SEPTEMBER 1973

LAKE PONTCHARTRAIN, LA. and VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN

DETAILED DESIGN MEMORANDUM NO. 8
RIGOLETS LOCK
VOLUME 1

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

27

STANLEY CONSULTANTS, INC.
STANLEY BUILDING
MUSCATINE, IOWA 52761

AND

B. M. DORNBLATT AND ASSOCIATES, INC.
826 LAFAYETTE STREET
NEW ORLEANS, LOUISIANA 70113

A JOINT VENTURE

LMVED-TD (NOD 20 Sep 73) 1st Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg,
Miss. 39180 9 Nov 73

TO: HQDA (DAEN-CWE-B) WASH DC 20314

1. The subject feature design memorandum is forwarded for review pursuant to para 21a(7), ER 1110-2-1150. Approval is recommended subject to final resolution of the lock size and the comments in the following paragraphs.

2. Para 8d, Page I-5, and Plate I-3. Landscaping should be accomplished in accordance with the guidelines contained in EM 1110-2-301, dated 29 Dec 72, and LMVED-TD letter of 5 Apr 73, subject: Landscape Planting at Floodwalls, Levees, and Embankment Dams. Specifically, a 3-ft root free zone should be established to provide a margin of safety between the deepest expected penetration of plant roots and the external limits of the levee or berm cross section required for stability and/or seepage control.

3. Section III. a General. (1) This section should include a paragraph describing the proposed construction of chamber levees.

(2) The geologic profile along the centerline of the structure as shown on Plate 32 of DM No. 2, General Design, Supplement No. 2, Rigolets Lock and Adjoining Levee, should be included in this DM in order to give a clearer description of soil conditions under the lock (para III-2).

b. Para 2, Page III-1, and Plate I-2. The locations of the 1969 borings should be shown on Plate I-2. This paragraph should contain a sentence referring to Plate I-2 for locations of borings.

c. Para 5f, Page III-3, and Plate III-18. Construction piezometers should be installed beneath both gate bay excavations.

d. Para 5h, Page III-4. Gravel packs should not be used around piezometers.

e. Para 9, Pages III-5 and III-6. It should be noted that although the computed required depth of penetration was to el -11.2, the sheet pile will actually be driven to a lower elevation for seepage control purposes.

f. Para 11, Pages III-7 and III-8, and Plates III-15, III-16, and III-17. (1) Design pile penetration should be shown on these plates as stated in para 11b of the DM.

(2) This paragraph should include a recommendation of the size of pile to be tested and to be used for construction.

g. Para 13 and Plate III-27. The sheet pile cutoff beneath both gate bays should be limited in depth to about el -50 for the following reasons:

(1) Blow counts from soil borings indicate that the foundation sands range from dense to very dense. Past experiences have indicated that steel sheet piles cannot be driven satisfactorily to depths greater than about 30 ft in this type material.

(2) Experiences with similar type structures indicate that a 20-ft depth of sheet pile cutoff provides sufficient protection against piping due to underseepage.

(3) Lane's creep ratio analysis shown on Plate III-7 is an empirical analysis which is more applicable to structures founded on a relatively deep impervious stratum. A more accurate method of determining potential underseepage problems is a flow net analysis in which exit gradients are computed on the downstream end of the structure. A preliminary flow net analysis by this office for the Gulf side gate bay assuming an ineffective cutoff indicates an exit gradient less than 0.3. This implies that the structure will not be susceptible to piping due to underseepage.

h. Para 18, Page III-10, and Plate III-27. The "C" piezometers in the Pleistocene clays should be deleted. There is no apparent need for these piezometers.

i. Plates III-9, III-13, III-14, and III-15. (1) Soil properties and/or stratification used in the stability analysis should be consistent with those shown for boring 3-RU or 1-UL on Plates III-2 and III-3, respectively.

(2) In the analysis for channel station 7+00, Plate III-14, the unit weight of the clay stratum from el 0 to el -6 should be 92 pcf instead of 78. According to our computations, the factors of safety for wedges A-1 and A-2 are 1.07 and 1.16 instead of 1.25 and 1.35, respectively. The analysis should be revised using the proper unit weight and the slope redesigned if necessary.

j. Para 17, Page III-9, and Plates 12, 13, and 14. Riprap layer thickness is inadequate for the maximum size stone specified. Layer thickness should be not less than the spherical diameter of the upper limit stone or less than 1.5 times the median diameter stone, whichever results in the greater thickness. According to Plate 30, EM 1110-2-1001, dated 1 Jul 70, the layer thickness of the erosion protection riprap should be increased from 2.5 ft to 3.0 ft and from 2.0 ft to 2.75 ft.

k. Plates III-15 and III-16. The design pile penetrations for piles under both gate bays are considered unconservative for the following reasons:

(1) The pile capacity curves were computed assuming that about 1/2 the overburden pressure above the base of the structure would contribute to the pile capacity. As the gate bay is 110-ft wide and the depth of design pile penetration below the structure is only 36 ft for lakeside gatebay and 26 ft for the gulfside gatebay, it is doubtful that any influence of the overburden would be felt by the piles near the center of the structure.

(2) The design pile penetrations require that pile be driven within 3 ft of the top of the underlying clay stratum. There is some question as to whether the pile can develop its full point bearing capacity with its tip only 3 ft from the underlying softer clay. Also, if the top of the clay stratum is not uniform, there is a possibility that some of the piles might penetrate into the clay which will result in a considerable decrease in point bearing capacity of these piles.

For the reasons given above, consideration should be given to revising the pile capacity computations by (1) assuming no overburden pressure from above the base of the structure and (2) limiting the pile penetration to 5 ft above the top of underlying clay stratum.

l. Plates III-23 and III-24. The bottom of the sheet pile for the I-wall (Plate III-23) and the T-wall (Plate III-24) should extend to about el -30 for the reason given in para 3g(1) above.

m. Plate III-25. It is not apparent how a value of R = 2758 ft was obtained from the flow net. This should be clarified.

n. Plate III-26. The flow net and the computed factors of safety for the "Uplift Analysis" shown on Plate III-26 appears to be in error. The flow net should have a transform factor ($\sqrt{k_v/k_h}$) of 1/2 but actually has a transform factor of less than 1/10. The computed factors of safety against uplift appear to be based on total forces instead of net forces. Also the section shown on Plate III-26 does not agree with the final section shown on I-3. Plate III-26 and reference to plate in para 13 should be deleted. As the area between the chamber levee and connecting levee on the south side of the structure will contain a planting berm, the top of which varies from el 6 to el 9, it is considered that this berm will provide sufficient weight to adequately resist uplift forces which may develop in the underlying sand strata, and therefore, a revised seepage analysis is not required.

4. Section IV. a. The gatebay monoliths and the floodwalls should also be investigated for the critical design conditions assuming the sheet pile cutoff to be pervious.

b. Para 5, Page IV-8. The method used to compute the pile loads shown on Plates IV-5 through IV-19 should be given.

c. Paras 17 and 22, Pages IV-15 and IV-17. Greenheart timbers would have to be purchased outside the United States and specifying this material would require approval by higher authority. Treated domestic timbers should be considered as an alternative for the gate and guide wall fenders.

d. Plates IV-5 thru IV-19. (1) The lateral earth and water pressure diagrams should be shown on these plates.

(2) The tabulation of the pile reactions should be revised to indicate in which row the maximum and minimum pile reaction occurs for each group.

e. Plate IV-80. The discrepancies between "Typical Elevation" and "Typical Section," marked in red, should be reconciled.

5. Sec V, Para 3. a. Pages VI, VII, and VIII. The description of the hydraulic system should be amplified to describe completely all items and clearly state their general and specific operation, both individually and collectively.

b. Para 10, Page V-5. Final plans and specificatons for the sewage treatment facility should include provisions for wasting and disposing of excess solids from the extended aeration plant. This is required by the Louisiana State Dept. of Health in accordance with Environmental Protection Agency regulations on secondary treatment.

c. Para 11a, Page V-5. Since only one generator is furnished, the need for an isochronous governor should be explained or the governor deleted.

d. Plate VI. The effect of inundation due to maximum stages on the sewage lift station and the potable water well should be discussed.

e. Plate V4. Consider raising the control house floor at el 19.5 approximately 2 ft to provide adequate headroom in the machinery space.

f. Plate V4. Consider locating the horn compressor on the operating floor instead of in the machinery space.

g. Figure V-2. The WES Miscellaneous Paper H-71-4, para 14, does not categorically state that sector gate operating forces should include the dead load friction moments multiplied by 4.5; this statement should be rewritten as indicated in red.

h. Figure V-19, Electric Motor. In view of the generally conservative approach of the mechanical design, consider using a 40 horsepower pump drive motor as discussed in para 6g below.

i. Plate V6. To counteract system inertia, in the event of gate movement due to collision or any other cause, and at a time when valve A4 is either blocked or shifted in the wrong direction, suggest the "A-5/A-6" assembly be moved to a position immediately adjacent to the motor, "B". See changes marked in red.

j. Figure V-17; Speed Reducer. Since the pump volumes are adjustable and the pump horsepower is considered adequate, the nearest available standard ratio should be permitted instead of specifying such a precise ratio.

k. Figure V-22; General. ASTM A216 should be specified as an alternative material.

l. Figure V-26; Spur Gear. The use of the word "stretched" in the fifth line is presumed to indicate a long addendum/short addendum arrangement. If so, this paragraph should be reworded to use more precise language. In this regard, the use of 14-1/2 degree, circular pitch gearing is not really standard under the ANSI standard referenced, but is normally restricted to replacement gearing. Serious consideration should be given to changing over to 20 degree, diametral pitch gearing throughout the machine.

m. Figure V-69. Consider specifying SAE 64 and QQ-C-390, alloy 937 as an alternative.

n. General; Section V - Mechanical Design. References are either not identified at all or are incompletely identified. All references should be clearly and accurately identified and listed in an appropriate table or tables.

6. Section VI. a. Para 2b(1), Page VI-1. Consider permitting a maximum voltage dip of 20 to 25 percent.

b. Para 2b(2), Page VI-1. Across-the-line starting should be used.

c. Para 2c, Page VI-2. With the greater voltage dip discussed in para 6a and smaller motors (para 6g below), it may be possible to reduce the generator to a 100 kW rating. This should be considered.

d. Para 9, Page VI-6. It is suggested that the two speakers facing into the chamber be connected so they can be used individually.

e. Para 17, Page VI-9. The rationale used to determine that cathodic protection is not needed for the steel sheet pile dolphins should be explained.

f. Para 22b, Page VI-10. The risers should be stranded copper cables.

g. Para 29, Pages VI-11 thru VI-15. Since conservative calculations indicate the maximum power requirement (which occurs only at high speed gate operation with 2 ft of differential head) is 39.6 horsepower, consideration should be given to reducing the gate hydraulic pump motors from 50 to 40 horsepower. This will permit a reduction in the size of the engine generator.

h. Plate VI. Type of anode guide should be shown.

7. Section VII, Para 2, Page VII-4. A feature by feature comparison of the cost estimate with the latest approved cost estimate (PB-3) and project document should be presented.

8. The assumptions made in the Hrennikoff method of analysis referred to in para 2 of the letter of submittal should be discussed and a tabular comparison of loads computed by the two methods should be presented.

9. Refer to comments marked in red on page I-4, Plates I-2, I-3, I-5, pages II-3, II-4, III-3, Plates III-9, III-12, III-13, III-14, III-18, III-23, III-25, pages IV-1, IV-16, IV-17, Plates IV-80, IV-85, pages V-3, V-4, V-6, Figures V-2, V-5, V-6, V-26, V-33, V-34, V-36, V-47, V-48, V-49, V-50, V-52, V-53, Plates V-6, V-7, and pages VI-5 and VI-16.

FOR THE DIVISION ENGINEER:

R. H. RESTA
Chief, Engineering Division

1 Incl (14 cy)
wd 2 cy

CF:
LMNED-MP w mrkd cy
DM No. 8

DAEN-CWE-B (LMNED-MP, 20 Sep 73) 2d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, Office of the Chief of Engineers, Washington, D.C. 20314, 20 December 1973

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

1. Approved, subject to the comments of the Division Engineer in the 1st indorsement and to the comments furnished in the following paragraphs.

2. 1st Indorsement, Paragraph 5f. The horn compressor will be noisy and therefore it should be retained in the machinery space.

3. Plate V7, Items A1 and A2. An Oilgear Company Type DM-6017-M pump should be used. This pump when operating at 860 RPM is capable of meeting all design requirements for the operating machinery and it will not generate as much noise as a DM-6025-M pump operating at 1160 RPM. The procurement specifications should stipulate that the speed of the pump shall not exceed 900 RPM.

4. Plate VI 7. The availability of lock lighting fixtures should be checked since several manufacturers have discontinued this type fixture.

FOR THE CHIEF OF ENGINEERS:

L. E. Slayton
for HOMER B. WILLIS
Chief, Engineering Division
Directorate of Civil Works

1 Incl
wd

LMVED-TD (NOD 20 Sep 73) 3d Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss.
39180 27 Dec 73

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

Referred to note approval subject to comments of 1st and 2d Indorsements.

FOR THE DIVISION ENGINEER:

R. H. RESTA
Chief, Engineering Division

LMNED-MP (20 Sep 73) 4th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, New Orleans District, Corps of Engineers, PO Box 60267,
New Orleans, LA 70160 23 Apr 74

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

1. The proposed disposition of comments presented in the 1st, 2d and 3d Indorsements to the subject DM follows (paragraph numbers refer to like-numbered paragraphs in the respective indorsements).

2. 1st Ind, para 2. Concur. Final plans and specifications for landscaping will be in accordance with the guidelines contained in EM 1110-2-301, dated 29 December 1972 and LMVED-TD letter of 5 April 1973, subject: Landscape Planting at Floodwalls, Levees, and Embankment Dams. Landscaping will be accomplished using the best available knowledge and recognizing that great variation exists in nature, thus making precision impossible.

3. Para 3a(1). Paragraph 1 of Section III is expanded to include a subparagraph "b" as follows:

"b. The lock chamber embankment will consist of sand fill with seepage through the embankment controlled by a 10-foot-wide clay plug extending from the top of the embankment to elevation -2.0 and steel sheet piling extending down to elevation -24.0. The embankment will be constructed in the dry utilizing the sand stockpiled adjacent to the lock excavation. The poor foundation soils along the embankment alinement extending from the ground surface to approximate elevation -9.0 will be removed as part of the lock excavation."

4. Para 3a(2). Concur. Add the following sentence to page III-1, para III-3, "Geologic profiles along the baseline and along the centerline of the lock are shown on plate III-7A." Plate III-7A is inclosed herewith as incl 2.

5. Para 3b. Concur. On page III-1, para 2, add the following sentence: "For locations of borings, see plate I-2." Plate I-2 is revised to include the locations of the 1969 borings and is inclosed herewith as incl 3.

6. Para 3c. Concur. The plans and specifications will require installation of construction piezometers beneath both gate bay excavations.

7. Para 3d. Concur. Sand will be used in lieu of gravel packs and will be covered in the P&S.

8. Para 3e. On pages III-5 and III-6, para 9, add the following sentence: "Although the computed depth of penetration was to elevation -11.2, the sheet pile will be driven to the lower elevation shown for seepage control purposes."

9. Para 3f(1). Concur. Plates III-15, III-16, and III-17 have been revised to show the design pile penetration. See inclosures 4, 5 and 6.

10. Para 3f(2). Concur. Paragraph 11a, page III-7 should be modified by inserting "14-inch" before "steel H-piles" in the first sentence. Paragraph 12, page III-8 should be modified by inserting "14-inch steel H" before "test piles" in the first sentence.

11. Para 3g. Concur. The sheet pile cutoff beneath both gate bays will extend to elevation -50.

12. Para 3h. Concur. The "C" piezometers will be deleted.

13. Para 3i(1). Plates III-9, III-12, and III-13 have been revised to reflect the revised soils data. See incls 7, 8 and 9. Factors of safety are not materially affected by this change.

14. Para 3i(2). The channel section at station 7+00 has been redesigned using a unit weight of 92 pcf, in lieu of 78 pcf, for the clay stratum between elevation 0 and elevation -6.5. The channel slopes were revised from 1V on 3H to 1V on 4.5H to satisfy minimum stability requirements. The revised stability analysis is shown on inclosure 10.

15. Para 3j. Concur. Armor stone thickness on main levees will be changed from 2.5 feet to 3.0 feet. Armor stone thickness on lock and chamber levees will be changed from 2.0 feet to 2.75 feet. Final plans and specifications will incorporate these changes.

16. Para 3k(1). Consideration was given to this comment. In order to substantiate the pile capacity curves presented in the DDM, an analysis was performed to determine the induced effective pressure on the pile foundation below elevation -24.0 due to soil located above and to the sides of the lock slab. Boussinesq's method was used to calculate the induced pressure on piles located at the edges and at the center of the lock slab. The values obtained were then averaged and added to the effective overburden pressure below elevation -24.0. These effective pressures, which were determined for an average pile located between the edge and center of the slab, were approximately the same as that based on an average overburden pressure from elevation -20.0 (as presented in the DDM).

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SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

17. Para 3k(2). Concur. The design load versus pile penetration curves shown on plates III-15 and III-16 will be used to determine the lengths of piles for the purpose of canvassing bids. The actual lengths of the service piles will be based on the results of pile load tests conducted at the lock gate sites. It has been our experience in the New Orleans District that the values calculated by the static pile equations give conservative results when compared to results obtained from pile load tests. Based on the pile tests results, and applying an appropriate factor of safety, there should be no problem in obtaining the design loads at 5 feet above the top of the underlying clay stratum.

18. Para 31. Concur. The bottom of the sheet piling for the I-wall (plate III-23) and T-wall (plate III-24) will extend to elevation -30.0.

19. Para 3m. The value of "R" from the flow net was based on the following equation:

$$\ln R/A = \frac{2\pi KD\ (H - hc)}{Qw}$$

$$\ln R/A = \frac{2(3.14)(0.0215)(41)(69-33)}{127}$$

$$\ln R/A = 1.57$$

$$\ln R = 1.57 + \ln 571 = 7.92$$

$$R = 2{,}758'$$

20. Para 3n. Concur. Plate III-26 and the reference thereto in paragraph 13 of the text should be deleted.

21. Para 4a. Gate bay monoliths have also been investigated for the design condition assuming the sheet pile cutoff to be pervious and the results are presented on revised plates IV-5 through IV-19. See inclosures 11 thru 25.

22. Para 4b. The A-E Pilan method used to compute the pile loads is based upon an indeterminate structures analysis assuming a rigid headstock supported on pile columns. The method assumes no lateral support of the piles by the soil and an 8-foot pile length is assumed. Development is based upon matrix analysis presented in "Matrix Structural Analysis" by John L. Meek published by McGraw-Hill, 1971. The program is available through Scientific & Technical Computing Centre Pty., Ltd., Brisbane, Queensland, Australia.

23. Para 4c. Concur. Treated domestic timber will be specified and used for the gate and guidewall fenders.

24. Para 4d(1) Water elevations and lateral water pressure diagrams have been taken from plates IV-1 and IV-2 and shown on the longitudinal section of plates IV-7 thru IV-12 and IV-15 thru IV-19. The lateral earth pressure diagrams are not shown since they vary along the width and length of the gate bay and a single pressure diagram would not represent the soil pressures. Presentation of further pressure diagrams would tend to confuse the plate data presentation without benefit since these diagrams cannot be used to determine resultant loads unless dimensional layouts on other plates are considered in the computations.

25. Para 4d(2). The tabulation of pile reactions has been revised on plates IV-5 thru IV-19 to indicate in which row and which pile the maximum and minimum pile reaction occurs.

26. Para 4e. Concur. Plate IV-80 has been revised and is inclosed herewith as inclosure 26.

27. Para 5a. Concur. The following changes should be included in the text:

a. Para 3a is revised to read, "a. A schematic diagram of the hydraulic circuit of the gate operating machinery is shown on plate V-6. The circuit terminates at the item designated "Power Takeoff" which is the speed reducer referred to herein as an item of the gear train portion of the gate operating machinery. Item numbers listed correlate with the items listed on plate V-7 and the items in the schematic diagram on plate V-6.

b. Para 3b is revised to read, "b. The following is a description of each major item and its specific operation in the circuit."

c. Para 3b(1) is revised to read, "(1) Items A and B. A closed loop hydraulic circuit will be used which will automatically provide dynamic breaking if an external load on the gate should try to drive through the hydraulic motor. In this situation, the hydraulic motor will try to deliver more oil to the variable displacement pump than the pump is capable of accepting. The resulting pressure increase at the opposite pump and motor ports produces the dynamic breaking effect. The dynamic breaking characteristic requires the hydraulic motor and pump to be fully capable of developing full pressure at both ports."

d. The following is added to para 3b(3). "When low speed pump capacity is less than the motor slip capacity, the drive would stall as load is placed on the system if the pressure compensator did not add small amounts of pump stroke. As pressure increases, additional stroke is added to maintain the preset slow speed."

e. Para 3b(4) is revised to read, "(4) Items A2 and A2-2. Pump is equipped with a volume control that offers a neutral position and four different adjustable stroke settings. It is integrally mounted to the pump housing. The control is designed to operate with large areas so that only 125 psi pilot pressure is required.

Four pump outputs are obtained by using various combinations of four solenoid actuated pilot valves and four control pistons. Pilot pressure from gear pump A2-5 through the solenoid actuated pilot valve actuates a control piston. Each control piston positions the force amplifier signal spool, which the force amplifier follows. The force amplifier positions the pump stroke mechanism. Adjustable control knobs on each of the control pistons control the piston stroke, and thereby the pump stroke, from zero to full stroke. A spring centering mechanism returns the pump to neutral (zero stroke) when all four solenoids are deenergized. The four solenoid pilot valves are actuated by limit switches on the gates and in the traveling nut switch housing described in para 5.

f. The following is added to para 3b(9), "This valve controls the opening or closing of the gate by reversing the direction of oil flow from pump A2."

g. Para 3b(10), "Item A5" is changed to "Item B2".

h. Para 3b(11), "Item 7-2" is changed to "Item A7" and (A2-5) is changed to (A2).

28. Para 5b. Concur. The final plans and specifications for the sewage treatment facility will include provisions for wasting and disposing of excess solids from the package treatment plant. Since the volume of sludge production is difficult to estimate, solids wasting schedules will be based on operating data developed after the facility is installed. Specifications for the packaged waste treatment unit will require the inclusion of sludge blowdown lines for the aeration tank, clarifier, and chlorine contact tank. Because of the relative infrequency of sludge wasting anticipated, disposal to vacuum truck for ultimate disposal by landfill or to a public treatment works will provide the most feasible sludge wasting alternative.

29. Para 5c. Concur. Delete the words "hydraulic isochronous governor" from the tabulation of accessories in para 11a and replace with the words "hydraulic speed governor."

30. Para 5d.

a. The possibility of contamination of the potable water well during heavy storms is minimized by placing the top of the well casing at elevation 9.0. A pitless adaptor will seal the well head as discussed in Design Memorandum No. 2 - General Design, Supplement No. 2 - Rigolets Lock, 4th Indorsement, para 1n. In addition, a vent pipe will be extended upward to elevation 14.0, turned down and provided with a screen. It is expected this will prevent well contamination by inundation. After a major storm and periodically, the safe procedure will be to test and disinfect the well and the potable water piping to avoid danger of unknown sources of pollutants.

b. The top of the sewage lift station will be set at the maximum design stillwater surface elevation of 11.5, on the lakeside of the barrier. This will prevent inundation except by wave action of the most severe storm. After severe wave overtopping, the sewage lift station will be flooded and it will be restored to operation along with the other facilities at the site.

31. Para 5e. Do not concur. Freshwater Bayou Lock has the same headroom, and it has proved to be satisfactory.

32. Para 5f. This comment is superseded by para 2 in the 2d Ind.

33. Para 5g. Concur. Item 1 under the first paragraph of figure V-2 is rewritten as follows: "1. Dead load friction moments, multiplied by a factor of 4.5 as indicated in the Waterways Experiment Station Miscellaneous Paper H-71-4, para 14."

34. Para 5h. The hydraulic and frictional forces used for the design of the gate machinery have been determined from model and prototype studies. Neither of these studies is exact and should be considered as approximations only. The increase from 39.6 to 50 horsepower is justified as a factor of safety against any inaccuracies in the method used to determine the operational forces.

35. Para 5i. Concur. Plates V-6 and V-7 are revised to show Items A5 and A6 adjacent to Item B, the hydraulic motor. The revised plates also include those modifications requested on the markup received with the indorsements. See inclosures 27 and 28.

36. Para 5j. Concur. In the final design the nearest available standard ratio will be selected.

37. Para 5k. Concur. ASTM A216 will be specified as an alternative material.

38. Para 5l. Figure V-26; Spur Gear. The spur gear in question will be enlarged to avoid undercut due to the number of teeth in the spur gear. The long addendum/short addendum system referred to in the comments would result in thinning and weakening of the idler gear teeth and consequently in excessively strong rack tooth forms. Instead, the standard distance between the spur gear and the idler gear will be increased to such an extent as to allow the spur gear to mesh with a standard idler gear on increased center distance. Thus the idler gear and rack gear will be cut with standard tooth forms. The 14 1/2° pressure angle gearing is considered desirable because of less backlash than a 20° pressure angle gearing during periods of large pitch line separation. Excessive backlash has been a problem in the past; therefore, the 14 1/2° gearing should be permitted.

39. Para 5m. Concur. SAE 64 and QQ-C-390, alloy 937 are acceptable as alternatives.

40. Para 5n. Reference referred to in the shaft strength calculation is ~~Shigley~~ "Mechanical Engineering Design" by Shigley, page 617.

41. Para 6a. Concur. The sizing of the emergency generator will be based upon using a 20 percent voltage dip.

42. Para 6b. Do not concur. The power company serving the area prefers that some type of reduced voltage starters be utilized on large motors where intermittent duty is necessary. Across the line starting causes objectional flicker on their lines.

43. Para 6c. The emergency generator size has been recomputed allowing a 20-percent voltage dip and utilizing reduced voltage starting. On the same basis of these criteria, the analysis presented in Section VI, para 29 is valid up through para 29c(8) on page VI-13. Referring to the "Power Selection Table VI-1" on page VI-14, it is seen that a generator rated at 90 kw is adequate.

44. Para 6d. Concur. The two speakers facing into the chamber will be connected in the final plans so they can be used individually.

45. Para 6e. Cathodic protection will not be provided for the steel sheet pile dolphins in accordance with the rationale given in the 4th Indorsement to Design Memorandum No. 2 - General Design, Supplement No. 2 - Rigolets Lock and Adjoining Levees. Specifically page 9, para 1, referring to para 10b of the 1st Indorsement which states "It is proposed to utilize only the coal tar epoxy coatings to protect these dolphins. Installation of zinc anodes on the dolphins below the water line would only provide limited protection in the tidal zone where the greatest damage usually occurs."

46. Para 6f. Concur. Para 22b on page VI-10 is revised to read "b. Stranded copper cable risers from the piling to the control house will be provided for connection to equipment grounding taps."

47. Para 6g. Refer to para 34.

48. Para 6h. The type of anode guide and installation is described in the following addition to para 20 on page VI-9:

"a. Anode guides and protection. Anode guides will be permanently mounted on the gate structure and will consist of sections of 4-inch nominal diameter steel pipe, split longitudinally into half-sections and installed as vertical troughs. A lining of split plastic pipe will be provided for the steel pipe and the entire assembly will be securely held together by means of lined retainers made of identical split steel pipe, plastic lined and secured by means of metal aviation type hose clamps. The retainers will be spaced at such intervals as to protect the anodes from leaving the guide. Anode strings will be installed by lowering from the top of the gate and any string may be withdrawn as desired for inspection, repair or replacement."

49. Para 7. A feature-by-feature comparison of estimates is included herewith as inclosure 29.

50. Para 8. The assumptions made in the Hrennikoff method of analysis referred to in para 2 of the letter of submittal are included on revised plate IV-5 and a tabular comparison of loads computed by the two methods is presented on the revised plates.

51. Para 9. The comments marked in red in the DDM are noted and resolved in inclosures 30 and 31. Additional changes made necessary by these comments have been incorporated into plates I-6, III-24, and IV-86. These revised plates are included herewith as inclosures 32, 33 and 34, respectively.

52. <u>2d Ind, para 2</u>. Concur.

53. <u>Para 3</u>. Concur. The changes to the oil gear equipment are included in the answers to the comments in the first indorsement and in the revisions to plate V-7.

54. <u>Para 4</u>. The lock light fixtures shown on plate VI-7 are available from at least three reputable manufacturers. The final design will reconsider their availability and if these fixtures become obsolete, an optional equivalent fixture will be specified.

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

FOR THE DISTRICT ENGINEER:

Walter G Mask
for JEROME C. BAEHR
Chief, Engineering Division

33 Incl (16 cys)
Added 33 incl
2. Revised plate III-7A
3. Revised plate I-2
4-6. Revised plates III-15 thru III-17
7. Revised plate III-9
8 & 9. Revised plates III-12 and III-13
10. Rev. Stab. analysis - sta. 7+00
11-25. Revised plates IV-5 thru IV-19
26. Rev. plate IV-80
27 & 28. Revised plates V-6 and V-7
29. Comparison of estimates
30. Resolution of comments marked in DDM
31. Revised figures V-2, V-6, V-33, V-34,
    V-36, V-47, V-48, V-49, V-50, V-52,
    V-53 and V-58
32. Revised plate I-6
33. Revised plate III-24
34. Revised plate IV-86

No copies of 4th Ind Received w/ incl's

LMVED-TD (NOD 20 Sep 73) 5th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg,
Miss. 39180 24 May 74

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

The information furnished and actions described in the 4th Ind are satisfactory subject to the following comments:

a. Para 34, 4th Ind. A 50 horsepower motor is not justified. The dead load friction moment, which constitutes at least 70% of the total moment in all cases, has already been multiplied by a factor of 4.5. A 40 horsepower motor, which will actually put out 60 horsepower for short periods, should be specified.

b. Note corrections marked in red on page 16 of 4th Ind and Figures V-6, and V-53 of Incl 31.

FOR THE DIVISION ENGINEER:

wd all incl

R. H. RESTA
Chief, Engineering Division

CF:
DAEN-CWE-B w 14 cy 3d
and 4th Indorsements

LMNED-MP (20 Sep 73) 6th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans,
LA 70160 7 August 1974

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

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

2. Para a. NOD recommends that 50 hp electric motors, not 40 hp motors, be used because of the following design considerations:

a. The maximum horsepower for the electric motor is computed to be 39.6 hp at a 2-foot differential head with fast speed operation (hp for a 2-foot forward head is approximately equal to hp for a 2-foot reverse head). This calculated hp could be exceeded frequently at a 2-foot differential head if inaccuracies exist in the model or prototype studies. The prototype study, which was the basis for the 4.5 multiplier, was made on an existing 56-foot sector gate and is the only study in which the dead load friction on sector gates was observed. No information is available to verify that the multiplier will be exactly 4.5 for a 110-foot sector gate. Also, the calculated hp would be exceeded if the gates were operated at fast speed with differential heads in excess of 2 feet.

b. The maximum torque used to design the gearing and to obtain the pressure rating for the hydraulic system occurs at a 9-foot reverse head, slow speed, while the maximum hp occurs at a 2-foot reverse head, fast speed (see plate V-3). The design computations indicate that the gearing and hydraulic system can withstand 25 percent additional torque during the maximum hp operation without exceeding the allowable torque used for design of the machinery; thus, the hp could safely be increased by 25 percent.

c. While a motor may be operated for intermittent periods at higher that design hp, it is felt that such operation would result in a higher than design temperature rise of the motor, thereby shortening the life of the motor. The practice of operating a motor at 25 percent overload has a damaging effect on the motor since the temperature rise of the motor increases approximately as the square of the load current. The magnitude of the damage is a function of the magnitude and duration of the overload and the ambient temperature in which the motor operates. A 50 hp motor could operate within its continuous rating at a 2-foot differential head with loads 25 percent greater than design, whereas a 40 hp motor would be operating at an undesireable overload.

LMNED-MP (20 Sep 73) 6th Ind 7 August 1974
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain
Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

d. The estimated increases in cost for the 50 hp motors is $2,000.

e. To summarize: The possibility of frequent overloads to a 40 hp motor does exist. The machinery has an inherent allowable load capacity to withstand up to 50 hp. Use of a 50 hp motor at a small increase in cost would reduce the possibility if motor damage of overloads occur.

f. Notwithstanding the above, our past experience with underpowered machinery on many sector gated structures dictates the conclusion to use a larger size motor. Although the model and prototype tests have defined operating forces previously overlooked in design, the accuracy of the force computations is debatable. The calculation procedure contains inexact parameters such as efficiencies, coefficients of friction, and multipliers. To compound the possibility of inaccuracies, we have no source of prototype information for a 110-foot sector gate. Since underpowered machinery limits the usefulness of a lock and since there are no apparent detrimental effects of using a 50 hp motor, the choice of a larger size motor at a small increase in cost seems wise. Therefore, the use of 50 hp motors to power the machinery at Rigolets lock is recommended.

3. Para b. The corrections are noted.

4. It is recommended that the disposition of comments presented herein be approved.

FOR THE DISTRICT ENGINEER:

William

JEROME C. BAEHR
Chief, Engineering Division

LMVED-TD (NOD 20 Sept 73) 7th Ind
SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 22 Aug 74

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

We concur in your proposal to provide 50 horsepower motors.

FOR THE DIVISION ENGINEER:

R. H. RESTA
Chief, Engineering Division

CF:
DAEN-CWE-B
w 14 cy 6th Ind

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

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

IN REPLY REFER TO
LMNED-MP

20 September 1973

SUBJECT: Lake Pontchartrain, Louisiana and Vicinity, Lake Pontchartrain Barrier Plan, Detail Design Memorandum No. 8, Rigolets Lock

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-TD

1. The subject detail design memorandum is submitted herewith for review in accordance with the provisions of ER 1110-2-1150 dated 1 October 1971.

2. In accordance with instructions furnished by LMVD, the pile foundation analysis was checked for both the lakeside and gulfside gates by NOD. Maximum and minimum pile loads were computed for both battered pile groups by the Hrennikoff method of analysis utilizing the GE 225 time sharing system. All loading conditions were checked. The maximum difference in the pile loads shown in the design memorandum and our computed loads was approximately 6 percent for the gulfside gate and 9 percent for the lakeside gate.

3. In order to comply with the A-E contract schedule, LMVD review should not exceed 30 calendar days from the date of this submission, and OCE review should not exceed 90 calendar days from the date the DDM is forwarded to OCE from LMVD.

4. Approval of this memorandum is recommended.

Richard L. Hunt

1 Incl (16 cys) fwd sep
DDM No. 8

RICHARD L. HUNT
Colonel, CE
District Engineer

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - GENERAL DESIGN
RIGOLETS LOCK

STATUS OF DESIGN MEMORANDUMS

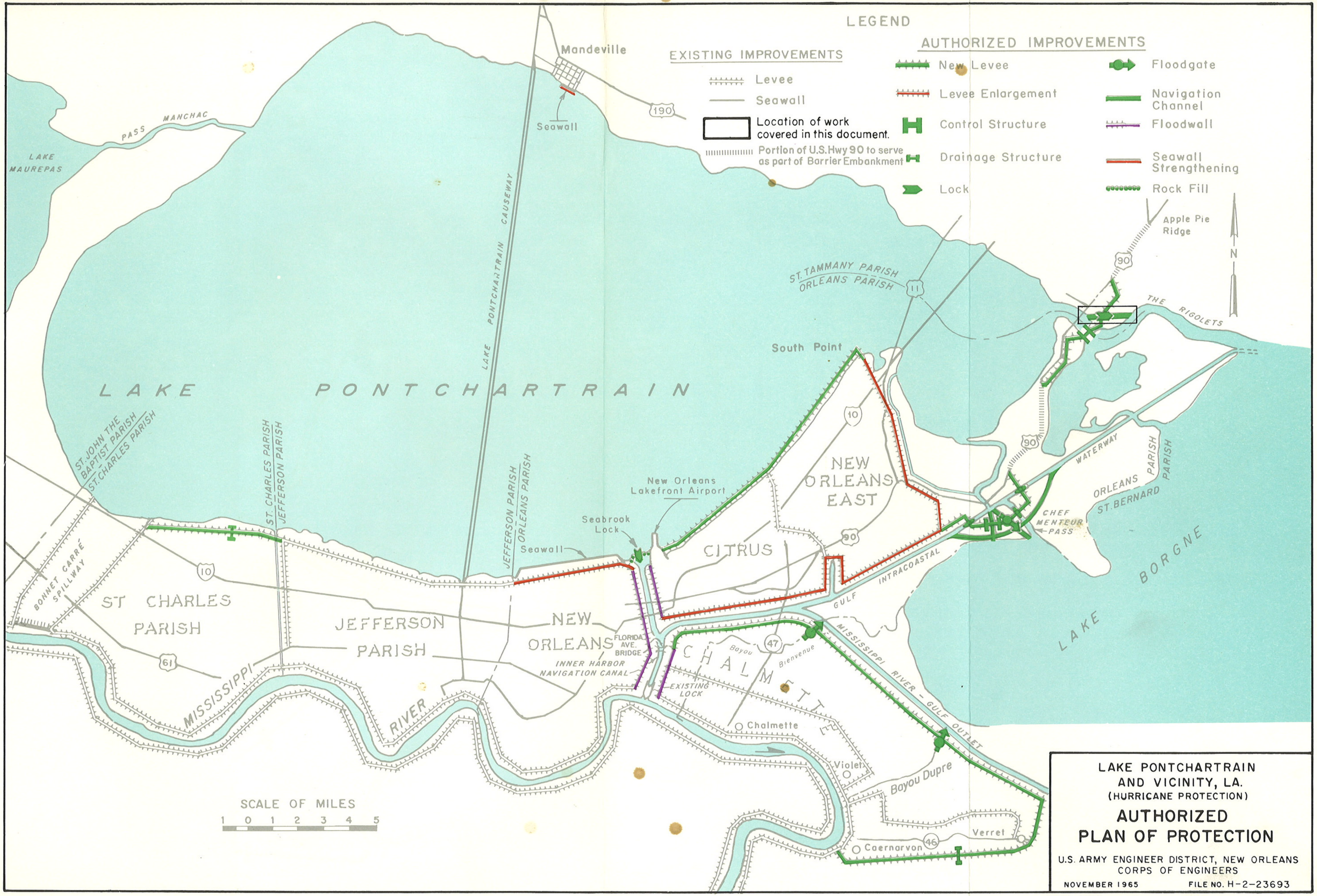
Design Memo No.	Title	Status
1	Hydrology and Hydraulic Analysis	
	Part I - Chalmette	Approved 27 Oct 66
	Part II - Barrier	Approved 18 Oct 67
	Part III - Lakeshore	Approved 6 Mar 69
	Part IV - Chalmette Extension	Approved 1 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees	Approved 31 May 67
2	Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee	Approved 29 Dec 67
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam, and Adjoining Levees	Approved 10 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees	Approved 19 Oct 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex	Approved 19 Sep 69
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees	Approved 18 Aug 71
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC	Scheduled Oct 74

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
2	Lake Pontchartrain Barrier Plan, GDM, Supplement 5A, Citrus Lakefront Levees - IHNC to Paris Road	Scheduled Nov 73
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5B, New Orleans East Lakefront Levee - Paris Road to South Point	Approved 5 Dec 72
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5C, Orleans Parish Outfall Canals - West of the IHNC	Scheduled Jan 75
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees	Approved 4 Nov 70
2	Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish, Mandeville Seawall	Indefinite
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	Approved 1 May 73
3	Chalmette Area Plan, GDM	Approved 31 Jan 67
3	Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension	Approved 12 Aug 69
4	Lake Pontchartrain Barrier Plan, and Chalmette Area Plan, GDM Florida Avenue Complex, IHNC	Scheduled Mar 74
5	Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre Control Structures	Approved 29 Oct 68

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Status
6	Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure	Scheduled Oct 73
7	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure	Scheduled Nov 73
8	Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock	Submitted 20 Sep 73
9	Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure	Scheduled Sep 74
10	Lake Pontchartrain Barrier Plan, Corrosion Protection	Approved 21 May 69
12	Sources of Construction Materials	Approved 30 Aug 66
1	Lake Pontchartrain, Louisiana and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, GDM, Seabrook Lock	Approved 4 Nov 70
2	Lake Pontchartrain, Louisiana and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, DDM, Seabrook Lock	Scheduled May 74



LAKE PONTCHARTRAIN
AND VICINITY, LA.
(HURRICANE PROTECTION)

AUTHORIZED PLAN OF PROTECTION

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

NOVEMBER 1965 FILE NO. H-2-23693

REV. DEC. 1970

LAKE PONTCHARTRAIN AND VICINITY, LOUISIANA
LAKE PONTCHARTRAIN BARRIER PLAN
DETAIL DESIGN MEMORANDUM NO. 8
RIGOLETS LOCK

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PLATES

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PLATES

Plates marked thus (*) are bound in Volume 2. Remainder of plates are bound in Volume 1.

TABLE OF CONTENTS (continued)

PLATES

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LAKE PONTCHARTRAIN AND VICINITY, LOUISIANA
LAKE PONTCHARTRAIN BARRIER PLAN
DETAIL DESIGN MEMORANDUM NO. 8
RIGOLETS LOCK

VOLUME 2

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DETAIL DESIGN MEMORANDUM NO. 8
RIGOLETS LOCK

PERTINENT DATA

Lock structure

"U" frame, reinforced concrete bays.
Earth chamber, timber guide wall

Gates - Sector type

Guide walls - Timber

Dimensions	Feet
Width of lock (inside)	110
Usable length of lock	800
Center to center of gate pintles	862
Total length of lock (excluding guide walls)	972
Length of guide walls (gulf end and lake end)	350 south side of channel 100 north side of channel

Elevations	Feet, m.l.g.
Top of lock walls and guide walls	13.5
Gate sills	-14.0
Lock floor	-14.0
Top of gates	13.5
Effective elevation of skin plates on gates	13.5 gulf side 6.0 lake side
Operating floor of control houses	19.5
Ground elevation of reservation area	9.0
Floor elevation of powerhouse and office	19.5

Hydraulic design criteria	
Maximum tide (storm)	el. 12.8 feet m.l.g.
Minimum tide (storm)	el. -6.5 feet m.l.g.
Maximum differential head, gulf to lake side	16.0 feet
Maximum reverse head, lake side to gulf	15.25 feet
Maximum storm tide elevation at which lock will be operated	el. 4.0 feet m.l.g.* (normal) el. 6.0 feet m.l.g.* (emergency)

*Above elevation 6 feet m.l.g., the lakeside lock gate will be overtopped. Both gates will be left closed above elevation +6.0.

PERTINENT DATA (continued)

Lock cost

Federal Non-Federal	(To be provided later)

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
RIGOLETS LOCK AND CHANNEL
DESIGN MEMORANDUM NO. 8
DETAIL DESIGN OF MODIFIED LOCK AND CHANNEL

SECTION I - GENERAL

1. Project authorization. The project was authorized by Public Law 298, 89th Congress, First Session, approved 27 October 1965. The work is to be prosecuted in accordance with plans recommended by the Chief of Engineers, dated 4 March 1964, and printed in House Document No. 231, 89th Congress, First Session, and by the 6th Indorsement, dated 19 October 1971, from the Chief of Engineers, to Division Engineer, Lower Mississippi Valley, subject "Lake Pontchartrain, Louisiana, and Vicinity, Lake Pontchartrain Barrier Plan, General Design Memorandum No. 2, Supplement No. 2, Rigolets Lock and Adjoining Levees," approving the recommendation of the Division Engineer, Lower Mississippi Valley that authorized the design and approved the NOD proposed actions in the 9th Indorsement dated 28 January 1972.

2. Purpose. This detail design memorandum presents the essential data, assumptions, and criteria used in the design of the principal features of the modified Rigolets lock. It is prepared for the purpose of developing the detail design and for developing subsequent construction plans and specifications without additional design analyses.

3. Previous reports. General information and basic data on the entire project are included in Design Memorandum No. 2, General Design, Citrus Back Levee, approved 27 December 1967. Basic information relating specifically to this project feature is contained in Design Memorandum No. 2, General Design, Supplement No. 2, Rigolets Lock and Adjoining Levees, Approved 28 January 1972.

4. Location. The Rigolets Lock, as shown on Plate I-1, is located in St. Tammany Parish in southern Louisiana, northeast of New Orleans, Louisiana. The lock will be on the east bank of The Rigolets between Lake Pontchartrain and Lake Borgne and approximately 4.1 miles north of the Gulf Intracoastal Waterway and 0.8 miles south of U. S. Highway 90. Access to the lock is available by either water or land.

5. Datum plane. All elevations are in feet and refer to mean sea level, unless otherwise noted.

6. Description.

a. The lock will consist, essentially, of the following features:

(1) Two reinforced concrete gate bays with steel sector gates.

(2) Earth chamber with timber chamber guide walls.

(3) Timber approach guide walls at each end of lock.

(4) Reservation area.

(5) Approach channels and tie-in levees.

b. The reinforced concrete gate bays, supported on steel piling, are each 110 feet in length by 110 feet in chamber width and are separated by 752.0 feet of lock chamber. The center-to-center distance of pintles is 862.0 feet. Each gate is at elevation -14.0 and top of wall at elevation 13.5. In each gate bay are two 70 degree steel gate leaves which are operated by an electro-hydraulic system. The gate operating machinery is located on the gate bay walls. The operation floor in the control houses will be at elevation 19.5 to keep hydraulic pump, valves, electric motor, and control panels above maximum still water surface and reduce damage from hurricane waves.

c. The lock chamber will be an earthen chamber with bottom at elevation -14.0 and 1V on 4H side slopes. The bottom and side slopes will be riprapped for the entire length. Timber guide walls will be provided on each side of the chamber.

d. The approach guide walls will extend 350 feet from each end of lock on the south side of the channel and 100 feet from each end of lock on the north side of the channel. The walls will be treated timber fendering supported by treated timber pile bents. Top of guide wall is at elevation 13.5.

e. Steel sheet pile dolphins will be constructed at the end of each approach guide wall. The dolphins will be a circular sheet pile cell filled with grouted riprap and capped with concrete. Top elevation will be 13.5.

f. Development and beautification of the area will consist of plantings and landscaping work in the immediate lock area as described below.

g. Reservation area will be at elevation 9.0. The buildings on the reservation are the powerhouse and office building, and a storage building. The powerhouse and office building will be supported by prestressed concrete piles with floor at elevation 19.5, and will be of hurricane resistant construction.

h. Navigation channels are 150 feet wide at the bottom and excavated to elevation -14.0 with a two foot allowable overdepth. A 1,000 foot section of the east channel will be widened to 225 feet.

i. Seven pile cluster timber pile dolphins are provided on each side and at each end of the navigation channel at the junction with the Rigolets to mark the channel.

j. An observation platform at elevation 30.0 is provided on the north side of the lock. The platform will be constructed of reinforced concrete and supported on prestressed concrete piles.

k. A general plan of the structure, levees, and approach channels is shown on plate I-1, a plan and an elevation of the lock and reservation area are shown on plates I-2 and I-3, typical sections are shown on plates I-3, -4, -5, and landscape development is shown on plates I-7, I-8, and I-9. Timber pile dolphins are shown on plates I-1 and IV-80. The observation platform is shown on plates I-2 and IV-84.

l. Connection levees between Stations 7+35.92 and 15+72.92, as shown on plate I-2, will be included in the contract for lock construction.

7. Beautification.

a. Utilization of Federally controlled lands for public recreational and educational activities permit increased site flexibility and provision of a valuable service to the general public. Development of the Rigolets Lock site will offer a unique opportunity to view the local marsh environment providing positive public relations and educational benefits which result in a rewarding environmental experience.

b. Site landscaping with walkways for pedestrian circulation will accommodate potential public utilization of the site. Establishment of an observation area to view the locking operation with control of pedestrian circulation allows public visitation with minimal disturbance to the locking operation efficiency and safety.

c. Walkways will be 5 feet wide and constructed with a 4-inch deep crushed shell surface. Elevated pedestrian boardwalks of timber construction will be provided over water and marsh areas north of the reservation area to protect the delicate ecological balance. See plate I-5.

d. The spatial and structural configuration of the planters, vegetation, and concrete elements will be arranged to serve to visually unify and link the elevated structures to the site, provide effective site development and comfortable observation areas. See plates I-7, -8, and -9

e. Native trees, shrubs, and grasses will be used in combination to create spatial patterns and appealing aesthetic environment.

f. Trees and large shrubs located on the reservation fills will be enclosed by concrete pipe to prevent potential degradation of the fill. See plate I-9.

8. Departures from General Design Memorandum No. 2, Supplement No. 2, dated June, 1969. The following changes which are within the discretionary authority of the Chief of Engineers has been incorporated into the authorized plan:

a. Floodwalls: Where the height of floodwall is in excess of 6 feet above the ground surface, the wall will be an inverted T-wall in lieu of the soil filled reinforced concrete box construction proposed because of economic considerations.

b. Powerhouse and office: Support piling was changed from timber to prestressed concrete.

c. Gate bay piling: Additional soils information and design considerations indicate the piling can be founded in the sand strata overlying the Pleistocene clays. The shorter piles result in a more economical design and is, therefore, used in the design.

d. Beautification:

(1) Landscaping is provided on both sides of the lock utilizing on-site fill materials which would otherwise be placed in a spoil area.

(2) The berm on the south side of the lock is required to control underseepage at the levee toe. The random fill planting berm is placed above elevation 6 as required for drainage and will be landscaped.

(3) The planting berm on the north side of the lock and around the powerhouse and office enhance the lock area. This area also provides for public utilization of site with minimal disturbance to the lock efficiency. Walks and points of interest are provided for general public recreational and educational activities.

9. Environmental analysis.

a. Environmental quality:

(1) General. The engineering treatment required for preserving the environmental quality of the project area has been considered during preparation of this memorandum. Extensive coordination has been accomplished with the appropriate agencies relative to effects of the project on fish and wildlife resources and water quality control during and subsequent to construction.

(2) Enhancement. Construction of the Rigolets Lock, approach channels and adjoining tie-in levee alters the existing terrain to the extent that these works will be installed contiguous to a natural tidal pass of two major water bodies, namely Lakes Pontchartrain and Borgne, and additionally to the extent that an earthen tie-in levee will be constructed across open marshland. Essentially, all borrow material necessary for construction will be obtained from a borrow pit in the bottom of the Rigolets. Structural construction materials will be used to build the lock bays and appurtenances within a dry coffered area. Specific beautification measures designed to insure aesthetic compatibility with the natural environmental setting are described above.

b. Environmental statement. The environmental statement for the entire Lake Pontchartrain, Louisiana, and vicinity hurricane protection project will be made available to the President, Council on Environmental Quality about December 1973. This statement, in part, describes the effects of the Rigolets Lock feature construction essentially as follows:

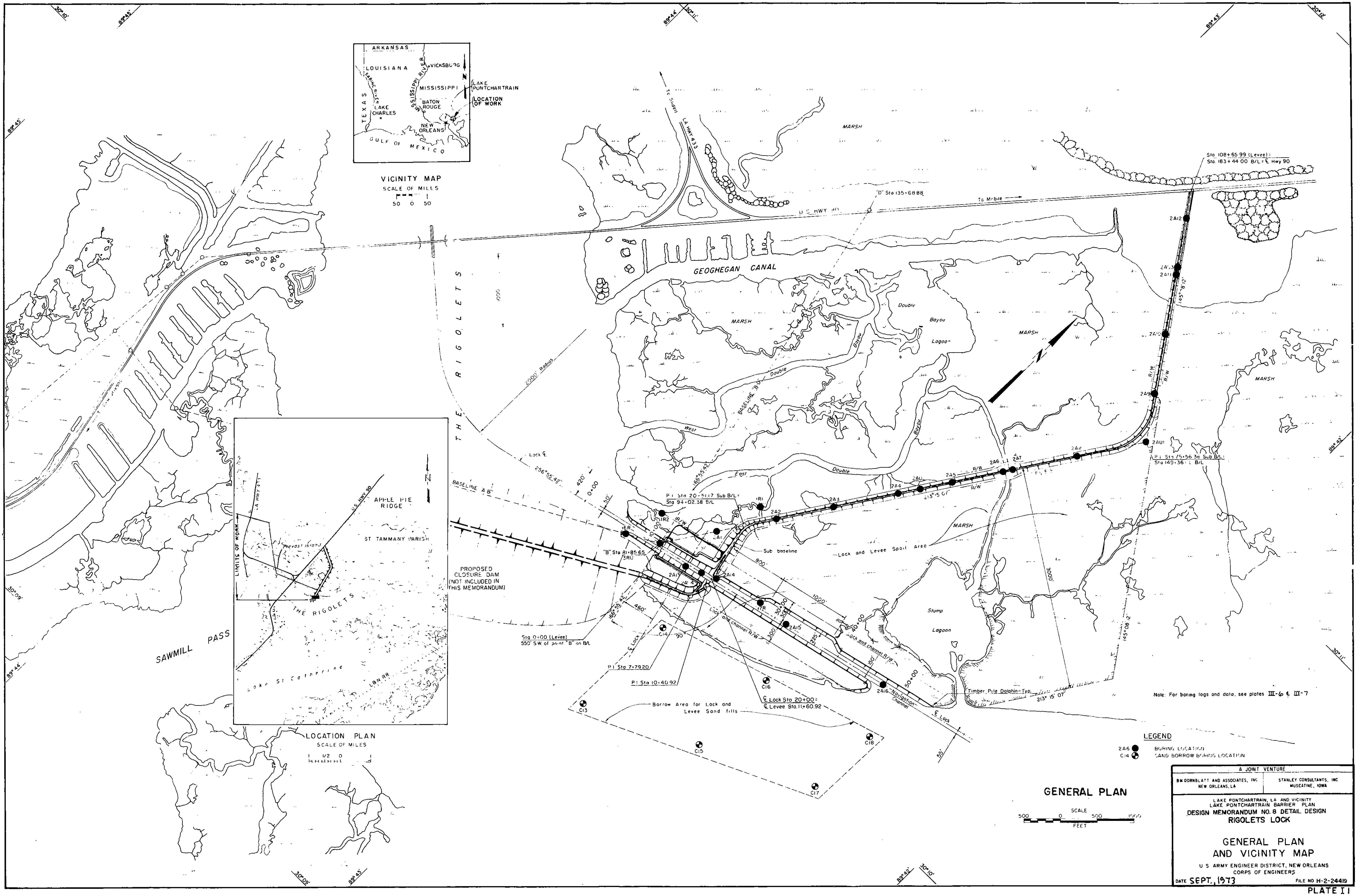
(1) Environmental changes that will occur at the Chef Menteur and Rigolets construction sites will be the destruction of salt marsh by the construction of protection levees, new channels, and control structures. At the Chef Menteur site, 1,656 acres of marshland will be affected. The Rigolets control structure and Rigolets Lock will affect 400 acres. Natural channels will be modified and many small channels will be closed and replaced with manmade channels. Navigation through the project area will be diverted to the new navigation canals. Turbid water conditions with associated silting, due to dredging, pumping, and levee construction, will occur only during construction periods. Unwanted dredge materials will be deposited in spoil-disposal areas and construction materials removed from select borrow areas.

(2) Beneficial aspects of the Rigolets and Chef Menteur construction on and near the construction area are the filling of undeveloped marshlands with spoil, formation of ponds for duck hunting and fishing in land borrow excavations, and the formation of deep fishing holes by removing borrow materials from the bottoms of Lake Pontchartrain and other waterways. Spoil deposit results in higher ground elevations necessary for construction in this area. Higher elevations in spoil areas will lead to the invasion of these areas by trees, shrubs, and other upland plants. This increased elevation with associated vegetation will provide habitat in the form of food, shelter, and breeding sites for upland wildlife including game species. The removing of bottom materials with the formation of deep holes creates desirable fishing spots for croakers, drum, and speckled trout. Aspects related to excavation and filling are not permanent because natural processes will eventually result in the return of the original setting.

(3) Detrimental aspects of the Rigolets and Chef Menteur construction on and near the construction area will be the direct destruction of areas of natural salt marsh by protection levees, channels, borrow and spoil areas, and the very turbid water conditions that will occur during construction. Navigation through the project area will be through new navigation channels, Chef Menteur navigation structure and Rigolets Lock.

(4) Temporary turbid water conditions during construction will decrease the amount of primary production in the disturbed area by decreasing the light available to phytoplankton and other aquatic plants. Shading and silting will result in the destruction of rooted shoreline vegetation which provides habitats for commercial species and organisms which provide food for commercial species. Silting may result in the direct destruction of bottom organisms including clams, worms, and other important food organisms in the disturbed area.

(5) Construction plans and specifications at the Rigolets and Chef Menteur complexes will include provisions to minimize the accidental spillage of harmful materials and the sanitary disposal of domestic wastes.



Note: For boring logs and data, see plates III-6 & III-7

GENERAL PLAN

SCALE
500 0 500 1000
FEET

LEGEND

2A6 ●	BORING LOCATION
C14 ⊕	SAND BORROW BORING LOCATION

A JOINT VENTURE

B M DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 DETAIL DESIGN
RIGOLETS LOCK

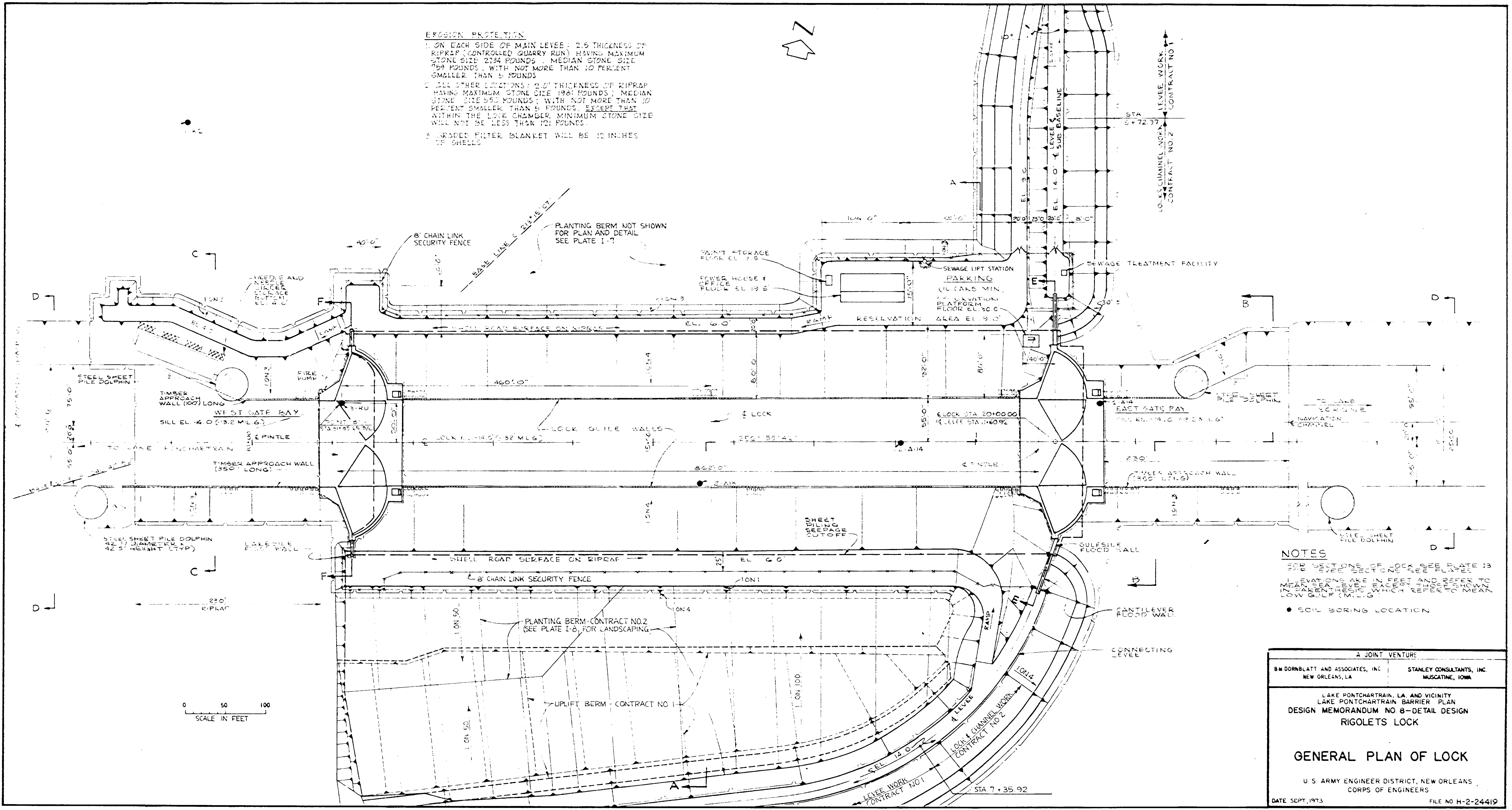
GENERAL PLAN AND VICINITY MAP

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE SEPT., 1973

FILE NO H-2-24419

PLATE I I



ERROSION PROTECTION

1. ON EACH SIDE OF MAIN LEVEE: 2.5' THICKNESS OF RIPRAP (CONTROLLED QUARRY RUN) HAVING MAXIMUM STONE SIZE 2734 POUNDS, MEDIAN STONE SIZE 759 POUNDS, WITH NOT MORE THAN 10 PERCENT SMALLER THAN 5 POUNDS
2. ALL OTHER LOCATIONS: 2.0' THICKNESS OF RIPRAP HAVING MAXIMUM STONE SIZE 1981 POUNDS; MEDIAN STONE SIZE 550 POUNDS; WITH NOT MORE THAN 10 PERCENT SMALLER THAN 5 POUNDS, EXCEPT THAT WITHIN THE LOCK CHAMBER MINIMUM STONE SIZE WILL NOT BE LESS THAN 121 POUNDS.
3. GRADED FILTER BLANKET WILL BE 12 INCHES OF SHELLS.

NOTES

FOR SECTIONS OF LOCK SEE PLATE 13
FOR LEVEE SECTIONS SEE PLATES

ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL EXCEPT THOSE SHOWN IN PARENTHESIS WHICH REFER TO MEAN LOW GULF (M.L.G.)

● SOIL BORING LOCATION

A JOINT VENTURE

B M DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

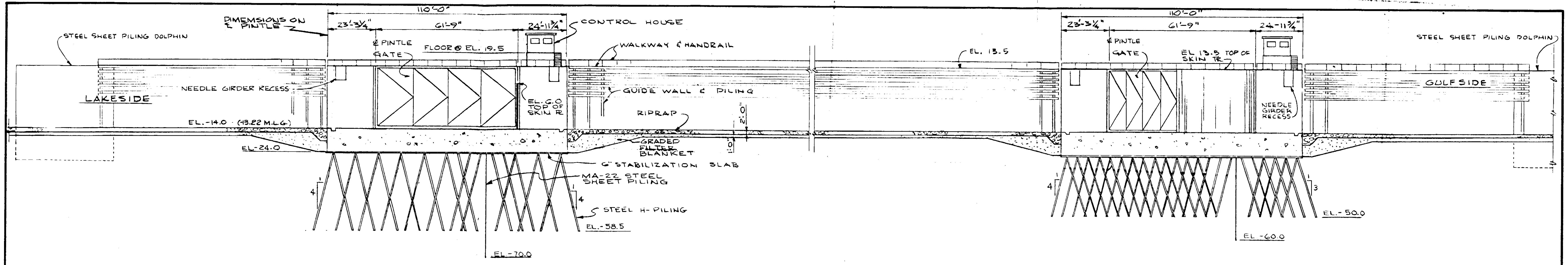
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8—DETAIL DESIGN
RIGOLETS LOCK

GENERAL PLAN OF LOCK

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

DATE SEPT., 1973
FILE NO H-2-24419

PLATE I2

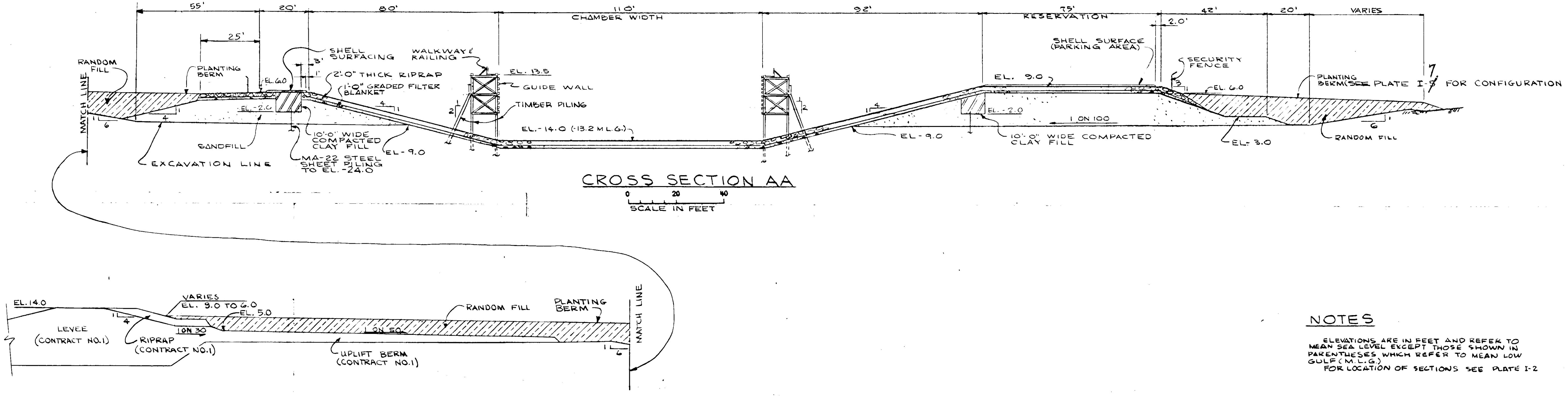


LONGITUDINAL SECTION AT ℄

0 20 40
SCALE IN FEET

LAKESIDE GATE BAY

GULFSIDE GATE BAY



CROSS SECTION AA

0 20 40
SCALE IN FEET

NOTES

ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL EXCEPT THOSE SHOWN IN PARENTHESES WHICH REFER TO MEAN LOW GULF (M.L.G.)

FOR LOCATION OF SECTIONS SEE PLATE I-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC. NEW ORLEANS, LA.	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

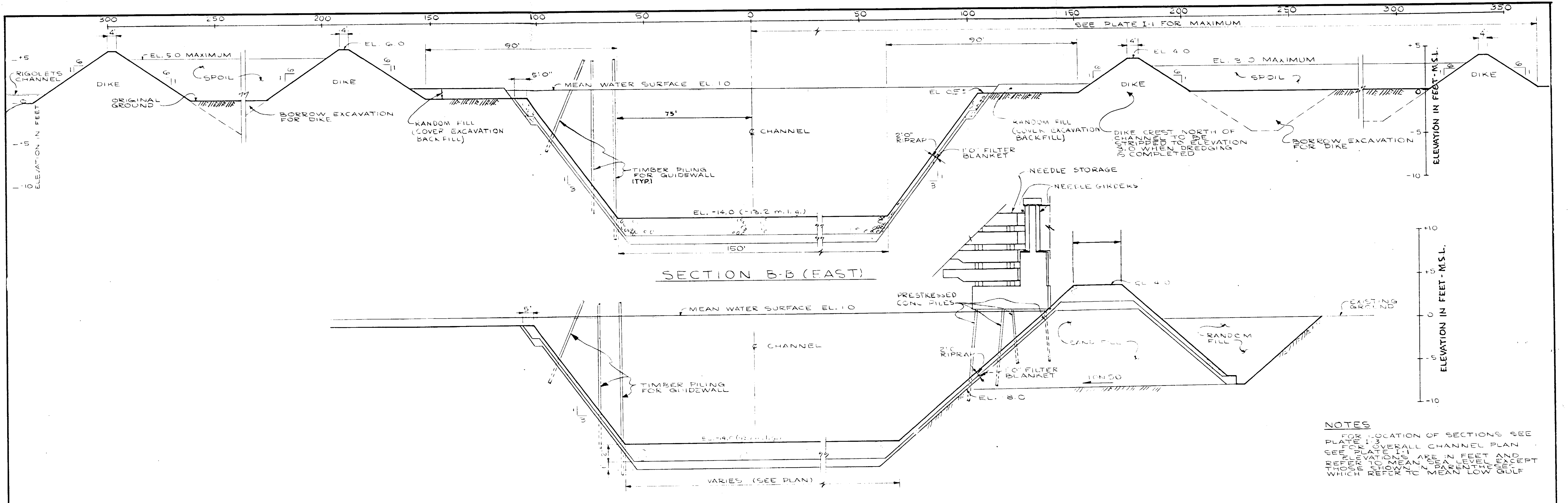
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 – DETAIL DESIGN
RIGOLETS LOCK

LOCK SECTIONS

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

DATE: SEPT., 1973
FILE NO. H-2-24419

PLATE I3



SECTION B-B (EAST)

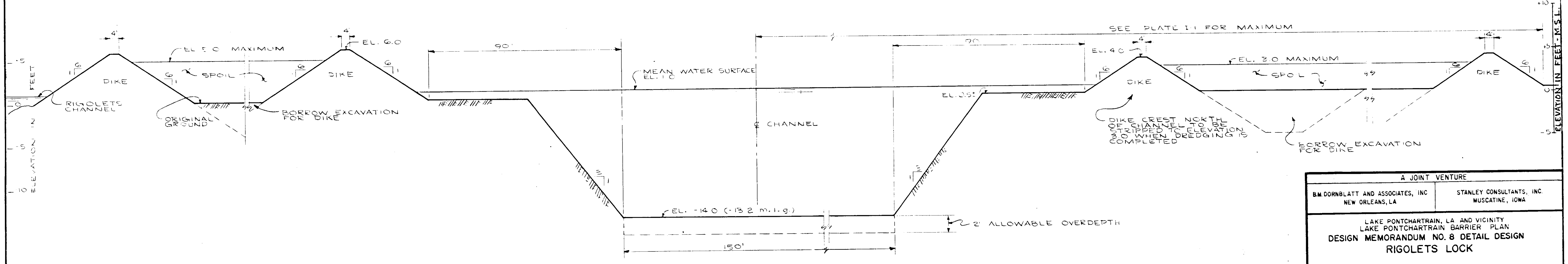
SECTION C-C (WEST)

NOTES

FOR LOCATION OF SECTIONS SEE PLATE I-3

FOR OVERALL CHANNEL PLAN SEE PLATE I-1

ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL EXCEPT THOSE SHOWN IN PARENTHESES WHICH REFER TO MEAN LOW GULF



SECTION D-D

NOTE DIKES AND SPOIL TO BE PLACED EAST OF LEVEE AND LOCK ONLY.

0 20 40
HORIZ. SCALE IN FEET

0 5 10
VERT. SCALE IN FEET

A JOINT VENTURE

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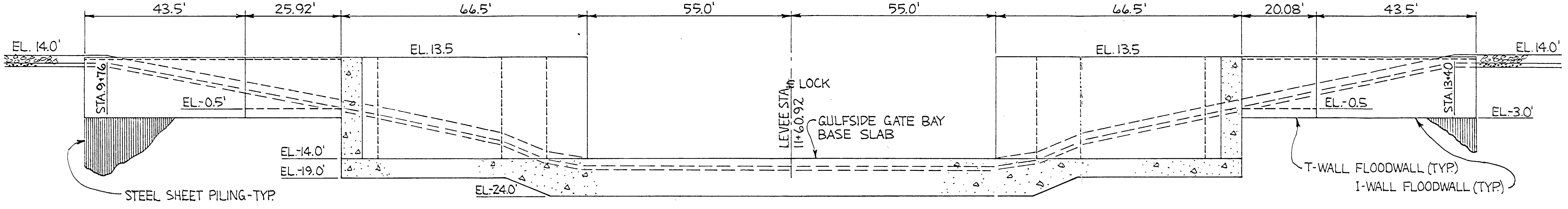
DESIGN MEMORANDUM NO. 8 DETAIL DESIGN
RIGOLETS LOCK

CHANNEL SECTIONS

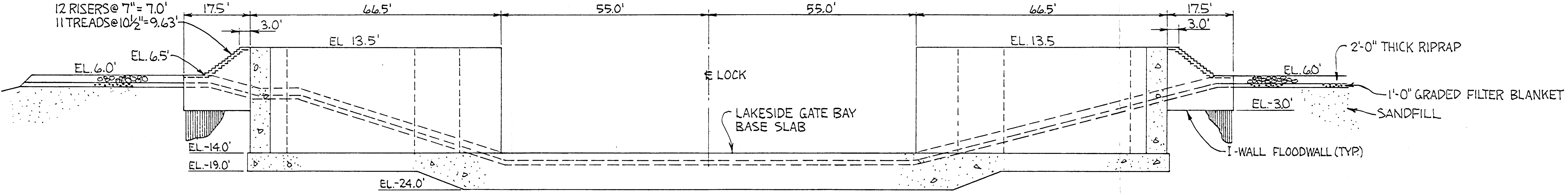
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE SEPT.,1973
FILE NO. H-2-24419



SECTION EE (EAST)

0 20 40
SCALE IN FEET



SECTION FF (WEST)

0 20 40
SCALE IN FEET

A JOINT VENTURE

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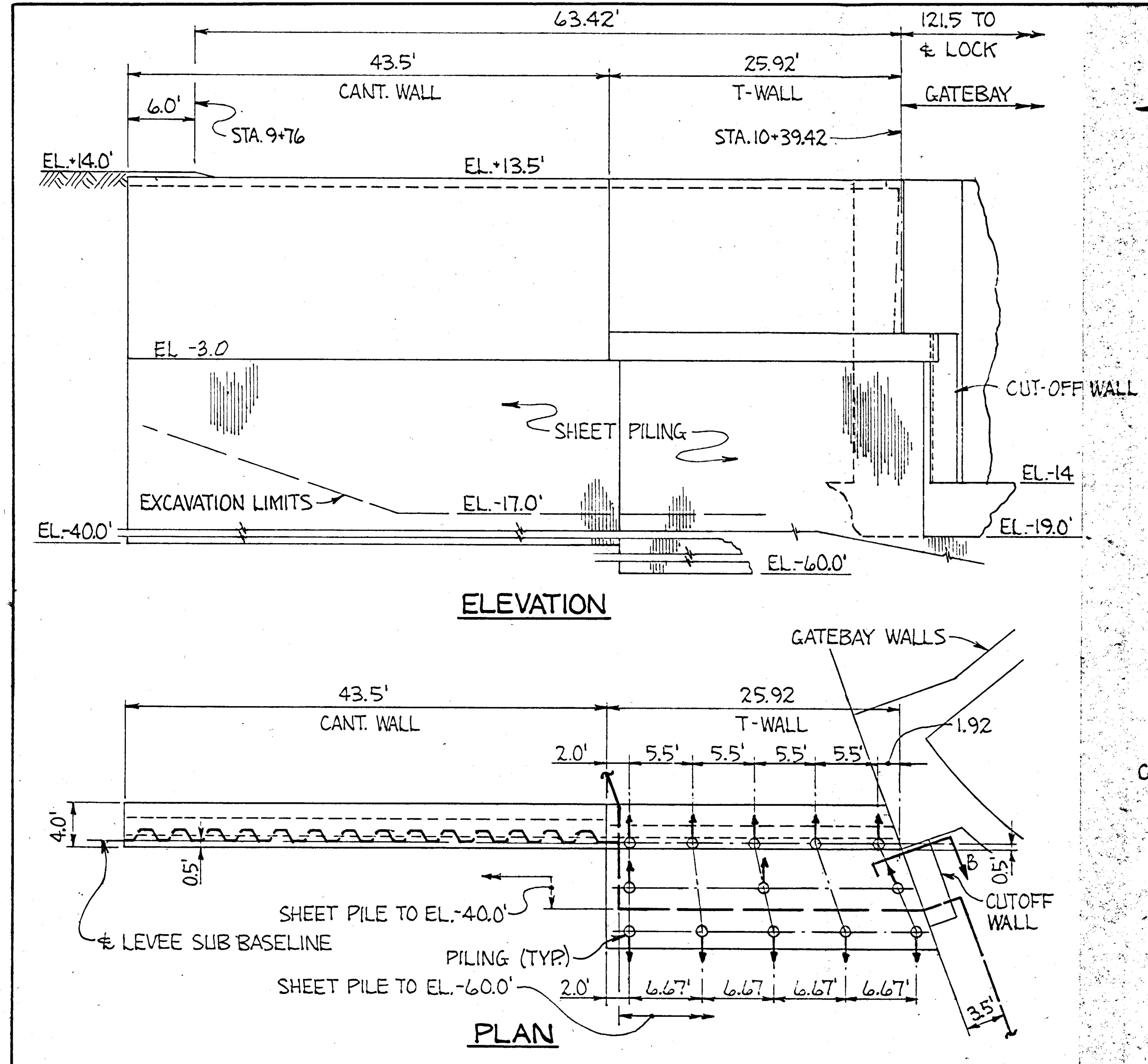
RIGOLETS LOCK

LOCK SECTIONS

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

DATE: SEPT. 1973
FILE NO. H-2-24419

PLATE I5

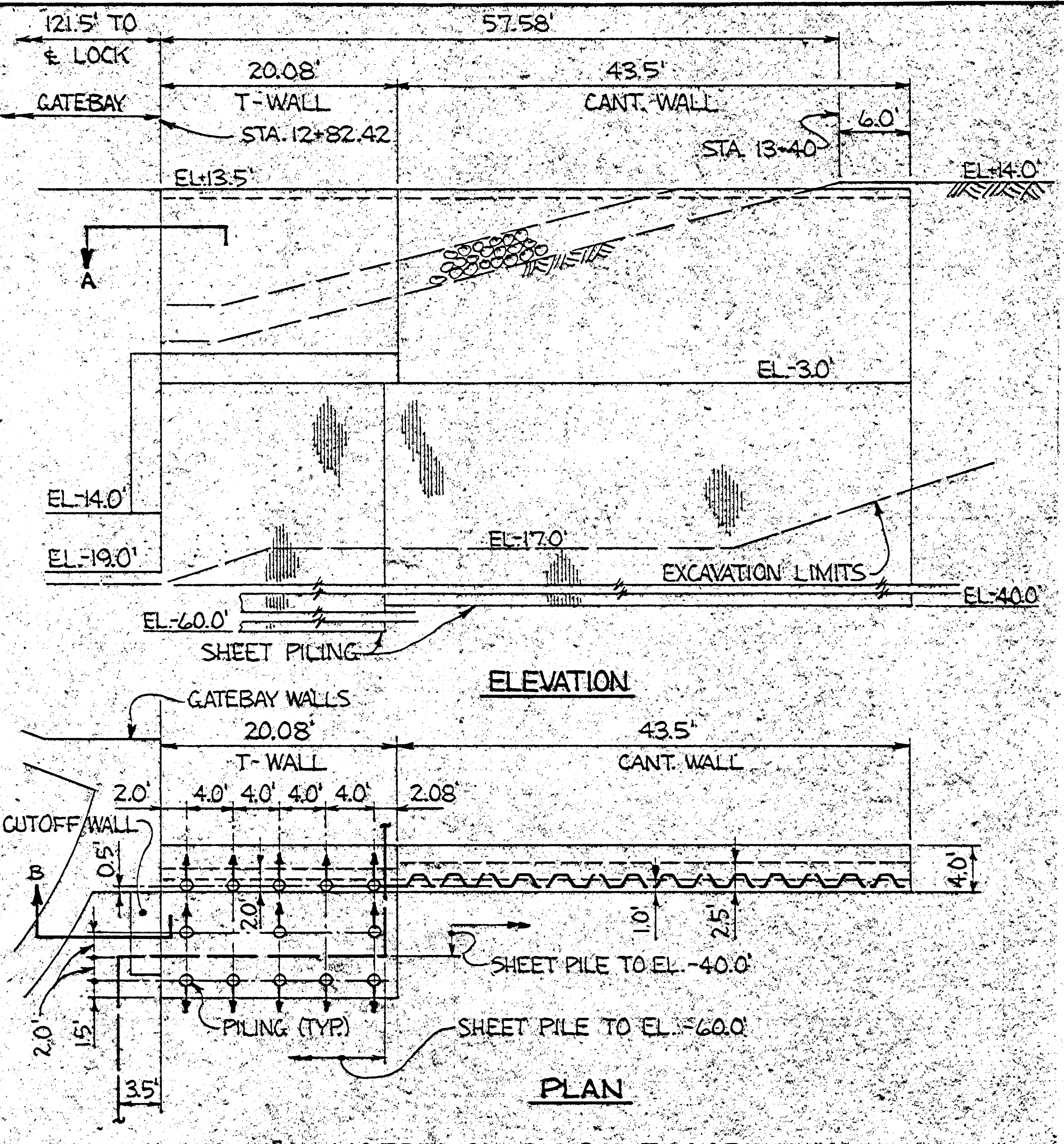


ELEVATION

PLAN

SOUTH GULFSIDE FLOODWALL

SCALE: 3/32" = 1'-0"

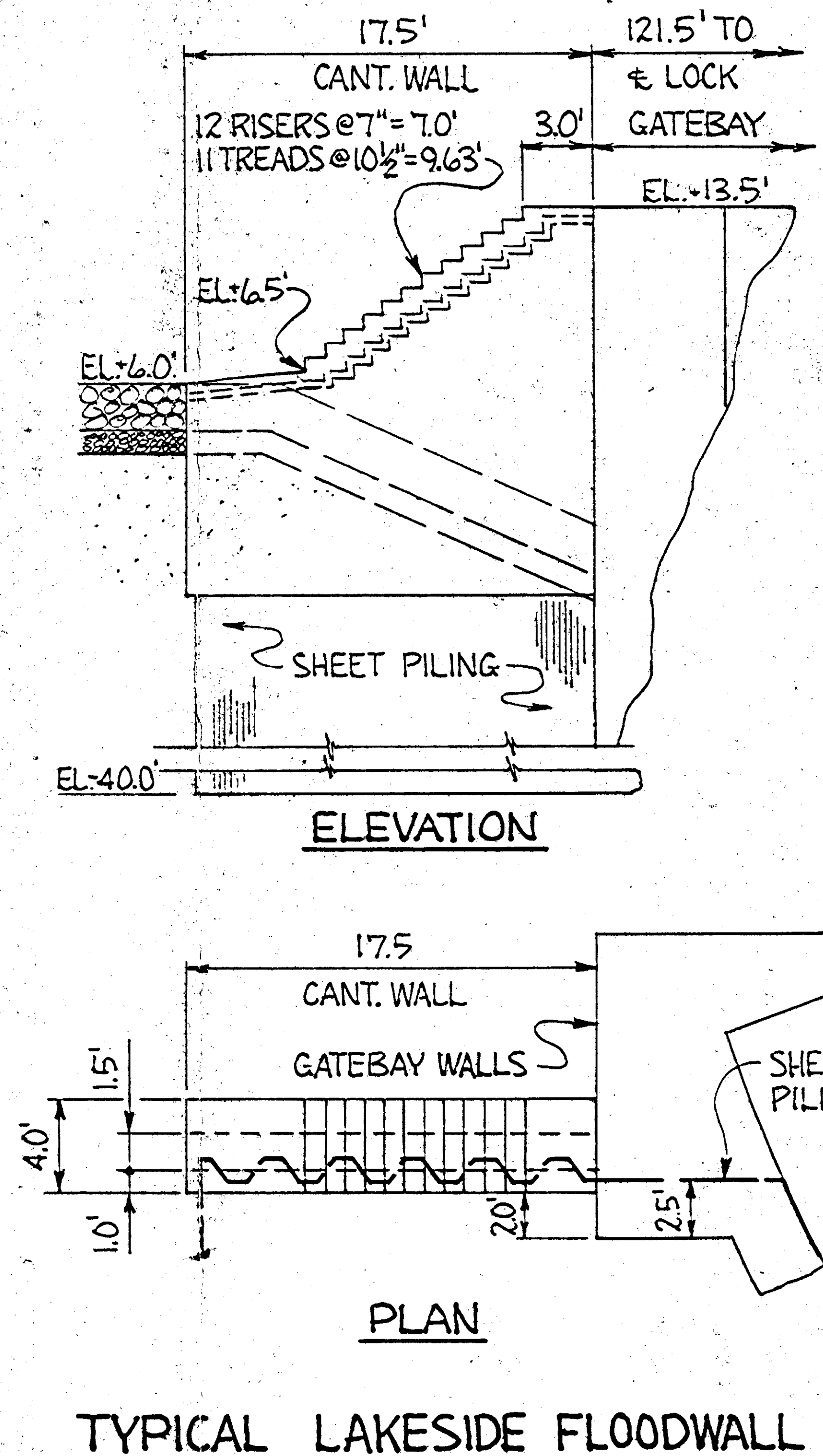


ELEVATION

PLAN

NORTH GULFSIDE FLOODWALL

SCALE: 3/32" = 1'-0"

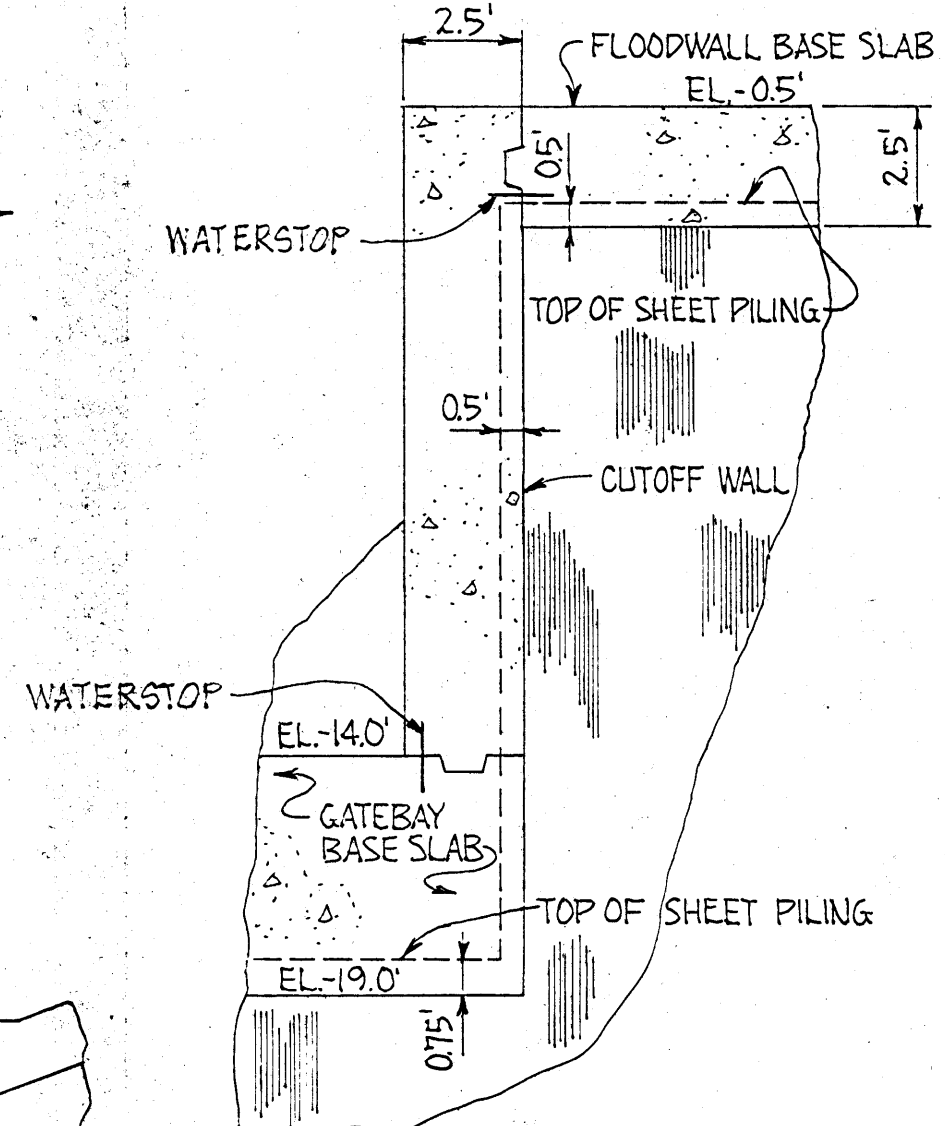


ELEVATION

PLAN

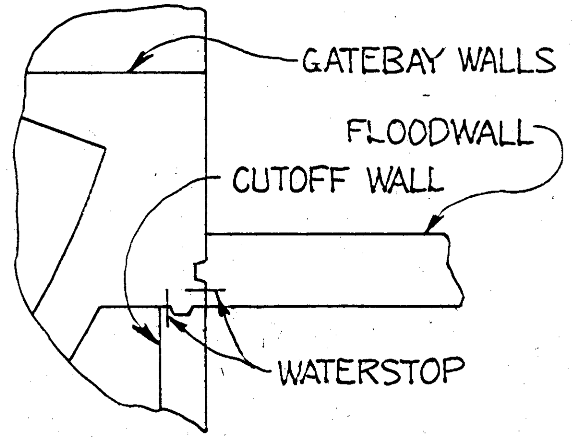
TYPICAL LAKESIDE FLOODWALL

SCALE: 1/8" = 1'-0"



SECTION "B"

SCALE: 1/4" = 1'-0"



SECTION "A"

SCALE: 3/32" = 1'-0"

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC.
NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

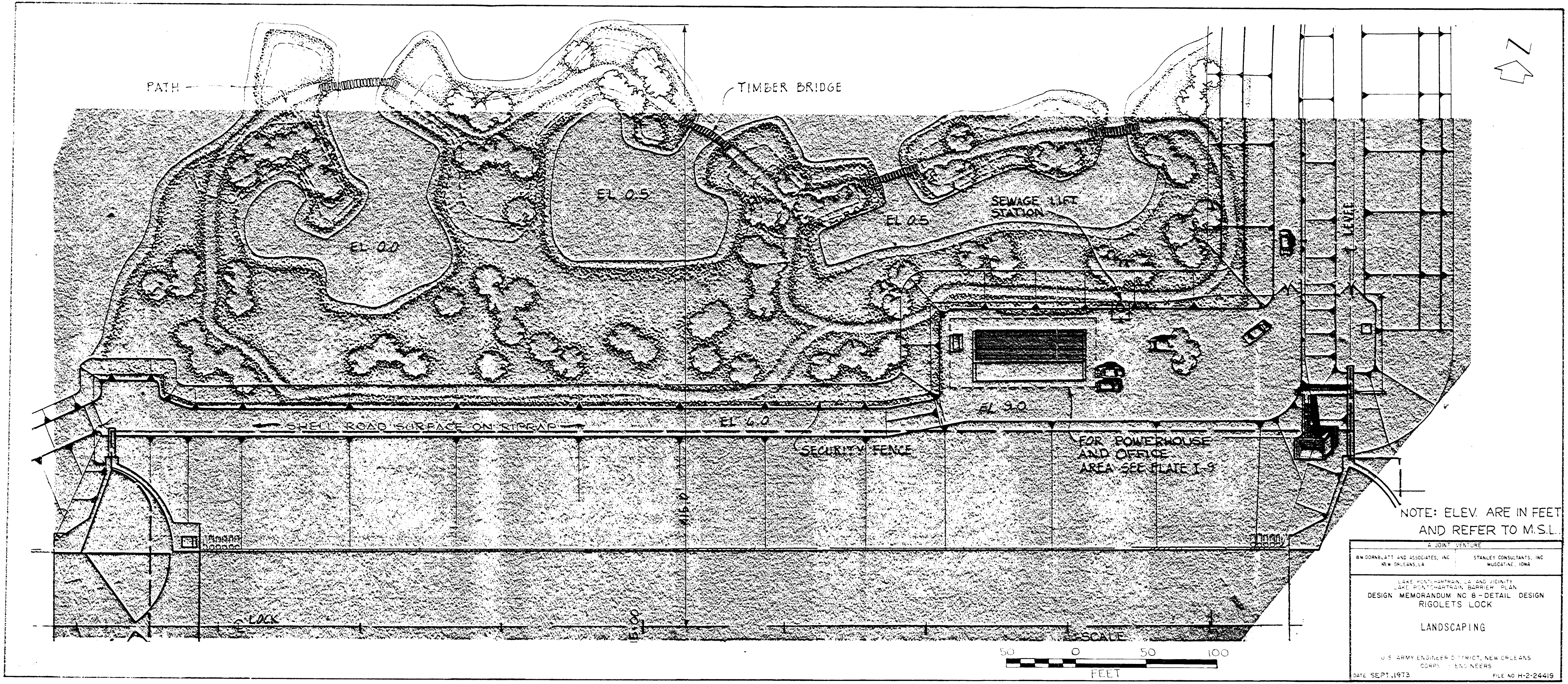
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 – DETAIL DESIGN
RIGOLETS LOCK

FLOOD WALLS
PLAN AND PROFILE

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

DATE: SEPT., 1973
FILE NO H-2-24419

PLATE I6



NOTE: ELEV. ARE IN FEET AND REFER TO M.S.L.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC
MUSCATINE, IOWA

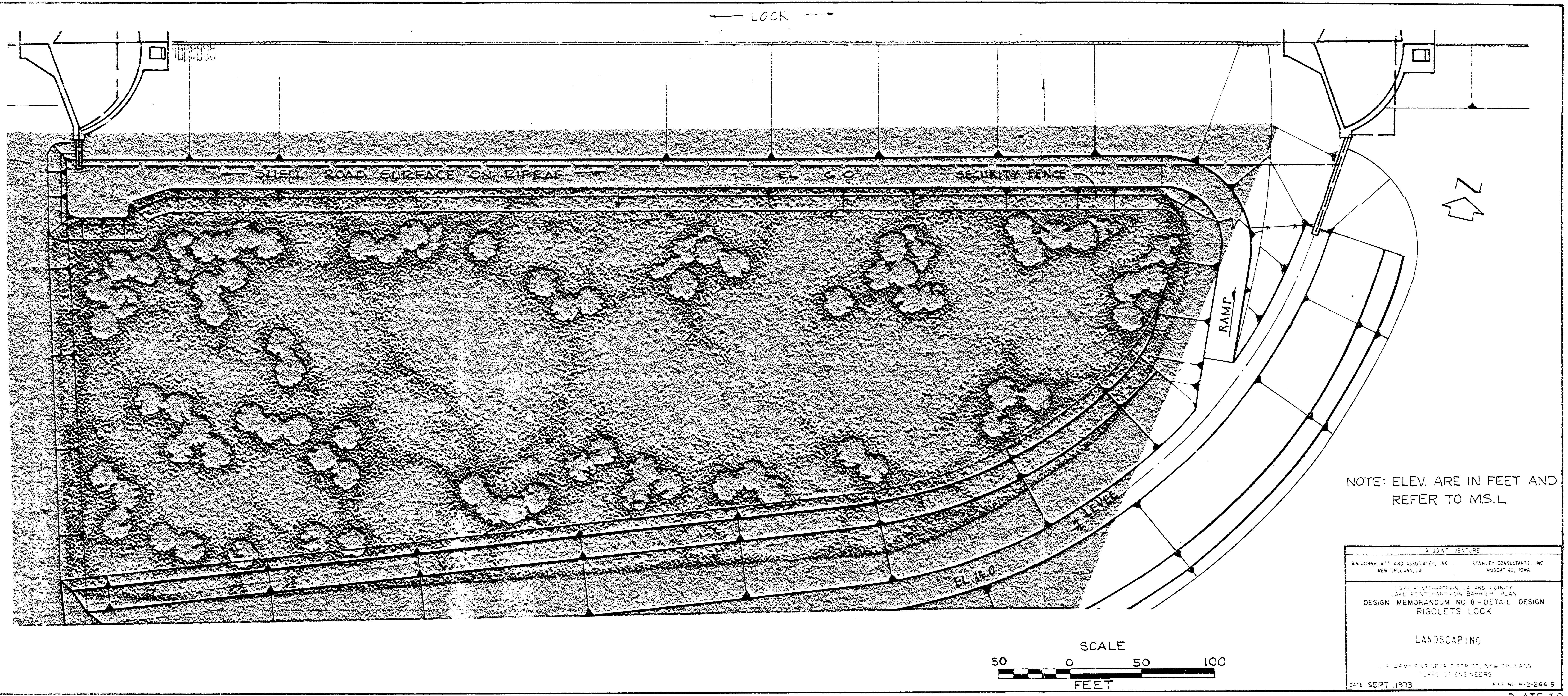
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

LANDSCAPING

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

DATE SEPT., 1973
FILE NO H-2-24419

PLATE I7



A JOINT VENTURE

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DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

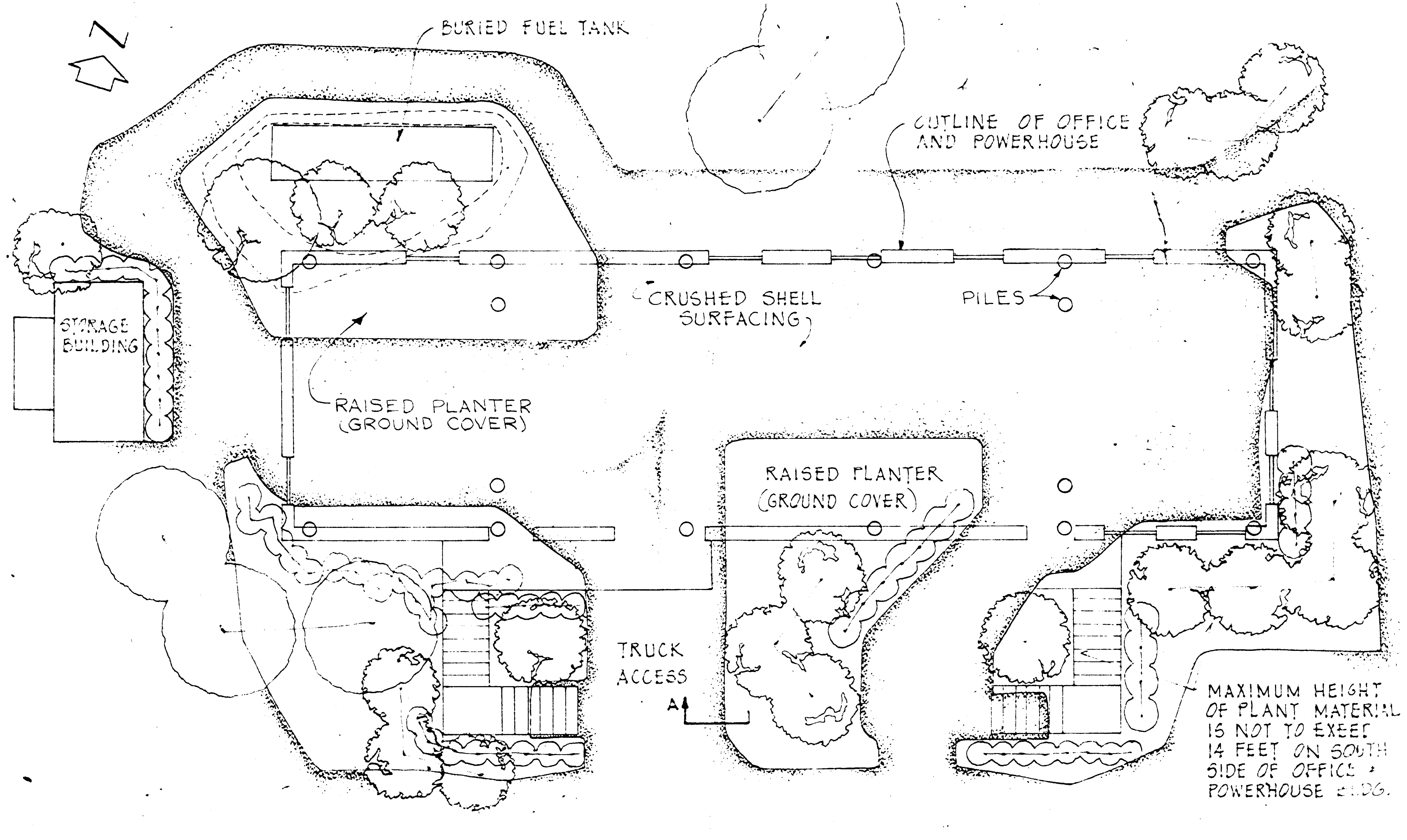
LANDSCAPING

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

DATE SEPT. ,1973

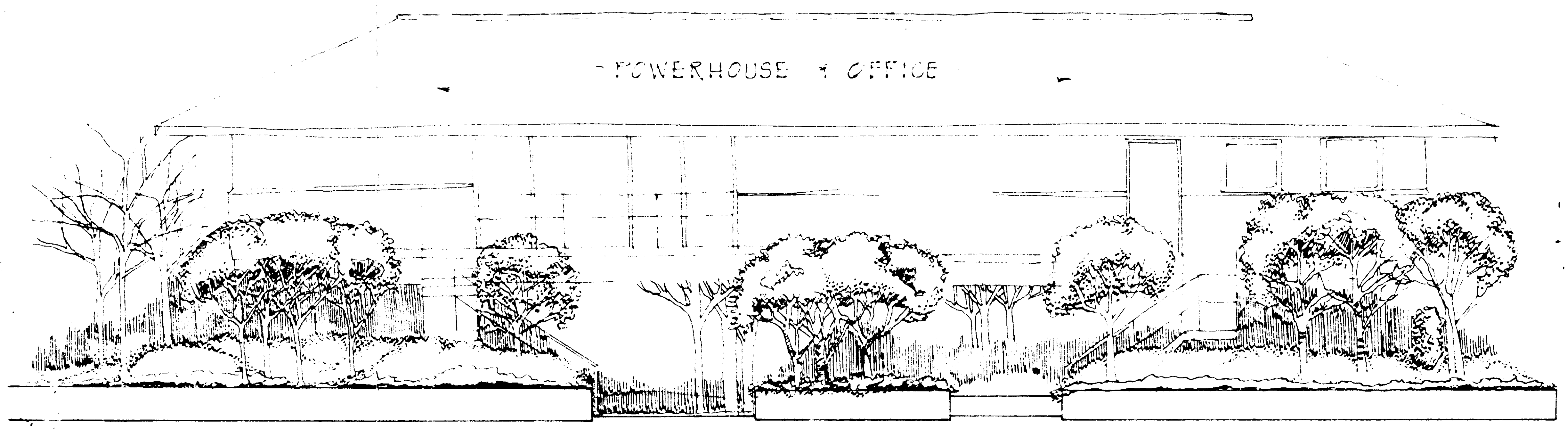
FILE NO. H-2-24419

PLATE 18



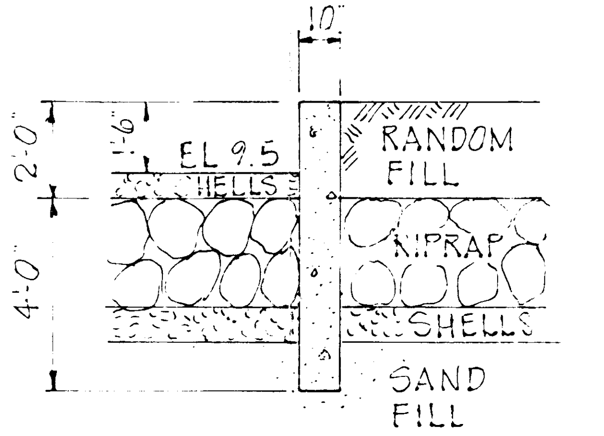
PLAN - POWERHOUSE AND OFFICE AREA

SCALE : 1/8" = 1'-0"



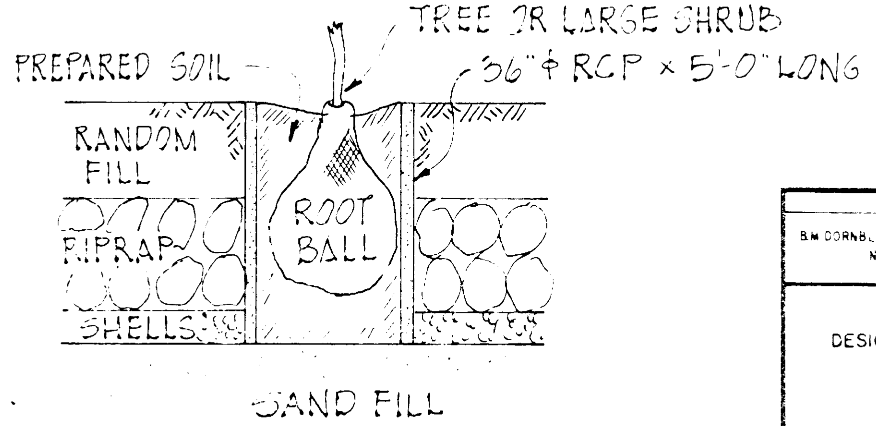
SOUTH ELEVATION

SCALE : 1/8" = 1'-0"



SECTION A

SCALE : 1/4" = 1'-0"



TYPICAL PLANTING DETAIL

SCALE : 1/4" = 1'-0"

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

LANDSCAPING

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

DATE SEPT., 1973
FILE NO H-2-24419

PLATE I9

SECTION II - HYDRAULIC DESIGN

1. Hydraulics of lock.

a. Hydraulic data pertaining to the lock are included in Design Memorandum No. 1 - Hydrology and Hydraulic Analysis, Part I - Chalmette and Part II - Barrier dated August, 1966, and August, 1967, respectively.

b. The lock will be operated between a minimum water surface elevation of -3.0 and a maximum water surface elevation of 4.0. At stages exceeding these elevations, the proximity of the hurricane would be such as to prohibit navigation. Hydraulic data for lock design is shown on plates II-1, -2, -3, and -4 and selected design elevations are summarized on plates IV-1 and IV-2. Differential heads for gate machinery design modes were chosen to satisfy turbulence and horse power limitations. Gate operating characteristics are shown on plates II-5, -6, -7, and -8.

c. Overtopping of the barrier levees will occur during severe hurricane conditions. Maximum storm conditions result in raising the still water surface to elevation 12.8 on the gulf side (Lake Borgne) and lowering to elevation -1.0 on the Lake Pontchartrain side. The largest differential at the structure occurs for corresponding elevations of 10.0 and -6.5 on the gulf side and Lake Pontchartrain side, respectively.

d. The maximum reverse head, Lake Pontchartrain to gulf side (Lake Borgne), results in raising the still water surface to elevation 10.0 on the Lake Pontchartrain side and a lowering to elevation -5.25 on the gulf side.

e. The expected frequency and duration of heads on the lock are shown on plates II-1, -2, -3, and -4.

2. Filling and emptying. The lock will be filled and emptied by opening the sector gates and allowing water to flow through the passage between gates. There will be four 70-degree sector leaves, two at each end of the lock chamber as shown on plate I-2. For sections through lock chamber, see plate I-3.

3. Gate operation. The control system provides four optional gate opening modes made available through a manual selector switch. "High speed" operation (mode 1), with a minimum gate opening time of about 2 3/4 minutes, will be used for head differentials up to 2 feet. Maximum opening time (mode 4) requires slightly over

15 minutes for completion, but may be used for head differentials as high as 7 feet. Modes 2 and 3 require opening times of 4 1/4 and 6 1/2 minutes, respectively, and are available for maximum head differentials of 3.1 feet and 4.4 feet, respectively. Modes 1 through 4 employ combinations of up to four speeds of gate rotation during the opening cycle. Gate speeds employed are 0.002 rpm, 0.010 rpm, 0.03 rpm, and 0.1 rpm. The gate opening modes will be selected by a manual switch. The gate speeds in each mode will be automatically switched during opening by adjustable speed-change switch settings at various gate opening angles. Plate II-8 shows the locations of speed-change switch settings and their operation in the four gate opening modes. Closing of the gates will occur in the high speed operating mode only.

4. Filling and emptying time.

a. Based upon experience at Algiers and Bayou Sorrel locks, the maximum allowable turbulence factor is set at 33,000 lb./sec. "Turbulence factor" is defined as the total energy of inflow into the lock chamber in foot-pounds/sec. divided by the depth of water cushion in the lock.

b. Turbulence during opening is computed as follows:

Let H_1 = depth of water over sill in approach channel (ft.)

h = head differential, level of water inside lock below level in approach channel at any time t seconds after the beginning of lock filling (ft.)

h_o = head differential at beginning of opening (ft.)

$D = H_1 - h$ = depth of water in chamber

b = width of opening between gates at time t (ft.)

w = water surface width within chamber (ft.)

L = length of chamber (ft.)

A = water surface area within chamber (sq. ft.)

T = turbulence (lb./sec.)

B = bed width of lock chamber (ft.)

Z = cotangent of lock chamber side slope

R = radius of gate (ft.)

N = gate opening speed (rpm)

W = unit weight of water (lb./ft.^{3})

c. Inflow to the lock at any instant is considered as resulting from a combination of weir and orifice flow where:

$$Q \text{ weir} = C_1 \times 3.33 \times b \times h^{1.5}$$

$$Q \text{ orifice} = C_2 \times b \times D \times \sqrt{2\ gh}$$

When values of the discharge coefficients C_1 and C_2 are set at $C_1 = C_2 = 0.95$, total inflow is given by:

$$Q = 0.95b\ [D\ \sqrt{2\ gh} + 3.33\ h^{1.5}]$$

$$= 4.46b\ \sqrt{h}\ (1.71H_1 - h)$$

d. The rate of rise of water level within the lock is given by:

$$\frac{dD}{dt} = -\frac{dh}{dt} = \frac{Q}{A} = \frac{Q}{\underset{\leftarrow \text{small } w}{\textcircled{W}}L} = \frac{Q}{(B + 2ZD)L} = \frac{Q}{[B + 2Z(H_1 - h)]L} \text{ feet/sec.}$$

e. In any short interval of time Δt seconds:

h decreases from h_1 to h_2

b increases from b_1 to b_2

Q changes from Q_1 to Q_2

gate angle opens 6N Δt degrees

f. If the initial gate angle is θ° from the closed position,

$$b_1 = 2R\ [\cos 20 - \cos (20 + \theta)]$$

$$b_2 = 2R\ [\cos 20 - \cos (20 + \theta + 6N\ \Delta t)]$$

g. Corresponding values of Q_1 and Q_2 may now be computed if h_1 and h_2 are known. When short intervals of time are examined in succession from the beginning of opening when $h_1 = h_o$, the value h_2 at the end of each time increment is given by:

$$h_2 = h_1 - \frac{\Delta t}{2}\left[\frac{Q1}{B + 2Z\ (H_1 - h_1)L} + \frac{Q2}{B + 2Z\ (H_1 - h_2)L}\right]$$

h. The above implicit solution was solved by successive approximation. It is of a form capable of solution by computer or programmable desk calculator. The accuracy of the finite difference method employed was checked by comparing results with those obtained using one half the time interval. When no significant difference was found, results were accepted.

i. Turbulence was computed at the end of each time increment by means of the equation:

$$T = \frac{.95\ Wb\ [(H_1 - h)\ \sqrt{2\ gh}\ x\ h + 3.33\ h^{1.5}\ x\ h/2]}{H_1 - h}$$

$$= \frac{.95\ Wb\ h^{1.5}\ [8.02\ (H_1 - h) + 1.65\ h]}{H_1 - h}$$

$$= \frac{6.05\ Wb\ h^{1.5}\ [1.26\ H - h]}{H_1 - h}$$

j. For Rigolets Lock, the following values were used:

B = 110 feet

L = 862 feet

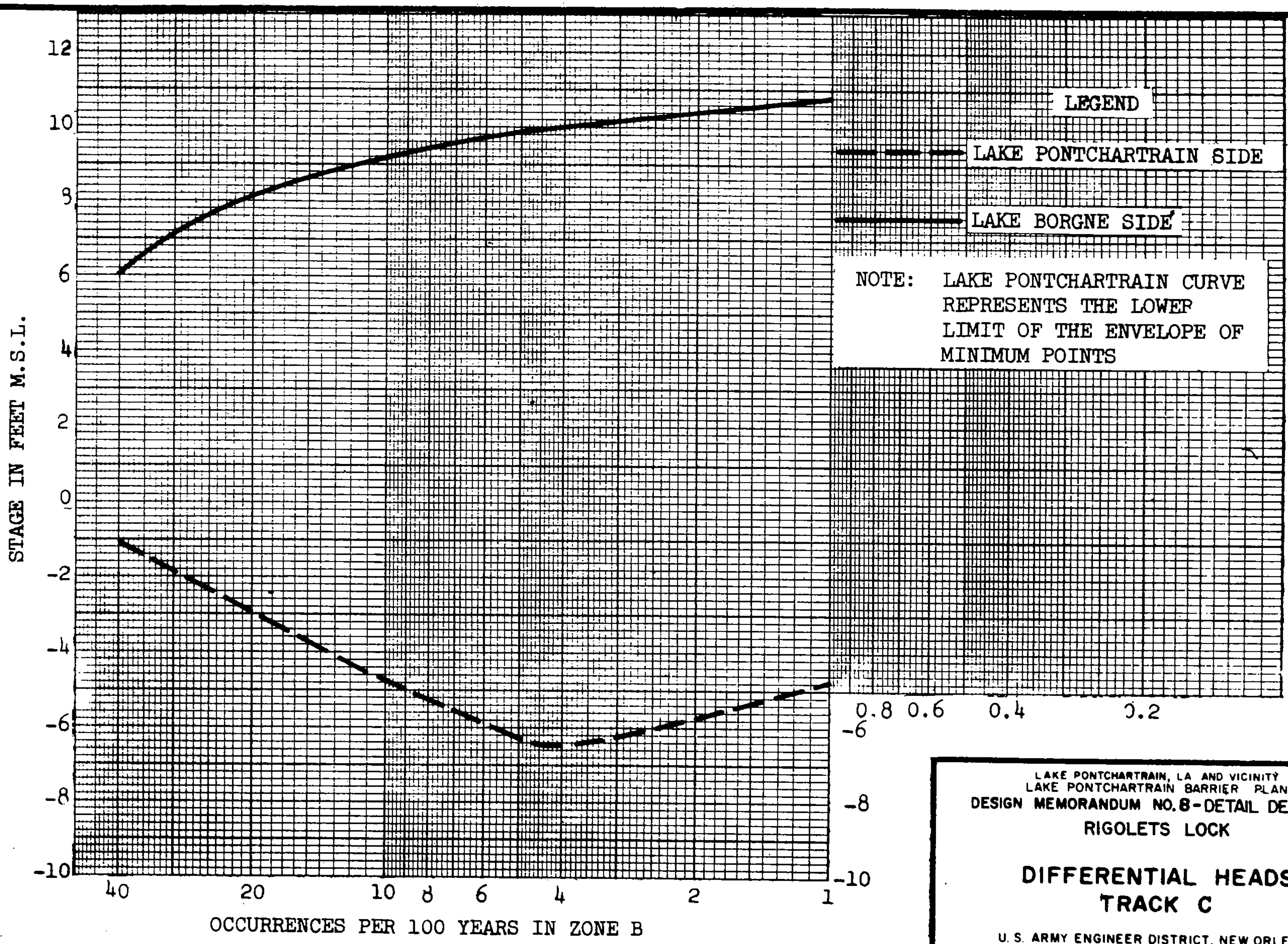
Z = 4

R = 60.76 feet

W = 64 lb/ft^3

k. Combinations of gate opening rotational speeds were tried for various initial head differentials up to the maximum working differential of 7.00 feet. At any given speed, turbulence reaches a maximum and then diminishes. Gate opening may then be switched to a faster speed. By trial and error, position of switches were selected to maintain turbulence (and hence gate opening speed) at a maximum without exceeding an allowable turbulence of 33,000 lb./sec.

Values of gate opening, head differential and turbulence, plotted against time, throughout the significant portion of gate opening for maximum initial head differential conditions applicable to each of the four operating modes are given in plates II-5, -6 and -7.



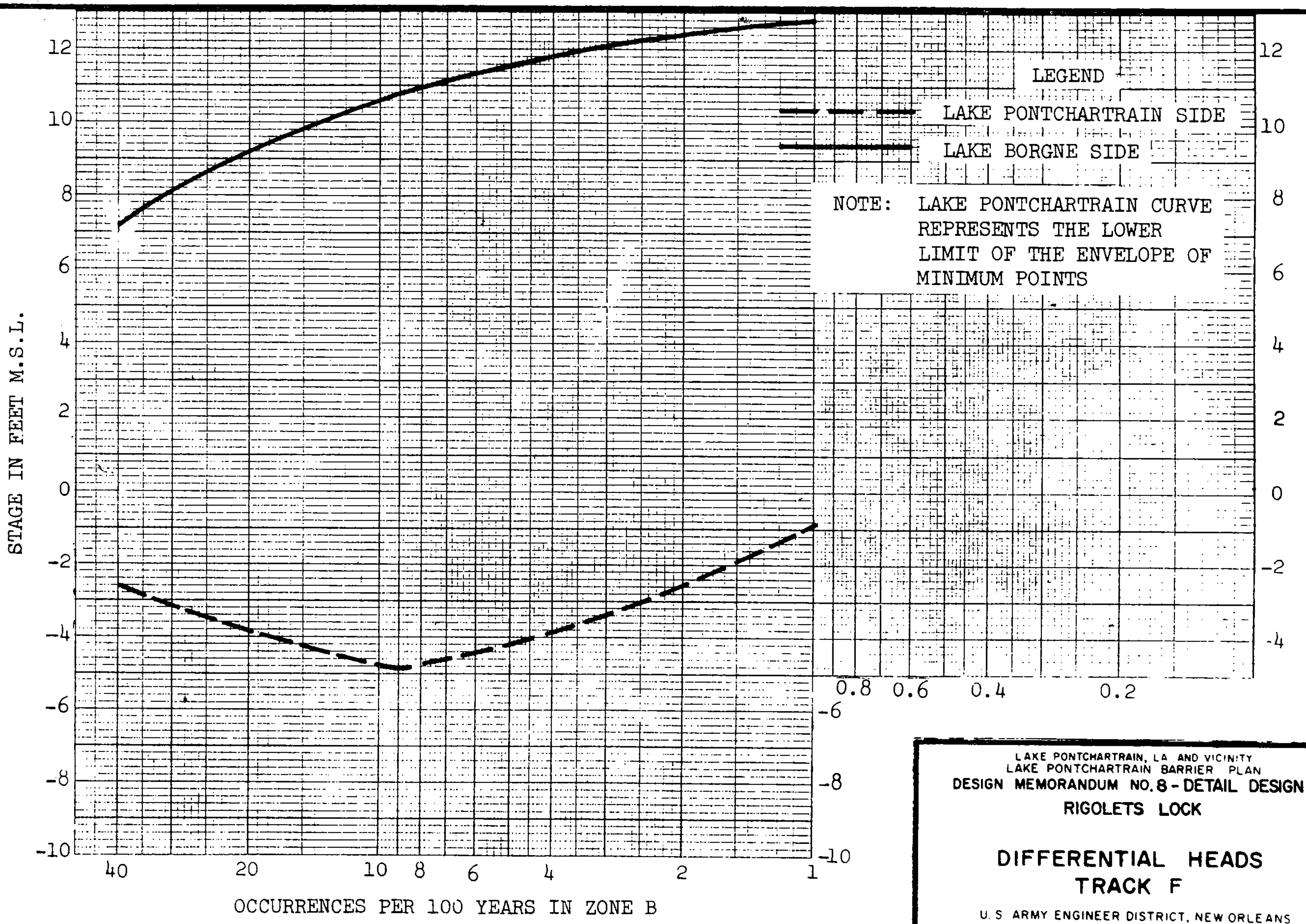
NOTE: LAKE PONTCHARTRAIN CURVE REPRESENTS THE LOWER LIMIT OF THE ENVELOPE OF MINIMUM POINTS

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DIFFERENTIAL HEADS
TRACK C

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

FILE NO H-2-24719

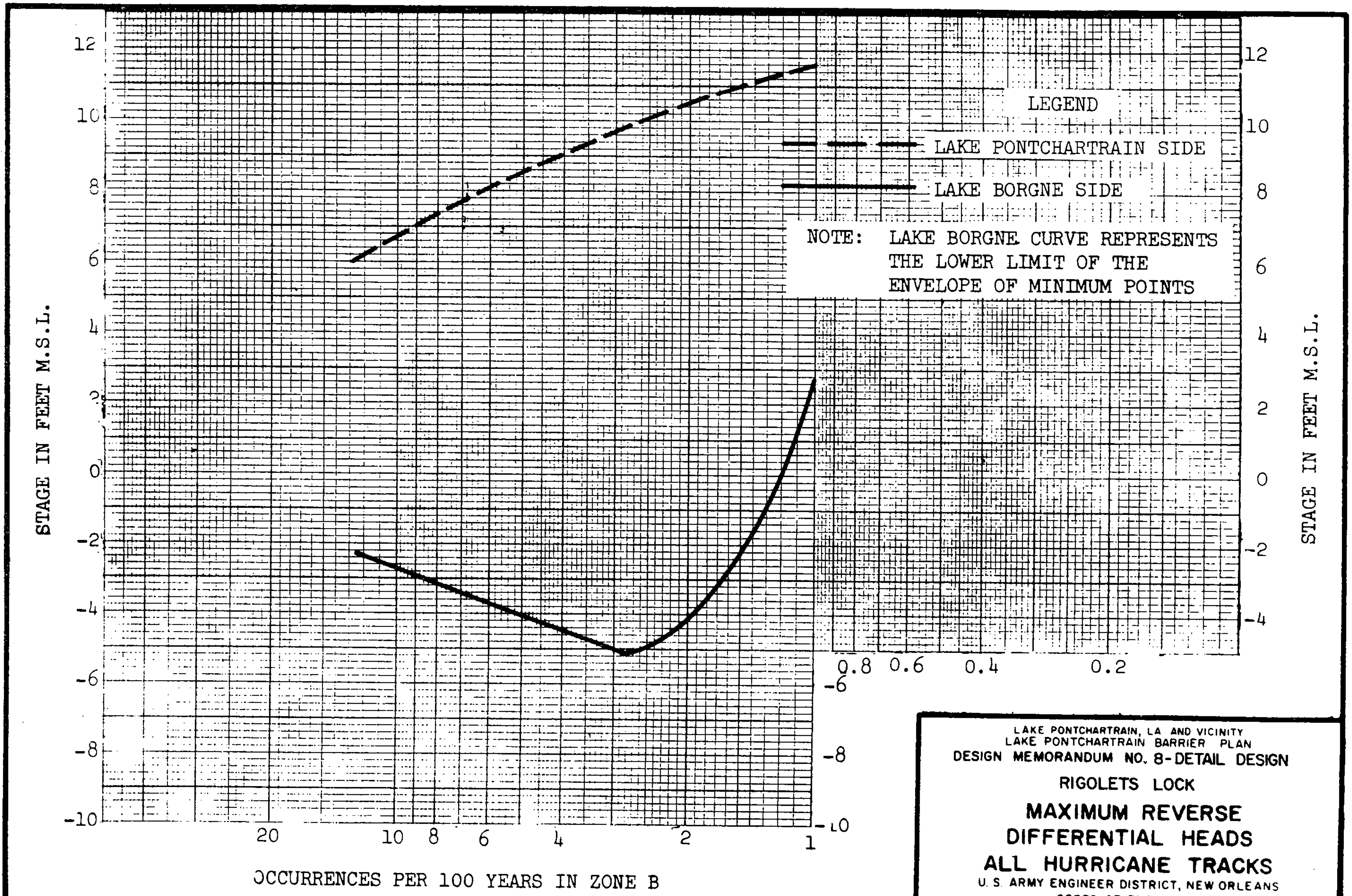


LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DIFFERENTIAL HEADS
TRACK F

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

FILE NO H-2-24719



NOTE: LAKE BORGNE CURVE REPRESENTS THE LOWER LIMIT OF THE ENVELOPE OF MINIMUM POINTS

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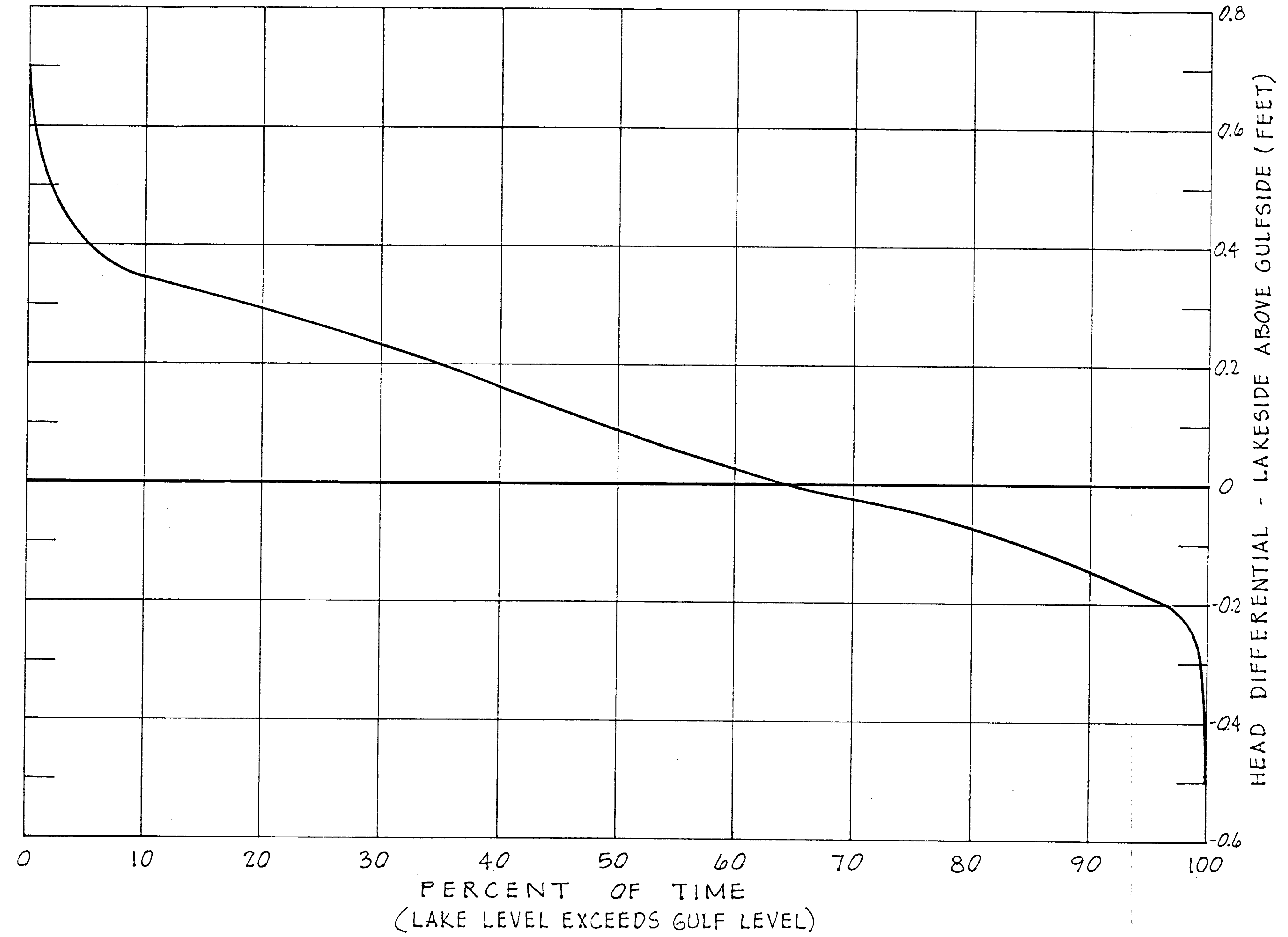
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8-DETAIL DESIGN

RIGOLETS LOCK

MAXIMUM REVERSE
DIFFERENTIAL HEADS
ALL HURRICANE TRACKS

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

FILE NO H-2-24719



NOTES:

CURVES WERE GENERATED USING SPRINGTIDE RECORDED DATA FOR PERIOD 24 APRIL 1971 TO 1 JUNE 1971.

PERIOD WHERE NEAP TIDE OCCURED WERE NOT USED.

TOTAL HOURS USED 754.

SOURCE: NEW ORLEANS DISTRICT, CORPS OF ENGINEERS

A JOINT VENTURE

B.M DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

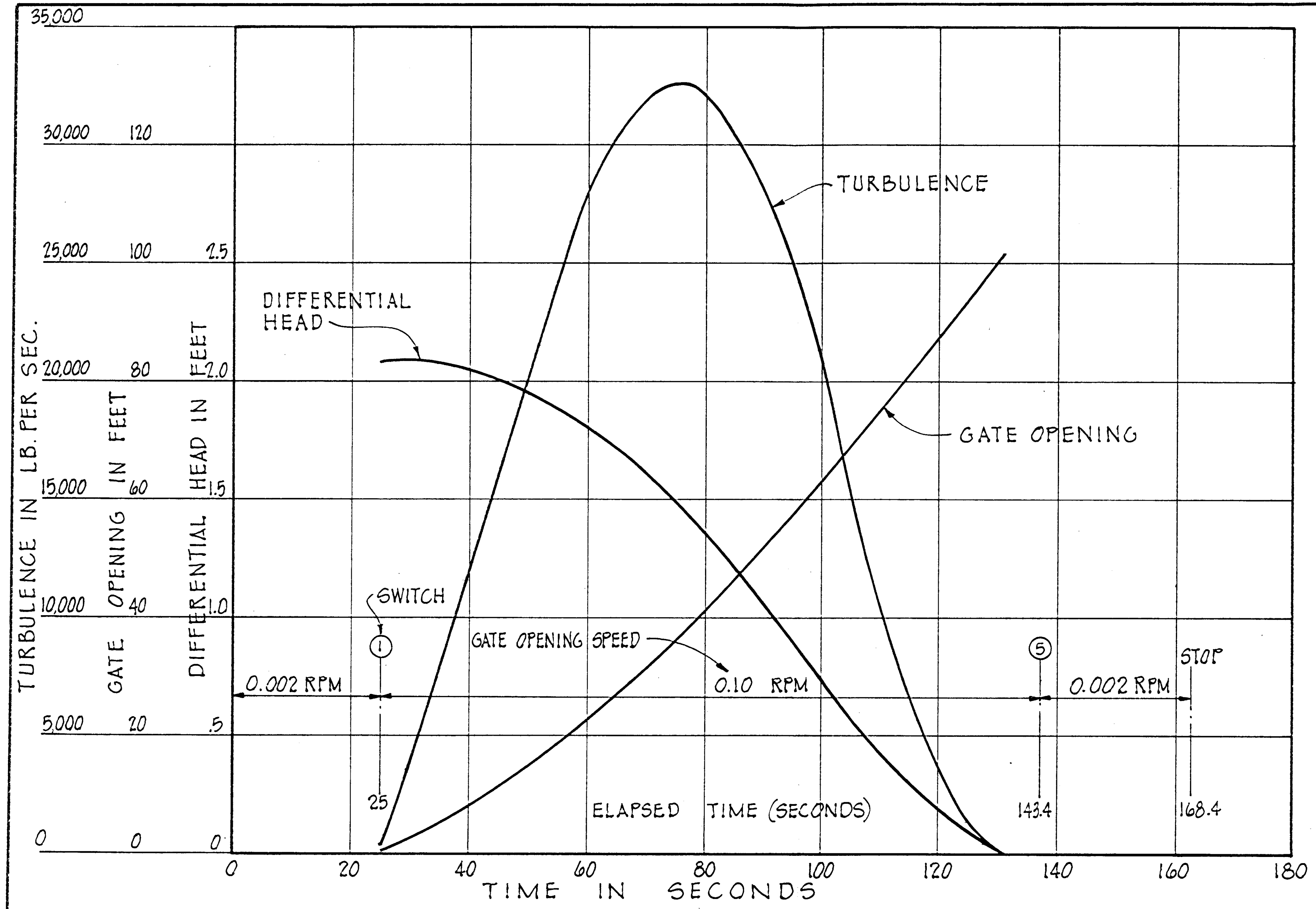
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

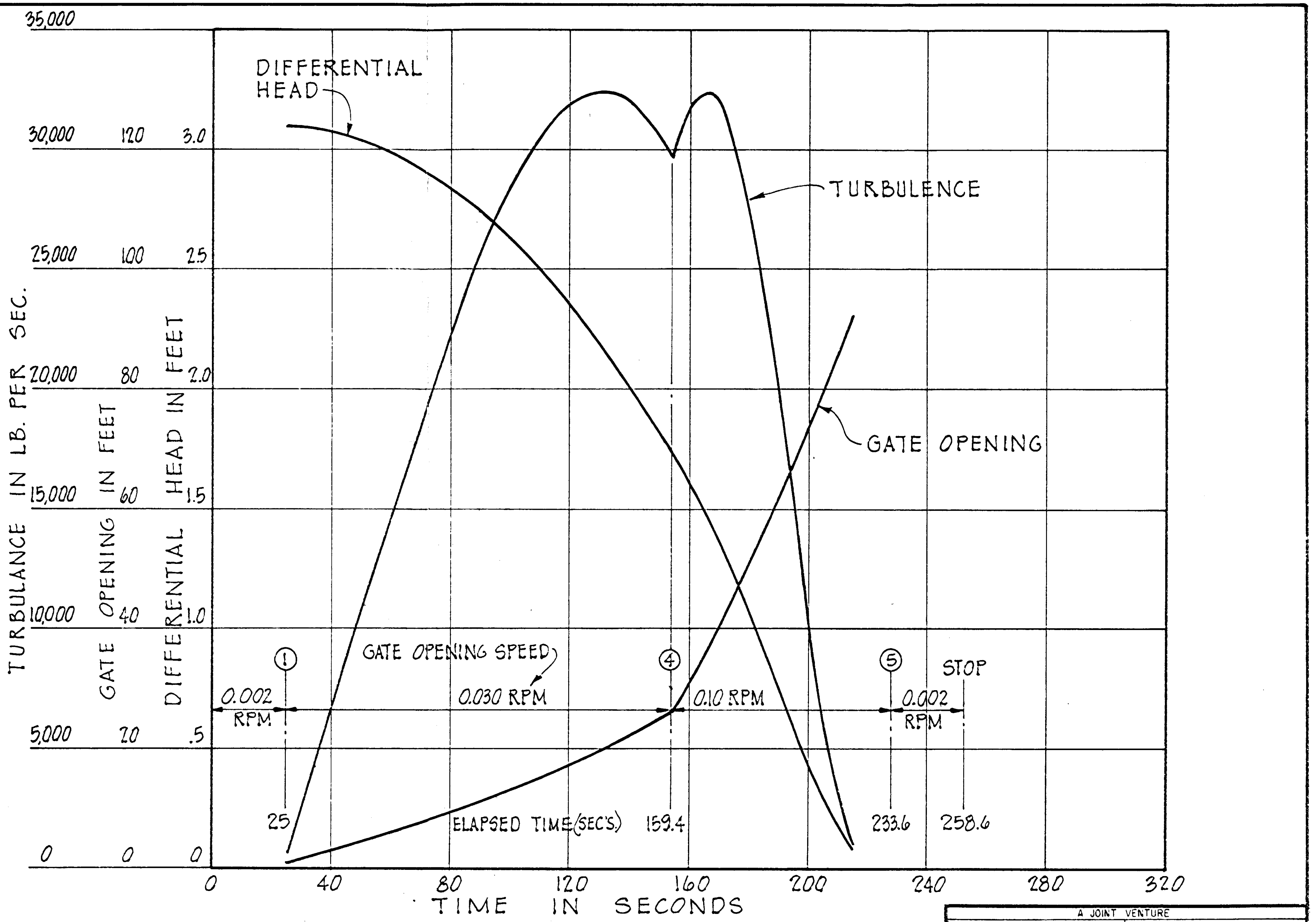
HEAD DIFFERENTIALS DURATION CURVE

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

DATE: SEPT., 1973
FILE NO H-2-24419

PLATE II4





GATE OPENING MODE 1

(MAX. HEAD DIFFERENTIAL 2.1')

DESIGN CRITERIA

GULFSIDE STAGE	+1.25
LAKESIDE STAGE	-0.85
DIFFERENTIAL	2.10

DEPTH OVER SILL IN APPROACH CHANNEL = +1.25-(-14) = 15.25'

DESIGN CRITERIA

GULFSIDE STAGE	+1.8
LAKESIDE STAGE	-1.3
DIFFERENTIAL	3.1

DEPTH OVER SILL IN APPROACH CHANNEL = +1.8-(-14) = 15.8'

GATE OPENING MODE 2

(MAX. HEAD DIFFERENTIAL 3.1')

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC
MUSCATINE, IOWA

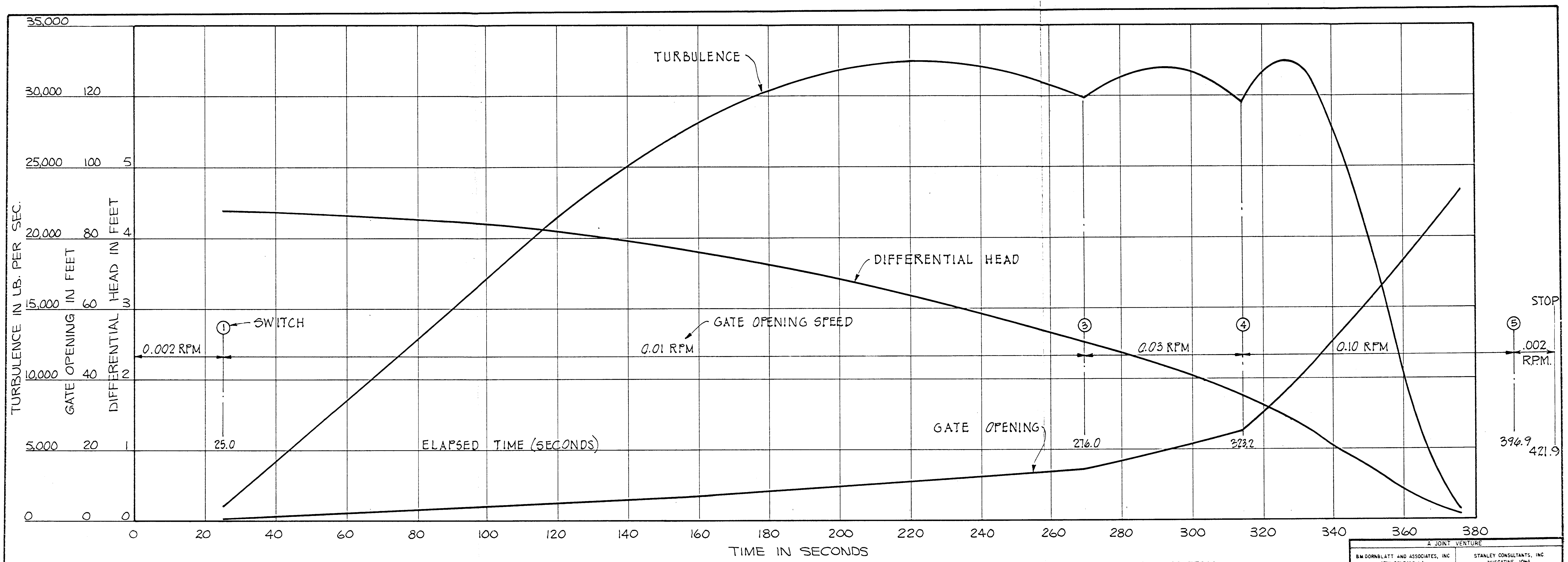
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

FILLING SYSTEM CURVES

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

DATE: SEPT. 1973 FILE NO H-2-24419

PLATE II 5



GATE OPENING MODE 3

(MAX. HEAD DIFFERENTIAL 4.4')

DESIGN CRITERIA

GULFSIDE STAGE	+2.7'
LAKESIDE STAGE	-1.7'
DIFFERENTIAL	4.4'

DEPTH OVER SILL IN
APPROACH CHANNEL =
+2.7-(-14) = 16.7'

A JOINT VENTURE

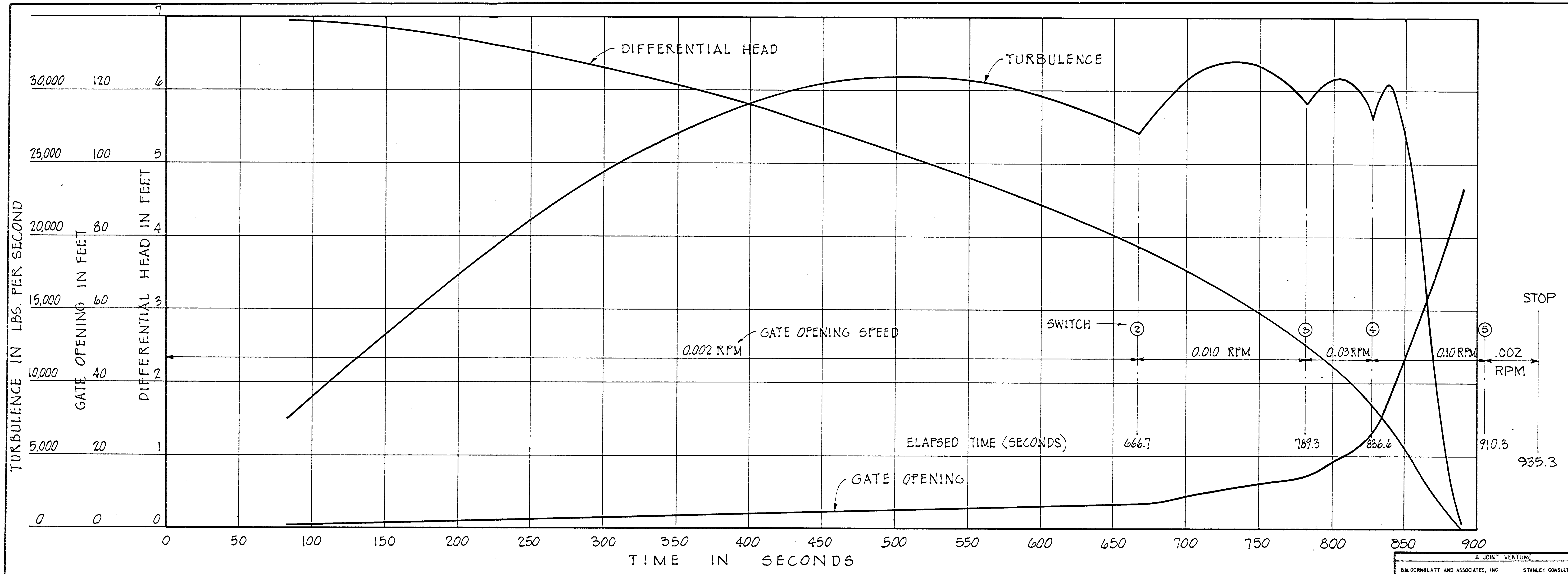
B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

FILLING SYSTEM CURVES

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

DATE: SEPT.,1973
FILE NO H-2-24419



GATE OPENING MODE 4

(MAX. HEAD DIFFERENTIAL 7.0')

DESIGN CRITERIA

GULFSIDE STAGE	+4.0
LAKESIDE STAGE	-3.0
DIFFERENTIAL	7.0

DEPTH OF WATER OVER SILL IN APPROACH CHANNEL = +4-(-14) = 18.0'

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

FILLING SYSTEM CURVES

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

DATE: SEPT., 1973
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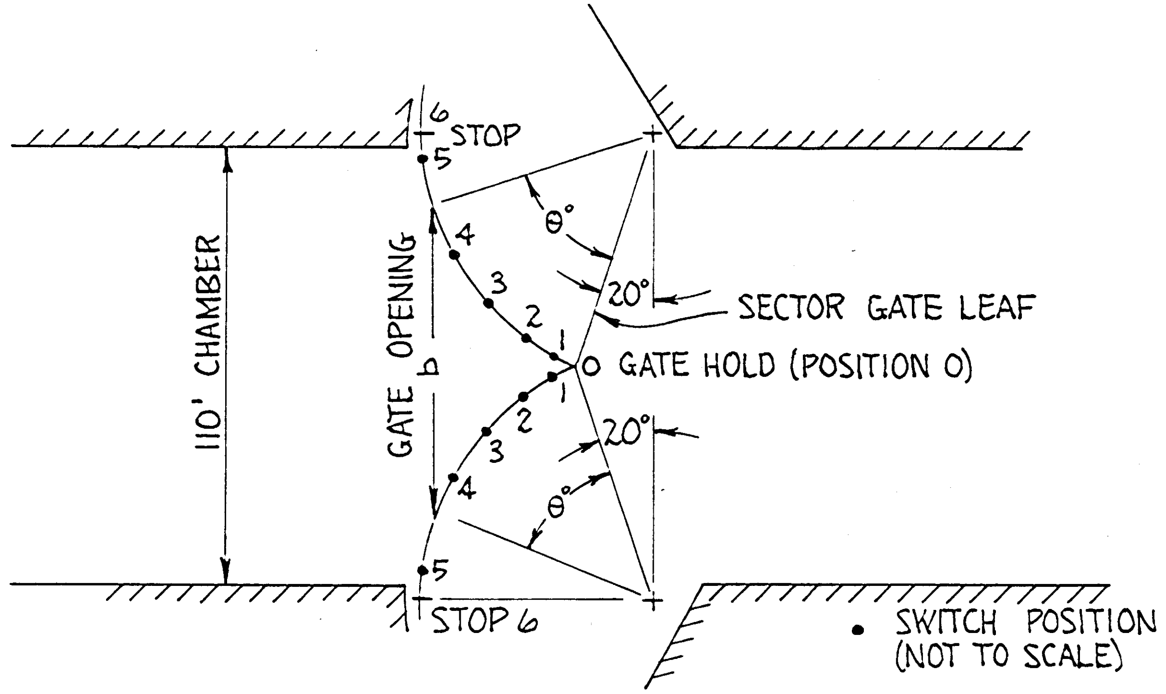


PLAN

SWITCH OPERATIONS												
OPERATION MODE	MAX. HEAD (FT.)	BETWEEN SWITCHES	GATE RPM.	BETWEEN SWITCHES	GATE RPM.	BETWEEN SWITCHES	GATE RPM.	BETWEEN SWITCHES	GATE RPM.	BETWEEN SWITCHES	GATE RPM.	TOTAL TIME OF GATE TRAVEL (MINS.)
1	2.0	0 - 1	.002	1 - 5	.100	5 - 6	.002	-	-	-	-	2.8
2	3.1	0 - 1	.002	1 - 4	.030	4 - 5	.100	5 - 6	.002	-	-	4.3
3	4.4	0 - 1	.002	1 - 3	.010	3 - 4	.030	4 - 5	.100	5 - 6	.002	7.1
4	7.0	0 - 2	.002	2 - 3	.010	3 - 4	.030	4 - 5	.100	5 - 6	.002	15.6
CLOSE	-	6 - 5	.002	5 - 1	.100	1 - 0	.002	-	-	-	-	2.8

SWITCH LOCATIONS		
SWITCH NO.	θ	b
0	0	0
1	0.3°	0'-2 5/8"
2	8.0°	6'-10 3/4"
3	15.0°	14'-7 3/4"
4	23.5°	26'-0 1/2"
5	69.7°	113'-8 3/8"
6	70.0°	114'-4"

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

GATE SWITCH OPERATIONS

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

DATE: SEPT., 1973
FILE NO. H-2-24419

SECTION III - FOUNDATION INVESTIGATION

1. General. The Rigolets Lock and Channel will be constructed on the east bank of the Rigolets Pass between Lake Pontchartrain and Lake Borgne. The centerline of the lock will intersect the Rigolets levee centerline at the levee substation B/L 11+60.92. The lock structure and facilities will consist of concrete sector gate bays supported on steel H-piling; earthen chamber with 1 on 4 side slopes, and 110-foot bottom width, protected with riprap on a 12-inch shell blanket; access channel and treated timber guide walls on each end of the lock and on each side of the lock chamber; a steel sheet pile dolphin at the end of each approach guide wall; timber pile cluster dolphins at the end of and each side of the navigation channel; pile supported I-type and inverted T-type concrete flood walls connecting to the tie-in levees; reservation area; reservation buildings supported by pre-stressed concrete piling; observation platform supported by pre-stressed concrete piling; concrete needles and steel needle girder; and needle girder storage rack supported by pre-cast concrete piling. For the general lock plans, see plate I-2 and for plan and elevations, see plate I-3 and I-4.

2. Investigation. General Design Memorandum No. 2, Supplement No. 2, Rigolets Lock and Adjoining Levees, dated June, 1969, contains a discussion of the geology of the area and subsurface exploration and laboratory test data for the proposed lock site. Additional borings, consisting of one 5-inch diameter undistrubed soil boring, and eight 1 7/8-inch I.D. general type core borings, were made at the proposed lock site subsequent to submittal of the referenced design memorandum. Soil boring logs and detailed undisturbed shear strength data are included in this design memorandum. See plates III-1 through III-7.

3. Soil conditions. The subsoils encountered from the ground surface to approximately elevation -10 along the alignment of the lock and channel are recent deposits consisting of very soft to soft fat clays containing organic matter. From lock and channel centerline station 11+00 to about station 17+50, these very soft clays and underlain by a thin stratum of loose silty sand. This thin silty sand stratum is also encountered in the vicinity of station 20+50. Underlying these near surface deposits is the post-Pleistocene erosion horizon encountered at elevations of about -10 to -12. Between station 11+00 and station 31+00, medium to stiff tan and gray clays, both CH and CL, occur below this horizon. The clay strata are relatively thin, extending to an elevation of about -19 at station 11+00 and about -13 at station 30+00. Underlying

these clay strata, and elsewhere along the lock and channel centerline immediately underlying the marsh deposits, is a stratum of medium dense to very dense fine sand with variable coloration of white, tan, brown, but predominantly gray. This sand stratum terminates at about elevation -63 at the lakeside gate bay, about -53 at the gulfside gate bay, and at approximately elevation -50 at station 46+00. The predominant materials beneath the sand stratum are medium to very stiff greenish-gray and brown clays with some relatively minor strata of silt and silty sand.

4. Design problems. The principal earth work and foundation problems that had to be resolved were as follows:

a. Provide hydrostatic relief during construction in the sand strata down to elevation -30.

b. Design excavation slopes, berm distances, protection dikes, and spoil sections so that they will be stable during construction.

c. Design final slopes and berm distances so that they will be stable and floodwalls will be as short as possible.

d. Determine required penetration for the piles beneath the lock gate bays, reservation building, guide walls, floodwalls, and needle girder storage.

e. Estimate settlement of protection dikes during construction to provide for adequate initial overbuild, and estimate settlements of the levee and reservation fills.

f. Determine required pressure relief and seepage control for operating conditions; the stability of the walls; erosion protection; and types and locations of engineering measurement devices.

5. Unwatering system.

a. Construction requires unwatering of the excavated area for gate bays down to elevation -30.00. This will entail partial dewatering of the fine sand aquifer having a bottom elevation varying from about elevation -53.0 to elevation -63.0 over the area. Hydraulic properties of this zone were tested, results of which are reported in Design Memorandum No. 8 - Detail Design, Field Pumping Test, Appendix No. A. Hydraulic interconnection between piezometric levels in the aquifer and Rigolets Pass levels were indicated during the test. The results of the pumping test indicate that the foundation sand has an average coefficient of horizontal permeability of .0215 ft./min.

b. The method by which the ground water is to be lowered will be left to the contractor with the specifications being prepared on an "end-result" basis. The specifications will allow the use of wells, sumps, pumps, etc., as well as wellpoints. The dewatering system presented on plate III-25 is for cost estimating purposes and for use in evaluating the adequacy of the contractor's proposed dewatering system. Dewatering requirements are analyzed by an approximate flow-net of the piezometric surface of the aquifer at equilibrium during dewatering. Assuming a water surface elevation of 6.0 in Rigolets Pass, 16 wells each pumping 60 gpm will be required to lower the piezometric levee at the ring of wells to elevation -33.0. Plate III-25 also shows construction details of a typical tubular relief well and observation piezometer. Similar designs have been successfully employed in the New Orleans area.

c. Ample factor of safety over the total pumping capacity indicated by the computation will be provided for the actual dewatering system. Two additional wells are recommended as a minimum to provide factor of safety for well capacity. See plate III-25. Standby pumps and motors will be required to maintain reliability in the dewatering system.

d. Effluent from each well will be discharged over the temporary protection dike shown on plate III-18. The point of discharge will be 15 feet from the outer toe of the protection dike to avoid endangering slope stability from erosion due to water discharge.

e. Rainwater will readily drain away through the sandy bottom of the excavation and will be disposed of by the dewatering pumps. Sump pumps in each gate bay will assure water removal should the surface become impervious.

f. Control of the dewatering should be maintained by periodic measurement of the discharge from each well and check of the piezometric surface at the relief wells and observation piezometers. Arrangement of nine observation piezometers is shown on plate III-25. An air line or other suitable device will be employed to indicate the level in each pumped well.

g. The unwatered volume of the aquifer at maximum drawdown is approximately 14 million cubic feet requiring the removal of about 16 million gallons of ground water in addition to that naturally replaced by flow within the aquifer as piezometric levels are lowered. The time to reach equilibrium at the required final levels will be accelerated by the use of higher pumping rates and pumps within the excavation during the initial drawdown process.

h. Wells and piezometers will be constructed with gravel packs of material sized to prevent the fine aquifer sand from being drawn into the wells in appreciable quantity. Upon completion of installation, wells should be thoroughly developed by surging or over-pumping, followed by removal by bailing of fine sand drawn into the well.

i. Wells should each be given an 8-hour pumping test at a uniform discharge of about 100 gpm as soon as possible after completion. These tests should be performed at times when the acquifer is not being distrubed by pumping from nearby wells or the effects of reverse rotary drilling. The test will confirm adequacy of equipment and well and reveal significant differences in hydraulic properties of the aquifer over the area. Adjacent completed wells and piezometers will be used as observation points during testing. Readings of water levels and pumping discharge rate should be taken at 30-minute intervals during the tests.

6. Temporary protection dikes and spoil retention dikes. Protection from flooding during construction will be provided by protection dikes to elevation 6.0 and by the levees built during the levee contract. The gulfside protection dike will be constructed during the first levee contract. The lakeside protection dike will be constructed of impervious materials taken from the excavated area. Protection along the south side of the lock is provided by the levee built in the first levee contract. Spoil retention dikes will be constructed with material cast from adjacent borrow within the proposed spoil area.

7. Lock excavation method.

a. Flotation channel access and initial excavation (see plates III-18 and-19) will be performed by hydraulic dredge. The initial excavation will include the areas in the gate bay, chamber, and side levees to elevation -8.0. All initial excavation will be wasted in the lock and levee spoil area shown on plate I-1. Retention dikes will contain the material within the spoil area.

b. Upon completion of the hydraulic dredge operations, the clay materials in the gate bay and chamber areas will be excavated in the wet as required to construct the lake side protection dike and the unwatering system will be installed.

c. The remaining gate bay excavation will be accomplished in the dry with clay material being stockpiled outside the protection dike and sand materials used in the chamber side levees.

d. The remaining chamber excavation will be accomplished in the dry as required initially by the contractor's operation and used the same as the gate bay excavation. Final chamber excavation will be performed when the material can be placed directly in the final fill section.

e. Chamber protection. The shell blanket and riprap protection will be placed in the dry.

f. Material used in the gulfside and lakeside protection dikes and that placed in stockpile will be used in the required fill sections.

g. Access channels. Additional quantities of random fill required will be excavated from the channels in the wet. The remainder of the channel excavation will be performed by hydraulic dredge and wasted in the spoil area shown on plate I-1.

h. Excavation plans and sections are shown on plates I-4, I-5, II-18, and II-19.

8. Stability of slopes.

a. During construction. The stability of the excavation and fill slopes of the gate bays and chamber was determined by the method of planes based on the water conditions and (Q) design shear strengths shown on plates III-8 through III-12. The stability was investigated for various depths of failure in the foundation, and factors of safety with respect to shear strength were determined for the various assumed failure planes. The assumed failure surfaces and their corresponding data are shown on plates III-8 through III-12.

b. Operating condition. The stability of the final sections of the lock chamber and of the channel was determined by the method of planes based on the minimum operating water condition and (Q) design shear strengths as shown on plates III-13 and III-14. The assumed failure surfaces and their corresponding data are shown on plates III-13 and III-14.

9. Cantilevered I-wall. The results of tidal hydraulic analyses indicate that the I-wall will be subjected to the pressure and forces imparted by non-breaking waves. In the stability

analyses, the dynamic wave effect was applied as a line force acting through the centroid of the dynamic wave pressure distribution diagram. The static water pressure diagram resulting from wave action was considered effective only to the top of the impervious clay, inasmuch as the period of time the wave will exist is too short to allow water pressure to become effective in the impervious clays. The stability and required penetration of the steel sheet piling below the fill surface were determined by the method of planes. The longterm (S) shear strengths governed for design. A factor of safety of 1.25 was applied to the friction angle as follows: ϕ_d = developed friction angle = $\tan^{-1} \left(\frac{\text{Tan } \phi_A}{\text{Factor of Safety}} \right)$. This developed angle was used to determine K_A AND K_p lateral earth pressure coefficient values as follows: $K_A = \text{Tan}^2 \, (45° - \frac{\phi_d}{2})$ and $K_P = \frac{1}{K_A}$. Using the resulting shear strengths, net horizontal water and earth pressure diagrams were determined for movement toward each side of the sheet pile. Using these distributions of pressures, the summation of horizontal forces was equated to zero for various tip penetrations. At these penetrations, summations of overturning moments about the bottom of the sheet pile were determined. The depths of penetration required for stability were determined as those where the summation of moments was equal to zero. The analysis is shown on plates III-23 and IV-85.

10. Gate bay and T-wall.

a. Steel sheet pile cutoff. A steel sheet pile cutoff will be used beneath the gate bays and T-walls to provide protection against hazardous seepage. The recommended tip elevations of the cutoffs are shown on plate III-26. The net pressure diagram along the sheet pile cutoff was determined as follows:

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

(2) The assumption was made that the value of (R_B) at the bottom of the base of the structure was zero.

(3) For each analysis the net driving force, i.e., (D_A - D_p) - (R_A + R_B + R_p) was determined. The value of D_A included the weight of water between the tailwater elevation and the SWL elevation located above the active wedge.

(4) The assumption was made that the net driving force above the bottom of the base of the structure was carried by the structure.

(5) Considering driving (D_A) positive and all resistance negative (D_p, R_p, R_B, and R_A) in the expression $D = D_A - D_p - R_p - R_B - R_A$, using the method of planes stability analyses, ΣD was determined by assuming failure at bottom of the base of the structure and at each foot in depth thereafter. The value of the algebraic difference in ΣD, between 1-foot intervals, was used to develop the pressure diagram. If the incremental difference is negative, the pressure diagram indicates an available horizontal resistance in excess of that required, and if the incremental difference is positive, the pressure diagram indicates an unbalanced horizontal pressure in excess of the available soil resistance. It is considered that such an excess must be carried by the sheet pile cutoff.

(6) The net pressure diagrams presented on plates III-24 and-27 indicate that the total available horizontal resistance is in excess of the total horizontal waterload. Therefore, the bearing piles are not required to carry any additional lateral load acting on the sheet pile cutoff.

11. Pile penetration.

a. Loads from the gate structures and floodwalls are to be carried by steel H-piles battered as required for stability against lateral loads and embedded in the dense to very dense sand stratum. The pile load capacity curves were determined for the gate structures and floodwalls of the lock using the design soil conditions shown on plate III-7. Ultimate pile load capacity curves developed utilizing these design soil conditions are shown on plates III-15 and III-16. An octagonal precast, pre-stressed concrete pile will be used for support of needle girder storage and the reservation structures. Ultimate pile load capacity curves for these piles are shown on plate III-17. Also shown on plate III-17 are ultimate pile load capacity curves for the timber guide wall piles.

b. Required pile penetrations were determined by applying a factor of safety to the ultimate capacity as shown in Table 1.

TABLE 1 - PILE FACTOR OF SAFETY

	Factor of Safety	
Load Condition	Tension Piles	Compression Piles
Construction case	2.0	2.0
Dewatered case (gate bays)	2.0	2.0
Operating differential heads to 7 feet	2.0	2.0
Hurricane conditions	1.75	1.5

The design pile penetrations are shown on plates III-15,-16, and-17.

12. Test piles. Ten test piles will be driven in each gate bay excavation to determine driving resistances and to further investigate the adequacy of piles seated in the sand stratum overlying the clay. After all test piles have been driven, two in each gate bay with the tip founded in the sand strata and one with the tip founded in the Pleistocene layer will be selected for load tests to verify the design load capacities. One concrete pile will be driven and tested in the reservation area. See plates III-15,-16, and-17.

13. Seepage and hydrostatic uplift control.

a. Sheet pile cutoffs will be provided beneath the lock gate bay structures and connecting floodwalls extending downwards to elevation -70.0 at the lake end and elevation -60.0 at the gulf end. The cutoff will penetrate into the underlying clay deposit and provide protection from damaging seepage through the sand layer immediately underlying the structures. Plate III-26 shows the seepage analyses.

b. Chamber levees will be provided with sheet pile cutoffs extending to elevation -24.0. Safety against piping and seepage inflow analyses are shown on plate III-26.

14. Ultimate settlement. The near surface compressible subsoils will be removed prior to construction of the lock chamber slopes. Some slight recompression settlement is expected when the

lock chamber slopes are constructed, but the major part of this is expected to occur during the construction period and no future raising of these areas will be necessary. The lakeside protection dike is expected to settle approximately 2 feet during the lock construction. The anticipated 2 feet of settlement in the closure section across the access channel will occur completely in the clay fill. For the remainder of the lakeside protection dike, about one-half of the settlement is anticipated for the foundation materials with the other half occurring in the fill materials. The gulfside protection dike is expected to settle approximately 1.8 feet during lock construction due to consolidation of the foundation subsoils. The contractor will be required to maintain the portection dike to net grade for the duration of the construction.

15. Structural backfill. Because of the cost of obtaining suitable clay material and the abundance of silty sands in the immediate area, the excavation areas will be backfilled with the silty sands.

16. Spoil disposal. Excavation spoil will be placed within retention dikes on the gulfside of the levee only. No spoil will be placed on the Lake Ponchartrain side of the levee. For disposal area, see plate I-1.

17. Erosion protection. Protection against erosion of the chamber bottom and slopes, and reservation area will be as shown on plates I-2,-3, and-4. Stone sizes for erosion protection is based upon Technical Report No. 4, "Shore Protection Planning and Design."

Significant design waves 4.9 feet high in Lake Borgne necessitate a controlled quarry run armor stone protection of median size of 759 pounds with a maximum of 2,734 pounds and not more than 10% weighing less than five pounds. Because severe overtopping is to be expected, the armor will be used on the Lake Pontchartrain side of the levee. Armor stone thickness will be 2.5 feet.

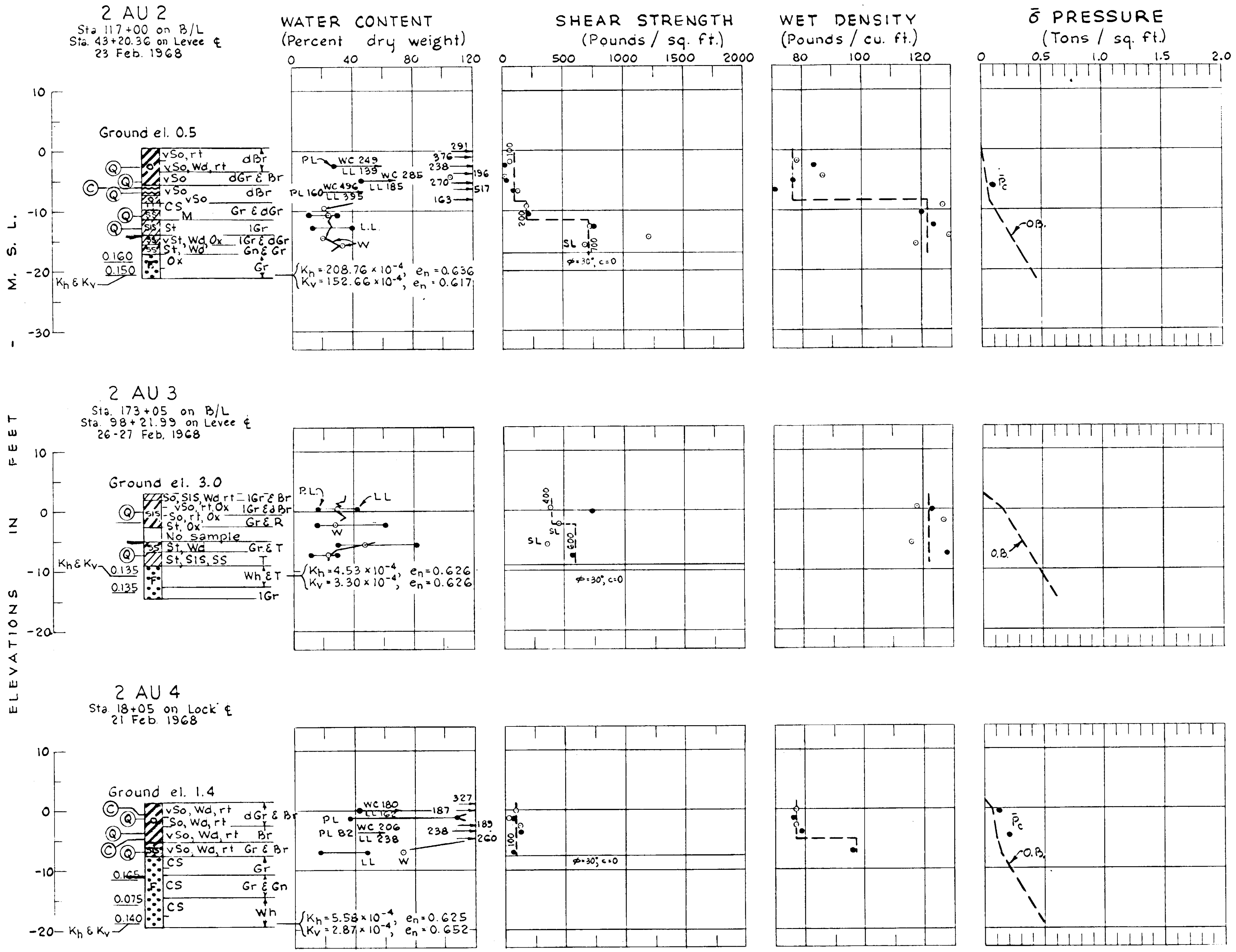
The lock chamber side slopes will be protected from overtopping waves. A rated riprap sufficient to withstand 4.0 feet of waves acting against the one on three side slopes has been selected. Median stone size will be 550 pounds with a maximum of 1,981 pounds and a minimum of 121 pounds. Armor stone thickness will be 2.0 feet. Smaller stones will not be used in the layer because of the danger of movement by propellor wash.

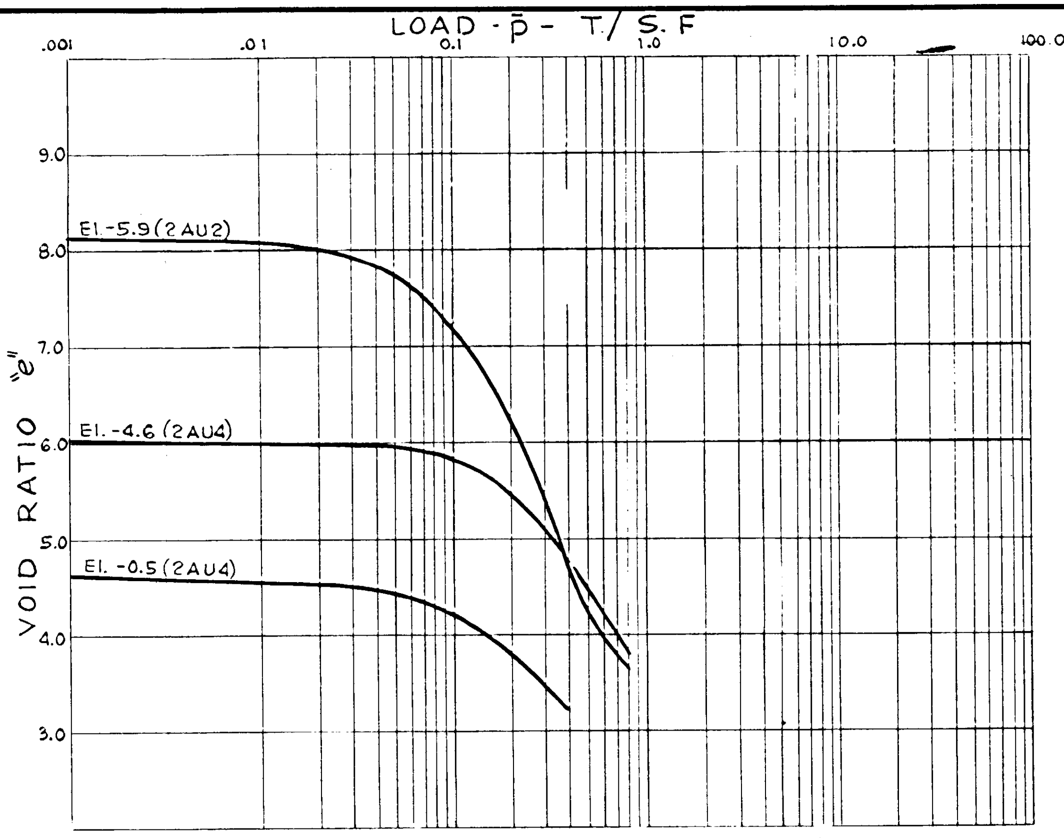
Bedding will consist of a 12-inch layer of shell blanket.

18. Engineering observations. Permanent reference marks will be installed on the gate bays, flood walls, and powerhouse and office structure. Settlement observations will be made yearly on these marks until settlement is essentially complete. Also, observations for lateral movement of the flood walls will be made yearly until it becomes apparent that there is no lateral movement or that movement has ceased.

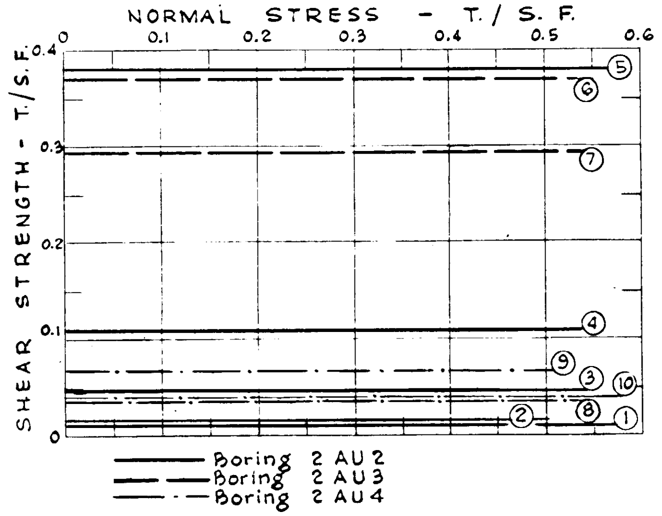
Scour and silting surveys will be made yearly and/or after major storms in the area to determine dredging needs. Once the area has become stabilized, the surveys will be limited to those after major storms in the area.

Piezometers will be installed beneath the gate bay structures to observe pore water pressures at selected locations. See plate III-27 for locations.



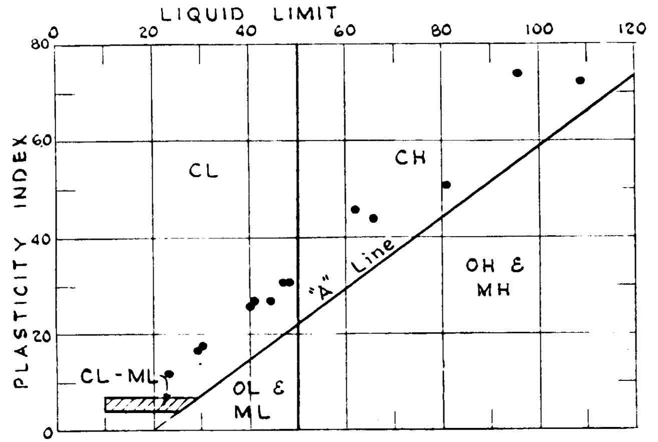


CONSOLIDATION DATA



	ENVELOPE		TYPE	STRENGTH		CLASS.
	NO.	EL.		φ°	c. t.s.f.	
2 AU2	1	-2.2	Q	0	0.010	CHO
	2	-4.8			0.015	CHO
	3	-6.6			0.047	PT
	4	-10.3			0.110	CL
	5	-12.5			0.380	CL
2AU3	6	+ 0.1			0.370	CH
	7	-7.2			0.293	CL
2AU4	8	-1.4			0.035	CHO
	9	-3.7			0.068	CHO
	10	-7.0			0.040	CH

SHEAR STRENGTH DATA



PLASTICITY CHART

For soil boring legend see plate A.
For general notes see plate III-2
For detail shear test data see plate III-4
For location of borings see plate I-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

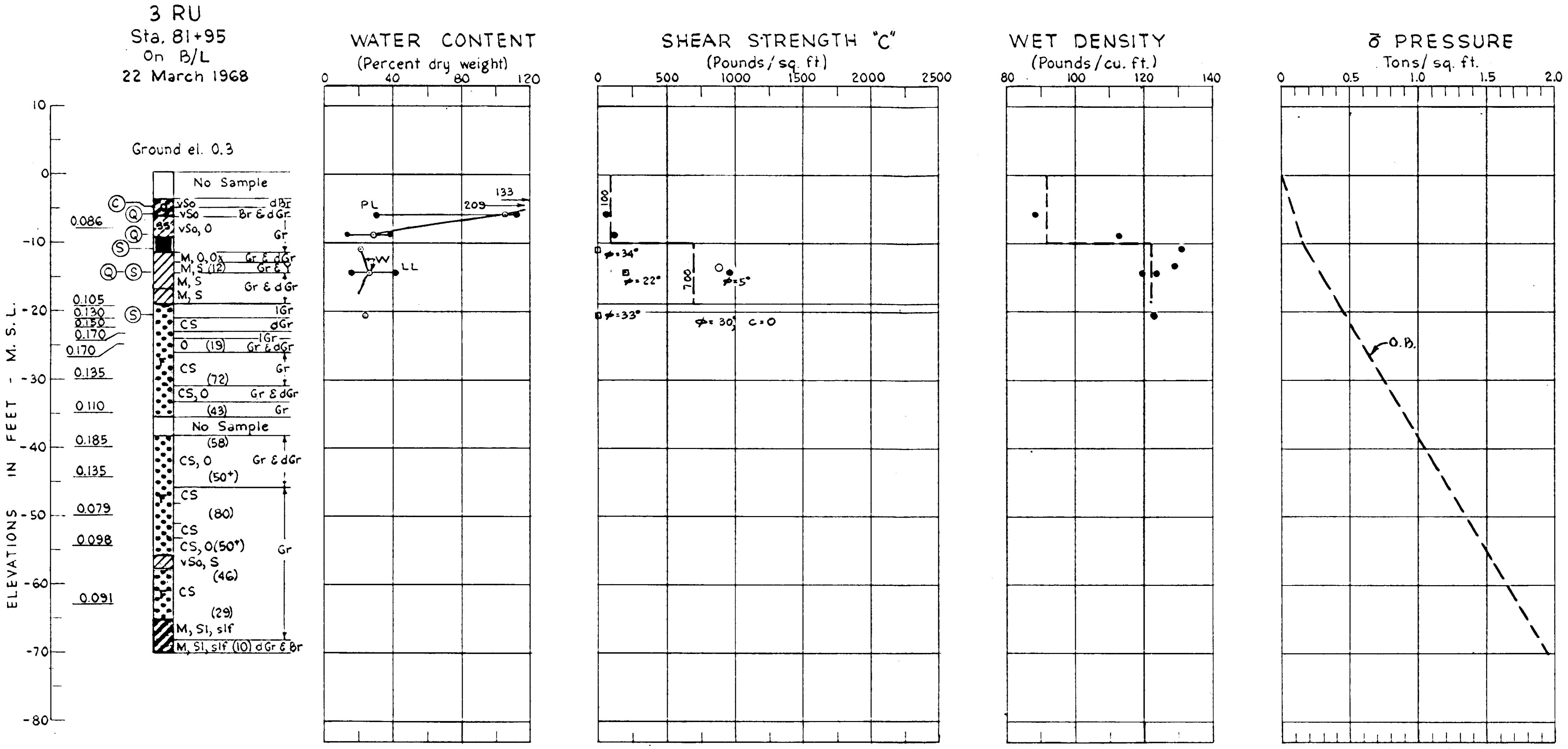
STANLEY CONSULTANTS, INC
MUSCATINE, IOWA

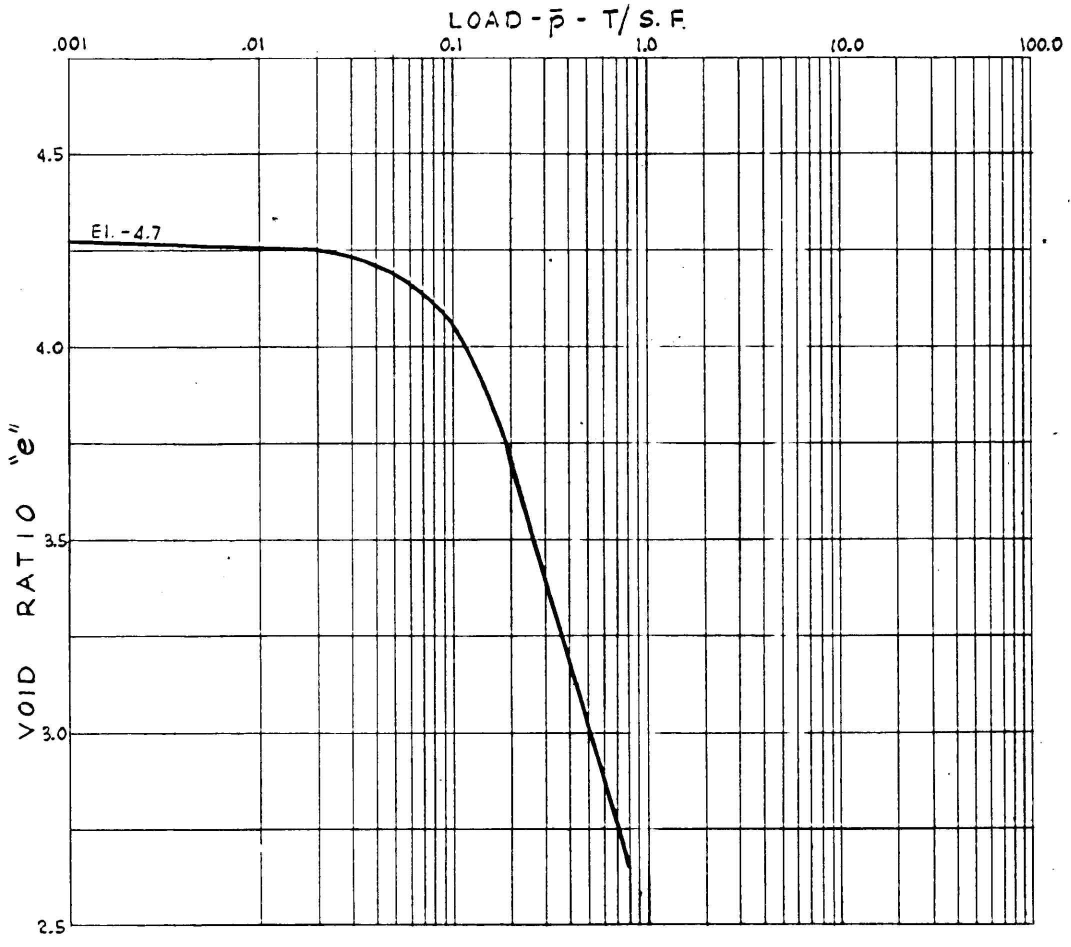
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SOIL BORINGS 2 AU2, 2 AU3, AND 2 AU4 DATA

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

DATE SEPT., 1973
FILE NO H-2-24419





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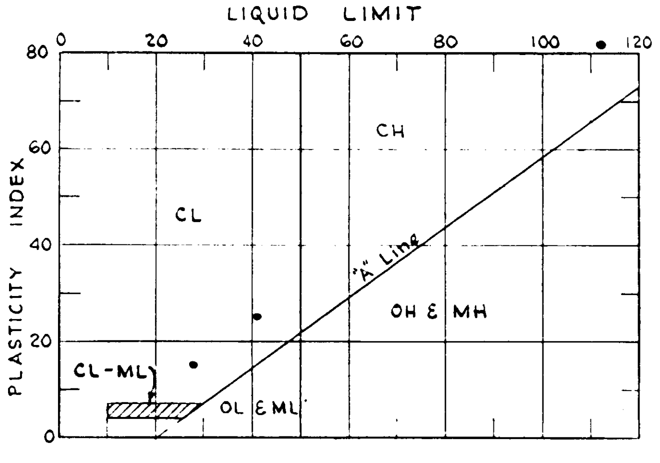

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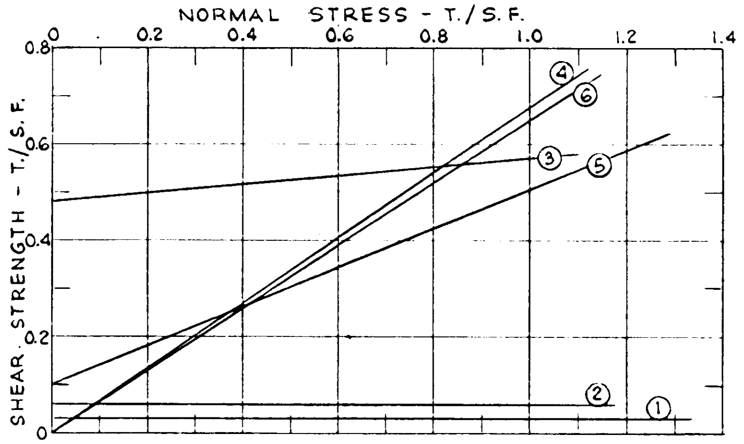


ENVELOPE		TYPE	STRENGTH		CLASS.
NO.	EL.		φ°	c. t.s.f.	
1	-5.5	Q	0	0.03	CH
2	-8.5		0	0.06	CL
3	-13.9		5	0.48	CL
4	-10.6	S	34	0	SM
5	-13.9		22	0.10	CL
6	-20.3		33	0	SM

SHEAR STRENGTH DATA

GENERAL NOTES

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

NOTE:
UNDISTURBED BORINGS 2AU2 THRU 2AU4 & 3RU & 1-UL WERE TAKEN WITH A 5" DIAMETER STEEL TUBE PISTON TYPE SAMPLER.

WHERE DRIVING RESISTANCES ARE SHOWN, SAMPLES WERE TAKEN WITH A 1 3/8" I.D., SPLIT SPOON SAMPLER USING A 140 LB. HAMMER AND A 30" DROP.

NOTES:

FOR SOIL BORING LEGEND SEE PLATE A
FOR LOCATION OF BORING SEE PLATE I-2
FOR DETAIL SHEAR STRENGTH DATA SEE PLATE III-4

A JOINT VENTURE

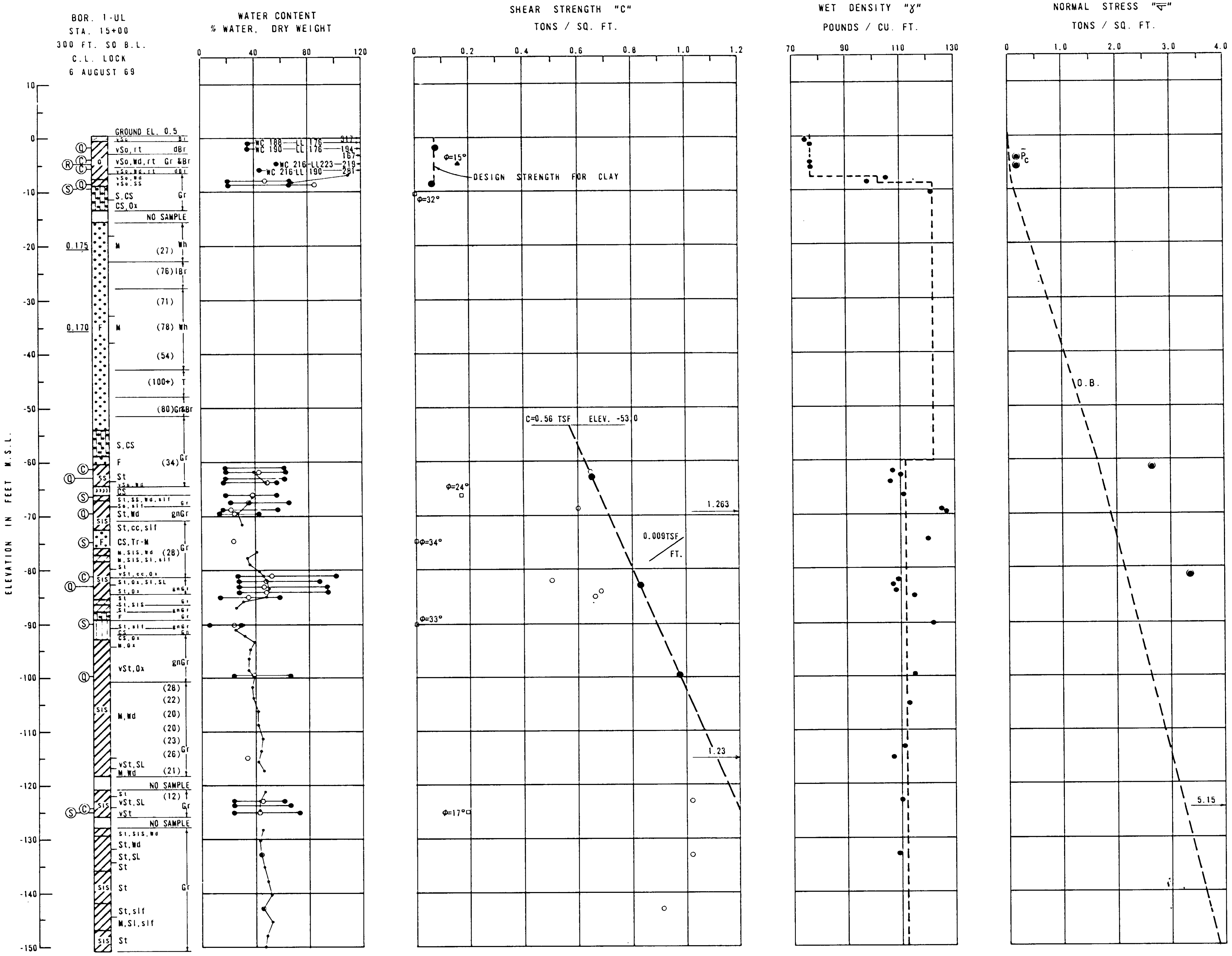
B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

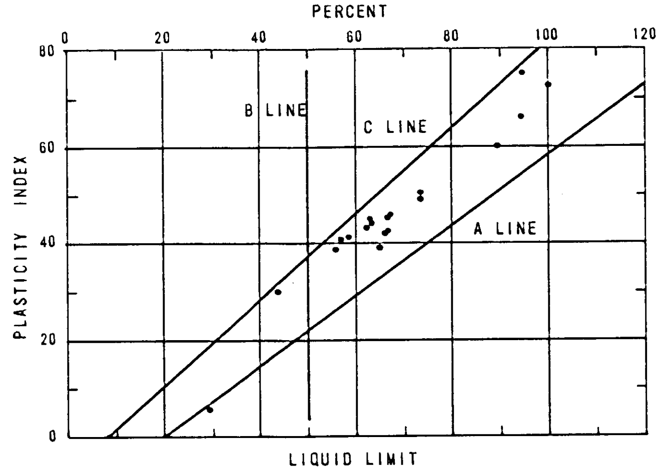
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SOIL BORING 3RU
DATA

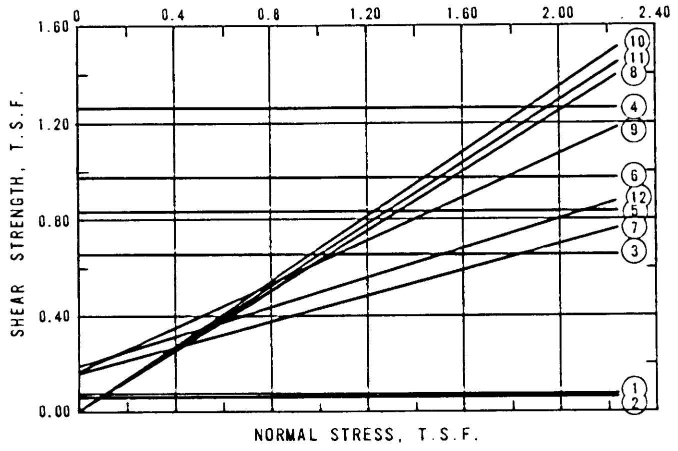
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT., 1973
FILE NO H-2-24419





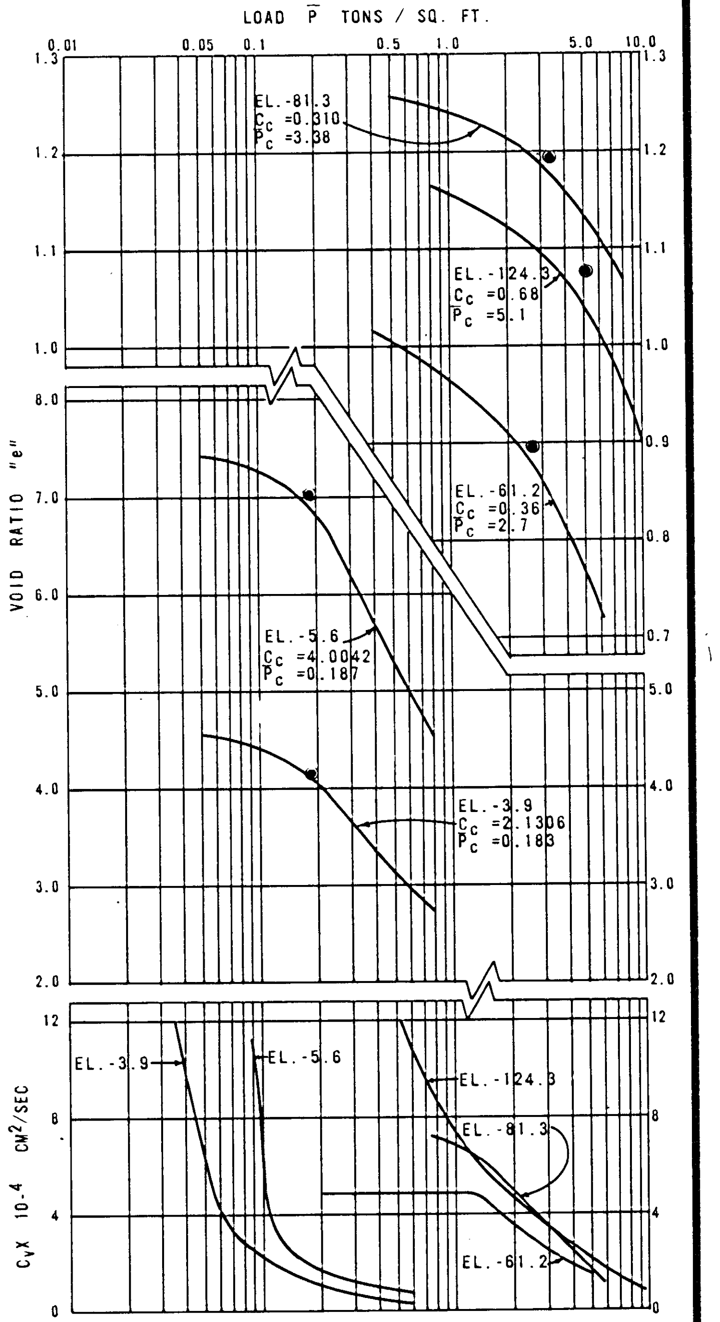
PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE		TYPE	STRENGTH		CLASS
NO.	EL.		φ	C - TSF	
1	-1.6	Q	0	.078	CH
2	-8.4		0	.063	CH
3	-62.8		0	.653	CH
4	-69.4		0	1.263	CL
5	-82.9		0	.833	CH
6	-99.6		0	.975	CH
7	-4.7	R	15	.160	CH
8	-10.3	S	32	.000	SM
9	-66.3		24	.170	CH
10	-74.6		34	.000	SM
11	-90.0		33	.000	ML
12	-125.0		17	.190	CH

NOTES:
FOR GENERAL NOTES SEE PLATE III-2
FOR LOCATION OF BORING SEE PLATE I-2
FOR SOIL BORING LEGEND SEE PLATE A
FOR DETAIL SHEAR STRENGTH DATA SEE PLATE III-5



CONSOLIDATION DATA

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

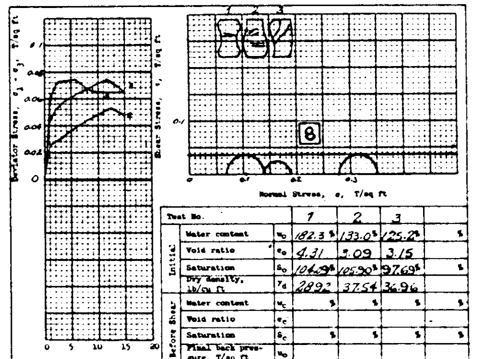
LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SOIL BORING I-UL
DATA

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

DATE: SEPT., 1973

FILE NO H-2-24419



Test No.			1	2	3	
Initial	Water content	w_o	182.3%	133.0%	125.2%	%
	Void ratio	e_o	4.31	3.09	3.15	
	Saturation	S_o	104.09%	105.90%	97.69%	%
	Dry density, lb/cu ft	γ_d	28.92	37.54	36.96	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.14	0.28	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.07	0.05	0.07	
Time to failure, min		t_f	6.2	5.0	3.5	
Rate of strain, percent/min			0.72	0.72	0.72	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.035 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

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

Classification So (dGr; CH4-ob; dw & rts thru-out

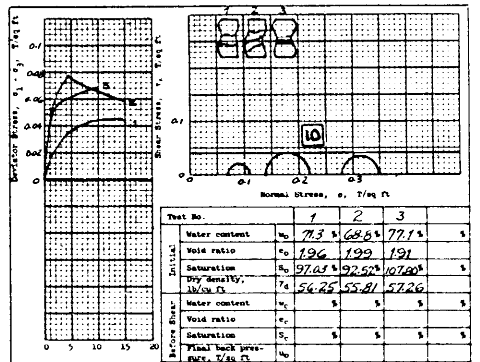
LL 109 | PL 37 | PI 72 | G_s 2.46

Remarks

TEST SECTION

Project Lake Pont. La. & Vicinity 1968
(Additional Borings)
Area Sta. 7+00 on C/L
Boring No. 2-AU4 | Sample No 1-D
Depth 2.0
El. -1.4 | Date 2 Mar 68
TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	71.3%	68.8%	77.1%	%
	Void ratio	e_o	1.96	1.99	1.91	
	Saturation	S_o	97.03%	92.52%	107.80%	%
	Dry density, lb/cu ft	γ_d	56.25	55.81	57.26	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.14	0.28	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.04	0.08	0.07	
Time to failure, min		t_f	20.1	6.2	13.0	
Rate of strain, percent/min			0.71	0.68	0.77	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = .024 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

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

Classification vSo (Gr; CH3; lns & ars ML; org ars; rts

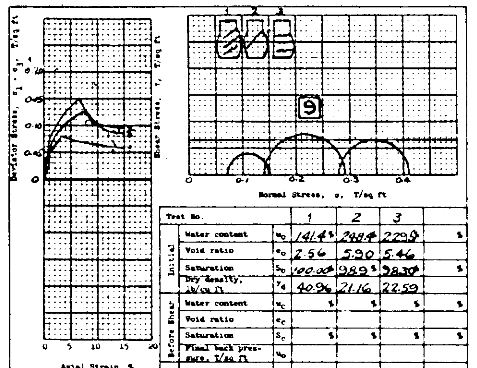
LL 48 | PL 17 | PI 31 | G_s 2.67

Remarks Sample #3 slumped under its own weight. Test stopped after 10% strain.

TEST SECTION

Project Lake Pont. La. & Vicinity 1968
Area Sta. 7+00 on C/L
Boring No. 2-AU4 | Sample No. 3-A
Depth 8.4
El. -7.0 | Date 2 Mar 68
JER TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	141.4%	248.4	229.9	%
	Void ratio	e_o	2.56	5.90	5.46	
	Saturation	S_o	100.00%	98.9%	98.30%	%
	Dry density, lb/cu ft	γ_d	40.96	21.16	22.59	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.14	0.28	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.08	0.15	0.13	
Time to failure, min		t_f	4.4	9.8	10.9	
Rate of strain, percent/min			0.72	0.67	0.68	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.068 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

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

Classification vSo (Br) CH4-ob; lns ML; dw; pcs wd thru-out; rt

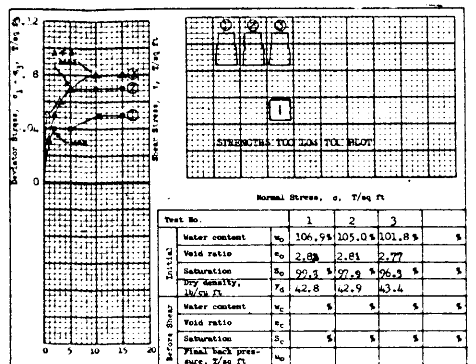
LL 238 | PL 82 | PI 156 | G_s 2.34

Remarks

TEST SECTION

Project Lake Pont. La. & Vicinity 1968
(Additional Borings)
Area Sta. 7+00 on C/L Tentative Lock & Channel
Boring No 2-AU4 | Sample No. 2-B
Depth 5.7
El -3.7 | Date
JER TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	106.9%	105.0%	101.8%	%
	Void ratio	e_o	2.83	2.81	2.77	
	Saturation	S_o	99.3%	97.9%	96.3%	%
	Dry density, lb/cu ft	γ_d	42.8	42.9	43.4	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.04	0.07	0.08	
Time to failure, min		t_f	2	11	11	
Rate of strain, percent/min			0.88	0.94	0.94	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	0.04	0.07	0.08	
Initial diameter, in.		D_o	1.39	1.38	1.38	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = .003 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

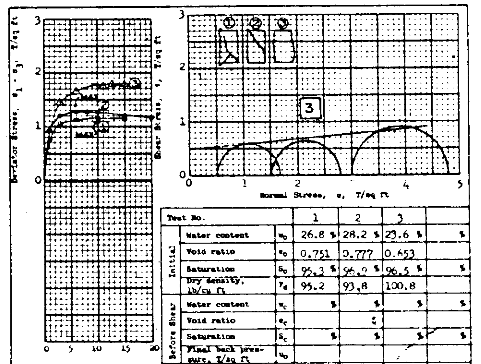
Classification CLAY (CH), grey, w/organic matter and silt

LL 112 | PL 30 | PI 82 | G_s 2.63

Remarks

Project LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
Area RIGOLETS COMPLEX
Boring No. 3-RU | Sample No. 2-C
Depth 5.8 | Date 12 JUNE 1967
RA TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	26.8%	28.2%	23.6%	%
	Void ratio	e_o	0.751	0.777	0.653	
	Saturation	S_o	95.3%	96.9%	96.5%	%
	Dry density, lb/cu ft	γ_d	95.2	93.8	100.8	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.16	1.28	1.79	
Time to failure, min		t_f	19	9	13	
Rate of strain, percent/min			0.53	0.68	0.94	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	1.16	1.28	1.79	
Initial diameter, in.		D_o	1.39	1.39	1.41	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 5 °

tan φ = 0.088

c = 0.48 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

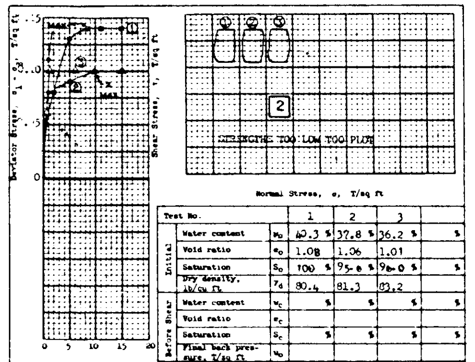
Classification SANDY CLAY (CL), grey

LL 41 | PL 16 | PI 25 | G_s 2.67

Remarks

Project LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
Area RIGOLETS COMPLEX
Boring No. 3-RU | Sample No. 4-C
Depth 14.2 | Date 13 JUNE 1967
RA TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	40.3%	37.8%	36.2%	%
	Void ratio	e_o	1.08	1.06	1.01	
	Saturation	S_o	100%	95.6%	96.0%	%
	Dry density, lb/cu ft	γ_d	80.4	81.3	83.2	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.5	1.5	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.14	0.10	0.10	
Time to failure, min		t_f	19	26	4	
Rate of strain, percent/min			0.44	0.38	0.33	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$	0.14	0.10	0.10	
Initial diameter, in.		D_o	1.39	1.39	1.39	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.06 T/sq ft

Method of saturation ______

☐ Controlled stress
☒ Controlled strain

Type of test Q | Type of specimen UNDISTURBED

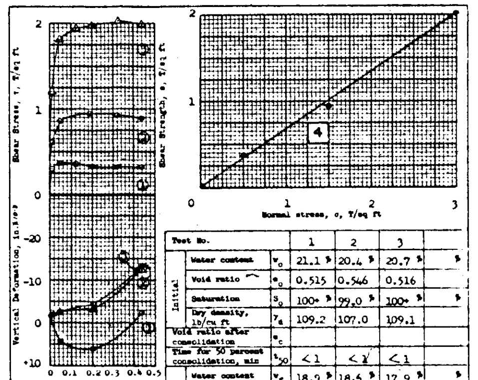
Classification SILTY CLAY (CL), grey, w/fine sand

LL 28 | PL 13 | PI 15 | G_s 2.68

Remarks

Project LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
Area RIGOLETS COMPLEX
Boring No. 3-RU | Sample No. 3-B1
Depth 8.8 | Date 12 JUNE 1967
RA TRIAXIAL COMPRESSION TEST REPORT

ENG FORM 1 JUN 65 2089 (EM 1110-2-1902) PREVIOUS EDITIONS ARE OBSOLETE
TRANSLUCENT



Test No.			1	2	3	
Initial	Water content	w_o	21.1%	20.4%	20.7%	%
	Void ratio	e_o	0.515	0.546	0.516	
	Saturation	S_o	100+%	99.0%	100+%	%
	Dry density, lb/cu ft	γ_d	109.2	107.0	109.1	
Void ratio after consolidation		e_c				
Time for 50 percent consolidation, min		t_{50}	<1	<1	<1	
Final	Water content	w_f	18.9%	18.6%	17.9%	%
	Void ratio	e_f				
	Saturation	S_f	%	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft		τ_{max}	0.37	0.94	2.02	
Actual time to failure, min		t_f	360	1230	2040	
Rate of strain, in./min			.00012	.00015	.00016	
Ultimate shear stress, T/sq ft		τ_{ult}	0.32	0.89	1.98	

Shear Strength Parameters

φ' = 34 °

tan φ' = 0.674

c' = 0 T/sq ft

☐ Controlled stress
☒ Controlled strain

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

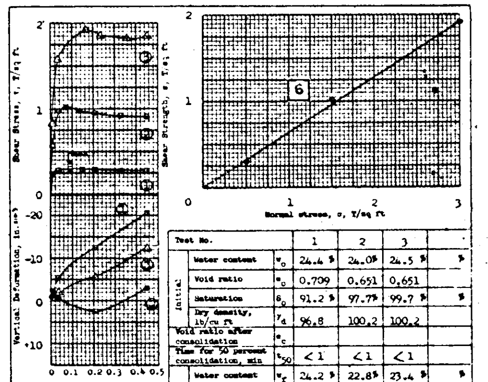
Classification SILTY SAND (SM), gray

LL - | PL - | PI - | G_s 2.65

Remarks

Project LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
Area RIGOLETS COMPLEX
Boring No. 3-RU | Sample No. 3-D
Depth 10.9 | Date 5 June 1967
GDA DIRECT SHEAR TEST REPORT

ENG FORM 1 JUN 66 2092 PREVIOUS EDITIONS ARE OBSOLETE PLATE IX-3



Test No.			1	2	3	
Initial	Water content	w_o	24.4%	24.0%	24.5%	%
	Void ratio	e_o	0.709	0.651	0.651	
	Saturation	S_o	91.2%	97.7%	99.7%	%
	Dry density, lb/cu ft	γ_d	96.8	100.2	100.2	
Void ratio after consolidation		e_c				
Time for 50 percent consolidation, min		t_{50}	<1	<1	<1	
Final	Water content	w_f	24.2%	22.8%	23.4%	%
	Void ratio	e_f				
	Saturation	S_f	%	%	%	%
Normal stress, T/sq ft		σ	0.5	1.5	3.0	
Maximum shear stress, T/sq ft		τ_{max}	0.30	1.02	1.92	
Actual time to failure, min		t_f	660	540	1080	
Rate of strain, in./min			.00014	.00013	.00015	
Ultimate shear stress, T/sq ft		τ_{ult}	0.28	0.91	1.82	

Shear Strength Parameters

φ' = 33 °

tan φ' = 0.649

c' = 0 T/sq ft

☐ Controlled stress
☒ Controlled strain

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

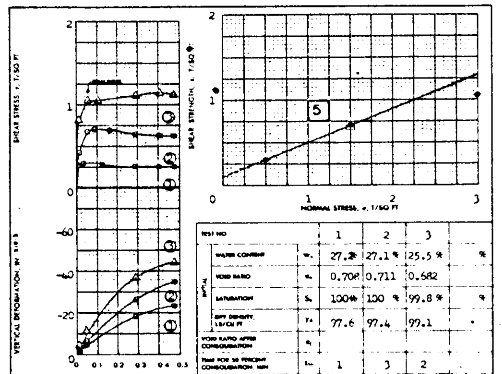
Classification SILTY SAND (SM), gray

LL - | PL - | PI - | G_s 2.65

Remarks

Project LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
Area RIGOLETS COMPLEX
Boring No. 3-RU | Sample No. 7-B
Depth 20.6 | Date 5 June 1967
GDA DIRECT SHEAR TEST REPORT

ENG FORM 1 JUN 66 2092 PREVIOUS EDITIONS ARE OBSOLETE PLATE IX-3



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	27.2%	27.1%	25.5%	%
	VOID RATIO	e_o	0.708	0.711	0.682	
	SATURATION	S_o	100%	100%	99.8%	%
	DRY DENSITY, LB/CU FT	γ_d	97.6	97.4	99.1	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	1	3	2	
FINAL	WATER CONTENT	w_f	27.4%	25.1%	23.6%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	0.5	1.5	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.30	0.70	1.05	
ACTUAL TIME TO FAILURE, MIN		t_f	270	540	360	
RATE OF STRAIN, IN./MIN			.00014	.00016	.00015	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}	0.25	0.62	1.05	

SHEAR STRENGTH PARAMETERS

φ = 22 °

TAN φ = 0.404

c = 0.10 T/SQ FT

☐ CONTROLLED STRESS
☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED | 3.01 IN SQUARE | 0.465 IN THICK

CLASSIFICATION SANDY CLAY (CL), gray, homogeneous

LL 41 | PL 16 | PI 25 | G_s 2.67

REMARKS

PROJECT LAKE PONTCHARTRAIN & VICINITY
HURRICANE PROTECTION
AREA RIGOLETS COMPLEX
BORING NO 3-RU | SAMPLE NO 4-C
DEPTH 14.2 | DATE 2 June 1967
GDA DIRECT SHEAR TEST REPORT

ENG FORM 1 JUN 66 2092 (EM 1110-2-1906) PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PLATE IX-3

NOTE:

- [1] Indicates reference number shown under shear data on Plates
- (Q) - Unconsolidated - undrained triaxial compression test.
- (S) - Consolidated - drained direct shear test.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC.
NEW ORLEANS, LA.

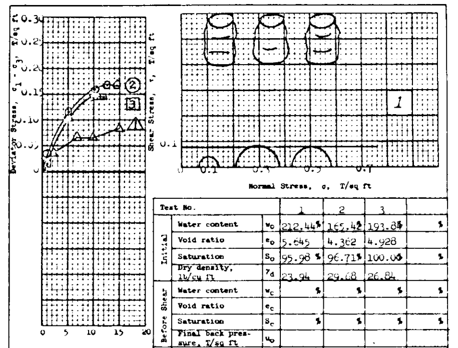
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DETAIL SHEAR STRENGTH DATA
BORINGS 2 AU4 AND 3 RU

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

DATE: SEPT., 1973
FILE NO. H-2-24419



Test No.			1	2	3	
Initial	Water content	w_o	212.44%	165.42%	193.84%	%
	Void ratio	e_o	5.645	4.362	4.928	
	Saturation	S_o	95.98%	96.71%	100.00%	%
	Dry density, lb/cu ft	γ_d	23.94	29.68	26.84	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.21	0.43	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.07	0.17	0.14	
Time to failure, min		t_f	10.52	19.12	15.39	
Rate of strain, percent/min			0.64	0.65	0.64	
Wet Density, lb/cu ft			74.83	78.77	78.88	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.078 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification vSo(dBr)CH3-OB rt

*LL 176 PL 36 PI 140 G_s 2.5539

Remarks NOD Testing Section

*Attb.from 1-B

Project Lk.Pont.La.&Vic.Hurr.Prot.Barrier Plan

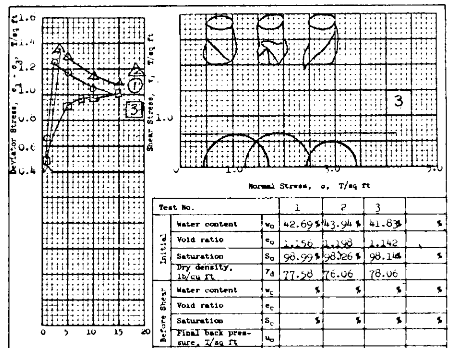
DDM #8 Rigolets Lock 1969

Area Sta. 9+00 - C/L Lock

Boring No. 1-UL Sample No. 1-C

Depth 2.1 El -1.6 Date 31 Dec.69

TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	42.69%	43.94%	41.83%	%
	Void ratio	e_o	1.156	1.198	1.142	
	Saturation	S_o	98.99%	98.26%	98.14%	%
	Dry density, lb/cu ft	γ_d	77.58	76.06	78.06	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.43	1.21	2.43	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.25	1.36	0.97	
Time to failure, min		t_f	4.42	14.38	29.46	
Rate of strain, percent/min			0.87	0.26	0.26	
Wet Density, lb/cu ft.			110.69	109.48	109.90	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.653 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification St(Gr)CH3;lns&lys & ars SP

*LL 62 PL 18 PI 44 G_s 2.6819

*Remarks NOD Testing Section

Attb. & SG from 17-A

Project Lk.Pont.La.&Vic.Hurr. Prot.Barrier Plan

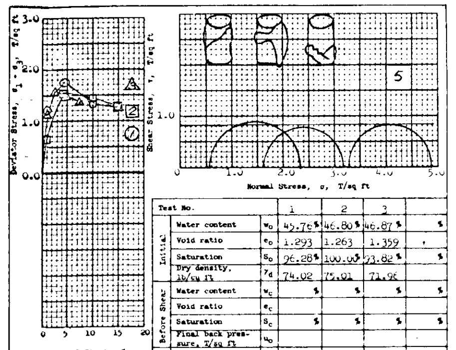
DDM #8 Rigolets Lock

Area Sta. 9+00 - C/L Lock

Boring No 1-UL Sample No. 17-C

Depth 63.3 El -62.8 Date 5 Jan. 70

TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	45.76%	46.80%	46.87%	%
	Void ratio	e_o	1.293	1.263	1.359	
	Saturation	S_o	96.28%	100.00%	93.82%	%
	Dry density, lb/cu ft	γ_d	74.02	75.01	71.96	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.57	1.64	3.29	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.74	1.53	1.59	
Time to failure, min		t_f	4.00	17.97	11.50	
Rate of strain, percent/min			1.24	0.24	0.24	
Wet Density, lb/cu ft.			107.90	110.11	105.69	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0.0 °

tan φ = 0.0

c = 0.833 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification St(gnGr)CH4;few lns&ars ML;ox ars;spcs dw;few org stks.

*LL 94 PL 28 PI 66 G_s 2.7151

*Remarks NOD Testing Section

Attb. from 26-B

Project Lk.Pont.La.&Vic.Hurr.Prot.Barrier Plan

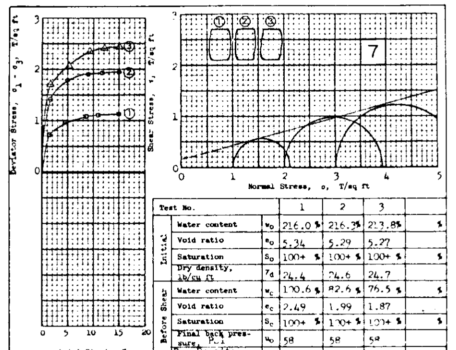
DDM#8 Rigolets Lock 1969

Area Sta. 9+00 C.L. Lock

Boring No. 1-UL Sample No. 26-A

Depth 83.4 El -82.9 Date 7 Jan. 70

TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	216.0%	216.3%	213.8%	%
	Void ratio	e_o	5.34	5.29	5.27	
	Saturation	S_o	100+ %	100+ %	100+ %	%
	Dry density, lb/cu ft	γ_d	24.4	24.6	24.7	
Before Shear	Water content	w_c	100.6%	82.6%	76.5%	%
	Void ratio	e_c	2.49	1.99	1.87	
	Saturation	S_c	100+ %	100+ %	100+ %	%
	Final back pressure, Psi	u_o	58	58	58	
	Dry Density lb/cu ft	γ_d	44.4	51.8	54.0	
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	1.0	2.0	3.0	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	1.11	1.94	2.44	
Time to failure, min		t_f	125	115	107	
Rate of strain, percent/min			0.12	0.13	0.14	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.39	1.38	1.38	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 15 °

tan φ = 0.268

c = 0.16 T/sq ft

Method of saturation BP

☐ Controlled stress

☒ Controlled strain

Type of test R Type of specimen UNDISTURBED

Classification PLASTIC CLAY (CH), black, highly organic

LL 223 PL 57 PI 166 G_s 2.48

Remarks

Typical specimen

shape before shear

Project LK. PONT., LA. & VIC.-HURR. PROT. - 1969

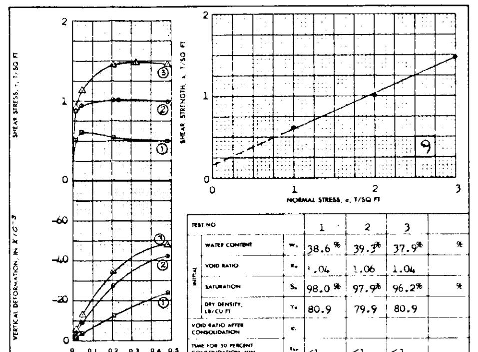
BARRIER PLAN; DDM NO 8

Area RIGOLETS LOCK

Boring No. 1-UL Sample No. 2-B

~~Depth~~ El -4.7 Date 6 OCTOBER 1969

TES TRIAXIAL COMPRESSION TEST REPORT



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	38.6%	39.3%	37.9%	%
	VOID RATIO	e_o	1.04	1.06	1.04	
	SATURATION	S_o	98.0%	97.9%	96.2%	%
	DRY DENSITY, LB/CU FT	γ_d	80.9	79.9	80.9	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	<1	<1	<1	
FINAL	WATER CONTENT	w_f	37.3%	35.0%	33.4%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.61	1.01	1.48	
ACTUAL TIME TO FAILURE, MIN		t_f	360	1320	1920	
RATE OF STRAIN, IN./MIN			.00017	.00017	.00017	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS

φ' = 24°

TAN φ' = 0.445

c' = 0.17 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

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

CLASSIFICATION PLASTIC CLAY (CH), gray, contains a trace of shell fragments

LL 57 PL 18 PI 39 G_s 2.64

REMARKS

PROJECT LK. PONT., LA. & VIC.-HURR. PROT. - 1969

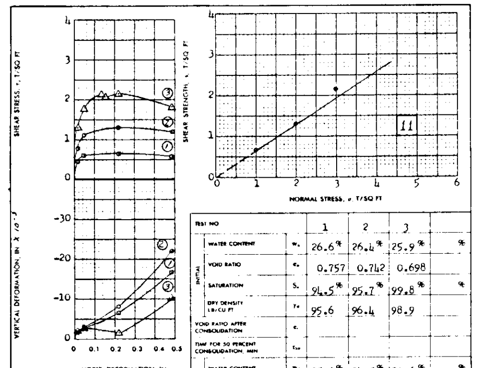
BARRIER PLAN; DDM NO. 8

AREA RIGOLETS LOCK

BORING NO 1-UL SAMPLE NO 18-D

~~DEPTH~~ EL -66.3 DATE 13 OCTOBER 1969

WJH DIRECT SHEAR TEST REPORT



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	26.6%	26.4%	25.9%	%
	VOID RATIO	e_o	0.757	0.742	0.698	
	SATURATION	S_o	94.5%	95.7%	99.8%	%
	DRY DENSITY, LB/CU FT	γ_d	95.6	96.4	98.9	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	25.6%	24.5%	23.6%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.66	1.30	2.14	
ACTUAL TIME TO FAILURE, MIN		t_f	1350	1350	840	
RATE OF STRAIN, IN./MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS

φ' = 33°

TAN φ' = 0.649

c' = 0 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

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

CLASSIFICATION SANDY SILT (ML), greenish gray

LL 29 PL 24 PI 5 G_s 2.69

REMARKS

PROJECT LK. PONT., LA. & VIC.-HURR. PROT.

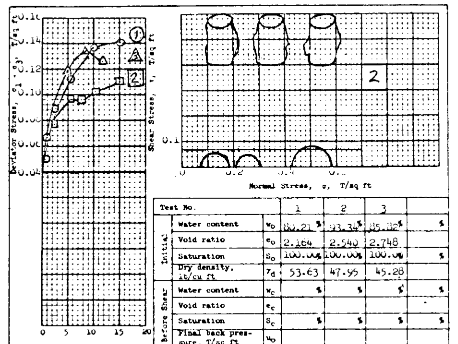
BARRIER PLAN; DDM NO. 8

AREA RIGOLETS LOCK - 1969

BORING NO 1 - UL SAMPLE NO 29-B

~~DEPTH~~ EL -90.0 DATE 12 JANUARY 1970

GDA DIRECT SHEAR TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	80.21%	93.34%	85.82%	%
	Void ratio	e_o	2.164	2.540	2.748	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	53.63	47.95	45.28	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.07	0.21	0.43	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	0.11	0.10	0.14	
Time to failure, min		t_f	8.94	23.23	32.55	
Rate of strain, percent/min			0.64	0.25	0.26	
Wet Density, lb/cu ft			96.65	92.74	108.83	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0 °

tan φ = 0

c = 0.063 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification vSo(Gr)CH2;lns&lys&ars SP;org stks

*LL 67 PL 21 PI 46 G_s 2.7186

Remarks NOD Testing Section

* Attb.from 3-A

Project LK.Pont.La.&Vic.Hurr.Prot.Barrier Plan

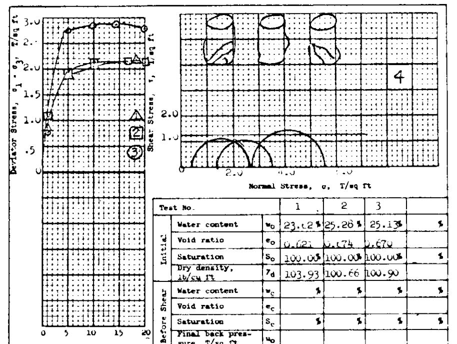
DDM #8 Rigolets Lock

Area Sta. 9+00 - C/L Lock

Boring No. 1-UL Sample No. 3-B

Depth 8.9 El -8.4 Date 5 Jan.70

TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	23.62%	25.28%	25.13%	%
	Void ratio	e_o	0.621	0.674	0.670	
	Saturation	S_o	100.00%	100.00%	100.00%	%
	Dry density, lb/cu ft	γ_d	103.93	100.66	100.90	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.43	1.36	2.71	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	2.19	2.13	2.86	
Time to failure, min		t_f	14.10	12.20	22.90	
Rate of strain, percent/min			1.30	1.36	0.62	
Wet Density, lb/cu ft.			128.48	126.11	126.26	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0.0 °

tan φ = 0.0

c = 1.263 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification St(gGr)CL6;lns&lys &ars ML;dw;org stks

*LL 44 PL 14 PI 30 G_s 2.6994

Remarks NOD Testing Section

*Attb. from 19-B

Project Lk.Pont.La.&Vic.Hurr.Prot.Barrier Plan

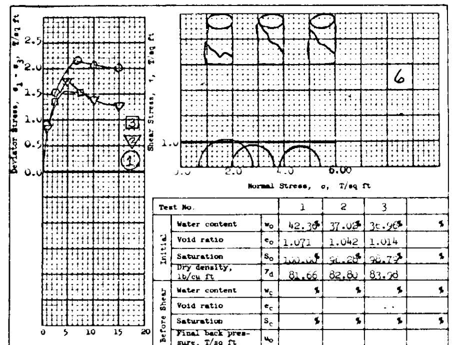
DDM #8 Rigolets Lock

Area Sta. 9+00 C.L. Lock

Boring No. 1-UL Sample No. 19-C

Depth 69.9 El -69.4 Date 6 Jan.70

TRIAXIAL COMPRESSION TEST REPORT



Test No.			1	2	3	
Initial	Water content	w_o	42.36%	37.02%	36.96%	%
	Void ratio	e_o	1.071	1.042	1.014	
	Saturation	S_o	100.00%	96.28%	98.79%	%
	Dry density, lb/cu ft	γ_d	81.66	82.80	83.98	
Before Shear	Water content	w_c	%	%	%	%
	Void ratio	e_c				
	Saturation	S_c	%	%	%	%
	Final back pressure, T/sq ft	u_o				
Final	Water content	w_f	%	%	%	%
	Void ratio	e_f				
Minor principal stress, T/sq ft		σ_3	0.64	1.93	3.86	
Max deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{max}$	2.16	1.74	1.55	
Time to failure, min		t_f	5.25	6.82	6.70	
Rate of strain, percent/min			0.74	0.74	0.64	
Wet Density, lb/cu ft			116.24	113.46	115.01	
Ult deviator stress, T/sq ft		$(\sigma_1-\sigma_3)_{ult}$				
Initial diameter, in.		D_o	1.40	1.40	1.40	
Initial height, in.		H_o	3.00	3.00	3.00	

Shear Strength Parameters

φ = 0.0 °

tan φ = 0.0

c = 0.975 T/sq ft

Method of saturation ________

☐ Controlled stress

☒ Controlled strain

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

Classification vSt (gnGr)CH3;lns&ars ML;ox;ars;specs dw

LL 65 PL 26 PI 39 G_s 2.7124

Remarks NOD Testing Section

Project Lk.Pont.La.&Vic.Hurr.Prot.Barrier Plan

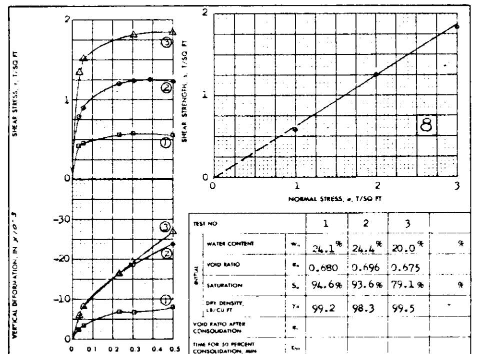
DDM #8 Rigolets Lock 1969

Area Sta. 9+00 C/L Lock

Boring No. 1-UL Sample No. 32-C

Depth 100.1 El -99.6 Date 31 Dec. 69

TRIAXIAL COMPRESSION TEST REPORT



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	24.1%	24.4%	20.0%	%
	VOID RATIO	e_o	0.680	0.696	0.675	
	SATURATION	S_o	94.6%	93.6%	79.1%	%
	DRY DENSITY, LB/CU FT	γ_d	99.2	98.3	99.5	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	20.5%	19.4%	19.6%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.57	1.25	1.84	
ACTUAL TIME TO FAILURE, MIN		t_f	1680	2100	2760	
RATE OF STRAIN, IN./MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS

φ' = 32°

TAN φ' = 0.625

c' = 0 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED 3.00 IN. SQUARE 0.557 IN. THICK

CLASSIFICATION SAND (SM), grey, contains pockets of clay

LL - PL - PI - G_s 2.67

REMARKS

PROJECT LK. PONT., LA. & VIC.-HURR. PROT. - 1969

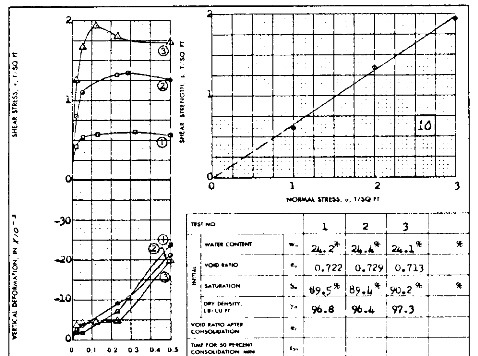
BARRIER PLAN; DDM NO 8

AREA RIGOLETS LOCK

BORING NO. 1-UL SAMPLE NO 3-D

~~DEPTH~~ EL -10.3 DATE 13 OCTOBER 1969

JHM DIRECT SHEAR TEST REPORT



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	24.2%	24.4%	24.1%	%
	VOID RATIO	e_o	0.722	0.729	0.713	
	SATURATION	S_o	89.5%	89.4%	90.2%	%
	DRY DENSITY, LB/CU FT	γ_d	96.8	96.4	97.3	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}				
FINAL	WATER CONTENT	w_f	22.9%	23.2%	23.5%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.60	1.34	1.94	
ACTUAL TIME TO FAILURE, MIN		t_f	1800	1620	720	
RATE OF STRAIN, IN./MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS

φ' = 34°

TAN φ' = 0.674

c' = 0 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED 3.00 IN. SQUARE 0.557 IN. THICK

CLASSIFICATION SILTY SAND (SM), gray

LL NP PL NP PI NP G_s 2.67

REMARKS

PROJECT LK. PONT., LA. & VIC.-HURR. PROT.

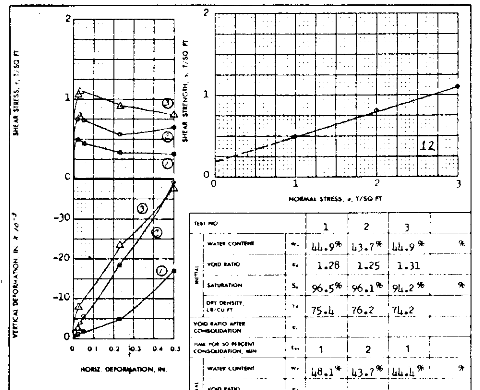
BARRIER PLAN; DDM NO. 8

AREA RIGOLETS LOCK - 1969

BORING NO 1-UL SAMPLE NO 21-C

~~DEPTH~~ EL -74.6 DATE 29 DECEMBER 1969

GDA DIRECT SHEAR TEST REPORT



TEST NO			1	2	3	
INITIAL	WATER CONTENT	w_o	44.9%	43.7%	44.9%	%
	VOID RATIO	e_o	1.28	1.25	1.31	
	SATURATION	S_o	96.5%	96.1%	94.2%	%
	DRY DENSITY, LB/CU FT	γ_d	75.4	76.2	74.2	
VOID RATIO AFTER CONSOLIDATION		e_c				
TIME FOR 50 PERCENT CONSOLIDATION, MIN		t_{50}	1	2	1	
FINAL	WATER CONTENT	w_f	48.1%	43.7%	44.4%	%
	VOID RATIO	e_f				
	SATURATION	S_f	%	%	%	%
NORMAL STRESS, T/SQ FT		σ	1.0	2.0	3.0	
MAXIMUM SHEAR STRESS, T/SQ FT		τ_{max}	0.50	0.81	1.10	
ACTUAL TIME TO FAILURE, MIN		t_f	180	240	360	
RATE OF STRAIN, IN./MIN			.00018	.00018	.00018	
ULTIMATE SHEAR STRESS, T/SQ FT		τ_{ult}				

SHEAR STRENGTH PARAMETERS

φ' = 17°

TAN φ' = 0.306

c' = 0.19 T/SQ FT

☐ CONTROLLED STRESS

☒ CONTROLLED STRAIN

TYPE OF SPECIMEN UNDISTURBED 3.00 IN. SQUARE 0.557 IN. THICK

CLASSIFICATION PLASTIC CLAY (CH), gray, contains silt seams

LL 73 PL 24 PI 49 G_s 2.75

REMARKS

PROJECT LK. PONT., LA. & VIC. - HURR. PROT.

BARRIER PLAN; DDM NO. 8

AREA RIGOLETS LOCK - 1969

BORING NO 1-UL SAMPLE NO 43-D

~~DEPTH~~ EL -125.0 DATE 7 JANUARY 1970

GDA DIRECT SHEAR TEST REPORT

NOTE:

$\boxed{3}$ INDICATES REFERENCE NUMBER SHOWN UNDER SHEAR DATA ON PLATES

(Q) UNCONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST.

(R) CONSOLIDATED - UNDRAINED TRIAXIAL COMPRESSION TEST.

(S) CONSOLIDATED - DRAINED DIRECT SHEAR TEST.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

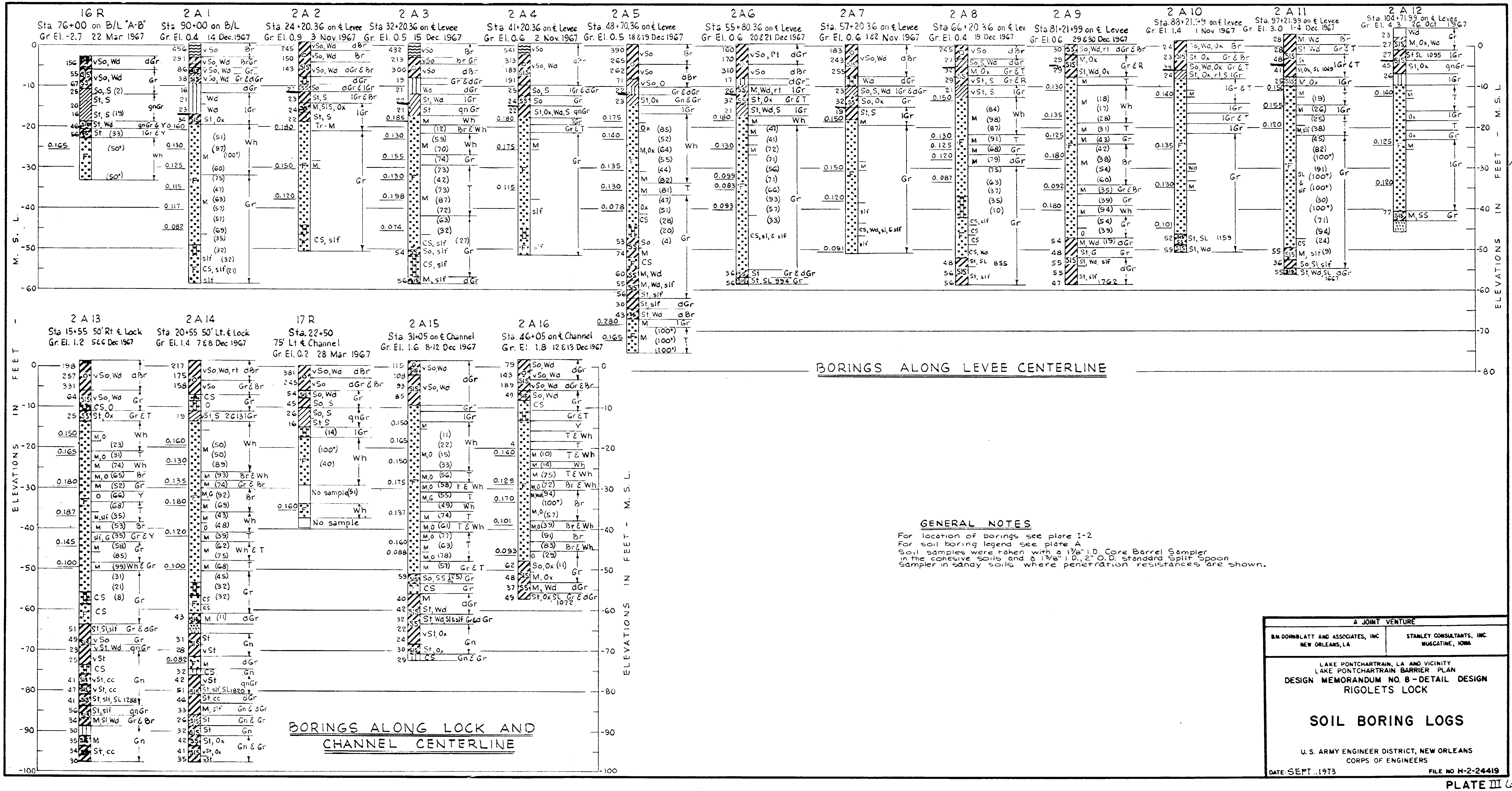
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DETAIL SHEAR STRENGTH DATA
BORING 1-UL

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

DATE: SEPT. 1973 FILE NO. H-2-24419

PLATE III 5



BORINGS ALONG LEVEE CENTERLINE

BORINGS ALONG LOCK AND CHANNEL CENTERLINE

GENERAL NOTES

For location of borings see plate I-2
For soil boring legend see plate A
Soil samples were taken with a 1⅞" I.D. Core Barrel Sampler in the cohesive soils and a 1⅜" I.D., 2" O.D. standard Split Spoon Sampler in sandy soils where penetration resistances are shown.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

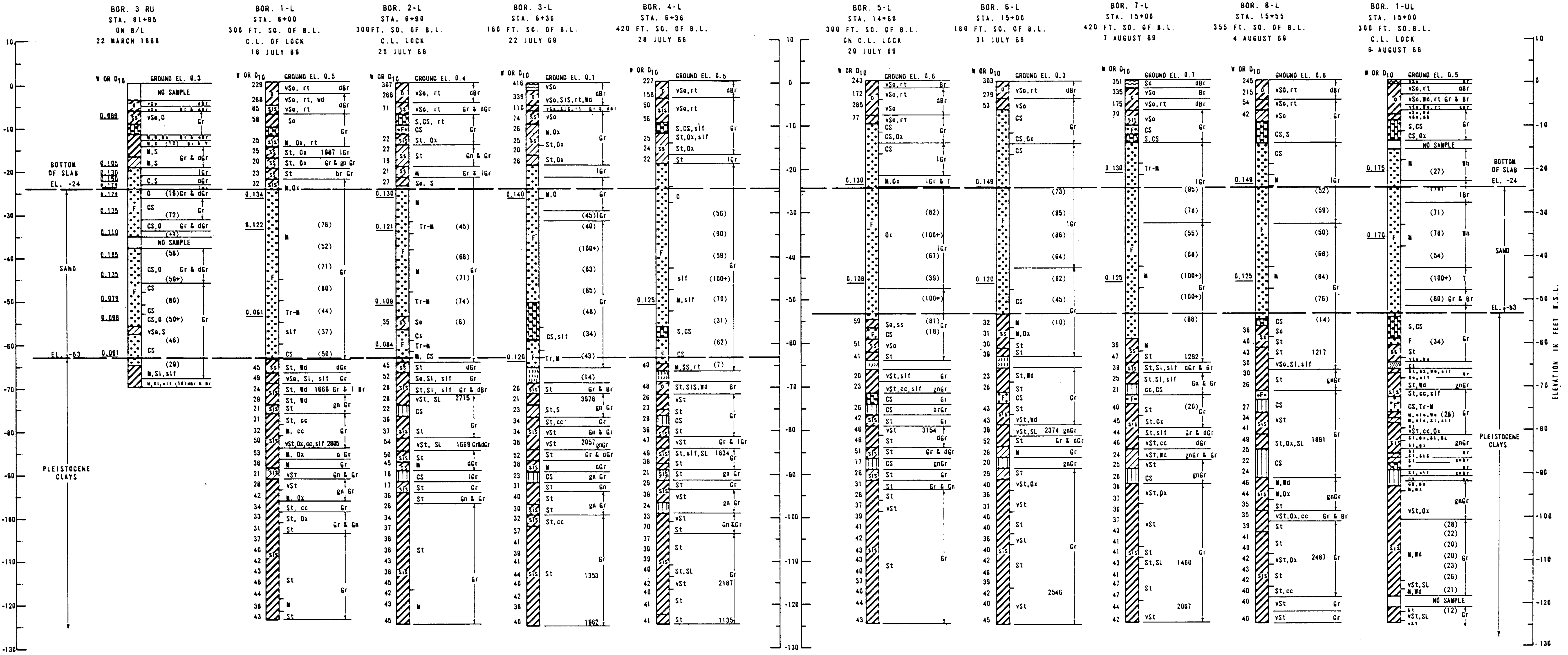
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SOIL BORING LOGS

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

DATE: SEPT. 1973
FILE NO H-2-24419



BORINGS AT LAKESIDE GATE BAY

BORINGS AT GULFSIDE GATE BAY

SOIL PROPERTIES FOR PILE ANALYSIS

SEE BORING 1-UL

SAND	PLEISTOCENE CLAYS
K_C=1.0	COHESION (C) = 0.56 TSF @ EL. -53 AND INCREASES AT A RATE OF 0.009 TSF PER FOOT BELOW EL. -53.
K_T=0.7	
Φ=34°	
N_q=25	ADHESION (pile/soil) = 0.5 TSF
δ=30°	
γ'=60psf	

NOTES:

GENERAL TYPE BORINGS WERE MADE WITH A 1 7/8" I.D. CORE BARREL SAMPLER. UNDISTURBED TYPE BORINGS WERE TAKEN WITH A 5-INCH DIAMETER STEEL TUBE PISTON TYPE SAMPLER. FOR LOCATION OF BORINGS SEE PLATE I-2. SEE PLATE A FOR SOIL BORING LOCATION.

A JOINT VENTURE

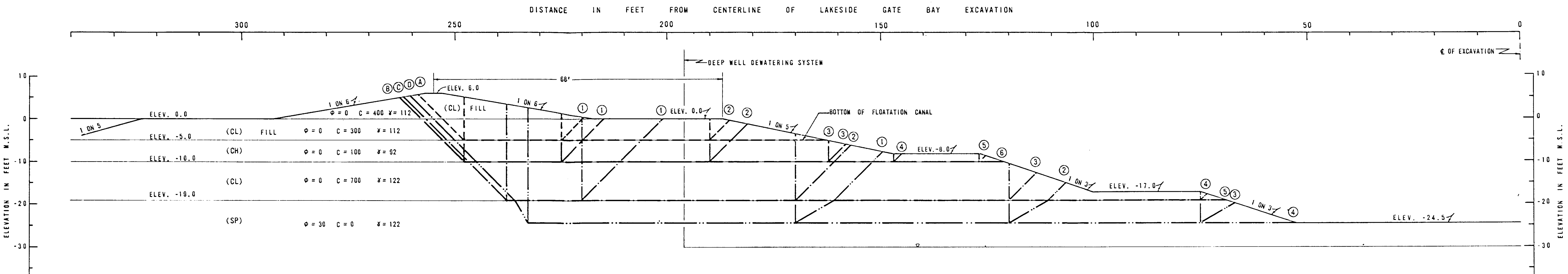
B.M. DORNBLATT AND ASSOCIATES, INC. NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SOIL BORING LOGS

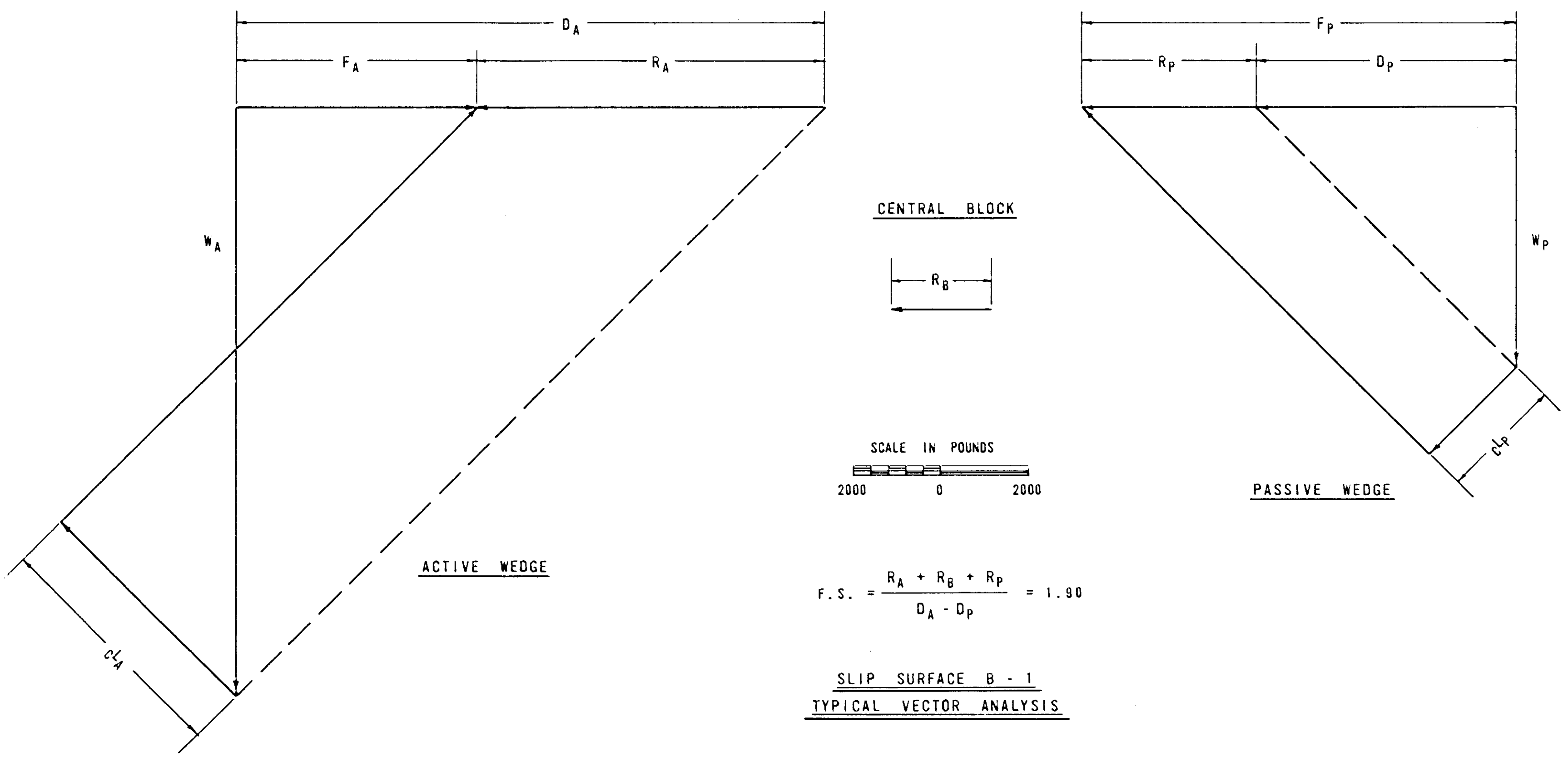
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT. 1973
FILE NO H-2-24419



LAKESIDE PROTECTION DIKE & GATE BAY EXCAVATION
BASED ON BORING 3-RU

LOCK STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY $\Sigma R / \Sigma D$
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	
LAKESIDE PROTECTION DIKE AND GATE BAY EXCAVATION	A	1	- 5	6,516	1,922	4,594	7,571	6,900	3,343	17,814	3.88
		2			1,360	5,156		17,400	2,800	27,771	5.39
		3			0	6,516		25,800	0	33,371	5.12
	B	1	-10	13,468	5,942	7,526	8,000	2,300	4,000	14,300	1.90
		2			4,888	8,560		5,800	3,300	17,100	1.99
		3			956	12,512		8,600	833	17,433	1.39
		4			183	13,285		10,100	400	18,500	1.39
		5			137	13,331		12,100	300	20,400	1.53
		6			0	13,468		12,700	0	20,700	1.54
	C	1	-19	31,878	19,545	12,333	20,714	12,600	16,600	49,914	4.05
		2			10,644	21,214		47,600	13,400	81,714	3.85
		3			3,432	28,446		82,399	9,100	112,213	3.95
		4			182	31,696		93,434	2,100	116,248	3.67
		5			0	31,878		93,857	0	114,571	3.59
	D	1	-24.5	46,789	19,211	27,578	31,126	100,955	34,710	166,791	6.05
		2			7,969	38,820		159,781	18,951	209,858	5.41
		3			2,173	44,616		188,249	4,346	223,721	5.01
		4			0	46,789		197,388	0	228,514	4.88



$$F.S. = \frac{R_A + R_B + R_P}{D_A - D_P} = 1.90$$

SLIP SURFACE B - 1
TYPICAL VECTOR ANALYSIS

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

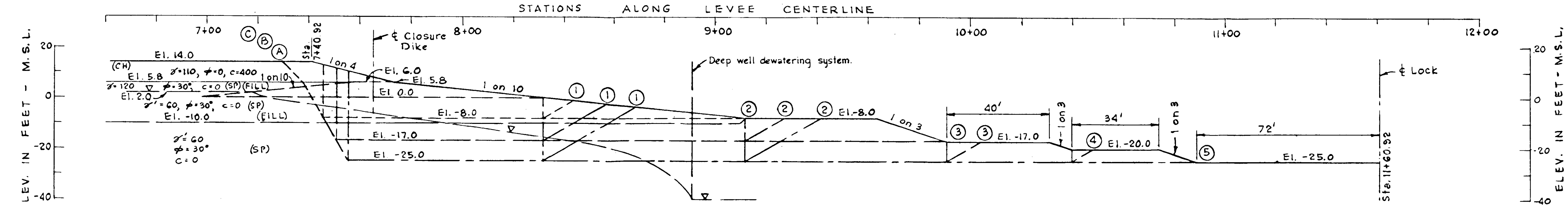
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

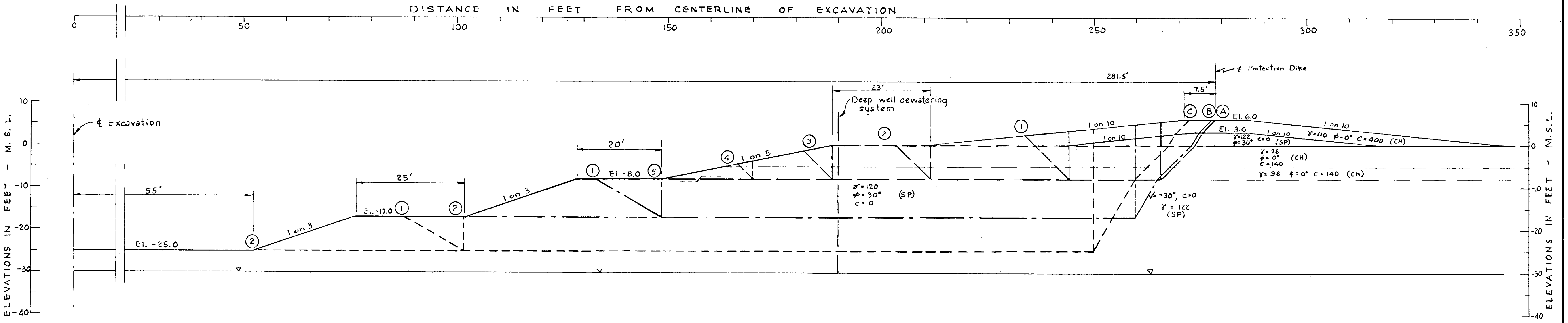
CONSTRUCTION "Q" STABILITY

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

DATE SEPT., 1973
FILE NO. H-2-24419



LEVEE AT SOUTH SIDE OF GULFSIDE GATE BAY EXCAVATION



GULFSIDE PROTECTION DIKE

Based on Boring 1-UL

LEVEE STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma\bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
LEVEE AT SOUTH SIDE OF GULFSIDE GATE BAY EXCAVATION	A	1	- 8	26,227	3,273	22,954	21,579	73,783	6,546	101,908	4.44
		2			0	26,227		95,953	0	117,532	4.48
	B	1	-17	53,163	14,781	38,382	39,537	100,010	29,563	169,110	4.41
		2			4,860	43,303		171,726	9,720	220,983	4.57
		3			0	53,163		212,568	0	252,105	4.74
	C	1	-25	75,774	29,589	46,185	54,610	113,827	59,177	227,614	4.93
		2			17,340	58,434		222,262	34,680	311,552	5.33
		3			3,840	71,934		306,890	7,680	369,180	5.13
		4			1,500	74,274		333,113	3,000	390,724	5.26
		5			0	75,774		347,490	0	402,100	5.31

LEVEE STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma\bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R/\Sigma D$
GULFSIDE PROTECTION DIKE	A	1	- 8	9,990	5,390	4,600	5,668	3,080	4,022	12,770	2.78
		2			2,583	7,407		7,630	2,240	15,538	2.10
		3			2,167	7,823		10,850	1,867	18,385	2.35
		4			689	9,301		13,440	1,003	20,111	2.16
		5			0	9,990		15,584	0	21,252	2.13
	B	1	-17	26,294	4,938	21,356	16,577	115,093	9,877	141,547	6.63
		2			0	26,294		136,330	0	152,907	5.82
	C	1	-25	46,905	3,902	43,003	30,941	206,820	7,803	245,564	5.71
		2			0	46,905		227,669	0	258,610	5.51

For general notes see plate III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC.
NEW ORLEANS, LA.

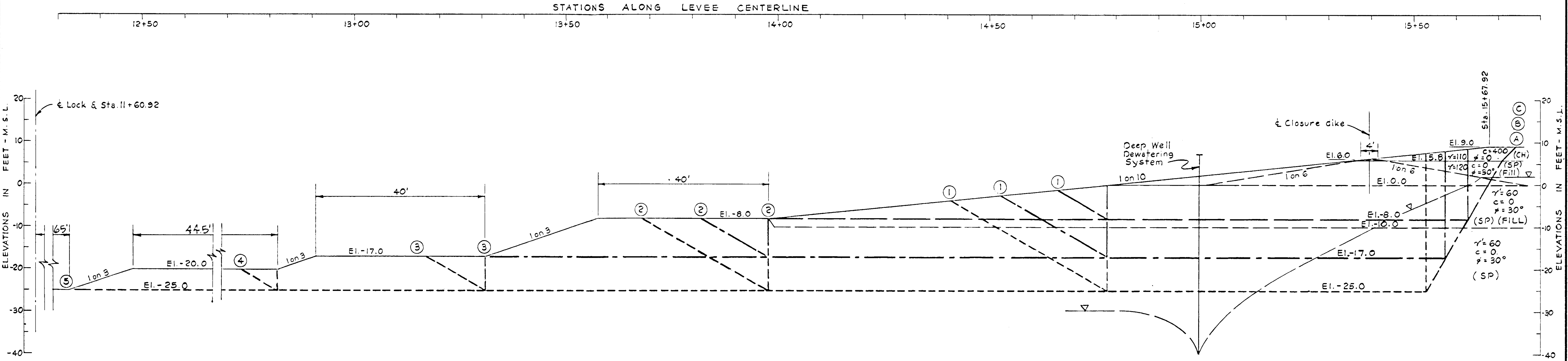
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

CONSTRUCTION "Q" STABILITY

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

DATE: SEPT., 1973
FILE NO. H-2-24418



LEVEE AT NORTH SIDE OF GULFSIDE GATE BAY EXCAVATION

LEVEE STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY $\Sigma R / \Sigma \bar{D}$
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	
LEVEE AT NORTH SIDE OF GULFSIDE GATE BAY EXCAVATION	A	1	-8	13,798	3,273	10,525	11,383	68,978	6,546	86,907	8.26
		2			0	13,798		91,148	0	102,531	7.43
	B	1	-17	29,361	14,781	14,580	21,753	106,450	29,563	157,766	10.82
		2			4,860	24,501		178,503	9,720	209,976	8.57
		3			0	29,361		211,862	0	233,615	7.96
	C	1	-25	47,925	31,965	15,960	34,134	135,018	63,912	233,064	14.60
		2			17,340	30,585		251,412	34,680	320,226	10.47
		3			3,840	44,085		321,906	7,680	363,720	8.25
		4			1,500	46,425		348,130	3,000	385,264	8.30
		5			0	47,925		362,506	0	396,640	8.28

For general notes see plate III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA.

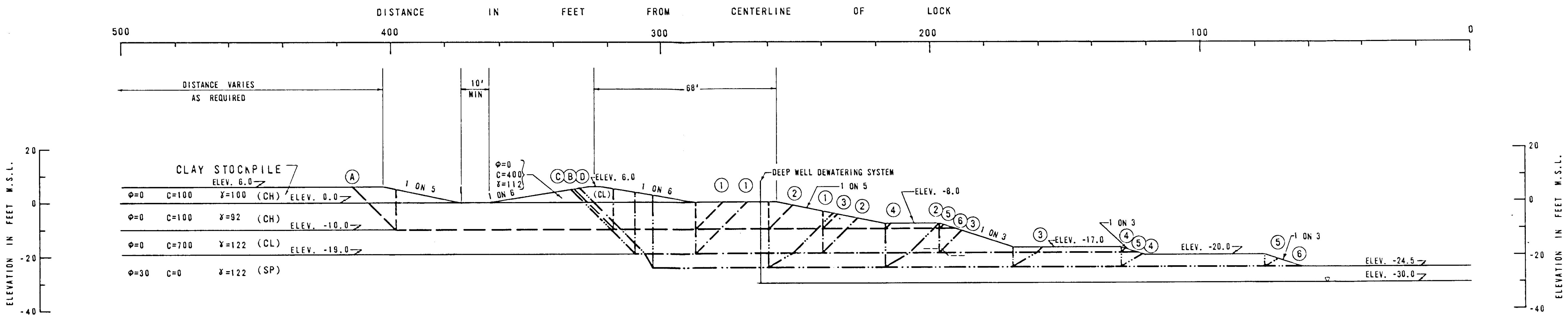
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

CONSTRUCTION "Q" STABILITY

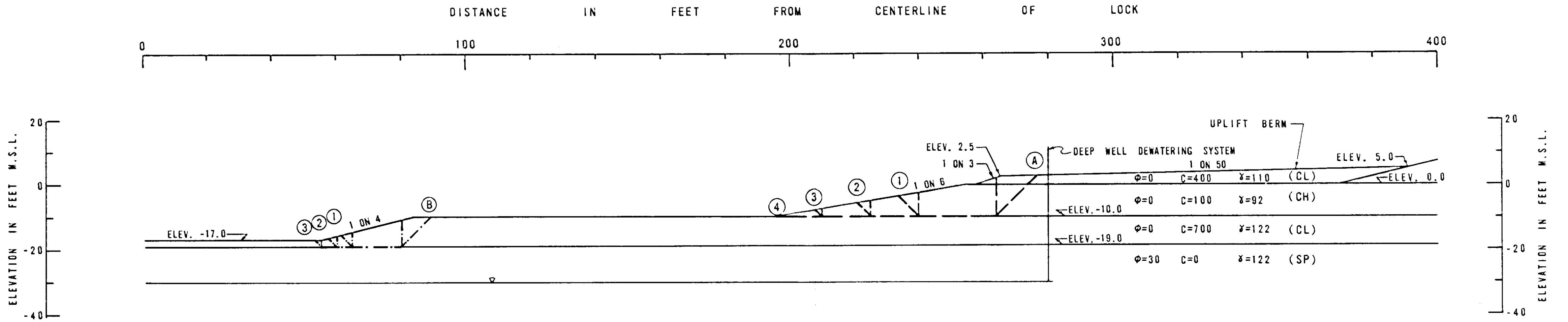
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT., 1973
FILE NO. H-2-24419



NORTH SIDE OF LAKESIDE GATE BAY EXCAVATION

BASED ON BORING 3-RU



LOCK STATION 13+00

BASED ON BORING 3-RU

LOCK STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	$\Sigma R / \Sigma D$
CLAY STOCKPILE	A	1	-10	12,156	4,596	7,560	3,200	11,100	2,000	16,300	2.16
		2			4,220	7,936		13,800	1,767	18,767	2.37
		3			1,667	10,489		15,800	1,100	20,100	1.92
		4			183	11,973		18,100	400	21,700	1.81
		5			137	12,019		20,100	300	23,600	1.96
		6			0	12,156		20,700	0	23,900	1.97
NORTHSIDE OF LAKE-SIDE GATE BAY EX-CAVATION	B	1	-10	12,717	4,596	8,121	6,000	3,100	2,000	11,100	1.37
		2			4,220	8,497		5,800	1,767	13,567	1.60
		3			1,667	11,050		7,800	1,100	14,900	1.35
		4			183	12,534		10,100	400	16,500	1.32
		5			137	12,580		12,100	300	18,400	1.46
		6			0	12,717		12,700	0	18,700	1.47
	C	1	-19	30,527	17,812	12,715	18,486	16,100	14,600	49,186	3.87
		2			10,536	19,991		49,000	13,400	80,886	4.05
		3			5,350	25,177		79,100	11,550	109,136	4.34
		4			182	30,345		96,947	2,100	117,533	3.87
		5			0	30,527		97,370	0	115,856	3.80
	D	1	-24.5	44,589	25,925	18,664	28,759	68,137	39,182	136,078	7.29
		2			15,667	28,922		126,396	30,763	185,918	6.43
		3			3,429	41,160		171,664	9,171	209,594	5.09
		4			2,173	42,416		192,795	4,346	225,900	5.33
		5			631	43,958		211,154	1,263	241,176	5.49
		6			0	44,589		212,920	0	241,679	5.42
13 + 00	A	1	-10	7,794	2,215	5,579	4,180	2,400	1,286	7,866	1.41
		2			984	6,810		3,900	857	8,937	1.31
		3			245	7,549		5,400	429	10,009	1.32
		4			0	7,794		6,900	0	11,080	1.42
	B	1	-19	4,808	986	3,822	12,600	6,736	5,040	24,376	6.38
		2			514	4,294		8,100	3.640	24,340	5.67
		3			243	4,565		9,025	2,800	25,425	5.35

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

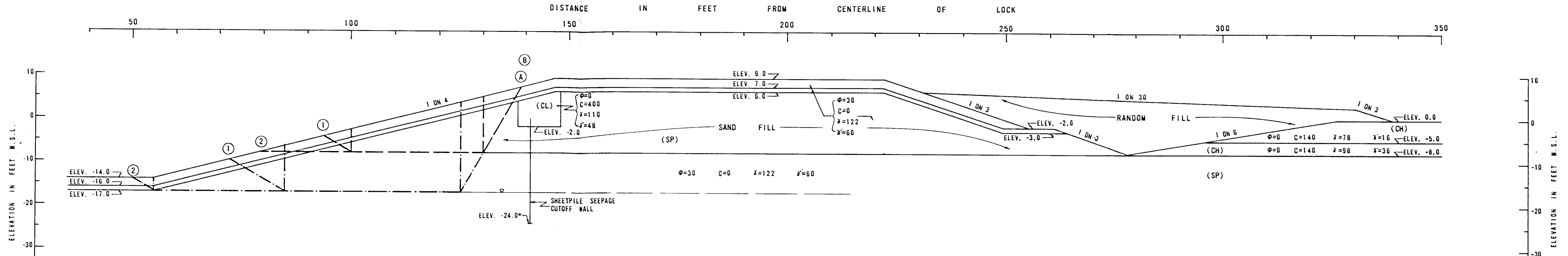
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

CONSTRUCTION "Q" STABILITY

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

DATE SEPT., 1973 FILE NO H-2-24419

PLATE III 11

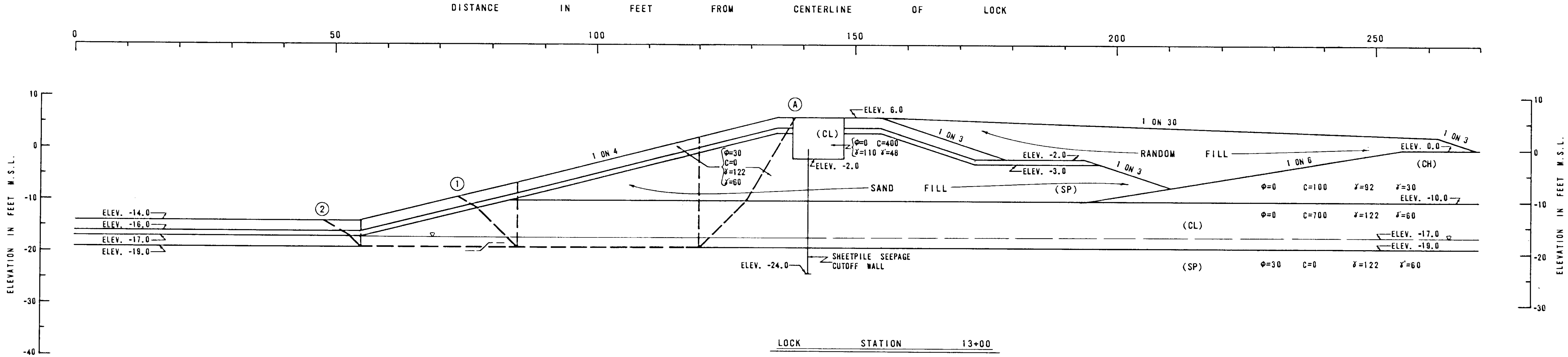


LOCK STATION 18+50

BASED ON BORING 1-UL

* -24.0 WITHIN 120' OF GULF FLOODWALL
THEN CONTINUES AT -40.0 TO WALL

LOCK STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY $\Sigma R / \Sigma D$
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	
18 + 50	A	1	- 8	11,601	1,172	10,429	7,734	19,018	2,343	29,095	2.79
		2			0	11,601		22,901	0	30,635	2.64
	B	1	-17	29,979	4,690	25,289	19,986	43,671	9,380	73,037	2.89
		2			548	29,431		57,934	1,096	79,016	2.69
13 + 00	A	1	-19	34,183	7,439	26,744	24,418	24,500	11,404	60,322	2.26
		2			1,399	32,784		40,505	3,896	68,819	2.10



LOCK STATION 13+00

BASED ON BORING 3-RU

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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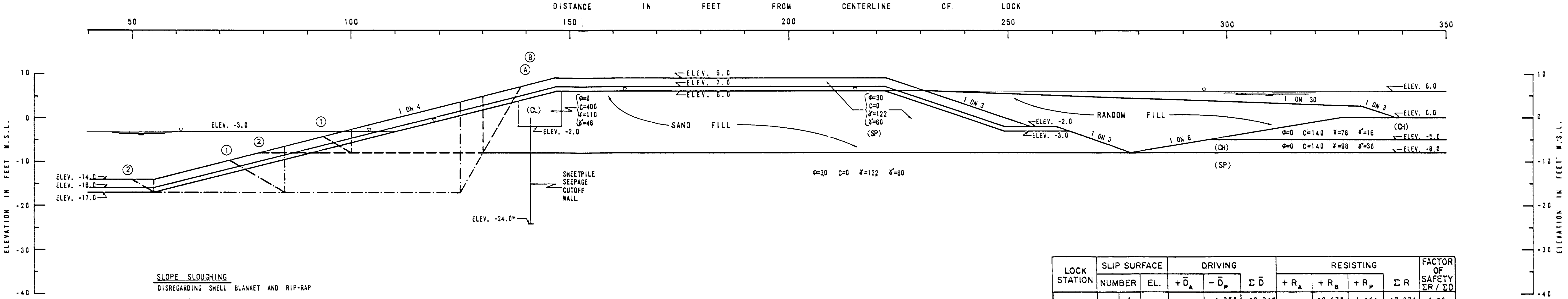
CONSTRUCTION "Q" STABILITY

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

DATE: SEPT., 1973
FILE NO H-2-24419

PLATE III 12



SLOPE SLOUGHING

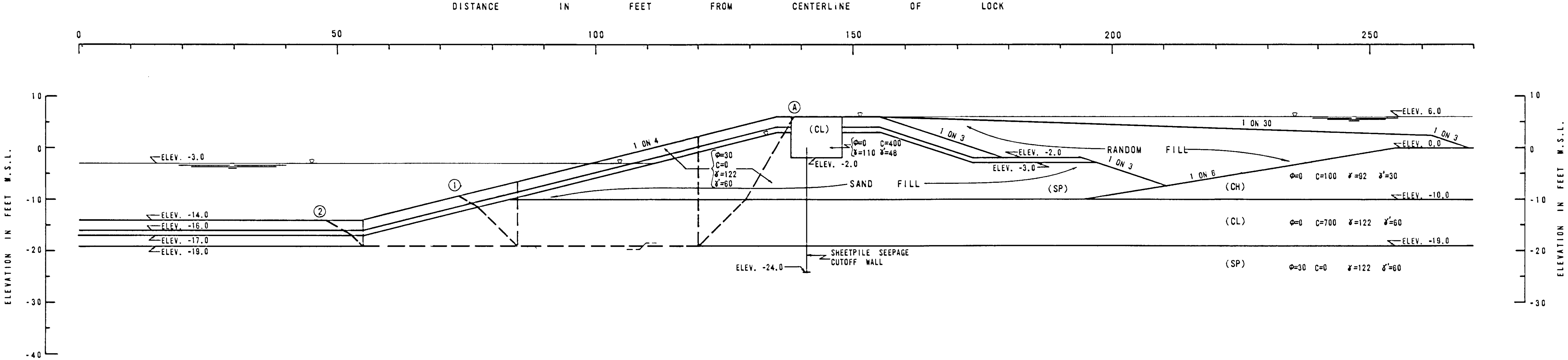
DISREGARDING SHELL BLANKET AND RIP-RAP

F.S. = $\frac{\gamma'}{\gamma}$ M TAN ϕ = 1.14
M = COTANGENT OF THE SLOPE
γ' = SUBMERGED UNIT WEIGHT
γ = SATURATED UNIT WEIGHT
ϕ = ANGLE OF INTERNAL FRICTION
F.S. = FACTOR OF SAFETY (≥1.0 ok)

LOCK STATION 18+50

BASED ON BORING 1-UL
* -24.0 WITHIN 120' OF GULF FLOODWALL;
THEN CONTINUES AT -40.0 TO WALL

LOCK STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY $\Sigma R / \Sigma \bar{D}$
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	
18 + 50	A	1 2	- 8	11,601	1,355 774	10,246 10,827	5,435	10,675 12,586	1,161 0	17,271 18,021	1.69 1.66
	B	1 2	- 17	29,979	8,380 6,342	21,599 23,637	12,584	22,408 29,423	4,613 539	39,605 42,546	1.83 1.80
13 + 00	A	1 2	- 19	34,308	11,651 8,681	22,657 25,627	19,533	20,840 29,933	11,016 3,339	51,389 52,805	2.27 2.06



LOCK STATION 13+00

BASED ON BORING 3-RU

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC.
NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
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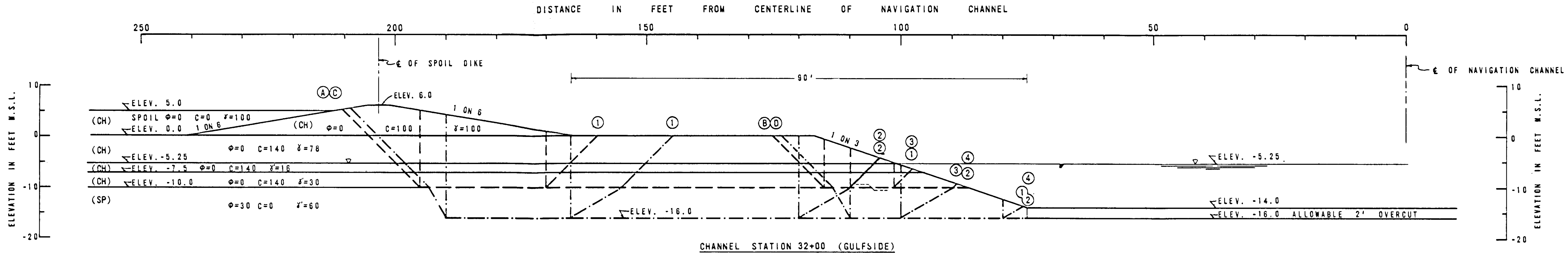
OPERATING "Q" STABILITY

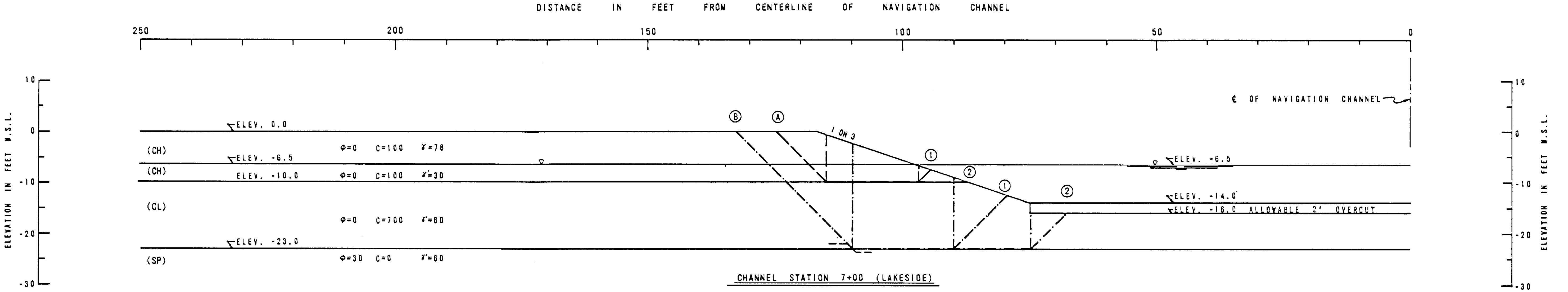
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT., 1973
FILE NO H-2-24419



CHANNEL STATION 32+00 (GULFSIDE)

BASED ON BORING 1-UL



CHANNEL STATION 7+00 (LAKESIDE)

BASED ON BORING 3-RU

CHANNEL STATION	SLIP SURFACE			DRIVING			RESISTING				FACTOR OF SAFETY $\Sigma R / \Sigma D$
	NUMBER		EL.	$+\bar{D}_A$	$-\bar{D}_P$	$\Sigma \bar{D}$	$+R_A$	$+R_B$	$+R_P$	ΣR	
32+00 (GULFSIDE)	A	1	-10	10,511	3,469	7,042	3,829	3,500	2,800	10,129	1.44
		2			1,081	9,430		11,900	1,610	17,339	1.84
		3			198	10,313		12,953	997	17,779	1.72
		4			0	10,511		13,502	0	17,331	1.65
	B	1	-10	3,214	198	3,016	2,800	1,753	997	5,550	1.84
		2			0	3,214		2,302	0	5,102	1.59
	C	1	-16	17,373	7,505	9,868	8,486	15,817	11,288	35,591	3.61
		2			4,857	12,516		38,875	9,250	56,611	4.52
		3			1,534	15,839		46,963	3,234	58,683	3.71
		4			0	17,373		51,798	0	60,284	3.47
	D	1	-16	6,528	255	6,273	5,084	7,672	510	13,266	2.12
		2			0	6,528		8,166	0	13,250	2.03
7+00 (LAKESIDE)	A	1	-10	3,557	125	3,432	2,000	1,800	500	4,300	1.25
		2			0	3,557		2,800	0	4,800	1.35
	B	1	-23	16,000	4,361	11,639	20,200	11,230	14,700	46,130	3.96
		2			1,468	14,532		17,179	9,800	47,179	3.25

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC.
NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
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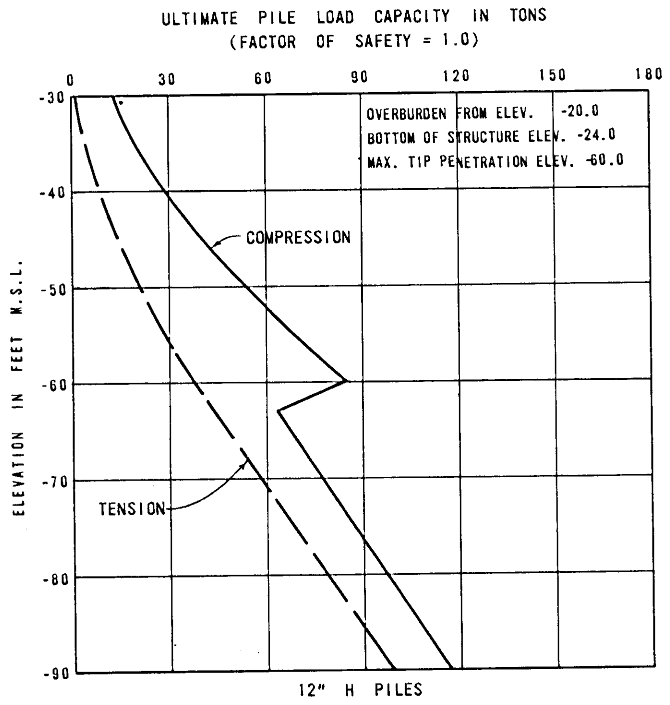
RIGOLETS LOCK

OPERATING "Q" STABILITY

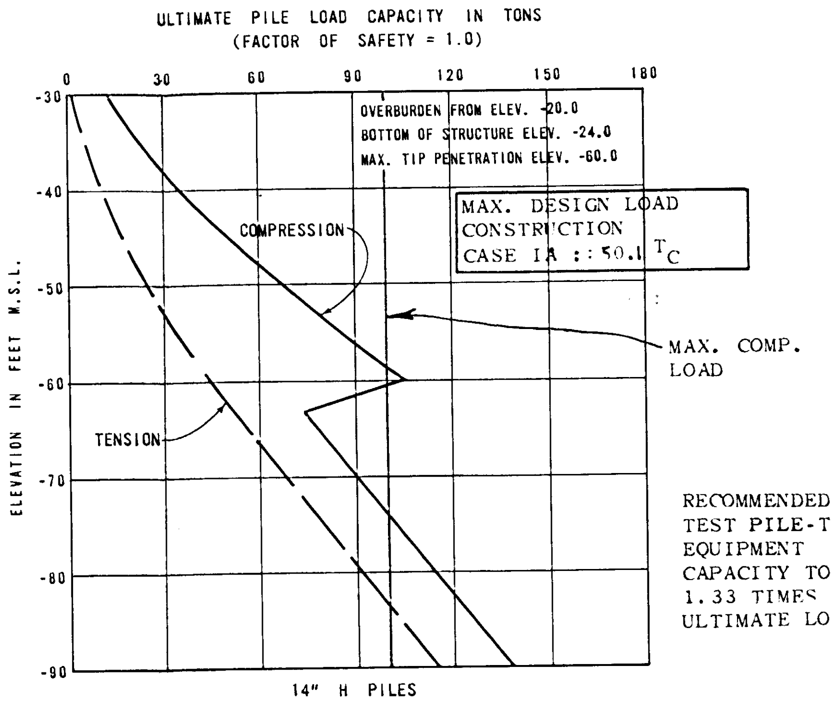
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT., 1973
FILE NO H-2-24419

PLATE III 14



OVERBURDEN FROM ELEV. -20.0
BOTTOM OF STRUCTURE ELEV. -24.0
MAX. TIP PENETRATION ELEV. -60.0

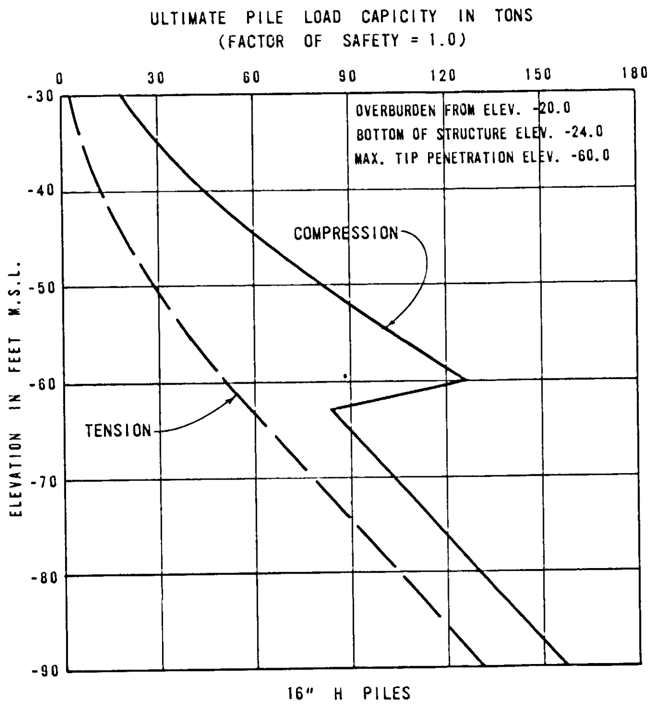


OVERBURDEN FROM ELEV. -20.0
BOTTOM OF STRUCTURE ELEV. -24.0
MAX. TIP PENETRATION ELEV. -60.0

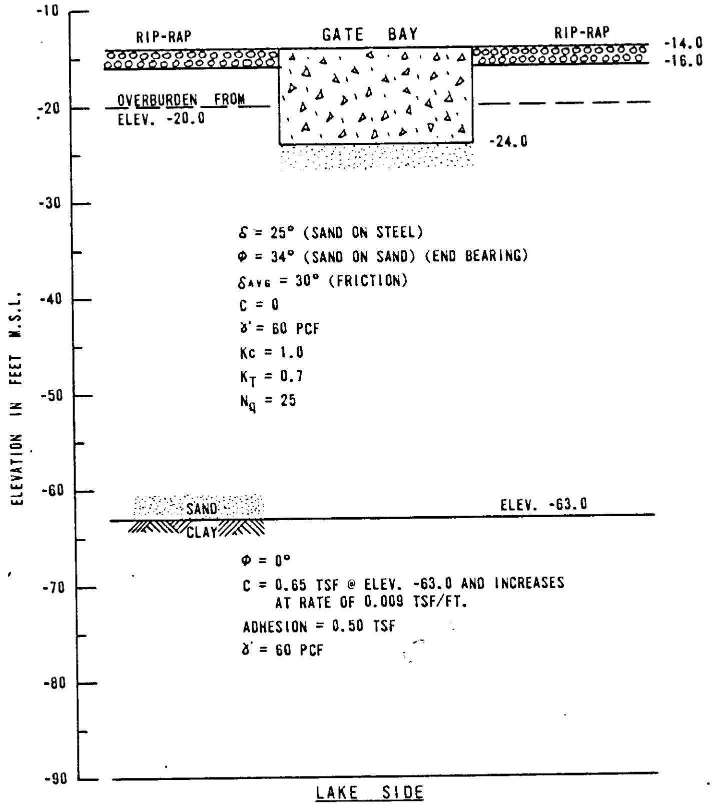
MAX. DESIGN LOAD
CONSTRUCTION
CASE IA :: 50.1 T_C

RECOMMENDED
TEST PILE-TYP.
EQUIPMENT
CAPACITY TO BE
1.33 TIMES
ULTIMATE LOAD

LAKESIDE GATE BAY



OVERBURDEN FROM ELEV. -20.0
BOTTOM OF STRUCTURE ELEV. -24.0
MAX. TIP PENETRATION ELEV. -60.0



δ = 25° (SAND ON STEEL)
Φ = 34° (SAND ON SAND) (END BEARING)
δ_{AVG} = 30° (FRICTION)
C = 0
γ' = 60 PCF
Kc = 1.0
K_T = 0.7
N_q = 25

Φ = 0°
C = 0.65 TSF @ ELEV. -63.0 AND INCREASES
AT RATE OF 0.009 TSF/FT.
ADHESION = 0.50 TSF
γ' = 60 PCF

LAKE SIDE

SOIL STRATIFICATION AND PILE DESIGN PARAMETERS

PILE LOAD SUMMARY

CASE	PILE A		PILE B	
	MAX(K)	MIN(K)	MAX(K)	MIN(K)
Ia	100.3	94.4	74.4	68.5
Ib	98.9	93.1	76.0	70.2
*I+III 1	105.1	87.1	28.8	10.8
*I+III 4	99.5	84.1	30.3	14.9
*I+III 6B	31.9	8.6	98.6	75.3
I+III 7	62.8	58.6	47.9	43.7
I+III 8	8.3	5.5	7.7	4.9

* HURRICANE CONDITIONS
F.S. COMP 1.5
F.S. TENS 1.75
ALL OTHER CASES, F.S. = 2.0 FOR COMPRESSION AND TENSION PILES.

FOR GENERAL NOTES SEE PLATE III-2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

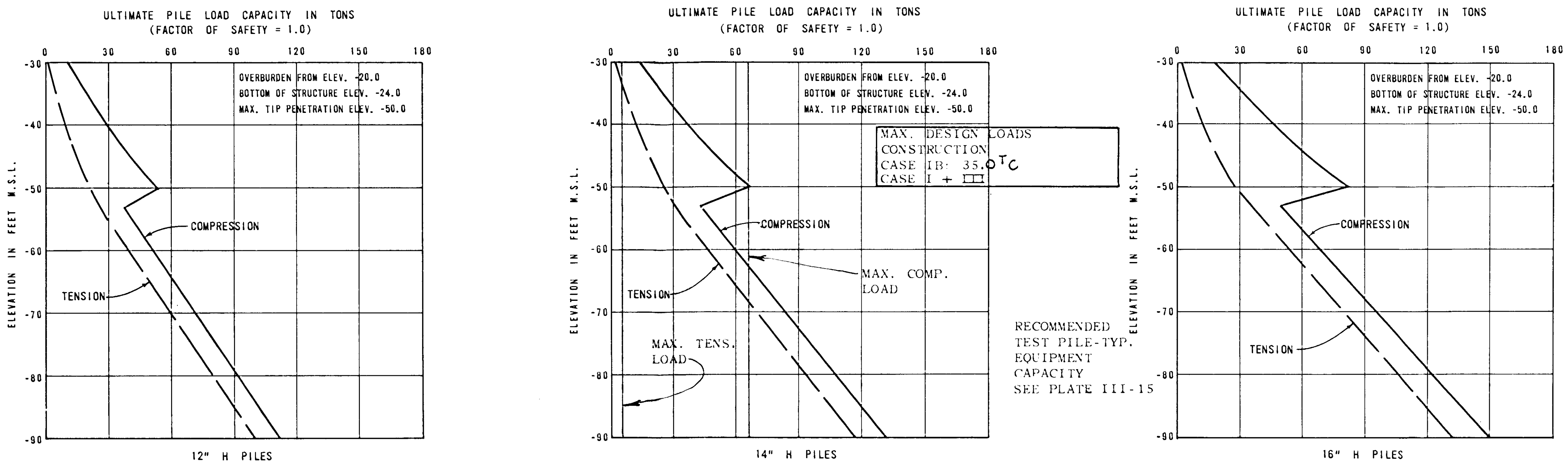
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

PILING DATA
LAKESIDE GATE BAY

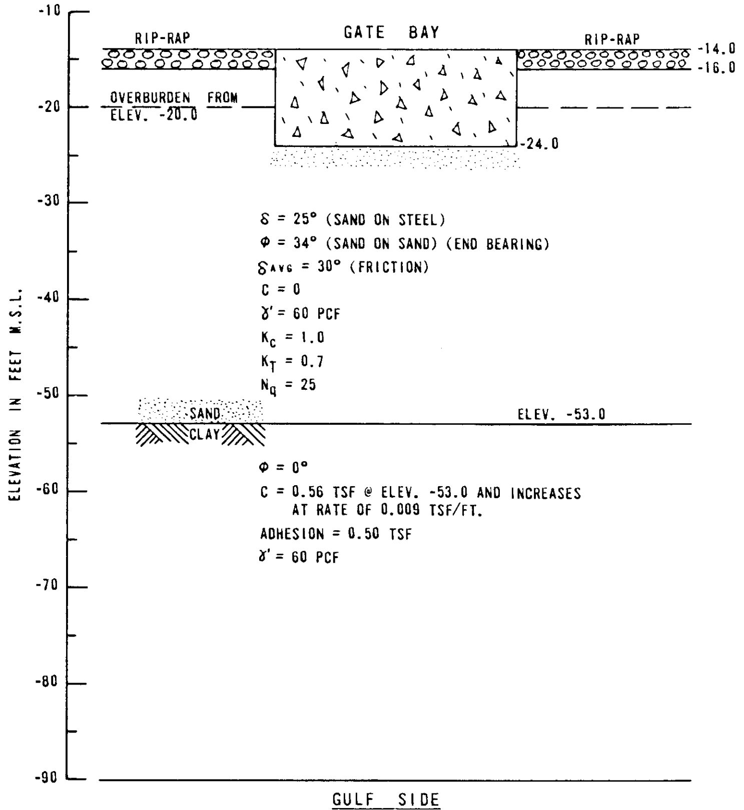
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: SEPT., 1973
FILE NO H-2-24419



RECOMMENDED
TEST PILE-TYP.
EQUIPMENT
CAPACITY
SEE PLATE III-15

GULFSIDE GATE BAY



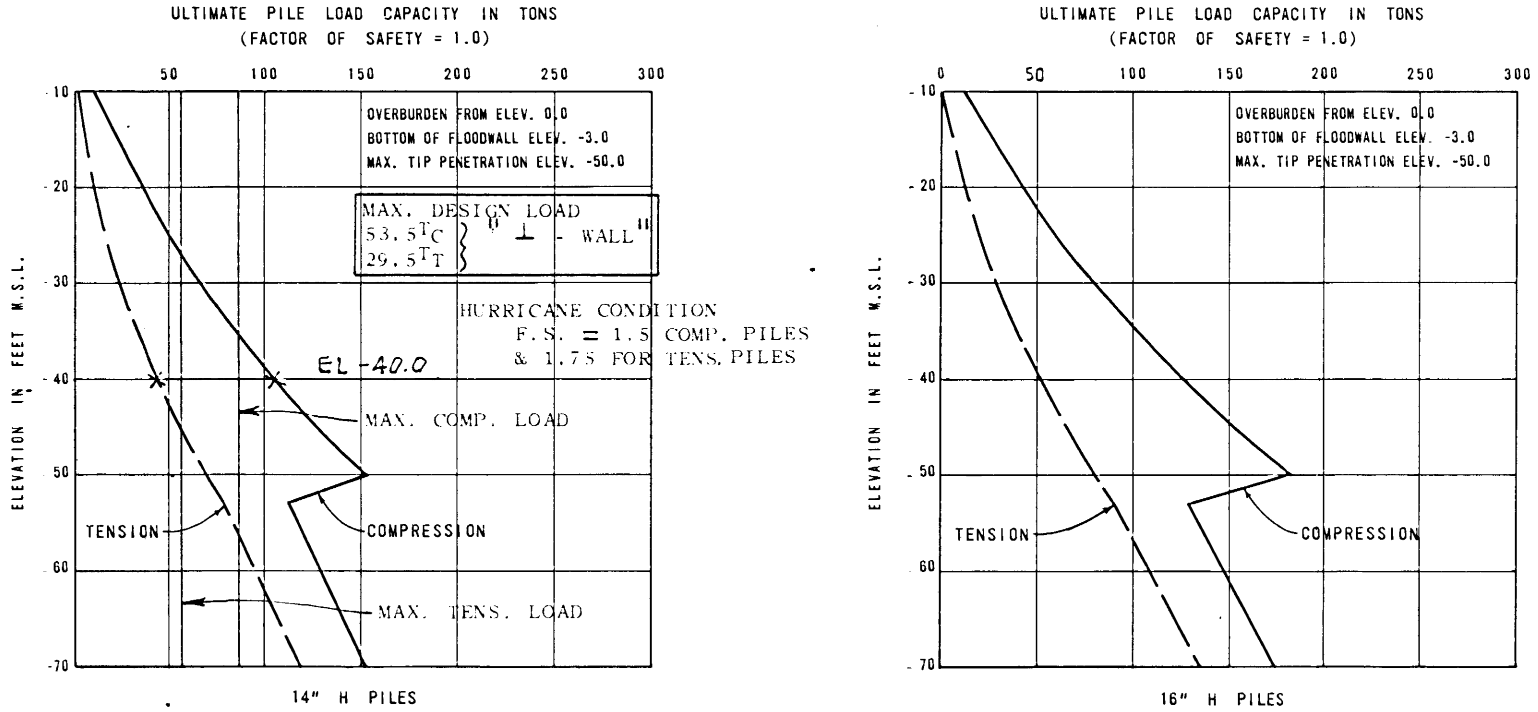
GULF SIDE

SOIL STRATIFICATION AND PILE DESIGN PARAMETERS

PILE LOAD SUMMARY

CASE	PILE A		PILE B	
	MAX(K	MIN(K)	MAX(K)	MIN(K)
Ia	49.9	49.0	55.1	54.2
Ib	64.4	58.6	69.9	64.3
*I+III 1	77.6	68.4	1.6	-7.2
*I+III 5	49.9	45.8	27.5	23.6
*I+III 7	25.0	7.8	72.3	55.8
I+III 10	30.5	19.9	58.8	48.7
I+III 11	38.2	34.9	41.2	38.1
I+III 12	15.3	10.5	15.8	11.3

* HURRICANE CONDITIONS
F.S. COMP 1.5
F.S. TENS 1.75
ALL OTHER CASES, F.S. = 2.0 FOR COMPRESSION AND TENSION PILES.



HURRICANE CONDITION
F.S. = 1.5 COMP. PILES
& 1.75 FOR TENS. PILES

GULFSIDE FLOODWALL

FOR GENERAL NOTES SEE PLATE III 2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

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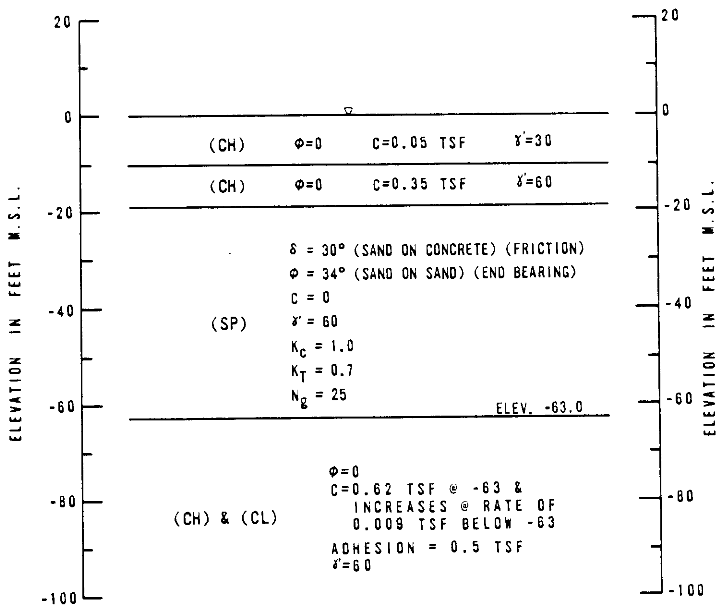
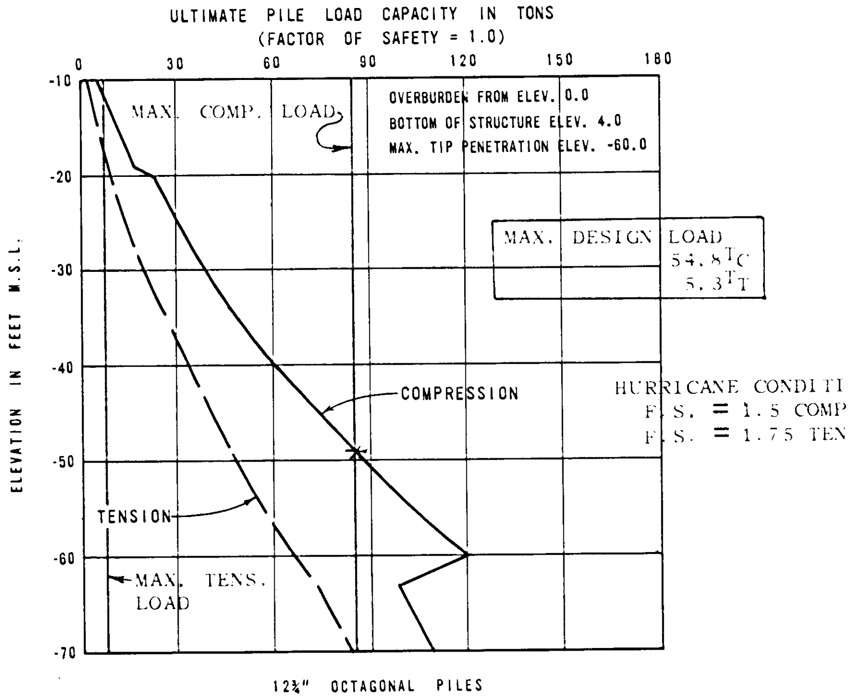
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

PILING DATA
GULFSIDE GATE BAY

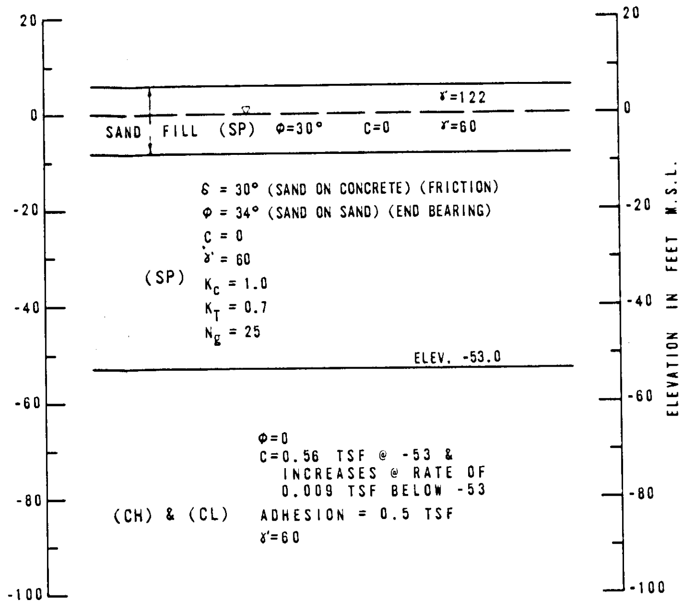
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

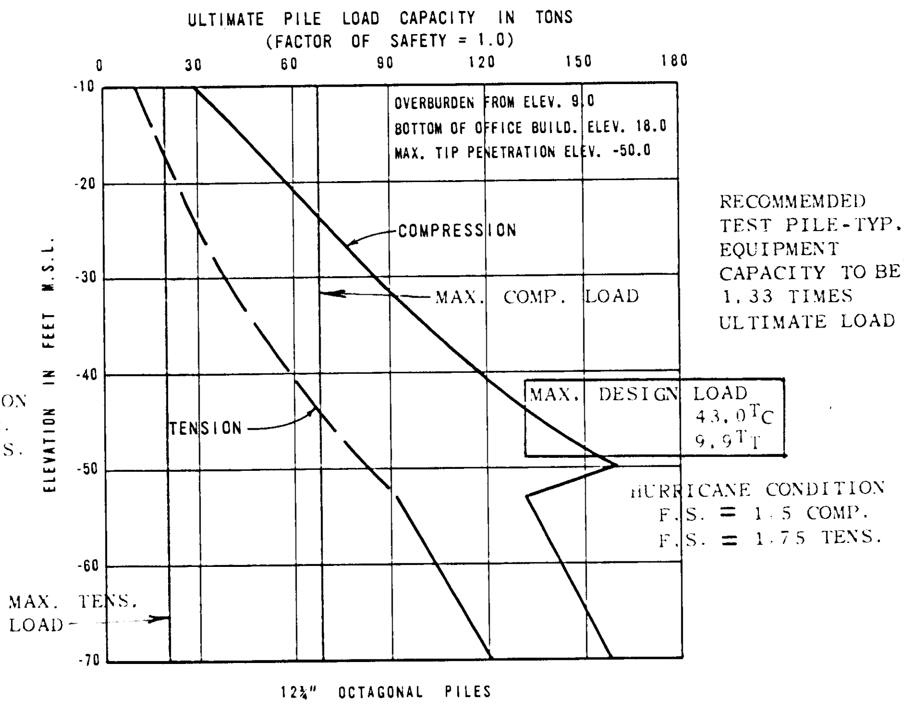
DATE: SEPT., 1973
FILE NO H-2-24419



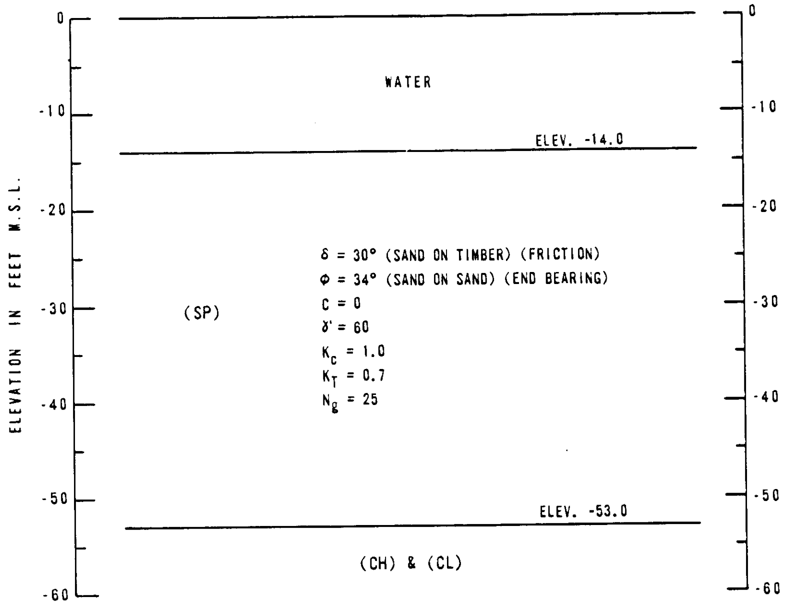


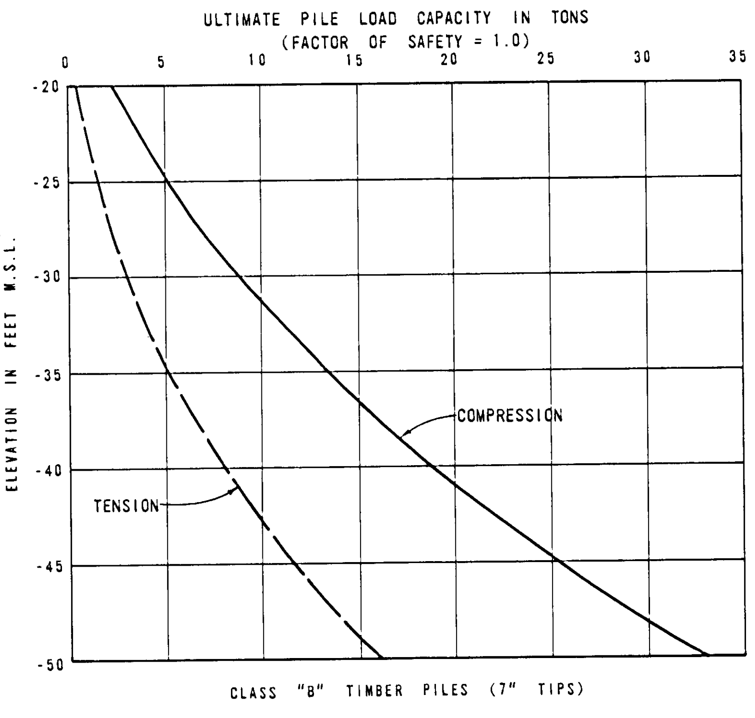
NEEDLE GIRDER STORAGE





RESERVATION AREA





TIMBER GUIDE WALLS

NORMAL LOADS
F.S. = 2.0 FOR TENSION PILES
F.S. = 2.0 FOR COMP. PILES

HURRICANE LOADS
F.S. = 1.75 FOR TENSION PILES
F.S. = 1.5 FOR COMP. PILES

FOR GENERAL NOTES SEE PLATE III 2

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

PILING DATA

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

DATE: SEPT., 1973
FILE NO H-2-24419

PLATE III 17

CORPS OF ENGINEERS

U.S. ARMY

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

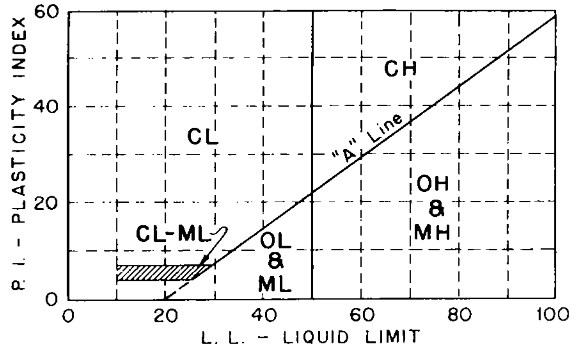
DESCRIPTIVE SYMBOLS

COLOR

COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	BK
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH-GRAY	br Gr
GRAYISH-BROWN	gy Br
GREENISH-GRAY	gn Gr
GRAYISH-GREEN	gy Gn
GREEN	Gn
BLUE	Bl
BLUE-GREEN	Bl Gn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS

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



PLASTICITY CHART

For classification of fine - grained soils

MODIFICATIONS

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

NOTES:

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

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

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

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

▽	Ground-water surface and date observed
Ⓒ	Denotes location of consolidation test **
Ⓢ	Denotes location of consolidated-drained direct shear test **
Ⓡ	Denotes location of consolidated-undrained triaxial compression test **
Ⓠ	Denotes location of unconsolidated-undrained triaxial compression test **
Ⓣ	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.

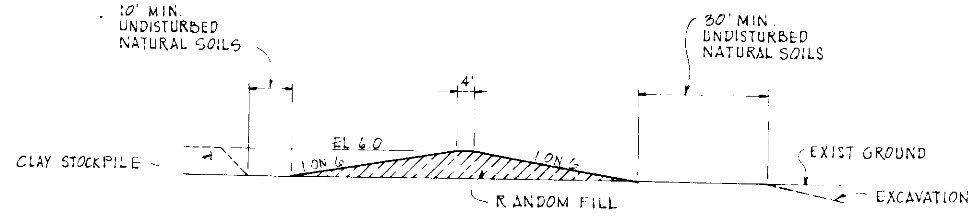
Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

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

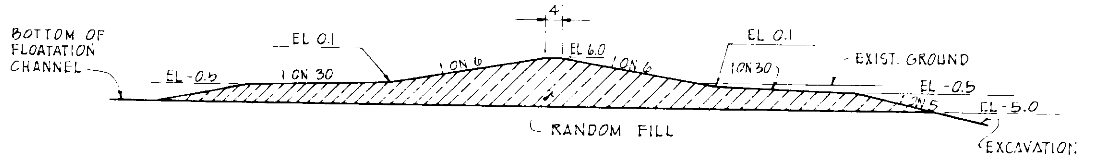
SOIL BORING LEGEND

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

PLATE A



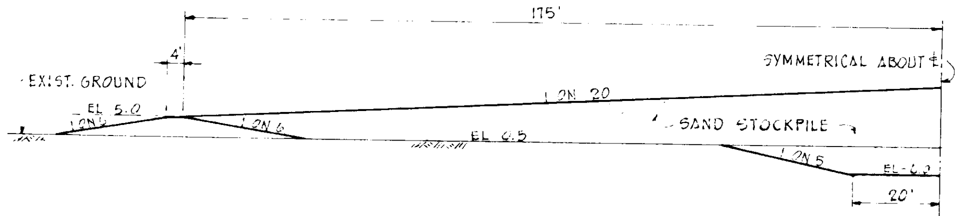
TYPICAL SECTION



SECTION AT FLOATATION CHANNEL

LAKESIDE PROTECTION DIKE SECTIONS

0 20 40
SCALE IN FEET

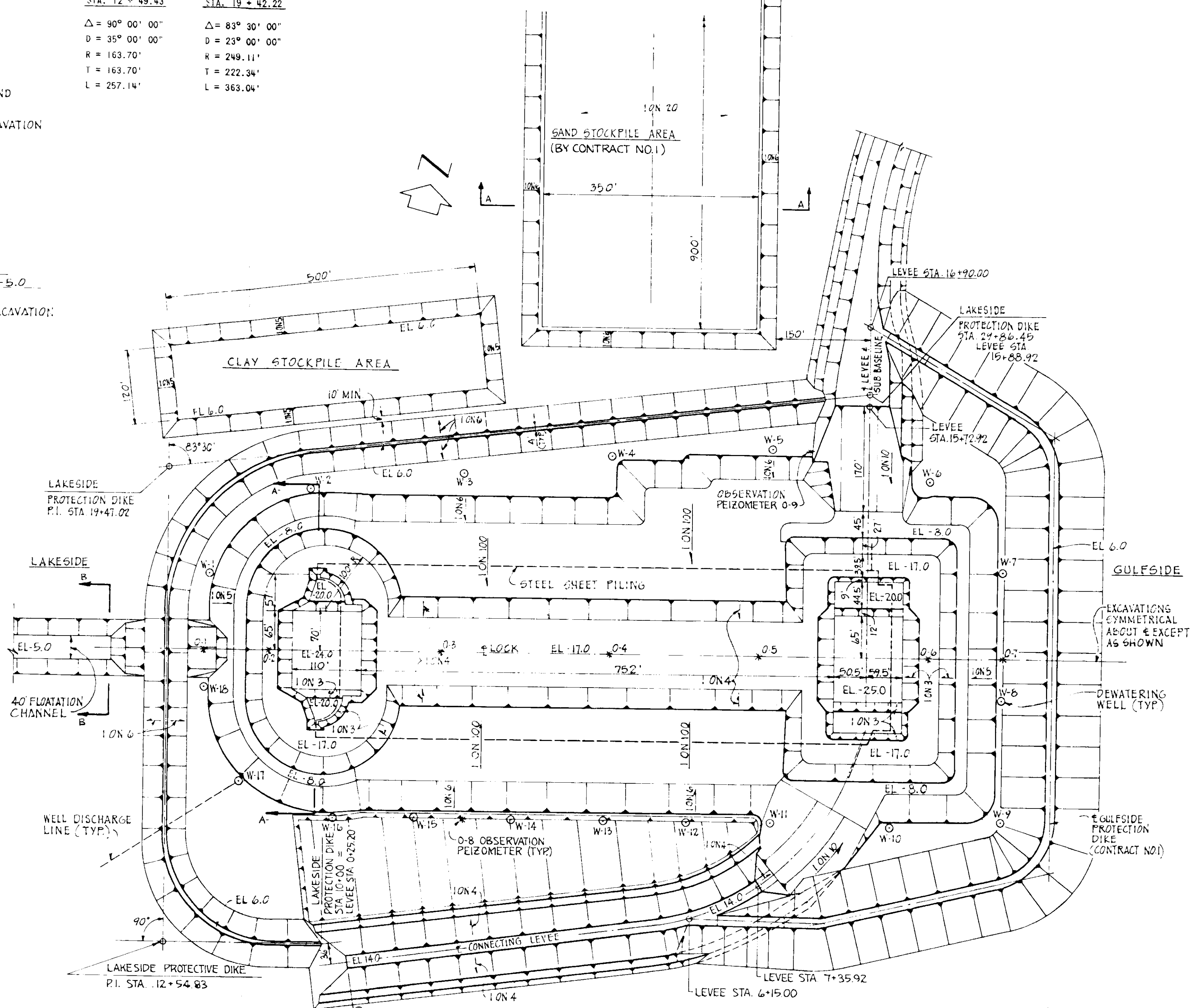


SECTION A

0 20 40
SCALE IN FEET

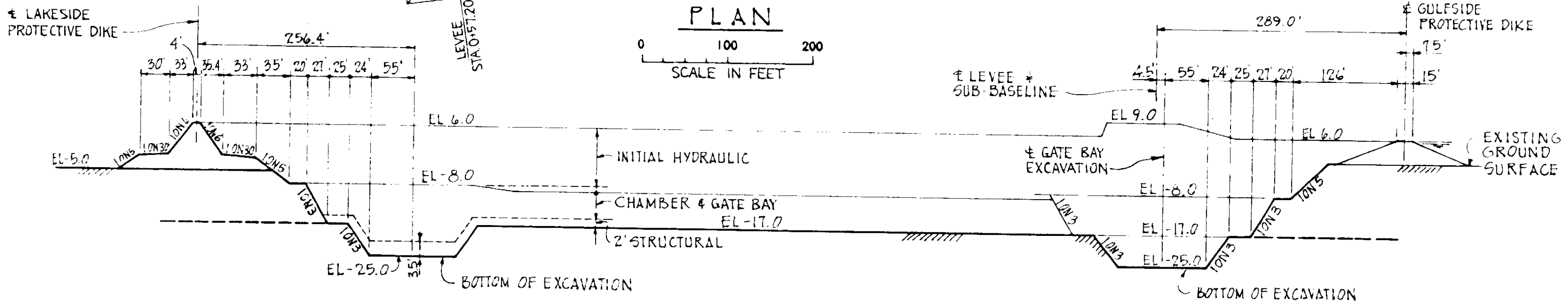
LAKESIDE PROTECTION DIKE - CURVE DATA

STA. 12 + 49.43	STA. 19 + 42.22
Δ = 90° 00' 00"	Δ = 83° 30' 00"
D = 35° 00' 00"	D = 23° 00' 00"
R = 163.70'	R = 249.11'
T = 163.70'	T = 222.34'
L = 257.14'	L = 363.04'



PLAN

0 100 200
SCALE IN FEET



PROFILE - ℄ LOCK

0 20 40 VERT SCALE IN FEET
0 100 200 HORIZ. SCALE IN FEET

CONSTRUCTION SEQUENCE

1. CONSTRUCTION OF MAIN LEVEE, CONNECTING LEVEE, GULFSIDE PROTECTION DIKE, SAND STOCKPILE AND UPLIFT SEEPAGE BERM PRECEDE THE DDM WORK AND ARE EXISTING PRIOR TO START OF THE LOCK EXCAVATION AND INSTALLATION OF THE DEWATERING SYSTEM.
2. PERFORM FLOTATION CHANNEL AND INITIAL EXCAVATION BY HYDRAULIC DREDGE TO PLATEAU AT APPROXIMATELY ELEVATION - 8.0; WASTE TO LEVEE AND LOCK SPOIL AREA, SEE PLATE I 1.
3. PLACE RIDGE OF FILL TO APPROXIMATELY ELEVATION 3.0 IN AREAS OF RELIEF WELLS TO FACILATE INSTALLATION OF DEEP WELL SYSTEM, PRIOR TO UNWATERING EXCAVATION.
4. INSTALL DEEP WELL SYSTEM AND OBSERVATION PIEZOMETERS WHILE CONSTRUCTING PROTECTION DIKES FROM CLAY BORROW REMOVED FROM THE GATE BAY AND CHAMBER EXCAVATIONS BELOW ELEVATIONS - 8.0. OBSERVATION PIEZOMETERS INSIDE CHAMBER AREA TO BE PLACED AFTER GATE BAY AND PARTIAL CHAMBER EXCAVATIONS ARE COMPLETED.
5. CLOSE ACCESS FLOTATION CHANNEL.
6. UNWATER EXCAVATION WHILE OPERATING DEWATERING SYSTEM SUCH THAT RAPID DRAWDOWN CONDITIONS ARE PREVENTED AND THE HEAD IN THE SANDS IS MAINTAINED AT THE WATER SURFACE IN THE EXCAVATION (±1'). AFTER THE WATER IS REMOVED FROM THE EXCAVATION, MAINTAIN THE PHREATIC SURFACE A MINIMUM OF 5 FEET BELOW THE BOTTOM OF THE EXCAVATION LEVELS.
7. COMPLETE GATE BAY EXCAVATION TO FINAL GRADE AND PERFORM EXCAVATION IN THE LOCK CHAMBER AS REQUIRED BY CONTRACTORS OPERATIONS. PLACE CLAY MATERIAL IN STOCKPILE AND USE SAND MATERIAL TO BUILD CHAMBER SIDE LEVEES.
8. CONSTRUCT GATES, CUTOFFS, TIE-IN FLOODWALLS. COMPLETE BACKFILL AROUND GATES, COMPLETE CHAMBER EXCAVATION, AND BUILD CHAMBER SIDE LEVEES. UTILIZE SAND AND CLAY MATERIALS FROM CHAMBER AND STOCKPILES. REMOVE AND SEAL OBSERVATION PIEZOMETERS IN THE CHAMBERS AS WORK PROGRESSES.
9. CONSTRUCT CHAMBER GUIDE WALLS AND PLACE SHELL BLANKET AND RIPRAP WITHIN THE PROTECTION DIKES.
10. FLOOD GATE AND CHAMBER AREAS WHILE OPERATING THE DEWATERING SYSTEM SUCH THAT THE PHREATIC SURFACE IS CONTROLLED AS IT RISES TO THE TOP OF THE RIPRAP; COMPLETE FLOODING OF LOCK.
11. REMOVE DEWATERING SYSTEM AND SEAL WELL AND PIEZOMETER HOLES WITH GROUT.
12. REMOVE GULFSIDE AND LAKESIDE PROTECTION DIKES. USE MATERIAL TO COMPLETE TIE-IN LEVEES TO GULF GATE BAY, AS CLAY FILL, AS TOPPING FOR SAND FILLS AT GATE BAYS AND AS RANDOM FILL.
13. DREDGE APPROACH CHANNELS AND PLACE HYDRAULIC SPOIL IN LEVEE AND LOCK SPOIL AREA. OBTAIN RANDOM FILL FROM CHANNEL EXCAVATION AS REQUIRED.
14. CONSTRUCT APPROACH GUIDE WALLS AND DOLPHINS AND PLACE REMAINING SHELL BLANKET AND RIPRAP IN THE APPROACH CHANNEL AREAS AT EACH END OF THE LOCK.

NOTES:

ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL.

LEVEE, CONNECTING LEVEE, GULFSIDE PROTECTION DIKE AND SAND STOCKPILE ARE BY CONTRACT NO. 1. REMAINDER OF WORK BY CONTRACT NO. 2.

FOR SECTIONS SEE PLATE III 19.

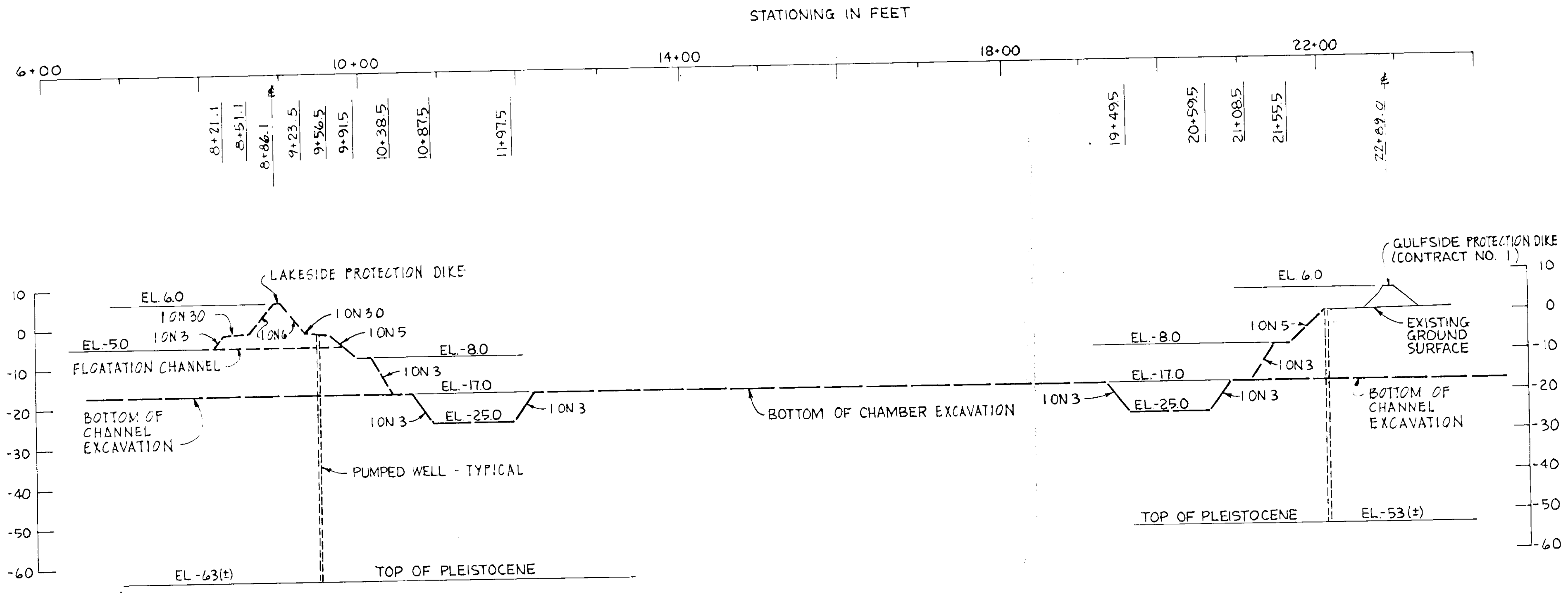
A JOINT VENTURE	
B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

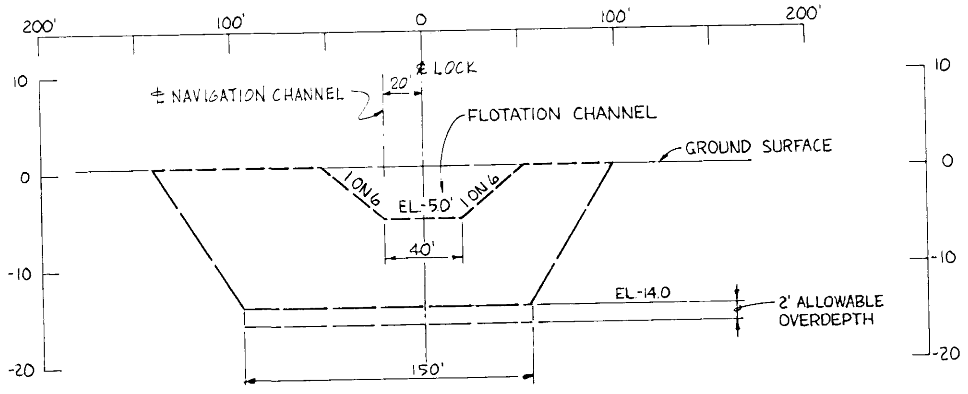
EXCAVATION PLAN

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

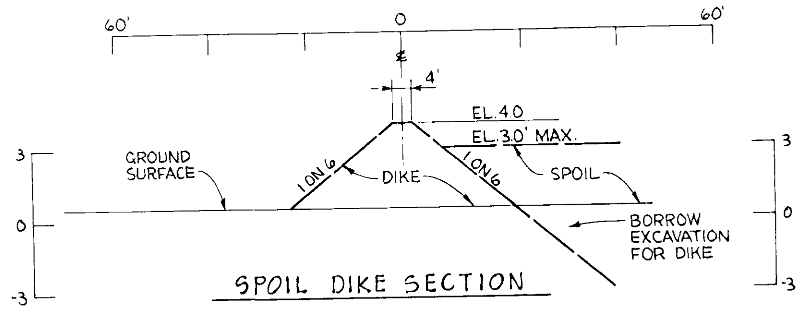
DATE SEPT., 1973
FILE NO. H-2-24419



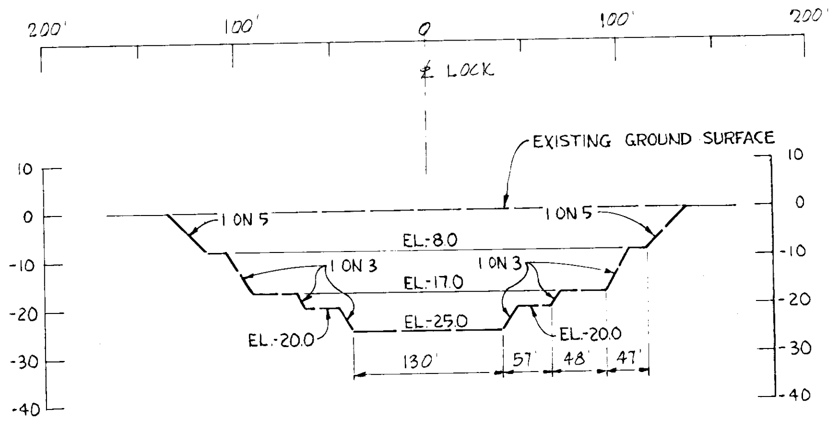
SECTION ALONG CENTERLINE OF LOCK



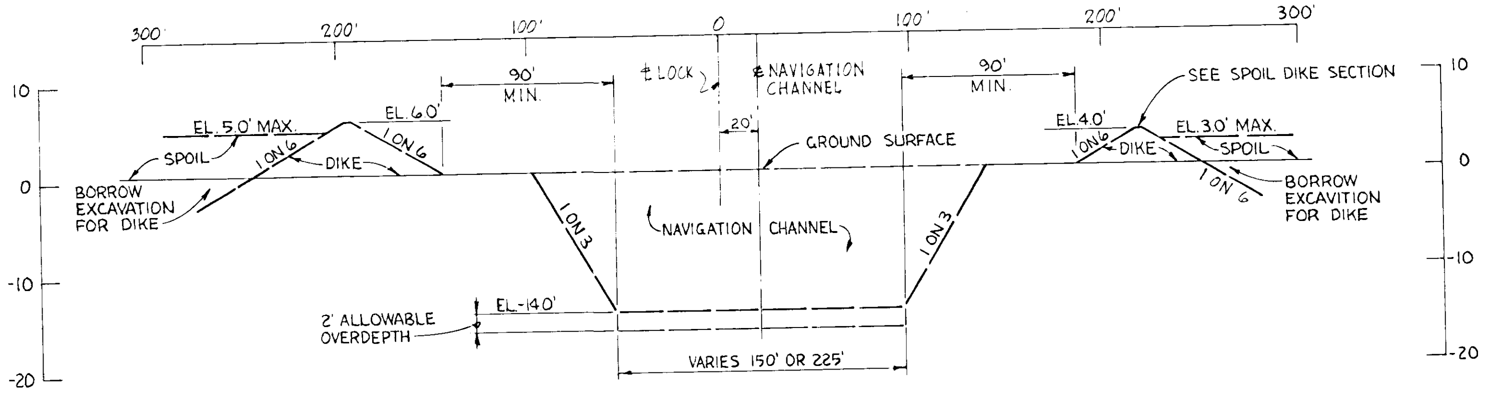
SECTION B-B



SPOIL DIKE SECTION



SECTION A-A



SECTION THROUGH EAST NAVIGATION CHANNEL

GENERAL NOTES:

FOR LOCATION OF SECTIONS SEE PLATE III 18
ELEVATIONS ARE IN FEET M.S.L.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

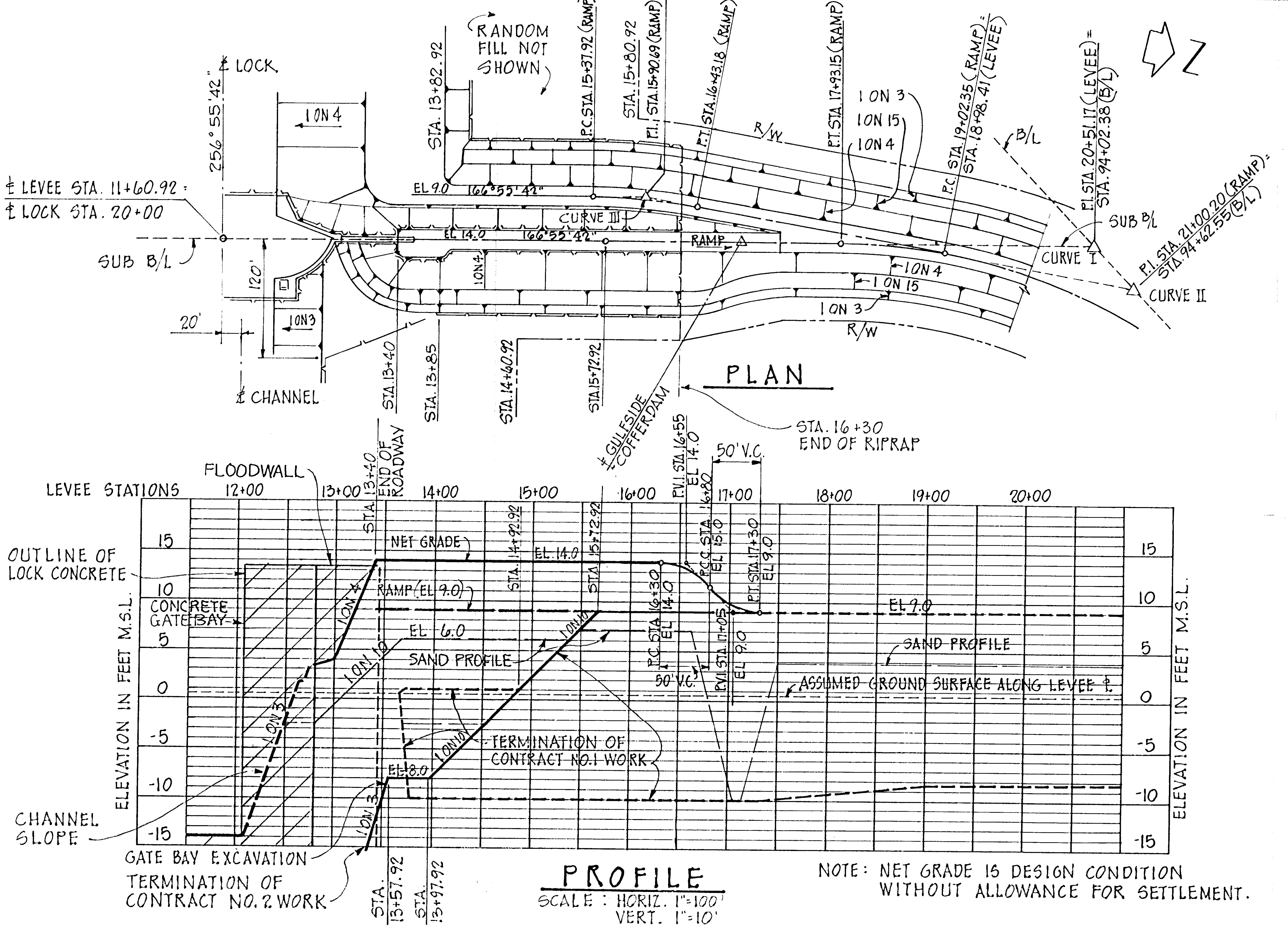
LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

EXCAVATION SECTIONS

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

DATE SEPT., 1973 FILE NO H-2-24419

PLATE III 19



NOTE: NET GRADE IS DESIGN CONDITION WITHOUT ALLOWANCE FOR SETTLEMENT.

CURVE DATA

	I	II	III
	P.I. STA. 20+51.17 = STA. 94+02.38 B/L	P.I. STA. 21+00.20 = STA. 94+62.55 B/L	P.I. STA. 15+90.69
Δ	46°19'25"	36°19'25"	10°00'00"
D	9°30'00"	9°30'00"	9°30'00"
R	603.11'	603.11'	603.11'
T	258.02'	197.85'	52.77'
L	481.61'	382.35'	105.26'

A JOINT VENTURE

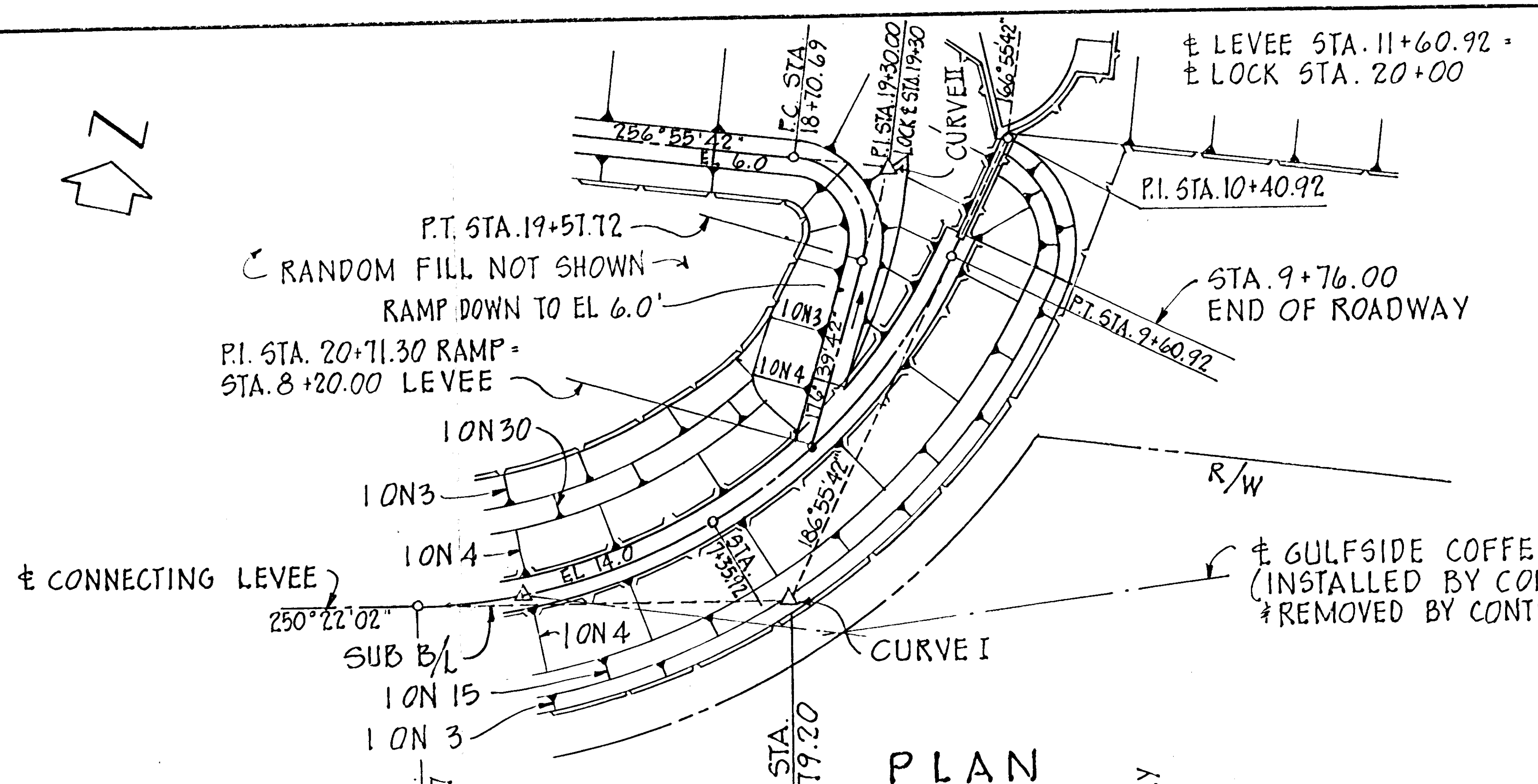
B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

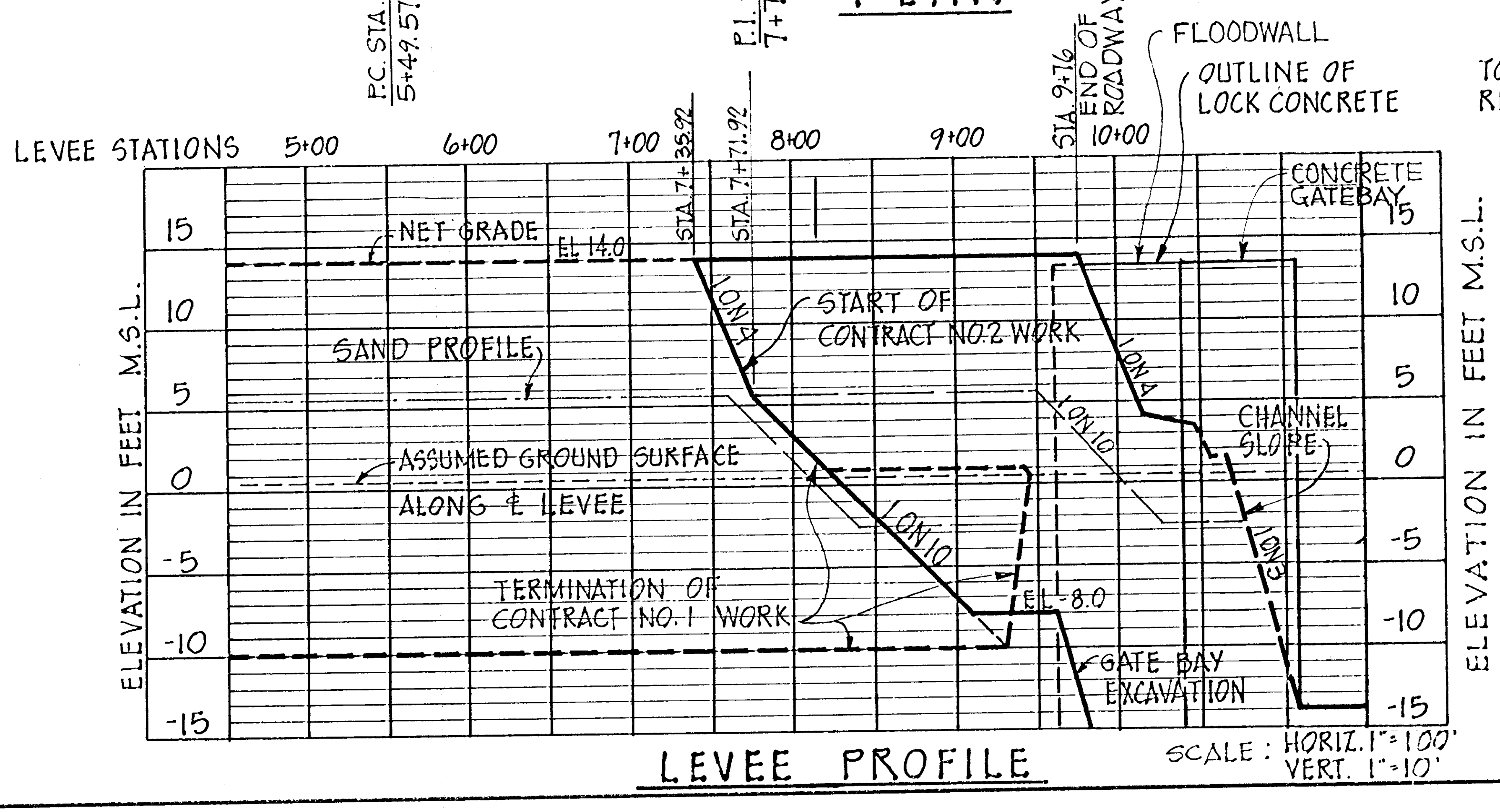
NORTH LEVEE CONNECTION

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

DATE SEPT., 1973
FILE NO H-2-24419

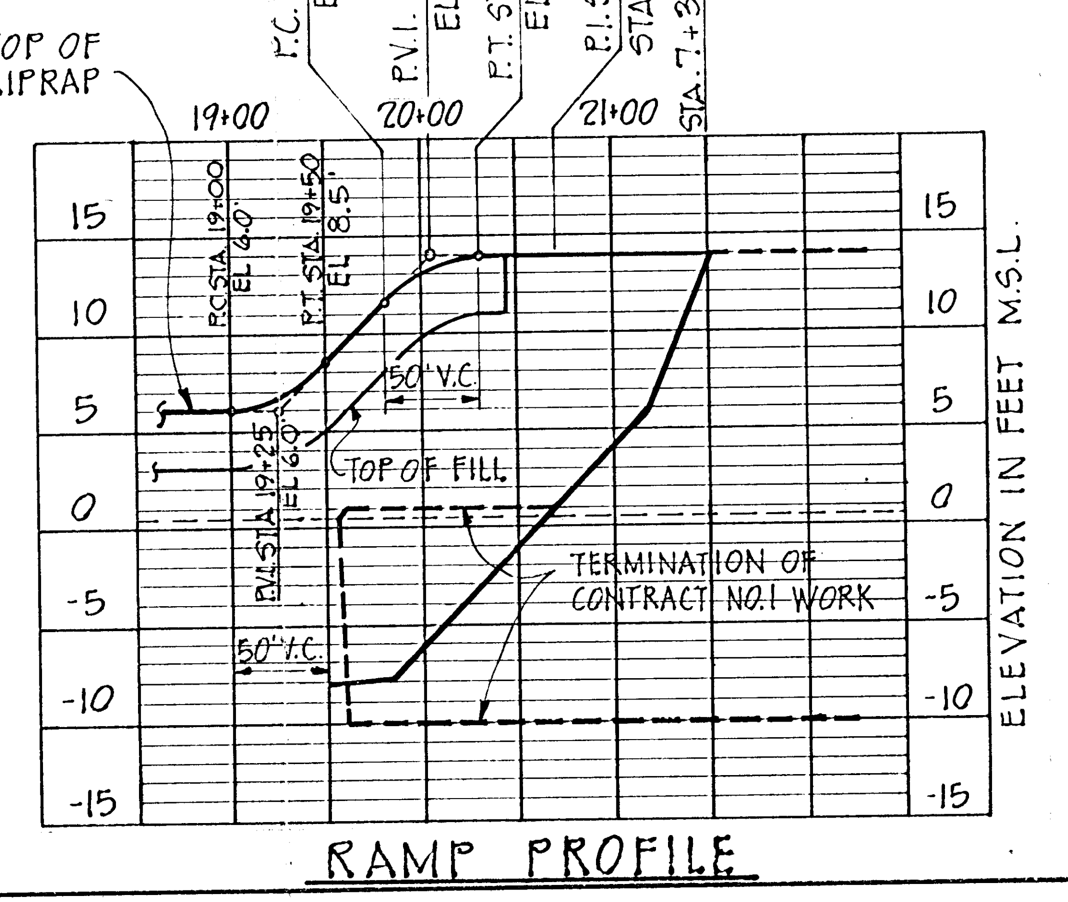


PLAN



LEVEE PROFILE

SCALE: HORIZ. 1" = 100'
VERT. 1" = 10'



RAMP PROFILE

CURVE DATA

	I	II
P.I. STA.	7+79.20	19+30.00
Δ =	63°26'20"	99°44'00"
D =	15°25'19"	114°35'30"
R =	371.52'	50.00'
T =	229.63'	59.31'
L =	411.35'	87.03'

A JOINT VENTURE

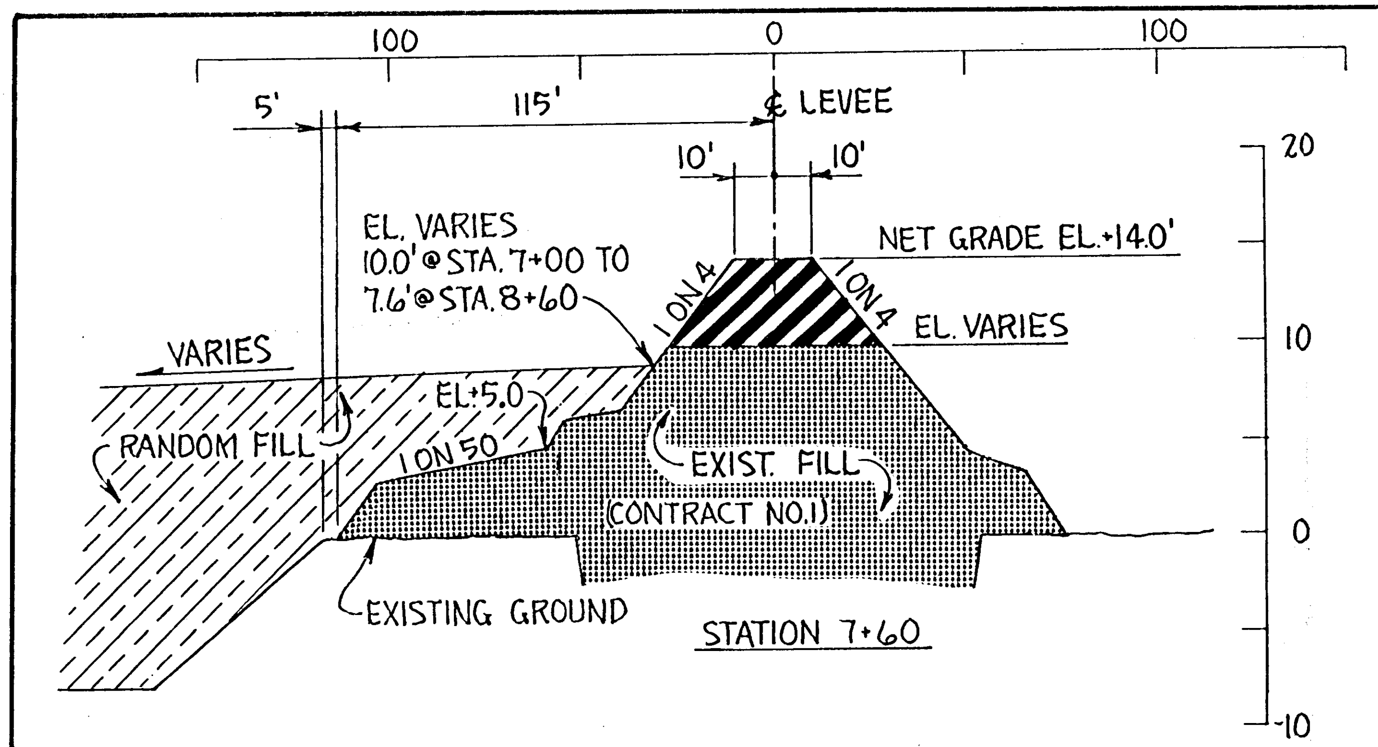
B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

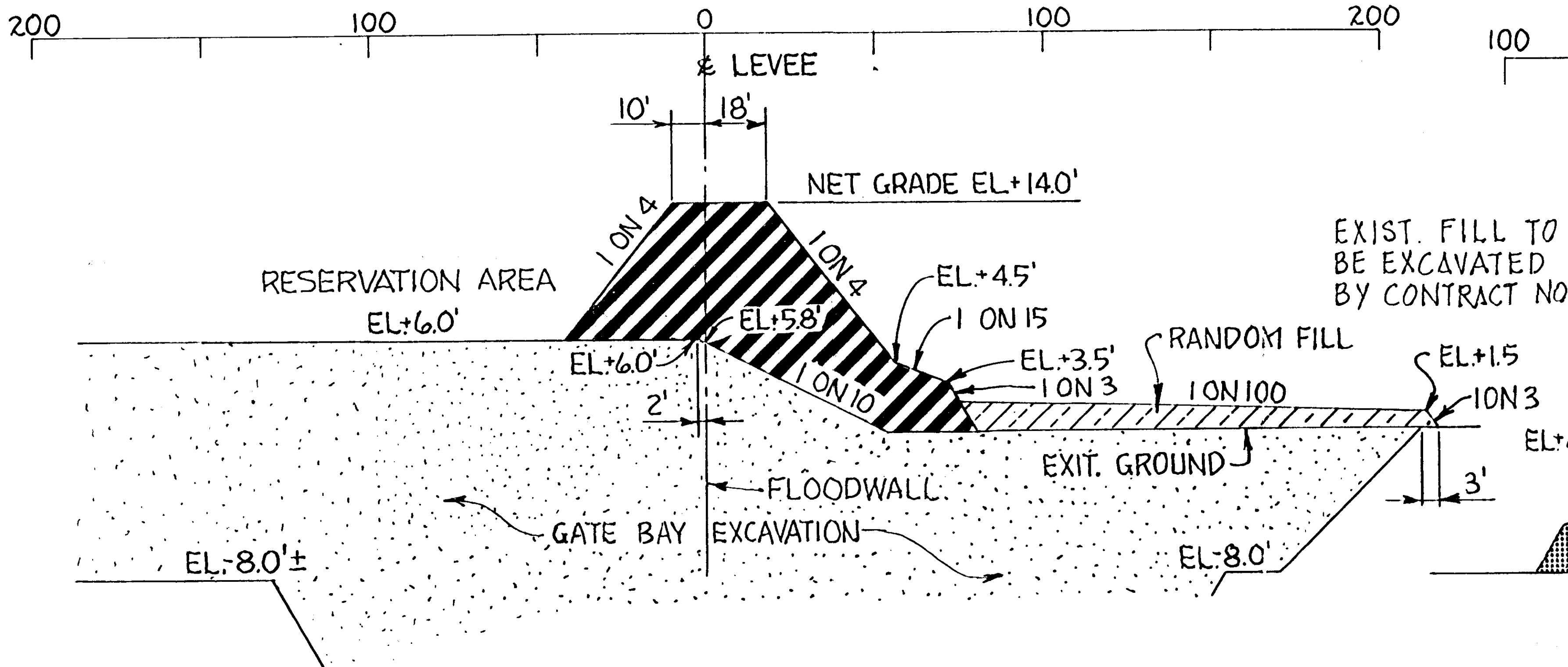
SOUTH LEVEE CONNECTION

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

DATE SEPT., 1973
FILE NO H-2-24419



STATION 7+60



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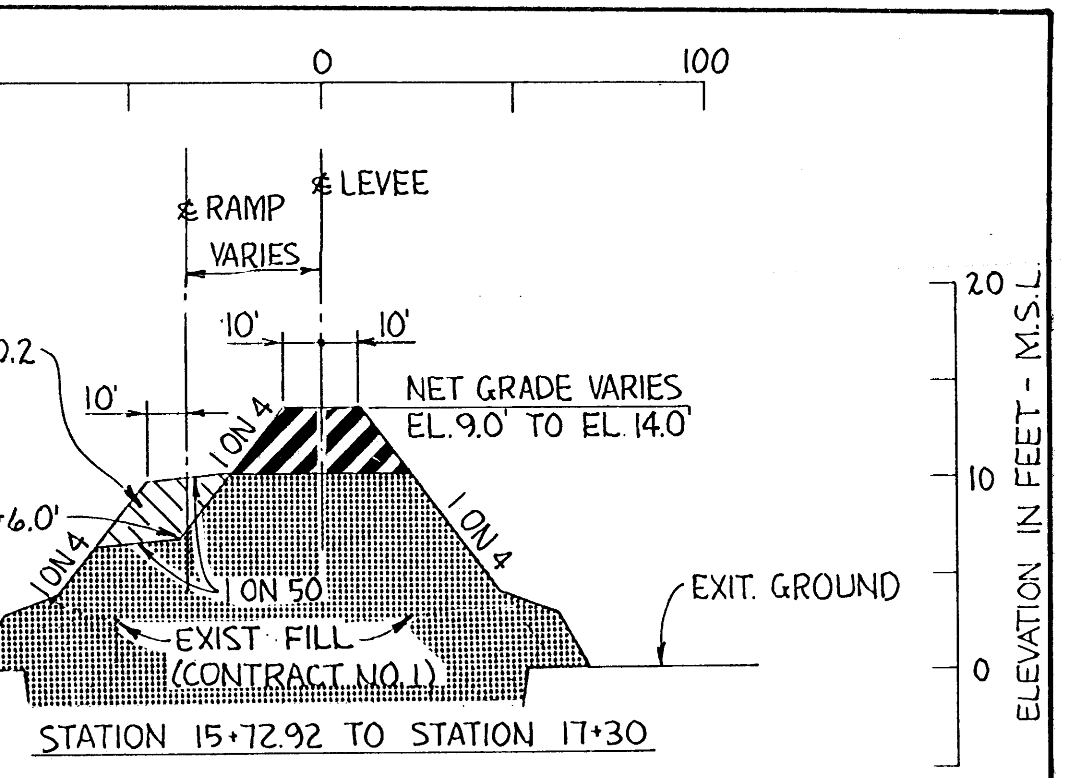
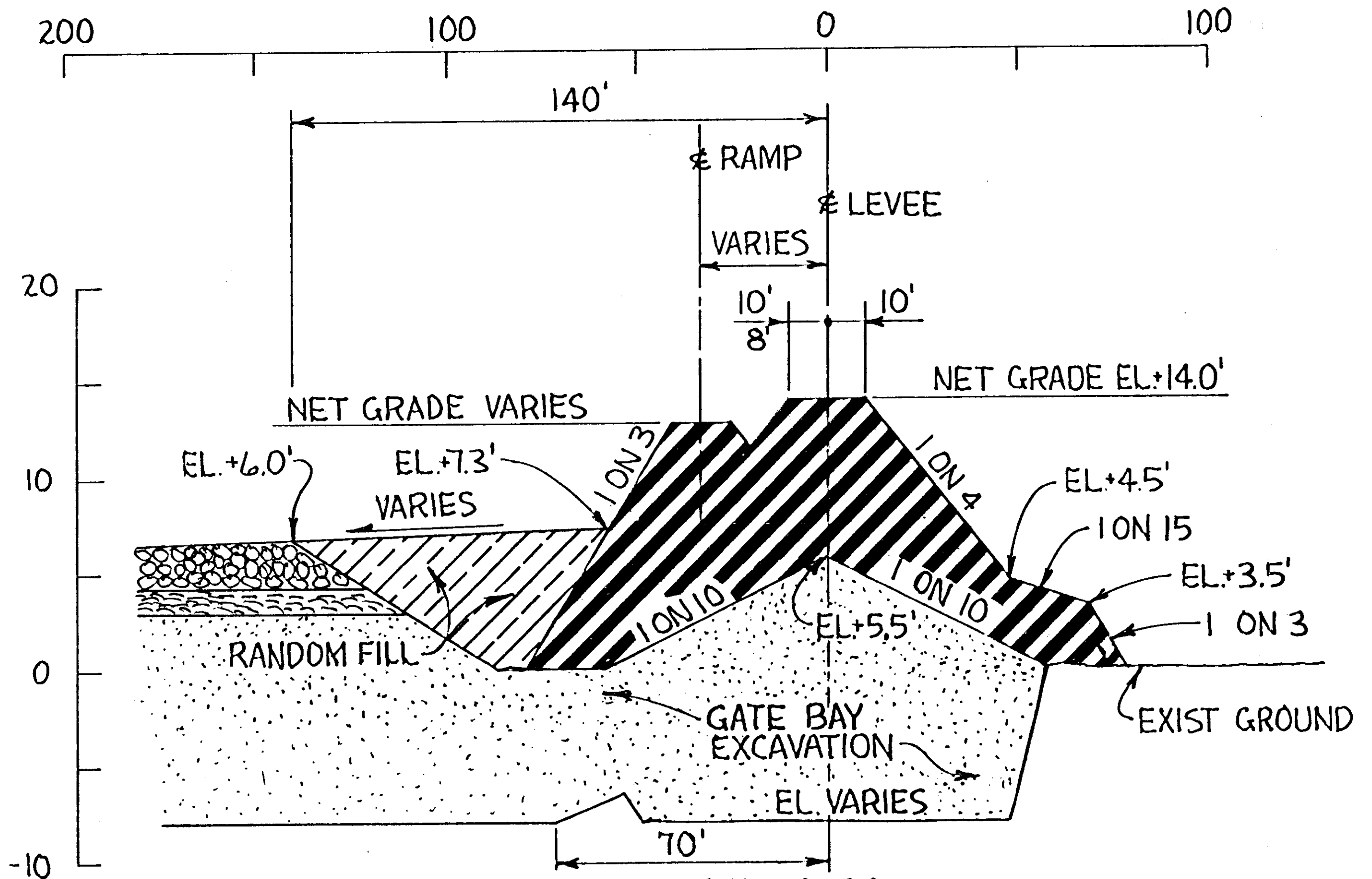
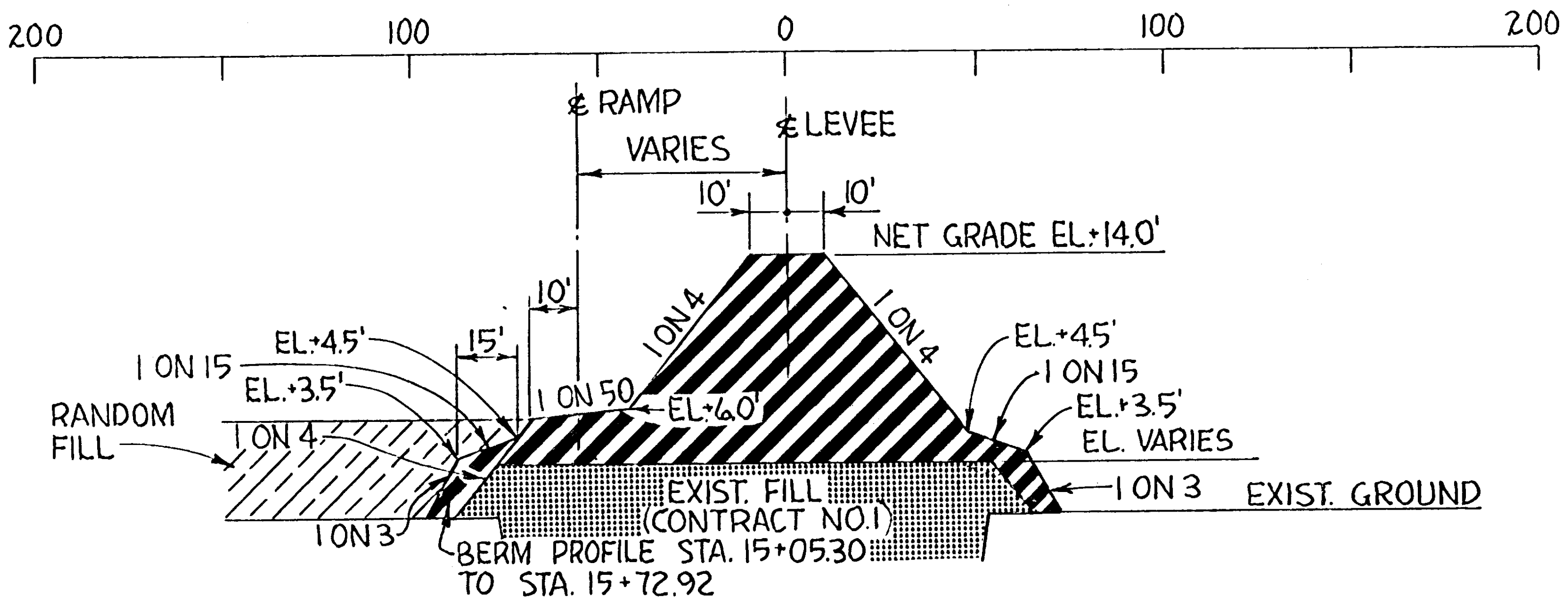


STATION 15+72.92 TO STATION 17+30



STATION 9+00



STATION 15+10

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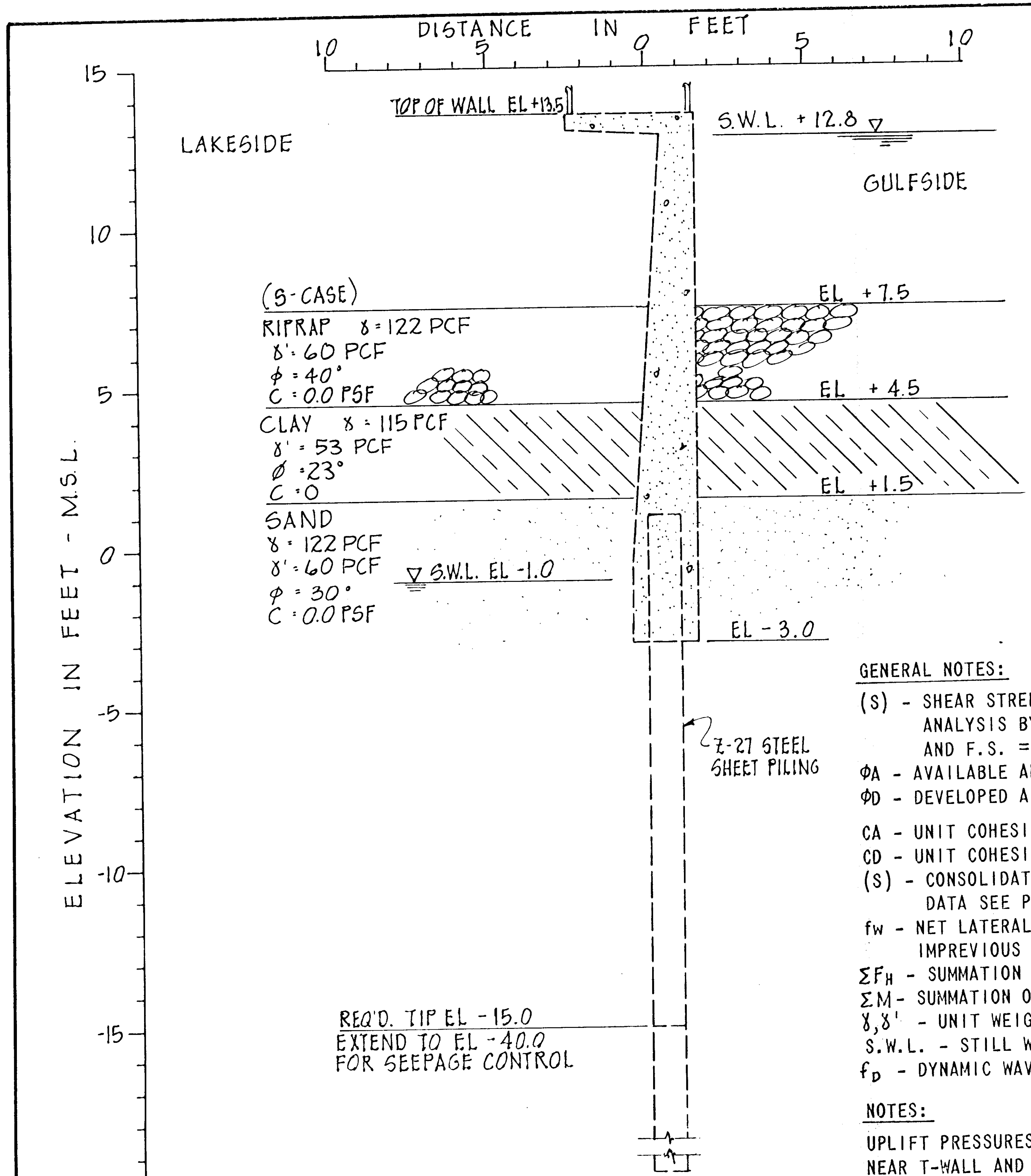
CONNECTION LEVEE SECTIONS

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

DATE: SEPT., 1973
FILE NO. H-2-24419



(S) CASE F.S. = 1.25
WITH WAVE

GENERAL NOTES:

(S) - SHEAR STRENGTH CASE GOVERNED FOR DESIGN. STABILITY ANALYSIS BY THE METHOD OF PLANES WITH SURFACES 45± $\frac{\phi d}{2}$ AND F.S. = 1.25 APPLIED TO SHEAR STRENGTH OF THE SOIL.

ΦA - AVAILABLE ANGLE OF INTERNAL FRICTION IN DEGREES.

ΦD - DEVELOPED ANGLE OF INTERNAL FRICTION = $\tan^{-1}\left(\frac{\tan \phi A}{F.S.}\right)$

CA - UNIT COHESION AVAILABLE.

CD - UNIT COHESION DEVELOPED = CA ÷ F.S.

(S) - CONSOLIDATED-DRAINED SHEAR STRENGTH OF SOIL. FOR UNDISTURBED SHEAR TEST DATA SEE PLATES.

fw - NET LATERAL WATER PRESSURE (WATER PRESSURE FROM WAVES EFFECTIVE TO TOP OF IMPREVIOUS CLAY LAYER).

ΣF_H - SUMMATION OF HORIZONTAL FORCES.

ΣM - SUMMATION OF MOMENTS ABOUT THE SHEET PILE TIP.

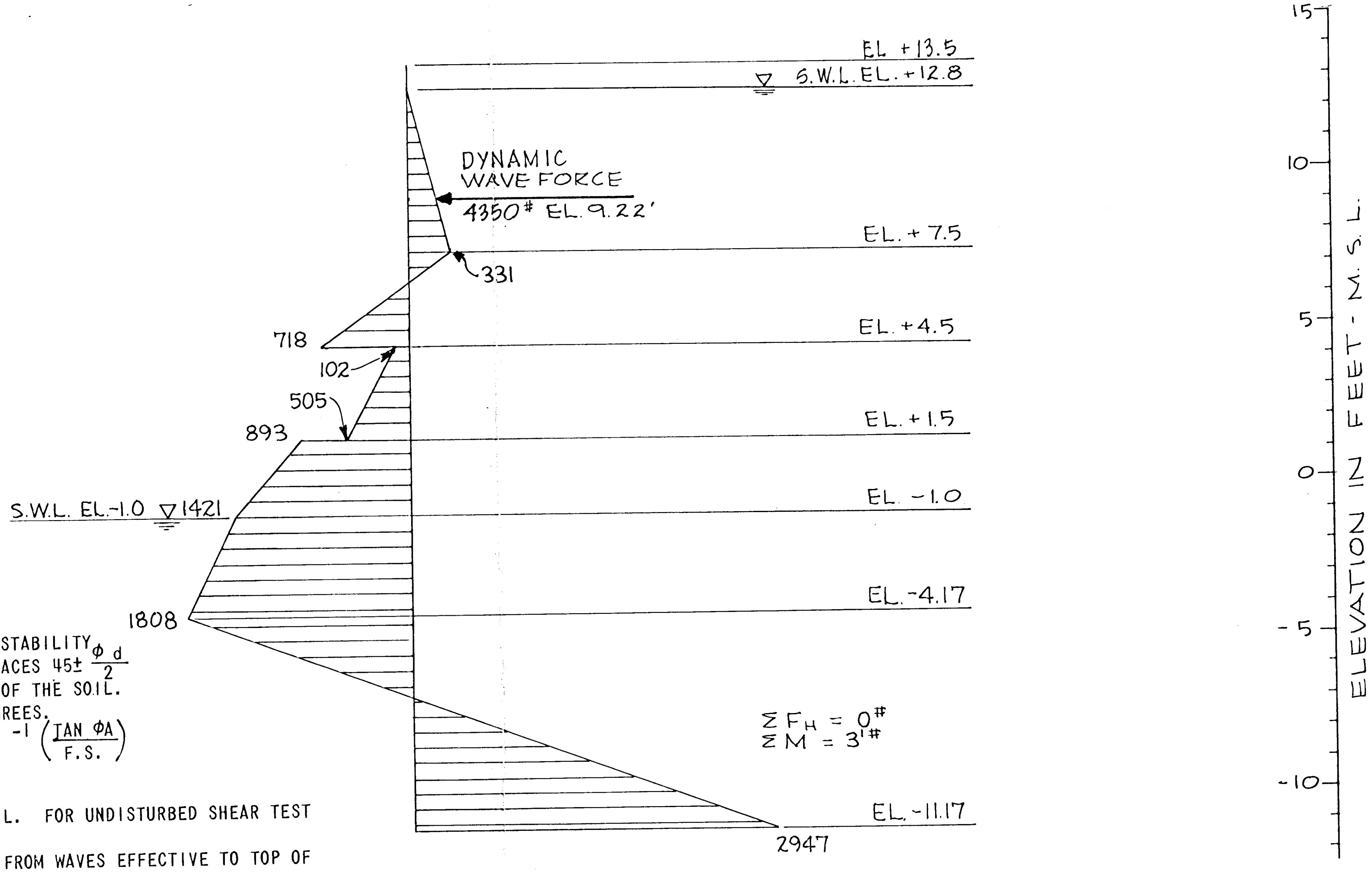
γ, γ' - UNIT WEIGHTS P.C.F.

S.W.L. - STILL WATER LEVEL.

f_D - DYNAMIC WAVE FORCE, EFFECTIVE TO TOP OF IMPERVIOUS CLAY LAYER.

NOTES:

UPLIFT PRESSURES DEVELOPED IN SAND ON THE PROTECTED SIDE WILL BE RELIEVED THROUGH SAND NEAR T-WALL AND FLAT AREA OF CHAMBER SIDE LEVEE.



NET PRESSURE DIAGRAM
S - CASE
F.S = 1.25
LOADING I+II
SCALE: HORIZ. 1" = 1000 PSF
VERT. 1" = 4'

A JOINT VENTURE

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GULFSIDE FLOODWALL
I - WALL STABILITY (S)

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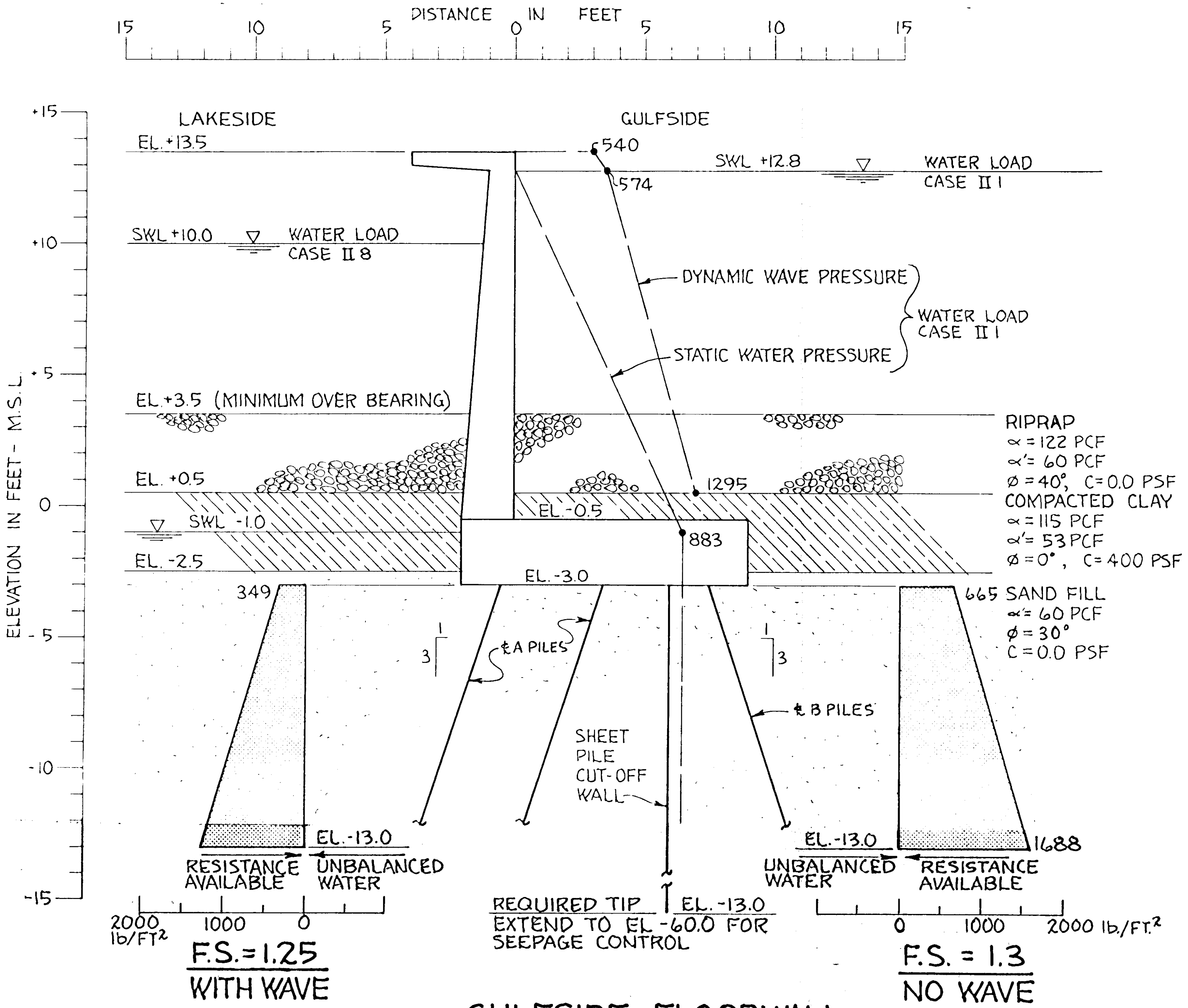
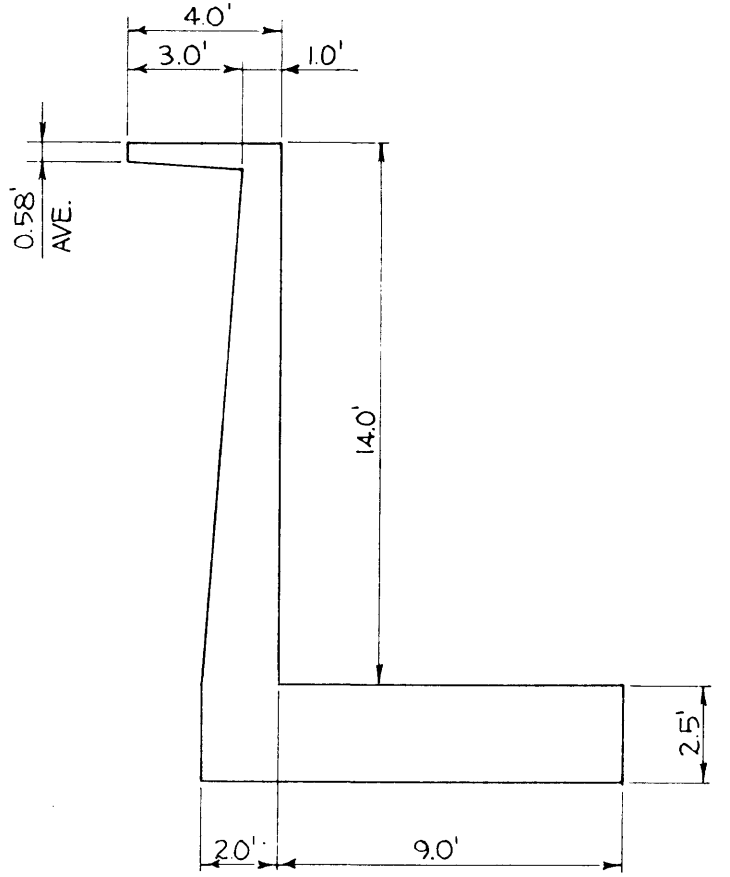
DATE: SEPT., 1973
FILE NO H-2-24419



GULFSIDE FLOODWALL

T-WALL SHEET PILE CUT-OFF ANALYSIS



DIMENSIONAL SECTION

PILE LOAD SUMMARY

CASE	PILE A		PILE B	
	MAX (K)	MIN (K)	MAX (K)	MIN (K)
I + II 1	- 59.0	- 54.7	+ 126.9	+ 61.5
I + II 7	+ 45.4	+ 41.1	- 11.5	- 5.2

NOTES: RESISTANCE DUE TO BEARING PILES SUPPORTING T-WALL WAS NEGLECTED.

AVAILABLE RESISTANCE SHOWN IS THAT IN EXCESS OF THE RESISTANCE DEVELOPED TO BALANCE THE WATERLOAD.

THE FACTOR OF SAFETY OF 1.25 AND 1.30 WERE INCORPORATED INTO THE UNBALANCED WATER ANALYSIS.

UNBALANCED WATER ANALYSIS INDICATE NO UNBALANCED WATER LOAD TO BE TRANSFERED TO THE BEARING PILES

A JOINT VENTURE

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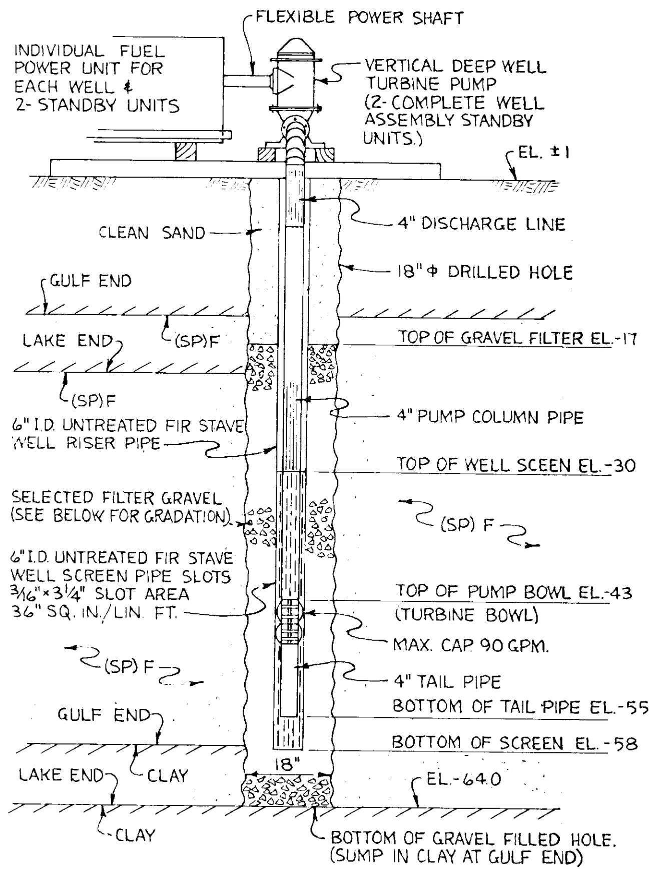
RIGOLETS LOCK

T-WALL FLOODWALL
UNBALANCED WATER ANALYSIS

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

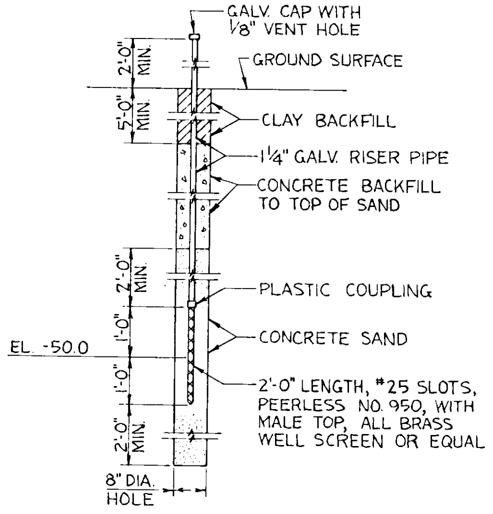
DATE: SEPT., 1973
FILE NO. H-2-24419



HYDROSTATIC PRESSURE RELIEF WELL

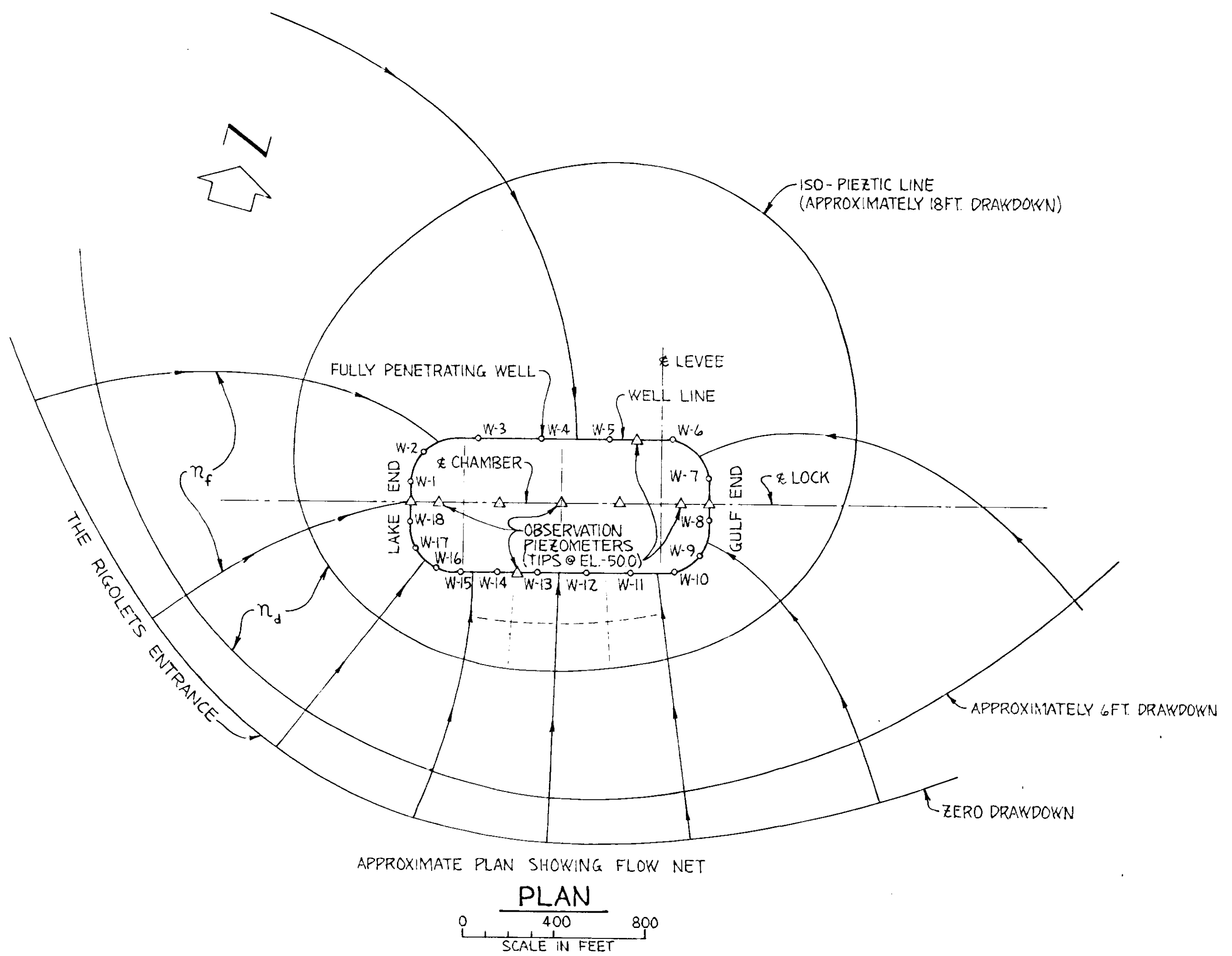
FILTER GRAVEL

SIEVE	% BY WT. PASSING
3/4 IN.	100
3/8 IN.	85-100
NO. 4	65-90
NO. 8	40-73
NO. 16	20-40
NO. 30	8-18
NO. 50	0-5
NO. 100	0



OBSERVATION PIEZOMETER DETAIL

NO SCALE



APPROXIMATE PLAN SHOWING FLOW NET

PLAN

$\eta_f / \eta_d = \frac{9}{2.25} = 4$

$K_h = 0.0215'/\text{MIN.}$, $D = 41'$,

$H\text{-}hc = 69-33 = 36' =$ EL. -30 (STAGE +6)

$Q_t = KD\frac{\eta_f}{\eta_d}(H\text{-}hc) = 127\ \text{cfm} \times 7.5 = 952$ G.P.M.

η = NUMBER OF WELLS $= \frac{Q_t}{Q_w} = \frac{952}{60} = 16$

GIVEN: A = 571', R (FROM NET) = 2,758'

R' FROM PUMP TEST: (H-hw) FOR $Q_w = 60$

$= \frac{60}{39} \times 7.5' = 11.69'$

$\text{IN}\ \frac{R'}{r_w} = \frac{2\pi KD(H\text{-}hw)}{Q_w} = \frac{5.4036 \times 11.69}{8.0}$

R' = 2,015 FT.

ARTESIAN FLOW

R (FROM NET) = 2,758', R (FOR SINGLE WELL, $Q_w = 60$ GPM) = 2,015' (P. TEST)

R (FROM CTR. OF EQUIVALENT CIRCLE, A = 571') = 2,015' + 571' = 2,586'

AVERAGE R = 1/2 (2758 + 2586) = <u>2,672'</u> (USE THIS VALUE)

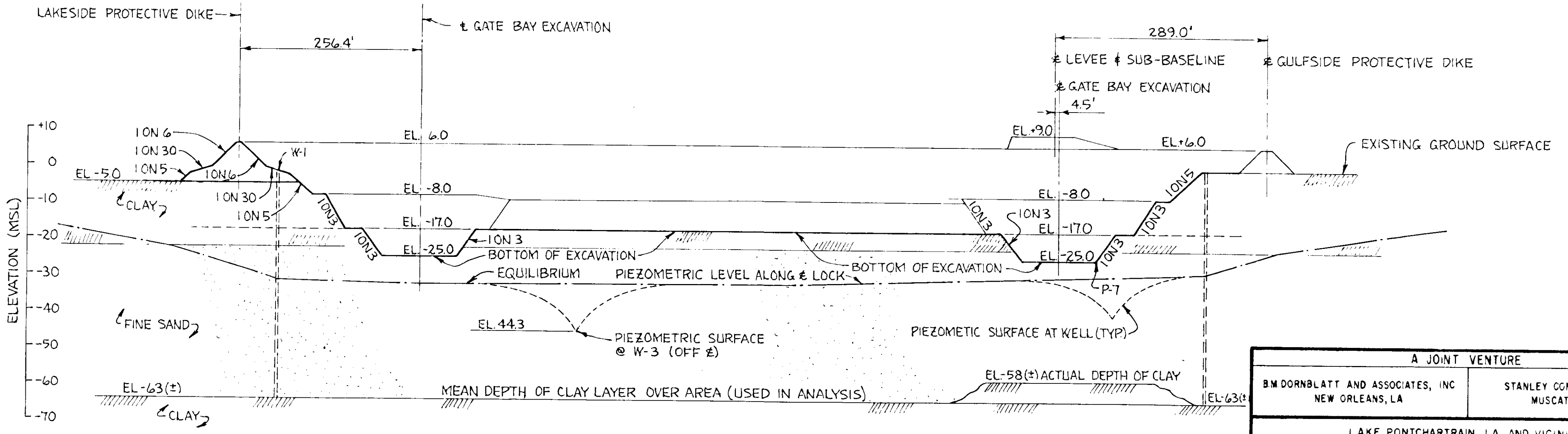
(EQ. 3-77 & 3-88) $\eta = \frac{2\pi KD(H\text{-}hc)}{Q_w \ln R/A} = \frac{199.4}{8 \times 1.543} = \frac{199.4}{12.34} = 16.2$ WELLS

(EQ. 3-79a & 3-87) $(H\text{-}hw) = \frac{Q_w[\eta \ln R/A + \ln A/\eta r_w]}{2\pi KD} = 1.444(24.69 + 3.86)$

hw = 69.0' - 41.0' = 28' = EL. -35.0 < -40.0 (O.K.)

16.2 × 1.2 = 19.4 WELLS, USE 18 SPACED AS SHOWN SINCE ONLY 14 WELLS (~75% OF 18-WELL SYSTEM) ARE REQUIRED UNDER NORMAL STAGES.

NOTE: PROCEDURE FROM CHAPTER NO. 3 "DEWATERING" FOUNDATION ENGINEERING TEXT, LEONARDS EDITOR. AUTHORS - MANSUR AND KAUTMAN.



PIEZOMETRIC PROFILE - ℄ LOCK

(EQUILIBRIUM DISCHARGE FROM 18 WELLS)
(EACH PUMPED AT ABOUT 64 GPM)

0 20 40
VERT. SCALE IN FEET

0 100 200
HORIZ. SCALE IN FEET

A JOINT VENTURE

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DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DEWATERING SYSTEM

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

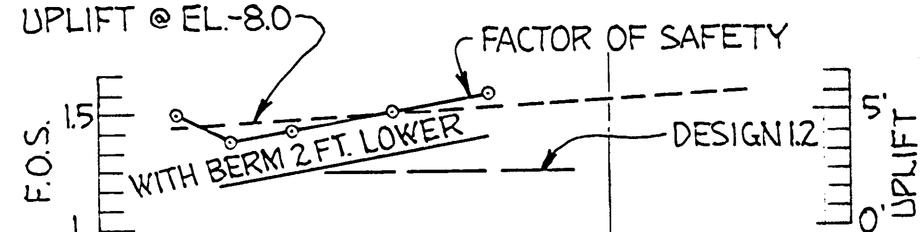
DATE SEPT., 1973
FILE NO. H-2-24419

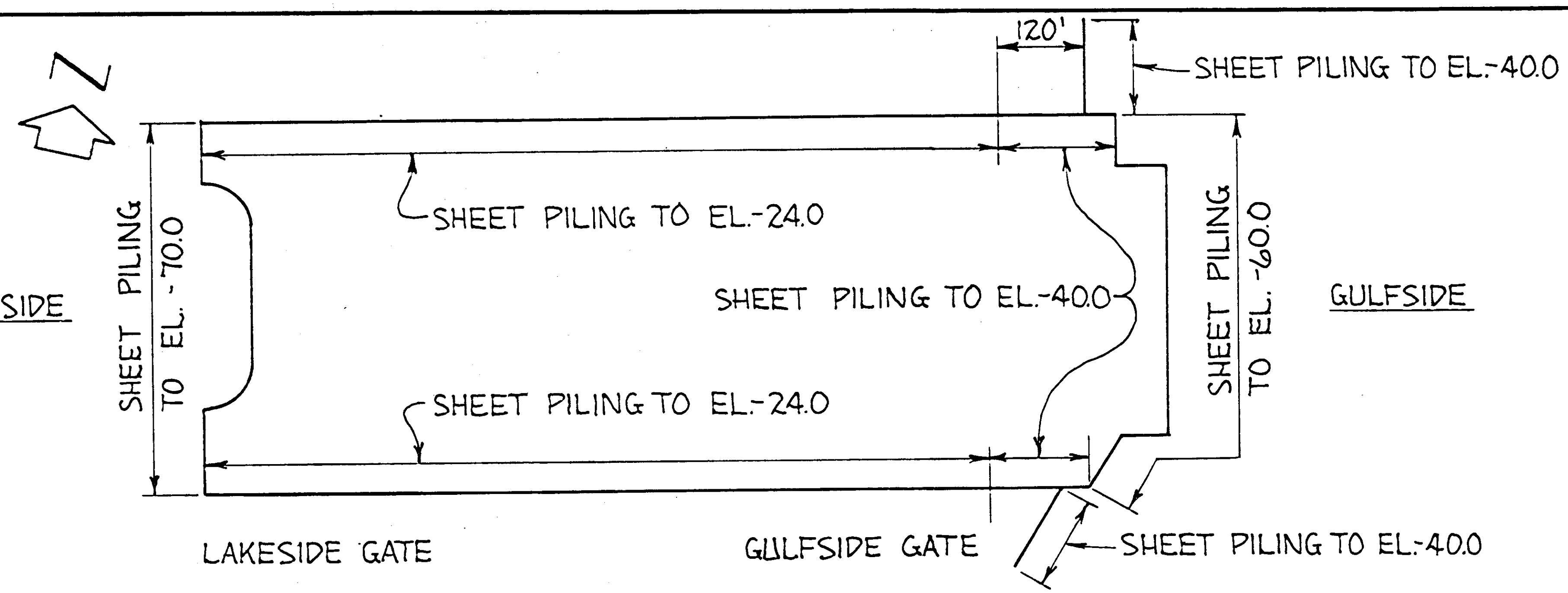
PLATE III 25

$\eta_f/\eta_d = 3/6 = 1/2$, $K_h/K_v = 4$, $10/6 = 1.67'/\text{DROP}$, $K' = 0.01$ F.P.M.

$q_t = K'h_t(\eta_f/\eta_d) = 0.01 \times 10 \times 0.5 = 0.05$ C.F.M. = 0.375 G.P.M./FT.

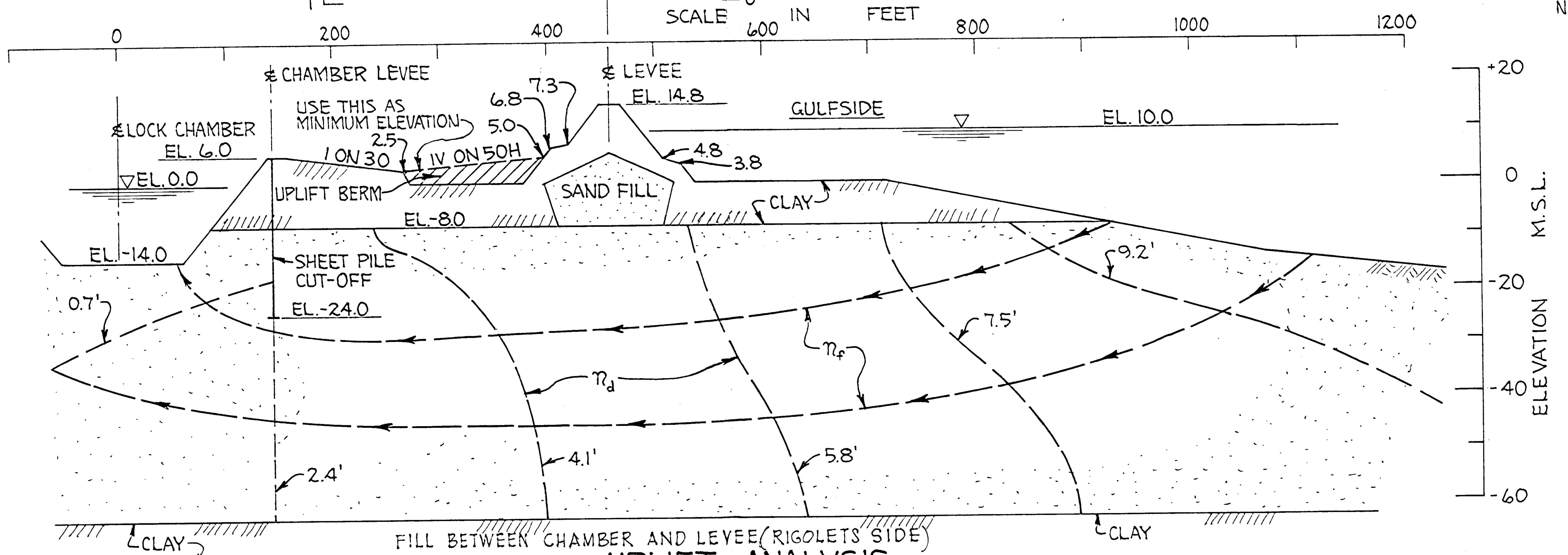
(LESS THAN OTHER SEEPAGE INFLOW ANALYSIS, O.K.)



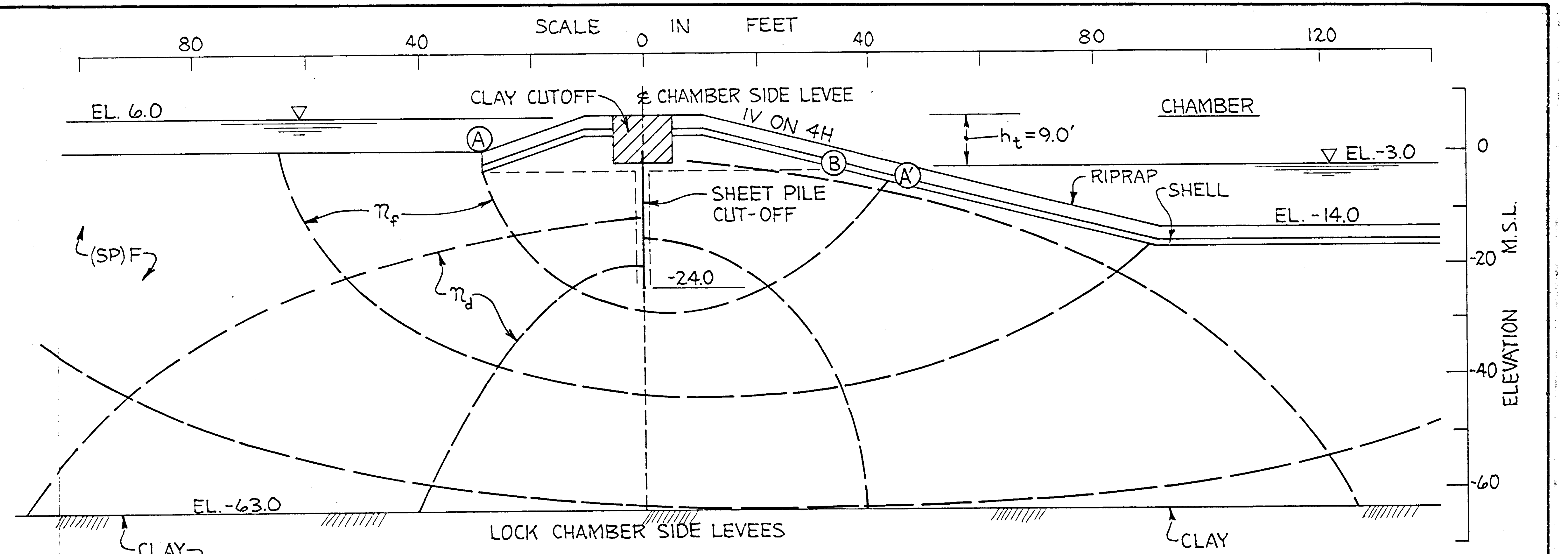


PLAN OF LOCK SHOWING SHEET PILE CUTOFF DEPTHS

NO SCALE



UPLIFT ANALYSIS



SEEPAGE INFLOW ESTIMATE

GIVEN: $K_H/K_V = 4$, TRANS. FACTOR $= \sqrt{1/4} = 1/2$

$K_H = 0.0215$ FPM., $K' = \sqrt{K_H \times K_V} = 0.01$ FPM.

$\eta_f/\eta_d = 3/5 = 0.6$, $h_t = 9.0$ FT.

INFLOW: $q_t = K'h_t(\eta_f/\eta_d) = 0.01 \times 9 \times 0.6 = 0.054$ CFM.

$q_t = 0.054 \times 7.5 = 0.4$ GPM./LIN. FT. LEVEE

Q_t (CHAMBER SIDES) $= 2 \times 800' \times 0.4 = 640$ GPM.
SAND IS CUT-OFF BENEATH GATES, TOTAL
INFLOW~ 640 GPM. (NEGLIGIBLE, CUTOFF TO -24 O.K.)

CHECK PATH	CREEP W.C.R
A - A'	10.0
A - B	7.0 (O.K.)

BY NET: EXIT GRADIENT~0.1 (O.K.)
(DISREGARDING SHELL BLANKET)

A JOINT VENTURE

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NEW ORLEANS, LA.

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

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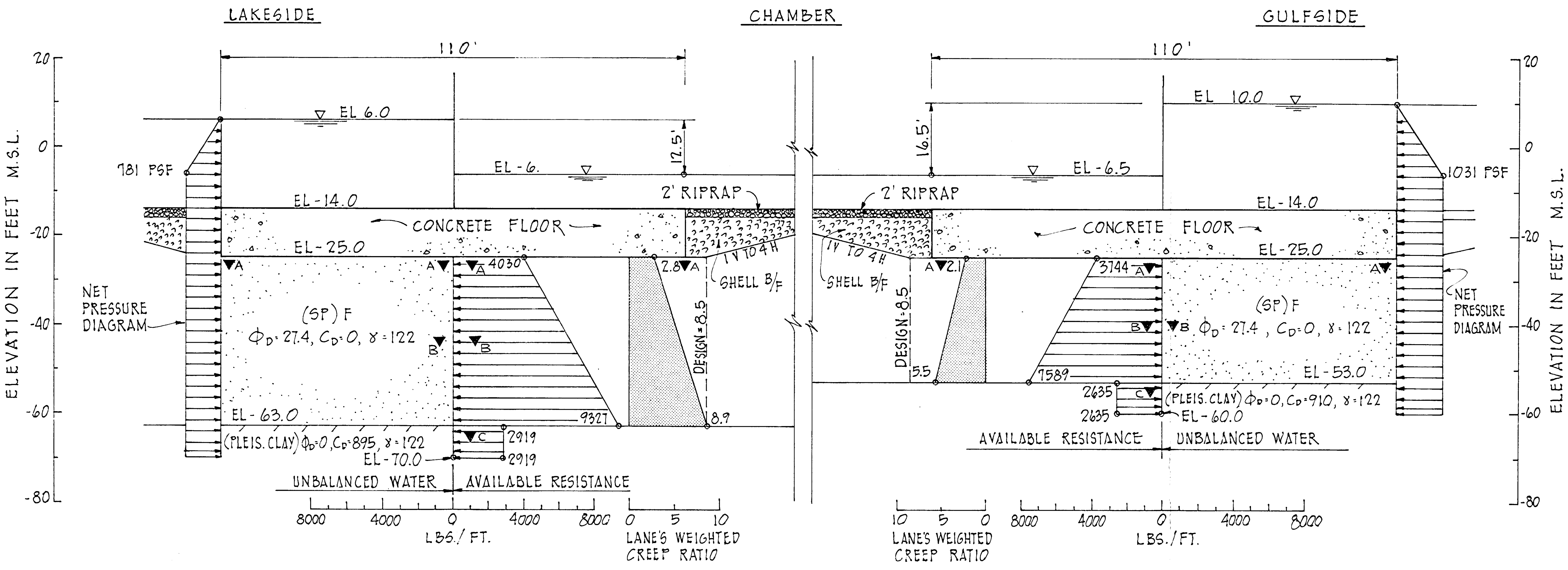
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

SEEPAGE ANALYSIS

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

DATE: SEPT., 1973
FILE NO. H-2-24419



LAKESIDE GATE
UNBALANCED WATER ANALYSIS
&
LANE'S WEIGHTED CREEP RATIO ANALYSIS

GULFSIDE GATE
UNBALANCED WATER ANALYSIS
&
LANE'S WEIGHTED CREEP RATIO ANALYSIS

A- PIEZOMETERS	2 FT. BENEATH SLAB EL- 27.0		
B- PIEZOMETERS	CENTER OF SAND STRATUM	EL.- 44.0	(LAKESIDE GATE)
		EL.- 39.0	(GULFSIDE GATE)
C- PIEZOMETERS	3. FT. INTO CLAY STRATUM	EL.- 66.0	(LAKESIDE GATE)
		EL.- 56.0	(GULFSIDE GATE)

NOTES:

UNBALANCED WATER ANALYSIS INDICATES NO UNBALANCED WATER LOAD TO BE TRANSFERED TO BEARING PILES.

A FACTOR OF SAFETY OF 1.30 WAS INCORPORATEDINTO THE SOIL PARAMETERS FOR THE UNBALANCED WATER ANALYSIS.

DUE TO LOW CREEP RATIO VALUES SHEET PILE CUTOFF IS EXTENDED TO EL. - 70.0 AT THE LAKESIDE GATE AND - 60.0 AT THE GULFSIDE GATE IN ORDER TO CUTOFF (SP)F STRATUM. SEE PLAN ON PLATE III-26 FOR SHEET PILE LOCATION.

A JOINT VENTURE

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RIGOLETS LOCK

GATE BAY SEEPAGE
AND UNBALANCED WATER ANALYSIS

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

DATE: SEPT., 1973
FILE NO H-2-24419

SECTION V - MECHANICAL DESIGN

GATE OPERATING MACHINERY

1. General. The gate operating machinery will consist of an electric motor-driven, positive displacement, variable delivery, multiple radial piston type pump with electric remote five position control, a hydraulic motor, parallel shaft speed reducer, an angle drive unit, limit switches, electric brake, valves, piping, and accessories.

2. Arrangement. The hydraulic pumping unit, consisting of a reservoir with electric motor, hydraulic pump and valves mounted thereon, will be installed on the operating floor (el. 19.5) of the control house. The small emergency hydraulic pumping unit also will be installed on the operating floor (el. 19.5). The hydraulic motor, the speed reducer, the electric brake, and the limit switch will be mounted in the water-tight compartment below the operating floor. The angle drive unit will be mounted in a recess so that the final or idler gear can mesh with the rack on the sector gate.

3. Description of the hydraulic circuit.

a. A schematic diagram of the hydraulic circuit is shown on plate V-6. An itemized list of equipment in the hydraulic circuit is shown on plate V-7.

b. Following is a description of the main features in the circuit with reference to items of equipment as identified by item number in the itemized list of equipment.

(1) Item A2. A closed loop hydraulic circuit will be used which will automatically provide dynamic braking if the load should try to drive through the hydraulic motor. The dynamic braking characteristic requires the hydraulic motor and pump to be fully capable of developing full pressure at both ports.

(2) Item A2a. High pressure relief valves are designed into the circuit with their exhaust connected to the opposite port of the pump. This type of circuiting will prevent the pump from cavitating if a high load condition should develop. These are integrally mounted in the pump housing.

(3) Item A2-1. A pressure compensating device is included that will adjust pump stroke setting as pressure changes so that the drive will maintain a relatively constant speed setting

and will not stall when being used in the slow modes. This item is integrally mounted to the pump. This control is designed to operate on the force amplifier signal spool, and consequently requires very low force.

(4) Item A2-2. Pump is equipped with a volume control that offers a neutral position and four different adjustable speed settings. It is integrally mounted to the pump housing. The control is designed to operate with large areas so that only 125 psi pilot pressure is required.

(5) Item A2-3. Three disc type super-charge valves are provided to control pump back pressure. Each check valve is capable of full-flow capacity with only atmospheric pressure assistance to protect the pump from cavitation should a break in the line occur. These check valves are provided in single assembly integrally mounted to the pump body.

(6) Item A2-4. Adjustable flow controls are included to separately control acceleration and deceleration with a solenoid selector also included which will give a fast deceleration for an emergency stop. This item is integrally mounted to the pump.

(7) Items A2-5 and A2-6. The pump and relief valve are provided to furnish a pilot pressure source for the control and directional valve, and also to furnish a replenishing supply. The pump and relief valve are integrally designed into the pump housing. An automatic bleed off device is included to bleed a small quantity of oil from the low pressure side of the hydraulic loop. This device is included to promote cooling and cleaning of the oil without excessive power or performance loss regardless to which side of the loop the pressure is being developed.

(8) Item A3. Ports are provided on pump (A2-5) so that the entire gear pump volume may be removed from the pump and directed through a filter and then directed back into the sump before the oil flow goes into the back pressure or replenishing area. This provides for the filtering of the entire auxiliary pump flow continuously while the electric motor is running, regardless of the drive speed setting.

(9) Item A4. This 4-way directional control valve has integrally mounted check valves to control the plunger shifting speeds in each direction.

(10) Item A5. High pressure relief valves are included in the circuit with their exhaust connected to the opposite port of the hydraulic motor. This type of circuiting will prevent the hydraulic motor from cavitating if a high load condition should develop.

(11) Item 7-2. This small electric motor driven pump and directional valve is added to the circuit to provide a means of operating the hydraulic motor in both clockwise and counterclockwise directions at slow speed when the large pump (A2-5) is inoperable.

(12) Item B. This hydraulic motor is equipped with an integrally mounted bleed-off valve which will bleed a small volume of oil from the low pressure side only. When dynamic braking is required, the high pressure transfers from one port to another and the bleed-off location likewise changes so that the high pressure will not be exposed to the bleed-off orifice and cause a reduction in performance and creation of excess heat. The bleed-off oil is directed through the motor bearings and case via an internal passage to promote good lubrication and cooling.

4. Description of gear train powered from hydraulic motor drive. This portion of the gate operating machinery is shown on plate V-4.

a. A speed reducer is connected to the hydraulic motor through a flexible coupling.

b. An electric operated brake is provided on the extended output shaft of the speed reducer. It will be enclosed in a water-tight housing.

c. A limit switch of the traveling nut type with sufficient switch elements to control high and low speed and stop functions will be provided. The limit switch enclosure will be water-tight.

d. An angle drive unit is connected to the output shaft of the speed reducer through a flexible coupling. The angle drive consists of a bevel pinion and gear with a spur gear on the bevel-gear shaft and an idler gear to transmit the force to the rack on the sector gate. Due to the possibility of flooding by hurricane tides, all bearings will be of the bronze sleeve type and will be pressure lubricated by grease. A fabricated steel housing will be provided.

5. Limit Switch and Drive. The limit switch will be of the traveling nut type totally enclosed in a water-tight case. The limit switch will be driven from the low speed shaft (output) of the speed reducer by a pair of sprockets and a chain. The limit switch selected is a Westinghouse type TN traveling nut having 80 turns on the driving shaft with maximum travel of 20 inches. All switches, except switch Nos. 1 and 6 shown on plate II-8 will be mounted in the switch box. Switch Nos. 1 and 6 will be a special switch mounted on the chamber wall and actuated by an actuator on the gate rack.

a. The low speed shaft or output shaft of the speed reducer makes 17.78 turns to open or close the gate. Using an 80 turn switch the ratio required is 80/17.78 or 4.499/1 for the drive. The sprocket on the low speed shaft of the speed reducer will have 84 teeth and the drive sprocket on the limit switch shaft will have 19 teeth. This gives a ratio of $\frac{84}{19} = \frac{4.421}{1}$.

b. The 84 tooth sprocket must be specially fabricated to fit on a 6 1/2 inch diameter shaft. Outside diameter of a commercial 84 tooth sprocket using 5/8" pitch single strand roller chain is 17.079 inches. The 19 tooth sprocket is 4.120 inches in diameter. The small sprocket will be made of high carbon steel and teeth will be induction or flame hardened. The large sprocket will be made of carburized medium carbon steel and teeth will be hardened.

c. The large sprocket will be similar to Morse Roller chain sprockets Type A and the small sprocket will be similar to Morse Roller chain sprockets Type B.

d. The roller chain will be similar to Morse Sintered Bushing Chain No. 50 SB single strand 5/8" pitch-riveted type. Rating of this chain is in excess of 1/2 hp.

e. An adjustable chain tightener will be provided.

6. Computations. The basic assumptions, design criteria, allowable stresses and computations for the gear train are contained in figure V-1 through figure V-82.

7. Plates. Plates V-3, V-4, V-5, V-6, and V-7 show the sector gate machinery operating loads, loading conditions, the operating machinery, and the hydraulic circuit schematic diagram and equipment list.

UTILITIES

8. Fire protection. Two 100 gpm electric motor-driven fire pumps will be provided. One fire pump will be installed on the north side of the lock and the other fire pump will be installed on the south side of the lock near the west gate bay. Hose reels will be located as shown on plates V-1 and V-2. Each hose reel will be provided with an Elkhart No. UP20 pressure regulating angle valve and an Elkhart No. L-206 combination fog and straight stream nozzle. Each hose reel will be a Hannay Series 7500 with Type FH-3 roller and spool assembly. Hand extinguishers (CO_2) will be provided in the powerhouse and gate control houses.

9. Potable water. A well will be drilled to the sand strata located between 340 to 590 feet. A well capable of producing between 10 to 15 gpm should be adequate. The water storage tank will be located in the powerhouse. Proposed location of the well is shown on plate V-1.

10. Sewerage system. Sewage from the powerhouse and future visitor's restrooms will be pumped from an underground lift station to a package treatment unit. Discharge of treated sewage will be on the gulf side of the lock. Treatment of the effluent will be provided by a flow-through chlorination unit with soluble disinfecting tablets. Proposed locations of the lift station and treatment unit together with capacities and other design data are shown on plates V-1 and V-2.

11. Diesel generating unit. The diesel generating unit is rated 135-150 Kw at 0.8 power factor and 1800 rpm. Generator voltage will be 480 a-c, 60 hertz, 3 phase, 3 wire. The generating unit with its accessories will be factory assembled, wired and piped, and mounted on a common structural steel base ready for installation on block-type concrete foundation using vibration isolators.

a. Engine will be six cylinder, four stroke cycle, turbocharged capable of operation on No. 2 diesel fuel oil, with the following accessories.

fuel oil filters
fuel oil supply pump
fuel oil strainer
jacket water pump
lubricating oil cooler
radiator
air intake filter
exhaust muffler
lube oil filter
battery starting system
hydraulic isochronous governor
necessary gages
protective devices

b. Generator and exciter will be direct connected to engine shaft. Exciter will be of the solid state static type with regulation system.

c. Special equipment accessories will include a control panel with instrumentation, a battery charger, and a fuel oil day tank of approximately 30 gallons which will serve as a supply tank for the engine driven supply pump and to receive all fuel oil returns from the engine.

12. Diesel generating unit fuel oil storage tank. A horizontal underground fuel oil storage tank (3'-6" diameter x 15'-6" long) having a nominal capacity of 1,100 gallons will be provided. A submersible fuel oil transfer pump having a capacity of approximately 10 gpm will be provided to transfer fuel oil from the storage tank to the diesel generating unit fuel oil day tank which will be located adjacent to the diesel engine. The tank will be constructed of fiberglass reinforced plastic. Location is shown on plate V-1.

SECTOR GATE DESIGN DATA

General

The design of the sector gate operating machinery has been based on the dead load friction moments, and hydraulic moments imposed on the gates under the various operating conditions. These conditions are tabularized on Plate V-3 .

Hydraulic Conditions

In order to determine the load and horsepower requirements for the operating machinery, it will be necessary to calculate the gate loadings under each of the varying conditions of differential head and operating speed.

Allowable Stresses

All components of the operating machinery which are stressed in proportion to the torque developed by the hydraulic motor have been proportioned so that the stresses will not exceed 75% of the yield point of the material under stalling torque conditions of the hydraulic motor.

Figure V-1

OPERATING MACHINERY CAPACITY

General

The force required on the rack to move the sector gate will be determined by the summation of the following moments imposed on the gate under the various operating conditions:

1. Dead load friction moments, multiplied by a factor of 4. 5, as specified by the Corps of Engineers miscellaneous paper H-71-4, Para. 14.
2. Friction moments due to hydraulic loads acting on the sector date. (Data from Sector Gate Design Computations.)
3. Seal friction moment due to hydraulic head - forward head only.
4. Hydraulic moment, T_a, acting on sector gate. (Data from Sector Gate Design Computations.)

Design Data and Assumptions

Weight of each sector gate - 288. 8 kips

Radius centerline pintle to centerline of seal surface - 60. 98'

Radius centerline pintle to pitch line rack 736. 967" = 61. 414'

Length of seal surface - 73. 13'

Dia. hinge pin - 20"

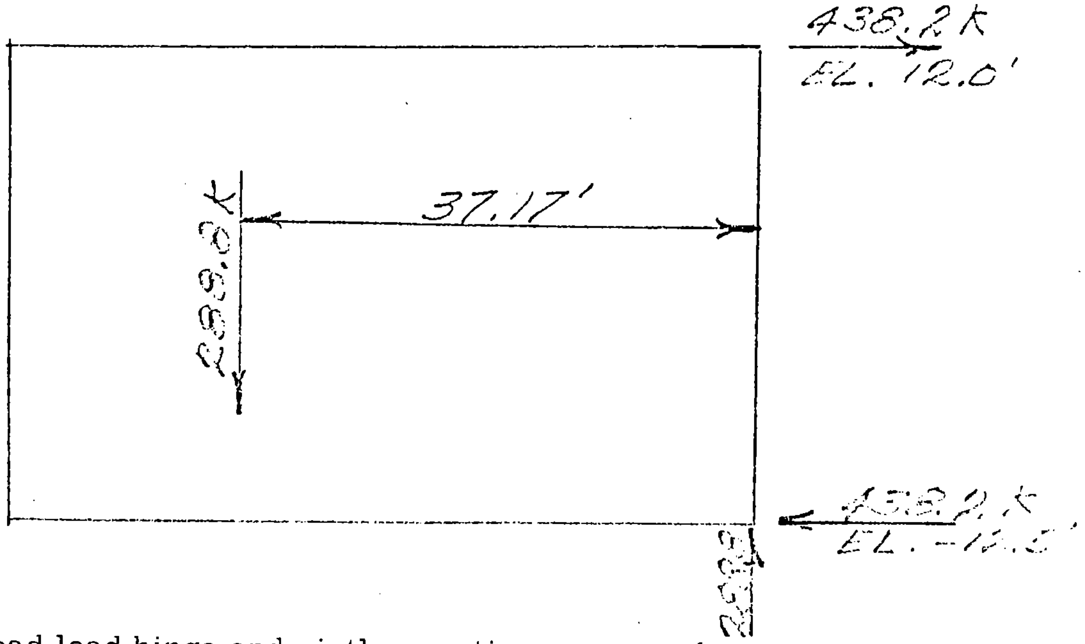
Dia. pintle ball - 27"

Figure V-2

Assume weight of sector gate acting at 2/3 pintle ball radius = 9"

Assume a coefficient of friction for the pintle and hinge of 0.25 and 1.0 for the seal.

Friction Moment Imposed Due to Dead Load



The dead load hinge and pintle reactions are as shown in the above sketch (from gate design calculations).

Hinge moment = load x coefficient of friction x radius of pin

$$= \frac{438.2 \times 0.25 \times 10}{12} = 91.29 \text{ K ft.}$$

Pintle moment due to horizontal load = load x coefficient of friction x radius of pintle ball

$$= \frac{438.2 \times 0.25 \times 13.5}{12} = 123.24 \text{ K ft.}$$

Figure V-3

Pintle moment due to vertical load = load x coefficient of friction x 2/3 pintle radius

$$= \frac{288.8 \times 0.25 \times 9}{12} = 54.15 \text{ K ft.}$$

Total dead load moment = 91.29 + 123.24 + 54.15

M_d = 268.68 K ft.

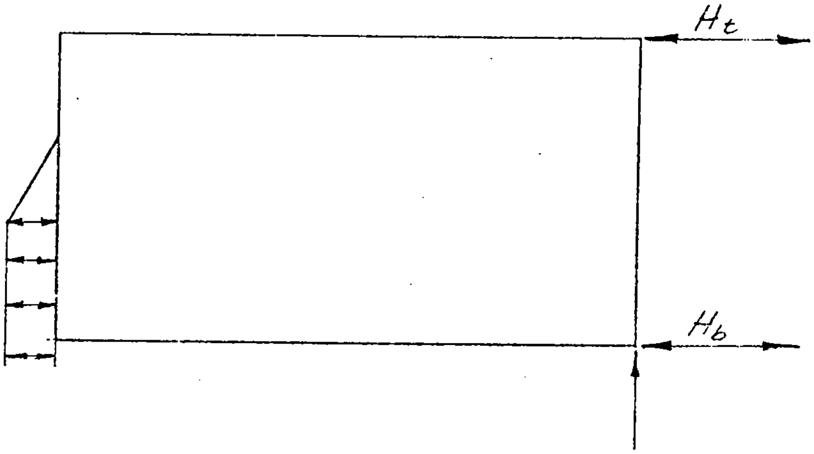
Total dead load friction moment multiplied by 4.5 factor (Section I)

= 268.68 x 4.5 = 1209.06 K ft.

Figure V-4

Calculation of Hydraulic Forces Imposed

Horizontal hydraulic forces H_t and H_b acting on the hinge and pintle are computed with the maximum water surface at elevation 4.0, except the 9 foot differential head which assumes the maximum water surface at elevation 6.0. Water load is applied between the center vertical seal and the recess vertical seal angle. An effective chord length of 68.57 feet is used.



Compute H_t and H_b for 2.0 foot differential head (0.1 rpm gate operating speed); computations for the other differential heads are computed in the same manner and shown in table V-1.

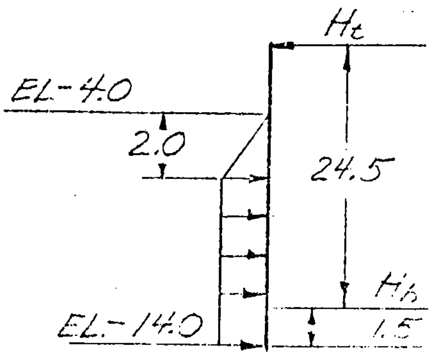


Figure V-5

$$H_t = \left[\frac{2(64)\,(2)\,(15.17)}{(2)\,(24.5)} + \frac{2(64)\,(16)\,(6.5)}{(24.5)} \right] \times \frac{68.57}{1000} = 42.7^k$$

$$H_b = \left[\frac{2(64)\,(2)\,(9.33)}{(2)\,(24.5)} + \frac{2(64)\,(16)\,(18)}{(24.5)} \right] \times \underline{68.57} = 106.5^k$$

Table V-1

Gate Operating Speed (rpm)	Differential Head (ft)	H_t (k)	H_b (k)
0.002	9	161.1	450.2
0.002	7	107.1	338.3
0.010	4.4	80.4	224.7
0.030	3.1	61.6	162.2
0.100	2.0	42.7	106.5

Hydraulic torques about the centerline of the hinge and pintle are analyzed using the sector gate technical reports referenced below.

References:

1. Technical Report H-70-2, Operating Forces on Sector Gates Under Reverse Heads.
2. Technical Report H-70-2, Operating Forces on Sector Gates Under Reverse Heads, Appendix A: Results of Supplemental Tests.

Compute the hydraulic operating torque, Ta, on the gate leaf due to hydraulic forces producing a closing torque about the vertical centerline of the gate hinge and pintle.

Ta = Computed horizontal hydraulic torque about the vertical centerline of the hinge and pintle (K-ft).

Tr = Horizontal hydraulic torque about the vertical centerline of the hinge and pintle from reference 2. (K-ft)

Ra = Actual radius from vertical centerline of the hinge and pintle to face of skin plate = 60.76 feet.

Rr = Radius from vertical centerline of the hinge and pintle to face of skin plate from reference 2 = 42.03 feet.

Wa = Actual width of vertical skin plate support + vertical truss member + vertical recess seal angle = 8 + 24 + 4.5 = 36.5 inches.

Wr = Width of vertical skin plate support + vertical truss member + vertical recess seal angle from reference 2 = 8 + 18 + 4.5 = 30.5 inches.

For reverse head:

$$Ta = Tr \times \frac{Ra}{Rr} \times \frac{Wa}{Wr} = Tr \times \frac{60.76}{42.03} \times \frac{8 + 24 + 4.5}{8 + 18 + 4.5} = 1.73\ Tr$$

Tr obtained from reference 2, PLATE A4a and A4c.

Figure V-7

Table V-2 Torque For Reverse Head

Gate Operating Speed (rpm)	Lower Pool Depth (ft)**	Differential Head (ft)	Gate Opening (ft)	Tr (k-ft)	Use Ta (k-ft)
0.002	12	9	7	314*	550
	12		5	302	
	12	7	7	250*	440
	12		5	212	
0.010	12	4.4	7	133*	248
			5	143	
0.030	16	3.1	5	128	221
0.100	16	2.0	5	86	149

* Torque from graph A4c; all others from graph A4a.

** Torque computed on the basis of curves for lower pool depth tested which is closest to actual design depth. Relationship for variation in lower pool depth discussed on page A3 of reference 2 was neglected. This results in a variation of between zero to two percent in total gate operating torque.

For normal head:

$$Ta = Tr \times \frac{Ra}{Rr} = Tr \times \frac{60.76}{42.03} = 1.445\ Tr$$

Tr obtained from reference 2, PLATE A6b.

Figure V-8

Table V-3 Torque For Normal Head

Gate Operating Speed (rpm)	Lower Pool Depth (ft)	Differential Head (ft)	Gate Opening (ft)	Tr (k-ft)	Ta (k-ft)
0.002	12	9	5	82	115
	12	7	5	68	98
0.010	12	4.4	5	41	60
0.030	16	3.1	5	27	39
0.100	16	2.0	5	14	20

Figure V-9

Case 1: 2.0' Forward Head

Seal moment M_s = .444 fWHRL

Where: f = coefficient of friction, 1.0
W = width of seal in contact, 0.8125"
H = hydraulic head, feet
R = radius centerline pintle to seal, 60.98'
L = seal length, 73.13'

M_s = .444 x 1.0 x 0.8125 x 2.0 x 60.98 x 73.13 x 12

M_s = 38.61 K ft.

Hinge moment M_h = H_t fR

Where: H_t is abstracted from Table I

f = coefficient of friction, 0.25
R = radius of hinge, 10"

$$M_h = \frac{(-42.7)\ \ 0.25 \times 10}{12} = -8.90 \text{ K ft.}$$

Pintle moment M_p = H_b fR

Where: H_b is abstracted from Table I

f = coefficient of friction, 0.25
R = radius of pintle ball, 13.5"

$$M_p = \frac{106.5 \times 0.25 \times 13.5}{12} = 29.95 \text{ K ft.}$$

Total Moment $M_t = M_d + M_s + M_h + M_p + T_a$

= 1209.06 + 38.61 - 8.90 + 29.95 + 20

M_t = 1288.72 K ft.

Figure V-10

Force on rack tooth = $\frac{1,288,720}{61.414}$ = 20,989 lbs.

Rack HP = $\frac{1,288,720 \times .1}{5252}$ = 24.54 hp

Case 2: 3.1' Forward Head

The seal, hinge, and pintle moments will be calculated as in Case 1, for 3.1' of head differential.

M_s = .444 x 1.0 x 0.8125 x 3.1 x 60.98 x 73.13 x 12 = 59.85 K ft.

M_h = $\frac{(-61.6)\ .25 \times 10}{12}$ = -12.83 K ft.

M_p = $\frac{162.2 \times .25 \times 13.5}{12}$ = 45.62 K ft.

M_t = 1209.06 + 59.85 - 12.83 + 45.62 + 39

M_t = 1340.7 K ft.

Force on rack tooth = $\frac{1,340,700}{61.414}$ = 21,835 lbs.

Rack HP = $\frac{1,340,700 \times .03}{5252}$ = 7.66 hp

Case 3: 4.4' Forward Head

M_s = 84.94 K ft.

M_h = $\frac{(-80.4)\ .25 \times 10}{12}$ = - 16.75 K ft.

M_p = $\frac{224.7 \times .25 \times 13.5}{12}$ = 63.20 K ft.

M_t = 1209.06 + 84.94 - 16.75 + 63.20 + 60

M_t = 1400.45 K ft.

Figure V-11

$$\text{Force on rack tooth} = \frac{1{,}400{,}450}{61.414} = 22{,}796 \text{ lbs.}$$

$$\text{Rack HP} = \frac{1{,}400{,}450 \times .01}{5252} = 2.67 \text{ hp}$$

Case 4: 7.0' Forward Head

$$M_s = 135.14 \text{ K ft.}$$

$$M_h = \frac{(-107.1)\ .25 \times 10}{12} = -\ 22.31 \text{ K ft.}$$

$$M_p = \frac{338.3 \times .25 \times 13.5}{12} = 95.15 \text{ K ft.}$$

$$M_t = 1209.06 + 135.14 - 22.31 + 95.15 + 98$$

$$M_t = 1515.04 \text{ K ft.}$$

$$\text{Force on rack tooth} = \frac{1{,}515{,}400}{61.414} = 24{,}669 \text{ lbs.}$$

$$\text{Rack HP} = \frac{1{,}515{,}040 \times .002}{5252} = 0.58 \text{ hp}$$

Case 5: 9.0' Forward Head

$$M_s = 173.75 \text{ K ft.}$$

$$M_h = \frac{(-161.1)\ 0.25 \times 10}{12} = -\ 33.56 \text{ K ft.}$$

$$M_p = \frac{450.2 \times 0.25 \times 13.5}{12} = 126.62 \text{ K ft.}$$

$$M_t = 1209.06 + 173.75 - 33.56 + 126.62 + 115 = 1590.87 \text{ K ft.}$$

Figure V-12

$$\text{Force on rack tooth} = \frac{1,590,870}{61.414} = 25,906 \text{ lbs.}$$

$$\text{Rack HP} = \frac{1,590,870 \times .002}{5252} = 0.61 \text{ hp}$$

Under reverse head conditions there is no seal friction moment since the hydraulic forces lift the seal from the bottom surface of the gate bay.

The pintle and hinge moments due to hydraulic load have been previously calculated, and change sign, only, for reverse head conditions. T_a for reverse head is taken from Table 1.

Case 6: 2.0' Reverse Head

$$M_t = 1209.06 + 8.90 - 29.95 + 149 = 1337.01 \text{ K ft.}$$

$$\text{Force on rack tooth} = \frac{1,337,010}{61.414} = 21,770 \text{ lbs.}$$

$$\text{Rack HP} = \frac{1,337,010 \times 0.1}{5252} = 25.46 \text{ hp}$$

Case 7: 3.1' Reverse Head

$$M_t = 1209.06 + 12.83 - 45.62 + 221 = 1397.27 \text{ K ft.}$$

$$\text{Force on rack tooth} = \frac{1,397,270}{61.414} = 22,747 \text{ lbs.}$$

$$\text{Rack HP} = \frac{1,397,279 \times .03}{5252} = 7.98 \text{ hp}$$

Case 8: 4'4 Reverse Head

M_t = 1209.06 + 16.75 - 63.20 + 248 = 1410.61 K ft.

Force on rack tooth = $\frac{1,410,610}{61.414}$ = 22,975 lbs.

Rack HP = 2.69 hp

Case 9: 7.0' Reverse Head

M_t = 1209.06 + 22.31 - 95.15 + 440 = 1576.22 K ft.

Force on rack tooth = $\frac{1,576,220}{61.414}$ = 25,662 lbs.

Rack HP = 0.60 hp

Case 10: 9.0' Reverse Head

M_t = 1209.06 + 33.56 - 126.62 + 550 = 1666 K ft.

Force on rack tooth = $\frac{1,666,000}{61.414}$ = 27,127 lbs.

Rack HP = 0.63 hp

Results of Computations

The results of the above calculations are tabularized on Plate V-3 . From the calculations, the operating load requirements for the drive are determined to be:

1. 1666 K ft. total moment on the sector gate under 9' of reverse head, Case 10.

2. 1337 K ft. moment at 2' of reverse head at 0.1 rpm gate operating speed where it must supply 25.46 hp in the rack, Case 6. The normal operating force required on the rack at 9' reverse head equals the total moment divided by the pitch radius of the rack:

$$F = \frac{1,666,000}{61.414} = 27,127 \text{ lbs.}$$

Allowing 10% for impact, the force required on the rack will be 29,840 lbs.

Figure V-15

DESIGN

General

Preliminary layouts and calculations of several different arrangements of the operating machinery were made in order to find arrangements that would have the proper capacity and fit the available space.

Angle Drive Unit

The maximum gate operating speed as specified by the design data will be 0.1 rpm. The linear velocity of the pitch line of the rack on the sector gate then is:

$$V = 2 \pi RN$$

Where: R = pitch radius of rack
N = speed, rpm

$$V = 2 \pi \; 61.414 \times 0.1 = 38.59 \text{ fpm}$$

The linear velocity of the idler gear, which meshes with the spur rack, would also be 38.59 fpm. However, the angular velocity would be:

$$\text{rpm} = \frac{1029 \times .1}{40} = 2.57 \text{ rpm}$$

The linear velocity of the spur gear, which meshes with the idler gear, would also be the same as the idler gear. Angular velocity of the spur gear would be:

$$\text{rpm} = \frac{2.57 \times 40}{23} = 4.474 \text{ rpm}$$

The bevel gear will have the same angular velocity as the spur gear, since it is keyed to the same shaft.

The bevel pinion will have a 22:45 ratio with the bevel gear. Therefore the angular velocity of the bevel pinion will be:

$$4.474 \times \frac{45}{22} = 9.151 \text{ rpm}$$

As the bevel pinion will be keyed to the pinion shaft, which is coupled to the low speed shaft of a speed reducer, the low speed shaft of the speed reducer will also operate at 9.151 rpm.

Speed Reducer

A commercially manufactured speed reducer with a standard reduction ratio of 130.78:1 will be selected. This reducer will be supplied with a double extended input shaft to allow mounting a brake to one input shaft and coupling the other input shaft to the hydraulic motor.

The input shaft of the speed reducer will operate at:

$$9.151 \times 130.78 = 1197 \text{ rpm.}$$

Full Operating Load Forces and Torques

The full load forces and torques are based on the friction and hydraulic moments imposed on the sector gate as calculated in the previous computation for gate loading, and the rated capacities of the gate operating machinery. These forces and torques are indicated below:

Force on rack = 29,840 lbs.

Force on mating idler gear assuming 96% efficiency for the gear mesh = $\frac{29,840}{0.96}$ = 31,083 lbs.

Force on spur gear assuming 96% efficiency for the mesh = $\frac{31,083}{0.96}$ = 32,378 lbs.

Torque on spur gear

$$T = \frac{23 \times 4.5 \times 32,378}{2\pi} = 533,348 \text{ in. lbs.}$$

The above calculation is based on a 23 tooth, 4.5 circular pitch spur gear.

Torque on the bevel gear is also 533,348 in. lbs. since both gears are keyed to the same shaft.

Force on bevel gear = $\frac{533,348}{22.5}$ = 23,704 lbs.

Where: 22.5 = the outside pitch radius of the bevel gear.

Force on the bevel pinion = $\frac{23,704}{0.96}$ = 24,692 lbs.

Where: 0.96 = the efficiency of the bevel gear and pinion mesh.

Torque on the bevel pinion and thus the output shaft of the speed reducer = 24,692 x 11 = 271,612 in. lbs.

Where: 11" = the outside pitch radius of the bevel pinion.

Figure V-18

Torque on the input shaft of the speed reducer

$$= \frac{271,612}{.94 \times 130.78} = 2209 \text{ in. lbs.}$$

Where: .94 = the efficiency of the reducer

130.78 = reduction ratio of the speed reducer.

Torque on the hydraulic motor shaft will also be 2209 in. lbs. since it is coupled directly to the input shaft of the speed reducer.

At high speed operation of the gates under conditions of low differential head, the torque required from the hydraulic motor will be $\frac{2209 \times 1337}{1666} = 1773$ in. lbs.

Where: 1666 K ft. is the low speed gate moment imposed and

1337 K ft. is the high speed gate operating moment.

Electric Motor

The output horsepower of the hydraulic motor will be:

$$HP = \frac{T \times N}{63,025} = \frac{1,773 \times 1,197}{63,025} = 33.67 \text{ hp}$$

Assuming an overall efficiency of the hydraulic motor, hydraulic pump combination of 85%, the input to the pump and the output of the electric motor will be $\frac{33.67}{.85} = 39.6$ hp

A 50 hp electric motor will be selected.

Hydraulic Motor

The relief valve setting of the hydraulic system will be set at approximately 150% of the operating pressure so that the maximum stalling torque will be 1.5 x 2,209 = 3,314 in.lbs.

The hydraulic motor selected will develop 2,209 in.lbs. of output torque at 1453 psi input pressure.

The pressure at the maximum stalling torque will be:

1453 x 1.5 = 2,180 psi

The hydraulic motor must operate at 1,197 rpm. In order to obtain the necessary gate operating speeds an axial piston type hydraulic motor of approximately 11.25 cu. in. per revolution will be selected.

Hydraulic Pump

The capacity of the hydraulic pump will be:

$$\text{gpm} = \frac{\text{rpm of motor x displacement}}{231} = \frac{1,197 \text{ x } 11.25}{231} = 58 \text{ gpm.}$$

A heavy duty variable delivery hydraulic pump will be selected with electric remote operated multi-position controls for four (4) pre-set adjustable positions of the slide block and neutral. Pressure compensation will be provided on the low speed operating position to compensate for varying volume requirements of the hydraulic motor due to changes in output torque requirements.

Stalling Forces and Torques

The stalling torque on the input shaft of the speed reducer will be 3,314 in. lbs. and is the same as the stalling torque of the hydraulic motor. The stalling torque on the output shaft of the speed reducer will be: 3,314 x 130.78 x .94 = 407,401 in. lbs.

Where: 130.78 = the reduction ratio of the reducer

.94 = the efficiency of the reducer.

Stalling torque on the bevel pinion will also be 407,401 in. lbs.

Stalling force on the bevel pinion = $\frac{407,401}{11}$ = 37,036 lbs.

Stalling force on the bevel gear = 37,036 x 0.96 = 35,555 lbs.

Stalling torque on the bevel gear = 35,555 x 22.5 = 799,987 in. lbs.

Stalling torque on the spur gear will also = 799,987 in. lbs.

Stalling force on the spur gear will be:

$$\frac{799,987 \times 2 \times \pi}{23 \times 4.5} = 48,565 \text{ lbs.}$$

Stalling force on the idler gear = 48,565 x .96 = 46,622 lbs.

Stalling force on the rack = 46,622 x .96 = 44,757 lbs.

Stalling torque on the rack = 44,757 x 61.414 = 2748.7 K ft.

A solenoid operated shoe brake will be selected which is rated at 4800 in. lbs. maximum torque. This is in excess of 150 percent of maximum normal torque of the hydraulic motor. The brake will be enclosed in a watertight housing.

GEARING

General

Each gate machinery gear system will consist of a speed reducer of commercial manufacture and a custom-built right angle drive unit. The right angle drive unit will consist of a bevel gear set, a spur gear and an idler gear meshing with the spur rack on the sector gate. All gears will be contained in a welded steel housing.

The idler, spur, bevel and bevel pinion gears will be checked for beam strength and dynamic load. The limiting load for wear will not be considered since the gears will be subjected to intermittent service at very low speeds.

The stalling force produced by the hydraulic motor will be used in determining the required tooth beam strength but shall not exceed 75% of the yield strength of the material used.

The rack, idler, spur and bevel gear and pinion will be made from cast steel, ASTM designation A148-60 grade 80-40, which has a yield point of 40,000 psi.

Spur Rack

In order to maintain sufficient tooth engagement and contact ratio

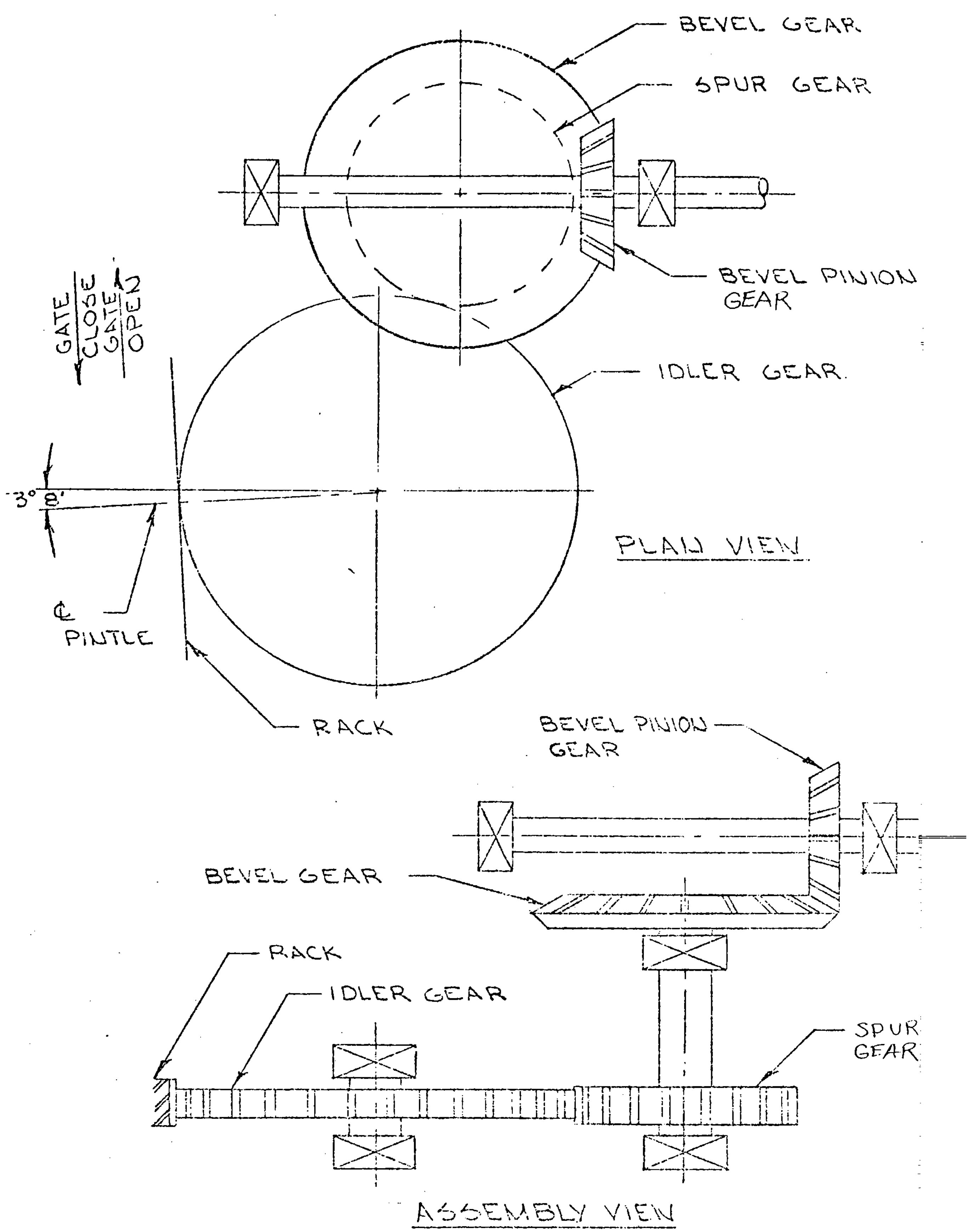

BEVEL GEAR
SPUR GEAR
BEVEL PINION GEAR
GATE CLOSE
GATE OPEN
IDLER GEAR
3° 8'
℄ PINTLE
PLAIN VIEW
RACK
BEVEL PINION GEAR
BEVEL GEAR
RACK
IDLER GEAR
SPUR GEAR
ASSEMBLY VIEW

Figure V-23

under the extremes of temperature and hydraulic loading conditions, the rack will be manufactured as a 4.5" circular pitch, 14.5° pressure angle, 1,029 tooth gear. The face width will be 5.5". The rack and idler gear will be set so that expansion due to maximum temperature will cause the pitch lines to coincide. At all lower temperatures the gear teeth will be slightly out of pitch.

To provide extra strength to resist the error in action caused by the gear teeth being out of pitch, the idler gear teeth will be made 4.5" face width. The extra inch width on the rack teeth is to insure full contact between the idler and rack teeth after field alignment and adjustment.

The rack will have a central angle of 70°, therefore, the number of teeth required for the rack will be:

$$N = \frac{1029 \text{ x } 70}{360} = 200 \text{ teeth}$$

Two extra teeth will be provided at each end of the rack to insure full contact of the idler gear under the conditions where the gate is either fully opened or fully closed. Therefore, the total number of teeth required for the rack will be 204.

The beam strength of the rack teeth was not computed as the rack beam strength will be greater than that of the idler gear due to the higher outline factor and greater face width of the teeth.

Idler Gear

The idler gear which mates with the rack has been selected as a 40 tooth, 4.5" circular pitch, 14.5° pressure angle, full depth involute teeth, with a face width of 4.5". The stalling force on the idler gear is 46,622 lbs. The Lewis formula for the beam strength is:

$$S_t = \frac{W_b}{pFY}$$

Where:

W_b = load (stalling load), lbs.
p = circular pitch
F = face width, inches
Y = form factor = .107 (from tables)

$$S_t = \frac{46,622}{4.5 \times 4.5 \times .107} = 21,517 \text{ psi}$$

$$\text{Required yield point} = \frac{21,517}{.75} = 28,689 \text{ psi}$$

The material used for the idler gear has a yield point of 40,000 psi.

The equation for dynamic load for spur gears is:

$$W_d = \frac{.05V\ (FC+W)}{.05V + \sqrt{FC+W}} + W$$

Where:
W = applied load, lbs.
V = pitch line velocity, fpm
W_d = dynamic load, lbs.
C = deformation factor = 8,000 (from tables)
F = face width of gear, inches

$$W_d = \frac{.05 \times 38.59\ (4.5 \times 8,000 + 31,083)}{.05 \times 38.59 + (4.5 \times 8,000 + 31,083)^{\frac{1}{2}}} + 31,083$$

$$= \frac{129,437}{260.9} + 31,083$$

$$= 31,579 \text{ lbs.}$$

This is less than the stalling load of 46,622 lbs.

Spur Gear

The spur gear which mates with the idler gear has been selected as a 23 tooth, 4.5 circular pitch, 14.5° pressure angle, full depth involute, 5" face width spur gear. The extra 1/2" width on the spur gear is provided to eliminate any mis-match with the mating idler gear. This spur gear will be stretched in accordance with ASA B6.1-1932 to mate with a standard gear on increased center distance.

The stalling force on the spur gear is 48,565 lbs.

The Lewis formula for beam strength is:

$$S_t = \frac{W_b}{pFY}$$

The notations used in this formula are as in the previous calculation.

BEVEL GEAR SET

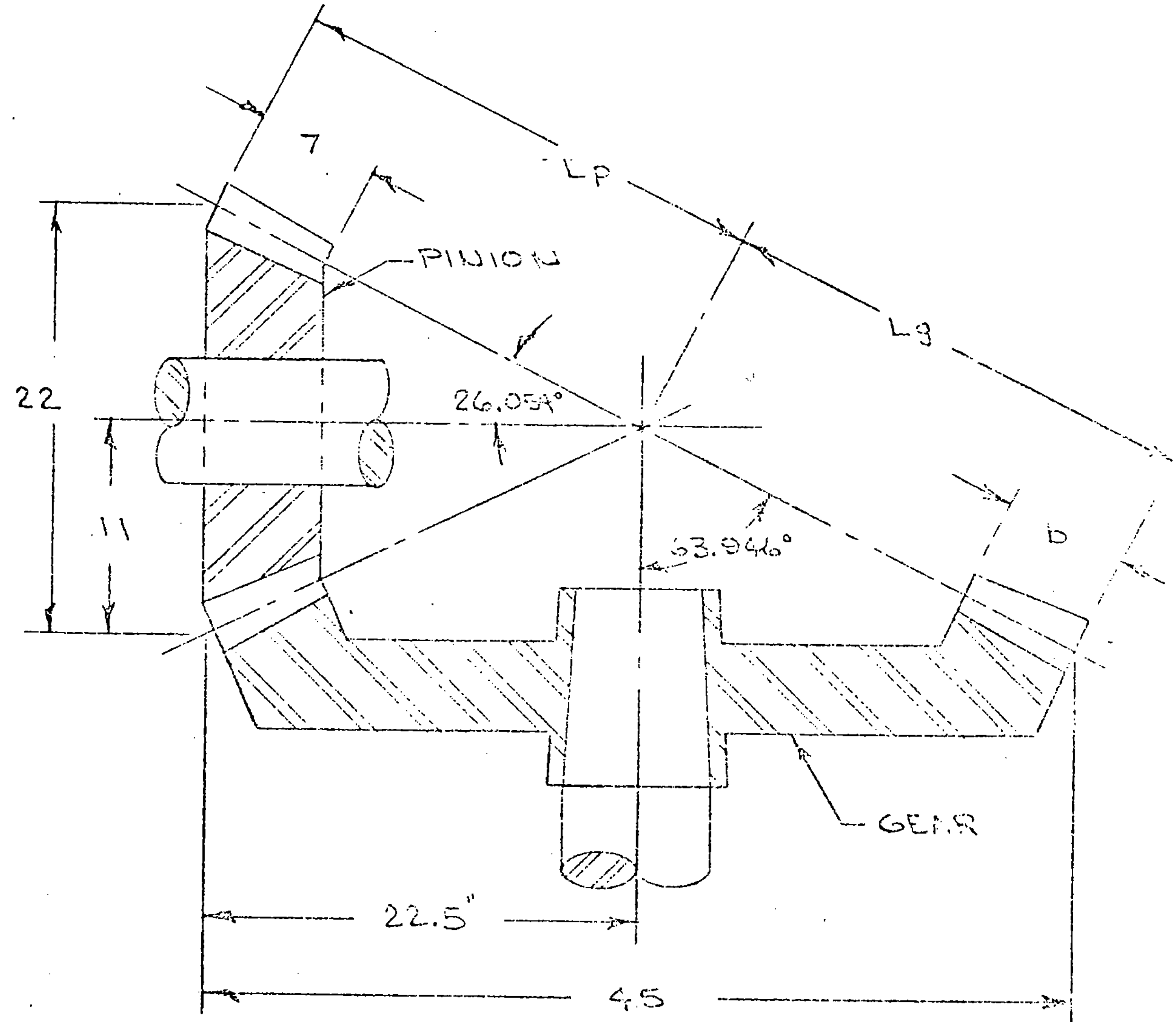


Figure V-27

$$S_t = \frac{48,565}{4.5 \times 5 \times .094} = 22,962 \text{ psi}$$

$$\text{Required yield point} = \frac{22,962}{.75} = 30,616 \text{ psi.}$$

The material used for the spur gear has a yield point of 40,000 psi.

The equation for dynamic load for spur gears is:

$$W_d = \frac{.05V\ (FC+W)}{.05V + (FC+W)^{1/2}} + W$$

The notations used in this formula are as in the previous calculation.

$$W_d = \frac{.05 \times 38.59\ (5 \times 8,000 + 32,378)}{.05 \times 38.59 + (5 \times 8,000 + 32,378)^{1/2}} + 32,378$$

$$= \frac{139,653}{270.96} + 32,378 = 32,893 \text{ lbs.}$$

This is less than the stalling load on the spur gear of 48,565 lbs.

Bevel Gear Set

The bevel gear set has been selected as a 22/45 tooth, one diametral pitch, 20° involute teeth set. The gear has a 45" pitch diameter and a face width of 7". The pinion has a 22" pitch diameter and a face width of 7".

Bevel Gear

The set will operate at a shaft angle of 90°. The pitch cone angle of the bevel gear is then

$$\delta = \text{arc tan } \frac{N_g}{N_p}$$

Where: N_g = number of teeth in the gear
N_p = number of teeth in the pinion

$$\alpha = \text{arc tan } \frac{45}{22} = 63.946^\circ .$$

The pitch cone radius of the gear will be:

$$L_g = \frac{P_g}{\sin\alpha}$$

Where: P_g = pitch radius of gear, inches
α = pitch cone angle of the gear

$$L_g = \frac{22.5}{.89838} = 25.045''$$

The virtual number of teeth in the gear will be:

$$N'_g = \frac{N}{\cos} = \frac{45}{.43921} = 102 \text{ teeth}$$

The Lewis formula for the beam strength is:

$$S_t = \frac{W_b\, P_d\, L_g}{\pi\, Y b\, (L_g - b)}$$

Where: W_b = tooth (stalling) load, lbs.
P_d = diametral pitch
L_g = pitch cone radius, inches
Y = outline factor for 102 teeth
= .142 (from tables)
b = face width of tooth = 7"

$$S_t = \frac{35,555 \times 1 \times 25.045}{\pi \times .142 \times 7\,(25.045 - 7)}$$

$$S_t = 15,803 \text{ psi}$$

$$\text{Required yield point} = \frac{15,803}{.75} \quad 21,070 \text{ psi}$$

The material used for the bevel gear has a yield point of 40,000 psi.

The equation for dynamic load for bevel gears with cut teeth is:

$$W_d = \frac{.05V\ (FC+W)}{.05V\ (FC+W)^{1/2}} + W$$

Where: W_d = dynamic load, lbs.
V = pitch line velocity, fpm
F = face width of tooth, inches
W = applied load, lbs.
C = deformation factor
= 8,300 (from tables)

$$V = \frac{45 \times 4.474\pi}{12} = 52.71 \text{ fpm}$$

$$Wd = \frac{.05 \times 52.71\ (7 \times 8,300 + 23,704)}{.05 \times 52.71 + (7 \times 8,300 + 23,704)^{1/2}} + 23,704$$

$$= 24,445 \text{ lbs.}$$

This is less than the stalling load of 35,555 lbs.

Bevel Pinion

Since the gear set operates at a shaft angle of 90°, the pitch cone angle of the pinion will be:

$$\beta = \text{arc tan } \frac{N_p}{N_g} = \text{arc tan } \frac{22}{45}$$

$$\beta = 26.053°$$

The pitch cone radius of the pinion will be:

$$L_p = \frac{P_p}{\sin \beta}$$

$$= \frac{11}{\sin\beta} = 25.045''$$

Figure V-30

The virtual number of teeth in the bevel pinion will be:

$$N_p' = \frac{N}{\cos\beta} = \frac{22}{\cos\beta} = 24.488$$

$$N_p' = 24 \text{ teeth}$$

The Lewis formula for the beam strength is:

$$S_t = \frac{W_b\ P_d\ L_g}{\pi\ Y b (L_g - b)}$$

The notations used in this formula are as in the previous calculation.

$$S_t = \frac{37,036 \times 1 \times 25.045}{\pi \times .107 \times 7 \times 18.045}$$

$$= 21,845 \text{ psi}$$

Required yield point $= \frac{21,845}{.75} = 29,126$ psi

The material used for the bevel pinion has a yield point of 40,000 psi.

The equation for dynamic loads on bevel gears with cut teeth is:

The notations used in this formula are as in the previous calculation.

$$W_d = \frac{.05V\ (FC + W)}{.05V + (FC+W)^{1/2}} + W$$

$$W_d = \frac{.05 \times 52.71\ (7 \times 8,300 + 24,692)}{.05 \times 52.71 + (7 \times 8,300 + 24,692)^{1/2}} + 24,692$$

$$= 24,979 \text{ lbs.}$$

This is less than the stalling load on the bevel pinion of 37,036 lbs.

SHAFT STRESS CALCULATIONS

Figure V-32

General Comments

The shafting for each right angle drive unit will consist of bevel gear shaft and a bevel pinion gear shaft. A shaft extension (floating shaft) will be provided to couple the bevel pinion shaft to the speed reducer output shaft.

The stalling force produced by the hydraulic motor will be used in determining the stresses and no stress can exceed 75% of the material's yield strength.

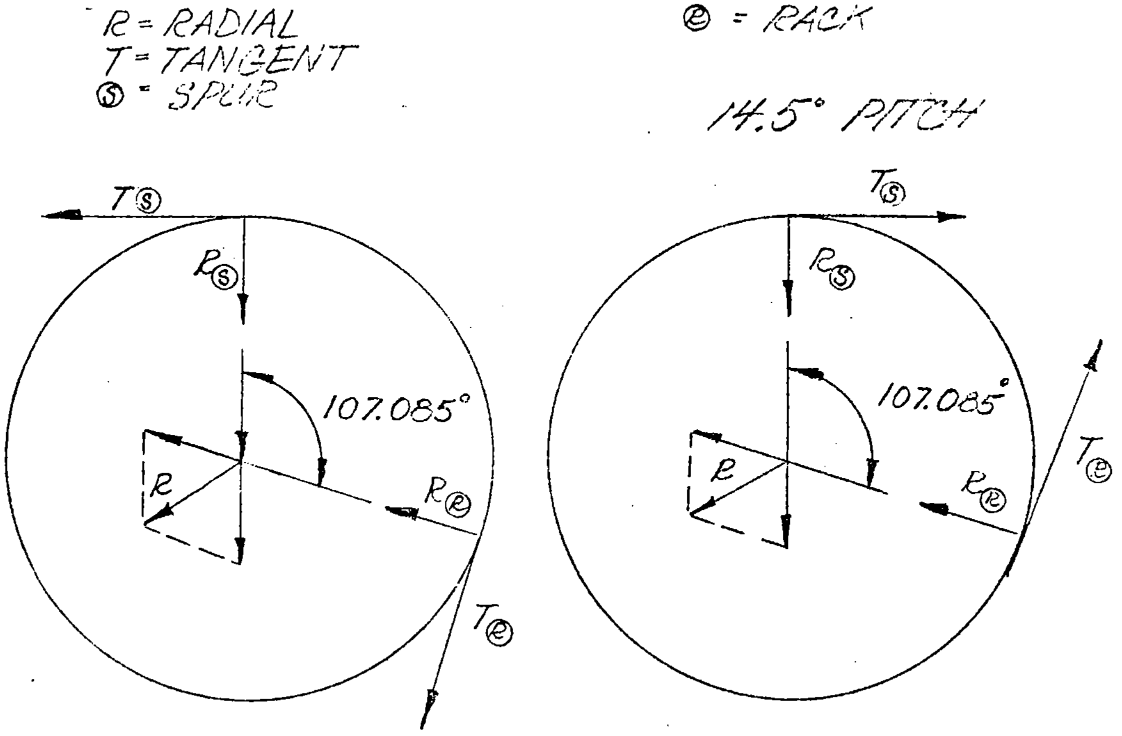
The shafting for the right angle drive unit will be made from alloy steel, ASTM designation A237-62T class C, which has a yield strength of 60,000 psi.

The floating shaft will be made from alloy steel, ASTM designation A434-60T, cold finished class B-B, which has a yield strength of 75,000 psi.

Idler Gear Shaft

The idler gear shaft will be subjected to bending only. The forces producing bending on the shaft will be the radial force tending to separate the gears and the tangential force transmitted from the spur gear, through the idler gear to the rack.

The stalling force on the idler gear will be 46,622 lbs. This force will be tangent to the pitch diameter of the gear and produce a radial force caused by the shape of the gear teeth. The radial force from the spur gear will act 107. 085° from the radial reaction of the rack.



(Gate opening) (Gate closing)

Figure V-34

The radial force from the rack and spur gear will be:

$$R_s = R_r = 46,622 \tan 14.5°$$

$$= 12,057 \text{ lb.}$$

The resultant force due to the radial forces will be:

$$R = 12,057 \ (\sin (36.12°))(2)$$

$$= 7,107(2) = 14,215 \text{ lb.}$$

The resultant due to the tangential forces will be:

$$T = (46,622)\ (2)\ (\sin (53°))$$

$$= 74,468 \text{ lb.}$$

From the previous sketch, it is seen that the maximum bending force will occur when the gate is opened.

$$F = T + R$$

$$= 74,468 + 14,215 = 88,683 \text{ lb.}$$

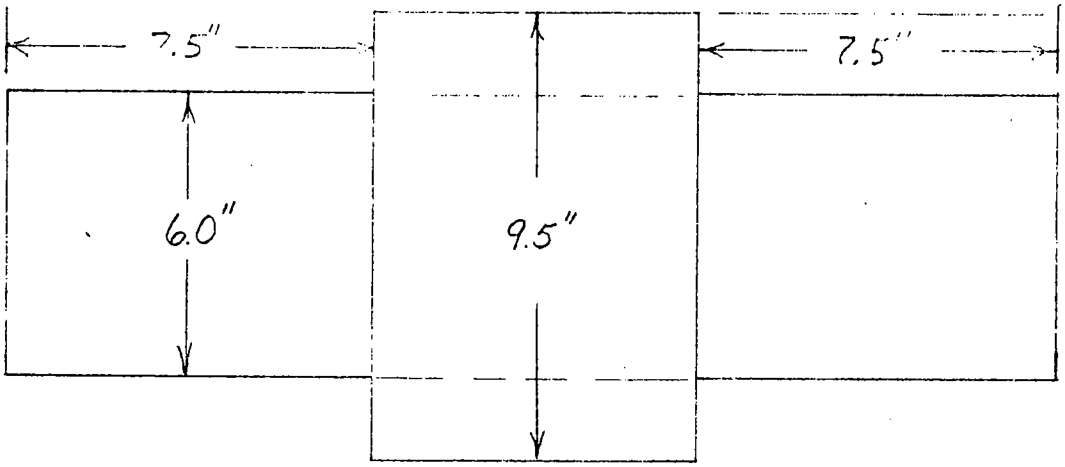
The load will be symetrical so the load on each bearing will be: 44,341 lb.

Maximum bending moment will occur at the center of the shaft and will be:

$$(44,341)\ (6'') = 266,046 \text{ in.-lb.}$$

The bending moment at shaft fillet at edge of gear will be:

(44,341) (3.5) = 155,194 in.-lb.



Since the maximum bending moment will occur at the center of the idler gear hub, the tensile or compressive stress due to bending at the change in shaft diameter will be considered only.

$$S = \frac{Mc\ K_t\ K_e}{I}$$ Shigley - Page 617

Where:

M = (maximum moment) 155,194 in.-lb.

c = $d/2 = 3$

K_t = 1.75

I = $d^4/64 = 63.6$

K_e = fatique and minor shock factor = 2.0

$$S = \frac{155,194\ (3)(1.75)(2.0)}{63.6} = 25,622 \text{ psi.}$$

The required yield strength will be: $\frac{25,622}{.75}$ = 34,162 psi.

Figure V-36

The material that will be selected has a yield strength of 60,000 psi.

Spur and Bevel Gear Shaft

The spur and bevel gear shaft will be subjected to compression, torsion and bending. In compression the thrust and weight of the bevel gear will comprise the load.

The stalling torque on the shaft will be: 799,987 in. -lb.

The radius to the middle of the bevel gear teeth will be: 19.5"

The tangential force at the middle of the bevel gear teeth will be:

$$F_t = 35,555 \frac{22.5}{19.5}$$

$$= 41,025 \text{ lb.}$$

The radial force due to the tooth load on the bevel gear will be:

$$F_r = 41,025 \ (\tan 20)\ (\cos 63.946°)$$

$$= 41,025 \ (.3640)\ (.4392)$$

$$= 6558 \text{ lb.}$$

Where: 20° = tooth pressure angle and 63.946° = cone angle

The thrust load due to the tooth load on the bevel gear will be:

$$F_t = 41,025 (\tan 20°)(\sin 63.946°)$$

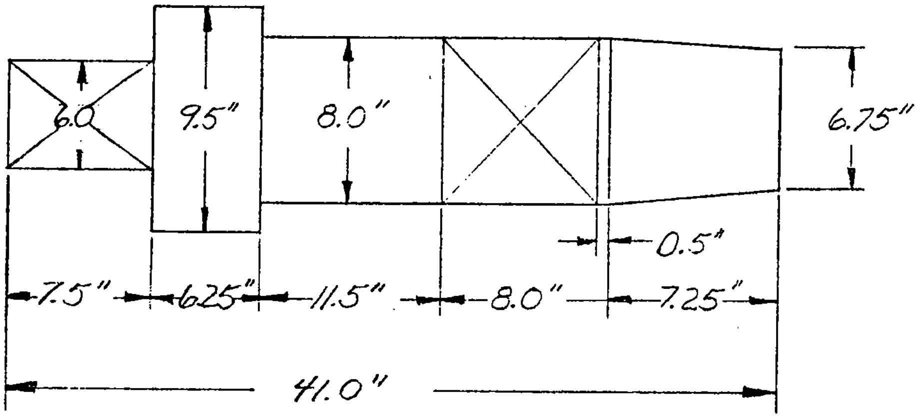
$$= 13,415 \text{ lb.}$$

The radial force due to the tooth load on the spur gear will be:

$$F_r = 48,565 \tan 14.5°$$

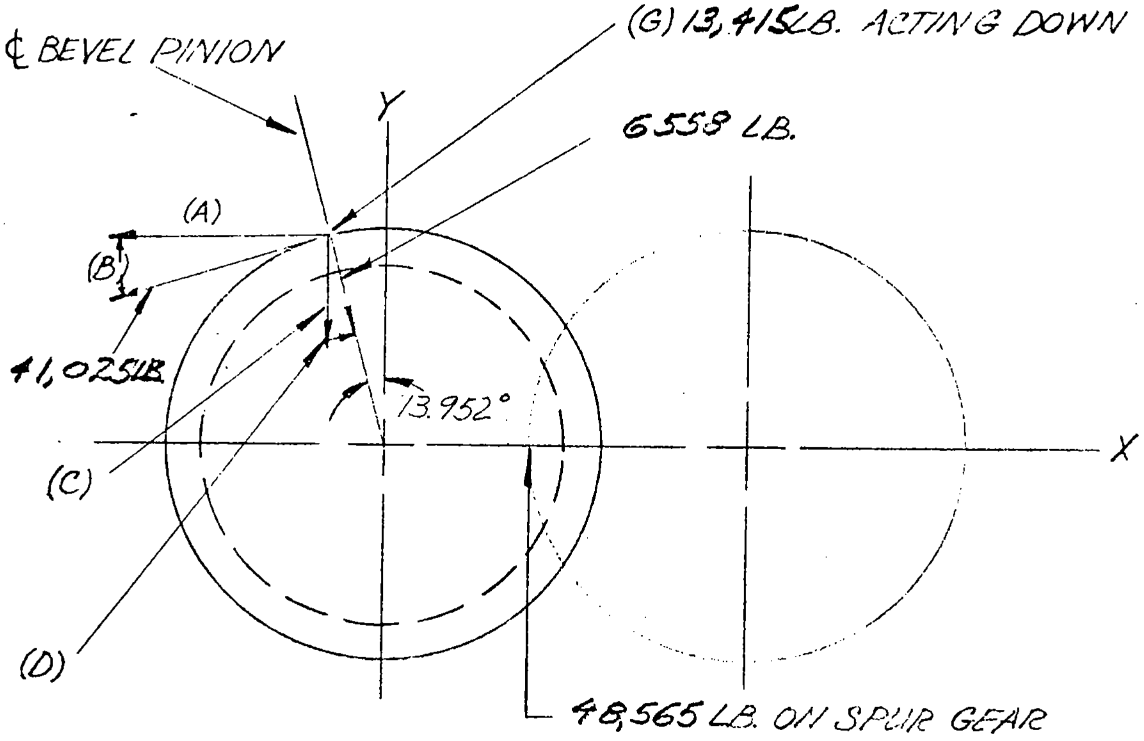
$$= 12,560 \text{ lb.}$$

Where 14.5° = the tooth pressure angle



BEVEL AND SPUR GEAR SHAFT

Figure V-38



BENDING FORCES ON SHAFT

(Gate Opening)

Since the loads are acting at an angle of 103. 95° apart, these forces will be resolved into x and y components.

From the preceding sketch it can be seen that the radial force from the spur gear in the x direction will be equal to 12,560 lb. The tangent force will be equal to 48,565 lb.

Figure V-39

The tangential force of the bevel gear in the x direction will be:

(a) = 41,025 cos 13.95

= 39,815 lb.

The tangential force of the bevel gear in the y direction will be:

(b) = 41,025 (sin 13.95)

= 9890 lb.

The radial force of the bevel gear in the x direction will be:

(d) = 6558 (sin 13.95)

= 1581 lb.

The radial force of the bevel gear in the y direction will be:

(c) = 6558 (cos 13.95) = 6365 lb.

Force (g) will act down with a 18.924" lever with respect to the y plane and a 4.702" lever with respect to the x plane.

The summation of forces in the x direction will be:

Spur gear = 12,560 lb.

Bevel gear = 39,815 - 1581 = 38,234 lb.

Moment (force (g)) = (63,077) in.-lb.

Figure V-40

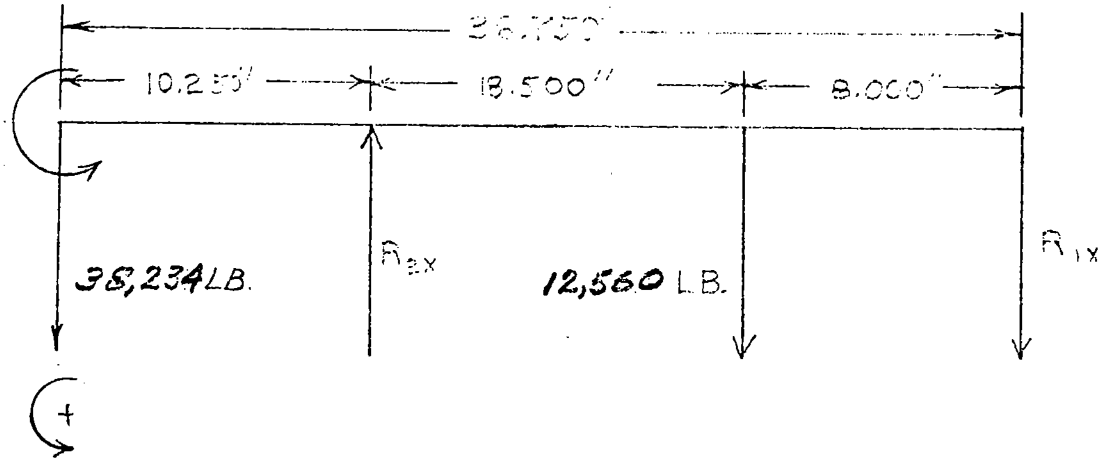
The summation of the forces in the y direction will be:

Spur gear = 48,565 lb.

Bevel gear = + 6365 + 9890 = 16,255 lb.

Moment (force (g)) = -(253,865) in. -lb.

The x coordinate shaft reactions at center of bearings will be:



$$M_{R1x} = (12,560)\,(8.00) + (38,234)\,(36.750) - (R_{2x})\,(26,500) + 63,077 = 0$$

$$R_2 = \frac{100,480 + 1,405,100 + 63,077}{26.5} = 59,195 \text{ lb.}$$

$$M_{R2x} = (38,234)\,(10.25) - (12,560)\,(18.500) - R_{1x}\,(26.500) + 63,07 = 0$$

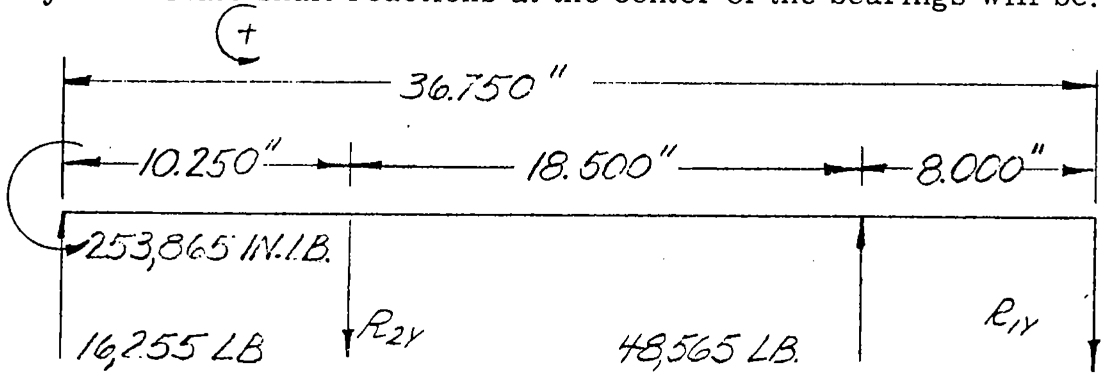
$$R_{1x} = \frac{391,899 - 232,360 + 63,077}{26.5} = 8401 \text{ lb.}$$

Calculation Check:

$$38,234 + 12,560 + 8401 = 59,195 \text{ lb.} = -R_{2x}$$

Figure V-41

The y coordinate shaft reactions at the center of the bearings will be:



$$M_{R1y} = (16,255)\,(36.750) - (48,565)\,(8.000) + R_{2y}\,(26.5) + 253,865 = 0$$

$$R_{2y} = \frac{+597,371 + 388,520 - 253,865}{26.5} = 27,624 \text{ lb.}$$

$$M_{R2y} = (16,255)\,(10,250) + (48,565)\,(18.500) - R_{1y}\,(26.5) + 253,865 = 0$$

$$R_{1y} = \frac{-166,614 + 898,453 + 253,865}{26.5} = 37,196 \text{ lb.}$$

Calculation Check:

$$16,255 + 48,565 - 37,196 = 27,624 = R_{2y}$$

Figure V-42

The shear and moment diagrams in the X direction will be:

(Gate opening) 100 SCALE

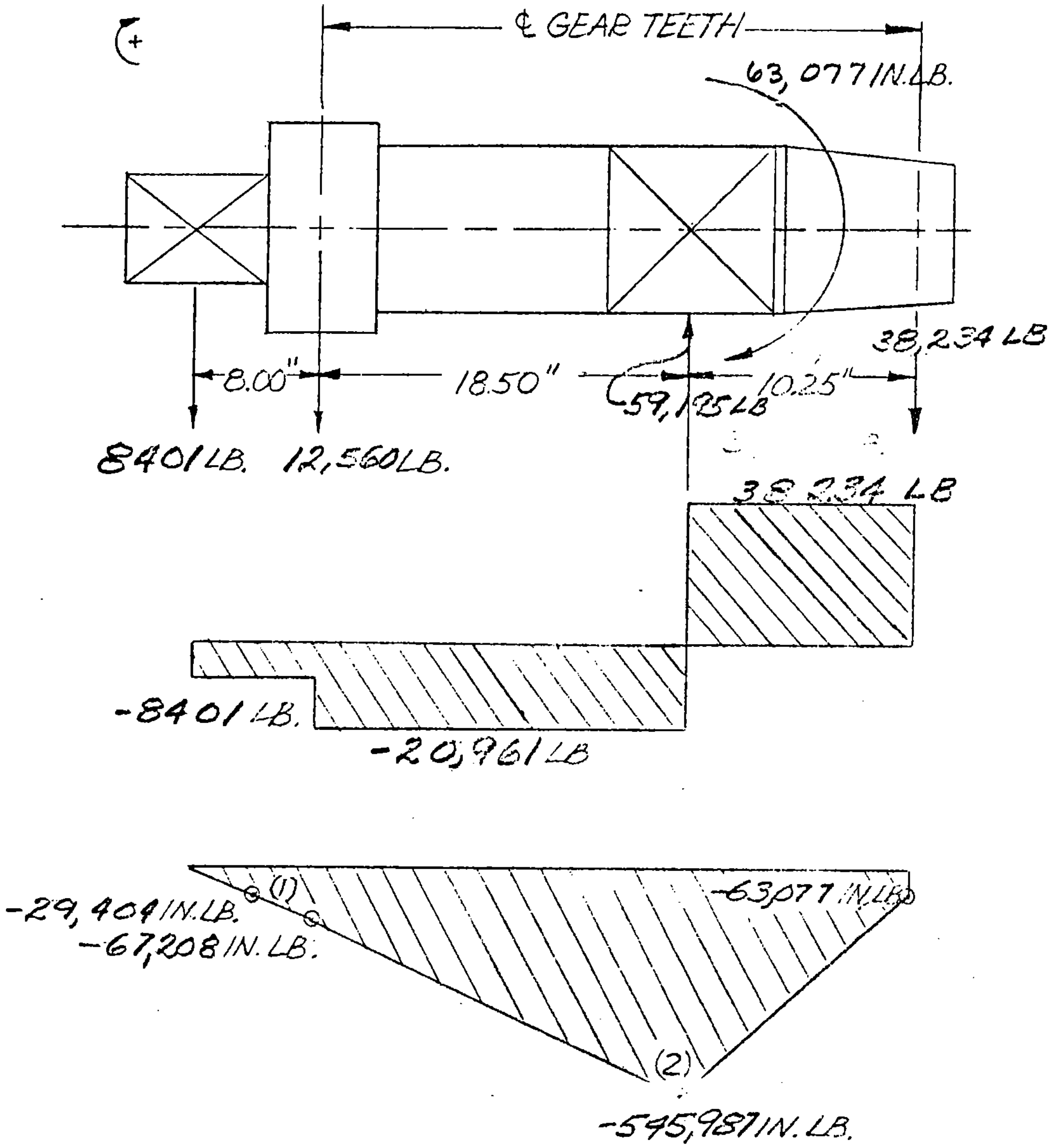


Figure V-43

The shear moment diagrams in the Y direction will be:

(Gate opening)

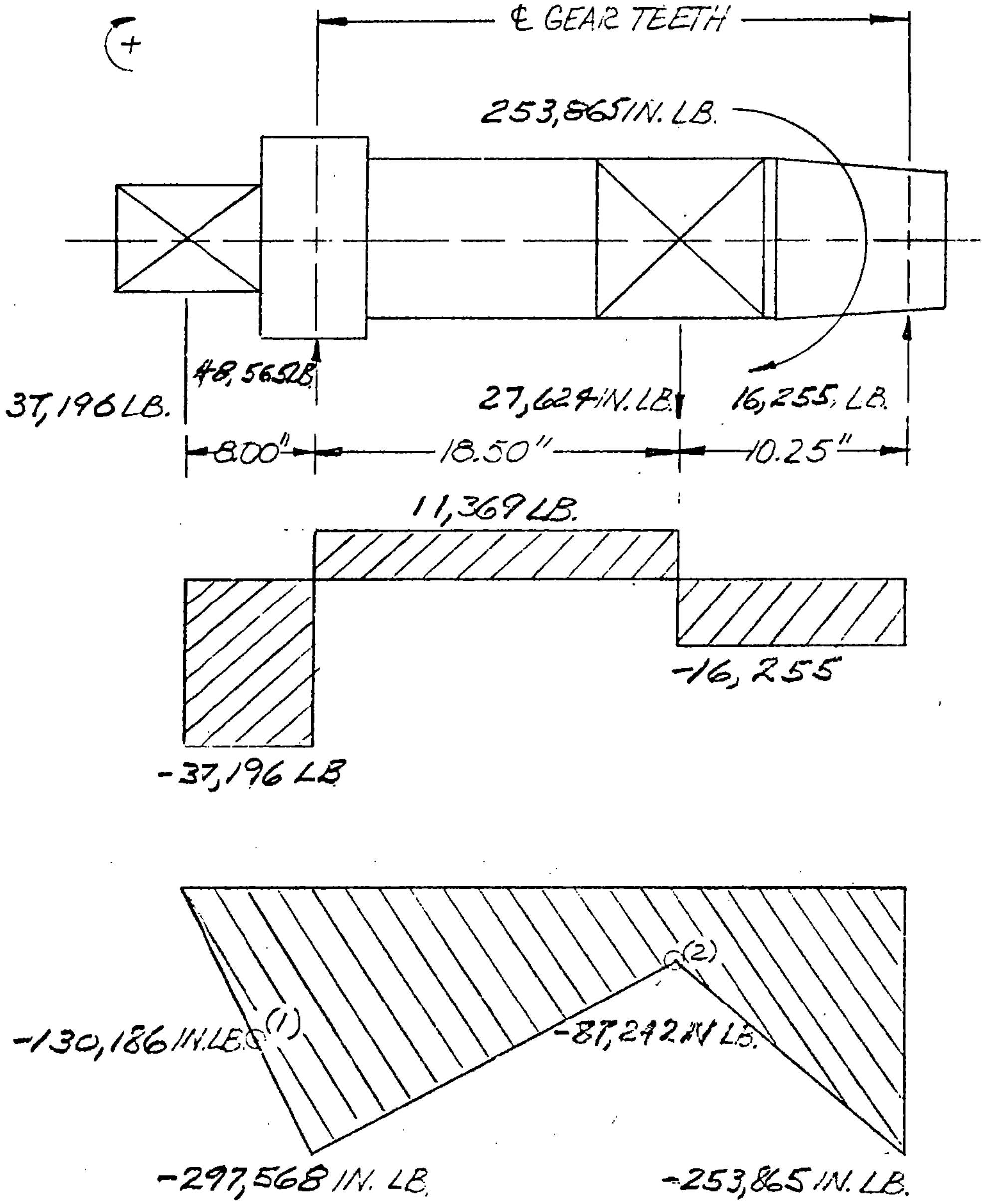


Figure V-44

From the preceding diagrams it can be seen that the maximum moment will occur at point (2). The moment at point (1) and (3) will also be considered.

The resultant bending moments on the shaft for the "gate opening" condition will be:

$$M = \left(M_x^2 + M_y^2\right)^{1/2}$$

$$M_{(1)} = \left((130,186)^2 + (29,404)^2\right)^{1/2}$$

$$= 133,465 \text{ in.-lb.}$$

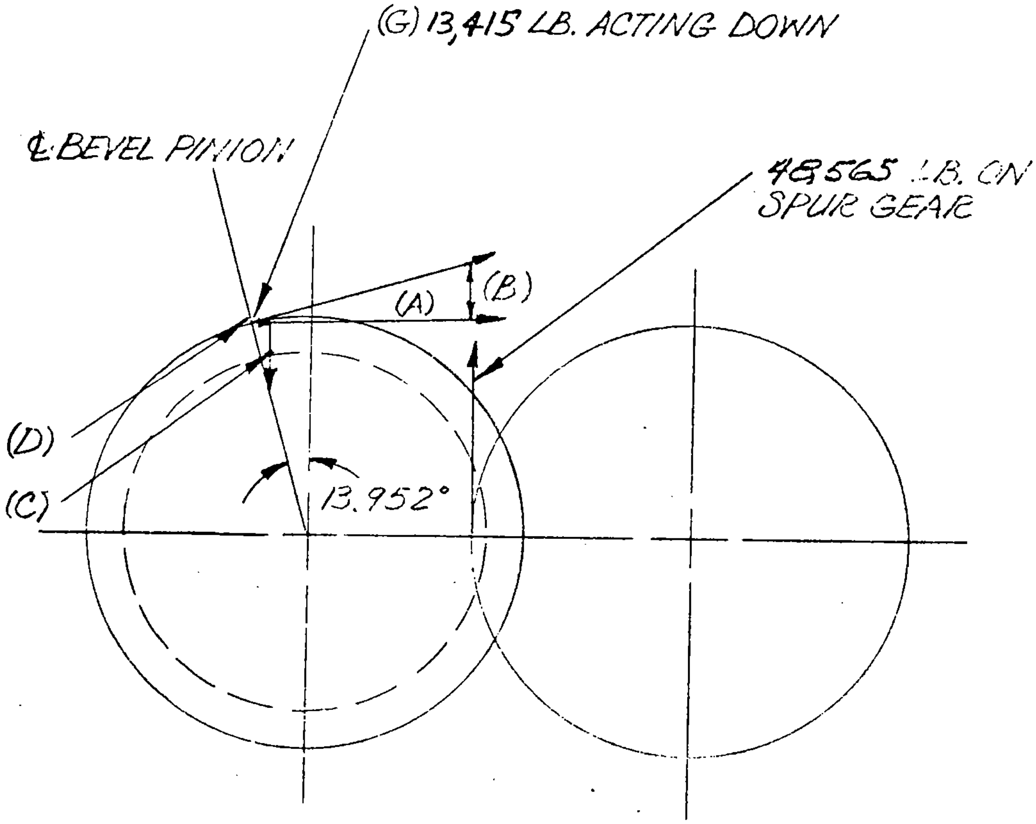
$$M_{(2)} = \left((87,242)^2 + (545,987)^2\right)^{1/2}$$

$$= 552,913 \text{ in.-lb.}$$

$$M_{(3)} = \left((297,568)^2 + (67,208)^2\right)^{1/2}$$

$$= 305,063 \text{ in.-lb.}$$

Figure V-45



BENDING FORCES ON SHAFT

(Gate Closing)

The summation of the forces in the x direction will be:

Spur gear = 12,560 lb.

Bevel gear = 39,815 + 1581 = 41,396 lb.

Moment (force (g) = 63,077 in. -lb.

Figure V-46

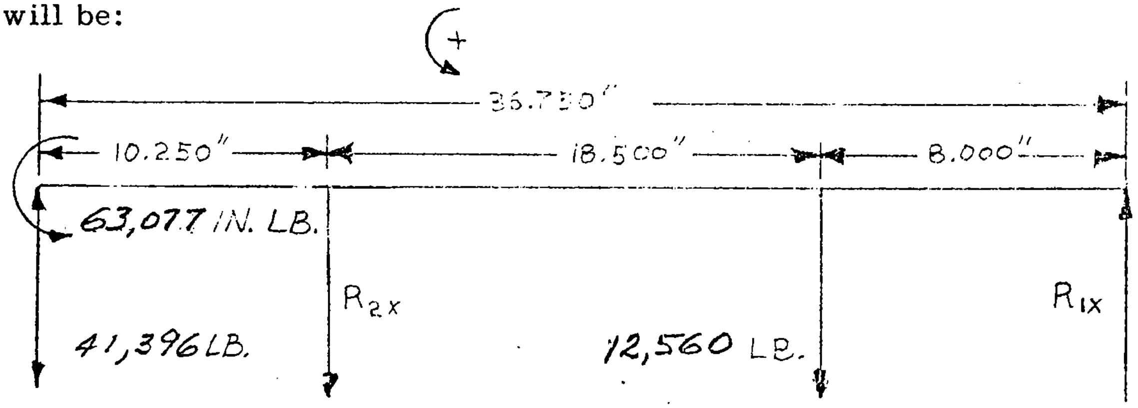
The summation of the forces in the y direction will be:

Spur gear = 48,565 lb.

Bevel gear = -6365 + 9890 = 3525 lb.

Moment (force (g) = (253,865) in. -lb.

The reactions at the centers of the shaft bearings in the x direction will be:



$$\Sigma M_{R1x} = R_{2x}(26.500) + (12,560)(8.000) - (41,396)(36.750) + 63,077$$

$$\Sigma R_{2x} = \frac{1,521,303 - 100,480 - 63,077}{26.5} = 51,236 \text{ lb.}$$

$$M_{R2x} = (41,396)(10.250) - (12,560)(18.500) + R_{1x}(26.500) + 63,077$$

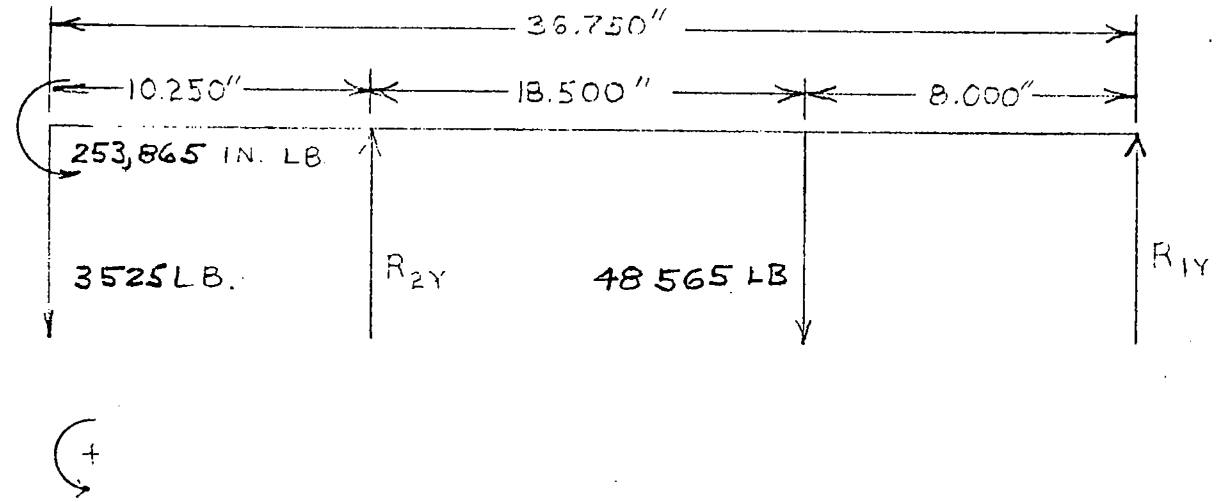
$$R_{1x} = \frac{+424,309 + 232,360 - 63,077}{26.500} = 22,400 \text{ lb.}$$

Calculation Check:

$$41,394 + 22,400 - 12,560 = R_{2x} = 51,236 \text{ lb.}$$

Figure V-47

The reactions at the centers of the bearings in the y direction will be:



$$\Sigma M_{R2y} = (3525)\ (10.25)\ -\ (48,565)\ (18.500)\ +\ R_{1y}\ (26.500) \\ +\ 105,331$$

$$R_{1y} = \frac{898,453\ -\ 36,131\ -\ 253,865}{26.500} = 22,961\ \text{lb.}$$

$$\Sigma M_{R1y} = (3525)\ (36.750)\ +\ (48,565)\ (8.000)\ -\ R_{2y}\ (26.500) \\ +253,865$$

$$R_{2y} = \frac{129,544\ +\ 388,520\ +\ 253,865}{26.500} = 29,129\ \text{lb.}$$

Calculation Check

$$3525\ +\ 48,565\ -\ 29,129 = R_{2y} = 22,961\ \text{lb.}$$

Figure V-48

The shear and moment diagrams in the Y direction will be:

(Gate closing)

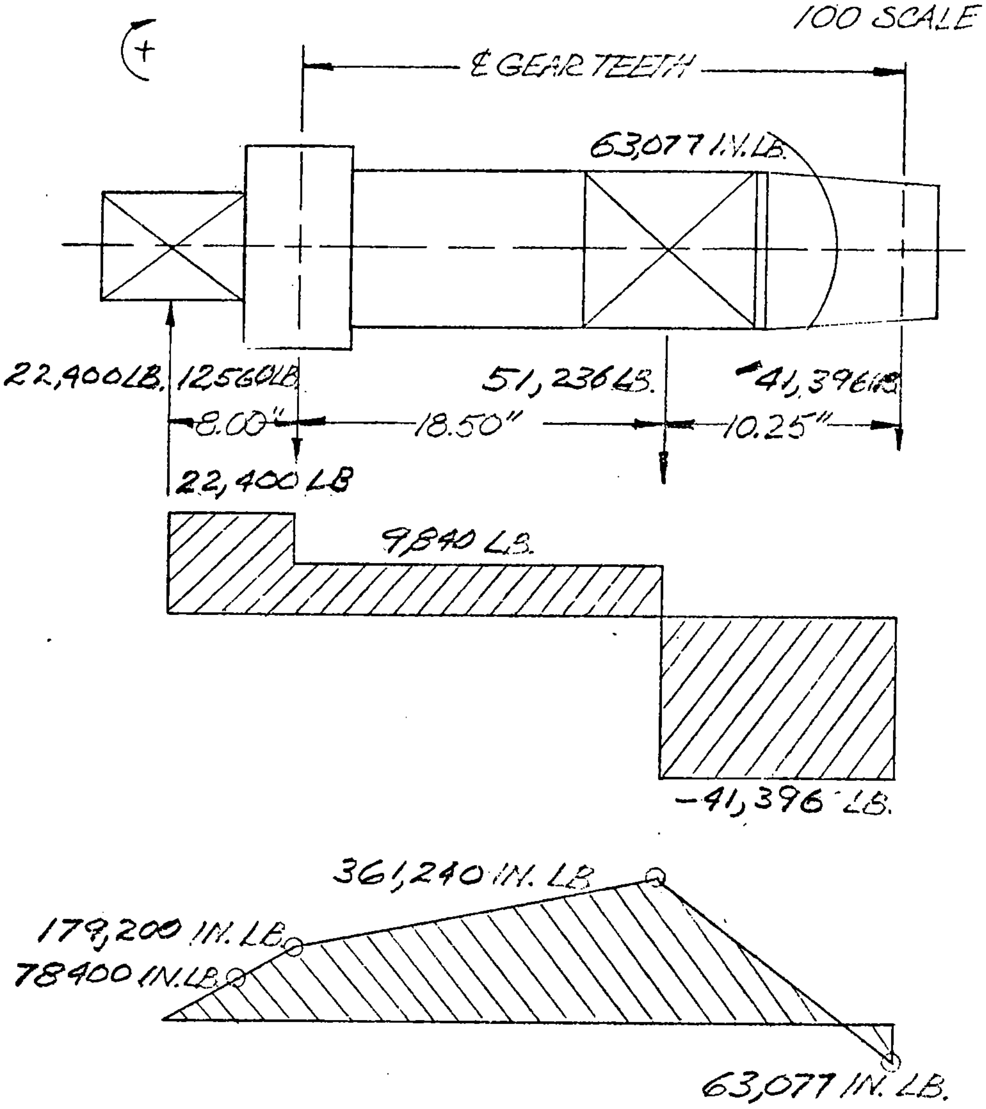


Figure V-49

The shear moment diagrams in the X direction will be:

(Gate closing)

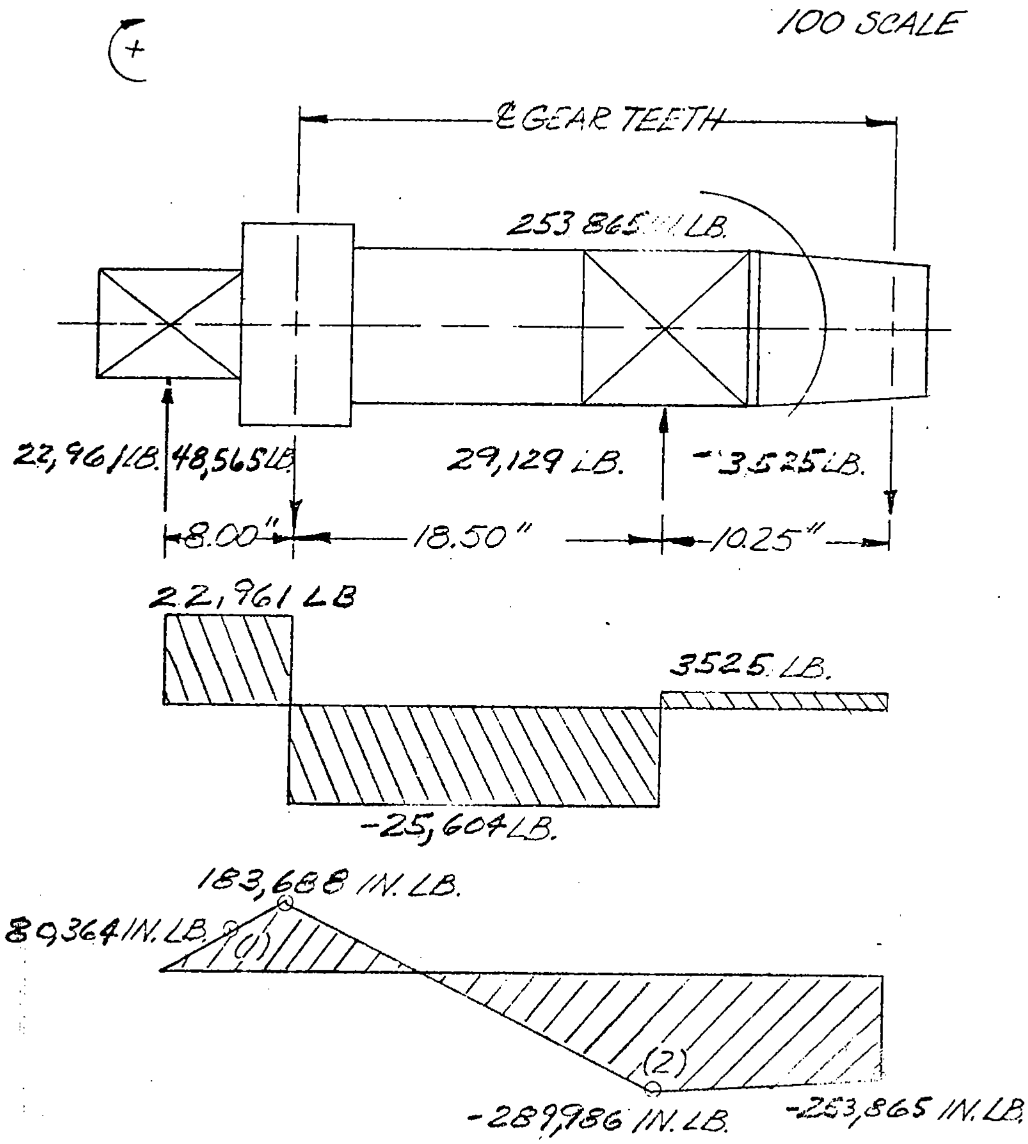


Figure V-50

From the preceding diagrams it can be seen that the maximum moment will occur at point (2). The moment at point (1) where there is an abrupt change in the shaft diameter will also be considered.

The resultant bending moments on the shaft will be:

(Gate Closing)

$$M = \left((M_x)^2 + (M_y)^2\right)^{1/2}$$

$$M_{(1)} = \left((80,364)^2 + (78,400)^2\right)^{1/2}$$

$$= 112,272 \text{ in.-lb.}$$

$$M_{(2)} = \left((289,986)^2 + (361,240)^2\right)^{1/2}$$

$$= 463,235 \text{ in.-lb.}$$

The axial or thrust load on the shaft will be:

Point (2)

$$F_a = F_n + W_b + W_s$$

Where:

F_n = Thrust load from bevel gear teeth = 13,415 lb.

W_b = Weight of bevel gear = 837 lb.

W_s = Weight of shaft above point (2) = 152 lb.

$$F_a = 13,415 + 152 + 837$$

$$= 14,404 \text{ lb.}$$

Figure V-51

Knowing the stalling torque, 799,987 in.- lb., the maximum bending moments at the two critical points and the thrust load, the maximum shearing stresses will be determined.

The ASME code equation for a solid circular shaft in torsion, bending and thrust is:

$$S_s = \left(\left(\frac{K_t\ 16T}{\pi\ d^3} \right)^2 + 1/4 \left(\frac{(K_m\ 32M)}{\pi\ d^3} + \alpha \frac{(4F_a)}{\pi d^2} \right)^2 \right)^{1/2}$$

Where: d = Diameter of shaft, in.
T = Stalling torque in.-lb.
F_a = Thrust load
α = Ratio of maximum stress to average stress = 1 (where bearings are arranged so that there is no long unsupported length of shaft.)
K_t = Shock and fatique factor for torsion = 1.5 (for suddenly applied minor shock load)
K_m = Shock and fatique

Safety factor for bending = 2.0 (for suddenly applied minor shock load)

Stress at Point (2)

d = 8.00"
T = 799,987 in.-lb.
F_a = 14,404 lb.
α = 1
K_t = 1.5"
K_m = 2.0"
M = 552,913 in.·lb.

Figure V-52

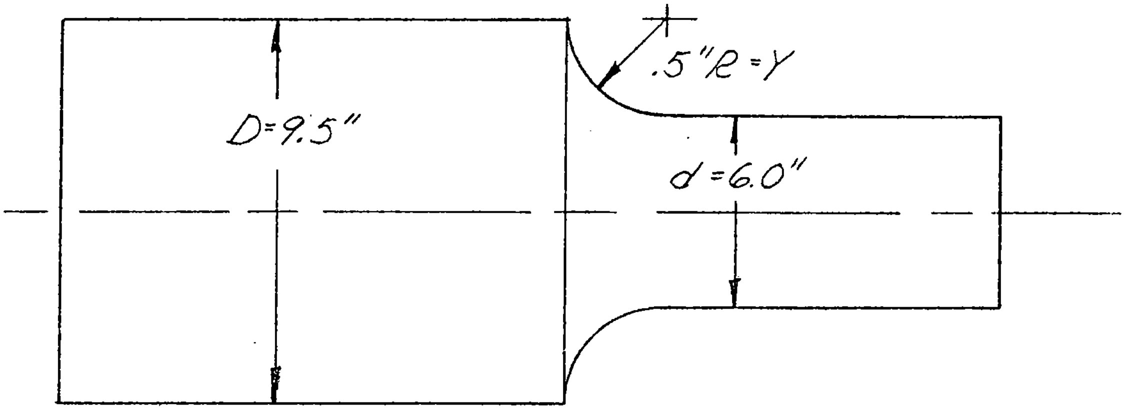
$$S_s = \left[\left(\frac{(1.5)(16)(799,987)}{\pi\ (8.00)^3}\right)^2 + 1/4\left(\frac{(2.0)(32)(552,913)}{\pi\ (8.00)^3} + \frac{(1)(4)(14,404)}{\pi\ (8.00)^3}\right)^2\right]^{\frac{1}{2}} = 16,244 \text{ psi.}$$

Stress At Point (1)

Since this portion of the shaft will be subjected to bending only the maximum tensile stress will be found by using the following equation:

$$S_t = \frac{M\ C\ K_t\ K_f}{I}$$

Where:
$C = d/2 = 3$
M = Maximum moment = 133,465 in.-lb.
$K_t = 1.75$
$I = d^4/64 = 63.6$ in.^{4}
K_f = Fatique and minor shock factor = 2.0



FROM SHIGLEY PAGE 617---IF $Y/d = .5/6 = .08$
AND $D/d = 9.5/6 = 1.6$ THEN $K_t = 1.75$

So: $S_t = \frac{(133,465)\ (3)\ (1.75)\ (2.0)}{63.6} = 22,034$ psi

The stress levels for points (1) and (2) are safe since the material yields at 60,000 psi and the required yield strength will be:

$$\frac{22,034}{.75} = 29,379 \text{ psi}$$

Bevel Pinion Shaft

The bevel pinion shaft will be subjected to torsion and bending. The stalling torque (407,401 in.-lb.) will exert the torsion. The thrust and radial components of the tooth load will exert the bending force.

The tangential force at the middle of the bevel pinion teeth will be:

$$F_t = \frac{407,401}{18.5} = 22,022 \text{ lb.}$$

The radial force due to the tooth load on the bevel pinion will be:

$$F_r = 22,022 \ (\tan 20.000)\ (\cos 26.054)$$

Where: 20.0° = tooth pressure angle
26.054° = pitch angle

$$F_r = 22,022 \ (.36397)\ (.8984)$$

$$= 7200 \text{ lb.}$$

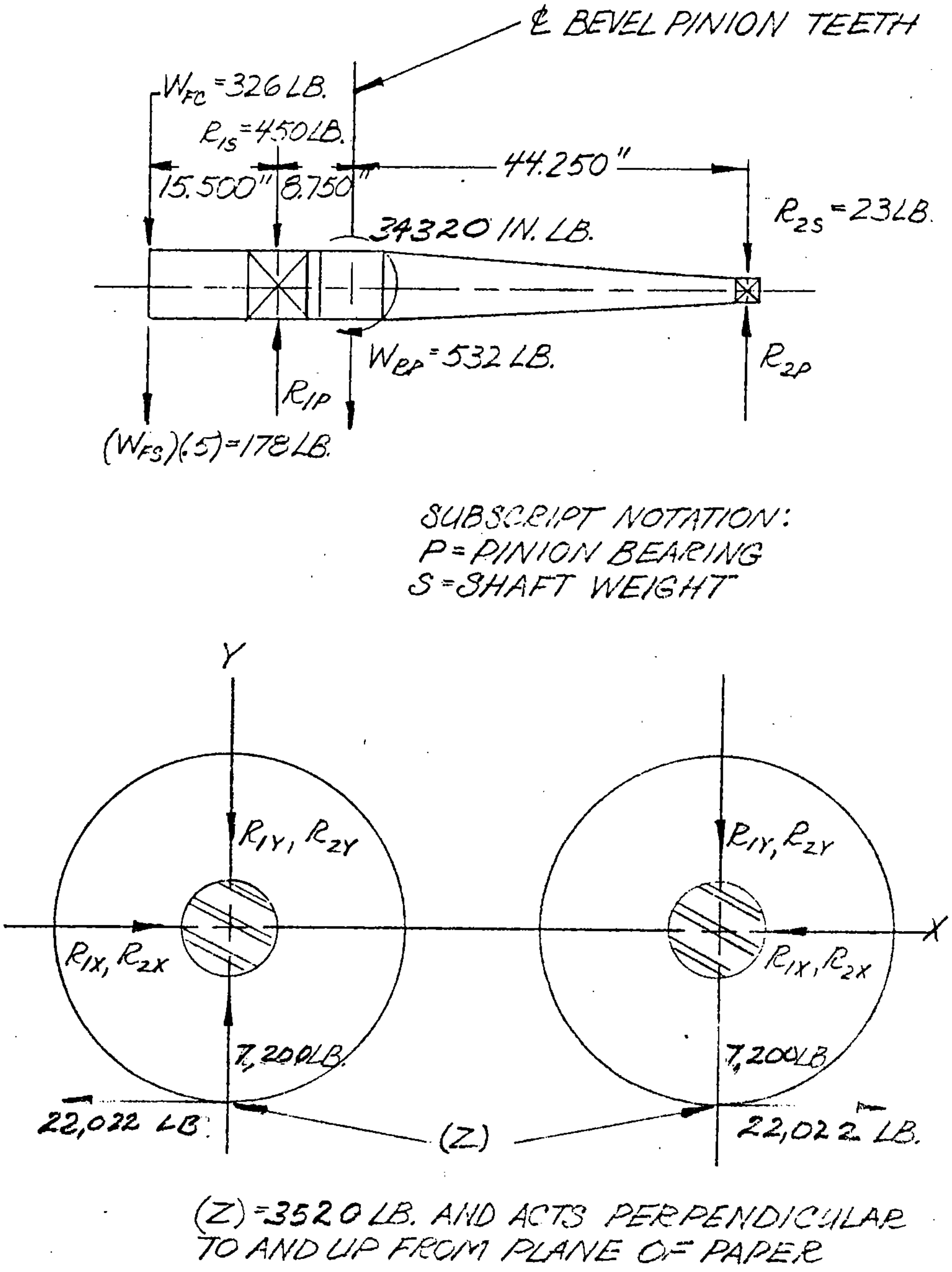
The thrust force due to the tooth load on the bevel pinion will be:

$$F_n = 22,022 \ (\tan 20.000)\ (\sin 26.054)$$

$$= 22,022 \ (.36397)\ (.4392)$$

$$= 3520 \text{ lb.}$$

BEVEL PINION SHAFT



Gate Closing

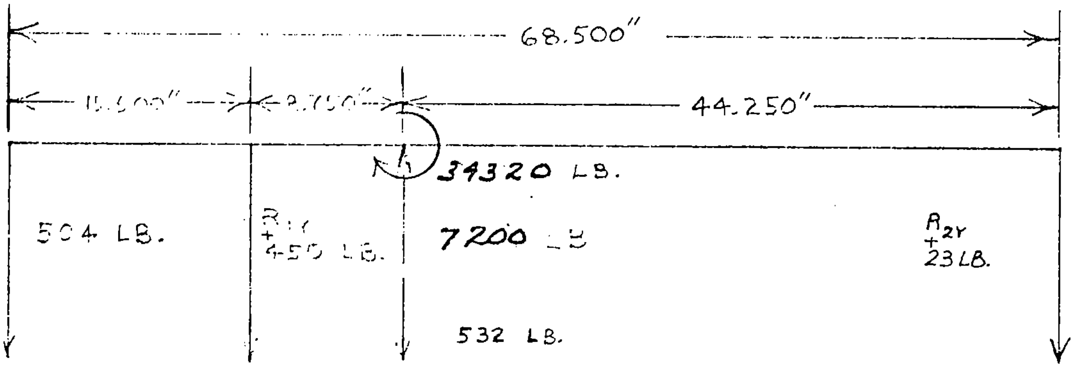
Gate Opening

(View from outside of gear cage)

Figure V-55

BENDING FORCES ON SHAFT

(y direction)



Forces

(Gate opening and gate closing)

$$\Sigma M_{R1y} = (504)\,(15.5) - 532\,(8.75) - (23)\,(53.00) - R_{2y}\,(44.25)$$
$$- 34,320 + (7200)\,(8.75)$$

$$R_{2y} = \frac{-4655 - 1219 + 7812 - 34,320 + 63,000}{53.00} = 578 \text{ lb.}$$

$$\Sigma M_{R2y} = (504)\,(68.5) + (450)\,(53.00) + R_{1y}\,(53.00)$$

$$+ 532\,(44.25) - 34,320 - (7200)\,(44.25)$$

$$R_{1y} = \frac{-34524 - 23850 - 23,541 + 34,320 + 318,600}{53.00}$$

$$R_{1y} = 5113 \text{ lb.}$$

Calculation Check:

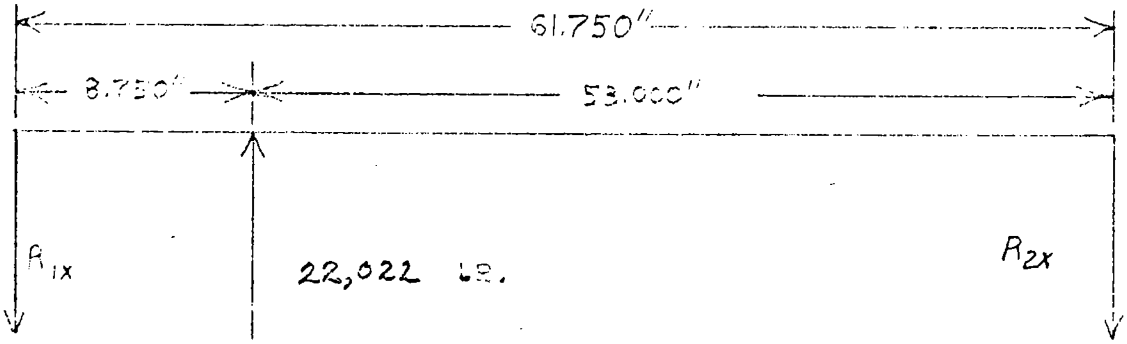
$$7200 - 504 - 450 - 532 - 23 - 578 = R_{1y} = 5113 \text{ lb.}$$

Figure V-56

X Direction

The reactions at the centers of the shaft bearings, gate closing, in the x direction will be the same in magnitude but opposite in direction with respect to the reactions during the opening of the gate.

The reactions at the centers of the shaft bearings, gate opening, will be:



Forces
(Gate opening)

$$\Sigma M_{R1x} = (22,022)(8.75) - R_{2x}(61.75)$$

$$R_{2x} = \frac{(22,022)(8.75)}{61.75} = 3121 \text{ lb.}$$

$$\Sigma M_{R2x} = (22,022)(53) + R_{1x}(61.75)$$

$$R_{1x} = \frac{(+22,022.)(53)}{61.75} = 18,901 \text{ lb.}$$

Calculation Check:

$$22,022 - 3121 = R_{1x} = 18,901 \text{ lb.}$$

Figure V-57

The shear moment diagram in the X direction will be:

(Gate opening)

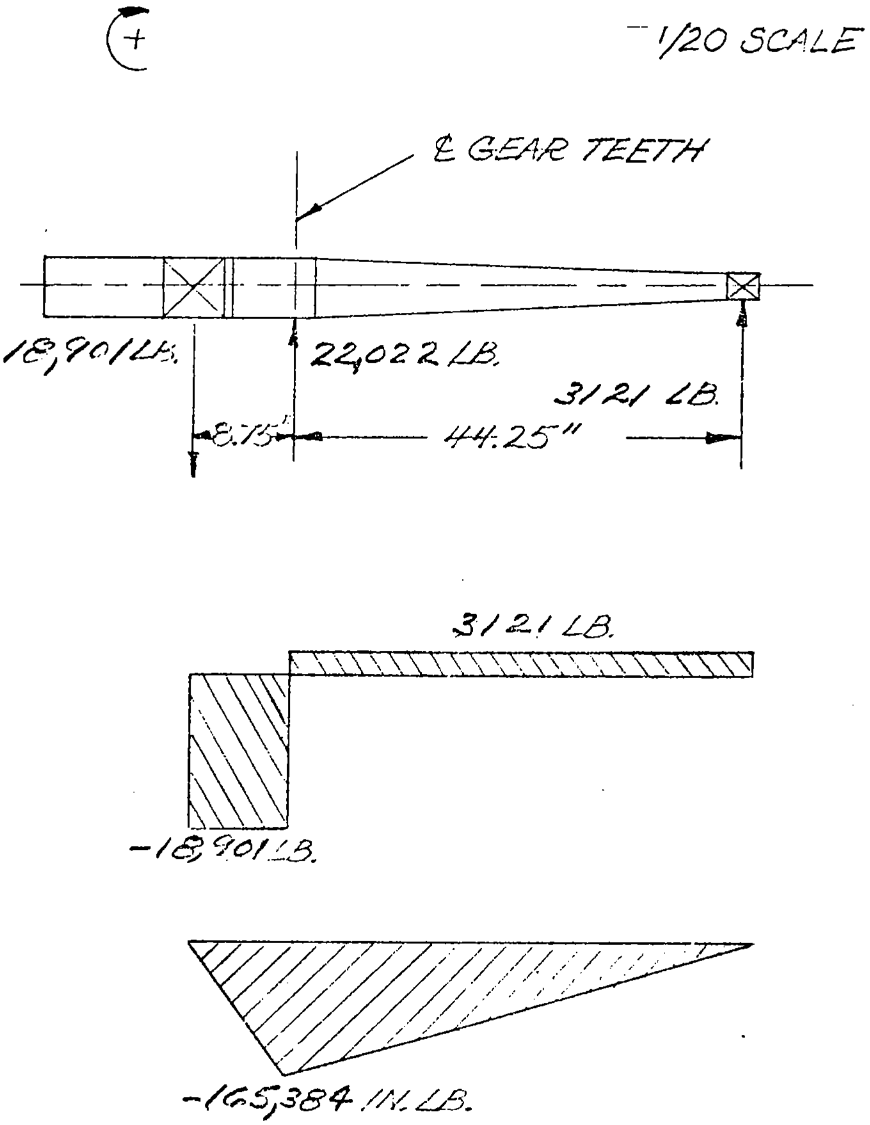


Figure V-58

The shear moment diagram in the Y direction will be:

(Gate opening and gate closing)

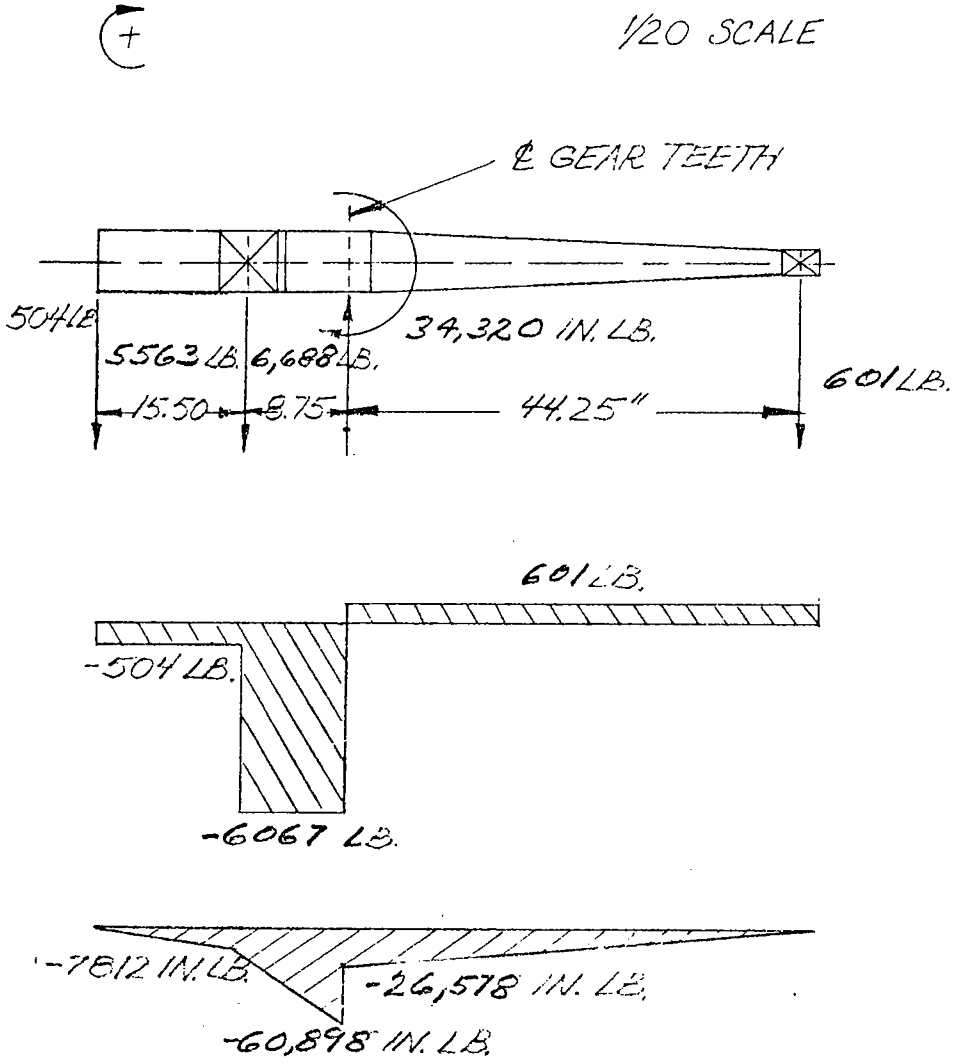


Figure V-59

The resultant maximum bending moment on the shaft will be:

$$M_{max} = \left((M_x)^2 + (M_y)^2\right)^{1/2}$$

$$= \left((165,384)^2 + (60,898)^2\right)^{1/2}$$

$$= 176,240 \text{ in.-lb.}$$

Knowing the stalling torque of 407,401 in.-lb. and the maximum bending moment of 176,240 in.-lb., the maximum shearing stress will be determined using the same equation that was used to calculate the stresses in the vertical shaft.

Where: All constants are the same and the thrust is infinitely small.

So:

$$S_s = \left(\left(\frac{(1.5)(16)(407,401)}{\pi \quad (6.5)^3}\right)^2 + 1/4 \left(\frac{(2.0)(32)(176,240) + 0}{\pi \quad (6.5)^3}\right)^2\right)^{1/2}$$

$$= 13,083 \text{ psi}$$

Material yield strength of $\frac{13,083}{.75}$ = 17,444 psi will be required and the material chosen yields at 60,000 psi.

Floating Shaft

A shaft extension will be provided to couple the bevel pinion shaft to the speed reducer using single engagement gear type couplings.

A 6 1/2" diameter shaft of A 434-60T cold finished class B-B steel will be used.

The stress in this shaft will be due to torsion only since the shaft will be 6 1/2" in diameter and 38" long and bending can be neglected. This is a good assumption because the shaft's weight produces the only bending moment.

The stress will be:

$$S_s = \frac{K_t \; 16T}{\pi \; d^3}$$

Where: K_t = 1.5 for torsion (suddenly applied minor shock load)
T = 407,401 in.-lb. (stalling torque)
d = 6.5 (diameter of shaft)

$$S_s = \frac{(1.5)(16)(407,401)}{\pi \, (6.5)^3} = 11,333 \text{ psi}$$

The required yield point will be:

$$\frac{11,333}{.75} = 15,111 \text{ psi}$$

The material assumed for the shaft will have a yield strength of 75,000 psi

SHAFT - KEY STRESS CALCULATIONS

Figure V-62

GENERAL COMMENTS

Square keys of C-1020 cold drawn steel will be selected. The distortion energy shear theory will be used to determine the stress levels allowable. This theory will give us the safest estimate of maximum stress levels. Key thicknesses of about 1/4 of the shaft diameter will be assumed.

The distortion energy theory states:

$S_{sy} = .577\ S_y$

Where:

S_{sy} = Yield strength for shear

S_y = Yield strength for tension

Tensile yield strength for C-1020 steel = 65,000 psi

The maximum yield strength (tensile) allowable will be:

(.75)(65,000 = 48,750 psi

The maximum shear stress allowable will be:

$S_{sy} = (.577)(48,750) = 28,129$ psi

For failure by shear reference will be made to Shigley (Page 265)

Failure by crushing will also be checked against an allowable stress level of 48,750 psi.

Figure V-63

Failure by Shear

$$S_s = \frac{F}{tl}$$

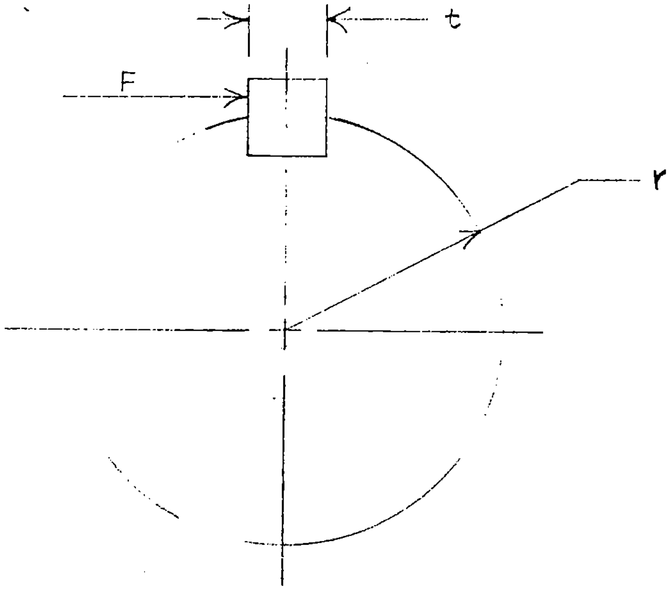
Where:

S_s = Shear stress present

$F = \frac{T}{r} = \frac{\text{Torque}}{\text{Radius of shaft}}$

t = Thickness of key

l = Length of key



Failure by Crushing

$$S_s = \frac{F}{tl/2}$$

This stress indicates the stress at which face deformation will occur on the key. This stress will always be twice the stress indicated by the "failure by shear" test.

Figure V-64

Idler Gear Key

Since the idler shaft will not transmit torque and the idler gear will form a press fit on it a key will not be used on this shaft.

Spur Gear Key

Failure by shear

$$S_s = \frac{F}{tl}$$

$$F = \frac{799,987}{4.75} = 168,418 \text{ lb.}$$

$$t = 1/4\,(9.5) = 2.3'' \text{ (use } 2.0'')$$

$$l = 5.5''$$

$$S_s = \frac{168,418}{(2.0)(5.5)} = 15,311$$

Stress level allowable = 28,129 psi

Failure by crushing

$$S_s = (15,311)\,(2) = 30,622 \text{ psi}$$

Stress level allowed = 48,750 psi

Bevel Gear Key

Failure by shear

$$S_s = \frac{F}{tl}$$

$$F = \frac{799,987}{3.688} = 216,916 \text{ lb.}$$

Failure by shear - cont.

$t = (1/4)(D) = 1.84''$

$l = 7.0''$

$$S_s = \frac{216,916}{(1.84)(7.0)} = 16,841 \text{ psi}$$

Stress level allowable = 28,129 psi

Failure by crushing

$$S_s = (16,841)(2) = 33,683 \text{ psi}$$

Stress level allowable = 48,750 psi

Bevel Pinion Key

Failure by shear

$$S_s = \frac{F}{tl}$$

$$F = \frac{407,401}{3.25} = 125,354 \text{ lb.}$$

$t = 1/4\,(D) = 1.625''$ (use 1.5'')

$l = 7.5''$

$$S_s = \frac{125,354}{(1.5)(7.5)} = 11,143 \text{ psi}$$

Stress level allowable - 28,129 psi

Failure by crushing

$$S_s = (11,143)(2) = 22,285 \text{ psi}$$

Stress level allowable = 48,750 psi

Figure V-66

Coupler Keys

(A Lovejoy, flange type, double engagement, size 55 coupler will be selected.)

The coupler has a maximum torque rating of 642,000 in.-lb. and the stalling torque for pinion shaft will be 407,401 in.-lb.

Failure by shear

$$S_s = \frac{F}{tl}$$

$$F = \frac{407,401}{3.25''} = 125,354 \text{ lb.}$$

$$t = 1.5''$$

$$l = 6.625''$$

$$S_s = \frac{125,354}{(6.625)(1.5)} = 12,614 \text{ psi}$$

Stress level allowable - 28,129 psi

Failure by crushing

$$S_s = (12,614)\ 2 = 25,229 \text{ psi}$$

Stress level allowable = 48,750 psi

BEARING STRESS CALCULATIONS

Figure V-68

GENERAL COMMENTS

Since the right angle drive units may be partially submerged during periods of high water, force feed grease lubricated journal bearings will be selected.

The bearings will be made from bronze ASTM designation B22-61 alloy C, which has a maximum allowable pressure of 1,000 psi.

Idler Gear Shaft Bearings

The projected area of each bearing will be:

$$6'' \times 7'' = 42 \text{ in.}^2$$

The load on each bearing will be:

$$F = 44,341 \text{ lb.}$$

The compressive stress on each bearing will be:

$$\frac{44,341}{42} = 1056 \text{ lb.}$$

This stress is within reasonable limits of the allowable stress levels.

Spur and Bevel Gear Shaft Bearings

Lower Bearing

The bearing projected area will be: $7.0'' \times 6.0'' = 42 \text{ in.}^2$

The maximum bearing load will be:

(Gate opening)

$$F = \left((37,196)^2 + (8401)^2\right)^{1/2}$$

$$= 38,133 \text{ lb.}$$

(Gate closing)

$$F = \left((22,400)^2 + (22,961)^2\right)^{1/2}$$

$$= 32,078 \text{ lb.}$$

Lower bearing - cont.

The case when the gate is opening applies the largest force.

The compressive stress will be:

$$\frac{38,133}{42} = 908 \text{ psi}$$

Allowable maximum stress - 1,000 psi

Upper bearing

Bearing projected area will be: 8.0" x 8.0" = 64 in.^{2}

The maximum bearing load will be:

(Gate closing)

$$F = \left((29,129)^2 + (51,236)^2\right)^{1/2} = 58,937 \text{ lb.}$$

(Gate opening)

$$F = \left((59,195)^2 + (27,624)^2\right)^{1/2}$$

$$= 65,323 \text{ lb.}$$

The case when the gate will be opened applies the largest force.

$$F = 65,323 \text{ lb.}$$

The compressive stress will be:

$$\frac{65,323}{64} = 1021 \text{ psi}$$

This stress is within reasonable limits of the allowable stress levels.

Figure V-70

Bevel Pinion Shaft Bearings

(Larger bearing)

The bearing projected area will be: 6.5" x 7.0" = 45.5 in.^{2}

The maximum bearing load will be:

$$F = \left((5,563)^2 + (18,901)^2\right)^{1/2}$$

$$= 19,703 \text{ lb.}$$

The compressive stress will be:

$$\frac{19,703}{45.5} = 433 \text{ psi}$$

The allowable maximum stress = 1,000 psi

(Smaller bearing)

The bearing projected area will be: 3.0" x 2.5" = 7.5 in.^{2}

The maximum bearing load will be:

$$F = \left((601)^2 + (3,131)^2\right)^{1/2}$$

$$F = 3178 \text{ lb.}$$

The compressive stress will be:

$$\frac{3178}{7.5} = 706 \text{ psi}$$

The allowable maximum stress = 1,000 psi

Idler Gear Thrust Bearing

The thrust load will be due to the weight of the idler gear and idler shaft.

The thrust will be:

W_i = 3,196 lb.

W_{is} = 247 lb.

Thrust = 3,196 + 247 = 3,443 lb.

The area of the thrust bearing will be:

$$\pi\left(\frac{(10.5)^2 - (7.0)^2}{4}\right) = 48 \text{ in.}^2$$

The bearing stress will be:

$$\frac{3443}{48} = 71 \text{ psi}$$

The allowable maximum stress = 1,000 psi

Spur and Bevel Gear, Shaft Thrust Bearing

The thrust load will be due to the thrust load on the bevel gear teeth and the weight of the spur gear, the bevel gear, and the shaft.

The thrust load will be:

T_b = (Bevel gear tooth thrust) 13,415 lb.

W_b = 837 lb.

W_s = 700 lb.

W_{bs} = 563 lb.

Thrust = 13,415 + 837 + 700 + 563

= 15,515 lb.

The area of the thrust bearing will be:

$$\frac{\pi\left((10.5)^2 - (7.0)^2\right)}{4} = 48 \text{ in.}^2$$

The bearing stress will be :

$$\frac{15,515}{48} = 323 \text{ psi}$$

The allowable maximum stress = 1,000 psi

Bevel Pinion Shaft Bearing

The load on the thrust bearing will be due to the thrust from the tooth load on the bevel pinion.

The thrust will be: 3520 lb.

The bearing area will be:

$$\frac{\pi\left((10.5)^2 - (6.5)^2\right)}{4} = 53 \text{ in.}^2$$

The bearing stress will be:

$$\frac{3520}{53} = 66 \text{ psi}$$

The allowable maximum stress = 1,000 psi

WEIGHT CALCULATIONS

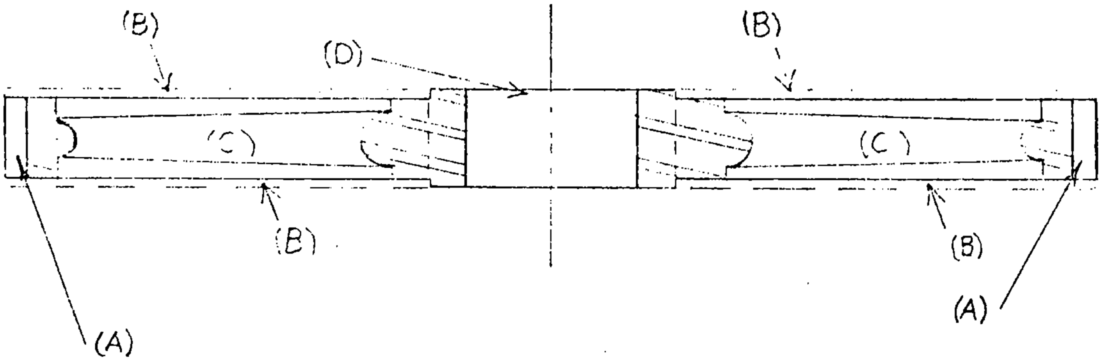
Figure V-74

ASSUMPTIONS

1. The volume occupied by gear teeth will be 50% metal.
2. The volume occupied by webs will be 50% metal.
3. The density of steel will be considered as being .282 lb./in.^{2}
4. The term (total volume) will be used to describe the volume outlined by the outermost dotted line.
5. Volume of the teeth will be found by rotating the cross sectional area of one tooth 360° at the radius of the gear in question.

Figure V-75

IDLER GEAR WEIGHT



$$W_i = \left(\overset{\text{(total volume)}}{\frac{\pi (60.0)^2 \; 5.5}{4}} - \overset{\text{(A)}}{\frac{\pi \left((60.0)^2 - (56.0)^2\right) (45)(.5)}{4}} \right.$$

$$- \overset{\text{(B)}}{\frac{\pi \left((60.0)^2 - (13.5)^2\right) (.5)\, 2}{4}} - \overset{\text{(C)}}{\frac{\pi \left((56.0)^2 - (13.5)^2\right) (4.5)(.5)}{4}}$$

$$\left. - \overset{\text{(D)}}{\frac{\pi (9.5)^2 \; 5.5}{4}} \right) .282$$

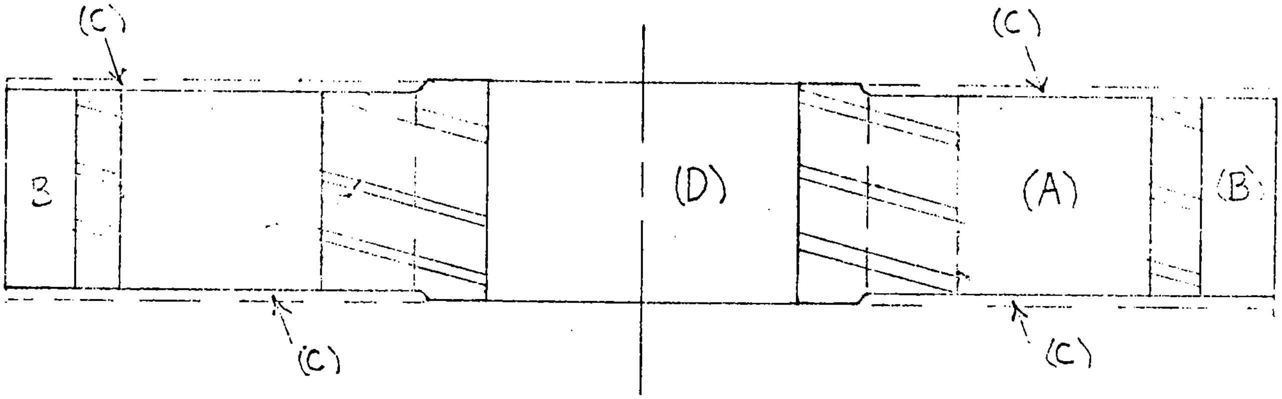
$$W_i = (\overset{\text{(total volume)}}{15,551} - \overset{\text{(A)}}{820} - \overset{\text{(B)}}{2684} - \overset{\text{(C)}}{322} - \overset{\text{(D)}}{390})\ .282$$

$$= (11,335)(.282)$$

$$= 3196 \text{ lb.}$$

Figure V-76

SPUR GEAR WEIGHT



$$W_s = \left(\overset{\text{(total volume)}}{\frac{\pi (35.5)^2\ 5.5}{4}} - \overset{\text{(A)}}{\frac{\pi \left((33.25)^2 - (13.0)^2\right)(5)(.5)}{4}} \right.$$

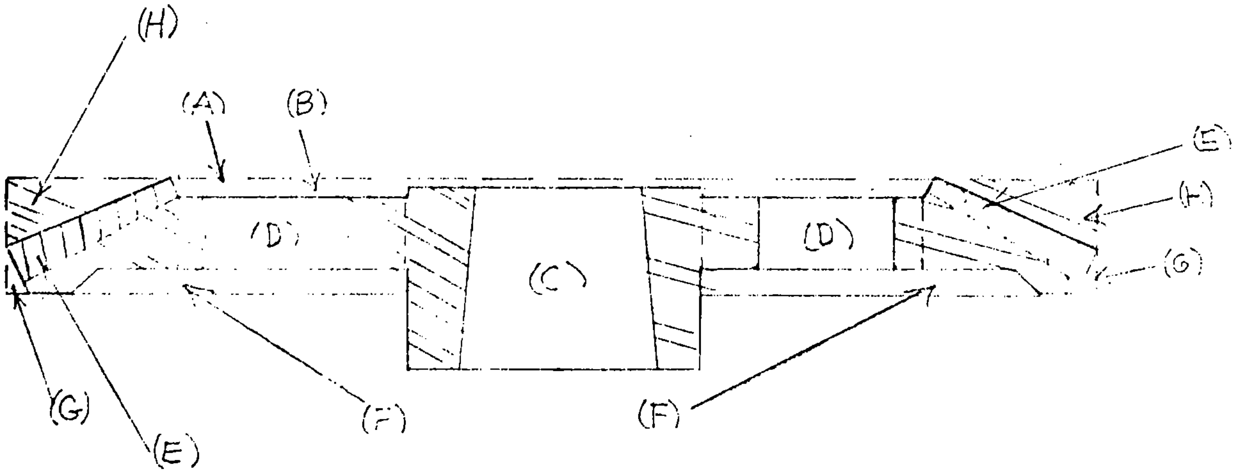
$$- \overset{\text{(B)}}{\frac{\pi \left((35.5)^2 - (33.25)^2\right)\ (5)(.5)}{4}}$$

$$\left. - \overset{\text{(C)}}{\frac{\pi \left((35.5)^2 - (13.0)^2\right)\ (.25)(2)}{4}} - \overset{\text{(D)}}{\frac{\pi (9.5)^2\ (5.5)}{4}} \right) .282$$

$$W_s = (\overset{\text{(total volume)}}{5444} - \overset{\text{(A)}}{1839} - \overset{\text{(B)}}{304} - \overset{\text{(C)}}{429} - \overset{\text{(D)}}{390})\ .282 = 700 \text{ lb.}$$

Figure V-77

BEVEL GEAR WEIGHT



$$W_b = \Bigg(\overset{\text{(total volume)}}{\frac{\pi(43.75)^2\ 5.5}{4}} - \overset{\text{(A)}}{\frac{\pi(32.25)^2\ (1.2)}{4}} - \overset{\text{(B)}}{\frac{\pi\left((31.5)^2 - (12.0)^2\right)(.25)}{4}}$$

$$- \overset{\text{(C)}}{\frac{\pi(8.00)^2\ 7.25}{4}} - \overset{\text{(D)}}{\frac{\pi\left((31.5)^2 - (12.0)^2\right)(3.0)(.5)}{4}}$$

$$- \overset{\text{(E)}}{(12.25)(\pi)(38.75)(.5)} - \overset{\text{(F)}}{\frac{\pi\left((40.0)^2 - (12.0)^2\right)}{4}}$$

$$- \overset{\text{(G)}}{\frac{\left((43.75)^2 - (43.5)^2\right)(2)(.5)}{4}} - \overset{\text{(H)}}{\frac{\left((43.75)^2-(33.0)^2\right)(.5)(3)}{4}}\Bigg)\ .282$$

Figure V-78

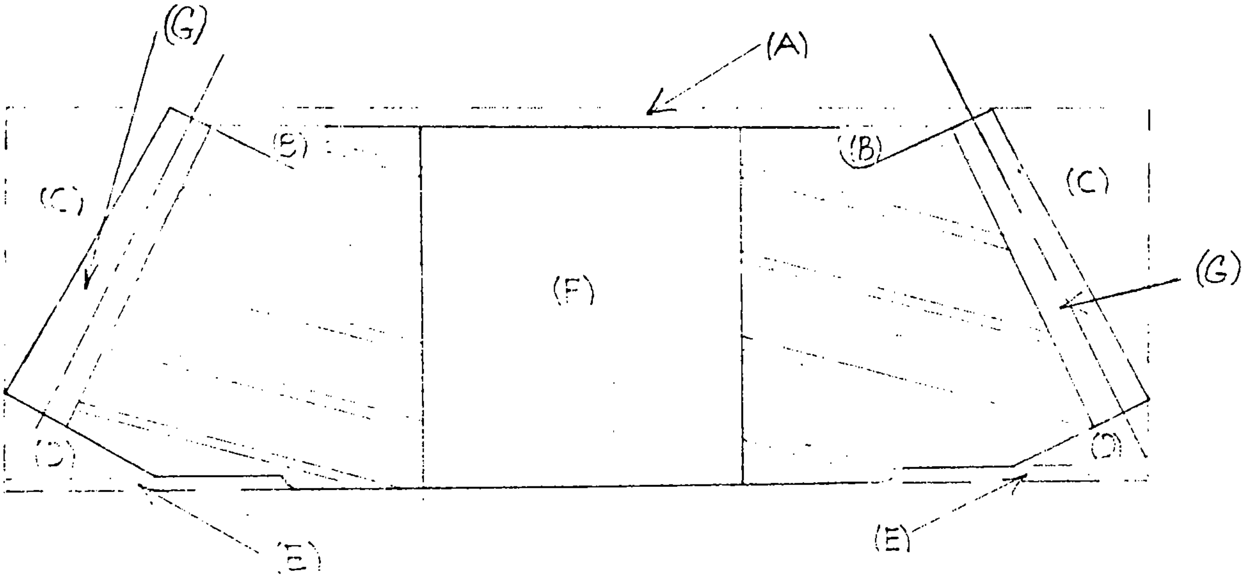
BEVEL GEAR WEIGHT
(Cont.)

$$W_b = (\overset{\text{(total volume)}}{8268} - \overset{(A)}{980} - \overset{(B)}{167} - \overset{(C)}{364} - \overset{(D)}{999} - \overset{(E)}{746}$$

$$-\overset{(F)}{1144} - \overset{(G)}{17} - 972)\ .282 = 837\ \text{lb.}$$

Figure V-79

BEVEL GEAR PINION WEIGHT



$$W_{bp} = \Bigg(\overset{\text{(total volume)}}{\frac{\pi\,(23.75)^2\; 8.0}{4}} - \overset{\text{(A)}}{\frac{\pi\,(16.0)^2\,(.5)}{4}} - \overset{\text{(B)}}{\frac{\pi\Big((15.25)^2 - (10.5)^2\Big)\,(1.0)(.5)}{4}}$$

$$- \overset{\text{(C)}}{\frac{\pi\Big((23.75)^2 - (17.0)^2\Big)\;(6.0)(.5)}{4}} - \overset{\text{(D)}}{\frac{\pi\Big((23.75)^2 - (17.5)^2\Big)\,(2.0)(.5)}{4}}$$

$$- \overset{\text{(E)}}{\frac{\pi\Big((23.75)^2 - (12.5)^2\Big)\;(.25)(.5)}{4}} - \overset{\text{(F)}}{\frac{\pi\,(6.5)^2\,(7.5)}{4}}$$

$$- \overset{\text{(G)}}{\pi(19.25)\,(12.25)\,(.5)}\Bigg)\;.282$$

Figure V-80

BEVEL GEAR PINION WEIGHT
(Cont.)

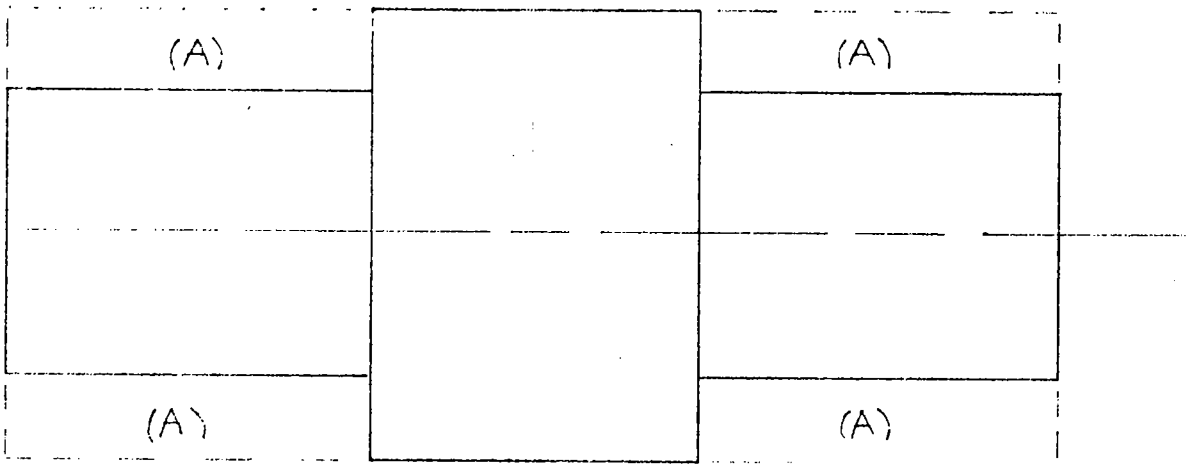
$$W_{bp} = (\overset{\text{(total volume)}}{3544} - \overset{(A)}{101} - \overset{(B)}{48} - \overset{(C)}{648} - \overset{(D)}{2\text{-}2} - \overset{(E)}{40} - \overset{(F)}{249}$$

$$- \overset{(G)}{370})\ .282$$

$$= 532 \text{ lb.}$$

Figure V-81

IDLER SHAFT WEIGHT



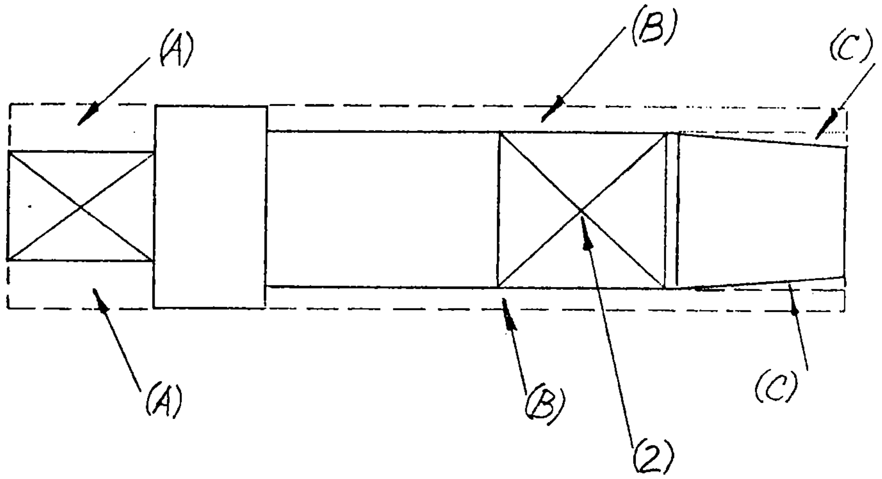
$$W_{is} = .282\left(\overset{\text{(total volume)}}{\frac{\pi\,(9.5)^2\;21.4}{4}} \qquad - \qquad \frac{\pi\left((9.5)^2 - (6.0)^2\right)(7.5)(2)}{4}\right)$$

$$= .282\;(\;\;1517 \qquad \overset{\text{Total Volume}}{} \qquad - \qquad \overset{\text{(A)}}{639})$$

$$= 247\ \text{lb.}$$

Figure V-82

BEVEL GEAR SHAFT WEIGHT



$$W_{bs} = \Bigg(\overset{\text{(total volume)}}{\frac{\pi (9.5)^2 \quad 41}{4}} - \overset{\text{(A)}}{\frac{\pi\left((9.5)^2 - (6.0)^2\right) \quad 7.0}{4}}$$

$$- \overset{\text{(B)}}{\frac{\pi\left((9.5)^2 - (8.0)^2\right) \quad 27}{4}} - \overset{\text{(C)}}{\frac{\pi\left((8.0)^2 - (7.4)^2\right) \quad 7.25}{4}} \Bigg) \; .282$$

$$= \overset{\text{(total volume)}}{(2906} \quad - \overset{\text{(A)}}{298} - \overset{\text{(B)}}{557} - \overset{\text{(C)}}{53} \quad .282$$

$$= (\ 1998\ )\ (.282) \ = \ 563 \text{ lb.}$$

Figure V-83

BEVEL GEAR SHAFT WEIGHT
(Cont.)

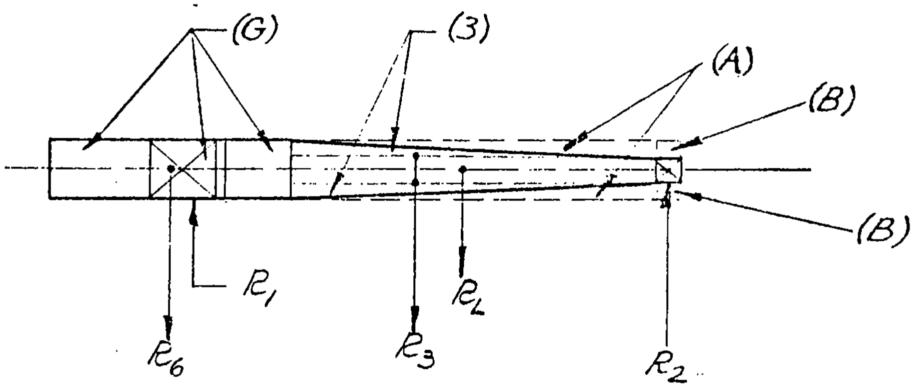
$$W_{bs} \text{ (Above Point 2)} = .282\left(\frac{\pi (8.0)^2 (11.75)}{4} - \frac{\pi \left((8.0)^2 - (7.4)^2\right) 7.25}{4}\right)$$

$$= (591 - 53)\ .282$$

$$= 152 \text{ lb.}$$

Figure V-84

BEVEL PINION SHAFT WEIGHT



$$W_{bps} = .282\left(\overset{\text{(total volume)}}{\frac{\pi(6.5)^2\ 70}{4}} - \overset{A}{\frac{\pi(6.5)^2 - (2.5)^2}{4}}\right)\underline{(39.75)(.5)}$$

$$- \overset{B}{\frac{\pi(6.5)^2 - (2.5)^2\ 3}{4}}$$

$$= (2323 - 562 - 85)\ .282$$

$$= 473 \text{ lb.}$$

$$\underset{\circlearrowright +}{\Sigma M_{r2}} = \pi\left(\frac{(2.5)^2\ \overset{R_1}{(41.25)^2}}{(4)(2)}\right)\ .282$$

$$+ \pi\left(\frac{(6.5)^2 - (2.5)^2}{4}\right)^{R_3}\underline{(39.75)(.282)(27.99)}$$

$$+ \frac{\pi(6.5)^2\ \overset{R_g}{(27)(.282)}}{4}\quad 54.75 \quad - \quad R_1\ (53.00)$$

$$R_1 = \frac{1178 + 8871 + 13833}{53.00} = 450 \text{ lb.}$$

Figure V-85

BEVEL PINION SHAFT WEIGHT
(Cont.)

Total Weight = 473 lb. so R_2 will be:

$$473 - 450 = 23 \text{ lb.} = R_2$$

WEIGHT OF FLOATING SHAFT COUPLER

Solid Hub Weight = 470 lb.

Acutal Weight with 6.5" bore will be =

$$W_{fc} = 470 - \frac{\pi(6.5)^2 (6.625)(2)(.282)}{4}$$

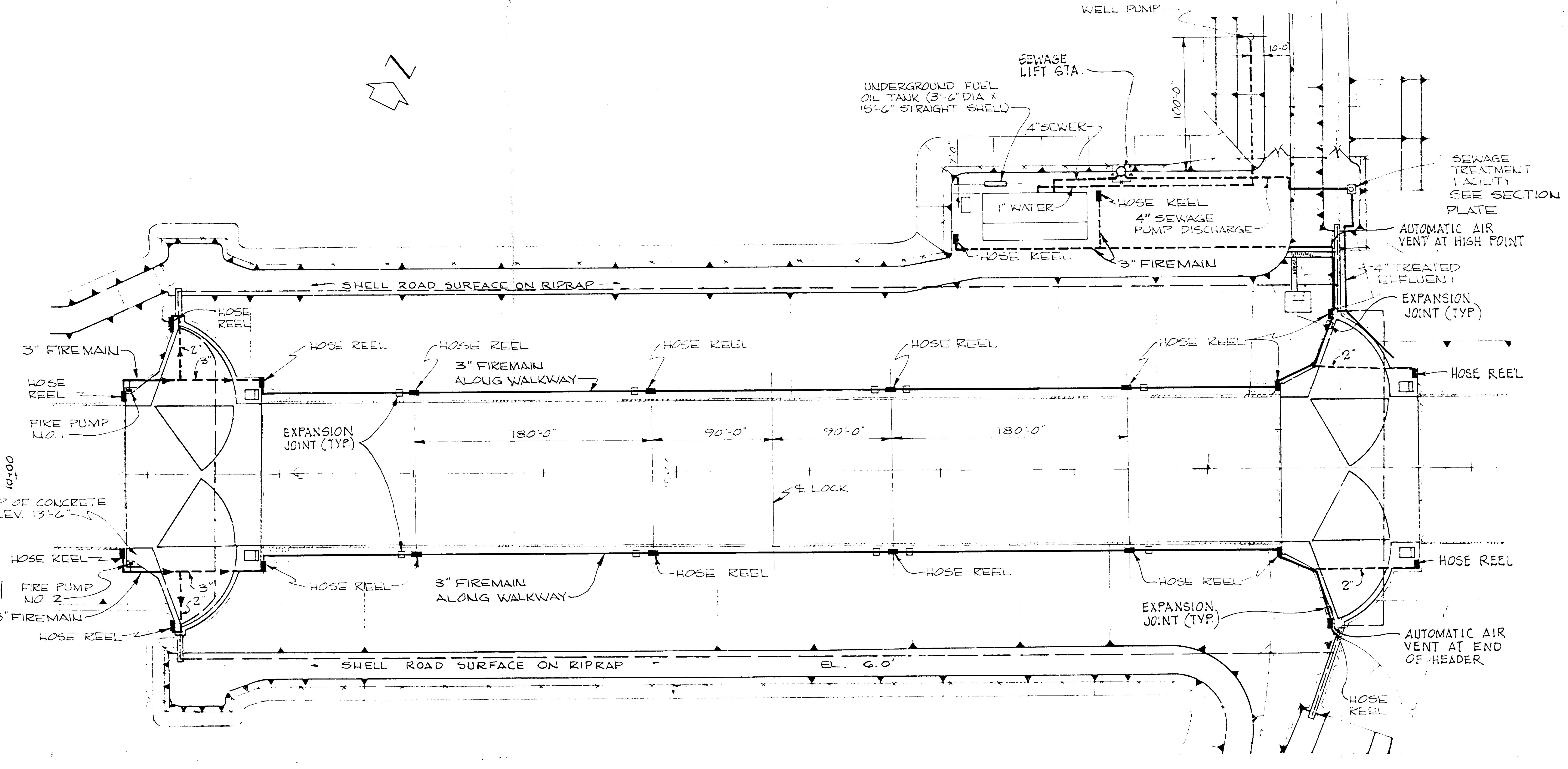
$$= 470 - 124$$

$$= 326 \text{ lb.}$$

WEIGHT OF FLOATING SHAFT

$$W_{fs} = \frac{\pi (6.5)^2 (38)(.282)}{4} = 356 \text{ lb.}$$

Figure V-86



FIRE PROTECTION SYSTEM
FIRE PUMPS
QUANTITY: 2.
CAPACITY: 100 GPM EACH AT 100 PSIG.
TYPE: VERTICAL TURBINE, 15 HP MOTOR(ESTIMATED); 460 VOLTS, 3 PHASE, 3600 RPM.
HOSE REELS
TYPE: HEAVY DUTY STEEL CONSTRUCTION; GEARED CRANK REWIND; 1 1/2" INLET AND OUTLET; CHROMED ROLLER AND SPOOL ASSEMBLY.
HOSE: 150 FEET OF 1 1/2" DIAMETER HOSE PER REEL.
NOZZLES: COMBINATION FOG AND STRAIGHT STREAM.

POTABLE WATER SUPPLY SYSTEM
WELL PUMP
CAPACITY: 10 GPM MINIMUM.
TOTAL HEAD: 775 FT.(ESTIMATED).
ESTIMATED MOTOR HORSEPOWER: 5.
460 VOLTS, 3-PHASE, 3450 RPM.
WELL
CASING PIPE: 6" DIAMETER.
DEPTH OF WELL: 340-590 FT.(ZONE 1)
PNEUMATIC STORAGE TANK
SIZE: 36" DIAMETER BY 72" HIGH.
CAPACITY: 315 GALLONS
TANK PRESSURE: 50 PSIG MAXIMUM.
WATER HEATER
TYPE: ELECTRIC.
SIZE: 50 GALLONS

SEWAGE TREATMENT FACILITY
TYPE: EXTENDED AERATION PACKAGE PLANT.
CAPACITY: 1000 GALLONS PER DAY.

SEWAGE LIFT STATION
TYPE: HEAVY DUTY SCREENLESS WET PIT DUPLEX UNIT.
CAPACITY OF EACH PUMP: 60 GPM. AT ESTIMATED 27 FT. HEAD.
3" SOLIDS.
2 HP MOTORS (ESTIMATED).
460 VOLTS, 3-PHASE, 1150 RPM.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA.	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

OUTSIDE PIPING

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

DATE: SEPT., 1973
FILE NO. H-2-24419

PLATE VI

CONTROL DEVICE LEGEND

INDICATING LIGHT (B-BLUE, G-GREEN, R-RED, W-WHITE, Y-YELLOW)
FUSE
LIMIT SWITCH
T.C. TIMING RELAY CONTACT, TIMED CLOSING AFTER ENERGIZATION
T.O. TIMING RELAY CONTACT, TIMED OPENING AFTER DE-ENERGIZATION
DEVICE OPERATING COIL
SOLENOID
NORMALLY OPEN CONTACT
NORMALLY CLOSED CONTACT
PUSHBUTTON, NORMALLY OPEN
PUSHBUTTON, NORMALLY CLOSED

CONTROL DEVICE FUNCTION

C	BRAKE CONTACTOR
CR	EMERGENCY STOP RELAY
CS	GATE CONTROL SWITCH
CSN	NAVIGATION SIGNAL CONTROL SWITCH
CSS	GATE CONTROL SWITCH (FOR GATES AT OPPOSITE END OF LOCK)
GLS	GATE LIMIT SWITCH
M	HYDRAULIC PUMP STARTER
M_C	GATE CLOSING CONTROL CONTACTOR
M_G	NAVIGATION SIGNAL CONTROLLER (GREEN)
M_O	GATE OPENING CONTROL CONTACTOR
M_R	NAVIGATION SIGNAL CONTROLLER (RED)
NLS	NAVIGATION SIGNAL LIMIT SWITCH
OL	THERMAL OVERLOAD
PS	HYDRAULIC PUMP CONTROL SWITCH
PSS	HYDRAULIC PUMP CONTROL SWITCH (FOR GATES AT OPPOSITE END OF LOCK)
SS	GATE OPENING MODE SELECTOR SWITCH
SV1 SV2 SV3 SV4	HYDRAULIC PUMP CONTROL SOLENOIDS (SEE SOLENOID OPERATION DEVELOPEMENT CHART FOR SECTOR GATE SPEEDS)
SVP	SOLENOID FOR PRESSURE COMPENSATOR
TD	TIMING RELAY
X	AUXILIARY RELAY

1	DENOTES DEVICE AT CONTROL HOUSE NO. 1
2	DENOTES DEVICE AT CONTROL HOUSE NO. 2
3	DENOTES DEVICE AT CONTROL HOUSE NO. 3
4	DENOTES DEVICE AT CONTROL HOUSE NO. 4
*	NUMBER PREFIX TO CONTROL DEVICE INDICATES ASSOCIATED SECTOR GATE.

NOTES:

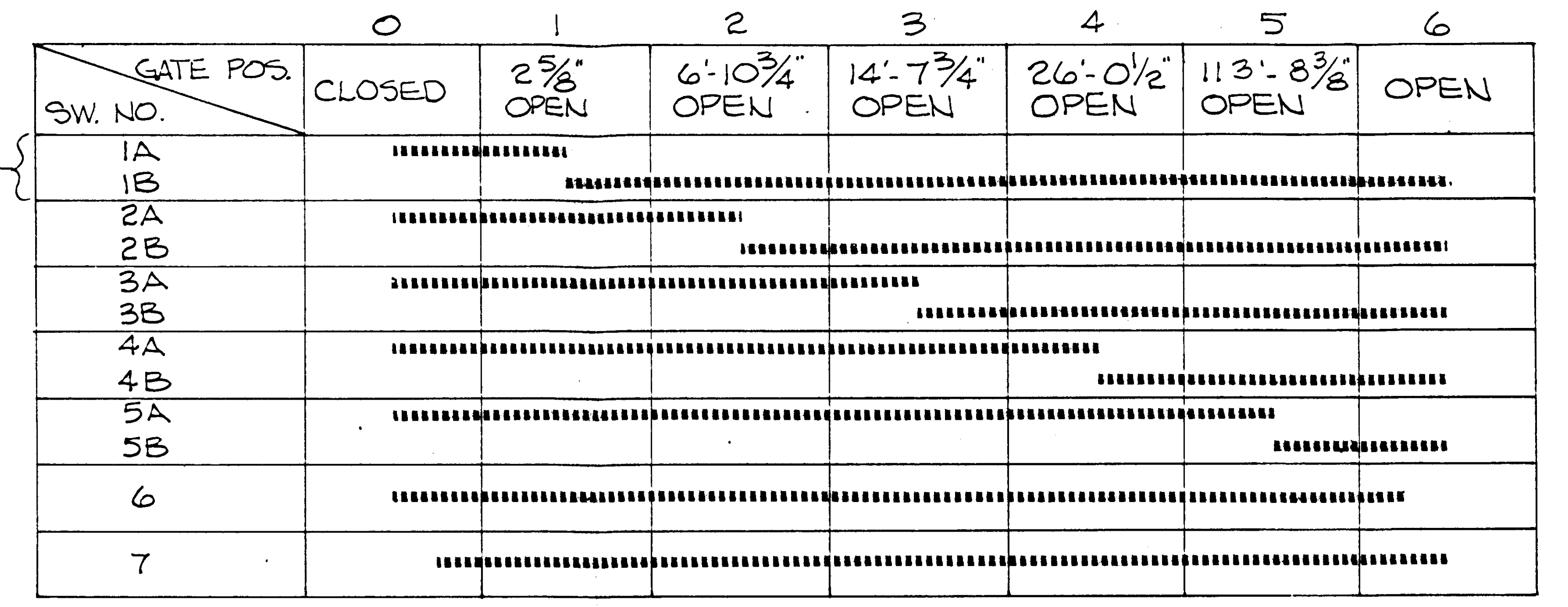
ALL DEVICES SHOWN ON THIS DRAWING ARE LOCATED IN CONTROL HOUSE NO. 1 UNLESS OTHERWISE NOTED. CONTROL SCHEMATIC SHOWN IS FOR SECTOR GATE NO. 1 SECTOR GATE NO. 3 IS SIMILAR.
SEE PLATE VI 3 FOR CONTROL SWITCH AND LIMIT SWITCH DEVELOPMENTS.

A JOINT VENTURE
B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA.
STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

GATE 1 CONTROL CIRCUIT

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1973
FILE NO H-2-24419



SECTOR GATE LIMIT SWITCH (DEVICE GLS)

(TRAVELING NUT OPERATED)

CONTACT *	Ø	OFF	1	INT.	2	INT.	3	INT.	4
1	2						X		X
3	4		X		X		X		X
5	6		X		X		X		
7	8								X
9	10						X		
11	12				X				
13	14		X						
15	16				X		X		X
17	18						X		X

(MAINTAINED POSITION SWITCH)

OPENING MODE SELECTOR SWITCH (DEVICE SS)

CONTACT \ POSITION	START	NEUTRAL	STOP
1	X		
2			X

(SPRING RETURN TO NEUTRAL)

HYDRAULIC PUMP MOTOR CONTROL SWITCH (DEVICE PS & PSS)

CONTACT \ POSITION		OPEN	NEUTRAL	CLOSE
*	1	X		
*	2			X
Ø	3	X		
Ø	4			X

(SPRING RETURN TO NEUTRAL)

SECTOR GATE CONTROL SWITCH (DEVICE CS & CSS)

CONTACT \ POSITION		BYPASS	NORMAL
*	1	X	
Ø	2	X	

GATE INTERLOCK BYPASS SWITCH

OPERATING MODE \ SOLENOID		EMERG. STOP	OPEN	SVP	SV1	SV2	SV3	SV4	CLOSE
SYSTEM OFF									
ELECTRIC MOTOR ON		X							
OPEN (GATE RPM)	.100	X	X					X	
	.030	X	X				X		
	.010	X	X			X		X	
	.002	X	X	X	X			X	
NORMAL STOP (OPEN) (ELECTRIC MOTOR ON)		X	X						
EMERG. STOP (OPEN) (ELEC. MOTOR MUST STAY ON)			X						
CLOSE (GATE RPM)	.100	X						X	X
	.002	X		X	X			X	X
NORMAL STOP (CLOSE) (ELECTRIC MOTOR ON)		X							X
EMERG. STOP (CLOSE) (ELEC. MOTOR MUST STAY ON)									X

HYDRAULIC PUMP SOLENOID OPERATION CHART

NOTES:

ALL DEVICES SHOWN ON THIS DRAWING ARE LOCATED IN CONTROL HOUSE NO. 2 UNLESS OTHERWISE NOTED.
CONTROL SCHEMATIC SHOWN IS FOR SECTOR GATE NO. 2, SECTOR GATE NO. 4 IS SIMILAR.
SEE PLATE VI 2 FOR "DEVICE LEGEND" AND "DEVICE FUNCTION".
* INDICATES CONTACTS USED WITH GATE 1 CONTROLS
Ø INDICATES CONTACTS USED WITH GATE 2 CONTROLS
X INDICATES CONTACTS CLOSED OR SOLENOID ENERGIZED.

A JOINT VENTURE

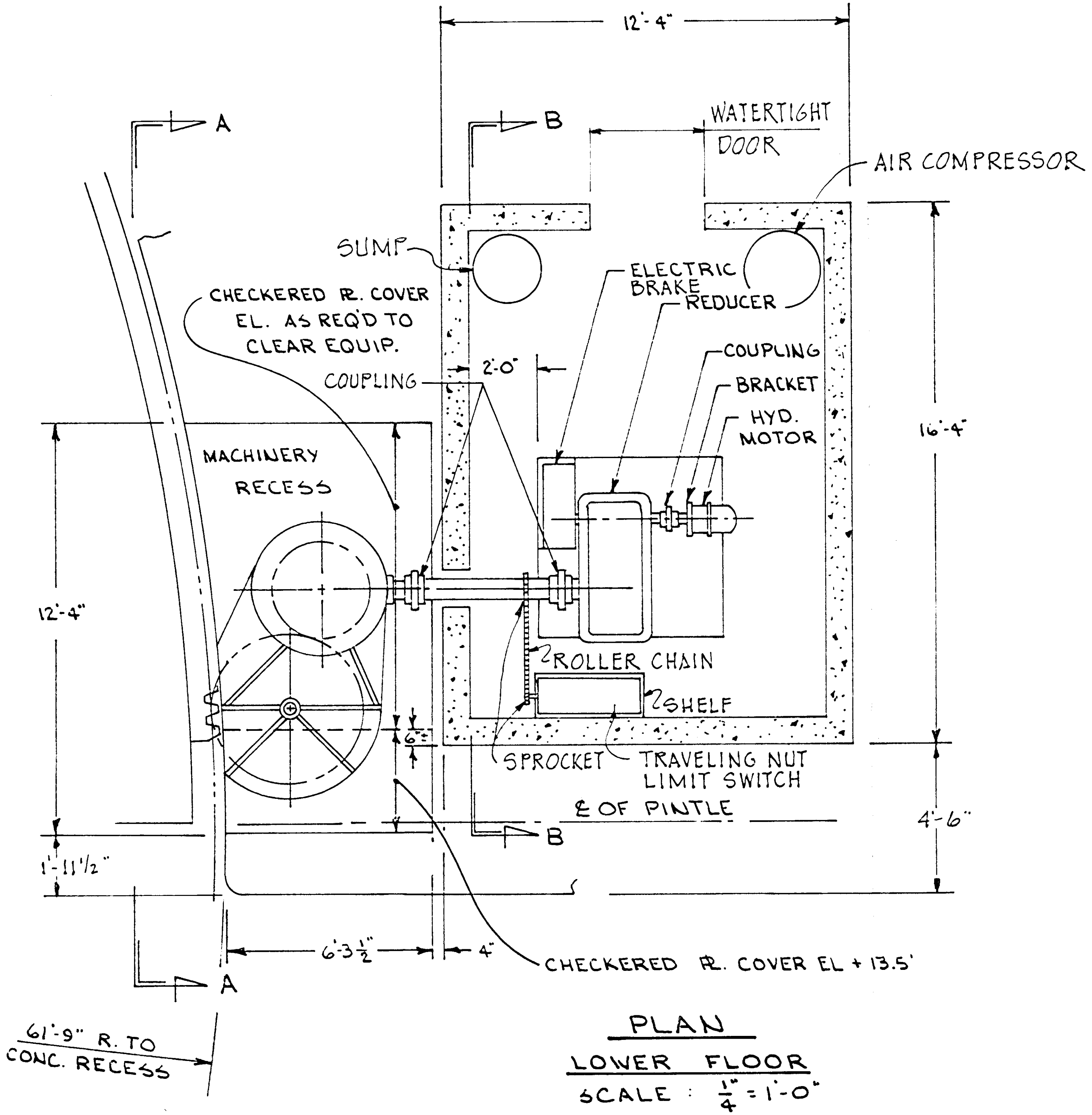
B.M. DORNBLATT AND ASSOCIATES, INC. NEW ORLEANS, LA.	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

GATE 2 CONTROL CIRCUIT

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

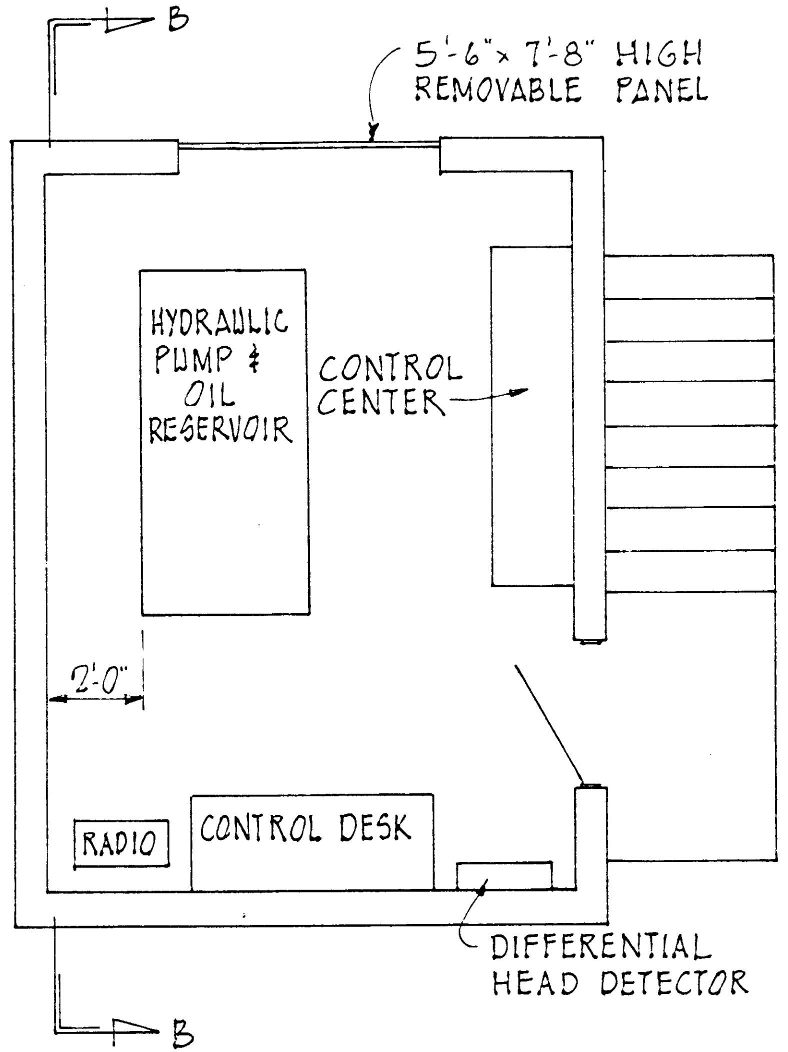
DATE: SEPT., 1973
FILE NO. H-2-24419



PLAN

LOWER FLOOR

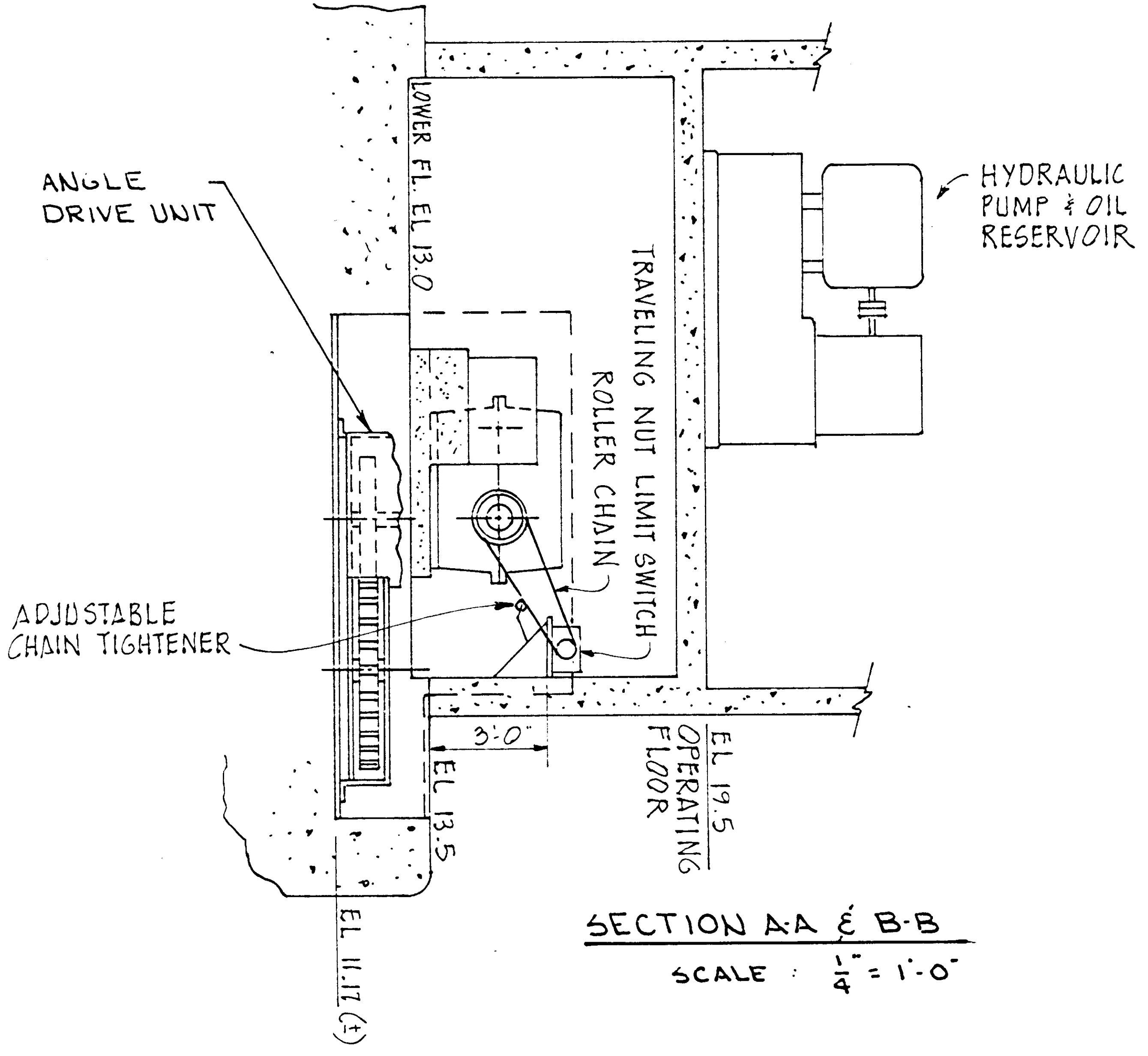
SCALE : ¼" = 1'-0"



PLAN

OPERATING FLOOR

SCALE : ¼" - 1'-0"



SECTION A-A & B-B

SCALE : ¼" = 1'-0"

A JOINT VENTURE

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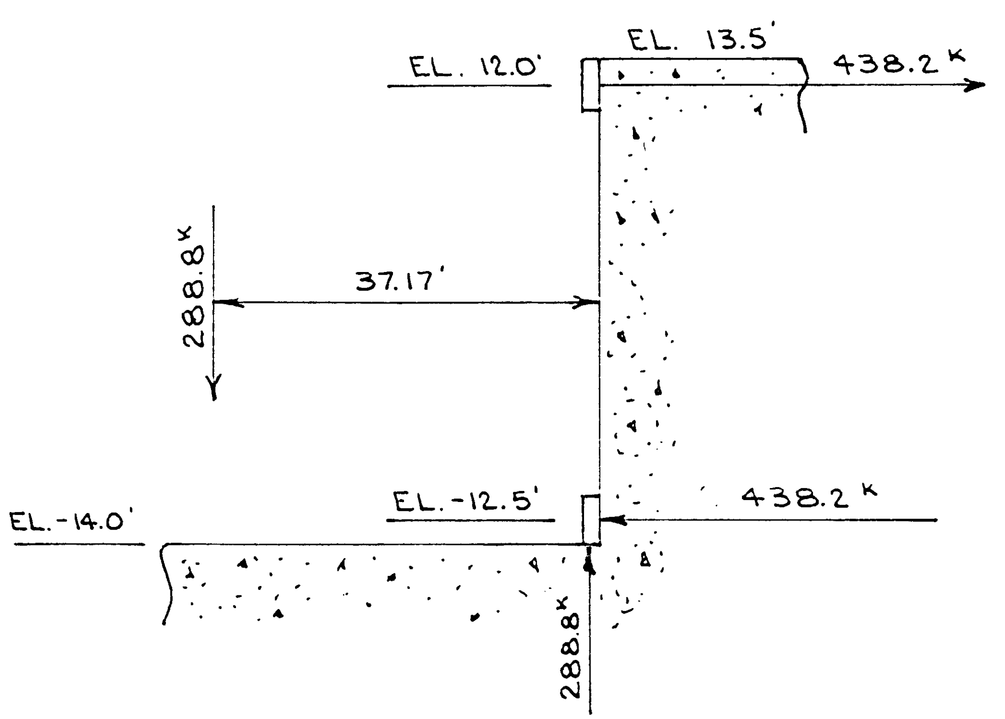
DESIGN MEMORANDUM NO. 8 – DETAIL DESIGN
RIGOLETS LOCK

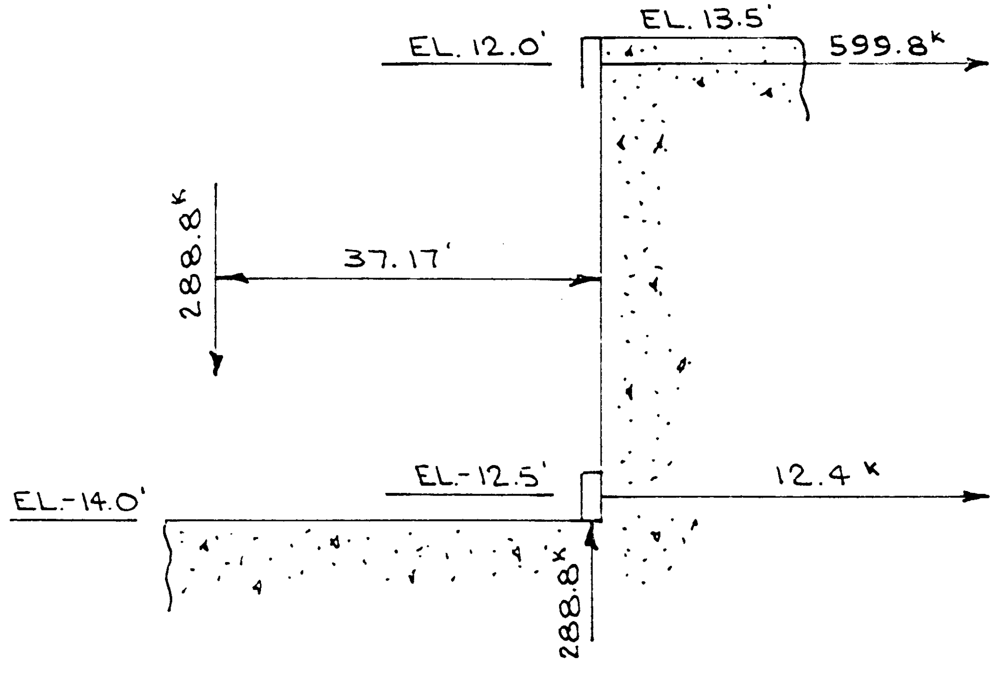
DETAIL DESIGN OF
OPERATING MACHINERY

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

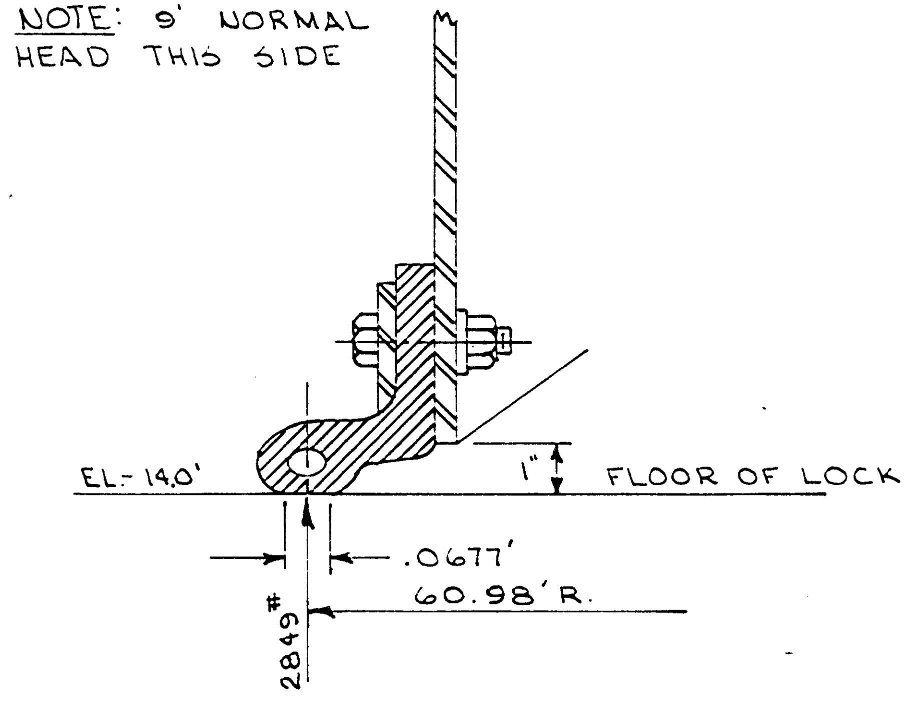
DATE: SEPT. 1973 FILE NO H-2-24419



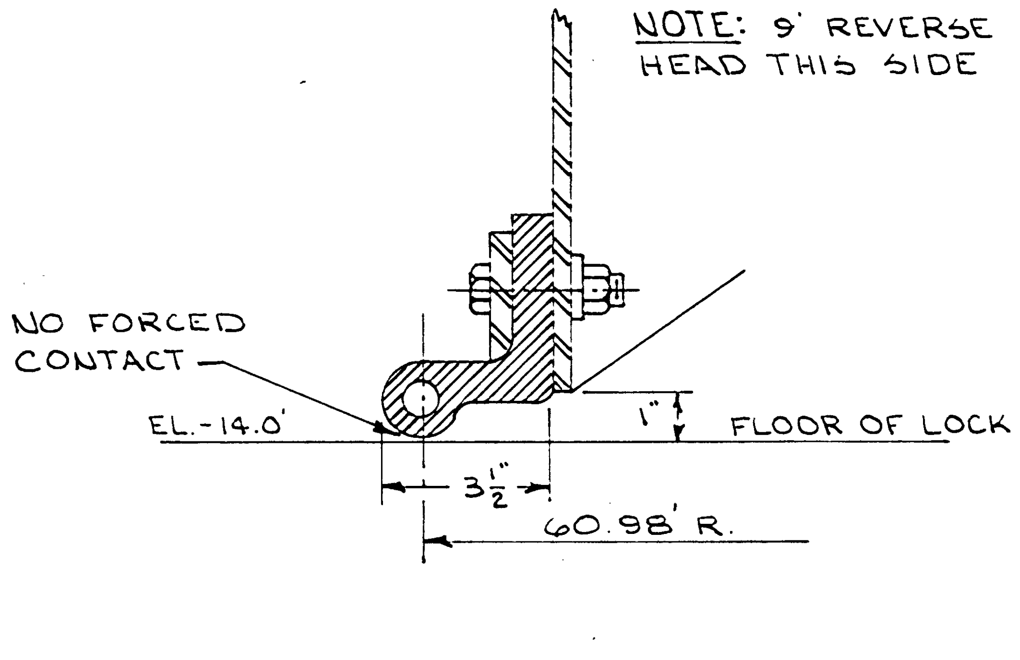
DEAD LOAD
HINGE AND PINTLE REACTIONS



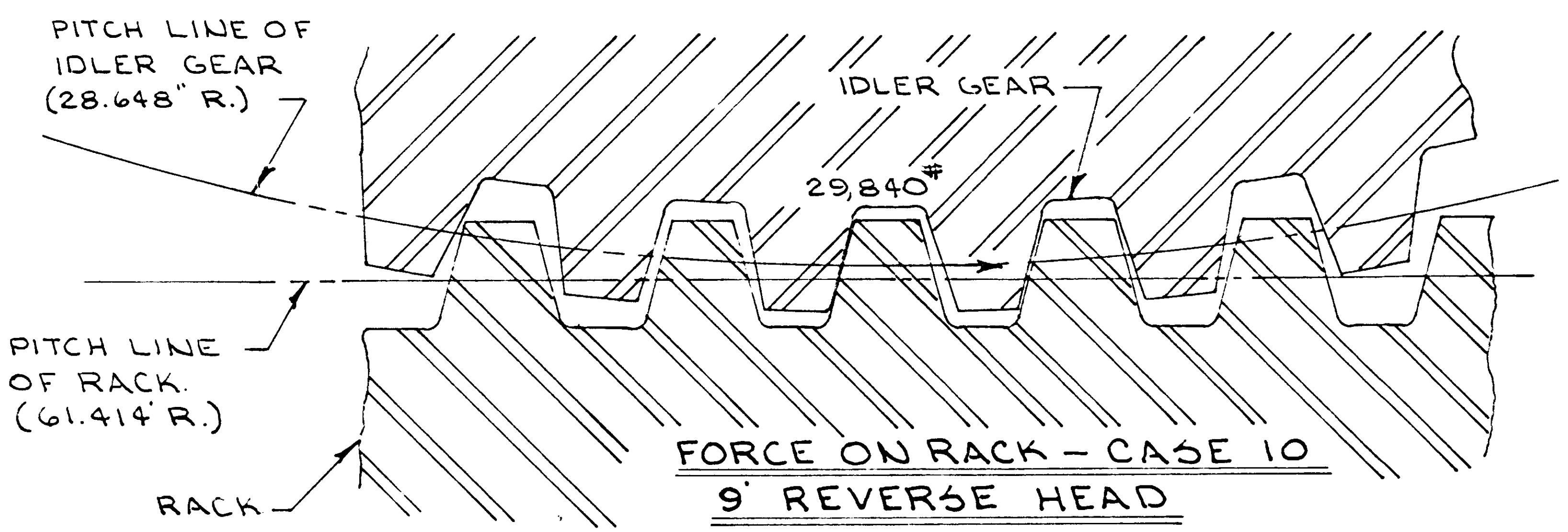
9' REVERSE HEAD - CASE 10
HINGE AND PINTLE REACTIONS



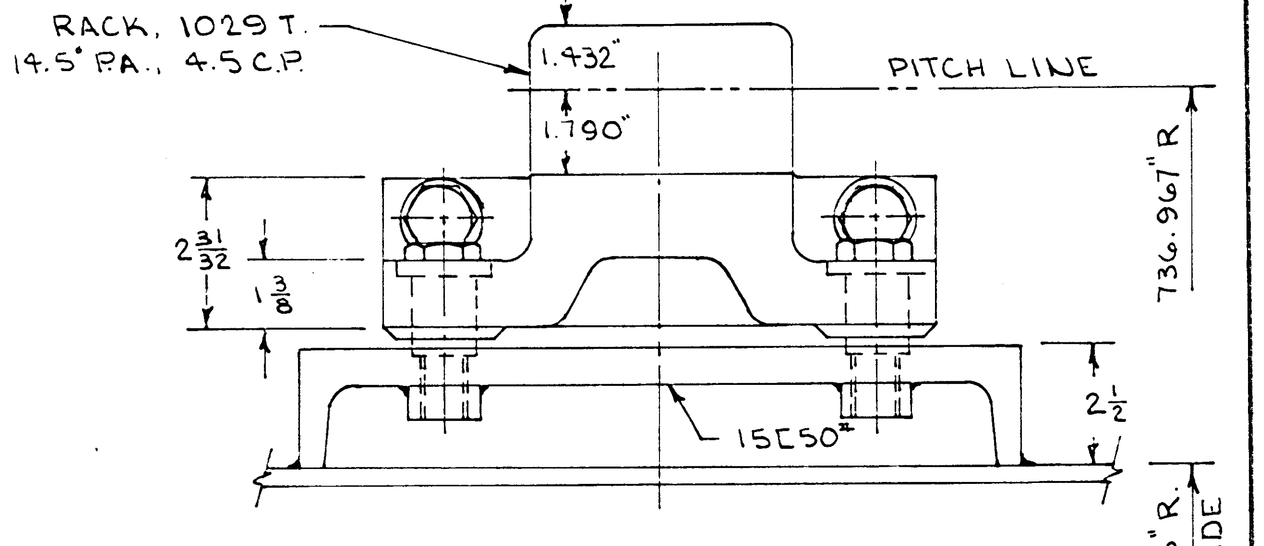
RUBBER SEAL LOADING REACTION



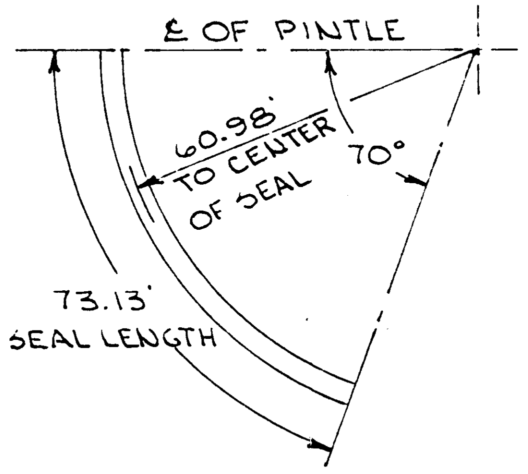
NO RUBBER SEAL LOADING REACTION



FORCE ON RACK - CASE 10
9' REVERSE HEAD



RACK MOUNTING DETAIL
SCALE - 1/4" = 1"



BOTTOM SEAL

A JOINT VENTURE

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MUSCATINE, IOWA

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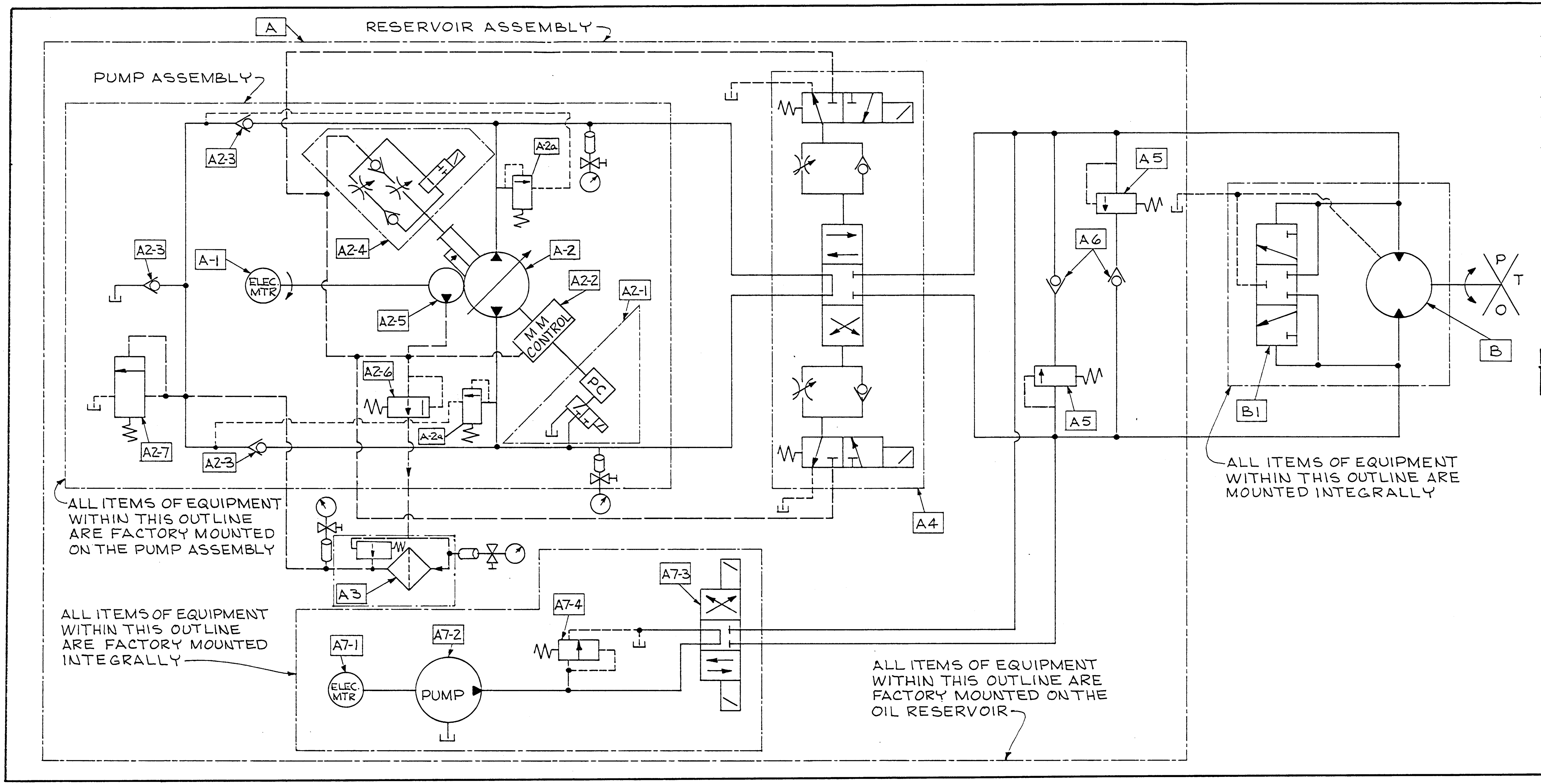
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

DETAIL DESIGN OF
LOADING CONDITIONS

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

DATE SEPT., 1973
FILE NO. H-2-24419

PLATE V 5



LEGEND

- WORKING LINE
- PILOT LINE
- DRAIN LINE
- ENCLOSURE OUTLINE
- LINES CROSSING
- LINES JOINING
- FLOW CONTROL, ADJUSTABLE
- DIRECTION OF FLOW (HYDRAULIC)
- OIL PRESSURE GAGE
- RESERVOIR, LINES TERMINATE ABOVE FLUID LEVEL
- RESERVOIR, LINES TERMINATE BELOW FLUID LEVEL
- FILTER
- CHECK VALVE
- PRESSURE RELIEF VALVE
- HYDRAULIC MOTOR, BIDIRECTIONAL
- HYDRAULIC PUMP, BOTH DIRECTION AS PUMP, VARIABLE DISPLACEMENT, PRESSURE COMPENSATED.
- SPRING
- ELECTRICAL SOLENOID CONTROL
- POWER TAKEOFF

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

OPERATING MACHINERY-
HYDRAULIC CIRCUIT SCHEMATIC

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

DATE: SEPT., 1973
FILE NO H-2-24419

EQUIPMENT LIST

ITEM	QUANTITY	DESCRIPTION
A	4	RESERVOIR - BASE WITH ITEMS A1 THRU A6 FACTORY MOUNTED AND INTERCONNECTED WITH PIPING AS A COMPLETE ASSEMBLY.
A1	4	MOTOR, ELECTRIC, 50 HP, 440 VOLT, A-C, 3 PHASE, 60 HERTZ, 1200 RPM,TOTALLY ENCLOSED FAN COOLED.
A2	4	PUMP, VARIABLE DELIVERY, RADIAL PISTON TYPE, 59.4 GPM LARGE VOLUME @ 3000 PSIG AND A 16 GPM SMALL VOLUME @ 300 PSIG WITH ITEMS A2a THRU A2-7 MOUNTED ON EACH PUMP: THE OILGEAR CO. TYPE DM-6025-M.
A2a	2/PUMP	HIGH PRESSURE RELIEF VALVES INTERGRAL MOUNTED IN PUMP HOUSING, EXHAUST CONNECTED TO OPPOSITE PORT OF PUMP.
A2-1	1/PUMP	SOLENOID OPERATED PRESSURE COMPENSATION CONTROL VALVE.
A2-2	1/PUMP	PUMP VOLUME CONTROL, NEUTRAL POSITION AND FOUR DIFFERENT ADJUSTABLE SPEED SETTINGS.
A2-3	3/PUMP	DISC TYPE SUPERCHARGE VALVES.
A2-4	1/PUMP	ADJUSTABLE ACCELERATION CONTROL AND SOLENOID OPERATED BY-PASS.
A2-5	1/PUMP	16 GPM GEAR TYPE PUMP. INTEGRALLY DESIGNED INTO ITEM A2 HOUSING.
A2-6	1/PUMP	RELIEF VALVE INTEGRALLY DESIGNED INTO ITEM A2 HOUSING.
A2-7	1/PUMP	BACK PRESSURE RELIEF VALVE;PART OF ASSEMBLY ITEM A2-3.
A3	1/PUMP	THE OILGEAR CO. MODEL JF20-1J10-PM0 FILTER INCLUDING DIRT LEVEL INDICATOR, OVER PRESSURE BYPASS VALVE AND MAGNETIC TRAPS (MOUNTED ON RESERVOIR).
A4	1/PUMP	1" - 4-WAY DIRECTIONAL VALVE THE OILGEAR CO. MODEL LGMFX-408.
A5	2/PUMP	1" HIGH PRESSURE RELIEF VALVES
A6	2/PUMP	1" CHECK VALVES
A7	4	ELECTRIC MOTOR DRIVEN EMERGENCY PUMPING UNIT WITH THE FOLLOWING INTEGRALLY BUILT-ON ITEMS A7-1 THRU A7-4.
A7-1	1/UNIT	MOTOR, ELECTRIC, 3 HP, 440 VOLT, A-C, 3 PHASE, 60 HERTZ 1200 RPM, TOTALLY ENCLOSED FAN COOLED.
A7-2	1/UNIT	PUMP, GEAR TYPE, 6 GPM @ 3000 PSIG, 1200RPM. THE OILGEAR CO. MODEL PVQ06-LSAY-HNSN HYDURA.
A7-3	1/UNIT	1/2" DUAL SOLENOID FOUR-WAY VALVE.
A7-4	1/UNIT	1/4" 3000 PSIG RELIEF VALVE
B	4	HYDRAULIC MOTOR, 0-1200 RPM. ROTATION; CLOCK-WISE AND COUNTER-CLOCK-WISE, TORQUE 2209 IN. LB. @ 1453 PSIG FOR LOW SPEED OPERATION; 1773 IN. LB. @ 1166 PSIG FOR HIGH SPEED OPERATION; 3314 IN. LB. @ 2180 PSIG FOR 150% STALLED TORQUE OVERLOAD. UNIT EQUIPPED WITH THE FOLLOWING INTEGRALLY MOUNTED ITEMS. THE OILGEAR CO. MODEL MFS-~~060~~ 113
B1	1/UNIT	BLEED-OFF VALVE.

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC
NEW ORLEANS, LA

STANLEY CONSULTANTS, INC.
MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

OPERATING MACHINERY-
HYDRAULIC CIRCUIT EQUIPMENT LIST

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

DATE SEPT., 1973
FILE NO H-2-24419

SECTION VI - ELECTRICAL DESIGN

POWER SYSTEM

1. Power supply.

a. Power will be supplied to the lock facility by the Washington-St. Tammany Electric Cooperative (REA). The power cooperative will construct an overhead pole line operating at nominally 13,800 volts and routed generally along the access road levee.

b. A pole-mounted transformer bank will be located in the reservation area and will include metering facilities. Service to the lock facility will be at 480 volts, 3-phase, 60-hertz.

2. Emergency generator.

a. The commercial power supply is at the end of the Washington-St. Tammany Electric Cooperative system, and because of severe storms in this area, power outages are expected to be frequent. Because of the importance to ensure lock operation during and immediately following a storm, a diesel-driven generator will be provided to supply power to the lock facility during the system outages.

b. The emergency generator is sized on the basis of the following:

(1) A maximum voltage dip of 10% upon starting of the largest motor.

(2) Use of reduced-voltage starters for each gate hydraulic pump motor. Starters will be set on the 80% voltage tap.

(3) Use of a solid-state type generator voltage regulator to provide rapid recovery for voltage disturbances.

(4) Adequate capacity to start a second gate hydraulic pump motor with the following loads already running or energized:

1 Gate Hydraulic Pump
1 Fire Pump
1 Well Pump
1 Sewage Pump and Treatment Plant
1 Control House Sump Pump
Building Heaters or Air Conditioner
  (but not both)
Office Water Heater
Lock Lights)
Gate Lights)
Guard Lights)
Security Lights) Approximately 15 kw
Office Lights)
Control House Lights)

(5) Starting of 2 gate hydraulic pumps simultaneously would result in an excessively large generator, and is not deemed necessary.

c. On the basis of the above criteria, the generator will be rated between 135 kw and 150 kw, 0.8 P.F., 480 volts, 3-phase, 60-hertz.

d. A free-standing generator control panel will be provided which will include instruments, protective devices, voltage regulator, and transfer switch. Control equipment will be provided so that upon loss of the normal incoming supply voltage, the generator will start automatically, come up to proper speed and voltage, and be connected to the system. A transfer switch will prevent paralleling of the emergency generator with the commerical power supply.

e. The engine-generator will be provided with the following accessories:

(1) Cranking equipment, including motor, controls, battery, and charger.

(2) Shutdown device in event of high water temperature.

(3) Shutdown device in event of low oil pressure.

(4) Lockout device to disconnect the exciter until the unit gets up to speed.

3. Power distribution.

a. General. Power will be distributed to five motor control centers at 480 volts, 3-phase. A motor control center will be provided in each gate control house and in the powerhouse and office.

b. The power distribution system is shown in one-line form on plate VI-1.

GATE CONTROL

4. General.

a. The lock sector gates will be operated from controls located in the gate control houses.

b. Gates will be controlled normally from the control house adjacent to the gate on the north side of the lock chamber; i.e., the east gates will be controlled normally from Control House No. 1 and the west gates will be controlled normally from Control House No. 3. Complete controls for the associated gates, including opening mode selection, will be included in these control houses.

c. Opening and closing of the east gates can also be accomplished from Control Houses Nos. 2 and 3. However, the east gate opening mode selection can only be done at Control House No. 1. Opening of the east gates from Control House No. 3 can occur only in the two slow speeds.

d. Opening and closing of the west gates can also be accomplished from Control Houses Nos. 1 and 4. However, west gate opening mode selection can only be done at Control House No. 3. Opening of the west gates from Control House No. 1 can occur only in the two slow speeds.

e. Differential head at the east gate can be visually determined by a staff gage and a bubble gage located in Control House No. 1. Differential head at the west gate can be visually determined by a staff gage and a bubble gage located in Control House No. 3.

f. Controls will be mounted on control desks of the free-standing, floor-mounted type.

5. Scheme of control.

a. The scheme of control is designed to accomplish the following:

(1) Opening and closing operations will be performed in the minimum feasible times.

(2) Opening operation will be selected from four modes of operation to suit the differential head conditions existing in order to prevent excessive turbulence within the lock chamber and in the channel immediately adjacent to the gate bays. Greater differential heads will require longer operating times for the gates.

(3) The closing operation will always be at the highest speed.

(4) The gates will always start the opening and closing operation at a slow speed.

(5) The gates will always decelerate to a slow speed before stopping in the fully-opened or fully-closed position.

b. Gate operation as related to differential heads and speeds of operation is more fully described in Section II and on Plate II-8.

6. Operation.

a. The following is the sequence of operation for opening a pair of gates:

(1) Determine the differential head across the gate and select the appropriate operating mode.

(2) Turn on the hydraulic pumps. Pump No. 1 starts, followed after a preset time by Pump No. 2. When both pumps are up to speed, a white "Ready" light comes on. The pumps are started in sequence (not simultaneously) to reduce the capacity requirements of the emergency generator.

(3) Turn the gate control switch momentarily to the "Open" position. Brake will release and gate will open in the speed sequence (mode) as selected in Step (1) above. A blue "Opening" indicating light comes on while the gate is opening. Speeds will change at various gate positions as detected by a traveling nut type limit switch which is geared to the gate operating machinery. Speeds of operation are controlled by the energization and de-energization of solenoid valves in the hydraulic circuit, all as more fully described in Section V.

(4) The gate continues to run until the fully-opened position is reached, whereupon a green "Open" indicating light comes on. A timing relay prevents the operator from turning off the hydraulic pumps for a preset time after stoppage of the gate.

(5) Should it be necessary to stop the gate and/or to change the mode of operation during the opening operation, the operator depresses the "Emergency Stop" switch, which stops the gate (hydraulic pumps continue to run). Gate can be restarted in either direction after first depressing the "Emergency Stop Reset" switch.

(6) Interlocking will be provided to prevent opening of a pair of gates unless the gates at the opposite end of the lock are closed. A switch to bypass this interlock will be provided for emergency use.

b. The following is the sequence of operation for closing of a pair of gates:

(1) Turn on the hydraulic pumps. Pump No. 1 starts after a preset time, followed by Pump No. 2. When both pumps are up to speed, a white "Ready" light comes on.

(2) Turn the gate control switch momentarily to the "Close" position. Brake will release and gate will start the closing sequence. A Yellow "Closing" indicating light comes on while the gate is closing. Gate speeds change at various positions in the closing sequence. Gate positions are detected and speed changes are accomplished in the same manner as in the opening operation.

(3) The gate continues to run until the fully-closed position is reached, whereupon a red "Closed" indicating light comes on. A timing relay prevents the operator from turning off the hydraulic pumps for a preset time after stoppage of the gate.

(4) The closing operation can be stopped by depressing the "Emergency Stop" switch (hydraulic pumps continue to run). Gate can be restarted in either direction after first depressing the "Emergency Stop Reset" switch.

c. Schematic control connections for gates are shown on plates VI-2 and VI-3.

SIGNAL AND COMMUNICATION SYSTEMS

7. Disc and light navigation signals.

a. Disc and light navigation signals will be provided on the north side of the lock at each end of the chamber. Details of the navigation signals are shown on plate VI-4.

b. Each navigation signal will be controlled by means of a switch on the control desk in the adjacent control house. The signal control circuits will be interlocked with the gate control circuits in such a manner that the "red" signal will be displayed at all times except when the sector gates at that end of the lock are in the fully-open position. The schematic control diagram for the east navigation signal is shown on plate VI-5.

8. Horn signals. Air horns will be installed on Control Houses Nos. 2 and 4, and the associated air compressors will be located in these control houses. Horns will be installed to face the lock approach. Pushing the navigation control switch handle will sound the adjacent horn (see plate VI-5).

9. Public address system. The public address system will consist of four loudspeaker trumpets, two microphones, two amplifiers, and the necessary wiring. Two loudspeaker trumpets will be mounted on light standards at each end of the chamber, with one loudspeaker trumpet facing into the chamber and the other facing toward the lock approach. Controls will be arranged in Control Houses Nos. 1 and 3 so that the operator will be able to talk through the loudspeakers adjacent to the associated control house. Location of loudspeakers is shown on plates VI-6 and VI-7.

10. Telephone system. A sound-powered, common-talking, selective-ringing telephone system with six stations will be provided. One station will be located in each control house, one in the office, and one in the powerhouse.

LIGHTING SYSTEM

11. Building lighting.

a. General. Power for building lighting will be at 120 volts supplied from single-phase, dry-type transformers located in motor control centers (see plate VI-1).

b. Illumination levels and luminaire types for various areas will be as follows:

(1) Office area: 70 ft-c, fluorescent.

(2) Gate control houses (on control desks): 50 ft-c, incandescent.

(3) Paint storage building: 10 ft-c, incandescent.

(4) Powerhouse, shop, washroom, other areas: 30 ft-c, fluorescent.

c. Illumination levels listed above are as recommended by the Illuminating Engineering Society.

12. Lock lights.

a. General. Power for lock lights will be at 480 volts supplied from Motor Control Center No. 1 (see plate VI-1).

b. Illumination level will be approximately 1.0 ft-c.

c. Luminaires will be the pendent type with 400-watt mercury-vapor lamps, complete with reflectors and refractors and equipped with disconnecting and lowering hangers for servicing.

d. Mounting. Luminaires will be mounted on brackets attached to wood pole on the lock chamber guide walls at a mounting height approximately 29 feet above the walkway (see plates VI-6 and VI-7).

e. Control. Lock lights will be controlled automatically by photoelectric cell (see plate VI-8).

13. Gate lights.

a. General. Lights will be provided in the vicinity of each control house and gate to provide an illumination level of nominally 1.0 ft-c.

b. Luminaires. Luminaires will be the pendent type with 400-watt mercury-vapor lamps, complete with reflectors and refractors and equipped with disconnecting and lowering hangers for servicing.

c. Mounting. Luminaires will be mounted on 30-foot tapered aluminum alloy pole with bracket arms. Poles will have sufficient strength to withstand hurricane winds (see plate VI-7).

d. Power supply will be at 480 volts from Motor Control Centers Nos. 1 and 3 (see plate VI-1).

e. Control. Gate lights will be controlled automatically by photoelectric cell (see plate VI-8).

14. Security lights.

a. General. Security lights will be provided in the reservation area and along fenced perimeter of site (see plate VI-6).

b. Illumination levels will be in accordance with Section IV of Publication FM 19-3, and will be as follows:

(1) Reservation area: 1.0 ft-c.

(2) Perimeter: 0.2 ft-c.

c. Luminaires will be the pendent type with either 175-watt or 400-watt mercury-vapor lamps complete with reflectors and refractors and equipped with disconnecting and lowering hangers for servicing (see plate VI-6).

d. Mounting. Luminaires will be mounted on 25-foot or 30-foot tapered aluminum alloy poles with bracket arms. Poles will have sufficient strength to withstand hurricane winds (see plate VI-7).

e. Power supply will be at 480 volts from Motor Control Centers Nos. 2 and 5 (see plate VI-1).

f. Control. Security lights will be controlled automatically by photoelectric cell (see plate VI-8).

15. Guard lights.

a. General: guard lights will be provided on dolphins on each side of the channel at each lock approach.

b. Luminaires will be 250 mm marine lantern, vacuum and pressure tight and equipped with automatic lamp changer (see plate VI-7).

c. Power supply.

(1) Guard lights on steel sheet pile dolphins at the termination of the approach guide walls will be supplied from 120-volt panel in Motor Control Centers Nos. 1 and 3 (see plate VI-1).

(2) Guard lights on timber pile dolphins on each end of the navigation channel will be supplied from self-contained battery units.

d. Control. Guard lights will be controlled automatically by self-contained photoelectric cells.

16. Emergency lights. Gate control houses will each be equipped with semi-portable, battery-powered lighting units to provide emergency illumination of control desks. Emergency lighting units will be complete with self-contained battery and charger.

CATHODIC PROTECTION

17. General. Cathodic protection will be provided for the sector gates. The system is designed to protect only the frame side of the skin plate to Elevation +6.0 m.s. l. No cathodic protection will be provided for the steel sheet pile dolphins. Design of system is in accordance with the Department of the Army Technical Manual TM5-811-4, "Electrical Design - Corrosion Control."

18. System. The cathodic protection system will be the impressed-current type. The number, size, and arrangement of anodes will be as shown on plate VI-9, and is based on providing a current density of not less than 0.003 amperes per square foot of protected surface area, and without exceeding the manufacturer's recommended maximum current per anode.

19. Rectifiers are sized to provide protection assuming 100% loss of protective coating on metal surfaces. Four such rectifiers will be provided, one at each control house for protection of the associated sector gate leaf. Rectifiers will have continuous ratings not less than 42 amperes at 30 volts d-c and will be suitable for 120-volt a-c supply.

20. Anodes will consist of twenty-five pound bars of high silicon cast iron and will be arranged to permit removal for inspection.

GROUNDING SYSTEM

21. General. A grounding system will be provided to which all steel conduits and electrical equipment will be grounded.

22. Gate grounding system.

a. Steel piles under the gate foundations will be utilized for ground electrodes. Steel piling will be electrically bonded with steel rods.

b. Steel risers from the piling to the control houses will be provided for connection to equipment grounding taps.

23. Reservation grounding system. Five 3/4" x 10' copper-clad ground rods will be driven near the powerhouse and office, including one rod at the transformer service pole. Ground rods will be interconnected with No. 4/0 bare copper cable.

INSULATED WIRE AND CABLE

24. Power, control, and lighting circuits. Insulated wire and cable for power, control, and lighting circuits will conform to Guide Specification No. CE1404.04, Insulated Wire and Cable (For Hydraulic Structures).

25. Switchboard wire. Insulated wire for the motor control centers, generator control panel, and control desks will conform to the requirements of NEMA Standards Publication WC-1-1963 for Thermoplastic Asbestos Insulated Wire.

26. Communication cables. Cables for the public address and telephone systems will have polyethylene insulated conductors with metallized paper shielding tape and polyvinylchloride sheath.

27. Installation.

a. Wire and cables within buildings will be installed in metallic conduit system.

b. Wire and cables between adjacent gate control houses will be installed in non-metallic conduits embedded in base slab of gate structure.

c. Interconnecting wiring between powerhouse and office and gate control houses, as well as perimeter security lighting system wiring, will be direct burial.

28. Conductors will be sized to limit voltage drop at full load to 1% for power and lighting circuit feeders and to 2% for power and lighting branch circuits.

CALCULATIONS

29. Sizing of emergency generator.

a. Consider following loads for supply from emergency generator:

Fire Pump #1 (15 HP) - Operating
Fire Pump #2 (15 HP) - Not Operating
Well Pump (5 HP) - Operating
Fuel Oil Pump (1/2 HP) - Not Operating
Sump Pump (3/4 HP) - Intermittant - Assume Operating
Brakes on Gates - Ignore, de-energized until both
   Gate Hydraulic pumps operating
Control House Heaters (3 kw) - Assume 1.5 kw Operating
Office Heaters (3 kw) - Operating
Water Heater (10 kw) - Operating
Air Conditioner (2 HP) - Assume off it heaters on
Gate #1 Hydraulic Pump (50 HP) - Operating
Gate #2 Hydraulic Pump (50 HP) - Starting
Lights -
   Lock Lights - 9,000 W.
   Guard Lights - 200 W.
   Gate Lights - 2,200 W.
   Security Lights - 3,700 W.
   Office Lights - 2,000 W.
   C. H. Lights - 1,200 W.
   18,300 W. - Say 15 kw Operating

b. Most servere duty on generator is that condition where Gate #2 Hydraulic Pump must be started with other loads already operating as indicated above.

(1) Operating load from above list:

Motors = ~~71 1/4~~ 120.75 HP (Approximate kw =
~~70 1/4~~ x 0.85 = ~~60)~~ 102.6
Lights = 15 kw
Heaters = 16 kw

(2) Starting load = 50 HP

c. Following calculations for determining generator size are based upon methods and data published by the Caterpillar Tractor Company. Use of data of other manufacturers results in essentially the same answers:

(1) Total running requirement = ~~60~~ 102.6 + 15 + 16 = ~~91~~ 133.6 kw
Allow ~~20%~~ 15% reserve capacity = ~~91~~ 133.6 x 1.~~20~~15 = ~~109~~ kw 153.3
Standard generator size to meet this standby running load
requirement = ~~135~~ 155 kw

(2) Divide 135 kw rating by HP of motors already started: 135/70.~~2~~75 = 1.9~~2~~

(3) Using following Figure VI-1, determine multiplier to compensate for motors on the line (= 1.06).

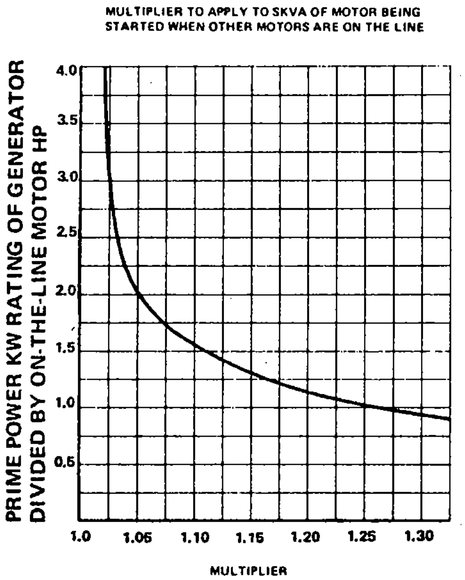


FIGURE VI-1

(4) HP of motor to be started = 50 (Gate Hydraulic Pump).

(5) Effective HP of motor to be started = 1.06 x 50 = 53 HP.

(6) Assume 50 HP Gate Hydraulic Motor is NEMA Code letter F.

(7) From following Figure VI-2, determine starting kva of motor to be started.

IDENTIFYING CODE LETTERS ON AC MOTORS*

NEMA Code Letter	Starting KVA per HP	
A	0.00 - 3.14	
B	3.15 - 3.54	
C	3.55 - 3.99	
D	4.00 - 4.49	
E	4.50 - 4.99	
F	5.00 - 5.59	← Use 5.30 (average)
G	5.60 - 6.29	
H	6.30 - 7.09	
J	7.10 - 7.99	
K	8.00 - 8.99	
L	9.00 - 9.99	
M	10.00 - 11.19	
N	11.20 - 12.49	
P	12.50 - 13.99	
R	14.00 - 15.99	
S	16.00 - 17.99	
T	18.00 - 19.99	
U	20.00 - 22.39	
V	22.40 -	

*Wound Rotor Motor Has no code letter
Note: Code letters apply to motors up to 200 HP.

FIGURE VI-2

(8) Starting kva = 5.30 x Effective HP = 5.30 x 53 = 281.

(9) Using reduced voltage starting, 80% tap and allowing 10% voltage drop, following Table VI-1 indicates that the Caterpillar Model 3306 rated 135 kw should be used

d. Repeat calculation for simultaneous starting of 2-50 HP Gate Hydraulic Pump motors.

(1) Operating load:

Motors = ~~21 1/4~~ 120.75 HP (Approx. kw = ~~21.25~~ 120.75 x 0.85 = ~~18)~~ 102.6
Lights = 15 kw
Heaters = 16 kw
Total = ~~49~~ 133.6 kw

(2) Starting load = 100 HP.

(3) By judgement select 135 kw unit as minimum size for starting point.

(4) Divide 135 kw rating by motors already started--135/~~21.25~~ 20.75 = ~~6.35.~~ 6.5

(5) From curve, Figure VI-1, determine multiplier to compensate for motors on the line - use ~~1.03.~~ 1.02

(6) Effective HP of motors to be started = 2 x 50 x ~~1.03~~ 1.02 = ~~103~~ 102.

POWER SELECTION TABLE VI-1

I. Running KW (without fan) II. Starting KVA

Model	Prime	Standby	Across the Line			80% Tap			65% Tap		
1200 RPM SRCR generators			10% Dip	20% Dip	30% Dip	10% Dip	20% Dip	30% Dip	10% Dip	20% Dip	30% Dip
D399	800	900	575	1200	2000	825	1775	2900	1250	2560	4258
D398	600	675	275	650	1125	400	925	1675	600	1350	2400
D379	400	450	225	475	925	325	700	1350	475	1000	2000
D353	300	335	200	400	800	300	600	1180	420	850	1680
1800 RPM SRCR generators											
D349	670	750	470	1260	1600	700	1860	2320	1000	2690	3410
D348	500	565	360	790	1300	510	1200	1860	740	1680	2770
D346	335	375	210	480	690	310	700	1000	450	1050	1470
D343	250	285	310	470	570	455	680	830	670	1000	1215
D334	175	205	150	340	545	220	500	800	320	730	1160
3306	135	155	200	300	375	295	420	525	410	640	800
3304	90	100	155	225	270	230	330	400	335	480	575
3304**	55	60	50	90	120	75	130	180	105	190	260
1800 RPM Brushless generators											
D343	250	285	160	335	535	240	490	785	350	710	1125
D334	175	205	150	340	480	205	475	710	300	715	930
3306	135	155	70	140	255	105	200	385	135	300	525
3160*	75	85	25	60	105	40	90	155	55	130	220
3150*	60	70	25	50	90	35	80	130	55	115	190
3145*	50	60	25	40	65	35	60	95	50	90	135

Good for 60 Hz and 0.8 P.F.
*KW ratings with fan.
**Naturally Aspirated.
Fan KW requirement and altitude deration information is available from your Caterpillar Dealer as needed.
NOTE: 3304 and 3306 formerly designated D330 and D333, respectively.

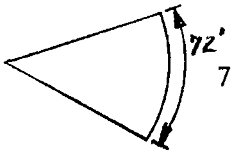
(7) Assume motors NEMA Code Letter F and starting kva = 5.30 x Effective HP = 5.30 x ~~103~~ 102 = ~~546~~. 540.6

(8) Using reduced voltage starting, 80% tap and allowing 10% voltage drop, Table VI-1 indicates that Caterpillar Model D349 rated 670 kw is required.

e. Conclusion - Design gate controls to prevent simultaneous starting of Gate Hydraulic Motors, and thereby permit sizing of emergency generator at approximately 135-150 kw.

30. <u>Cathodic protection computations</u>.

a. Compute area of gate skinplate.



72 x 20 = 1,440 ft^2 Say 1,500 ft^2

b. Compute area of structural steel.

(1) Main beams 55 x 9 = 495

(2) Braces 206 x 3 = 618

1,113

(3) Assume 6 ft^2/lineal ft or 6 x 1,113 = 6,618

Say 7,000 ft^2

(4) Skinplate stiffeners:

Horizontal 3 x 72 x 6 = 1,296
Vertical 5 x 24 x 6 = 720
Ribs 36 x 24 x 4 = 3,456
5,472 Say 5,500 ft^2

Total Area 14,000 ft^2

c. Water analysis for Rigolets, opposite Sawmill Pass per Hurricane Study - Lake Pontchartrain, Louisiana, and Vicinity.

Date Data Was Gathered	Depth of Sample (ft)	PH	Dissolved Solids (PPM)
10-15-68	2.0	7.6	13,914
10-15-68	28.0	7.4	14,022
12-10-68	5.0	8.1	7,942
12-10-68	25.0	7.6	7,989
1-16-69	5.0	7.6	4,560
1-16-69	25.0	7.5	5,616
4-23-69	5.0	6.6	4,776
4-23-69	20.0	6.9	4,316
1-19-70	5.0	7.3	7,356
1-19-70	25.0	7.7	7,356
3-26-70	5.0	7.7	4,598
3-26-70	25.0	7.5	5,517
6-22-70	5.0	7.5	5,977
6-22-70	25.0	7.5	5,977
9-21-70	5.0	7.2	13,333
9-21-70	25.0	7.9	12,873

d. Determine water resistivity.

(1) Per Manual TM 5-811-4, Page 233.

(2) Resistivity of Water (P) = 625,000/solids in ppm.

(3) From water analysis

$$P_{max} = \frac{625,000}{4.316} = 145 \text{ ohm-cm}$$

$$P_{min} = \frac{625,000}{14,022} = 44.6 \text{ ohm-cm}$$

(4) On this basis water can be considered to be "brackish".

e. Review of literature indicates that sacrificial cathodic protections (magnisium anodes) are not suitable for brackish water applications. Reaction with brackish water will destroy anodes in too short a time to be suitable. High silicone cast iron has provéd to work well under these conditions; therefore, impressed current cathodic protection systems have been used with good results with cast iron anodes in sea water.

f. Anode sizing:

(1) Assume current density of 3ma/ft^2 and 100% bare area after 20 years.

(2) Total required current .003 x 14,000 = 42 amperes.

(3) Typical deterioration rate of cast iron in sea water is .75 lb/amp year.

(4) Total loss is then .75 x 42 x 20 = 630 lbs.

(5) Using 25 lb anodes this would require 25 anodes; however, due to shape of gate, use 30 anodes at 25 lb each.

A JOINT VENTURE

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LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

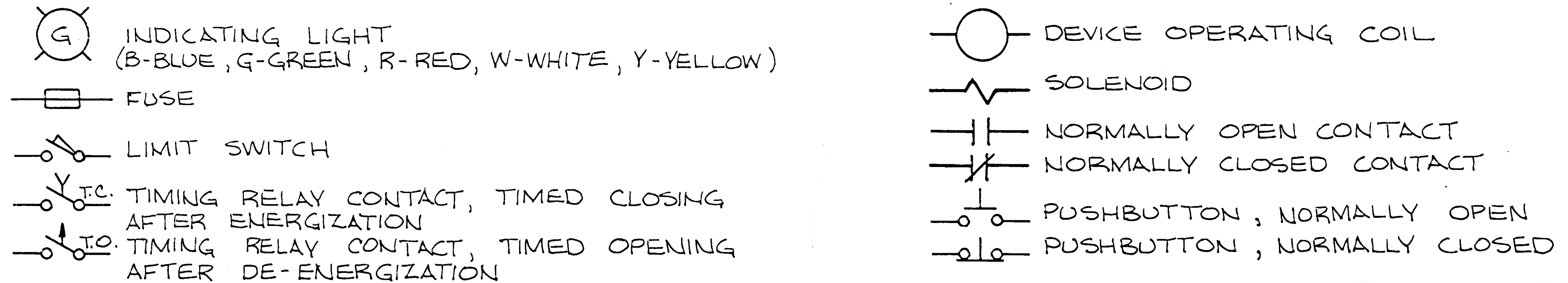
ELECTRICAL ONE LINE DIAGRAM

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

DATE: SEPT. 1973
FILE NO. H-2-24419

PLATE VI 1

CONTROL DEVICE LEGEND



INDICATING LIGHT
(B-BLUE, G-GREEN, R-RED, W-WHITE, Y-YELLOW)
FUSE
LIMIT SWITCH
T.C. TIMING RELAY CONTACT, TIMED CLOSING AFTER ENERGIZATION
T.O. TIMING RELAY CONTACT, TIMED OPENING AFTER DE-ENERGIZATION
DEVICE OPERATING COIL
SOLENOID
NORMALLY OPEN CONTACT
NORMALLY CLOSED CONTACT
PUSHBUTTON, NORMALLY OPEN
PUSHBUTTON, NORMALLY CLOSED

CONTROL DEVICE FUNCTION

C	BRAKE CONTACTOR
CR	EMERGENCY STOP RELAY
CS	GATE CONTROL SWITCH
CSN	NAVIGATION SIGNAL CONTROL SWITCH
CSS	GATE CONTROL SWITCH (FOR GATES AT OPPOSITE END OF LOCK)
GLS	GATE LIMIT SWITCH
M	HYDRAULIC PUMP STARTER
Mc	GATE CLOSING CONTROL CONTACTOR
MG	NAVIGATION SIGNAL CONTROLLER (GREEN)
Mo	GATE OPENING CONTROL CONTACTOR
MR	NAVIGATION SIGNAL CONTROLLER (RED)
NLS	NAVIGATION SIGNAL LIMIT SWITCH
OL	THERMAL OVERLOAD
PS	HYDRAULIC PUMP CONTROL SWITCH
PSS	HYDRAULIC PUMP CONTROL SWITCH (FOR GATES AT OPPOSITE END OF LOCK)
SS	GATE OPENING MODE SELECTOR SWITCH
SV1 SV2 SV3 SV4	HYDRAULIC PUMP CONTROL SOLENOIDS (SEE SOLENOID OPERATION DEVELOPEMENT CHART FOR SECTOR GATE SPEEDS)
SVP	SOLENOID FOR PRESSURE COMPENSATOR
TD	TIMING RELAY
X	AUXILIARY RELAY

$\boxed{1}$ DENOTES DEVICE AT CONTROL HOUSE NO. 1
$\boxed{2}$ DENOTES DEVICE AT CONTROL HOUSE NO. 2
$\boxed{3}$ DENOTES DEVICE AT CONTROL HOUSE NO. 3
$\boxed{4}$ DENOTES DEVICE AT CONTROL HOUSE NO. 4
* NUMBER PREFIX TO CONTROL DEVICE INDICATES ASSOCIATED SECTOR GATE.

NOTES:

ALL DEVICES SHOWN ON THIS DRAWING ARE LOCATED IN CONTROL HOUSE NO. 1 UNLESS OTHERWISE NOTED. CONTROL SCHEMATIC SHOWN IS FOR SECTOR GATE NO. 1 SECTOR GATE NO. 3 IS SIMILAR.
SEE PLATE VI 3 FOR CONTROL SWITCH AND LIMIT SWITCH DEVELOPMENTS.

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RIGOLETS LOCK

GATE 1 CONTROL CIRCUIT

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE: SEPT. 1973
FILE NO H-2-24419

PLATE VI 2

CONTACT * 1	Ø 2	OFF	1	INT.	2	INT.	3	INT.	4
1	2						X		X
3	4		X		X		X		X
5	6		X		X		X		
7	8								X
9	10						X		
11	12				X				
13	14		X						
15	16				X		X		X
17	18						X		X

(MAINTAINED POSITION SWITCH)

OPENING MODE SELECTOR SWITCH (DEVICE SS)

POSITION / CONTACT	START	NEUTRAL	STOP
1	X		
2			X

(SPRING RETURN TO NEUTRAL)

HYDRAULIC PUMP MOTOR CONTROL SWITCH (DEVICE PS & PSS)

POSITION / CONTACT		OPEN	NEUTRAL	CLOSE
*	1	X		
*	2			X
Ø	3	X		
Ø	4			X

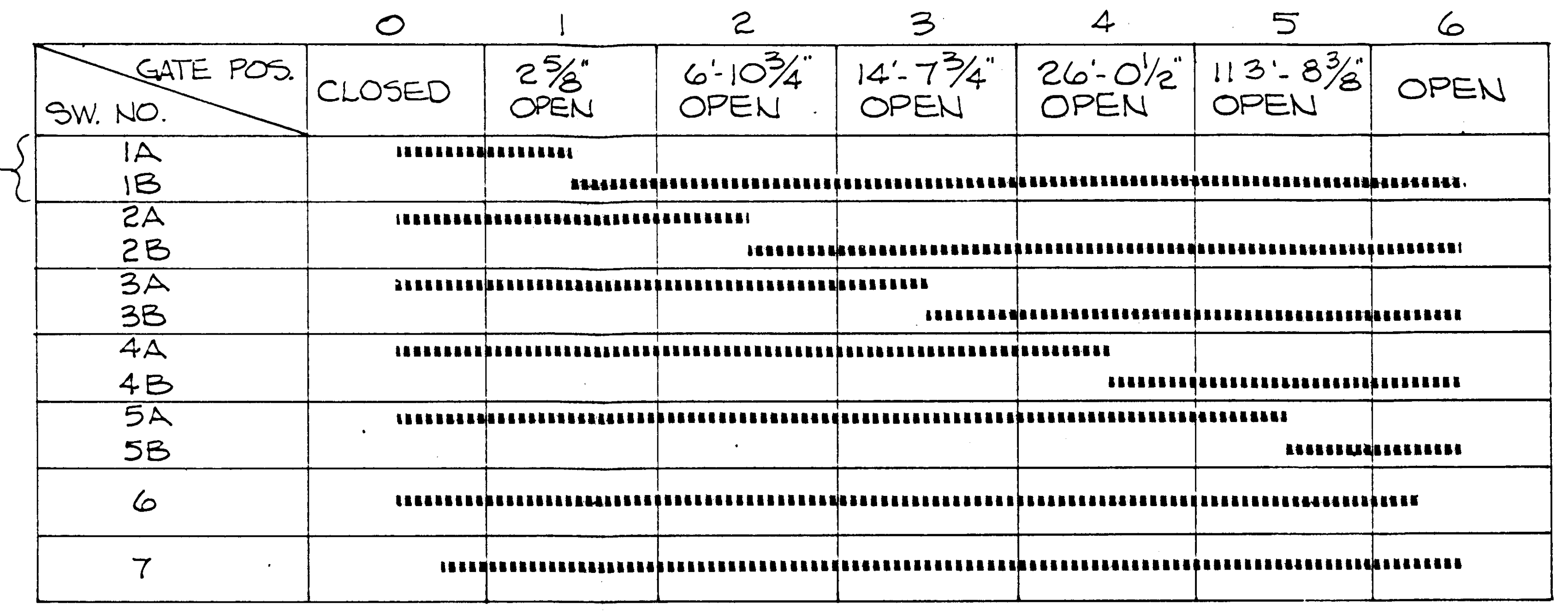
(SPRING RETURN TO NEUTRAL)

SECTOR GATE CONTROL SWITCH (DEVICE CS & CSS)

POSITION / CONTACT		BYPASS	NORMAL
*	1	X	
Ø	2	X	

GATE INTERLOCK BYPASS SWITCH

SWITCHES NO'S 1A & 1B ARE MOUNTED ON GATE WALL AND ARE NOT PART OF THE TRAVELING NUT MECHANISM



SECTOR GATE LIMIT SWITCH (DEVICE GLS)

(TRAVELING NUT OPERATED)

SOLENOID / OPERATING MODE		EMERG. STOP	OPEN	SVP	SV1	SV2	SV3	SV4	CLOSE
SYSTEM OFF									
ELECTRIC MOTOR ON		X							
OPEN (GATE RPM)	.100	X	X					X	
	.030	X	X				X		
	.010	X	X			X		X	
	.002	X	X	X	X			X	
NORMAL STOP (OPEN) (ELECTRIC MOTOR ON)		X	X						
EMERG. STOP (OPEN) (ELEC. MOTOR MUST STAY ON)			X						
CLOSE (GATE RPM)	.100	X						X	X
	.002	X		X	X			X	X
NORMAL STOP (CLOSE) (ELECTRIC MOTOR ON)		X							X
EMERG. STOP (CLOSE) (ELEC. MOTOR MUST STAY ON)									X

HYDRAULIC PUMP SOLENOID OPERATION CHART

NOTES:

ALL DEVICES SHOWN ON THIS DRAWING ARE LOCATED IN CONTROL HOUSE NO. 2 UNLESS OTHERWISE NOTED.
CONTROL SCHEMATIC SHOWN IS FOR SECTOR GATE NO. 2, SECTOR GATE NO. 4 IS SIMILAR.
SEE PLATE VI 2 FOR "DEVICE LEGEND" AND "DEVICE FUNCTION".
* INDICATES CONTACTS USED WITH GATE 1 CONTROLS
Ø INDICATES CONTACTS USED WITH GATE 2 CONTROLS
X INDICATES CONTACTS CLOSED OR SOLENOID ENERGIZED.

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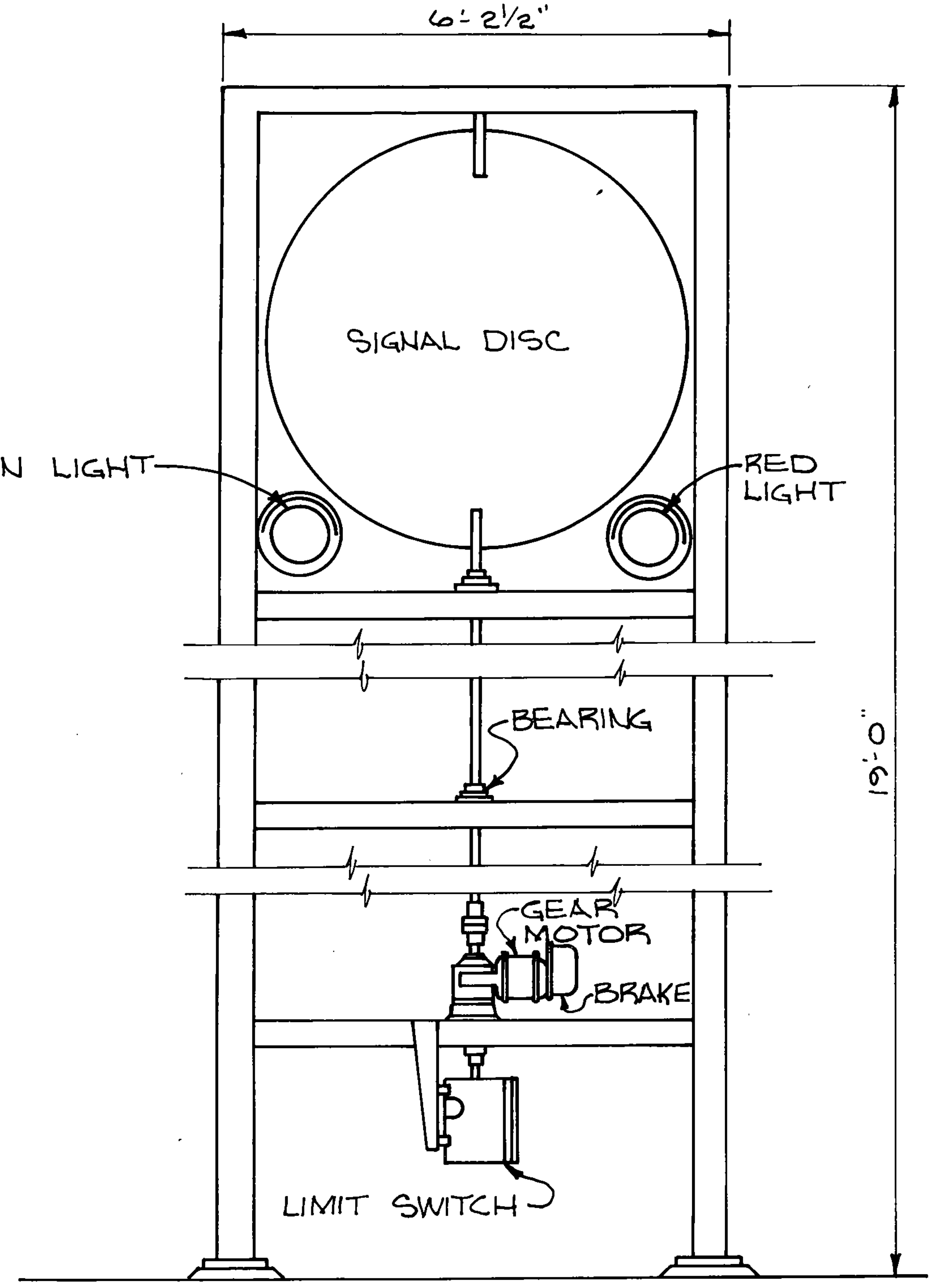
GATE 2 CONTROL CIRCUIT

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

DATE: SEPT., 1973
FILE NO. H-2-24419



NOT TO SCALE

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RIGOLETS LOCK

NAVIGATION SIGNAL

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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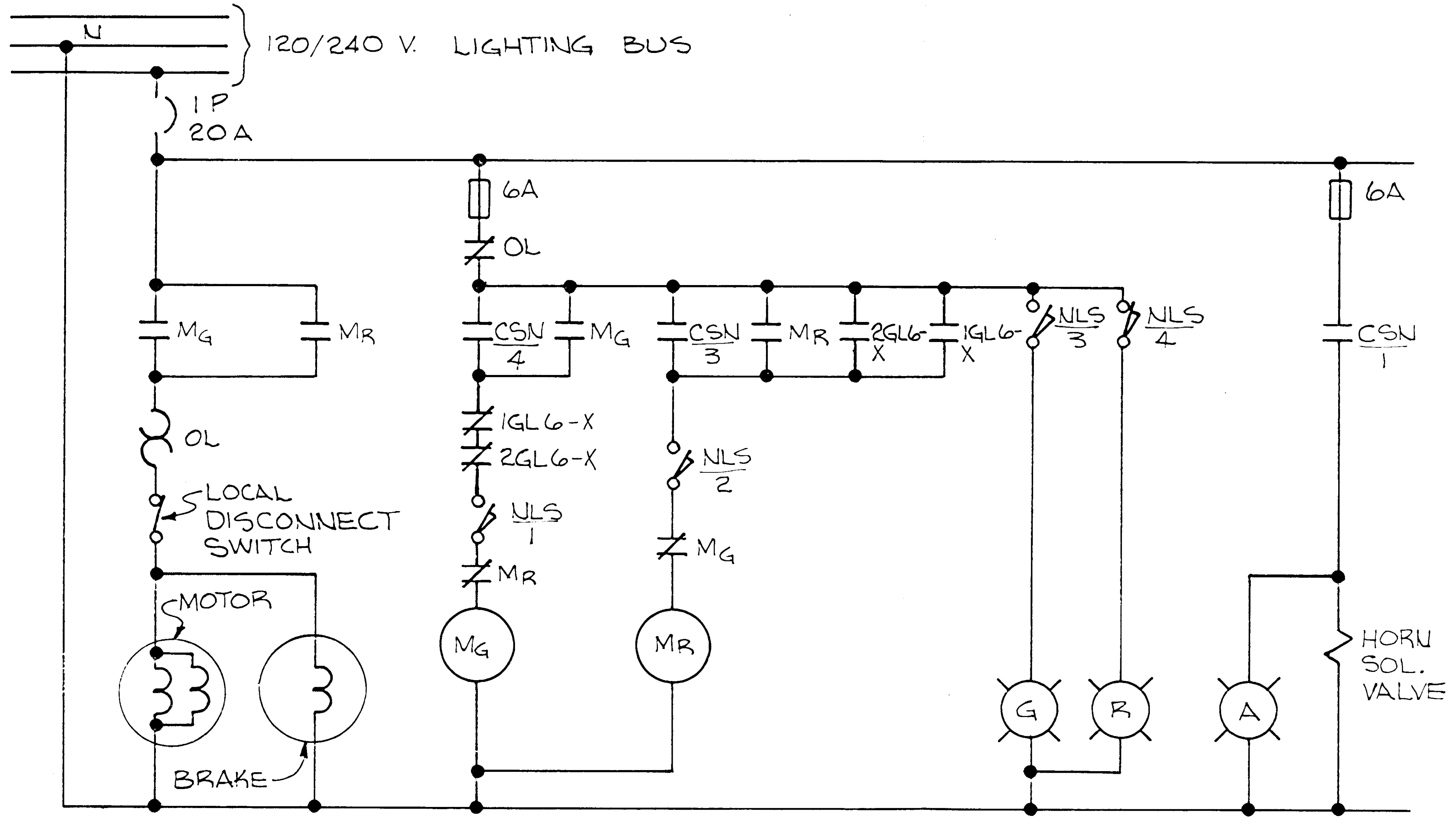
DATE: SEPT., 1973 FILE NO. H-2-24419

PLATE VI 4



NOTES:

FOR CONTROL DEVICE LEGEND AND LISTING OF CONTROL DEVICE FUNCTIONS SEE PLATE VI 2

GATES 1 AND 2 SHOWN CLOSED

FOR GATE LIMIT SWITCH DEVELOPMENT, SEE PLATE VI 3

CIRCUIT SHOWN IS FOR NAVIGATION SIGNAL AT EAST END OF LOCK. CIRCUIT FOR SIGNAL AT WEST END OF LOCK IDENTICAL EXCEPT GATE LIMIT SWITCHES ARE '3GL6-X' AND "4GL6-X"

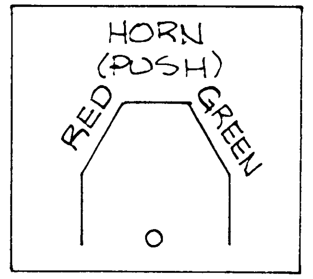
ODD
EVEN
•LATERAL CONTACTS
ITEM NO.
CSN

4	3	2	1	CONTACT	SWITCH FUNCTION
	☒	SEE	BELOW	RED	
				HORN	
☒				GREEN	

LATERAL CONTACTS

HANDLE: NORMALLY OUT- LOCKED WHEN IN - PUSHED IN, IN HORN POSITION ONLY
ACTION: SPRING RETURN OUT
WHEN PUSHED: CLOSES CONTACTS #1 AND #2

NAVIGATION SIGNAL



HANDLE
TYPE: PISTOL GRIP
COLOR: BLACK

ACTION
SPRING RETURN TO HORN

CONTROL SWITCH DETAILS

NAVIGATION SIGNAL CONTROL SWITCH DEVELOPMENT

CONTACT NO.	DEGREES OF ROTATION											
	R					G						R
	0 – 30	30 – 60	60 – 90	90 – 120	120 – 150	150 – 180	180 – 210	210 – 240	240 – 270	270 – 300	300 – 330	330 – 360
1	▬	▬	▬	▬	▬	▬						▬
2						▬	▬	▬	▬	▬	▬	▬
3						▬	▬					
4	▬	▬	▬	▬					▬	▬	▬	▬

NAVIGATION SIGNAL LIMIT SWITCH (DEVICE NLS)
(CAM OPERATED)
CONTACT DEVELOPMENT

A JOINT VENTURE

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DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

NAVIGATION SIGNAL AND HORN
CONTROL CIRCUIT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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DATE SEPT., 1973
FILE NO H-2-24419

LEGEND:

GDL - GUARD LIGHT
GTL - GATE LIGHT
LL - LOCK LIGHT
SL - SECURITY LIGHT

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DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

LIGHTING PLAN

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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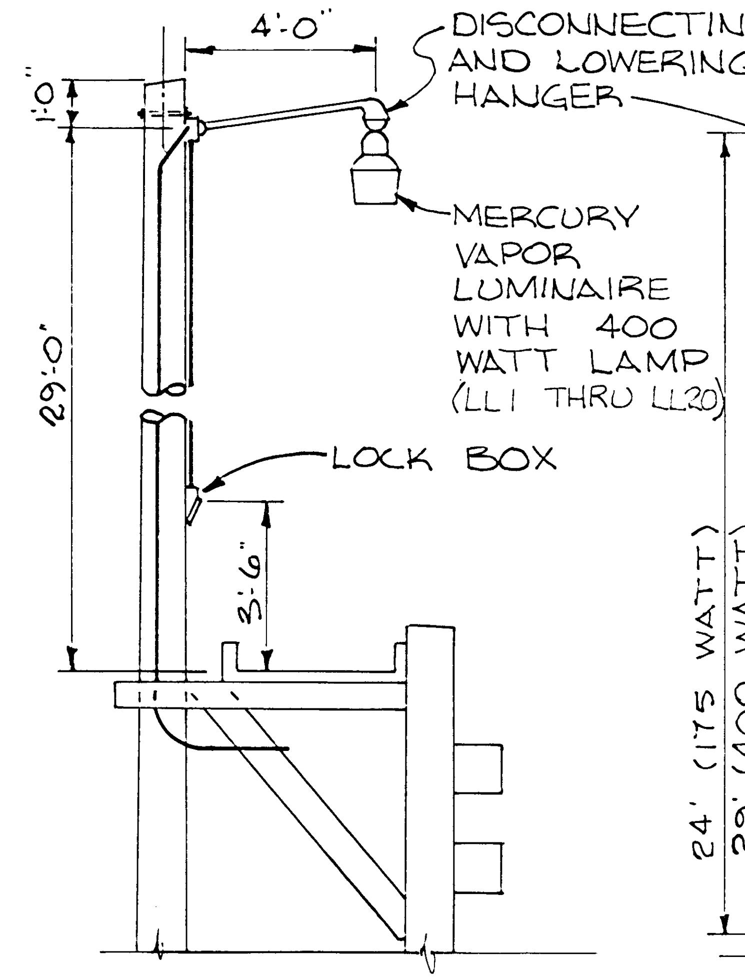
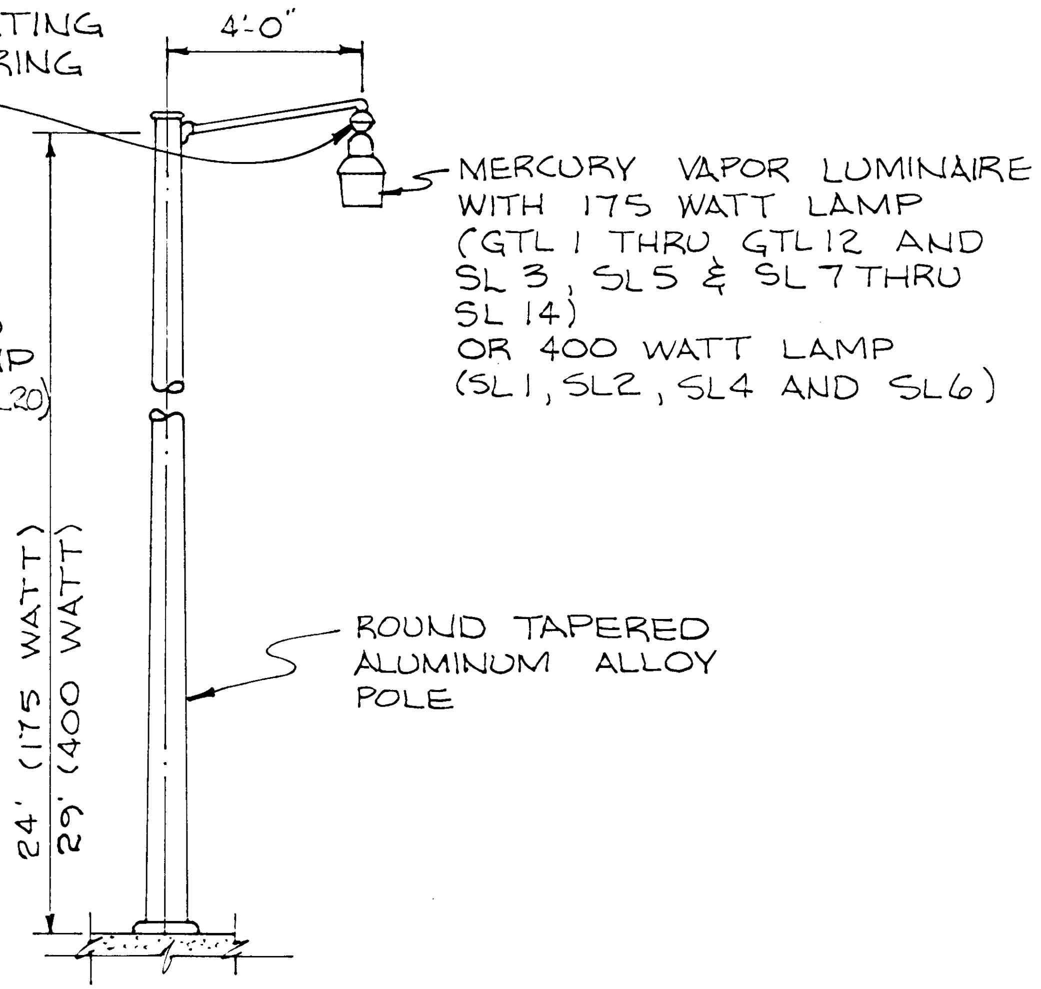
DATE: SEPT., 1973
FILE NO H-2-24419

PLATE VI 6



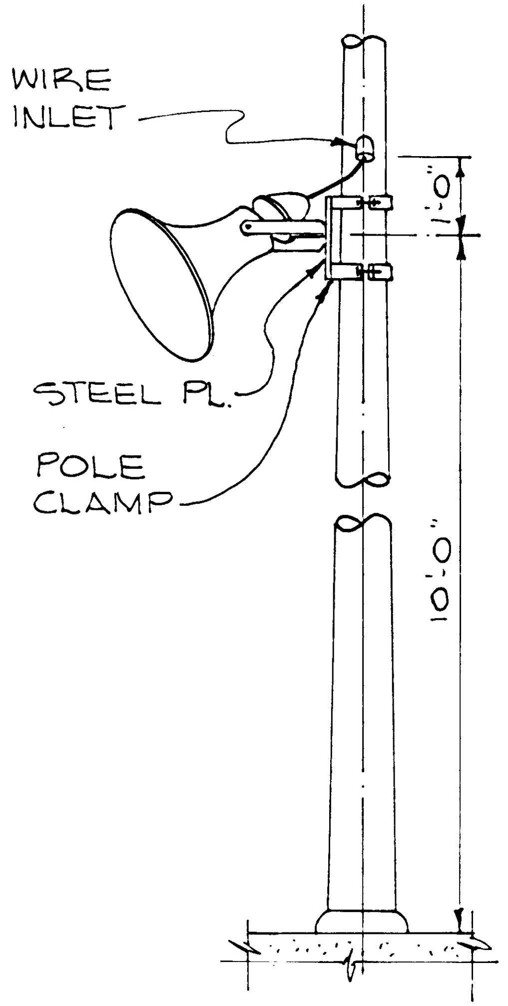
LOCK LIGHT (GUIDE WALLS)

20 REQUIRED



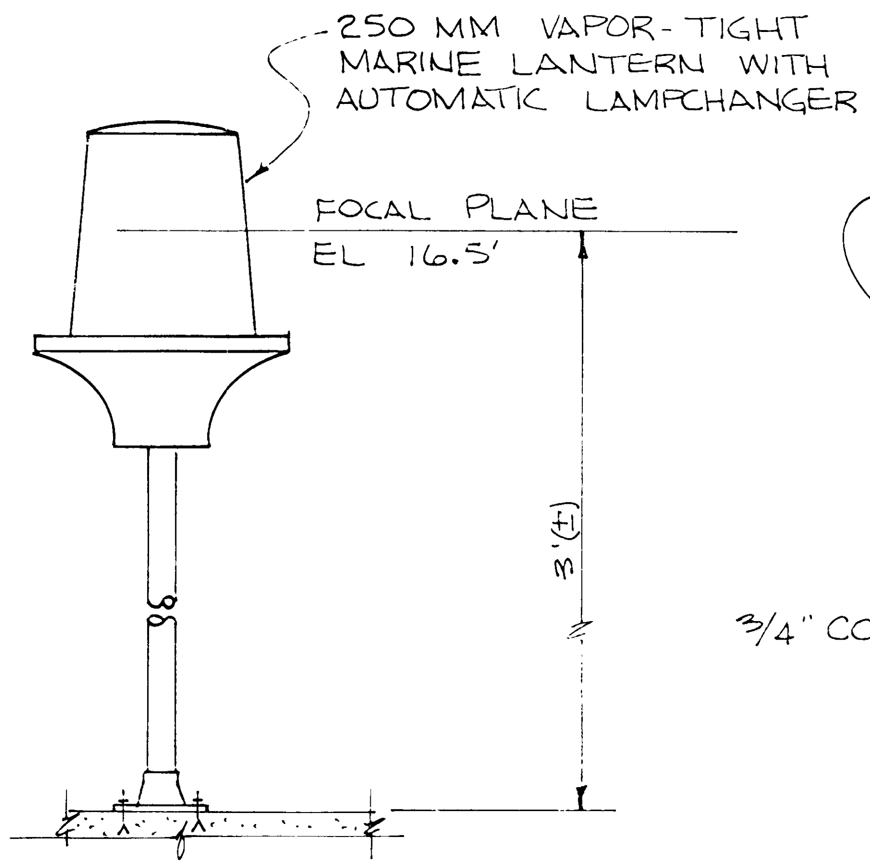
GATE LIGHT AND SECURITY LIGHT

4 REQUIRED 30'
22 REQUIRED 25'



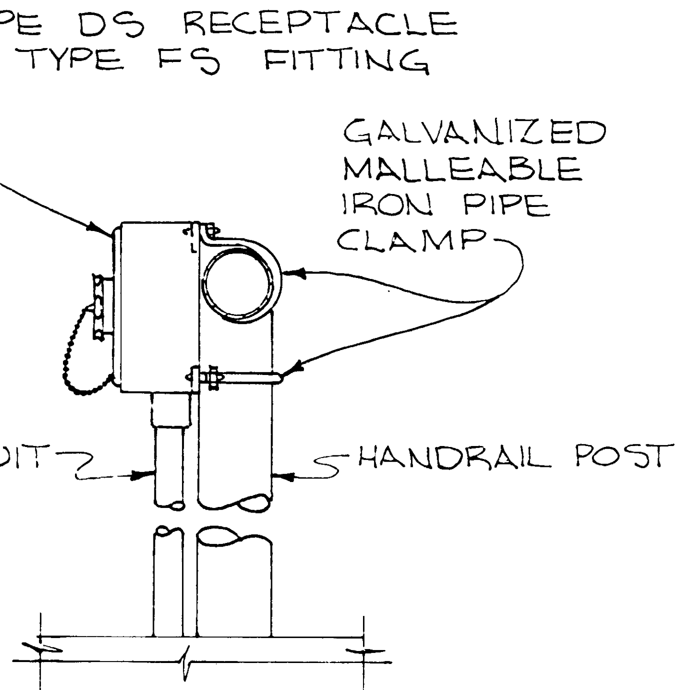
LOUD SPEAKERS

4 REQUIRED (1 EA. ON GATE LIGHT STANDARDS 1, 5, 7 AND 11.



GUARD LIGHT

4 REQUIRED



WEATHERPROOF RECEPTACLE

4 REQUIRED

A JOINT VENTURE

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LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 – DETAIL DESIGN
RIGOLETS LOCK

LIGHTING DETAILS

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

DATE SEPT., 1973
FILE NO H-2-24419

PLATE VI 7

NOTE:

WEST GATE LIGHTS CONTROL SIMILAR TO EAST GATE LIGHTS CONTROL EXCEPT DEVICES LOCATED IN CONTROL HOUSE 3

A JOINT VENTURE

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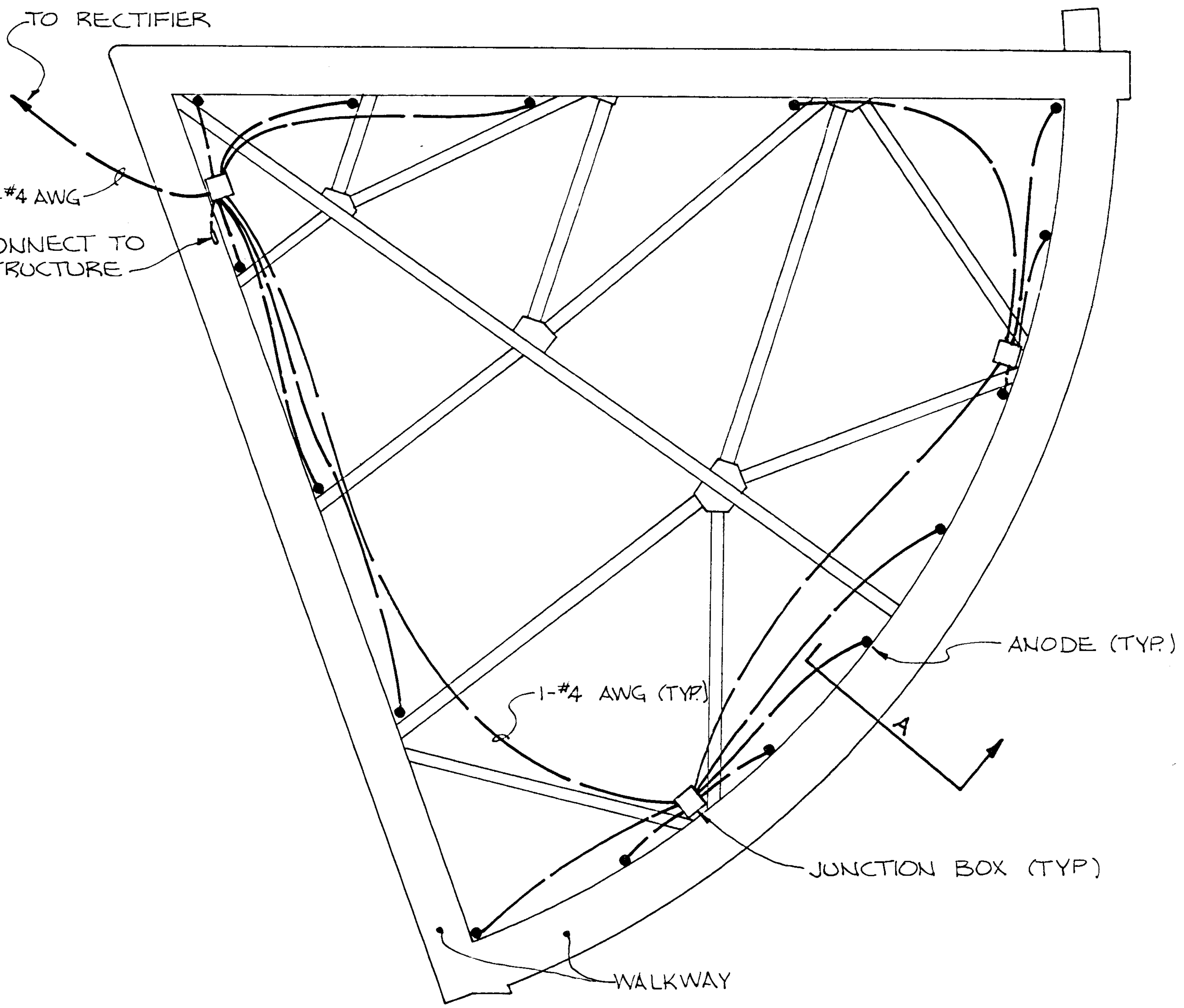
RIGOLETS LOCK

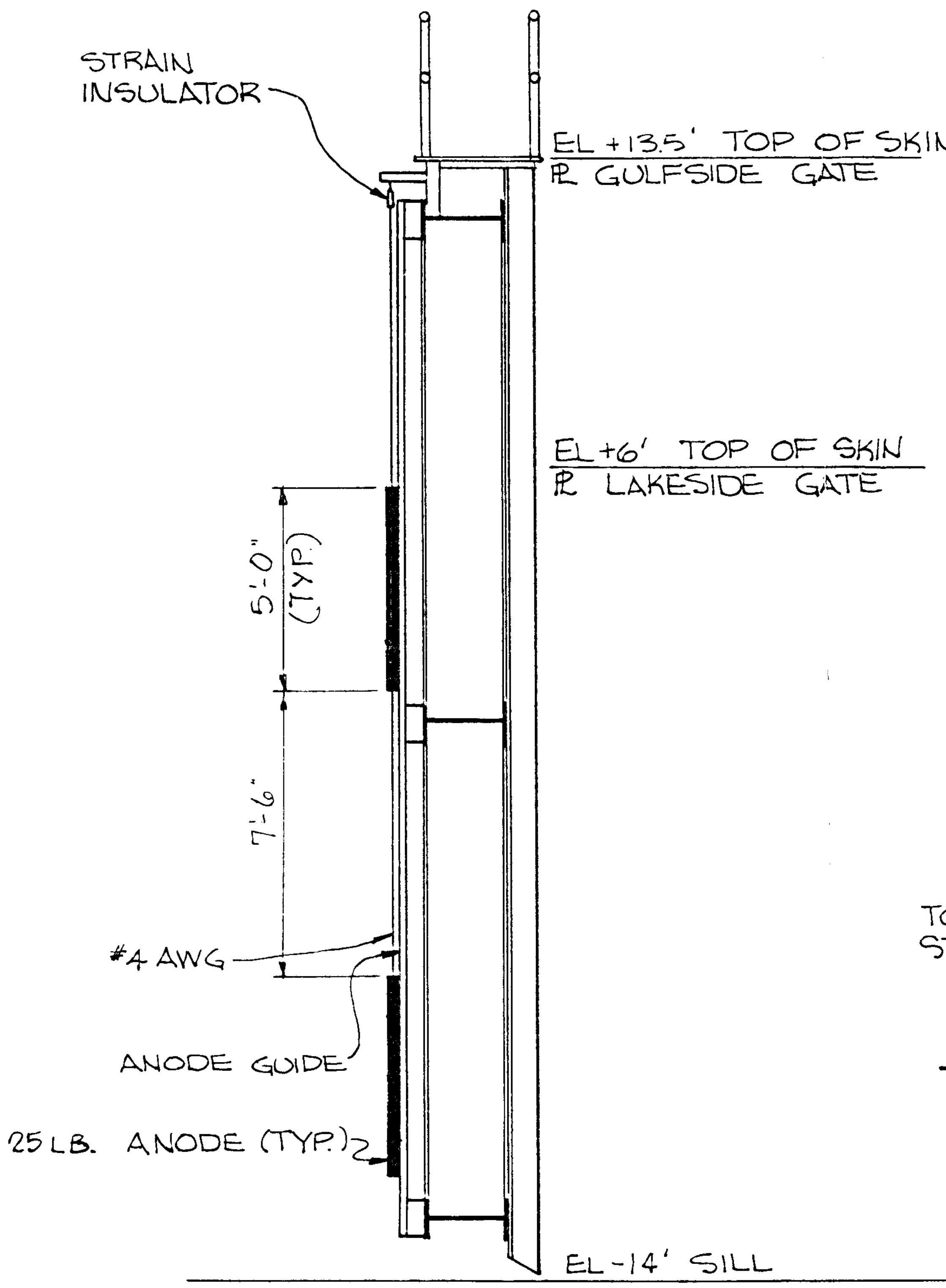
LIGHTING CONTROL CIRCUITS

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

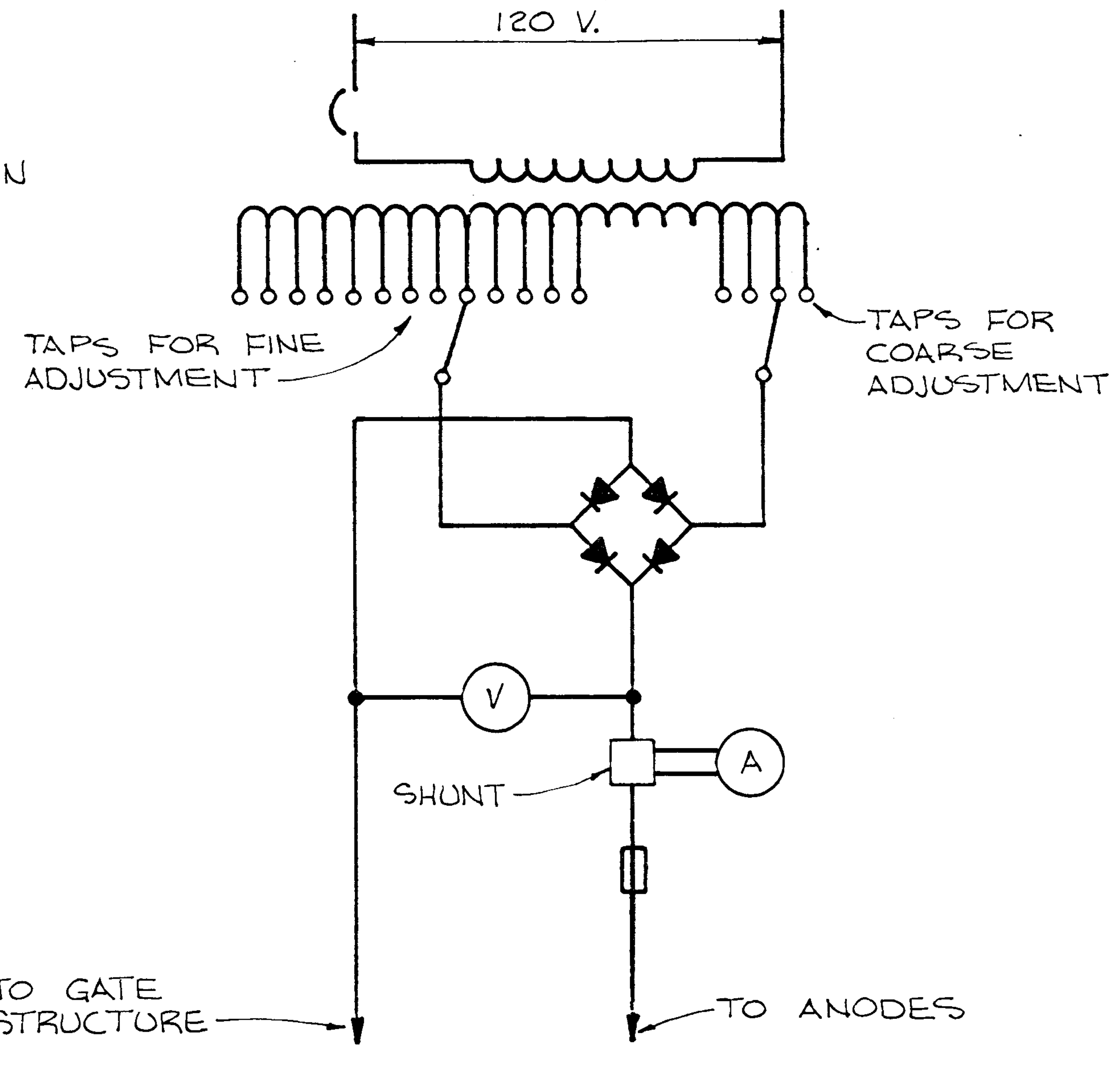
DATE: SEPT., 1973
FILE NO. H-2-24419



PLAN OF TYPICAL SECTOR GATE



SECTION A



RECTIFIER WIRING DIAGRAM

A JOINT VENTURE

B.M. DORNBLATT AND ASSOCIATES, INC NEW ORLEANS, LA	STANLEY CONSULTANTS, INC. MUSCATINE, IOWA

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

CATHODIC PROTECTION

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

DATE: SEPT., 1973
FILE NO H-2-24419

SECTION VIII - ESTIMATE OF COST

1. Estimate of cost. The estimated cost (July, 1973, price level) of the lock and appurtenant work is as follows:

Cost Account No.	Description	Estimated Quantity	Unit	Unit Price	Total Amount
05 LOCK	MASONRY				
	Excavation, Initial	204,300	c.y.	$ 1.00	$204,300
	Excavation, Chamber	88,600	c.y.	1.30	115,180
	Excavation, Structural	13,900	c.y.	2.00	27,800
	Dewatering	---	l.s.	---	500,000
	Lake Side Protection Dike	33,900	c.y.	1.40	47,460
	Maintenance of Gulf Side Prot. Dike	---	l.s.	---	6,000
	Disposal Area Dikes	122,300	c.y.	1.10	134,530
	Sand Fill	71,700	c.y.	0.80	57,360
	Backfill	87,500	c.y.	1.90	166,250
	Ramdom Fill	109,600	c.y.	0.70	76,720
	Compacted Clay Fill	5,300	c.y.	6.00	31,800
	Riprap	38,000	ton	16.40	623,200
	Graded Filter Blanket	19,900	c.y.	15.00	298,500
	Concrete, Stabilization Slab	905	c.y.	55.00	49,775
	Concrete, Base Slab	15,030	c.y.	55.00	826,650
	Concrete, Walls	4,750	c.y.	85.00	403,750
	Concrete, Floodwalls	240	c.y.	115.00	27,600
	Portland Cement	107,950	cwt.	1.65	178,118
	Reinforcing Steel	3,203,000	lbs.	0.22	704,660
	Embedded Metal, Miscellaneous	51,500	lbs.	0.60	30,900
	Steel Pile, 14BP73	42,700	l.f.	13.65	582,855
	Steel Pile, 12BP53	1,210	l.f.	10.65	12,887
	Pile Load Test	10	ea.	3,500.00	35,000
	Steel Sheet Piling, MA-22	68,000	s.f.	5.50	374,000
	Steel Sheet Piling, Z-27	9,940	s.f.	6.30	62,622
	Steel Sheet Pile Dolphins	4	ea.	65,000.00	260,000
	Timber Piling (Guide Walls)	60,030	l.f.	4.30	258,129
	Prestressed Concrete Piling	2,260	l.f.	8.50	19,210

Cost Account No.	Description	Estimated Quantity	Unit	Unit Price	Total Amount
LOCK (continued)					
	Timber Chamber Guide Walls	1,514	l.f.	$150.00	$227,100
	Timber Approach Guide Walls	900	l.f.	150.00	135,000
	Control Houses	4	ea.	21,000.00	84,000
	Office and Power House	---	l.s.	---	48,000
	Handrail	1,910	l.f.	10.00	19,100
	Fence	2,240	l.f.	6.00	13,440
	Drives and Parking	46,000	s.f.	0.25	11,500
	Utilities	---	l.s.	---	18,000
	Fire Protection System	---	l.s.	---	39,000
	Well	---	l.s.	---	17,000
	Needle Girders and Supports	---	l.s.	---	44,000
	Concrete Needles	---	l.s.	---	39,000
	Needle & Needle Girder Storage Rack	---	l.s.	---	31,000
	Paint Storage Building	---	l.s.	---	1,500
	Navigation Aids	---	l.s.	---	60,000
	Observation Platform	---	l.s.	---	17,000
	Beautification	---	l.s.	---	50,000
	Field Office	---	l.s.	---	5,000
	Subtotal				$6,974,896
	Contingencies (20%)				1,395,104
	TOTAL STRUCTURE				$8,370,000
	GATES AND OPERATING MACHINERY				
	Sector Gates	---	l.s.	---	$686,000
	Electric System	---	l.s.	---	197,000
	Cathodic Protection	---	l.s.	---	29,000
	Operating Machinery	---	l.s.	---	365,000
	Subtotal				$1,277,000
	Contingencies (20%)				255,000
	TOTAL, GATES AND OPERATING MACHINERY				$1,532,000
	TOTAL, LOCK				$9,902,000

Cost Account No.	Description	Estimated Quantity	Unit	Unit Price	Total Amount
09	CHANNELS AND CANALS				
	Excavation	594,600	c.y.	$ 0.75	$445,950
	Dolphins	4	ea.	1,800.00	7,200
	Subtotal				$453,150
	Contingencies (20%)				90,850
	TOTAL, CHANNELS AND CANALS				$544,000
11	LEVEES AND FLOODWALLS				
	EMBANKMENT (SOUTH OF LOCK)				
	Killing Grass	0.75	acre	$2,000.00	$ 1,500
	Sand Fill	4,100	c.y.	1.05	4,305
	Clay Fill	6,750	c.y.	1.25	8,438
	EMBANKMENT (NORTH OF LOCK)				
	Killing Grass	1.2	acre	$2,000.00	$ 2,400
	Sand Fill	5,540	c.y.	1.05	5,817
	Clay Fill	7,200	c.y.	1.25	9,000
	Subtotal				$ 31,460
	Contingencies (20%)				6,540
	TOTAL EMBANKMENT				$ 38,000
	SLOPE PROTECTION (SOUTH OF LOCK)				
	Riprap	3,000	ton	$ 16.40	$ 49,200
	Graded Filter Blanket	1,300	c.y.	15.00	19,500
	SLOPE PROTECTION (NORTH OF LOCK)				
	Riprap	5,200	ton	16.40	85,280
	Graded Filter Blanket	2,200	c.y.	15.00	33,000
	Subtotal				$186,980
	Contingencies (20%)				37,020
	TOTAL SLOPE PROTECTION				$224,000

Cost Account No.	Description	Estimated Quantity	Unit	Unit Price	Total Amount
LEVEES AND FLOODWALLS (continued)					
	ROADWAY				
	Compacted Shell Surfacing				
	(South of Lock)	7,120	s.f.	$ 0.25	$ 1,780
	(North of Lock)	13,670	s.f.	0.25	3,418
	Subtotal				$ 5,198
	Contingencies (20%)				902
	TOTAL, ROADWAY				$ 6,000
	TOTAL, LEVEE & FLOODWALLS				268,000
	TOTAL, CONTRACT 2 (LOCK, CHANNELS & CANALS AND LEVEES & FLOODWALLS)				$10,714,000

2. Comparison of cost estimate. The estimate of $10,714,000 for the construction of the lock is an increase of $2,657,000 from the estimate included in the approved project document, General Design Memorandum No. 2 - General Design, Supplement No. 2, Rigolets Lock and Adjoining Levees dated June, 1969. The increase reflects the effects of escalation and a greater refinement in the design because of the detail included in this design memorandum.

SECTION VIII - RECOMMENDATION

1. Recommendation. The lock consists essentially of concrete gate bays with steel sector gates, earth chamber with timber guide walls, connecting levees, navigation channel, timber approach guide walls, and reservation. The detail design of the lock as presented in this memorandum is recommended for approval.

Department of the Army
Corps of Engineers

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
RIGOLETS LOCK
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN

FIELD PUMPING TEST
APPENDIX NO. A

Prepared in the Office of the District Engineer
U. S. Army Engineer District, New Orleans
New Orleans, La.

July 1969

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
RIGOLETS LOCK
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN

FIELD PUMPING TEST
APPENDIX NO. A

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PLATES

CORRESPONDENCE

Lake Pontchartrain, La. and Vicinity
Lake Pontchartrain Barrier Plan
Rigolets Lock
Design Memorandum No. 8 - Detail Design

Field Pumping Test
Appendix No. A

1. General. A field pumping test was performed at the proposed structure site during the period 21-29 April 1969 to determine the insitu horizontal permeability of the foundation sands. Knowledge concerning the insitu permeability of the foundation sands was considered necessary for design of dewatering facilities and for estimating pumping requirements during construction. The investigation consisted of installing a test well and ranges of open-type piezometers extending radially from the well. The test well extended in depth to elevation -64.4 ft. m.s.l. and the centers of the piezometer screens were set at approximate elevation -35.0 m.s.l. The locations and details of the well and piezometers are shown on plates 1 and 2. The field investigation consisted of pumping the well at two different drawdowns, and reading the piezometers.

2. Test well. The test well was located as shown on Plate 1 at the intersection of four piezometer ranges, 150 feet south of the centerline of the structure at the 1959 survey baseline station 10+60, opposite the center of the proposed lock. The test well consisted of two 20-foot lengths of 8-inch I.D. commercial slotted stainless steel well screen and an 8-inch I.D. galvanized iron riser pipe. The screen in the sand aquifer was a no. 8 slot size (0.008 in. slot width). The length of screen was 40 feet and extended from elevation -24.4 to -64.4 m.s.l., approximately 1 1/2-feet below the bottom of the sand aquifer.

3. Well installation. The well was installed with a no. 1500 Failing drill rig operating on an 18- by 45-foot steel pontoon with a drill hole through the deck. The pontoon was spudded down with the drill hole located over the intersection of the four piezometer ranges. A 10-inch diameter steel pipe casing was placed through the drill hole and was pushed down through the cohesive overburden and seated at approximate elevation -23.5 in the foundation sand. The material inside of the 10-inch pipe was removed and the screen placed inside of the casing. The screen was advanced by jetting through the 8-inch screen and removing the sand from within the space between the screen and the casing. The screen was lowered through the sand aquifer and the bottom end of the screen was set into the clay underlying the foundation sand. The bottom end of the screen was not plugged. A detail of the well is shown on Plate 2.

4. Piezometers. Piezometers consisting of 1 1/4-inch No. 18 slot brass commercial well point screens 2-feet long with 1 1/4-inch plastic riser pipes were installed in the sand aquifer to provide data on the drawdown during the pumping tests. The piezometers were installed along four ranges extending in a direction south, east, north, and northwest of the test well. The piezometers were placed in the aquifer with the centers of the screens at approximate elevation -35 m.s.l. The locations and a detail of the piezometers are shown on Plate 1.

5. Pumping equipment. A 4-inch gasoline-driven, centrifugal pump, with a rated capacity of 500 g.p.m. was used to pump the well. The pump operated from the deck of the steel pontoon. The suction line consisted of 21-feet of 3-inch galvanized iron pipe. Sufficient clearance between the suction pipe and the inside of the screen was available to permit determination of the water level in the well and utilization of the well flow meter.[1] The well flow meter, located a few feet above the top of the screen section, was used for measuring the discharge during the tests. The total discharge was checked by determining the time required to fill a 5 gallon container. The well flow meter also was lowered into the screen section to determine the distribution of flow into the well. These data are shown on Plate 2. After the well was installed and prior to performing the pumping tests, the well was developed by surging with a double 7 1/2-inch - 2 block surging tool for 50 roundtrips at a rate of approximately 80-feet per minute and pumping at an 8-foot drawdown for approximately 3 1/2 hours. After the development period, the amount of sand was measured and approximately 1/2 gallon of sand infiltrated into the well through the screen.

6. Pumping test. The periods during which the pumping tests were performed are shown on Plate 2 together with the Rigolets stage and the stabilized water elevation in the test well prior to pumping. The 5-foot and 10-foot drawdown tests were performed on 29 April 1969. Although the actual drawdowns were slightly different from those given above, the above terminology is used for simplicity. The drawdown in the well during the pumping tests are plotted against elapsed time in hours on Plate 2. When equilibrium was reached at each pumping rate, all piezometer levels were recorded and the well flow meter was lowered into the screen

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[1] Corps of Engineers, Waterways Experiment Station, Waterways Experiment Station Relief Well Flow Meter, Misc. paper No. 5-83, Vicksburg, Miss. (April 1954).

to determine the flow in the well screen at approximately 5-foot intervals of depth. The distribution of flow into the well screen in terms of percent of total flow is shown on Plate 2.

7. Analysis of data. The piezometer data at equilibrium for each pumping rate are plotted versus the lograithm of the radial distance from the well on Plate 2. The drawdowns have been corrected for the varying Rigolets stage during testing. The fact that the drawdown curves consist of two relatively straight-line segments indicates that the flow to the well was radial and horizontal in the aquifer. The drawdown curves away from the well were extended as straight lines to the point of zero drawdown thereby simulating an equivalent radius of influence. The horizontal permeability of the foundation sands was determined from the drawdown curves using the Thiem formula for artesian flow:

$$K_H = \frac{Q_w \ln r_2/r_1}{2\pi D\ (h_2 - h_1)}$$

in which Q_w = Rate of pumping well.

K_H = Coefficient of horizontal permeability.

D = Thickness of aquifer

h_1, h_2 = The head at any two points on the drawdown curve.

r_1, r_2 = The distance from the well at which h_1 and h_2 are measured, respectively.

The straight-line portion of the drawdown curve was used in the above formula to determine the horizontal permeability of the sand aquifer. The permeability calculation and well flow versus drawdown in the well are shown on Plate 2. The results of the pump test indicate that the foundation sand has an average horizontal permeability of approximately 110×10^{-4} c.m. per second and a specific yield of approximately 4 g.p.m. per foot of drawdown.

8. Field explorations. A 1 7/8" I.D. core barrel boring was taken at each of the piezometer locations. A general type boring was made immediately adjacent to the test well with a 1 7/8" I.D. sampler in the cohesive materials and a 1 3/8" I.D. 2" O.D. split-spoon sampler, using a 140 lb hammer and 30-inch drop in sand. The boring logs are shown on plates 3 and 4. The field pump tests and field explorations were made by the New Orleans District. Borings made for other features of the subject project are shown in the GDM.

9. Soils laboratory tests. Laboratory tests consisted of visual classification and natural water content determinations on all samples and sieve analyses on representative non-cohesive samples. These data are shown on plates 2, 3, and 4.

CORPS OF ENGINEERS

U.S. ARMY

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION		TYPE	LETTER SYMBOL	SYMBOL	TYPICAL NAMES
COARSE - GRAINED SOILS More than half of material is larger than No. 200 sieve size	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size	CLEAN GRAVEL (Little or No Fines)	GW	▨	GRAVEL, Well Graded, gravel - sand mixtures, little or no fines
			GP	▨	GRAVEL, Poorly Graded, gravel-sand mixtures, little or no fines
		GRAVEL WITH FINES (Appreciable Amount of Fines)	GM	▨	SILTY GRAVEL, gravel - sand - silt mixtures
			GC	▨	CLAYEY GRAVEL, gravel - sand - clay mixtures
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size	CLEAN SAND (Little or No Fines)	SW	▨	SAND, Well - Graded, gravelly sands
			SP	▨	SAND, Poorly - Graded, gravelly sands
		SANDS WITH FINES (Appreciable Amount of Fines)	SM	▨	SILTY SAND, sand - silt mixtures
			SC	▨	CLAYEY SAND, sand - clay mixtures
FINE - GRAINED SOILS More than half the material is smaller than No. 200 sieve size		SILTS AND CLAYS (Liquid Limit < 50)	ML	▨	SILT & very fine sand, silty or clayey fine sand or clayey silt with slight plasticity
			CL	▨	LEAN CLAY; Sandy Clay; Silty Clay; of low to medium plasticity
			OL	▨	ORGANIC SILTS and organic silty clays of low plasticity
		SILTS AND CLAYS (Liquid Limit > 50)	MH	▨	SILT, fine sandy or silty soil with high plasticity
			CH	▨	FAT CLAY, inorganic clay of high plasticity
			OH	▨	ORGANIC CLAYS of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt	▨	PEAT, and other highly organic soil
WOOD			Wd	▨	WOOD
SHELLS			Sl	▨	SHELLS
NO SAMPLE					

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

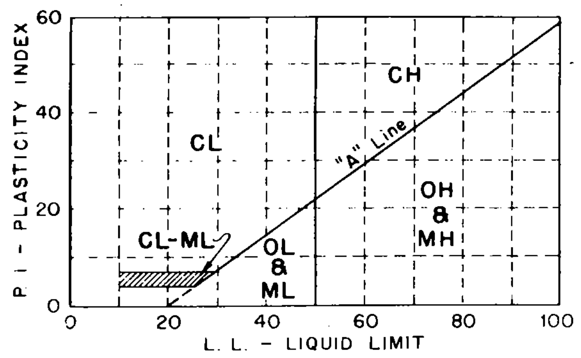
DESCRIPTIVE SYMBOLS

COLOR

COLOR	SYMBOL
TAN	T
YELLOW	Y
RED	R
BLACK	BK
GRAY	Gr
LIGHT GRAY	lGr
DARK GRAY	dGr
BROWN	Br
LIGHT BROWN	lBr
DARK BROWN	dBr
BROWNISH - GRAY	br Gr
GRAYISH - BROWN	gy Br
GREENISH - GRAY	gn Gr
GRAYISH - GREEN	gy Gn
GREEN	Gn
BLUE	Bl
BLUE - GREEN	Bl Gn
WHITE	Wh
MOTTLED	Mot

CONSISTENCY FOR COHESIVE SOILS

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



PLASTICITY CHART

For classification of fine - grained soils

MODIFICATIONS

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

NOTES:

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

Are natural water contents in percent dry weight

When underlined denotes D_{10} size in mm *

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

Are liquid and plastic limits, respectively

SYMBOLS TO LEFT OF BORING

▽	Ground - water surface and date observed
Ⓒ	Denotes location of consolidation test **
Ⓢ	Denotes location of consolidated - drained direct shear test **
Ⓡ	Denotes location of consolidated - undrained triaxial compression test **
Ⓠ	Denotes location of unconsolidated - undrained triaxial compression test **
Ⓣ	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.

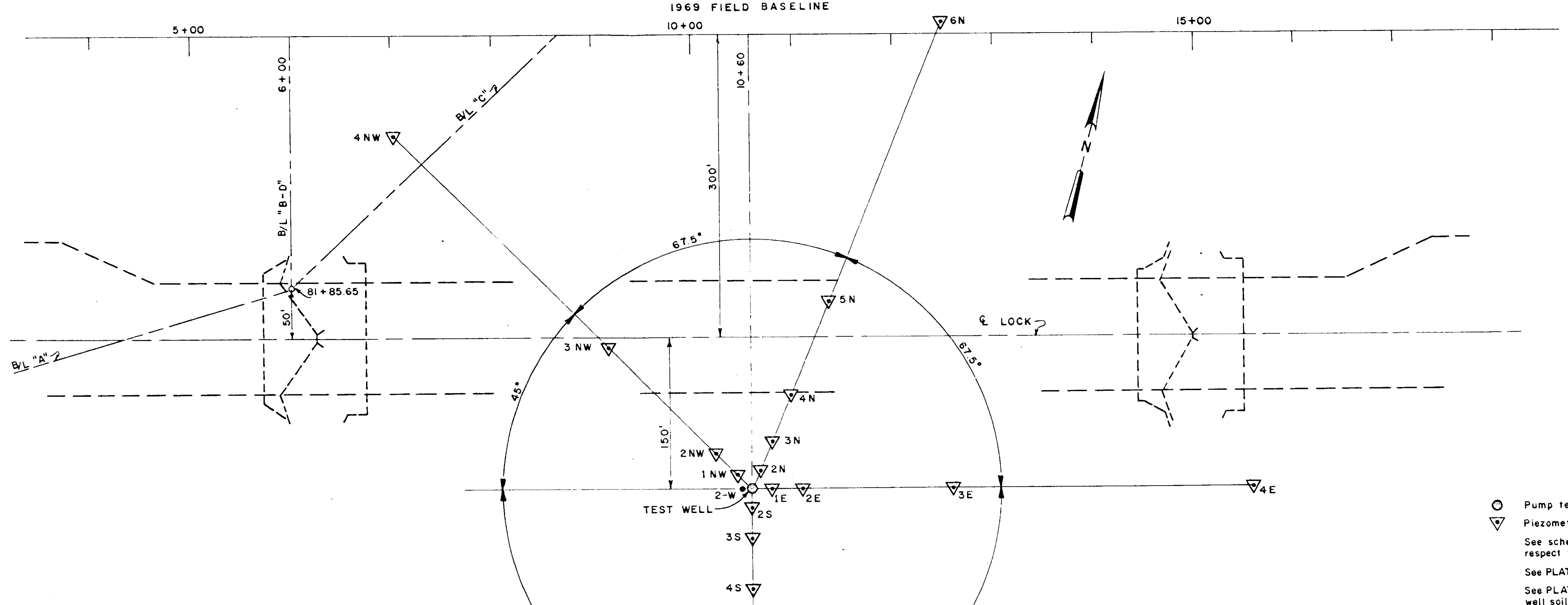
Consistency of cohesive soils shown on the boring logs is based on driller's log and visual examination and is approximate, except within those vertical reaches of the borings where shear strengths from unconfined compression tests are shown.

REVISION	DATE	DESCRIPTION	BY
2	6-8-64	SYMBOL FW, NOTE REVISED	ORAL FROM LMVGG 5 JUNE 1964
	9-[illegible]-63	1ST PAR OF GENERAL NOTES REVISED	LMVD MULTIPLE LETTER, DATED 5 SEPT. 1963

SOIL BORING LEGEND

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

PLATE A



GENERAL NOTES

○ Pump test well, 8-in. I.D.

▽ Piezometer and general type soil borings.

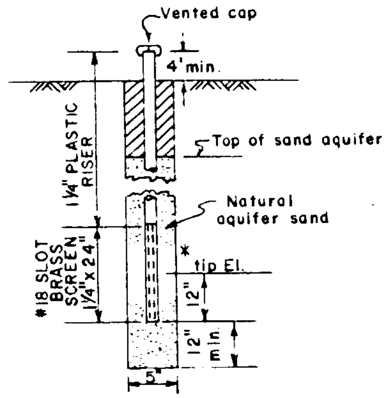
See schedule for locations of piezometers with respect to test well.

See PLATE No. 2 for field pumping test data.

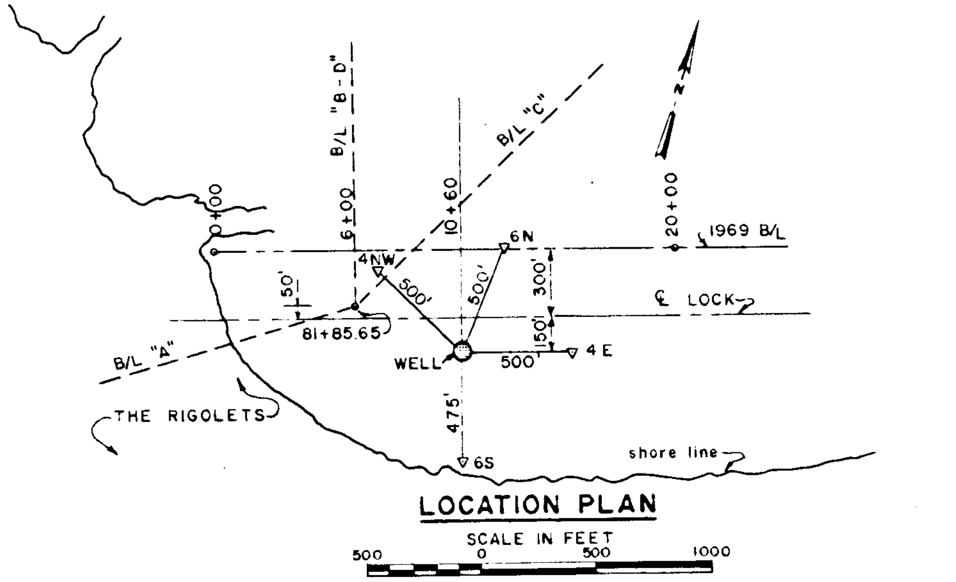
See PLATE Nos. 3 and 4 for piezometer and well soil boring data.

RANGE	PIEZOMETER NUMBER	DISTANCE FROM TEST WELL (FT.)	*TIP ELEVATION (M.S.L.)
SOUTH	2 S	20	-34.77
	3 S	50	-33.59
	4 S	100	-34.95
	5 S	200	-34.76
	6 S	475	-34.8C
EAST	1 E	20	-35.17
	2E	50	-34.88
	3E	200	-34.96
	4E	500	-35.03
NORTH	2N	20	-34.68
	3N	50	-34.77
	4 N	100	-34.73
	5N	200	-35.06
	6N	500	-34.83
NORTH WEST	1 NW	20	-34.81
	2 NW	50	-34.28
	3 NW	200	-34.15
	4 NW	500	-34.68

PIEZOMETER SCHEDULE



PIEZOMETER DETAIL



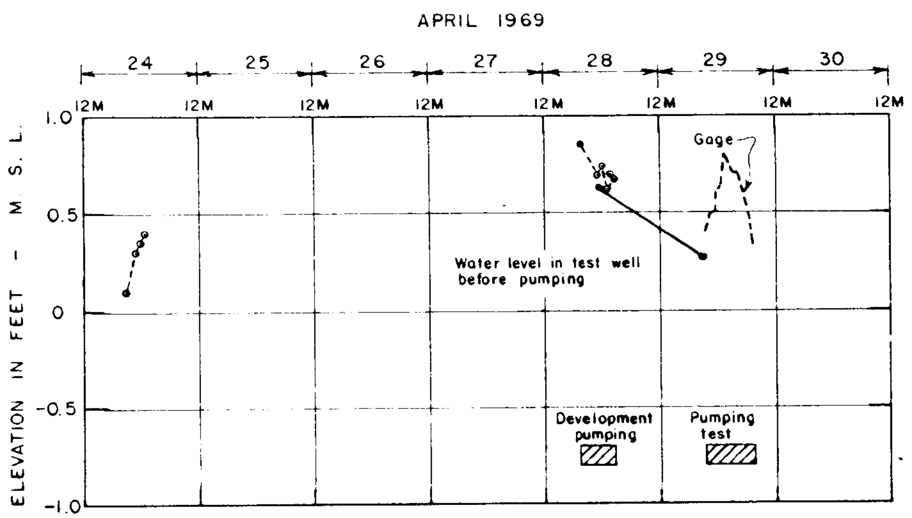
LOCATION PLAN

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

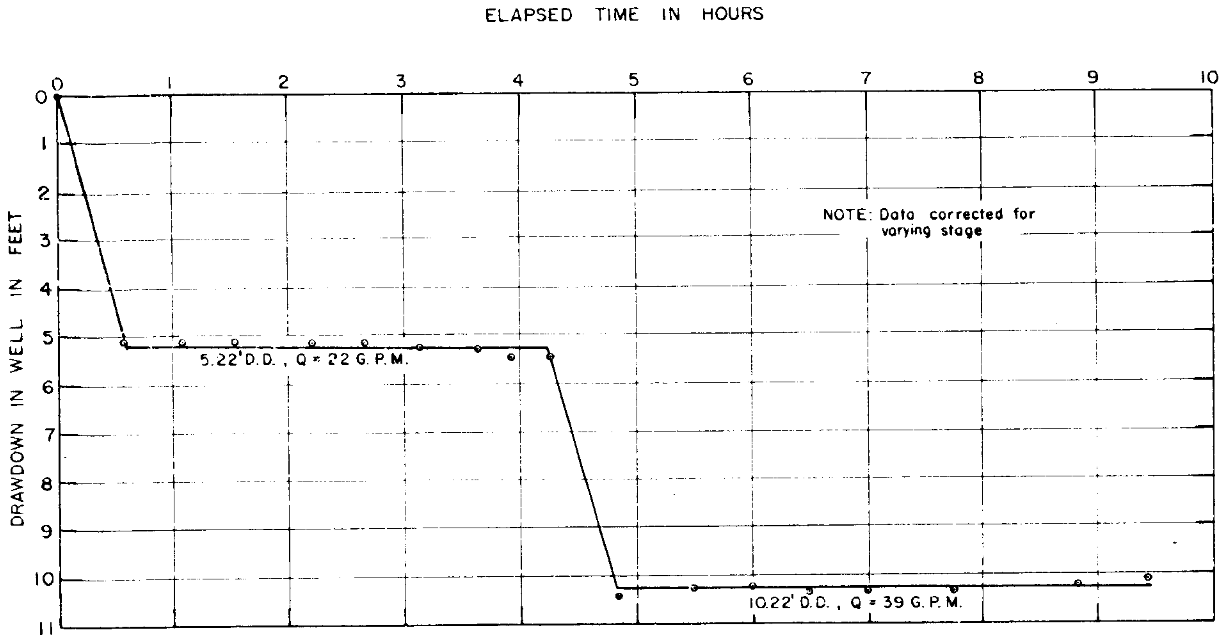
FIELD PUMPING TEST
TEST WELL AND PIEZOMETER LOCATIONS

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

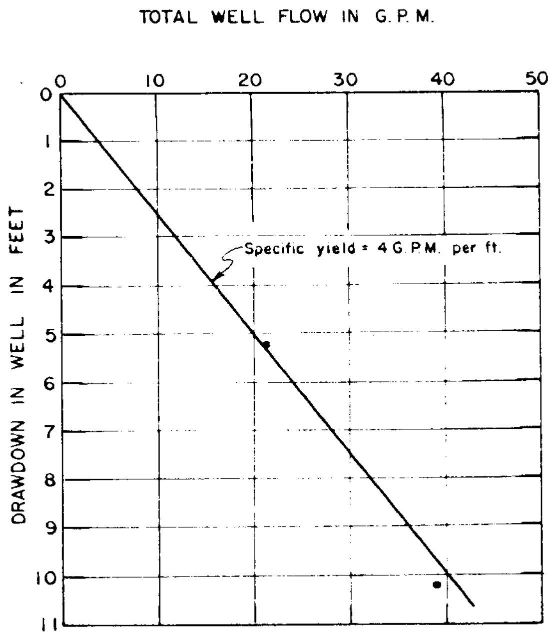
JULY 1969
FILE NO. H-2-24419



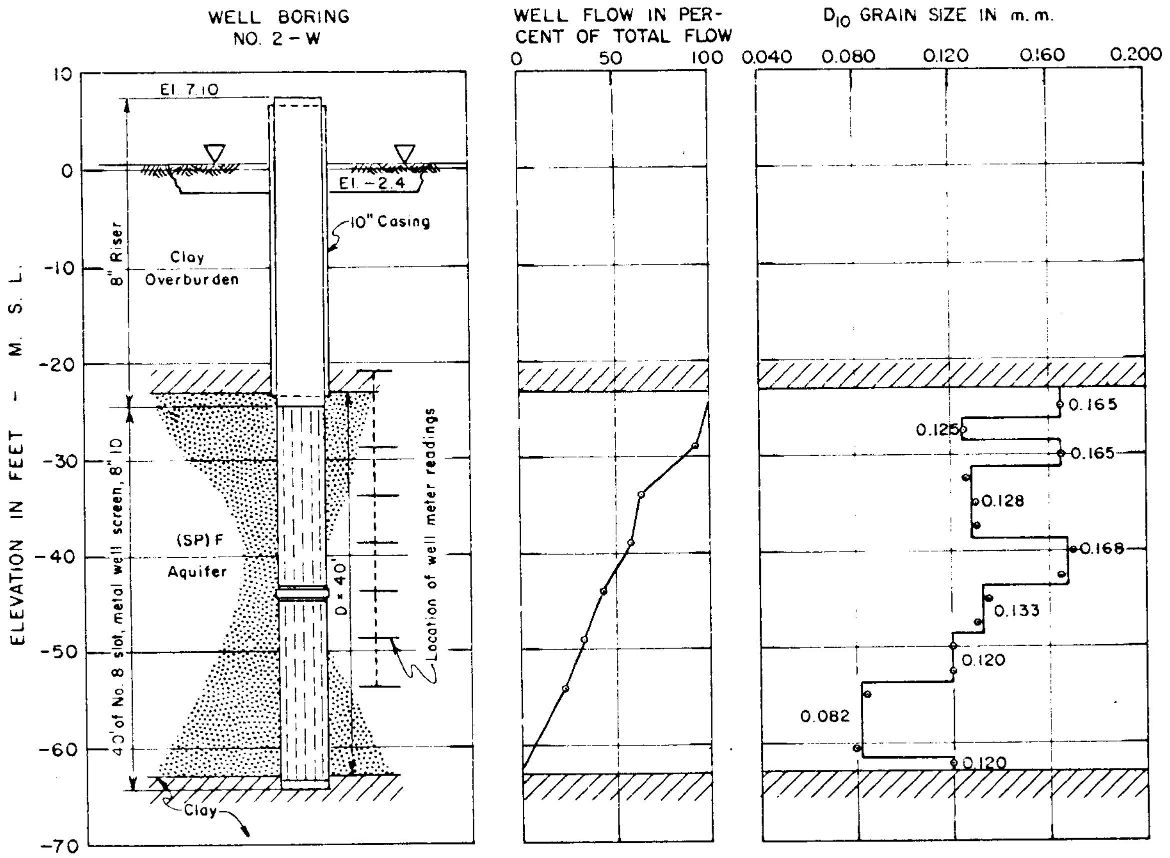
SCHEDULE OF TEST PUMPING



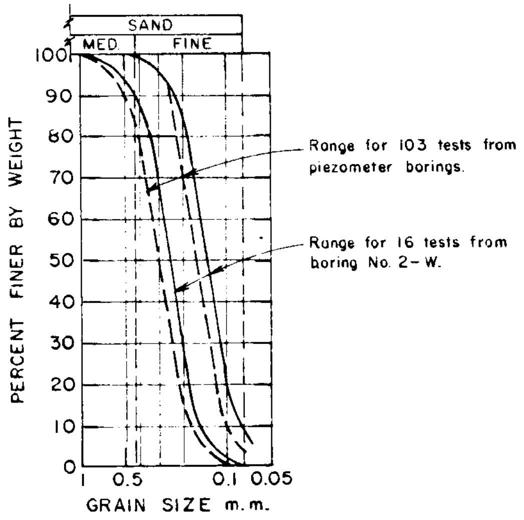
DRAWDOWN IN WELL VERSUS TIME



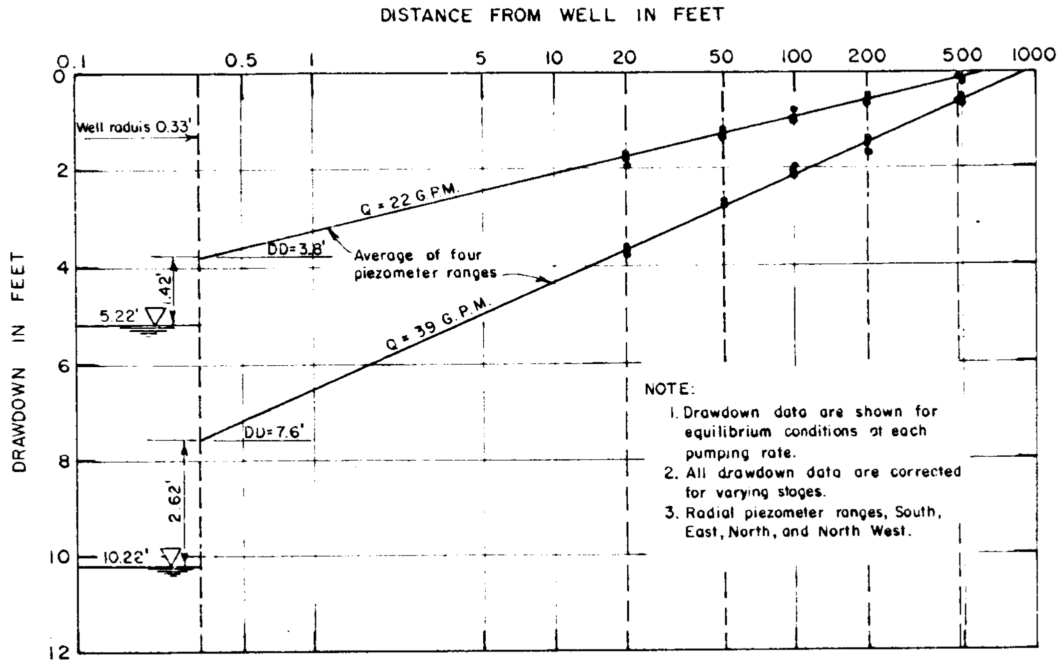
WELL FLOW VS DRAWDOWN IN WELL



WELL DETAIL, FLOW DATA, AND D_{10} SIZE



GRAIN SIZE GRADATION



DRAWDOWN IN WELL AND PIEZOMETERS

PERMEABILITY CALCULATIONS

$$K_H = \frac{Q_w \ln R/r_w}{2\pi D(H-h_w)}; \quad Q_w = \frac{39}{7.5} = 5.2 \text{ cfm}, R = 900', r_w = 0.33', D = 40', H-h_w = 7.6',$$

$$2\pi = 6.2832$$

$$K_H = \frac{5.2 \ln 2{,}700}{6.2832 \times 40 \times 7.6} = \frac{5.2 \times 7.9}{1{,}910} = \frac{41}{1{,}910} = 0.0125' \text{ per. min.}$$

$$K_H = 0.0215 \times 0.508 = 0.0109 = 109 \times 10^{-4} \text{ cm per. sec.}$$

LAKE PONTCHARTRAIN, LA. AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

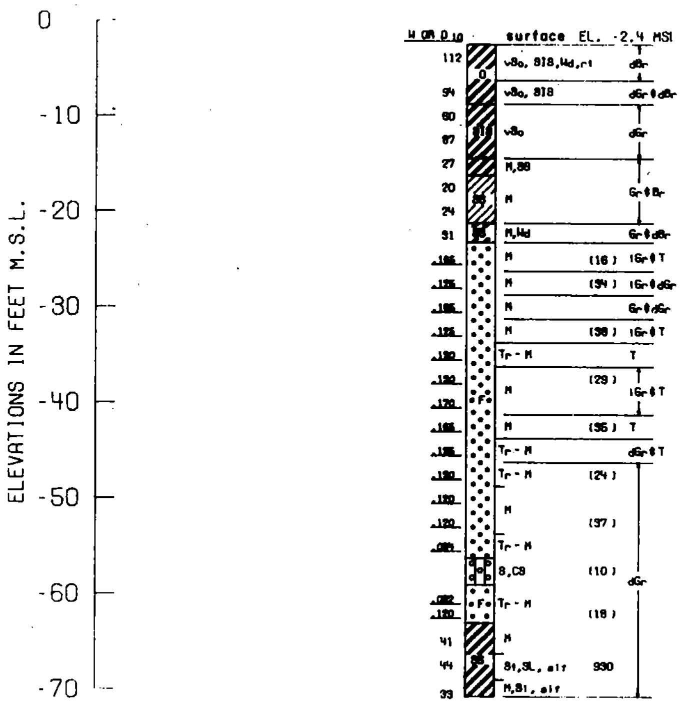
FIELD PUMPING TEST
FIELD PERMEABILITY DATA

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

JULY 1969
FILE NO. H-2-24419

BOR. 2-W

10 FT. WEST OF WELL SITE
WATER SURFACE ELEV 0.80 MSL
30 APRIL 69



NOTE: Boring located 450' south of 1969
B/L sta. 10 + 60.

NOTE: General type boring logs were taken with a 1⅞ inch I.D. core barrel sampler. 1⅜ I.D. 2 inch O.D. splitspoon sampler. See PLATE A for boring legend.

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

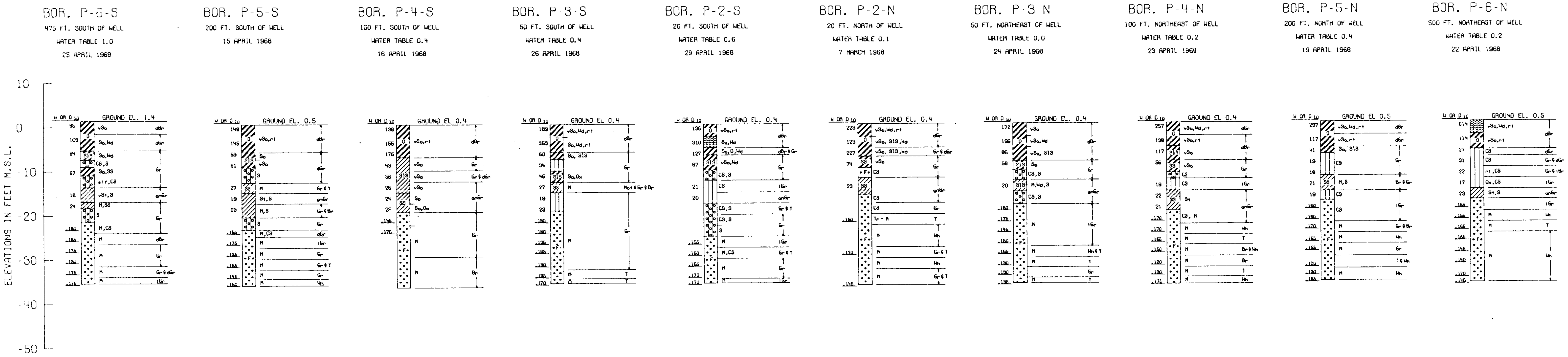
FIELD PUMPING TEST

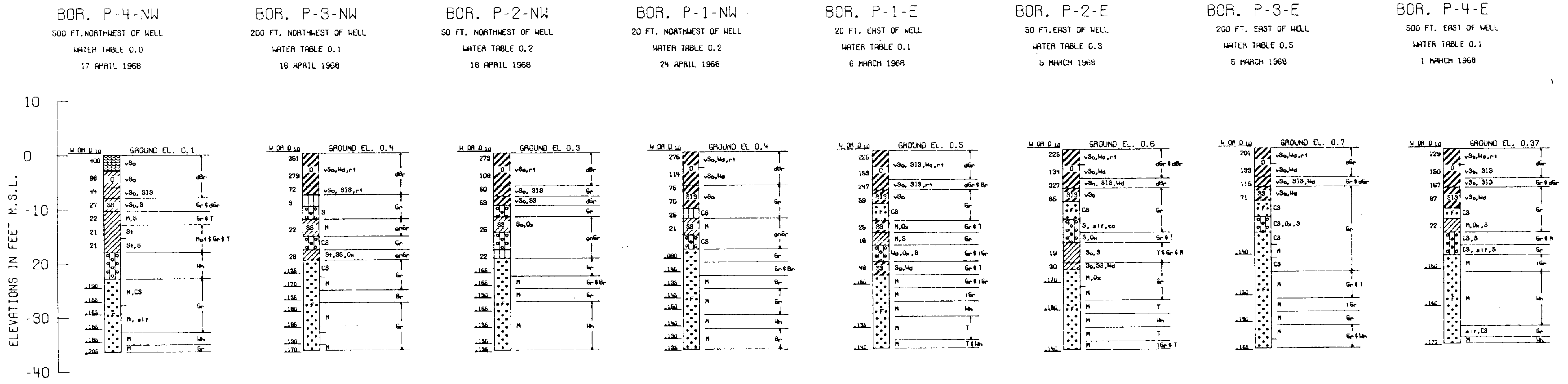
WELL BORING NO. 2-W

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

JULY 1969

FILE NO. H-2-24419





NOTE: General type boring logs were taken with a
1 7/8 inch I.D. core barrel sampler.
See PLATE A for boring legend.

LAKE PONTCHARTRAIN, LA AND VICINITY
LAKE PONTCHARTRAIN BARRIER PLAN
DESIGN MEMORANDUM NO. 8 - DETAIL DESIGN
RIGOLETS LOCK

FIELD PUMPING TEST
PIEZOMETER BORING LOGS

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

JULY 1969
FILE NO. H-2-24419

APPENDIX "A"
PLATE 4

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

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

LMNED-FS

26 August 1969

SUBJECT: Foundation Pumping Test Report, Rigolets Lock, Hurricane Protection, Lake Pontchartrain, La. and Vicinity, Barrier Plan, DDM No. 8

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-G

1. The report for the foundation pumping test at Rigolets Lock Site is inclosed.

2. The test was performed by this office for furnishing the Architect-Engineer responsible for the design of the lock.

3. An early approval of the pumping test report is requested.

FOR THE DISTRICT ENGINEER:

1 Incl (dupe)
Pump Test Rpt

JEROME C. BAEHR
Chief, Engineering Division

Incl. 1

LMVED-G (NOD 26 Aug 69) 1st Ind
SUBJECT: Foundation Pumping Test Report, Rigolets Lock, Hurricane
Protection, Lake Pontchartrain, La. and Vicinity, Barrier
Plan, DDM No. 8

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg,
Miss. 39180 3 Sep 69

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

1. The report is approved subject to the following comment:
On Plate 2 the value of K_H should be 0.0215 ft per minute instead of 0.0125 ft per minute.

2. We wish to commend your staff on preparing this excellent report.

FOR THE DIVISION ENGINEER:

A. J. Davis

wd incl

A. J. DAVIS
Chief, Engineering Division