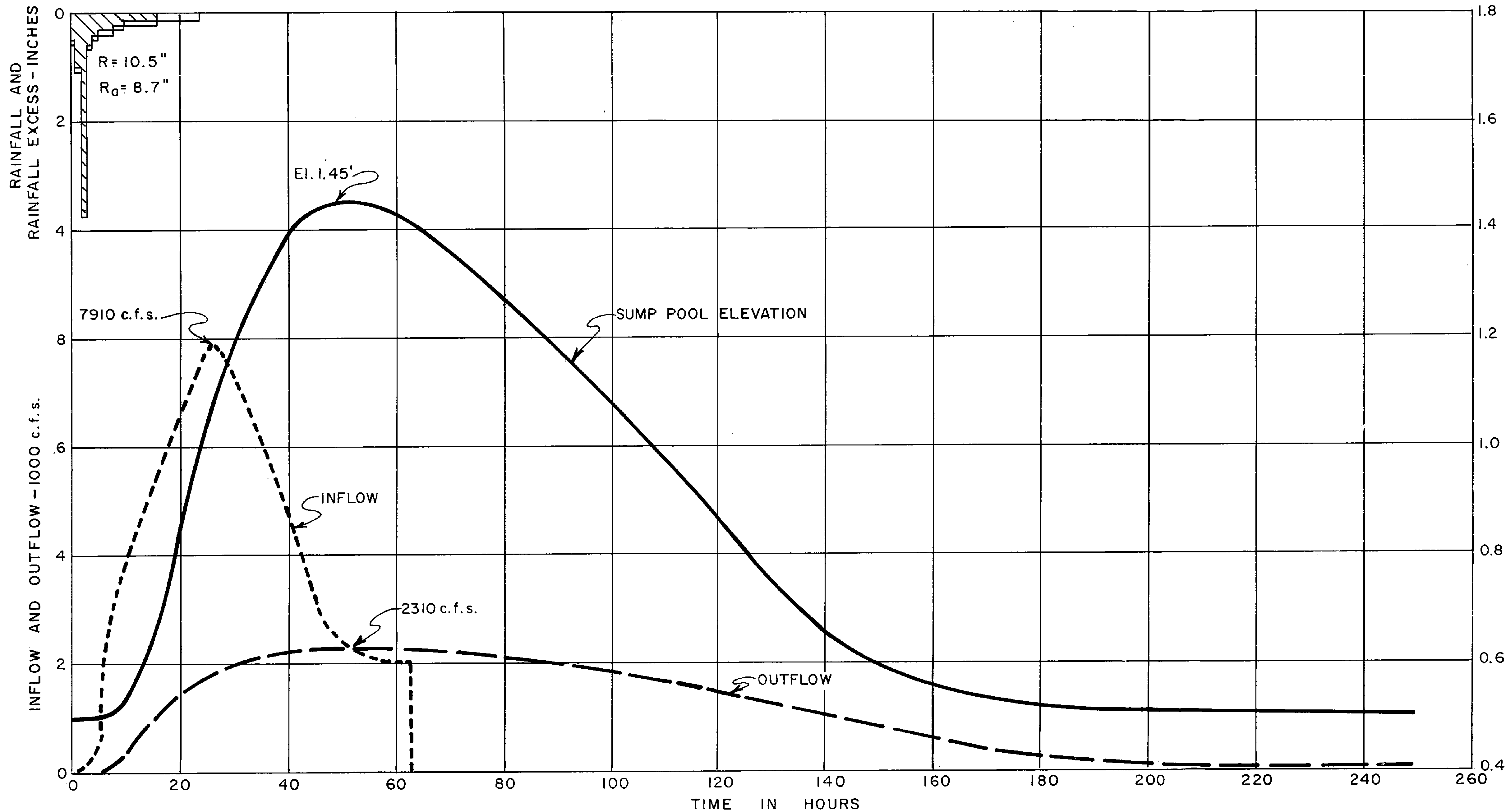
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

HYDRAULIC DATA

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

SEPT. 1969 FILE NO. H-2-24624



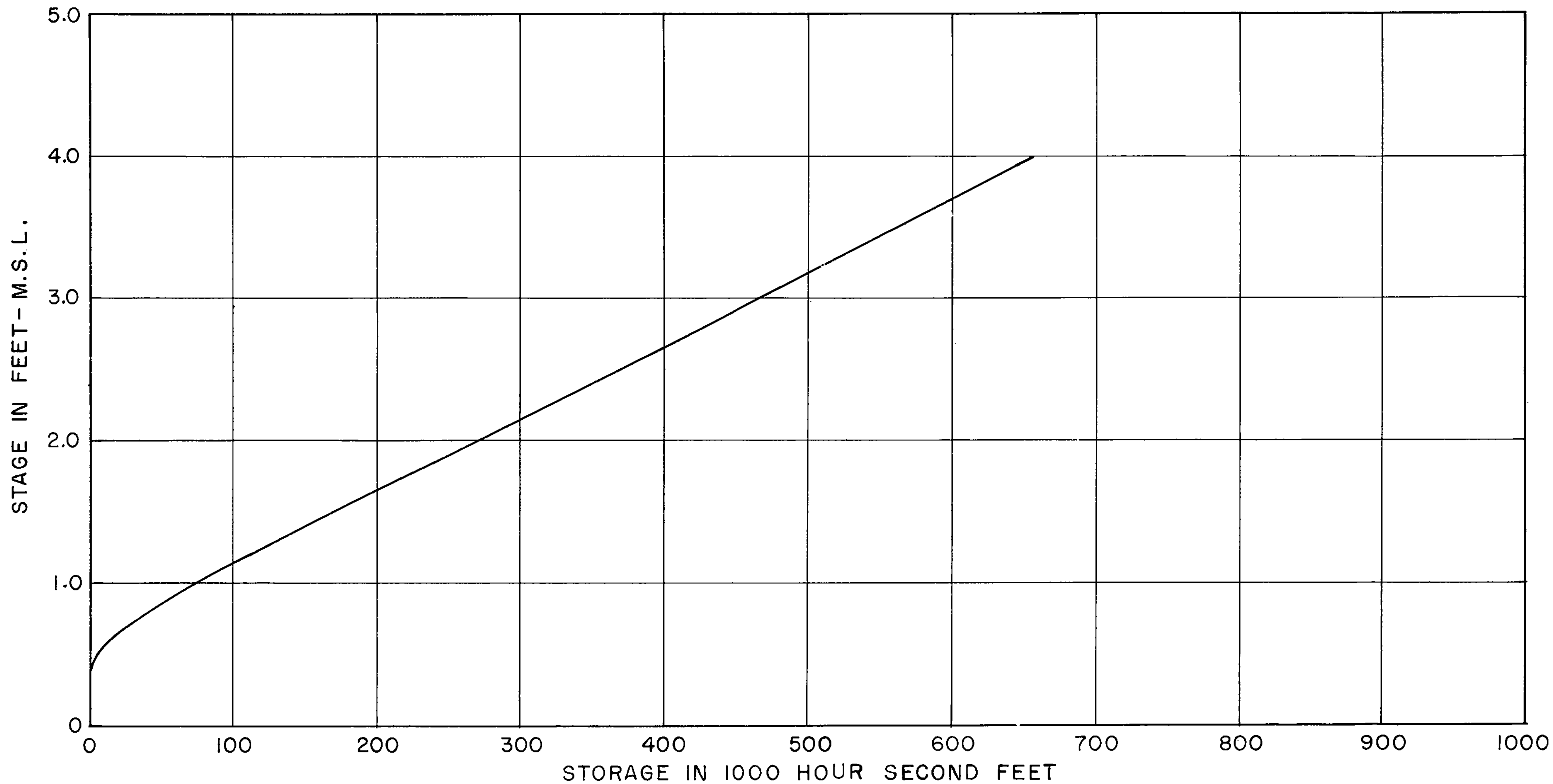
DESIGN STORM = 24 HOUR - 25 YEAR

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

DRAINAGE STRUCTURE DESIGN DATA

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

SEPT. 1969 FILE NO. H-2-24624

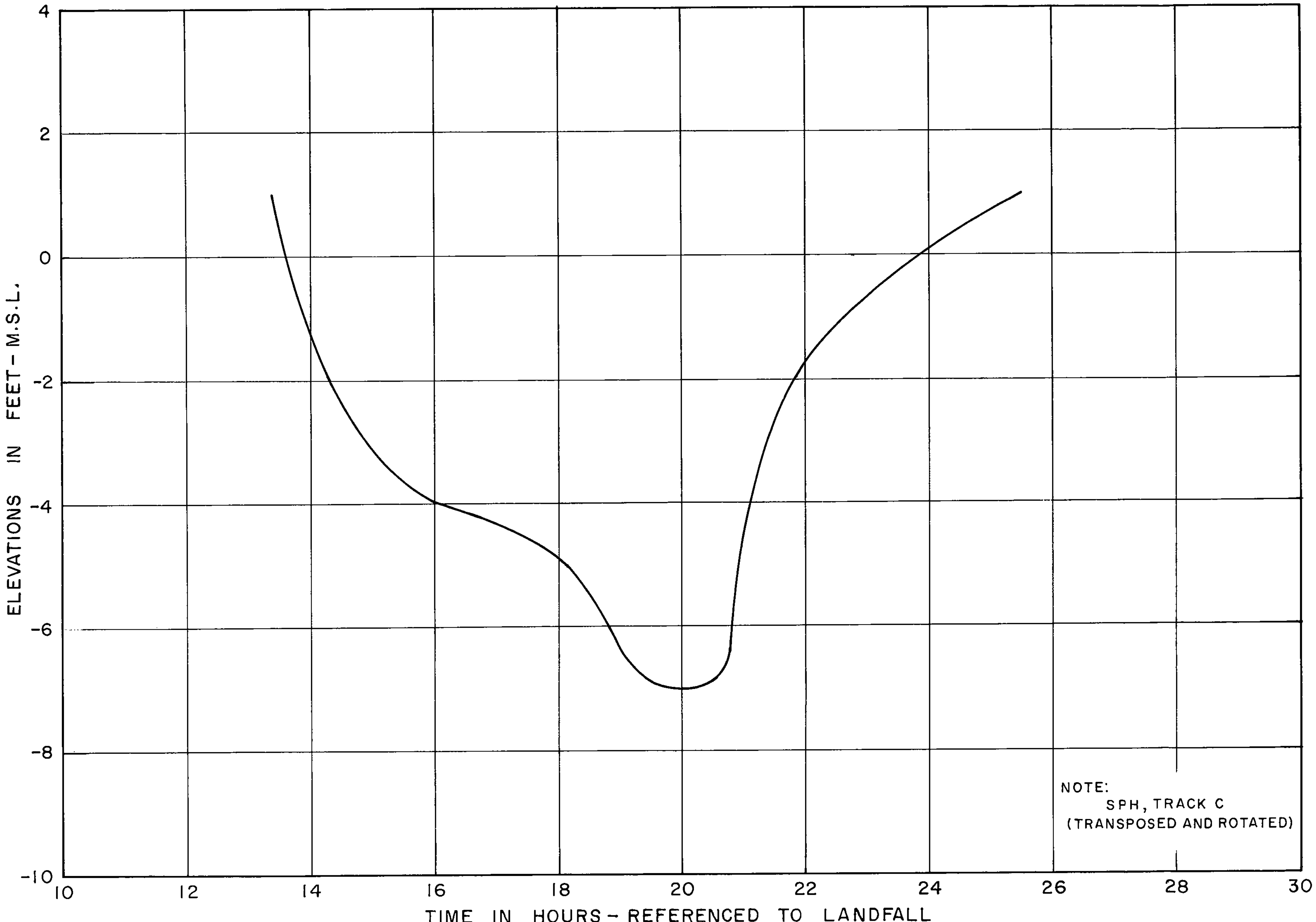


STORAGE CURVE

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

STORAGE CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624



LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE

LAKESIDE STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SEPT. 1969 FILE NO. H-2-24624

APPENDIX B

CORRESPONDENCE RELATIVE TO COORDINATION WITH OTHER AGENCIES

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 on 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 for 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,

THOMAS J. BOWEN
Colonel, CE
District Engineer

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)

Copies furnished: w/incl
U. S. Fish & Wildlife Service
315 Peeples-Newman Bldg.
Vicksburg, Miss. 39180

La. Wild Life & Fisheries Commission
400 Royal Street
New Orleans, La. 70130

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

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 on 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:

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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,

THOMAS J. BOWEN
Colonel, CE
District Engineer

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)

CF:
La. State Bd of Health
P. O. Box 60630
N.O., La. 70160

La. Stream Control Comm
P.O. Drawer FC
Baton Rouge, La. 70803

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,

John P. Moore
for WILLIAM C. GALEGAR
Regional Director

cc: Louisiana Stream Control Commission

LMNED-PP 26 June 1968

Mr. William C. Galegar, Regional Director
U. S. Department of the Interior
Federal Water Pollution Control Administration
Third Floor--1402 Elm Street
Dallas, Texas 75202

Dear Mr. Galegar:

This is in reply to your letter dated 15 May 1968 relative to the general design memorandum for the Lake Pontchartrain Barrier Plan feature of the "Lake Pontchartrain, Louisiana and Vicinity" project.

Our proposed plan for implementation of water pollution control measures is as follows:

a. Provisions relative to water quality degradation during construction, minimizing the accidental spillage of petroleum products or other harmful materials, will be incorporated into the construction plans and specifications.

b. With respect to construction contractors providing and maintaining sanitation facilities that will adequately treat domestic wastes, the following provisions, as appropriate, will be incorporated into the construction plans and specifications:

(1) For construction sites accessible by road, collection of domestic waste will be by means of portable containment toilets or similar facilities and wastes deposited in a municipal sewerage system which will provide effective treatment. Location of municipal plant will be subject to approval of the Government and will generally follow the approved list published on 6 February 1968 by your agency.

(2) For hydraulic dredge operations, all domestic waste material will be collected and periodically discharged into the spoil area through the discharge line or otherwise buried in the spoil area.

(3) For small construction sites not accessible by land and a crew not exceeding 25 personnel, domestic waste will be disposed of by use of a Macerator-chlorinator unit, or similar equipment.

c. The Seabrook Lock will be operated to provide a desirable salinity regimen in Lake Pontchartrain to the end that deleterious alterations in lake ecology will be avoided. The plan of operation has been developed with the advice of the State and Federal fish and wildlife agencies. Further, our current data collection program includes extensive coverage of Lake Pontchartrain salinities. Upon completion of the lock we shall expand this coverage, if necessary, to permit an adequate evaluation of the effects of lock operation on the salinity regimen, and a determination as to the extent that the lock operation is producing the salinity regimen indicated by model test data.

Your cooperation in providing comments on the project is very much appreciated.

Sincerely yours,

THOMAS J. BOWEN
Colonel, CE
District Engineer

LEON GARY
DIRECTOR

STATE OF LOUISIANA
DEPARTMENT OF PUBLIC WORKS
BATON ROUGE, LA. 70804

July 30, 1969

Mr. Jerome C. Baehr, Chief
Engineering Division
U. S. Army, Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNED - PP
May 27, 1969
St. Charles Parish
Lakefront Levee

Dear Mr. Baehr:

This office is in receipt of your letter of May 27, 1969, together with plates 1-L, 2-L, 3-L & 4-L, Map file No. H-2 - 24624 relative to the hurricane protection plan for St. Charles Parish on Lake Pontchartrain.

We have reviewed the general provisions of the proposed plan and recommend the following:

1) The proposed collector ditch be relocated a minimum of 1000' landward of the levee centerline.

2) That an additional drainage structure be constructed in the lakefront levee about half way between the proposed structure near Bayou Piquant and the Bonnet Carre' Floodway.

The proposed levee centerline is satisfactory as shown. We appreciate the opportunity of commenting on your proposed design.

Yours very truly,

HU B. MYERS
Chief Engineer

/jjw

C O P Y

LMNED-PP

7 August 1969

Mr. Hu B. Myers, Chief Engineer
State of Louisiana
Department of Public Works
Baton Rouge, Louisiana 70804

Dear Mr. Myers:

Thank you for your 30 July 1969 letter furnishing recommendations relative to the general plan for the St. Charles Parish Lakefront Levee feature of the Lake Pontchartrain, Louisiana and Vicinity hurricane protection project.

We have reviewed your recommendations and propose to relocate the collector ditch approximately 1000 feet landward of the levee centerline. However, since our detailed hydraulic studies indicate that the proposed Bayou Piquant Drainage Structure (eight 9' by 5' combination flap and vertical lift gates) will have sufficient capacity to dispose of inflows from high intensity storms without excessive overflow of lands and will provide for prompt evacuation of impounded runoff following periods of gate closure, an additional drainage structure is not required.

With respect to providing additional interior drainage capability for future development, the conditions of local cooperation for the referenced project state, inter alia, that local interests will, without cost to the United States, provide all interior drainage and pumping plants required for reclamation and development of the protected areas.

Your cooperation in providing comments on this project is very much appreciated.

Sincerely yours,

/s/ Jerome C. Baehr
JEROME C. BAEHR
Chief, Engineering Division

APPENDIX C

STRUCTURAL DESIGN CALCULATIONS

LAKE PONTCHARTRAIN, LA. & VICINITY

LAKE PONTCHARTRAIN BARRIER PLAN

G.D.M. No. 2, SUPPLEMENT No. 6

ST. CHARLES PARISH LAKEFRONT LEVEE

DRAINAGE STRUCTURE

WAVE LOADING

REF: Shore Protection, Planning & Design – Tech. Report No. 4, 3rd Ed., 1966, by U.S. Army Coastal Engineering Research Center, Corps of Engineers

HYDRAULICS DATA FOR MAX. DESIGN WAVE

FETCH LENGTH	F	= 5 MILES
WINDSPEED	U	= 87 M.P.H.
STILLWATER SURGE EL.	SWL	= 10.5' M.S.L.
AVE. DEPTH OF FETCH	d_o	= 22.6'
WAVE PERIOD	T	= 7.10 SEC.
DEEP WATER WAVE LENGTH	L_o	= 258.10'
DEEP WATER WAVE HEIGHT	H_o	= 8.21'
AVE. OF HIGHEST 10% OF ALL WAVES	H_{10}	= 9.86'
AVE. OF HIGHEST 1% OF ALL WAVES	H_1	= 12.96'
SIGNIFICANT WAVE HEIGHT	H_s	= 7.76'
DEEP WATER WAVE BREAKING DEPTH	d_b	= 10.07'
WAVE HEIGHT ON BREAKING	H_b	= 7.85'

ST. CHARLES PARISH

DRAINAGE STRUCTURE

REV. WAVE PRESSURES & LOADS:

BREAKWATER ELEV. +2.0 SEAWARD OF OUTFLOW CHANNEL

USE $d = 10.5 - 2.0 = 8.5'$

$H = \frac{1.837}{T}(d)^{3/2} = 6.4118'$ (FORM. 1-37 IN REF.)

$H = \frac{d}{1.28} = 6.6406'$ (FORM. 1-35 IN REF.)

FOR DESIGN, USE $H = 6.64'$ $d = 8.5'$ $L_0 = 258.1'$

$d/L_o = \frac{8.5}{258.1} = .03293297$

FROM TABLE D-1 IN REF., $d/L = .0749882255$ $L = 113.3511'$

$2\pi\, d/L = 0.4711649167$

$\sinh\left(\frac{2\pi d}{L}\right) = .4887922613$

$\cosh\left(\frac{2\pi d}{L}\right) = 1.113066878$

$\coth\left(\frac{2\pi d}{L}\right) = 2.277177783$

$h_o = \frac{\pi H^2}{L} \times \coth\left(\frac{2\pi d}{L}\right) = 2.78264'$

TOP OF STANDING WAVE CREST EL. $= 10.5 + H + h_o = 19.923'$ MSL

$P_1 = \frac{wH}{\cosh\left(\frac{2\pi d}{L}\right)} = 372.8437$ #/□' @ EL. +2.0 M.S.L.

$P_1 + 8.5 \times 62.5 = 904.0937$ #/□' @ EL. +2.0

@ EL. +12.5 $P_T = \frac{(19.923 - 12.5)904.0937}{(19.923 - 2.0)} = 374.447$ #/□'

@ EL. +10.5 $P_o = \frac{(19.923 - 10.5)904.0937}{17.923} = 475.332$ #/□'

@ EL -6.0 $P_2 = \frac{(19.923 + 6.0)904.0937}{17.923} - 62.5(10.5+6) = 276.384$ #/□'

@ EL -9.5 $P_B = \frac{(19.923 + 9.5)904.0937}{17.923} - 62.5(10.5+9.5) = 234.183$ #/□'

T-WALL CUT-OFF MONO. T-7, T-8 & T-9

(SAME AS ABOVE EXCEPT FOR LOWER LIMITS)

@ EL. -3.0 $P_3 = \frac{(19.923+3.0)904.0937}{17.923} - 62.5(10.5+3) = 312.560$ #/□'

@ EL. -5.5 $P_4 = \frac{(19.923+5.5)904.0937}{17.923} - 62.5(10.5+5.5) = 282.418$ #/□'

@ EL. -8.5 $P_5 = \frac{(19.923+8.5)904.0937}{17.923} - 62.5(10.5+8.5) = 246.247$ #/□'

ST. CHARLES PARISH

DRAINAGE STRUCTURE & T-WALL

REV. WAVE PRESSURES & LOADS (CONT.):

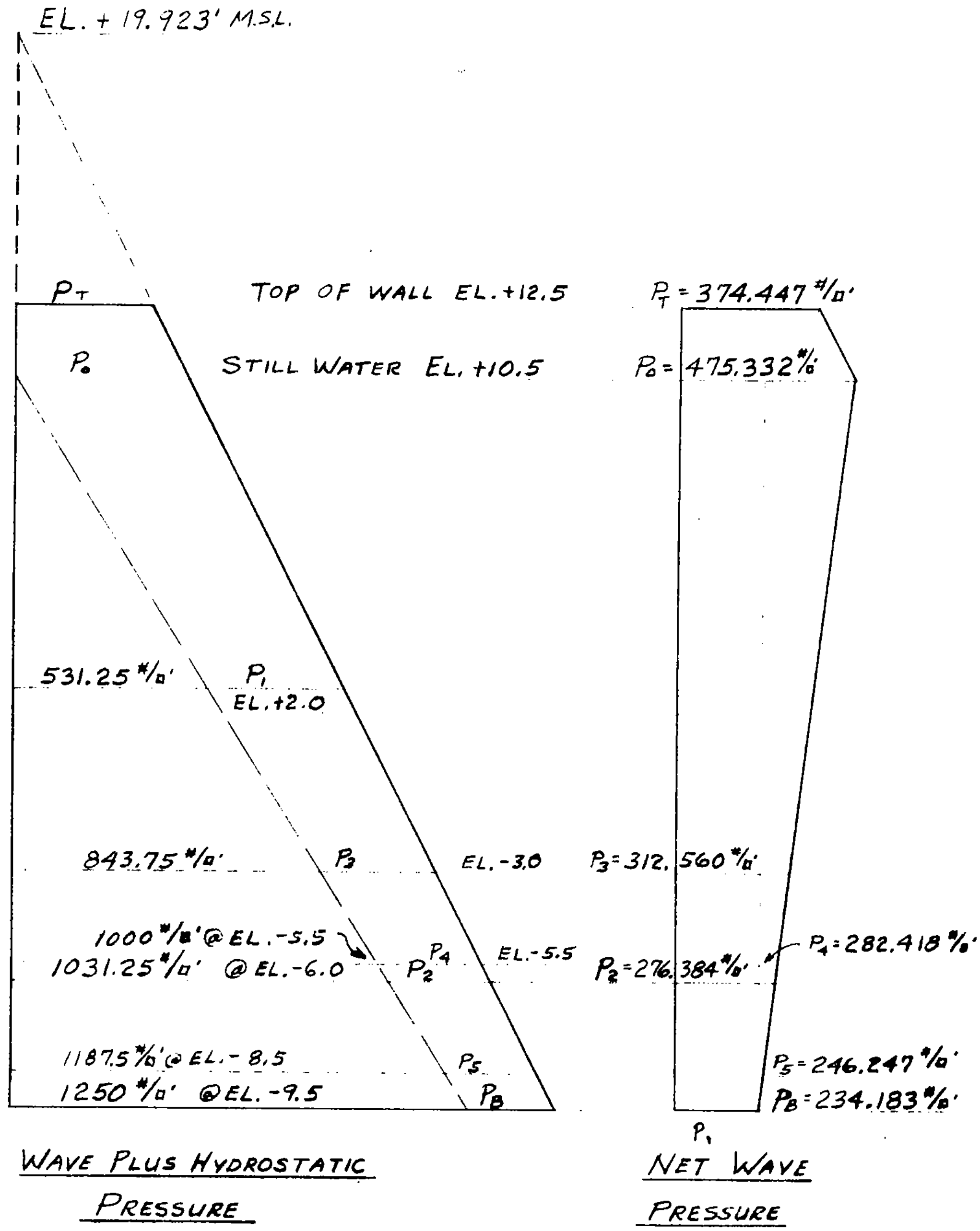


FIG. C-3

ST. CHARLES PARISH

DRAINAGE STRUCTURE & T-WALL

CKD: E.J.M.

REV. WAVE PRESSURES & LOADS (CONT.):

HORIZ. WAVE FORCES & MOM. ON STRUCT.

COMP.	H	ℓ	M
-374.447 x2	- 748.894	21.0	-15,726.774
-½ x 100.885 x2	- 100.885	62/3	-2084.9567
- 234.183 x 20	-4683.660	10.0	-46836.60
- ½ x 241.149 x 20	- 2411.490	40/3	-32,153.20
	-7,944.929 #/'		-96,801.530667 '#/'
TOTALS	- 7.9449 K/'		- 96.80153 'K/'
FOR MONO. 1 & 4 (L = 77/3)	-203.9198 K ✓		-2484.5726 'K ✓
FOR MONO. 2 & 3 (L = 73/3)	-193.3266 K		-2355.5039 'K

HORIZ. WAVE FORCES & MOM. ON T-WALL MONO. T-9

COMP	H	ℓ	M
-374.447 x 2 x 25	-18,722.35	20.0	-374,447.0
-½ x 100.885 x 2 x 25	-2,522.125	59/3	- 49,601.79
- 246.247 x 19 x 25	-116,967.325	9.5	-1,111,189.59
- ½ x 229.085 x 19 x 25	-54,407.6875	38/3	- 689,164.042
	-192,619.49 #		-2,224,402.42 '#
T-9 TOTALS	-192.6195 K		-2224.4024 'K

HORIZ. WAVE FORCES & MOM ON T-WALL MONO T-7 & T-8

COMP	H	ℓ	M
- 374.447 x 2 x 25		17.0	318,279.95
- ½ x 100.885 x 2 x 25		50/3	42,035.42
- 282.418 x 16 x 25		8.0	903,737.60
- ½ x 192.914 x 16 x 25		32/3	411,549.87
	-172,794.475 #		-1,675,602.83 '#
T-7 & T-8 TOTALS	-172.7945 K		-1,675.6028 'K

ST. CHARLES PARISH DRAINAGE STRUCT. REV. 4/19/69

WAVE LOADS ON MONO. T-4 W/BRIDGE CKD. BY: THJ 4-23-69

MAX. BROKEN WAVES 12' BASE x 39' LONG

STILL WATER EL. +10.5 $d_b = 4'$ $H_b = 3.125'$

TOP OF WALL EL. +12.5 $h_c = 0.7 H_b = 2.1875'$

TOP OF WAVE EL. $= 10.5 + h_c = 12.6875 > 12.5$ (TOP OF WALL)

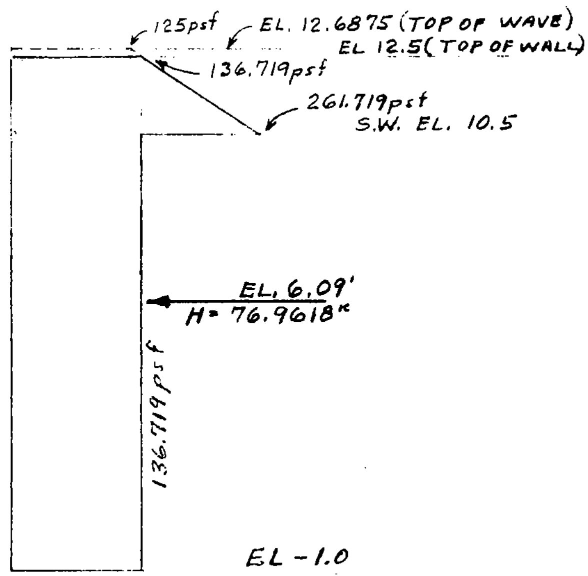
$P_m = \frac{W d_b}{2} = 62.5 \times 4 \times .5 = 125$ psf @ top of wave

$P_T = P_m + (12.6875 - 12.5) 62.5 = 136.719$ psf @ Top of wall

$d' = 2'$ (Top of wall El. - S.W. El.)

$P_W = P_T + Wd' = 136.719 + 62.5 \times 2 = 261.719$ psf. @ SW. El.

$P_S = W h_c = 62.5 \times 2.1875 = 136.719$ psf



COMP	H	ℓ	M
.5 × 2 × 125 × 39/1000	4.875	36.5/3	59.3125
13.5 × 136.719 × 39/1000	71.9826	6.75	485.8822
	76.8576K	(7.09')	545.1947 'K

FIG C-5

ST. CHARLES PARISH

DRAINAGE STRUCTURE

REV. WAVE LOADS ON I-WALL

MAX. BREAKING WAVE @ END OF WALL:

TOP OF WALL EL. +12.5

$d = 4.0'$ $d_b = 4.0'$ $H_b = 3.125'$ STILLWATER SURGE EL +10.5

$L_o = 258.1'$ USE $S = \frac{1}{15}$

$d/L_o = .015497869$

FROM APPENDIX D OF T.R. 4, $d/L_d = .05047642$ $L_d = 79.2449'$

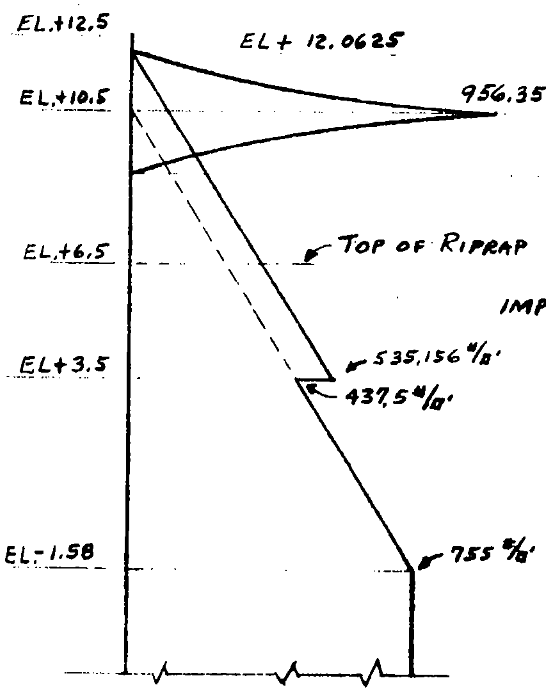
$D = d + L_d S = 4 + 79.2449\left(\frac{1}{15}\right) = 9.283'$

$D/L_o = .0359666596$ $D/L_D = .07863$ $L_D = 118.059'$

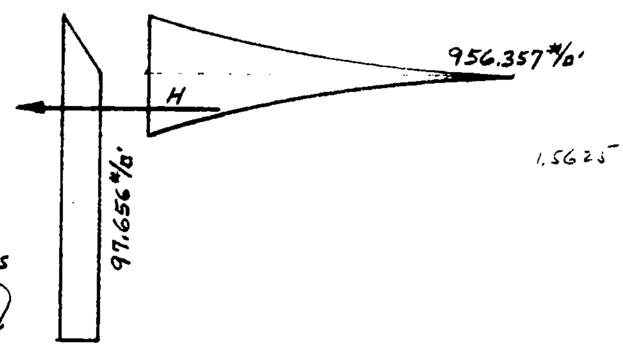
$P_m = \frac{101 H_b w}{L_D} \times \frac{d}{D}(D+d) = \frac{101 \times 3.125 \times 62.5 \times 4 \times 13.283}{118.059 \times 9.283} = 956.357\ \#/\square'$

TOP OF WAVE EL. $= 10.5 + \frac{H_b}{2} = 12.0625'$

$P_s = \frac{w H_b}{2} = 97.656\ \#/\square'$



WAVE & HYDROSTATIC PRESSURES



NET WAVE PRESSURES

$H = \frac{1}{3} \times 956.357 \times 3.125 + \frac{1}{2}(7 + 8.5625)\,97.656$

$H = \underline{1756.09\ \#/LF}$

$M_{3.5} = 996.21 \times 7 + \frac{1}{2} \times 1.5625 \times 97.656 \times (22.5625 \times \frac{1}{3}) +$
$+ 7 \times 97.656 \times 3.5 = 9{,}939.801\ '\#/LF$

H @ EL. $3.5 + \frac{M}{H} = \underline{9.16'}$

FIG. C-6

E. J. M. 4/24/61
Sh. 1 of 7
Ckd: RJG

LAKE PONTCHARTRAIN, LA. & VICINITY

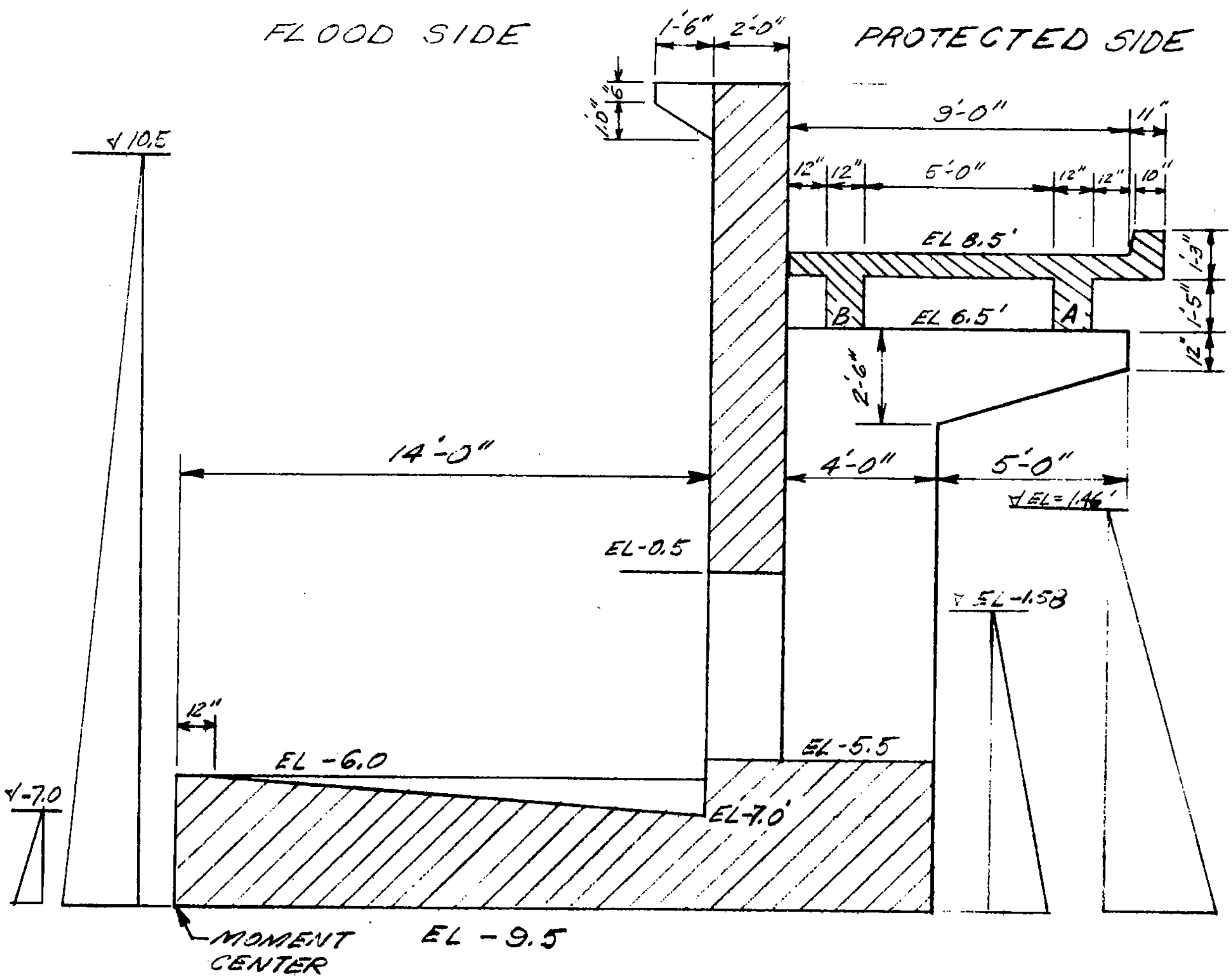
LAKE PONTCHARTRAIN BARRIER PLAN

GDM No 2, SUPPLEMENT No. 6

ST CHARLES PARISH LAKEFRONT LEVEE

DRAINAGE STRUCTURE

BRIDGE DESIGN



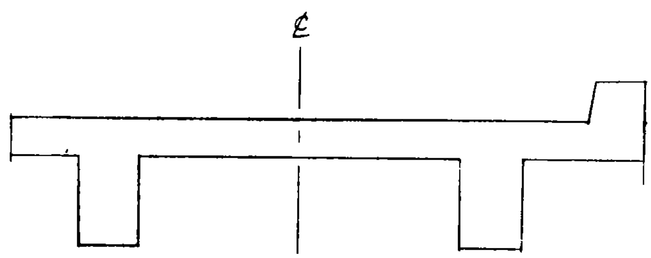
S10, S11, S12, S13

TYP. SECTION

FIG. C-7

ST. CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN – LOADING

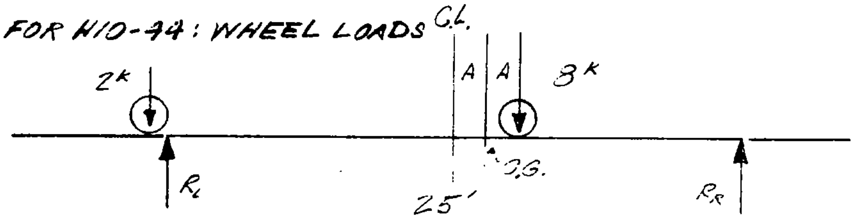


LOADINGS

BRIDGE DESIGNED FOR AASHO H10 SINGLE TRUCK LOAD
SPANS ARE SIMPLY SUPPORTED AND ARE 25' LONG

LIVE LOAD PER BEAM

FOR H10-44: WHEEL LOADS



MAXIMUM MOMENT OF VEHICLE

CG OF WHEEL LOADS = $\frac{8000(14)}{10000}$ = 11.2' FROM R_L

$A = \frac{14 - 11.2}{2} = 1.4'$

2000 # LOAD FALLS OFF SPAN WHEN C.G. 12.6' FROM R_L

$\therefore M_{MAX} = \frac{PL}{4}$

DEAD LOAD

BEAM A:

$W_D = 150\,[(1.25 \times 0.875 \times 1)_{CURB} + (1 \times 1.42 \times 1)_{BEAM} + (4.5 \times .53 \times 1)_{SLAB}] = 769$ PLF

$V_D = \frac{WL}{2} = \frac{769(25)}{2} = 9600$ #

$M_D = \frac{WL^2}{8} = \frac{769(25)^2}{8} = 60{,}000$ FT #

FIG C-8

ST CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN – T BEAM

DEAD LOAD:

FOR BEAM B

$$W_D = 150[(1\times 1.42\times 1)_{BEAM} + (4.5\times .58\times 1)_{SLAB}] = 603 \text{ PLF}$$

$$V_D = \frac{W_D L}{2} = \frac{(603)(25)}{2} = 7537 \ \#$$

$$M_D = \frac{wL^2}{8} = \frac{(603)(25)^2}{8} = 47,109 \text{ FT}\#$$

LIVE LOAD:

FOR BEAM A AND B:

MAXIMUM SHEAR OCCURS WITH 8^K WHEEL AT END.

$$V_L = 8000 + \frac{2000(25-14)}{25} = 8000 + 880 = 8880\#$$

$$M_L = \frac{PL}{4} = \frac{8000(25)}{4} = 50000 \text{ FT}\#$$

IMPACT LOAD:

USE 30% OF LIVE LOAD (S.S H.B. p 21)*

$$V_I = 8880(.30) = 2664\#$$

$$M_I = 50000(.3) = 15000 \ \#\text{FT}$$

DESIGN OF BEAM A & B:

USE BEAM A:

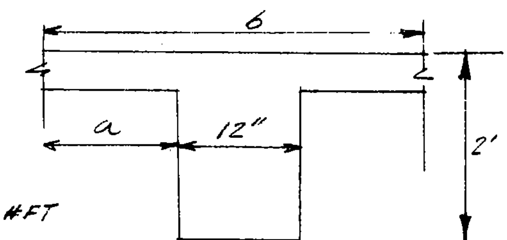
"T" BEAM REQUIREMENTS (906 ACI)

$b < \frac{1}{4}(25') = 6.25'$

$a < 8(7'') = 56'' \Rightarrow b = 10.3'$

$a < 1/2\,(5)' = 2.5'$

USE $b = 3'$



V_D = 9600#	M_D = 60000#FT
V_L = 8880#	M_L = 50000#FT
V_I = 2664#	M_I = 15000#FT
V_T = 21144#	M_T = 125000#FT

$b = 36''$

$t_s = 7''$

$f_y = 40$ KSI $\quad f_s = 20000$ PSI

$f'_c = 3$ KSI $\quad f_c = 1050$ PSI

$n = 9.2$

$d = 22'' \quad \frac{t}{d} = \frac{7}{22} = .318$

* STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES (AASHO)

ST CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN - T BEAM

CRITERIA FROM "REINFORCED CONCRETE DESIGN HANDBOOK-WORKING STRESS METHOD" EX.-3 p 15

1) FROM TABLE 3, FOR 20000/9.2/1050 AND $\frac{t}{d}$=.32
K = 152
FROM TABLE 4, FOR $b \times d$ = 36×22 READ F = 1.45

THEN:

M	= 125 KFT
KF = 152×1.45	= 220.4 KFT
M - KF	= -95.0 KFT

NO COMPRESSION STEEL REQUIRED WHEN (M-KF) IS NEGATIVE

2) FROM TABLE 3, FOR 20000 + $\frac{t}{d}$ = .32 READ a = 1.45
THEREFORE

$$A_s = \frac{M}{a d} = \frac{125}{1.45(22)} = 3.918 \square''$$

FOR STIRRUPS SEE P6

BRIDGE DESIGN - SLAB

$$M_{LIVE} = \left(\frac{S+2}{32}\right)P_{10}^{*} = \frac{5.58+2}{32}(8000) = 1895 \text{ FT\#}$$

$$M_{IMPACT} = .3(1895) = 569 \text{ FT\#}$$

$$M_{DEAD} = \frac{1}{10} wL^2 = \frac{[(1\times.58)(160)]\, 5.58^2}{10} = 338 \text{ FT\#}$$

M SLAB PER FT OF WIDTH 2802 FT#

DESIGN CRITERIA FROM R.C.D.H.

BOTTOM STEEL (TRANSVERSE)

$$A_s = \frac{M}{a d} = \frac{2.8}{1.44(5)} = .39 \square'' \text{ PER FT WIDTH}$$

MINIMUM STEEL:

$$A_{SMIN} = .002(12)(7) = .168 \square'' \text{ PER FT OF WIDTH}$$

BOTTOM STEEL (PARALLEL TO TRAFFIC)

"FOR MAIN REINFORCEMENT PERPENDICULAR TO TRAFFIC"*

$$\% = \frac{220}{\sqrt{S}} = \frac{220}{(5.58)^{1/2}} = 93.4\% > 67\%$$

$$\therefore A_s = .39(.67) = .261 \square'' \text{ PER FT. WIDTH}$$

REQUIRED BOTTOM STEEL IN SLAB.

PARALLEL TO TRAFFIC	= .261 □"/FT. WIDTH
PERPENDICTULAR TO TRAFFIC	= .39 □"/FT. WIDTH

* S.S.H.B (ASSHO) p.31, p 32

FIG C-10

ST CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN – CANTILEVER

TOP STEEL IN SLAB

CURB WT/FT WIDTH = (.88)(.67)(1)(.15) = .09K
SLAB OVERHANG = (.58)(1.83)(1)(.15) = .16K

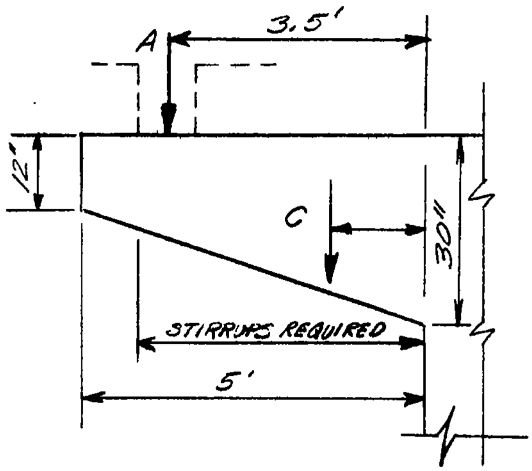
M DEAD = (.09)(1.46) + (.16)(1.0) = .29 KFT
LIVE LOAD = 85#/□'
M LIVE = (.085)(1)(1.0)(1.58) = .13 KFT

M DESIGN = .42 K FT

$$A_s = \frac{M}{ad} = \frac{.42}{1.44(5)} = .059□" < .168□" \text{(MIN. STEEL)}$$

FOR TOP STEEL USE .168□" PER FT WIDTH

BRIDGE PIER SUPPORT CANTILEVER



LOAD A

V_D = 2(9.6K) = 19.20K
V_L = 8.88K
V_I = 2.66
V_{TOTAL} 30.74 KIPS

LOAD C (ASSUME $d_{SUPPORT}$ = 27")

$$W = .15[(1.5)(\frac{2.5+1.0}{2} \times 5)] = 1.97K$$

CENTER OF GRAVITY

$$CG = \frac{(1)(5)(2.5) + \frac{(5)(1.5)}{2}(1.67)}{(1)(5) + \frac{(5)(1.5)}{2}} = 2.13'$$

MOMENT ON CANTILEVER

M = 30.74(3.5) + 1.97(2.13)
M = 111.79 KFT
FROM TABLE ② (R.C.D.H.)
FOR 20000/9.2/1050 ⇒ K = 152

$$F = \frac{M}{K} = \frac{111.79}{152} = .89$$

FROM TABLE ④ FOR F = .89
AND b = 18 ⇒ d ≈ 25" < 27" OK

NOTE: SINCE COMP. FACE OF CONC. IS NOT PARALLEL TO TENSION FACE, USE d = T − 4"

A_s @ FACE OF SUPPORT:

$$A_s = \frac{111.79}{1.44(30-4)} = 2.92□"$$

CRITICAL V @ EDGE OF BEAM A

$V = 30.74 + 1(2)(1.5)(.15) + .5(2)^2(\frac{1.5}{2})^2(5)$
V = 31.33 KIP
T = 12 + 24($\frac{1.5}{5}$) = 19.2" ⇒ d = 15.2"

$$v = \frac{V}{bd} = \frac{31330}{18(15.2)} = 114.5 > 60 \text{psi}$$

CHECK V @ FACE OF SUPPORT
V = 30.74 + 1.97 = 32.71K

$$v = \frac{V}{bd} = \frac{32710}{18(26)} = 69.9 > 60 \text{ PSI}$$

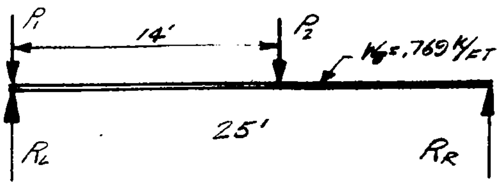
∴ STIRRUPS REQ'D. AS SHOWN

FIG. C-11

ST CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN – T BEAM STIRRUPS

LOAD AT END OF SPAN:



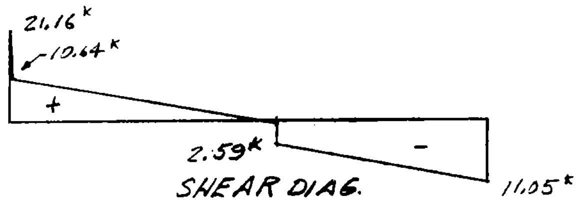
$P_1 = 8^K + .3(8) = 10.4^K$ (.3 = IMPACT)

$P_2 = 2^K + .3(2) = 2.6^K$

$WT_B = .769(25) = 19.225^K$

$R_L = 10.4 + 2.6\left(\frac{11}{25}\right) + \frac{19.225}{2} = 21.157$

$R_R = 2.6\left(\frac{14}{25}\right) + 9.6 = 11.05^K$



SHEAR DIAG.

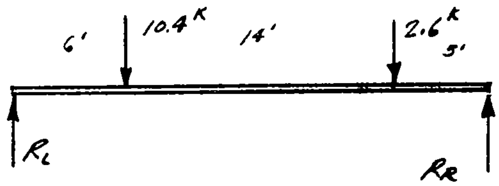
FOR 1/4 POINT:

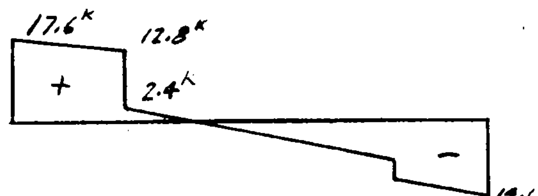
$R_R = 10.4\left(\frac{6}{25}\right) + 2.6\left(\frac{20}{25}\right) + 9.6$

$R_R = 2.6 + 2.0 + 9.6 = 14.6^K$

$R_L = 13 + 19.2 - 14.6 = 17.6^K$

LOAD AT 1/4 POINT OF SPAN:





SHEAR DIAG.

STIRRUP DESIGN

$V_{MAX} = 21.1^K$

SHEAR STRESS AT SUPPORT

$v_s = \frac{V}{bd} = \frac{21.1^K}{12(22)} = 79\ \#/\square''$

SHEAR AT d:

$V_d = 21.1 - .769\left(\frac{22}{12}\right) = 19.7^K$

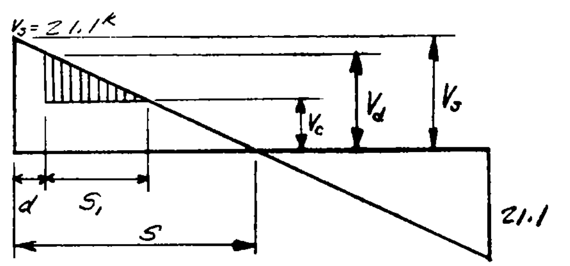
SHEAR STRESS AT d:

$v_d = \frac{19.7}{264} = 75\ \#/\square''$

SHEAR CARRIED BY STIRRUPS

$v' = v_d - v_c = 75 - 60 = 15\ \#/\square''$

ASSUMED DESIGN SHEAR DIAG.*



REQ'D STIRRUP DIST. IN FT.

$S_1 = \frac{v'}{v_s} S = \frac{15}{79}(12.5) = 2.37'$

ASSUME #3 U BARS TO BE USED FOR STIRRUPS

* BASED ON END AND 1/4 PT SHEAR DIAGRAMS

FIG C-12

ST CHARLES PARISH DRAINAGE STRUCTURE

BRIDGE DESIGN – T BEAM STIRRUPS

REQUIRED STIRRUP SPACING

FROM DIAG. 17 (R.C.D.H., p 104)
FOR $f_T = 20$ KSI AND #3 U BAR $\Rightarrow f_T A_v = 4400$ #
USING VERTICAL STIRRUPS:
FROM TAB. 16 $\Rightarrow B = 1$ THEREFORE,

$$\frac{v'b}{BA_v f_T} = \frac{15(12)}{(1)(4400)} = .04$$

FROM DIAG. 17, FOR .04 AND $S_1 = 2.37 \Rightarrow 1 @ 18''$
MAXIMUM STIRRUP SPACING (1206 ACI 318-63)

$$S \le \frac{d}{2} = \frac{22}{2} = 11'' \quad \text{WHERE } v_s < 3\sqrt{f_c'}$$

$$79\#/\square'' < 164\#/\square''$$

AND:

$$S = \frac{A_v}{.0015b} = \frac{2(.11\square'')}{.0015(12)} = 12.2''$$

THEREFORE: USE #3 U BARS @ 11"

STIRRUPS SHALL BE PROVIDED A DISTANCE d BEYOND THEORETICAL CUTOFF (1202 ACI 318-63)

PLACEMENT OF STIRRUPS

$$L = d + 2.37 + d = 22'' + 29'' + 22'' = 73''$$

SPACE STIRRUPS 8 #3U @ 11", FROM EACH END
SPACE STIRRUPS 7 #3U @ 18", MIDDLE OF SPAN

STIRRUP EMBEDMENT (919 a ACI 318-63)

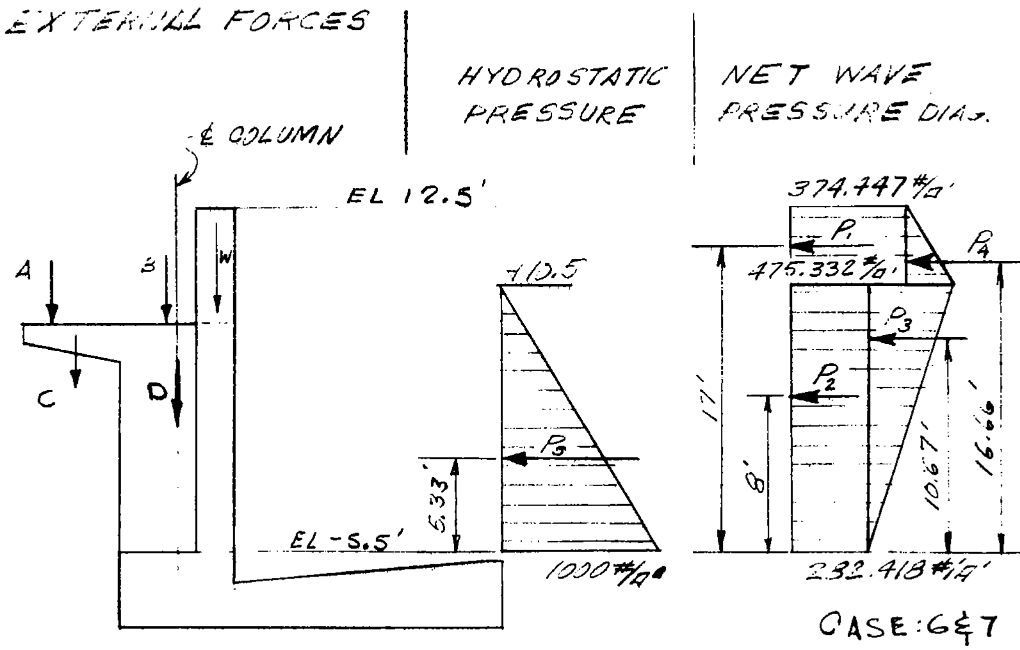
TABLE 15 (R.C.D.H., p. 103)

MIN = 8.4" < 20" OK

LAKE PONTCHARTRAIN, LA. & VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
GDM NO. 2, SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
DRAINAGE STRUCTURE

E.J.M. 4/22/69
Sh. 1 of 14
Ckd: THJ
5/7/69

MONO S-10 - PIER DESIGN



CASE: 6&7

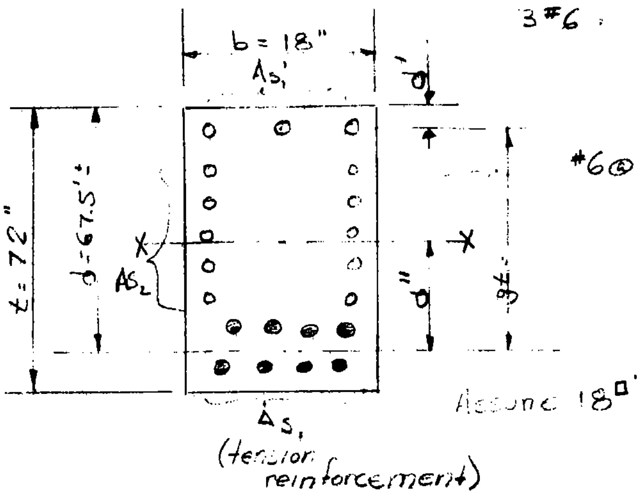
ITEM	FORCE PER FOOT	LENGTH FORCE ACTS	TOTAL FORCE	DIST. FT.	MOMENT K-FT
P_5	$\frac{(1000)(16)}{2} = 8^K$	12.5	100.000^K	5.33	533.000
P_1	374.447(2) = 748.89 #	12.5	9.361^K	17.00	159.139
P_4	$\frac{(100.885)(2)}{2}$ = 100.885	12.5	1.261^K	16.66	21.022
P_3	$\frac{(192.914)(16)}{2}$ = 1543 #	12.5	19.291^K	10.67	205.833
P_2	282.418 (16) = 4518.69 #	12.5	56.483^K	8.00	451.869
TOTAL HORIZONTAL FORCE			186.396^K		1370.869 SUB.
A (TOTAL)			30.74^K	6.5	199.810
B (TOTAL)			26.04^K	0.5	13.020
C			1.97	5.13	10.110
W	2 × 6 × 1.5' × .15		2.70	-2.00	-5.400
D	(6)(12)(1.5)(.15)		16.20^K	—	—
TOTAL (LIVE LOAD) + MOMENT			77.65^K	—	1588.41
A (DEAD)	MINUS LIVE LOAD		-11.54	6.5	- 75.01
B (DEAD)	MINUS LIVE LOAD		-11.54	0.5	- 5.770
TOTAL (DEAD LOAD) + MOMENT			54.57^K		1507.63

FIG C-14

ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN: THJ
DATE: 5/12/69
CK. BY. RJG
DATE: 5/26/69
sheet 2 of 14

MONO S-10 PIER DESIGN



$f'_c = 3000$ psi
$f_c = 1050$ psi
$f_y = 40{,}000$ psi
$f_s = 13{,}600$ psi
$n = 9.2$ $g = 0.90$
$b = 18''$ $d' \approx 3''$
$d \approx 67.5''$ $N = 77.65^k$
$t = 72''$ $M = 1588.4'^k$

DESIGN CRITERIA FROM R.C.D.H. p 75 & 61

1) Assume: $p = 0.015$ and $p' = 0.001$

$A_{st} = 18 + 12 \times .44 + 3 \times .44 = 24.6$ sq in ; $p_g = \frac{24.6}{1296} = 0.019$

$A_{s_1} = 18$ sq in $p_1 = \frac{18.0}{1296} = 0.014$

$A_{s_1}' = 3 \times 0.44 = 1.32$ sq in $p_1' = \frac{1.32}{1296}$ 0.001

$A_{s_2} = 2 \times 6 \times .44 = 5.28$ sq in $p_2 = \frac{5.28}{1296} = 0.004$

$$p x_1 = p_1 + 0.35 p_2'$$
$$= 0.015 + 0.35(.004)$$
$$p x_1 = 0.0164$$

$$p x_1' = p_1'' + 0.035 p_2$$
$$= 0.001 + 0.035(.004)$$
$$p x_1' = 0.0024$$

FIG C-15

2) Compute $\frac{N}{f'_c A_s} = \frac{77.65^k}{(3)(1296)} = 0.020$

FROM table 10c: for $f'_c = 3$, $f_y = 40$, $p_1 = 0.015$ and $p_1' = 0.001$

$$\frac{P_b}{f'_c A_s} = 0.20 > 0.02 \therefore \text{Design in Region III}$$

3) Compute:

$$m = np_1 + (2n-1)p_1'$$
$$= 9.2(0.0164) + (2(9.2)-1)(.0024) = 0.192$$

$$q = np + (2n-1)p_1'\left(\frac{d'}{d}\right)$$
$$9.2(.0164) + [2 \times 9.2 - 1](.0024)\left(\frac{3}{67.5}\right) = 0.153$$

From Table 11, for $m = 0.192$, $q = 0.153$ find $K = 0.393$

For Entering Table 12, determine

$$1/k \times \frac{(2n-1)(A's)}{bd} = \frac{0.0417}{0.393} = 0.106$$

$$1/k \times \frac{d'}{d} = \frac{1}{.393} \times \frac{3}{67.5} = 0.113$$

From Table 12: $z = 0.30$

From Table 13 for $z = 0.30$ and $K = 0.393$ find $j = 0.885$

4) Compute equivalent pure moment, Moe.

From Table 10b: $D' = -0.052$

HENCE: $M_{oe} = M_x - D'\left(\frac{Nt}{12}\right)$
$$= 1588.4 - [-0.052\left(\frac{77.65(72)}{12}\right)$$
$$\therefore M_{oe} = 1612.6^{'k}$$

5) Determine tensile reinforcement

$$A_s : \frac{12\, M_{OE}}{(.85)(.40)(f_y\, j\, d \times 4/3)} = \frac{(12)(1612.6)}{(.85)(.4)(40)(.885)(67.5)(4/3)}$$

$$A_{s_1} = 17.86 \text{ sq in}$$

$$P_1 = \frac{17.86}{18 \times 72} = 0.0140 \therefore \underline{OK}$$

check Concrete stress:

$$M_1 = \tfrac{1}{2} f_c\, K\, j\, b\, d^2$$

$$M_1 = \tfrac{1}{2}(1.05)(4/3)(0.393)(.885)(18)(67.5)^2 \times \tfrac{1}{12}$$

Allow : $M_1 = 1663.9'^{K} > 1612.6'^{K}$

$\therefore$ CONC. OK.

Check Tensile Steel

$$M = A_s\, f_s\, j\, d$$

$$M = (18)(13.6)(.885)(67.5) \times 4/3 \times \tfrac{1}{12}$$

$$M = 1624.5'^{K} > 1612.6'^{K}$$

$\therefore$ Steel OK.

NOTE: Compression reinforcement not required. $\therefore$ Use min. temp. steel.

RECAP:
A_{s_1} = 17.86 sq in
A_{s_1}' = 1.32 sq in
A_{s_2} = 2.64 sq in (in two faces)

FIG C-17

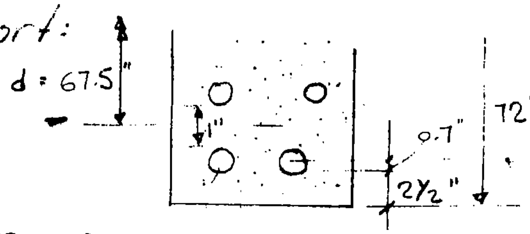
ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN: THJ
DATE: 5/8/69
CK BY: RJG
DATE: 5/27/69

Check Pier as Beam

shear at face of support:

V = 186.4 K
b = 18"
d = 67.5'



$v = \frac{V}{bd} = \frac{186.4}{18 \times 67.5} = 153 psi > 80$ ∴ Shear may be critical

#11 assumed

Check at "d" away from face of support.

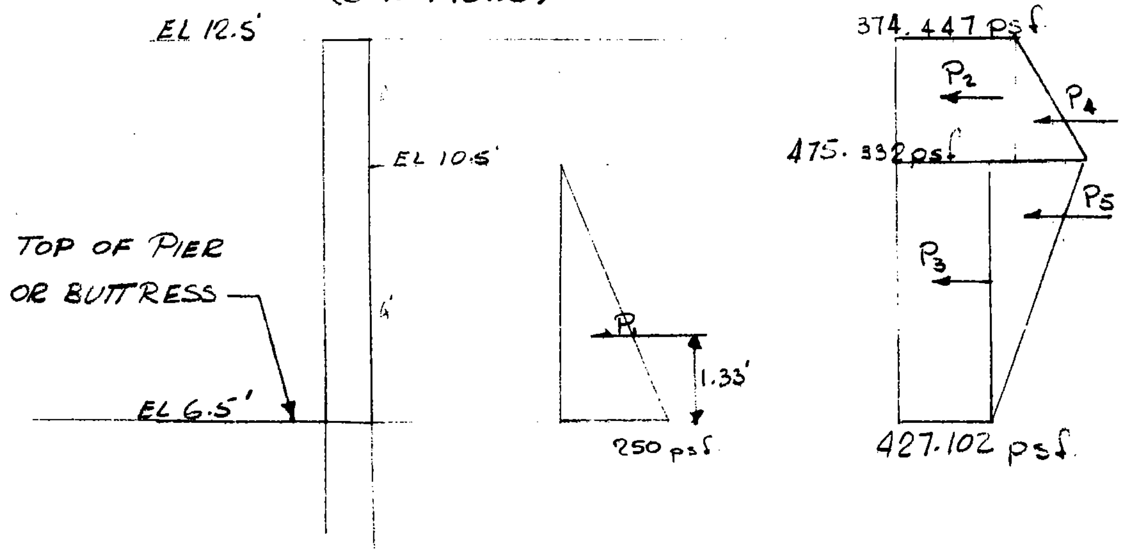
(@ EL 0.0') V = 107.73
b = 18"
d = 67.5"

$v = \frac{107.73}{18 \times 67.5} = 88.7 psi > 80$ ∴ shear reinforce req'd.

∴ Allow column ties to take up excess of 8.7 psi in shear.

CONCRETE DESIGN

DESIGN OF STEM (EL +6.5' TO EL 12.5') (CASE 6 & 7)
(S-10 MONO)



ITEM	FORCE (PER FOOT)	LEVER ARM	MOMENT FT-K
P_1	$\frac{1}{2}(.250)(4) = 0.5^K$	1.33	0.665
P_2	$2(.3744) = 0.7488$	5.0'	3.740
P_3	$4(0.427) = 1.708$	2.0'	3.417
P_4	$\frac{1}{2}(.1009)(2) = 0.1009$	4.667	0.471
P_5	$\frac{1}{2}(.0482)(4) = 0.0964$	2.667	0.257
	$V = 3.15^K$		$8.55^{'K}$

$\therefore M = 8.55^{'K}$ Actual $d \simeq 21"$

$M_c = K b d^2$

$d = \sqrt{\frac{M_c}{K b}} = \sqrt{\frac{8.55 \times 12}{0.152 \times 12}} = 7.50"$

A_s req'd $= \frac{8.55}{1.44(21) \times 1.33}$

$A_s = 0.212\ in^2/ft$

Check TEMP STEEL & TENSILE

① $A_s = 12" \times 24" \times .002 = 0.576\ in^2/ft$ – in comp face

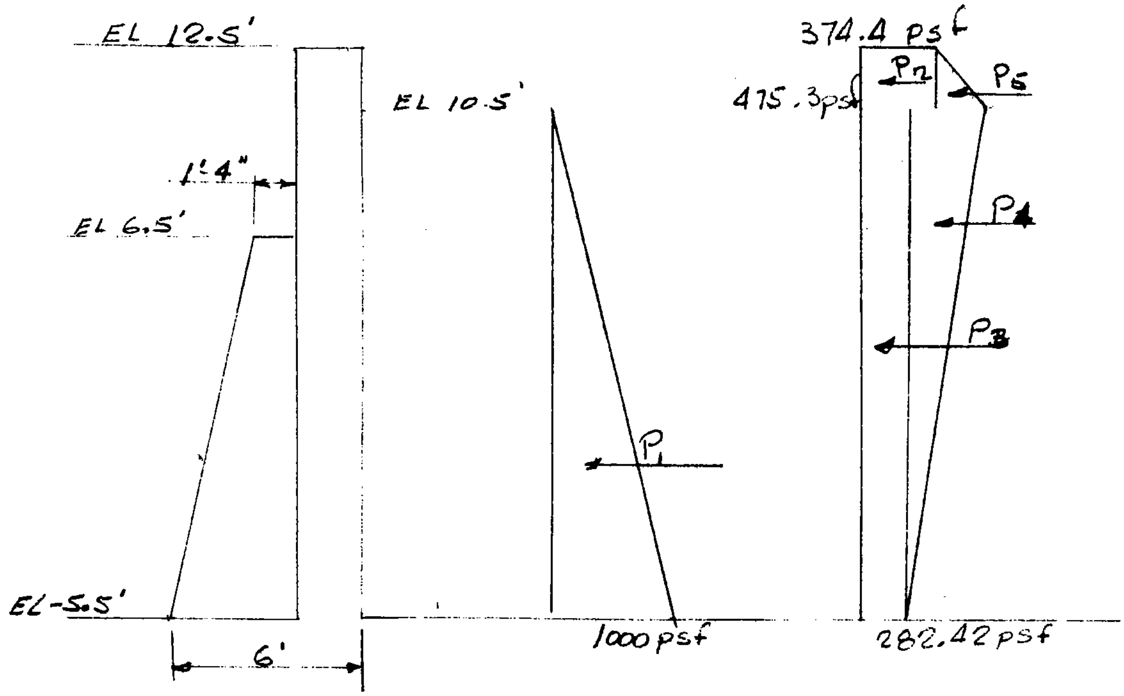
② $A_s = 12 \times 21 \times .0025 = 0.630\ in^2/ft$ – in tension face.

$\therefore$ TEMP & TENSION STEEL GOVERN

FIG C-19

ST. CHARLES PARISH
DRAINAGE STRUCTURE
MONO S-10
DESIGN OF BUTTRESS

DESIGN: THJ
DATE: 5/07/69
CK: RJG
DATE: 5/27/69
Sheet 7 of 14



Item	FORCE Per foot	Contribut. Length	Total Force	Lever Arm	Moment ft k
P_1	8^k	6.25	50^k	5.33	266.5
P_2	0.7488	6.25	4.68^k	17.0	79.6
P_3	4.518	6.25	28.24^k	8.0	225.9
P_4	1.543	6.25	9.65	10.67	102.9
P_5	0.1089	6.25	0.631	16.67	10.5

$V = 93.2^k$ $M = 685.4'^k$

b = 12"
D = 72"
d = 68"

$$d\ req'd = \sqrt{\frac{685.4}{0.152}} = 67.15" < 68" \therefore OK.$$

$$A_s = \frac{685.4}{1.44 \times 68 (1.33)} = 5.26 in^2 \text{ (tension face)}$$

Temp A_{s_T} 72 x 12 x 0.002 = 1.73 in^2 (temp in Comp face)

ST CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN : THJ
DATE : 5/7/69
CK BY · RJG
DATE : 5/28/69
Sheet 8 of 14

Check Buttress Shear.

① At face of support

$v = \frac{V}{bd}$ $d \approx 67.5''$ (will need 2 rows of steel)

$v = \frac{93,200}{(12)(67.5)} = 115.06$ psi

v allow = $60 \times \frac{4}{3}$ (WAVE) = 80 psi

∴ Shear may be critical - check at "d" away from face of support.

Since varying cross section - check at 48" away from face of support.

(@ El -1.5')
$d \approx 56.7$
$b = 12.0''$
$V = 65.2^k$

$v = \frac{65.2}{12 \times 56.7} = 95.8$ psi > 80 psi

∴ Shear reinforcement required.

Check if "b" is increased to 15"

$v = \frac{65.2}{15 \times 56.7} = 76.7$ psi < 80 psi ∴ OK.

∴ USE b = 15"

Recheck d

$d_{req'd} = \sqrt{\frac{685.4 \times 12}{.152 \times 15}} = 60.1'' < 67.5$ ∴ OK.

Temp Steel = A_{sT} = 72 × 15 × 0.002 = 2.160 in²

Recap: Concrete Stress = $1.05 \times \frac{60.1}{67.5} = 0.934$ ksi ∴ OK

A_s - tension face = 5.26 in²

A_{sT} - temp. in comp face - 2.16 in²

FIG. C-21

ST. CHARLES PARISH
DRAINAGE STRUCTURE
MONO S-10

DESIGN - THJ
DATE: 5/7/69
CK BY: RJG
DATE: 5/28/69
Sheet 9 of 14

DESIGN OF STEM STEEL.

- Assume stem spans longitudinally between Pier and Buttress. between EL 6.5 to top of gate opening (-0.5). Stem designed as a vertical cantilever from EL. 6.5 to 12.5. Torsion from vertical cantilever assumed to be distributed from EL 6.5 to EL -0.5'.

DETERMINE EQUIVALENT LOAD/sq.f.

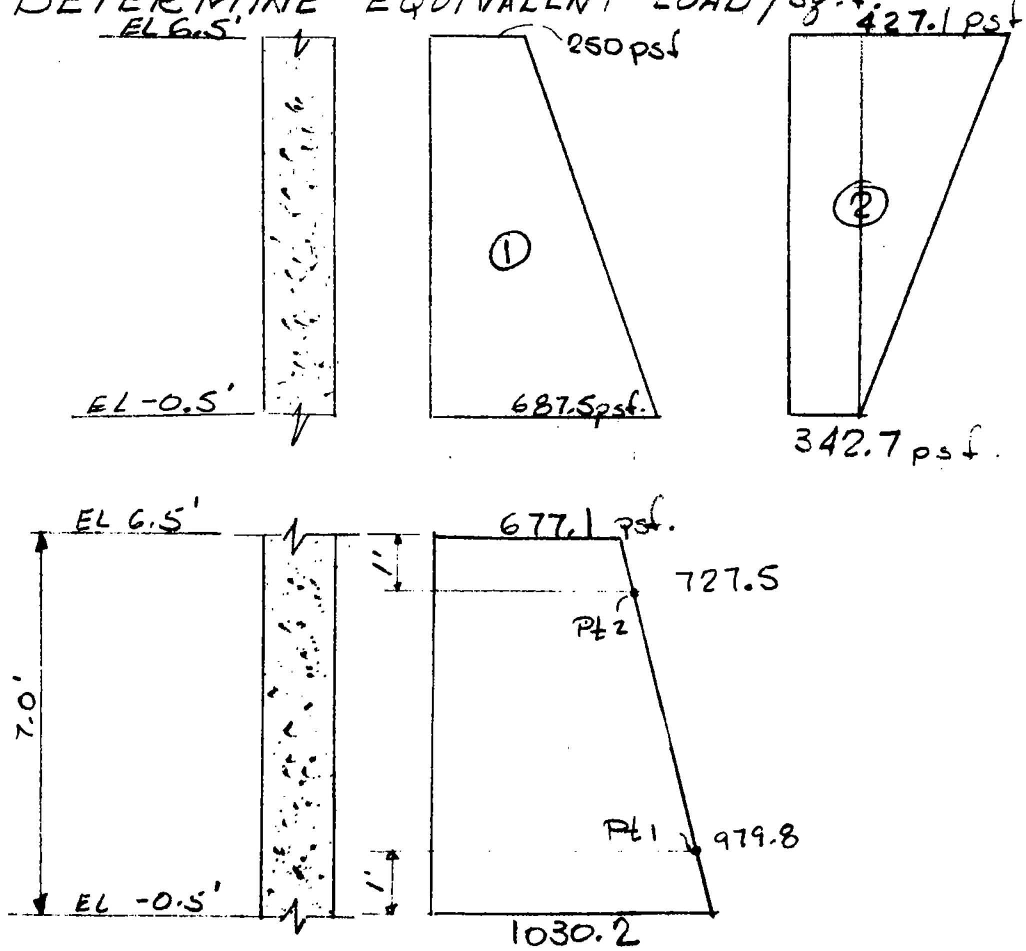


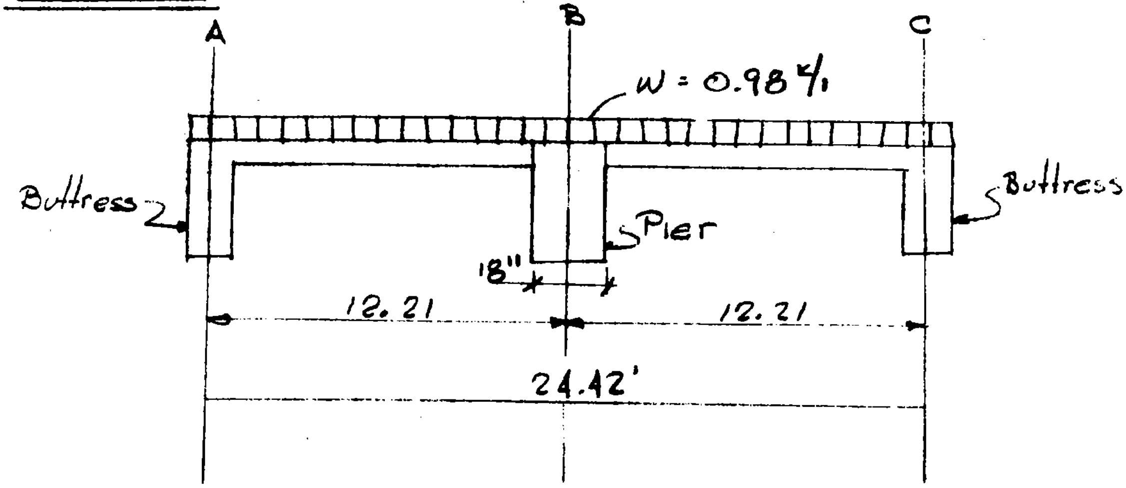
FIG. C-22

ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN : THW
DATE : 5/15/69
CK BY : RJG
DATE : 5/28/69
Sheet 10 of 14

Longitudinal Stem Steel

Point 1



$$M_B = 1/8\, w\, l^2$$
$$= 1/8(.98)(12.21)^2$$
$$M_B = -18.3^{\prime K}$$

$$\text{Pos: } M = \frac{9}{128}(w)(l^2) = \frac{9}{128}(.98)(12.21)^2$$
$$M = +10.3^{\prime K}$$

Reduce −M to face of column.

Max −M = $-18.3^{\prime K}$

Max V = 5.98

Deduct $1/3\,V\,la$ = 3.0

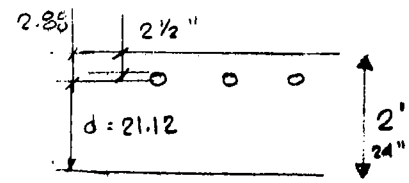
Design M = $-15.3^{\prime K}$

Pos Design M = 10.3 − 1.5

Design M = $+8.8^{\prime K}$

ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN: THJ
Date: 5/15/69
CK BY: RJG
Date: 5/29/69
Sheet 11 of 14



__Neg. Steel__

$$A_s = \frac{M}{ad} = \frac{15.3}{1.44(21.12)(4/3)}$$

$A_s = 0.377 \text{ in}^2/\text{ft req'd}$

Positive Steel $= \frac{8.8}{1.44(21.12)(4/3)}$

$A_s = 0.218 \text{ in}^2/\text{ft req'd}$

__Check min steel.__

$A_s = .0025\,bd$

$= 0.0025(12)(21.12)$

$A_s = 0.634 \text{ in}^2/\text{ft req'd.}$

∴ Min. Steel Requirement Governs.

∴ Use $A_s = 0.634 \text{ in}^2/\text{ft}$ (each face)

__LOAD ON GATE & OPENING__

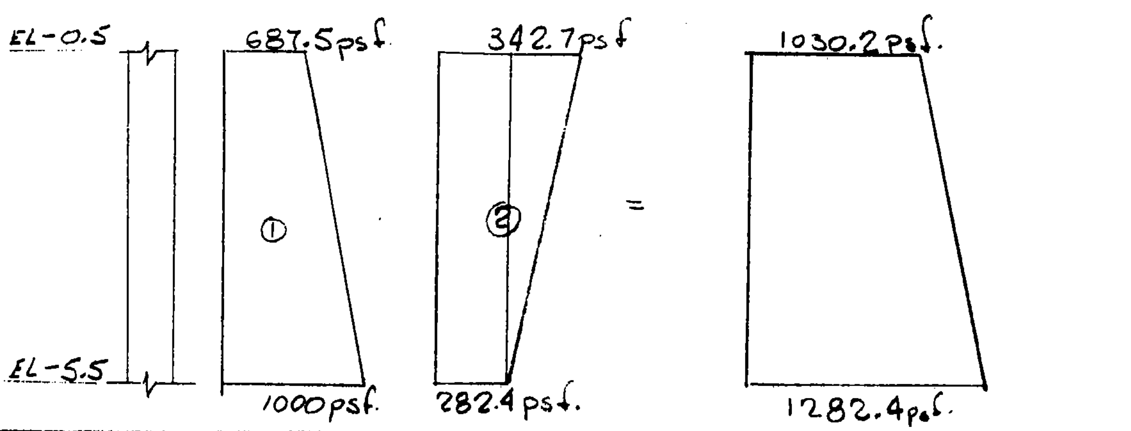


FIG C-24

ST. CHARLES PARISH
DRAINAGE STRUCTURE

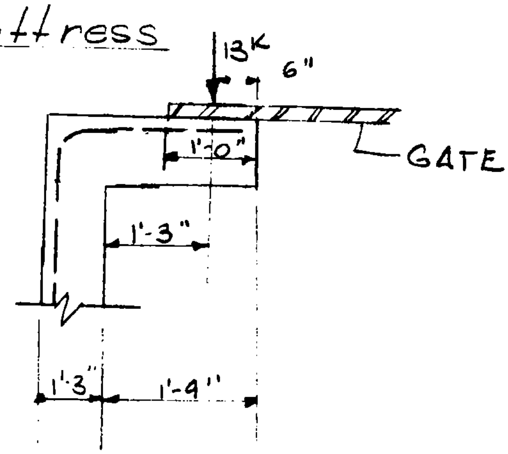
DESIGN : THJ
DATE : 5/16/69
CK BY : RJG
DATE : 5/29/69

∴ LOAD ON GATE.

$$P = \frac{1030.2 + 1282.4}{2 \times 1000} \times 5' \times 9' = 52^K$$

Approximate load on edge = $\frac{52}{4} = 13^K$

AT Buttress



CANTILEVER MOMENT = $13^K \times 1.25' = 16.25^{K-'}$

$M/ft = \frac{16.25}{5} = 3.25'^K/ft.$

Check steel:

$$A_s = \frac{3.25}{1.44(21.1)(9/2)} = 0.08 \ in^2/ft.$$

∴ Min. Steel "GOVERNS"

ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN: THJ
DATE: 5/16/69
CK. BY: RJG
DATE: 5/29/69

LONGITUDINAL STEEL IN BASE SLAB

Sheet 13 of 14

EQUILIVANT UNIFORM LOAD. (CASE 6)

WAVE =	99.3^K
Water =	381.1^K
Base =	256.8^K
GATE =	32.0^K
BRACKET =	1.8^K
Thimbles =	6.7^K
Wall =	111.6^K
water =	30.8^K
Uplift =	− 279.5^K
	640.6^K

CONC. LOADS.

EACH Buttress = 4.8^K
Pier, + Bridge LL & D.L = 69.5^K

$$\omega = \frac{640.6}{25.67} \approx 25.0^{K}/ft.$$

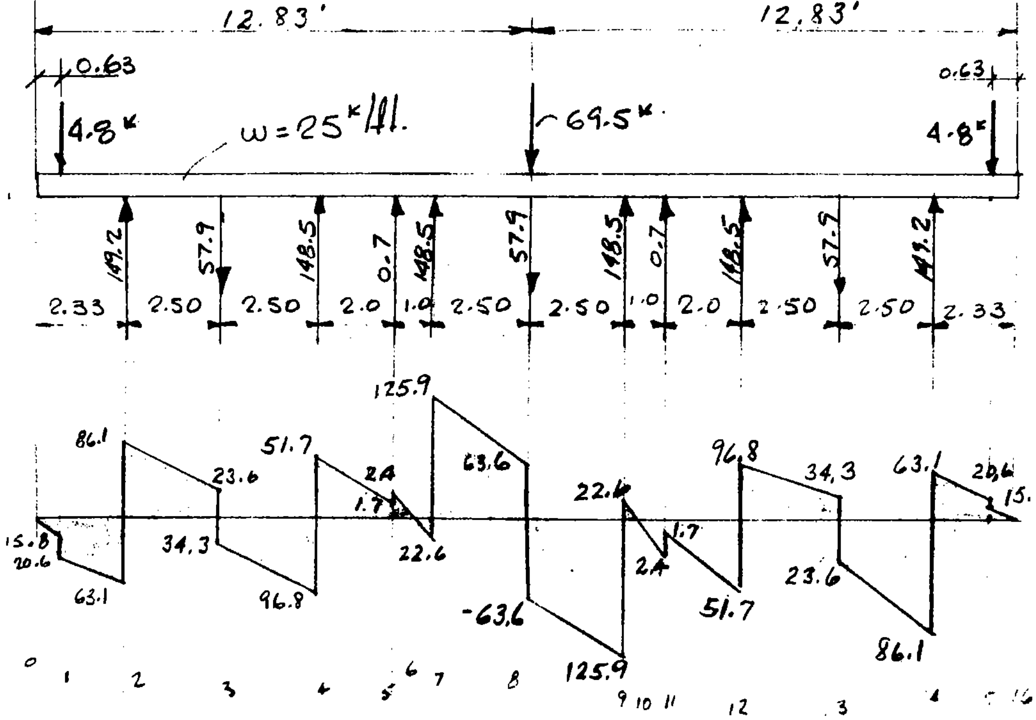


FIG C-26

ST. CHARLES PARISH
DRAINAGE STRUCTURE

DESIGN: THJ
DATE: 5/16/69
CK. BY: RJG
DATE: 5/29/69
Sheet 14 of 14

Moment = Area under shear diag.

Point	INCR	Shear	dM	M
0	0	0	0	0
1	0.63	-15.8/-20.6	-5.0	-5.0
2	1.70	-63.1/+86.1	-71.1	-76.1
3	2.50	+23.6/-31.3	+137.1	+61.0
4	2.50	-96.8/+51.7	-163.9	-102.9
5	2.0	+1.7/+2.4	+53.4	-49.5
6	0.112	0/0	+0.1	-49.4
7	0.888	-22.6/+125.9	-10.0	-59.4
8	2.5	+63.6/-63.6	+236.9	+177.5
9	2.5	-125.9/+22.6	-236.9	-59.4
10	0.91	0/0	+10.0	-49.4
11	0.09	-2.4/-1.7	-0.1	-49.5
12	2.0	-51.7/+96.8	-53.4	-102.9
13	2.5	+34.3/-23.6	+163.9	+61.0
14	2.5	-86.1/+63.1	-137.1	-76.1
15	1.7	+20.6/+15.8	+71.1	-5.0
16	0.63	0	+5.0	0

M_{max} per ft. of width $= \frac{177.5^{'K}}{20} = 8.88^{'K}$

$A_s = \frac{M}{a\,d \times 4/3} = \frac{8.88}{1.44 \times 26 \times 4/3} = 0.178^{\square''}$

Min. Tension Steel:

$A_{s\,min} = .0025\,bd = .0025(12)(26) = 0.78^{\square''}$ ea face

∴ Min. Tens. Steel Governs.

Note: A_s will vary as "d" varies across the section.

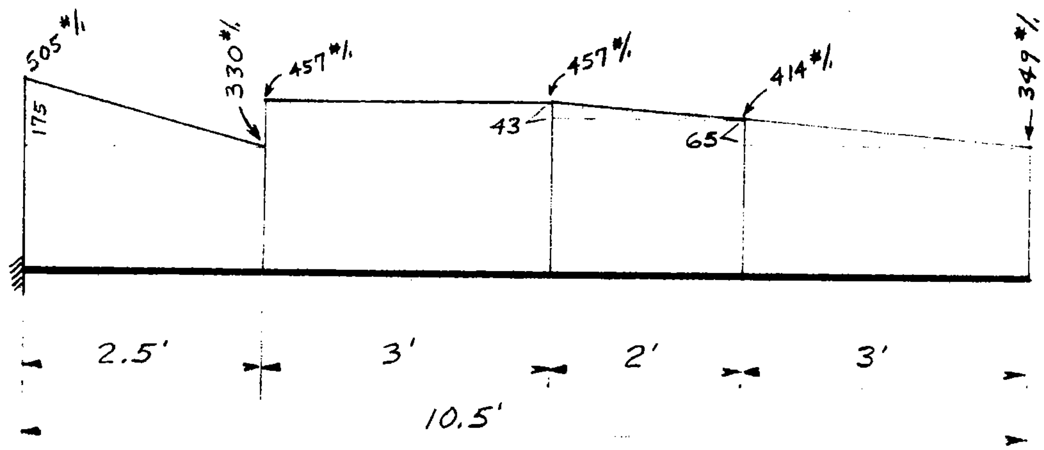
FIG C-27

LAKE PONTCHARTRAIN, LA. & VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
G.D.M. No. 2, SUPPLEMENT No. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
DRAINAGE STRUCTURE

REQUIRED SHEET PILE SECTION FOR CUT-OFF UNDER STRUCT.

ASSUME SHEET PILE FIXED IN CONC. BASE AND CANTILEVERED INTO SOIL W/NET SOIL PRESS. PLUS HYDROSTATIC PRESS. AS LOAD.

LOADING: Q-Case, F.S.=1.5, W/O Wave



MAX. $M = (330 \times 2.5 \times 1.25) + (.5 \times 175 \times 2.5 \times \frac{2.5}{3}) + (457 \times 3 \times 4) + (414 \times 2 \times 6.5) + (.5 \times 43 \times 2 \times \frac{18.5}{3}) + (349 \times 3 \times 9) + (.5 \times 65 \times 3 \times 8.5)$

$M = 22,596$ '# ALLOW. $F_b = 18,000$ psi

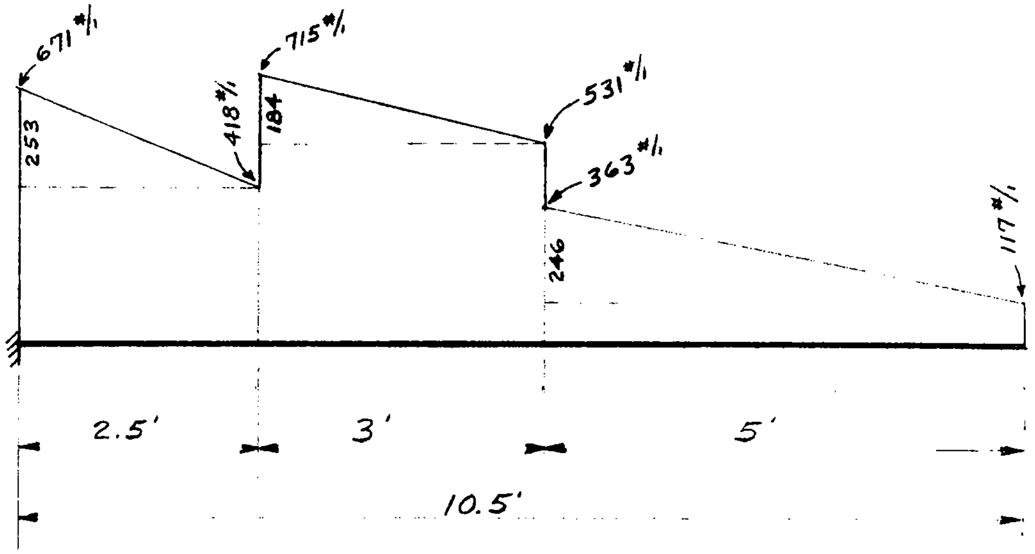
REQ'D. $S = M/F_b = \frac{22,596 \times 12}{18,000} = 15.1$ in.³/L.F.

NEED: Z27 sheet piles

Fig C-28

ST. CHARLES PARISH DRAINAGE STRUCTURE
REQUIRED SHEET PILE SECTION FOR CUT-OFF

LOADING: S-Case, F.S.=1.25, W/Wave



$MAX.\ M = (418 \times 2.5 \times 1.25) + (.5 \times 253 \times 2.5 \times \frac{2.5}{3}) + (531 \times 3 \times 4) + (.5 \times 184 \times 3 \times 3.5) +$
$+ (117 \times 5 \times 8) + (.5 \times 246 \times 5 \times \frac{21.5}{3}) = 17,995'^{\#}$

$M = 17,995'^{\#}$ ALLOW. $F_b = 18,000 \times \frac{4}{3} = 24,000$ psi

REQ'D. $S = M/F_b = \frac{17,995 \times 12}{24,000} = 9.0\ in.^3/L.F.$

USE Z27 SHEET PILES ($S = 30.2\ in^3/L.F.$)

Fig. C-29

APPENDIX D

SALINITY DATA

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, SOUTH END CAUSEWAY

1962	Chlorides as CL^-, p.p.m.					
Date	Jan	Feb	Mar	Apr	May	Jun
1						
2						
3						
4				170		
5						
6						
7		53	93			
8						
9						
10				130		
11						
12						
13						
14		48	80			
15	No				No	
16	Record				Record	
17						
18						370
19						
20						
21		103				
22						
23						
24						
25						370
26						
27						
28		150	100			
29						
30						
31						

2ck

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, SOUTH END CAUSEWAY

1962 Date	Chlorides as CL^-, p.p.m. Jul	Aug	Sept	Oct	Nov	Dec
1						
2	590			1800		
3						
4						
5						
6		1450			1850	
7						
8						3100
9	850			2500		
10			2500		1900	
11						
12						
13		1400				
14						
15						2550
16	1200			2300		
17			1850			
18						
19						
20		1700			2600	
21						
22						2000
23	1050			2350		
24			2500			
25						
26						
27					2950	
28						
29						2150
30	1200			2400	3400	
31		1650				

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, SOUTH END CAUSEWAY

1963 Date	Chlorides as CL^-, p.p.m. Jan	Feb	Mar	Apr	May	Jun
1				2300		
2						
3						
4	2200	1900	1900			
5						
6					2850	
7	2250					
8				2200		
9						
10						3450
11		2250	2100			
12						
13					2900	
14	2050					
15				2700		
16						
17						4500
18		3000	2350			
19						
20					2900	
21	1950					
22				3150		
23						
24						3300
25		2000	2350			
26						
27					2950	
28	2000					
29				2750		
30						
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, SOUTH END CAUSEWAY

1963	Chlorides as CL^-, p.p.m.					
Date	Jul	Aug	Sept	Oct	Nov	Dec
1	3500					
2						4200
3			4300			
4					5600	
5		3600				
6						
7				5100		
8	4200					
9			4500			4600
10						
11						
12		4000			4200	
13						
14				5400		
15	5000					
16			4800			3700
17						
18					4700	
19		4100				
20						
21				5800		
22	3900					
23			4800			
24						
25						
26		4200			4700	
27						
28				5600		
29	3900					
30			5400			4100
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, SOUTH END CAUSEWAY

1964	Chlorides as CL^-, p.p.m.					
Date	Jan	Feb	Mar	Apr	May	Jun
1						
2						
3		3100				
4						
5						
6						
7						
8						
9						
10		3700				
11						
12						
13	3500					
14						
15			No Record	No Record	No Record	No Record
16						
17		3300				
18						
19						
20	3300					
21						
22						
23						
24		2900				
25						
26						
27	3300					
28						
29						
30						
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, FRENIER BEACH

1962 Date	Chlorides as CL^-, p.p.m. Jan	Feb	Mar	Apr	May	Jun
1						
2						
3						
4				95		
5						
6						
7		30	70			
8						
9						
10				100		
11						
12						
13						
14		93	78			
15	No				No	
16	Record				Record	
17						
18						530
19						
20						
21		98				
22						
23						
24						
25						370
26						
27						
28		105	80			
29						
30						
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, FRENIER BEACH

1962	Chlorides as CL^-, p.p.m.					
Date	Jul	Aug	Sept	Oct	Nov	Dec
1				1225		
2	270					
3						
4						
5					1450	
6						
7						1850
8						
9	330				1650	
10			925			
11						
12						
13		650				
14						1850
15				1350		
16	370					
17			925			
18						
19					1650	
20		650				
21						1850
22				1300		
23	360					
24			925			
25						
26					1900	
27						
28						1650
29				1800		
30	400					
31		725				

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, FRENIER BEACH

1963	Chlorides as CL^-, p.p.m.					
Date	Jan	Feb	Mar	Apr	May	Jun
1				2000		
2						
3						3000
4	1650	1200	1250			
5						
6					2950	
7	1650					
8				2000		
9						
10						3200
11		1650	1750			
12						
13					3050	
14	1600					
15				2100		
16						
17						3150
18		1800	2000			
19						
20					2900	
21	1650					
22				2250		
23						
24						2850
25		1700	1850			
26						
27					2950	
28	1150					
29				2750		
30						
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, FRENIER BEACH

1963	Chlorides as CL^-, p.p.m.					
Date	Jul	Aug	Sept	Oct	Nov	Dec
1	3000					
2						2800
3			3800			
4					4700	
5		3600				
6						
7				4200		
8	3200					
9			4000			3000
10						
11						
12		3600			3700	
13						
14				4200		
15	3200					
16			4200			3400
17						
18					3400	
19		3700				
20						
21				4200		
22	3500					
23			4100			
24						
25						
26		3700			3900	
27						
28				4300		
29	3400					
30			4100			3500
31						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN, FRENIER BEACH

1964	Chlorides as CL^-, p.p.m.					
Date	Jan	Feb	Mar	Apr	May	Jun
1						
2						
3		1500				
4						
5						
6						
7						
8						
9						
10		2700				
11						
12						
13	1150					
14						
15			No	No	No	No
16			Record	Record	Record	Record
17		2600				
18						
19						
20	1135					
21						
22						
23						
24		2600				
25						
26						
27	1200					
28						
29						
30						
31						

LOUISIANA WATER RESOURCES RESEARCH INSTITUTE
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA
LOCATION--LAKE PONTCHARTRAIN - Chloride as CL^-, p.p.m.

1968 Date	Sta. II-3	Sta. II-4	Sta. II-5	Sta. III-3	Sta. III-4	Sta. V-4	Sta. V-5
June 4	4000	450	4000				
5				4300			
10						4600	5200
18	900	450	4800				
19				4200	4200		
24						5200	5500
July 1	5100						
2		4800	5400				
3				5100	5400		
8						6000	6600
16	4900	4400	4700				
17				4800	4800		
22						5900	6200

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1962
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jan	Feb	Mar	Apr	May	Jun
1	140	120		140	90	150
2	180	110	200	130	100	150
3	240		200	180	110	150
4	250	120	130	110	100	150
5	210	170	180	130	100	120
6	180	140	140	170	120	150
7		170	130		110	150
8	160	150	120	140	130	150
9		150	120	130	110	
10	130	180	130	130	110	150
11	140	180	140	130	120	150
12	150	170	140	130	130	160
13	150	160	140	130	150	170
14	200	130	130		120	170
15	170	130	110	130	110	160
16	150	110	110	130	100	160
17	120	100	140	130	100	
18	110	120	150	130	100	160
19	110	100	130	130	100	170
20	110	110	120	130		170
21	120	100	130	120	100	170
22	140	80	130	110	110	
23	140	60	160	110	110	170
24	130	80	140	90	140	
25	130	90	120	90	120	300
26	150	180	80	100		410
27	170	180	90		120	330
28	160		180	130	130	450
29	130			150	120	480
30				140	140	590
31	130				140	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1962
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	540	1350	2200	3000	2800	3300
2	590	1400	2500	2900	2800	3300
3	600	1400	1950	3000	2900	3300
4	650	1500	1900	2900	2700	3000
5	750	1300	1900	2900	2700	3300
6	880	1500	2100	2900	2900	2800
7	850	1400	2350	2700	2900	2900
8	750	1400	2450	2600	2900	3000
9	700	1450	2500	2700	2900	3100
10	800	1500	2500	2700	2900	3300
11	880	1550	2800	2700	2800	3100
12	930	1650	2600	2700	2800	3100
13	980	1700	2600	2800	3000	2900
14	950	1700	2600	2800	2900	3000
15	1050	1850	2600	2800	2800	
16	980	1650	2500	2600	2800	3000
17	1380	1750	2500	2700	2800	3200
18		1750	2500	2700	2800	3100
19	1350	1800	2600	2600	2800	3200
20	1400	1800	2700		3100	3200
21	1400	1700	2600	2600	3200	3200
22	1400	1750	2900	2700	3100	3200
23	1400	1650	2900	2700	3100	3000
24	1100	1850	2900		3200	3000
25	1400		2900	2800.	3200	2900
26	1350		2900	2800	3300	2800
27	1350	2150	3100	2800	3200	2700
28	1350	2050	3100	2800	3100	2700
29	1350	2250	3100	2800	3200	2700
30	1350	2100	3100	2800	3300	2300
31	1350	2050		2800		2300

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1963
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jan	Feb	Mar	Apr	May	Jun
1	2500	2700	2400	2500	1100	3300
2	2700			2600	1100	3300
3	2800	2900	2500	2600	1100	3200
4	2700	3000	2500	2500	1100	3300
5		3000	2700	2500	1100	3300
6		3000	2500	2500	1100	3200
7		2900	2600	2500	1100	3200
8	2600	2900	2600	2500	1100	3300
9	2700	2700	2500	2500	1100	3400
10	2700	2400	2500	2500	1200	3500
11	2700		2400	2600	1200	3500
12	2700	2600	2500	2600	1100	3600
13	2600	2600	2600	2600	2900	3700
14	2600	2700	2600	2500	2800	3700
15	2700	2600	2600	2600	2800	3600
16	2600	2600	2700	2600	2900	
17	2600	2400	2700	2600	2800	3700
18	2800		2500	2700	2900	3700
19	2800	2400	2700	2700		3700
20	2700	2400	2500	2700	2800	
21	2800	2500	2700	2700	2800	3700
22	2800	2600	2700	2600	2800	3600
23	2800	2500	2600		2900	3600
24	2700	2400	2600			3500
25	2800	2400	2500		3000	
26	2700	2400	2600	2600	3000	3600
27		2500	2600	2600		3600
28	2600	2400	2600	2600	2800	3500
29	2700		2600	1100	2800	3600
30	2600			1100	3000	3500
31	2600		2600		3100	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1963
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	3500	3900	4800	5600	6250	
2	3500	4000	4800	5500	6250	5250
3	3400	4000	4800	5600	6000	5000
4	3500	4000	4900	5600	6250	5000
5	3500	4000	4800	5600	6000	5250
6	3600	4000	4800			5250
7	3600	4000	4800	5600	6000	5500
8	3600	4000	4700	5600	6000	5000
9	3600	4100	4800	5400	6000	
10	3700	4000	4800	5500		5000
11	3700	4100	4900	5500	5250	5000
12	3600	4000	5000	5300	5250	5000
13	3700	4000	5000	5100	5750	5000
14	3700	4100	4900	5200	5250	5000
15	3900	4000		5600	5750	5000
16	3900	4100	4900	5600	5750	5250
17	3700	4100	4600	5600	5750	5000
18	3800	4200	5600	5600	5500	5000
19	3600	4200	5900	5500	5500	4750
20	3600	4300	5500	5400	5500	4750
21	3700	4300	5600	5700	5250	4750
22		4200	4900	5800	5500	
23	3700	4200	5600	5600	5500	5500
24	3800	4200	5800	5900	5000	5250
25	3800	4300	5500	5900	5500	4750
26	3800	4300	5500	5900	5500	5000
27	3800	4300		5800	5500	5000
28	3800	4400	5500	5900	5500	
29	3700	4500	5500	5900	5250	4750
30	3700	4600	5600	6100	5000	4750
31	3800	4600		6000		5000

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1964
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jan	Feb	Mar	Apr	May	Jun
1	4750	4000		2700	2300	2000
2	4750	4000	3500	2800	2400	2200
3	4500	4000	3500	2700	2400	2100
4	4750	4250	3500	2600	2300	2100
5	4750	4250	3500	2300	2300	2200
6	5000	4250	3500	2600	2200	
7	5000	4000	3500	2700	2300	2200
8	4750	4000	3500	2700	2200	
9	4750	4000	3700	2400	2200	2200
10	5000	4000	3600	2600	2200	2200
11	5000	4000	3500	2600	2100	2200
12	4750	4000	3500	2600	2000	
13	4500	4000	3400	2600	2000	2200
14	4500	4000	3400	2400	1900	2200
15	4500	4000	2800	2500	2100	2200
16	5000	4000	2300	2600	2000	2100
17	4750	4100	2400	2700	2000	2100
18	4500	4100	2500		2000	2200
19	4250	4000	2700	2600	1900	2100
20	4250	3700	2600	2300	2100	2100
21	4250	3700	2600	2400	2100	2200
22	4250	3800	2500	2500	2100	2200
23	4000	3600	2600	2600	2100	2200
24	4000	3800	2300	2500	2100	
25	4250	3700	2200	2300	1900	2000
26	4250	3600	2400	2600	2000	2000
27	3750	3600	2400	2400	2100	1900
28	4250	3500	2500	2400	2200	
29	4000	3400	2500	2400	2200	2000
30	4000		2600	2400	2200	2100
31	4000		2700		2100	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1964
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	2100	2200	2900		3400	2800
2			2700		3400	2900
3	2000	2100	2900		3300	2900
4		2200	2800		3400	2700
5	2100	2300	2800		3300	2800
6	2000	2400	2800		3400	3000
7	2200	2300	2900		3400	2500
8	2200		2800		3300	2500
9	2200	2200	2400		3100	2500
10	2300	2200	2500		2900	2600
11	2400	2200	2800		2900	
12	2300	2200	2800		3100	
13	2200	2200	2800		3200	2600
14	2100	2400	2700		3200	2500
15	2200	2300	2700		3300	2500
16	2100	2400	2700	No	3100	2700
17	2300	2400	2600	Record	3200	2500
18	2200	2400			3200	2400
19		2500	2600		3300	2100
20	2200	2400	2600		3200	2100
21	2200	2400	2600		3100	2200
22	2300	2500	2600		3200	1900
23	2300	2600	2500		3900	1900
24	2300	2400	2500		3200	2000
25	2300	2600	2500		3500	2000
26	2200	2700	2500		3500	2100
27	2300	2600	2700		2800	2100
28	2200	2700	2600		3100	2000
29	2200	2700	2700		3100	2200
30	2200	2800	2500		3700	2000
31	2200	2800			3300	2200

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1965
CHLORIDES AS CL⁻ IN PARTS PER MILLION

Day	Jan	Feb	Mar	Apr	May	Jun
1	2400		1400	1400	1600	2100
2	2300	2000	1400	1400	1600	2300
3		1900	1300	1600	1700	2200
4	2100	1900	1400	1700	1600	
5	2000	2000	1000	1800	1700	2300
6	2000	1900	1300	1600	1600	2200
7	2100	1900	1200	1500	1700	1900
8	2000	1800	1400	1600	1800	2000
9		1800	1400	1600	1800	1800
10	2100	1800	1400		2100	
11	2000	1700	1600	1700	2100	
12	2000	1800	1600	1800	2000	1800
13	2100	1700	1500	1800	2100	1900
14	2100	1700	1600	1700	2000	1800
15	2100	1700	1900	1600	2000	1900
16	2000	1700	1500	1600	2000	1900
17	2100	1800	1500	1700	1800	1900
18	2000	1800	1500	1700	1700	2100
19	2200	1900	1300	1600	1700	2000
20	2100	1900	1500	1600	1800	1900
21	2200	1300	1300	1700	1800	
22	2100	1900	1300	1700		2200
23	2100	1900	1200	1600	1800	2100
24	2100	1900	1300	1500	1800	2100
25	2200	1600	1300	1600	1800	2200
26	2100	1500	1500	1700	2100	2200
27	2200	1300	1500	1600	2100	2300
28	2100	1400	1300	1600	2100	2300
29	2200		1300	1800	2000	2300
30	2200			1800	2000	2300
31	2100		1400		2000	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1965
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	2300	2800	3200	3500	4700	4400
2	2300	2700	3200	3700	4700	4500
3	2300	3000	3300	3800	4700	4400
4	2300	3100	3400	3800	4600	4500
5	2300	3300	3400	4100		4500
6	2300	2900	3300	5000	4400	4600
7	2300	3600	3400	4900		
8	2400	2800	3400	4400	4400	4700
9	2400	2800	3400	3900		4700
10	2400	2900		4000	4300	4700
11	2200		3400	4200	4400	4700
12	2400	3300	2200	4200		4700
13	2300		2300	4200	4300	4700
14	2300	2700	2900	4200	4300	4700
15	2200	3100	3200	4100	4300	4600
16	2200	2700	3000	4400	4400	4600
17	2600	2800	3200	4200	4300	4700
18	2700	2800		4000	4300	4600
19			3400	4200	4400	4700
20	2700	3000	3600	4200	4300	4000
21	2800	3100	3500	4200	4200	3750
22	2700	3000		4200	4200	3500
23	2500	3000	3000	4400	4200	3750
24		3100	3100	4600	4200	3500
25	2700	3000	3300	4300	4200	3500
26	2700	2900	3300	4400	4300	3500
27	2700	3000	3500	4400	4200	3500
28	2700	3200	3900	4500	4300	3500
29	2600		4400	4600	4300	3750
30	2700	3200	3700	4600	4300	3750
31	2800	3300	3300	4700		3750

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1966
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jan	Feb	Mar	Apr	May	Jun
1	3500	2750	1625	1050		1625
2		2500	1375		1000	1700
3	3250	2500	1300	1050	1125	1750
4	3250	2000	1300	1075	1125	1750
5				1125		1675
6	3250	1925	750	1100	1300	1625
7	3250	1925	675	1125	1575	1625
8		2000	750	1125	1575	1425
9	3250	2000	800	1125	1550	1500
10	3000	3025	1000		1650	1425
11	3000	3025	1050	1200	1500	1325
12	3000	3025	1050	1000	1200	
13	2750	2750	1125	950	1125	1700
14	2750	2500	1000	1050	1175	1450
15	2750	4000	900	1200	1175	1450
16	2500	3000	675	1125	1375	1450
17	2500	1950	800	1200	1500	1500
18	2500	1850	700	950	1425	
19	2500	1700	875	875	1575	1500
20	2500	1750	1000	700	1600	1500
21	2500	1500	900	750	1600	1650
22	2500	1500	1000	775		1650
23	2500	1500	1125	1000	1375	
24	2500	1450	1250	625		
25	2750	1450	1125	450	1275	
26	2750	1550	1125		1325	
27	2750			725	1375	3025
28	2750	1575	1050	850	1375	1650
29	2750		1025	825	1425	1625
30			1025	900	1425	1625
31	3000		925		1625	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1966
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	1700	1600	2400	2200	2500	2900
2	1300	1600	2200	2500	2500	2900
3	1400	1600	1900	2500	2200	2900
4	1400	1500	1800	2600	2200	3200
5	1400	1600	1900	2700	2700	3200
6	1400	1500	1900	2700	2400	3500
7	1500	1500	2000	2700	2400	3400
8	1300	1500	2200	2800	2500	3200
9	1400	1500	2300	2800	2300	3400
10	1500	1600	2000	2800	2600	2800
11	1500	1400	1800	2700		3400
12	1700	1400	2000	2800	2700	3400
13	1600	1400	2000	2800	2700	3300
14	1500			2800	3000	3300
15	1600	1400	2400	2500	1900	3300
16	1700	1500	2500	2700	2700	3300
17	1500	1600		2400	2700	2800
18	1600	1600	2500	2800	2700	2800
19	1600	1500	2700	2400	2700	2700
20	1600	1600	2400	2800	2700	3300
21	1600	1600	2500	2900	2700	2900
22	1600	1800	2500	3100	2700	2700
23		1800	2400	3100	3000	3000
24	2100	2000	2400	2900	3000	2700
25	2100	1900	2500	2900	3200	2900
26	2200	2000	2400	3000	3200	3000
27	2100	2100	2500	2900	3400	3200
28	1800	2300	2500	2600	2800	2800
29	1700	2100	2400	2400	2700	2700
30	1700	2400	2200	2600	3400	2800
31	1600	2300		2500		3000

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1967
CHLORIDES AS CL^- IN PARTS PER MILLION

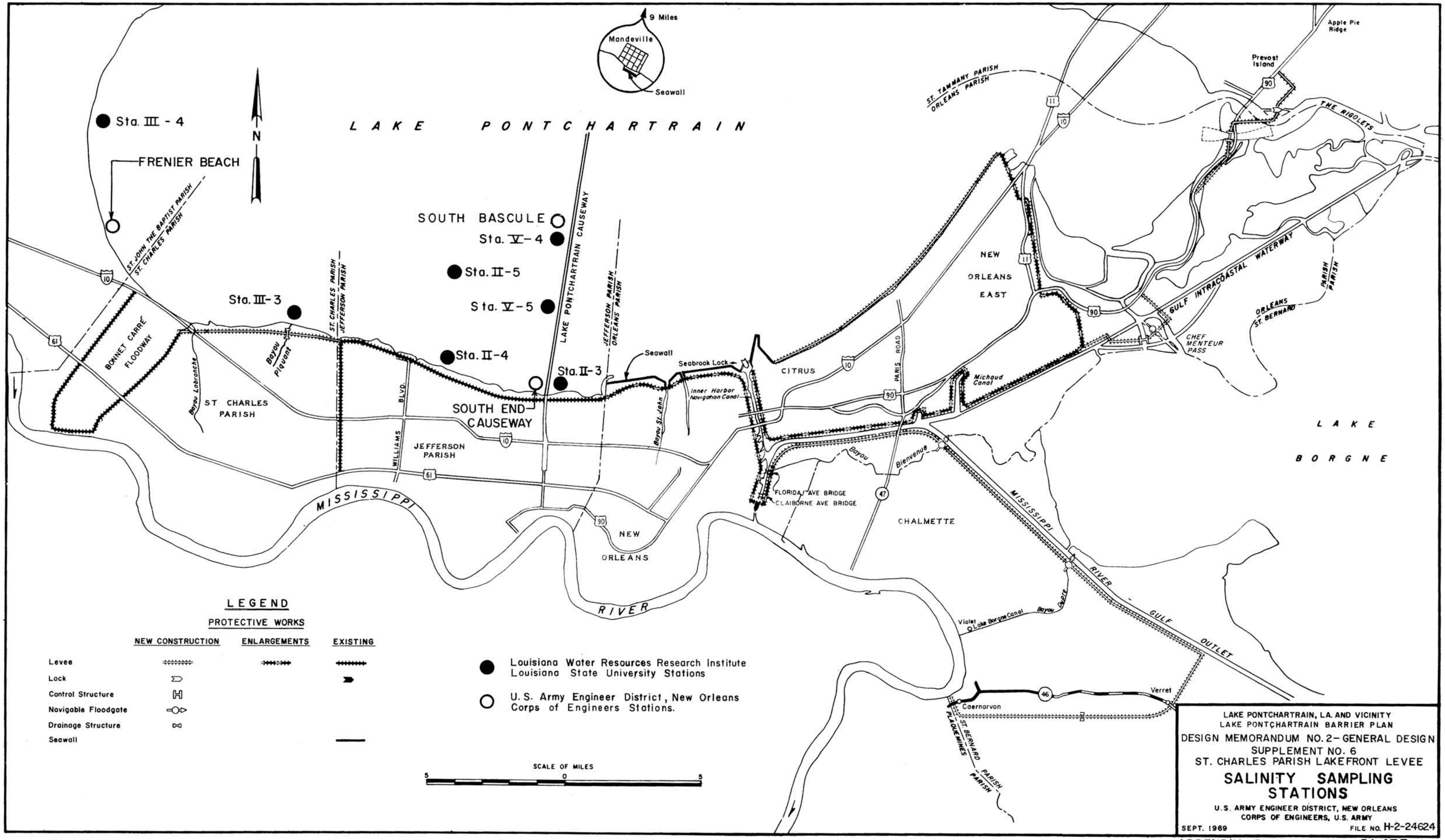
Day	Jan	Feb	Mar	Apr	May	Jun
1	3100	2700	2700	2500	2700	2700
2	3000	2500	2700	2500	2200	2800
3	3100	2700	2700	2600		2800
4		2700	2800	2700	2400	2800
5	3200	2900	2700	2800	2600	2800
6		2800	2600	2900	2600	3000
7	3000	2800	2600	2900	2500	3000
8	2800	2800	2600	2900	2400	3000
9	2900	2800	2600	2900	2700	3000
10	2900	2800	2800	2900	2700	2900
11	3000	2800	2500	2900	2600	2800
12	2900	2800	2600	3000	2500	2900
13	3000	2800	2600	2900	2400	3000
14		2800	2700	2800	2400	3000
15	3000	2800	2800	2800	2400	2700
16	3000	2700	2700	2800	2500	2700
17	3000	2700	2600	2700	2500	2700
18	3000	2700	2700	2700	2700	2700
19	2900	2700	2800	3000	2600	2700
20	3000	2800	3000	3000	2600	2700
21	2900	2600	3000	2800	2600	2800
22	2900	2700	3000	2700	2600	2700
23	2900	2800	3000	2600	2500	2800
24	2700	2800	3000	2500	2900	2800
25	2900	2800	3000	2700	2800	2700
26	2900	2800	2700	2700	3000	2900
27	3100	2800	2700	2600	2800	2800
28	2800	2700	2900	2900	2800	2800
29	2800		2700	2900	2400	2700
30	2800		2800	2900	2900	
31	2800		2600		2700	

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM: LAKE PONTCHARTRAIN
LOCATION: SOUTH BASCULE OF GREATER NEW ORLEANS EXPRESSWAY BRIDGE

1967
CHLORIDES AS CL^- IN PARTS PER MILLION

Day	Jul	Aug	Sept	Oct	Nov	Dec
1	2200		3500	3500	3250	4000
2	2700	3200	3500	4000	3500	4000
3	2700	3300	3500	3800	3250	3500
4	2600	3300		3900	3500	4000
5	2800			3800	3250	3750
6	2700	3400	3800	3700	3500	4000
7	2700	3300	3400	3700	3750	3750
8	2700	3300	3400	3700	3500	4000
9	2800	3400		3500	3750	4000
10	2600	3400	3300	3400	3500	
11	2700	3400	3300	3400	3750	4000
12	2900	3600	3200	3500	3500	3750
13	2900	3700	3300	3400		3750
14	3000	3600	3400	3500	3750	3750
15	3100	3600	3600	3500	3750	3500
16	3100	3700	4000		3750	3500
17	3300	3700	3900	3750	3750	3500
18	3300	3600	3800	3750		3250
19	3200	3600	3700	3500	3750	3250
20	3200		3700	3500	4000	3500
21	3200	3700	3800		3750	3000
22	3200	3700	3900	3250	4000	3250
23	3200	3600	3800	3250	3750	3250
24	3200	3700	3700	3500	3750	3250
25	3200	3700	3500	3250	3750	3250
26	3300		3900	3500	3500	3500
27	3400	3600	3800	3250	4000	3500
28	3400	3600	3800	3250		3500
29	3400	3400	3900	3500	4250	3500
30	3400	3500	3800	3500	4000	3500
31	3200	3400		3000		3500


LAKE PONTCHARTRAIN
9 Miles
Mandeville
Seawall
N
Sta. III - 4
FRENIER BEACH
SOUTH BASCULE
Sta. V - 4
Sta. II - 5
Sta. III - 3
Sta. V - 5
Sta. II - 4
Sta. II - 3
SOUTH END CAUSEWAY
LAKE PONTCHARTRAIN CAUSEWAY
ST. JOHN THE BAPTIST PARISH
ST. CHARLES PARISH
ST. CHARLES PARISH
JEFFERSON PARISH
JEFFERSON PARISH
ORLEANS PARISH
ST. TAMMANY PARISH
ORLEANS PARISH
BONNET CARRÉ FLOODWAY
Bayou Labranche
Bayou Piquant
ST CHARLES PARISH
WILLIAMS BLVD
JEFFERSON PARISH
Seawall
Seabrook Lock
Bayou St. John
Inner Harbor Navigation Canal
CITRUS
PARIS ROAD
NEW ORLEANS EAST
Michoud Canal
Apple Pie Ridge
Prevost Island
THE RIGOLETS
GULF INTRACOASTAL WATERWAY
CHEF MENTEUR PASS
ORLEANS PARISH
ST. BERNARD PARISH
LAKE BORGNE
Bayou Bienvenue
FLORIDA AVE BRIDGE
CLAIBORNE AVE BRIDGE
CHALMETTE
NEW ORLEANS
MISSISSIPPI RIVER
MISSISSIPPI RIVER - GULF OUTLET
Violet
Lake Borgne Canal
Bayou Dupre
Caernarvon
Verret
PLAQUEMINES PARISH
ST. BERNARD PARISH
LEGEND
PROTECTIVE WORKS
NEW CONSTRUCTION
ENLARGEMENTS
EXISTING
Levee
Lock
Control Structure
Navigable Floodgate
Drainage Structure
Seawall
Louisiana Water Resources Research Institute
Louisiana State University Stations
U. S. Army Engineer District, New Orleans
Corps of Engineers Stations.
SCALE OF MILES
5
0
5
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 6
ST. CHARLES PARISH LAKEFRONT LEVEE
SALINITY SAMPLING STATIONS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U.S. ARMY
SEPT. 1969
FILE NO. H-2-24624