U. S. ARMY, CORPS OF ENGINEERS

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

B-1U etc.
& D-2
as listed below

DESIGN MEMORANDUM No. 5
DETAIL DESIGN
BAYOU BIENVENUE AND BAYOU DUPRE
CONTROL STRUCTURES

BIENVENUE

B-1U B-4
B-2 B-5
B-3

DUPRE

D-U-3 D-3
D-1-U D-4
D-1
D-2

Prepared by:

Waldemar S. Nelson & Company, Inc.
Engineers & Architects
New Orleans, La.

U. S. Army Engineer District, New Orleans
Corps of Engineers, U. S. Army
New Orleans, La.

MARCH 1968

LMVED-TD (NOD 25 Jun 68) 7th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 17 Apr 69

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

The procedure shown on Incl 9 is satisfactory.

FOR THE ACTING DIVISION ENGINEER:

1 all incl

A. J. DAVIS
Chief, Engineering Division

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

IN REPLY REFER TO

LMNED-PP

25 June 1968

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

1. The subject detail design memorandum is submitted herewith for review and approval in accordance with the provisions of ER 1110-2-1150 dated 1 July 1966.

2. Waldemar S. Nelson and Company, Inc., Engineers and Architects, New Orleans, Louisiana, prepared this design memorandum under the provisions of Contract No. DA-16-047-CIVENG-66-320.

3. On 15 March 1968, the final version of the design memorandum was submitted by the A-E; however, subsequent to review by this District, major revisions to the memorandum were required prior to submission to the Division Engineer.

4. Appropriate revisions have been made and approval of the subject design memorandum is recommended.

1 Incl (16 cys)
DDM No. 5

THOMAS J. BOWEN
Colonel, CE
District Engineer

LMVED-TD (NOD 25 Jun 68) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 30 Jul 68

TO: Chief of Engineers, ATTN: ENGCW-EZ

Pursuant to para 17a, ER 1110-2-1150, subject detailed design memorandum is submitted for your review and approval. While it is realized that the voluminous comments inclosed herewith will be taxing upon reviewers, it is imperative that the design of these structures proceed without delay to insure the orderly completion of the project. Approval is recommended, subject to the inclosed comments.

FOR THE DIVISION ENGINEER:

2 Incl
wd 4 cy incl 1
Added 1 incl (dupe)
2. Comments w/incl

A. J. DAVIS
Chief, Engineering Division

CF:
NOD-LMNED-PP
w/cmts

30 July 1968

DEPARTMENT OF THE ARMY
LOWER MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
VICKSBURG, MISSISSIPPI 39180

COMMENTS ON DESIGN MEMORANDUM NO. 5, DETAIL DESIGN, BAYOU BIENVENUE AND BAYOU DUPRE CONTROL STRUCTURES, LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, CHALMETTE AREA PLAN, INCLOSED WITH LETTER, LMNED-PP, 25 JUNE 1968, SUBJECT: LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, CHALMETTE AREA PLAN, DETAIL DESIGN MEMORANDUM NO. 5, BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

1. Para 8b, page I-3. This paragraph states that the guide wall at each end of the gate bay is 95 feet long while Plate I-7 shows the guide wall to be 96 feet long. This difference should be resolved. This paragraph should also mention the 72-foot long timber fender which is opposite the timber guide wall at each end of the gate bay.

2. Para 8d, page I-3. Elevations quoted in this paragraph are referenced to two different datum planes. Both should be referenced to mean sea level.

3. All Plates. Graphic rather then ratio scales should be used where the drawing is to be reduced.

4. Plate I-5. a. The new retention dike for the spoil area (as well as the existing dike to be left in place or removed) should be indicated on this plate.

b. If the existing retention dike is to be left in place as shown at Sta. 17+00 on the left of the plate and thence toward the proposed levee centerline as indicated on Plate I-2, a stability study should be made to determine the effect of excavating the 1 on 5 slope from el 6 to the approximate toe of this existing dike.

5. Plate I-6. a. The Mississippi River-Gulf Outlet should be labeled.

b. There should be no reference to scale in the title block.

6. Plate I-7. Provisions should be made for a handrail on all guide wall and timber fender walkways.

7. Paras 1a and b, page II-1. a. The descriptions given cannot be followed on Plate II-1 since it is illegible.

b. The pumping station capacities listed do not agree with those quoted in para 3a, page II-5. This difference should be reconciled.

8. Para 5a, page III-2. Although Boring U-3 at the Bayou Dupre site indicates a 5-foot sand stratum thickness, other borings at this site show different thicknesses of sand. These variations have been properly considered in the dewatering and pressure relief analyses. However, the borings and method used to select the design thickness should be discussed in this paragraph.

9. Para 5b(1), page III-3, and Calculation Sheets 1-4 of 10. a. The procedures used in the Bayou Dupre dewatering and pressure relief analyses are valid for a well system that fully penetrates the pervious aquifer. However, the well point tips are shown at el -31.0 which gives a well penetration of approximately 36 percent. Therefore, the analyses and resulting costs of dewatering should be restudied using one of the following alternatives:

(1) Use well points with long screens extending to el -40.0 to give 100 percent well penetration of the aquifer. If 3-foot well point screens are used, possibly they can be staggered at various elevations between the top and bottom of the aquifer to yield an effective 100 percent well penetration. The procedures on Calculation Sheets 1-10 of 10 would then be satisfactory. Another possibility is to install wells which fully penetrate the aquifer and which are pumped by deep well pumps. A single stage of these wells could be installed either at ground surface or on the berm at el 3. If this system is used, minor adjustments in the calculations should be made to compute the flow and drawdown.

(2) Use a partially penetrating well system and follow the procedures outlined on Incl 1, "Artesian Flow From an Infinite Line Source to a Circular Group of Unequally-Spaced Wells."

(3) Use a partially penetrating well system and use the procedures outlined in para 31 of WES TR No. 3-619, "Three-Dimensional Electrical Analogy Seepage Model Studies," dated March 1963.

b. Approximate calculations by this office indicate for the conditions stated in the next-to-last sentence of the paragraph and Plate III-20, the factor of safety with respect to net uplift is about 1.7 for both sites rather than 1.3 cited in the last sentence of the paragraph.

10. Para 5b(1)(c), page III-4. The quantity of flow in gpm for the Bayou Dupre construction pressure relief analysis should be revised to agree with the results of the study discussed in para 9 above.

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11. Para 5b(2)(a), page III-4 and Calculation Sheets 8-10 of 10.

a. The sand drain pressure relief design as discussed in this paragraph and indicated on the calculation sheets does not provide an adequate factor of safety with respect to uplift. A piezometric elevation in the sand stratum at the center of the excavation cannot be less than the discharge elevation of the vertical sand drain, el -14.28. The computed factor of safety with respect to uplift at the center of the completed excavation under these conditions is 1.06, which is not adequate. Therefore, a design should be prepared for pressure relief and dewatering considering the use of wells or well points. A single stage system of wells with deep well pumps, a single stage eductor well point system, or a conventional two-stage well point system may be required. A two-stage system would require a larger excavation, but the system of well points required should be less than that required for the open excavation plan.

b. The procedure used to calculate the percent reduction in quantity of flow due to the sheet pile wall should be reinvestigated based on the results of the following study made by this office. Incl 2 shows a simplified plan of flow with and without the steel sheet pile wall considered in the studies. Using the method of fragments discussed in Section 6-6 of "Groundwater and Seepage" by Milton E. Harr, our calculations indicate that the percent reduction used in the analyses on the design memorandum calculation sheets may be greatly underestimated. Although the procedure on Incl 2 does not consider the radical flow pattern which would exist for a ring source of seepage with a concentric circular well array, nevertheless, it suggests only a one percent reduction in flow due to sheet piling with a 1/16-inch interlock opening. Thus, it appears that while this analysis is not exact, it shows that the sheet piling cannot be safely relied on to greatly reduce dewatering requirements. Based on these results, it is suggested that, for simplicity, the influence of the sheet piling on dewatering flows be neglected in the design of the dewatering system even though some reduction may result. Thus, a thorough analysis should be made to provide an accurate cost estimate and sound excavation plan to permit an evaluation of the recommended method of excavation and dewatering.

12. Para 5c, page III-4. The paragraph should state that the structure has been designed considering full uplift pressures beneath the entire base slab. This is considered satisfactory.

13. Para 9, pages III-7 and III-9. The stability of the "I" and "T" type floodwalls and wingwalls should also be investigated for conditions of maximum reverse differential head (MR-GO side el 0.0, landside el +5.0) using Q and S design shear strengths and a factor of safety of 1.5.

14. Para 11d, page III-11. The stream closure settlements indicated in this paragraph are considered low when compared to the measured settlements for fills of less height discussed in para 11c. The settlements of the stream closures should be checked to insure that adequate settlement allowances have been provided in the design and estimates of cost.

15. Plate III-2. Symbols used to denote the unconfined compression and unconsolidated undrained test results in the shear strength versus elevation plot should be revised to conform with those indicated in the general notes on Plate III-1.

16. Plates III-7 and III-8. It should be noted that test results presented on these plates were performed by the A-E. These tests, especially the R tests, were not performed in accordance with procedures in EM 1102-2-1906. Future shear testing should comply with established Corps of Engineer testing procedures.

17. Plate III-13. Analyses should be performed for the third lift with the water level on the MR-GO side of the closure at el 13.0 and the results reported in a manner similar to that on Plate III-12.

18. Plate III-14. a. Both sections on this plate should be analyzed for a condition with the channel excavation complete to el -13.78 prior to placing the shell and riprap materials. A factor of safety of 1.3 should be provided for this condition.

b. Procedures used to estimate the gain in foundation shear strength due to stage construction should be shown. At the Bayou Bienvenue levee, the assumed gain in strength ranges from 92 to 200 percent of the initial strength, which values appear high. If the strength gains are not obtained during construction, the design will not be adequate. To evaluate the adequacy of the design, the size and shape of the surcharge fill and all other lifts to be placed in this area should be described. The strength gain should be estimated using procedures shown on Figure 3 of draft EM 1110-2-1902, Stability of Earth and Rockfill Dams, dated February 1968, using conservative estimates of the percent consolidation occurring between stages. This requires a knowledge not only of the Q strength but also the R strength of each foundation stratum. Although R test data are meager, it is considered that an R strength of $\phi = 13°$, $c = 0$ can be assumed for these clays for design purposes. The results of this evaluation and revised stability analyses should be presented in this DM.

19. Plate III-15. A similar analysis should be performed for the area in which riprap and shell are to be placed. Although the high bank is at a lower elevation, the section should be analyzed for the condition of channel excavation complete to el -13.78 prior to placing the riprap and shell materials. The section should be designed to provide a factor of safety of 1.3 under these conditions.

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20. Plate III-20. The stability analyses for open excavation should be revised in accordance with comments on the pressure relief systems discussed above.

21. Plate III-21. a. In designing the sheet pile inclosure, the influence of the sloping excavation above el -5 and temporary protection levee should be considered. A series of trial wedges can be used to compute the earth forces and pressures on the sheeting and bracing. The assumed water table elevation is considered appropriate for wells or well points to be installed as discussed previously.

b. Because of arching and rigidity of the truss, loads in the truss may be higher than those computed. Therefore, low-working stresses should be used to design the truss.

c. The design should be checked using S shear strengths.

22. Plate III-22. a. The note in the lower right hand corner of the plate should be checked. Plate I-5 does not indicate a section similar to that analyzed on Plate III-22.

b. A stability analysis should be made for the southeast channel bank and retention dike at about Sta 16+00 at the Bayou Dupre structure. It appears that this section may be more critical than that shown on Plate III-22.

c. In the Bayou Bienvenue retention dike analyses, a design shear strength of $\emptyset = 0°$, c = 400 psf has been used from el -35.0 to el -51.0 rather than el -47.0 as indicated on Plate III-1 and other plates showing Bayou Bienvenue area stability analyses. The analysis on Plate III-22 is conservative and considered satisfactory.

d. Minimum distances from the retention dike centerlines to the top of bank of MR-GO, excavated channels and backwater canals should be established for both the Bayou Bienvenue and Dupre locations. This should be done based on the new and existing retention dike configuration and anticipated maximum spoil heights.

e. Show the maximum allowable height or elevation for the spoil to be retained.

23. Para 3, page IV-1. Select backfill material is to be used adjacent to the gate bay walls and sheet pile wingwalls above el 0. Thus, the equivalent fluid pressure for the active and at-rest lateral earth pressure for the saturated and submerged conditions should be shown for this type of backfill.

24. Para 6.b, page IV-[illegible]. Case V loading condition here was water elevation 15.0 in MR-GO which does not agree with the MR-GO water elevation 16.0 given in the Case V loading description on Plate IV-22. This difference should be reconciled or explained.

25. Para 8.b, page IV-10. It is stated in this paragraph that at rest earth pressures were used in the design of the gate recess walls, yet an equivalent fluid pressure for submerged shell of 8.5 pounds is used in the load diagrams on Plates IV-9 and IV-10. This does not agree with the at-rest lateral pressure for shell of 20 pounds included in para 3, page IV-1.

26. Para 13b, page IV-15. a. Water analyses should be performed on samples from the water in the MR-GO and ground water at these sites to determine if sulphate contents of the magnitude described in this paragraph will be encountered. If the sulphate contents are found to exceed the limits for Type II cement outlined in Civil Works Bulletin 56-18, all concrete exposed to the sulphate water should be made using Type V cement.

b. If Type V cement is required and is not locally available, the cost estimate should reflect the increased price due to having to procure this cement from other sources, if this has not been done.

c. Should the water sample analyses indicate Type V cement is not required, Type II cement should be used for all concrete. Type I cement should not be used.

27. Plates IV-3 thru IV-8. a. The tabulation of the pile reactions should be revised to indicate in which row the maximum and minimum pile reaction occurs for each of the pile groups.

b. Due to the walls being relatively thick and the structures being supported by pile foundations, the yield of the structures may not be sufficient to produce the totally active earth pressure condition. At rest earth pressures should have been used but the active lateral earth pressures used are conservative, since an increased lateral load on the walls will tend to reduce the moment in the base slab.

28. Plates IV-3 thru IV-11. The lateral water and earth pressures should be properly identified as shown in red on Plates IV-3, [illegible].

29. Plates IV-4, IV-6, IV-7, and IV-8. Select backfill equivalent fluid pressures above the water surface vary from 50 to 70 pounds in the analyses. This discrepancy should be reconciled.

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30. Plate IV-6. A lateral earth pressure of 47.5 lbs/ft^2/ft is used on the land side for the submerged select backfill, but on the MR-GO side, a lateral earth pressure of only 8.5 lbs/ft^2/ft is used for the same material. These inconsistencies should be corrected.

31. Plates IV-6 and IV-8. The equivalent fluid pressures used below the assumed water levels on the protected and MR-GO sides are not in agreement. This discrepancy should be reconciled.

32. Plates IV-9, IV-10, IV-20, and IV-27. To properly identify the design loading condition used in the design, the appropriate case loading number should be used instead of a partial description of the case loading.

33. Plate IV-11. At rest lateral earth pressures should be used in the design of these walls, since they will not yield sufficient to produce an active condition.

34. Plate IV-21. There are irregularities in the loads applied to the horizontal girders since the distribution of loads from the vertical skin plate supports to the three horizontal girders is not consistent. The design should be checked.

35. Plate IV-37. a. This plate should indicate the loading case for which the designs presented have been analyzed. Further, the stratification and available shear strengths should be shown.

b. The reason for use of el -7.0 on the channel side of the wall rather than el -10.78 is not apparent and should be explained.

36. Plate IV-38. The presentation on this plate of the "Detail of Erosion Protection" is not understood. Para 15, page III-12, implies erosion protection is not required. This discrepancy should be reconciled.

37. Para 1c(3), page V-1. Recommend stainless steel wire rope and fittings (if available) be specified in lieu of the galvanized carbon steel wire rope.

38. Para 1c(5), page V-1. Recommend the limit switches be located at or in the gate recesses and actuated by a cam or similar device on the gate. This will eliminate the necessity for adjustment due to variations in length of the wire rope.

39. Para 1c(6), page V-2. Recommend use of a handwheel in lieu of a crank handle for safety reasons.

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40. Plate V-1. Recommend the motor be specified to have a shaft extension on each end and the electric brake be shown connected to the end opposite the reducer connection rather than between the reducer and motor as is now shown. This will permit maintenance on the brake without disturbing the motor.

41. Para 3c, page VI-1. It is suggested that watertight lever type limit switches, installed similarly to those at Schooner Bayou Control Structure, be utilized to stop the gates in the fully open and fully closed positions. This will eliminate the necessity for resetting the switches as the operating cables stretch.

42. Para 7a, page VI-2. Add at end of paragraph: "or shall be insulated with cross-linked thermosetting polyethylene insulation conforming to Interim Standard No. 2 to NEMA Pub. WC-7."

43. Para 7b, page VI-2. Change to read: "and control circuits will be single conductor conforming to Guide Specification CE-1404.04, dated December 1967.

44. Para 8, page VI-3. Because of the difficulties experienced with opening sector gates under reverse-head conditions, the motor size should be increased from 3 to 7-1/2 horsepower (high speed rating). This will require an increased generator size from 10 to 25 kW.

45. Plates No. VI-1 and VI-2. The control schematic diagrams are unnecessarily complicated. Suggest that they be simplified and made similar to the Schooner Bayou Control circuits. While the brake and pawl interlocks should be retained, indicating lights for these interlocks are not necessary and should be deleted.

46. Section VIII - Cost Estimate. a. Although clay backfill is included in the estimate, no source of material is indicated in the text.

b. Since the sector gates at both locations are identical, the difference of $7,500 in the electrical systems and $3,250 in the navigation lights should be explained.

c. The cost for the cathodic protection systems seems excessive. The cost should not exceed $12,000 for each of the structures. It is not apparent why the cost for one structure exceeds the other by $5,400.

47. Para 3, page VIII-7. Although a tabulation showing the comparison of the current estimate with the latest approved PB-3 is given, it does not explain the increase of $834,000 as required by ER 1110-2-1150.

30 July 1968

48. Also refer to annotations in red on the frontispiece map; page iii; Plates I-4, I-5; pages II-2, III-6, III-7, III-11, III-13; computation sheets 2 of 10, 6 of 10, and 9 of 10 in Section III; Plates III-7, III-8, III-14, III-20; pages IV-7, IV-8, IV-9, IV-10, IV-11, IV-14; Plates IV-3, IV-5, IV-6, IV-7, IV-8, IV-9, IV-10, IV-11, IV-12, IV-20, IV-21, IV-22, IV-23, IV-25, IV-27, IV-32, IV-37; and page VI-1.

2 Incl
1. Artesian Flow From an Infinite Line Source to a Circular Group of Unequally Spaced Wells
2. Calculations

ENGCW-EZ (LMNED-PP, 25 Jun 68) 2nd Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, Office of the Chief of Engineers, Washington, D. C. 20315 10 October 1968

TO: Division Engineer, Lower Mississippi Valley

1. Design Memorandum No. 5 is approved, subject to the comments of the Division Engineer and the following comments.

2. Plate IV-2, Section A. Consideration should be given to extending the steel sheet piling (MA-22) to elevation-36.00. This would get the sheet piling through the sand layer, thus giving more positive protection against piping. The 5.00' impervious clay layer on each side of the steel sheet piling (MA-22) should be eliminated and replaced with a 12" layer of clam shells.

3. Plate IV-2, Piling Layout Half Plan. To allow the steel sheet piling to be driven to elevation -36.00, the battered pile should be shifted one foot to landside and one foot to the floodside, changing the two 5.00' dimensions in the middle to 6.00'and the 3.00' dimensions at each edge to 2.00'.

4. Plate IV-36 Section A and the Wing Wall Section. The reentrant corners for the walkway and the pile cap should have diagonal reinforcement.

5. Plate IV-36, Joint Detail. Consideration should be given to eliminating the inverted "T" wall end bulkhead and the concrete sheet pile "I" wall key and making the two walls butt against each other with expansion joint material and PVC waterstop between them. The 4'-0' dimension of the inverted "T" wall end bulkhead may be reduced; however a minimum of 1'-4" should be used.

6. Plate IV-36, Wing Wall Section. Consideration should be given to eliminating the 12"Ø corrugated pipe around the tie rod.

FOR THE CHIEF OF ENGINEERS:

Homer B. Willis

wd all incl

WENDELL E. JOHNSON
for Chief, Engineering Division
Civil Works

LMVED-TD (NOD 25 Jun 68) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 29 Oct 68

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

1. Referred to note approval, subject to comments set forth in the 1st and 2d Indorsements and to furnish the following guidance relative to comments of 2d Indorsement.

2. Para 2. a. As previously discussed in the 1st Ind to NOD letter dated 2 Nov 67, subject: "Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5 - Bayous Bienvenue and Dupre Control Structures (2d Draft)," if the primary purpose of the steel sheet pile cutoff wall beneath the gate bay structure and the inverted "tee" floodwall is to control piping directly beneath the base slab should roofing occur, we consider that the proposed cutoff tip elevation of -26.0 is satisfactory.

b. OCE's comment is directed to consideration of the steel sheet pile cutoff for controlling seepage and piping in the lower sand stratum. In investigating such a cutoff in these sands, it is noted that a cutoff tip elevation of -36.0 would be satisfactory for the Bayou Bienvenue structure as indicated by borings on Plates III-1 and III-4 of the DM. However, a cutoff tip elevation of -36.0 is not adequate for the Bayou Dupre structure as evidenced by borings shown on Plates III-3 and III-4. The steel sheet pile cutoff for this structure should penetrate to approximate el -50.

3. Para 3. The suggested revision to the piling layout will raise the elastic center of the pile foundation, thus increasing the moment about the elastic center and resulting in greater pile loads. Present maximum pile loads are near the design load of 32 kips for group 1 loads and 43 kips for group 2 loads. See cases 4 and 4-A on Plate IV-6 for maximum group 1 loads, and cases 6 and 6-A on Plate IV-8 for maximum group 2 loads. The change will require reanalysis and possibly greater pile penetration. Note that certain piles adjacent to the floodside of the gate recesses cannot be shifted due to minimum clearance from the edge of the concrete slab. At these locations, the pile spacing must be reduced. Comments in para 2b above must be considered in evaluation of the Bayou Dupre pile spacing should the steel sheet piling (MA-22) be extended to cut off the lower sands.

LMVED-TD (NOD 25 Jun 68) ~~1st~~ 3rd Ind 29 Oct 68
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

4. Para 5. The detail of the wall joint should be given careful study. Since it is anticipated that the vertical settlement and horizontal deflection of the "I" wall will exceed that of the "T" wall, a joint detail should be developed which will permit the movement without damage to the structure, and still remain watertight.

5. Para 6. If not previously accomplished, an analysis should be made to determine settlement of the backfill over the tie rods. Tie rod stresses due to this settlement should then be estimated assuming that the sleeve pipe is not used. A tie rod should be designed to withstand these stresses. In this manner, a comparative cost estimate can be prepared for the tie rod designed to withstand the backfill drag loading computed above and for the 1-1/2-inch tie rod inclosed by a sleeve pipe similar to that shown on Plate IV-36. The most economical design should be used.

FOR THE ACTING DIVISION ENGINEER:

George B. Davis
GEORGE B. DAVIS
Acting Chief, Engineering Division

LMNED-PP (NOD 25 Jun 68) 4th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, La. 70160 6 Feb 69

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

1. Proposed disposition of comments in the 1st, 2d, and 3d indorsements of this chain of correspondence is as follows:

a. 1st Ind, incl 2.

(1) Par. 1. The guide wall at each end of the gate bay is 96 feet long. The remainder of this comment is concurred in.

(2) Par. 2. This comment is concurred in; however, the elevation of -9.22 m.s.l. as shown in red on the LMVD marked copy of the DDM should be elevation -10.78 m.s.l.

(3) Par. 3. This comment is concurred in.

(4) Par. 4a. This comment is concurred in.

(5) Par. 4b. A stability study has been made to determine the effect of excavating the 1 on 5 slope from elevation 6.0 to the approximate toe of the existing retaining dike and a minimum factor of safety of 1.3 was found. The analysis shown on plate III-15 of the DDM is typical throughout the area in question.

(6) Par. 5a and 5b. These comments are concurred in.

(7) Par. 6. Handrail details are shown on plate IV-39.

(8) Par. 7a. This comment is concurred in.

(9) Par. 7b. The correct pumping station capacities are as follows:

Pumping Station No. 1	635 c.f.s.
Pumping Station No. 2	445 c.f.s.
Pumping Station No. 3	980 c.f.s.
Pumping Station No. 4	980 c.f.s.

(10) Par. 8. An average design thickness to elevation -40.0 was selected, based on borings D-3, U-3, D-4, and D-1-U, for the purpose of designing the dewatering and pressure relief systems.

(11) Par. 9a(1), (2), and (3). A dewatering system using 3-foot well point screens with tip elevations staggered between elevations -31 and -40 was used in order to yield an effective 100 percent well penetration. Accordingly, the cost for dewatering at the Bayou Dupre site for the open excavation plan (plan 1) will increase approximately $7,000.

(12) Par. 9b. This comment is concurred in.

(13) Par. 10. There will be no change in the quantity of flow if the well point tip elevation is staggered as indicated in paragraph 1a(11) above.

(14) Par. 11a. The sand drain pressure relief design has been eliminated and a design was prepared for pressure relief and dewatering considering the use of well points. Refer to paragraph 1a(15) below.

(15) Par.11b. In accordance with the referenced comment, a dewatering system was designed neglecting the influence of the sheet piling on dewatering flows. The system consists of well points connected to a header which is in turn connected to the suction side of a pump. Refer to calculation sheet 1-3 of 3 (incl 3) for design analysis. This dewatering system will increase the Bayous Bienvenue and Dupre construction costs by $91,400 and $97,400, respectively (refer to revised Section VIII - Estimate of Cost, of the subject DDM, incl 8). Accordingly, the total estimated construction costs for "Plan 2 - Open Excavation with Steel Sheet Pile Inclosure of Foundation Mat" are as follows:

Bayou Dupre	
Initial excavation (dragline)	$ 14,280
Sheet piling	138,400
Bracing system (including support piles)	108,000
Excavation (within inclosure)	17,220
Dewatering system	155,120
Total	$433,020

Bayou Bienvenue	
Initial excavation (dragline)	$ 24,150
Sheet piling	126,000
Bracing system (including support piles)	108,000
Excavation (within inclosure)	17,220
Dewatering system	149,120
Total	$424,490

In view of the increased cost for excavation plan 2, open excavation plan 1 is recommended.

(16) Par. 12. This comment is concurred in.

(17) Par. 13. The stability of the "I" and "T" type floodwalls and wingwalls has been investigated for conditions of maximum reverse differential head using (Q) and (S) design shear strengths and a factor of safety of 1.5, and found to be satisfactory.

(18) Par. 14. The stream closure settlements have been checked and adequate settlement allowances have been provided in the design and estimates of costs. The settlements referred to on page III-11, paragraph 11d of the DDM, are settlements of the final lift. Prior to placement of the second and third lifts, soils borings will be taken and appropriately evaluated to determine the soils conditions existing at that time.

(19) Par. 15. This comment is concurred in.

(20) Par. 16. This comment is noted.

(21) Par. 17. The analyses for the third lift with the water elevation on the MR-GO side of the closure at 13.0 were performed. Failure surfaces C-5 and C-6 shown on plate III-13 should have been appropriately footnoted.

(22) Par. 18a. Both sections on plate III-14 were analyzed for a condition with the channel excavation complete to elevation -13.78 prior to placing the shell and riprap. Factors of safety of 1.3 or greater were found for this condition.

(23) Par. 18b. As stated in paragraph 8a, page III-6 of the subject design memorandum, calculated values of increased soil shear strengths used in stability analyses were based on procedures developed for analyzing levee stabilities during preparation of Design Memorandum No. 3, General Design, Chalmette Area Plan, approved 31 January 1967. Refer to paragraph 38, pages 20-28 of the referenced GDM.

(24) Par. 19. The section on plate III-15 has been analyzed for a condition with the channel excavation complete to elevation -13.78 prior to placing the shell and riprap. Factors of safety of 1.3 or greater were found for this condition.

(25) Par. 20. The stability analyses for the open excavation has been reexamined based on comments relative to the pressure relief system and no changes were required.

(26) Par. 21a. The influence of the sloping excavation above elevation -5.0 and the temporary protection levee was previously considered in designing the sheet pile inclosure. Trial wedges were used to compute the earth forces and pressures against the sheeting and bracing.

(27) Par. 21b. This comment is concurred in.

(28) Par. 21c. The design was checked and it was determined that the (S) shear strengths were not critical.

(29) Par. 22a. This comment is concurred in. Reference should be made to plate I-2 in lieu of plate I-5.

(30) Par. 22b. The stability analysis shown on plate III-15 of the DDM is typical for the area in question.

(31) Par. 22c. This comment is concurred in.

(32) Par. 22d and 22e. These comments are concurred in. The appropriate dimensions will be established during the preparation of plans and specifications.

(33) Par. 23. This comment is concurred in. A saturated unit weight of 110 pounds per cubic foot, cohesion value of 120 pounds, and Ø angle of zero degrees were used.

(34) Par. 24. The water elevation should be 13.0 for the Case V loading description on plate IV-22. Reference should be made to plate IV-20 for wave loads and heights.

(35) Par. 25. The at-rest lateral pressure of 20 pounds for shell as indicated in paragraph 3, page IV-1, should have been used in the design of the gate recess walls. Therefore, the design was reviewed using at-rest pressures and found to be satisfactory. Refer to inclosed revised plates IV-9 and IV-10 (incl 4 and 5, respectively).

(36) Par. 26a, 26b, and 26c. Based on water analyses performed by the New Orleans Public Service, Inc., of water samples from the MR-GO in the vicinity of the structure sites, the yearly average sulphate content exceeds 1,000 ppm. Refer to table 1 below:

Table 1

Sulfates as SO_4 - PPM

1965

	January	February	March	April	May	June
	784	459	487	728	1464	1669
	678	792	302	619	1355	1467
	398	767	1120	1083	1294	1606
	510	342	734	1506		792
				1389		
Avg.	593	590	661	1065	1371	1384

	July	August	September	October	November	December
	930	1606	2030	1182	1309	1926
	2008	1753	1434	1630	1182	1070
	1708	1176	1660		1030	1606
	1467	1184	1518		1184	
	1434		1820			
Avg.	1509	1430	1692	1406	1176	1534

In addition, the chlorine content in the MR-GO has been increasing since 1965. Therefore, it can be assumed, with a reasonable degree of accuracy, that the sulphate content is also increasing. Accordingly, it is recommended that all concrete for construction of the Bayous Bienvenue and Dupre Control Structures be made using Type V cement. The cost estimate for cement as shown on inclosed revised Section VIII - Estimate of Cost, is considered satisfactory.

(37) Par. 27a. Refer to the inclosed tabulation (incl 6) which indicates in which row the maximum and minimum pile reactions occur for each of the pile groups.

(38) Par. 27b. This comment is concurred in.

(39) Par. 28. This comment is concurred in.

(40) Par. 29. Above the water table a saturated unit weight of 110 pounds per cubic foot and a cohesion value of 120 pounds were used for the clay backfill. Below the water table a unit weight of 47 (110-63) pounds per cubic foot was used. To obtain the lateral pressure at any depth the relationship of lateral pressure = γ h $\tan^2 (45° - \frac{\phi}{2})$ - 2C $(\tan 45° - \frac{\phi}{2})$ was used, with $\phi = 0°$. The computed value at the

water surface was plotted on the pressure diagram and for design purposes the pressure diagram was extended from this point to zero at the top of the backfill. If pressures are computed at different depths, joining the diagram to zero at the ground surface will produce different slopes. This method is more conservative than showing no pressure for a depth of $2C/\gamma$ as rigorous application of the formula dictates.

(41) Par. 30 and 31. The pressure diagrams shown on the referenced plates are not equivalent fluid pressures, but are net pressure diagrams for water pressures and soil pressures (refer to lateral pressure relationship given in paragraph 1a(40) above). The slope of the net pressure diagram is dependent on the amount of water pressure relative to the amount of soil pressure.

(42) Par. 32. This comment is concurred in.

(43) Par. 33. This comment is concurred in. Accordingly, the wall design was reviewed using at-rest lateral earth pressures and found to be satisfactory. Refer to inclosed revised plate IV-11 (incl 7).

(44) Par. 34. The sector gates were analyzed as a three-dimensional space frame utilizing an IBM 1130 computer and the program "STRESS." The shears and moments shown include forces from members normal to the sheet and also include secondary effects from joint rigidity. Sufficient manual calculations were performed to verify accuracy of the results.

(45) Par. 35a. The designs presented on plate IV-37 have been analyzed for loading condition No. 1. The remainder of this comment is concurred in.

(46) Par. 35b. Since the wingwall begins 7 feet from the edge of the channel and the side slope from the edge of the channel is 3 horizontal to 1 vertical, the elevation of the first several sheets of wingwall is approximately elevation -7.0.

(47) Par. 36. It was determined that some degree of erosion protection should be provided where waves will strike the vertical face of the I-type floodwall; whereas, erosion protection will not be required for the structure backfill and adjacent levees.

(48) Par. 37. Substituting stainless steel wire rope and fittings in lieu of the galvanized carbon steel wire rope is questionable because of the anodic relationship between the base metal sheaves and the cathodic stainless steel wire rope. Accordingly, it is recommended that the galvanized wire rope, as presented in the DDM, be specified.

(49) Par. 38, 39, 40, 41, 42, and 43. These comments are concurred in and will be incorporated into the plans and specifications for the structures.

(50) Par. 44. A model study is presently being conducted by the U. S. Army Engineer Waterways Experiment Station relative to the difficulties experienced with opening sector gates under reverse head conditions. The results of this study should be available shortly. Therefore, it is recommended that proper sizing of the motor and drive accessories be made during preparation of the plans and specifications subsequent to receipt of the above study results.

(51) Par. 45. The indicating lights for the brake and pawl interlocks will be deleted.

(52) Par. 46a. The clay backfill will be obtained from stockpiles of select material available from the structure excavations.

(53) Par. 46b. The Bayou Bienvenue structure is located within Orleans Parish and approximately a 20-minute boat ride from the junction of Paris Road and the MR-GO. However, the Bayou Dupre structure is located in St. Bernard Parish and requires approximately a 60-minute automobile drive from the junction of Paris Road and the MR-GO followed by a 30-minute boat ride. Accordingly, the cost estimates reflect the additional cost of labor and transportation of materials to the construction sites, as appropriate.

(54) Par. 46c. The costs for the cathodic protection systems have been rechecked and verified. The difference in costs is as explained in paragraph 1a(53) above.

(55) Par. 47. Refer to inclosed revised Section VIII - Estimate of Cost, of the subject DDM (incl 8).

(56) Par. 48. These comments are concurred in. With respect to specific comments annotated in red in the DDM, the following is offered:

(a) Section III, computation sheet 9 of 10. These computations have been revised in accordance with paragraph 11 of the 1st Indorsement.

(b) Plate III-14. Refer to paragraph 1a(23) above.

(c) Page IV-10. Refer to paragraph 1a(35) above.

LMNED-PP (NOD 25 Jun 68) 4th Ind 6 Feb 69
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

(d) Plate IV-9. Refer to paragraph 1a(35) above.

(e) Page VI-1. Refer to paragraph 1a(50) above.

b. 2d Ind.

(1) Par. 2. Since the primary purpose of the steel sheet pile cutoff wall beneath the gate bay structure and inverted T-type floodwall is to control piping directly beneath the base slab should roofing occur, the cutoff tip elevation of -26.0 as presented in the DDM is considered satisfactory. In addition, to provide positive protection against seepage and potential piping through the sheet piling interlocks, the clay layer on each side of the sheet piling is considered necessary. The control of seepage and piping in the lower sand stratum has been further investigated and since the underlying sand stratum covers a much greater area than that covered by the structure, controlling seepage and piping through the sand stratum was found impracticable.

(2) Par. 3. In accordance with paragraph 1b(1) above, shifting the battered pile will not be required.

(3) Par. 4. This comment will be complied with during the preparation of plans and specifications.

(4) Par. 5. Consideration was given to construction of the walls butted against each other with expansion joint material and PVC waterstop between them. However, based on experience with other major structures where significant differential settlement has occurred, the type of joint as presented in the DDM has provided a positive seal and is easily maintained by the addition of filler matrix.

(5) Par. 6. The 12" diameter corrugated pipe around the tie rod will be deleted and the tie rod size increased to a 2" diameter rod.

c. 3d Ind.

(1) Par. 2a and 2b. Refer to paragraph 1b(1) above.

(2) Par. 3. Refer to paragraphs 1b(1) and (2) above.

(3) Par. 4. Refer to paragraph 1b(4) above.

(4) Par. 5. Refer to paragraph 1b(5) above.

FOR THE DISTRICT ENGINEER:

JEROME C. BAEHR
Chief, Engineering Division

(See next page for incl)

LMNED-PP (NOD 25 Jun 68) 4th Ind 6 Feb 69
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

6 Incl (16 cys)
3. Calculation sheet 1-3 of 3, dewatering system
4. Revised plate IV-9
5. Revised plate IV-10
6. Tabulation of pile reactions
7. Revised plate IV-11
8. Revised section VIII of DDM

LMVED-TD (NOD 25 Jun 68) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, Lower Mississippi Valley Division, Corps of Engineer, Vicksburg, Miss. 39180 4 Mar 69

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

1. Action taken to satisfy comments of previous indorsements is satisfactory except as discussed below.

2. Para 1a(23), 4th Ind. The referenced procedure for estimating increased soil strength values due to stage construction assumes that no excess pore pressure exists when successive lifts are constructed. Experience has shown that excess pore pressures do exist during the construction process of loading these foundation soils even when stage construction allows several years between lift placements. Therefore, a conservative estimate of percent consolidation expected to occur between lifts should be assumed and the gain in strength estimated using procedures shown in Fig, 3 of draft EM 1110-2-1902, Stability of Earth and Rockfill Dams, dated February 1968. The results of this evaluation and revised stability analyses should be presented in the design memorandum.

FOR THE ACTING DIVISION ENGINEER:

6 Incl
wd 6 cy Incl 3-8

A. J. DAVIS
Chief, Engineering Division

LMNED-PP (NOD 25 Jun 68) 6th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Chalmette Area Plan, Detail Design Memorandum No. 5, Bayous Bienvenue and Dupre Control Structures

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, La. 70160 2 Apr 69

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

Proposed disposition of the comment in the 5th indorsement of this chain of correspondence is as follows:

5th Ind, par 2. The referenced procedure used for estimating increased soil strength values due to stage construction does assume that excess pore pressure exists. The percent consolidation expected to occur between lifts was calculated and the gain in strength conservatively estimated based on these calculated values. The procedure is shown on inclosure 9 and is similar to Figure 3 of draft EM 1110-2-1902, Stability of Earth and Rockfill Dams, dated Feb 1968. The values shown on inclosure 9 were used for the stability analyses presented in the GDM.

FOR THE DISTRICT ENGINEER:

for [signature]
JEROME C. BAEHR
Chief, Engineering Division

1 Incl
wd incl 3-8
Added 1 incl (16 cys)
9. Design increased
shear strengths

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
DESIGN MEMORANDUM NO. 5 - DETAIL
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

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	Schedule Jul 68
	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 Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Scheduled Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Complex	Scheduled Apr 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Scheduled Jul 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees	Scheduled Apr 70

10/5/05

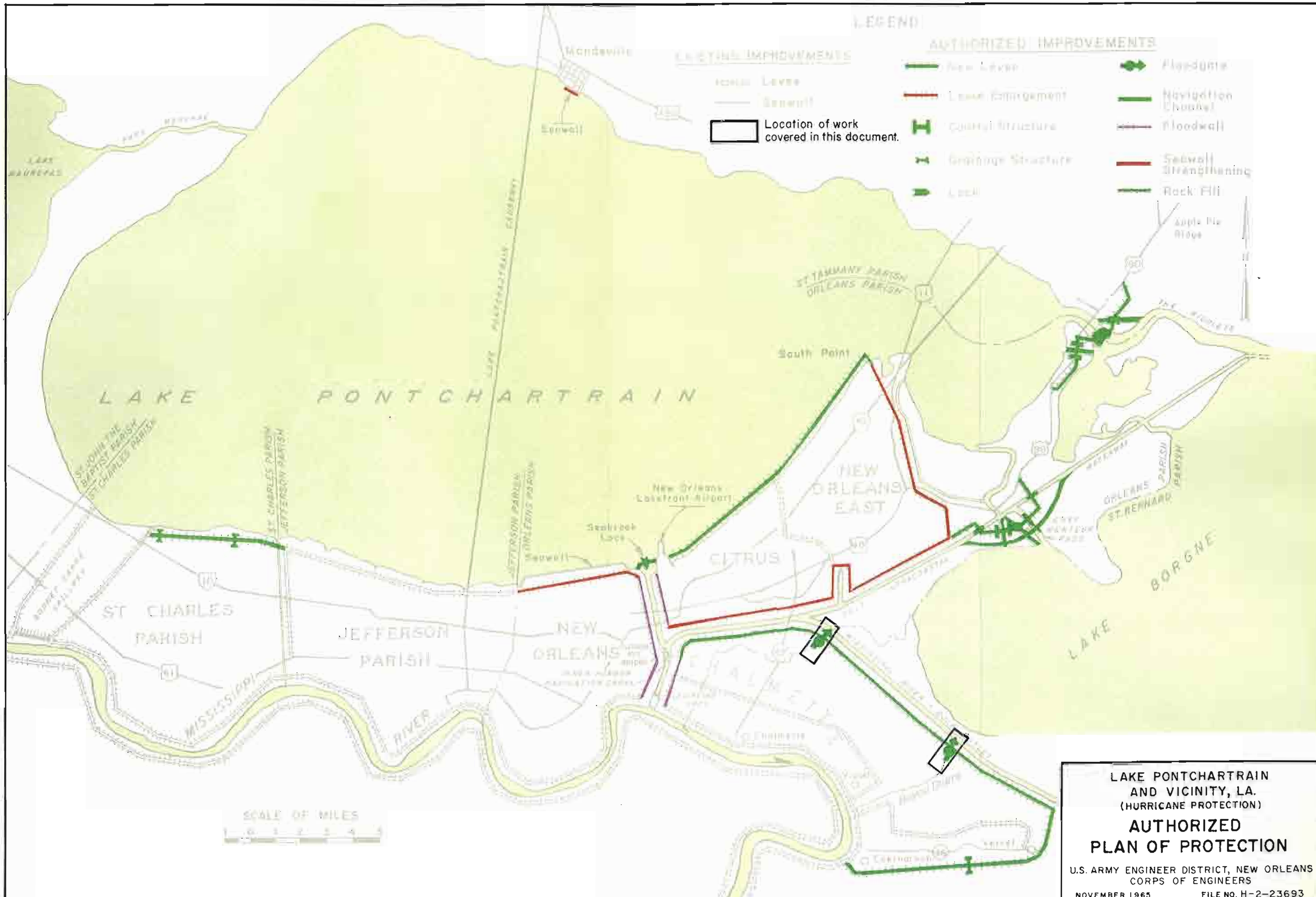
M/55ed

STATUS OF DESIGN MEMORANDUM (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Scheduled Dec 68
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Scheduled Feb 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 GIW	Scheduled Mar 69
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan GDM, Supplement No. 1, Chalmette Extension	Scheduled May 68
4	Lake Pontchartrain Barrier Plan & Chalmette Area Plan, GDM Florida Avenue Complex, IHNC	Not scheduled
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre	Submitted 25 Jun 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Scheduled Feb 69
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Feb 69
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Submitted Feb 69
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled Jan 69

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
10	Lake Pontchartrain Barrier Plan, DDM, Gantry Crane - Chef Menteur Control Structure	Scheduled Jan 70
11	Lake Pontchartrain Barrier Plan, DDM, St. Charles Parish Drainage Structure	Scheduled Jan 70
12	Source of Construction Materials	Approved 30 Aug 66
13	Lake Pontchartrain Barrier Plan, DDM, Gantry Crane - Rigolets Control Structure	Scheduled Jul 70
14	Beautification	Not scheduled
1	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., GDM, Seabrook Lock	Scheduled Mar 68
2	Lake Pontchartrain, La. and Vicinity, and Mississippi River-Gulf Outlet, La., DDM, Seabrook Lock	Scheduled Aug 68



REV. APRIL 1968

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10/05/05 M:SSED

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PLATES

TABLE OF CONTENTS (cont'd)

PLATES (cont'd)

MISSED

TABLE OF CONTENTS (cont'd)

PLATES (cont'd)

PERTINENT DATA

Location of project	Southeastern Louisiana in Orleans and St. Bernard Parishes
Structures	"U" frame, reinforced concrete gate bays
Gates	Sector type
Guide walls	Timber
Dimensions	**Feet**
Width	56
Length (excluding guide walls)	76
Length of guide walls	96 each
Length of timber fenders	72 each
Elevations	**Feet, m.s.l.**
Top of gate bay walls	17.5
Top of gates	17.5
Guide wall	10.0
Sill	-10.8 (-10.0 m.l.g.)
Operating floor of control house	17.5
Hydraulic design criteria	**Feet**
Maximum differential head, MR-GO to landside	11.0
Maximum reverse head, landside to MR-GO	5.0
Cost	
Bayou Bienvenue Structure	$2,900,000
Bayou Dupre Structure	$2,776,000

DESIGN MEMORANDUM NO. 5 - DETAIL DESIGN
BAYOU BIENVENUE AND BAYOU DUPRE
CONTROL STRUCTURES

SECTION 1 - GENERAL

1. Project Authorization. The Bayous Dupre and Bienvenue Control Structures are features of the Chalmette Area Plan of the "Lake Pontchartrain, Louisiana and Vicinity", hurricane protection project authorized by Public Law 298-89th Congress, 1st Session, approved 27 October 1965. By LMNED-PR letter dated 29 November 1966, it was recommended that the approved plan of hurricane protection for the Chalmette area contained in Design Memorandum No. 3, General Design, for Lake Pontchartrain, La. and Vicinity, Chalmette Area Plan, be modified, under the discretionary authority of the Chief of Engineers, to provide for enlargement of the protected area by construction of a levee from the Mississippi River levee near Caernarvon, La., to the vicinity of Verret, La., thence to and along the Mississippi River-Gulf Outlet spoil bank to a junction with the approved plan levee at Bayou Lawler; and elimination of the levee in the approved plan from Bayou Lawler to Violet. This recommendation was approved by OCE on 31 January 1967 in 2d Indorsement to the basic letter. LMNED-PR letter dated 29 November 1966 subject "Lake Pontchartrain, La. and Vicinity Modification of the Chalmette Area Plan to Include Larger Area" and indorsements thereto are included herein as Appendix A.

2. Purpose. This detail design memorandum presents the essential data, assumptions, and criteria used in the design of the principal features of the navigable control structures to be located on Bayous Bienvenue and Dupre. It is prepared to facilitate the preparation of plans and specifications for the construction of these structures and also to assist in the review of the construction plans and specifications.

3. Related Reports. The following listed reports pertain to the area wherein the structures of this design memorandum are located:

Design Memorandum	Status
Chalmette Area Plan Design Memorandum No. 3 General Design	Approved 31 Jan. 1967
Lake Pontchartrain, La. and Vicinity Design Memorandum No. 1-Hydrology and Hydraulic Analysis, Part I-Chalmette	Approved 27 Oct. 1966
Lake Pontchartain, La. and Vicinity Design Memorandum No. 1-Hydrology and Hydraulic Analysis, Part IV-Chalmette Extension	Approved 1 Dec. 1967

Chalmette Area Plan, General Design Memorandum, Supplement No. 1-Chalmette Extension.	Scheduled Apr. 1968

4. Local Cooperation. An act of assurance for the portion of the Chalmette Area Plan located in Orleans Parish, 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. An acceptable joint act of assurance for the portion of the Chalmette Area Plan, exclusive of the approved modification thereto located in St. Bernard Parish, supported by resolutions adopted by the St. Bernard Parish Police Jury and the Board of Commissioners of the Lake Borgne Basin Levee District on 15 and 16 August 1966, respectively, was approved and accepted on behalf of the United States on 28 September 1966. In addition, an acceptable joint act of assurance for the Chalmette Area Plan modification, supported by resolutions adopted by the St. Bernard Parish Police Jury and the Board of Commissioners of the Lake Borgne Basin Levee District on 6 June 1967, was approved and accepted on behalf of the United States on 6 July 1967.

5. Location. The locations of the two control structures are shown on Plate I-1. The Bayou Bienvenue control structure is located at the eastern edge of Orleans Parish, Louisiana and the Bayou Dupre control structure is located in St. Bernard Parish, Louisiana with both bayous draining into the Mississippi River-Gulf Outlet (MR-GO). The Bayou Bienvenue structure will be located at approximate MR-GO base line Sta. 367+50, which is approximately four hundred feet west of the present intersection of Bayou Bienvenue and MR-GO. The Bayou Dupre structure will be located at approximate MR-GO base line Sta. 708+00 which is approximately seventeen hundred feet southeast of the present intersection of Bayou Dupre and the MR-GO.

6. Datum Plan. All elevations indicated or stated are in feet and refer to Mean Sea Level datum unless otherwise noted.

7. Coordination With Other Agencies. In addition to the coordination with other agencies presented in Design Memorandum No. 3-General, Chalmette Area Plan, the Regional Director, Federal Water Pollution Water Control Administration was requested by letter dated 22 June 1967 to furnish comments relative to the Bayous Bienvenue and Dupre control structures. By letter dated 24 August 1967, the Regional Director stated, "These proposed projects should have little effect on the water quality with the water pollution control and disposal of material specifications. However, all contractors should provide and operate sanitation facilities that will adequately treat or dispose domestic wastes to conform with Federal and local health regulations." Provisions relative to maintenance of adequate sanitary facilities by construction contractors will be incorporated into the construction plans and specifications. Copies of the above letters are inclosed as Appendix B.

8. Description. Each control structure will consist of the following features:

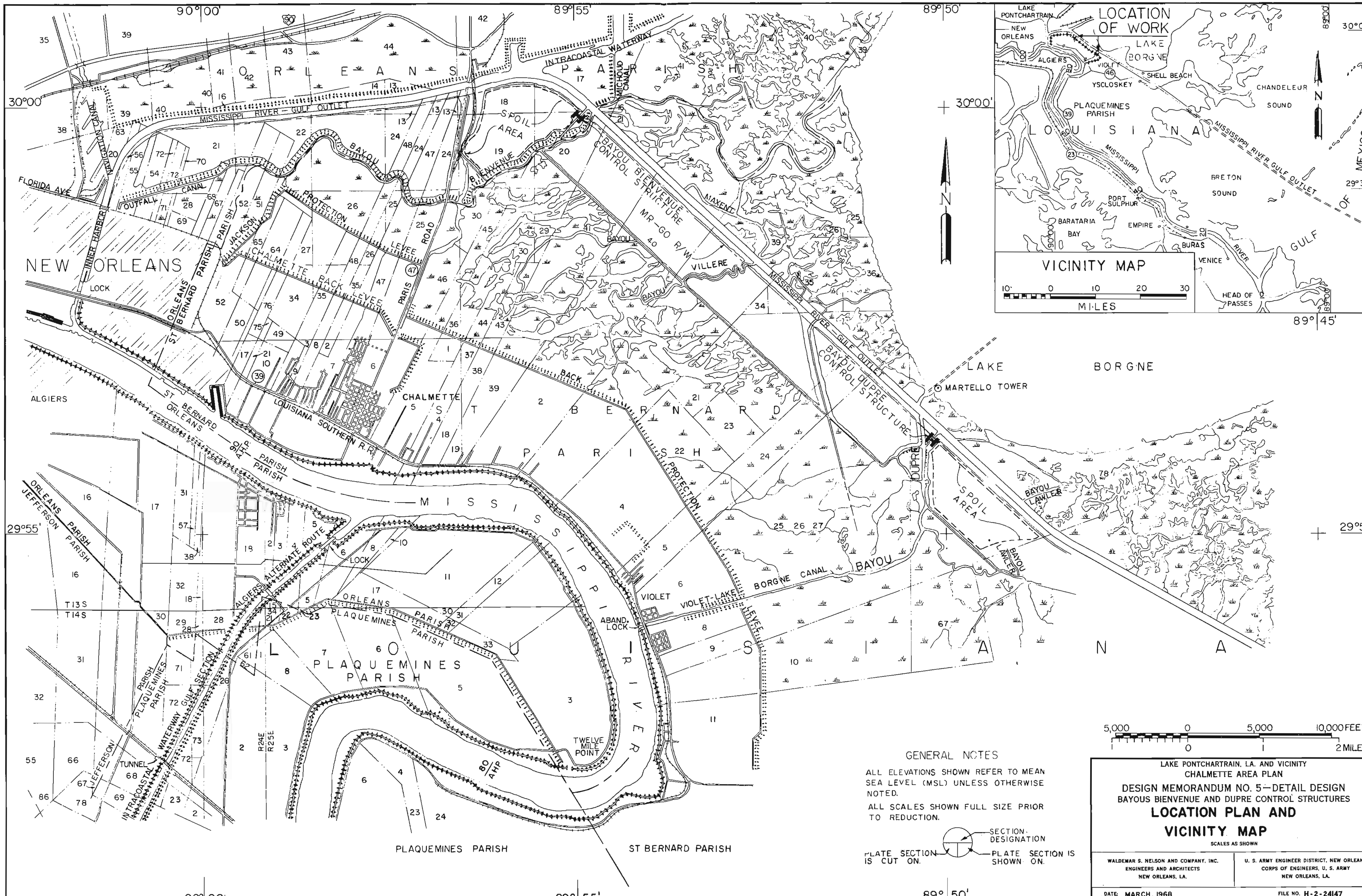
a. Reinforced concrete gate bay 76 feet in length and 56 feet channel width with steel sector gates all supported on untreated timber piling.

b. 95 foot long timber guide wall at each end of the gate bay.

c. Concrete floodwall as tie-in levee to the end of the earthen levee.

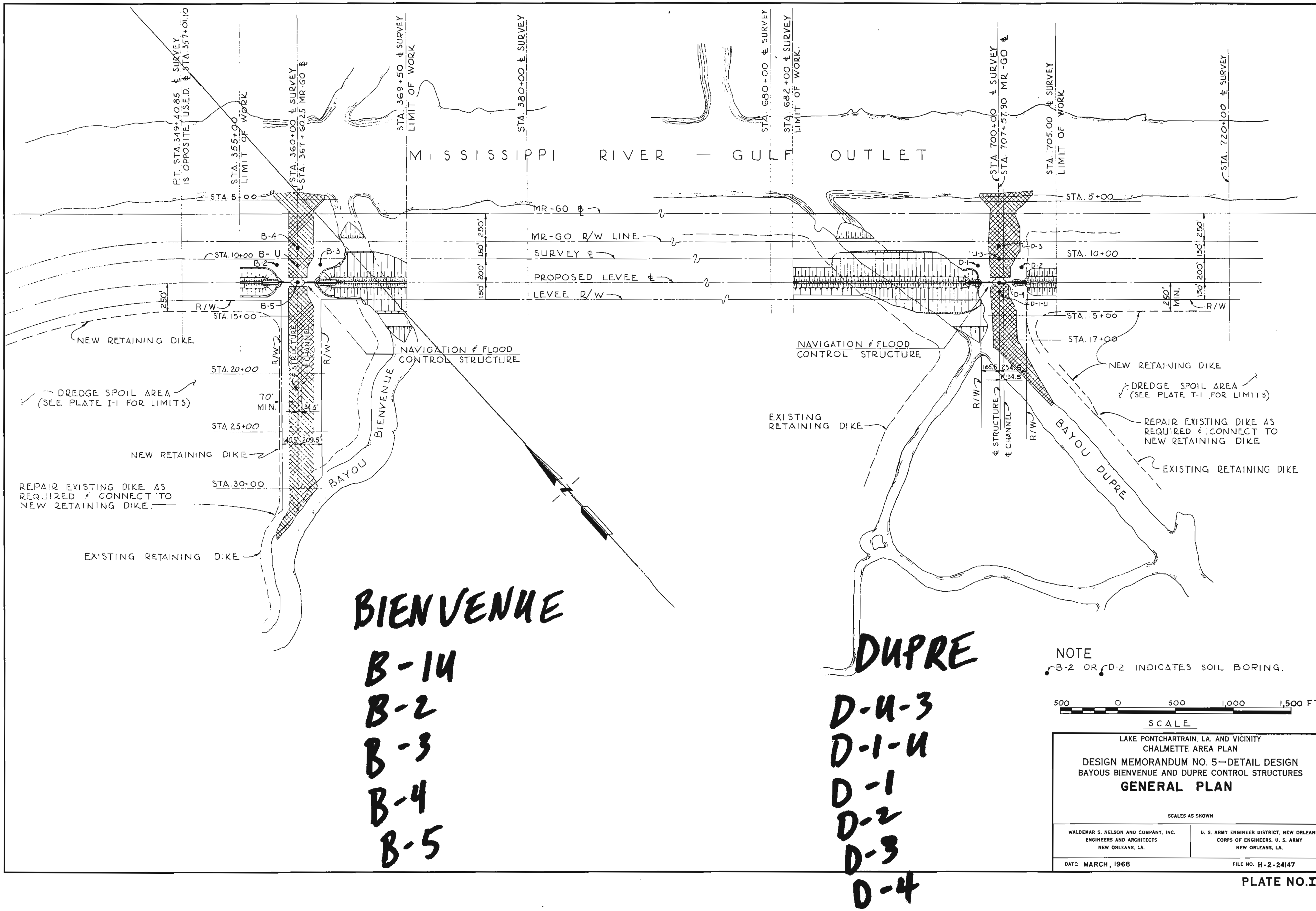
d. Sill elevation will be -10.0 MLG and the top of the gates and floodwalls will be 17.5 MSL.

Operation of the sector gates will be by electric motors through speed reducers and pull cable storing on cable drums. Machinery for manual operation of the gates will be provided. Each structure will contain a butane gas engine driven generator set. Approach channels to the structures will be included in this work.



LOCATION OF WORK
LAKE PONTCHARTRAIN
NEW ORLEANS
LAKE BORGNE
ALGIERS
VIOLET
SHELL BEACH
YSCLOSKEY
CHANDELEUR SOUND
PLAQUEMINES PARISH
LOUISIANA
MISSISSIPPI RIVER GULF OUTLET
MISSISSIPPI
BRETON SOUND
GULF OF MEXICO
PORT SULPHUR
BARATARIA BAY
EMPIRE
BURAS
VENICE
RIVER
HEAD OF PASSES
VICINITY MAP
MILES
ORLEANS PARISH
ST BERNARD PARISH
NEW ORLEANS
INTRACOASTAL WATERWAY
MISSISSIPPI RIVER - GULF OUTLET
MICHOUD CANAL
SPOIL AREA
BAYOU BIENVENUE
BAYOU BIENVENUE CONTROL STRUCTURE
MR-GO R/W
MAXENT
BAYOU VILLERE
PROTECTION LEVEE
CHALMETTE BACK LEVEE
PARIS ROAD
INNER HARBOR NAVIGATION CANAL
FLORIDA AVE
OUTFALL CANAL
JACKSON
LOCK
ORLEANS PARISH
ST BERNARD PARISH
CHALMETTE
LOUISIANA SOUTHERN R.R.
BACK LEVEE
LAKE BORGNE
MARTELLO TOWER
BAYOU DUPRE CONTROL STRUCTURE
DUPRE
SPOIL AREA
BAYOU LAWLER
BAYOU BORGNE CANAL
VIOLET-LAKE BORGNE CANAL
ABAND. LOCK
ALGIERS
MISSISSIPPI RIVER
ORLEANS PARISH
JEFFERSON PARISH
ALGIERS ALTERNATE ROUTE
INTRACOASTAL WATERWAY GULF SECTION
PLAQUEMINES PARISH
TUNNEL
JEFFERSON
LOUISIANA
TWELVE MILE POINT
PLAQUEMINES PARISH
ST BERNARD PARISH
T13S
T14S
R24E
R25E
90°00'
89°55'
89°50'
89°45'
30°00'
29°55'
5,000 0 5,000 10,000 FEET
1 0 1 2 MILES
GENERAL NOTES
ALL ELEVATIONS SHOWN REFER TO MEAN SEA LEVEL (MSL) UNLESS OTHERWISE NOTED.
ALL SCALES SHOWN FULL SIZE PRIOR TO REDUCTION.
SECTION DESIGNATION
PLATE SECTION IS CUT ON.
PLATE SECTION IS SHOWN ON.
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES
LOCATION PLAN AND
VICINITY MAP
SCALES AS SHOWN
WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LA.
DATE: MARCH, 1968
FILE NO. H-2-24147

PLATE NO. I-1



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

GENERAL PLAN

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968

FILE NO. H-2-24147

PLATE NO. I-2

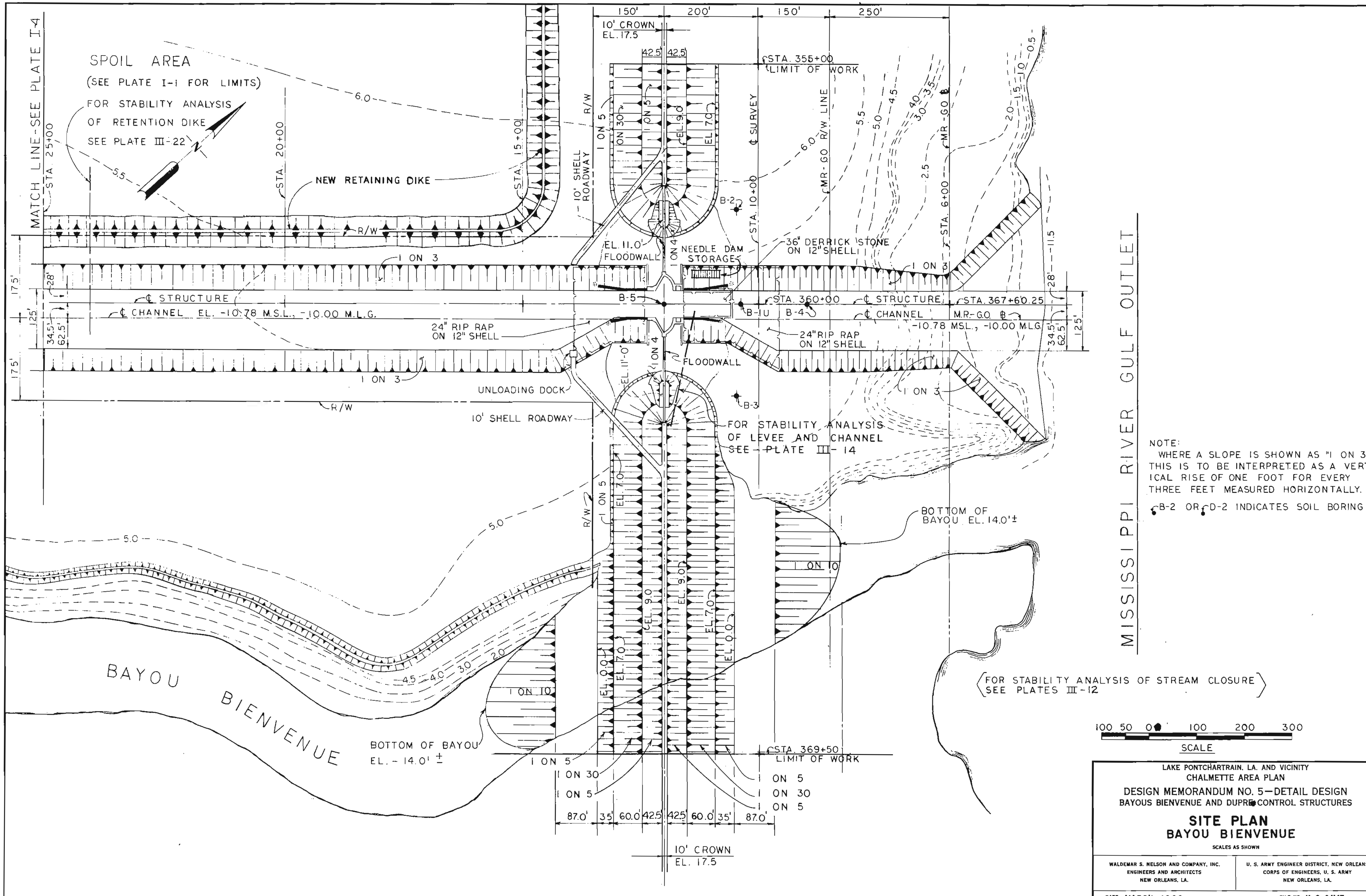
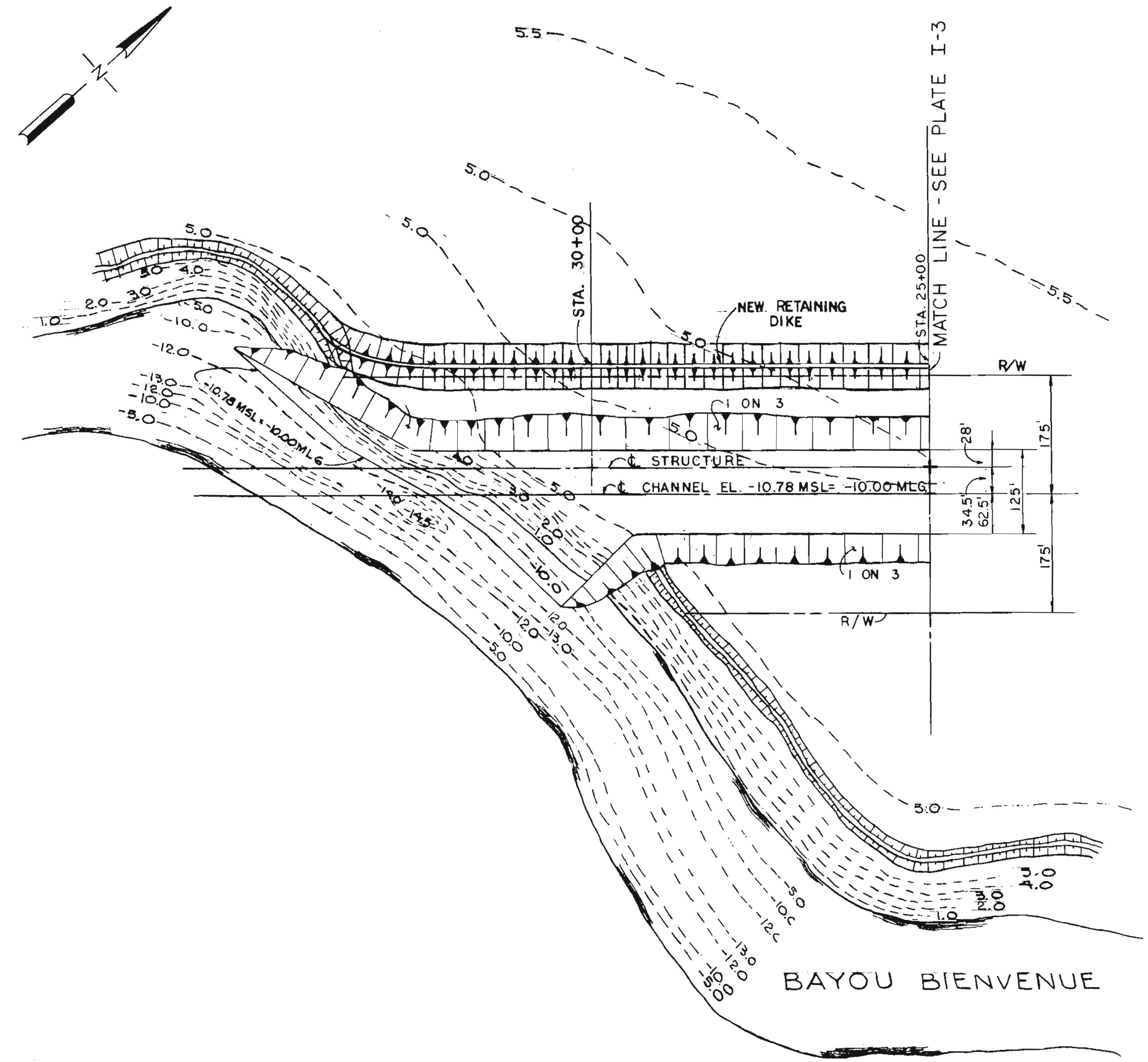

SPOIL AREA
(SEE PLATE I-1 FOR LIMITS)
FOR STABILITY ANALYSIS OF RETENTION DIKE SEE PLATE III-22
MATCH LINE-SEE PLATE I-4
STA. 25+00
STA. 20+00
STA. 15+00
STA. 10+00
STA. 6+00
NEW RETAINING DIKE
R/W
1 ON 3
¢ STRUCTURE
¢ CHANNEL EL. -10.78 M.S.L., -10.00 M.L.G.
24" RIP RAP ON 12" SHELL
UNLOADING DOCK
10' SHELL ROADWAY
10' SHELL ROADWAY
EL. 11.0' FLOODWALL
FLOODWALL
NEEDLE DAM STORAGE
36" DERRICK STONE ON 12" SHELL
STA. 355+00 LIMIT OF WORK
STA. 360+00
STA. 367+60.25
STA. 369+50 LIMIT OF WORK
¢ SURVEY
MR-GO R/W LINE
MR-GO ¢
-10.78 MSL., -10.00 MLG.
10' CROWN EL. 17.5
150' 200' 150' 250'
87.0' 35' 60.0 42.5 42.5 60.0 35' 87.0'
FOR STABILITY ANALYSIS OF LEVEE AND CHANNEL SEE PLATE III-14
BOTTOM OF BAYOU EL. 14.0'±
BOTTOM OF BAYOU EL. -14.0'±
BAYOU BIENVENUE
MISSISSIPPI RIVER GULF OUTLET
1 ON 10
1 ON 5
1 ON 30
FOR STABILITY ANALYSIS OF STREAM CLOSURE SEE PLATES III-12
NOTE:
WHERE A SLOPE IS SHOWN AS "1 ON 3", THIS IS TO BE INTERPRETED AS A VERTICAL RISE OF ONE FOOT FOR EVERY THREE FEET MEASURED HORIZONTALLY.
B-2 OR D-2 INDICATES SOIL BORING
100 50 0 100 200 300
SCALE
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES
SITE PLAN
BAYOU BIENVENUE
SCALES AS SHOWN
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968
FILE NO. H-2-24147

PLATE NO. I-3



NOTE:
WHERE A SLOPE IS SHOWN AS "1 ON 3" THIS IS TO BE INTERPRETED AS A VERTICAL RISE OF ONE FOOT FOR EVERY THREE FEET MEASURED HORIZONTALLY.

100 50 0 100 200 300 FT.
SCALE

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SITE PLAN
BAYOU BIENVENUE – CONT.'D

SCALES AS SHOWN

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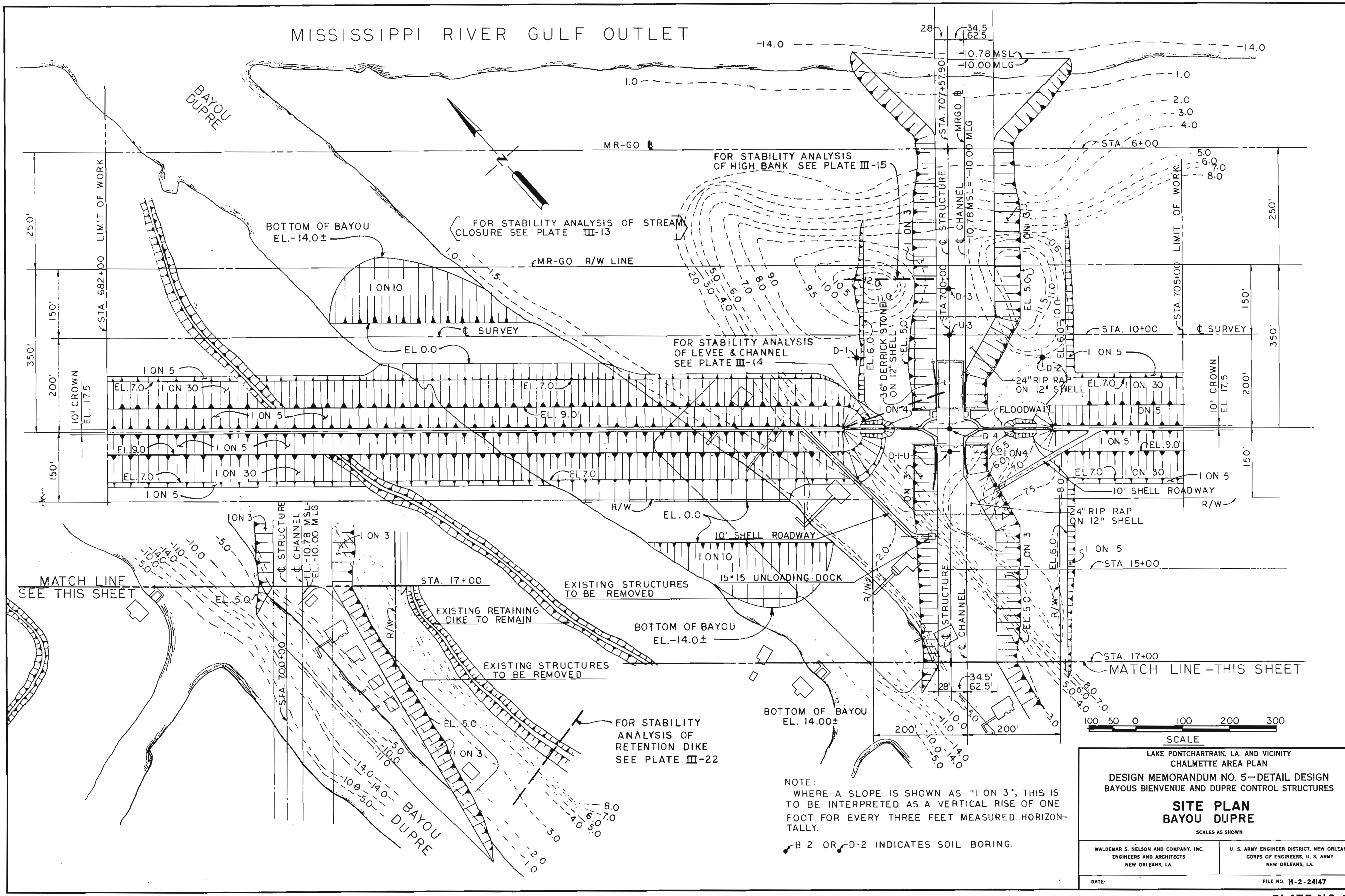
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. I-4



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SITE PLAN
BAYOU DUPRE

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

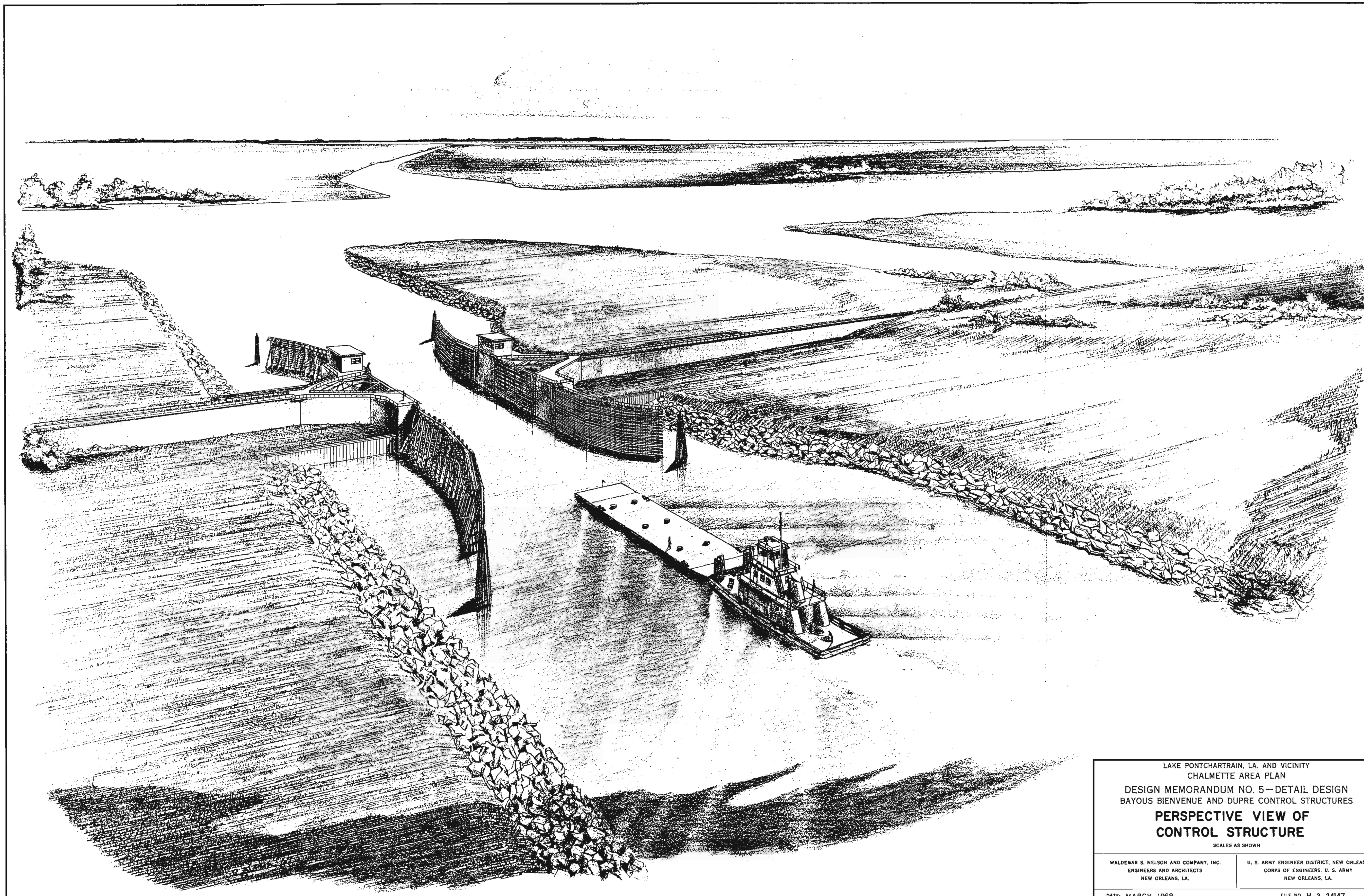
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LA.

DATE:
FILE NO. H-2-24147

NOTE:
WHERE A SLOPE IS SHOWN AS "I ON 3", THIS IS TO BE INTERPRETED AS A VERTICAL RISE OF ONE FOOT FOR EVERY THREE FEET MEASURED HORIZONTALLY.

B 2 OR D-2 INDICATES SOIL BORING.

PLATE NO. I-5



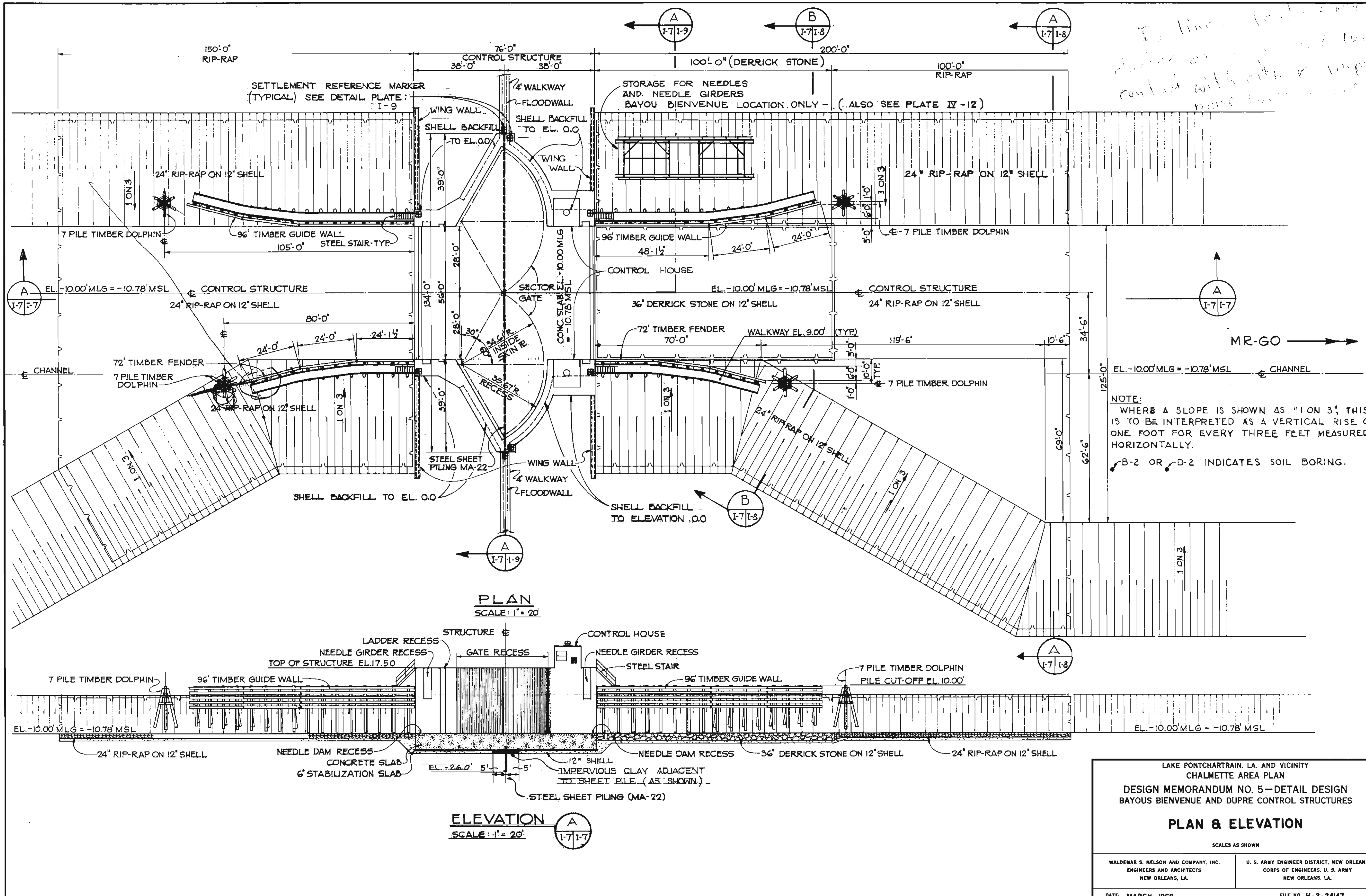
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PERSPECTIVE VIEW OF CONTROL STRUCTURE

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PLAN & ELEVATION

SCALES AS SHOWN

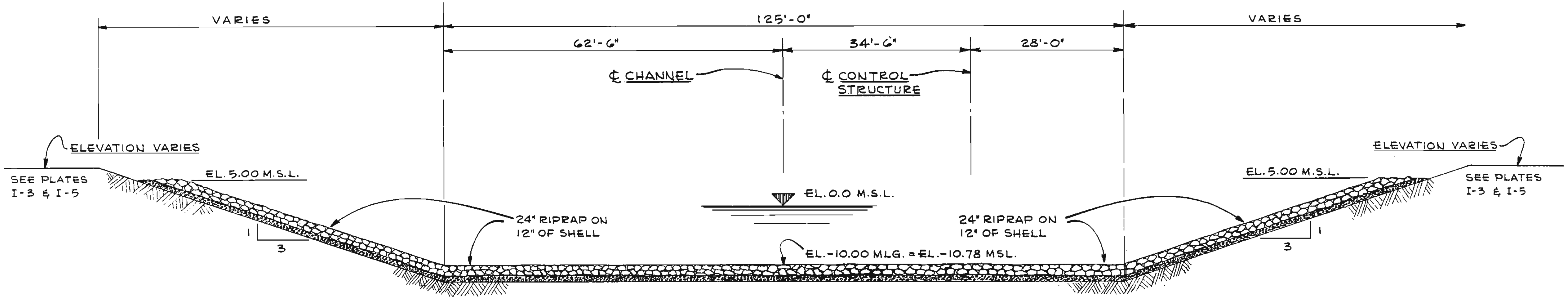
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE: MARCH, 1968

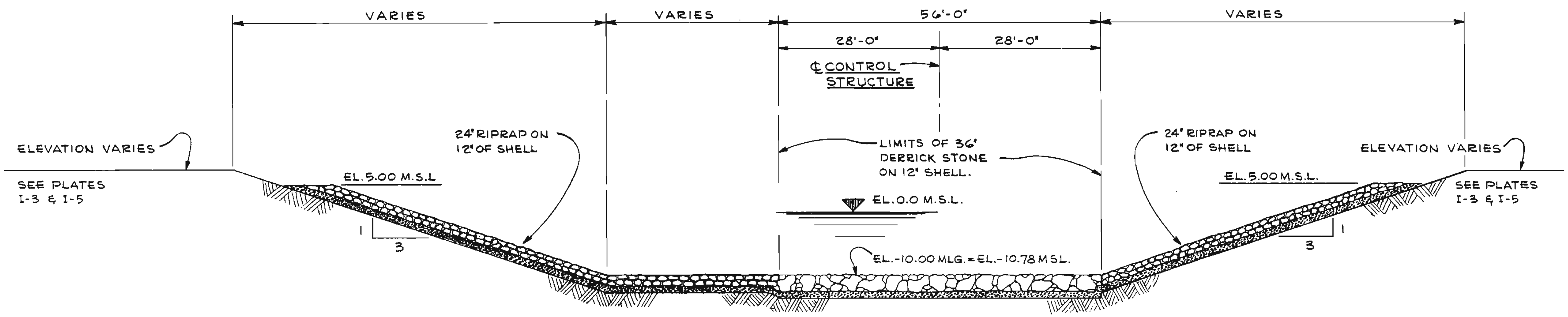
FILE NO. H-2-24147

PLATE NO. I-7



SECTION (A) I-7 | I-8

SCALE 1" = 10'-0"



SECTION (B) I-7 | I-8

SCALE 1" = 10'-0"

NOTE: FOR LOCATION OF SECTIONS SEE PLATE I-7.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

TYPICAL CHANNEL SECTIONS

SCALES AS SHOWN

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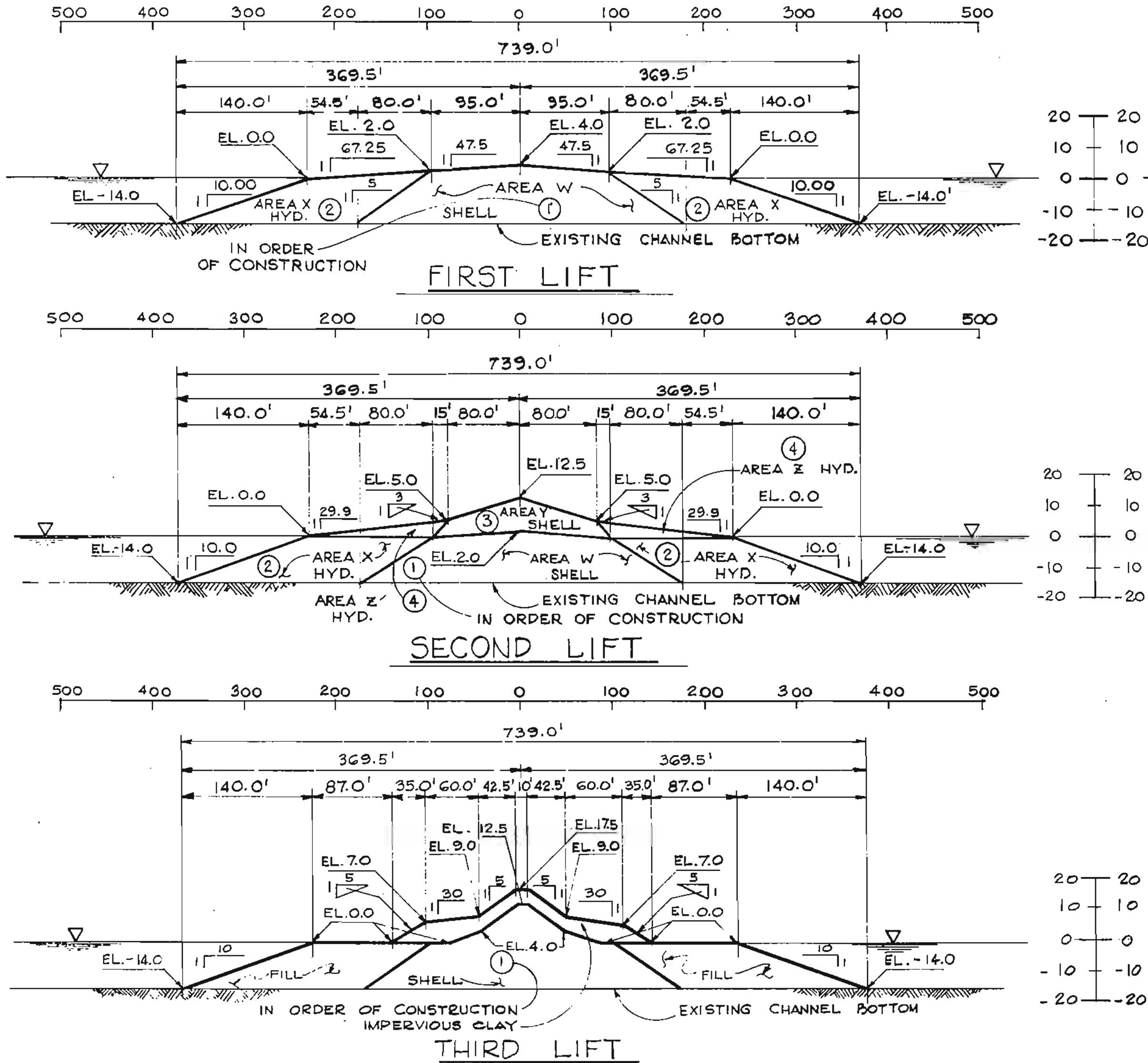
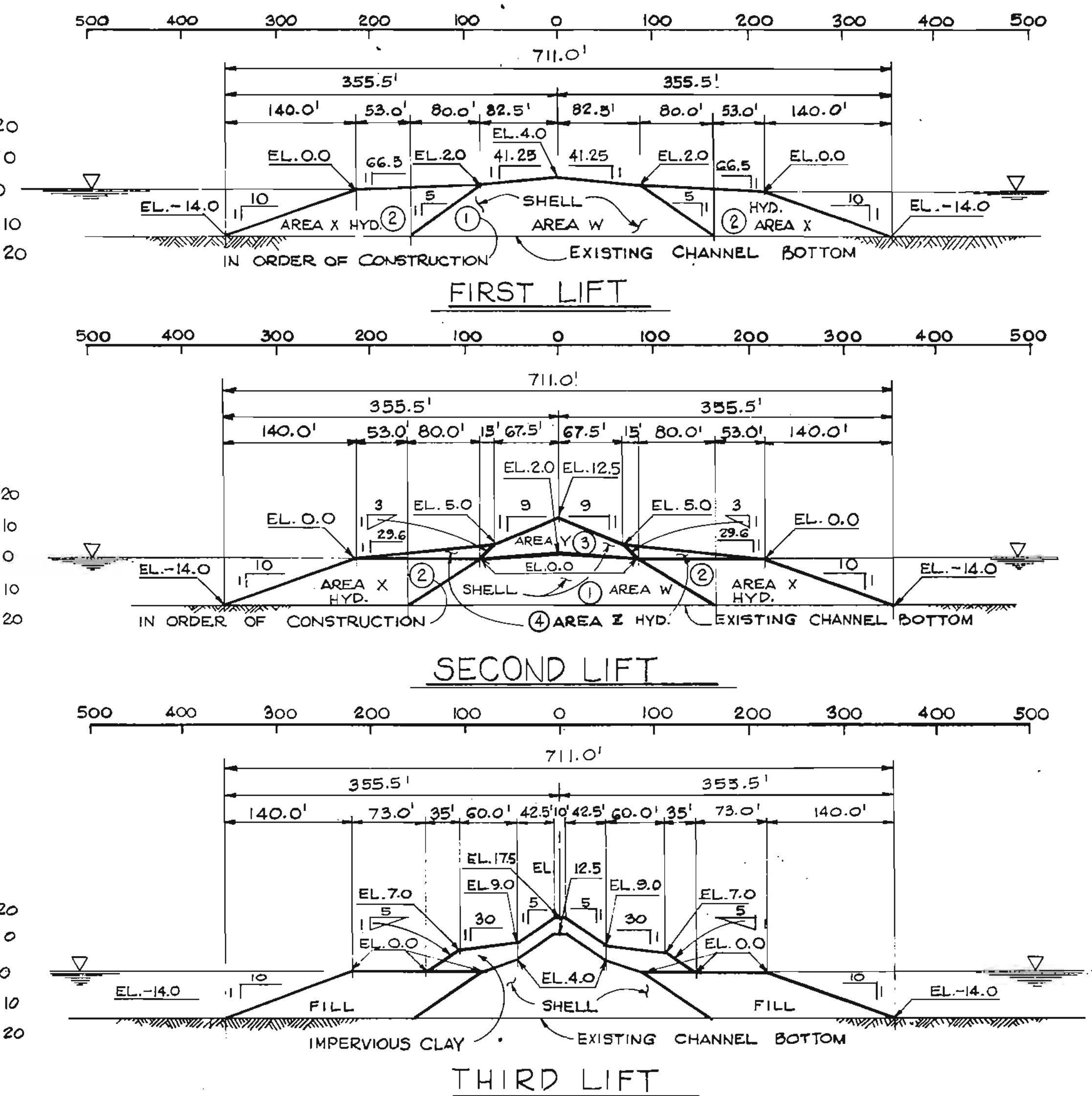
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. I-8



STREAM CLOSURE SECTION AT BAYOU BIENVENUE



STREAM CLOSURE SECTION AT BAYOU DUPRE

STREAM CLOSURE CONSTRUCTION

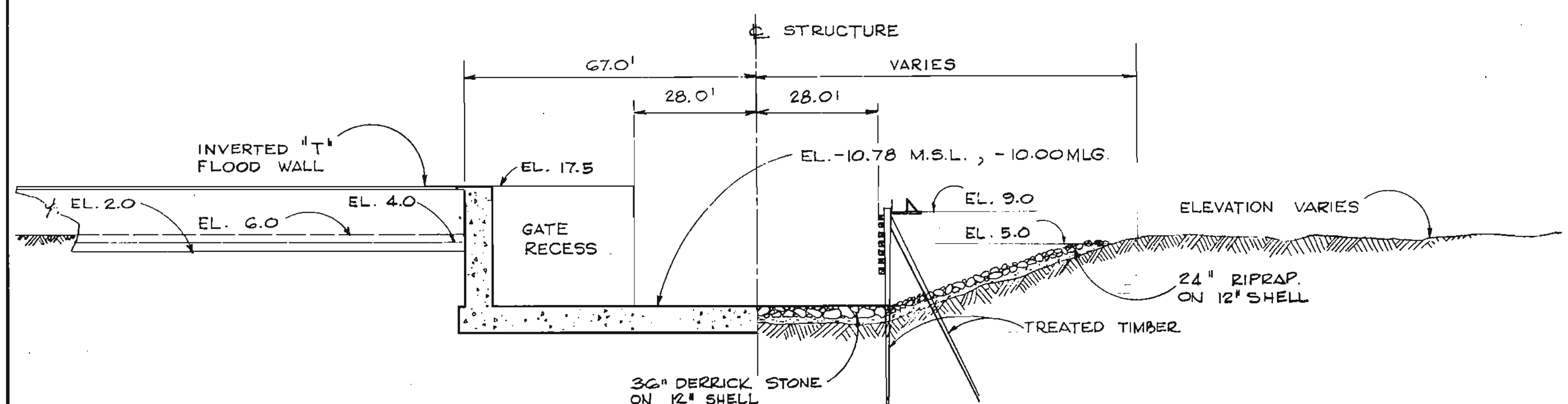
1- FIRST LIFT : PLACE SHELL IN AREA W THEN HYDRAULIC FILL IN AREA X.

2.- SECOND LIFT : TWO YEARS AFTER CONSTRUCTION OF FIRST LIFT PLACE SHELL IN AREA Y THEN HYDRAULIC FILL IN AREA Z

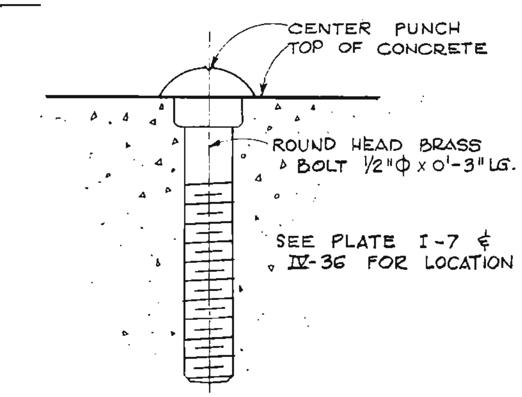
3.- FINAL LIFT : THREE YEARS AFTER CONSTRUCTION OF FIRST LIFT RESHAPE AREA Y THEN PLACE IMPERVIOUS CLAY LAYER

4.- SEE PLATES III-12, & III-13 FOR STABILITY ANALYSIS.

5.- SEE PLATES I-3 & I-5 FOR LOCATION OF STREAM CLOSURES.



SECTION A I-7 I-9
SCALE 1" = 20'-0"



SETTLEMENT REFERENCE MARKER

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

TYPICAL SECTIONS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

SECTION II - HYDRAULIC DESIGN

1. General.

a. The control structures at Bayou Bienvenue and Bayou Dupre must discharge drainage from the area enclosed by the following levees or embankments:

The Chalmette area plan levee along the Inner Harbor Navigation Canal and the MR-GO, and from the MR-GO to Verret; the natural ridge and embankment of Louisiana Highway No. 46 from Verret to Poydras near Caernarvon; and the main line Mississippi River levee from Poydras to the entrance of the Inner Harbor Navigation Canal; all as shown on Plate II-1. This area is divided by the Chalmette Back Levee roughly parallel to and about two miles from the Mississippi River. Land enclosed by the Chalmette Back Levee, between the Inner Harbor Navigation Canal and Lake Borgne Canal is under pumped drainage. The following pumping stations discharge into the general area to be drained by the control structures:

Pumping Station No. 1	635 cfs
Pumping Station No. 2	445 cfs
Pumping Station No. 3	980 cfs
Pumping Station No. 4	980 cfs

(Pumping Stations No. 3 and No. 4 are under construction at this time.)

In addition, Bayou Bienvenue receives pumped discharge from the City of New Orleans Sewerage and Water Board Pumping Station No. 5, 2500 cfs. 2000 cfs of the 2500 cfs originates west of the Inner Harbor Navigation Canal.

b. The area to be enclosed by the Chalmette Area Plan levee wherein control structures for Bayou Bienvenue and Bayou Dupre are located is described in Design Memorandum No. 3, General Design, Chalmette Area Plan, and additionally described in Design Memorandum No. 3, Supplement No. 1, Chalmette Extension being prepared at this time. See Plate II-1. Approximately 51,000 acres will be enclosed under the modified Chalmette Plan. The area bounded by the Mississippi River levee, Inner Harbor Navigation Canal, existing Chalmette back levee and Lake Borgne Canal contains approximately 11,500 acres and is presently drained by two pumping stations which discharge across the Chalmette back levee into marshland subject to tidal inundation. Two additional stations are presently under construction. In addition to the above four pumping stations, Sewerage and Water Board of New Orleans pumping station No. 5 discharges into Bayou Bienvenue. For location of pumping stations, see Plate II-1. The area along the Inner Harbor Navigation Canal and the MR-GO, containing approximately 6,400 acres, received spoil from the excavation of the MR-GO and has an elevation ranging from four to eight feet. Area between the Chalmette back levee and the spoil area, containing approximately

13,400 acres, has an average elevation of 0.5 feet and is subject to tidal inundation. In addition to the above, an additional area has been included under the modified Chalmette Area Plan and is described in Design Memorandum No. 3, General Design, Supplement No. 1, Chalmette Extension scheduled for submission in April 1968. The additional area is comprised of approximately 3,400 acres south of Louisiana Highway 46, 5,200 acres between Louisiana Highway 46 and the Violet-Verret back levee, 1,000 acres along the MR-GO spoil bank, and approximately 9,200 acres of marshland subject to tidal inundation. The protected area south of Louisiana Highway 46 will be drained by gravity towards the south through the levee between Verret and Caernarvon and the protected area north of Louisiana Highway 46 is drained by gravity to the north through two flood gates in the back levee. The marshland, totalling approximately 22,600, is all subject to tidal inundation and upon completion of the project this area will serve as a ponding area. The areas were determined from quadrangle maps and aerial photographs and the acreage was obtained with a planimeter.

c. Upon completion of the modified Chalmette Area Plan levees, runoff from the 46,700 acres of protected area north of Louisiana Highway 46 will be drained through two control structures -- one at Bayou Dupre and one at Bayou Bienvenue. In addition to providing drainage, the control structures will serve to protect the general area from hurricane tidal overflows and will allow water traffic to proceed normally to and from the MR-GO via Bayous Bienvenue and Dupre. Subsequent to completion of the two control structures, the area served by Bayous Bienvenue and Dupre will eventually become more developed and generate greater amounts of water traffic.

d. The area south of Louisiana Highway 46, approximately 3,400 acres, will be drained by gravity southward to drainage structures to be installed in the levee between Caernarvon and Verret. The drainage structures will consist of corrugated metal pipes controlled by flapgates at the downstream end and emergency slide gates. These structures will be more fully described in Design Memorandum No. 3, General Design, Supplement No. 1, Chalmette Extension.

2. Hydraulics of Structures.

a. The ponding area north of Louisiana Highway 46 contains a number of small canals and bayous which normally direct flow towards Bayous Bienvenue and Dupre. Directly land side of the spoil area is a canal which parallels the spoil area and acts as a drainage collector for the entire ponding area. See Plate II-1. Tides in excess of elevation 0.5 to 1.0 will overflow these canals and commence flooding the ponding area. Rainfall on the area and discharges from the pumping stations also tend to overflow these canals and cover the ponding area. When tides in the MR-GO become lower than the water level within the ponding area the flow of water will be within canals and overland for water stages greater than elevation 1.0 and through the canals for water stages less than elevation 1.0 towards Bayous Dupre and Bienvenue.

b. Automatic water level recording gauges were placed as shown on Plate II-1 and the following description: (1) at the intersection of Bayou Dupre and the MR-GO; (2) approximately 16,000 feet inland along Bayou Dupre; and (3) adjacent to the existing back levee remote from the MR-GO. Study of the gauge charts for a three-month period (April, May, June, 1967) indicated that when high tides in the MR-GO ranged between 1.0 and 1.5 feet, the remote gauge was little affected by the tide and that the differential head between the mouth of Bayou Dupre and 16,000 feet inland ranged in the magnitude of 0.2 feet. When high tides ranged between 2.0 and 2.5 feet it was found that the remote gauge was affected with a high-low cycle of 0.5 feet where the tide in the MR-GO ranged approximately 2.0 feet. The differential head in Bayou Dupre between the MR-GO and a point 16,000 feet inland was in the magnitude of 0.5 feet for flood tide and 0.7 feet for ebb tide.

c. Velocity measurements were made by the Corps of Engineers at the intersection of Bayous Bienvenue and Dupre and the MR-GO on 26 April 1967 and 5 May 1967. Maximum velocity at Bayou Dupre on 26 April 1967 was 0.55 feet per second and 0.87 feet per second on 5 May 1967. Review of the gauge charts for the above periods indicated a negligible head differential on 26 April and approximately 0.2 feet on 5 May 1967 in Bayou Dupre between the MR-GO and a point 16,000 feet inland. The peak velocity for 5 May 1967 was verified by computing a velocity, using the head differential at the time of the peak velocity measurement on 5 May 1967, with the use of Manning's open channel flow formula.

d. The automatic water level recording gauge installed at the intersection of Bayou Dupre and the MR-GO recorded tidal cycles during the period of 11 April to 6 July 1967. Study of the gauge chart indicated a maximum high tide at elevation 2.64 and a minimum low tide at elevation -0.95. This range appears to cover tides that would normally be experienced through the year. With adverse winds, high tides can be expected to reach an elevation of 4.0 several times a year.

e. The area presently is drained by four exits, however, subsequent to completion of the control structures there will be only two exits -- Bayous Bienvenue and Dupre -- through the control structures. Since the waterway will be restricted, there will be some increase in velocities at these points.

f. There is available for ponding a total of 22,600 acres, with the inter-connection of the many old bayous and canals and the back canal there will be an equal distribution of flow to and from the two control structures. A storage curve, shown on Plate II-2, was developed for one-half of the total ponding area. A computer program was developed to route tidal waters through the Bayou Dupre control structure. 2,063 hourly readings of water elevation, taken from the gauge chart recorded at the intersection of Bayou Dupre and the MR-GO, were used as input data. The storage curve and a head loss versus velocity curve, based on results of model studies contained in Waterways Experiment Station Technical Report 2-636, dated November 1963, shown on Plate II-2, were also used as input data. Using reiterative computation, tidal water was routed through the structure into the ponding area on a rising tide and reversing the flow on a falling tide when water levels became equal. Comparison of the ponding area water level hydrograph with that obtained from the inland automatic recorder showed very little increase in water level elevation due to construction of the two control structures. The main difference is in the greater time interval between time of flood tide in the MR-GO and peak elevation in the ponding area. See Plate II-2 for actual and computed hydrographs for two typical periods of the three-month period used.

g. During the period of automatic gauge record (11 April - 6 July 1967) the tide in the MR-GO at Bayou Dupre ranged between a high of elevation 2.64 and a low of elevation -0.95. Head loss through the structure ranged from zero feet to one foot which produced velocities ranging to slightly over seven feet per second. Based on 2.063 hourly readings the following table of velocity frequency was obtained in routing tidal waters through the control structure:

Velocity (FPS)	Per Cent of Time Velocity Exceeded
0	100.00
1	86.86
2	73.29
3	57.00
4	41.73
5	26.41
6	11.68
7	1.01
8	0.00

See Plate II-2 for curve of above tabulation. It is felt that under normal tidal cycles velocities as represented by the above tabulation can be tolerated.

3. Storm Drainage.

a. Rainfall runoff from 46,700 acres will be passed through the two control structures. In addition to the above area, Sewerage and Water Board of New Orleans pumps 2,000 cfs through their pumping station No. 5 into Bayou Bienvenue. This water originates west of the Inner Harbor Navigation Canal. An additional 500 cfs is pumped by this station from approximately 1,900 acres which is included in the Chalmette Area Plan and is part of the 46,700 acres mentioned above. In addition to the pumping station mentioned above, there are existing St. Bernard Parish stations No. 1 and No. 2 with capacities of 615 and 470 cfs respectively. These stations drain the area between the Mississippi River Levee, the Orleans Parish Levee, the Chalmette Back Protection Levee, and the Lake Borgne Canal in St. Bernard Parish. Presently under construction are two new pumping stations for this same area, No. 3 and No. 4 with 980 cfs capacity each. Due to the size of the ponding area, high intensity rains of relative short duration will not present any drainage problem through the structures. Assuming an 8" rainfall over the project area, the ponding area level would rise approximately one foot if no out flow was allowed. With gates open during such a rainfall the rise would not exceed 0.5 feet.

b. The control structure gates will be closed when water levels in the ponding area reach an elevation 2.0 in advance of hurricane warnings. The rainfall accompanying a hurricane is usually heavy. However, its distribution during the passage of the hurricane is not uniform.

c. Although 14 inches of rain in 24 hours has occurred in the past (April, 1927), it is improbable that more than 12 inches in 72 hours would occur during the passage of the design hurricane over the area. This assumption is based on 25 year frequency data (a 12.5 inch rainfall in 3 days) as outlined in Weather Bureau Technical Paper No. 49 titled "Two to Ten Day Precipitation for Return Period of 2-100 Years in the Contiguous United States". Assuming that the control structure gates are closed when ponding area elevation reaches 2.0 and there is a 12.5 inch rainfall over the contributory area of 46,700 acres along with the Sewerage and Water Board pumping station No. 5 contributing an average of 1,000 cfs over a period of 72 hours, there will be an accumulation of 2,376,200,000 cubic feet of water in the ponding area. This would result in an increase of water level of 2.4 feet to a ponding area elevation of 4.4.

d. After passage of a hurricane, the storm surge will fall rapidly. For the design hurricane it has been estimated that a tide level of elevation 2.0 in the MR-GO would occur approximately twenty-two to twenty-four hours after the peak storm surge. A recording water level gauge located in the MR-GO at Paris Road Bridge (New Orleans) indicated a time interval of approximately forty-eight hours after passage of the peak surge to normal tide level for the hurricane "Betsy" in September, 1965.

e. Assuming that the control structure gates are opened as the MR-GO tide is at elevation 4.4 and falling, the ponding area would begin discharging through the structures. Based on the hydrograph recorded for hurricane "Betsy", approximately thirty-two hours after the gates are opened at elevation 4.4 the tide level in the MR-GO would be at elevation 2.0. The ponding area will reach MR-GO tide level approximately three to five days after opening of the gates at elevation 4.4. This will depend on tidal fluctuations in the MR-GO after the receding of the storm surge. If the gates are opened as stated above, velocities of approximately ten feet per second will be experienced eight to twelve hours after opening of the gates based on the computed hydrograph for the design storm. The duration of maximum velocities is dependent on how fast the storm surge tide will recede. Based on the hydrograph of hurricane "Betsy", velocities will be less than seven feet per second approximately thirty-six hours after opening of the gates.

f. Based on studies involved in the preceding paragraphs, it was found that the magnitude of tidal cycle in the MR-GO can vary the lowering of the ponding area water levels from three to five days. The additional area which is included under the modified levee plan increased the area to be drained and also increased the ponding area. This increase of area does not affect the magnitude of velocities since that is a function of the speed of receding storm surge tide. Increasing the width of the structures because of the increased area is not indicated since, to significantly reduce the velocities, opening widths four to five times that proposed would be required. Based on the estimated maximum velocities, additional erosion protection in the vicinity of the structures is not indicated.

4. Waves and Surges. The elevation of the top of the gate structure was established equal to that of the top of levee at each side of the structure. This elevation was based on data contained in Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part 1 - Chalmette, of the Lake Pontchartrain, La. and Vicinity Project. The net grade elevation was based on computed hurricane tidal elevations plus run-up on the levee. In addition, the gate structure was studied with the effects of wave characteristics for the Bayou Dupre and Bayou Bienvenue areas. The wave characteristics are as follows:

swl	Stillwater level elevation	13.0
H_s	Significant wave height, in feet	7.0
T	Wave period, seconds	6.4
L_o	Deep water wave length, in feet	210.0
H'_o	Deep water wave height, in feet	7.5 *
H_{max}	Maximum wave which can be supported in feet	9.0
d_T	Effective depth at toe, in feet	10.0 *

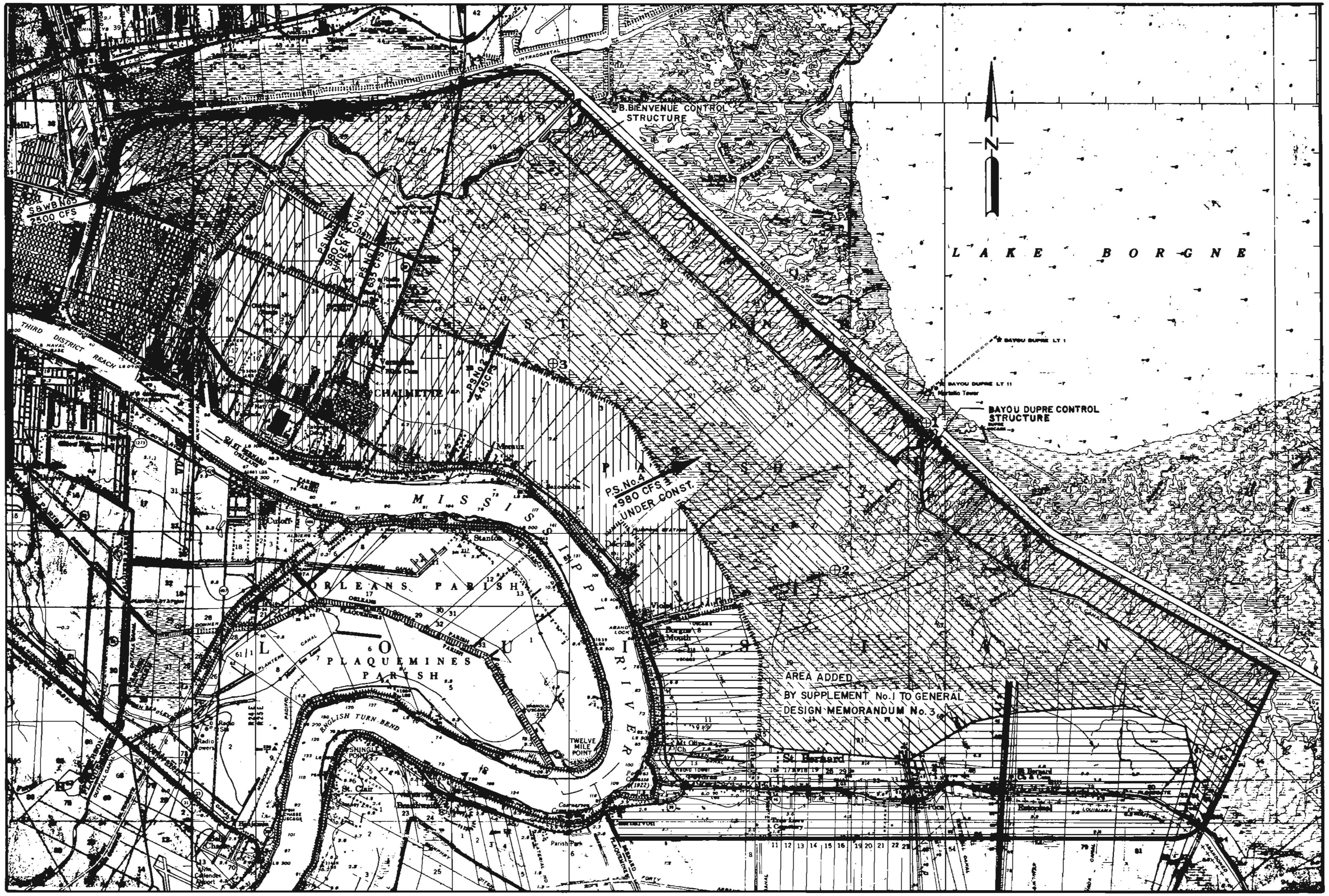
*For information only.

5. Gates. Each structure contains two 60-degree sector leaves with rubber seals at the bottom and sides which control a clear channel width of 56 feet.

6. Gate Operation. The control structure gate will be closed when rising tides, in advance of an approaching hurricane, exceed elevation 2.0. The gates will remain closed until such time as tides in the MR-GO are equal to or lower than the water elevation within the ponding area and are falling. The control of the gates is designed for two speeds of

opening and closing, three-minute and twelve-minute cycles. The rapid opening and closing speed will be used when water stages are relatively equal or in emergencies when passage to the protected side is necessary after the gates have been closed. The slow speed of 12 minutes opening or closing will be utilized in the event that closing or opening of the gates must be accomplished during a significant head differential.

7. Tidal Flows. The MR-GO is directly influenced by tidal action in the Gulf. In general, ninety per cent of the time normal high tides are less than elevation 2.0. However, several times during the year the tides will exceed elevation 2.0 and may, in conjunction with adverse winds, reach elevation 4.0.



LEGEND

- SPOIL AREA GRAVITY RUNOFF
- PONDING AREA
- AREA UNDER PUMPS
- GRAVITY DRAINAGE
- H CONTROL STRUCTURE

TOTAL AREA = 50,100± ACRES

PONDING AREA = 22,600± ACRES

⊕ TIDE GAUGE

TIDE GAUGE	DESCRIPTION
⊕1	SOUTHWEST BANK OF MR-GO MILE 53, STA. 686+40 AND MOUTH OF BAYOU DUPRE
⊕2	THE EAST BANK OF CANAL APPROX. 550' NORTH OF JUNCTION WITH LAKE BORGNE CANAL
⊕3	CHALMETTE BACK LEVEE STA. 150+00

5,000 0 5,000 10,000 15,000 FEET
1 0 1 2 3 MILES

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

HYDRAULIC DATA - I

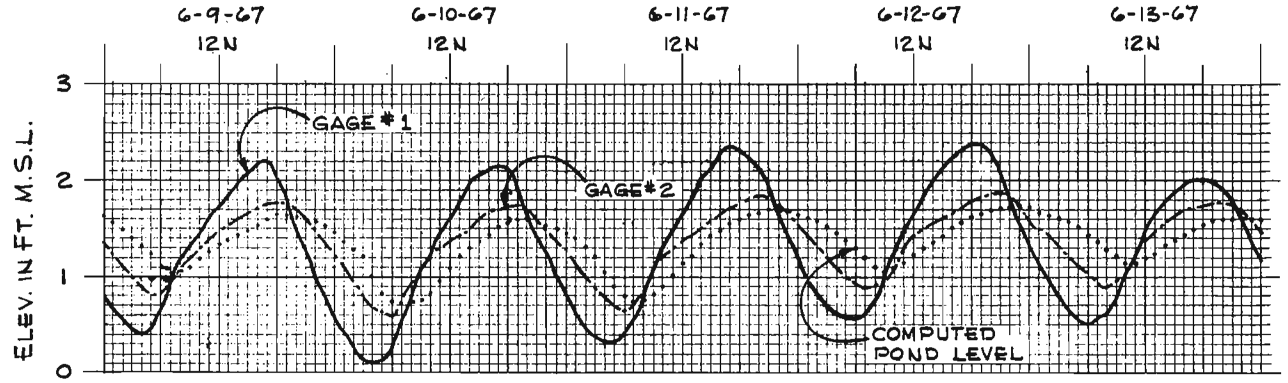
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

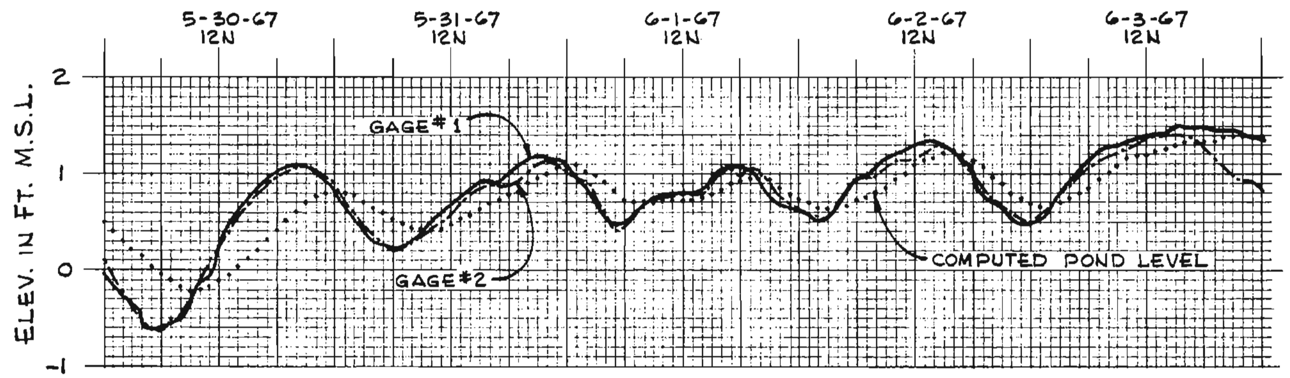
DATE MARCH, 1968

FILE NO. H-2-24147

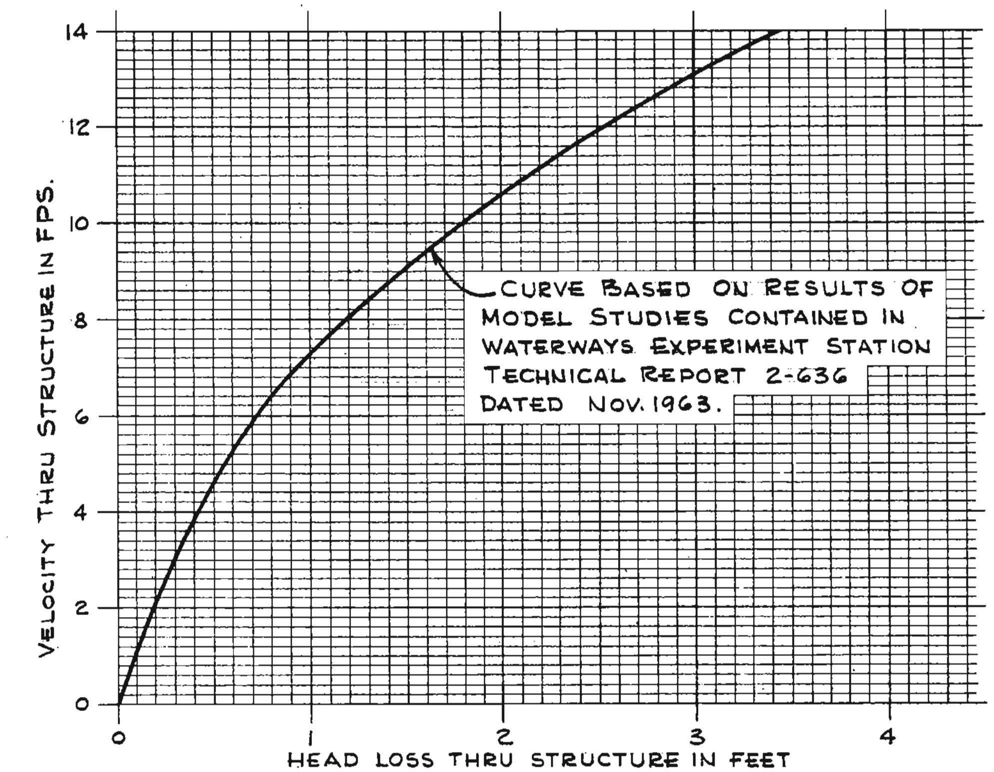


HYDROGRAPH - HIGH TIDE CYCLE

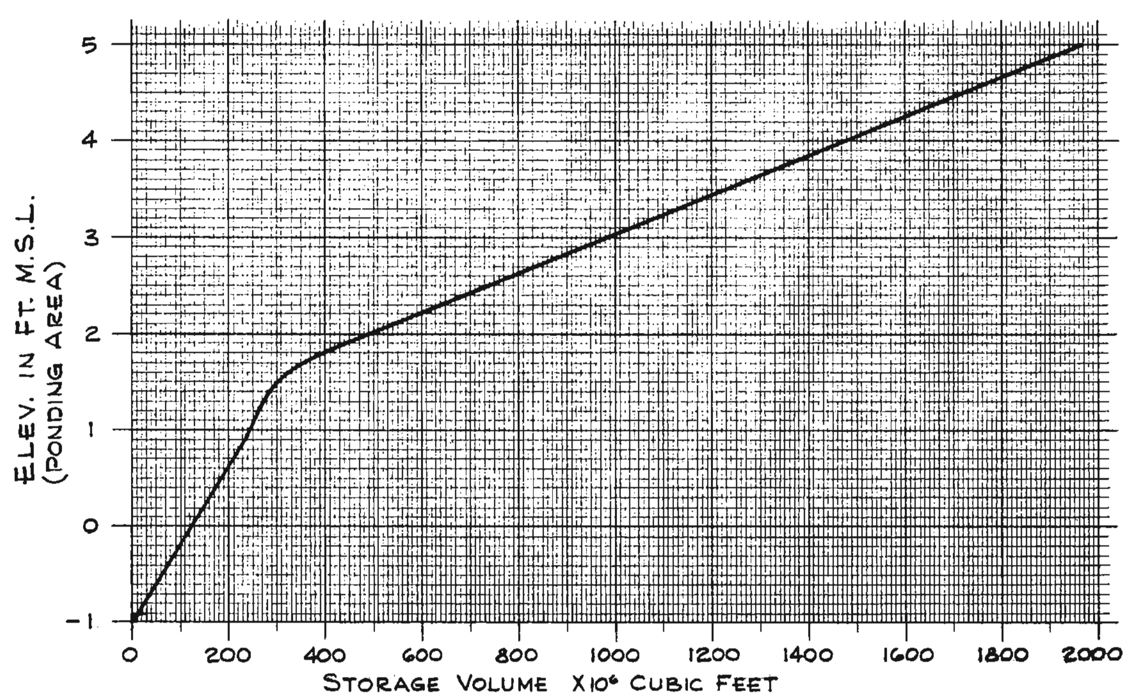
NOTE: GAGE 1 AT INTERSECTION OF BAYOU DUPRE & M.R.-G.O.
GAGE 2 16,000 FEET INLAND (SEE PLATE II-1)



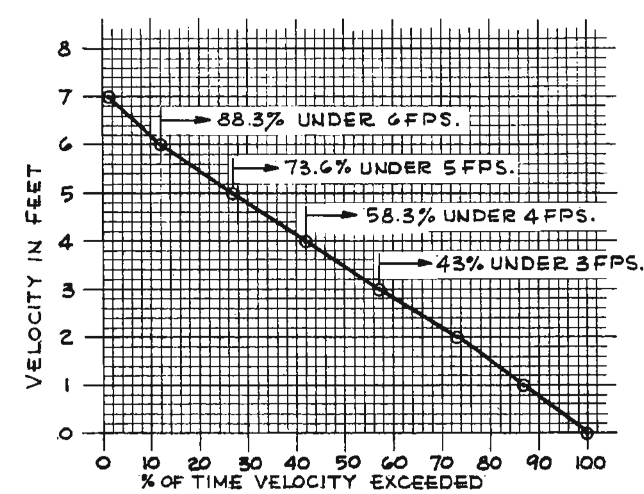
HYDROGRAPH - LOW TIDE CYCLE
(SEE NOTE ABOVE FOR GAGE LOCATION)



VELOCITY VS. HEAD LOSS THRU STRUCTURE



STORAGE VOLUME VS. PONDING AREA LEVEL
(11,300 ACRES = 1/2 OF TOTAL PONDING AREA)



NOTE: CURVE BASED ON 2,063 HOURLY READINGS
MAX. HIGH TIDE 2.64 MIN. LOW TIDE -0.95

VELOCITY THRU STRUCTURE VS. PERCENT OF TIME

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

HYDRAULIC DATA - 2

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. II-2

SECTION III - FOUNDATION INVESTIGATIONS

1. General. Flood control structures will be constructed along the authorized levee alignment adjacent to the present channels of Bayous Bienvenue and Dupre. (See Plate I-2). The control structures will consist of concrete sector gate bays supported on untreated timber piles, treated timber guide walls, and pile supported inverted "tee" and "I" type floodwalls connecting the gate chamber to the earthen levee on each side and will include access channels to the structures. For general plan see Plate No. I-2.

2. Investigations. Design Memorandum No. 3, General Design, Chalmette Area Plan, dated November 1966 contains a discussion of the geology of the general area and subsurface exploration and laboratory test data of the general area. In addition, four 3" I.D. general type borings were made by the Corps of Engineers at each structure location and the logs are shown on Plate III-4. At Bayou Bienvenue one 5" I.D. undisturbed boring designated as B-IU was made by the Corps of Engineers and the results of (Q), (R) and (S) tests are shown on Plates III-5 and III-6. Boring U-3 (5"I.D.) at Bayou Dupre was made by the Engineer-Architect during the preparation of Design Memorandum No. 3, General Design, Chalmette Area Plan, and is repeated herein and tests results are shown on Plates III-7 and III-8. An additional undisturbed boring designated as D-IU (5"I.D.) was made by the Corps of Engineers at Bayou Dupre and the results of (Q), (R), and (S) tests are shown on Plates III-9 and III-10. Locations of all borings are shown on Plates I-2, I-3, and I-5.

3. Soil Conditions.

a. The subsurface soils in the vicinity of the Bayou Dupre control structure are indicated in the log of Boring U-3 and shown on Plate III-2. The upper stratum from existing ground at elevation 8 to elevation -3 consists of very soft gray clays (CH) with roots, peat and organic matter and having water content varying from 43% to 85%. From elevation -3 to elevation -23 there are alternating layers of soft clays (CL) and soft silty clay with clayey silt layers. Water contents in these layers range from 34% to 45%. From elevation -23 to elevation -26 and from -31 to -58 there are layers of gray clays (CH) with some fine sand, sand lenses and shell fragments. Consistencies vary from stiff to medium stiff and water contents vary from 46% to 65%. Between elevations -26 and -31 there is a stratum of sand. From elevation -58 to elevation -64 a medium dense fine gray sand stratum occurs just on top of the Pleistocene formation at elevation -64. Except for a soft dark gray clay stratum occurring between elevation -65.5 and elevation -67.5 having an average water content of 30%, the remainder of the subsoil on down to elevation -91 consists of layers of medium stiff to stiff clays CL and CH with water contents varying from 23% to 45%.

b. Boring D-IU was made fifty feet land side of the transverse centerline of the Bayou Dupre control structre. The log of this boring is shown on Plate III-3. This boring indicates similar soft clays as found in Boring U-3 but does show greater amounts of silts and sands. A comparison of Borings U-3 (made 200 feet flood side of the centerline of the structure), D-4 (made on the centerline), and D-IU (made fifty feet land side of the structure) indicates an increase of silts and sands starting at Boring D-4 and increasing towards D-IU fifty feet away. Plots of the (Q) tests results from Boring D-IU indicate no change is necessary in the design shear strengths used based on Boring U-3.

c. Log of Boring B-IU in the vicinity of Bayou Bienvenue control structure is shown on Plate III-1. From existing ground at elevation 5.5 to elevation about -8, the soil is very soft dark gray and dark brown clay with peat, wood, and fine rootlets and has a water content which ranges up to 310%. From elevation -8 to elevation -28 the stratum consists of soft to very soft gray clay with silt pockets, sandy silt pockets and shell fragments and having a water content between 50 and 80%. From elevation -28 to elevation -35 there is a stratum of gray sand ranging from loose to dense. From elevation -35 to elevation -63 there is a soft to stiff gray clay with silt pockets and occasional small shell fragments. From elevation -63, which is the top of the Pleistocene, to elevation -78, the limit of the boring, the soil consists of soft to medium gray clays, green clays, with silt and sand lenses.

4. <u>Design Problems.</u> The earth work and foundation problems that had to be resolved were as follows: Design excavation slopes and berms that will be stable during construction; design of the alternate method of excavation design slopes and sheet pile enclosure; design of permanent channel slopes for operating condition; determination of the required penetration for the piles beneath the gate structure and inverted "tee" floodwall; determination of the required penetration for the "I" type wall; design to prevent piping under the structure; and design against up-lift.

5. <u>Seepage, Dewatering and Pressure Relief for Structures.</u>

a. Both sites for the structures have received hydraulic spoil from the excavation of the MR-GO. Underlying the spoil are very soft clays with sand and silt lenses and organic matter typical of the marshy areas of this locality. Underlying these strata is a sand stratum between elevations -26 and -31 at Bayou Dupre (Boring U-3) and between -28 and -35 at Bayou Bienvenue (Boring B-IU). Study of this condition indicates the need of some form of pressure relief during the construction period.

b. Dewatering and pressure relief during construction were studied and analyzed for two methods of excavation which are described in detail in Paragraph 7 of this Section. Procedure used in design of pressure relief system is outlined in Chapter No. 3, "Dewatering", "Foundation Engineering Text" edited by Leonards. The authors of Chapter No. 3 are

Mansur and Kaufman. The coefficients of permeability (k) was taken as 300×10^{-4} cm/sec. The D_{10} grain size as shown on the log of Boring D-1U and B-1U was assumed to be an average of 0.11 mm. With this D_{10} size the value of (k) was obtained from Fig. 3-39 of the above text. Calculation sheets 1 of 10 through 7 of 10 are attached following this section and cover the design of the pressure relief system for the plan of "Open Excavation". Sheets 8 of 10 through 10 of 10 are also attached and cover the analysis of sand drains required for the second plan of excavation, "Open Excavation With Steel Sheet Pile Enclosure of the Foundation Mat". The above reference was also used for this analysis..

(1) Slope stability studies for the open excavation plan were made and are shown on Plate III-20. See Paragraph 7b of this Section for proposed procedure for the open excavation plan. The stability studies indicated that during the initial dewatering to elevation -5 there would be a potential heave of the excavation bottom if the tide level in the MR-GO exceeded an elevation of 2. An outer ring of well points installed in the upper berm, elevation 2 at Bayou Dupre and 3 at Bayou Bienvenue, was designed to relieve the hydrostatic pressure in the underlying sands. With the tide in the MR-GO at elevation 8 and the outer well point system operating, the piezometric pressure reading in the sands would be at elevation -5 at the center of the excavation. At this point there would be a factor of safety of 1.3 against bottom heave when dewatered to elevation -5.

(a) The rate of unwatering requirements is as follows: Drop of water level not to exceed two feet per day for the first ten feet and one foot per day thereafter, but in no case other than as directed by the Contracting Officer.

(b) When the berm at elevation -5 has been exposed, the inner ring of well points will be installed. The well points will completely encircle the excavation and will be spaced approximately 10 feet on centers. Although the analysis shown on Sheets 1 through 7 of 10 of the attached calculations indicate a twelve foot spacing, the cost has been figured for a ten foot spacing to allow for more efficient use. The Bayou Dupre location will have well point tips at elevation -31 and elevation -35 at the Bayou Bienvenue location. With a tide level of 5 in the MR-GO, the piezometric pressure reading in the underlying sands would be at elevation -21 in the center of the excavation with inner ring of well points in operation. The outer ring can be removed when the inner ring begins pumping. See Plates III-16 and III-18 for well point and piezometer locations. Boring D-1U at Bayou Dupre indicates a silty clay stratum between elevation -10 and -23. Pressures in this stratum will be relieved by encasing the well points with sand from elevation -10 to the sand stratum that water is being withdrawn from and above elevation -10 to the berm at elevation -5 the well points will be encased in clay .

(c) Based on the pressure relief analysis it is estimated that the inner ring will pump approximately 500 gallons per minute at Bayou Dupre and 265 gallons per minute at Bayou Bienvenue.

(d) Sump pumps will also be required to remove some seepage which can be expected from the side slopes of the excavation, and to remove surface runoff within the excavation from rainfall of a 25-year frequency rain storm.

(2) A second plan of excavation was developed and is described in detail in Paragraph 7c of this Section. This plan proposes a combination of open excavation and a steel sheet pile enclosure of foundation mat area with all excavation being done in the "dry". See Plates III-17 and III-19 for general plan.

(a) When initial excavation is completed to elevation -5, steel sheet pile will be driven to completely enclose the foundation mat area and the area to receive the derrick stone. Sheet pile will be driven to a tip elevation of -55 at Bayou Bienvenue and -60 at Bayou Dupre. It has been assumed that some seepage will enter the enclosure through sheet pile joints where the sand stratum has been penetrated. See sheets 8 through 10 of 10 of attached calculations for sand drain pressure relief in the underlying sand. Analysis for the Bayou Dupre location is presented and it is quite obvious that the flow at Bayou Bienvenue would be less. It is recommended that 12" diameter sand drains be placed every twenty feet around the periphery, inside the enclosure. The sand drains and piezometers will be installed when the excavation is at elevation -5 after the sheet pile wall has been installed. The drains will extend through the underlying sand to approximate elevations -40 at Bayou Dupre and -37 at Bayou Bienvenue. This will allow a self-relieving condition as the excavation is carried down and with the use of sump pumps the working area can be kept dry. Sufficient pumping capacity shall be provided to remove surface runoff within the excavation from rainfall of a 25-year frequency rain storm. See Plates III-17 and III-19 for locations of piezometers and sand drains.

c. During an unwatered condition it is assumed that the water on the MR-GO side is at elevation 5.0 and the water on the land side is at elevation 2.0. Under these conditions and the structure completely dewatered there is a factor of safety of 1.16 against uplift disregarding the hold down straps on the piles. Assuming the cut off wall impervious and the same water heights as above, a factor of safety of 1.07 exists against uplift disregarding the hold down straps on the piles. Therefore, no presure relief is required.

d. During the normal operating condition, that is the gates open, no pressure relief is required.

e. A steel sheet pile cut-off wall will be driven below the base slab and inverted "tee" wall. This cut-off wall will effectively stop piping action in the event that roofing occurs.

6. Temporary Protection Dikes. Protection from flooding of the construction area will be provided by placing a temporary levee around the excavation. The existing ground elevation at Bayou Bienvenue is between 5 and 6 and at Bayou Dupre 6 and 8. The construction areas would be well protected from normal tidal waters and also from high tides in conjunction with adverse winds without the levees. To protect the construction areas from storms of less than design size, the temporary levee will be constructed to an elevation of 8. This elevation will protect the construction areas from high waters resulting from majority of the storms experienced in this locality. However, the temporary levee will be subject to over-topping by severe storms approaching design intensity. Frequency of such storms does not warrant raising the levee any higher.

7. Method of Excavation.

a. General. Both areas have received hydraulic spoil from the excavation of the MR-GO. Underlying the spoil are very soft clays with sand and silt lenses and organic matter typical of the marshy areas of this locality. This material is generally typical at both areas although Bayou Dupre area contains more silt. Two methods of excavation have been studies and presented in the paragraphs below.

b. Plan No. 1, Open Excavation. A temporary protection levee will be constructed prior to commencing the excavation using material from within the construction area. Excavation will be accomplished by dredge to approximately 3 feet above the bottom of the final excavation. At Bayou Bienvenue the final side slopes would generally be one vertical to eight horizontal with a berm at elevation 3 and -5. At Bayou Dupre the side slopes will be one vertical to four horizontal with a berm at elevation 2 and -5. Upon completion of the initial excavation the dredge would be withdrawn and the shallow flotation channel would be closed to provide a completely enclosed excavation. With the closure of the excavated area completed pumps would be placed and dewatering would commence at the rate as stated in Paragraph 5b(1)(a). Piezometers and well point systems will be installed as described in Paragraph III-5. When the entire excavation has been dewatered the final 3 feet would be excavated by clam shell crane or other suitable means. See Plates III-16 and III-18 for plan and section.

c. Plan No. 2, Open Excavation With Steel Sheet Pile Enclosure of Foundation Mat Area. The area to be enclosed by the steel sheet pile will be initially excavated to elevation -5 and sloping to natural ground on one vertical to eight horizontal at Bayou Bienvenue and one vertical to four horizontal at Bayou Dupre. Large draglines equipped with booms of 185 feet or longer and four cubic yard buckets can accomplish this excavation while positioned at the top of the slope and casting well back from the excavation where the material can be stockpiled by smaller cranes or dozers. The protection dikes will be constructed from this material. Necessary sump pumps will be operated to maintain the working area in a dry condition. Upon completion of the excavation to elevation -5, the untreated support piles for the wale system will be driven, the wale system installed and the steel sheet pile enclosure completed. Concurrently, the sand drains and piezometers will be installed. The excavation within the enclosure will be accomplished by cranes equipped with eighty-five to one hundred foot booms and one cubic yard clam shell bucket. These cranes can operate on mats around the enclosure at the -5 elevation. The excavation will be carried down to elevation -14 with the traveling cranes. For the final excavation to elevation -19, two working platforms supported by untreated piling will be erected, one on each side of the enclosure. The one yard cranes equipped as described above can reach all areas of the foundation mat site. After completion of the excavation the cranes will remain mounted on the working platform and will assist in the construction work to follow. The excavated material can be easily cast near the top of the slope at Bayou Bienvenue and well up on natural ground at Bayou Dupre where it can be rehandled to stockpile. The excavation will be kept dry at all times by sump pumps and the area around the enclosure at elevation -5 will be ditched to intercept surface runoff from the slopes and pumped from sumps. See Plates III-17 and III-19 for plan and section and Plate III-21 for enclosure stability studies and details of the wale system.

d. Summary. See Section VIII for cost estimates of each plan and recommendation for method of excavation.

e. Approach Channels. Upon completion of all construction and placement of the derrick stone and shell backfill in the dry the approach channel will be dredged to project depth by hydraulic dredge with the spoil being placed in areas shown on Plate I-1 and I-2. Under Plan No. 2, after placement of the derrick stone and shell backfill, the steel sheet piling will be removed prior to any dredging. With the flooding of the control structure area, the dredge will move through the structure and complete excavation of the approach channel. The side slopes will then be shaped by dragline and the clam shell and riprap placed in the wet.

8. Stability of Slopes.

a. Construction slopes and permanent slopes for both structure locations were analyzed by the "method of planes" for stability with a minimum factor of safety of 1.3. Shear strengths based on "Q" test results obtained from samples of Boring B-IU were used for Bayou Bienvenue and from Boring U-3 for Bayou Dupre. Values of increased shear strengths used were based on procedures developed in analyzing levee stabilities for the preparation of Design Memorandum No.3, General Design, Chalmette Area Plan, dated November 1966.

b. The following sections were analyzed for stability:

(1) Stream closure of Bayou Bienvenue and Bayou Dupre with the stability studies shown on Plates III-12 and III-13, and locations shown on Plates I-3 and I-5. Studies indicated that a shell core would be required for stability. Additional discussion on the construction of the closures is covered in Paragraph 13 of this Section

(2) A stability study was made of a high bank section adjacent to the approach channel at Bayou Dupre. The study is shown on Plate III-14, and the location of the section is shown on Plate I-5. Results of this study indicated the need for degrading high areas adjacent to the approach channel to elevation 6 and sloping to drain towards the channel. Water elevation in the approach channel was assumed as 0.0 in the study.

(3) Studies were made of the stability of a section taken from the end of the levee to the approach channel. The stability studies are shown on Plate III-15 and the locations of the sections on Plates I-3 and I-5. Water surface in the approach channel was assumed at elevation 0.0. The full levee height and increased shear strengths were used. This study determined the location of the toe of the levee with relation to the top of bank of the approach channel. This also defined definite lengths of floodwall for each location. For finished lengths of floodwall see Plate IV-36.

(4) Stability studies for the open excavation at Bayou Bienvenue and Bayou Dupre are shown on Plate III-20. Three conditions were analyzed at each location; they are as follows:

<u>Condition No. 1:</u> Initial dredge excavation completed with the bottom at elevation -16. Water behind the temporary protection levee at elevation 2 and the water in the excavation at elevation -5 with outer ring of well points operating.

<u>Condition No. 2:</u> This condition will normally be experienced during construction. Completed excavation to elevation -19.28. Water behind the temporary portection levee at elevation 2 and in the excavation at elevation -19.28, with the well point system operating.

<u>Condition No. 3:</u> This is a storm condition with water behind the temporary protection levee at elevation 8 and at -19.28 in the excavation with the well point system operating.

(5) The alternate method of excavation, open excavation with sheet pile enclosure of the foundation mat, was also analyzed for stability for each location for Condition 2 of paragraph (4) above without the well point system. Studies are shown on Plate III-21. Also shown on Plate III-21 are the design details of the enclosure anchor wale system.

(6) Retention dikes for the spoil areas were analyzed for stability and the studies are shown on Plate III-22.

9. <u>Stability of Floodwalls and Wing Walls.</u>

a. Floodwalls will be required to connect the control structures to a point where the full levee section will begin. Adjacent to the structures, an inverted "tee" type wall will be constructed and an "I" type wall will make the transition between the inverted "tee" wall and the full levee section.

b. The inverted "tee" wall, of reinforced concrete, is supported by prestressed concrete bearing piles, driven at a batter, and a steel sheet pile cut-off wall. See Plate IV-36 for dimensions and pile layout. Design soil shear strengths and densities used in the stability study of the inverted "tee" wall were obtained from test results of samples from Boring B-IU, shown on Plate III-1, for the Bayou Bienvenue location and Boring U-3, shown on Plate III-2, for the Bayou Dupre location. The stability of the inverted "tee" wall was analyzed for loading conditions described below.

(1) The dead load of the wall and walkway and the weight of earth on the base slab acting downward vertically and the soil lateral pressure acting horizontally. On the flood side, the still water elevation set at 13 with a seven foot broken wave and ground water on the protected side at elevation 2. The water was also placed on the base slab as a vertical downward load. Uplift pressures were placed against the base slab assuming the cut-off wall as pervious and impervious, and uplift pressure also placed on the under side of the walkway on the flood side of the wall.

(2) Same as stated in Paragraph (1) above but the still water elevation was set at 8.3 with a two foot broken wave on the flood side.

(3) A factor of safety of 1.75 was used for determining compressive pile penetration and 2.0 for tension piles with a conjugate stress coefficient K_o of 1.0 and 0.7 respectively.

(4) Two methods of analysis were used in the stability study of the inverted "tee" wall.

(a) The first method used was that presented by A.Hrennikoff in paper No. 2401, ASCE Transactions titled, "Analysis of Pile Foundation With Batter Piles" and a paper by M. T. Davisson and H. L. Gill in Journal No. 3509, May 1963 of Soil and Foundations Division of ASCE "Laterally Loaded Piles in a Layered Soil System". Analysis based on the above references was performed for each of the loading conditions for each location. Computations for one loading condition at Bayou Bienvenue are attached following this section. A group of curves was developed showing actual and allowable stresses and deflections of the battered piles for various assumed modulus of subgrade reaction (K) values, See Figure 36 of 36. Approximate values of K were obtained from unconfined compression test results based on methods presented in a paper by Terzaghi, "Evaluation of Coefficients of Subgrade Reaction", GEOTECHNIQUE, London, England, Vol. V, 1966 and a paper by Bengt B. Broms, "Lateral Resistance of Piles in Cohesive Soils" No. 3825, Journal of the Soil Mechanics and Foundation Division, ASCE, March 1964. Low average unconfined compression (q_u) values, based on test results from Boring B-IU and U-3, of 300 psf for Bayou Bienvenue location and 500 psf for Bayou Dupre resulted in K values of 62 psi and 104 psi respectively. Positions of these values on the above mentioned group of curves indicated that the battered pile foundation of the inverted "tee" wall was satisfactory.

(b) The second method of analysis was based on the "Method of Elastic Centers" as presented in the book titled "Substructure Analysis and Design", by Paul Andersen. This study is presented on Plate IV-37.

c. The "I" type flood wall will be constructed from precast prestressed concrete sheet piles driven in place and capped by a concrete walkway. Stability studies were made using the "method of planes" utilizing soil data obtained from laboratory test results of soil samples from Boring B-IU and U-3. The floodwall was analyzed for a hurricane condition with a still water elevation of 13 and a five foot broken wave on the flood side and ground water at elevation 2 on the protected side. The wall was investigated for both (Q) and (S) design shear strengths for a factor of safety of 1.5 with static water level at the top of the wave and a factor of safety of 1.25 with the dynamic force of the wave added. The effect of drag force on the wall was investigated and found to be not critical. See Plate IV-38 for the stability studies and governing conditions.

d. At each end of the gate bay there will be an anchored precast prestressed concrete sheet pile retaining wing wall. The wing walls were analyzed for stability using (Q) shear strengths and other soil data obtained from soil samples of Borings B-IU and U-3. The water was assumed to be at elevation 0.0 on the channel side and behind the wall. The walls were also checked for stability using the (S) shear strengths. A factor of safety of 1.5 was used in both analyses. See Plate IV-37 for loads and resulting diagrams. Other forms of retaining walls were considered and evaluated for economy. The precast prestressed concrete sheet pile wall appeared to be the most practical and economical for use in this location.

10. <u>Pile Penetration.</u> The upper soils, in general, at the locations of the control structures have low shear strength, high sensitivity and are compressible indicating the need for bearing piles under the gate structure. Pile lengths were determined by using the (Q) values obtained from the soil boring laboratory results applied to the full length of the pile. A factor of safety of 1.75 was used for compression piles and 2.00 was used for tension piles. Pile penetrations were also determined by using (S) values, obtained from laboratory results of the soil samples, applied to the lower two-thirds of the pile length. Pile lengths using the appropriate (Q) or (S) curve were determined for each structure, see Plate III-11 for the curves, design shear strength and pile design loads. Steel sheet pile cut-off walls are provided beneath the gate bay structure and beneath the inverted "tee" floodwall with tips at elevation -26. The cut-off walls are provided to prevent piping beneath the structure in the event roofing occurs below the slab. Pile lengths shown below are for estimating purpose only and final lengths will be determined after pile load tests are performed at each location.

BAYOU BIENVENUE

Location	Tip Elevation	Cut-Off Elevation
Base Slab Battered	-70	Varies (Untreated Timber) -16.78 (530) -15.28 (22) -13.78 (84)
Inverted "tee" Floodwall Battered	-62	2.75 (12"x12" Prestressed Concrete)
Dock	-60	1.5 (Treated Timber)
Guide Wall	-60	10.0 (Treated Timber)
Needle Dam Storage	-53	6.0 (12"x12" Prestressed Concrete)

BAYOU DUPRE

Location	Tip Elevation	Cut-Off Elevation
Base Slab Battered	-65	Varies (Untreated Timber) -16.78 (530) -15.28 (22) -13.78 (84)
Inverted "tee" Floodwall Battered	-48	2.75 (12"x12" Prestressed Concrete)
Dock	-60	1.5 (Treated Timber)
Guide Wall	-60	10.0 (Treated Timber)

11. Ultimate Settlement.

a. Structure. The weight of earth that will be excavated is approximately equal to the weight of the structure, therefore, there will be little net change in the soil pressures below the structure, however, bearing piles are required for stability under the various loading conditions and to transfer loads induced to deeper and stronger soil strata. It is anticipated that there will be little or no settlement of the structure.

b. Inverted "tee" Wall. It is anticipated that there will be little or no settlement in the wall adjacent to the gate structure and a settlement of approximately 2 inches at the connection to the "I" type wall.

c. "I" Wall. Previous studies in preparation of the Design Memorandum No. 3, General Design, Chalmette Area Plan, indicated that at Bayou Bienvenue the levee first lift would have a settlement of 1.49 feet and subsequent settlement of 1.45 feet. Spoil from the excavation of the MR-GO was deposited at the site of the Bayou Bienvenue control structure several years ago and at present the ground has an average elevation of 5.5 feet. At the time of construction of the control structure approximately all of the settlement equivalent to the first lift will have occurred. At Bayou Dupre computations indicated first lift settlement of 2.55 feet and no subsequent subsidence. The average ground elevation at the Bayou Dupre structure site is presently approximately 8.0 feet. This area has received spoil from the MR-GO and has had a portion of the settlement equivalent to the first lift. Settlement plates have been installed by the Corps of Engineers prior to placement of the first lift of levee between Stations 368+00 and 570+00 and between 594+00 and 770+00. The nearest settlement plate to the Bayou Bienvenue structure site is located at Station 375+00 (1500 feet east of the structure). This area had not received any previous spoil and existing ground was at elevation 3 prior to placement of first lift. Approximately three weeks after placement of the first lift, the plate had subsided 1.49 feet. Survey notes indicate that about twelve feet of fill had been placed prior to the check of the settlement plate. The nearest settlement plate to the Bayou Dupre structure site is located at Station 706+00 (600 feet east of the structure site). Approximately 4.5 feet of fill had been placed at this point to a gross grade of elevation 18.75. Readings indicated a subsidence of 0.25 feet about one week after placement of fill. Upon commencement of construction at both structure sites, the area from the end of the inverted "tee" wall to the limits of work will be pre-loaded with material obtained from the excavation. Settlement plates will be installed prior to placement of the pre-load material and frequent settlement readings will be taken to determine time rate of settlement. The last work to be done will be the installation of the "I" wall approximately one year after placement of pre-load. Construction elevation of the cap beam of the "I" wall will be determined from the settlement plate readings and this information will be furnished to the contractor when he is ready to install the cap beam.

d. Stream Closure. Studies have indicated that closure settlements would range between one to three feet with the higher range occurring at Bayou Bienvenue and the lower range occurring at Bayou Dupre.

12. Structure Backfill. The excavation adjacent to the gate bay walls and sheet pile wing walls will be backfilled with clam shell to elevation zero. The remainder of the backfill to elevation 6.0 will be made utilizing selected material from the spoil area. See Plate I-8 for area of clam shell backfill.

13. Backfill of Existing Bayou Channels. Upon completion of the gate control structures, floodwalls, levee tie-in, and access channels the closure of Bayou Bienvenue and Bayou Dupre will be made at the location of the levee centerline. The closure at each location will be made in three stages. This will allow underlying clays to gain increased shear strengths during the period between stages of construction. The first stage will be the placement of a clam shell core and hydraulic fill. The shell core is required as a back-up for the hydraulic fill. The second stage will consist of additional shell and hydraulic fill. The third stage will be the final shaping and a clay blanket. See Plate I-9 for typical sections and Plates III-12 and III-13 for stability studies of stage construction.

14. <u>Spoil Disposal.</u> Excess excavation spoil and access channel spoil will be placed in spoil areas adjacent to the structure and channel as shown on Plates I-1 and I-2. See Plate III-22 for stability study of spoil area.

15. <u>Erosion Control and Protection.</u> Erosion protection for the access channel bottom adjacent to the control structure on the flood side will consist of 3 feet of derrick stone on one foot of shell extending 100 feet from the gate bay and 2 feet of riprap on one foot of shell extending an additional 100 feet and on the protected side will be 2 feet of riprap on one foot of shell extending 150 feet from gate structure. The channel side slope within the above limits will have 2 feet of riprap on one foot of shell to elevation 5. Erosion protection beyond the above limits is not included in this Detail Design Memorandum and will be placed by local interests as required. Erosion protection as described is required as protection against high velocities that will occur under certain conditions. Under normal operations (gates open) velocities of seven feet per second can be anticipated approximately one per cent of the time. See Plate II-2 for curve titled "Velocity Thru Structure Vs. Percent of Time". An abnormal condition might occur where there would be a reverse head resulting from closure of the gates for hurricane approach and abnormal rainfall ponded within the area and delay in re-opening of the gates and a rapid drop in tide in the MR-GO. In cases such as this, eroding velocities would occur dictating the need for erosion protection. The shell beneath the derrick stone and riprap is required to form a supporting blanket, otherwise the stone would eventually sink into the soft channel bottom. Ground elevation in the area of the structures and adjacent levees range between 5 and 6 feet and the structures and levees are located approximately five hundred feet from the edge of the MR-GO. Erosion protection of the structure backfill and adjacent levees is not indicated for the condition of high tides and wave wash from passing vessels since the ground elevation and the distance from the MR-GO would eliminate the above problem.

16. <u>Engineering Observations</u>.

a. Bearing pile tip elevations given in Paragraph 10 of this section are for estimating purpose only. Upon completion of excavation, three Class B treated timber piles of different lengths will be driven at each structure site as part of the base slab foundation. At each site, the short pile and the intermediate pile will be tested in compression. If test results show that either of these two piles can carry twice the design loads, the long pile will not be tested. One pile at each site will be tested in tension. At Bayou Bienvenue the test piles will be driven to the following tip elevations: -65, -70, -75. At Bayou Dupre the test piles will be driven to the following tip elevations: -60, -65, and -70. The results of the load tests will be evaluated to confirm tip elevations of the 12x12 concrete pile supporting the inverted "tee" wall.

b. Settlement observations of the structure will be made frequently during construction. Settlement plates will be placed in the surcharged area and observed frequently during and after pre-loading so as to determine the time rate of settlement. This data will be used in determining the required gross elevation of the concrete cap of the "I" floodwall. Elevation measurements will be taken prior to each concrete pour of the base slab and gate bay walls. Permanent reference markers will be placed on the structure and the floodwall as shown on Plates I-8 and IV-36.

c. Settlement and lateral movement observations will be made quarterly for the first two years after completion of construction, and annually thereafter. A periodic examination of this schedule for adequacy will be made as the data are obtained. Scour surveys will be made, at the same time settlement measurements are made, at each end of the gate structure and in the area adjacent to the riprap until it has been determined that the channel bottom has become stabilized.

17. <u>Construction Sequence.</u> See Paragraph III-7, "Method of Excavation", for initial steps. Dry material excavated will be used as surcharge load in area of floodwall and connecting levee. After the excavation is dewatered, a dry bottom of shell will be placed for a working surface. Pile driving equipment will be placed in the hole either on mats or travel piles. Test piles will be driven and tested as specified in Paragraph 16a. After all piles are driven, the piles will be cut to the proper elevation and heads coated and hold-down straps installed. Six inches of lean dry bottom concrete will be placed to furnish a dry solid working surface for the placement of base slab reinforcement. Upon completion of the base slab, wall forms will be erected and the walls constructed. The sector gates will be prefabricated and brought to the site on a barge. After erection of the gates the timber wales will be installed. The operating machinery and electric circuits will be installed concurrently. The wing walls will be driven when the walls of the gate bays are completed. Clam shell backfill and derrick stone placement follow the installation of the wing walls. Selected earth backfill will be placed around the gate bay walls and where necessary to form the banks of the approach channel. The approach channel will be made with a hydraulic dredge after satisfactory operation of the gates. The banks of the approach channel in the areas receiving shell and riprap will be dressed by a dragline and the shell and riprap placed. At this time, the sheet pile cut-off wall and the prestressed concrete piles for the inverted "tee" floodwall will be driven and necessary additional earth for the tie-in levee will be placed and shaped and the closure of the bayou started. The inverted "tee" wall will be formed and poured and the connecting "I" wall installed. Upon completion of the "I" wall the access walk between the levee and the gate structure will be formed and poured on top of the floodwall. Piling for the fender, guide walls, dolphins, and loading ramps will be driven and the timbers installed. As a final step the entire area will be cleared of all construction debris and dressed up.

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PROCEDURE USED IS AS OUTLINED IN CHAPTER No. 3 "DEWATERING" FOUNDATION ENGINEERING TEXT, LEONARDS - EDITOR. AUTHORS OF ABOVE CHAPTER - MANSUR AND KAUFMAN.

IT HAS BEEN ASSUMED THAT THE CONDITIONS AT BAYOUS BIENVENUE AND DUPRE ARE SIMILAR TO THAT SHOWN ON PAGE 304 FIG 3-37a OF THE ABOVE TEXT AND THAT AN ARTESIAN FLOW EXISTS. IT HAS BEEN ASSUMED THAT THE WELL POINT ARRAY IS ROUGHLY A CIRCLE.

THE METHOD OF CALCULATION USED IS AS FOLLOWS:

1. ESTABLISH DESIRED HYDROSTATIC RELIEF IN UNDERLYING SANDS.
2. USING EQ 3-77 SOLVE FOR F_c'
3. USING EQ 3-92a SOLVE FOR Q_w
4. USING EQ 3-93 & 3-77 SOLVE FOR h_w AT NEAR WELL AND FAR WELL.
5. OBTAIN LOSSES IN SYSTEM FROM FIG 3-41

BAYOU DUPRE

BASED ON SOIL BORINGS U-3, D-4 AND D-1-U THE TOP OF THE SAND HAS BEEN ASSUMED AT ELEVATION -26 AND SINCE THE STRATUM THICKNESS VARIES THE BOTTOM IS ASSUMED AT -40 SEE SHEET 2 FOR SECTION.

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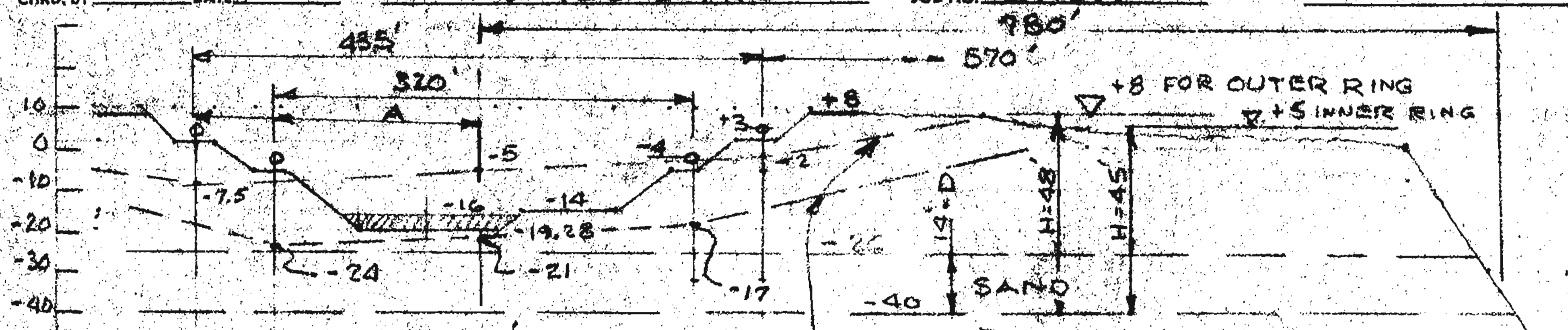
BY LJB DATE 5-1-68 SUBJECT PRESSURE RELIEF
CHKD. BY ____ DATE ____ BAYOU DUPRE
SHEET NO. 2 OF 10
JOB NO. 67006



V = 20'
M = 43 OUTTER RING
= 36 INNER RING
ASSUME TIPS AT ELEV -31

D_{10} = 0.14 mm
$k_H = 300 \times 10^{-4}$ cm/sec ≑ 0.06 Ft/min
FROM FIG 3-39 PAGE 308

OUTER RING

PRESSURE IN SANDS REQUIRE RELIEF TO AVOID BOTTOM HEAVE AT ELEV -16 WHEN DEWATERING TO -5 IS DONE

ASSUME PIEZOMETRIC READING OF -5 AT CENTER
$H - h_c = 13$, $48 - 13 = 25 = h_w$
FOR $H - h = 13$ R FROM FIG 3-39 = 800'
FROM PAGE 308 (BOTTOM) $L_w = 570' > R/2 = 400'$

FOR OUTER RING NEAR WELL USE $L_w = 400$

ASSUME MAX. WELL SPACING = 12'
OUTER RING $\frac{435 \times 3.14}{12} = \sim 114 = n$

INNER RING $\frac{320 \times 3.14}{12} = \sim 84 = n$

OUTER RING
SOLVE FOR F'_c AT CENTER
EQ 3-77 $H - h_c = \frac{F_c}{2\pi k D}$

$13 = \frac{F'_w}{2 \times 3.14 \times 0.06 \times 14} = 69$
(5.29)

SOLVE FOR Q_w WITH $F'_c = 69$
EQ 3-92a $F'_c = Q_w n \ln \frac{2L}{A}$
$69 = Q_w \, 114 \times \ln \frac{2 \times 617}{217}$
$Q_w = \frac{69}{198} = 0.348$ cfm/well
2.62 GPM/WELL

SOLVE FOR F'_w AT NEAR WELL
EQ 3-93 $F'_w = Q_w \left(n \ln \frac{2L_w}{A} + \ln \frac{A}{n r_w}\right)$
$= 0.348 \left(114 \times \ln \frac{2 \times 400}{217} + \ln \frac{217}{114 \times 0.1}\right)$
$= 53$

SOLVE FOR $H - h_w$ AT NEAR WELL
$H - h_w = \frac{F'_w}{2\pi k D} = \frac{53}{5.29} = 10$
$h_w = 48 - 10 = 38$
DRAWDOWN TO ELEV -2

REPEAT LAST 2 STEPS FOR FAR WELL

$$F'_w = 0.348 \left(114 \times \ln \frac{2 \times 835}{217} + \ln \frac{217}{114 \times 0.1}\right)$$

$$= 82$$

$$H - h_w = \frac{82}{5.29} = 15.5$$

$$h_w = 48 - 15.5 = 32.5$$

DRAWDOWN TO ELEV -7.5

COMPUTE H_w FROM FIG 3-41

$H_w = H_e + H_s + H_r + H_v$ (EQ 3-101)

H_e (FROM CURVE 1 FIG 3-41(a)) = 0.1'

H_s (FROM FIG 3-41(b)) = ~0.1'

$H_r + H_v$ (FROM FIG 3-41(c)) FOR 34' LONG 1½" PIPE = ~0.1

H_w = ~0.3'

$h_w - H_w \geq M - V$ (USE FAR WELL)

$32.5 - 0.3 \geq 43 - 20$

$32.2 > 23$

INNER RING

REPEAT ALL PREVIOUS STEPS WITH H = 45

REQUIRE PRESSURE RELIEF AT CENTER TO ELEV -21 WHEN MR-GO IS AT +5. DRAWDOWN = 26' AND $h_c = 19$

SOLVE FOR F'_c

$$H - h_c = \frac{F'_c}{2\pi k D}$$

$$F'_c = 26 \times 5.29 = 137$$

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SOLVE FOR Qw

$$137 = Q_w \times 84 \times \ln \frac{2 \times 617}{160}$$

$$Q_w = \frac{137}{171} = 0.8 \text{ cfm/WELL}$$
6.0 GPM/WELL

SOLVE FOR F'W FAR WELL

$$F'_w = 0.8\left(84 \times \ln \frac{2 \times 777}{160} + \ln \frac{160}{84 \times 0.1}\right)$$
$$= 0.8 \times 193$$
$$= 154$$

SOLVE FOR H-hw FAR WELL

$$H - h_w = \frac{154}{5.29} = 29 ; \quad h_w = 16 \quad (\text{ELEV } -24)$$

SOLVE FOR F'W NEAR WELL

$$F'_w = 0.8\left(84 \times \ln \frac{2 \times 458}{160} + \ln \frac{160}{84 \times 0.1}\right)$$
$$= 0.8 \times 149 = 117$$

SOLVE FOR H-hw NEAR WELL

$$H - h_w = \frac{117}{5.29} = 22 ; \quad h_w = 23 \quad (\text{ELEV } -17)$$
OK

FROM FIG 3-41

$H_e = \sim 0.1$
$H_s = \sim 0.3$
$H_v + H_r = \sim 0.1$
$H_w = 0.5$

$h_w - H_w \geq M - 20$ (USE FAR h_w)
$16 - 0.5 \quad 36 - 20$
$15.5 \cong 16$ (OK TO USE SINCE THIS IS EXTREME CASE & WELL SPAC. CAN BE VARIED)

BAYOU BIENVENUE

PROCEDURE USED ON PRECEDING SHEETS ARE CONTINUED FOR THIS LOCATION, SAND STRATUM SHOWN ON BORING B-1-U IS BETWEEN ELEVATIONS -28 AND -35.

SEE SHEET 6 FOR SECTION AND DIMENSIONS.

SINCE REQUIRED RELIEF IS THE SAME AS PRECEDING PROBLEM, LW FROM NEAR WELL WILL BE ASSUMED THE SAME

LW OUTER RING = 400' MEASURED FROM NEAR WELL
LW INNER RING = 492' do do do do

OUTER RING

CIRCUM = 1800
1800/12 = 150 WELLS

SOLVE FOR F_c'

DRAWDOWN TO -5 ; $H - h_c = 13$

$$F_c' = 13 \times \underbrace{2\pi \times 0.06 \times 7}_{2.64} = 34$$

SOLVE FOR QW

$$Q_W = \frac{34}{150 \times \ln \frac{2 \times 687}{287}} = \frac{34}{236} = 0.144 \text{ cfm/WELL}$$
$$= 1.08 \text{ GPM/WELL}$$

SOLVE FOR F_W' FOR WELL

$$F_W' = 0.144 \left(150 \times \ln \frac{2 \times 974}{287} + \ln \frac{287}{150 \times 0.1} \right)$$

$$F_W' = 42$$

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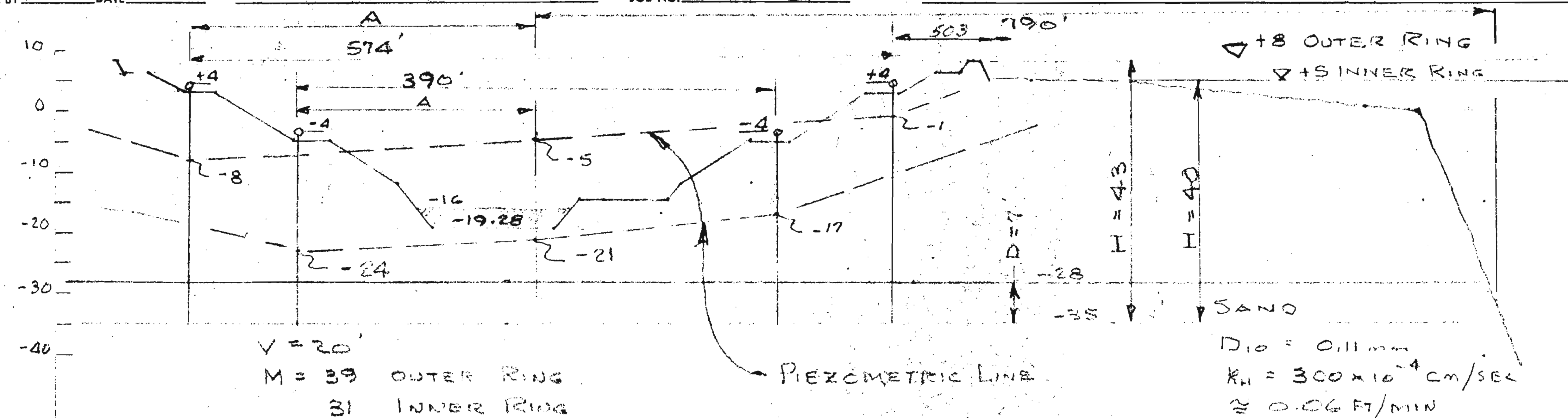
BY L.J.B. DATE 5-2-68 SUBJECT PRESSURE RELIEF BAYOU BIENVENUE SHEET NO. 6 OF 10
CHKD. BY ______ DATE ______ JOB NO. 67006



V = 20'
M = 39 OUTER RING
31 INNER RING
W.P. TIP @ -35
k_w = 0.1

OUTER RING (CONT.)

SOLVE FOR $H-h_w$ FOR FAR WELL

$H-h_w = \frac{42}{2.64} = 15.9$; $h_w = 27$ (ELEV -8)

SOLVE FOR F'_w NEAR WELL

$F'_w = 0.144\left(150 \times \ln\frac{2\times 400}{287} + \ln\frac{287}{150\times 0.1}\right)$

$F'_w = 24$

SOLVE FOR $H-h_w$ NEAR WELL

$H-h_w = \frac{24}{2.64} = 9.1$; $h_w = 34$ (ELEV -1)

SINCE FLOW IS SO LOW $H_w < 0.5'$
$h_w - H_w \geq M - 20$ (FAR WELL)
26.5 > 19

INNER RING

CIRCUM. = 1225   No. OF WELLS = 1225/12 = 102
DRAWDOWN CENTER TO -21 ; $H-h_c = 26$

SOLVE FOR F'_c

$F'_c = 26 \times 2.64 = 69$

SOLVE FOR Q_w

$Q_w = \frac{69}{102 \cdot \ln\frac{2\times 687}{195}} = 0.346$ CFM/WELL
2.6 GPM/WELL

SOLVE FOR F'_w FAR WELL

$F'_w = 0.346\left(102 \times \ln\frac{2\times 882}{195} + \ln\frac{195}{102\times 0.1}\right)$

$= 77$

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BY LJB DATE 5-2-68 SUBJECT PRESSURE RELIEF BAYOU BIENVENUE (CONT.)
CHKD. BY ____ DATE ____

JOB NO. 67006

SOLVE FOR H - h_w FAR WELL

$$H - h_w = \frac{77}{2.64} = 29 \;;\; h_w = 11 \;(\text{ELEV} -24)$$

SOLVE FOR F'_w NEAR WELL

$$F'_w = 0.346\left(102 \times \ln \frac{2 \times 492}{195} + \ln \frac{195}{102 \times 0.1}\right)$$

$$= 58$$

SOLVE FOR H - h_w NEAR WELL

$$H - h_w = \frac{58}{2.64} = 22 \;;\; h_w = 18 \;(\text{ELEV} -17)$$

SINCE FLOW IS SO LOW $H_w < 0.5$

$$h_w - H_w \geq M - 20 \quad (\text{FAR WELL})$$
$$10.5 \cong 11$$

BY ADJUSTING WELL SPACING AND DECREASING FLOW IN FAR WELLS AND INCREASING FLOW IN NEAR WELLS, THE PIEZOMETRIC LINE CAN BE FLATTENED.

A 10% DECREASE AND INCREASE IN THE ABOVE Q_w WOULD RESULT IN PIEZOMETRIC ELEV OF -21 AT FAR WELL AND -19 AT NEAR WELL.

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BY LJB DATE 5-6-68 SUBJECT PRESSURE RELIEF
SAND DRAINS
SHEET NO. 8 OF 10
CHKD. BY ____ DATE ____
JOB NO. 67006

THE REFERENCE NOTED ON SHEET No 1 IS USED IN THE ANALYSIS OF PRESSURE RELIEF BY SAND DRAINS FOR THE PLAN OF "OPEN EXCAVATION WITH STEEL SHEET PILE ENCLOSURE"

THE EXAMPLE SHOWN IN FIG 3-49 OF THE REFERENCE IS USED AS A GUIDE. THE EXAMPLE SHOWN IS FOR "GRAVITY" FLOW WHEREAS CONDITION OF THIS PROJECT IS "ARTESIAN" FLOW AND THE PURPOSE OF THE SAND DRAINS IS TO LOWER HYDROSTATIC PRESSURES IN THE UNDERLYING SANDS WHICH MAY BUILD UP BY SEEPAGE THRU THE JOINTS OF THE SHEET PILES.

IT IS ASSUMED THAT THE SANDS ARE SUBJECT TO SEEPAGE BY A LINE SOURCE (MR-GO) AND THAT THE ENCLOSURE IS ROUGHLY A CIRCLE AND THE CONDITIONS ARE SIMILAR TO THAT SHOWN IN FIG 3-37(a) OF THE REFERENCE. SEE SHEET NO. 9 FOR SECTION AND DIMENSIONS.

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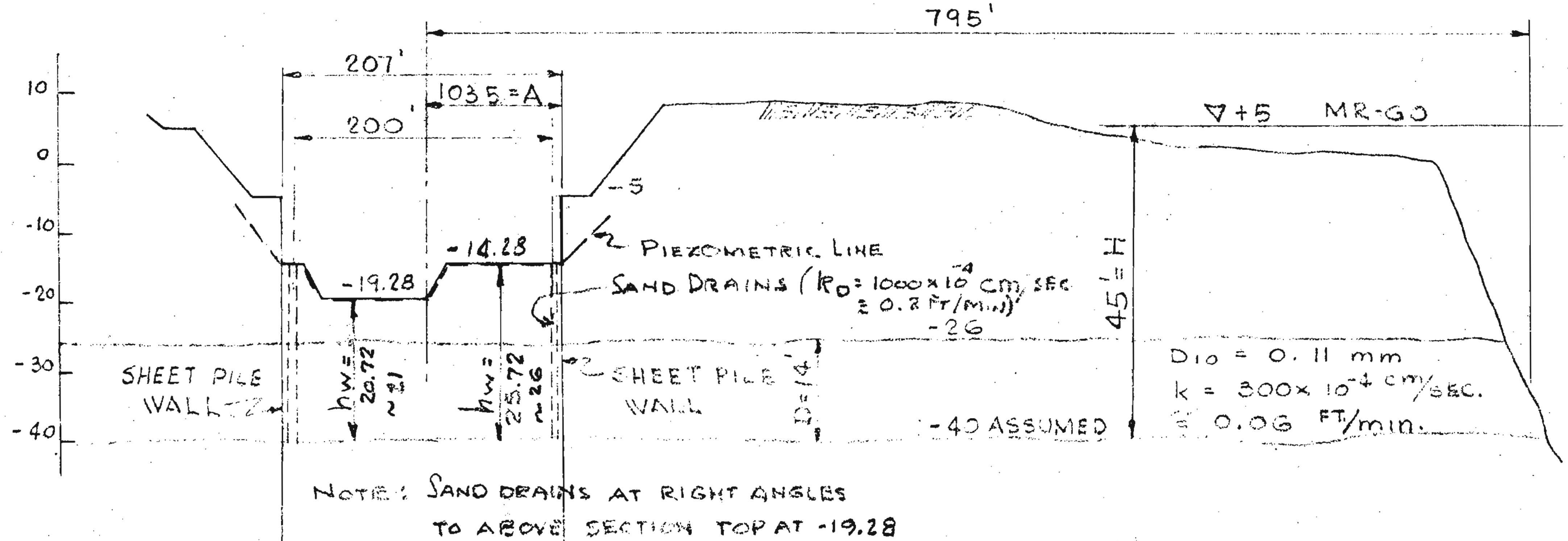
BY LJB DATE 5-20-68 SUBJECT SAND DRAIN / BAYOU DUPRE
CHKD. BY ____ DATE ____



For $k = 300 \times 10^{-4}$ from Fig 3-59
$R = 500$ for $H - h_w = 10$

For $H - h_w = 19$; $R = 1.9 \times 500 = 950$
$H - h_w = 24$; $R = 2.4 \times 500 = 1200$

Since 795' (℄ to MR-GO) > R/2
(Ref. Bot page 308 text)
Use $L = R/2 = 950/2 = 475$ & $1200/2 = 600$

Circum of wall = 207 × 3.14 = 650'
Area of wall in sand: 14 × 650 = 9100 Sq Ft
No of joints 650/1.5 = 434
Assume ea. joint open 1/16" × 14' = 0.07 Sq Ft
Total opening: 434 × 0.07 = 30.4 Sq Ft.

Ratio joint open. to sand area
30.4/9100 × 100 = 0.334%

IF NO WALL SOLVE FOR Q_w

Solve for F'_c for $H - h_w = 19$
$H - h_w = 24$

Eq 3-77: $F'_c = 19 \times 2 \times \pi \times 0.06 \times 14 = 100$
$24 \times 2 \times \pi \times 0.06 \times 14 = 127$

Solve for Q_w
Eq 3-92 (a) Let n = 1

$$Q_w = \frac{100}{\ln \frac{2 \times 475}{103.5}} = 45 \text{ cfm} \quad (337 \text{ GPM})$$

$$= \frac{127}{\ln \frac{2 \times 600}{103.5}} = 52 \text{ cfm} \quad (388 \text{ GPM})$$

Use Q_w no wall = 52 cfm
With wall: 52 × 0.334% = 0.173 cfm
(1.3 GPM)

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TO FIND VERTICAL FLOW IN THE SAND DRAIN, EQ 3-1 $Q_D = kiA$ IS USED WITH THE FOLLOWING VALUES

$k = 1000 \times 10^{-4}$ cm/SEC $\tilde{=}$ 0.2 FT/MIN,
i = 12/26 = 0.46
A = 0.785 SQ FT.

Q_D = 0.2 × 0.46 × 0.785 = 0.072 CU FT/MIN

SEEPAGE THRU WALL FROM SH 9 = 0.173 CU FT/MIN

FROM THE ABOVE IT CAN BE SEEN THAT THEORETICALLY ~ 3 DRAINS SATISFY THE PROBLEM BUT THE THEORY OF A DRAINAGE SLOT AS PRESENTED IN THE REFERENCE TEXT IS NOT REALIZED.

IT IS RECOMMENDED THAT 12"ϕ SAND DRAINS BE PLACED AT 20' SPACING AROUND THE PERIPHERY OF THE WALL ON THE INSIDE OF THE ENCLOSURE AT EACH LOCATION.

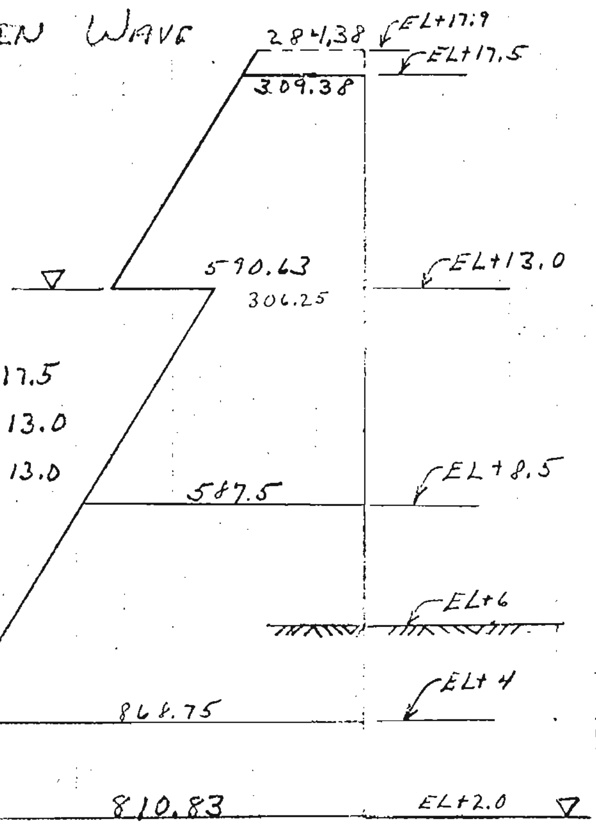
LOADING CONDITION #1:

FLOOD SIDE ⟹ STILL WATER EL +13.00
7' BROKEN WAVE

LAND SIDE ⟹ STILL WATER EL +2.00

SHEET PILE CUTOFF WALL IMPERVIOUS.

LOADING FOR 7' BROKEN WAVE



$h_b = 1.3 H_b = 1.3(7) = 9.1'$

$h_c = 0.7 H_b = 0.7(7) = 4.9$

$P_m = \frac{62.5}{2}(9.1) = 284.38$

$P = 284.38 + 0.4(62.5) = 309.38$ @ EL+17.5

$P = 284.38 + 4.9(62.5) = 590.63$ @ EL+13.0

$P = 4.9(62.5) = 306.25$ @ EL+13.0

$P = 13.9(62.5) = 868.75$ @ EL+4.0

$P = 15.9(62.5) = 993.75$ @ EL+2.0

$P = 9.4(62.5) = 587.50$ @ EL+8.5

(1,392.21 + 632.81 + 2756.25 + 2531.25 + 1621.66 + 57.92)

$\text{TOTAL FORCE} = 309.38(4.5) + 281.25(4.5)(\tfrac{1}{2}) + 306.25(9.0) + 562.5(9)(\tfrac{1}{2}) + 810.83(2) + 57.92(2)(\tfrac{1}{2}) = 8992.10^{\#}$

$\bar{y} = \frac{1392.21(13.25) + 632.81(12.5) + 2756.25(6.5) + 2531.25(5)}{8992.10} + \frac{1621.66(1) + 5792(0.67)}{8992.10} = 6.52'$

Figure 1 of 36

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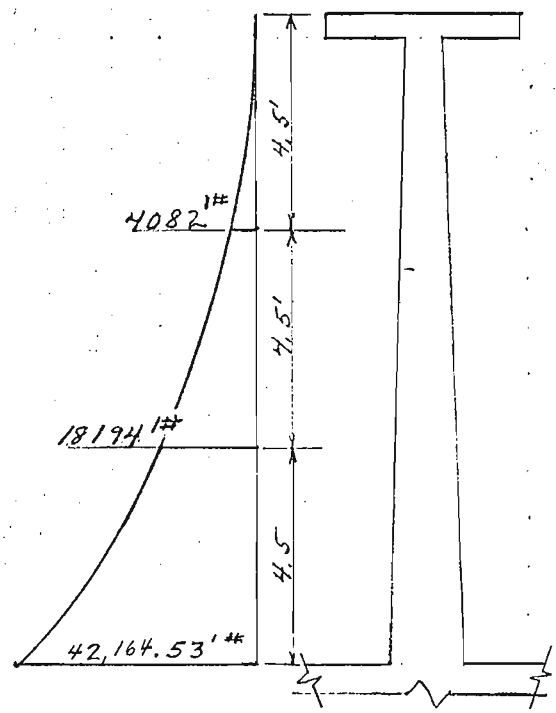
BY [signature] DATE 2/15/68 SUBJECT Inverted "T" Floodwall SHEET NO. 5 OF ____
CHKD. BY BMC DATE 3/12/68 JOB NO. 67006

MOMENT DIAGRAM FOR STEM



$\Sigma M_{4.5'} = 1392.21(2.25) + 632.81(1.5) = 4081.69$ '#

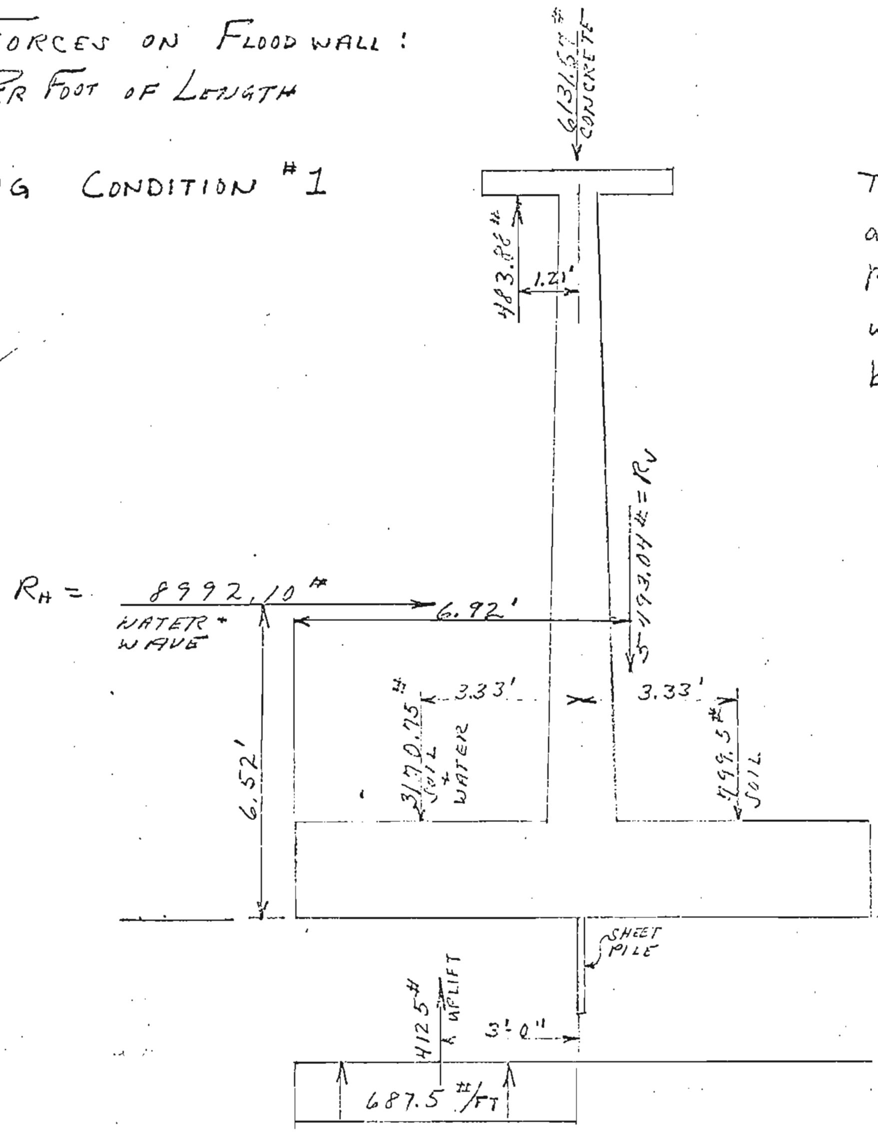
$\Sigma M_{9.0'} = 1392.21(6.75) + 632.81(6.0) + \overset{3100.78}{306.25(4.5)(2.25)} + \overset{1898.44}{281.25(4.5)(1.5)} = 18193.50$ '#

$\Sigma M_{13.5'} = 1392.21(11.75) + 632.81(10.5) + \overset{12403.13}{306.25(9.0)(4.5)} + \overset{7593.75}{562.5(9)(3)(\tfrac{1}{2})} = 42,164.53$ '#

$A_s = \dfrac{42,164.53(12)}{26,667(.871)(12)} = 1.8\ in^2/FT$

FORCES ON FLOODWALL:
PER FOOT OF LENGTH

LOADING CONDITION #1



The pressure of 306.25#/FT applied under the MRGO side of the walkway was designated by LJB on 2/15/68.

MRGO SIDE Soil+Water Wt. = .75(5.33) = 399.75#(2) + 62.5(7)(5.42') = 3170.75#
LAND SIDE Soil Wt = .75(5.33) = 399.75#(2) = 799.50#
UPLIFT = 62.5(11) = 687.5#/FT (6 FT) = 4125#
UPLIFT UNDER WALK WAY = 306.25#/FT (1.58 FT) = 483.88#

$\Sigma F_V = 5493.04\#$

$$\bar{y} = \frac{6131.67(6) + 3170.75(2.64) + 799.50(9.33) - 483.88(4.58) - 4125(3)}{5493.04} = 6.92'$$

$\Sigma F_H = 8992.10\# \longrightarrow$

$\bar{y} = 6.52'$

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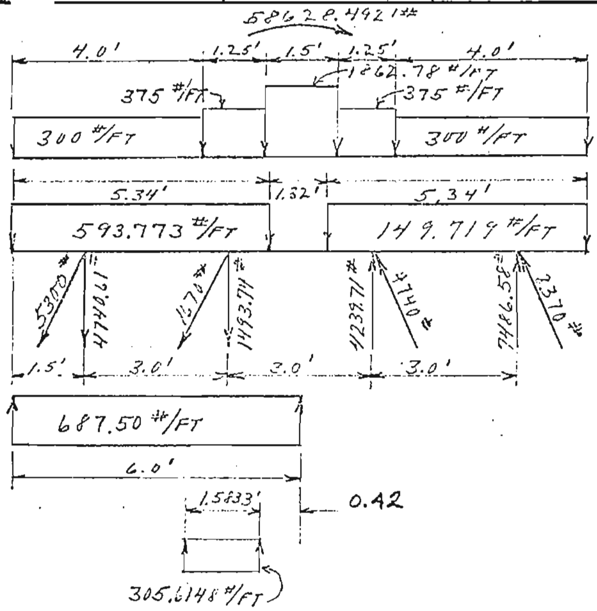
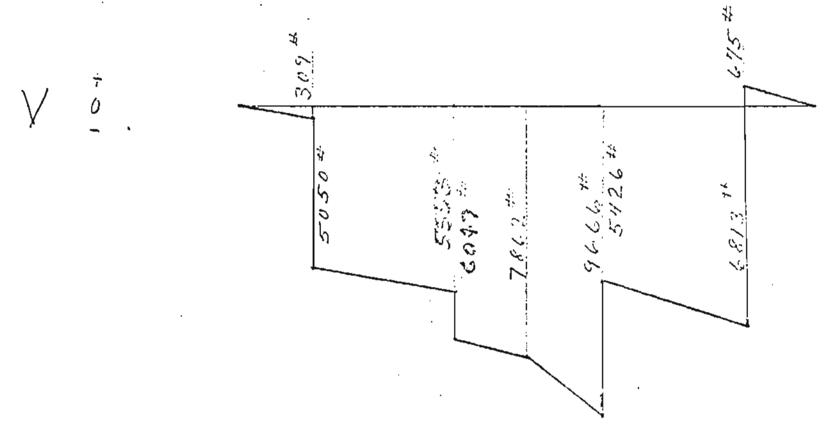
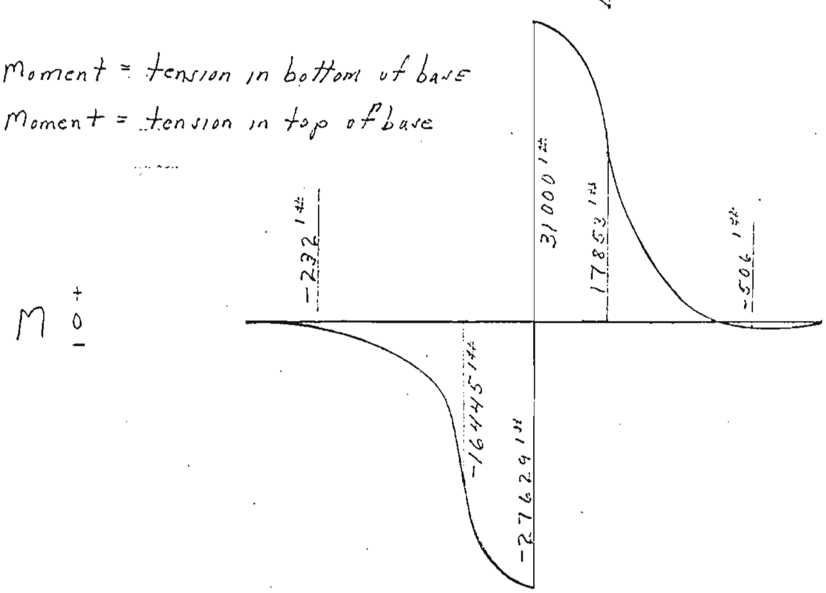
BY [illegible] DATE 2/21/68 SUBJECT [illegible] "T" [illegible] SHEET NO. 18 OF
CHKD. BY BMC DATE 3/12/68 JOB NO. 67006

Moment per ft. of Wall





+ Moment = tension in bottom of base
- Moment = tension in top of base



In Bottom:

$A_s = \frac{31^{1K}(12)}{26.67(.891)(14.5)}$

$A_s = 1.08 \text{ in}^2/\text{FT}$

In Top:

$A_s = \frac{27.629^{1K}(12)}{26.67(.891)(19.5)}$

$A_s = 0.72 \text{ in}^2/\text{FT}$

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SHEET NO. 19 OF
JOB NO. 67006

Re: ANALYSIS OF PILE FOUNDATION WITH BATTER PILES

By A. Hrennikoff Paper No. 2401 ASCE TRANSACTIONS

Loading Condition #1

12"x12" Prestressed Concrete Piles

$E = 4,280,000$ #/sq. in $A = 144$ sq. in. $I = 1728$ in^4

For Bayou Bienvenue

$L = 72.4'$

$n = \frac{2AE}{L} = \frac{144(4.28)(10^6)(2)}{72.4(12)}$

$n = 1.42(10^6)$ #/in

For Bayou Dupre

$L = 56.7'$

$n = \frac{2AE}{L} = \frac{144(4.28)(10^6)(2)}{56.7(12)}$

$n = 1.81(10^6)$ #/in

For $K = 50$ psi

Bayou Bienvenue:

$\beta = \sqrt[4]{\frac{K}{4EI}} = \sqrt{\frac{50}{4(3)(10^6)(1728)}}$

$\beta = 0.07(10^{-1})$

$t_\delta = \frac{K}{2\beta} = \frac{50}{0.007(2)} = 3.57(10^3)$

$r_1 = \frac{t_\delta}{n} = \frac{3.57(10^3)}{1.42(10^6)}$

$r_1 = 2.514(10^{-3})$

Bayou Dupre:

$\beta = \sqrt[4]{\frac{K}{4EI}} = \sqrt[4]{\frac{50}{4(3)(10^6)(1728)}}$

$\beta = 0.07(10^{-1})$

$t_\delta = \frac{K}{2\beta} = \frac{50}{0.007(2)} = 3.57(10^3)$

$r_1 = \frac{t_\delta}{n} = \frac{3.57(10^3)}{1.81(10^6)}$

$r_1 = 1.97(10^{-3})$

Figure 5 of 36

See Sheet 15 of

$\phi_1 = 63°-26'$ $X_1 = -54"$ $X_2 = -18"$

$\phi_2 = 116°-34'$ $X_3 = 18"$ $X_4 = 54"$

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For Bayou Bienvenue

$$X'_x = \frac{X_x}{n} = -\sum_g \left[N(\cos^2\phi + r_1 \sin^2\phi)\right]$$

$$= -\left[2(0.20002 + 0.002514(0.79997)) + 2(0.20002 + 0.002514(0.79997))\right]$$

$$X'_x = -0.80812$$

$$Y'_x = \frac{X_y}{n} = \frac{Y_x}{n} = -\frac{1}{2}(1-r_1)\sum_g (N \sin 2\phi)$$

$$= -\frac{1}{2}(1-0.002514)\left[2(0.80003) + 2(-0.8003)\right]$$

$$Y'_x = 0.0$$

$$Y'_y = \frac{Y_y}{n} = -\sum_g \left[N(\sin^2\phi + r_1 \cos^2\phi)\right]$$

$$= -\left[2(0.79997 + 0.002514(0.20002)) + 2(0.79997 + 0.002514(0.20002))\right]$$

$$Y'_y = -3.2019$$

$$m'_x = X'_\alpha = -\frac{1}{2}(1-r_1)\sum_g (N \bar{x} \sin 2\phi)$$

$$= -\frac{1}{2}(\overset{0.997486}{1-0.002514})\left[2(36)(0.8003) + 2(-36)(-0.8003)\right]$$

$$m'_x = -57.457$$

$$m'_y = Y'_\alpha = -\sum_g \left[(\sin^2\phi + r_1 \cos^2\phi) N \bar{x}\right]$$

$$= -\left[((0.79997 + 0.002514(0.20002))(2)(36) + ((0.79997 + 0.002514(0.20002))(2)(-36)\right]$$

$$m'_y = 0.0$$

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$$m'_\alpha = -\sum_{\theta}\left[(\sin^2\phi + r_1 \cos^2\phi) \sum_{N} (x^2) \right]$$

$$= -\left[(0.79997+0.002514(0.20002))(\overset{3240}{18^2+54^2}) + (0.79997+0.002514(0.20002))(18^2+54^2)\right]$$

$$m'_\alpha = -5187.0456$$

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SHEET NO. 22 OF

JOB NO. 67006

$$X'_x \Delta'_x + Y'_x \Delta'_y + M'_x \alpha' + X = 0$$

$$Y'_x \Delta'_x + Y'_y \Delta'_y + M'_y \alpha' + Y = 0$$

$$M'_x \Delta'_x + M'_y \Delta'_y + M'_\alpha \alpha' + M = 0$$

$$-0.80812 \Delta'_x + 0.0 \Delta'_y - 57.457 \alpha' + 8992.10 = 0$$

$$0.0 \Delta'_x - 3.2019 \Delta'_y + 0.0 \alpha' + 5493.04 = 0$$

$$-57.457 \Delta'_x + 0.0 \Delta'_y - 5187.0456 \alpha' + 764{,}185.07 = 0$$

from Computer Output See Sheet 155

$$\Delta'_x = 3071.098$$

$$\Delta'_y = 1715.556$$

$$\alpha' = 113.307$$

for PILE #1

$$\delta_l' = \Delta_x' \cos\phi_2 + \Delta_y' \sin\phi_2 + \alpha' x_1 \sin\phi_1$$

$$= \overset{-1373.52}{3071.098(-0.44724)} + \overset{+1534.41}{1715.556(0.89441)} + \overset{-5472.52}{113.307(-54)(0.89441)}$$

$$\delta_l' = -5311.63$$

$$\delta_t' = \Delta_x' \sin\phi_2 - \Delta_y' \cos\phi_2 - \alpha' x_1 \cos\phi_2$$

$$= \overset{2746.79}{3071.098(0.89441)} - \overset{+767.27}{1715.556(-0.44724)} - \overset{-2736.47}{113.307(-54)(-0.44724)}$$

$$\delta_t' = 777.59$$

$$P_1 = \delta_l' = -5311.63$$

$$Q_1 = -r_1 \delta_t'$$

$$= -0.002514(777.59)$$

$$Q_1 = -1.95$$

$$\delta_t = \frac{\delta_t'}{n} = \frac{777.59}{1.42(10^6)} = 0.55(10^{-3}) \text{ inches/FT}$$

Allowable Reations in #/FT OF WIDTH

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JOB NO. 67006

for PILE #2

$$\delta_l' = \Delta_x' \cos\phi_2 + \Delta_y' \sin\phi_2 + \alpha' x_2 \sin\phi_2$$

$$= -1373.52 + 1534.41 + \underbrace{113.307(-18)(0.89441)}_{-1824.17}$$

$$\delta_l' = -1663.28$$

$$\delta_t' = \Delta_x' \sin\phi_2 - \Delta_y' \cos\phi_2 - \alpha' x_2 \cos\phi_2$$

$$= 2746.78 + 767.27 - \underbrace{113.307(-18)(-0.44724)}_{912.16}$$

$$\delta_t' = 2601.89$$

$$P_2 = \delta_l' = -1663.28$$

$$Q_2 = -r_1 \delta_t'$$

$$= -0.002514(2601.89)$$

$$Q_2 = -6.53$$

$$\delta_t = \frac{\delta_t'}{n} = \frac{2601.89}{1.42(10^6)} = 1.83(10^{-3}) \text{ inches/FT}$$

Allowable Reaction in #/FT OF WIDTH

for Pile #3

$$\delta'_{\ell} = \Delta'_x \cos\phi_1 + \Delta'_y \sin\phi_1 + \alpha' x_3 \sin\phi_1$$

$$\quad 1373.52 \qquad + \quad 1534.41 \qquad + 1824.17$$

$$= 3071.098(0.44724) + 1715.556(0.89441) + 113.307(18)(0.89441)$$

$$\delta'_{\ell} = 4732.10$$

$$\delta'_t = \Delta'_x \sin\phi_1 - \Delta'_y \cos\phi_1 - \alpha' x_3 \cos\phi_1$$

$$\quad 2746.82 \qquad - \quad 767.27 \qquad - \quad 912.16$$

$$= 3071.098(0.89441) - 1715.556(0.44724) - 113.307(18)(0.44724)$$

$$\delta'_t = 1067.39$$

$$P_3 = \delta'_{\ell} = 4732.10$$

$$Q_3 = -r\,\delta'_t$$

$$= -0.002514(4732.10)$$

$$Q_3 = -11.88$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{1067.39}{1.42(10^6)} = 0.75(10^{-3}) \text{ inches/FT}$$

Allowable Reactions in #/FT OF WIDTH

for Pile #4

$$\delta'_\ell = \Delta'_x \cos\phi_1 + \Delta'_y \sin\phi_1 + \alpha' x_4 \sin\phi_1$$

$$= 1373.52 + 1534.41 + \overset{5472.52}{113.307(54)(0.89441)}$$

$$\delta'_\ell = 8380.45$$

$$\delta'_t = \Delta'_x \sin\phi_1 - \Delta'_y \cos\phi_1 - \alpha' x_3 \cos\phi_1$$

$$= 2746.82 - 767.27 \overset{-\;2736.47}{-\;113.307(54)(0.44724)}$$

$$\delta'_t = -756.92$$

$$P_4 = \delta'_\ell = 8380.45$$

$$Q_4 = -r\,\delta'_t$$

$$= -0.002514(-756.92)$$

$$Q_4 = 1.90$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{-756.92}{1.42(10^6)} = -0.53(10^{-3}) \text{ inches/FT}$$

Allowable Reactions in #/FT OF WIDTH

Try K = 125 psi

For Bayou Bienvenue

$n = 1.42(10^6)$ pg.

For Bayou Dupre

$n = 1.81\ (10^6)$ pg

$\beta = \sqrt[4]{\frac{K}{4EI}} = \sqrt[4]{\frac{125}{4(3)(10^6)(1728)}}$

$\beta = 0.88\ (10^{-2})$

$t_\delta = \frac{K}{2\beta} = \frac{125}{0.88(10^{-2})(2)}$

$t_\delta = 7.102(10^3)$

For Bayou Bienvenue:

$r_1 = \frac{t_\delta}{n} = \frac{7.102(10^3)}{1.42(10^6)}$

$r_1 = 5.00(10^{-3})$

For Bayou Dupre:

$r_1 = \frac{t_\delta}{n} = \frac{7.102\ (10^3)}{1.81\ (10^6)}$

$r_1 = 3.92(10^{-3})$

For Bayou Bienvenue

$$X'_x = \frac{X_x}{n} = -\sum_g \left[N(\cos^2\phi + r_1 \sin^2\phi)\right]$$

$$= -\left[2(0.20002 + 0.005\ (0.79997)) + 2(0.20002 + 0.005\ (0.79997))\right]$$

$$X'_x = -0.816$$

$$Y'_x = \frac{X_y}{n} = \frac{Y_x}{n} = -\frac{1}{2}(1-r_1)\sum_g (N \sin 2\phi)$$

$$= -\frac{1}{2}(1-0.005)\left[2(0.80003) + 2(-0.80003)\right]$$

$$Y'_x = 0.0$$

$$Y'_y = \frac{Y'_y}{n} = -\sum_g \left[N(\sin^2\phi + r_1 \cos^2\phi)\right]$$

$$= -\left[2(0.79997 + 0.005\ (0.20002)) + 2(0.79997 + 0.005\ (0.20002))\right]$$

$$Y'_y = -3.204$$

$$m'_x = X'_\alpha = -\frac{1}{2}(1-r_1)\sum_g (N \bar{x} \sin 2\phi)$$

$$= -\frac{1}{2}(\overset{0.995}{1-0.005})\left[(2)(36)(0.80003) + 2(-36)(-0.80003)\right]$$

$$m'_x = -57.333$$

$$m'_y = Y'_\alpha = -\sum_g \left[(\sin^2\phi + r_1 \cos^2\phi) N \bar{x}\right]$$

$$= -\left[(0.79997 + 0.005\ (0.20002))(2)(36) + (0.79997 + 0.005\ (0.20002))(2)(-36)\right]$$

$$m'_y = 0.0$$

$$M'_\alpha = -\sum_{g} \left[(\sin^2\phi + r_1 \cos^2\phi) \sum_{N} (X^2) \right]$$

$$= -\left[(0.79997 + 0.005(0.20002))(18^2 + 54^2) + (0.79997 + 0.005(0.20002))((-18)^2 + (-54)^2) \right]$$

(3240 written above $18^2 + 54^2$)

$$= -5190.2856$$

$$X'_x \Delta'_x + Y'_x \Delta'_y + M'_x \alpha' + X = 0$$

$$Y'_x \Delta'_x + Y'_y \Delta'_y + M'_y \alpha' + Y = 0$$

$$M'_x \Delta'_x + M'_y \Delta'_y + M'_\alpha \alpha' + M = 0$$

$$-0.816 \ \Delta'_x + 0.0 \ \Delta'_y - 57.333 \ \alpha' + 8992.10 = 0$$

$$0.0 \ \Delta'_x - 3.204 \ \Delta'_y + 0.0 \ \alpha' + 5493.04 = 0$$

$$-57.333 \ \Delta'_x + -0.0 \ \Delta'_y - 5190.2856 \ \alpha' + 764185.07 = 0$$

FROM COMPUTER OUTPUT SEE SHEET 156

$$\Delta'_x = 3014.709$$

$$\Delta'_y = 1714.431$$

$$\alpha' = 113.932$$

for PILE #1

$$\delta'_l = \Delta'_x \cos\phi_2 + \Delta'_y \sin\phi_2 + \alpha' x_1 \sin\phi_2$$

$$= \overset{+1348.30}{3014.709(0.44724)} + \overset{+1533.40}{1714.431(0.89441)} + \overset{-5502.70}{113.932(-54)(0.89441)}$$

$$\delta'_l = -5317.60$$

$$\delta'_t = \Delta'_x \sin\phi_2 - \Delta'_y \cos\phi_2 - \alpha' x_1 \cos\phi_2$$

$$= \overset{2696.39}{3014.709(0.89441)} - \overset{+766.76}{1714.431(-0.44724)} - \overset{-2751.46}{113.932(-54)(-0.44724)}$$

$$\delta'_t = 711.69$$

$$P_1 = \delta'_l = -5317.60$$

$$Q_1 = -r\,\delta'_t$$

$$= -0.005\ (711.69)$$

$$Q_1 = -3.56$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{711.69}{1.42(10^6)} = 0.50\ (10^{-3})\ in/FT$$

Allowable Reactions in #/FT OF WIDTH

for Pile #2

$$\delta_l' = \Delta_x' \cos\phi_2 + \Delta_y' \sin\phi_2 + \alpha' x_2 \sin\phi_2$$

$$= -1348.30 + 1533.40 + 113.932(-18)(0.89441)$$

(−1834.23)

$$\delta_l' = -1649.13$$

$$\delta_t' = \Delta_x' \sin\phi_2 - \Delta_y' \cos\phi_2 - \alpha' x_2 \cos\phi_2$$

$$= 2696.39 + 766.76 - 113.932(-18)(-0.44724)$$

(−917.15)

$$\delta_t' = 2546.00$$

$$P_2 = \delta_l' = -1649.13$$

$$Q_2 = -r\delta_t'$$

$$= -0.005(2546.00)$$

$$Q_2 = -12.73$$

$$\delta_t = \frac{\delta_t'}{n} = \frac{2546.00}{1.42(10^6)} = 1.79(10^{-3})\ in/FT$$

Allowable Reactions in #/FT of WIDTH

for PILE #3

$$\delta'_\ell = \Delta'_x \cos\phi_1 + \Delta'_y \sin\phi_1 + \alpha' X_3 \sin\phi_1$$

$$= 1348.30 + 1533.40 + 1834.23$$

$$\delta'_\ell = 4715.93$$

$$\delta'_t = \Delta'_x \sin\phi_1 - \Delta'_y \cos\phi_1 - \alpha' X_3 \cos\phi_1$$

$$= 2696.39 - 766.76 - 915.15$$

$$\delta'_t = 1014.48$$

$$P_3 = \delta'_\ell = 4715.93$$

$$Q_3 = -r\,\delta'_t$$

$$= -0.005(1014.48)$$

$$Q_3 = -5.07$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{1014.48}{1.42(10^6)} = 0.71(10^{-3})\ \text{in/FT}$$

Allowable Reactions in #/FT OF WIDTH

for PILE #4

$$\delta'_l = \Delta'_x \cos\phi_1 + \Delta'_y \sin\phi_1 + \alpha' x_4 \sin\phi_1$$

$$= 1348.30 + 1533.40 + 5502.70$$

$$\delta'_l = 8384.40$$

$$\delta'_t = \Delta'_x \sin\phi_1 - \Delta'_y \cos\phi_1 - \alpha' x_4 \cos\phi_1$$

$$= 2696.39 - 766.76 - 2751.46$$

$$\delta'_t = -821.83$$

$$P_4 = \delta'_l = 8384.40$$

$$Q_4 = -r\,\delta'_t$$

$$= -0.005(-821.83)$$

$$Q_4 = 4.11$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{-821.83}{1.42(10^6)} = -0.58\,(10^{-3})\ \text{in/FT}$$

Allowable Reaction in #/FT OF WIDTH

Try K = 200 psi

For Bayou Bienvenue

$n = 1.42(10^6)$ pg.

For Bayou Dupre

$n = 1.81(10^6)$ pg

$$\beta = \sqrt[4]{\frac{K}{4EI}} = \sqrt[4]{\frac{200}{4(3)(10^6)(1728)}}$$

$$\beta = 0.992(10^{-2})$$

$$t_\delta = \frac{K}{2\beta} = \frac{200}{0.992(10^{-2})(2)}$$

$$t_\delta = 10.08(10^3)$$

For Bayou Bienvenue:

$$r_1 = \frac{t_\delta}{n} = \frac{10.08(10^3)}{1.42(10^6)}$$

$$r_1 = 7.10(10^{-3})$$

For Bayou Dupre:

$$r_1 = \frac{t_\delta}{n} = \frac{10.08(10^3)}{1.81(10^6)}$$

$$r_1 = 5.57(10^{-3})$$

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FOR BAYOU BIENVENUE

$$\chi'_x = \frac{\chi_x}{n} = -\sum_g \left[N(\cos^2\phi + r\sin^2\phi)\right]$$

$$= -\left[2(0.20002 + 0.0071(0.79997)) + 2(0.20002 + 0.0071(0.79997))\right]$$

$$\chi'_x = -0.8228$$

$$\Upsilon'_x = \frac{\chi_y}{n} = \frac{\Upsilon_x}{n} = -\frac{1}{2}(1-r_1)\sum_g (N\sin 2\phi)$$

$$= -\frac{1}{2}(1-0.0071)\left[2(0.80003) + 2(-0.80003)\right]$$

$$\Upsilon'_x = 0.0$$

$$\Upsilon'_y = \frac{\Upsilon_y}{n} = -\sum_g \left[N(\sin^2\phi + r_1\cos^2\phi)\right]$$

$$= -\left[2(0.79997 + 0.0071(0.20002)) + 2(0.79997 + 0.0071(0.20002))\right]$$

$$\Upsilon'_y = -3.2056$$

$$m'_x = \chi'_\alpha = -\frac{1}{2}(1-r_1)\sum_g (N\bar{x}\sin 2\phi)$$

$$= -\frac{1}{2}\overset{0.9929}{(1-0.0071)}\left[2(36)(0.80003) + 2(-36)(-0.80003)\right]$$

$$m'_x = -57.1932$$

$$m'_y = \Upsilon'_\alpha = -\sum_g \left[(\sin^2\phi + r_1\cos^2\phi)N\bar{x}\right]$$

$$= -\left[(0.79997 + 0.0071(0.20002))(2)(36) + (0.79997 + 0.0071(0.20002))(2)(-36)\right]$$

$$m'_y = 0.0$$

$$M'_\alpha = -\sum_g \left[(\sin^2\phi + r_i \cos^2\phi) \sum_N (x^2) \right]$$

$$= -\left[(0.79997 + 0.0071(0.20002))(\overset{3240}{(18)^2 + (54)^2}) + (0.79997 + 0.0071(0.20002))((-18^2) + (-54)^2) \right]$$

$$M'_\alpha = -5193.0072$$

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$$X'_x \Delta'_x + Y'_x \Delta'_y + M'_x \alpha' + X = 0$$

$$Y'_x \Delta'_x + Y'_y \Delta'_y + M'_y \alpha' + Y = 0$$

$$M'_x \Delta'_x + M'_y \Delta'_y + M'_\alpha \alpha' + M = 0$$

$$-0.8228\, \Delta'_x + 0.0\, \Delta'_y - 57.1932\, \alpha' + 8992.10 = 0$$

$$0.0\, \Delta'_x - 3.2056\, \Delta'_y + 0.0\, \alpha' + 5493.04 = 0$$

$$-57.1932\, \Delta'_x + 0.0\, \Delta'_y - 5193.0072\, \alpha' + 764185.07 = 0$$

from Computer Output See Sheet 158

$$\Delta'_x = 2984.648$$

$$\Delta'_y = 1713.576$$

$$\alpha' = 114.285$$

for PILE #1

$$\delta'_\ell = \Delta'_x \cos\phi_2 + \Delta'_y \sin\phi_2 + \alpha' X_1 \sin\phi_2$$

$$\quad -1334.85 \qquad + 1532.64 \qquad - 5519.75$$

$$= 2984.648(-0.44724) + 1713.576(0.89441) + 114.285(-54)(0.89441)$$

$$\delta'_\ell = -5321.96$$

$$\delta'_t = \Delta'_x \sin\phi_2 - \Delta'_y \cos\phi_2 - \alpha' X_1 \cos\phi_2$$

$$\quad 2669.50 \qquad + 766.38 \qquad - 2760.09$$

$$= 2984.648(0.89441) - 1713.576(-0.44724) - 114.285(-54)(-0.44724)$$

$$\delta'_t = 675.79$$

$$P_1 = \delta'_\ell = -5321.96$$

$$Q_1 = -r\,\delta'_t$$

$$= -0.0071(675.79)$$

$$Q_1 = -4.80$$

$$\delta_t = \frac{\delta_t}{n} = \frac{675.79}{1.412(10^6)} = 0.48(10^{-3}) \text{ in/FT}$$

Allowable Reactions in #/FT OF WIDTH.

for PILE #2

$$\delta'_{\ell} = \Delta'_x \cos\phi_2 + \Delta'_y \sin\phi_2 + \alpha' x_2 \sin\phi_2$$

$$= -1334.85 + 1532.64 + \overset{-1839.92}{114.285(-18)(0.89441)}$$

$$\delta'_{\ell} = -1642.13$$

$$\delta'_t = \Delta'_x \sin\phi_2 - \Delta'_y \cos\phi_2 - \alpha' x_2 \cos\phi_2$$

$$= 2669.50 + 766.38 - \overset{-920.03}{114.285(-18)(-0.44724)}$$

$$\delta'_t = 2515.85$$

$$P_2 = \delta'_{\ell} = -1642.13$$

$$Q_2 = -r\,\delta'_t$$

$$= -0.0071(2515.85)$$

$$Q_2 = -17.86$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{2515.85}{1.42(10^6)} = 1.77(10^{-3})\ \text{in/FT}$$

Allowable Reactions in #/FT OF WIDTH

for PILE #3

$$\delta_l' = \Delta_x' \cos\phi_1 + \Delta_y' \sin\phi_1 + \alpha' x_3 \sin\phi_1$$

$$= 1334.85 + 1532.64 + 1839.92$$

$$\delta_l' = 4707.41$$

$$\delta_t' = \Delta_x' \sin\phi_1 - \Delta_y' \cos\phi_1 - \alpha' x_3 \cos\phi_1$$

$$= 2669.50 - 766.38 - 920.03$$

$$\delta_t' = 983.09$$

$$P_3 = \delta_l' = 4707.41$$

$$Q_3 = -r\,\delta_t'$$

$$= -0.0071(983.09)$$

$$Q_3 = -6.98$$

$$\delta_t = \frac{\delta_t'}{n} = \frac{983.09}{1.42(10^6)} = 0.69\,(10^{-3})\ \text{in/FT}$$

Allowable Reactions in #/FT OF WIDTH

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NEW ORLEANS, LA., 70130

for Pile #4

$$\delta'_\ell = \Delta'_x \cos\phi_1 + \Delta'_y \sin\phi_1 + \alpha' x_4 \sin\phi_1$$

$$= 1334.85 + 1532.64 + 5519.75$$

$$\delta'_\ell = 8387.24$$

$$\delta'_t = \Delta'_x \sin\phi_1 - \Delta'_y \cos\phi_1 - \alpha' x_4 \cos\phi_1$$

$$= 2669.50 - 766.38 - 2760.09$$

$$\delta'_t = -856.97$$

$$P_4 = \delta'_\ell = 8387.24$$

$$Q_4 = -r\,\delta'_t$$

$$= -0.0071(-856.97)$$

$$Q_4 = +6.08$$

$$\delta_t = \frac{\delta'_t}{n} = \frac{-856.97}{1.42(10^6)} = -0.60\,(10^{-3})\ \text{in/FT}$$

Allowable Reactions in #/FT OF WIDTH

DETERMINE allowable TRANSVERSE LOAD and DEFLECTION on PILE HEAD AT BAYOU BIENVENUE AND BAYOU DUPRE

12 x 12 Prestressed Concrete PILE $f'_c = 5000$ psi

$f_c = 0.35 f'_c = 1750$ psi $w = 150$ #/FT³ $A = 144$ in² $I = 1728$ in⁴

FOR BAYOU BIENVENUE AND BAYOU DUPRE:

MAX ALLOWABLE PILE LOAD = 50.7^K T & 66.7^K C
MAX PILE LOADS = 42.4^K T & 66.7^K C

Ref: 1. ACI Bldg. Code (ACI 318-63)

2. Std. Prestressed Conc. Piles (10" to 24" square) Design Sheet by Joint Committee of AASHO & PCI

3. Journal #3509, May '63, of Soil Mechanics and Foundations Division of ASCE "Laterally Loaded Piles in a Layered Soil System" by M.T. Davisson & H. L. Gill

minimum prestress after losses = 700 psi } Ref. 2
effective prestress after losses = 840 psi }

$E = (w)^{3/2}\, 33\sqrt{f'_c} = (150)^{3/2}(33)\sqrt{5000}$

$E = 4.28(10^6)$ psi Ref. 1

For $K = 50$ psi

$R = \sqrt[4]{\frac{EI}{K}} = \sqrt{\frac{4.28(10^6)(1784)}{50}} = 113$ in Ref. 3

TENSION PILES

$f_a = \frac{P_T}{A} = \frac{50700(.75)}{144} = 264$ psi

$F_a = 700$ psi

COMPRESSION PILES

$f_a = \frac{P_c}{A} = \frac{66900(.75)}{144} = 349$ psi

$F_a = 1750 - 840 = 910$ psi

Max Moment Coefficient = 0.5 Ref. 3

$M = 0.5RQ = 0.5(113)Q = 56.5Q$ "K $= 56500Q$ "#

Q = Max Transverse Load applied at Pile Head in Kip

$S = \frac{bd^2}{6} = 288$ in^3

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1200 ST. CHARLES AVENUE
NEW ORLEANS, LA., 70130

BY [illegible] DATE 3/6/68 SUBJECT Inverted "T" Floodwall SHEET NO. 162 OF

CHKD. BY BMC DATE 3/12/68 JOB NO. 67006

$$f_b = \pm \frac{M}{S} = \frac{56500Q}{288} = \pm 196\ Q\ psi$$

$$F_{bT} = 700\ psi \qquad F_{bC} = 910\ psi$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{264 + 196Q}{700} \leq 1$$

$$Q_T = 2.22^K$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{349 + 196Q}{910} \leq 1$$

$$Q_C = 2.86^K$$

Deflection Coefficient = 1.4

$$Y = \frac{1.4QR^3}{EI} = \frac{1.4(113)^3 Q}{4.28(10^6)(1728)} = 0.275(10^{-3})\,Q$$

$$Y_T = 0.610''$$

$$Y_C = 0.786''$$

Determine allowables for $K = 125$ psi

$$R = \sqrt[4]{\frac{EI}{K}} = \sqrt[4]{\frac{4.28(10^6)(1728)}{125}} = 87.7'' \quad \text{Ref. 3}$$

Max Moment Coefficient = 0.5 Ref. 3

$$M = 0.5RQ = 0.5(87.7)Q = 43.85\,Q^{'K} = 43850\,Q^{''\#}$$

$$f_b = \frac{M}{S} = \frac{43850Q}{288} = 152Q \text{ psi}$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{264 + 152Q}{700} \leq 1$$

$$Q_T = 2.88^K$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{349 + 152Q}{910} \leq 1$$

$$Q_C = 3.69^K$$

$$Y = \frac{1.4(87.7)^3 Q}{4.28(10^6)(1728)} = 0.1282(10^{-3})Q$$

$$Y_T = 0.369''$$

$$Y_C = 0.473''$$

Determine allowables for $K = 200$ psi

$$R = \left(\frac{EI}{K}\right)^{1/4} = \left(\frac{4.28(10^6)(1728)}{200}\right)^{1/4} = 78 \text{ in} \quad \text{Ref. 3}$$

Max Moment Coefficent = 0.5 Ref. 3

$$M = 0.5RQ = 0.5(78)(Q) = 39Q^{\prime K} = 39000Q^{\prime \#}$$

$$f_b = \frac{M}{S} = \frac{39000 \cdot Q}{288} = 135.2Q$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{264 + 135.2Q}{700} \leq 1$$

$$Q_T = 3.225^K$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$\frac{349 + 135.2Q}{910} \leq 1$$

$$Q_C = 4.149^K$$

$$Y = \frac{1.4(78)^3 Q}{4.28(10^6)(1728)} = 0.09Q(10^{-3})$$

$$Y_T = 0.290''$$

$$Y_C = 0.373''$$

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1200 ST. CHARLES AVENUE
NEW ORLEANS, LA., 70130

BY: [illegible] DATE 3/7/68 SUBJECT Inverted "T" Floodwall

CHKD. BY BMC DATE 3/12/68

SHEET NO. 165 OF ____
JOB NO. 67006

TABULATION OF PILE LOADS IN KIPS/FT OF WALL

STRIP #	ELASTIC CENTER		K=50 HRENNIKOFF				K=125 HRENNIKOFF				K=200 HRENNIKOFF			
			B. BIENVENUE		B. DUPRE		B. BIENVENUE		B. DUPRE		B. BIENVENUE		B. DUPRE	
	P	Q	P	Q	P	Q	P	Q	P	Q	P	Q	P	Q
	LOADING CONDITION #1													
1	-5.30	0.0	-5.31	-0.002	-5.31	-0.002	-5.32	-0.004	-5.32	-0.003	-5.32	-0.005	-5.32	-0.004
2	-1.67	0.0	-1.66	-0.007	-1.67	-0.005	-1.65	-0.013	-1.66	-0.010	-1.64	-0.018	-1.65	-0.014
3	4.74	0.0	4.73	-0.012	4.74	-0.002	4.72	-0.005	4.72	-0.004	4.71	-0.007	4.71	-0.005
4	8.38	0.0	8.38	0.002	8.38	0.001	8.38	+0.004	8.38	+0.003	8.39	0.006	8.39	0.005
	LOADING CONDITION #1-A													
1	-4.53	0.0	-4.57	-0.012	-4.56	-0.009	-4.60	-0.022	-4.59	-0.018	-4.62	-0.030	-4.61	-0.024
2	-2.44	0.0	-2.34	-0.015	-2.38	-0.012	-2.30	-0.028	-2.33	-0.022	-2.25	-0.045	-2.29	-0.031
3	5.51	0.0	5.44	-0.011	5.45	-0.009	5.37	-0.020	5.40	-0.016	5.32	-0.027	5.35	-0.022
4	7.60	0.0	7.64	-0.008	7.63	-0.006	7.67	-0.014	7.66	-0.012	7.69	-0.019	7.67	-0.016
	LOADING CONDITION #2													
1	0.88	0.0	0.86	-0.009	0.87	-0.007	0.84	-0.017	0.85	-0.014	0.83	-0.024	0.84	-0.019
2	0.51	0.0	0.57	-0.009	0.56	-0.003	0.61	-0.017	0.59	-0.013	0.64	-0.023	0.62	-0.019
3	2.91	0.0	2.57	-0.005	2.85	-0.004	2.82	-0.008	2.84	-0.007	2.79	-0.011	2.81	-0.009
4	2.54	0.0	2.57	-0.005	2.57	-0.004	2.59	-0.009	2.58	-0.007	2.60	-0.012	2.59	-0.010
	LOADING CONDITION #2-A													
1	1.31	0.0	1.27	-0.015	1.29	-0.012	1.25	-0.025	1.26	-0.016	1.23	-0.038	1.24	-0.031
2	0.08	0.0	0.16	-0.013	0.15	-0.011	0.24	-0.025	0.21	-0.020	0.29	-0.035	0.26	-0.028
3	3.34	0.0	3.27	-0.009	3.28	-0.007	3.19	-0.017	3.22	-0.014	3.14	-0.022	3.18	-0.018
4	2.11	0.0	2.16	-0.011	2.14	-0.008	2.18	-0.019	2.17	-0.016	2.20	-0.026	2.19	-0.021

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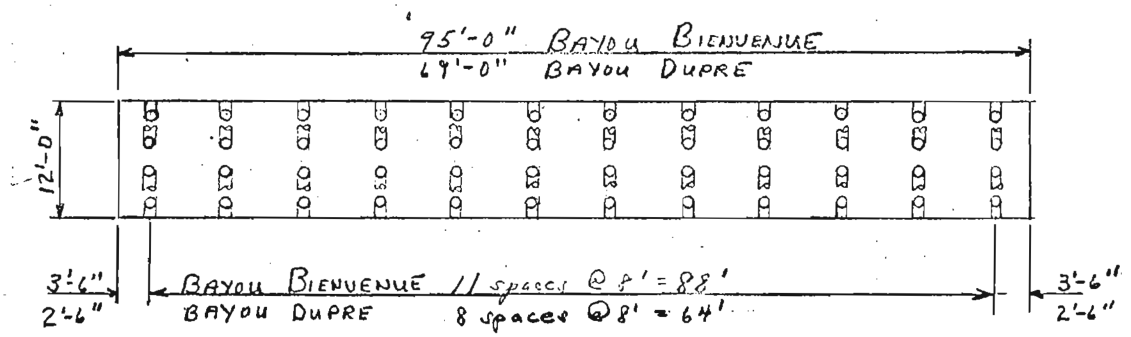
1200 ST. CHARLES AVENUE
NEW ORLEANS, LA., 70130

BY [illegible] DATE 2/21/68 SUBJECT Inverted "T" Floodwall SHEET NO. 17 OF
CHKD. BY BMC DATE 3/12/68 JOB NO. 67006

Pile Layout



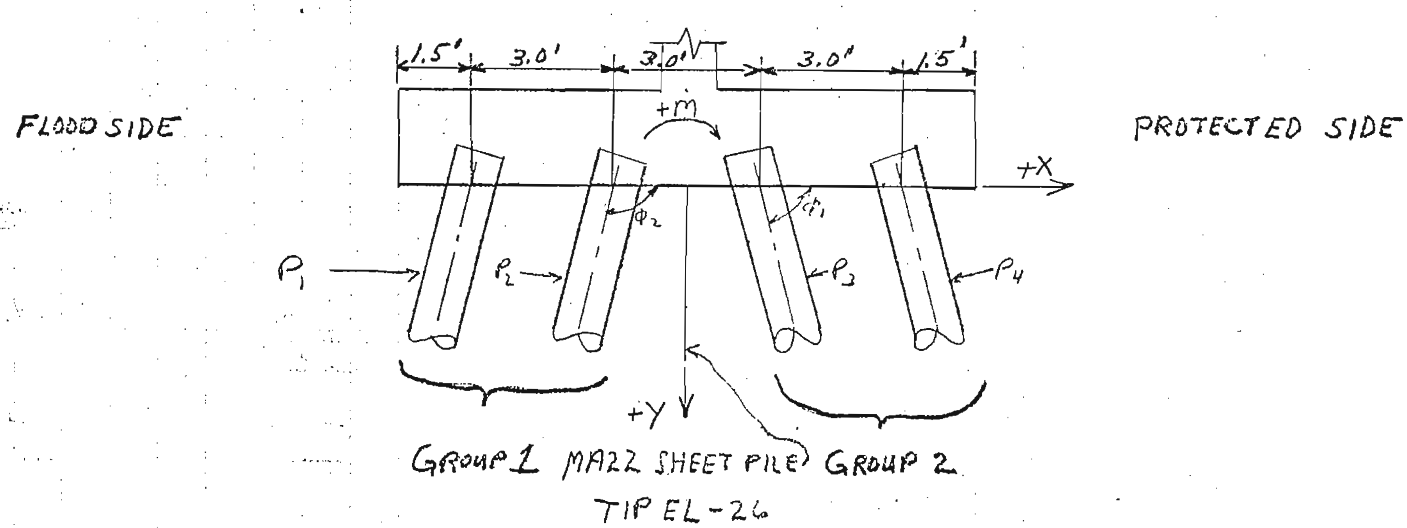


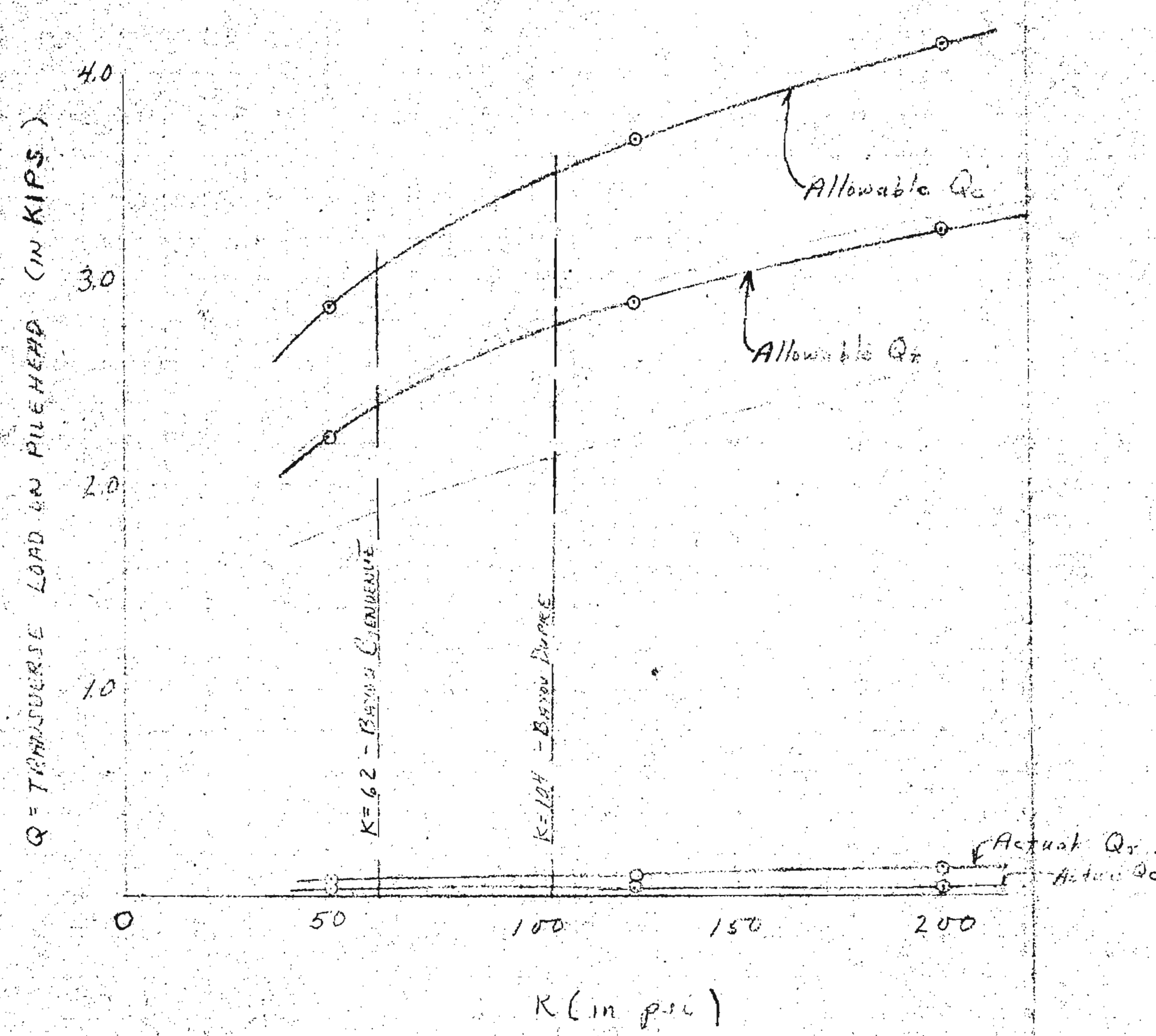
Figure 35 of 36

WALDEMAR S. NELSON AND COMPANY
INCORPORATED
ENGINEERS AND ARCHITECTS

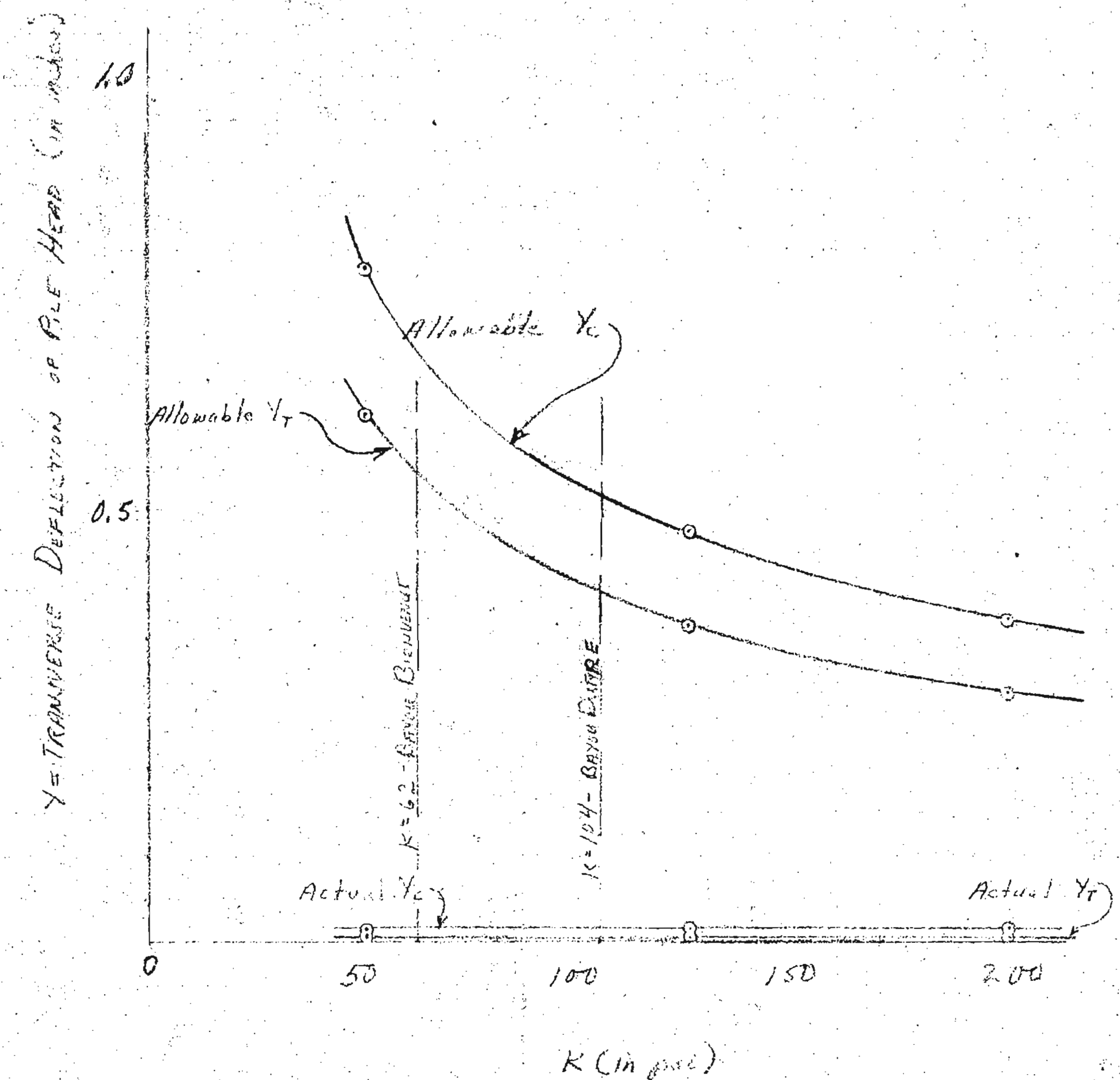
1200 ST. CHARLES AVENUE
NEW ORLEANS, LA., 70130

BY ____ DATE 3/7/68 SUBJECT Inverted "T" Floodwall SHEET NO. 166 OF ____
CHKD. BY BMC DATE 3/12/68 JOB NO. 67006

LOADING CONDITION #1 - BAYOU BIENVENUE

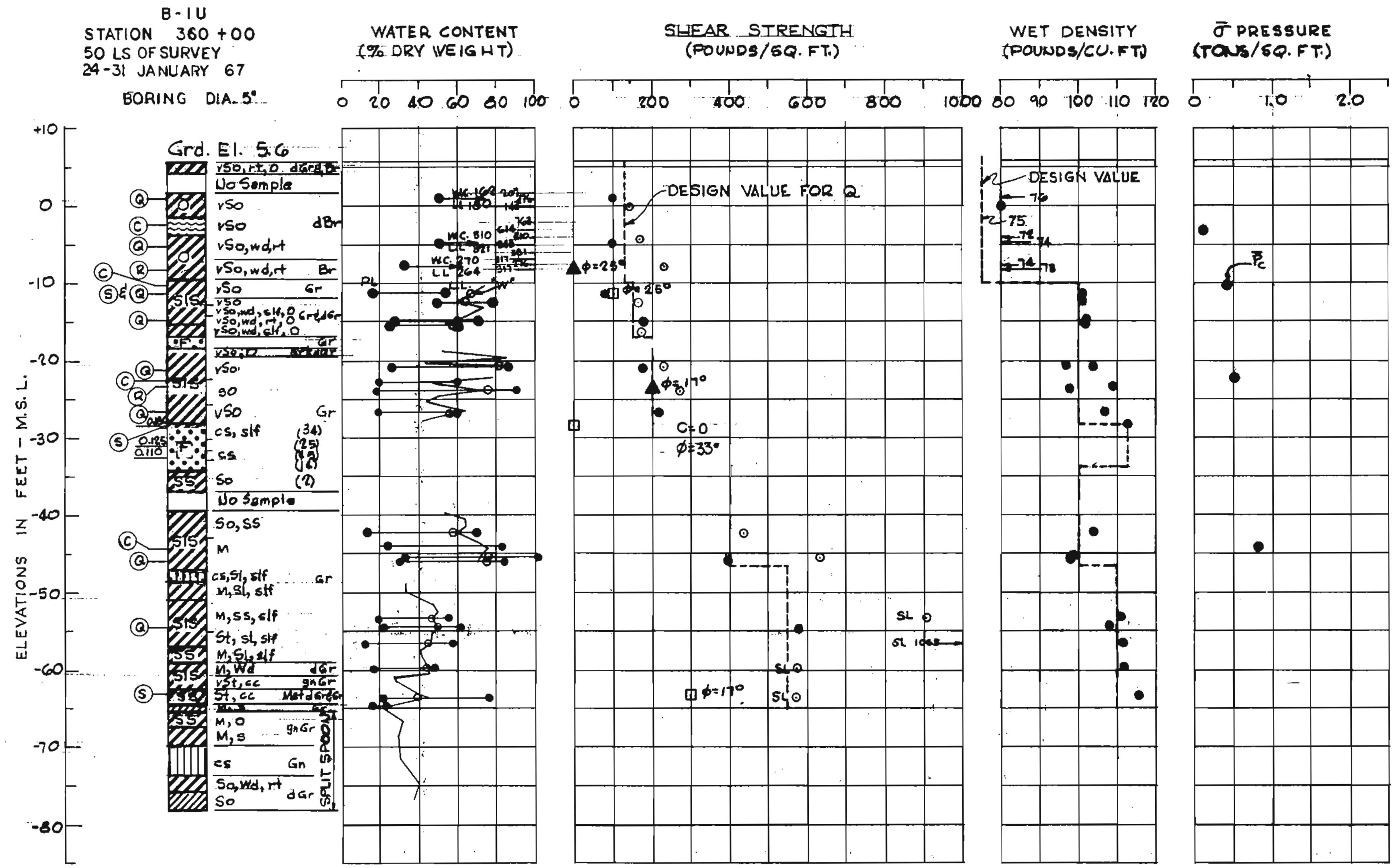


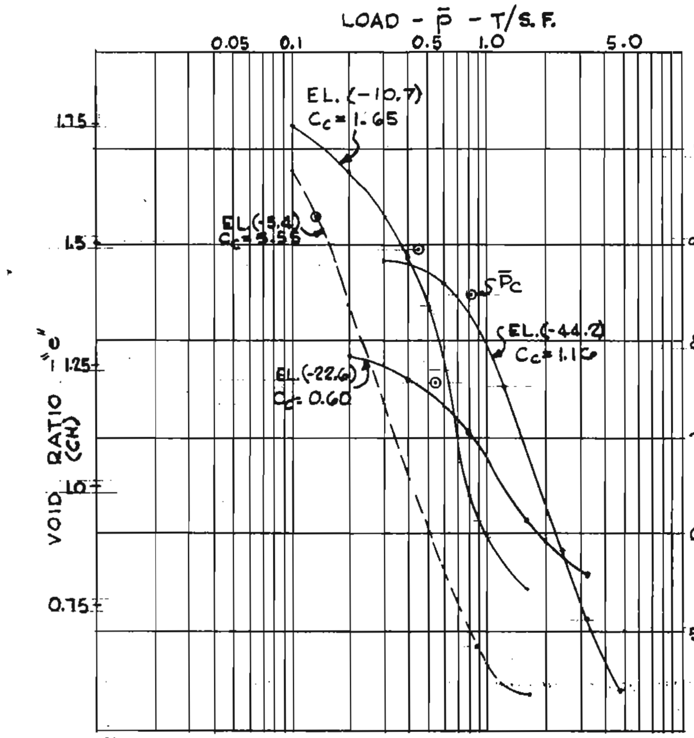
Piles 8' o.c.



Piles 8' o.c.

B-1U
STATION 360 +00
50 LS OF SURVEY
24-31 JANUARY 67
BORING DIA. 5"

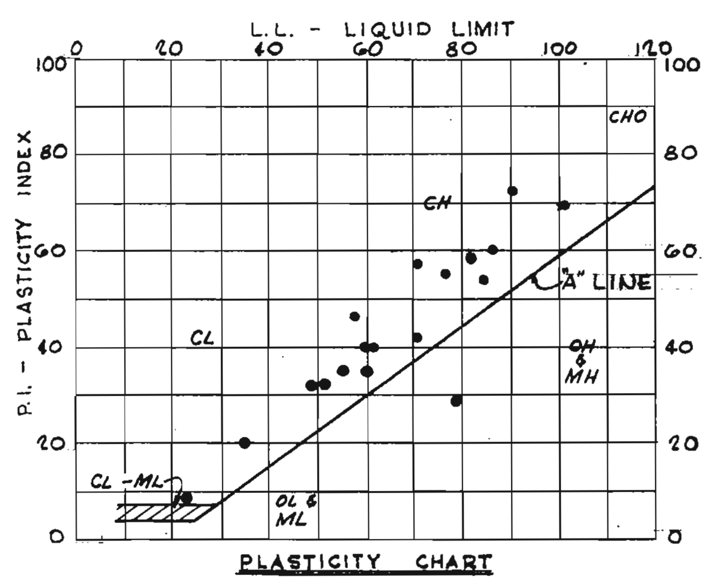




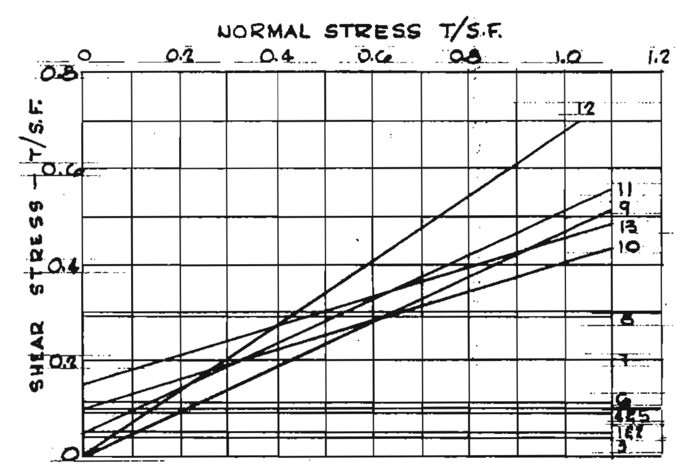
CONSOLIDATION DATA

GENERAL NOTES

SEE PLATE "A" FOR SOIL BORING LEGEND
⊙UC – UNCONFINED COMPRESSION SHEAR
•Ⓠ – UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR
▲Ⓡ – CONSOLIDATED UNDRAINED TRIAXIAL SHEAR
⊡Ⓢ – CONSOLIDATED DRAINED DIRECT SHEAR
Ⓒ – CONSOLIDATION TEST
W – NATURAL WATER CONTENT
LL – LIQUID LIMIT
PL – PLASTIC LIMIT
c – UNIT COHESION
φ – ANGLE OF FRICTION
γ – UNIT WEIGHT OF SOIL-WATER SYSTEM
$\bar{\sigma}$ – NORMAL STRESS
O.B. – OVERBURDEN
$\bar{P}_c$ – PRECONSOLIDATION PRESSURE
e – VOID RATIO
C_c – COMPRESSION INDEX



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		φ°	c (tsf)	
1	+0.7	Q	0	0.05	CH
2	-5.2			0.05	CH
3	-11.5			0.04	CH
4	-15.1			0.09	CH
5	-21.2			0.09	CH
6	-26.7			0.11	CH
7	-46.0			0.20	CH
8	-54.2		0	0.29	CH
9	-8.4	R	25	0	PT
10	-28.6		17	0.10	CL
11	-11.5	S	25	0.05	CH
12	-28.4		34	0	SM
13	-63.1		17	0.15	CH

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

UNDISTURBED BORING B-1U

TEST DATA

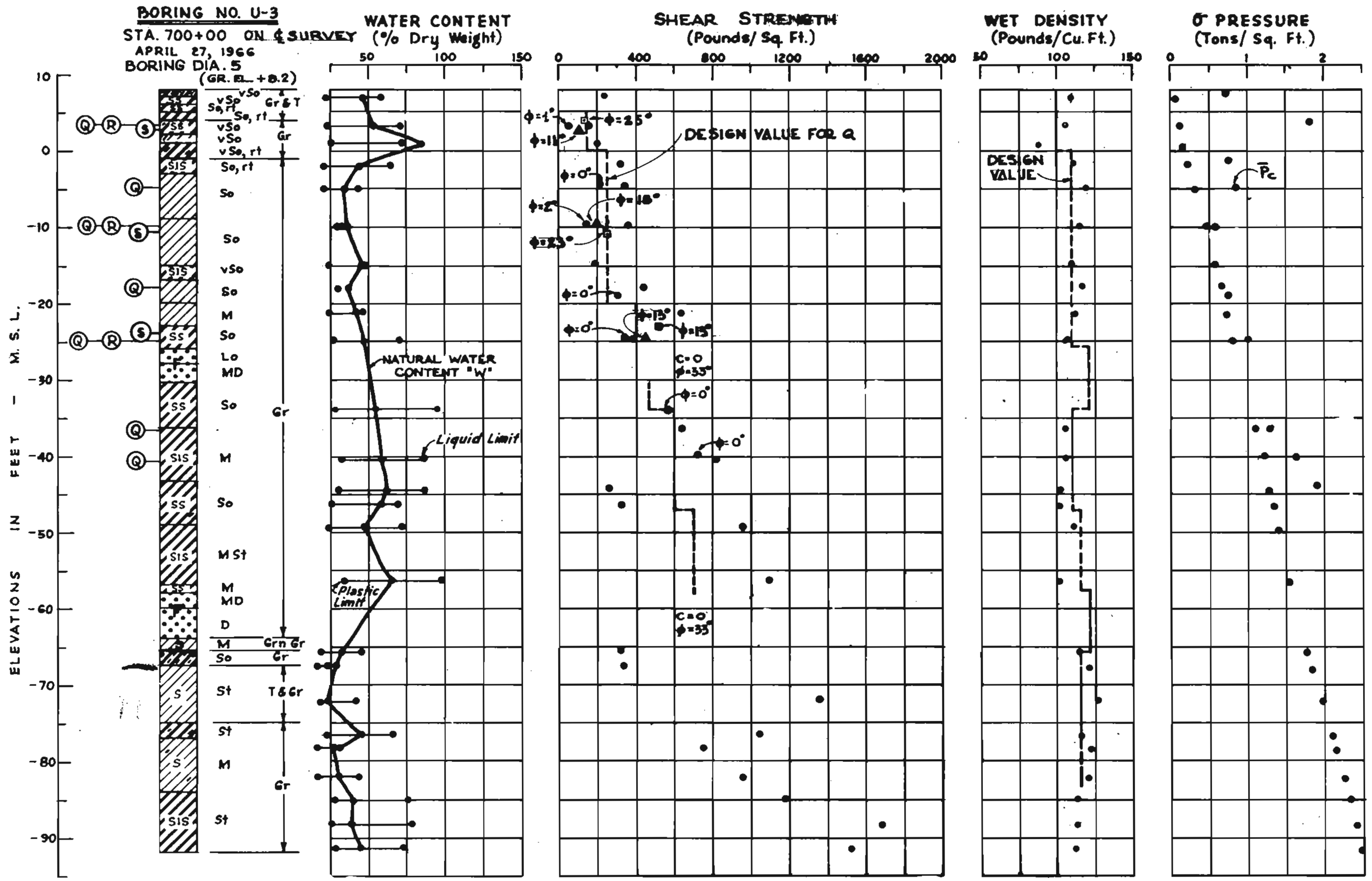
SCALES AS SHOWN

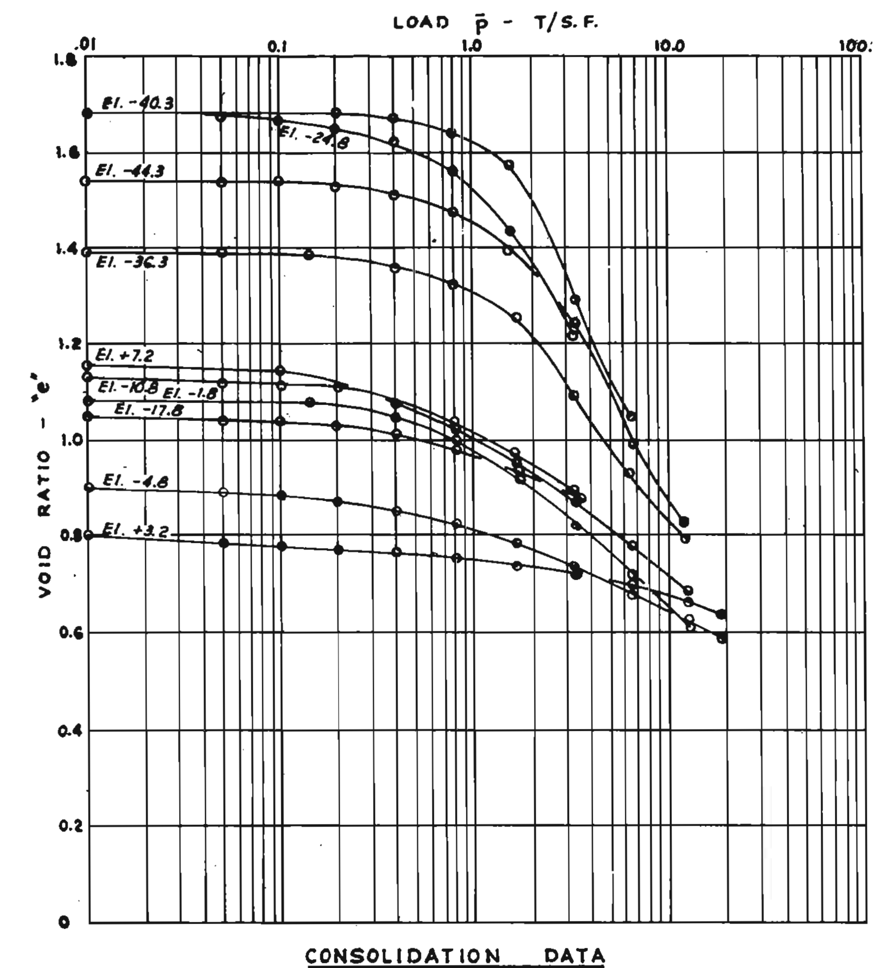
WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

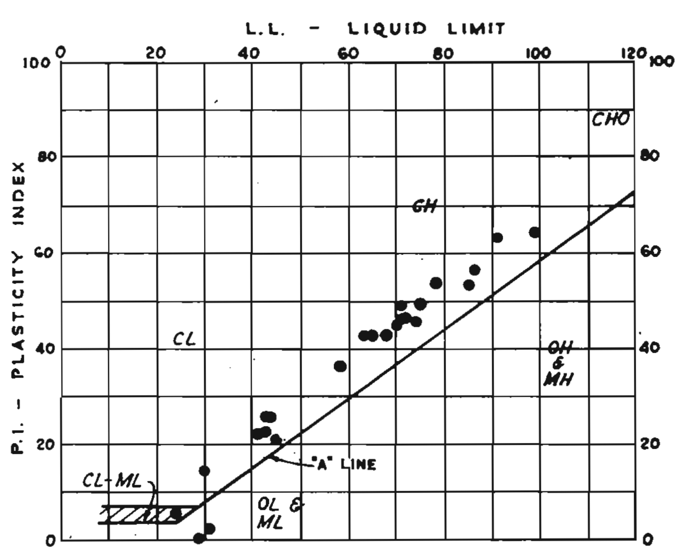
DATE: MARCH, 1968 FILE NO. H-2-24147

PLATE NO. III-1

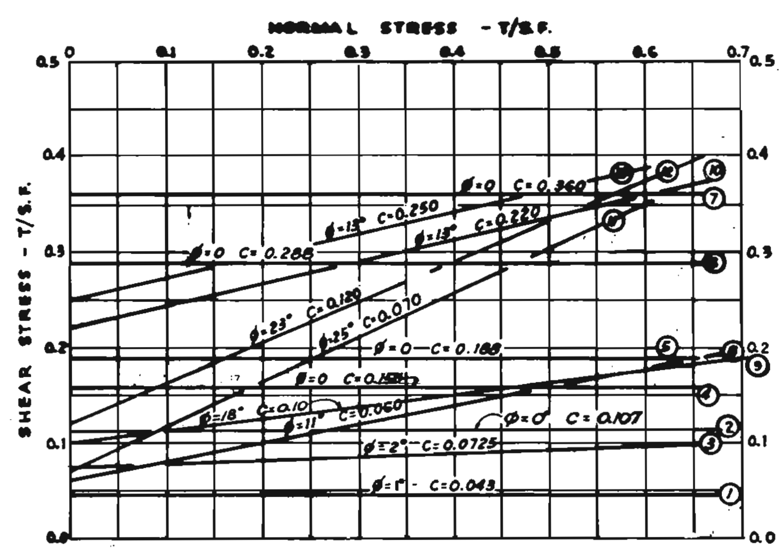




CONSOLIDATION DATA



PLASTICITY CHART



SHEAR STRENGTH

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH φ°	STRENGTH c (tsf)	CLASS
1	+3.7	Q	1	0.04	CH
2	-4.8	Q	0	0.11	CL
3	-9.8	Q	2	0.07	CL
4	-18.8	Q	0	0.16	CL
5	-24.8	Q	0	0.19	CH
6	-33.8	Q	0	0.29	CH
7	-40.3	Q	0	0.36	CH
8	3.7	R	11	0.06	CH
9	-9.8	R	18	0.10	CL
10	-24.8	R	13	0.22	CH
11	3.2	S	25	0.07	CH
12	-10.8	S	23	0.12	CL
13	-22.8	S	13	0.25	CH

See Plate A for soil boring legend
See Plate III-1 for General Notes

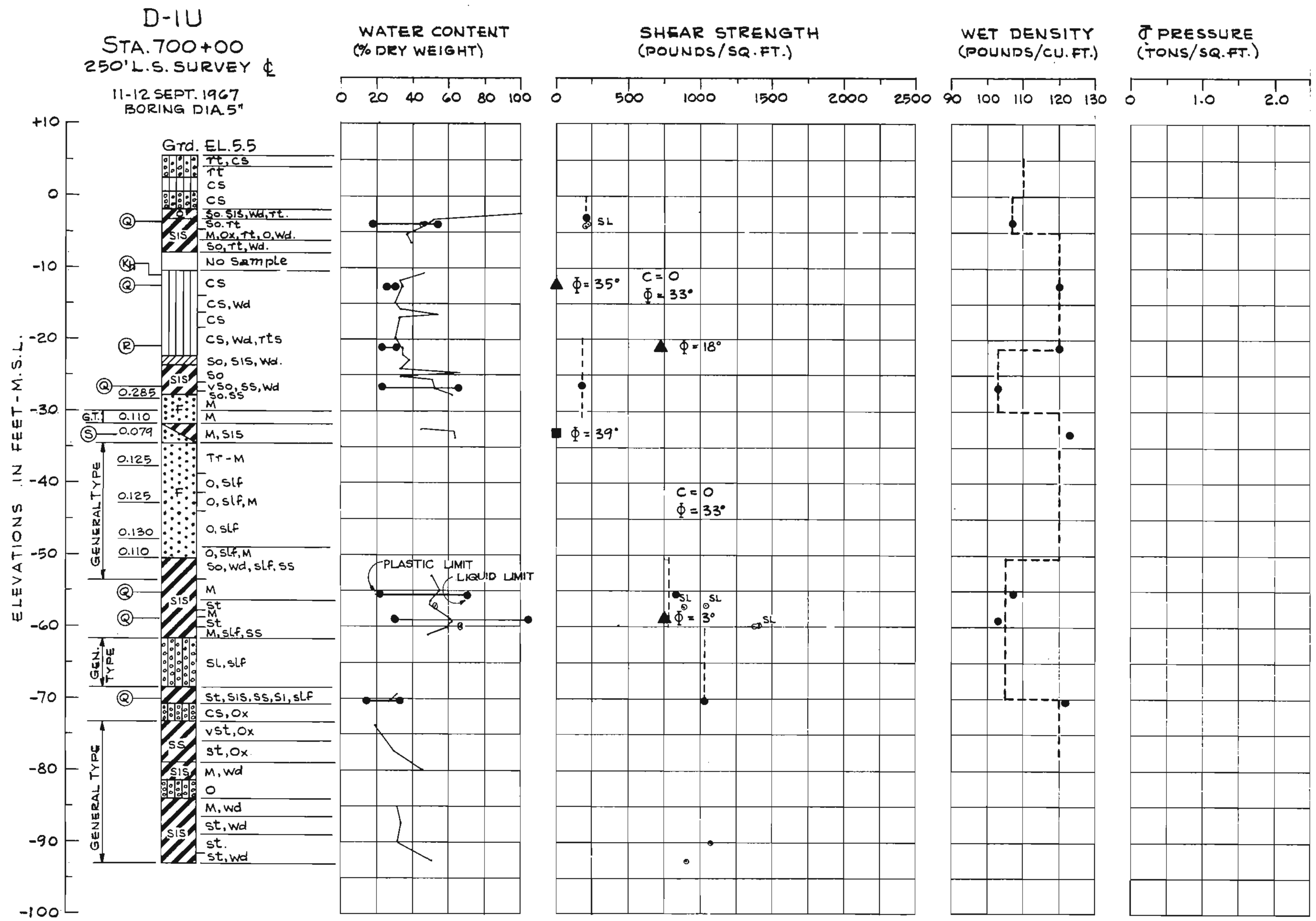
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

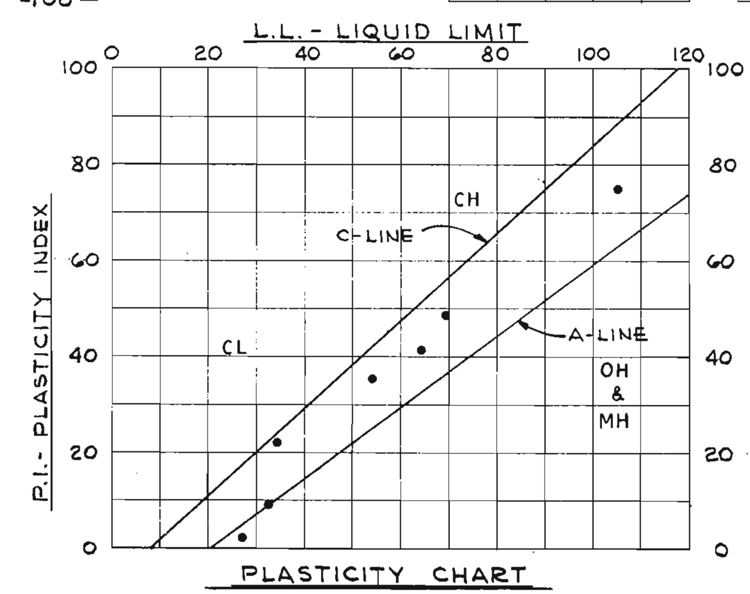
UNDISTURBED BORING U-3
TEST DATA

SCALES AS SHOWN

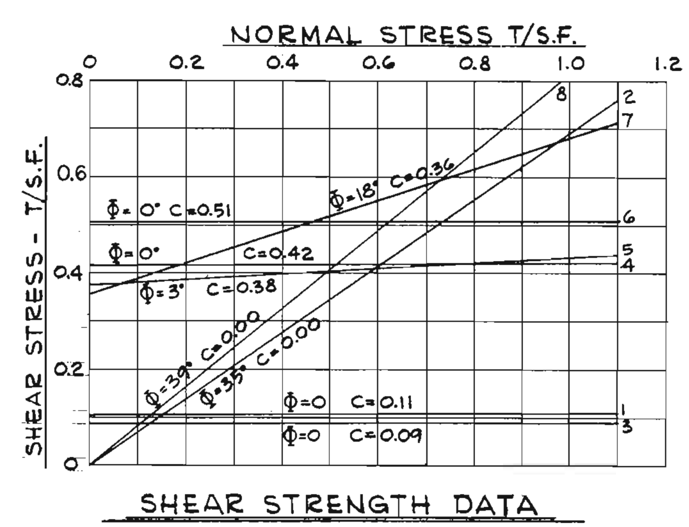
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



GENERAL NOTES
SEE PLATE III - 1



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		φ°	C (+SP)	
1	-3.6		0	0.11	CH
2	-12.7		35	0.00	SM
3	-27.0		0	0.09	CH
4	-55.3		0	0.42	CH
5	-59.0		3	0.38	CH
6	-70.3		0	0.51	CL
7	-21.2	R	18	0.36	ML
8	-33.3	S	39	0.00	SM

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

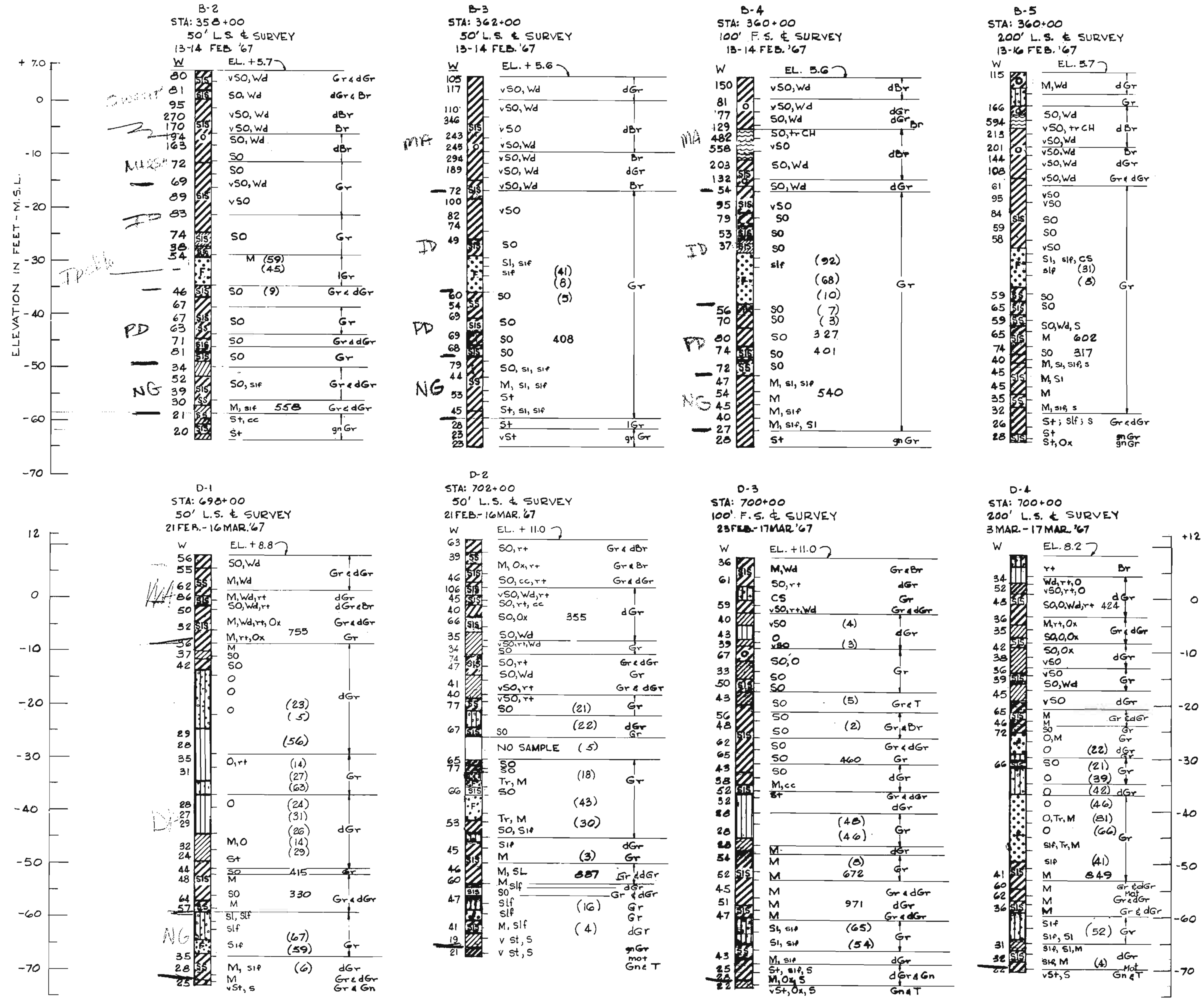
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

UNDISTURBED BORING D-I-U
TEST DATA

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. III-3



General Notes:

1.) SEE PLATE "A" FOR SOIL BORING LEGEND.
2.) L.S. LANDSIDE
F.S. FLOODSIDE
3.) COHESIVE SOIL SAMPLES WERE TAKEN WITH A 1 7/8" I.D. CORE BARREL SAMPLER. NON-COHESIVE SOIL SAMPLES WERE TAKEN WITH A 1 3/8" I.D., 2" O.D. SPLIT SPOON SAMPLER USING A 140 lbs. HAMMER WITH A 30" DROP.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

GENERAL BORINGS

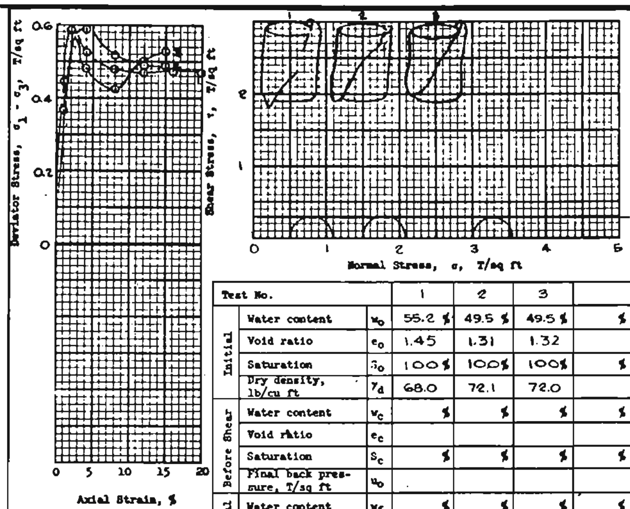
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 FILE NO. H-2-24147

PLATE NO. III-4



Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.29 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	55.2 %	49.5 %	49.5 %	%
	Void ratio	e_o	1.45	1.31	1.32	
	Saturation	S_o	100 %	100 %	100 %	%
	Dry density, lb/cu ft	γ_d	68.0	72.1	72.0	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.60	0.60	0.57	
Time to failure, min		t_f	7	17	12	
Rate of strain, percent/min			0.33	0.18	0.17	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), W/ SILTY CLAY SEAMS & SHELL FRAGMENTS

LL 62 | PL 22 | PI 40 | G_s 2.67

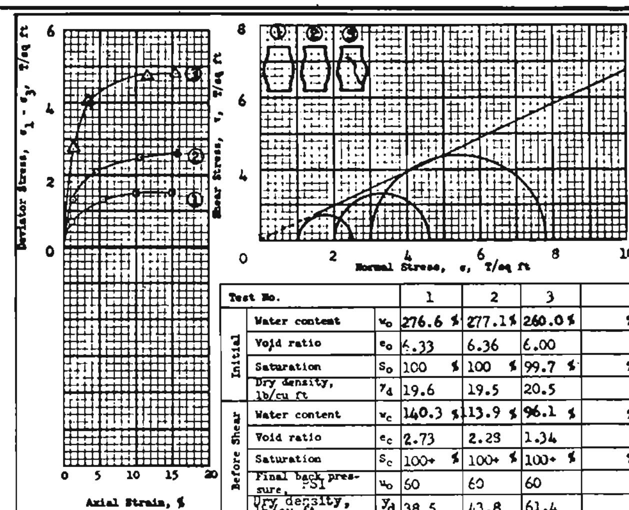
Remarks: TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY, DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 16-D

Depth El -54.2 | Date 4/17/67



Shear Strength Parameters

φ = 25 °

tan φ = 0.466

c = 0 T/sq ft

Method of saturation BP

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	276.6 %	277.1 %	260.0 %	%
	Void ratio	e_o	4.33	6.36	6.00	
	Saturation	S_o	100 %	100 %	99.7 %	%
	Dry density, lb/cu ft	γ_d	19.6	19.5	20.5	
Before Shear	Water content	w_c	140.3 %	113.9 %	96.1 %	%
	Void ratio	e_c	2.73	2.29	1.34	
	Saturation	S_c	100+ %	100+ %	100+ %	%
	Final back pressure, PSI	u_o	60	60	60	
	Dry density, lb/cu ft	γ_d	38.5	43.8	61.4	
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.51	2.60	4.80	
Time to failure, min		t_f	136	143	128	
Rate of strain, percent/min			0.11	0.11	0.12	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	1.51	2.60	4.80	
Initial diameter, in.		D_o	1.38	1.38	1.38	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test R | Type of specimen UNDISTURBED

Classification PEAT (Pt), brown, finely divided

LL 336 | PL 157 | PI 179 | G_s 2.30

Remarks: TRIAXIAL COMPRESSION TEST REPORT

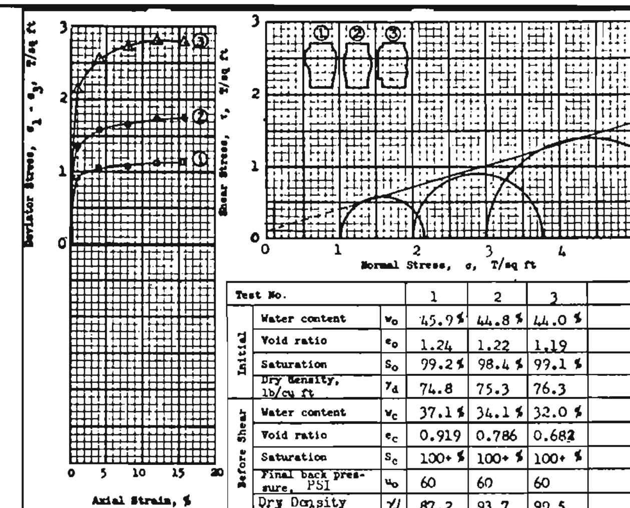
Project LAKE PONTCHARTRAIN & VICINITY, CHALMETTE LEVEE

Area DRAINAGE STRUCTURE AT BAYOU BIENVENUE

Boring No. B-1U | Sample No. 4-C

El -8.4 | Date 12 April 1967

PJR



Shear Strength Parameters

φ = 17 °

tan φ = 0.306

c = 0.10 T/sq ft

Method of saturation BP

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	45.9 %	44.8 %	44.0 %	%
	Void ratio	e_o	1.24	1.22	1.19	
	Saturation	S_o	99.2 %	98.4 %	99.1 %	%
	Dry density, lb/cu ft	γ_d	74.8	75.3	76.3	
Before Shear	Water content	w_c	37.1 %	34.1 %	32.0 %	%
	Void ratio	e_c	0.919	0.786	0.682	
	Saturation	S_c	100+ %	100+ %	100+ %	%
	Final back pressure, PSI	u_o	60	60	60	
	Dry Density lb/cu ft	γ_d	87.2	93.7	99.5	
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.14	1.75	2.80	
Time to failure, min		t_f	157	157	120	
Rate of strain, percent/min			0.10	0.10	0.10	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	1.14	1.75	2.79	
Initial diameter, in.		D_o	1.39	1.39	1.39	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test R | Type of specimen UNDISTURBED

Classification SILTY CLAY (CL), AND SILT (ML) in alternating 1/8" horizontal *

LL — | PL — | PI — | G_s 2.68

Remarks *layers, gray.

TRIAXIAL COMPRESSION TEST REPORT

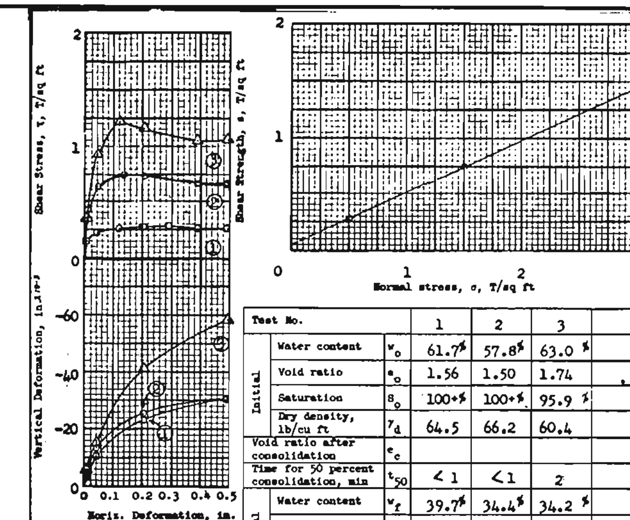
Project LAKE PONTCHARTRAIN & VICINITY, CHALMETTE LEVEE

Area DRAINAGE STRUCTURE AT BAYOU BIENVENUE

Boring No. B-1U | Sample No. 6-A

El - 23.6 | Date 13 APRIL 1967

PJR



Shear Strength Parameters

φ' = 25 °

tan φ' = 0.466

c' = 0.05 T/sq ft

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	61.7 %	57.8 %	63.0 %	%
	Void ratio	e_o	1.56	1.50	1.74	
	Saturation	S_o	100+ %	100+ %	95.9 %	%
	Dry density, lb/cu ft	γ_d	64.5	66.2	60.4	
Void ratio after consolidation		e_c				
Time for 50 percent consolidation, min		t_{50}	< 1	< 1	2	
Final	Water content	w_f	39.7 %	34.4 %	34.2 %	%
	Void ratio	e_f				
	Saturation	S_f	%	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft		τ_{max}	0.28	0.75	1.22	
Actual time to failure, min		t_f	1920	990	900	
Rate of strain, in./min			.00015	.00014	.00014	
Ultimate shear stress, T/sq ft		τ_{ult}	0.26	0.66	1.05	

Type of specimen UNDISTURBED | 3.00 No. 1 & 2, 3.01 No. 3 square | 0.470 No. 1 & 2, 0.626 No. 3 thick

Classification CLAY (CH), gray, w/silty sand pockets

LL - | PL - | PI - | G_s 2.65 From Q Test

Remarks: DIRECT SHEAR TEST REPORT

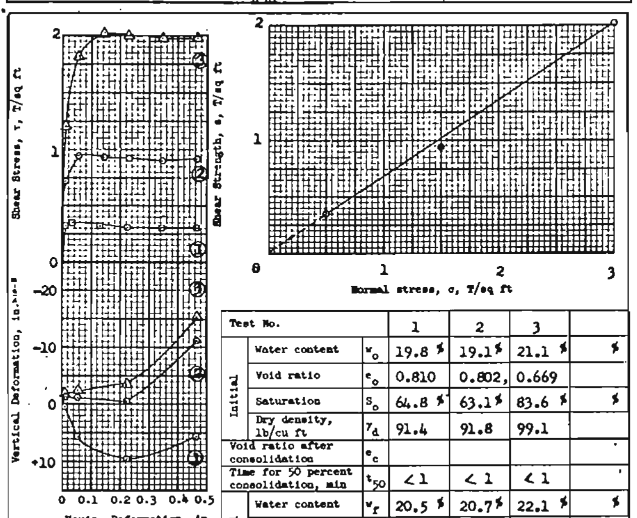
Project LAKE PONTCHARTRAIN & VICINITY, CHALMETTE LEVEE

Area DRAINAGE STRUCTURE AT BAYOU BIENVENUE

Boring No. B-1U | Sample No. 5-B

El -11.5 | Date 21 April 1967

GDA



Shear Strength Parameters

φ' = 34 °

tan φ' = 0.674

c' = 0 T/sq ft

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	19.8 %	19.1 %	21.1 %	%
	Void ratio	e_o	0.810	0.802	0.669	
	Saturation	S_o	64.8 %	63.1 %	83.6 %	%
	Dry density, lb/cu ft	γ_d	91.4	91.8	99.1	
Void ratio after consolidation		e_c				
Time for 50 percent consolidation, min		t_{50}	< 1	< 1	< 1	
Final	Water content	w_f	20.5 %	20.7 %	22.1 %	%
	Void ratio	e_f				
	Saturation	S_f	%	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft		τ_{max}	0.35	0.94	2.02	
Actual time to failure, min		t_f	330	960	990	
Rate of strain, in./min			.00011	.00015	.00015	
Ultimate shear stress, T/sq ft		τ_{ult}	0.31	0.90	1.98	

Type of specimen UNDISTURBED | 3.01 in. square | 0.465 in. thick

Classification SAND (SM), gray, w/broken pieces of shell

LL NP | PL NP | PI NP | G_s 2.65

Remarks: DIRECT SHEAR TEST REPORT

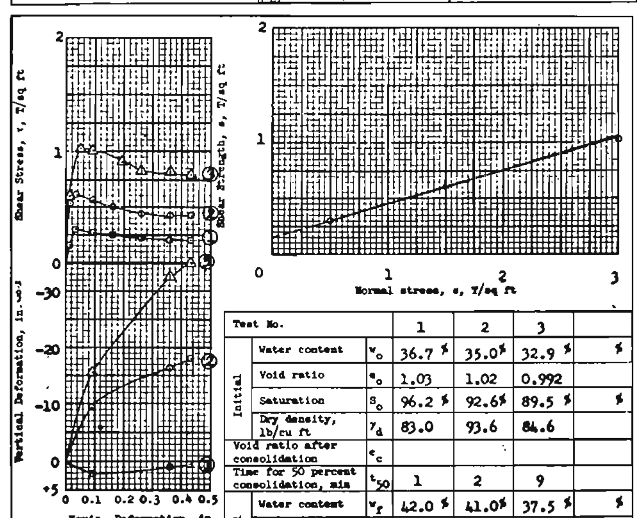
Project LAKE PONTCHARTRAIN & VICINITY, CHALMETTE LEVEE

Area DRAINAGE STRUCTURE AT BAYOU BIENVENUE

Boring No. B-1U | Sample No. 9-C2

El -28.4 | Date 9 May 1967

GDA



Shear Strength Parameters

φ' = 17 °

tan φ' = 0.306

c' = 0.15 T/sq ft

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	36.7 %	35.0 %	32.9 %	%
	Void ratio	e_o	1.03	1.02	0.992	
	Saturation	S_o	96.2 %	92.6 %	89.5 %	%
	Dry density, lb/cu ft	γ_d	83.0	93.6	84.6	
Void ratio after consolidation		e_c				
Time for 50 percent consolidation, min		t_{50}	1	2	9	
Final	Water content	w_f	42.0 %	41.0 %	37.5 %	%
	Void ratio	e_f				
	Saturation	S_f	%	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft		τ_{max}	0.30	0.61	1.02	
Actual time to failure, min		t_f	360	360	540	
Rate of strain, in./min			.0001	.0001	.0001	
Ultimate shear stress, T/sq ft		τ_{ult}	0.20	0.42	0.80	

Type of specimen UNDISTURBED | 3.00 in. square | 0.470 in. thick

Classification CLAY (CH), gray

LL 81 | PL 23 | PI 58 | G_s 2.70

Remarks: DIRECT SHEAR TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY, CHALMETTE LEVEE

Area DRAINAGE STRUCTURE AT BAYOU BIENVENUE

Boring No. B-1U | Sample No. 19-B2

El -63.1 | Date 23 April 1967

GDA

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

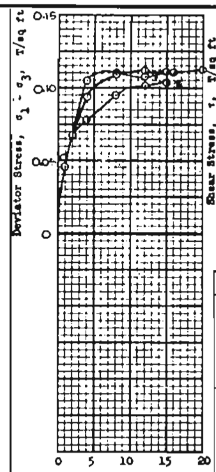
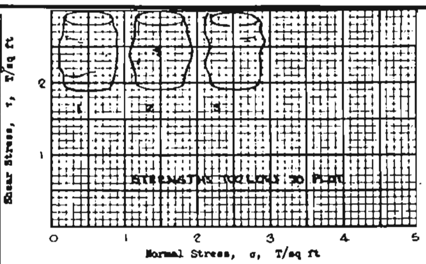
DETAIL SHEAR STRENGTH DATA
BORING B-1U "Q" "R" & "S" TEST

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 | FILE NO. H-2-24147

Test No.			1	2	3	
Initial	Water content	w_o	150.0%	170.8%	162.8%	%
	Void ratio	e_o	3.80	4.53	4.23	
	Saturation	S_o	98.3%	93.9%	95.8%	%
	Dry density, lb/cu ft	γ_d	32.4	28.1	29.7	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.11	0.10	0.11	
Time to failure, min		t_f	16	15	15	
Rate of strain, percent/min			0.97	0.97	0.97	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.05 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification DARK GRAY CLAY (CH), W/ ORGANIC MATTER & FINE ROOTS

LL 180 | PL 51 | PI 129 | G_s 2.49

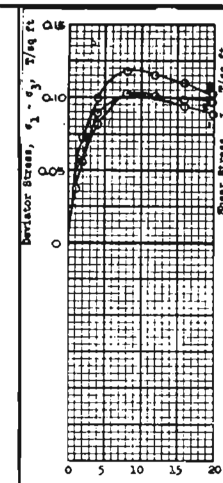
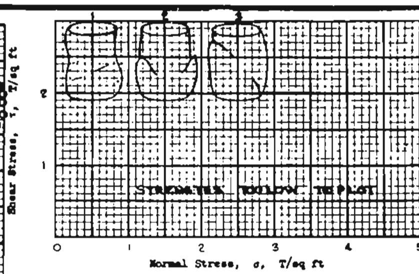
Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 2-B

Depth El +0.7 | Date 4/12/67

Test No.			1	2	3	
Initial	Water content	w_o	243.5%	250.5%	254.5%	%
	Void ratio	e_o	5.56	5.74	5.88	
	Saturation	S_o	99.8%	99.5%	98.7%	%
	Dry density, lb/cu ft	γ_d	21.7	21.1	20.7	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.10	0.10	0.12	
Time to failure, min		t_f	14	19	15	
Rate of strain, percent/min			0.67	0.49	0.47	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.05 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification DARK GRAY CLAY (CH), W/ FIBROUS ORG. MAT.

LL 253 | PL 54 | PI 199 | G_s 2.28

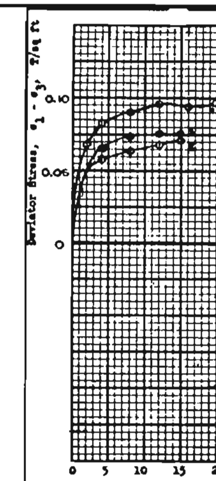
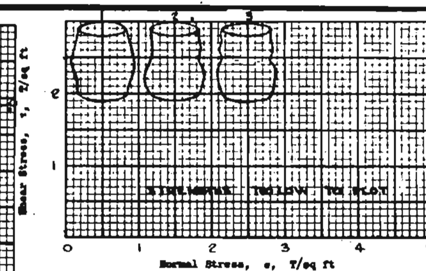
Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 3-D

Depth El -5.2 | Date 4/12/67

Test No.			1	2	3	
Initial	Water content	w_o	62.5%	72.4%	65.0%	%
	Void ratio	e_o	1.64	1.92	1.71	
	Saturation	S_o	100%	99.9%	100%	%
	Dry density, lb/cu ft	γ_d	62.6	56.6	61.1	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.10	0.07	0.08	
Time to failure, min		t_f	13	16	12	
Rate of strain, percent/min			0.93	0.97	1.00	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.04 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), W/ SILT POCKETS

LL 54 | PL 17 | PI 37 | G_s 2.65

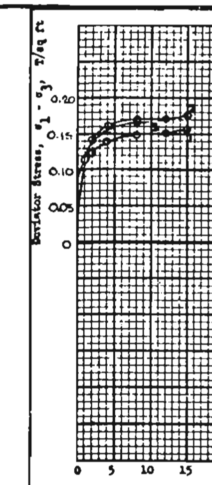
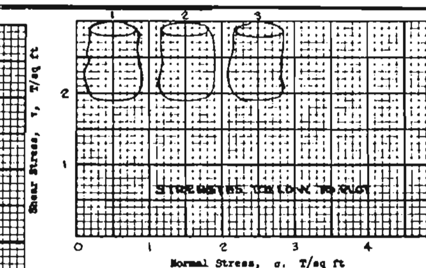
Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 5-B

Depth El -11.5 | Date 4/13/67

Test No.			1	2	3	
Initial	Water content	w_o	62.9%	60.0%	60.6%	%
	Void ratio	e_o	1.69	1.62	1.63	
	Saturation	S_o	100%	99.6%	100%	%
	Dry density, lb/cu ft	γ_d	62.4	64.1	63.8	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.16	0.18	0.17	
Time to failure, min		t_f	16	16	16	
Rate of strain, percent/min			0.97	0.97	0.97	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.09 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), W/ SMALL SHELLS & SHELL FRAGMENTS

LL 71 | PL 29 | PI 42 | G_s 2.69

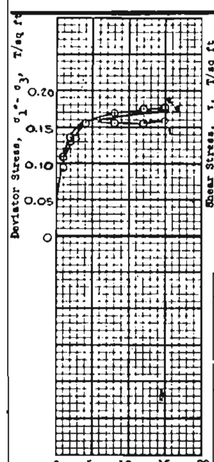
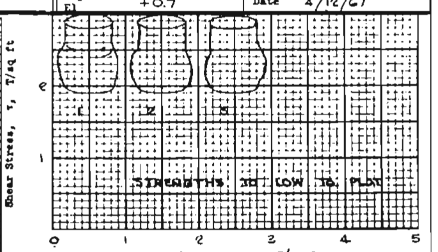
Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 6-B

Depth El -15.1 | Date 4/13/67

Test No.			1	2	3	
Initial	Water content	w_o	55.5%	54.9%	54.5%	%
	Void ratio	e_o	1.50	1.46	1.46	
	Saturation	S_o	99.2%	99.7%	100%	%
	Dry density, lb/cu ft	γ_d	67.0	68.1	68.1	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.16	0.18	0.17	
Time to failure, min		t_f	10	36	16	
Rate of strain, percent/min			0.66	0.39	0.97	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.09 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification SOFT GRAY CLAY (CH), W/ SANDY SILT PARTINGS & SEAMS

LL 52 | PL 20 | PI 32 | G_s 2.68

Remarks SANDY SILT PARTINGS & SEAMS IN ONLY ONE-HALF OF SPECIMEN HEIGHT.

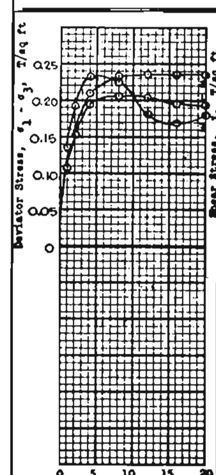
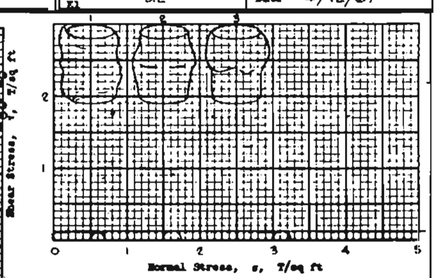
Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 7-D

Depth El -21.2 | Date 4/13/67

TRIAXIAL COMPRESSION TEST REPORT

Test No.			1	2	3	
Initial	Water content	w_o	53.3%	50.7%	52.1%	%
	Void ratio	e_o	1.39	1.35	1.39	
	Saturation	S_o	100%	100%	100%	%
	Dry density, lb/cu ft	γ_d	70.0	71.1	70.0	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.21	0.24	0.23	
Time to failure, min		t_f	17	19	9	
Rate of strain, percent/min			0.49	0.47	0.47	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.11 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY CLAY (CH), W/ SAND SEAMS

LL 56 | PL 19 | PI 37 | G_s 2.68

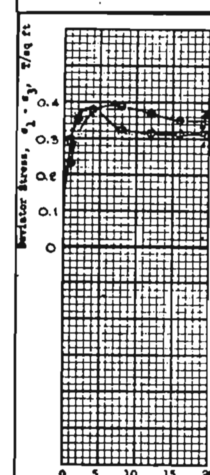
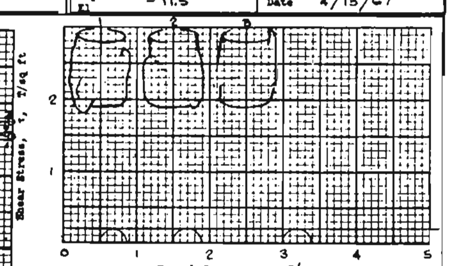
Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 9-A

Depth El -26.7 | Date 4/14/67

Test No.			1	2	3	
Initial	Water content	w_o	74.6%	74.6%	62.5%	%
	Void ratio	e_o	2.00	1.99	1.70	
	Saturation	S_o	100%	100%	98.5%	%
	Dry density, lb/cu ft	γ_d	55.8	55.9	62.0	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.37	0.38	0.40	
Time to failure, min		t_f	9	8	88	
Rate of strain, percent/min			0.47	0.38	0.18	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Axial Strain, %

Shear Strength Parameters

ϕ = 0°

tan ϕ = 0

c = 0.20 T/sq ft

Method of saturation ______

☐ Controlled stress

☑ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

Classification GRAY & TAN CLAY (CH), W/ SILT SEAMS

LL 85 | PL 31 | PI 54 | G_s 2.68

Remarks TRIAXIAL COMPRESSION TEST REPORT

Project LAKE PONTCHARTRAIN & VICINITY DRAINAGE STRUCTURE, CHALMETTE LEVEE

Area BAYOU BIENVENUE

Boring No. B-1U | Sample No. 14-D

Depth El -46.0 | Date 4/14/67

LAKE PONTCHARTRAIN, LA. AND VICINITY

CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN

BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

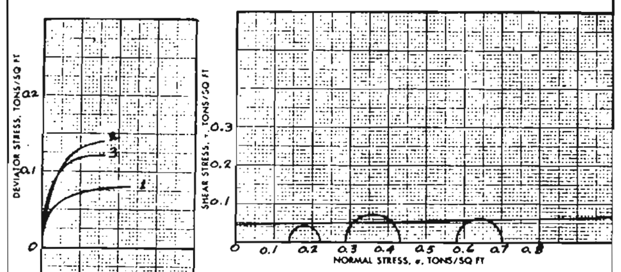
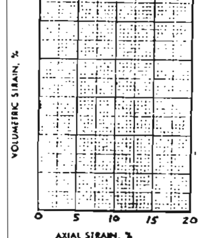
DETAIL SHEAR STRENGTH DATA

BORING B-1U "Q" TEST

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

Triaxial Compression Test Report — Boring U-3, Sample 5

Test No.	1	2	3
Initial: Water content, %	50.2	56.6	53.9
Initial: Void ratio	1.34	1.45	1.41
Initial: Saturation, %	99	100	100
Initial: Dry density, lb/cu ft	71.6	68.2	69.4
Final: Water content, %	50.2	56.6	53.9
Final: Void ratio	1.34	1.45	1.41
Max deviator stress, T/sq ft	0.08	0.14	0.12
Minor principal stress, tons/sq ft	0.14	0.29	0.58
Time to failure, min	12	8	8
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 1°; tan φ = .017; c = 0.043 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: CH - Very soft gray clay

LL 71 — PL 22 — PI 49 — Gs 2.68

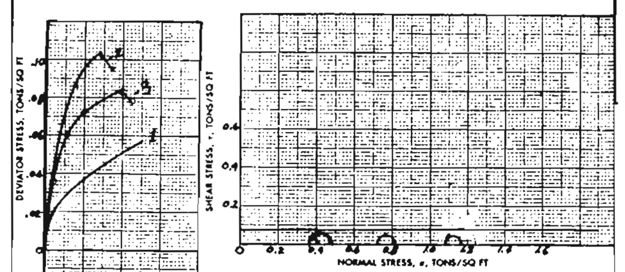
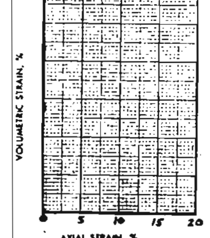
Remarks: W/organic matter & roots

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 5 — Depth El. +3.7 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 14

Test No.	1	2	3
Initial: Water content, %	41.9	38.8	33.8
Initial: Void ratio	1.11	1.02	0.85
Initial: Saturation, %	100	100	100
Initial: Dry density, lb/cu ft	79.1	82.6	90.3
Final: Water content, %	41.9	38.8	33.8
Final: Void ratio	1.11	1.02	0.85
Max deviator stress, T/sq ft	0.058	0.104	0.083
Minor principal stress, tons/sq ft	0.36	0.72	1.08
Time to failure, min	11	7	10
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 0; tan φ = 0; c = 0.107 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: CL - Soft gray & tan silty clay

LL 43 — PL 20 — PI 23 — Gs 2.68

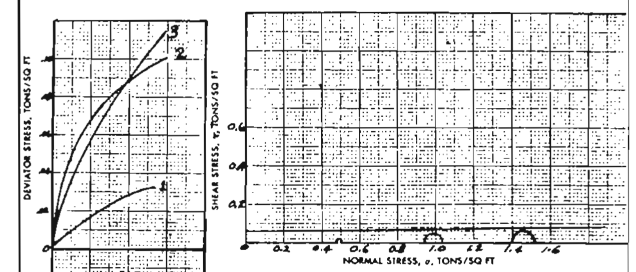
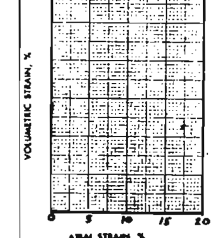
Remarks: Shear values taken from large scale plot.

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 14 — Depth El. -4.8 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 19

Test No.	1	2	3
Initial: Water content, %	35.5	34.0	35.7
Initial: Void ratio	0.95	0.87	0.92
Initial: Saturation, %	100	100	100
Initial: Dry density, lb/cu ft	85.6	89.1	86.8
Final: Water content, %	35.5	34.0	35.7
Final: Void ratio	0.95	0.87	0.92
Max deviator stress, T/sq ft	0.033	0.100	0.115
Minor principal stress, tons/sq ft	0.47	0.94	1.40
Time to failure, min	13	15	
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 2°; tan φ = .035; c = 0.072 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: ML - Very soft gray silty clay

LL 31 — PL 29 — PI 2 — Gs 2.67

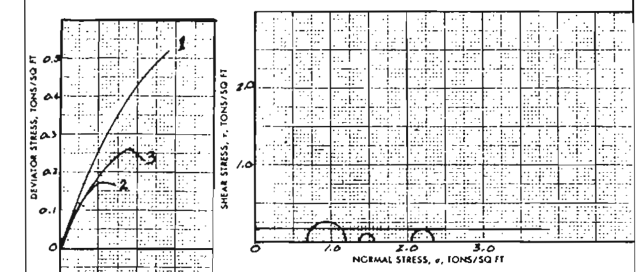
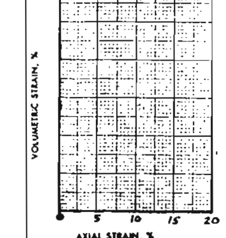
Remarks: W/clayey silt layers. Shear values taken from large scale plot

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 19 — Depth El. -9.8 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 27

Test No.	1	2	3
Initial: Water content, %	35.4	37.3	35.4
Initial: Void ratio	0.93	0.96	0.92
Initial: Saturation, %	100	100	100
Initial: Dry density, lb/cu ft	85.7	84.2	85.3
Final: Water content, %	35.4	37.3	35.4
Final: Void ratio	0.93	0.96	0.92
Max deviator stress, T/sq ft	0.52	0.17	0.28
Minor principal stress, tons/sq ft	0.68	1.37	2.05
Time to failure, min	14	6	7
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 0; tan φ = 0; c = 0.148 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: ML - Loose gray clayey silt

LL 29 — PL 29 — PI 0 — Gs 2.65

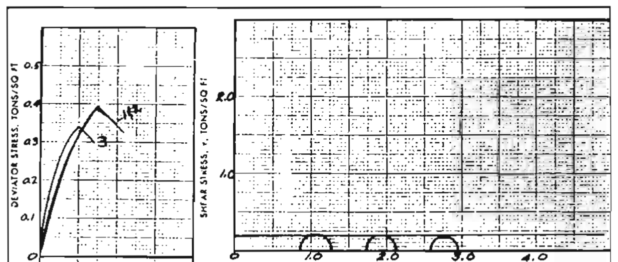
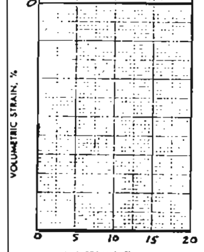
Remarks: W/clay lenses

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 27 — Depth El. -18.8 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 34

Test No.	1	2	3
Initial: Water content, %	44.4	45.6	50.9
Initial: Void ratio	1.21	1.24	1.35
Initial: Saturation, %	98	98	100
Initial: Dry density, lb/cu ft	75.6	74.5	71.3
Final: Water content, %	44.4	45.6	50.9
Final: Void ratio	1.21	1.24	1.35
Max deviator stress, T/sq ft	0.39	0.39	0.34
Minor principal stress, tons/sq ft	0.86	1.73	2.59
Time to failure, min	7	7	5
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 0; tan φ = 0; c = 0.188 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: CH - Soft gray clay

LL 70 — PL 25 — PI 45 — Gs 2.68

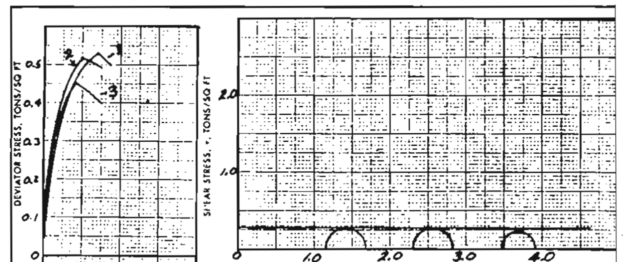
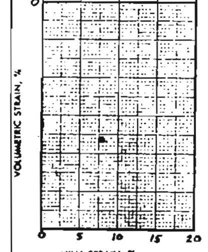
Remarks: W/sand layers & pockets

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 34 — Depth El. -24.8 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 42

Test No.	1	2	3
Initial: Water content, %	54.8	56.5	55.1
Initial: Void ratio	1.47	1.49	1.45
Initial: Saturation, %	100	100	100
Initial: Dry density, lb/cu ft	68.6	67.2	68.3
Final: Water content, %	54.8	56.5	55.1
Final: Void ratio	1.47	1.49	1.45
Max deviator stress, T/sq ft	0.54	0.52	0.44
Minor principal stress, tons/sq ft	1.15	2.30	3.46
Time to failure, min	7	5	5
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 0; tan φ = 0; c = 0.288 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: CH - Medium stiff gray clay

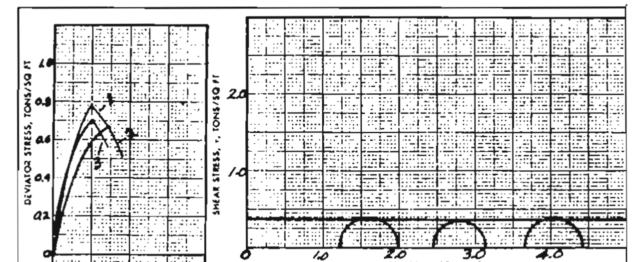
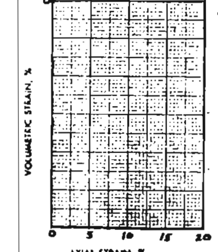
LL 91 — PL 28 — PI 63 — Gs 2.68

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 42 — Depth El. -33.8 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

Triaxial Compression Test Report — Boring U-3, Sample 46

Test No.	1	2	3
Initial: Water content, %	61.2	60.1	59.0
Initial: Void ratio	1.64	1.60	1.55
Initial: Saturation, %	100	100	100
Initial: Dry density, lb/cu ft	63.7	64.8	66.0
Final: Water content, %	61.2	60.1	59.0
Final: Void ratio	1.64	1.60	1.55
Max deviator stress, T/sq ft	0.75	0.67	0.71
Minor principal stress, tons/sq ft	1.22	2.45	3.67
Time to failure, min	5	7	5
Initial diameter, in.	1.40	1.40	1.40
Initial height, in.	3.00	3.00	3.00

Shear values: φ = 0; tan φ = 0; c = 0.360 tons/sq ft

Type test "Q" — Controlled strain

Type of specimen: Undisturbed — Rate of strain: .030 in/min

Classification: CH - Medium stiff gray clay

LL 85 — PL 32 — PI 53 — Gs 2.70

Remarks: W/silt lenses

Project: Proposed Protection Levee, St. Bernard Parish, Louisiana

Boring No. U-3 — Sample No. 46 — Depth El. -40.3 MSL — Date August 1966

TRIAXIAL COMPRESSION TEST REPORT

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

DETAIL SHEAR STRENGTH DATA
BORING U-3 "Q" TEST

SCALES AS SHOWN

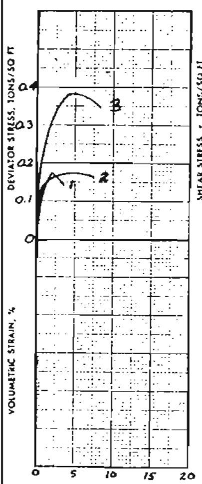
WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

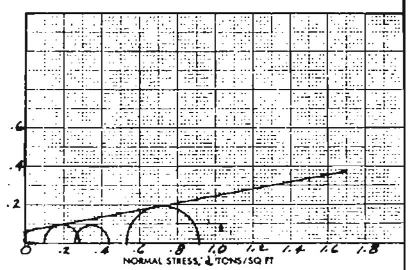
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LA.

DATE: MARCH, 1968 — FILE NO. H-2-24147

PLATE NO. III-7

TRIAXIAL COMPRESSION TEST REPORT — Boring U-3, Sample No. 5





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	57.2%	58.0%	59.5%	%
	VOID RATIO	e_o	1.48	1.50	1.58	
	SATURATION	S_o	100%	100%	100%	%
	DRY DENSITY LB/CU FT	γ_d	67.3	66.3	64.8	
BEFORE TEST	WATER CONTENT	w_c	55.5%	55.8%	55.1%	%
	SATURATION	S_c	100%	100%	100%	%
	CONSOLIDATION PRESS., TONS/SQ FT	σ_c	0.14	0.29	0.58	
	VOID RATIO	e_c	1.38	1.35	1.36	
FINAL	WATER CONTENT	w_f	55.5%	55.8%	55.1%	%
	VOID RATIO	e_f	1.38	1.35	1.36	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{max}$	0.17	0.17	0.38	
MINOR PRINCIPAL STRESS, TONS/SQ FT		σ_3	0.10	0.26	0.53	
TIME TO FAILURE, MIN			2.5	3	4	
INITIAL DIAMETER, IN.			1.40	1.40	1.40	
INITIAL HEIGHT, H_o, IN.			3.00	3.00	3.00	

SHEAR VALUES

φ = 11°

TAN φ = .194

c = 0.06 TONS/SQ FT

TYPE TEST "R"

METHOD OF SATURATION ________ ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed — RATE OF STRAIN .030 IN./MIN

CLASSIFICATION CH - Soft gray clay

LL 71 | PL 22 | PI 49 | G_s 2.68

REMARKS W/sand lenses

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

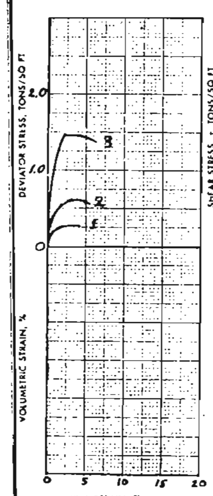
AREA

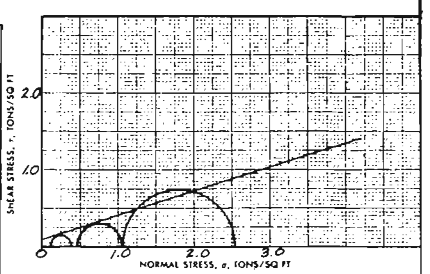
BORING NO. U-3 | SAMPLE NO. 5

DEPTH EL. +3.7 MSL | DATE August 1966

TRIAXIAL COMPRESSION TEST REPORT

TRIAXIAL COMPRESSION TEST REPORT — Boring U-3, Sample No. 19





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	37.8%	40.0%	39.5%	%
	VOID RATIO	e_o	1.00	1.03	1.05	
	SATURATION	S_o	1.00%	100%	100%	%
	DRY DENSITY LB/CU FT	γ_d	83.2	82.2	81.1	
BEFORE TEST	WATER CONTENT	w_c	32.0%	34.4%	30.8%	%
	SATURATION	S_c	100%	100%	100%	%
	CONSOLIDATION PRESS., TONS/SQ FT	σ_c	0.47	0.94	1.40	
	VOID RATIO	e_c	0.94	0.92	0.87	
FINAL	WATER CONTENT	w_f	32.0%	34.4%	30.8%	%
	VOID RATIO	e_f	0.94	0.92	0.87	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{max}$	0.26	0.61	1.46	
MINOR PRINCIPAL STRESS, TONS/SQ FT		σ_3	0.12	0.46	1.06	
TIME TO FAILURE, MIN			1	2.5	2	
INITIAL DIAMETER, IN.			1.40	1.40	1.40	
INITIAL HEIGHT, H_o, IN.			3.00	3.00	3.00	

SHEAR VALUES

φ = 18°

TAN φ = .325

c = 0.10 TONS/SQ FT

TYPE TEST "R"

METHOD OF SATURATION ________ ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed — RATE OF STRAIN .030 IN./MIN

CLASSIFICATION ML - Very soft gray silty clay

LL 31 | PL 29 | PI 2 | G_s 2.67

REMARKS W/silty clay & clayey silt layers

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

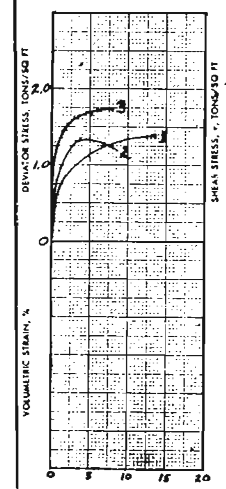
AREA

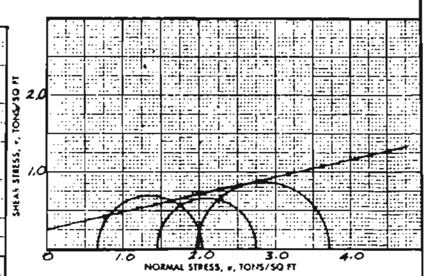
BORING NO. U-3 | SAMPLE NO. 19

DEPTH EL. −9.8 MSL | DATE August 1966

TRIAXIAL COMPRESSION TEST REPORT

TRIAXIAL COMPRESSION TEST REPORT — Boring U-3, Sample No. 34





TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	38.7%	36.5%	42.1%	%
	VOID RATIO	e_o	1.01	0.98	1.09	
	SATURATION	S_o	100%	100%	100%	%
	DRY DENSITY LB/CU FT	γ_d	83.1	84.4	80.1	
BEFORE TEST	WATER CONTENT	w_c	34.9%	30.4%	31.3%	%
	SATURATION	S_c	100%	100%	100%	%
	CONSOLIDATION PRESS., TONS/SQ FT	σ_c	0.86	1.73	2.59	
	VOID RATIO	e_c	0.89	0.81	0.79	
FINAL	WATER CONTENT	w_f	34.9%	30.4%	31.3%	%
	VOID RATIO	e_f	0.89	0.81	0.79	
MAX DEVIATOR STRESS, T/SQ FT		$(\sigma_1-\sigma_3)_{max}$	1.37	1.31	1.71	
MINOR PRINCIPAL STRESS, TONS/SQ FT		σ_3	0.66	1.45	1.97	
TIME TO FAILURE, MIN			13	3	8	
INITIAL DIAMETER, IN.			1.40	1.40	1.40	
INITIAL HEIGHT, H_o, IN.			3.00	3.00	3.00	

SHEAR VALUES

φ = 13°

TAN φ = .231

c = 0.22 TONS/SQ FT

TYPE TEST "R"

METHOD OF SATURATION ________ ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed — RATE OF STRAIN .030 IN./MIN

CLASSIFICATION CH - Soft gray clay

LL 70 | PL 25 | PI 45 | G_s 2.68

REMARKS W/silt lenses

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

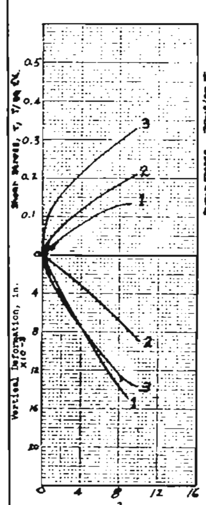
AREA

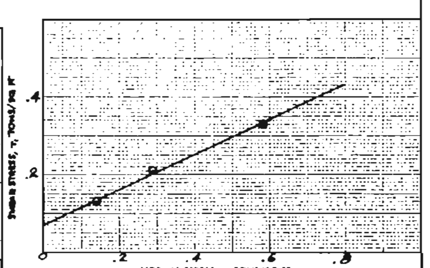
BORING NO. U-3 | SAMPLE NO. 34

DEPTH EL. −24.8 MSL | DATE August 1966

TRIAXIAL COMPRESSION TEST REPORT

DIRECT SHEAR TEST REPORT — Boring U-3, Sample No. 6





Test No.			1	2	3	
Initial	Water content	w_o	55.8%	40.1%	60.4%	%
	Void ratio	e_o	1.50	1.09	1.63	
	Saturation	S_o	100%	99%	99%	%
	Dry density, lb/cu ft	γ_d	66.8	80.0	63.5	
Void ratio after consolidation		e_c	1.43	1.02	1.39	
Time for 50 percent consolidation, min		t_{50}				
Final	Water content	w_f	56.3%	39.7%	55.2%	%
	Void ratio	e_f	1.38	0.99	1.34	
	Saturation	S_f	100%	100%	100%	%
Normal stress, T/sq ft		σ	0.14	0.29	0.58	
Maximum shear stress, T/sq ft		τ_{max}	0.13	0.21	0.33	
Actual time to failure, min		t_f	806	720	635	
Rate of strain, in./min			.0001	.0001	.0001	
Ultimate shear stress, T/sq ft		τ_{ult}				

3.00 in. square | 1.00 in. thick

SHEAR VALUES

φ = 25°

TAN φ = .466

c = 0.070 TONS/SQ FT

TYPE TEST "S" ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed

CLASSIFICATION CH - Soft gray clay

LL 71 | PL 22 | PI 49 | G_s 2.68

REMARKS W/sand layer & pockets

Test Specimen #2 contained large sand layer.

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

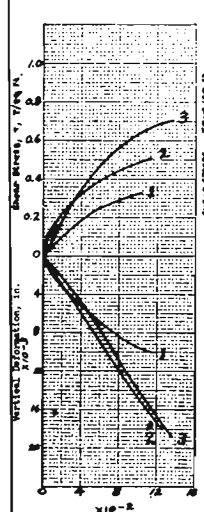
AREA

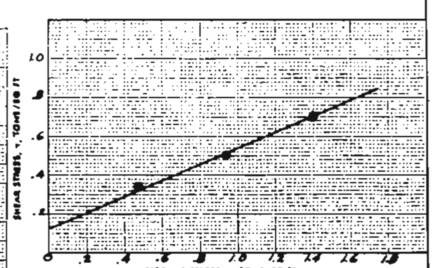
BORING NO U-3 | SAMPLE NO 6

DEPTH EL. +3.2 MSL | DATE August 1966

DIRECT SHEAR TEST REPORT

DIRECT SHEAR TEST REPORT — Boring U-3, Sample No. 20





Test No.			1	2	3	
Initial	Water content	w_o	34.1%	36.8%	35.7%	%
	Void ratio	e_o	0.92	0.98	0.95	
	Saturation	S_o	99%	100%	100%	%
	Dry density, lb/cu ft	γ_d	86.8	84.1	85.3	
Void ratio after consolidation		e_c	0.85	0.86	0.83	
Time for 50 percent consolidation, min		t_{50}				
Final	Water content	w_f	34.9%	34.9%	34.2%	%
	Void ratio	e_f	0.82	0.82	0.78	
	Saturation	S_f	100%	100%	100%	%
Normal stress, T/sq ft		σ	0.47	0.94	1.40	
Maximum shear stress, T/sq ft		τ_{max}	0.32	0.50	0.70	
Actual time to failure, min		t_f	788	740	815	
Rate of strain, in./min			.0001	.0001	.0001	
Ultimate shear stress, T/sq ft		τ_{ult}				

3.00 in. square | 1.00 in. thick

SHEAR VALUES

φ = 23°

TAN φ = .424

c = 0.12 TONS/SQ FT

TYPE TEST "S" ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed

CLASSIFICATION ML - Soft gray silty clay

LL 31 | PL 29 | PI 2 | G_s 2.67

REMARKS W/trace of fine sand

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

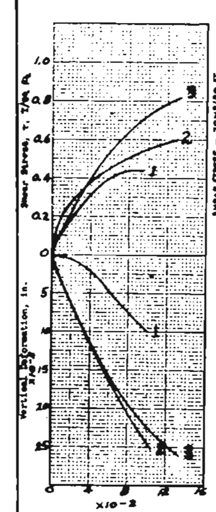
AREA

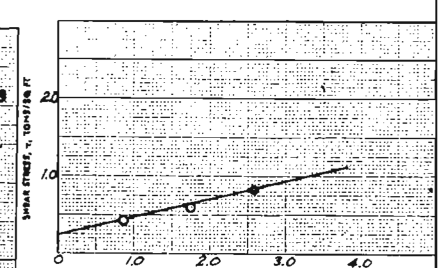
BORING NO U-3 | SAMPLE NO 20

DEPTH EL. −10.8 MSL | DATE August 1966

DIRECT SHEAR TEST REPORT

DIRECT SHEAR TEST REPORT — Boring U-3, Sample No. 32





Test No.			1	2	3	
Initial	Water content	w_o	57.0%	61.7%	67.7%	%
	Void ratio	e_o	1.51	1.62	1.80	
	Saturation	S_o	100%	100%	100%	%
	Dry density, lb/cu ft	γ_d	66.7	63.8	59.8	
Void ratio after consolidation		e_c	1.40	1.41	1.65	
Time for 50 percent consolidation, min		t_{50}				
Final	Water content	w_f	58.9%	57.5%	53.9%	%
	Void ratio	e_f	1.38	1.34	1.51	
	Saturation	S_f	100%	100%	96%	%
Normal stress, T/sq ft		σ	0.86	1.73	2.59	
Maximum shear stress, T/sq ft		τ_{max}	0.44	0.59	0.82	
Actual time to failure, min		t_f	745	734	875	
Rate of strain, in./min			.0001	.0001	.0001	
Ultimate shear stress, T/sq ft		τ_{ult}				

3.0 in. square | 1.00 in. thick

SHEAR VALUES

φ = 13°

TAN φ = .231

c = 0.25 TONS/SQ FT

TYPE TEST "S" ☐ CONTROLLED STRESS ☒ CONTROLLED STRAIN

TYPE OF SPECIMEN Undisturbed

CLASSIFICATION CH - Soft gray clay

LL 70 | PL 25 | PI 45 | G_s 2.68

REMARKS W/silt lenses

PROJECT Proposed Protection Levee

St. Bernard Parish, Louisiana

AREA

BORING NO U-3 | SAMPLE NO 32

DEPTH EL. −22.8 MSL | DATE August 1966

DIRECT SHEAR TEST REPORT

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

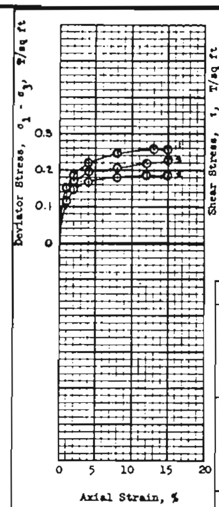
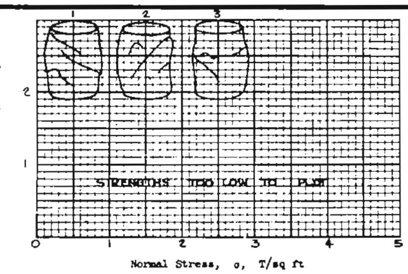
DETAIL SHEAR STRENGTH DATA
BORING U-3 "R" & "S" TEST

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA. | U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.

DATE: MARCH, 1968 | FILE NO. H-2-24147

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 3-B

Axial Strain, %

Shear Strength Parameters

φ = 0°

tan φ = 0

c = 0.11 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	41.6 %	43.0 %	41.1 %	%
Initial	Void ratio	e_o	1.15	1.18	1.14	
Initial	Saturation	S_o	95.9 %	96.6 %	95.5 %	%
Initial	Dry density, lb/cu ft	γ_d	77.0	76.0	77.8	
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.26	0.19	0.23	
Time to failure, min		t_f	27	19	25	
Rate of strain, percent/min			0.48	0.65	0.61	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test: Q — Type of specimen: UNDISTURBED

Classification: GRAY SILTY CLAY (CH), W/ SAND SEAMS

LL 54 — PL 19 — PI 35 — G_s 2.65

Remarks ________

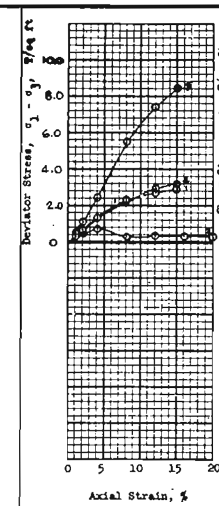
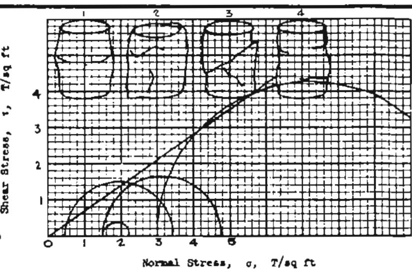
Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 3-B

Depth El -3.6 — Date 11/2/67

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 5-C

Axial Strain, %

Shear Strength Parameters

φ = 35°

tan φ = 0.700

c = 0 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	4
Initial	Water content	w_o	27.1 %	27.9 %	25.4 %	26.3 %
Initial	Void ratio	e_o	0.763	0.768	0.733	0.742
Initial	Saturation	S_o	94.5 %	96.6 %	92.2 %	94.3 %
Initial	Dry density, lb/cu ft	γ_d	94.2	93.9	95.8	95.3
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	1.50
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	2.86	0.78	8.45	3.18
Time to failure, min		t_f	27	7	33	19
Rate of strain, percent/min			0.57	0.57	0.45	0.81
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	1.41
Initial height, in.		H_o	3.00	3.00	3.00	3.00

Type of test: Q — Type of specimen: UNDISTURBED

Classification: GRAY SILTY FINE SAND (SM)

LL 27 — PL 25 — PI 2 — G_s 2.66

Remarks ________

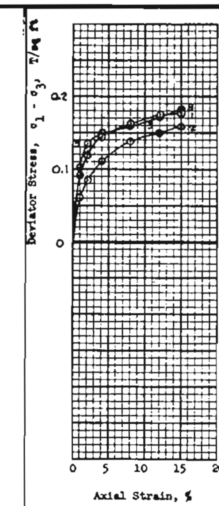
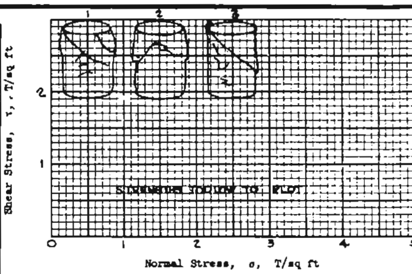
Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 5-C

Depth El -12.7 — Date 11/2/67

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 9-A

Axial Strain, %

Shear Strength Parameters

φ = 0°

tan φ = 0

c = 0.09 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	64.5 %	57.2 %	62.0 %	%
Initial	Void ratio	e_o	1.70	1.53	1.65	
Initial	Saturation	S_o	100+ %	100+ %	100+ %	%
Initial	Dry density, lb/cu ft	γ_d	62.4	66.6	68.5	
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.18	0.16	0.18	
Time to failure, min		t_f	31	16	16	
Rate of strain, percent/min			0.48	0.97	0.97	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test: Q — Type of specimen: UNDISTURBED

Classification: GRAY CLAY (CH), W/ SILT & SAND SEAMS

LL 65 — PL 24 — PI 41 — G_s 2.70

Remarks: SPECIMEN NO. 2 CONTAINED MORE SILT SEAMS THAN 1 OR 3.

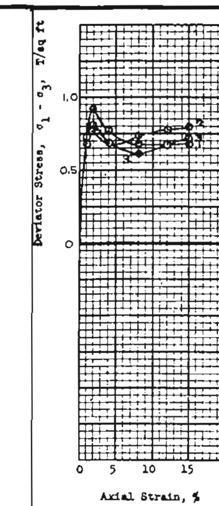
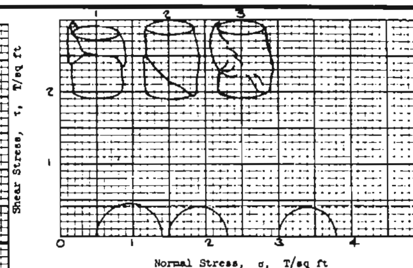
Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 9-A

Depth El -27.0 — Date 11/3/67

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 20-B

Axial Strain, %

Shear Strength Parameters

φ = 0°

tan φ = 0

c = 0.42 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	51.6 %	45.2 %	53.5 %	%
Initial	Void ratio	e_o	1.41	1.26	1.49	
Initial	Saturation	S_o	99.9 %	97.9 %	98.0 %	%
Initial	Dry density, lb/cu ft	γ_d	70.7	75.4	68.4	
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.91	0.81	0.78	
Time to failure, min		t_f	6	13	17	
Rate of strain, percent/min			0.33	0.15	0.10	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test: Q — Type of specimen: UNDISTURBED

Classification: GRAY CLAY (CH), WITH SANDY SILT SEAMS

LL 69 — PL 21 — PI 48 — G_s 2.73

Remarks ________

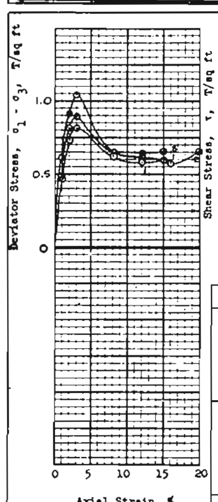
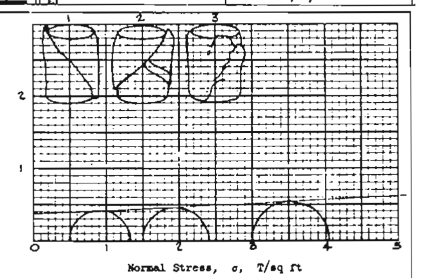
Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 20-B

Depth El -55.3 — Date 11/3/67

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 21-A

Axial Strain, %

Shear Strength Parameters

φ = 3°

tan φ = 0.052

c = 0.38 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	71.5 %	66.6 %	65.6 %	%
Initial	Void ratio	e_o	1.83	1.84	1.78	
Initial	Saturation	S_o	100+ %	99.5 %	100+ %	%
Initial	Dry density, lb/cu ft	γ_d	60.6	60.5	61.7	
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.50	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.81	0.90	1.04	
Time to failure, min		t_f	18	18	19	
Rate of strain, percent/min			0.17	0.17	0.16	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test: Q — Type of specimen: UNDISTURBED

Classification: DARK GRAY & TAN CLAY (CH)

LL 104 — PL 30 — PI 74 — G_s 2.75

Remarks ________

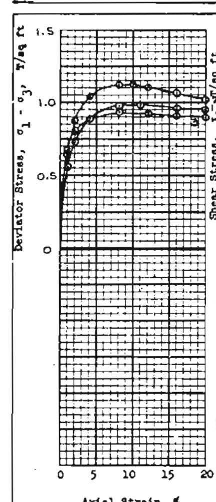
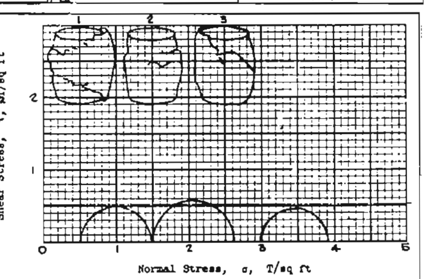
Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 21-A

Depth El -59.0 — Date 11/8/67

TRIAXIAL COMPRESSION TEST REPORT — Boring D-1-U, Sample 25-B

Axial Strain, %

Shear Strength Parameters

φ = 0°

tan φ = 0

c = 0.51 T/sq ft

Method of saturation ________

☐ Controlled stress
☑ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	27.4 %	26.9 %	28.7 %	%
Initial	Void ratio	e_o	0.761	0.767	0.789	
Initial	Saturation	S_o	96.5 %	94.0 %	97.5 %	%
Initial	Dry density, lb/cu ft	γ_d	95.0	94.7	93.5	
Before Shear	Water content	w_c	%	%	%	%
Before Shear	Void ratio	e_c				
Before Shear	Saturation	S_c	%	%	%	%
Before Shear	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
Final	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.60	1.50	3.00	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.99	1.12	0.94	
Time to failure, min		t_f	18	17	13	
Rate of strain, percent/min			0.61	0.61	0.61	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.41	1.41	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test: Q — Type of specimen: UNDISTURBED

Classification: GRAY VERY SANDY CLAY (CL), W/ MANY SHELL FRAGMENTS

LL 34 — PL 12 — PI 22 — G_s 2.68

Remarks ________

Project: CHALMETTE AREA PLAN

Area

Boring No. D-1-U — Sample No. 25-B

Depth El — Date 11/8/67

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

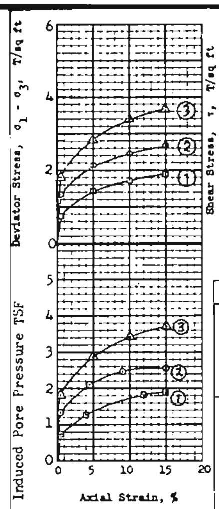
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

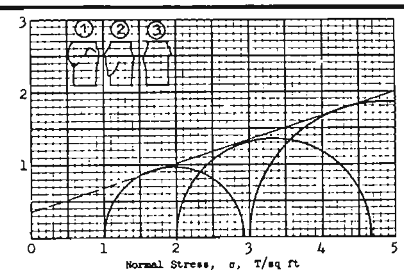
DETAIL SHEAR STRENGTH DATA
BORING D-1-U "Q" TEST

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. III-9





Shear Strength Parameters*

φ = 18°

tan φ = 0.325

c = 0.36 T/sq ft

Method of saturation BP

☐ Controlled stress

☒ Controlled strain

Test No.			1	2	3	
Initial	Water content	w_o	34.3 %	35.9%	36.4%	%
	Void ratio	e_o	0.914	0.948	0.957	
	Saturation	S_o	100+ %	100+ %	100+ %	%
	Dry density, lb/cu ft	γ_d	87.4	85.9	85.5	
Before Shear	Water content	w_c	30.6 %	29.7%	28.6%	%
	Void ratio	e_c	0.823	0.752	0.709	
	Saturation	S_c	99.6 %	100+ %	100+ %	%
	Final back pressure, PSI	u_o	60	60	60	
	Dry density lb/cu ft	γ_d	91.8	95.5	97.9	
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.92	2.67	3.71	
Time to failure, min		t_f	107	100	115	
Rate of strain, percent/min			0.14	0.15	0.13	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.38	1.38	1.37	
Initial height, in.		H_o	3.00	3.00	3.00	

Type of test R | Type of specimen UNDISTURBED

Classification SANDY-SILT (ML) gray, contains a few 1/16" layers of clayey-silt (ML) & a few small pieces of wood

LL 32 | PL 23 | PI 9 | G_s 2.68

Remarks Portion of sample allowed to drain to permit trimming

* See attached plot for effective values

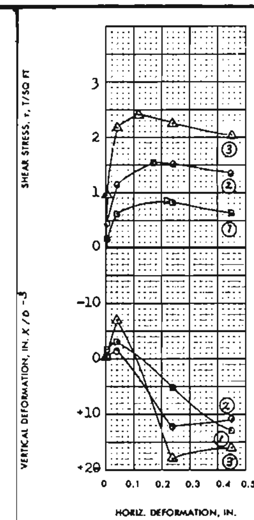
Project CHALMETTE AREA PLAN
BAYOU DUPRE

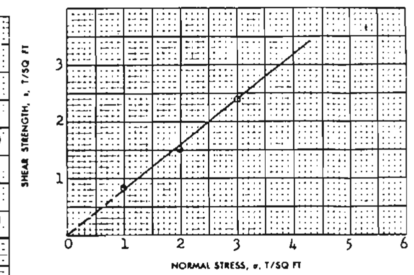
Area

Boring No. D-1-U | Sample No. 7-C

~~Depth~~ El -21.2 | Date 14 November 1967

PJR TRIAXIAL COMPRESSION TEST REPORT





SHEAR STRENGTH PARAMETERS

φ' = 39

TAN φ' = 0.810

c' = 0 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TEST NO.			1	2	3	
INITIAL	WATER CONTENT	w_o	21.4 %	19.8 %	20.2 %	%
	VOID RATIO	e_o	0.631	0.652	0.615	
	SATURATION	S_o	90.6 %	81.1 %	87.7 %	%
	DRY DENSITY, LB/CU FT	γ_d	102.2	100.9	103.2	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	<1	<1	<1	
FINAL	WATER CONTENT	w_f	18.6 %	18.8 %	19.8 %	%
	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}	0.84	1.52	2.40	
ACTUAL TIME TO FAILURE, MIN		t_f	1200	990	720	
RATE OF STRAIN, IN./MIN			.00016	.00016	.00016	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

TYPE OF SPECIMEN UNDISTURBED | 3.00 IN. SQUARE | 0.560 IN. THICK

CLASSIFICATION SILTY SAND (SM), grey

LL — | PL — | PI — | G_s 2.67

REMARKS Sample contained layers Of Clay (CH) not used

PROJECT CHALMETTE AREA PLAN
BAYOU DUPRE

AREA

BORING NO. D-1-U | SAMPLE NO 11-A (In lieu of 11B)

DEPTH EL -33.3 | DATE 20 November 1967

WJH DIRECT SHEAR TEST REPORT

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

DETAIL SHEAR STRENGTH DATA
BORING D-1-U "R" & "S" TEST

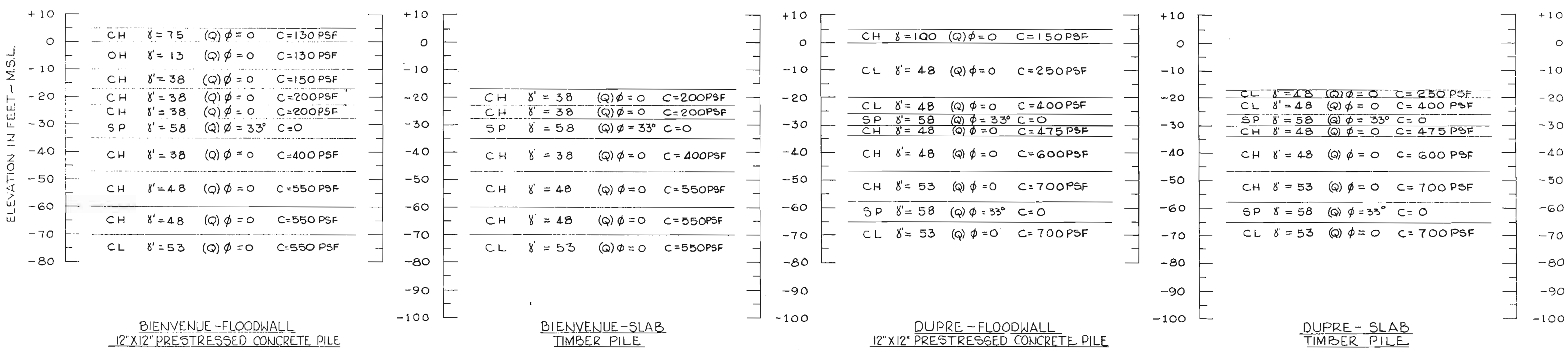
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

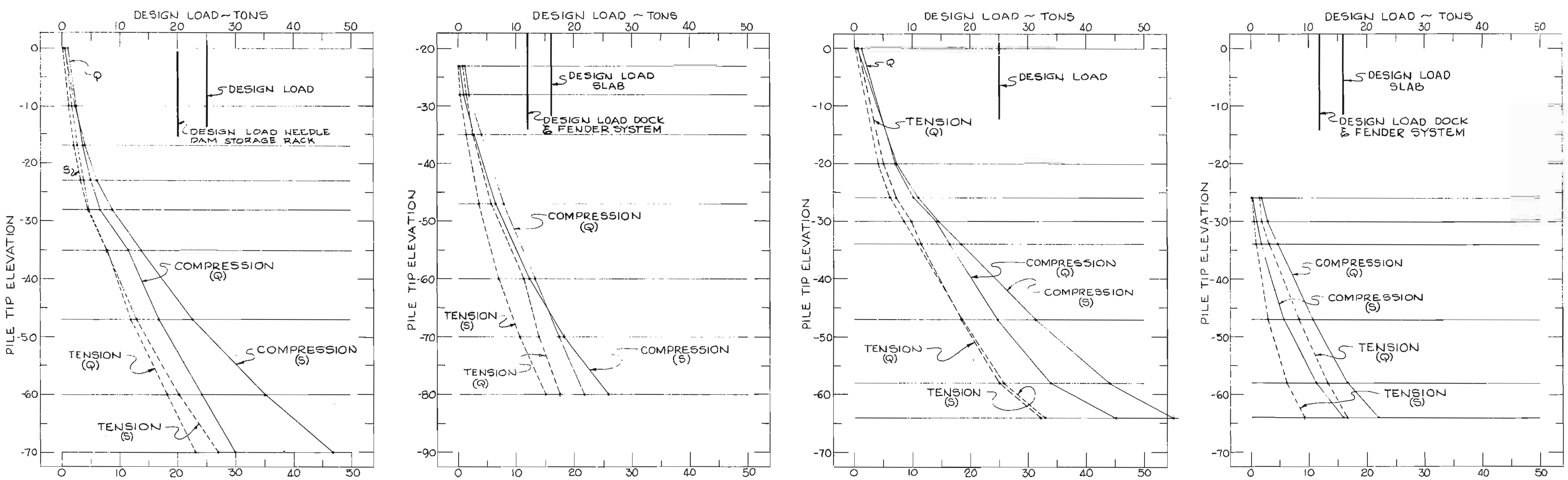
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LA.

DATE: MARCH, 1968 | FILE NO. H-2-24147

PLATE NO. III-10



SOIL SECTIONS



DESIGN LOAD VS. TIP ELEVATION

SHEAR STRENGTH DESIGN DATA

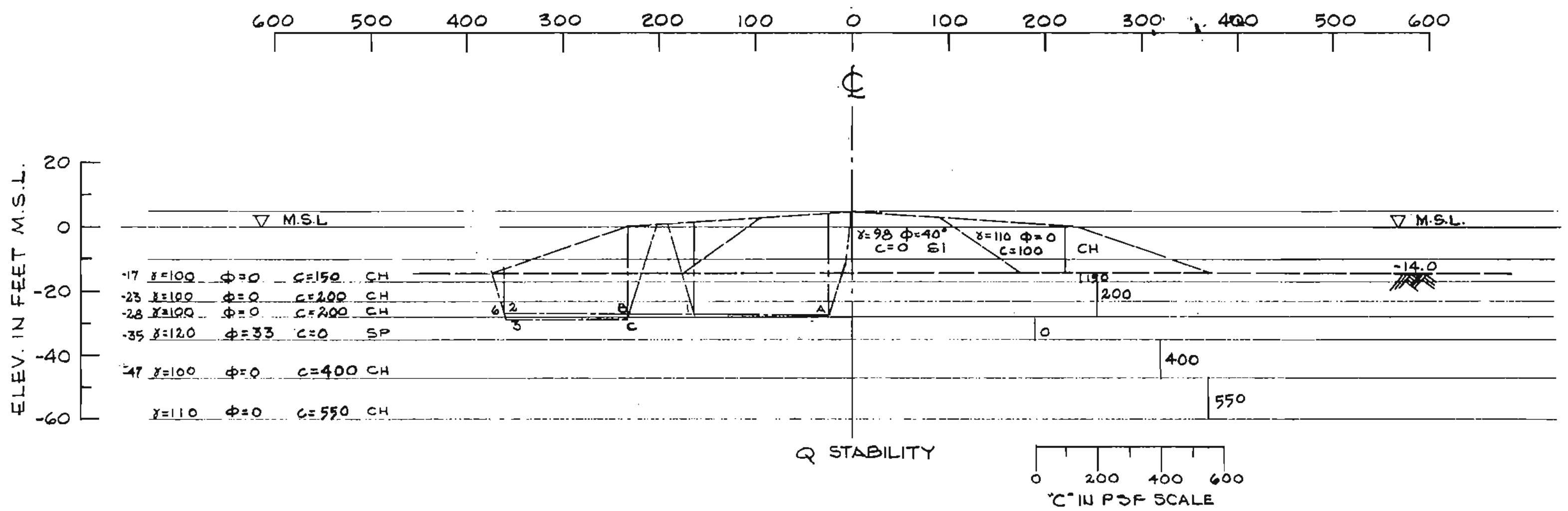
APPLIED FACTORS OF SAFETY, 1.75 IN COMPRESSION & 2.0 IN TENSION.
APPLIED CONJUGATE STRESS RATIOS - K: 1.00 IN COMPRESSION & 0.7 IN TENSION.
(S) STRENGTH IN CLAYS: φ=23°, C=0, (Q) & (S) STRENGTH IN SANDS: φ=33°, C=0.
(Q) STRENGTH IN CLAYS ARE AS SHOWN IN SOIL SECTIONS.
DESIGN LOADS INCREASED BY 1/3 FOR GROUP 2 LOADINGS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PILE DESIGN LOAD VS TIP ELEVATION

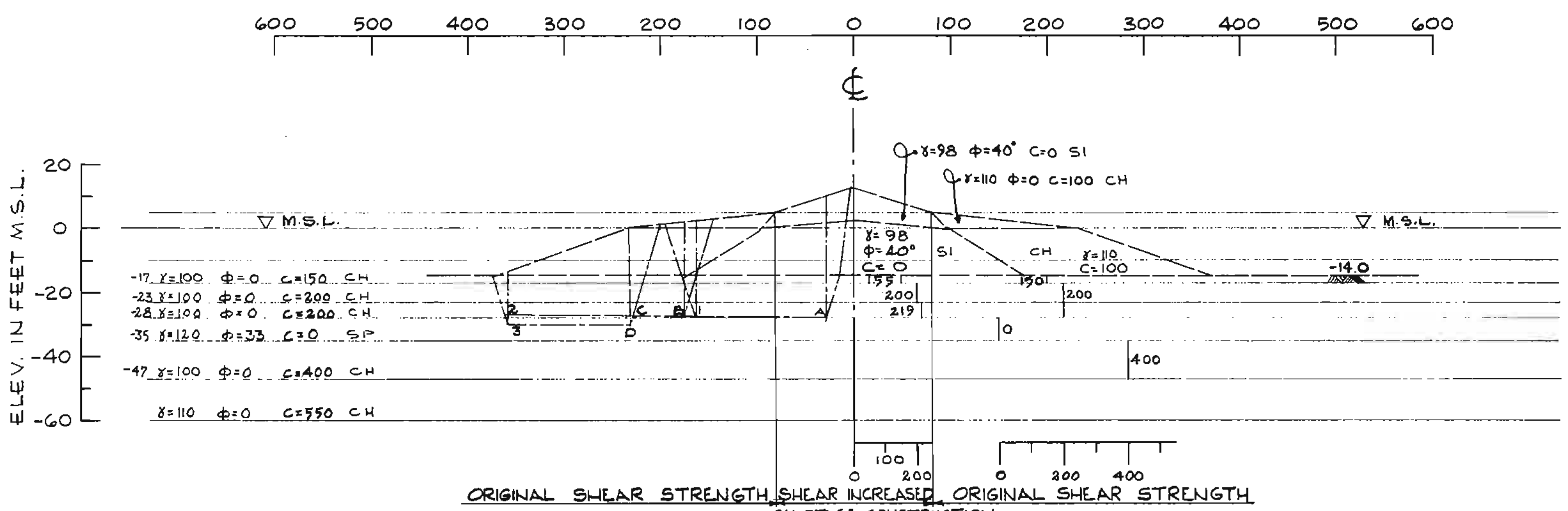
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



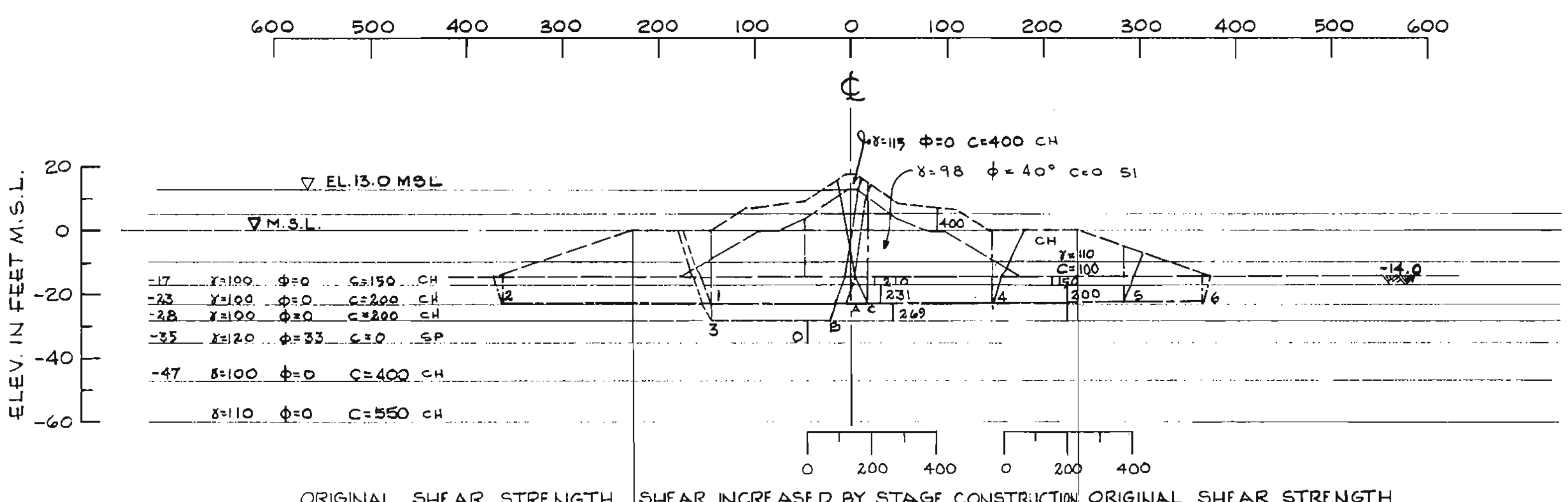
1ST. LIFT

VERT. SCALE 1" = 30' HORZ. SCALE 1" = 100'



2ND. LIFT

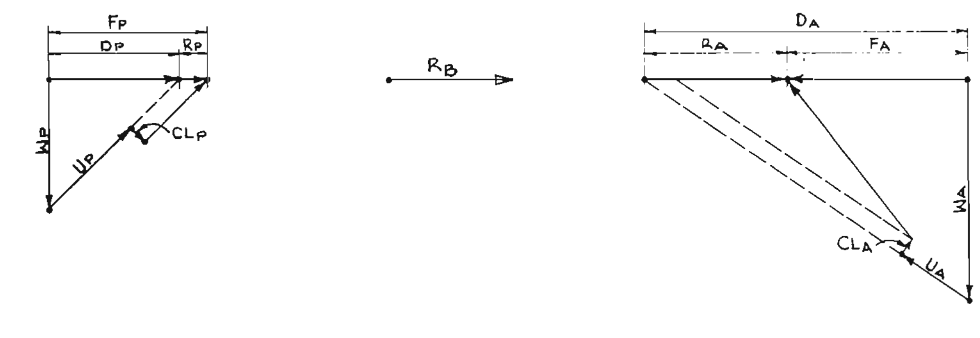
SCALE AS SHOWN ABOVE



3RD LIFT

SCALE AS SHOWN ABOVE

BAYOU BIENVENUE											
SECTION	FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY
	NO.		EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
FIRST LIFT	A	1	-27.5	48,225	42,918	5,307	12,616	28,004	8,017	48,637	2.16
	A	2	-27.5	48,225	27,364	20,861	12,616	67,121	5,100	84,837	4.07
	B	2	-27.5	41,382	27,364	14,018	7,988	25,912	5,100	39,000	2.78
	C	3	-28.5	44,373	29,700	14,673	8,617	77,063	6,021	91,701	6.25
SECOND LIFT	A	1	-27.5	75,068	46,103	28,965	26,267	28,137	8,583	62,987	2.17
	A	2	-27.5	75,068	27,364	47,704	26,267	67,412	5,100	98,779	2.07
	B	2	-27.5	48,025	27,364	20,661	10,245	37,378	5,100	52,723	2.55
	C	2	-27.5	42,430	27,364	15,066	8,391	26,189	5,100	39,680	2.63
	D	3	-28.5	45,382	29,700	15,682	9,019	77,384	6,020	92,423	5.89
THIRD LIFT	A	1	-22.5	80,350	28,118	52,232	41,760	35,301	6,146	83,207	1.59
	A	2	-22.5	80,350	17,008	63,342	41,760	75,304	2,950	120,014	1.89
	B	3	-27.5	100,512	40,585	59,927	44,412	38,419	8,798	91,629	1.53
	*C	4	-22.99	80,041	26,808	53,233	29,111	32,480	10,692	72,283	1.36
	*C	5	-22.99	80,041	23,171	56,870	29,111	59,363	4,880	93,354	1.64
	*C	6	-22.99	80,041	18,108	61,933	29,111	75,763	3,187	108,061	1.74



PASSIVE WEDGE CENTRAL WEDGE ACTIVE WEDGE

SURFACE B3 THIRD STAGE F.S. WITH RESPECT TO SHEAR STRENGTH

$$= \frac{RA+RB+RP}{DA-DP} = \frac{91,629}{59,927} = 1.53$$

VECTOR DIAGRAM

(METHOD OF PLANES)
SCALE: 1" = 30,000#

NOTES:
SEE PLATE I-3 FOR LOCATION OF STREAM CLOSURE SECTION.
SEE PLATE I-9 FOR DETAIL DIMENSIONS OF SECTIONS.
MANY OTHER FAILURE PLANES HAVE BEEN STUDIED BUT ARE NOT SHOWN ON THIS DWG. ONLY THE WORST CONDITIONS HAVE BEEN SHOWN.
*WATER MR-GO SIDE AT EL. 13.0

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

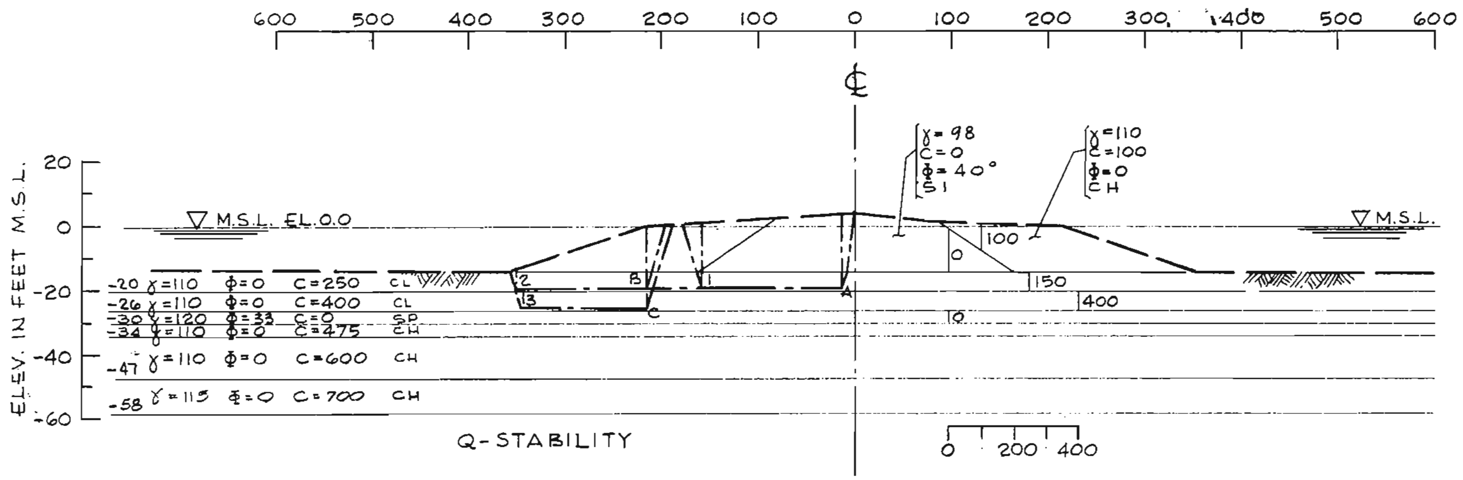
STABILITY ANALYSIS-I

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

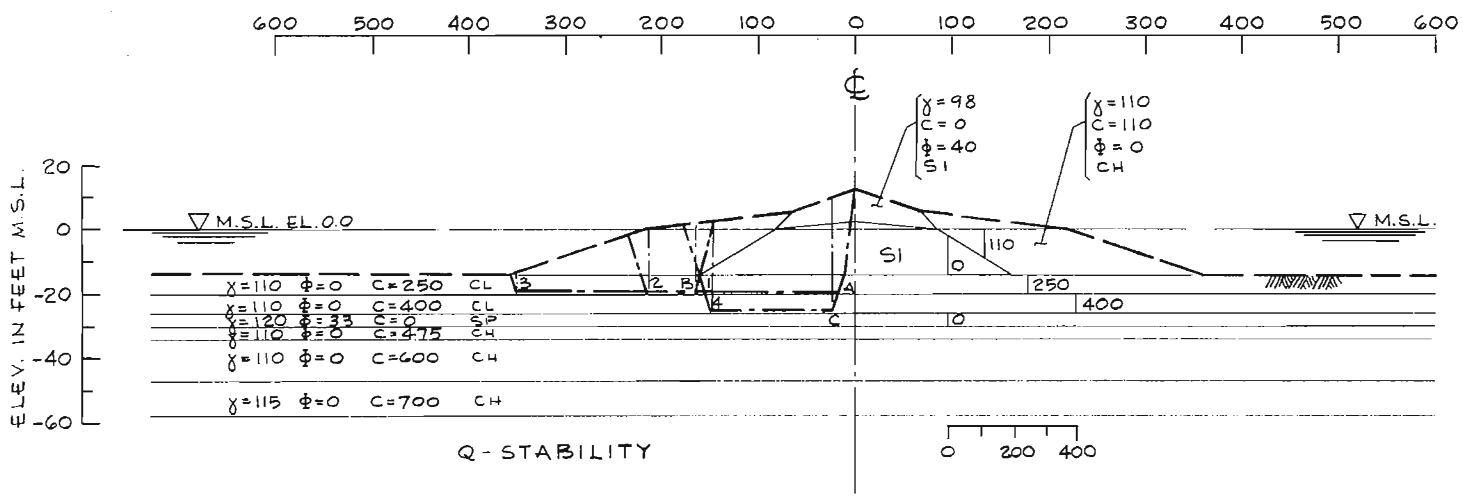
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS, U. S. ARMY
NEW ORLEANS, LA.

DATE: MARCH, 1968 FILE NO. H-2-24147



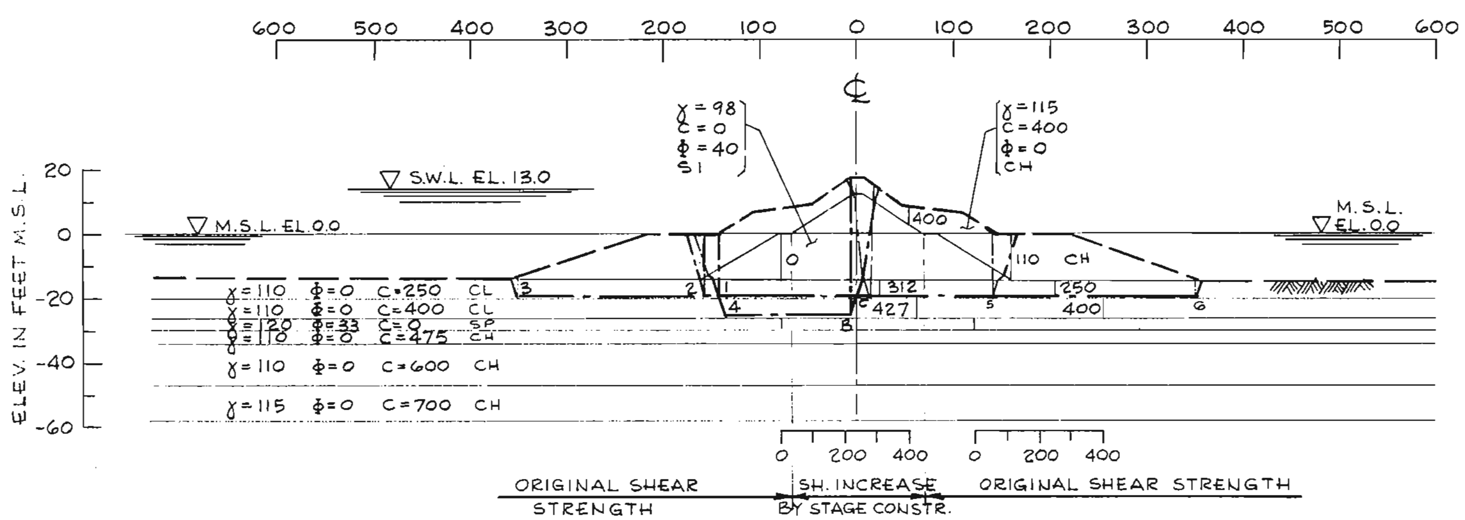
1ST. LIFT

VERT. SCALE 1"= 30' HORZ. SCALE 1"=100'



2ND. LIFT

SCALE AS SHOWN ABOVE

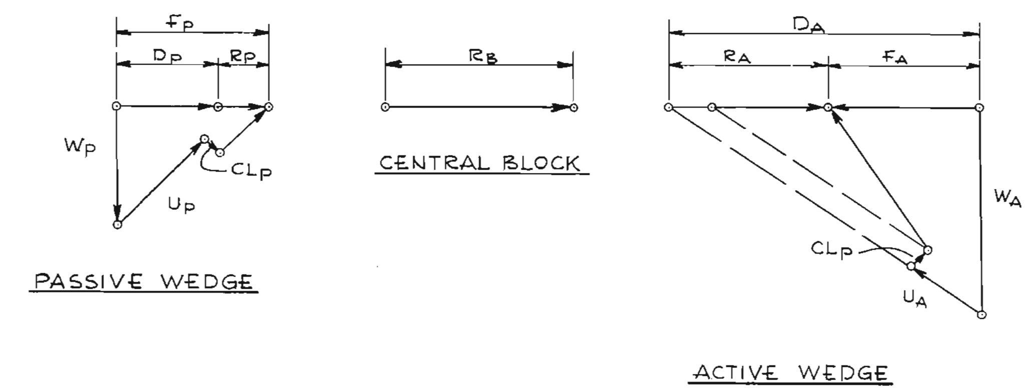


3RD. LIFT

SCALE AS SHOWN ABOVE

BAYOU DUPRE

SECTION	FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY
	No.		EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	Σ_R	Σ_R/Σ_D
FIRST LIFT	A	1	-19.5	26917	20606	6311	10248	35753	5692	51693	8.19
	A	2	-19.5	26917	12584	14333	10248	85401	2750	98399	6.87
	B	2	-19.5	19475	12584	6891	5612	35173	2750	43535	6.32
	C	3	-25.5	33655	23503	10152	10277	53446	7400	71123	7.01
SECOND LIFT	A	1	-19.5	47670	24561	23109	23498	34551	6434	64483	2.79
	A	2	-19.5	47670	19801	27869	23498	50161	5371	79030	2.84
	A	3	-19.5	47670	12584	35086	23498	84411	2750	110659	3.15
	B	3	-19.5	25446	12584	12862	6414	47186	2750	56350	4.38
	C	4	-25.5	67499	40684	26815	28148	50482	11084	89714	3.35
THIRD LIFT	A	1	-19.5	64446	20875	43571	33098	38937	10487	82522	1.89
	A	2	-19.5	64446	20887	43559	33098	43890	5830	82818	1.90
	A	3	-19.5	64446	27707	36739	33098	93390	2750	129238	3.51
	B	4	-25.5	88846	35473	53373	38106	55164	13604	106874	2.00
	C	5	-19.99	71,110	22,342	48768	34971	33642	11412	80026	1.64
	C	6	-19.99	71,110	13,332	57788	32931	88827	2995	124753	2.16



SURFACE A-1 THIRD LIFT

FACTOR OF SAFETY WITH RESPECT TO SHEAR STRENGTH

$$= \frac{R_A + R_B + R_C}{D_A - D_P} = \frac{82522}{43571} = 1.89$$

VECTOR DIAGRAM

METHOD OF PLANES - SCALE: 1"=20,000#

NOTES: SEE PLATE I-5 FOR LOCATION OF STREAM CLOSURE SECTION. MANY OTHER FAILURE PLANES HAVE BEEN STUDIED BUT ARE NOT SHOWN ON THIS DWG.- ONLY THE WORST CONDITIONS HAVE BEEN SHOWN. SEE PLATE I-9 FOR DETAIL DIMENSIONS OF SECTIONS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

STABILITY ANALYSIS-2

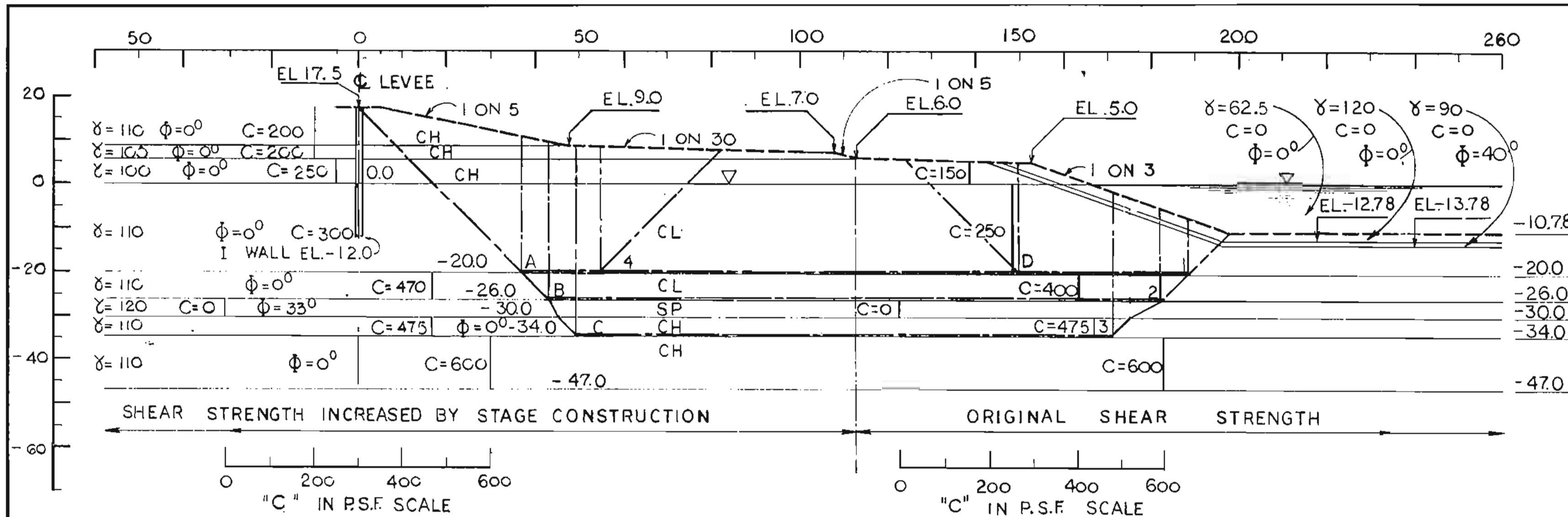
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

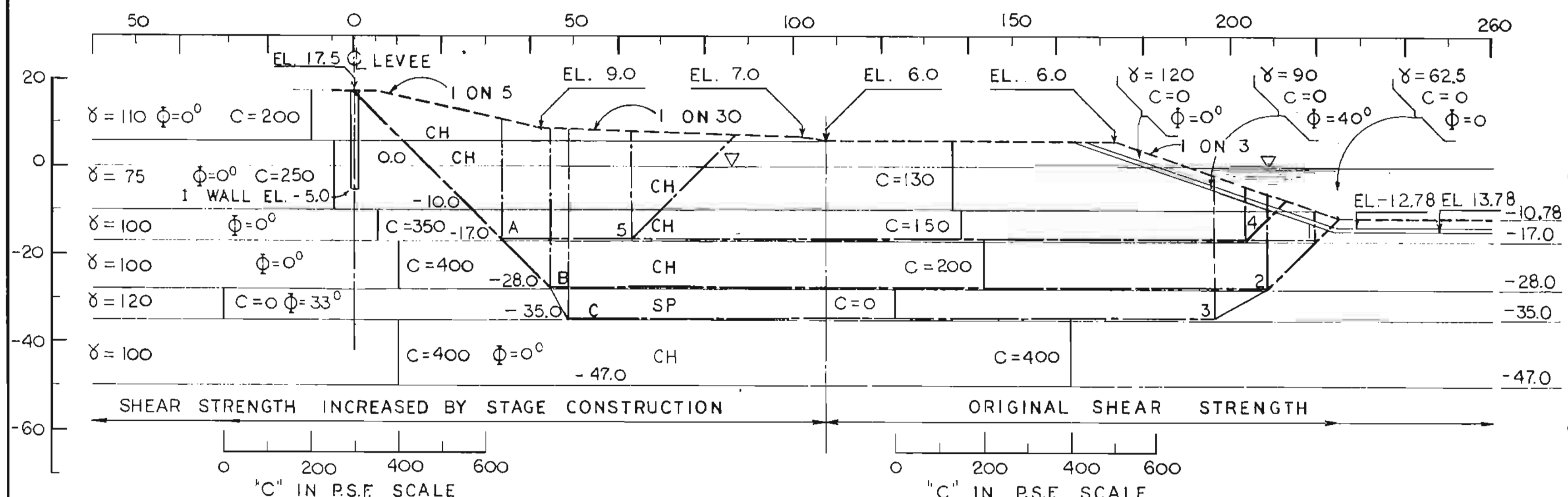
DATE: MARCH, 1968

FILE NO. H-2-24147



BAYOU DUPRE – SECTION THRU LEVEE AND CHANNEL

"Q" STABILITY

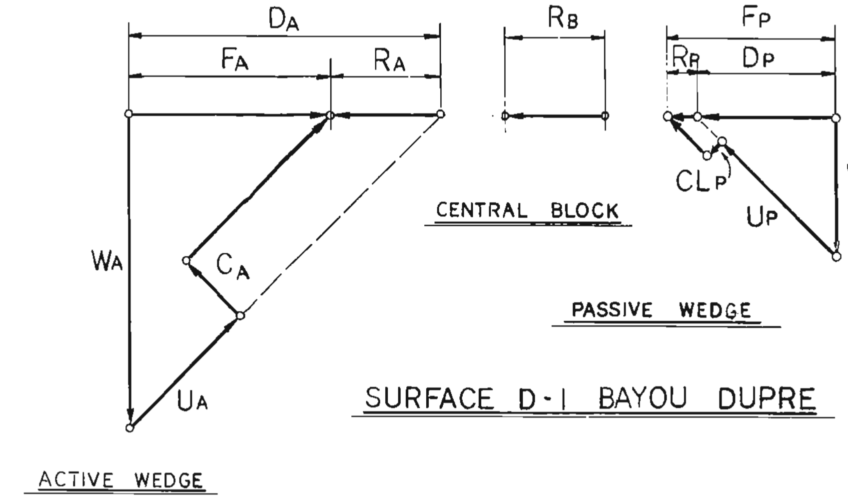


BAYOU BIENVENUE – SECTION THRU LEVEE AND CHANNEL

"Q" STABILITY

SECTION	FAILURE SURFACE NUMBER		EL.	DRIVING FORCES $+D_A$	$-D_P$	ΣD	RESISTING FORCES R_A	R_B	R_P	ΣR	FACTOR OF SAFETY $\Sigma R / \Sigma D$	F.O.S. NEGLECT'G STRENGTH INCREASE
BAYOU DUPRE	D	1	-19.5	32579	14230	18349	11453	10455	3139	25047	1.37	1.37
	A	1	-19.5	61871	14230	47641	19300	41801	3139	64240	1.35	1.21
	B	2	-25.5	83111	27131	55980	24770	60860	7789	93419	1.67	1.51
	C	3	-33.5	116626	52001	64825	35100	58406	22539	116045	1.79	1.73
	A	4	-19.5	63221	43864	19357	19300	4350	15900	39550	2.04	1.82
BAYOU BIEN-VENUE	B	2	-22.5	77963	28058	49905	25766	46375	4182	76323	1.53	1.15
	A	1	-16.5	45998	7308	38690	17016	43689	1300	62005	1.57	1.11
	C	3	-35.5	107754	52524	55230	35227	59655	23079	117961	2.14	2.05
	A	4	-16.5	45998	10448	35550	17016	41438	5527	63981	1.80	1.11
	A	5	-16.5	63221	43864	19357	19300	4350	15900	39550	2.04	1.06

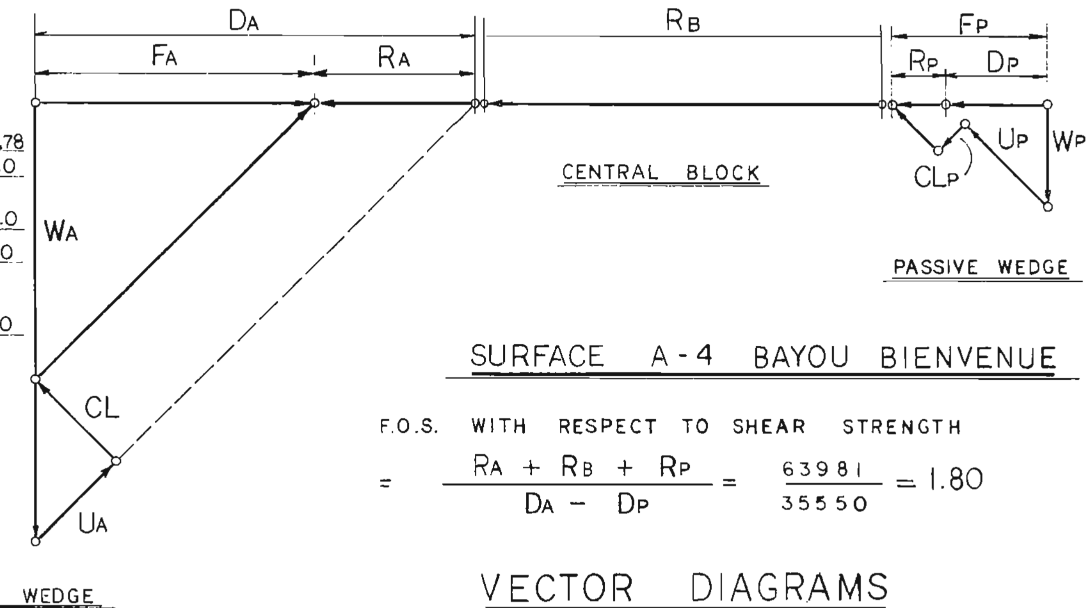
STABILITY CALCULATIONS



SURFACE D-1 BAYOU DUPRE

F.O.S. WITH RESPECT TO SHEAR STRENGTH

$$= \frac{R_A + R_B + R_P}{D_A - D_P} = \frac{25047}{18349} = 1.37$$



SURFACE A-4 BAYOU BIENVENUE

F.O.S. WITH RESPECT TO SHEAR STRENGTH

$$= \frac{R_A + R_B + R_P}{D_A - D_P} = \frac{63981}{35550} = 1.80$$

VECTOR DIAGRAMS

(METHOD OF PLANES)

SCALE : 1" = 10,000#

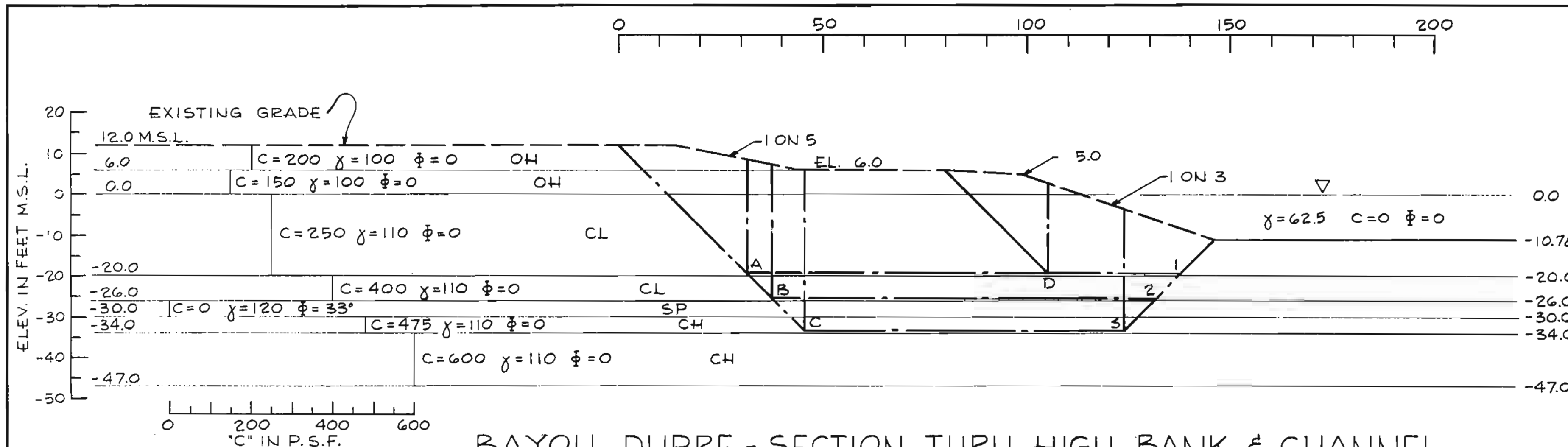
NOTE :
SEE PLATES I-3 AND I-5 FOR LOCATION OF SECTIONS THRU LEVEE AND CHANNEL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

STABILITY ANALISIS - 3

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



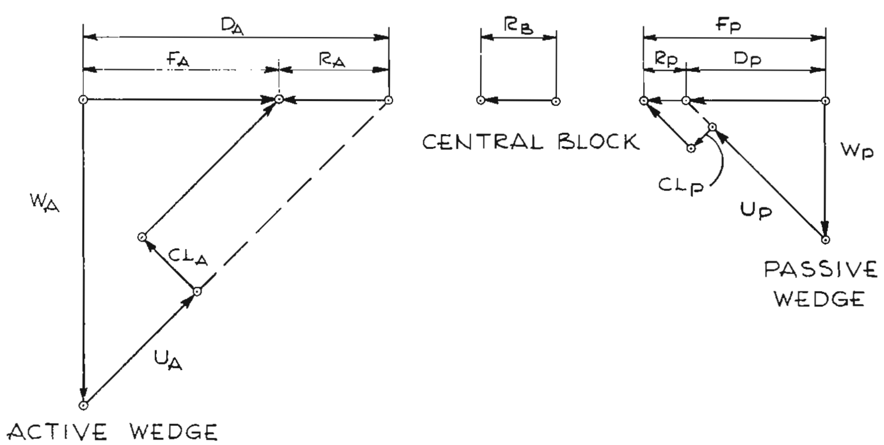
BAYOU DUPRE - SECTION THRU HIGH BANK & CHANNEL

Q - STABILITY

SECTION	FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY
	No.		ELEV.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
BAYOU DUPRE HIGH BANK & CHANNEL	A	1	-19.5	48451	14316	34135	13950	26250	4377	44577	1.31
	B	2	-25.5	68041	27251	40790	18600	37200	9028	64828	1.59
	C	3	-33.5	99622	52098	47524	28110	35843	23769	87722	1.85
	D	1	-19.5	31759	14316	17443	11392	7881	4378	23651	1.36

NOTES:

SEE PLATE I-5 FOR LOCATION OF BAYOU DUPRE SECTION THRU HIGH BANK & CHANNEL.



SURFACE D-1

HIGH BANK & CHANNEL

F.O.S. WITH RESPECT TO SHEAR STRENGTH =

$$= \frac{R_A + R_B + R_P}{D_A - D_P} = \frac{23651}{17443} = 1.36$$

VECTOR DIAGRAM

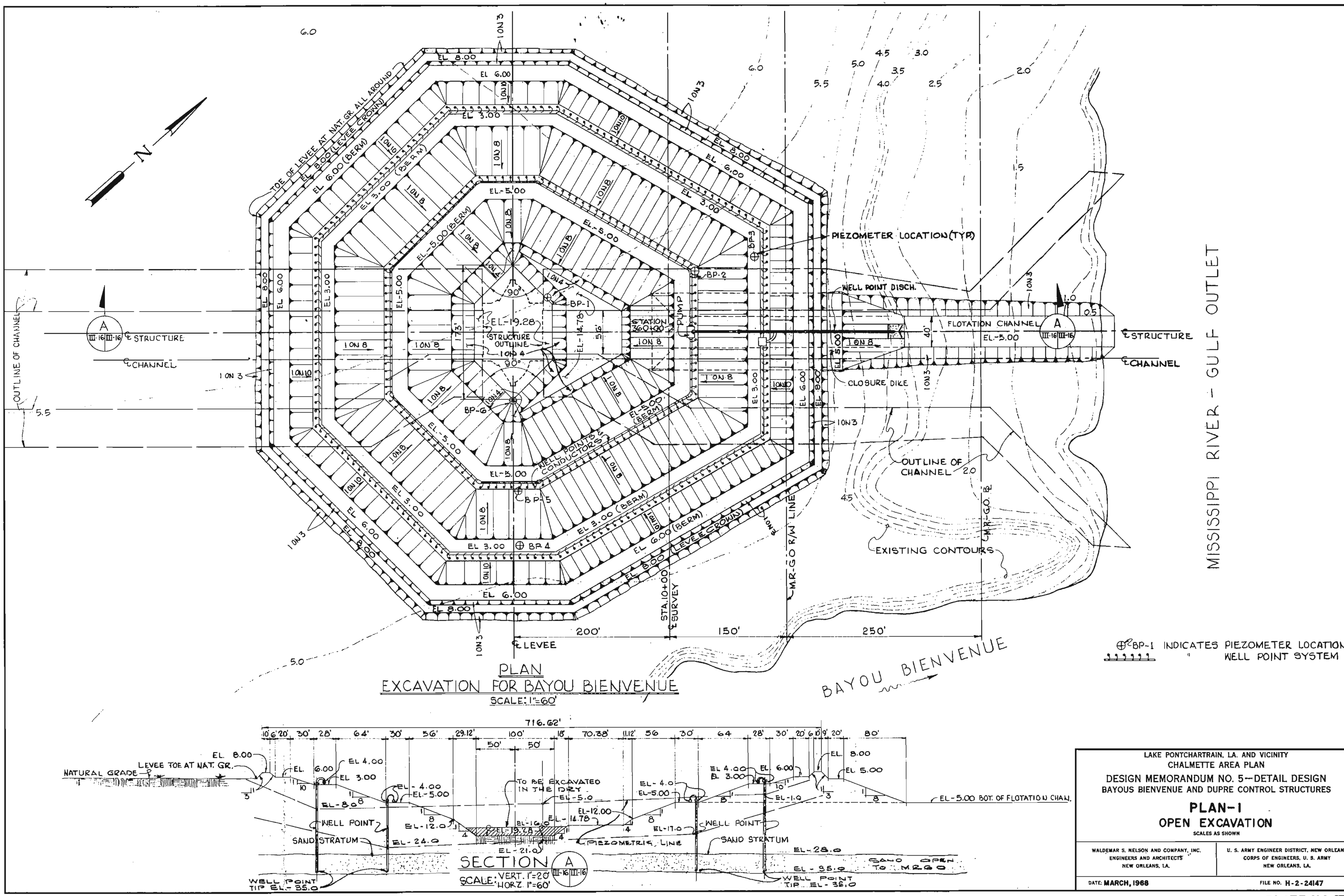
METHOD OF PLANES - SCALE: 1" = 10,000#

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

STABILITY ANALYSIS - 4

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147

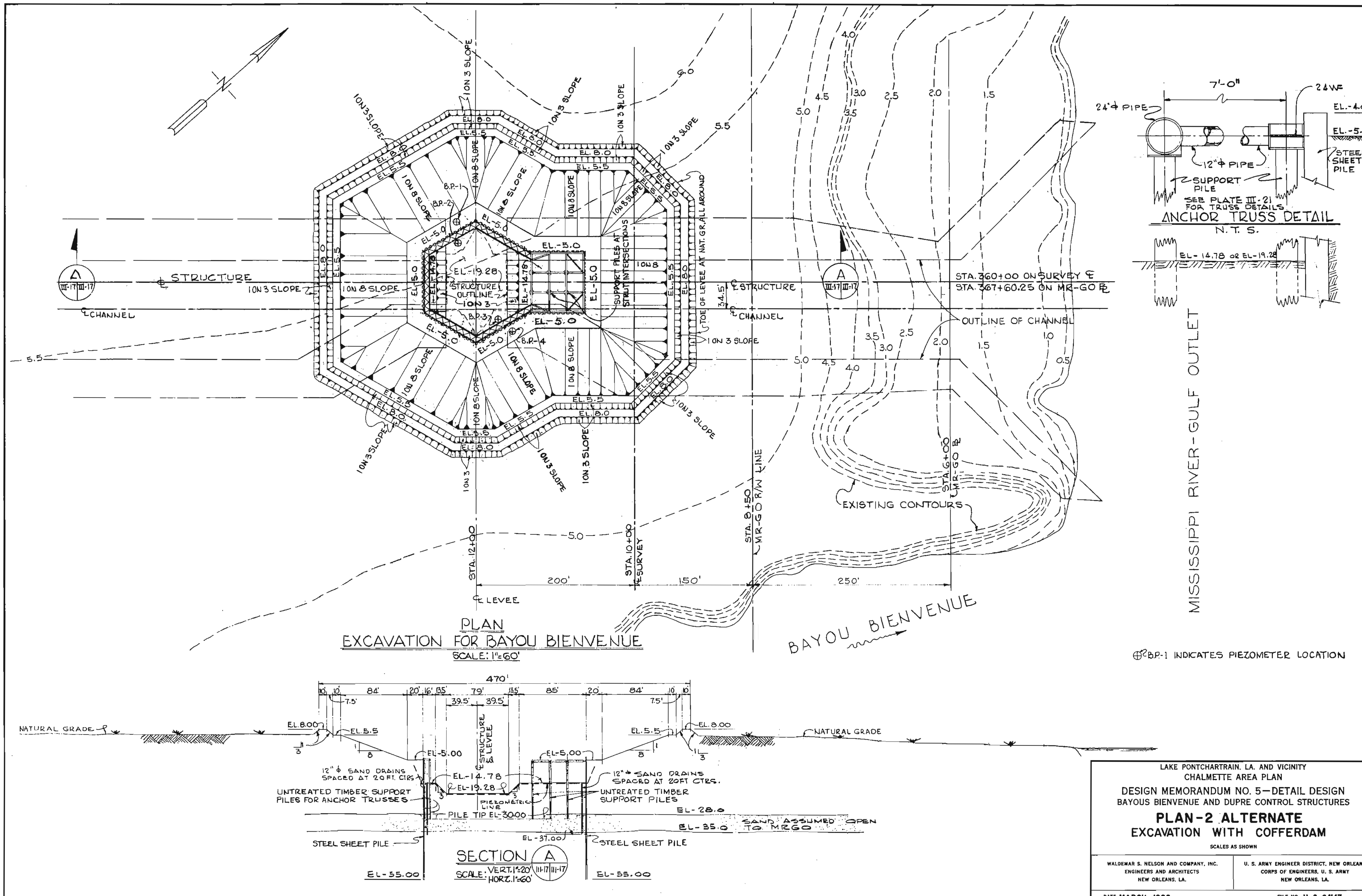


LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PLAN-1
OPEN EXCAVATION
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



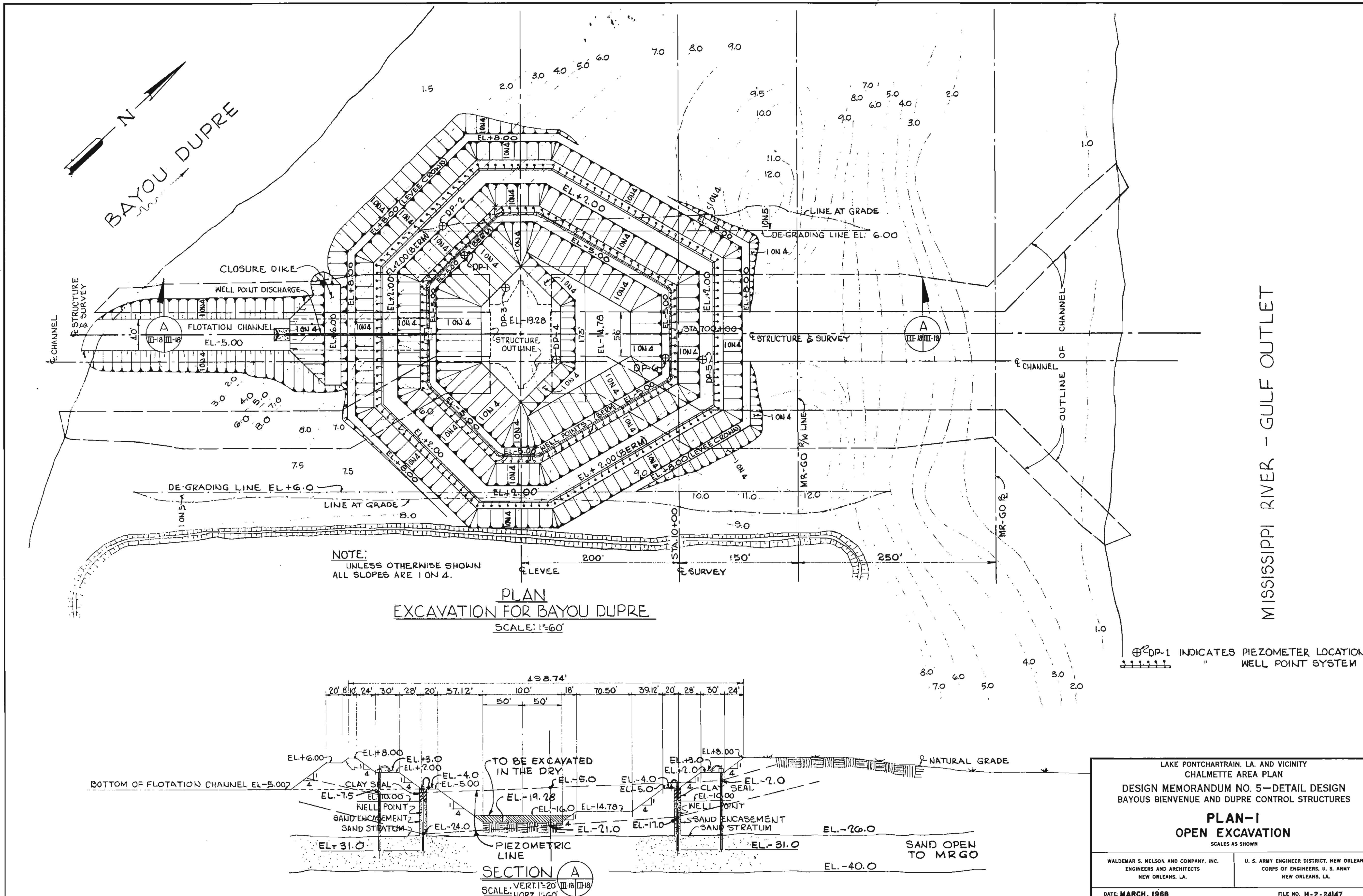
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PLAN-2 ALTERNATE
EXCAVATION WITH COFFERDAM

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PLAN-1
OPEN EXCAVATION

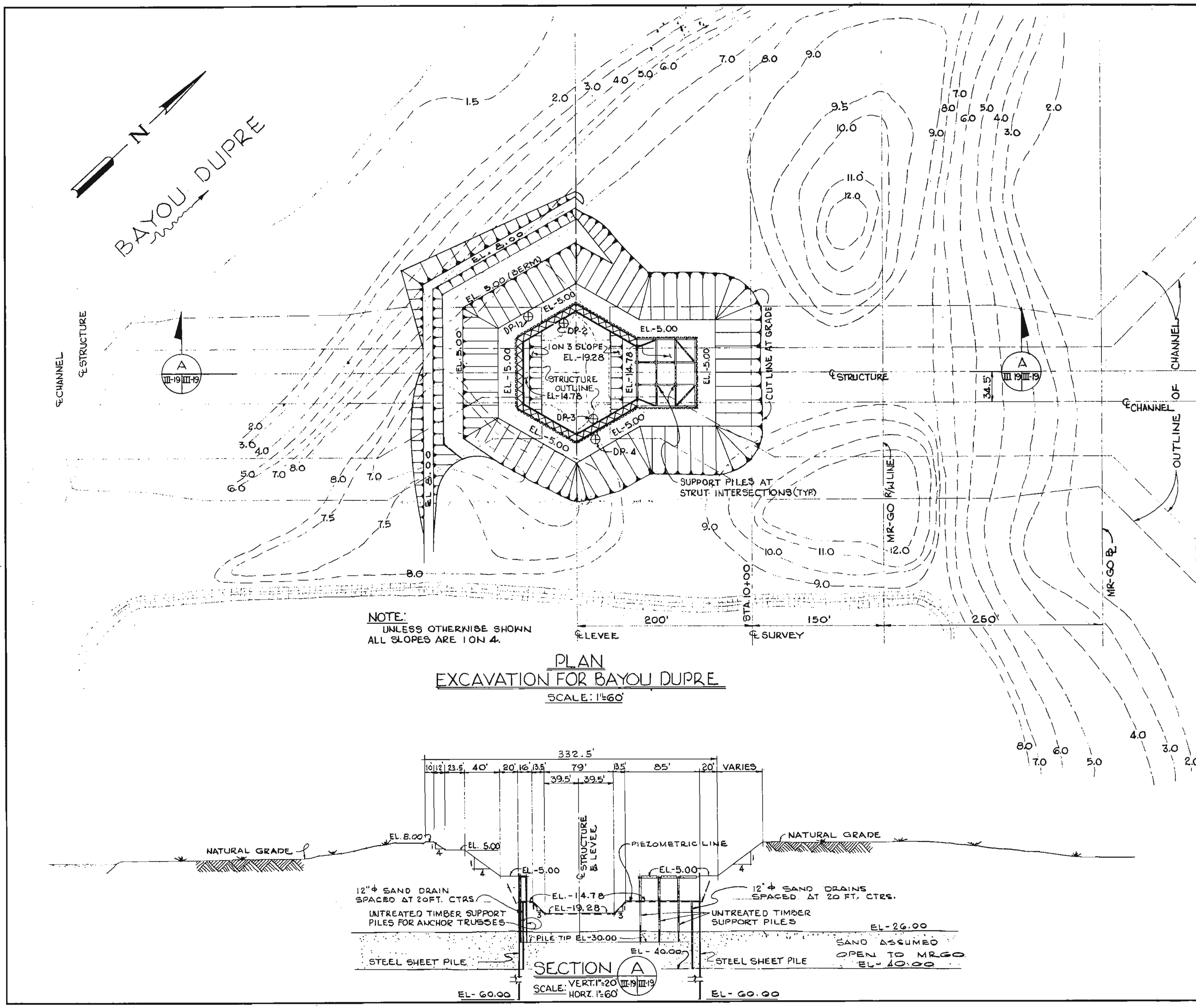
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 FILE NO. H-2-24147

PLATE NO. III-18



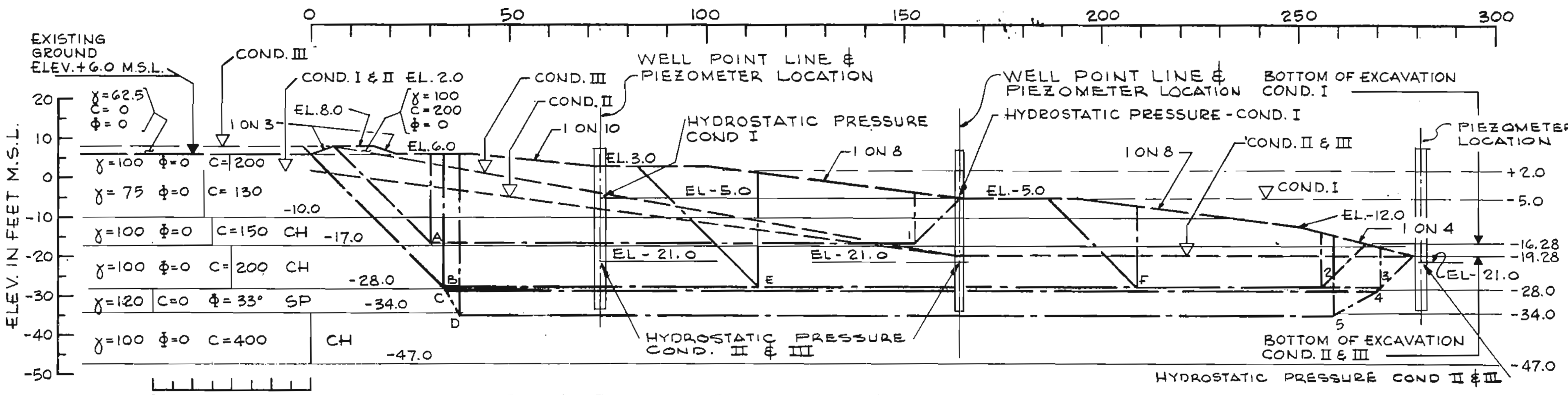
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

PLAN-2 ALTERNATE
EXCAVATION WITH COFFERDAM
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

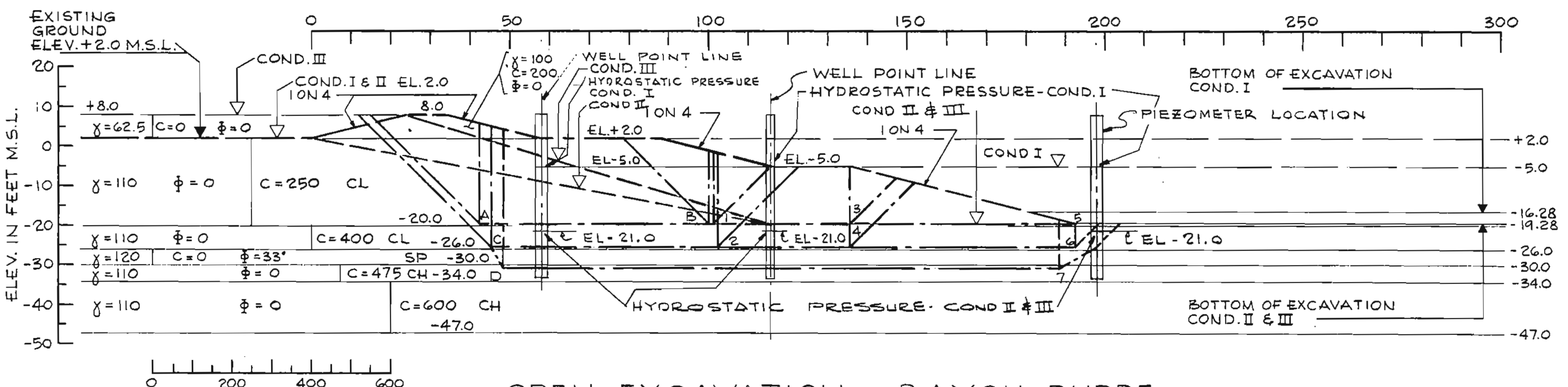
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.

DATE: MARCH, 1968 — FILE NO. H-2-24147



OPEN EXCAVATION — BAYOU BIENVENUE

Q - STABILITY



OPEN EXCAVATION BAYOU DUPRE

Q - STABILITY

SECTION		FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY
			No.	ELEV.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
BIENVENUE	COND. I	B	2	-27.5	52262	18753	33509	11020	44000	4416	59436	1.77
		A	1	-16.5	23962	6107	17855	7470	18150	3250	28870	1.62
	COND. II	B	3	-27.5	52262	4341	47921	11020	47256	3288	61564	1.28
		E	3	-27.5	38264	4341	33923	9820	31256	3288	44364	1.31
		F	3	-27.5	21740	4341	17399	7600	12256	3288	23144	1.33
	COND. III	B	3	-27.5	52762	4341	48421	11020	47256	3288	61564	1.27
		C	4	-28.5	55864	5463	50401	11577	120102	3614	135293	2.68
		D	5	-34.5	76982	15602	61380	16611	87988	9128	113727	1.85
DUPRE	COND. I	A	1	-19.5	38401	14455	23946	12450	14687	7250	34387	1.44
		C	2	-25.5	56819	25620	31199	16780	23000	11900	51680	1.66
	COND. II	A	5	-19.5	38401	3	38398	12450	37757	110	50317	1.31
		B	5	-19.5	23275	3	23272	10750	23320	110	34180	1.47
		C	4	-25.5	56819	18152	38667	16800	36700	9774	63274	1.63
	COND. III	A	3	-19.5	38916	9091	29825	12430	23500	5749	41679	1.40
		A	5	-19.5	38916	4	38912	12430	37564	122	50116	1.29
		C	6	-25.5	57699	2660	55039	16840	56552	4760	78152	1.42
		D	7	-30.5	75663	8987	66676	22718	61674	12536	96928	1.45

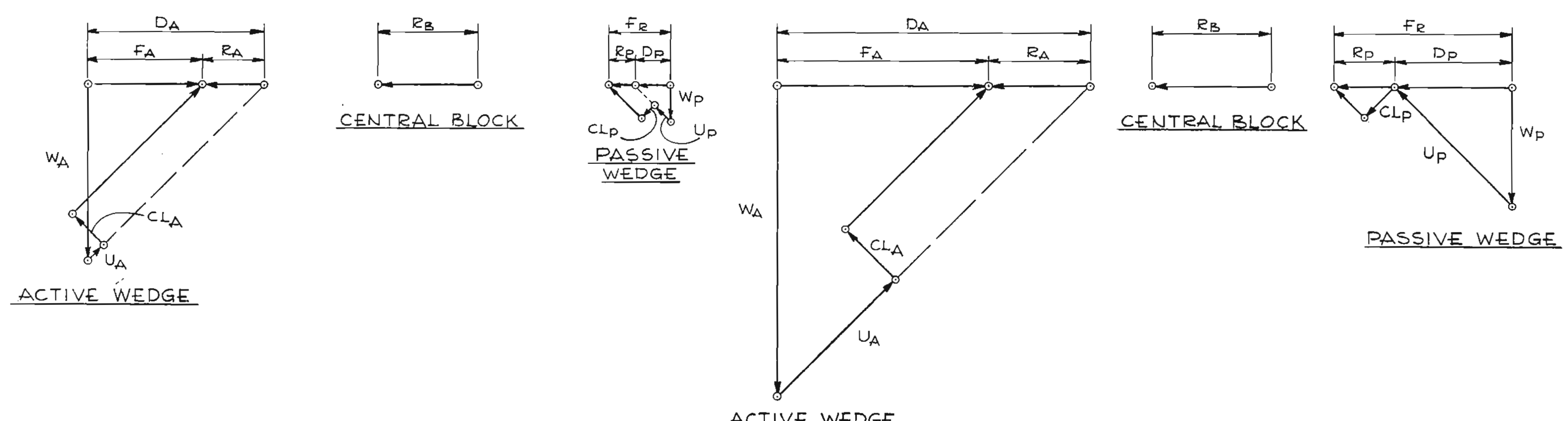
STABILITY CALCULATIONS

NOTES:

CONDITION I : HYDRAULIC DREDGING TO 3 FT. ABOVE FINAL GRADE; PRESSURE IN THE UNDERLYING SANDS RELIEVED TO AN AVERAGE ELEV. OF -5.0 FT. BY THE UPPER WELL POINT RING.

CONDITION II: HYDRAULIC DREDGING COMPLETE; EXCAVATION DEWATERED TO EL.-19.28; LOWER WELL POINT SYSTEM OPERATING AND PRESSURE RELIEF IN SAND TO EL.-21.0.

CONDITION III: HYDRAULIC DREDGING COMPLETE; EXCAVATION DEWATERED TO EL.-19.28 WITH WATER AT EL.+8.0 IN BACK OF LEVEE; WELL POINT SYSTEM OPERATING AND PRESSURE RELIEF, IN SAND TO EL.-21.0



SURFACE F-3
BAYOU BIENVENUE - CONDITION II

F.O.S. WITH RESPECT TO SHEAR STRENGTH =

$$= \frac{R_A + R_B + R_P}{D_A - D_R} = \frac{23144}{17399} = 1.33$$

SURFACE A-1
BAYOU DUPRE - CONDITION I

F.O.S. WITH RESPECT TO SHEAR STRENGTH =

$$= \frac{R_A + R_B + R_P}{D_A - D_R} = \frac{34.387}{23946} = 1.44$$

VECTOR DIAGRAM

METHOD OF PLANES - SCALE: 1" = 10,000#

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

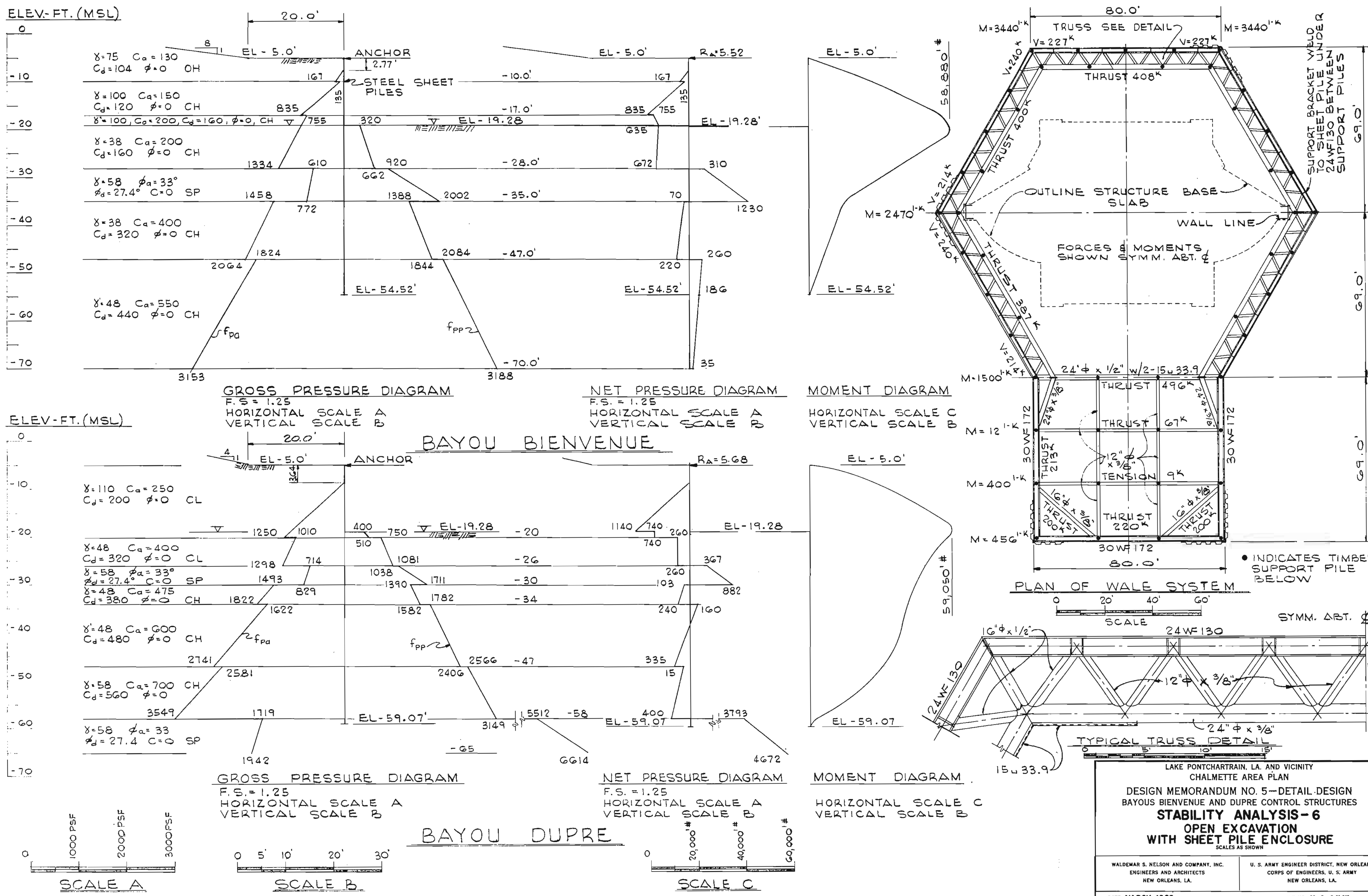
STABILITY ANALYSIS - 5

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE MARCH, 1968 FILE NO. H-2-24147



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

STABILITY ANALYSIS-6
OPEN EXCAVATION
WITH SHEET PILE ENCLOSURE

SCALES AS SHOWN

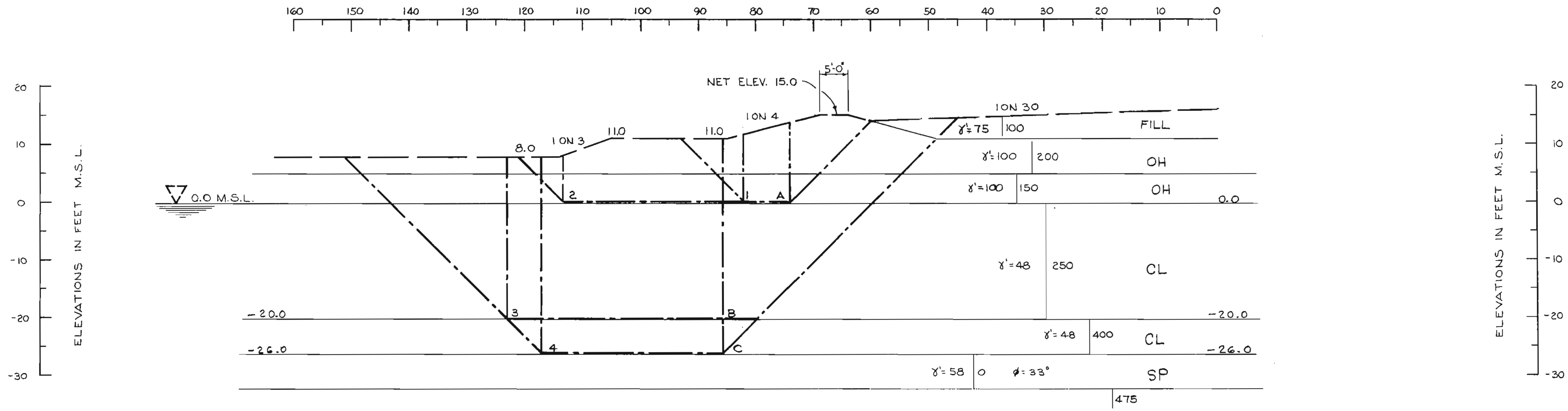
WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968

FILE NO. H-2-24147

PLATE NO. III-21

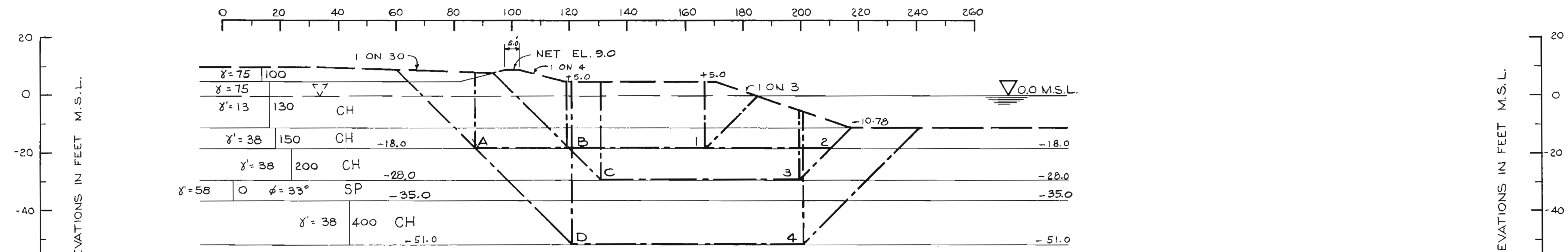


RETENTION DIKE AT BAYOU DUPRE

Q – STABILITY

0 200 400 600

"C" IN P.S.F.



0 200 400

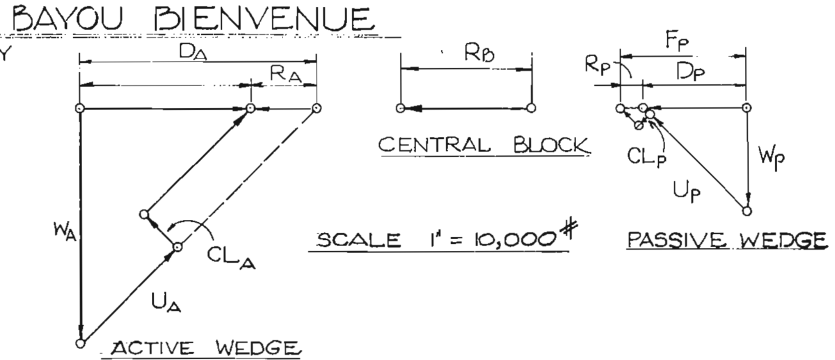
"C" IN P.S.F.

RETENTION DIKE AT BAYOU BIENVENUE

Q – STABILITY

SECTION	FAILURE SURFACE			DRIVING FORCES			RESISTING FORCES				FACTOR OF SAFETY
	NO.		EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R / \Sigma D$
BAYOU DUPRE	A	1	+.1	11,078	6,348	4,730	5,070	1,230	3,870	10,170	2.15
		2	+.1	11,078	3,291	7,787	5,070	5,880	2,670	13,620	1.75
	B	3	-19.9	61,372	41,857	19,515	14,570	10,925	12,650	38,145	1.95
	C	4	-25.9	83,828	62,011	21,817	19,340	12,680	17,420	49,440	2.27
BAYOU BIENVENUE	A	1	-17.9	27,043	16,511	10,532	7,051	12,014	4,930	23,995	2.28
	B	2	-17.9	24,873	10,992	13,881	7,010	13,755	2,070	22,835	1.65
	C	3	-28.9	51,713	32,755	18,958	11,400	13,940	6,460	31,800	1.68
	D	4	-50.9	153,835	114,370	39,465	31,754	31,359	33,299	96,412	2.44

STABILITY CALCULATIONS



SURFACE B-2

F.S. WITH RESPECT TO SHEAR STRENGTH

$$= \frac{R_A + R_B + R_P}{D_A - D_P} = \frac{22,835}{13,881} = 1.65$$

VECTOR DIAGRAM

METHOD OF PLANES

SEE PLATES I-3 AND I-5 FOR LOCATION OF STABILITY ANALYSIS PRESENTED.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

STABILITY ANALYSIS – 7

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

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

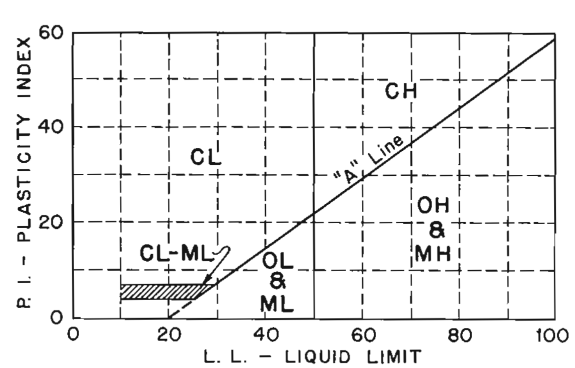
DESCRIPTIVE SYMBOLS

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 sub-surface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract.

Ground-water elevations shown on the boring logs represent ground-water surfaces encountered on the dates shown. Absence of water surface data on certain borings implies that no ground-water data is available, but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of these borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM L.M.V.G.G. 5 JUNE 1964
1	9-17-63	IST. PAR. OF GENERAL NOTES REVISED	L. M. V. D. MULTIPLE LETTER, DATED 5 SEPT., 1963

SOIL BORING LEGEND

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-21800

SECTION IV - STRUCTURAL DESIGN

1. General. All structural design has been made in accordance with standard engineering practice and with criteria as set forth in engineering manuals for Civil Work Construction, published by the Office of Chief of Engineers.

2. Basic Data. Basic data relevant to the dimensions of the structure, water elevations, and channel are as shown on Plates I-7 and I-8 and in the following table:

Top of Gate Walls	Elev. 17.5
Sill	Elev. -10.0 MLG(-10.78 MSL)
Width of Gate Channel	56 Ft.
Maximum Water Surface MR-GO Side	Elev. 13.0
Maximum differential Head MR-GO Side	Elev. 13.0
Land Side	Elev. 2.0
Maximum Differential Head (Reverse)	
MR-GO Side	Elev. 0.0
Land Side	Elev. 5.0

3. Unit Weights. The following values of unit weights, earth pressure, and soil properties were used in the design:

Unit Weight	Weight-Lbs.Per Cubic Foot
Water	62.5
Concrete	150
Earth	See Plates III-1 and III-2
Shell Backfill	98

Lateral Pressure	
Shell Backfill ($\emptyset = 40^{\circ}$)	Equivalent Fluid Pressure
Active (Above Water)	21.3 Lbs.
Active (Submerged)	8 Lbs.
At Rest (Above Water)	54 Lbs.
At Rest (Submerged)	20 Lbs.

4. Allowable Working Stresses. The allowable working stresses for structural steel and concrete are in accordance with those recommended in "Working Stresses for Structural Design", EM 1110-1-2101 of 1 November 1963. For convenient reference allowable stresses are tabulated as follows:

a. Allowable Working Stresses Structural Steel, ASTM A-36.

APPLICATION	GROUP 1 LOADING PSI	GROUP 2 LOADING PSI
(1) Tension		
Structural steel net section except at pin holes	18,000	24,000
Net section at pin holes in eyebars, pin connected plates, or built-up members	13,500	18,000
(2) Shear		
On the gross section of beam and plate girder webs	12,000	16,000
(3) Compression		
On gross section of axially loaded compression member for (Kl/r) less than C_c	$0.83\ K_1F_y$	$1.11\ K_1F_y$

$$K_1 = \frac{\left[1 - \frac{(Kl/r)^2}{2C_c^2}\right]}{F.S.} \qquad \text{where; } C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 126.1$$

K = Effective Length Factor

$$F.S. = \frac{5}{3} + \frac{3}{8}\,\frac{(Kl/r)}{C_c} - \frac{(Kl/r)^3}{8C_c^{\ 3}}$$

	GROUP 1	GROUP 2
For axially loaded column with l/r greater than C_c	$\frac{124,000,000}{\left(\frac{Kl}{r}\right)^2}$	$\frac{165,000,000}{\left(\frac{Kl}{r}\right)^2}$
On secondary member, modify the above values by multiplying by the following factor:	$\frac{1}{1.6 - l/200r}$	$\frac{1}{1.7 - l/200r}$ *
On gross area of plate girder stiffeners	18,000	24,000
On web rolled shapes at toe of fillet	22,500	30,000

*This modification factor is applied to secondary members for $l/r \geqq 150$. For l/r between C_c and 150, a factor of 1.0 is applied.

APPLICATION	GROUP 1 LOADING PSI	GROUP 2 LOADING PSI
(4) Bending		
Tension and compression on extreme fibers of rolled sections, plate girders and built-up members having axis of symmetry and meeting required dimension proportions	20,000	26,500
Tension and compression on extreme fibers of unsymmetrical members (with compression flange supported)	18,000	24,000
Tension and compression on extreme fibers of box type members not meeting required dimension proportions	18,000	24,000
Tension on extreme fibers of other rolled shapes, built-up members and plate girders	18,000	24,000
Compression on extreme fibers of rolled shapes, plate girders and built-up members having axis of symmetry in the plane of the web (Formula 4)	$0.50\ K_2F_y$	$0.67\ K_2F_y$

$$K_2 = 1 - \frac{(l/r)^2}{2C_c^2\ C_b}$$

$$C_b = 1.75 - 1.05\left(\frac{M_1}{M_2}\right) + 0.3\left(\frac{M_1}{M_2}\right)^2 \text{, but not more than 2.3}$$

M_1 is the smaller and M_2 the larger bending moment at the ends of the unbraced length.

	GROUP 1	GROUP 2
(Formula 5)	$\dfrac{10{,}000{,}000}{\frac{ld}{A_f}}$	$\dfrac{12{,}000{,}000}{\frac{ld}{A_f}}$

Use larger value computed by Formula 4 or 5 but not more than basic stress. Where l/r is less than 40, Formula 4 may be neglected. For allowable stresses based on the use of Formula 4, see Appendix 1 of EM 1110-1-2101.

APPLICATION	GROUP 1 LOADING PSI	GROUP 2 LOADING PSI
Compression on extreme fibers of channels. Value computed by Formula 5, but not more than	18,000	24,000
Tension and compression on extreme fibers of large pins (max. For Group 2 Loading, 0.90 F_y)	27,000	32,500
Tension and compression on extreme fibers of rectangular bearing plates (Max. for Group 2 Loading, 0.85 F_y)	22,500	30,500
(5) Bearing		
Milled surfaces and pins in reamed, drilled or bored holes (max. for Group 2 Loading, 0.90 F_y)	27,000	32,500
Finished stiffeners (Max. for Group 2 Loading 0.80 Fy)	24,000	29,000
Expansion rollers and rockers (lbs./lin. inch)	$0.83\ K_3d$	$1.11\ K_3d$

$$K_3 = \left(\frac{F_y - 13{,}000}{20{,}000}\right) 660$$

d = Diameter of Roller or Rocker in Inches.

(6) Bolts (Tension)		
A307 Bolts	11,500	15,500
A325 Bolts	33,500	44,500
A354 Bolts (Grade BC)	41,500	55,500
(7) Bolts (Shear) (Bearing Type Connections)		
A307 Bolts	8,500	11,000
A325 Bolts when threading is not excluded from shear planes	12,500	16,500
A325 bolts when threading is excluded from shear planes	18,500	24,500
A354 bolts (Grade BC) when threading is not excluded from shear planes	16,500	22,000
A354 bolts (Grade BC) when threading is excluded from shear planes	20,000	26,500

APPLICATION	GROUP 1 LOADING PSI	GROUP 2 LOADING PSI
(8) Bolts (Shear) (Friction Type Connections)		
A325 Bolts	12,500	16,500
A354 Bolts (Grade BC)	16,500	22,000
(9) Bolts (Bearing) (Bearing Type Connections)		
Bearing on projected area (max. for Group 2 Loading 1.35 F_y)	1.13 F_y	1.35 F_y
(10) Welds		
Fillet, plug, slot and partial penetration groove welds using A233 Class E-60 electrodes or submerged arc Grade SAW-1	11,500	15,000
Fillet, plug, slot and partial penetration groove welds using A233 Class E-70 electrodes or submerged arc Grade SAW-2	13,000	17,500

Complete penetration groove welds shall have the same allowable for tension, compression, bending, shear and bearing stresses as those allowed for the connected material.

(11) Combined Stresses

(a) Axial Compression and Bending. Members subject to both axial compression and bending stresses shall be proportioned to satisfy the following requirements:

(1) When $f_a/F_a \leqq 0.15$,

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leqq 1$$

(2) When $f_a/F_a > 0.15$,

$$\frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \dfrac{f_a}{K_4 F_e}\right) F_b} \leqq 1$$

F_e = Euler stresses divided by factor of safety

$$F_e = \frac{149,000,000}{\left(\dfrac{Kl_b}{r_b}\right)^2}$$

and, in addition, at points braced in the plane of bending,

$$\frac{f_a}{K_5 F_y} + \frac{f_b}{F_b} \leqq 1$$

APPLICATION	GROUP 1 LOADING PSI	GROUP 2 LOADING PSI

Where K_4 = 0.83 for Group 1 Loading and 1.11 for Group 2 Loading.
Where K_5 = 0.50 for Group 1 Loading and 0.67 for Group 2 Loading.
C_m = a coefficient - See Section 1.6 AISC Specifications in Manual of Steel Construction, Sixth Edition.

(b) Shear and Tension. Rivets and bolts subject to combined shear and tension shall be proportioned so that the tension stress from the force applied to the connected part does not exceed the following:

For A307 Bolts .... $F_t = 15{,}000-1.6\ f_v \leqq 10{,}500$
For A325 Bolts in Bearing Type Joints ..... $F_t = 37{,}500-1.6\ f_v \leqq 30{,}000$
For A354 Bolts (Grade BC) in Bearing Type Joints .... $F_t = 45{,}000-1.6\ f_v \leqq 37{,}500$

where f_v, the shear produced by the same force, shall not exceed the value for shear given in Section (7) and (8) of this paragraph.

For bolts used in friction type joints, the allowable shear stresses shall be reduced to meet the following:

For A325 Bolts .... $F_v \leqq 11{,}000\ (1-\ f_t A_b/T_b)$
For A354 Bolts .... $F_v \leqq 15{,}000\ (1-\ f_t A_b/T_b)$
T_b = the proof load of the bolt.

b. Allowable Working Stresses Concrete (3,000 p.s.i., 28 Days). Concrete which will be subjected to submergence, wave action and spray will be designed with working stresses in accordance with ACI Building Code with the following modifications:

Flexure (f_c):

Extreme fiber stress in compression	$0.35\ f'_c$
Extreme fiber stress in tension (Plain concrete for footings and walls but not for other portions of gravity section	$1.2\sqrt{f'_c}$
Extreme fiber stress in tension (for other portions of gravity sections)	$0.6\sqrt{f'_c}$

Types of structures to which those modifications apply are:

Floodwalls
Lock Walls, Guide and Guard Walls
Retaining Walls subject to contact with water.

Allowable stresses in reinforcement will be in accordance with the ACI Building Code except for tension in deformed bars with a yield strength of 60,000 p.s.i. or more, the stress shall not exceed 20,000 p.s.i. based upon Group 1 Loading.

For Group 2 Loading the above stresses may be increased by 33-1/3%.

c. Application of Working Stresses.

(1) Group 1 Loading: Allowable working stresses as listed for structural steel and for reinforced concrete will be applied to the following loads:

Dead Load
Live Load
Buoyancy
Earth Pressure
Water Pressure

(2) Group 2 Loading: Allowable working stresses as listed for structural steel and for reinforced concrete will be applied to the following loads when combined with Group 1 Loads:

Wind Loads
Wave Loads
Boat Loads
Erection Loads

5. Design of Structures.

a. Foundation. The results of subsurface exploration, soil tests, and foundation studies are presented in Section III. The structure will be supported on untreated timber piling and unbalanced lateral forces will be compensated for by battered piling. The piling will extend into Pleistocene clays to a tip elevation of -65 at Bayou Dupre and -70 at Bayou Bienvenue. It is anticipated that the piling will have to be jetted through the sand stratum between elevations -28 and -35 at both sites.

b. Gate Bay.

(1) General Description. The structure will consist of a reinforced concrete gate bay 76 feet in length and a 95 foot long timber guide wall and a 70 foot long timber fender at each end of the gate bay. The gate bay was designed as a reinforced concrete "U" frame. The gate channel will have a clearance of 56 feet. The gate bay will be supported

driven to a tip elevation as stated above. Steel sector type gates will be used. The elevation of the top of gates, the gate bay walls, and the floodwalls connecting the structure to the adjacent protection levee will be 17.5. The gate bay will be provided with slots for needle girder and needles so that the gate bay can be dewatered for repair or painting of the gates. At the ends of the gate bay there will be concrete sheet pile wing walls installed with tie backs into the gate bay wall. These serve as 90 degree wing walls to retain the adjacent backfill. The approach channels bottom and side slopes will be lined with riprap to minimize erosion from high stream velocities. Operation of the sector gates will be by electric motors through a speed reducer and a pull cable storing on a cable drum. Machinery for manual operation of the gates will also be provided for emergency use. A butane engine driven generator will provide power for normal operation of the gates and lighting requirements. Two small control houses will be provided for each structure. These houses, constructed of reinforced concrete, will be located above the machinery space on each side of the gate bay. Control House No. 1 will contain the engine driven generator and the electrical switchgear. Both control houses will contain machinery for manual operation and control panels to start the generator and to operate the gates from either side.

6. Design Loading Conditions.

a. Base Slab.

Case 1 Gate open, backfill not in place, no buoyancy.
Case 1A Gate open, backfill in place, no buoyancy.
Case 2 Structure complete, backfill in place, water at Elev. 0.0, buoyancy active.
Case 3 Needle dams in place, structure dewatered, gates removed, water at Elev. 5.0, buoyancy active.
Case 4 Hurricane condition, gate closed, water in MR-GO at Elev. 13.0, water on land side at Elev. 2.0, buoyancy active.
Case 5 Gate closed, water in MR-GO at Elev. 0.0, water on land side at Elev. 5.0, buoyancy active.
Case 5A Case 5 above cut-off wall assumed pervious.

All of the above conditions are considered as Group 1 Loadings.

Case 6 Case 4 above and wave loading (Group 2 Loading)
Case 6A Case 6 above, cut-off wall assumed pervious (Group 2 Loading).

b. Sector Gates.

Case 1 Dead load only which includes truss members, skin plate, skin plate supports, fender system and fender system supports.
Case 2 Dead load, water in MR-GO at Elev. 13.0, water on land side at Elev. 2.0.

Case 3 Dead load, water in MR-GO at Elev. 0.0, water on land side at Elev. 5.0.

Cases 1, 2 and 3 are considered as Group 1 Loadings.

Case 4 Case 3 with a boat load of 120 kips acting at right angle to canal truss.

Case 5 Dead load, water at Elev. 13.0 in MR-GO and a wave loading on MR-GO side and water on land side at Elev. 2.0. The wave characteristics are as follows:

Wave Characteristics for Chalmette Area Plan, Bayous Dupre and Bienvenue.

swl	Stillwater level, in feet MSL	13.0
H_s	Significant wave height, in feet	7.0
T	Wave period, seconds	6.4
L_o	Deep water wave length, in feet	210
H_o	Deep water wave height, in feet	7.5 *
H_{max}	Maximum wave which can be supported, in feet	9.0
d_T	Effective depth at toe, in feet	10.0 *

*For information only.

Case 6 Case 2 with a boat load of 120 kips acting at right angle to skin plate.

Cases 4, 5, and 6 are considered as Group 2 Loadings.

Inasmuch as in the threat of a hurricane the gates will be closed when the water elevation in Lake Borgne reaches 2 feet, other cases have been investigated including the following:

(1) Boat loads applied on MR-GO side with various elevations ranging from 2 ft. to 13 ft. on the MR-GO side and water at Elev. 2.0 on land side.

(2) Boat load applied on protected side with various water elevations ranging from 2 ft. to 7 ft. on the MR-GO side and water elevations ranging from 2 ft. to 5 ft. on protected side.

7. Base Slab, (See Plates IV-1 through IV-8).

a. The base slab, treated as a monolithic unit, has been designed to withstand the bending moment of forces producing bending in both the transverse and longitudinal directions for the various loading conditions as described in Paragraph 6a.

b. Case No. 6 was found to be critical for design in the longitudinal direction and Case No. 1A was critical in the transverse direction.

c. The base slab under Case 3 which is a dewatered condition with buoyancy active has a factor of safety of 1.16 against up-lift if the tension capabilities of the piles are disregarded and 2.1 considering all piles active in tension.

d. In developing longitudinal and transverse moment diagrams, it was assumed that total amount of all forces on the structure producing bending has been uniformly distributed over the width of the base slab for each direction of bending.

e. In developing reinforcement details, in the preparation of plans and specifications for the base slab, it will be taken into consideration that moments in both longitudinal and transverse directions will tend to be concentrated in the area of the massive walls upstream and downstream of the gate recess, and the slab will be checked locally in these areas for the moment induced from the walls.

8. Gate Bay Walls.

a. Gate recess walls were designed as rectangular panels supported along the sides, top and bottom. Moment coefficients were taken from the bulletin "Concrete Information No. ST-63, Rectangular Concrete Tanks" as published by the Portland Cement Association, Chicago, Ill. In this bulletin the moment coefficients are expressed as a function of triangular hydrostatic load for edge restraint assumed as follows:

(1) Sides fixed, top and bottom hinged.
(2) Sides fixed, bottom hinged, top free.
(3) Sides and bottom fixed, top free.

b. Design moments were computed for a triangular load equivalent in magnitude to earth and water loading using at rest earth pressures and for edge restraint in accordance with assumptions (1), (2), or (3), whichever produced the larger moment. See Plate IV-9 and IV-10.

c. The walkway on top of the recess wall was designed as a horizontal rectangular beam to take the shear at the top edge of the recess wall for condition (1). In addition, the walkway was designed to support a live load of 200 pounds per square foot. The large walls flanking the gate recess were designed to resist the pressures of earth and water combined with reactions from recess walls, sector gates, and needle girder. See Plate IV-11.

9. Needle Dam. The needle dam consists of reinforced concrete needles horizontally supported by a single span steel girder with two vertical supports to minimize deflection and bending due to the weight of the girder. Concrete needles have proven to be more durable than timber needles and can be economically mass produced by precasting and are

superior to timber needles in resisting up-lift forces. [illegible] can be easily placed by a crane mounted on a barge. One set of 22 needles and 2 girders will be fabricated. Loading, moments and shear diagrams for the needles and the needle girder are shown on Plates IV-12 and IV-13. Needles and needle girders will be stored at the Bayou Bienvenue Control Structure.

10. Control House. The control houses will be located on the gate walls above the machinery space and will have a floor elevation of 17.5. The control houses will be constructed of reinforced concrete with windows positioned so that movement in the approach channels can be observed. All windows will be protected by metal shutters. See Plate IV-14.

11. Sector Gates.

a. General Description. The gates are sector type gates designed for welded construction. Each gate consists of two identical gate leaves with a central angle of 60 degrees. The radius to the inside of skin plate is 34.61 feet and the height of gate leaf is 28.28 feet. Each leaf has two vertical trusses which carry the load to the hinge and pintle. Vertical dead load reaction is carried by the pintle alone. The operation of gate leaves is by means of a pull cable storing on a cable drum. The cable centerline is 2'-6" below top of gate leaves and the operating machinery is mounted in the gate wall.

b. Method of Analysis. In analyzing the steel frame of the sector gate for the various loading conditions, a computer program titled, "Structural Engineering System Solver (STRESS)" for the IBM 1130, was utilized. This program analyzes the entire sector gate as a space frame with rigid or pinned joints as the case may be. The resulting moments and shears include all primary and secondary stresses induced by the various loading conditions. Sufficient manual computations were made to verify the computer output.

c. Basic Stresses. See Paragraph 4 for allowable working stresses.

d. Skin Plate. The skin plate was designed as a member spanning in the vertical direction across horizontal ribs. The spacing of the horizontal ribs will permit using a 3/8" thickness of plate throughout. See Plate IV-20 for moments and stresses.

e. Horizontal Skin Plate Ribs. The skin plate is supported by horizontal ribs consisting of 4x6x3/8 angles, spanning in a horizontal direction. The ribs were designed as beams continuous over five supports with a portion of the skin plate acting as one flange. Maximum moments and stresses are shown on Plate IV-20.

f. Vertical Skin Plate Supports. Loads on skin plate and horizontal skin plate ribs are assumed to act directly on the vertical beams. The vertical beams were designed to withstand water and boat loads. The water and boat loads were assumed to act directly on the beam neglecting concentrated rib reactions. Outside vertical beams form part of the two vertical trusses. The loads, shears and moments are shown on Plate IV-20. The weights of the outer portions of skin plate, horizontal ribs, and vertical skin plate supports are carried to the vertical trusses through the skin plate. Center portions of the above are carried to vertical trusses through the diagonals.

g. Horizontal Girders. Horizontal girders are part of the horizontal frames which transfer loads that occur on the vertical skin plate to the vertical trusses. They were designed to carry stresses induced by water and boat loads combined with their own dead weight. Upper and center girders are 33WF118 and the lower girder is a 27WF84. For the loads, moments and shears see Plate IV-21.

h. Horizontal and Vertical Frames. Various members of the horizontal and vertical frames are designed for maximum stresses resulting from combination of dead load, water load and boat load. Maximum stresses in the horizontal frames are given on Plate IV-30. Stresses in the vertical trusses are shown on Plates IV-24 and IV-26. The final dimensions and sizes of members are shown on Plates IV-23 and IV-25. The effect of bending, resulting from friction in hinge and pintle, normal to the top and bottom horizontal frames has been investigated using a friction coefficient of 0.25.

i. Fender System. A fender system will be provided for the channel side of the gate. The system consists of 8"x12" treated timbers bolted to vertical 10WF77 beams which in turn are welded to 14WF78 horizontal beams. The system will be connected to the canal truss by bolting the horizontal beams to the vertical truss members. See Plate IV-17.

j. Walkways. Access across the gate bay is provided by walkways mounted on the gates. The walkways are designed for a uniform live load of 100 pounds per square foot. For details of walkways, see Plate IV-15.

k. Hinge and Pintle. The gate frames are to be supported at the top by a hinge and at the bottom by a pintle. Horizontal reactions are transferred to the gate chamber walls through cylindrical bronze bushings on hinge and pintle. All vertical loads are transferred to the concrete base slab through a bronze disc on the pintle. The loading conditions and bearing pressures are shown for the hingle and pintle on Plate IV-32. Details of hinge are shown on Plates IV-18 and IV-33; and of pintle on Plates IV-19, 34 and 35.

(1) Hinge and Pintle Anchorage.

(a) The hinge anchorage was designed for a maximum tensile strength of 33,500 p.s.i. using steel with a minimum yield point of 50,000 p.s.i. In order to insure firm contact between the movable and fixed hinge casting under normal conditions, the anchorage bolts will be prestressed by tightening the nuts sufficiently to induce a force of approximately 83,750 pounds in each bolt prior to the time of mounting the gates. The prestress of 83,750 pounds is about four times the maximum calculated for dead load and about one and one-half times the maximum calculated for live load.

(b) The amount of prestress indicated in the above paragraph will be determined in the field by measuring the torque applied in tightening the nuts with the contact between nut, bolt, and casting well lubricated and assuming a coefficient of friction of 0.10.

(c) The amount of torque to be applied was determined by the formula given on Page 25 of "Fasteners Data Book" published by the Industrial Fasteners Institute of Cleveland, Ohio. This formula with nomemclature and constants is presented below.

$$\frac{PL}{W} = U_B R_B + R_T \left[\frac{U_T \operatorname{Sec} B + \dfrac{1}{2\pi N R_P}}{1 - \dfrac{U_T \operatorname{Sec} B}{2\pi N R_P}} \right]$$

- P = Force applied to wrench in pounds.
- L = Effective length of wrench in inches.
- W = Total induced tension in bolt = 83,750 pounds.
- R_P = Pitch radius of thread in inches = 0.93 in.
- R_B = Effective radius of action of frictional forces on bearing face of bolt or nut = 1.25 in.
- R_T = Effective radius of friction forces on thread of contact faces = 0.93 in.
- U_B = Effective coefficient of friction of bearing face = 0.10.
- U_T = Effective coefficient of friction on contacting surfaces of thread flanks = 0.10.
- B = Angle between mating faces of threads and a normal to the thread axis = 30 degrees.
- N = Number of threads per inch = 4.5.
- PL = Applied torque.

PL=83,750x0.10x1.25+~~77,000~~ 83,750 x0.93

$$\left[\frac{0.10 \times 1.155 + \dfrac{1}{6.283 \times 4.5 \times 0.93}}{1 - \dfrac{0.10 \times 1.155}{6.283 \times 4.5 \times 0.93}} \right]$$

= 10,469 + ~~11,041~~ 12,000
= ~~21,510~~ in lb. 22,469
= ~~1,792~~ ft. lb. 1870

12. Appurtenances.

a. Floodwalls. Two types of floodwalls will be constructed between the gate bays and adjacent levees. The floodwalls will be inverted "tee" type supported by concrete piling and "I" type concrete sheet piling. The inverted "tee" floodwall will commence at the gate bay wall and will be constructed to a point 95 feet at Bayou Bienvenue and 69 feet at Bayou Dupre, from the end of the gate wall thence concrete sheet piling will be placed for the remainder of the floodwall. The elevation at the top of the floodwall will be 17.5 feet. A 4 foot wide concrete access walkway will form the top of the floodwall. The inverted "tee" type of floodwall consists of a pile-supported concrete base slab and stem, with a steel sheet pile cut-off wall. The steel sheet pile wall will extend to approximately elevation -26. The wall is supported against settlement and overturning by battered prestressed concrete piles with tip elevations of -48 at Bayou Dupre and -62 at Bayou Bienvenue. The "I" wall consists of prestressed concrete sheet pile with a full length groove on one edge and a partial groove and tongue on the other edge. After driving the void area of the groove will be cleaned and grouted. The floodwalls are designed against lateral loading resulting from hurricane tides, waves, and soil pressures. See Plates IV-36, 37 and 38.

b. Concrete Sheet Pile Wing Wall. Concrete sheet pile wing walls will be placed on each end of the gate bay to retain earth fill at the entrance and exit of the gate chamber. The concrete sheet pile wing wall was designed with a tie back to the gate wall structure. See Plate IV-36.

c. Timber Guide Walls, Fenders and Dolphins. Timber guide walls will be constructed on each side of the chamber at the entrance and exit of the chamber. The length of the approach guide wall is 95 feet. The walls consist of treated timber piles, vertical and batter, and treated timber wales. At each end of the timber guide wall, a seven pile timber dolphin will be constructed. See Plate IV-39.

d. Dock and Loading Ramp. The portion of levee between Bayou Bienvenue and Bayou Dupre will be inaccessible except by boat. Levee maintenance equipment such as mowing machines, dozers, and cranes will be transported to either the Bayou Bienvenue or Bayou Dupre structure by barge. At each structure there will be provided an unloading dock and a ramp to facilitate movement of equipment between barge and shore. The dock will be constructed of treated timbers on treated timber piles. The ramp from the dock to the shore and to the top of levee will be constructed of shell. See Plate IV-40 for details.

13. Materials.

a. Sources of Construction Materials. Information relative to materials sources is contained in Design Memorandum No. 12, "Sources of Construction Materials", dated 27 June 1966 and approved 30 August 1966.

b. Cement. Water analysis, made by New Orleans Public Service Incorporated, of water samples obtained from the Intracoastal Waterway in vicinity of their Michoud Generating Plant indicated the following sulphate content:

2 September	1964	2,464 ppm
22 October	1964	2,645 ppm
19 May	1967	2,330 ppm

Civil Works Bulletin 56-18 dated 3 August 1956, "Use of Sulphate-Resistant Cement" from Office, Chief of Engineers, defined the limits of sulphate contents for use with Type II cement as 150 to 1,000 ppm and above these limits made the use of Type V cement mandatory. Accordingtly, Type V cement will be used for the base slab, gate bay and wing wall sheet piling. However, Type 1 cement will be used for the inverted "tee" and "I" type floodwall.

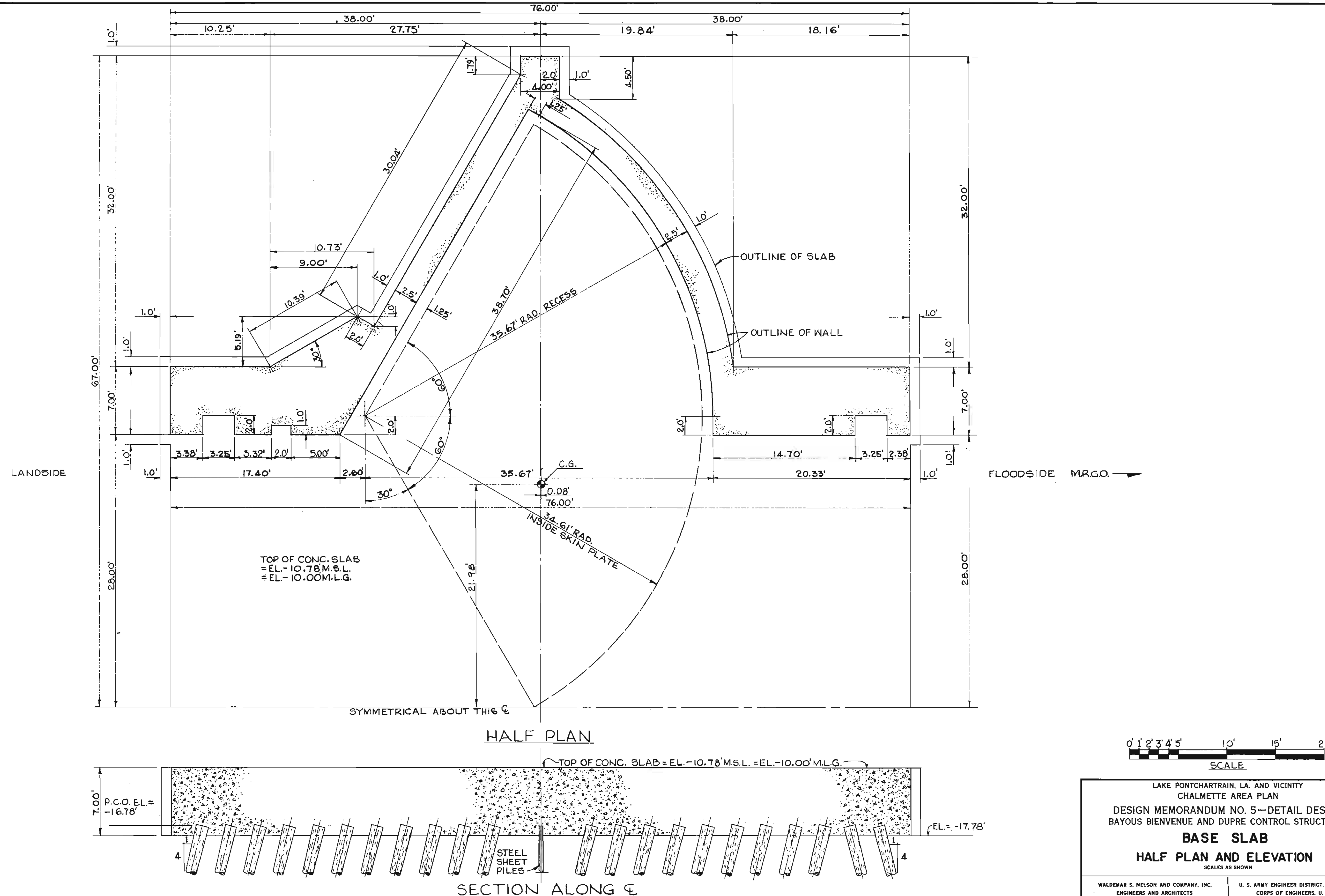
c. Treated Timber Piling. Treated timber piling for guide walls, fenders, dolphins and docks will have the following minimum retention of creosote-coal tar solution by assay method:

Southern Yellow Pine	20 pcf
Douglas Fir	15 pcf

All timber used in the construction of the guide walls, fenders and docks, will have the following minimum retention of creosote-coal tar solution by assay method for material under 5 inches thick and by gauge method for material 5 inches and thicker:

Southern Yellow Pine	16 pcf
Douglas Fir	12 pcf

d. Piling. All timber piling will be Class B. Piling for the inverted "tee" wall will be 12"x12" prestressed concrete piling. Steel sheet piling for the cut off wall will conform to ASTM Designation A-328, "Standard Specification for Steel Sheet Piling", as amended to date.



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

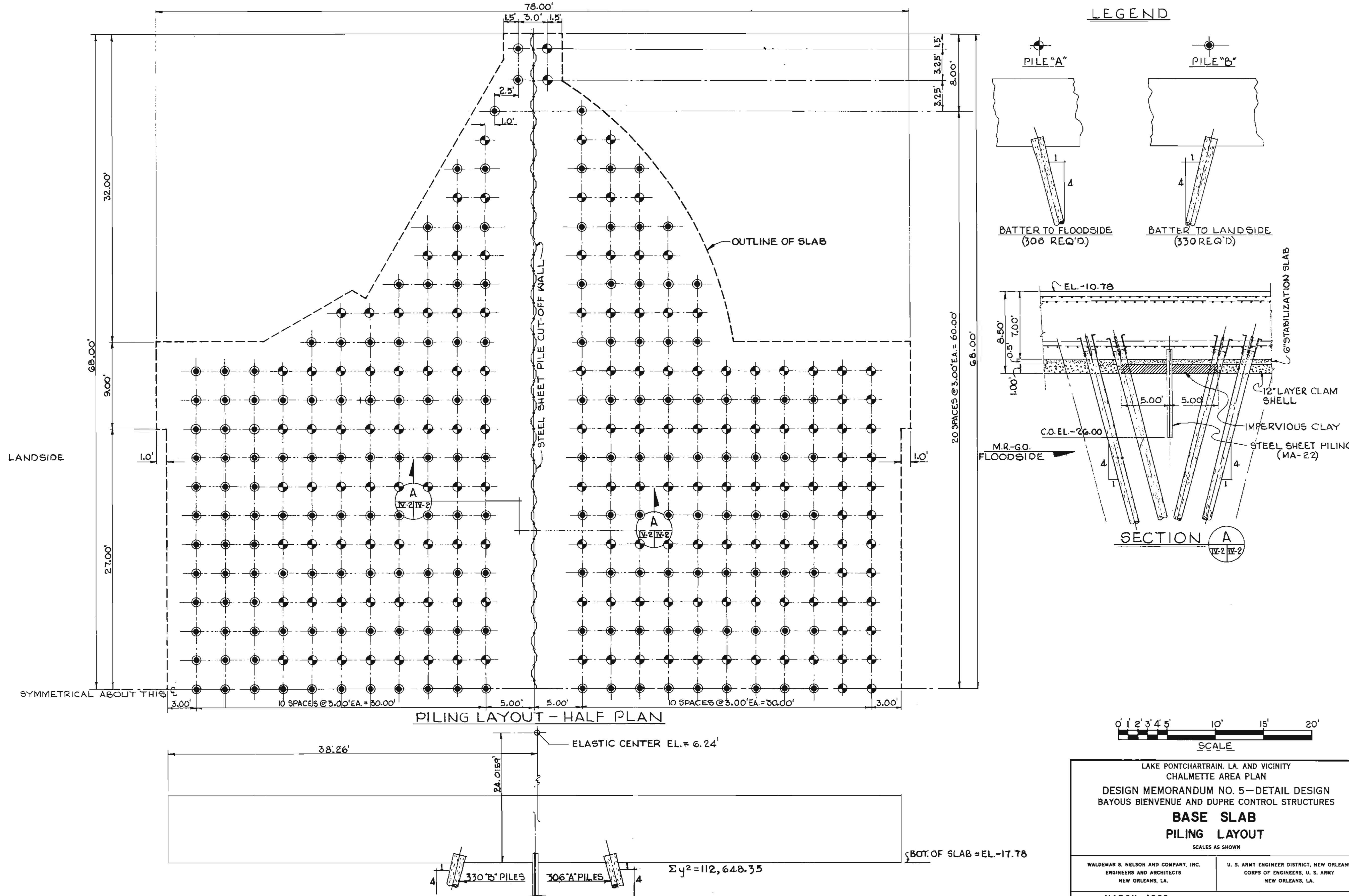
BASE SLAB

HALF PLAN AND ELEVATION

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-1



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

BASE SLAB
PILING LAYOUT

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-2

LOADING CONDITION: CASE I

GATE OPEN, BACKFILL NOT IN PLACE, NO BUOYANCY.

PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANVERSE DIRECTION.

LOADING CONDITION: CASE I-A

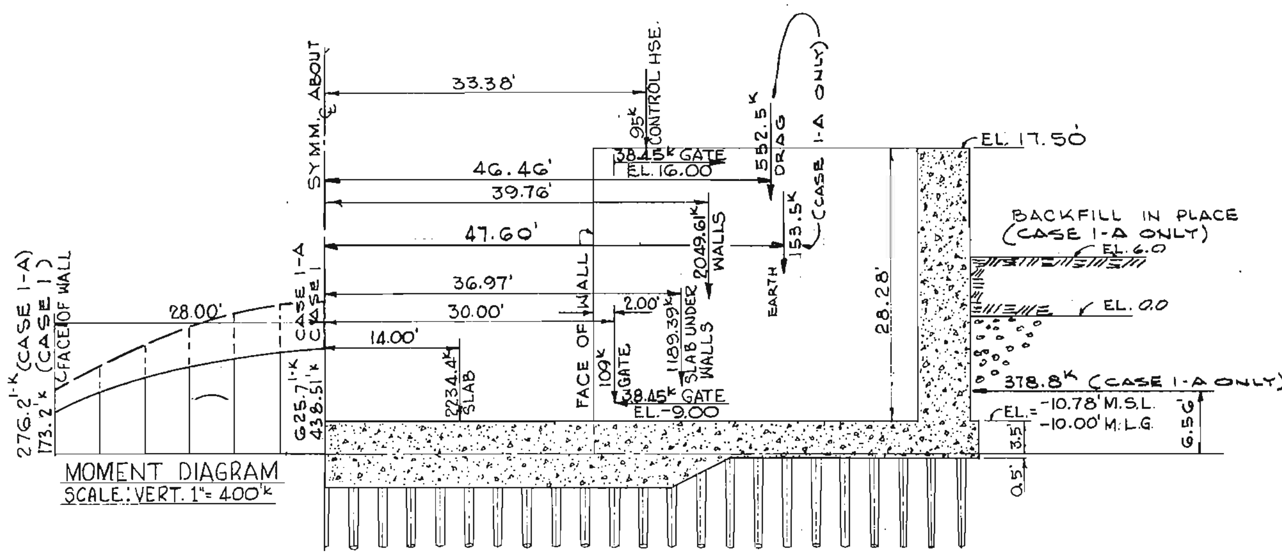
SAME AS CASE I EXCEPT BACKFILL IN PLACE

NOTES:

LOADS SHOWN ARE FOR HALF OF STRUCTURE.

MOMENTS SHOWN ARE FOR ONE FOOT STRIP.

⌒ INDICATES TENSION IN TOP OF SLAB.



LOADING DIAGRAM

TRANSVERSE SECTION

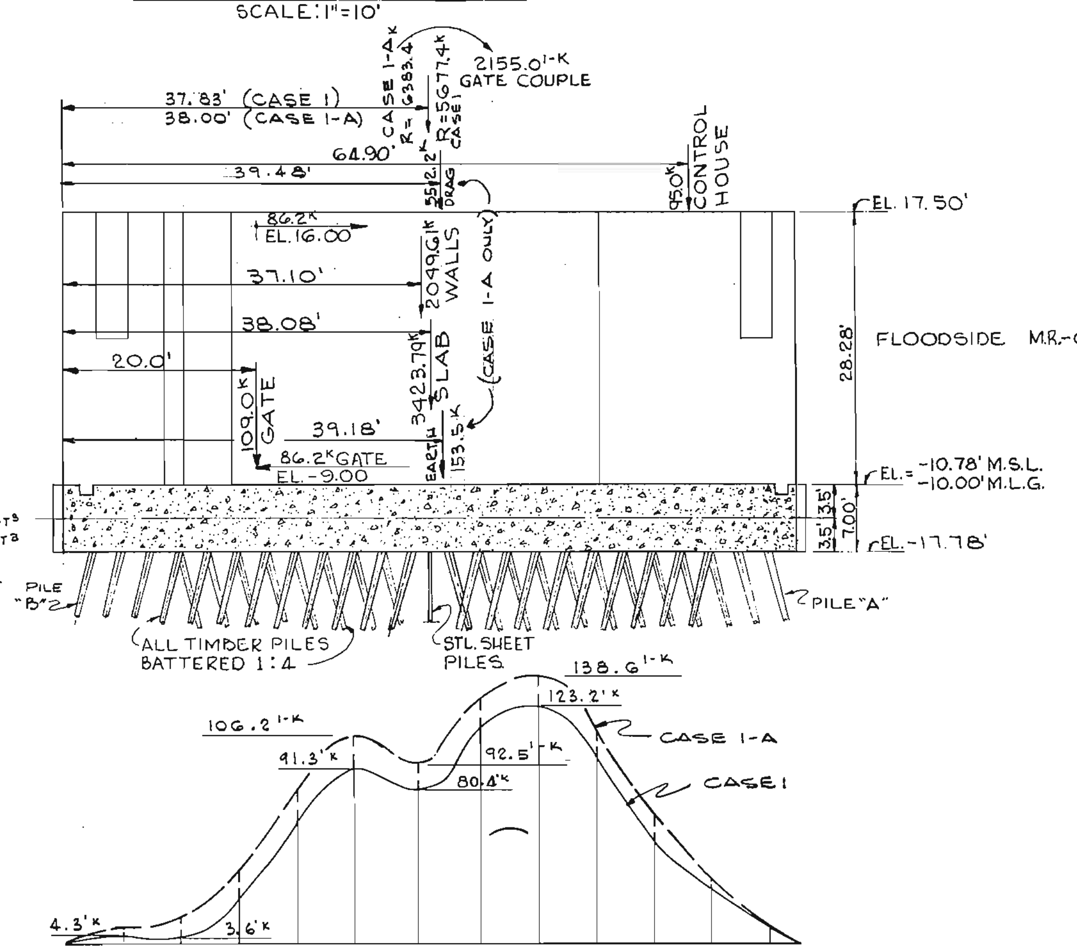
SCALE: 1" = 10'

CASE I

PILE REACTIONS		
	MAXIMUM	MINIMUM
PILES A	19.21 K	19.04 K
PILES B	17.81 K	17.63 K

CASE I-A

PILE REACTIONS		
	MAXIMUM	MINIMUM
PILES A	21.61 K	21.38 K
PILES B	20.07 K	19.82 K



MOMENT DIAGRAM - SCALE: VERT 1" = 50'k

LONGITUDINAL SECTION - SCALE: 1" = 10'

DRAG FORCE COMPUTATION:

EL. 6.0 TO EL. 0.0 CLAY C = 120 P.S.F. $\phi = 0°$ $\gamma = 110\#/FT^3$

EL. 0.0 TO EL. -17.78 SHELL C = 0 P.S.F. $\phi = 40°$ $\gamma = 98\#/FT^3$

DRAG FORCE FOR CLAY = (6) C X LENGTH OF WALL

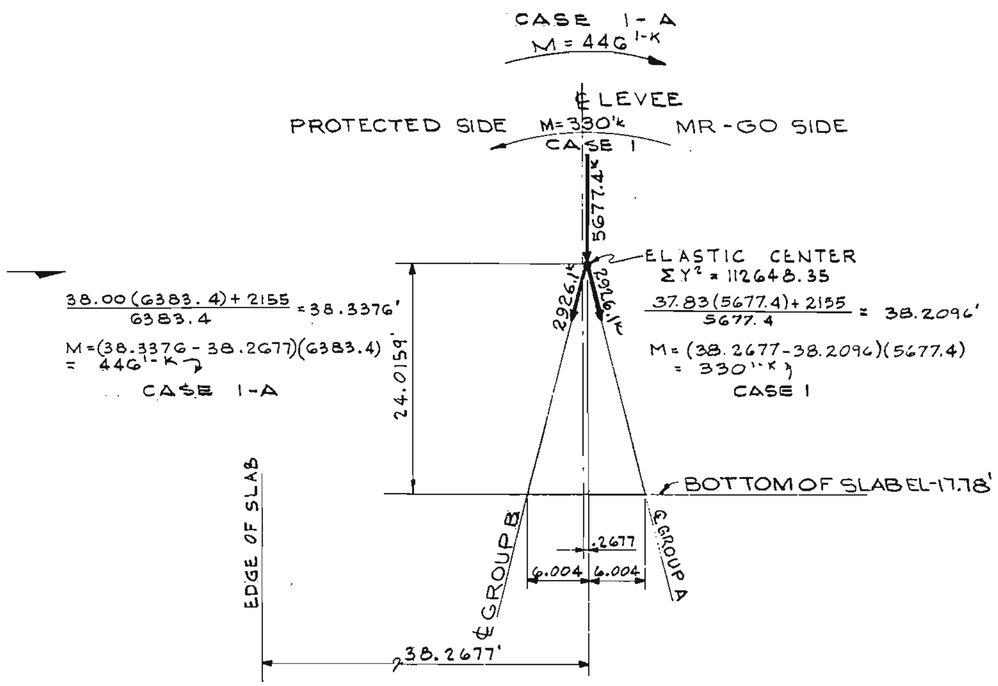
DRAG FORCE FOR SHELL = LATERAL FORCE X TAN ϕ X L

LATERAL FORCE = OVERBURDEN WT. X $TAN^2(45 - \phi/2)$

TOTAL DRAG FORCE = DRAG FORCE FROM CLAY + SHELL

LENGTH OF WALL FROM EL. 17.5 TO EL -14.78 = 89 FT.

LENGTH OF WALL FROM EL. 17.5 TO EL -17.78 = 29 FT.



STABILITY DIAGRAM

SCALE: LINEAR: 1" = 10'
LOADS: 1" = 5000K

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

BASE SLAB - I

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147

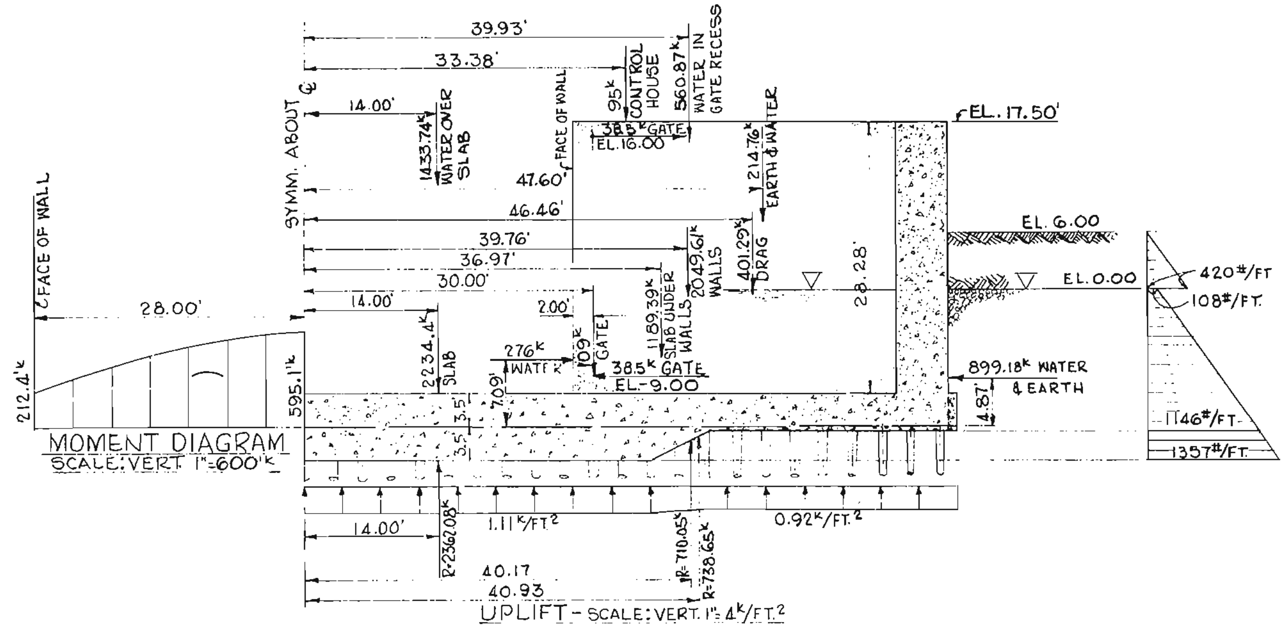
PLATE NO. IV-3

LOADING CONDITION: CASE 2
STRUCTURE COMPLETE, BACKFILL IN PLACE, WATER AT 0.00 M.S.L., BUOYANCY ACTIVE.
PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANSVERSE DIRECTION.

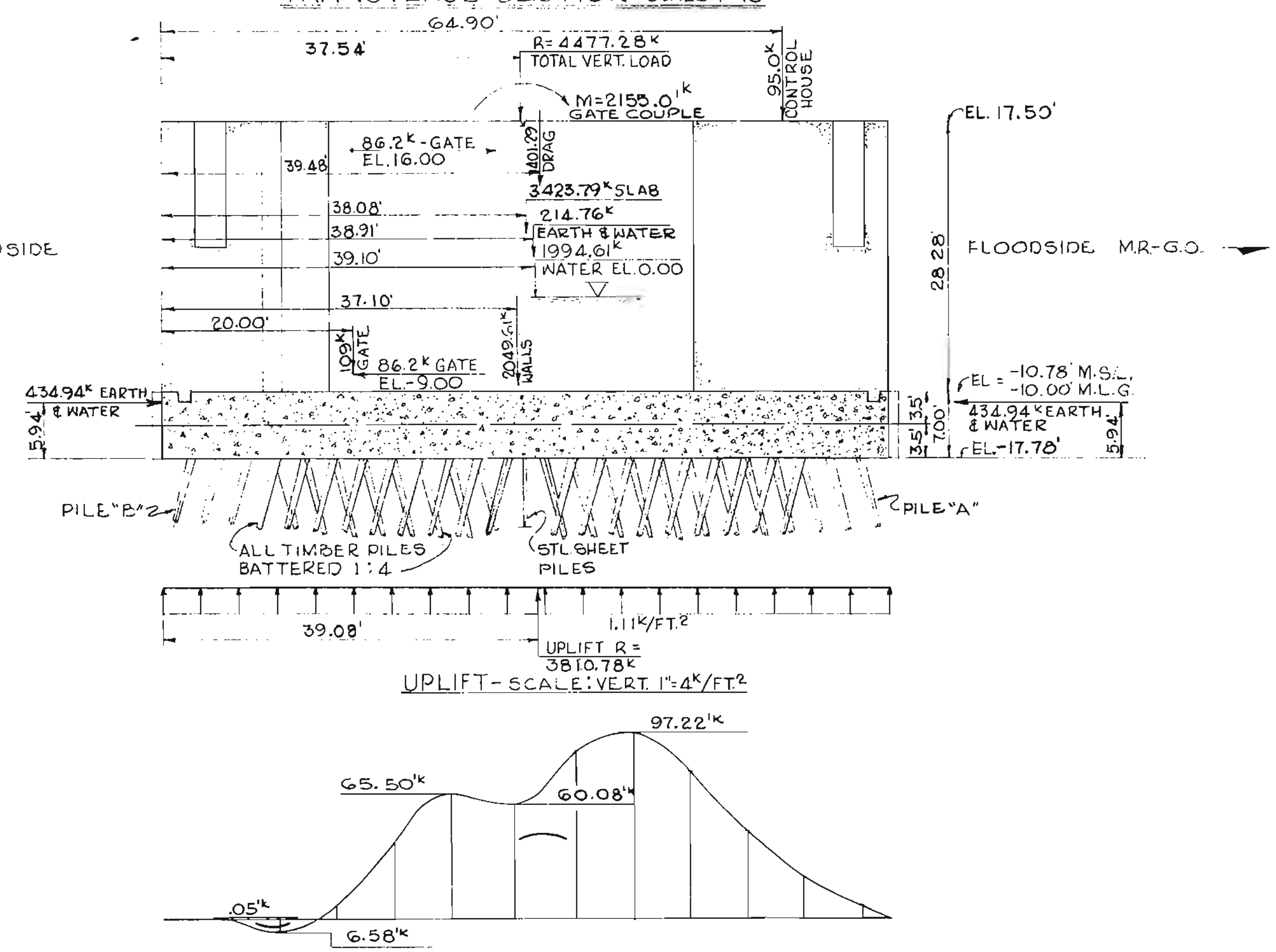
NOTES:
LOADS SHOWN ARE FOR HALF OF STRUCTURE.
MOMENTS SHOWN ARE FOR A ONE FOOT STRIP.
⌒ INDICATES TENSION IN TOP OF SLAB.
◡ INDICATES TENSION IN BOTTOM OF SLAB.

CASE 2

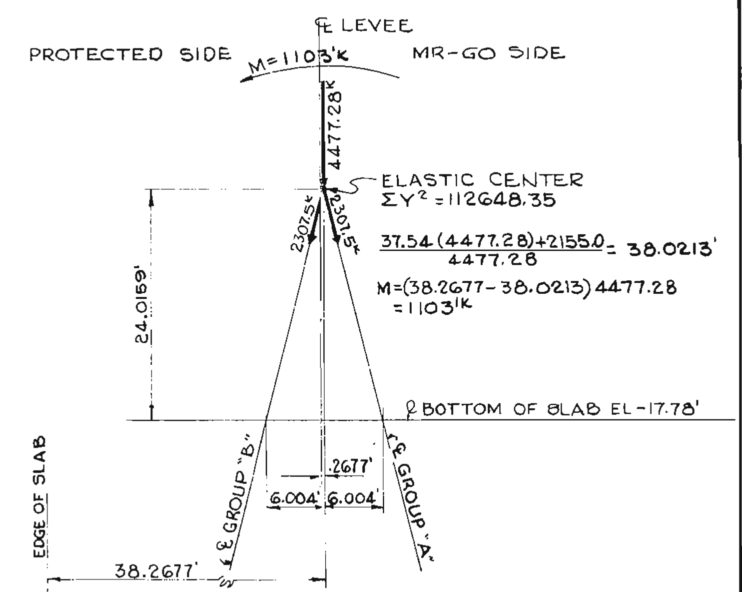
PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	15.38^K	14.80^K
PILE "B"	14.26^K	13.65^K



LOADING DIAGRAM
TRANSVERSE SECTION - SCALE: 1"=10'



MOMENT DIAGRAM SCALE: VERT. 1"=50'ᴷ
LONGITUDINAL SECTION SCALE: 1"=10'



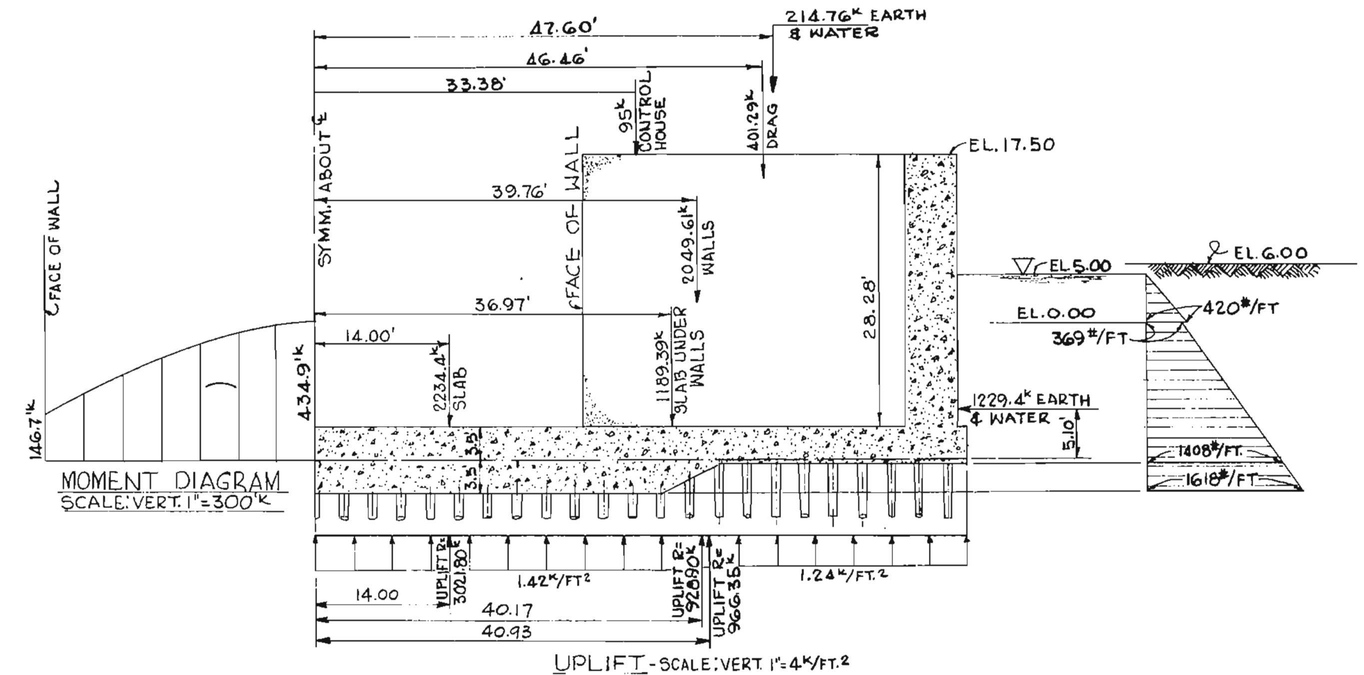
STABILITY DIAGRAM
SCALE: LINEAR: 1"=10'
LOADS: 1"=4000ᴷ

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

BASE SLAB – 2

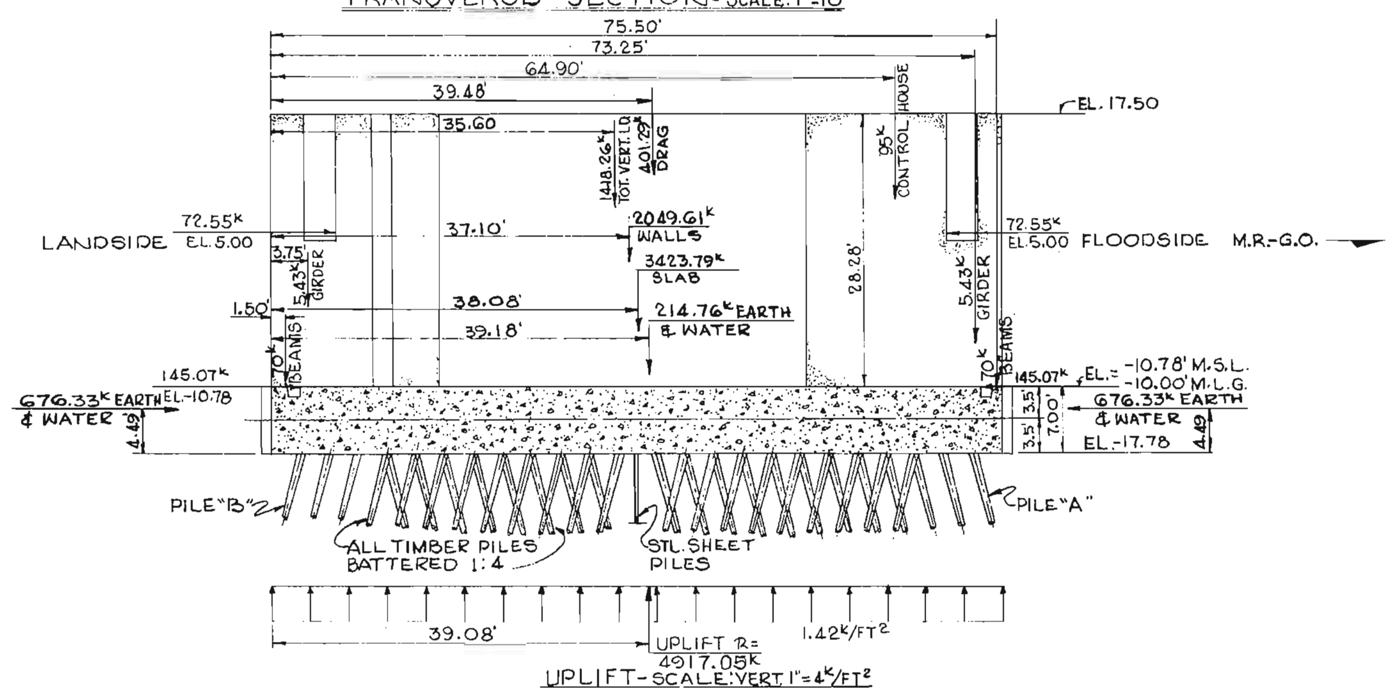
SCALES AS SHOWN

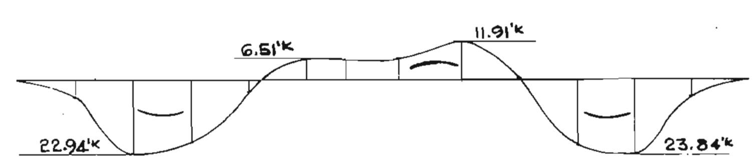
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



LOADING DIAGRAM

TRANSVERSE SECTION - SCALE: 1"=10'





MOMENT DIAGRAM SCALE: VERT. 1"=30'ᴷ

LONGITUDINAL SECTION

SCALE: 1" = 10'

LOADING CONDITION: CASE 3

STRUCTURE COMPLETE, BACKFILL IN PLACE, NEEDLE DAMS IN PLACE, STRUCTURE DEWATERED, GATES REMOVED, WATER AT EL. +5.00 M.S.L., BUOYANCY ACTIVE.

PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANSVERSE DIRECTION.

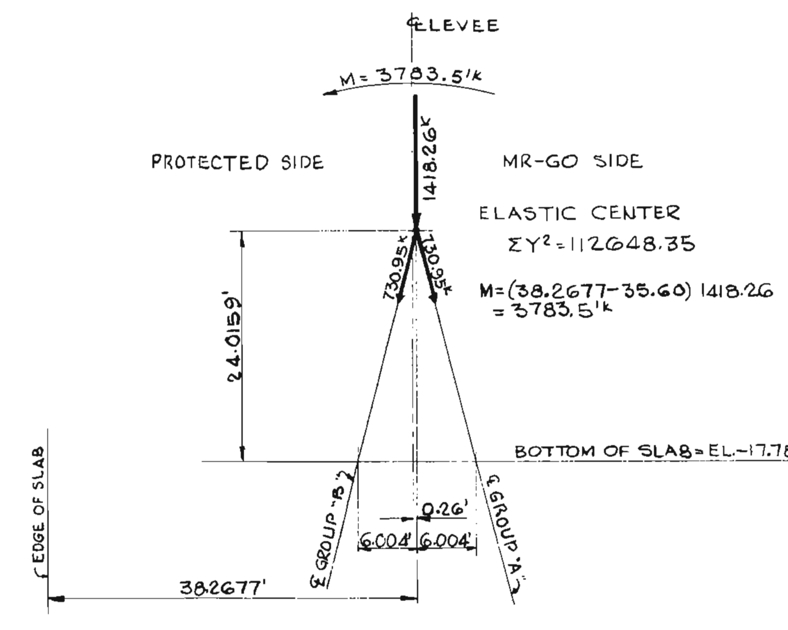
NOTES:

LOADS SHOWN ARE FOR HALF OF STRUCTURE.
MOMENTS SHOWN ARE FOR A ONE FOOT STRIP.
⌒ INDICATES TENSION IN TOP OF SLAB.
◡ INDICATES TENSION IN BOTTOM OF SLAB.

CASE 3

PILE REACTIONS

	MAXIMUM	MINIMUM
PILE "A"	5.82ᴷ	3.84ᴷ
PILE "B"	5.38ᴷ	3.29ᴷ



STABILITY DIAGRAM

SCALE: LINEAR: 1"=10'
LOADS 1"=1000ᴷ

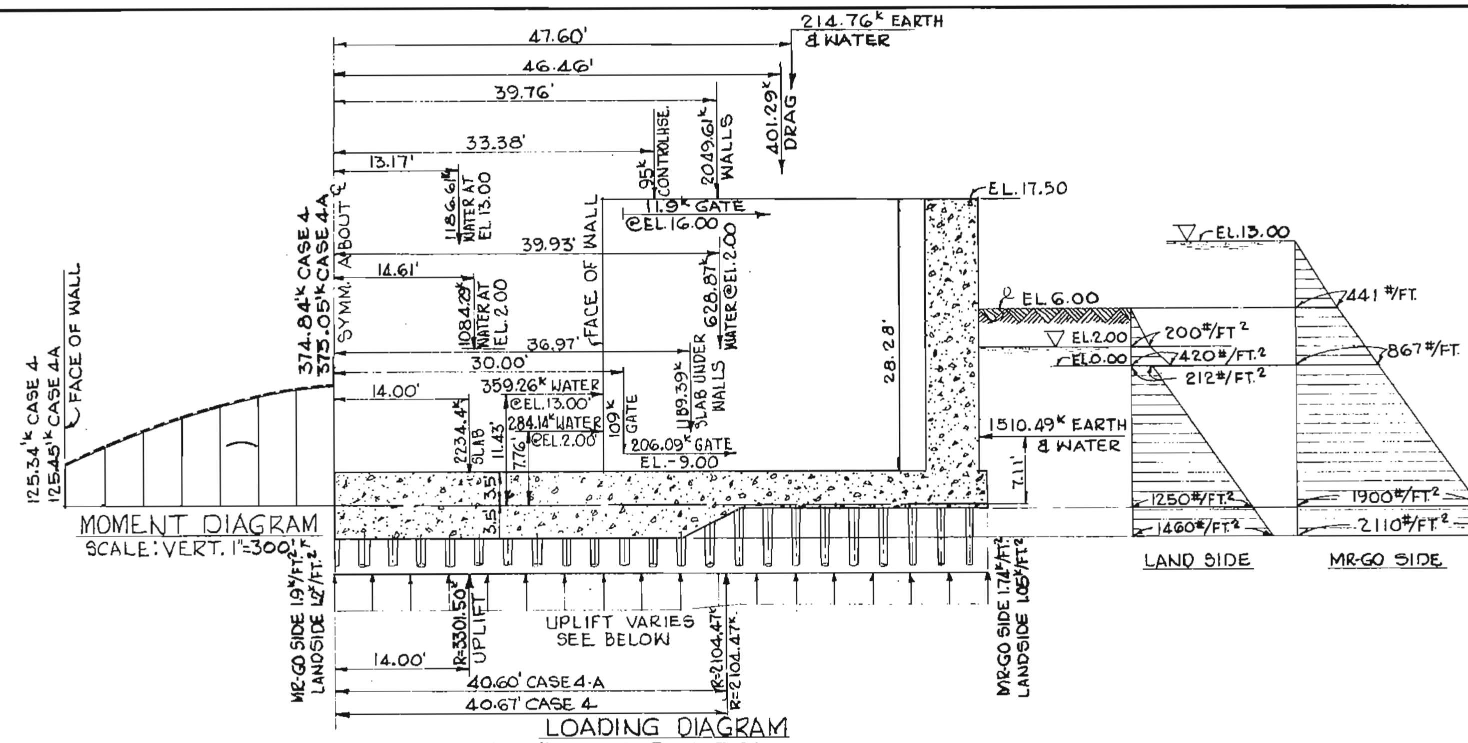
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

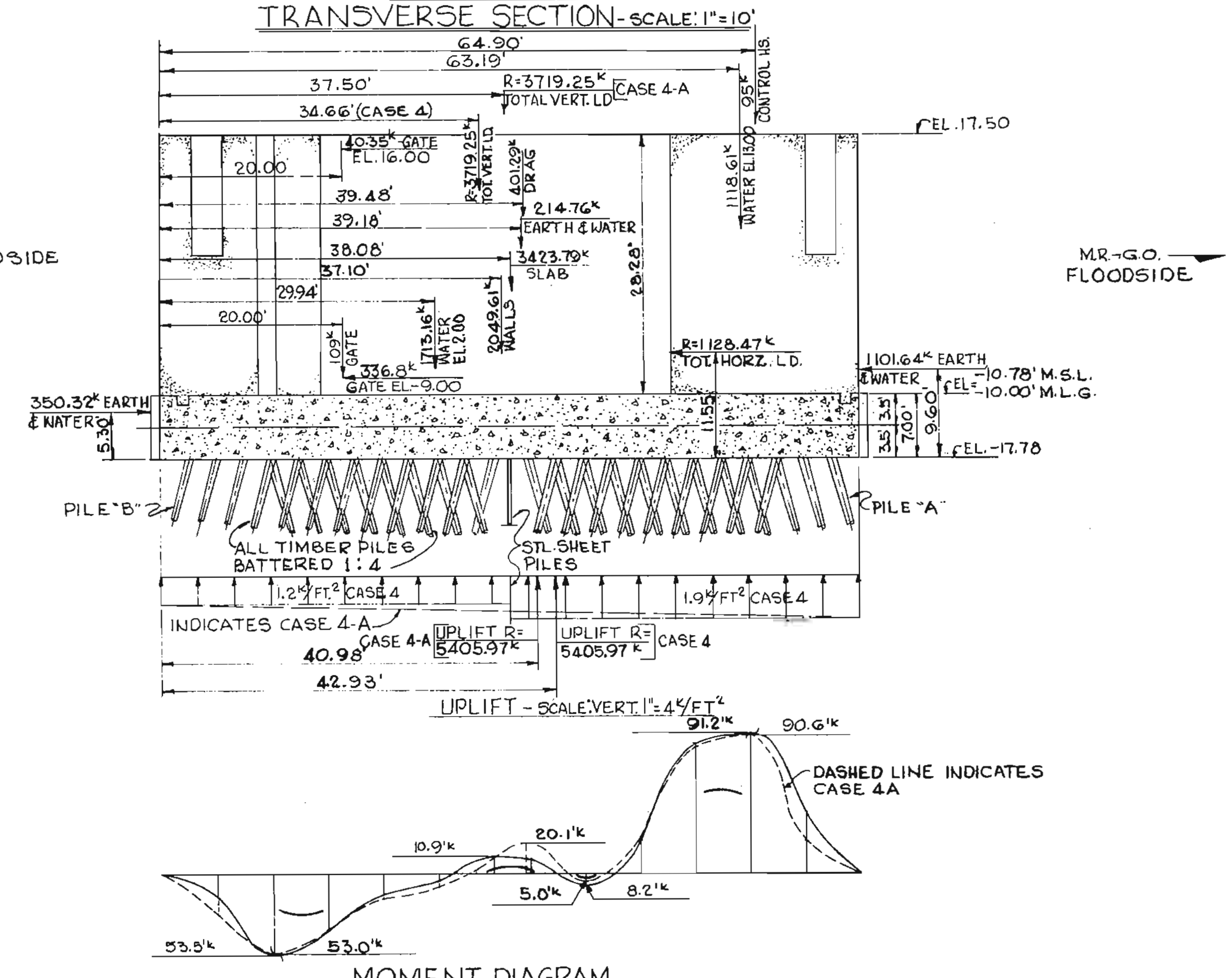
BASE SLAB– 3

SCALES AS SHOWN

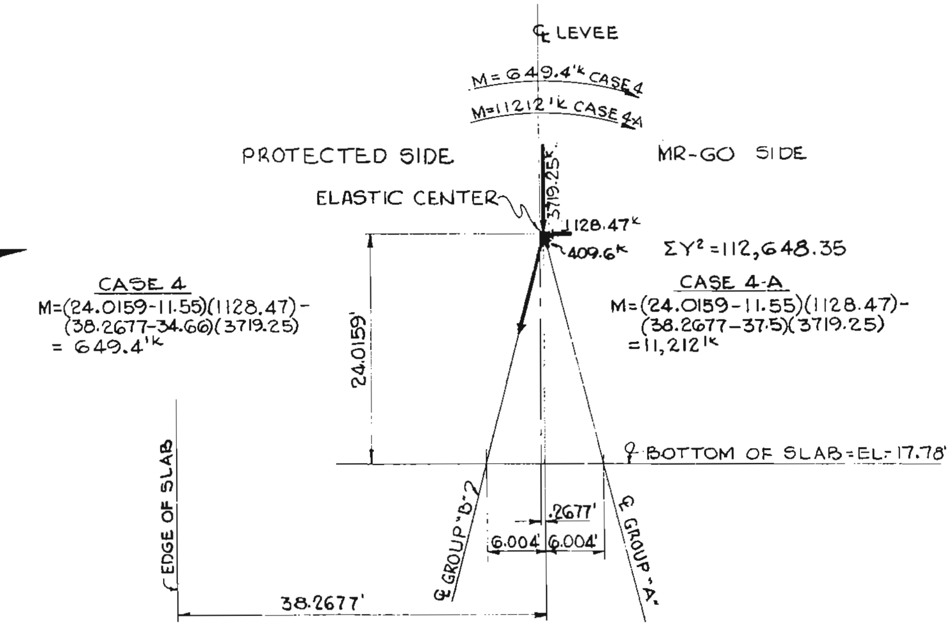
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



TRANSVERSE SECTION - SCALE: 1"=10'



LONGITUDINAL SECTION - SCALE: 1"=10'



STABILITY DIAGRAM

SCALE: LINEAR: 1"=10'
LOADS 1"=4000k

LOADING CONDITION: CASE 4

STRUCTURE COMPLETE, BACKFILL IN PLACE, HURRICANE CONDITION, GATE CLOSED, WATER M.R.-G.O. SIDE AT EL.+13.00 M.S.L., WATER LANDSIDE AT EL.+2.00 M.S.L., BUOYANCY ACTIVE, SHEET PILE CUT-OFF WALL IMPERVIOUS.

PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANSVERSE DIRECTION.

LOADING CONDITION: CASE 4-A

SAME AS CASE 4 EXCEPT SHEET PILE CUT-OFF WALL PERVIOUS.

NOTES:

LOADS SHOWN ARE FOR HALF OF STRUCTURE.
MOMENTS SHOWN ARE FOR A ONE FOOT STRIP.
⌢ INDICATES TENSION IN TOP OF SLAB.
⌣ INDICATES TENSION IN BOTTOM OF SLAB.

CASE 4

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	-2.50k*	-2.84k*
PILE "B"	25.89k	25.54k

CASE 4-A

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	0.11k	-5.77k*
PILE "B"	29.05k	22.87k

* DENOTES TENSION

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

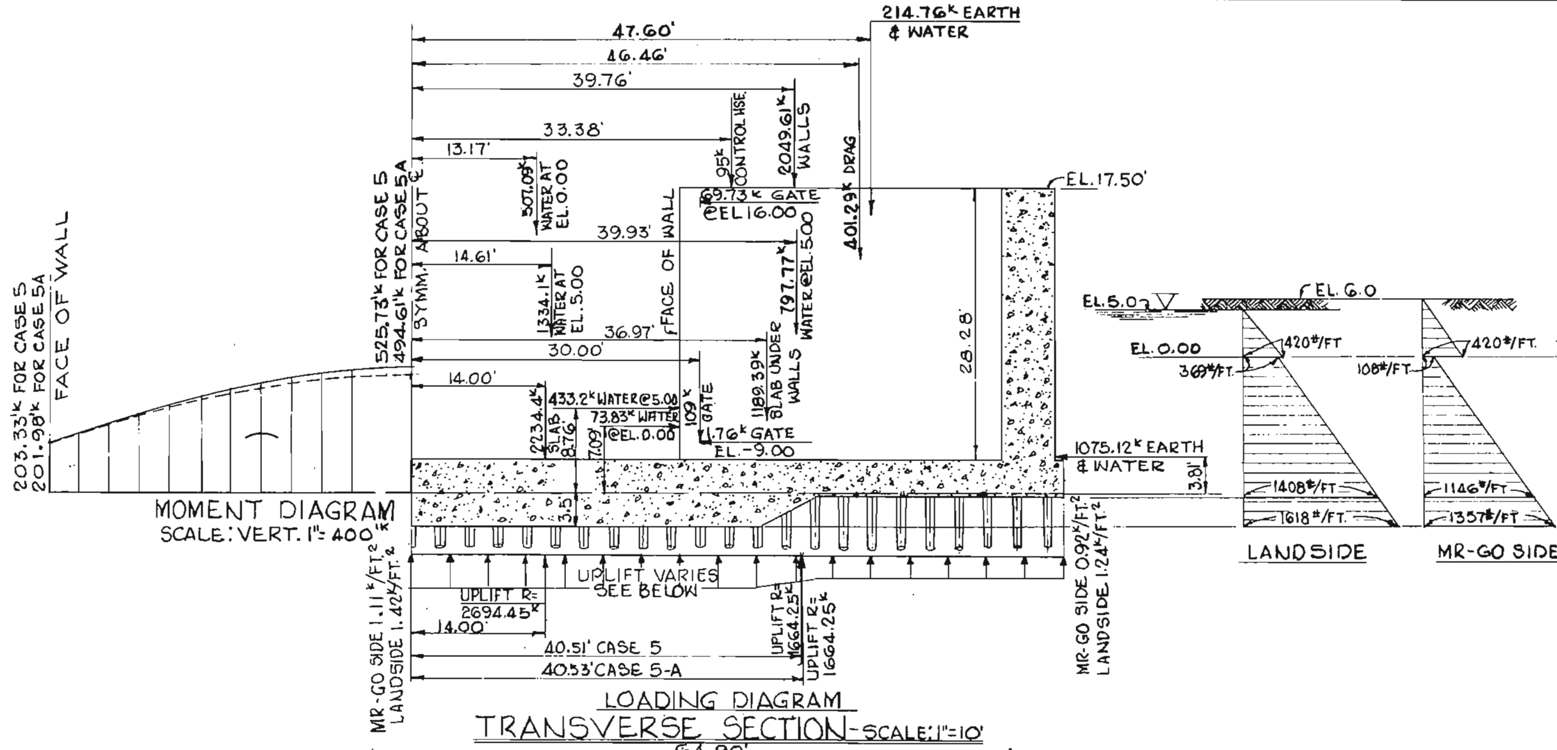
BASE SLAB — 4

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968
FILE NO. H-2-24147



LOADING CONDITION: CASE 5

STRUCTURE COMPLETE, BACKFILL IN PLACE, REVERSE HEAD, GATE CLOSED, WATER M.R-GO SIDE AT EL. 0.00 MSL, WATER LANDSIDE AT EL +5.00 MSL, BUOYANCY ACTIVE, SHEET PILE CUT-OFF WALL IMPERVIOUS.
PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANSVERSE DIRECTION.

LOADING CONDITION: CASE 5 A

SAME AS CASE 5 EXCEPT SHEET PILE CUT-OFF WALL PERVIOUS.

NOTES:

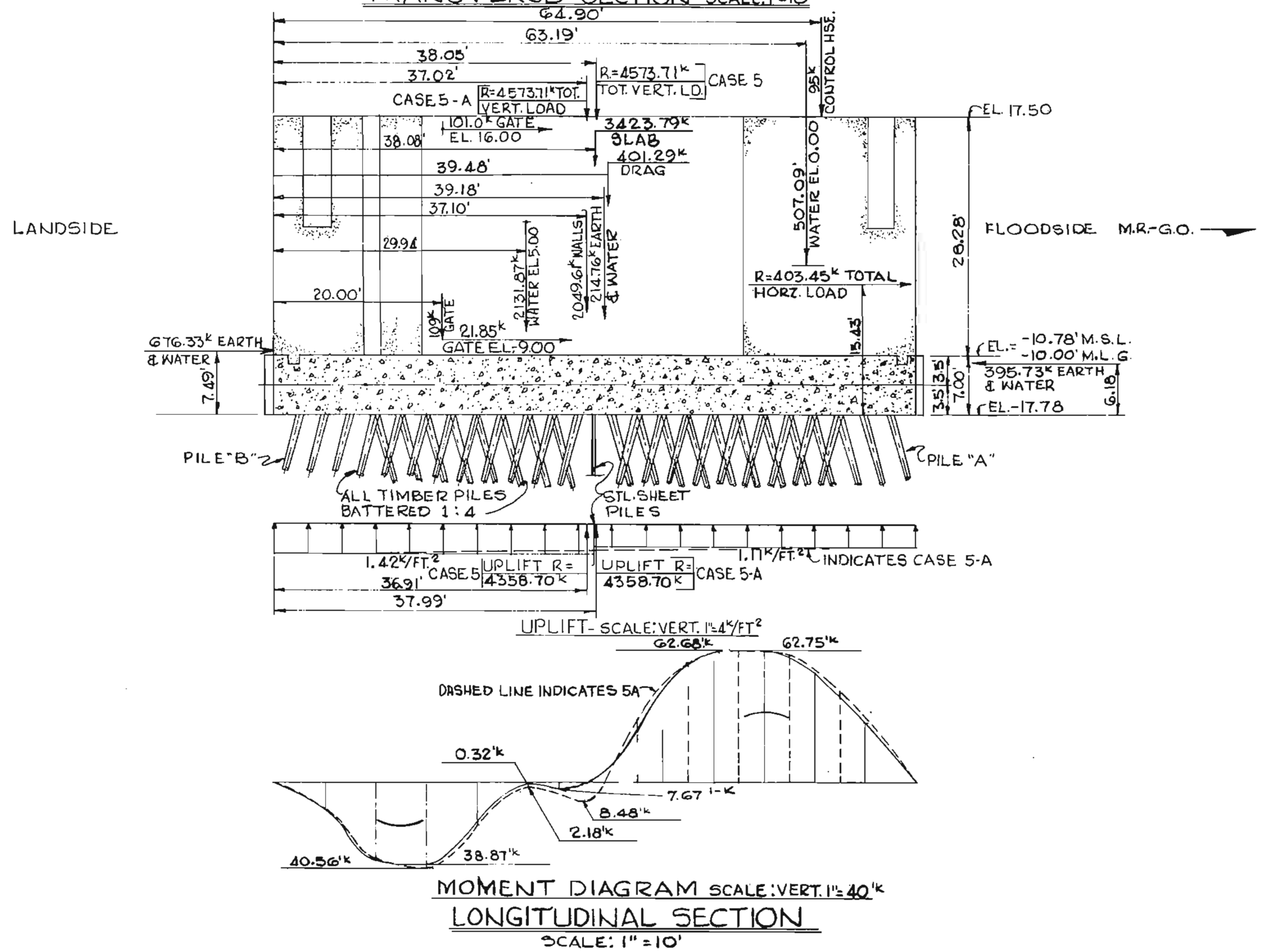
LOADS SHOWN ARE FOR HALF OF STRUCTURE.
MOMENTS SHOWN ARE FOR A ONE FOOT STRIP.
⌒ INDICATES TENSION IN TOP OF SLAB.
◡ INDICATES TENSION IN BOTTOM OF SLAB.

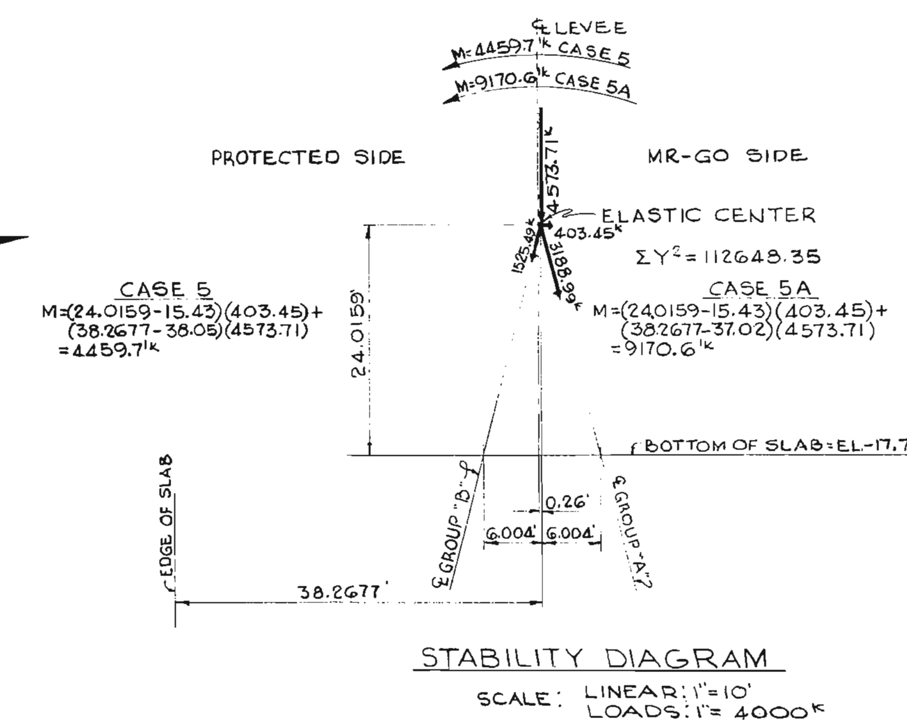
CASE 5

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	22.07k	19.73k
PILE "B"	10.37k	7.91k

CASE 5-A

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	23.38k	18.57k
PILE "B"	11.56k	6.50k



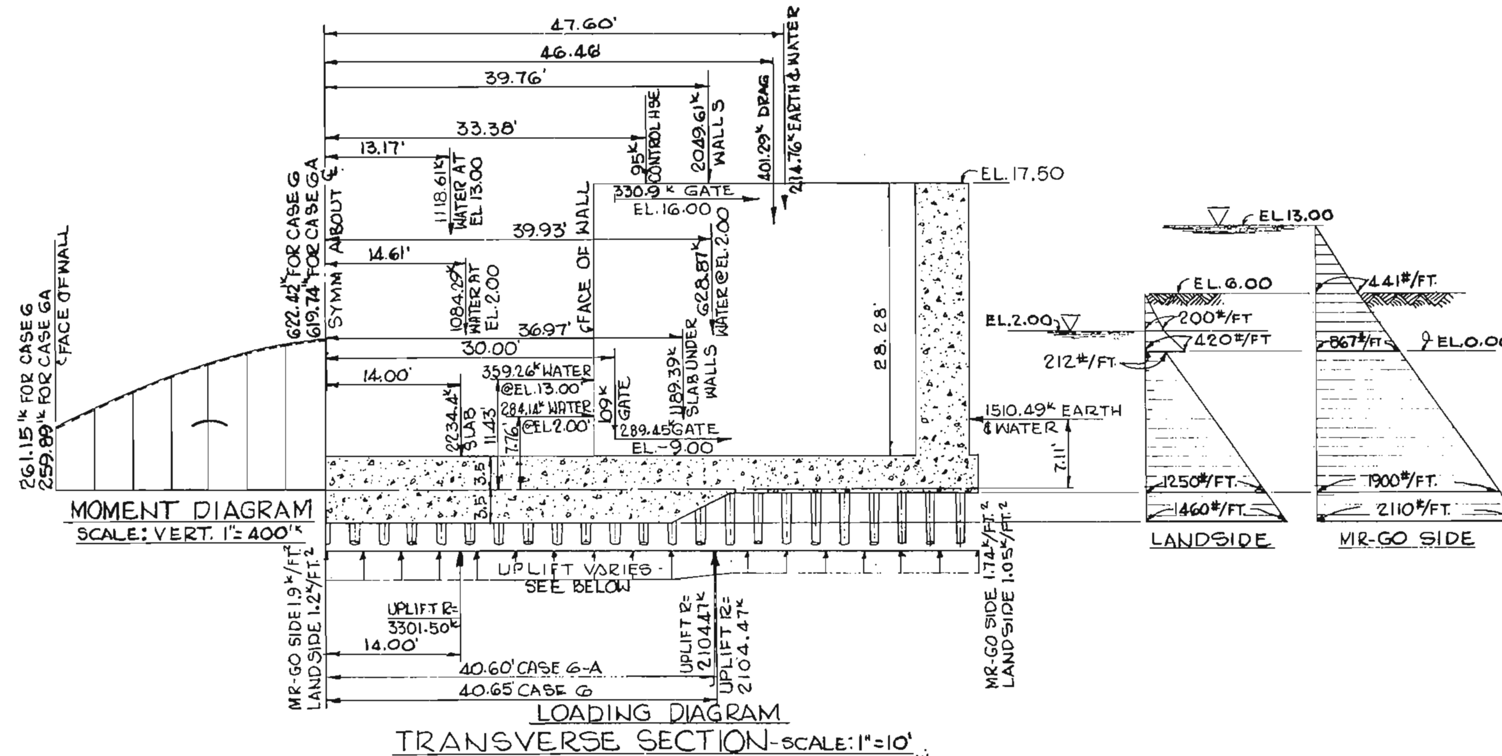


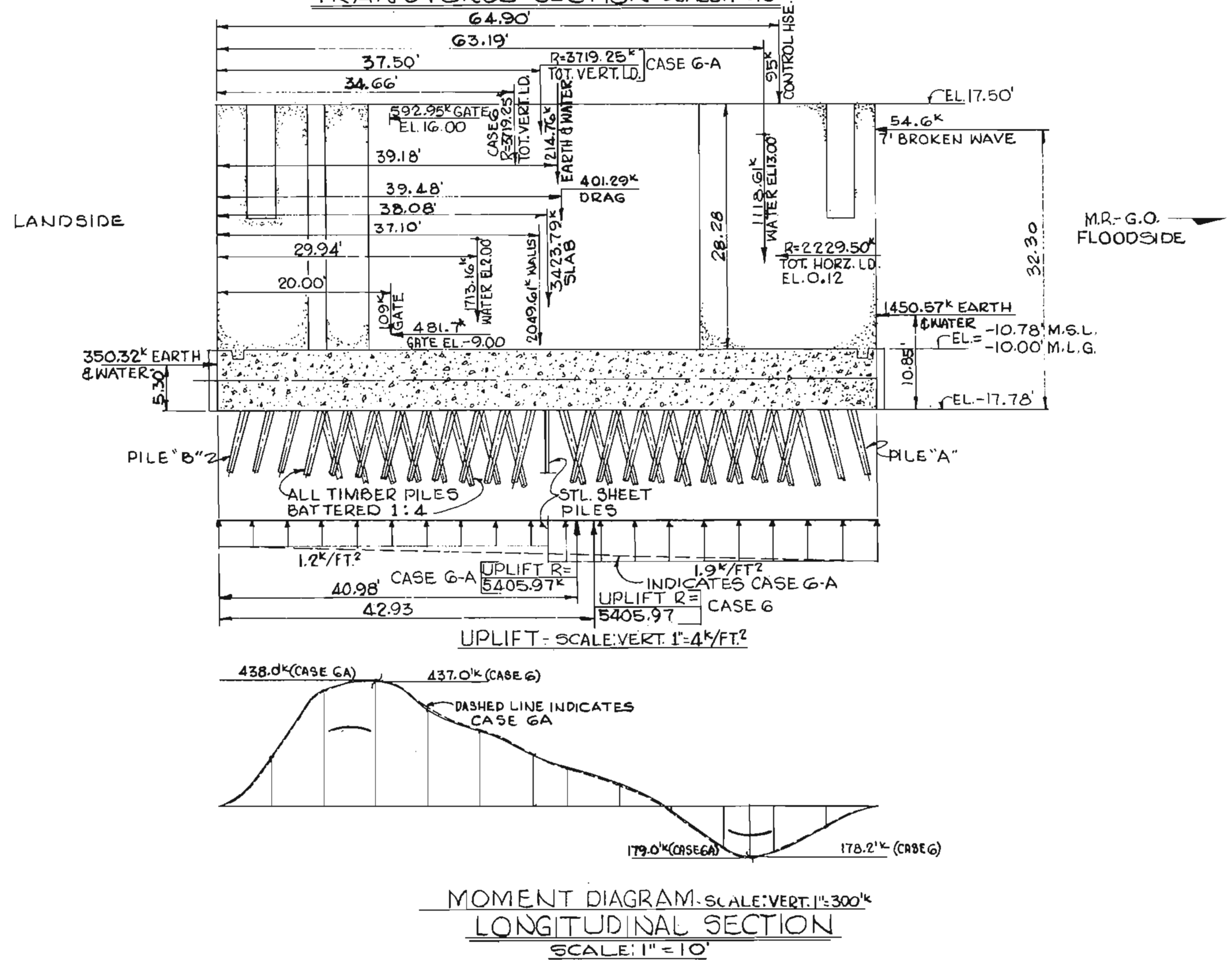
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

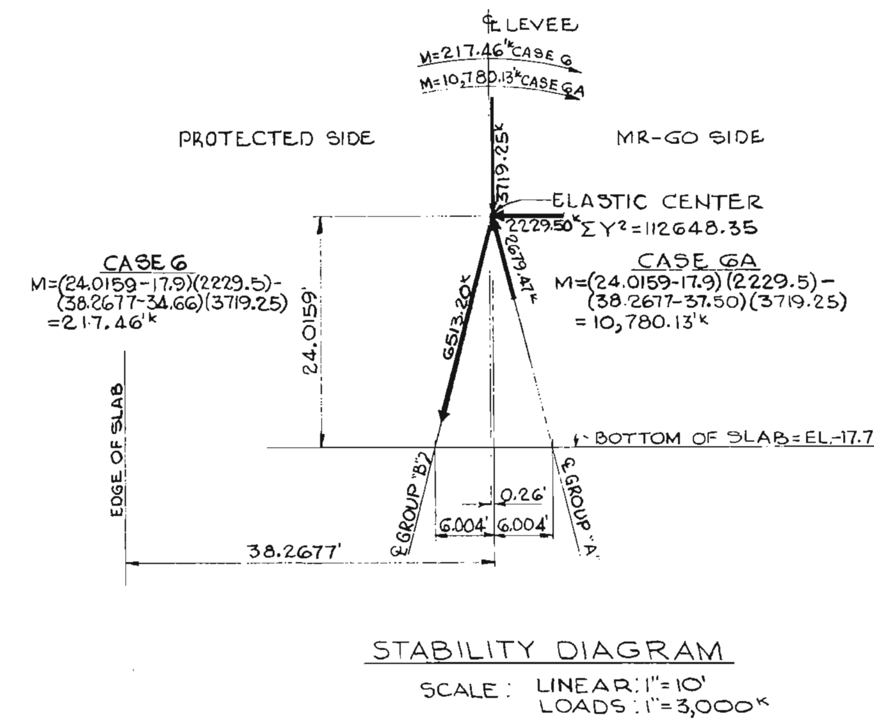
BASE SLAB-5

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147







LOADING CONDITION: CASE 6

STRUCTURE COMPLETE, BACKFILL IN PLACE, HURRICANE CONDITION, GATE CLOSED, WATER M.R.-GO. SIDE AT EL+13.00M.S.L., WATER LANDSIDE AT EL+2.00 M.S.L., BUOYANCY ACTIVE, SHEET PILE CUT-OFF WALL IMPERVIOUS, WAVE LOAD M.R.-GO. SIDE.

PILE REACTIONS ASSUMED UNIFORMLY DISTRIBUTED IN TRANSVERSE DIRECTION.

LOADING CONDITION: CASE 6-A

SAME AS CASE 6 EXCEPT SHEET PILE CUT-OFF WALL PERVIOUS.

NOTES:

LOADS SHOWN ARE FOR HALF OF STRUCTURE.
MOMENTS SHOWN ARE FOR A ONE FOOT STRIP.
⌒ INDICATES TENSION IN TOP OF SLAB.
‿ INDICATES TENSION IN BOTTOM OF SLAB.

CASE 6

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	-17.42k*	-17.54k*
PILE "B"	39.51k	39.39k

CASE 6-A

PILE REACTIONS	MAXIMUM	MINIMUM
PILE "A"	-14.81k*	-20.47k*
PILE "B"	42.39k	36.73k

* DENOTES TENSION

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

BASE SLAB- 6

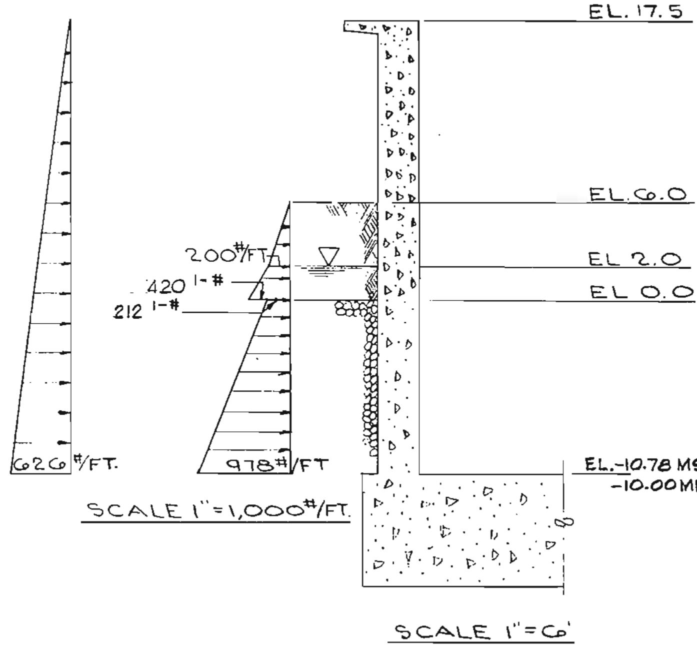
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE: MARCH, 1968

FILE NO. H-2-24147



LOADING DIAGRAMS

LOADS SHOWN ARE FOR HURRICANE CONDITIONS

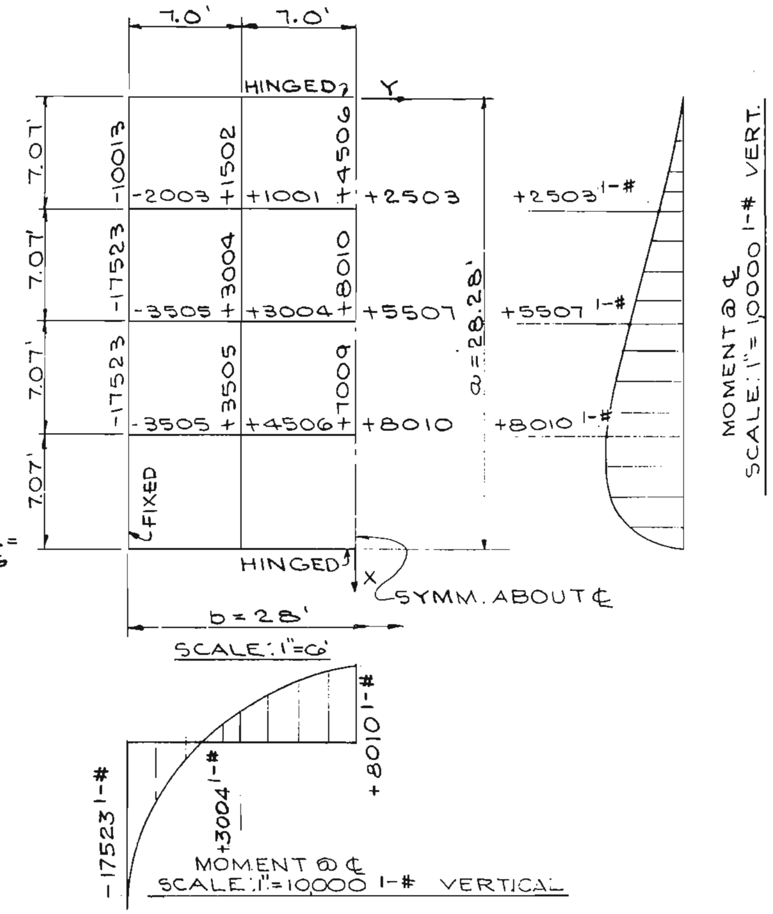


TABLE I

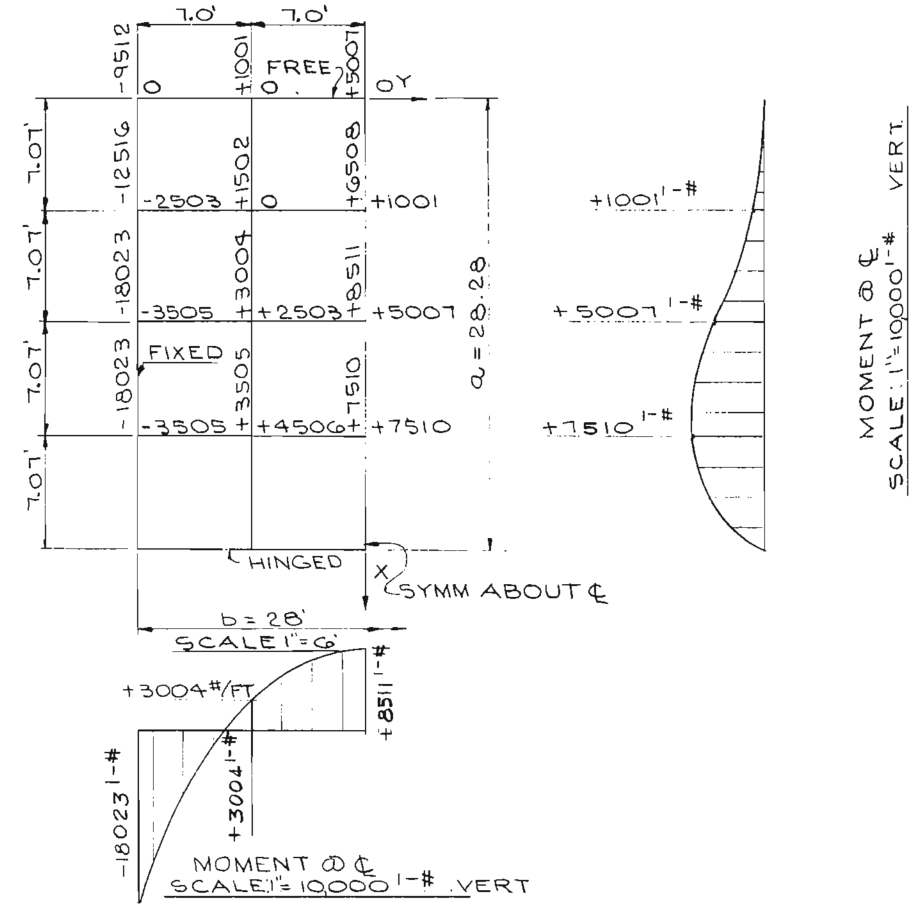


TABLE II

NOTE:
M = Wa³ x C, WHERE C IS A COEFFICIENT TAKEN FROM TABLES IN BULLETIN "CONCRETE INFORMATION NO. ST. 63, RECTANGULAR CONCRETE TANKS" PUBLISHED BY THE PORTLAND CEMENT ASSOCIATION, CHICAGO, ILL.

$As = \frac{M}{Fs\,jd} = \frac{M \times 12}{20 \times 7/8 \times 25} =$

$0.0275 \times (M^{FT}/_{K}) IN^2$

$Fc' = 3000$ psi. $Fc = 1050$, $n = 9$

$b/a = 28/28.28 = .99$ SAY 1.0

$Wa^3 = 626 (28.28)^2 = 500650$

$M = 500650 (C^{\#}/FT)$

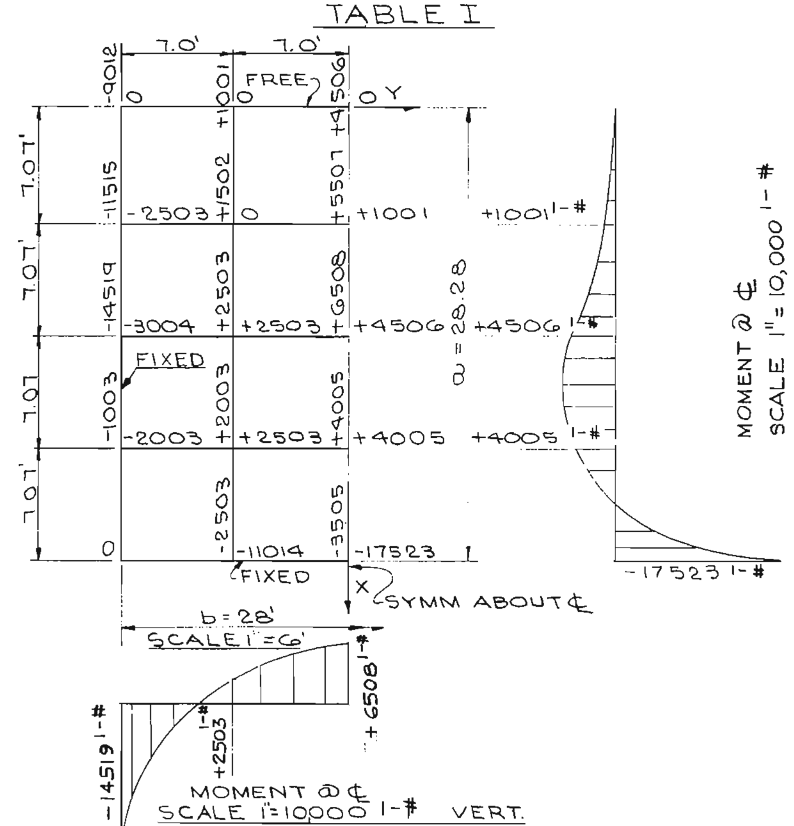
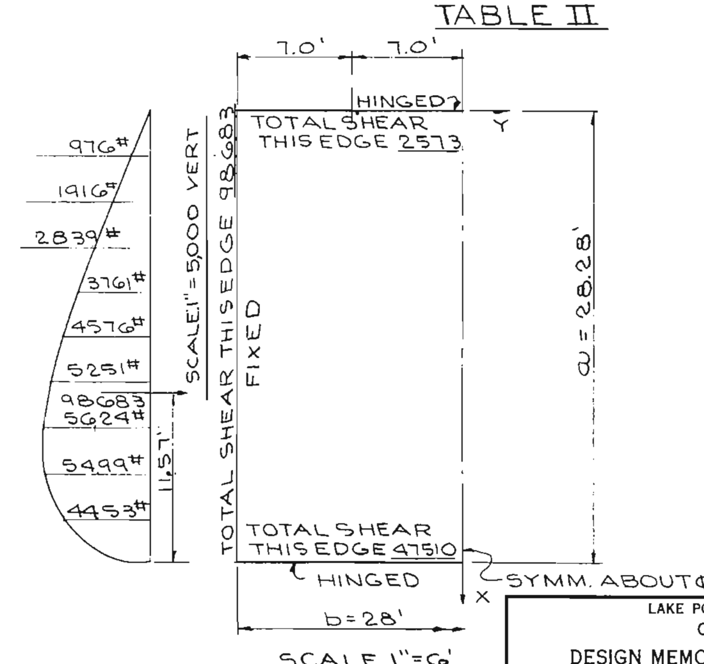


TABLE III



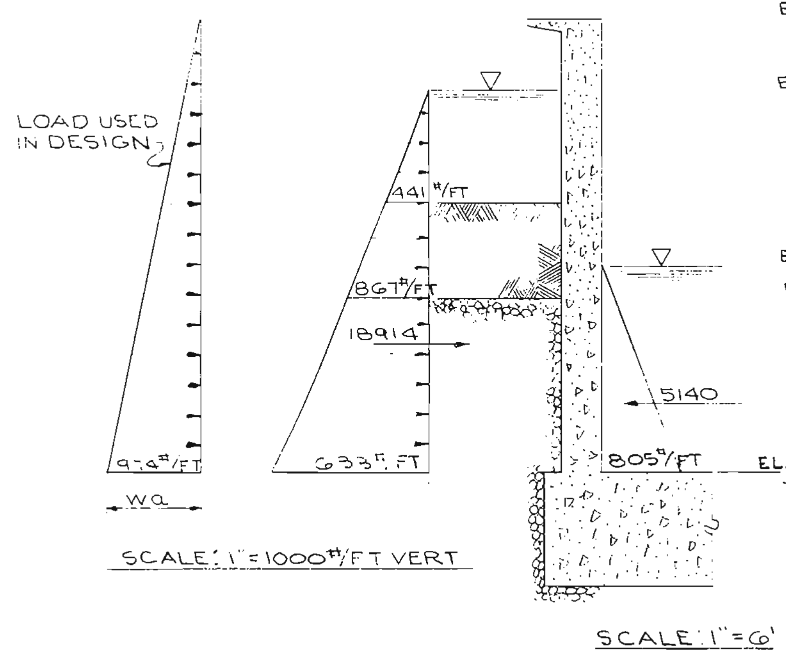
SHEARS

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

GATE BAY WALL – I

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



LOADING DIAGRAMS

LOADS SHOWN ARE FOR HURRICANE CONDITION.

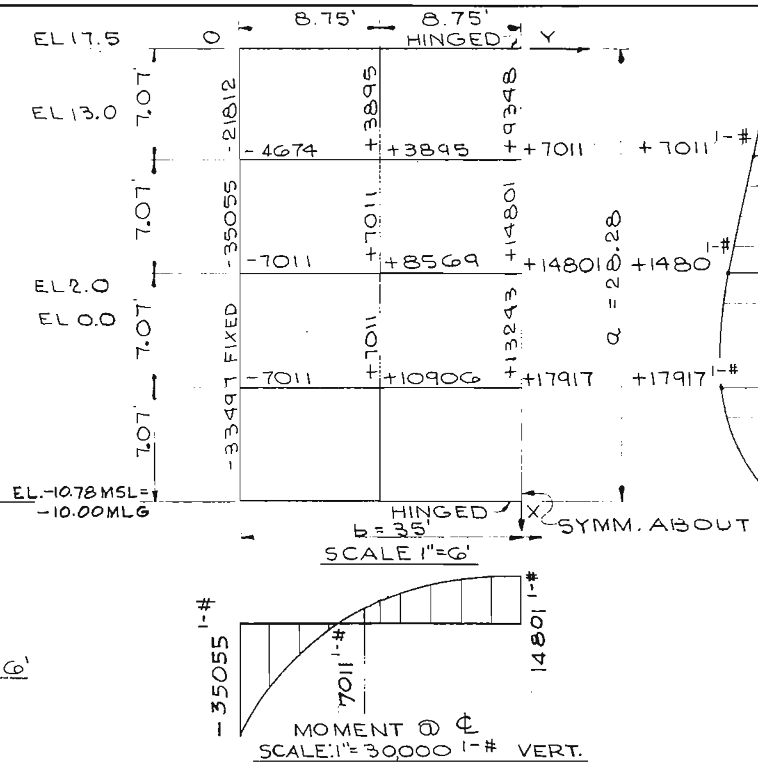


TABLE I

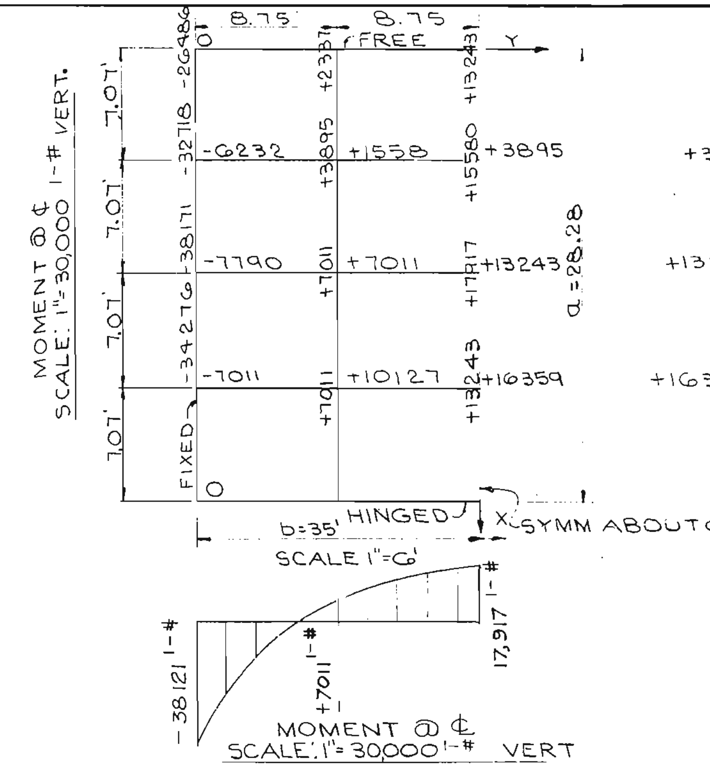


TABLE II

NOTE:

M = Wa³ x C. WHERE C IS A COEFFICIENT TAKEN FROM TABLES IN BULLETIN "CONCRETE INFORMATION NO. ST. 63, RECTANGULAR CONCRETE TANKS" PUBLISHED BY THE PORTLAND CEMENT ASSOCIATION, CHICAGO, ILL.

$As = \frac{M}{Fs\,jd} = \frac{M \times 12}{20 \times 7/8 \times 25} = 0.0275 \times (M^{FT}/K)\,IN^2$

Fc' = 3000 PSI. Fc' = 1050, n = 9

b/a = 35/28.28 = 1.24

$Wa^3 = 974(28.28)^2 = 779{,}000$

M = 779,000 (C#/FT)

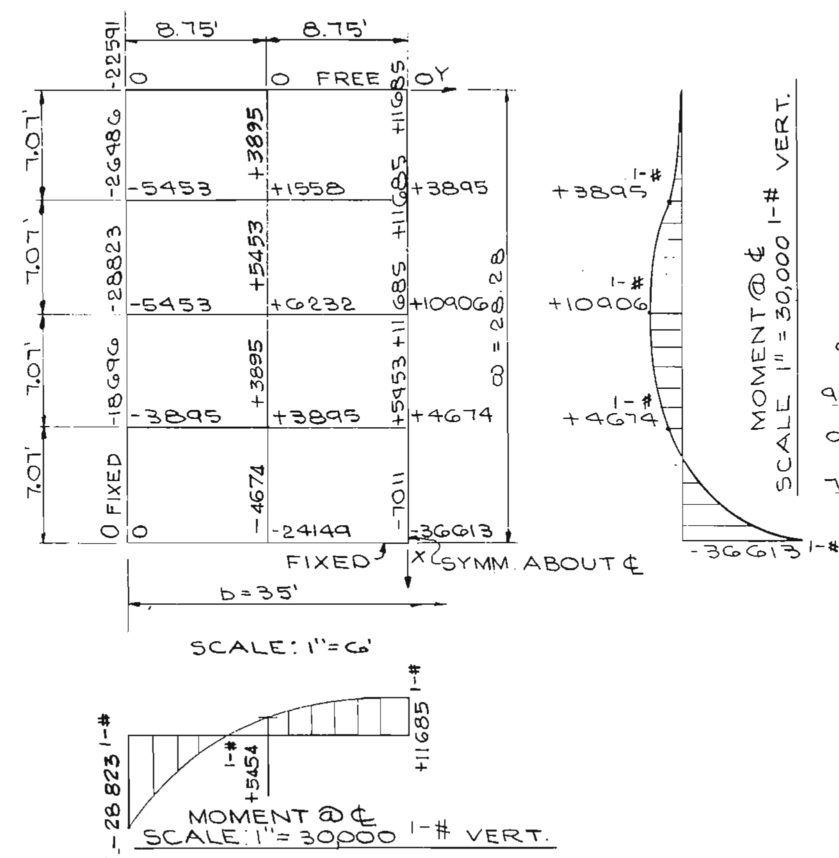
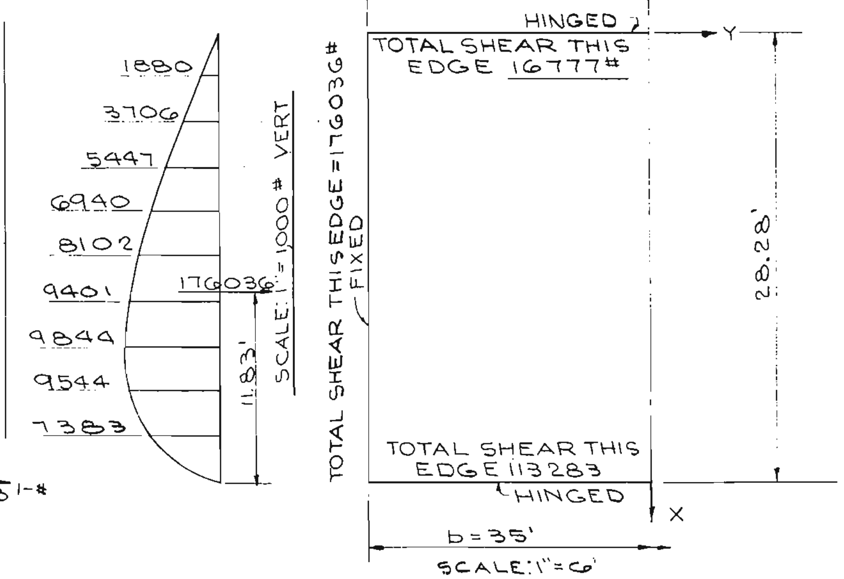


TABLE III



SHEARS

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

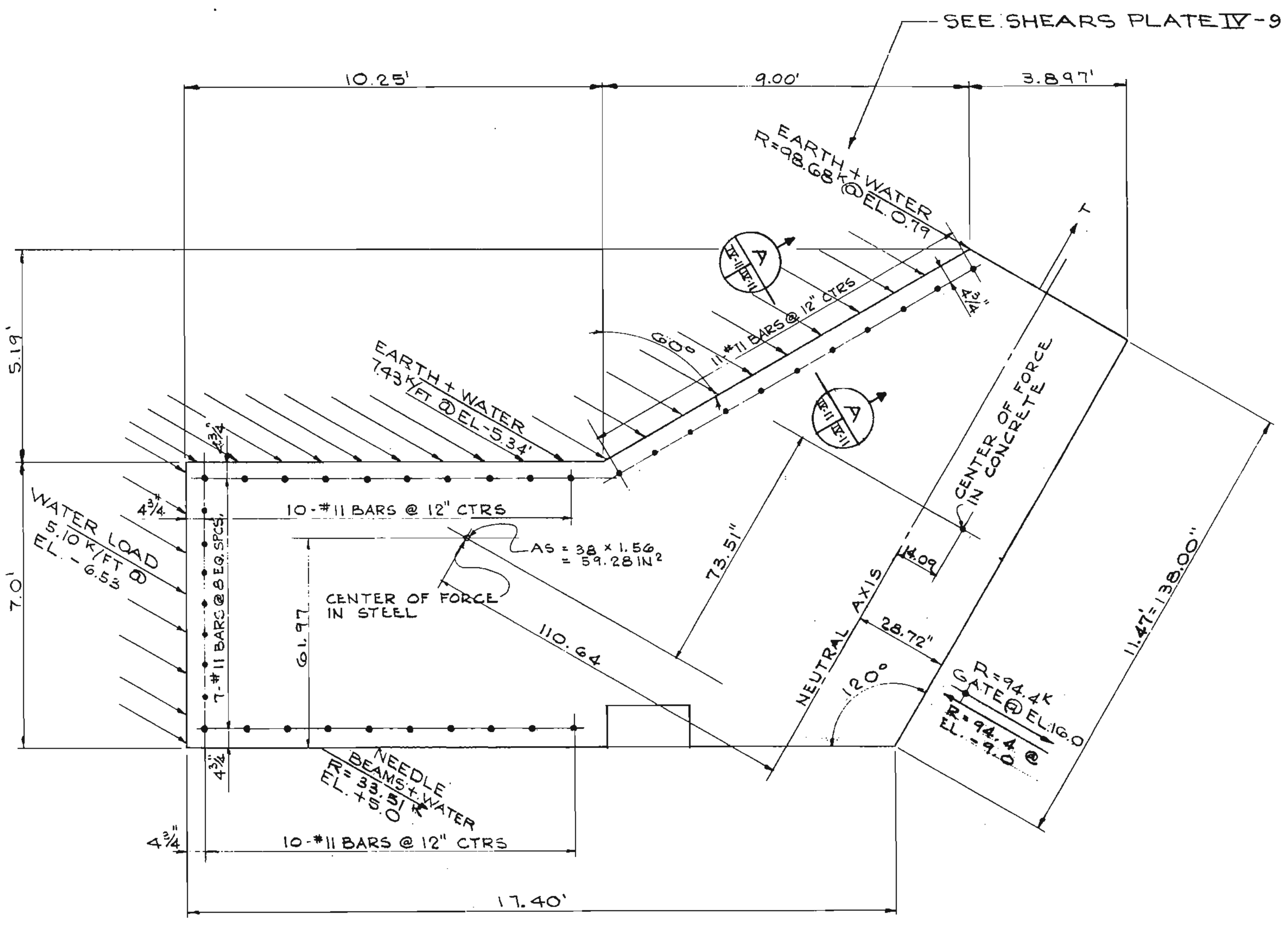
GATE BAY WALL - 2

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 | FILE NO. H-2-24147



PLAN OF WALL AT EL -10.00 M.L.G. = -10.78 M.S.L.

SCALE: 1" = 2'

CASE 3 EXCEPT GATES NOT REMOVED

(WATER AT EL. 2.0 ON LANDSIDE

TENSION IN WALL = T

fs AVERAGE = 7.512 K.S.I.
TOTAL TENSION = 455.32K
TOTAL COMP. = 455.32K

$$T = \frac{455.32\ (73.51)}{18.85\ (12)} = 144.72^K$$

$$As_1 = \frac{144.72}{20} = 7.236^{\square''} \text{ IN TOP OF WALL}$$

MOMENT AT EL. -10.00 M.L.G.

+ 94.4K x 25.00'	2360.00
+ 98.68K x 11.57	1141.73
+ 7.43 x 5.44 x 14.121	570.76
+ 5.10 x 4.25 x 6.062	131.39
+ 33.51 x 15.78	528.79
	ΣM = 4732.66 ¹·ᴷ

REINF. STEEL: $\Sigma_Y = 4204.35$ IN
$\Sigma_{Y2} = 558438.75$ IN²

NEUTRAL AXIS: 4204.35 x 9 x 1.56 = 59029

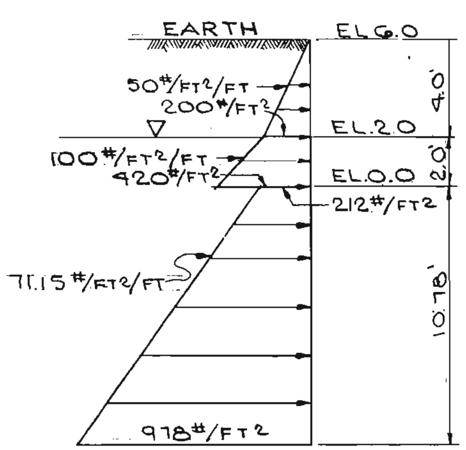
137.68 x 28.716 x 14.358 = 56766
1/2 x 28.716 x 16.58 x 9.57 = 2278
59044

$$I = \tfrac{1}{3} \times 137.68 \times 28.72^3 + 16.58 \times 28.72^3/12 + 9 \times 1.56 \times 558439 = 8959929.14 \text{ IN}^4$$

$$fs\,MAX = \frac{4732.66 \times 12 \times 187.65 \times 9}{8959929.14} = 10.70 \text{ K.S.I.}$$

$$fc\,MAX = \frac{4732.66 \times 12 \times 28.72}{8959929.14} = 0.182 \text{ K.S.I.}$$

fc' = 3000 psi
fc = 1050 psi
fs = 20,000 psi
n = 9



SECTION (A) IV-11 IV-11

SCALE 1" = 400#/FT²

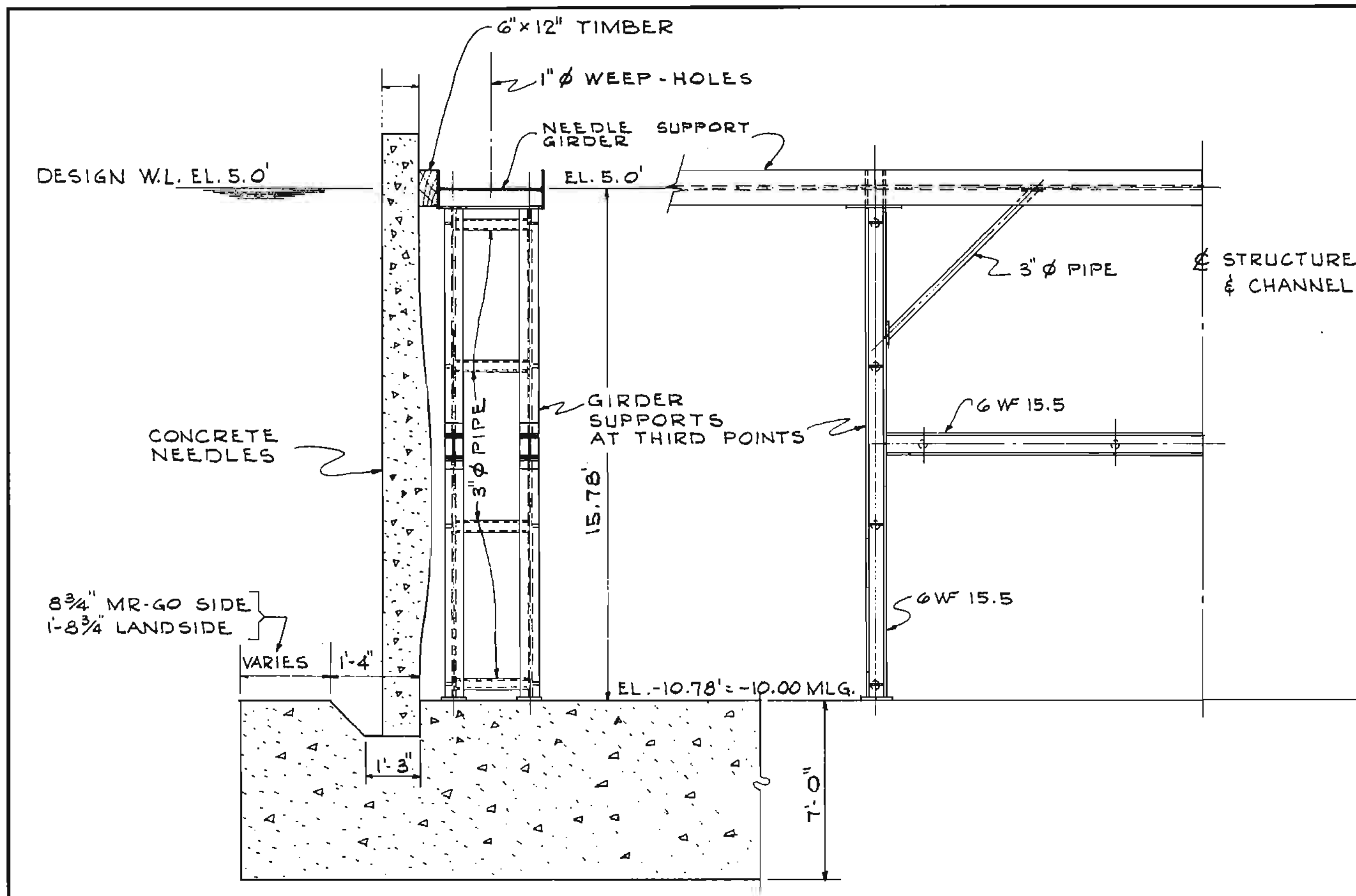
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

GATE BAY WALL-3

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

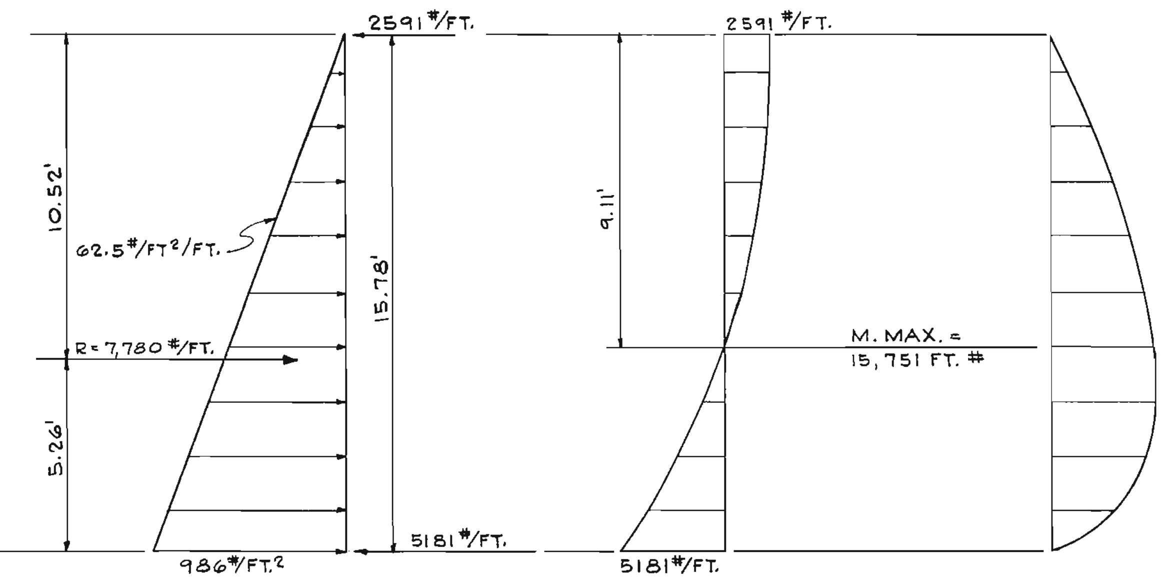
PLATE NO. IV-11



SECTION THRU NEEDLE DAM

N. T. S.

22 NEEDLES REQUIRED TO BE STORED AT ONE STRUCTURE



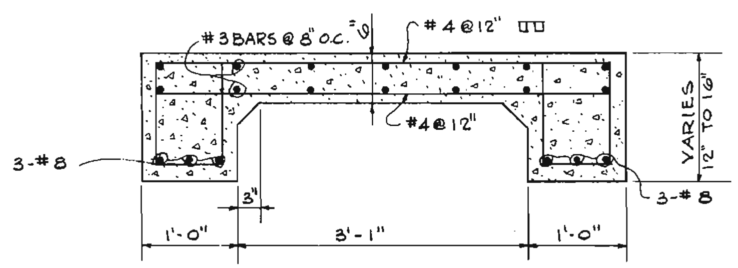
LOAD

SHEAR

MOMENT

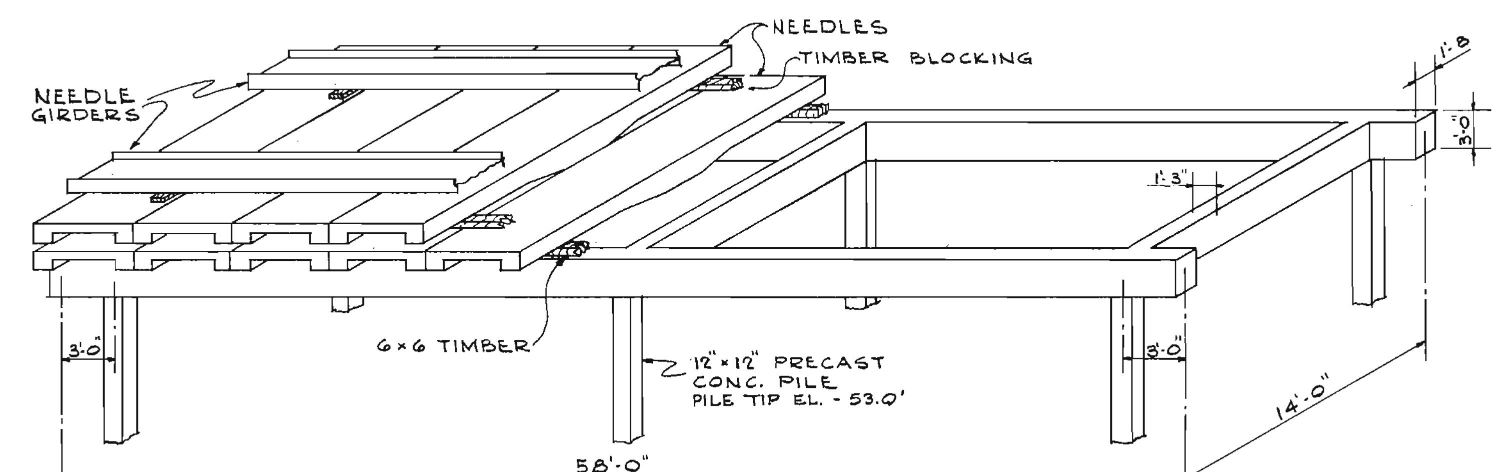
NEEDLE BEAMS

N. T. S.



SECTION THRU NEEDLE

N. T. S.



ISOMETRIC VIEW OF NEEDLE DAM STORAGE RACK

(BAYOU BIENVENUE STRUCTURE ONLY)

(SEE PLATE I-7 FOR LOCATION)

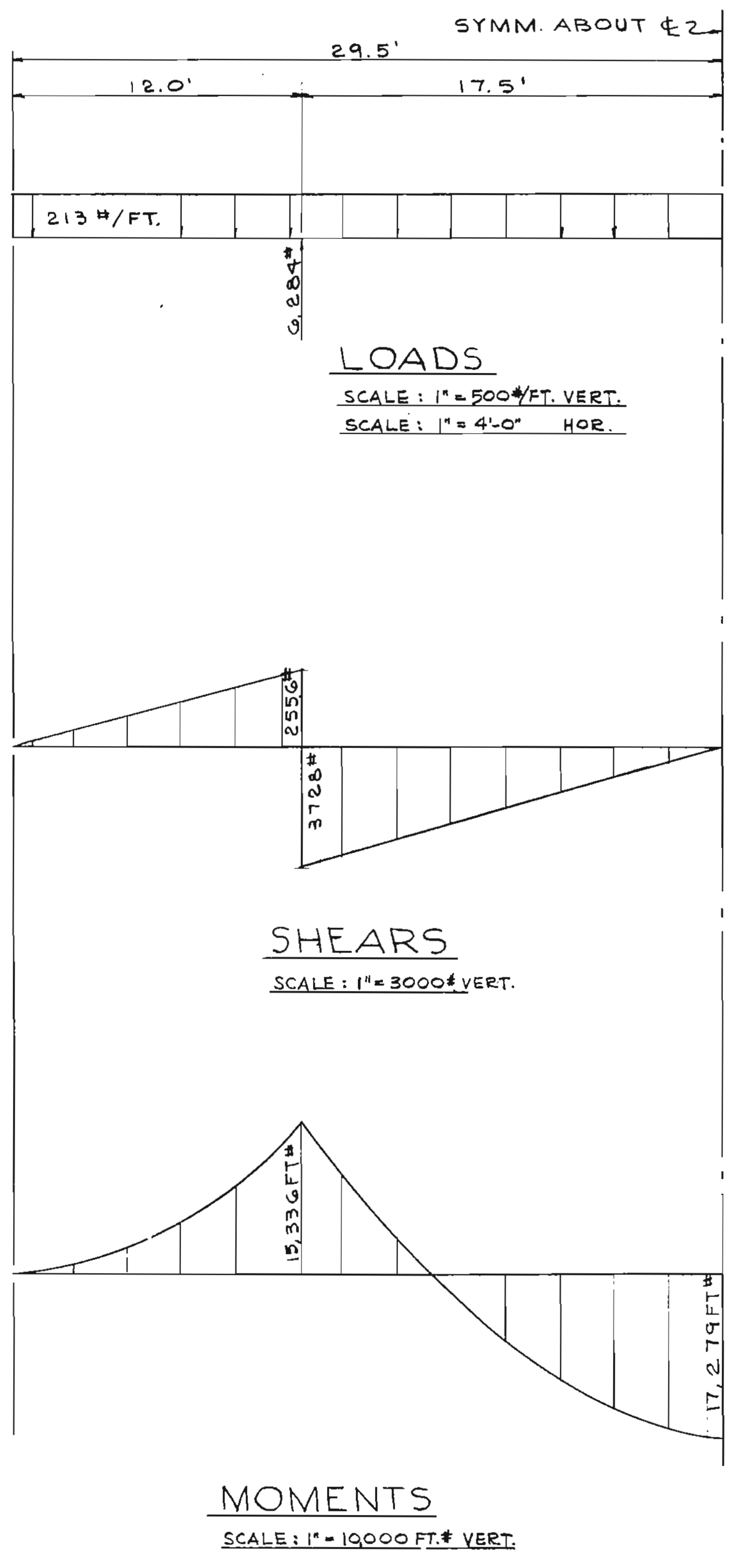
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

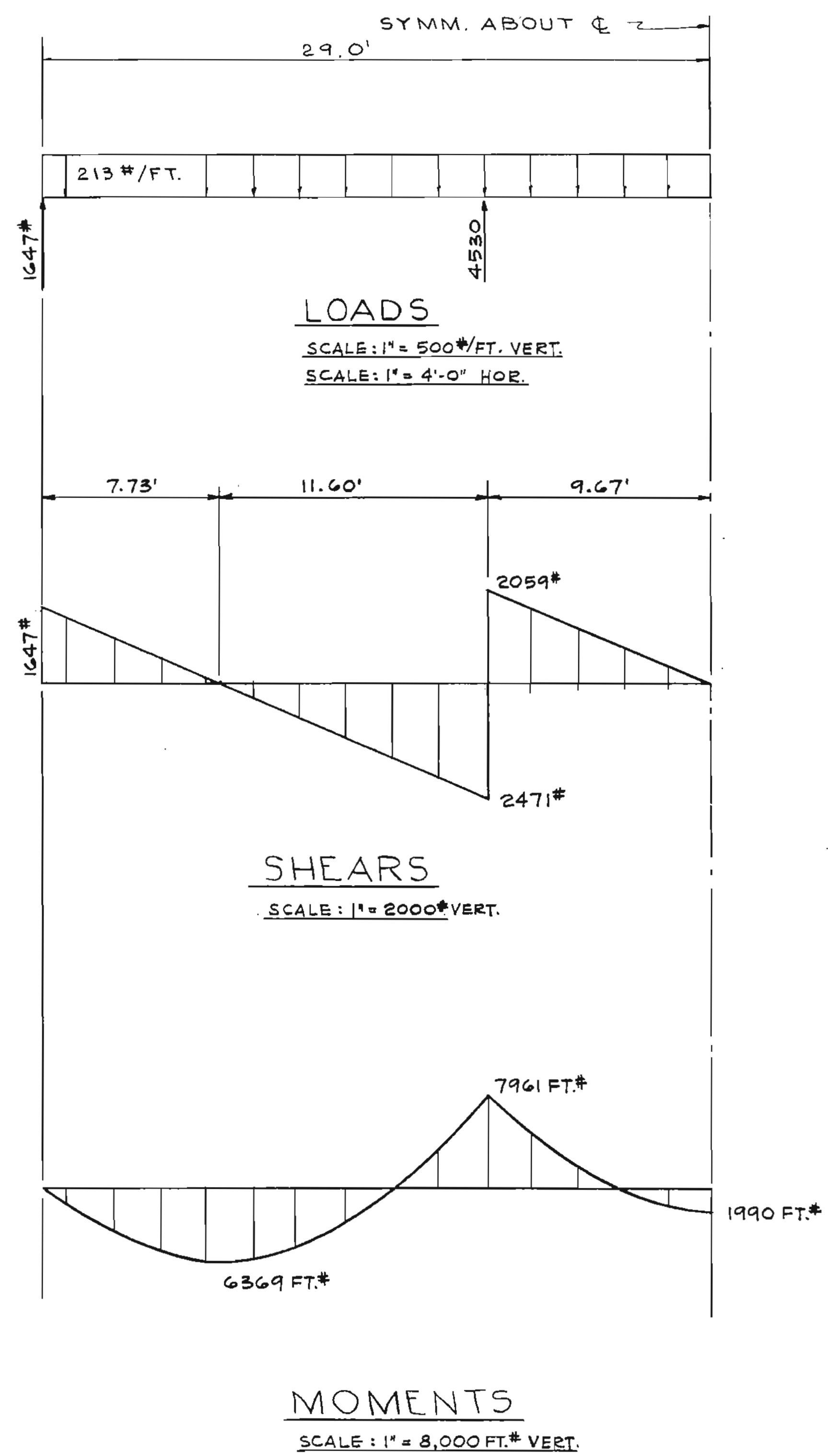
NEEDLE DAM

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147

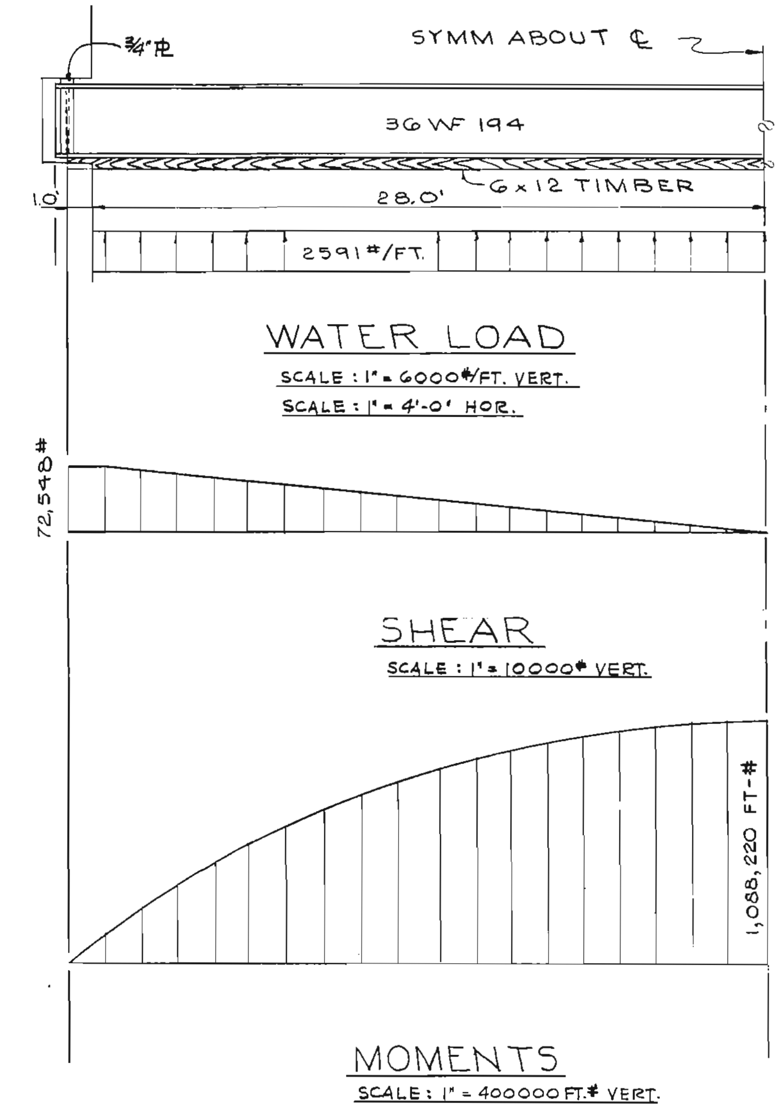


LIFTING STRESSES



DEAD LOAD OF GIRDER

2 GIRDERS ARE REQUIRED



WATER LOADS

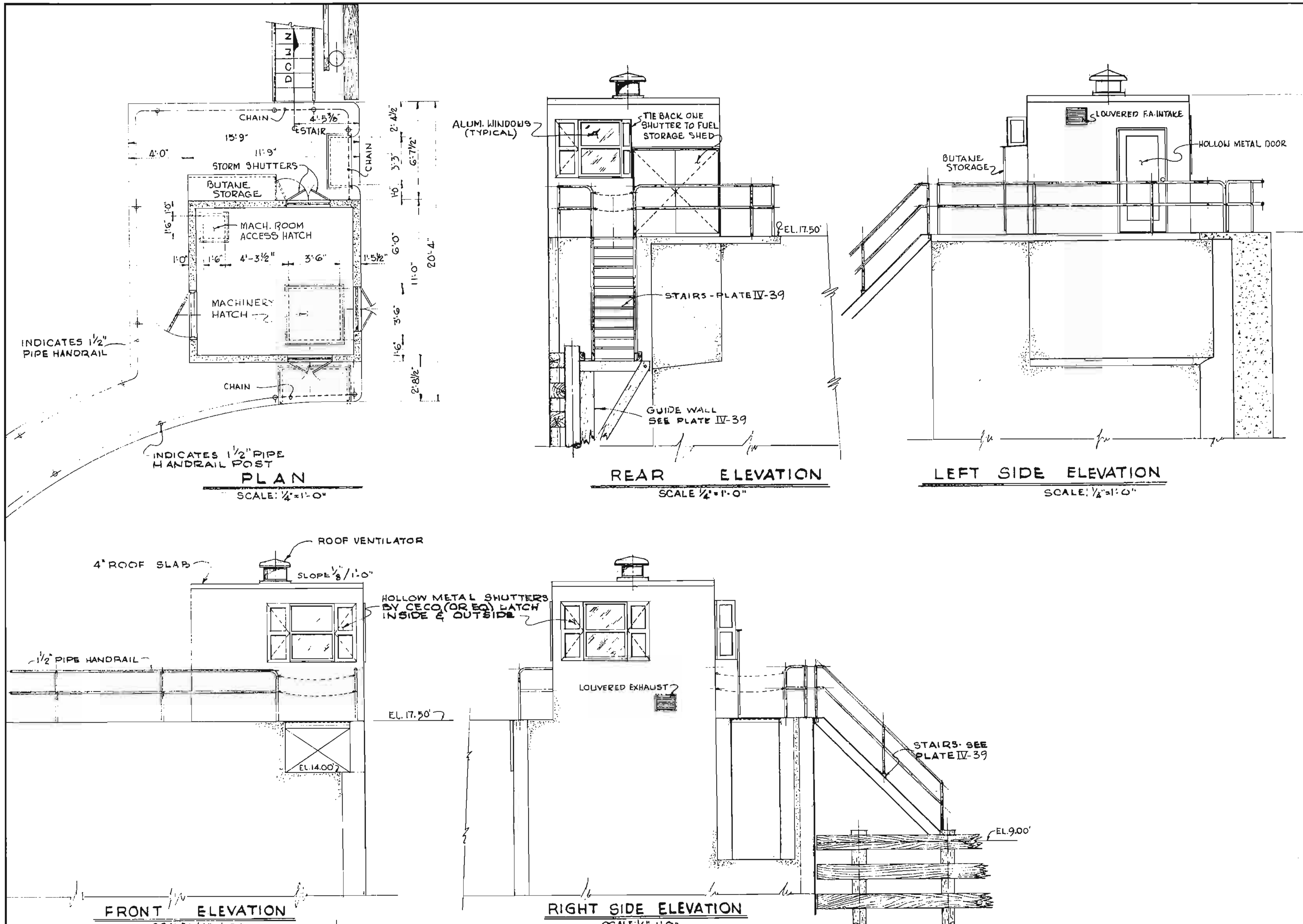
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

NEEDLE GIRDER

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-13



NOTES

FOR MECHANICAL DWGS. SEE SECTION V

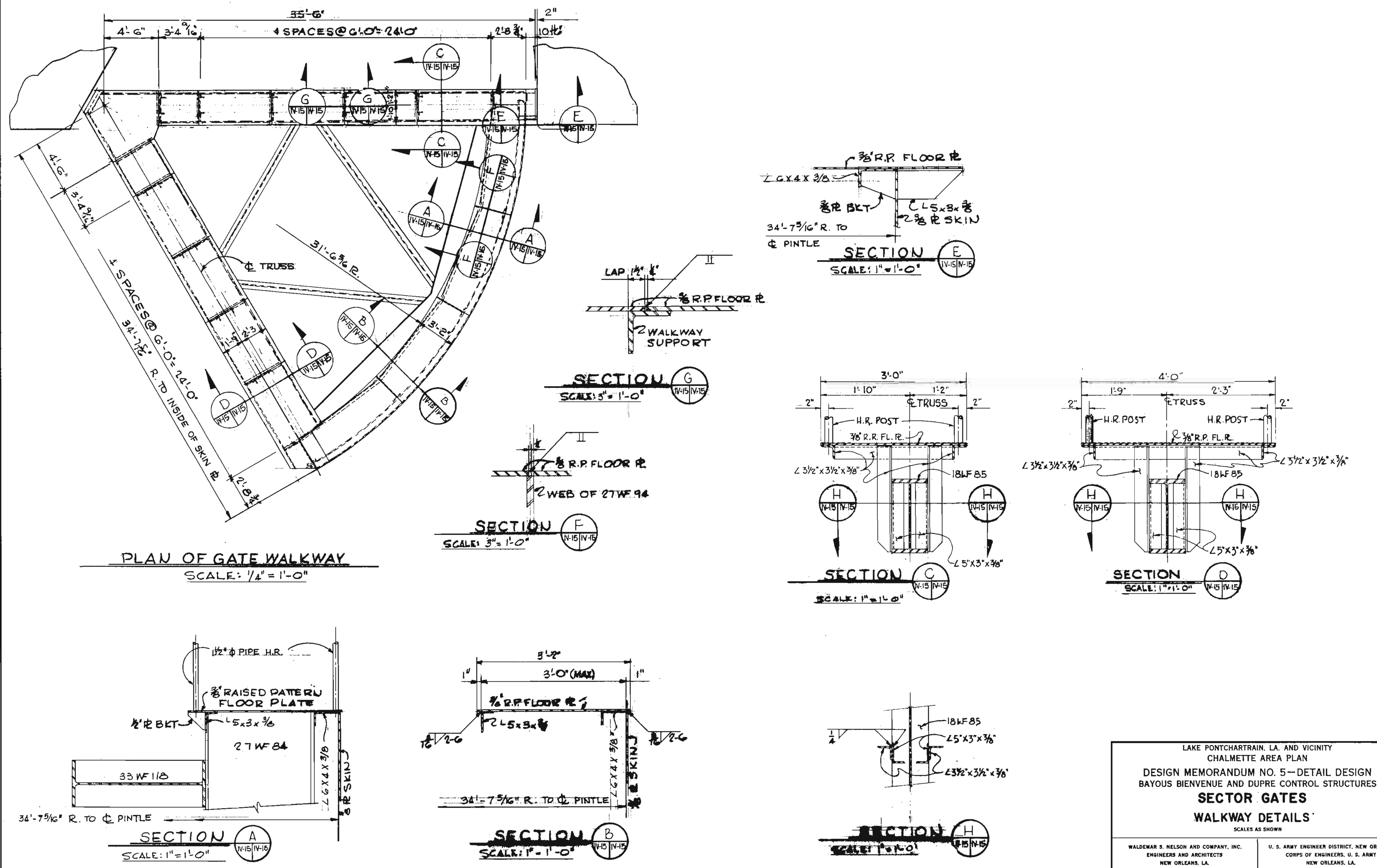
FOR ELECTRICAL DWGS SEE SECTION VI

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

CONTROL HOUSE

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

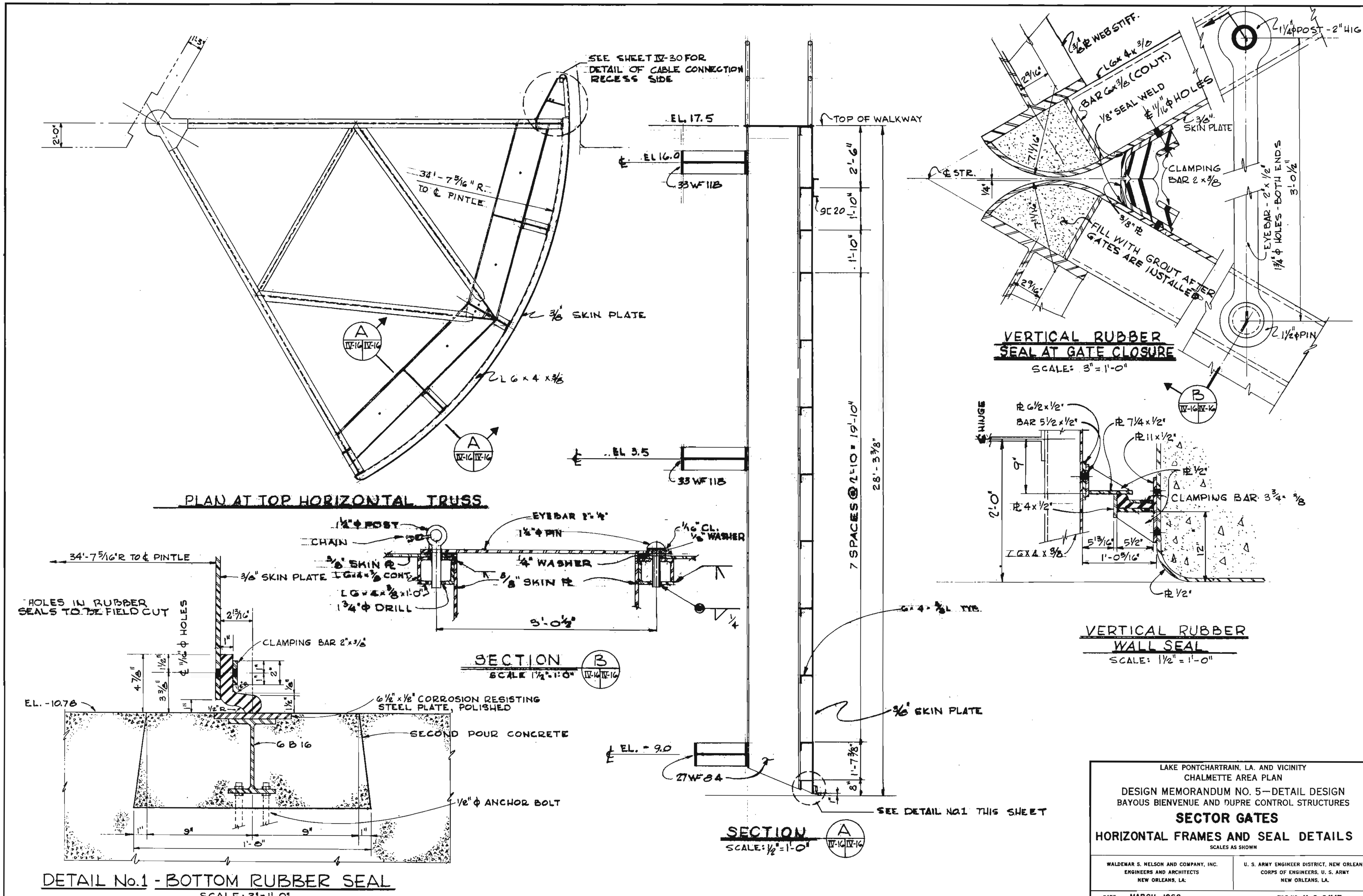
SECTOR GATES

WALKWAY DETAILS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-15

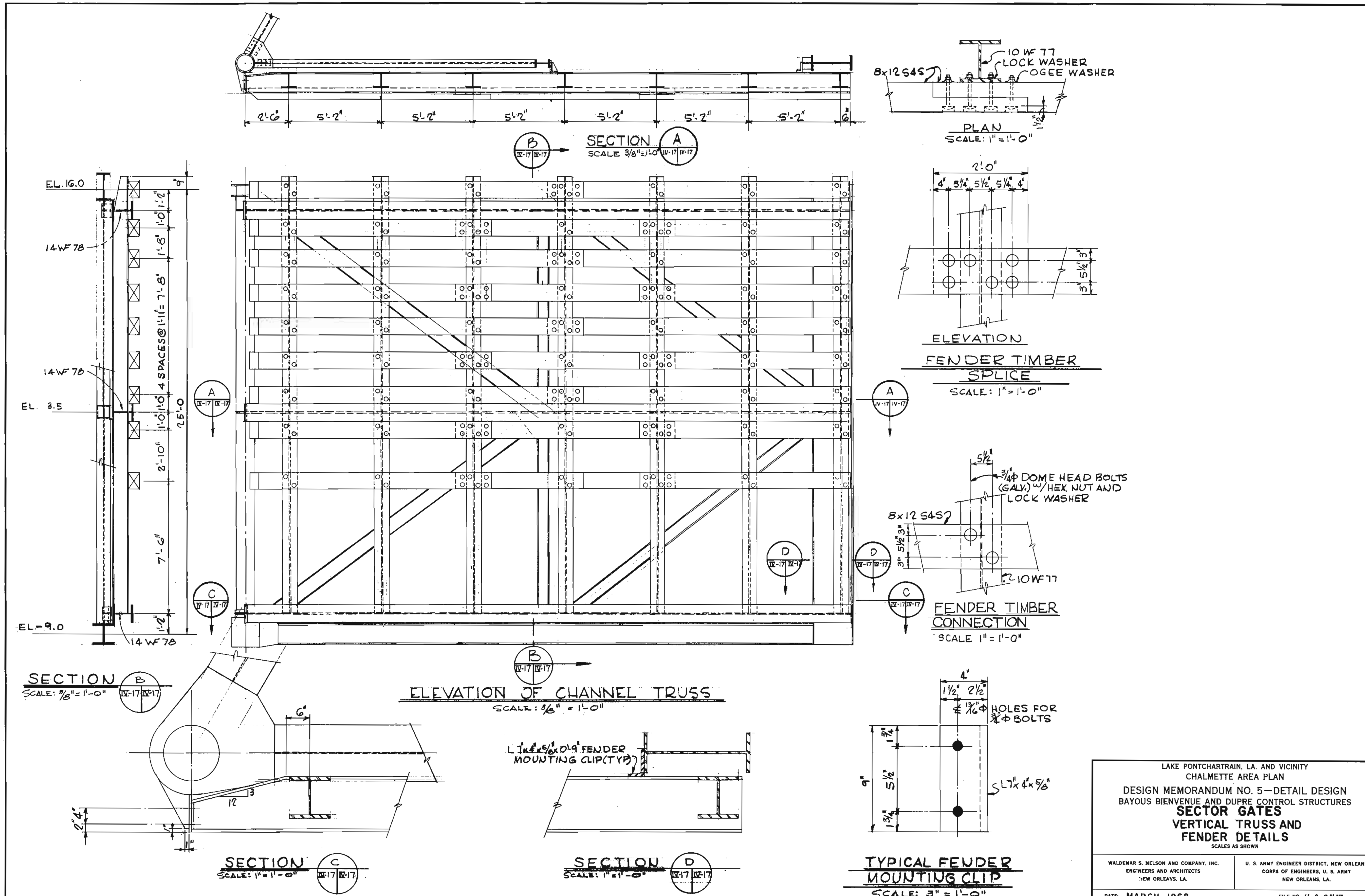


LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES
SECTOR GATES
HORIZONTAL FRAMES AND SEAL DETAILS
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE: MARCH, 1968 FILE NO. H-2-24147



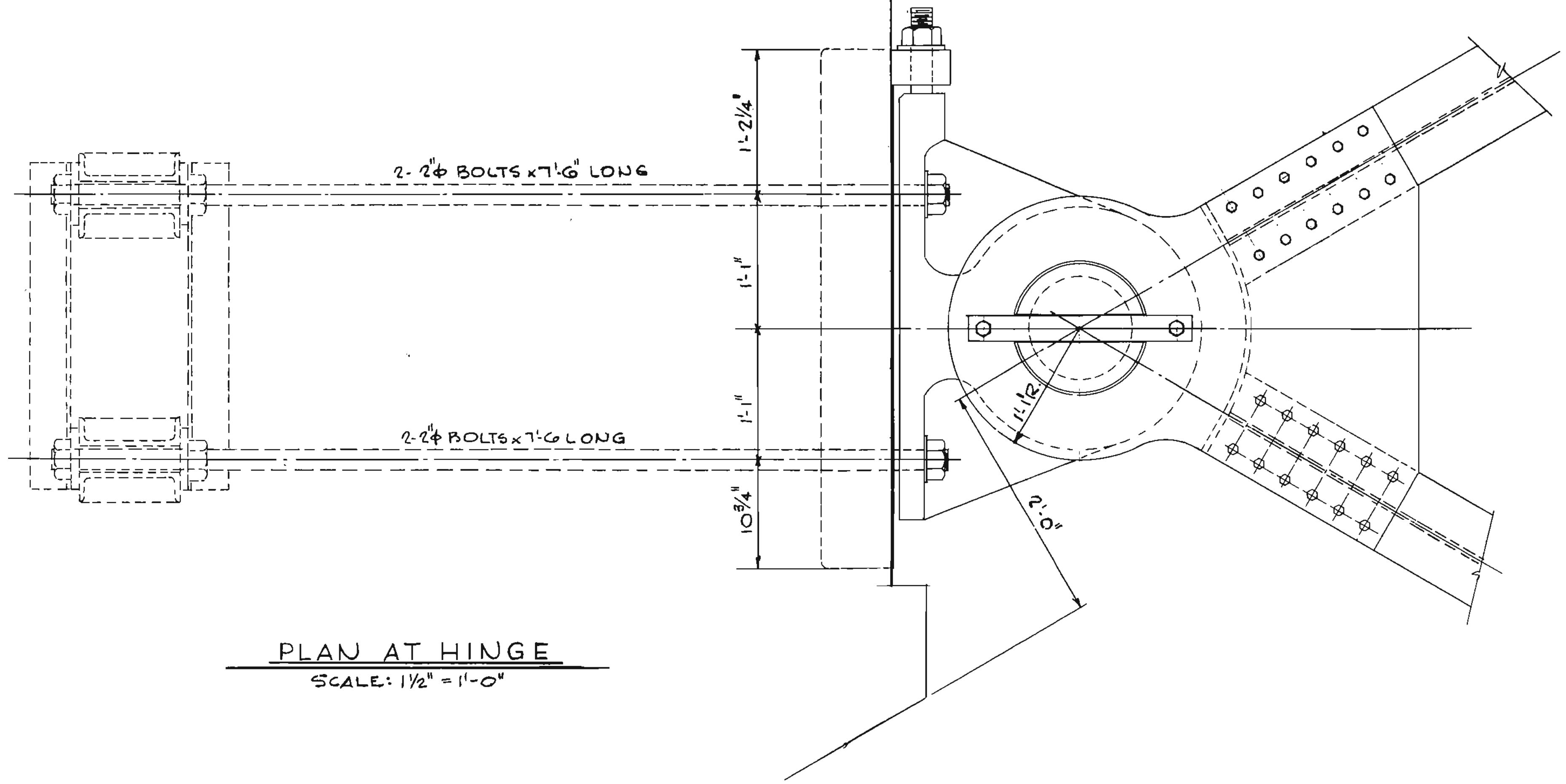
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

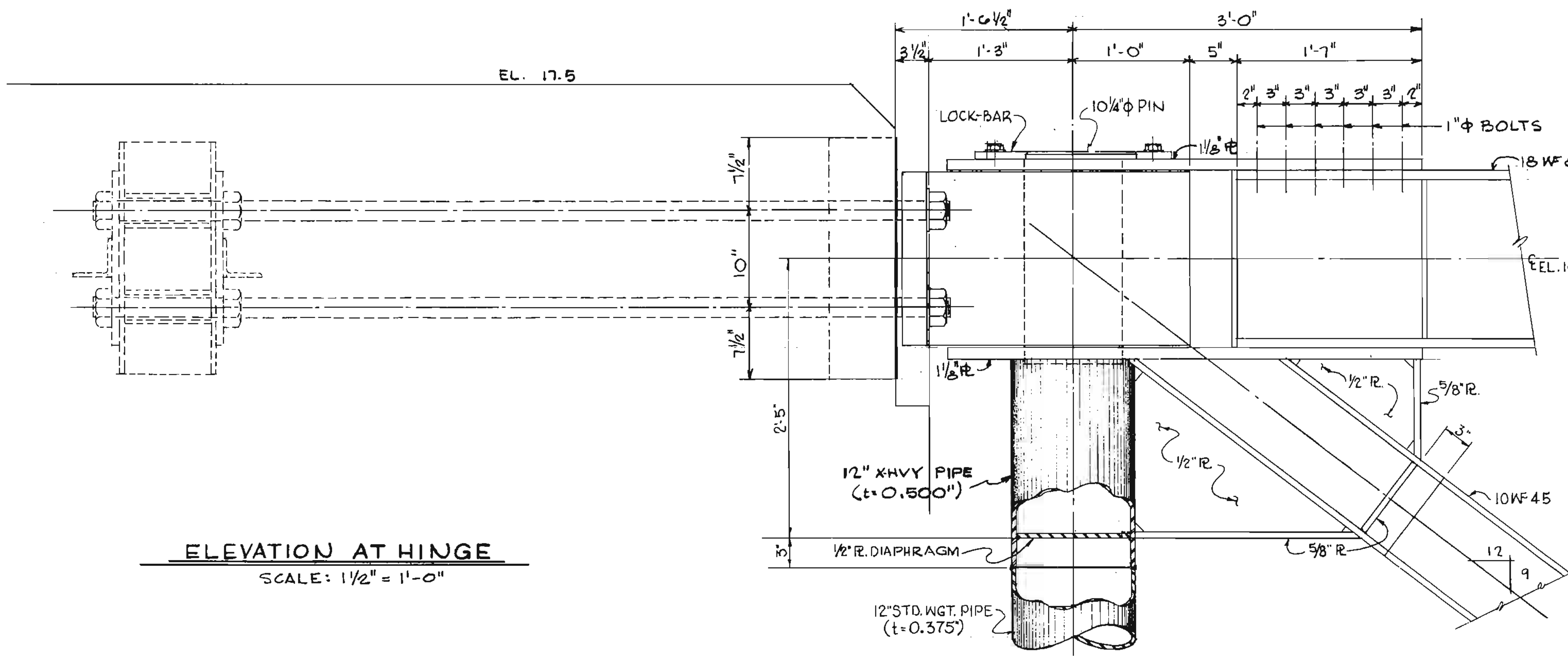
SECTOR GATES
VERTICAL TRUSS AND FENDER DETAILS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147



PLAN AT HINGE
SCALE: 1 1/2" = 1'-0"

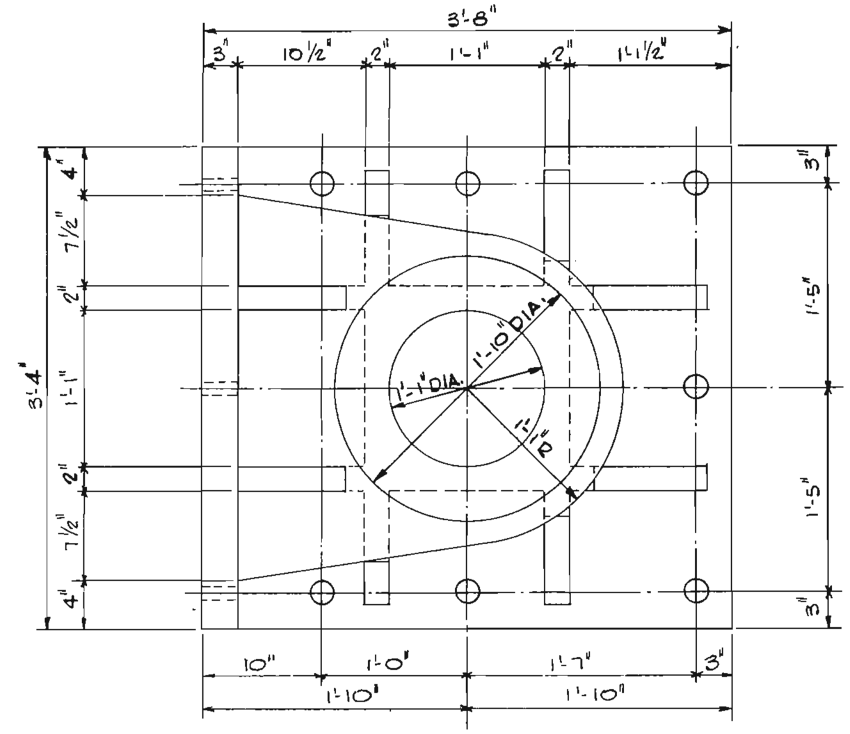


ELEVATION AT HINGE
SCALE: 1 1/2" = 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

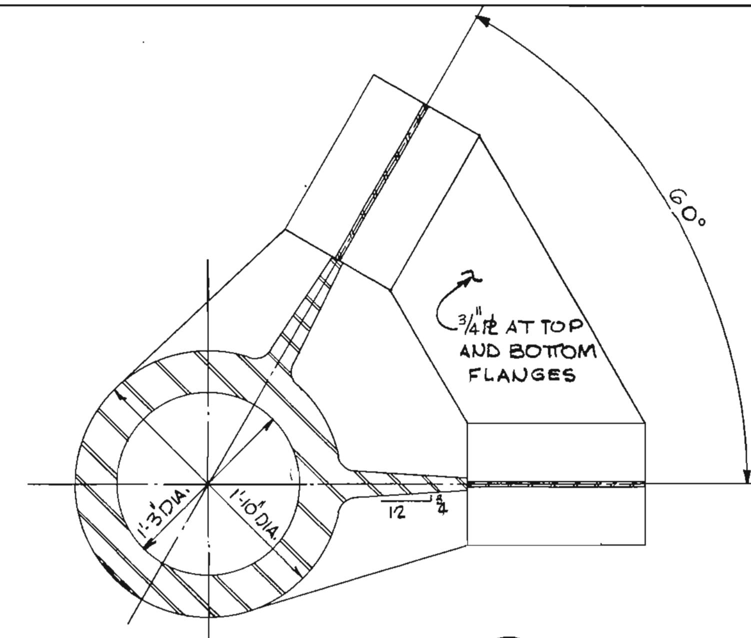
SECTOR GATES
HINGE DETAILS
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



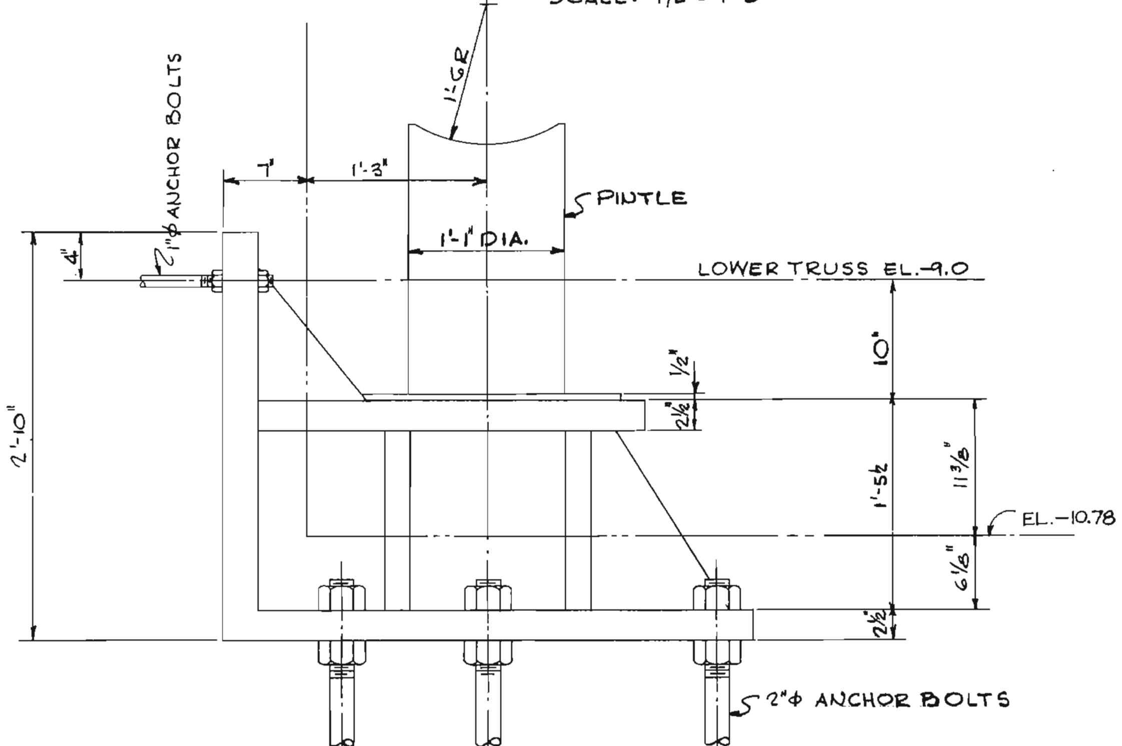
PLAN OF LOWER PINTLE CASTING

SCALE: 1 1/2" = 1'-0"



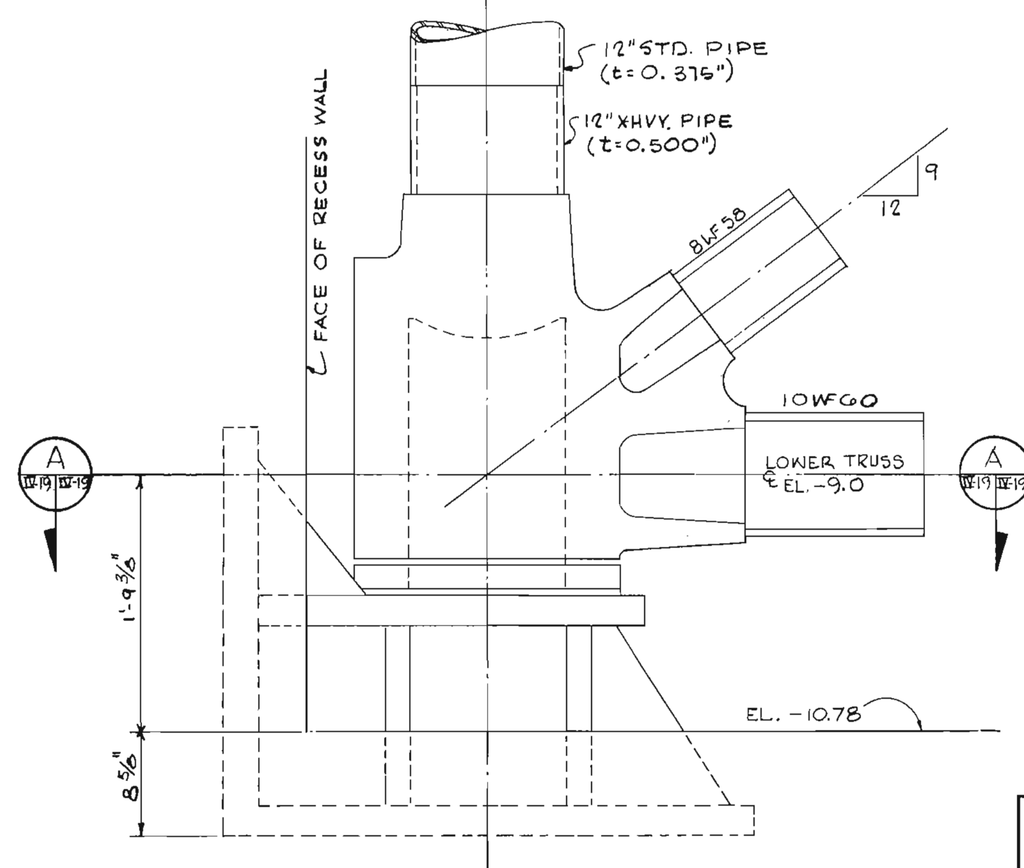
SECTION A (IV-19 / IV-19)

SCALE: 1 1/2" = 1'-0"



ELEVATION OF PINTLE

SCALE: 1 1/2" = 1'-0"



ELEVATION SHOWING UPPER PINTLE CASTING

SCALE: 1 1/2" = 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
PINTLE DETAILS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

MAX. LOAD: 688#/SQ. FT.

3/8" SKIN PLATE

$S = \frac{1}{6} \times 12 \times (\frac{3}{8})^2 = 0.281\ IN.^3$

$M_{MAX.} = \frac{688 \times \ell^2 \times 12}{12} = 688\ \ell^2\ IN.\#$

$\frac{688\ \ell^2}{0.281} = 20{,}000\ P.S.I.$

$\ell = 2.86'$

MAX. SPAN ALLOWED 2.86' (USE 2'-10")

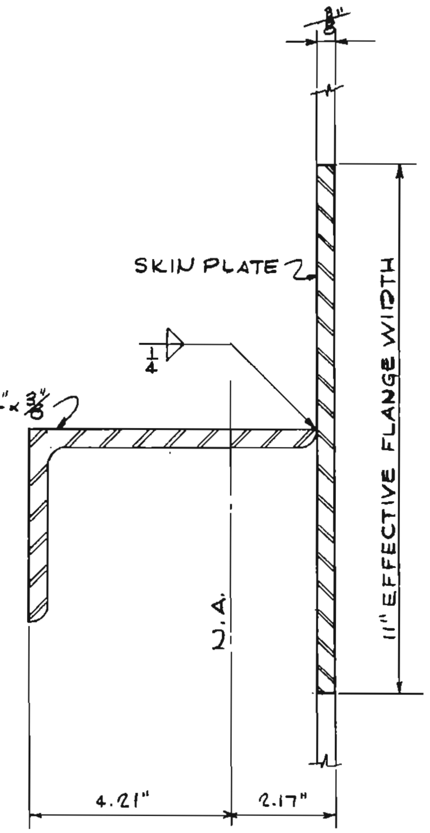
END SPAN

$M_{MAX} = \frac{1}{10} \times 688 \times (1.609)^2 \times 12$

$M_{MAX} = 2{,}138\ IN\#$

$f_b = \frac{2{,}138}{0.281} = 7609\ P.S.I. < 20{,}000\ P.S.I.$

SKIN PLATE DESIGN



SCALE: HALF-SIZE

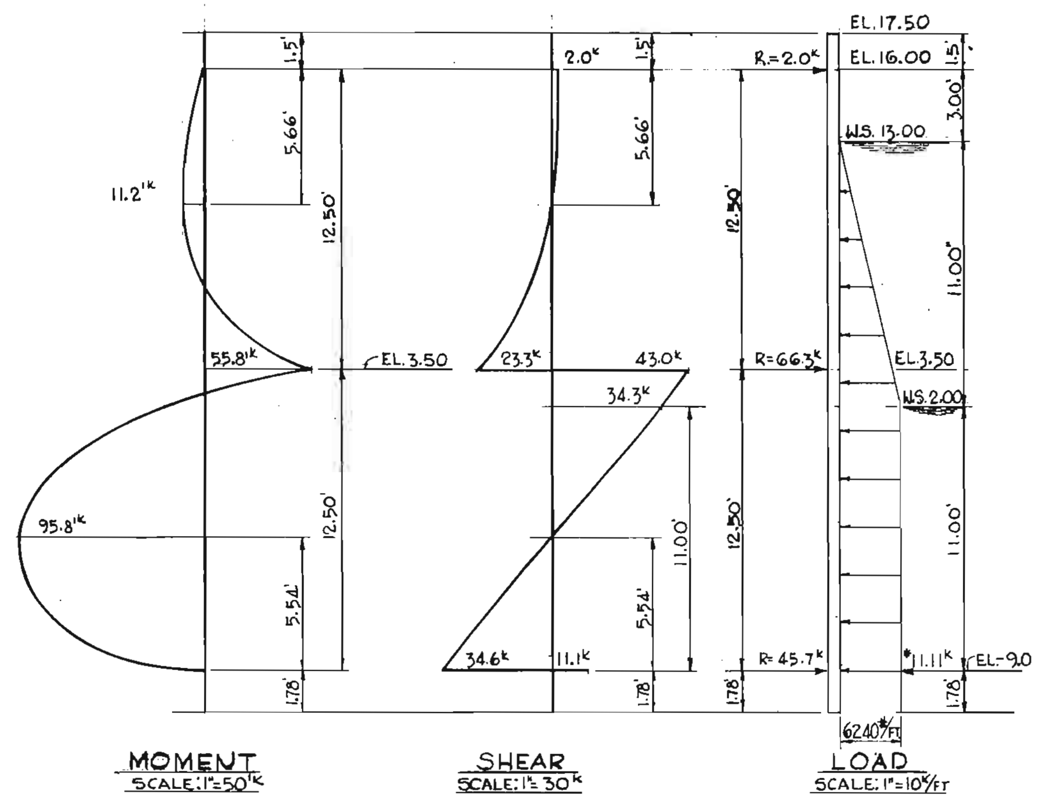
$M_{MAX.} = 16.66^{1K}$

$f_{b_{MAX.}} = \frac{16.66 \times 12}{11.51} = 17{,}370\ PSI < 18{,}000\ PSI$

$V_{MAX.} = \frac{10{,}670 \times 12.97}{48.41 \times .375} = 7{,}625\ PSI < 12{,}000\ PSI$

USE 1/4" WELD

HORIZONTAL RIB



MOMENT SCALE: 1"=50'K — SHEAR SCALE: 1"=30K — LOAD SCALE: 1"=10K/FT

HURRICANE LOADING - 11'-0" DIFFERENTIAL HEAD
9.07' SPACING OF SUPPORTS
VERT. SCALE: 1"=4'

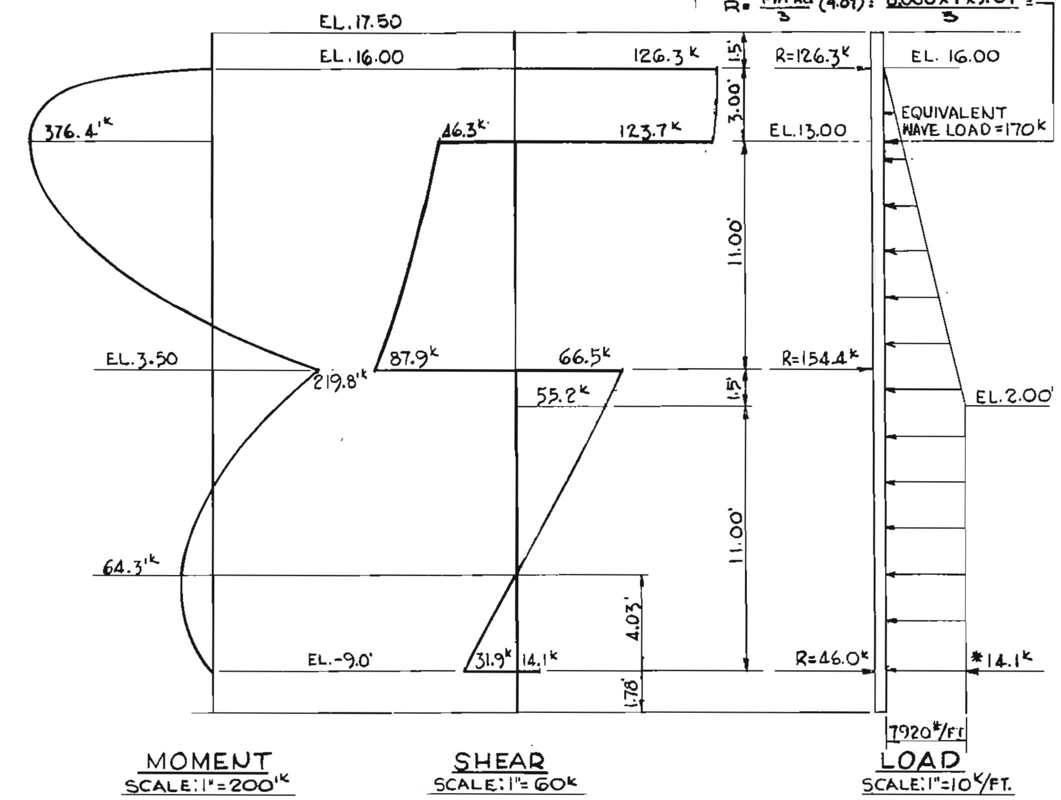
EQUIVALENT WAVE LOAD AS DETERMINED BY THE MINIKIN METHOD REF. PAGE 256 SHORE PROTECTION, PLANNING & DESIGN TECHNICAL REPORT #4

$P_m = 101 \frac{H}{L} w \frac{d}{D}(D+d)$

$P_m = \frac{101 \times 7 \times 62.5}{226.6} \times \frac{23.78}{33.4}(33.0+23.78)$

$P_m = 8000\ PSF$

$R = \frac{P_m H d}{3}(4.07) = \frac{8{,}000 \times 7 \times 9.07}{3}$



MOMENT SCALE: 1"=200'K — SHEAR SCALE: 1"=60K — LOAD SCALE: 1"=10K/FT.

HURRICANE WAVE LOADING
9.07' SPACING OF SUPPORTS

M MAX. = 376.4'K

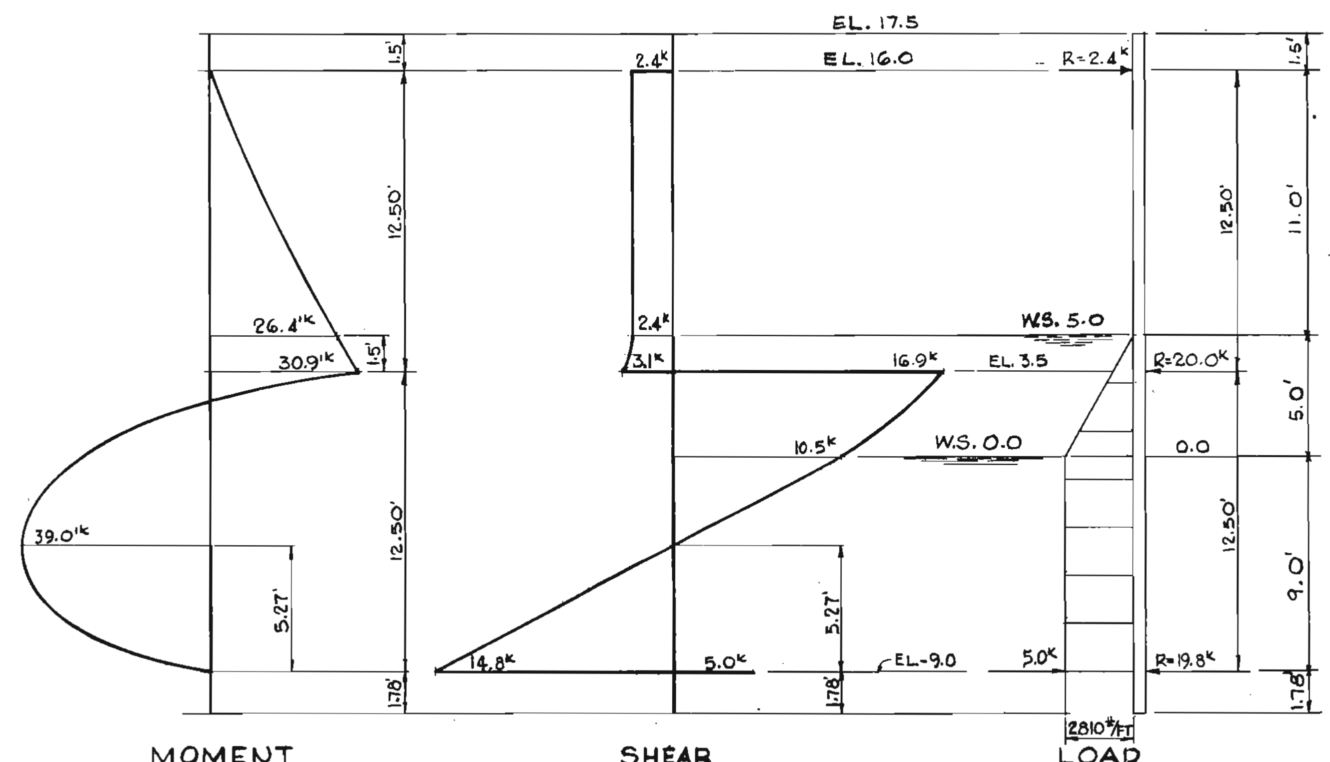
$S\ REQUIRED = \frac{376.4 \times 12}{26.50} = 170.4\ IN^3$

USE 27 WF 84 ($S = 211.7\ IN^3$)

VERTICAL SKIN PLATE SUPPORTS

* CONCENTRATED LOAD APPLIED AT EL.-9.00 IS THE EFFECT OF WATER PRESSURE ON THE SMALL CANTILEVER SECTION BELOW EL.-9.00.

THE LOADS, SHEARS, AND MOMENTS SHOWN WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN I.B.M. 1130 COMPUTER AND THE "STRESS" PROGRAM. SEE PLATE NO. IV-23 FOR LOADING CONDITIONS.



MOMENT SCALE: 1"=20'K — SHEAR SCALE: 1"=6K — LOAD SCALE: 1"=4K/FT.

REVERSED HEAD CONDITION - 5'-0" DIFFERENTIAL HEAD 9.07' SPACING OF SUPPORTS

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

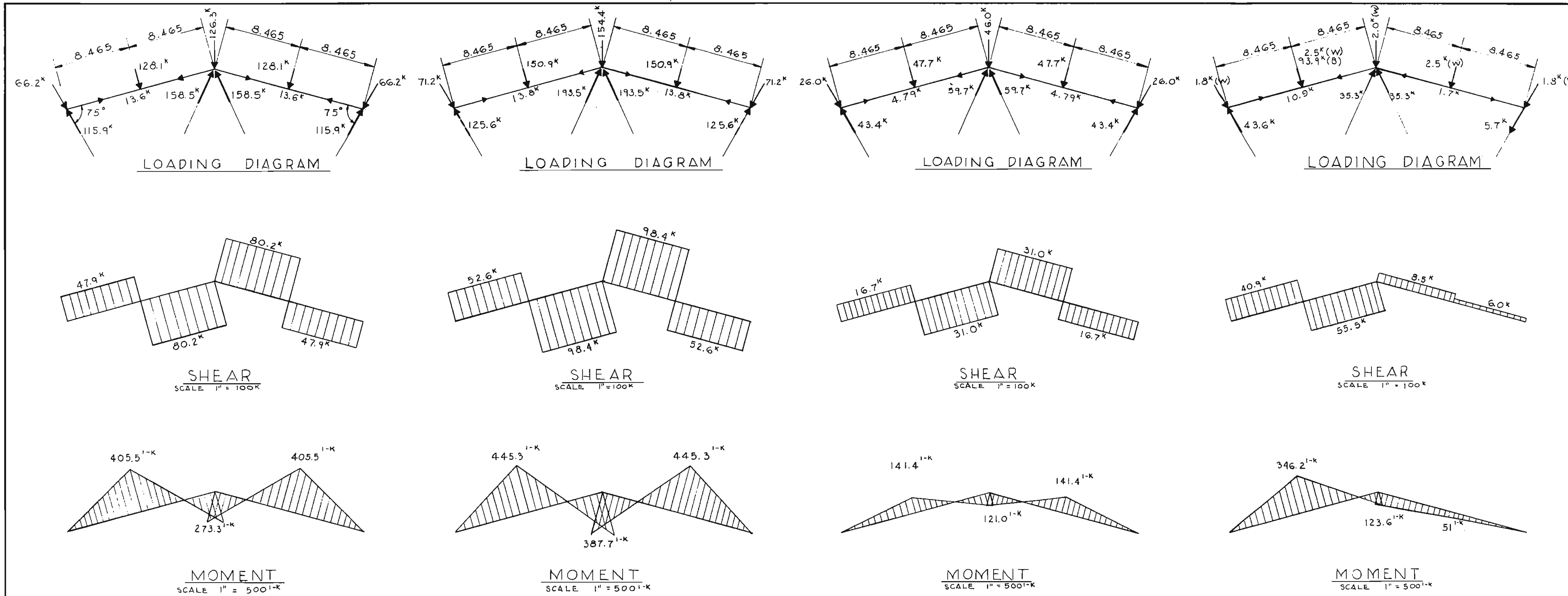
SECTOR GATES
SKIN PLATE & SUPPORTS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE: MARCH, 1968 — FILE NO. H-2-24147



TOP GIRDER — CENTER GIRDER — BOTTOM GIRDER — TOP GIRDER

CASE V DL + W + WAVE

CASE VI-A DL + BOAT LOAD

Top Girder (Case V)

MAX. MOMENT = $405.5^{1\text{-}K}$

TRY 33 WF 118 S = 358.3 IN^3 A = 34.71 SQ.IN.

$f_b = \frac{405.5\,(12)}{358.3} = 13.6$ K.S.I. $F_B = 26.5$ K.S.I.

$\frac{\ell}{r} = \frac{8.465\,(12)}{2.22} = 46$

F_A = 24.9 K.S.I.

$f_A = \frac{13.6}{34.71} = 0.4$ K.S.I.

$\frac{0.4}{24.9} + \frac{13.6}{26.5} = .008 + .513 = .521 < 1.0$

USE 33 WF 118

Center Girder (Case V)

MAX. MOMENT = $445.3^{1\text{-}K}$

TRY 33 WF 118 S = 358.3 IN^3 A = 34.71 SQ.IN.

$f_b = \frac{445.3\,(12)}{358.3} = 14.9$ K.S.I. $F_B = 26.5$ K.S.I.

$\frac{\ell}{r} = \frac{8.465\,(12)}{2.22} = 46$

F_A = 24.9 K.S.I.

$f_A = \frac{13.8}{34.71} = 0.4$ K.S.I.

$\frac{0.4}{24.9} + \frac{14.9}{26.5} = .008 + .562 = .570 < 1.0$

USE 33 WF 118

Bottom Girder (Case V)

MAX. MOMENT = $141.4^{1\text{-}K}$

TRY 27 WF 84 S = 98.2 IN^3 A = 24.71 SQ.IN.

$f_b = \frac{141.4\,(12)}{98.2} = 17.3$ K.S.I. $= F_B = 26.5$ K.S.I.

$\frac{\ell}{r} = \frac{8.465\,(12)}{1.97} = 52$

F_A = 24.2 K.S.I.

$f_A = \frac{4.79}{24.71} = 0.2$ K.S.I.

$\frac{0.2}{24.2} + \frac{17.3}{26.5} = .008 + .653 = .661 < 1.0$

USE 27 WF 84

Top Girder (Case VI-A)

MAX MOMENT = $346.2^{1\text{-}K}$

AXIAL FORCE = 10.9K

THIS CASE DOES NOT EXCEED CASE V AND THEREFORE DOES NOT GOVERN.

(W) WATER LOAD REACTION ON TOP GIRDER

(B) BOAT LOAD REACTION ON TOP GIRDER

THE LOADS, SHEARS AND MOMENTS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN I.B.M. 1130 COMPUTER AND THE "STRESS" PROGRAM.
SEE PLATE IV-23 FOR LOADING CONDITIONS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

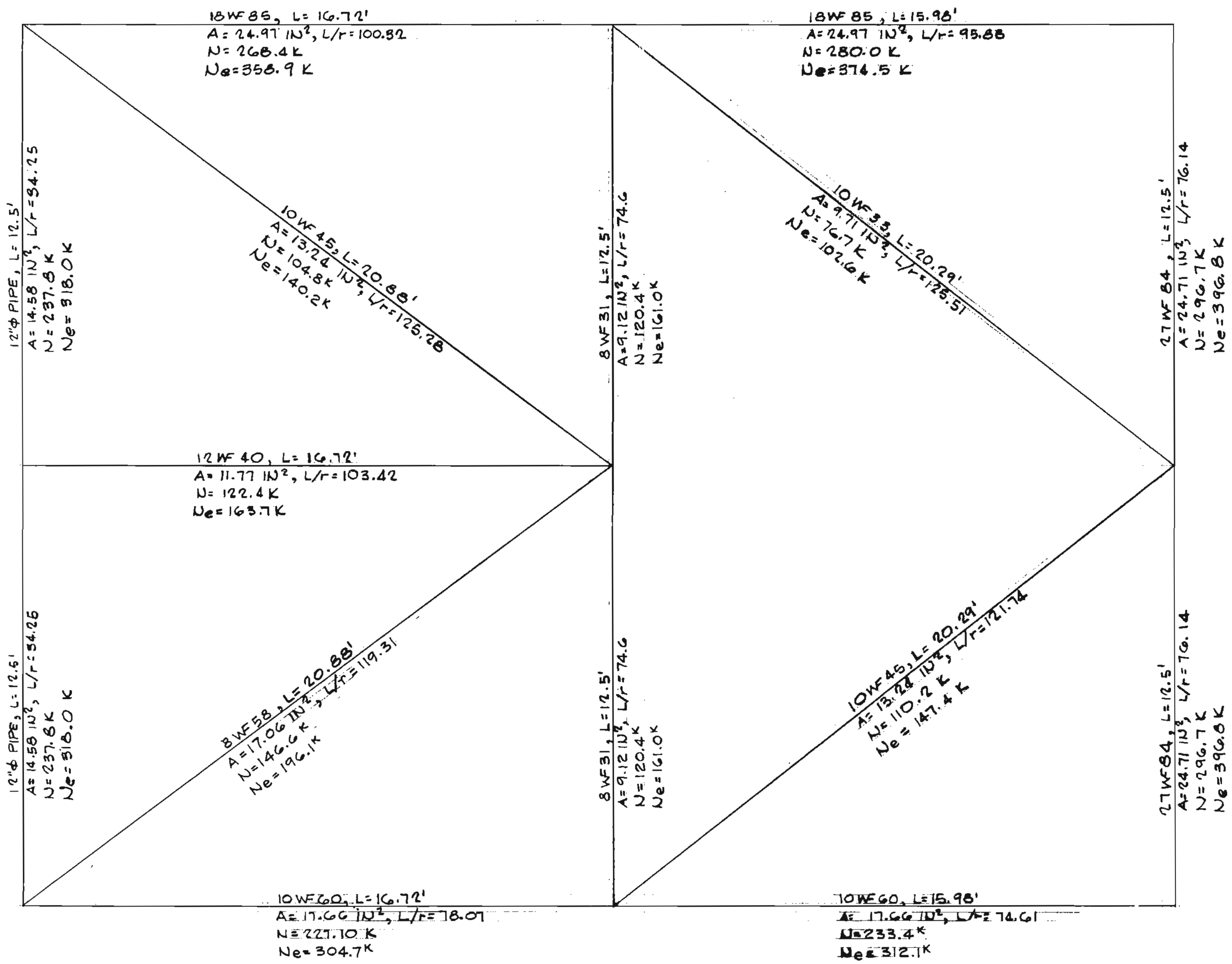
SECTOR GATES
HORIZONTAL GIRDERS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 FILE NO. H-2-24147



CANAL & RECESS
TRUSS MEMBERS

½" = 1'-0

NOTE:
N = ALLOWABLE COMPRESSIVE LOAD WHEN BASIC TENSILE STRESS = 18000 PSI.
Ne = ALLOWABLE COMPRESSIVE LOAD WHEN BASIC TENSILE STRESS = 24000 PSI.

LOADING CONDITIONS

CASE I DEAD LOAD ONLY.
CASE II DEAD LOAD PLUS HURRICANE.
CASE III DEAD LOAD PLUS REVERSE HEAD.
CASE IV A DEAD LOAD PLUS BOAT LOAD OF 120K AT EL.(+)6.0 ON FENDER AT HINGE WITH REVERSE HEAD.
CASE IV B DEAD LOAD PLUS BOAT LOAD OF 120K AT EL.(+)6.0 ON FENDER AT MIDDLE POST WITH REVERSE HEAD.
CASE IV C DEAD LOAD PLUS BOAT LOAD OF 120K AT EL.(+)6.0 ON FENDER AT END POST WITH REVERSE HEAD.
CASE V DEAD LOAD PLUS HURRICANE PLUS WAVE.
* CASE VI A DEAD LOAD PLUS BOAT LOAD OF 120K AT 15° AND EL (+) 14.0
* CASE VI B DEAD LOAD PLUS BOAT LOAD OF 120K AT 30° AND EL.(+) 14.0
* CASE VI C DEAD LOAD PLUS BOAT LOAD OF 120K AT 45° AND EL.(+) 14.0
* ALSO INCLUDES HURRICANE LOAD.

WATER LOAD DISTRIBUTION		
CASE NO.	WATER EL. MRGO	WATER EL. L.S.
I	–	–
II	13.0	2.0
III	0.0	5.0
IV-A	0.0	5.0
IV-B	0.0	5.0
IV-C	0.0	5.0
V	16.0	2.0
VI-A	13.0	2.0
VI-B	13.0	2.0
VI-C	13.0	2.0

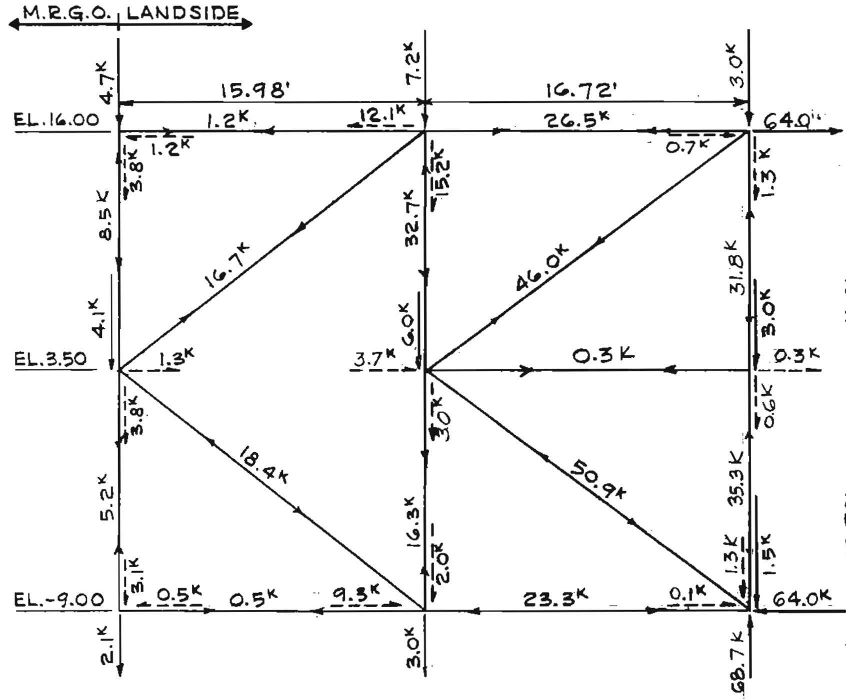
ANALYSIS OF THE SECTOR GATES FOR THE ABOVE LOADING CONDITIONS WERE PERFORMED WITH THE AID OF AN I.B.M. 1130 COMPUTER AND THE "STRESS" PROGRAM; ASSUMING THE SECTOR GATES TO BE THREE DIMENSIONAL SPACE FRAMES WITH RIGID JOINTS. THIS ANALYSIS CONSIDERS BOTH THE VERTICAL AND HORIZONTAL DISTRIBUTION OF LOADS ON A THREE DIMENSIONAL BODY. ALSO CONSIDERED IN THE ANALYSIS IS THE EFFECT OF DEFLECTIONS IN THE VARIOUS MEMBERS, WHICH DEFLECTIONS PRODUCE ADDITIONAL STRESSES IN THE MEMBERS. THESE STRESSES ARE NORMALLY CALLED SECONDARY STRESSES. THE "STRESS" PROGRAM INCLUDES THEM IN THE FINAL OUTPUT SO THAT THE STRESSES SHOWN ARE A COMBINATION OF PRIMARY & SECONDARY STRESSES PRODUCED BY THE LOADS IMPOSED ON THE STRUCTURE.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

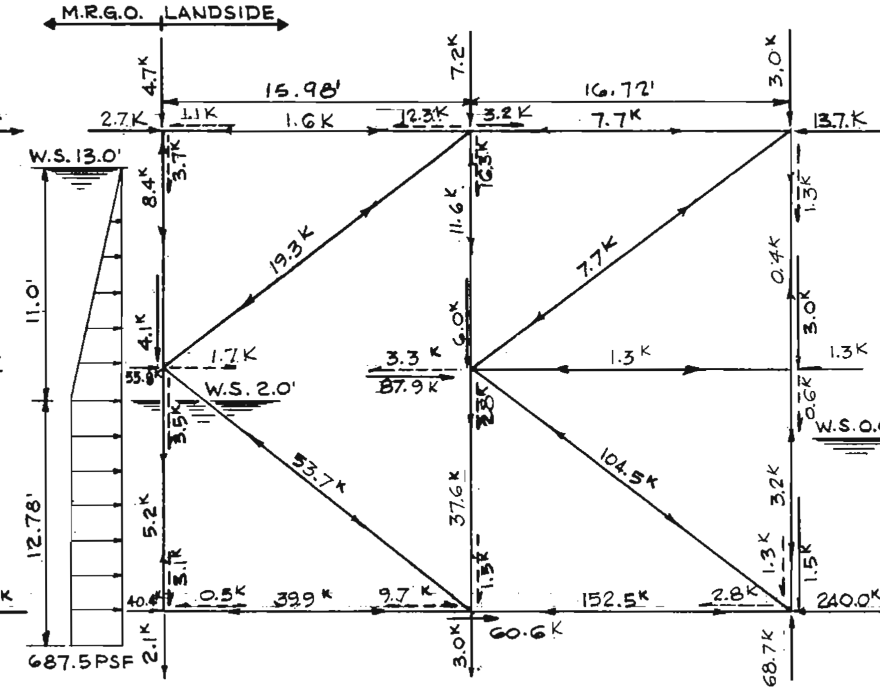
SECTOR GATES
TRUSS MEMBERS AND LOADING CONDITIONS

SCALES AS SHOWN

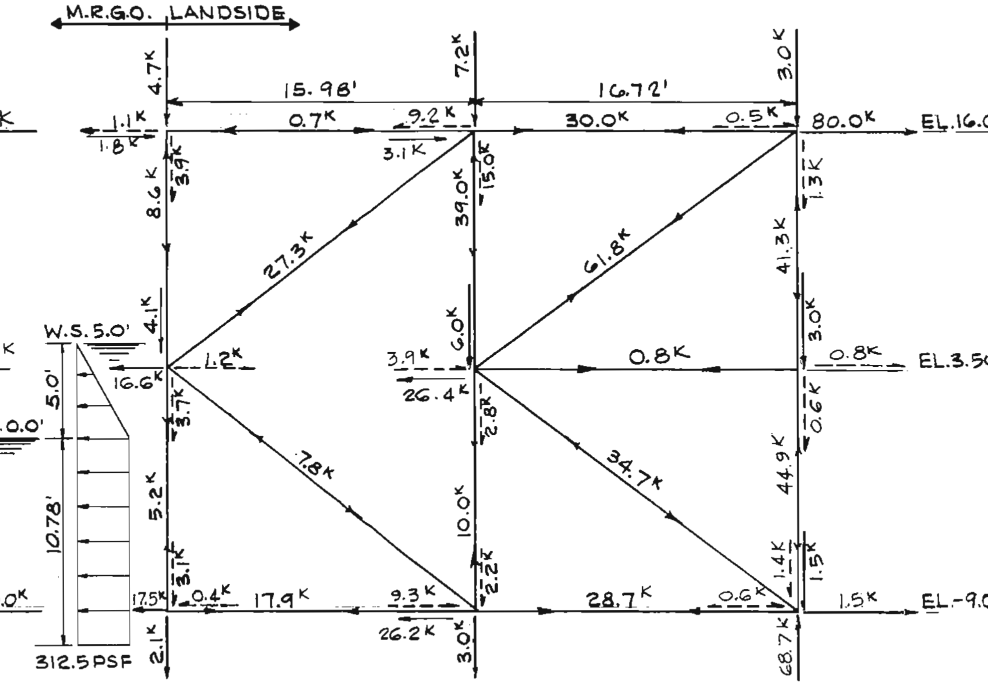
WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



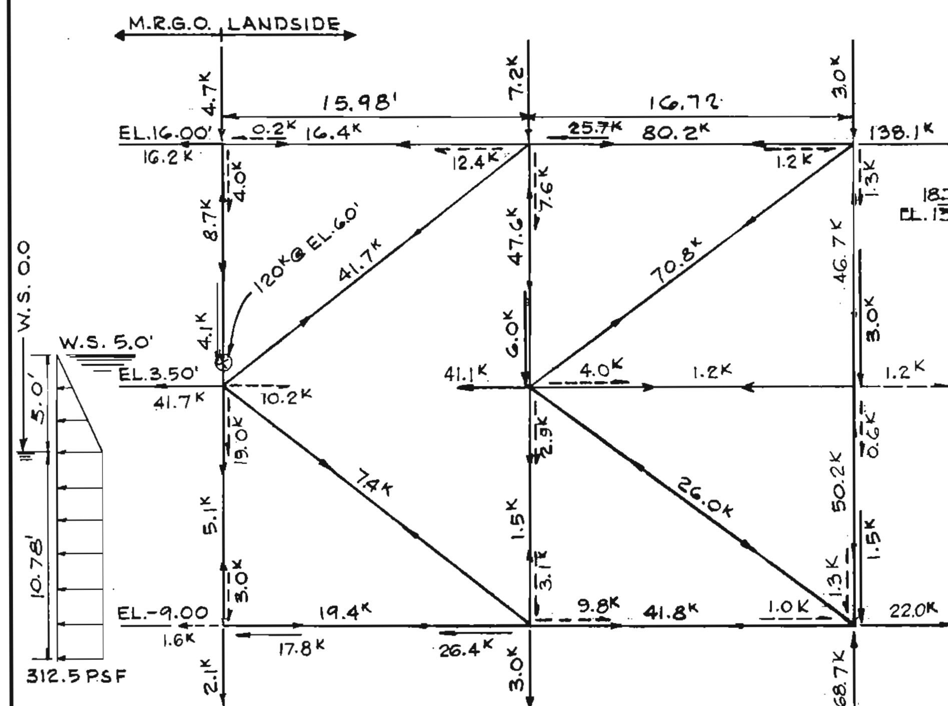
CASE I - D.L. ONLY



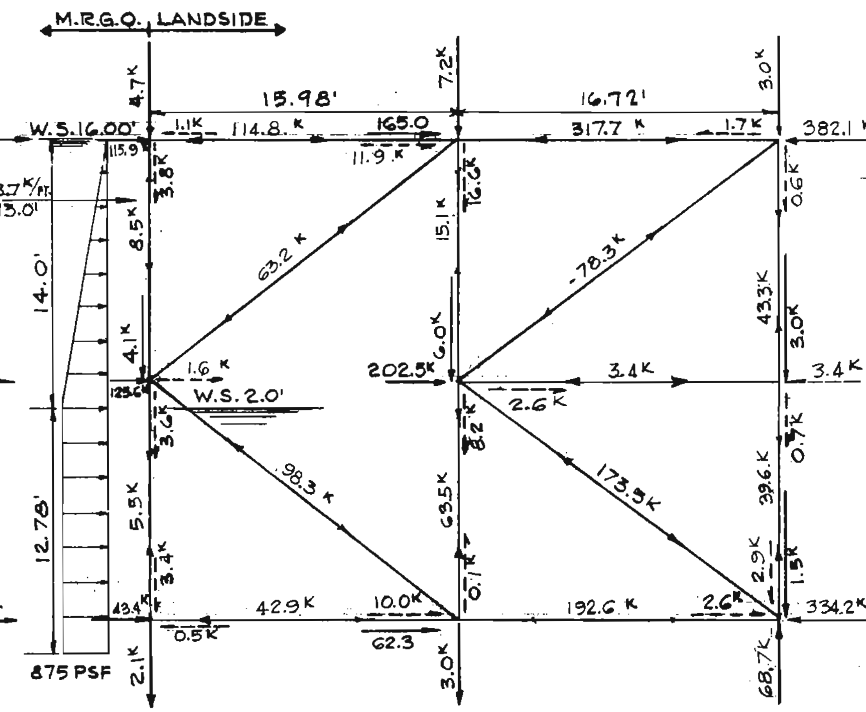
CASE II - D.L. AND W.



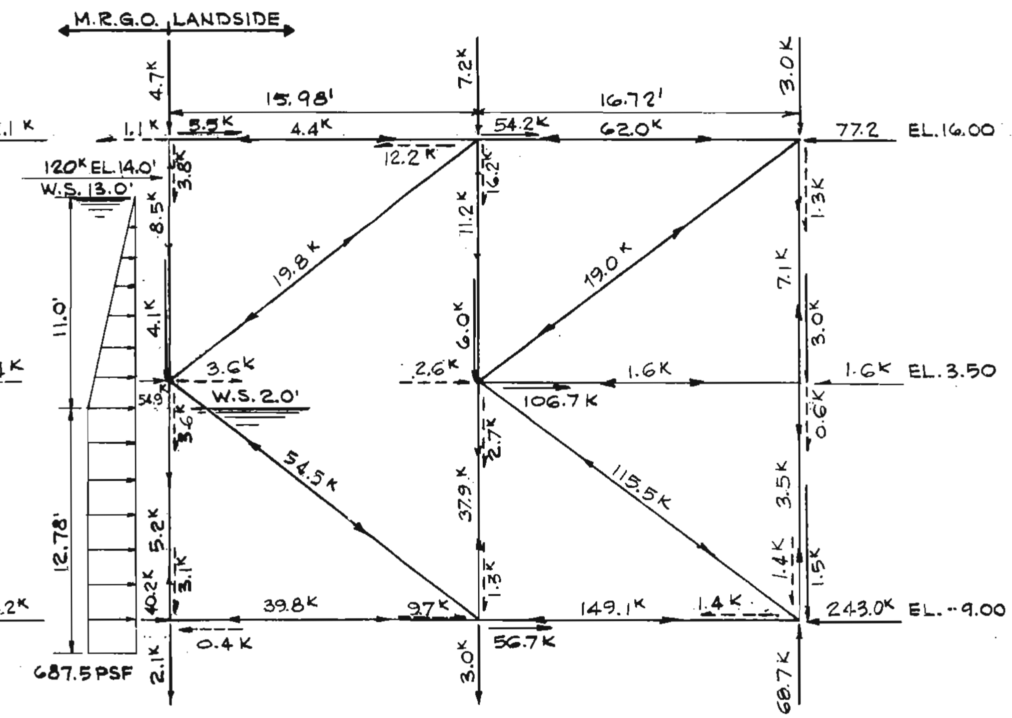
CASE III - D.L. AND W.



CASE IVC - D.L. AND BOAT



CASE V - D.L. AND W & WAVE



CASE VI B - D.L. AND BOAT

NOTE:

——◄——► INDICATES COMPRESSION
——►——◄ INDICATES TENSION

SEE PLATE IV-25 FOR RECESS TRUSS MEMBER FORCES. ALL LOADS AND FORCES SHOWN ARE IN KIPS EXCEPT AS NOTED. SEE PLATE IV-22 FOR LOADING CONDITIONS. THE FORCES AND LOAD DISTRIBUTIONS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN IBM 1130 COMPUTER AND THE "STRESS" PROGRAM.

NOTE (cont'd.): — 5.2^K → INDICATES FORCE PRODUCED AT THE JOINT DUE TO MEMBERS NOT IN THE PLANE OF THE TRUSS OR THE EFFECT OF DEFLECTIONS ON THE STRUCTURE.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

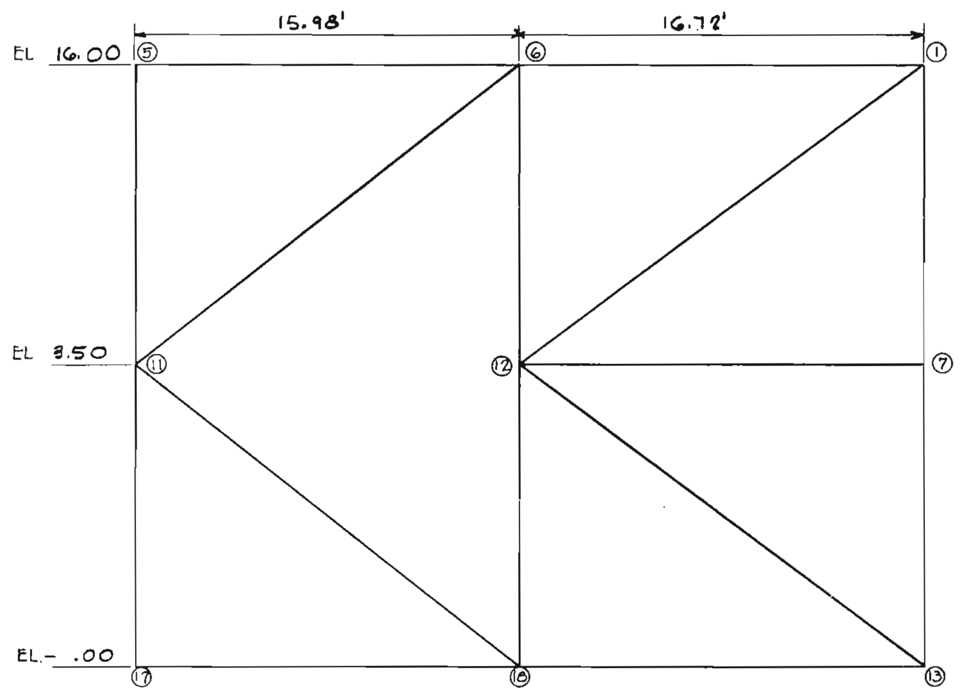
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES

CANAL TRUSS

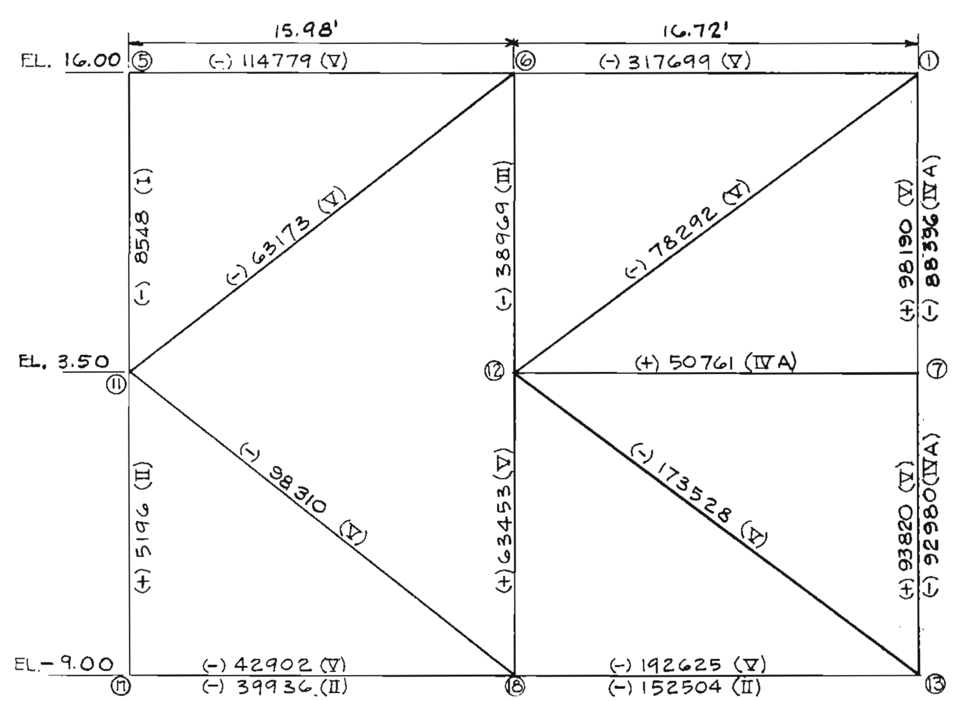
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



CANAL TRUSS

SCALE 1" = 4'-0"



DESIGN STRESSES

SCALE 1" = 4'-0"

MEMBER	I	II	III	IV A	IV B	IV C	V	VI A	VI B	VI C
1-6	+26470	-7743	+30035	+31240	+44083	+80194	-317699	-33992	-62003	-90784
1-12	+45973	-7742	+61836	+29105	+55973	+70786	-78292	-15880	-19093	-16085
1-7	-31750	+ 350	-41310	-20946	-37854	-46650	+43330	+5550	+7090	+5635
7-12	+342	-1287	+831	+50761	+147	+1202	-3396	-1446	-1579	-1591
7-13	-35310	-3210	-44940	-24834	-41742	-50210	+39620	+1866	+3460	+1951
6-5	+1152	-1591	-683	-351	+4692	+16426	-114779	+5707	-4430	-43502
6-11	+16682	-19256	+27270	+27426	+27899	+41662	-63173	-17702	-19828	-27632
6-12	-32692	-11623	-38969	-40243	-39545	-47591	+15117	-12611	-11235	-6548
5-11	-8548	-8412	-8608	-8460	-8574	-8656	-8511	-8439	-8492	-8420
11-17	+5154	+5196	+5156	+5260	+5194	+5051	+5534	+5167	+5228	+5299
11-18	-18353	-53732	-7830	-7594	-7263	+7367	-98310	-52135	-54473	-62280
12-18	+16354	+37589	+9983	+8834	+9459	+1487	+63453	+36584	+37886	+42464
12-13	-50857	-104523	-34667	-67612	-40640	-26012	-173528	-112541	-115509	-112356
13-18	-23312	-152504	+28654	+29959	+30573	+41770	-192625	-148864	-149088	-153889
17-18	+459	-39936	+17947	+18256	+18242	+19398	-42902	-40345	-39769	-37397

NOTE:

LOADS SHOWN IN TABLE ARE IN POUNDS.
− = COMPRESSION.
+ = TENSION.
MEMBERS 1-7 AND 7-13 COMMON TO BOTH TRUSSES.
FOR TOTAL DESIGN STRESS SEE PLATE IV-26.
CASES I, II AND III GROUP 1 LOADING.
CASES IV A THRU VI C GROUP 2 LOADING.
FOR DETAILS AND DESIGN STRESS OF TENSION MEMBER 6-16, SEE PLATE IV-30.

DEFLECTION - JOINT 17	
CASE I	0.150"
CASE II	0.147"
CASE III	0.145"

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES

CANAL TRUSS STRESSES

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
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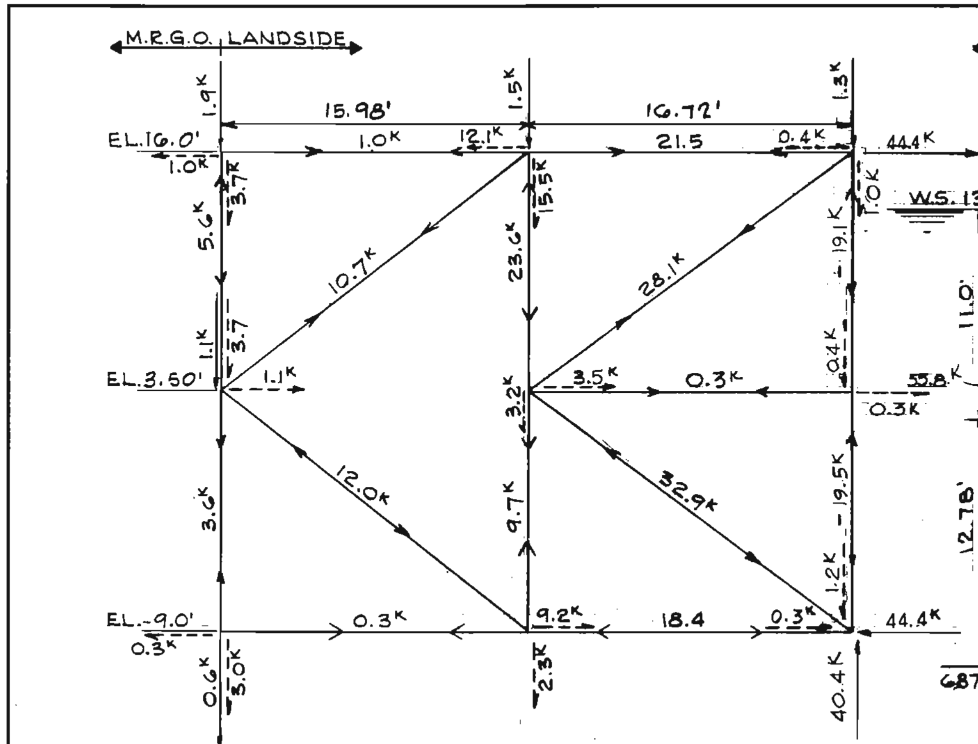
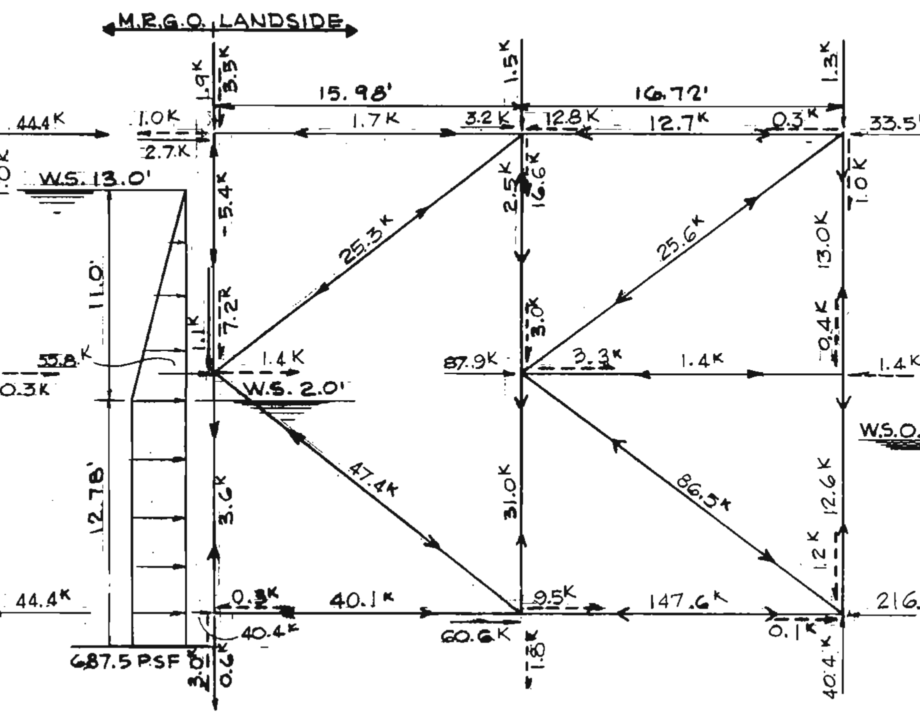
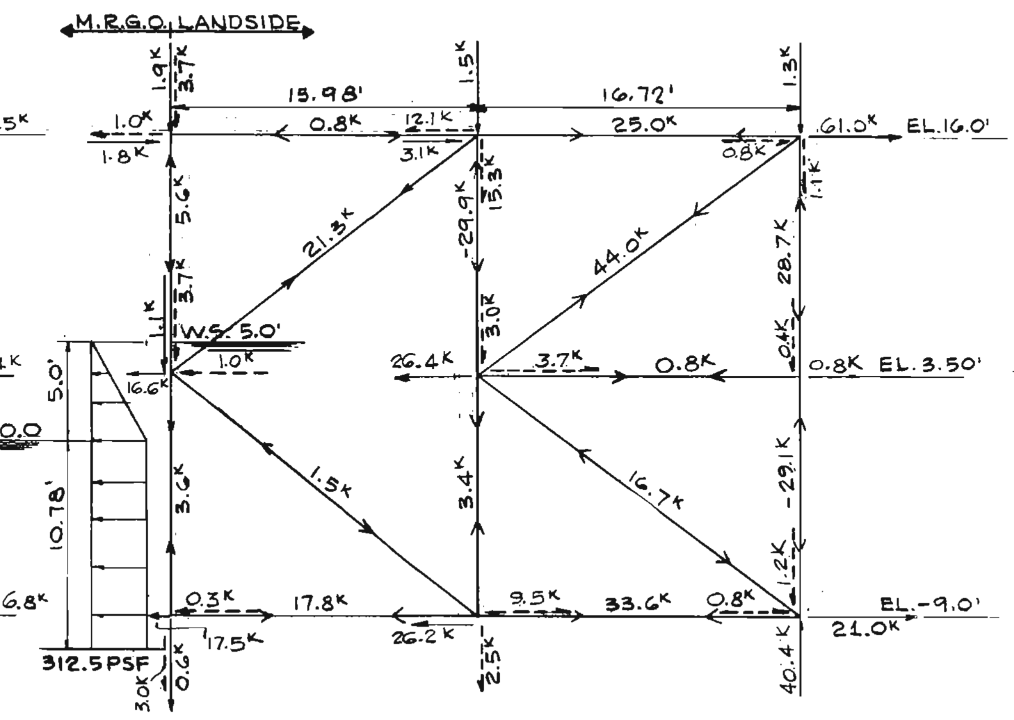


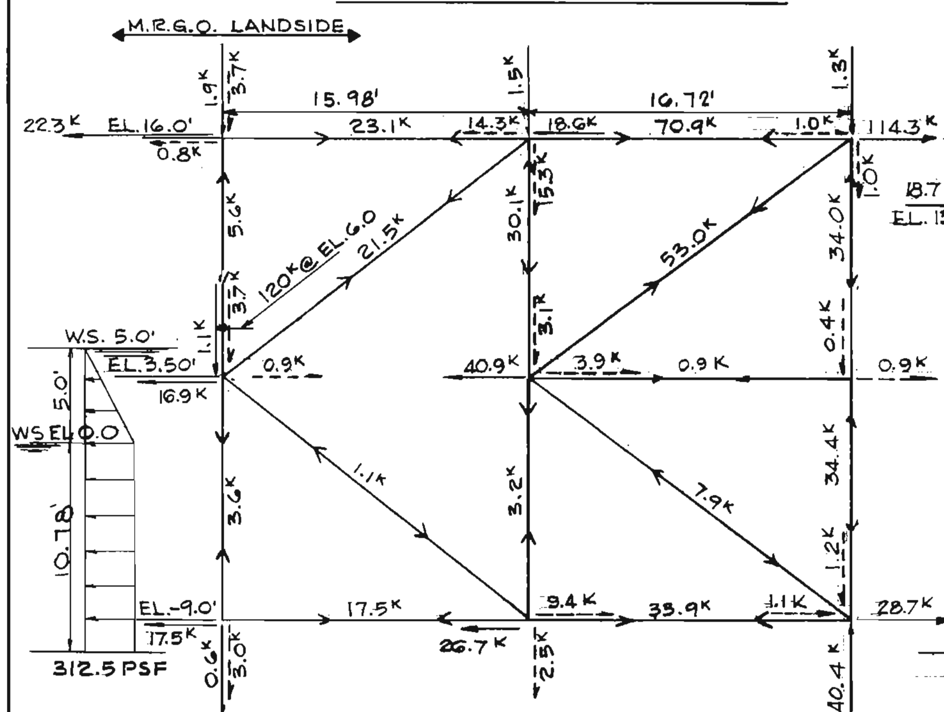
CASE I - DL ONLY



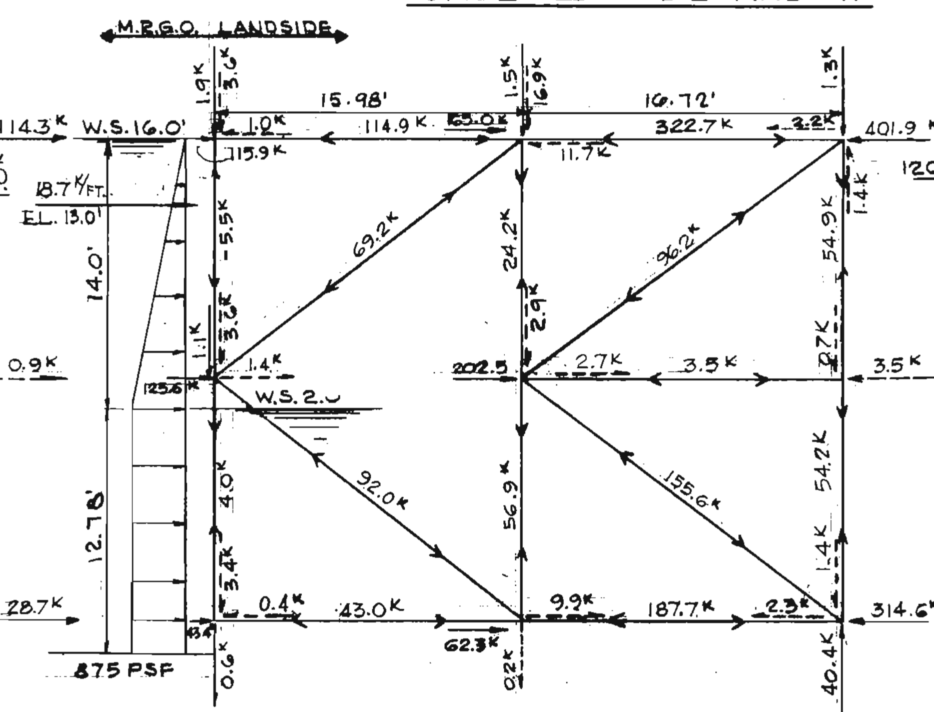
CASE II - DL AND W



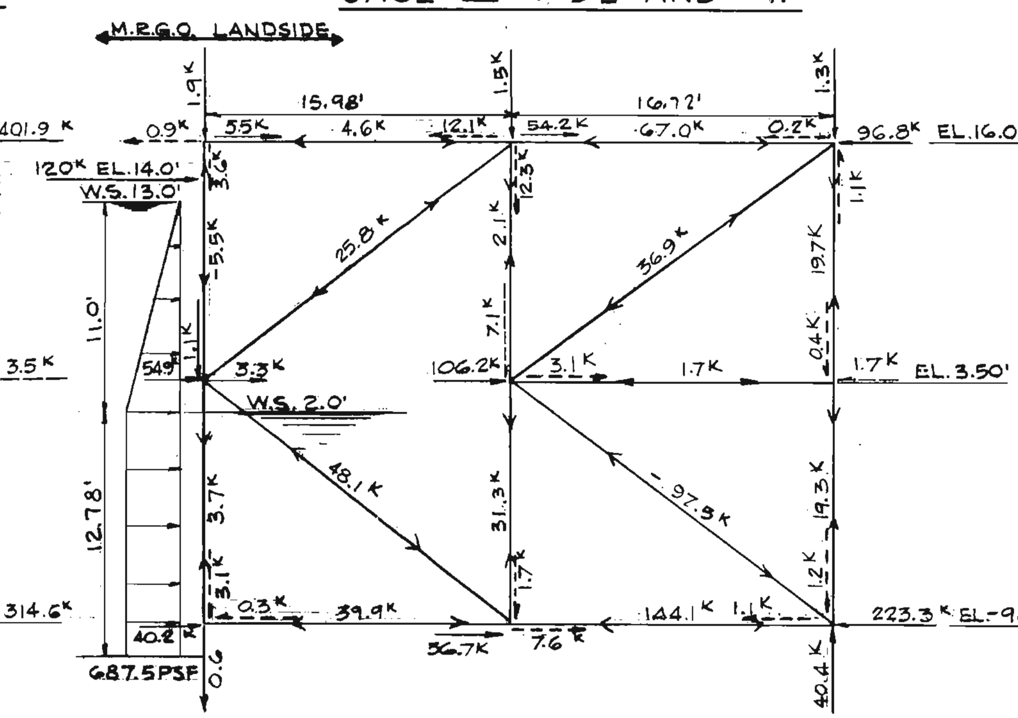
CASE III - DL AND W



CASE IV C - DL AND BOAT



CASE V - DL AND BOAT



CASE VI B - DL AND BOAT

NOTE :

——◄——◄—— INDICATES COMPRESSION

——►——◄—— INDICATES TENSION

SEE PLATE IV-23 FOR CANAL TRUSS MEMBER FORCES. ALL LOADS AND FORCES SHOWN ARE IN KIPS EXCEPT AS NOTED. SEE PLATE IV-22 FOR LOADING CONDITIONS. THE FORCES AND LOAD DISTRIBUTIONS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN IBM 1130 COMPUTER AND THE "STRESS" PROGRAM.

NOTE: (cont'd.): — 5.2K — INDICATES FORCE PRODUCED AT THE JOINT DUE TO MEMBERS NOT IN THE PLANE OF THE TRUSS OR THE EFFECT OF DEFLECTIONS ON THE STRUCTURE.

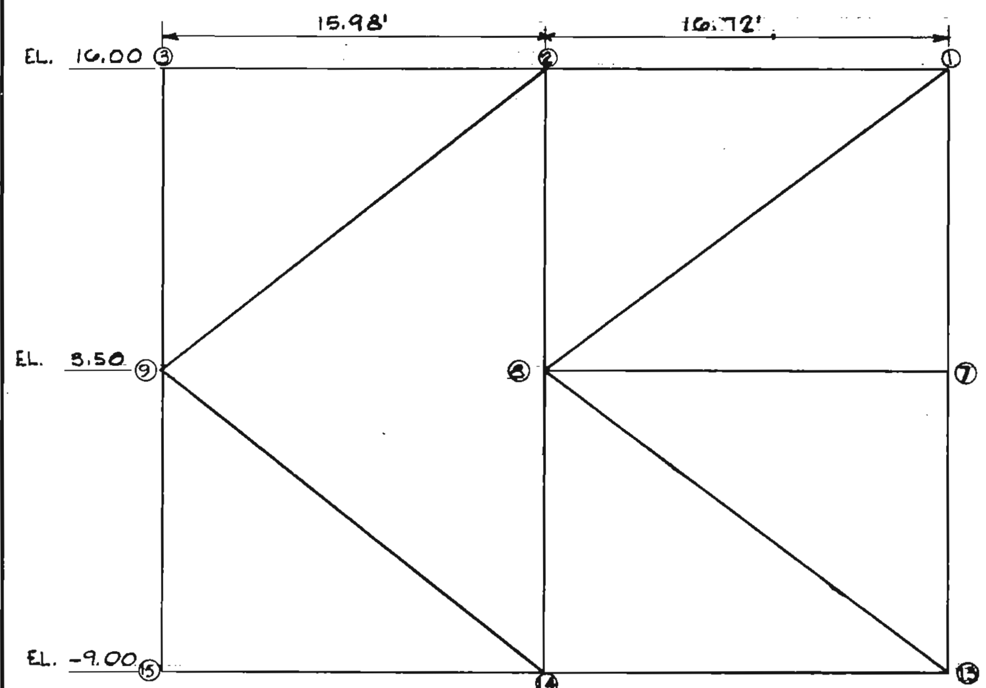
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES

RECESS TRUSS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147



RECESS TRUSS

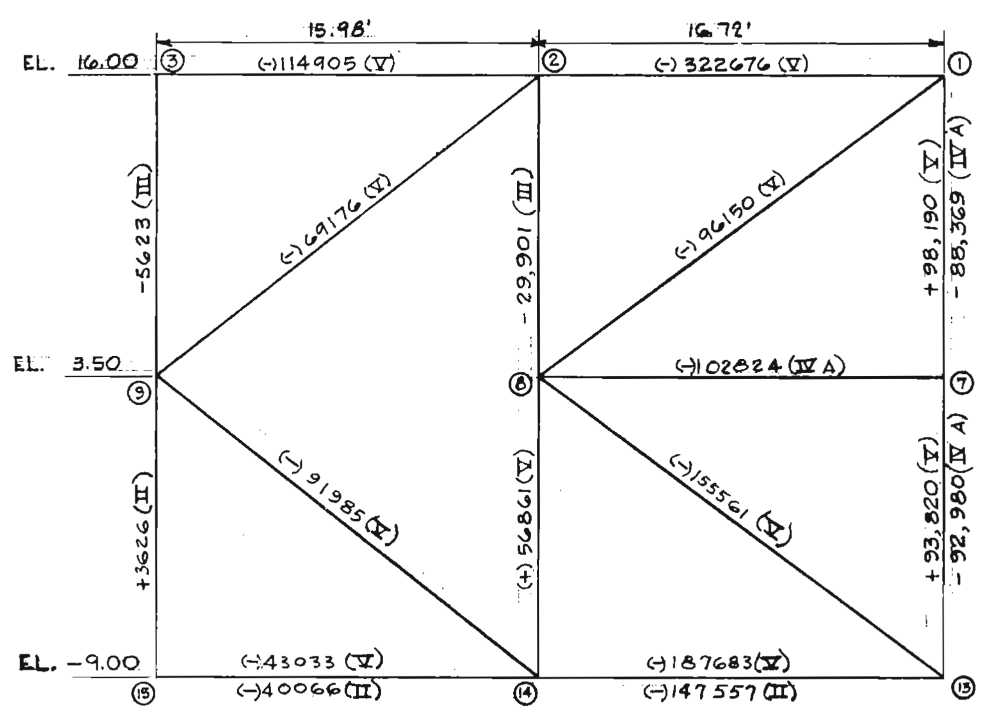
SCALE 1" = 4'-0"

MEMBER	I	II	III	IV A	IV B	IV C	V	VI A	VI B	VI C
1-2	+21485	-12723	+25047	+27160	+63885	+70883	-322676	-95765	-66987	-38974
1-8	+28127	-25601	+43993	+106024	+78760	+53014	-96150	-33944	-36897	-33740
1-7	-19110	+12990	-28670	-67423	-50030	-34010	+54860	+18342	+19730	+18214
2-3	+ 1024	- 1719	- 811	- 605	+12070	+25116	-114905	-43630	-4558	+ 5581
2-9	+10678	-25262	+21264	+ 21649	+ 21957	+21533	-69176	-33639	-25834	-23708
2-8	-23622	-2529	-29901	-28641	-30031	-30103	+24215	+ 2849	+2140	-3516
3-9	- 5562	-5416	-5623	- 5735	- 5592	-5577	-5511	- 5422	-5496	- 5443
7-8	+ 264	- 1363	+ 752	-102824	+ 2174	+940	-3470	-1666	-1655	-1522
7-13	-19480	+12620	-29110	-68146	-50703	-34380	+54200	+17796	+19290	+17709
8-13	-32889	-104502	-16699	+46666	+18979	- 7882	-155561	-94381	-97535	-94567
8-14	+ 9732	+30986	+ 337!	+ 4461	+ 3260	+ 3236	+56861	+35866	+31286	+29983
9-15	+ 3584	+ 3626	+ 3584	+ 3538	+ 3590	+ 3575	+ 3968	+ 3730	+ 3659	+ 3598
9-14	- 12015	- 47400	- 1487	- 1215	- 726	- 1108	-91985	-55947	-48138	-45800
13-14	- 18359	-147557	+33611	+35561	+35975	+ 33891	-187683	-148742	-144139	-143915
14-15	+ 330	-40066	+17817	+18002	+18011	+17512	-43033	-37527	- 39898	-40475

NOTE:

LOADS SHOWN IN TABLE ARE IN POUNDS.
- = COMPRESSION.
+ = TENSION.
CASES I, II AND III - GROUP 1 LOADINGS.
CASES IV A, THRU VI C - GROUP 2 LOADINGS.
MEMBERS 1-7 AND 7-13 COMMON TO BOTH TRUSSES.
TOTAL DESIGN STRESS MEMBER 1-7 = -88,369
TOTAL DESIGN STRESS MEMBER 7-13 = -92,980
FOR DETAILS AND DESIGN STRESS OF TENSION MEMBER 2-16,
SEE PLATE IV-30.

DEFLECTION - JOINT 15	
CASE I	0.083'
CASE II	0.065'
CASE III	0.085'



DESIGN STRESSES

SCALE 1" = 4'-0"

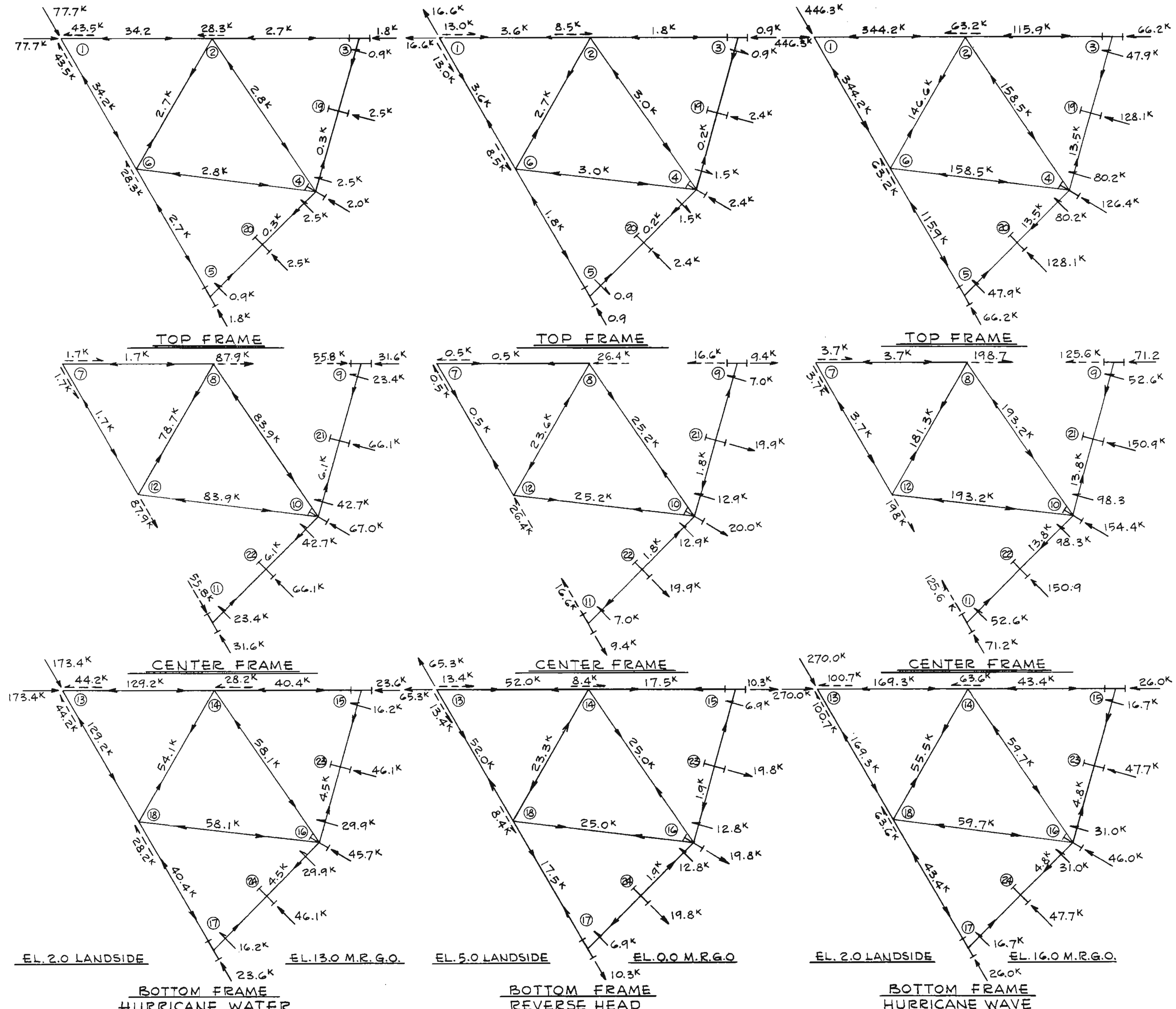
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES

RECESS TRUSS STRESSES

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



BOTTOM FRAME HURRICANE WATER — BOTTOM FRAME REVERSE HEAD — BOTTOM FRAME HURRICANE WAVE

NOTE:

⟵⟶ INDICATES COMPRESSION.

⟶⟵ INDICATES TENSION.

ALL LOADS AND FORCES SHOWN ARE IN KIPS EXCEPT AS NOTED. SEE PLATE IV-22 FOR LOADING CONDITIONS.

THE FORCES AND LOAD DISTRIBUTIONS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN IBM 1130 COMPUTER AND THE "STRESS" PROGRAM.

- - 5.2K - -> INDICATES FORCE PRODUCED AT THE JOINT DUE TO MEMBERS NOT IN THE PLANE OF THE TRUSS OR THE EFFECT OF DEFLECTIONS ON THE STRUCTURE.

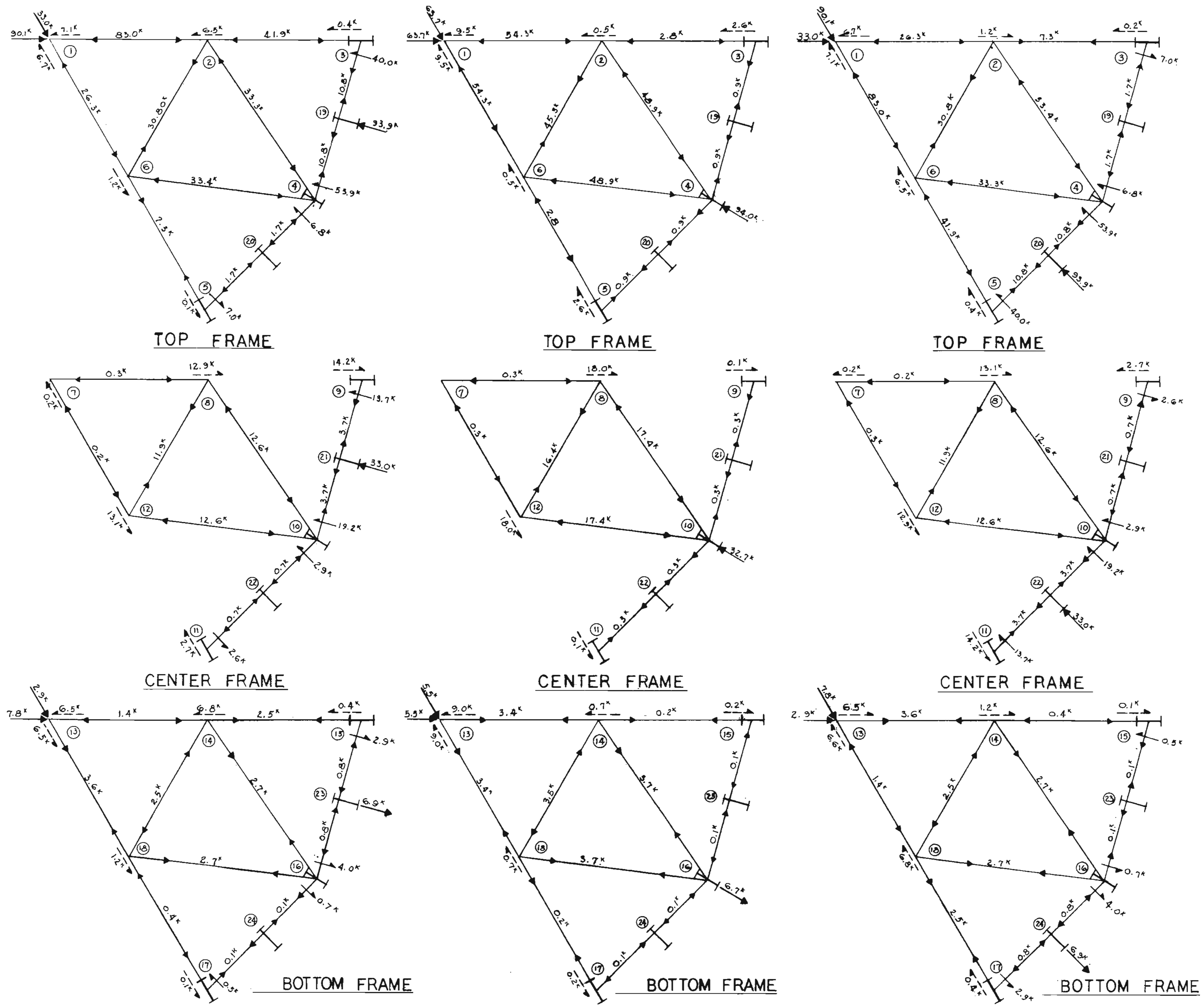
FORCES SHOWN AT THE ENDS OF THE HORIZONTAL GIRDERS REPRESENT SHEAR FORCES IN THE GIRDERS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
WATER LOAD DISTRIBUTION

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



BOAT LOAD OF 120 K AT 15° & EL. 14 ON SKIN PL.

BOAT LOAD OF 120 K AT 30° & EL. 14 ON SKIN PL.

BOAT LOAD OF 120 K AT 45° & EL. 14 ON SKIN PLATE

NOTE:
ALL LOADS AND FORCES SHOWN ARE IN KIPS EXCEPT AS NOTED. SEE PLATE IV-22 FOR LOADING CONDITIONS. THE FORCES AND LOAD DISTRIBUTIONS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN I.B.M. 1130 COMPUTER AND THE "STRESS" PROGRAM.

5.2K → INDICATES FORCE PRODUCED AT THE JOINT DUE TO MEMBERS NOT IN THE PLANE OF THE TRUSS OR THE EFFECT OF DEFLECTIONS ON THE STRUCTURE.

FORCES SHOWN AT THE ENDS OF THE HORIZONTAL GIRDERS REPRESENT SHEAR FORCES IN THE GIRDERS.

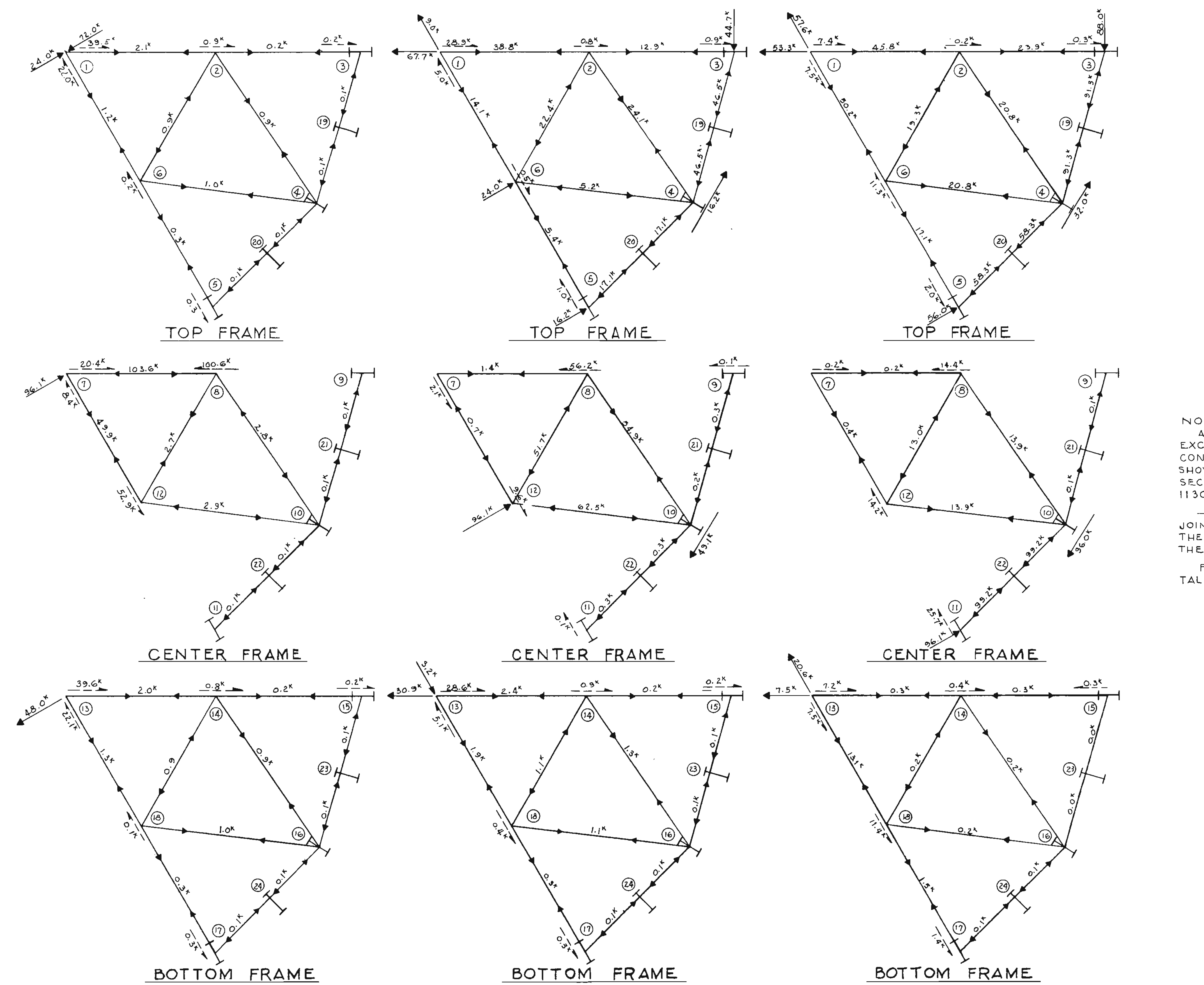
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
BOAT LOAD DISTRIBUTION

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-28



BOAT LOAD OF 120K @ EL.6 ON FENDER AT HINGE — BOAT LOAD OF 120K @ EL.6 ON FENDER AT MIDDLE POST — BOAT LOAD OF 120K @ EL.6 ON FENDER AT END POST

NOTE:

ALL LOADS AND FORCES SHOWN ARE IN KIPS EXCEPT AS NOTED. SEE PLATE IV-22 FOR LOADING CONDITIONS. THE FORCES AND LOAD DISTRIBUTIONS SHOWN ABOVE WERE OBTAINED BY ANALYZING THE SECTOR GATES AS SPACE FRAMES USING AN I.B.M. 1130 COMPUTER AND THE "STRESS" PROGRAM.

— 5.2K → INDICATES FORCE PRODUCED AT THE JOINT DUE TO MEMBERS NOT IN THE PLANE OF THE TRUSS OR THE EFFECT OF DEFLECTIONS ON THE STRUCTURE.

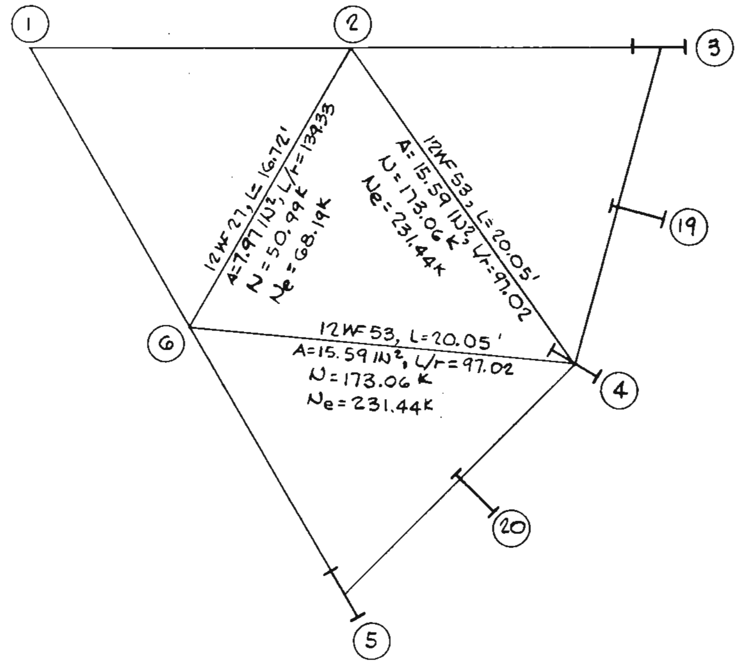
FORCES SHOWN AT THE ENDS OF THE HORIZONTAL GIRDERS REPRESENT SHEAR FORCES IN THE GIRDERS.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

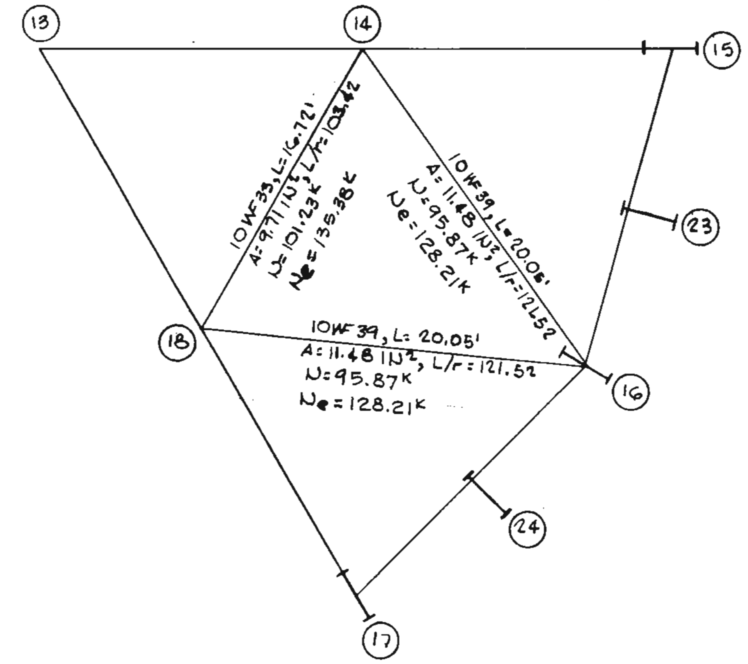
SECTOR GATES
BOAT LOAD DISTRIBUTION

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



TOP FRAME

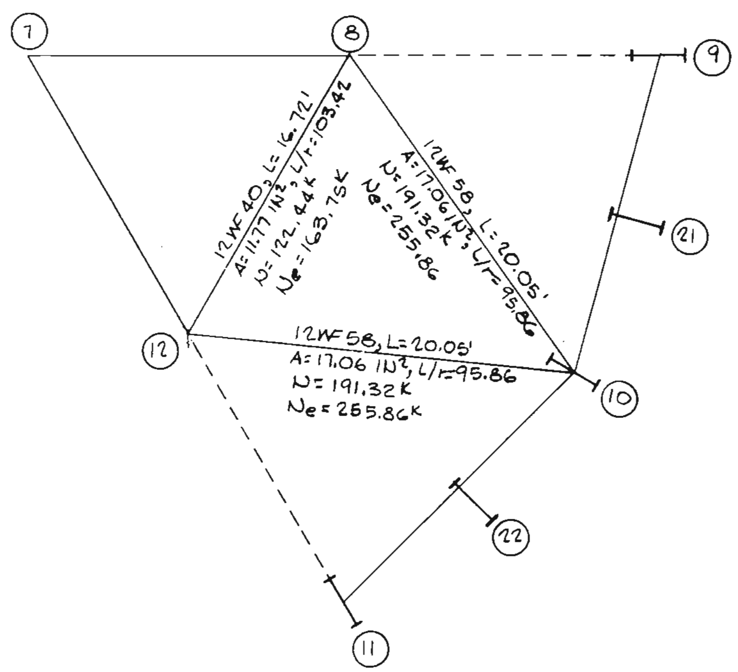


BOTTOM FRAME

SCALE 1" = 5'-0"

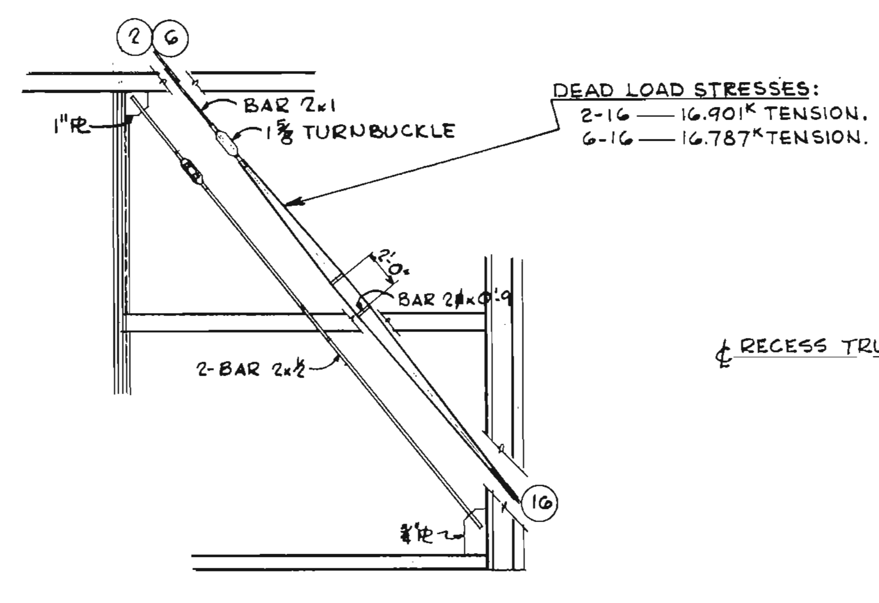
NOTES

N= ALLOWABLE COMPRESSIVE LOAD WHEN BASIC TENSILE STRESS = 18000 PSI.
Ne= ALLOWABLE COMPRESSIVE LOAD WHEN BASIC TENSILE STRESS = 24000 PSI.
FOR DESIGN OF MEMBERS 5-20, 20-4, 4-19, 19-3, 11-22, 22-10, 10-21 AND 21-9 SEE PLATE IV-21.
FOR DESIGN OF VERTICAL MEMBERS SEE PLATE IV-20.
FOR DESIGN OF MEMBERS 1-6, 6-5, 7-12, 13-18 AND 18-17 SEE PLATE IV-24
FOR DESIGN OF MEMBERS 1-2, 2-3, 7-8, 13-14 AND 14-15 SEE PLATE IV-26.
FOR DESIGN OF MEMBERS 17-24, 24-16, 16-23 AND 23-15 SEE PLATE IV-21.
* TENSION MEMBERS ARE FROM JOINT 6 TO JOINT 16 AND FROM JOINT 2 TO JOINT 16.



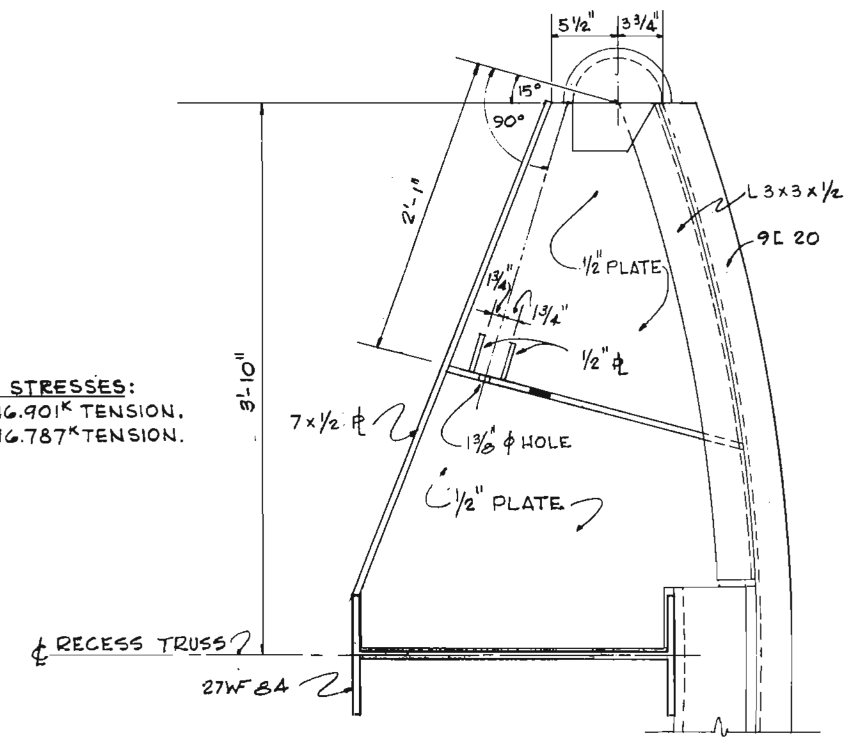
CENTER FRAME

SCALE 1" = 5'-0"



* DETAIL OF TENSION MEMBERS

(2)-(16) AND (6)-(16)



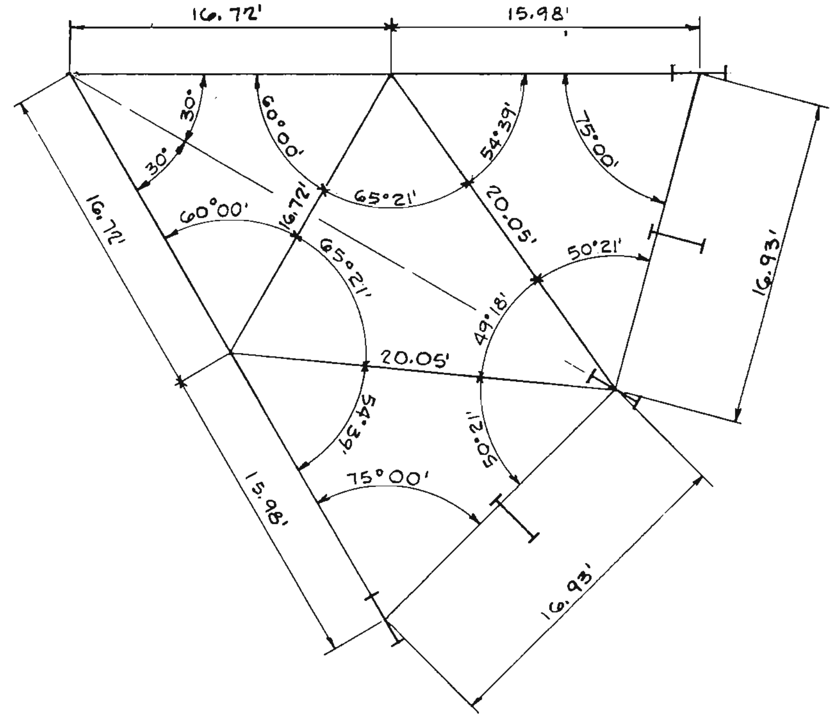
PLAN OF CABLE CONNECTION
RECESS SIDE
SCALE: 1 1/2" = 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

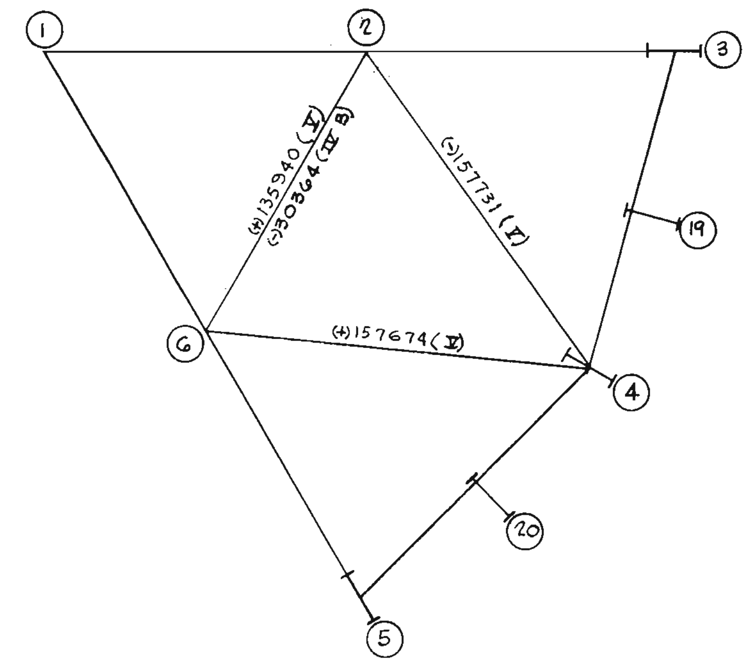
SECTOR GATES
HORIZONTAL FRAMES

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147



PLAN VIEW



TOP FRAME

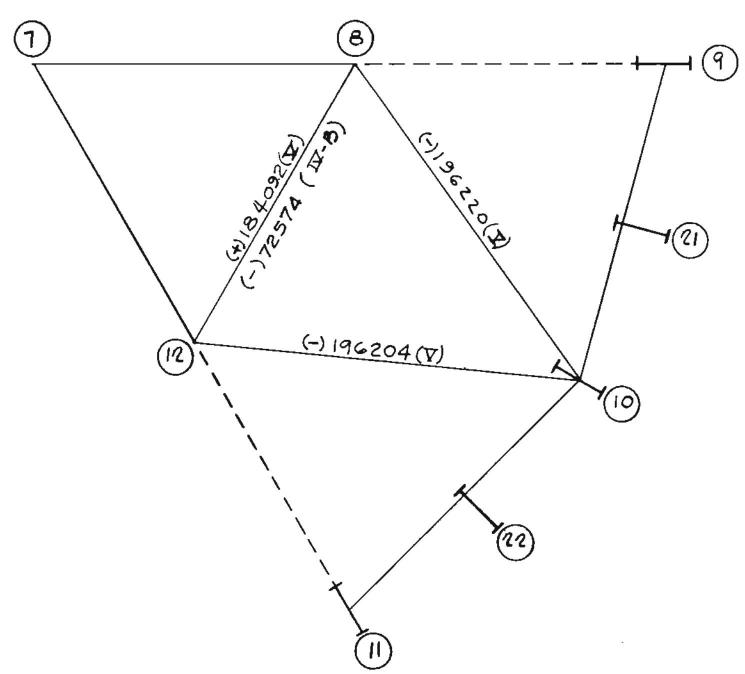
SCALE 1" = 5'-0"

MEMBER	I	II	III	IV A	IV B	IV C	V	VI A	VI B	VI C
2-6	-10669	-7938	-7929	-8837	-30364	-27241	+135940	+22860	+37353	+22860
2-4	+802	-2040	-2206	-1274	+21865	+18589	-157751	-35285	-50928	-35465
4-6	+859	-1987	-2147	-1145	-7305	+18697	+157674	-35409	-50872	-35232
8-12	+2774	+81444	-20856	-18178	-72574	-33881	+184092	+93294	+97803	+93295
8-10	-2973	-86868	+22226	+19446	+77094	+36116	-196220	-99461	-104279	-99474
10-12	-2964	-86855	+22234	+19348	-40229	+36086	-196204	-99485	-104266	-99473
14-18	+8357	+62461	-14949	-15876	-16082	-15153	+63889	+59921	+58975	+59921
14-16	-8839	-66899	+16167	+17097	+17434	+16394	-68509	-64195	-63167	-64176
16-18	-8828	-66887	+16178	+17217	+17297	+16411	-68499	-64195	-63156	-64184
*6-16	+16787	+16547	+16895	+16900	+16796	+16812	+16897	+16650	+16595	+16685
*2-16	+16901	+16656	+17011	+17022	+17001	+16961	+17009	+16793	+16695	+16760

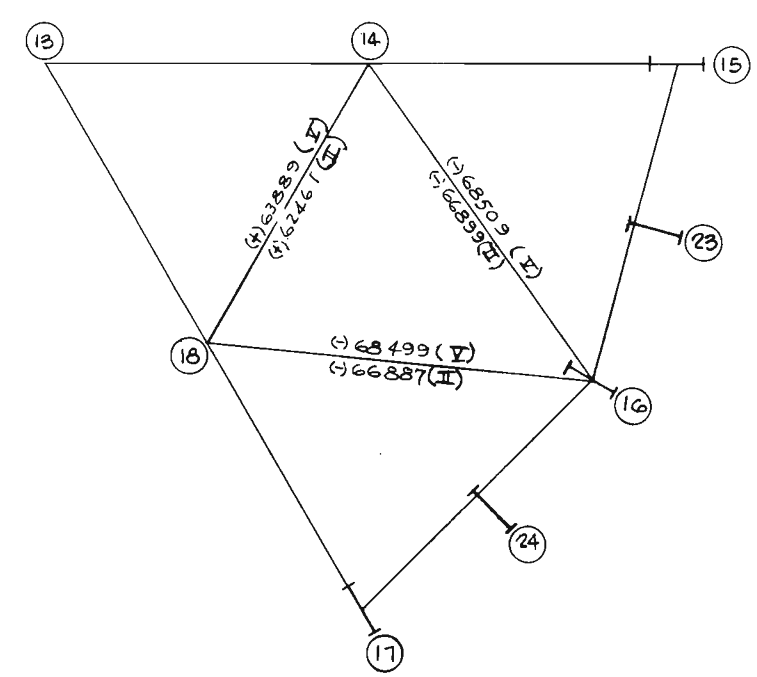
NOTES

ALL LOADS SHOWN ARE IN POUNDS.
- = COMPRESSION
+ = TENSION

FOR STRESSES IN VERTICAL MEMBERS SEE PLATE IV - 20.
FOR STRESSES IN MEMBERS 1-2, 2-3, 7-8, 13-14 AND 14-15 SEE PLATE IV-26.
FOR STRESSES IN MEMBERS 1-6, 6-5, 7-12, 13-18 AND 18-17 SEE PLATE IV-24.
FOR STRESSES IN MEMBERS 5-20, 20-4, 4-19, 19-3, 11-22, 22-10, 10-21 AND 21-9 SEE PLATE IV-21.
FOR STRESSES MEMBERS 17-24, 24-16, 16-23 AND 23-15 SEE PLATE IV-21.
* TENSION MEMBERS - FOR DETAIL SEE PLATE IV-30.
CASES I, II AND III GROUP 1 LOADING.
CASES IV A THRU VI C GROUP 2 LOADING.



CENTER FRAME



BOTTOM FRAME

SCALE 1" = 5'-0"

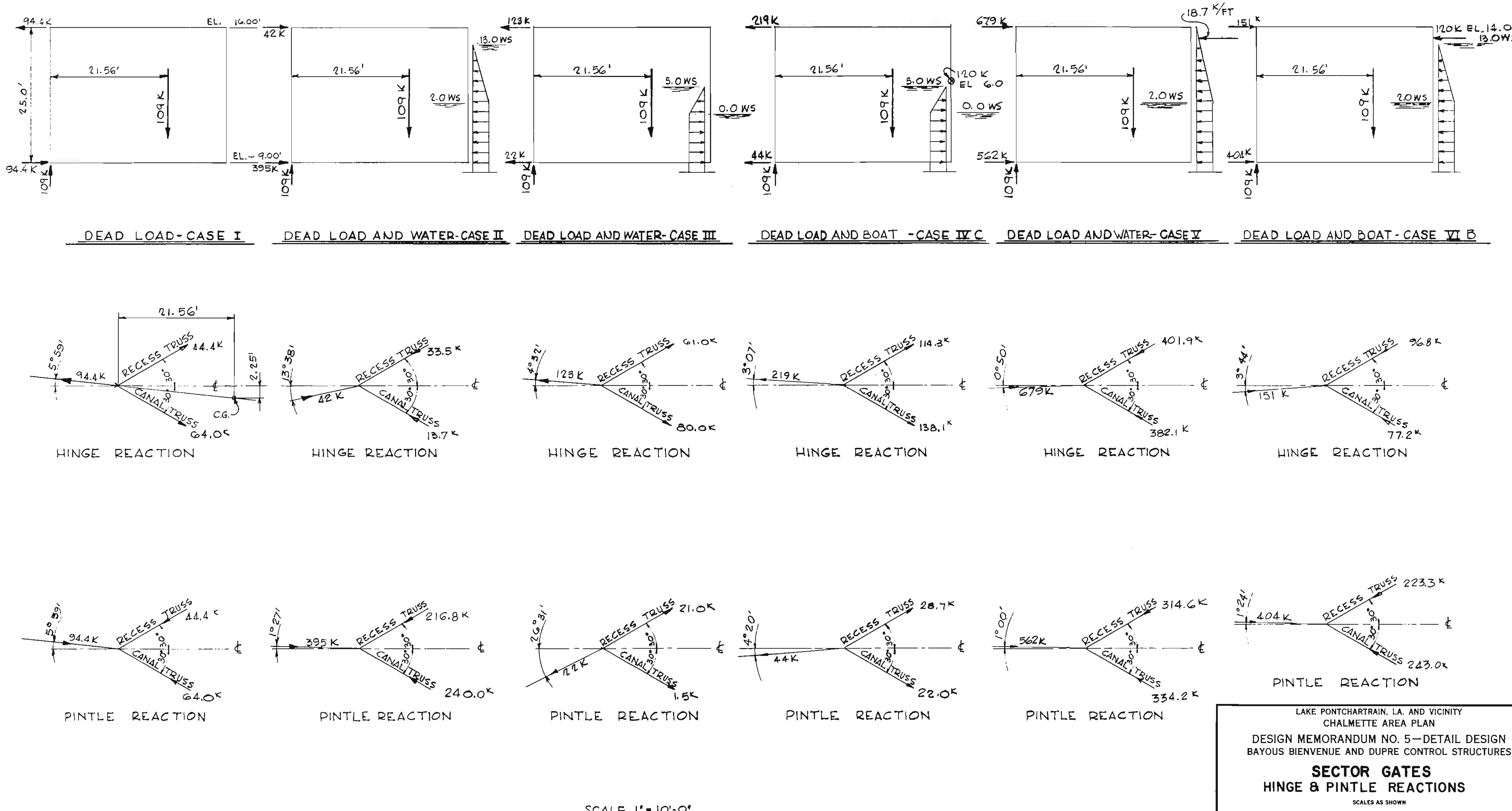
LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
HORIZONTAL FRAME STRESSES

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE MARCH, 1968	FILE NO. H-2-24147

PLATE NO. IV-31



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
HINGE & PINTLE REACTIONS

SCALES AS SHOWN

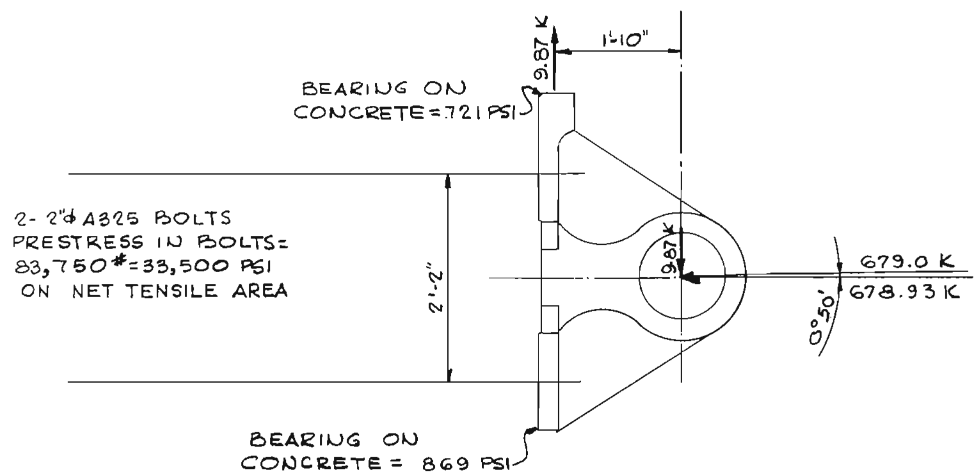
WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968 — FILE NO. H-2-24147

PLATE NO. IV-32

BEARING AREA ON CONCRETE =
51" x 25" = 1275 IN.²



MAXIMUM COMPRESSION
DEAD LOAD PLUS WAVE LOAD - CASE V
N. T. S.

BEARING AREA OF 10¼" φ x 18" PIN = 184.5 SQ-INS.

BEARING ON PIN = $\frac{679{,}000}{184.5}$ = 3,680 PSI < 40,000 PSI (NOT MOVING)

BEARING FROM CASE III = 123,000#

BEARING ON 14" O.D. x 18" BUSHING = $\frac{123{,}000}{252}$ = 489 PSI (MOVING)

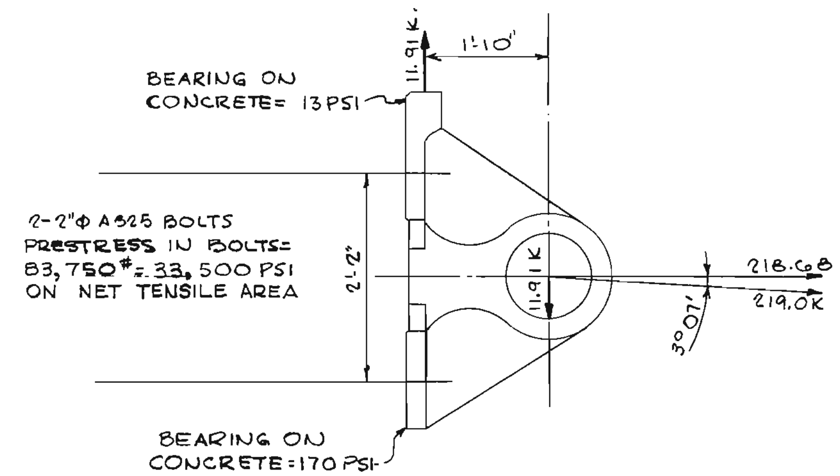
BENDING ON 10¼" φ PIN (S = 105.73 IN³, A = 82.47 IN²)

M_{MAX} = 339,500 x (9.16 - 4.50) = 1,582,100 IN#

$f_s = \frac{1{,}582{,}100}{105.73}$ = 14,964 PSI < 32,500 PSI

SHEAR ON PIN = $\frac{339{,}500\#}{82.47\ IN^2} \times \frac{4}{3}$ = 5488 PSI < 16,000 PSI

BEARING ON 1⅛" PIN PLATE = $\frac{679{,}000}{2 \times 10.25 \times 1.125}$ = 29,442 PSI < 32,500 PSI



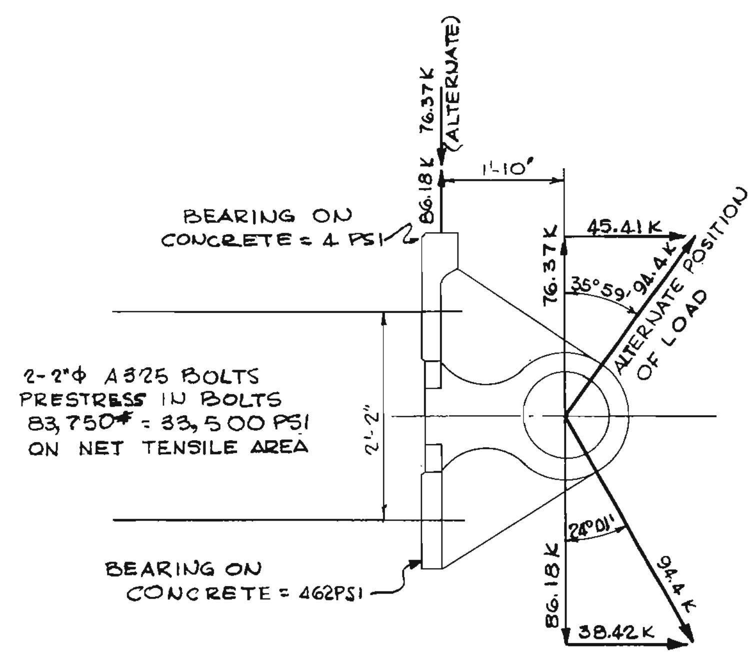
SECTION AT PIN HOLE:

ALLOWABLE STRESS = 18,500 PSI

MAXIMUM LOAD ON ONE PLATE = $\frac{219{,}000}{2}$ = 109,500#

REQUIRED AREA = $\frac{109{,}500}{18{,}000}$ = 6.08 IN² TRANSVERSE TO LOAD AND MINIMUM AREA OF ⅔ x 6.08 = 4.05 IN² IN DIRECTION OF LOAD.

MAXIMUM TENSION
DEAD LOAD PLUS REVERSE HEAD PLUS BOAT LOAD
CASE IV C
N. T. S.



MAXIMUM ASYMMETRIC LOAD
DEAD LOAD ONLY - CASE I
N. T. S.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES

HINGE DESIGN

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
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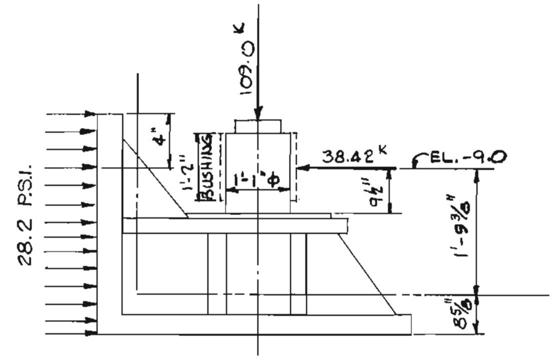


SIDE VIEW
N. T. S.

TENSION ON BOLTS:

$N = 109.0^{K}$

$M: 2585.40^{''-K}$

$e = \frac{M}{P} = 23.7$

$p = \frac{109000}{40\,(44)}\left(1 \pm \frac{6(23.7)}{40}\right) = \begin{cases} +282.09 \text{ PSI} \\ -158.23 \text{ PSI} \end{cases}$

TOTAL BOLT TENSION = 50,023#

TENSION ON ONE BOLT = 16,674#

USE A325 BOLTS AND ALLOW 33,500 PSI AT ROOT OF THREAD.

REQUIRED NET AREA = $\frac{16674}{33500} = 0.50$ SQ. IN.

PINTLE

LOADS:

CASE I $R = 94.4^{K}$ ($\alpha = 5°\ 59'$)

CASE V $R = 562.0^{K}$ ($\alpha = 1°\text{-}00'$)

CASE IV C $R = -44.0^{K}$ ($\alpha = 4°\ 20'$)

α = ANGLE OF RESULTANT WITH ℄ OF STRUCTURE.

** AVERAGE BEARING ON PINTLE = $\frac{562000}{13 \times 14} = 3088$ PSI < 4000 PSI.

BEARING AREA OF 11½"Φ DISC = $11.5^2 \times \frac{\pi}{4} = 103.82$ IN²

BEARING ON DISC = $\frac{109000}{103.82} = 1050$ PSI < 3000 PSI

BENDING ON 13"Φ PIN

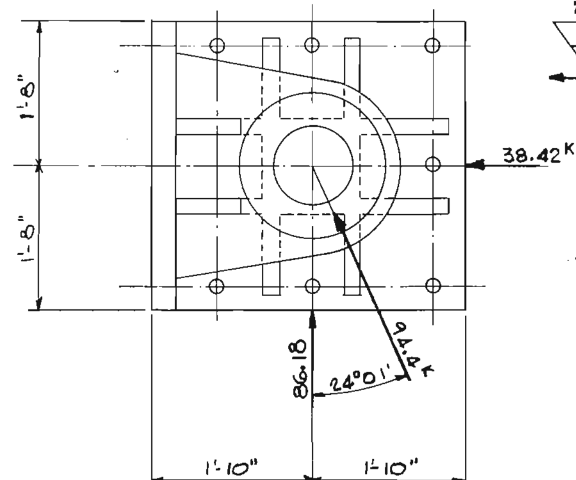
$S = \frac{\pi\, 13^3}{32} = 215.58$ IN³ $A = \pi(6.5)^2 = 132.67$ IN²

$M_B = 562000 \times 9.5 = 5,339,000$ IN. LB.

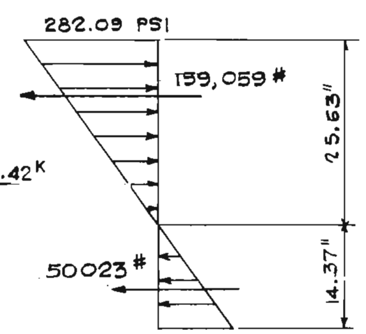
$F_S = \frac{5339000}{215.58} = 24766$ PSI < 32500 PSI

MAXIMUM SHEAR $v = \frac{562000}{132.67} \times \frac{4}{3} = 5648$ PSI < 16000 PSI.

** NOT MOVING



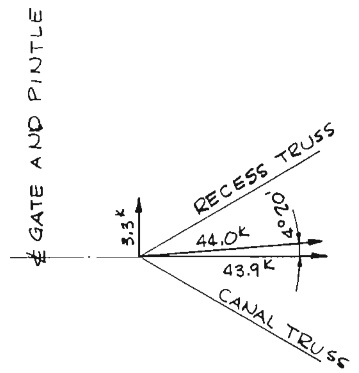
TOP VIEW
N. T. S.

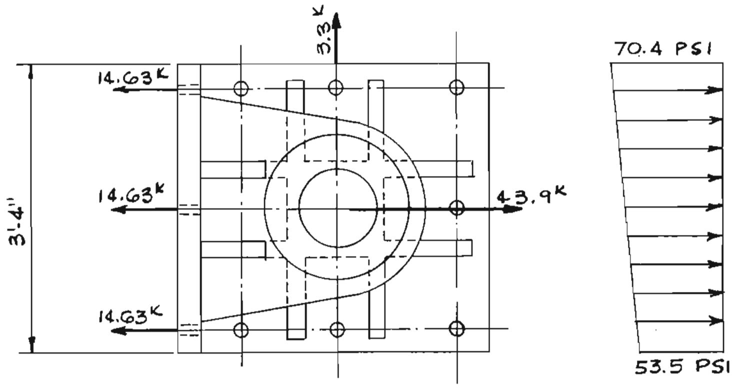


MAXIMUM ASYMMETRIC LOAD
DEAD LOAD ONLY – CASE - I
N. T. S.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES
SECTOR GATES
PINTLE DESIGN - I
SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

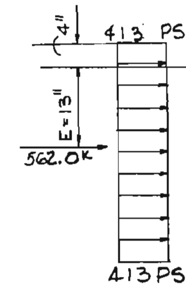


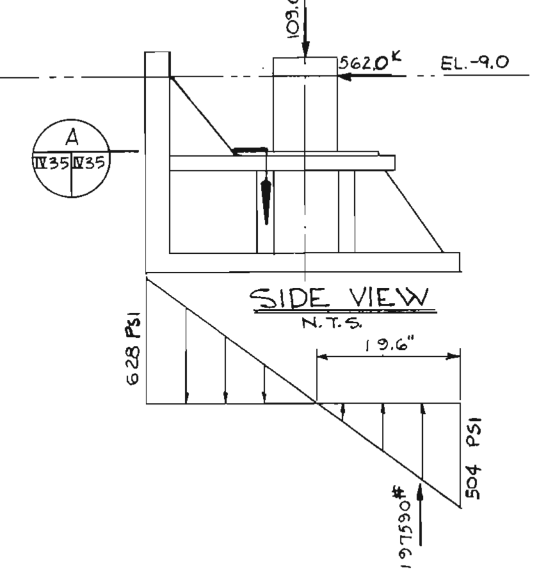


TOP VIEW
N.T.S.

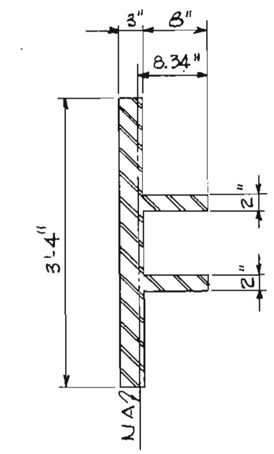
TENSION ON ONE BOLT = 14,680#
USE A325 BOLTS AND ALLOW 44,500 PSI
AT ROOT OF THREAD.
REQUIRED AREA = $\frac{14630}{44500}$ = 0.33 SQ.IN.
USE 1"ϕ BOLT
NET AREA = 0.606 SQ. IN.

MAXIMUM TENSION LOAD
DEAD LOAD PLUS REVERSE HEAD PLUS BOAT LOAD - CASE IV-C
N.T.S.





TOTAL BOLT TENSION = 197,590#
TENSION ON ONE BOLT = 65,863#
USE A325 BOLTS AND ALLOW 44,500 PSI
AT ROOT OF THREAD
REQUIRED AREA = $\frac{65863}{44500}$ = 1.48 SQ.IN.
USE 2"ϕ BOLT.
NET AREA = 2.50 SQ.IN.



SECTION (A IV35 IV35)
N.T.S.

I_o = 1024.88 IN⁴
M_o = 1,618,960"K
MAXIMUM $f_b = \frac{1618960(8.34)}{1024.88}$ = 13174 PSI. < 24000 PSI

MAXIMUM COMPRESSION LOAD
DEAD LOAD PLUS WAVE LOAD - CASE V
N.T.S.

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CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

SECTOR GATES
PINTLE DESIGN - 2
SCALES AS SHOWN

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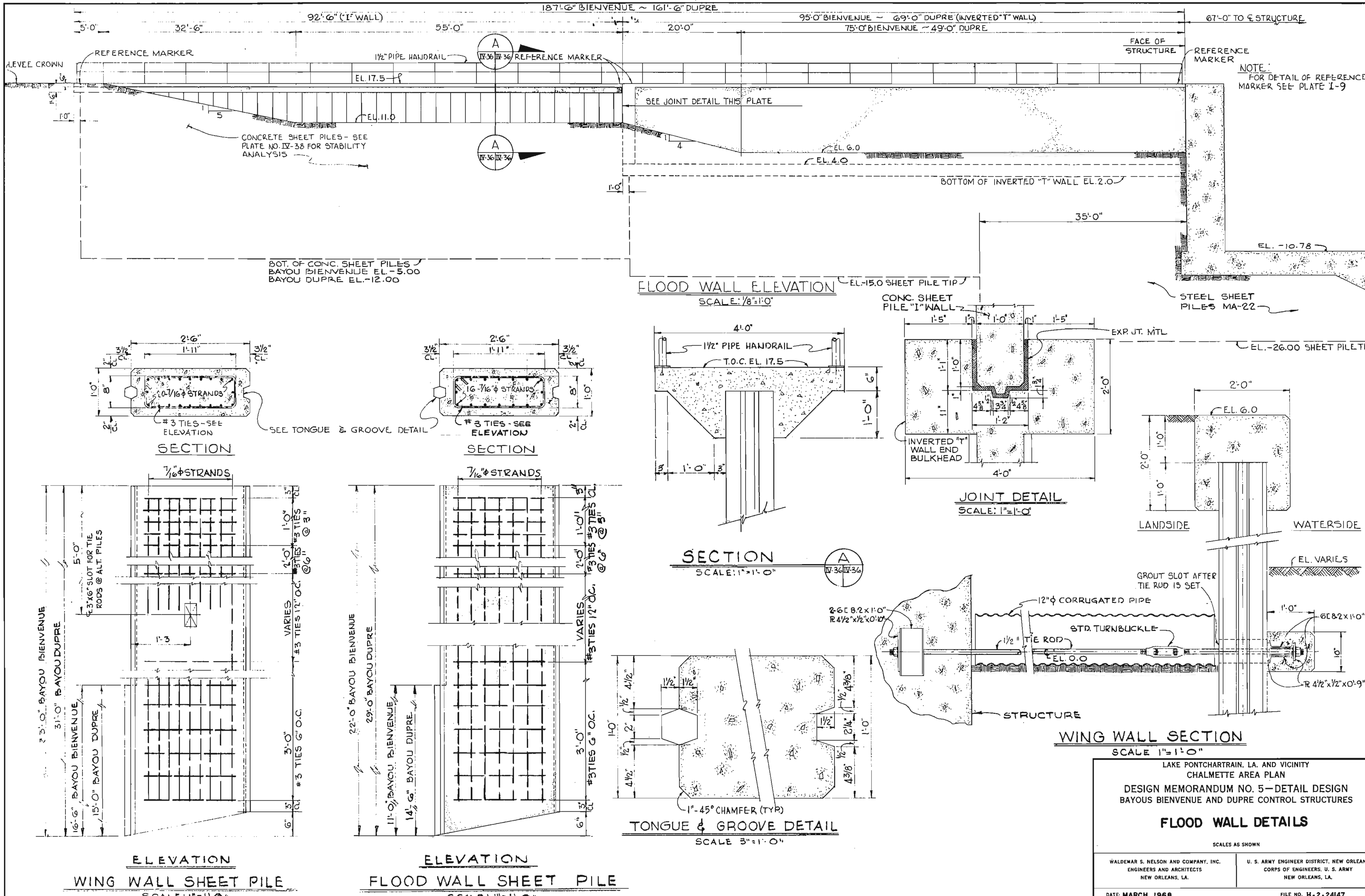

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

FLOOD WALL DETAILS

SCALES AS SHOWN

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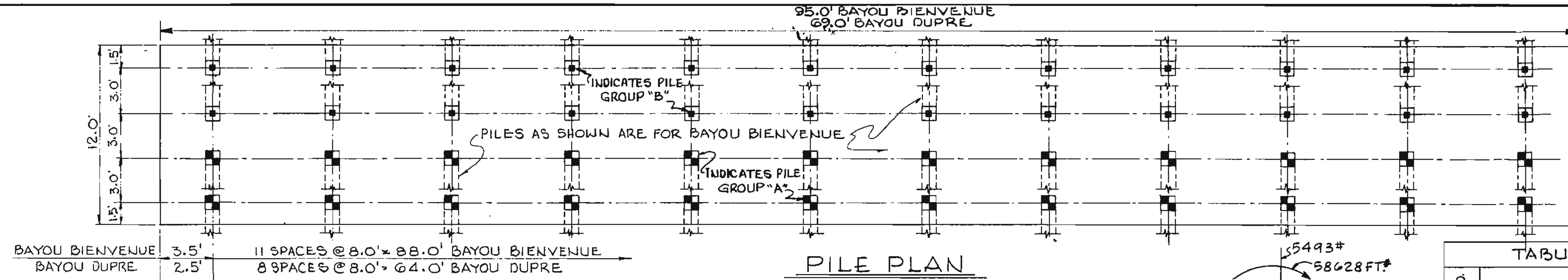
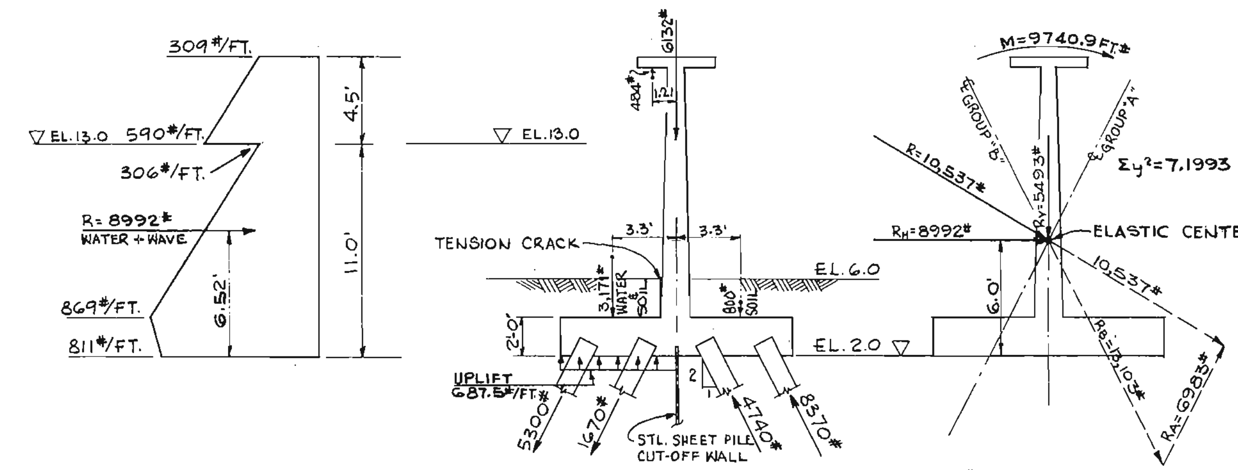
DATE: MARCH, 1968	FILE NO. H-2-24147

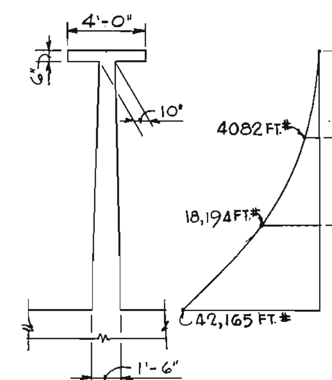
PLATE NO. IV-36



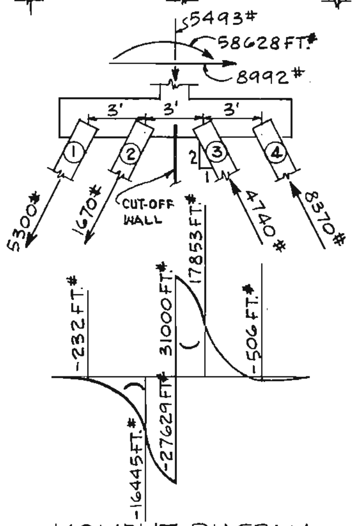
PILE PLAN
1" = 5'-0"



LOADS AND PILE REACTIONS ON INVERTED "T" FLOOD WALL
SCALE: 1" = 5'-0"
1" = 5000 FT.#



MOMENT DIAGRAM
FOR STEM
SCALE: 1" = 3'-0"
1" = 40,000 FT.#



MOMENT DIAGRAM
FOR BASE
SCALE: 1" = 3'-0"
SCALE: 1" = 10,000 FT.#

TABULATION OF PILE LOADS IN KIPS

PILE NO.	ELASTIC CENTER		K=50 HRENNIKOFF				K=125 HRENNIKOFF				K=200 HRENNIKOFF			
			BIENVENUE		DUPRE		BIENVENUE		DUPRE		BIENVENUE		DUPRE	
	P	Q	P	Q	P	Q	P	Q	P	Q	P	Q	P	Q
LOADING CONDITION NO. 1														
1	-42.4	0.0	-42.5	-0.016	-42.5	-0.016	-42.6	-0.032	-42.6	-0.024	-42.6	-0.040	-42.6	-0.032
2	-13.4	0.0	-13.3	-0.056	-13.4	-0.040	-13.2	-0.104	-13.3	-0.080	-13.1	-0.144	-13.2	-0.112
3	37.9	0.0	37.8	-0.960	37.9	-0.016	37.8	-0.040	37.8	-0.032	37.7	-0.056	37.7	-0.040
4	67.0	0.0	67.0	-0.016	67.0	0.008	67.0	0.032	67.0	0.024	67.1	0.048	67.1	0.040
LOADING CONDITION NO 1-A														
1	-36.2	0.0	-36.6	-0.096	-36.5	-0.072	-36.8	-0.176	-36.7	-0.144	-37.0	-0.240	-36.9	-0.192
2	-19.5	0.0	-18.7	-0.120	-19.0	-0.096	-18.4	-0.224	-18.6	-0.176	-18.0	-0.360	-18.3	-0.248
3	44.1	0.0	43.5	-0.088	43.6	-0.072	43.0	-0.160	43.2	-0.128	42.6	-0.216	42.8	-0.176
4	60.8	0.0	61.1	-0.064	61.0	-0.048	61.4	-0.112	61.3	-0.096	61.5	-0.152	61.4	-0.128
LOADING CONDITION NO. 2														
1	7.0	0.0	6.9	-0.072	7.0	-0.056	6.7	-0.136	6.8	-0.112	6.6	-0.192	6.7	-0.152
2	4.1	0.0	4.6	-0.072	4.5	-0.024	4.9	-0.136	4.7	-0.104	5.1	-0.184	5.0	-0.152
3	23.3	0.0	23.0	-0.040	23.0	-0.032	22.5	-0.064	22.7	-0.056	22.3	-0.088	22.5	-0.072
4	20.3	0.0	20.6	-0.040	20.6	-0.032	20.7	-0.072	20.6	-0.056	20.8	-0.096	20.7	-0.080
LOADING CONDITION NO. 2-A														
1	10.5	0.0	10.2	-0.120	10.3	-0.096	10.0	-0.224	10.1	-0.128	9.8	-0.304	9.9	-0.248
2	0.6	0.0	1.3	-0.104	1.2	-0.088	1.92	-0.200	1.7	-0.160	2.3	-0.280	2.1	-0.224
3	26.7	0.0	26.2	-0.072	26.2	-0.056	25.5	-0.136	25.8	-0.112	25.1	-0.176	25.4	-0.144
4	16.9	0.0	17.3	-0.088	17.1	-0.064	17.4	-0.152	17.4	-0.128	17.6	-0.208	17.5	-0.168

NOTES:

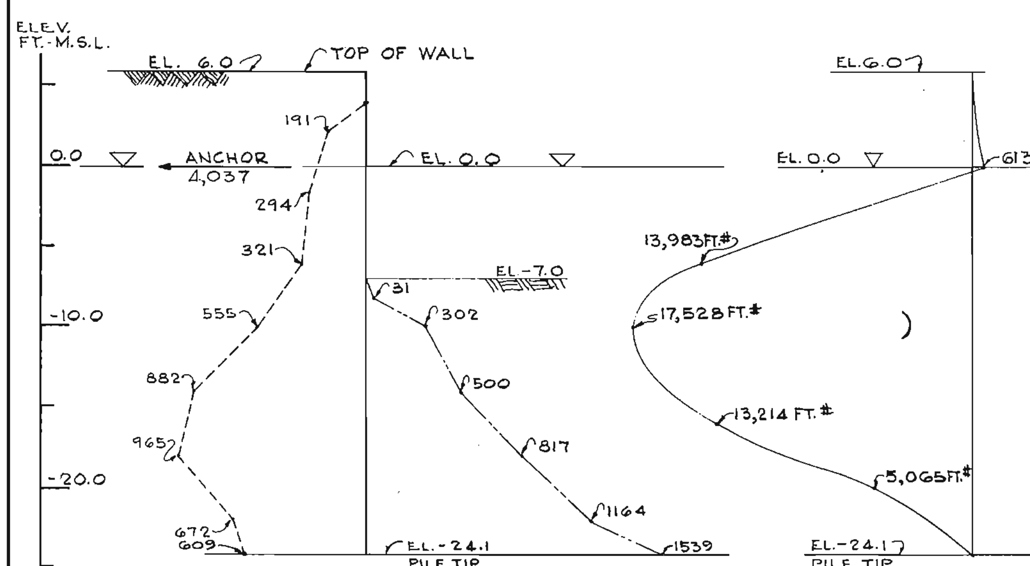
LOADING CONDITION NO. 1-
STILL WATER OF EL. 13.0, 7FT. BROKEN WAVE, SHEET PILE CUT-OFF WALL ASSUMED IMPERVIOUS, LANDSIDE WATER EL. 2.0.

LOADING CONDITION NO. 1-A-
SAME AS CONDITION NO. 1 EXCEPT SHEET PILE CUT-OFF WALL ASSUMED PERVIOUS.

LOADING CONDITION NO. 2-
STILL WATER OF EL. 8.3, 2FT BROKEN WAVE, SHEET PILE CUT-OFF WALL ASSUMED IMPERVIOUS, LANDSIDE WATER EL. 2.0.

LOADING CONDITION NO. 2-A-
SAME AS CONDITION NO. 2 EXCEPT SHEET PILE CUT-OFF WALL ASSUMED PERVIOUS.

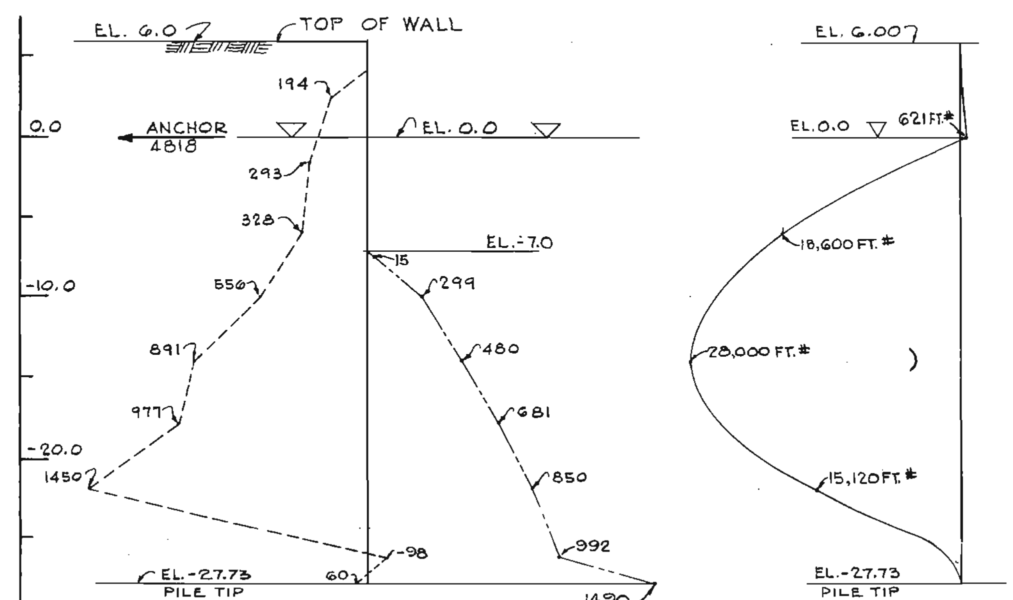
⌒ INDICATES TENSION IN TOP OF BASE SLAB.
‿ " " BOT. " " "
ABOVE LOADINGS ARE GROUP II LOADINGS.



PRESSURE DIAGRAM
SCALE: 1" = 500 (P.S.F.)
1" = 6'-0"
F.O.S. = 1.5

MOMENT DIAGRAM
SCALE: 1" = 6'-0"
1" = 5000 FT.#

WING WALL STABILITY
BAYOU DUPRE



PRESSURE DIAGRAM
SCALE: 1" = 500 (P.S.F.)
1" = 6'-0"
F.O.S. = 1.5

MOMENT DIAGRAM
SCALE: 1" = 6'-0"
1" = 10,000 FT.#

WING WALL STABILITY
BAYOU BIENVENUE

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BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

FLOOD WALL STABILITY - I

SCALES AS SHOWN

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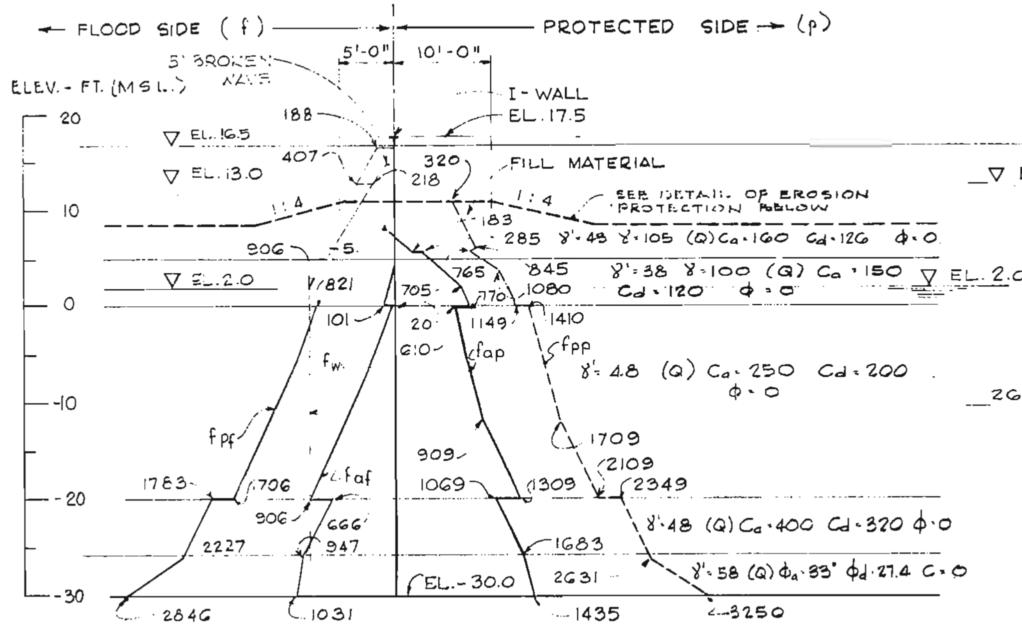
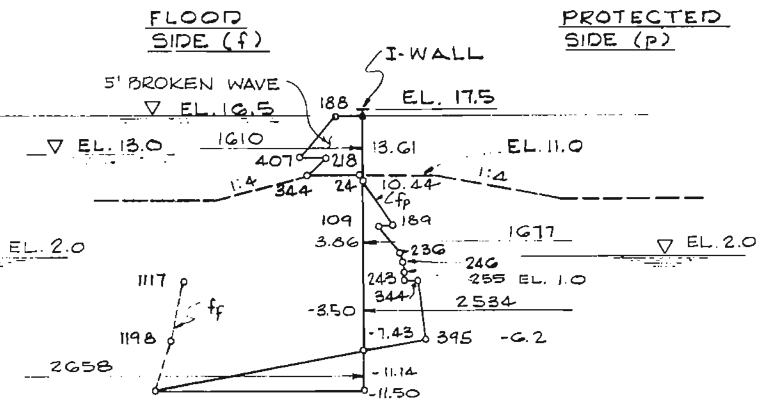
DATE: MARCH, 1968	FILE NO. H-2-24147



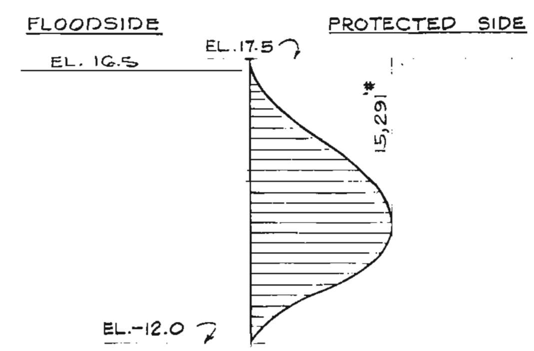
GROSS PRESSURE DIAGRAM

F.S. = 1.25
SCALE 1" = 1000 PSF
SCALE 1" = 10'-0"



NET PRESSURE DIAGRAM

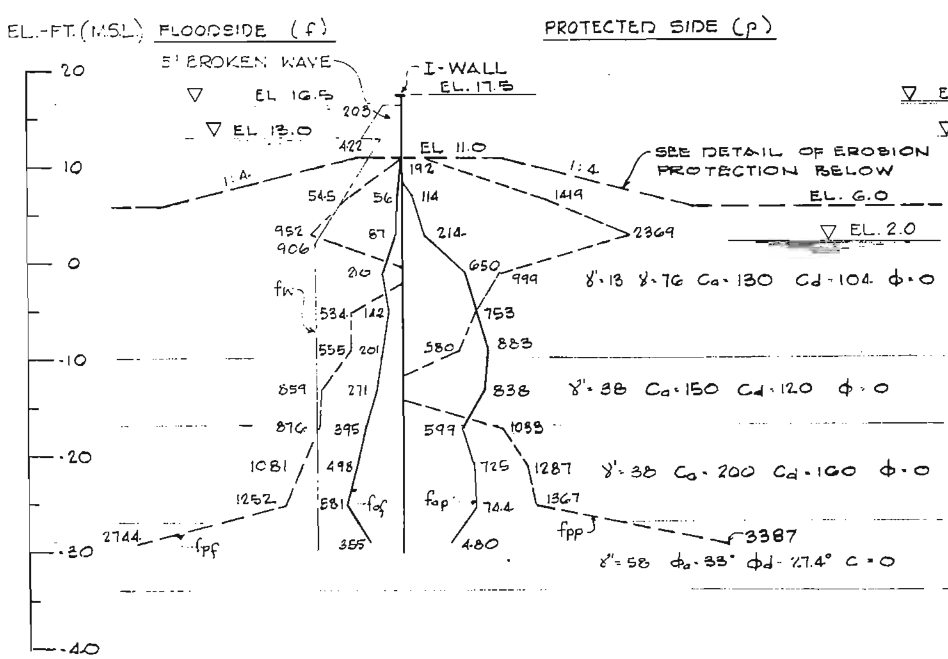
"Q" STABILITY
SCALE 1" = 600 P.S.F.
SCALE 1" = 10'-0"
F.S. = 1.25



MOMENT DIAGRAM

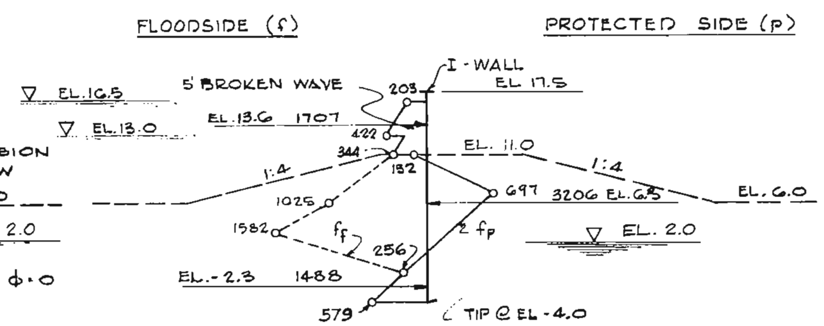
F.S. = 1.25
SCALE 1" = 10,000 FT. LB.
SCALE 1" = 10'-0"

BAYOU DUPRE



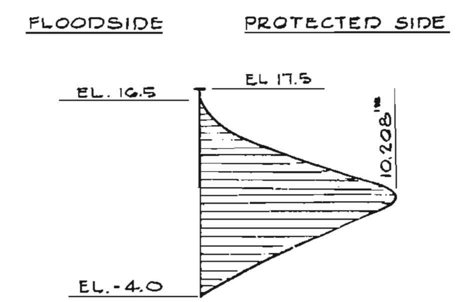
GROSS PRESSURE DIAGRAM

F.S. = 1.25
SCALE 1" = 1000 PSF
SCALE 1" = 10'-0"



NET PRESSURE DIAGRAM

"Q" STABILITY
SCALE 1" = 1000 PSF
SCALE 1" = 10'-0"
F.S. = 1.25



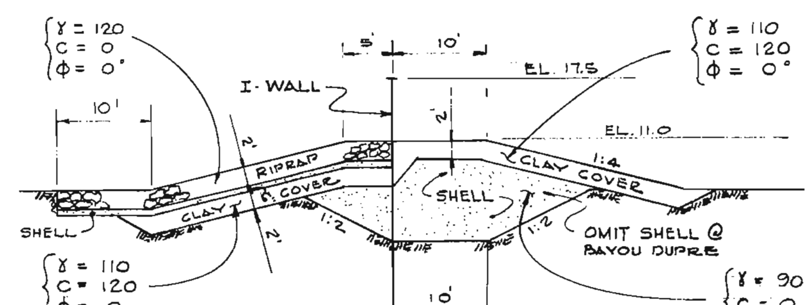
MOMENT DIAGRAM

F.S. = 1.25
SCALE 1" = 5000 FT. LB.
SCALE 1" = 10'-0"

NOTE

THE FOLLOWING CASES HAVE BEEN STUDIED BUT CONTROLLING CASES ONLY ARE SHOWN:

1. 'Q' STABILITY: S.W.L. @ EL. 13.0, TOP OF WAVE @ EL. 16.5, DYNAMIC LOAD OMITTED, F.O.S. = 1.50.
2. 'Q' STABILITY: SAME AS (1) EXCEPT DYNAMIC LOAD ADDED & F.O.S. = 1.25.
3. 'S' STABILITY: SAME AS (1).
4. 'S' STABILITY: SAME AS (2).



DETAIL OF EROSION PROTECTION

SCALE 1" = 10'-0"

BAYOU BIENVENUE

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DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

FLOOD WALL STABILITY - 2

SCALES AS SHOWN

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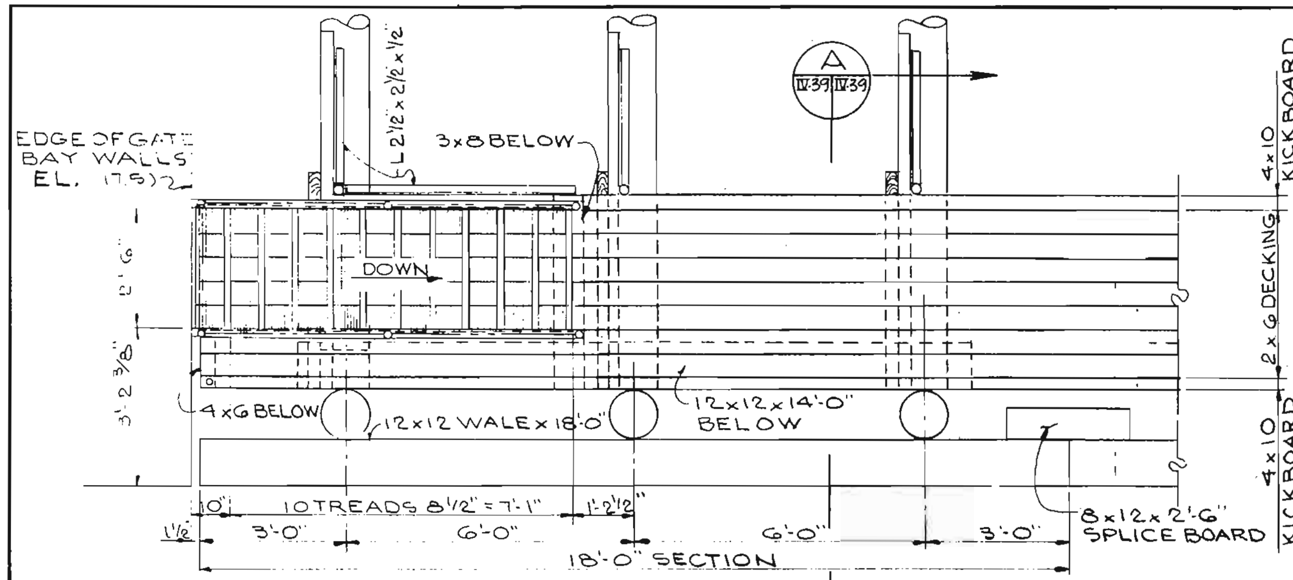
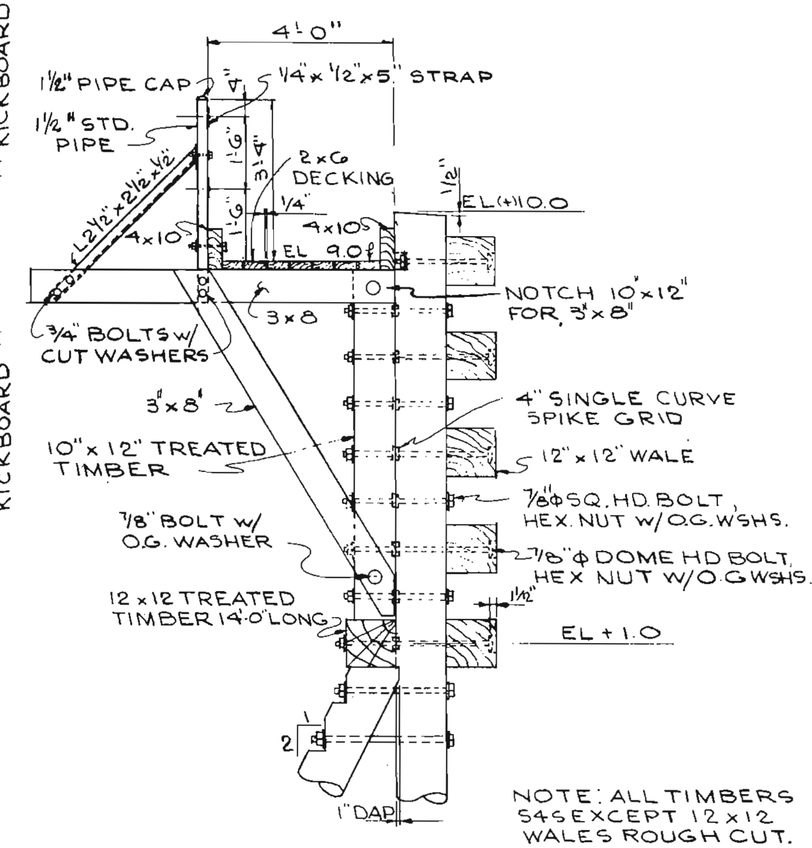


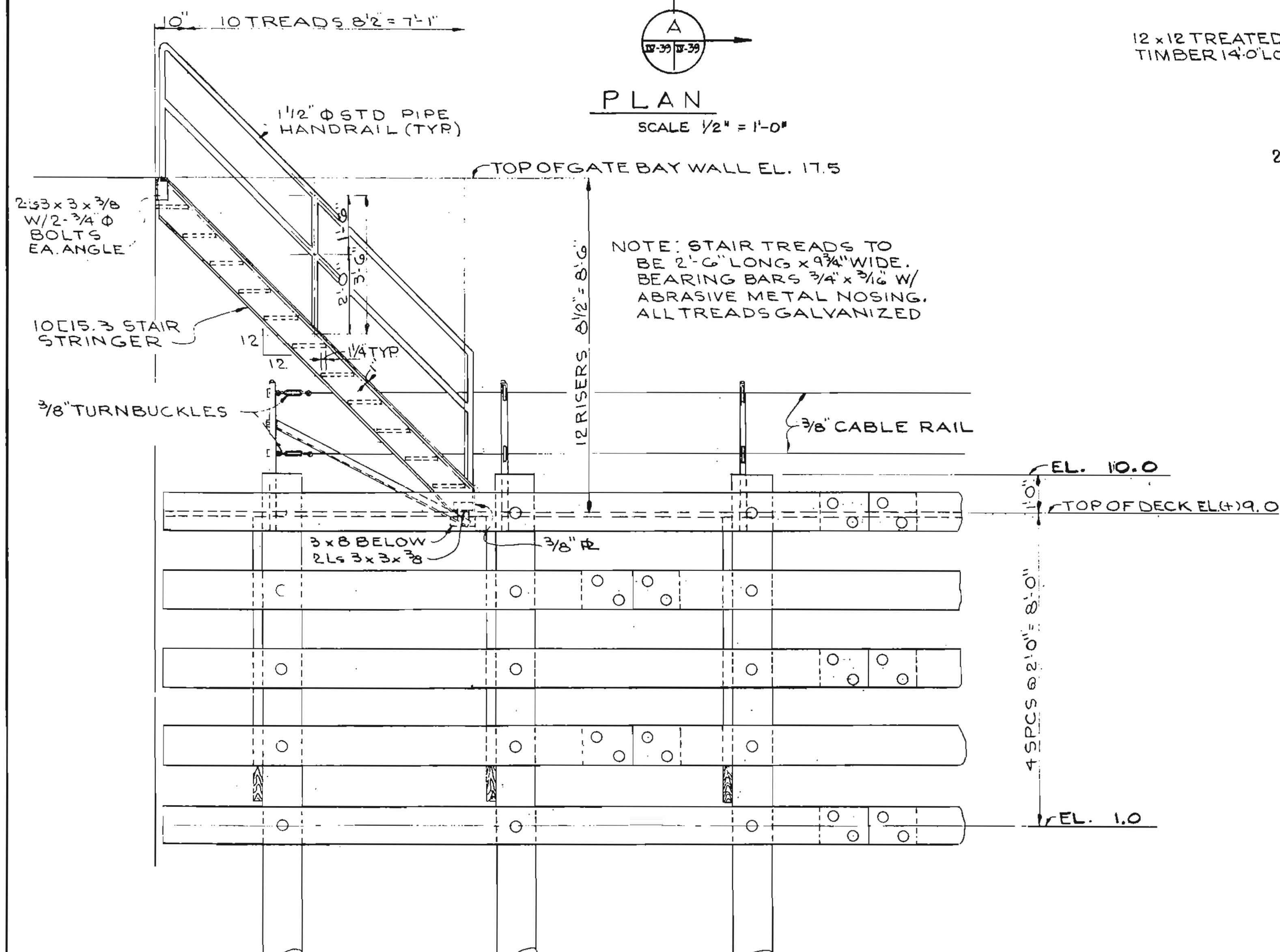
PLAN

SCALE ½" = 1'-0"



SECTION A

SCALE ½" = 1'-0"



ELEVATION

SCALE ½" = 1'-0"

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DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

GUIDEWALL & FENDER DETAILS

SCALES AS SHOWN

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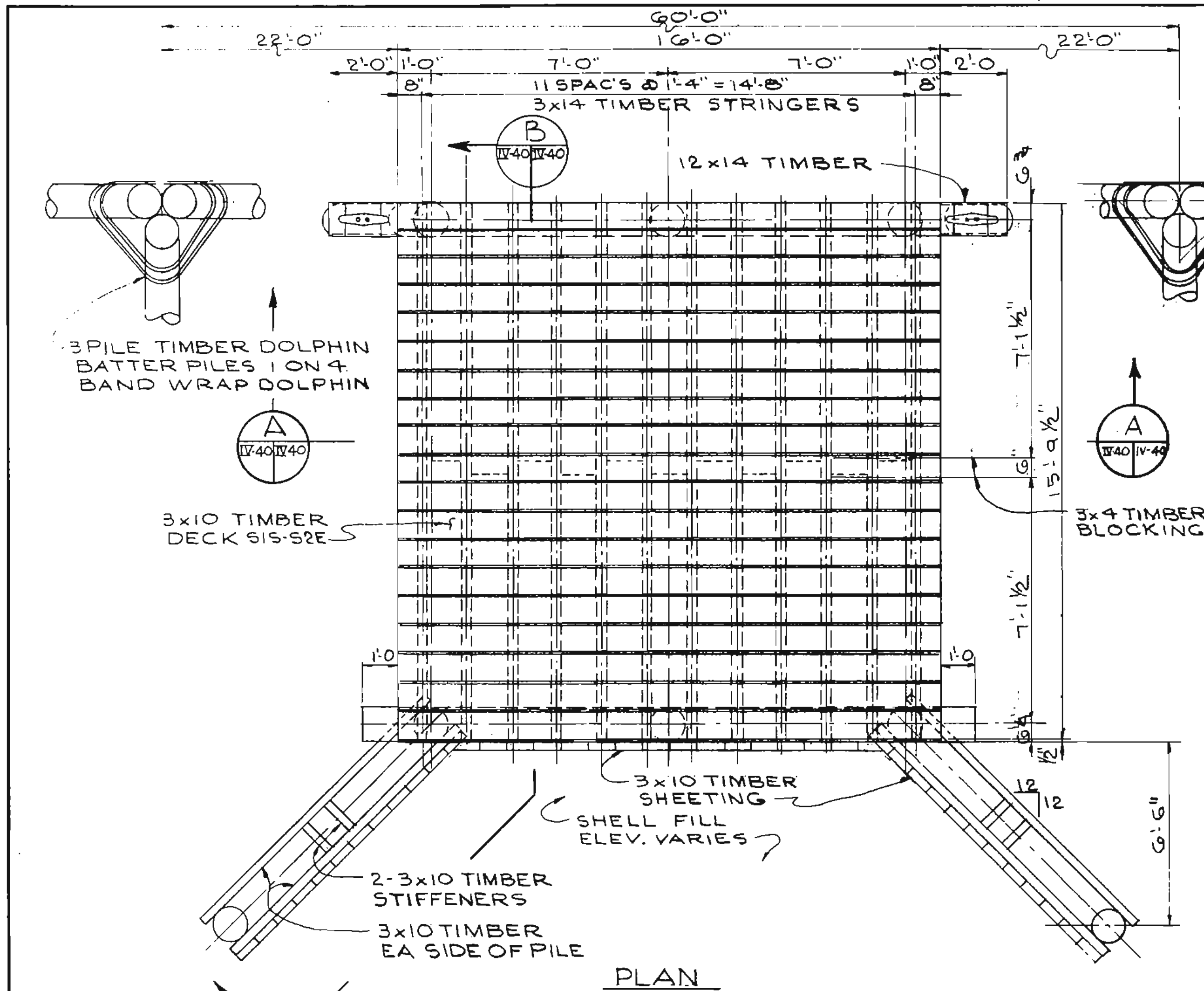
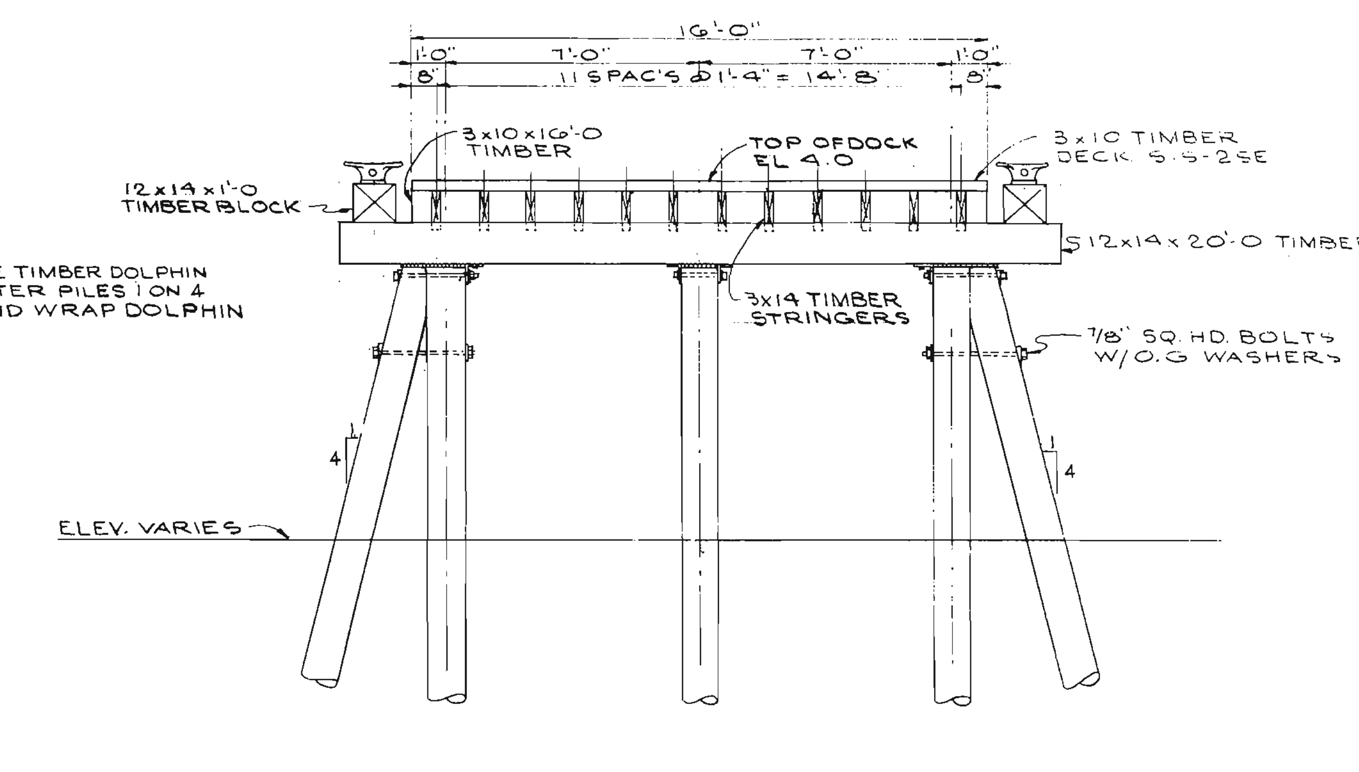
DATE MARCH, 1968	FILE NO. H-2-24147

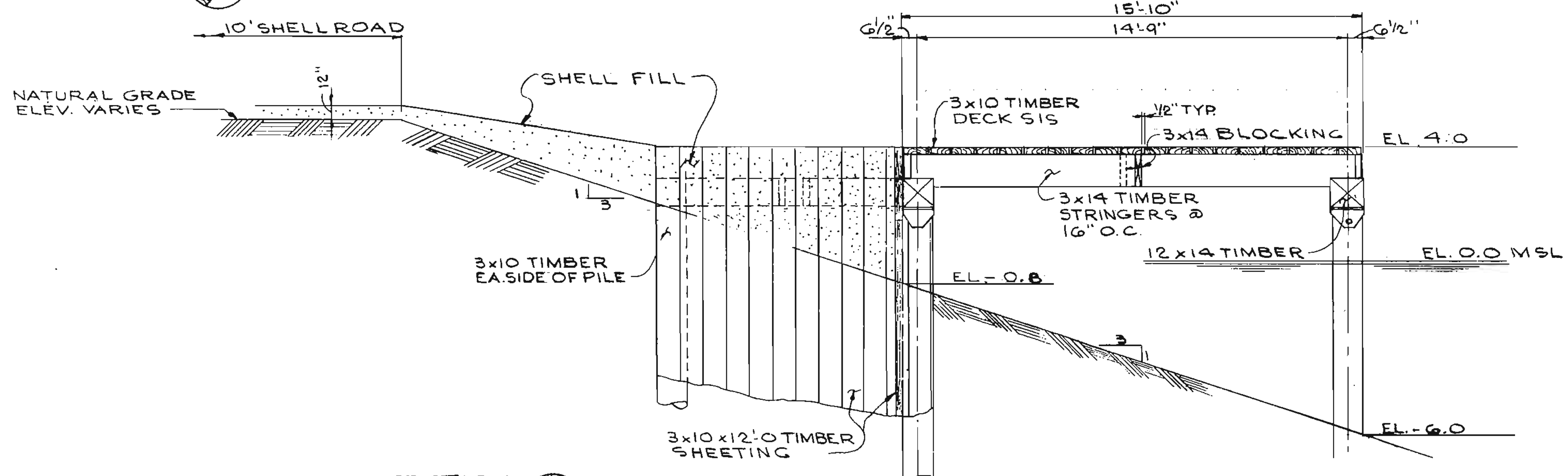


PLAN



SECTION A
SCALE 3/8 = 1'-0"
IV-40 IV-40

NOTE:
1. ALL ELEVATIONS SHOWN REFER TO MEAN SEA LEVEL.
2. ALL PILES SHALL BE 65' LONG CLASS "B", TREATED TIMBER PILES, TIP ELEVATION -63.0±.
3. TIMBER COMPONENTS, OTHER THAN PILES, SHALL BE S4S FINISH, EXCEPT DECKING SHALL BE S1S-S2E FINISH.
4. ALL FASTENINGS INCLUDING COMMON NAILS SHALL BE HOT DIP GALVANIZED.



SECTION B
SCALE 3/8" = 1'-0"
IV-40 IV-40

0 1 2 3 4 5 10 FT
SCALE

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CHALMETTE AREA PLAN
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BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

DOCK & LOADING RAMP

SCALES AS SHOWN

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DATE: MARCH, 1968	FILE NO. H-2-24147

SECTION V - MECHANICAL DESIGN

1. Gate Operating Machinery.

a. General. The gate operating machinery will consist of a butane gas engine driven A.C. generator, a two-speed geared electric motor with reversing starter, a parallel shaft quadruple helical gear reducer, a cable winch on output shaft of reducer, and gate operating cables and sheave assembly. A chain and gear manual emergency operating mechanism will also be provided.

b. Arrangement. The gas engine driven generator set will be installed on the operating floor (Elev. 17.5) of control house No. 1. The manual operating unit will also be situated on the same floor in such a position as to give the operator a clear view of the gate through the window. The drive motor-reducer assembly, winch and the sheave assembly will be mounted in the compartment below the operating floor.

c. Description.

(1) Power Supply. A butane gas engine driven three-phase, A.C. generator, will be selected to supply the power requirements of both gate leaves and will be mounted in control house No. 1. The engine will normally be started by an electrical starter but in case of a low battery, it can readily be hand cranked. A starting crank will be provided.

(2) Drive Motor and Reducer. A three-phase, two speed induction motor, with reversing starter, will be directly coupled to a quadruple helical reduction gear, both mounted on a common bed plate. The output shaft of the reducer will be extended and a cable drum mounted on this shaft. An outboard bearing on a separate pedestal will be provided for the extended shaft.

(3) Sheave Assembly. The gate operating cables will be guided to the sheave assembly by suitable idlers, and the sheaves will be so mounted that the operating cables will mate fairly with the cable track on the gate leaf. All sheaves and idlers will be mounted on bronze pins and will be pressure lubricated with grease. Wire rope will be hot dip galvanized with lubricant around each strand and a lubricant-filled fiber center. Lubricant will be as recommended by rope manufacturer.

(4) Electrical Control Gear. The gas engine driven electric generator unit will be complete with all necessary switches, protective devices and batteries. Each motor will be supplied from a two-speed reversing combination starter located in the motor control center, all as described in Section VI.

(5) Limit Switches. Limit switches will be provided to limit the travel of the gate in the open and closed positions and to enforce

switching to slow speed near the ends of travel. The limit switches will be of the watertight type, and will be mounted on an auxiliary shaft of the reducer, extended on opposite side of the reducer from the drum.

(6) Manual Operation. A manually operated control gear assembly unit will drive the reducer input shaft by a voller chain. As the manual unit will be connected while the power unit is in operation, a removable crank handle will be provided. It will be hung on brackets mounted on the manual unit housing when not in use. A hand operated pawl will engage a ratchet mounted on the manual operation unit driving sprocket to lock the gate in the closed position for protection against the results of brake failure. A limit switch will be used to prevent starting the electric motor when this pawl is engaged.

d. Computations. The basic assumptions, design criteria, allowable stresses and computations for the machinery are contained on Sheets 1 thru 21 of this section.

e. Plates. Plates V-1 and V-2 show the general arrangement of the equipment.

SECTOR GATE DESIGN DATA

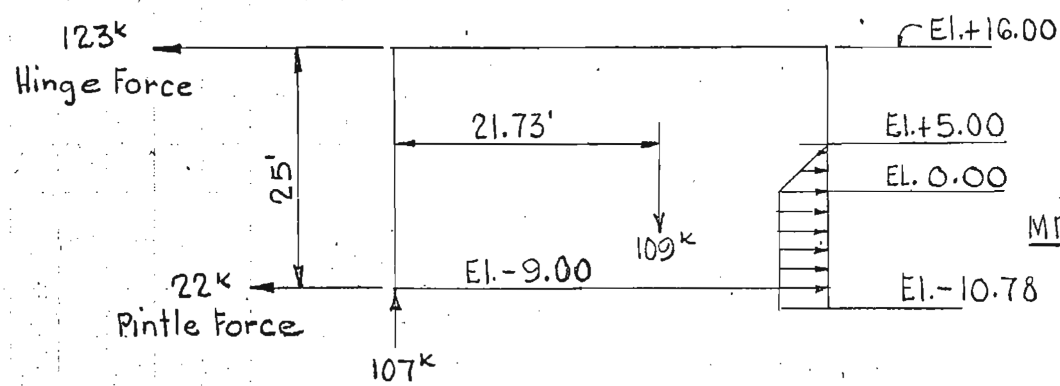
General

The design of the sector gate operating machinery has been based on the dead load of the gate leaf and the hydraulic conditions as sketched below, which are determined by conditions under which the gate leaves must be operated.

The two extreme conditions are shown below.

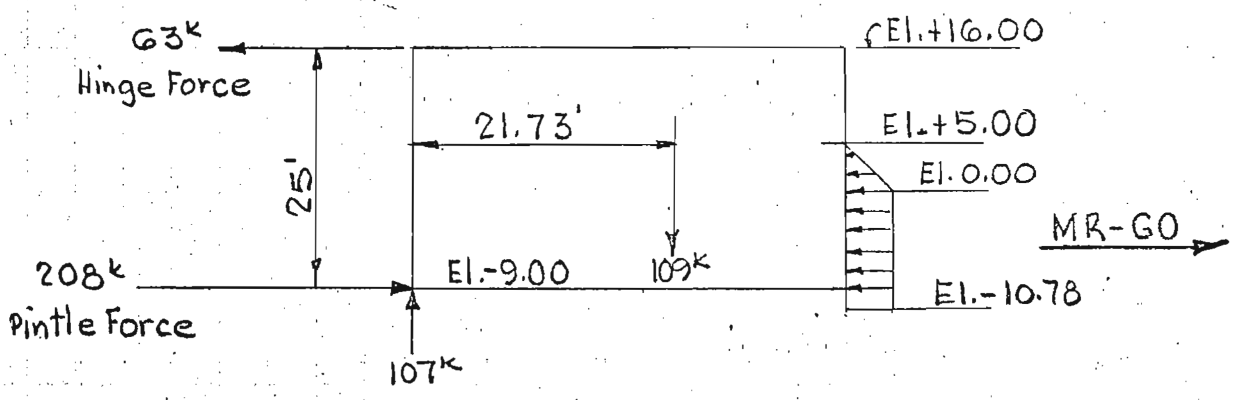
CASE III (See PLATE No. IV-28)

Case A - Normal use as floodgate



Gate Closed

Case B - Proposed use as lock gate

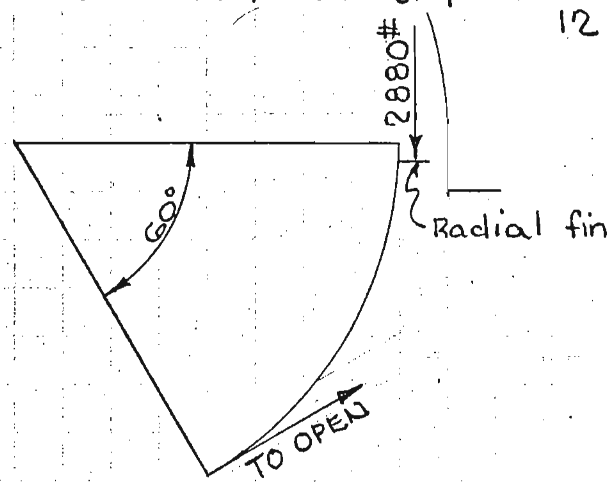


In addition to the radial hydraulic load on the gate, an 8.25" radial stop for the vertical seal is attached to the outer skin. The pressure on this radial projection is computed as follows:

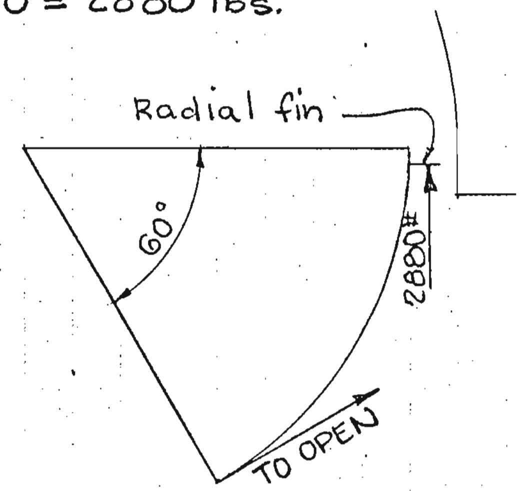
$$\text{Force per ft. run} = \frac{\text{Total force on Gate, Kips}}{\text{Projected length of Chord, Ft.}}$$

$$= \frac{145^{k}}{34.67'} = 4{,}190 \text{ lbs/ft}$$

$$\text{Force on radial stop} = \frac{8.25}{12} \times 4190 = 2880 \text{ lbs.}$$



CASE A



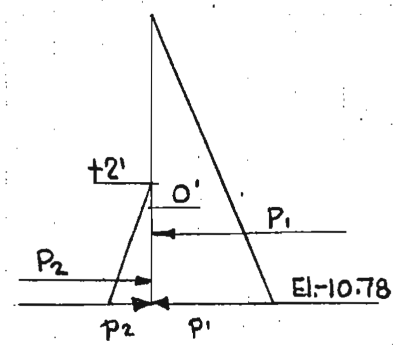
CASE B

The cable tension due to this force on the seal fin will be: $\frac{35}{34.68} \times 2880 = 2900$ lbs.

For CASE A a force of 2900 lbs. must be added to the force required to overcome the frictional moments.

For CASE B this force must be deducted.

For flood conditions, 13' head, OD, on the MR-GO side and 2' head, OD, on the land side, the net force acting on the radial fin will be:



$p_1 = 62.5 \times 23.78 = 1486$ lbs per ft^2
$p_2 = 62.5 \times 12.78 = 800$ " " "

$P_1 = \frac{1}{2} \times 1486 \times 23.78 = 17{,}670$ lbs per ft

$P_2 = \frac{1}{2} \times 800 \times 12.78 = \underline{5{,}110}$ " " "

Net Pressure = 12,560 " " "

Force on radial fin (Exposed Area) $= \frac{5.81}{12} \times 12{,}560 = 6080$ lbs. ✓

Under the condition stated this force will act in such direction as to tend to cause the gate to open. The braking system used will be adequate to hold against this force, all friction being neglected.

Hydraulic Conditions

From the preceding sketches it is seen that there are two (2) cases of differential head to consider –

	CASE A	CASE B
Landside elevation	El. +5.00	El. 0.00
MR-GO side elevation	El. 0.00	El. 5.00
Differential head	+5'	+5'

Allowable Stresses

The parts of the operating machinery which are stressed in proportion to the torque will be so proportioned that the stresses when stalling occurs will not exceed 75% of the yield point of the materials used.

OPERATING MACHINERY CAPACITY

General

The force acting on the cable to move the gate will be determined by the following loads acting on the gate

Dead load of the gate.
Water load acting on the gate skin.
" " " " " vertical seal fin.
Seal friction.

Weight of Gate

The weight of each sector gate will be 109^k.

Loads

The gate loads as here-in-after presented were obtained from the gate design computations.

Radius of gate from ℄ of pintle to outside of skin plate = 34.64'

Radius of gate from ℄ of pintle to the pitch line of the cable track = 34.68'

Radius of gate from ℄ of pintle to the ℄ of the bottom seal = 34.87'

Assume uniform pressure over the area of the pintle thrust bearing; without wear the effective lever arm of the friction force will be at two-thirds of the disc radius or $\frac{2}{3} \times 6 = 4"$

Assumed Coefficients of Friction —

Bearing surfaces = 0.25
Rubber seals (wet) = 0.25

Case A: 5' differential head land side

Hinge: Load 123^k

Moment = Load x coef of friction x pin radius

$$= \frac{123{,}000 \times 0.25 \times 7}{12} = 17{,}950 \text{ ft. lbs}$$

Pintle: Loads, Water = 22^k

Dead = 109^k

Moment due to water load

$$= \frac{22{,}000 \times 0.25 \times 6.5}{12} = 2{,}980 \text{ ft. lbs}$$

Moment due to dead load

$$= \frac{109{,}000 \times 0.25 \times 4}{12} = 9{,}100 \text{ ft. lbs}$$

Seal: 156# x 34.87 = 5,450 ft. lbs.

(See pg. 15 of 21)

The moments, excluding that due to the vertical seal fin = Hinge moment + pintle moments

= 17,950 + 2,980 + 9,100 + 5,450 = 37,280 ft. lbs.

The cable tension required to open the gate

$$= \frac{\text{Sum of moments}}{\text{Track radius}} + \text{Pressure on Vertical fin}$$

$$= \frac{37{,}280}{34.68} + 2900 = 1065 + 2900 = 3{,}965 \text{ lbs}$$

Adding 10% for shock, the cable tension for Case A = **4,300** lbs.

Case B 5' differential head MR-GO side

Hinge: Load 63^k

$$\text{Moment} = \frac{63{,}000 \times 0.25 \times 7}{12} = 9{,}200 \text{ ft. lbs}$$

Pintle: Loads, Water = 208^k

Dead = 109^k

Moment due to water load

$$= \frac{208{,}000 \times 0.25 \times 6.5}{12} = 28{,}100 \text{ ft. lbs}$$

Moment due to dead load

$$= \frac{109{,}000 \times 0.25 \times 4}{12} = 9{,}100 \text{ ft. lbs.}$$

Seal: *(Calculations for seal pressure for Case B are shown on Sheet 15.)*

(The hydraulic load = 4,600 lbs.)

The moment due to seal friction is,

Moment = hydraulic load x coef. of friction x seal radius

= 4,600 x 0.25 x 34.87 = 40,200 ft. lbs.

The total moment for Case B = hinge moment + pintle moment + seal moment, the pressure on the vertical seal fin being neglected.

Total Moment = 9,200 + 28,100 + 9,100 + 40,200 = 86,620 ft. lbs.

The cable tension required to open the gate

$$= \frac{\text{Sum of moments}}{\text{Track radius}} - 2{,}900$$

$$= \frac{86{,}620}{34.68} - 2{,}900 = 2{,}550 - 2{,}900 = -350 \text{ lbs.}$$

Case B (cont'd.)

Adding 10% = -385 lbs say -390 lbs

Use Case A cable tension.

Required Capacity

Since the operating cable tension for case A exceeds that of Case B, the former value, 2700 lbs, will be used as the basis for machinery design.

The power will be supplied by a Butane gas-generator unit of adequate capacity to drive two (2) gate leaves.

Each winch motor must have a torque output large enough to transmit sufficient force to the operating cables to move the gate leaf under the most severe operating condition, i.e., a tension of 4300 lbs.

The brake must be capable of holding the gate leaf in any position and must have a rating of at least 250% of the rated full load torque of the motor.

DESIGN

General

Preliminary layouts and computations of several arrangements of operating machinery were made to insure an arrangement that would have adequate capacity and fit into the available space.

Cable Travel and Speed

Assuming the gate operating time to be three (3) minutes, the velocity of the gate cable track will be:

Travel $s = r\theta$

Where the track radius $r = 34.68$

Cable Travel and Speed (cont'd.)

$$\theta = 60^\circ = \frac{\pi}{3} \text{ radians}$$

$$s = \frac{34.68\,\pi}{3} = 36.4 \text{ ft.}$$

$$V_1 = \frac{s}{3} = \frac{36.4}{3} = \underline{\underline{12.13}} \text{ fpm}$$

Machinery

Where winch drum diameter, d = 26 5/8" (2.22')

$$\text{rpm (winch drum)} = \frac{12.13}{\pi \times d} = \frac{12.13}{3.14159 \times 2.22} = \frac{12.13}{6.97} = 1.74 \text{ say } 1.75 \text{ rpm}$$

Reducer output shaft rpm = 1.75
Say 1.8 rpm to allow for slow down in last few inches of travel.

Reducer input shaft rpm = 1,800

$$\text{Ratio required} = \frac{\text{input shaft rpm}}{\text{output shaft rpm}} = \frac{1800}{1.8} = \underline{\underline{1000:1}}$$

Assumed efficiencies:

Winch = 95%
Reducer (helical) = 85%

Power required:

$$\text{Winch output} = \frac{\text{tension} \times 12.13}{33{,}000} = \frac{4300 \times 12.13}{33{,}000}$$

$$= \frac{52{,}159}{33{,}000} = \underline{1.58} \text{ hp}$$

$$\text{Winch input (Reducer output)} = \frac{1.58}{.95} = \underline{1.67 \text{ hp}}$$

$$\text{Reducer input} = \frac{1.67}{.85} = \underline{\underline{1.97}} \text{ hp}$$

Use 3hp motor

Machinery (cont'd.)

Torques:

Rated torque of motor $= \frac{hp \times 63025}{rpm}$

$= \frac{3 \times 63025}{1800} = \frac{189{,}075}{1800} = 105$ in. lbs. ✓

Torque (winch) $=$ tension $\times \left(\frac{\text{drum dia.}}{2}\right) = 4300 \times \left(\frac{26.625}{2}\right)$

$= 4300 \times 13.31 = 57{,}233$ in. lbs

say 58,000 in. lbs ✓

Reducer output $= \frac{58{,}000}{.95} = 61{,}052.6315$

say 62,000 in. lbs. ✓

Reducer input $= \frac{62{,}000}{985 \times .85} = \frac{62{,}000}{837.25} = 74.05$ in. lbs.

say 75 in. lbs. ✓

Stalling torque and forces:

The stalling torque of the motor will not exceed two and one-half (2½) times the full rated torque. The maximum forces and torque at various points will thus be increased by the factor k.

$k = 2.5 \times \frac{\text{full load torque}}{\text{estimated load torque}}$

$= 2.5 \times \frac{105}{75} = 2.5 \times 1.4 = 3.5$ ✓

The estimated torque and forces at various points are recapitulated below.

The corresponding stalling values using k=3.5 are also given.

Machinery (cont'd.)

LOCATION	VALUES-GATE MOVING FORCE (lbs)	VALUES-GATE MOVING TORQUE (in.lbs)	VALUES-GATE STALLED FORCE (lbs)	VALUES-GATE STALLED TORQUE (in. lbs)
Motor Shaft	—	75	—	270 (262.5)
Reducer Input	—	75	—	270
" Output	—	62,000	—	220,000 (217,000)
Winch Shaft	—	62,000	—	220,000
Cable	4300	—	15,100 (15,050)	—

Torque at el.+13' flood condition:

At winch = 80,000 in. lbs.

At high speed reducer shaft = 81 in. lbs.

At crank shaft = 300 in. lbs.

$$\text{Force at pawl} = \frac{300}{4.37} = 70 \text{ lbs}$$

Operating Cable:

The operating cable shall be galvanized 3/4" diameter, extra flexible, six (6) strand, thirty-seven (37) wires per strand, improved plow steel with hemp core having a breaking strength of 20.3 tons

The stalling load is approx. 6.25 tons
The working load is 2.125 tons

$$\text{Safety factor, stalled} = \frac{20.3}{6.25} = 3.25$$

$$\text{Safety factor, working} = \frac{20.3}{2.125} = 9.55$$

Sheaves and winch drum:

$$\text{Recomended diameter} = \frac{3}{4} \times 31 = 23.25'' \checkmark$$

$$\text{Minimum diameter} = \frac{3}{4} \times 21 = 15.75'' \checkmark$$

Machinery (cont'd.)

Sheaves and winch drum: (cont'd.)
The sheaves used shall be 18" diameter.
The winch drum used shall be 27" diameter.

Fittings:
All cable fittings shall be of the best quality galvanized, and be used in accordance with good practice where extreme safety is required.

POWER SUPPLY

General

Power shall be supplied by a Butane gas powered engine directly connected to an A.C. generator. The engine and generator shall be mounted on a common bed plate.

Engine

The engine shall be air-cooled, Butane gas fired with a Twelve (12) volt starting system. The engine must be able to be readily hand-cranked in the event of a low battery. At the time of installation the ignition system shall be sprayed with a commercial waterproofing compound. In the event of damp wiring subsequent to installation, the ignition system shall be wiped clean and dry, the engine started and run and the ignition system resprayed while still dry.

The piston displacement of the engine shall be not less than 107 cu. in. and the engine shall develop not less than 22.5 hp at its operating speed.

The engine shall have an adjustable gear-driven governor to give a speed regulation not to exceed 5%, no-load to full-load.

The engine shall be constructed of high quality metals or alloys suitable for each of its components.

POWER SUPPLY (cont'd.)

Engine (cont'd.)

A pressure lubrication system shall be used for the main and connecting rod bearings.

All necessary accessories such as starting equipment, air and oil filters, electrical meters, etc. shall be included.

The muffler shall be of the spark arrestor type suitable for vertical mounting and equipped with a soot collector and drain. All gases shall be discharged outside the control house.

There shall be two (2) adequate sized louvered openings in the building walls to allow for free circulation of outside air into building and exhaust of heated engine air from the building by means of engine cooling fan induced positive pressure.

The engine instruments shall include oil pressure gage, battery charging ammeter, ammeter, voltmeter and frequency meter.

The engine shall be provided the following safety controls:

(1.) A low oil pressure cut-out to shut down engine in the event of of low oil pressure.

(2.) A high head tempertwre cut-out to shut down engine in the event the engine temperture rises above the safe level.

(3.) A positive control to shut down engine if engine attains a speed higher than 10% above its rated speed.

(4.) An electric solenoid gas shut-off valve to shut-off the fuel when engine is turned off.

Generator

The generator shall be of the four (4) pole, revolving field type with a 240 volt, 3 phase delta winding, 60 cycle and a rating of not less than ten (10) K.W. at 0.80 power factor. One leg of the delta shall be tapped for 120 volts. A suitable voltage regulator shall be provided to regulate the voltage to within ± 3% of the rated voltage, no load to full load. The

POWER SUPPLY (cont'd.)

Generator (cont'd.)

instantaneous voltage drop shall be less than 12% of rated voltage at full load and rated power factor. Recovery to within ± 1% of rated voltage shall occur within not more than two (2) seconds. The temperature rise shall be within the rating defined by NEMA MG1-22.40. Radio interference reduction shall be within the requirements for commercial applications.

The exciter may be either of the built-in or solid state type. All required accessories shall be included.

The control panel for the engine and generator shall be mounted over the generator.

Fuel Storage

Estimated full load fuel consumption on Butane = 71 cu.ft./hr.

Allowing for storage of fuel for 15 - 1 hr full load operating cycles the butane to be stored will be 15 x 71 = 1065 cu.ft.

One gallon of butane = 31.0 cu. ft.

Gallons stored = $\frac{1065}{31}$ = 34.4

Eight (8) five (5) gallon cylinders, each weighing approx. 41 lbs, full, shall be stored. *(The next larger cylinder, 15 gallons, weighs 105 lbs. and is considered too heavy for easy handling on site.)*

The eight (8) cylinders will be housed in two (2) tiers in an angle iron - sheet metal box against one side of the control house. The doors shall be hinged and strong hasps provided for locks. The cylinders shall rest on an open grid floors with the bottom floor about 6" above concrete deck. The walls shall not extend below the bottom grid Floor, the space being left open to prevent trapping of gas in event of cylinder leakage.

The eight (8) cylinders shall be connected to a common manifold on which shall be fitted all necessary couplings, valves, gauges and pressure regulators. A fuel supply line of adequate size shall connect the manifold to the engine.

POWER SUPPLY (cont'd.)

Motor and Brake

The motor shall be of the squirrel cage induction type, Design Class D, 230 volts, 3 phase, 60 cycles with the stator winding so connected as to have four (4) poles for 1800 rpm and sixteen (16) poles for 450 rpm, synchronous speed. The motor shall be of the geared type with a reduction ratio of 15.2 : 1.

The brake shall be of the solenoid operated shoe type and have a torque rating 2.5 times the motor full load torque, and shall be mounted on the input (high speed) shaft of the reducer.

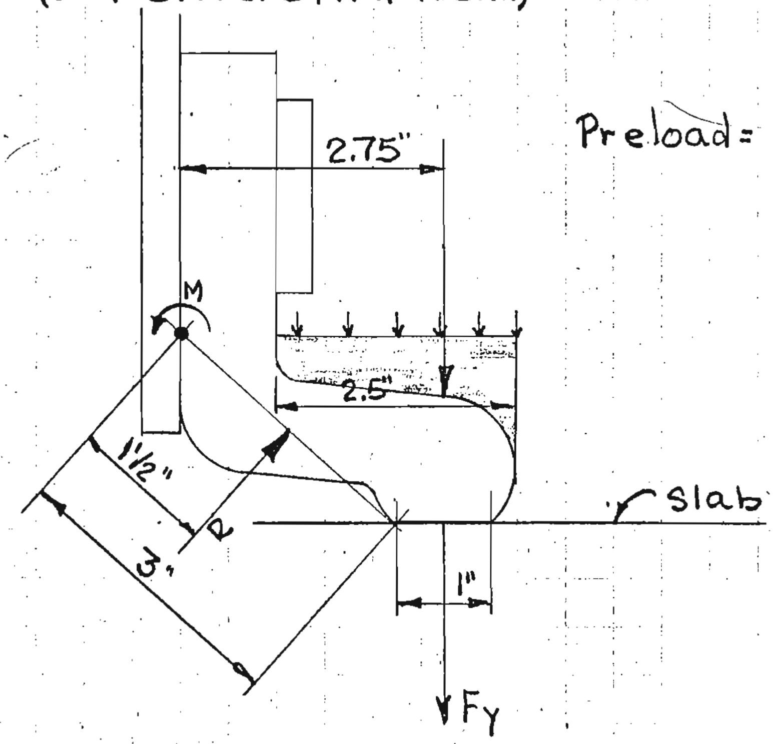
Manual Operating Unit

The sprocket sizes on the hand crank shaft and the reducer shaft have been chosen so that a chain drive to a 12" radius crank located in the control house can be used to open the gate leaf in approximately 36 minutes assuming 40 turns per minute. The force required on the crank handle will be 20 pounds. The sprockets shall be Type B.

A manually engaged pawl shall be used on the on the crank shaft to lock the gate leaf in position as a protection against possible brake failure. A limit switch, with pilot light, shall be used to prevent starting when the pawl is engaged.

BOTTOM SEAL LOAD

(5 Ft. differential head)



Preload = 5 lb/sq.in.

Land Side

$5' = \frac{5}{2.31} = 2.2$ lbs/sq.in.

$2.2 \times 3 = 6.6$ lbs/lin.in.

$M_{cw} = 5 \times 1 \times 2.75 = 13.75$

$M_{ccw} = 6.6 \times 1.5 = \underline{9.90}$

$M_T = M_{cw} - M_{ccw} = 3.85$ say $\underline{3.9}$ lbs/lin.in.

$F_y = \frac{3.9}{2.75} = 1.42$ lb/lin.in

Assume coef. of friction for seal (Rubber to steel, wet) is f=0.25

$F_{HDR} = 0.25 \times 1.42 \times 438 = \underline{156 \text{ lbs}}$

MR-GO side

$M_{ccw_1} = 2.2 \times 2.5 \times 2.75 = 15.13$

$M_{cw_2} = 5 \times 1 \times 2.75 = \underline{13.75}$

$M_T = M_{ccw_1} + M_{cw_2} = 28.88$

$F_y = \frac{28.88}{2.75} = 10.50$ lb/lin.in.

Hydraulic load = 10.5 × 438 = $\underline{\underline{4600 \text{ lbs}}}$

DETAIL DESIGN CALCULATIONS

Design Criteria

Cable tension (gate moving) ---- 4,300 lbs.
Cable tension (gate stalled) ---- 15,100 lbs. (15,050)
Gate speed (maximum) ---- 12.4 ft/min.
Winch speed ---- 1.8 rpm
Reducer ratio ---- 985:1
Motor speed ---- 1800-450 rpm
Gate closing time $\left(\frac{36.4}{12.4}\right)$ ---- 2.96 min.

Table of torques, h.p. and r.p.m.

ITEM	HIGH SPEED			LOW SPEED			STALLED	MANUAL		
	rpm	torque in.lbs.	hp	rpm	torque in.lbs.	hp.	torque in.lbs	rpm	torque in.lbs	hp
WINCH	1.8	58,000	1.58	.45	58,000	.41	220,000	.142	58,000	—
REDUCER OUTPUT	1.8	62,000	1.67	.45	62,000	.43	220,000	.142	62,000	—
REDUCER INPUT	1800	75	1.97	450	75	.49	270	140	75	—
MOTOR SHAFT	1800	75	1.97	450	75	.49	270	140	75	—
MANUAL CRANK	—	—	—	—	—	—	—	40	280	—

Cable pull (gate moving) 4,300 lbs.
Cable pull (gate stalled) 15,100 lbs (15,050)
Cable pull (flood water-gate closed) 4,700 lbs

Cable

3/4" dia. 6 X 37 hemp core galvanized wire rope with a 40,600 lb. breaking strength.

$$\text{Safety factor (moving)} = \frac{40,600}{4300} = 9.5$$

$$\text{Safety factor (stalled)} = \frac{40,600}{15,100} = 2.69$$

$$\text{safety factor (flood)} = \frac{40,600}{4700} = 8.7$$

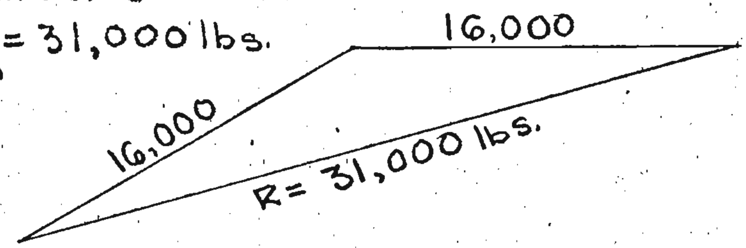
Cable O.K

WALDEMAR S. NELSON AND COMPANY
INCORPORATED
ENGINEERS AND ARCHITECTS
1200 ST. CHARLES AVENUE
NEW ORLEANS, LA., 70130

DETAIL DESIGN CALCULATIONS (cont'd.)

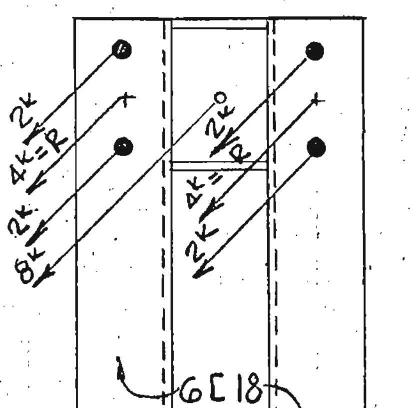
Sheaves

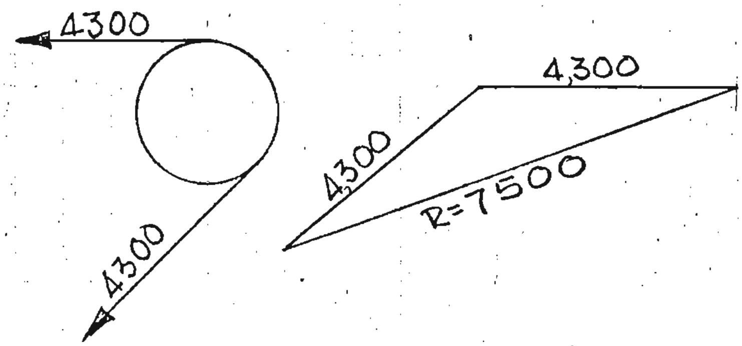
Use 18" diameter sheaves.
Maximum shear = 31,000 lbs.
Pin diameter = 2 3/4"



6" and 10" [frame -
Five (5) 1"φ anchor bolts each frame
.785 × 5 × 15,000 - O.K. for shear anchor bolts.

Analysis of Sheave Frame





Shear on anchor bolts (moving gate) = 2000 lbs.
Shear on anchor bolts (stalled gate) = 7800 lbs.

Moment = 8000 × 5 = 40,000 in. lbs.

$I = 2(6.1 + 5.2 \times 4^2)$

$I = 2 \times 89.3 = 178.6$ say 180

$f = \frac{MC}{I} = \frac{40,000 \times 4}{180} = 890$ lbs/sq.in. (gates moving)

7800 - 4300 = 3500 lbs/sq.in. (gates stalled)

Assume channels not tied together so as to act as a composite beam

Moment (1 channel) = 4000 × 5 = 20,000 in. lbs.

DETAIL DESIGN CALCULATIONS (cont'd.)

Analysis of Sheave Frame (Cont'd.)

$\frac{20000}{2.6} = 7700$ say 8000 lbs/sq.in. (gate moving)

20000 + 8000 = 28000 lbs/sq.in. (gate stalled)
(O.k. for stress of short duration)

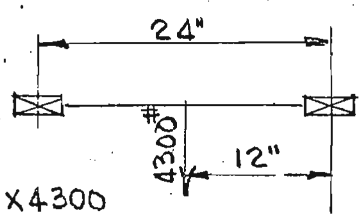
The preceding analysis is somewhat crude & inexact but is on the safe side.

Drum

Use cast steel winch drum as used on Calumet Flood Gates, West Atchafalaya Flood Basin. Drum to be altered to fit 4½" dia. reducer shaft. This drum is more than ample for maximum cable pull.

Winch Shaft

Shaft moment =



M (gate moving) = 12 × 4300
= 51,600 say 52,000 in. lbs. (see Sheet 16 of)

M (gate stalled) = 12 × 15,100
= 181,200 say 182,000 in. lbs.

Torsional M (gate moving) = 4300 × 13.5 = 58,050 say 58,100 in. lbs.

Torsional M (gate stalled) = 15,100 × 13.5 = 203,850 say 204,000 in. lbs.

4½" dia. 4140 shaft O.K.

(With gates stalled, shaft is stressed at approx. 2 times working stress but for loads of short duration reducer is built to take 285% of normal load)

Winch Shaft Bearings

Link Belt Cat. No. 2-1479 Z good for normal load

Bearing pressure (gate stalled) 400 lbs/sq.in. = O.K.

DETAIL DESIGN CALCULATIONS (con't.)

Speed Reducer

$$\text{Ratio} = \frac{1800}{1.8} = 1000:1$$

Can get 985:1 std. Philadelphia Gear Corp. Reducer
Need 1.97 hp @ 1.0 serv. factor } gate moving.
Need 58,000 in.lbs torque @ 1.0 serv. factor }

Need 7.5 hp @ 220,000 in.lbs. torque, gates stalled.
Note: Can use 285% overload for stalled gate.
∴ Need 2.65 hp @ 78,000 in.lbs. torque, gates stalled.

Use Philadelphia Gear Corp. Quadruple Reduction Unit size 409.

Ratio = 985:1
hp @ 1800 rpm input = 2.75
torque = 90,000 in.lbs

O.K.

Anchor Bolts

Bearing - 4-7/8" bolts - O.K.
Reducer - 8-3/4" bolts - O.K.
Reducer base - 8-1" bolts - O.K.

Reducer Base

Reducer sets on a common cast iron base with motor, designed to take full 300%+ torque capacity of motor and reducer.

Flexible Coupling (Motor to Reducer)

Use Philadelphia Gear Corp. Size 1 bored to fit motor & speed reducer.

Motor

A 3 hp @ 1800 rpm & .75 hp @ 450 rpm protected motor. See electrical specifications.

DETAIL DESIGN CALCULATIONS (cont'd)

Brake

The brake shall be a solenoid operated shoe type as manufactured by General Electric Corp. (Cat. No. 1C9516-461) and having a torque rating of 300 in lbs. The brake shall be mounted on the input shaft of the reducer. The brake shall be spring-actuated when the drive motor is not operating. When the motor is started, a solenoid switch shall release the brake. The brake shall have a hand release so the manual operator can be used.

Manual Crank

Circumference of winch drum = $\pi \times 2.22 = 6.97'$/revolution.

$\frac{40\text{ rpm}}{985} = .0406$ rpm of drum @ 1:1 ratio.

$\frac{36.4}{6.97} = 5.22$ revolutions req'd. to open gate in 36 min.

$\frac{36}{5.22} = 6.89$ say 6.9 minutes per revolution

$\frac{1}{6.9} = .145$ rpm

$.145 \times 985 = 142.83$ rpm say 143 rpm

$\frac{143}{40} = 3.58$ ratio

$hp = \frac{75 \times 143}{63{,}025''\#} = \frac{10{,}725}{63{,}025} = .17$

Use RC40 chain.

For driven sprocket use 16T; P.D. = 2.56"

For driver sprocket use $(16 \times 3.58) = 57.28$ Say 58T; P.D. = 9.23"

$.145 \times 6.97 = 1.01$ ft./min.

$\frac{36.4}{1.01} = 36$ minutes to close gates.

Torque @ crank = $14 \times 20 = 280$ in. lbs.

" @ h.s. shaft = $\frac{280}{3.58} \times .95 = 78.21 \times .95 = 74.30$ in. lbs.

Torque @ winch shaft = $74.30 \times 985 \times .90 = 65{,}867$ in. lbs. O.K.

DETAIL DESIGN CALCULATIONS (Cont'd.)

Manual Crank (cont'd.)

Shaft torque = 280 in. lbs.
Shaft moment = 7 x 20 = 140 in. lbs
Use 1 3/16" shaft

Bearings

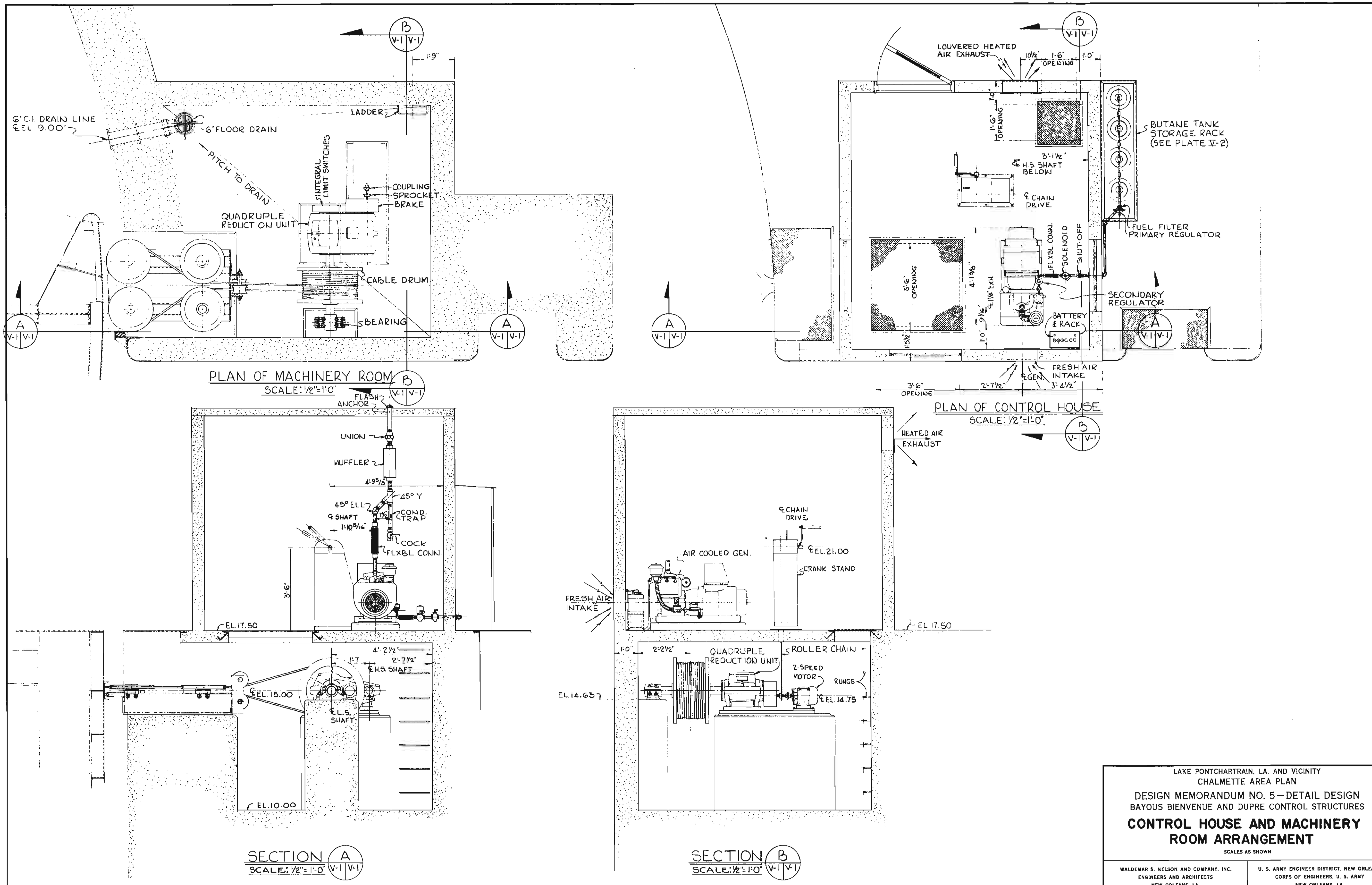
Use Dodge "Bronzoil" Type "F"

Crank

Use 14" detatchable Crank.

Ratchet and Pawl

Use Stephens-Adamson ratchet Pattern No. 1510



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

CONTROL HOUSE AND MACHINERY ROOM ARRANGEMENT

SCALES AS SHOWN

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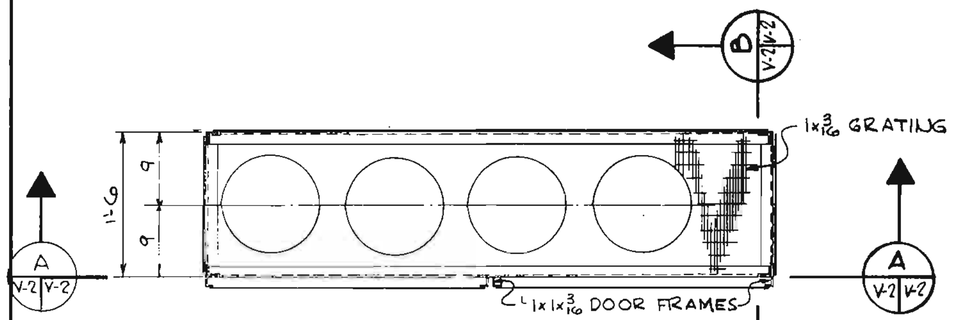
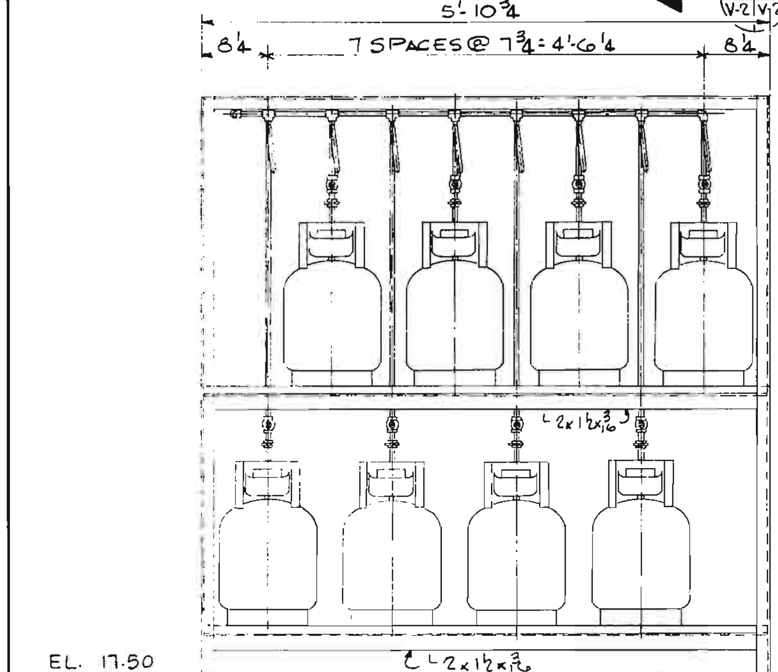
DATE MARCH, 1968	FILE NO. H-2-24147

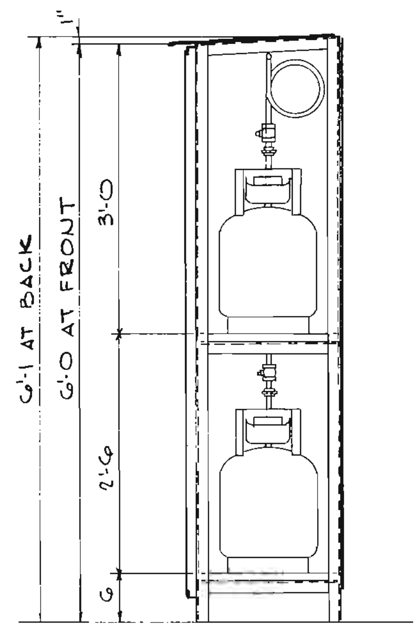
PLATE NO. V-1



PLAN AT LOWER SHELF



SECTION A V-2 V-2



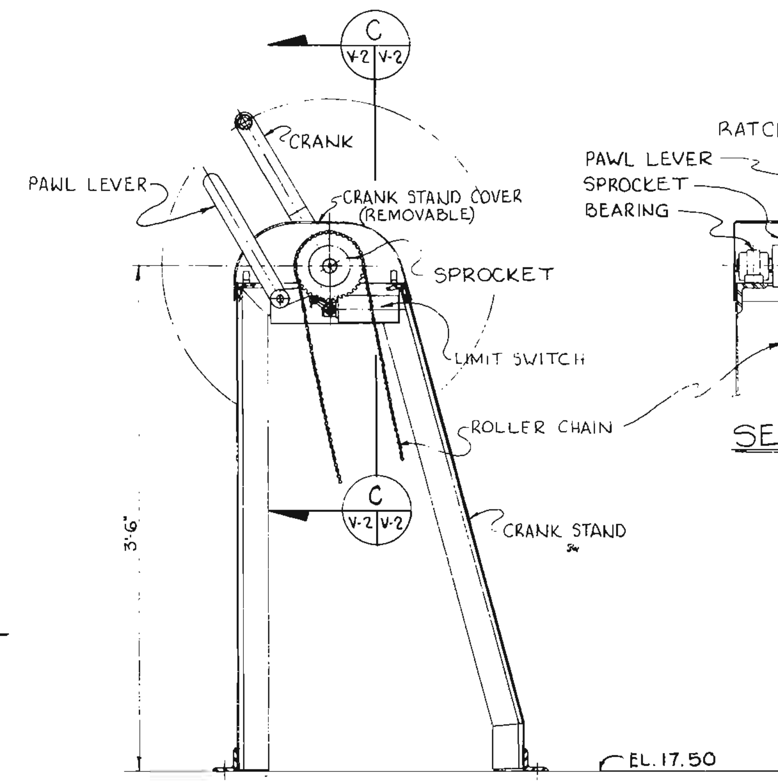
SECTION B V-2 V-2

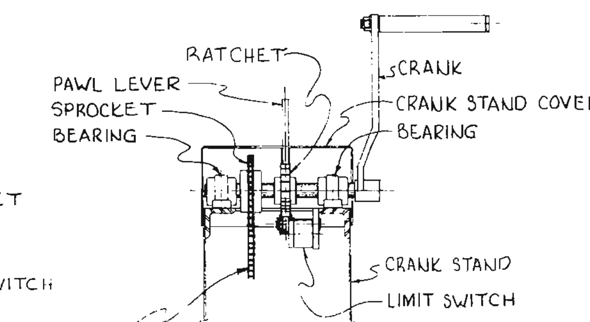
NOTES:

1. ALL MEMBERS ARE ∟1½x1½x3/16 EXCEPT AS NOTED OTHERWISE.
2. ALL PIPING IS ¾" NOM. COPPER TUBING.
3. STRUCTURE IS COVERED WITH 16 GA. STEEL WELDED CONTINUOUSLY.
4. BUTANE CONTAINERS SHOWN ARE OF APPROXIMATELY 5 GALLON CAPACITY.
5. FOR LOCATION SEE PLATE NO. V-1.
6. A SUITABLE THEFT PROOF LOCKING SYSTEM SHALL BE PROVIDED FOR SHED DOORS.
7. STORAGE SHED SHALL BE SECURED TO FLOOR AND CONTROL HOUSE WALL.

BUTANE STORAGE DETAILS

SCALE: 1" = 1'-0





SECTION C V-2 V-2

MANUAL OPERATOR

SCALE: 1½" = 1'-0"

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

FUEL STORAGE AND MACHINERY DETAILS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.	U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS, U. S. ARMY NEW ORLEANS, LA.
DATE: MARCH, 1968	FILE NO. H-2-24147

PLATE NO. V-2

SECTION VI - ELECTRICAL DESIGN

1. Power Supply.

a. Because of the remote location of the control structures, commercial power is presently unavailable. Power will therefore be supplied at each floodgate location by an engine-driven generator. Electrical conduits will, however, be stubbed out of each control house for future power supply from a commercial source.

b. Fuel supply, starting methods, and other mechanical details concerning the engine are described in Section V. The generator will be rated 10 KW, 0.8 P.F., 240 volts, three-phase, delta-connected. One phase of the delta winding will be center-tapped for supply to 120-volt incandescent lights and receptacles. The kilowatt rating of the generator is selected on the basis of limiting the voltage drop to a reasonable value during full-voltage starting of the floodgate drive motors, as well as on the total load to be served.

2. Power Distribution. Power will be fed from the generator to a motor control center, which will incorporate 230-volt motor starters and auxiliary controls, and a three-wire 120/240 volt distribution panel for lighting and receptacle circuits. The motor control center will include starters for both gates of the control structure. Incandescent lighting and three convenience receptacles will be provided on the upper floor of each control house. Incandescent lighting only will be provided on the lower floor.

3. Gate Control.

a. Each gate will be operated by a two-speed, three-horsepower, two-winding, squirrel-cage induction motor, which will provide full gate travel in three minutes on high-speed operation, or in twelve minutes on slow-speed operation. A spring-set, electrically-released brake on each drive unit will be interlocked with the controls so that the brake is energized and de-energized when the motor is started and stopped.

b. Both gate leaves in each control structure will be controllable from either control house. Starting and stopping of the emergency generator will also be able to be accomplished from either control house. Manual cranking of each gate will be able to be accomplished from its respective control house only.

c. Each gate drive unit will be provided with a set of integrally-mounted limit switches, which will cause shutdown of the motors and setting of the brakes at the ends-of-travel in the fully-open and fully-closed positions, and will also cause conversion to slow speed operation during the final few inches of travel, regardless of whether high speed or slow speed operation is selected by the operator.

4. Navigation Lights.

a. Navigation lights will consist of 150-millimeter, 360-degree, red acrylic, Fresnel lens units using 6.2-volt, 0.46 amp. lamps. The lamps will be powered by primary dry cells which provide approximately 9 months operation, using 2400 ampere-hour batteries.

b. Each unit will be provided with a sunswitch, a four-lamp automatic lampchanger, and a manual off-on switch. All lights will have a fixed characteristic.

c. Each gate will also be provided with additional lights operated through a limit switch on the gear reduction unit to indicate when the gate is closed or partially closed. These lights will be located on top of the gates near the outer periphery. The lights will be rated 6.2 volts, 0.46 amps., and will be powered by a primary battery operating through a sunswitch, and equipped with a four-lamp automatic lampchanger. The lights will be provided with a 200-millimeter red Fresnel lens with directional beams up and down the channel. Two lights will be mounted on both sides of the gates.

5. Communication System. The upstairs room of each control house will be provided with a sound-powered telephone, a signal generator, and a bell to provide communication across the structure. Conduits from each room will be stubbed to the outside for possible future commercial telephone service.

6. Grounding.

a. Ground rods will be copper-clad steel ground rods three-fourths inch in diameter by 15 feet long. Ten rods will be driven under the base slab of the gate bay, connected by bare wire up to the pull boxes and to the motor control center ground bus. The grounding systems should have resistivity to ground of 3 ohms or less.

b. The electrical raceway system will be grounded and will form the means of grounding motor and generator frames and metal enclosures. The center-tap of the generator winding and the neutral bus of the lighting panel will also be grounded to the motor control center ground bus.

7. Materials and Equipment.

a. Insulated wire for the control center and control panel will conform to the requirements of NEMA Std. Pub. WC-1-1963 for Thermoplastic Asbestos Insulated Wire.

b. Insulated wire and cable for lighting, power and control circuits will conform to the applicable requirements of IPECA-NEMA Std. Pub. No. WC-3-1964, titled "Rubber Insulated Wire and Cable for the Transmission and Distribution of Elec. Energy", and will have neoprene jackets.

c. Communication cables will be polyethylene insulated conductors with metallized paper shielding tape and polyvinyl-chloride sheath.

d. Conduits will be hot dip galvanized rigid steel.

e. Motor control centers will be manufacturer's standard design meeting all applicable requirements of NEMA Standards. The construction will be NEMA Class II, Type C, in order to minimize the amount of field wiring. Enclosures will be standard NEMA Type 1.

8. <u>Calculations.</u> Gate drive motors are rated three-horsepower, which corresponds to an input of approximately 3 KVA, considering efficiency and power factor. Assume starting KVA = 6 x rated KVA = 18 KVA. Electrical contactors and relays in the control circuits will not drop out if the voltage across their terminals does not fall below about 70% of their rated voltage. Therefore, the allowable voltage drop on the generator during motor starting conditions must be less than about 30%. Engine-generators are available with a voltage drop not in excess of 12% with a suddenly-applied load equal to the generator rating. Assuming a 10 KW, 12.5 KVA generator is used, the voltage drop during starting of one 3-HP motor will be approximately 12 x 18.0x12.5 = 17.2%. This will cause appreciable dimming of lights, but will not result in contactor or relay drop-out. Calculations of maximum load of the generator and maximum current in any phase, as shown on the following Sheet 1 of Section VI calculations, indicate that a 10 KW, 0.8 P.F. unit will be adequate for the immediately-anticipated loads.

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BY H.I.M. DATE 3-7-68 SUBJECT SECTION VI SHEET NO. 1 OF 1

CHKD. BY ______ DATE ______ JOB NO. 67006

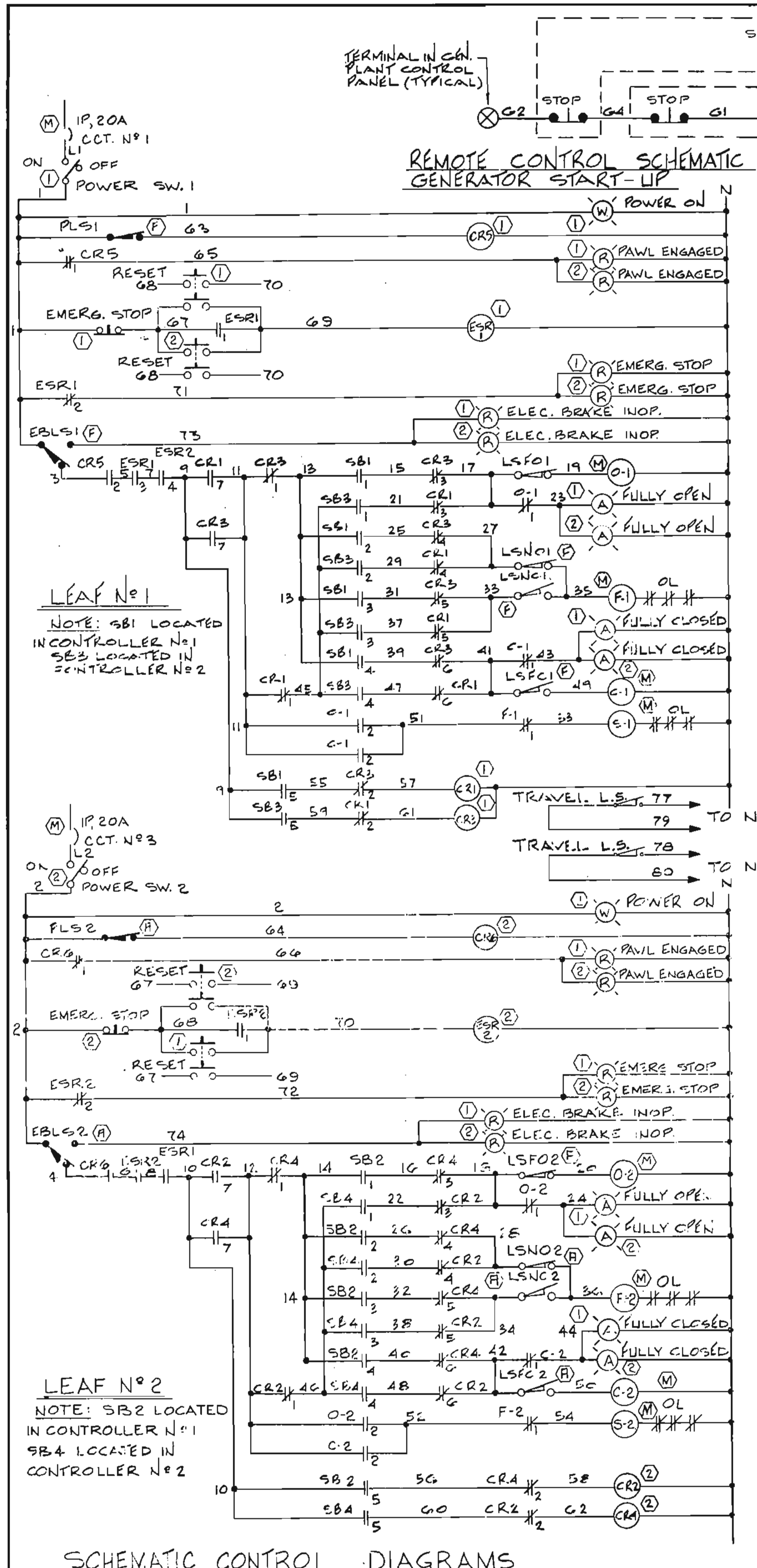
ELECTRICAL LOAD CALCULATIONS

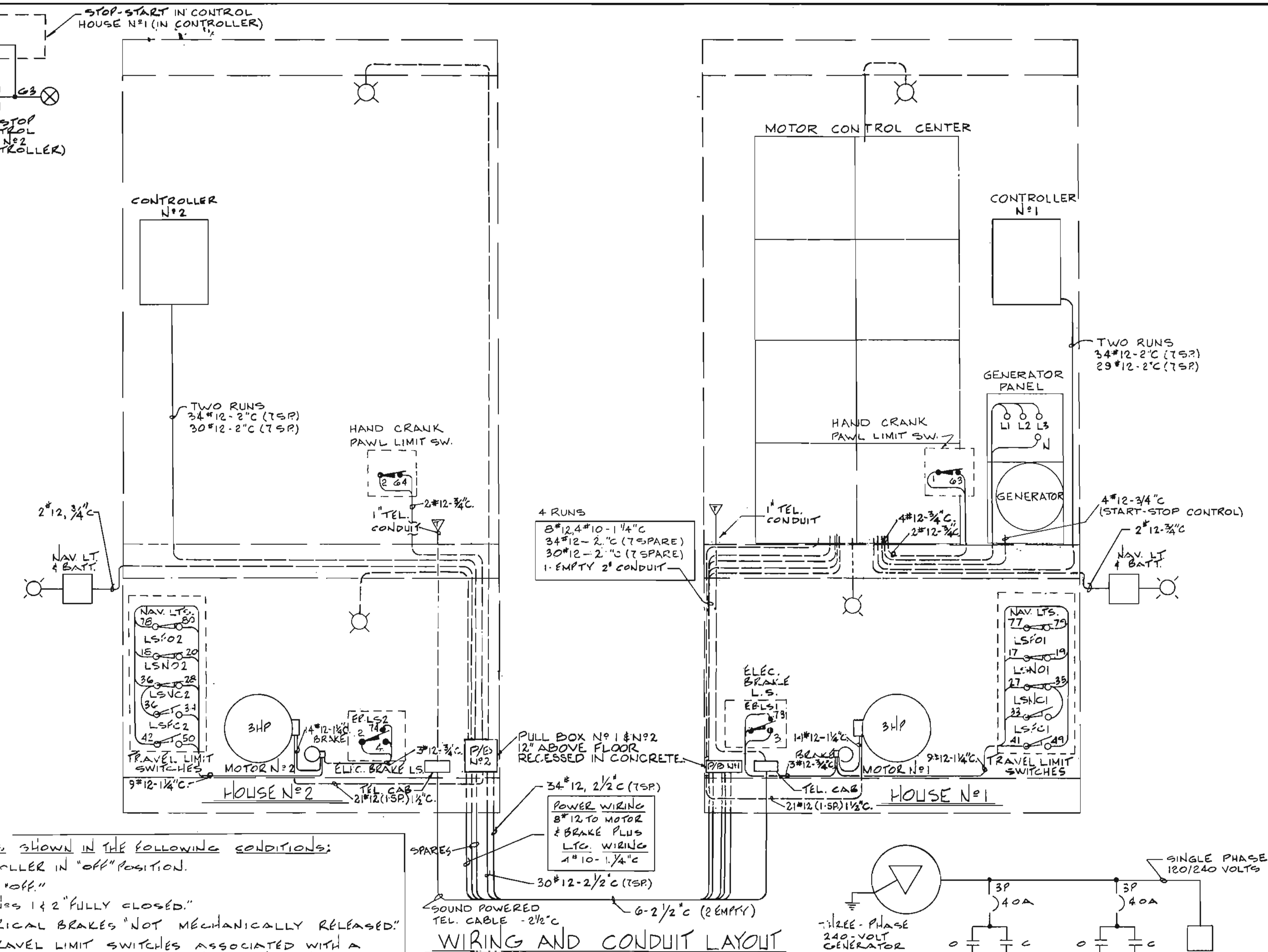
LOAD DESCRIPTION	CONNECTED LOAD (KVA)	DIVERSIFIED DEMAND (KVA)	LINE CURRENTS (AMPS.) PHASE A	PHASE B	PHASE C
LEAF DRIVE MOTORS (2 @ 3 HP EA.)	6.0	6.0	14.4	14.4	14.4
INCANDESCENT LIGHTS (16 @ 150 W EA.)	2.4	2.4	10.0	10.0	0.0
120-V RECEPTACLES (6 @ 15 A EA.)	10.8	1.2	5.0	5.0	0.0
TOTALS	19.2	9.6	29.4	29.4	14.4

NOTE: ARITHMETIC ADDITION RATHER THAN VECTOR ADDITION WAS USED TO OBTAIN CURRENT TOTALS. THEREFORE, LINE CURRENTS OBTAINED ARE MAXIMUM POSSIBLE FOR ANY COMBINATION OF LOAD POWER FACTORS.

FL CURRENT OF 10 KW, 0.8 PF GENERATOR $= \dfrac{10}{0.8 \times \sqrt{3} \times 0.240}$

$= 30.0$ AMPS.





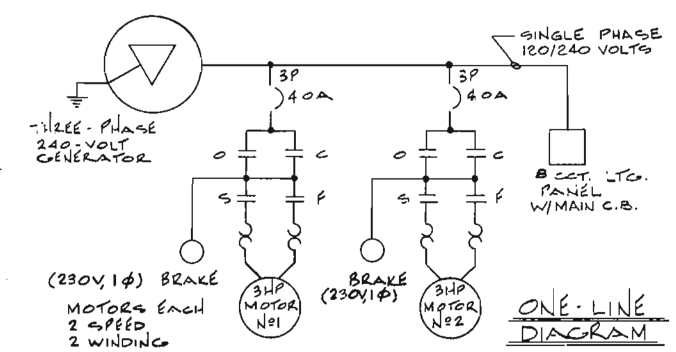
NOTE:

DEVICES SHOWN IN THE FOLLOWING CONDITIONS:

1. CONTROLLER IN "OFF" POSITION.
2. POWER "OFF."
3. LEAF Nos 1 & 2 "FULLY CLOSED."
4. ELECTRICAL BRAKES "NOT MECHANICALLY RELEASED."
5. ALL TRAVEL LIMIT SWITCHES ASSOCIATED WITH A PARTICULAR GATE ARE MOUNTED ON SPEED REDUCER OF THAT GATE OPERATOR.
6. PAWL DISENGAGED.

SYMBOLS

▽	SOUND POWERED TELEPHONE		ELEC. BRAKE LIMIT SWITCH "EBLS1" DENOTES ELEC. BRAKE INTERLOCK ON LEAF Nº1; LIMIT SWITCH OPERATES ON MANUAL RELEASE OF BRAKE.
- - -	WIRING CONCEALED IN FLOOR, WALLS, OR BELOW GRADE		
⌒	WIRING CONCEALED IN CEILING		
—	WIRING EXPOSED		
O	OPEN (NUMBER DENOTES ASSOCIATED LEAF)		
C	CLOSE (NUMBER DENOTES ASSOCIATED LEAF)	R	RED INDICATION LIGHT
S	SLOW (NUMBER DENOTES ASSOCIATED LEAF)	W	WHITE INDICATION LIGHT
F	FAST (NUMBER DENOTES ASSOCIATED LEAF)		TRAVEL LIMIT SWITCH (NO. DENOTES LEAF) "LSNC" DENOTES LEAF NEARLY CLOSED
OL	OVERLOAD		"LSFC" " " FULLY "
A	AMBER INDICATION LIGHT		"LSFO" " " " OPEN
SP	SPARE Nº12 AWG CONTROL COND.		"LSNO" " " NEARLY "
SB	MASTER CONTROL SWITCH * (* NUMBER 1 & 3 CONTROL LEAF Nº1; 2 & 4 CONTROL LEAF Nº2)	(1)	DEVICE LOCATED IN CONTROLLER Nº1
		(2)	DEVICE LOCATED IN CONTROLLER Nº2
CR	CONTROL RELAY-1,3 & 5 — LEAF Nº1. 2,4 & 6 — " " 2.	(F)	DEVICE LOCATED IN FIELD (LEAF Nº1)
ESR	EMERG. STOP RELAY.	(A)	DEVICE LOCATED IN FIELD. (LEAF Nº2)
PLS	PAWL LIMIT SWITCH. (HAND CRANK)	(M)	DEVICE LOCATED IN MCC.



LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN

DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

ELECTRICAL ONE-LINE DIAGRAM AND CONTROL SCHEMATICS

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC.
ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE: MARCH, 1968

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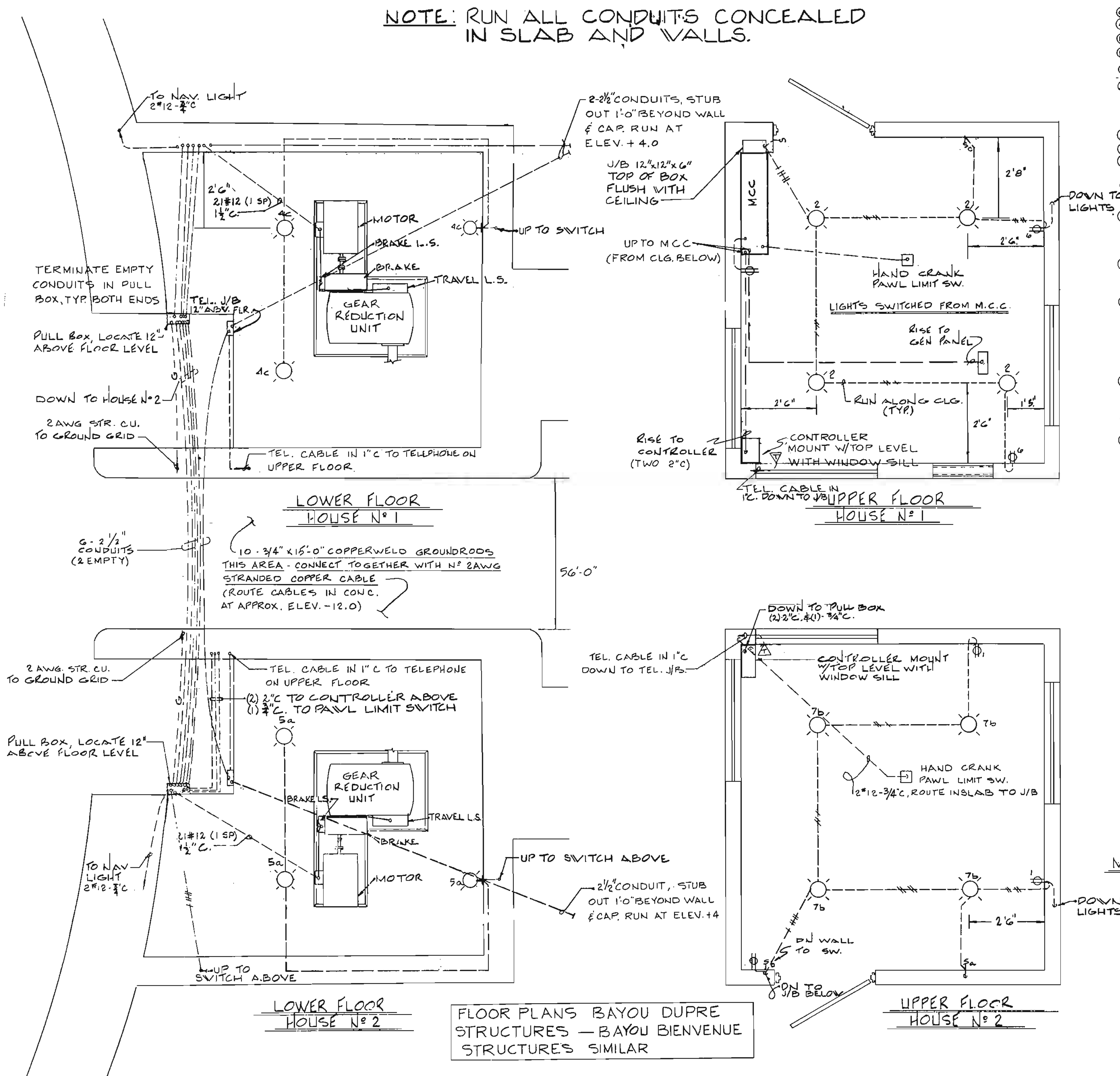
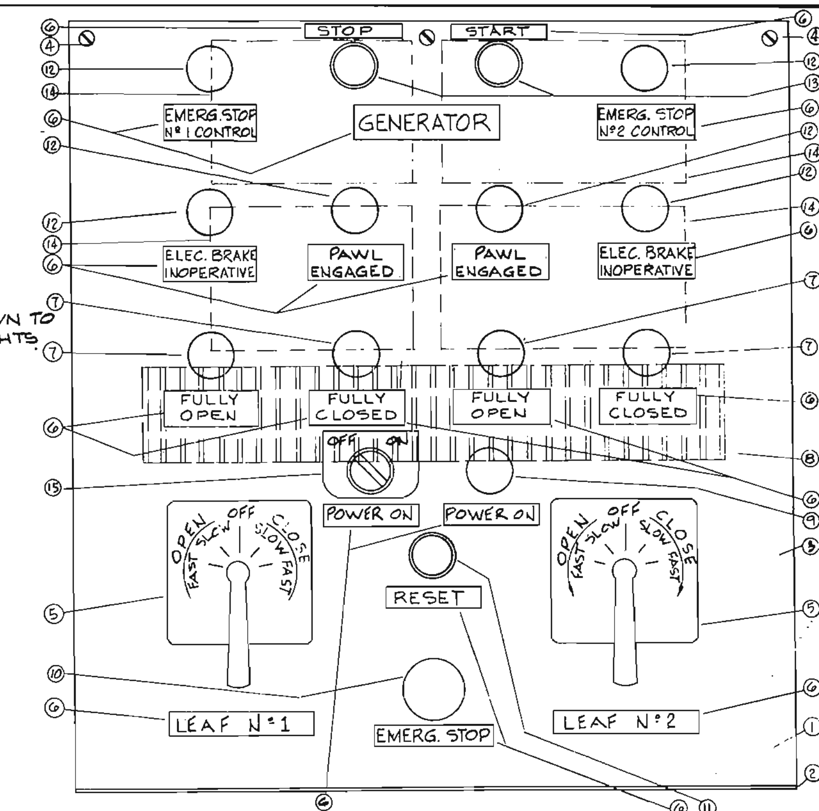


FLOOR PLANS BAYOU DUPRE STRUCTURES — BAYOU BIENVENUE STRUCTURES SIMILAR



CONTROLLER LAYOUT

NOT TO SCALE

CONTACT	SWITCH POSITIONS OPEN FAST	OPEN SLOW	OFF	CLOSE SLOW	CLOSE FAST
1	X	X			
2	X				
3					X
4				X	X
5	X	X		X	X

MASTER CONTROL SWITCH DEVELOPMENT

NOTES:

1. 24"x20"x8" HINGED NEMA 1 CONTROLLER ENCL.
2. CONTINUOUS HINGE
3. INTERIOR CABLE ASSY. TO LIMIT 90° SWING OF FRONT
4. CAPTIVE SCREW (FRONT RELEASE)
5. TYPE "SB" SWITCH
6. NAMEPLATE - WHITE W/BLACK ENGRAVED LETTERS
7. AMBER PUSH-TO-TEST LIGHT
8. 75 SECTION TERMINAL STRIP, MTD. ON BACK PLATE
9. WHITE PUSH-TO-TEST LIGHT.
10. P.B. WITH RED MUSHROOM OPERATOR.
11. P.B. WITH BLACK INSERT.
12. RED PUSH-TO-TEST LIGHT.
13. RED "STOP" & BLACK "START" PUSHBUTTONS.
14. CONTROL RELAYS - MTD. ON BACK PLATE
15. TWO POS. SELECTOR SW

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

ELECTRICAL POWER AND LIGHTING LAYOUT

SCALES AS SHOWN

WALDEMAR S. NELSON AND COMPANY, INC. ENGINEERS AND ARCHITECTS NEW ORLEANS, LA.

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

DATE: MARCH, 1968   FILE NO. H-2-24147

PLATE NO. VI-2

SECTION VII - CATHODIC PROTECTION

1. Structure to be Protected.

a. For purposes of computing the total surface area of steel to be protected, the cathodically protected area is considered to include all structural members comprising the lower half of the gate structure up to elevation 1.5, including the inner and outer faces of the skin plate.

b. The coal tar epoxy coating is assumed to be 99% efficient initially to allow for voids, and 61% efficient at the end of 10 years to allow for deterioration. This results in an average efficiency of 80%, or a factor of 0.20 to be applied in computing the effective area of exposed steel surface.

2. Life Expectancy of Cathodic Protection System. In order to minimize maintenance requirements the total anode weight is computed on the basis of a 10-to 20-year life expectancy of the cathodic protection system. The actual life of the anodes will be dependent upon the actual versus the assumed efficiency of the paint system, variations in water conductivity, motion and temperature of the water, and other factors.

3. Water Resistivity.

a. Salinity observations in the MR-GO at Bayous Bienvenue and Dupre, and at Paris Road Bridge, are given in Appendix C.

b. The readings for Bayous Bienvenue and Dupre were taken in the channel at various depths from 5 to 35 feet over a period from October, 1963 through November, 1966. The readings at the 5-foot depth are most nearly applicable to the average depth at the control structures. At Bayou Dupre the average of all readings at the 5-foot depth if 5442 ppm, and at Bayou Bienvenue the average is 5186 ppm. Since these two averages are substantially the same, the cathodic protection systems can be made identical, based on an overall average salinity of 5314 ppm.

c. Salinity observations at Parish Road Bridge were taken only at mid-depth for the period from 1948 through 1961. From 1962 through 1966 readings were taken at the surface, mid-depth, and bottom of the MR-GO. Considering only surface readings for the period 1964 through 1966, the average salinity is 5264 ppm, which is essentially the same as the average 5-foot depth readings at Bayous Bienvenue and Dupre.

d. Using 5314 ppm dissolved chlorides as representative of average conditions, the resistivity is computed to 118 ohm-cm. (See calculations, Sheet 1).

4. Required Current Density. U. S. Army Corps of Engineers Manual TM-5-118-4, page 203, lists current densities for bare steel in sea water

ranging from 3.0 to 10.0 milliamps per square foot. Sea Water has a resistivity range from 15 to 40 ohm-cm., as compared to the considerably higher 118 ohm-cm. for the MR-GO at the proposed control structure locations. Thus an assumed current density of 6.0 ma. per square foot is considered an adequate criterion for protection of the structures, and this is in keeping with experiences on other structures in similar waters.

5. Calculations. See attached Sheets 1 through 4 of 4.

WATER RESISTIVITY

REFER TO U.S. CORPS. OF ENGINEERS MANUAL TM-5-811-4, EQUATION 7, PAGE 233:

$\rho = 625{,}000/T$

WHERE ρ = WATER RESISTIVITY IN OHM-CM.
T = TOTAL DISSOLVED SOLIDS IN PPM
= 5314 (SEE PRECEDING TEXT)

$\rho = 625000/5314$
= 118 OHM-CM.

OUTER FACE OF SKIN PLATE

AREA = $60/360 \times 2\pi R \times H$
= $1/6 \times 2 \times 3.14 \times 34.65 \times 12.28$
= 446 SQ. FT.

EFFECTIVE AREA = AREA × (1.00 − COATING EFF.)
= 446 × (1.00 − 0.80)
= 89.2 SQ. FT.

CURRENT REQ'D. = EFFECTIVE AREA × CURRENT DENSITY
= 89.2 × 0.006
= 0.535 AMPS.

ANODE WEIGHT = 8760 Y I/HF (SEE TM-5-811-4, EQ. 9, P. 234)

WHERE W = ANODE WT. IN POUNDS
I = ANODE CURRENT IN AMPS.
Y = ANODE LIFE IN YEARS
H = THEORETICAL AMP-HR/LB FOR ZINC
F = ANODE EFFICIENCY

W = (8760 × 10 × 0.535)/(372 × 0.90)
= 140 LBS.

USING 60-LB. ANODES, 140/60 = 2.33 ANODES FOR 10-YEAR LIFE, OR 4.66 ANODES FOR 20-YEAR LIFE.
USE 4 ANODES FOR GOOD CURRENT DISTRIBUTION, AND FOR LIFE APPROACHING 20 YEARS.

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ANODE RESISTANCE

REFER TO U.S. CORPS. OF ENGINEERS MANUAL TM-5-811-4, FIG. 7-18, PAGE 169:

RESISTANCE OF 2" x 2" x 5' BARE ZINC ANODE IN ELECTROLITE WITH 118 OHM-CM RESISTIVITY = 0.80 OHM.

CURRENT PER ANODE = NET DRIVING POTENTIAL / ANODE RESIS.
= 0.25 / 0.80
= 0.312 AMPS.

CURRENT REQ'D. PER ANODE = TOTAL CURRENT / NO. OF ANODES
= 0.535 / 4
= 0.134 AMPS.

THUS THEORETICAL CURRENT OUTPUT PER ANODE IS GREATER THAN REQUIRED CURRENT, AND ANODES WILL AFFORD PROTECTION TO STRUCTURE. HOWEVER, SALINITY DATA INDICATES SALINITY MAY VARY OVER APPROXIMATELY A 6 TO 1 RATIO, AND THIS VARIATION, TOGETHER WITH VARIATIONS IN TEMPERATURE, CONDITION OF CATHODIC SURFACE, AND OTHER FACTORS, WILL CAUSE ACTUAL CURRENT FLOW TO VARY APPRECIABLY FROM THE CALCULATED VALUE. THEREFORE, PROVISION IS INCLUDED IN THE DESIGN FOR INSERTION OF RESISTORS IN SERIES WITH THE ANODE LEADS TO OBTAIN OPTIMUM PERFORMANCE OF THE SYSTEM, IF FOUND DESIRABLE BASED ON POTENTIAL MEASUREMENTS OF THE SYSTEM AS INSTALLED.

STRUCTURAL MEMBERS & INNER FACE OF SKIN PLATE

DESCRIPTION	AREA/FT. OF LGTH.	LGTH.	AREA
10WF21	3.57	21.0	75.0
10WF33	4.30	16.72	71.8
10WF39	4.33	40.1	174.0
10WF45	4.36	34.08	148.0
10WF54	5.03	41.8	210.0
10WF60	5.08	65.4	332.0
27WF84	7.80	61.4	478.0
12" PIPE	3.34	10.5	35.1
½x2 BAR	0.42	53.8	22.6
2x6 ∠	1.67	180.0	300.0
SKIN PLATE			446.0
TOTAL AREA			2292.5

EFFECTIVE AREA = 2292 × 0.20 = 458 SQ. FT.
CURRENT REQ'D. = I = EFFECTIVE AREA × CURRENT DENSITY
= 458 × 0.006
= 2.75 AMPS.
ANODE WEIGHT = W = 8760 Y I / HF
= (8760 × 10 × 2.75)/(372 × 0.90)
= 720 LBS. FOR 10-YR. LIFE
= 1440 LBS. FOR 20-YR. LIFE

USING 150-LB. ANODES, 1440/150 = 9.60, OR 10 ANODES FOR 20-YR. LIFE, TO MATCH LIFE OF ANODES ON FRONT FACE OF SKIN PLATE.

REAR FACE OF SKIN PLATE AND 27WF84'S LOCATED ADJACENT TO THE SKIN PLATE COMPRISE 40% OF THE EXPOSED AREA. THEREFORE, 40% OF THE ANODES, OR 4 ANODES, SHOULD BE LOCATED IN THE VICINITY OF THE SKIN PLATE.

THE REMAINING 60% OF THE EXPOSED AREA IS DISTRIBUTED AMONG THE REMAINING STRUCTURAL MEMBERS, AND POSITIONING OF THE REMAINING 6 ANODES SYMMETRICALLY AS INDICATED ON PLATE VII - 1 SHOULD GIVE ADEQUATE CURRENT DISTRIBUTION TO THESE MEMBERS.

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REFER TO U.S. CORPS. OF ENGINEERS MANUAL TM-5-811-4, EQUATION 1, PAGE 210:

$$R = (\rho / 2\pi L)[(\ln 4L/r) - 1]$$

WHERE

R = ANODE RESISTANCE IN OHMS
ρ = WATER RESISTIVITY IN OHM-CM
L = LENGTH OF ANODE IN CM.
r = RADIUS OF ANODE IN SAME UNITS AS L
$\ln = 2.3 \times \log_{10}$

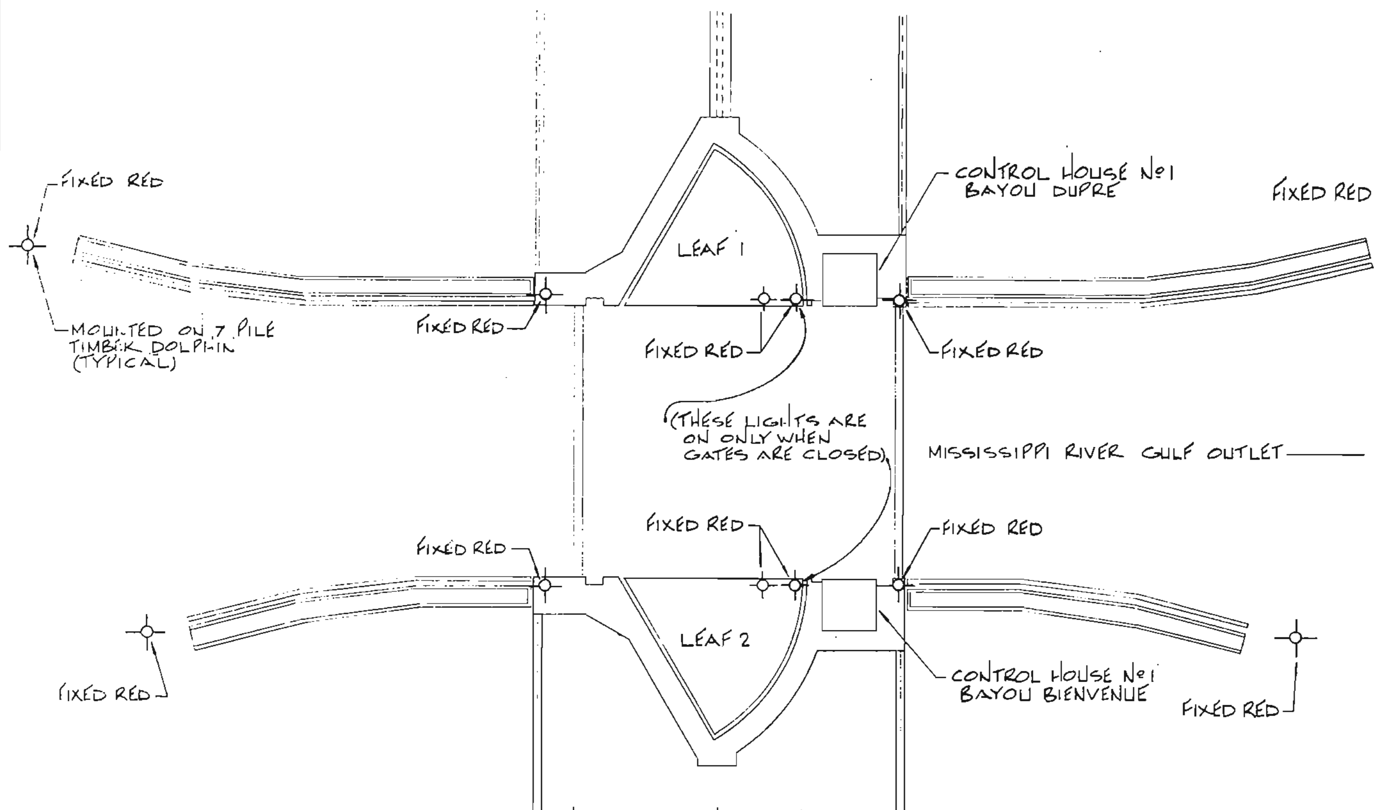
FOR 4" × 4" × 36", 150 # ANODE:

$$R = [118/(2\pi \times 36 \times 2.5)][(2.3 \times \log \frac{4 \times 36}{2}) - 1]$$
$$= [118/565][(2.3 \times 1.857) - 1]$$
$$= 0.209 \times 3.28$$
$$= 0.685 \text{ OHMS}$$

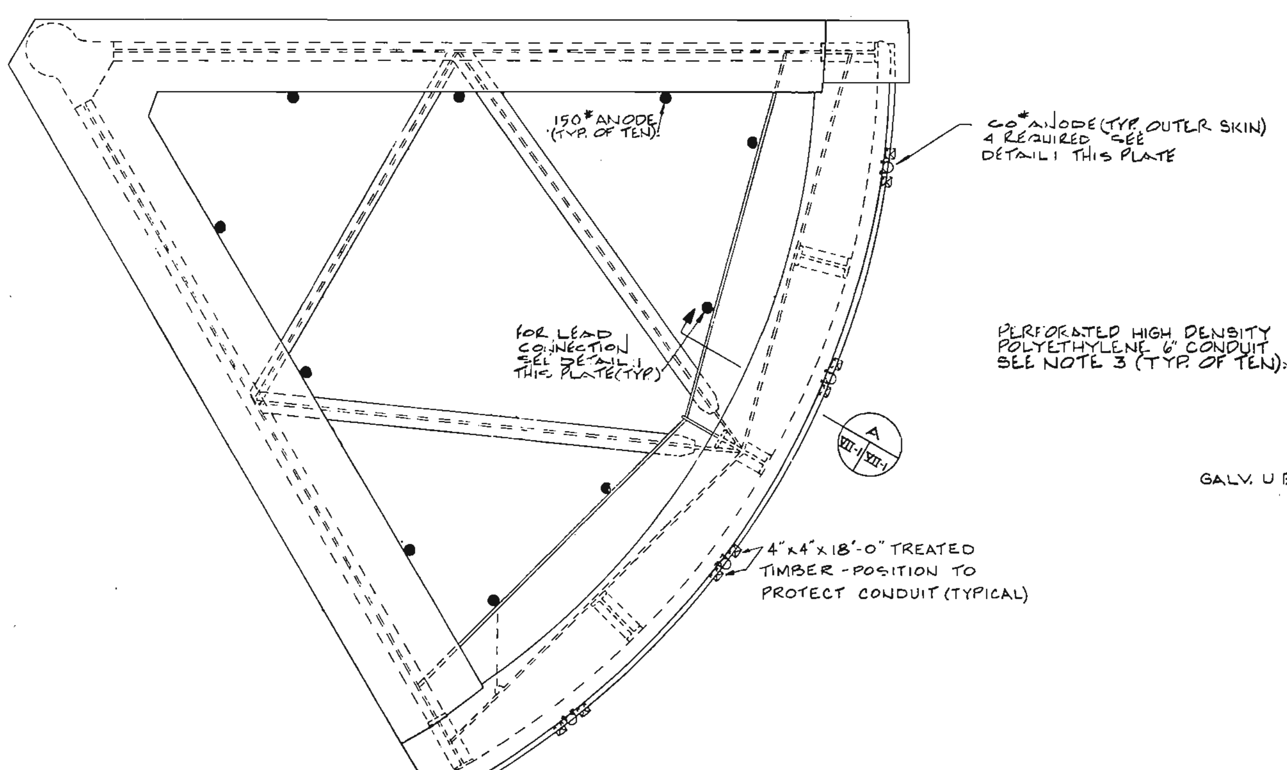
ANODE CURRENT = NET DRIVING POTENTIAL / RESISTANCE
= 0.25/0.685
= 0.365 AMPS.

FOR 10 ANODES, I = 0.365 × 10 = 3.65 AMPS.

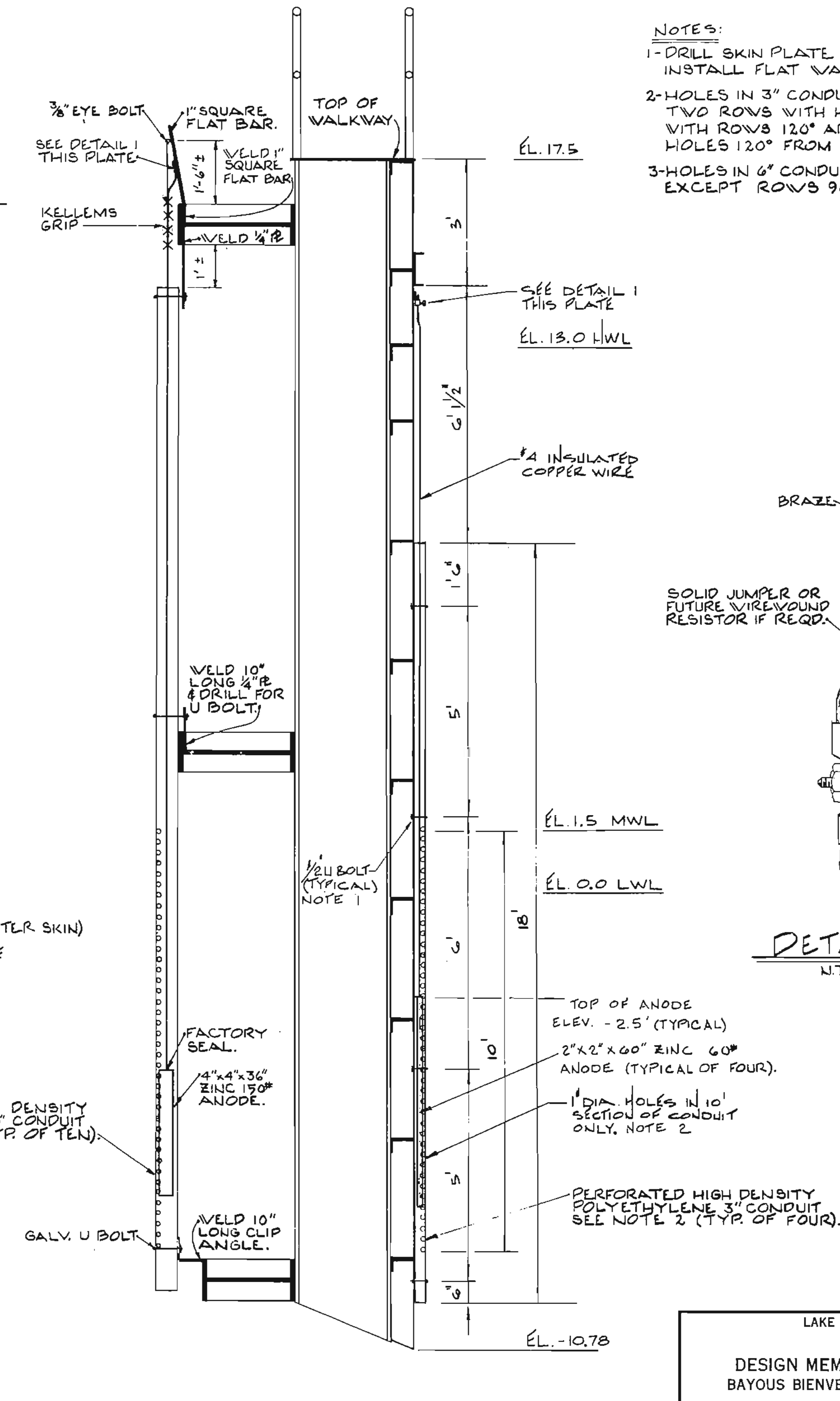
THIS IS 33% ABOVE THE CALCULATED REQUIRED CURRENT OF 2.75 AMPS., AND IS THEREFORE OF THE CORRECT ORDER OF MAGNITUDE. HOWEVER, SINCE THE ACTUAL CURRENT FLOW MAY VARY OVER RELATIVELY WIDE LIMITS DUE TO CHANGES IN SALINITY, TEMPERATURE, CONDITION OF PROTECTIVE COATING, AND OTHER FACTORS, PROVISION IS INCLUDED IN THE DESIGN FOR INSERTION OF RESISTORS IN THE ANODE LEADS TO OBTAIN OPTIMUM PERFORMANCE OF THE SYSTEM IF FOUND DESIRABLE AS A RESULT OF POTENTIAL MEASUREMENTS OF THE SYSTEM AS INSTALLED.



NAVIGATION LIGHTING
BAYOU DUPRE
(BAYOU BIENVENUE SIMILAR)
N.T.S.



PLAN OF ANODE LOCATIONS
SCALE 1/4" = 1'0"



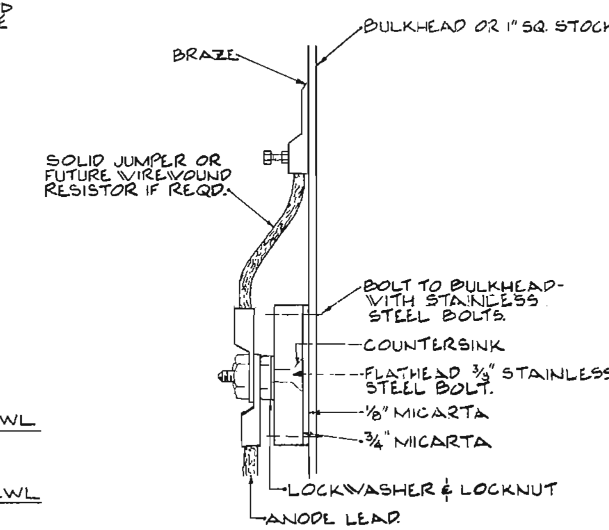
SECTION
SCALE 1/2" = 1'-0"

NOTES:

1- DRILL SKIN PLATE AND INSERT NEOPRENE GROMMET. INSTALL FLAT WASHERS AND JAM NUTS.

2- HOLES IN 3" CONDUIT SHALL BE AS FOLLOWS: TWO ROWS WITH HOLES 1" IN DIA. 3" ON CENTER WITH ROWS 120° APART POSITION CONDUIT WITH HOLES 120° FROM PLANE OF SKIN PLATE.

3- HOLES IN 6" CONDUIT SHALL BE SAME AS ABOVE EXCEPT ROWS 90° APART.



DETAIL 1
N.T.S.

LAKE PONTCHARTRAIN, LA. AND VICINITY
CHALMETTE AREA PLAN
DESIGN MEMORANDUM NO. 5—DETAIL DESIGN
BAYOUS BIENVENUE AND DUPRE CONTROL STRUCTURES

NAVIGATION LIGHTING AND CATHODIC PROTECTION

SCALES AS SHOWN

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ENGINEERS AND ARCHITECTS
NEW ORLEANS, LA.

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

DATE MARCH, 1968 | FILE NO. H-2-24147

SECTION VIII - ESTIMATE OF COST

1. Comparison of Costs for Excavation.

a. Studies have been made for alternate methods of excavation for the control structures at each site. The two methods are covered in detail in Paragraph 7 of Section III. Two methods of pressure relief, well points and sand drains were considered. For Plan 1 - Open Excavation, pressure relief by well points was considered the more practical method and for Plan 2 - Open Excavation With Steel Sheet Pile Enclosure of Foundation Mat, sand drains extending from elevation -19 to the sands at elevation -26 at Bayou Dupre and -28 at Bayou Bienvenue was considered more practical.

b. Estimated construction cost for each of the two methods of excavation at each location is as follows:

(1) Plan 1 - Open Excavation

(a) Bayou Dupre

Item	Quantity	Unit	Unit Price	Estimated Cost
Initial Excavation (Dredging)	91,500	C.Y.	$ 0.85	$ 77,750
Dewatering (including well point system for 12-months)			Lump Sum	274,000
Structural Excavation	2,700	C.Y.	2.10	5,670
				$357,420

(b) Bayou Bienvenue

Item	Quantity	Unit	Unit Price	Estimated Cost
Initial Excavation (Dredging)	126,900	C.Y.	$ 0.85	$107,865
Dewatering (including well point system for 12-months)			Lump Sum	290,000
Structural Excavation	2,700	C.Y.	2.10	5,670
				$403,535

(2) Plan 2 - Open Excavation With Steel Sheet Pile Enclosure of Foundation Mat.

(a) Bayou Dupre

Item	Quantity	Unit	Unit Price	Estimated Cost
Initial Excavation (Dragline)	20,400	C.Y.	$ 0.70	$ 14,280
Sheet Piling	34,600	S.F.	4.00	138,400
Bracing System (including support piles)	120	Tons	900.00	108,000

Item	Quantity	Unit	Unit Price	Estimated Cost
Excavation (within enclosure)	8,200	C.Y.	$ 2.10	$ 17,220
Dewatering (including sump pumps for 12-months)			Lump Sum	51,000
Sand Drains	672	L.F.	10.00	6,720
				$335,620

(b) Bayou Bienvenue

Item	Quantity	Unit	Unit Price	Estimated Cost
Initial Excavation (Dragline)	34,500	C.Y.	$ 0.70	$ 24,150
Sheet Piling	31,500	S.F.	4.00	126,000
Bracing system (including support piling)	120	Tons	900.00	108,000
Excavation (within enclosure)	8,200	C.Y.	2.10	17,220
Dewatering (including sump pumps for 12-months)			Lump Sum	51,000
Sand Drains	672	L.F.	10.00	6,720
				$333,090

c. Summary. Plan 2 as presented herein presents many advantages which would make material handling easier resulting in some cost saving. Based on the comparison of estimated construction costs, it is recommended that Plan 2 be used in the preparation of the plans and specifications.

2. Detailed Estimate of First Cost. The items of work included herein for the Bayous Bienvenue and Dupre Control Structures are included in the feature levees and floodwalls (Account 11) in the Chalmette Area Plan of the Lake Pontchartrain, La. and Vicinity-Hurricane Protection Project Cost Estimate (PB-3). Detailed estimates of first costs are shown in Table 1.

TABLE 1

DETAILED ESTIMATE OF FIRST COST
BAYOU DUPRE CONTROL STRUCTURE
JUNE 1968 PRICE LEVELS

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
STRUCTURE					
11	Levees and floodwalls				
	Masonry				
	Initial excavation	20,400	C.Y.	$ 0.70	$ 14,280
	Dewatering (including sump pumps for 12-months period)	Job		Lump Sum	51,000
	Temporary piezometers	Job		Lump Sum	400
	Sand Drains	672	L.F.	10.00	6,720
	Sheet Piling, Steel, Z32	34,600	S.F.	4.00	138,400
	Bracing System	120	Tons	900.00	108,000
	Structural Excavation (within enclosure)	8,200	C.Y.	2.10	17,220
	Untreated Timber Piling (slab foundation)	32,400	L.F.	2.00	64,800
	Prestressed concrete piling (inverted "tee" wall foundation)	1,900	L.F.	5.50	10,450
	Treated timber piling (guide wall)	7,900	L.F.	3.60	28,440
	Shell (dry bottom)	350	C.Y.	5.00	1,750
	Concrete (dry bottom)	150	C.Y.	40.00	6,000
	Concrete (base slab)	2,100	C.Y.	45.00	94,500
	Concrete (gate walls)	800	C.Y.	60.00	48,000
	Concrete (inverted "tee")	110	C.Y.	70.00	7,700
	Cement	4,300	Bbl.	5.50	23,650
	Reinforced Steel	602,000	Lb.	0.16	96,320
	Piling, concrete, sheet, prestressed, 12"x30" (wing wall and "I" wall including walkway)	11,600	S.F.	6.00	69,600
	Embedded metal, misc.	33,000	Lb.	0.40	13,200
	MA 22 Steel Sheet Pile	4,500	S.F.	3.50	15,750
	Handrails	1,640	L.F.	6.00	9,840
	Treated timber (guide walls)	36	MFBM	800.00	28,800
	Dolphins	4	Ea.	2,250.00	9,000
	Control House	2	Ea.	3,000.00	6,000
	Backfill (Shell)	4,400	C.Y.	5.00	22,000

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
	Shell (riprap)	2,600	C.Y.	$ 6.00	$ 15,600
	Riprap	10,500	Tons	13.00	136,500
	Derrick stone	1,400	Tons	13.00	18,200
	Barge dock	Job		Lump Sum	5,200
	Shell (ramp)	300	C.Y.	5.00	1,500
	Backfill (clay)	35,500	C.Y.	2.75	97,625
					$1,166,445
		Contingencies (20%)			233,555
		Subtotal			$1,400,000
	Gates and Operating Machinery				
	Sector gates	Job		Lump Sum	$ 103,000
	Electric system	Job		Lump Sum	38,500
	Operating Machinery	Job		Lump Sum	32,000
	Navigation Lights	Job		Lump Sum	25,000
	Cathodic Protection	Job		Lump Sum	22,800
					$ 221,300
		Contigencies (20%)			44,700
		Subtotal			$ 266,000
	Channels and Levees				
	Dredging	92,000	C.Y.	$ 0.85	$ 78,200
	Levees	85,000	C.Y.	2.75	233,800
	Shell (closure)	39,000	C.Y.	3.50	136,500
					$ 448,500
		Contingencies (20%)			89,500
		Subtotal			$ 538,000
11.	Levees and floodwalls, total construction cost				$2,204,000
30.	Engineering and design (11.4%)				251,000
31.	Supervision and administration (10.2%)				225,000
	Total cost levees and floodwalls				$2,680,000
	Lands				
	Improvements-camps	11	Ea.	$2,500.00	$ 27,000
		Contingencies (20%)			5,500
		Subtotal			$ 33,000
	Real Estate				
	Estimated quantity				
	38.09		Acre	$ 790.00	$ 30,000
		Total real estate cost			$ 63,000

TABLE 1

DETAILED ESTIMATE OF FIRST COST
BAYOU BIENVENUE CONTROL STRUCTURE
JUNE 1968 PRICE LEVELS

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
STRUCTURE					
11	Levees and floodwalls				
	Masonry				
	Initial Excavation	34,500	C.Y.	$ 0.70	$ 24,150
	Dewatering (including sump pumps for 12-month period)	Job		Lump Sum	51,000
	Temporary piezometers	Job		Lump Sum	400
	Sand Drains	672	L.F.	10.00	6,720
	Sheet piling, Steel Z32	31,500	S.F.	4.00	126,000
	Bracing system	120	Tons	900.00	108,000
	Structural excavation (within enclosure)	8,200	C.Y.	2.10	17,220
	Untreated timber piling (slab foundation)	35,700	L.F.	2.00	71,400
	Prestressed concrete piling ("tee" wall foundation)	3,550	L.F.	5.50	19,525
	Treated timber piling (guide wall)	7,840	L.F.	3.60	28,224
	Shell (dry bottom)	350	C.Y.	5.00	1,750
	Concrete (dry bottom)	150	C.Y.	40.00	6,000
	Concrete (base slab)	2,100	C.Y.	45.00	94,500
	Concrete (gate walls)	800	C.Y.	60.00	48,000
	Concrete (inverted "tee")	150	C.Y.	70.00	10,500
	Cement	4,360	Bbl.	5.50	23,980
	Reinforced Steel	610,000	Lb.	0.16	97,600
	Piling, concrete, sheet, prestressed 12"x30" (wing wall and "I" wall including walkway)	10,500	S.F.	6.00	63,000
	Embedded metal, misc.	33,000	Lb.	0.40	13,200
	MA 22 steel sheet pile	5,600	S.F.	3.50	19,600
	Handrails	1,640	L.F.	6.00	9,840
	Treated timber (guide walls)	36	MFBM	800.00	28,800

Item	Description	Quantity	Unit	Unit Price	Estimated Cost
	Dolphins	4	Ea.	$2,250.00	$ 9,000
	Control House	2	Ea.	3,000.00	6,000
	Backfill (shell)	4,500	C.Y.	5.00	22,500
	Shell (riprap)	2,600	C.Y.	6.00	15,600
	Riprap	10,500	Tons	13.00	136,500
	Derrick stone	1,400	Tons	13.00	18,200
	Barge dock	Job		Lump Sum	5,200
	Shell (ramp)	300	C.Y.	5.00	1,500
	Backfill (clay)	36,000	C.Y.	2.75	99,000
	Needle dam storage rack	Job		Lump Sum	5,000
	Needle dam	Job		Lump Sum	6,500
					$1,194,409
		Contingencies (20%)			238,591
		Subtotal			$1,433,000
	Gates and Operating Machinery				
	Sector gates	Job		Lump Sum	$ 103,000
	Electric system	Job		Lump Sum	31,000
	Operating machinery	Job		Lump Sum	32,000
	Navigation lights	Job		Lump Sum	21,750
	Cathodic Protection	Job		Lump Sum	17,400
					$ 205,150
		Contingencies (20%)			41,850
		Subtotal			$ 247,000
	Channels and Levees				
	Dredging	260,000	C.Y.	$ 0.85	$ 221,000
	Levees	72,000	C.Y.	2.75	198,000
	Shell (closure)	36,000	C.Y.	3.50	126,000
					$ 545,000
		Contingencies (20%)			109,000
		Subtotal			$ 654,000
11.	Levees and floodwalls, total construction cost				$2,334,000
30.	Engineering and design (11.4%)				266,000
31.	Supervision and administration (10.2%)				238,000
	Total cost levees and floodwalls				$2,838,000
	Relocation				
	Light No. 115	1	Ea.		$ 2,000
	Lands Real Estate				
	Real estate				
	Estimated quantity 22.59		Acre	$2,640.00	$ 60,000

3. Comparison of Costs. The cost of $5,643,000 for the Bayous Bienvenue and Dupre control structures represents an increase of $834,000 from the latest PB-3 effective 1 July 1967. Table 2 shows a comparison of the PB-3, and detail design memorandum estimates.

TABLE 2
BAYOUS BIENVENUE AND DUPRE
COMPARISON OF ESTIMATES

	Feature	PB-3 eff. 1 Jul.67	Design Memo No. 5	Difference DM No.5--PB-3
11	Levees & Floodwalls	$3,940.000	$4,538,000	+$ 598,000
30	Engineering & Design	429,000	517,000	+ 88,000
31	Supervision & Administration	315,000	463,000	+ 148,000
	Subtotal	$4,684,000	$5,518,000	+$ 834,000
	Lands & damages	123,000	123,000	----
	Relocations	2,000	2,000	----
	Subtotal	$ 125,000	$ 125,000	$ ----
	TOTAL	$4,809,000	$5,643,000	+$ 834,000

SECTION IX - RECOMMENDATIONS

1. Recommendations. The Bayous Bienvenue and Dupre Control Structures consist essentially of concrete gate bays supported on timber piles, two steel sector gate leaves, timber guide walls, appurtenant channels, and "tee" type and "I" type floodwall connecting the gate chamber to the earthen levee on each side of the structures. This plan is considered to be the best means of accomplishing the project objectives and is recommended for approval.

APPENDIX A

St Bernard

LMNED-PR 29 November 1966

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

TO: Acting Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD and LMVPD-F

1. Reference is made to the following:

a. Flood Control Act of 1965 authorizing subject project.

b. Project document for subject project (H.Doc. 231/89th Congress).

c. Design Memorandum No. 3, General Design for Lake Pontchartrain, La. and Vicinity, Chalmette Area Plan, submitted 1 November 1966.

d. Flood Control Act of 1962 authorizing hurricane protection for the Mississippi River Delta Area at and below New Orleans, Louisiana, and Reach E, Violet to Verret, in particular.

e. Project document for Mississippi River Delta at and below New Orleans, La. (New Orleans to Venice, La.) (H.Doc. 550/87th Congress).

f. Resolution adopted 8 May 1964 by the House Public Works Committee authorizing a restudy of hurricane protection in St. Bernard Parish.

g. Paragraph 2 of 1st Ind file LMVED-PR dated 25 February 1966 to NOD letter of 21 February 1966 subject "Review 6f St. Bernard Parish, Louisiana - Plan of Survey."

h. Paragraph 9.b. of ER 1110-2-1150 dated 1 July 1966.

2. Hurricane protection for the Chalmette area was authorized as an item of the "Lake Pontchartrain, Louisiana and Vicinity," project by the Flood Control Act of 1965 (page 5 of PL 89-298) "...substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 231, Eighty-Ninth Congress, 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...."

3. The recommendations of the Board as stated in paragraph 4 of the report are as follows:

> "Subject to re-examination of the levee alignment in the preconstruction stage with a view to protecting additional lands, and to certain requirements of local cooperation, the Board recommends authorization for construction of the improvements, essentially as planned by the reporting officers, provided...."

The Chief of Engineers concurred in the recommendations of the Board subject to certain modifications pertaining to the Rigolets lock as a result of a change in the interest rates.

4. The present plan of improvement for the Chalmette area is shown in Design Memorandum No. 3, General Design (reference 1.c.). This plan, also shown on the attached map, provides for protection of the Chalmette area against a standard project hurricane (described in paragraph 14 of the DM) having an estimated frequency of about once in 200 years.

5. Protection for the Reach E area, Violet to Verret, against a hurricane having a frequency of about once in 100 years was authorized as a feature of the project "New Orleans to Venice, La.," by the Flood Control Act of 1962. The plan of improvement provided for raising existing back levees from the Mississippi River at Violet to the highway at Verret (see attached map).

6. St. Bernard Parish interests were dissatisfied with this plan and secured authorization for a restudy (reference 1.f.) which was initiated in FY 1966 and is being continued in FY 1967. At the public hearing in Chalmette on 15 December 1965, the Parish Police Jury, State of Louisiana, Department of Public Works, and others requested hurricane protection for a much larger area in St. Bernard Parish including the settlements of Caernarvon, Reggio, Delacroix, Yscloskey, and Hopedale. The locations of the levees proposed by the sponsors at the public hearing are shown on the attached map.

7. After preliminary examination of the requested levee alignment, previous studies, and damages caused by hurricane "Betsy" (9 September 1965), it was deemed advisable to move the levee about halfway between the requested location and the highway from Poydras to Verret because of better levee construction conditions (Reach A-B on the inclosed map). The area thus deleted from the proposed protected area is entirely undeveloped marsh in which only minor enhancement benefits would be

obtained from hurricane protection. It was also deemed advisable to consider the initial plan as protection for the Poydras to Verret area which, if added to the Chalmette area, would eliminate the need for the return levee between the Mississippi River-Gulf Outlet spoil bank and the Mississippi River levee at Violet, a very expensive section of levee to construct and maintain (see reference 1.c.). The remainder of the requested levees would be considered as increments thereto. The plan of survey recommending this approach was submitted 21 February 1966 and approved 25 February 1966 (see reference 1.g.).

8. Initial studies of the additional protection requested for St. Bernard Parish have been essentially completed. Maximum utilization has been made of the data developed during preparation of the design memorandum for the Chalmette area. The levee sections and estimated construction requirements and unit prices for comparable areas in the Chalmette plan have been used for cost estimates. Hydraulic studies have been made to estimate levee grades. Field reconnaissance and hydraulic studies have been made for benefit estimates.

9. The net levee grade for the Chalmette area plan levee along the spoil banks of the Mississippi River-Gulf Outlet gulfward of Paris Road is 17.5 feet m.s.l. (plates 10 through 15 of design memorandum, reference 1.c.). Hydraulic studies have been made and levee grades established for the additional area under study as follows: along the entire spoil bank, 17.5 feet m.s.l.; Caernarvon to the highway at Verret, 16.5 feet; Verret to spoil bank, 17.5 feet; and Verret to Reggio, and thence along Bayou LaLoutre to the Mississippi River-Gulf Outlet spoil bank, 17.0 feet. Levees to these grades would provide the same degree of protection for the entire area as that under the existing Chalmette area plan.

10. The estimated cost of modifying the Chalmette area plan to include the settlements of Caernarvon, Poydras, and Verret (by levees A, B, C, D) in the protected area is as shown below. A detailed estimate of the costs is inclosed.

Item	Estimated cost
Levee construction	$ 9,548,500
Foreshore protection along MR-GO	703,000
Drainage structure	146,000
Relocations	
Highway crossings(2)	93,800
Pipelines(7)	295,000
Subtotal	$10,786,300
Contingencies (20%+)	2,157,700
Subtotal	$12,944,000
Engineering and design	776,000
Supervision and administration	1,099,000
Total construction cost	$14,819,000
Rights-of-way	537,000
Total estimated cost of additional levees	$15,356,000(1)
Less levee from Bayou Lawler (Point D) to Violet made unnecessary	7,212,000(2)
Total increased cost for additional protection	$ 8,144,000(1)

(1) Includes $966,000 for foreshore protection along Mississippi River-Gulf Outlet, Reach C-D on the inclosed map.
(2) Section IV, pages 52-53 of D.M. reference 1.c.

11. The estimated annual charges based on the increased costs in the preceding paragraph, a 100-year life, and an interest rate of 3-1/8% are:

Item		Amount
Interest		$255,000
Amortization		12,000
Maintenance and operation		
16 miles levee @ $5,000/mile	80,000	
Less: maintenance levee--Bayou Lawler to Violet(par. 65 D.M. ref. 1)	42,000	
Increased levee maintenance		38,000
Increased annual charges		$305,000

12. The benefits from the additional protection are estimated at $359,200 average annually, consisting of $13,100 crop, $178,600 non-crop, and $167,500 land enhancement. A detailed computation of the benefits is inclosed.

13. Based on annual charges in paragraph 11 and annual benefits in paragraph 12, the benefit-cost ratio for the protection of the additional area is 1.2.

14. Consideration was given to extending the protection eastward and southward of Verret generally as requested by the local sponsors and shown on the attached map. However, these studies indicate protection for a larger area cannot be justified in the foreseeable future. The length of levee required would be relatively large in relation to the levee eliminated and the increased area protected. The area is sparsely inhabited and the improvements are of low value. Reconnaissance scope studies show that the estimated incremental first costs and annual charges for extending the hurricane protection from the Poydras-Verret area to include Yscloskey (excludes Hopedale and Delacroix), generally as shown on the inclosed map (levees B, E, F, I, C), are $18,000,000 and $670,000, respectively. The estimated incremental first costs and annual charges for extending the hurricane protection from Verret to Hopedale (levees F, G, H, I) are $28,000,000 and $1,000,000, respectively. The average annual benefits for extending the hurricane protection from Verret to Hopedale are only $195,000 (exclusive of Delacroix) ($5,000 crop, $140,000 non-crop, and $50,000 land enhancement). In view of the very small benefit-cost ratio for the area from Verret to Yscloskey (less than 0.2), no studies were made of the levees along Bayou Terre aux Boeufs to include Delacroix in the protected area.

15. A survey of the highway from Poydras to Verret shows the controlling elevation to be about 5 feet mean sea level. Over two miles of the highway have a controlling elevation of less than 6.0 feet m.s.l. Hurricane "Betsy" produced stillwater elevations in excess of 10.0 feet m.s.l. in the Poydras-Verret-Hopedale area. The protection to be provided under the authorized project "Reach E" is obviously inadequate for a residential area. In recognization of this, the State of Louisiana, Department of Public Works, at the request of the Board of Commissioners of the Lake Borgne Levee District, has recently (about 1 November 1966) initiated the construction of a small levee to elevation 10.0 feet m.s.l. (by dragline) from Caernarvon to Verret generally along the alignment proposed herein and shown on the attached map. The alignment and levee section have been examined in this office. The work being accomplished, unless enlarged and raised, will soon settle

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until it would provide only a small amount of additional protection. However, it will be of substantial value in expediting the construction of the levee to the full grade and section recommended herein. Local interests should be given credit for the work accomplished on their Caernarvon to Verret levee.

16. It is recommended that the presently approved plan of hurricane protection for the Chalmette area contained in the general design memorandum (reference 1.c.) be modified under the authority quoted in paragraphs 2 and 3 to provide for the construction of the levee from Caernarvon via Verret and the Mississippi River-Gulf Outlet spoil bank to the approved plan levee at Bayou Lawler (Point D) generally along the alignment shown on the attached map and for the elimination of the levee in the approved plan from Bayou Lawler to Violet (Section IV in reference 1.c.). This modification will increase the total estimated cost of the Chalmette area plan from $29,552,200 to $37,697,000, which includes $4,337,400 for foreshore protection along the Mississippi River-Gulf Outlet)(an increase of $966,000). The estimated Federal cost will be increased from $21,697,952 to $27,689,000 and the estimated non-Federal cost from $7,854,236 to $10,008,000.

17. It is further recommended that, when the modification in the authorized plan is approved, this District be authorized to proceed with work necessary to prepare a supplement to the general design memorandum for the Chalmette area (reference 1.c.) on the modified plan.

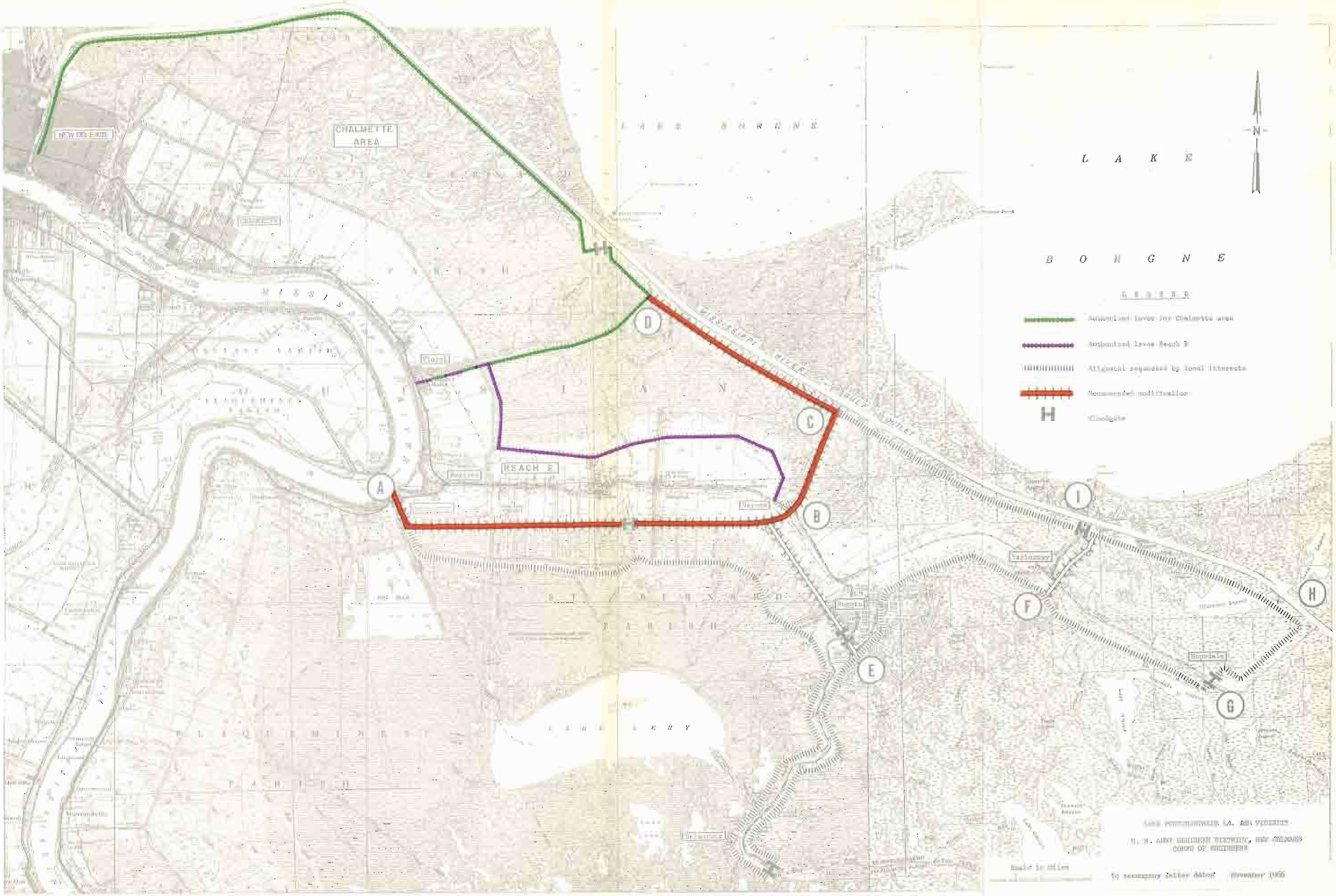
4 Incl (quint)
1. Map
2. Cost est.
3. Benefit est.
4. Apportionment of costs

THOMAS J. BOWEN
Colonel, CE
District Engineer

Mask

Hudson

Exe Ofc



NEW ORLEANS
CHALMETTE AREA
L A K E   B O R G N E
N
L A K E
B O R G N E
LEGEND
Authorized levee for Chalmette area
Recommended modification
Floodgate
MISSISSIPPI RIVER GULF OUTLET
REACH E
LAKE LERY
A
B
C
D
E
F
G
H
I

DETAILED ESTIMATED FIRST COST
FOR
ADDING POYDRAS-VERRET AREA TO THE
CHALMETTE AREA PLAN

1. ESTIMATES OF FIRST COSTS

The estimates of first cost for the plan of improvement for the Poydras to Verret area, based on October 1966 prices, are as follows:

a. REACH A-B.

Estimated first cost

Cost acct. No.	Item	Quantity	Unit cost	Estimated cost
	FEDERAL CONSTRUCTION			
11	Levees and floodwalls			
	Levee			
	Hydraulic fill	8,212,000 cu.yd.	$ 0.60	$4,927,200
	Shape up	1,026,000 cu.yd.	0.40	410,400
	Cast fill for dikes	385,000 cu.yd.	0.30	115,500
	Haul fill for levee	313,000 cu.yd.	1.50	469,500
	Seeding	264 acre	75.00	19,800
	Subtotal			$5,942,400
	Contingencies (20%)			1,188,600
	Subtotal			$7,131,000
15	Floodway control and diversion structures			
	Drainage structure	job		$ 146,000
	Contingencies (20%)			29,000
	Subtotal			$ 175,000
30	Engineering and design (6%)			$ 438,000
31	Supervision and administration (8%)			620,000
	Total estimated Federal construction first cost			$8,364,000

Incl 2

a. REACH A-B (cont'd)

Cost acct. No.	Item	Quantity	Unit cost	Estimated cost
	RELOCATIONS			
02.3	Relocation of pipelines			
	3-20" gas pipeline	L.S.		$ 161,000
	2-16" gas pipeline	L.S.		86,000
	1-12" gas pipeline	L.S.		32,000
	1-6" gas pipeline	L.S.		16,000
	Subtotal			$ 295,000
	Contingencies (20%)			59,000
	Subtotal			$ 354,000
02.1	Relocation of roads			
	La.Hwy.39 (Caernarvon)			
	Earthfill	26,200 cu.yd.	$ 1.50	$ 39,300
	Asphalt ramp	630 ft.	12.00	7,600
	Subtotal			$ 46,900
	Contingencies (20%)			9,100
	Subtotal			$ 56,000
30	Engineering and design (6%)			25,000
31	Supervision and administration (8%)			35,000
	Total estimated cost of relocations			$ 470,000
01	Lands and damages			
	Fee area	928 acres		$ 269,000
	Improvements			20,000
	Severance			10,000
	Contingencies (15%)			45,000
	Acquisition costs (83 tracts)			17,000
	Total cost for rights-of-way			$ 361,000
	TOTAL ESTIMATED COST FOR REACH A-B			$9,195,000

b. REACH B-C.

Estimated first cost

Cost acct. No.	Item	Quantity	Unit cost	Estimated cost
	FEDERAL CONSTRUCTION			
11	Levees and floodwalls			
	Levee			
	Hydraulic fill	3,032,000 cu.yd.	$ 0.60	$1,819,200
	Shape up	379,000 cu.yd.	0.40	151,600
	Cast fill for dikes	142,000 cu.yd.	0.30	42,600
	Haul fill for levee	313,000 cu.yd.	2.50	782,500
	Seeding	140 acre	75.00	10,500
	Subtotal			$2,806,400
	Contingencies (20%)			561,600
	Subtotal			$3,368,000
30	Engineering and design (6%)			$ 202,000
31	Supervision and administration (8%)			285,000
	Total estimated Federal construction first cost			$3,855,000
	RELOCATIONS			
02.1	Relocations			
	La.Hwy. 46 (Verret)			
	Earthfill	26,200 cu.yd.	$ 1.50	$ 39,300
	Asphalt ramp	630 ft.	12.00	7,600
	Subtotal			$ 46,900
	Contingencies (20%)			9,100
	Subtotal			$ 56,000
30	Engineering and design (6%)			4,000
31	Supervision and administration (8%)			5,000
	Total estimated first cost for relocations			$ 65,000
01	Lands and damages			
	Fee area	306 acres		$ 85,000
	Improvements			3,000
	Severances			5,000
	Contingencies (15%)			14,000
	Acquisition costs			1,000
	Total costs for rights-of-way			$ 108,000
	TOTAL COST FOR REACH B-C			$4,028,000

c. REACH C-D.

Estimated first cost

Cost acct. No.	Item	Quantity	Unit cost	Estimated cost
	FEDERAL CONSTRUCTION			
11	Levees and floodwalls			
	Levee			
	Hydraulic fill	1,198,000 cu.yd.	$ 0.60	$ 718,800
	Shape up	150,000 cu.yd.	0.40	60,000
	Cast fill for dikes	56,000 cu.yd.	0.30	16,800
	Seeding	54 acres	75.00	4,100
	Subtotal			$ 799,700
	Contingencies (20%)			160,300
	Subtotal			$ 960,000
30	Engineering and design (6%)			57,000
31	Supervision and administration (8%)			82,000
	Total estimated cost of levee			$1,099,000
11	Foreshore protection along MR-GO			
	Excavation & backfill	121,000 cu.yd.	1.00	121,000
	Riprap	54,000 ton	10.00	540,000
	Shell	12,000 cu.yd.	3.50	42,000
	Subtotal			$ 703,000
	Contingencies (20%)			141,000
	Subtotal			$ 844,000
30	Engineering and design (6%)			50,000
31	Supervision and administration (8%)			72,000
	Total estimated costs for foreshore protection			$ 966,000
	Total estimated Federal construction cost			$2,065,000
01	Lands and damages			
	Fee area	116 acres		$ 58,000
	Improvements			None
	Severance			None
	Contingencies (15%)			9,000
	Acquisition costs			1,000
	Total estimated costs for rights-of-way			$ 68,000
	TOTAL ESTIMATED COST REACH C-D			$2,133,000

d. Summary.

	A-B	B-C	C-D	Total
Federal construction	$8,364,000	$3,855,000	$2,065,000	$14,284,000
Relocations	470,000	65,000	None	535,000
Lands & damages	361,000	108,000	68,000	537,000
Total	$9,195,000	$4,028,000	$2,133,000	$15,356,000

ESTIMATE OF BENEFITS
FOR
POYDRAS-VERRET AREA

DESCRIPTION

The study area is rural in nature and is characterized by several small communities located along the highways which traverse the area. Along La. State Highway 39 are the settlements of Violet, Poydras, and Caernarvon. St. Bernard, Toca, Estopinal, and Verret are situated along La. State Highway 46. Estimated total population (1960 census) is 3,100 representing a growth rate of approximately 34% in the last decade. Improvements are generally located on high ground along the alluvial banks of the Mississippi River and Bayou Terre aux Boeufs, a former distributary of the Mississippi River at Poydras.

ECONOMIC DEVELOPMENT

Railway transportation is provided by the Louisiana Southern Railroad track (Southern Railway System) running along the west side of La. State Highway 39 and south of La. State Highway 46 as far east as the community of Toca. The Mississippi River-Gulf Outlet, a tidewater channel deep enough to accommodate seagoing vessels, borders on the northeastern boundary of the study area; to the north, Bayou Dupre and connecting Lake Borgne Canal afford a shallow navigation channel for smaller boats.

Economic activity in the area is primarily agricultural with truck crops and the production of beef cattle predominating. One industrial natural gas plant and one petroleum plant are in operation at Toca; no mineral production exists at this time. A few small, local business establishments are scattered along the highways. A large part of the income enjoyed by residents is derived outside of the area; primary sources include business and industrial establishments in metropolitan New Orleans, nearby oil production facilities, commercial fishing, sport fishing services, and fur trapping.

Development within the area has shown consistent gains over the past 25 years despite inadequate flood protection; its geographic position within the Greater New Orleans area indicates sustained future growth.

EXTENT AND CHARACTER OF FLOODEDAREA

Within the project area are some 17,900 acres of land subject to inundation, including 3,800 acres cleared, 9,500 acres woods, and 4,600 acres marshland. About 6,300 acres lying north of La. State Highway 46 receive some protection from flooding as a result of the Bayou Terre aux Boeufs alluvial ridge to the south and a protection levee up to +8 feet above mean sea level to the north. Nearly all improvements in the

Incl 3

area are residential, with a few small commercial businesses and two industrial plants. These improvements are generally located on the alluvial ridges at elevation +5 feet to +10 feet above mean sea level. Agricultural production is based primarily on small farm truck crop production and the raising of beef cattle.

The present estimated land value within the project area is $16,750,000 and the improvements are valued at $18,050,000 for a total valuation of $34,800,000. Annual value of agricultural production, under flood-free conditions, is about $250,000.

Due to the extreme peril to life and property in the area because of possible tidal overflow, it becomes necessary for a mass evacuation whenever there is an indication of approaching hurricanes or severe tropical disturbances. Highway and railway access is subject to disruption during these periods.

FLOOD DAMAGES

As a result of hurricane tidal overflows, damages are sustained by residences, house trailers, small business establishments, two industries, schools, churches, utilities, highways, and the railroad. Additional losses are suffered to truck crops, pastures, drowned livestock, fowl, and wildlife. Mass evacuation costs, flood fighting costs, business and personal income losses are also incurred.

Flood damages determined during surveys following hurricanes "Flossy" (September 1956) and "Betsy" (September 1965) were adjusted to reflect present conditions and used as a basis for developing stage-damage curves for agricultural and non-agricultural damages. In turn, average annual damages were determined by combining stage-damage and stage-frequency curves to obtain damage-probability curves.

Under present conditions, average annual losses within the project area are estimated at $13,100 crop and $119,600 non-crop for a total of $132,700.

Analysis of the growth trend for the metropolitan New Orleans area indicates continued growth for the next 50 years in this region. It was assumed that future improvements would take place in proportion to population increases and that the population within the study area would double by the end of a 50-year period and remain constant thereafter. No increase for agricultural production was assumed. On this basis of future development, average annual damages discounted for a 50-year growth and 100-year project life are estimated to be $13,100 crop and $178,600 non-crop for a total of $191,700.

ESTIMATES OF BENEFITS

Protection of the area from storms up to SPH frequency (about 200 years) will be afforded by the proposed works. Residual damages with the improvement are considered to be negligible; therefore, average annual flood damages prevented are estimated to be $13,100 crop and $178,600 non-crop or a total of $191,700.

The present appraised value of lands in the study area are estimated at $16,750,000; with protection from tidal overflow the value is anticipated to approximate $20,100,000 or an increase of $3,350,000. Annual value of land enhancement is estimated (at a 5 percent interest rate) to be $167,500.

Total average annual benefits attributable to the proposed project are $359,200, composed of $191,700 flood damage prevented and $167,500 enhancements.

Apportionment of Increased First Costs
for
Poydras to Verret Area

Project first cost	
Increased first cost (including riprap foreshore protection along MR-GO)	$ 8,144,000
Less foreshore protection	966,000
Total cost for additional levees	$ 7,178,000

Apportionment of costs

Item	Federal	Non-Federal
Levees	$ 5,024,600(70%)	$ 2,153,400 (30%)
Foreshore protection	966,000(100%)	-
Total incremental cost	$ 5,990,600	$ 2,153,400
Existing plan (cost from p. 40 of ref. 1.c.)	$21,697,952	$ 7,854,236
Total for modified project	$27,688,552	$10,007,636
Round to	$27,689,000	$10,008,000
Cost for lands & relocations	(orig. project)	3,968,755
	(modification)	1,072,000
		$ 5,040,755 *
Contribution required for modified project		$ 4,966,8??
Round to		$ 4,967,000

*This is in error in that it includes $1,393,400 for lands & damages and relocations (MR-GO to Violet) which will be eliminated under the modification. Correct total should be $3,647,355.

Incl A

LMVED-TD (NOD 29 Nov 66) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 13 Dec 66

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

1. The recommendations of the District Engineer in paras 16 and 17 of basic communication are concurred in, subject to the comments below. General Design Memorandum No. 3 (reference 1c) was forwarded to OCE by our 1st Ind, LMVED-TD, dated 1 Dec 66, on NOD letter, dated 1 Nov 66, subject: Lake Pontchartrain, La. and Vicinity, General Design Memorandum No. 3, Chalmette Area Plan.

2. Para 1f, basic letter. In connection with studies being made in response to referenced resolution, present indications are that the part of the area below Verret will probably have a very low B/C ratio.

3. Para 16, basic fletter. The estimate of $29,552,200 is that shown in General Design Memorandum No. 3 and has not been approved in a Project Cost Estimate (PB-3). The estimate of $37,697,000 should be designated as approximate in view of the comment in para 5 below.

4. Incl 1. a. Location of drainage structure should be shown.

b. Upon approval of enlarged Chalmette Area, consideration should be given to locating the east-west portion of levee A-E approximately 2,000 feet north of the recommended alignment in order to provide a slightly better foundation and to place the levee on somewhat higher ground.

5. Incl 2. It should be noted that levee fill volumes and costs are based on data furnished in General Design Memorandum No. 3. As pointed out in para 5 of our 1st Ind dated 1 Dec 66, cited in para 1 above, the data and analyses presented in the GDM are not completely adequate to permit the levee to be constructed in stages to final grade without additional studies. As a result, at this time we do not actually know the volume of levee fill required to construct the levee to an ultimate grade taking into account all future settlement and displacement. Thus, the cost estimate for the levee is based on the best information available at this time.

6. Incl 4. Upon approval of the modified plan, local interests should be apprised of the plan including the increase in required

LMVED-TD (NOD 29 Nov 66) 1st Ind 13 Dec 66
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

non-Federal contribution and their views discussed in the proposed supplement to the general design memorandum.

FOR THE DIVISION ENGINEER:

4 Incl (quad)
wd 1 cy ea

A. J. DAVIS
Chief, Engineering Division

Copy furnished:
NOD, ATTN: LMNED-PR

ENGCW-EZ 2nd Ind Mr. Hanscomb/jh/55104
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, CofEngrs, Washington, D.C. 20315, 31 January 1967

TO: Division Engineer, Lower Mississippi Valley Division

1. References:

a. 2nd Indorsement, ENGCW-EZ, 27 October 1966, on letter LMNED-PP, 18 August 1966, subject: "Lake Pontchartrain, Louisiana and Vicinity, Design Memorandum No. 1, Hydrology and Hydraulic Analysis, Part I - Chalmette."

b. 2nd Indorsement, ENGCW-EZ, 31 January 1967 on letter LMNED-PP, 1 November 1966, subject: "Lake Pontchartrain, Louisiana and Vicinity, General Design Memorandum No. 3, Chalmette Area Plan."

2. The modification recommended by the District Engineer in paragraph 16 of the basic letter is approved subject to the comments of the Division Engineer, the comments in OCE 2nd indorsement referenced in paragraph 1a above, and the following additional comment.

3. Since the modification involves a significant increase in the project cost, the Appropriations Committees of Congress will have to be notified by this office. For this purpose the views of local interests on the plan and the increase in the non-Federal contribution is necessary. It is requested that the modification be discussed with local interests and this office be advised of the results thereof.

4. Cost for Reach 2, shown in orange on Inclosure No. 1, should be stated in the supplement mentioned below, since the levee ABCD will replace this authorized levee as well as that shown in green.

5. Preparation of the supplement recommended in paragraph 17 of the basic letter is approved.

FOR THE CHIEF OF ENGINEERS:

wd incl

DANIEL D. HALL
Major, Corps of Engineers
Assistant Director of Civil Works
for Mississippi Valley

VF
SKR
MSG
WMF

LMVED-TD (NOD 29 Nov 66) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 9 Feb 67

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

1. Referred to note approval, subject to comments of 1st and 2d Indorsements.

2. Early action should be taken in regard to para 3, 2d Ind so that OCE may be furnished required information prior to impending Appropriations Hearings. In addition to a statement setting forth the views of local interests on the proposed modification and the increase in local costs, the submittal should clearly show that the modification of the Chalmette Area levee plan will obviate the need for the "Reach E" feature of the New Orleans to Venice hurricane protection project at a saving of $__________ to that project. Furthermore, the modified levee plan will eliminate the Bayou Lawler to Violet segment of the Chalmette Area as now planned at a saving of $__________. This proposed addition to the Chalmette Area will provide protection to all areas in St. Bernard Parish that can be economically justified at this time.

FOR THE DIVISION ENGINEER:

A. J. DAVIS
Chief, Engineering Division

23 Feb 67
Chatry/kn/239

LMNED-PP (NOD 29 Nov 66) 4th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, New Orleans District, CE, New Orleans, La. 70160 23 Feb 67

TO: Division Engineer, Lower Miss. Valley, CE, ATTN: LMVED-TD

1. In accordance with paragraph 3 of the 2d Indorsement, the State of Louisiana, Department of Public Works, which was designated by the Governor of Louisiana on 2 November 1965 as "...the agency to coordinate the efforts of local interests and to see that the local commitments are carried out promptly....," was requested to comment on the acceptability of the subject modification to local interests and their willingness to provide an additional local contribution therefor of approximately $2,150,000, inclusive of the value of lands, damages, relocations, and a cash contribution (or equivalent work) amounting to ~~$1,080,000~~ $2,470,000. A copy of our telegraphic request is inclosed.

2. By letter dated 13 February 1967, the Department of Public Works concurred in the modification and gave assurance that "...the requirements made of local interests will be carried out by the appropriate local governmental units." A copy of this response is inclosed.

3. The modified Chalmette Area Plan will extend hurricane protection to all areas in St. Bernard Parish for which such protection can be economically justified at this time. Since the entire Reach "E" feature of the "New Orleans to Venice, La.," project is located within the protected area of the modified Chalmette Area Plan, construction of this plan will, in addition to producing other benefits, generate all of the benefits realizable through construction of the Reach "E" feature, thus obviating the need for construction of the feature at a saving of $1,316,000 ($921,900 Federal, $394,100 non-Federal, based on PB-3 approved 2 June 1966). In addition, the return levee along Bayou Dupre, a segment of the Chalmette Area Plan as originally authorized, is not required with the modified plan, and its elimination results in an additional saving of $7,212,000 ($5,048,400 Federal and $2,163,600 non-Federal, based on DM No. 3, 1 November 1966).

Mask

2 Incl (dupe)
5. NOD telegram LMNED-PP-6, 7 Feb 67
6. DPW ltr dtd 13 Feb 67

THOMAS J. BOWEN
Colonel, CE
District Engineer

Hudson

Exe Ofc

67-265

LMVED-TD (NOD 29 Nov 66) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 27 Feb 67

TO: Chief of Engineers, ATTN: ENGCW-EZ

Information requested by OCE 2d Ind is forwarded for your information. To avoid misinterpretation of the last sentence of para 3, 4th Ind, and to correct minor discrepancies, a summary of costs rounded to nearest $1,000 is furnished below.

Cost of Modifying Chalmette Area Plan

Total Const. Cost	$14,819,000
Right of Way	537,000
Total Cost	$15,356,000
Less Levee Violet to Point D	7,212,000
Total Cost of Modifying Plan	$ 8,144,000

Cost of Chalmette Area Plan as Modified

Total Cost of Modified Plan	$37,697,000
Previous Estimate	29,553,000
Increase	$ 8,144,000
Federal Cost of Modified Plan	$27,689,000
Previous Estimate	21,698,000
Increase	$ 5,991,000
Non-Federal Cost of Modified Plan	$10,008,000
Previous Estimate	7,854,000
Increase	$ 2,154,000

Additional Saving

Elimination of Reach E of New Orleans to Venice Hurricane Protection Project

Total Savings	$ 1,316,000
Federal Cost	$ 922,000
Non-Federal Cost	$ 394,000

FOR THE DIVISION ENGINEER:

2 Incl
Dupe ~~ey~~ wd

GEORGE B. DAVIS
Acting Chief, Engineering Division

Copy furnished:
NOD, ATTN: LMNED-PP

Rec'd NOD 5/5/67

ENGCW-EZ (LMNED-PR, 29 Nov 66) 6th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, CofEngrs, Washington, D.C. 20315, 12 April 1967

TO: Division Engineer, Lower Mississippi Valley Division

1. Reference is made to letter, LMVED-A, 21 March 1966, subject: "Hurricane Protection - Lake Ponchartrain and Vicinity - Chalmette Area" and 1st indorsement, ENGCW-OM, 15 April 1966 thereon.

2. The construction costs presented in the 4th and 5th indorsements and in the GDM (DM #3) include costs for riprap foreshore protection along the Mississippi River - Gulf Outlet reach of the project. 1st indorsement ENGCW-OM, 15 April 1966, referenced in paragraph 1 above, directed that these costs be charged to the navigation project (MR-GO) as a Federal cost for wave protection. These costs, including the modified plan, are in excess of $4,000,000. The estimated costs should be adjusted by the District and revised estimates submitted to OCE, together with draft of letters to Congressional Committees. Since the riprap should be included in the Gulf Outlet (MR-GO) project, the necessary revisions to the design memorandum for the Gulf Outlet project should be made, or a supplement be prepared, and furnished OCE.

FOR THE CHIEF OF ENGINEERS:

wd incl

WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

LMVED-TD (NOD 29 Nov 66) 7th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 2 May 67

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

1. Referred for necessary action.

2. The question of charging the cost of riprap protection along the GIWW has been submitted to OCE by letter, LMVBC, SUBJECT: Hurricane Protection, Lake Pontchartrain and Vicinity, 24 Apr 67 for guidance. You will be advised when a decision is reached.

FOR THE ACTING DIVISION ENGINEER:

George B. Davis
GEORGE B. DAVIS
Acting Chief, Engineering Division

LMVED-PP (NOD 29 Nov 66) 8th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of The Chalmette Area Plan to Include Larger Area

DA, New Orleans District, CE, New Orleans, La. 70160 14 Jul 67

TO: Division Engineer, Lower Miss. Valley, CE, ATTN: LMVED-TD & LMVBC

1. In addition to the prior elements of this chain, reference is made to LMVBC letter dated 24 April 1967, subject "Hurricane Protection - Lake Pontchartrain and Vicinity," and 1st through 3d Indorsements thereto.

2. Forwarded herewith are the following:

a. Draft of proposed letter from the Chief of Engineers to the Special Assistant to the Secretary of the Army for Civil Functions explaining the inclusion of foreshore protection costs in the "Mississippi River-Gulf Outlet, La.," project.

b. Draft of proposed letter from the Special Assistant to the Director, Bureau of the Budget, transmitting a draft of proposed letters to the Public Works and Appropriations Committees of the United States Congress notifying them of the increase in cost of the "Mississippi River-Gulf Outlet, La.," project as a result of including foreshore protection in the plan of improvement, and requesting information as to whether there is any objection by the Bureau to the submission of the proposed letters to the respective committees.

c. Draft of proposed letter to the Committees.

3. Design for a portion of the foreshore protection has been covered in the general design memorandum (No. 3) for the Chalmette Area Plan. Inasmuch as the foreshore protection is more or less integral to and must be coordinated with the levee construction, it is planned to cover the design of the remaining foreshore protection in the general design memorandum for the Lake Pontchartrain Barrier Plan (No. 2) and in Supplement No. 1 to the general design memorandum for the Chalmette Area Plan. In addition a very brief letter-type supplement to the general design memorandum for the Mississippi River-Gulf Outlet (MR-GO) will be prepared and submitted for approval. This supplement, which will present the bases for inclusion of foreshore protection in the MR-GO project, the location of such protection, and a revised cost estimate for the overall project, will be prepared and submitted for approval after the notification of the Congressional Committees has been effected.

13 Jul 67
Chatry/kn/239
14 Jul 67

LMNED-PP (NOD 29 Nov 66) 8th Ind (contd)
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

4. Approval of the course of action outlined in paragraph 3. above is recommended.

3 Incl (dupe)
7, 8, & 9 as listed

GEORGE H. HUDSON
Acting District Engineer

Mask

Hudson

67-877

LMVED-TD (NOD 29 Nov 66) 9th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 14 Aug 67

TO: Chief of Engineers, ATTN: ENGCW-EZ

1. In our opinion the drafts of letters as prepared by the New Orleans District, mentioned in paragraph 2, 8th Ind, are not fully responsive to the request of the Chief of Engineers in his 2d and 6th Ind. Actually there are 3 projects being modified under the discretionary authority of the Chief of Engineers. Modification of the Chalmette Area affects both the Lake Pontchartrain and Vicinity project and the New Orleans to Venice project. Modification of the Mississippi River-Gulf Outlet project includes levee protection affecting the Lake Pontchartrain and Vicinity project. In addition the New Orleans to Venice project is being modified because of need to change net levee grade and construct levees on modified alignments. Thus, it is our opinion that each of these projects should be covered separately but concurrently. For this reason we are forwarding for each of the three projects the following:

a. Draft of proposed letter from the Chief of Engineers to the Special Assistant to the Secretary of the Army for Civil Functions.

b. Draft of proposed letter from the Special Assistant to the Director, Bureau of the Budget.

c. Draft of proposed letter to the Committees.

2. The course of action outlined in paragraph 3 of 8th Ind is concurred in except we recommend proceeding with preparation of the supplement to the general design memorandum for the Mississippi River-Gulf Outlet project without waiting for notification of the Congressional Committee.

ACTING
FOR THE/DIVISION ENGINEER:

A. J. Davis

A. J. DAVIS
Chief, Engineering Division

9 Incl (dupe)
wd Incl 7, 8, and 9
Added: 10 thru 18, as listed

Copy furnished:
NOD, ATTN: LMNED-PP

ENGCW-EZ (LMNED-PR, 29 Nov 66)   10th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, CofEngrs, Washington, D. C., 20315, 16 November 1967

TO: Division Engineer, Lower Mississippi Valley Division

1. The action indicated in paragraph 2 of the 9th indorsement is satisfactory.

2. It is proposed to notify the Committees of Congress at an early date of the modifications of the projects, indicated in paragraph 1 of the 9th indorsement, which are considered to be within the discretionary authority of the Chief of Engineers.

FOR THE CHIEF OF ENGINEERS:

wd Incls

Homer B. Willis
WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

LMVED-TD (NOD 29 Nov 66) 11th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity - Modification of the Chalmette Area Plan to Include Larger Area

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 22 Nov 67

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

Referred to note approval of action indicated in 9th Indorsement.

FOR THE DIVISION ENGINEER:

George B. Davis
for A. J. DAVIS
Chief, Engineering Division

APPENDIX B

C O P Y

LMNED-PP 22 June 1967

Mr. William C. Galegar, Acting Regional Director
Federal Water Pollution Control Administration
1114 Commerce Street
Dallas, Texas 75202

Dear Mr. Galegar:

This office is presently engaged in preparing a detail design memorandum covering the Bayous Bienvenue and Dupre Control Structures which are part of the Chalmette Area Plan feature of the "Lake Pontchartrain, La. and Vicinity," project which was authorized by the Flood Control Act of 1965 (Public Law 89-298, approved 27 October 1965).

The overall project is described in House Document Numbered 231, 89th Congress, 1st Session, and the location and general layout of the structures are shown on inclosures 1 and 2. The structures will normally remain in the fully open position to permit tidal influx and efflux; provide outlet for drainage flows from the protected area, and permit passage of marine traffic on Bayous Bienvenue and Dupre. When passage of a hurricane impends, the structures will be closed to exclude the hurricane surge.

Operation of the structures will be the responsibility of local interests. It is anticipated that the structures will be visited only to close the gates when a hurricane impends, subsequently to return the gates to the open position after the hurricane threat is over, and occasionally for maintenance purposes. Only in the event that major repairs are required would personnel be likely to remain at the structures for more than an hour or so.

Your comments relative to the structures are requested. Because of the urgent nature of work to be covered by the detail design memorandum, receipt of your comments prior to 16 August 1967 will be very much appreciated.

Sincerely yours,

GEORGE H. HUDSON
Acting District Engineer

2 Incl
1. Dwg file H-2-23820, plate 59
2. Dwg file H-2-23820, plate 62

File
E-5-4.0

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
South Central Region
1114 Commerce Street
Dallas, Texas 75202

August 24, 1967

Your Ref: LMNED-DL

District Engineer
U. S. Army Engineer District, New Orleans
P. O. Box 60267
New Orleans, Louisiana 70160

Attn: Mr. George H. Hudson, Chief
Engineering Division

Dear Sir:

Reference is made to your letters of July 14 and 20, 1967 requesting our review and comments on the following construction projects in Louisiana:

> Floodwall which will become a part of the Lake Ponchartrain, Louisiana and Vicinity Hurricane Project;
>
> Enlargement of the East Atchafalaya Basin Protection Levee between approximate Stations 2772+00 and 2949+00.

We have had an opportunity to review the information submitted in accordance with Executive Order 11288, Section 1 (3) and 1 (7) and Section 4 and find as follows:

> These proposed projects should have little effect on the water quality with the water pollution control and disposal of material specifications. However, all contractors should provide and operate sanitation facilities that will adequately treat or dispose domestic wastes to conform with Federal and local health regulations.
>
> Based upon the preliminary description furnished to us with your above letters and the submitted water quality and pollution control measures, additional coordination on these projects does not appear warranted. However, we will keep you advised should

we receive information or data to alter this situation and would ask that this office be advised of any significant changes from the preliminary description furnished us.

This will confirm the telephone conversation of August 21 between Mr. W. E. Shell, Jr., District Water Pollution Coordinator, and Mr. D. E. Kretzer of this office concerning our review and comments on the above projects. This review was delayed due to having only one set of large documents, quadrangle sheet, drawing 1 of 78, and aerial photo plan, which was circulated between the two Louisiana water pollution control agencies for review. Our review and coordination with the State agencies would be expedited, if such large documents could be furnished in triplicate; so that, the above agencies and this office could review similar projects simultaneously.

The comments of the Louisiana Stream Control Commission and the Louisiana State Board of Health have been incorporated in our review.

Your cooperation in this effort is very much appreciated.

Sincerely yours,

WILLIAM C. GALEGAR
Regional Director

cc: Louisiana State Board of Health
Louisiana Stream Control Commission

APPENDIX C

BAYOU DUPRE AND BAYOU BIENVENUE
SALINITY OBSERVATIONS

1. Paris Road Bridge

a.	Daily readings	July 1948 - Dec 1966
b.	Intermittent	May 1962 - June 1966

2. MR-GO at Bayou Bienvenue

Intermittent — Oct 1963 - Nov 1966

3. MR-GO at Bayou Dupre

Intermittent — Oct 1963 - Nov 1966

Attach 11

Table 51

Gulf Intracoastal Waterway at Paris Road Bridge (AJ)

1948 — Mid-depth Chlorides as Cl^-, 1000 p.p.m. — 1948

Day	January	February	March	April	May	June	July	August	September	October	November	December
1								1.15	1.70	2.10	2.25	1.25
2								1.30	1.65	2.10	2.25	.75
3								1.35	1.75	2.20	1.75	1.25
4								1.42	1.45	2.10	1.75	1.00
5								1.45	1.25	1.90	1.75	1.25
6								1.45	1.25	2.10	1.75	1.25
7									1.30	1.90	1.50	1.25
8									1.20	1.70	1.50	1.25
9									1.30	1.70	1.75	1.25
10									1.00	1.80	1.75	1.25
11									[illegible]	[illegible]	1.75	1.25
12									1.50	1.80	1.75	1.25
13									2.15	1.80	1.50	1.25
14									1.95	1.50	1.75	1.25
15									1.95	1.50	1.75	1.25
16									2.00	1.60	1.50	1.00
17									2.15	1.70	1.50	1.25
18									1.25	1.70	1.50	1.00
19									1.25	1.70	1.50	1.25
20							1.20		1.20	1.60	1.50	.75
21							.85		1.35	1.70	1.50	1.00
22							.95		1.35	1.80	1.75	1.00
23							.95		1.30	1.70	1.00	1.00
24							.95		1.70	1.90	1.00	1.00
25							1.00		2.30	2.00	1.00	1.00
26							1.00		2.30	2.00	1.25	1.00
27							1.05		2.30	2.00	1.25	1.00
28							1.05		2.30	2.00	1.50	.75
29							1.00		2.00	2.00	1.50	.75
30							1.05	1.70	2.10	2.00	1.25	.50
31							1.15	1.65		2.25		.75

1949 — Mid-depth Chlorides as Cl^-, 1000 p.p.m. — 1949

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	0.75	0.50	0.35	0.30	0.28	0.28	0.20	0.25	0.42	2.00	1.10	1.30
2	.75	.40	.35	.25	.25	.30	.45	.25	.60	2.50	1.00	1.40
3	.75	.45	.40	.25	.25	.32	.50	.25	.65	2.75	1.10	1.50
4	1.00	.50	.40	.25	.25	.32	.40	.20	82	2.50	1.10	1.70
5	1.00	.40	.40	.25	.25	.25	.30	.15	.75	2.50	1.00	1.60
6	.75	.50	.40	.35	.25	.25	.20	.20	.50	2.00	1.50	1.60
7	.75	.40	.40	.35	.25	.30	.25	.22	.42	1.75	1.60	1.60
8	.75	.30	.40	.40	.28	.30	.40	.18	.40	1.75	1.70	1.50
9	.62	.40	.40	.40	.30	.30	.25	.23	.40	1.75	1.60	1.70
10	.62	.30	.30	.35	.35	.35	.20	.26	.45	1.75	1.70	1.70
11	.50	.30	.30	.30	.35	.35	.20	.21	1.18	1.75	1.70	1.70
12	.70	.30	.35	.25	.30	.30	.20	.17	2.50	1.75	1.70	1.70
13	.60	.30	.40	.30	.30	.25	.20	.17	2.10	1.75	1.60	1.40
14	.50	.35	.35	.30	.30	.25	.20	.19	1.20	1.75	1.30	1.40
15	.50	.35	.35	.30	.30	.25	.20	.19	1.10	1.75	1.40	1.40
16	.60	.30	.25	.30	.30	.25	.20	.21	1.10	1.50	1.20	1.20
17	.80	.30	.30	.30	.30	.25	.25	.21	1.00	1.50	1.20	1.30
18	.80	.35	.25	.30	.30	.27	.25	.17	1.00	1.50	1.20	1.70
19	.70	.40	.25	.30	.30	.25	.25	.19	1.00	1.50	1.30	1.40
20	.70	.35	.35	.28	.25	.26	.20	.18	1.20	1.50	1.40	1.40
21	.70	.30	.35	.30	.30	.35	.30	.19	1.30	1.50	1.30	1.30
22	.60	.40	.40	.35	.30	.35	.35	.23	1.20	1.50	1.40	1.20
23	.60	.40	.30	.35	.30	.30	.40	.27	1.20	1.50	1.40	1.20
24	.55	.40	.30	.35	.30	.30	.30	.28	1.20	1.25	1.40	1.30
25	.60	.40	.25	.35	.30	.25	.32	.30	1.30	1.50	1.40	1.80
26	.60	.30	.30	.30	.30	.30	.35	.55	2.00	1.50	1.20	2.00
27	.60	.40	.25	.28	.30	.25	.30	.52	2.10	1.50	1.20	1.80
28	.50	.35	.30	.25	.30	.22	.28	.50	2.00	1.50	1.30	1.80
29	.50		.15	.25	.30	.20	.20	.45	1.75	1.50	1.20	1.30
30	.60		.18	.25	.30	.20	.20	.42	1.75	1.50	1.30	1.50
31	.60		.25		.30		.20	.42		1.25		1.70

1950 — Mid-depth Chlorides as Cl^-, 1000 p.p.m. — 1950

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	2.00	1.10	0.19	0.13	0.07	0.13	0.15	0.50	2.45	3.85	2.50	2.75
2	2.30	1.00	.08	.12	.07	.13	.17	.50	2.30	3.85	2.50	2.75
3	2.30	.90	.38	.13	.09	.15	.20	.50	2.35	4.10	2.50	2.75
4	2.40	.90	.37	.13	.07	.10	.25	.50	2.55	3.30	2.50	2.25
5	2.50	.90	.08	.09	.06	.13	.23		2.00	2.75	2.50	2.25
6	2.60	.90	.07	.06	.06	.13	.14		1.40	2.50	2.75	3.00
7	1.40	.60	.05	.05	.07	.20	.14		1.75	2.50	2.50	2.25
8	1.90	.70	.05	.04	.07	.18	.16	.95	1.90	2.50	2.75	2.00
9	2.20	.70	.05	.06	.07	.13	.22	.95	1.95	2.25	2.75	2.00
10	1.80	.75	.04	.06	.11	.10	.30	.90	1.95	2.25	2.75	2.25
11	1.30	.85	.06	.07	.10	.07	.30	.90	1.85	2.25	2.75	2.25
12	1.30	1.10	.05	.08	.06	.07	.27	.90	1.85	2.50	2.75	2.25
13	1.40	1.20	.04	.10	.08	.07	.26	.75	1.85	2.50	2.75	2.25
14	1.30	.80	.04	.12	.07	.07	.20	.65	1.85	2.75	2.75	1.25
15	1.60	.80	.04	.10	.07	.07	.22	.70	1.85	3.00	3.00	1.25
16	1.50	.80	.04	.11	.08	.06	.24	.95	2.00	3.00	3.00	1.25
17	1.50	.80	.04	.13	.07	.06	.27	1.05	2.10	3.00	3.00	1.25
18	1.50	.80	.04	.15	.08	.06	.25	1.15	2.10	3.75	3.00	1.25
19	1.50	.80	.04	.07	.11	.06	.19	1.20	2.25	4.25	3.00	1.00
20	1.40	.80	.04	.06	.15	.06	.18	1.15	2.00	3.38	3.00	1.00
21	1.20	.80	.04	.06	.15	.07	.17	1.05	2.20	3.38	3.00	1.00
22	1.20	.70	.03	.07	.15	.08	.31	1.00	1.80	3.25	3.00	1.00
23	1.20	.80	.03	.08	.15	.07	.40	1.25	1.80	2.50	3.00	1.00
24	1.20	.70	.03	.12	.15	.07	.75	1.40	2.10	2.75	3.00	1.00
25	1.20	.70	.03	.15	.15	.07	.90	1.20	2.40	2.75	2.00	1.00
26	1.30	.60	.04	.15	.10	.07	.50	1.20	3.20	2.75	2.25	1.00
27	.90	.60	.16	.15	.08	.09	.45	1.65	3.75	2.75	2.25	2.00
28	.90	.35	.06	.13	.08	.09	.55	1.90	3.65	3.00	2.25	2.50
29	1.00		.04	.13	.10	.09	.50	2.35	3.65	3.00	2.50	2.50
30	1.10		.04	.13	.08	.12	.50	2.40	3.40	3.00	2.75	2.00
31	1.10		.10		.08		.50	2.55		2.50		2.00

(Continued)

(Sheet 1 of 5 sheets)

Table 51 (Continued)

1951 Day	January	February	March	April	May	June	July	August	September	October	November	December
					Mid-depth Chlorides as Cl⁻, 1000 p.p.m.							1951
1	2.00	1.25	1.25	1.25	0.75	0.80	0.90	0.75	1.60	4.40	3.15	3.40
2	2.00	1.25	1.25	1.25	.75	.80	.90	.80	1.70	4.70	2.90	3.40
3	2.00	1.25	1.25	1.25	.75	.85	.70	.85	1.40	4.10	2.30	3.70
4	2.00	1.25	1.25	1.25	.75	.85	.70	.85	2.10	3.70	2.50	3.80
5	2.00	1.25	1.00	1.25	.75	.80	.70	.85	1.90	3.40	2.40	3.60
6	2.00	1.25	1.25	1.25	.75	.75	.75	.90	1.90	3.05	2.90	3.00
7	2.00	1.25	1.00	1.25	.75	.75	.80	.75	1.90	3.75	2.20	3.12
8	2.00	1.25	1.25	1.00	.75	.70	.90	.80	2.00	2.55	2.25	3.12
9	2.00	1.25	1.25	1.25	.75	.75	1.10	.85	2.30	2.80	2.40	3.00
10	1.75	1.25	1.00	1.00	.75	.75	1.40	.90	2.30	2.80	2.60	2.50
11	1.75	1.25	1.25	.75	1.00	.80	1.45	.95	2.85	2.80	2.70	2.29
12	1.75	1.25	1.00	1.00	.75	.80	1.40	1.00	3.60	2.90	2.90	2.00
13	1.75	1.25	1.25	1.00	1.00	.80	1.25	1.30	3.20	3.00	3.20	2.12
14	1.75	1.25	1.50	1.00	1.00	.80	1.00	1.45	2.95	3.20	3.25	2.62
15	1.75	1.25	1.25	1.00	1.00	.80	.90	1.50	2.75	3.50	3.00	2.00
16	1.75	1.25	1.25	1.00	1.00	.90	.90	1.50	2.85	3.70	3.30	2.62
17	1.75	1.25	1.50	1.00	1.00	.80	.90	1.65	2.90	4.10	2.30	3.12
18	1.75	1.25	1.25	1.00	.75	.90	.90	1.70	3.10	4.40	2.10	3.00
19	1.75	1.25	1.50	1.00	.75	.90	.90	1.70	3.10	4.40	2.35	3.00
20	1.75	1.25	1.50	1.00	.75	.80	1.30	1.70	3.10	4.20	2.50	3.75
21	2.00	1.25	1.50	1.00	.75	.80	1.15	1.80	3.10	4.00	3.00	2.75
22	2.00	1.25	1.25	1.00	.75	.90	1.20	1.85	3.10	4.30	3.60	2.50
23	2.00	1.25	1.25	.75	.75	1.10	1.40	1.90	2.70	4.00	3.50	2.75
24	1.50	1.25	1.25	.75	.55	1.20	1.45	1.80	2.35	3.30	3.10	2.75
25	1.75	1.25	1.25	.75	.75	1.20	1.50	1.70	2.00	3.40	3.10	2.75
26	1.75	1.25	1.25	.75	.85	1.30	1.40	2.00	1.95	3.45	3.10	2.75
27	1.75	1.25	1.25	.75	.85	1.30	1.40	2.20	2.00	3.30	3.00	2.25
28	1.75	1.25	1.25	.75	.80	1.30	1.15	2.20	2.05	2.70	3.00	2.50
29	1.75		1.25	.75	.75	1.10	.90	1.60	2.45	3.15	3.40	2.75
30	1.25		1.25	.75	.80	1.10	1.10	1.50	3.40	3.60	3.40	2.75
31	1.50		1.25		.70		.60	1.50		3.25		2.75

1952 Day	January	February	March	April	May	June	July	August	September	October	November	December
					Mid-depth Chlorides as Cl⁻, 1000 p.p.m.							1952
1	2.75	2.50	1.60	1.60	1.40	1.10	1.40	2.50	3.40	3.60	5.90	5.25
2	3.00	3.00	1.70	1.60	1.40	1.10	1.60	2.40	3.80	3.40	5.40	4.75
3	3.00	2.50	1.85	1.30	1.40	1.10	1.80	2.30	3.90	3.80	5.70	4.75
4	1.90	2.30	1.60	1.80	1.50	1.10	2.10	2.40	3.50	3.90	6.00	4.75
5	1.70	2.20	1.70	1.70	1.50	1.10	2.20	2.40	3.30	4.60	5.70	4.75
6	1.80	2.20	1.80	1.70	1.50	1.10	1.70	2.50	3.40	5.30	5.20	4.75
7	2.00	2.20	1.80	1.40	.90	1.10	1.60	2.50	4.60	4.60	5.00	4.75
8	2.25	2.20	1.70	1.40	.90	1.20	1.60	2.60	4.90	3.70	5.60	5.25
9	2.40	2.10	1.90	1.40	.90	1.60	1.70	2.60	5.40	4.00	5.70	5.00
10	1.90	2.10	2.30	1.50	.90	1.40	1.90	2.60	6.20	3.90	5.50	5.00
11	2.40	2.25	2.10	1.50	.90	1.20	2.10	2.70	5.70	4.10	4.00	7.75
12	2.80	2.35	1.80	1.50	.90	1.30	2.00	2.60	5.40	4.20	4.10	4.25
13	2.80	2.45	1.70	1.50	.90	1.30	2.00	2.40	5.40	4.30	4.60	4.25
14	2.80	2.50	1.70	1.50	.90	1.40	2.60	2.50	4.10	4.70	4.90	4.75
15	2.90	2.75	1.70	1.50	1.20	1.40	3.20	2.50	4.10	4.90	4.90	4.50
16	2.90	2.80	1.70	1.50	1.40	1.40	3.60	2.50	3.40	4.80	5.30	4.25
17	3.00	2.05	1.70	1.50	1.70	1.40	3.50	2.50	3.50	4.50	4.50	4.25
18	2.10	2.05	1.80	1.50	1.70	1.40	2.90	2.40	3.90	4.60	5.75	5.00
19	1.70	2.00	1.60	1.50	1.70	1.50	2.50	2.80	4.00	4.00	5.75	4.75
20	2.00	2.00	1.60	1.50	1.40	1.50	2.30	3.00	4.00	5.10	5.00	5.00
21	2.40	1.90	1.90	1.50	1.10	1.30	2.20	2.40	4.00	5.40	4.25	4.50
22	3.20	2.00	1.90	1.50	1.10	1.50	2.40	2.40	4.00	6.00	4.50	4.75
23	3.50	2.40	1.60	1.50	1.30	1.50	2.30	2.40	4.00	5.40	4.50	4.00
24	3.50	1.70	1.60	1.20	1.00	1.50	2.30	3.00	4.00	4.90	4.50	4.25
25	3.70	1.70	1.70	1.50	1.10	1.40	2.50	3.50	4.30	4.80	5.50	4.50
26	3.50	2.10	1.60	1.50	1.10	1.60	2.40	3.70	4.60	4.50	4.50	4.50
27	3.30	1.80	1.30	1.50	1.10	1.60	2.80	3.90	4.20	4.70	4.50	4.50
28	2.90	1.80	1.30	1.50	1.20	1.80	2.60	3.70	3.80	4.30	4.25	4.00
29	2.30	1.80	1.30	1.40	1.20	1.80	2.30	3.70	3.90	4.10	4.75	4.50
30	2.30		1.30	1.40	1.20	1.90	2.50	3.60	3.80	5.00	5.25	5.00
31	2.50		1.50		1.20		2.60	3.30		5.40		4.25

1953 Day	January	February	March	April	May	June	July	August	September	October	November	December
					Mid-depth Chlorides as Cl⁻, 1000 p.p.m.							1953
1	2.75	3.75	2.50	1.90	1.80	1.50	1.18	1.30	1.25	2.10	2.75	1.60
2	2.00	3.75	2.50	1.60	2.00	1.50	1.10	1.30	1.20	2.30	2.70	1.80
3	3.75	3.25	2.30	2.00	2.00	1.70	1.10	1.30	1.30	2.30	2.70	1.80
4	3.75	3.00	2.50	1.60	1.80	1.80	1.10	1.30	1.40	2.80	2.75	2.10
5	3.75	3.25	2.50	1.70	1.80	1.80	1.10	1.30	1.40	2.50	2.80	1.90
6	4.00	3.75	2.40	2.00	2.00	1.80	1.20	1.40	1.30	2.10	2.90	1.90
7	3.25	3.50	2.40	1.90	2.00	1.50	1.30	1.40	1.30	2.10	2.80	1.80
8	4.25	3.25	2.30	2.00	1.90	1.70	1.25	1.40	1.30	2.10	3.00	1.80
9	3.75	3.25	2.40	2.00	2.10	1.50	1.30	1.30	1.45	2.10	2.80	1.70
10	3.75	4.00	2.50	1.90	2.20	1.40	1.25	1.30	1.60	2.30	2.50	1.80
11	3.75	4.00	2.75	2.00	2.00	1.40	1.40	1.40	1.80	2.10	2.50	1.70
12	3.75	3.75	2.80	2.00	2.00	1.20	1.45	1.50	1.65	2.10	2.50	1.70
13	3.75	3.25	2.50	2.00	1.90	1.20	1.70	1.50	1.50	2.10	2.40	1.60
14	4.00	3.00	2.50	2.00	1.80	1.15	1.70	1.30	1.60	2.10	2.60	1.80
15	4.25	3.50	2.35	2.00	1.80	1.10	1.80	1.30	1.60	2.20	2.50	1.70
16	4.50	3.25	2.40	1.80	1.80	1.20	1.70	1.40	1.60	2.20	2.60	1.70
17	4.25	3.00	2.40	2.00	1.80	1.08	1.40	1.50	1.70	2.20	2.70	1.30
18	4.25	3.00	2.20	1.80	1.70	1.12	1.50	1.70	1.70	2.30	2.80	1.60
19	3.75	3.50	2.30	1.80	1.70	1.18	1.40	1.40	1.90	2.10	2.90	1.50
20	3.25	3.50	2.40	1.80	1.70	1.35	1.60	1.40	2.00	2.70	2.90	1.60
21	3.00	2.50	2.60	1.80	1.90	1.35	1.50	1.30	2.00	2.70	2.40	1.50
22	3.25	2.75	2.50	1.80	1.90	1.35	1.40	1.50	2.00	2.70	2.15	1.50
23	4.00	2.50	2.60	1.90	2.00	1.42	1.40	1.50	2.10	3.50	1.90	1.50
24	3.25	2.50	2.20	1.90	2.00	1.48	1.40	1.50	2.40	2.50	1.65	1.50
25	3.50	2.25	2.20	1.90	1.90	1.48	1.40	1.70	2.30	2.60	1.90	1.60
26	3.25	2.25	2.20	1.60	2.00	1.45	1.40	1.60	2.50	2.90	2.10	1.30
27	3.25	2.50	1.90	1.90	1.90	1.38	1.40	1.35	2.40	2.80	1.90	1.00
28	3.25	2.50	1.90	1.90	1.80	1.38	1.30	1.10	2.20	2.50	1.70	1.40
29	3.50		2.00	1.70	2.00	1.20	1.30	1.30	2.10	2.40	1.40	1.30
30	3.25		2.00	1.70	1.90	1.15	1.40	1.20	2.00	2.50	1.80	1.30
31	3.75		2.10		1.60		1.40	1.40		2.50		1.30

(Continued)

1954 — Mid-depth Chlorides as Cl^-, 1000 p.p.m.

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	1.20	1.00	0.80	0.90	1.90	1.10	1.70	2.20	4.10	5.00	4.75	5.89
2	1.00	1.00	.80	1.10	1.80	1.10	1.70	2.30	4.10	5.50	4.75	5.00
3	1.20	.90	.90	1.10	1.50	1.00	1.60	2.20	4.30	5.75	5.00	5.00
4	1.10	.90	.90	.90	1.10	1.00	1.60	2.20	4.30	6.50	5.25	4.75
5	1.00	.80	.90	1.00	1.00	1.10	1.80	2.20	4.20	5.25	4.00	4.75
6	1.00	.70	.90	1.15	1.00	1.30	1.90	2.20	4.50	4.75	3.75	4.75
7	1.00	.70	.90	1.15	1.00	1.30	1.60	2.20	4.50	4.75	3.75	4.75
8	1.00	.60	.80	1.13	1.00	1.30	1.50	2.20	4.50	6.00	4.00	5.50
9	1.00	.60	.80	1.10	1.00	1.30	1.50	2.30	4.80	7.00	4.25	5.50
10	1.10	.60	.80	1.40	1.00	1.30	1.50	2.30	3.60	7.00	4.25	5.25
11	.80	.70	.80	2.10	1.20	1.30	1.60	2.70	3.80	5.50	5.50	5.25
12	.70	1.00	.80	1.65	1.30	1.30	1.70	3.00	4.00	6.25	5.50	5.25
13	.80	1.00	.80	1.00	1.00	1.40	1.90	3.00	4.30	5.75	6.00	5.25
14	1.00	.90	.80	1.00	1.00	1.60	1.90	3.10	5.40	5.25	6.00	5.25
15	1.00	1.00	.80	1.40	.90	1.60	1.70	3.10	6.30	4.75	6.25	5.25
16	1.00	1.00	.80	1.00	.90	1.60	1.60	2.90	7.00	4.50	5.00	5.25
17	.80	1.00	.90	1.00	.90	1.50	2.00	3.60	6.50	4.50	4.75	4.75
18	.90	1.00	.80	1.00	.90	1.50	2.00	3.10	4.70	4.50	4.75	3.75
19	.90	1.10	.90	1.10	.90	5.50	2.10	3.30	5.00	4.50	4.75	4.00
20	1.00	1.10	.80	1.30	.90	1.70	2.40	3.20	4.50	4.50	4.75	4.00
21	.90	1.00	.80	1.20	1.10	1.60	2.30	3.00	4.50	4.50	4.50	4.00
22	.80	1.00	.80	1.50	1.10	1.70	1.80	3.40	4.50	5.00	4.50	4.50
23	.70	.90	.80	1.50	1.10	1.50	1.80	3.80	4.40	5.00	4.75	4.75
24	.90	.80	.80	1.50	1.30	1.50	1.70	4.10	4.50	5.50	4.75	4.75
25	.90	.80	.80	1.50	1.50	1.50	1.90	3.30	5.20	6.00	4.25	5.25
26	1.00	.80	.90	1.50	1.60	1.50	1.90	3.50	4.30	6.00	4.50	5.25
27	.80	.80	.90	1.50	1.80	1.50	2.40	3.30	4.30	6.00	4.75	5.50
28	.80	.90	1.00	1.40	1.50	1.50	3.30	3.10	4.00	5.25	4.75	5.25
29	.80		1.00	1.10	1.40	1.50	3.00	3.10	4.00	5.00	4.63	4.75
30	.90		1.00	1.60	1.20	1.60	2.60	3.20	4.00	4.25	4.89	4.00
31	.90		1.00		1.10		2.00	3.80		4.50		4.12

1955 — Mid-depth Chlorides as Cl^-, 1000 p.p.m.

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	4.25	2.60	2.50	2.70	2.10	2.20	2.90	3.50	2.58	3.00	3.75	4.50
2	3.75	2.90	2.40	2.40	2.10	2.30	2.80	3.32	2.55	2.75	4.25	4.50
3	3.75	3.60	2.40	2.40	2.10	2.00	2.70	2.62	2.52	3.50	4.00	4.50
4	3.75	3.50	2.50	2.40	2.10	2.00	2.60	2.56	2.55	3.25	3.75	4.00
5	3.75	3.90	2.30	2.80	2.10	2.00	2.50	2.38	2.45	4.00	4.00	3.75
6	3.75	3.90	2.30	2.80	2.00	2.00	2.40	2.22	2.18	4.00	4.00	4.25
7	3.75	3.40	2.40	2.40	2.10	2.10	2.40	2.22	2.13	3.50	4.00	4.00
8	3.75	2.20	2.60	2.40	2.00	2.10	2.60	2.20	2.15	3.50	4.00	3.50
9	3.75	2.60	2.50	2.80	1.90	2.00	2.70	2.10	2.02	4.00	4.00	3.25
10	4.00	1.50	2.60	2.80	1.90	2.10	2.90	2.12	3.10	4.00	4.00	3.75
11	4.00	3.00	2.20	2.70	1.80	2.10	2.60	2.15	2.85	3.75	3.75	3.75
12	4.00	3.00	2.40	2.40	2.20	2.10	2.70	2.15	2.42	3.25	4.00	3.75
13	4.00	2.80	2.50	2.20	2.10	2.10	2.61	2.22	2.92	3.50	3.50	3.75
14	4.00	2.80	2.40	2.30	1.90	2.10	2.37	2.15	3.18	3.25	4.00	4.00
15	4.00	2.80	2.50	2.60	1.90	2.10	2.47	2.15	3.00	3.50	3.50	4.25
16	3.50	2.70	2.50	2.50	2.10	2.30	2.55	2.15	3.12	3.25	4.00	3.75
17	3.25	2.70	2.50	2.50	2.20	2.30	2.55	2.12	3.62	3.00	4.25	3.75
18	3.25	2.70	2.50	2.50	2.60	2.50	2.39	2.15	4.10	3.25	5.00	4.00
19	3.25	3.30	2.60	1.90	2.60	2.30	2.37	2.08	3.42	3.50	4.00	4.00
20	3.00	2.90	2.50	2.30	2.00	2.30	2.55	2.08	3.28	3.75	4.50	
21	1.75	3.10	2.80	2.20	1.80	2.30	2.72	2.18	3.00	3.50	4.25	
22	2.00	2.50	3.00	2.50	2.00	2.40	2.62	2.20	2.50	3.50	4.25	
23	2.25	2.50	2.90	2.50	2.00	2.40	2.65	2.22	2.75	3.75	4.25	
24	2.50	2.10	2.90	2.50	2.00	2.40	2.50	2.22	2.50	3.75	3.50	
25	2.70	2.40	2.90	2.50	1.90	2.50	2.34	2.30	2.75	7.50	4.00	
26	2.10	2.60	2.80	2.30	1.90	2.50	2.74	3.00	2.50	4.25	3.25	
27	2.40	2.50	2.80	2.10	1.90	2.50	2.69	3.10	2.25	4.25	3.50	
28	2.70	2.30	2.70	2.20	1.90	2.50	2.31	2.85	3.75	4.50	3.75	
29	2.50		2.50	2.30	2.20	2.90	2.21	2.60	3.50	4.50	3.25	
30	2.60		2.40	2.10	2.40	2.90	2.30	2.62	3.25	3.50	3.75	
31	2.60		2.50		2.20		2.02	2.50		3.50		

1956 — Mid-depth Chlorides as Cl^-, 1000 p.p.m.

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	3.50	3.25	1.95	1.60	1.60	1.60	1.70	1.90	3.00	5.00	4.60	4.80
2	3.50	4.00	2.05	1.70	1.60	1.65	1.60	1.80	2.90	2.80	4.90	4.90
3	3.00	3.25	2.05	1.70	1.70	1.70	1.60	1.90	3.20	3.20	5.00	4.20
4	3.00	3.25	2.05	1.60	1.70	1.70	1.60	1.90	4.10	3.90	5.10	4.30
5	2.75	3.50	2.00	1.60	1.50	1.60	1.60	2.10	4.20	3.60	5.80	5.00
6	3.00	3.75	1.90	1.50	1.50	1.70	1.70	2.00	4.60	3.90	5.20	5.10
7	3.00	3.25	1.95	1.80	1.50	1.80	1.70	2.00	4.90	3.80	5.00	4.60
8	3.50	3.25	2.00	1.70	1.60	1.80	1.60	2.00	5.00	4.00	4.70	4.80
9	3.75	3.50	1.95	1.70	1.50	1.80	1.50	2.30	5.20	4.10	4.50	4.90
10	2.75	3.25	1.55	1.70	1.60	1.80	1.50	2.70	5.20	4.10	4.40	4.00
11	2.75	2.75	2.05	1.60	1.50	2.10	1.50	2.70	5.50	4.10	4.30	4.00
12	2.75	2.50	1.45	1.70	1.60	2.50	1.40	2.80	5.00	4.90	4.40	4.50
13	2.75	2.50	1.50	1.60	1.60	2.60	1.40	2.90	4.50	5.40	4.50	4.80
14	3.25	2.50	1.60	1.60	1.60	2.80	1.40	3.00	4.40	5.40	5.10	4.60
15	2.75	2.50	1.50	1.70	1.60	1.90	1.40	2.70	4.40	4.80	5.40	4.50
16	3.75	1.00	1.50	1.60	1.60	1.80	1.40	2.30	4.40	4.10	5.20	4.40
17	3.75	2.00	1.50	1.60	1.60	1.75	1.50	2.70	4.20	4.10	5.20	4.30
18	3.75	2.05	1.40	1.70	1.50	1.70	1.50	2.60	4.40	4.20	4.80	4.20
19	2.25	2.00	1.40	1.70	1.60	1.20	1.60	2.60	4.30	4.20	4.90	4.00
20	3.25	2.10	1.40	1.70	1.60	1.60	1.70	3.00	4.50	4.40	4.70	3.90
21	3.25	2.00	1.40	1.60	1.50	1.60	1.80	2.00	4.90	4.80	5.20	2.80
22	4.50	2.05	1.70	1.70	1.60	1.70	1.80	2.70	5.60	4.60	4.30	3.10
23	4.25	2.00	1.90	1.60	1.50	1.80	1.90	3.00	6.80	4.60	4.50	3.40
24	3.75	1.90	1.50	1.70	1.60	1.80	1.90	3.30	7.10	4.80	4.30	3.50
25	3.75	1.90	1.50	1.80	1.60	1.90	1.90	3.30	5.50	4.90	4.40	3.40
26	3.50	1.95	1.50	1.70	1.60	2.00	2.00	3.40	4.70	5.10	4.10	3.30
27	3.50	2.10	1.60	1.60	1.70	2.00	2.00	3.00	4.40	4.90	3.90	3.00
28	2.75	2.05	1.60	1.50	1.70	2.00	2.00	3.20	4.70	5.10	4.20	3.10
29	3.25	2.15	1.50	1.60	1.60	1.70	2.00	3.10	5.20	5.30	4.90	3.30
30	3.50		1.50	1.60	1.60	1.60	1.90	3.00	5.20	5.30	4.90	3.00
31	3.25		1.50		1.70		1.90	3.00		5.10		2.90

(Continued)

Table 51 (Continued)

1957 Day	January	February	March	April	May	June	July	August	September	October	November	December 1957
	Mid-depth Chlorides as Cl^-, 1000 p.p.m.											
1	3.00	3.00	3.00	3.20	2.30	2.20	2.20	1.80	3.00	2.40	2.80	2.65
2	3.60	3.00	3.30	2.50	2.20	2.20	2.20	1.90	3.00	2.30	3.20	2.30
3	3.70	3.20	3.40	2.20	2.30	2.20	2.30	1.90	3.00	2.20	3.10	2.60
4	3.50	2.60	3.40	2.70	2.10	1.90	2.30	1.70	2.90	2.20	2.95	2.75
5	3.60	3.00	3.70	2.50	2.20	2.10	2.30	1.90	2.90	2.20	3.20	2.65
6	3.20	2.90	3.70	3.00	2.30	2.20	2.30	1.70	2.90	2.30	3.40	2.60
7	3.20	2.90	3.30	2.90	2.10	2.20	2.30	1.80	2.80	2.40	3.40	2.85
8	3.10	3.00	3.40	2.80	2.60	2.20	2.40	2.10	2.80	2.50	3.20	2.55
9	3.30	3.00	3.30	2.60	2.60	2.20	2.10	2.50	3.60	2.55	2.75	2.50
10	3.10	2.90	3.30	2.70	2.60	2.00	2.20	2.20	3.70	2.50	3.20	2.50
11	3.20	3.10	3.40	2.70	2.10	2.00	2.20	2.20	3.70	2.65	3.35	2.25
12	3.30	3.10	3.60	2.80	2.10	2.00	2.40	2.20	3.60	2.60	3.70	2.40
13	3.40	3.50	3.40	2.70	2.20	2.00	2.20	2.20	3.70	3.20	3.75	2.60
14	3.30	3.40	3.00	2.70	2.10	2.10	2.20	2.30	3.10	3.70	3.15	2.70
15	3.30	3.20	3.00	2.60	2.10	2.00	2.10	2.30	3.30	3.95	3.15	2.60
16	3.10	3.10	3.00	2.50	2.10	2.10	1.80	2.30	3.40	3.85	3.00	2.60
17	3.30	4.00	2.70	2.80	2.10	2.10	1.90	2.30	3.00	3.00	2.90	2.65
18	3.00	3.90	2.80	2.50	2.10	2.00	2.00	2.20	4.20	2.85	2.95	2.65
19	3.20	3.60	2.40	2.50	2.10	2.00	2.00	2.30	3.00	2.65	2.95	2.60
20	3.80	3.40	2.50	2.60	2.00	1.90	2.10	2.40	2.00	2.85	2.95	2.20
21	3.90	3.30	2.60	2.60	2.10	2.00	2.10	2.70	2.00	3.60	3.00	2.30
22	3.30	3.30	2.50	2.50	2.30	2.00	2.00	2.90	2.50	3.95	3.30	2.55
23	3.10	3.50	2.50	2.50	2.40	2.00	2.00	3.20	2.40	3.90	3.40	2.30
24	3.40	3.80	2.50	2.30	2.70	1.90	2.00	3.50	2.40	3.00	3.20	2.30
25	3.40	4.00	2.50	2.30	2.70	1.90	2.00	2.80	2.50	3.05	3.20	2.10
26	3.80	3.10	3.10	2.30	2.50	2.00	2.00	2.90	2.90	3.00	2.90	2.10
27	3.50	3.30	3.00	2.30	2.50	2.00	2.10	2.40	3.40	2.95	2.90	2.10
28	3.50	3.40	2.90	2.40	2.60	2.20	2.00	2.60	3.10	3.00	2.90	1.65
29	3.50		2.60	2.50	2.70	2.30	1.90	3.30	2.90	3.05	3.20	1.65
30	3.00		2.90	2.50	2.60	2.20	2.00	3.30	2.50	3.10	2.80	1.80
31	3.10				2.70		2.00	3.10		3.15		2.25

1958 Day	January	February	March	April	May	June	July	August	September	October	November	December 1958
	Mid-depth Chlorides as Cl^-, 1000 p.p.m.											
1	1.65	1.70	1.55	1.05	0.75	0.70	0.85	0.75	0.75	1.30	2.10	2.00
2	1.65	1.75	1.40	1.00	.75	.70	.85	.75	.80	1.40	2.00	2.20
3	1.70	1.70	1.40	1.05	.75	.70	.80	.65	.95	1.25	2.00	2.10
4	1.90	1.65	1.45	.90	.65	.70	.80	.65	1.20	1.50	2.05	1.80
5	2.10	1.80	1.45	.95	.65	.70	.80	.70	1.30	1.55	2.20	1.90
6	2.95	1.75	1.50	.90	.70	.75	.80	.75	1.10	1.45	2.30	1.95
7	2.40	1.70	1.15	.95	.70	.75	.60	.80	1.20	1.55	2.10	2.15
8	1.80	1.60	1.50	1.00	.75	.75	.60	.80	1.05	1.85	2.15	2.00
9	1.85	1.60	1.50	1.10	.75	.70	.60	.85	1.30	1.55	2.05	2.05
10	1.90	1.60	1.45	1.20	.80	.75	.55	.80	1.15	1.40	2.00	2.05
11	2.00	1.75	1.35	.95	.80	.75	.55	.75	1.00	1.60	2.25	2.20
12	2.05	1.65	1.30	1.00	.80	.80	.75	.75	1.05	2.25	2.25	2.15
13	2.05	1.50	1.25	1.00	.70	.80	.75	.75	2.05	2.30	2.25	2.20
14	1.85	1.60	1.30	1.00	.70	.85	.75	.80	2.00	2.40	2.30	2.05
15	1.90	1.50	1.25	1.05	.80	.75	.75	.95	1.90	2.40	2.30	1.95
16	1.75	1.45	1.20	1.00	.80	.85	.75	.90	2.05	2.50	2.30	2.00
17	1.70	1.30	1.20	.80	.85	.85	.75	.80	2.05	2.50	2.20	1.75
18	1.65	1.10	1.15	.85	.90	.85	.75	.80	2.05	2.40	2.25	1.70
19	1.85	1.40	1.20	.90	.85	.85	.75	.80	2.00	2.40	1.90	1.75
20	1.90	1.35	1.25	.90	.70	.85	.75	.85	1.70	2.00	2.20	1.75
21	1.90	1.35	1.15	.90	.80	.85	.75	.85	1.55	2.00	1.90	2.00
22	1.75	1.40	1.20	.80	.80	.85	.75	.80	1.45	1.70	1.80	2.00
23	1.65	1.50	1.20	.70	.80	.85	.75	.75	1.45	1.70	1.80	2.00
24	1.75	1.45	1.25	.85	.80	.85	.75	.75	1.40	1.80	1.95	1.90
25	1.60	1.25	1.20	.75	.80	.85	.75	.75	1.40	1.80	2.00	1.90
26	1.65	1.30	1.10	.75	.85	.85	.75	.75	1.45	1.80	1.95	2.20
27	1.70	1.40	.95	.85	.85	.85	.75	.70	1.40	2.05	2.10	2.35
28	1.70	1.50	.85	.85	.85	.85	.75	.75	1.35	2.05	2.25	2.20
29	1.50		.90	.75	.85	.85	.70	.70	1.55	2.15	1.85	2.10
30	1.50		1.10	.95	.80	.85	.70	.70	1.55	2.45	2.00	2.00
31	1.55		1.00		.75		.75	.75		2.75		2.10

1959 Day	January	February	March	April	May	June	July	August	September	October	November	December 1959
	Mid-depth Chlorides as Cl^-, 1000 p.p.m.											
1	2.00	1.85	0.95	0.85	0.65	0.80	0.70	0.50	0.36	0.90	1.50	1.15
2	2.05	1.70	.90	.75	.70	.75	.70	.50	.40	.90	1.40	1.10
3	2.10	2.25	.95	.60	.85	.75	.70	.50	.48	1.20	1.20	1.05
4	2.20	2.15	.80	.70	.65	.75	.70	.50	.50	1.40	1.70	1.10
5	2.25	1.90	1.10	.80	.65	.75	.65	.50	.50	1.45	1.65	1.20
6	2.30	1.80	.95	.75	.65	.70	.70	.50	.52	1.50	1.25	1.05
7	2.05	1.80	.75	.80	.55	.70	.70	.55	.60	1.45	1.30	.75
8	2.10	1.75	.70	.85	.60	.75	.70	.43	.66	2.20	1.30	.85
9	1.90	1.60	.75	.90	.60	.80	.70	.40	.72	1.70	1.30	.95
10	1.90	1.65	.75	.80	.65		.70	.43	.68	1.65	1.35	1.05
11	1.90	1.55	.75	.85	.70	.70	.65	.43	.72	1.20	1.50	1.10
12	1.85	1.70	.75	.80	.75	.70	.65	.46	.74	1.20	1.40	1.20
13	1.85	1.65	.65	.65	.75	.70	.70	.54	.66	1.00	1.55	1.00
14	1.85	1.50	.70	.70	.65	.65	.65	.56	.68	.95	1.50	1.10
15	2.00	1.30	.70	.70	.65	.65	.65	.60	.70	.90	1.55	1.30
16	1.65	1.35	.85	.70	.65	.65	.65	.60	.72	.70	1.40	1.25
17	1.50	1.35	1.00	.90	.70	.75	.65	.56	.70	1.20	1.35	1.25
18	1.60	1.30	1.00	.95	.70	.65	.65	.54	.70	1.10	1.25	1.10
19	1.60	1.15	1.10	1.00	.70	.55	.70	.54	.72	1.15		.75
20	2.05	1.45	1.10	.70	.70	.55	.65	.58	1.26	1.35	1.40	
21	2.65	1.60	1.00	.95	.70	.60	.65	.58	1.60	1.70	1.55	.65
22	1.75	1.30	.85	.85	.70	.50	.65	.60	1.08	1.70	1.55	.85
23	1.95	1.25	.90	.65	.70	.60	.80	.58	1.25	1.55	1.45	1.15
24	2.00	.75	.95	.60	.70	.65	.75	.60	1.20	1.05	1.35	1.30
25	2.00	1.30	.90	.60	.70	.70	.65	.58	1.20	.95	1.05	1.05
26	2.10	1.15	.90	.65	.70	.65	.65	.58	1.10	1.20	.90	1.30
27	2.00	1.05	.90	.65	.70	.65	.65	.52	.90	1.15	1.15	1.40
28	2.05	1.05	.90	.60	.75	.65	.65	.44	.90	1.70	.90	1.40
29	1.85		1.00	.55	.11	.65	.50	.38	.90	2.10	1.00	.90
30	1.90		1.00	.60	.13	.65	.60	.38	.90	1.60	1.05	1.15
31	1.85		1.00		.11		.50	.38		1.65		1.20

(Continued)

Table 51 (Concluded)

1960 Day	January	February	March	April	May	June	July	August	September	October	November	December
					Mid-depth Chlorides as Cl^-, 1000 p.p.m.							
1	1.50	0.75	0.75	0.55	0.52	0.48	0.98	1.60	1.90	2.20	1.90	2.60
2	1.40	.75	.70	.55	.50	.48	.95	1.60	1.95	2.30		2.70
3	1.40	.95	.60	.55	.50	.45	.98	1.50	2.25	2.20	1.80	2.60
4	1.20	1.00	.55	.55	.58	.50	1.05	1.50	1.80	2.30	2.10	2.60
5	1.20	.95	.65	.50	.68	.52	1.10	1.50	1.70	2.40	2.10	2.70
6		.80	.65		.62	.52	1.10	1.60	1.60	2.40	2.00	2.70
7	1.10	.70	.70	.40	.50	.52	1.15	1.55	1.80	2.40	2.10	2.70
8	1.10	.70	.70	.40	.38	.45	1.18	1.55	2.10	2.40	2.30	2.50
9	1.10	.70	.70	.40	.32	.48	1.28	1.60	3.10	2.20		2.60
10	1.10	.70	.65	.40	.40	.60	1.28	1.65	3.15	2.20	2.10	3.00
11	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	1.00	1.00	.70		.35	.62	1.22	1.85	1.95	2.20	2.20	1.60
13	1.00	.95	.70	.35	.35	.58	1.50	1.90	1.75	2.20	2.20	2.50
14	1.00	.65	.70	.45	.42	.55	1.30		1.[illegible]5	2.20	2.10	1.80
15	1.00	.65	.70	.48	.45	.55	1.40		2.55	2.20	2.00	2.50
16	1.00	.75	.60	.48	.42	.60	1.35	2.10	2.20	2.10	1.90	2.10
17	1.00	.55	.65	.48	.45	.60	1.35	.75	2.15	2.10	2.00	2.00
18	.90	.55	.60	.42	.45	.78	1.30	2.00	2.25	2.10	2.20	2.10
19	.95	.60	.60	.45		.88	1.20	1.90	2.30	2.20	2.20	2.20
20	.85	.45	.45	.48	.48	.92	1.10	1.90	2.50	1.80	2.30	2.30
21	.80	.50	.45	.45	.42	.95	1.05	1.90	2.35	2.20	2.30	1.90
22	.80	.70	.50	.50	.45	.88	1.10	1.85	2.20	2.30	2.30	2.00
23	.95	.65	.50	.48	.45	.82	1.15	1.60	2.35	1.90	2.20	2.10
24	1.00	.60	.50	.42	.40	.80	1.35	1.50	2.75	2.10	2.10	2.20
25	1.00	.65	.50	.42	.42	.82	1.30	1.60	2.85	2.20	2.10	2.00
26	1.00	.60	.55	.42	.42	.88	1.15	1.80	2.85	2.40	1.90	2.00
27	1.05	.50	.55	.42	.42	.92	1.15	2.15	2.60	2.30	1.90	1.70
28	1.00	.50	.55	.45	.45		1.50	1.90	2.40	2.10	2.00	2.10
29	1.00	.65		.45	.45	1.00	1.70	2.10	2.20	2.20	1.80	2.20
30	.70		.50	.42	.45	1.00	1.60	1.90	2.20	2.40	2.10	2.10
31	.70		.50	.58	.48		1.60			2.00		2.20

1961 Day	January	February	March	April	May	June	July	August	September	October	November	December
					Mid-depth Chlorides as Cl^-, 1000 p.p.m.							
1	1.50	1.50	0.85	0.26	0.40	0.68	0.80	1.00	1.05	1.70	1.60	1.05
2	1.80	1.50	.85	.28	.40	.68	.75	.75	1.15	1.50	1.55	1.05
3	1.80	1.40	.85	.28	.40	.68	.75	1.05	.85	1.00	1.65	.95
4	1.80	1.40	.90	.27	.40	.60	.65	.80	1.00	1.55	1.75	1.00
5	1.70	1.50	.85	.27	.40	.55	1.20	1.10	.85	1.55	1.60	1.00
6	2.00	1.60	.80	.27	.41	.55	.90	1.20	.85	1.55	1.30	1.00
7	2.10	1.60	.75	.36	.41	.70	.80	1.05	1.05	1.50	1.55	1.05
8	2.20	1.40	.75	.39	.42	.65	1.25	.90	1.45	1.55	1.35	1.55
9	2.20	1.30	.75	.38	.39	.62	1.50	1.00	1.60	1.55	1.50	1.25
10	1.90	1.30	.65	.30	.39	.72	1.85	1.05	1.65	1.45	1.80	1.30
11	2.00	1.40	.80	.31	.42	.82	1.60	1.30	1.65	1.40	1.80	1.20
12	2.00	1.40	.85	.38	.43	.78	1.50	1.40	1.20	1.40	1.95	1.00
13	2.10	1.30	.85	.30	.49	.88	1.55	1.20	2.60	1.40	1.85	.70
14	1.90	1.40	.85	.30	.46	.80	1.30	1.30	2.15	1.40	1.80	.75
15	1.40	1.40	.85	.32	.44	.78	1.20	1.50	1.70	1.45	1.50	.70
16	1.40	1.40	.80	.30	.41	.75	1.15	1.50	1.55	1.55	.95	.60
17	1.40	1.50	.85	.32	.44	.90	1.10	1.25	1.70	1.50	.80	.60
18	1.50	1.60	.90	.35	.41	1.28	1.35	1.35	1.65	1.50	.80	.55
19	1.50	1.40	.65	.34	.41	1.30	1.40	1.40	1.70	1.35	.75	.60
20	1.40	1.20	.55	.34	.41	1.10	1.80	1.40	1.75	1.15	.90	.55
21	1.20	1.10	.43	.36	.40	.90	1.50	1.15	1.75	1.30	1.05	.55
22	1.50	.95	.36	.38	.41	.80	1.55	1.00	1.75	1.20	1.25	.55
23	1.60	.90	.27	.38	.39	.85	1.55	1.00	1.75	1.30	1.15	.50
24	1.40	.90	.26	.37	.46	.65	1.45	.90	1.75	1.55	.85	.50
25	1.90	.85	.35	.37	.55	.70	1.30	1.05	1.60	1.70	.85	.50
26	1.80	.80	.31	.38	.60	.75	1.15	1.15	1.55	1.85	.85	.50
27	1.60	.85	.34	.38	.98	.85	1.10	1.20	1.65	2.00	.85	.50
28	1.60	.90	.41	.42	.92	1.10	1.20	1.15	1.45	1.95	.75	.50
29	1.50		.31	.40	.98	.85	1.30	1.15	1.50	1.85	.80	.48
30	1.50		.42	.40	.82	.75	1.30	.90	1.60	1.75	1.05	.50
31	1.40		.26		.68		1.05	.85		1.80		.55

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

WATER QUALITY DATA

STREAM: Intracoastal Waterway
STATION: [illegible]
LOCATION: [illegible] Road Bridge

depths
S 5'
M 15'
B 25'

YEAR [illegible]

CHLORIDES AS CL⁻ IN 1000 PARTS PER MILLION

Date	January			February			March			April		
	Surf	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.
1	.58	.60	.60	[illegible]		[illegible]	[illegible]	1.50	1.45	1.40	2.20	2.00
2	.53	.53	.53	.45		.41	[illegible]	1.80	2.25	[illegible]	[illegible]	2.00
3	.45	.45	.45	.48		1.1	[illegible]	[illegible]	2.08	[illegible]	[illegible]	[illegible]
4	.53	.63	.63	.65	1.38	1.40	[illegible]	[illegible]	1.25	[illegible]	[illegible]	[illegible]
5	.68	.70	.72	.70	1.30	2.00	[illegible]	[illegible]	1.50	[illegible]	1.70	[illegible]
6	.70	.70	.70	.98	1.10	1.15	.93	[illegible]	.63	[illegible]	[illegible]	[illegible]
7	.45	.45	.45	.63	.82	.90	.80	.80	.38	1.60	2.50	3.[illegible]
8	.43	.42	.40	.72	.55	[illegible]	.70	.70	.70	1.50	1.50	1.5[illegible]
9	.45	.48	.48	.58	.40	.90	1.08	1.50	1.30	1.70	.30	1.5[illegible]
10	.40	.40	.40	.30	.28	.28	.95	2.50	3.75	[illegible]	1.38	[illegible]
11	.35	.35	.35	.45	.27	.31	1.1[illegible]	2.40	2.90	1.50	1.48	1.75
12	.22	.22	.22	.45	.46	.47	1.45	2.00	4.40	1.[illegible]	1.80	[illegible]
13	.25	.25	.25	.24	.24	.28	1.[illegible]	1.40	1.40	[illegible]	[illegible]	1.[illegible]
14	.44	.45	.45	.20	.21	.21	1.40	1.40	1.40	.16	1.10	1.70
15	.50	.50	.50	.35	.37	.37	2.1[illegible]	2.50	3.70	[illegible]	1.10	[illegible]
16	.35	.35	.35	.48	.62	.58	[illegible]	2.50	2.50	[illegible]	[illegible]	1.5[illegible]
17	.36	.35	[illegible]	1.05	2.00	2.2[illegible]	1.10	2.80	3.10	1.[illegible]	[illegible]	[illegible]
18	.30	.30	[illegible]	[illegible]	1.40	2.30	1.35	1.90	2.65	[illegible]	[illegible]	[illegible]
19	.36	.36	[illegible]	[illegible]	1.50	2.40	1.60	[illegible]	1.80	1.2[illegible]	[illegible]	[illegible]
20	.33	.33	[illegible]	[illegible]	1.40	1.7[illegible]	1.8[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	.3[illegible]	.3[illegible]	[illegible]				1.1[illegible]	3.10	3.70	3.10	[illegible]	[illegible]
22	.34	.34	[illegible]	[illegible]	.44	[illegible]	[illegible]	[illegible]	4.00	2.60	[illegible]	7.25
23	.25	.27	[illegible]	[illegible]	.63	1.3[illegible]	[illegible]	[illegible]	5.60	2.10	1.25	[illegible]
24	[illegible]	.13	.11	[illegible]	2.40	[illegible]		.60	5.75	[illegible]	.20	[illegible]
25	.13	.13	.1[illegible]	1.[illegible]	1.40	2.10	[illegible]	2.20	6.15	[illegible]	[illegible]	
26	.19	.19	.1[illegible]	.95	.95	1.15	[illegible]	[illegible]	5.75	[illegible]	[illegible]	[illegible]
27	.10	.10	.10	.58	1.6[illegible]	2.00	1.1[illegible]	2.70	8.75	1.[illegible]	[illegible]	[illegible]
28	.04	.04	.04	.62	2.15	[illegible]	1.[illegible]	3.80	8.[illegible]	[illegible]	[illegible]	[illegible]
29	.04	.04	.0[illegible]				1.70	2.40	7.00	2.00	[illegible]	[illegible]
30	.04	.04	.04				2.20	7.00	3.75	1.50	2.8[illegible]	
31	.04		.04				2.60	3.10	7.50			

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

WATER QUALITY DATA

STREAM: INTRACOASTAL WATERWAY
STATION: A-7
LOCATION: PARIS ROAD BRIDGE

Depths:
5 10 ft
" 20
" 30

YEAR [illegible]

CHLORIDES AS CL^- IN 1000 PARTS PER MILLION

Date	May			June			July			August		
	Surf	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.
1	1.50	3.60	3.80	2.70	2.70	2.90	[illegible]	6.25	9.75	[illegible]	7.75	10.8
2	1.50	1.80	3.[illegible]	2.70	2.70	2.90	[illegible]	6.50	8.75	6.[illegible]	[illegible]	[illegible]
3	1.50	1.70	2.10	1.90	2.25	2.25				[illegible]	[illegible]	10.[illegible]
4	1.50	1.80	2.20	1.80	1.90	2.30	[illegible]	[illegible].70	5.80	[illegible]	[illegible]	11.8
5	1.10	1.15	1.20				[illegible]	4.75	3.80	[illegible]	[illegible]	[illegible]
6	1.00	1.00	1.00	1.18	1.18	1.43	[illegible]	4.50	4.80	[illegible]	[illegible]	11.0
7	1.05	1.65	1.10	.95	1.65	1.45	2.90	1.60	6.70	11.5	12.5	14.0
8	.85	.85	.90	1.30	2.25	[illegible]	[illegible]	5.40	5.75	10.0	14.8	14.8
9	.85	.95	.95	1.90	2.60	4.80	4.70	7.70	7.75	[illegible]	13.5	14.5
10	.90	.95	.95	2.10	4.30	5.00				[illegible]	11.5	12.5
11	.95	2.20	2.65	2.40	4.60	4.80	8.[illegible]	9.75	10.5	10.3	11.0	11.3
12	1.65	4.00	4.50				7.50	10.8	11.0	9.75	9.75	11.5
13	1.75	1.70	3.90	2.70	5.00	7.80	7.75	8.75	10.8	7.00	8.50	9.75
14							7.75	8.50	10.8	6.75	7.50	9.25
15	6.75	5.00	3.50	3.70	4.70	7.00	5.75	7.50	10.3	6.75	7.75	10.8
16	2.70	5.20	5.75	4.30	4.60	7.75	6.25	7.25	10.5	6.75	7.75	7.75
17	2.40	4.00	5.50	4.60	4.80	8.00				6.00	6.50	9.75
18	[illegible]	4.00	4.00	4.30	4.70	9.00	6.75	7.75	11.8	6.00	7.50	9.50
19	1.50	3.75	3.75				7.25	11.3	9.00	6.50	10.8	12.5
20	2.90	1.60	4.40	2.80	3.30	3.90	7.75	9.25	11.0	13.5	7.75	12.5
21				2.70	3.30	4.00	6.75	8.00	10.5	8.00	10.5	11.3
22	2.10	2.[illegible]	3.10	2.50	3.30	3.90	6.[illegible]	[illegible]	9.75	7.25	9.25	11.8
23	2.00	2.[illegible]	5.00	2.30	3.20	6.30	8.[illegible]	10.3	10.8			
	2.10	2.40	2.70	1.70	2.60	5.60	8.00	12.3	11.8	[illegible]	[illegible]	[illegible]
25	2.[illegible]	2.10	2.60	2.00	4.30	6.20	[illegible]	12.0	[illegible]	[illegible]	[illegible]	[illegible]
26	2.[illegible]	2.40	3.20				[illegible]	13.0	[illegible]	[illegible]	[illegible]	11.0
27	4.[illegible]	2.10	5.70	3.90	[illegible]	10.3				[illegible]	[illegible]	[illegible]
28				4.90	7.[illegible]	8.00	8.25	9.00	[illegible]			
29	2.[illegible]	3.60	5.10	4.70	5.50	7.75	7.50	8.25	[illegible]	[illegible]	[illegible]	[illegible]
30	2.40	4.30	4.00	4.80	6.00	9.75	6.75	7.50	[illegible]	[illegible]	[illegible]	[illegible]
31	2.20	2.80	4.80				6.25	8.00	10.8	[illegible]	5.25	8.25

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

WATER QUALITY DATA

STREAM: INTRACOASTAL WATERWAY
STATION: AT
LOCATION: PARIS ROAD BRIDGE

Depths
S 10 ft
M 20
B 30

YEAR [illegible]

CHLORIDES AS CL⁻ IN 1000 PARTS PER MILLION

Date	September			October			November			December		
	Surf	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.	Surf.	Mid.	Bot.
1	5.00	5.75	8.25	6.25	6.00	[illegible]	[illegible]	[illegible]	6.25	4.90	4.90	5.40
2	5.25	6.25	6.50	4.50	5.50	5.00	[illegible]	6.00	[illegible]	4.50	4.90	4.90
3	5.00	5.50	8.00	5.00	5.00	[illegible]	[illegible]	[illegible]	[illegible]	5.00	5.10	5.30
4							[illegible]	[illegible]	[illegible]	4.70	5.10	5.90
5	5.25	9.00	10.5	4.75	5.00	[illegible]	[illegible]	7.25	[illegible]	4.00	4.20	6.40
6	6.00	8.00	10.5	5.25	5.00	7.00				3.90	4.50	6.20
7	6.75	8.75	11.3	5.00	5.75	[illegible]	[illegible]	[illegible]	7.25	[illegible]	10.0	6.25
8	7.00	7.75	11.0	6.25	5.50	7.25	6.50	6.50	8.25	[illegible]	12.0	13.8
9	6.75	7.25	11.5				5.00	8.00	7.75	11.5	12.3	12.0
10	7.00	7.75	9.75	5.50	6.00	7.75	8.25	5.50	7.50	11.5	10.5	7.50
11	10.8	11.0	11.8	6.00	6.25	5.75	[illegible]	3.50	8.50			
12	9.75	9.75	11.5	6.25	6.75	11.0	[illegible]	10.5	11.0	[illegible]	9.75	8.75
13	7.00	8.50	9.25	6.25	6.75	[illegible]				7.50	7.25	7.50
14	6.75	7.50	9.25	6.75	9.25	[illegible]	7.00	7.75	9.00	[illegible]	7.50	8.75
15	6.75	7.75	10.8	6.25	8.75	9.25	7.00	7.50	9.25	7.00	9.50	8.50
16	6.75	7.75	7.75				6.50	6.75	8.50	7.50	[illegible]	8.25
17	6.00	[illegible]	[illegible]	6.25	6.25	8.25	6.25	6.25	9.25	7.25	[illegible]	9.25
18	6.00	7.50	9.50	5.50	6.00	7.25	6.75	8.25	9.00			
19	6.50	[illegible]	[illegible]	5.25	6.25	7.50	7.00	7.25	8.75	8.00	10.3	10.0
20	8.3	7.7	[illegible]	5.75	6.25	6.25				7.50	10.8	10.5
21	8.00	[illegible]	11.3	5.25	5.75	7.25	6.25	6.00	6.00	7.50	[illegible]	11.5
22	7.25	9.25	11.8	5.00	6.50	7.00	3.50	3.60	6.80	8.25	10.8	11.8
23							4.10	5.20	8.00	10.5	10.0	7.50
24	6.00	8.50	7.25	6.25	6.75	7.00	4.00	5.00	5.75	[illegible]	8.75	[illegible]
25	7.00	7.25	12.8	6.75	7.00	9.25	4.00	4.50	6.50			
26	6.50	7.50	12.0	6.00	6.50	6.00	4.50	4.75	5.75	5.00	5.00	[illegible]
27	5.50	6.50	10.3	6.00	6.50	7.00				[illegible]	[illegible]	[illegible]
28				6.00	6.00	6.25	[illegible]	[illegible]	5.50	5.25	[illegible]	[illegible]
29	5.00	5.50	5.50	6.00	6.00	6.25	[illegible]	5.10	5.30	5.50	5.25	[illegible]
30	5.00	5.50	8.50				[illegible]	5.20	5.50	4.50	4.75	5.40
31	4.75	5.25	8.25	5.50	6.25	9.00				3.75	4.00	4.50

2A

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM- GIWW
LOCATION- PARIS RAOD BRIDGE
STATION SYMBOL- AJ

1963

CHLORIDES AS CL-, P.P.M.

	JANUARY			FEBRUARY			MARCH		
DAY	SURF	MID	BOT	SURF	MID	BOT	SURF	MID	BOT
01				3,500	2,750	3,250	3,250	3,250	3,250
02	4,250	4,500	5,000	2,750	9,250	8,750	2,800	4,400	5,300
03	4,250	4,250	5,250	3,500	9,750	10,000	3,200	4,100	8,000
04	3,750	7,000	8,000	4,250	5,000	8,750	3,700	4,400	8,800
05	4,500	8,500	9,000						
06	4,750	6,000	11,000	3,250	4,000	9,000	3,200	3,300	7,500
07	4,250	4,750	10,750	3,500	5,000	5,000	3,100	3,600	7,200
08				4,250	5,500	6,250	3,800	5,000	6,400
09	6,000	8,750	10,250	4,250	6,250	7,500	4,100	5,600	6,400
10	5,750	8,000	8,750	4,500	7,500	9,000	4,000	5,200	7,500
11	5,750	8,250	8,750	5,000	9,250	10,000	3,300	3,700	5,500
12	7,000	10,000	8,750	4,000	5,250	7,500			
13	5,000	7,250	10,000	3,500	4,750	4,250	3,900	3,900	5,500
14	5,750	6,500	9,750	3,500	7,250	8,750	3,500	4,400	7,600
15				4,500	4,500	9,500	4,000	4,700	7,400
16	5,750	5,750	6,250	7,000	8,750	10,250	4,250	4,500	7,250
17	5,750	5,750	5,500	5,250	9,250	10,000	4,250	4,750	7,500
18	5,500	5,750	5,750	5,250	9,250	6,500	4,500	4,500	7,500
19	4,250	4,250	7,000						
20	4,250	6,750	5,250	3,500	4,000	8,000	3,250	3,500	3,750
21	3,750	4,500	8,500	3,500	3,500	7,250	3,250	3,500	3,500
22				4,000	4,000	5,000	4,500	4,750	7,250
23	4,250	5,250	7,250	4,000	4,250	4,500	4,500	4,500	6,250
24	4,000	4,000	4,000	4,000	4,250	4,500	4,500	4,500	6,250
25	4,500	4,750	5,500	3,750	3,750	4,000	4,250	4,500	5,000
26	4,750	4,750	5,250						
27	4,500	4,750	5,000	2,750	3,000	3,750	5,000	5,250	6,000
28	4,250	4,500	4,500	2,750	2,500	3,250			
29							5,250	5,750	9,000
30	4,250	4,000	4,250				4,750	6,500	9,000
31	3,000	3,500	3,500				4,250	5,000	7,000

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM- GIWW
LOCATION- PARIS RAOD BRIDGE
STATION SYMBOL- AJ

1963

CHLORIDES AS CL-, P.P.M.

	APRIL			MAY			JUNE		
DAY	SURF	MID	BOT	SURF	MID	BOT	SURF	MID	BOT
01	4,000	6,250	7,250	5,250	6,750	8,500	6,750	7,750	9,750
02				6,500	7,000	7,500	7,000	8,250	9,750
03	5,000	5,000	6,250	7,500	6,250	5,500	7,250	7,750	9,500
04	4,500	5,500	8,500	5,500	5,750	6,750			
05	4,500	5,000	6,250	3,750	5,500	7,250	5,500	6,250	12,000
06	4,000	6,000	7,000	3,750	5,500	7,000	7,000	5,500	10,750
07	2,750	4,500	5,750				6,000	7,000	9,250
08	4,250	5,500	6,000	5,000	7,500	9,750	6,000	6,750	10,500
09				6,000	8,750	8,750	6,000	7,750	11,500
10	4,750	7,750	8,250	6,500	8,750	9,500	6,000	8,500	11,250
11	6,500	7,500	10,500	7,000	9,250	8,000			
12	6,250	7,500	9,000	8,000	11,250	13,000	6,500	10,500	10,750
13	6,250	8,250	9,500	8,250	12,250	12,500	7,500	10,500	11,750
14	6,000	9,000	10,250				8,750	12,000	12,500
15	5,750	6,750	8,500	9,250	11,750	12,000	8,000	11,750	11,750
16	6,250	9,500	9,500	8,250	12,000	12,000	12,000	14,000	14,000
17	6,250	9,750	10,000	8,750	10,500	13,500	12,750	15,000	15,000
18	6,500	9,750	10,000	11,500	14,000	14,250			
19	6,500	10,250	10,250	10,250	14,000	14,250	10,750	13,500	15,500
20	6,750	10,000	10,500	9,750	13,250	14,250	11,500	12,250	15,500
21	7,000	12,000	12,250				11,000	12,250	14,750
22	7,000	11,500	12,250	8,750	9,500	13,000	14,750	10,000	12,250
23	7,750	8,250	10,500	8,000	8,250	11,000	9,000	10,500	12,250
24				7,750	8,250	12,250	10,250	12,000	8,500
25	8,250	9,250	10,750	7,500	9,750	8,000			
26	7,500	8,250	9,000	6,250	6,750	9,000	7,250	9,000	10,500
27	6,750	7,000	8,500	5,500	6,750	8,000	7,000	8,500	8,500
28	5,750	6,250	9,250	6,250	6,250	8,250	6,000	7,500	9,000
29	5,750	6,750	9,250	6,750	7,750	9,750	7,250	8,000	9,750
30				5,750	6,750	8,750	7,250	10,500	11,000
31				6,500	8,000	8,750			

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM- GIWW
LOCATION- PARIS RAOD BRIDGE
STATION SYMBOL- AJ

1963

CHLORIDES AS CL-, P.P.M.

	JULY			AUGUST			SEPTEMBER		
DAY	SURF	MID	BOT	SURF	MID	BOT	SURF	MID	BOT
01	11,500	7,250	12,000	7,500	7,500	9,500	11,250	10,750	10,500
02				7,250	7,500	10,500	9,750	11,000	12,000
03	8,750	13,750	7,000	7,000	8,000	11,000	10,000	10,750	15,750
04	7,750	10,000	8,250	7,750	6,750	6,750	9,750	10,250	11,500
05	9,500	8,750	7,750	7,000	8,250	10,000	9,000	10,000	15,000
06	9,500	8,500	8,500				8,000	11,000	15,000
07	7,750	9,750	10,500	7,500	8,500	10,750			
08	7,000	8,750	9,250	7,250	9,250	10,750	9,750	12,000	15,250
09				6,500	9,250	11,250	9,750	11,500	13,000
10	8,000	10,000	10,500	10,750	8,000	11,750	10,000	12,750	15,250
11	9,250	11,250	11,500	9,000	11,750	13,750	10,500	12,750	14,250
12				14,000	10,750	14,500	10,000	11,750	14,000
13	9,000	10,250	12,000	14,500	14,500	14,500	10,750	14,750	12,000
14	10,000	12,250	12,750	12,500	14,750	14,750			
15	9,000	11,250	13,250	13,750	15,250	15,250	9,750	10,250	11,500
16				15,000	15,500	16,000	9,500	9,250	11,250
17	9,750	11,000	13,250	13,250	14,500	15,000	8,500	8,500	9,250
18	10,250	9,500	14,000	10,500	11,500	13,000	8,250	8,500	8,500
19	9,500	9,750	13,500	10,500	11,000	12,250	6,250	6,750	7,250
20	8,750	9,500	9,750				6,000	6,500	7,250
21	8,000	9,250	11,000	9,500	11,000	11,750	4,750	5,750	6,000
22	7,750	9,000	10,500	10,500	12,000	15,500			
23				10,500	14,750	15,500	6,000	6,750	7,500
24	8,000	10,500	12,750	10,250	14,750	15,250	8,250	9,500	7,500
25	7,750	9,750	8,750	11,000	13,250	14,250	7,750	8,000	9,000
26	9,250	11,500	12,000	12,500	13,750	14,500	7,250	7,250	7,500
27	8,500	10,500	11,000				6,750	7,250	7,250
28	8,250	8,750	11,250	12,250	14,250	16,500			
29	7,500	8,000	10,250	12,000	13,750	16,500	6,250	6,750	8,000
30				11,750	13,000	15,500	6,000	7,000	6,500
31	7,750	7,500	12,500						

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

STREAM- GIWW
LOCATION- PARIS RAOD BRIDGE
STATION SYMBOL- AJ

1963

CHLORIDES AS CL-, P.P.M.

	OCTOBER			NOVEMBER			DECEMBER		
DAY	SURF	MID	BOT	SURF	MID	BOT	SURF	MID	BOT
01	6,250	6,500	6,500	8,000	8,500	11,500	6,250	7,000	7,250
02	6,250	6,250	6,250				6,000	6,250	6,250
03	6,250	6,250	6,750	8,250	9,500	11,000	10,000	9,500	6,250
04	6,000	6,750	7,000	8,500	8,750	10,500	6,750	7,000	7,750
05	6,750	7,500	7,750	8,500	8,250	8,750	6,750	8,000	9,250
06	7,000	7,500	9,250	8,750	8,250	8,250	7,250	8,250	7,500
07	7,500	8,000	8,500	8,250	10,000	8,750			
08	7,500	8,750	12,750	7,750	7,750	8,500	8,500	9,750	9,500
09	8,000	8,500	10,250				6,250	5,750	6,000
10	7,750	8,250	9,500	7,750	7,750	8,000	7,500	8,250	10,500
11	7,750	8,250	9,500	7,500	7,750	8,500	8,500	10,000	11,750
12	7,250			6,750	7,250	8,250	8,750	13,250	14,000
13	7,250	7,250	7,250	6,250	6,750	6,250	8,750	11,250	11,500
14	7,500	7,750	7,500	6,500	6,500	7,000	8,750	13,250	10,500
15	7,750	8,250	10,500	6,500	6,500	6,500			
16	8,750	8,750	10,250				9,750	7,500	6,500
17	8,500	10,750	10,000	6,750	6,750	6,750	6,500	7,000	8,500
18	8,500	9,750	10,750	6,750	7,000	7,750	6,750	6,750	8,250
19				6,750	7,500	10,250	6,500	6,500	7,000
20	8,250	8,250	8,250	7,250	7,750	9,500	6,000	6,500	6,750
21	8,500	9,500	8,250	7,250	7,000	8,000	6,500	6,750	6,750
22	8,750	8,000	12,250	7,250	7,250	8,000			
23	9,000	8,250	12,250	6,750	6,750	7,500	5,750	5,750	6,000
24	8,500	9,250	10,000	7,000	7,000	8,500	5,500	5,250	5,750
25	8,750	8,750	9,500	7,250	7,250	6,500	5,250	5,500	5,750
26				7,250	7,000	7,000	5,750	6,500	5,750
27	8,250	8,750	10,750	6,500	7,000	7,750	6,000	12,000	13,750
28	8,000	8,250	11,250	7,000	7,000	6,750	6,500	12,750	14,750
29	7,500	9,000	12,000	5,750	5,750	5,750			
30	8,250	8,750	10,750				7,500	11,500	14,250
31	8,500	8,000	10,000				8,000	10,500	13,500

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

AJ. GIWW

YEAR 1964

PARIS ROAD BRIDGE

CHLORIDES AS CL- IN P.P.M.

	JANUARY				FEBRUARY				MARCH			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	6250	7250	8500	41	4250	5000	5750	52	NR	NR	NR	NR
2	6500	7500	8750	44	NR	NR	NR	NR	3750	3750	3750	56
3	8750	6500	7250	45	4500	4500	5750	53	3250	3250	3250	55
4	7750	8500	10250	46	4250	4500	5000	54	3250	3250	3250	58
5	NR	NR	NR	NR	4250	4250	4750	58	3000	3000	3000	51
6	7500	10250	11750	48	4000	4000	4000	52	3000	3000	3000	55
7	6250	9500	11000	47	3750	4000	4000	53	3000	3000	3100	61
8	6000	10750	11250	47	NR	NR	NR	NR	NR	NR	NR	NR
9	5750	6250	11250	48	NR	NR	NR	NR	3100	3100	3100	64
10	5000	5250	10000	47	4000	4250	4750	52	2800	2800	2800	58
11	5250	5500	7500	45	5250	7250	9750	52	2800	2800	2800	61
12	NR	NR	NR	NR	5000	10250	7250	55	2800	2900	2900	60
13	4250	4250	4750	45	5500	6250	10500	54	2800	2900	2900	62
14	4500	4750	6250	44	5250	4500	9500	57	2900	3000	3000	65
15	5000	5250	5750	44	4750	5000	9750	57	NR	NR	NR	NR
16	5000	5250	5500	43	NR	NR	NR	NR	2800	2800	3600	63
17	5250	5250	6000	43	4750	5000	6000	52	3000	3300	3600	63
18	5000	5000	5250	42	4000	4000	4250	55	2700	3200	4000	64
19	NR	NR	NR	NR	4250	4250	4000	53	3300	3300	3400	65
20	4750	4750	5250	46	4000	4000	4250	50	3200	3300	3400	65
21	6750	4250	4250	45	4250	4250	4500	53	2900	3000	3100	62
22	4500	5750	7500	48	4500	4500	4500	53	NR	NR	NR	NR
23	4250	4500	7000	48	NR	NR	NR	NR	2700	2700	2700	61
24	4250	5250	8000	52	4250	4250	5000	50	2800	2800	2800	63
25	4250	7750	8750	48	5000	5250	5750	51	2800	2800	2800	65
26	NR	NR	NR	NR	4750	5250	5000	50	2600	2600	2500	62
27	4500	4500	8500	54	4500	4750	5000	54	2500	2500	2500	62
28	4500	5250	8000	52	4500	4500	4750	52	2700	2800	2800	65
29	4750	5250	7750	50	3750	4000	4250	53	NR	NR	NR	NR
30	4500	4750	6500	51	NR	NR	NR	NR	1900	1900	2300	61
31	4500	4750	5000	52	NR	NR	NR	NR	1800	1900	2000	60
MAX	8750	10750	11750	54	5500	10250	10500	58	3750	3750	4000	65
MIN	4250	4250	4250	41	3750	4000	4000	50	1800	1900	2000	51
AVG	5388	6064	7685	46	4463	4906	5750	53	2851	2909	3013	61

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

AJ GIWW — PARIS ROAD BRIDGE

YEAR 1964 — CHLORIDES AS CL- IN P.P.M.

	APRIL				MAY				JUNE			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	1800	1800	1800	63	2100	2100	2100	73	4300	4400	4300	77
2	2100	2200	2200	65	2100	2100	2100	75	NR	3200	3500	77
3	2100	2100	2200	66	NR	NR	NR	NR	3400	3600	5600	79
4	2300	2300	2300	66	2100	2100	2100	75	3500	5700	5400	78
5	NR	NR	NR	NR	2100	2100	2100	76	4000	5900	5500	78
6	2200	2200	2200	71	2100	2100	2100	75	4100	4900	7400	82
7	2100	2000	2100	71	2100	2100	2100	74	4500	4700	6700	81
8	2000	2000	2000	62	2100	2100	2100	76	4500	4600	6700	83
9	2000	2000	2300	65	2100	2100	2100	76	4000	4500	6800	82
10	2200	2200	2500	67	NR	NR	NR	NR	4100	4500	5700	82
11	2300	2300	2700	66	2100	2100	2100	76	3700	3800	5200	82
12	NR	NR	NR	NR	2100	2100	2100	77	3600	3800	3900	80
13	2200	2300	2300	70	2000	2000	2000	75	3300	3800	4100	82
14	2300	2300	2500	69	2000	2000	2000	74	3700	3700	4500	85
15	1900	1900	2000	66	2000	2000	2000	73	3600	3700	4500	84
16	2000	2000	2100	69	2000	2000	2000	75	NR	NR	NR	NR
17	2000	2000	2000	68	NR	NR	NR	NR	3600	6300	5100	84
18	2000	2000	2000	70	NR	NR	NR	NR	4000	4400	7200	85
19	NR	NR	NR	NR	2000	2000	2100	77	4500	4600	4600	78
20	2000	2000	2000	72	2000	2100	2100	79	NR	NR	NR	NR
21	2000	2000	2000	73	2200	2200	2100	78	NR	NR	NR	NR
22	2000	2000	2000	73	2300	2200	2200	78	6100	8500	11250	85
23	2000	2000	2000	73	2800	3000	3400	80	8000	7750	7500	84
24	2000	2000	2000	74	NR	NR	NR	NR	7250	7500	9250	NR
25	2000	2000	2000	76	2700	3200	3800	76	7500	8000	8000	85
26	NR	NR	NR	NR	2600	3000	2600	79	NR	NR	NR	NR
27	2000	2000	2000	74	2700	3000	3900	80	NR	NR	NR	NR
28	2200	2200	2200	75	2700	2800	2900	80	NR	NR	NR	NR
29	2100	2100	2100	74	2800	3600	4700	78	4750	6750	8750	84
30	2200	2200	2200	72	3600	4700	4200	79	NR	NR	NR	NR
31	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
MAX	2300	2300	2700	76	3600	4700	4700	80	8000	8500	11250	85
MIN.	1800	1800	1800	62	2000	2000	2000	73	3300	3200	3500	77
AVG	2076	2080	2142	69	2296	2432	2520	76	4545	5156	6150	81

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

AJ GIWW
YEAR 1964

PARIS ROAD BRIDGE
CHLORIDES AS CL- IN P.P.M.

	JULY				AUGUST				SEPTEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	NR	NR	NR	NR	6500	6500	6750	87	6750	9250	10250	85
2	3200	4400	3300	78	7000	7250	8000	83	7750	10000	10500	86
3	3600	5000	3800	83	6250	8250	8750	83	11250	8750	8000	80
4	3300	4900	9400	82	4500	5750	6750	82	6250	9250	10000	86
5	5700	4000	9750	82	6500	7000	5750	83	7750	8750	9750	84
6	10750	5250	5000	80	5750	5750	6500	85	8500	10000	10000	82
7	4750	5750	10250	83	6500	7250	7500	86	6000	6000	6000	82
8	5750	5750	5500	80	6250	6500	7750	85	5250	6250	6750	82
9	10250	5000	5500	77	5000	5250	4750	85	4250	4750	5000	84
10	4750	5250	7750	84	4250	5000	6250	81	3750	4500	7250	81
11	3750	7000	7500	76	4000	5000	6750	82	2400	3600	5900	79
12	3750	4250	4250	83	3750	5250	6000	82	7700	10000	11000	80
13	3750	7000	8750	80	7750	9000	6750	83	8500	9250	7500	77
14	9750	9750	6000	83	7250	8250	9250	84	6000	8500	10000	76
15	7500	10250	11250	81	5250	6250	6500	78	9750	10000	8000	76
16	7250	10250	10750	80	7250	7250	7500	84	10250	7500	9250	78
17	7000	10000	9250	80	6250	6250	8250	84	7250	6500	7250	79
18	6750	7000	13000	84	7000	7500	7500	82	6750	5750	5500	74
19	6750	7250	10250	82	5750	7750	8750	84	5500	6000	8000	79
20	6750	6750	5750	82	6750	10250	9250	77	6000	5500	5500	79
21	5000	6750	7500	79	6250	7250	7500	83	6000	5250	5500	79
22	4750	5000	6250	80	6500	7250	8750	83	4000	5750	7500	79
23	8000	5000	5500	82	6250	7500	7500	83	5500	5500	5500	77
24	10250	10000	9500	79	8000	8000	7250	84	5000	5750	7000	80
25	13250	10250	13000	81	9500	7000	8500	84	5500	6000	6750	76
26	9750	13000	8750	82	7500	8500	7250	84	5500	5000	4750	78
27	7000	10750	12750	83	7750	8000	8500	84	5750	5750	6250	79
28	6250	10250	7750	82	8750	9750	10750	86	5750	5750	5750	76
29	6500	10750	10000	80	7250	7750	9500	83	4500	5000	5250	NR
30	5250	8750	11500	81	7750	10250	12000	86	4000	4000	8000	78
31	6500	7500	6250	76	7250	7500	9750	84	NR	NR	NR	NR
MAX	13250	13000	13000	84	9500	10250	12000	87	11250	10000	11000	86
MIN.	3200	4000	3300	76	3750	5000	4750	77	2400	3600	4750	74
AVG	6881	7426	8191	80	6556	7290	7822	83	6303	6795	7455	79

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

AJ GIWW
YEAR 1964

PARIS ROAD BRIDGE
CHLORIDES AS CL- IN P.P.M.

	OCTOBER				NOVEMBER				DECEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	4250	4500	4500	NR	4750	5750	5750	67	5750	6000	5750	57
2	5000	5250	5250	NR	5500	6250	8750	68	5500	5250	5500	39
3	3000	3000	3250	NR	6250	7750	9250	67	6750	5250	5750	56
4	3000	3100	3000	NR	7750	6250	6500	68	5750	5750	5500	60
5	3000	3000	3100	NR	7000	6250	7250	68	4250	4750	4750	54
6	3000	3100	3000	NR	5500	6500	7000	71	4250	5250	4750	47
7	3000	3000	3200	NR	6500	6500	7250	71	3750	4250	4250	52
8	3100	3200	3400	67	6250	6250	6500	69	4000	4000	4250	48
9	3400	3700	4000	66	6250	7250	7250	64	4250	3750	4000	52
10	4000	4300	4000	65	6250	7000	8000	66	4500	4500	4500	55
11	4000	4200	4300	68	6750	6750	6750	67	4500	4500	4500	58
12	4400	4200	4200	64	7000	7000	7000	70	4250	4250	3750	54
13	4300	4400	4500	67	6750	6750	7250	70	3750	4000	5000	55
14	4700	4700	5100	67	6750	7000	7000	71	3750	5250	5000	52
15	5200	4900	7300	64	6750	6750	6500	72	4000	4750	3750	47
16	4100	4500	4900	63	6000	6000	6000	71	3750	4000	4250	52
17	4200	5900	7900	66	5750	5750	5750	72	4000	4250	4750	52
18	4900	7400	8500	65	5750	5500	4750	71	4250	4000	5500	52
19	5500	7700	10750	65	5250	5750	5750	70	4000	4250	4750	48
20	7750	6750	10250	65	6000	6000	6750	64	4000	4250	4250	51
21	7750	8000	10250	66	7000	7000	6750	58	3500	3250	3500	54
22	8750	11250	11250	65	6750	7000	7250	54	3750	4000	4000	56
23	10750	9500	11250	68	14250	7250	6500	52	4000	3750	4250	57
24	11000	11000	10250	66	6000	6000	6250	55	3750	3750	4000	60
25	9500	9000	9500	62	4750	5250	5750	52	4750	4000	3750	56
26	8500	7250	8000	65	5750	5250	5750	56	3250	3500	3750	57
27	6750	5750	7250	67	5500	5750	5750	58	4750	4750	7000	58
28	6250	6750	6750	69	5750	6000	6000	64	4750	4750	9750	58
29	4750	5750	6250	60	6500	6500	6750	62	9500	7000	4250	54
30	4000	5250	4750	66	5500	6000	5500	57	4000	4500	5000	60
31	4750	4750	5750	68	NR	NR	NR	NR	NR	NR	NR	NR
MAX	11000	11250	11250	69	14250	7750	9250	72	9500	7000	9750	60
MIN	3000	3000	3000	60	4750	5250	4750	52	3250	3250	3500	39
AVG	5372	5646	6311	65	6416	6366	6641	64	4500	4516	4791	53

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

AJ GIWW PARIS ROAD BRIDGE
YEAR 1965 CHLORIDES AS CL- IN P.P.M.

	JANUARY				FEBRUARY				MARCH			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	4250	4500	4500	61	3250	3750	3750	NR	5700	5800	3500	NR
2	4250	4250	4250	62	4250	6000	6000	NR	3300	4300	1000	NR
3	4000	4250	4750	62	2750	3250	3500	NR	2900	5500	4500	NR
4	4500	4000	4500	56	2750	2750	3000	NR	3000	3200	3200	NR
5	3750	3750	4000	57	2750	2500	2750	NR	1700	2100	1800	NR
6	3750	3750	3750	58	2500	2500	2500	NR	2100	2000	2000	NR
7	3750	3500	3750	65	2750	2750	2750	NR	4900	4900	3700	NR
8	3500	3500	3750	58	2750	2500	2500	NR	3900	6600	8000	NR
9	3750	3750	3500	60	3000	3000	3000	NR	8400	8700	9500	NR
10	3500	3500	4000	58	3000	3000	3000	NR	9100	9600	12200	NR
11	3750	3750	3500	NR	2750	2750	3750	NR	11000	10000	9750	NR
12	4250	4500	5500	NR	2900	3000	3100	NR	7500	6750	8250	NR
13	4500	4750	5750	NR	3000	3300	3600	NR	4750	5750	6750	NR
14	4500	4250	7500	NR	3400	3400	3500	NR	5500	5750	7750	NR
15	3750	4250	6250	NR	3500	3500	3600	NR	6750	5250	7750	NR
16	4750	4750	5750	NR	2500	2500	2500	NR	7250	4500	4500	NR
17	NR	NR	NR	NR	2600	2600	2600	NR	4250	4500	4000	NR
18	3250	3250	3500	NR	2700	2700	2800	NR	3250	4250	5750	NR
19	3500	3750	3750	NR	2200	2200	2200	NR	4250	5000	4750	NR
20	4000	4000	3750	NR	2000	2000	2000	NR	5000	4750	5000	NR
21	3750	4250	4250	NR	2100	2200	2200	NR	4500	4750	3750	NR
22	4000	4500	4250	NR	2100	2100	2100	NR	3750	3750	3750	NR
23	4000	4250	4500	NR	1600	1900	1700	NR	3750	3750	3750	NR
24	2750	3250	3000	NR	2200	2200	2200	NR	2500	2500	2750	NR
25	2500	2200	2200	NR	2000	2500	2250	NR	3250	2750	2750	NR
26	3500	3250	2500	NR	2000	1800	1900	NR	3000	3000	3500	NR
27	1750	1750	2500	NR	1900	1900	1900	NR	3250	3500	3750	NR
28	2500	2500	2500	NR	2400	3100	5100	NR	3750	3750	3800	NR
29	2750	2500	3750	NR	NR	NR	NR	NR	3500	3500	3500	NR
30	2750	2750	2750	NR	NR	NR	NR	NR	3000	3000	3000	NR
31	3000	3500	3500	NR	NR	NR	NR	NR	3000	3000	3000	NR
MAX	4750	4750	7500	65	4250	6000	6000	NR	11000	10000	12200	NR
MIN	1750	1750	2200	56	1800	1800	1700	NR	1700	2000	1000	NR
AVG	3616	3690	4053	59	2635	2773	2919	NR	4572	4724	4869	NR

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

AJ GIWW
YEAR 1965

PARIS ROAD BRIDGE
CHLORIDES AS CL- IN P.P.M.

	APRIL				MAY				JUNE			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	2500	2500	2750	NR	4250	4500	6000	NR	5250	5000	5750	NR
2	2500	2500	5250	NR	6500	9500	9750	NR	5000	5250	5500	NR
3	3500	4000	4750	NR	6000	8250	9500	NR	4500	4500	5250	NR
4	3750	5000	5000	NR	6250	7500	9000	NR	3750	5000	4750	NR
5	3750	4500	4500	NR	8000	6750	9250	NR	4750	4000	5000	NR
6	3750	4250	4250	NR	6750	6500	6750	NR	4500	5750	4500	NR
7	4750	3750	3750	NR	5750	5250	5250	NR	5000	4750	5500	NR
8	3000	2500	4400	NR	5500	5000	5750	NR	4250	4750	5000	NR
9	5200	3400	2900	NR	5250	5000	6000	NR	3750	3750	3750	NR
10	3200	3400	6300	NR	5250	5500	7000	NR	3750	4500	4750	NR
11	5200	4600	4800	NR	4000	5500	7000	NR	4500	4250	5000	NR
12	5300	7200	6900	NR	3500	5000	4500	NR	4750	4500	4750	NR
13	6300	7000	4400	NR	5000	3750	5000	NR	4000	3750	3750	NR
14	5200	6100	8000	NR	5250	5500	6000	NR	4000	3500	4750	NR
15	4300	5200	5600	NR	5750	5750	6000	NR	3750	3750	3750	NR
16	3400	5600	5500	NR	6250	6000	5500	NR	3750	3750	4500	NR
17	5700	5500	7800	NR	4750	5000	5000	NR	4020	4620	4400	80
18	7600	6200	5600	NR	4250	4000	4250	NR	3700	3820	3940	79
19	5400	6400	9400	NR	3750	4500	4250	NR	4310	4170	4150	77
20	5400	6500	5400	NR	4000	4000	4000	NR	4100	4100	4190	83
21	5000	5400	8000	NR	3750	4000	4000	NR	3200	3700	3700	80
22	5500	5250	6250	NR	4500	4000	3750	NR	3900	3900	4000	81
23	4750	4750	6000	NR	3750	4000	4000	NR	3800	3800	3750	80
24	4500	4250	4750	NR	4000	3750	3750	NR	2750	2950	3100	81
25	4500	4000	5000	NR	4250	3500	3750	NR	2500	2650	4900	78
26	3750	3750	3750	NR	3750	2750	2750	NR	4900	3350	4050	83
27	4500	5500	6000	NR	2750	6250	6500	NR	4300	5600	5050	82
28	4000	5250	6000	NR	5250	4500	5500	NR	4200	5400	4050	82
29	4000	4750	6000	NR	6000	4250	4750	NR	5150	5200	6050	82
30	4750	5250	5500	NR	4750	6250	5500	NR	4850	4950	5500	84
31	NR	NR	NR	NR	5250	5250	5000	NR	NR	NR	NR	NR
MAX	7600	7200	9400	NR	8000	9500	9750	NR	5250	5750	6050	84
MIN	2500	2500	2750	NR	2750	2750	2750	NR	2500	2650	3100	77
AVG	4515	4808	5483	NR	4967	5201	5645	NR	4164	4298	4569	80

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

AJ GIWW PARIS ROAD BRIDGE
YEAR 1965 CHLORIDES AS CL- IN P.P.M.

	JULY				AUGUST				SEPTEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	4300	4400	4400	79	4800	5700	6400	83	7900	8700	9300	88
2	4100	4400	5500	82	4200	3900	5800	82	8100	8300	8400	88
3	4200	4500	5000	83	8500	9800	9800	84	7500	7600	7700	87
4	4400	4400	5100	82	6600	9300	9000	83	7200	7300	7500	85
5	4500	7500	6700	85	7300	7500	8500	84	6900	6900	7000	83
6	7100	6400	5100	79	7500	7600	8600	83	5900	6000	6200	84
7	5900	7300	9000	85	7100	7400	8400	83	5800	5400	5500	82
8	8400	9100	9500	83	6400	6900	7500	81	5700	5900	5600	81
9	7600	7200	9900	83	6400	6900	7700	83	5500	5800	6100	81
10	7500	8400	9300	83	6900	7700	9200	84	5700	7300	8200	78
11	8200	9900	9800	84	7700	8400	5600	83	NR	NR	NR	NR
12	9700	10200	13300	82	7800	9100	10900	84	NR	NR	NR	NR
13	7300	7600	9600	82	7500	7900	10000	83	NR	NR	NR	NR
14	8200	9700	10400	83	7400	7400	9400	84	6200	8000	7100	81
15	8000	8800	10200	83	6900	7000	7600	82	6700	7500	6000	83
16	5700	8000	7400	83	7200	5700	7800	81	7100	6400	5800	83
17	8300	10800	11200	82	5400	8200	9600	85	6400	7200	9300	85
18	8300	10900	13000	82	7700	8800	10300	84	NR	NR	NR	NR
19	3000	12000	12500	84	9000	10800	12100	83	NR	NR	NR	NR
20	11200	11500	13200	83	9300	10800	12600	83	NR	NR	NR	NR
21	12300	13600	14700	83	10100	10900	13400	82	NR	NR	NR	NR
22	10100	8200	13200	85	9500	10000	12300	84	NR	NR	NR	NR
23	8400	9100	11300	86	8900	9900	9900	83	NR	NR	NR	NR
24	8000	8000	8200	88	8300	8800	8800	85	NR	NR	NR	NR
25	7300	7600	8400	87	7800	8300	8100	83	NR	NR	NR	NR
26	7000	7400	7200	84	8200	8200	8500	83	NR	NR	NR	NR
27	NR	NR	NR	NR	7300	8800	9500	84	NR	NR	NR	NR
28	6100	6900	9400	86	7300	8500	9000	82	NR	NR	NR	NR
29	7400	6800	7800	84	9400	8700	7900	83	NR	NR	NR	NR
30	7600	7500	7600	83	7600	8800	9300	83	NR	NR	NR	NR
31	7100	6200	5900	82	8900	9000	9900	86	NR	NR	NR	NR
X	12300	13600	14700	88	10100	10900	13400	86	8100	8700	9300	88
	3000	4400	4400	79	4200	3900	5600	81	5500	5400	5500	78
	7200	8143	9133	83	7583	8260	9116	83	6614	7021	7121	83

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

AJ GIWW — PARIS ROAD BRIDGE

YEAR 1965 — CHLORIDES AS CL- IN P.P.M.

	OCTOBER				NOVEMBER				DECEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	NR	NR	NR	NR	NR	NR	NR	NR	7000	7100	7900	62
2	NR	NR	NR	NR	NR	NR	NR	NR	7100	7300	6700	60
3	NR	NR	NR	NR	NR	NR	NR	NR	6700	7000	7300	58
4	NR	NR	NR	NR	6900	6900	7000	74	6200	10200	6700	62
5	NR	NR	NR	NR	7000	7000	7100	68	6100	6900	9800	59
6	NR	NR	NR	NR	6600	6600	6700	68	6100	7800	6600	60
7	4700	4700	4700	72	6400	6400	6500	70	6700	6700	8100	58
8	5600	4600	4800	70	5700	5900	6300	66	7200	7300	8900	55
9	8000	8600	5500	73	5800	5900	6000	68	7200	7400	7800	58
10	6300	9300	10400	73	5900	6000	6100	68	7200	7200	7400	58
11	7600	9500	11100	73	6000	6100	6200	68	7500	8000	7600	60
12	10500	11100	9000	75	6200	6300	6500	70	7500	7700	8400	62
13	8500	8600	9800	73	5700	6000	6200	70	7500	7600	8200	60
14	8200	8500	10000	75	5700	5700	6300	70	7000	7100	7200	61
15	7900	7600	8100	73	5500	5600	6300	72	6700	6800	6900	62
16	5500	7500	7700	76	5400	5500	6100	70	6300	6400	6900	62
17	7500	7500	7700	74	4900	5300	6500	68	5300	5500	8400	59
18	6700	6800	7000	77	5500	5700	7400	64	5900	6000	7800	58
19	6700	7100	6900	74	5600	7400	9800	68	5800	5900	5900	57
20	6500	6800	6900	74	5900	12800	13300	70	5800	5900	5900	58
21	5100	5100	6300	71	6900	13700	14800	72	5900	5900	5900	58
22	5100	5100	5200	72	7500	13800	14900	69	6000	5900	6000	56
23	4600	6100	6500	68	9200	12500	13700	67	5900	5900	5900	56
24	5200	5400	5700	68	8700	10300	13500	68	5900	5900	6000	56
25	7000	7000	7000	68	8700	8800	12000	70	5300	5700	5800	56
26	NR	NR	NR	NR	8000	8500	10400	70	5400	5400	5500	56
27	NR	NR	NR	NR	8200	9100	10400	69	5400	5400	5500	55
28	NR	NR	NR	NR	8400	8500	9400	66	5300	5300	5300	55
29	NR	NR	NR	NR	7600	7800	8400	64	5200	5400	5600	55
30	NR	NR	NR	NR	8300	8300	8500	62	3750	3750	4250	NR
31	NR	NR	NR	NR	NR	NR	NR	NR	4250	3750	4000	NR
MAX.	10500	11100	11100	77	9200	13800	14900	74	7500	10200	9800	62
MIN.	4700	4600	4700	68	4900	5300	6000	62	3750	3750	4000	55
AVG	6589	7205	7384	72	6748	7866	8751	68	6164	6454	6779	58

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

AJ GULF INTRACOASTAL WATERWAY AT PARIS ROAD BR.
YEAR 1966 CHLORIDES AS CL- IN P.P.M.

	JANUARY				FEBRUARY				MARCH			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	4000	4000	8000	NR	3000	3750	4000	NR	1000	1100	1100	NR
2	5250	10500	11000	NR	3000	3500	5000	NR	1100	1100	1100	NR
3	6250	9500	10500	NR	3000	3250	5000	NR	1100	1100	1100	NR
4	5750	6250	7500	NR	3000	3000	3000	NR	1200	1100	1100	NR
5	4750	5250	5500	NR	3500	3750	4000	NR	1100	1100	1100	NR
6	3750	4000	7250	NR	3250	3500	3750	NR	1100	1100	1200	NR
7	4000	3750	4500	NR	3750	4000	5000	NR	1100	1100	1100	NR
8	3750	4000	4750	NR	3750	3750	4000	NR	1100	1100	1200	NR
9	3500	3750	3750	NR	3750	3750	3750	NR	1300	2000	2000	NR
10	3750	3750	3750	NR	4250	4500	5750	NR	2100	2000	2000	NR
11	3250	3750	3750	NR	3750	3750	4000	NR	2100	4750	4500	NR
12	3500	3250	3750	NR	3000	3000	3750	NR	2000	2100	1800	NR
13	3250	3500	3750	NR	3250	4000	3000	NR	1900	1900	2000	NR
14	3500	3500	3750	NR	2500	2500	2500	NR	1100	1100	1200	NR
15	3500	8500	9250	NR	2500	2400	2400	NR	1000	1000	1200	NR
16	4000	5250	4500	NR	2400	2400	2300	NR	1100	1000	1100	NR
17	4000	4000	7750	NR	2000	2000	2000	NR	1000	1200	1100	NR
18	4000	4000	4250	NR	2200	2300	2100	NR	1000	1000	1000	NR
19	4000	4000	4250	NR	2000	1800	2000	NR	650	850	800	NR
20	4000	3750	4250	NR	1900	2000	2000	NR	750	800	850	NR
21	3500	3500	3750	NR	1900	1900	4750	NR	650	800	550	NR
22	3250	3500	3500	NR	4750	4750	4750	NR	3000	3300	2750	NR
23	3500	3750	3500	NR	4750	4750	4750	NR	2100	3000	2300	NR
24	3500	3750	3250	NR	2100	2100	2100	NR	2900	3100	3600	NR
25	3500	3500	3250	NR	2000	2000	2000	NR	2700	2600	2800	NR
26	4250	4250	4250	NR	1800	2000	1900	NR	3200	3600	4500	NR
27	4250	4250	4000	NR	2200	2200	2200	NR	3500	4000	4200	NR
28	3000	2750	2750	NR	1000	1100	1100	NR	4200	6600	5000	NR
29	3500	3000	5750	NR	NR	NR	NR	NR	6400	6800	4600	NR
30	3000	3250	3000	NR	NR	NR	NR	NR	5500	5200	4600	NR
31	3000	3000	3000	NR	NR	NR	NR	NR	3500	3700	2750	NR
MAX	6250	10500	11000	NR	4750	4750	5750	NR	6400	6800	5000	NR
MIN	3000	2750	2750	NR	1000	1100	1100	NR	650	800	550	NR
AVG	3870	4411	5024	NR	2866	2989	3316	NR	2014	2312	2135	NR

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

AJ GULF INTRACOASTAL WATERWAY AT PARIS ROAD BR.

YEAR 1966 CHLORIDES AS CL- IN P.P.M.

DAY	APRIL SURFACE	APRIL MIDDLE	APRIL BOTTOM	APRIL TEMP.	MAY SURFACE	MAY MIDDLE	MAY BOTTOM	MAY TEMP.	JUNE SURFACE	JUNE MIDDLE	JUNE BOTTOM	JUNE TEMP.
1	3000	3000	4000	NR	2500	2200	2600	NR	6250	6250	6750	NR
2	5000	6750	3750	NR	2000	2100	2500	NR	5500	5500	5500	NR
3	5250	5750	5750	NR	2000	2300	3300	NR	4750	3000	6750	NR
4	7250	7000	7750	NR	2500	2500	2800	NR	4750	4500	4750	NR
5	5750	6750	6750	NR	2700	2900	3400	NR	4000	4500	6000	NR
6	6750	7750	7750	NR	2600	2600	3200	NR	4250	4000	4250	NR
7	11000	7500	6750	NR	3100	2900	3100	NR	3250	3750	3750	NR
8	8500	9250	9500	NR	2700	2800	2800	NR	3000	3250	4750	NR
9	10250	11250	11250	NR	2200	2500	2200	NR	3000	3000	4000	NR
10	10000	11250	10500	NR	2100	2000	2200	NR	2500	2500	3500	NR
11	9250	10000	9750	NR	2300	1800	2000	NR	7000	6250	6250	NR
12	8750	9000	9000	NR	2200	2200	2300	NR	6750	6750	4750	NR
13	7500	8250	7000	NR	1600	1700	2000	NR	3750	3500	8250	NR
14	5750	6750	8750	NR	2000	2200	2000	NR	4000	8750	4500	NR
15	5500	8750	10000	NR	1300	1300	1700	NR	4500	6000	4500	NR
16	5750	8250	7500	NR	2700	1400	1400	NR	4500	5000	7750	NR
17	10250	10000	8250	NR	1600	3000	9000	NR	5000	5000	10250	NR
18	10500	7500	6250	NR	4200	11000	11750	NR	NR	NR	NR	NR
19	5500	7000	10000	NR	3500	6300	11250	NR	6000	6250	9500	NR
20	10250	8750	6500	NR	4500	5500	10750	NR	5250	5750	6250	NR
21	5250	5500	5250	NR	5000	5000	7500	NR	5500	5000	7000	NR
22	6500	4250	6250	NR	5500	7750	4500	NR	4500	4500	7000	NR
23	3750	3750	4000	NR	4250	5000	10250	NR	4500	4500	4750	NR
24	3250	3250	3250	NR	5500	6250	8250	NR	8500	4250	5000	NR
25	2750	2500	3750	NR	4500	5250	10000	NR	5000	3750	3750	NR
26	2500	2500	2750	NR	4500	5000	9500	NR	3250	3250	4500	NR
27	2500	3025	4500	NR	5000	9500	5250	NR	3500	3500	5500	NR
28	2000	3025	3000	NR	4250	7000	9500	NR	3500	3500	3500	NR
29	4050	4050	3000	NR	5750	7000	8750	NR	4500	5250	5500	NR
30	4050	2100	2500	NR	6250	8750	10000	NR	4000	4100	4750	NR
31	NR	NR	NR	NR	6500	6500	9250	NR	NR	NR	NR	NR
MAX	11000	11250	11250	NR	6500	11000	11750	NR	8500	8750	10250	NR
MIN	2000	2100	2500	NR	1300	1300	1400	NR	2500	2500	3500	NR
AVG	6278	6481	6500	NR	3461	4329	5645	NR	4646	4555	5629	NR

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

AJ GULF INTRACOASTAL WATERWAY AT PARIS ROAD BR.
YEAR 1966 CHLORIDES AS CL- IN P.P.M.

	JULY				AUGUST				SEPTEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	6250	7500	7250	NR	8000	NR	9250	NR	5250	NR	8250	NR
2	6750	6000	7250	NR	7250	NR	9500	NR	5250	NR	8000	NR
3	6000	6500	6250	NR	6500	NR	9750	NR	9000	NR	9250	NR
4	8000	NR	5750	NR	7500	NR	9500	NR	5750	NR	8000	NR
5	5500	6750	6250	NR	7500	NR	9750	NR	11000	NR	13000	NR
6	NR	NR	NR	NR	10750	NR	11000	NR	10250	NR	13000	NR
7	NR	NR	NR	NR	10000	NR	12750	NR	12250	NR	11750	NR
8	NR	NR	NR	NR	11250	NR	12500	NR	NR	NR	NR	NR
9	NR	NR	NR	NR	10250	NR	14000	NR	8250	NR	10000	NR
10	NR	NR	NR	NR	12250	NR	10250	NR	6250	NR	6500	NR
11	NR	NR	NR	NR	9750	NR	12750	NR	5500	NR	6750	NR
12	NR	NR	NR	NR	9500	NR	11500	NR	5750	NR	7000	NR
13	NR	NR	NR	NR	9250	NR	11750	NR	4750	NR	5750	NR
14	NR	NR	NR	NR	11000	NR	8000	NR	5000	NR	6000	NR
15	5000	NR	9000	NR	10750	NR	9500	NR	3750	NR	7250	NR
16	5750	NR	9500	NR	7000	NR	10750	NR	4250	NR	6500	NR
17	6000	NR	9500	NR	7000	NR	9750	NR	4000	NR	6250	NR
18	6000	NR	9250	NR	7250	NR	9750	NR	4750	NR	6750	NR
19	9500	NR	5750	NR	6000	NR	9750	NR	4750	NR	7750	NR
20	5500	NR	5750	NR	6500	NR	10250	NR	4000	NR	5750	NR
21	5750	NR	5750	NR	6250	NR	10750	NR	6500	NR	5250	NR
22	7250	NR	6750	NR	7000	NR	10500	NR	5000	NR	7500	NR
23	6250	NR	6250	NR	NR	NR	NR	NR	6500	NR	10250	NR
24	6000	NR	5500	NR	7500	NR	11000	NR	7500	NR	9750	NR
25	NR	NR	NR	NR	8000	NR	10250	NR	7500	NR	10500	NR
26	4250	NR	4000	NR	8750	NR	8000	NR	8500	NR	11000	NR
27	4500	NR	4000	NR	10000	NR	8000	NR	7750	NR	11000	NR
28	NR	NR	NR	NR	8000	NR	8500	NR	10750	NR	7500	NR
29	NR	NR	NR	NR	8000	NR	9000	NR	8000	NR	11000	NR
30	NR	NR	NR	NR	7000	NR	7750	NR	11000	NR	8250	NR
31	NR	NR	NR	NR	7500	NR	8250	NR	NR	NR	NR	NR
MAX	9500	7500	9500	NR	12250	NR	14000	NR	12250	NR	13000	NR
MIN	4250	6000	4000	NR	6000	NR	7750	NR	3750	NR	5250	NR
AVG	6132	6687	6691	NR	8441	NR	10133	NR	6853	NR	8465	NR

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

AJ GULF INTRACOASTAL WATERWAY AT PARIS ROAD BR.
YEAR 1966 CHLORIDES AS CL- IN P.P.M.

	OCTOBER				NOVEMBER				DECEMBER			
DAY	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.	SURFACE	MIDDLE	BOTTOM	TEMP.
1	8250	NR	10500	NR	10500	NR	11750	NR	9750	NR	10250	NR
2	7500	NR	8000	NR	4250	NR	11750	NR	10500	NR	10250	NR
3	7250	NR	7500	NR	5750	NR	6750	NR	10000	NR	10000	NR
4	7500	NR	7500	NR	7750	NR	8250	NR	5250	NR	6500	NR
5	7250	NR	8750	NR	7000	NR	8500	NR	6500	NR	6750	NR
6	6500	NR	7000	NR	8250	NR	9000	NR	6750	NR	6750	NR
7	6750	NR	7000	NR	7250	NR	9000	NR	5250	NR	5250	NR
8	7000	NR	7500	NR	8500	NR	6750	NR	5000	NR	5500	NR
9	7000	NR	7250	NR	7500	NR	10500	NR	5000	NR	5250	NR
10	6250	NR	6750	NR	7500	NR	10500	NR	4250	NR	4250	NR
11	5500	NR	6750	NR	9500	NR	12000	NR	4250	NR	4250	NR
12	5750	NR	5750	NR	8750	NR	11750	NR	NR	NR	NR	NR
13	5500	NR	5750	NR	6250	NR	7500	NR	4500	NR	4750	54
14	5750	NR	5750	NR	6750	NR	7500	NR	4500	NR	4750	54
15	4750	NR	5250	NR	6500	NR	7000	NR	4500	NR	4750	54
16	5000	NR	5500	NR	6250	NR	6750	NR	4500	NR	7500	52
17	5000	NR	5000	NR	6250	NR	7000	NR	4500	NR	7750	52
18	5250	NR	5250	NR	6500	NR	6750	NR	4750	NR	7750	50
19	3500	NR	4500	NR	6000	NR	6500	NR	4750	NR	8000	52
20	4000	NR	5000	NR	5750	NR	6500	NR	4750	NR	7750	54
21	4250	NR	4500	NR	5750	NR	8000	NR	8500	NR	10000	50
22	4250	NR	5000	NR	6250	NR	10000	NR	8250	NR	8000	NR
23	6500	NR	5500	NR	NR	NR	NR	NR	7250	NR	7000	NR
24	5250	NR	10750	NR	NR	NR	NR	NR	6750	NR	7250	52
25	8750	NR	11750	NR	NR	NR	NR	NR	6750	NR	7250	48
26	11500	NR	9250	NR	NR	NR	NR	NR	6750	NR	7250	48
27	8000	NR	12750	NR	NR	NR	NR	NR	6750	NR	7250	50
28	8750	NR	13750	NR	NR	NR	NR	NR	8000	NR	7250	53
29	13000	NR	14000	NR	NR	NR	NR	NR	3500	NR	4500	50
30	14250	NR	9250	NR	NR	NR	NR	NR	4500	NR	4750	50
31	8750	NR	12500	NR	NR	NR	NR	NR	3500	NR	3250	50
AX	14250	NR	14000	NR	10500	NR	12000	NR	10500	NR	10250	54
IN	3500	NR	4500	NR	4250	NR	6500	NR	3500	NR	3250	48
VG	6919	NR	7782	NR	7034	NR	8636	NR	5991	NR	6725	51

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

WATER QUALITY DATA

STREAM: MISS. R. GULF OUTLET
STATION: PARIS ROAD BRIDGE, " AJ "
LOCATION: AT STATE HWY. 47

1962

SAMPLES TAKEN AT CENTERLINE OF DREDGED CHANNEL
Chlorides as CL in 1000 p.p.m.

OBS. WEEK NO.	DATE TAKEN 1962		DEPTH OF SAMPLES 10.0'	15.0'	20.0'	25.0'	30.0'	35.0'	40.0'			
1	14	May	3.10	3.70	8.00	4.20	[illegible]	5.50	6.75			
2	21	May	1.90	1.75	2.30	2.20	4.70	6.50	7.00			
3	28	May	2.50	3.20	3.80	7.00	7.25	7.25	7.25			
4	5	June	1.50	1.60	1.60	1.70	1.75	1.75	1.95			
5	14	June	3.50	3.60	5.20	7.25	8.75	9.25	10.3			
6	19	June	2.10	2.40	2.90	3.30	3.70	8.75	10.0			
7	26	June	3.00	4.10	7.50	8.75	9.50	9.75	9.75			
8	3	July	3.90	3.90	4.00	3.90	3.90	3.90	5.00			
9	10	July	6.75	7.50	8.50	9.00	9.50	9.25	9.75			
10	17	July	4.10	4.90	6.00	7.25	8.75	9.25	9.75			
11	27	July	8.50	9.25	9.75	10.5	13.5	10.6	13.8			
12	1	Aug		6.75		9.0		9.5	10.3			
13	9	Aug	14.3	12.8	12.8	12.3	12.3	14.5	14.3			
14	14	Aug		7.25		7.75		10.8	11.3			
15	23	Aug	7.25	7.50	8.75	10.8	12.0	11.8	12.0			
16	28	Aug	5.50	5.75	5.75	5.75	5.75	6.25	6.00			
17	4	Sept	5.00	5.00	5.25	6.75	7.50	9.25	10.00			
18	11	Sept	6.50	6.50	6.50	6.50	6.75	7.25	9.00			
19	18	Sept	6.00	6.25	6.75	9.00	9.25	9.50	9.50			
20	25	Sept	6.25	6.25	6.25	6.25	6.25	6.25	6.75			
21	4	Oct	4.4	4.5	4.7	5.1	5.6	5.2	8.75			
22	9	Oct	5.5	5.3	5.3	5.3	5.5	5.5	5.5			
23	16	Oct	6.75	7.75	8.25	6.0	9.75	9.75	8.75			
24	23	Oct	5.25	5.5	6.0	5.75	6.50	7.0	6.75			
25	30	Oct	4.00	6.10	6.10	7.00	7.00	7.00	8.00			
26	6	Nov	4.70	4.90	5.10	5.10	6.70	6.25	5.80			
27	13	Nov.	5.20	5.80	5.80	9.00	8.50	6.75	9.75			
28	20	Nov.	6.50	6.50	6.50	8.50	10.3	7.25	8.50			
29	27	Nov.	5.25	5.25	5.25	5.00	5.25	5.25	7.25			
30												
31												

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

WATER QUALITY DATA

STREAM: MISS. R. GULF OUTLET
STATION: PARIS ROAD BRIDGE, "AJ"
LOCATION: AT STATE HWY. 47

SAMPLES TAKEN AT CENTERLINE OF DREDGED CHANNEL
CHLORIDES AS CL- IN 1000 P.P.M.

	DATE TAKEN ~~1962~~ 1963		DEPTH OF SAMPLES									
			10.0'	15.0'	20.0'	25.0'	30.0'	35.0'	40.0'			
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	11	June	5.80	6.75	7.50	8.50	11.3	11.3	11.5			
2	18	June	14.3	14.5	14.8	13.8	13.8	13.0	13.3			
3	25	June	8.75	8.25	8.25	8.50	9.00	11.0	9.25			
4	2	July	8.50	11.5	13.8	13.8	15.0	15.3				
5	9	July	6.25	8.0	8.75	10.3	13.3	12.5	8.75			
6	16	July	8.75	8.75	9.00	9.00	9.00	9.00	9.00			
7	23	July	10.5	7.00	9.25	9.75	9.00	9.25	11.3			
8	30	July	7.75	7.75	8.00	7.50	7.50	8.00	8.25			
9	6	Aug	8.50	9.00	9.00	11.0	11.0	11.3	11.0			
10	20	Aug	10.0	10.3	11.0	12.0	12.3	14.5	15.5			
11	27	Aug	12.5	14.5	14.3	14.5	15.5	15.5	15.5			
12	31	Aug	11.3	12.0	12.0	12.8	13.3	14.8	14.5			
13	7	Sept	9.00	8.75	8.75	8.75	8.75	14.5	15.8			
14	14	Sept	10.0	10.0	10.5	10.5	11.0	11.3	12.5			
15	[illegible]	Sept	6.0	5.75	5.75	5.75	5.75	5.75				
16	[illegible]	Sept	6.75	7.00	6.75	7.00	7.00	8.00	8.00			
17	5	Oct	6.75	7.25	8.50	7.25	7.50	9.50	9.75			
18	12	Oct.	7.75	7.75	8.00	7.75	8.00	7.75	8.00			
19	19	Oct	8.25	8.50	8.50	8.50	8.25	8.50	8.25			
20	26	Oct.	8.75	8.75	8.75	8.75	8.50	8.75	9.25			
21	2	Nov.	7.25	8.25	7.75	9.50	9.75	11.3	11.8			
22	9	Nov.	8.25	8.25	8.00	8.25	8.00	8.00	7.75			
23	16	Nov.	6.50	6.75	6.75	6.50	6.50	6.75	6.50			
24	30	Nov.	5.25	5.25	5.50	5.25	5.50	5.75	6.00			
25	7	Dec.	7.50	7.75	8.25	10.0	10.5	10.8	9.25			
26	15	Dec.	7.25	7.50	7.00	7.50	8.25	8.00	8.25			
27	22	Dec.	6.5	6.50	6.75	6.50	6.75	6.75				
28	29	Dec.	7.25	12.0	14.0	14.5	14.8	14.8				
29												
30												
31												

1964

AJ 4

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

WATER QUALITY DATA

STREAM: MISS. R. GULF OUTLET
STATION: PARIS ROAD BRIDGE, "AJ"
LOCATION: AT STATE HWY. 47

SAMPLES TAKEN AT CENTERLINE OF DREDGED CHANNEL
CHLORIDES AS CL- IN 1000 P.P.M.

	DATE TAKEN 1964		DEPTH OF SAMPLES 5'	10'	15'	20'	25'	30'	35'	40'		
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1												
2	5	Jan	7.0	8.0	8.75	10.25	10.5	10.75	11.0			
3	12	Jan	5.5	5.5	5.5	5.75	6.25	6.25	6.0			
4	19	Jan	4.75	4.75	4.75	4.75	4.75	4.75	4.75			
5	26	Jan		4.5	4.25	4.5	4.5	4.5	4.25	4.25		
6	2	Feb		4.1	4.1	4.2	4.1	4.2	4.2	4.2		
7	10	Feb	4.0	3.8	3.8	4.0	4.0	3.8	4.0			
8	16	Feb		4.5	4.5	4.5	4.5	4.5	4.5	4.5		
9	23	Feb	4.3	4.4	4.3	4.4	4.4	4.3	4.3			
10	1	Mar		4.1	4.0	4.1	4.0	4.0	4.0	4.0		
11	8	Mar	3.0	3.1	3.0	3.1	3.0	3.0	3.1			
12	15	Mar		2.7	2.7	2.8	2.7	2.7	2.7	2.7		
13	22	Mar	2.7	2.7	2.7	2.7	2.7	2.8	2.7			
14	29	Mar	2.1	2.0	2.1	2.3	2.4	2.5	2.5			
15	5	Apr	2.4	2.5	2.4	2.4	2.4	2.4	2.3			
16	12	Apr	2.25	2.3	2.3	2.25	2.3	2.25	2.3			
17	26	Apr	2.05	2.05	2.05	2.00	2.05	2.10	2.05			
18	10	May	2.1	2.1	2.1	2.1	2.1	2.0	2.1			
19	24	May	2.85	3.0	3.1	3.45	3.15	4.05	2.30			
20	14	June	4.15	4.15	4.1	4.2	4.3	4.25	4.25			
21	19	Apr	2.0	2.0	2.0	2.1	2.1	2.1	2.1			
22	3	May	2.3	2.4	2.3	2.3	2.3	2.3	2.3			
23	17	May	2.3	2.2	2.2	2.2	2.2	2.2	2.1			
24	31	May	4.5	4.5	4.5	4.5	5.0	5.2	5.6			
25	7	Jun	4.2	4.2	4.4	4.3	7.1	5.7	7.6			
26	21	Jun	5.25	6.75	7.25	5.25	7.25	6.75	7.5			
27	28	Jun	4.75	6.00	5.75	11.5	8.25	9.75	11.25			
28	12	July	4.5		8.75				8.75			
29												
30												
31												

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

WATER QUALITY DATA

STREAM: MISS. R. GULF OUTLET
STATION: PARIS ROAD BRIDGE, "AJ"
LOCATION: AT STATE HWY. 47

SAMPLES TAKEN AT CENTERLINE OF DREDGED CHANNEL
CHLORIDES AS CL- IN 1000 P.P.M

	DATE TAKEN		DEPTH OF SAMPLES									
	1964		5'		15'		25'		35'			
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15	26	July	6.5		8.75		12.75		12.50			
16	16	Aug	6.25		11.75		11.75		12.00			
17	30	Aug	7.50		13.0		14.0		14.75			
18	13	Sep	5.25		7.75		11.5		11.5			
19	27	Sep	5.75		6.00		10.0		10.0			
20												
21	11	Oct	4.00		4.00		8.5		9.0			
22	25	Oct	10.0		10.0		12.0		14.25			
23		Oct										
24	8	Nov	6.0		8.5		8.5		5.75			
25	23	Nov	8.0		8.0		8.0		9.25			
26		Dec										
27	27	Dec	4.5		4.5		6.25		6.00			
28												
29												
30												
31												

1/1965 AJ 6

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

WATER QUALITY DATA

STREAM: MISS. R. GULF OUTLET
STATION: PARIS ROAD BRIDGE, "AJ"
LOCATION: AT STATE HWY. 47

SAMPLES TAKEN AT CENTERLINE OF DREDGED CHANNEL
CHLORIDES AS CL- IN 1000 P.P.M.

	DATE TAKEN		DEPTH OF SAMPLES									
	1965		5'	10'	15'	20'	25'	30'	35'			
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	17	Jan	4.25		4.75		4.75		4.75			
2	31	Jan	3.00		3.50		8.25		8.75			
3	14	Feb	2.75		3.0		7.75		8.5			
4	28	Feb	2.3		2.4		2.3		2.4			
5	14	Mar	6.25		8.25		8.5		8.5			
6	21	Mar	3.5		3.75		4.25		4.25			
7	4	Apr	6.50		3.40		7.50		6.6			
8	21	Apr	1.40		1.90		2.40		2.6			
9	2	May	4.25		4.0		5.50		6.0			
10	16	May	11.25		11.5		11.5		11.75			
11	6	June	5.75		5.25		5.0		4.75			
12	27	June	4.25		4.25		4.25		4.50			
13	12	July	8.60	10.8	12.2	13.0	12.1	13.3	13.2			
14	25	July	7.80	8.6	10.5	12.4	11.9	11.7	11.9			
15	12	Aug	10.0	10.0	10.0	10.1	10.1	10.4	10.2			
16	22	Aug	10.5	11.0	12.7	12.9	12.9	13.0	12.9			
17												
18												
19	2	Oct	5.9	6.0	6.2	6.1	6.2	6.4	6.6			
20	12	Oct	8.0	9.5	9.3	12.8	12.5	13.6	12.7			
21	24	Oct	6.1	6.7	6.8	7.2	8.0	8.6	9.2			
22	10	Nov	5.9	5.8	5.8	5.8	5.8	5.8	5.8			
23	21	Nov	7.7	10.4	11.2	12.0	12.4	13.7	12.8			
	8	Dec	6.6	6.6	6.7	6.9	7.4	8.1	8.5			
25	20	Dec		5.8		5.9		5.9				
26												
27												
28												
29												
30												
31												

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

WATER QUALITY DATA

STREAM: Miss. R. Gulf Outlet
STATION: Paris Road Bridge, "AJ"
LOCATION: At State Hwy. 47

Samples Taken at Centerline of Dredged Channel
Chlorides as CL^- in 1,000 P.P.M.

DATE TAKEN		DEPTH OF SAMPLES									
1966		5'	10'	15'	20'	25'	30'	35'			
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3	Jan.	3.75	3.75	3.75	4.0	4.5	6.25	8.0			
16	Jan.	3.75	3.75	3.75	3.75	3.75	4.5	4.0			
23	Jan.	2.5	3.25	3.5	BROKEN		7.75	3.75			
5	Feb.	3.25	3.75	3.75	3.75	4.25	5.25	4.5			
20	Feb.	2.0	2.0	2.0	2.0	2.0	2.1	2.0			
7	Mar.	1.1	1.1	1.2	1.3	1.3	1.3	1.3			
20	Mar.	0.7	0.75	0.7	0.75	0.75	0.4	0.75			
4	Apr.	6.5	7.25	8.0	8.25	8.75	9.25	8.75			
24	Apr.	3.75	3.25	3.5	3.5	3.75	5.75	6.75			
9	May	2.5	2.5	2.5	2.5	2.5	2.75	2.5			
22	May	3.75	4.5	5.0	9.0	11.25	11.25	10.5			
6	June	3.25	3.25	3.25	3.5	3.5	7.5	5.0			
19	June	5.0	5.75	9.5	11.0	10.75	10.75	8.75			

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: "I-9.5", Mile 58.8
Bayou Bienvenue

Chlorides as cl- in 1000 p.p.m.

DATE TAKEN	DEPTH OF SAMPLES									
1963	5.0'	10.0'	15.0'	20.0'	25.0'	30.0'	35.0'	40.0'	45.0'	
20 Oct. 63	8.00		8.50		12.0		13.3			
11 Nov. 63	6.75		7.25		8.00		9.50			
25 Nov. 63	7.00		7.25		8.00		9.75			
16 Dec. 63	7.00		6.75		7.75		11.8			
30 Dec. 63	7.75		8.25		14.3		14.5			
1964										
13 Jan 64	4.00		4.75		5.00		8.00			
27 Jan 64	4.00		4.50		7.25		8.50			
10 Feb 64	3.75		4.50		5.00		4.75			
23 Feb 64	4.00		4.75		5.00		5.25			
2 Mar 64	3.75		4.00		4.00		3.75			
23 Mar 64	2.70		2.70		2.70		2.70			
14 Apr 64	3.00		3.00		3.10		3.10			
27 Apr 64	2.00		2.00		2.00		2.00			
11 May 64	2.10		2.10		2.10		2.10			
[illegible] May 64	2.70		3.00		3.90		5.20			
[illegible] June 64	4.00		4.30		5.20		6.10			
29 June 64	4.50		4.75		5.75		10.0			
12 July 64	4.75		6.25		8.50		8.75			
25 July 64	6.25		10.5		12.8		10.0			
16 Aug 64	7.25		11.0		12.5		12.8			
30 Aug 64	8.75		14.0		14.8		14.8			
13 Sep 64	6.25		7.75		11.5		10.8			
27 Sep 64	5.75		5.75		11.0		10.3			
11 Oct 64	4.00		4.75		9.5		9.5			
25 Oct 64	10.0		11.3		14.5		14.3			
8 Nov 64	6.0		11.0		12.3		13.0			
22 Nov 64	8.75		8.75		9.5		9.5			
6 Dec 64	3.50		3.75		4.50		7.25			
27 Dec 64	4.25		4.50		5.75		6.25			

FWS

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: "I-9.5", Mile 58.8
Bayou Bienvenue

Chlorides as cl- in 1000 p.p.m.

	Date		Depth of samples 5'		15'		25'		35'			
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	19	65										
2	17	Jan	4.50		4.50		4.50		10.5			
3	31	Jan	3.25		3.50		9.25		9.75			
4	14	Feb	2.80		3.00		7.90		8.80			
5	28	Feb	2.30		2.30		2.40		2.80			
6	14	Mar	5.50		7.00		6.50		8.50			
7	21	Mar	3.50		3.50		4.00		8.50			
8	4	Apr	3.25		6.25		7.00		7.50			
9	21	Apr	4.00		3.50		6.25		7.00			
10	2	May	4.25		4.50		4.15		6.25			
11	16	May	12.25		12.25		12.25		12.00			
12	6	June	10.75		11.25		10.25		10.75			
13	27	June	4.25		4.50		4.50		4.50			
14	13	July	9.50		12.30		14.80		14.80			
15	25	July	7.70		9.90		10.90		11.50			
16	12	Aug	7.60		9.00		10.2		11.2			
17	22	Aug	10.4		12.6		13.1		13.0			
18												
19												
20	2	Oct	6.2		6.4		6.1					
21	12	Oct	8.0		11.2		14.1		14.1			
22	21	Oct	7.7		10.3							
23	10	Nov	5.9		6.0		6.0		6.1			
24	21	Nov	7.8		[illegible]		[illegible]		12.9			
25	8	Dec	6.8		7.0		8.00		8.8			
26	20	Dec	3.5		3.75		4.25		5.25			
27												
28												
29												
30												
31												

MRGO I-9.5

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: I-9.5, mile 58.8
Bayou Bienvenue

Chlorides as CL- in 1000 p.p.m.

	1966		Depth of Samples 5'		15'		25'		35'			
	~~Jan~~	~~Feb~~	~~Mar~~	~~Apr~~	~~May~~	~~June~~	~~July~~	~~Aug~~	~~Sept~~	~~Oct~~	~~Nov~~	~~Dec~~
1	8	Jan	3.75		4.00		6.00		5.50			
2	16	Jan	3.75		3.75		7.00		11.3			
3	22	Jan	3.75				3.75		4.00			
4	5	Feb	3.25		3.50		5.00		6.25			
5	20	Feb	2.20		2.40		2.10		2.10			
6	7	Mar	1.30		1.30		1.40		1.30			
7	20	Mar	.80		.85		.85		2.45			
8	4	Apr	6.25		7.25		8.00		8.50			
9	24	Apr	3.50		3.75		3.75		4.00			
10	9	May	2.50		2.75		2.75		3.75			
11	22	May	4.50		4.50		7.50		8.00			
12	6	Jun	3.50		3.50		4.25		6.00			
13	19	Jun	4.50		6.75		10.5		10.5			
14	5	Jul	4.00		4.00		4.25		5.50			
15	17	Aug	6.25		7.50		9.75		9.00			
16	13	Sep	5.00		5.75		7.00		10.0			
17	19	Oct	4.00		4.50		5.25		6.0			
18	16	Nov	6.00		6.50		7.75		10.5			
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: "I-2", Mile 52.8
Bayou Dupre

Chlorides as cl- in 1000 p.p.m.

	DATE TAKEN	DEPTH OF SAMPLES									
	1963	5.0'	10.0'	15.0'	20.0'	25.0'	30.0'	35.0'	40.0'	45.0'	
	Jan / Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	20 Oct. 63	8.75		8.75		12.8		14.0			
2	11 Nov. 63	6.50		8.00		8.00		8.25			
3	25 Nov. 63	7.75		8.25		9.25		10.0			
4	16 Dec. 63	6.75		6.75		6.50		9.5			
5	30 Dec. 63	7.00		7.00		13.5		13.8			
6											
7	1964										
8	13 Jan 64	5.25		5.50		5.25		7.00			
9	27 Jan 64	4.75		5.00		6.25		10.3			
10	10 Feb 64	5.00		7.00		7.50		7.75			
11	23 Feb 64	4.50		4.75		5.25		8.75			
12	2 Mar 64	4.00		4.25		4.00		4.00			
13	23 Mar 64	2.80		2.90		3.00		3.00			
14	14 Apr 64	2.90		3.00		3.40		9.00			
15	27 Apr 64	2.00		2.10		2.10		2.10			
16	11 May 64	2.10		2.10		2.10		2.10			
17	25 May 64	3.00		3.70		5.00		5.80			
18	15 June 64	5.20		7.70		7.60		7.70			
19	29 June 64	3.90		4.20		8.60		13.5			
20	12 July 64	7.00		12.0		11.0		11.0			
21	26 July 64	5.50		13.3		13.0		13.3			
22	16 Aug 64	7.50		12.5		12.8		13.3			
23	30 Aug 64	9.50		12.3		15.8		16.0			
	13 Sep 64	6.00		12.5		13.0		10.8			
25	27 Sep 64	5.75		6.50		9.00		7.00			
26	11 Oct 64	4.50		5.00		11.0		12.0			
27	25 Oct 64	9.00		11.0		11.5		14.8			
28	8 Nov 64	7.00		7.00		11.8		14.8			
29	23 Nov 64	5.75		6.25		6.25		8.25			
30	6 Dec 64	4.75		4.75		4.50		5.00			
31	21 Dec 64	4.00		4.25		5.00		6.00			

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: "I-2", Mile 52.8
Bayou Dupre

Chlorides as cl- in 1000 p.p.m.

Date	Depth of Samples 5'	15'	25'	35'
1965				
17 Jan	4.00	4.25	5.00	5.50
31 Jan	3.75	3.75	6.75	10.5
14 Feb	3.50	3.50	5.75	9.25
28 Feb	2.50	2.60	3.30	5.50
14 Mar	3.75	6.75	6.75	8.75
21 Mar	4.00	4.00	4.00	4.25
4 Apr	3.50	6.50	6.50	7.50
21 Apr	2.50	3.50	6.50	7.00
2 May	4.00	4.00	4.75	6.00
16 May	12.50	12.75	12.50	12.50
6 June	11.75	11.25	11.50	11.25
27 June	4.50	4.50	4.25	4.00
13 July	8.70	13.80	15.10	15.80
25 July	7.30	8.00	14.70	12.20
12 Aug	7.5	8.0	10.2	10.5
22 Aug	11.8	13.2	13.4	13.4
2 Oct	6.6	6.7	6.8	6.8
12 Oct	8.4	11.3	14.0	14.0
[illegible] Oct	15.1	8.2	12.4	13.2
10 Nov	6.1	6.1	6.2	6.3
21 Nov	8.1	13.0	13.2	13.4
8 Dec	7.3	7.3	8.2	8.5
20 Dec	4.0	4.0	4.25	5.0

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

WATER QUALITY DATA

STREAM: Mississippi River Gulf Outlet Channel
STATION: "I-2," Mile 52.8
Bayou Dupre

Chloride as CL- in 1000 p.p.m.

1966		Depth of samples 5'		15'		25'		35'			
~~Jan~~	~~Feb~~	~~Mar~~	~~Apr~~	~~May~~	~~June~~	~~July~~	~~Aug~~	~~Sept~~	~~Oct~~	~~Nov~~	~~Dec~~
8	Jan	4.00		3.25		5.75		3.25			
16	Jan	3.75		3.75		6.50		7.00			
22	Jan	2.00				3.75		4.50			
5	Feb	3.75		4.00		6.25		6.50			
20	Feb	2.30		2.50		2.70		2.50			
7	Mar	1.60		1.70		1.70		1.70			
20	Mar	1.20		1.20		1.40		2.50			
4	Apr	7.00		7.00		9.00		9.00			
24	Apr	4.00		4.00		4.00		4.25			
9	May	3.25		3.25		3.25		3.25			
22	May	3.75		5.25		8.25		7.50			
6	Jun	3.25		3.50		4.00		6.50			
19	Jun	4.25		6.75		10.5		11.0			
5	Jul	4.25		4.25		5.25		6.50			
17	Aug	5.75		6.50		8.75		8.75			
13	Sep	5.25		5.25		8.00		10.0			
19	Oct	5.00		5.50		5.50		5.25			
16	Nov	5.75		6.25		7.75		10.0			