NEW ORLEANS TO VENICE, LOUISIANA

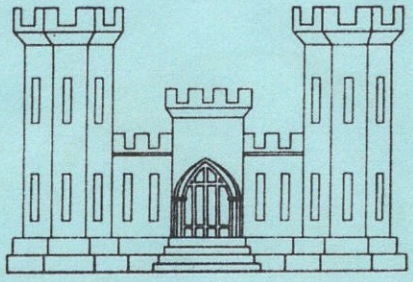
HURRICANE PROTECTION

REACH B-1 - TROPICAL BEND TO FORT JACKSON

EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 2

4 OCTOBER 1978



DEPARTMENT OF THE ARMY

NEW ORLEANS DISTRICT, CORPS OF ENGINEERS

NEW ORLEANS, LOUISIANA

Mr. Patel/kg/464

IN REPLY REFER TO
LMNED-DG

2 February 1979

SUBJECT: New Orleans to Venice, Louisiana (Hurricane Protection); Empire to the Gulf of Mexico Waterway; Empire Floodgate, Periodic Inspection Report No. 2, October 1978

Division Engineer, Lower Mississippi Valley
ATTN: LMVED-G

1. Subject report in compliance with ER 1110-2-100, is submitted herewith for review and approval.

2. Approval of the report is recommended.

FOR THE DISTRICT ENGINEER:

1 Incl (quad)
as

FREDERIC M. CHATRY
Chief, Engineering Division

MARSALONE
LMNED-DG

JOHNSON
LMNED-DD

BRUPBACHER
LMNED-D

PICCIOLA
LMNED-F

BECNEL
LMNED-H

CHATRY
LMNED

NETTTLES
LMNCD

LMVED-G (NOD 2 Feb 79) 1st Ind
SUBJECT: New Orleans to Venice, Louisiana (Hurricane Protection); Empire to the Gulf of Mexico Waterway; Empire Floodgate, Periodic Inspection Report No. 2, October 1978

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 12 JUN 79

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

The inclosed inspection report is approved subject to the following comments:

a. Para 2-01, page II-1. The location map mentioned in this paragraph has not been included in the report. No change is necessary for this report. However, future similar inspection reports for this project should include this location map.

b. Para 4-02a, page IV-1. This paragraph states in part, ". . . mark 3+43E settled 1.05 feet and mark 3+43W settled 0.80 feet. Therefore, the alignment survey indicating that the structure possibly moved to the north is erroneous." The rationale for these statements is not fully understood. Additional explanations should, therefore, be given stating the method for determining settlement of these marks, how the settlement of these marks affects the lateral movement measurements, and reasons why the location of these marks cannot be more precisely determined.

c. Para 4-02b and Plate I-2.

(1) The third sentence states that the survey of September 1978 shows some settlements and some rebounds. The data presented on Plate I-2 show no rebound of the structure and T-wall. Rebound is shown for some points on the sheet piling and levee. This paragraph should be revised for clarity.

(2) In future similar inspection reports for this project, the settlement reference mark data for the sheet piling and levee shown on Plate I-2 should be plotted on a plate similar to Plates I-3 and I-4.

d. Para 5-03d, page V-3. This paragraph mentions riprap erosion protection that is missing on most of the slope south of the east wall. This proposed remedial action for this item should be included in para 6-02.

FOR THE DIVISION ENGINEER:

1 Incl
3 cy incl 1 wd

R. H. RESTA
Chief, Engineering Division

CF:
HQDA (DAEN-CWE-BB) w incl
& cy bsc ltr

Mr. Patel/jm/464

LMNED-DG (2 Feb 79) 2d Ind
SUBJECT: New Orleans to Venice, Louisiana (Hurricane Protection); Empire to the Gulf of Mexico Waterway; Empire Floodgate, Periodic Inspection Report No. 2, October 1978

DA, New Orleans District, Corps of Engineers, PO Box 60267, New Orleans, Louisiana 70160 20 July 1979

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

Disposition of comments a. through d. presented in 1st Indorsement follows:

a. Pages IV-1, IV-2 and VI-1 have been revised in accordance with your comments. Copies of the revised pages are inclosed and should be inserted in your copies of the report.

b. In future similar inspection reports, the location map will be included, and the settlement data for the sheet piling and levee will be plotted similar to Plates I-3 and I-4.

FOR THE DISTRICT ENGINEER:

MARSALONE
LMNED-DG

JUDLIN
LMNED-DA

1 Incl
wd incl 1
added incl 2 (trip)
2. as

FREDERIC M. CHATRY
Chief, Engineering Division

CHATRY
LMNED

LMVED-G (NOD 2 Feb 79) 3d Ind
SUBJECT: New Orleans to Venice, Louisiana (Hurricane Protection); Empire to the Gulf of Mexico Waterway; Empire Floodgate, Periodic Inspection Report No. 2, October 1978

DA, Lower Mississippi Valley Division, Corps of Engineers, Vicksburg, Miss. 39180 13 AUG 79

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

The disposition of comments furnished by the 2d Ind is satisfactory.

FOR THE DIVISION ENGINEER:

R. H. RESTA
Chief, Engineering Division

wd incl

CF:
HQDA (DAEN-CWE-BB) w incl 2
& cy 2d Ind

NEW ORLEANS TO VENICE, LOUISIANA

HURRICANE PROTECTION

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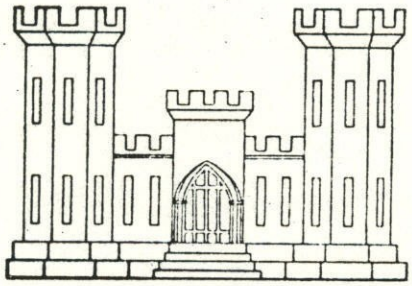
EMPIRE FLOODGATE

PERIODIC INSPECTION REPORT NO. 2

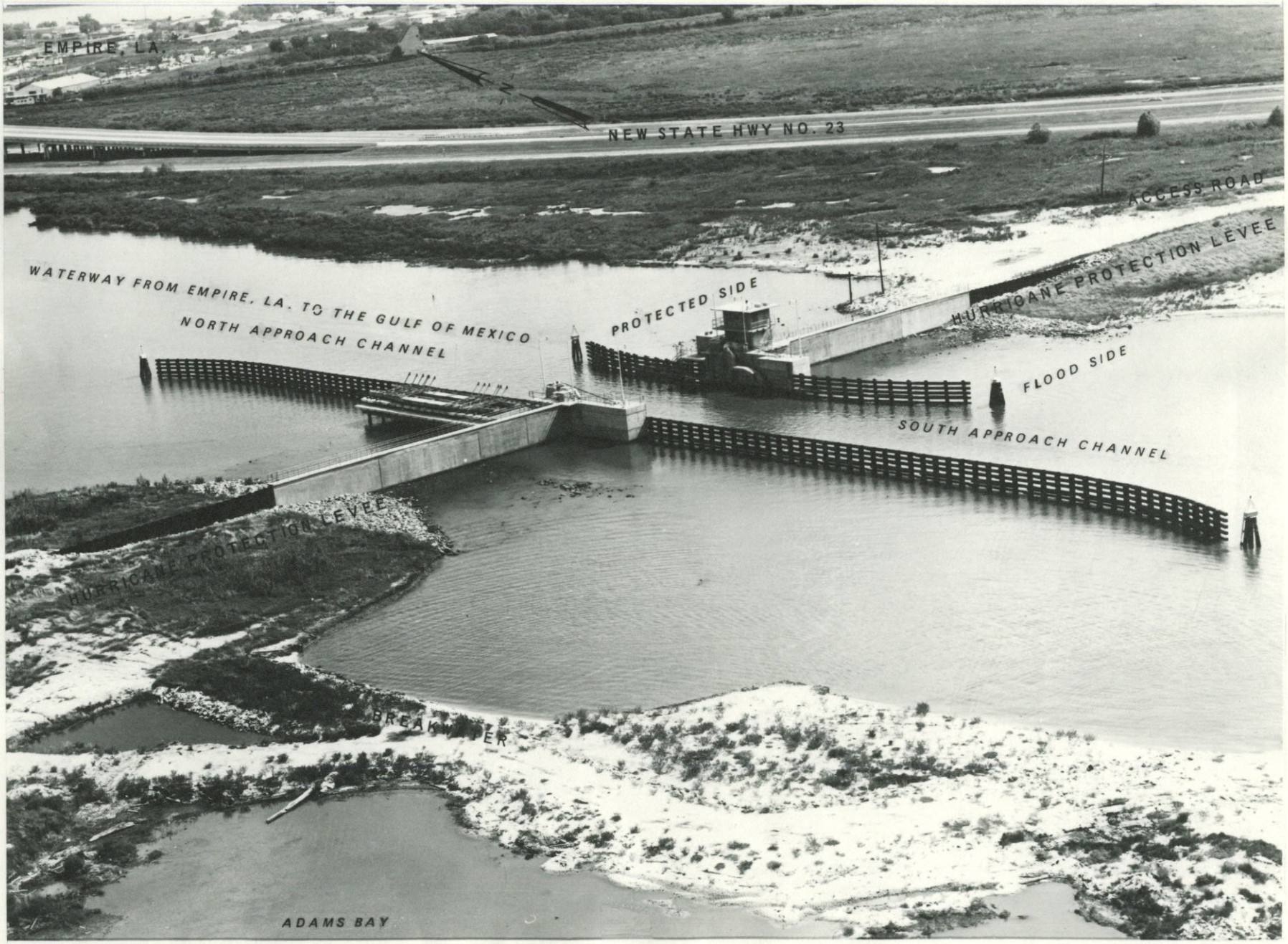
OCTOBER 1978



U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

NEW ORLEANS, LA



EMPIRE FLOODGATE

PHOTO TAKEN 28 JULY 1976

EMPIRE FLOODGATE

PERIODIC INSPECTION NO. 2

TABLE OF CONTENTS

SECTION I - INTRODUCTION

1-01 Authority. Authority is provided by ER 1110-2-100, subject, "Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures".

1-02 Purpose and Scope. The results and conclusions of the inspection and evaluation for assuring the structural integrity and operational adequacy of the structure are presented herein.

1-03 Datum. All elevations, except where otherwise indicated, are in feet and refer to mean sea level (m.s.l.).

SECTION II - PROJECT DESCRIPTION AND BACKGROUND

2-01 General. The description of the structure, historical and other general background information, are included in report no. 1 which also contains selected construction drawings illustrating typical sections and details. A location map is included in this report (plate I-1). This report is supplementary to previously numbered reports.

SECTION III - CURRENT OPERATION AND MAINTENANCE DATA

3-01 Operating Statistics. Permanent statistics are not kept for this floodgate.

3-02 Operation and Maintenance Problems. The following work was done at the structure since the last inspection.

a. Replacement of broken counterweight chains. This work involved raising two counterweights and tying them off while the broken chains were replaced. This work was performed on 2-3 May 77.

b. WES tests on chains. WES installed measuring devices on the chains and obtained strain and acceleration measurements on the chains under controlled load conditions. Testings were performed on 8 Dec 77. Results of the testing are shown in Appendix A.

c. Replacement of two hoist wildcats. This work involved cutting the pillow blocks, removing the old wildcats and installing two new wildcats. This work was performed on 13-31 Mar 78.

3-03 Action on Deficiencies from Last Inspection. The proposed remedial work included in the last inspection report was accomplished. The work consisted of: the placing of riprap, increasing the idler drum diameter from 8 to 14 inches, repositioning the gate locking device retainer plates, and sufficiently grinding down flap gate bearing plates to allow proper bearing against the reaction grillage bearing surface.

SECTION IV - REVIEW OF DESIGN AND ANALYSIS OF INSTRUMENTATION

4-01 Review of Design. Current design criteria contained in EM 1110-1-2101, dated November 1963, were compared to original design criteria and found to be in close agreement. In studying the overall stability of safety of the structure, no errors in the design were found. The assumptions and criteria listed in the design analysis remained approximately the same as shown in Periodic Inspection Report No. 1 dated September 1975 in Section III. No critical dangers were found from a brief comparison between the original design criteria and current design criteria. The stability of the structure was not checked for dewatering case at this time, but will be analyzed carefully when the structure is scheduled for dewatering. Overall, the analyses show the structure to be stable and structurally sound.

The earthquake design criteria have been revised by ER 1110-2-1806 dated 30 April 1977. These new criteria reduce the coefficient of earthquake acceleration to 0.025g. The analysis of earthquake loading will be done at the time of dewatering analysis.

4-02 Analysis of Instrumentation.

a. Alinement. The alinement surveys indicate an apparent movement to the north. However, no indication of any horizontal movement of this magnitude was observed during the inspection. Moreover, the reference marks (3+43E & 3+43W) used as the basis for the measurement reflected vertical movement (settlement) of 1.08 feet and 0.8 foot, respectively. The magnitude of horizontal movement, if any, could not be determined, but the reliability of the reference marks for precise measurements is questionable. For future surveys, consideration will be given to establishing new reference marks beyond the zone of influence of the levees adjacent to the structure.

Revised July 1979

SECTION IV - REVIEW OF DESIGN AND ANALYSIS OF INSTRUMENTATION

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The earthquake design criteria has been revised by ER 1110-2-1806 dated 30 April 77. This new criteria reduces the coefficient of earthquake acceleration to 0.025g. The analysis of earthquake loading will be done at the time of dewatering analysis.

4-02 Analysis of Instrumentation.

a. Alinement. Alinement survey is based on two reference marks 3+43E and 3+43W. Between Dec 75 and Sep 78, mark 3+43E settled 1.05 feet and mark 3+43W settled 0.80 feet. Therefore, the alinement survey indicating that the structure possibly moved to the north is erroneous. No indication of horizontal movement was observed in this inspection.

VOID

SEE REVISED PAGE

b. Settlement. Between December 1975 and May 1976 very little settlement has occurred at the structure. Between May 1976 and July 1977, settlement survey shows greater settlement than previous survey. Present survey of September 1978 shows some points on sheet piling and levee apparently rebounding slightly. It also appears that elevation of PBM is questionable. Elevation of PBM will be reestablished in next survey. No distress cracks were observed at the structure in the inspection.

c. Distances Between Reference Marks. No major movement is indicated.

d. Scour Survey. No scour problems were noted at the structure. Some minor siltation has occurred near the structure, but no action is required at the present.

4-03 Instrumentation Plates.

Plate No.	Title	File No.
I-1	Location of Instrumentation	H-4-27323
I-2	Alinement and Settlement Reference Marks - Tabulation	H-4-27323
I-2A	Alinement Differential Chart	H-4-27323
I-3	Settlement and Reference Marks Differential Movement	H-4-27323
I-4	Settlement and Reference Marks Differential Movement	H-4-27323
I-5	Plan and Profile	H-4-27323
I-6	Scour Survey (ranges 0+37-0+79 South)	H-4-27323
I-7	Scour Survey (ranges 1+00-3+00 South)	H-4-27323

b. Settlement. Between December 1975 and May 1976 very little settlement has occurred at the structure. Between May 76 and July 77, settlement survey shows greater settlement than previous survey. Present survey of September 1978 shows some settlements and some rebounds. It also appears that elevation of PBM is not accurate as it should be. Elevation of PBM will be reestablished in next survey. The subsequent survey may show true picture of structure and reference marks. No distress cracks were observed at the structure in the inspection.

c. Distances between reference marks. No major movement is indicated.

d. Scour Survey. No scour problems were noted at the structure. Some minor siltation has occurred near the structure, but no action is required at the present.

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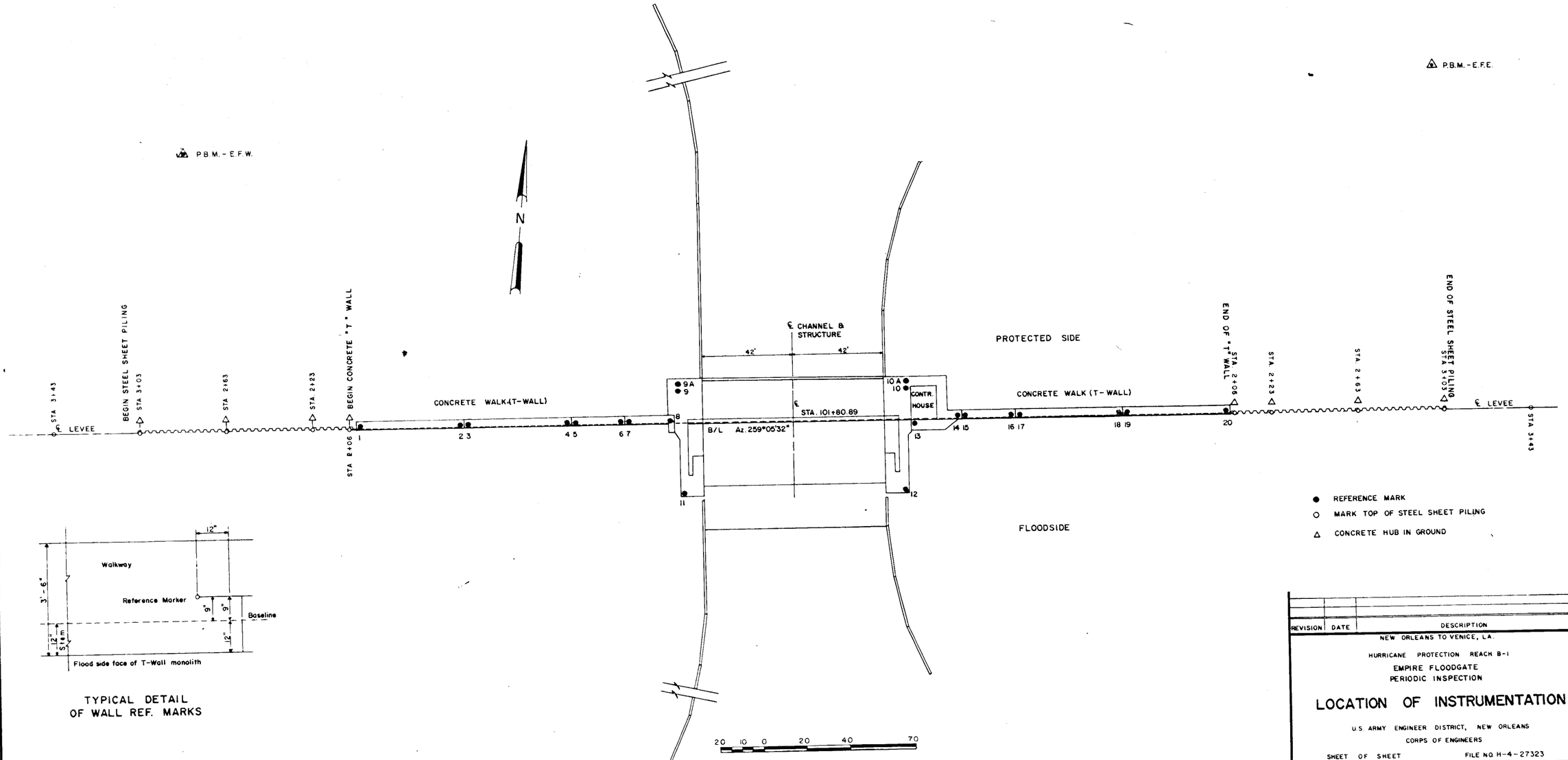
Plate No.	Title	File No.
I-8	Scour Survey (ranges 4+00-5+00 South)	H-4-27323
I-9	Scour Survey (ranges 0+19-0+74 North)	H-4-27323
I-10	Scour Survey (ranges 0+96-3+00 North)	H-4-27323
I-11	Scour Survey (ranges 4+00-5+00 North)	H-4-27323



TYPICAL DETAIL
OF WALL REF. MARKS

REVISION	DATE	DESCRIPTION	BY

NEW ORLEANS TO VENICE, LA.

HURRICANE PROTECTION REACH B-1

EMPIRE FLOODGATE
PERIODIC INSPECTION

LOCATION OF INSTRUMENTATION

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

SHEET OF SHEET FILE NO. H-4-27323

PLATE I-1

SETTLEMENT REFERENCE MARK - SHEET PILING & LEVEE

REFERENCE MARK EAST OR WEST	2+06E	2+06E	2+23E	2+23E	2+63E	2+63E	3+03E	3+03E	3+43E	E-W	2+06W	2+06W	2+23W	2+23W	2+63W	2+63W	3+03W	3+03W	3+43W
INITIAL DATE	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75		12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75
ORIGINAL READINGS	14.13	7.65	13.89	8.13	13.78	7.96	13.76	14.45	14.11		13.87	7.11	13.38	7.56	13.03	7.80	12.65	13.91	11.69
DATE OF OBSERVATIONS: 19 MAY 1976	14.01	7.46	13.69	7.92	13.45	7.62	13.33	13.96	13.64		13.82	7.04	13.31	7.48	12.94	7.66	12.52	13.75	11.49
18 APRIL 1977	13.86	7.26	13.51	7.70	13.20	7.34	13.02	13.54	13.31		13.74	6.90	13.22	7.35	12.80	7.52	12.36	13.53	13.03
5 JULY 1977	13.84	7.21	13.48	7.65	13.16	7.29	12.98	13.47	13.24		12.74	6.87	13.22	7.31	12.79	7.49	12.34	13.48	11.21
9 NOVEMBER 1977	13.82	7.18	13.45	7.62	13.12	7.24	12.92	13.37	13.17		13.71	6.84	13.17	7.28	12.74	7.45	12.28	13.43	11.08
23 MARCH 1978	13.79	7.14	13.44	8.56*	13.12	7.20	12.86	13.15	13.06		13.72	6.82	13.18	7.28	12.67	7.44	12.26	13.39	10.85*
21 SEPTEMBER 1978	13.83	7.16	13.42		13.08	7.12	12.87	13.11	13.06		13.82	6.88	13.27	7.33	12.82	7.52	12.33	13.45	10.89

NOTE FIRST STATIONINGS LISTED ARE ON STEEL SHEET PILINGS ELEVATIONS FOR 3+43 E & W ARE ON CONCRETE MONUMENTS

* Appears to be field error

ALINEMENT

REFERENCE MARK	3+43W	RM-1	RM-2	RM-3	RM-4	RM-5	RM-6	RM-7	RM-8	RM-13**	RM-14	RM-15	RM-16	RM-17	RM-18	RM-19	RM-20	3+43E	TEMP
INITIAL DATE	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	54°
ORIGINAL DISTANCE		11.844	11.750	11.938	12.219	12.063	12.219	11.813	12.063	21.563	11.438	11.500	11.750	11.563	11.563	11.469	11.344		
DATE OF OBSERVATIONS: 24 MAY 1976		12.438	12.344	12.375	12.812	12.938	12.750	12.562	12.781	20.625	12.187	12.375	12.562	12.312	12.406	12.500	12.531		78°
5 JULY 1977		12.562	12.500	12.500	12.750	12.593	12.750	12.531	12.656	20.500	12.375	12.625	12.781	12.593	12.531	12.718	12.531		
19 SEPTEMBER 1978		12.750	12.812	12.812	13.093	12.437	12.562	12.250	12.531	20.437	12.625	12.625	12.968	13.656*	12.750	12.875	13.000		88°

NOTE RM-1 THRU RM-8 ALINEMENT SHOTS ARE TAKEN WITH INSTRUMENT SET UP ON 3+43 W. RM-13 THRU RM-20 ALINEMENT SHOT ARE TAKEN WITH INSTRUMENT SET UP ON 3+43 E

** RM-13 IS SOUTH OF BASELINE ALL OTHER REFERENCE MARKS ARE NORTH OF BASELINE

** RM-13 IS SOUTH OF BASELINE
ALL OTHER REFERENCE MARKS ARE NORTH OF BASELINE

SETTLEMENT REFERENCE MARKS - STRUCTURE & T-WALL

NO. OF REFERENCE MARKS	RM-1	RM-2	RM-3	RM-4	RM-5	RM-6	RM-7	RM-8	RM9	RM-9A	RM-10	RM10A	RM-11	RM-12	RM-13	RM-14	RM-15	RM-16	RM-17	RM-18	RM-19	RM-20	Temp	Gage1	Gage2	Remarks	P.B.M.** E.F.E.	P.B.M.** E.F.W.
INITIAL DATE	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	5-19-76	12-2-75	5-19-76	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	49°	032			12-2-75	
ORIGINAL READINGS	14.59	14.72	14.73	14.78	14.76	14.77	14.79	14.74	14.76	14.77	14.71	14.70	14.74	14.73	14.75	14.68	14.67	14.67	14.66	14.61	14.61	14.57					3.122	
DATE OF OBSERVATIONS: 19 MAY 1976	14.56	14.71	14.72	14.77	14.74	14.75	14.76	14.70	14.73	14.72	14.67	14.66	14.71	14.69	14.71	14.65	14.63	14.63	14.63	14.58	14.58	14.51	71°	0.30			3.122	
5 JULY 1977	14.51	14.68	14.68	14.72	14.70	14.70	14.71	14.64	14.68	14.67	14.62	14.61	14.66	14.64	14.65	14.59	14.58	14.59	14.58	14.53	14.53	14.43	88°	0.00				4.363
15 SEPTEMBER 1978	14.49	14.66	14.66	14.70	14.68	14.68	14.68	14.62	14.64	14.64	14.56	14.56	14.63	14.59	–	14.54	14.53	14.54	14.53	14.48	14.48	14.36		0.90			3.122	4.396

** ELEVATION OF BENCH MARK USED

DISTANCES TO REFERENCE MARKS

NO. OF REFERENCE MARKS	RM2-RM3	RM4-RM5	RM6-RM7	RM9A-RM10A	RM11-RM12	RM14-RM15	RM16-RM17	RM18-RM19	TEMP	Remarks
INITIAL DATE	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	12-2-75	54°	
ORIGINAL DISTANCE	24.313	24.500	23.750	105.83*	103.96*	24.000	24.094	24.313		
DATE OF OBSERVATIONS: 24 MAY 1976	24.312	24.500	23.406	106.86	104.98	24.000	24.094	–	78°	
1 JULY 1977	24.437	24.531	23.750	106.82	104.97	23.968	24.125	24.531	88°	
14 SEPTEMBER 1978	24.468	24.500	23.625	106.92	105.07	23.937	24.250	24.531	89°	

NOTE * APPEARS TO BE SURVEY ERROR

P.B.M. - E.F.E. (USE) 1975-76 ELEVATION 3.122 FEET M.S.L. TOP OF 1 1/2 INCH PIPE CAP.

P.B.M. WAS SET AS FOLLOWS: IS TOP OF 1 1/2 INCH DIA. GALVANIZED PIPE SET IN BORE HOLE AT 200 FEET THEN DRIVEN AN ADDITIONAL 5 FEET INTO STRATA. P.B.M. IS LOCATED ON THE EAST BANK OF THE WATERWAY FROM EMPIRE TO GULF OF MEXICO, JUST NORTH OF THE EMPIRE FLOODGATE. EAST LEVEE AT STATION 104+80 (BASELINE OF STRUCTURE) AND 160 FT. NORTH OF THE EAST AND WEST LEVEE. PIPE AND CAP ARE ENCLOSED IN A 3 INCH PIPE CASING WHICH IS APPROX. 12 INCHES ABOVE THE GROUND AND SURROUNDED WITH CONCRETE FLUSH WITH THE GROUND. THE 3 INCH PIPE IS GUARDED BY FOUR 1 DIA. PIPES AND ALL ARE PAINTED YELLOW.

P.B.M. - E.F.W. (USE) 1975-76 ELEVATION 4.363 FEET M.S.L. TOP OF 1 1/2 INCH PIPE CAP.

P.B.M. WAS SET AS FOLLOW: IS TOP OF 1 1/2 INCH DIA. GALVANIZED PIPE SET IN BORE HOLE AT 200 FEET THEN DRIVEN AN ADDITIONAL 5 FEET INTO STRATA. P.B.M. IS ON THE WEST BANK OF THE WATERWAY FROM EMPIRE TO GULF OF MEXICO JUST NORTH OF EMPIRE FLOODGATE AT LEVEE STATION 99+00 (BASELINE OF STRUCTURE) AND 130 FEET NORTH OF THE EAST AND WEST LEVEE. PIPE AND CAP ARE ENCLOSED IN A 3 INCH PIPE CASING WHICH IS APPROX 12 INCHES ABOVE THE GROUND AND SURROUNDED WITH CONCRETE FLUSH WITH THE GROUND. THE 3 INCH PIPE IS GUARDED BY FOUR 1 DIA. PIPES AND ALL ARE PAINTED YELLOW.

P.B.M. J-279 (1971 ADJUSTMENT) ELEVATION 0.755 FEET M.S.L.

P.B.M. WAS SET AS FOLLOWS: ABOUT 1.5 MILES SOUTHEAST ALONG STATE HIGHWAY 23 FROM THE DRAW BRIDGE OVER THE DOULLUT CANAL AT EMPIRE, THENCE 0.1 MILE NORTHEAST ALONG A SHELL DRIVEWAY, 205 FEET NORTH OF THE CENTER OF THE CROSSING OF THE DRIVEWAY AND THE MISSOURI PACIFIC RAILROAD, 174 FEET NORTHWEST OF THE CENTER LINE OF THE DRIVE, 65.6 FEET NORTHEAST OF THE NORTHEAST RAIL, 48 FEET SOUTHWEST OF THE CENTER LINE OF A SHELL ROAD WHICH FOLLOWS THE TOP OF THE MISSISSIPPI RIVER LEVEE, 1 1/2 FEET SOUTHEAST OF A POWER POLE, 0.6 FOOT NORTHWEST OF A METAL WITNESS POST, ABOUT LEVEL WITH THE TRACK, AND ON THE TOP OF A COPPER-COATED ROD THAT IS DRIVEN TO A DEPTH OF 80 FEET AND THAT IS ENCASED IN A 6-INCH METAL PIPE THAT PROJECTS 0.2 FOOT.

P.B.M. - K-195 (1971 ADJUSTMENT) ELEVATION 7.320 FEET M.S.L.

P.B.M. WAS SET AS FOLLOWS: AT EMPIRE, SET IN THE TOP OF THE NORTHEAST END OF THE NORTHWEST CONCRETE ABUTMENT OF THE STATE HIGHWAY 23 DRAW BRIDGE OVER THE DOULLUT CANAL AT EMPIRE, 21.4 FEET NORTHEAST OF THE CENTER OF THE HIGHWAY, 4.3 FEET NORTHWEST OF THE BRIDGE OPERATORS HOUSE, 0.8 FOOT SOUTHWEST OF THE NORTHEAST END OF THE ABUTMENT AND 1 FOOT BELOW THE LEVEL OF THE HIGHWAY.

NOTE: THE ABOVE P.B.M. ELEVATIONS WERE DERIVED FROM THE LATEST LEVELING AND ARE BASED ON A SUPPLEMENTARY ADJUSTMENT OF 1971 COPIED FROM VERTICAL CONTROL DATA BY THE GEODETIC SURVEY QUAD 290893, PAGES 1, 5 AND 6, LINE 101 ADJUSTED ELEVATIONS OF 1971. THIS INFORMATION IS ON FILE IN THE SURVEY BRANCH.

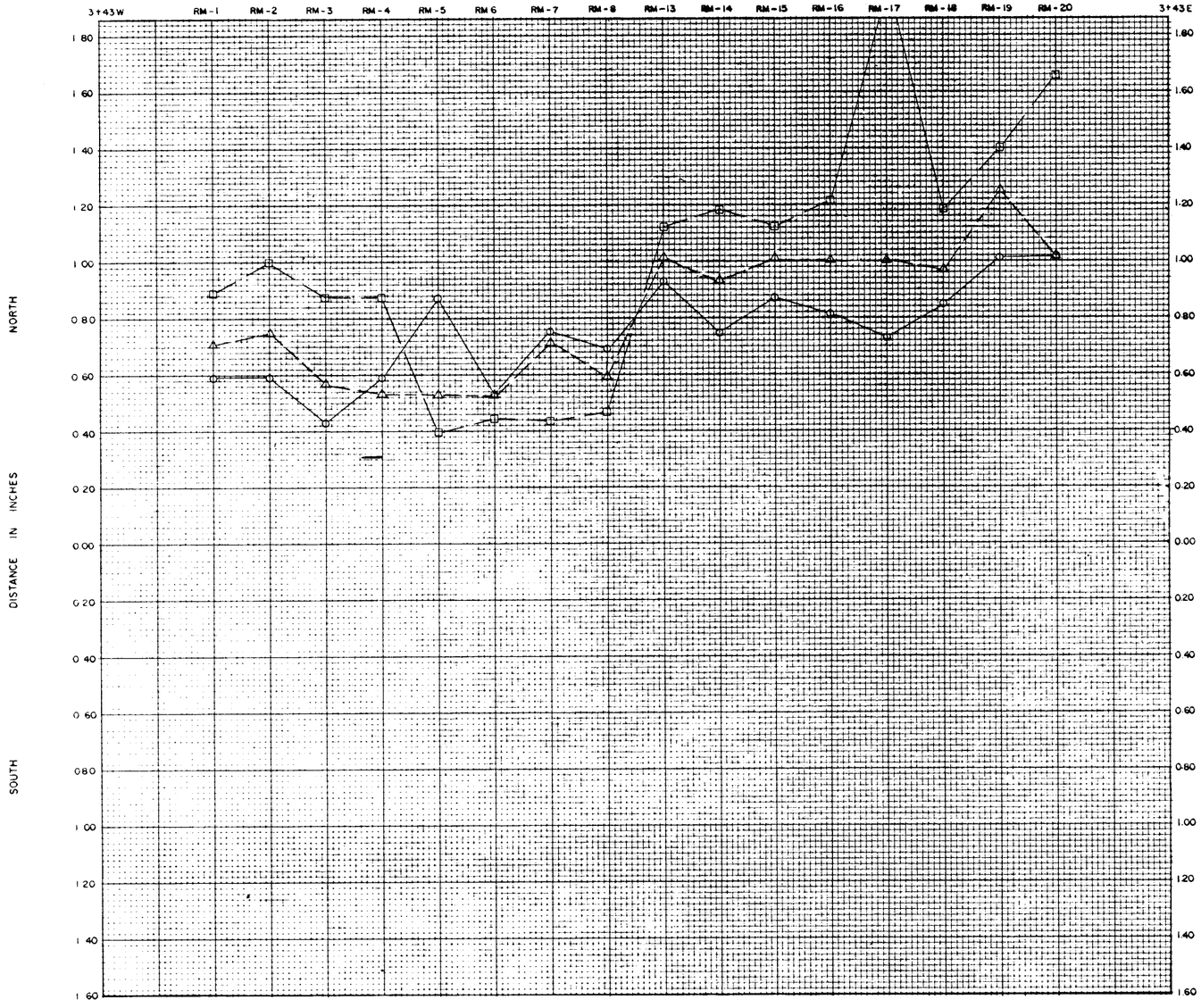
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

ALINEMENT AND SETTLEMENT REFERENCE MARKS - TABULATIONS

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

SHEET OF SHEET FILE NO. H-4-27323/

PLATE I-2



LEGEND

MAY 24 1976

JULY 5 1977

SEPTEMBER 1978

NOTE Reference Marks at Sta 3+43 are Brss Caps in Concrete Monument

NOTE For location of Reference Marks see Plate

NEW ORLEANS TO VENICE, LA

HURRICANE PROTECTION REACH 8-1

PERIODIC INSPECTIOION

EMPIRE FLOODGATE

ALINEMENT

DIFFERENTIAL CHART

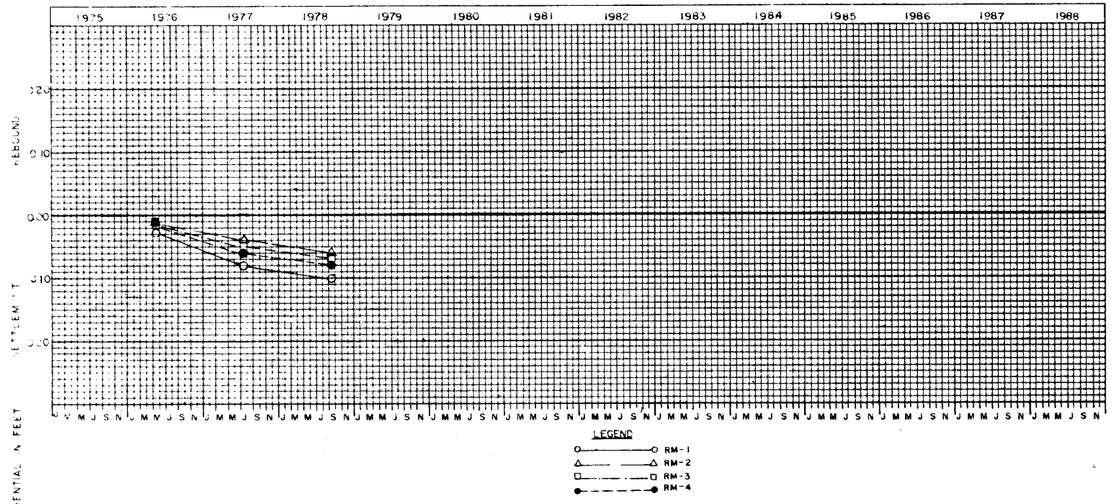
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

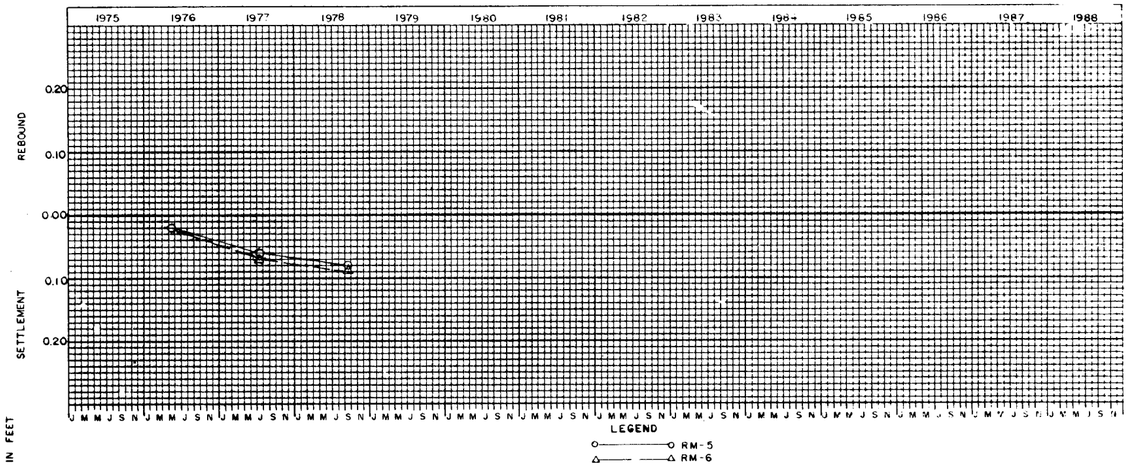
CORPS OF ENGINEERS

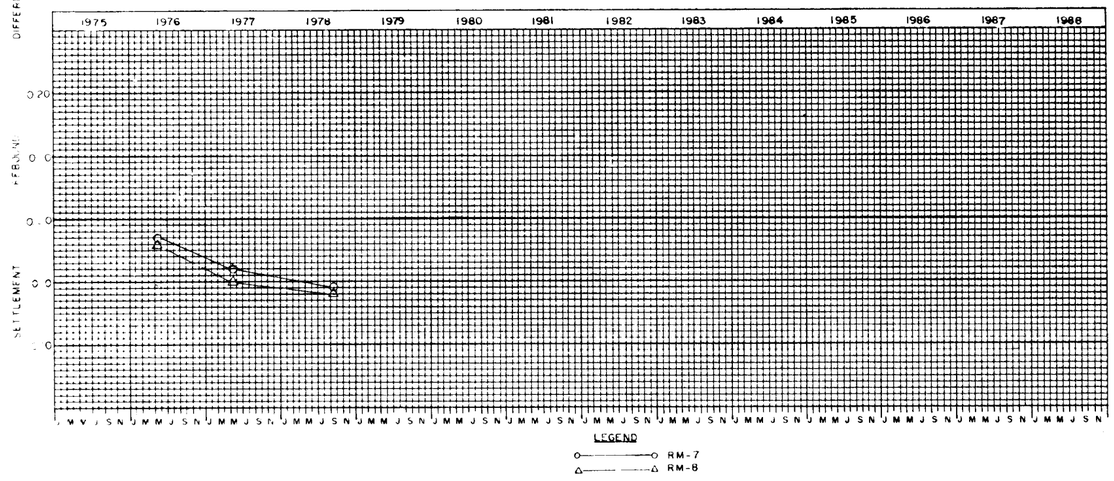
SHEET OF SHEET

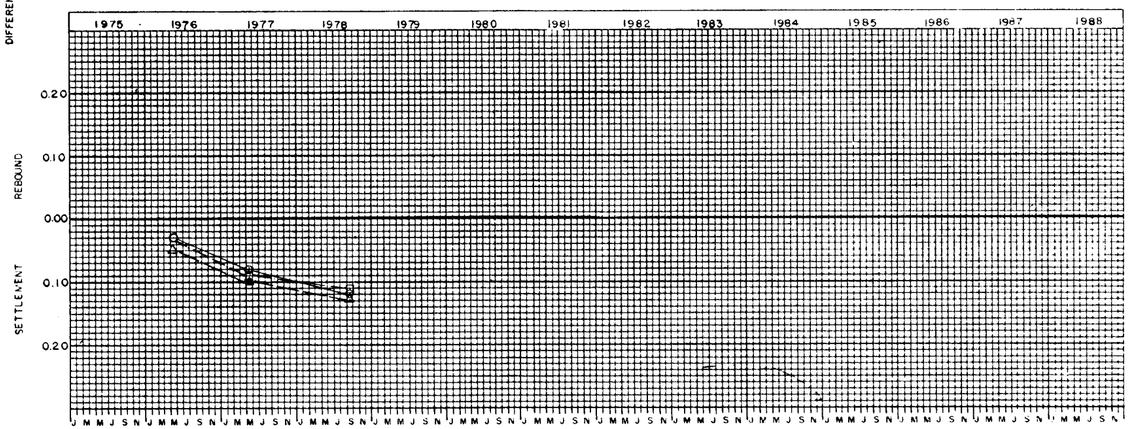
FILE NO H-4 27323/

PLATE I-2A









NOTE: FOR LOCATION OF SETTLEMENT REFERENCE MARKS SEE PLATE.
FOR TABULATION OF ELEVATIONS SEE PLATE.

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1

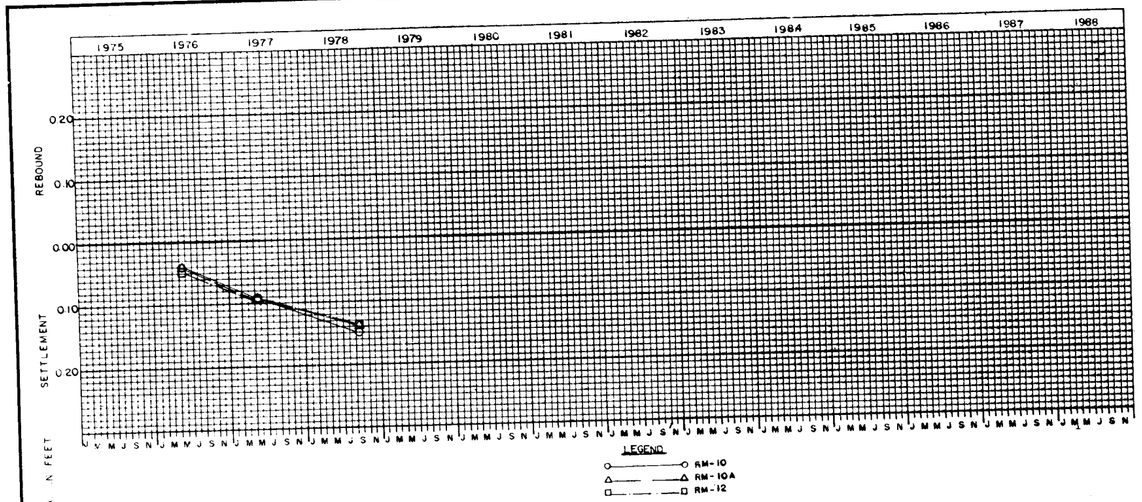
PERIODIC INSPECTION
EMPIRE FLOODGATE

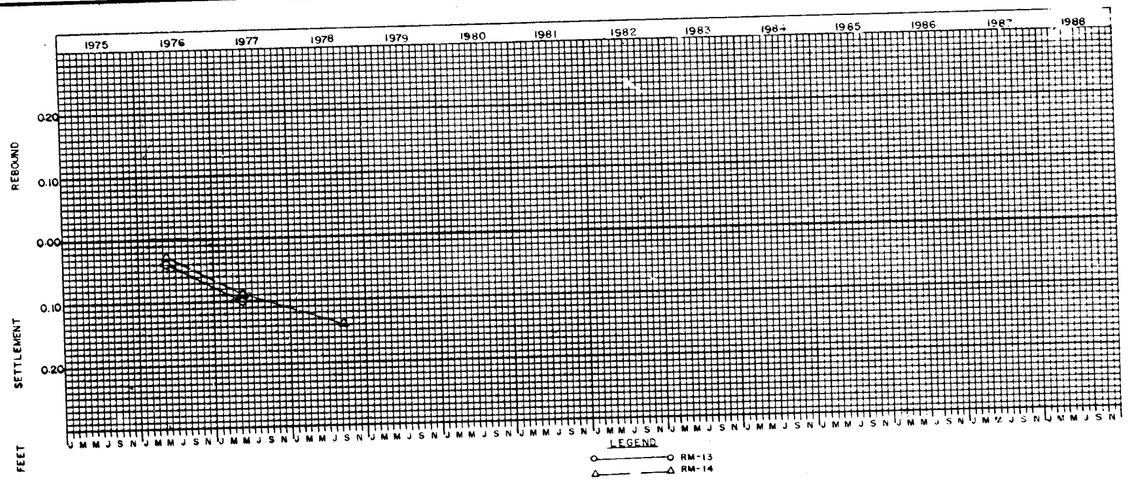
SETTLEMENT AND REFERENCE MARKS
DIFFERENTIAL'S MOVEMENT

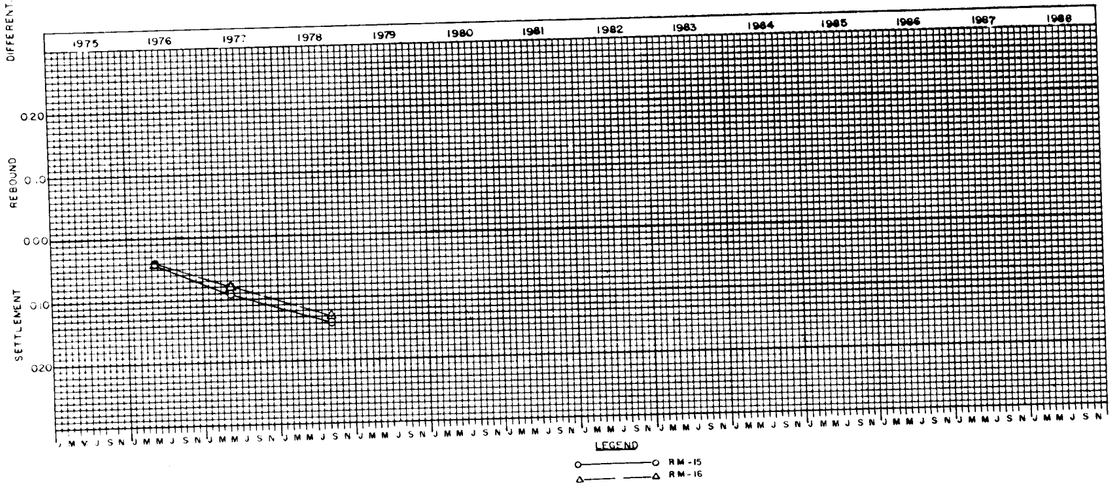
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

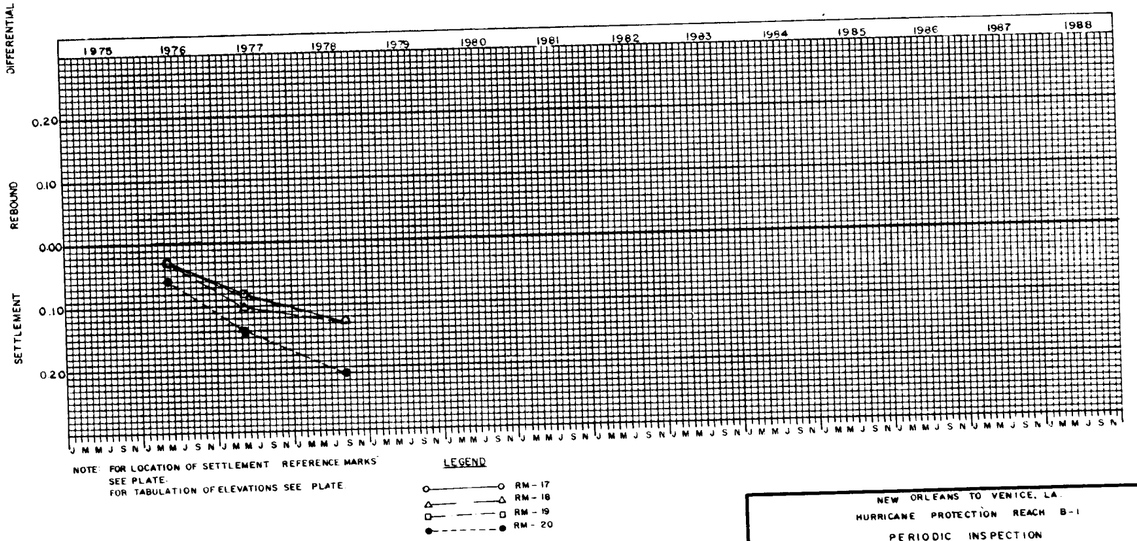
FILE NO H-4-27323

PLATE I-3









NOTE: FOR LOCATION OF SETTLEMENT REFERENCE MARKS SEE PLATE.
FOR TABULATION OF ELEVATIONS SEE PLATE

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE

SETTLEMENT AND REFERENCE MARKS DIFFERENTIAL'S MOVEMENT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO H-4-27323

PLATE I-4

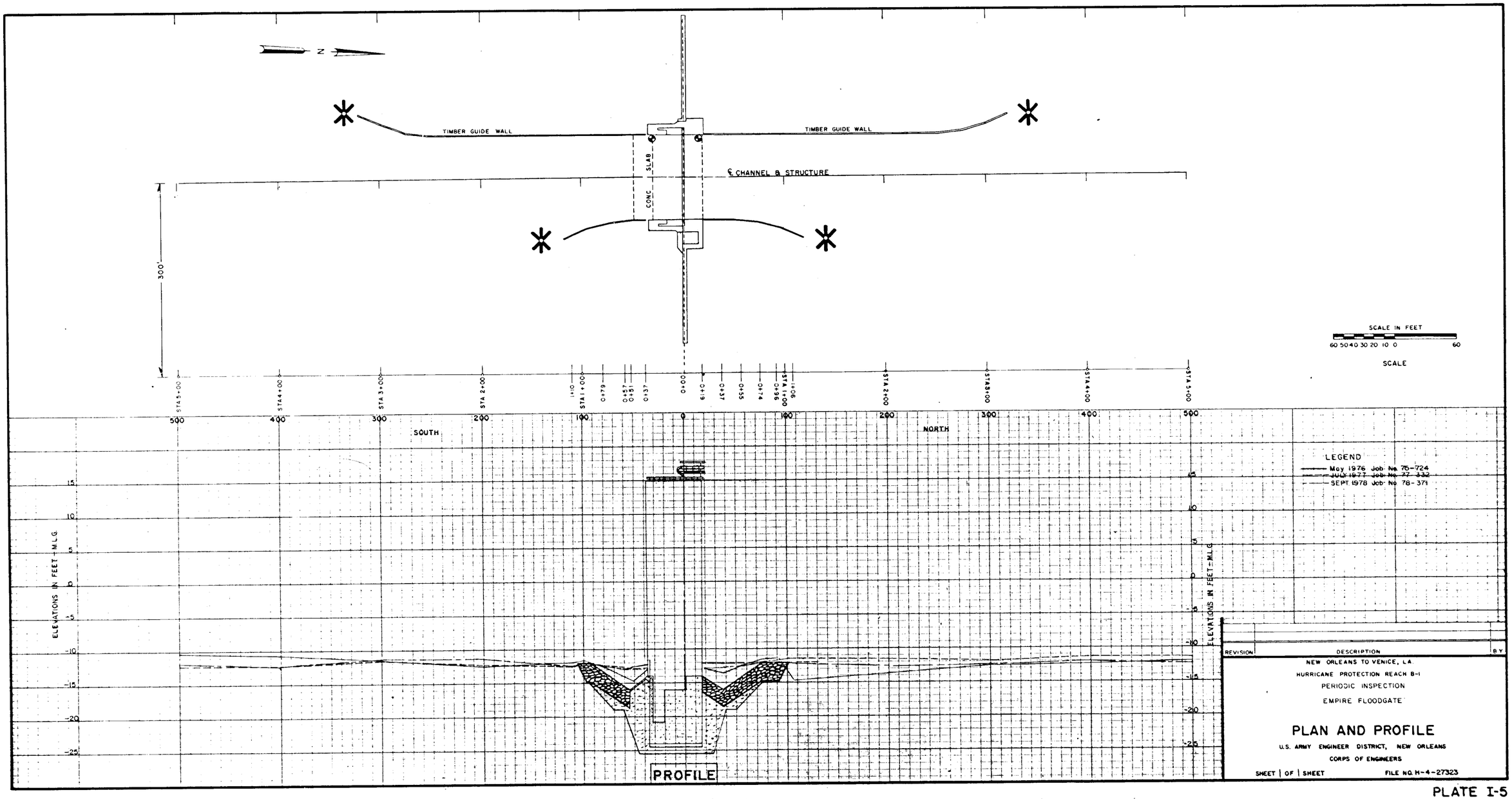

N
TIMBER GUIDE WALL
TIMBER GUIDE WALL
CONC SLAB
℄ CHANNEL & STRUCTURE
300'
STA 5+00
STA 4+00
STA 3+00
STA 2+00
STA 1+00
0+00
STA 2+00
STA 3+00
STA 4+00
STA 5+00
SCALE IN FEET
60 50 40 30 20 10 0 60
SCALE
SOUTH
NORTH
ELEVATIONS IN FEET-M.L.G.
LEGEND
MAY 1976 Job No. 76-724
JULY 1977 Job No. 77-332
SEPT 1978 Job No. 78-371
PROFILE
REVISION
DESCRIPTION
BY
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
PERIODIC INSPECTION
EMPIRE FLOODGATE
PLAN AND PROFILE
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
SHEET 1 OF 1 SHEET
FILE NO. H-4-27323

PLATE I-5

LEGEND

DESIGN

NOTE

NEW ORLEANS TO VENICE, LA.

HURRICANE PROTECTION REACH B-1

EMPIRE FLOODGATE - SOUTH APPROACH CHANNEL

SCOUR SURVEY (73-78)

PLATE I-6


WEST
EAST
1+00.00
1+10.00
2+00.00
3+00.00
ELEVATIONS IN FEET
LEGEND
DESIGN
21 MAY 1976 JOB NO. 76-724
01 JULY 1977 JOB NO. 77-232
NOTE
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE - SOUTH APPROACH CHANNEL
SCOUR SURVEY (73-78)

PLATE I-7

LEGEND

DESIGN
21 MAY 1976 JOB NO. 76-724
01 JULY 1977 JOB NO. 77-232
22 SEPT 1978 JOB NO. 78-271

NOTE
SECTION PLOTTED LOOKING SOUTH

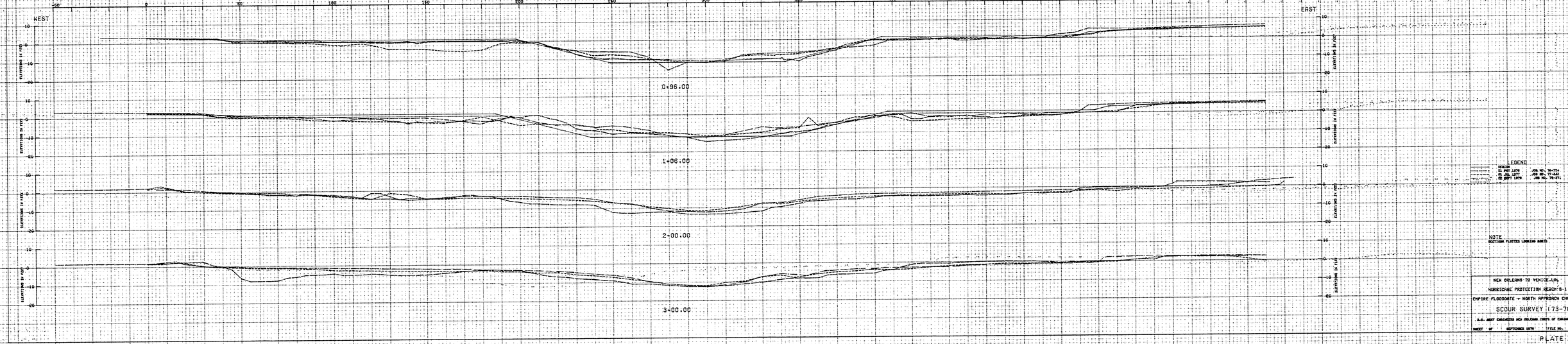
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE - SOUTH APPROACH CHANNEL
SCOUR SURVEY (73-78)
U.S. ARMY ENGINEERS NEW ORLEANS CORPS OF ENGINEERS
SHEET OF SEPTEMBER 1978 FILE NO.

PLATE I-8

NOTE
SECTIONS PLOTTED LOOKING NORTH

NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE + NORTH APPROACH CHANNEL
SCOUR SURVEY (73-78)
U.S. ARMY ENGINEERS NEW ORLEANS CORPS OF ENGINEERS
SHEET OF SEPTEMBER 1978 FILE NO.

PLATE I-9



NEW ORLEANS TO VENICE, LA.,

HURRICANE PROTECTION REACH 8-1

EMPIRE FLOODGATE - NORTH APPROACH CHANNEL

SCOUR SURVEY (73-78)

U.S. ARMY ENGINEER DIV. NEW ORLEANS DISTR. OF ENGINEERS

SHEET OF SEPTEMBER 1978 FILE NO.

PLATE I-10


WEST
EAST
4+00.00
5+00.00
LEGEND
21 MAY 1976 JOB NO. 76-724
01 JUL 1977 JOB NO. 77-33C
22 SEPT 1978 JOB NO. 78-371
NOTE
SECTIONS PLOTTED LOOKING NORTH
NEW ORLEANS TO VENICE, LA.
HURRICANE PROTECTION REACH B-1
EMPIRE FLOODGATE + NORTH APPROACH CHANNEL
SCOUR SURVEY (73-78)
U.S. ARMY ENGINEERS NEW ORLEANS CORPS OF ENGINEERS
SHEET OF SEPTEMBER 1978 FILE NO.
PLATE I-11

SECTION V - INSPECTION

5-01 Inspection Team. The inspection of the structure was conducted on 4 October by following personnel:

LMVD	
Mr. Joe Harz	Technical Engineering Branch
NOD	
Mr. Theodore F. Mehrtens	General Engineering Section
Mr. Suryakant D. Patel	General Engineering Section
Mr. Dennis C. Strecker	General Engineering Section
Mr. Gerard P. Jesclard	General Engineering Section
Mr. Philip J. Napolitano	F&M Branch
Mr. Drew Viosca	Structural Design Section
Mr. Larry Dement	H&H Branch
DEPARTMENT OF PUBLIC WORKS	
Joseph Kopfler	Resident Engineer
PLAQUEMINES PARISH COMMISSION COUNCIL	
Carroll Martin	Supervisor-Heavy Equipment
Henry Urban	Foreman-Engineer
Rubin Victory	Party Chief-Engineers
Charles Thigpen	Inspector

5-02 Orientation. Prior to the inspection, the team members were given a brief orientation of the following features of the structure: Hydraulic and hydrology, structural considerations, foundations, operating machinery and construction history.

5-03 Observation. The floodgate was not dewatered at the time of inspection, all the observations recorded hereinafter refer to those surfaces above water.

a. Reinforced Concrete.

(1) Floodwall. There were a few shrinkage and temperature cracks noted on top of the east and west walkways, but all exposed concrete surfaces were in satisfactory condition. The T-wall joints between instrumentation reference marks RM18-RM19, RM4-RM5 and RM2-RM3 appears to be enlarging at the walkway slab and had movements approximately 1/2 inch to 1 inch. These movements were larger at the walkway and appeared to be very small at the water line. See photo no. 1, 2, and 3.

(2) Gatebay Monolith. The wall armour of the channel walls had extensive corrosion. On the west side of the monolith a small crack with some efflorescene was observed on the vertical flood side wall face. Overall the gatebay monolith, superstructure above the water, control house and pump platform appeared to be in good condition.

(3) Needle Storage Rack - In general, the overall condition of the needles, needle beams, and storage rack was excellent. The only deficiency noted was sand deposits in the needle beams causing corrosion.

b. Sheetpile. The sheetpile I-wall on both sides of the structure has settled near the tie-in levee. Consequently, the waterstop between the I-wall and T-wall interface no longer makes contact, resulting in an open space of approximately 1 inch at the joint. See photo no. 4 for location of waterstop.

c. Flap gate. The flap gate was raised to closed position. The operation of gate was satisfactory. Only the portion of gate not covered by water was inspected. Overall, the gate was in good condition, the paint of the underside of the gate was discolored and a large amount of soil deposits was trapped on the walkway. See photo no. 5.

d. Approach channels. Condition of approach channel was good. The riprap erosion protection was missing on most of slope south of east wall, leaving the shell backfill exposed.

e. Operating Machinery. The operating machinery worked satisfactorily. Electrical system was also in good condition. The hoist and counterweight chains were rusted. They should be checked for loss of diameter on a 6 month bases. See photo no. 5 for rusted chain.

PHOTO NO. 1 - Joint Between Reference Mark RM18-RM19

PHOTO NO. 2 - Joint Between Reference Mark RM4-RM5

PHOTO NO. 3 - Joint Between Reference Mark RM2-RM3

PHOTO NO. 4 - Location of Waterstop Between T-Wall Monolith and Sheetpiling

PHOTO NO. 5 - Trapped Soil Deposits on Walkway and Rusted Chain

SECTION VI - CONCLUSIONS AND REMEDIAL ACTION

6-01 Conclusion. It is concluded that Empire Floodgate is a stable, safe, well maintained structure in satisfactory operating condition.

6-02 Remedial Action. The following are remedial actions:

a. Movement of T-wall monoliths should be closely monitored. Any opening at the joint should be sealed.

b. The opening between sheet piling and T-wall monolith interface on both sides of structure should be sealed during regular maintenance in FY 1979.

c. The cross section of chain should be checked for reduction in diameter for safe operation.

d. The joint between reference marks RM18-RM19, RM4-RM5, and RM2-RM3 should be sealed in FY 1979.

e. Missing riprap on the slope south of east wall should be replaced.

6-03 Next Inspection. The next inspection of Empire Floodgate is scheduled for December 1980. The structure will not be dewatered at that time.

SECTION VI - CONCLUSIONS AND REMEDIAL ACTION

6-01 Conclusion. It is concluded that Empire Floodgate is a stable, safe, well maintained structure in satisfactory operating condition.

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c. The cross section of chain should be checked for reduction in diameter for safe operation.

d. The joint between reference marks RM18-RM19, RM4-RM5, and RM2-RM3 should be sealed in FY 1979.

6-03 Next Inspection. The next inspection of Empire Floodgate is scheduled for December 1980. The structure will not be dewatered at that time.

VOID
SEE REVISED PAGE

APPENDIX A

EMPIRE FLOODGATE VIBRATION AND STRAIN MEASUREMENTS

EMPIRE, LOUISIANA

by

Timothy L. Fagerburg

Hydraulics Laboratory
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

EMPIRE FLOODGATE VIBRATION AND STRAIN MEASUREMENTS, EMPIRE, LOUISIANA

PART I: INTRODUCTION

Pertinent Features of the Project

1. Empire floodgate is located approximately one mile southwest of Empire, Louisiana. The purpose of the project is to provide protection to the city of Empire and surrounding communities from floodwaters resulting from hurricanes. This protection is provided in conjunction with the associated levee system.

2. The structure consists of a 55-ft-long by 83-ft wide chamber, with the floor at el -14.0* and the top of the chamber wall at el 15.0. A 310-ft-long timber guide wall extends both upstream and downstream along the west side of the structure. A 30.5- by 83-ft, bottom-hinged, steel flap gate is used to control the floodwaters. It is raised and lowered by a set of heavy anchor chains. A pair of 35,000-lb counterweights, also connected to the gate by another set of heavy anchor chains, aid in lifting the gate. The gate is operated from a control house located on the east side of the structure. The general features of the project are shown in Plate 1.

Purpose and Scope of the Study

Purpose

3. At the request of the U. S. Army Engineer District, New Orleans, the U. S. Army Engineer Waterways Experiment Station (WES) conducted a series of tests at Empire Floodgate. Specific objectives of these tests were to:

---

* Elevations (el) cited herein are in feet referred to mean sea level.

a. Measure the strains in the gate hoist and counterweight chains under various traffic conditions to determine whether these strains correlated with the recent failure of the counterweight chains.

b. Determine any significant movement of the counterweights that may have contributed to the failure of the counterweight chains in service.

c. Determine the bottom profile of the chamber in the area of the flap gate.

d. Determine the density of the sediment material deposited on the flap gate.

e. Determine the speed of vessels under controlled and uncontrolled conditions passing through the structure and the resulting wave heights.

Scope

4. On 8 December 1977, 30 tests were conducted in two parts. The first set of test measurements (tests 1-12) consisted of the following.

a. Releasing the counterweights from their supports thus loading the counterweight chains.

b. Recording strains on the gate hoist and counterweight chains as motor vessels passed through the structure.

c. Recording the acceleration of the counterweights as an event occurred.

d. Making auxiliary measurements, including:

(1) Boat size and type.

(2) Boat speed through the structure.

(3) Wave heights associated with the boat speed and size.

5. The second set of tests (13-30) consisted of:

a. Operating the flap gate to put tension on the hoist chains, and repeating 4b-d above.

b. Recording strains on the gate hoist and counterweight chains on an event-related basis.

c. Recording the acceleration of the counterweights on an event-related basis.

d. Making auxiliary measurements, including:

(1) Boat size and type.

(2) Boat speed through the structure.

(3) Wave heights associated with speed and size of the boat.

PART II: TEST FACILITIES AND EQUIPMENT

Strain Gages

6. A total of eight locations on the counterweight and gate hoist chains were chosen for installation of strain gages as shown in Plate 2. The strain gages labeled C-1, C-2, C-3, and L-1 are located on the east side of the structure. Those labeled C-4, C-5, C-6, and L-2 are on the west side of the structure. At each location, four strain gages were attached to the chain link as shown in Plate 3. An average strain measurement for the link was obtained from this arrangement.

Accelerometers

7. Acceleration was measured with a ±5-g accelerometer, mounted on each counterweight as shown in Plate 2. Accelerometer A-1 was mounted on the counterweight on the east side of the structure and accelerometer A-2 on the west side.

Recording Equipment

8. The signals from the strain gages and accelerometers were amplified and recorded with a Sangamo 14-channel magnetic tape data recorder. The signals were simultaneously printed on direct-write oscillograph paper. All of the recording equipment was located in the lower level of the control house on top of the east wall. Embedded electrical conduit in the structure was used for passing the wires from the opposite wall strain gages and accelerometer to the recording equipment.

Other Equipment

9. The District supplied a 40-ft survey boat which was used to make controlled speed tests that could be repeated. A 16-mm movie camera was used to film the passing boats and their waves created within the structure.

PART III: TEST CONDITIONS AND PROCEDURES

Conditions

10. As stated previously, 30 tests were conducted in two parts at Empire. All were concerned primarily with determining the strains and accelerations of the chains and counterweights resulting from the passing of motor vessels through the structure. The first 12 tests were conducted with the flap gate in the full open position and with slack in the gate hoist chain. The second series of tests was conducted with the gate hoist chain tightened. It is not known how high the gate was raised because the gate closing indicator was not functioning at the time of the tests.

11. All of the local traffic (including the survey boat) was monitored during the tests for speed and size of vessel as well as resulting wave heights and chain strains and accelerations. Table 1 lists the data pertinent to the vessels passing through the structure during the tests.

Procedures

12. After the strain gages and accelerometers were installed and connected to the recording equipment, the procedures for tests 1-12 (slack gate hoist chain) and 13-30 (taut gate hoist chain) were as follows:

a. Start recording on magnetic tape and oscillograph as the vessel nears the guide wall.

b. Record the direction, size of vessel, and time for vessel to pass through the structure.

c. Record on video tape the passing of the vessel and the waves induced within the structure.

d. End the recording when all movement of strain gage and accelerometer traces subside.

PART IV: TEST RESULTS AND CONCLUSIONS

Strain Measurements

13. In order to obtain meaningful data from the strain gages installed on the counterweight and gate hoist chains, the system was calibrated as follows. The counterweight of known weight was released from its supports and the indicated strain recorded. The recorder pen deflection for this load was used as the calibration standard for the tests. Table 2 lists the sensor designation and the maximum strains and accelerations for each test. It should be noted that only two tests (19 and 26) indicated any significant movement of the counterweight.

14. Plate 4 is a sample of the oscillograph record from test 19. It illustrates the fluctuations of the strain on the counterweight and gate hoist chains.

Acceleration Measurements

15. A representative sample of the acceleration recordings is shown in Plate 4. The maximum accelerations during the study were observed during tests 19 and 26. The acceleration obtained during test 19 was examined to determine its magnitude and frequency. Plate 5 is an expanded playback of the acceleration over a 2.0-sec time period. The playback was further analyzed to obtain the frequency decomposition (Plate 6).

16. The data reduction from test 19 produced the following results. The counterweight accelerations, in the vertical direction, decreased in frequency from 3.42 to 1.71 Hz. The maximum peak-to-peak accelerations following loading was 0.031 g's. The displacement was calculated with regard to the maximum and minimum accelerations (a^+ and a^-, respectively) and dominant frequency, f_D. An equivalent simple harmonic peak-to-peak displacement X is calculated in the form

$$X = \frac{|a^+| + |a^-|}{(2\pi f_D)^2} \qquad (1)$$

The counterweight displacements that occurred during the tests were very small, the maximum displacement being 0.026 in. which occurred during test 19.

Other Measurements

17. Prior to the testing the U. S. Geological Survey (USGS) obtained bottom profile measurements directly over the area of the flap gate. The average bottom elevation was found to be -11.0 and the elevation of the gate surface is -14.0. This indicates that the depth of sediment on the flap gate is approximately 3.0 ft. Sediment samples were obtained from the area directly over the area of the flap gate. The density of the sediment was determined to be 1.3 g/cc. The type of sediment present was determined as a very soft, gray, silty clay with large areas of silt (organic with rootlets). The classifying symbol associated with the sediment is CL-6.

Conclusions

18. The forces acting on the gate hoist and counterweight chains were affected by both the wave height within the structure and the position of the gate when the boats travel through the structure. It was determined from the test data that only a boat similar in size to the Corps survey boat traveling through the structure in a downstream direction between 12 and 14 mph would cause conditions in which impact loading of the counterweight chain could occur (see Tables 1 and 2). The larger boats traveled at much slower speeds thus causing very little change from static conditions. No impact loads could be determined for the area in which the counterweight chain failed because no measurements were taken of the gate movement. However, rough estimates of impact loading may be made by using the information that has been presented. From the test results listed in Table 2, it can be seen that the most dramatic results occurred during tests in which the chains were in tension. It is therefore recommended that the chains always remain in the "slack" condition during the passage of all traffic.

Table 2

Maximum Strains and Accelerations

Test No.	Maximum Strain μ in./in. at Location								Maximum Peak-to-Peak Acceleration g	
	C-1	C-2	C-3	C-4	C-5	C-6	L-1	L-2	A-1	A-2
1	175	107	48.6	220	160	0.0	0.0	0.0	0.0	0.0
2			43.0							
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13			48.6			5.7	313.3	270.0		
14			43.0			0.0	300.0			
15			48.6			0.0	300.0			
16			54.2			5.7	300.0			
17			51.4			0.0	316.6		0.0020	
18			43.0			0.0	300.0		0.0	
19			54.2			8.6	330.0	279.2	0.031	
20			43.0			5.7	300.0	278.6	0.0	
21			51.4			8.6	311.0	270.0		
22			43.0			2.8	308.3			
23			48.6			5.7	308.3			
24			43.0			0.0	300.0			
25			43.0			0.0	300.0			
26			54.2			11.4	316.6		0.0225	
27			51.4			11.4	311.0		0.0	
28			43.0			11.4	311.0		0.0	
29			51.4			11.4	316.6		0.0	
30			43.0			0.0	300.0		0.0	

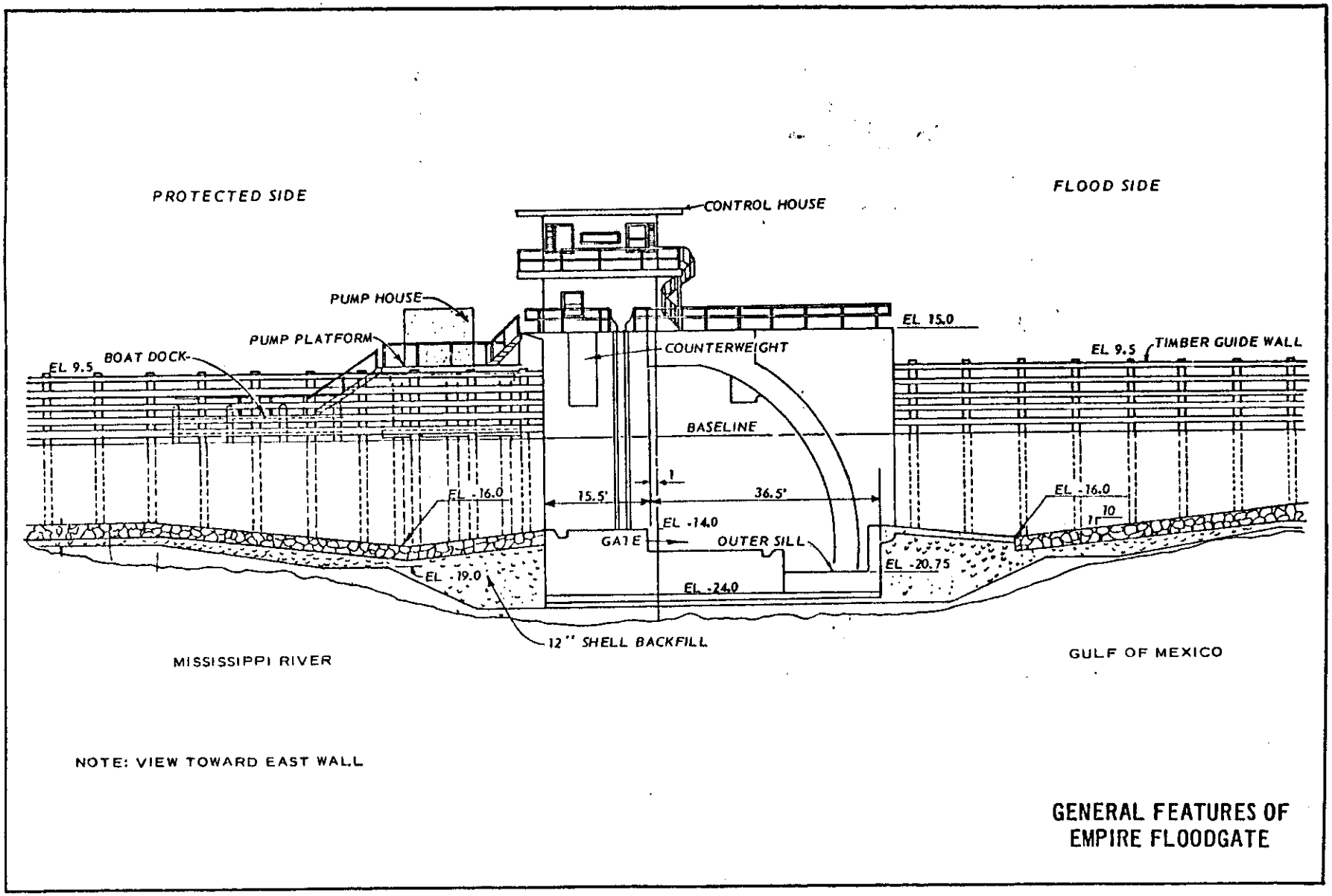
Table 1

Passage of Vessels During Testing

Test No.	Length ft	Type	Type of Test*	Boat Speed mph	Direction US/DS**	Wave Height ft	Comments
			Gate Hoist Chain Slack				
1	35	Corps survey boat	C	5.0	US	--	Tests 1-12; counter-weights released from supports; gate in full-open position
2	35	Corps survey boat	C	11.8	DS	2.0	
3	35	Corps survey boat	C	11.8	US	2.0	
4	55	Shrimp boat	U	8.9	US	1.0	
5	35	Corps survey boat	C	23.6	DS	2.5	
6	35	Corps survey boat	C	27.3	DS	3.0	
7	55	Shrimp boat	U	8.4	DS	1.0	
8	40	Small towboat	U	7.9	US	1.5	
9	35	Corps survey boat	C	25.3	DS	3.0	
10	35	Corps survey boat	C	30.8	US	3.5	
11	35	Corps survey boat	C	27.3	DS	4.0	
12	35	Corps survey boat	C	0.0	--	--	Boat nosed into wall over gate
			Gate Hoist Chain Tightened				
13	35	Corps survey boat	C	11.8	US	2.0	
14	55	Shrimp boat	U	4.7	US	1.0	
15	55	Shrimp boat	U	8.4	US	1.0	
16	35	Corps survey boat	C	10.9	DS	2.5	
17	35	Corps survey boat	C	10.1	US	3.5	
18	50	Towboat and barge	U	4.7	US	0.5	
19	35	Corps survey boat	C	11.4	DS	3.0	
20	35		C	23.6	US	5.5	
21	35		C	19.7	DS	3.0	
22	35		C	27.3	US	3.5	
23	35		C	23.6	DS	3.5	
24	35		C	0.0	US	--	Power full-on above gate
25	35		C	0.0	DS	--	Power full-on above gate
26	35		C	14.2	DS	2.5	
27	35		C	11.8	DS	3.0	
28	35	Crew boat	U	13.1	DS	3.5	
29	35	Crew boat	U	13.1	DS	3.0	
30	50	Towboat and barge	U	4.5	DS	1.0	

* U = Uncontrolled test; C = controlled test.

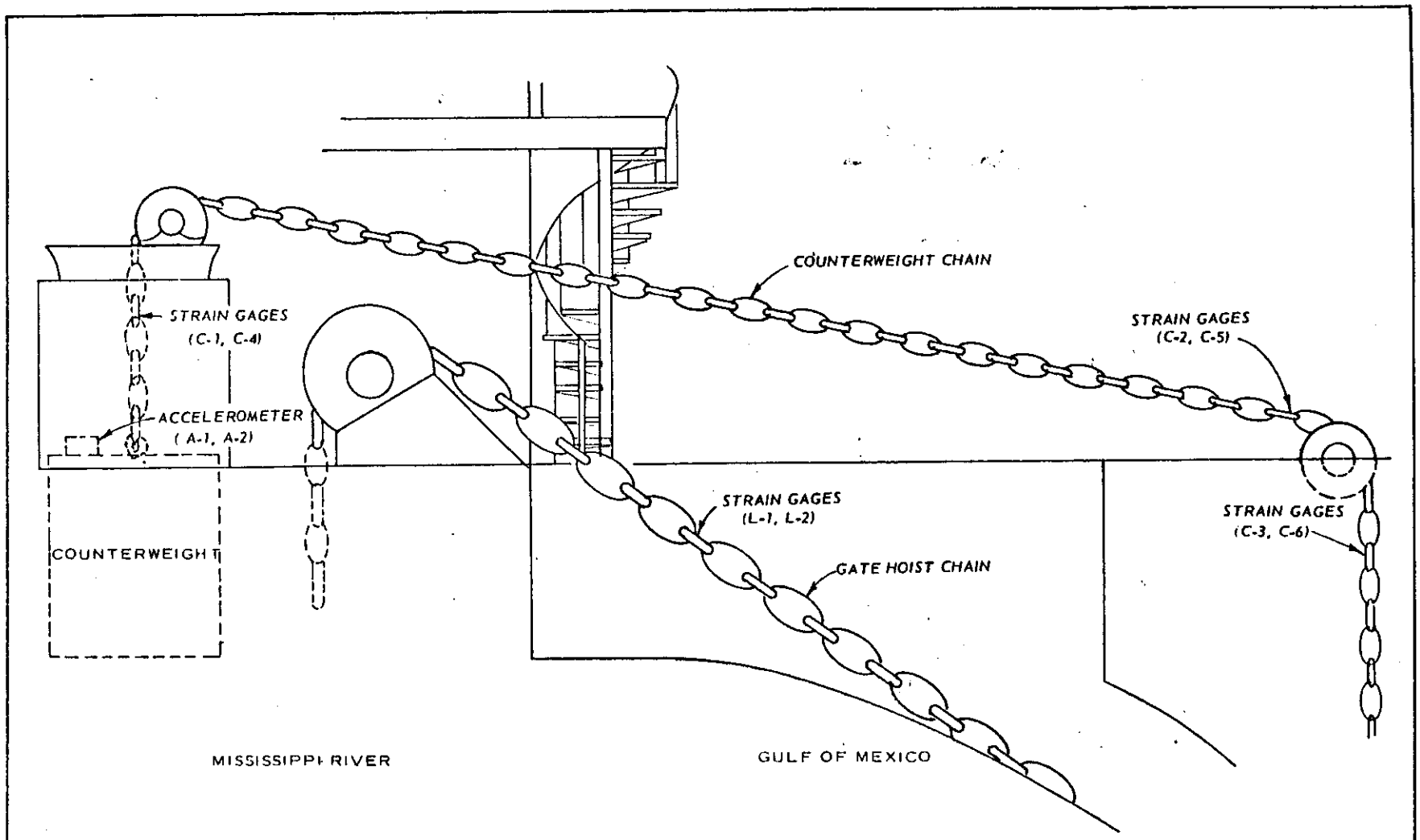
** DS = downstream direction, i.e. toward the Gulf; US = upstream direction, i.e. toward the town of Empire.



NOTE: VIEW TOWARD EAST WALL

PLATE 1

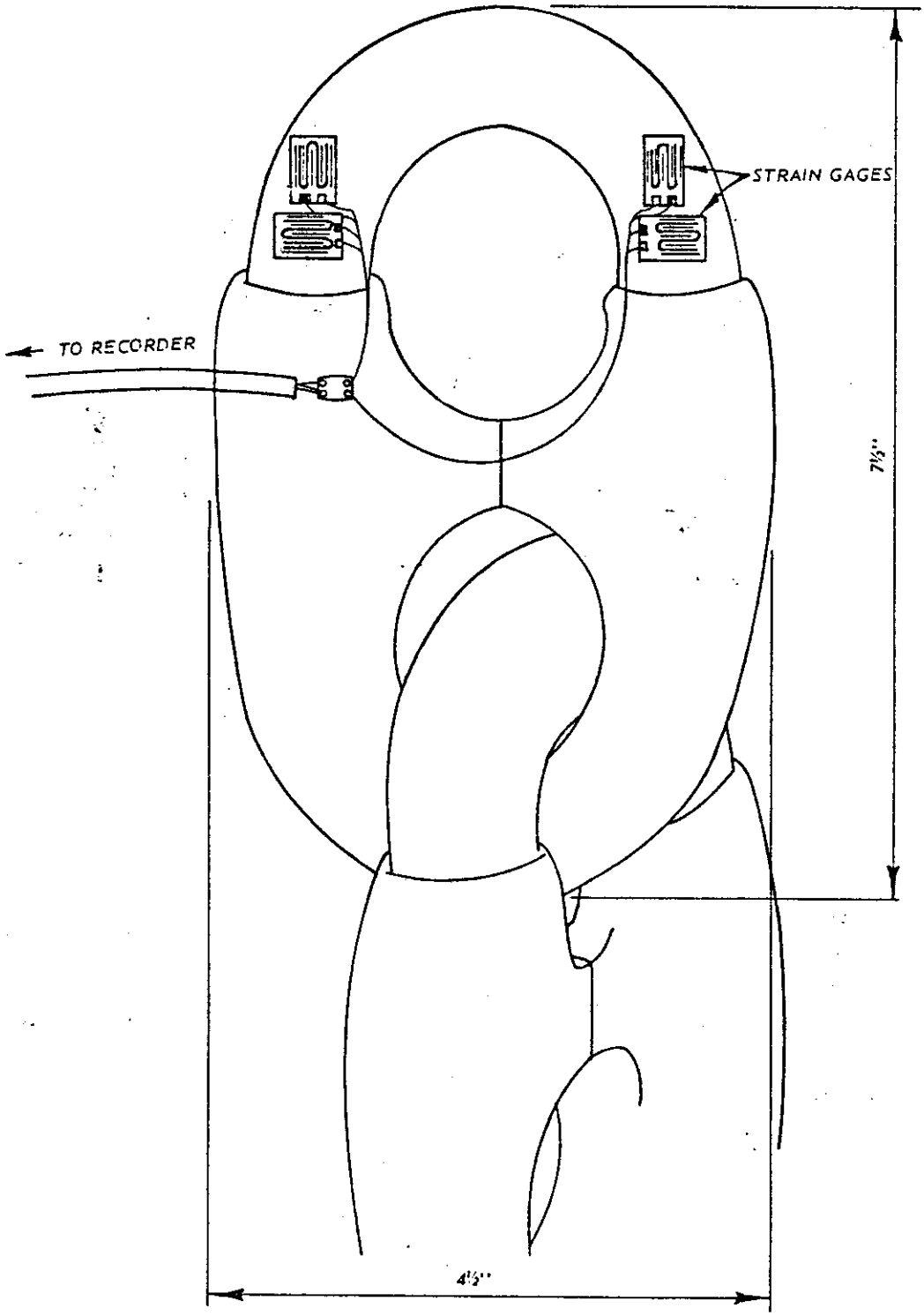
GENERAL FEATURES OF EMPIRE FLOODGATE



NOTE, VIEW TOWARD EAST WALL

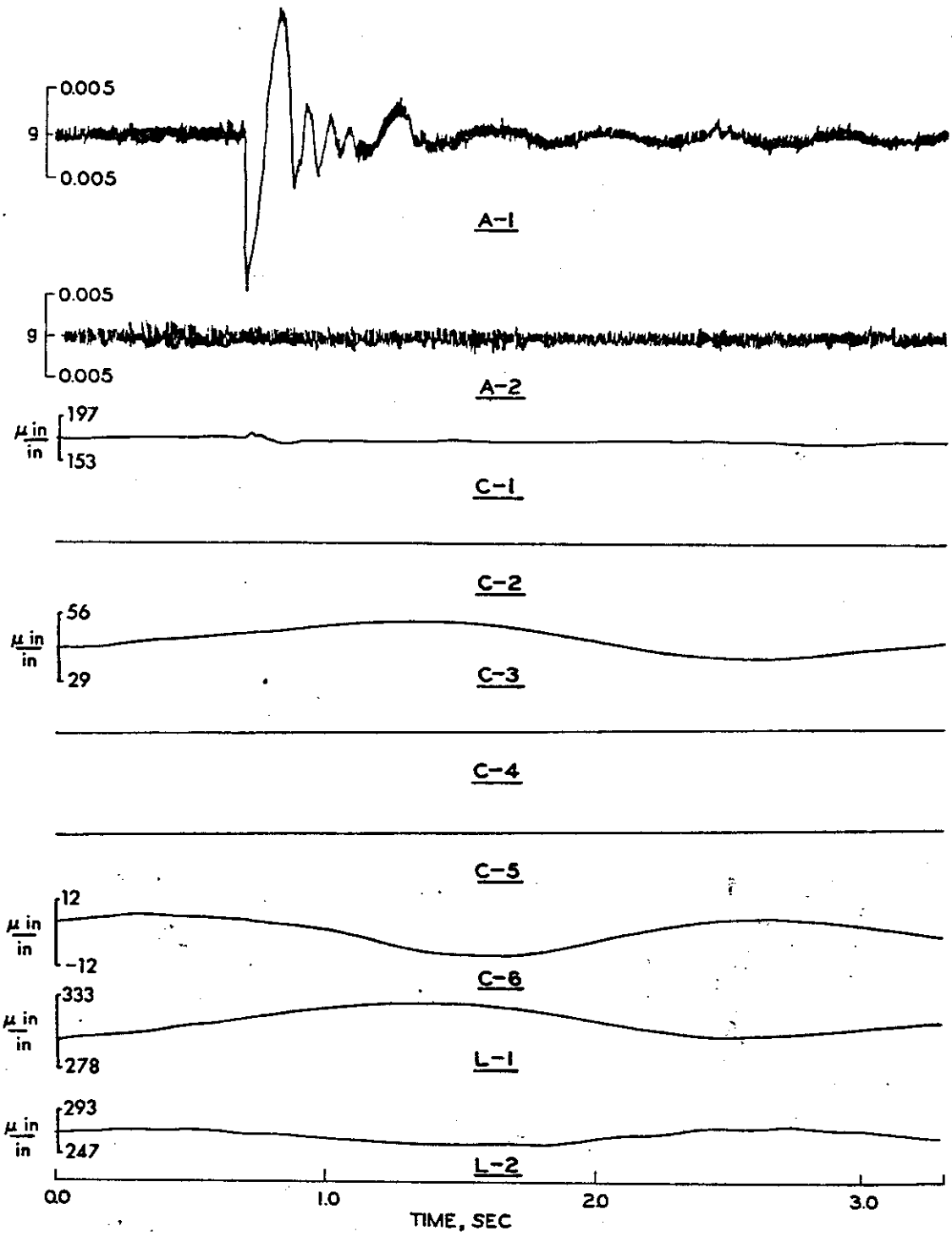
LOCATION OF STRAIN GAGES ON HOIST AND COUNTERWEIGHT CHAIN

PLATE 2



STRAIN GAGE
ARRANGEMENT
ON CHAIN

PLATE 3

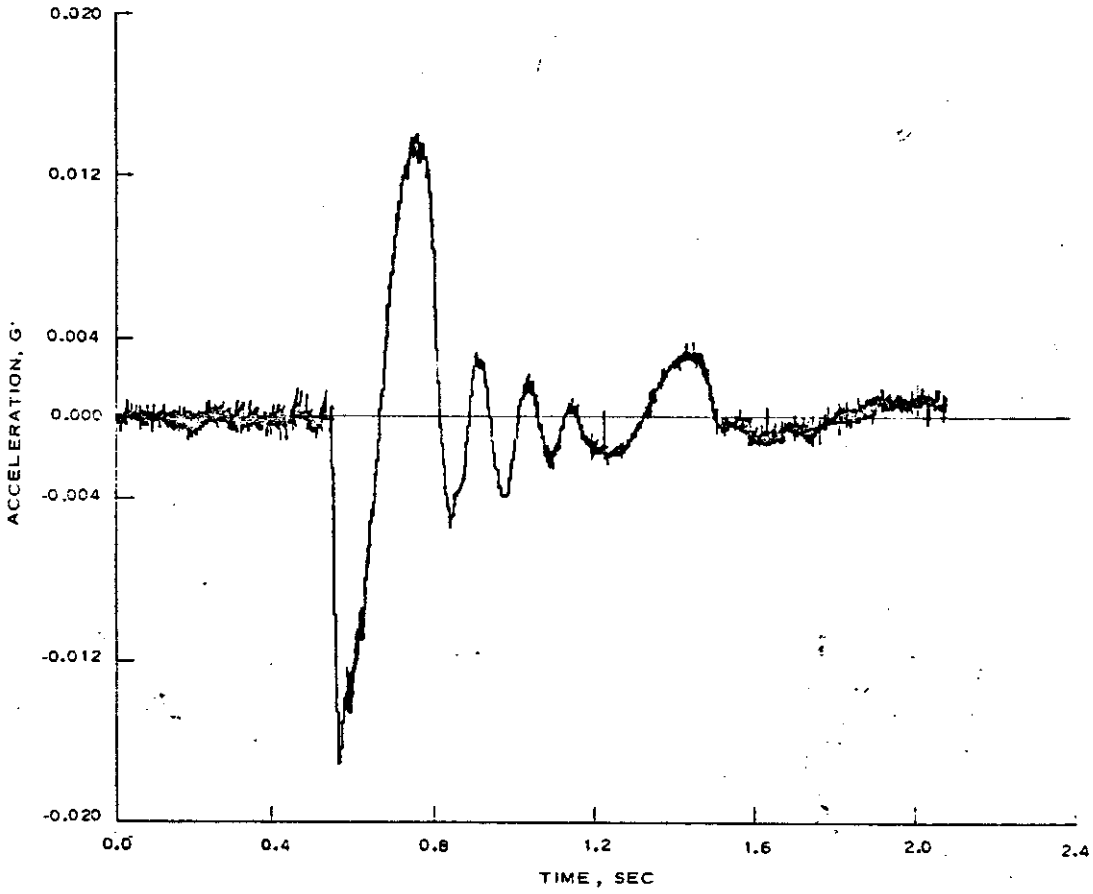


SAMPLE OSCILLOGRAPH RECORD

TEST 19

40' SURVEY BOAT ; DOWNSTREAM; 11.5 MPH

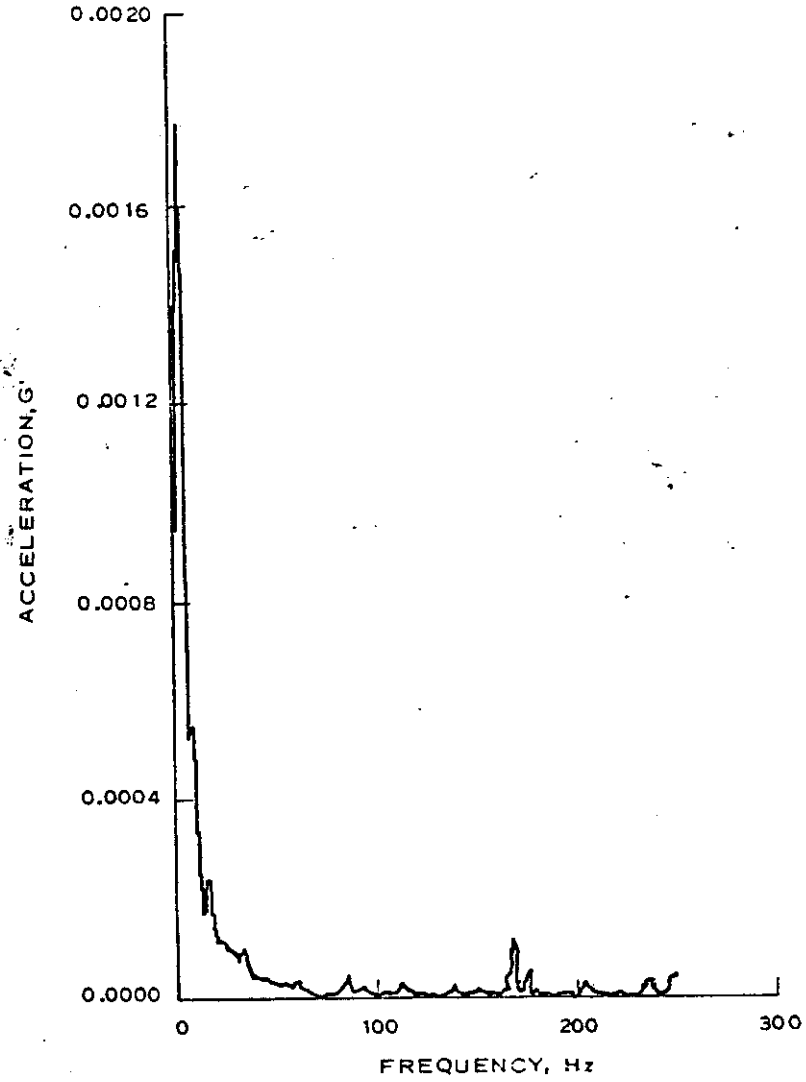
PLATE 4



DIGITAL PLAYBACK

TEST 19
8 DECEMBER 1972

PLATE 5



CHANNEL NO. 1
MAX = 0.0017724
DOF = 9
FREQ = 3 41797
RATE = 500
POINTS = 103
RMS = 0.00396

FREQUENCY TEST

TEST 19
8 DECEMBER 1978

PLATE 6