U. S. ARMY, CORPS OF ENGINEERS

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

CHEF MENTEUR
BARRIER COMPLEX

DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

BP-1MU...5MU, 10MU, 11MU
BP-3M... BP-26M

BP-30M ... BP-39M
BP-27M

prepared for

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

by

BURK & ASSOCIATES, INC.
NEW ORLEANS, LOUISIANA

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

JOINT VENTURE

MAY, 1969

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TC202 N46L3P6 no.2 suppl.3 1969

LMVED-TD (NOD 17 Jun 69) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 22 Oct 69

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

1. Referred to note approval, subject to comments in previous indorsements.

2. Reference para 10a of 2d Ind. The proposed single bridge to accommodate both the crane tracks and vehicular traffic will require the clear distance between the crane legs to be adequate to pass any vehicle, or construction equipment, expected to use the bridge. In addition, the roadway will be obstructed during removal or replacement of gate sections. The above should be considered in evaluating the comment.

3. Reference Plate 15, Section B2-B2. With the pile arrangement indicated, stability against rotational moments due to any eccentricity of the resultant load about the elastic center of the piling must be resisted by lateral passive earth resistance and lateral resistance of the piling. This could result in objectionable bending stresses in the piling and poor alignment of the monoliths at the monolith joints. In order provide more positive resistance to rotational moments, consider add[illegible] vertical piles on each side.

FOR THE DIVISION ENGINEER:

George B. Davis

GEORGE B. DAVIS
Acting Chief, Engineering Division

LMVED-TD (NOD 17 Jun 69) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 24 Jul 69

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

1. Pursuant to para 17a, ER 1110-2-1150, the subject design memorandum is forwarded for review and approval. Approval is recommended subject to the following comments.

2. Paras 14 and 15, pages 9 and 10. Although the grades cited agree with those approved in DM No. 1, Part II-Barrier, the following comments should be given consideration:

a. Erosion may constitute a serious problem in the reaches of levee having a net grade at el 9 because these levees can be overtopped. Para 36 states that no erosion protection is considered necessary on the levee slopes. It is likely that serious erosion exceeding the scope of "normal" maintenance operations may occur. Thus, the need for providing erosion protection should be reconsidered, taking into account the degree of risk involved if no protection is provided. In this regard we understand from NOD that the levee crown width of 20 ft was selected to help provide a more stable section under overtopping conditions and to help reduce erosion damage.

b. Should the study in subpara a above indicate that erosion protection is not needed, we consider that the levee should have a crown at el 14, or higher, from a point 200-ft west of the control structure to approximately sta 205+00.

c. Although a net grade of el 14 has been selected for the structures and portions of the levee covered in the DM, it should be noted that the grade of the adjacent New Orleans East back levee is to be at el 17.5. This higher elevation was selected allowing for 4.5 ft of wave runup superimposed on a wind tide level of 13.0. Thus, if the New Orleans East back levee is to be constructed to el 17.5, it would appear that those portions of the Chef Menteur Pass Complex which are not to be overtopped also should be constructed to el 17.5.

3. Table 1, page 11, Cases 5 and 8. Explanation of water surface elevations should be included.

4. Para 17, page 12. a. A discussion of the range and duration of velocities and discharges that could be encountered during the closure operation should be included in the GDM.

b. Gradation of the material to be used for the sand portion of the closure dam should be given.

c. The method of construction of the closure dam, the number of dredges, or the capacity of the dredge or dredges should be included in the feature design memorandum.

d. For the design condition (3.25 fps) a total discharge of 130,000 cfs was estimated. It was assumed that the discharge would be distributed, according to available cross section, among the three outlets (control channel, navigation channel and Chef Menteur Pass). Using the design condition and assumption above, Q = 80,000 cfs and V = 5.32 fps when the closure dam is assumed to be at el -15. Computations indicate that the sediment transport capability through this section would be approximately 264,000 cubic yards per day; at el -10 (Q = 67,200, V = 6.72) the figure would be 296,000 cubic yards per day. If the discharge estimated above is reasonable and occurs frequently and is of long duration, attaining a -10 elevation could be difficult and as a result require excessive fill material.

e. The trapezoidal, flat crest shape of the sand portion of the closure dam looks good on paper; however, a more realistic shape would be in the form of a mound with a slightly rounded peak and slopes of 1 on 20 or less going away on each side until sediment transport capability is diminished, at which point the slope would become the angle of repose 1 on 6. For the crest length of approximately 1300 feet, as shown on Plate 19, at a -10 elevation, considerably more material will be needed, thereby increasing the cost for this item. Therefore, it is suggested that sediment transport capability computations be made at various sections through the fill site to determine the final shape and size of the sand fill portion of the closure dam.

5. <u>Para 17c(2), page 17 and Plates 18, 20, 33, 36, 43 and 44.</u>

a. The last sentence of the paragraph states that the soft clay strata in the Chef Menteur Pass will be excavated from beneath the closure dam. Based on a study of the physical properties of the upper clay strata indicated by borings 10MU, 6M and 11MU as well as the adjacent borrow borings, we question the need for removing this material. The stability analyses suggest lower strength foundation materials could be tolerated. If consolidation of these soft clays under closure dam loading controlled the decision to excavate this material, this should have been clearly presented in the design memorandum. If not previously accomplished, a comparative study of closure dam design should be made considering both excavation and non-excavation of the soft clay strata to determine the most feasible and economical design and construction procedure.

b. In conjunction with the above study consideration also should be given to a type of construction which displaces the soft clays from beneath the closure dam section.

c. If the above studies indicate excavation of the soft clays is required, the feature design memorandum should present sufficient data to permit preparation of plans and specifications in which the depth and lateral extent of the materials to be excavated can be reasonably delineated. The boring data presented in this general design memorandum are not sufficient to satisfactorily accomplish this.

d. The results of the study should be presented in the feature design memorandum (see para 17a(1), page 12) for the control structure in which the design of the closure dam is to be incorporated.

6. Para 17f, page 19 and Plates 19, 20, 33, 36 and 37. a. A maximum water elevation of 13 on the Gulf side is used in the seepage analysis on Plate 19 while a maximum Gulf side water elevation of 14 is indicated on Plate 20. This discrepancy should be reconciled.

b. Computations of critical uplift pressure for the closure dam section should be presented in the feature design memorandum.

c. For the effective grain-sizes of the sands to be excavated for the closure dam fill Fig. 17 of Vol 1, WES TM No. 3-424, "Investigation of Underseepage and Its Control, Lower Mississippi River Levees," October 1956, indicates permeability values considerably greater than those on Plate 19. As the sand is to be placed by hydraulic methods the laboratory values for the coefficient of permeability may not be applicable. Although use of a considerably greater composite value for the coefficient of permeability may not result in excessive seepage flows, the permeability coefficient used for design seems low and should be reevaluated.

d. Consideration should be given to placing an impervious blanket on the Gulf side 1 on 6 hydraulic fill (sand) slope to reduce uplift pressures and seepage flows. This would permit a large reduction in the base width and volume of sand required for the closure provided the large base is not governed by hydraulic considerations related to constructing the closure.

7. Para 17g, page 19 and Plates 18 and 19. a. To reduce the estimated settlement of the hydraulically placed clay and facilitate keeping the closure dam to grade, consideration should be given to replacing a portion of this clay with hydraulic fill sand. For example, if the sand were placed to el 0 at the centerline, the amount of clay levee to be built over the sand would be greatly reduced.

b. If the base width of the closure dam cannot be reduced appreciably, consideration should be given to shifting the dam centerline approximately 500 ft toward the Gulf side to avoid placing hydraulic fill sand in the low area north of baseline "A" shown on Plate 18. Although this may necessitate realignment of the protection levees on either side of the closure dam, the closure alignment should be studied further to try to reduce costs.

8. Para 28a, page 23 and Plates 7 and 8. a. The foundation conditions for the levee reach between stas 220+00 and 278+59.65 also should be included in this paragraph.

b. The boring logs on Plates 7 and 8 do not agree with the foundation conditions described for stas 150+00 to 220+00 in para 28a(3). This discrepancy should be reconciled.

9. Para 28b(3), page 24 and Plate 5. The foundation conditions described in this paragraph do not agree with either of the two borings shown on Plate 5 for this reach. This discrepancy should be reconciled.

10. Para 32a(4), page 26. The results of the additional borings, testing and any reevaluation of the stability analyses required should be submitted to this office prior to or together with the plans and specifications for this work.

11. Para 32b, page 26, and Plates 24 and 28 to 30. a. The need for stage construction and borings and tests between stages is concurred in. To help evaluate strength gain, Casagrande open-type piezometers should be installed prior to construction and observed during and after construction.

b. Para 5, page 3 suggests that the first lift of embankment closures (levees) is covered in sufficient detail to prepare plans and specifications. This DM Supplement does not contain the stability analyses for the first stage of either the closures or adjacent levees. It presents stability analyses of the final net GIWW barrier embankment closure sections, and protection levee sections. As the shear strengths used in these analyses are those existing prior to construction and no increase in strength is assumed from stage construction, the analyses indicate that the final net levee section should be stable with respect to shear failure. However, they do not assure that the first stage is stable. The stability analyses for the first lift GIWW barrier embankment closure sections and levee sections assuming existing shear strengths prior to construction, should be submitted for review as a letter-type supplement with or preferably prior to plans and specifications for this work. Further, stability analyses for each subsequent lift or shaping of these closure sections (using increased shear strengths based on additional undisturbed borings and laboratory testing and piezometric data) should be submitted as described above for the particular lift or shaping under consideration.

12. Para 35, pages 27 and 28. The last sentence of para 35a, page 27 should be revised to indicate that total settlement of the levee embankments also will depend upon the amount of lateral, no volume change, movement of the foundation. Data in Section VI, para 97, of NOD Interim Report, Field Tests of Levee Construction, Test Sections I, II, and III, East Atchafalaya Basin Protection Levee indicate as much as 45 percent of the observed vertical settlement may result from lateral, no volume change, movement of the foundation. Therefore, the cost estimates for embankment quantities in Table 6 should include an allowance for increased settlement caused by lateral spreading of the foundation as appropriate.

13. Para 38, page 30. This paragraph indicates that the pipeline is to be relocated over the final levee grade. Since the levee is to be constructed in stages over a period of time, it will not be possible to relocate this pipeline on top of the levee, if the levee is to support the pipeline, until the levee is completed. Also, it may be necessary to remove the existing pipeline from beneath the levee base prior to constructing the first lift. If the design for relocating the pipeline has not considered the above, local interest should be informed of this requirement and the restrictions involved and cost estimates for relocations revised if necessary.

14. Para 42b, page 31. The need for two engine-generator sets on the gantry crane is questioned. Consider the need for providing two cranes.

15. Para 42c, page 32. Reference is made to the second sentence. The temperature of the structure during construction and before flooding of the site could be quite high. After completion, the temperature would drop to about the water temperature during the winter. The need for contraction joints should be reconsidered during final design.

16. Para 44a(2), page 35 and Table 5, page 34 and Plates 38 and 39. The reason for selection of the design shear strengths in a manner indicated in Table 5 is not apparent. The use of these shear strengths could yield misleading results. The shear strength variations with depth, as indicated by borings 1-MU and 2-MU on Plates 38 and 39, should be used for the design analyses for the control and navigation structures.

17. Para 44b(2), page 36. Uplift assumed equal to the Gulf side head on the Gulf side, and Lake side head on the Lake side of the sheet pile cutoff is believed more reasonable for both structures where a sand and gravel drain is provided.

18. Para 44b(4), page 36. Suggest that batter piles should not be driven on a batter flatter than 2 on 1.

19. Para 44c(2), page 37. With a pile arrangement as shown on Plate 15, any moment about the elastic center (intersection of the projected axis of the two piles) must be balanced by the differential passive earth pressure and the bending strength of the piles. With the weak soils indicated, net active pressure may exist to some depth below the wall footing. Such unbalanced pressures will contribute to the load and moment on the wall and should be taken into account in the final design. Also, differential heads at lower stages may result in a larger moment about the elastic center.

20. Para 44d(1), page 38. a. The term "Z" used in the active and passive earth pressure equations in the next-to-last sentence of the paragraph should be defined.

b. The last sentence of the paragraph apparently is in error. Multiplying the cohesion component of active earth pressure by a factor of safety of 1.5 will decrease the active earth pressure. The factor of safety should properly be applied by dividing the cohesion component of active earth pressure by 1.5.

21. Paras 44d(2) and 45, page 38. If not previously accomplished the analyses discussed in these paragraphs should be checked for the "S" stability condition. The final design should be selected from the governing condition (Q or S).

22. Para 45, page 38. The settlement of the levee fill will result in a drag force on piles supporting the "tie-in" walls. The effect of this drag should be taken into account in the final design. The amount of settlement could be reduced by preloading the foundation in advance of construction.

23. Para 46, pages 38 and 39. It is not apparent from the information presented exactly what the total settlement figures in subparas a and b represent, i.e., total settlements of the control and navigation structures, total settlements of the pile foundation groups or a combination of the above. The paragraph should be revised to clearly define the settlements presented as well as indicate total settlement of the control and navigation structures.

24. Para 47, page 39. A study of the cofferdams and dewatering of each structure site should be presented in the feature design memorandum, to permit an evaluation of the cost estimate. When computing the discharge from the dewatering system, the permeability of sand strata should be estimated from Fig. 17, Vol 1, WES TM No. 3-424.

25. Table 9, page 51. The assumption that the protection levee and closure dam will be completed by September 1977 and August 1981, respectively, seems optimistic. Based on experiences with Atchafalaya Basin guide levees, it has been found that completion dates for levees built in stages on soft foundations are generally underestimated. The above should be recognized when data from this table are used for planning purposes.

26. Plates 1, 13, 22 and 23. a. The typical sections indicate that access will be provided from both east and west of the navigation structure by the shell roadway on the levee crown. Discussion with NOD personnel indicates access from both directions is provided as there is no vehicle access across the navigation structure. These discussions also indicate that the Chef Menteur protection levee ties into the New Orleans East back levee at sta 0+00 which does not presently include access road. Thus, consideration should be given to providing access to the control and navigation structures by a shell roadway from U. S. 90 Highway located approximately as shown in red on Plate I. This would eliminate need for providing access on top of either the New Orleans East back levee or South Point to GIWW levee.

b. The need for providing 20 car-parking areas as indicated on Plate 13 should be reexamined. The access roads proposed are for operation and maintenance and the need for parking areas of this size is not readily apparent.

27. Plate 7. Borings 10-MU and 11-MU should be indicated in plan on this drawing.

28. Plate 15. a. Section B-B. In feature design studies, consider reducing the distance between the levee crown and gate structure. At present, this distance and resulting length of "tie-in" wall seem excessive.

b. Sections B1-B1 and B2-B2. Wave forces will cause an uplift force under the roadway slab.

29. Plate 16. Limits of riprap on channel slopes should be revised as shown in red. Otherwise, toe scour just beyond the riprap could undermine overlying riprap.

30. Plate 17. a. In feature design studies, consider reducing the distance between the levee crown and gate structure. At present, this distance and resulting length of "tie-in" wall seem excessive.

b. The elevation view indicates a steel sheet pile cutoff. Sections A-A and B-B indicate prestressed concrete sheet piles.

c. The penetration of the sheet pile cutoff (20 feet ±) may be excessive since the foundation soils are impervious.

d. The 4-foot thick piers may not be thick enough since the depth of gate slots is estimated at about 19 inches.

e. Deflection of the base slab should be checked. Excessive deflection will result in non-uniform support of the gates and may cause trouble with the seals.

f. The pile arrangement in Section A-A and Section B-B apparently results in a rather high elastic center, which may result in a rather large eccentricity of the resultant force. If the penetration of the sheet piling can be reduced, a more desirable pile arrangement may be possible.

31. The operation of the structures should be discussed indicating when the gates would be closed and when they would be opened. The only access to the structures is via highway 90 and the levee crown. The levee crown at el 9 and probably the highway are subjected to being inundated during a storm. Unless operating personnel remain on the structure there is a possibility that due to flooding and possible damage to the highway and levee roadway, the structure may be inaccessible, following a hurricane, except by boat.

32. Plate 20. The hydrostatic uplift diagram indicated for the stability analysis of the closure dam (final shaping) cannot be checked. Apparently the flow net presented on Plate 19 has not been considered in computing the uplift. The uplift should be rechecked and corrected if necessary.

33. Plates 23 and 29. Although not discussed in the design memorandum, the excavation to el -13.0 on 1 on 3 side slope with a 174 ft bottom shown on the typical section through the protection levee and also on the stability analyses for stas 125+09.83 to 177+40 and 193+40 to 198+40, apparently is required due to the presence of very low shear strength material (ϕ=0, c=50 psf) as indicated by boring 2-MU. The stability analyses should be reanalyzed using the additional borings and laboratory tests discussed in para 32a(4), page 26, to determine if this method of embankment construction can be eliminated. In the event the analyses discussed above indicate excavation to el -13.0 is required, consideration should be given to backfilling this excavation with hydraulic fill sand rather than hydraulic fill clay.

34. Plate 24. a. The design shear strengths and stability analyses used to ascertain the template sections shown on this plate should be discussed in the design memorandum.

b. The column in the table shown on the plate entitled "Settlement At Centerline" should be referenced to explain exactly what settlement the figures in this column represent.

35. Plates 27 and 31. The 40-ft minimum berm distance shown for the typical section of relocated GIWW, navigation channel, cast dikes and spoil areas on Plate 27 does not agree with the berm distance shown on the GIWW relocation stability analysis for sta 660+00 to 770+00 on Plate 31. The contract drawings for the new GIWW should be prepared so as to provide the berm distances required by the slope stability analyses.

36. Plate 30. The design shear strength used for the embankment in the stability analyses indicated on this plate is $\phi=0°$, c=400 psf whereas all other embankment design shear strengths used in the stability analyses in the design memorandum are $\phi=0°$, c=300 psf. The use of this higher value for the embankment in the analyses on this plate shoud be explained.

37. Plate 32. a. The water surface elevations considered in the stability analyses presented on this plate should be indicated.

LMVED-TD (NOD 17 Jun 69) 1st Ind 24 Jul 69
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex

b. Reference is made to Note 1 on this plate. It is not apparent how this can be effectively written into the specifications or rigidly enforced during construction. This requirement should be reevaluated.

38. Plate 35. The stability of the existing GIWW bank after making the 1 on 2 slope for borrow excavation should be investigated and presented in the DM.

39. Refer to comments marked in red on pages 7, 9, 17, 18, 22, 26, 29 and 35 of the text and on Plates 1, 2, 16, 17, 19, 28, 29, 30, 31 and 32.

FOR THE DIVISION ENGINEER:

1 Incl
wd 2 cy

A. J. DAVIS
Chief, Engineering Division

CF:
NOD-LMNED-PP w marked cy incl

ENGCW-EZ (LMNED-PP, 17 Jun 69) 2nd Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex

DA, Office of the Chief of Engineers, Washington, D. C. 20315, 19 September 1969

TO: Division Engineer, Lower Mississippi Valley

1. General Design Memorandum No. 2 - Supplement No. 3 is approved, subject to the comments of the Division Engineer in the 1st indorsement and the following comments.

2. 1st Indorsement, Paragraph 2. In connection with the comments of the Division Engineer, the rationale for selecting net levee and structure grades of 9 and 14 feet m.s.l. should be presented. If further consideration of the design grades results in recommended changes, supporting information should be provided to permit an independent appraisal of the recommendations of the District and Division Engineers.

3. Paragraph 43a and Plates 14 and 15.

a. Consideration should be given to widening the proposed navigation structure. An increase from the proposed 56-foot width to 84 feet is suggested, making it the same width as the Seabrook Lock.

b. Full use should be made of recent studies by WES on the sector gate shape at meeting point of gates to insure that a design will be used that will permit satisfactory operation under reverse head.

4. Paragraph 43b. The design memorandum should indicate the prevailing wind direction and its effect upon traffic through the navigation structure.

5. Paragraph 44b(4). The final design analysis of integrated pile action should be submitted to OCE for information. Consideration should be given in the pile foundation design to settlement of foundation materials and down drag forces.

6. Paragraph 45. The factor K_o should be defined. The final design should consider bearing value reduction due to group action and its effect on design safety factors.

7. Paragraph 49. In regard to the beautification aspects, additional thought should be given to what effect the planned development might have on all possible future development in the area. Similar existing areas and

development therein should be used as a guide. Waste and borrow areas should be selected accordingly. The appearance of adjacent land areas to the relocated GIWW should be taken into consideration and beautification measures applied where appropriate.

8. Discussion should be given concerning the effects of project construction on the use or maintenance of traffic of the existing GIWW.

9. Plate 14. Consideration should be given to full length straight timber guide walls with protective sheet pile cells at the ends to assist the alinement of barge tows at the navigation structure entrance.

10. Plate 17.

a. In final design, consideration should be given to raising the roadway and gantry track to Elevation 17.5 and combining them on a single bridge above covered gate recesses.

b. Consideration should be given to a T-wall non-overflow section at each end of the control section, similar to Section B2 on Plate 15.

FOR THE CHIEF OF ENGINEERS:

B J Blankinship
for WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

1 Incl
wd

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

LMNED-PP

17 June 1969

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 3, Chef Menteur Pass Complex

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

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

2. Burk and Associates, Inc., Engineers, New Orleans, Louisiana and Harza Engineering Company, Consulting Engineers, Chicago, Illinois prepared this design memorandum under the provisions of Contract No. DACW29-68-C-0010.

3. Approval of the subject design memorandum is recommended.

1 Incl (16 cys)
GDM No. 2, Supp. No. 3

Herbert R. Haar, Jr.
HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

STATUS OF DESIGN MEMORANDA

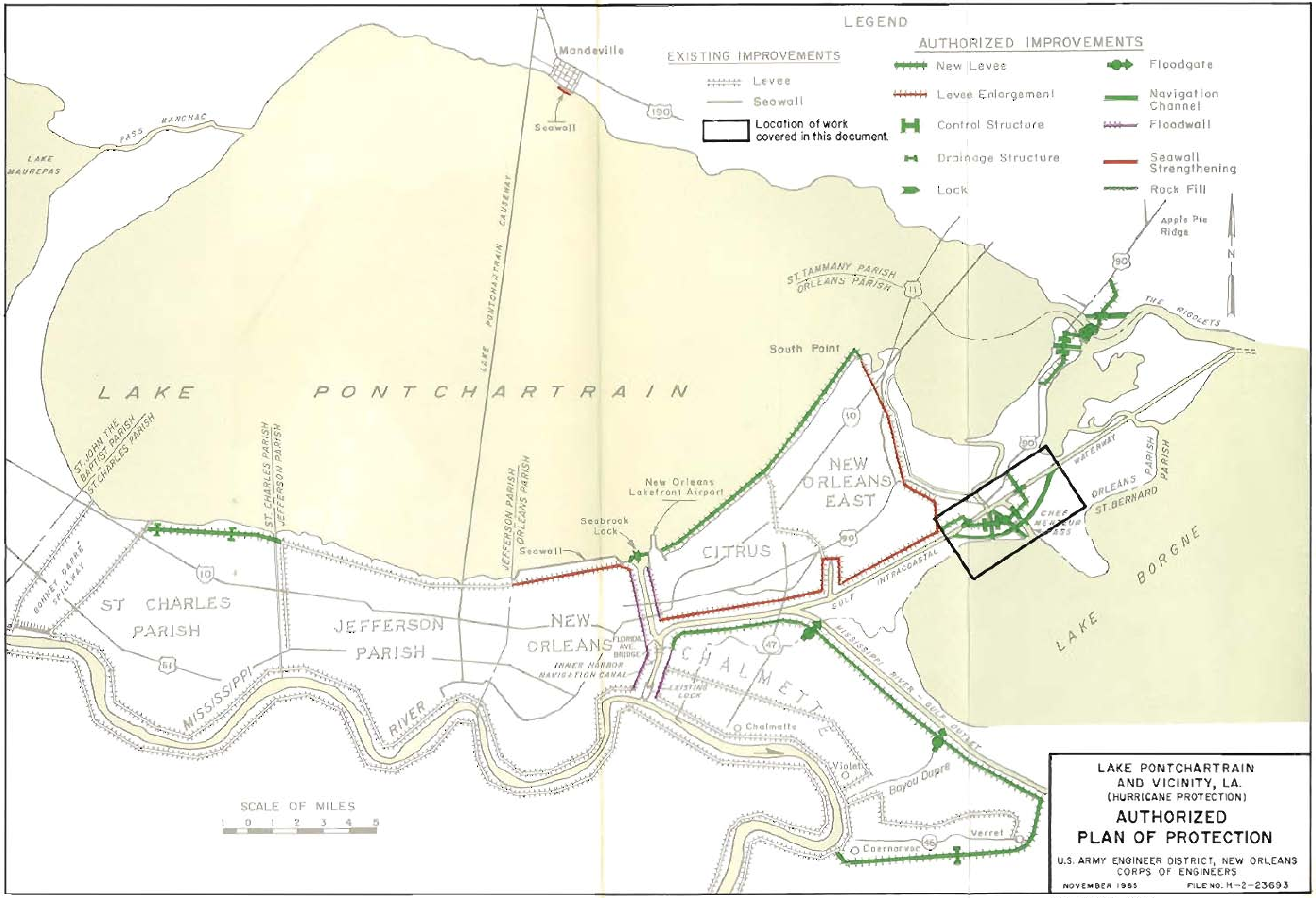
Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 6 Mar 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Approved 29 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Scheduled Dec 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Scheduled Jul 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex	Submitted 17 Jun 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Scheduled Jan 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	Scheduled Jan 71

STATUS OF DESIGN MEMORANDA (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5A, Orleans Parish Lakefront Levee - East of of IHNC	Scheduled Sept 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Scheduled Aug 69
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 GIWW	Scheduled Sept 71
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Submitted 21 Oct 68
4	Lake Pontchartrain Barrier Plan and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC	Not scheduled
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre	Approved 29 Oct 68
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Scheduled Jan 71
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Jul 70
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Scheduled Sept 70

STATUS OF DESIGN MEMORANDA (cont'd)

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



LAKE PONTCHARTRAIN AND VICINITY, LA.
(HURRICANE PROTECTION)

AUTHORIZED PLAN OF PROTECTION

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

NOVEMBER 1965 FILE NO. H-2-23693

REV. APRIL 1968

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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TABLES

PERTINENT DATA

Location of project	Southeastern Louisiana, Orleans Parish, Chef Menteur Pass
Hydrologic data	
Temperature: Maximum monthly	87.1°F
Minimum monthly	43.0°F
Average annual	69.7°F
Annual percipitation: Max.	85.74 inches
Min.	31.07 inches
Avg.	60.58 inches

Hydraulic design criteria - tidal

Design hurricane - standard project hurricane (SPH)

Frequency	1 in 200 years
Central pressure index (CPI)	27.6 inches of mercury
Maximum 5-min. average wind	100 m.p.h.
Protection works - levee, structures & dam	**Net grade***
Protection levee	9.0
Control structure	14.0
Navigation structure	14.0
Closure dam	14.0
Intervening levee	14.0
Channel dimensions	
Control channel	700 feet x 6,650 feet
Navigation channel	125 feet x 12,050 feet
Relocated G.I.W.W.	150 feet x 36,671 feet
Rights-of-way	
Fee area	847 acres
Temporary easement	809 acres

*Elevations are in feet and refer to mean sea level, unless otherwise noted.

PERTINENT DATA (cont'd)

Estimated first cost	
G.I.W.W. relocation	$ 1,133,000
Protection levee	6,277,000
Control structure	5,336,000
Navigation structure	2,700,000
Control and navigation channels	772,000
Closure dam	3,220,000
Engineering and design	2,333,000
Supervision and administration	1,400,000
Lands and damages	718,000
Relocation	11,000
Total	$ 23,900,000

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

GENERAL

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

2. Project location and description. The "Lake Pontchartrain, La. and Vicinity", hurricane protection project comprises two independent and justifiable units, the Lake Pontchartrain Barrier Plan and the modified Chalmette Area Plan, and is located in southeast Louisiana in the parishes of St. Tammany, Orleans, St. Bernard, Jefferson, and St. Charles. The features of the project, as authorized, are shown on the flyleaf map File No. H-2-23693. Only the Lake Pontchartrain Barrier Plan unit is pertinent to this supplement. The salient feature of the Barrier Plan is the Lake Pontchartrain Barrier, a system of embankments and structures in Orleans and St. Tammany Parishes, the purpose of which is to limit the uncontrolled entry of hurricane tides into Lake Pontchartrain while preserving navigation access. Also included in the Barrier Plan are new lakeshore levees in St. Charles Parish and the Citrus and New Orleans East areas of Orleans Parish and enlargement or strengthening of existing protective works in Jefferson and Orleans Parishes and at Mandeville, Louisiana.

3. The report of the Chief of Engineers dated 4 March 1964, printed in House Document No. 231, 89th Congress, 1st Session, submitted for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers and the concurring report of

the Mississippi River Commission for those areas under its jurisdiction. The report of the Board of Engineers for Rivers and Harbors stated:

> "...For protection from hurricane flood levels, the reporting officers find that the most suitable plan would consist of a barrier extending generally along United States Highway 90 from the easternmost levee to high ground east of the Rigolets, together with floodgates and a navigation lock in the Rigolets, and flood and navigation gates in Chef Menteur Pass; construction of a new lakeside levee in St. Charles Parish extending from the Bonnet Carre Spillway guide levee to and along the Jefferson Parish line; extending upward of the existing riprap slope protection along the Jefferson Parish levee; enlargement of the levee landward of the seawall along the 4.1-mile lakefront, and construction of a concrete-capped sheet-pile wall along the levee west of the Inner Harbor Canal in New Orleans; raising the rock dikes and landward gate bay of the planned Seabrook Lock; construction of a new levee lakeward of the Southern Railway, extending from the floodwall at the New Orleans Airport to South Point; enlargement of the existing levee extending from the United States Highway 90 to the Gulf Intracoastal Waterway, thence westward along the waterway to the Inner Harbor Canal, together with riprap slopes along the canal; construction of a concrete capped sheet-pile wall along the east levee of the Inner Harbor Canal between the Gulf Intracoastal Waterway and the New Orleans Airport...."

4. The report of the Chief of Engineers stated:

> "...The Board (of Engineers for Rivers and Harbors) recommends authorization for construction essentially as planned by the reporting officers....I concur in the recommendation of the Board of Engineers for Rivers and Harbors."

5. Purpose and scope. This supplement presents the essential data, assumptions, criteria, and computations for developing the plan, design and costs for the protective works for that portion of the Lake Pontchartrain Barrier in the vicinity of Chef Menteur Pass which consists of a control structure and appurtenant

channels; navigation structure and appurtenant channels; closure dam; relocation of the Gulf Intercoastal Waterway (G.I.W.W.); and barrier embankment located between the existing New Orleans East levee and a point on U.S. Highway 90 about 0.8 mile east of Chef Menteur Pass. The first lift barrier embankment G.I.W.W. closures and relocation of the G.I.W.W. will be presented in sufficient detail to provide an adequate basis for preparing plans and specifications without additional design analyses.

6. Local cooperation. The conditions of local cooperation, pertinent to this supplement, specified in the report of the Board of Engineers for Rivers and Harbors, and concurred in by the report of the Chief of Engineers, are as follows:

> "....That the barrier plan for protection from hurricane floods of the shores of Lake Pontchartrain...be authorized for construction...Provided that prior to construction of each separable independent feature local interests furnish assurances satisfactory to the Secretary of the Army that they will, without cost to the United States:
>
> "(1) Provide all lands, easements, and rights-of-way, including borrow and spoil-disposal areas, necessary for construction of the project;"
>
> "(2) Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities made necessary by the construction works;"
>
> "(3) Hold and save the United States free from damages due to the construction works;"
>
> "(4) Bear 30 percent of the first cost, to consist of the fair market value of the items listed in subparagraphs (1) and (2) above and a cash contribution presently estimated at $14,384,000 for the barrier plan, to be paid either in a lump sum prior to initiation of construction or in installments at least annually in proportion to the Federal appropriation prior to start of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers, or, as a substitute for any part of the cash contribution,

accomplish in accordance with approved construction schedules items of work of equivalent value as determined by the Chief of Engineers, the final apportionment of costs to be made after actual costs and values have been determined;"

"(5) For the barrier plan, provide an additional cash contribution equivalent to the estimated capitalized value of operation and maintenance of the Rigolets navigation lock and channel to be undertaken by the United States, presently estimated at $4,092,000, said amount to be paid either in a lump sum prior to initiation of construction of the barrier or in installments at least annually in proportion to the Federal appropriation for construction of the barrier;"

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

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

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

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

7. <u>Investigations.</u>

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

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

(1) Aerial and topographic surveys of the area between U.S. Highway 90 and Lake Borgne in the vicinity of the Chef Menteur Pass;

(2) Soils investigations, including general and undisturbed type borings and associated laboratory evaluations;

(3) Detailed design studies for earthen levees and channels including levee and channel stability determinations;

(4) Tidal hydraulics studies required for establishing design grades for protective works based on revised hurricane parameters furnished subsequent to project authorization by the U.S. Weather Bureau;

(5) Real estate requirements and appraisals;

(6) Cost estimates for levees, closures, channels, and structures;

(7) Office studies evaluating alternate alignments for the Lake Pontchartrain Barrier. (refer to appendix A).

8. <u>Status of local cooperation</u>. The conditions of local cooperation as specified by the authorizing law, are quoted in paragraph 6. Essentially local interests must:

a. Provide all lands, easements, and rights-of-way required for construction;

b. Accomplish necessary alterations and relocations to existing facilities required by construction of the project;

c. Hold and save the United States free from damages due to the construction works;

d. Bear 30 percent of the first cost including the fair market value of items a. and b. above;

e. Provide an additional cash contribution equivalent to the estimated capitalized value of operating and maintaining the Rigolets lock;

f. Provide all interior drainage and pumping plants required for development of the protected areas;

g. Maintain and operate the project works in accordance with regulations prescribed by the Secretary of the Army; and

h. Acquire adequate easements to prevent encroachments on existing ponding areas and/or provide substitute storage or pumping capacity.

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

Mr. Leon Gary, Director
State of Louisiana
Department of Public Works
Baton Rouge, Louisiana 70804

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

10. Views of local interests. The Board of Levee Commissioners of the Orleans Levee District represents local interests. The plan presented herein was coordinated in detail with the Board's engineering staff and bears the approval of the Board. The intention and capability of the local sponsor to provide the required non-Federal contribution have been amply demonstrated; in fact, considerable work which ultimately will be incorporated into the overall project has already been accomplished by the sponsor.

11. Coordination with other agencies.

a. General. As previously mentioned, the State of Louisiana, Department of Public Works was appointed project coordinator for the State by Govenor McKeithen. This agency has functioned to coordinate the needs, desires, and interests of State agencies and the Corps of Engineers. The Orleans Levee District, which will provide the local cooperation for all features of the project other than those located in St. Bernard Parish, actively assisted in coordinating the project planning. The project plan presented herein is acceptable to both the above agencies.

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

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

(1) Minimizing water quality degradation during construction.

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

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

d. Provisions relative to water quality degradation during construction, control of accidental spillages, and maintenance of adequate sanitary facilities by construction contractors will be incorporated into the construction plans and specifications. The Seabrook Lock will be operated to provide a desirable salinity regimen in Lake Pontchartrain to the end that deleterious alterations in lake ecology will be avoided. The Regional Director has been advised of the action to be taken in connection with his comments.

Copies of correspondence with the Regional Director are included in appendix B.

12. Protective works. The plan herein covers all of project works in the vicinity of the Chef Menteur Pass, and includes:

a. Chef Menteur Pass control structure and appurtenant channels.

b. Chef Menteur Pass closure dam.

c. Chef Menteur Pass navigation structure and appurtenant channels.

d. All new barrier embankment located between the existing New Orleans East levee and a point on U.S. Highway 90 about 0.8 mile east of Chef Menteur Pass.

e. Relocation of the G.I.W.W.

13. Departure from the project document plan. An extensive change has been made to the plan as presented in the authorizing document. The change, which is within the discretionary authority of the Chief of Engineers and has been incorporated into the authorized plan. The alignment of the Lake Pontchartrain Barrier between New Orleans East and a point just east of Chef Menteur Pass was modified to relocate the embankment gulfward of an expanding prestige-class residential and commercial development located between the eastern limit of the existing levee system and Chef Menteur Pass. Bases and justification for this modification are contained in LMNED-PP letter dated 13 March 1967, subject "Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier", copy of which is included herein as appendix A. The modification was approved by OCE on 15 May 1967.

HYDROLOGY AND HYDRAULICS

14. General. The tidal hydraulic analysis and design for the Chef Menteur Pass Complex protective structures are presented in Design Memorandum No. 1, "Hydrology and Hydraulic

Analysis, Part II - Barrier", approved 18 October, 1967 which contains descriptions of the methods used in the tidal hydraulic design and covers essential data, climatology, criteria, and the results of studies which provide the basis for determining surges, routings, wind tides, runup, overtopping, and frequencies. In Part I - Chalmette, approved 27 October 1966, the climatology and hydrology for the entire Lake Pontchartrain, Louisiana and vicinity was presented.

15. The design hurricane for the protective works relative to the Chef Menteur Pass Complex is the Standard Project Hurricane (SPH) having a frequency of about once in 200 years, a central pressure index of 27.6 inches of mercury, a maximum 5-minute average wind velocity of 100 m.p.h. at 30 feet above water surface and a radius of 30 nautical miles from the center, moving on a track critical to the Chef Menteur Pass Complex at a forward speed of 11 knots. Detailed information on the design hurricane is contained in the above referenced memoranda. The net grade elevations[1] along the Chef Menteur Pass Complex resulting from the design hurricane are as follows:

Location	Net Grade
100' west of Control Structure to 100' east of Closure Dam	14.0
All others	9.0

16. Design conditions. Hydraulic and hydrology studies indicate design conditions as shown by Table 1 can be expected. These conditions are based on the premise that when the water level on either side of the protection levee is greater than elevation 9 ft., the overtopping will cause a water level build-up on the opposite side. Essential data, assumptions, criteria, and the results of studies which provide the basis for determining the hydraulic effect of overtopping is included herein as appendix C.

1 All elevations used herein are in feet and refer to mean sea level (m.s.l.) unless otherwise noted.

TABLE 1

CHEF MENTEUR PASS COMPLEX

– DIFFERENTIAL HEAD CONDITIONS –

CASE	WATER ELEVATION		STRUCTURAL DESIGN BASIC ALLOWABLE STRESSES STEEL / CONCRETE			REMARKS
	GULFSIDE	LAKESIDE	D.L. + W.L.	D.L.+W.L.+WAVE	D.L.+W.L.+BOAT	
1	+12.8	+ 4.0		0.67 FY 0.45 f'_c		HURRICANE CONDITIONS-INCREASED ALLOWABLE STRESSES-DESIGN FOR MAXIMUM CONDITIONS
2	+ 11.8	– 2.0		0.67 FY 0.45 f'_c		
3	+ 10.5	– 4.0		0.67 FY 0.45 f'_c		
4	+ 9.0	– 5.0	0.50 FY 0.35 f'_c			HURRICANE CONDITION-NORMAL ALLOWABLE STRESSES
5	+ 5.0	+ 2.5	0.50 FY 0.35 f'_c			MAXIMUM DIRECT HEAD UNDER WHICH GATES OPERATE FOR STRUCTURAL AND MECHANICAL DESIGN.
6	– 3.0	+11.5		0.67 FY 0.45 f'_c		HURRICANE CONDITION-INCREASED ALLOWABLE STRESSES
7	– 4.0	+ 9.0	0.50 FY 0.35 f'_c			HURRICANE CONDITION-NORMAL ALLOWABLE STRESSES
8	– 3.0	+ 2.5	0.50 FY 0.35 f'_c			MAXIMUM REVERSE HEAD UNDER WHICH GATES OPERATE FOR STRUCTURAL AND MECHANICAL DESIGN.

D.L. = DEAD LOAD
W.L. = WATER LOAD

SEGMENT 3
CHEF MENTEUR PASS COMPLEX
CONTROL STRUCTURE

CASE	WATER ELEVATION		STRUCTURAL DESIGN BASIC ALLOWABLE STRESSES STEEL / CONCRETE			REMARKS
	GULFSIDE	LAKESIDE	D.L. + W.L.	D.L.+W.L.+WAVE	D.L.+W.L.+BOAT	
1	+12.8	+ 4.0		0.67 FY 0.45 f'_c		HURRICANE CONDITIONS-INCREASED ALLOWABLE STRESSES-DESIGN FOR MAXIMUM CONDITIONS
2	+ 11.8	– 2.0		0.67 FY 0.45 f'_c		
3	+ 10.5	– 4.0		0.67 FY 0.45 f'_c		
4	+ 9.0	– 5.0	0.50 FY 0.35 f'_c		0.67 FY 0.45 f'_c	HURRICANE CONDITION-NORMAL ALLOWABLE STRESSES
5	+ 5.0	+ 2.5	0.50 FY 0.35 f'_c		0.67 FY 0.45 f'_c	MAXIMUM DIRECT HEAD UNDER WHICH GATES OPERATE FOR STRUCTURAL AND MECHANICAL DESIGN.
6	– 3.0	+11.5		0.67 FY 0.45 f'_c		HURRICANE CONDITION-INCREASED ALLOWABLE STRESSES
7	– 4.0	+ 9.0	0.50 FY 0.35 f'_c		0.67 FY 0.45 f'_c	HURRICANE CONDITION-NORMAL ALLOWABLE STRESSES
8	– 3.0	+ 2.5	0.50 FY 0.35 f'_c		0.67 FY 0.45 f'_c	MAXIMUM REVERSE HEAD UNDER WHICH GATES OPERATE FOR STRUCTURAL AND MECHANICAL DESIGN.
9	+ 5.0	+ 5.0	0.50 FY 0.35 f'_c			DEWATERED CONDITION

D.L. = DEAD LOAD
W.L. = WATER LOAD

SEGMENT 3
CHEF MENTEUR PASS COMPLEX
NAVIGATION STRUCTURE

17. Closure dam.

a. Hydraulics of Closure

(1) The Chef Menteur Pass is one of the two natural outlets of Lake Pontchartrain. This pass, which connects Lakes Pontchartrain and Borgne, is naturally developed and is approximately 7 miles long, 1000 feet wide, and has a nominal depth of 43 feet. The general plan of the project covered by this report includes the construction of a 400 foot wide by 25 foot deep control structure with approach channels flaring at a 12.5 degree angle horizontally from the 400-foot width at the structure to a width of 700 feet, from which point a constant width of 700 feet will be maintained. The channel bottom will slope 1 on 10 from elevation -25.0 at the structure to elevation -40.0 from which point a constant channel bottom elevation of -40.0 will be maintained. The new channel and control structure will replace approximately two and two-thirds miles of the existing channel which will be closed by an earthen embankment. Detail design of this closure will be included in the detail design memorandum for the Chef Menteur Pass control structure.

(2) The control structure and its approach channels have been designed to maintain substantially the same hydraulic characteristics for the Chef Menteur Outlet as the existing natural channel system except when hurricane tides are imminent and the control structure is closed.

(3) If the control structure and its approach channels are constructed prior to beginning of the closure, it will permit placing of hydraulic fill for the embankment with a minimum difficulty due to lower velocities of flow across the closure.

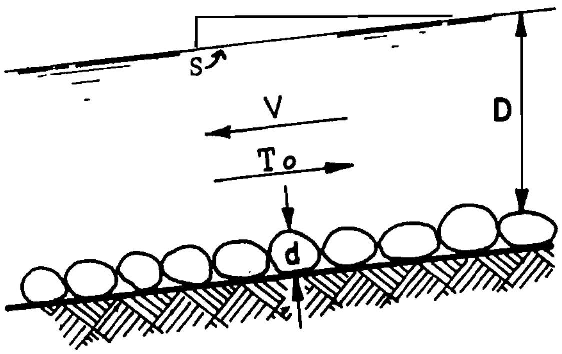
(4) Because both Lake Pontchartrain and Lake Borgne are very large as compared to the connecting channel, the physical changes to the outlet during construction of this project will not have any significant effect on the water level in the two large bodies of water. For this preliminary study it has been conservatively assumed that the design water level at the intersection of the control channel and the Chef Menteur Pass and the water

level in Lake Borgne are not affected by the construction of the control channel or closure dam. Based on measured current velocities in the existing Chef Menteur Pass, a velocity of 3.25 f.p.s. has been determined as a suitable design condition for closure of the existing channel. Based on this velocity, it has been calculated that the friction head loss between the control channel intersection and Lake Borgne is 0.6 feet. Before the closure is started, the velocity and hydraulic gradient between these two points will be fairly uniform; however, as the depth of water over the closure is decreased the velocity will increase and the slope of the hydraulic gradient over the closure will become steeper. The gradient of the remainder of the channel will necessarily become flatter, and velocity decreased, in order that the total head loss will not vary when compared to conditions prior to closure.

b. Bed load transport. The increased velocity over the closure embankment during construction will cause lateral movement of the soil particles by saltation or moving bed. If the velocity is high enough, particles will go into suspension. Considerable study and research in the field of soil conservation(2) regarding stream erosion has developed theories and design procedures for evaluating the amount of channel bed material being laterally transported under various conditions. These theories have been used in this study to evaluate the suitability of various types of material for use in construction of the closure embankment.

(2) Technical Bulletin No. 1026, "Bed-load Function for Sedimentation Transportation in Open Channel Flow", Hans A. Einstein, U.S. Department of Agriculture, SCS, September, 1950.

BEDLOAD TRANSPORTATION FORMULAE



S = Slope of water surface
V = Velocity of water, ft./sec.
γ_s = Soil density, lbs./c.f.
γ_f = Water density, lbs./c.f.
g = Gravity acceleration, ft./sec.^{2}
τ_o = Shear on bed caused by flow, lbs./sf.
R = Hydraulic radius
n_s = Coefficient of friction, (Manning's Eq.)=$0.034d^{1/6}$
V_c = Max. velocity which can occur and particle remain stable.
Ψ,ϕ = Einstein's bedload parameter

$\tau_o = SR\gamma_f$ (1)
also $\tau_o = d(\gamma_s-\gamma_f)\div\Psi$ (2)(Einstein)
$V = (1.486/n_s)R^{2/3}S^{1/2}$ (3)(Manning)

From equation (1), $S = \tau_o \div R\gamma_f$, and substituting this value for S in equation (3):

$$V = \left(\frac{1.486}{n_s}\right) R^{2/3} \left(\frac{\tau_o}{R\gamma_f}\right)^{1/2}$$

$$\left(\frac{\tau_o}{R\gamma_f}\right)^{1/2} = \frac{Vn_s}{1.486R^{2/3}}$$

$$\tau_o^{1/2} = \frac{Vn_s R^{1/2}\gamma_f^{1/2}}{1.486R^{2/3}}$$

$$\tau_o = \frac{V^2 n_s^2 \gamma f}{2.21R^{1/3}} \qquad (4)$$

I. Determination of V_c, critical velocity:

Substituting value of τ_o in equation (4) for τ_o in equation (2), V becomes V_c and:

$$\frac{V_c^2 n_s^2 \gamma_f}{2.21R^{1/3}} = \frac{d(\gamma_s-\gamma_f)}{\Psi}$$

$$V_c = \frac{1.486R^{1/6}\, d^{1/2}\, (\gamma_s-\gamma_f)^{1/2}}{n_s\, \gamma_f^{1/2}\, \Psi^{1/2}} \qquad (5)$$

II. **Determination of critical slope, S_c:**

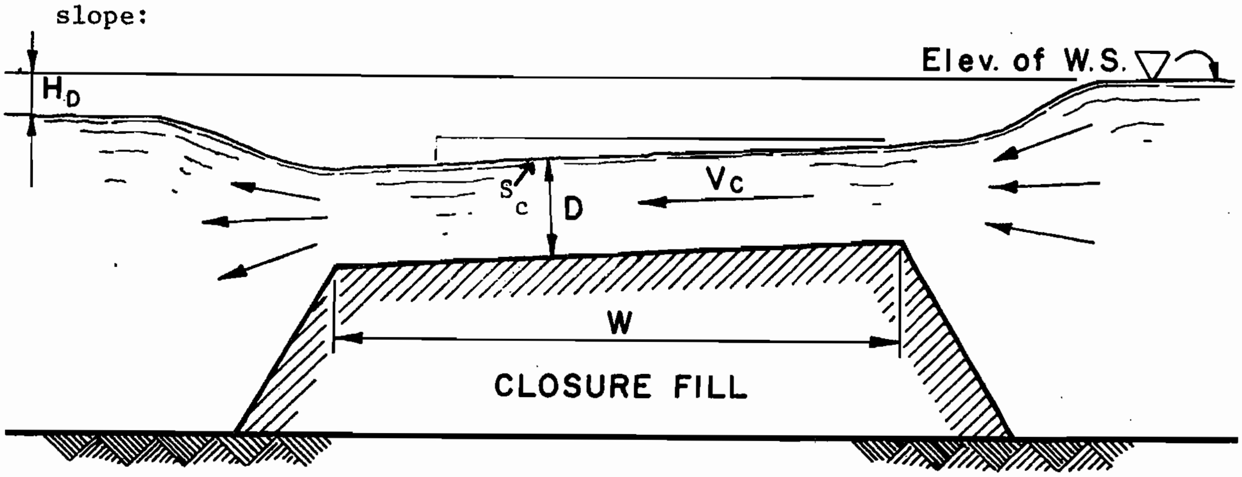
Substituting value of V_c in equation (5) for V in equation (3):

$$\frac{1.486R^{1/6}\ d^{1/2}\ (\gamma_s-\gamma_f)^{1/2}}{n_s\gamma_f^{\ 1/2}\ \Psi^{1/2}} = \frac{1.486R^{2/3}\ S^{1/2}}{n_s}$$

$$S^{1/2} = \frac{1.486R^{1/6}\ d^{1/2}(\gamma_s-\gamma_f)^{1/2}n_s}{1.486R^{2/3}\ n_s\gamma_f^{\ 1/2}\ \Psi^{1/2}}$$

$$S_c = \frac{d(\gamma_s-\gamma_f)}{R\gamma_f\Psi} \qquad (6)$$

III. Determination of width W at critical velocity and critical slope:



$$S_c = \frac{H_D}{W}$$

Substituting value of S_c in equation (6) into above equation:

$$\frac{d(\gamma_s-\gamma_f)}{R\gamma_f\Psi} = \frac{H_D}{W}$$

$$W = \frac{R\gamma_f\Psi\ H_D}{d(\gamma_s-\gamma_f)} \qquad (7)$$

IV. Determination of Einstein's bedload parameters, ϕ and Ψ:

q_B = bedload transport rate, lb./sec.

$$q_B' = \frac{q_B}{\text{Eff. channel width}}, \text{ lb./sec./ft.}$$

$$\phi = \frac{q_B'}{\gamma_s}\left(\frac{\gamma f}{\gamma_s - \gamma_f}\right)^{1/2}\left(\frac{1}{gd^3}\right)^{1/2} \qquad (8)$$

$$\Psi = \left(\frac{40}{\phi}\right)^{1/3} \qquad (9)$$

c. Stability.

(1) Two separate phases must be considered in analysing the stability of an embankment placed using hydraulic dredges; when the soil-water mixture is a fluid and has no shearing strength; and, as the water drains away the soil gains shearing strength. The slope of repose will be dependent upon the size of the particles being pumped, the concentration of solids, density of liquid medium (water and fines in homogeneous mixture), and whether the dredge is pumping into water or on land. Based on observations of various types of material, the following table of slopes is considered applicable for this project.

TABLE 2
SLOPE OF REPOSE

Type of Material	Slope of Repose
Sand under water	1 on 6
Sand above water	1 on 20
Soft Clay under water	1 on 25
Soft Clay above water	1 on 40
Stiff Clay under water	1 on 6
Stiff Clay above water	1 on 20

(2) In addition to the slope of repose, as the height of the embankment increases the stability with respect to the shearing strength may become critical. For this report, the proposed section of the closure dam has been analyzed for stability using the method of planes as described in EM 1110-2-1902. Shearing strength for clay placed with hydraulic dredge has been taken as approximately 50 percent of the in situ strength. Further, the soft clay strata in the Chef Menteur Pass be excavated from beneath the closure dam.

d. Methods

(1) The following methods were considered for making the closure:

Method A. Construct the fill using hydraulic fill (stiff pleistocene clay) for the entire embankment.

Method B. Construct the fill using hydraulic fill (soft clay) for the entire embankment.

Method C. Construct the fill using hydraulic fill (fine sand) with impervious blanket of hydraulic fill (soft clay).

(2) Method A was not considered suitable because borings taken in the Chef Menteur Pass indicated that the quality and quantity of stiff clay in the borrow area were inadequate. To obtain this type of material in another location would require the removal of 30 to 50 feet of over-burden before reaching the Pleistocene and considerable additional pumping distance.

(3) Method B was rejected because the extremely flat angle of repose for the pumped fill would necessitate the placing of an excessive amount of fill.

(4) Method C is recommended as being the most suitable and economical method for constructing the closure dam embankment. The typical section of the closure has been designed to meet the slope of repose criteria and bed load transport criteria. The section has been checked for stability due to shearing strength of soil at closure completion and after final shaping. The results indicate a factor of safety of not less than 1.3.

e. Wave protection. Both the gulf side slope and the Lake Pontchartrain side slope of the closure embankment will be protected against erosion due to wave action.

f. Hydrostatic pressure relief and seepage. During periods of hurricane tides when the closure structure gates are closed, a hydrostatic head differential will be created. The cross section has been designed to resist uplift pressure with a F.S. of 1.5 minimum. Calculation of the seepage flow indicates that it is not excessive and no special provisions other than described above are necessary.

g. Settlement. The removal of soft clay below the closure dam and the use of sand in the embankment to elevation - 10 minimizes the amount of settlement to be expected. Settlement in the clay layer beneath the embankment has been estimated as 1.22 feet at the centerline. It is estimated that approximately 7.0 feet of settlement at the centerline will occur in the soft hydraulically placed clay. Most of this settlement will occur during the first three years after the first lift of closure embankment has been completed. Final shaping of the closure dam will provide for a 2-foot over-build to accommodate any future settlement.

GEOLOGY

18. Physiography. The project(3) area is located within the Central Gulf Coastal Plain, or more specifically, on the eastern flank of the Mississippi River Deltaic Plain. Dominant physiographic features are marshes, natural levees, and abandoned distributaries. Relief in the area is very slight with a maximum variation of about 4 feet between the remnant alluvial ridge marking the location of an ancient distributary of the Mississippi River and the adjacent lowlands. Maximum elevations of 2 feet are found toward the southern end of the project area along the remnant alluvial ridge located between U.S. Highway 90 and Interstate Highway 10 (I-10). Minimum elevations of -4 feet are found in drained marsh areas near the north or Lake Pontchartrain end of the project.

(3) The term "project" as used in this paragraph refers only to the portion of the overall project covered by this supplement.

19. General geology. Only the geologic history since the end of the Pleistocene period is significant for this project. At that time, with sea level about 450 feet below its present level, the project area was a flat, highland plain bordering on the northeast side of the deeply entrenched Mississippi River. During this period the upper part of the Pleistocene was desiccated and weathered. About 5,000 years ago, sea level reached its present stand and the Mississippi began to migrate laterally back and forth across the alluvial valley. Approximately 4500 to 4000 years ago, the first Recent deltaic and alluvial sediments were carried into the project area when the Mississippi River occupied the Cocodrie Course. About 3500 years ago, the Mississippi River shifted its course over to the western part of the delta and occupied the Teche Course until approximately 2800 years ago. During this period, the project area was subjected to erosion and subsidence. The river then began shifting eastward to the La Loutre or St. Bernard Course and sediments were once again carried into the area. A major distributary at this time was Bayou Metairie, trending east-northeast through New Orleans. The remnant alluvial ridge from this distributary transverses the project area between U.S. Highway 90 and I-10. About 1500 years ago, the Mississippi River abandoned the La Loutre course and occupied the Lafourche course to the west. The project area was not subject to a heavy influx of sediments again until approximately 1200 years ago when the Mississippi shifted its course back into the study area and occupied the present Plaquemine course. Construction of levees along the Mississippi River has eliminated flood waters from the region and at present no sediments are being introduced into the project area.

20. Subsidence. Progressive subsidence and downwarping of the region in the vicinity of the project area have been occurring since the end of the Pleistocene Epoch. The Pleistocene surface has been downwarped towards the south and west from zero at the Pleistocene outcrop north of Lake Pontchartrain to a maximum of about 500 feet near the edge of the Continental Shelf, about 80 miles south of New Orleans. The overall rate of subsidence in the project area has been about 0.39 foot per century. In addition, large settlements of the ground surface have occurred in the marsh and swampland area that has been reclaimed and drained, as a result of the shrinking of the highly organic surface soils after drainage.

21. Investigations performed. General type and undisturbed borings, as indicated in table 3, were made in connection with preparation of this design memorandum.

TABLE 3
Number, Type and
General Location of Borings

Location	1-7/8" D Core Barrel Sampler	5" D Steel Tube Piston Type Sampler
On alignment of protection levee, control structure, navigation structure & closure dam	13	7
On alignment of control channel and navigation channel	5	0
On alignment of relocated G.I.W.W.	7	0
Borrow areas in Chef Menteur Pass	10	0

In addition, borings and geologic information from other sources were available for the interpretation of the physiography, subsurface, and foundation conditions of the area.

22. Foundation conditions. Generalized soil and geologic profiles are shown on plates 21,25 and 26. Recent deposits 45 to 60 feet in thickness consist of very soft marsh clays with organic matter to approximately 12 feet in depth; from that point to 45 to 60 feet in depth, the soil consists of soft intradelta clays and silts with layers and areas of sand. From approximately station 960 + 00 on baseline "E" (G.I.W.W. relocation alignment) and station 240 + 00 on baseline "A" (protection levee alignment) northward, buried sand beach deposits are encountered increasing in thickness from south to north. Maximum thickness indicated by borings approximates 35 feet in the general vicinity of station 255 + 00 on baseline "A" and station 987 + 00 on baseline "E".

This buried beach deposit is overlain with clay layers 12 to 15 feet thick. The Recent deposits are underlain by Pleistocene (Prairie Formation) deposits consisting of alternating layers of medium, stiff and very stiff clay, and layers of fine sand and silty sand.

23. Mineral resources. Oil and gas production do not exist in the immediate vicinity of the project. However, future exploration and production of these natural resources may take place in the area, but this will not be adversely affected by the project.

24. Conclusions. Due to the low shear strength and high compressibility of some of the recent materials, stability and settlement are major problems.

SOILS AND FOUNDATIONS DESIGN

25. General. This section covers the soil and foundation investigations and design for the project in the vicinity of Chef Menteur Pass between Lakes Pontchartrain and Borgne. The project consists of: barrier embankment, control and navigation structures and appurtenant channels, closure dam, and extends from the eastern terminus of the New Orleans East back levee to U.S. Highway 90 approximately 0.8 mile east of Chef Menteur Pass. Detailed soils investigation and design for the Chef Menteur Pass Control Structure and Closure, and Navigation Structure will be included in respective detail design memoranda.

26. Field investigation. Seven 5-inch diameter undisturbed borings were made along the barrier levee alignment. Thirty-five 1-7/8 inch ID general type (GT) soil borings were made in the project area: 13 along the levee alignment; 7 along alignment for the G.I.W.W. relocation; 5 along the control channel and navigation channel alignments; 5 for the borrow area investigation in Chef Menteur Pass at the intersection of the existing G.I.W.W.; and 5 for the borrow area investigation in the Chef Menteur Pass at the intersection of G.I.W.W. relocation alignment. The borings extended in depth to elevations varying from -58.0 to -100.0. Location and logs of borings are shown in plan and profile for respective levee and channels alignments (plates 2 through 11). Logs of undisturbed borings are shown on plates 38 through 44. Boring locations and logs for borrow areas are shown on plates 29 and 31.

27. Laboratory tests. Visual classifications were made on all samples obtained from the soil borings. Water content determinations were made on all cohesive soil samples. Consolidation (C) tests, unconfined compression (UC), unconsolidated-undrained (Q), consolidated-undrained (R), and consolidated-drained (S) shear tests were performed on representative soil samples encountered in the undisturbed borings. Liquid and plastic limits were determined for all cohesive samples on which consolidation and shear tests were performed. Grain size gradation tests were performed on representative foundation sand samples. The locations and results of the soils tests are shown on plates 38 through 44.

28. Foundation conditions. The subsurface along the project consists generally of 10 to 12 feet of very soft organic clay overlying 35 to 40 feet of recent deposits of soft clay, silts and sand which are underlain by the Pleistocene soils. The top of the Pleistocene was encountered at elevations varying from approximately -45 to -50. Generalized soil profiles are shown on plates 21, 25, and 26. The portion of the subsurface soils above the Pleistocene deposit, which directly affect the foundation for this project, consist generally of the following.

a. Protection levee

(1) Sta 0 +00 to 100+00 Very soft organic clay extends to elevations varying from -10 to -20 which overlies a thick strata of soft clay extending to elevations varying from -45 to -50, the top of the Pleistocene.

(2) Sta 100+00 to 150+00 Very soft clay extends to approximate elevation -17; a soft clay layer to approximate elevation -25; a sand, silty sand and silt layer to approximate elevation -30; and finally a stratum of soft clay extends to the top of the Pleistocene at approximate elevation -50.

(3) Sta 150+00 to 220+00 Very soft clay extends to approximate elevation -14; a silt layer to approximate elevation -25; a soft clay layer to approximate elevation -38; and a layer of sand extends to approximate elevation -54.

b. G.I.W.W. relocation

(1) Sta 660+00 to 770+00 Very soft organic clay extends to elevations varying from -10 to -20 which overlies strata of soft clay extending to approximate elevation -45.0.

(2) Sta 770+00 to 940+00 Very soft organic clay extends to approximate elevation -11; a silt and silty sand layer to approximate elevation -18; and soft clay strata extend to the top of the Pliestocene at approximate elevation -46.

(3) Sta 940+00 to 990+00 Very soft clay extends to approximate elevation -13; a silt layer to approximate elevation -18; a soft clay layer to approximate elevation -27; and fine sand strata extend to approximate elevation -58.

c. Navigation channel and control channel. Very soft clay extends to elevations varying from -14 to -16; a silt layer to elevations varying from -24 to -28; and a soft clay layer extends to approximate elevation -50.

d. Water contents of soils. The very soft clays have water contents varying from 60 to 100 percent. Water contents of the very soft organic clays vary from 100 to 500 percent, depending on its organic content. Soft clays in Recent deposits vary from 40 to 70 percent, while the medium and stiff clays in the Pleistocene have water contents of 40 percent or less.

29. Design and construction problems. The following were the principal design and construction problems for this project:

a. Type of protection.
b. Location of protection
c. Levee and channel stability.
d. Chef Menteur Pass closure dam (to be included in subsequent detail design memorandum).
e. Seepage and hydrostatic uplift relief (to be included in subsequent detail design memorandum).
f. Foundation for structures (to be included in subsequent detail design memorandum).
g. Settlement.
h. Erosion protection.
i. Source of fill material.
j. Method of construction.

The design and construction problems in connection with the control structure and navigation structures are discussed in paragraphs 40 -48 of this report.

30. Type of protection. Because the area in which this project is to be constructed is undeveloped except for a few fishing camps adjacent to U.S. Highway 90, conventional earthen levees provide the most economical type of construction. Although hydraulic and hydrologic studies indicate possible tidal elevations of 13 feet, the general protection levee for the undeveloped area adjacent to Chef Menteur Pass is proposed to be constructed to elevation 9.0. This will result in overtopping which has been considered in the overall Lake Pontchartrain Barrier Plan. The control structure, navigation structure, and closure dam will be constructed to elevation 14.0. It is therefore considered advisable to construct the protection levees adjacent to and between these structures to elevation 14.0 to prevent a concentration of flow and erosive water action adjacent to the principal structures.

31. Location of the protection. The location of the project was determined from an analysis of previous studies and meetings with interested parties. Details of these considerations are contained in LMNED-PP letter dated 13 March 1967, subject "Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans involving Modifications in the Alignment of the Lake Pontchartrain Barrier", a copy of which is included herein as appendix A.

32. Stability.

a. Channels.

(1) The G.I.W.W. channel relocation will have a bottom width of 150 feet at a depth of 12 feet below mean low gulf with side slopes of 1 on 3. Rights of way for dredging the channel will have a width of 500 feet. It is anticipated that a 500 foot strip on the Lake Borgne side of the channel right-of-way will be required for spoil area.

(2) The navigation structure channel will have a bottom width of 125 feet and a depth, side slope, and right-of-way similar to G.I.W.W. channel.

(3) The control channel will be excavated to a bottom width of 700 feet at a depth of 40 feet below mean sea level with appropriate transition vertical and horizontal on each side of the 400-foot control structure. Spoil from the control channel and the navigation channel shall be spread over the area bounded by the existing G.I.W.W., the relocated G.I.W.W., and the Chef Menteur Pass, except that no spoil shall be discharged in any area which will subsequently be used for some element of this project.

(4) Using generalized soil profiles considered typical for particular reaches of construction and (Q) shear strengths from the undisturbed soil borings, the stability of the channel slopes was investigated by the method of planes. Because the shear strength tests of organic clay strata appear to be unrealistically low, a higher value for (Q) shear strength (100 psf) was used for stability analysis of the navigation channel. Additional borings and tests are now being made and the results will be available prior to preparation of plans and specifications for this portion of the work. The critical failure surfaces, force vector diagrams and factor of safety for the channel slopes and representative foundation sections along the channel locations are shown on plates 31 and 32.

b. Protection levee. Using cross sections representative of existing conditions along the protection levee alignment, the slope and berm distances for the levees were designed for hurricane water condition at still water level (elevation 13.0 for 14 foot levee and 9.0 for 9 foot levee) for the project hurricane and assumed failure toward land side. The stability of the levee was determined by the method of planes using the design (Q) shear strength shown on the stability plates and applying a minimum factor of safety with respect to strength of 1.3. For transition between proposed New Orleans East levee (El 17.5) and new levee in this project (E 9.0), (Q) shear strength was based on estimated increase due to load of first lift (see Plate 29). Actual strength increase will be ascertained by additional undisturbed borings and laboratory tests prior to construction of second lift. The critical failure surfaces, force vector diagrams and factor of safety are shown by plates 28, 29, 30 and 35.

c. Borrow areas. Areas within the existing G.I.W.W. and Chef Menteur Pass designated for obtaining fill material for protection levee and closure dam have been investigation for slope stability with maximum anticipated borrow excavation. Results of these investigations are shown on plates 35 and 37.

33. Seepage and hydrostatic uplift relief. Sand and other pervious strata are generally quite deep in the project area and, except in the Chef Menteur Pass, are overlain with a minimum of 10 feet of impervious clay. It was determined that this clay layer

will prevent any significant under seepage of the protection levee and hydrostatic uplift pressure. Seepage and hydrostatic uplift relief for the closure dam are discussed in paragraph 17.

34. Foundation of structures. Assumptions relative to design of the structures foundations are included in paragraph 44 of this report. Detail design of the foundation for the structures will be included in respective detail design memoranda.

35. Settlement.

a. Based on the results of the soil borings, laboratory tests on soils borings and observations made on projects constructed with similar soil conditions, analyses were made to determine estimates of settlement and the rate at which this settlement may occur. The total settlement of levee embankments will result from two main factors: consolidation of the underlying subsoils and consolidation of the embankments fill material itself.

b. Settlement computations for the underlying subsoils were made using the procedures outlined in EM 1110-2-1904. The results of these calculations are given in the following table.

TABLE 4
Estimate of Ultimate Settlement and Time of 90 Percent Consolidation

Location of Protection Levee	Net Grade of Levee (ft.-m.s.l.)	Ultimate 1st lift (feet)	Settlement Final Section (feet)	Time for 90% Consolidation (years)
0+00 to 37+50	9.0	8.05	9.61	12.6
37+50 to 100+00	9.0	6.19	7.31	9.9
100+00 to 125+09.83	9.0	7.37	8.61	14.6
125+09.83 to 198+40	14.0	7.49	10.38	10.2
198+40 to 278+63.36	9.0	3.89	4.33	7.4

c. Because of the nature of hydraulic fills, the classic theory of consolidation cannot be directly applied to determine an estimate of settlement or the rate of settlement of the fill. An estimate has been made based on information regarding observations made during and after construction of similar projects using similar material. Clays, when dredged hydraulically, are deposited in individual balls within a matrix of semi-fluid soil. The individual balls retain most of their undistrubed cohesive strength and compression characteristics, however, as the fill pressure is increased by subsequently placed layers of fill, the matrices are displaced by the clay balls which deform to fill the vacated interstices and considerable settlement results.

d. The magnitude of this settlement has been estimated, based on observations of other similar fills, as 25 percent of the height of fill. Nearly all of this settlement will take place during or within two or three years after construction.

36. Erosion protection. Due to the short duration of hurricane flood stages and the resistant nature of clayey soils, no erosion protection is considered necessary on the levee slopes along most of the protection levee alignment. Since more frequent and severe wave action can be expected where the levee crosses the existing G.I.W.W. and Chef Menteur Pass, shore protection will be provided on the gulf side of the G.I.W.W. closures and both sides of the Chef Menteur Pass closure dam. Details of riprap protection are shown on plates 19 and 22. Foreshore protection will be provided along existing G.I.W.W. where it is adjacent to the protection levee.

37. Source of fill material. Consideration was first given to using material excavated from the G.I.W.W. relocation construction for the first lift construction of the protection levee. Analyses of soil borings along the G.I.W.W. relocation alignment indicate that the materials are very soft organic clays with extremely high water contents and extremely low shear strengths. Accordingly, these materials are considered unsuitable as fill material. Since the control channel is required to be excavated to a depth of 40 feet, and useable fill is available above this depth,this channel location will be used as a borrow area. Utilizing this area for borrow will require wasting material above approximate elevation -20 foot.

Additional usable fill material will be obtained from borrow areas at the bottom of the existing G.I.W.W. channel and Chef Menteur Pass. Borings within designated borrow areas in the Chef Menteur Pass indicate medium stiff clay, silty sand, and fine sand, which would make ideal fill material. Material for normal levee construction shall be obtained from the control channel borrow area or existing G.I.W.W. Material for the closure dam and the closure of other existing significant channels will be obtained from the Chef Menteur Pass.

Because of the convenient availability of the medium stiff clay in the Chef Menteur Pass the use of a more costly material such as shell for the closures is not advantageous.

38. Method of construction. The channels will be excavated by either boom type equipment or hydraulic pipeline dredge or a combination thereof. Spoil areas are provided adjacent to all channels and spoil shall be retained a minimum distance from the channel as indicated on the stability analyses plates 31 and 32. Protection levees will be constructed using a hydraulic pipeline dredge. Earth levees will be built by stage construction methods. This construction will take place over a period of several years to compensate for settlement due to consolidation of the subsurface strata as well as that of the levee fill material and to take advantage of increased shear strengths in the subsurface strata due to the aforementioned consolidation thereof. Material for normal levee construction will be obtained from designated borrow areas in the control channel area and existing G.I.W.W. channel. The protection levee crossing the existing G.I.W.W., Bayou Thomas, and the channel paralleling the south side of U.S. Highway 90 will be constructed using material from borrow areas within the Chef Menteur Pass. Proposed stage construction is shown by lift and shaping details on plate 24. The material required for the final cross section and the intermediate shaping, taking into consideration the shrinkage and consolidation of the levee embankment as well as the ultimate settlement of the subsurface strata, will be placed in one or more lifts. The height of the various lifts and shapings shown on the stage-construction plans are not to be exceeded during the construction period. Due to the nature and existing shear strengths of the soils in the subsurface strata, slides and base failure will occur if the fill is overloaded either by fill material or an excessive depth of runoff water from the hydraulic placement of the levee material. The height of the various lifts and shapings was based on providing a factor of safety of 1.3 against shear failure during all stages of construction.

The high pressure gas line and telephone pole(s) and supported cable (see plate 9) will require relocation. The telephone pole(s) will be relocated outside the levee right-of-way and the pipeline relocated over the final levee grade. The telephone cable will be relocated to provide a minimum clearance of 14 feet over final levee grade. After final levee and closure shaping, a shell roadway (16-foot width x 9 inches thick) shall be constructed over the full length of levee and closures.

39. Settlement observations. Settlement plates will be placed below the fill prior to the start of construction. Grade measurements will be made on the plates prior to the beginning of filling operations, during construction, and after completion of the fill. Details and location of settlement plates will be shown on the construction drawings for this work. Settlement observations will be made on all structures and levees after completion of construction and yearly thereafter until settlement is essentially complete. Observations will be made on all protection features approximately every 5 years thereafter.

OTHER PLANS INVESTIGATED

40. Control structure and gates. Various types of gates, methods of gate operation and corresponding structures were studied before adopting the scheme of sectionalized vertical lift gates operated by a gantry crane. Tainter and vertical lift gates operated by individual hoists were considered as a fast, relatively easy and reliable means of closure. Because the gates must be kept raised in the open position most of the time, they would present a large surface area constantly subject to wind forces. This was considered undesirable. Eight hoists would require more maintenance than a gantry crane. The fixed hoists for vertical lift gates would require costly superstructure. Tainter gates, with their trunnions above normal water level, and their hoists above wave action would require larger piers and the gates themselves would not be easily accessible for maintenance. In view of the foregoing, a scheme of sectionalized vertical lift gates operated by a gantry crane was adopted. The alternate studies are included herein as appendix D.

41. Navigation structure and gate. A structure with a gate hinged at the bottom, similar to the Empire and Buras floodgates planned for Reach B1 of the "New Orleans to Venice, La." project was considered. Such a gate, and the corresponding structure required to house it, so that it could be unwatered for maintenance, was not considered suitable for the requirement that the structure be convertible to a lock, when or if justified in the future. A

flat gate, which could be stored in a wet pit adjacent to the waterway and rolled out of the pit to close the waterway, was also considered. Such an arrangement would allow closing off and unwatering the wet pit to maintain the gate without interrupting traffic in the waterway. The reliability of operation and the incorporation into a future lock of such an arrangement is questionable and therefore was not considered suitable. Due to reverse head conditions and the requirement that the structure be convertible to a lock, it was considered that sector type gates would be most suitable. The alternate studies are included herein as appendix E.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

42. Control structure.

a. The control structure as shown on plates 16 and 17, will provide 9,200 square feet of opening below elevation zero. The opening will be closed by placing two gate section in each of the eight gate bays. The gate sections will be placed by a gantry crane and lifting beam. To place the sections, which will be stored in slots with their bottoms at elevation 3.0, the top section will be raised by the gantry crane and coupled to the lower section and the two sections lowered as a unit into the waterway. Each gate section will roll on four wheels with self-aligning spherical bearings that will reduce frictional resistance so that the gates may be placed under the maximum flow conditions possible in either direction. The use of only four wheels on each gate section will eliminate the need for close tolerances of the straightness of tracks in the gate slots. The skin-plates of the gates will be on the Lake Pontchartrain side of the structure as will the j-seals. The seals will be arranged to provide a tight seal in either direction.

b. The rate capacity of the gantry crane will be the pull required to raise the two coupled sections of a gate loaded with the unbalanced head on the gate resulting from design condition case 5 listed in paragraph 16. The gantry crane will be self-powered by an engine-generator mounted on the crane. Two engine-generator sets will be provided, one for operating and one for standby service. The gantry crane will be parked at the northeast end of the control structure when not in use, and, while parked, will be plugged into a standby connection that will power the crane lights and charge the batteries of the engine-generator sets.

c. The gated portion of the control structure will consist of a continuously reinforced concrete base slab with construction joints at the centers of the gate bays. No contraction joints will be provided since the slab will normally be submerged and therefore have little temperature differentials. However, to accommodate shrinkage during construction, the slab will be placed in alternate pours or with short closure pours at the center of the gate bay. Details will be finalized in details design memorandum no. 7. The slab will be supported on timber piles. Nine 4-foot piers, spaced 50 feet on centers, will be poured on top of the slab to form eight gate bays. A curtain wall, with bottom at elevation 2.0 in order to clear normal water levels, will span between piers. The possibility of raising the bottom elevation of the curtain wall and using higher gates was considered, but the idea was abandoned because higher gates would require: (1) greater lifting capacity for the gantry crane, (2) a higher gantry crane resulting in a greater stability problem for the crane design, (3) larger wheel loads for the gates, and (4) the gates would protrude farther above the deck of the structure. The lake side crane rail for the gantry crane will be carried by the curtain wall, and a concrete girder spanning between piers will carry the gulf side rail. A 12-foot roadway will be provided across the structure so that land based equipment may be used to maintain the levee between the control and navigation structures. The economy of using prestressed concrete for the curtain wall, the crane rail girder, and the bridge girders was investigated but found to be more costly than a reinforced concrete design. (See page D-6 of appendix). The gated portion of the control structure will be tied into the levees on either side by a reinforced concrete bulkhead wall supported by reinforced concrete piers 50 feet on centers. The piers will be carried on reinforced concrete footings and timber piles. A strutwall between the piers will stabilize the piers.

d. Considering that the normal tidal range between Lakes Pontchartrain and Borgne is about 1 foot, no provisions are necessary to prevent navigation from entering the control structure.

43. Navigation structure

a. The navigation structure, in the 125 foot wide navigation channel, as shown on plates 14 and 15, will provide a 56 foot wide clear opening with sill at elevation - 12.0 feet m.l.g. Steel sector type gates will be used because of reversed head conditions and the requirement that the structure be convertible to a lock. The minimum stage anticipated when the waterway is open to traffic is zero m.l.g., providing a minimum depth over the sill of 12 feet. The structure will consist essentially of a concrete gate bay on timber piling, flanked by floodwalls tying into the levee on either side of the structure. The gate bay will be designed as a reinforced concrete "U" frame. The floodwalls will be inverted T-type walls consisting of reinforced concrete supported by 12-inch square prestressed concrete bearing piles with a sheet pile cutoff. The top of the gate bay and the floodwalls will be at elevation 14.0 m.s.l.

b. Timber guide walls 300 feet long, with braced pile bents and horizontal timber walers, will be located on the southwest side at each end of the gate bay. Timber fenders 100 feet long will be provided on the northeast side at each end of the gate bay. The top of the timber guide walls will be at elevation 14.0 m.s.l. to provide approximately 10 feet of freeboard above mean high water for navigational purposes. The gate bay will be provided with slots for needle girders and needle beams so that the gate bay can be unwatered for repair or painting of the sector gates.

c. Two two-story control and gate operating machinery houses, one on each side at the gulf end of the gate bay, will be provided. The second floor of the houses will contain gate control panels and the first floor will contain an electric motor driven variable displacement hydraulic pump for driving the gate operating machinery. In addition, the first floor of the control house on the northeast side of the gate bay will contain a diesel-generator set to provide emergency power for operating the sector gates, a fire protection pump, and lighting of key areas of the navigation and control structures. The northeast side control house was chosen to house the generator set because it is assumed that the normal approach to the project will be across the shorter length of levee to U.S. Highway 90 on this side. However, provisions for remote starting of the diesel-generator set from the southwest control house will be provided. Two 10-foot access bridges will be provided, one from each side

TABLE 5
SOILS DESIGN PARAMETERS

	Control structure			Navigation structure		
	Marsh Deposits	Recent Deposits	Pleis-tocene	Marsh Deposits	Recent Deposits	Pleis tocene
Water content (%)						
Max.	432	85	42	533	95	38
Min.	137	35	32	165	45	22
Design	294	71	37	294	73	30
Liquid limit (%)						
Max.	377	105	71	288	103	62
Min.	201	38	50	176	35	38
Design	277	83	60	235	77	50
Plastic limit (%)						
Max.	158	39	20	194	38	21
Min.	40	19	18	51	19	15
Design	97	27	19	124	25	18
Plasticity index (%)						
Design	180	56	41	111	52	32
Wet density (pcf)						
Max.	76	120	119	81	119	125
Min.	71	93	117	79	94	115
Design	74	101	118	80	101	120
Dry density (pcf)						
Design	19	59	86	20	58	92
Buoyed density (pcf)						
Design	12	39	56	18	39	58
Cohesion (psf) (unconsolidated soils, ø=0)						
Max.	180	400	860	60	540	---
Min.	120	220	860	60	40	---
Design	140	280	860	60	280	900*
Friction (ø) (consolidated soils, C=0)						
Max.	---	36	---	---	35	35
Min.	---	20	---	---	20	28
Design	---	28	28**	---	28	31

* - Unconfined compression test.
** - Estimated value.

of the gate bay to the adjoining Levee. Power for operation of the sector gates, the fire protection pump, normal lighting, and engine-generator battery charging will be brought to the project site from the New Orleans Public Service Company lines on U.S. Highway 90.

d. Operation of the sector gates will be by rack and pinion with the rack located near the top of the gate and the machinery mounted on the gate bay wall. An electric motor driven hydraulic pump with hydraulic motor will be used to permit mounting the electric motor above maximum water level and to provide maximum flexibility for gate operation.

44. Preliminary design criteria.

a. Soil foundations.

(1) Control and navigation structures. The subsurface along the navigation and control structures consists generally of 10 feet of organic marsh deposits overlying 35 feet of Recent deposits of clay, silts, and sands which are underlain by a Pleistocene deposit encountered at elevation -45. A generalized soil profile is shown on plate 22.

(2) Soils design parameters. The ranges of soil test results and the values chosen for design of the control and navigation structures are given in table 5 . The results from boring 1 MU were used for the control structure and from boring 2 MU for the navigation structure.

b. Stability - navigation and control structures.

(1) Design loading conditions. A design for foundations for structures was made for the most severe loading cases in the list in paragraph 16. The most severe loading cases for foundation design are considered to be those with the greatest horizontal forces. Since an overstress is permitted in the foundation for cases that included dynamic loads, it was necessary to select cases for design both with and without dynamic forces included.

Preliminary studies indicated that the cases with greatest horizontal forces are the following:

With headwater on gulf side:
- Case 2 - Dead load + static water force + dynamic wave force.
- Case 4 - Dead load + static water force.

With headwater on lake side:
- Case 6 - Dead load + static water force + dynamic wave force.
- Case 7 - Dead load + static water force.

(2) Uplift. A sand and gravel drain was placed beneath the control structure, as shown on plate 16. Uplift along the foundation was assumed to vary linearly between headwater and tailwater. Vertical water loads and uplift were not computed for the navigation structure; instead the concrete was assumed bouyant below tailwater elevation.

(3) Stability analyses. Stability analyses of the control structure indicate it could be made stable against overturning but not against sliding, unless very deep toe buttresses are provided. Thus, the need for a batter pile foundation was indicated. Preliminary calculations also indicated the need for batter piles beneath the navigation structure. Therefore, the preliminary design of foundations for both the navigation and control structures has been based on pile foundations. The pile foundations of both structures were checked for stability as very large footing and found to be stable.

(4) Design assumptions. A pile foundation was designed for each of the loading cases given in paragraph 44.b.(1). For loading cases containing dynamic forces, an increase of 33 1/3 percent was permitted in the allowable pile load. Preliminary design of the control structure showed that the pile requirements for Cases 2 and 6 were greater than for Cases 4 and 7. In the navigation structure, the pile requirements for Cases 4 and 7 were greater than for Cases 2 and 6. The pile foundation finally selected for each structure and shown on the plates was based on Cases 2 and 6 for the control structure and on Cases 4 and 7 for the navigation structure. Two pile groups were designed for each structure. One group of batter piles was assumed to resist entirely all external horizontal forces from the critical gulf side loading, and the other group of batter piles acted independently of the first group and

entirely resisted all external horizontal forces from the critical lake side loading. The entire pile foundation consists of the sum of all the piles in both groups. The batter angle was assumed to be the same as the direction of the resultant of external forces, but limited to a maximum batter of 30 degrees from the vertical. Each pile group was arranged such that the external moment about its center of gravity was either zero or very small. Thus, all piles in the group are nearly uniformly loaded. Using the above simplifying assumptions, the integrated action of the piles cannot be checked. A more detailed analysis of the integrated action will be made during preparation of the detail design memoranda. The pile foundations will be analyzed using Vetter's and Hrennikoff's methods.

c. Stability - inverted T-type floodwall and access bridge.

(1) Design loading conditions. The design of the floodwalls and access bridge which tie into the protection levee was based on loading Cases 2 and 6 as described in paragraph 44.b.(1). These loading cases were found to be more severe than Cases 4 and 7 owing to the much greater ratio of horizontal to vertical forces caused by wave action.

(2) Design assumptions. Piles were assumed to be loaded axially. Separate pile foundations for each loading from Cases 2 and 6 were not designed as for the control and navigation structures. Rather, an integrated pile foundation was designed to resist loadings from both the gulf side (Case 2) and the lake side (Case 6). This foundation will be analyzed using Vetter's and Hrennikoff's method during preparation of the detail design memoranda.

d. Stability - Cantilever I-Type Floodwalls.

(1) Design criteria. The design of the floodwalls was based on loading cases, as given in paragraph 44b(1). Soil densities and strengths were taken as the design values presented in table 5 . Since the soils are basically cohesive soils, and are unconsolidated, their entire strength was assumed to be derived from cohesion and none of it from internal friction. The density and strength of the fill above elevation zero was assumed to be 122 pcf

(moist), 60 pcf (submerged) and 100 psf, respectively. Active earth pressures were evaluated by the formula $Pa = Z - 2C$, and passive earth pressures by the formula $p_p = z + 2C$. A factor of safety was applied by multiplying the cohesion component of active earth pressure by 1.5 and by dividing the cohesion component of passive earth pressure by 1.5.

(2) Stability analyses. Using the resulting shear strengths, net lateral water and earth pressure diagrams were determined for movement toward each side of the sheet pile. Using these distributions of pressure, the summation of horizontal forces was equated to zero for various tip penetrations. At these penetrations, summations of over-turning moments about the bottom of the sheet pile were determined. The required depth of penetration to satisfy the stability criteria was determined as that which the summation of moments was equal to zero.

e. Stability - control structure bridge piers. The design loading conditions and design assumptions are the same as for the control structure, (refer to paragraph 44(b)1 above), except that loading Cases 4 and 7 were found to be critical, and therefore used, for the end pier adjacent to the levee. The switch in critical loading cases is caused by the unsymmetrical loading of this pier.

45. Structural foundations. Piles for the navigation and control structures and bridge piers are to be timber piles with an average diameter of 12 inches. Piles for the inverted T-type floodwall and access bridge are to be 12-inch square concrete piles. The adhesion of the soil to the pile was taken as the cohesion determined from the undisturbed boring (Q) tests and using a factor of safety of 1.75 and $K_o = 1.0$ in compression, and a factor of safety of 2.0 and $K_o = 0.70$ in tension. Negative skin friction was not considered. No reduction of pile capacity was made for group efficiency because it was felt the method of design was overly conservative. Preliminary pile lengths were determined assuming friction piles with no end bearing. Pile lengths for construction will be determined from full scale field tests.

46. Settlement - navigation and control structures. Preliminary settlement analyses indicate both the navigation and control structures will settle about 0.5 foot each. More detailed settlement analysis,

including the effects of negative skin friction, will be made during the preparation of the detail design memoranda. The foundation settlement at various depths for the control and navigation structures was computed and is as follows:

a. Control structure

Elevation	Total settlement (ft)
-85	0.42
-130	0.15
-200	0

b. Navigation structure

Elevation	Total settlement (ft)
-90	0.49
-150	0.11
-200	0

47. Methods of construction - navigation and control structures. The sequence of construction is as follows: construct temporary cofferdams, dewater interior; excavate to construction grade, drive piling, construct structure; and remove cofferdams. Dewatering of the interior of the cofferdam will be accomplished by pumping from a sump, using well points as required.

48. Corrosion protection of gates. The navigation gates and gate guides for the control gates will be provided with cathodic protection against corrosion. The cathodic protection system used will be the rectifier type with duriron anodes. The protective system will be designed to give to the protected structures a potential of -850 millivolts relative to a copper-copper sulphate half-cell.

48A. Source of construction materials. Design Memorandum No. 12 "Lake Ponchartrain Hurricane Protection, Source of Construction Materials", dated 27 June 1966 and approved 30 August 1966 lists sources of sand, gravel, shell and rocks.

BEAUTIFICATION

49. The area in which this project will be constructed is at this time undeveloped so that beautification is presently of little importance. Considering that the future development will of necessity

be oriented to be compatible with the protective works covered herein, the open area provided by the wide levee and channel right-of-ways will contribute to the aesthetic character of the development. It is therefore not considered necessary to provide any additional beautification other than the normal grading and turfing of the protection levee.

REAL ESTATE REQUIREMENTS

50. All rights-of-way will be acquired by the Orleans Levee District and furnished without cost to the United States. There will be no acquistion by the United States.

ESTIMATE OF COST

51. General. Based on March 1969 price levels, the estimated first cost for the Chef Menteur Pass Complex is $23,900,000. This estimate consists of $718,000 for lands and damages, $11,000 for relocations, $2,700,000 for the navigation structure, $5,336,000 for the control structure, $1,905,000 for channels and canals, $9,497,000 for levees and floodwalls, $2,333,000 for engineering and design, and $1,400,000 for supervision and administration. Detailed estimate of first cost is shown in table 6.

52. Comparison of estimates.

a. The current estimate of $23,900,000 for the Chef Menteur Pass Complex represents an increase of $6,537,000 over the latest PB-3 effective 1 July 1968. The estimate presented in the PB-3 is the 13 March 1967 LMNED-PP letter report (appendix A) estimate escalated to July 1968 price levels. Table 8 shows a comparison of the project document, PB-3, and general design memorandum estimates. Reasons for the difference between the design memorandum and PB-3 estimates are as follows:

(1) Navigation structure. The increase of $1,100,000 reflects the added costs for increased quantities of various items as a result of general refinements in the estimate based on the availability of more detailed information and also the added costs for increases in price level between July 1968 and March 1969.

(2) Control structure. The increase of $1,747,000 reflects the added cost for (1) providing a vehicular bridge crossing over the structure; (2) increased quantities of various items as a result of general refinements in the estimate based on the availability of more detailed information; and (3) increases in price level between July 1968 and March 1969.

(3) Channels and canals. The decrease of $294,000 reflects the use of material excavated from the control channel for levee fill since the material excavated for relocation of the G.I.W.W. was determined not suitable for levee fill, and the added costs for increases in price level between July 1968 and March 1969.

(4) Levees and floodwalls. The increase of $2,289,000 reflects added cost because (1) the material excavated for the G.I.W.W. relocation cannot be used for levee embankment as originally planned; (2) a shell roadway on top the levee and closure has been included in the project; (3) general refinements have been made to the estimate based on the availability of more detailed information; and (4) the price level increases between July 1968 and March 1969.

(5) Engineering and design. The increase of $1,180,000 reflects the added E&D as a result of applying to the increased construction cost the E&D percentage determined by use of the 1962-1965 OCE curves.

(6) Supervision and administration. The increase of $407,000 reflects the added S&A as a result of applying to the increased construction cost the S&A percentage determined by use of the 1962-1965 OCE curves.

(7) Lands and damages. The increase of $97,000 reflects an increase in unit values for land based on the more detailed appraisals made for this memorandum and also the more detailed studies made relative to the limits of the required rights-of-way.

(8) Relocations. The increase of $11,000 reflects the relocations required as a result of additional field investigation made during preparation of this memorandum. All previous documents did not realize the need for any relocations for this project feature.

b. The estimate of $23,900,000 for the Chef Menteur Pass Complex also represents an increase of $16,806,000 over the project document estimate. Reasons for the difference between the design memorandum and the project document estimates are as follows:

(1) Navigation structure. The increase of $1,693,000 is comprised of $1,100,000 as previously described in paragraph 52.a.(1) and $593,000 as a result of escalating the project document estimate to reflect July 1968 price levels and using 20 percent contingencies in the PB-3 estimate in lieu of the 15 percent used in the project document.

(2) Control structure. The increase of $2,925,000 is comprised of $1,747,000 as previously described in paragraph 52.a.(2) and $1,178,000 as a result of escalating the project document estimate to reflect July 1968 price levels and using 20 percent contingencies in the PB-3 estimate in lieu of the 15 percent used in the project document.

(3) Channels and canals. The increase of $308,000 is comprised of (1) a $602,000 increase as a result of modifying the Barrier alignment as described in LMNED-PP letter report dated 13 March 1967 (appendix A), escalating the 13 March 1967 report estimate to reflect July 1968 price levels, and using 20 percent contingencies in the PB-3 estimate in lieu of the 15 percent used in the project doucment and letter report; and (2) a decrease of $294,000 as previously described in paragraph 52.a.(3).

(4) Levees and floodwalls. The increase of $8,328,000 is comprised of $2,289,000 as previously described in paragraph 52.a.(4) and $6,039,000 as a result of (1) modifying the Barrier alignment as described in LMNED-PP letter report dated 13 March 1967 (appendix A); (2) escalating the 13 March 1967 estimate to reflect July 1968 price levels; and (3) using 20 percent contingencies in the PB-3 estimate in lieu of the 15 percent used in the project document.

(5) Engineering and design. The increase of $1,988,000 is comprised of $1,180,000 as previously described in paragraph 52.a.(5) and $808,000 as a result of modifying the Barrier alignment as described in LMNED-PP letter report dated 13 March 1967 (appendix A) and escalating the 13 March 1967 estimate to reflect July 1968 price levels.

(6) Supervision and administration. The increase of $934,000 is comprised of $407,000 as previously described in paragraph 52.a.(6) and $527,000 as a result of modifying the Barrier alignment as described in LMNED-PP letter report dated 13 March 1967 (appendix A) and escalating the 13 March 1967 estimate to reflect July 1968 price levels.

(7) Lands and damages. The increase of $619,000 is comprised of $97,000 as previously described in paragraph 52.a.(7) and $522,000 for additional rights-of-way as a result of modifying the Barrier alignment as described in LMNED-PP letter report dated 13 March 1967 (appendix A) and escalating the 13 March 1967 estimate to reflect July 1968 price levels.

(8) Relocations. The increase of $11,000 is described in paragraph 52.a.(8).

LAKE PONTCHARTRAIN BARRIER PLAN
CHEF MENTEUR PASS COMPLEX
ESTIMATE OF FIRST COST

TABLE 6
March 1969 price levels

Cost account No. Item	Estimated quantity	Unit	Unit price	Estimated amount
Construction				
09 Channels and canals				
GIWW relocation	3,935,400	c.y.	$ 0.24	$ 944,496
Contingencies, 20%±				188,504
Subtotal, GIWW relocation				$1,133,000
30 Engineering and design, 12%±				136,000
31 Supervision and administration, 7.2%±				82,000
Total GIWW relocation				$1,351,000
11 Levees and floodwalls				
Levee fill (1st lift)				
9-ft. levee	1,638,300	c.y.	1.00	1,638,300
14-ft. levee	1,050,200	c.y.	1.00	1,050,200
Channel closure	391,000	c.y.	0.90	351,900
Chef Menteur Pass closure	3,616,000	c.y.	0.40	1,446,400
Levee fill (2d lift)				
9-ft. levee	906,000	c.y.	0.90	815,400
14-ft. levee	434,900	c.y.	0.90	391,410
Channel closure	78,500	c.y.	0.90	70,650
Chef Menteur Pass closure	234,900	c.y.	0.90	211,410
Levee fill (3d lift - hauled and shaped)				
Channel closure	16,400	c.y.	2.40	39,360
Fill shaping (3d lift)				
9-ft. levee	222,000	c.y.	0.50	111,000
14-ft. levee	92,000	c.y.	0.50	46,000
Chef Menteur Pass closure	23,000	c.y.	0.50	11,500
Fill shaping (4th lift)				
9-ft. levee	196,000	c.y.	0.50	98,000
14-ft. levee	41,500	c.y.	0.50	20,750
Chef Menteur Pass closure	23,000	c.y.	0.50	11,500
Shell (wave protection)				
9-ft. levee	4,700	c.y.	3.50	16,450
Channel closure	8,750	c.y.	3.50	30,625
Chef Menteur Pass closure	24,400	c.y.	3.50	85,400

TABLE 6 (cont'd)

Cost account No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
	Riprap				
	9-ft. levee	17,500	tons	$ 8.00	$ 140,000
	Channel closure	41,500	tons	8.00	332,000
	Chef Menteur Pass closure	114,240	tons	8.00	913,920
	Shell (in place for roadway)				
	9-ft. levee	7,500	c.y.	5.00	37,750
	14-ft. levee	1,530	c.y.	5.00	7,650
	Channel closure	610	c.y.	5.00	3,050
	Chef Menteur Pass closure	510	c.y.	5.00	2,550
	Fertilizing and seeding				
	9-ft. levee	223	acre	110.00	24,530
	14-ft. levee	47	acre	110.00	5,170
	Channel closure	9	acre	110.00	990
	Subtotal, Levees and floodwalls				$7,913,865
	Contingencies, 20%±				1,583,135
	Subtotal, Levees and floodwalls				$9,497,000
30	Engineering and design, 12%±				1,140,000
31	Supervision and administration, 7.2%±				684,000
	Total, Levees and floodwalls				$11,321,000
15	Control Structure				
	Structure excavation	116,000	c.y.	1.50	174,000
	Backfill	30,000	c.y.	2.00	60,000
	Dewatering	1	job		440,000
	Filter gravel	1,570	c.y.	10.00	15,700
	Filter sand	1,710	c.y.	10.00	17,100
	Riprap in channel	60,000	tons	13.00	780,000
	Gravel	9,300	c.y.	10.00	93,000
	Sand	9,300	c.y.	10.00	93,000
	Steel sheet piling, MA-22	24,500	s.f.	3.50	85,750
	Concrete sheet piling	7,800	s.f.	7.00	54,600
	Concrete, Cl.A - Bridge and Crane Girders	2,550	c.y.	100.00	255,000
	Concrete, Cl.A - Piers, bulkheads, & strut walls	7,850	c.y.	50.00	392,500
	Concrete, Cl.A - Floor slab, pier footings	7,260	c.y.	35.00	254,100
	Cement	24,700	bbls.	5.20	128,440

TABLE 6 (cont'd)

Cost account No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
15	Control Structure (cont'd)				
	Reinf. steel	3,080,000	lbs.	$ 0.15	$ 462,000
	Untreated timber piling - B	95,600	l.f.	2.00	191,200
	Pile testing	1	lump sum		15,000
	Struc. steel - gates and miscellaneous	1,000,000	lbs.	0.60	600,000
	Waterstops	560	l.f.	6.50	3,640
	Pipe handrails - 1 1/2"	1,110	l.f.	10.00	11,100
	Parapet railing	2,220	l.f.	7.00	15,540
	Crane rails	44,400	lbs.	0.45	19,980
	Gantry crane	1	lump sum		250,000
	Lighting	1	lump sum		15,000
	Fence	1,900	l.f.	6.00	11,400
	Building	1	lump sum		2,000
	Subtotal, Control structure				$4,440,050
	Contingencies, 20%±				895,950
	Subtotal, Control structure				$5,336,000
30	Engineering and design, 12%±				640,000
31	Supervision and administration, 7.2%±				384,000
	Subtotal, Control structure				$6,360,000
09	Channels and canals				
	Control structure channel excavation	1,872,800	c.y.	0.24	449,472
	Contingencies, 20%±				90,528
	Subtotal, Control channel				$ 540,000
30	Engineering and design, 12%±				65,000
31	Supervision and administration, 7.2%±				39,000
	Subtotal, Control channel				$ 644,000
	Total, Control structure and channel				$7,004,000
05	Navigation Structure				
	Gate bay and approaches				
	Structure excavation	34,000	c.y.	$ 2.00	$ 68,000
	Backfill	23,000	c.y.	2.00	46,000
	Sand backfill	2,070	c.y.	6.00	12,400
	Dewatering	1	job		200,000
	Concrete, Cl.A - walls	1,300	c.y.	50.00	65,000
	Concrete, Cl.A - floor slabs	1,450	c.y.	35.00	50,750
	Cement	3,850	bbl.	5.25	20,215
	Reinf. steel	287,000	lb.	0.15	43,000
	Pipe handrail	1,750	l.f.	10.00	17,500

TABLE 6 (cont'd)

Cost acct No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
05	Navigation Structure (cont'd)				
	Steel sheet piling, MA-22	2,700	s.f.	3.50	9,450
	Untreated timber piling - B	18,100	l.f.	2.00	36,200
	Filter gravel	130	c.y.	10.00	1,300
	Filter sand	230	c.y.	10.00	2,300
	Riprap	43,000	ton	13.00	559,000
	Gravel	6,000	c.y.	10.00	60,000
	Sand	6,000	c.y.	10.00	60,000
	Floodwalls and access bridge (2)				
	Concrete, Cl.A - footing	780	c.y.	$50.00	$ 39,000
	Concrete, Cl.A - wall, bridge deck	900	c.y.	60.00	54,000
	Cement	2,350	bbl.	5.25	12,340
	Reinf. steel	200,000	lb.	0.15	30,000
	Concrete piles 12" sq.	16,000	l.f.	8.00	128,000
	Steel sheet piling, Z-32	17,000	s.f.	4.50	76,500
	Bulkheads				
	Concrete sheet pile (12")	8,000	s.f.	7.00	56,000
	Timber Guide Walls				
	Treated timber piles (marine treatment)	26,000	l.f.	3.60	93,600
	Treated timber	58	MFBM	800.00	46,400
	Sector Gate				
	Struc. steel (installation and painting)	165,000	lb.	0.75	123,750
	Pipe handrail 1 1/2"	380	l.f.	10.00	3,800
	Rubber seals	200	l.f.	6.00	1,200
	Timber fenders	3.5	MFBM	800.00	2,800
	Cathodic protection	1	job		25,000
	Upper and Lower Hinges				
	Structural steel	5,500	lb.	0.60	3,300
	Cast steel	7,500	lb.	0.65	4,875
	Bronze	300	lb.	2.60	780
	Corr. Res. steel	800	lb.	1.60	1,280
	Embedded Parts				
	Structural steel	6,700	lb.	0.60	4,020
	Corr. Res. steel	700	lb.	1.60	1,120
	Needle beam seats, corner protect. plates, ladders				
	Structural steel	10,000	lb.	0.40	4,000
	Sector gate machinery	1	lump sum		68,000
	Pile testing	1	lump sum		15,000
	Electrical system (includes navigation signals)	1	lump sum		90,000
	Fire protection system	1	lump sum		6,000
	Fence	2,000	l.f.	6.00	12,000

TABLE 6 (cont'd)

Cost account No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
05	Navigation structure (cont'd)				
	Landscaping		lump sum		$ 1,800
	Elec. service to site utility company		lump sum		95,000
	Subtotal, Navigation structure				$2,250,680
	Contingencies, 20%+				449,320
	Subtotal, Navigation structure				$2,700,000
30	Engineering and design, 12%+				324,000
31	Supervision and administration, 7.2%+				194,000
	Subtotal, Navigation structure				$3,218,000
09	Channels and canals				
	Navigation channel excavation	803,000	c.y.	$ 0.24	$ 192,720
	Contingencies, 20%+				39,280
	Subtotal, Navigation structure				$ 232,000
30	Engineering and design, 12%+				28,000
31	Supervision and administration, 7.2%+				17,000
	Subtotal, Navigation structure channel				$ 277,000
	Total, Navigation structure and channel				$3,495,000
	Lands and Damages				
01	Levee permanent right-of-way	74	acre	2,500	$ 185,000
	Levee permanent right-of-way	41	acre	5,000	205,000
	Levee permanent right-of-way	117	acre	200	23,400
	GIWW relocation permanent right-of-way	375	acre	200	75,000
	Control channel permanent right-of-way	20	acre	2,500	50,000
	Control channel permanent right-of-way	145	acre	200	29,000
	Navigation channel permanent right-of-way	75	acre	200	15,000
	Temporary spoil easements	809	acre	50	40,450
	Subtotal, Lands and damages				$ 622,850
	Contingencies, 15%+				92,650
	Subtotal, Lands and damages				$ 715,500
	Acquisition cost by others				2,500
	Total, Lands and damages				$ 718,000

TABLE 6 (cont'd)

Cost account No.	Item	Estimated quantity	Unit	Unit price	Estimated amount
02	Relocations				
	4" gas line	1	lump sum		$ 5,000
	Telephone line	1	lump sum		2,500
	Subtotal, Relocations				$ 7,500
	Contingencies, 20%±				1,700
	Subtotal, Relocations				$ 9,200
30	Engineering and design, 12%±				1,100
31	Supervision and administration, 7.2%±				700
	Total, Relocations				$ 11,000

TABLE 7

CHEF MENTEUR PASS COMPLEX
RECAPITULATION OF FIRST COST

Cost Account No.	Item	Estimated amount
09	Channels and canals	$ 1,905,000
05	Navigation structure	2,700,000
15	Control structure	5,336,000
11	Levees and floodwalls	9,497,000
30	Engineering and design	2,333,000
31	Supervision and administration	1,400,000
01	Lands and damages	718,000
02	Relocations	11,000
	Total	$23,900,000

TABLE 8

CHEF MENTEUR PASS COMPLEX
COMPARISON OF ESTIMATES

	Feature	Project document	PB-3 eff.1 Jul 68	GDM No. 2 Supp. No. 3	Difference Supp.No.3 - PB-3	Difference Supp. No. 3 - Project document
05	Navigation structure	$1,007,000	$ 1,600,000	$ 2,700,000	+$1,100,000	+$ 1,693,000
15	Control structure	2,411,000	3,589,000	5,336,000	+ 1,747,000	+ 2,925,000
09	Channels and canals	1,597,000	2,199,000	1,905,000	-294,000	+308,000
11	Levees and floodwalls	1,169,000	7,208,000	9,497,000	+ 2,289,000	+ 8,328,000
30	Engineering & design	345,000	1,153,000	2,333,000	+ 1,180,000	+ 1,988,000
31	Supervision & administration	466,000	993,000	1,400,000	+407,000	+934,000
	Subtotal	$6,995,000	$16,742,000	$23,171,000	+$6,429,000	+$16,176,000
01	Lands and damages	$ 99,000	$ 621,000	$ 718,000	+$ 97,000	+$ 619,000
02	Relocations	-	-	11,000	+11,000	+11,000
	Subtotal	$ 99,000	$ 621,000	$ 729,000	+$ 108,000	+$ 630,000
	TOTAL	$7,094,000	$17,363,000	$23,900,000	+$6,537,000	+$16,806,000

TABLE 9

CHEF MENTEUR PASS COMPLEX

SCHEDULES FOR DESIGN AND CONSTRUCTION

Contract	Design		Construction			Estimated construction cost
	Start	Complete	Advertise	Award	Complete	(including contingencies)
GIWW relocation	Nov 67	Oct 69	Nov 69	Jan 70	Sep 70	$1,133,000
Levee	Nov 67	Oct 69				
1st Lift			Nov 69	Jan 70	Dec 70	3,705,000
2d Lift			Nov 72	Jan 73	Dec 73	1,533,000
3d Lift			Nov 74	Jan 75	Sep 75	236,000
4th Lift			Nov 76	Jan 77	Sep 77	143,000
Roadway, fertilizing, seeding, and levee wave protection			Mar 77	May 77	Sep 77	660,000
Navigation structure	Nov 67	Jan 71	Feb 71	Apr 71	Aug 73	2,700,000
Control structure	Nov 67	Jan 71	Feb 71	Apr 71	Aug 73	5,336,000
Navigation channel	Nov 67	Jan 71	Aug 73	Oct 73	Feb 74	232,000
Control channel	Nov 67	Jan 71	Aug 73	Oct 73	Feb 74	540,000
Closure dam	Nov 67	Jan 71				
1st Lift			Jan 74	Mar 74	Jun 74	1,736,000
2d Lift			Jan 77	Mar 77	Jun 77	254,000
3d Lift			Jan 79	Mar 79	Jun 79	14,000
4th Lift, roadway and wave protection			Jan 81	Mar 81	Aug 81	1,216,000

SCHEDULES FOR DESIGN AND CONSTRUCTION (cont'd)

To maintain the schedule of construction for the Chef Menteur Pass Complex, total funds will be required by fiscal years as follows:

Funds Required:*	FY 1970	$3,466,000
	1971	3,556,000
	1972	3,570,000
	1973	4,294,000
	1974	4,022,000
	Balance to complete	2,657,000
	TOTAL	$21,565,000

*Includes construction, lands and damages, relocations, engineering and design, 4.6 percent S&A on construction costs and 11.5 percent S&A on engineering and design costs.

OPERATION AND MAINTENANCE

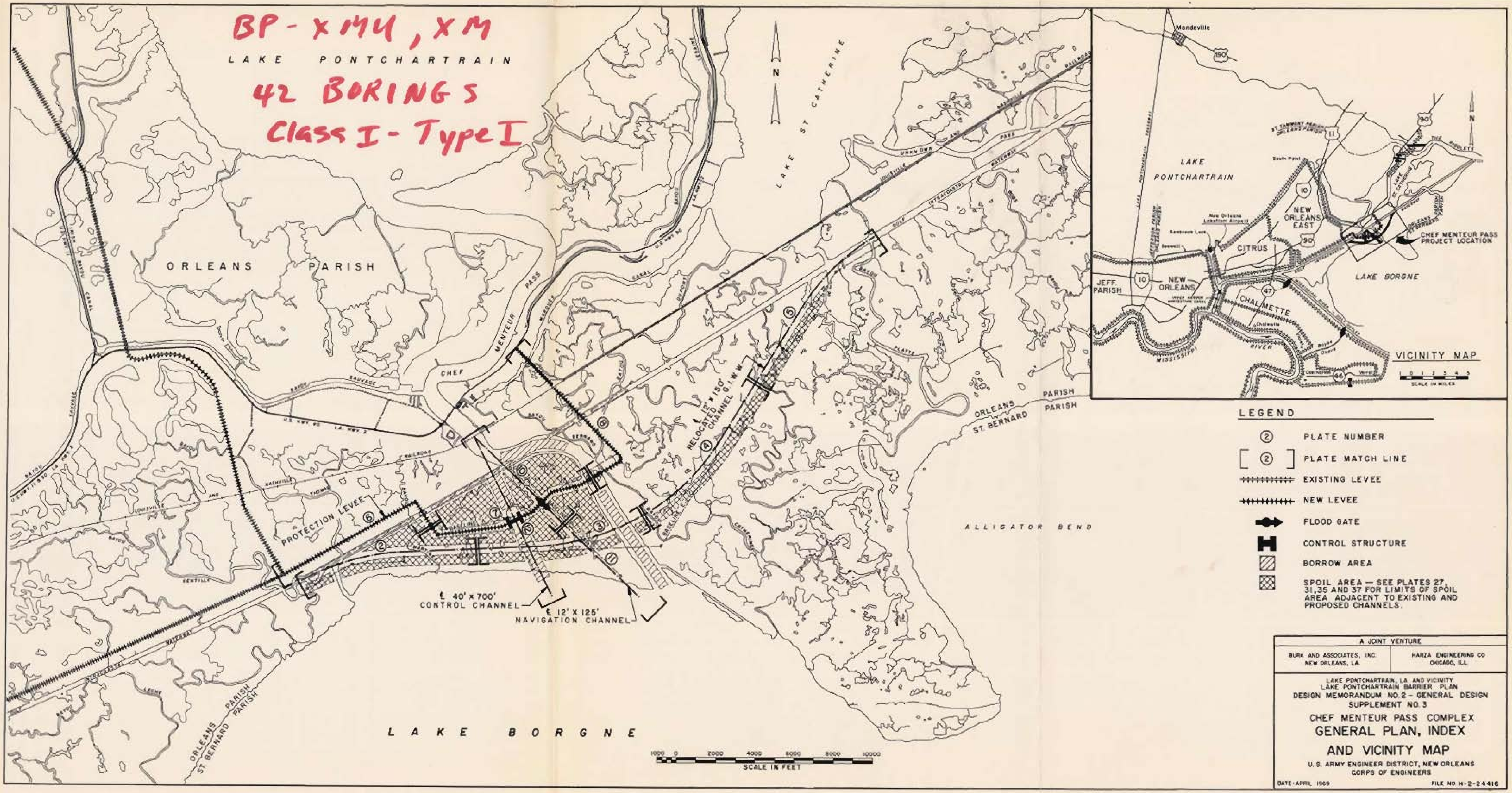
53. General. As specified in the authorizing act, local interests are required to maintain and operate all complete works in accordance with regulations prescribed by the Secretary of the Army (except the Seabrook Lock, and Rigolets Lock and Channel). Operation and maintenance of the navigation gates and control structure is estimated to cost $63,400 per year; maintenance of levees is estimated to cost $8,000 per year. The total estimated annual cost to local interests for operation and maintenance of the works covered in this supplement is, accordingly, $71,400.

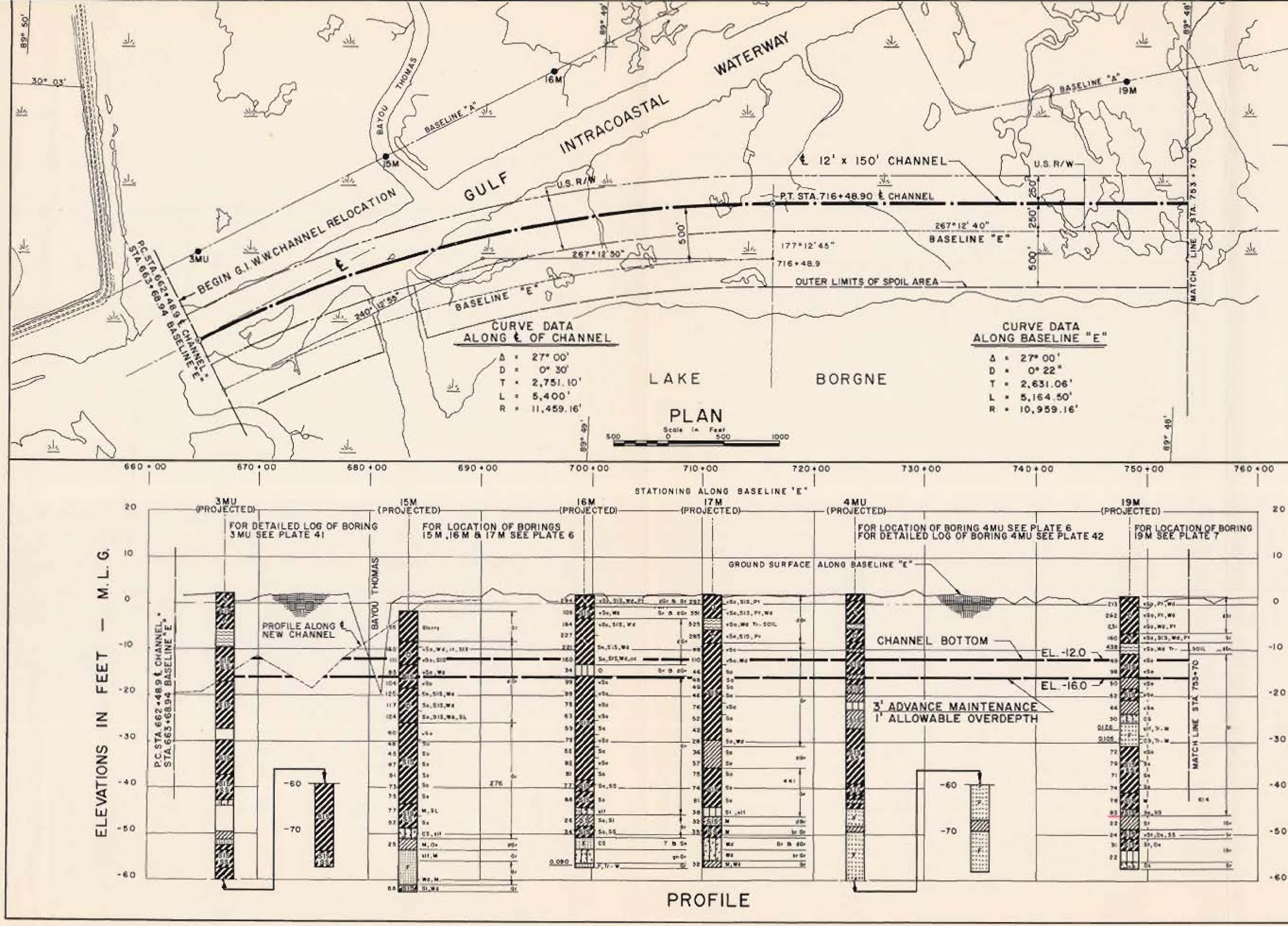
ECONOMICS

54. The Chef Menteur Pass Complex is not an independent element of the Lake Pontchartrain Barrier Plan, and an independent economic analysis for the complex is not practicable. The current economic analysis (LMV Form 23) for the entire Lake Pontchartrain, La. and Vicinity hurricane protection project, based on the July 1968 PB-3 costs, indicates a benefit-to-cost ratio of 12.3 to 1. The additional cost of the flood protective works covered herein over that shown in the current PB-3 will not significantly change the approved benefit-to-cost ratio.

RECOMMENDATIONS

55. General. The plan of protection presented herein for the protective works in the vicinity of the Chef Menteur Pass consists of a new earthen protection levee from the southeastern terminus of the New Orleans East levee to U.S. Highway 90 approximately 0.8 mile east of the Chef Menteur Pass bridge; a control structure with eight 46 foot gates to provide desirable tidal flow between Lake Pontchartrain and Lake Borgne and the Gulf of Mexico; a navigation structure; approach channels to control and navigation structures; and an earthen dam to close the existing Chef Menteur Pass. This plan will provide capabilities for effectively limiting the inflow of hurricane tides into Lake Pontchartrain through the Chef Menteur Pass without causing adverse affects on the hydraulic regime or fish and oyster life in Lake Pontchartrain and the gulf waters. The plan is considered to be the optimum one for accomplishing the project purposes and is, accordingly, recommended for approval.


BP - XMU, XM
42 BORINGS
Class I - Type I
LAKE PONTCHARTRAIN
ORLEANS PARISH
LAKE ST CATHERINE
CHEF MENTEUR PASS
BAYOU SAUVAGE
PROTECTION LEVEE
RELOCATED ℄ 12' x 150' G.I.W.W. CHANNEL
℄ 40' x 700' CONTROL CHANNEL
℄ 12' x 125' NAVIGATION CHANNEL
ALLIGATOR BEND
ORLEANS PARISH
ST. BERNARD PARISH
LAKE BORGNE
SCALE IN FEET
VICINITY MAP
Mondeville
LAKE PONTCHARTRAIN
NEW ORLEANS EAST
CITRUS
JEFF. PARISH
NEW ORLEANS
CHALMETTE
MISSISSIPPI RIVER
LAKE BORGNE
CHEF MENTEUR PASS PROJECT LOCATION
SCALE IN MILES
LEGEND
② PLATE NUMBER
[②] PLATE MATCH LINE
EXISTING LEVEE
NEW LEVEE
FLOOD GATE
CONTROL STRUCTURE
BORROW AREA
SPOIL AREA — SEE PLATES 27, 31, 35 AND 37 FOR LIMITS OF SPOIL AREA ADJACENT TO EXISTING AND PROPOSED CHANNELS.
A JOINT VENTURE
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.
HARZA ENGINEERING CO CHICAGO, ILL.
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
GENERAL PLAN, INDEX AND VICINITY MAP
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969
FILE NO. H-2-24416



compare w/ plate 6

LEGEND

3MU ● SOIL BORING LOCATION AND NUMBER

GENERAL NOTES

SEE PLATE A FOR SOIL BORING LEGEND.

BORINGS 3M — 27M WERE TAKEN WITH A 1 7/8" I.D. CORE BARREL SAMPLER.

BORINGS 1 MU — 5 MU WERE TAKEN WITH A 5" DIAMETER STEEL TUBE PISTON TYPE SAMPLER.

ELEVATIONS ARE IN FEET MEAN SEA LEVEL (M.S.L.) UNLESS OTHERWISE NOTED.

MEAN LOW GULF (M.L.G.) IS -0.78 FEET M.S.L.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

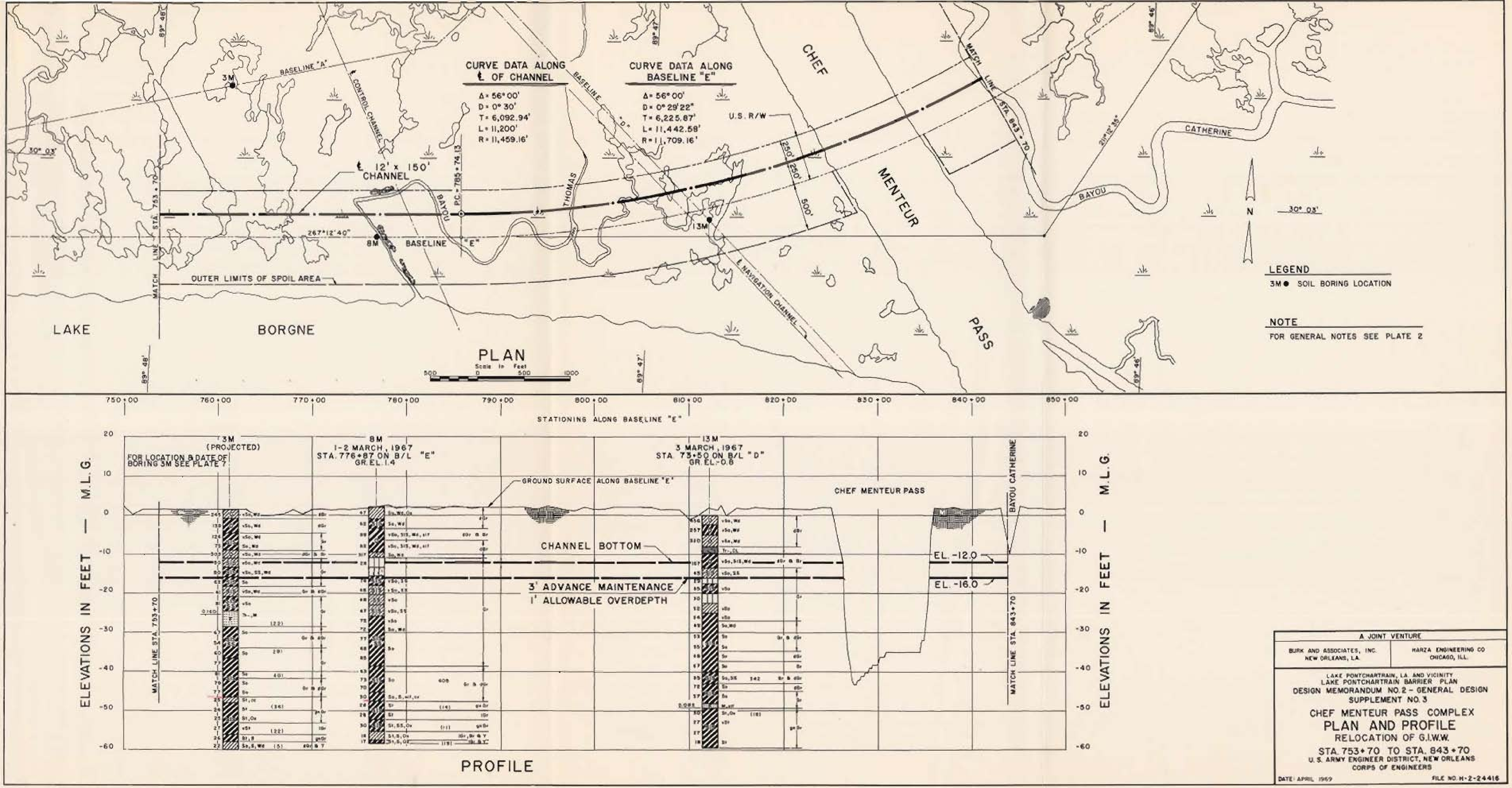
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
RELOCATION OF G.I.W.W.
STA. 663+68.94 TO STA. 753+70

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

DATE: APRIL 1969 FILE NO. H-2-24416

PLATE 2



CURVE DATA ALONG
℄ OF CHANNEL
Δ = 56° 00'
D = 0° 30'
T = 6,092.94'
L = 11,200'
R = 11,459.16'
CURVE DATA ALONG
BASELINE "E"
Δ = 56° 00'
D = 0° 29' 22"
T = 6,225.87'
L = 11,442.58'
R = 11,709.16'
BASELINE "A"
BASELINE "D"
BASELINE "E"
℄ 12' x 150' CHANNEL
U.S. R/W
CHEF MENTEUR PASS
BAYOU CATHERINE
LAKE BORGNE
OUTER LIMITS OF SPOIL AREA
MATCH LINE STA. 753+70
MATCH LINE STA. 843+70
℄ NAVIGATION CHANNEL
℄ CONTROL CHANNEL
PLAN
Scale in Feet
STATIONING ALONG BASELINE "E"
ELEVATIONS IN FEET — M.L.G.
3M (PROJECTED)
FOR LOCATION & DATE OF BORING 3M SEE PLATE 7
8M
1-2 MARCH, 1967
STA. 776+87 ON B/L "E"
GR. EL. 1.4
13M
3 MARCH, 1967
STA. 73+50 ON B/L "D"
GR. EL. -0.6
GROUND SURFACE ALONG BASELINE "E"
CHANNEL BOTTOM
3' ADVANCE MAINTENANCE
1' ALLOWABLE OVERDEPTH
EL. -12.0
EL. -16.0
PROFILE
LEGEND
3M ● SOIL BORING LOCATION
NOTE
FOR GENERAL NOTES SEE PLATE 2
A JOINT VENTURE
BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.
HARZA ENGINEERING CO
CHICAGO, ILL.
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
RELOCATION OF G.I.W.W.
STA. 753+70 TO STA. 843+70
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969
FILE NO. H-2-24416

PLATE 3

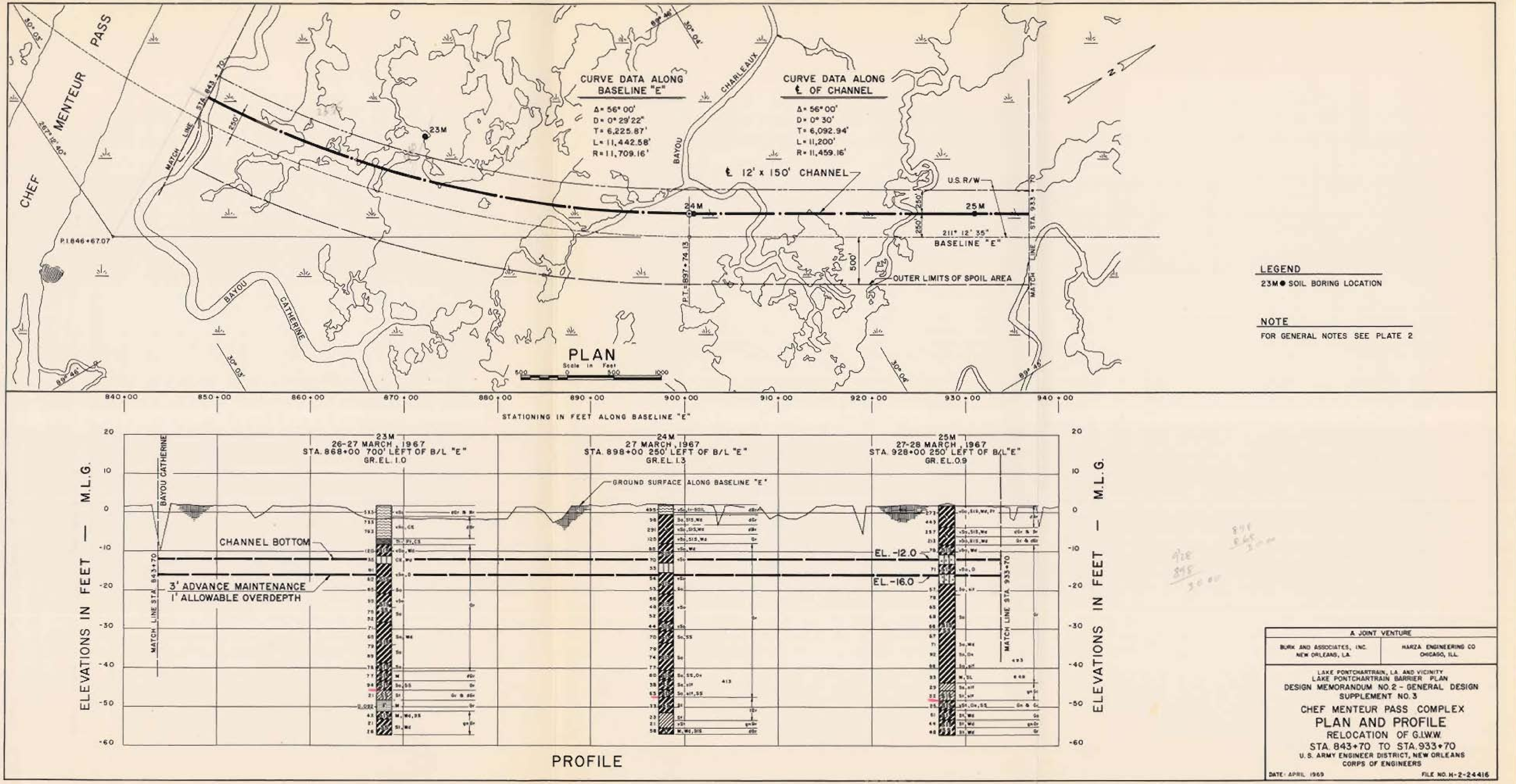
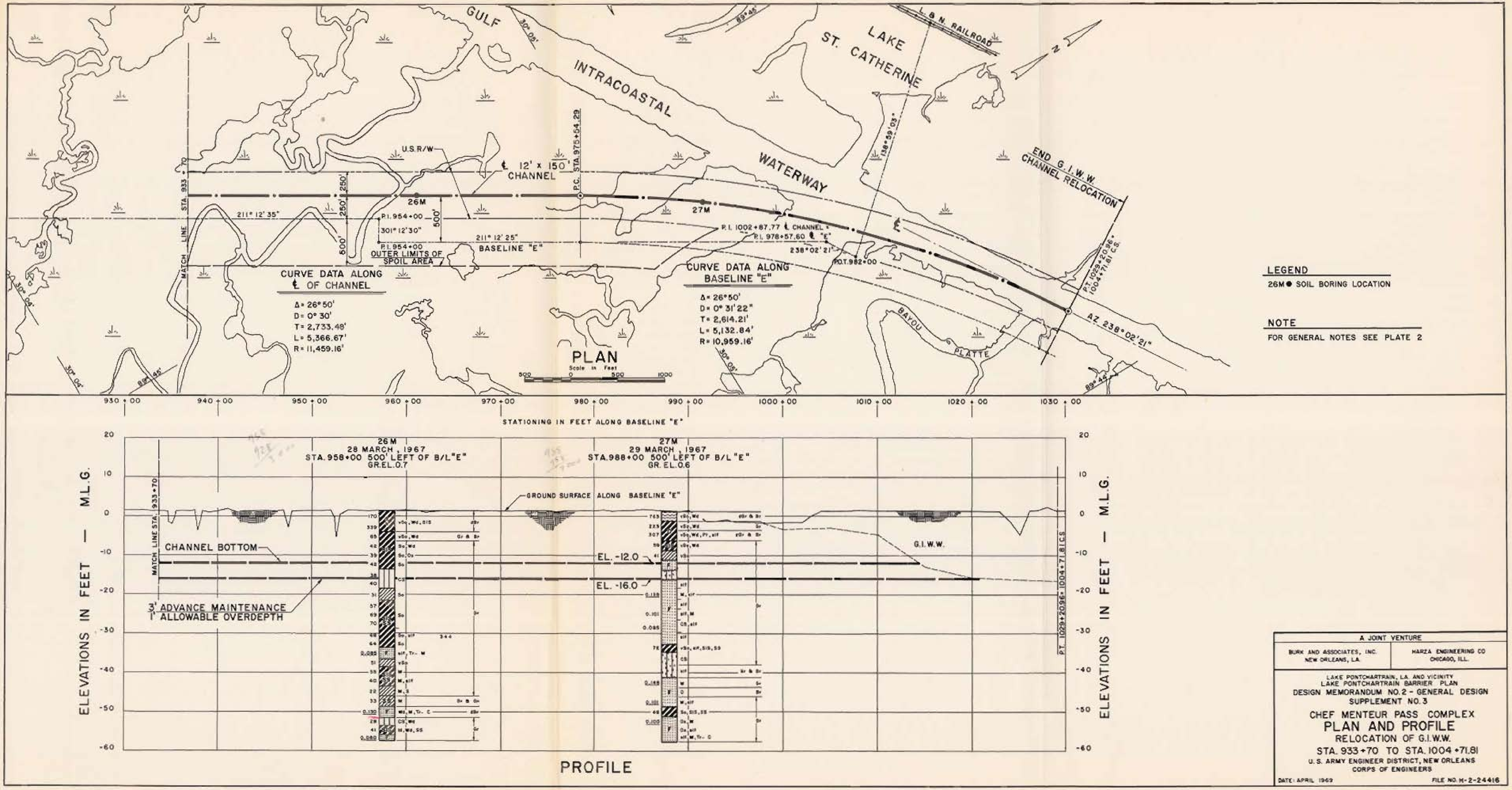
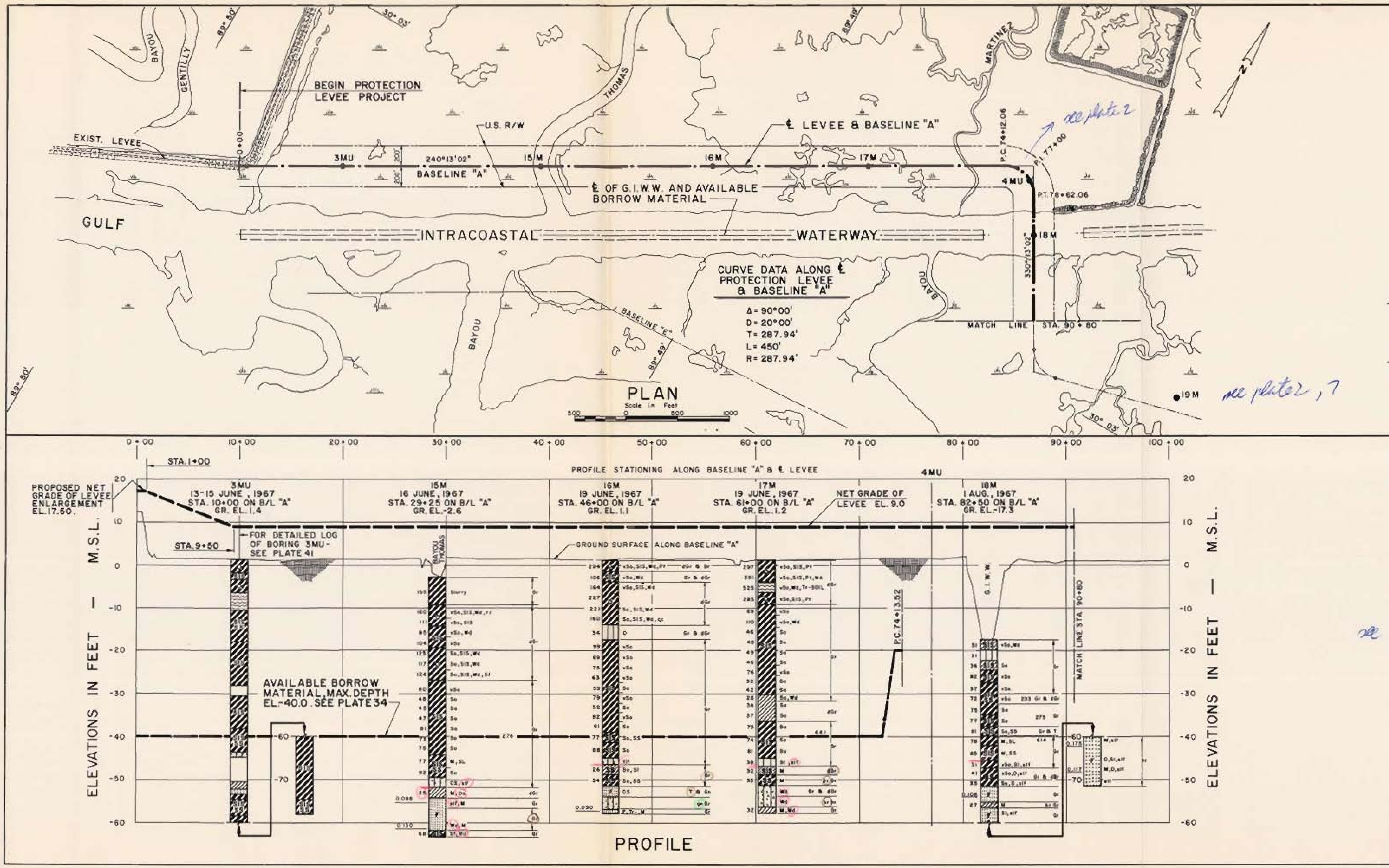

CHEF MENTEUR PASS
MATCH LINE STA 843+70
P.I. 846+67.07
BAYOU CATHERINE
23M
CURVE DATA ALONG BASELINE "E"
Δ= 56° 00'
D= 0° 29' 22"
T= 6,225.87'
L= 11,442.58'
R= 11,709.16'
BAYOU CHARLEAUX
CURVE DATA ALONG ℄ OF CHANNEL
Δ= 56° 00'
D= 0° 30'
T= 6,092.94'
L= 11,200'
R= 11,459.16'
℄ 12' x 150' CHANNEL
24M
25M
U.S. R/W
P.T.= 897+74.13
211° 12' 35"
BASELINE "E"
500'
OUTER LIMITS OF SPOIL AREA
MATCH LINE STA 933+70
PLAN
Scale in Feet
LEGEND
23M ● SOIL BORING LOCATION
NOTE
FOR GENERAL NOTES SEE PLATE 2
STATIONING IN FEET ALONG BASELINE "E"
23M
26-27 MARCH, 1967
STA. 868+00 700' LEFT OF B/L "E"
GR. EL. 1.0
24M
27 MARCH, 1967
STA. 898+00 250' LEFT OF B/L "E"
GR. EL. 1.3
25M
27-28 MARCH, 1967
STA. 928+00 250' LEFT OF B/L "E"
GR. EL. 0.9
GROUND SURFACE ALONG BASELINE "E"
CHANNEL BOTTOM
EL. -12.0
EL. -16.0
3' ADVANCE MAINTENANCE
1' ALLOWABLE OVERDEPTH
ELEVATIONS IN FEET — M.L.G.
PROFILE
A JOINT VENTURE
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.
HARZA ENGINEERING CO CHICAGO, ILL.
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
RELOCATION OF G.I.W.W.
STA. 843+70 TO STA. 933+70
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969
FILE NO. H-2-24416

PLATE 4


GULF
INTRACOASTAL
WATERWAY
LAKE
ST. CATHERINE
L & N. RAILROAD
N
U.S. R/W
℄ 12' x 150' CHANNEL
P.C. STA. 975+54.29
MATCH LINE STA. 933+70
26M
27M
211° 12' 35"
P.I. 954+00
301° 12' 30"
211° 12' 25"
BASELINE "E"
P.I. 954+00
OUTER LIMITS OF SPOIL AREA
500'
250'
P.I. 1002+87.77 ℄ CHANNEL
P.I. 978+57.60 ℄ "E"
238° 02' 21"
P.O.T. 982+00
138° 59' 03"
END G.I.W.W. CHANNEL RELOCATION
P.T. 1029+20.96 = 1004+71.81 C.S.
AZ 238° 02' 21"
BAYOU
PLATTE
CURVE DATA ALONG ℄ OF CHANNEL
Δ= 26°50'
D= 0° 30'
T= 2,733.48'
L= 5,366.67'
R= 11,459.16'
CURVE DATA ALONG BASELINE "E"
Δ= 26°50'
D= 0° 31' 22"
T= 2,614.21'
L= 5,132.84'
R= 10,959.16'
PLAN
Scale in Feet
500 0 500 1000
LEGEND
26M ● SOIL BORING LOCATION
NOTE
FOR GENERAL NOTES SEE PLATE 2
STATIONING IN FEET ALONG BASELINE "E"
930+00 940+00 950+00 960+00 970+00 980+00 990+00 1000+00 1010+00 1020+00 1030+00
ELEVATIONS IN FEET — M.L.G.
20 10 0 -10 -20 -30 -40 -50 -60
26M
28 MARCH, 1967
STA. 958+00 500' LEFT OF B/L "E"
GR. EL. 0.7
27M
29 MARCH, 1967
STA. 988+00 500' LEFT OF B/L "E"
GR. EL. 0.6
GROUND SURFACE ALONG BASELINE "E"
MATCH LINE STA. 933+70
CHANNEL BOTTOM
EL. -12.0
EL. -16.0
3' ADVANCE MAINTENANCE
1' ALLOWABLE OVERDEPTH
G.I.W.W.
P.T. 1029+2096 = 1004+71.81 C.S.
PROFILE
A JOINT VENTURE
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.
HARZA ENGINEERING CO CHICAGO, ILL.
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
RELOCATION OF G.I.W.W.
STA. 933+70 TO STA. 1004+71.81
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969
FILE NO. H-2-24416



LEGEND

3MU ● SOIL BORING LOCATION

NOTE

FOR GENERAL NOTES SEE PLATE 2

NOTE

FOR DETAIL LOG OF BORING 4MU SEE PLATE 41.

A JOINT VENTURE

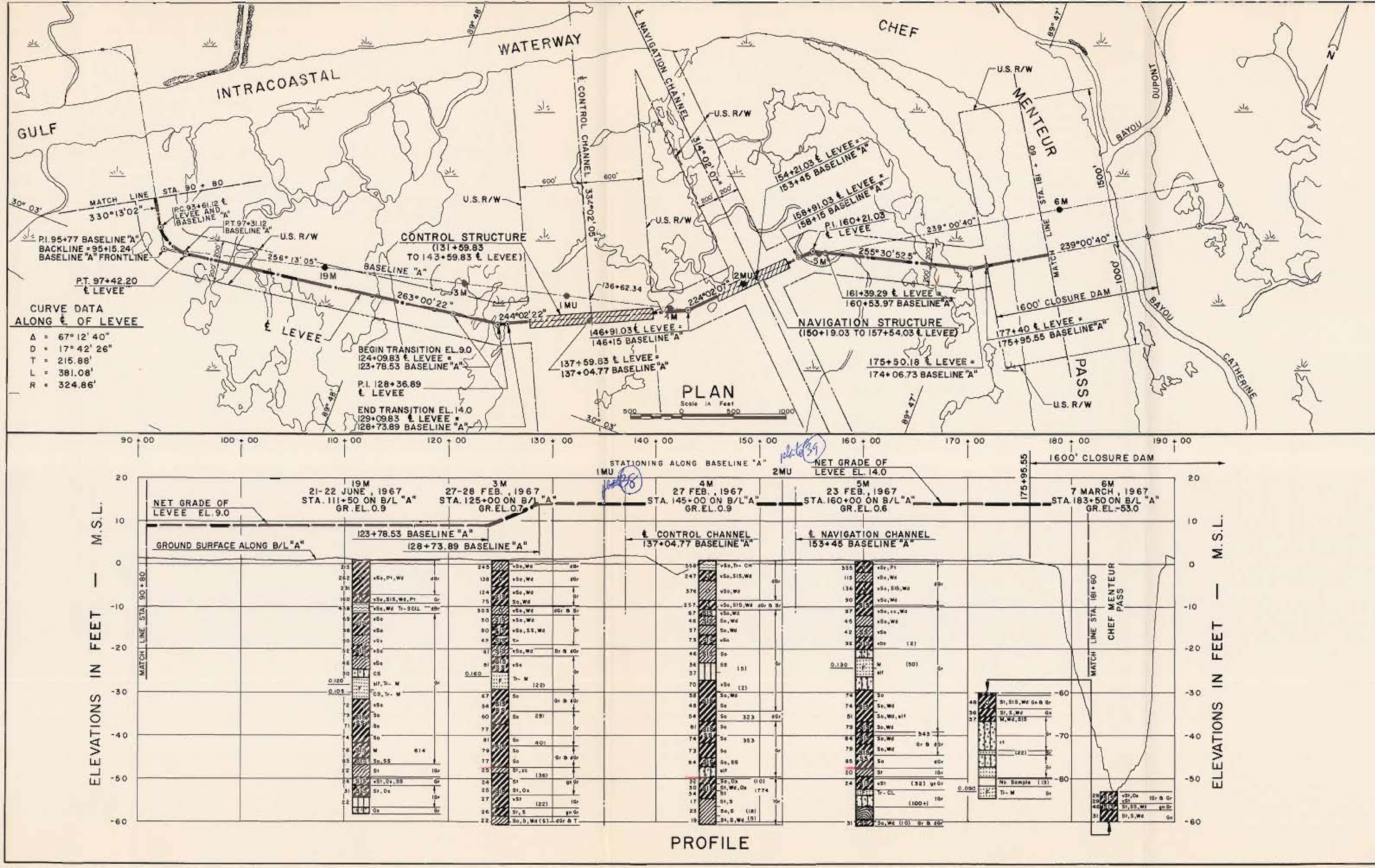
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
PROTECTION LEVEE
STA. 0+00 TO STA. 90+80

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

DATE: APRIL 1969 FILE NO. H-2-24416



LEGEND

19M● SOIL BORING LOCATION

NOTE

FOR GENERAL NOTES SEE PLATE 2.

NOTE

FOR DETAILED LOGS OF BORINGS 1MU AND 2MU, SEE PLATE NOS. 38 & 39 RESPECTIVELY.

A JOINT VENTURE

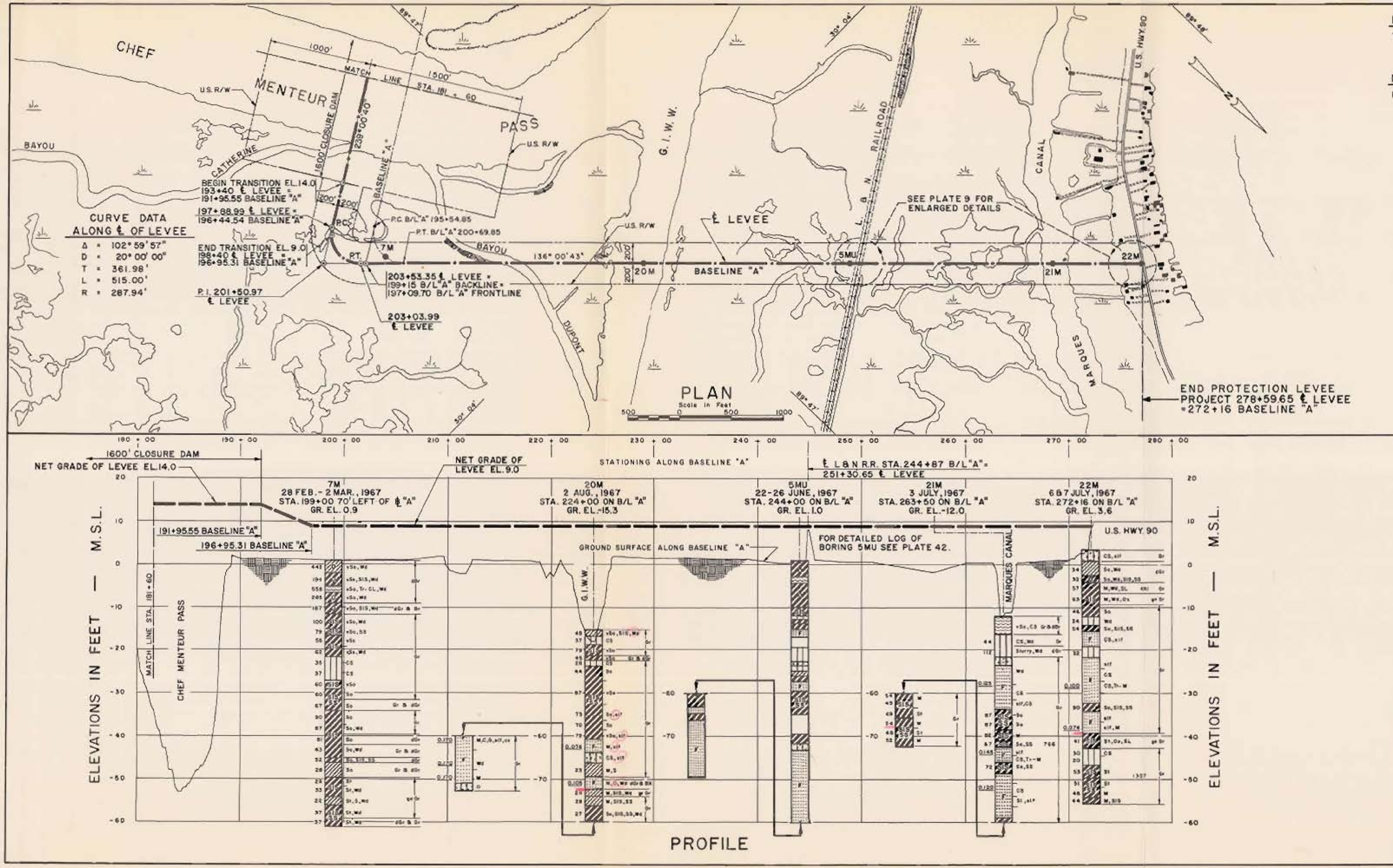
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
PROTECTION LEVEE
STA. 90+80 TO STA. 181+60

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

DATE: APRIL 1969 FILE NO. H-2-24416



LEGEND

7M● SOIL BORING LOCATION

NOTE

FOR GENERAL NOTES SEE PLATE 2.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

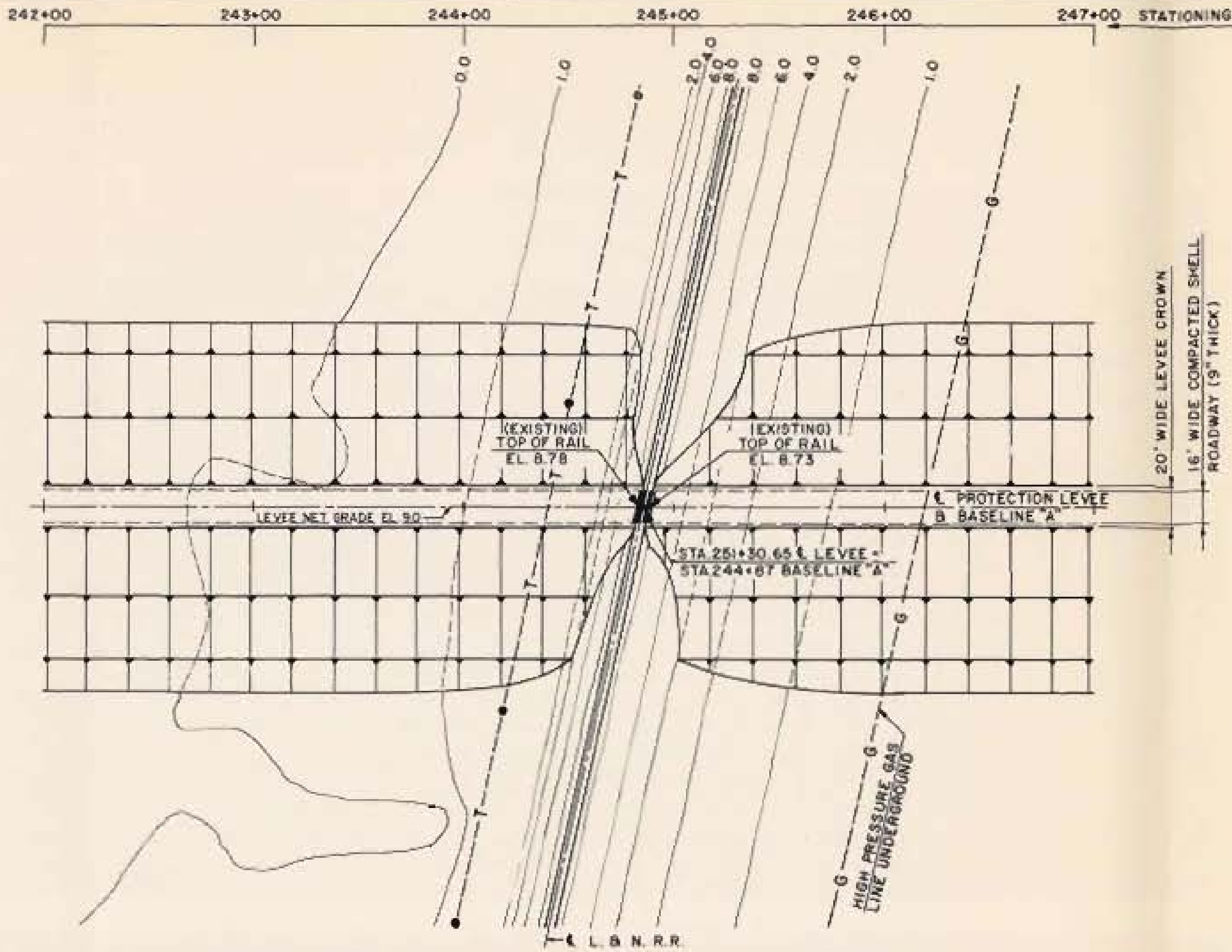
CHEF MENTEUR PASS COMPLEX
PLAN AND PROFILE
PROTECTION LEVEE
STA. 181+60 TO STA. 272+16

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

DATE: APRIL 1969 FILE NO. H-2-24416

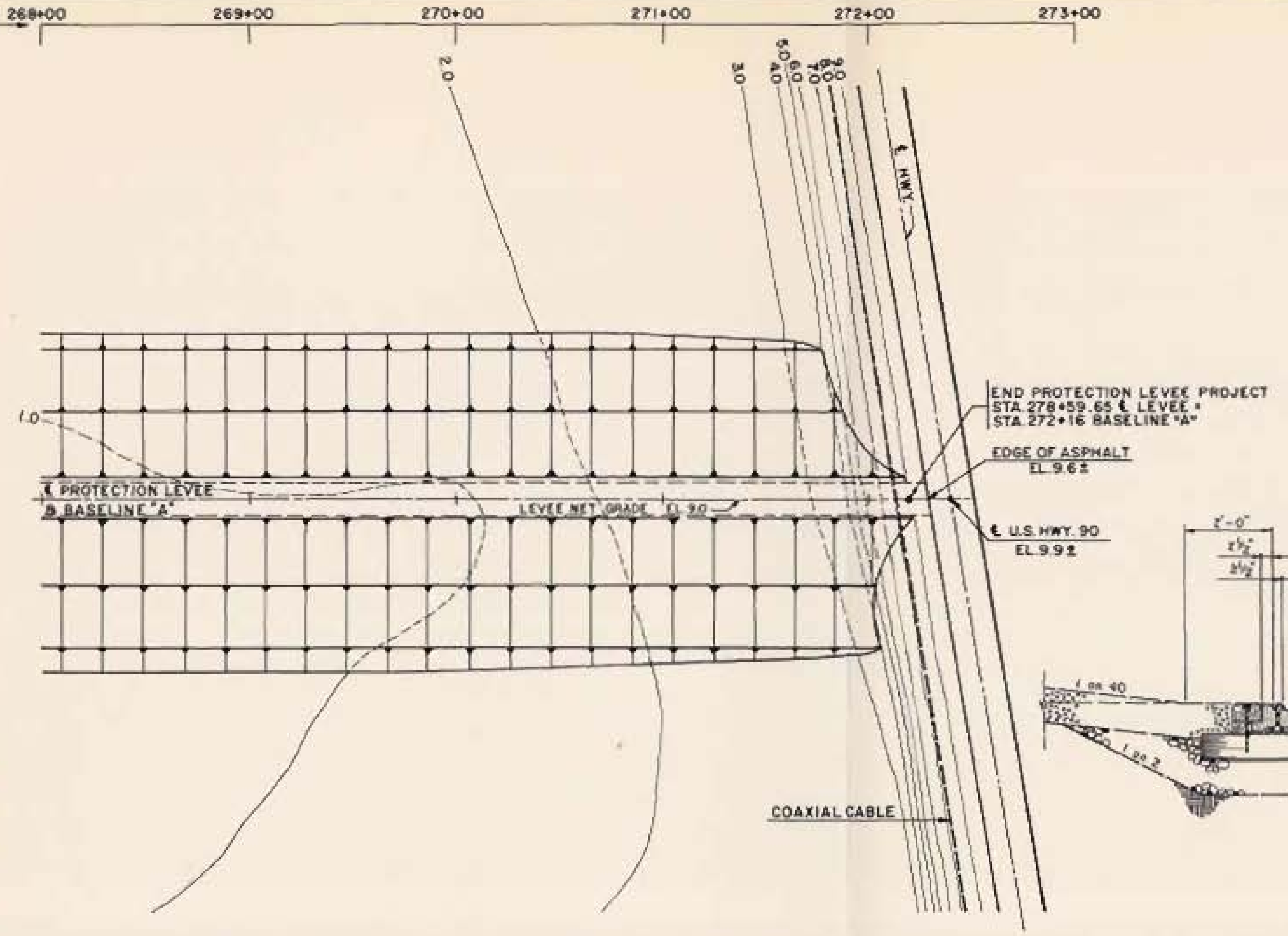
NOTE

FOR GENERAL NOTES SEE PLATE 2 .



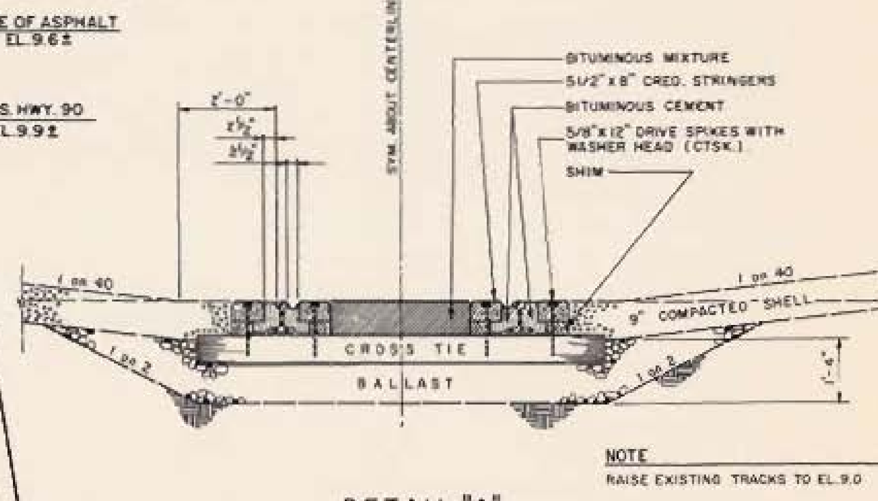
PLAN AT INTERSECTION OF PROTECTION LEVEE AND L.& N. R.R.

SCALE IN FEET



PLAN AT INTERSECTION OF PROTECTION LEVEE AND U.S. HIGHWAY 90

SCALE IN FEET

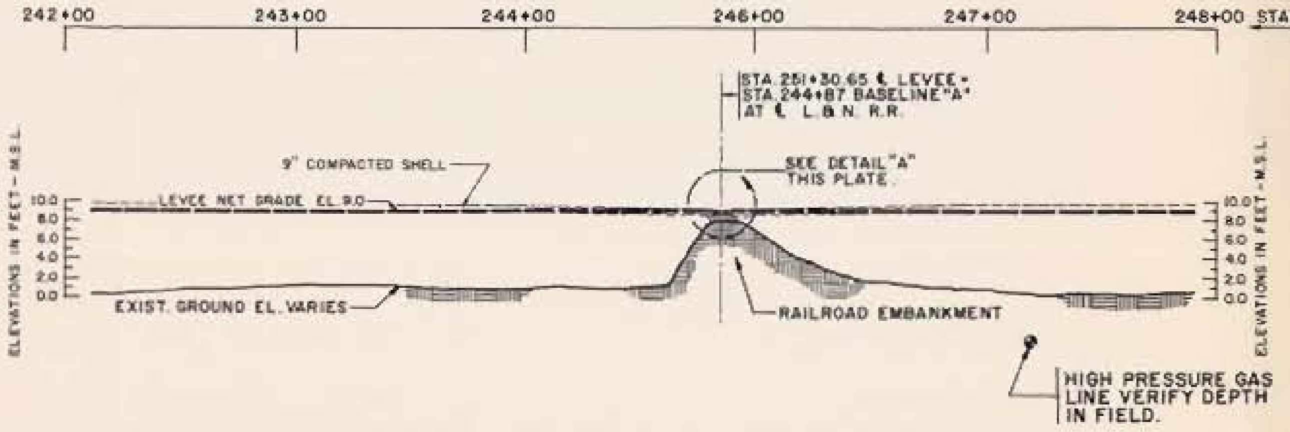


NOTE

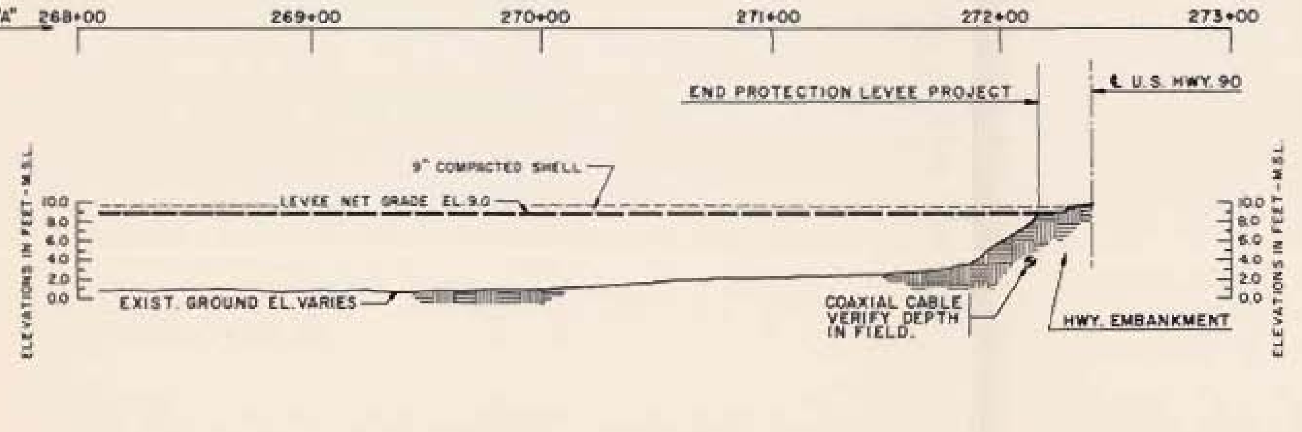
RAISE EXISTING TRACKS TO EL.9.0

DETAIL "A"

SCALE IN FEET



SECTION AT ℄ PROTECTION LEVEE



SECTION ℄ PROTECTION LEVEE

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

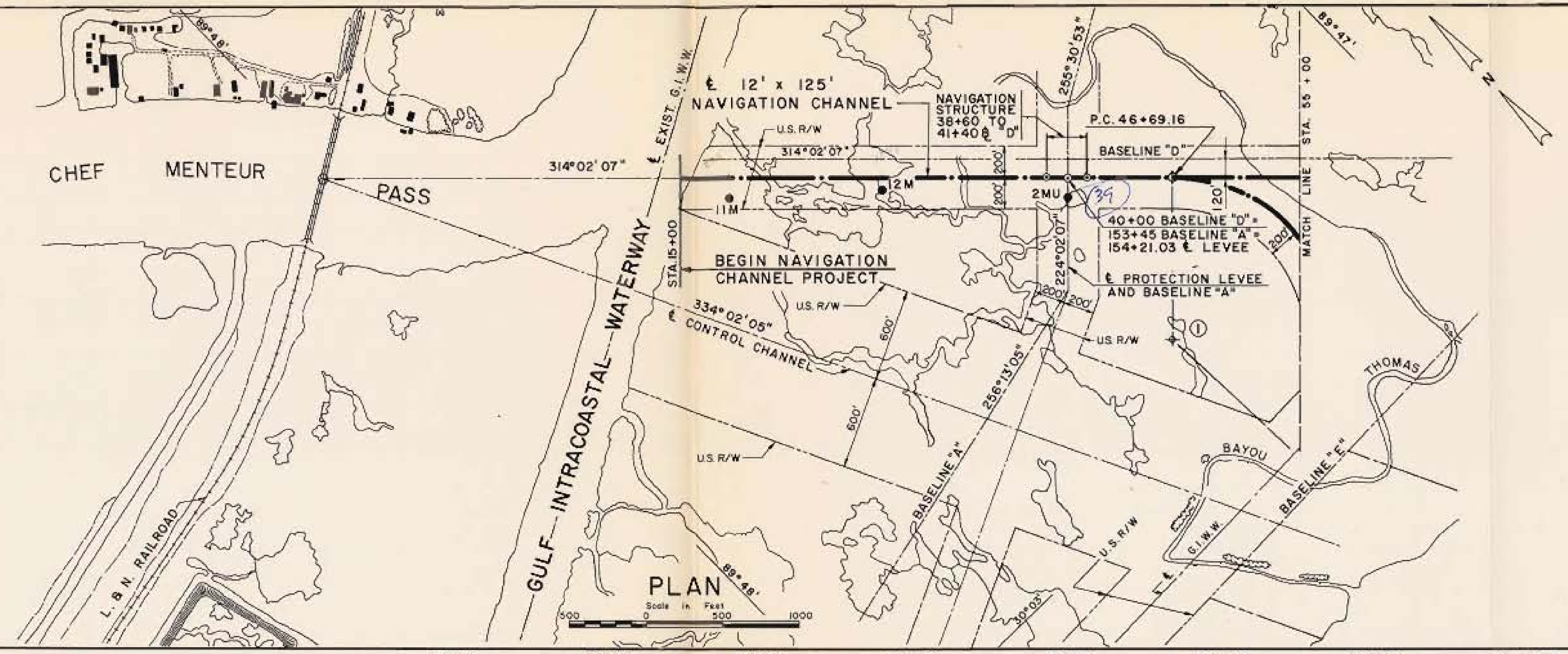
CHEF MENTEUR PASS COMPLEX

INTERSECTION DETAILS

PROTECTION LEVEE AT L.& N. R.R. & U.S. HWY. 90

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

DATE: APRIL 1969 FILE NO. H-2-24416



LEGEND

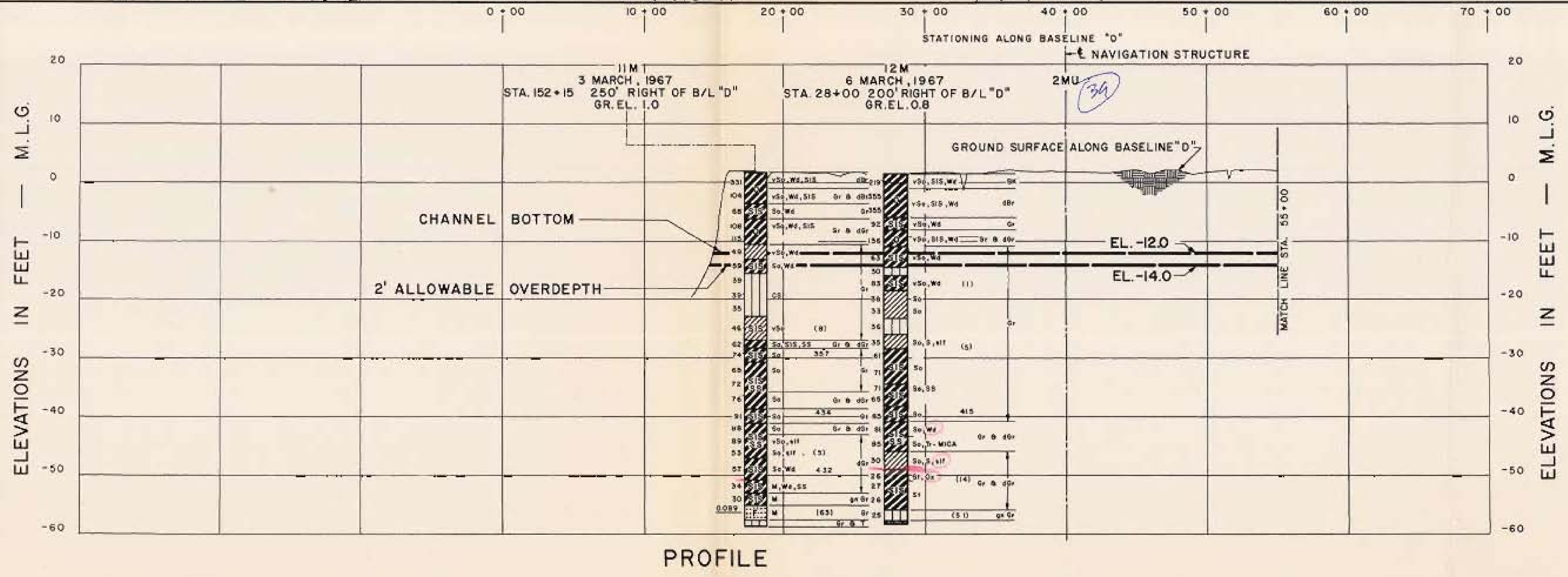
11M ● SOIL BORING LOCATION

NOTES

FOR GENERAL NOTES SEE PLATE 2

FOR CURVE (1) CURVE DATA SEE PLATE 11.

SEE PLATES 1, 27, 31 AND 37 FOR LIMITS OF SPOIL AREA.



NOTE
FOR DETAIL LOG OF BORING 2MU SEE PLATE 39.

A JOINT VENTURE

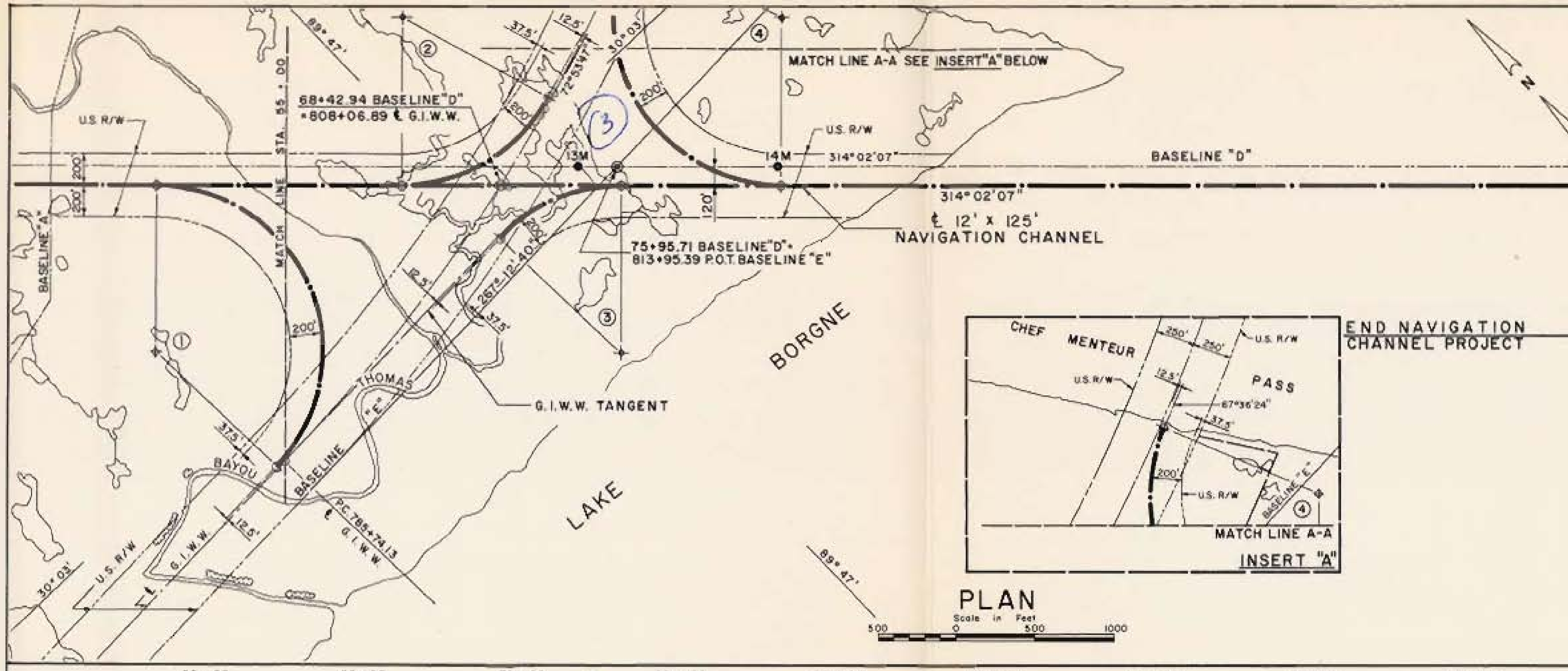
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

PLAN AND PROFILE

NAVIGATION STRUCTURE CHANNEL
STA. 15+00 TO STA. 55+00
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



LEGEND

13M ● SOIL BORING LOCATION

NOTES

FOR GENERAL NOTES SEE PLATE 2.
SEE PLATES 1, 27, 31 AND 37 FOR LIMITS OF SPOIL AREA.

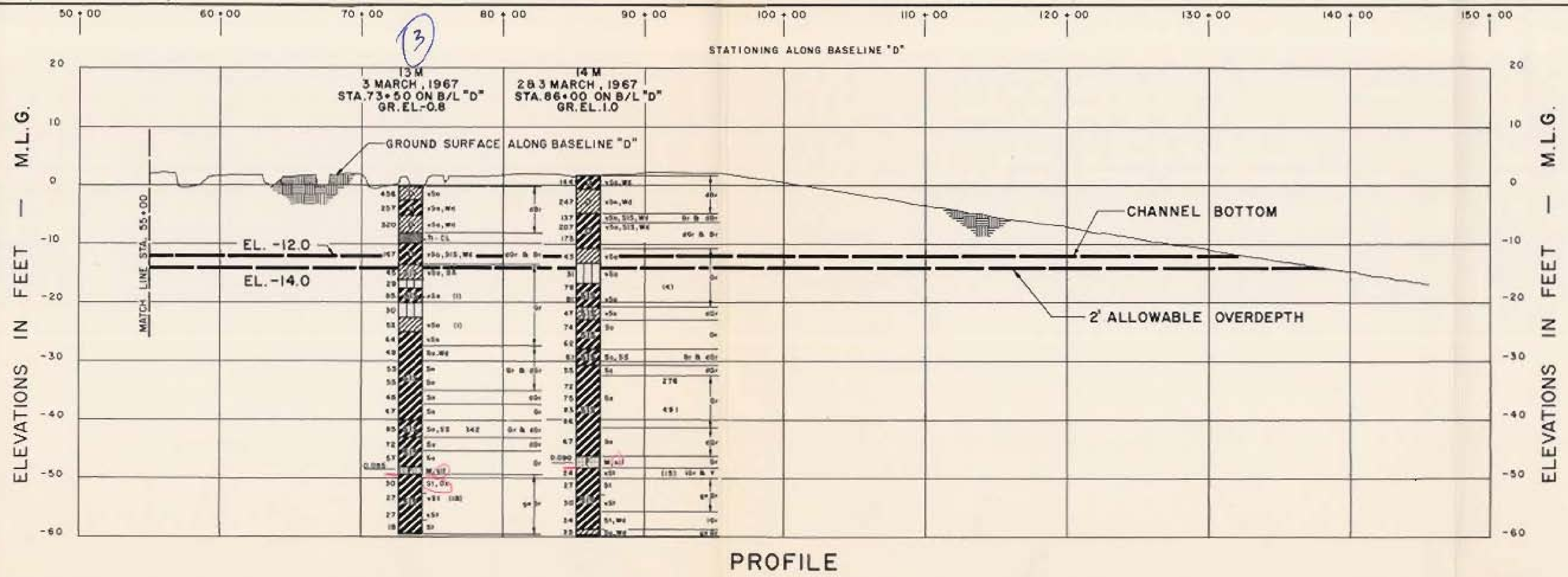
CURVE DATA

CURVE ①
P.C. = 46+69.16 BASELINE "D"
P.T. = 785+30.53 BASELINE "E"
R. = 1,062.50'
T. = 2,453.86'
Δ = 133°-10'-33"
L = 2,468.76'

CURVE ②
P.C. = 62+20.88 BASELINE "D"
P.T. = 814+37.89 ℄ G.I.W.W.
R. = 1,062.50'
T. = 627.60'
Δ = 61°-8'-20"
L = 1,133.87'

CURVE ③
P.C. = 76+17.46 BASELINE "D"
P.T. = 805+47.95 G.I.W.W. TANGENT
R. = 1,062.50'
T. = 460.03'
Δ = 46°-49'-27"
L = 868.01'

CURVE ④
P.C. = 86+14.85 BASELINE "D"
P.T. = 824+95.41 ℄ G.I.W.W.
R. = 1,062.50'
T. = 1,622.79'
Δ = 113°-34'-17"
L = 2,105.34'



A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | MARZA ENGINEERING CO. CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

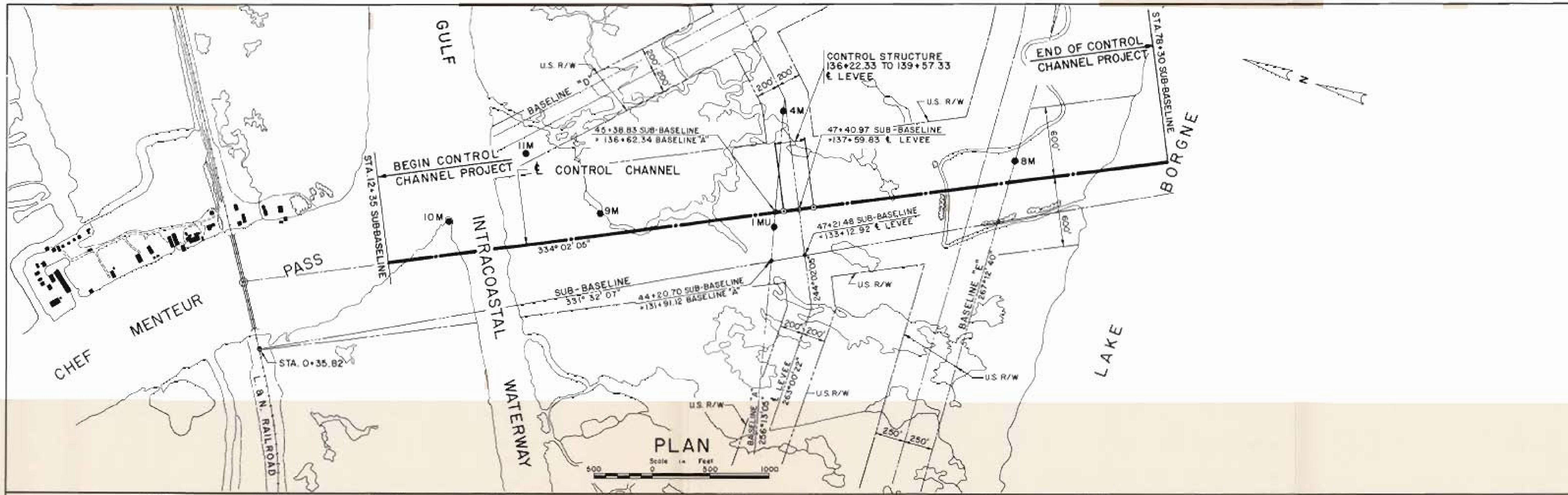
CHEF MENTEUR PASS COMPLEX

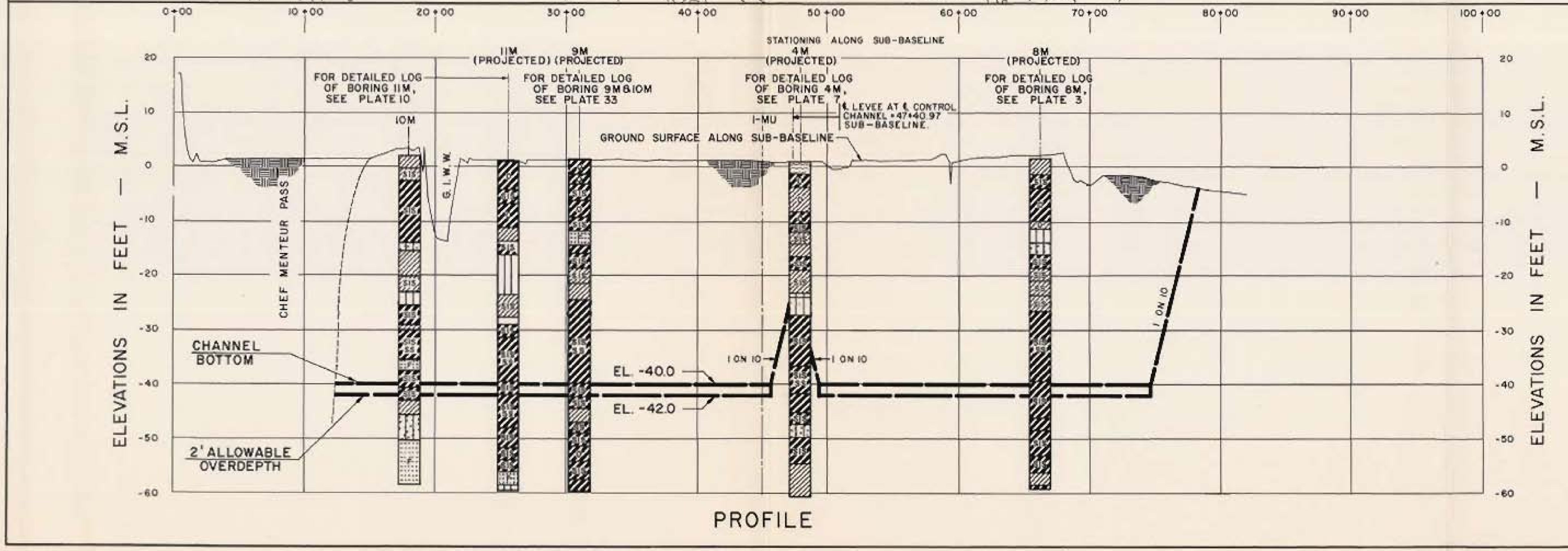
PLAN AND PROFILE

NAVIGATION STRUCTURE CHANNEL
STA. 55+00 TO STA. 135+50

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

DATE: APRIL 1969 FILE NO. H-2-24416





LEGEND

11M ● SOIL BORING LOCATION

NOTES

FOR GENERAL NOTES SEE PLATE 2.

SEE PLATES 1, 27 AND 35 FOR LIMITS OF BORROW AREA.

NOTE

FOR DETAIL LOG OF BORING 1MU SEE PLATE 38.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

PLAN AND PROFILE
CONTROL STRUCTURE CHANNEL
STA. 12+35 TO STA. 78+30

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

DATE: APRIL 1969 FILE NO. H-2-24416

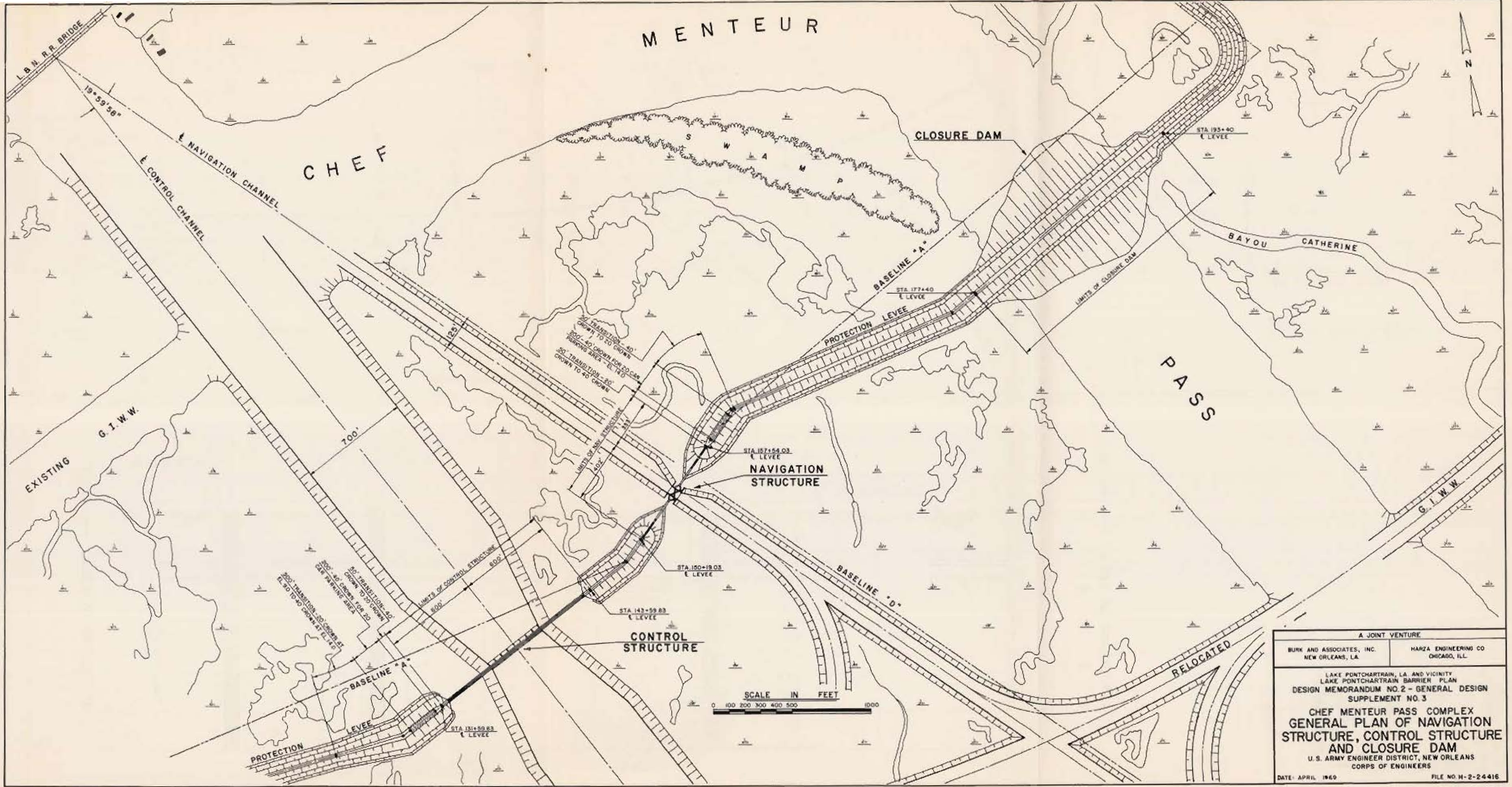
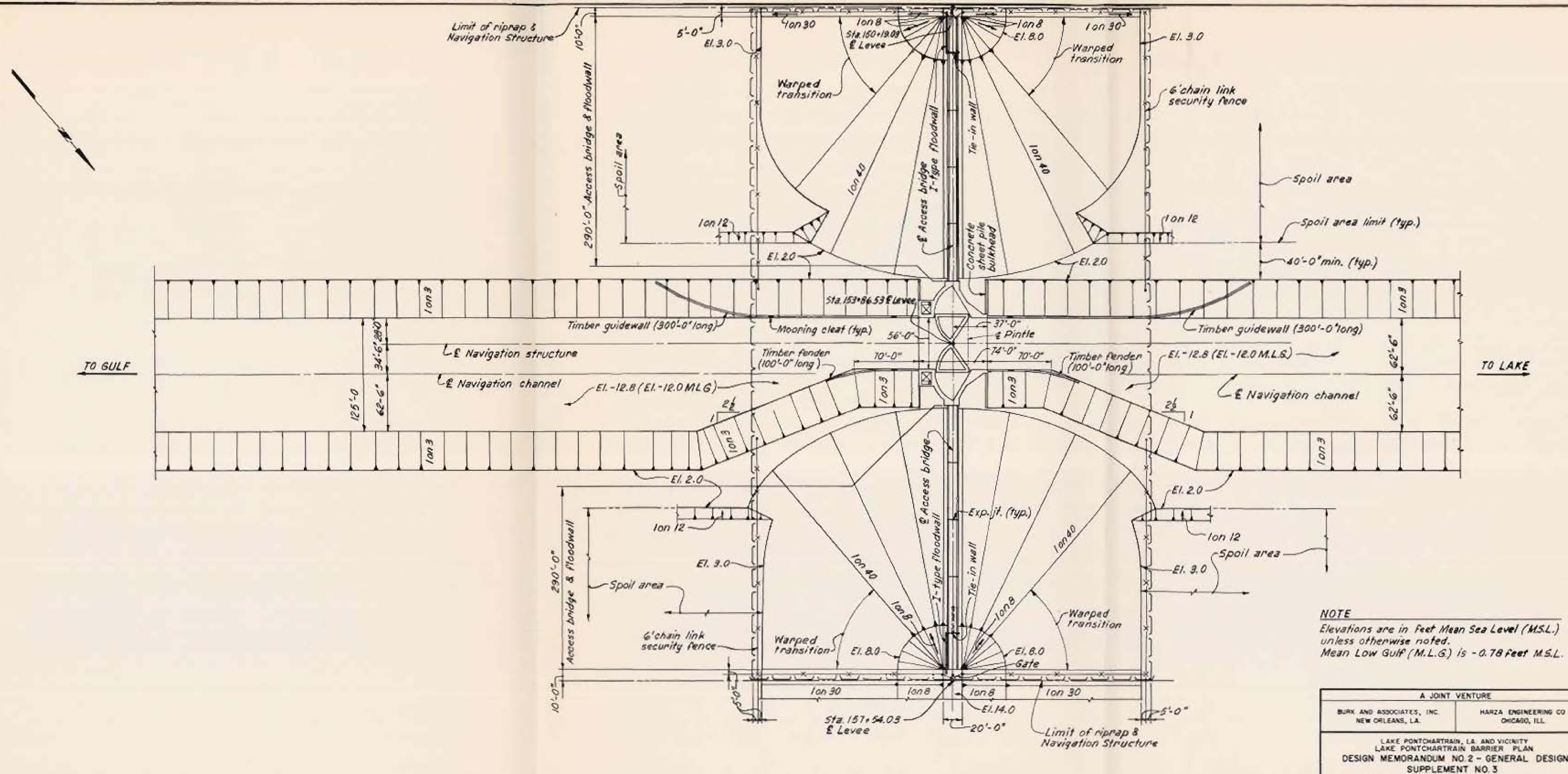

MENTEUR
CHEF
PASS
SWAMP
L.&N. R.R. BRIDGE
19°59'58"
℄ NAVIGATION CHANNEL
℄ CONTROL CHANNEL
CLOSURE DAM
STA 193+40
℄ LEVEE
BAYOU CATHERINE
LIMITS OF CLOSURE DAM
BASELINE "A"
STA 177+40
℄ LEVEE
PROTECTION LEVEE
STA 157+54.03
℄ LEVEE
NAVIGATION STRUCTURE
STA 150+19.03
℄ LEVEE
STA 143+59.83
℄ LEVEE
CONTROL STRUCTURE
STA 131+59.83
℄ LEVEE
BASELINE "D"
LIMITS OF NAV. STRUCTURE
LIMITS OF CONTROL STRUCTURE
EXISTING G.I.W.W.
G.I.W.W.
RELOCATED
700'
125'
600'
SCALE IN FEET
0 100 200 300 400 500 1000
A JOINT VENTURE
BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.
HARZA ENGINEERING CO
CHICAGO, ILL.
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO.2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
GENERAL PLAN OF NAVIGATION
STRUCTURE, CONTROL STRUCTURE
AND CLOSURE DAM
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969
FILE NO. H-2-24416

PLATE 13



PLAN

SCALE IN FEET

50 25 0 50 100

NOTE

Elevations are in Feet Mean Sea Level (M.S.L.) unless otherwise noted.
Mean Low Gulf (M.L.G.) is -0.78 feet M.S.L.

A JOINT VENTURE	
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

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LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

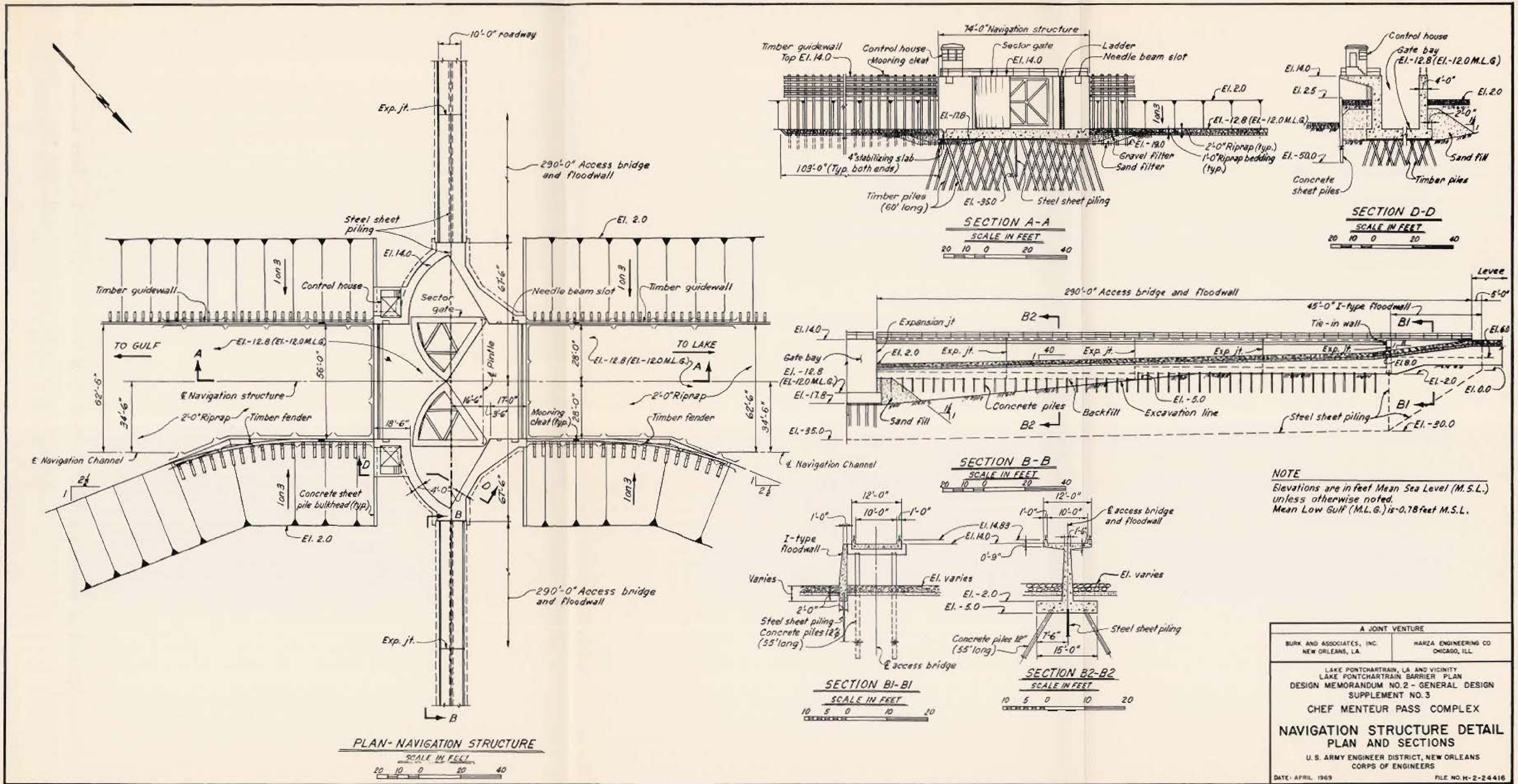
CHEF MENTEUR PASS COMPLEX

NAVIGATION STRUCTURE
GENERAL PLAN

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

DATE: APRIL 1969 FILE NO. H-2-24416

PLATE 14



A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

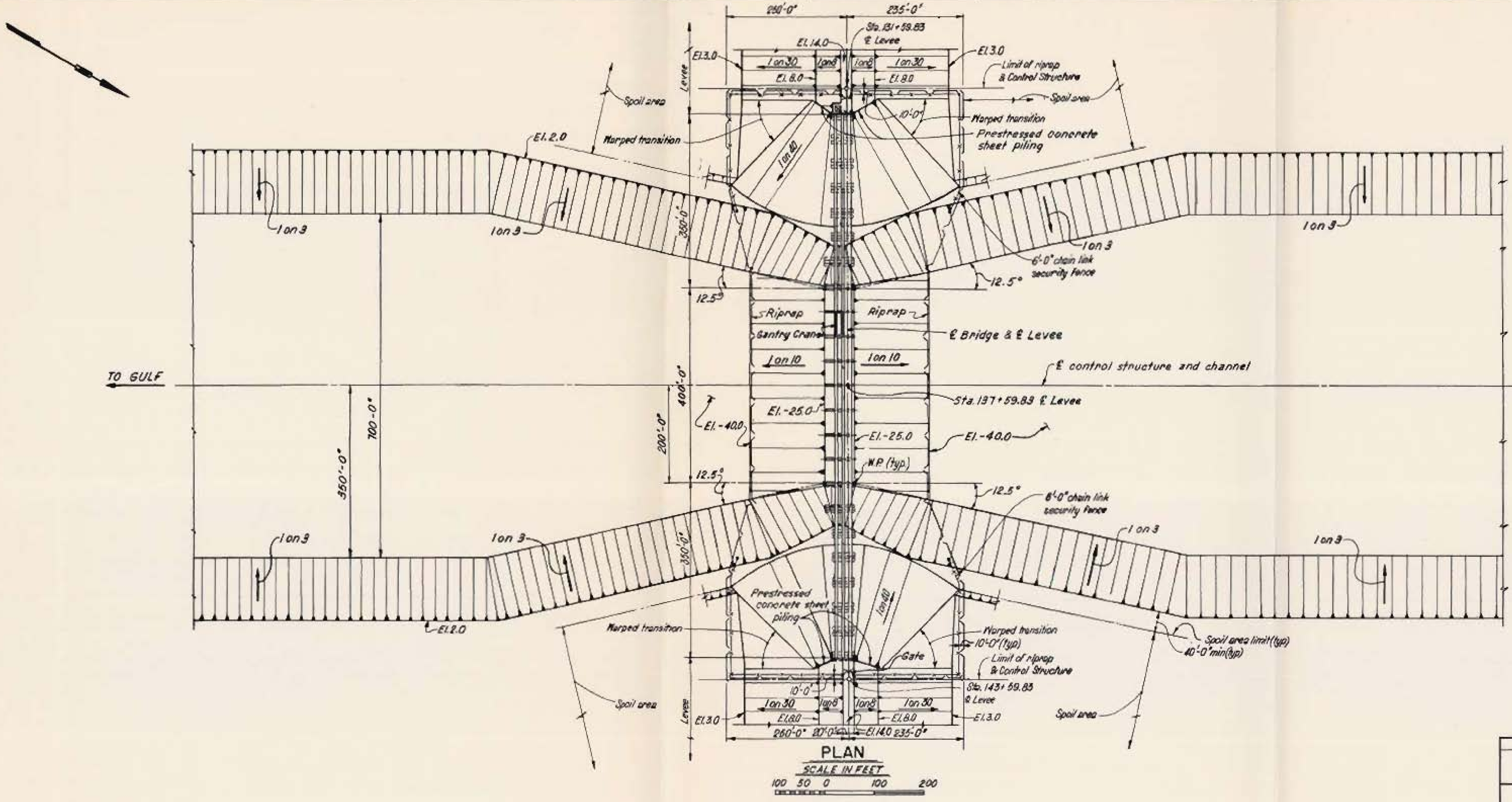
CHEF MENTEUR PASS COMPLEX

NAVIGATION STRUCTURE DETAIL
PLAN AND SECTIONS

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

DATE: APRIL 1969 FILE NO. H-2-24416

PLATE 15



PLAN

SCALE IN FEET

100 50 0 100 200

NOTE

Elevations are in feet Mean Sea Level (M.S.L.) unless otherwise noted.
Mean Low Gulf (M.L.G.) is -0.78 feet M.S.L.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO. CHICAGO, ILL.

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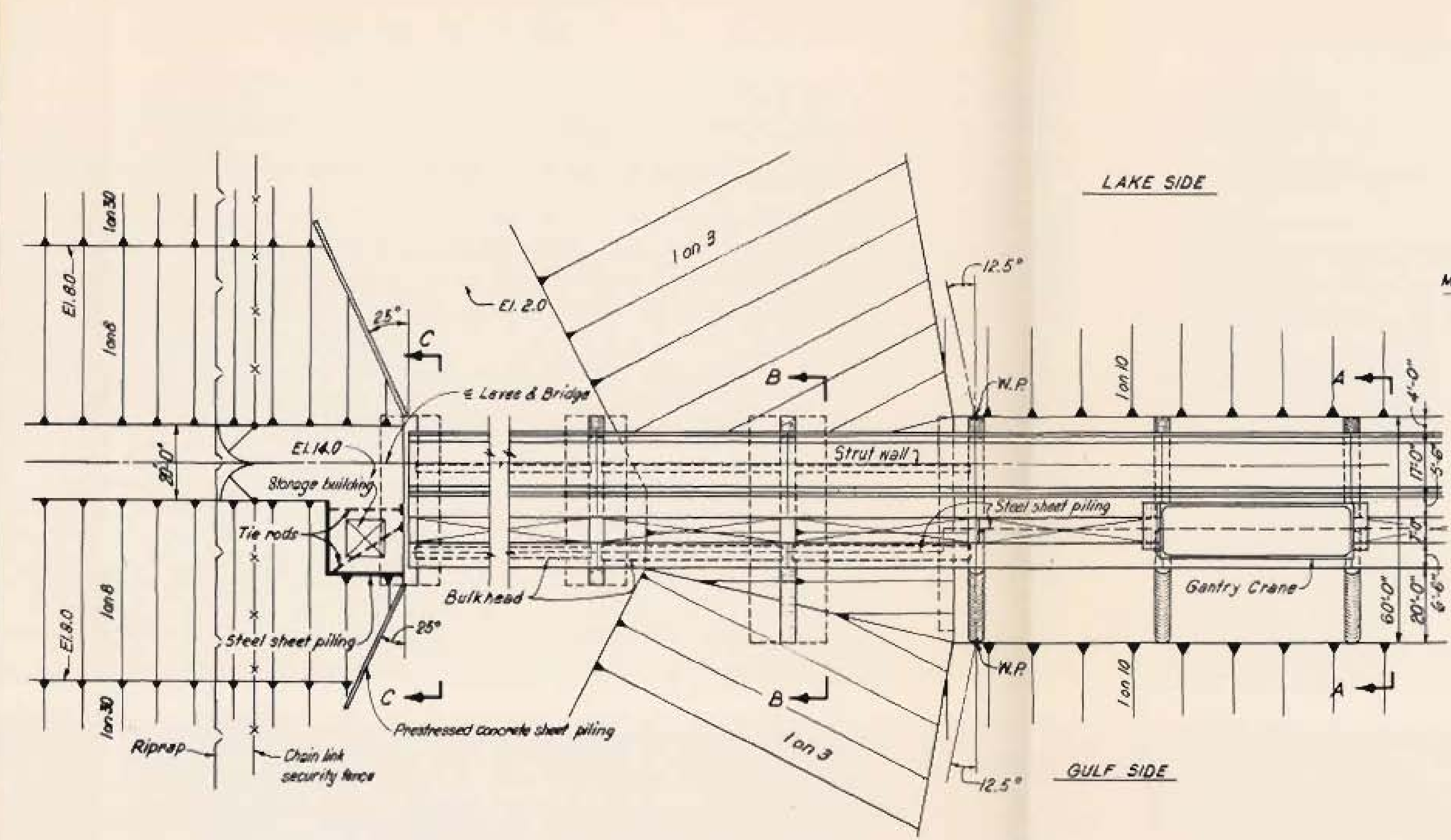
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

CONTROL STRUCTURE

GENERAL PLAN

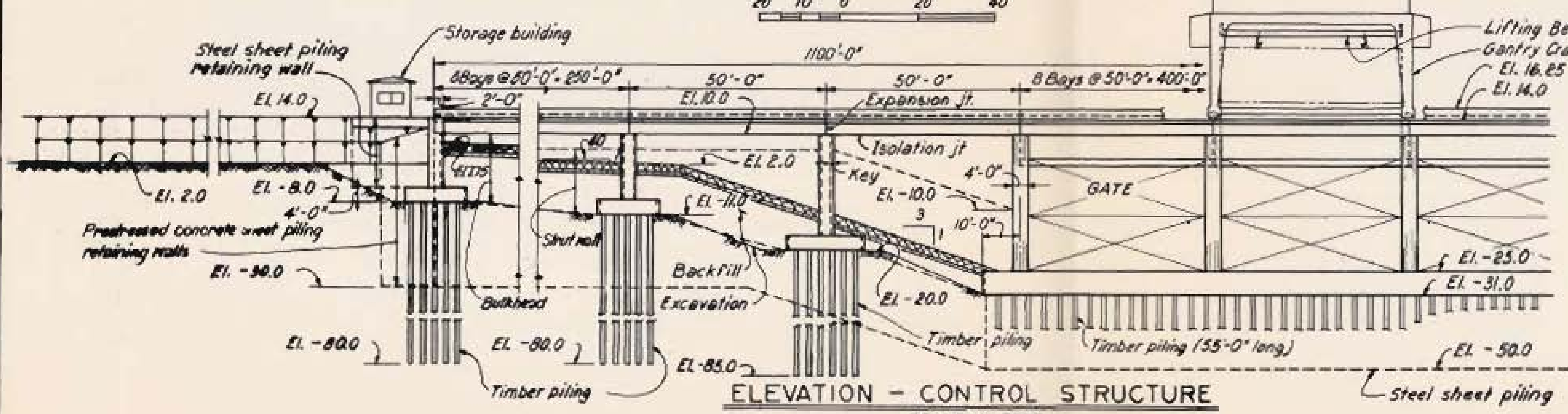
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



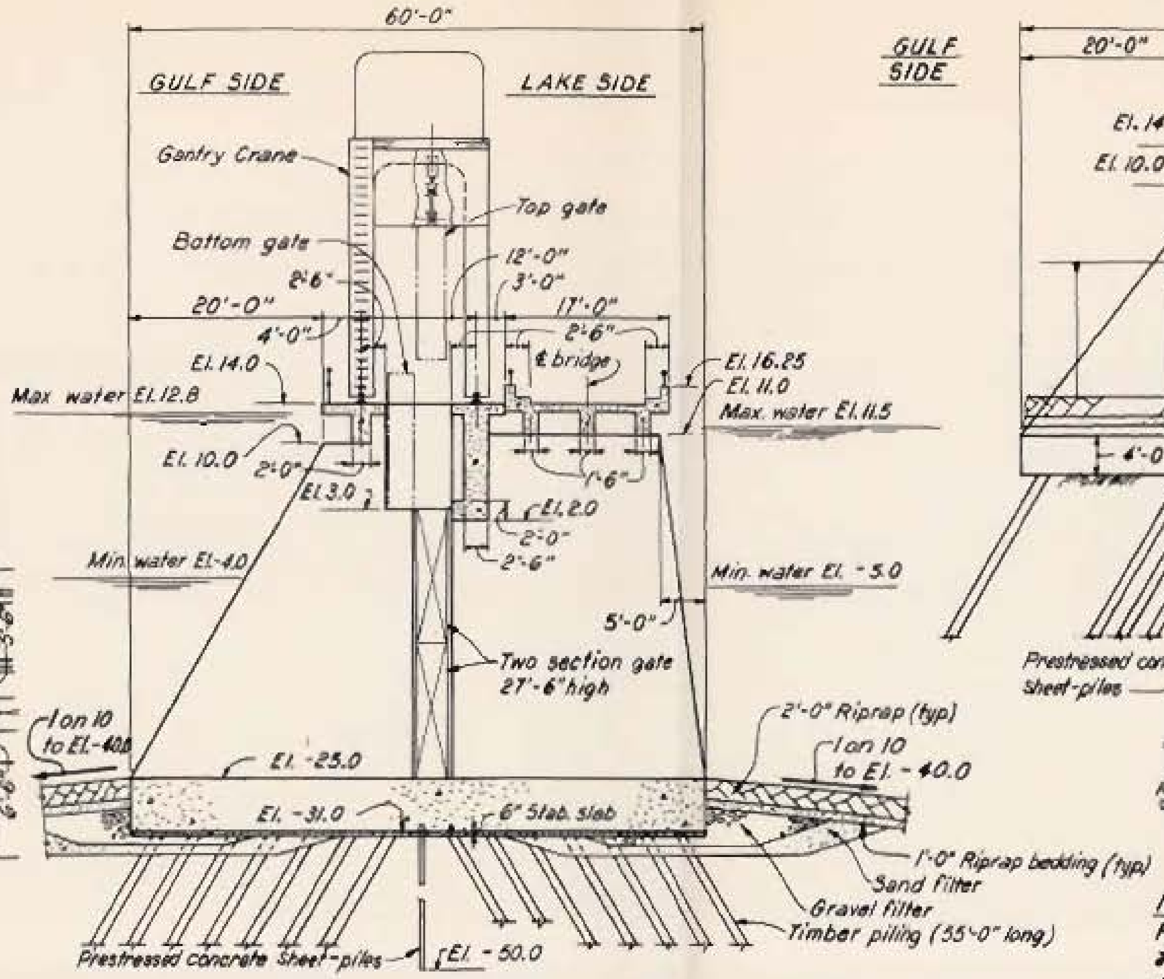
PLAN - CONTROL STRUCTURE

SCALE IN FEET



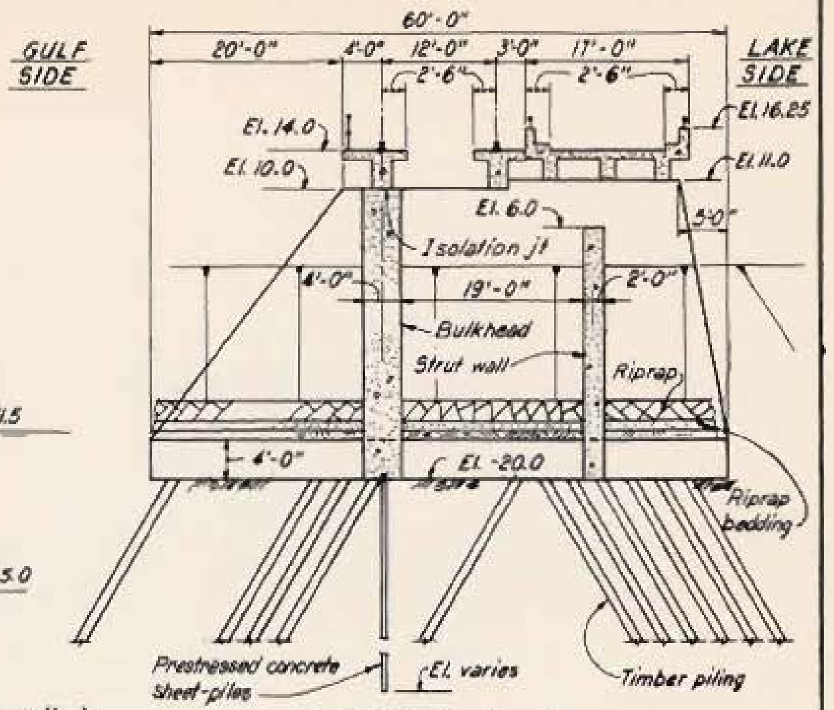
ELEVATION - CONTROL STRUCTURE

SCALE IN FEET



SECTION A - A

SCALE IN FEET

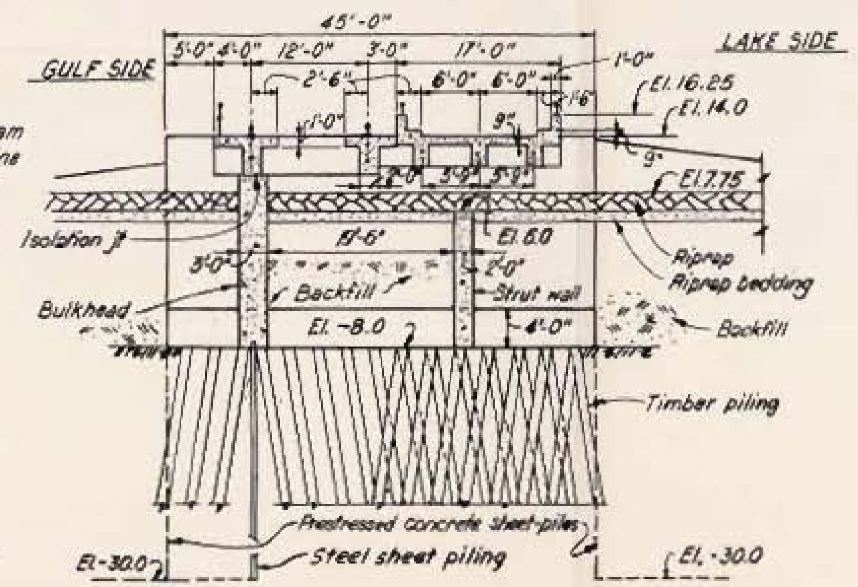


SECTION B - B

SCALE IN FEET

Note

For corresponding water elevations on Gulf and Lake sides see table of water elevations on page 15



SECTION C - C

SCALE IN FEET

NOTE

Elevations are in feet Mean Sea Level (M.S.L.) unless otherwise noted.
Mean Low Gulf (M.L.G.) is -0.78 feet M.S.L.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

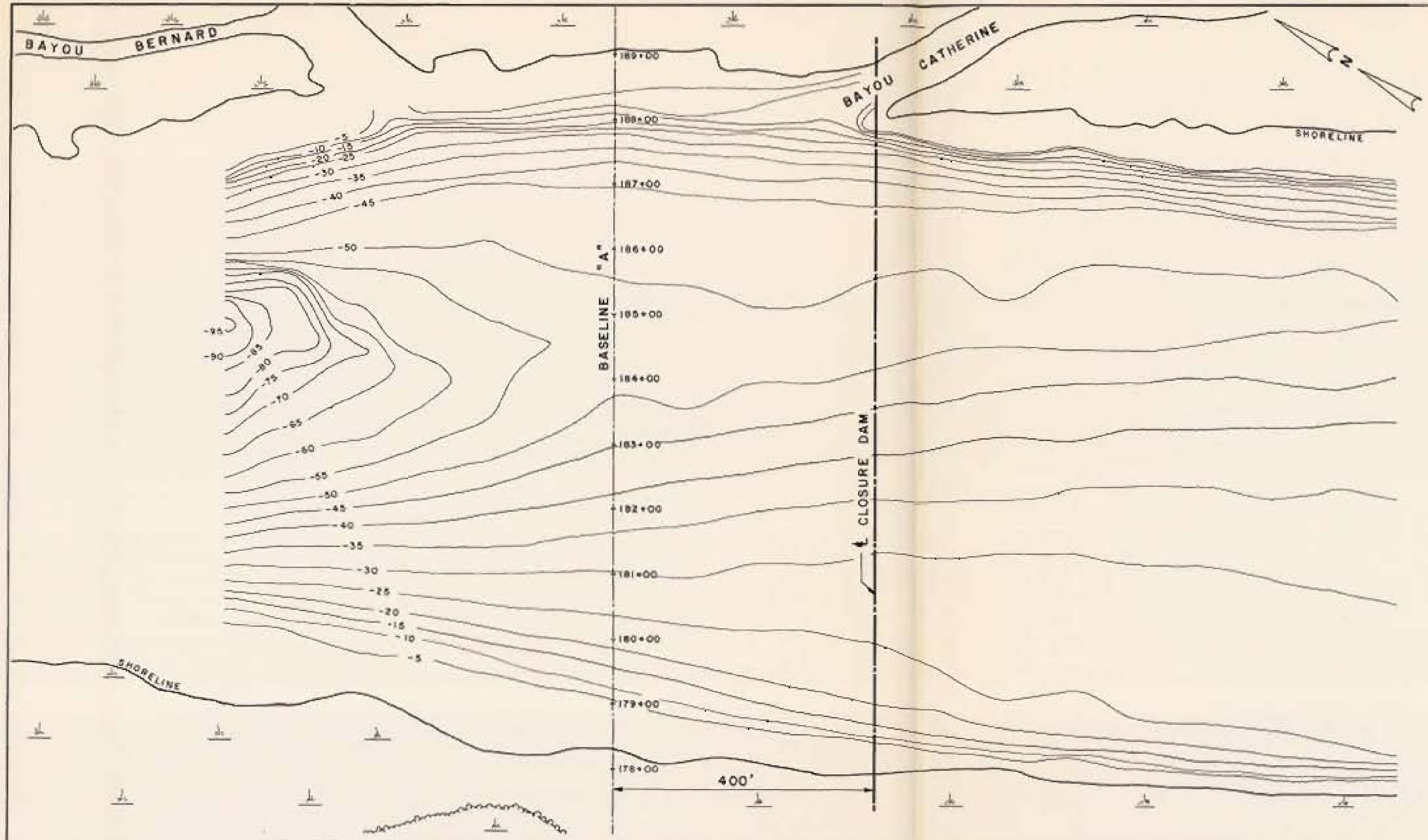
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

CONTROL STRUCTURE DETAIL
PLAN AND SECTIONS

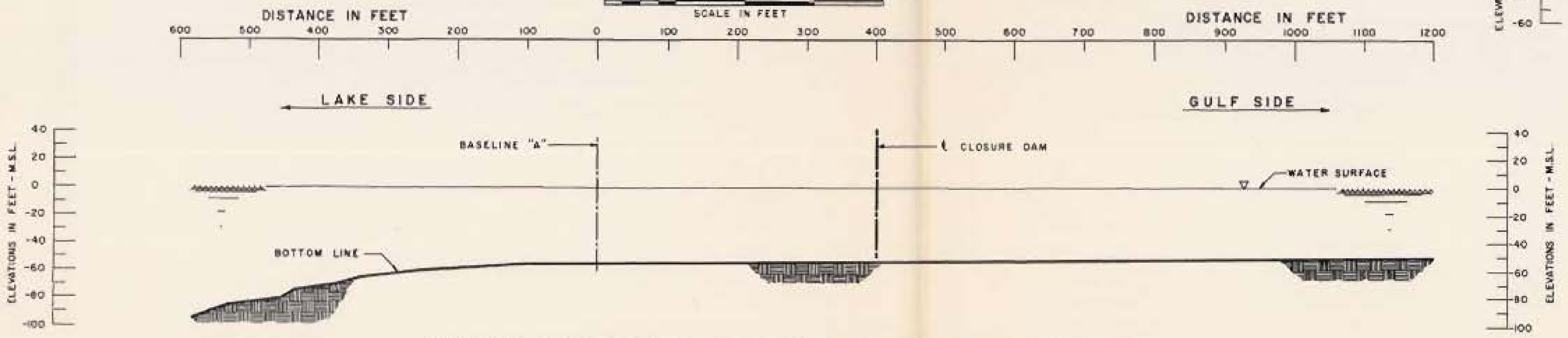
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

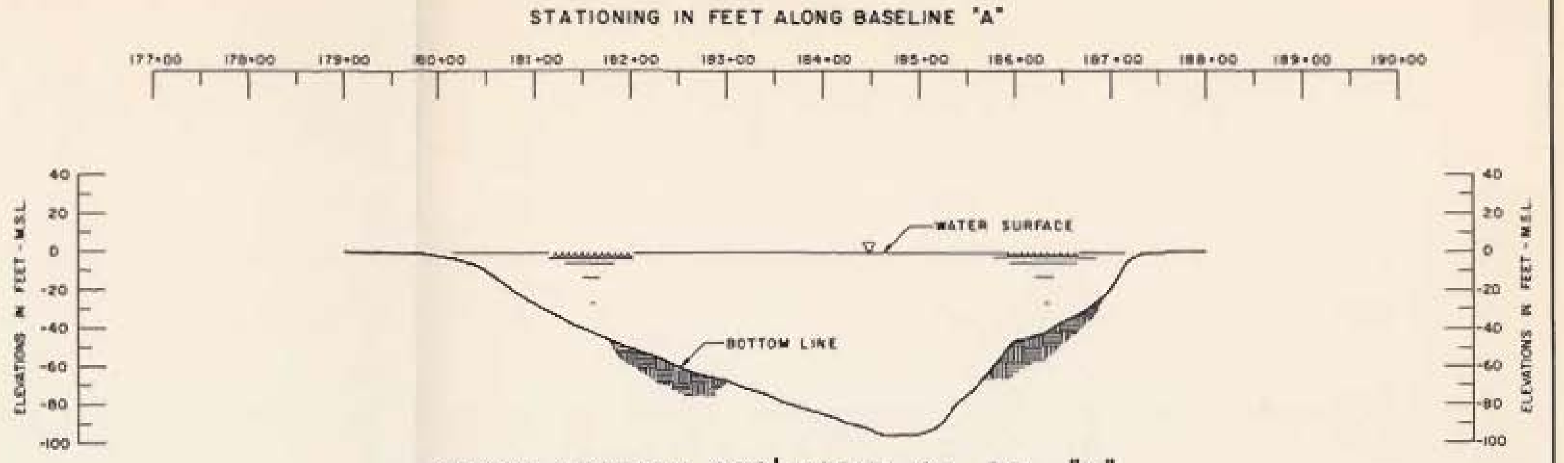
PLATE 17



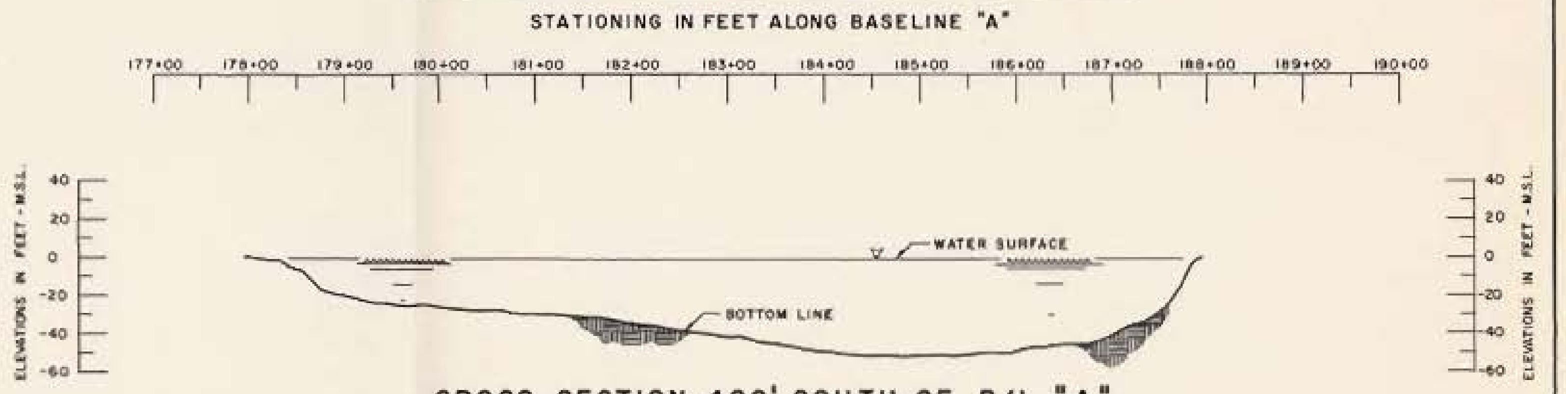
CHEF MENTEUR PASS CLOSURE DAM — HYDROGRAPHIC AND TOPOGRAPHIC PLAN



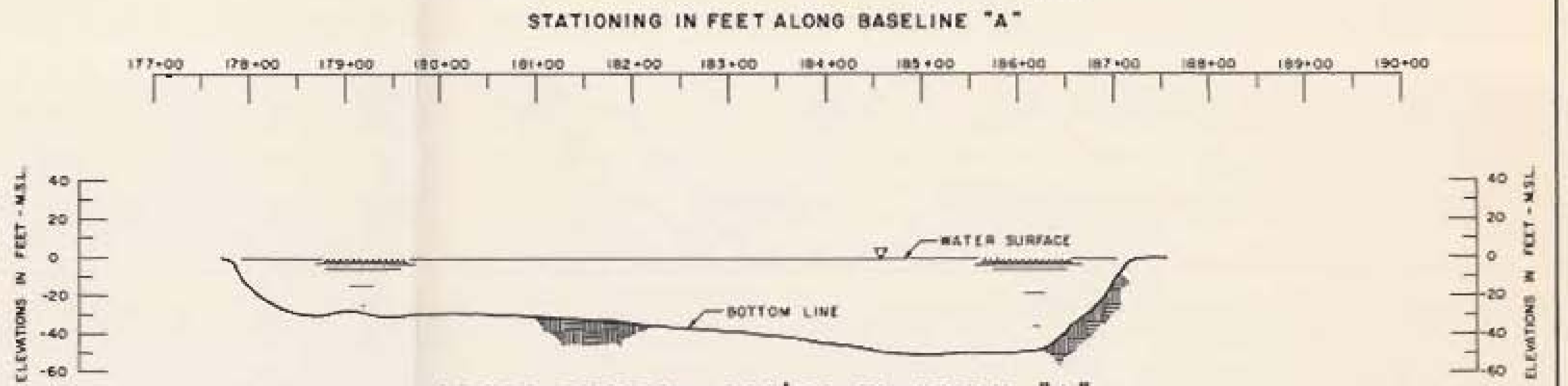
THALWEG THRU PORTION OF CHEF MENTEUR PASS SHOWN ABOVE



CROSS SECTION 600' NORTH OF B/L "A"



CROSS SECTION 400' SOUTH OF B/L "A"



CROSS SECTION 1200' SOUTH OF B/L "A"

A JOINT VENTURE

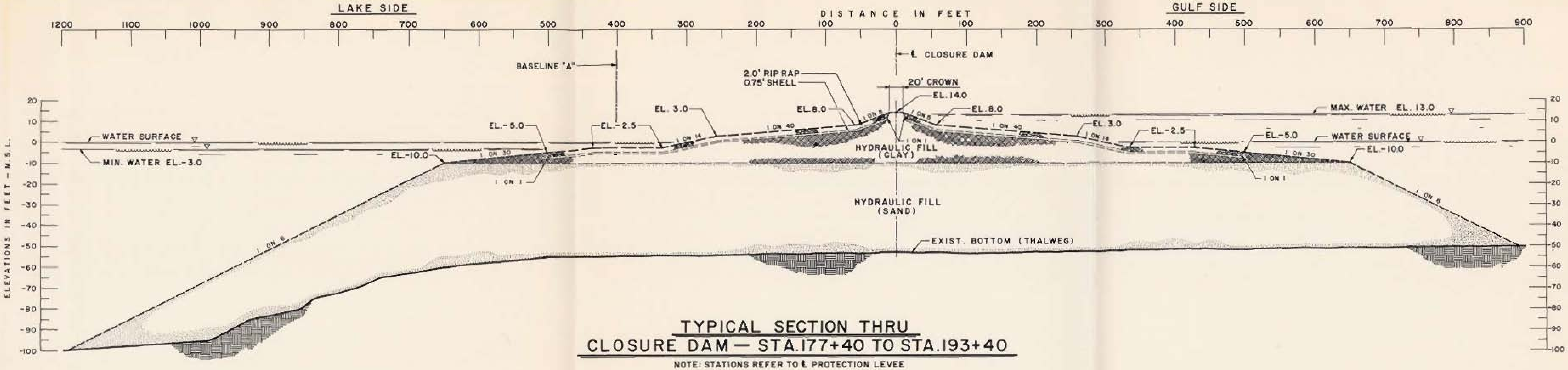
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
CLOSURE DAM HYDROGRAPHIC
AND TOPOGRAPHIC PLAN

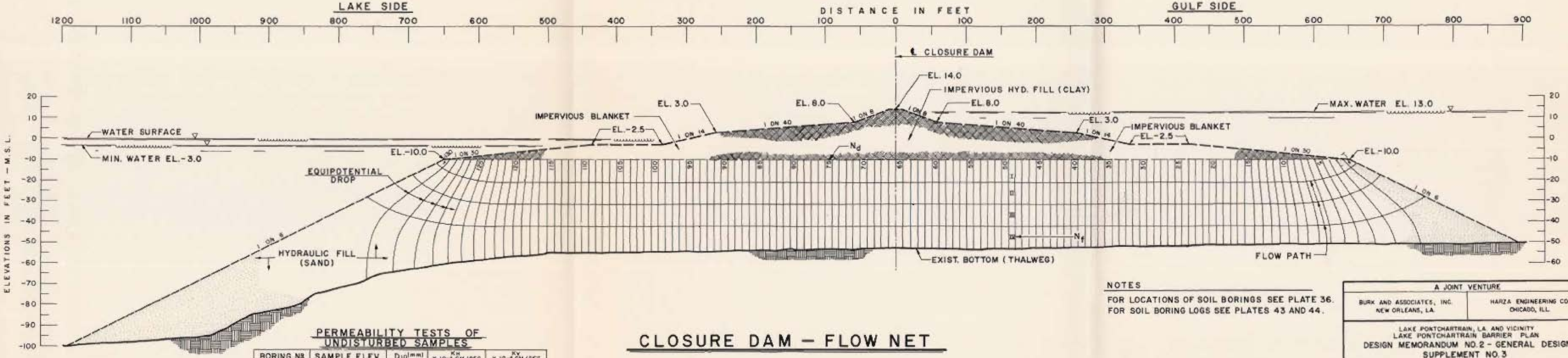
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



TYPICAL SECTION THRU CLOSURE DAM — STA.177+40 TO STA.193+40

NOTE: STATIONS REFER TO ℄ PROTECTION LEVEE



PERMEABILITY TESTS OF UNDISTURBED SAMPLES

BORING №	SAMPLE ELEV.	D_{10} (mm)	K_H x 10^{-4} CM/SEC	K_V x 10^{-4} CM/SEC
10MU	-33.0 TO -41.0	.081	00.1095	00.1077
10MU	-60.5 TO -80.0	.077	49.94	51.41
10MU	-80.0 TO -100.0	.130	135.52	140.71
11MU	-60.0 TO -80.0	.140	196.39	190.77
11MU	-80.0 TO -100.0	.110	125.87	110.31

NOTE: HYDRAULIC FILL WILL BE MORE PERMEABLE THAN UNDISTURBED SAMPLE. A COMPOSITE K OF 200 x 10^{-4} CM/SEC IS CONSIDERED A SUITABLE DESIGN VALUE.

CLOSURE DAM — FLOW NET

N_f = 4
N_d = 130
h = 13 - 0 = 13' = Net seepage head
K = 200 x 10^{-4} cm per sec = 28.35 ft per day
$Q = \frac{N_f}{N_d} \cdot h \cdot k = (\frac{4}{130})(13)(28.35)$
Q = 11.34 ft^3 per day per lin. ft. of Closure Fill.

NOTES

FOR LOCATIONS OF SOIL BORINGS SEE PLATE 36.
FOR SOIL BORING LOGS SEE PLATES 43 AND 44.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO. CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

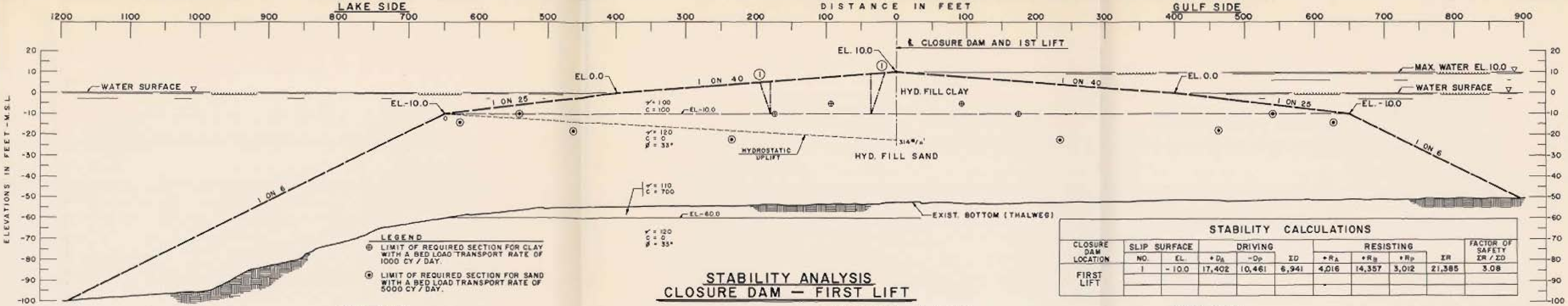
CHEF MENTEUR PASS COMPLEX

CLOSURE DAM

TYPICAL SECTION & SEEPAGE ANALYSIS

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

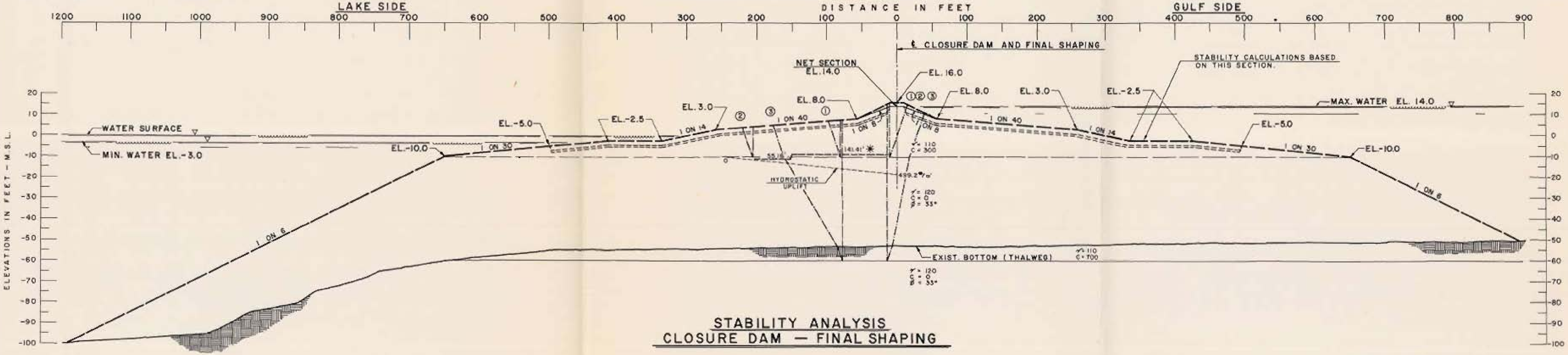
DATE: APRIL 1969 FILE NO. H-2-24416



STABILITY ANALYSIS CLOSURE DAM — FIRST LIFT

STABILITY CALCULATIONS

CLOSURE DAM LOCATION	SLIP SURFACE NO.	SLIP SURFACE EL.	DRIVING +D_A	DRIVING −D_P	ΣD	RESISTING +R_A	RESISTING +R_B	RESISTING +R_P	ΣR	FACTOR OF SAFETY ΣR / ΣD
FIRST LIFT	1	- 10.0	17,402	10,461	6,941	4,016	14,357	3,012	21,385	3.08



STABILITY ANALYSIS CLOSURE DAM — FINAL SHAPING

STABILITY CALCULATIONS

CLOSURE DAM LOCATION	SLIP SURFACE NO.	SLIP SURFACE EL.	DRIVING +D_A	DRIVING −D_P	ΣD	RESISTING +R_A	RESISTING +R_B	RESISTING +R_P	ΣR	FACTOR OF SAFETY ΣR / ΣD
FINAL SHAPING	1	-10.0	33,498	10,286	23,212	15,108	21,151	8,461	44,720	1.93
	2	-10.0	33,218	3,196	30,022	15,043	51,113	2,407	68,563	2.28
	3	-60.0	456,744	210,002	246,742	209,229	44,828	214,941	468,997	1.90

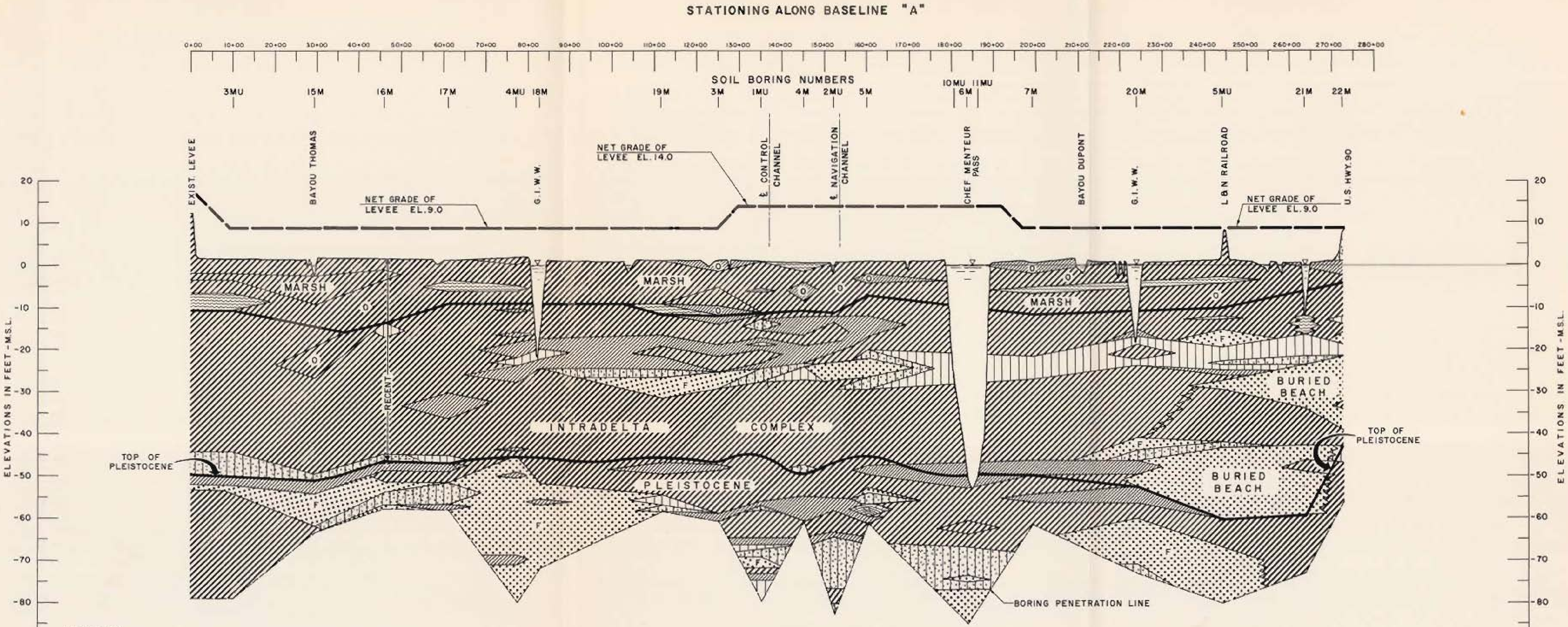
(LENGTH OF NEUTRAL BLOCK IN UPPER STRATA)

* (LENGTH OF NEUTRAL BLOCK IN LOWER STRATA)

NOTE
FOR GENERAL NOTES SEE PLATE 31.

A JOINT VENTURE
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.
HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX
CLOSURE DAM
STABILITY ANALYSIS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: APRIL 1969 FILE NO. H-2-24416



LEGEND

(PT)	PEAT	(ML)	SILT
(CH)	FAT CLAY	(SM)	SILTY SAND
(CHO)	FAT CLAY WITH ORGANIC MATTER	(SP)	SAND
(CL)	LEAN CLAY	(WD)	WOOD
(CLO)	LEAN CLAY WITH ORGANIC MATTER		

MARSH — VERY SOFT TO SOFT CH WITH ORGANIC MATTER AND PEAT.
INTRADELTA COMPLEX — SOFT CLAYS AND SILTS WITH LAYERS AND AREAS OF SAND.
BURIED BEACH — SAND WITH SHELL AND SHELL FRAGMENTS.
PLEISTOCENE — STIFF TO VERY STIFF CLAYS WITH LARGE LAYERS AND AREAS OF SAND.

GENERALIZED SOIL AND GEOLOGIC PROFILE ALONG BASELINE "A"

— PROTECTION LEVEE —

NOTES

FOR DETAILED BORING LOGS, SEE PLATES 2,3,6,7,8,39,40 & 41.
SEE PLATES 6,7 & 8 FOR BASELINE "A"

A JOINT VENTURE

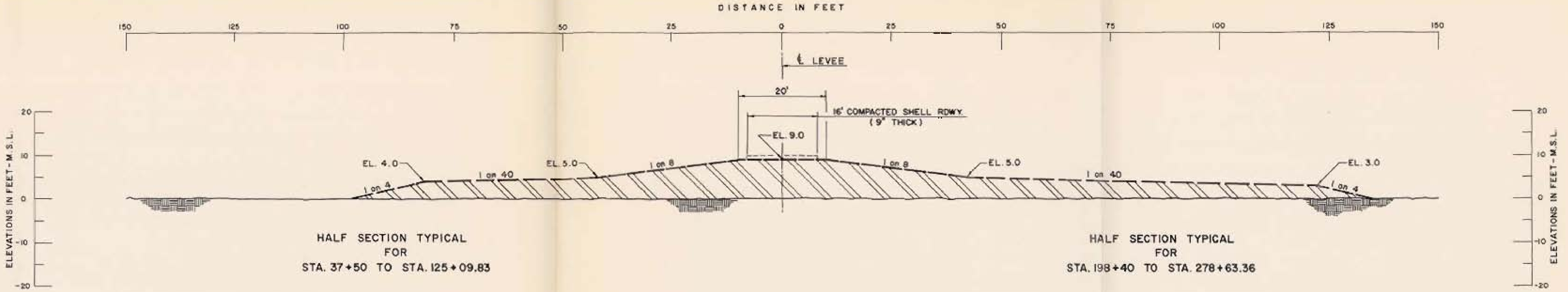
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. — HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

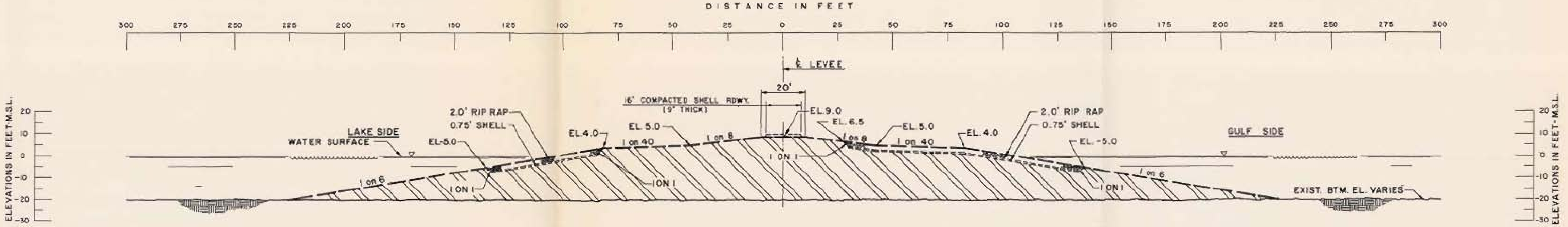
CHEF MENTEUR PASS COMPLEX
GENERALIZED SOIL AND GEOLOGIC PROFILE
PROTECTION LEVEE

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

DATE: APRIL 1969 FILE NO. H-2-24416



TYPICAL SECTION THRU PROTECTION LEVEE



TYPICAL SECTION THRU PROTECTION LEVEE AT G. I. W. W.
& MARQUES CANAL

A JOINT VENTURE

BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA

HARZA ENGINEERING CO
CHICAGO, ILL

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

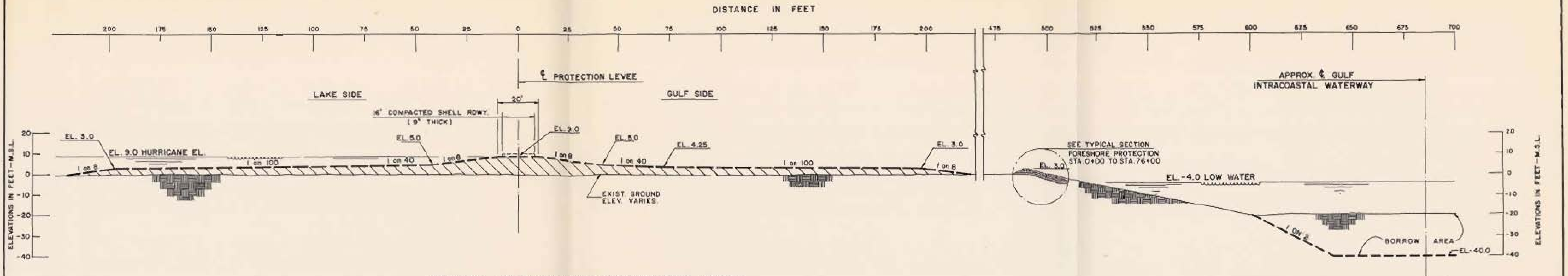
CHEF MENTEUR PASS COMPLEX

TYPICAL SECTIONS

PROTECTION LEVEE

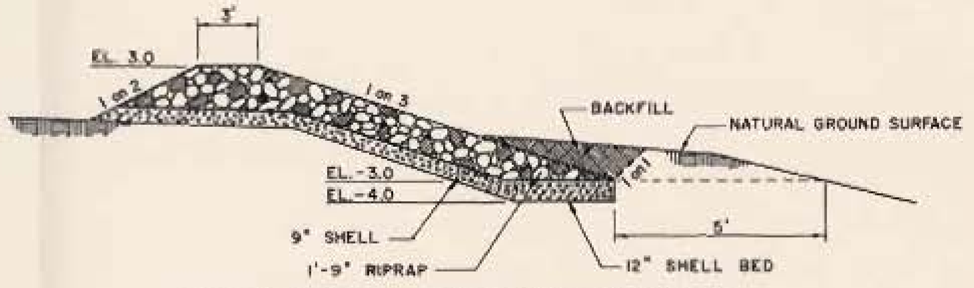
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

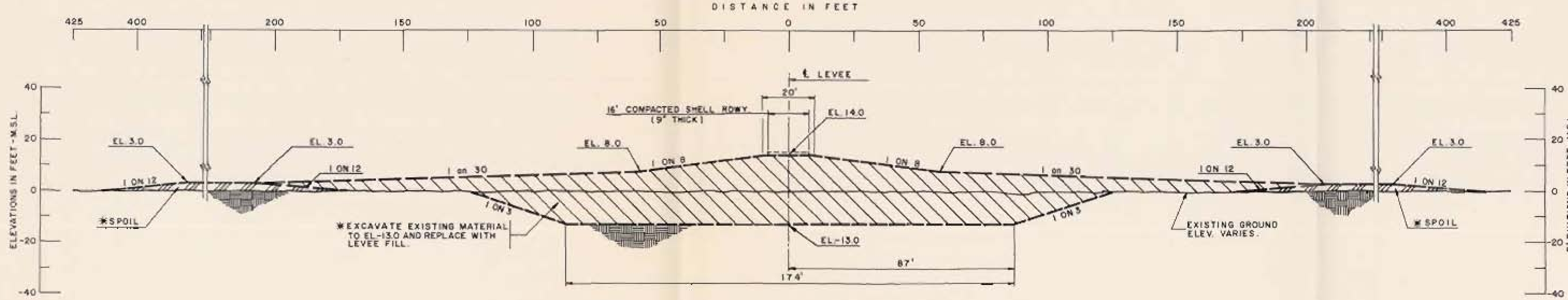


TYPICAL SECTION THRU PROTECTION LEVEE

STA. 0+00 TO STA. 37+50



TYPICAL SECTION – FORESHORE PROTECTION



TYPICAL SECTION THRU PROTECTION LEVEE

STA. 125+09.83 TO STA. 177+40
STA. 193+40 TO STA. 198+40

NOTE
ALL STATIONS REFER TO ℄ OF PROTECTION LEVEE.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

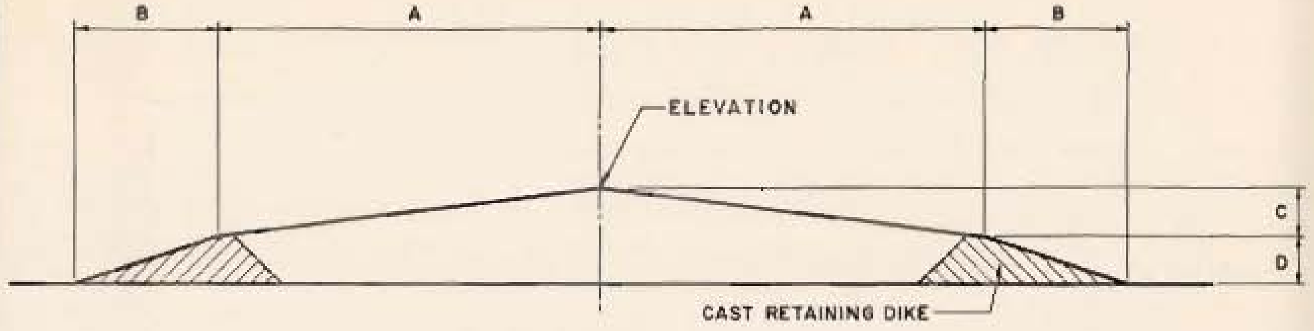
TYPICAL SECTIONS

PROTECTION LEVEE

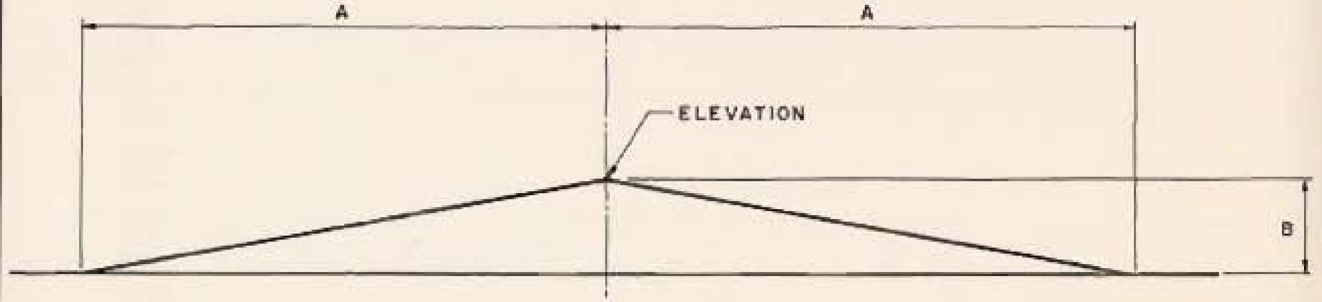
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

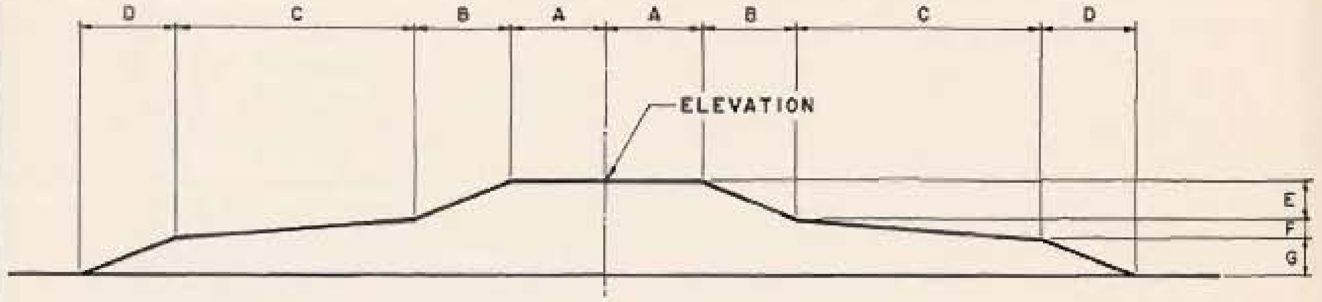
PLATE 23



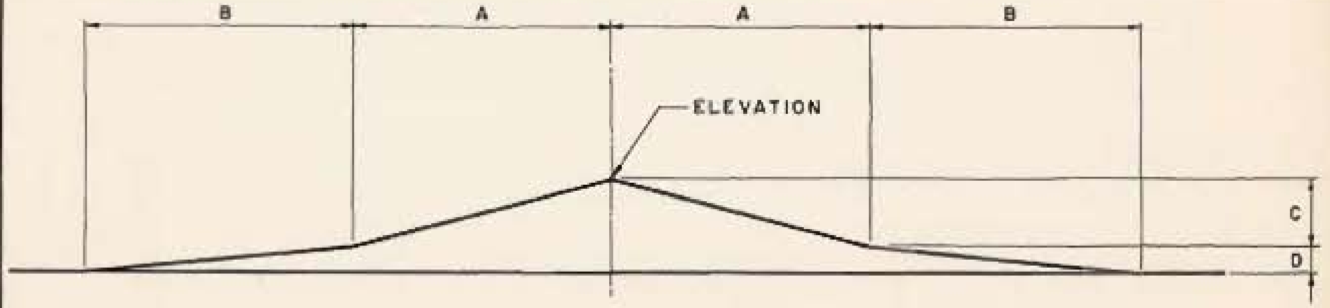
TEMPLATE I



TEMPLATE II



TEMPLATE III



TEMPLATE IV

STATION TO STATION	LIFT OR SHAPING	TEMPLATE	ELEV.	TIME OF NEXT LIFT	SETTLEMENT AT CENTERLINE	A	B	C	D	E	F	G
0+00 TO 37+50	1ST LIFT	I	11.0	3 YRS.	5.0'	225'	20'	5'	5'	–	–	–
	2ND LIFT	I	11.0	2 YRS.	3.0'	225'	20'	5'	6'	–	–	–
	1ST SHAPING	II	11.0	2 YRS.	2.0'	240'	10'	–	–	–	–	–
	FINAL SHAPING	III	11.0	–	–	10'	32'	135'	24'	6'	2'	3'
37+50 TO 125+09.83 ** 198+40 TO 278+63.36**	1ST LIFT	I	11.0	3 YRS.	5.0'	135'	20'	5'	5'	–	–	–
	2ND LIFT	I	11.0	2 YRS.	3.0'	135'	20'	5'	6'	–	–	–
	1ST SHAPING	II	11.0'	2 YRS.	2.0'	150'	10'	–	–	–	–	–
	FINAL SHAPING	III	11.0'	–	–	10'	32'	40'	12'	6'	1'	3'
125+09.83 TO 177+40 193+40 TO 198+40	1ST LIFT	I	14.0'	3 YRS.	9.0'	210'	✳ –	8'	5'	–	–	–
	2ND LIFT	I	16.0'	2 YRS.	4.0'	210'	✳ –	10'	3'	–	–	–
	1ST SHAPING	IV	16.0'	2 YRS.	2.0'	90'	120'	8'	5'	–	–	–
	FINAL SHAPING	III	16.0'	–	–	10'	48'	150'	✳ –	8'	5'	3'
G. I.W.W. CLOSURE 80+00 TO 85+00 226+47.36 TO 233+47.36 MARQUES CANAL CLOSURE 267+27.36 TO 271+27.36	1ST LIFT	I	9.0'	3 YRS.	3.5'	82'	156'	3'	26'	–	–	–
	2ND LIFT	I	9.0'	2 YRS.	2.0'	82'	156'	3'	26'	–	–	–
	HAULED FILL & FINAL SHAPING	III	11.0'	–	–	10'	32'	40'	156'	6'	1'	24'

NOTE

HYDRAULICALLY PLACED FILL (EXCLUDING FILL FOR CLOSURES) SHALL BE RETAINED BY A CAST EARTHERN DIKE. MATERIAL FOR DIKE OF THE FIRST LIFT IS TO BE EXCAVATED FROM EXISTING MATERIAL BENEATH PROPOSED LEVEE. DIKE MATERIAL FOR SUBSEQUENT LIFTS SHALL BE TAKEN FROM FILL OF PREVIOUS LIFT.

✳ FILL AGAINST SPOIL DIKE.

** EXCLUDE CANAL CLOSURE'S.

A JOINT VENTURE

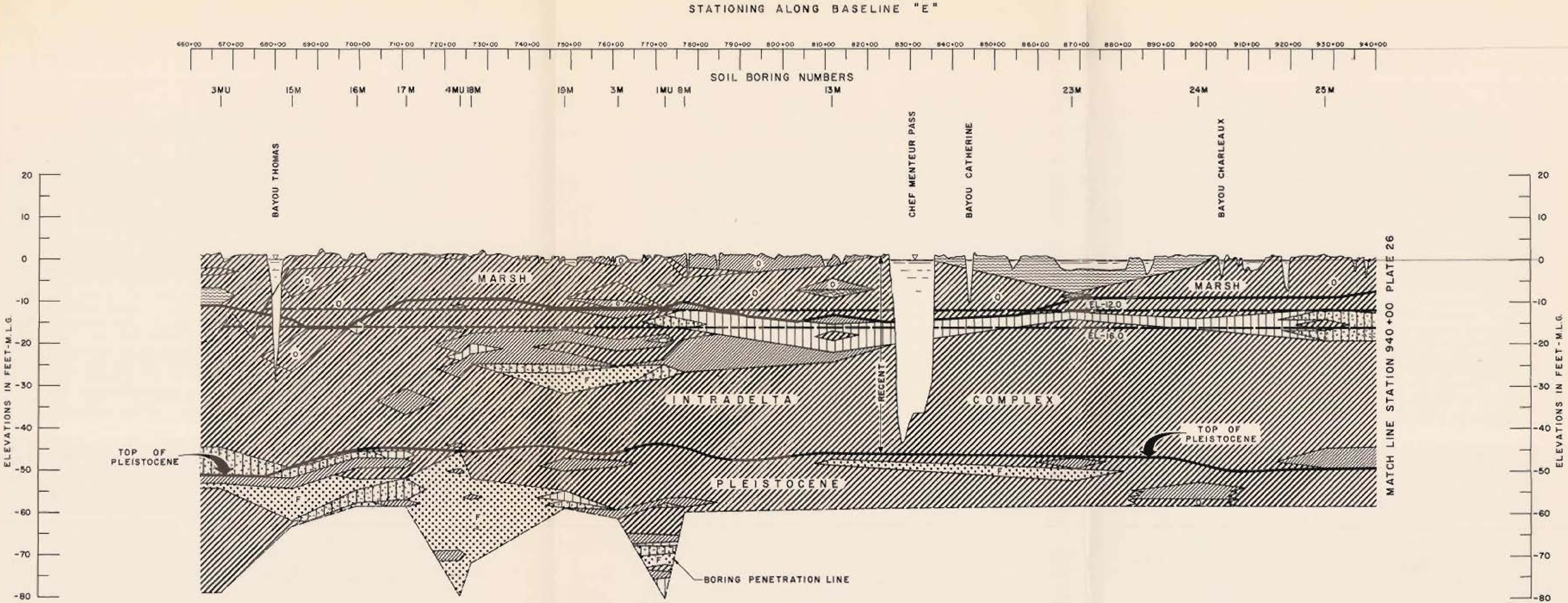
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
LIFT AND SHAPING DETAILS
PROTECTION LEVEE

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

DATE: APRIL 1969 FILE NO. H-2-24416



GENERALIZED SOIL AND GEOLOGIC PROFILE ALONG BASELINE "E"

—RELOCATED G. I. W. W.—

LEGEND

(PT)	PEAT	(ML)	SILT
(CH)	FAT CLAY	(SM)	SILTY SAND
(CHO)	FAT CLAY WITH ORGANIC MATTER	(SP)	SAND
(CL)	LEAN CLAY	(WD)	WOOD
(CLO)	LEAN CLAY WITH ORGANIC MATTER		

MARSH — VERY SOFT TO SOFT CH WITH ORGANIC MATTER AND PEAT.
INTRADELTA COMPLEX— SOFT CLAYS AND SILTS WITH LAYERS AND AREAS OF SAND.
BURIED BEACH — SAND WITH SHELL AND SHELL FRAGMENTS.
PLEISTOCENE — STIFF TO VERY STIFF CLAYS WITH LARGE LAYERS AND AREAS OF SAND.

NOTES

FOR DETAILED BORING LOGS SEE PLATES 2, 3, 4, 6, 39, 41 AND 42.
SEE PLATES 2, 3, 4 AND 5 FOR BASELINE "E".

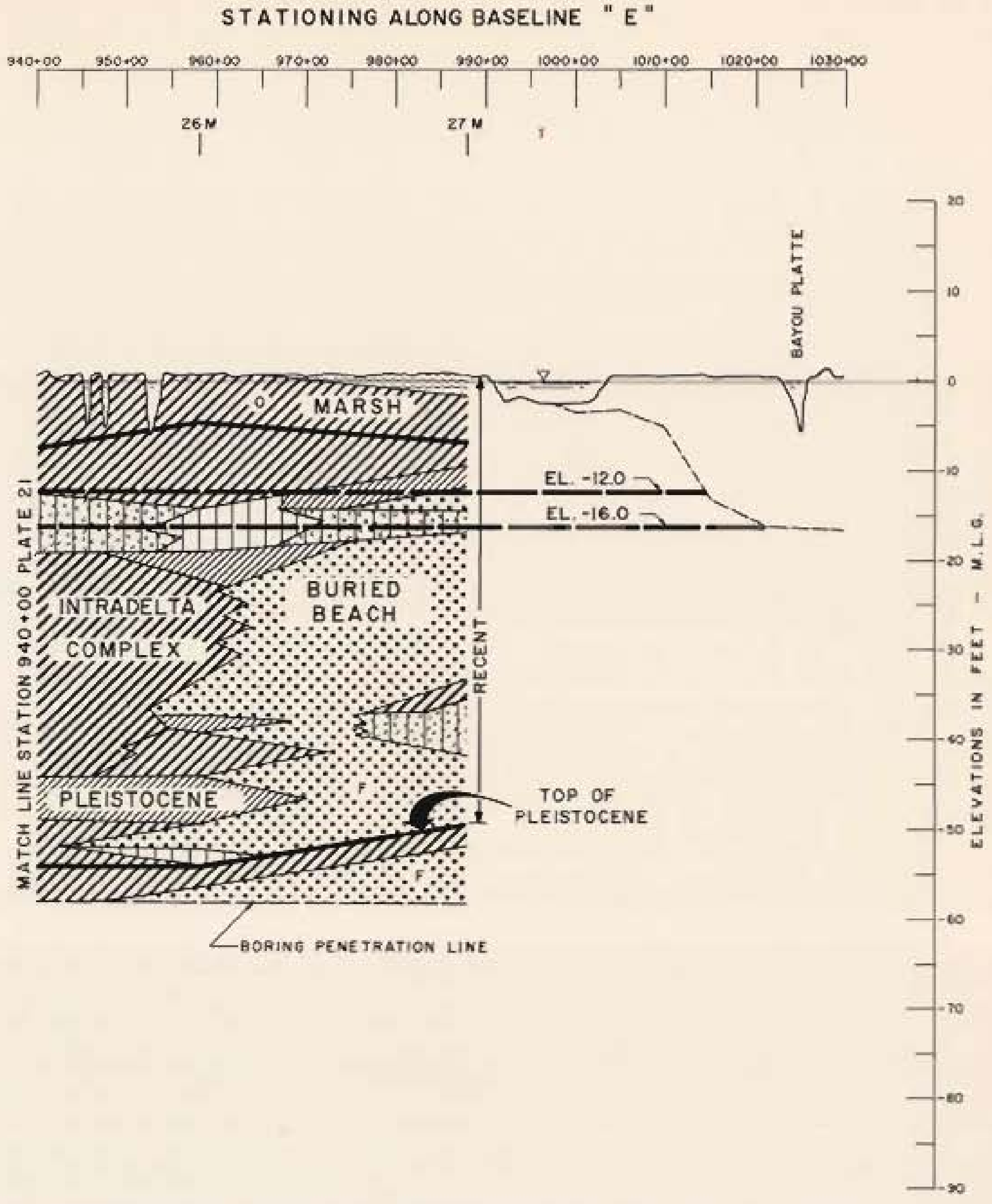
A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

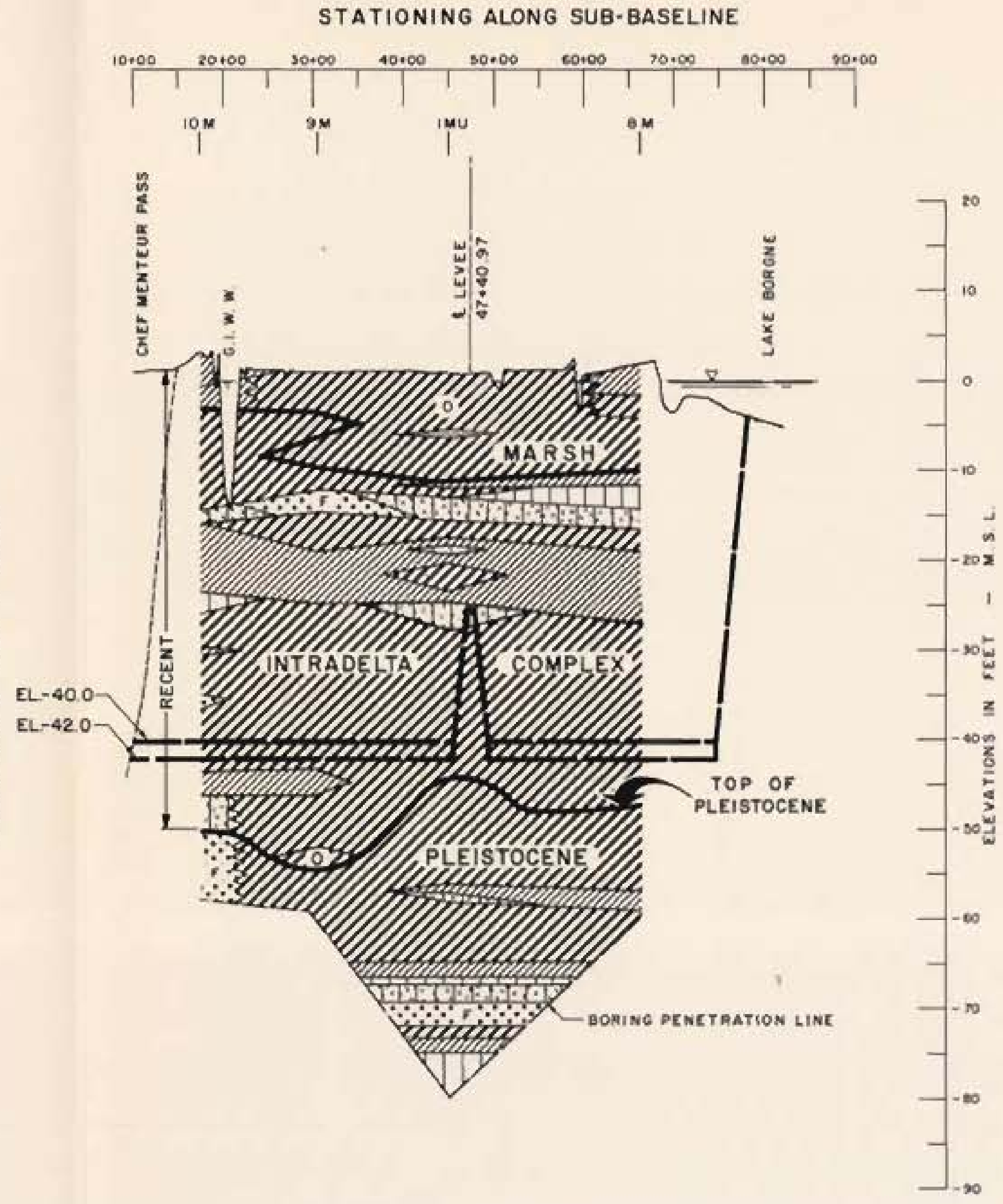
CHEF MENTEUR PASS COMPLEX
GENERALIZED SOIL AND GEOLOGIC PROFILE
G.I.W.W. RELOCATION
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



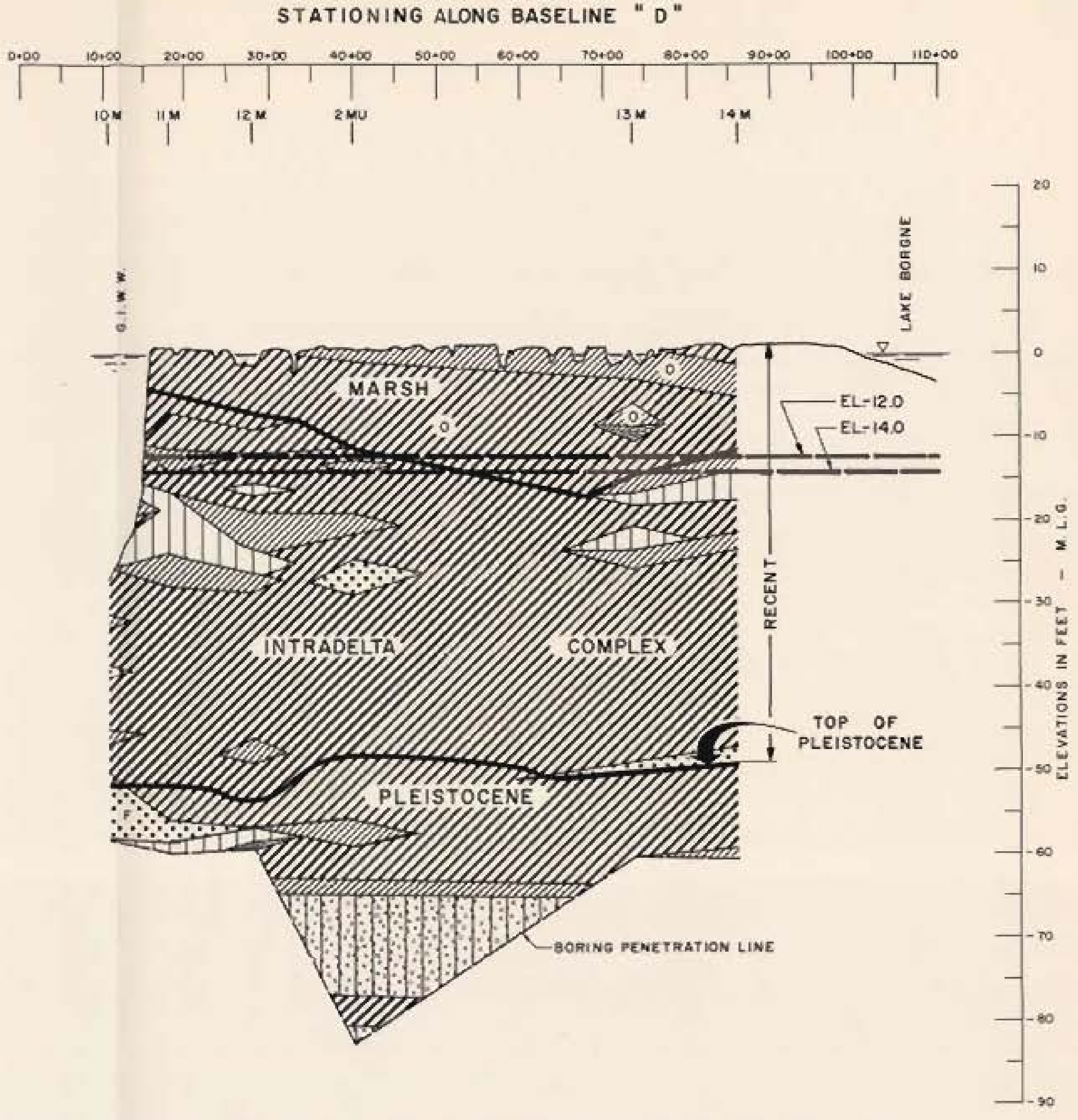
GENERALIZED SOIL AND GEOLOGIC PROFILE ALONG BASELINE "E"

—RELOCATED G.I.W.W.—



GENERALIZED SOIL AND GEOLOGIC PROFILE ALONG SUB-BASELINE

— CONTROL CHANNEL —



GENERALIZED SOIL AND GEOLOGIC PROFILE ALONG BASELINE "D"

— NAVIGATION CHANNEL —

LEGEND

(PT)	PEAT	(ML)	SILT
(CH)	FAT CLAY	(SM)	SILTY SAND
(CHO)	FAT CLAY WITH ORGANIC MATTER	(SP)	SAND
(CL)	LEAN CLAY	(WD)	WOOD
(CLO)	LEAN CLAY WITH ORGANIC MATTER		

MARSH — VERY SOFT TO SOFT CH WITH ORGANIC MATTER AND PEAT.
INTRADELTA COMPLEX— SOFT CLAYS AND SILTS WITH LAYERS AND AREAS OF SAND.
BURIED BEACH — SAND WITH SHELL AND SHELL FRAGMENTS.
PLEISTOCENE — STIFF TO VERY STIFF CLAYS WITH LARGE LAYERS AND AREAS OF SAND.

NOTES

FOR DETAILED BORING LOGS, SEE PLATES 3,5,10,11 & 33.
SEE PLATES 2,3,4 & 5 FOR BASELINE "E".
SEE PLATES 10 & 11 FOR BASELINE "D".
SEE PLATE 12 FOR SUB-BASELINE.

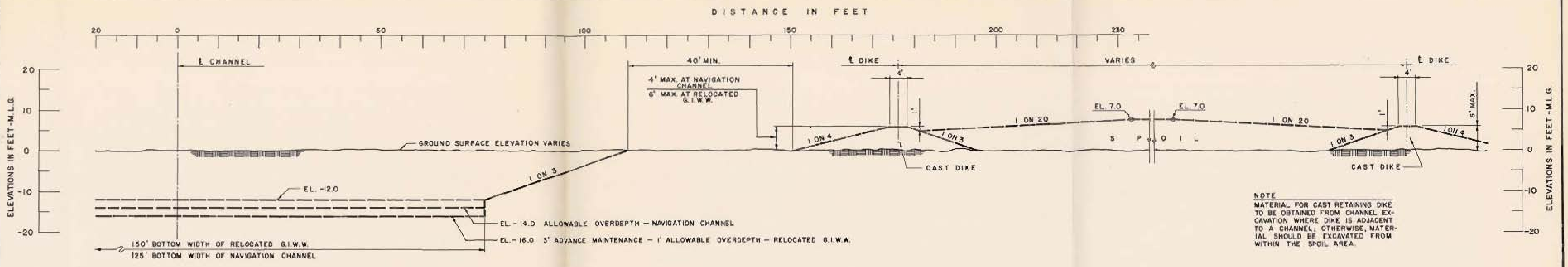
A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

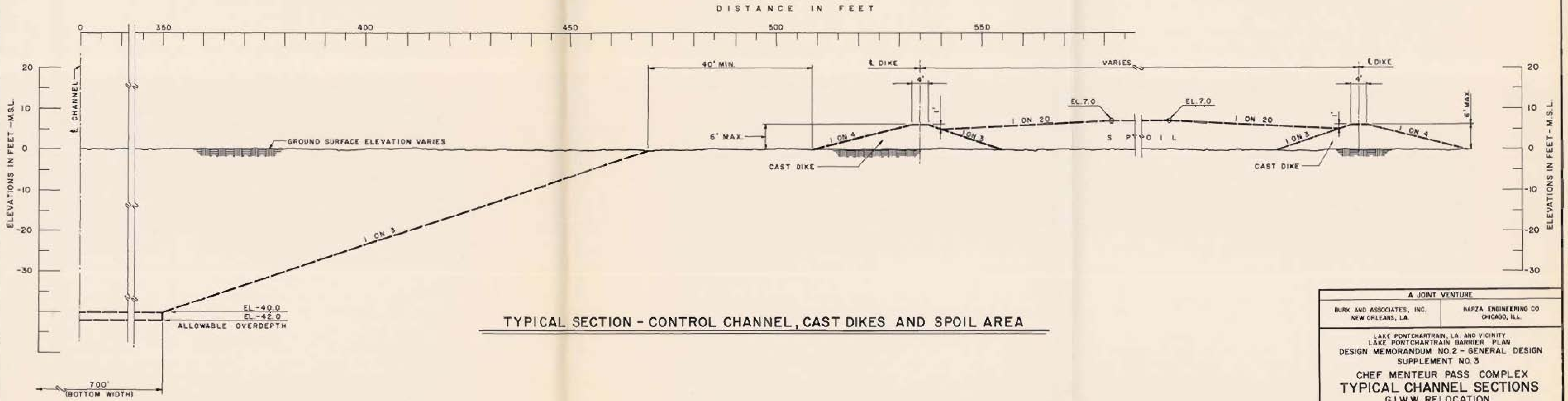
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
GENERALIZED SOIL AND GEOLOGIC PROFILE
G.I.W.W. RELOCATION, NAVIGATION CHANNEL AND CONTROL CHANNEL
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



TYPICAL SECTION - RELOCATED G.I.W.W., NAVIGATION CHANNEL, CAST DIKES AND SPOIL AREA



TYPICAL SECTION - CONTROL CHANNEL, CAST DIKES AND SPOIL AREA

A JOINT VENTURE

BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.

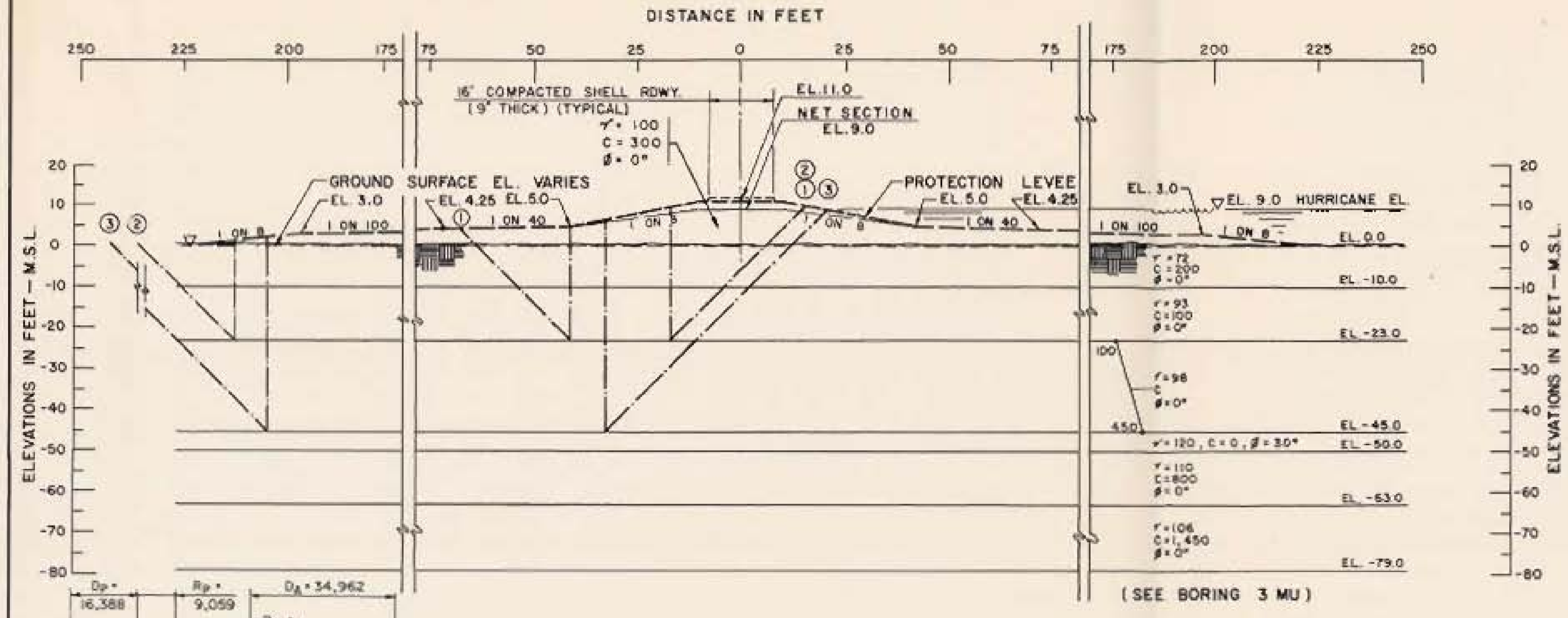
HARZA ENGINEERING CO
CHICAGO, ILL.

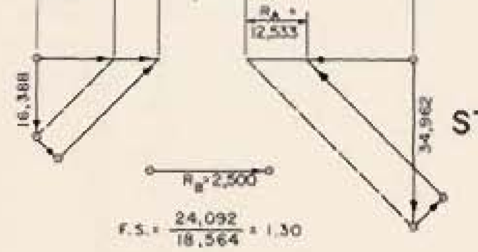
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
TYPICAL CHANNEL SECTIONS
G.I.W.W. RELOCATION
NAVIGATION AND CONTROL CHANNELS

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

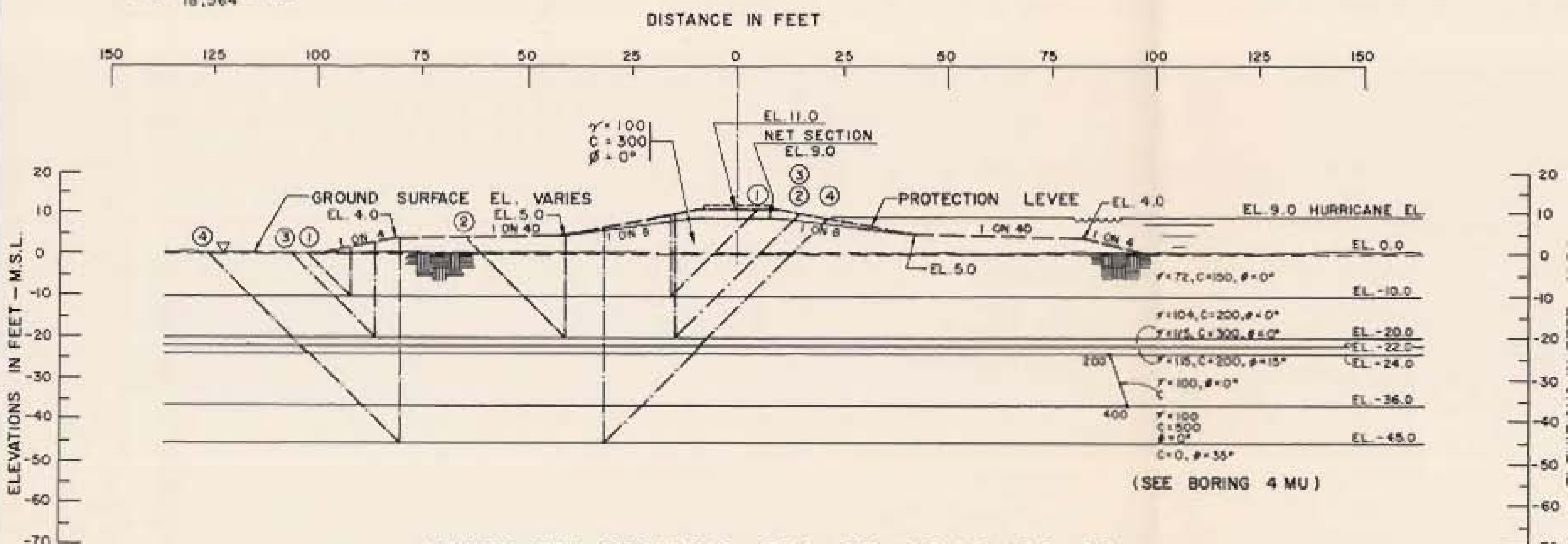
DATE: APRIL 1969 FILE NO. H-2-24416



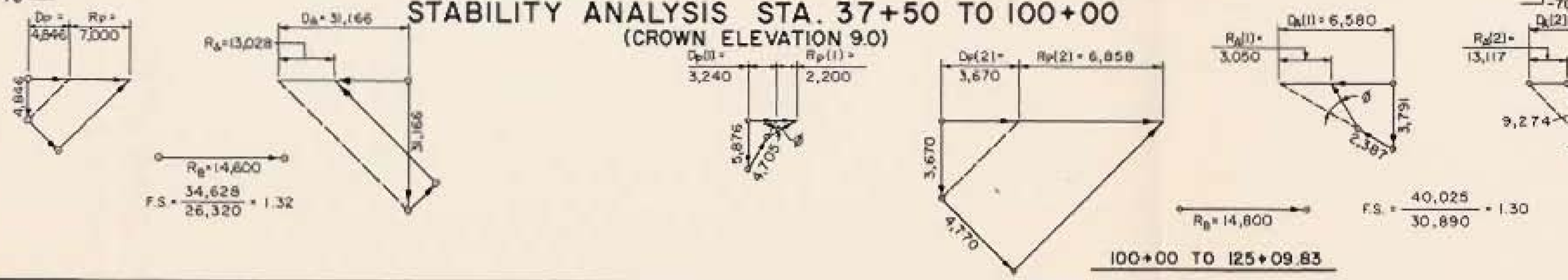


STABILITY ANALYSIS STA. 0+00 TO 37+50
(CROWN ELEVATION 9.0)
(STREAM CLOSURE EXCEPTED)

$F.S. = \frac{24,092}{18,564} = 1.30$



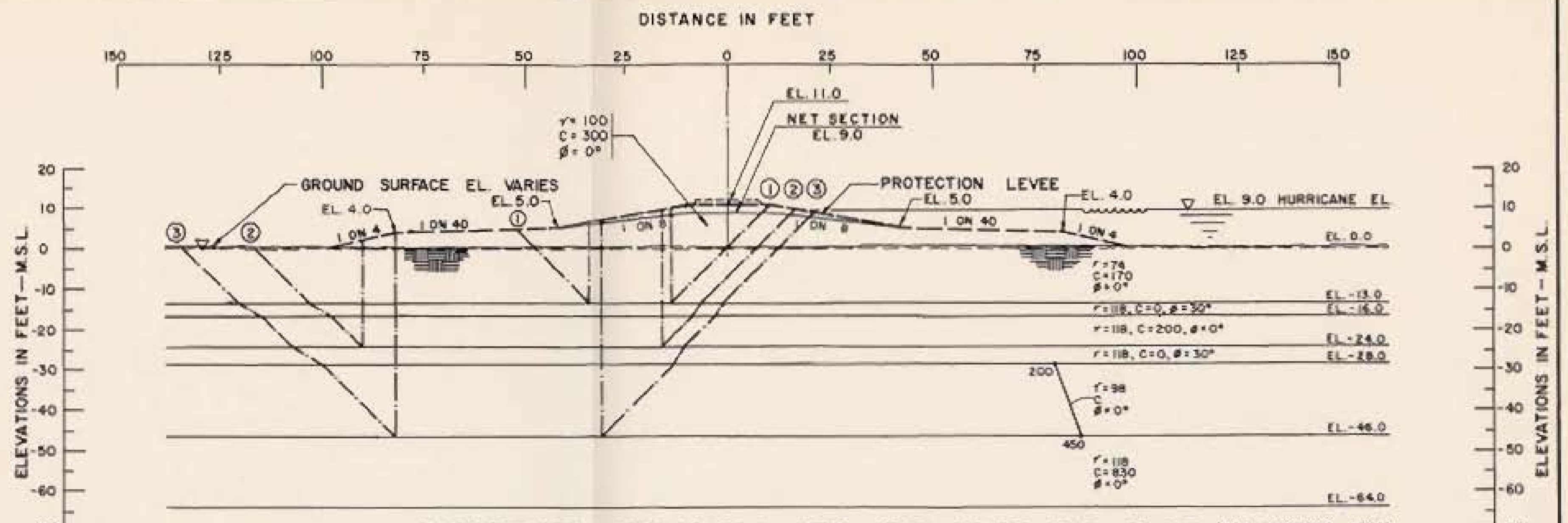
STABILITY ANALYSIS STA. 37+50 TO 100+00
(CROWN ELEVATION 9.0)



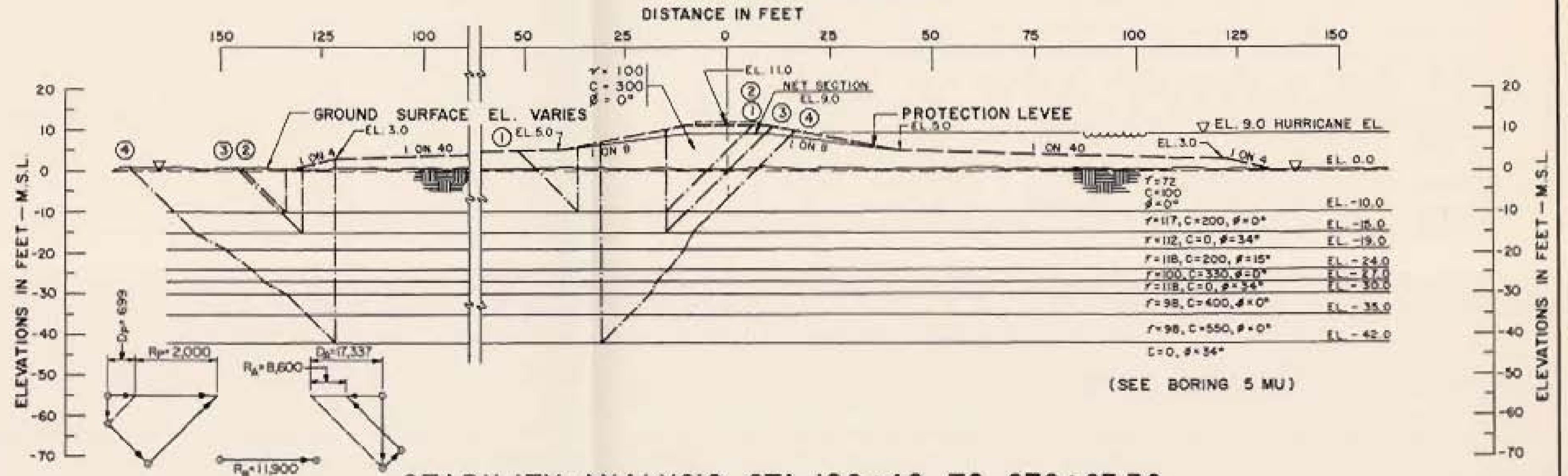
$F.S. = \frac{34,628}{26,320} = 1.32$

$F.S. = \frac{40,025}{30,890} = 1.30$

100+00 TO 125+09.83



STABILITY ANALYSIS STA. 100+00 TO 125+09.83 (SEE BORING 1 MU)
(CROWN ELEVATION 9.0)
(STREAM CLOSURE EXCEPTED)



$F.S. = \frac{22,500}{16,638} = 1.35$

STABILITY ANALYSIS STA. 198+40 TO 278+63.36
(CROWN ELEVATION 9.0)

STABILITY CALCULATIONS

PROTECTION LEVEE LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY ΣR / ΣD
	NO.	EL.	+D_A	−D_P	ΣD	+R_A	+R_B	+R_P	ΣR	
STA. 0+00 TO STA. 37+50	1	-23.0	34,962	16,388	18,564	12,533	2,500	9,059	24,092	1.30
	2	-23.0	34,962	5,166	29,795	12,533	19,600	6,600	38,133	1.30
	3	-48.0	73,536	25,767	47,767	24,062	44,150	18,700	86,912	1.82
STA. 37+50 TO STA. 100+00	1	-10.0	17,233	699	16,534	9,600	11,700	3,000	24,300	1.46
	2	-20.0	31,166	13,827	17,339	13,028	5,400	9,517	27,945	1.61
	3	-20.0	31,166	4,846	26,320	13,028	14,600	7,000	34,628	1.32
	4	-48.0	79,507	33,020	46,487	31,786	25,000	26,390	83,175	1.81
STA. 100+00 TO STA. 125+09.83	1	-13.0	21,239	9,193	12,047	11,017	3,400	7,227	21,644	1.80
	2	-24.0	37,800	6,910	30,890	16,167	14,800	9,058	40,025	1.30
	3	-46.0	84,464	36,412	48,052	32,568	22,950	27,818	83,336	1.73
STA. 198+40 TO STA. 278+63.36	1	-10.0	17,337	6,816	10,521	8,600	2,200	4,807	15,607	1.48
	2	-10.0	17,337	699	16,638	8,600	11,900	2,000	22,500	1.35
	3	-15.0	24,023	2,485	21,538	10,502	23,000	4,000	37,502	1.74
	4	-42.0	76,780	32,363	44,417	37,563	50,050	35,863	146,026	3.29

NOTE: ALL STATIONING REFER TO ℄ OF PROTECTION LEVEE.

NOTE
FOR GENERAL NOTES PLATE 31.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

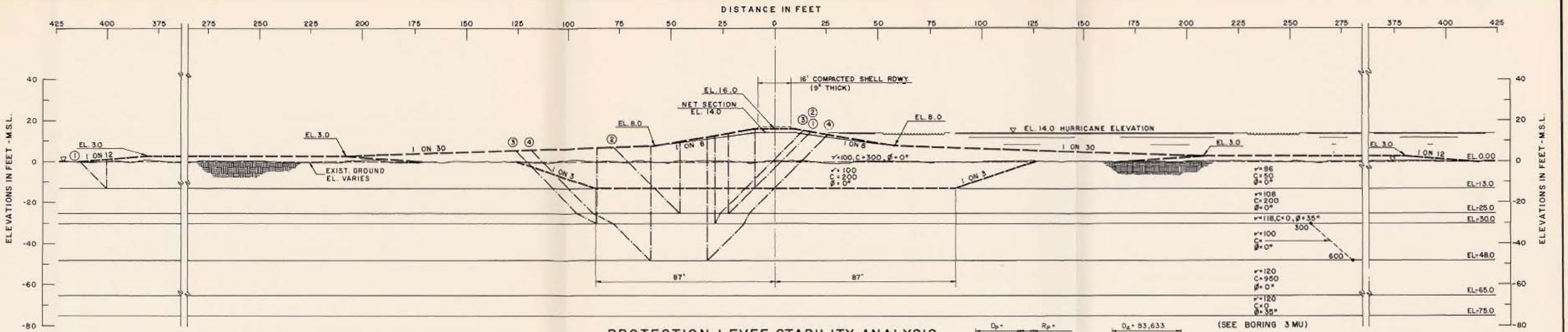
CHEF MENTEUR PASS COMPLEX

(Q) SHEAR STABILITY ANALYSIS

PROTECTION LEVEE

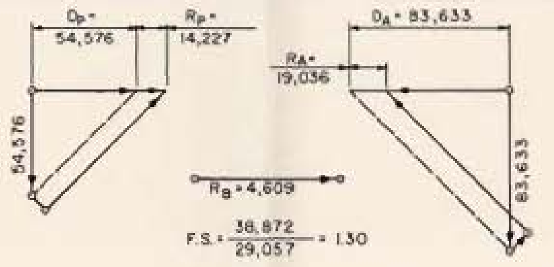
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

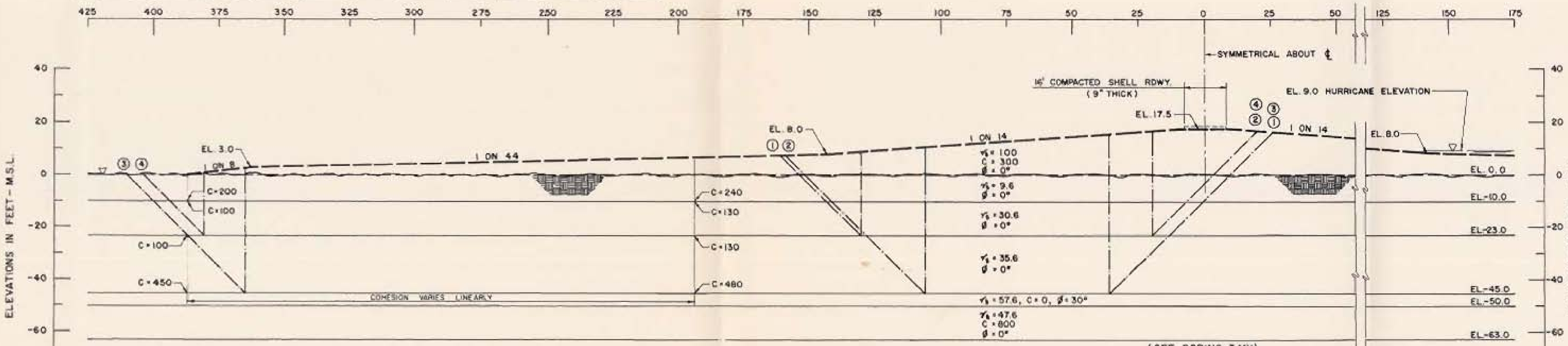


PROTECTION LEVEE STABILITY ANALYSIS

STA. 125 + 09.83 TO STA. 177 + 40
STA. 193 + 40 TO STA. 198 + 40
NOTE: STATIONS REFER TO ℄ PROTECTION LEVEE.



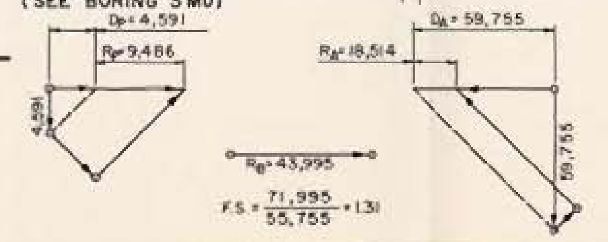
STABILITY CALCULATIONS										
PROTECTION LEVEE LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO	EL.	+ D_A	− D_P	ΣD	+ R_A	+ R_B	+ R_P	ΣR	ΣR / ΣD
STA. 125+09.83	1	− 13.0	42,485	7,907	34,578	14,231	30,918	1,303	46,452	1.34
TO STA. 177+40	2	− 25.0	83,633	54,576	29,057	19,036	4,609	14,227	38,872	1.30
STA. 193+40	3	− 30.0	105,347	63,599	41,748	34,011	17,137	36,000	41,748	2.09
TO STA. 198+40	4	− 48.0	205,847	149,315	56,532	50,079	16,263	57,501	123,843	2.19



(SEE BORING 3 MU)

TIE INTO NEW ORLEANS EAST LEVEE

STA. 0 + 00 BASELINE "A"



STABILITY CALCULATIONS										
PROTECTION LEVEE LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO	EL.	+ D_A	− D_P	ΣD	+ R_A	+ R_B	+ R_P	ΣR	ΣR / ΣD
STA. 0+00	1	− 45.0	114,324	66,593	47,731	31,349	33,725	26,091	91,165	1.91
	2	− 23.0	59,755	25,339	34,416	18,514	14,263	12,844	45,621	1.33
	3	− 45.0	114,324	26,133	88,191	31,349	154,875	18,793	205,017	2.32
	4	− 23.0	59,755	4,591	55,164	18,514	43,995	9,486	71,995	1.31

ESTIMATED "Q" STRENGTH TWO YEARS AFTER PLACING OF FIRST (FOR LEVEE TIE-IN — STA. 0+00)

	ΔP̄ (ULTIMATE) 100% SETTLEMENT			ΔP̄' (2 YRS.) 36% SETTLEMENT			C = COHESION (Q TEST) T/SF	Ø DEG.	C' = COHESION (2 YRS. AFTER LOAD) T/SF		
	℄	1/4 PT.	TOE	℄	1/4 PT.	TOE			℄	1/4 PT.	TOE
STRATA 1 EL. 0.0 TO EL.-10.0	.342	.262	.055	.123	.094	.020	.100	21	.125	.120	.100
STRATA 2 EL.-10.0 TO EL.-23.0	.335	.268	.070	.121	.096	.025	.050	13	.070	.065	.055
STRATA 3 EL.-23.0	.329	.272	.079	.118	.098	.028	.050	13	.065	.065	.055
TO EL.-45.0	.313	.285	.128	.113	.103	.046	.225	13	.240	.240	.230

$C' = C + C_R \cdot \Delta p' \cdot \tan \phi$

C_R = CORRECTION FACTOR DETERMINED BY FIELD OBSERVATIONS = .60

NOTE
FOR GENERAL NOTES SEE PLATE 31.

A JOINT VENTURE

BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.

HARZA ENGINEERING CO
CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

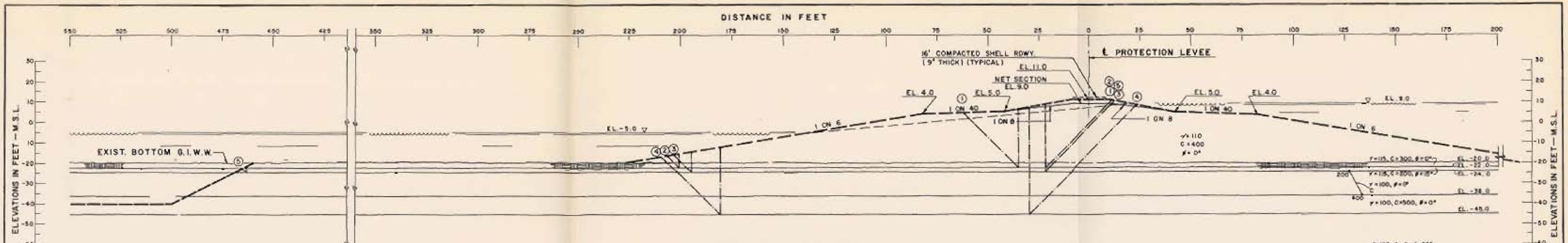
CHEF MENTEUR PASS COMPLEX

(Q) SHEAR STABILITY ANALYSIS

PROTECTION LEVEE

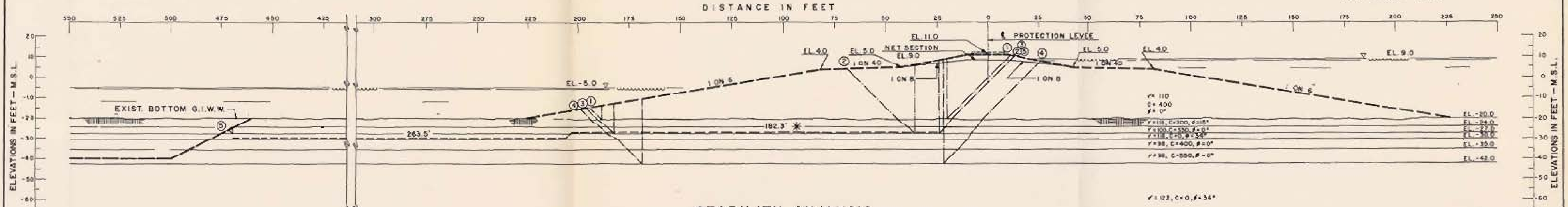
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



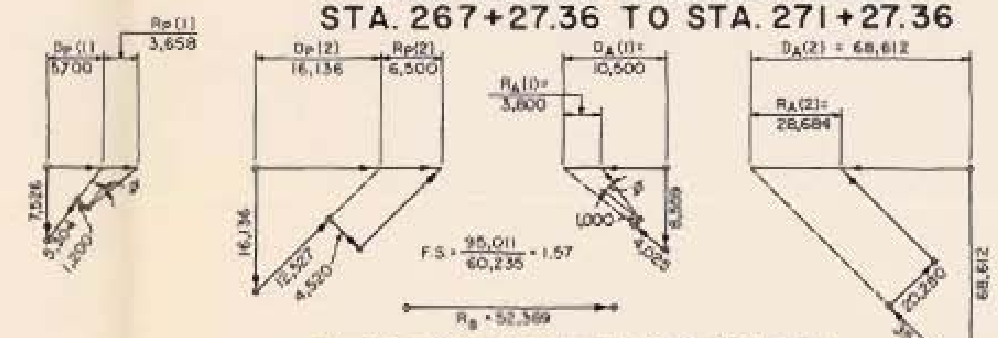
STABILITY ANALYSIS
PROTECTION LEVEE ACROSS EXISTING G. I. W.W.
STA. 80+00 TO STA. 85+00

(SEE BORING 4 MU)



STABILITY ANALYSIS
PROTECTION LEVEE ACROSS EXISTING G. I. W.W.
STA. 226+47.36 TO STA. 233+47.36
AND ACROSS MARQUES CANAL
STA. 267+27.36 TO STA. 271+27.36

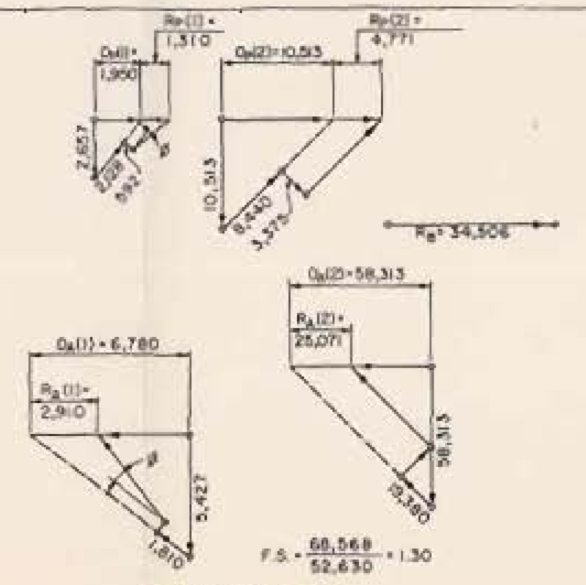
(SEE BORING 5 MU)



226+47.36 TO 233+47.36 & 267+27.36 TO 271+27.36

(LENGTH OF NEUTRAL BLOCK IN UPPER STRATA)

* (LENGTH OF NEUTRAL BLOCK IN LOWER STRATA)



80+00 TO 85+00

STABILITY CALCULATIONS										
PROTECTION LEVEE LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO.	EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	ΣR / ΣD
STA. 80+00 TO STA. 85+00	1	-22.0	59,458	38,743	20,715	26,117	4,219	20,492	50,828	2.45
	2	-22.0	59,458	9,276	50,182	26,117	53,395	3,805	83,317	1.66
	3	-24.0	65,093	12,463	52,630	27,981	34,506	6,081	68,568	1.30
	4	-45.0	164,229	68,043	96,186	42,725	75,195	21,520	139,440	1.45
	5	-24.0	65,093	11,756	53,337	27,981	88,334	1,333	117,648	2.21
STA. 226+47.36 TO STA. 233+47.36 STA. 267+27.36 TO STA. 271+27.36	1	-20.0	52,455	7,327	45,128	24,833	63,900	4,005	92,738	2.06
	2	-27.0	79,112	53,423	25,689	32,484	3,967	29,602	66,053	2.57
	3	-27.0	79,112	18,877	60,235	32,484	52,369	10,158	95,011	1.57
	4	-42.0	152,853	60,447	92,406	52,176	80,359	29,994	162,529	1.76
	5	-27.0	79,112	14,677	64,435	32,494	119,735	661	152,890	2.37

NOTE: STATIONS REFER TO ℄ PROTECTION LEVEE.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO. CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

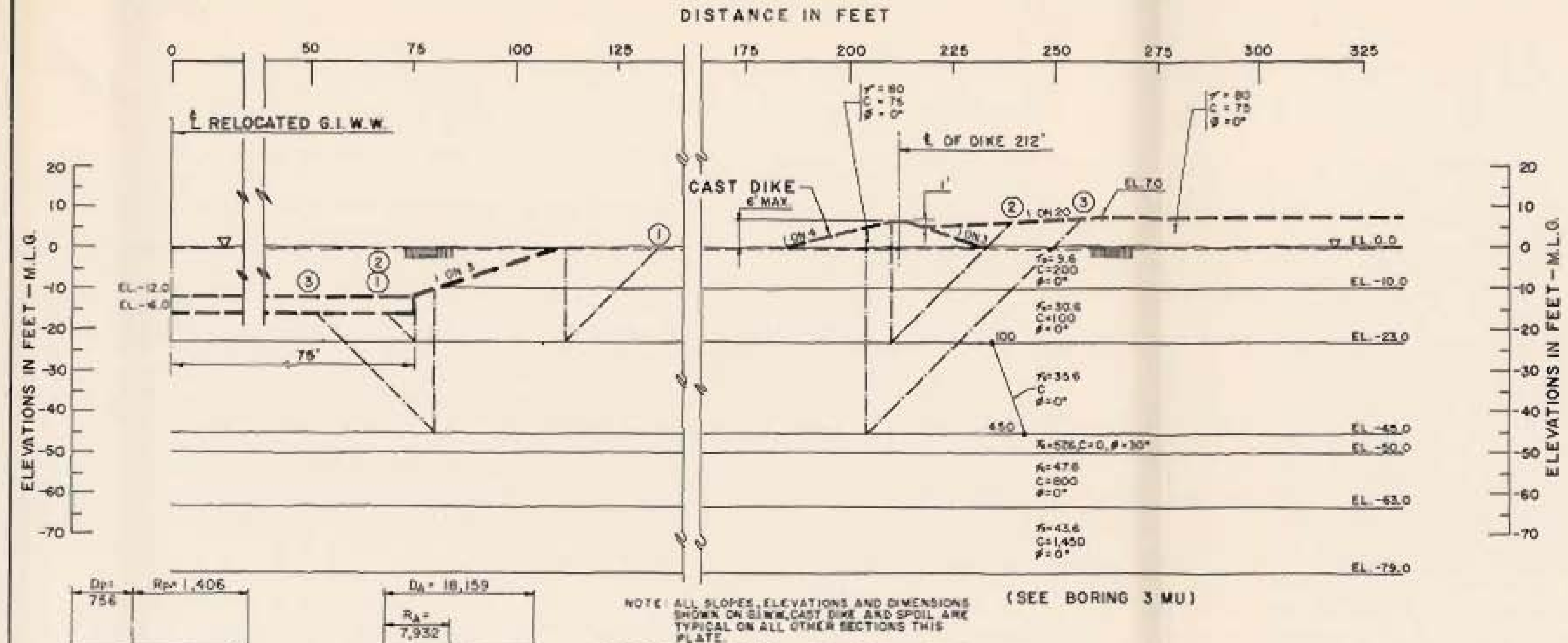
CHEF MENTEUR PASS COMPLEX

(Q) SHEAR STABILITY ANALYSIS

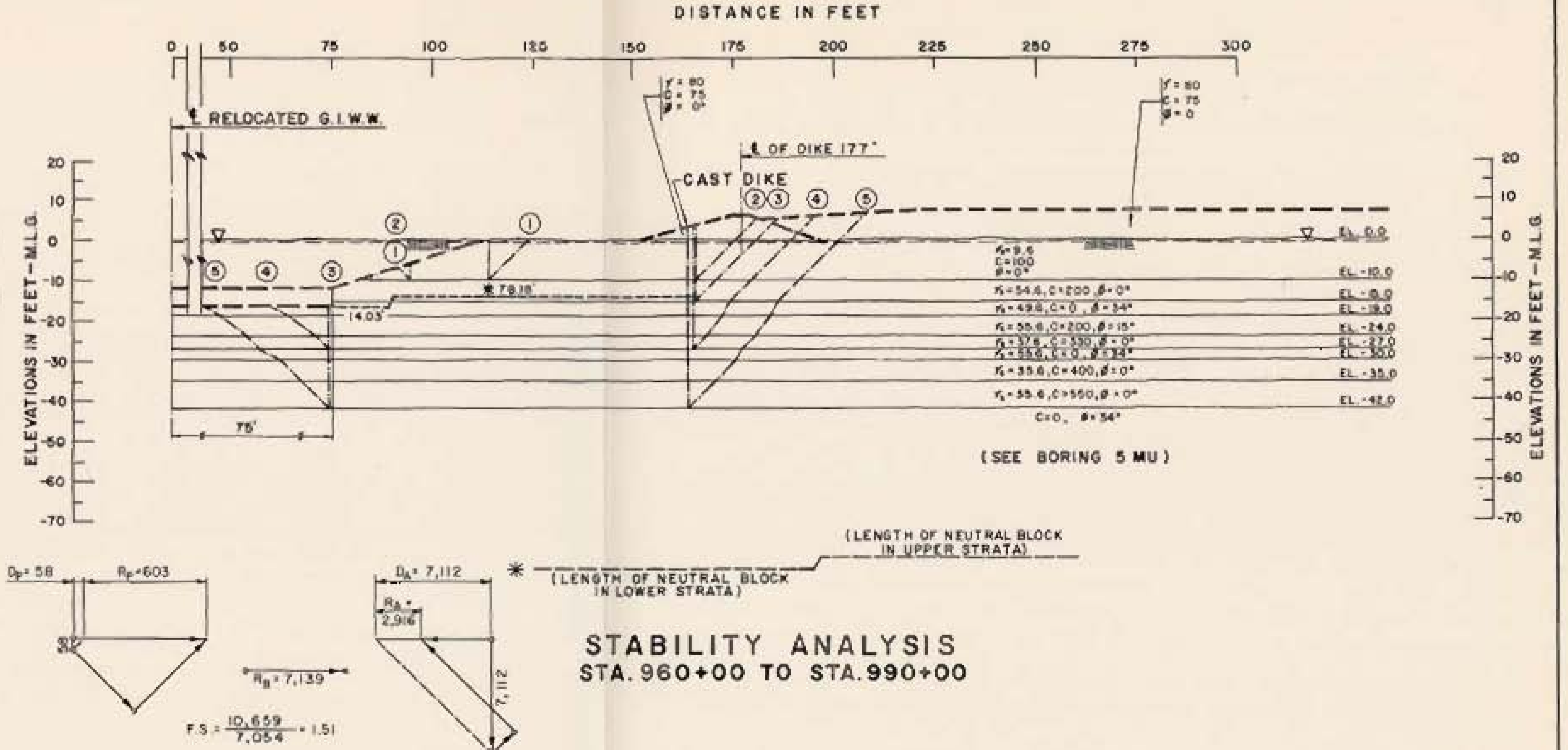
PROTECTION LEVEE ACROSS G.I.W.W.

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

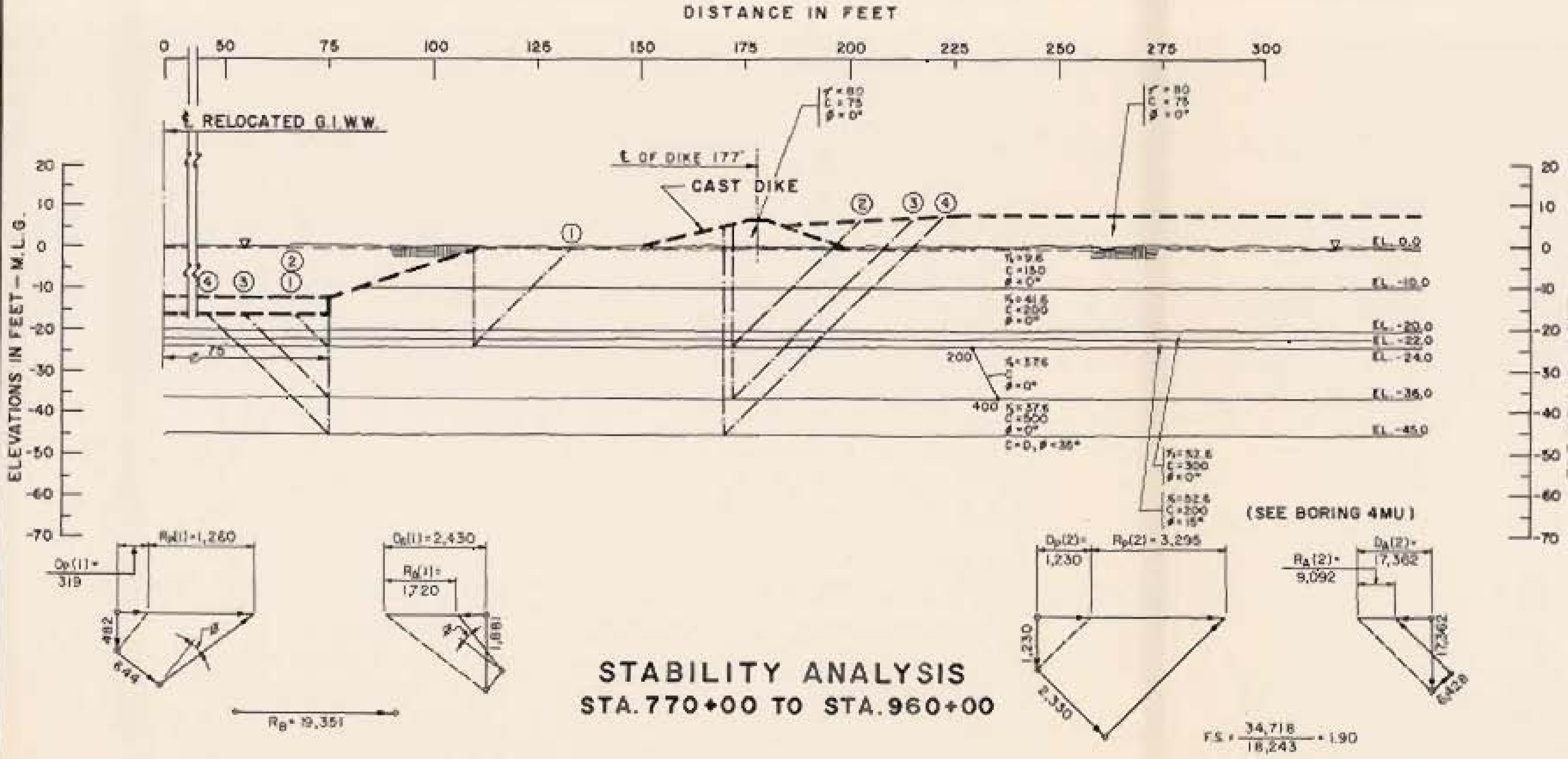
DATE: APRIL 1969 FILE NO. H-2-24416



STABILITY ANALYSIS
STA. 660+00 TO STA. 770+00



STABILITY ANALYSIS
STA. 960+00 TO STA. 990+00



STABILITY ANALYSIS
STA. 770+00 TO STA. 960+00

STABILITY CALCULATIONS

RELOCATED G.I.W.W. LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY ΣR/ΣD
	NO.	EL.	+D_A	-D_P	ΣD	+R_A	+R_B	+R_P	ΣR	
STA. 660+00 TO STA. 770+00	1	-23.0	6,142	772	5,370	7,103	3,749	1,421	12,272	2.29
	2	-23.0	18,159	756	17,403	7,932	13,532	1,406	22,870	1.31
	3	-45.0	48,902	15,054	33,848	20241	55,573	13,624	89,437	2.64
STA. 770+00 TO STA. 960+00	1	-24.0	7,084	1,542	5,542	21,043	7,229	4,544	21,043	3.80
	2	-24.0	19,792	1,549	18,243	10,812	19,351	4,555	34,718	1.90
	3	-36.0	38,576	8,955	29,621	18,870	39,336	11,920	70,126	2.34
	4	-45.0	53,329	18,227	35,102	26,888	47,042	20,925	94,855	2.70
STA. 960+00 TO STA. 990+00	1	-10.0	1,349	59	1,290	2,182	1,929	609	4,720	3.66
	2	-10.0	7,112	58	7,054	2,916	7,139	603	10,659	1.51
	3	-15.0	10,527	0	10,527	4,911	17,905	0	22,816	2.17
	4	-27.0	25,723	3,070	22,653	14,082	30,218	6,008	50,308	2.22
	5	-42.0	53,925	17,379	36,546	29,959	49,605	23,870	103,434	2.83

GENERAL NOTES

(Q) – UNCONSOLIDATED – UNDRAINED SHEAR STRENGTHS IN LBS. PER SQ. FT.
(Y) – UNIT WEIGHT OF SOIL WATER SYSTEM IN LBS. PER CU. FT.
(Y') – SUBMERGED UNIT WEIGHT IN LBS. PER CU. FT.
(ϕ) – ANGLE OF INTERNAL FRICTION IN DEGREES
(D) – HORIZONTAL DRIVING FORCE IN LBS.
(R) – HORIZONTAL RESISTING FORCE IN LBS.
(F.S.) – FACTOR OF SAFETY WITH RESPECT TO (Q) SHEAR STRENGTH
(M.U.) – 5" DIAMETER UNDISTURBED SOIL BORING
(Yw) – UNIT WEIGHT OF WATER IN P.C.F.
STATIONS ARE REFERENCED TO BASELINE

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

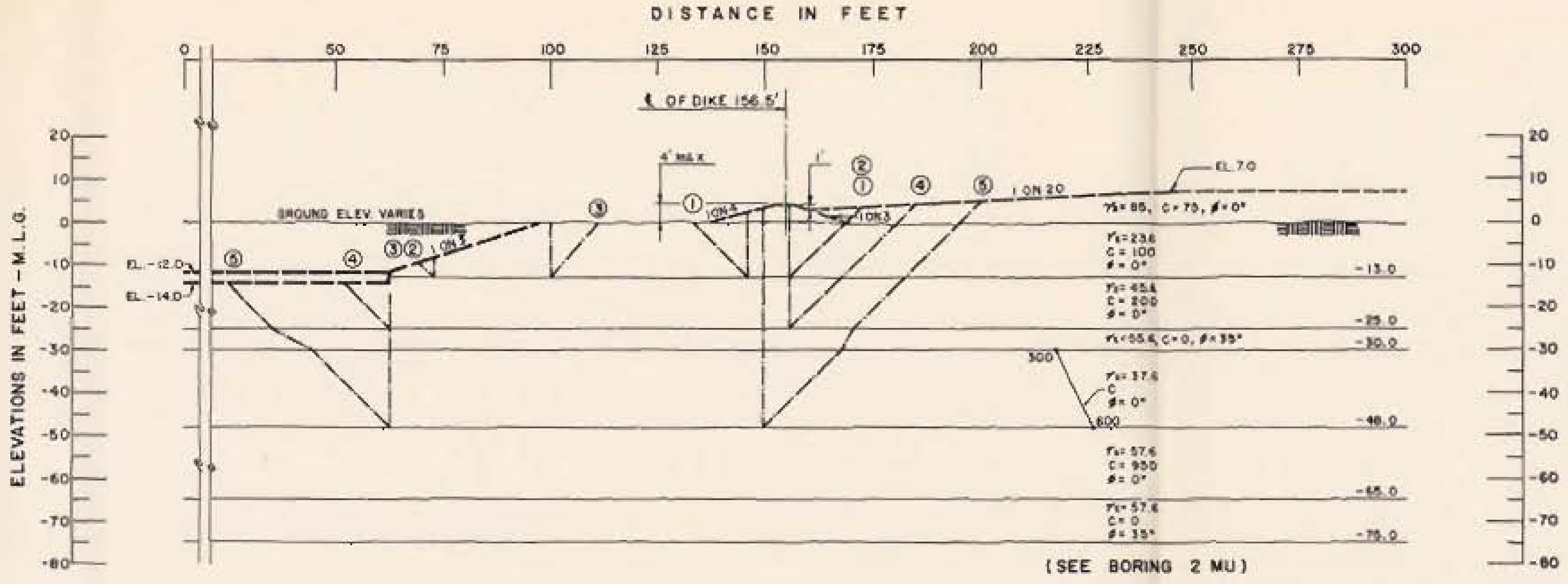
CHEF MENTEUR PASS COMPLEX

(Q) SHEAR STABILITY ANALYSIS

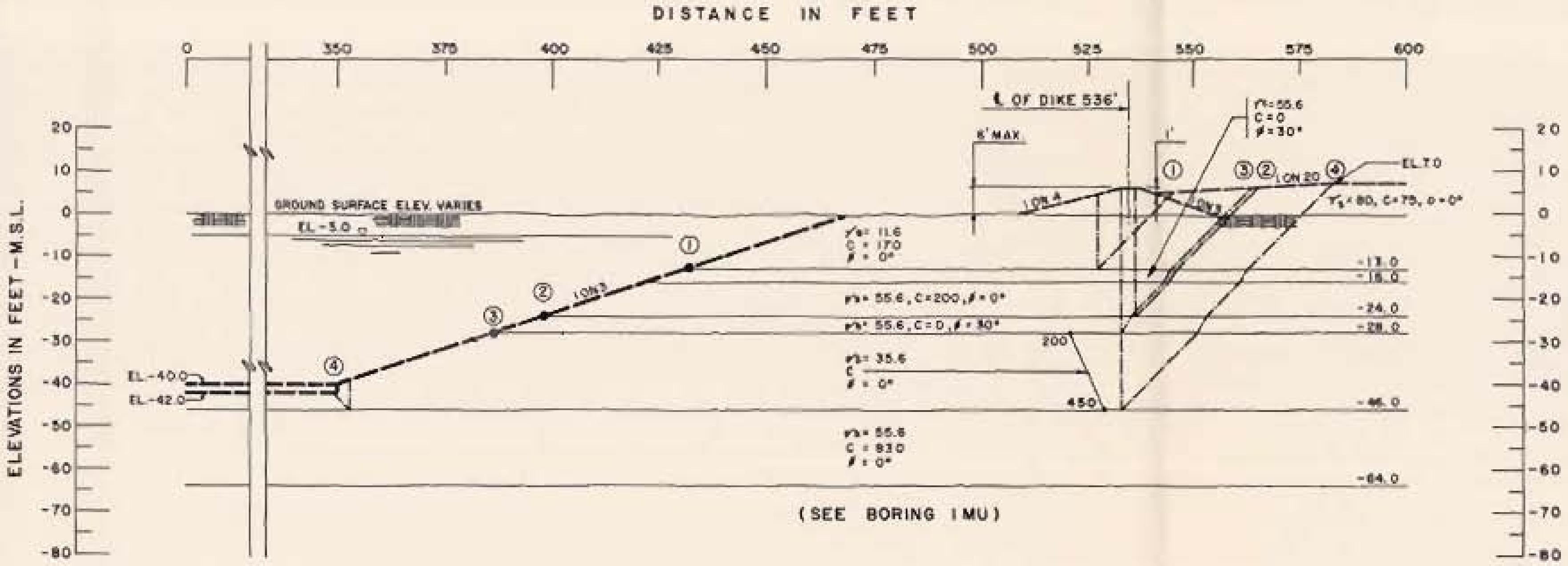
G.I.W.W. RELOCATION

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

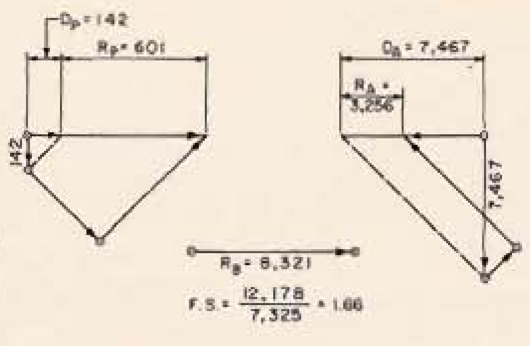
DATE: APRIL 1969 FILE NO. H-2-24416



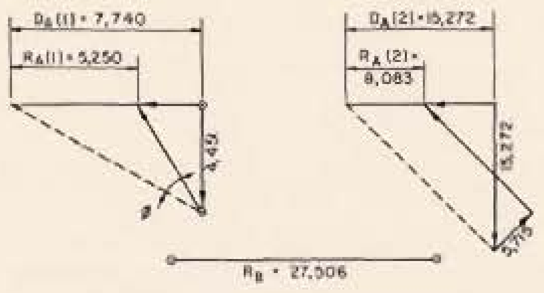
NAVIGATION CHANNEL STABILITY ANALYSIS



CONTROL CHANNEL STABILITY ANALYSIS



NAVIGATION CHANNEL



CONTROL CHANNEL

NOTES

1. UNIT WEIGHT OF SOIL BASED ON ONLY TOP ORGANIC CLAY STRATA BEING SPOILED. IF HEAVIER MATERIAL IS SPOILED IT MUST BE PLACED FAR ENOUGH AWAY FROM CANAL BANK AS SO NOT TO EFFECT STABILITY (200' MINIMUM).
2. FOR GENERAL NOTES SEE PLATE 31.

STABILITY CALCULATIONS

NAVIGATION CHANNEL	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO.	EL.(MGL.)	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	ΣR / ΣD
	1	-13.0	7,696	3,420	4,276	3,331	923	2,870	7,124	1.67
	2	-13.0	7,467	142	7,325	3,256	8,321	601	12,178	1.66
	3	-13.0	3,125	143	2,982	2,816	2,715	603	6,134	2.06
	4	-25.0	19,179	1,861	17,318	8,231	18,697	3,614	30,542	1.76
	5	-48.0	59,150	22,416	36,735	30,373	72,212	26,755	108,940	2.96
CONTROL CHANNEL	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO.	EL.(M.S.L.)	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	ΣR / ΣD
	1	-13.0	7,525	0	7,525	5,386	9,500	0	14,887	1.98
	2	-24.0	18,358	0	18,358	10,258	25,867	0	36,125	1.97
	3	-28.0	23,012	15	22,997	13,333	27,506	29	40,868	1.78
	4	-46.0	56,157	592	55,565	25,511	80,957	3,396	109,864	1.98

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO. CHICAGO, ILL.

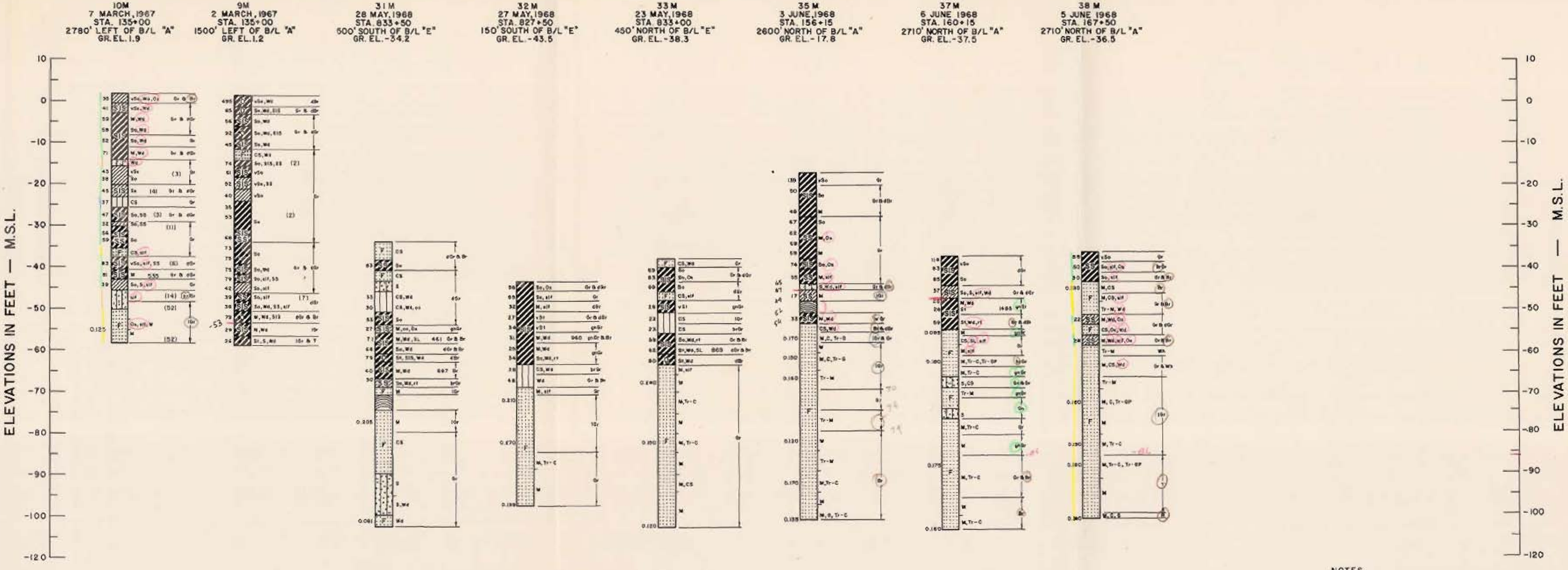
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

(Q) SHEAR STABILITY ANALYSIS
NAVIGATION CHANNEL AND CONTROL CHANNEL

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

DATE: APRIL 1969 FILE NO. H-2-24416



NOTES

FOR GENERAL NOTES SEE PLATE 2.
FOR LOCATION OF SOIL BORINGS SEE PLATE 36.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

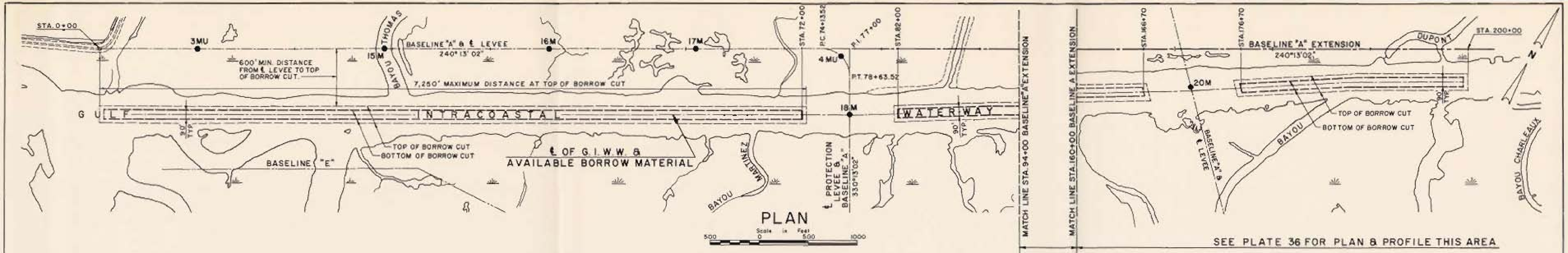
GENERAL TYPE

SOIL BORINGS

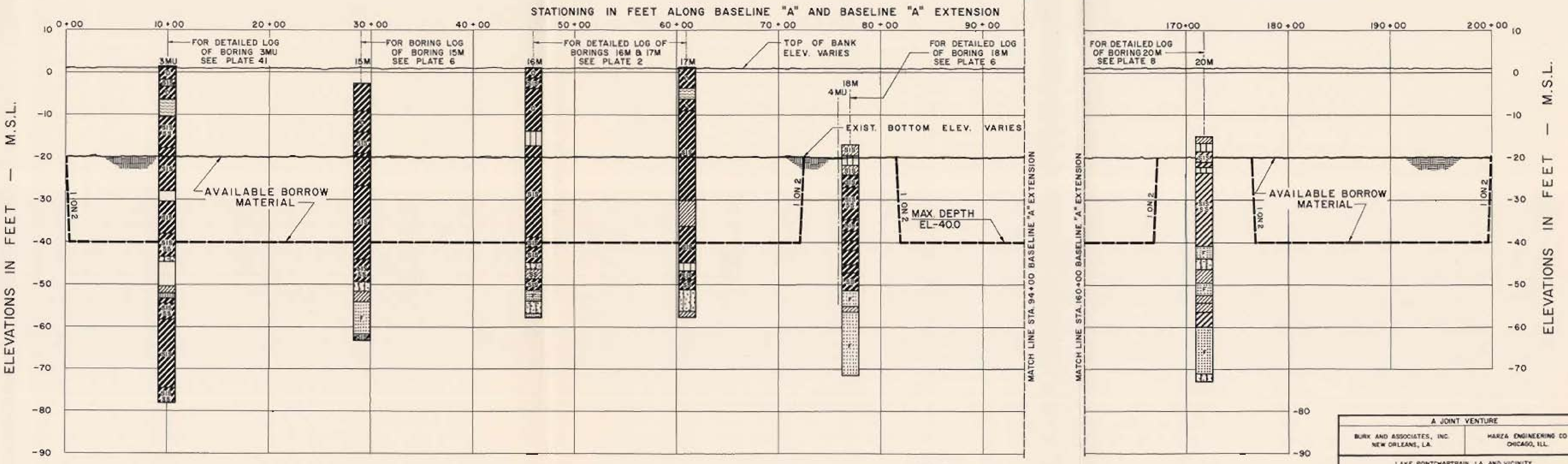
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

PLATE 33



PLAN



PROFILE

LEGEND

3MU● SOIL BORING LOCATION

NOTE:

FOR GENERAL NOTES SEE PLATE 2.

FOR DETAIL LOG OF BORING 4MU SEE PLATE 41.

A JOINT VENTURE

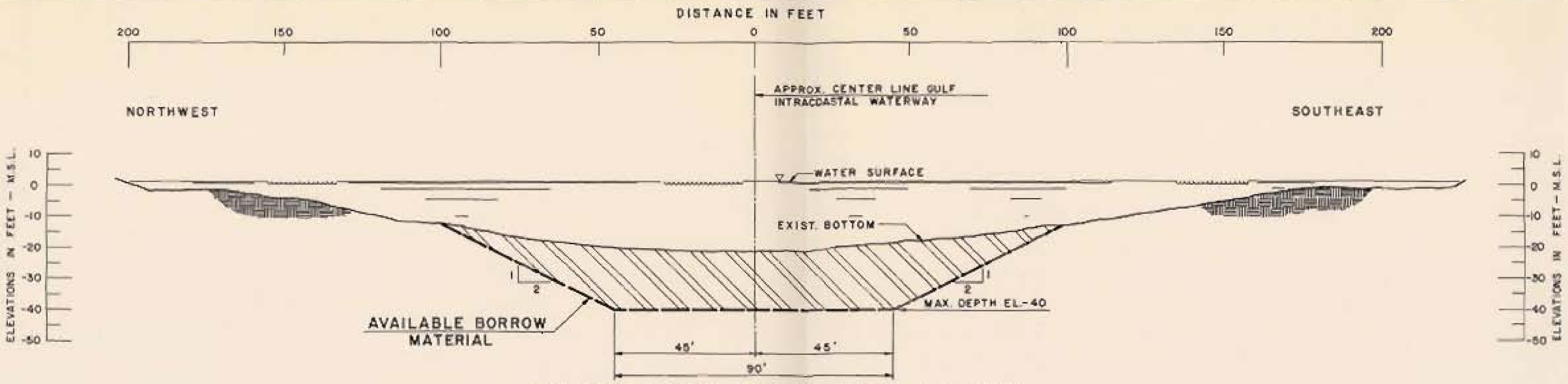
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

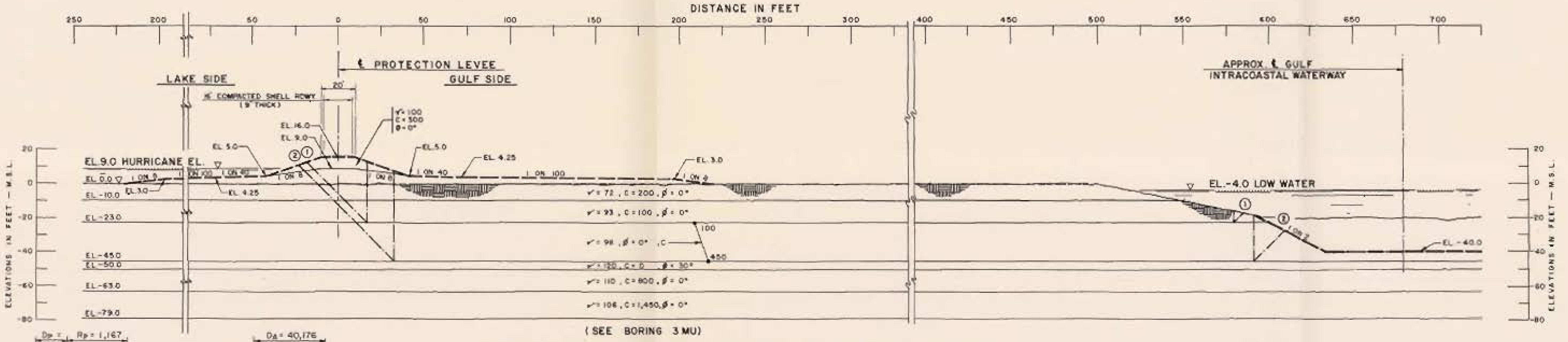
CHEF MENTEUR PASS COMPLEX
LIMITS OF BORROW AREA AND BORING LOGS
EXISTING G.I.W.W.

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

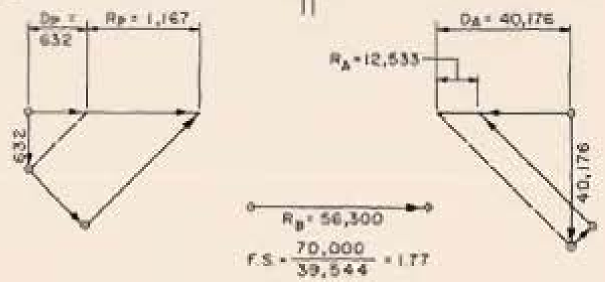
DATE: APRIL 1969 FILE NO. H-2-24416



TYPICAL CROSS SECTION THRU G. I. W. W.



STABILITY ANALYSIS — PROTECTION LEVEE & G.I.W.W.



STABILITY CALCULATIONS

G.I.W.W. LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO.	EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	ΣR / ΣD
	1	-23.0	40,176	632	39,544	12,533	56,300	1,167	70,000	1.77
	2	-45.0	84,593	7,449	77,144	23,873	256,050	9,170	289,093	3.75

NOTE:
FOR GENERAL NOTES SEE PLATE Nº 31.

A JOINT VENTURE

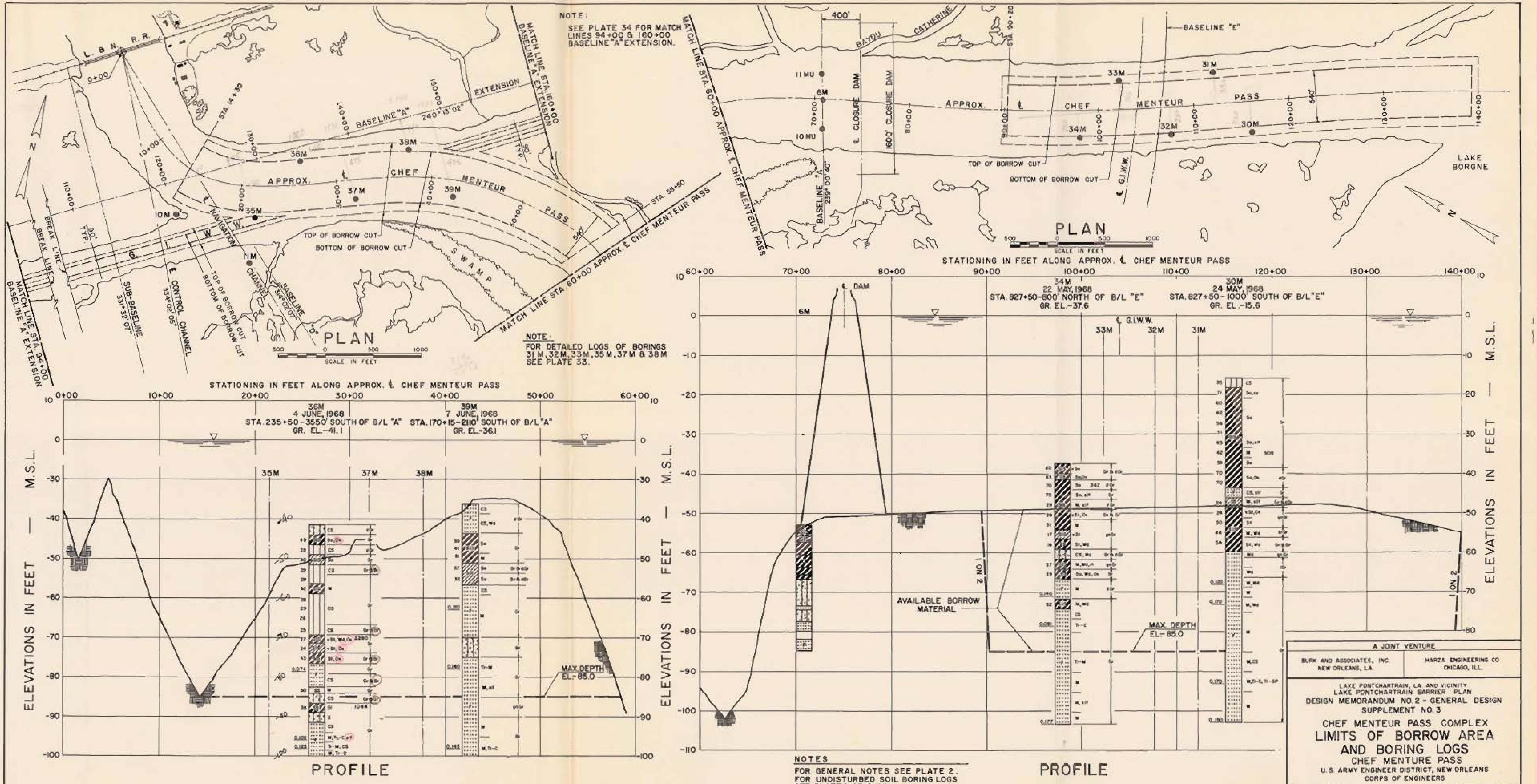
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
BORROW PIT IN EXISTING G.I.W.W.
TYPICAL CROSS SECTION
AND STABILITY ANALYSIS

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

DATE: APRIL 1969 FILE NO. H-2-24416



NOTES
FOR GENERAL NOTES SEE PLATE 2.
FOR UNDISTURBED SOIL BORING LOGS SEE PLATES 43 & 44.

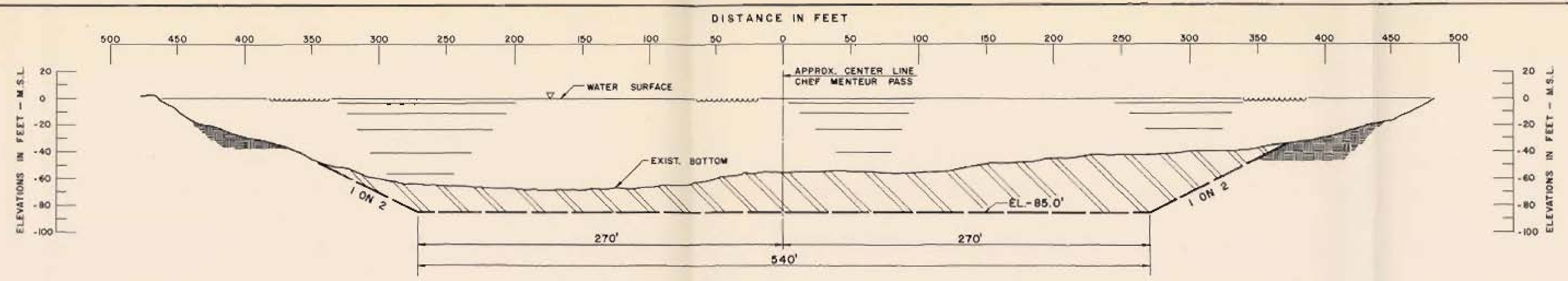
A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

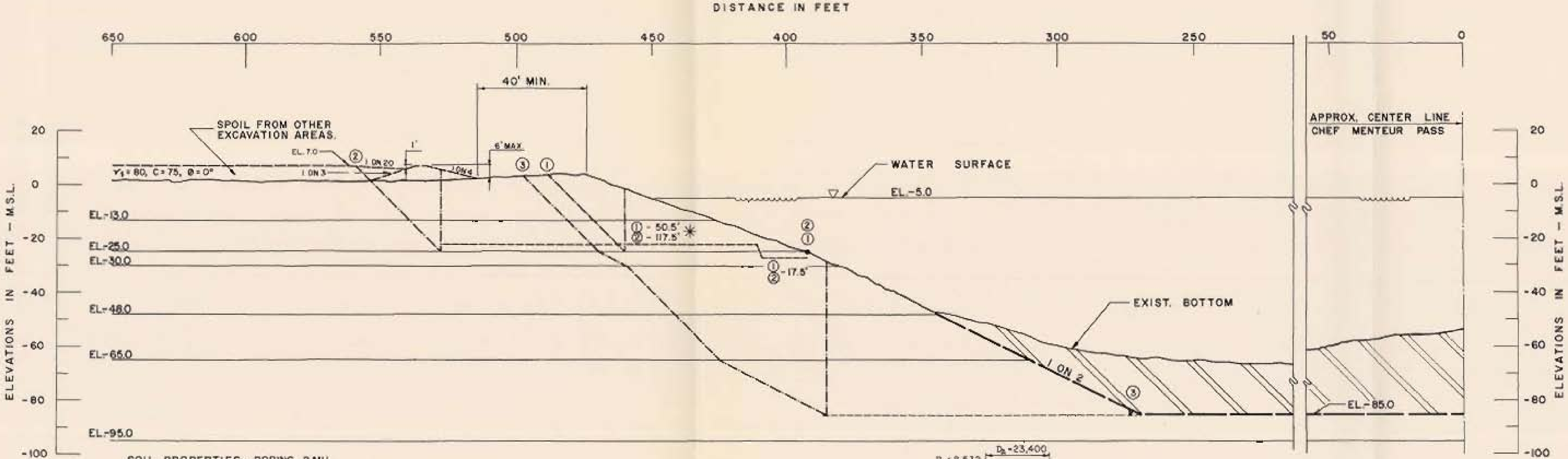
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
LIMITS OF BORROW AREA AND BORING LOGS
CHEF MENTURE PASS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416



TYPICAL CROSS SECTION THRU CHEF MENTEUR PASS



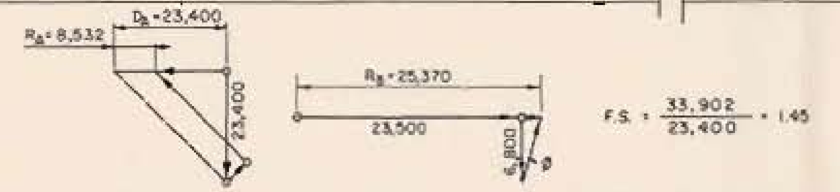
SOIL PROPERTIES - BORING 2 MU

EL.0.0 TO EL-13.0 γ_s = 23.6, C = 100, Ø = 0°
EL-13.0 TO EL-25.0 γ_s = 45.6, C = 200, Ø = 0°
EL-25.0 TO EL-30.0 γ_s = 55.6, C = 0, Ø = 35°
EL-30.0 TO EL-48.0 γ_s = 37.6, C = VARIES; 300 @ EL-30.0, 600 @ EL-48.0, Ø = 0°
EL-48.0 TO EL-65.0 γ_s = 57.6, C = 950, Ø = 0°
EL-65.0 TO EL-95.0 γ_s = 57.6, C = 0, Ø = 35°

STABILITY ANALYSIS

* (LENGTH OF NEUTRAL BLOCK IN LOWER STRATA)

(LENGTH OF NEUTRAL BLOCK IN UPPER STRATA)



$$F.S. = \frac{33,902}{23,400} = 1.45$$

STABILITY CALCULATIONS										
CHEF MENTEUR PASS LOCATION	SLIP SURFACE		DRIVING			RESISTING				FACTOR OF SAFETY
	NO.	EL.	$+D_A$	$-D_P$	ΣD	$+R_A$	$+R_B$	$+R_P$	ΣR	ΣR / ΣD
	1	-25.0	10,950	0.000	10,950	7,682	11,812	0.000	19,494	1.78
	2	-25.0	23,400	0.000	23,400	8,532	25,370	0.000	33,902	1.45
	3	-85.0	109,844	62	109,782	96,532	128,384	166	225,082	2.05

NOTE
FOR GENERAL NOTES SEE PLATE 31.

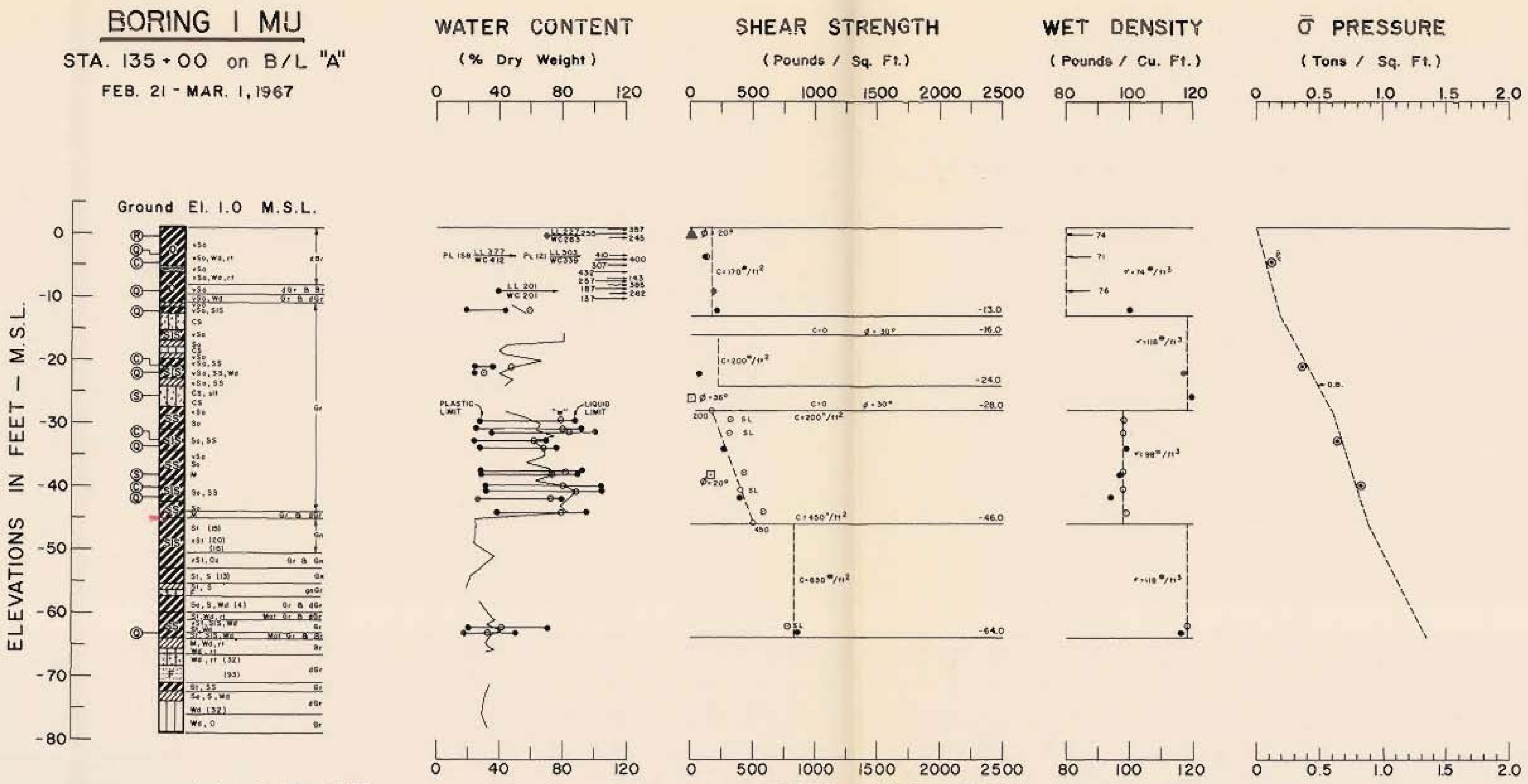
A JOINT VENTURE
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.
HARZA ENGINEERING CO CHICAGO, ILL.

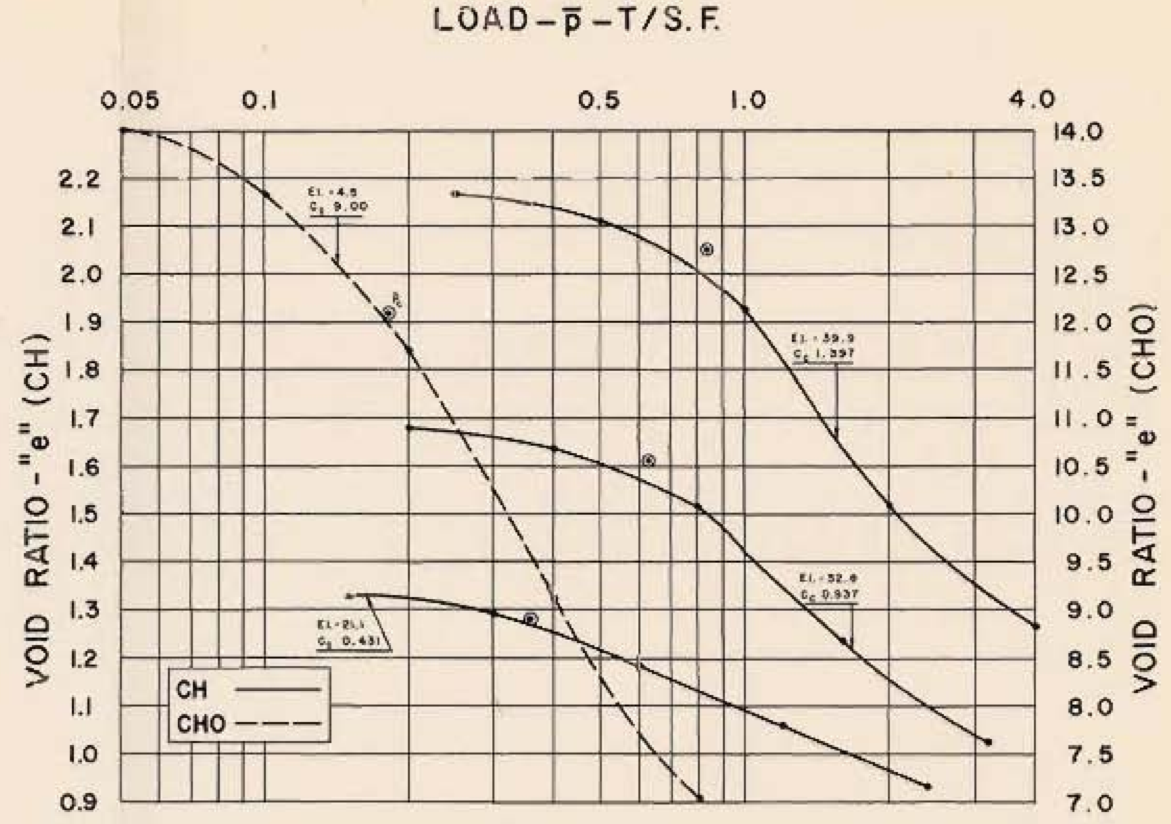
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
BORROW PIT IN CHEF MENTURE PASS
TYPICAL CROSS SECTION
AND STABILITY ANALYSIS

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

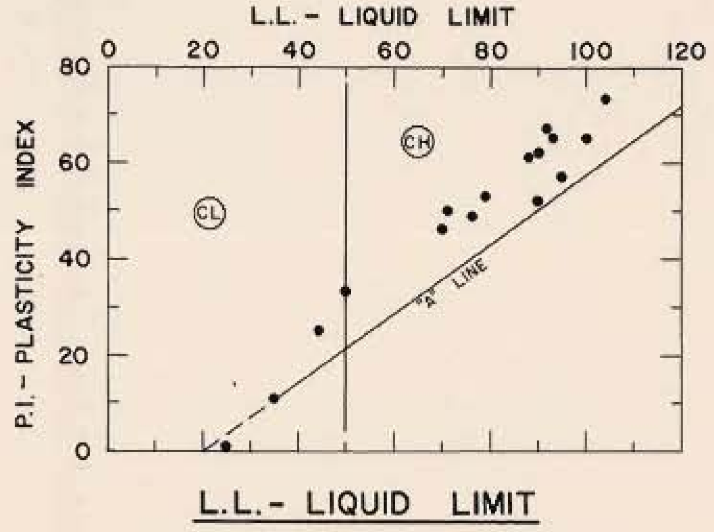
DATE: APRIL 1969
FILE NO. H-2-24416



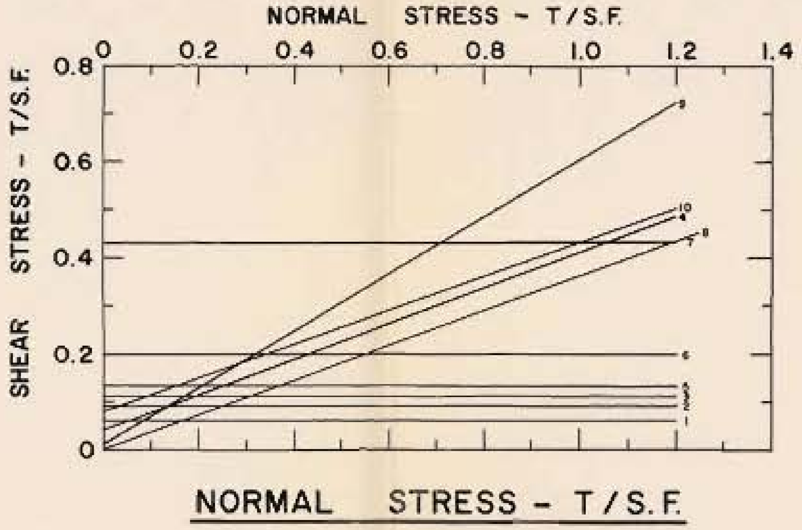


CONSOLIDATION DATA

SHEAR STRENGTH TREND APPLIED TO DESIGN OF LEVEE FROM STATIONS 100+00 TO 125+09.83 AND TO DESIGN OF CONTROL CHANNEL FROM STATIONS 12+50 TO 79+00.



PLASTICITY CHART



SHEAR DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Ø°	STRENGTH C, T.S.F.	CLASS
1	- 3.5	Q	0	0.06	Pt
2	- 9.1	Q	0	0.09	CH
3	-12.1	Q	0	0.11	CL
4	-22.0	Q	21	0.04	ML
5	-33.7	Q	0	0.13	CH
6	-41.7	Q	0	0.20	CH
7	-63.0	Q	0	0.43	CH
8	- 0.3	R	20	0.00	CH
9	-25.7	S	36	0.01	SM
10	-38.1	S	20	0.08	CH

GENERAL NOTES

○UC — UNCONFINED COMPRESSION SHEAR TEST
●Ⓠ — UNCONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
▲Ⓡ — CONSOLIDATED UNDRAINED TRIAXIAL SHEAR TEST
⊡Ⓢ — CONSOLIDATED DRAINED DIRECT SHEAR TEST
Ⓒ — CONSOLIDATED TEST
W — NATURAL WATER CONTENT
LL — LIQUID LIMIT
PL — PLASTIC LIMIT
C — UNIT COHESION
Ø — ANGLE OF FRICTION
Y — UNIT WEIGHT OF SOIL-WATER SYSTEM
$\bar{\sigma}$ — NORMAL STRESS
$\bar{pc}$ — PRECONSOLIDATED PRESSURE
e — VOID RATIO
CC — COMPRESSION INDEX
O.B — OVER BURDEN

FOR SOIL BORING LEGEND SEE PLATE A.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

UNDISTURBED BORING

I-MU DATA

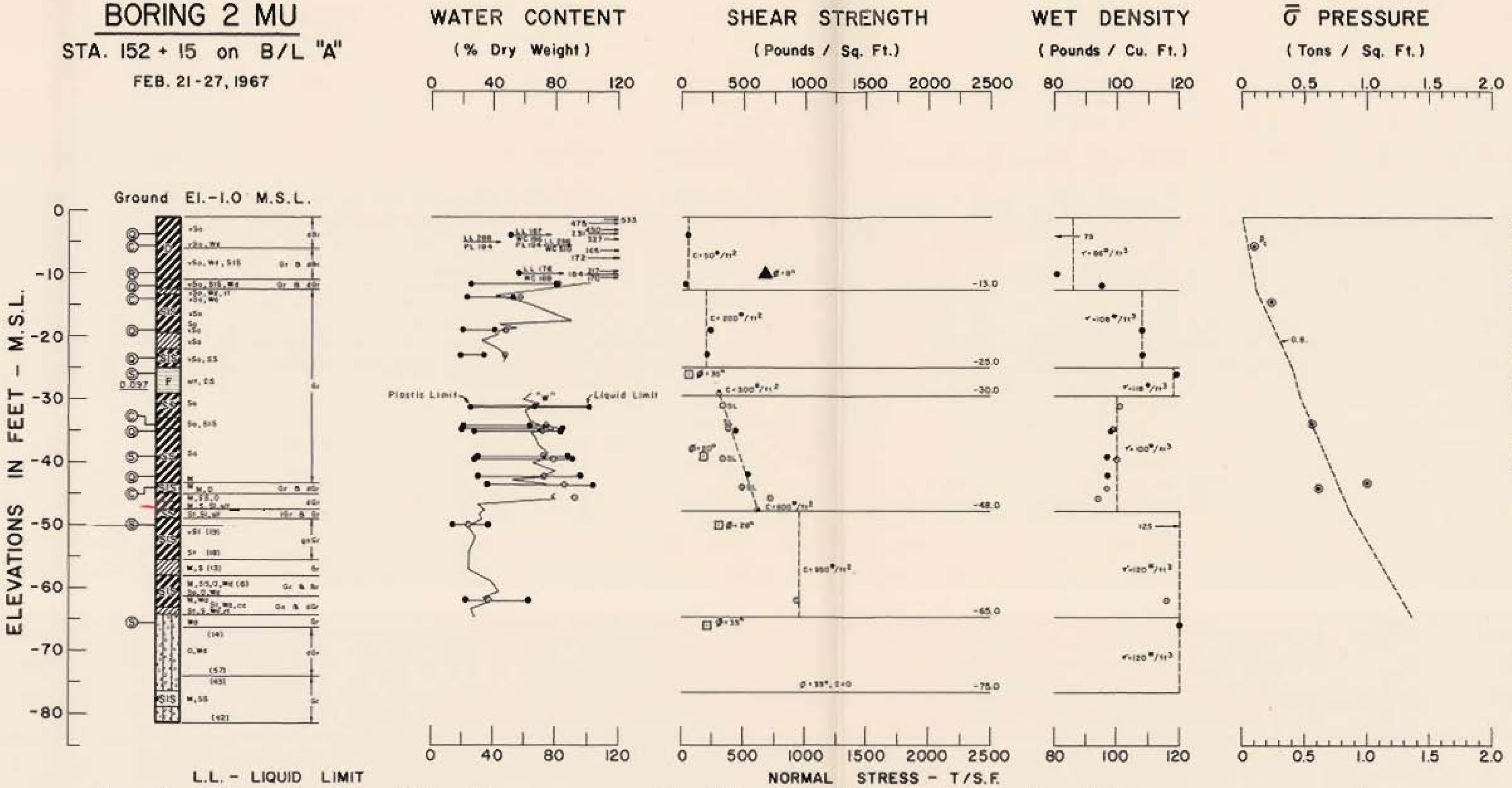
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

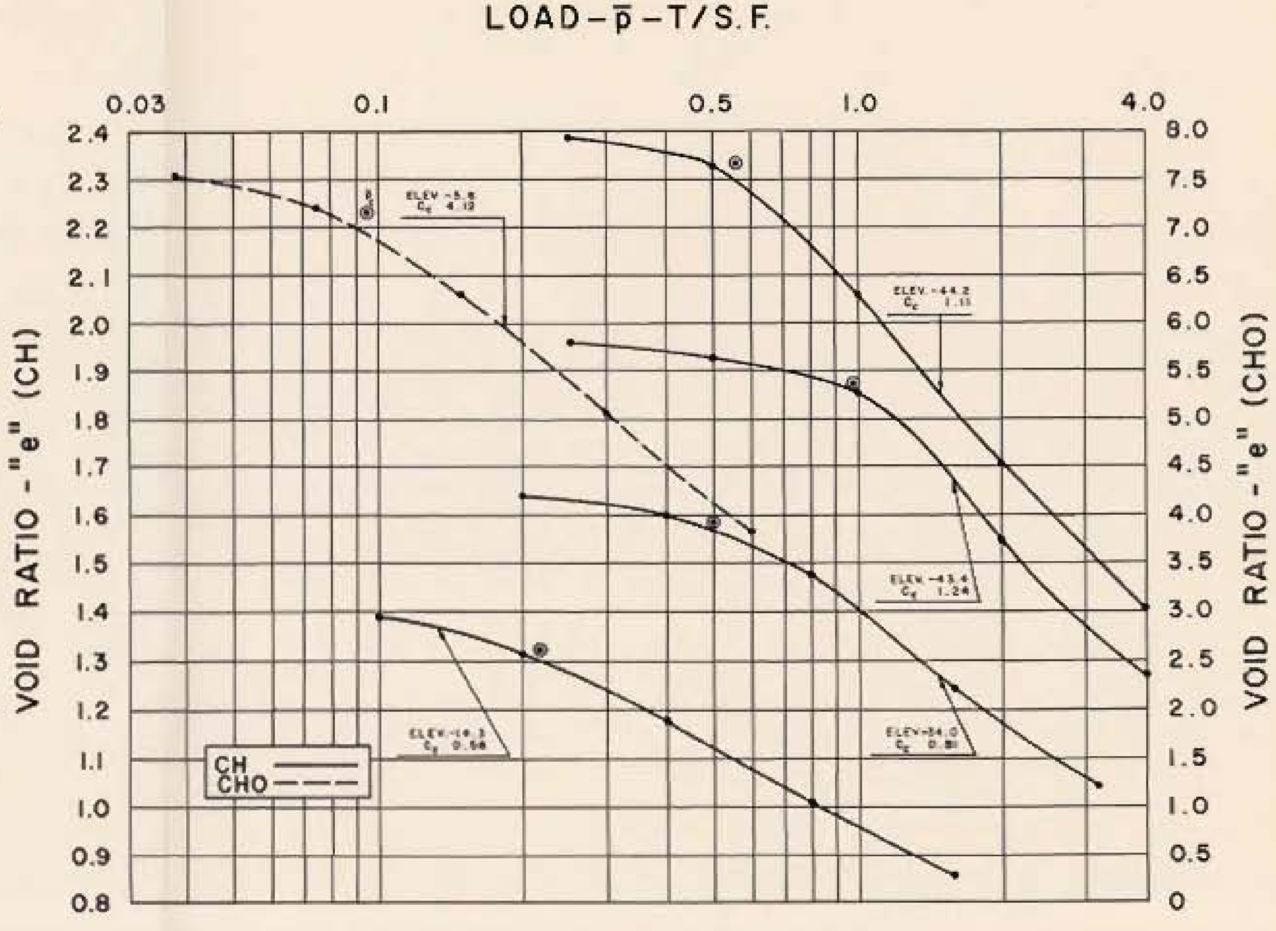
DATE: APRIL 1969 FILE NO. H-2-24416

BORING 2 MU

STA. 152 + 15 on B/L "A"

FEB. 21-27, 1967



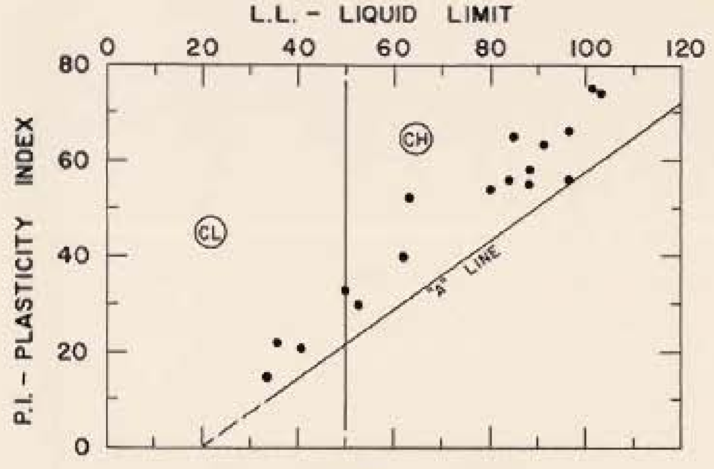


CONSOLIDATION DATA

NOTES

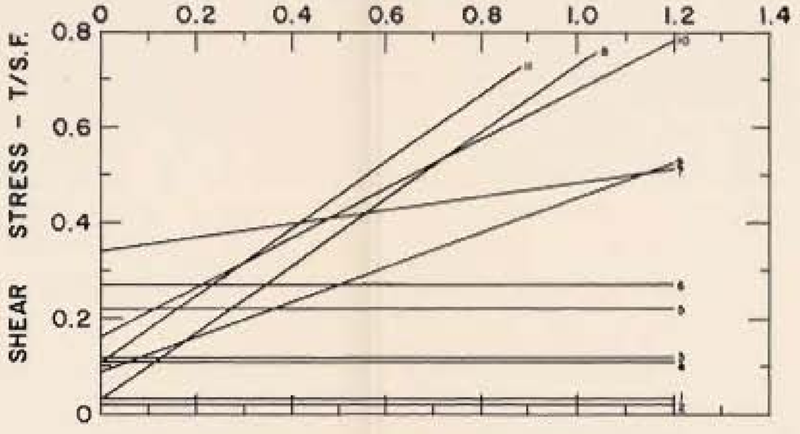
FOR GENERAL NOTES SEE PLATE 38.

SHEAR STRENGTH TREND APPLIED TO DESIGN OF LEVEE FROM STATIONS 125+09.83 TO 177+40 & 193+40 TO 198+40 TO NAVIGATION CHANNEL FROM STATIONS 15+00 TO 135+50 AND TO DESIGN OF CHEF CLOSURE BORROW STABILITY.



L.L. - LIQUID LIMIT

PLASTICITY CHART



NORMAL STRESS - T/S.F.

SHEAR DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		ø°	C, T.S.F.	
1	- 3.5	Q	0	0.03	CH
2	- 12.0	Q	0	0.02	CH
3	- 19.0	Q	0	0.12	CH
4	- 23.6	Q	0	0.11	ML
5	- 35.3	Q	0	0.22	CH
6	- 42.4	Q	0	0.27	CH
7	- 10.0	R	8	0.34	CH
8	- 26.2	S	35	0.03	SM
9	- 39.6	S	20	0.09	CH
10	- 50.8	S	28	0.16	CL
11	- 66.5	S	35	0.11	SM

A JOINT VENTURE

BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.

HARZA ENGINEERING CO
CHICAGO, ILL.

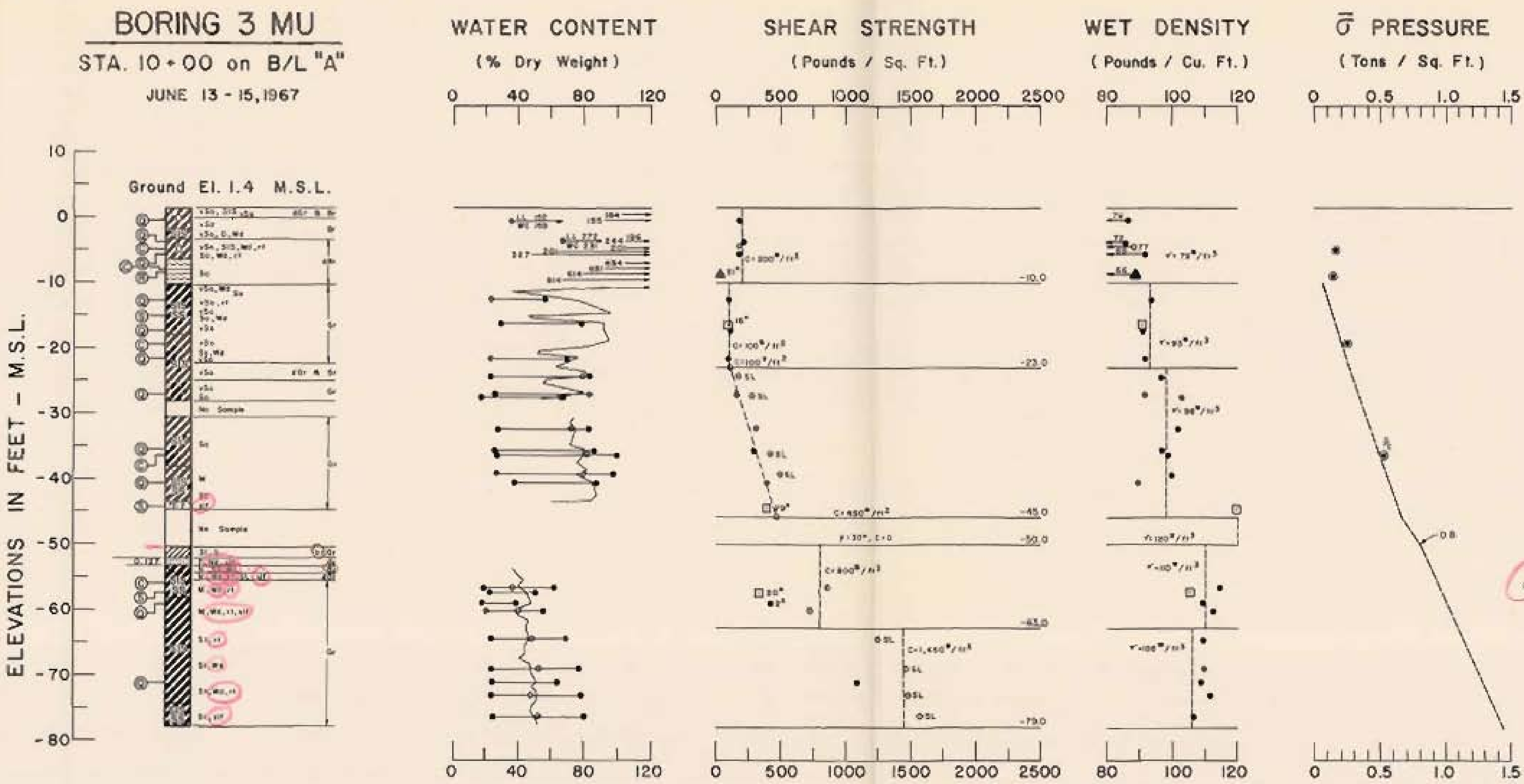
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

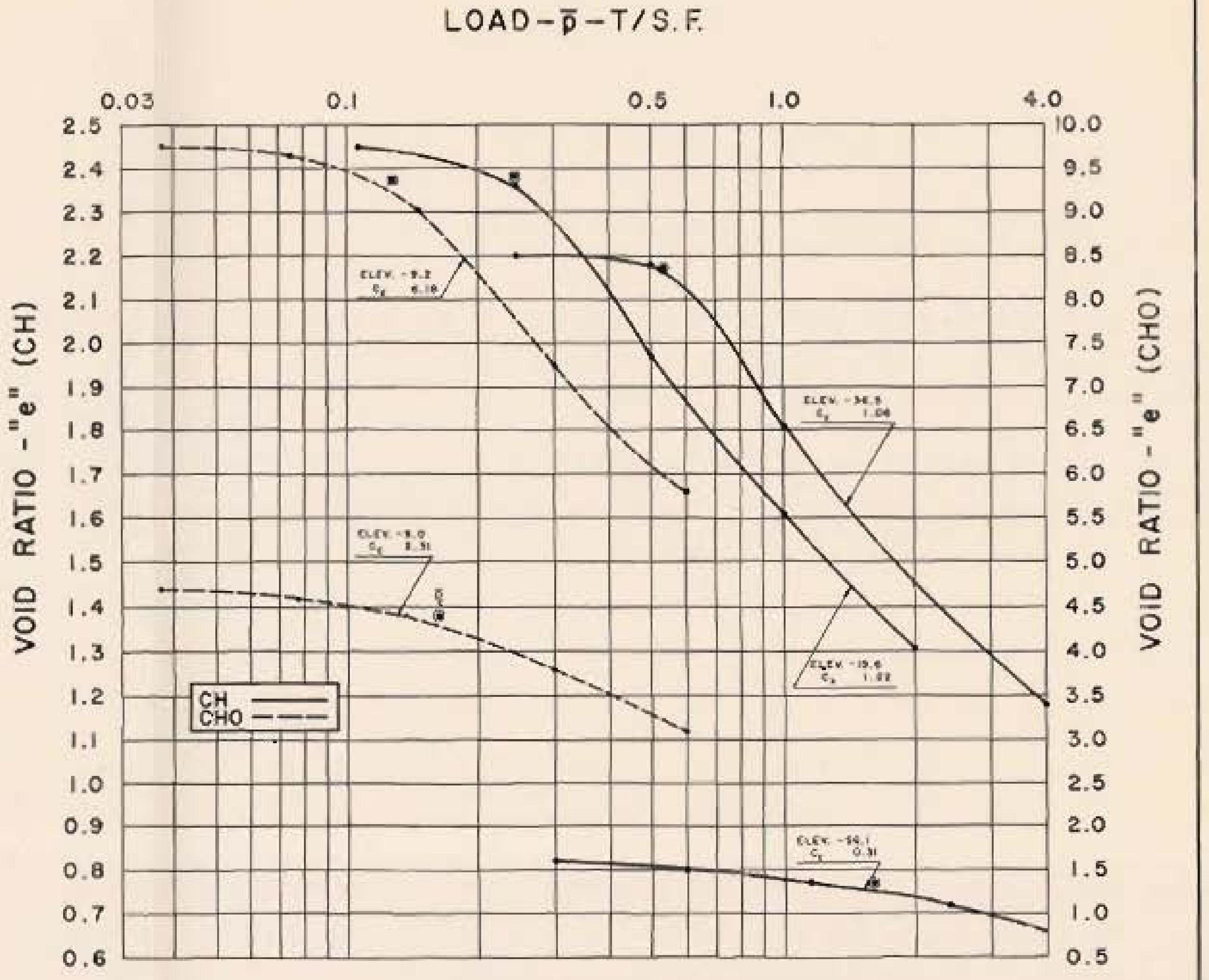
CHEF MENTEUR PASS COMPLEX

UNDISTURBED BORING
2-MU DATA

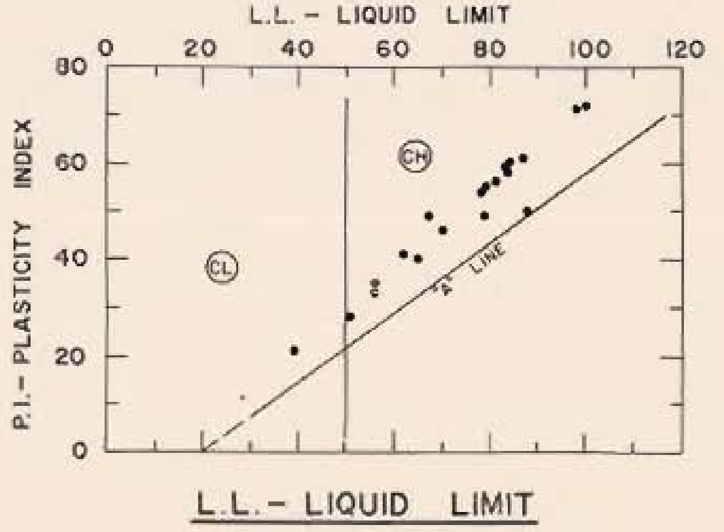
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: APRIL 1969 FILE NO. H-2-24416

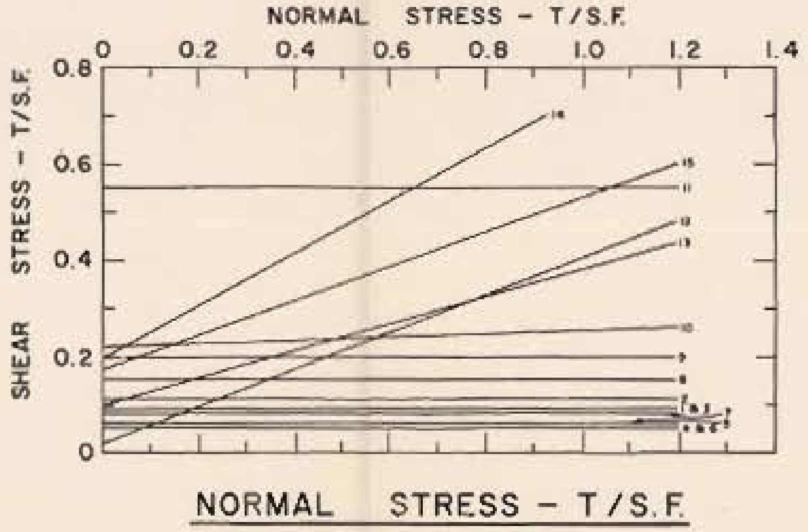




CONSOLIDATION DATA



PLASTICITY CHART



SHEAR DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH ø°	STRENGTH C, T.S.F.	CLASS
1	-0.6	Q	0	0.09	CHO
2	-3.9	Q	0	0.11	CHO
3	-5.8	Q	0	0.09	CHO
4	-12.6	Q	0	0.05	CH
5	-17.2	Q	0	0.06	CH
6	-21.6	Q	0	0.05	CH
7	-27.0	Q	0	0.08	CH
8	-35.7	Q	0	0.15	CH
9	-40.5	Q	0	0.20	CH
10	-59.0	Q	2	0.22	CL
11	-71.0	Q	0	0.55	CH
12	-8.8	R	21	0.02	Pt
13	-16.3	S	16	0.10	CH
14	-44.4	S	29	0.20	SC
15	-57.3	S	20	0.17	CH

NOTES

FOR GENERAL NOTES SEE PLATE 38.

SHEAR STRENGTH TREND APPLIED TO DESIGN OF LEVEE FROM STATIONS 0+00 TO 37+50, AND TO DESIGN OF G.I.W.W. CHANNEL FROM STATIONS 660+00 TO 770+00 AND TO DESIGN OF G.I.W.W. BORROW FROM STATIONS 0+00 TO 72+14.

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

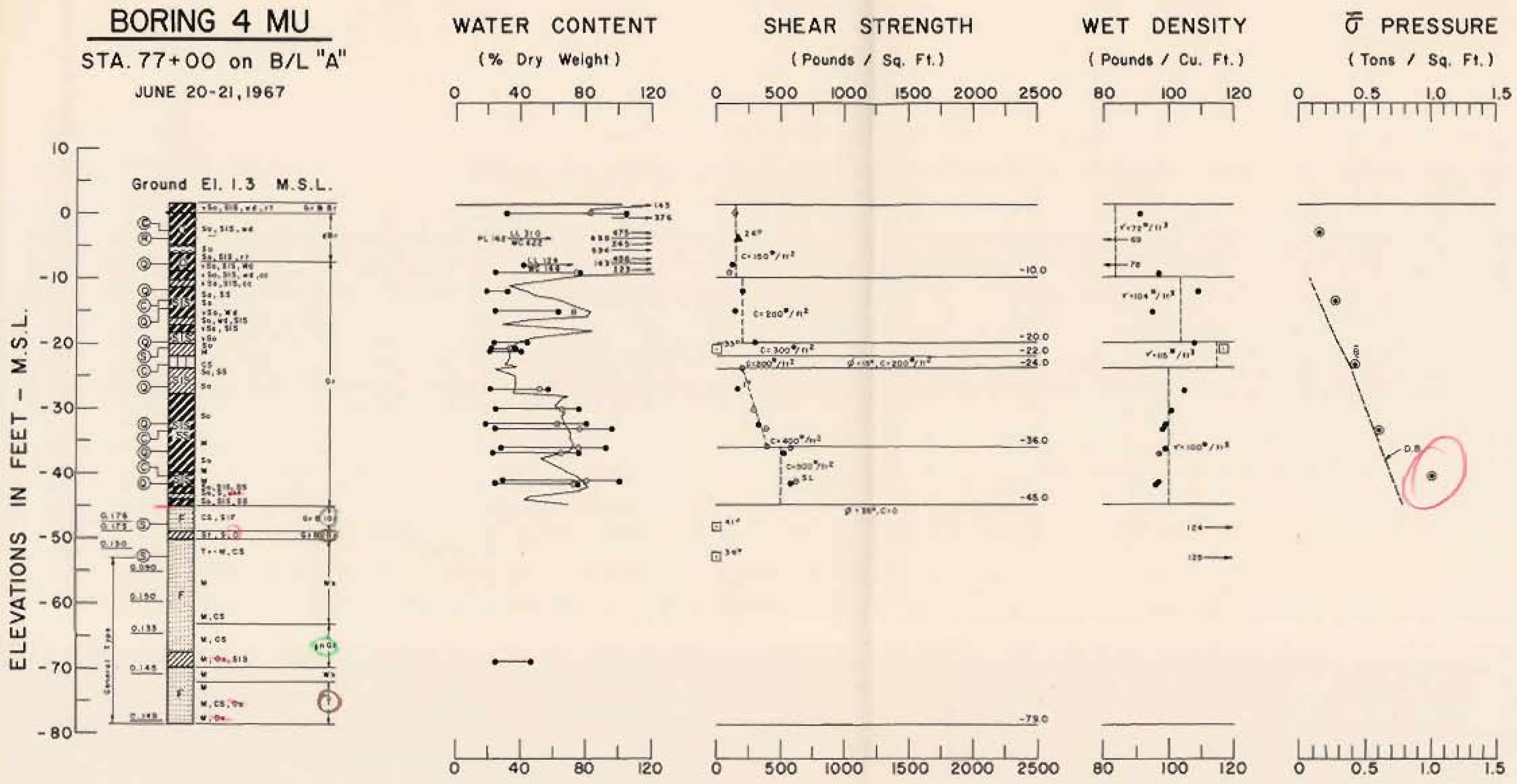
CHEF MENTEUR PASS COMPLEX

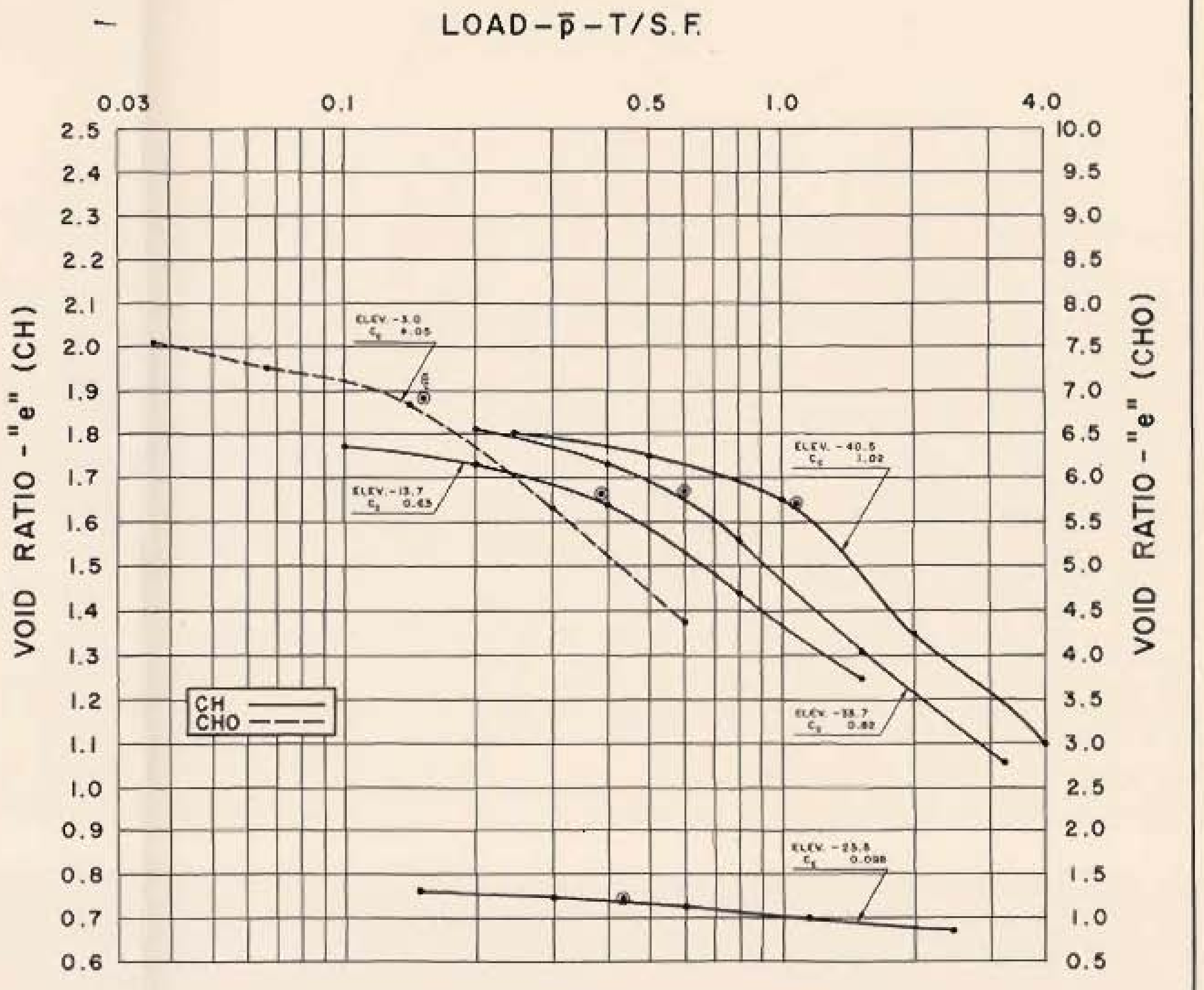
UNDISTURBED BORING

3-MU DATA

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

DATE: APRIL 1969 FILE NO. H-2-24416



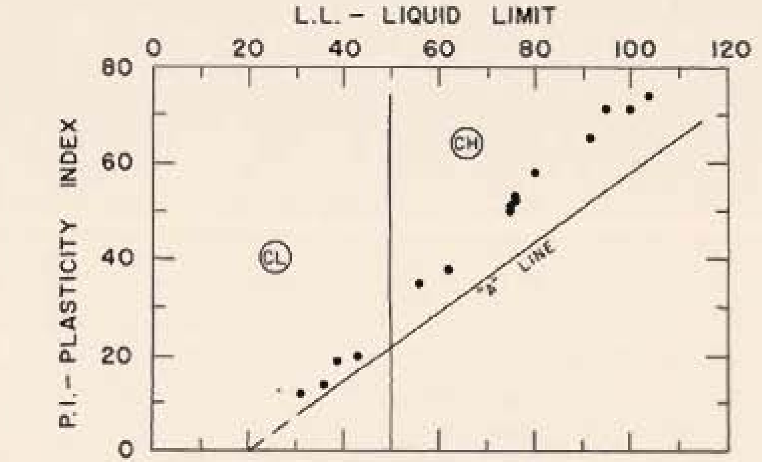


CONSOLIDATION DATA

NOTES

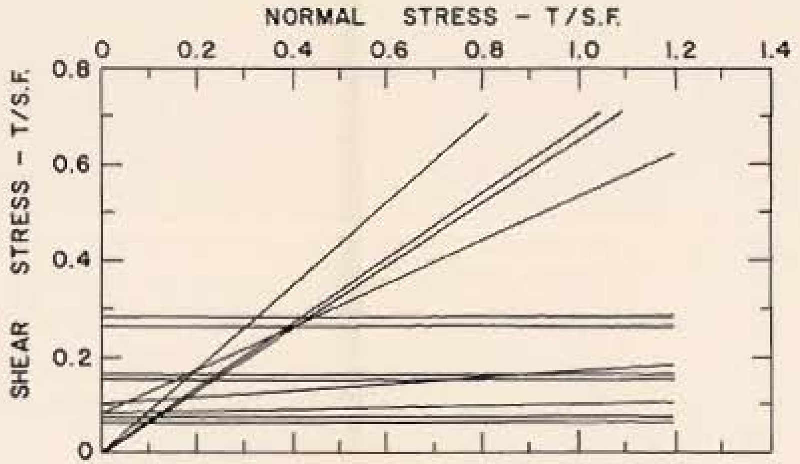
FOR GENERAL NOTES SEE PLATE 38.

SHEAR STRENGTH TREND APPLIED TO DESIGN OF LEVEE FROM STATIONS 37+50 TO 100+00, TO DESIGN OF G.I.W.W. CHANNEL FROM STATIONS 770+00 TO 960+00 AND TO DESIGN OF G.I.W.W. CLOSURE FROM STATIONS 80+00 TO 85+00



L.L. - LIQUID LIMIT

PLASTICITY CHART



NORMAL STRESS - T/S.F.

SHEAR DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Ø°	STRENGTH C, T.S.F.	CLASS
1	-8.0	Q	0	0.06	CHO
2	-12.0	Q	4	0.10	CL
3	-15.1	Q	0	0.07	CH
4	-20.0	Q	0	0.15	CL
5	-27.1	Q	1	0.08	CH
6	-32.6	Q	0	0.16	CH
7	-37.0	Q	0	0.26	CH
8	-41.7	Q	0	0.28	CH
9	-4.0	R	24	0.08	Pt
10	-20.9	S	33	0	CL
11	-48.5	S	41	0	SM
12	-52.9	S	34	0	SP

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | HARZA ENGINEERING CO. CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

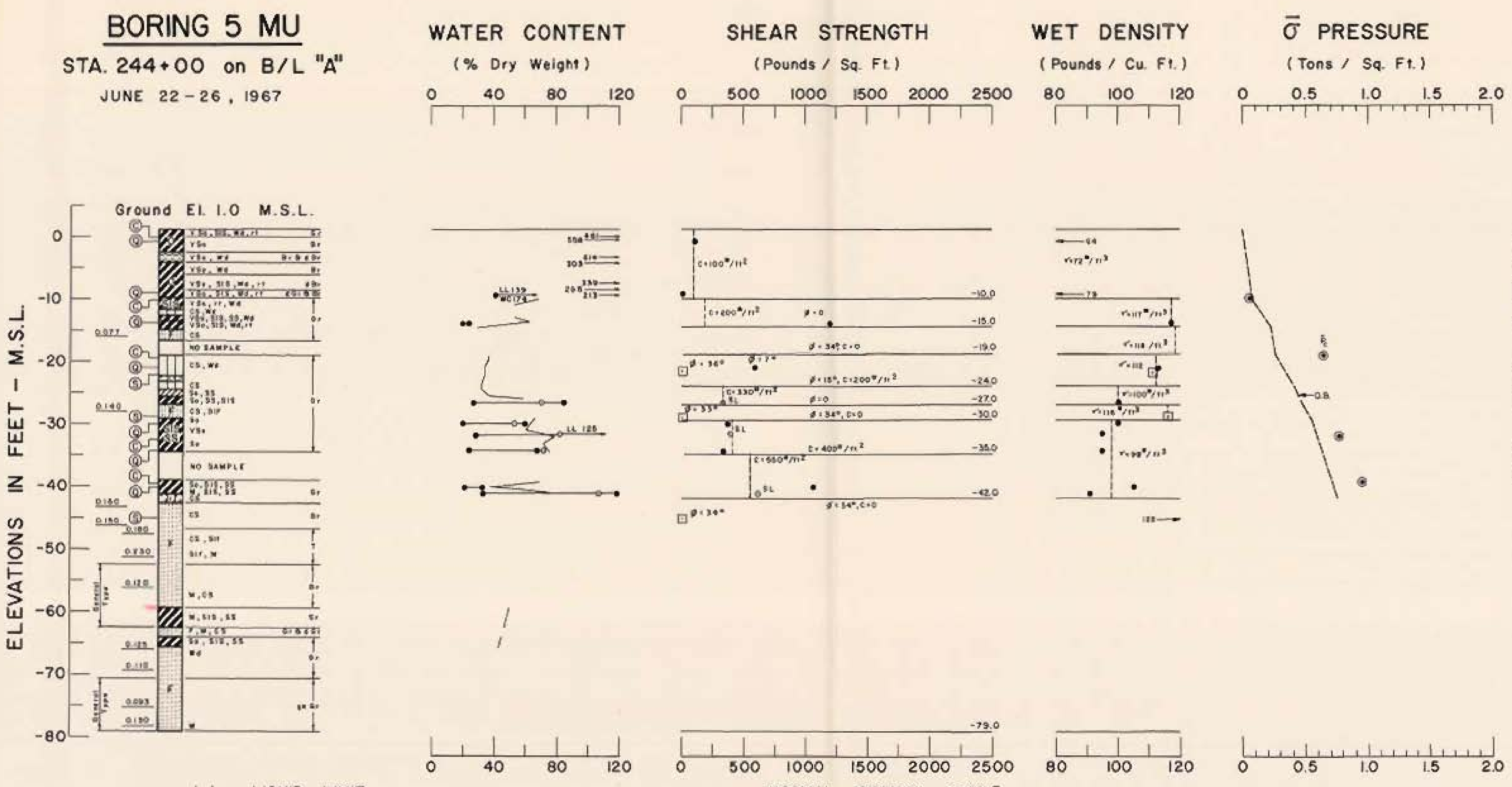
CHEF MENTEUR PASS COMPLEX

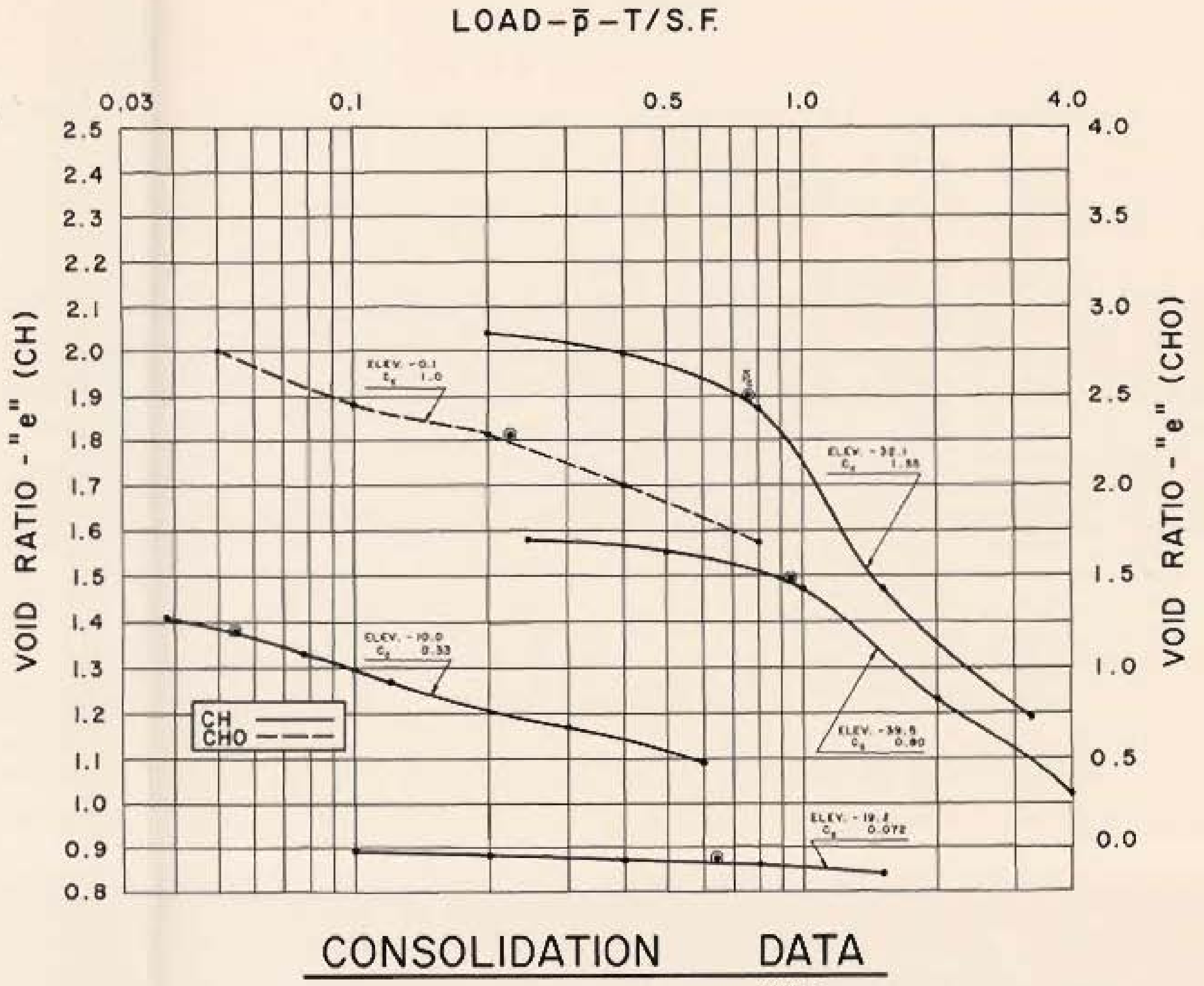
UNDISTURBED BORING

4-MU DATA

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

DATE: APRIL 1969 FILE NO. H-2-24416



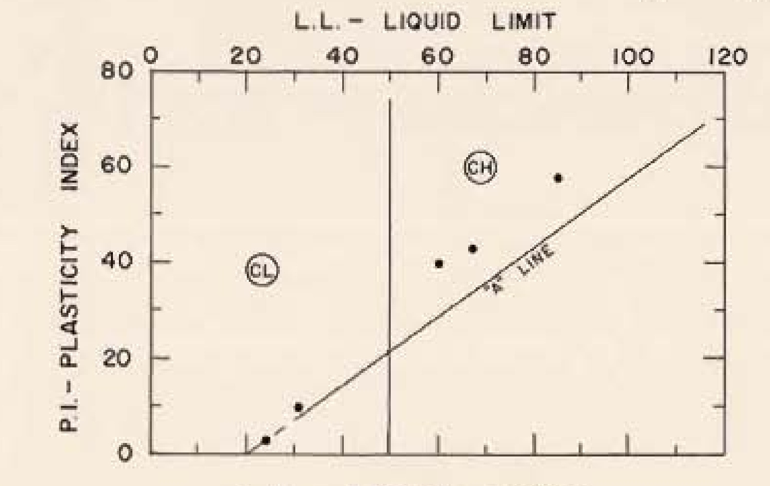


CONSOLIDATION DATA

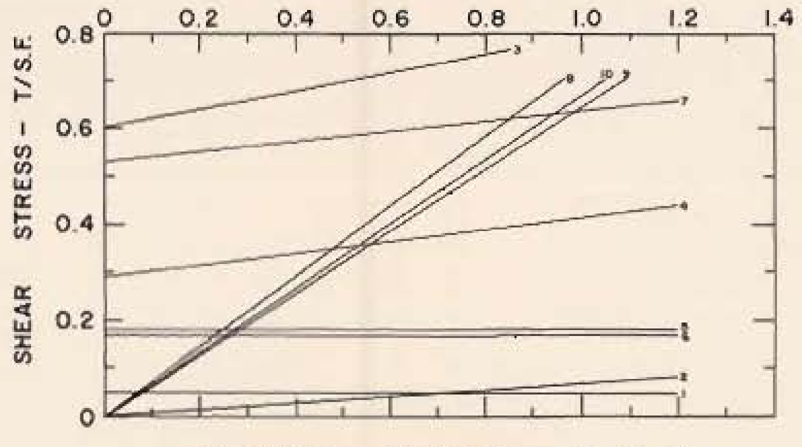
NOTES

FOR GENERAL NOTES SEE PLATE 38.

STRENGTH TREND APPLIED TO DESIGN OF LEVEE FROM STATIONS 193+40 TO 278+63.36 AND TO DESIGN OF G.I.W.W. CHANNEL FROM STATIONS 960+00 TO 990+00 AND TO DESIGN OF STREAM CLOSURES STATIONS 226+47.36 TO 233+47.36 AND 267+27.36 TO 271+27.36.



PLASTICITY CHART



SHEAR DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Ø°	STRENGTH C,T.S.F.	CLASS
1	- 0.7	Q	0	0.05	CHO
2	- 9.2		4	0.00	CHO
3	-13.8		11	0.60	SM
4	-21.0		7	0.29	ML
5	-29.9		0	0.18	CH
6	-34.2		0	0.17	CH
7	-40.0		6	0.53	CL
8	-21.7	S	36	0.00	SM
9	-29.0		33	0.00	SM
10	-45.0		34	0.00	SP

A JOINT VENTURE

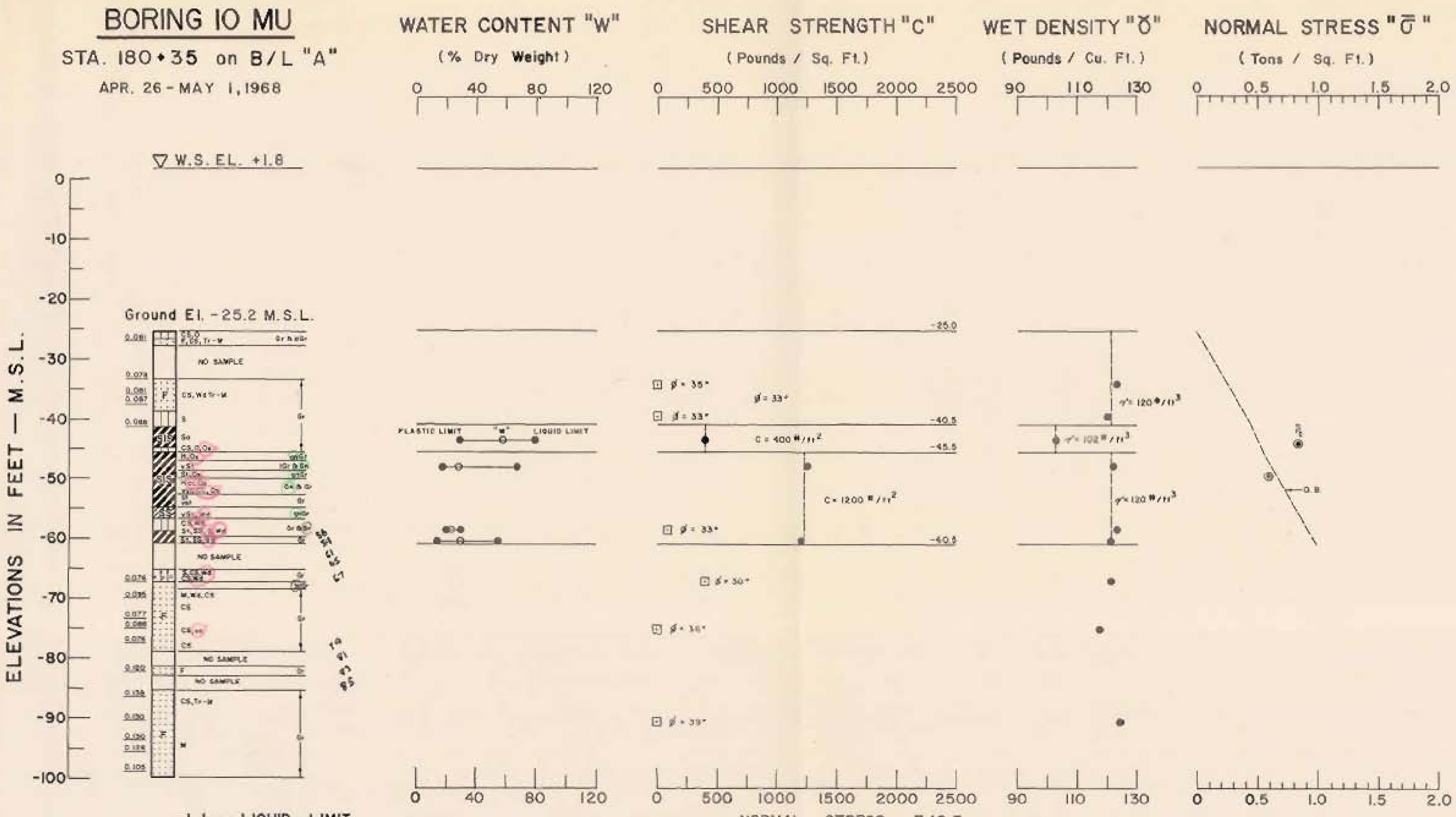
BURK AND ASSOCIATES, INC. NEW ORLEANS, LA. | HARZA ENGINEERING CO CHICAGO, ILL.

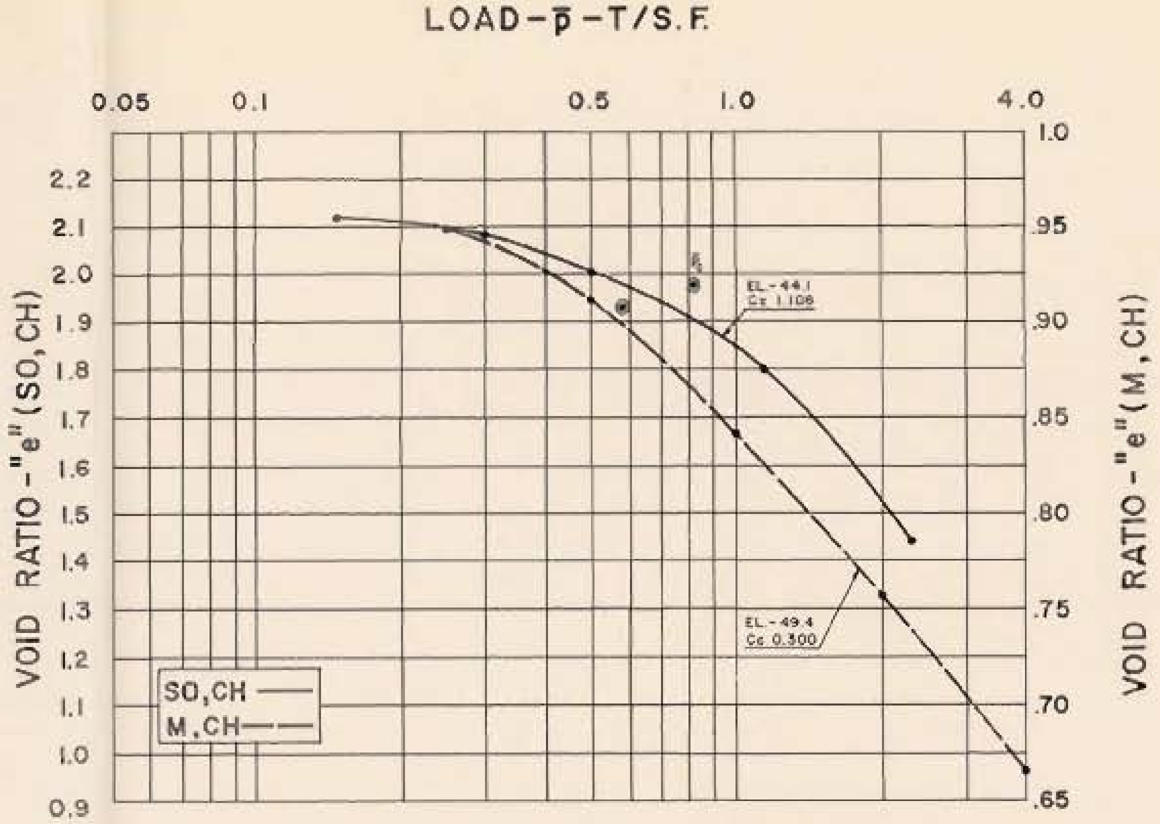
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
UNDISTURBED BORING
5-MU DATA

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

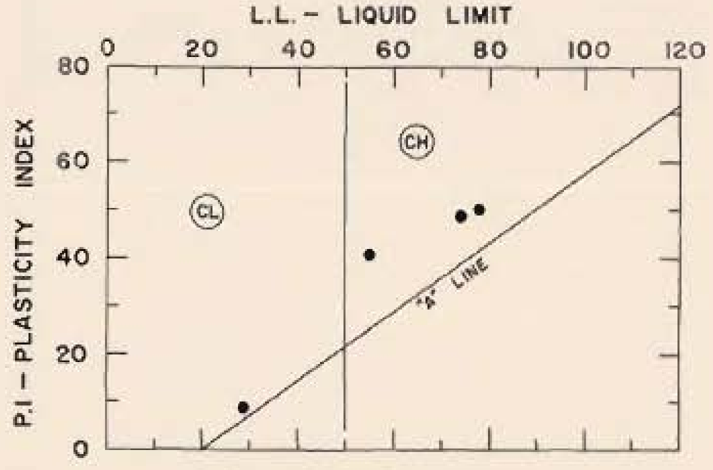
DATE: APRIL 1969 FILE NO. H-2-24416



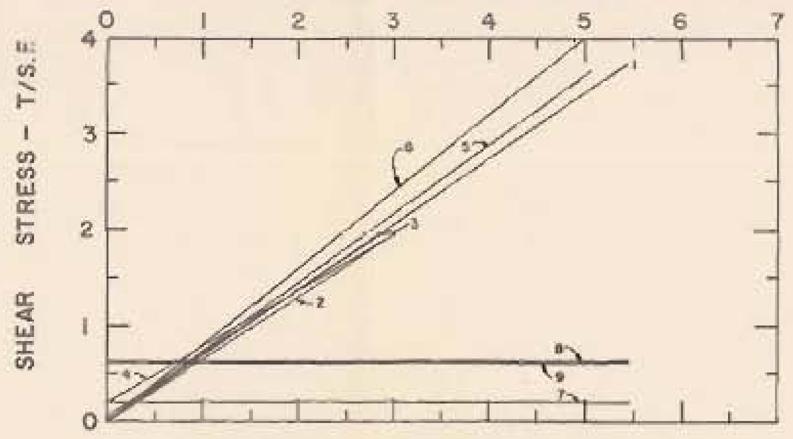


CONSOLIDATION DATA

NOTES
FOR GENERAL NOTES SEE PLATE 38.
STRENGTH TREND APPLIED TO DESIGN OF CHEF MENTEUR PASS CLOSURE DAM.



L.L. - LIQUID LIMIT
PLASTICITY CHART



NORMAL STRESS - T/S.F.
SHEAR DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		Ø°	C, T.S.F	
1	-34.2	S	35	0.00	SM
2	-39.3	S	33	0.00	SM
3	-58.3	S	33	0.04	CL
4	-66.9	S	30	0.20	SM
5	-74.9	S	36	0.00	SM
6	-90.3	S	39	0.00	SP
7	-43.4	Q	0	0.20	CH
8	-47.8	Q	0	0.63	CH
9	-60.1	Q	0	0.60	CH

A JOINT VENTURE

BURK AND ASSOCIATES, INC. NEW ORLEANS, LA.	HARZA ENGINEERING CO CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
UNDISTURBED BORING
10-MU DATA

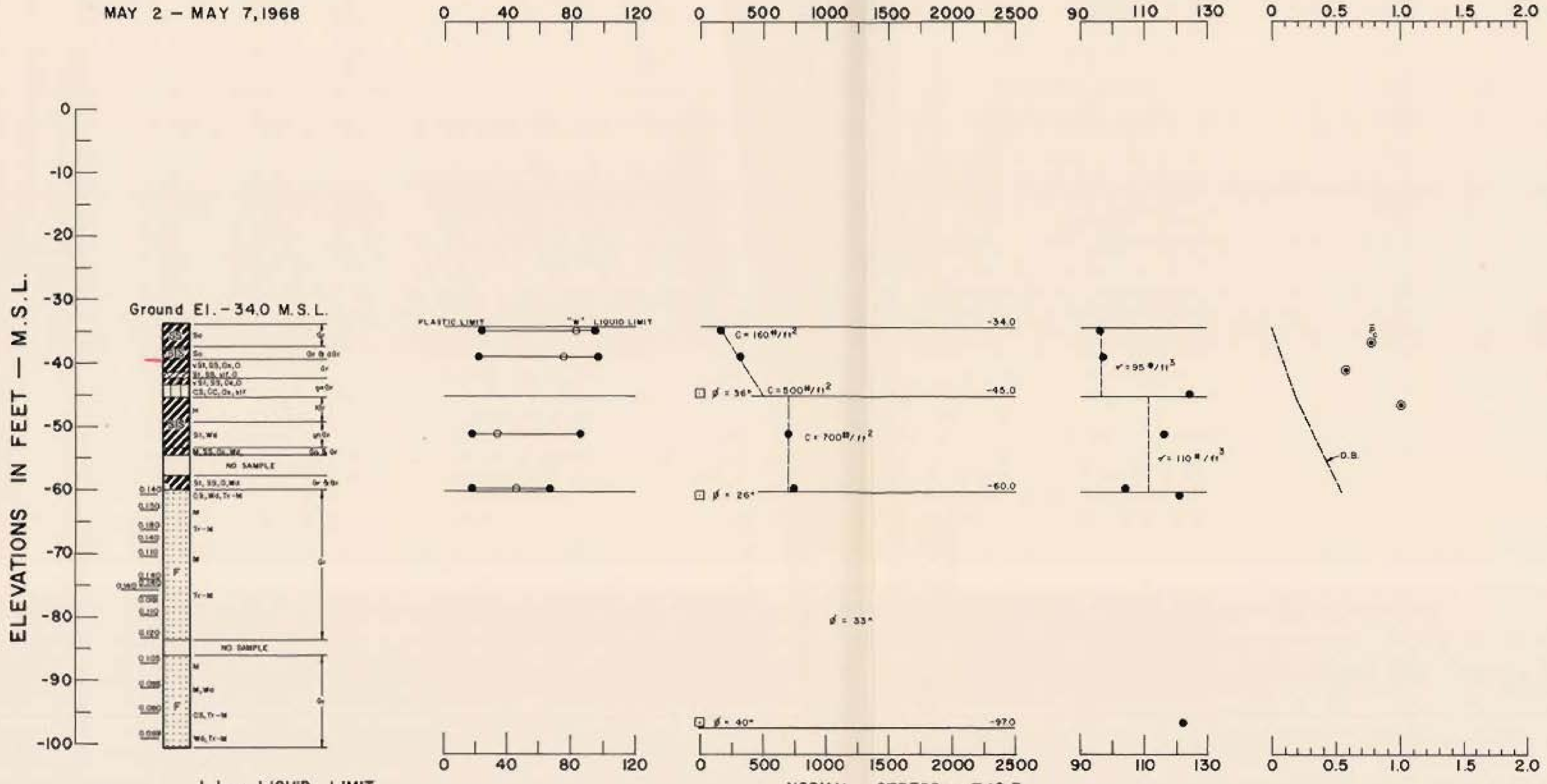
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

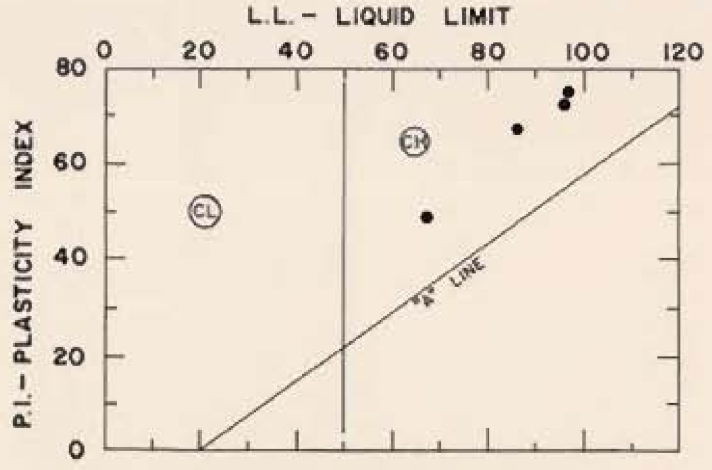
DATE: APRIL 1969 FILE NO. H-2-24416

BORING 11 MU

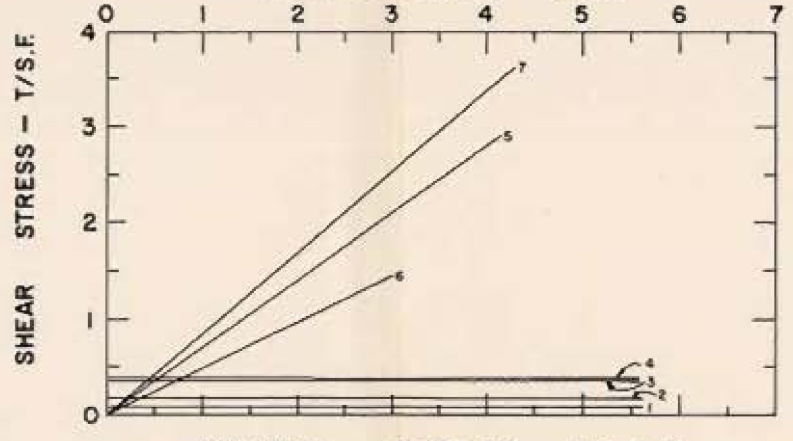
STA. 187+55 on B/L "A"

MAY 2 – MAY 7, 1968



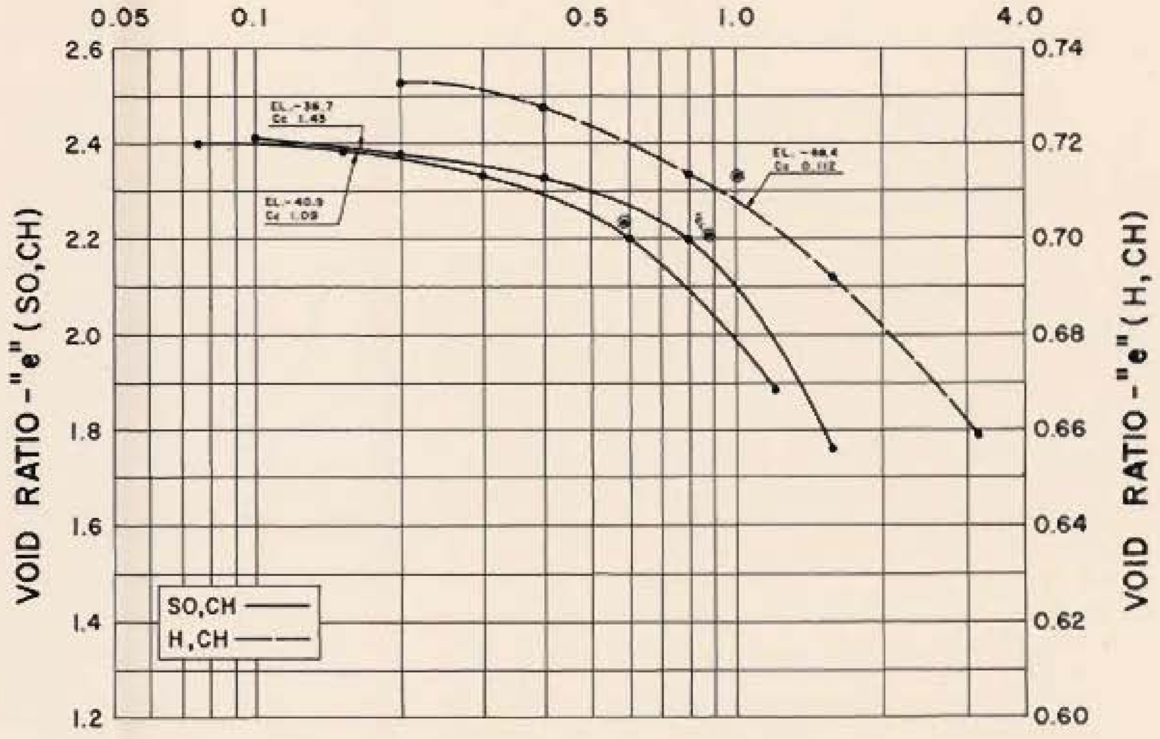


PLASTICITY CHART



SHEAR DATA

ENVELOPE NO.	EL.	TYPE	STRENGTH ø°	C, T.S.F.	CLASS
1	-34.9	Q	0	0.08	CH
2	-38.9	Q	0	0.16	CH
3	-51.0	Q	0	0.35	CH
4	-59.7	Q	0	0.37	CH
5	-44.5	S	36	0.00	ML
6	-60.7	S	26	0.00	SP
7	-96.2	S	40	0.00	SM



CONSOLIDATION DATA

NOTE
FOR GENERAL NOTES SEE PLATE 38.

A JOINT VENTURE

BURK AND ASSOCIATES, INC.
NEW ORLEANS, LA.

HARZA ENGINEERING CO
CHICAGO, ILL.

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 – GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
UNDISTURBED BORING
11-MU DATA

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

DATE: APRIL 1969 FILE NO. H-2-24416

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			SI		SHELLS
NO SAMPLE					

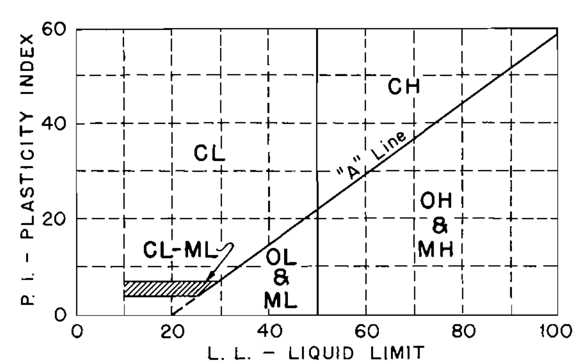
NOTE: Soils possessing characteristics of two groups are designated by combinations of group symbols

DESCRIPTIVE SYMBOLS

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	gyBr
GREENISH-GRAY	gnGr
GRAYISH-GREEN	gyGn
GREEN	Gn
BLUE	Bl
BLUE-GREEN	BlGn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS

CONSISTENCY	COHESION IN LBS./SQ.FT. FROM UNCONFINED COMPRESSION TEST	SYMBOL
VERY SOFT	< 250	vSo
SOFT	250 - 500	So
MEDIUM	500 - 1000	M
STIFF	1000 - 2000	St
VERY STIFF	2000 - 4000	vSt
HARD	> 4000	H



PLASTICITY CHART
For classification of fine – grained soils

MODIFICATIONS

MODIFICATION	SYMBOL
Traces	Tr-
Fine	F
Medium	M
Coarse	C
Concretions	cc
Rootlets	rt
Lignite fragments	lg
Shale fragments	sh
Sandstone fragments	sds
Shell fragments	slf
Organic matter	O
Clay strata or lenses	CS
Silt strata or lenses	SIS
Sand strata or lenses	SS
Sandy	S
Gravelly	G
Boulders	B
Slickensides	SL
Wood	Wd
Oxidized	Ox

NOTES:

FIGURES TO LEFT OF BORING UNDER COLUMN "W OR D_{10}"

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

FIGURES TO LEFT OF BORING UNDER COLUMNS "LL" AND "PL"

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

∇ Ground-water surface and date observed

(C) Denotes location of consolidation test **

(S) Denotes location of consolidated-drained direct shear test **

(R) Denotes location of consolidated-undrained triaxial compression test **

(Q) Denotes location of unconsolidated-undrained triaxial compression test **

(T) Denotes location of sample subjected to consolidation test and each of the above three types of shear tests **

FW Denotes free water encountered in boring or sample

FIGURES TO RIGHT OF BORING

Are values of cohesion in lbs./sq.ft. from unconfined compression tests

In parenthesis are driving resistances in blows per foot determined with a standard split spoon sampler ($1\frac{3}{8}$" I.D., 2" O.D.) and a 140 lb. driving hammer with a 30" drop

Where underlined with a solid line denotes laboratory permeability in centimeters per second of undisturbed sample

Where underlined with a dashed line denotes laboratory permeability in centimeters per second of sample remoulded to the estimated natural void ratio

* The D_{10} size of a soil is the grain diameter in millimeters of which 10% of the soil is finer, and 90% coarser than size D_{10}.

**Results of these tests are available for inspection in the U.S. Army Engineer District Office, if these symbols appear beside the boring logs on the drawings.

GENERAL NOTES:

While the borings are representative of subsurface conditions at their respective locations and for their respective vertical reaches, local variations characteristic of the subsurface materials of the region are anticipated and, if encountered, such variations will not be considered as differing materially within the purview of clause 4 of the contract.

Ground-water elevations shown on the boring logs represent ground-water surfaces encountered on the dates shown. Absence of water surface data on certain borings implies that no ground-water data is available, but does not necessarily mean that ground water will not be encountered at the locations or within the vertical reaches of these borings.

Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM L.M.V.G.G. 5 JUNE 1964
1	9-17-63	1ST. PAR. OF GENERAL NOTES REVISED	L.M.V.D. MULTIPLE LETTER, DATED 5 SEPT., 1963

SOIL BORING LEGEND

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO. H-2-21800

APPENDIX A

REPORT ON EVALUATION OF ALTERNATE PLANS INVOLVING MODIFICATIONS
IN THE ALIGNMENT OF THE LAKE PONTCHARTRAIN BARRIER

LMVED-TD (NOD 13 Mar 67) 3d Ind
SUBJECT: Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 19 May 67

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

Referred to note approval.

FOR THE DIVISION ENGINEER:

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

ENGCW-EZ (LMNED-PP 13 Mar 67) 2d Ind

SUBJECT: Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier

DA, CofEngrs, Washington, D. C., 20315, 15 May 1967

TO: Division Engineer, Lower Mississippi Valley Division

The recommendations of the District Engineer in paragraph 15 of the basic letter are approved, subject to the comment of the Division Engineer in the 1st indorsement.

FOR THE CHIEF OF ENGINEERS:

wd incl

WENDELL E. JOHNSON
Chief, Engineering Division
Civil Works

LMVED-TD (NOD 13 Mar 67) 1st Ind

SUBJECT: Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier

DA, Lower Miss. Valley Div, CE, Vicksburg, Miss. 39180 28 Mar 67

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

1. Subject report is forwarded for review and approval pursuant to para 9b, ER 1110-2-1150. The recommendations of the District Engineer, in para 15, are concurred in.

2. The last sentence under Plan A, page 4, would be clearer if written as follows:

"It must be pointed out that these areas will remain subject to flooding by overtopping of the barrier from lesser hurricanes than the SPH, and in addition will be vulnerable to overflow from Lake Pontchartrain."

FOR THE DIVISION ENGINEER:

19 Incl (10 cy)
wd 1 cy ea

GEORGE B. DAVIS
Acting Chief, Engineering Division

Copy furnished:
NOD, ATTN: LMNED-PP

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

IN REPLY REFER TO
LMNED-PP

13 March 1967

SUBJECT: Lake Pontchartrain, La. and Vicinity - Evaluation of Alternate Plans Involving Modifications in the Alignment of the Lake Pontchartrain Barrier

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

1. Scope. This report was prepared in accordance with paragraph 9.b. of ER 1110-2-1150 dated 1 July 1966. Its purpose is to establish the bases for adopting a barrier alignment, other than that specified in the project document, and for providing wavewash protection for portions of the barrier, as departures from the project document plan within the discretionary authority of the Chief of Engineers.

2. Project authorization. The "Lake Pontchartrain, La. and Vicinity," project was authorized by the Flood Control Act of 1965 (Public Law 89-298, approved 27 October 1965), substantially in accordance with the recommendations of the Chief of Engineers in his report printed as House Document No. 231, 89th Congress.

3. Project description. The project consists of two independent features--the Lake Pontchartrain Barrier Plan and the Chalmette Area Plan. The Chalmette Area Plan comprises a protection levee extending along the east bank of the Inner Harbor Navigation Canal (IHNC) from the IHNC lock to the Mississippi River-Gulf Outlet (MR-GO), then along the MR-GO to Bayou Lawler, then tieing into the Mississippi River levee at Violet, La., with floodgates in Bayous Bienvenue and Dupre. The Lake Pontchartrain Barrier Plan will serve to protect areas contiguous to the shores of Lake Pontchartrain from flooding by hurricane surges, and has, as its salient segment, the Lake Pontchartrain barrier--a system of levees and control structures extending from New Orleans East to high ground east of the Rigolets, the purpose of which is to limit uncontrolled entry of hurricane tides into Lake Pontchartrain, while preserving navigation access. The barrier, which utilizes the existing U. S. Highway 90 embankment wherever the grade of that embankment is at or above elevation 9[1], also includes new embankment to elevation 9 and regulating

[1] Unless otherwise specified, elevations are in feet and refer to mean sea level.

tidal and/or navigation structures at Chef Menteur Pass, the Rigolets, and Seabrook. In addition to the barrier, the Lake Pontchartrain Barrier Plan includes new lakeshore levees in St. Charles Parish and the Citrus and New Orleans East areas of Orleans Parish, and enlargement or strengthening of existing protective works in Jefferson and Orleans Parishes and at Mandeville (see incl 1).

4. Detailed description of the authorized Lake Pontchartrain barrier. The barrier alignment, as authorized, extends generally eastward from the existing New Orleans East levee for a distance of about 2.4 miles along the north banks of Bayou Sauvage and Chef Menteur Pass, thence southeast across Chef Menteur Pass to the embankment of U. S. Highway 90, thence along the highway embankment to a point about 0.6 mile from the highway bridge crossing the Rigolets, thence across the Rigolets about 0.7 mile southeast of the bridge, thence back to the highway embankment and along that embankment to Apple Pie Ridge (see plate 1). The controlling elevation of the barrier is 9.

5. The structural complex at Chef Menteur Pass consists of a gated control structure of eight bays, each 50 feet wide with invert at elevation -25; a navigable floodgate 56 feet wide with sill at elevation -12; a closure dam in the Pass with crown at elevation 14; and connecting channels for the control and navigation structures. The Rigolets complex consists of a gated control structure of 23 bays, each 50 feet in width, with invert at elevation -20; a navigation lock 860 feet long (pintle to pintle) by 84 feet wide with sill at elevation -14; a closure dam in the Rigolets with crown at elevation 14; and connecting channels for the control structure and navigation lock. U. S. Highway 90 will be rerouted over the control structure.

6. The embankment of U. S. Highway 90 is generally at or above 9 and serves, without modification, as the barrier for a total distance of 7 miles between the closure dam in Chef Menteur Pass and Apple Pie Ridge (see plate 1). For a distance of about 1.5 miles along the northwest shore of Lake St. Catherine, however, the highway is substantially below 9. In this area, a levee with net grade of 9 will be provided adjacent to the highway on the Lake St. Catherine side.

7. Erosion protection will be provided at the structure abutments, on the slopes of the closure dams, and adjacent to the structures in the connecting channels.

8. The authorized barrier is, in some locations, subject to overtopping by hurricane surges which exceed elevation 9. The highway embankment has, in the past, demonstrated marked resistance to erosion damage when overtopped, and erosion is not expected to be a problem in the future. The new barrier embankment will undoubtedly be somewhat more vulnerable; however, experience in hurricane "Betsy," when numerous levees of various descriptions were overtopped without a single instance of what could be described as a structural failure or crevasse, indicates that any damage which might occur during the infrequent instances of short duration overtopping would be of such nature as could be dealt with adequately in connection with maintenance operations. An allowance for such work has been included in the estimated costs for maintenance and operation. All structures and closure dams have top elevations of 14, which elevation is above the surge produced by the standard project hurricane on a path critical to the barrier.

9. Provisions of authorizing legislation pertaining to alterations in levee locations. The project authorization is based on the report of the Chief of Engineers which states, inter alia, that "...The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers....Subject to re-examination of the levee alignment in the preconstruction planning stage with a view to protecting additional lands, and to certain requirements of local cooperation, the Board recommends authorization for construction of the improvements....Subject to these modifications, I concur in the recommendations of the Board of Engineers for Rivers and Harbors...." (ENGCW-PD letter dated 4 March 1964 subject "Lake Pontchartrain and Vicinity, La.")

10. Alterations in standard project hurricane parameters subsequent to project authorization. Revised parameters for the standard project hurricane were received from the Weather Bureau, Environmental Science Services Administration, on 3 November 1965. The revised parameters are more severe than those used in studies leading to project authorization. Studies utilizing the revised parameters indicate, however, that a controlling elevation of 9 for the barrier remains the optimum value. The more severe parameters do, however, result in a requirement for increased grades on confining levees, and such grades have been used in evaluating the Plan C alternate considered herein.

11. Alternate plans considered. Three plans involving modification of the Lake Pontchartrain barrier have been considered. Descriptions of these alternate plans follow:

Plan A. Elements of this plan are shown on plate 2. The plan is a modification of the authorized barrier location in the vicinity of Chef Menteur Pass. Consideration of this plan was prompted by vociferous objections to the project document alignment by the firm of New Orleans East, Inc., which is constructing improvements in a 1,533-acre tract located between the Gulf Intracoastal Waterway (GIW) and Bayou Sauvage and extending from the existing New Orleans East levee to Chef Menteur Pass. The 1,533 acres comprise 75 acres of residential developments, 218 acres of future residential development, and 1,240 acres of future recreational and industrial development. The modification consists of relocating the barrier embankment to the south or gulfward side of the above area, and shifting the Chef Menteur Pass structural complex to accommodate the revised alignment. The revised alignment crosses the GIW at two points and requires relocation of that waterway between mile 22 and mile 26 (east of Harvey Lock) as shown on plate 2. Use of this alignment will permit future construction of a lock in lieu of a floodgate, when and if justified, by the addition of another set of gates. Riprap foreshore protection, as authorized for the New Orleans East back levee, will be provided for the revised alignment adjacent to the GIW extending from the New Orleans East levee to the Chef Menteur Pass control structure. Typical cross sections for the relocated barrier embankment and closure dam are shown on plates 5 and 6, respectively. Plan A will provide some measure of protection to the area being developed by New Orleans East as well as to an area east of Chef Menteur Pass. It must be pointed out, however, that these areas remain subject to flooding from lesser hurricanes than the SPH, which overtop the barrier, and in addition, are vulnerable to overflow from Lake Pontchartrain.

Plan B. Plan B was derived from a plan suggested for consideration by Mr. W. S. Nelson, a local consulting engineer, formerly retained by New Orleans East, Inc. The plan proposed by Mr. Nelson located the barrier on the north bank of the GIW as far east as Big Deedle Lake, from whence it turned northward to cross the Rigolets and tie into the U. S. Highway 90 embankment at Apple Pie Ridge. The Nelson plan proposed to locate combination control, navigation, and closure structures in the existing channels of Chef Menteur Pass and the Rigolets. These structures were to be constructed in shipyards on huge barge-like hulls, towed to the selected sites, and there sunk, anchored, and outfitted. For various reasons, this method of construction is not considered feasible in the instant locations. Conventional construction would not be possible at Chef Menteur Pass with the Nelson alignment as existing and potential improvements in the area so restrict the space available for construction as to make impracticable a satisfactory layout of the overall structural complex. By substituting the Plan A alignment in the Chef Menteur area for that of the Nelson plan, and providing for conventional construction of the Rigolets structural complex, a physically feasible plan, equivalent to Mr. Nelson's original plan, can be realized. Economic analyses of this plan must, however, be based on incremental comparison of that portion of Plan B east of Chef Menteur Pass with the corresponding portion of the authorized plan. The Plan B layout is shown on plate 3. Typical sections of the relocated barrier embankment and closure dams for this plan are shown on plates 5 and 6, respectively.

Plan C. As can be seen on plate 4, Plan C involves a radical departure from the project document plan and involves not only modifications in the Lake Pontchartrain barrier, but in the overall Lake Pontchartrain Barrier Plan and the Chalmette Area Plan as well. In effect, Plan C moves the primary line of hurricane defense for Orleans and St. Bernard Parishes eastward to the western shore of Lake Borgne. The modified levee alignment would cross both the MR-GO and the GIW. An opening 400 feet wide by 40 feet deep below mean low gulf would be provided where the alignment crosses the MR-GO, with closure during hurricanes to be effected by a floating gate. A navigation lock 110 feet by 1,200 feet with sill at elevation -14, located in a bypass channel, would provide for uninterrupted use of the GIW. This plan would eliminate much of the levee required for the Chalmette Area Plan and drastically reduce the grade requirements for the Citrus and New Orleans East back levees and the IHNC. Plan C was advanced by an employee of this District. Consideration of a very similar plan was recommended by a local group.

12. Costs. Cost estimates for all work of the authorized Lake Pontchartrain barrier between New Orleans East and Apple Pie Ridge and the Plans A and B modifications are shown on tables I, II, and III, respectively. Derivation of net additional first and annual operation and maintenance costs for Plans A and B, as compared with the authorized plan, is shown on tables IV and V. Cost estimates for the Plan C modification and the portions of the authorized plan it eliminates are shown on tables VI and VII, respectively. Summarized net additional first and annual operation and maintenance costs for Plan C are shown on table VIII. Summarized data on additional annual charges for the various plans are shown on table IX. The total additional annual charges for Plans A, B, & C, respectively, are $38,700, $464,200, and $247,000.

13. Benefits. Discussion of the added benefits, incremental to the project document plan, for the three alternate plans follows:

a. Plan A. (1) The modified barrier alignment in the Chef Menteur area would provide protection to improvements south of Bayou Sauvage and U. S. Highway 90 against hurricanes not overtopping the barrier embankment. These improvements include homes, camps, and commercial establishments. Of particular importance is the Venetian Isles development of New Orleans East, Inc., a Florida-type subdivision located west of Chef Menteur Pass between U. S. Highway 90 and Bayou Sauvage which features waterfront homes in the $50,000 and up price class and miscellaneous commercial establishings (including land). When complete, the development will include 639 homes and 52 commercial establishments having an aggregate value, exclusive of land, in excess of $25,000,000.

(2) The building sites in the Venetian Isles development are raised to elevation 8.5, and damage, under the authorized barrier alignment, would not begin until the hurricane surge reached about 10. Based on damage-frequency analyses, the average annual damage to existing and future development would be $134,700. With the Plan A modification, these damages would be eliminated.

(3) Damage to other homes, camps, and businesses south of U. S. Highway 90 from the New Orleans East area to the tie-in of the Plan A alignment modification and the authorized barrier would begin, under the authorized plan, when the hurricane surge reached 5. Damage-frequency analyses indicate that the average annual damage to existing improvements outside the Venetian Isles area would be $4,900. The Plan A modification would eliminate these damages. Future development outside the Venetian Isles area, with the authorized barrier alignment, would be very limited, and such development was ignored in computing the above damages.

(4) A total of 1,830 acres enclosed by Highway 90 and the Plan A modification in the barrier alignment would be relieved of the threat of direct hurricane overflow from Lake Borgne, and would be enhanced to some extent thereby. Most of this acreage would, however, remain subject to overflow from ordinary high tides, and all would be vulnerable to damage from overflow by storm-driven waters from Lake Pontchartrain. It was estimated that land values would increase from 10% to 25%, depending upon the location. The average annual enhancement was taken to be 5% of the gross increase in land value. On this basis, the average annual enhancement attributable to the Plan A alignment modification is $14,600.

(5) Under existing conditions, the Louisville and Nashville Railroad embankment is subject to damage from overtopping by hurricane surges. With the authorized barrier in place, however, the area between the railroad and U. S. Highway 90 will, with the barrier structural complexes closed, be without an outlet until the barrier embankment begins to overtop. Thus, stages will tend to rise on the Lake Pontchartrain side of the railroad embankment as the surge approaches and thereby limit the stage differential across that embankment. Studies indicate that the maximum velocity of flow over the railroad embankment for the SPH critical to the barrier would be about 2.5 feet per second and that the velocity of flow would exceed one foot per second for only three hours, resulting in negligible damage to the railroad embankment. With the Plan A barrier alignment modification, the flow overtopping the barrier embankment would be diverted to Lake Pontchartrain through Chef Menteur Pass and overtopping of the railroad embankment in the area enclosed by the highway and Plan A modified barrier alignment would not occur. There would, accordingly, be no appreciable damage to this section of the railroad embankment for either the authorized or Plan A barrier alignments. Inasmuch as portions of the railroad embankment will remain directly exposed to hurricane surges under all plans, none of the plans will provide any alleviation of railway traffic delays.

(6) Based on benefit analyses described in (1) through (4) above, Plan A will produce a total average annual benefit of $154,200.

b. Plan B. (1) Plan B would provide, in addition to the benefits described for Plan A, benefits attributable to the protection to improvements located between U. S. Highway 90 and the Plan B barrier alignment east of Chef Menteur Pass. Based on analyses similar to those previously described, the average annual damages in this area with the authorized barrier in place would be $69,300. The Plan B alignment would eliminate these damages.

(2) In addition to the above, the value of 7,497 acres of land within the above area would be enhanced. The increase in land value would average about 10%. The average annual value of enhancement, computed as 5% of the gross increase in land value, would be $33,000.

(3) For the same reasons described in paragraph 13.a.(5) above, average annual damages to the L&N Railroad embankment with the authorized barrier in place would be negligible. With the Plan B modified barrier alignment east of Chef Menteur, however, due to the limited openings in the railroad embankment, the area between the GIW

and the railroad embankment will fill rapidly with water after overtopping of the barrier embankment occurs, and the railroad embankment may be expected to overtop while stages in the Lake St. Catherine area are relatively depressed. Velocities over the railroad embankment would approach a maximum of 6 feet per second for the SPH on a path critical to the barrier and velocities in excess of 2.5 feet per second would be sustained for about four hours. The railroad embankment is constructed of slag and its vulnerability to damage by overflow has been demonstrated several times in the past, particularly in hurricane "Betsy," when a total of $1,095,900 in damages was sustained between the existing New Orleans East levee and the vicinity of Big Deedle Lake. Based on damage-frequency analyses, the average annual damage to the L&N Railroad embankment east of Chef Menteur Pass to its crossing with the Plan B barrier alignment modification would be $11,700. Since these damages would be induced by the Plan B alignment modification, they would reduce the additional benefit attributable to that plan.

(4) Based on benefit analyses described in (1) through (3) above, Plan B would produce, in addition to those produced by Plan A, average annual benefits in the amount of $90,600.

c. Plan C. (1) Plan C would provide benefits similar to those described for Plan A in the Venetian Isles development, and to homes, camps, and commercial establishments located south of U. S. Highway 90 between the existing New Orleans East levee and the Plan C levee. In addition, Plan C would provide protection from the hurricane surge to industrial development adjacent to the IHNC located outside the authorized levee and to lands bounded by the GIW, MR-GO, and the Plan C levee.

(2) Damage to the homes, camps, and commercial developments located in the area described above would begin, under the authorized plan, when the hurricane surge reached elevation 5. Based on damage-frequency analyses, the average annual damage on existing and future development would be $329,600.

(3) Operation of two features of Plan C, namely the floating gate in the MR-GO and the lock in the GIW, would impede seagoing and inland navigation. Studies indicate that the floating gate, along with the other structures in Plan C, would be closed an average of 9 days per year, and in some years, the closure period might be as long as two weeks. At such times, traffic could reach the Port of New Orleans from seaward via the Mississippi River only. Use of the longer route would result in an average annual loss of $210,600. Traffic through the lock

in the GIW would have to be locked through during the 9 days per year the barrier would be closed. In addition, there would be occasional periods in which normal tidal action would cause velocities through the lock to reach magnitudes considered unsafe for navigating the open lock. Studies indicate that the lock would have to be operated an average of 24 days per year to pass traffic during these periods. Under normal operation, traffic would make direct transit of the open lock. All vessels with tows, however, would have to reduce speed and proceed with caution. Based on a loss of 15 minutes per transit, the annual loss is estimated to be approximately 1,280 hours per year. The delay to traffic in the GIW, as a result of the lock being operated an average of 33 days per year, would generate an average annual loss of $83,700, and the delays due to slow transit would generate an additional annual loss of $174,000. The total loss attributable to delays to navigation would, therefore, average $468,300 annually.

(4) Plan C would enhance approximately 4,339 acres of land located south of Highway 90 and located between the Plan C alignment and the MR-GO. The present land value would be increased from 15% to 25% depending on location. The average annual enhancement of Plan C, computed as 5% of the increased land value, is $57,700.

(5) Based on (1) through (4) above, Plan C would result in a net increase in benefits of $53,700 (134,700 + 329,600 + 57,700 -468,300) annually as compared with the authorized plan.

(6) Beyond the fact that it would involve additional costs in excess of the additional benefits it could produce, Plan C is undesirable for a number of other reasons. Its adoption would mean that none of the work already accomplished by local interests subsequent to project authorization would be incorporated into the Federal project and no credit for such work could be allowed. Further, the modifications involved in Plan C are so broad in scope as to be beyond the discretionary authority of the Chief of Engineers to adopt, so that project review and subsequent Congressional action would be required. During the time that this process was being accomplished, progress in planning and constructing some of the most urgently needed project features would be discontinued. Assuming that the plan is authorized and funded, substantially greater planning and construction times would be involved. In view of the extended delay in realizing protection under the Federal project, it is likely that local interests would find it necessary to proceed independently and at great cost with improvements to the existing levee systems for interim protection. For these reasons, the Orleans

Levee District, the agency designated by the Governor to provide the local cooperation required for the project, and the State of Louisiana, Department of Public Works, local coordinator for the project, have expressed their opposition to the plan. (See incl 17, 18, (19.)

14. Conclusions. In accordance with the information presented herein, it is concluded that:

a. Altering the authorized barrier alignment, in the vicinity of Chef Menteur Pass, to that of Plan A is engineeringly feasible, economically justifiable, and desirable. Plan A is the most suitable plan to provide some protection from hurricane surges to the 1,533 acres belonging to New Orleans East, Inc. Plan A would have an additional average annual cost of $38,700 over the portion of the authorized plan it replaces and would provide an additional average annual benefit of $154,200, resulting in a favorable incremental benefit-cost ratio of 4.0 to 1. The change involved is clearly within the discretionary authority of the Chief of Engineers.

b. Altering the authorized barrier alignment east of Chef Menteur Pass to that of Plan B is not economically justifiable. The portion of Plan B east of Chef Menteur Pass would have an additional average annual cost of $464,200 over the portion of the authorized plan it replaces and would provide an additional average annual benefit of $90,600, resulting in an unfavorable incremental benefit-cost ratio of 0.2 to 1.

c. Adoption of Plan C in lieu of the Chalmette Area Plan and the Lake Pontchartrain Barrier Plan as now authorized is not economically justifiable and is considered impracticable. The portion of Plan C between the floating gate in the GIW to the authorized barrier east of Chef Menteur Pass would have an additional average annual cost of $247,000 over the portion of the authorized plan it replaces and would provide an additional average annual hurricane protection benefit of $53,700, resulting in an unfavorable incremental benefit-cost ratio of 0.22 to 1.

15. Recommendations. It is recommended that the authorized plan of improvement for the Lake Pontchartrain Barrier Plan be modified to provide for construction of the Lake Pontchartrain barrier as described herein under Plan A; that this change be covered in the general design

memorandum for the Lake Pontchartrain Barrier Plan as a departure from the project document plan within the discretionary authority of the Chief of Engineers; and that this report be included as an appendix to that design memorandum.

THOMAS J. BOWEN
Colonel, CE
District Engineer

19 Incl
1. Map file H-2-23693
2-7 Plates 1 through 6
8-16 Tables I through IX
17. Ltr of DPW dtd 8 Feb 67
18. Ltr of Orleans Levee Dist, dtd 22 Feb 67
19. Ltr of Orleans Levee Dist, dtd 22 Feb 67

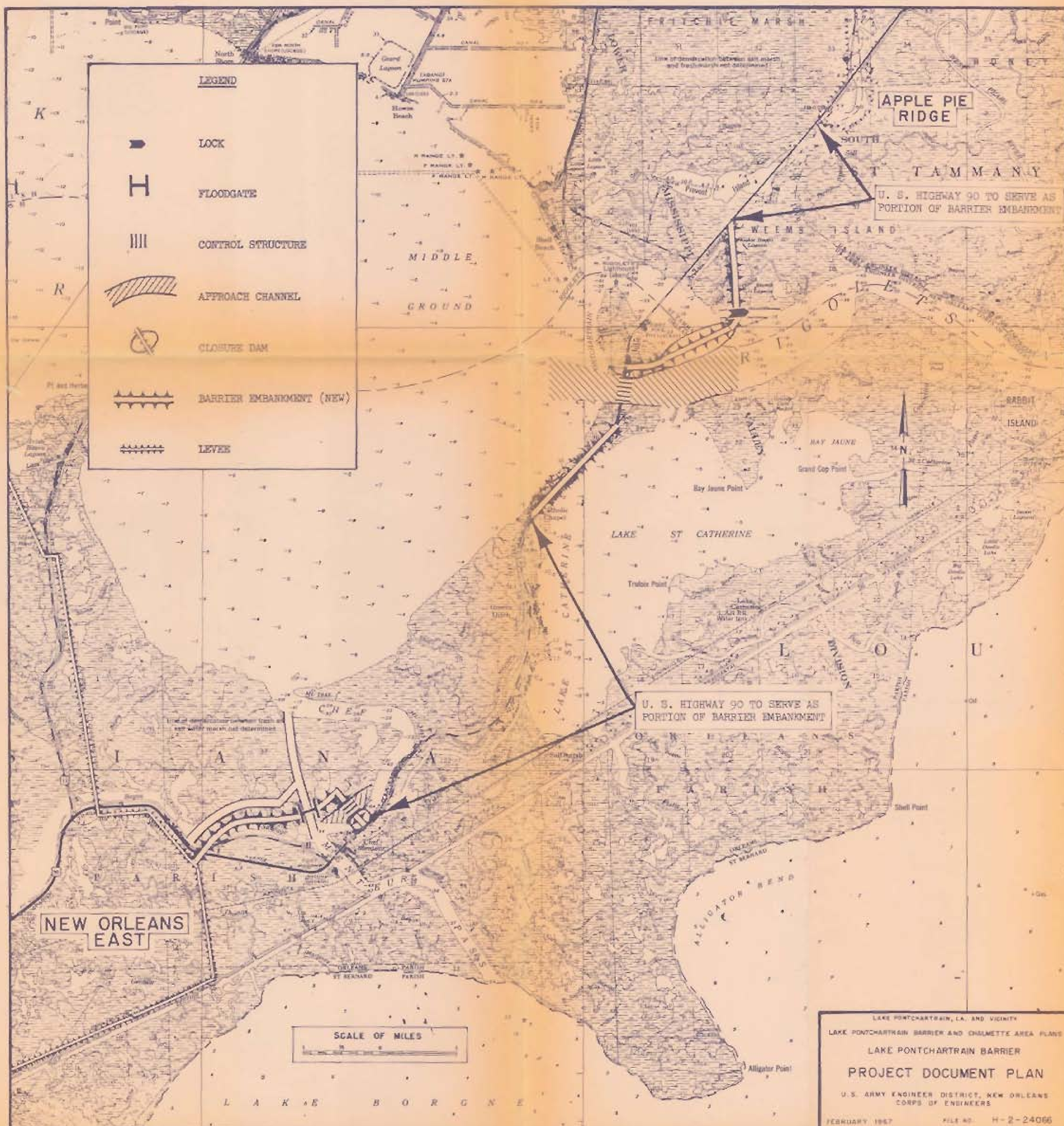
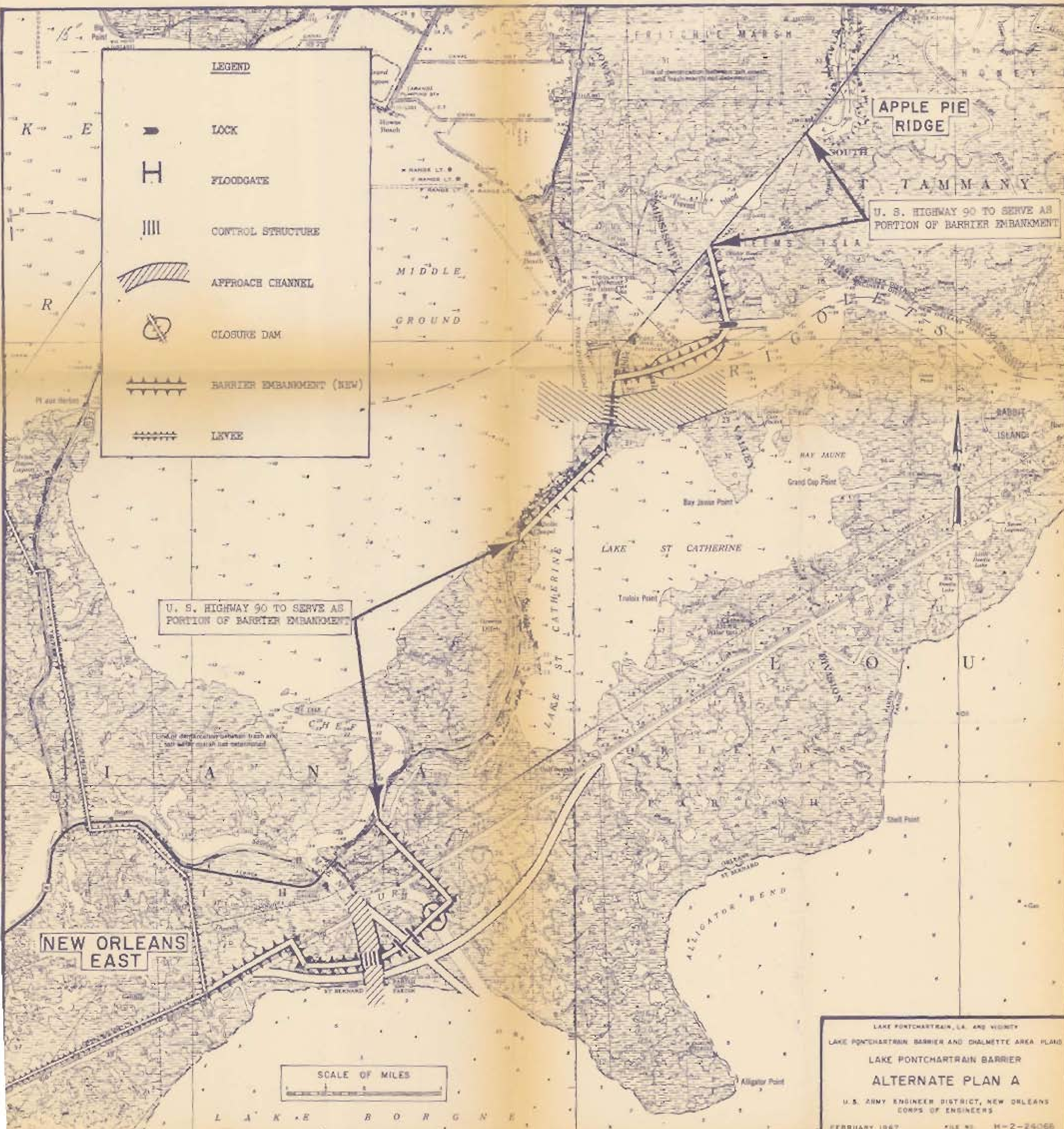

LEGEND
LOCK
FLOODGATE
CONTROL STRUCTURE
APPROACH CHANNEL
CLOSURE DAM
BARRIER EMBANKMENT (NEW)
LEVEE
APPLE PIE RIDGE
U. S. HIGHWAY 90 TO SERVE AS PORTION OF BARRIER EMBANKMENT
U. S. HIGHWAY 90 TO SERVE AS PORTION OF BARRIER EMBANKMENT
ST TAMMANY
WEEMS ISLAND
RIGOLETS
MIDDLE GROUND
FRITCHIE MARSH
LAKE ST CATHERINE
BAY JAUNE
Bay Jaune Point
Grand Cop Point
RABBIT ISLAND
Alligator Point
ALLIGATOR BEND
Shell Point
NEW ORLEANS EAST
LOUISIANA
ORLEANS PARISH
CHEF
LAKE BORGNE
SCALE OF MILES
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER AND CHALMETTE AREA PLANS
LAKE PONTCHARTRAIN BARRIER
PROJECT DOCUMENT PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEBRUARY 1967
FILE NO. H-2-24066

PLATE 1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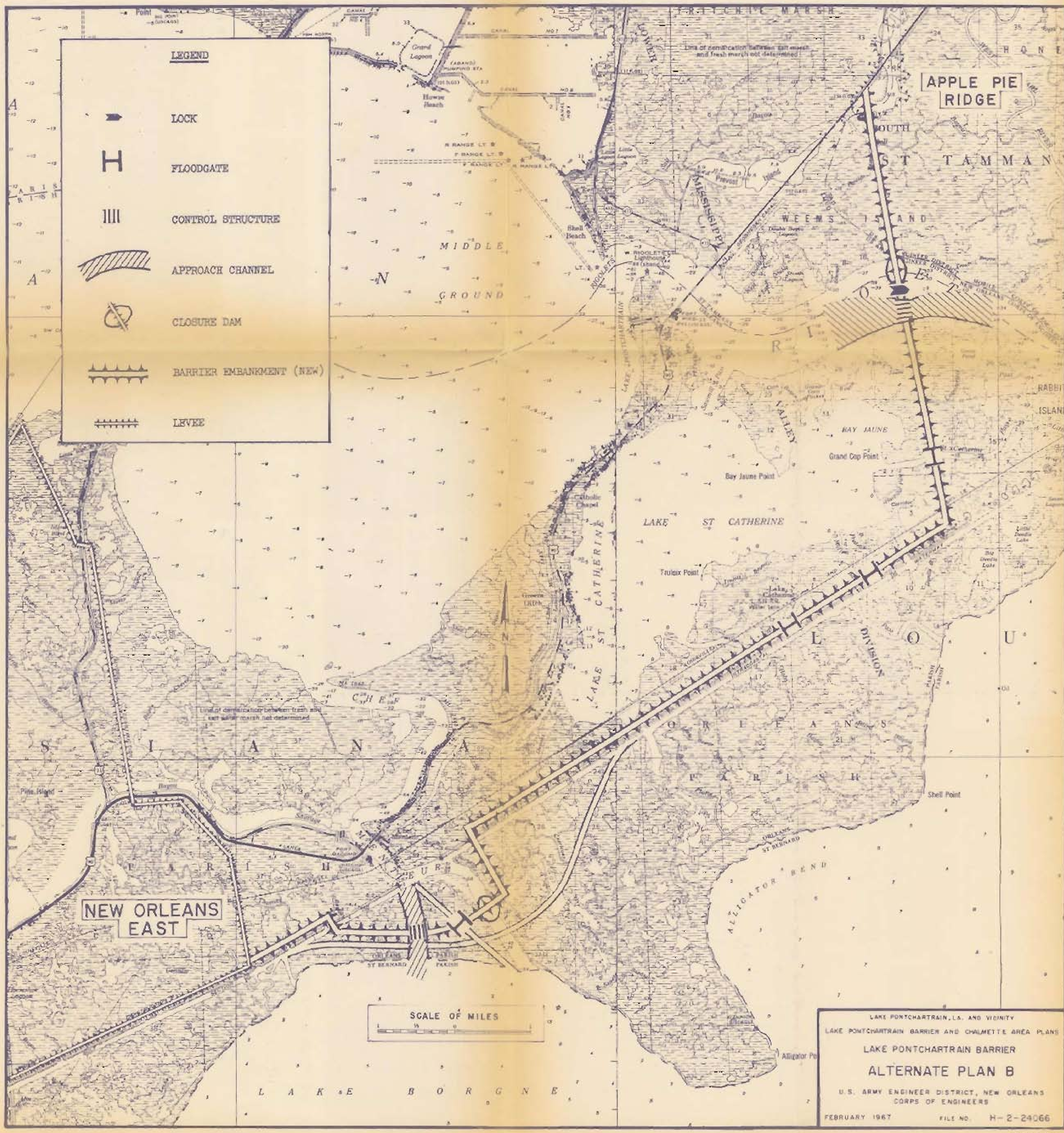
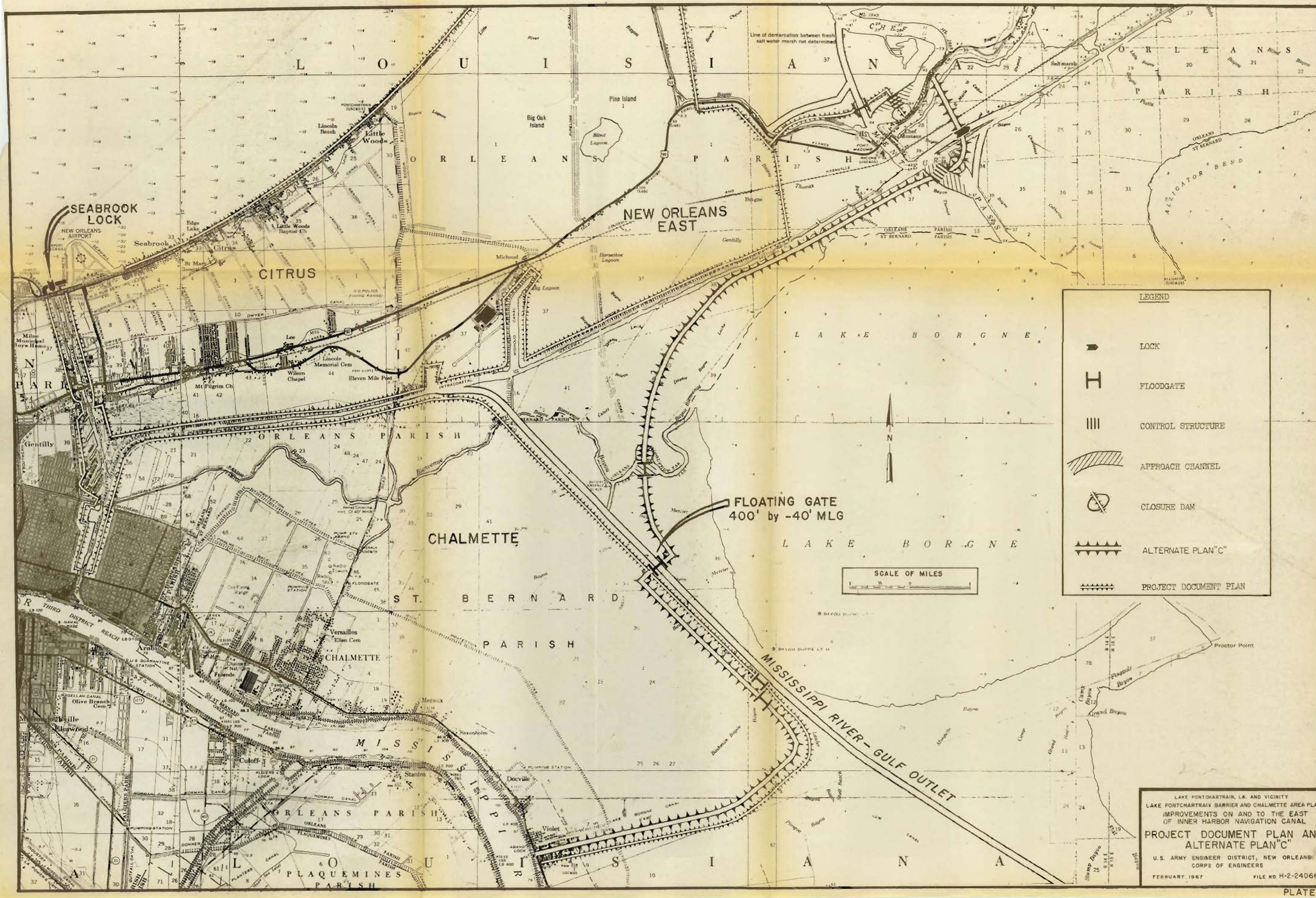
LOCK
FLOODGATE
CONTROL STRUCTURE
APPROACH CHANNEL
CLOSURE DAM
BARRIER EMBANKMENT (NEW)
LEVEE
APPLE PIE RIDGE
U. S. HIGHWAY 90 TO SERVE AS PORTION OF BARRIER EMBANKMENT
U. S. HIGHWAY 90 TO SERVE AS PORTION OF BARRIER EMBANKMENT
NEW ORLEANS EAST
MIDDLE GROUND
RIGOLETS
LAKE ST CATHERINE
BAY JAUNE
ALLIGATOR BEND
LAKE BORGNE
SCALE OF MILES
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER AND CHALMETTE AREA PLANS
LAKE PONTCHARTRAIN BARRIER
ALTERNATE PLAN A
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEBRUARY 1967
FILE NO. H-2-24066



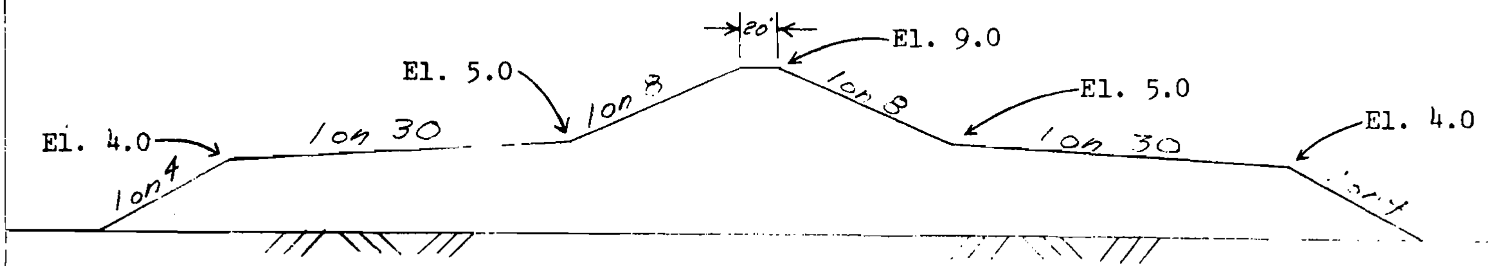
LEGEND
LOCK
FLOODGATE
CONTROL STRUCTURE
APPROACH CHANNEL
CLOSURE DAM
BARRIER EMBANKMENT (NEW)
LEVEE
APPLE PIE RIDGE
NEW ORLEANS EAST
MIDDLE GROUND
LAKE ST CATHERINE
Bay Jaune Point
Grand Cop Point
Truleix Point
Shell Beach
Howze Beach
Shell Point
Alligator Point
ALLIGATOR BEND
LAKE BORGNE
RABBIT ISLAND
SCALE OF MILES
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER AND CHALMETTE AREA PLANS
LAKE PONTCHARTRAIN BARRIER
ALTERNATE PLAN B
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEBRUARY 1967
FILE NO. H-2-24066

PLATE 3


SEABROOK LOCK
NEW ORLEANS AIRPORT
CITRUS
NEW ORLEANS EAST
CHALMETTE
ST. BERNARD PARISH
ORLEANS PARISH
LOUISIANA
LAKE BORGNE
MISSISSIPPI
MISSISSIPPI RIVER - GULF OUTLET
Line of demarcation between fresh salt water marsh not determined
FLOATING GATE
400' by -40' MLG
SCALE OF MILES
LEGEND
LOCK
FLOODGATE
CONTROL STRUCTURE
APPROACH CHANNEL
CLOSURE DAM
ALTERNATE PLAN "C"
PROJECT DOCUMENT PLAN
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER AND CHALMETTE AREA PLANS
IMPROVEMENTS ON AND TO THE EAST OF INNER HARBOR NAVIGATION CANAL
PROJECT DOCUMENT PLAN AND ALTERNATE PLAN "C"
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FEBRUARY 1967
FILE NO. H-2-24066
PLATE 4

Lake Pontchartrain, La. & Vicinity
Typical Section - Barrier Embankment

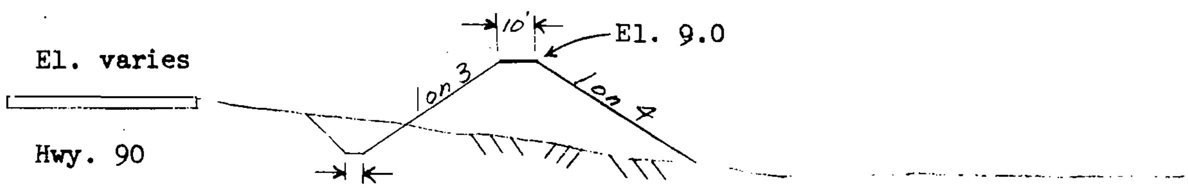
New Embankment - Authorized and
Plans A & B



See Note for Foreshore Protection.

Crown width for portion of Plan B between Chef Menteur Pass and the Rigolets is 10 feet.

Embankment Enlargement - Authorized
and Plan A, South of
Rigolets Control Structures



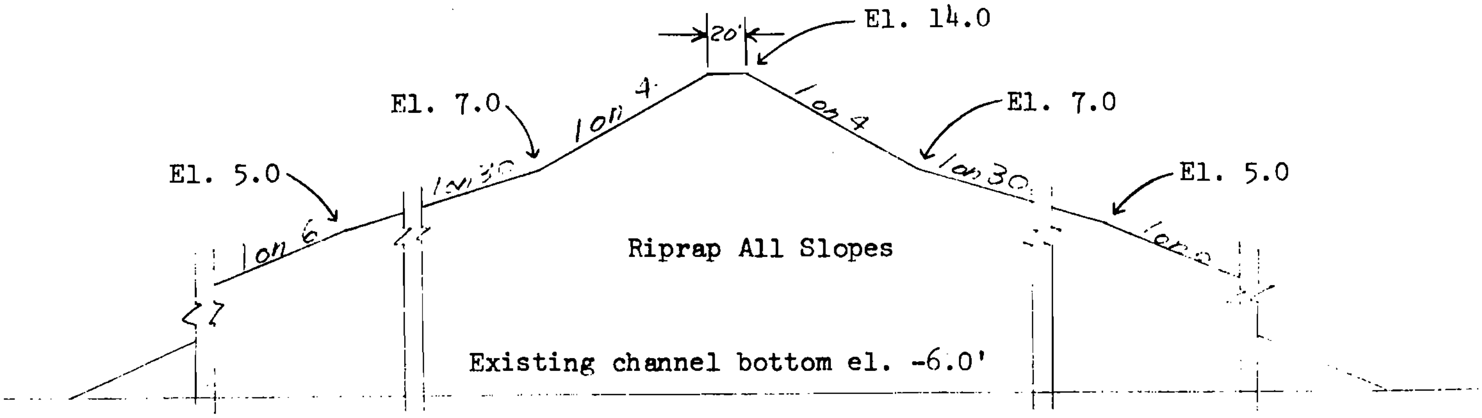
Elevations are in feet referred to m.s.l.

Feb 1967
Plate 5

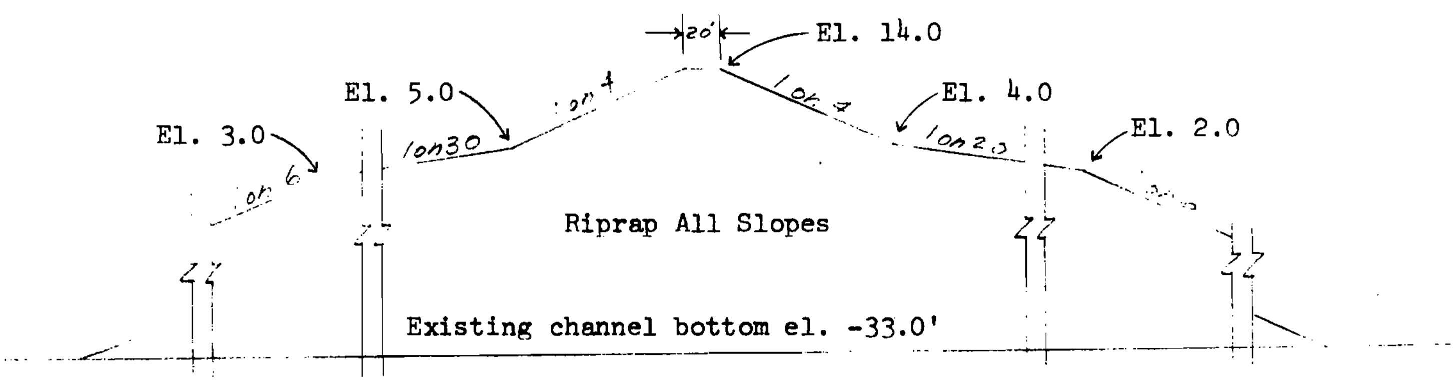
Note: Foreshore protection, extending from el. -3.0 to +3.0 feet m.s.l., will be provided for the portions of Plans A & B adjacent to the GIWW.

Lake Pontchartrain, La. & Vicinity
Typical Sections - Closure Dams
Authorized and Plans A & B

Chef Menteur Pass Closure



Rigolets Closure



Elevations are in feet referred to m.s.l.

Feb 1967
Plate 6

TABLE I

Lake Pontchartrain Barrier (Authorized)
Cost Estimate
(Jul 1966 price level)
New Orleans East to U. S. Highway 90 Embankment East of Chef Menteur Pass

Item	Quantity	Unit	Unit price	Cost
Structures, Chef Menteur (Project Document Estimate) (Dec 1961 price level)				
Drainage culvert				$ 3,060
Navigation floodgate				875,847
Control structure				2,097,270
Subtotal				$2,976,177
Contingencies 15%				447,427
Subtotal				$3,422,604
Escalated to Jul 1966 price level				4,083,200
E&D				445,100
S&A				351,200
Total				$4,879,500
Channels, Chef Menteur (Project Document Estimate) (Dec 1961 price level)				
Navigation - floodgate				$ 174,960
Approach - control structure				1,213,560
Subtotal				$1,388,520
Contingencies				208,278
Subtotal				$1,596,798
Escalated to Jul 1966 price level				1,905,000
E&D				207,600
S&A				163,800
Total				$2,276,400
Closure dam, Chef Menteur				
1st lift pump	1,560,000	cu.yd.	$ 0.80	1,248,000
2d lift pump	780,000	cu.yd.	0.80	624,000
3d lift shaping	234,000	cu.yd.	0.50	117,000
4th lift shaping	140,000	cu.yd.	0.50	70,000
5th lift shaping	94,000	cu.yd.	0.50	47,000
Riprap	71,400	ton	8.00	571,200
Shell	20,400	cu.yd.	4.50	91,800
Subtotal				$2,769,000
Contingencies				415,350
Subtotal				$3,184,350
E&D				347,100
S&A				273,900
Total				$3,805,400

TABLE I (cont'd)

Item	Quantity	Unit	Unit price	Cost
Levee, Chef Menteur				
Barrier				
1st lift pump	575,300	cu.yd.	$ 0.70	$ 402,700
2d lift pump	288,100	cu.yd.	0.70	201,700
3d lift shaping	120,500	cu.yd.	0.50	60,300
4th lift shaping	51,800	cu.yd.	0.50	25,900
Shell	3,000	cu.yd.	8.00	24,000
Seeding & fertilizing	42	acre	100.00	4,200
Subtotal				$ 718,800
Contingencies				107,800
Subtotal				$ 826,600
E&D				90,100
S&A				71,100
Total				$ 987,800
Levee, New Orleans East (Extending between GIW & U.S. Highway 90) (Project Document Estimate) (Dec 1961 price level)				
1st lift pump	452,900	cu.yd.	0.76	344,200
2d lift pump	188,700	cu.yd.	0.76	143,400
3d lift pump	113,200	cu.yd.	0.76	86,000
4th lift shaping	37,700	cu.yd.	0.40	15,100
5th lift shaping	22,600	cu.yd.	0.40	9,000
6th lift shaping	15,200	cu.yd.	0.40	6,100
Seeding	36	acre	75.00	2,700
Subtotal				$ 606,500
Contingencies				91,000
Subtotal				$ 697,500
Escalated to Jul 1966 price level				832,100
E&D				62,000
S&A				53,000
Total				$ 947,100
Lands and damages				
Chef Menteur complex				123,700
Levees				806,400
Subtotal				$ 930,100
Contingencies				139,500
Total				$1,069,600
First cost				$13,965,800
Operation and maintenance - annual				
Chef Menteur complex				$ 63,400
Levee				5,000
Total				$ 68,400

TABLE I (cont'd)

U. S. Highway 90 Embankment East of
Chef Menteur Pass to Apple Pie Ridge

Item	Quantity	Unit	Unit price	cost
Structures, Rigolets (Project Document Estimate) (Dec 1961 price level)				
Drainage culvert				$ 4,700
Navigation lock				2,217,100
Control structure				4,581,300
Subtotal				$ 6,803,100
Contingencies				1,020,500
Subtotal				$ 7,823,600
Escalated to Jul 1966 price level				9,333,600
E&D				989,400
S&A				793,400
Total				$11,116,400
Channels, Rigolets (Project Document Estimate) (Dec 1961 price level)				
Control structure & lock	21,626,000	cu.yd.	0.18	3,892,600
Contingencies				583,900
Subtotal				$ 4,476,500
Escalated to Jul 1966 price level				5,340,500
E&D				566,100
S&A				453,900
Total				$ 6,360,500
Closure dam, Rigolets				
1st lift pump	2,377,000	cu.yd.	0.80	1,901,600
2d lift pump	1,188,000	cu.yd.	0.80	950,400
3d lift shaping	356,500	cu.yd.	0.50	178,300
4th lift shaping	213,900	cu.yd.	0.50	106,900
5th lift shaping	142,600	cu.yd.	0.50	71,300
Riprap	198,000	ton	8.00	1,584,000
Shell	59,000	cu.yd.	4.50	265,500
Subtotal				$ 5,058,000
Contingencies				758,700
Subtotal				$ 5,816,700
E&D				616,600
S&A				494,400
Total				$ 6,927,700

TABLE I (cont'd)

Item	Quantity	Unit	Unit price	Cost
Levee, Rigolets				
Barrier - North of Rigolets				
1st lift pump	465,700	cu.yd.	$ 0.70	$ 326,000
2d lift pump	233,200	cu.yd.	0.70	163,200
3d lift shaping	97,500	cu.yd.	0.50	48,800
4th lift shaping	41,900	cu.yd.	0.50	21,000
Shell	2,400	cu.yd.	8.00	19,200
Seeding & fertilizing	34	acre	100.00	3,400
Barrier - South of Rigolets				
Cast	244,800	cu.yd.	0.60	146,900
Seeding & fertilizing	30	acre	100.00	3,000
Subtotal				$ 731,500
Contingencies				109,700
Subtotal				$ 841,200
E&D				61,400
S&A				58,000
Total				$ 960,600
Highway relocation, Rigolets (Project Document Estimate) (Dec 1961 price level)				
Embankment pump	220,000	cu.yd.	0.76	167,200
1st lift shaping	15,400	cu.yd.	0.40	6,160
2d lift shaping	6,600	cu.yd.	0.40	2,640
Concrete surface	15,500	sq.yd.	5.50	85,250
Seeding	15	acre	75.00	1,125
Subtotal				$ 262,375
Contingencies				39,625
Subtotal				$ 302,000
Escalated to Jul 1966 price level				360,600
E&D				38,200
S&A				30,700
Total				$ 429,500
Lands and damages				
Rigolets complex				$ 858,800
Levees				413,500
Relocations - Vicinity Rigolets control structure				
Aerial powerline				$ 30,000
AT&T coaxial cable				83,200
Telephone cable				10,000
First cost				$27,190,200
Operation and maintenance - annual				
Rigolets complex				$ 167,800
Barrier levee				12,800
Total O&M				$ 180,600

TABLE II

Lake Pontchartrain Barrier
Alternate Plan "A"
Cost Estimate
(Jul 1966 price level)
New Orleans East to U. S. Highway 90 Embankment East of Chef Menteur Pass

Item	Quantity	Unit	Unit price	Cost
Structures, Chef Menteur (Project Document Estimate) (Dec 1961 price level)				
Navigation floodgate				$ 875,847
Control structure				2,097,270
Subtotal				$ 2,973,100
Contingencies				446,000
Subtotal				$ 3,419,100
Escalated to Jul 1966 price level				4,079,000
E&D				444,600
S&A				350,800
Total				$ 4,874,400
Channels, Chef Menteur				
Navigation floodgate				196,300
Approach control structure				1,440,000
Subtotal				$ 1,636,300
Contingencies				245,400
Subtotal				$ 1,881,700
E&D				205,100
S&A				161,800
Total				$ 2,248,600
Closure dam				
Chef Menteur				
1st lift pump	1,560,000	cu.yd.	0.80	$ 1,248,000
2d lift pump	780,000	cu.yd.	0.80	624,000
3d lift shaping	234,000	cu.yd.	0.50	117,000
4th lift shaping	140,000	cu.yd.	0.50	70,000
5th lift shaping	94,000	cu.yd.	0.50	47,000
Riprap	71,400	ton	8.00	571,200
Shell	20,400	cu.yd.		91,800
GIW (2 dams)				
1st lift pump	153,000	cu.yd.	0.70	107,100
2d lift pump	77,000	cu.yd.	0.70	53,900
3d lift shaping	24,000	cu.yd.	0.50	12,000
4th lift shaping	14,000	cu.yd.	0.50	7,000
5th lift shaping	8,000	cu.yd.	0.50	4,000
Riprap	15,800	ton	8.00	126,400
Shell	4,600	cu.yd.	4.50	20,000

TABLE II (cont'd)

Item	Quantity	Unit	Unit price	Cost
Closure dam (cont'd)				
Subtotal				$ 3,099,400
Contingencies				464,900
Subtotal				$ 3,564,300
E&D				388,500
S&A				306,500
Total				$ 4,259,300
Levee, barrier Chef Menteur				
1st lift pump	1,356,000	cu.yd.	$ 0.70	949,200
2d lift pump	679,000	cu.yd.	0.70	475,300
3d lift shaping	284,000	cu.yd.	0.50	142,000
4th lift shaping	122,000	cu.yd.	0.50	61,000
Riprap	39,200	ton	13.00	509,500
Shell	16,200	cu.yd.	8.00	129,600
Seeding & fertilizing	100	acre	100.00	10,000
Subtotal				$ 2,276,600
Contingencies				341,500
Subtotal				$ 2,618,100
E&D				191,100
S&A				180,600
Total				$ 2,989,800
Lands and damages				
Chef Menteur complex				128,100
Relocated GIW				70,800
Barrier levee				292,400
Subtotal				$ 491,300
Contingencies				73,700
Total				$ 565,000
First cost				$14,937,100
Operation and maintenance - annual				
Chef Menteur complex				$ 63,400
Levees				8,000
Total O&M				$ 71,400

U. S. Highway 90 Embankment East of
Chef Menteur Pass to Apple Pie Ridge
Same as Authorized Plan
($27,190,200)

TABLE III

Lake Pontchartrain Barrier
Alternate Plan "B"
Cost Estimate
New Orleans East to North Bank of GIW East of Chef Menteur Pass

Item	Quantity	Unit	Unit price	Cost
Structures - Same as Plan "A" ($4,874,400)				
Channels - Same as Plan "A" ($2,248,600)				
Closure dams - Same as Plan "A" ($4,259,300)				
Levee				
1st lift pump	1,139,000	cu.yd.	$ 0.70	$ 797,300
2d lift pump	570,400	cu.yd.	0.70	399,300
3d lift shaping	238,600	cu.yd.	0.50	119,300
4th lift shaping	102,500	cu.yd.	0.50	51,300
Riprap	39,200	ton	13.00	509,500
Shell	16,200	cu.yd.	8.00	129,600
Seeding & fertilizing	100	acre	100.00	10,000
Subtotal				$ 2,016,300
Contingencies				302,400
Subtotal				$ 2,318,700
E&D				176,200
S&A				160,000
Total				$ 2,654,900
Lands and damages				
Chef Menteur complex				$ 128,100
Relocated GIW				70,800
Barrier levee				245,600
Total				$ 444,500
First cost				$14,481,700
Operation and maintenance - annual				
Chef Menteur complex				$ 63,400
Barrier levee				6,000
Total O&M				$ 69,400

TABLE III (cont'd)

North Bank of GIW East of Chef Menteur Pass to Apple Pie Ridge

Item	Quantity	Unit	Unit price	Cost
Structures (Project Document Estimate) (Dec 1961 price level)				
Navigation lock				$ 2,217,100
Control structure				4,581,300
Floodgates (3)				2,115,000
Subtotal				$ 8,913,400
Contingencies				1,337,000
Subtotal				$10,250,400
Escalated to Jul 1966 price level				12,228,700
E&D				1,296,200
S&A				1,039,400
Total				$14,564,300
Closure dam, Rigolets				
1st lift pump	2,415,000	cu.yd.	0.80	1,932,000
2d lift pump	1,076,000	cu.yd.	0.80	860,800
3d lift shaping	300,000	cu.yd.	0.50	150,000
4th lift shaping	200,000	cu.yd.	0.50	100,000
5th lift shaping	110,000	cu.yd.	0.50	55,000
Riprap	198,000	ton	8.00	1,584,000
Shell	59,000	cu.yd.	4.50	265,500
Subtotal				$ 4,946,800
Contingencies				742,000
Subtotal				$ 5,688,800
E&D				603,000
S&A				483,500
Total				$ 6,775,300
Channels, Rigolets				
Control structure & lock	18,750,000	cu.yd.	0.20	3,750,000
Contingencies				562,500
Subtotal				$ 4,312,500
E&D				457,100
S&A				366,600
Total				$ 5,136,200

TABLE III (cont'd)

North Bank of GIW East of Chef Menteur Pass to Apple Pie Ridge

Item	Quantity	Unit	Unit price	Cost
Levee				
1st lift pump	5,615,700	cu.yd.	$ 0.70	$ 3,931,000
2d lift pump	2,834,500	cu.yd.	0.70	1,984,200
3d lift shaping	1,101,900	cu.yd.	0.50	551,000
4th lift shaping	473,400	cu.yd.	0.50	236,700
Riprap	130,500	ton	13.00	1,696,500
Shell	53,900	cu.yd.	0.80	43,100
Seeding & fertilizing	388	acre	100.00	38,800
Subtotal				$ 8,481,300
Contingencies				1,272,200
Subtotal				$ 9,753,500
E&D				712,000
S&A				673,000
Total				$11,138,500
Lands and damages				
Barrier levee				620,800
Rigolets complex				230,000
Subtotal				$ 850,800
Contingencies				127,600
Total				$ 978,400
First cost				$38,592,700
Operation and maintenance - annual				
Levee				$ 31,300
Rigolets complex				167,800
Floodgates (3)				35,600
Boat to service structures				5,000
Total O&M				$ 239,700

TABLE IV

Derivation of Additional First Cost for Barrier
(Jul 1966 price level)
Plans A & B as compared with Authorized Plan

Plan	Segment: New Orleans East to East of Chef Menteur	Segment: East of Chef Menteur to Apple Pie Ridge	Total cost	Difference Plan vs. Authorize
Authorized	$13,965,800	$27,190,200	$41,156,000	-
Plan "A"	14,937,100	27,190,200	42,127,300	$ +971,300
Plan "B"	14,481,700	38,592,700	53,074,400	+11,918,400

TABLE V

Derivation of Additional O&M Cost for Barrier
(Jul 1966 price level)
Plans A & B as compared with Authorized Plan

Plan	Segment: New Orleans East to East of Chef Menteur	Segment: East of Chef Menteur to Apple Pie Ridge	Total cost	Difference Plan vs. Authorized
Authorized	$68,400	$ 180,600	$249,000	-
Plan "A"	71,400	180,600	252,000	$ 3,000
Plan "B"	69,400	239,700	309,100	60,100

Incl 12

TABLE VI

Lake Pontchartrain Barrier Plan and Chalmette Area Plan
Alternate Plan "C"

Cost Estimate
Floating Gate to Authorized Barrier Levee
East of Chef Menteur Pass
(Jul 1966 price level)

Construction cost for portion of Plan "C" from the floating gate to Highway 90	
Levee	
Hydraulic fill and shaping	$15,650,300
Structures	
Floating gate - MR-GO	20,610,200
Chef Menteur control structure and navigable floodgate including associated channels and closure dams	10,560,700
Bayou Bienvenue navigable floodgate and associated channel	1,691,300
GIW lock including associated channels	6,874,000
L&N RR ramp	25,000
Lands and damages	1,200,300
First cost	$56,611,800
Operation and maintenance	
Levee	60,900
Structures	118,400
Subtotal	$ 179,300
Replacement - Annual	$ 142,700

TABLE VII

Lake Pontchartrain Barrier Plan and Chalmette Area Plan

Costs for Items Which Would Be Eliminated by Plan "C"
(Jul 1966 price level)

Chalmette(1)	
IHNC to floating gate	
Levee and floodwall including bank stabilization	$10,972,900
Bayou Bienvenue navigable floodgate and associated channels	1,691,300
Lake Pontchartrain barrier plan (2)	
New Orleans	
IHNC - levee and floodwall	4,978,200
Citrus	
IHNC and back levee and floodwall	8,977,300
New Orleans East	
Back levee	7,841,200
Chef Menteur barrier struct. floodgate	1,720,800
Chef Menteur barrier struct. levee	1,666,700
Chef Menteur barrier control struct.	5,429,000
Barrier levee	
New Orleans East to Highway 90 embankment east of Chef Menteur Pass	987,800
Lands and damages	
Chef Menteur barrier structures	123,700
Citrus - IHNC and back levee	1,823,750
New Orleans East - back levee	331,250
Barrier levee	763,800
New Orleans	1,038,800
Chalmette	1,823,000
Relocations	
New Orleans East - back levee	274,600
Chalmette	100,000
First cost	$50,544,100
Operation and maintenance - annual	
Chalmette	$ 60,200
Chef Menteur complex	63,400
Barrier levee	5,000
New Orleans East - back	11,700
Citrus - back	10,100
Total O&M	$ 150,400

TABLE VII (cont'd)

Replacement - annual	
New Orleans - IHNC	$ 77,300
Citrus - IHNC	41,300
Chalmette	5,400
Total	$ 124,000

(1) All work along Inner Harbor Navigation Canal and Mississippi River-Gulf Outlet to floating gate would be eliminated. Costs of eliminated work are taken from "Design Memorandum No. 3, General Design, Chalmette Area Plan," dated 1 November 1966.

(2) Existing levees and floodwalls on the Inner Harbor Navigation Canal and the Citrus and New Orleans East back levees are of sufficient height to provide protection from non-hurricane high tides and would require no further work under the authorized project. The authorized Chef Menteur barrier complex, including the levee along Bayou Sauvage, would be replaced by the Plan "C" complex. Costs are from PB-3 dated 1 July 1966.

TABLE VIII

Lake Pontchartrain Barrier Plan and Chalmette Area Plan

Derivation of Additional First Cost and O&M for Plan "C"
Plan "C" as compared with Authorized Plan
(Jul 1966 price level)

Features	Authorized Plan Eliminated by Plan "C"	Plan "C"	Difference Plan "C" vs. Authorized
	Chalmette - MR-GO at floating gate to IHNC lock; Barrier Plan - IHNC levees; Citrus back levee; New Orleans East back levee; Barrier, New Orleans East to U. S. Highway 90 embankment east of Chef Menteur Pass	Floating gate to authorized barrier levee east of Chef Menteur Pass	
First cost	$50,544,100	$56,611,800	$+6,067,700
Operation & maintenance - annual	150,400	179,300	+28,900
Replacement - annual	124,000	142,700	+18,700

TABLE IX

Summarized Additional Annual Charges
Plans "A," "B," & "C"

Plan "A" vs. Authorized Plan

Item	Authorized plan	Plan "A"	Additional ann. charges
Interest and amortization (3-1/8%, 100 yrs.)	$1,564,200	$1,599,900	$ 35,700
Operation and maintenance	249,000	252,000	3,000
Replacement	0	0	0
Total annual charges	$1,813,200	$1,851,900	$ 38,700

Plan "B" vs. Authorized Plan(1)

Item	Authorized plan	Plan "B"	Additional ann. charges
Interest and amortization (3-1/8%, 100 yrs.)	$ 943,600	$1,348,700	$ 405,100
Operation and maintenance	180,600	239,700	59,100
Replacement	0	0	0
Total annual charges	$1,124,200	$1,588,400	$ 464,200

Plan "C" vs. Authorized Plan(2)

Item	Authorized plan	Plan "C"	Additional ann. charges
Interest and amortization (3-1/8%, 100 yrs.)	$1,800,600	$2,000,000	$ 199,400
Operation and maintenance	150,400	179,300	28,900
Replacement	124,000	142,700	18,700
Total annual charges	$2,075,000	$2,322,000	$ 247,000

(1) Plans "A" & "B" are essentially the same between New Orlans East and east of Chef Menteur Pass. Accordingly, evaluation of Plan "B" must be based on a comparison of the portion of that plan between east of Chef Menteur Pass and Apple Pie Ridge with the corresponding portion of the authorized plan. The figures tabulated are those for the increments east of the Chef Menteur Pass for both the authorized plan and Plan "B."
(2) Costs are for elements of Plan "C" and features of authorized plan which would be eliminated by construction of Plan "C."

1507-03 (Lake Pontchartrain)

STATE OF LOUISIANA
DEPARTMENT OF PUBLIC WORKS
BATON ROUGE

LEON GARY
DIRECTOR

February 8, 1967

Colonel Thomas J. Bowen
District Engineer
New Orleans District
Corps of Engineers, U.S. Army
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Bowen:

Reference is made to your letter of January 27, 1967, relative to the proposed modified plan for the "Lake Pontchartrain, Louisiana and Vicinity" project. Reference is also made to the enclosed letter to Mr. A. L. Willoz, Chief Engineer, Orleans Levee District, dated January 24, 1967, and accompanying drawing entitled "Lake Pontchartrain, La. and Vicinity - Lake Pontchartrain Barrier and Chalmette Area Plans, Improvements on and to the East of Inner Harbor Navigation Canal - Project Document Plan and Alternate Plan "C", File No. H-2-24066.

The Department of Public Works has carefully examined Alternate Plan "C" and is of the firm opinion that this plan should not be adopted. We believe that the delay that would be entailed in a restudy of the authorized plan would be unthinkable in view of the urgent need for hurricane protection for the City of New Orleans and adjacent parishes.

We further believe that the proposed 400' x minus 40' MGL floating gate in the Mississippi River Gulf Outlet would not be a safe or a practical means of closing this channel. Also, we believe that this gate could be a serious obstacle to the navigation interests who use this channel.

The lock which would be required in the Intracoastal Canal east of Chef Menteur would be a definite obstacle to the users of this navigation channel. We further believe that the construction of the embankment leading from the location of the 400' barge gate to Chef Menteur would take much too long.

For these reasons, we object to the proposed adoption of Alternate Plan "C".

Sincerely yours,

Calvin T. Watts

CALVIN T. WATTS
Assistant Director

/an
cc - Orleans Levee District
Mr. Arthur R. Theis

cl17

1507-03 (Lake Pontchartrain)

523-5042

The Board of Levee Commissioners

OF THE

Orleans Levee District

200 WILDLIFE AND FISHERIES BUILDING
418 ROYAL STREET

New Orleans, La.
70130

February 22, 1967

Colonel Thomas J. Bowen
District Engineer
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Bowen:

The management of the Orleans Levee Board objects to the suggested modification to the Lake Pontchartrain, Louisiana and Vicinity project because it is not in the best interest of our community.

The proposed modification would mean to stop work on the existing project. The modification plan also would cause the present plan to be delayed even though the modification would be rejected by Congress.

If the plan was approved, it could possibly be as much as 20 years in the building. I am sure that the citizens of our community and the Orleans Levee Board would not agree to this condition.

There are many other reasons why we are opposed to this plan being submitted to Congress for consideration, however, you have received a letter from Armand L. Willoz, Chief Engineer for the Orleans Levee Board, that more clearly states our position.

I am forwarding a copy of Mr. Willoz's letter and my letter to our congressional delegation and I will certainly seek their assistance in getting the modification plan rejected.

Board of Levee Commissioners
Orleans Levee District

In the best interest of the people of New Orleans, I ask that you, as District Engineer for the U. S. Army Corps of Engineers, recommend against the suggested modification to the Lake Pontchartrain, Louisiana and Vicinity Project.

Sincerely,

Milton E. Dupuy
President

MED:baf

cc: Armand L. Willoz, Chief Engineer, Orleans Levee Board
The Honorable Hale Boggs, Member of the House of Representatives
The Honorable Allen J. Ellender, United States Senator
The Honorable Russell B. Long, United States Senator
The Honorable F. Edward Hebert, Member of the House of Representatives
The Honorable John R. Rarick, Member of the House of Representatives

523-5042

The Board of Levee Commissioners

OF THE

Orleans Levee District

200 WILDLIFE AND FISHERIES BUILDING
418 ROYAL STREET

New Orleans, La.
70130

COMMISSIONERS
MILTON E. DUPUY, PRESIDENT
CLAUDE W. DUKE, PRES. PRO-TEM.
JAMES V. AVALLONE
HENRY H. BUSH
CHARLES C. DEANO

EX-OFFICIO
MAYOR VICTOR H. SCHIRO
COUNCILMAN PHILIP C. CIACCIO

A. L. WILLOZ, CHIEF ENGINEER
JAMES E. GLANCEY, JR., SECRETARY

22 February 1967

Colonel Thomas J. Bowen, CE
District Engineer - Dept. of the Army
New Orleans District,
Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

RE: LMNED-PP

Dear Colonel Bowen:

Reference is made to our recent discussions with yours Messrs. Chatry and Mask, of your office, on 18 January 1967, and your letter of 24 January 1967, relative to an evaluation study of suggested modification to the "Lake Pontchartrain, La. and Vicinity," project.

Consideration of the proposed modification would mean an instant stopping of all planning and work on the existing project by the U. S. Corps of Engineers until Congress had acted.

Should Congress reject the modification, it would mean several years of unnecessary delay in the execution of the present plan.

Should Congress approve the modification it may be as much as twenty years before the new plan be completely executed.

The use of a floating gate, we are certain, will be strongly opposed by the navigation interests, because it will necessitate the closing of the Mississippi River-Gulf Outlet for several days, whenever the area is threatened by a hurricane.

Should the modified plan be adopted, the local agencies would be pressed by the public to provide interim protection along the Industrial Canal, the Mississippi River-Gulf Outlet and the Intracoastal Canal, which would mean an expenditure of about $29,000,000.
In addition, the local agencies would be required to contribute 30% of the cost of the modified plan, which would amount to about $15,000,000. The total of the interim protection and the contribution to the modified plan would mean a total local expenditure in excess of $44,000,000. This expenditure would be difficult to finance by local interest, particularly, in view, that $29,000,000. would be spent on interim protection.

Board of Levee Commissioners
Orleans Levee District

Col. T. J. Bowen, Dist. Eng.
Feb. 22, 1967 - Page 2
RE: LMNED-PP

It is our view that the modification of the Lake Pontchartrain, La. and Vicinity Project is not to the best interest of the City of New Orleans, because we feel certain that the citizens would strongly oppose any delay in execution of the hurricane protection in this area, and expose a great part of the City to hurricane tides for a long period of years.

It would not be within the present authority of this Board, to finance such a large local contribution.

Under the circumstances, we must oppose any modification to the present plans as it would be against the best interest of our Community.

Sincerely yours,

A. L. WILLOZ
CHIEF ENGINEER

ALW:mgl

cc: Mr. M. E. Dupuy

APPENDIX B

CORRESPONDENCE RELATIVE TO COORDINATION WITH OTHER AGENCIES

LMNED-PP 2 April 1968

Mr. C. Edward Carlson, Regional Director
U. S. Department of the Interior
Fish and Wildlife Service
Peachtree-Seventh Building
Atlanta, Georgia 30323

Dear Mr. Carlson:

Please refer to our letter dated 21 April 1967 requesting your views and comments on the general design memorandum for the Lake Pontchartrain Barrier Plan feature of the "Lake Pontchartrain, La. and Vicinity" project.

Our letter dated 21 April 1967 indicated that your views and comments would be requested for each supplement to the general design memorandum. However, we now feel that your views on the entire Lake Pontchartrain Barrier Plan would be preferable. The layout of the Lake Pontchartrain Barrier Plan, as described in House Document No. 231, 89th Congress, 1st Session, is shown on inclosure 1. The plan, layout of which is shown on inclosure 2, now under consideration is essentially the same as that presented in the House Document, with the following exceptions:

a. Barrier. The Chief of Engineers has approved a change in the alignment of the barrier in the Chef Menteur Pass area to that shown on inclosure 3. The barrier elevation will be 9 feet mean sea level or the elevation of existing U. S. Highway 90, whichever is higher. The remaining structures sites will remain as specified in the House Document, except that consideration is being given to widening the Rigolets Lock from 84 feet to 110 feet. The modification of the width of the Rigolets Lock is not for public release.

b. Seabrook Lock. The Chief of Engineers has approved a change in the controlling elevation of the Seabrook Lock from 13.2 feet to 7.2 feet mean sea level. This change will be effected by lowering the crown of the rock dike which will tie the lock to the levee system. In addition, auxiliary control structures, located on each side of the

Mr. Hardy/dal/430

LMNED-PP
Mr. C. Edward Carlson

2 April 1968

lock, will be added to provide for passage of flows for salinity control and riparian use when the lock is passing traffic.

c. Levees. Based on revised parameters for the standard project hurricane, as developed by the U. S. Weather Bureau, the levee grades recommended in House Document No. 231 were increased by as much as 1 to 2 feet.

d. St. Charles Parish Levees. The St. Charles Parish Lakefront levee will extend across the Parish Line Canal and tie into the Jefferson Parish Lakefront levee, rather than having a levee extending south approximately 3.5 miles along the west side of the Parish Line Canal to the Illinois Central Railroad. Drainage structures will be provided in the Lakefront levee to allow gravity drainage of the area.

We have received your comments on Seabrook Lock and the Citrus Back Levee, i.e., the levee along the north bank of the Gulf Intracoastal Waterway from the Inner Harbor Navigation Canal to the Michoud Canal, by letters dated 7 June 1967 and 22 June 1967, respectively. Your views, recommendations, and comments on the remainder of the Lake Pontchartrain Barrier Plan are requested.

Because of the urgency of providing protection to the areas vulnerable to hurricane flooding, we are operating on a much compressed planning schedule. Accordingly, it would be very much appreciated if your comments are provided not later than 1 June 1968.

Sincerely yours,

THOMAS J. BOWEN
Colonel, CE
District Engineer

Seale
Mask
Hudson
Exec Ofc

3 Incl
1. Gen map (file H-2-23693) dtd Nov 65
2. Gen map (file H-2-23693) rev May 67
3. Map - barrier alignment (file H-2-24066, plate 2)

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

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

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

May 15, 1968

District Engineer
U. S. Army, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to your letter of April 2, 1968, (LMNED-PP), requesting our views on the Lake Pontchartrain Barrier Plan feature of the Lake Pontchartrain, Louisiana, and Vicinity project.

The overall barrier plan and its influence on fish and wildlife resources have been discussed in prior Bureau reports, most recently our letter report of June 21, 1967.

As indicated in past reports, we are of the opinion that hurricane control structures in the Rigolets and Chef Menteur tidal passes will have little appreciable effect on salinities in Lakes Maurepas, Pontchartrain, and Borgne. Therefore, no adverse effects on fish and wildlife resources in these areas are expected.

Previous model tests have indicated that acceptable salinity levels for the preservation of fish and wildlife resources in Lake Pontchartrain can be obtained by utilization of the Seabrook Lock facility, which includes an auxiliary control structure on each side of the lock. Use of these auxiliary structures should insure that adequate diversion flows for salinity control and riparian use can be provided. The capability for adjusting salinities as may be required for fish and wildlife would tend to prevent the occurrence of detrimental effects.

New levee construction and levee enlargement works as planned, including the modified St. Charles Parish levee, are not expected to directly affect fish and wildlife resources to any great degree. Indirectly, the levee system will hasten urban and industrial development of additional marshland that now provides moderate quality habitat for wildlife. Your staff has indicated that the Parish Line Canal is no longer classed as a navigable waterway. Blockage of the channel, however, will inconvenience boat owners who now use the canal.

We are pleased with your previous recognition of the need for a salinity surveillance system at the Seabrook Lock upon its completion. This Bureau and the Louisiana Wild Life and Fisheries Commission will be glad to participate in the development and monitoring of such a system.

We appreciate the opportunity to provide these comments at this time. If current plans are modified, we request the opportunity for further review and comment.

A copy of this letter has been sent to the Louisiana Wild Life and Fisheries Commission. Any comments that agency wishes to make will be forwarded to you.

Sincerely yours,

W. L. Towns
Acting Regional Director

LMNED-PP 8 April 1968

Mr. William C. Galegar, Regional Director
Federal Water Pollution Control Administration
Third Floor--1402 Elm Street
Dallas, Texas 75202

Dear Mr. Galegar:

Please refer to our letter dated 21 April 1967 requesting your views and comments on the general design memorandum for the Lake Pontchartrain Barrier Plan feature of the "Lake Pontchartrain, La. and Vicinity" project.

Our letter dated 21 April 1967 indicated that your views and comments would be requested for each supplement to the general design memorandum. However, we now feel that your views on the entire Lake Pontchartrain Barrier Plan would be preferable. The layout of the Lake Pontchartrain Barrier Plan, as described in House Document No. 231, 89th Congress, 1st Session, is shown on inclosure 1. The plan, layout of which is shown on inclosure 2, now under consideration is essentially the same as that presented in the House Document, with the following exceptions:

a. Barrier. The Chief of Engineers has approved a change in the alignment of the barrier in the Chef Menteur Pass area to that shown on inclosure 3. The barrier elevation will be 9 feet mean sea level or the elevation of existing U. S. Highway 90, whichever is higher. The remaining structures sites will remain as specified in the House Document, except that consideration is being given to widening the Rigolets Lock from 84 feet to 110 feet. The modification of the width of the Rigolets Lock is not for public release.

b. Seabrook Lock. The Chief of Engineers has approved a change in the controlling elevation of the Seabrook Lock from 13.2 feet to 7.2 feet mean sea level. This change will be effected by lowering the crown of the rock dike which will tie the lock to the levee system. In addition, auxiliary control structures, located on each side of the lock, will be added to provide for passage of flows for salinity control and riparian use when the lock is passing traffic.

LMNED-PP
Mr. William C. Galegar

8 April 1968

c. Levees. Based on revised parameters for the standard project hurricane, as developed by the U. S. Weather Bureau, the levee grades recommended in House Document No. 231 were increased by as much as 1 to 2 feet.

d. St. Charles Parish Levees. The St. Charles Parish Lakefront levee will extend across the Parish Line Canal and tie into the Jefferson Parish Lakefront levee, rather than having a levee extending south approximately 3.5 miles along the west side of the Parish Line Canal to the Illinois Central Railroad. Drainage structures will be provided in the Lakefront levee to allow gravity drainage of the area.

We have received your comments on Seabrook Lock and the Citrus Back Levee, i.e., the levee along the north bank of the Gulf Intracoastal Waterway from the Inner Harbor Navigation Canal to the Michoud Canal, by letter dated 23 June 1967. Your views, recommendations, and comments on the remainder of the Lake Pontchartrain Barrier Plan are requested.

Because of the urgency of providing protection to the areas vulnerable to hurricane flooding, we are operating on a much compressed planning schedule. Accordingly, it would be very much appreciated if your comments are provided not later than 1 June 1968.

Sincerely yours,

THOMAS J. BOWEN
Colonel, CE
District Engineer

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Seale

WSM
Mask

Hudson

Exec Ofc

3 Incl
1. Gen map (file H-2-23693) dtd Nov 65
2. Gen map (file H-2-23693) rev May 67
3. Map - barrier alignment (file H-2-24066, plate 2)

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

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

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
1402 ELM STREET, 3RD FLOOR
DALLAS, TEXAS 75202

May 15, 1968

Your Ref: LMNED-PP

Colonel Thomas J. Bowen, District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to your letter of April 8, 1968 requesting review and comment on the remainder of the Lake Pontchartrain Barrier Plan.

We have reviewed the information submitted in accordance with Executive Order 11288, Sections 1(3) and 1(7) in regard to water pollution control measures and find as follows:

a. All contractors should perform construction operations in a manner that will reduce turbidity and siltation to the lowest practicable level.

b. All contractors should take precautions to prevent water pollution by accidental spillage of hazardous materials which would result in substantial harm to fish or shellfish. Also, all contractors should provide and maintain sanitation facilities that will adequately treat domestic wastes to conform with Federal and local health regulations.

c. It is desirable that the water quality control structures be constructed and operated so as to prevent changes in the present water quality and to ensure that ecological conditions remain unchanged.

The comments of the Louisiana Stream Control Commission have been incorporated in our review.

Colonel Thomas J. Bowen
C/E, New Orleans, Louisiana

5/15/68

Your cooperation in carrying out the requirements of the Order is appreciated.

Sincerely yours,

WILLIAM C. GALEGAR
Regional Director

cc: Louisiana Stream Control Commission

1507-03 (Lake Pontchartrain) DESIGN MEMO 26 Jun 68

LMNED-PP 26 June 1968

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

Dear Mr. Galegar:

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

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

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

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

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

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

Mr. Powell/kn/430
WWP

LMNED-PP
Mr. William C. Galegar

26 June 1968

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

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

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

Sincerely yours,

THOMAS J. BOWEN
Colonel, CE
District Engineer

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Exe Ofc

68-1158

LAKE PONTCHARTRAIN BARRIER PLAN
APPENDIX C
TO
SUPPLEMENT NO. 3, GENERAL DESIGN MEMORANDUM NO. 2
CHEF MENTEUR STRUCTURES AND ADJOINING LEVEES
LAKE PONTCHARTRAIN BARRIER
TIDAL HYDRAULICS

LAKE PONTCHARTRAIN BARRIER PLAN
APPENDIX C
TO
SUPPLEMENT NO. 3, GENERAL DESIGN MEMORANDUM NO. 2
CHEF MENTEUR STRUCTURES AND ADJOINING LEVEES
LAKE PONTCHARTRAIN BARRIER
TIDAL HYDRAULICS

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LAKE PONTCHARTRAIN BARRIER
TIDAL HYDRAULICS

SECTION I - DESIGN DIFFERENTIAL HEADS

1. General. The Hydrology and Hydraulic Analysis Design Memorandum No. 1 is being presented in a series of four separate reports subtitled Part I - Chalmette, Part II - Barrier, Part III - Lakeshore, and Part IV - Chalmette Extension. Parts I, II, and IV have been approved, and Part III - Lakeshore is scheduled for submission in August 1968. These documents present detailed descriptions of the procedures used in the tidal hydraulic design of the plan; include the essential data, assumptions, and criteria; and give results of studies which provide the bases for determining surges, routings, wind tides, wave runup, overtopping volumes, and design storm frequencies. However, specific design criteria will be developed for each structure to include design differential heads, wave data, and, where pertinent, critical design velocities.

2. Design considerations. Maximum surge elevations at the barrier site on the Lake Borgne side were determined in DM No. 1, Part II - Barrier. However, maximum and minimum elevations on the Lake Pontchartrain side and minimum stages on the Lake Borgne side are determined herein to indicate the conditions producing the most critical differential heads between Lakes Pontchartrain and Borgne. The net grade of 9.0 feet* for the barrier embankment limits major overflow from either side until overtopping occurs. The rate of discharge over the barrier embankment increases as the upstream stage increases. The hurricane winds, which generate the wind setup on one side of the structures, blow in such a direction as to cause setdown on the opposite side; consequently, a critical differential head will result across the structures. The differential head is a function of wind velocity, wind direction, and barrier elevation as these factors affect upstream stage, downstream controlling stage, and overtopping discharge. Computations of wind setdown at the eastern end of Lake Pontchartrain indicated that before overtopping of the barrier levee began, the lake bed near the barrier would become exposed for some hurricanes of intensity equal to or less than the

*Elevations refer to mean sea level datum unless otherwise noted.

SPH (Standard Project Hurricane) following tracks C and F (see plate 1). This illustrated a possible condition for which an 8- to 10-foot stage could occur on the Lake Borgne side of the structures and approximately a -6-foot stage on the Lake Pontchartrain side exposing the lake bed near the barrier. With passage of the hurricane, the stage on the Lake Borgne side of the barrier will increase, and the stage on the Lake Pontchartrain side of the barrier will decrease until overtopping of the barrier floods the control structure channel and lake bottom increasing the protected side stage.

3. Methods of computation. In order to determine the stage on the downstream side of the gates for any given rate of discharge, the location of a control section was determined. The average depth of a cross section of Lake Pontchartrain downstream from the structures is -6.0 feet (see plate 1). The lake is deeper upstream and downstream from this section.† Consequently, the control section was determined to govern backwater conditions when flow over the barrier began. Since the portion of the lake bed represented by this section is extremely wide and nearly horizontal, fluid mechanics governing horizontal rectangular channels of great width were assumed to apply. For a horizontal channel, slope $S_o=0$, the normal depth is infinite, and flow may be either below critical depth or above critical depth. The equation for water surface slope has the form:

$$\frac{dL}{dy} = \frac{1 - Q^2\ T/gA^3}{S_o - n^2Q^2/2.22A^2R^{4/3}} \qquad (1)$$

where Q = discharge,
T = width of channel at surface,
A = cross-sectional area,
R = hydraulic radius, equal to the depth y for wide channels,
n = Manning roughness coefficient,
g = acceleration due to gravity.

Flow below critical depth y_c would give lower stages and produce greater differential heads across the gates than flow above critical depth. For depths y less than critical, dL/dy is positive, the depth

†As referred to hereinafter in this appendix, upstream of the control section refers to the easterly or barrier side of the control section, and downstream of the control section refers to the westerly side of the control section.

increases in the downstream direction,[1‡] and the average velocity V is greater than the critical velocity V_c. The critical velocity V_c is equal to $(gy_c)^{1/2}$ and the critical depth may be computed by the equation:

$$y_c^3 = q^2/_g \tag{2}$$

where q = unit width discharge $\frac{Q}{T}$.

For a peak discharge over the barrier levee of 887,000 cubic feet per second caused by the SPH traveling along track F, the critical depth and velocity at the control section are 2.48 feet and 8.93 feet per second, respectively. The average width T at this section is 40,000 feet. However, a wind shear stress τ_s is imposed upon the water surface along the axis of flow. It can be shown that if the bottom shear stress τ_b is equal to the surface wind shear stress, the energy slope is constant and equal to zero.[2] The resisting force along a short reach of channel L (see plate 2) is equal to the relation $\tau_b LP_b$, where P_b is the wetted perimeter. The driving forces are the forces resulting from a difference in hydrostatic pressure $(p_1-p_2)A$, the axial weight component $\gamma A\Delta y$, and the wind force $\tau_s LP_s$, where gamma γ is the unit weight of water and P_s equals surface width. Equating these together and assuming $P_s \approx P_b$ gives the following:

$$\tau_b LP = \tau_s LP + \Delta pA + \gamma Ady \tag{3}$$

$$(\tau_b - \tau_s)LP = A(\Delta p + \gamma dy) \tag{4}$$

If $\frac{(\Delta p + \gamma dy)}{\gamma}$ = head losses h_f, and $\tau_s = \tau_b$

then $(\tau_b - \tau_s) = \frac{\gamma A h_f}{PL}$

Since $R = \frac{A}{P}$, $S = \frac{h_f}{L}$, and $\tau_b - \tau_s = 0$; $\gamma RS = 0$ (5)

where S represents the energy gradient and equals the head loss per unit length. The exact value of τ_s is not known but is related to the wind velocity U by the expression $k\rho_a U^2$, where the

‡Superscribed numbers refer to references in Section III - Bibliography.

coefficient k must be evaluated experimentally or estimated from past observations, and ρ_a is the density of air.[3] Hunt[4,5] has determined $k\rho_a$ to be equal to 8.65×10^{-6} for a deep bounded channel (y>3 feet) where setup can occur and reach a steady state. It is believed that $k\rho_a$ would be greater than 8.65×10^{-6} for a shallow unbounded channel.[6,7] If the shear stress is constant throughout the depth, then τ_b equals τ_s, and the average instantaneous velocity V may be computed by using Hunt's equation for τ_s and equating it to the bottom stress function τ_b:

$$\tau_b = \frac{f}{4} \rho \frac{V^2}{2} \qquad\qquad \tau_s = k\rho_a (U-8)^2$$

$$\frac{f}{4} \rho \frac{V^2}{2} = k\rho_a (U-8)^2 \qquad (6)$$

and solving for the water velocity gives

$$V = \sqrt{\frac{8k\rho_a (U-8)^2}{f\rho}} \qquad (7)$$

where ρ = density of water, 1.94 slugs/ft.^{3}

$k\rho_a$ = 8.65×10^{-6}

f = Darcy-Weisbach roughness coefficient evaluated from a Moody Diagram using the procedure for open channel flow.

The Lake Pontchartrain bed is composed of clays and silts and is free of ripples and dunes; therefore, a silt diameter of 0.061 millimeters (where 90% by weight is assumed finer[8]) was chosen as representative of the boundary roughness diameter ε. Assuming an average depth y of 2.0 feet and a peak instantaneous windspeed of 125 miles per hour (183.25 feet per second) $\frac{\varepsilon}{4y} = 0.00025$ and f is taken as 0.009; the peak instantaneous velocity would be:

$$V = \sqrt{\frac{8 \times 8.65 \times 10^{-6}}{1.94 \times 0.009} (183.25-8)^2}$$

$$= 11.06 \text{ feet per second}$$

Therefore, $V = 11.06 > V_c = 8.93$ and flow would be below critical depth y_c as follows:

$$y = \frac{Q}{VT} \tag{8}$$

$$= \frac{887{,}000 \text{ c.f.s.}}{11.06 \text{ f.p.s.} \times 40{,}000 \text{ feet}}$$

$$= 2.00 \text{ feet}$$

The average water surface elevation at the control section for the SPH would be -4 feet (-6 feet + 2 feet). For the conditions mentioned above, i.e., S =0, the water surface elevation was extended from the control section upstream to the entrance of Chef Menteur Pass. Backwater computations were made from the entrance of the pass upstream through the channels to the gates using the standard step method and relations for spatially varied flow.[9] The discharge over the barrier is channeled over the marsh by the spoil banks, the railroad embankment, and the highway embankment, and enters the approach channels from the sides as shown on plate 1. The solution of steady spatially variable flow into the approach channels was computed using the following differential equation:

$$S_o - S - \frac{\partial y}{\partial X} = \frac{V}{g}\frac{\partial V}{\partial X} + \frac{\partial Q}{\partial X}\frac{V}{ga} \tag{9}$$

The form was changed so that the differentials became finite differences as shown in the following equation:

$$a_{av}\,(y_1 - y_2) + a_{av}\,\Delta X\, S_{av} = \frac{a_1 V_1 (V_2 - V_1)}{g} + \frac{q V_2 \Delta X}{g} \tag{10}$$

where a_{av} = average approach channel cross section,
g = acceleration due to gravity,
q = unit width discharge along channel entering from the side,
S_{av} = average slope of energy gradient,
V = average velocity,
y = depth of flow,
ΔX = finite length of channel,
S_o = channel slope equal to zero,

in which the subscripts 1 and 2 apply to the upstream and downstream ends, respectively, for reaches of length X. This procedure was performed for several different discharge rates and controlling elevations coinciding with the different hypothetical hurricane intensities. Similar analyses were made to determine stages at the gates on the Lake Borgne side for a reverse differential head condition.

4. Design differential heads. For a 10.6-foot stage in Lake Borgne, a coincidental -3.8-foot stage was determined on the Lake Pontchartrain side and for a 12.8-foot stage on the Lake Borgne side, a coincidental 4.0-foot stage was determined on the Lake Pontchartrain side of the gates. These stages correspond, respectively, to Moderate and Standard Project Hurricanes on track F. A stage-frequency curve, based on four hypothetical moderate and severe hurricanes, was derived in order to determine the differential heads for any hurricane likely to occur. The minimum stages on the Lake Pontchartrain side, coincidental to maximum stages on the Lake Borgne side, were plotted at the frequency positions corresponding to the different hypothetical hurricanes. This plot provided a lower limit of points through which an envelope curve of minimum stages could be drawn. The maximum and minimum stage-frequency curves thus provided a means of determining coincident stages for any hurricane of an intensity equal to or less than the SPH. A study of these curves indicated that differential heads which fell between those actually computed were more critical than the less frequent differential caused by the SPH, and should be used for design of certain features. This procedure as illustrated on plate 3 was used to determine the differentials in both directions across the gates. Plates 4 and 5, respectively, illustrate stage-frequency curves for hurricanes following track C, and for hurricanes on any track producing higher stages on the Lake Pontchartrain side equal to or less than the SPH. Differentials produced by hurricanes which generate stages equal to or greater than 9.0 feet may prevail for 15 to 20 hours. Durations of this magnitude should be used in structural design considerations.

SECTION II - DESIGN WAVES

5. Wave data. The parameters which determine wave characteristics are fetch length, windspeed, duration of wind, and the average depth of water over the fetch. In determining the design wave characteristics, it was assumed that steady state conditions prevail; i.e., the windspeed is constant in one direction over the fetch and blows long enough to develop a fully risen sea. The windspeed U is an average velocity over the fetch length F and is obtained from the isovel patterns for the synthetic hurricane chosen as being critical to the location of interest. The average depth of fetch d is the average depth of water as shown by the charts and maps for the area, plus the increase in water elevation caused by wind. Data necessary to determine design wave characteristics in the vicinity of both structures are shown in table C-1 as follows:

TABLE C-1

DATA USED TO DETERMINE WAVE CHARACTERISTICS
DESIGN HURRICANE

	Lake Borgne side	Lake Pontchartrain side
Navigation floodgate		
F - Length of fetch (mi.)	5	1.3
U - Windspeed (m.p.h.)*	88	90
swl - Stillwater level(ft.m.s.l.)	12.8	11.5
d - Average depth of fetch(ft.)	19.4	10.5
Control structure		
F - Length of fetch (mi.)	5	1.3
U - Windspeed (m.p.h.)*	88	90
swl - Stillwater level(ft.m.s.l.)	12.8	11.5
d - Average depth of fetch(ft.)	19.4	51.5

*Represents a 5-minute average referenced to 30 feet above the boundary surface.

The significant wave height H_s and wave period T were determined from curves which are found in Coastal Engineering Research Center, Technical Report No. 4, June 1966, which relates H_s to T to the data in table C-1 above. The deepwater wave length L_o was determined from the equation: $L_o = 5.12\ T^2$. The equivalent deepwater wave height H_o' was determined from table D-1 of the above reference, which relates the relative depth d/L_o to H_s/H_o'. Wave characteristics for the design hurricane which are pertinent to the design of the structures are shown in table C-2 below:

TABLE C-2

WAVE CHARACTERISTICS - DESIGN HURRICANE

		Lake Borgne side	Lake Pontchartrain side
	Navigation floodgate		
H_s	- Significant wave height(ft.)	7.32	4.65
T	- Wave period (sec.)	6.70	5.25
L_o	- Deepwater wave length(ft.)	229.84	141.11
d/L_o,	- Relative depth	0.08419	0.07441
Hs/H_o'	- Shoaling	0.9491	0.9634
H_o'	- Deepwater wave height(ft.)	7.71	4.83
H_o'/T^2	- Wave steepness	0.172	0.175
d_b	- H_o' breaking depth (ft.)	9.30	5.79
H_b	- Wave height on breaking(ft.)	7.27	4.52
H_{10}	- Average of highest 10% of all waves (ft.)	9.30	5.91
H_1	- Average of highest 1% of all waves (ft.)	12.22	7.77
	Control structure		
H_s	- Significant wave height(ft.)	7.32	6.00
T	- Wave period (sec.)	6.70	9.60
L_o	- Deepwater wave length (ft.)	229.84	471.86
d/L_o,	- Relative depth	0.08419	0.10914
H_s/H_o'	- Shoaling coefficient	0.9491	0.9263
H_o'	- Deepwater wave height(ft.)	7.71	6.48
H_o'/T^2	- Wave steepness	0.172	0.070
d_b	- H_o' breaking depth (ft.)	9.30	10.51
H_b	- Wave height on breaking(ft.)	7.27	8.21
H_{10}	- Average of highest 10% of all waves (ft.)	9.30	7.62
H_1	- Average of highest 1% of all waves (ft.)	12.22	10.02

SECTION III - BIBLIOGRAPHY

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[2]R. O. Reid, Modification of the Quadratic Bottom-Stress Law for Turbulent Channel Flow in the Presence of Surface Wind-Stress, Beach Erosion Board, Technical Memorandum No. 93, February 1957, p. 22.

[3]Corps of Engineers, U. S. Army, Office of the District Engineer, Jacksonville, Fla. Project, CW-167, Waves and Wind Tide in Shallow Lakes and Reservoirs, Summary Report, June 1955, pp. 27, 28.

[4]I. A. Hunt, Jr., Effect of Wind on Surface of Liquids, unpublished Doctor's thesis, University of Grenoble, Grenoble, France, 1954.

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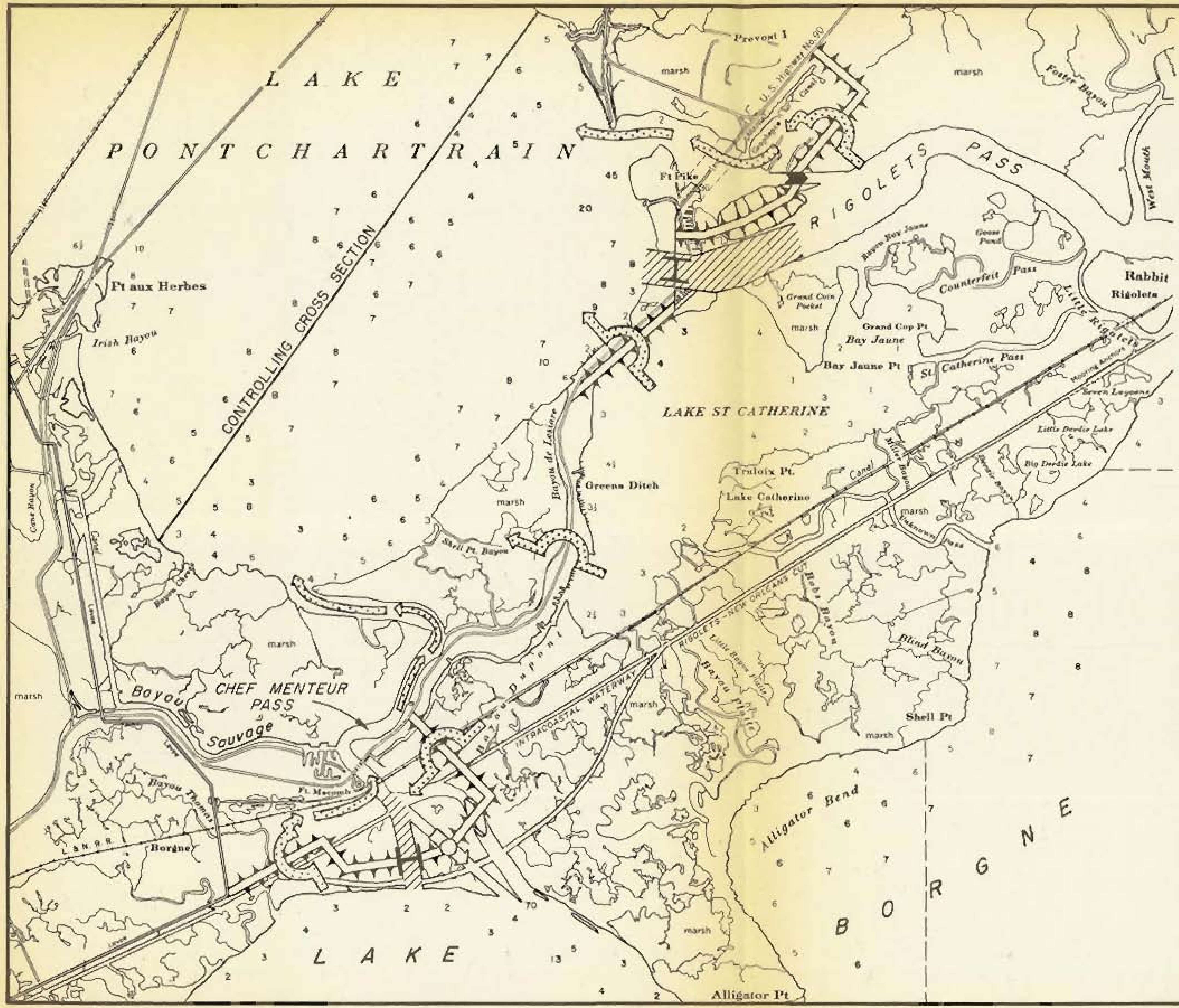
[7]Basil W. Wilson, The Prediction of Hurricane Storm-Tides in New York Bay, U. S. Army Beach Erosion Board (Contract No. DA-49-055-CIV-ENG-58-9) and Texas A&M College, 1959, pp. 40-41.

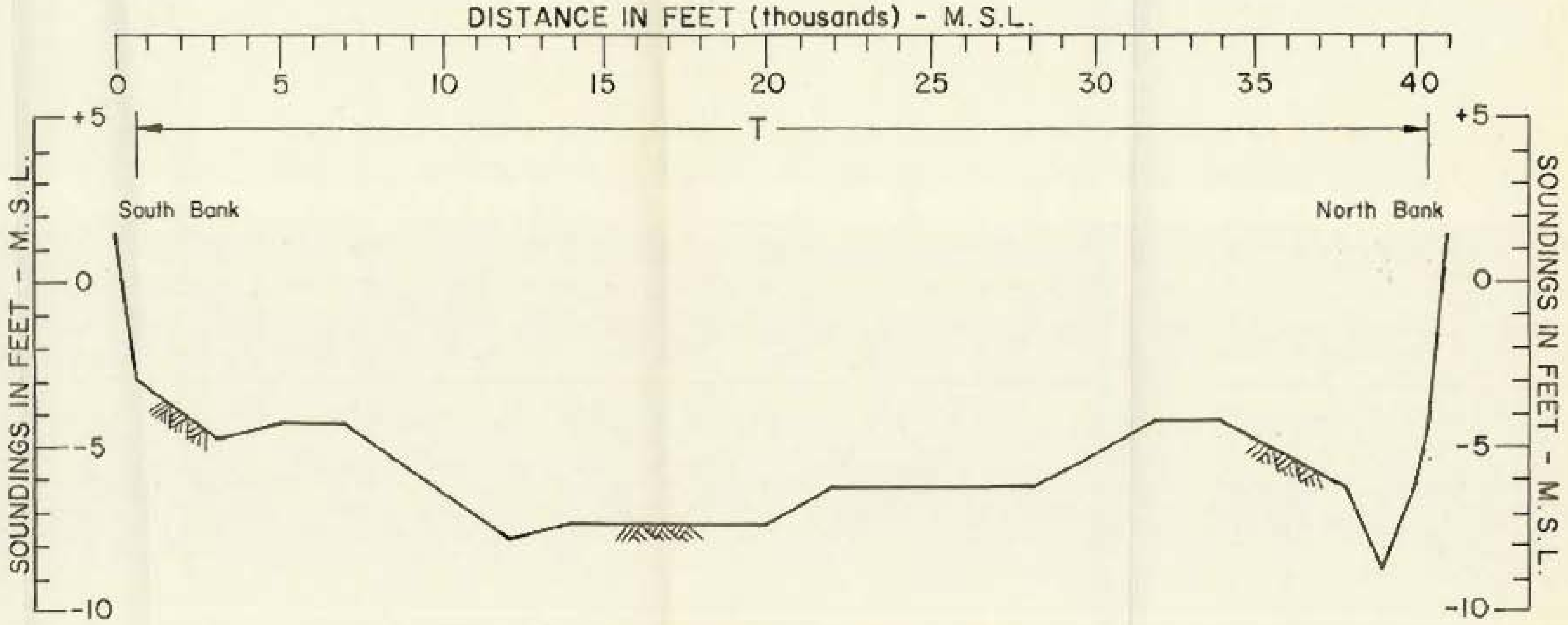
[8]A. J. Raudkivi, Loose Boundary Hydraulics, Pergamon Press, Inc., New York, 1967, pp. 42-43.

[9]H. W. King and E. F. Brater, Handbook of Hydraulics, New York, McGraw-Hill Book Company, Inc., 1963, Sec. 11, pp. 1-10 (Fifth ed.).



L E G E N D

- Lock
- Floodgate
- Control Structure
- Approach Channel
- Closure Dam
- Highway Embankment
- Barrier Embankment (new)
- Railroad Embankment
- Direction of Flow



LAKE PONTCHARTRAIN CONTROLLING CROSS SECTION

NOTE:
Soundings obtained from C. & G.S. Chart No. 1268.

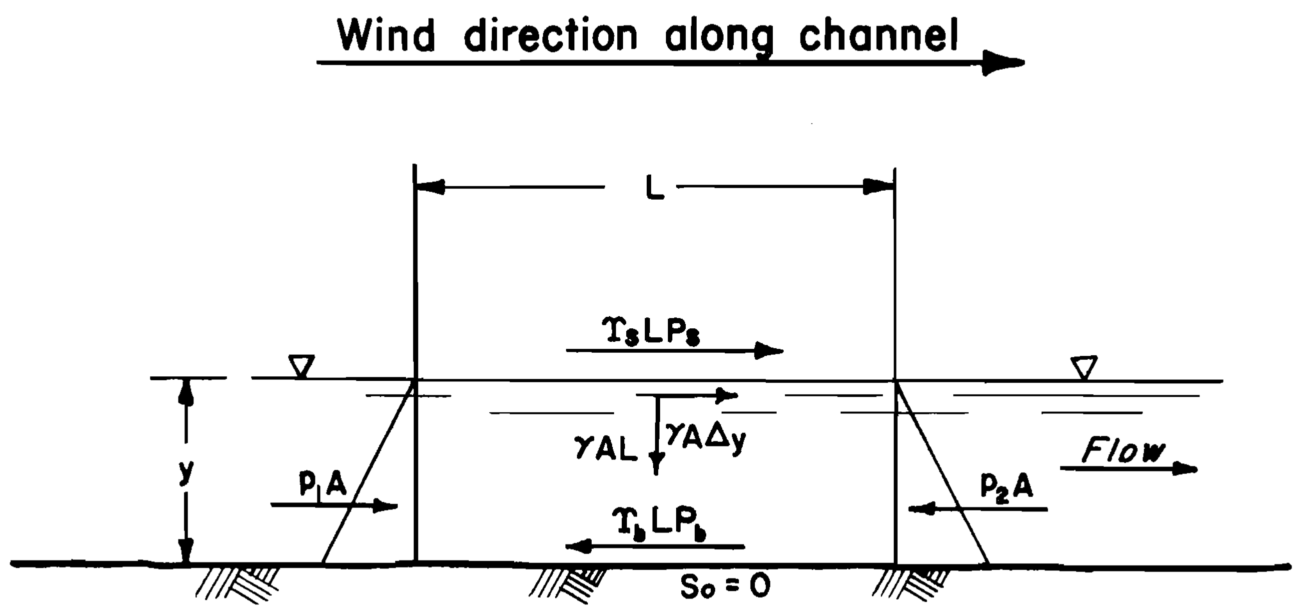
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

CONTROLLING CROSS SECTION
TRACKS C&F AND FLOW REGIMEN

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

SEPT. 1968 FILE NO. H-2-24730



Note:

Resisting force is $\tau_b L P_b$

Driving forces are $(p_1 - p_2)A + \gamma A \Delta y + \tau_s L P_s$

Equating forces gives $\tau_b L P_b = (\Delta p + \gamma \Delta_y) A + \tau_s L P_s$

Transposing wind stress term gives $(\tau_b P_b - \tau_s P_s) L = (\Delta p + \gamma \Delta_y) A$

Assuming $\tau_b = \tau_s$ and $P_b \simeq P_s$ then $(\Delta p + \gamma \Delta y) \frac{A}{P} = 0$

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3
CHEF MENTEUR PASS COMPLEX

EFFECT OF SURFACE WIND STRESS ON WATER PROFILES

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

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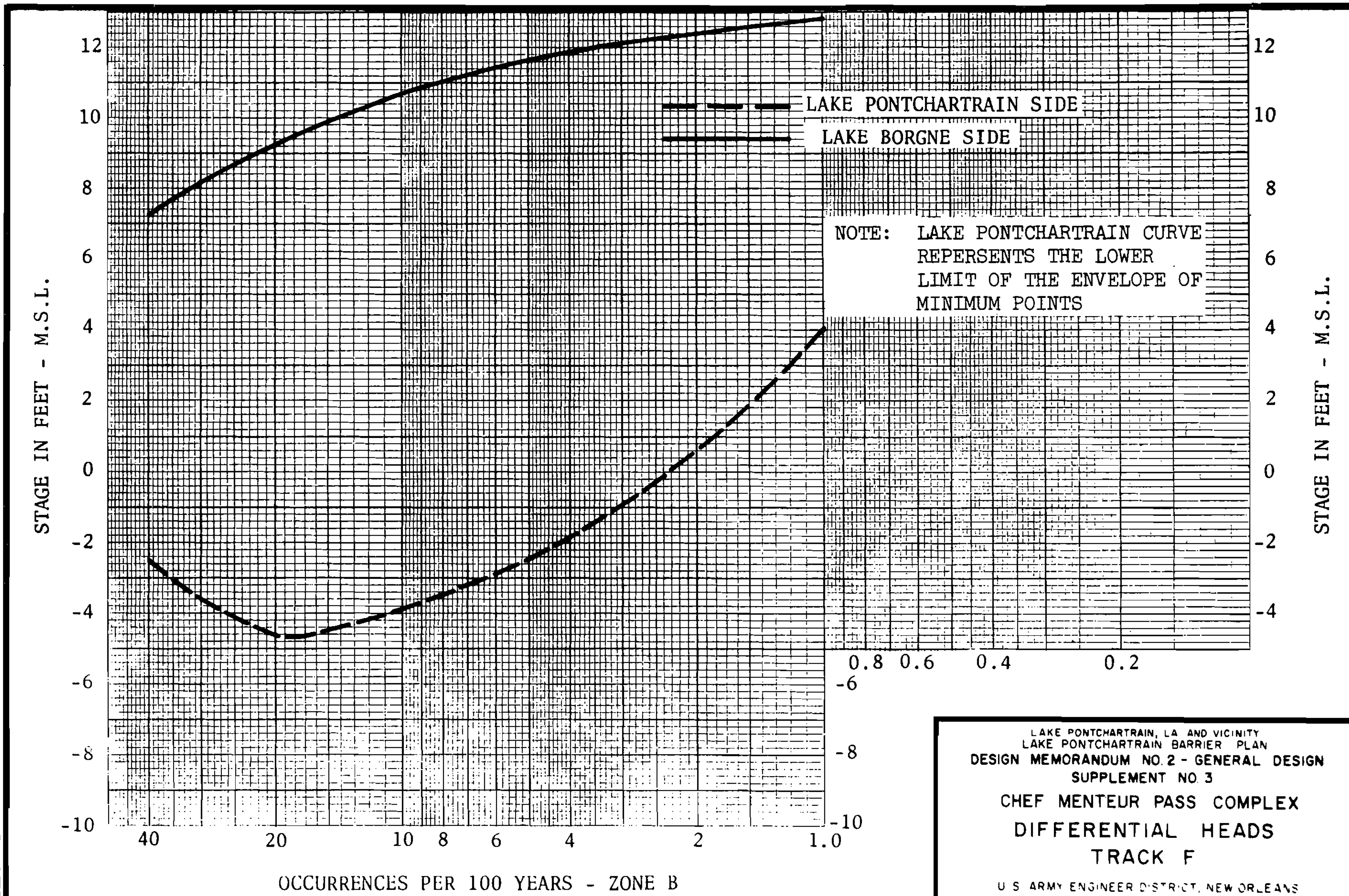

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX

DIFFERENTIAL HEADS

TRACK F

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

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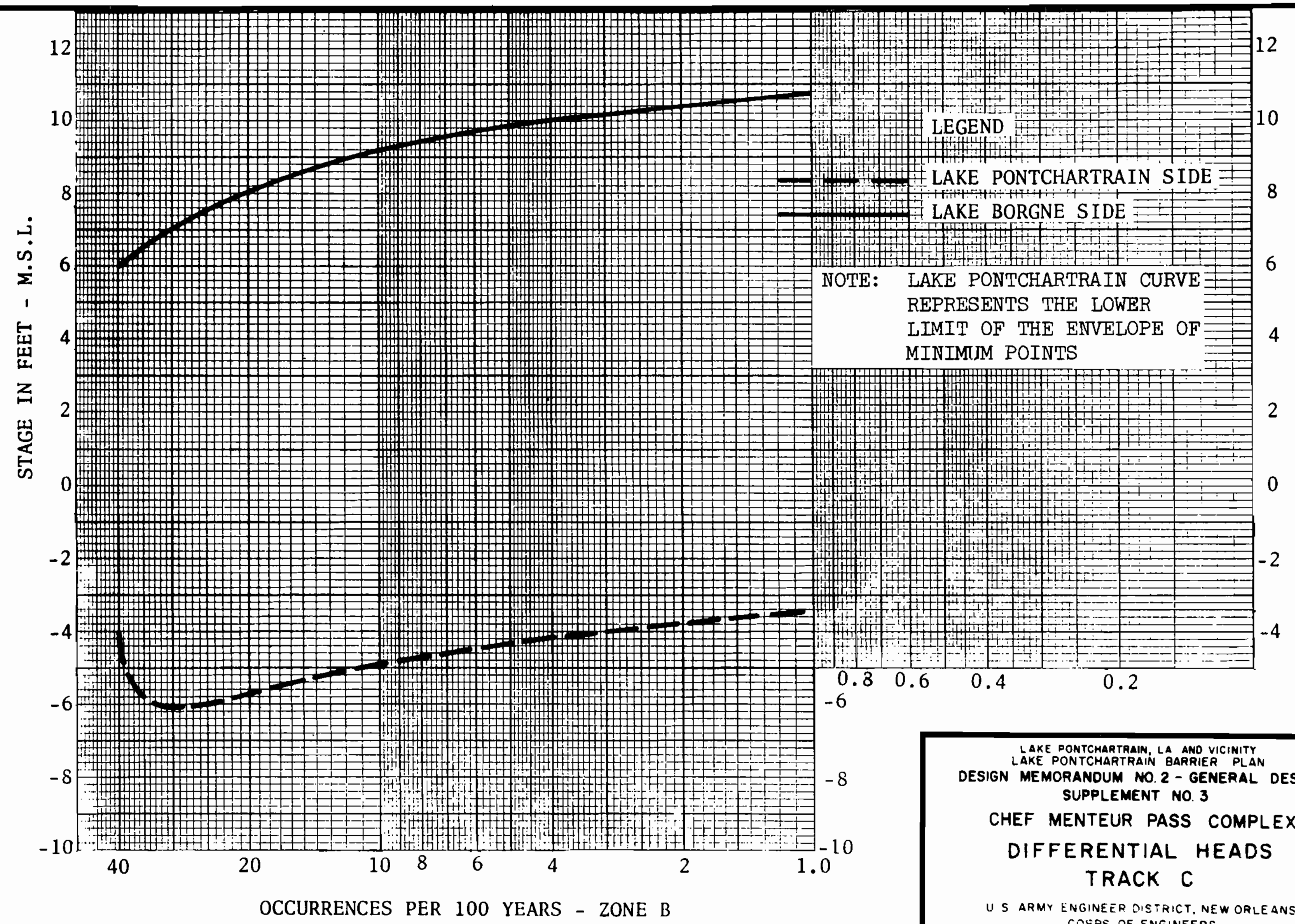
APPENDIX C

PLATE 3



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DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
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CHEF MENTEUR PASS COMPLEX

DIFFERENTIAL HEADS

TRACK C

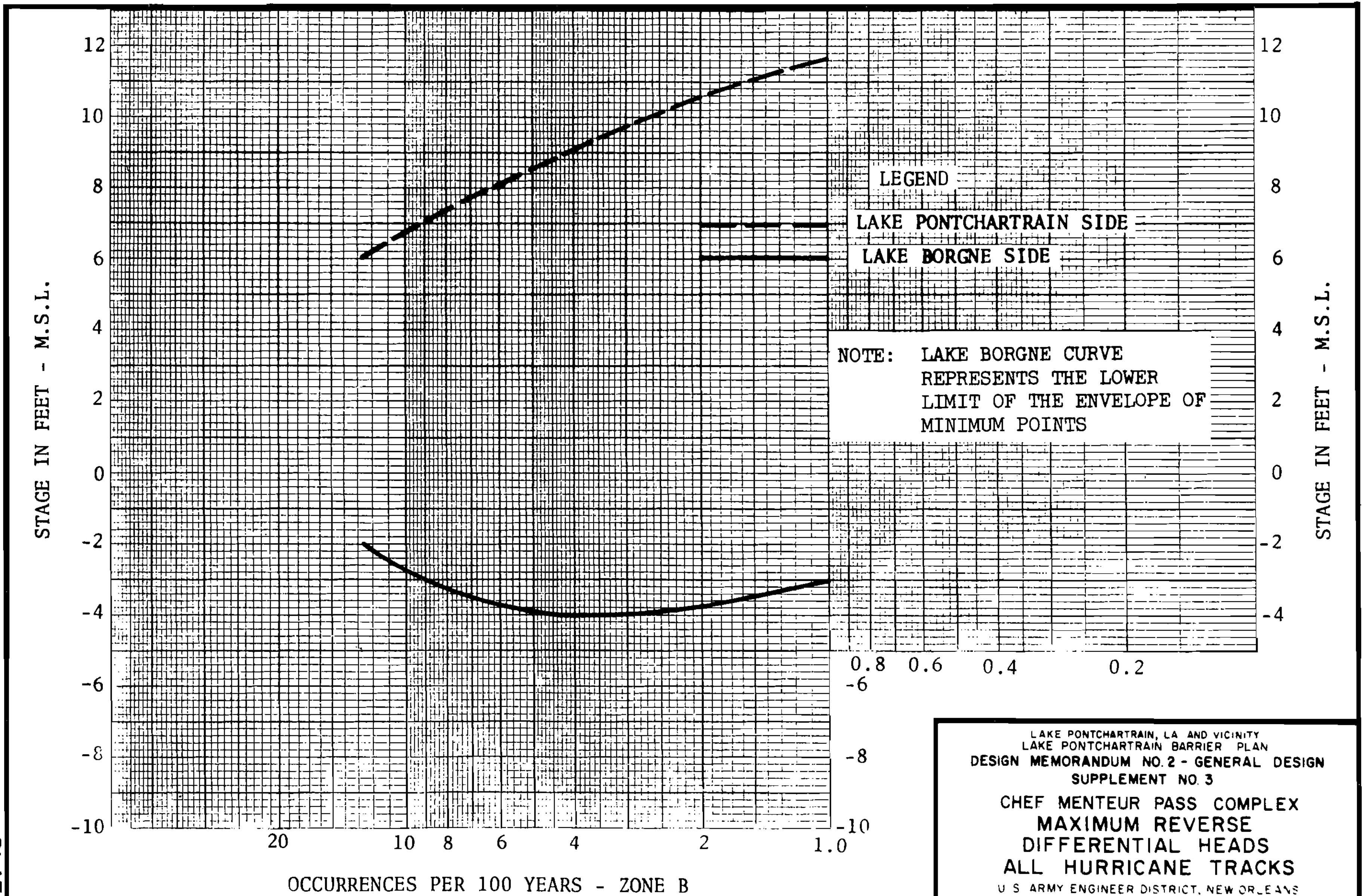
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT 1968

FILE NO H-2-24730

APPENDIX C

PLATE 4



LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 2 - GENERAL DESIGN
SUPPLEMENT NO. 3

CHEF MENTEUR PASS COMPLEX
MAXIMUM REVERSE
DIFFERENTIAL HEADS
ALL HURRICANE TRACKS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

SEPT 1968 FILE NO H-2-24730

PLATE 5

APPENDIX D

CONTROL STRUCTURE ALTERNATE STUDIES

Three alternate schemes were considered. They are:

1. The scheme shown on Plate 5 of the Interim Survey Report, Lake Pontchartrain and Vicinity, dated 21 November 1962. This scheme consists of a two section wheel gate being placed in each of the eight gate bays by means of a gantry crane. The gantry travels on rails carried between piers by a girder and a curtain wall. A separate 12' roadway is provided for access for land based maintenance equipment. To the levee between the control and navigation structures. A section showing the arrangement of this scheme is shown on page 2 of this appendix.

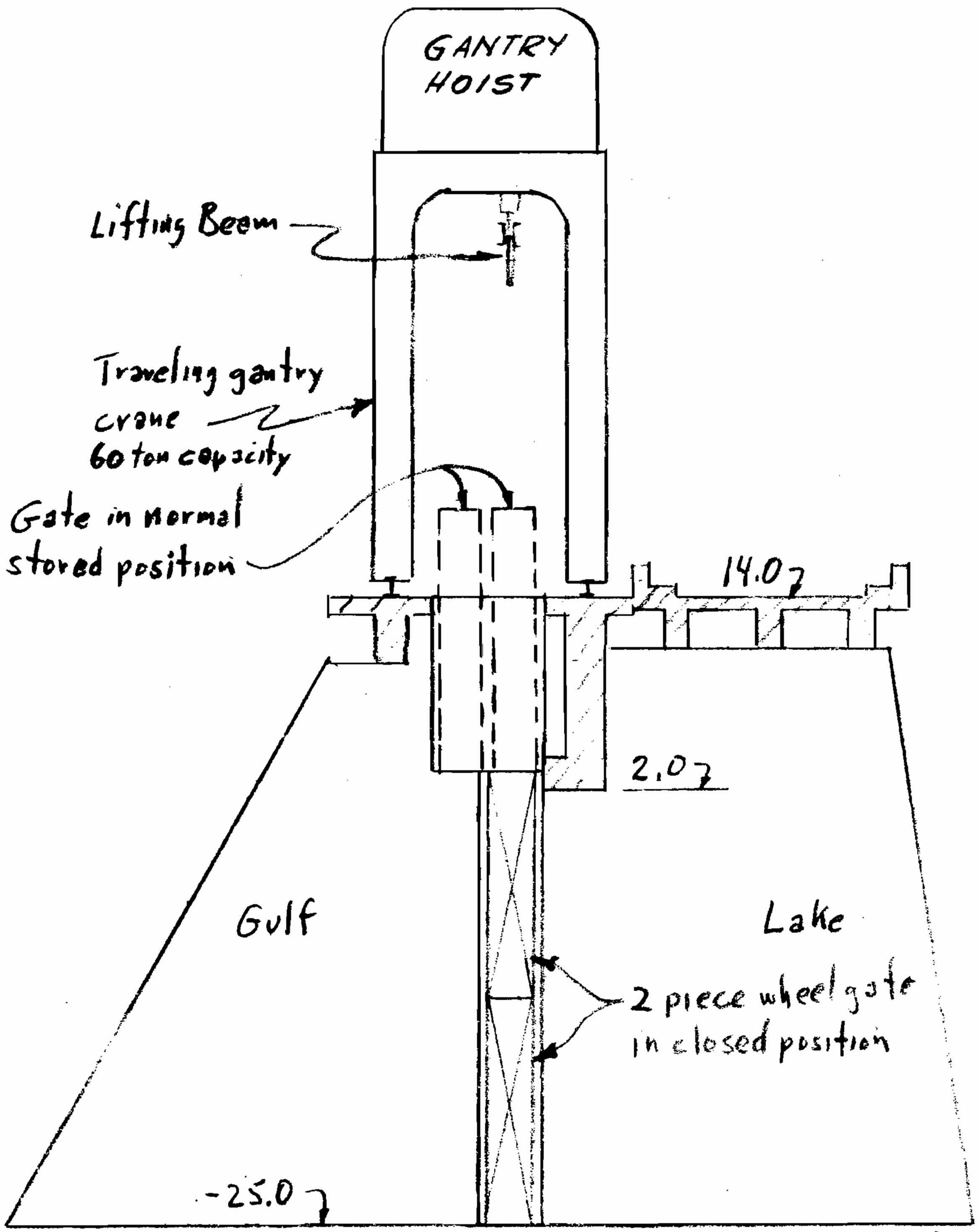
2. One piece vertical lift wheel gates, operated by their own hoists mounted on a steel superstructure. A section showing the arrangement of this scheme is shown on page 3 of this appendix.

3. Tainter gates operated by their own hoists. A section showing the arrangement of this scheme is shown on page 4 of this study.

Cost comparisons show that Scheme 3 would cost $81,200 less than Scheme 1 however, it would be difficult to maintain the gate, the open gate would present a large wind surface, the high piers would be unsightly, and more maintenance would be required for the eight individual hoists of Scheme 3 therefore Scheme 1 was adopted.

Scheme 1

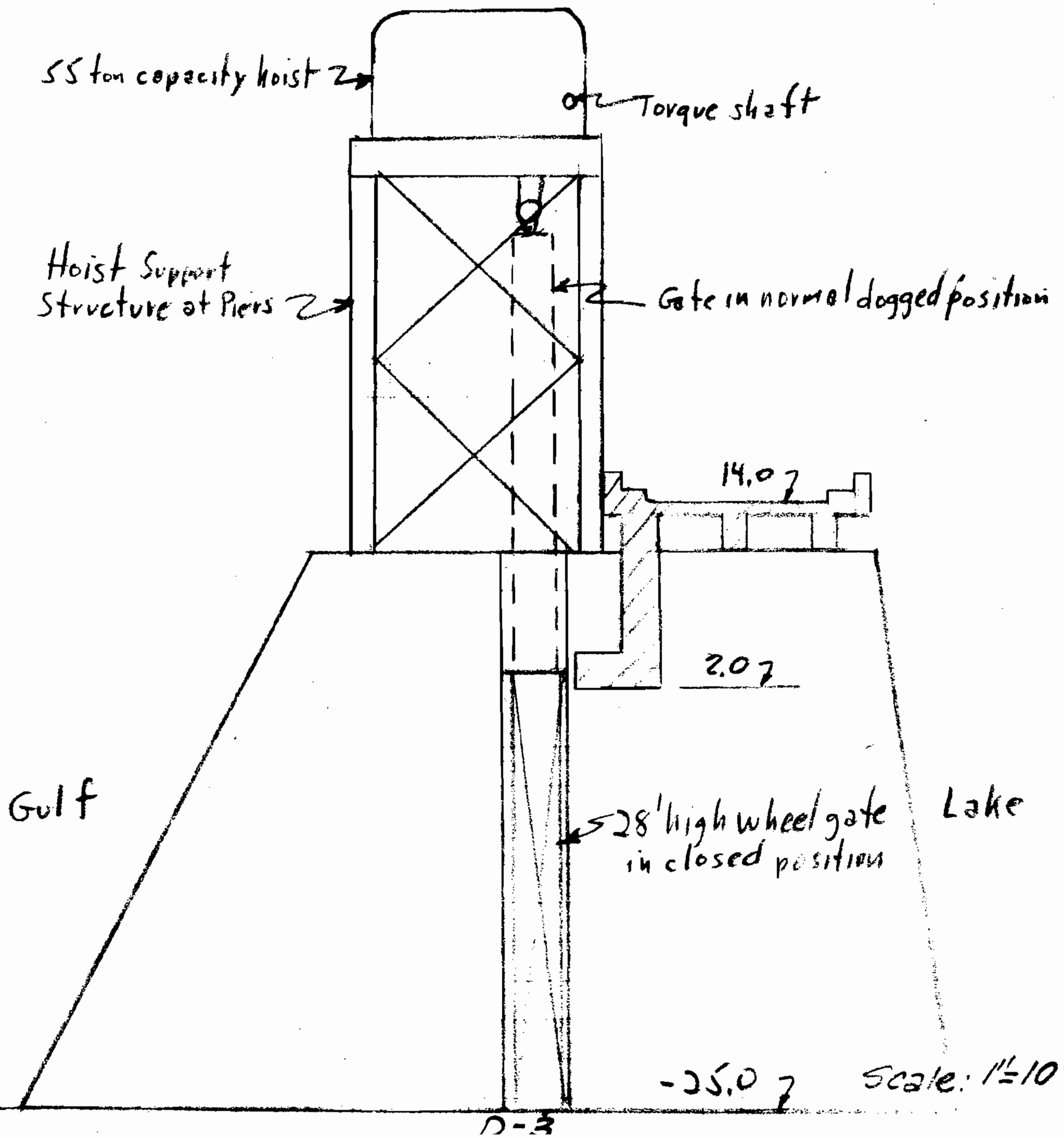
Wt. of each gate section = 55,000#
Wt. of embedded parts for each gate bay = 10,000#



Scale 1" = 10'

Scheme 2

wt. of each gate = 100,000#
Wt. of embedded parts for each gate bay = 10,000#
Wt. of hoist supporting structure for each gate bay = 10,000#



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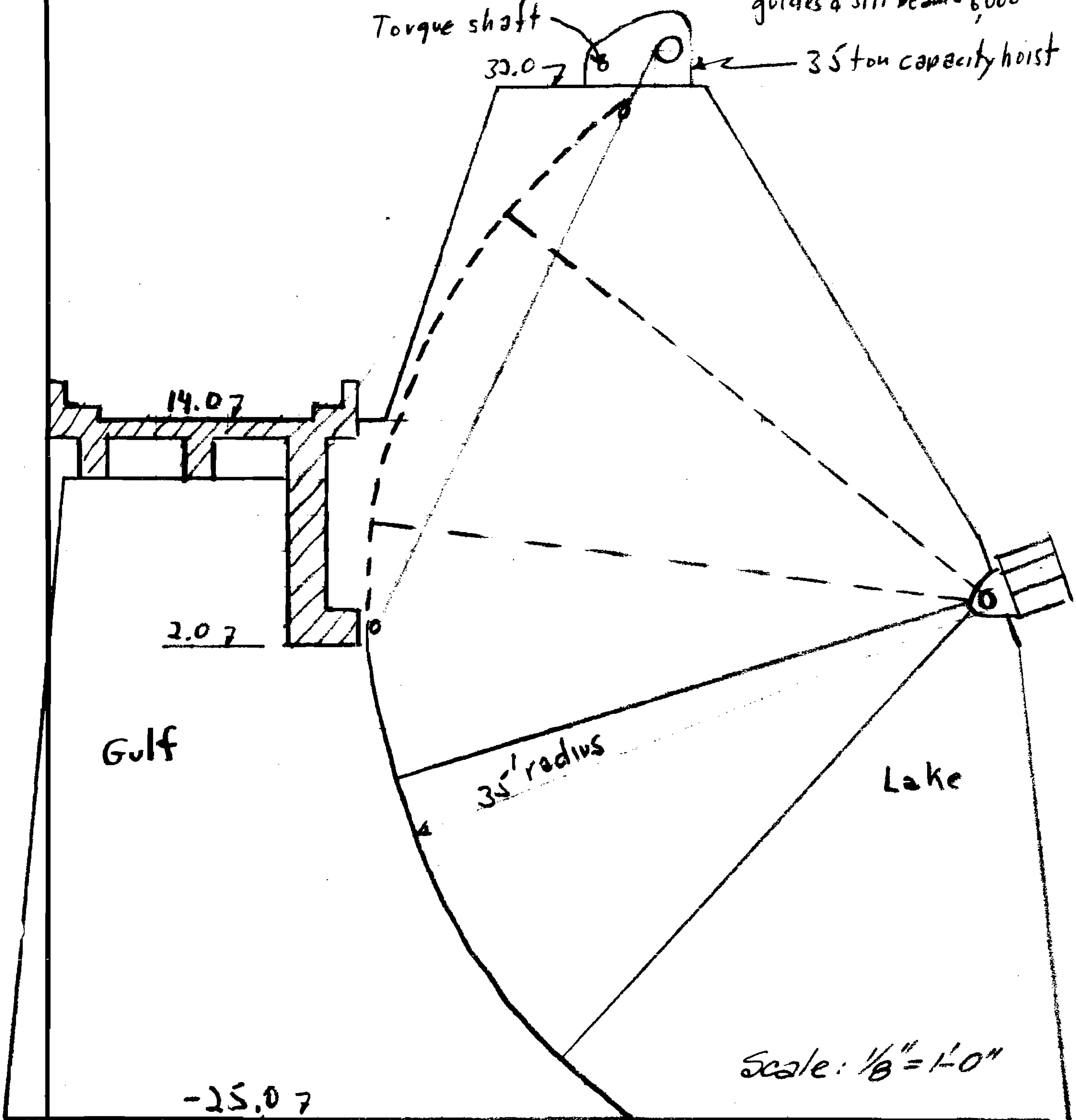
HARZA ENGINEERING COMPANY CHICAGO	SUBJECT CONTROL STRUCTURE ALTERNATE STUDIES	PROJECT CHEF MENTEUR
	COMPUTED PRM CHECKED	FILE NO. 453A
		DATE 3/7/68 PAGE 4 OF 7 PAGES

Scheme 3

Wt. of each gate = 60,000#
Wt. of each anchorage = 10,000#
Wt. of each set of embedded guides & sill beam = 6,000#



Cost Comparison

All other things being equal only the variables of each scheme are compared.

Scheme 1

Gantry Crane	=	$150,000
8 gates and embedded parts 8 (55,000# x 2 + 10,000#) at $0.60/lb	=	576,000
	Total	$726,000

Scheme 2

8 - 55 ton hoists at $40,000 each	=	$320,000
8 gates, embedded parts and hoist superstructure 8 (100,000 + 10,000 + 10,000) at $0.60/lb	=	576,000
	Total	$896,000

Scheme 3

8 = 35 ton capacity hoists at $30,000 each	=	$240,000
8 gates and embedded parts 8 (60,000 + 10,000 + 6,000) at $0.60/lb	=	364,800
1,000 c.y. pier concrete at $50/cy	=	50,000
	Total	$654,800

HARZA ENGINEERING COMPANY
CHICAGO

SUBJECT CONTROL STR BRIDGE
ALTERNATE STUDIES
COMPUTED JMS CHECKED JLF

PROJECT CHEF MENTEUR
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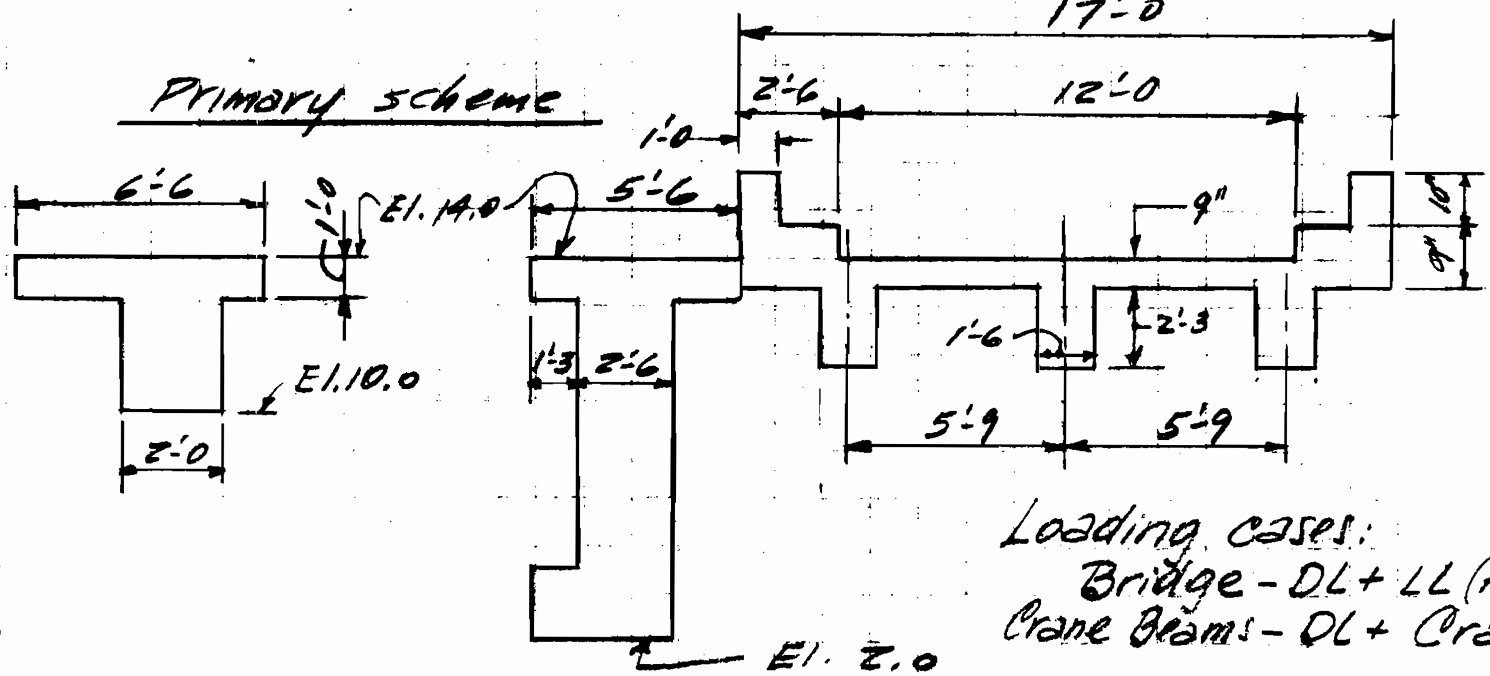
Primary scheme



Loading cases:
Bridge - DL + LL (H20 S16)
Crane Beams - DL + Crane

— Cast in place —

Bridge + Crane Girders - Conc. V = 1750 c.Y. @ $100 = $175000
Cement 1750 (1.4) = 2450 bbls. @ $5.20 = 12720

Reinf. st'l. - 260,000# @ 0.15 = 39000

$226,720

say 227,000$

From p.7 → 342,000 - 227,000 = $115,000

The cast in place (primary) scheme shown above costs $115,000 less than the prestressed (alternate) scheme (P.7).

29.63
10.13
19.50

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HARZA ENGINEERING COMPANY CHICAGO

SUBJECT: CONTROL STR. BRIDGE ALTERNATE STUDIES
COMPUTED: OH/JMB CHECKED: [illegible]
PROJECT: CHEF MENTEUR
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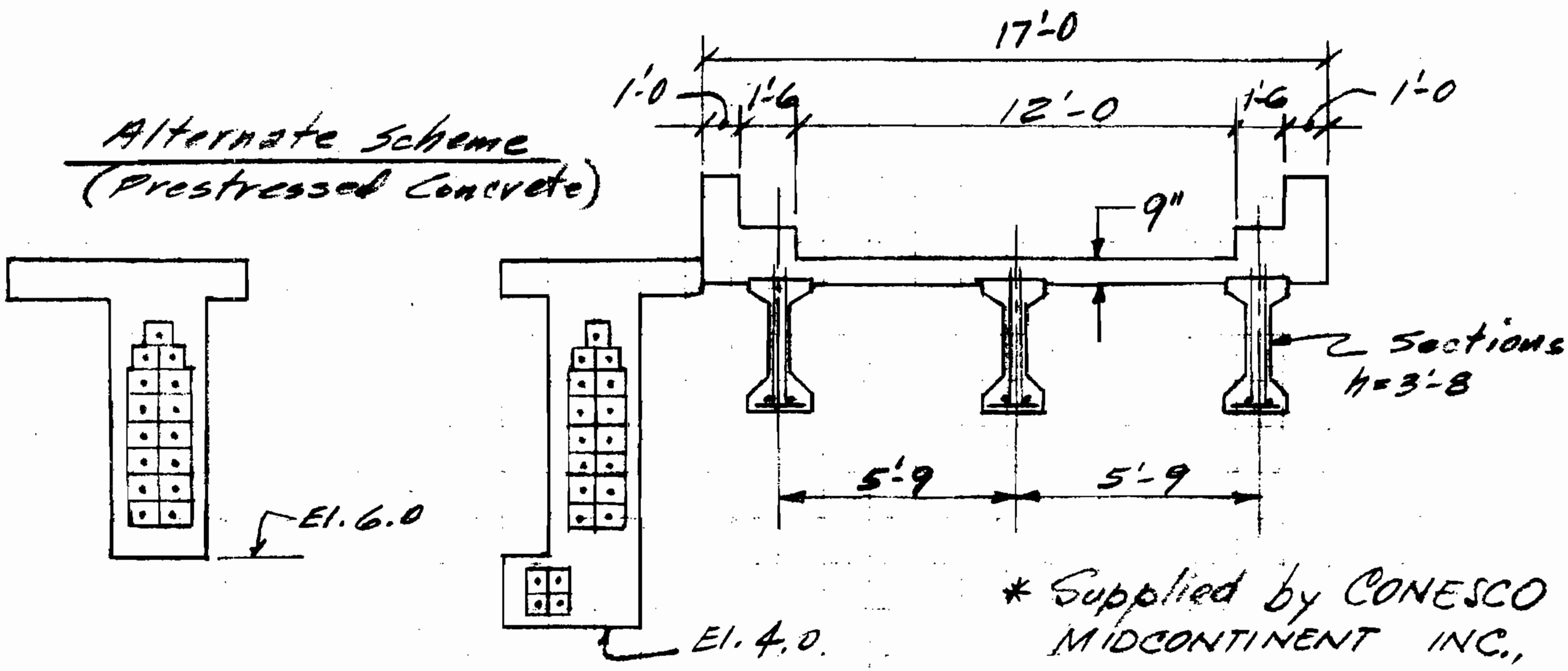
Alternate Scheme (Prestressed Concrete)



* Supplied by CONESCO MIDCONTINENT INC.,

-Prestressed-

Bridge Beams	3 @ \$1300/bay = \$3900*	× 14 bays =	\$54 600
Crane Bm.	\$5700*	× 20 " =	114 000
" " & Curtain Wall	\$8000*	× 8 " =	64 000
Cast in place Bridge	19.5(700)/27 = 506 c.y. @ \$100 =		50600
Cement	506(1.4) = 708 bbls @ \$5.20 =		3680
Reinf. st'l. =	74000 @ 0.15 =		11100
Additional Gate Cost	= 29.5/27.5 (600,000) - 600 000 =		44000
			\$341,980
			Say \$342,000

APPENDIX E

NAVIGATION STRUCTURE ALTERNATE STUDIES

Three alternative schemes were considered. They are:

1. The scheme shown on Plate 5 of the Interim Survey Report, Lake Pontchartrain and Vicinity, dated 21 November, 1962. This scheme consists of a conventional sector gate arrangement as used on locks. The two halves of the gate would normally be swung open and kept in gate chambers, one on each side of the structure. Maintenance of this gate would require needles placed at each end of the structure and unwatering the space between. This would interrupt traffic in the navigation channel.

2. A scheme consisting of a gate hinged at the bottom so that it would normally lie in a recess at the bottom of the channel. The scheme as originally conceived is similar to the Empire and Buras floodgates planned for Reach B1 of the New Orleans to Venice, Louisiana, project. The reason for studying this scheme is that it was believed the structure would require less concrete because gate bays would not be required and the structure would be shorter than that required for a sector gate scheme. After studies were initiated it became apparent that very little concrete would be saved because the bottom hinged gate would also require needles for unwatering and the structure would be just as long as for the sector gate scheme.

   Since it is necessary that the gate be opened against differential head from either side, a simple chain hoist as planned for the Empire and Buras gates could not be used because it would be necessary to push the gate down in one case. After some studies were made to try to achieve an economical and safe way of operating such a gate, the scheme was abandoned.

   The general features of this scheme are shown on Plate E-1 and Pages E-3 through E-20.

3. A scheme consisting of a flat gate, stored in a wet pit adjacent to the waterway. The gate would be rolled out of the pit on wheels running on a track in a recess in the bottom of the channel. The recess would normally be filled with a structural steel filler that would keep silt and debris out. Before rolling the

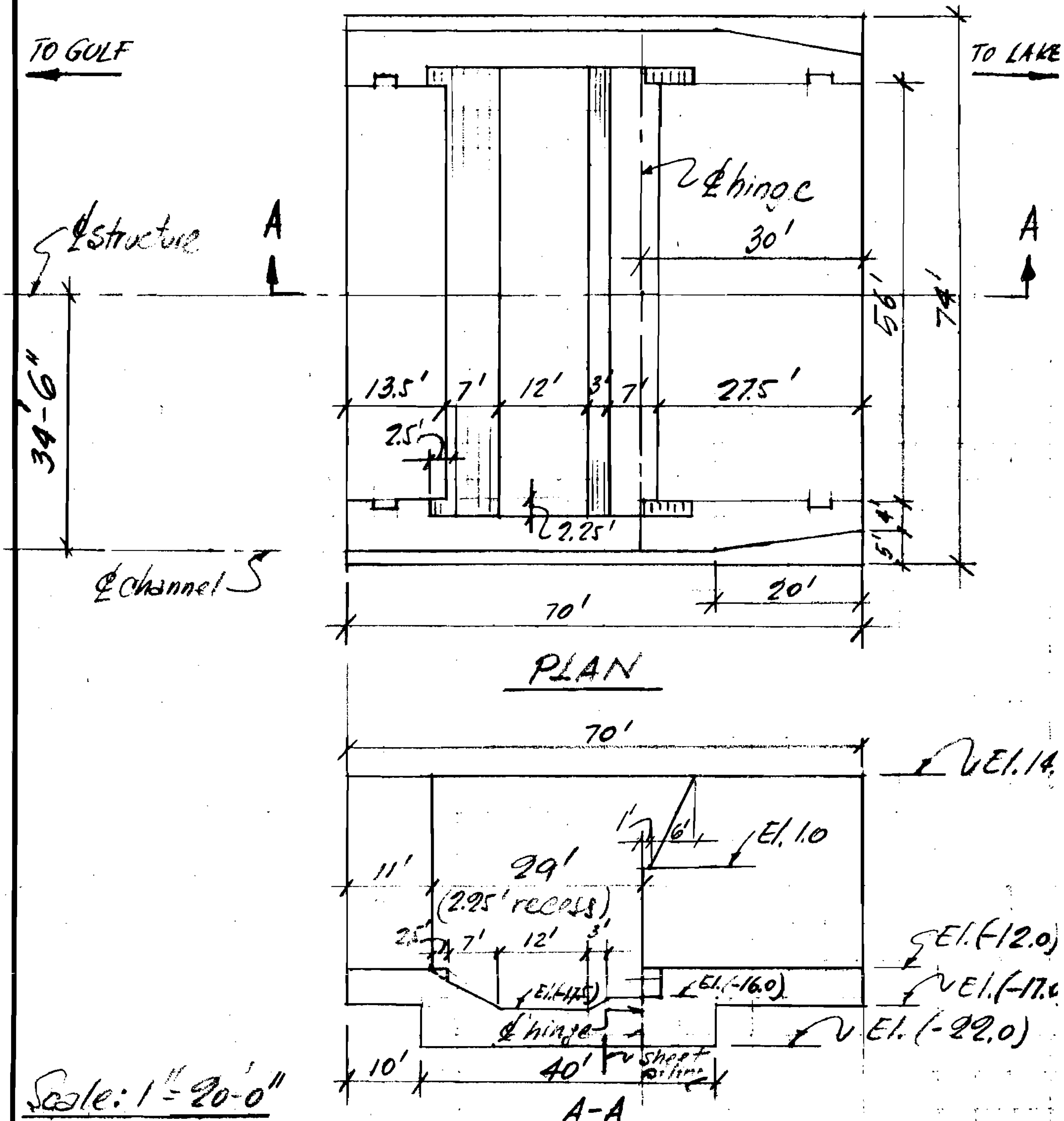
gate into its closed position, the filler would be raised, by synchronized hoists on each side of the structure. When in the raised position, the filler would act as a guide and support for the gate as it is rolled out against flow through the structure. The gate would consist of a skinplate spanning vertical members that frame into a horizontal girder at the top. The bottom of the gate would bear and seal on the vertical faces of the recess in the channel bottom. The top girder would bear on the raised recess filler. The drive to roll the gate could take various forms such as a reversible wire rope winch reaved to sheaves so that the gate could be pulled in both directions, or a rack on top of the gate, driven by a spur gear mounted over the wet pit, or a chain or gear drive for the wheels mounted on the gate itself.

The general features of this scheme are shown on Plates E-2 through E-7 and pages E-21 through E-52.

Recommendation

Scheme 3 has an advantage over schemes 1 and 2 in that the wet pit could be unwatered by placing stoplogs between it and the waterway allowing the gate to be maintained without interrupting traffic in the channel. Economically, however, it would seem that the costs of gate and operating machinery would be comparable as would concrete quantities between Schemes 1 and 3. Therefore, because of the requirement that the structure be convertible to a lock, and the known reliability of sector gates, it is recommended that Scheme 1 be adopted.

FLAP GATE SCHEME



Scale: 1" = 20'-0"

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. FLAP GATE	PROJECT CHEF MENTEUR
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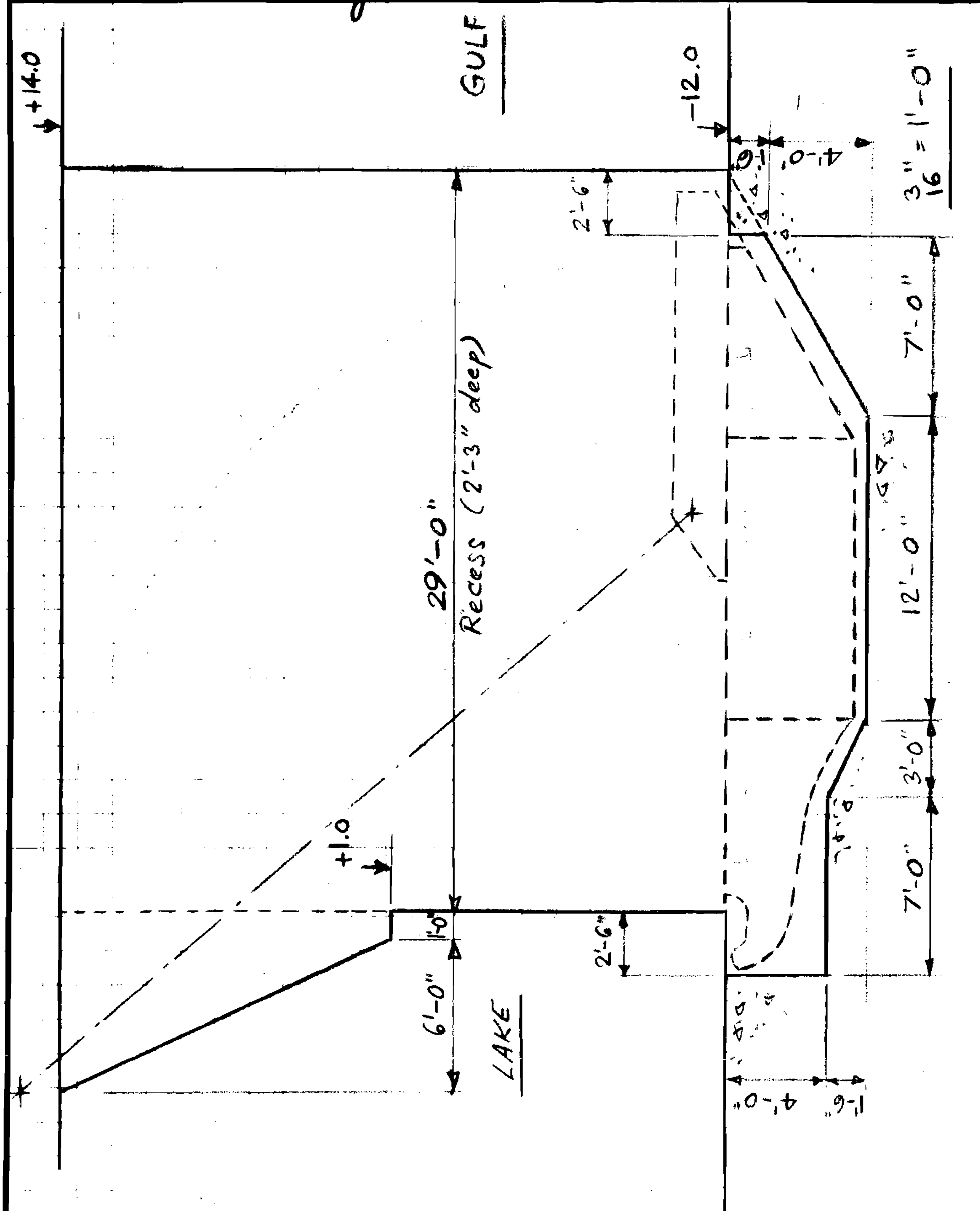

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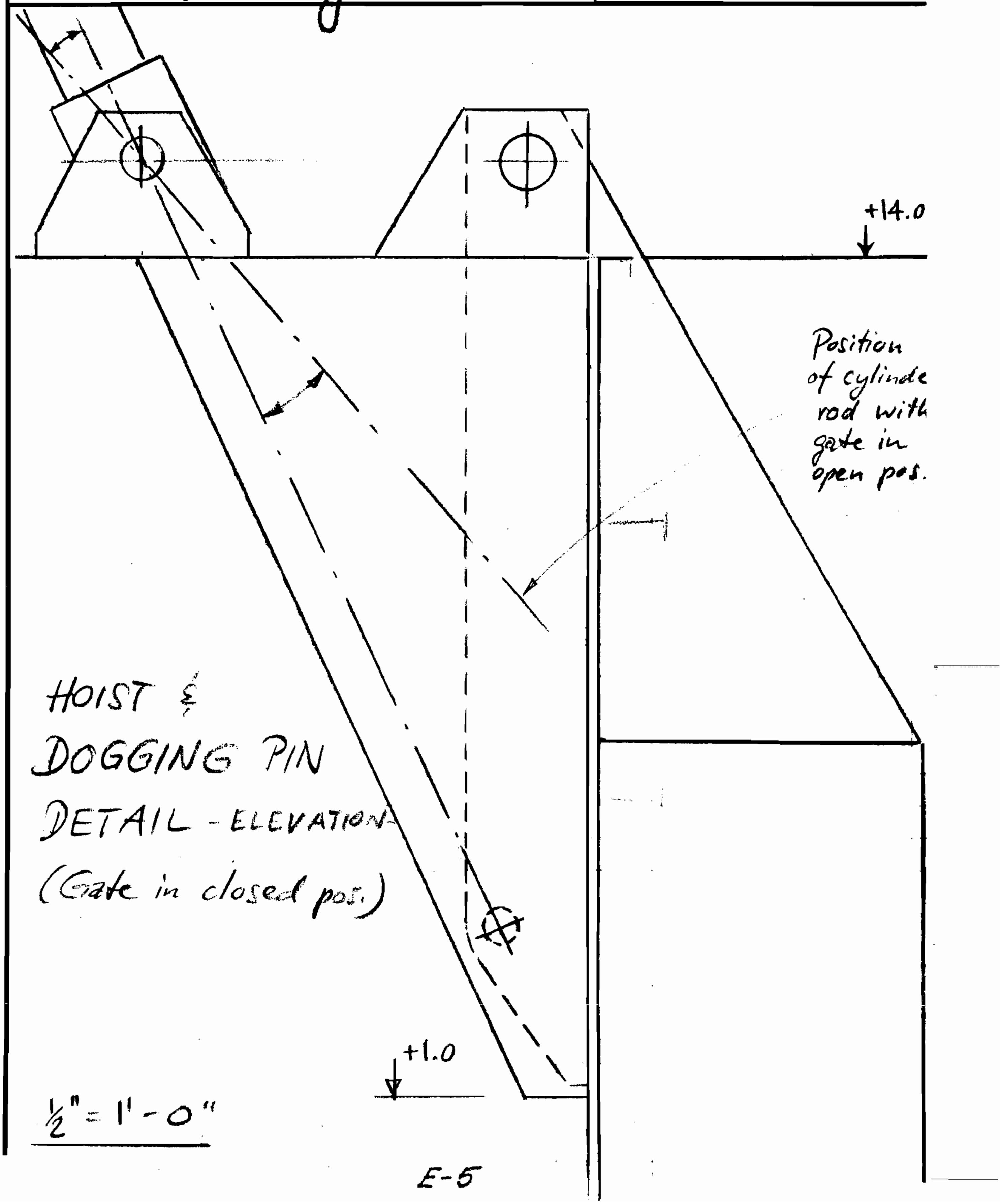

HOIST & DOGGING PIN DETAIL - ELEVATION

(Gate in closed pos.)

1/2" = 1'-0"

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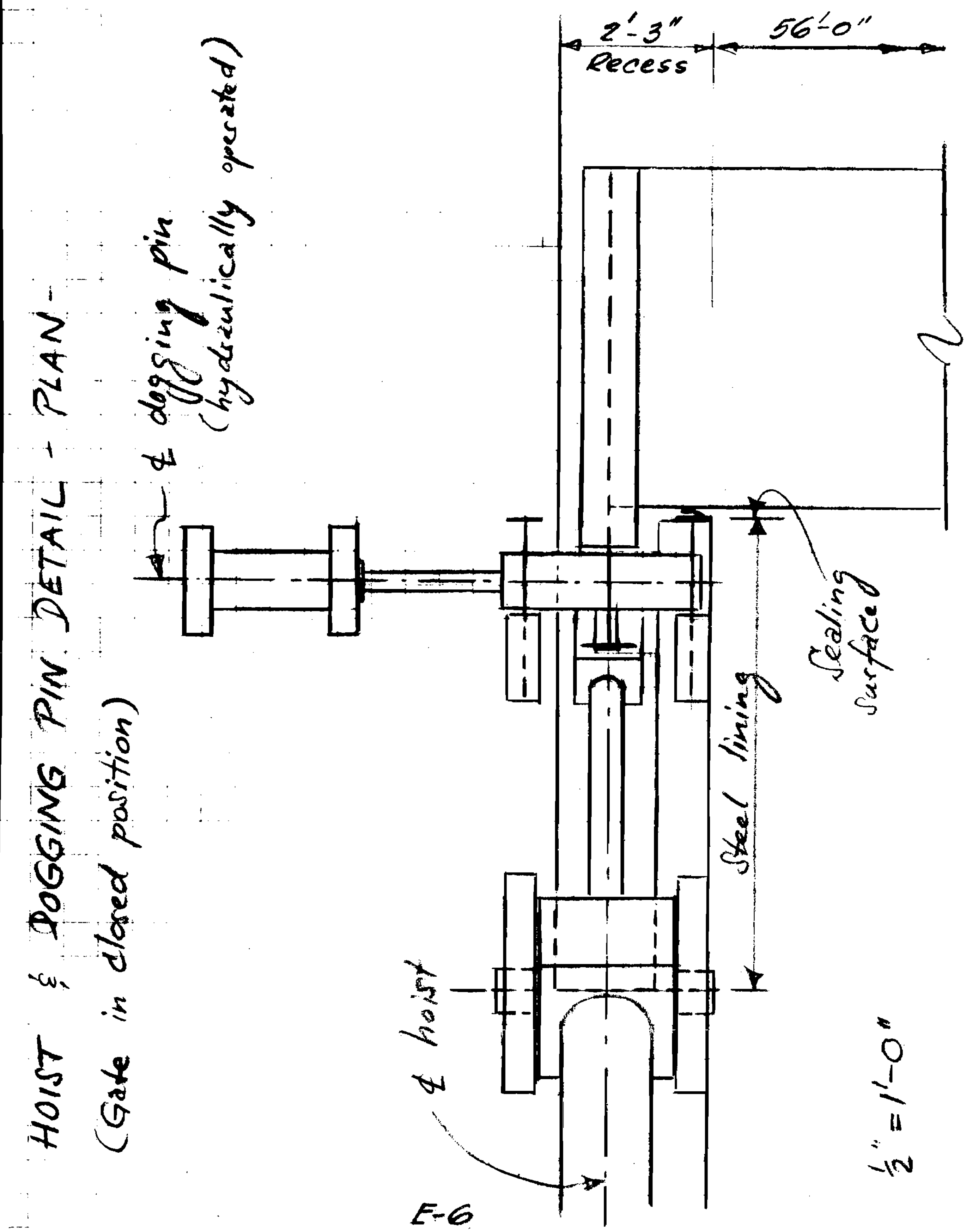

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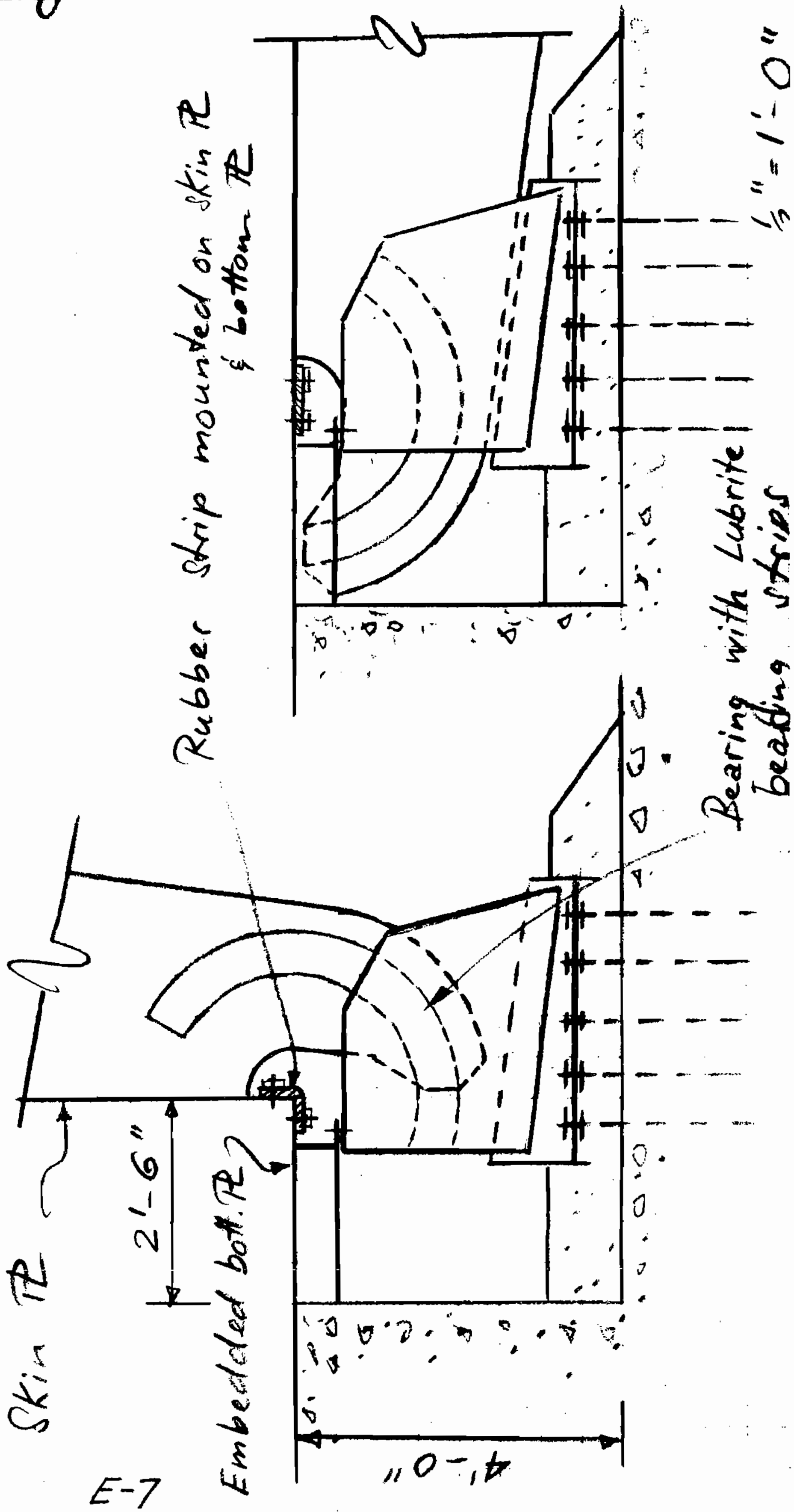
DETAIL OF GATE HINGE:

Gate closed

Gate open



LOADS:

A) GATE IN VERTICAL POSITION (CLOSED)

Case 2 $25.2 \times 56 = 1410^K$

B) TOP OF GATE AT EL. -3.0

Case 8 (p.8) $226 + 100\% = 452^K$

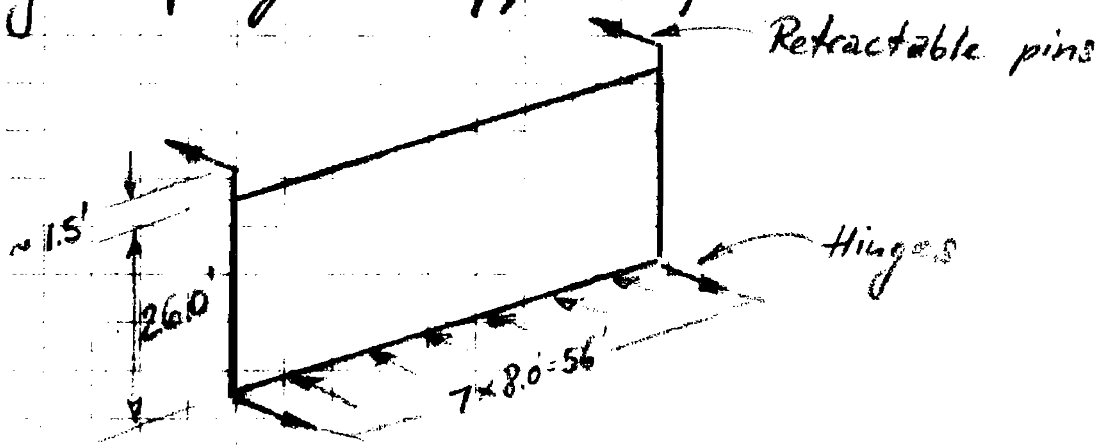
for pressure fluctuations

Dead load ~ 200^K ← Conserv. (actually 100^K See p. 11)

~ 650^K

Load case A) governing.

Arrgt. of gate supports for load case A).



Hinge loads (avg.) $(8 \times 25.2)^2$ — 40 700 (Water)

$\sim 30^2$ — 900 (d.l.)

$\sqrt{41\,600} = 204^K$

Use Bucfell - Bjorn. Flap hinges ($85 \times 2.2 = 187^K$ capacity)

Pin loads

$$\overset{K/ft}{25.2} \times \sim \overset{ft}{11.5} \times \frac{\overset{ft}{56}}{2} \times \frac{\overset{1/ft}{1}}{\sim 27.5} = 295^{K}$$

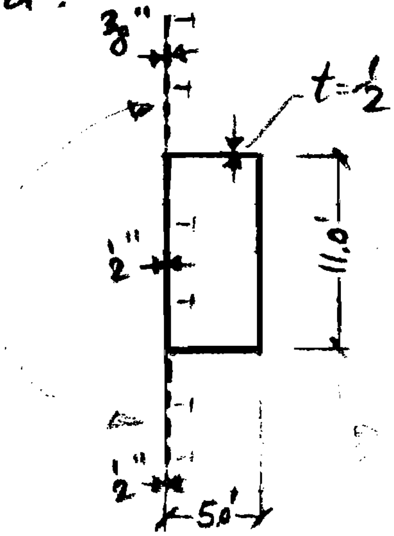
$$\sim 300^{K}$$

Outside hinge loads:

$$300 - \frac{1}{2} \times 204 = \sim 200^{K}$$

Gate section to transmit torque due to water load:

This portion neglected



Shear stress @ both ends of gate due to torque:

$$v = \frac{\overset{K/ft}{25.2} \times \overset{ft}{11.5} \times \overset{ft}{28} \times 1.}{\underset{ft}{2 \times 5} \times \underset{ft}{11} \times \underset{in^2/ft^2}{144} \times \underset{in}{.5}}$$

$= 12.3$ Ksi

Skin PL ($\frac{1}{2}$" @ box girder & below)

($\frac{3}{8}$" above box girder)

Spacing of horizontal beams 3.0' o.c.

$$f_{skin\ PL} = \frac{20.4 \times .434 \times 36^2 \times 6}{12 \times .5^2} = 23000 \text{ psi}$$

Horizontal beams: (7 I 15.3 or equiv.)

$$f = \frac{3 \times 20.4 \times .0625 \times 8^2 \times 12}{12 \times 10.4} = 24 \text{ KSi}$$

Skin ℞ neglected

Retractable pins: (10" ∅)

Bearing $p = \frac{300}{10 \times 2} = 15 \text{ KSi}$

Bending $f = \frac{300 \times 30}{.0982 \times 10^3 \times 4} = 23 \text{ KSi}$

Hydraulic cylinder:

Hoist pull:

1) Gate closed:

a) Load case 8: $5.5^2 \times .5 \times .0625 \times 56 = 53^K$

$5.5 \times 9 \times .0625 \times 56 = 173$

226^K

$$\frac{1}{3} \times \frac{9^2 + 9 \times 14.5 \times 14.5}{9 + 14.5} = 6.0'$$

$226 \times \frac{6}{\sim 6} = 226^K$ pull

or $\sim 60^t$ each side

b) Load case 5: $2.5^2 \times .5 \times .0625 \times 56 = 11^K$

$2.5 \times 14.5 \times .0625 \times 56 = 127^K$

138^K

$138 \times \frac{\sim 8}{\sim 6} = 185^K$ push

or $\sim 50^t$ each side

2) Gate being opened:

Moments abt. hinges of gate:

a) due to load case 8 (top of gate @ -3.0):

$\sim 450 \times \sim 13 = 5850'^K$

(p.6)

due to dead weight

$\sim 200 \times \sim 12 = 2400$

conservative (actually 100^K see p.11)

$8250'^K$

$\frac{8250}{\sim 14} = 590^K$ pull

or $\sim 150^t$ each side

b) due to load case 5 (top of gate @ -3.0)

$\sim 40 \times 56 = 2240'^K$ upward

due to dead weight : 100 × ~12 = 1200 K downwards

1000 K upwards

$\frac{1000}{\sim 14} = 71$ K push

c) due to load case 5 (top of gate @ +5.0):

~45 × 56 = 2520 'K upwards

due to dead weight

See note p. 4 → 100 × ~9 = 900 K downwards

1620 K upwards

$\frac{1620}{15.5} = 105$ K push

or ~ 26 t each side

Loading conditions 2 & 3 governing.

Cylinder rod 6" Ø

Tension $f_{max} = \frac{300}{28.2} = 10.6$ ksi

Compression $f_{max} = \frac{52}{28.2} = 1.84$ ksi ≪ 12.98 for $\frac{300}{3}$

↖ bending due to dead load neglected.

Cylinder I.D. 15":

Operating pressure $p = \frac{300\,000}{176 - 28.2} = 2030$ psi

ESTIMATED WEIGHTS:

GATE:

1 SKIN PL 90" × 3/8"	59'	6.8 K	
1 " " 222 × 1/2	59	22.3	
BOX GIRDER PLS 252 × 1/2	59	25.3	
6 INTERM. DIAPH. ~48 × 1/2	26	12.7	
2 END PLS ~60 × 1/2	26	5.3	
6 HORIZ. RIBS ~15	59	5.3	
REINF. PLS, RIBS, ETC.		17.3	
		95.0 K	~ 100 K

EMBEDDED PARTS:

1 BOTT. PL ASSY. 100#/'	56'	5.6 K	
8 HINGE ASSEMBLIES	750# ea.	6.0	
2 SIDE PL "	3500# ea.	7.0	
		18.6 K	~ 20 K

PIPE HANDRAIL	~ 80 l.f.
RUBBER SEALS	~ 110 l.f.
CORNER PROTECTION ∠S 15#/' ~80'	1.2 K

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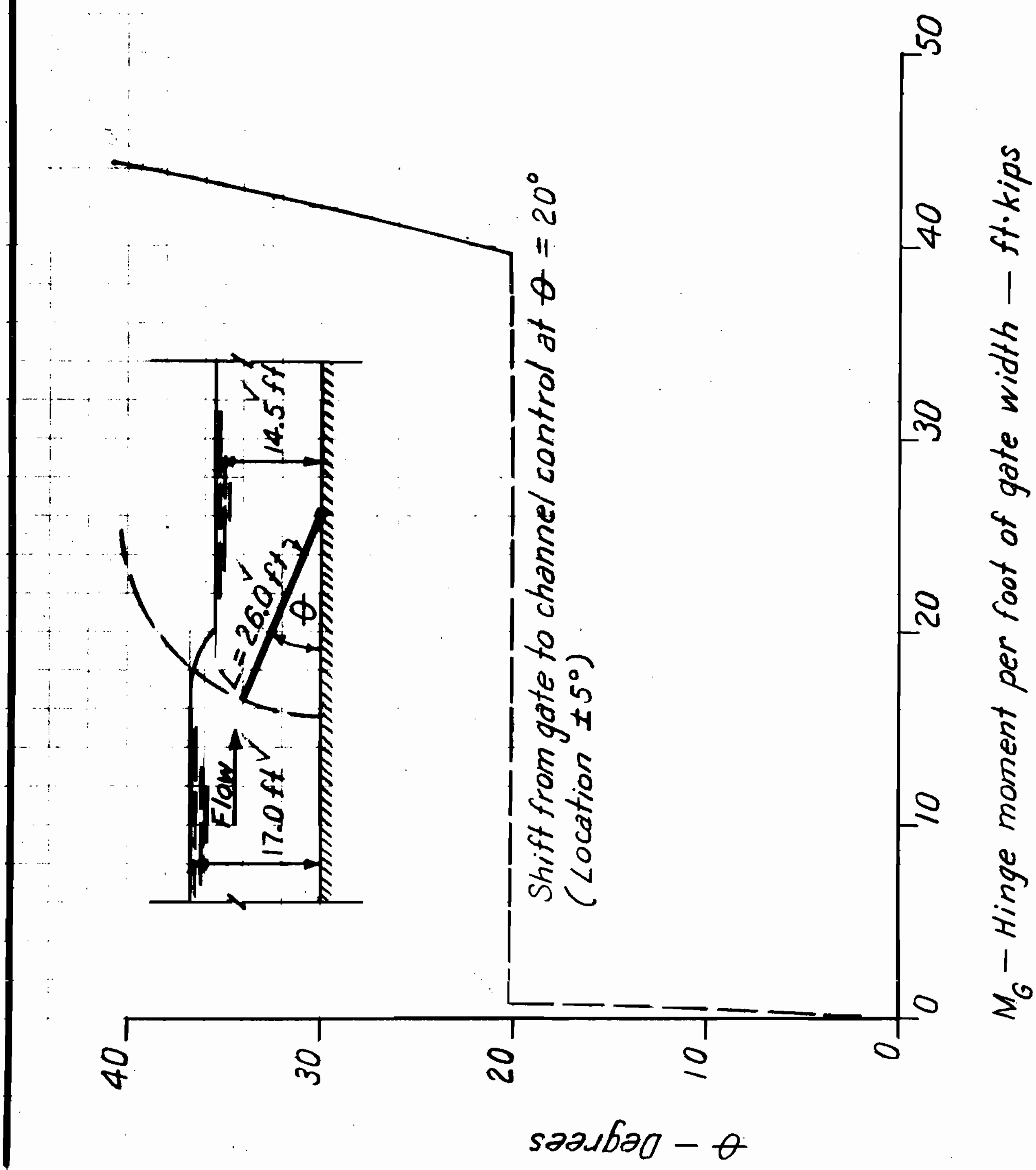

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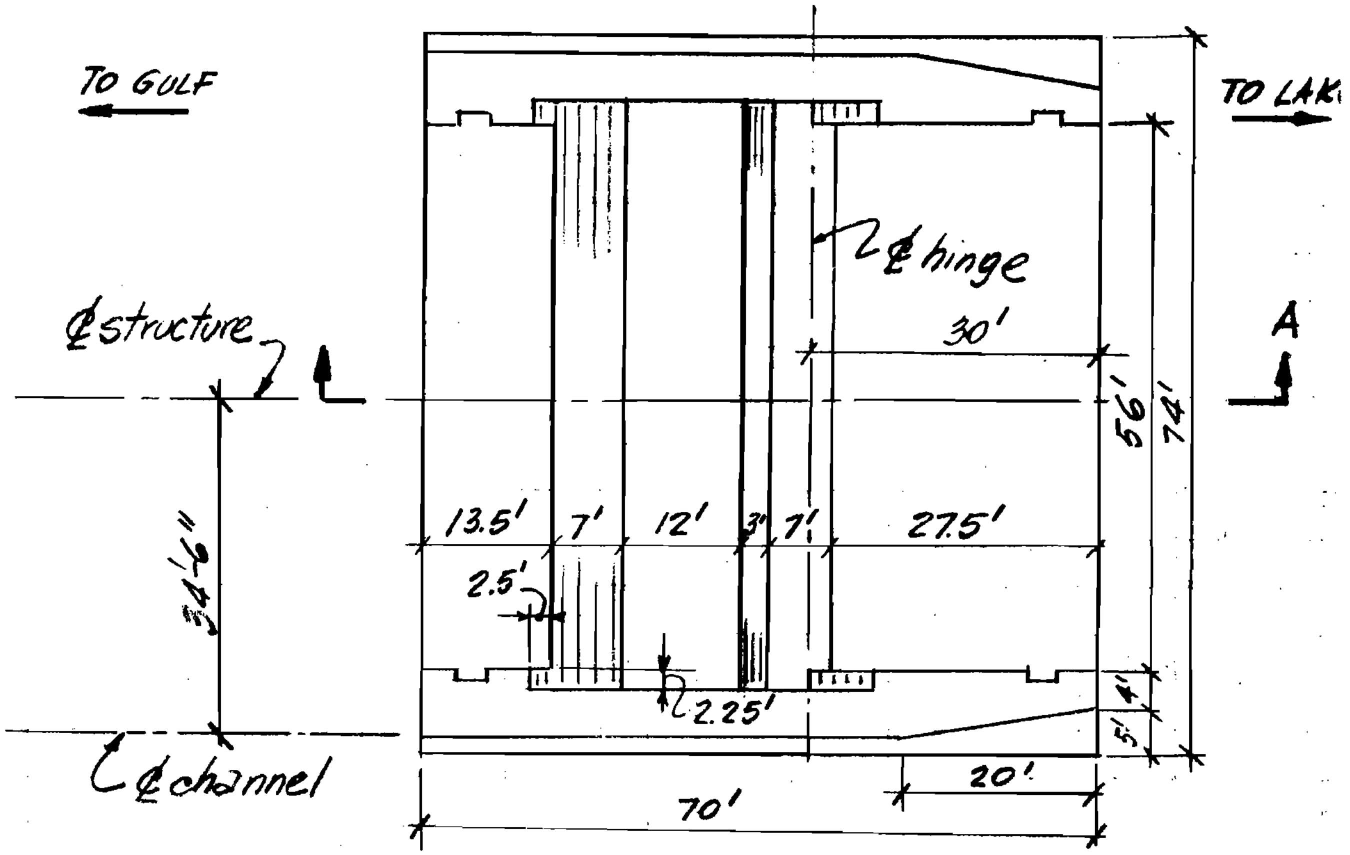
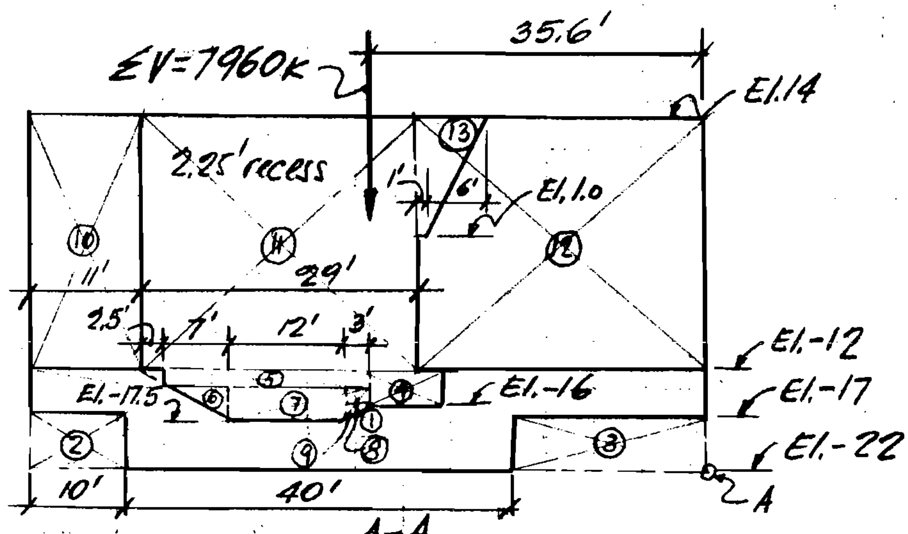
FLAP GATE SCHEME

CASE-D.L Concrete



PLAN



Scale: 1" = 20'-0"

A-A

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. FLAP GATE SCHEME	PROJECT CHEF MENTEUR
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D.L. CONCRETE & CENTER OF GRAVITY

	No.		Weight (K)	Arm (Ft)	+ M (IK)
SLAB	1	10×70×74×0.15	7780	35	272,000
	2	5×10×74 —"—	- 556	65	- 36,200
	3	5×20×74 —"—	-1110	10	- 11,100
	4	4×7×60.5 —"—	- 254.5	31	- 7,900
	5	22×1.5×60.5 —"—	- 300	45.5	- 13,650
	6	½×4×7×60.5 —"—	- 127	51.83	- 6,580
	7	12×4×60.5 —"—	- 435	43.5	- 18,950
	8	2.5×3×60.5 —"—	- 68.2	36	- 2,460
	9	½×3×1.5×60.5 —"—	- 20.5	36.5	- 750
		SUBTOTAL:	4908.8K		174,410 IK
WALLS	10	11×26×7×2×0.15	600	64.5	38,700
	11	29×26×4.75×2 —"—	1078	44.5	47,900
	12	30×26×7×2 —"—	1635	15	24,550
	13	½×7×13×9.25×2 —"—	- 307	27.67	- 8,855
	14	½×3×20×26×2 —"—	- 234	6.67	- 1560
		SUBTOTAL	3049 K		100,735 IK
		TOTAL:	7957.8K		283,145 IK
		Say	7960K		

$$\bar{x} = \frac{283,145}{7960} = 35.6'$$

Concrete Quantities:

$$\text{Slabs} = \frac{4908.8}{.15 \times 27} = 1,215 \text{ CY}$$

$$\text{Walls} = \frac{3049}{.15 \times 27} = 755 \text{ CY}$$

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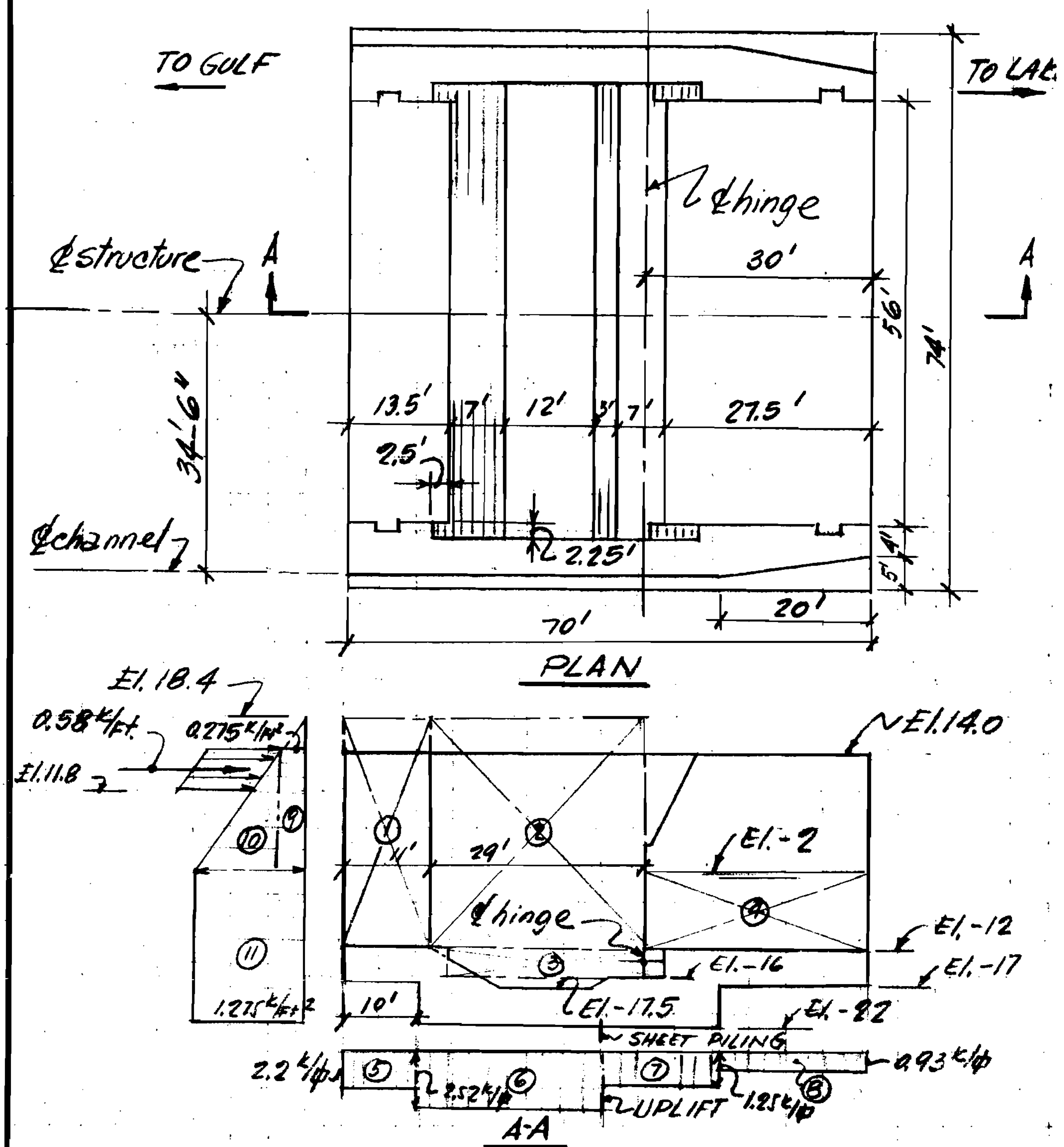
FLAP GATE SCHEME

CASE 2

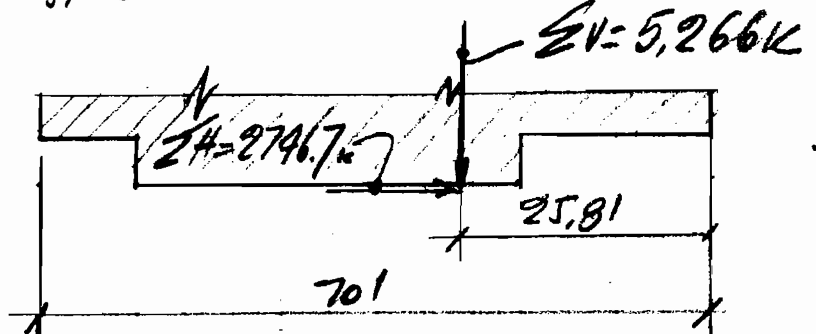


CASE 2 – Assumed Sheet piling is impervious

		H (k)	V (k) +	V (k) −	Arm (Ft)	M_A +	M_A −	
	D.L. Concrete		7960			283,145		
	D.L Gate		100		30	3,000		
1	11×30.4×60×0.0625		1250		64.5	80,450		
2	29×30.4×64.5 —		3550		44.5	158,000		
3	Same as Case 6		428		43.25	18,500		
4	27.5×10×60×0.0625		1032		13.75	14,200		
5	2.20×10×74			1630	65		105,900	Uplift
6	2.52×25×74			4660	47.5		221,000	Uplift
7	1.25×15×74			1388	27.5		38,100	Uplift
8	0.93×20×74			1376	10		13,760	Uplift
9	0.275×16×70	308			28		8620	Horizontal W.L
10	½×1.0×16×70	560			25.33		14,180	Horizontal W.L
11	1.275×20×72	1838			10		18,380	Horizontal W.L
12	0.58×70	40.7			34.9		1,420	Horizontal W.L
	ΣH =	2746.7	14,320	9054		557,295	421,360	

ΣV = 5,266 k ΣM = 135,935 'k

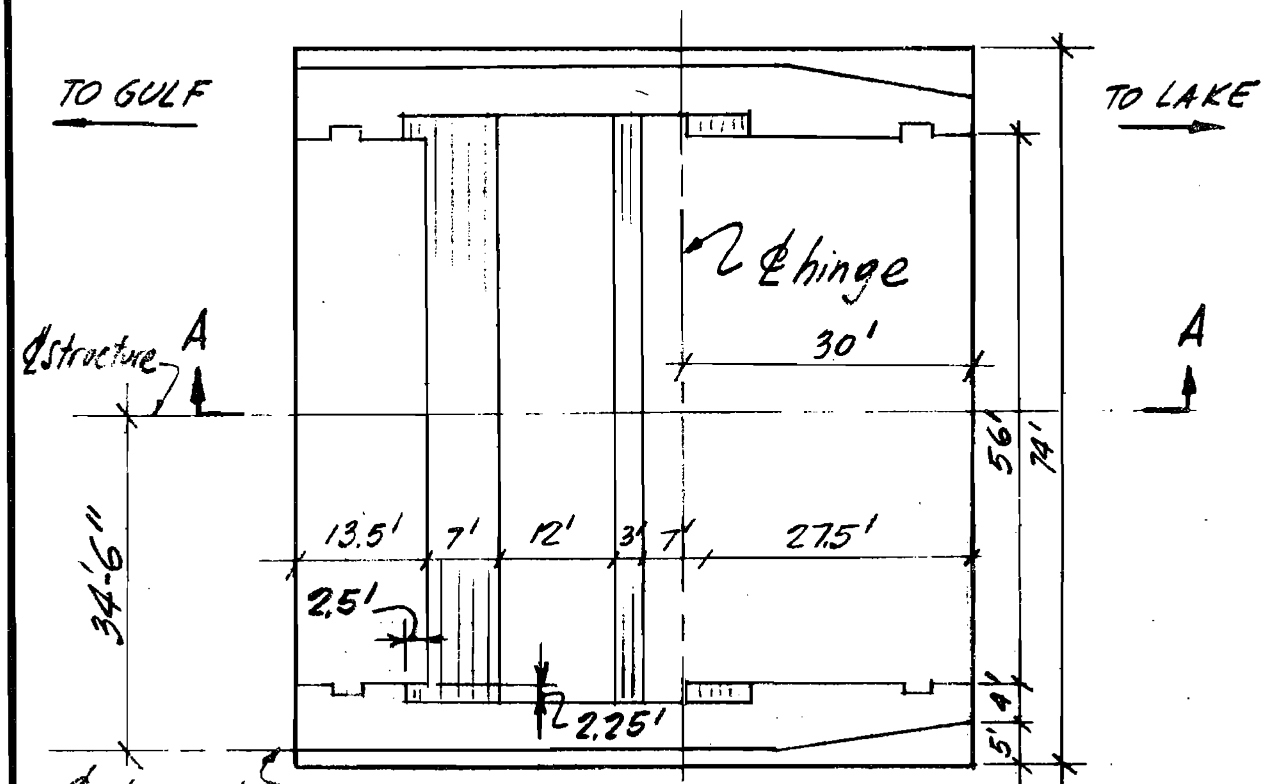
$$X = \frac{135,935}{5,266} = 25.8'$$



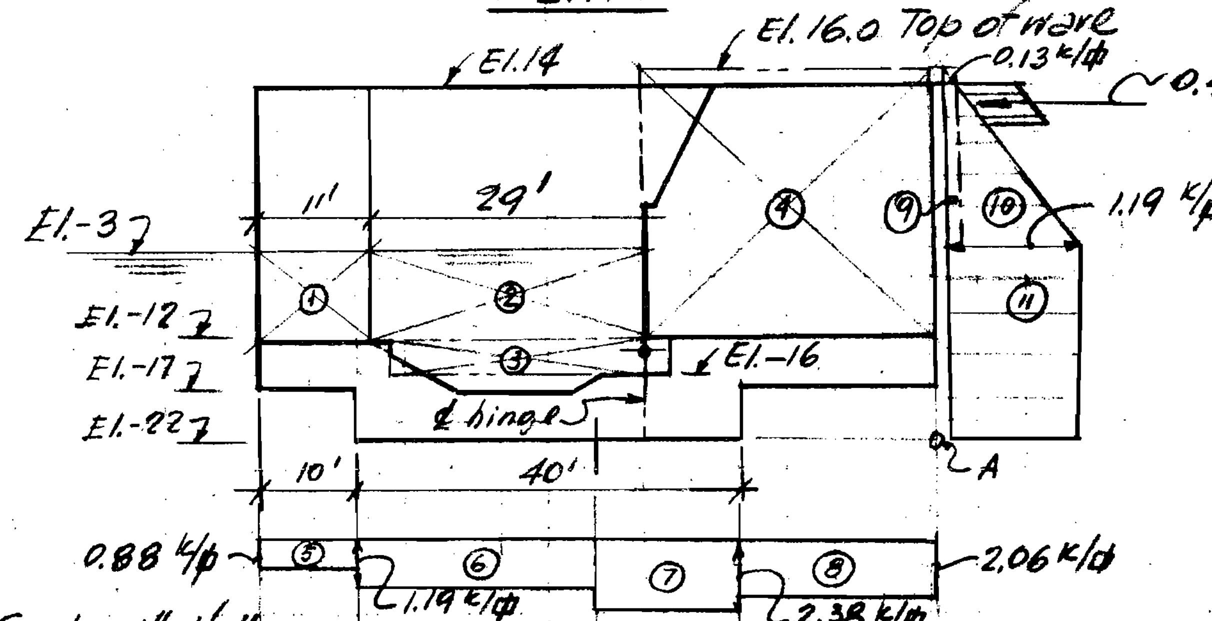
E-18

FLAP GATE SCHEME

CASE 6



PLAN



Scale: 1" = 1'-0"

A-A

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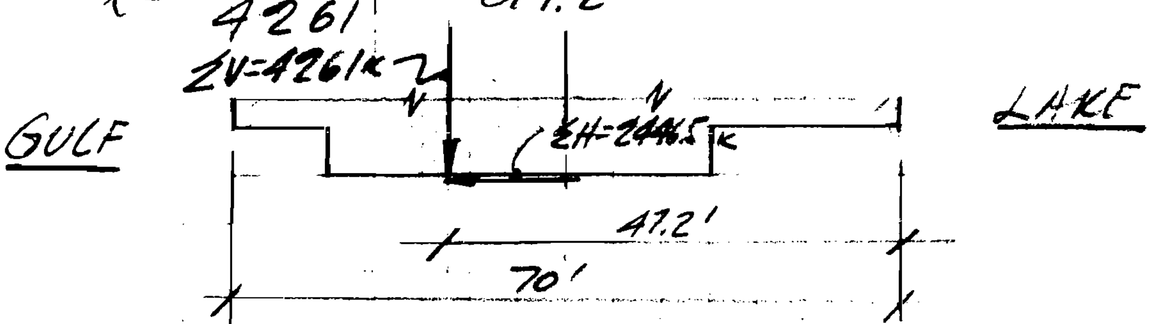
CASE 6 – Assumed Sheet piling is impervious

	Force	H(k)	V(k) +	V(k) −	Arm (Ft)	M_A +	M_A −	
	D.L. Concrete		7960			283,145		
	D.L. Gate		100		30	3,000		
1.	60×9×11×0.0625		371		64.5	23,900		Vertical W.L.
2.	64.5×9×29 –"–		1052		44.5	46,800		
3.	64.5×4×26.5 –"–		428		43.25	18,500		
4.	60×27.5×28 –"–		2890		13.75	39,700		
5	0.88×10×74			650	65		42,300	Uplift
6	1.19×25×74			2200	47.5		104,300	
7	2.38×15×74			2640	27.5		72,600	
8	2.06×20×74			3050	10		30,500	
9	0.13×17×70	155			27.5	4,260		Horizontal W.L.
10	½×1.06×17×70	630			24.67	15,580		
11	1.19×19×~72	1630			9.5	15,500		
12	0.45×70	31.5			34.75	1,095		
	ΣH=	2446.5	12,801	8540		451,480	249,700	
			ΣV=4261(k)			ΣM=201,780 (1k)		

$$\bar{x} = \frac{201{,}780}{4261} = 47.2'$$



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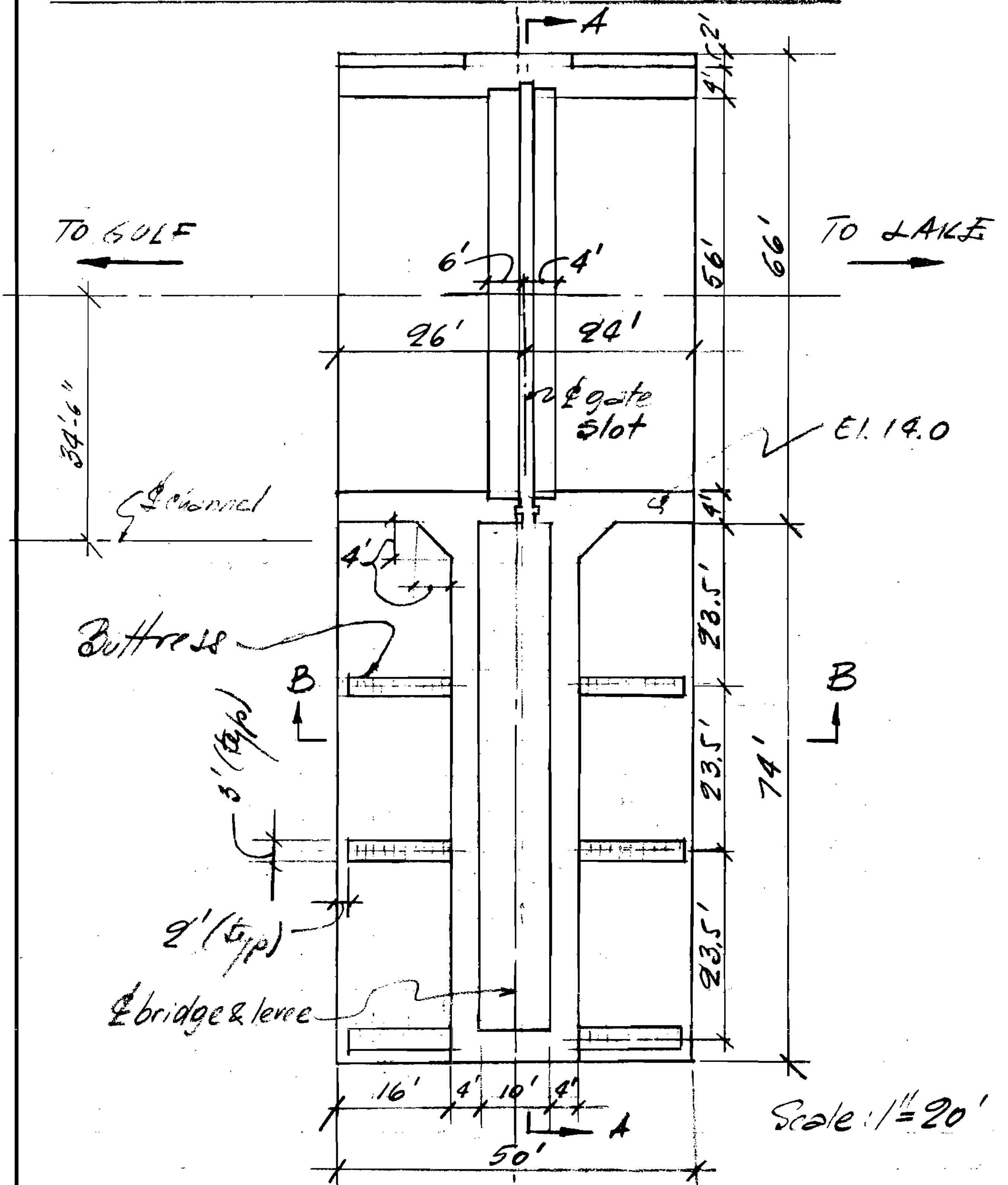
ROLLING FLAT GATE SCHEME



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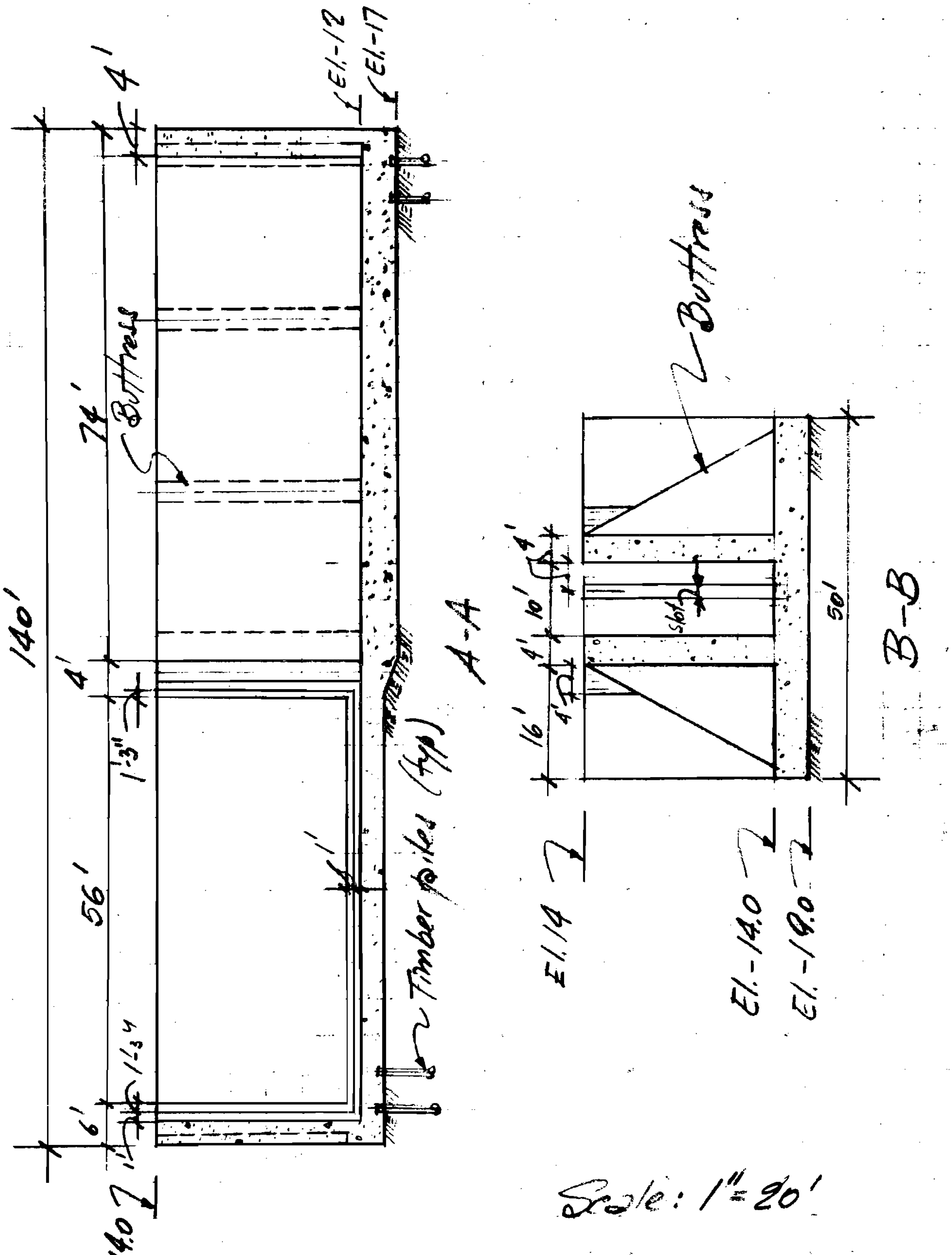
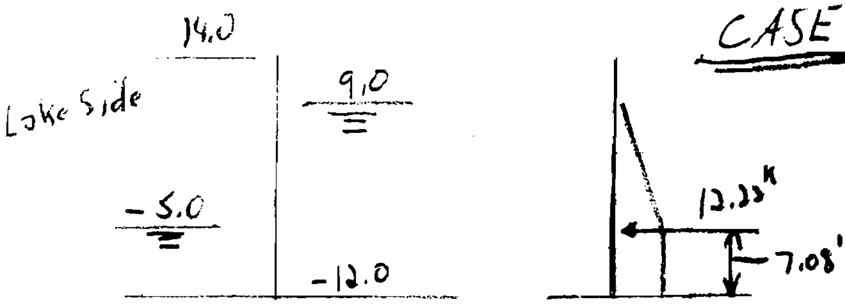


CASE 4

Normal Loading from Gulfside

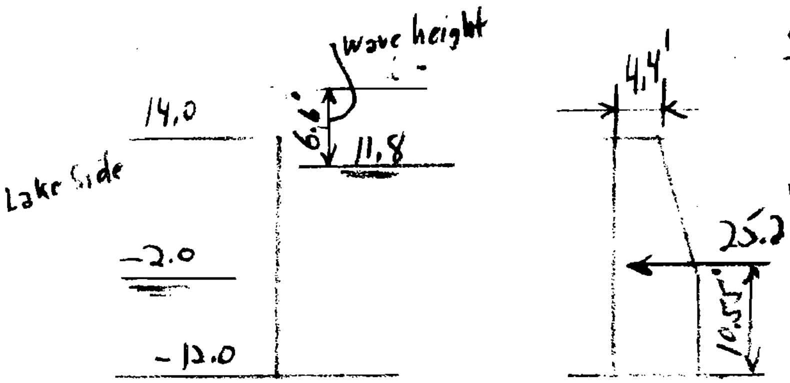


$$P/ft = \left(\overline{14}^2/2 + 14 \times 7\right) \times 0.0625 = 12.25^k$$

$$\bar{y} = \frac{\overline{14}^2/2\,(7 + 14/3) + 14 \times \overline{7}^2/2}{\overline{14}^2/2 + 14 \times 7} = 7.08'$$

CASE 2

Maximum Loading from Gulfside



$$P/ft = \left(4.4 \times 16 + \overline{16}^2/2 + 20.4 \times 10\right) .0625 = 25.2^k/ft$$

$$\bar{y} = \frac{4.4 \times 16 \times 18 + \overline{16}^2/2\left(10 + \frac{16}{3}\right) + 20.4 \times \frac{\overline{10}^2}{2}}{4.4 \times 16 + (16)^2/2 + 20.4 \times 10} = 10.55'$$

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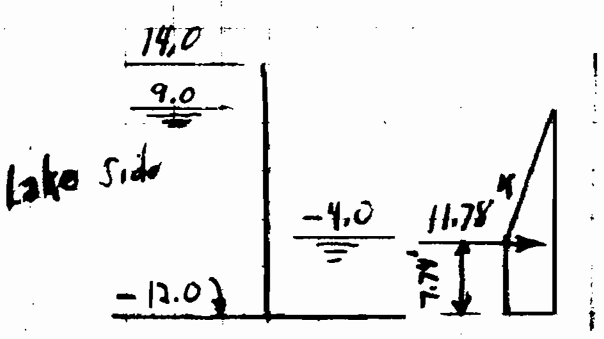
HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE COMPUTED PRM CHECKED	PROJECT CHEF MENTEUR FILE NO. 453A DATE 4-19-68 PAGE 4 OF 32 PAGES

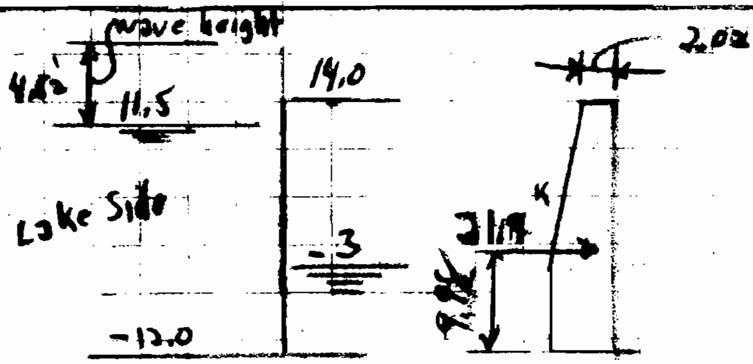


CASE 7

Normal Loading from Lakeside

$$P/\text{ft. width} = .0625\left(\frac{\overline{13}^2}{2} + 13\times 8\right) = 11.78^K/\text{ft. width}$$

$$\bar{y} = \frac{\overline{13}^2/2\left(8+\frac{13}{3}\right) + 13\times\overline{8}^2/2}{\frac{(13)^2}{2} + 13\times 8} = 7.74' \text{ from bottom}$$



CASE 6

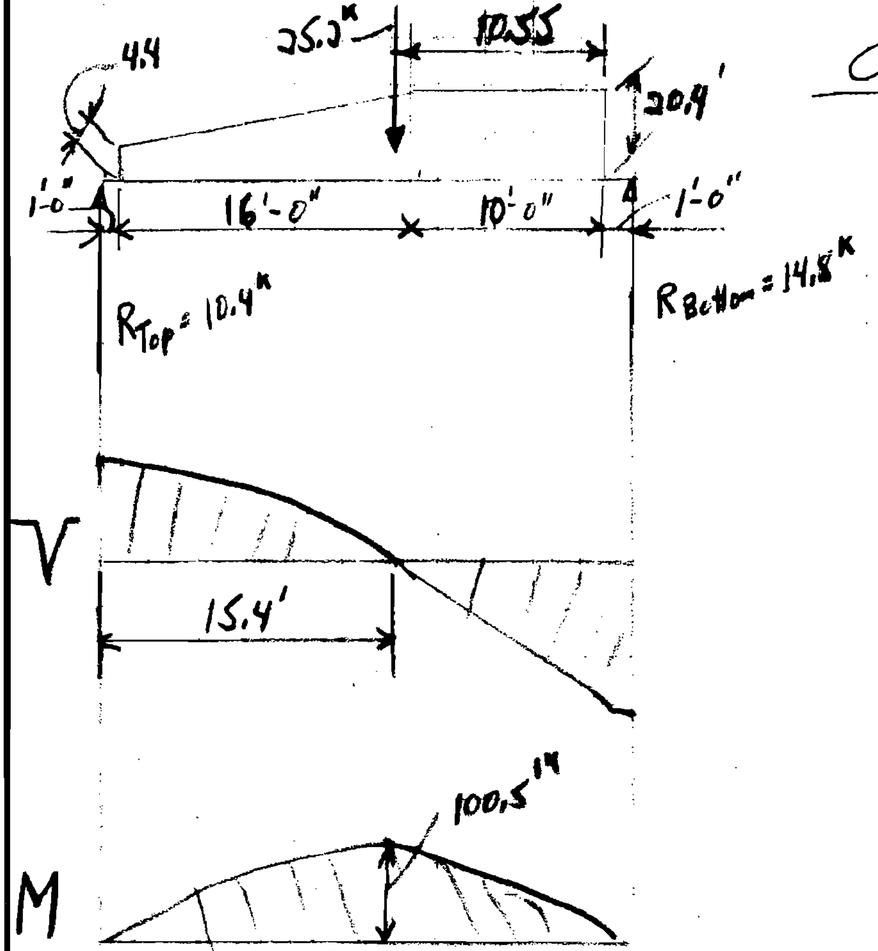
Maximum Loading from Lake side

Over loading / Over stresses

$$P/ft = \left(2.02\times 17 + \overline{17}^2/2 + 9\times 19.02\right).0625 = 21.9^K/ft$$

$$\bar{y} = \frac{2.02\times 17\times 17.5 + (17)^2/2\times\left(9+\frac{17}{3}\right) + 19.02\times\frac{\overline{9}^2}{2}}{2.02\times 17 + (17)^2/2 + 9\times 19.02} = 9.98'$$

CASE 2 Loading



The shear & moment on vertical beams spaced 2'-3" o.c. * will be $V = 23.4^K$, $M = 226^K$

The req'd. $S = \frac{226 \times 12}{24} = 113 in^3$ (21WF62 most economica

* Use 3/8" skin PL with allowable moment $= \frac{24{,}000(.375)^2}{6} = 565''^{\#}$

Spacing of skin PL supports to utilize 3/8" skin PL with max. pressure of $20.4 \times 0.434 = 8.88$ p.s.i.

$\frac{8.88(\ell)^2}{12} = 565 \quad \therefore \ell = 27.6''$

For vertical beams use equivalent of 21WF62 with one flange replaced by portion of 3/8" skin PL

ESTIMATED WEIGHTS

GATE:

1	SKIN ℞ 336" × 3/8"	60.0'	25.6 K
27	VERT. BEAMS ~ 45#/,	27.0	32.8
1	HOR. TOP BEAM 40 × 9/16	60.0	4.6
	2 × 20 × 2 1/4	60.0	18.4
1	HOR. BOTT. BEAM ~ 45#/,	60.0	2.7
	RIBS, WHEELS ETC.,		15.9
			100.0 K

SUPPORT BEAMS:

2	WEB ℞'s 34 × 3/8	60.0	5.2 K
2	FLANGE ℞'s 12 × 1	60.0	4.9

SAY 11.0 K EACH

REMOVABLE ℞ BETW. BEAMS ~5.0 K

TOTAL STRUCTURAL STEEL ~130 K

PIPE HANDRAIL ~200 l.f.

RUBBER SEALS ~110 l.f.

EMBEDDED PARTS: incl. anchor.

1 CRANE RAIL	104 lb/yd. ~ 40#/'	130'	5.2 K
2 LOWER BEARG. BARS	35	58	4.1
VERT. SEALG. SURF.	15	104	1.6
GUIDES FOR HOR. BEAMS	15	104	1.6
4 UPPER BEARG. BEAMS	75	3	0.9
			13.4 K

CRS MATERIAL 0.4 K

CORNER PROTECTIONS:

⌐ 5	15 #/'	~400'	6.0 K

GATE DRIVE:

ROLLING FRICTION $100 \times \frac{1}{4} \times 0.1 =$ 2.5 K
Gate weight ⤴ ↳ d/D ↳ Lubrite

SLIDING FRICTION $\sim 3 \times 60 \times 0.3 = 54.0$
(Due to lateral load) K/Ft ⤴ ↳ L

SAY 60.0K Incl. sheave efficiency

Use: 1¼"φ two part wire rope (IWRC)

Breaking strength 69.4 tons

Factor of safety $\frac{69.4}{30.0} \times 2 = 4.62$ Say OK

Use: $1.25 \times 24 = 30$" dia. sheaves & drums

Wraps on each drum:

$$\frac{\sim 120}{2.5 \times \pi} = 15.3$$ Say 18 wraps

HOIST FOR SUPPORT BEAMS:

DEAD WEIGHT (SUBMERGED) $13.5 \times .875 \simeq 12$K
SILT LOAD (ADD 100%) 12
24K

Use: ¾"φ Single CRS wire rope (IWRC)
breaking str. 25.6 tons − 10%

$$F.S. = 0.9 \frac{25.6}{12} \times 2 = 3.84$$ (Say OK, silt load conserv.)

Wraps on each drum of $.75 \times 24 = 18$"φ:

$$\frac{26}{1.5\pi} = 5.5$$ Say 8 wraps

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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE	PROJECT CHEF MENTEUR
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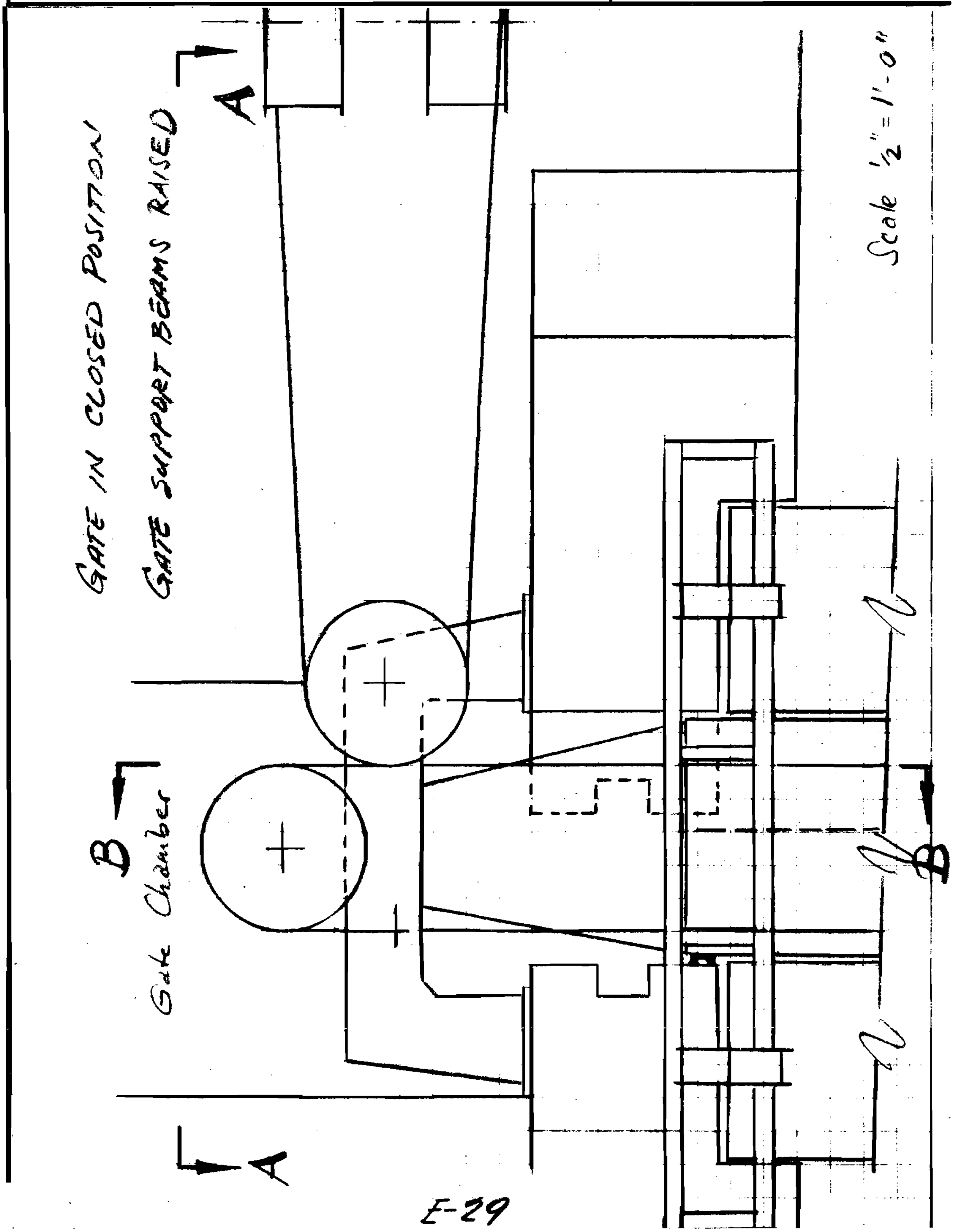
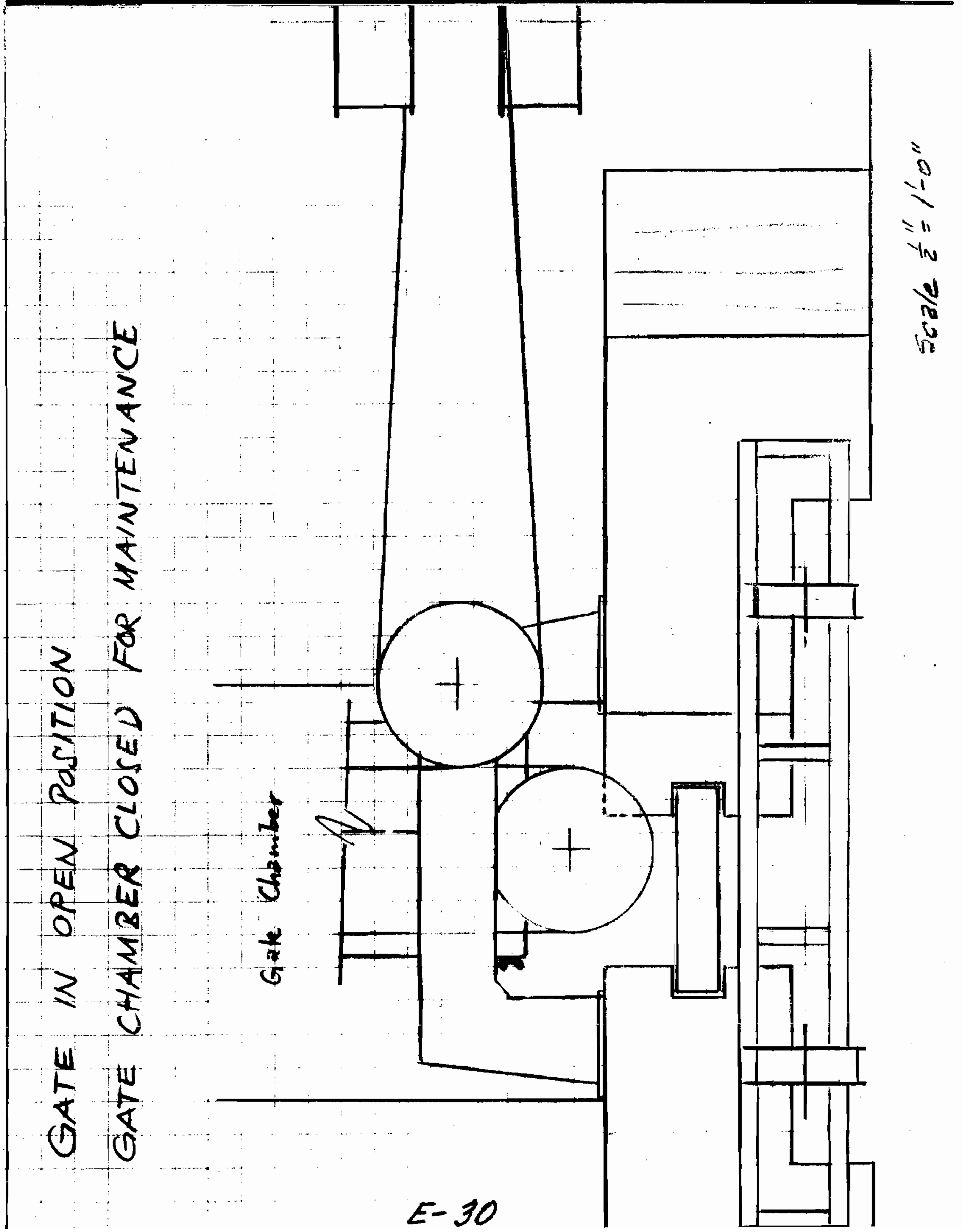


HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE	PROJECT CHEF MENTEUR
	COMPUTED HGK CHECKED	FILE NO. 453A
		DATE 4-23-68 PAGE 10 OF 32 PAGES



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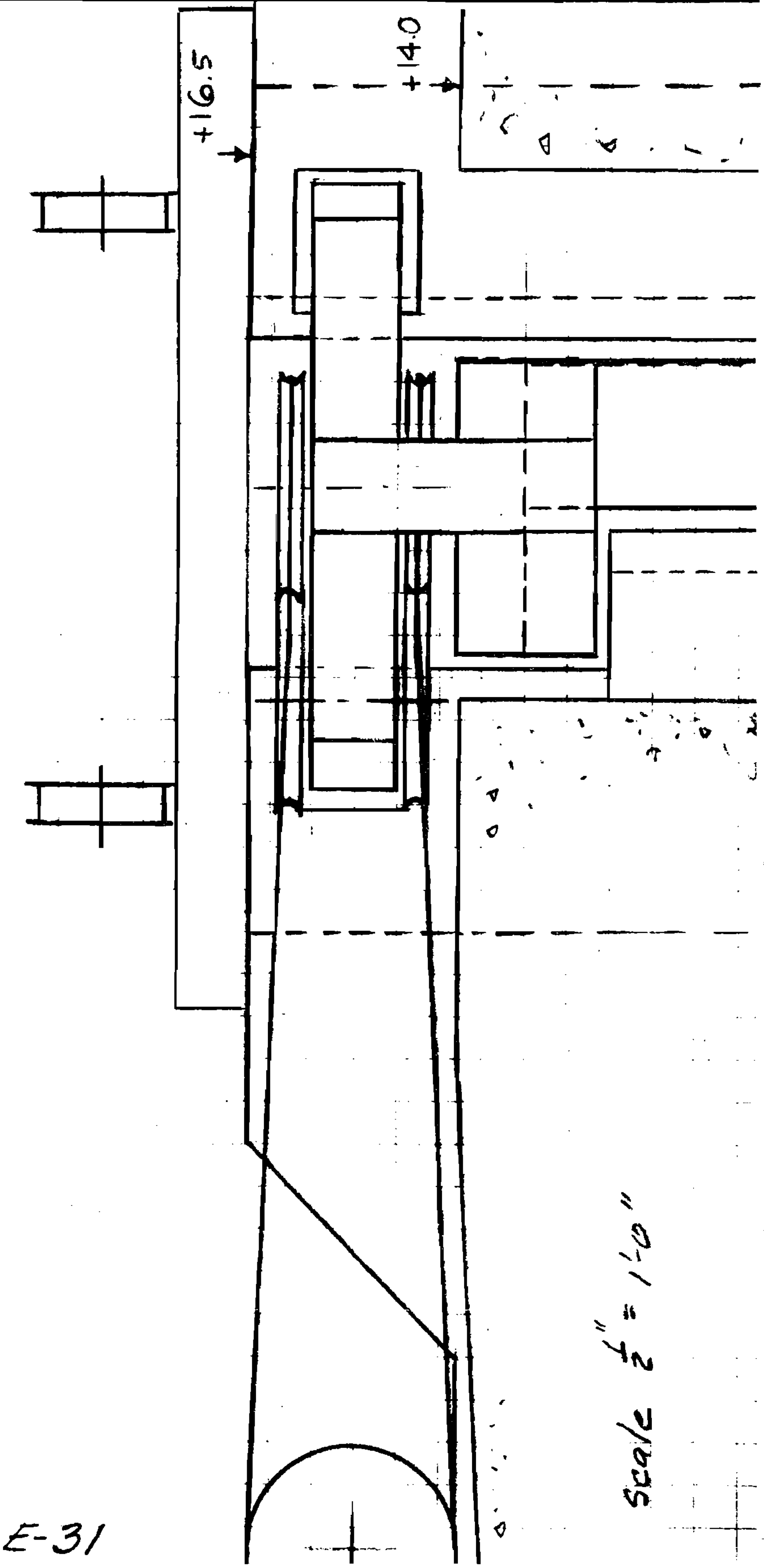
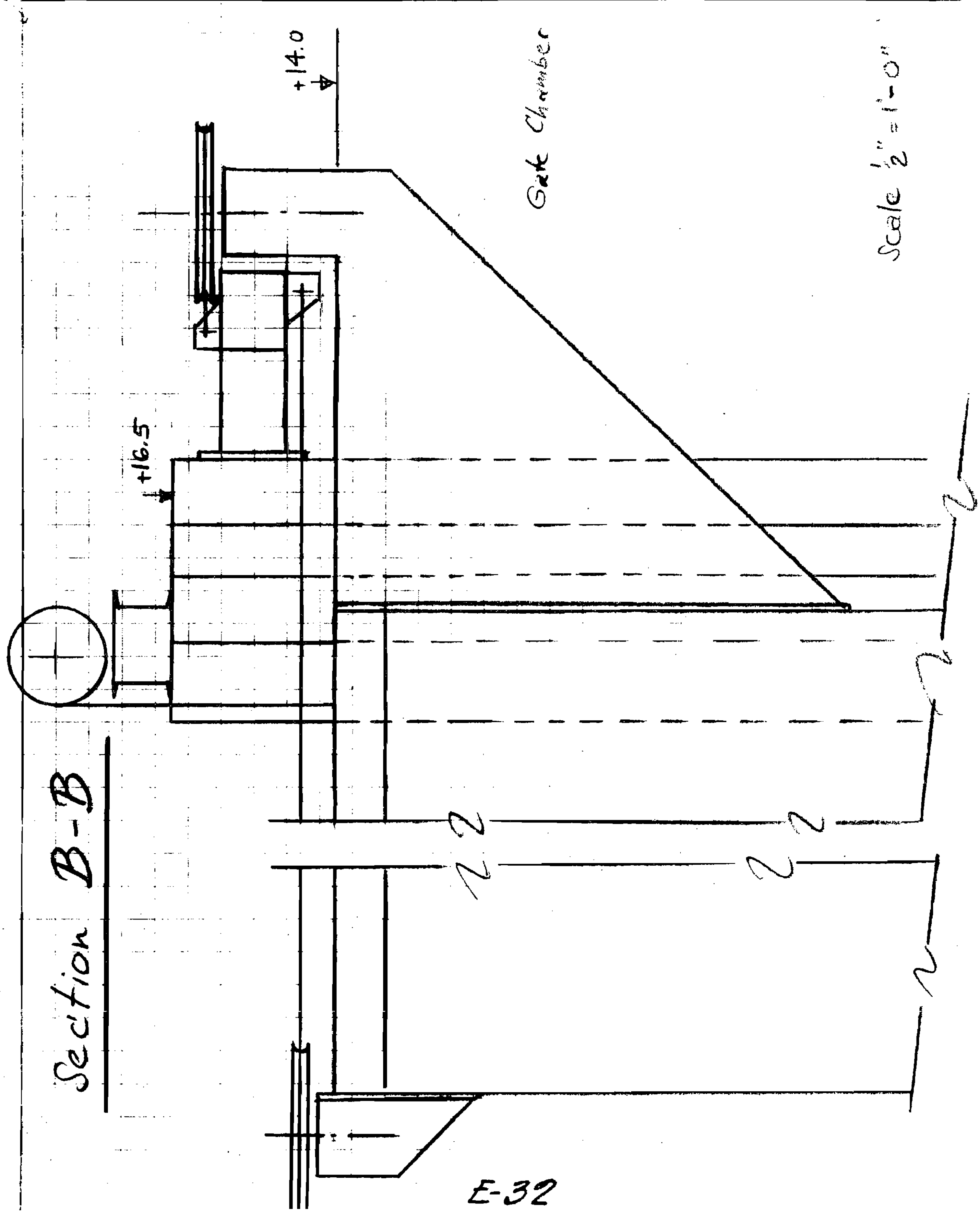


HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE	PROJECT CHEF MENTEUR
	COMPUTED HGK CHECKED	FILE No. 453A
		DATE 4-23-68 PAGE 12 OF 32 PAGES



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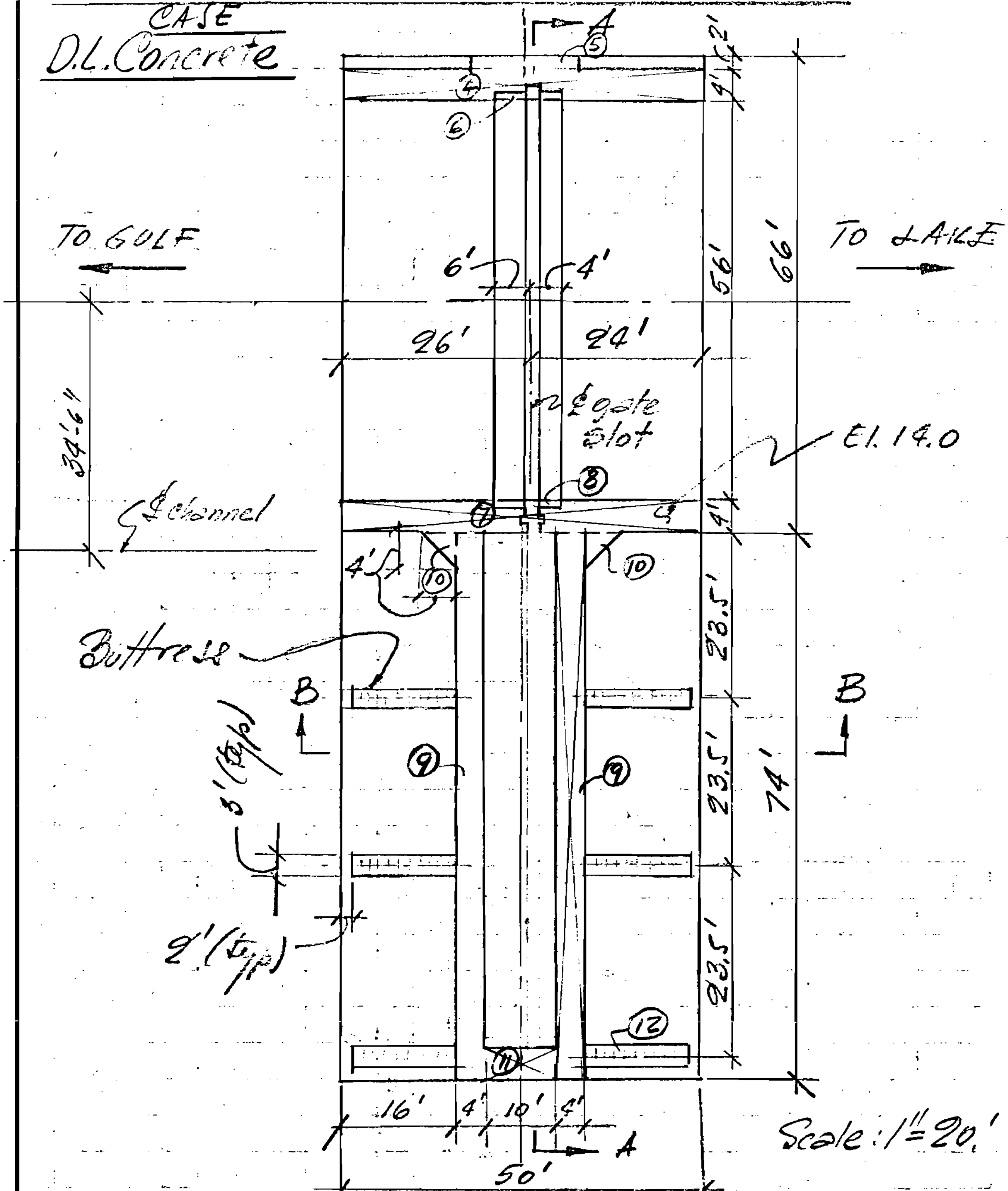
HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme COMPUTED [illegible] CHECKED	PROJECT CHEF MENTEU FILE NO. 4534 DATE 4-24-68 PAGE 13 OF 32 PAGES

ROLLING FLAT GATE SCHEME

CASE
D.L. Concrete



E-33

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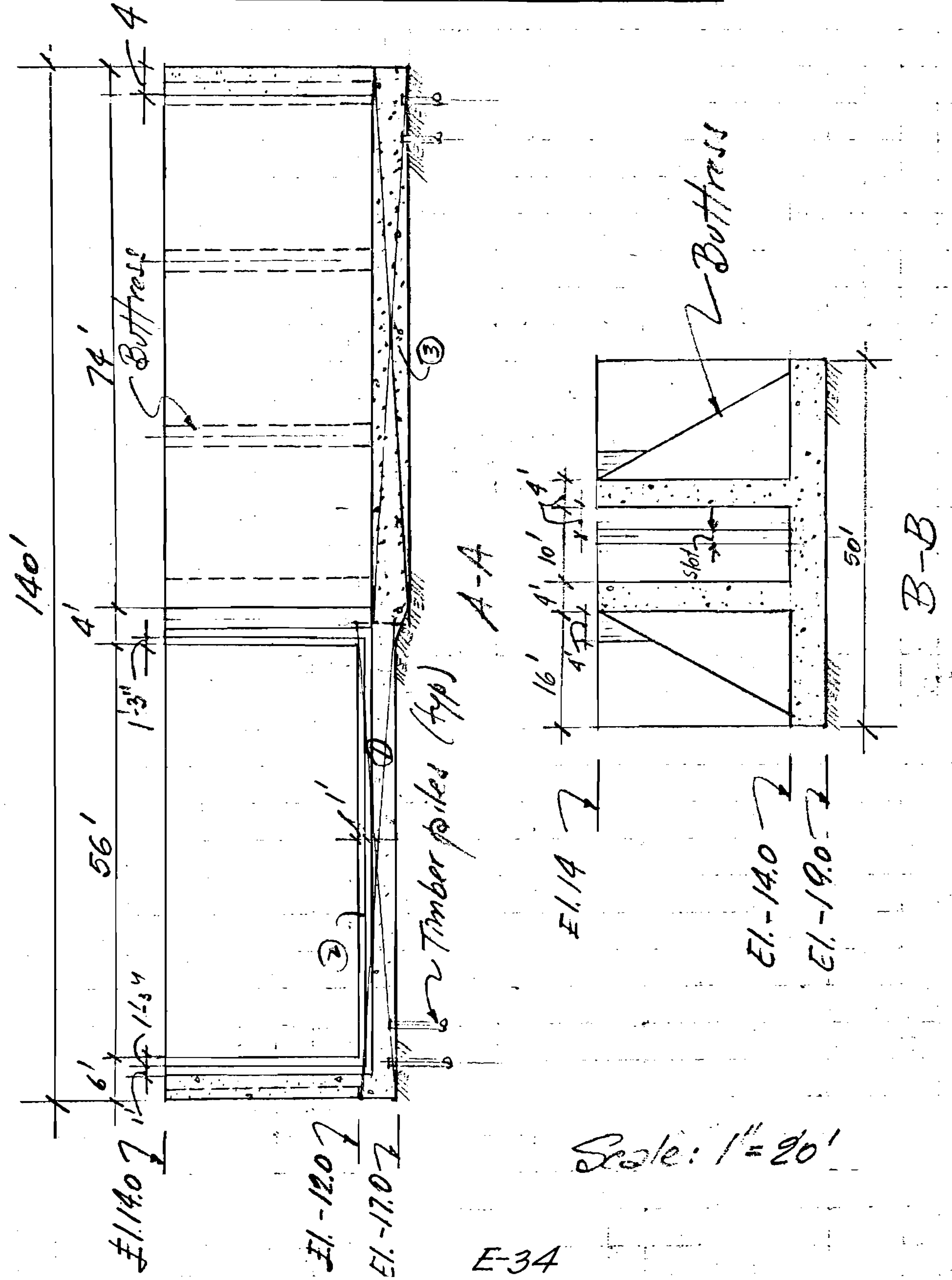
CASE - DL Concrete



Scale: 1" = 20'

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme	PROJECT CHEF MENTEUR
	COMPUTED [signature] CHECKED	FILE NO. 453A
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D.L. CONCRETE

	ITEM		WEIGHT (K.)
SLAB	1	$50 \times 65 \times 5 \times 0.15$	2440
	2	$-2 \times 10 \times 58 \times 0.15$	-174
	3	$50 \times 75 \times 5 \times$ —"—	2810
		SUBTOTAL:	5076
WALLS	4	$4 \times 50 \times 26 \times 0.15$	780
	5	$2 \times 15 \times 26$ —"—	117
	6	$-1.25 \times 10 \times 26$ —"—	-49
	7	$4 \times 50 \times 26 \times 0.15$	780
	8	$-1.25 \times 10 \times 26$ —"—	-49
	9	$4 \times 74 \times 26 \times 2$ —"—	2310
	10	$\frac{1}{2} \times 2 \times 4 \times 4 \times 26$ —"—	62.5
	11	$4 \times 10 \times 26$ —"—	156
	12	$6 \times \frac{1}{2} \times 14 \times 26 \times 3$ —"—	492
		SUBTOTAL:	4599.5
		TOTAL:	9675.5k
		Say	9700k

Assume that Center of gravity is at ℄ Structure.

Concrete Quantities:

$$\text{Walls} = \frac{4599.5}{0.15 \times 27} = 1{,}135 \text{ CY}$$

$$\text{Slabs} = \frac{5091.5}{0.15 \times 27} = 1{,}255 \text{ CY}$$

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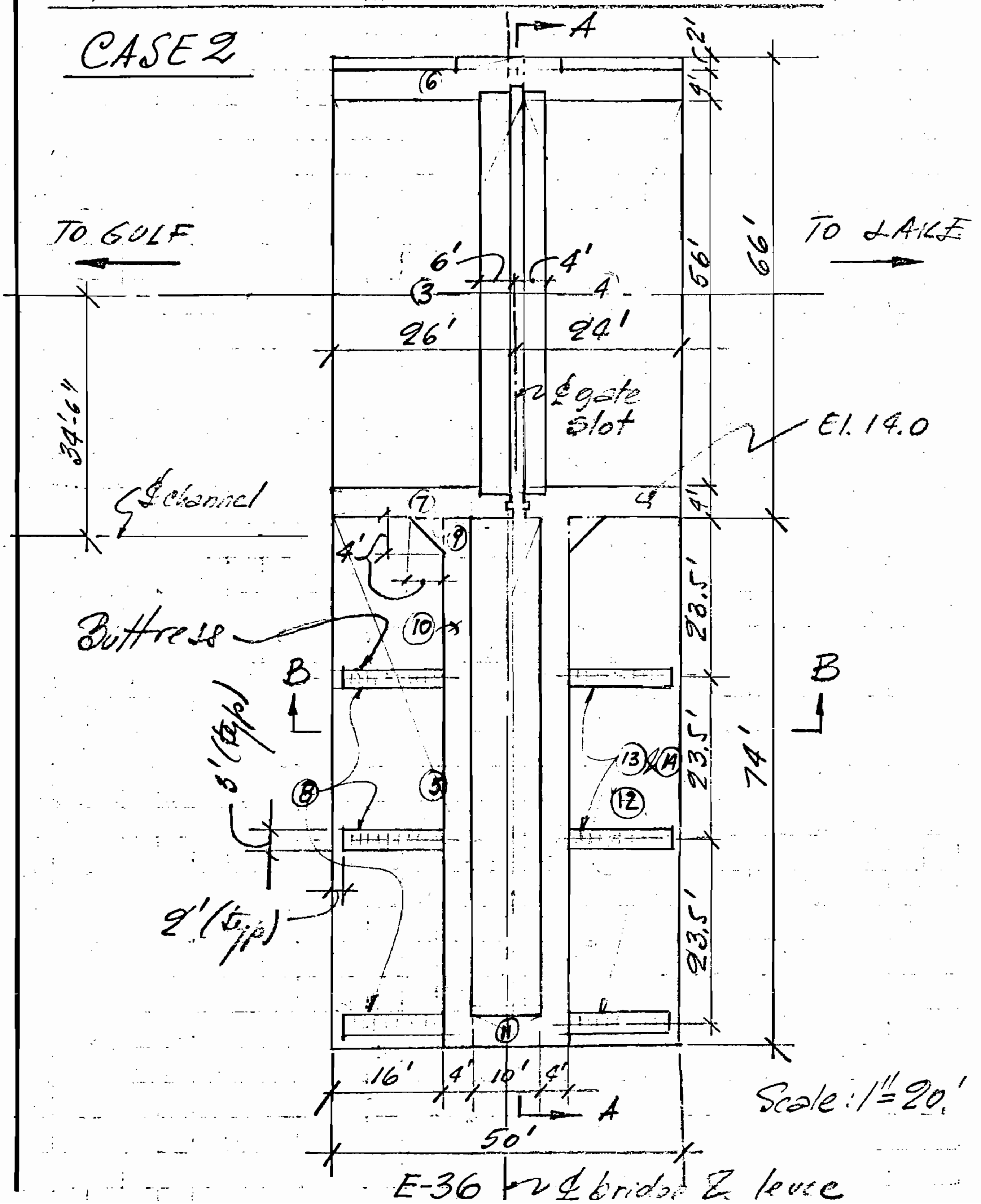
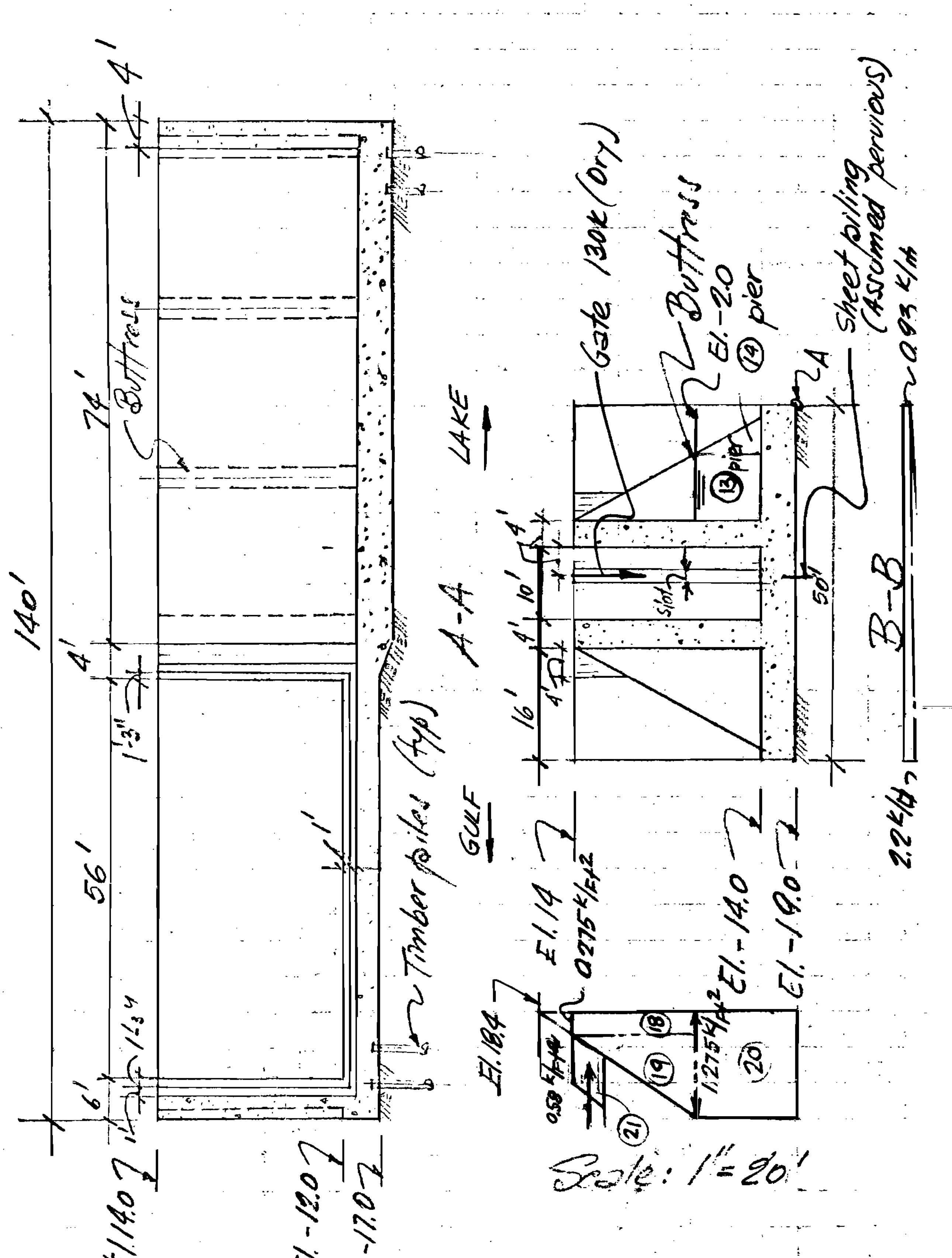
HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme COMPUTED Al. Gr. CHECKED	PROJECT CHEF MENTEUR FILE NO. 4534 DATE 4-24-68 PAGE 16 OF 32 PAGES

ROLLING FLAT GATE SCHEME

CASE 2



Scale: 1" = 20'



140'
74'
56'
4'
4'
1'-3"
1'-3"
6'
1'
Buttress
Timber piles (typ)
El. 14.0
El. -12.0
El. -17.0
LAKE
GULF
A-A
Gate 130k (dry)
Buttress
El. -20
(14) pier
(13) pier
slot
Sheet piling (Assumed pervious)
0.93 k/ft
2.2 k/ft
B-B
16'
10'
50'
El. 14
El. -14.0
El. -19.0
0.275 k/ft²
El. 18.4
0.58 k/ft
1.275 k/ft²
(18)
(19)
(20)
(21)
Scale: 1" = 20'

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme	PROJECT CHEF MENTEUR
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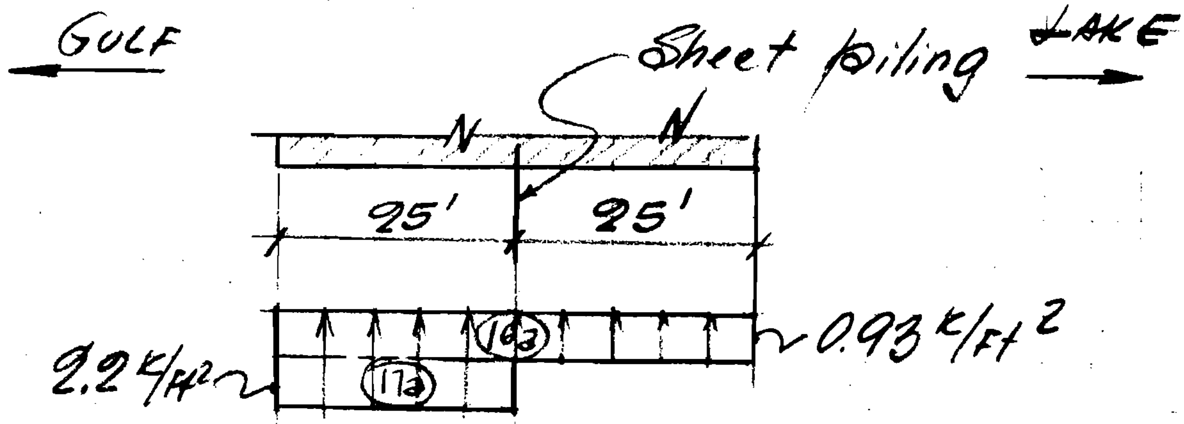
CASE 2 - Assumed Sheet Piling is pervious

	FORCE	H (K)	V (K) (+)	V (K) (−)	Arm (Ft)	M_A @A +	M_A @A −	Remarks
1.	D.L Concrete		9700		25	243,000		
2.	Gate		130		24	3,130		
3.	56×27×30.4×0.0625		2870		36.5	104,700		Vertical / W.L
4	56×23×10 —"—		806		11.5	9,300		Vertical / W.L
5	74×34×30.4 —"—		4780		33	157,800		Vertical / W.L
6	44×.5×27 —"—		37		36.5	1,350		Vertical / W.L
7	44×4×27 —"—		30		36.5	1,095		Vertical / W.L
8	3×½×14×26×3 —"—			102.5	38.7		3960	Vertical / W.L
9	½×4×4×26 —"—			13	35.33		460	Vertical / W.L
10	74×4×26 —"—			480	32		1540	Vertical / W.L
11	10×4×26 —"—			65	25		1625	Vertical / W.L
12	16×74×10 —"—		740		8	5920		Vertical / W.L
13	9×10×3×3 —"—			51	11.5		586	Vertical / W.L
14	½×5×10×3×3 —"—			14	5.33		75	Vertical / W.L
15	½×4×4×10 —"—			5	14.67		74	Vertical / W.L
16	.094×50×140			6575	25		164,500	uplift
17	½×1.275×50×140			4470	33.3		149,000	uplift
18	0.275×16×140	617			23		14,200	Horizontal W.L.
19	½×1.0×16×140	1120			20.33		22,700	Horizontal W.L.
20	1.275×15×140	2680			7.5		20,100	Horizontal W.L.
21	0.58×140	81			29.9		2,420	Horizontal W.L.
		4498	19,093	11,775.5		526,295	381,240	

↓ ΣV=7,317.5 ↺ ΣM=145,055

$$\bar{x} = \frac{145{,}055}{7{,}317.5} = 19.8' \qquad e = \frac{50}{2} - 19.8 = 5.2'$$

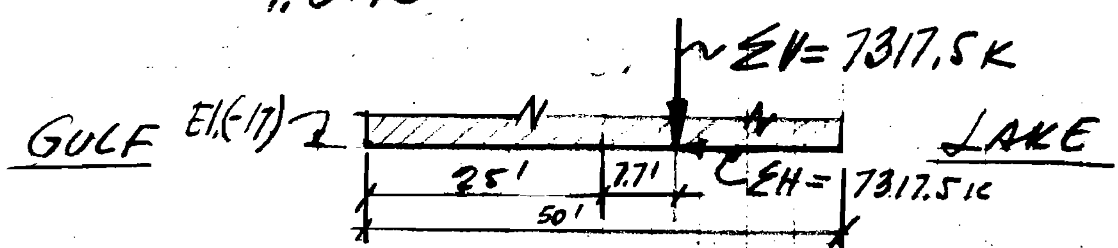
CASE 2 - Assumed Sheet piling is impervious



	FORCE	H(K)	V(K) +	V(K) −	Arm (Ft)	M_A ↺CA +	M_A ↺CA −	
	From p. 4	4498	19,093	11,775.5		526,295	381,240	
	See uplift p. 4.		6575			164,500		} uplift
			4470			149,00		
	Uplift as shown above:							
16a	0.94×50×140			6575	25		164,500	
17a	1.275×25×140			4470	37.5		167,500	
		4498	30,138	22,820.5		839,795	713,240	

$\Sigma V = 7317.5$ (K) $\quad \Sigma M = 126,555$ (IK)

$$X = \frac{126,555}{7,3175} = 17.3' \qquad e = 25 - 17.3 = 7.7'$$



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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme	PROJECT CHEF MENTEUR
	COMPUTED [illegible] CHECKED	FILE NO. 4534
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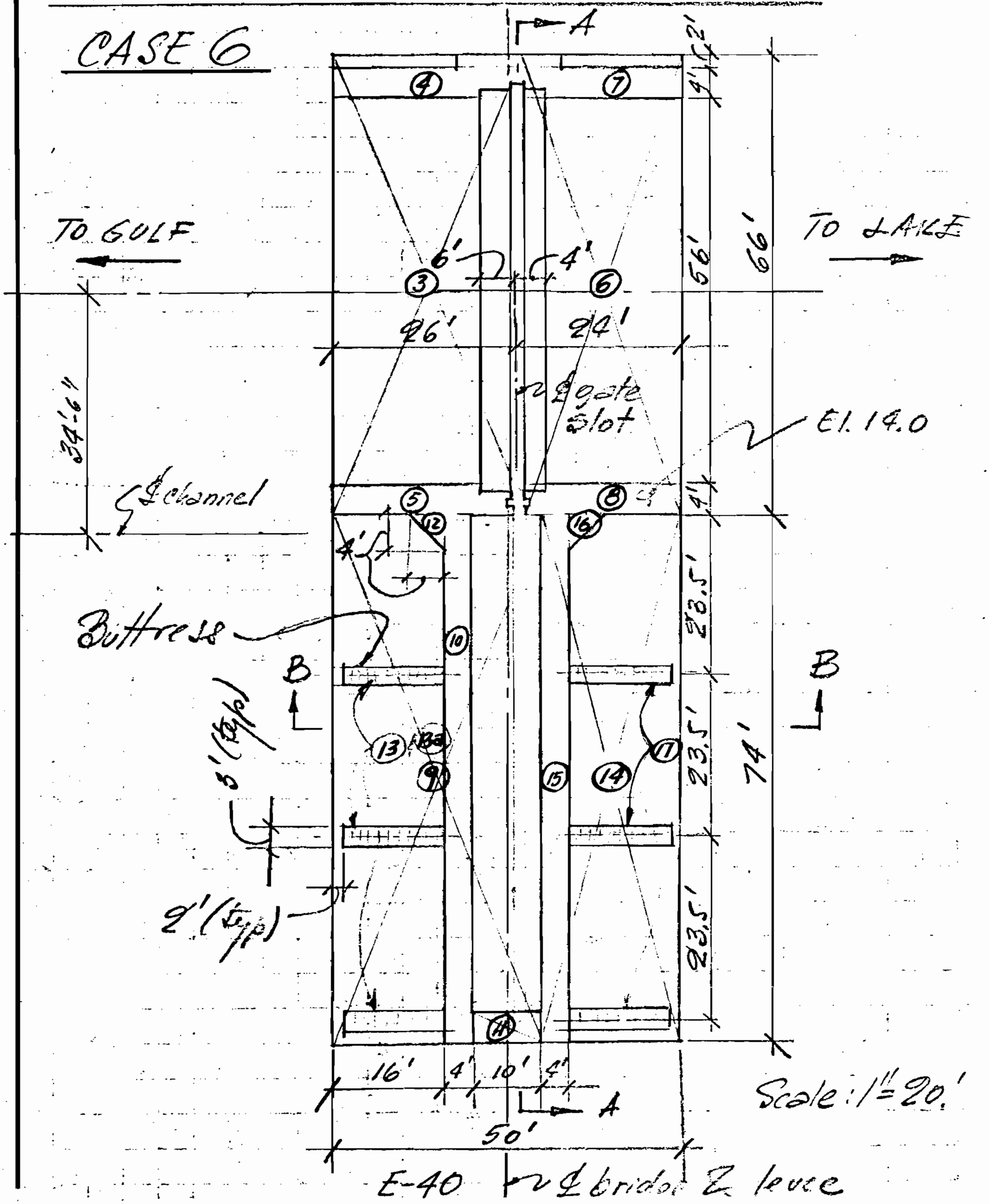
ROLLING FLATGATE SCHEME

CASE 6



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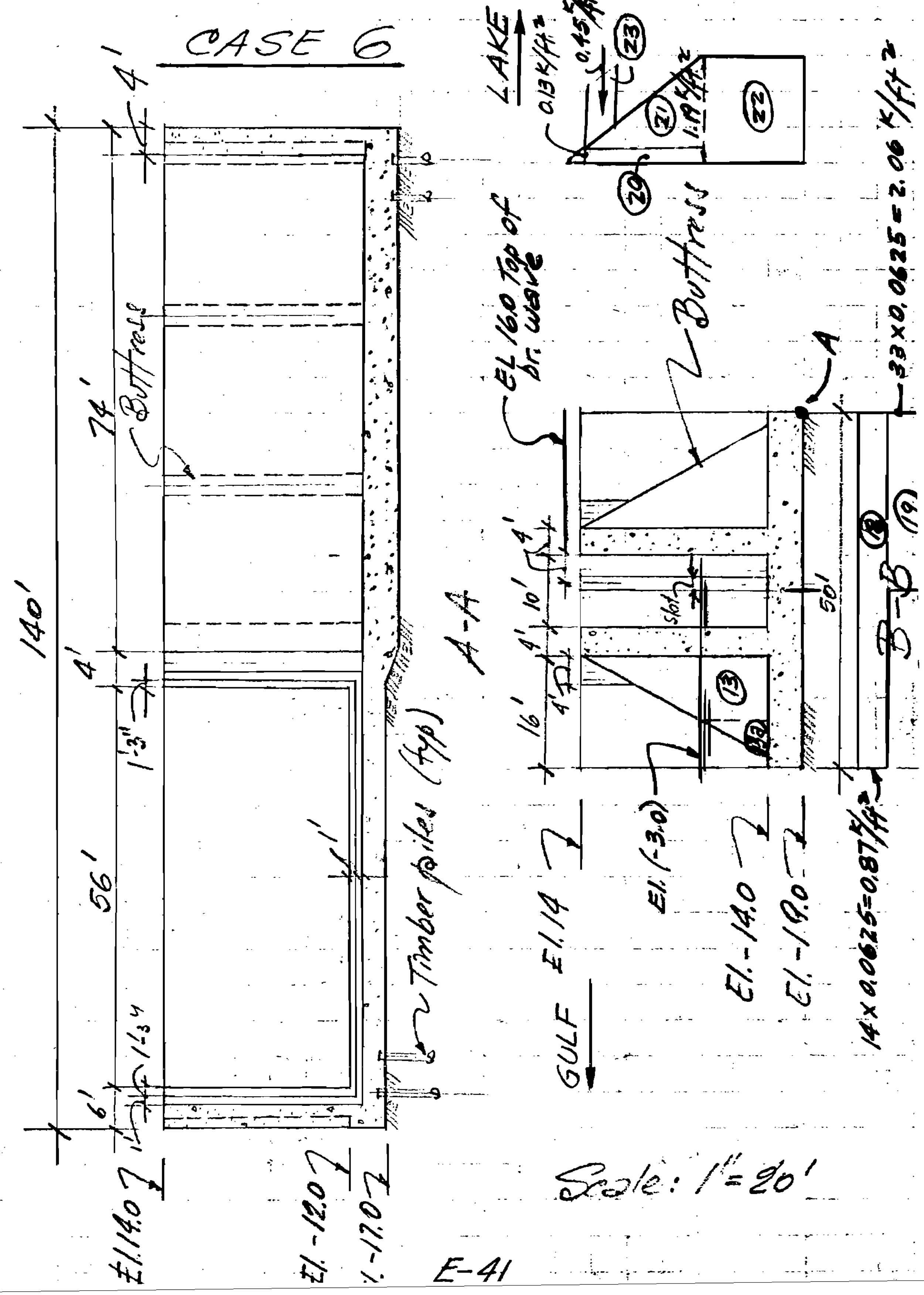
HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. Rolling Flat Gate Scheme COMPUTED CP. Fox CHECKED	PROJECT CHEF MENTEUR FILE No. 4534 DATE 4-25-68 PAGE 21 OF 32 PAGES

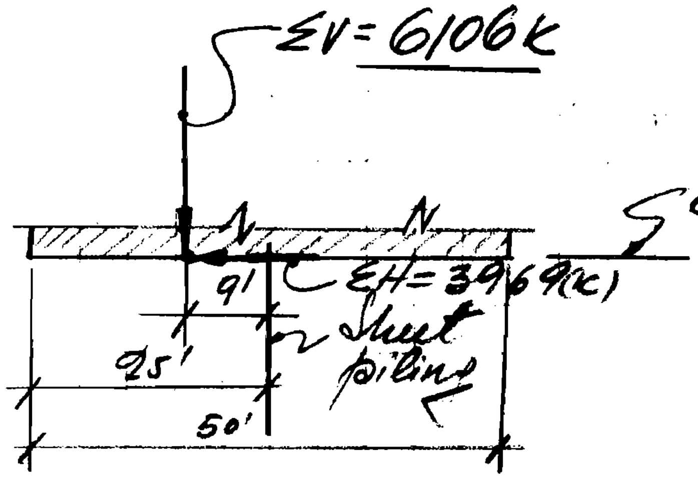


CASE 6 Assumed Sheet piling is impervious.

	Force	H(K)	V(K) +	V(K) −	Arm (Ft)	(M_A) @ A +	(M_A) @ A −	
1.	D.L. Concrete		9700		25	243,000		
2.	Gate		130		24	3,130		
3	27×66×9×0.0625		1005		36.5	36,700		Vertical W.L.
4	27×4×9 —"—			60.5	36.5		2210	
5	Same as (4)			60.5	36.5		2210	
6	23×66×28×0.0625		2660		11.5	30,600		
7	23×4×26 —"—			150	11.5		1730	
8	Same as (7)			150	11.5		1730	
9	30×74×9 —"—		1252		35	43,900		
10	4×74×9 —"—			166.5	32		5330	
11	4×10×9 —"—			22.5	25		565	
12	½×4×4×9 —"—			4.5	35.35		159	
13	9×9×3×3 —"—			45.6	38.5		1750	
13a	½×7×9×3×3 —"—			17.7	43.35		766	
14	20×74×28 —"—		2595		10	25,950		
15	Same as (10)			166.5	18		3000	
16	Same as (12)			4.5	14.67		66	
17	½×16×26×3×3 —"—			117.0	10.67		1250	
18	0.87×50×140			6110	25		152,800	Uplift
19	1.19×25×140			4160	12.5		52,000	
20	0.13×17×140	309			22.5	6,950		Horiz. W.L.
21	½×1.06×17×140	1262			19.67	24,850		
22	1.19×14×140	2335			7	16,350		
23	0.45×140	63			29.75	1,880		
			17,342	11,235.8		433,310	225,566	
		ΣH=3969k	ΣV=6,106.2			ΣM=207,744		

$$X = \frac{207{,}744}{6{,}106.2} = 34' \quad e = 34 - 25 = 9'$$

CASE 6 (Cont.) (33 1/3% overstress allowed)



COST ESTIMATE

1) Flap Gate (Hydr.)

2-Cylinders to operate gate

150 tons pull each - 22' stroke

2-Cylinders to operate Dogging device

5 tons pull each - 2' stroke

Power unit & Controls

TOTAL COST $50,000.-

2) Rolling Gate (Rope Hoist)

Rolling Gate Hoist

Horiz. Beam Support Hoist

TOTAL COST $25,000.-

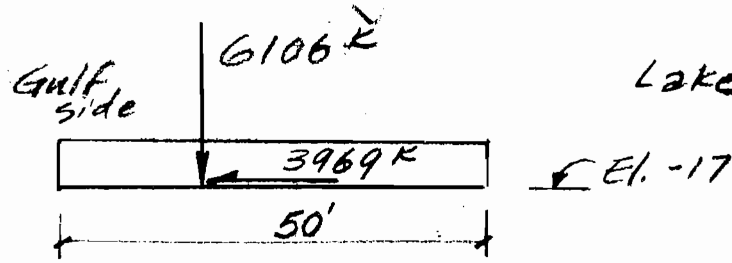
Purpose To design an alternative pile foundation for the navigation structure (Rolling flat gate scheme)

Assumptions:

1. Case 6 governs for both directions.
2. The pile foundation will contain two pile groups. The first group resists loads with headwater on the lake side. The second group resists loads with headwater on the gulf side

Given

① Case 6 loading.



The slab is 50' x 140'

② F.S. = 1.75

③ Allow 33⅓% overstress

④ For slab size and loading computation see p.23 Navigation structure - Rolling flat gate scheme

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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE COMPUTED KLW CHECKED	PROJECT CHEF MENTEUR FILE NO. 453A DATE 4-25-68 PAGE 26 OF 32 PAGES

(5) Construction case

Dead load concrete 9700^K at center of slab

Gate 130^K at about the center

Total dead load 9700 + 130 = 9830^K

Result p. 31

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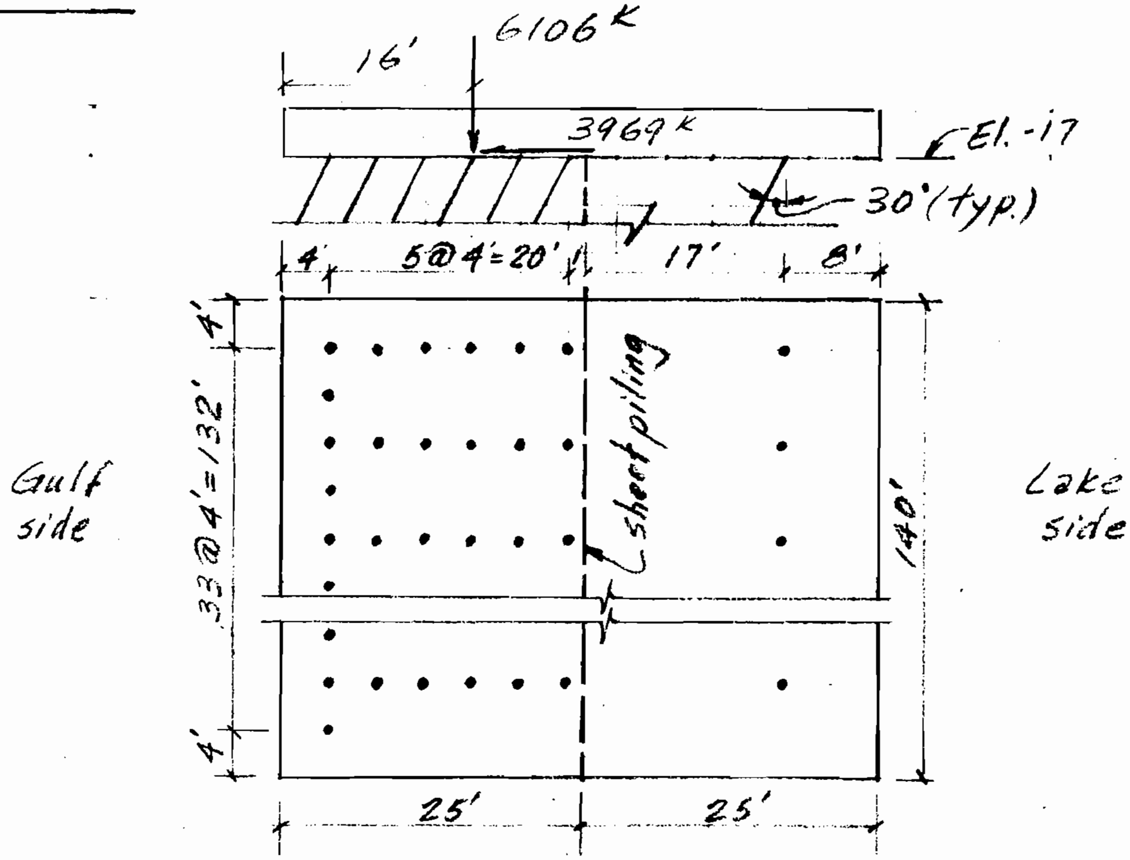
Case 6



Center of gravity (consider two adjacent rows)

is $\frac{6 \times 14' + 1 \times 42' + 1 \times 4'}{8} = \frac{130}{8} = 16.25'$ from gulf side edge

Eccentricity $= 16.25 - 16 = 0.25'$

$\frac{(\Sigma M)c}{I} = \frac{(\Sigma V \times e)c}{I} \doteq 0$

The resultant is acting $\theta = \tan^{-1}\frac{3969}{6106} = 33°$ with vertical

use 30° batter piles.

Total rows $\frac{140-4-4}{4} + 1 = 34$ rows

Total number of piles = 7 piles × 17 rows + 1 × 17 rows

= 136

Horizontal component of each pile load.

$$\frac{\Sigma H}{\text{No. of piles}} = \frac{3969}{136} = 29.2 \text{ kips/pile}$$

Axial pile load = 29.2 csc 30° = 58.4 Kips
Since a $33\frac{1}{3}\%$ overstress is allowed the desig pile load is $58.4 \times \frac{1}{1.333} = 44$ kips = 22 tons/pile

F.S. = 1.75

Required pile capacity = 44 × 1.75

= 77 kips/pile

= 38.5 tons/pile.

(batter 30°).

Required pile length 55 ft from the curve of "Maximum Batter Pile Capacity for Navigation Structure" by KLW. (A copy is attached)

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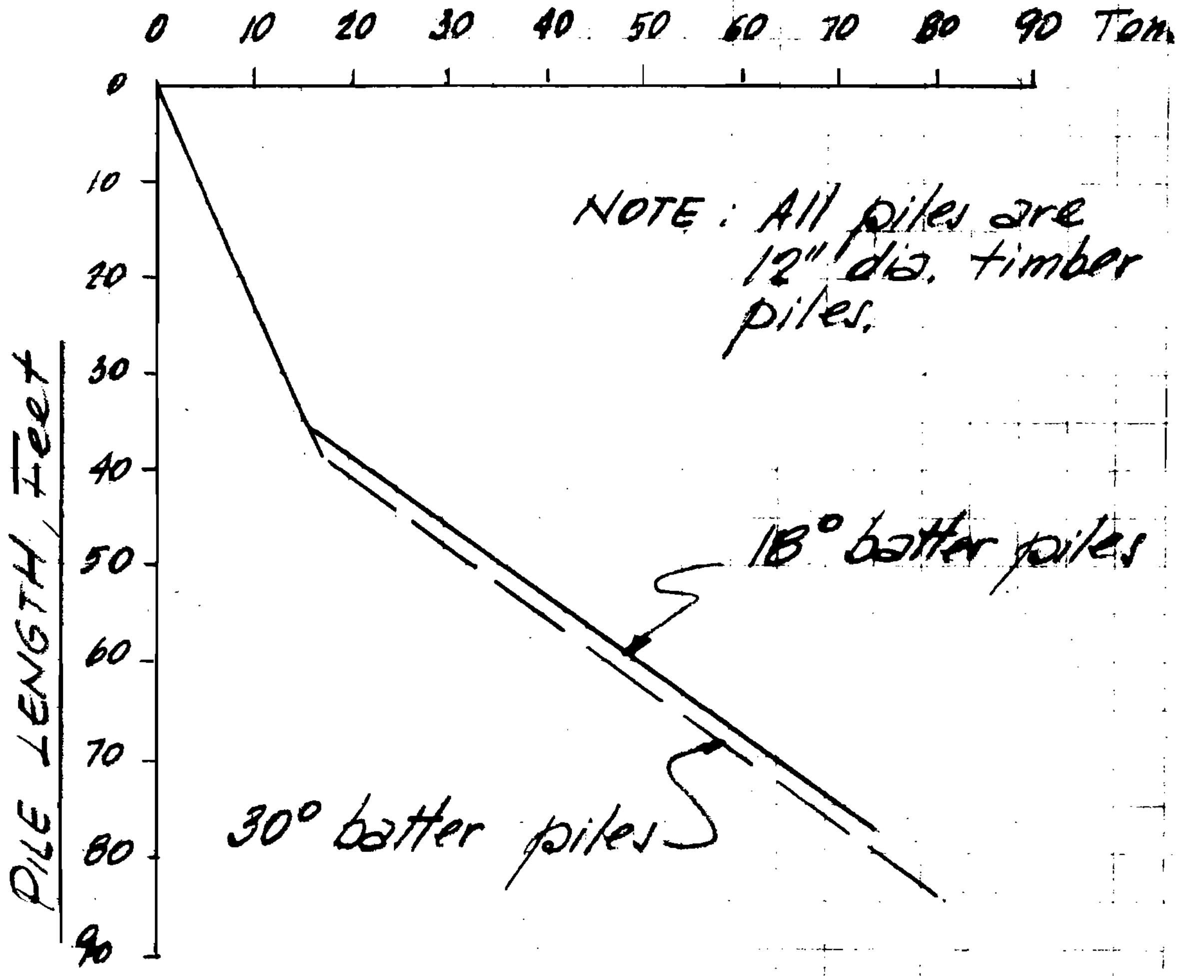
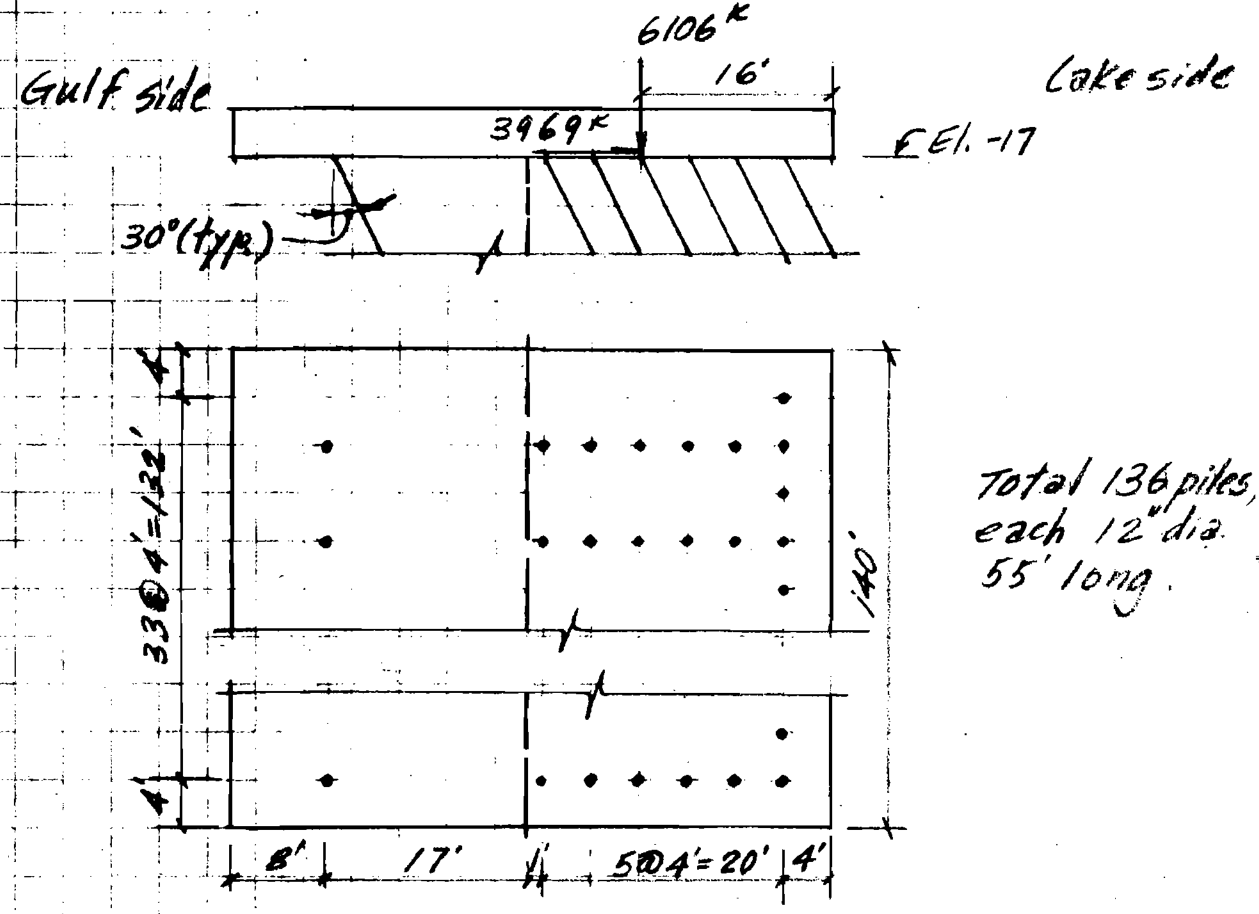
NAVIGATION STRUCTURE

MAXIMUM BATTER PILE CAPACITY



Reversed Case 6

Since the load is reversed the image of the previous design would be satisfied. The arrangement is shown below



Total 136 piles, each 12" dia. 55' long.

Construction case

The foundation will have the two groups of piles for "case 6 loading" and "reversed case 6 loading". The total number of piles is 2 × 136 = 272. The c.g. of these 272 is at the middle of slab, and so the dead load of the structure. The loading is evenly distributed to each pile

vertical component = $\frac{9830^k \text{ (Dead load)}}{272 \text{ piles}} = 36\ ^k/\text{pile}$

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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR. ROLLING FLAT GATE COMPUTED KLW CHECKED	PROJECT CHEF MENTEU FILE NO. 453A DATE 4-26-68 PAGE 31 OF 32 PAGES

The axial pile load = 36 × sec 30° = 42^k/pile

= 21 tons/pile.

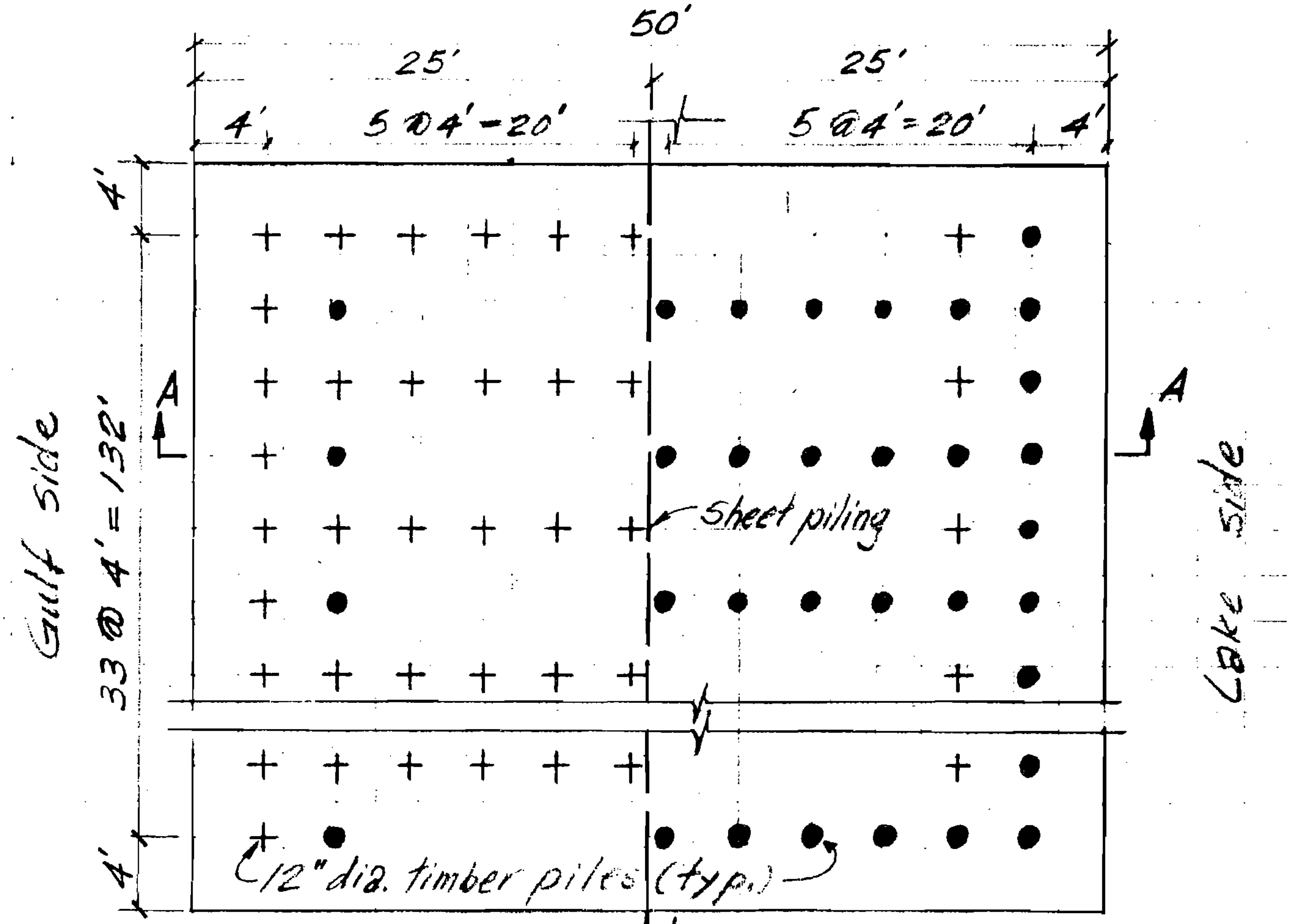
The pile capacity of a 55-ft timber pile with 12 in. in diameter is 38.5 tons/pile (P.28)

$$F.S. = \frac{38.5 \text{ tons/pile}}{21} = 1.84 > 1.75 \quad O.K.$$

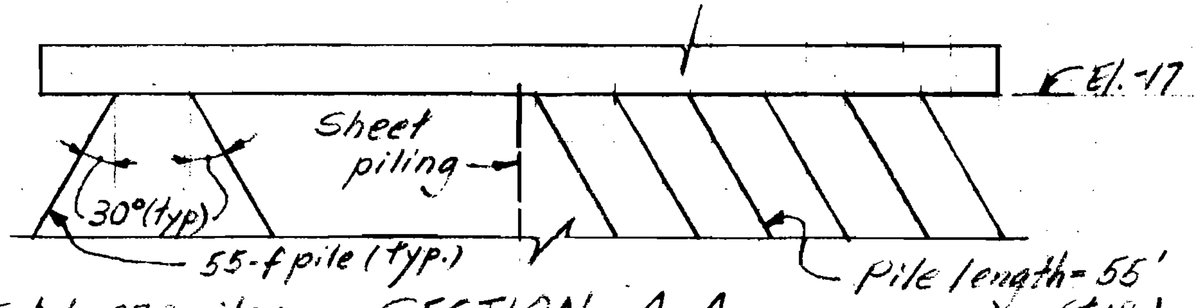
Total pile length 272 × 55 = 14,9[illegible] l.f.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT NAVIGATION STR ROLLING FLAT GATE	PROJECT CHEF MENTEUR
	COMPUTED KLW CHECKED	FILE NO. 453A
		DATE 4-26-68 PAGE 32 OF PAGES

ALTERNATIVE PILE FOUNDATION FOR NAVIGATION STR.



PLAN



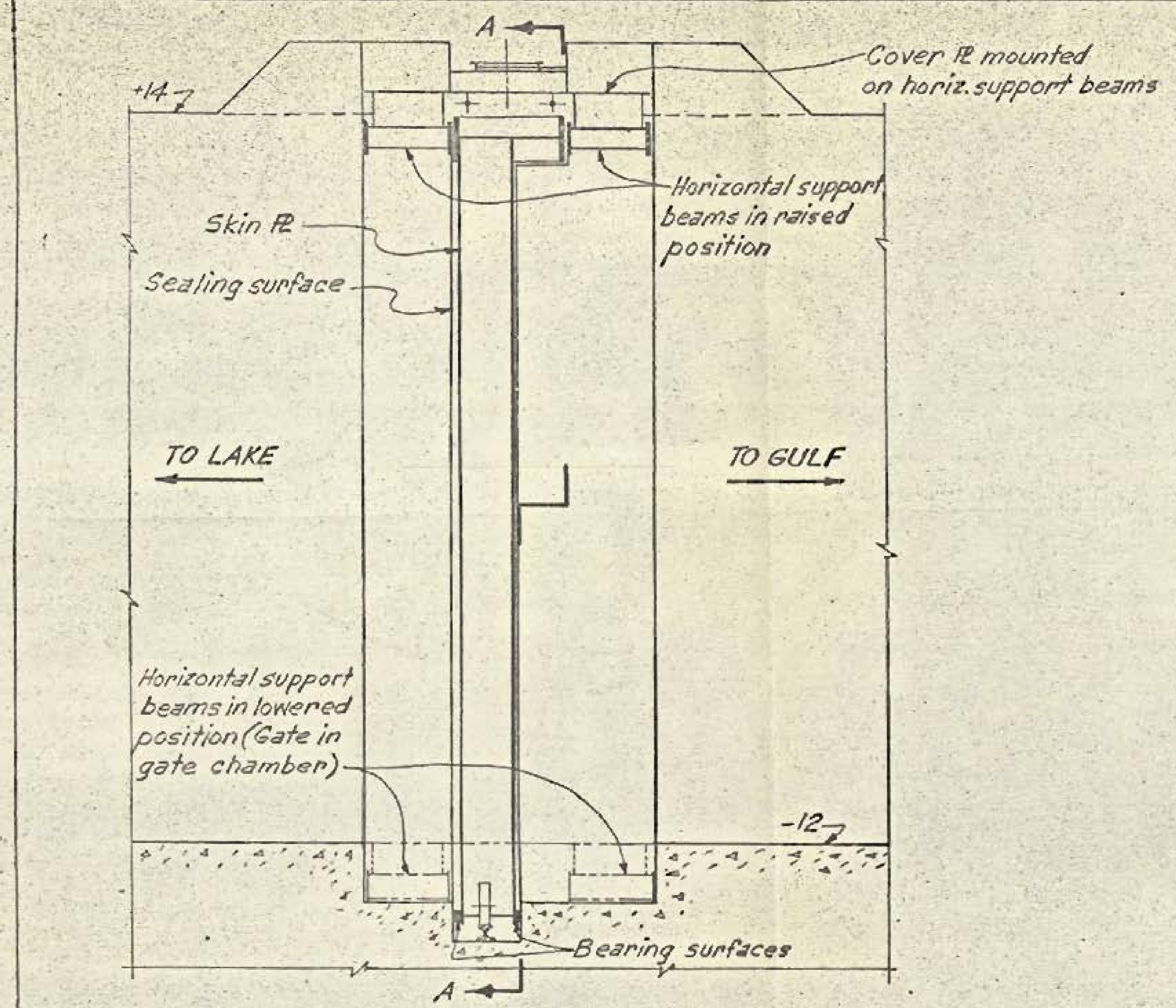
SECTION A-A

NOTE: Total 272 piles
Total pile length 15000'
All piles have a design pile load of 22 tons/pile

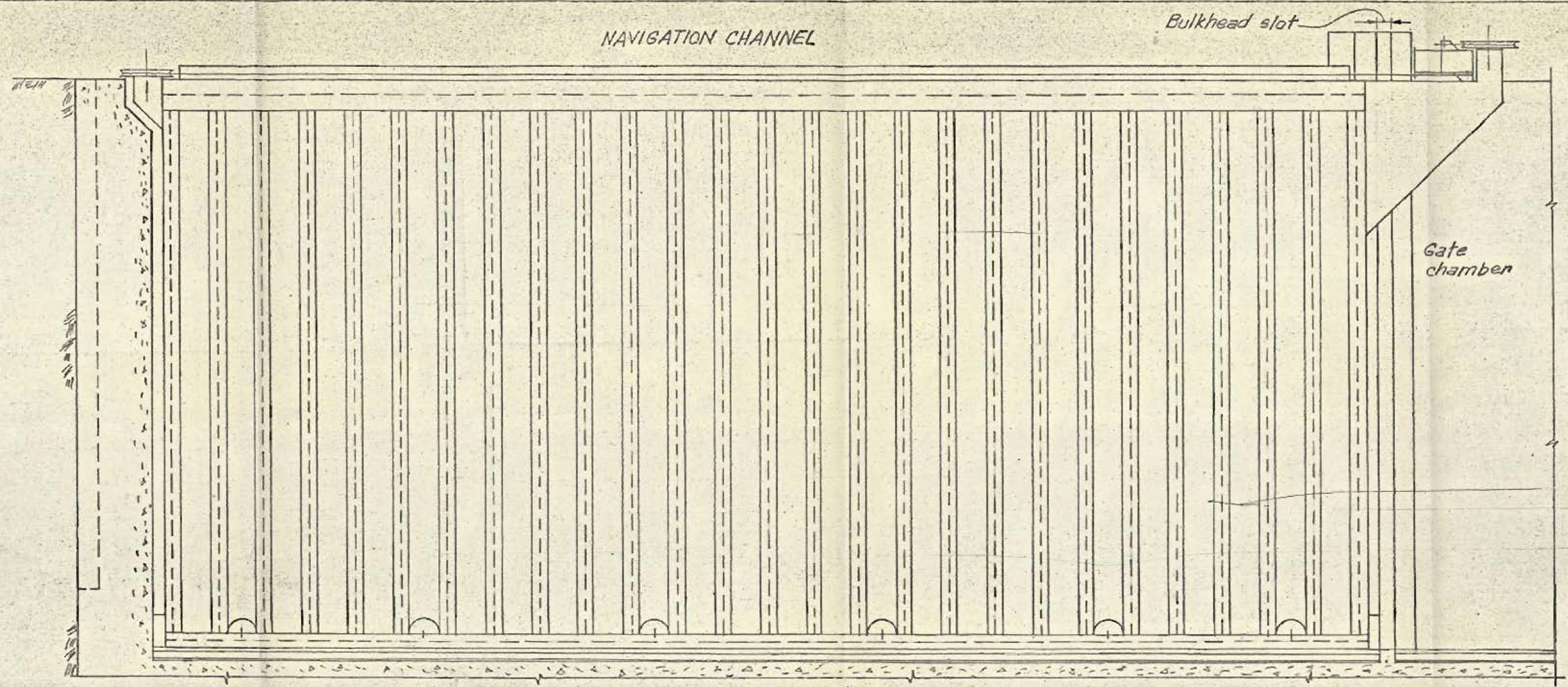
Scale 1" = 10'

A
+14
Dogging device
Sealing surface
Skin Pl
Steel lining flush with pier face to cover recess in concrete
2'-3" deep recess in pier
Flap gate in closed position
TO LAKE
TO GULF
℄ hoist cylinder (Flap gate in closed position)
Flap gate in open position
-12
A
SECTION
(Gate hoist not shown)
℄ hoist cylinder
℄ dogging pin (gate dogged)
℄ hoist cylinder
℄ dogging pin (gate dogged)
Hinges (typ)
A-A
Scale 1/4"=1'-0"
EURK & ASSOC. INC. NEW ORLEANS LA.
HARZA ENG. CO. CHICAGO, ILL.
CHEF MENTEUR PASS COMPLEX
NAVIGATION STRUCTURE
ALTERNATE STUDY
FLAP GATE SCHEME
458 SKC-1

PLATE E-1



SECTION (Gate machinery not shown)



A-A
(Gate shown in closed position)

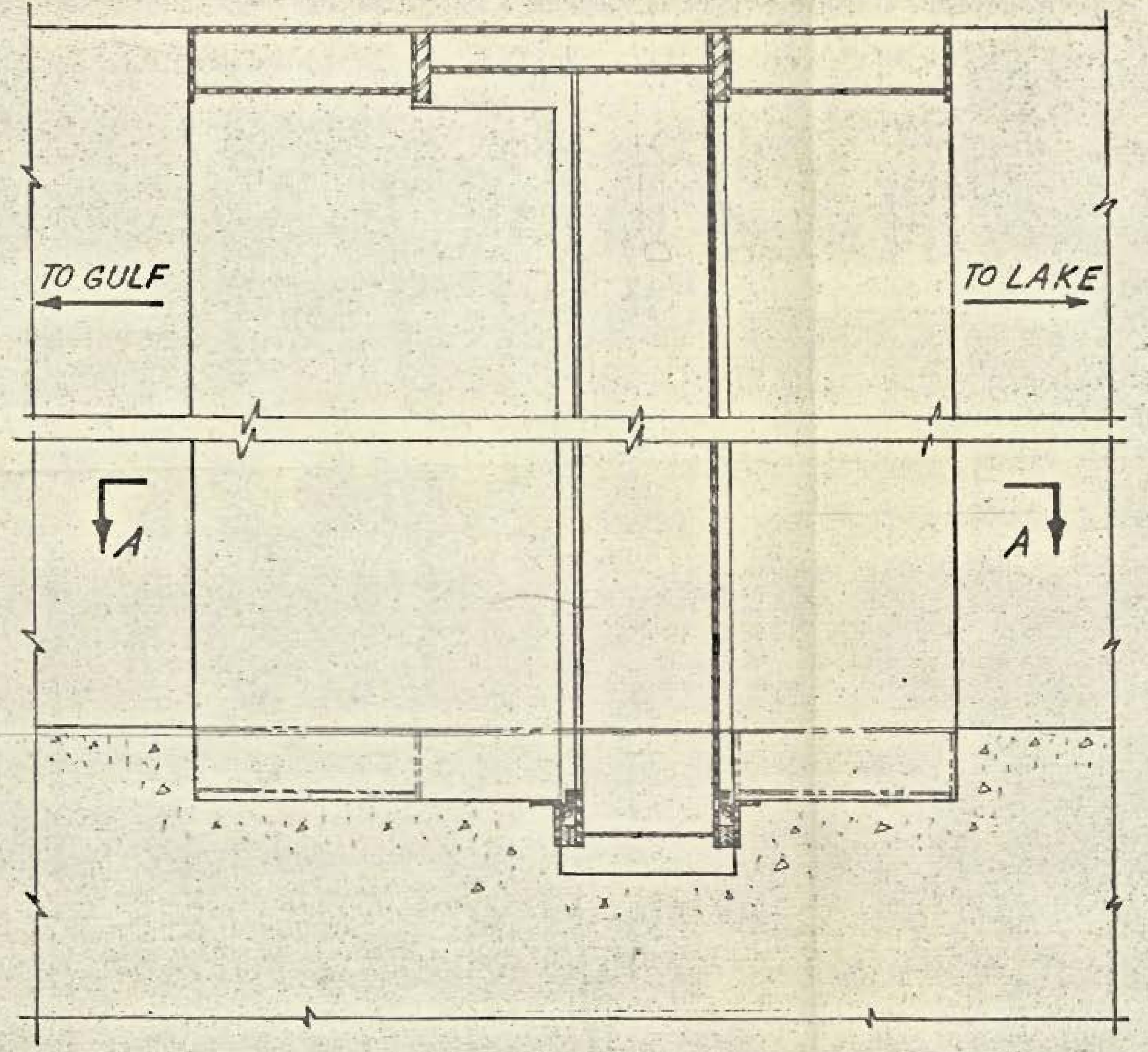
Scale 1/4"-1'-0"

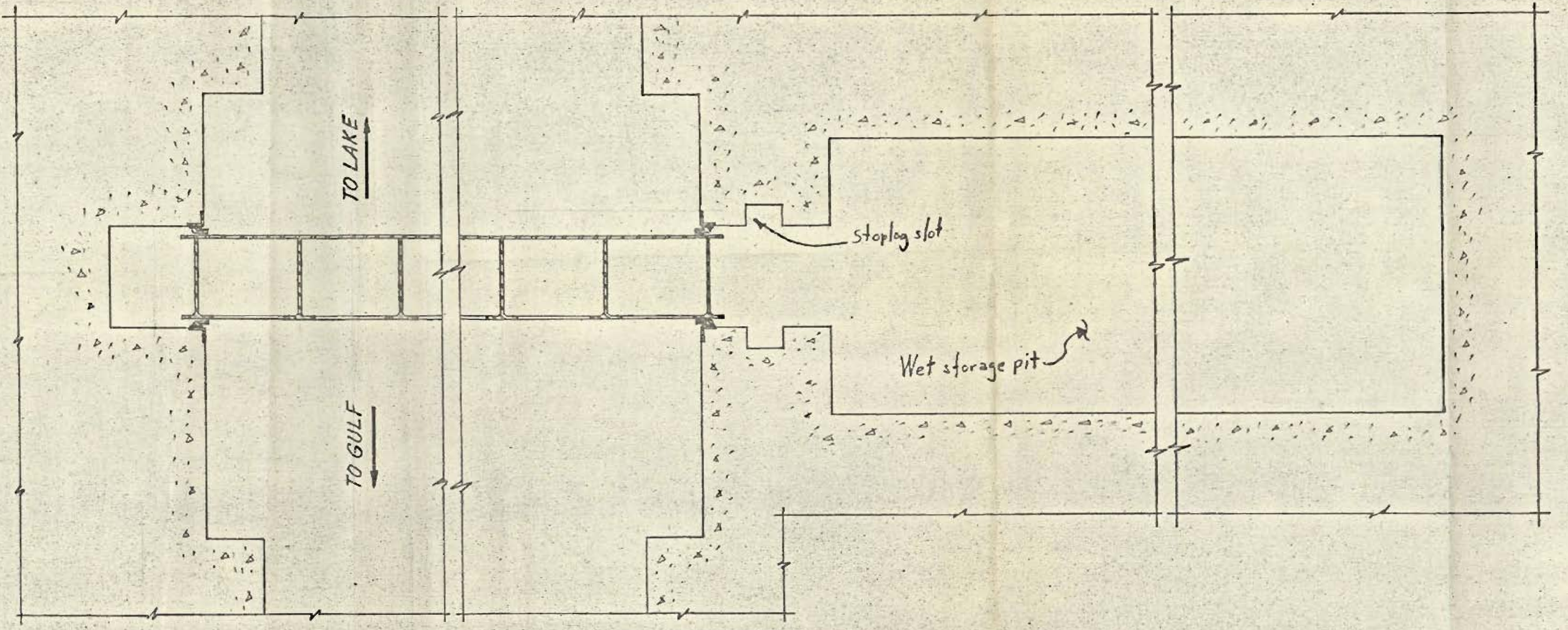
BURK & ASSOC. INC. NEW ORLEANS, LA	HARZA ENG. CO CHICAGO, ILL

CHEF MENTEUR PASS COMPLEX
NAVIGATION STRUCTURE
ALTERNATE STUDY
ROLLING GATE SCHEME

4F5 SKC-2

PLATE E-2

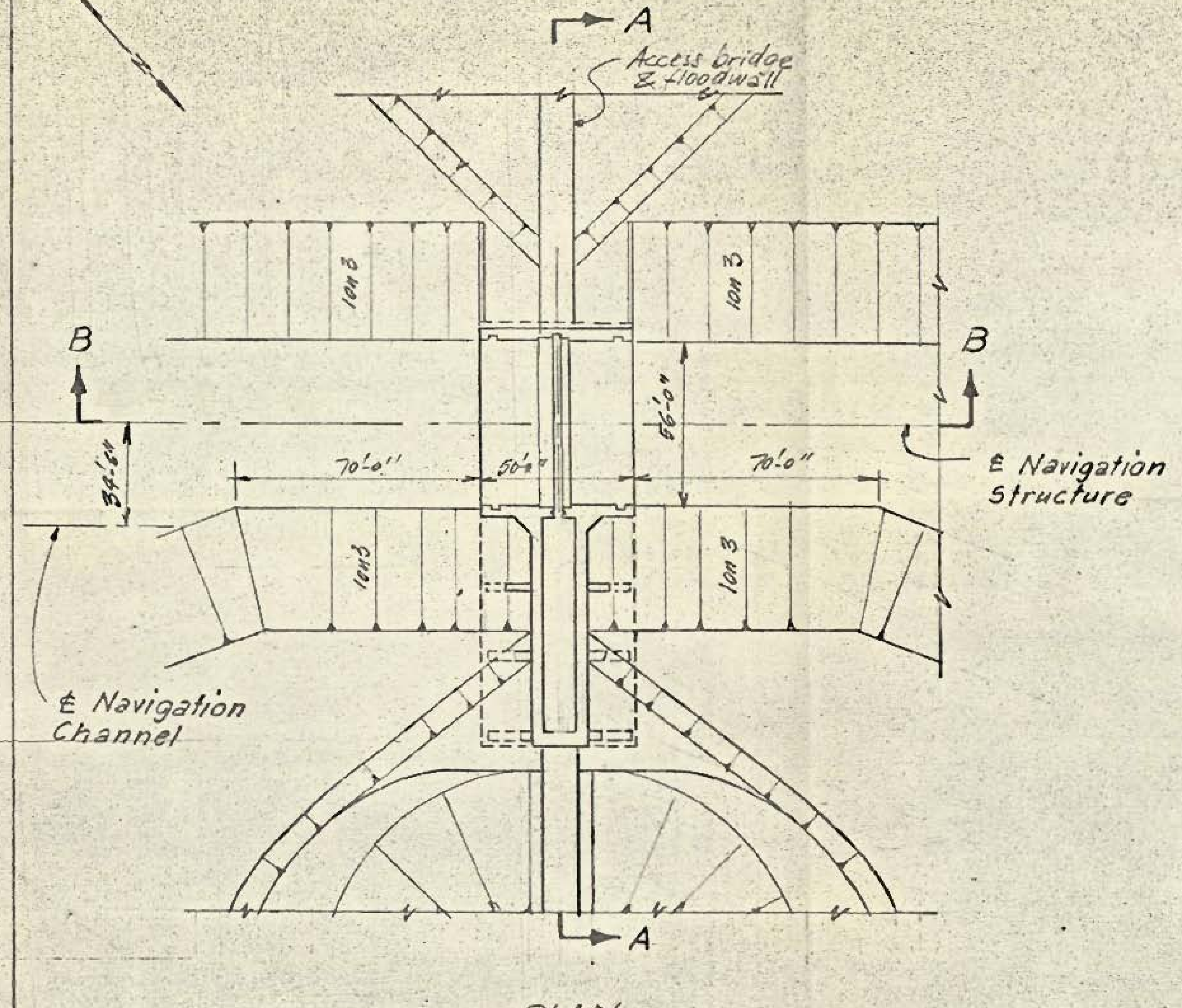




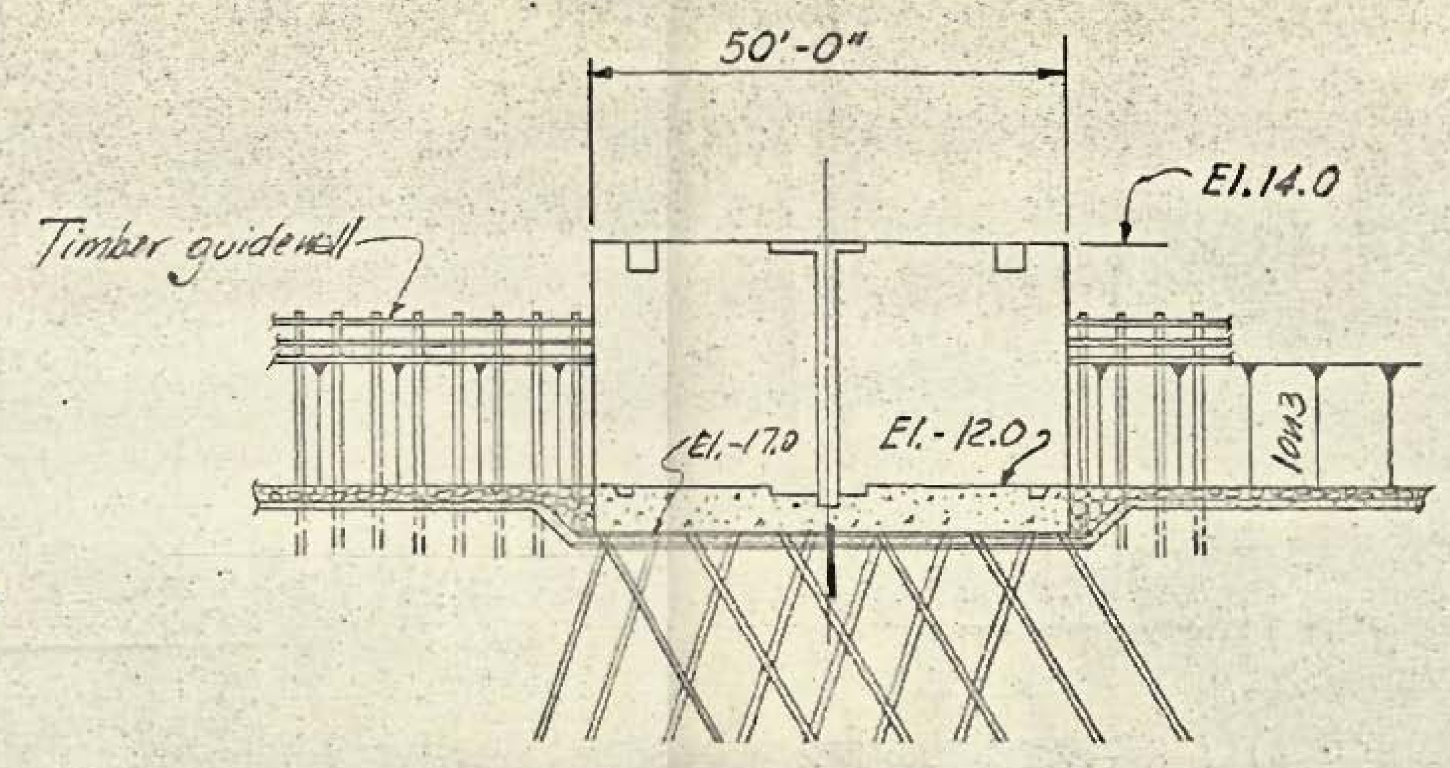
A–A

CHEF MENTEUR
NAVIGATION STRUCTURE
ALTENATE STUDY
ROLLING GATE SCHEME
453 SKC 3

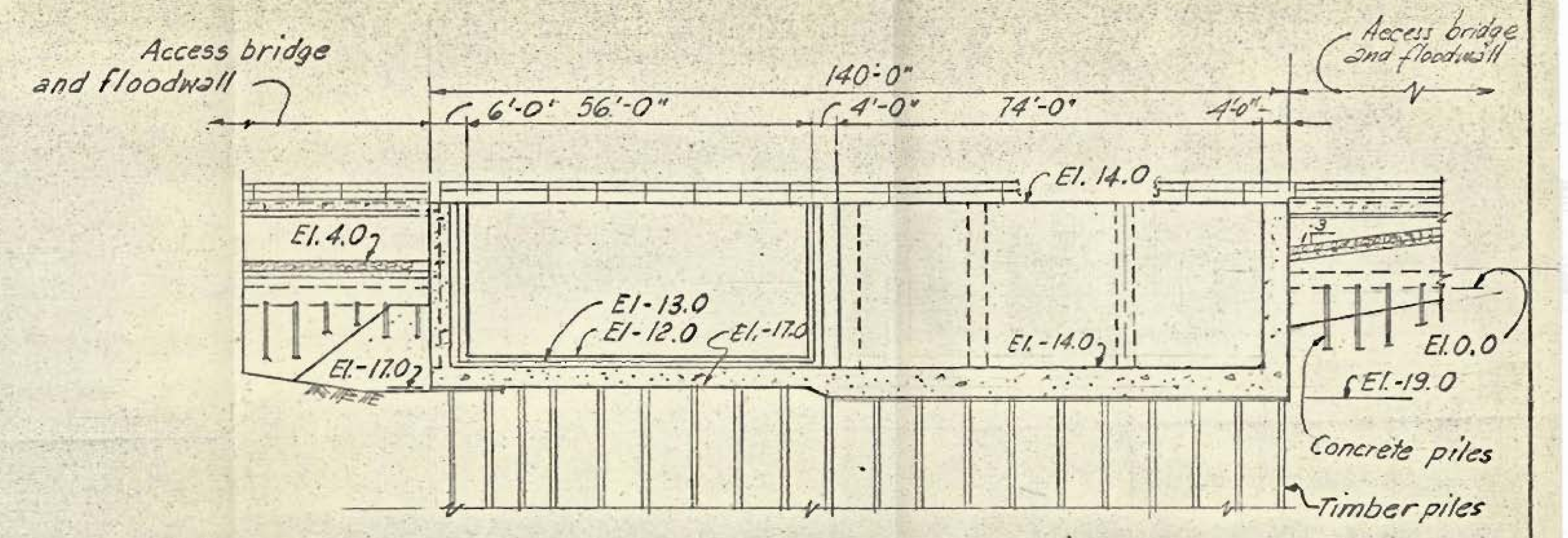
PLATE E-3



PLAN
Scale: 1"=40'



B - B
Scale: 1"=20'

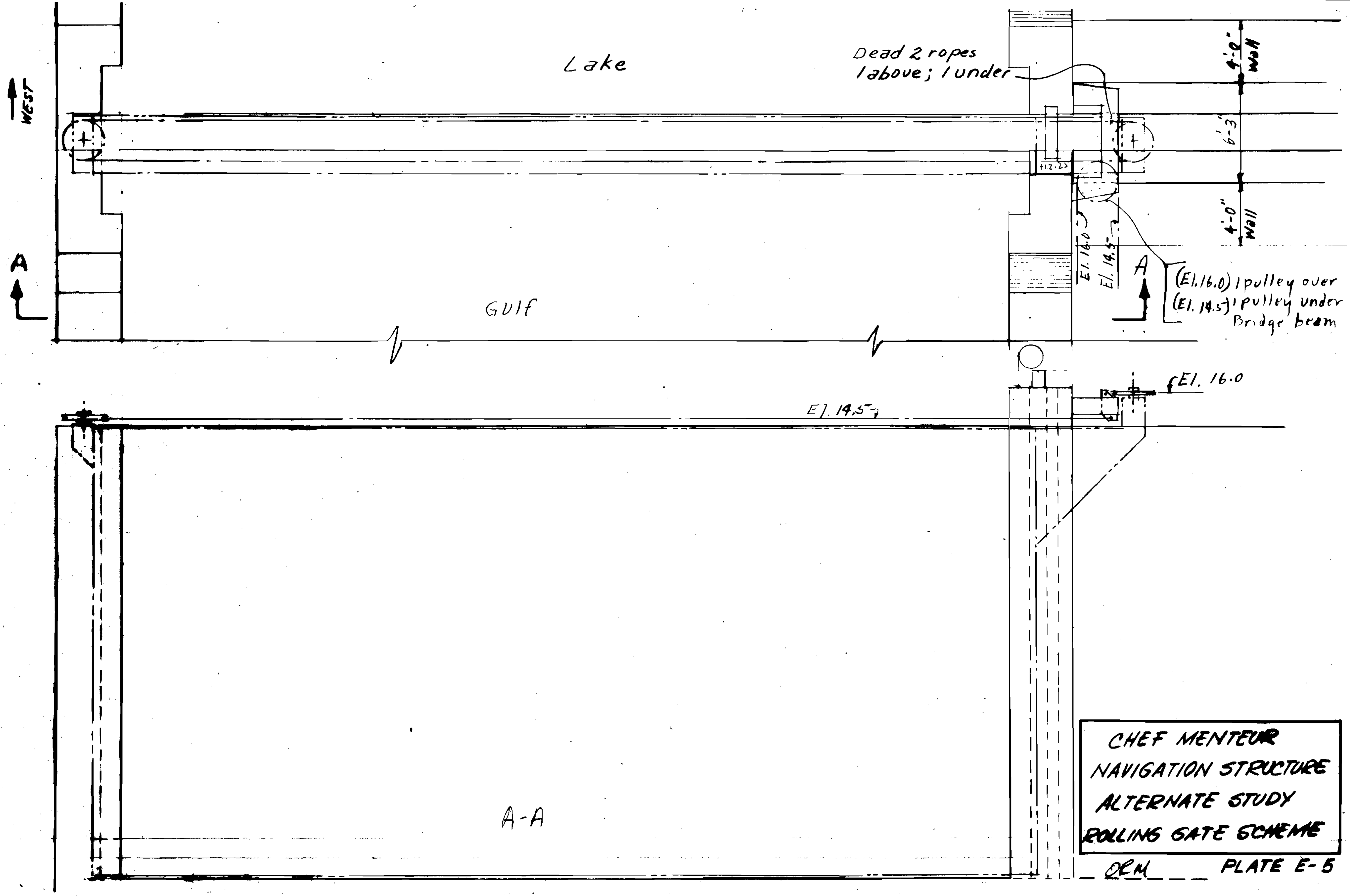


A - A
Scale: 1"=20'

CHEF MENTEUR
NAVIGATION STRUCTURE
ALTERNATE STUDY
ROLLING GATE SCHEME

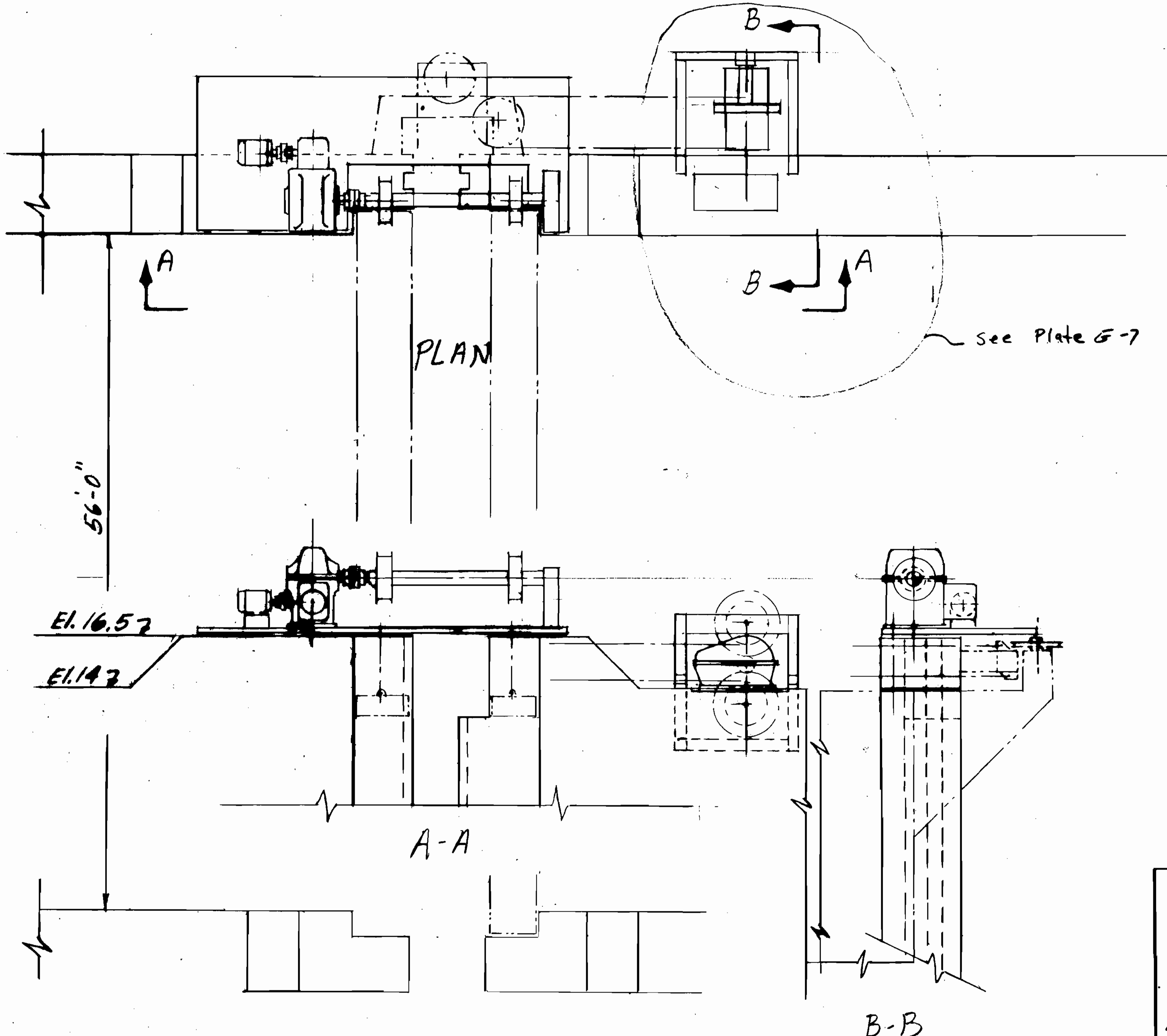
453 SKC 4

PLATE E-4



CHEF MENTEUR
NAVIGATION STRUCTURE
ALTERNATE STUDY
ROLLING GATE SCHEME

OCM PLATE E-5



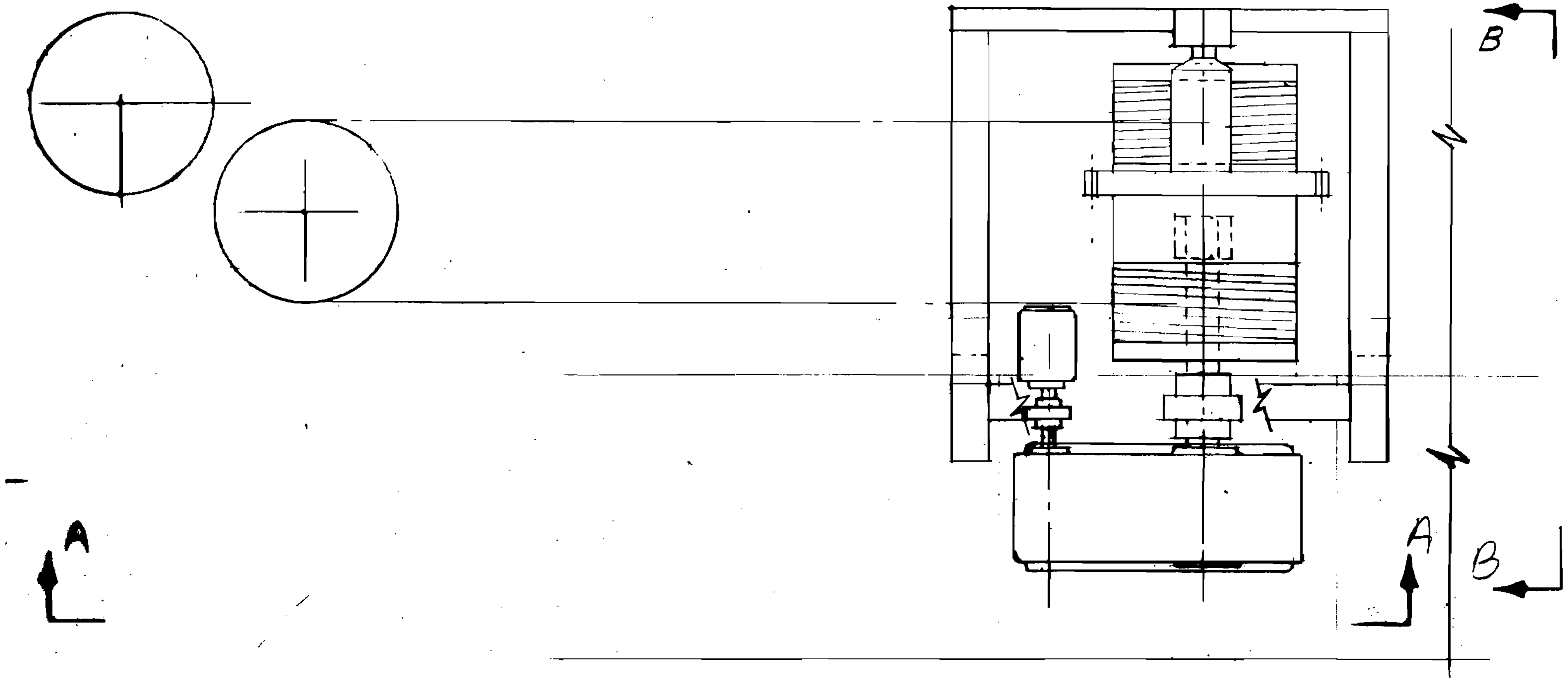
CHEF MENTEUR
NAVIGATION STRUCTURE
ALTERNATE STUDY
ROLLING GATE SCHEME

ORM

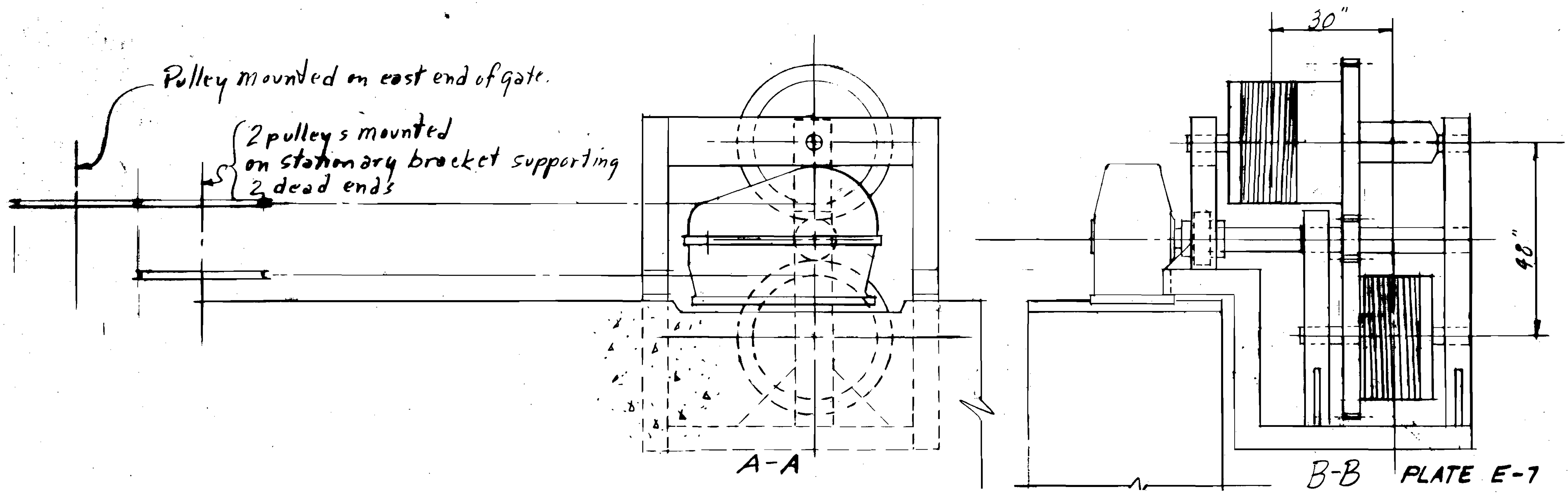
PLATE E-6

CHEF MENTEUR
NAVIGATION STRUCTURE
ALTERNATE STUDY
ROLLING GATE SCHEME

ORM



PLAN



A-A

B-B

PLATE E-7