FLOOD CONTROL
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES

ITEM M-29.4-R
EMPIRE LOCK-MODIFICATIONS

PLAQUEMINES PARISH, LOUISIANA
RELOCATION OF FACILITIES
DESIGN MEMORANDUM NO. 54

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

MAY 1978

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

IN REPLY REFER TO
LMNED-MR

19 May 1978

SUBJECT: Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-29.4-R, Empire Lock Modifications, Plaquemines Parish, Louisiana, Relocation of Facilities, Design Memorandum No. 54

President
Mississippi River Commission
ATTN: LMVED-TD

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

2. The final Environmental Impact Statement for the Mississippi River Levees and Channel Improvement projects, which include the Empire Lock Modification project, was filed with CEQ on 8 April 1976, and the notice of availability was published in the Federal Register on 4 April 1976.

3. A cultural resources survey was conducted in June 1976 between levee stations 2731+00 and 2875+06 along the right descending bank of the Mississippi River in Plaquemines Parish, Louisiana. The Empire Lock Modification is between levee stations 2766+87 and 2769+11. The cultural survey did not find remains considered culturally significant along the river banks or batture. No historic material or structures were found to be impacted within this reach of levee.

4. The Section 404 public notice was issued for the Buras Levee District, which the Empire Lock is located in, on 31 March 1976. No adverse comments were received regarding Section 404 requirements. Adverse comments were received regarding the planned excavation for levee material in the batture. The Empire Lock modification will not require borrow material for the levees, therefore those adverse comments do not apply to this project.

5. Report Status.

a. This relocations design memorandum (RDM) is being submitted approximately 4 months prior to the scheduled award of the construction contract in October 1978. A cost reimbursable contract with the Louisiana Department of Transportation and Development, Office of Public Works

LMNED-MR 19 May 1978

SUBJECT: Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-29.4-R, Empire Lock Modifications, Plaquemines Parish, Louisiana, Relocation of Facilities, Design Memorandum No. 54

is scheduled to be submitted to MRC prior to 1 June 1978 for approval. Plans and specifications prepared by the Office of Public Works will be reviewed by the New Orleans District during May and June 1978. The RDM and cost reimbursable contract must be approved prior to 16 June 1978 to permit the Office of Public Works to award the construction contract by 1 October 1978. This award date must be met to maintain the scheduled lock dewatering period of 15 November 1978 to 15 March 1979.

b. In FY 78, $150,000 is scheduled for obligation and expenditure for the Empire Lock Modification. Approximately $65,000 will be obligated and expended for the Office of Public Works engineering and design costs in FY 78 immediately after the cost reimbursable contract is executed in September 1978. The balance of the funds ($85,000) will be utilized in the Burnside Levee Slope Paving and Shaping project, item M-171.4-167.7-L for obligation and expenditure in FY 78.

6. In view of paragraph 5a above your timely review and approval of the subject relocations design memorandum is recommended.

Charles H. Bartis Jr. LTC CE

1 Incl
RDM No. 54 (11 copies)

for EARLY J. RUSH III
Colonel, CE
District Engineer

FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES

MISSISSIPPI RIVER LEVEES

ITEM M-29.4-R

EMPIRE LOCK MODIFICATIONS

PLAQUEMINES PARISH, LOUISIANA

RELOCATION OF FACILITIES

DESIGN MEMORANDUM NO. 54

STATUS OF DESIGN MEMORANDUMS

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
1	Flood Control, Mississippi River and Tributaries, Item M-25.0-R, Buras Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	23 Nov 70 (A)
2	Flood Control, Mississippi River and Tributaries, Item M-26.0-R, Upper Buras Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	21 Jan 71 (A)
3	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-14.9-R, Commander Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	11 Jun 71 (A)
4	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-10.7-R, Venice Levee Enlargement and Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	6 Apr 71 (A)
5	Lower Red River - South Bank Red River Levees, Item R-117.0-R (1957 Mileage), Levee Enlargement, Rapides-Cotton Bayou Levee, Rapides Parish, Louisiana, Relocation of Facilities	22 Jan 71 (A)
6	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-31.3-R, Tropical Bend Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	30 Mar 71 (A)
7	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-10.4-R, Lower Venice Levee Enlargement and Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	27 Aug 71 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
8	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-18.9-R, Fort Jackson-Boothville Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	30 Nov 72 (A)
9	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-21.5-R, Childress Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	23 Sep 71 (A)
10	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-23.2-R, Buras-Triumph Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	31 May 73 (A)
11	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-55.3-R, Upper Junior Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	21 Jun 71 (A)
12	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-51.0-L, Gravolet Levee Enlargement and Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	14 Sep 72 (A)
13	Flood Control, Mississippi River and Tributaries, Lower Red River - South Bank Red River Levees, Item R-123.5-R (1957 Mileage), Scott Home-Bertrand Levee Enlargement, Rapides Parish, Louisiana, Relocation of Facilities	15 Sep 72 (A)
14	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-96.9-R, Amelia Street Levee, Jefferson Parish, Louisiana, Relocation of Facilities	31 Aug 71 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
15	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-41.7-R, Port Sulphur Levee Enlargement and Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	28 Jan 74 (A)
16	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-33.4-R, Nairn Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	22 Dec 75 (A)
17	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-37.7-R, Homeplace Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	5 Jan 73 (A)
18	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-57.7-R, Myrtle Grove Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	31 Jan 73 (A)
19	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-28.0-R, Empire Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	30 Aug 74 (A)
20	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-49.5-R, Woodland Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	24 Aug 73 (A)
21	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-47.2-R, Nolan Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	29 Jun 73 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
22	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-45.0-R, Socola Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	28 Nov 72 (A)
23	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-75.0-L, Scarsdale Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	7 Dec 73 (A)
24	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-89.5-R, Cutoff Levee Setback, Orleans Parish, Louisiana, Relocation of Facilities	20 Dec 74 (A)
25	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-130.0-L, Gypsy Levee Setback, St. Charles Parish, Louisiana, Relocation of Facilities	30 Dec 74 (A)
26	Flood Control, Mississippi River and Tributaries, Atchafalaya River Levees, Item A-31.3-L, Cross Bayou Levee Setback, Pointe Coupee Parish, Louisiana, Relocation of Facilities	8 Nov 74 (A)
27	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-39.0-R, Freeport Levee Enlargement, Plaquemines Parish, Louisiana	27 Dec 74 (A)
28	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-30.2-R, Upper Empire Levee Enlargement and Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	30 Apr 75 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
29	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-63.0-L, Monsecour Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	15 Oct 75 (A)
30	Flood Control, Mississippi River and Tributaries, Atchafalaya River Levees, Item A-25.5-R, Goudeau Levee Setback, St. Landry Parish, Louisiana, Relocation of Facilities	30 Jun 76 (A)
31	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-320 to 303-R, Fifth Louisiana Levee District Levee Enlargement, Concordia, West Feliciana, and Pointe Coupee Parishes, Louisiana, Relocation of Facilities	30 Jun 75 (A)
32	Flood Control, Mississippi River and Tributaries, Atchafalaya River Levees, Item A-4.6-L, Legonier Levee Setback, Pointe Coupee Parish, Louisiana, Relocation of Facilities	30 Sep 75 (A)
33	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-35.0-R, Nairn Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	22 Dec 75 (A)
34	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-99.0-L, Louisiana Avenue Floodwall, Orleans Parish, Louisiana, Relocation of Facilities	21 Oct 75 (A)
35	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-144.5-L, Angelina Levee Setback, Saint John the Baptist Parish, Louisiana, Relocation of Facilities	12 Dec 75 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
36	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-205.0-R, Point Pleasant Levee Setback, Iberville Parish, Louisiana, Relocation of Facilities	29 Nov 76 (A)
37	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-58.0-L, St. Sophie Levee Enlargement, Plaquemines Parish, Louisiana, Relocation of Facilities	15 Sep 75 (A)
38	Flood Control, Mississippi River and Tributaries, Atchafalaya River Levees, Item A-38.0-L, Holloway Lake Levee Setback, Pointe Coupee Parish, Louisiana, Relocation of Facilities	26 Mar 76 (A)
39	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-90.5-L, Chalmette Slip Levee Enlargement, St. Bernard Parish, Louisiana, Relocation of Facilities	5 May 77 (A)
40	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-95.3-L, Thalia-Poydras Street Floodwall, Orleans Parish, Louisiana, Relocation of Facilities	10 Jun 76 (A)
41	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-217.5-L, Chariot Levee Setback, East Baton Rouge Parish, Louisiana, Relocation of Facilities	11 Jun 76 (A)
42	Flood Control, Mississippi River and Tributaries; Mississippi River Levees, Item M-52.6-R and M-52.1-R Junior and Lower Junior Levee Setbacks, Plaquemines Parish, Louisiana, Relocation of Facilities	24 Jan 77 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
43	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-86.0-R, Stanton Levee Setback, Orleans Parish, Louisiana, Relocation of Facilities	Jul 78 (S)
44	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-215.3-L, Manchac Bend Levee Setback, East Baton Rouge Parish, Louisiana, Relocation of Facilities	23 Dec 76 (A)
45	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-28.5-R, Empire Levee Setback, Plaquemines Parish Louisiana, Relocation of Facilities	16 Dec 77 (A)
46	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-49.0-R, Woodland Levee Setback, Plaquemines Parish Louisiana, Relocation of Facilities	28 Nov 77 (A)
47	Flood Control, Mississippi River and Tributaries, Atchafalaya Basin Floodway, New Berwick Floodwall, St. Mary Parish, Louisiana, Relocation of Facilities	Jun 78 (S)
48	Flood Control, Mississippi River and Tributaries, Atchafalaya Basin Floodway, New Morgan City Floodwall, St. Mary Parish, Louisiana, Relocation of Facilities	Oct 78 (S)
49	Flood Control, Mississippi River and Tributaries, Atchafalaya Basin Floodway, New Tiger Island Floodwall, St. Mary Parish, Louisiana, Relocation of Facilities	Aug 78 (S)
50	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-24.8-R, Buras-Triumph Levee Setback, Plaquemines Parish, Louisiana, Relocation of Facilities	30 Sep 77 (A)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
51	Flood Control, Mississippi River and Tributaries, East Atchafalaya Basin Protection Levee, Item E-69.0 and E-73.3, Levee Enlargements, St. Martin and Iberville Parishes, Louisiana, Relocation of Louisiana State Route 997	3 Jun 77 (A)
52	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-100.0-L, Nashville-Napoleon Floodwall, Orleans Parish, Louisiana Relocation of Facilities	25 Aug 77 (A)
53	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-88.0-R, Algiers Lock Forebay Levee Enlargement, Orleans Parish, Louisiana, Relocation of Facilities	1 Aug 77 (A)
54	Flood Control, Mississippi River and Tributaries, Mississippi River Levees, Item M-29.4-R, Empire Lock Modifications, Plaquemines Parish, Louisiana, Relocation of Facilities	May 78 (A)
55	Flood Control, Mississippi River and Tributaries, West Atchafalaya Basin Protection Levee, Item W-86.0 Levee Enlargement, St. Mary Parish, Louisiana, Relocation of Facilities	POSTPONED
56	Flood Control, Mississippi River and Tributaries, East Atchafalaya Basin Protection Levee, Item E-89, Driving Steel Sheet Piling and Levee Enlargement, St. Mary Parish, Louisiana, Relocation of Facilities	15 May 78 (A)
57	Flood Control, Mississippi River and Tributaries, Algiers Point Levee Enlargement and Setback, Item M-94.3-R, Orleans Parish, Louisiana, Relocation of Facilities	Oct 78 (S)

STATUS OF DESIGN MEMORANDUMS (cont'd)

Design Memo No.	Title	Actual (A) or Scheduled (S) Submission Date
58	Flood Control, Mississippi River and Tributaries, Pointe-a-la-Hache Ferry Landing, Plaquemines Parish, Louisiana, Relocation of Facilities	Jun 78 (S)
59	Flood Control, Mississippi River and Tributaries, Jackson Avenue Floodgate, Item M-97.2-L, Orleans Parish, Louisiana, Relocation of Facilities	May 78 (S)
60	Flood Control, Mississippi River and Tributaries, Item M-303 to 293-R, Levee Enlargement, Pointe Coupee Parish, Louisiana, Relocation of Facilities	Oct 78 (S)

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

PLATES

TABLE OF CONTENTS (Cont'd)

PLATES

APPENDIXES

ITEM M-29.4-R

EMPIRE LOCK MODIFICATIONS

PERTINENT DATA

LOCATION OF LOCK: The Empire Lock is located in southeast Louisiana, 58 miles south of New Orleans in the town of Empire, Plaquemines Parish, Louisiana. (Reference plate I-1.) The Empire Lock connects the Mississippi River with the Gulf of Mexico via the Doullut Canal and the Waterway from Empire, La., to the Gulf of Mexico.

PURPOSE: The Empire Lock Modification is a part of the Mississippi River and Tributaries Flood Control Project which embodies a plan to protect the Lower Mississippi Valley against the project design flood through the use of levees, floodwalls, floodways, channel improvements and major tributary flood control improvements.

AUTHORIZATION: The Flood Control Act of 15 May 1928 (Public Law 391, 70th Congress), as amended, provides authorization for the project.

LOCAL ASSURING AGENCY: The local assuring agency for the Empire Lock Modification project is the Plaquemines Parish Commission Council, governing body of the Buras Levee District.

OWNER: The owner of the Empire Lock is the State of Louisiana, Department of Transportation and Development, Office of Public Works.

DESCRIPTION: The proposed modifications to the Empire Lock consist of raising the riverside sector gates and riverside lock walls 5.0 feet to elevation 14.1 m.s.l.; raising the lock chamber walls, canal side walls and canal side gates 1.5 feet to elevation 10.6 m.s.l.; constructing approximately 140 linear feet of concrete I-type wall to elevation 15.1 m.s.l. to tie the existing forebay levees into the raised lock chamber walls; and constructing a new control house with a 17.0 m.s.l. top of floor elevation.

EMPIRE LOCK - MODIFICATIONS

RELOCATION DESIGN MEMORANDUM NO. 54

SECTION I - GENERAL

I -1. Project Authorization.

a. Project Authorization. Authority for construction, enlargement, or improvement of main line Mississippi River levees and thereby, for the Empire Lock - Modifications project, is contained in the Flood Control Act of 15 May 1928 (Public Law 391, 70th Congress), as amended. The Flood Control Act of 23 April 1934 (Public Law 171, 73d Congress) provides the authority for Federal reimbursement of costs to local cooperating agencies incurred in the course of accomplishing the relocation of interfering facilities. Pursuant to the provisions of DIVR 1110-2-1, which implements the Flood Control Act of 1934, the relocation of public roads, highways, railroads, public utilities, structures and public pipelines, as required for the construction of main line Mississippi River levees, will be accomplished at Federal expense. The furnishing of rights-of-way for levee foundations except for levee setbacks, and for floodwalls on the main stem Mississippi River is an obligation of local interests. (See section 3, Act of 15 May 1928.)

b. Legal Obligations. The legal obligations of the Federal Government regarding the affected facilities and the extent of authority for the relocations are as established in the attorney's report which is attached as appendix I.

I-2. Purpose of Design Memorandum. The purpose of this design memorandum is to present the plans for the relocation and alteration of the Empire Lock facilities which will be affected by the raising of the Empire Lock riverside sector gates from their existing height (9.1 m.s.l.) to the project design grade (14.1 m.s.l.). It is being submitted in compliance with part 3, section LXXIII, ER 1180-1-1, dated 1 December 1969 and DIVR 1110-2-1 dated 29 January 1968. It establishes the legal obligation of the Federal Government, and where appropriate, it will provide the basis for entering into a cost-reimbursable contract with the State of Louisiana, Department of Transportation and Development, Office of Public Works (OPW) for costs incurred in planning and accomplishing the relocations described herein.

I-3. Related Reports. The Mississippi River Levees and Banks, Mile 66 to Mile 10, Soil Report; Part I, Soil Data; Part II, Levee Stability Analysis; Part III, Bank Stability Analysis, and Part IV, Levee Alignment, described the levee alinement and design grade of the levee in the Empire Lock vicinity. The Upper Empire Levee Enlargement and Setback, Item M-30.2-R, Design Memorandum No. 28, and the Empire

Levee Enlargement, Item M-28.0-R, Design Memorandum No. 19, described the relocations required upstream and downstream of the Empire Lock.

I-4. Location of Lock. The Empire Lock is located in southeast Louisiana, 58 miles south of New Orleans in the town of Empire, Plaquemines Parish, Louisiana. (Reference plate I-1.) The Empire Lock connects the Mississippi River with the Gulf of Mexico via the Doullut Canal and the Waterway from Empire, La. to the Gulf of Mexico.

I-5 Datum Plane. The top of the lock walls is at elevation +9.1 m.s.l. The bottom of the lock chamber is at elevation -12.65 m.s.l. All elevations referred to in this report are feet and refer to mean sea level (m.s.l.) unless otherwise noted.

I-6 Description of Existing Facilities.

a. The lock is 40 feet wide and 21.75 feet deep. The top of the lock is at elevation +9.1, and the bottom is at elevation -12.65. The usable lock chamber is about 190 feet long. The lock chamber is a reinforced concrete, U-wall structure with a slab foundation. The remainder of the lock walls and slabs are also reinforced concrete construction. The lock gates are of structural steel and are the sector gate type. There are no piles in the lock structure itself, but there is a steel pile and timber guide wall on the upstream side of the river end of the lock, and timber pile guidewalls elsewhere.

b. The lock gates are the only means of filling and emptying the lock chamber, there being no bypass gates or valves. The lock gates are operated by an oil hydraulic cylinder system controlled from a reinforced concrete control house located about midway along the lock chamber and on the upriver side of the chamber. (See plate I-1.) The lock gates are painted and are further protected by a cathodic protection system.

I-7. Description of Proposed Changes to Existing Facilities. The proposed changes consist of: raising the river end of the lock walls and the faces of the river end gates 5.0 feet to elevation 14.1; raising the lock chamber walls and the faces of the canal side gates 1.5 feet to elevation 10.6; adding a steel sheet pile and concrete I-type floodwall with top at elevation 15.1 and connecting it to the river end of the lock and to an extension of and addition to the levee; and constructing a new and elevated, reinforced concrete control house. (See plates I-2, I-3, IV-35 and IV-37.)

I-8. Alternate Plans Considered. Two alternate plans which were studied, but rejected, are as follows:

a. A plan to remove the sector gates and modify them on land without dewatering was suggested by this district. OPW stated that this plan was not possible because the hinge design could not accommodate this type of removal. After review of the hinge design

and OPW comments, NOD concurred that the modifications should not be accomplished in the watered state.

b. A plan to raise the gates to elevation 10.7 m.s.l. (0.6 feet above the design flowline) was suggested by OPW, but this district recommended that the gates be designed to provide continuous flood protection equal to the project design grade of the main line Mississippi River levees.

I-9. Local Cooperation. The Plaquemines Parish Commission Council, governing body of the Buras Levee District, is the local assuring agency and will provide right-of-entry to the required levee right-of-way. No new levee right-of-way is required for the project. The Plaquemines Parish Commission Council has cooperated in scheduling the closing of the lock to assist in the reduction in the impact the lock closure will have on marine interests. The owner of the lock, OPW, has cooperated with this district in supplying the information contained in this report.

I-10. Coordination with Office of Public Works.

a. Design of Structure. OPW is designing the Empire Lock Modifications project. All design calculations, plans and specifications developed are being reviewed by this district. This district has furnished OPW with the design of the well point system, location of piezometers, and the floodwall design.

b. Method of Relocation. OPW and this district will enter into a cost-reimbursable contract for the Empire Lock Modifications project. OPW will award the construction contract to the responsible low bidder with the concurrence of this district. OPW will inspect and administer the construction contract. This district will monitor the progress of this construction.

c. Method of Reimbursement. The Federal Government will reimburse OPW for all reasonable costs to design, construct, inspect, and administer the modifications of the Empire Lock based on the cost-reimbursable contract to be signed. The Federal Government will review the plans and all plan changes to determine if any betterments are involved. If it is determined that OPW's criteria results in a betterment, that betterment will be discussed with OPW and disallowed by this district. This is in accord with paragraph 73-106 of ER 1180-1-1, which stipulates that "a substitute facility will be provided which will, as nearly as practicable, serve the owner in the same manner and reasonably as well as does the existing facility."

SECTION II - HYDRAULIC DESIGN

II-1. General. The only hydraulic structures involved are the sector gates themselves. These gates were originally analyzed hydraulicly only to the extent necessary to determine approximate time intervals required for filling and emptying the lock chamber at various river and Gulf stages. The actual operating conditions for the modified lock will be about the same as in the past because the new head conditions for the gates will occur only at times when the lock will not be operated.

II-2. Hydraulics of Existing Structures Other Than Gates. There are no hydraulic structures other than the gates.

II-3. Existing Gates (Riverside and Canal Side)

a. Description. The existing gates are structural steel of the sector type with an included sector angle of 60°. The gates are 21.75 feet high, have a radius to the faces of approximately 24.5 feet, and an arc distance of about 25.67 feet along the 24.5 feet radius. Gate framing consists of four horizontal trusses and two vertical trusses. Each gate is attached to the concrete recess wall by means of a cast steel hinge at the top frame and a cast steel pintle at the bottom frame. Actual wearing surfaces at the pintle and hinge are phosphor bronze on nickel steel. The horizontal

trusses are attached to the face of the gate by welding and to the vertical trusses by bolts. The vertical truss members are connected together by bolts and the gate is connected to the hinge and pintle by bolts.

b. Design Heads. Live loads on the sector gates were designed for water on the riverside to elevation 10.97 and water on the chamber side to elevation -0.78. The top of the existing lock walls was constructed to elevation 11.75 and is now at elevation 9.1.

c. Method and Speed of Operation. The gates are operated by an oil hydraulic cylinder system controlled through a console manipulated by an operator in the control house. The hydraulic system is powered by an electric motor but can, in an emergency, be powered by an auxiliary diesel engine. If the hydraulic system completely fails, then the gates can be operated manually by a winch and cable system. Maximum speed of operation with the oil hydraulic system is about 5 feet per minute along the arc of the gate faces. Minimum opening or closing time is about 5 minutes.

II-4. Modification to Existing Gates.

a. Description. The gates will be changed structurally by the raising of the riverside gate 5.0 feet and the canal side gate 1.5 feet, but there will be no basic change in the oil hydraulic system because there is no intention to actually operate the gates under

the new head conditions. The new heads are to be merely those that the gate structural system is designed to withstand.

b. Design Heads. The new design head consists of a differential head of 16.1 feet acting radially toward the hinge and pintle of the gate; the reverse head differential, acting radially outward from the hinge and pintle of the gate will not change from the original design.

c. Method and Speed of Operation. The method and speed of operation of the gates will be the same as that given in 11-3c previously except that the gates are expected to move a bit slower due to the increased mass of the gates resulting from the modification.

SECTION III - FOUNDATION INVESTIGATIONS

III-1. General - History and Description of Foundation. The lock is located on very recent deltaic deposits of the Mississippi River. These deposits consist primarily of soft silty clays from the old ground surface down to 10-15 feet below the surface, then an approximately 7-10 feet of sand and then soft silty clays down to the bottoms of the borings for the original structure. The surface of the entire area is subsiding as is exemplified by the fact that the top of the existing lock walls was constructed to elevation 11.75 in 1945-46 and is now at elevation 9.1. The lock structure is built with concrete base slabs on concrete stabilization slabs on this foundation. The foundation for the existing structure has not caused any noticeable shear failures in the soil nor noticeable differential settlement of any parts of the structure.

III-2. Investigations - Past Borings and Location of New Borings

a. Three borings, identified as Nos. 3, 4 and 5, were taken sometime before the fall of 1945 and prior to the construction of the existing structure. Refer to plate III-1 for boring locations and logs. Whether these were auger or core borings is not known, but it is known, as shown on plate III-1, that rough soil classifications were determined for the soils, and water contents, liquid limits and plasticity indices were determined for the clay soils.

b. Two new borings were taken by the New Orleans District, one 5-inch undisturbed boring (1-ELU) and one general type boring (2-EL), the results are shown on plates III-2 and III-3. The location of these borings are shown on plate III-1.

III-3. Soil Conditions - From Boring Information

a. Laboratory Tests. Visual classifications were made on all samples obtained from the soil borings. Water content determinations were made on all cohesive soil samples. Unconfined compression (UC), unconsolidated-undrained (Q) and shear tests were performed on representative cohesive soil samples from the undisturbed borings. Liquid and plastic limits tests were performed on all the undisturbed cohesive soil samples tested. The results of the soil tests on undisturbed soil samples from undisturbed boring 1-ELU are shown on plate III-2.

b. Foundation Conditions. The foundation consists of predominantly fat clays from the ground surface to approximately elevation -10.0 with about 4 feet of silt overlaying about 13 feet of fine sand. Below the sand layer are alternating layers of fat clay and silt.

c. Stability Analysis. From the topographic map of the area a most critical section, A-A, was obtained. Stability analyses were performed by the method of planes using the design (Q) shear strengths and a minimum 1.30 safety factor. (See plate III-4)

d. I-type Floodwall. The stability of the floodwall and required penetrations of the sheetpiling were determined by the method of planes using the (S) shear strengths shown on the stability plate. A factor of safety of 1.5 was applied to the design shear strengths. The hydrostatic soil pressure diagram is that for which the section should be structurally designed. (See plate III-5.)

e. Earthwork. The earthen embankment should be constructed simultaneously on both sides of the lock structure with not more than 2 feet of differential fill height. Any shaping or earthwork in the area between the earthen embankment toe and the lock structure should result in a fill height of not less than elevation 9.0 at the floodwall.

III-4. Stability of Gate Bays. The gate bays constitute a U-wall type of structure and consequently cannot fail by sliding in the transverse direction, unless all of the restraining soil were to be removed from one side and be left in place on the other side, which is not likely. The gate bays cannot slide in the longitudinal direction without moving either the approach section for the canal side gate bay or practically the entire lock in the case of the riverside gate bay. Minimum factor of safety against sliding is about 4.83 for the canal side gate bay, as shown on plate III-6. The maximum bearing pressure under the gate bays prior to modification is approximately 880 psf; the maximum bearing pressure after modifica-

tion is approximately 1,100 psf; the maximum allowable bearing pressure is approximately 3,000 psf.

III-5. Overall Structure Stability

a. As previously stated in paragraph III-4, the gate bay and the canal end of the structure has a 4.83 minimum factor of safety against sliding into the canal. Also, the foundation pressures under the gate bay are a maximum of 1,100 psf, which is considered to be safe. The foundation pressures under the lock chamber are a maximum of about 420 psf, which is almost negligible. However, with the river, the canal, and water in the foundation sand under the lock chamber at normal levels, and the lock chamber dewatered, then the lock chamber is not safe against uplift. (See plate III-7.)

b. To make the lock chamber safe against uplift, with a factor of safety of 1.25, during dewatering, the piezometric level in the foundation sand must be no higher than elevation -4.5, the river level must be no higher than 6.5, and the canal level no higher than 5.0. To keep the lock chamber safe and within these conditions while dewatered, a well point system will be used to lower the piezometric level to elevation -4.5, and the construction time will be selected to coincide with the required river and canal levels. (See plate III-8 and 9.)

III-6. Instrumentation and Engineering Observations

a. Reference marks are to be installed at the tops of the lock walls (plate III-10) to permit measurements to be made, during and after construction, of the movements of the lock structure. It is expected that these measurements will be made regularly after construction is complete. Three staff gauges will also be installed. One on the river end, one on the canal end and one in the lock chamber.

b. Before construction several piezometers will be set behind the lock walls and on each side of the lock to determine the piezometric levels in the foundation sand during the periods just before and during that part of the construction when the lock chamber is dewatered. (See plates III-8 and III-9.) The lock chamber structure is not safe against uplift when dewatered and with normal water levels in the foundation sand. (See plate III-7.) This situation is to be corrected by the construction and operation of a well point system (plates III-8 and III-9) before dewatering and during the period when the lock chamber is dewatered.

c. The instrumentation and observations shall be as follows:

(1) Instrumentation Devices

(a) General. The instrumentation devices to be installed and the measurements to be made to provide adequate monitoring during the dewatering are described in the following paragraphs. The instruments will be installed and read prior to starting any operations to rehabilitate the lock and forebay.

(b) Piezometers. Open system piezometers are to be installed in the foundation sands with tips at elevation -20.0 as shown on plate III-9.

(c) Reference Marks. Reference marks will be installed on the gate bay monoliths and on the lock chamber walls as on plate III-10 to measure vertical movements of the walls and base slab and to check for lateral movement. All reference marks will be 1/2-inch diameter round head brass bolts 3 inches long. Each mark will be centerpunched. A 1 1/2-inch x 2 1/2-inch x 1/4-inch plate will be set under the head of each bolt. The plate will be stamped with the reference mark designation.

(d) Staff gages. Staff gages will be installed on the river side, gulf side and in the lock chamber to read the correct elevation (m.s.l.).

(e) Installation. The instrumentation devices described in the previous paragraphs will be installed as part of the construction contract.

(2) Observations; Schedule of Observations. Readings or measurements will be made immediately after each device is installed and in accordance with the following schedule:

(a) Piezometers.

1. An installation report will be prepared for each piezometer installed. Each report should include: the elevation of top of riser pipe, elevation of tip, diameter of riser pipe, top and bottom elevation of bentonite plug, top and bottom elevation of sand, type collector, collector elevation and size of collector, as well as rising and falling head test results. When each piezometer is made operational, readings will be obtained daily until the well point system is operated. Upon operation of the well point system, readings will be required on four-hour intervals. Dewatering of the lock structure may begin when the piezometer system reflects a water surface elevation stabilized at elevation -4.5 for a period of at least 4 hours.

2. The well point system will have a backup system of pumps and power units as required by TM 5-818-5. If a total failure of the well point system occurs, then water should be added to the lock as rapidly as possible. For each foot of piezometric rise above elevation -4.5 the water in the lock should be raised 2.2 feet.

(b) Reference Marks. Reference marks will be read with each 2.0-foot drop in water within the lock structure and then once every 24 hours until refilling operations are begun. During refilling, the reference bolts should be again read with every 2.0 foot of change in water surface.

(c) Staff gages. All staff gages will be read every time the piezometers and reference marks are read.

(d) All observations including the piezometer installation reports should be furnished to the Corps of Engineers.

SECTION IV

STRUCTURAL DESIGN

IV-1. General. Structural design has been made in accordance with standard engineering practice, with criteria set forth in the Engineering Manual for Civil Works Construction published by the Office, Chief of Engineers, and Standard Specifications for Highway Bridges, published by the American Association of State Highway and Transportation Officials, the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings published by the American Institute of Steel Construction, and the ACI Code, by the American Concrete Institute.

IV-2. Basic Data. Basic data relevant to the elevations of the water surface, structure elevations and dimensions are shown on plates and in the following table:

a. Design Elevations (feet m.s.l.)

	River Side	Canal Side
Maximum direct head	14.1	-2.0
Top of existing lock walls and gates	9.1	
Maximum operating direct head	9.1	-2.6
Top of sill	-12.65	

b. Structure Elevations (feet m.s.l.)

Top of riverside gate & floodwall	14.1
Top of lock wall & canal side gate	10.6

c.	Structure Dimensions	Feet
	Width of lock	40
	Usable length of lock chamber	190

IV-3. Unit Weights. The following values of unit weights are used in design calculations:

Item	Lbs. per cu. ft.
Water	64.0
Concrete	150.0
Steel	490.0
Earth	110.0

IV-4. Design Loads. The assumed design loads used in the design of the lock and pertinent structures are tabulated below:

a.	Lateral pressures (psf/ft)	
	Earth	83
b.	Uniform live loads	Lbs. per sq. ft.
	Walkways and stairs	100
	Floor of control house	100
	Roof of control house	30 (in accordance with local building code)

c. Wind loads on exposed vertical surfaces and projected area of sloped surfaces. (Allowable stresses increased one-third in accordance with local building code.)

IV-5. Allowable Working Stresses. The allowable working stresses for a part of the concrete and structural steel are in accordance with those recommended in "Working Stresses for Structural Design," EM 1110-1-2101 of 1 November 1963, including Change 2 dated 17 January 1972. For convenient reference pertinent allowable stresses are tabulated as follows:

CONCRETE (Working Stress Method)	Stress psi
Compressive strength (28 days)	f'c = 3,000
Modulus of elasticity ratio	N = 9
Flexure:	
Extreme fiber in compression	fc = 1,050
Shear:	
(as measure of diagonal tension at a distance d from face of support)	
Beams with no web reinforcement	Vc = 60
Members with vertical or inclined web reinforcement or properly combined bent bars and vertical stirrups	V = 274
Slabs and footings:	
Peripheral shear	V = 110
Bearing:	
On full area	fc = 750
On one-third area or less	fc = 1,125

Development length of deformed bars for #11 bars or smaller $0.04\ A_b f_y / \sqrt{f'_c}$

but not less than $0.0004\ d_b f_y$

WHERE,

A_b = area of individual bar

f_y = specific yield strength of reinforcement

f'_c = compressive strength of concrete

d_b = normal diameter of bars

Reinforcing steel (tension and compression) fs = 20,000

Minimum tensile steel, flexural members: .0025 bd with a max. of #9, 12"

Minimum steel for members with varying degrees of restraint

Unrestrained member. Minimum area of steel: .0025 bt, half each face with maximum no. 6 bars at 12 inches in each face.

Member restrained at one edge. Minimum area of steel parallel to restrained edge: .0040 bt, half in each face, with maximum no. 9 bars at 12 inches in each face. Steel will be used for a distance equal to 1/4 length of the restraint from the restrained edge. Remainder of steel ratio will be as given for unrestrained member.

Member restrained at opposite edges. Area of steel perpendicular to restrained edges: .0040 bt, half each face, with maximum no. 9 bars at 12 inches in each face. Area of steel parallel to restrained edges for a distance from each restrained edge equal to 1/4 the length of restraint will be .0040 bt, half in each face. Remainder of steel parallel to restrained edges will be as given for unrestrained members.

Member restrained at two adjacent edges. Area of steel parallel to the restrained edges: .0040 bt, half in each face, with maximum of no. 9 bars at 12 inches in each face. This steel will be used for distance equal to 1/4 the length of restraint from each restrained edge. Remainder of steel ratio will be as given for unrestrained members.

CONCRETE - Ultimate Strength Method - ACI Code

f'_c = 3,000 psi

fy = 40,000 psi

Nominal permissible shear stress for nonprestressed concrete

$v_c \leq 2\sqrt{f'_c}$; for f'_c = 3,000 psi v_c = 109.54 psi

Capacity reduction factor "Ø"

(1) Bending = 0.90
(2) Shear = 0.85

Factor of safety "F.S."

(1) Dead Load = 1.4
(2) Live Load = 1.7

$\bar{M}_u = \frac{M_{sl}\ F.S.}{Ø\ Bending}$ where $\bar{M}_u$ is the ultimate design moment
M_{sl} is the service load moment
F.S. is the factor of safety
ØBending is the capacity reduction factor

STRUCTURAL STEEL (ASTM - A7; F_y = 33,000 psi)

	Dead Load and Hydraulic Loading (psi)
Basic tensile stress	16,500
Tension:	
Structural steel net section except at pinholes	16,500
Net section at pinholes	11,250

	Dead Load and Hydraulic Loading
Shear:	
On the gross section of beam and plate girder webs	11,000
Compression:	
On gross section of axially loaded compression member for $\frac{Kl}{r}$ less than C_c	$27{,}500\ K_1$

$$1 - \left[\frac{\left(\frac{Kl}{r}\right)^2}{2C_c^2} \right]$$

Where $K_1 = \dfrac{\qquad\qquad\qquad\qquad\qquad\qquad}{F.S.}$

$C_c = 131.7$

K = effective length factor

$$F.S. = \frac{5}{3} + \frac{3}{8}\left(\frac{\frac{Kl}{r}}{C_c}\right) - \frac{\left(\frac{Kl}{r}\right)^3}{8C_c}$$

For axially loaded column with $\frac{Kl}{r} > C_c$	$\dfrac{124 \times 10^6}{\left(\frac{Kl}{r}\right)^2}$
On gross area of plate girder stiffeners	16,500
On web of rolled shapes at toe of fillet	20,600
Bending:	
Tension and compression on extreme fibers of rolled sections, plate girders, and built-up members having axis of symmetry and meeting required dimension properties	18,000

Tension and compression on extreme fibers of unsymmetrical members (with compression flange supported)	16,500
Tension on extreme fiber of other rolled shapes, built-up members, and plate girders	16,500

Compression on extreme fibers of rolled shapes, plate girders, and built-up members having axis of symmetry in the plane of the web

(Formula 4) $$16{,}500 - \frac{0.476}{C_b}\left(\frac{l}{r}\right)^2$$

or

(Formula 5) $$\frac{10{,}000{,}000}{\frac{ld}{A_f}}$$

Where $$C_b = 1.75 - 1.05\left(\frac{M_1}{M_2}\right) + 0.3\left(\frac{M_1}{M_2}\right)^2 \quad \text{but} \geq 2.3$$

and M_1 is the smaller, M_2 the larger bending moment at the ends of the unbraced length

Use larger value computed by formulas 4 or 5 but not more than basic stress. Where $\frac{l}{r} < 40$, formula 4 may be neglected.

r is the radius of gyration of a tee-section comprising the compression flange plus one-sixth of the web area, about an axis in the plane of the web.

Tension and compression on extreme fibers of large pins	24,700
Bearing:	
Milled surfaces and pins in reamed, drilled, or bored holes	24,700
High strength bolts on projected area	40,000

Welds:

Fillet Welds (shear only)

Using A 233, Class E-60 electrodes or submerged arc Grade SAW-1	11,500
Using A 233, Class E-70 electrodes or submerged arc Grade SAW-2	13,000

Groove welds

Complete penetration groove welds shall have same allowables for tension, compression, bending, shear and bearing stresses as those allowed for the connected material

Bolts:

Tension:	
Unfinished bolts A 307	11,500
High strength bolts A 325	33,500
Shear:	
Bearing type connection:	
Unfinished bolts A 307	8,500
High strength bolts A 325, when threading is excluded from shear plane	18,500

Combined stresses (axial compression and bending):

Members subject to both axial compression and bending stresses shall be proportioned to satisfy the following requirements:

(a) When $\frac{f_a}{F_a} \leq 0.15$ $\quad \frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1.0$

(b) When $\frac{f_a}{F_a} > 0.15$ $\quad \frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \frac{f_a}{0.83F'_e}\right)F_b} \leq 1$

$$\frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \frac{f_a}{1.11F'_e}\right)F} \leq 1$$

$$F'_e = \frac{149{,}000{,}000}{\left(\frac{Kl_b}{r_b}\right)^2}$$

and in addition at points braced in the plane of bending $\frac{f_a}{16{,}500} + \frac{f_b}{F_b} \leq 1.0$ $\frac{f_a}{22{,}000} + \frac{f_b}{F_b} \leq 1.0$

C_m = a coefficient whose value is given in "Manual of Steel Construction," Seventh Edition

Combined stresses (axial tension and bending):

Members subject to both axial tension and bending stresses shall be proportioned to satisfy the following formula:

$$\frac{f_a}{16{,}500} + \frac{f_b}{F_b} \leq 1.0 \quad \frac{f_a}{22{,}000} + \frac{f_b}{F_b} \leq 1.0$$

Where f_b and F_b are respectively the computed and permitted bending tensile stresses; however, the computed bending compressive stress, taken alone, shall not exceed the values permitted by formulas (4) and (5).

Combined stresses (axial compression and bending):

Members subjected to both axial compression and bending stresses shall be proportioned to satisfy the following requirements:

(a) When $\frac{f_a}{F_a} \leq 0.15$ $\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0$

(b) When $\frac{f_a}{F_a} > 0.15$

$$\frac{f_a}{F_a} + \frac{C_{mx}\, f_{bx}}{\left(1 - \frac{f_a}{F'_{ex}}\right) F_{bx}} + \frac{C_{my}\, f_{by}}{\left(1 - \frac{f_a}{F'_{ey}}\right) F_{by}} \leq 1.0$$

$$F' = \frac{12\,\pi^2 E}{23\left(\frac{Kl_b}{r_b}\right)^2}$$

C_m = a coefficient whose value is given in "Manual of Steel Construction," seventh edition.

Combined stresses (axial tension and bending):

Members subject to both axial tension and bending stresses shall be proportioned to satisfy the following formula:

$$\frac{f_a}{0.60\, F_y} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \leq 1.0$$

$$F_a = \frac{\left(1 - \frac{\left(\frac{Kl}{r}\right)^2}{2C_c^2}\right) 27.0}{\frac{5}{3} + \left(\frac{3}{8}\right)\left(\frac{\frac{Kl}{r}}{C_c}\right) - \left(\frac{\frac{Kl}{r}}{8C_c}\right)^3}$$

MISCELLANEOUS METALS

Cast steel, Class 70-36	Fy = 36,000 psi (all allowable stresses are same as for structural steel, ASTM A36.)
Forged steel, Class G	Fy = 50,000 psi
Stainless steel, AlSl 420	Fy = 50,000 psi (All allowable stresses are proportional to those for structural steel, ASTM A36.)

Bronze Bushing

Bearing at sliding surfaces: 2,500 psi moving

IV-6 - Design of Lock Gates.

a. Narrative Description of Changes.

(1) The riverside lock gates are to be raised 5.0 feet to elevation 14.1 to accommodate the new project design grade. To accomplish this, the skin plates at the faces of the gates will be raised the necessary amount, the vertical beams taking the hydraulic loading from the skin plates will be lengthened as necessary and additional vertical beams will be added at lower levels as needed to avoid overstressing the skin plates by the increased hydraulic loading. The gate framing carrying the loads from the skin plates to the hinges and pintles was checked for over stressing and will be strengthened as necessary to carry the increased loading. It was found that the curved beam in the second gate frame from the bottom was overstressed at the center of the frame and it was found that this could be corrected by the addition of a short cover plate to the curved beam. It was also found that the members of the vertical trusses framing into the pintle gate casting were overstressed during the maximum load condition; it was determined that this could be corrected by the addition of a cover plate to each face of each member framing into the pintle casting. The walkways at the top of the riverside gates are to be raised 1.5 feet. This will be accomplished by cutting loose the walkways from the existing tops of gates and reattaching them to the raised gate tops.

(2) The canal side gates are to be raised 1.5 feet to elevation 10.6. To accomplish this, the skin plates will be raised the necessary amount, the vertical beams supporting the skin plates will be lengthened as necessary and additional vertical beams will be added at lower levels as needed. The gate framing was checked for overstressing and was found to be satisfactory. The walkways at the faces of the canal side gates will be raised 1.5 feet in a manner similar to that to be used at the riverside gates.

b. Design Plates. The load conditions, dimensional relationships, stresses in members and changes to be made in the gate frames, skin plates and walkways are shown on plates IV-1 thru IV-27.

IV-7 - Hinge and Pintle Analysis.

a. The hinge consists of a forged nickel steel pin bearing on a phosphor bronze bushing in a cast steel housing. The hinge pin was checked for shear (double) and bearing. The phosphor bronze bushing was checked for bearing. All checked satisfactorily except for the bronze bushing which will be subjected to a bearing stress at the maximum design load slightly greater than the 2,500 psi allowable. However, it is felt that the overstressed condition is not serious because the maximum design load will occur during a time when the gate is in the closed position and will remain in that condition as

long as the river is at project flood stage and because the 2,500 psi allowable bearing on the bushing is for a moving load. See plates IV-28 thru IV-31.

b. The pintle consists of a nickel steel ball bearing on a phosphor bronze bushing in a cast steel housing. The pintle ball and pin were checked for bearing and shear, and the phosphor bronze bushing was checked for bearing. All checked satisfactorily except the bearing on the phosphor bronze bushing which amounted to 3,540 psi as compared to the 2,500 psi allowable. This high stress is also considered to not be dangerous because of the stationary condition of the gate at the design load.

c. In addition to the checks on the shear and bearing in the hinge and pintle assemblies, the capacities of the bolts and castings connecting the hinge and pintle assemblies to the gate as well as the bearing on the concrete of the hinge and pintle wall castings were also checked and were found to be satisfactory.

IV-8 - Raising of Lock Chamber Walls

a. General. Plates I-2 and I-3 show the amounts of and, to some extent, the manner in which the lock walls are to be raised. The results of the analysis of the gate bay walls indicate that they are strong enough to withstand the new load conditions. The analysis of the

lock chamber walls for the dewatered condition indicate an overstress in the reinforcement steel; therefore a system of struts will be used inside the lock chamber during dewatering to reduce these stresses. The canalside and riverside gate blocks were also analyzed and the results are discussed below. The representative conditions, analyses and results are shown on plates IV-32, IV-32A, IV-33, IV-34 and IV-34A.

b. Riverside Gate Block. Another approach to the analysis of the gate support block is shown on plate IV-34. In this analysis the gate block is isolated as a free body and all external loads are resolved relative to an x, y coordinate system set up in its horizontal plane. The "Concrete General Flexure Analysis" computer program was used to perform the analysis for the two critical loading conditions, the dewatered condition and the maximum direct head condition. The results of the analysis show no overstressing for the dewatered condition and a small amount of overstress in several reinforcing bars which can be tolerated for the maximum direct head condition.

c. Canalside Gate Block. The same method of analysis used for the riverside gate block was used for the canalside gate block, except the only loading used in the analysis was the dewatered condition. The results of this analysis indicated an overstress in some of the reinforcement steel; therefore it was decided that the sector gates would be blocked up during the dewatering to reduce the upper hinge load on the

gate block, thus reducing the reinforcing steel stresses. The representative conditions, analyses and results are shown on plate IV-34A.

IV-9 - Floodwall Design and Stability. The floodwall tieing the earthen levee to the concrete lock structure is of the concrete capped, cantilevered steel sheet pile, I-wall type. It was designed for the maximum water surface at elevation 15.1, and the pressures resulting therefrom and acting on the sheet piling were determined by a computer analysis. These pressures, the determination of the steel sheet pile section and a detailed cross section of the floodwall are shown on plate IV-35. Details showing the method of tieing the floodwall to the lock wall are shown on plate IV-36.

IV-10 - Replacement of Control House

a. Control House Structure.

(1) The existing control house is a reinforced concrete building resting on a slab ground supported at grade at about elevation 9.0. At this elevation and with the riverside gates being raised to elevation 14.1, and the lock chamber walls and the canal side gates being raised to elevation 10.6, the sight conditions for the operator in the control house would not permit adequate surveillance of the lock operations. It was therefore concluded that the control house should

be raised so that the operating floor level would be high enough to permit adequate sight lines for the operator. It was first decided to do this by adding a second story to the existing control house, but on investigation, it was determined that the floor slab is not strong enough to sustain the added loads. Because of this it was decided to replace the existing control house with a new, elevated control house.

(2) The new, elevated control house is to be a reinforced concrete structure supported on precast, prestressed, reinforced concrete piles driven through pilot holes into the foundation soils. Sketches for the new control house are shown on plates IV-37 thru IV-41.

b. Mechanical System Modifications. The oil hydraulic system will be retained in its existing condition except for the addition of new hoses to take care of the increased height of the house.

c. Electrical System Modifications. The entire electrical system within the control house proper and in the control house area will be replaced by all new materials and equipment.

SECTION V

CATHODIC PROTECTION SYSTEM

V-1 - Gates to Be Protected. The existing gates are being protected by an existing cathodic protection system which was designed and built during 1954-55. This system is described and shown on plate V-1. As described, the system for each gate consists of eight 60-pound magnesium anodes suspended within the sector framework of the gate. Four of these anodes are suspended at about elevation -2.0, and four are suspended at about elevation -8.0. Along with the paint coating on the gates, the cathodic protection has been and is furnishing adequate protection to the gates. It has been determined by the continually retained consultant corrosion and cathodic protection engineer (Mr. James H. Collins, New Orleans, Louisiana) that the present system will also be adequate to protect the gates after the modifications are completed.

V-2 - Life Expectancy of Cathodic Protection System. The life expectancy of the cathodic protection system itself is indefinite. The magnesium anodes last on the order of 1-1/2 to 3 years. Their life depends on the river and canal stages and on the frequency of lockages. There is in force a program for checking the anodes periodically and replacing them as needed, this being done when the anodes are about 70 percent consumed. The anodes are expected to be

consumed slightly more quickly after the modifications due to the increased surface area of the gate metal.

V-3 - Water Resistivity. The river water resistivity varies from about 2,000 to 5,000 ohm-cm. Canal water resistivity measurements indicate about 45-250 ohm-cm (with one measurement of 1,920 ohm-cm, which is considered unusual). Resistivity varies with the river and canal stages and with the frequency of the lockages. Generally, there is a layering effect in the water, with saltier and less resistive water occupying the lower depths.

V-4 - Required Current Density. Current density for the lock system is indeterminate because: the current output varies inversely with the water resistivity, which usually ranges from 42 to 250 ohm-cm; part of the anode output is lost to the reinforcing steel in the concrete structure; and the lock gates are coated (and will be recoated as part of the modification) and the cathodic protection system is needed to protect only at the flaws and damaged areas of the coating. Current density, however, is not considered to be especially important for this type of structure. What is important is that the cathodic protection system is doing a good job and is expected to do an equally good job after the structure is modified. Probably the only noticeable difference will be that the anodes will be consumed slightly more quickly after the modification.

SECTION VI - BETTERMENTS

Betterments consist of the following:

a. Approximately 50% of the painting of the gates and appurtenances.

b. Approximately 90% of the installation of the rubber gate seals.

c. Approximately 2% of the fabricated and erected and/or installed structural steel and miscellaneous metal.

d. All of the creosoted timber piles to be furnished and driven for the extension of the guidewall system.

e. All of the creosoted timber and lumber to be furnished and erected and/or installed for the gate protection timbers and the guidewall system.

f. Approximately 63% of the oil hydraulic hose lines to be furnished and installed.

g. Approximately 50% of the fabricating and installing the supports for the cathodic protection system anodes and of the installing of the anodes.

h. All of the furnishing and installing of the lubrication system hose lines.

i. All of the furnishing and erecting and/or installing the gate desilting jet systems.

j. All of the furnishing and installing of the pressure relief valves for the gate oil hydraulic cylinders.

SECTION VII - ESTIMATE OF COST

VII-1. Detailed Estimate of Cost

Item	Quantity	Unit	Unit Cost($)	Cost($)
Mobilization			LS	30,000.00
Dewater Lock			LS	175,000.00
Control House			LS	25,000.00
Painting*			LS	75,000.00
Install Rubber Gate Seals*			LS	8,000.00
Structural Steel and Misc Metals*			LS	100,000.00
Struts and Blockup Canalside Gates			LS	65,000.00
Precast Prestressed Concrete Piles	360	LF	30.00	10,800.00
Creosoted Timber Piles*	250	LF	15.00	3,750.00
Creosoted Timber and Lumber*	1.7	MFBM	4,000.00	6,800.00
Steel Sheet Piling	2,198	SF	25.00	54,950.00
Reinforcing Steel	22,100	Lbs.	2.50	55,250.00
Concrete	184.5	CY	750.00	138,375.00
Hydraulic Hose Lines*			LS	20,000.00
Install Cathodic Protection System*			LS	6,000.00
Lubrication System Hose Lines*	100	LF	15.00	1,500.00
Gate Desilting Jet System*			LS	20,000.00
Pressure Relief Valves*			LS	1,500.00
Total Construction Cost				796,925.00
Owner Engineering and Design Costs				75,075.00
Owner Supervision and Inspection Costs				15,000.00
TOTAL COST				887,000.00

*Indicates part or all of costs are betterments.

VII-2. Estimate of Cost of Betterments

Item	Percent of Cost	Item Cost($)	Cost($)
Painting	50	75,000.00	37,500.00
Install Rubber Gate Seals	90	8,000.00	7,200.00
Structural Steel and Miscellaneous Metals	2	100,000.00	2,000.00
Creosoted Timber Piles	100	3,750.00	3,750.00
Creosoted Timber and Lumber	100	6,800.00	6,800.00
Hydraulic Hose Lines	63	20,000.00	12,600.00
Install Cathodic Protection System	50	6,000.00	3,000.00
Lubrication System Hose Lines	100	1,500.00	1,500.00
Gate Desilting Jet System	100	20,000.00	20,000.00
Pressure Relief Valves	100	1,500.00	1,500.00
TOTAL BETTERMENTS			95,850.00

VII-3. Distribution of Cost

a. Breakdown of construction costs

Total Cost of Construction	$796,925
Office of Public Works Share	95,850
Corps of Engineers Share	$701,075

b. Breakdown of Engineering and Design

(1) Office of Public Works share

$$\frac{95,850}{796,925} \times 100 = 12.0\%$$

		Cost
E&D	12.0% of $75,075	$9,009
S&I	12.0% of $15,000	$1,800

(2) Corps of Engineers Share of E&D and S&I

E&D ($75,075 - 9009)	$66,066
S&I ($15,000 - 1800)	$13,200

VII-4. Summary of Costs

	Federal Cost	Owner Cost
Construction costs	$701,075	$95,850
Owner E&D	66,066	9,009
Owner S&I	13,200	1,800
Subtotal	$780,341	$106,659
Contingencies (25%+)	194,659	26,341
Subtotal	$975,000	$133,000
Government E&D (6% +)	58,500	-
Government S&I (6%+)	58,500	-
	$1,092,000	$133,000

VII-5. Comparison with Prior Cost Estimates. The current working estimate of cost is summarized under the uniform cost classification for comparison with the latest approved cost estimate. The latest approved cost estimate is the Project Cost Estimate (PB-3) for the Mississippi River Levees project, New Orleans District, bearing an effective date of 1 October 1977, as approved 1 June 1977 (for construction funds). Since the PB-3 contains the relocation cost estimates for the entire Mississippi River Levees project, the funds included for item M-29.4-R, Empire Lock-Modifications have been broken out as follows for a suitable comparison.

Mississippi River Levees-Construction

Cost Acct. No.		Latest PB-3 ($1,000's)	Current Working Estimate ($1,000's)	Difference From PB-3 ($1,000's)
02	Relocations			
0.7	Util & Structures	1,463.0	975.0	488.0
30	E&D	58.5	58.5	0
31	S&A	58.5	58.5	0
	TOTAL	1,580.0	1,092.0	488.0[1]

[1]See Justification for Cost Revision paragraph for reasons.

VII-6. Justification for Cost Revision. The higher PB-3 cost estimate was developed without benefit of knowing exactly what modifications to the lock would be required. The current working estimate is based on the detailed analysis of the lock and preliminary plans and specifications.

SECTION VIII - RECOMMENDATIONS

VIII-1. Recommendations. It is recommended that this design memorandum be approved as the basis for entering into a cost-reimbursable contract with the State of Louisiana, Department of Transportation and Development, Office of Public Works for the costs incurred in modifying the Empire Lock.

FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES

MISSISSIPPI RIVER LEVEES

ITEM M-29.4-R

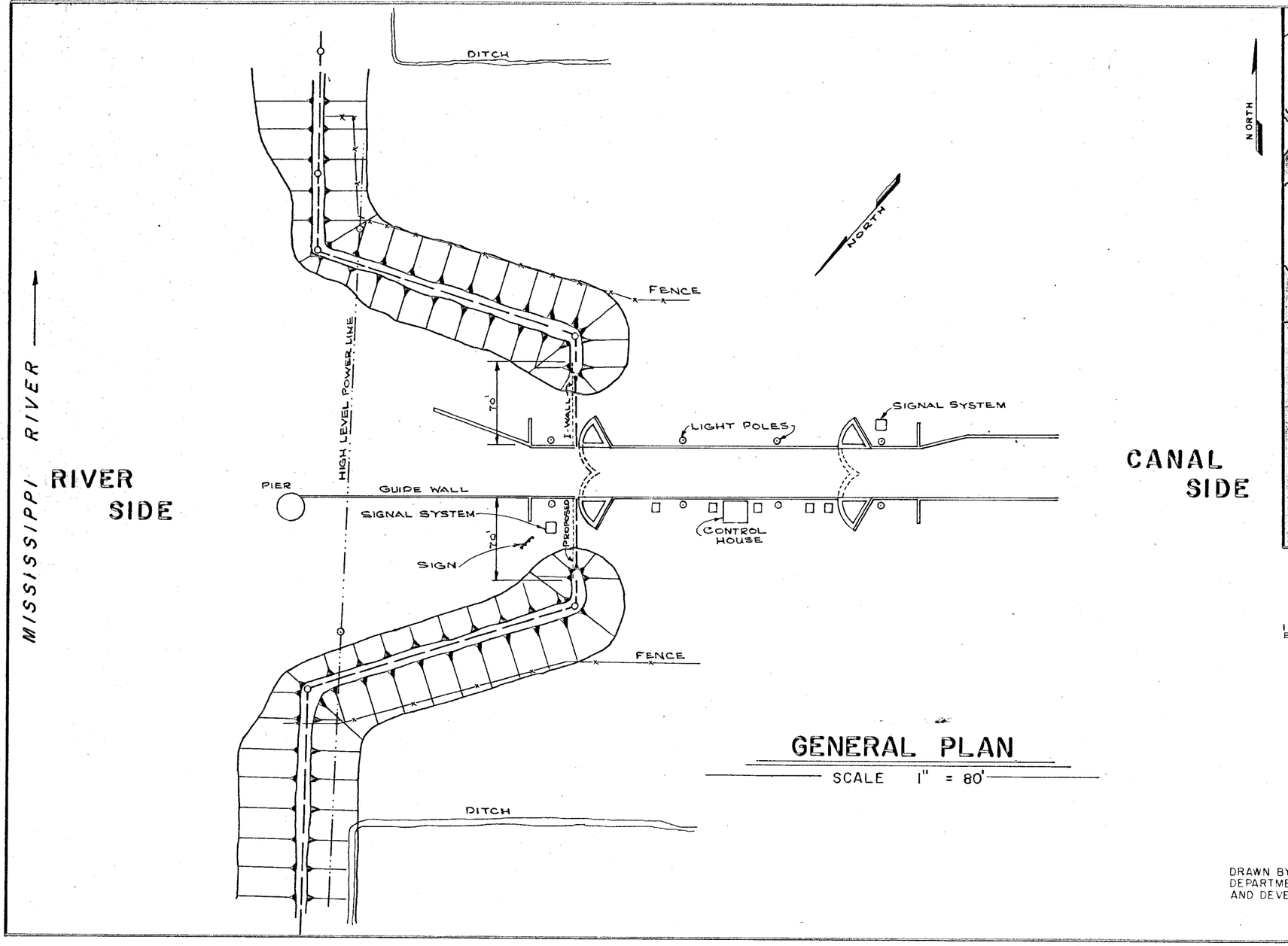
EMPIRE LOCK MODIFICATIONS

PLAQUEMINES PARISH, LOUISIANA

RELOCATION OF FACILITIES

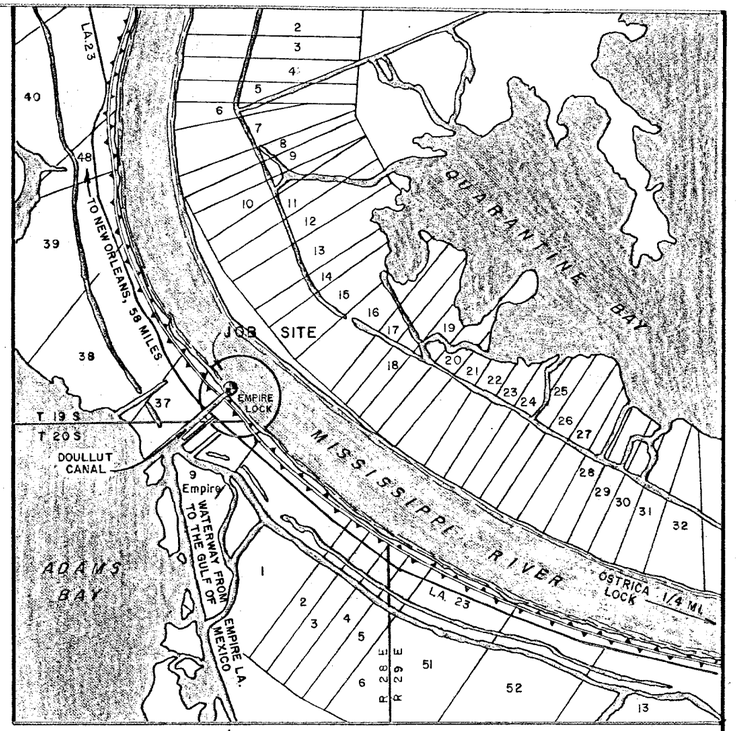
DESIGN MEMORANDUM NO. 54

PLATES



GENERAL PLAN

SCALE 1" = 80'



VICINITY MAP

SCALE : —— 1 : 62,500

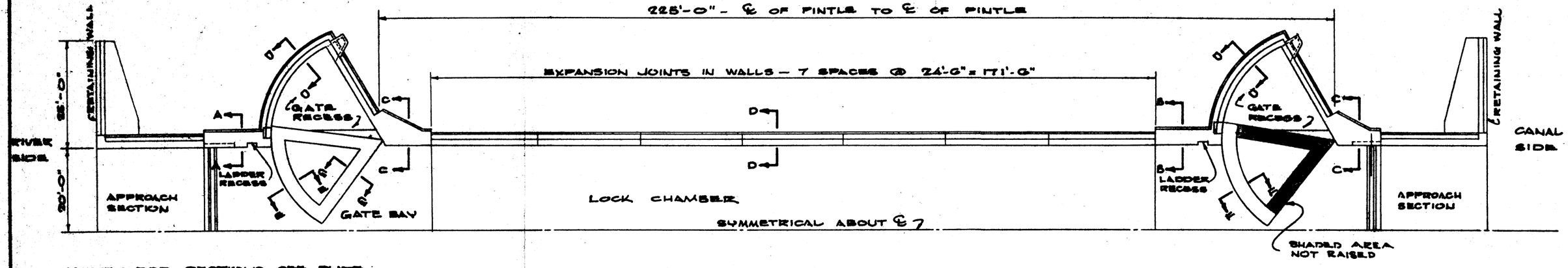
1 1/2 0 1 2 3 4 MILES

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

GENERAL PLAN & VICINITY MAP

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
GENERAL PLAN & VICINITY MAP
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

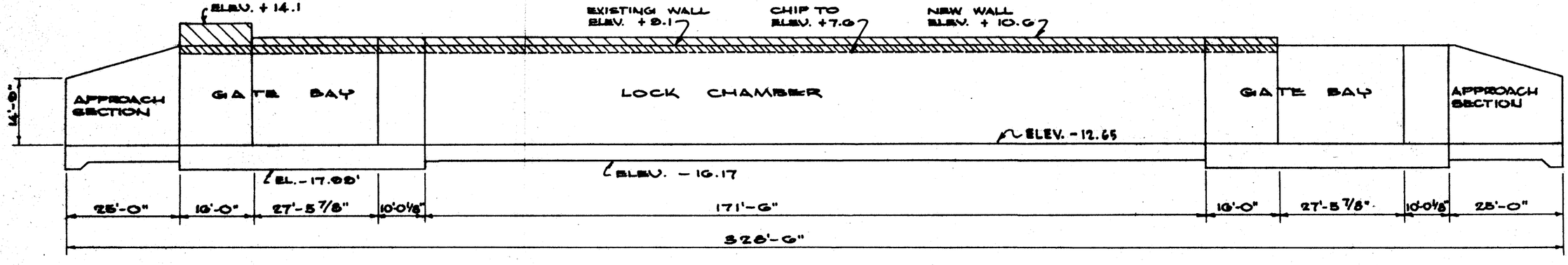
PLATE I-1



NOTE: FOR SECTIONS SEE PLATE

HALF PLAN VIEW OF LOCK

SCALE: 1"= 20'



SECTION THRU ℄ OF LOCK

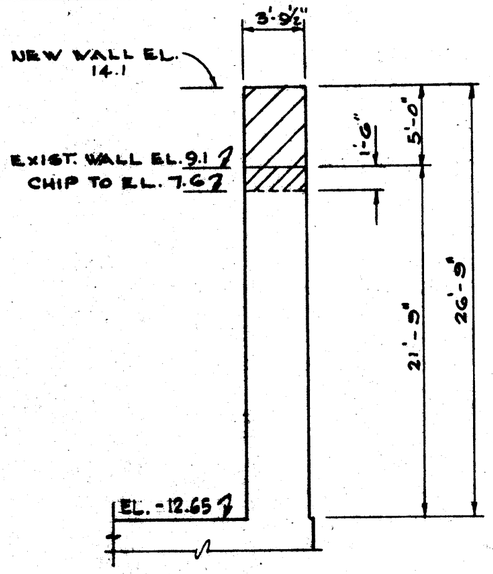
SCALE: 1"= 20'

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

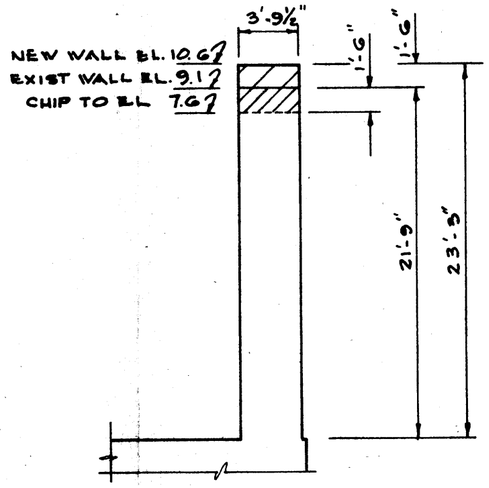
LOCKWALL & GATE MODIFICATION

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCKWALL & GATE MODIFICATION
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

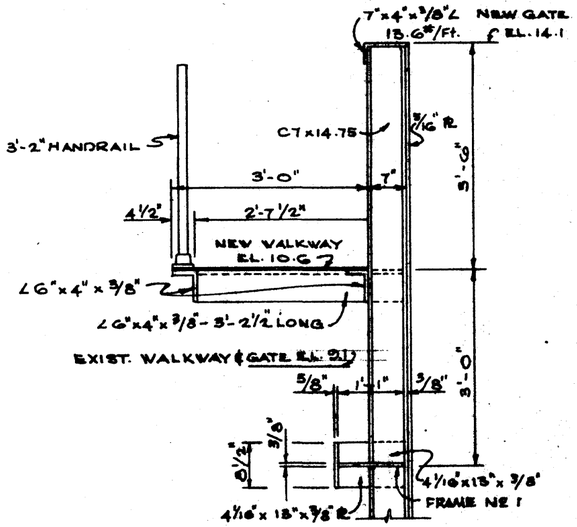
PLATE I-2



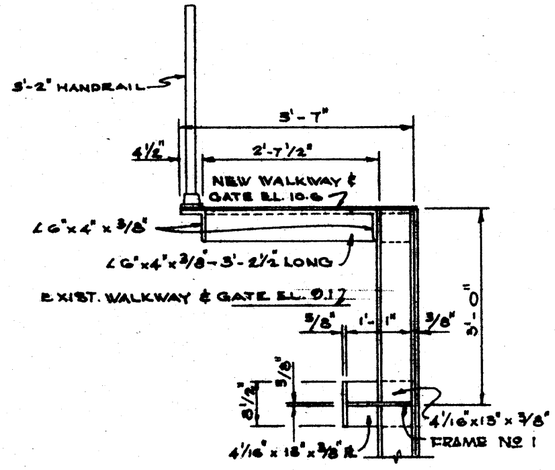
SECTION A-A
SCALE: 1/8"=1'-0"



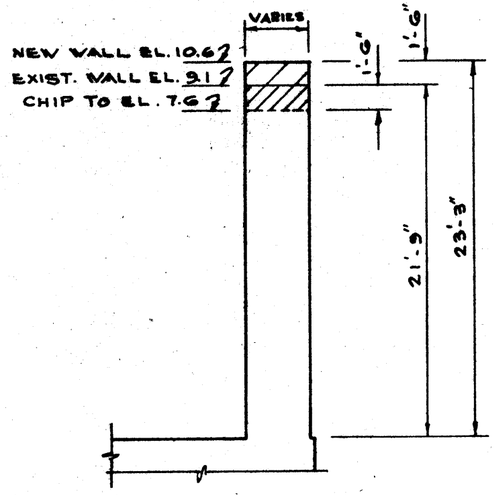
SECTION B-B
SCALE: 1/8" = 1'-0"



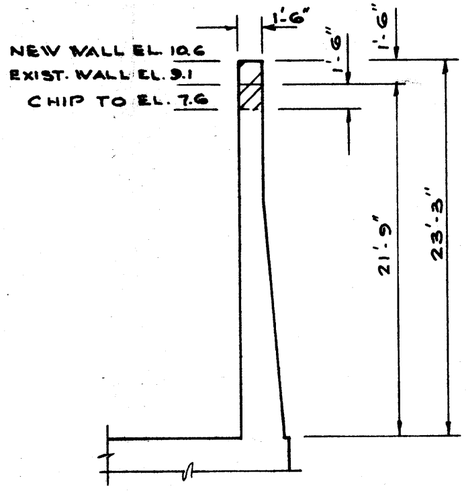
SECTION E-E
SCALE: 1/2" = 1'-0"



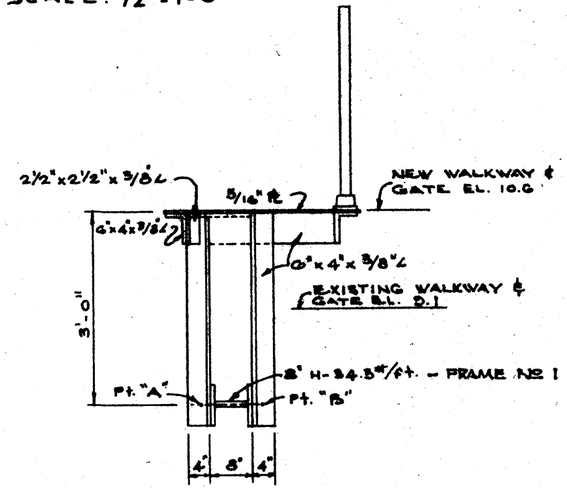
SECTION F-F
SCALE: 1/2" = 1'-0"



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



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



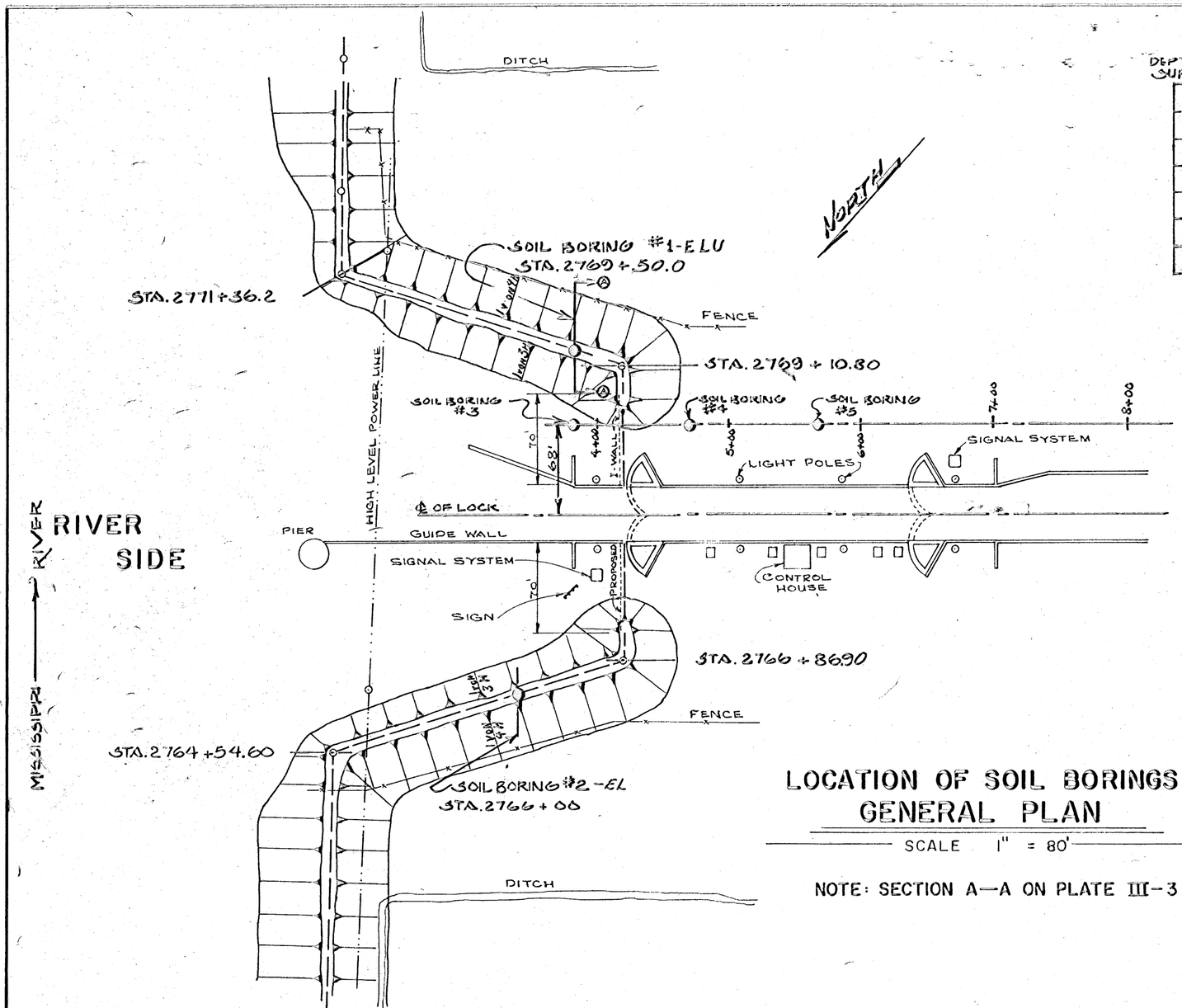
SECTION G-G
SCALE: 1/2" = 1'-0"

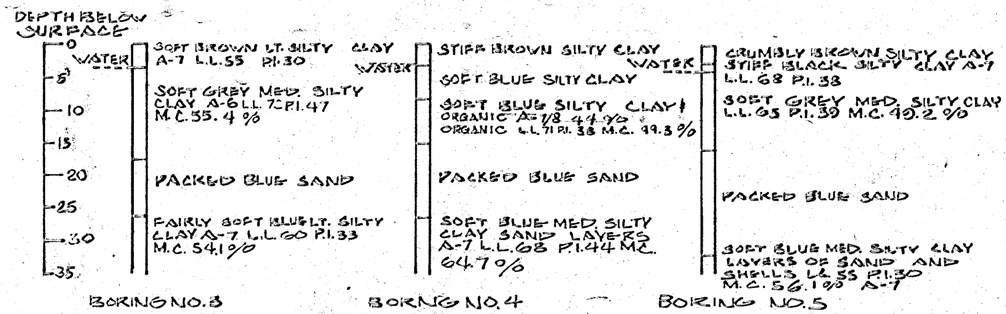
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

LOCKWALL & GATE MODIFICATION

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCKWALL & GATE MODIFICATION
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

PLATE I-3





WATER = WATER TABLE ; LL = LIQUID LIMIT ; PI = PLASTIC INDEX ; M.C. = MOISTURE CONTENT

NOTE: SOIL BORINGS #1-ELU & #2-EL ARE SHOWN ON PLATES " " "

ORIGINAL STRUCTURE
SOIL BORINGS

NOTE: BORINGS #3, 4 AND 5 ARE OLD BORINGS TAKEN FOR ORIGINAL CONSTRUCTION OF THE LOCK.

THESE BORINGS WERE MADE ABOUT 1944. (NO SOIL TEST WERE MADE.)

LOCATION OF SOIL BORINGS
GENERAL PLAN

SCALE 1" = 80'

NOTE: SECTION A—A ON PLATE III-3

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

SOIL BORINGS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
SOIL BORINGS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

PLATE III-1

BOR. 1-ELU

STA. 2769+50

C/L OF LEVEE

5-7 MARCH 75

GROUND EL. 8.8

ELEVATIONS IN FEET - M.S.L.

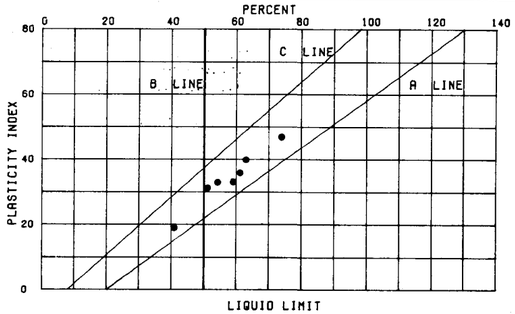
TEST DATA

WATER CONTENT % WATER, DRY WEIGHT

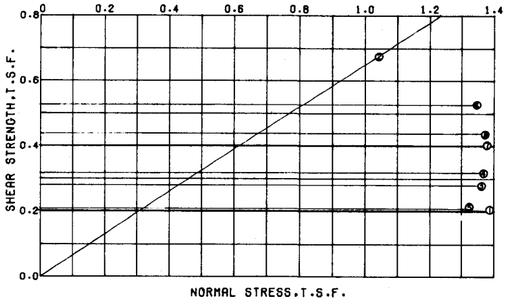
SHEAR STRENGTH TONS / SQ.FT.

WET DENSITY POUNDS / CU.FT.

NORMAL STRESS TONS / SQ. FT.



PLASTICITY CHART



SHEAR STRENGTH DATA

ENVELOPE NO.	ENVELOPE EL.	TYPE	STRENGTH Φ	STRENGTH C - TSF	CLASS
1	- 2.1	Q	0.0	0.20	CH
2	-21.9	S	33	0.00	SM
3	-32.7	Q	0.0	0.28	CH
4	-45.2	Q	0.0	0.32	CL
5	-57.4	Q	0.0	0.21	CH
6	-69.5	Q	0.0	0.53	CH
7	-81.2	Q	0.0	0.40	CH
8	-93.8	Q	0.0	0.44	CH

VOID RATIO

LOAD P TONS / SQ. FT.

CONSOLIDATION DATA

- (UC) UNCONFINED COMPRESSION TEST
- (Q) UNCONSOLIDATED - UNDRAINED SHEAR TEST
- (R) CONSOLIDATED - UNDRAINED SHEAR TEST
- (S) CONSOLIDATED - DRAINED SHEAR TEST

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

FOR SOIL BORING LEGEND SEE PLATE A

FOR LOCATION OF BORINGS SEE PLATE

DRAWN BY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
BORING DATA
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE III-2

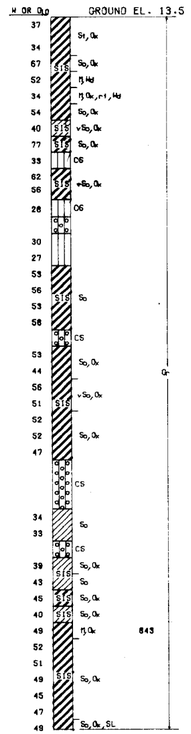
BOR. 2-EL

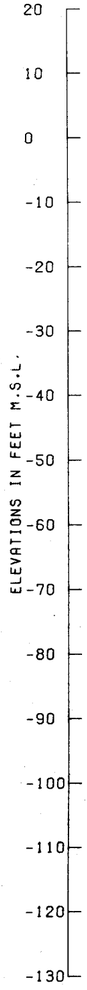
STA. 2766+00

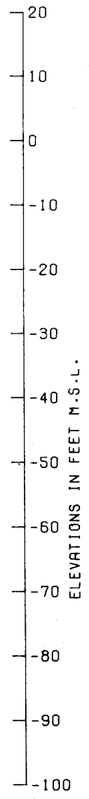
C/L OF LEVEE

24-27-28 FEB. 75

WATER TABLE ELEV. -6.5

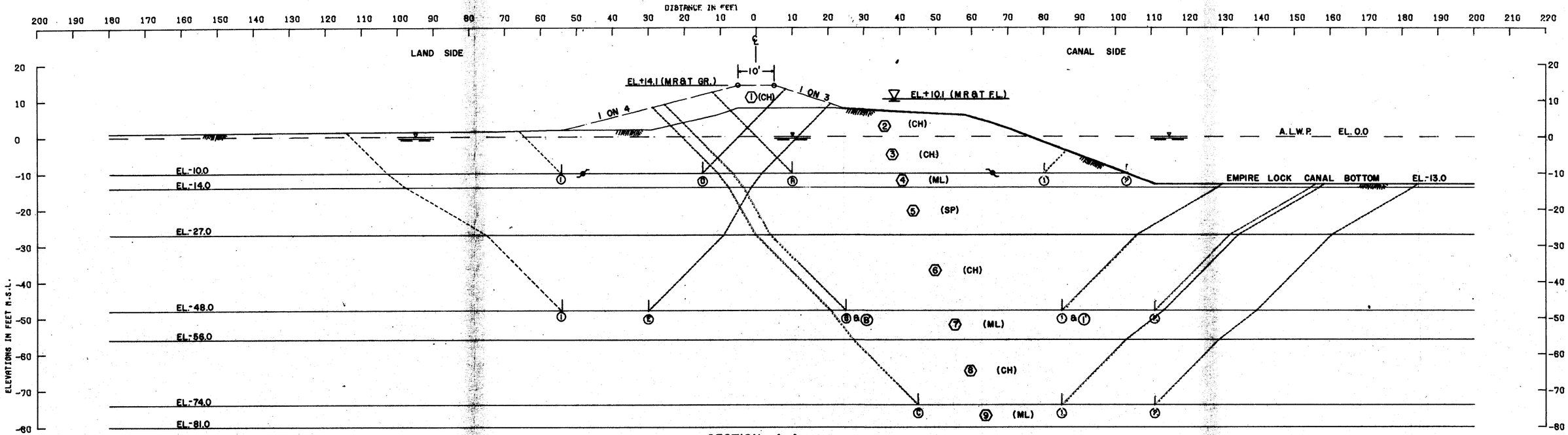






MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
SOIL BORING
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE III-3



SECTION A-A
SEE PLATE I-2 FOR LOCATION OF SECTION

GENERAL NOTES

CLASSIFICATION, STRATIFICATION, SHEAR STRENGTHS, AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF THE UNDISTURBED BORINGS. SEE BORING DATA PLATES.

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

STRATIFICATION BASED ON BORINGS I-ELU (STA. 2769+50) AND 2-EL (STA. 2766+00), BOTH ON ℄/L.

ASSUMED FAILURE NO.	ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓐ ①	-10.00	17824	27202	6014	28160	1078	50040	26120	1.992
Ⓐ ②	-10.00	17824	32864	0	28160	0	50688	28199	1.995
Ⓑ ①	-48.00	66614	36000	37604	162394	38770	140217	85184	1.645
Ⓑ ②	-48.00	66614	61600	37307	162394	37823	165420	91110	1.706
Ⓒ ①	-74.00	102462	28000	76169	288340	100655	204621	119785	1.708
Ⓒ ②	-74.00	102462	42900	75816	288340	94654	221178	126887	1.760
* Ⓕ ①	-48.00	66274	36000	37604	180692	38770	141878	91422	1.552

* WEDGES Ⓑ-① WERE RUN ASSUMING THE LEVEE IS CONSTRUCTED WITH A 1 FT. OVERBUILD TO EL.+15.1. BASED ON THE RESULTING SAFETY FACTOR OF 1.55, A 1 FT. OVERBUILD WILL BE ALLOWED.

STRATUM NO.	SOIL TYPE	EFFECTIVE UNIT WT. P.C.F. VERT. 1	VERT. 2	C - UNIT COHESION - P.S.F. CENTER OF STRATUM VERT. 1	VERT. 2	BOTTOM OF STRATUM VERT. 1	VERT. 2	FRICTION ANGLE DEGREES
①	CH	110.0	110.0	400.0	400.0	400.0	400.0	0.0
②	CH	102.0	102.0	400.0	400.0	400.0	400.0	0.0
③	CH	40.0	40.0	400.0	400.0	400.0	400.0	0.0
④	ML	65.0	65.0	200.0	200.0	200.0	200.0	15.0
⑤	SP	60.0	60.0	0.0	0.0	0.0	0.0	30.0
⑥	CH	43.0	43.0	600.0	600.0	600.0	600.0	0.0
⑦	ML	65.0	65.0	200.0	200.0	200.0	200.0	15.0
⑧	CH	43.0	43.0	650.0	650.0	650.0	650.0	0.0
⑨	ML	65.0	65.0	200.0	200.0	200.0	200.0	15.0

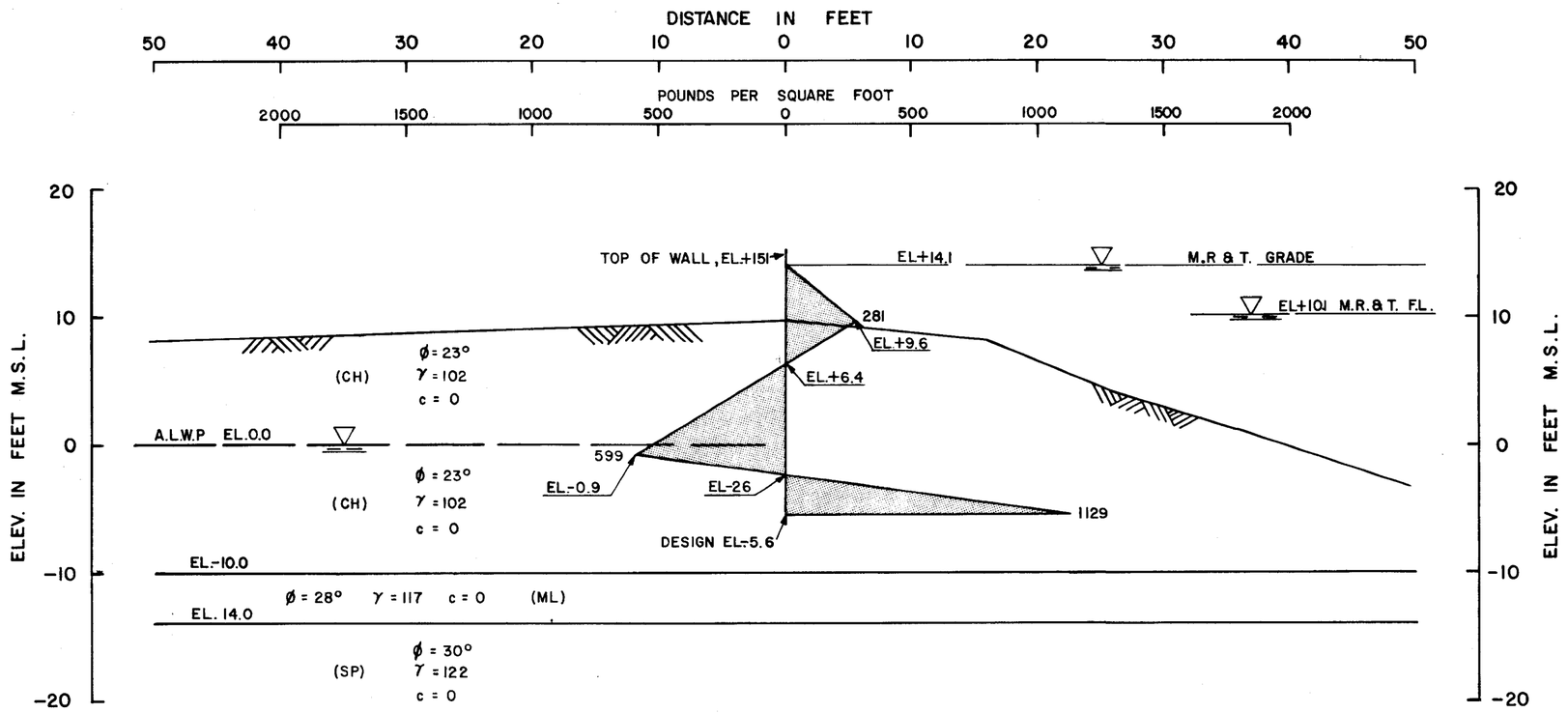
ASSUMED FAILURE NO.	ASSUMED SURFACE ELEV.	RESISTING FORCES R_A	R_B	R_P	DRIVING FORCES D_A	$-D_P$	SUMMATION OF FORCES RESISTING	DRIVING	FACTOR OF SAFETY
Ⓓ ①	-10.00	18463	15474	9312	28077	3960	43249	22117	1.955
Ⓔ ①	-48.00	66290	14400	67989	124202	63329	148679	60873	2.442

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

NOTES

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

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
STABILITY ANALYSIS
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



NET DIAGRAM
(S) CASE F.S.=1.5

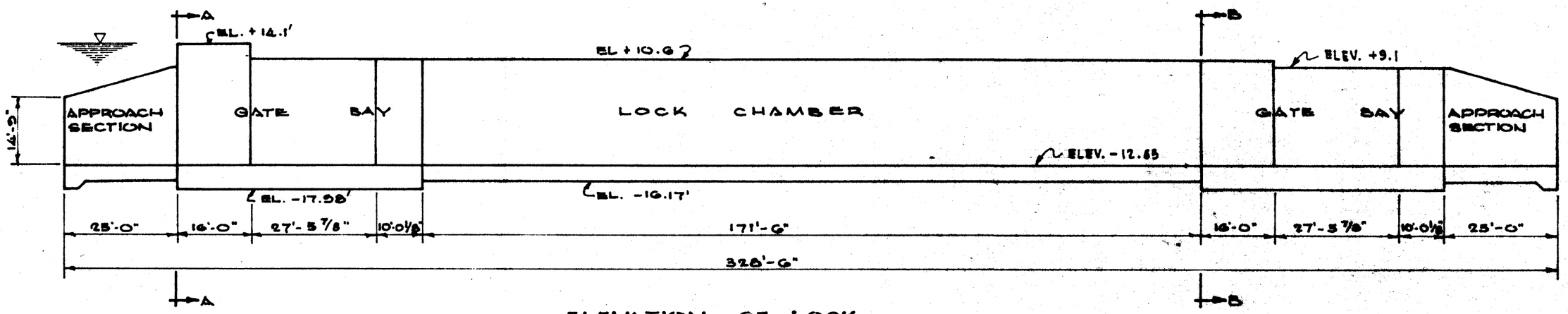
$M = \overset{\frown}{0}$

$F = \overset{\frown}{0}$

I-WALL ANALYSIS
(LEVEE TIE-IN)

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK-MODIFICATIONS
DESIGN MEMORANDUM NO 54
RELOCATION OF FACILITIES
I-WALL ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE III-5



ELEVATION OF LOCK

SCALE: 1"=20'

CASE I CONSIDER EVERYTHING TO THE RIGHT OF SECTION "A-A" SLIDING:

ASSUME SLIDING OCCURS AT EL. -17.58:

$\Rightarrow \phi = 30°$; $C = 0$

$$\Sigma H = \frac{(30.75)^2}{2}(64)(40) + \left[\frac{1}{2}\right]\left[\frac{(18.75)^2}{2}(64)(25)\right]$$

$\Sigma H = 1,772,820\ \# \rightarrow$

$\Sigma V = 1.72539 \times 10^7\ \# \downarrow$

$$F.S. = \frac{(1.72539 \times 10^7)(\tan 30°) + 0}{1,772,820} = 5.62$$

$F.S. = 5.62 \gg 1.5$

CASE II CONSIDER EVERYTHING TO THE RIGHT OF SECTION "B-B" SLIDING:

$$\Sigma H = \frac{(22.25)^2}{2}(64)(40) = 6.9102 \times 10^5\ \# \rightarrow$$

$\Sigma V = 5,791,670.93\ \# \downarrow$

$$F.S. = \frac{(5.791671 \times 10^6)(\tan 30°) + 0}{6.5192 \times 10^5} = 4.85 \gg 1.5$$

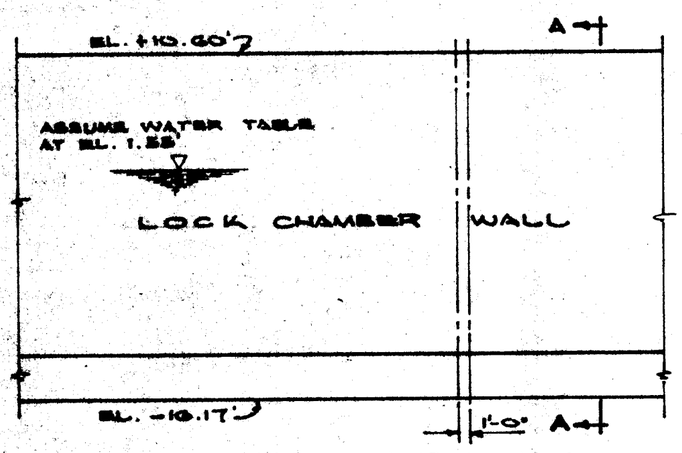
SHEAR STABILITY ANALYSIS (SLIDING)

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

LOCK CHAMBER

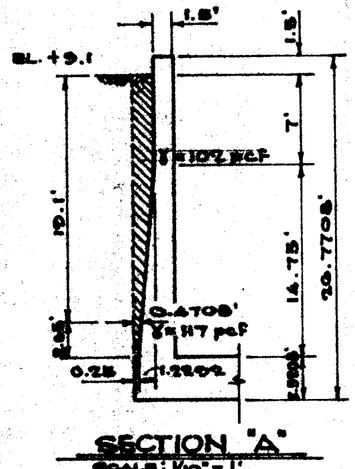
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCK CHAMBER
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE III-6



ELEVATION OF LOCK CHAMBER WALL
SCALE: 1/10" = 1'

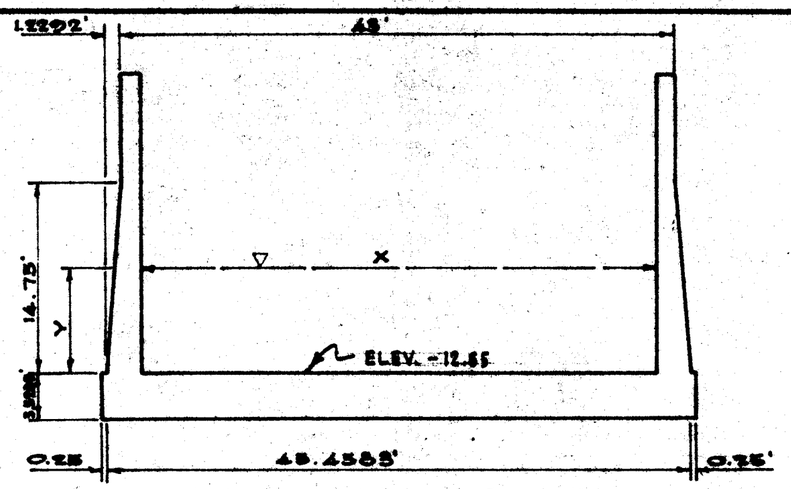
CONSIDER A ONE FOOT WIDE SECTION OF WALL
WEIGHT OF STRUCTURE = 37,454# ↓



SECTION "A"
SCALE: 1/10" = 1'

CONSIDER WEIGHT OF SOIL ACTING DOWN:
WT. = 4742# ↓

TOTAL FORCE ACTING DOWN: WT. = 37454 + 4742 = 42196
F.S. = (37,454 + 4,742)/30,501 = 0.834 < 1.25 NO GOOD



SECTION THRU LOCK CHAMBER
SCALE: 1/10" = 1'

FIND WATER TABLE THAT WOULD RESULT IN F.S. = 1.25:

1.25 = 42196.0#/F(UPLIFT)

F(UPLIFT) = 33756.8# ↑

33756.8# - (8.5208')(45.9583')(1')(64 pcf) =

33756.8# - 10,356# = 23400.8#

$23400.8^{\#} = [(45.4583 + X)/2][Y][64\ pcf]$

$X = 45.4583' - (2)\left(\frac{1.2292Y}{14.75}\right)$

$X = 45.4583' - 0.1667Y$

$23400.8^{\#} = [(45.4583' + 45.4583' - 0.1667Y)/2][Y][64]$

$23400.8^{\#} = [45.4583Y - 0.0834Y^2][64]$

$23400.8^{\#} = 2909.33Y - 5.34Y^2$

$0 = 23400.8^{\#} - 2909.33Y + 5.34Y^2$

$Y = \frac{-(-2909.33) \pm \sqrt{(2909.33)^2 - (4)(5.34)(23400.8^{\#})}}{(2)(5.34)}$

Y = 8.17' (OR) Y ≠ 536.05

∴ IF F.S. FOR UPLIFT IS TO EQUAL 1.25, THEN THE WATER TABLE MUST BE AT ELEVATION -4.45'

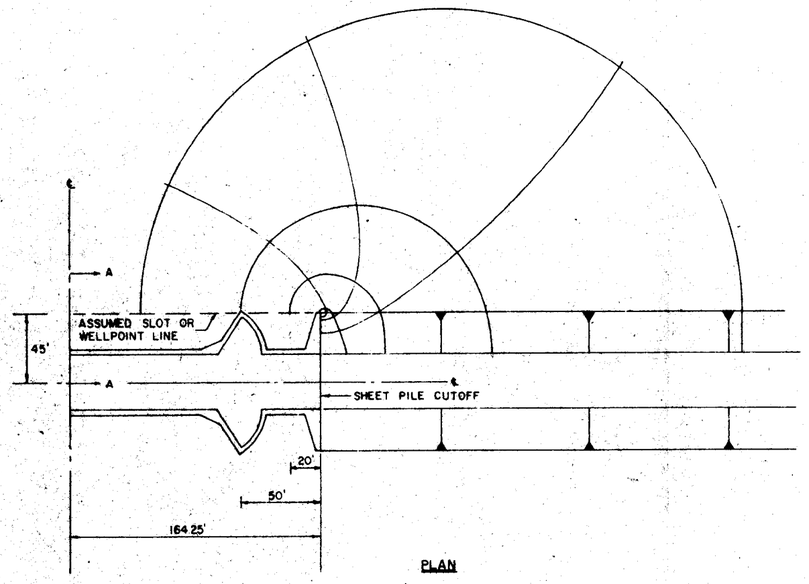
NOTE: WELL POINT SYSTEM IS REQUIRED (TO BE DESIGNED BY CORPS OF ENGINEERS)

UPLIFT ANALYSIS DURING DEWATERING

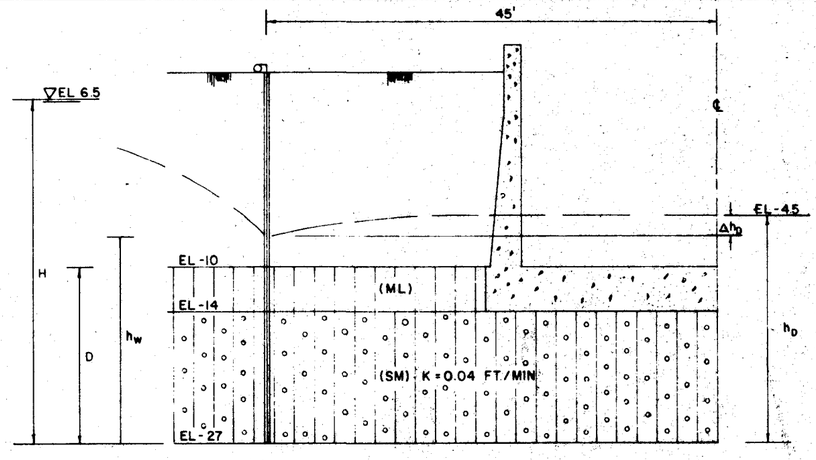
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

LOCK CHAMBER

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCK CHAMBER
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1976
FILE NO. H-2-58370



PLAN



SECTION A-A

FLOW COMPUTATIONS FIG IV-27

$N_f = 4.5$

$N_e = 4.0$

$\xi = N_f / N_e$

$= 4.5 / 4.5$

$= 1.125$

REQUIRE DRAWDOWN

$\Delta h = 6.5 - (-4.5)$

$= 11.0'$

TOTAL FLOW TO LINE OF WELLPOINTS

$Q_t = \Delta h \xi K D$ ..... EQ IV-27

$= (11.0)(1.125)(0.04)(17)$

$= 8.5$ CFM

FLOW PER FLOW PATH

$Q_p = Q_t / h_f$

$= 8.5 / 4.5$

$= 1.9$ CFM/FLOW PATH

∴ DETERMINE SPACING BASED ON THE CONFIGURATION OF THE FLOW PATHS AND FOR FLOWS AS FOLLOWS:

DISTANCE FROM CUTOFF	FLOW PER FT. OF SLOT
0' - 20'	(1.9)(2)/20 = 0.19 CFM/FT
20' - 50'	(1.9)(1)/30 = 0.06 CFM/FT
50' - 164.25	(1.9)(1.5)/114.25 = 0.02 CFM/FT

FACTOR OF SAFETY

WT (SOIL + STRUCTURE) = 42,209 LBS/FT

UPLIFT (TO EL -4.5) = 33608 LBS/FT

F.S. = 42,209/33608 = 1.26

DRAWDOWN COMPUTATIONS FIG IV-20

$h_e = h_d = 22.5'$ (REQUIRED) $H = 33.5'$

$\Delta h_w = Q_w / (2\pi KD) \ln (a/(2\pi r_w))$ EQ IV-75, WHERE

h_w = REQUIRED HEAD IN WELLPOINT

$= h_d - \Delta h_w$ EQ IV-76

a = WELLPOINT SPACING

r_w = EFFECTIVE RADIUS OF WELLPOINT = 0.42'

Q_w = FLOW/WELL

0' - 20' (ASSUME 5' SPACINGS)

$\Delta h_w = [(0.10)(.5)/2\pi(0.04)(17)] \ln [4/2\pi(0.42)]$

$= 0.14'$

$h_w = 22.5 - 0.16'$

$= 22.36'$

20' - 50' (ASSUME 9' SPACINGS)

$\Delta h_w = [(0.06)(9)/2\pi(0.04)(17)] \ln [11/2\pi(0.42)]$

$= 0.16'$

$h_w = 22.5 - 0.16'$

$= 22.34'$

50' 164.25' (ASSUME 18' SPACINGS)

$\Delta h_w = [(0.02)(18)/2\pi(0.04)(17)] \ln [18/2\pi(0.42)]$

$= 0.16'$

$h_w = 22.5 - 0.16'$

$= 22.34'$

THE REQUIRED DRAWDOWN AND THE REQUIRED SPACING (BASED ON A FACTOR OF SAFETY EQUAL TO 1.30) ARE

DISTANCE FROM CUTOFF	REQUIRED SPACING	DRAWDOWN $H - h_w$ *
0' - 20'	3.5'	11.14'
20' - 50'	6.5'	11.16'
50' - 164.25'	13.5'	11.16'

*HYDRAULIC LOSSES MUST BE ADDED TO THE REQUIRED DRAWDOWN

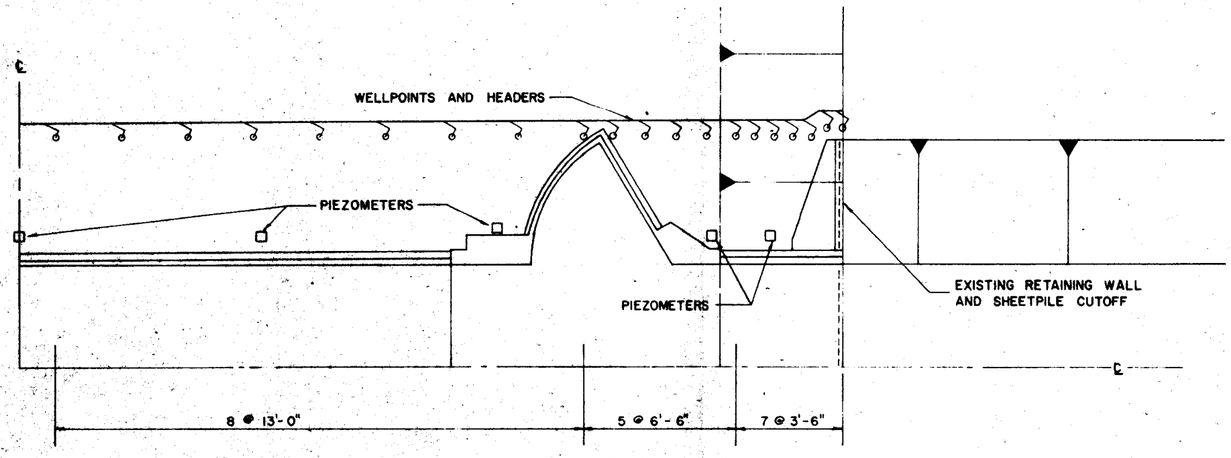
NOTE: FLOW AND DRAWDOWN CALCULATIONS BASED ON EQUATIONS AND FIGURES IN TM 5-818-5 DEWATERING AND GROUNDWATER CONTROL FOR DEEP EXCAVATION

WELL POINT DESIGN AND LOCATION OF PIEZOMETERS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

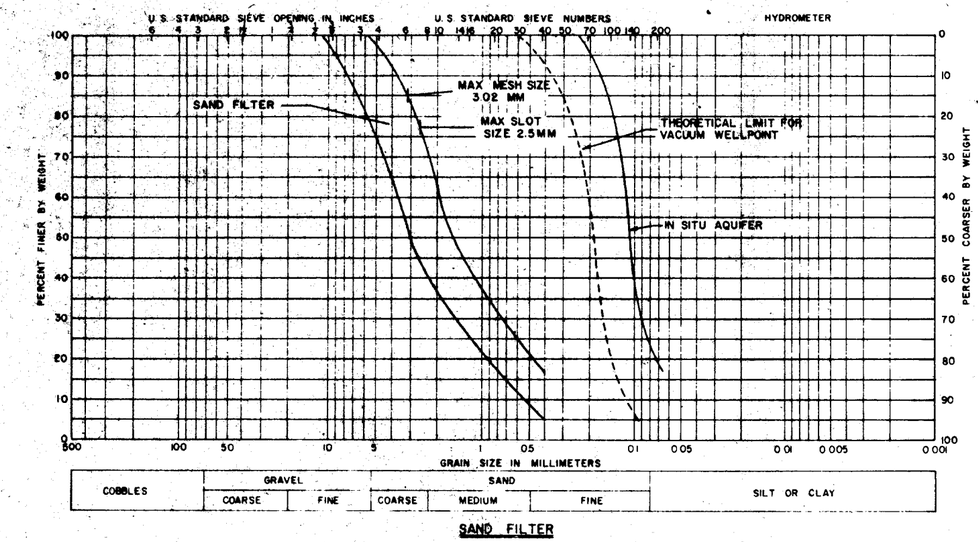
WELL POINT & PIEZOMETERS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
WELL POINT & PIEZOMETERS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



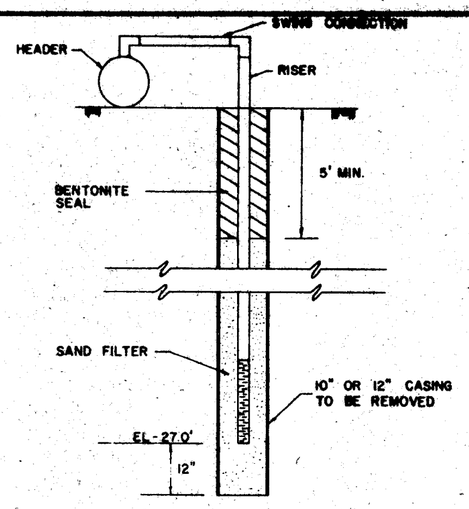
WELLPOINT LAYOUT

NOT TO SCALE

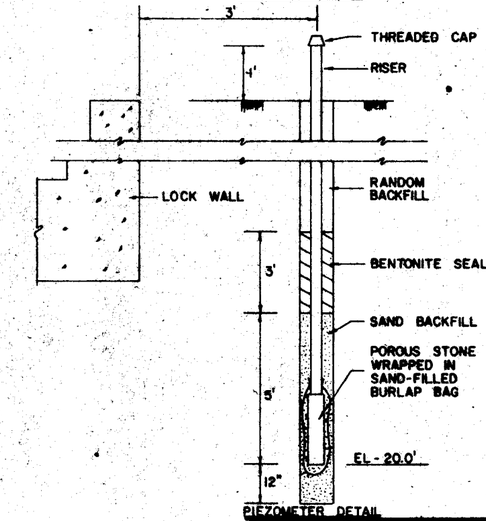


SAND FILTER

GRAIN SIZE CURVES



WELLPOINT DETAIL



PIEZOMETER DETAIL

% OPEN AREA FOR SCREEN

MAX ENTRANCE VELOCITY
= 0.1 FPS

$Q = VA$

$(0.19)(5) = (0.1)(60)(A)$

$A = 0.15\ FT^2$

$A_{SCREEN} = \pi (D)(L_{SCREEN})$

$= \pi (0.2)(L_{SCREEN})$

$\%\ OPEN\ AREA = \left(\frac{A}{A_{SCREEN}}\right) X\ 100$

$= 24/L_{SCREEN}$

WHERE: A = OPEN AREA

A_{SCREEN} = AREA OF SCREEN

L_{SCREEN} = LENGTH OF SCREEN

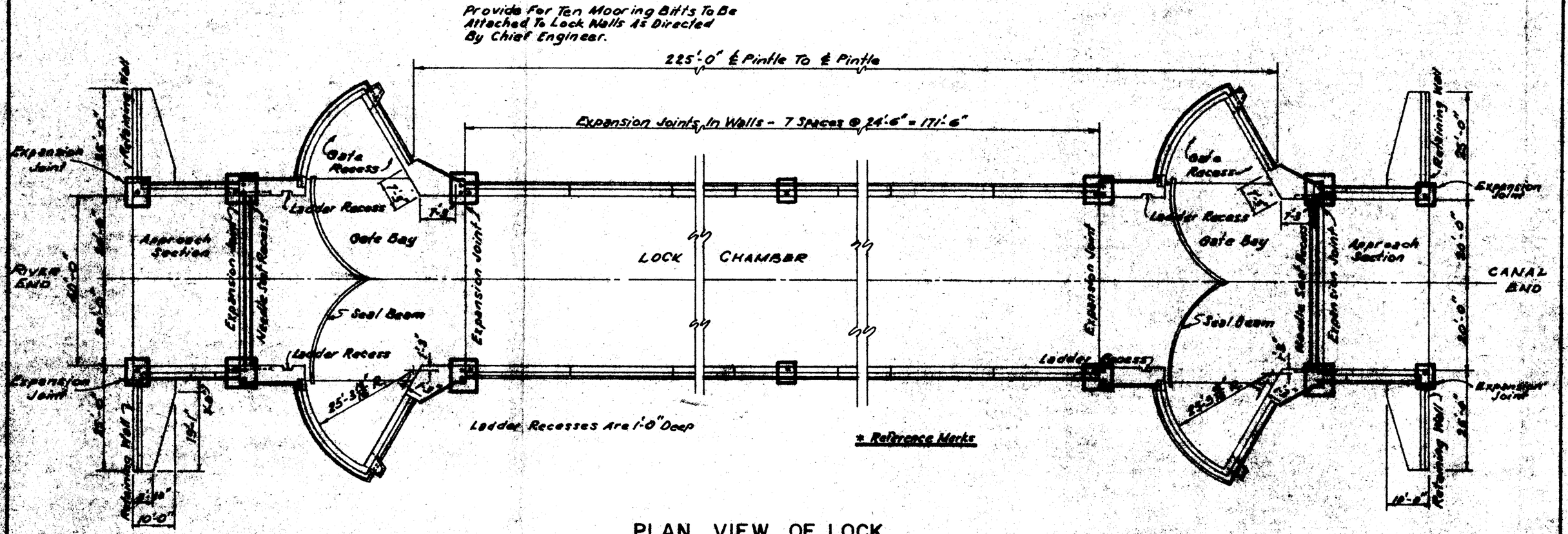
FILTER GRADATION

% FINER	SIEVE SIZE
100	3/8
100 - 85	NO. 3
85 - 50	NO. 6
50 - 30	NO. 14
25 - 10	NO. 30
15 - 0	NO. 40

WELL POINT DESIGN AND LOCATION OF PIEZOMETERS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
WELL POINT DESIGN
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



PLAN VIEW OF LOCK

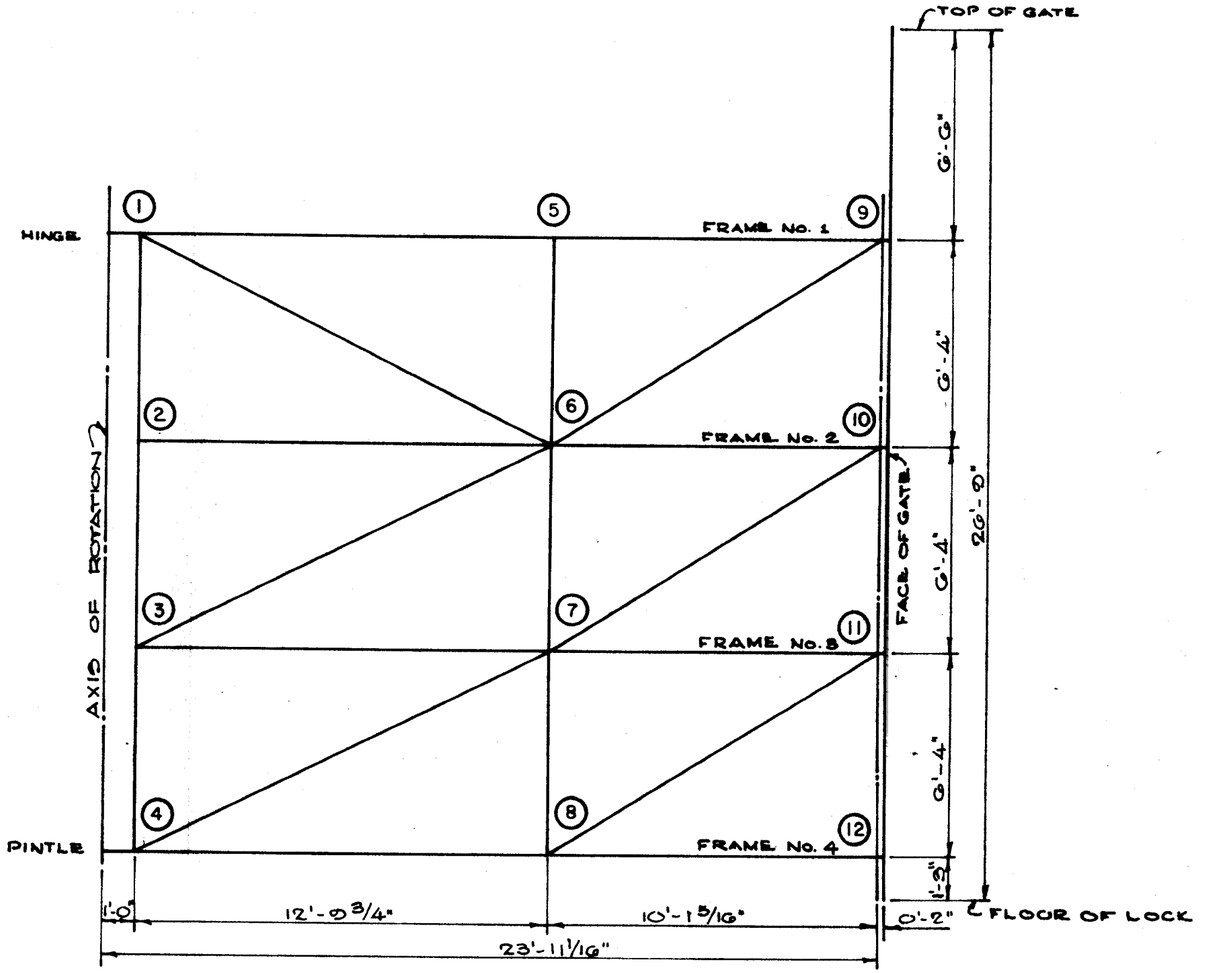
SCALE: 1" = 20'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

REFERENCE MARKS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
REFERENCE MARKS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE III-10



VERTICAL TRUSS
RECESS SIDE ELEVATION

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

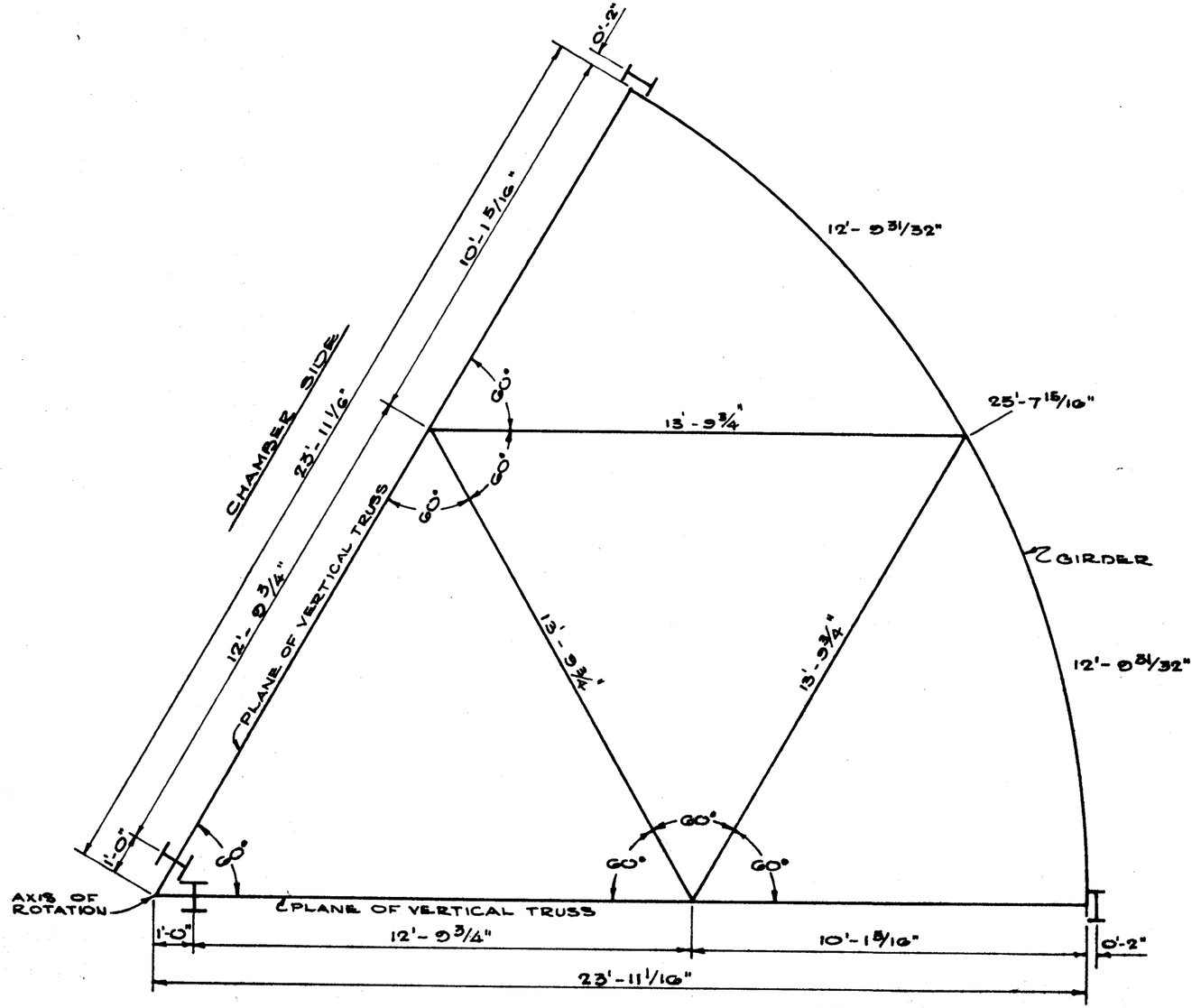
CHAMBER SIDE OPPOSITE HAND

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

PLATE IV-1



TYPICAL HORIZONTAL FRAME DIMENSIONS

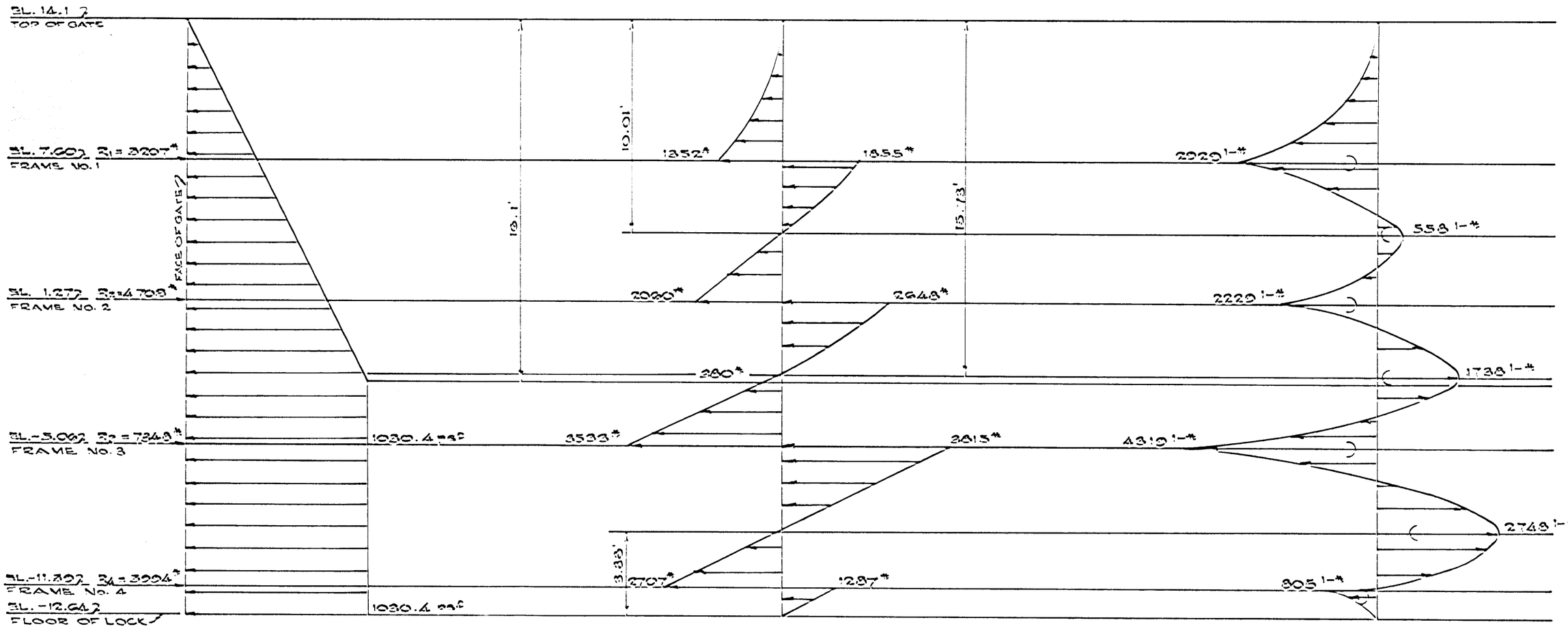
SCALE: 1" = 5'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1976
FILE NO. M-2-28370

PLATE IV-2

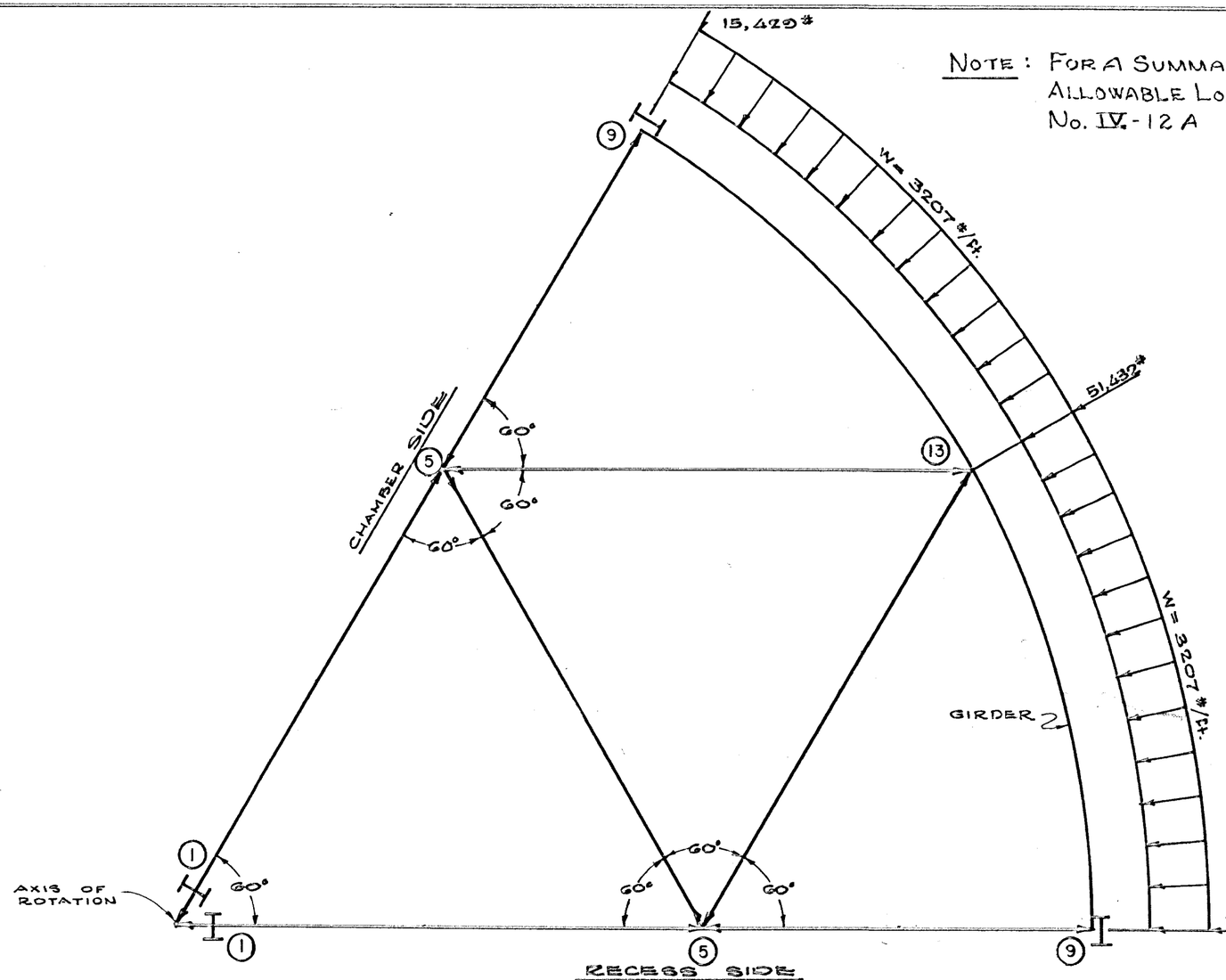


DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-3



NOTE: FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-12 A

WATER LOAD DISTRIBUTIONS

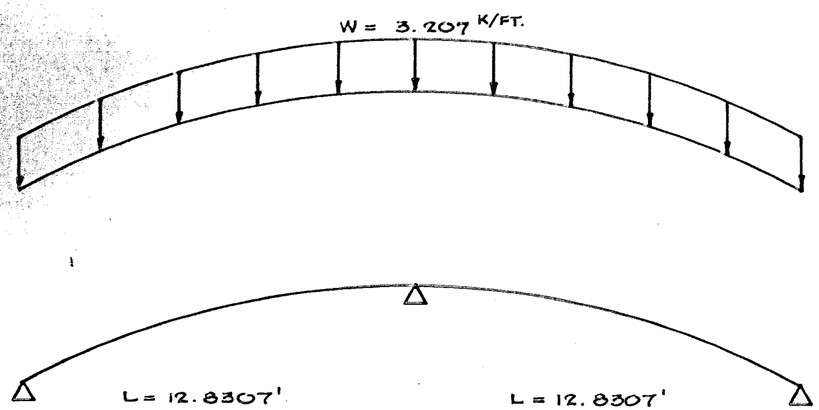
(FRAME Nº 1)

SCALE: 1" = 3'-0"

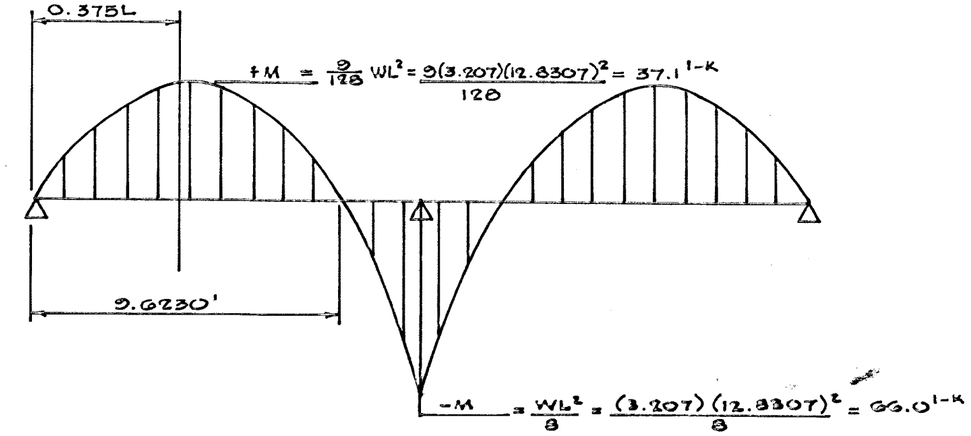
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

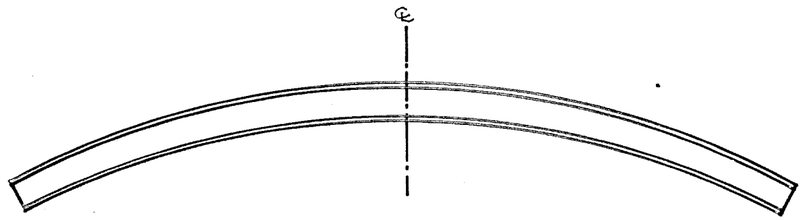
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK-MODIFICATIONS
DESIGN MEMORANDUM NO 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



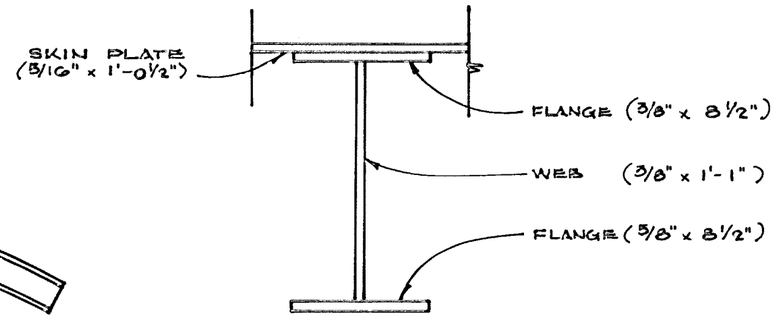
LOADING
(LIVE LOAD)
SCALE: 1/4" = 1'-0"



MOMENT DIAGRAM
SCALE: N.T.S. (HORIZ.)
1" = 40 I-K (VERT.)



FRAME Nº 1 GIRDER
SCALE: 1/4" = 1'-0"



DESIGN SECTION
SCALE: 1 1/2" = 1'-0"

CHECK -M AT ℄:

$S_{REQ'D.} = \frac{(66)(12)}{18} = 44.0 < 81.29$ O.K.

CHECK +M:

+M = 37.1 I-K

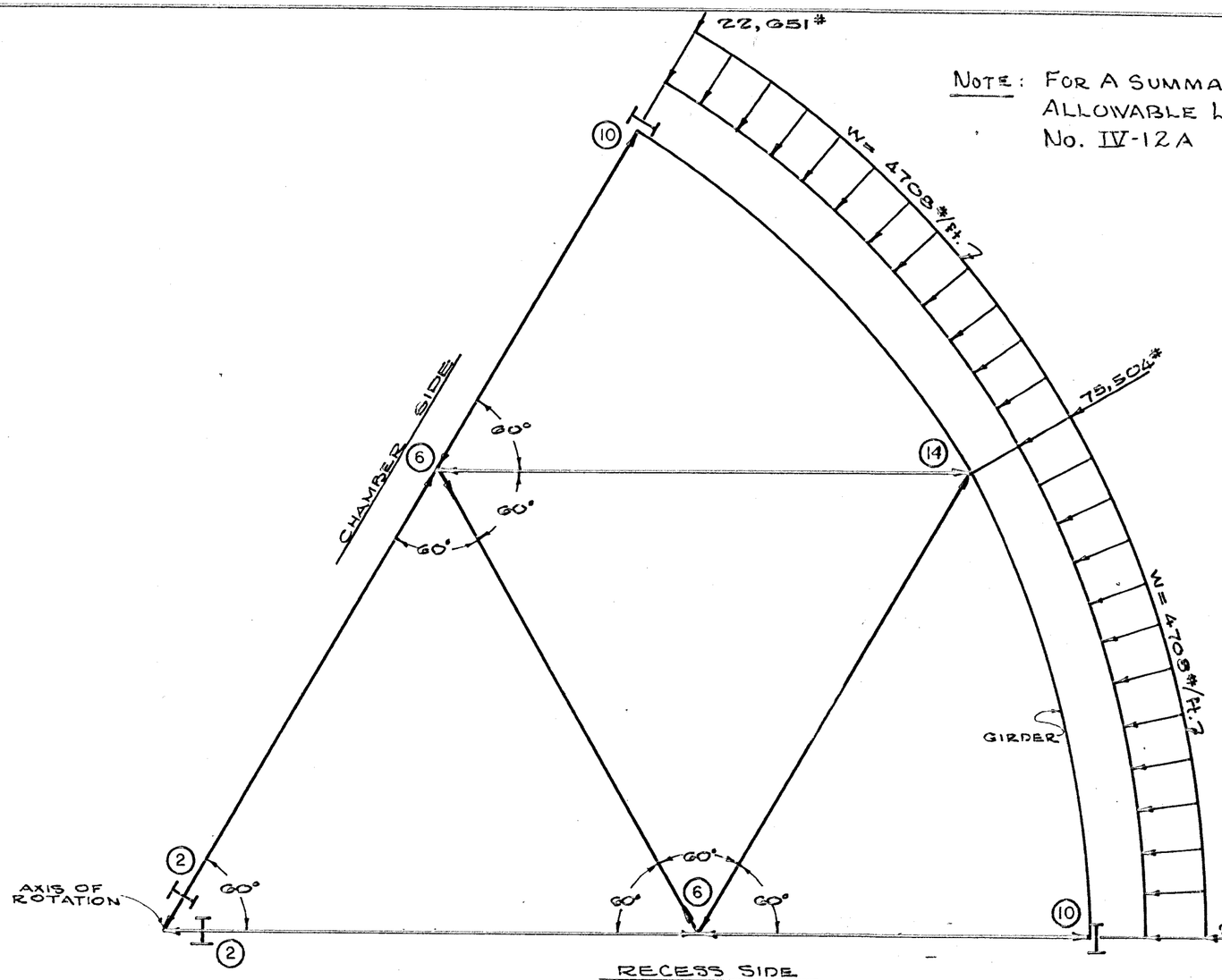
$M_A = \frac{(18)(81.29)}{12} = 121.94$ I-K

37.1 I-K < 121.94 I-K O.K.

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



NOTE: FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-12A

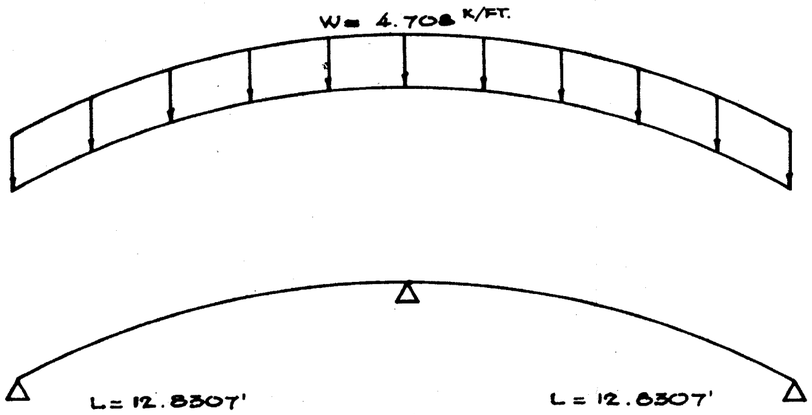
WATER LOAD DISTRIBUTIONS
(FRAME Nº 2)

SCALE: 1" = 3'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

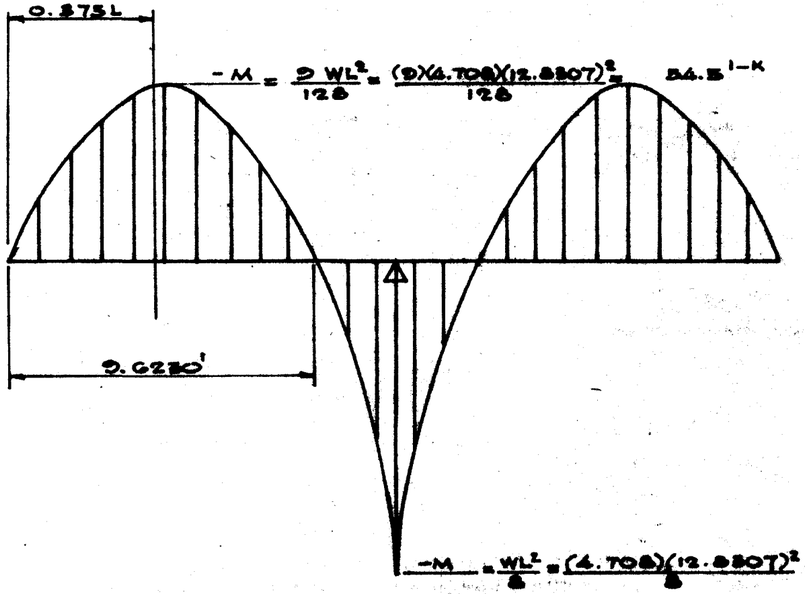
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



LOADING

(LIVE LOAD)

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



MOMENT DIAGRAM

SCALE: 1" = N.T.S.(HORIZ.)
1" = 40'-0"(VERT.)

CHECK +M:

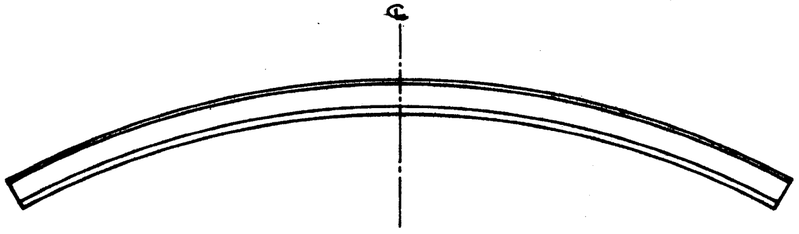
+M = 54.5 I-K

$M_A = \frac{(18)(81.65)}{12} = 122.84$ I-K

54.5 I-K < 122.84 I-K O.K.

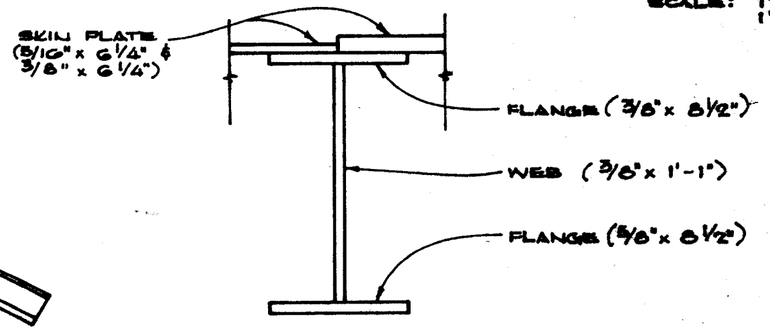
CHECK -M:

$S_{REQ'D.} = \frac{(90.9)(12)}{18} = 64.0 < 81.65$ O.K.



FRAME NO 2 GIRDER

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



DESIGN SECTION

SCALE: 1 1/2"=1'-0"

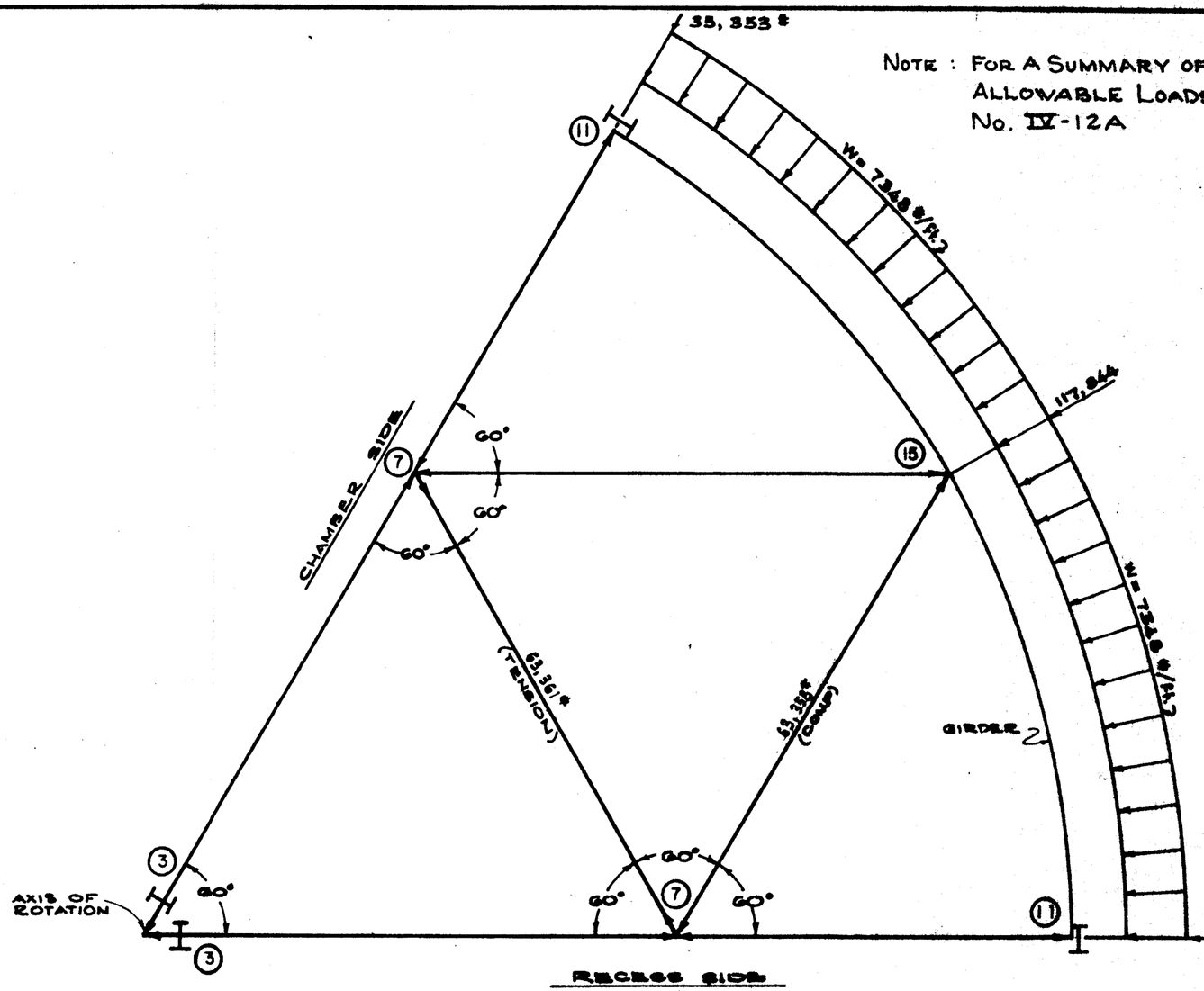
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE SIDE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. M-2-28370

PLATE IV-7

NOTE : FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-12A



RECESS SIDE

WATER LOAD DISTRIBUTIONS

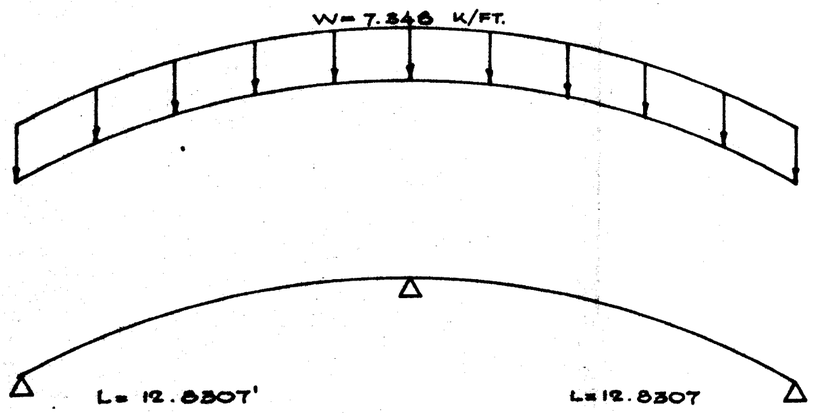
(FRAME No. 3)

SCALE: 1" = 5'-0"

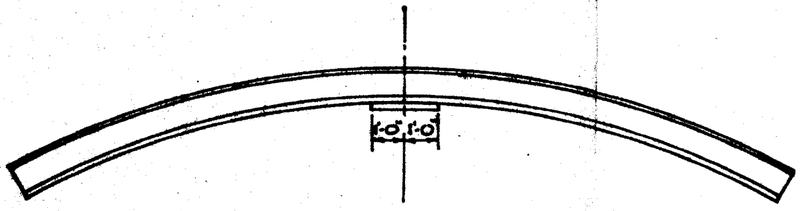
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

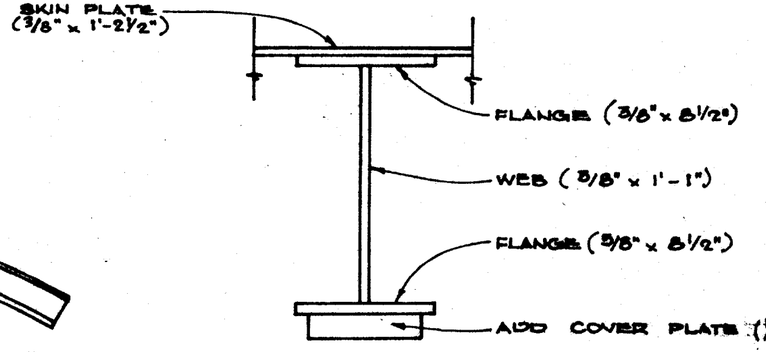
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1970 FILE NO. H-2-28370



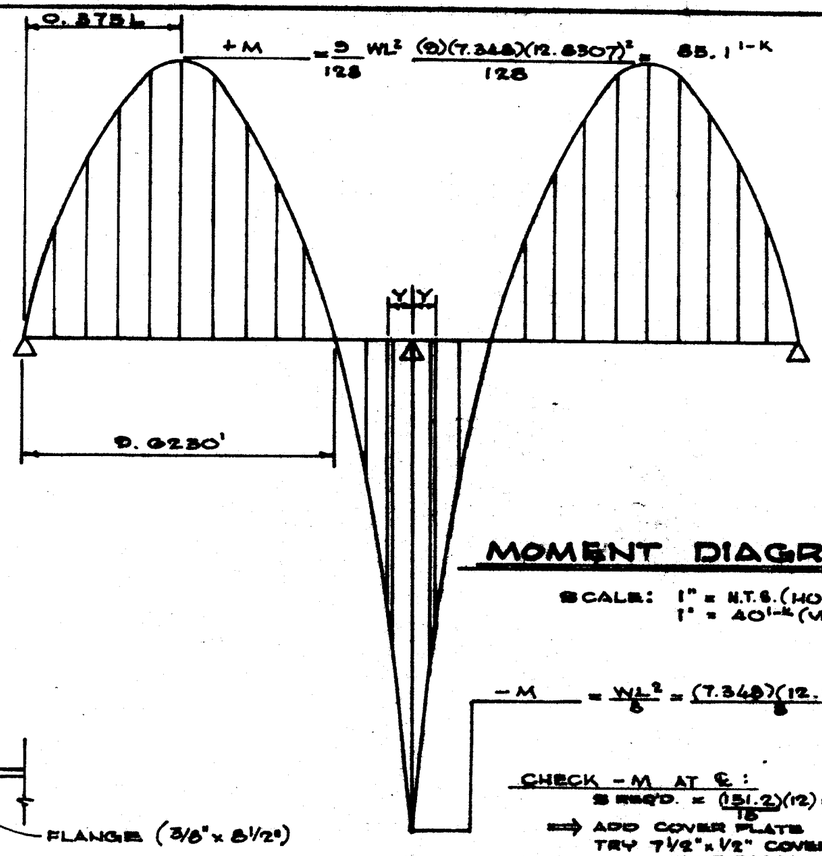
LOADING
(LIVE LOAD)
SCALE: 1/4" = 1'-0"



FRAME Nº 3 GIRDER
SCALE: 1/4" = 1'-0"



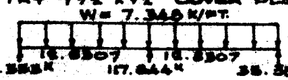
DESIGN SECTION
SCALE: 1 1/2" = 1'-0"



MOMENT DIAGRAM
SCALE: 1" = N.T.S. (HORIZ.)
1" = 40 I-K (VERT.)

$-M = \frac{WL^2}{8} = \frac{(7.348)(12.8307)^2}{8} = 151.2$ I-K

CHECK -M AT ℄ :
S REQ'D. = $\frac{(151.2)(12)}{16}$ = 100.8 > 83.96
⟹ ADD COVER PLATE
TRY 7 1/2" x 1/2" COVER PLATE
W = 7.348 K/FT.

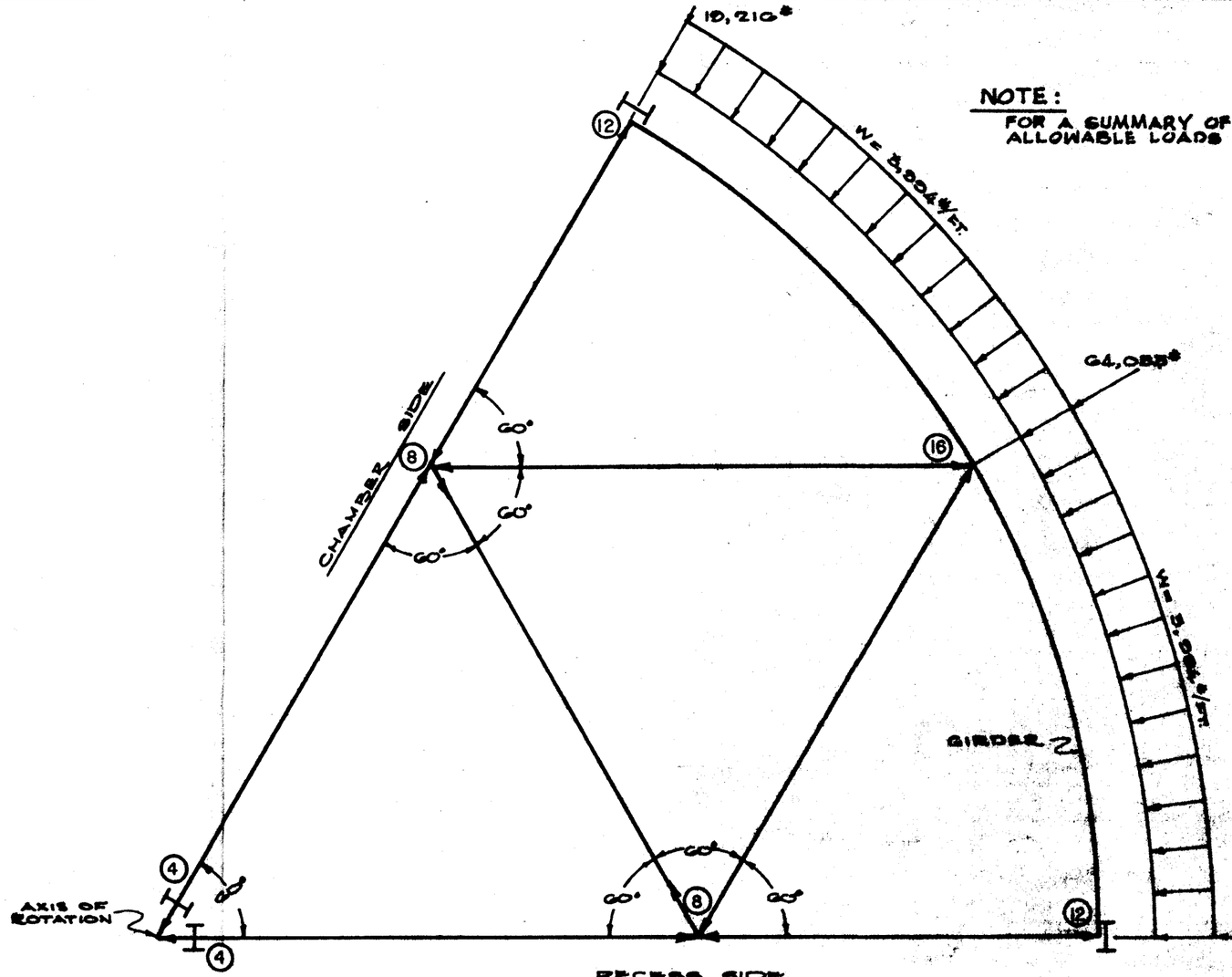


FIND LENGTH OF PLATE REQ'D. (Y)
MA = $\frac{(16)(83.96)}{16}$ = 124.89
(35.353)(12.83+Y)+(117.644)(Y)-$\frac{(7.348)(12.83+Y)^2}{2}$
= -124.89 I-K
Y = 0.46'
USE 7 1/2" x 1/2" x 2'-0" PLATE (3/16" WELD ALL AROUND)

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE



NOTE:
FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE NO. IX-12A

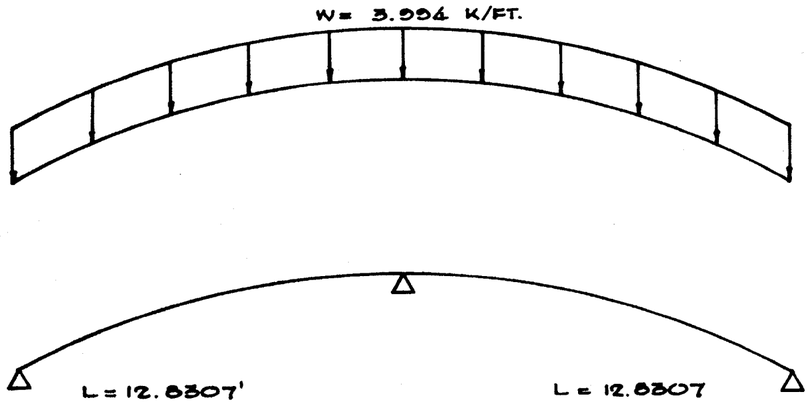
WATER DISTRIBUTIONS LOADS
(FRAME NO. 4)

SCALE: 1" = 5'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

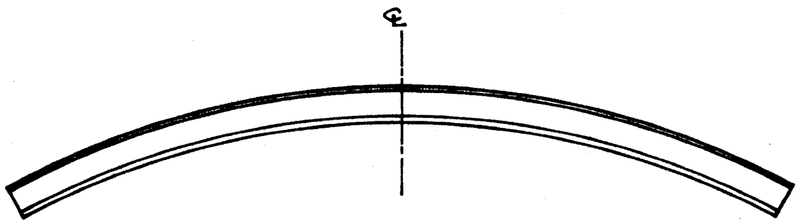
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



LOADING

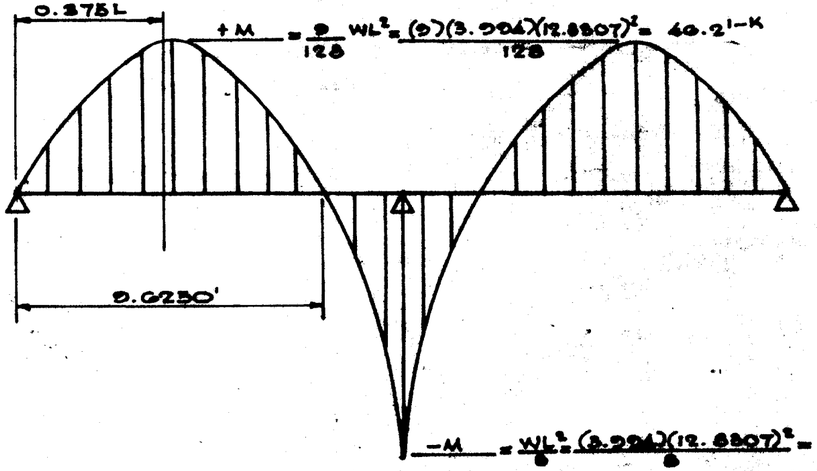
(LIVE LOAD)

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



FRAME NO 4 GIRDER

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



MOMENT DIAGRAM

SCALE : N.T.S. (HORIZ.)
1" = 40'-K (VERT.)

CHECK -M AT ℄ :

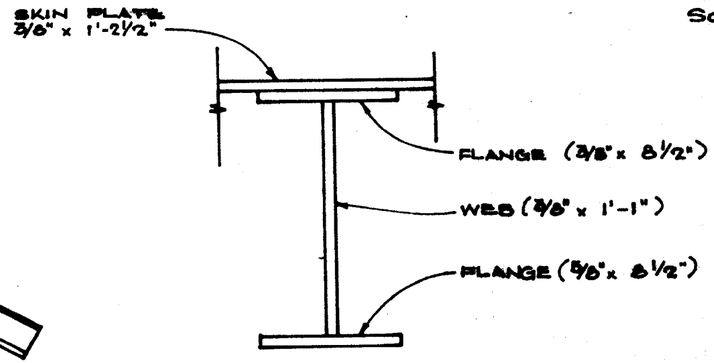
8 REQ'D. $\frac{(82.2)(12)}{16}$ = 54.8" < 55.3 O.K.

CHECK +M:

+M = 40.2 I-K

MA = $\frac{(16)(80.24)}{12}$ = 124.80 I-K

40.2 I-K < 124.80 I-K O.K.



DESIGN SECTION

SCALE : 1 1/2" = 1'-0"

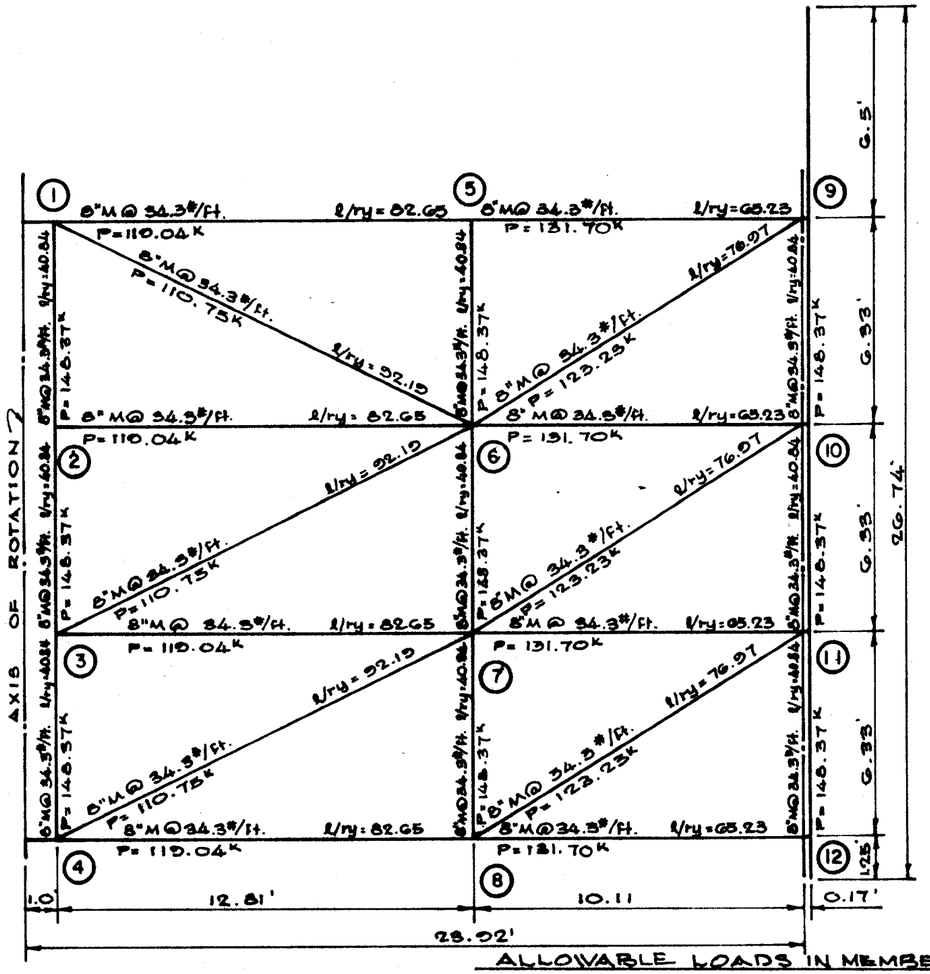
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-11

NOTE : FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-12A

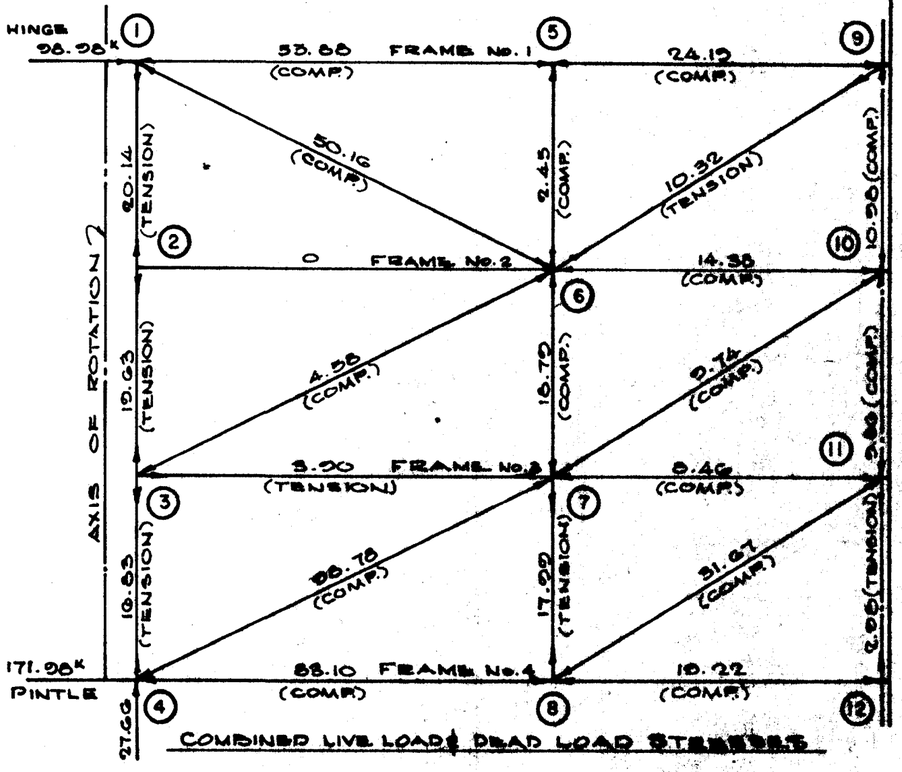


ALLOWABLE LOADS IN MEMBERS

RECESS SIDE ELEVATION

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

CHAMBER SIDE OPP. HAND



COMBINED LIVE LOAD & DEAD LOAD STRESSES

RECESS SIDE ELEVATION

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

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. M-2-28370

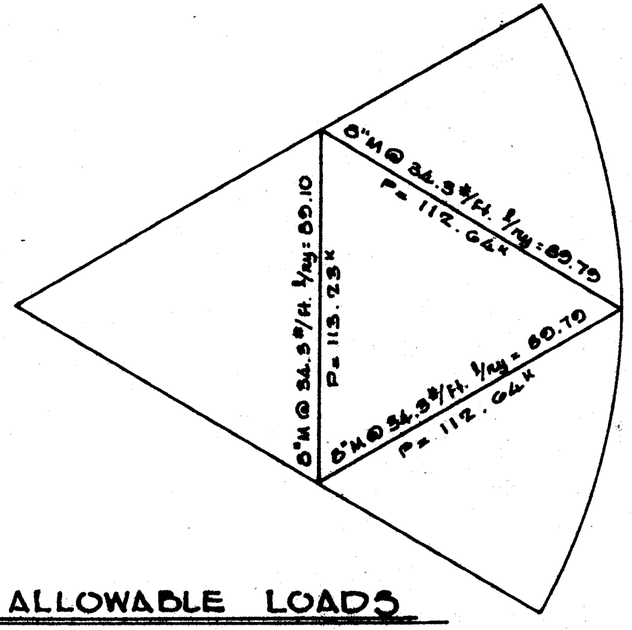
PLATE IV-12

MEMBER	DEAD LOAD	WATER LOAD	COMBINED LOAD	ALLOWABLE LOAD	MOMENT AT PINTLE	CONDITION
VERTICAL TRUSSES AND HORIZONTAL FRAMES						
1-2	-10.05 K	+30.18 K	+20.13 K	148.37 K		
1-5	+ 8.36 K	-62.26 K	-53.90 K	119.04 K		
1-6	+18.28 K	-68.41 K	-50.13 K	110.75 K		
5-6	- 2.45 K	0	- 2.45 K	148.37 K		
5-9	+ 8.36 K	-32.57 K	-24.21 K	131.70 K		
9-6	- 9.83 K	+20.18 K	+10.35 K	123.23 K		
9-10	- 0.30 K	-10.70 K	-11.00 K	148.37 K		
2-3	-10.56 K	+30.18 K	+19.62 K	148.37 K		
2-6	0	0	0	119.04 K		
6-3	-13.71 K	+ 9.16 K	- 4.55 K	110.75 K		
6-7	+ 4.69 K	-23.53 K	-18.84 K	148.37 K		
6-10	+12.49 K	-26.82 K	-14.33 K	131.70 K		
10-7	-14.69 K	+ 4.89 K	- 9.80 K	123.23 K		
10-11	+ 3.44 K	-13.29 K	- 9.85 K	148.37 K		
3-4	-17.37 K	+34.21 K	+16.84 K	148.37 K	15.35 I-K	OVERSTRESSED
7-4	-21.25 K	-77.55 K	-98.80 K	110.75 K	5.60 I-K	OVERSTRESSED
7-8	+ 4.69 K	+13.29 K	+17.98 K	148.37 K		
7-11	+ 5.56 K	-14.04 K	- 8.48 K	131.70 K		
11-8	- 9.57 K	-25.07 K	-31.64 K	123.23 K		
11-12	+ 2.98 K	0	+ 2.98 K	148.37 K		
4-8	- 5.56 K	-77.51 K	-83.07 K	119.04 K	6.50 I-K	OVERSTRESSED
8-12	0	-19.22 K	-19.22 K	131.70 K		
5-5	0	+31.37 K	+31.37 K	113.23 K		
5-13	0	-31.37 K	-31.37 K	112.64 K		
9-6	0	+43.39 K	+43.39 K	113.23 K		
6-14	0	-43.39 K	-43.39 K	112.64 K		
7-7	0	+63.36 K	+63.36 K	113.23 K		
7-15	0	-63.36 K	-63.36 K	112.64 K		
8-8	0	+40.17 K	+40.17 K	113.23 K		
8-16	0	-40.17 K	-40.17 K	112.64 K		
3-7	+12.28 K	- 8.22 K	+ 4.06 K	119.04 K		

(+) TENSION

(-) COMPRESSION

TABULATION OF MEMBER STRESSES



ALLOWABLE LOADS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVER SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVER SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-12A

MEMBER 4-7 (RIVER SIDE GATE)

TRY 5/8" THICK COVER PLATES:

$P = 98.78^{K}$ (COMP.)

$M_y = 5.80'\text{-}K$

$M_x = 0$

$L = 11.45'$

$A = 10.1^{\square''} + 8.44^{\square''} = 18.54^{\square''}$

$I_y = 34.9\ IN.^4 + \left[\frac{(5/8)(6.75)^3}{12}\right][2] = 66.94\ IN.^4$

$S_y = \frac{I_y}{c} = \frac{66.94}{4} = 16.74\ IN.^3$; $r_y = \sqrt{I/A} = 1.90$

$f_a = P/A = \frac{98.78^{K}}{18.54^{\square''}} = 5.33\ KSI$

$F_b = \frac{12M}{S_y} = \frac{(12)(5.80)}{16.74} = 4.16\ KSI$

$\frac{Kl}{r_y} = \frac{(.8)(12)(11.45)}{1.90} = 57.85$

$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 131.71$

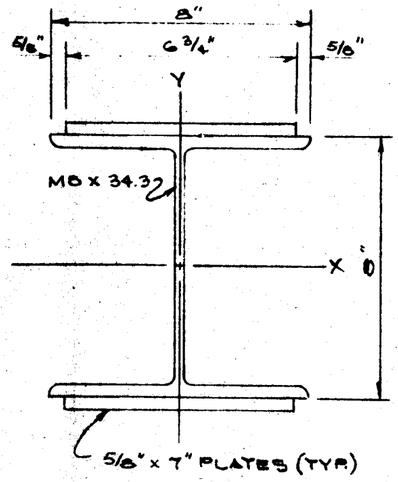
$F_a = \frac{\left[1 - \frac{(Kl/r)^2}{2C_c^2}\right][27.0]}{5/3 + (3/8)\left(\frac{Kl/r}{C_c}\right) - \frac{(Kl/r)^3}{8C_c^3}} = \frac{\left[1 - \frac{(57.85)^2}{2(131.71)^2}\right][27.0]}{5/3 + (3/8)\left(\frac{57.85}{131.71}\right) - \frac{(57.85)^3}{8(131.71)^3}}$

$F_a = 13.4$

$F_e' = \frac{12\pi^2 E}{23(Kl/r)^2} = 44.62$

$\frac{f_a}{F_a} + \frac{C_{m_x} f_{b_x}}{\left(1 - \frac{f_a}{F'_{e_x}}\right)} \leq 1.0$

$\frac{5.33}{13.4} + \frac{(.8)(4.16)}{\left(1 - \frac{5.33}{44.62}\right)(16.5)} = 0.64 < 1.0 \Rightarrow$ O.K.



TRY 1/4" PLATE:

$A = 13.48^{\square''}$

$I_y = 47.71\ IN.^4$

$S_y = 11.93\ IN.^3$

$r_y = 1.88$

$C_c = 131.71$

$F_a = 7.33\ KSI$

$f_b = 5.83\ KSI$

$Kl/r = 58.47$

$F_a = 13.6\ KSI$

$F'_e = 43.68$

$\frac{f_a}{F_a} + \frac{C_m f_b}{\left(1 - \frac{f_a}{F'_e}\right)(F_b)} \leq 1.0$

$0.9 \leq 1.0 \Rightarrow$ COULD USE A 1/4" PLATE

∴ USE A 3/8" PLATE TO ALLOW FOR CORROSION

NOTE:

MEMBER 4-7 ON THE RIVER GATE WAS THE MOST OVERSTRESSED MEMBER. ALL OTHER MEMBERS THAT WERE OVERSTRESSED (SEE TABLE, PLATE NO.) WILL HAVE A 3/8" COVER PLATE.

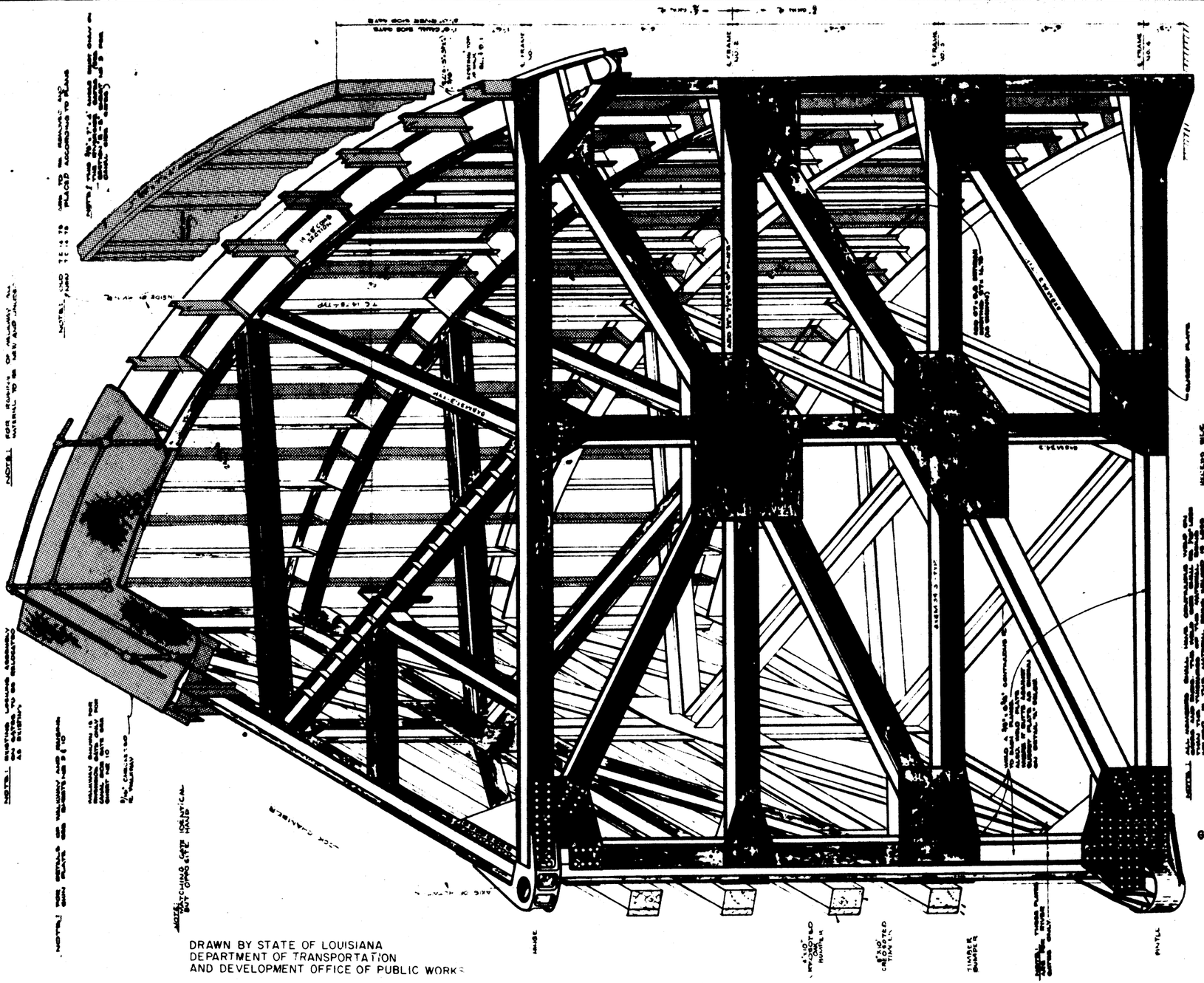
TYPICAL COVER PLATE DESIGN

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

TYPICAL COVER PLATE DESIGN

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
TYPICAL COVER PLATE DESIGN
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-12B



PICTORIAL VIEW - LOCK GATE STRUCTURE

NOT TO SCALE

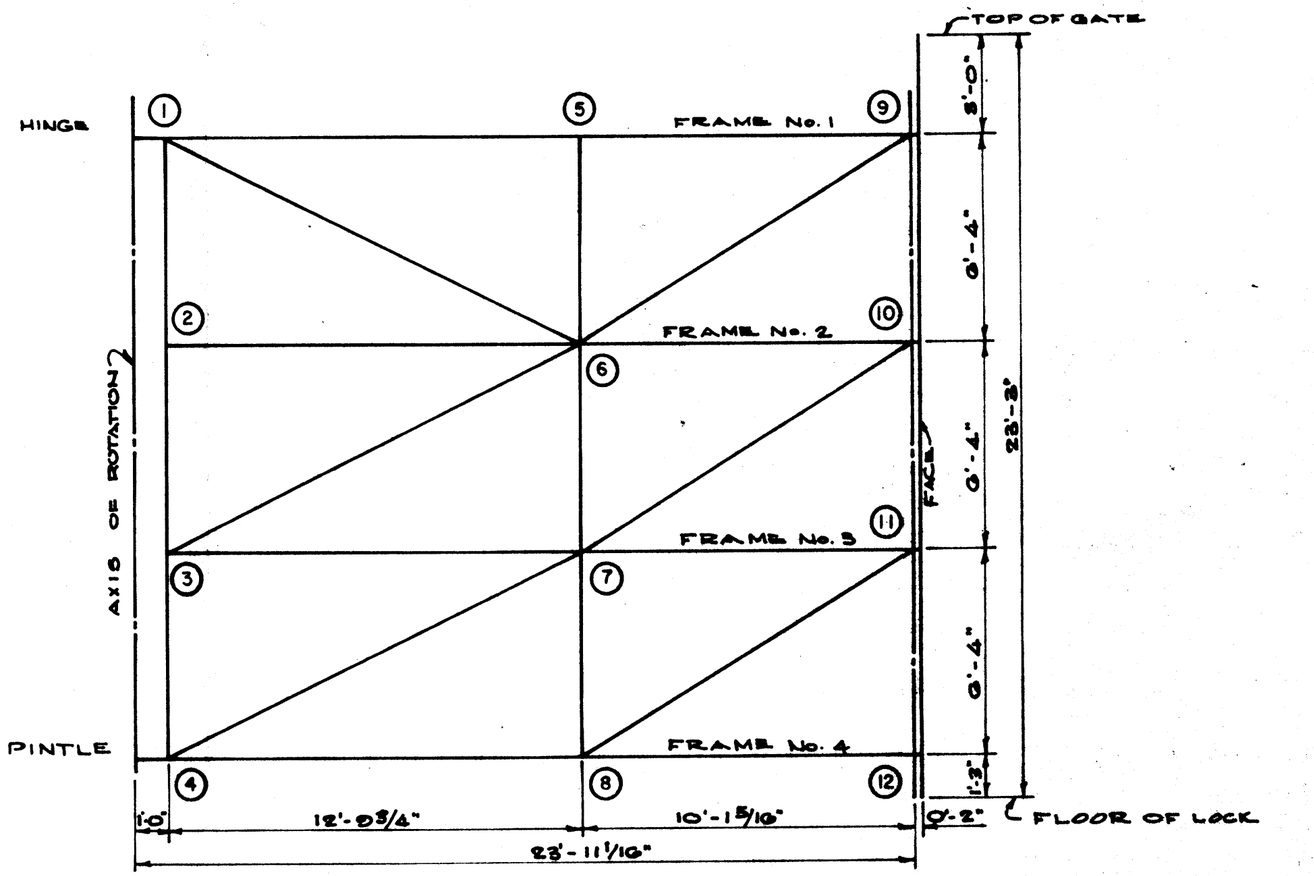
DETAIL "A"

GATE DETAILS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCK GATE STRUCTURE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-12 C



VERTICAL TRUSS

RECESS SIDE ELEVATION

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

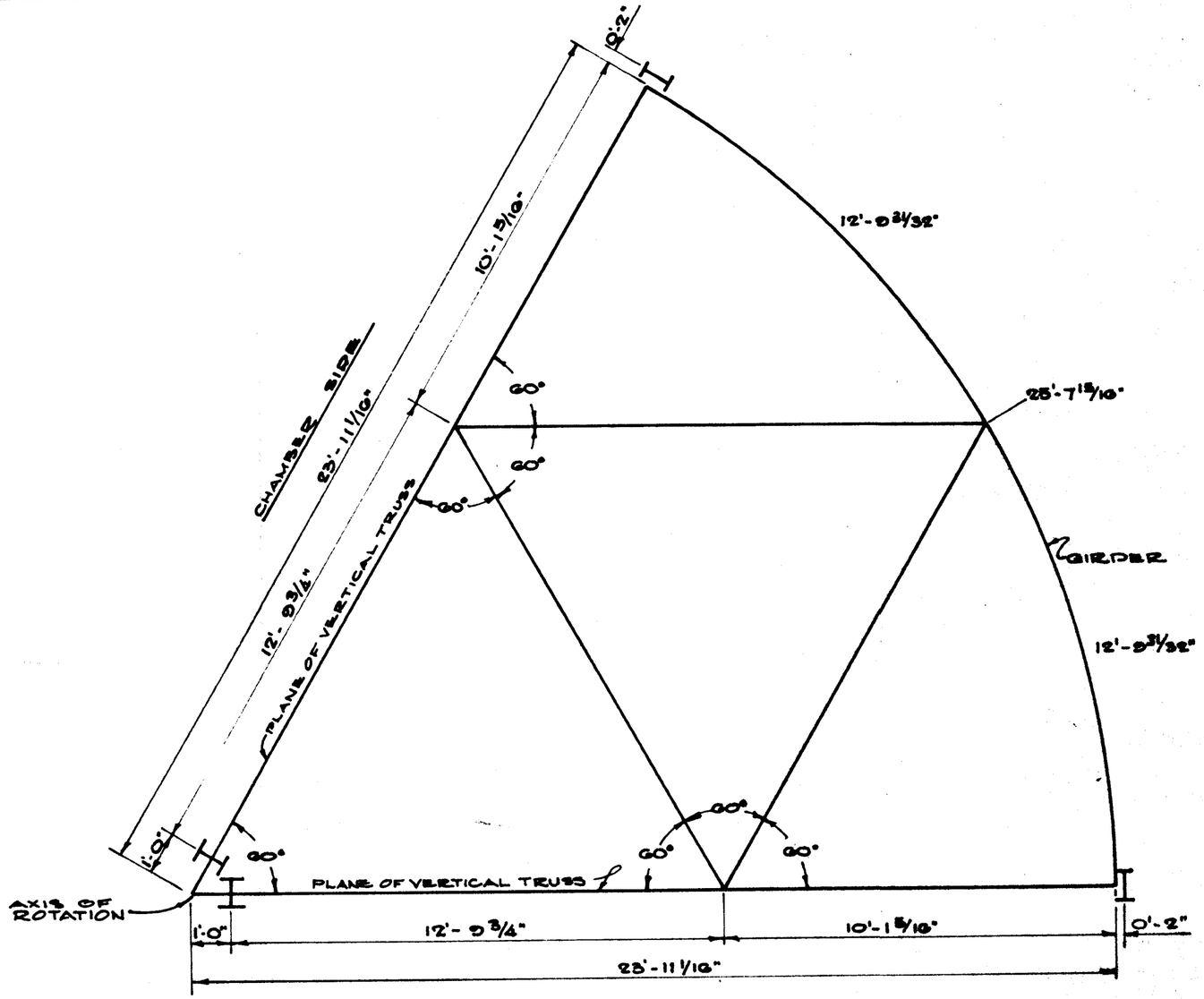
CHAMBER SIDE OPP. HAND

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1976 FILE NO. H-2-28370

PLATE IX-13



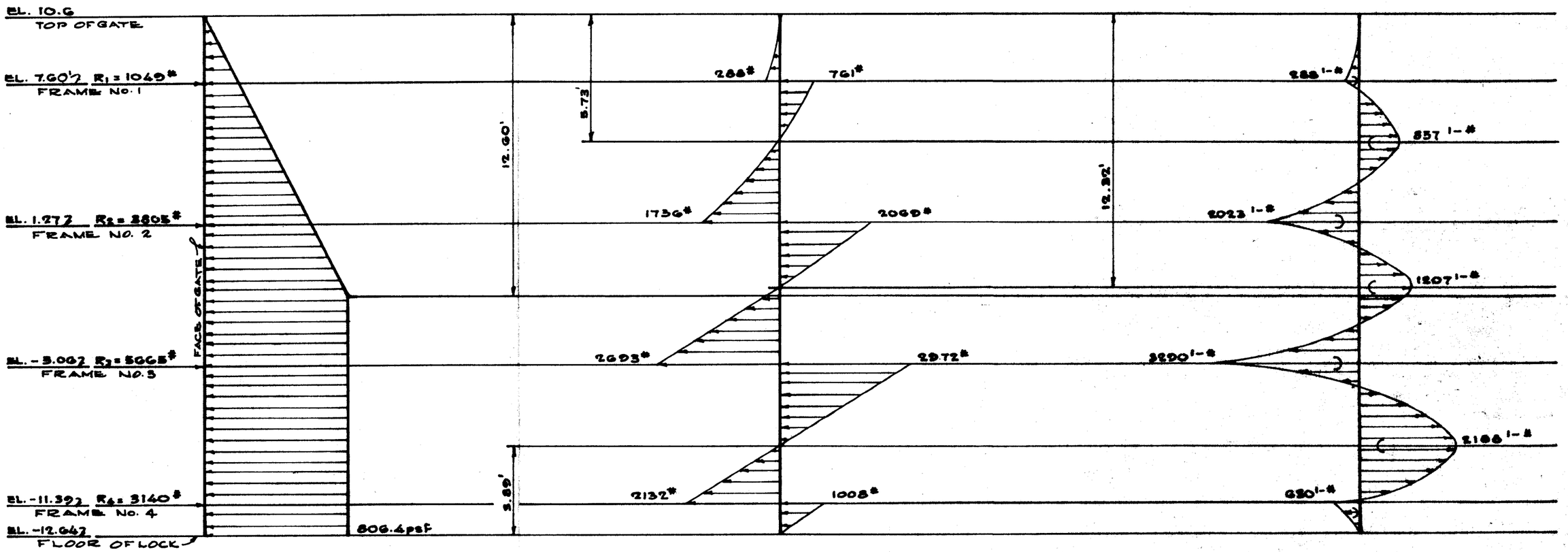
TYPICAL HORIZONTAL FRAME DIMENSIONS

SCALE: 1" = 5'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-28.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28570



LOAD

(WATER LOAD ONLY)

VERTICAL SCALE: 1" = 40'-0"

HORIZONTAL SCALE: 1" = 800 psf

SHEAR

VERTICAL SCALE: 1" = 40'-0"

HORIZONTAL SCALE: 1" = 2000 lbs.

MOMENT

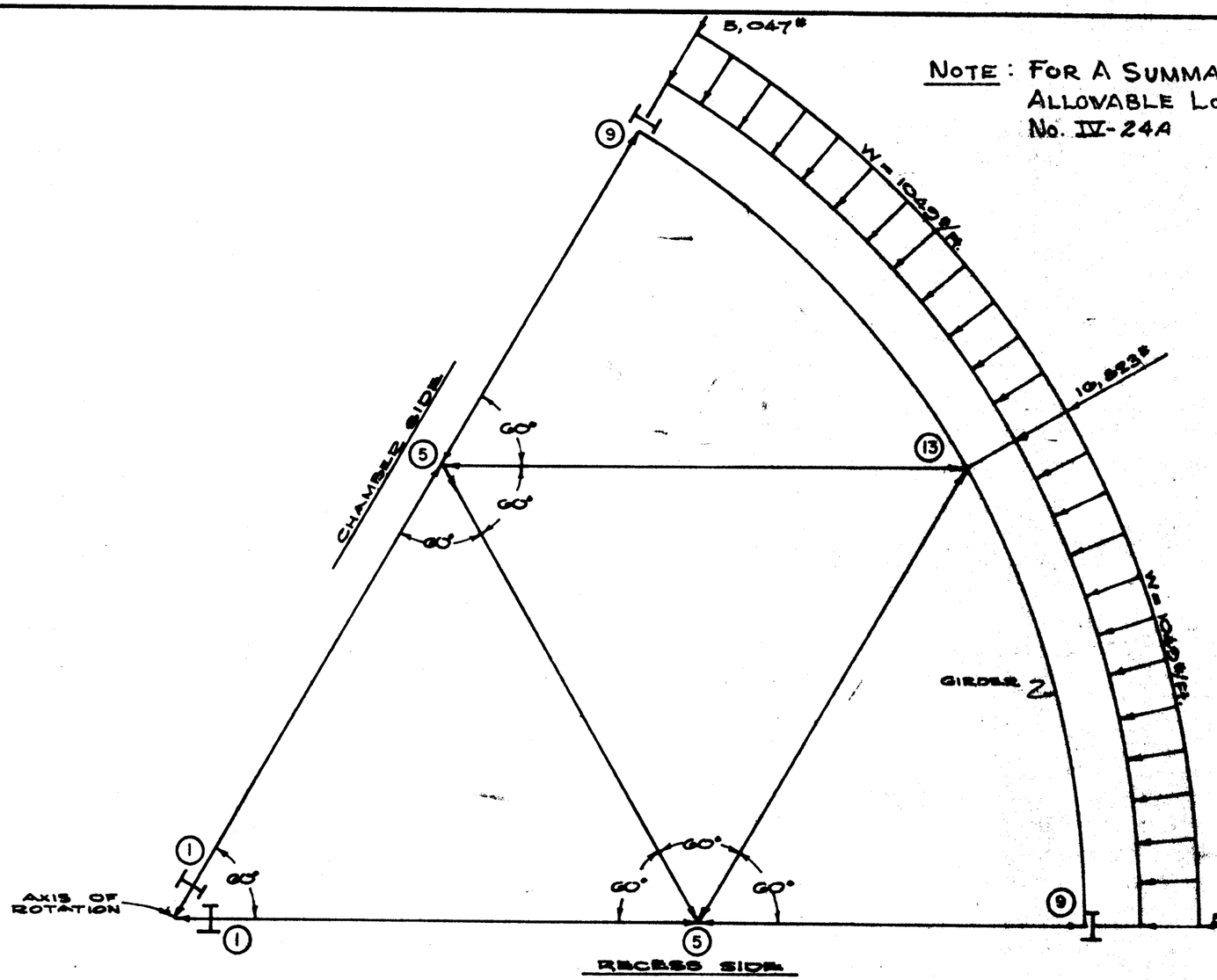
SCALE FOR MOMENT SAME AS FOR SHEAR

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-89370

PLATE IV-15



NOTE: FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-24A

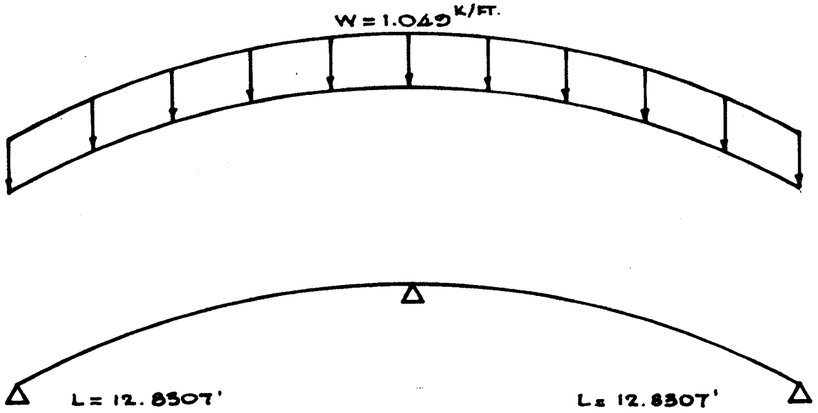
WATER LOAD DISTRIBUTIONS
(FRAME No 1)

SCALE: 1" = 8'-0"

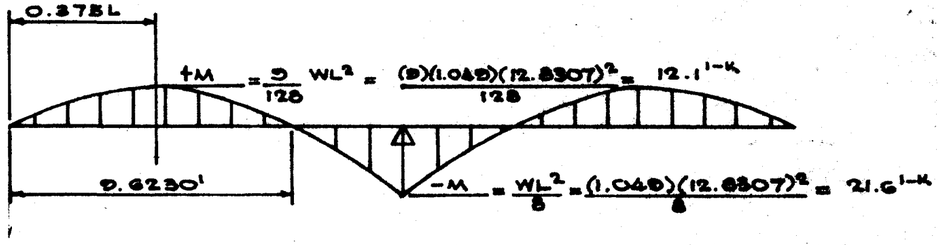
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1976
FILE NO. H-2-28370

PLATE IV-16



LOADING
(LIVE LOAD)
SCALE: 1/4" = 1'-0"



MOMENT DIAGRAM
SCALE: N.T.S. (HORIZ.)
1" = 40 I-K (VERT.)

CHECK + M :

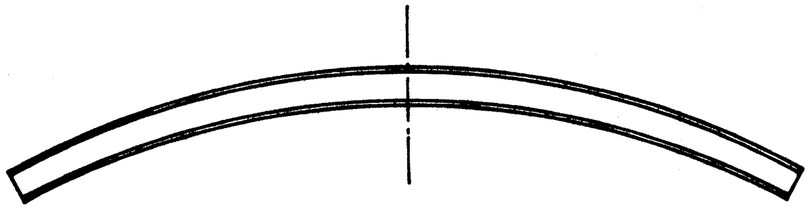
+M = 12.1 I-K

$M_A = \frac{(18)(81.29)}{12} = 121.94$

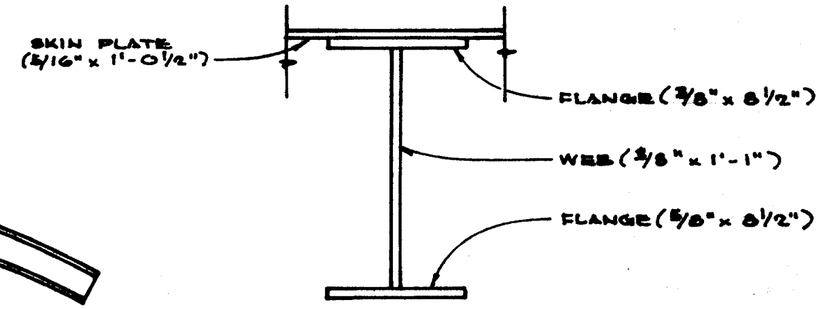
12.1 I-K < 121.94 I-K O.K.

CHECK − M :

REQ'D. $= \frac{(121.6)(12)}{18} = 14.4 < 81.29$ O.K.



FRAME No. 1 GIRDER
SCALE: 1/4" = 1'-0"



DESIGN SECTION
SCALE: 1 1/2" = 1'-0"

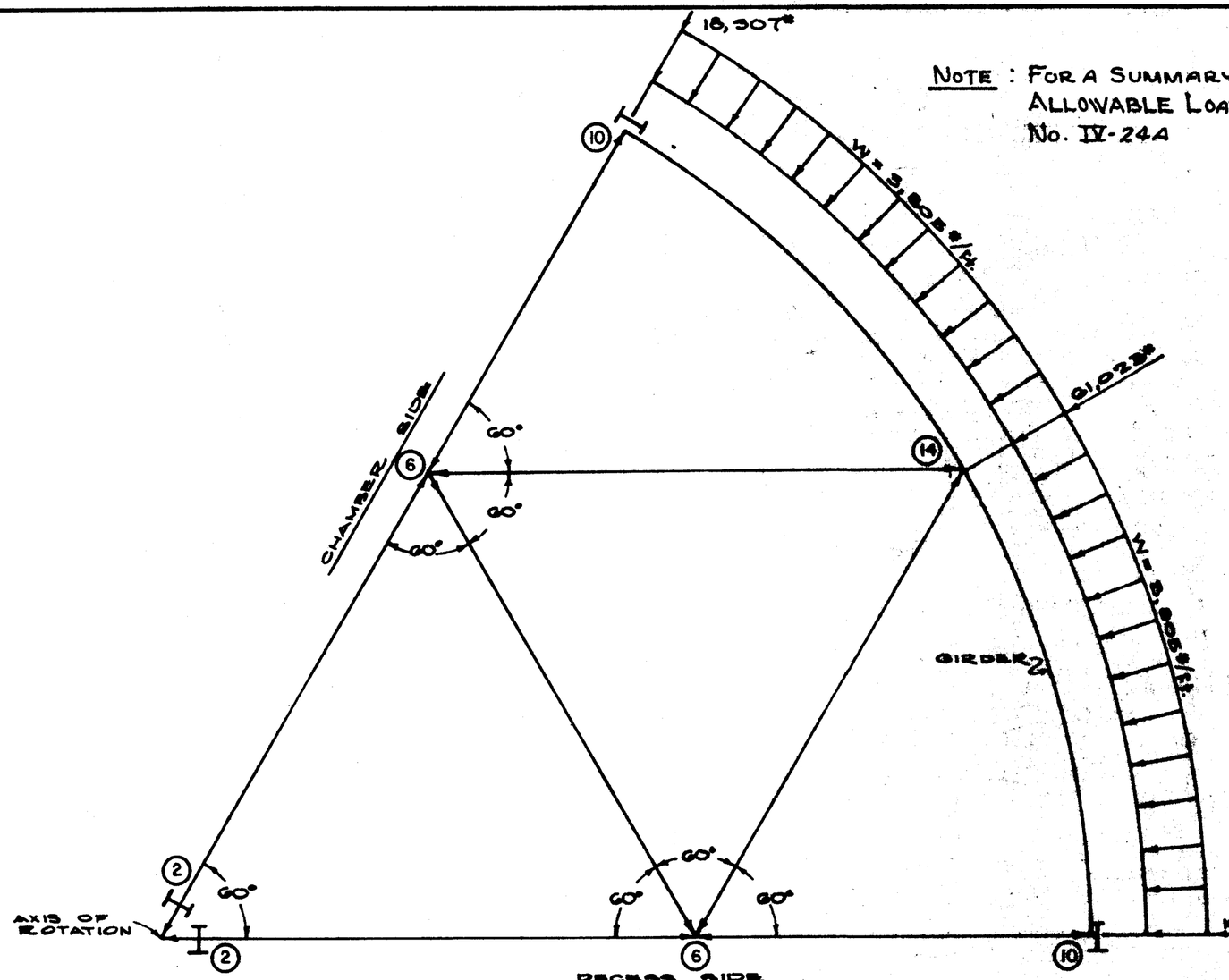
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

CANAL SIDE GATE

MISSOURI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-17

NOTE : FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-24A



WATER LOAD DISTRIBUTIONS
(FRAME NO 2)

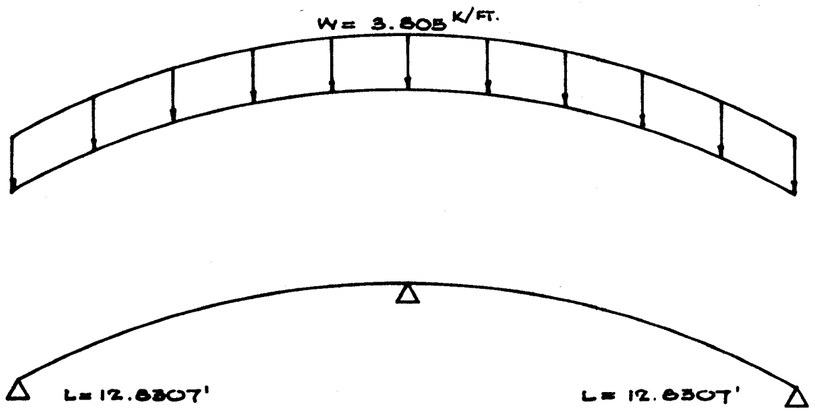
SCALE: 1" = 8'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

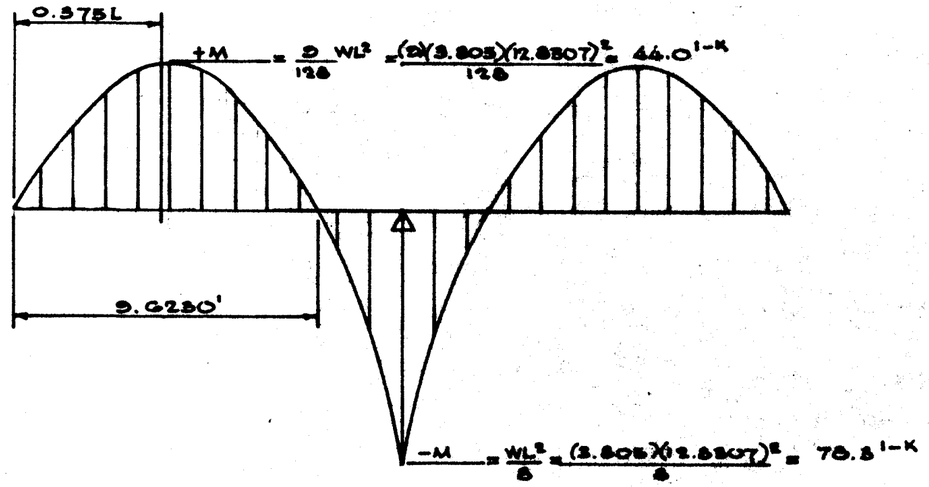
CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY, ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1979
FILE NO. H-2-29370

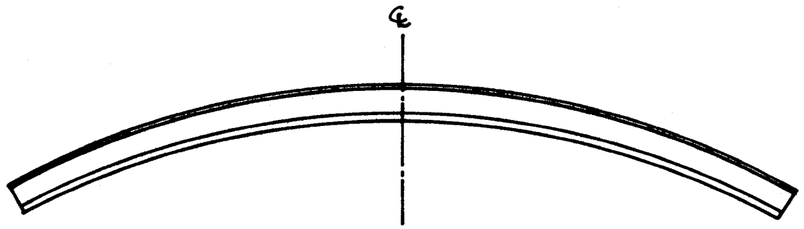
PLATE IV-18



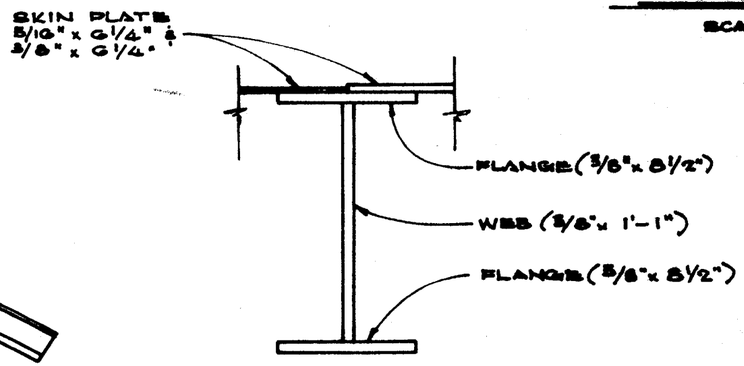
LOADING
(LIVE LOAD)
SCALE: 1/4"= 1'-0"



MOMENT DIAGRAM
SCALE: N.T.S. (HORIZ.)
1" = 40'-K (VERT.)



FRAME Nº 2 GIRDER
SCALE: 1/4"=1'-0"



DESIGN SECTION
SCALE: 1 1/2"= 1'-0"

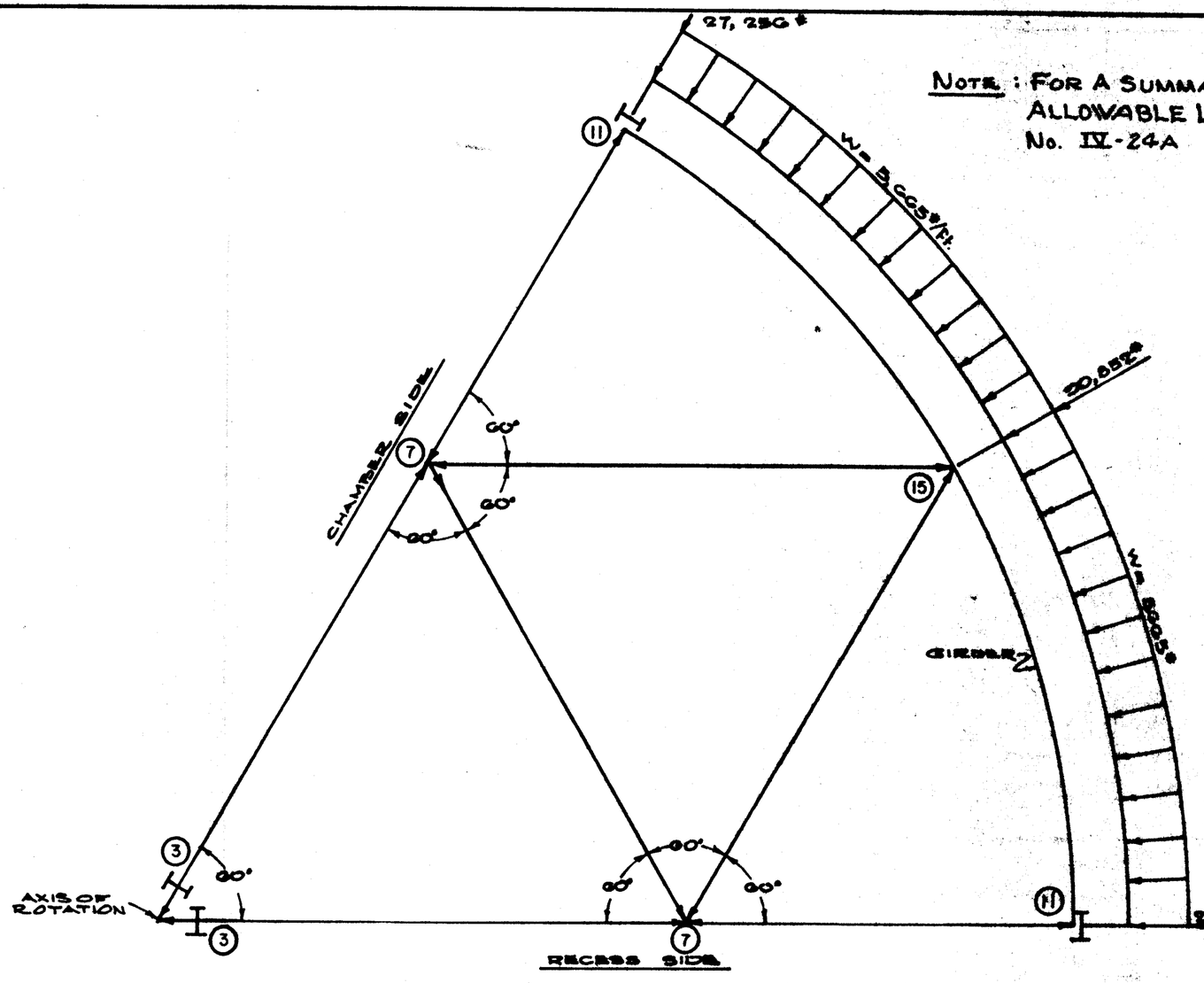
CHECK +M:
+M = 44.0 I-K
$M_A = \frac{(16)(81.29)}{16}$ = 122.84 I-K
44.0 I-K < 122.84 I-K O.K.

CHECK -M:
$\frac{9}{8}$ ESQ'D. = $\frac{78.8\,(16)}{16}$ = 82.20 < 81.29
O.K.

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1976 FILE NO. H-2-28370



NOTE: FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-24A

WATER LOAD DISTRIBUTIONS

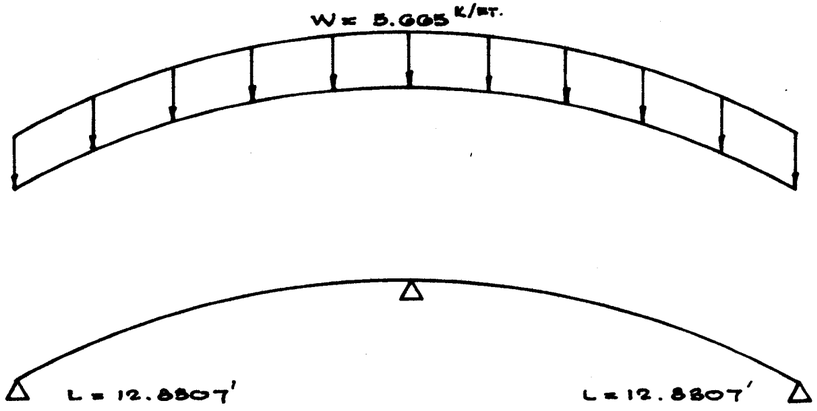
(FRAME NO 5)

SCALE: 1" = 5'-0"

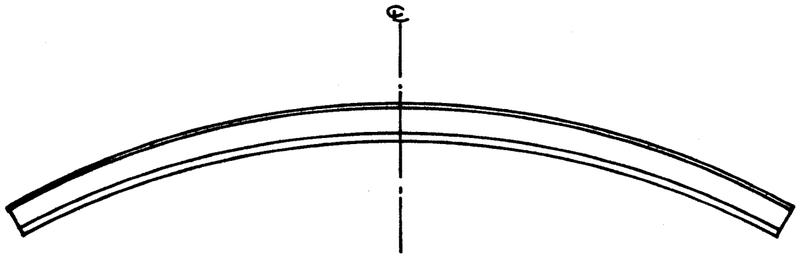
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

27,250# CANAL SIDE GATE

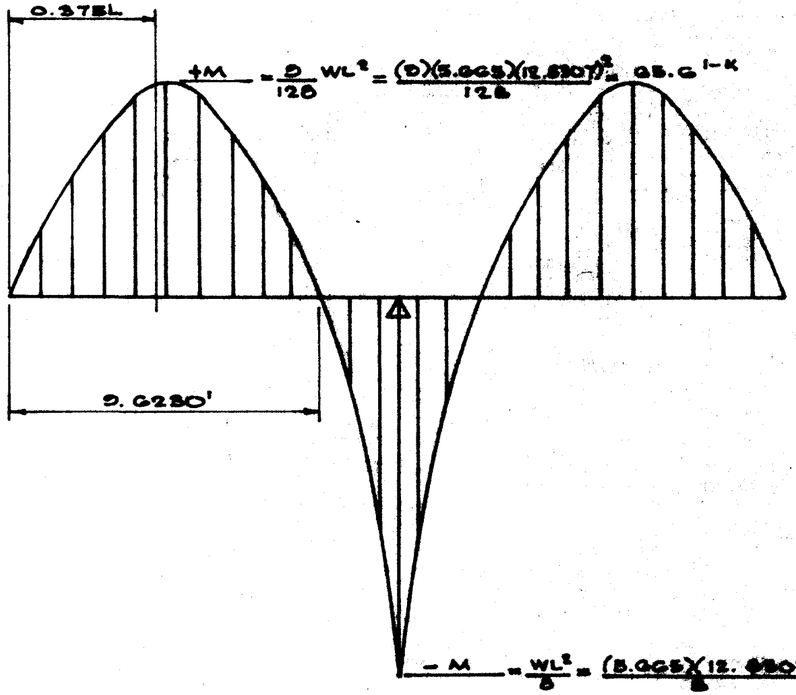
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



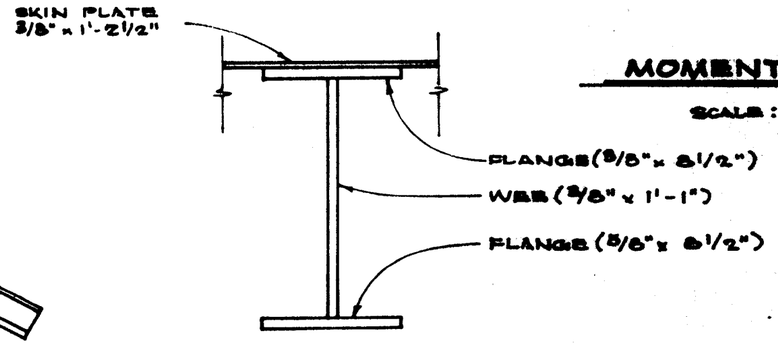
LOADING
(LIVE LOAD)
SCALE: 1/4" = 1'-0"



FRAME No 3 GIRDER
SCALE: 1/4" = 1'-0"



MOMENT DIAGRAM
SCALE: N.T.S. (HORIZ.)
1" = 40'-0" (VERT.)



DESIGN SECTION
SCALE: 1 1/2" = 1'-0"

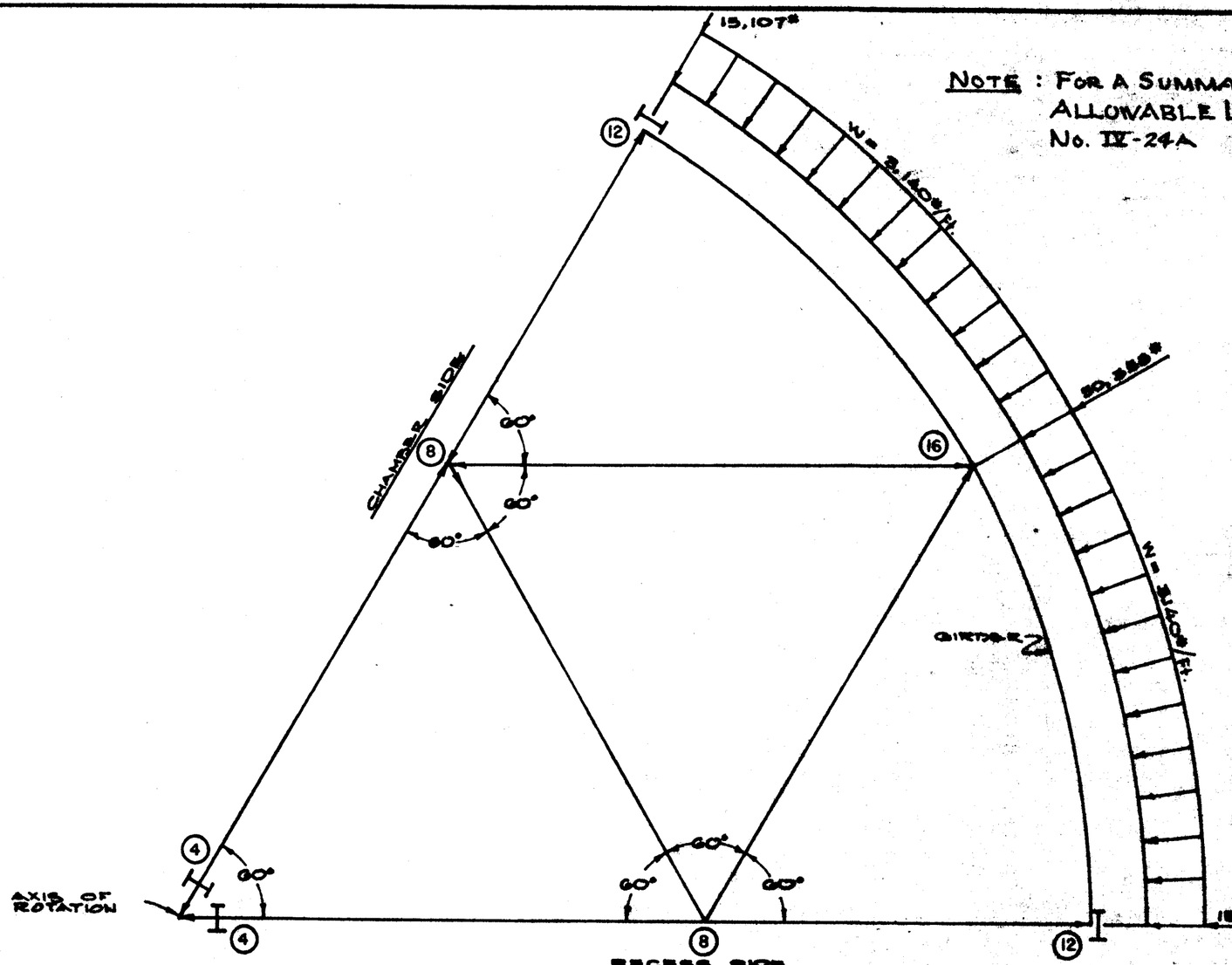
CHECK + M:
+M = 85.0 I-K
$M_A = \frac{(18)(69.39)}{18} = 124.89$ I-K
85.0 I-K < 124.89 I-K O.K.

CHECK - M:
$S_{REQ'D.} = \frac{(119.0)(12)}{18} = 77.7 < 88.26$ O.K.

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-20370

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.



NOTE : FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-24A

WATER LOAD DISTRIBUTIONS
(FRAME N2 4)

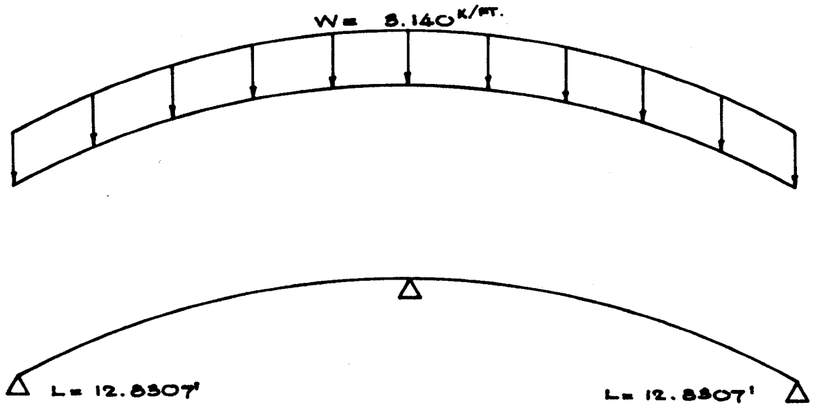
SCALE: 1"= 5'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

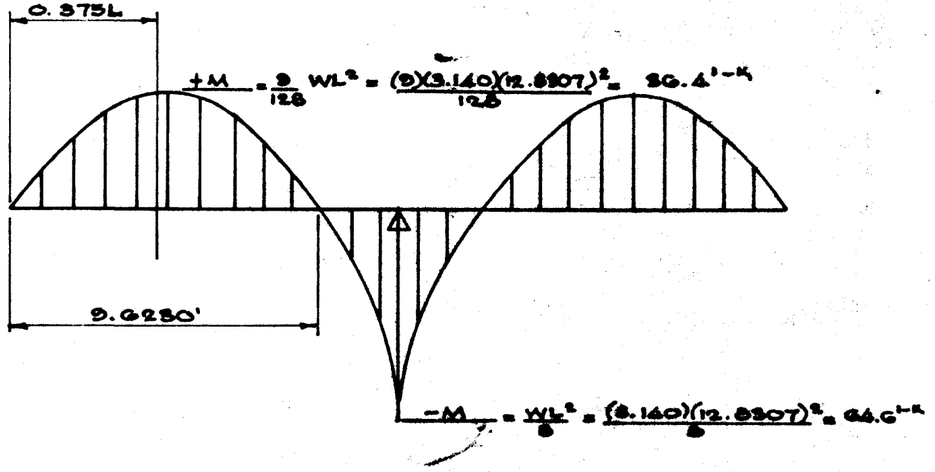
CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

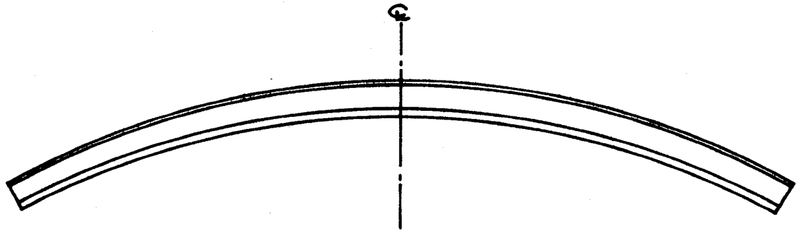
PLATE IV-22



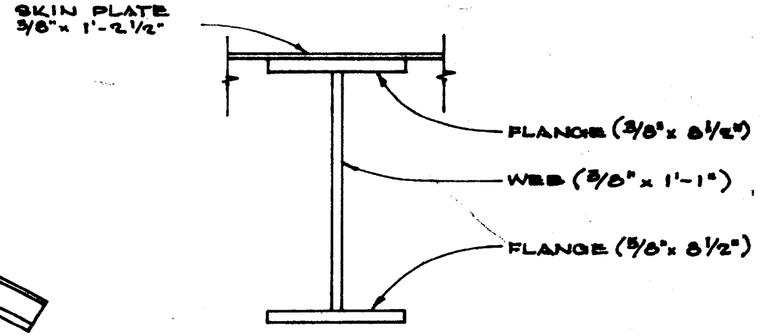
LOADING
(LIVE LOAD)
SCALE: 1/4" = 1'-0"



MOMENT DIAGRAM
SCALE: N.T.S. (HORIZ.)
1" = 40 ¹-ᴷ (VERT.)



FRAME Nº 4 GIRDER
SCALE: 1/4" = 1'-0"



DESIGN SECTION
SCALE: 1 1/2" = 1'-0"

CHECK +M:
+M = 30.4 ¹-ᴷ
$M_A = \frac{(18)(89.96)}{18} = 124.89$ ¹-ᴷ
30.4 ¹-ᴷ < 124.89 ¹-ᴷ O.K.

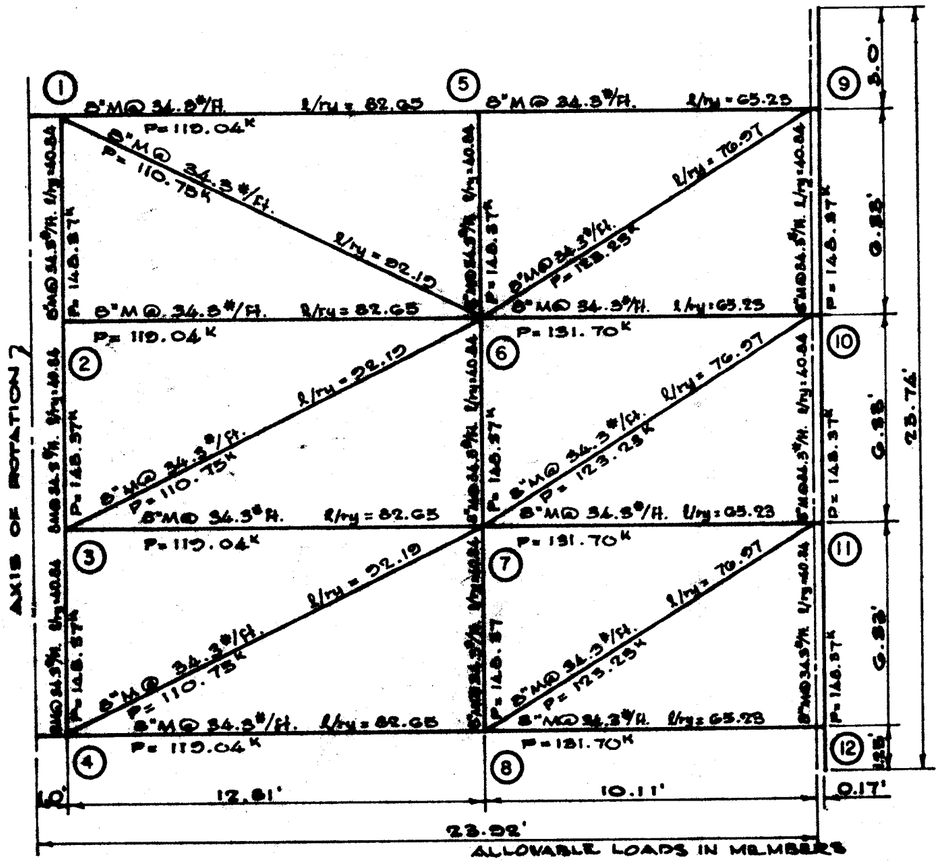
CHECK −M:
REQ'D. = $\frac{(64.6)(12)}{18}$ = 43.1 < 88.26 O.K.

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CANAL SIDE GATE

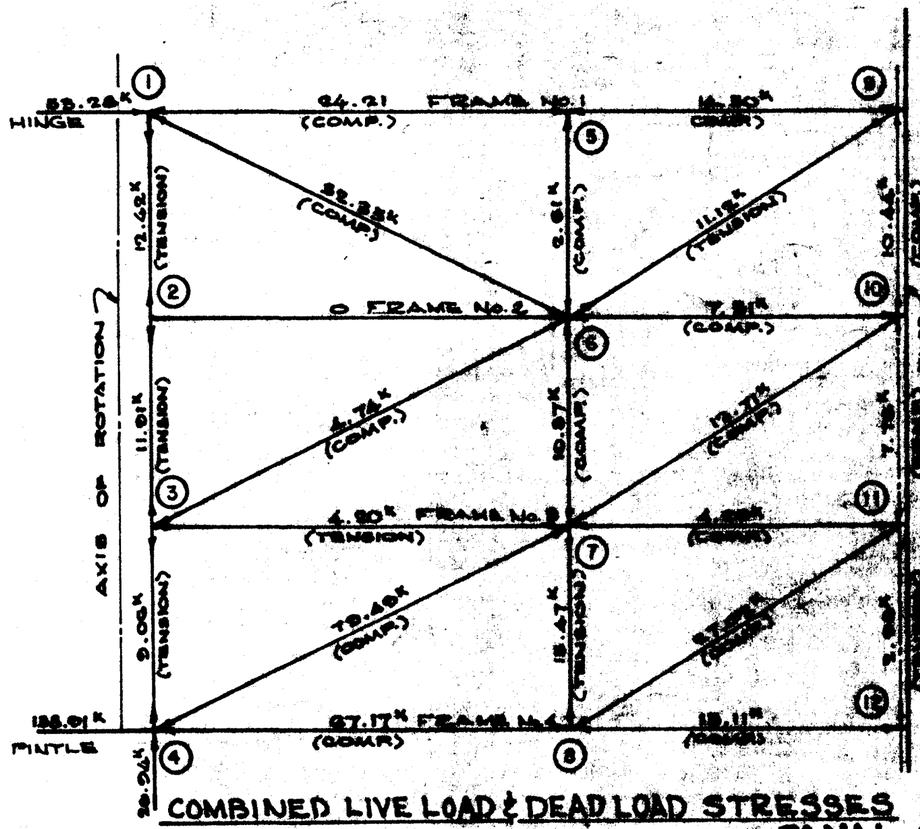
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M 29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

NOTE: FOR A SUMMARY OF MEMBER LOADS AND ALLOWABLE LOADS SEE TABLE ON PLATE No. IV-24A



RECESS SIDE ELEVATION

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



COMBINED LIVE LOAD & DEAD LOAD STRESSES

CANAL SIDE GATE

RECESS SIDE ELEVATION

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

CHAMBER SIDE OPPOSITE HAND

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1970 FILE NO. H-2-28370

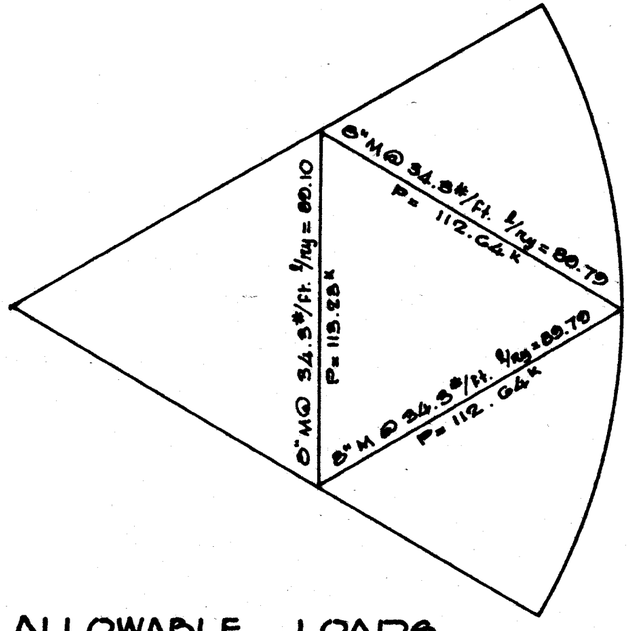
PLATE IV-24

MEMBER	DEAD LOAD	WATER LOAD	COMBINED LOAD	ALLOWABLE LOAD	MOMENT AT PINTLE	CONDITION
VERTICAL TRUSSES AND HORIZONTAL FRAMES						
1-2	- 9.75K	+22.17K	+12.42K	148.37K		
1-5	+ 7.69K	-31.90K	-24.21K	119.04K		
1-6	+17.87K	-50.22K	-32.35K	110.75K		
5-6	- 2.61K	0	- 2.61K	148.37K		
5-9	+ 7.69K	-22.19K	-14.50K	131.70K		
9-6	- 9.05K	+20.17K	+11.12K	123.23K		
9-10	+ 0.25K	-10.69K	-10.44K	148.37K		
2-3	-10.26K	+22.17K	+11.91K	148.37K		
2-6	0	0	0	119.04K		
6-3	-13.48K	+ 8.74K	- 4.74K	110.75K		
6-7	+ 4.46K	-15.33K	-10.87K	148.37K		
6-10	+11.66K	-19.17K	- 7.51K	131.70K		
10-7	-15.72K	+ 1.01K	-12.71K	123.23K		
10-11	+ 3.47K	-11.23K	- 7.76K	148.37K		
3-4	-16.96K	+26.02K	+ 9.06	148.37K	14.96 I-K	
3-7	+12.08K	- 7.88K	+ 4.20K	119.04K		
7-4	-20.54K	-58.95K	-79.49K	110.75K	5.66 I-K	OVERSTRESSED
7-8	+ 4.24K	+11.23K	+15.47K	148.37K		
7-11	+ 4.97K	- 9.26K	- 4.29K	131.70K		
11-8	- 5.84K	-21.18K	-27.02K	125.23K		
11-12	+ 2.98K	0	+ 2.98K	148.37K		
4-8	- 4.97K	-62.20K	-67.17K	119.04K	6.33 I-K	OVERSTRESSED
8-12	0	-15.11K	-15.11K	131.70K		
5-5	0	+ 9.71K	+ 9.71K	113.23K		
5-13	0	- 9.71K	- 9.71K	112.64K		
6-6	0	+35.23K	+35.23K	113.23K		
6-14	0	-35.23K	-35.23K	112.64K		
7-7	0	+52.45K	+52.45K	113.23K		
7-15	0	-52.45K	-52.45K	112.64K		
8-8	0	+29.07K	+29.07K	113.23K		
8-16	0	-29.07K	-29.07K	112.64K		

(+) TENSION

(-) COMPRESSION

TABULATION OF MEMBER STRESSES



ALLOWABLE LOADS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-24A

3/8" SKIN PLATE

EFFECTIVE THICKNESS = 5/16" (1/16" ALLOWED FOR CORROSION)

$M_{MAX} = 1/12\ wl^2$

$M = F_b(S)$

$F_b = 18{,}000$ psi

$S = 1/6\ bh^2$

CHECK SKIN PLATE BETWEEN FRAMES 2-3 & 3-4

C7 x 9.8 RIB @ 2.57' O.C.

$P_{MAX} = 1030.4$ #/Ft.

$S = 1/6(12)(5/16)^2 = 0.195\ in.^3$

$1/12\ (1030.4)(\ell^2)(12) = 18{,}000\ (0.195)$

$\ell_{All} = 1.85' < 2.57'$

∴ USE C7 x 9.8 @ 1.28' O.C.

5/16" SKIN PLATE

EFFECTIVE THICKNESS = 1/4" (1/16" ALLOWED FOR CORROSION)

$M_{MAX} = 1/12\ wl^2$

$M = F_b(S)$

$F_b = 18{,}000$ psi

$S = 1/6\ bh^2$

CHECK SKIN PLATE BETWEEN FRAME 1-2

$P_{MAX} = 821.12$ #/Ft.

$S = 1/6(12)(1/4)^2 = 0.125\ in.^3$

$1/12\ (821.12)(\ell^2)(12) = 18{,}000(0.125)$

$\ell_{All} = 1.66' < 2.57'$

∴ USE C7 x 9.8 @ 1.28' O.C.

RIVER SIDE

3/8" SKIN PLATE

EFFECTIVE SKIN THICKNESS = 5/16" (1/16" ALLOWED FOR CORROSION)

$M_{MAX} = 1/12\ wl^2$

$M = F_b(S)$

$F_b = 18{,}000$ psi

$S = 1/6\ bh^2$

CHECK SKIN PLATE BETWEEN FRAMES 2-3 & 3-4

C7 x 9.8 RIB @ 2.57 O.C.

$P_{MAX} = 800.40$ #/Ft.

$S = 1/6(12)(5/16)^2 = 0.195\ in.^3$

$1/12\ (800.40)(\ell^2)(12) = 18{,}000\ (.195)$

$\ell_{All} = 2.09' < 2.57$

∴ USE C7 x 9.8 @ 1.28' O.C.

5/16" SKIN PLATE

EFFECTIVE THICKNESS = 1/4" (1/16" ALLOWED FOR CORROSION)

$M_{MAX} = 1/12\ wl^2$

$M = F_b(S)$

$F_b = 18{,}000$ psi

$S = 1/6\ bh^2$

CHECK SKIN PLATE BETWEEN FRAME 1-2

$P_{MAX} = 507.12$ #/Ft.

$S = 1/6(12)(1/4)^2 = 0.125\ in.^3$

$1/12\ (507.12)(\ell^2)(12) = 18{,}000(0.125)$

$\ell_{All} = 1.94' < 2.57'$

∴ USE C7 x 9.8 @ 1.28' O.C.

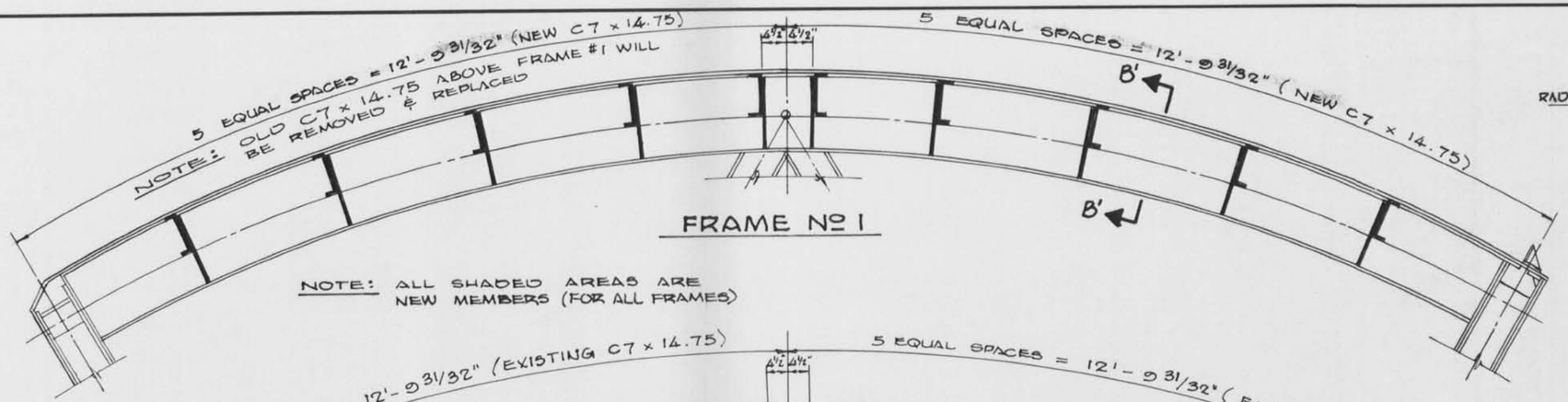
CANAL SIDE

SKIN PLATE DESIGN

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

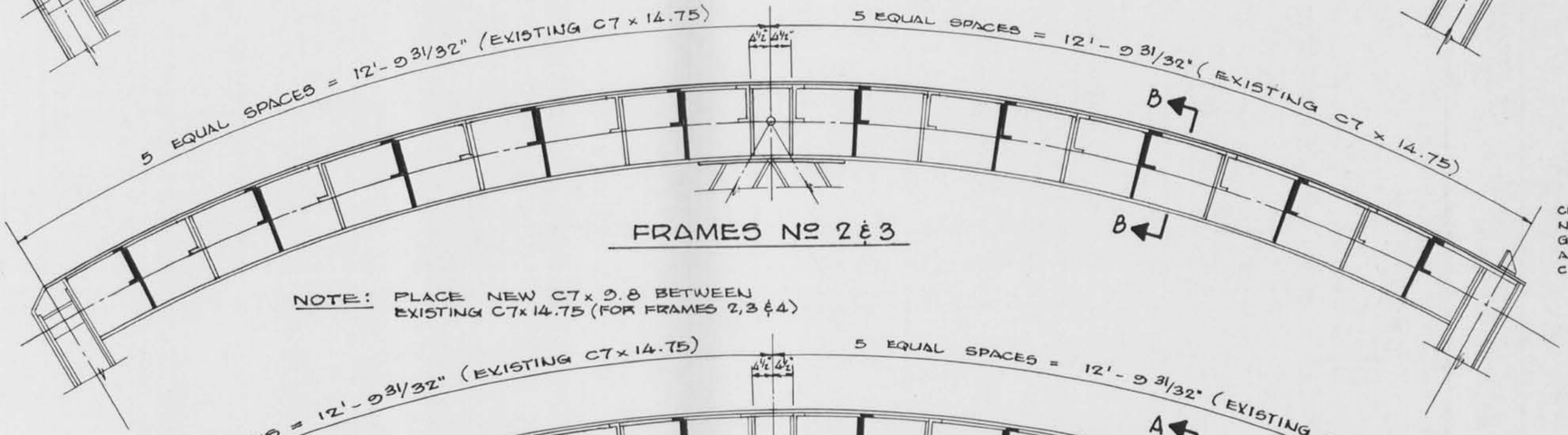
SKIN PLATE DESIGN

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
SKIN PLATE DESIGN
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



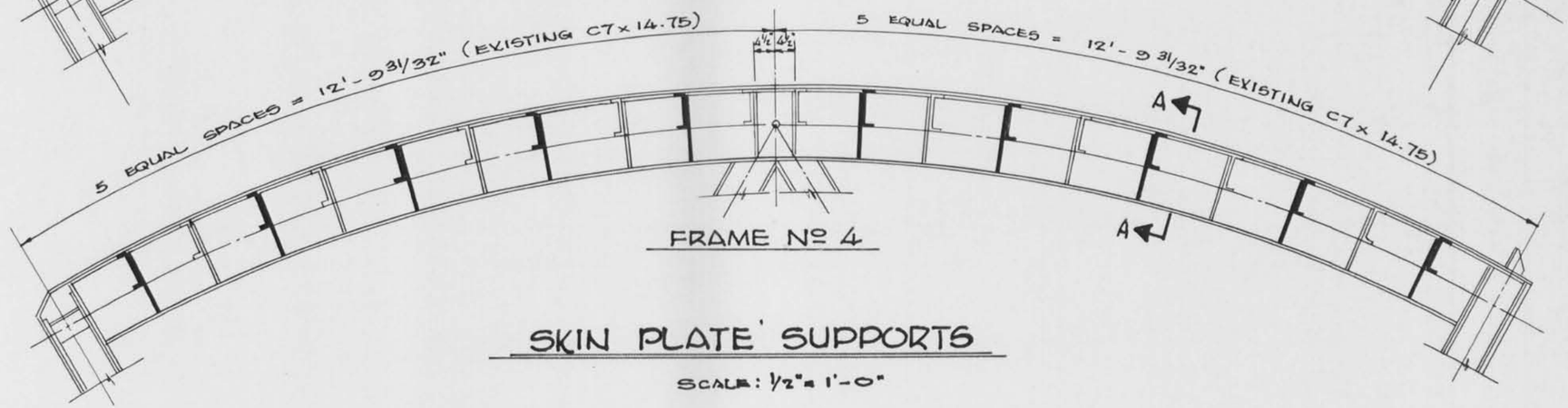
FRAME Nº 1

NOTE: ALL SHADED AREAS ARE NEW MEMBERS (FOR ALL FRAMES)



FRAMES Nº 2 & 3

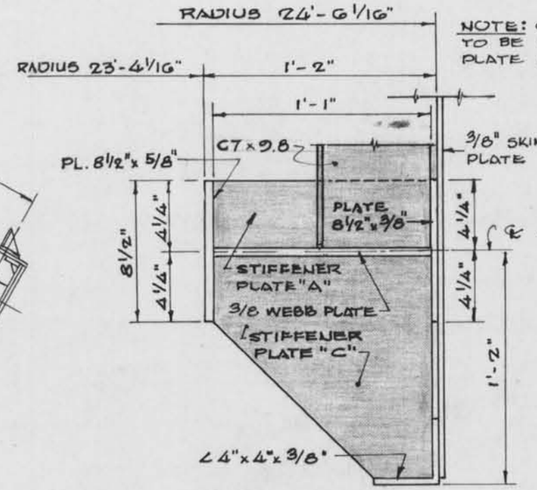
NOTE: PLACE NEW C7 x 9.8 BETWEEN EXISTING C7x 14.75 (FOR FRAMES 2, 3 & 4)



FRAME Nº 4

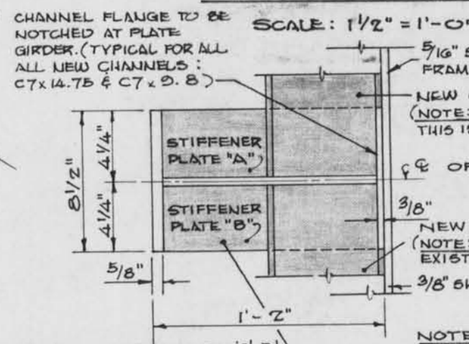
SKIN PLATE SUPPORTS

SCALE: ½" = 1'-0"



NOTE: CHANNEL FLANGE TO BE NOTCHED AT PLATE GIRDER.

SECTION A-A



NOTE: FOR SECTION 'B'-B' THIS IS AN EXISTING PLATE

NOTE: SECTION B'-B' IS SAME AS SECTION B-B EXCEPT WHERE NOTED.

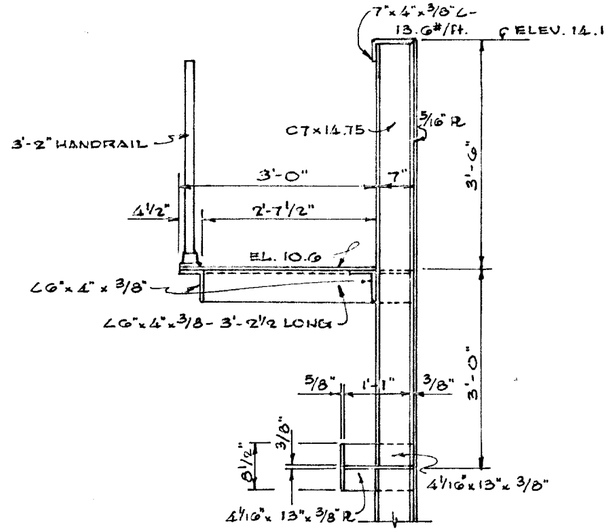
SECTION B-B

SCALE: 1½" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

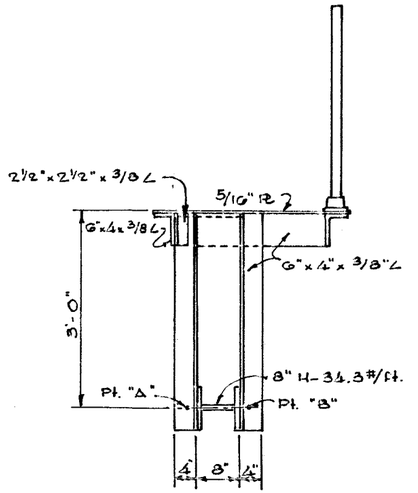
SKIN PLATE SUPPORTS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
SKIN PLATE SUPPORTS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



ALONG CURVED GIRDER

(RIVERGATE ONLY)



ALONG VERTICAL TRUSS

(RIVERGATE ONLY)

PROPOSED WALKWAY

SCALE : 1/2"=1'-0"

WALKWAY ALONG CURVED GIRDER :

LOADING:
DEAD LOAD
LIVE LOAD (100psf ON WALKWAY, WATER LOAD ON SKIN PLATE)

REACTIONS AT SUPPORT

$M_R = 3.00(41.21)+3.00(31.61)+1.79(38.69)+1.31(30.48)+0.13(34.95)-0.30(213.82)+2.17(3474.64)+(771)(1.79)$; $M_R = 9309.79^{1-\#}$

$R_V = 1.34^K$ $\quad R_H = 3.47^K$

C7 x 14.75: $r_y = 0.564$ in. $\quad d = 7$ in. $\quad K = 2.1$

$A = 4.33$ in.^{2} $\quad t_w = 0.419$ in. $\quad \frac{Kl}{r} = 134.04$

$S_x = 7.78$ in.^{3} $\quad l = 3.0'$

$f_a/F_a + f_b/F_b \le 1.0$ $\quad f_a/F_b \le 0.15$; $f_a/F_a = \frac{1.34^K/4.33\,in.^2}{8.32} = 0.04 < 0.15$

$\therefore 0.02 + \frac{(9.31)(12)/7.78}{18} = 0.02 + 0.80 = 0.82 < 1.0$ O.K.

SHEAR

$V = \frac{3.47^K}{(7)(0.419)} = 1.18$ ksi < 12.0 ksi O.K.

CHECK 6"x 4"x 3/8" < ; 3'-2 1/2" LONG

LOADING
DEAD LOAD
LIVE LOAD (100psf ON WALKWAY)

ΣM@ support => $M = (41.21^\#)(3.00') + (31.61^\#)(3.0') + (38.69^\#)(1.79') + (30.48^\#)(1.31') + (771^\#)(1.79')$

$M = 1829.40^{1-\#}$ SAY 1.83^{1-K}

MAXIMUM STRESS IN ANGLE = 7.78 KSI

$\frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \le 1.0$

$\frac{20.06^{1-K}/3.32}{18.87(.83)} + \frac{8.93^{1-K}/1.6}{19.8(.83)} \le 1.0$; $0.71 \le 1.0$ O.K.

WALKWAY ALONG VERTICAL TRUSS:

LOADING
DEAD LOAD
LIVE LOAD (100psf OF WALKWAY)

FINAL REACTIONS:

$+134.6^{1-\#} + 75.3^{1-\#} + 764.7^{1-\#} - 958.8^{1-\#} - 150.0^{1-\#}$

Ⓐ $105.9^{1-\#}$ $\quad$ Ⓑ $71.4^{1-\#}$

88.6# $\quad$ 88.6#

$R_{AV} = -206.3^\#$ $\quad R_{BV} = 2406.0^\#$

MAXIMUM STRESS IN SUPPORT ANGLES = 2.39 ksi

$Kl/r_{MIN.} = \frac{(1.2)(3)(12)}{0.877} = 49.3$

$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 126.1$

$F_a = \frac{\left[1 - \frac{(Kl/r)^2}{2C_c^2}\right]F_y}{5/3 + \frac{3(Kl/r)}{8C_c} - \frac{(Kl/r)^3}{8C_c^3}} = \frac{\left[1 - \frac{(49.3)^2}{(2)(126.1)^2}\right]36000psi}{5/3 + \frac{(3)(49.3)}{(8)(126.1)} - \frac{(49.3)^3}{(8)(126.1)^3}}$

$F_a = (18412.1psi)(.83) = 15282$ psi

$f_a/F_a = \frac{2406/3.61}{15282} = 0.04 \le 0.15$

$\therefore f_a/F_a + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} \le 1.0$

$0.04 + \frac{(78.3^{1-\#})(12)}{3.32} + \frac{(177.3^{1-\#})(12)}{1.20} \le 1.0$

$(21600)(.83) \quad (21600)(.83)$

$0.13 \le 1.0$ O.K.

PROPOSED WALKWAY ANALYSIS

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

WALKWAY ANALYSIS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
WALKWAY ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

HINGE CONNECTION ANALYSIS:

1) HINGE PIN : ($5\frac{3}{4}$" ϕ IN DOUBLE SHEAR)

ALLOWABLE SHEAR LOAD = $2AF_v = 2(\pi)(5.75)^2/4(.4)(33)(.83)$

$= 2(25.97)(.4)(33)(0.83) = 568.99^K > 171.44^K$ ∴ O.K. IN SHEER

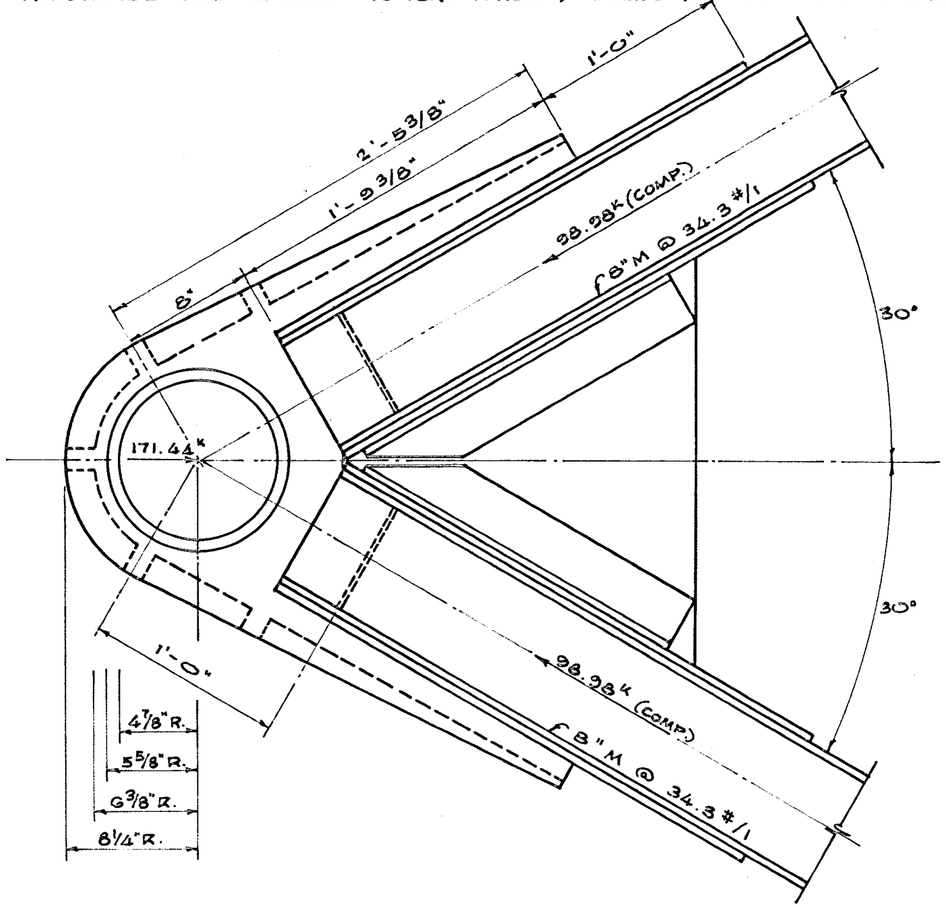
ALLOWABLE BEARING LOAD = AF_b

$= (5.75)(2.75)(33)(0.83)(0.90) = 389.79^K > 85.72^K$ ∴ O.K. IN BEARING

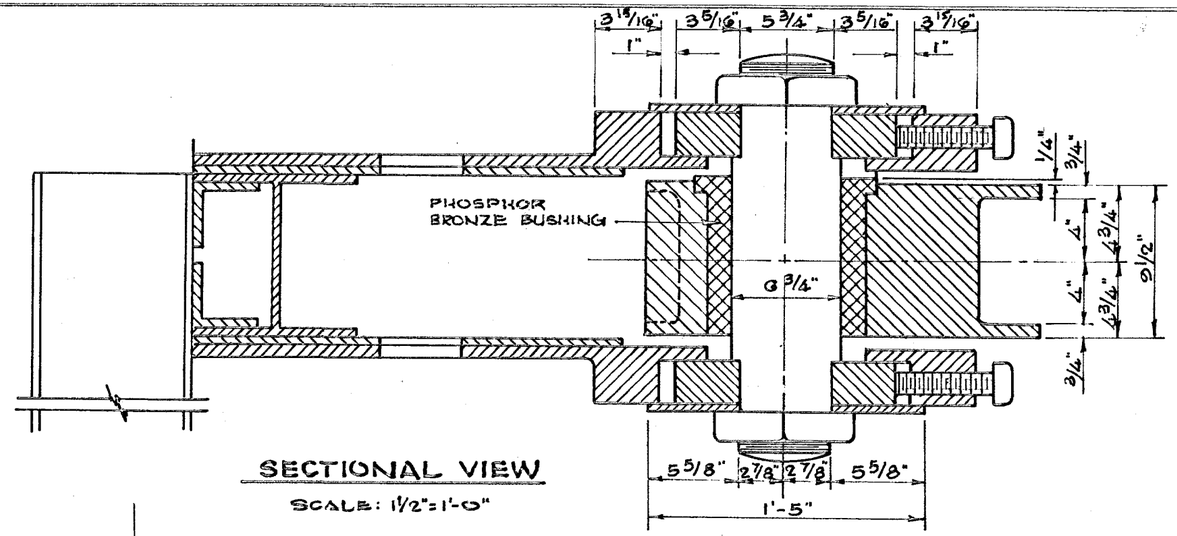
2.) BRONZE BUSHING:

ALLOWABLE BEARING STRESS = 3540 psi

ALLOWABLE BEARING LOAD = $(6.75)(9.75)(3.54) = 232.98^K > 171.44^K$ ∴ O.K. IN BEARING

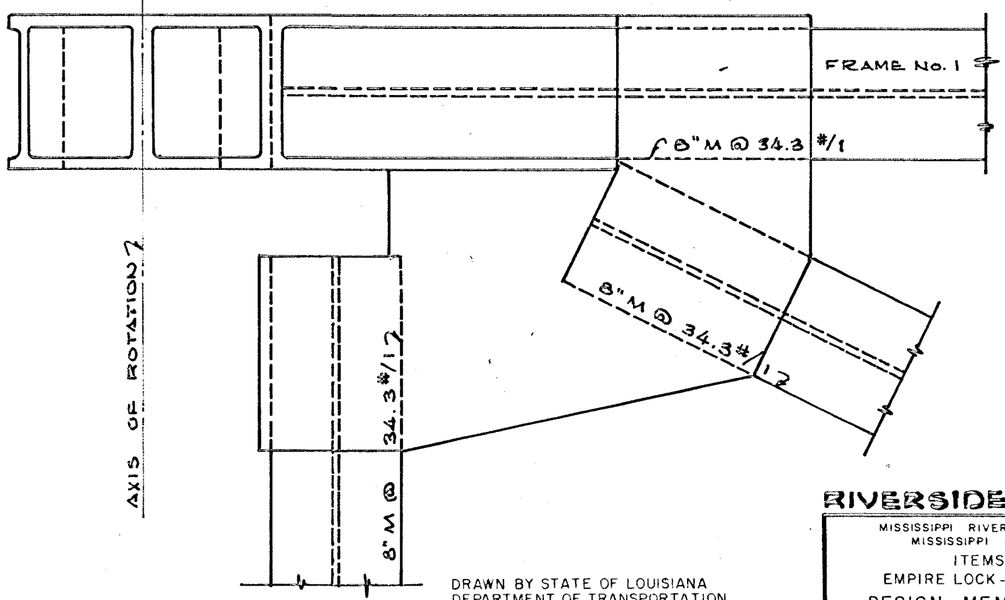


PLAN VIEW



SECTIONAL VIEW

SCALE: 1½"=1'-0"



ELEVATION

HINGE CONNECTION TO GATE FRAME

SCALE: 1½"= 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

PINTLE: ALLOWABLE SHEAR STRESS = 0.83 (0.4)(Fy) = 16.6 ksi

SHEAR AREA = $\frac{\pi D^2}{4} = \frac{\pi(8")^2}{4}$ = 50.3 SQ. IN.

ALLOWABLE SHEAR LOAD = 16.6 (50.3) = 835.0 K

ACTUAL SHEAR LOAD = 2(172.0) COS 30° = 297.9 K

835.0 K > 297.9K ∴ O.K. IN SHEAR

PINTLE: BUSHING:

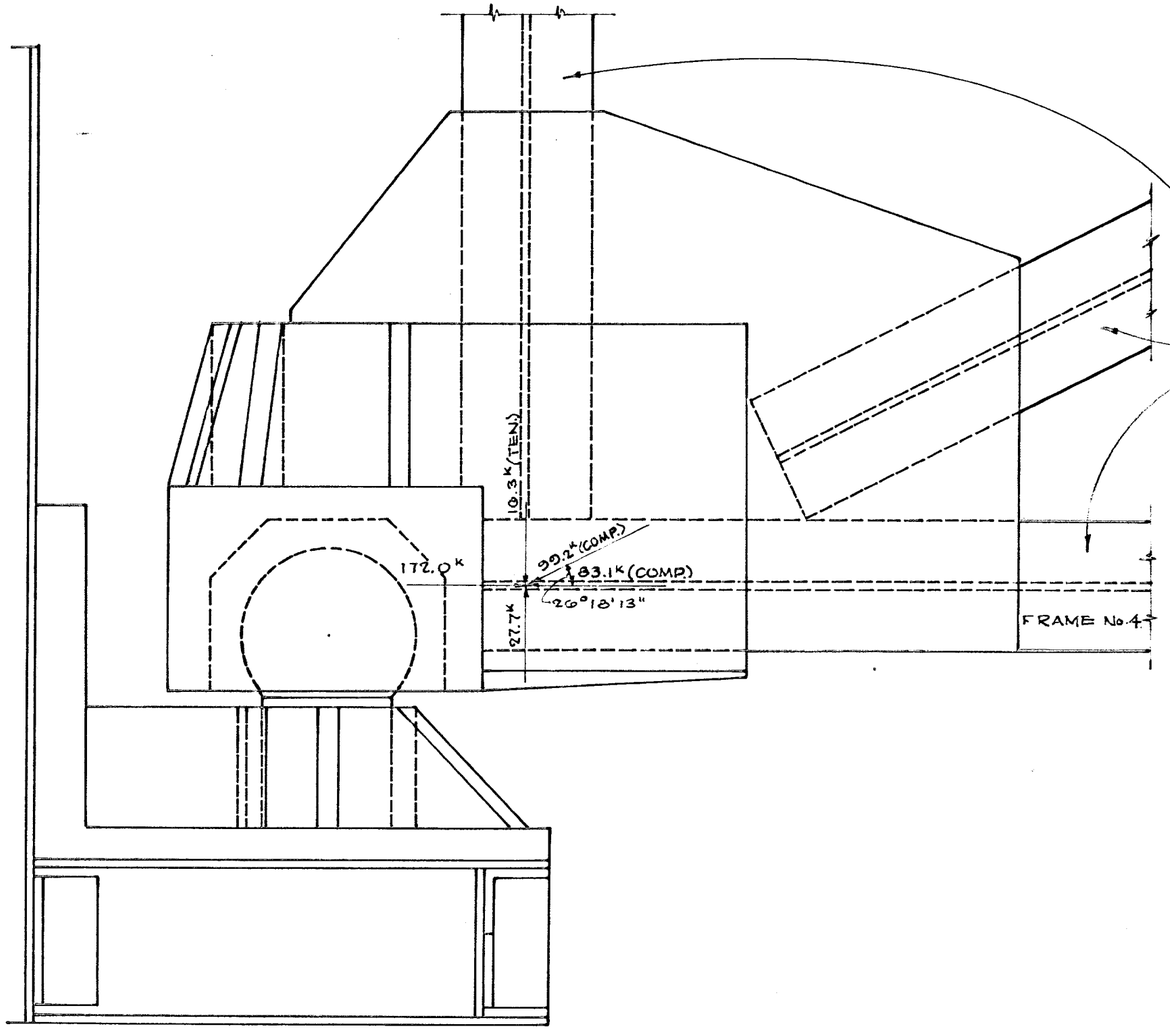
ALLOWABLE BEARING STRESS = 3540 psi (STATIC)

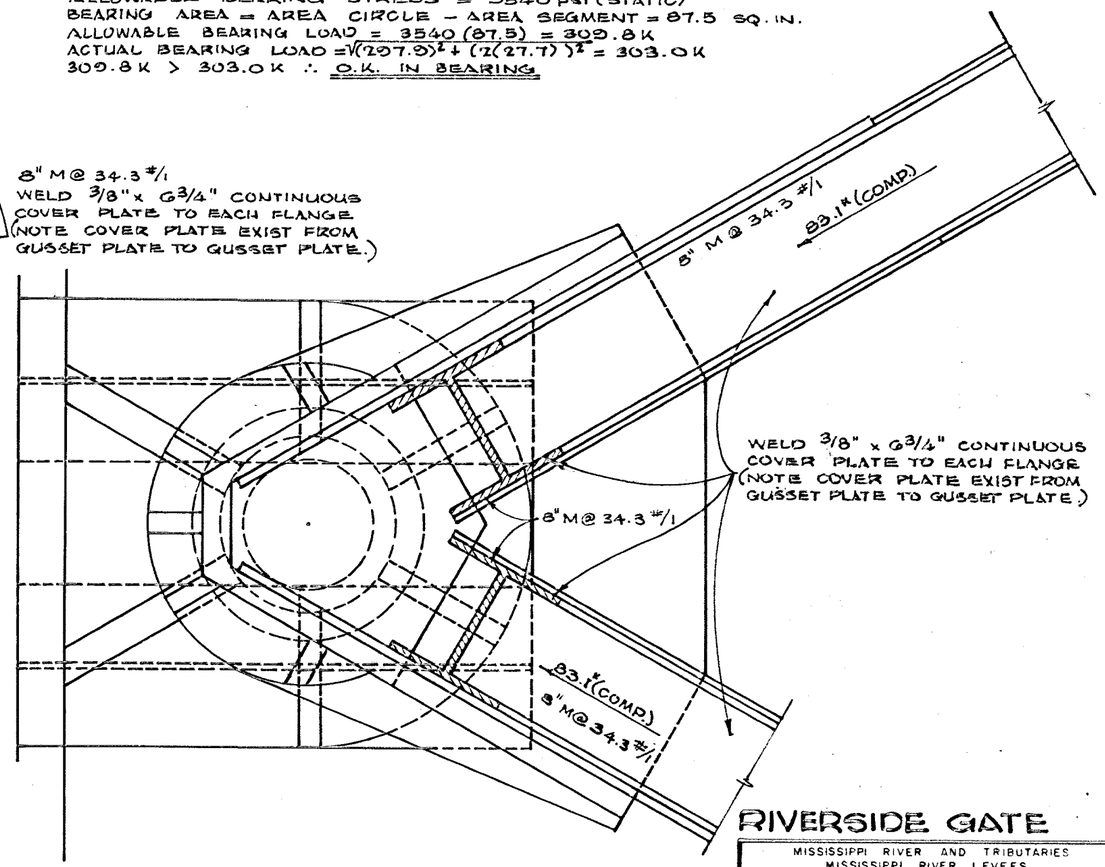
BEARING AREA = AREA CIRCLE − AREA SEGMENT = 87.5 SQ. IN.

ALLOWABLE BEARING LOAD = 3540 (87.5) = 309.8 K

ACTUAL BEARING LOAD = $\sqrt{(297.9)^2 + (2(27.7))^2}$ = 303.0 K

309.8 K > 303.0 K ∴ O.K. IN BEARING





PINTLE CONNECTION ANALYSIS

SCALE: 1 1/2" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

RIVERSIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO 54
RELOCATION OF FACILITIES
RIVERSIDE SIDE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

HINGE CONNECTION ANALYSIS:

1.) HINGE PIN: (5 3/4" Φ IN DOUBLE SHEAR)

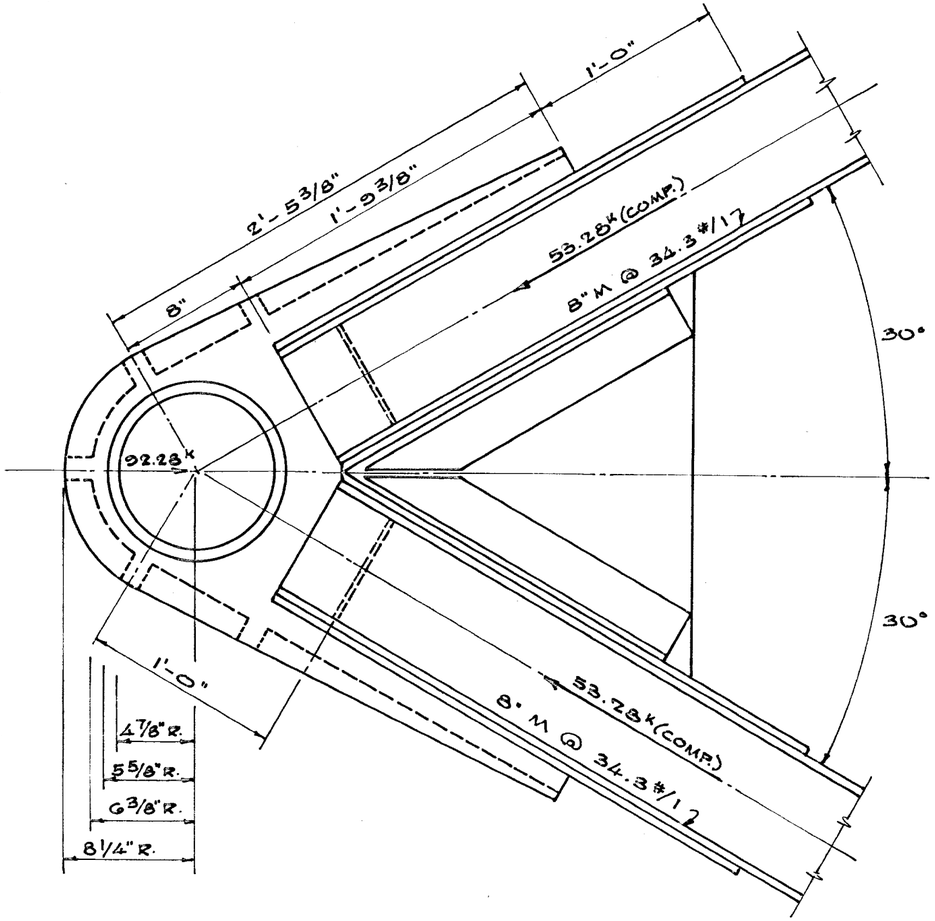
ALLOWABLE SHEAR LOAD = $2AF_v = 2(\pi)(5.75)^2/4(.4)(33)(.83)$
$= 2(25.97)(.4)(33)(0.83) = 568.99^k > 92.28^k$ ∴ O.K. IN SHEAR

ALLOWABLE BEARING LOAD = AF_b
$= (5.75)(2.75)(33)(0.83)(0.90) = 389.79^k > 46.14^k$ ∴ O.K. IN BEARING

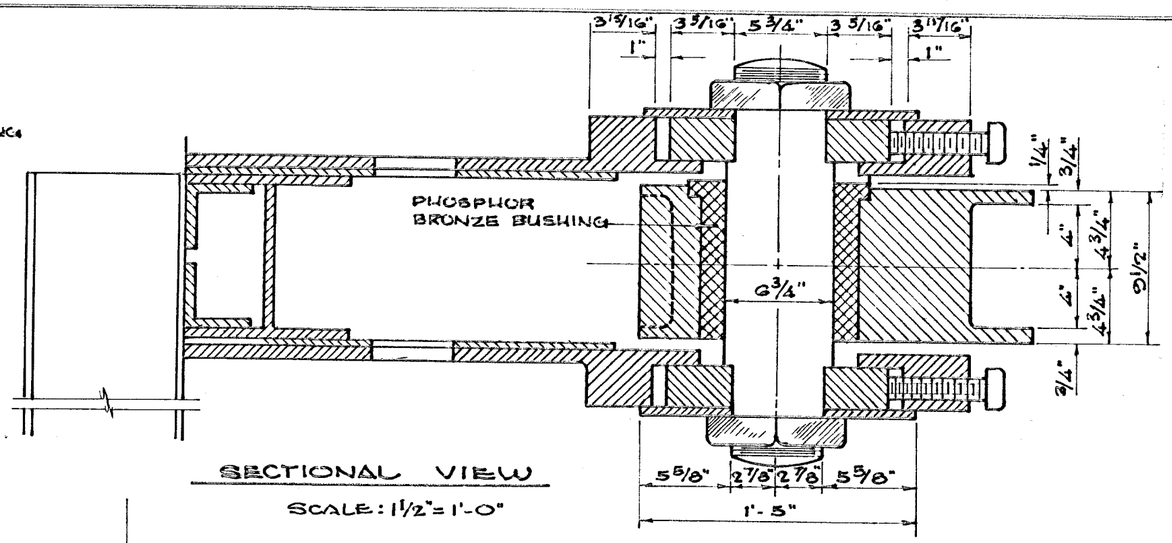
2.) BRONZE BUSHING:

ALLOWABLE BEARING STRESS = 3540 psi

ALLOWABLE BEARING LOAD = $(6.75)(9.75)(3.54) = 232.98^k < 92.28^k$ ∴ O.K. IN BEARING

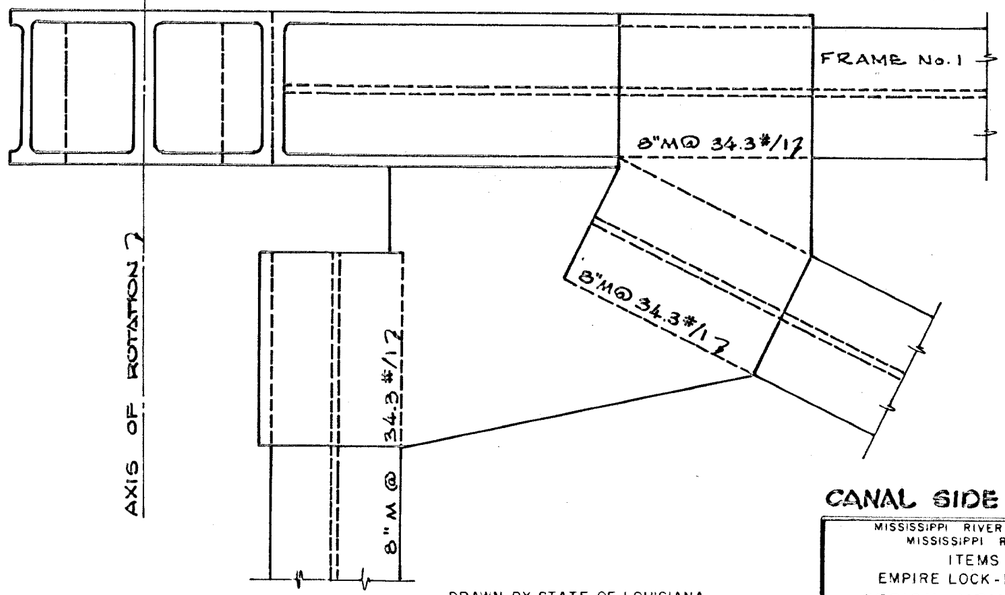


PLAN VIEW



SECTIONAL VIEW

SCALE: 1 1/2" = 1'-0"



ELEVATION

HINGE CONNECTION TO GATE FRAME

SCALE: 1 1/2" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CANAL SIDE GATE

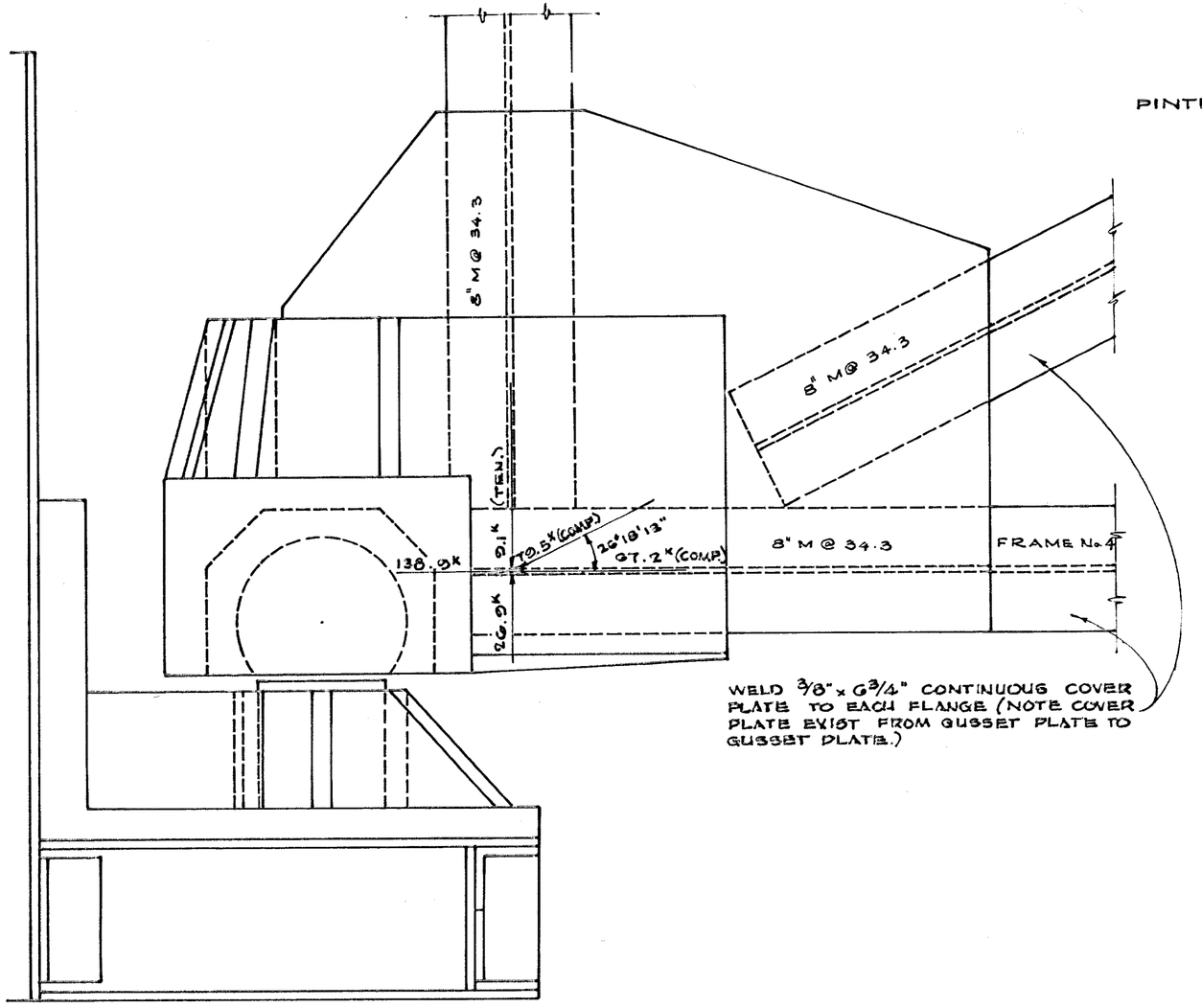
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

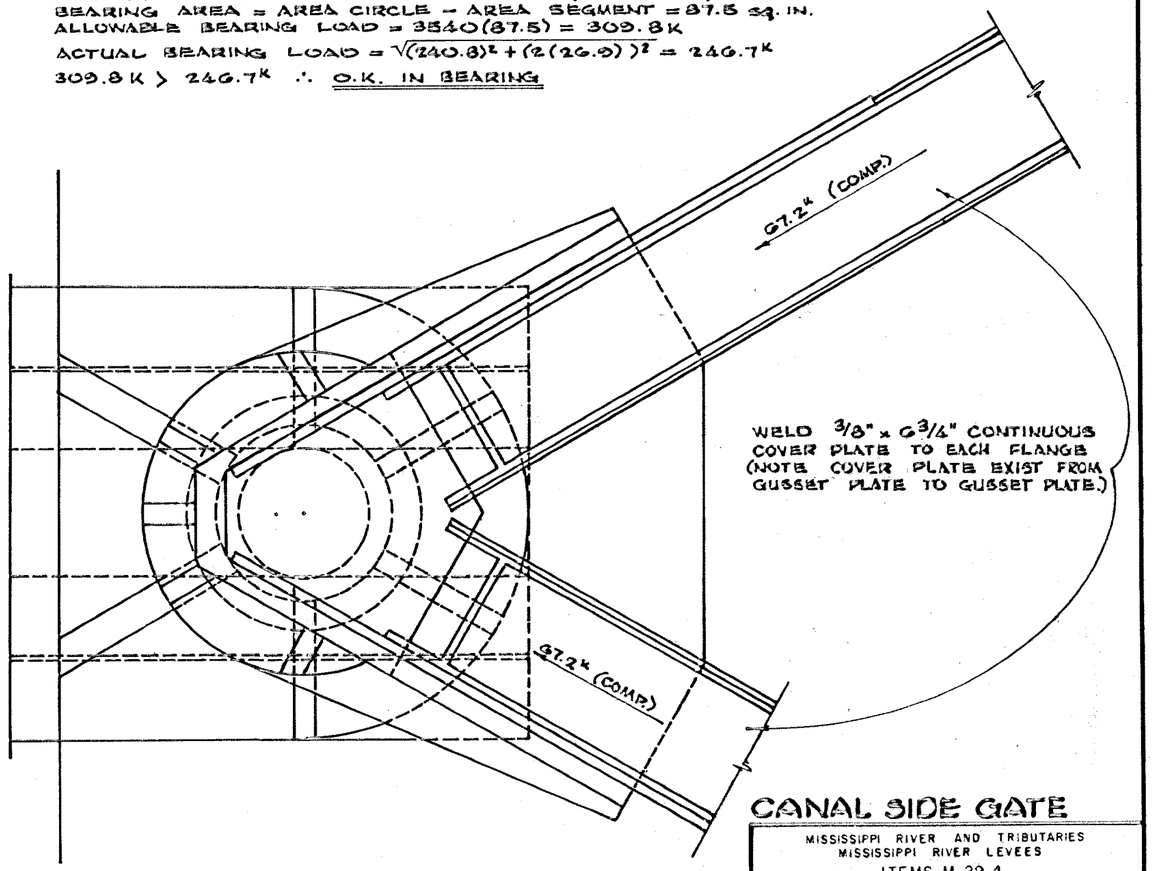
PINTLE: ALLOWABLE SHEAR STRESS = 0.33(0.4)(Fy) = 16.6 ksi

SHEAR AREA = $\frac{\pi D^2}{4} = \frac{\pi(8")^2}{4}$ = 50.3 SQ. IN.

ALLOWABLE SHEAR LOAD = 16.6 (50.3) = 835. OK
ACTUAL SHEAR LOAD = 2(139.0) COS. 30° = 240.8K
835. OK > 240.8K ∴ O.K. IN SHEAR

PINTLE: BUSHING:
ALLOWABLE BEARING STRESS = 3540 psi (STATIC)
BEARING AREA = AREA CIRCLE − AREA SEGMENT = 87.5 sq. IN.
ALLOWABLE BEARING LOAD = 3540(87.5) = 309.8K
ACTUAL BEARING LOAD = $\sqrt{(240.8)^2 + (2(26.9))^2}$ = 246.7K
309.8K > 246.7K ∴ O.K. IN BEARING





PINTLE CONNECTION ANALYSIS

SCALE: 1 1/2" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

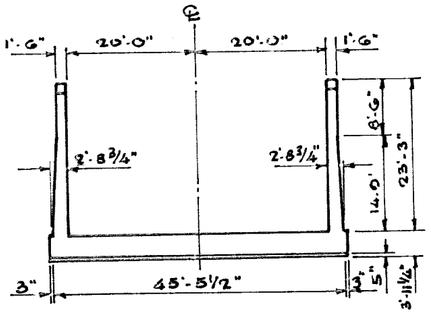
CANAL SIDE GATE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

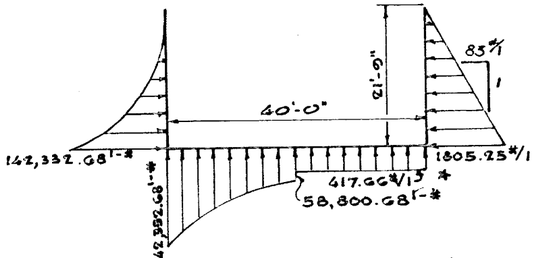
CASE I:
LOCK EMPTY, COMPACTED FILL IN PLACE AND EARTH PRESSURE ACTING. * FOUNDATION PRESSURE IS DUE TO TOTAL DEAD WEIGHT OF STUCTURE AND IS ASSUMED TO BE UNIFORMLY DISTRIBUTED ACROSS WIDTH OF BASE SLAB.

DESIGN CRITERIA:
γ_s = 110#/Ft.^{3}
γ_{HS} = 83#/Ft.^{3}
W_c = 150#/Ft.^{3}

NOTE: THE TOP 1'-6" OF EXISTING CONCRETE SHALL BE REMOVED WITH THE REBARS LEFT EXPOSED TO ALLOW THE NEW CONCRETE TO BE BONDED TO THE EXISTING CONCRETE.



TYPICAL SECTION



LOAD DIAGRAM ℄
MOM. DIAGRAM

CHECK d @ BASE OF WALL (ULTIMATE STRENGHT)

$V = 1.7\gamma h^2/2 = 33,374.56$

$d = \frac{V_u}{\phi u b} = \frac{33,374.56}{93(12)} = 29.91" + 2.25" = 32.16" < 32.75"$ ∴ O.K. IN SHEAR

CHECK MOMENT (ULTIMATE STRENGHT)

$M_{max} = 1.7\gamma h^3/0.9(6) = 268,850.62'-\#$

$A_s = pbd \Rightarrow p = 0.008$

$\bar{M}_u = pbd^2 f_y j = 311,112.81'-\# > 268,850.62'-\#$ ∴ O.K. IN MOMENT (O.F. OF WALL)

$A_s = pbd \Rightarrow p = 0.007$

$\bar{M}_u = 423,360.00'-\# > 268,850.62'-\#$ ∴ O.K. IN MOMENT (F.F. OF SLAB)

$\bar{M}_u$ @ 10' = 150,513.62'-#

$A_s = pbd \Rightarrow p = 0.0045$

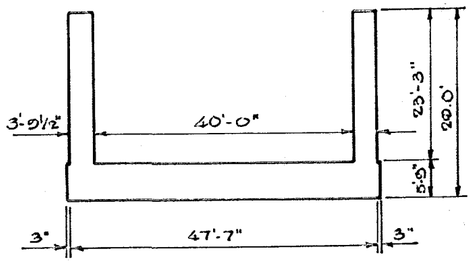
$\bar{M}_u = 277,920.00'-\# > 150,513.62'-\#$ ∴ O.K. IN MOMENT (F.F. OF SLAB)

LOCK CHAMBER WALL

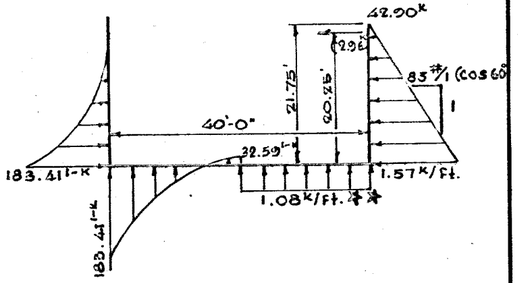
(CALCULATIONS BASED ON ORIGINAL HYPOTHESIS OF DESIGN)

CASE II:
LOCK EMPTY AND GATES IN CLOSED POSITION. COMPACTED FILL IN PLACE AND EARTH PRESSURE ACTING. HINGE REACTION FROM DEAD LOAD WEIGHT OF GATE COMBINES WITH EARTH THRUST. ONE COMPONENT ACTING PARALLEL TO CENTER LINE OF LOCK CAUSES NO BENDING MOMENT. OTHER COMPONENT ACTING PERPENDICULAR TO GATE BLOCK IS CONSIDERED DISTRIBUTED OVER A DISTANCE OF 7.25 FEET. PINTLE LOAD IS ASSUMED DISTRIBUTED OVER A 10 FOOT LENGTH OF BASE SLAB.
** FOUNDATION PRESSURE DUE TO WEIGHT OF STRUCTURE AND PINTLE LOAD IS ASSUMED AS UNIFORMLY DISTRIBUTED OVER WIDTH OF BASE SLAB.

DESIGN CRITERIA:
γ_s = 110#/Ft.^{3}
γ_{HS} = 83#/Ft.^{3}
W_c = 150#/Ft.^{3}



TYPICAL SECTION



LOAD DIAGRAM ℄
MOM. DIAGRAM

CHECK d @ BASE OF WALL (ULTIMATE STRENGHT)

$V = 1.7(\gamma H^2 + 2.96) = 38.98^K$

$d = \frac{V_u}{\phi u b} = \frac{38.98}{93(12)} = 30.45" < 43.25"$ ∴ O.K. IN SHEAR

CHECK MOMENT (ULTIMATE STRENGHT)

$\bar{M}_u = 1.7(183.41)/0.9 = 346.44'-K$

$A_s = pbd \Rightarrow p = 0.0076$

$\bar{M}_u = pbd^2 f_y j = 534.83'-K > 346.44'-K$ ∴ O.K. IN MOMENT

GATE BAY

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

LOCK WALL ANALYSIS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCK WALL ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

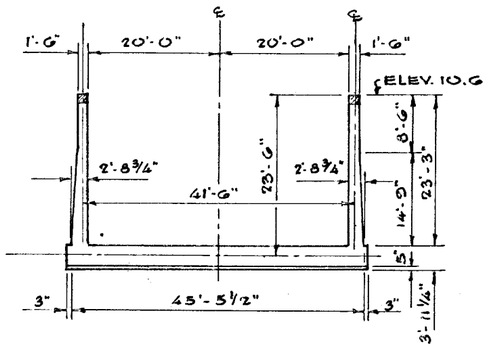
CASE I :

LOCK EMPTY, COMPACTED FILL IN PLACE AND EARTH PRESSURE ACTING. FOUNDATION PRESSURE ASSUMED UNIFORMLY DISTRIBUTED ACROSS WIDTH OF BASE SLAB.

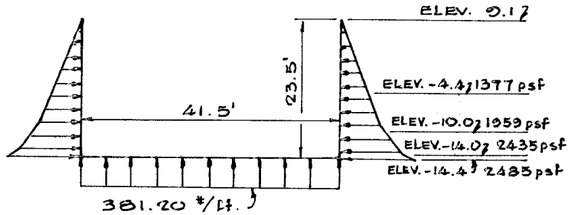
NOTE :

CALCULATIONS BASED ON WORKING STRESS DESIGN METHOD.

▨.....DESIGNATES NEW CONCRETE



DIMENSIONAL DIAGRAM



LOAD DIAGRAM

HORIZONTAL PRESSURE : TAKEN FROM BORINGS 1-ELU & 2-EL BY THE CORPS.

VERTICAL PRESSURE : $\left[\frac{23.25(1.5)(2)+\frac{1}{2}(14.75)(1.23)(2)+(45.96-41.5)(3.94)}{41.5}\right]150 = 381.20\ \#/Ft.$

CHECK MOMENT AT BASE: (ELEV. -14.4; ℄)

$M = \frac{1}{2}(13.5)(1377)(14.5)+1377(5.6)(7.20)+\frac{1}{2}(5.6)(582)(6.27)+1959(4.0)(2.4)+\frac{1}{2}(4.0)(476)(1.73)+2435(0.4)(0.2)+\frac{1}{2}(0.4)(50)(0.13) = 221,161.57^{1-\#}$

$M_{ALL} = A_s f_s j d$

$A_S = 3.41$ SQ. IN./FT. (1¼" □ @ 5½" O.C.); $d = 2'-8\frac{3}{4}" - 0'-2\frac{1}{4}" = 2'-6\frac{1}{2}" = 30.5"$

$f_s = 0.5 f_y = 20$ ksi

$K = \frac{1}{1+\frac{f_s}{nf_c}} = \frac{1}{1+\frac{20,000}{9(1050)}} = 0.321$

$j = 1-\frac{K}{3} = 1-\frac{0.321}{3} = 0.893$

$M_{ALL} = A_s f_s j d = 3.41(20,000)(0.893)(30.5)(1/12) = 154,800.88^{1-\#} < 221,161.57^{1-\#}$ ∴ OVERSTRESSED IN MOM.

% OVERSTRESSED $\frac{221,161.57}{154,800.88} = 42.9\%$ (OUTSIDE FACE OF WALL)

$M_{ALL} = A_s f_s j d = 3.41(20,000)(0.893)(40.0)(1/12) = 203,017.54^{1-\#} < 221,161.57^{1-\#}$ ∴ OVERSTRESSED IN MOM.

% OVERSTRESSED $= \frac{221,161.57}{203,017.54} = 8.9\%$ (FAR FACE OF SLAB)

CHECK SHEAR AT d FROM BASE:
(ELEV. -10.1, d = 27.98")

$V = \frac{1}{2}(13.5)(1377)+\frac{(1377+1059)}{2}(5.6)+\frac{(1059+1971)}{2}(0.1)$

$= 18,832.05\ \#$

$v = \frac{V}{bd} \Longrightarrow d = \frac{V}{vb}$

$v = 1.1\sqrt{f'c} = 60$ psi

$d_{REQ'D} = \frac{18,832.05\ \#}{60(12)} = 26.16" < 27.98$ ∴ O.K. IN SHEAR

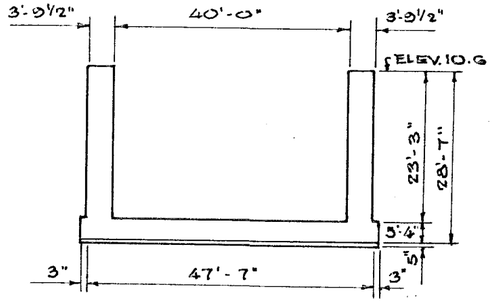
NOTE:

TO AVOID OVERSTRESSING, STRUTS WILL BE REQUIRED.

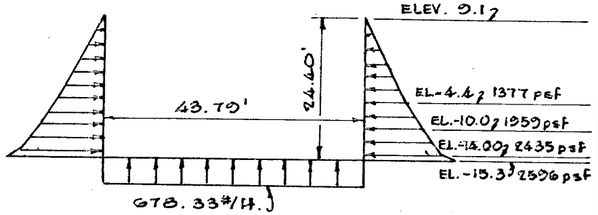
LOCK CHAMBER WALL

CASE I :

LOCK EMPTY, COMPACTED FILL IN PLACE AND EARTH PRESSURE ACTING. FOUNDATION PRESSURE ASSUMED UNIFORMLY DISTRIBUTED ACROSS WIDTH OF BASE SLAB.



DIMENSIONAL DIAGRAM



LOAD DIAGRAM

HORIZONTAL PRESSURE : TAKEN FROM BORINGS 1-ELU & 2 EL BY THE CORPS.

VERTICAL PRESSURE : $\left[\frac{2(23.25)(3.79)+(47.58-43.79)(5.75)}{43.79}\right]150 = 678.33^{1-\#}$

CHECK MOMENT AT BASE: (ELEV. -15.3)

$M = \frac{1}{2}(13.5)(1377)(15.4)+1377(5.6)(8.1)+\frac{1}{2}(5.6)(582)(7.17)+4.0(1959)(3.3)+\frac{1}{2}(4.0)(476)(2.63)+2435(1.3)(0.65)+\frac{1}{2}(1.3)(161)(0.43) = 247,749.24^{1-\#}$

$M_{ALL} = A_s f_s j d$

$A_S = 3.41$ SQ. IN./FT. (1¼" □ @ 5½" O.C.); $d = 3'-9\frac{1}{2}" - 2\frac{1}{4}" = 43.25"$

$f_s = 0.5 f_y = 20$ ksi

$K = \frac{1}{1+\frac{f_s}{nf_c}} = \frac{1}{1+\frac{20,000}{9(1050)}} = 0.321$

$j = 1-\frac{k}{3} = 1-\frac{0.321}{3} = 0.893$

$M_{ALL} = A_s f_s j d = 3.41(20,000)(0.893)(43.25)(1/12) = 219,512.72^{1-\#} < 247,749.24^{1-\#}$ ∴ OVERSTRESSED

% OVERSTRESSED $= \frac{247,749.24}{219,512.72} = 12.9\%$ (OUTSIDE FACE OF WALL)

$M_{ALL} = A_s f_s j d = 3.41(20,000)(0.893)(61.75)(1/12) = 313,408.33^{1-\#} > 247,749.24^{1-\#}$ ∴ O.K. (FAR FACE OF SLAB)

CHECK SHEAR AT d FROM BASE:
(ELEV. -9.0, d = 43.25")

$V = \frac{1}{2}(13.5)(1377)+\frac{(1377+1855)}{2}(4.6)$

$= 10,728.35\ \#$

$v = \frac{V}{bd} \Longrightarrow d = \frac{V}{vb}$

$v = 1.1\sqrt{f'c} = 60$ psi

$d_{REQ'D} = \frac{10,728.35}{60(12)} = 23.23" <$ 43.25" ∴ O.K. IN SHEAR

GATE BAY

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

LOCK WALL ANALYSIS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
LOCK WALL ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-32 A

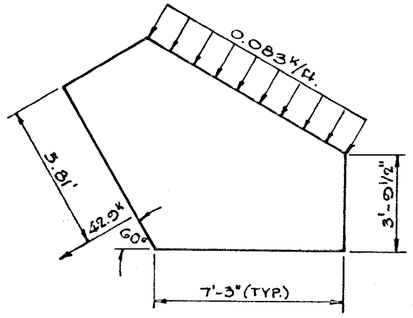
CASE I:

LOCK EMPTY AND GATES IN CLOSED POSITION. COMPACTED FILL IN PLACE AND EARTH PRESSURE ACTING. HINGE REACTION FROM DEAD LOAD WEIGHT OF GATE COMBINES WITH EARTH THRUST. COMPONENT ACTING PERPENDICULAR TO GATE BLOCK IS CONSIDERED DISTRIBUTED OVER A DISTANCE OF 4.33 FEET.

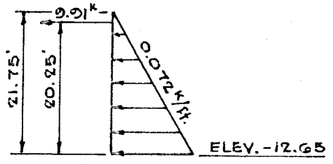
DESIGN CRITERIA:

$\gamma e = 110^{\#}/Ft.^3$
$\gamma He = 83^{\#}/Ft.^3$
$Wc = 150^{\#}/Ft.^3$

NOTE: THE TOP 1'-6" OF EXISTING CONCRETE SHALL BE REMOVED WITH THE REBARS LEFT EXPOSED TO ALLOW THE NEW CONCRETE TO BE BONDED TO THE EXISTING CONCRETE.



TYPICAL SECTION
SCALE: 1" = 5'-0"



LOAD DIAGRAM
SCALE: 1" = 20'-0"

CHECK SHEAR:

$V = \frac{\gamma h^2}{2} + 9.91^K = 26.94^K$

$V_u = 1.7V = 45.80^K$

$d = \frac{V_u}{\nu b} = \frac{45.80}{93(12)} = 41.04"$ ∴ O.K. IN SHEAR

CHECK MOMENT:

$M_{MAX} = \frac{\gamma h^3}{6} + 9.91(20.25) = 324.15^{1-K}$

$M_u = \frac{1.7 M_{MAX}}{0.9} = 612.28^{1-K}$

$A_s = pbd \Rightarrow P = 0.0040$

$\overline{M}_u = pbd^2 f_y j$

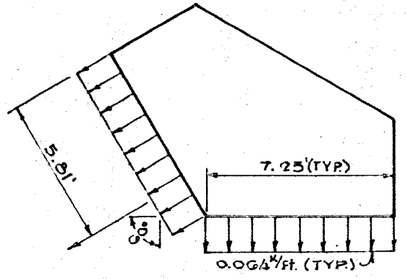
$\overline{M}_u = 1061.65^{1-K} > 612.28$ ∴ O.K. IN MOMENT

CASE II:

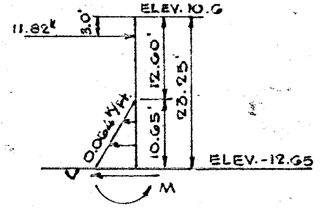
GATES IN CLOSED POSITION, WATER TO ELEV. 14.1 M.S.L. ON RIVER SIDE AND ELEVATION -2.0 M.S.L. LAND OR CHAMBER SIDE. NO THRUST FROM COMPACTED EARTH FILL. HINGE REACTION FROM LIVE LOAD AND DEAD LOAD OF GATE IS DISTRIBUTED ALONG GATE BLOCK. ONE COMPONENT ACTING PARALLEL TO CENTER-LINE OF LOCK CAUSES NO BENDING MOMENT. OTHER COMPONENT ACTING PERPENDICULAR TO GATE BLOCK IS CONSIDERED DISTRIBUTED OVER A DISTANCE OF 7.25 FEET.

DESIGN CRITERIA:

$\gamma e = 110^{\#}/Ft.^3$
$\gamma He = 83^{\#}/Ft.^3$
$Wc = 150^{\#}/Ft.^3$



TYPICAL SECTION
SCALE: 1" = 5'-0"



LOAD DIAGRAM
SCALE: 1" = 20'-0"

CHECK SHEAR:

$V = \frac{\gamma h^2}{2} + 11.82 = 15.45^K$

$V_u = 1.70 = 26.26^K$

$d = \frac{V_u}{\nu_u b} = \frac{26.26}{93(12)} = 23.53"$ ∴ O.K. IN SHEAR

CHECK MOMENT:

$M_{MAX} = \frac{\gamma h^3}{6} + 11.82(20.25) = 252.24^{1-K}$

$M_u = \frac{1.7 M_{MAX}}{0.9} = 476.45^{1-K}$

$A_s = pbd \Rightarrow p = 0.0022$

$\overline{M}_u = pbd^2 f_y j$

$\overline{M}_u = 501.74^{1-K} > 476.45^{1-K}$ ∴ O.K. IN MOMENT

GATE BLOCK ANALYSIS

(CALCULATIONS BASED ON ORIGINAL HYPOTHESIS OF DESIGN)

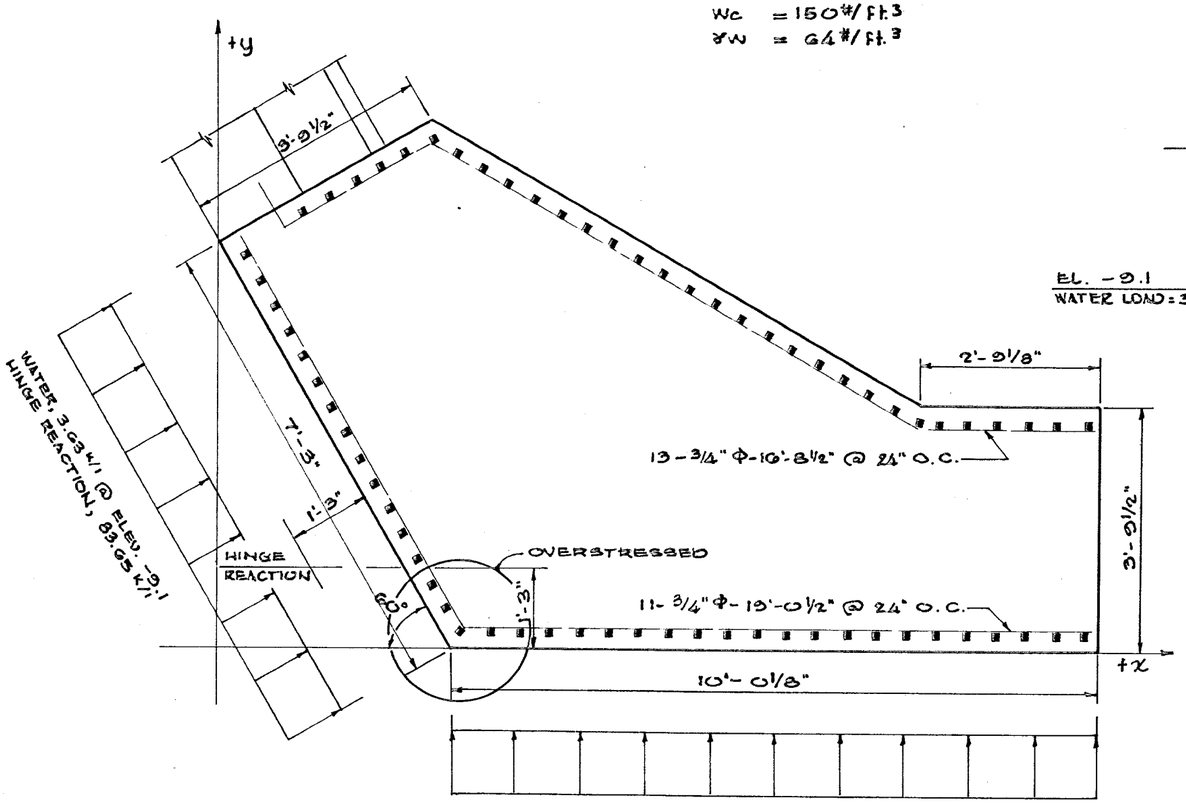
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

GATE BLOCK ANALYSIS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK-MODIFICATIONS
DESIGN MEMORANDUM NO 54
RELOCATION OF FACILITIES
RIVERSIDE GATE BLOCK ANALYSIS
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

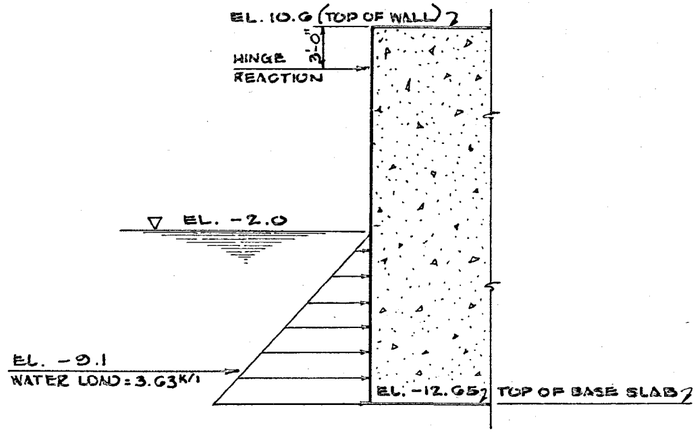
DESIGN CRITERIA

γ_s = 110 #/ft.³
γ_{he} = 83 #/ft.³
W_c = 150 #/ft.³
γ_w = 64 #/ft.³



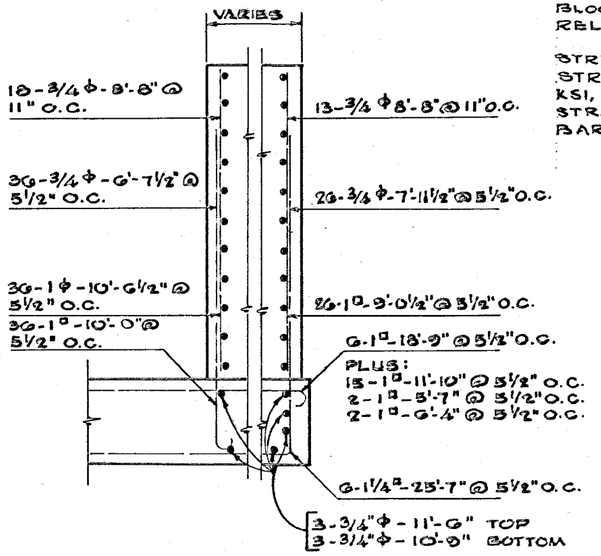
PLAN OF GATE BLOCK

SCALE: ½" = 1'-0"



CRITICAL LOAD DIAGRAM

SCALE: N.T.S.



TYPICAL SECTION

SCALE: N.T.S.

DESIGN PROCEDURE

THE EXISTING GATE BAY SUPPORT BLOCK IS DESIGNED USING THE "CONCRETE GENERAL FLEXURE ANALYSIS" COMPUTER PROGRAM. IN THE DESIGN, THE GATE BAY SUPPORT BLOCK IS ISOLATED AS A FREEBODY WITH TWO LOADING CONDITIONS. THE REINFORCING STEEL AND THE EXTERNAL LOADS FOR EACH CASE ARE RESOLVED RELATIVE TO AN X,Y COORDINATE SYSTEM. THE COMPUTER PROGRAM LOCATES THE NEUTRAL AXIS OF THE MEMBER ALONG WITH THE RESULTING FLEXURAL STRESS IN THE REINFORCING STEEL AND CONCRETE. WITH THE FLEXURAL STRESS OBTAINED IT IS NOW POSSIBLE TO COMPARE THE STRESSES TO THE ALLOWABLE STRESSES TO SEE IF ANY REINFORCING STEEL OR THE CONCRETE IS OVERSTRESSED.

THE CRITICAL LOADING CONDITION IS FOUND TO BE WHEN THE GATES ARE IN THE CLOSED POSITION. WATER IS AT ELEV. 14.1 ON RIVER SIDE AND ELEV. -2.0 ON CHAMBER SIDE. NO THRUST IS CONSIDERED FROM COMPACTED EARTH FILL. HINGE REACTION FROM LIVE LOAD AND DEAD LOAD OF GATE IS 171.44ᴷ.

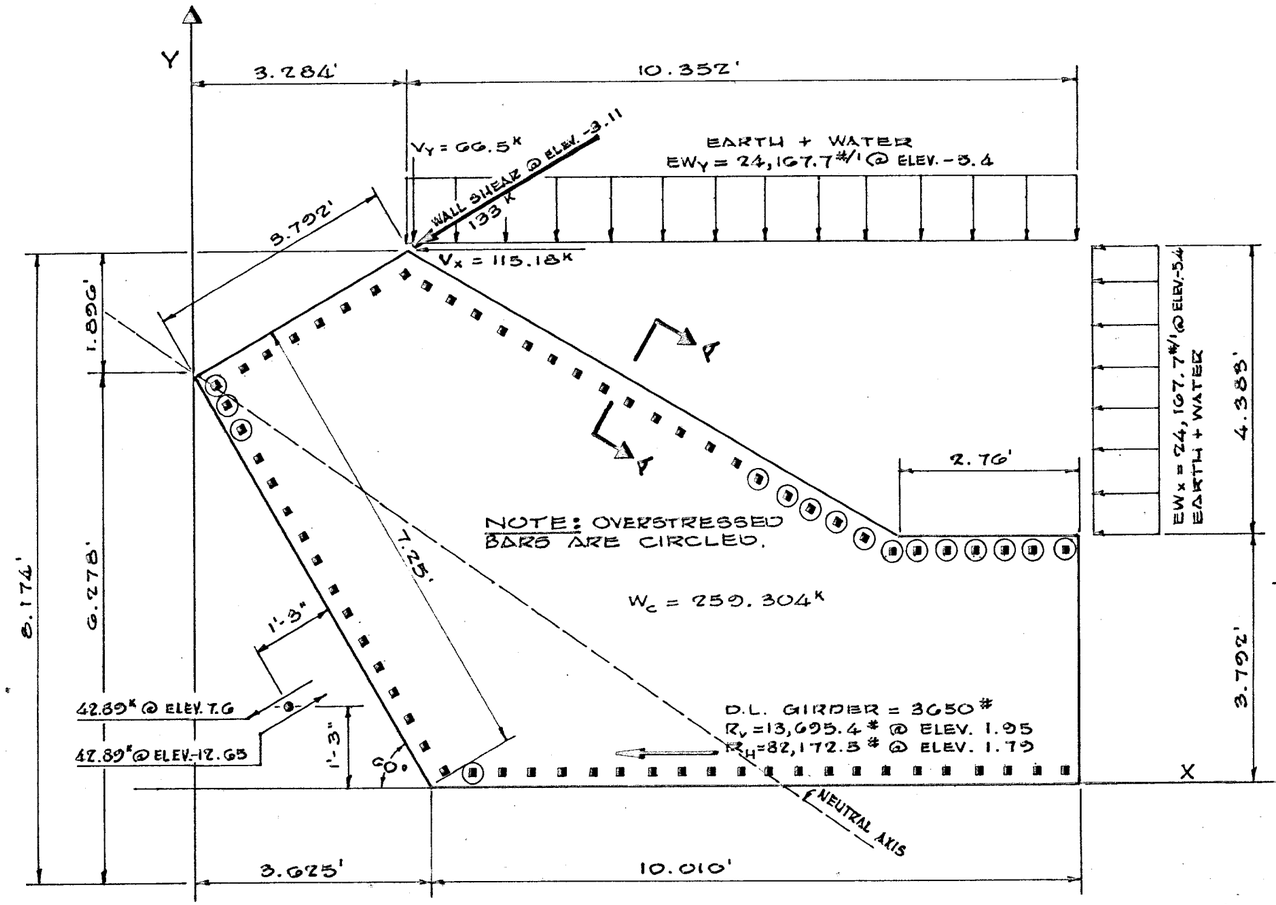
AS NOTED ON THE PLAN VIEW OF THE GATE BLOCK, FIVE BARS WERE SLIGHTLY OVER-STRESSED. HOWEVER, DUE TO RELIEVING OF STRESSES CAUSED BY EXISTING EARTH FILL BEHIND GATE BLOCK, THIS OVERSTRESSED CONDITION WILL BE ELIMINATED. IF THE EXISTING EARTH FILL FAILS TO ACT, THE YIELDING OF THE GATE BLOCK WILL REDISTRIBUTE THESE STRESSES THUS RELIEVING THIS SITUATION.

THE ALLOWABLE BAR STRESS IS 20KSI. THE OVER-STRESSED BARS WERE FOUND TO HAVE THE FOLLOWING STRESSES: 22.372 KSI, 21.449 KSI, 20.526 KSI, 21.492 KSI, AND 20.611 KSI. (NOTE: THIS IS ASSUMING A STRAIGHT LINE VARIATION IN STRESS IN A ROW OF BARS.)

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

GATE BLOCK ANALYSIS

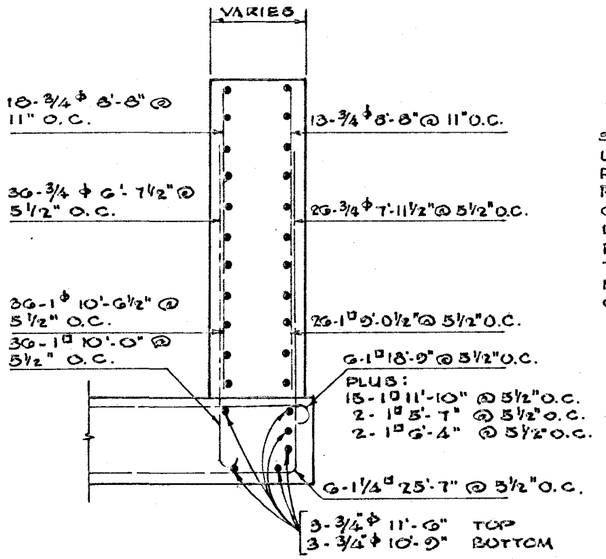
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
RIVERSIDE GATE BLOCK ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



GATE BAY SUPPORT BLOCK AT ELEV.-12.65

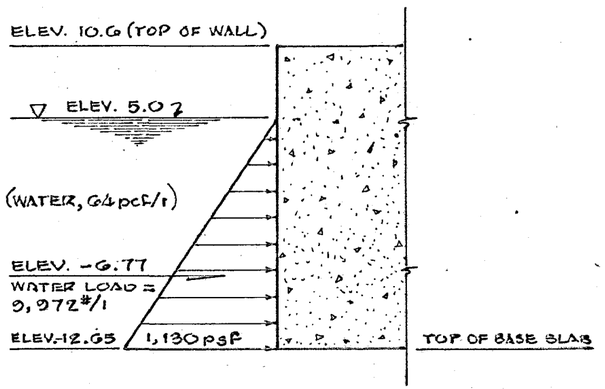
PLAN

SCALE: 1/2" = 1'-0"



CRITICAL LOAD DIAGRAM

SCALE: N.T.S.



LOAD DIAGRAM FOR DEWATERED CONDITION

SECTION "A-A"

SCALE: 1" = 10'

DESIGN PROCEDURE

THE EXISTING GATE BAY SUPPORT BLOCK WAS ANALYZED USING THE "CONCRETE GENERAL FLEXURE ANALYSIS" COMPUTER PROGRAM. CIRCLED BARS NOTED ON PLAN VIEW ARE OVERSTRESSED DUE TO DEAD WEIGHT OF GATE. BLOCKING OF THE GATE PRIOR TO DEWATERING WILL BE NECESSARY TO RELIEVE THIS OVERSTRESSED CONDITION.

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CANAL SIDE GATE BLOCK ANALYSIS

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CANAL SIDE GATE BLOCK ANALYSIS
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

I-WALL ANALYSIS:

LOCATE POINT OF ZERO SHEAR

$\overset{+}{\Sigma F_x} = 0$

$1/2\,(14.1'-9.6')(281\text{psf}) + 1/2\,(9.6'-6.4')(281\text{psf}) = 1/2\,(x)\frac{599\text{psf}}{[6.4'-(-0.9')]}(x)$

SOLVE FOR X; X = 5.1'; ELEV. 1.3'

FIND MAXIMUM MOMENT. (@ ELEV. 1.3')

$\overset{+}{\Sigma M}$ @ 1.3 = 0

$M_{MAX} = 1/2\,(14.1'-9.6')(281\text{psf})[(14.1'-9.6')(1/3)+(9.6'-1.3')]$
$+1/2(9.6'-6.4')(281\text{psf})[(9.6'-6.4')(2/3)+(6.4'-1.3')]$
$-1/2(6.4'-1.3')[(\frac{599\text{psf}}{6.4'-(-0.9')})(6.4'-1.3')](6.4'-1.3')(1/3)$

M_{MAX} = 7633.1 ft-lbs.

USE REGULAR CARBON GRADE STEEL; F_s = 25 KSI

FIND REQUIRED SECTION MODULUS.

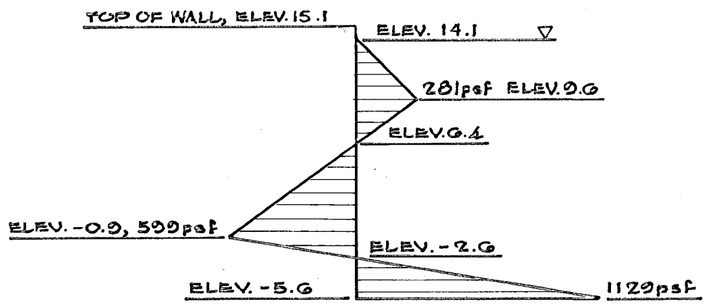
$S = \frac{M}{F_s} = \frac{7633.1\text{ft}\#(12\text{IN/ft})}{25000\text{psi}} = 3.7\ \text{IN}^3/\text{ft. OF WALL}$

USE PZ 27 WITH S = 30.2 $\text{IN.}^3/\text{FT.}$ OF WALL

MAXIMUM DEFLECTION AT TOP OF WALL (EL. 14.1) = 0.26 in (FS = 1.5)

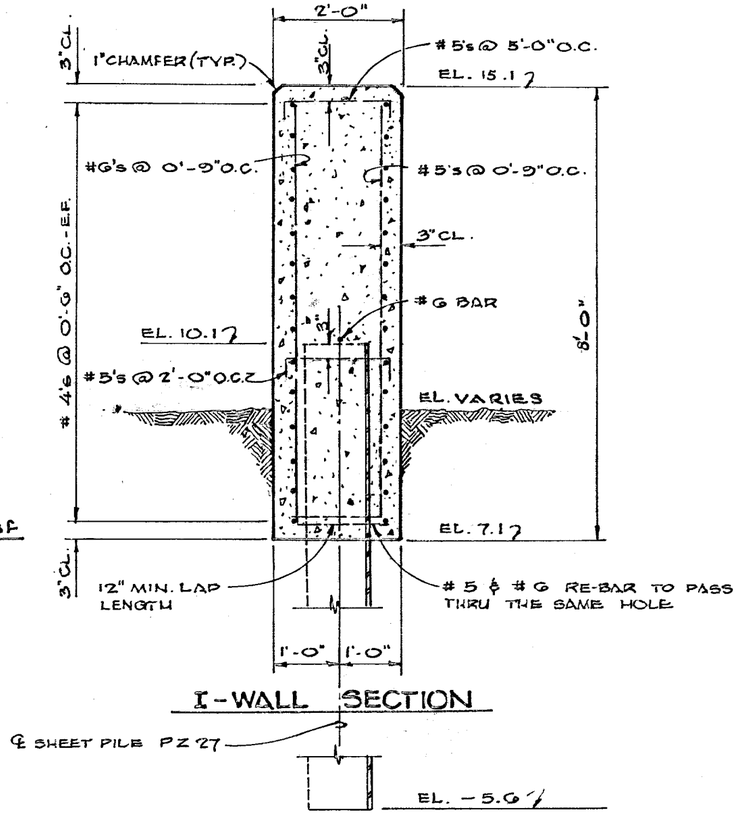
MOMENT = 7633.1 ft-lbs (12 in/ft) = 91,597.2 in-lb (FS = 1.5)

$f_b = \frac{M}{S} = \frac{91,597.2}{30.2\text{ in}^3} = 3,033\text{ psi}$



PRESSURE DIAGRAM

HORIZONTAL SCALE: 1" = 600 psf
VERTICAL SCALE: 1" = 10'



I-WALL SECTION

℄ SHEET PILE PZ 27

EL. -5.6

TYPICAL SECTION

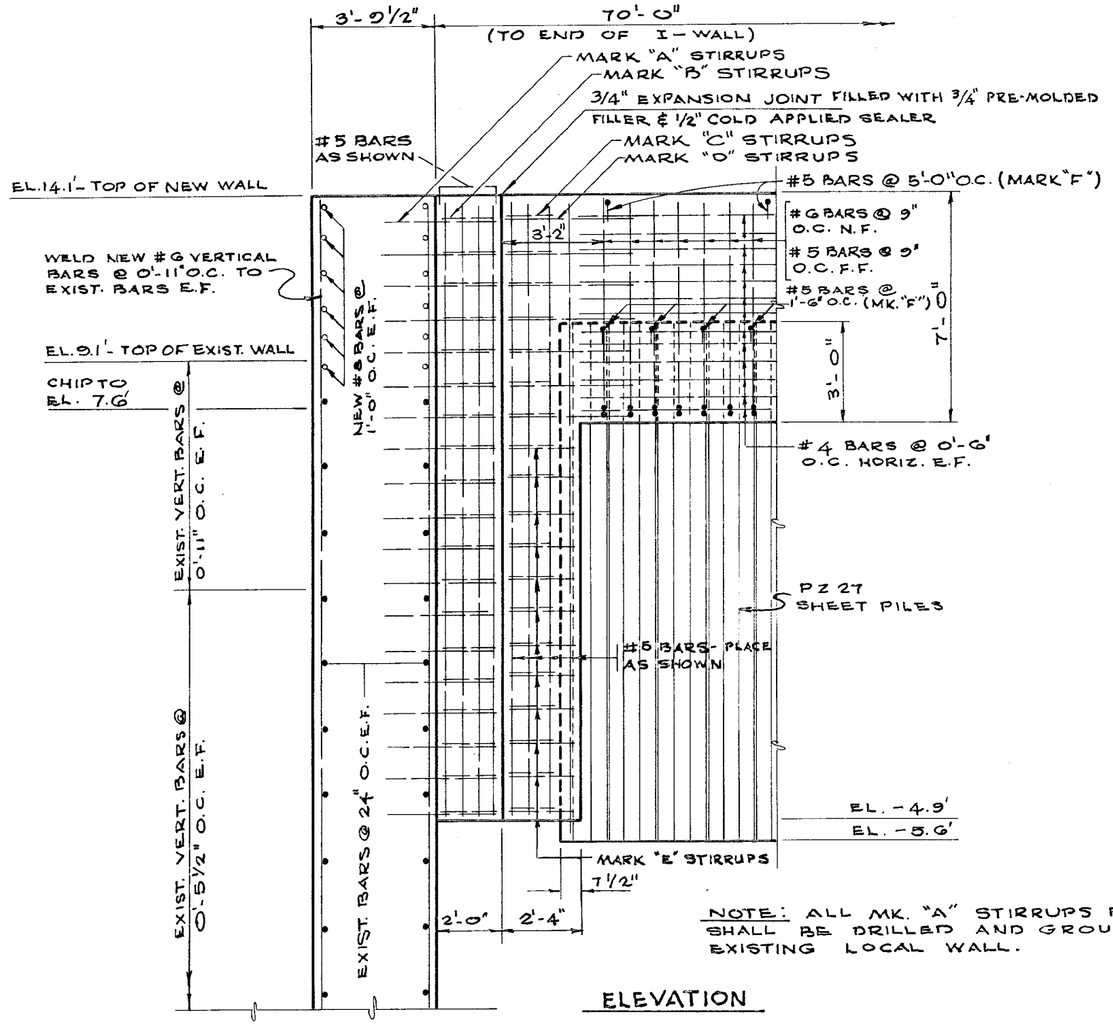
SCALE: 1/2" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

FLOODWALL

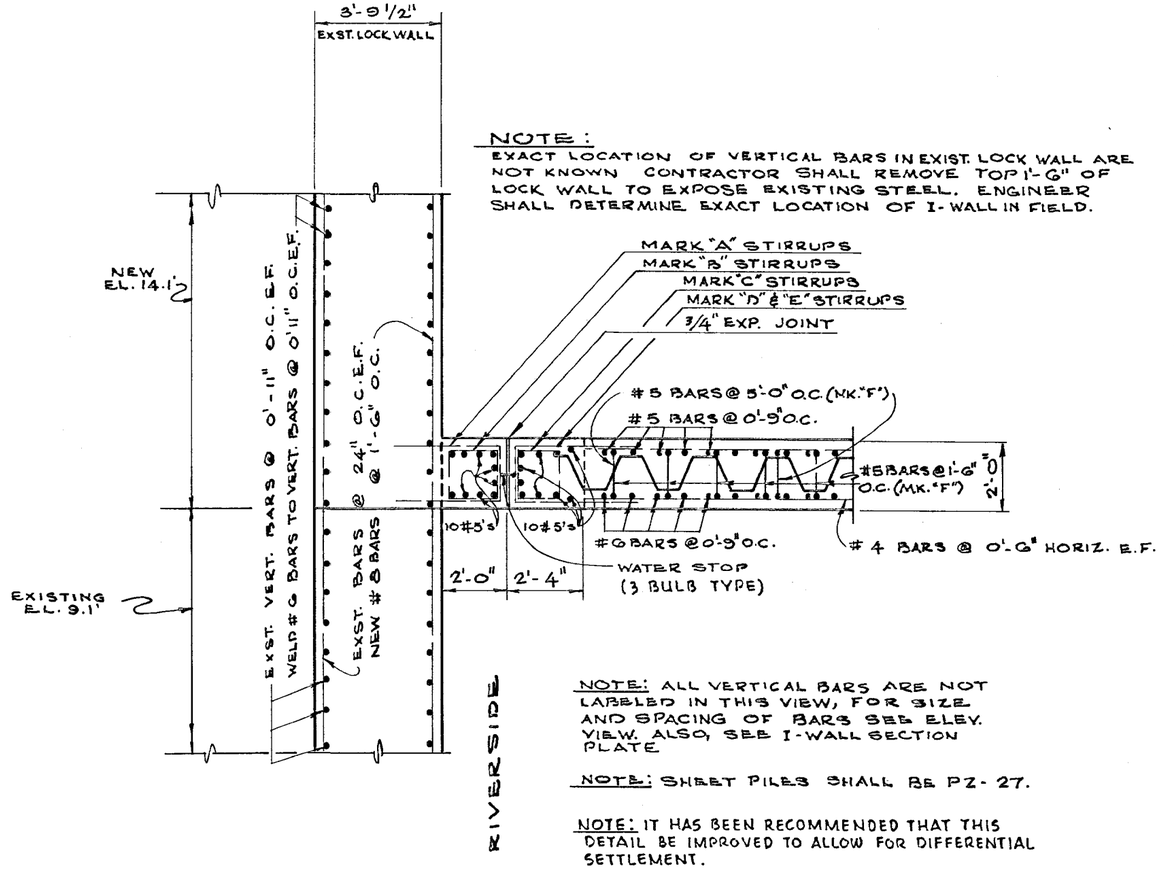
MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
FLOODWALL
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

PLATE IV-35



NOTE: ALL MK. "A" STIRRUPS BELOW ELEV. 7.6 SHALL BE DRILLED AND GROUTED INTO EXISTING LOCAL WALL.

ELEVATION



NOTE:
EXACT LOCATION OF VERTICAL BARS IN EXIST. LOCK WALL ARE NOT KNOWN. CONTRACTOR SHALL REMOVE TOP 1'-6" OF LOCK WALL TO EXPOSE EXISTING STEEL. ENGINEER SHALL DETERMINE EXACT LOCATION OF I-WALL IN FIELD.

NOTE: ALL VERTICAL BARS ARE NOT LABELED IN THIS VIEW, FOR SIZE AND SPACING OF BARS SEE ELEV. VIEW. ALSO, SEE I-WALL SECTION PLATE

NOTE: SHEET PILES SHALL BE PZ-27.

NOTE: IT HAS BEEN RECOMMENDED THAT THIS DETAIL BE IMPROVED TO ALLOW FOR DIFFERENTIAL SETTLEMENT.

PLAN

PILASTER DETAILS

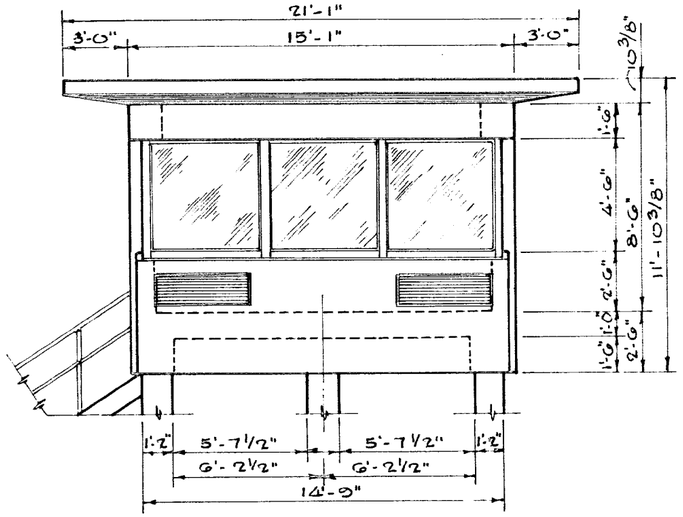
SCALE: 1/4" = 1'-0"

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

FLOODWALL

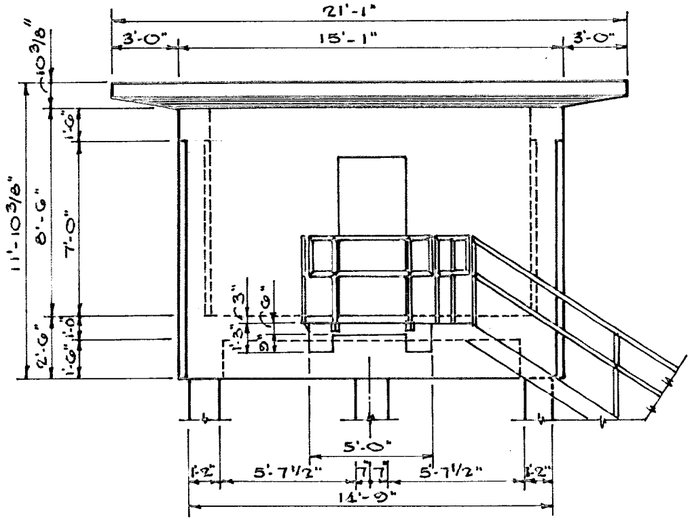
MISSISSIPPI RIVER AND TRIBUTARIES.
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
FLOODWALL
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-36



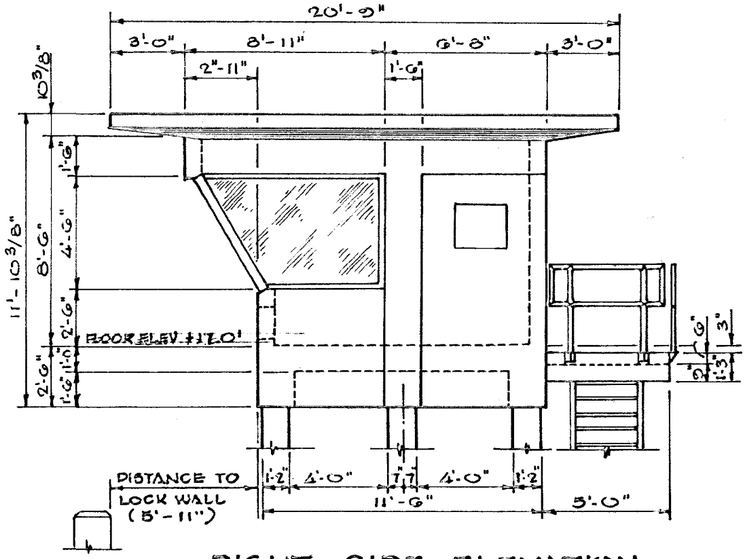
FRONT ELEVATION

SCALE: 3/16"=1'-0"



REAR ELEVATION

SCALE: 3/16"=1'-0"



RIGHT SIDE ELEVATION

SCALE: 3/16"=1'-0"

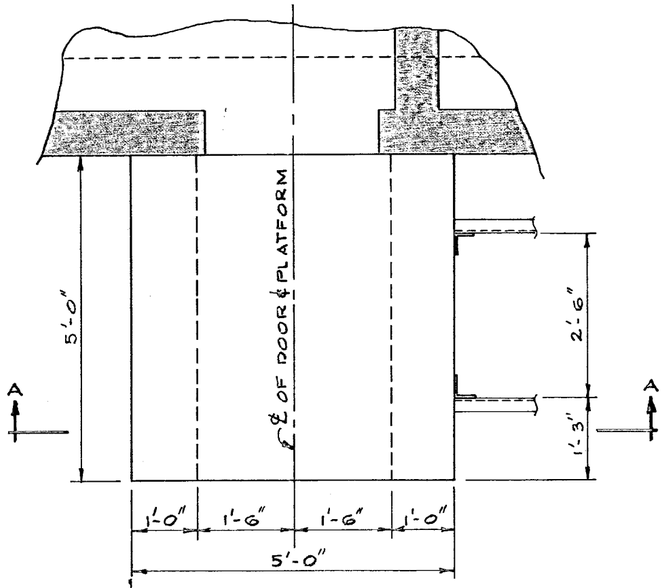
SEE NOTE ON SHEET IV-41

PROPOSED CONTROL HOUSE

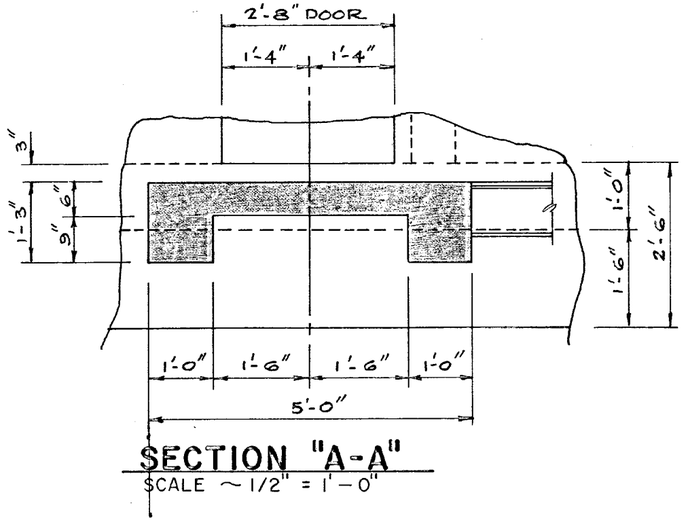
DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CONTROL HOUSE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CONTROL HOUSE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370



PLAN VIEW
SCALE ~ 1/2" = 1'-0"



SECTION "A-A"
SCALE ~ 1/2" = 1'-0"

ENTRANCE PLATFORM DESIGN

5'x 5' PLATFORM
ASSUME BEAM WITH t = 1'-3"; b = 1'-0"; d = 1'-0"
ASSUME SLAB 6" THICK
∴ FOR SLAB → NOTE PLACE STEEL IN CENTER OF SLAB
D.L. = (75 psf)(1.4) = 105 psf
L.L. = (100 psf)(1.7) = 170 psf
CONSIDER 1'-0" WIDE BEAM SPANNING 5'-0"

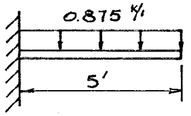
$\Rightarrow \bar{M} = \frac{(1/8 w l^2)}{\phi} = \frac{(1/8)(0.275^{K/'})(5)^2}{0.9} = 0.95^{'-K}$

$\bar{M} = pbd^2 f_y (1 - 0.59q)$
∴ P = 0.0027
USE $P_{MIN.} = 0.002$
$A_S = (0.002)(12)(3) = 0.07^{\square"/'}$
SHRINKAGE = .002 bt = 0.144 $^{\square"/'}$ ← GOVERNS

USE #4's @ 1'-0" BOTH DIRECTIONS

FOR BEAMS →

CASE I:
CONSIDER ONE BEAM CARRIES 1/2 LOAD FROM 5'x 5' AREA
⇒ LOAD ON BEAM ≈ 0.69 K/' + .188



$V_{MAX.} = 4.375^K$

$\bar{M}_{MAX.} = \frac{10.94^{'-K}}{.9} = 12.15^{'-K}$

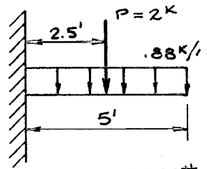
$d_{REQ'D.} = \frac{4375^{\#}}{(0.85)(2)(\sqrt{3000})(12)} = 3.92$ O.K.

$P[1 - 7.87P] = \frac{(12.15)(12)}{(12)(12)^2(40)} = 0.0021$

∴ P = 0.0021; $P_{MIN.} = 200/f_y = 0.005$
⇒ $A_S = (0.005)(12)(12) = 0.72^{\square"}$

USE 4-#4's ⇒ $0.8^{\square"}$

CASE II:
CONSIDER STAIRS PRODUCING POINT LOAD ON BEAM OF ENTRANCE PLATFORM:
ASSUME LOAD 2^K (CONCENTRATED) PLUS .88 K/' (UNIFORM)



$d_{REQ'D.} = \frac{6400^{\#}}{(.85)(2)(\sqrt{3000})(12)} = 5.73"$ O.K.

$\bar{M}_{MAX.} = \left[\frac{(.88)(5)^2}{2} + (2)(2.5)\right] \div [.9] = 17.78^{'-K}$ SAY $18^{'-K}$

$P[1 - 7.87P] = \frac{(18)(12)}{(12)(12)^2(40)} = 0.0031$

∴ P = .0032

$P_{MIN.} = \frac{200}{f_y} = 0.005$ USE $P_{MIN.}$

NOTE: BEAM O.K.

CONTROL HOUSE DESIGN

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CONTROL HOUSE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CONTROL HOUSE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370

PLATE IV-38

ROOF DESIGN

ASSUME: $t=6''$; $d=4.5''$; WALL THICKNESS $=8''$
$L_1=15.08'$; $L_2=14.75'$; $L_1/L_2=1.02\leq 2 \Rightarrow$ TWO WAY ACTION
FOR WT. CALCULATIONS LET $t_{AV}\approx 8$
$\therefore$ WT. $=43960^{\#}$
$\Rightarrow W_1=30\ psf+43360^{\#}/222.43^{\square'}=228\ psf=0.23\ ksf$
$M_{O(SHORT)}=(.125)(0.23)(15.08)(14.75-0.67)^2(1.15)(1.7)=168.0^{'-K}$
$M_{O(LONG)}=(.125)(0.23)(14.75)(15.08-0.67)^2(1.15)(1.7)=172.2^{'-K}$
C_i SHORT BEAM $=1.2-0.55r=0.64$
C_i for M.S.S.D. $=(0.6)(1-.64)=0.22$ ⟵
C_i for E.S.S.D $=(0.4)(1-0.64)=0.14$ ⟵
C_i LONG BEAM $=0.35+0.3r=0.66$
C_i for M.S.L.D. $=(0.6)(1-0.66)=0.20$ ⟵
C_i for E.S.L.D. $=(0.4)(1-0.66)=0.14$ ⟵
FIND MAX. MOMENT:
(a) M_O M.S.S.D. $=(0.6)(168.0)(0.22)/7.21=3.1^{'-K/FT.}$
(b) M_O M.S.L.D. $=(0.6)(172.2)(0.20)/7.04=3.0^{'-K/FT.}$
-AS M.S.S.D. $=?$; $-M_{(M.S.S.D.)}=(0.22)(0.6)(168.0^{'-K})/7.21=3.1^{'-k}$

$(3.1)(12)=(12)(4.5)^2(40)(P)(ju)$
$\therefore P=.0039$
A_S (REQ'D) $=0.21$; USE $A_S=0.20$ O.K.
NOTE: USE #4's @ 1'-0" BOTH FACES & BOTH DIRECTIONS

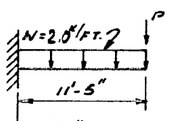
WALL DESIGN

$b=12''$; $t=8''$; $d=6\frac{1}{2}''$; $f_y=40$ ksi, $f'_c=3$ ksi
$M_u=0.41^{'-K}$; $P=1.65^K$
$M_{US}=M_u+P_u(d-t/2)=4.43^{'-K}$; $M'_{US}=\frac{4.43}{.4}=11.08^{'-K}$
$F=0.042$; $K_u=M'_{US}/F=263.8$; $\alpha_u=2.82$

$$A_S=\frac{M_{US}}{\alpha_u d}-\frac{P_u}{\phi f_y}=0.49^{\square''}/_{'}$$

USE #7's @ 1'-0" BOTH FACES & BOTH DIRECTIONS

DESIGN BEAM OVER WINDOW (ON SIDE WALLS):
CONSIDER: L.L. $=20\ psf$



$V_{MAX.}=28.53^K$
LET $d=18''$ FIND $b=?$
$18''=28530/(.85)(2)(\sqrt{3000})(b)=306.4/b$
$b=16.3$, SAY $16''$
$\therefore t=18''$; $b=16''$; $d=15''$
$M_{MAX.}=195.4^{'-K}$
$\frac{(195.4)(12)}{(16)(15)^2(40)}=P[1-0.59(40/3)P]=P[1-7.87P]$
$0.0163=P[1-7.87P]$
$\therefore P=0.0192$
$\Rightarrow A_S=(0.0192)(16)(15)=4.61^{\square}$

USE 2-#10's & 2-#9's $\Rightarrow A_S=4.54^{\square}$

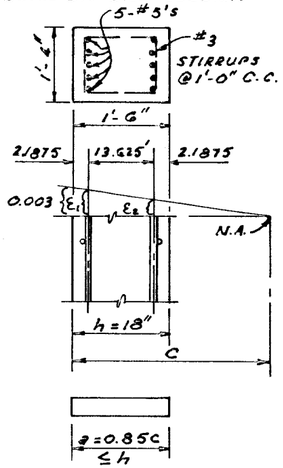
USE #3 STIRRUPS @ 18" O.C.

LET $\ell=8.08'$
FIND DEAD LOAD DEFLECTION:
$\Delta_{D.L.}=\frac{W\ell^4}{8EI}+\frac{P\ell^3}{3EI}=.13''$
FIND LIVE LOAD DEFLECTION:
$\Delta_{L.L.}=\frac{W\ell^4}{8EI}=.02''$
CONSIDER COLUMNS IN SIDE WALLS TO CARRY OVER-HANGING ROOF SYSTEM:

WEIGHT CALCULATIONS - [FOR PORTION OF ROOF SUPPORTED BY WALLS]
$\frac{\text{TOTAL LOAD}}{\text{LENGTH OF WALL}}=\frac{(30535.8+10396)}{28.42'}=1440\ ^{\#}/_{FT.}$

WEIGHT CALCULATIONS - [FOR PORTION OF ROOF WHICH IS A CANTILEVER]
TOTAL LOAD $=(50249.2+11912)=62161^{\#}$

LOAD ON ONE COLUMN



$(1.5)(1440\ ^{\#}/_{FT.})+\frac{62161^{\#}}{2}=33240.5^{\#}$ ↓
ASSUME $P=0.005 \Rightarrow \frac{A_S}{A_g}=0.005$
$\frac{A_S}{(16)(18)}=0.005$
$A_S=1.44^{\square}$
USE 5 #5's $\Rightarrow A_S=1.55^{\square}$ (EACH FACE)

COLUMN 8' TALL
ASSUME $e=0.1h=1.8''>1''$
USE $1.8'' \Rightarrow M=59833''^{\#}$
SLENDERNESS EFFECT
$K\ell_u/r < (34-12\ ^{M_1}/_{M_2})$
$(34-12\ ^{M_1}/_{M_2})=22$
NOTE e IS WITHIN MIDDLE 1/3
$K\ell_u/r=\frac{(1.0)(96)}{(0.3)(18)}=17.78$
$17.78<22$ $\therefore$ NEGLECT SLENDERNESS EFFECT

$P=33240.5^{\#}$
$M=59833''^{\#}$; $e=1.8''$
$\varepsilon_{s\ell}=\frac{40}{29\times10^3}=0.00138$

CASE A:
LET $e=0$; $C=\infty$; $a=18''$, $=\varepsilon_c=\varepsilon_1=\varepsilon_2=0.003$
KNOW $A_S=(1.55^{\square})(2)=3.10^{\square}$
$P_u=[0.70][(0.85)^2(3)(16)(18)+(3.10)(40)]=523.8^K$
$P_u=523.8^K$; $M_u=0$ ⟵

CASE B:
LET $C=\frac{18}{0.85}=21.18''$; $a=18''$
$\varepsilon_1=\left(\frac{0.003}{21.18}\right)(18.99)=0.00269>0.00138 \Rightarrow 0.00138=\varepsilon_1$
$\varepsilon_2=\left(\frac{0.003}{21.18}\right)(5.37)=0.00076$
$P_u=[0.7]\left[624.2+\left(\frac{3.10}{2}\right)(40)+\left(\frac{3.10}{2}\right)\left(\frac{0.00076}{0.00138}\right)(40)\right]=504.2^K$
$M_u=P_u e=(0.70)(62-34.1)(1/2)(13.625)=133.0''^{-K}$
$P_u=504.2^K$; $M_u=133.0''^{-K}$ ⟵
$e=0.2638''$

CASE C:
LET $C=18''$; $a=15.3''$
$\varepsilon_1=\left(\frac{13.3125}{18}\right)(0.003)=0.00264>0.00138 \Rightarrow$
$\varepsilon_1=0.00138$
$\varepsilon_2=\left(\frac{2.1875}{18}\right)(0.003)=0.00036$
$P_u=[0.70]\left[(0.85)^2(3)(15.3)(16)+\left(\frac{3.10}{2}\right)(40)+\left(\frac{3.10}{2}\right)(40)\left(\frac{36}{138}\right)\right]$
$P_u=426.1^K$
$M_u=P_u e=(371.4)(9-7.65)+(62-16.2)(6.8125)(.7)$
$P_u=426.1^K$; $M_u=719.8''^{-K}$
$e=1.6893''$

KNOW $M=59.8''^{-K}$; $P=33.2^K$ @ $e=1.8''$
USE #6's TO MATCH STEEL IN THE WALL

CONTROL HOUSE DESIGN

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CONTROL HOUSE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29 4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CONTROL HOUSE
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28370

FLOOR AND SPANDREL BEAM DESIGN

ASSUME $t = 1'-0"$; $d = 9"$

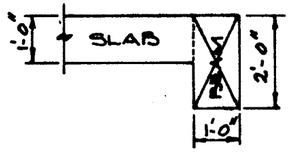
$w_1 = (1.7)(100\ psf) + (1.4)(1.0)(150\ pcf)$

$\rightarrow w_1 = 380\ psf$ SAY $0.4^{k}/_{ft}$ $\leftarrow$

$L_1/L_2 = 15.08/11.83 = 1.27 \leq 2 \Rightarrow$ TWO WAY ACTION

ASSUME COLUMN SIZE = 18"x18"

ASSUME BEAM SIZE = 12"x24"



ROOF LOAD = 72888#

WALL LOAD = 47177#

$\rightarrow w_2 = 2.85\ ^{k}/_{ft} \leftarrow$

SLAB $M_{o(SHORT)} = 0.125(0.4)(15.08)(11.83-1.0)^2(1.15) = 101.7\ ^{'-k}$ $\leftarrow$

BEAM $M_{o(SHORT)} = 0.125(2.85)(15.08)(11.83-{}^{18}/_{12})^2(1.15) = 660\ ^{'-k}$ $\leftarrow$

SLAB $M_{o(LONG)} = 0.125(0.4)(11.83)(15.08-1.0)^2(1.15) = 134.9\ ^{'-k}$ $\leftarrow$

BEAM $M_{o(LONG)} = 0.125(2.85)(11.83)(15.08-{}^{18}/_{12})^2(1.15) = 894\ ^{'-k}$ $\leftarrow$

ASPECT RATIO = 1.27

$\therefore$ C_i FOR SHORT BEAM = 1.2 - (.55)(1.27) = 0.5

C_i FOR M.S.S.D. = 0.6 (1-0.50) = 0.3

C_i FOR E.S.S.D. = 0.4 (1-0.50) = 0.2

C_i FOR LONG BEAM = 0.85 + 0.3(1.27) = 0.73

C_i FOR M.S.L.D. = 0.6 (1-0.73) = 0.16

C_i FOR E.S.L.D. = 0.4 (1-0.73) = 0.11

1ST TRIAL

MAXIMUM BEAM MOMENT = $(0.73)(894\ ^{'-k})(0.6) = 392\ ^{'-k}$

$(392\ ^{'-k})(12) = (12)(21)^2(40)[P(1-7.87P)]$

$\therefore P > P_{MAX.} = 0.021 \Rightarrow$ INCREASE SIZE OF BEAM

$d_{REQ'D.} = \frac{V}{\phi v_{cb}} = \frac{20961\#}{(.85)(2)(\sqrt{5000})(12)} = 18.8"$ O.K.

$(392)(12) = (12)(d)^2(40)[P(1-7.87P)]$

LET $P = 0.020$

$d = 24.1$ SAY $25"$ O.K.

LET $t = 28"$; $d = 25"$

$w_2 = 2.85\ ^{k}/_{ft}$

BEAM $M_{o(SHORT)} = (0.125)(2.86)(15.08)(11.83-{}^{18}/_{12})^2(1.15) = 662\ ^{'-k}$ $\leftarrow$

BEAM $M_{o(LONG)} = (0.125)(2.86)(11.83)(15.08-{}^{18}/_{12})^2(1.15) = 898\ ^{'-k}$ $\leftarrow$

2ND TRIAL

MAXIMUM BEAM MOMENT = $(0.73)(898)(0.6) = 394\ ^{'-k}$

$(394\ ^{'-k})(12) = (12)(25)^2(40)[P(1-7.87P)]$

$\Rightarrow P = 0.0185$

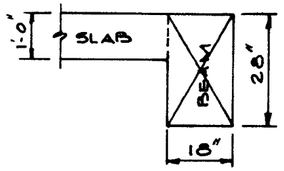
$\therefore P = 0.0185$

$\Rightarrow A_s = (0.0185)(12)(25) = 5.55$

USE 6-#9's $\Rightarrow A_s = 6.0^{\square"}$

NOTE: MUST INCREASE "b" TO 18"

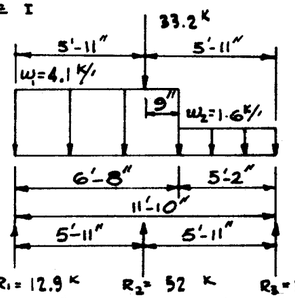
NOTE: USE # 3 STIRRUPS @ 18" O.C.



NOTE: TO ACCOMMODATE PILE CONNECTION "t" WAS INCREASED TO 30"

RE-DESIGN SPANDREL BEAM: (SINCE WE'VE ADDED 4 PILES TO THE STRUCTURE)

CASE I



(CONSIDER ENDS FIXED)

$t = 2'-6" = 30"$; $b = 18"$; $d = 25.5"$

$M_{MAX.} = 13.7\ ^{'-k}$; $V_{MAX.} = 12.9^{k}$

$d_{REQ'D.} = \frac{12900}{(2)(.85)(18)\sqrt{5000}} = 7.7$

$\bar{M} = \frac{13.7\ ^{'-k}}{0.9} = 15.2\ ^{'-k}$

$\bar{M} = pbd^2 f_y\left(1-0.59\frac{pf_y}{f'_c}\right)$

$0.00039 = P[1-7.87P]$

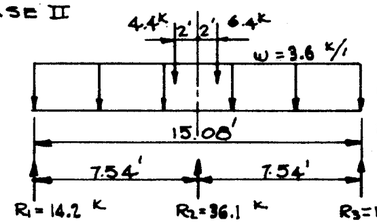
$\therefore P = 0.00039$; $P_{MIN.} = .005$

$\Rightarrow A_s = (0.005)(18)(25.5) = 2.3^{\square"}$

$\therefore$ USE 6-#6 E.F. $\Rightarrow A_s = 2.64^{\square"}$

NOTE: LEAVE 6-#9's

CASE II



(CONSIDER END FIXED)

NOTE: THE TWO CONC. LOADS ARE FROM ENTRANCE PLATFORM AND STAIRWAY.

$t = 30"$; $d = 25.5"$; $b = 18"$

$d_{REQ'D.} = \frac{18050}{2\sqrt{f'_c}(18)(.85)} = 10.8$

$M_{MAX.}$ CASE I = 15.2 $^{'-k}$

$M_{MAX.}$ CASE II = 25.4 $^{'-k}$

$\therefore A_{s\,MIN.}$ 15 O.K.

MAXIMUM SLAB MOMENT:

$[(0.3)(101.7)(.6)] \div [7.04] = 2.6\ ^{'-k}/_{ft}$ $\leftarrow$

OR

$[(0.16)(134.9)(.6)] \div [5.42] = 2.39\ ^{'-k}/_{ft}$

MAX. MOMENT = $2.6\ ^{'-k}/_{ft}$ (M.S.S.D.)

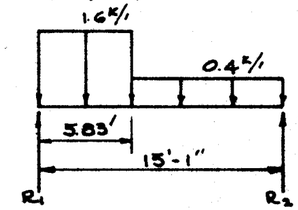
$(2.6\ ^{'-k})(12) = (12)(9)^2(40)[P(1-7.87P)]$

$0.0008 = P(1-7.87P)$

$\therefore$ USE $A_{s(MIN.)} = 0.002\,bt = 0.29^{\square"}/_{ft}$

USE #5's @ 1'-0" E.F. & B.D.

CONSIDER A ONE FOOT WIDE BEAM IN FLOOR SLAB SUPPORTING INTERIOR WALL (LONG DIRECTION OF FLOOR):



NOTE: $M_{MAX.} = 23.4\ ^{'-k}$

$V_{MAX.} = 8.66^{k}$

$d_{REQ'D.} = 7.75" < 9"$ O.K.

$\bar{M} = \frac{23.4}{.9} = 26.0\ ^{'-k}$

$t = 12"$; $d = 9"$; $b = 12"$

$\bar{M} = pd^2 bf_y(1-0.59q)$

$0.0080 = P(1-7.87P)$

$\therefore P = 0.0086$

$\Rightarrow A_s = (0.0086)(12)(9) = 0.929^{\square"}$

USE 3-#5 E.F. $\Rightarrow A_s = 0.93^{\square"}$

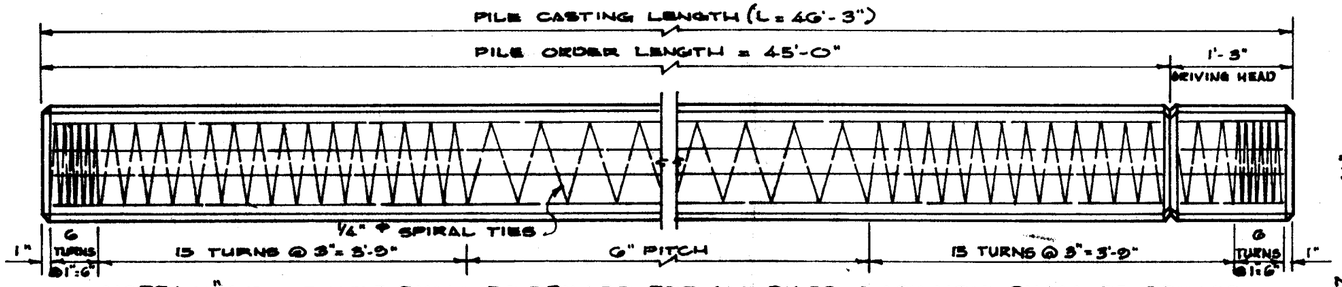
NOTE: USE UNDER EACH INTERIOR WALL

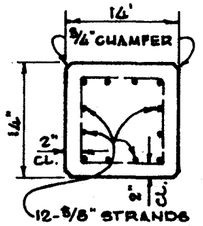
CONTROL HOUSE DESIGN

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CONTROL HOUSE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEM'S M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CONTROL HOUSE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. H-2-28470





NOTE: SECTION MODULUS = 457 IN.³

NOTE: 10"ϕ PILOT HOLE SHALL BE DRILLED FOR ALL PILES. EACH HOLE SHALL BE DRILLED UP TO 5 FEET FROM DESIGN TIP ELEVATION. THE HOLE SHALL BE MADE BY A ROTARY WELL DRILL AND KEPT OPEN BY DRILLING MUD. EVERY PRECAUTION SHALL BE TAKEN TO KEEP THE HOLE OPEN. THE BLOW COUNT SHALL BE LIMITED TO 50 BLOWS PER FOOT, WITH THE VULCAN No. 1 SINGLE ACTING HAMMER.

PILE DESIGN

TOTAL DEAD LOAD = 82360.0# + 43959.7# + 2843.2#

LIVE LOADS —
TOTAL LIVE LOAD = 8748.2# + 14437.5#

PILE LENGTH
CONSIDER PILES ACTING INDEPENDENTLY (8-14"x14" PILES)
CAPACITY REQ'D. = [(2)(2843.2# + 43959.7# + 82360.0# + 8748.2# + 14437.5#)] ÷ [8] + (2)(WT. OF PILES) + (INCREASE DUE TO MAX. MOMENT)(2)
= 30089.4# + (2)(WT. OF PILES) + (2)(INCREASE DUE TO MAX. MOMENT)

FOR 16.5' → C = 400 psf; ϕ = 0; γ = 102 pcf; "K" FOR SMOOTH FORM CONC. = 17°
F = C₂ + σ'h TAN K = 55983.5# (OR) F = C' + σ'h TAN ϕ
F = 34588.9# ← GOVERNS

CAPACITY REQ'D. @ THIS PT. = 30089.4# + 10004.2# + $\left(\frac{143378.9^{1-\#}}{3}/10.33\right)(2)$
= 57346.8

NEXT 4' → C = 200 psf; ϕ = 15°; K = 117 pcf
F = 15404.5# (OR) F = 14542.0# ← GOVERNS
PILE CAPACITY = 48875.3#

CAPACITY REQ'D. = 57346.8# + [2] $\left[\left(1+\frac{2}{12}\right)^2(4)(150)\right]$ = 58,980.1#

NEXT 13' → C = 0 psf; ϕ = 30°; K = 120 psf
P = 55140.5# ← GOVERNS (OR) F = 100806.3#
PILE CAPACITY = 107022.2#

CAPACITY REQ'D. = 58980.1# + [2] $\left[\left(1+\frac{2}{12}\right)^2(13)(150)\right]$ = 64288.4 O.K.

DIST. OF PILE OUT OF GROUND = 6'
1'-3" DRIVING CAP
∴ PILE LENGTH REQ'D. = 35.5 + 6' + 1.25' = 42.75'

USE PILE LENGTH OF 46'-3"

PILE LOADINGS —

CASE I — WITHOUT WIND LOAD
U = 1.4 D + 1.7 L = 220257#
U/PILE = 13.77 TONS/PILE

CASE II — ASSUME SEVERE WIND CONDITIONS
∴ 35 psf
(a) IF WINDS ARE FROM NORTH OR SOUTH
WIND FORCE = 6538
ASSUME POINT OF FIXITY @ 10' BELOW GROUND
→ H = 27.66'
MOMENT = 182808'-#
MAX. AXIAL LOAD ON PILE = $\frac{(220257^{\#})(0.75)}{8} + \frac{182808^{1-\#}}{3}/10.33$
= 26548# = 13.3 TONS.

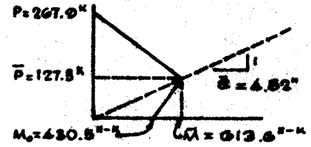
(b) IF WINDS ARE FROM EAST OR WEST
WIND FORCE = 5261.2
MOMENT = 148734.0'-#
MAX. AXIAL LOAD ON PILE = $\frac{220257^{\#}(0.75)}{8} + \frac{148734.0^{1-\#}}{3}/13.56$ = 24300.0#
= 12.2 TONS

8-14"x14" PILES
12 STRANDS @ 3/8" DIA.
14,000# OF PRESTRESSING/STRAND
ASSUME LOSSES = 35,000 psi + 20%
f's = 200,000 psi; f'c = 5000 psi
As/STRAND = 0.11045 in²
$r = \sqrt{I/A} = \sqrt{\frac{(14)^4}{12}/14^2} = 4.04$
ASSUME COLUMN EFFECTIVE LENGTH = 16'
$h/r = \frac{(16)(12)}{4.04} = 47.52 > 30$ BUT $< 100 \Rightarrow$ INTERMEDIATE COLUMN
$R = 1.22 - 0.007(h/r) \leq 1 = 0.887$

ASSUMED LOADINGS —
CASE I — M = 0 ←
P = (13.77 TONS)(2000)/R = 31048# = 31.0^K ←
CASE II — M = $\left[\frac{182808^{1-\#}}{8}\right]/[R]$ = 25762 '-# = 309.0 '-^K →
P = (13.3 TONS)(2000)/R = 29989.0# = 30.0^K ←
CASE III — M = $\left[\frac{148734.0^{1-\#}}{8}\right]/[R]$ = 20960.0'-# = 251.5 '-^K →
P = (12.2 TONS)(2000)/R = 27508.0# = 27.5^K ←

NOTE: PILES WILL BE DESIGNED AS TIED COLUMNS ⇒ "P" MUST BE REDUCED BY 15%

Fe = $\left(\frac{140000^{\#}}{0.11045} - 35{,}000\ psi\right)(0.11045)(12)(0.8)$ = 97268.8#
f'ce = Fe/Ag = 450.4 psi
A's = 0
CASE II → e = 7.80" ; CASE III → e = 5.86"
$\bar{e} = 0.25t\left(1+200\frac{f'ce}{f'c}\right) \leq 0.5t = 4.82" \leq 7"$
∴ e > ē FOR CASE II & III
∴ $\bar{P} = 0.17\,f'c\,Ag\left(1-85\frac{f'ce}{f'c}\right) \geq 0.05\,f'c\,Ag$
P̄ = 127817# ≥ 78400#
P̄ = 127.8^K
M̄ = (ē)(P̄) = (4.82")(127.8^K) = 613.6 "-^K
Me = 0.4 Mu
Mu = 0.29 d As f's ; d = 14"
Mu = 1076224.8 "-# = 1076.2 "-^K
Mo = 430.5.0 "-^K
P = [0.34 f'c Ag + f's A's − 0.4 Fe (0.44 + 0.000045 f'ce)] [0.85]
P = [(0.34)(5000)(14)² (0.4) − (0.4)(97268.8#)] [0.44 + (0.000045)(496.4)] [0.85]
P = 207027# = 207.0^K

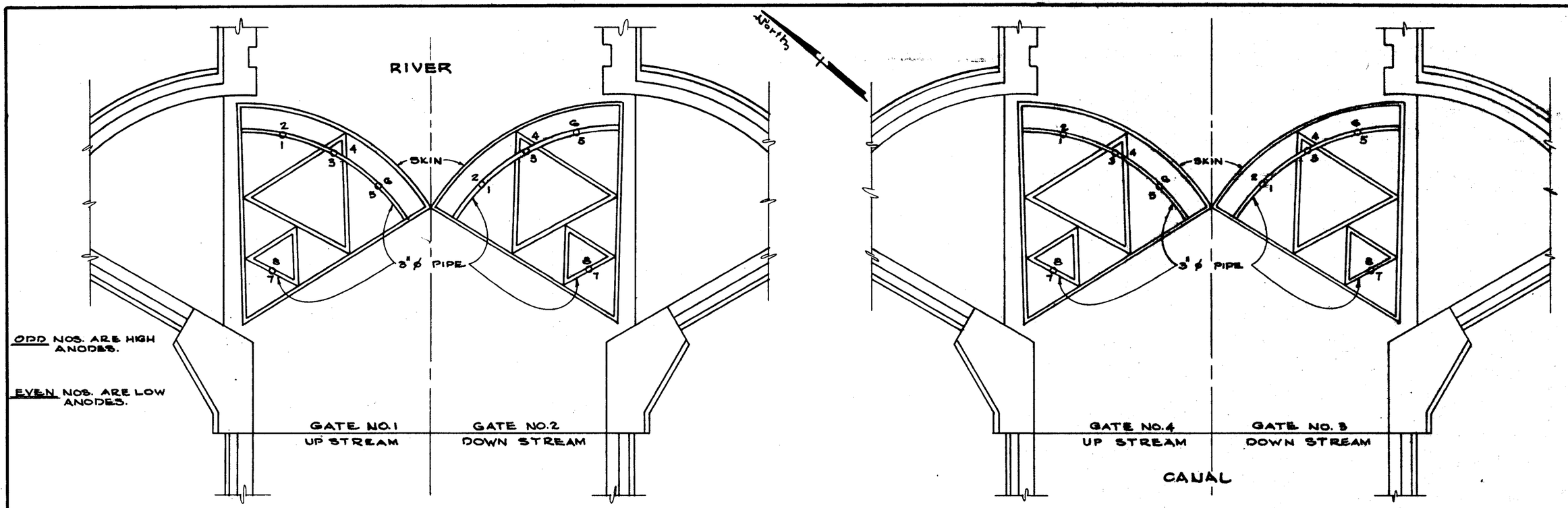


CASE I — $P_1 = 31.0^K$, $M_1 = 0$
CASE II — $P_2 = 30.0^K$, $M_2 = 309.0\ "-^K$
CASE III — $P_3 = 27.5^K$, $M_3 = 251.5\ "-^K$
} ALL PTS. ARE O.K.

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS

CONTROL HOUSE

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CONTROL HOUSE
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978 FILE NO. H-2-28370



RIVERSIDE GATES

CANALSIDE GATES

CATHODIC PROTECTION SYSTEM

SCALE: 1" = 10'

NOTE:

THE EXISTING CATHODIC PROTECTION SYSTEM FOR EMPIRE LOCKS CONSIST OF EIGHT - 60#. MAGNESIUM ANODES PER GATE; FOUR ARE SUSPENDED 17' BELOW THE DECK AND FOUR ARE SUSPENDED 11.0' BELOW THE DECK. THE ANODES ARE SUSPENDED AT ALTERNATE ELEVATIONS AS PER DETAILS SHOWN ON THIS SHEET.
JAMES H. COLLINS IS THE CATHODIC PROTECTION CONSULTING ENGINEER FOR EMPIRE AND OSTRICA LOCKS. MR. COLLINS HAS COMPLETED A STUDY OF THE EFFECT OF THE PROPOSED VERTICAL ADDITION. IN CONCLUSION, THE EXISTING CATHODIC SYSTEM WAS FOUND TO BE EFFECTIVE, HOWEVER, MOST OF THE ANODES AND ALL OF THE WIRES REQUIRE REPLACING.
PRIOR TO BEGINNING WORK ON THE CATHODIC PROTECTION SYSTEM, THE CONTRACTOR MUST MEET WITH JAMES H. COLLINS. MR. COLLINS' APPROVAL WILL BE REQUIRED BEFORE THE CONTRACTOR'S WORK ON THE SYSTEM IS ACCEPTED.
THE CONTRACTOR WILL BE SUPPLIED WITH THE 60# MAGNESIUM ANODES. THE CONTRACTOR WILL BE REQUIRED TO PROVIDE ALL MATERIALS, TOOLS, AND LABOR TO:

1. RELOCATE THE 3" ϕ PIPE TO THE NEW WALKWAY ELEVATIONS FOR RIVER GATE. (NOTE - ANODES WILL BE REPLACED AT EXIST. ELEVS.)
2. INSTALL ANODES (NOTE - CONTRACTOR WILL BE SUPPLIED WITH 60# ANODES AS REQUIRED.)
3. FURNISH & INSTALL NEW WIRES OF SAME SIZE AS EXISTING WIRES IN PLACE OF ALL EXISTING WIRES. (NOTE WIRE CONNECTIONS REQUIRE CADWELDS.)

DRAWN BY STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION
AND DEVELOPMENT OFFICE OF PUBLIC WORKS.

CATHODIC PROTECTION SYSTEM

MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES
ITEMS M-29.4
EMPIRE LOCK - MODIFICATIONS
DESIGN MEMORANDUM NO. 54
RELOCATION OF FACILITIES
CATHODIC PROTECTION SYSTEM
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
MAY 1978
FILE NO. M-2-28370

PLATE V-1

FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES

MISSISSIPPI RIVER LEVEES

ITEM M-29.4-R

EMPIRE LOCK MODIFICATIONS

PLAQUEMINES PARISH, LOUISIANA

RELOCATION OF FACILITIES

DESIGN MEMORANDUM NO. 54

APPENDIX I

ATTORNEY'S REPORTS

ATTORNEY'S INVESTIGATION AND
REPORT OF COMPENSABLE INTEREST

EMPIRE LOCK MODIFICATION
ITEM M-29.4
FLOOD CONTROL, MISSISSIPPI RIVER AND TRIBUTARIES
MISSISSIPPI RIVER LEVEES

This investigation and report is made in accordance with DIVR 1110-2-2 (see also DIVR 1110-2-1, 29 January 1968) and ER 1180-1-1, Section 73, Part 3, 73-203 and 73-204 on the following facilities which will be affected by the subject project.

EMPIRE LOCK

The subject facility is owned, operated, and maintained by the State of Louisiana, by and through the Department of Public Works. The lock is located at Empire, Plaquemines Parish, Louisiana, on the west bank of the Mississippi River, at approximate river mile 29.4 AHP.

Very little is known of the early history of the Doullut Canal in which the subject lock is located. However, it is known that this canal, an artificial outlet to the Mississippi River, was constructed some time in the beginning of the 20th century by one Milton P. Doullut and taken over by the State of Louisiana some time after that. The State constructed a lock and connecting levees. The State of Louisiana, by and through the Department of Public Works, by letter dated 11 January 1946 applied to the New Orleans District Engineer for a permit to replace the existing lock.

The request not being entirely routine since the proposed work was the first step in the future construction to replace an existing lock in a State-owned canal operated for many years without a permit, the District Engineer, by 1st indorsement dated 4 February 1946, submitted the State's request to the Chief of Engineers, U.S. Army, Washington, D.C. By 3rd indorsement dated 11 March 1946, the Office of the Chief of Engineers authorized the District Engineer to inform the State that the Department had no objection to the proposed construction of the river gate and connecting levees from the standpoint of navigation. By letter dated 2 April 1946, the District Engineer informed the State that the Department had no objection to the construction of the proposed work.

COMPENSABLE INTEREST AND OBLIGATION

Although the Doullut Canal is artificial and is located entirely within the boundary of the State of Louisiana and is owned and operated by it, it does not have a compensable interest in the subject structure and canal. Therefore, the Federal Government is not obligated to relocate the structure. The canal does sustain navigation, pleasure boats, and small commercial vessels, largely in the fish and oyster trade. It's origin as an artificial channel with subsequent man-made improvements does not alter its navigable, subservient character to the superior navigation servitude of the United States. See Perry v. Haines, 191 U.S. 17, 24 S. Ct. 8, 48 L.Ed. 73.

In the case involving the Illinois and Michigan Canal, a man-made waterway connecting Lake Michigan and the Chicago River with the Illinois and the Mississippi, the Supreme Court of the United States, in holding this to be a navigable waterway of the United States, declared:

"Navigable water situated as this canal is, used for the purposes for which it is used, a highway for commerce between ports and different places in different states . . . is public water of the United States and within the legitimate scope of the Admiralty jurisdiction conferred by the Constitution and Statutes of the United States, even though the canal is wholly artificial, and is wholly within the body of a state . . .." Ex parte Boyd, 109 U.S. 629.

In a Louisiana case, United Geophysical Company v. John Vela, 231 F2d 816, The United States Court of Appeals, Fifth Circuit, held the following:

"That a navigable stream ran for a distance through private property, did not change its character from being navigable water of the United States or restrict users from plying on through waters bounded by private property to end of waterway."

DISCRETIONARY AUTHORITY OF THE CHIEF OF ENGINEERS

Under the provisions of Section 111 of 72 Stat. 303, as amended by Section 309 of 79 Stat. 1094 (33 U.S.C. 633), the Chief of Engineers may in civil works projects, protect, alter, reconstruct, relocate or replace any structure or facility owned by an agency of Government (state, county, city or town, or any legally created subdivision thereof) and utilized in the performance of a Government function.

The provisions of this section may be applied to projects hereafter authorized and to those heretofore authorized but not completed as of July 3, 1958, and notwithstanding the navigation servitude vested in the United States, they may be applied to such structures or facilities occupying the beds of navigable waters of the United States. Public Law 85-500, Title I, section 111, July 3, 1958, 72 Stat. 303; Public Law 89-298, Title III, section 309, Oct. 27, 1965, 79 Stat. 1094.

Date: 1 February 1977

Chester C. Nolan

CHESTER C. NOLAN
Attorney
Real Estate Division
US Army Engineer District
New Orleans