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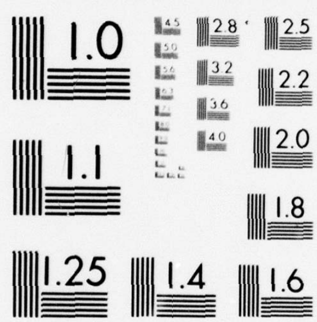

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TECHNICAL REPORT HL-79-4

KISSIMMEE RIVER STRUCTURES, CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL PROJECT

Hydraulic Model Investigation

by

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March 1979
Final Report

Prepared for U. S. Army Engineer District, Jacksonville
Jacksonville, Fla. 32201
and
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Kissimmee River structures S-65E, S-65D, and S-65B were reproduced in a 1:20-scale model in order to study ways of eliminating scour of the downstream riprap blankets by means of structural modifications of operating procedures. All of the models had low ogee type spillways with vertical lift gates. The models and testing conditions were reproduced according to prototype data received from the U. S. Army Engineer District, Jacksonville, and the South Florida Water Management District.

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20. ABSTRACT (Continued).

Cont The only structure that has baffle blocks in the stilling basin is S-65E, and it has experienced a negligible amount of scour. Results show that little or no scour damage should have occurred downstream from the structure under normal operating conditions.

Structures S-65D and S-65B experienced heavy scour of the downstream riprap blankets during a high discharge period in 1969. Two methods were evaluated to reduce the scouring action: placing baffle blocks in the stilling basin and replacing the existing 18-inch riprap with larger sizes of stone.

Economic analysis by the U. S. Army Engineer District, Jacksonville, showed that it would be more economical to add baffle blocks to the stilling basins than increase the size of the riprap. Thus, only structure S-65D was tested with larger sizes of riprap.

The test results showed that the scour potential will be greatly reduced by adding two rows of baffle blocks to the stilling basins.

PREFACE

The model investigation reported herein was authorized by the Office, Chief of Engineers, U. S. Army (OCE), on 24 March 1975 at the request of the U. S. Army Engineer Division, South Atlantic (SAD) and the U. S. Army Engineer District, Jacksonville (SAJ). Sponsors of the model study were SAJ and the South Florida Water Management District (SFWMD).

The study was conducted in the Hydraulics Laboratory of the U. S. Army Engineer Waterways Experiment Station (WES) from November 1975 to July 1977 under the direction of Mr. H. B. Simmons, Chief of the Hydraulics Laboratory, and Mr. J. L. Grace, Jr., Chief, Structures Division, and under the supervision of Mr. G. A. Pickering, Chief, Locks and Conduits Branch (LCB). The engineer in immediate charge of the model was Mr. H. O. Turner, Jr., LCB, who was assisted by Messrs. J. V. Hines and J. H. Riley, LCB. This report was prepared by Messrs. Turner and Pickering.

During the course of the investigation, SAJ personnel, Messrs. Bob Bullock, Henry Anderson, and Charles McManus; SAD personnel, Mr. Bert Holler; and SFWMD personnel, Messrs. Richard Irons, Joseph Schweigart, and Richard Slyfield, visited WES to observe model operation and discuss results. Observations of the prototype structures were made by WES personnel, Messrs. Turner and Pickering.

Directors of WES during the conduct of the tests and the preparation and publication of this report were COL G. H. Hilt, CE, and COL J. L. Cannon, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic feet per second	0.02831685	cubic metres per second
feet	0.3048	metres
feet per second	0.3048	metres per second
inches	25.4	millimetres
miles (U. S. statute)	1.609344	kilometres
square miles (U. S. statute)	2.589988	square kilometres

KISSIMMEE RIVER STRUCTURES, CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL PROJECT

Hydraulic Model Investigation

PART I: INTRODUCTION

The Prototype

1. The Kissimmee River control structures are located in Central Florida (Figure 1) in the floodplain and general alignment of the existing Kissimmee River. They were built by the U. S. Army Corps of Engineers as part of a flood control channel improvement project. The structures are operated by the South Florida Water Management District, a state agency authorized to represent local interests.

2. The overall project consists of six structures (S-65 through S-65E) and six navigation locks. Each lock is 30 ft* wide by 90 ft long and has sector gates to provide for navigation of pleasure craft. The spillways consist of gated, reinforced concrete structures with crests designed to conform to an ogee shape. The gates are vertical-lift type. The width of the structures ranges from 87.5 ft (three-gate bays) to 179.5 ft (six-gate bays).

Purpose of Model Study

3. During October 1969, a heavy rainfall associated with tropical storm Jenny resulted in a flood which caused scour damage to the riprap downstream from some of the structures. A model study was needed to study the problem and evaluate the effectiveness of structural modifications and operating procedures. Specifically, it was expected that the model would be used to:

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* A table for converting U. S. customary units of measurement to metric (SI) units is given on page 3.

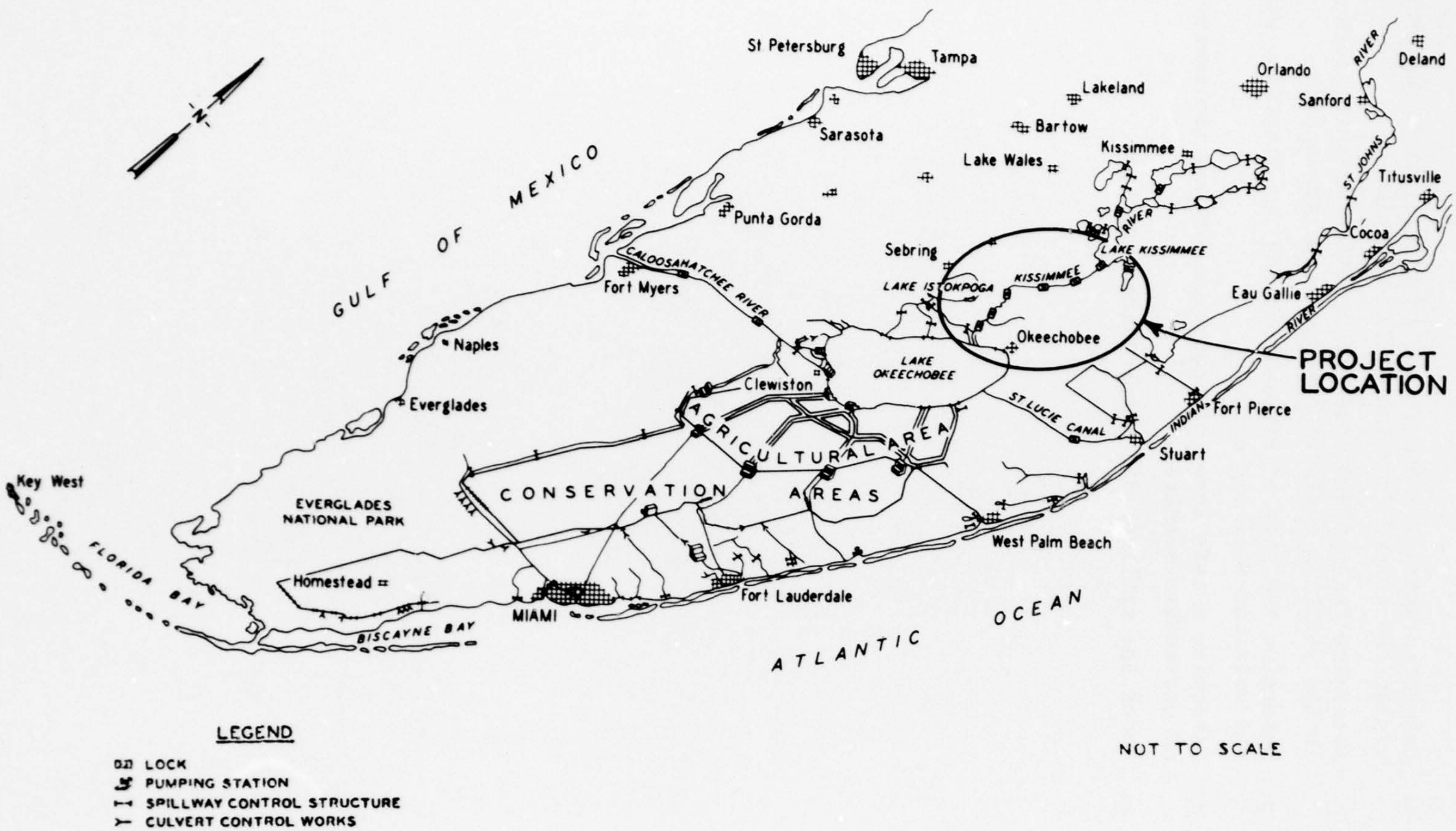

Figure 1. Location map

a. Determine hydraulic conditions that initiate scour of the riprap downstream from the stilling basins.

b. Determine the optimum size and location of baffle blocks in the stilling basins to reduce scour tendencies.

c. Determine the size of riprap required for stability with the existing stilling basins.

d. Determine a safe level of operation pending implementation of corrective measures.

e. Check the spillway discharge characteristics.

PART II: THE MODEL

Description

4. The 1:20-scale model was built according to prototype as-built drawings. The model included 250 ft of approach channel, the control structures, and 800 ft of exit channel. The model was initially constructed with the six-bay structure (S-65E) as shown in Figure 2, and later modified to simulate one of the four-bay structures, S-65D, (Figure 3), and then one of the three-bay structures, S-65B, (Figure 4). The approach and exit channels were molded in cement mortar to sheet metal templates. A mixture of crushed stone was placed in the appropriate areas to accurately simulate the prototype riprap. The spillway structures were constructed of plastic-coated plywood. The spillway and gate piers were fabricated of sheet metal.

5. Water used in the operation of the model was supplied by a constant head tank and discharges were measured with venturi meters. Water-surface elevations were measured with point gages and piezometers. Water velocities were measured with a pitot tube. Tailwater elevations were regulated by an adjustable gate at the end of the flume.

Scale Relationships

6. The equations of hydraulic similitude, based on Froude's Law, were used to convert model dimensions and hydraulic quantities to prototype equivalents as follows:

Characteristic	Dimension*	Model:Prototype
Length	L	$L_R = 1:20$
Area	L_R^2	$A_R = 1:400$
Velocity	$L_R^{1/2}$	$V_R = 1:4.4721$
Discharge	$L_R^{5/2}$	$Q_R = 1:1788.85$
Time	$L_R^{1/2}$	$T_R = 1:4.4721$

* Dimensions are in terms of length.

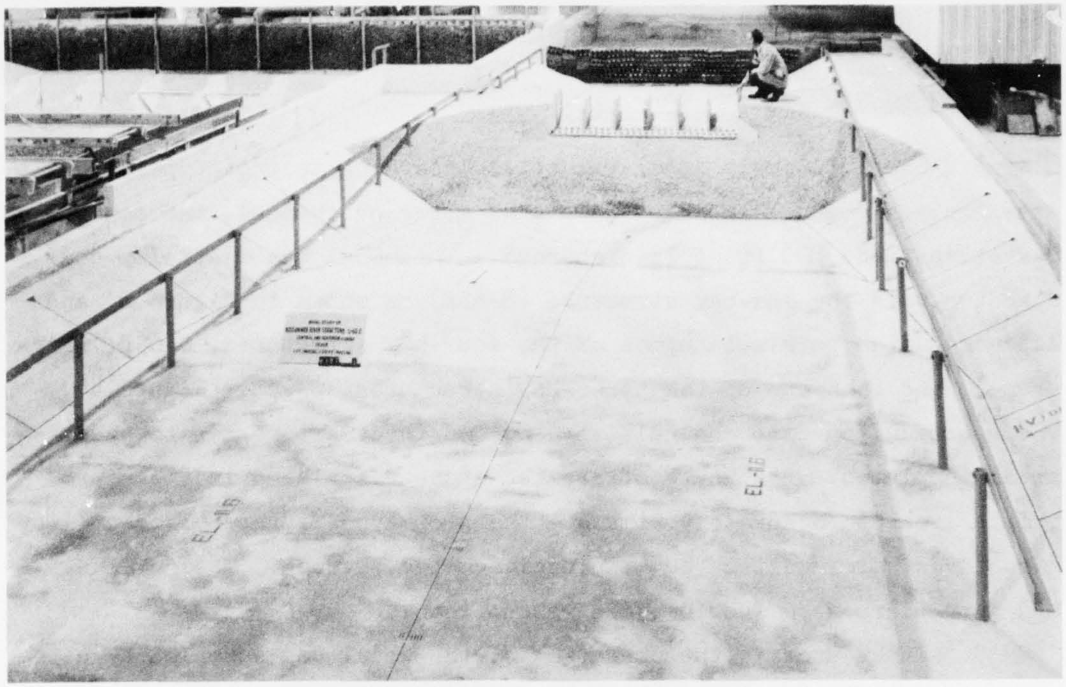

Figure 2. Downstream view of 6-bay model facility, Structure S-65E

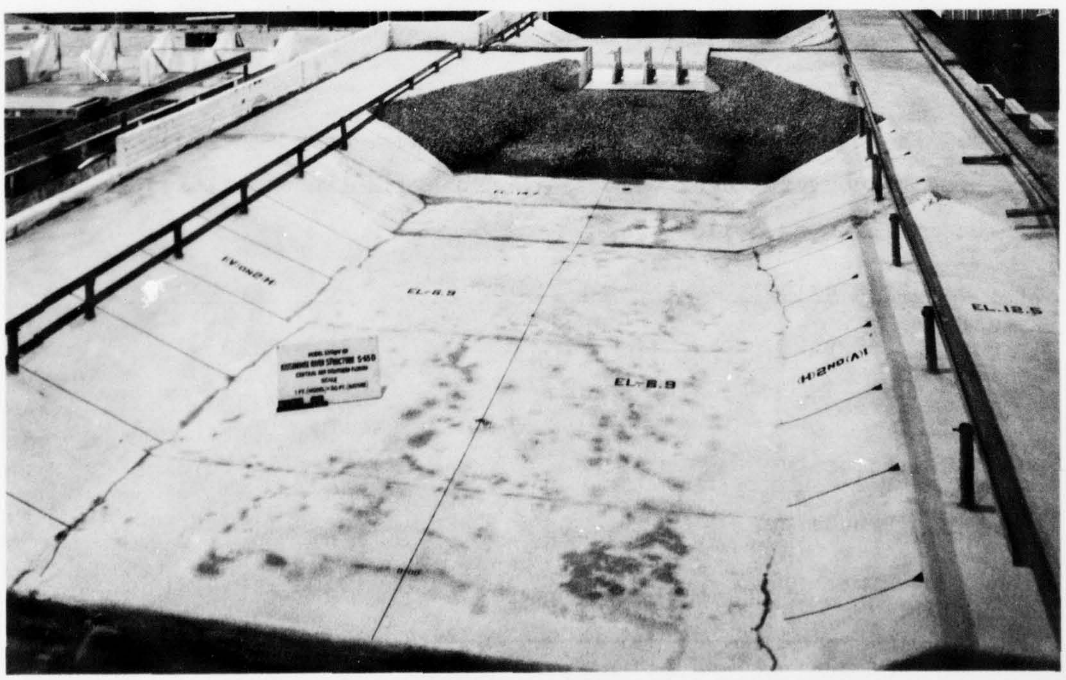

Figure 3. Downstream view of 4-bay model facility, Structure S-65D

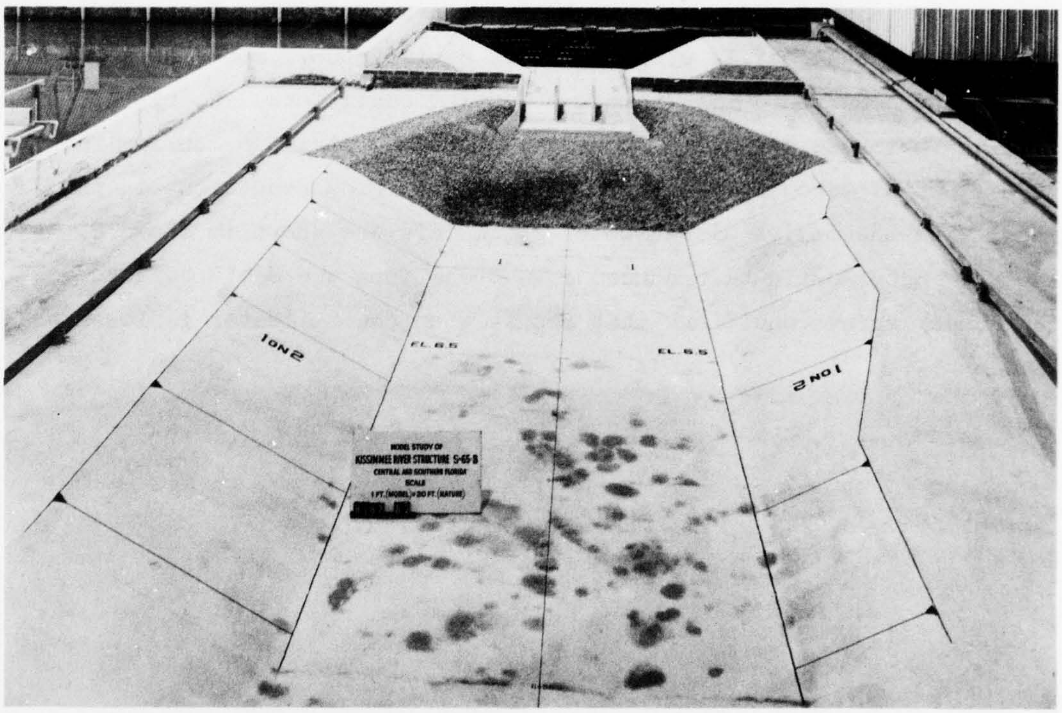

Figure 4. Downstream view of 3-bay model facility, Structure S-65B

PART III: TESTS AND RESULTS

Structure S-65E

Riprap tests

7. Initial tests were conducted to determine the adequacy of the riprap protection downstream from Structure S-65E (Figure 5). This is the only prototype structure that has baffle blocks in the stilling basin. Details of this structure are shown in Plate 1. Tests indicated that the existing baffle arrangement is satisfactory, since no scour of the riprap occurred during normal operating conditions. No riprap movement was observed downstream from the prototype structure during the high flows of October 1969 shown in Photo 1. Flow conditions in the model with the design discharge of 24,000 cfs are shown in Photo 2.

8. Scour could be produced downstream from the S-65E structure only under spray conditions that result when the tailwater is lower than

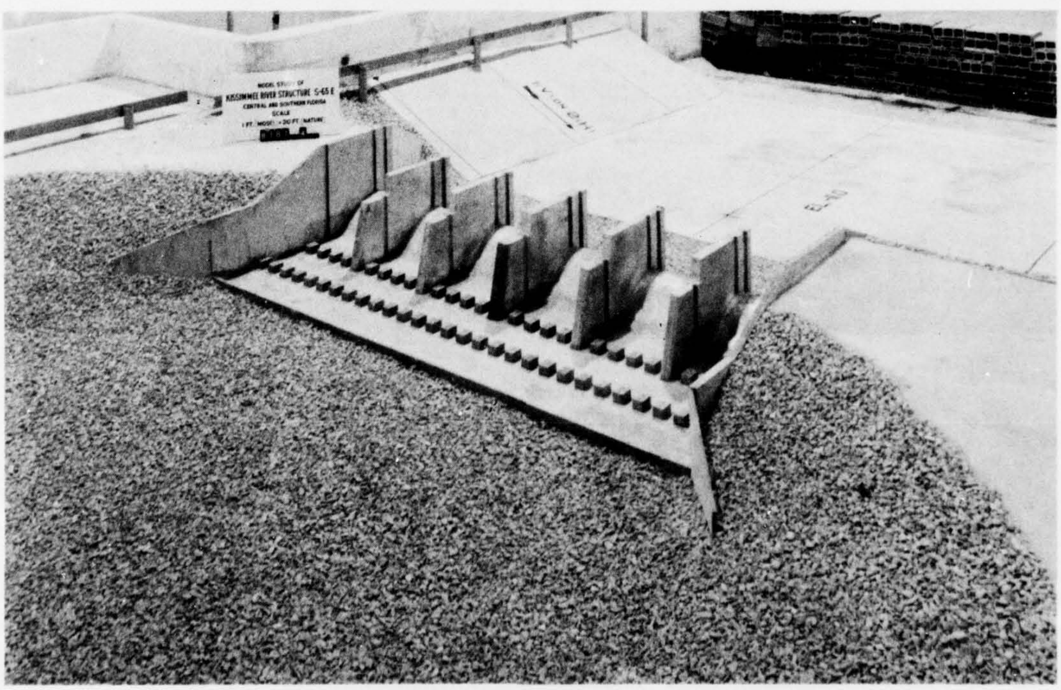

Figure 5. Stilling basin and downstream riprap, model structure S-65E

that required to maintain hydraulic jump action in the stilling basin. Plate 2 illustrates the tailwater elevations that permitted spray with various gate openings subject to the normal pool elevations of 21.0 ft.* Safe operation of S-65E should result with normal pool elevation, gate opening, and tailwater combinations that fall above the line shown in Plate 2.

Discharge calibration tests

9. Tests to determine the discharge characteristics of Structure S-65E were conducted for the following flow conditions.

a. Free uncontrolled flow. Gates fully open; upper pool unaffected by the tailwater.

b. Submerged uncontrolled flow. Gates fully open; upper pool controlled by the submergence effect of the tailwater.

c. Free controlled flow. Gates partially open; upper pool unaffected by the tailwater; controlled by the particular gate opening.

d. Submerged controlled flow. Gates partially open; upper pool controlled by both the submergence effect of the tailwater and the gate opening.

10. Free uncontrolled-flow characteristics were determined by introducing various constant discharges into the model and observing the corresponding upper pool elevation. Sufficient time was allowed for stabilization of the upstream flow conditions. Upper pool elevations were measured at a point 200 ft upstream from the spillway. Tailwater elevations were measured at a point 400 ft downstream of the end sill.

11. A similar procedure was followed for various gate openings to determine the discharge characteristics of free controlled flow.

12. Submerged-flow characteristics for both controlled and uncontrolled flows were determined by introducing several constant discharges into the model and varying the tailwater from an elevation at which no interference with spillway flow was evident to an elevation at which the flow was highly submerged. The elevation of the upper pool for each tailwater elevation was recorded.

13. Basic data obtained are presented in plots of approach channel

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* All elevations (el) are in feet referred to mean sea level (msl).

energy elevation (water surface plus velocity head based on average velocity) versus tailwater elevation. These data are shown in Plates 3-8.

14. The flow conditions and equations used to satisfy the calibration data are identified as follows:

a. Free uncontrolled flow:

$Q = CLH_e^{3/2}$, where C is a function of H_e

b. Submerged uncontrolled flow:

$Q = C_s Lh\sqrt{2g\Delta H}$, where C_s is a function of h/H_e

c. Free controlled flow:

$Q = C_g LG_o\sqrt{2gH_g}$, where C_g is a function of H_g and G_o

d. Submerged controlled flow:

$Q = C_{g_s} Lh\sqrt{2g\Delta H}$, where C_{g_s} is a function of h/G_o

Symbols used in these equations are defined as follows:

Q = total discharge, cfs

C = discharge coefficient for free uncontrolled flow

L = net length of spillway crest, ft

H_e = total energy head on weir, ft

C_s = discharge coefficient for submerged uncontrolled flow

h = tailwater elevation referred to weir crest, ft

g = acceleration due to gravity, ft/sec^2

ΔH = differential between total energy of the approach channel and depth of tailwater in reference to the crest in ft $(H_e - h)$

C_g = discharge coefficient for free controlled flow

G_o = gate opening, ft

H_g = total head on gate, ft $(H_e - G_o/2)$

C_{g_s} = discharge coefficient for submerged controlled flow

15. Known quantities determined from the basic data were substituted in the equations, and the discharge coefficients for the respective flow conditions were computed. These coefficients are shown in Plates 9-12.

Structure S-65D

16. Structure S-65D (Figure 6) was selected as a typical four-bay

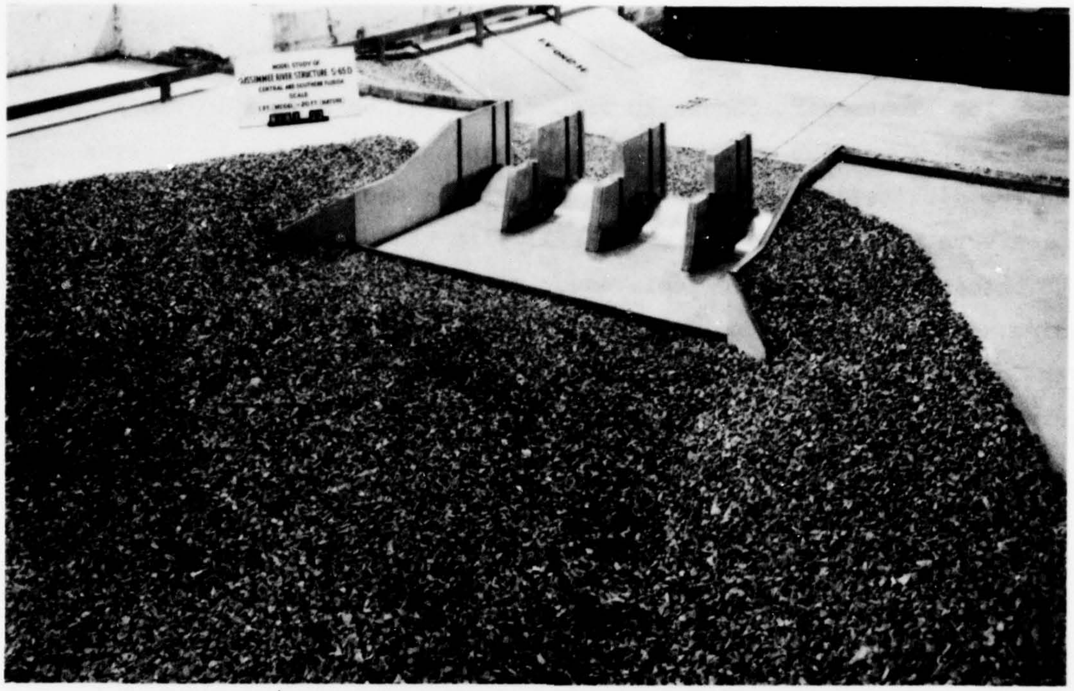

Figure 6. Stilling basin and downstream riprap, model structure S-65D, Type 1 design (prototype)

structure for model testing. Tests were conducted with a range of headwater and tailwater conditions so that results would be applicable to either of the four-bay structures. Details of Structure S-65D are shown in Plate 13. This structure does not have baffle blocks in the stilling basin and heavy scour damage occurred downstream during the high flows in 1969 (see Photo 3). Two alternatives were considered to remedy this problem: baffle blocks could be added on the stilling basin apron or the size of the protective stone downstream could be increased.

Operation of existing structures

17. Information was needed to determine a safe range of operation of the existing structures until corrective measures could be implemented. These data are shown in Plate 14 and were obtained by setting a gate opening and maintaining a constant pool while the tailwater was gradually lowered until movement of the existing 18-in. riprap occurred. Safe operation will result if tailwater and gate opening combinations

fall above a selected normal pool line.

Baffle block tests

18. Tests were conducted with various sizes of baffle blocks at different locations on the stilling basin apron in order to increase energy dissipation and reduce the downstream scour potential. Velocities were measured above the end sill with the design flow conditions to obtain the relative effectiveness of each type of baffle block design. Table 1 lists the different baffle designs that were tested and the velocities measured. The average velocity over the end sill measured at el 9.0 was used to compare the efficiency of each design in reducing the potential for downstream scour. The Type 5 (two rows of 3.5-ft-high baffles) and Type 15 (two rows of 4.3-ft-high baffles) designs resulted in the lowest average velocities at el 9.0. Plates 15, 16, and 17 show velocities measured with the Type 1 (prototype), Type 5, and Type 15 designs. The designs of Types 5 and 15 resulted in satisfactory flow conditions and velocities downstream. However, the baffles were slightly smaller with the Type 5 design (Figure 7), and it was recommended for the prototype modification. The design consisted of two rows of 3.5-ft-high baffles located 32 and 41 ft downstream from the toe of the spillway crest. The baffles were 3 ft wide and spaced 3 ft apart. Flow conditions with the Type 5 design are shown in Photo 4. Minimum safe operating conditions obtained with this design and the existing 18-in. riprap are shown in Plate 18.

Riprap tests

19. Tests were conducted with larger riprap downstream from the original basin to determine the size required for stability with the critical hydraulic conditions shown in the operations log. This condition for Structure S-65D was selected from the log entry dated 5 October 1969. On this date, the headwater was at el 31.14, the tailwater was at el 23.20, and the gate opening was at el 10. In order to verify that this condition would cause riprap failure, a test was conducted with the existing 18-in. riprap for a simulated time of 2 hr (26.83-min model). This flow condition in the model is shown in Photo 5. The results of this test are shown in Figure 8. The 18-in. riprap was

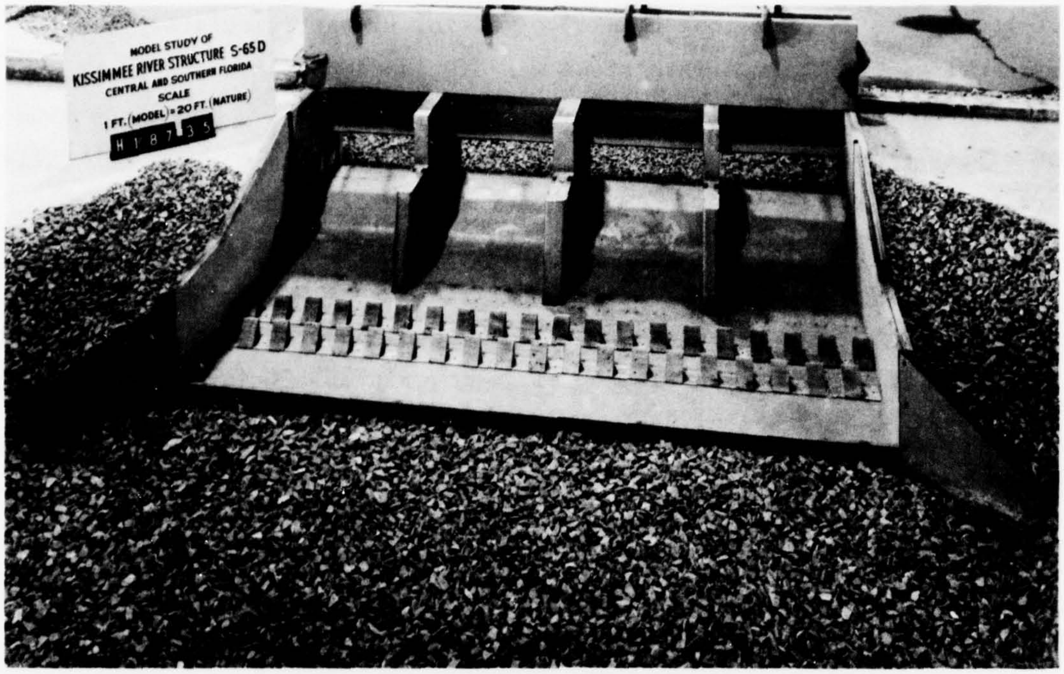

Figure 7. Stilling basin and downstream riprap, model structure S-65D with Type 5 design (3-ft-high baffles)

Figure 8. Downstream scour at model structure S-65D, Type 1 design (prototype), after 2-hr test at headwater el 31.24, tailwater el 23.20, all gates open 10 ft

replaced with a 30-ft-long blanket of 24-in. riprap immediately downstream from the basin. This stone was displaced near the end of the blanket during the test condition as shown in Figure 9. Thus, the size of riprap was increased to 36 in. This stone size was stable, but failure occurred at the downstream end of the blanket in the 18-in. riprap due to turbulence created by the larger stone. A transition blank of 24-in. riprap was added in order to prevent this type of failure. Several lengths of each stone were tested and the best plan (Figure 10), consisted of a 50-ft-long blanket of 36-in. riprap (54 in. thick) followed by a 30-ft reach of 24-in. riprap (36 in. thick).

Discharge calibration tests

20. Calibration tests for Structure S-65D were performed and analyzed as discussed in paragraphs 9-12. Basic data, presented as plots of approach channel energy elevation versus tailwater elevation, are shown in Plates 19-23. Discharge coefficients of Structure S-65D for the four types of flow are shown in Plates 24-27.

Structure S-65B

21. Structure S-65B (Figure 11) was selected as a typical three-bay structure for model testing. Again, tests were conducted with a range of headwater and tailwater conditions so that results would be applicable to any of the three-bay structures. Details of Structure S-65B are shown in Plate 28. None of the three-bay structures have baffle blocks in the stilling basin. Heavy scour was observed downstream from those structures after the high flows in 1969 (see Photo 6). Since SAJ had determined from an economic analysis that placing baffle blocks in the basin of the S-65D structure was less expensive than increasing the size of the downstream protection, only baffle blocks were considered as a corrective measure for the three-bay structures.

Operation of existing structures

22. Until corrective measures can be implemented, the information shown in Plate 29 was obtained as a minimum operating guide. This information was obtained by setting a gate opening and maintaining

Figure 9. Downstream scour at model structure S-65D, Type 16 design (24-in. riprap), after 2-hr test at headwater el 31.14, tailwater el 23.40, all gates open 10 ft

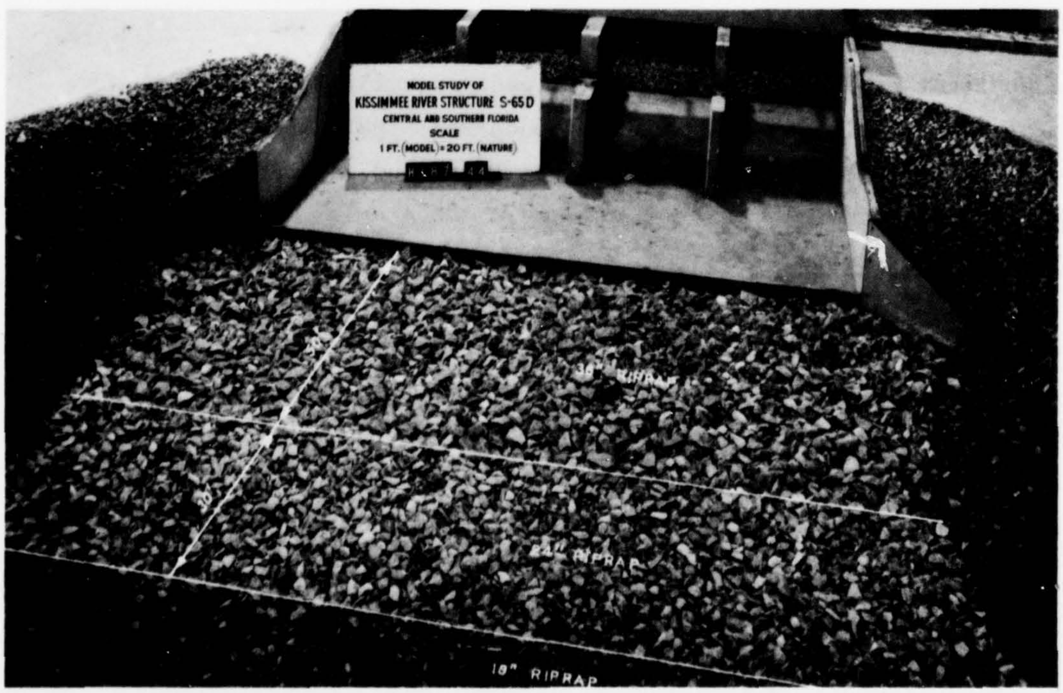

Figure 10. Stilling basin at model structure S-65D with Type 20 design (riprap)

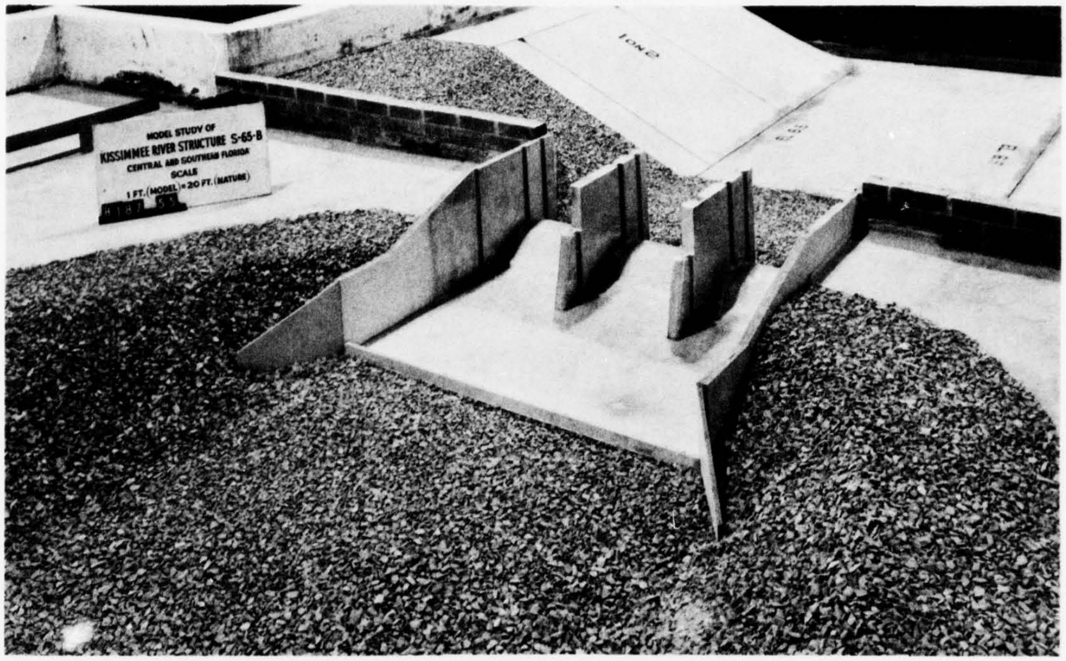

Figure 11. Stilling basin and downstream riprap, model structure S-65B, Type 1 design (prototype)

a constant pool while the tailwater was gradually lowered until movement of the existing 18-in. riprap occurred. Safe operation will result if tailwater and gate opening combinations fall above a selected normal pool line.

Baffle block tests

23. Tests were conducted with various sizes of baffle blocks at different locations in the stilling basin apron in order to increase energy dissipation and reduce the downstream scour potential. Velocities were measured above the end sill with the design flow conditions to obtain the relative effectiveness of each design. Table 2 lists the different baffle designs that were tested and the velocities measured. The average velocity over the end sill measured at el 23.0 was used to compare the efficiency of each design in reducing the potential for downstream scour. Of the designs tested, Types 19 and 25 produced the lowest average velocities at el 23.0. The existing riprap

downstream from the structure was stable for all expected flow conditions with either the Type 19 or Type 25 design and either design could be used for the prototype modification. Design flow conditions in both the Types 19 and 25 designs are shown in Photo 7.

Discharge calibration tests

24. Calibration tests for Structure S-65B were performed and analyzed as discussed in paragraphs 9-12. Basic data, presented as plots of approach channel energy elevation versus tailwater elevation, are shown in Plates 30-33. Discharge coefficients of Structure S-65B for the four types of flow are shown in Plates 34-37.

PART IV: DISCUSSION OF RESULTS AND CONCLUSIONS

25. Scour of the downstream riprap protection has been observed at several of the Kissimmee River structures. A model study was needed to determine what modificaitons could be made to the structures to reduce the scouring tendencies and to obtain a safe operating schedule until these modifications could be implemented. Since the structures vary in width and number of bays, three typical structures were modeled. These were S-65E, six bays; S-65D, four bays; and S-65B, three bays.

26. The only existing structure with baffle blocks in the stilling basin is S-65E. It has not experienced riprap scour downstream from the basin, and no scour was detected in the model until flow sprayed off the baffle blocks, a condition caused by extremely low tailwater. Thus, no modifications are needed at this structure.

27. None of the other structures have baffle blocks in the stilling basin and heavy scour damage occurred downstream during the high flows in 1969. To alleviate this problem, two alternatives were considered: baffle blocks could be added on the stilling basin apron or the size of the protective stone could be increased. After tests were conducted to determine the optimum size and configuration of the baffle blocks and the size and extent of riprap required, it was determined from an economical analysis that the baffle blocks would be less costly. Two rows of baffles were more effective than one in increasing energy dissipation and reducing velocities downstream. The optimum size and location of these blocks were determined for each structure.

28. Information was obtained to develop a guide for safe operation until the baffle blocks can be added. This information will allow the operator to determine a combination of headwater, tailwater, and gate opening that will not displace the existing 18-in. riprap.

29. Although model tests* had been conducted prior to these tests

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* U. S. Army Engineer Waterways Experiment Station, CE, "Typical Spillway Structure for Central and Southern Florida Water Control Project, Hydraulic Model Investigation," Technical Report 2-633, Sep 63, Vicksburg, Miss.

to determine discharge characteristics for a typical spillway structure, a limited amount of discharge calibration data were obtained for each of the structures. Discharge coefficients obtained were very close to those shown in the referenced report.

Table 1

Kissimmee River S-65D, Baffle Block Tests

Design Type	Baffle Block Height ft	Spacing Between Blocks ft	Location Downstream of Toe: 1st Row ft	Location Downstream of Toe: 2nd Row ft	Average Velocities Taken above End Sill (Sta 0+88 D/S): El 9.0 ft/sec	El 15.5 ft/sec	El 22.0 ft/sec
1	--	--	--	--	16.5	13.3	8.2
2	3.5	3.0	32.0	--	11.3	14.4	10.4
3	3.5	3.0	27.0	--	11.7	14.5	11.0
4	3.5	3.0	37.0	--	11.3	14.8	10.5
5	3.5	3.0	32.0	41.0	9.3	14.8	11.5
6	3.5	3.0	27.0	36.0	9.7	14.7	11.4
7	2.7	2.7	22.0	--	11.9	14.4	10.1
8	2.7	2.7	17.0	--	13.0	14.0	10.3
9	2.7	2.7	27.0	--	12.1	14.3	9.9
10	2.7	2.7	27.0	34.0	10.3	14.8	9.4
11	2.7	2.7	32.0	39.0	10.3	15.0	10.6
12	4.3	4.0	27.0	--	11.5	14.4	11.3
13	4.3	4.0	27.0	38.0	9.7	14.7	12.1
14	4.3	4.0	32.0	--	11.4	14.8	11.2
15	4.3	4.0	32.0	43.0	9.2	15.1	12.1

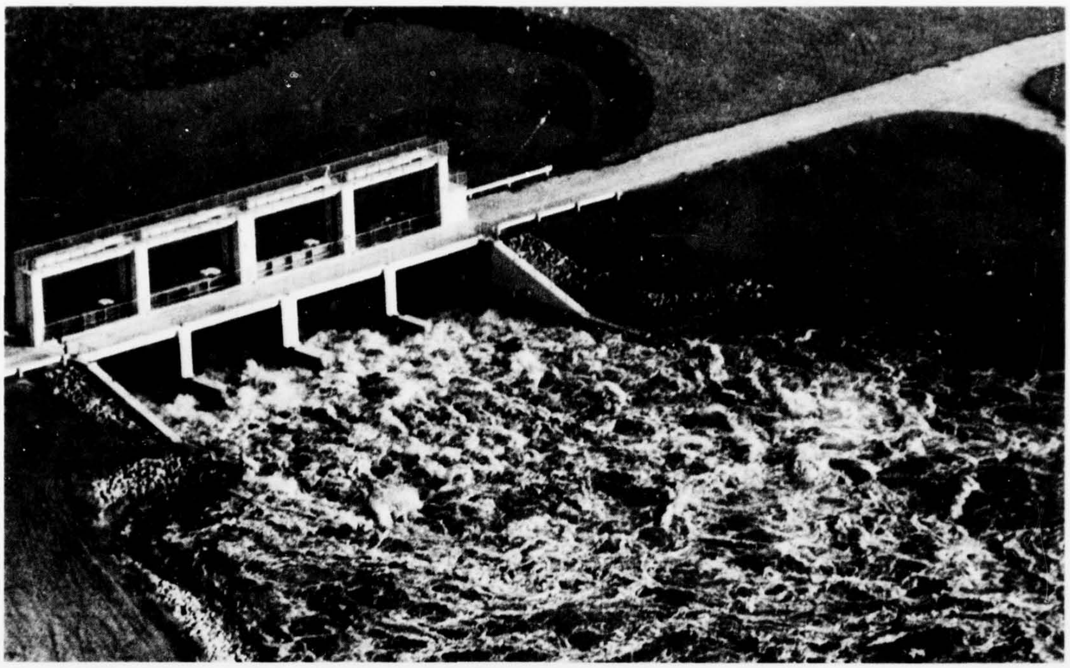
Table 2

Kissimmee River S-65B, Baffle Block Tests

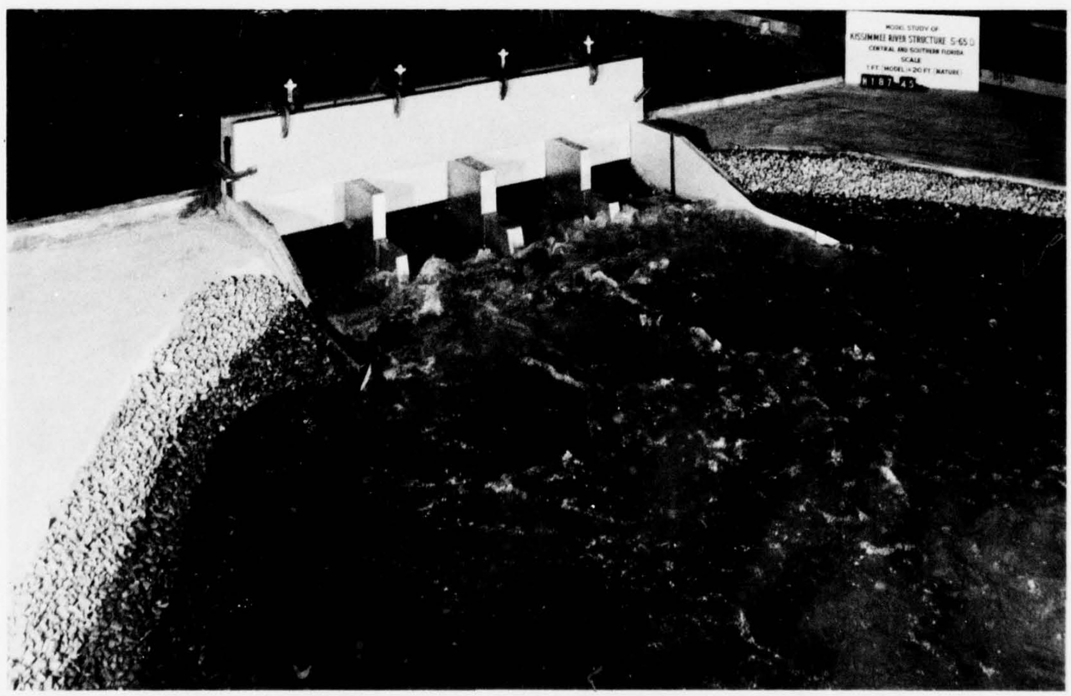
Design Type	Baffle Block Height ft	Spacing Between Blocks ft	Location Downstream of Toe: 1st Row ft	Location Downstream of Toe: 2nd Row ft	Average Velocities Taken above End Sill (Sta 0+83 D/S): El 23.0 ft/sec	El 15.5 ft/sec	El 22.0 ft/sec
1	--	--	--	--	17.1	13.7	8.7
2	3.14	3.14	29.0	--	12.0	14.8	11.1
3	3.14	3.14	24.0	--	12.2	14.3	10.9
4	3.14	3.14	24.0	32.0	10.7	14.8	11.9
5	3.14	3.14	29.0	37.0	10.3	15.4	11.9
6	3.14	3.14	34.0	42.0	10.0	15.2	11.6
7	3.14	3.14	34.0	--	11.4	14.6	10.6
8	2.75	2.75	29.0	--	12.0	14.5	10.6
9	2.75	2.75	24.0	--	12.0	14.4	10.9
10	2.75	2.75	34.0	--	11.9	14.5	10.4
11	2.75	2.75	34.0	41.0	10.5	15.1	11.1
12	2.75	2.75	29.0	36.0	10.3	15.1	11.6
13	2.75	2.75	24.0	31.0	10.6	15.0	11.8
14	3.67	3.67	29.0	--	11.3	14.8	11.5
15	3.67	3.67	24.0	--	11.7	14.7	11.7
16	3.67	3.67	34.0	--	11.1	15.0	11.2
17	3.67	3.67	29.0	38.0	10.0	15.2	12.6
18	3.67	3.67	24.0	33.0	10.6	15.0	12.6
19	3.67	3.67	34.0	43.0	9.5	15.3	12.3
20	4.40	4.40	29.0	--	11.0	14.9	11.9
21	4.40	4.40	24.0	--	11.5	14.6	12.0
22	4.40	4.40	34.0	--	10.7	15.2	12.2
23	4.40	4.40	29.0	40.0	10.2	14.8	12.9
24	4.40	4.40	24.0	35.0	9.7	15.3	13.5
25	4.40	4.40	34.0	44.0	9.2	15.7	13.6

Photo 1. Structure S-65E, headwater el 21.49, tailwater el 16.12, all gates open 9 ft

Photo 2. Structure S-65E, design flow conditions, headwater el 22.4, tailwater el 20.0, all gates open full

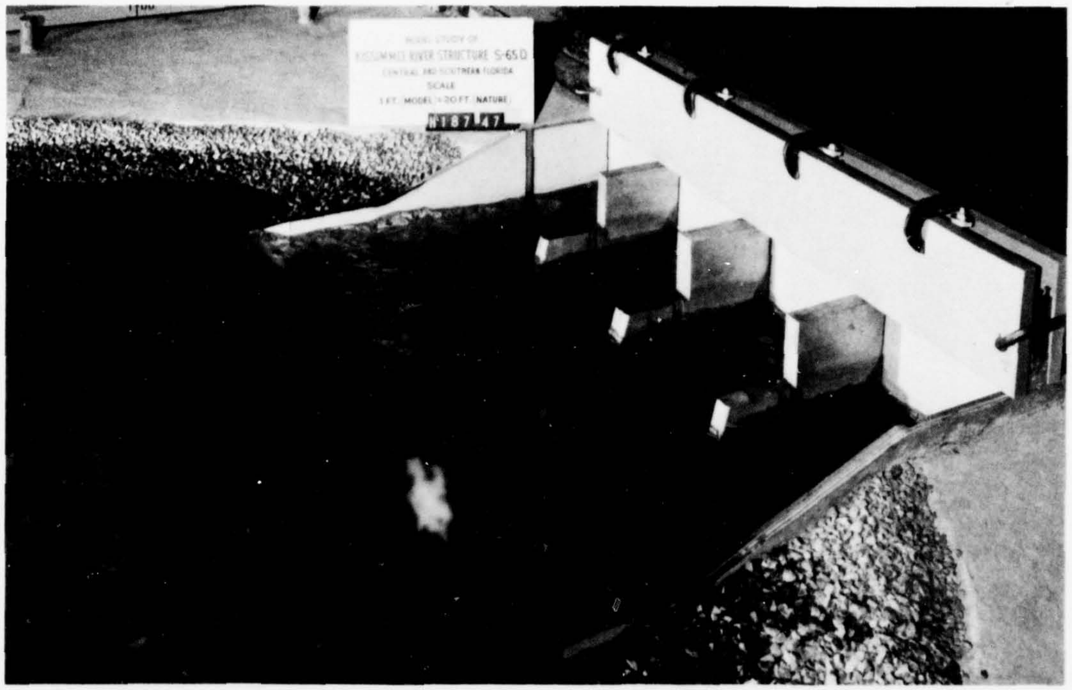


a. Prototype

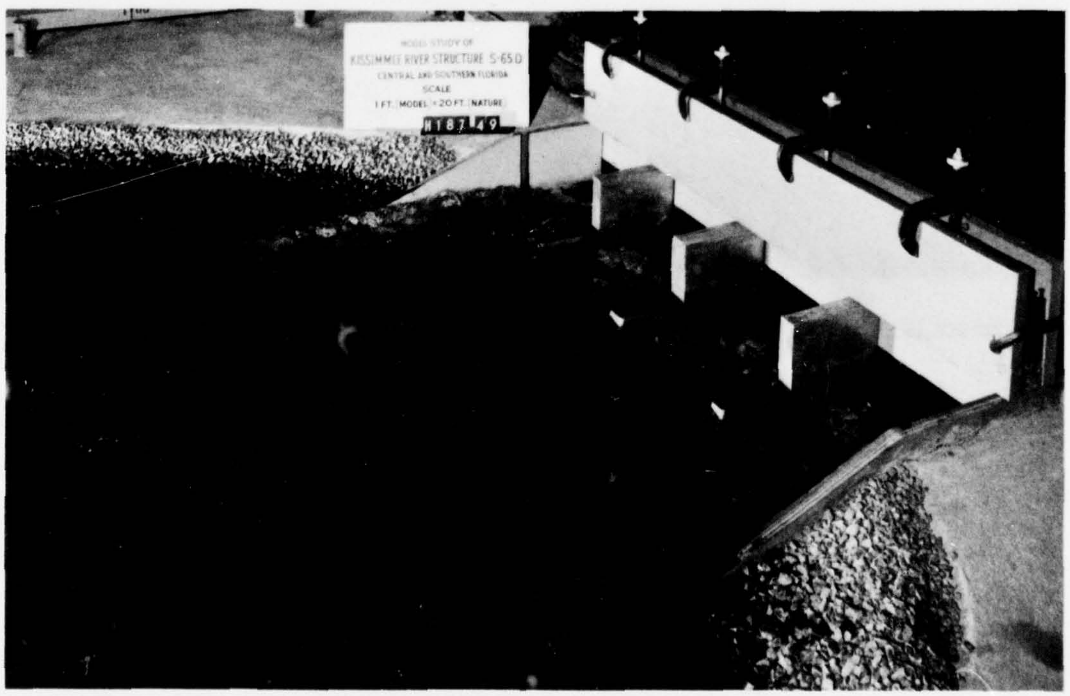


b. Model

Photo 3. Structure S-65D, headwater el 30.15, tailwater el 21.4, all gates open 10 ft



a. Normal flow conditions, headwater el 26.8, tailwater el 21.0, all gates open 4.0 ft



b. Design flow conditions, headwater el 28.0, tailwater el 23.4, all gates open full

Photo 4. Flow conditions with Type 5 design in Structure S-65D

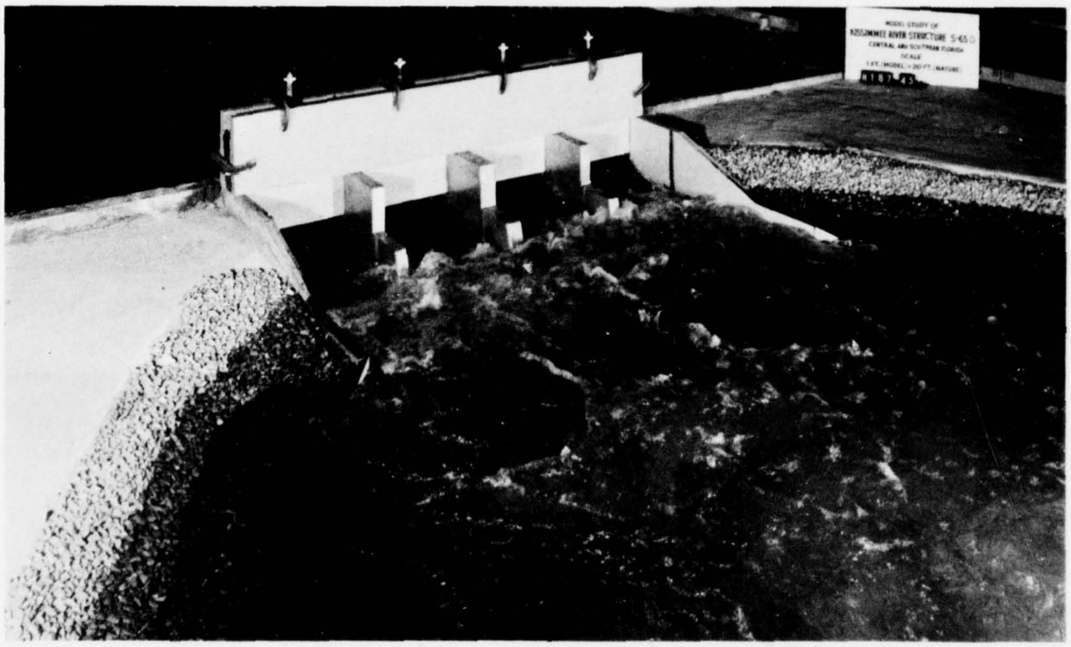
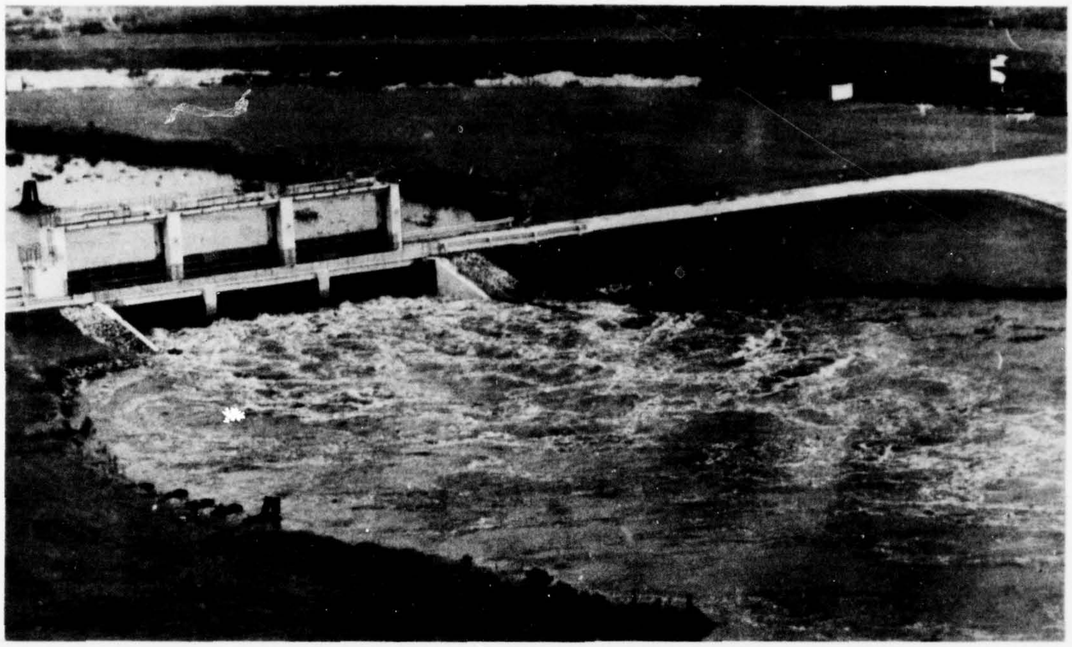


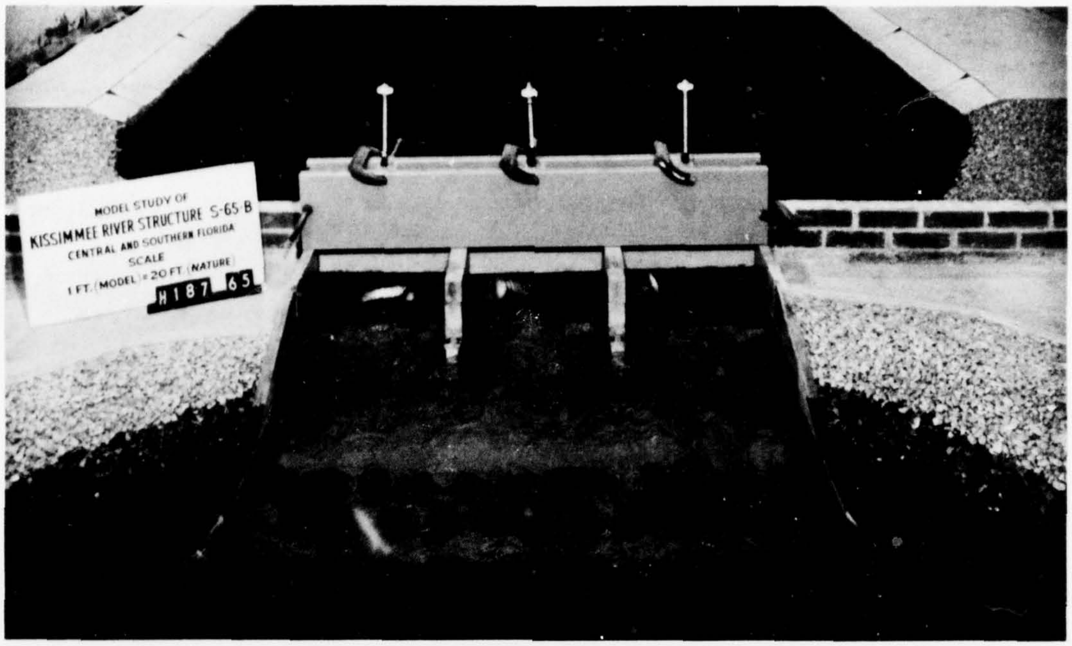
Photo 5. Structure S-65D, headwater el 30.15, tailwater el 21.4, all gates open 10 ft



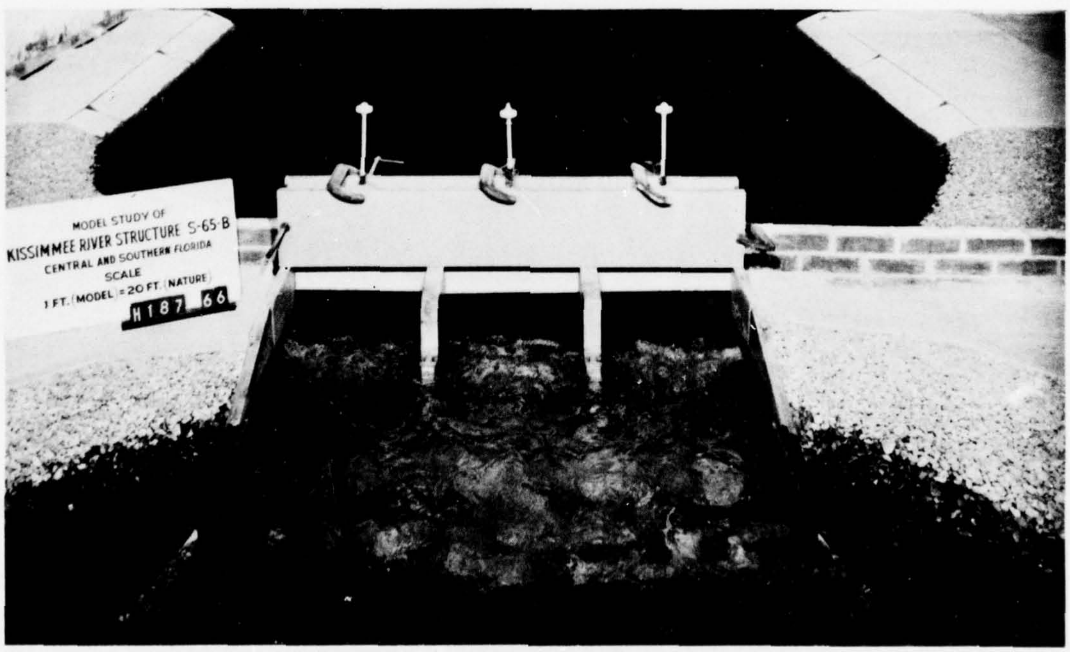
a. Prototype

b. Model

Photo 6. Structure S-65B, headwater el 43.08, tailwater el 39.55, all gates open 12 ft

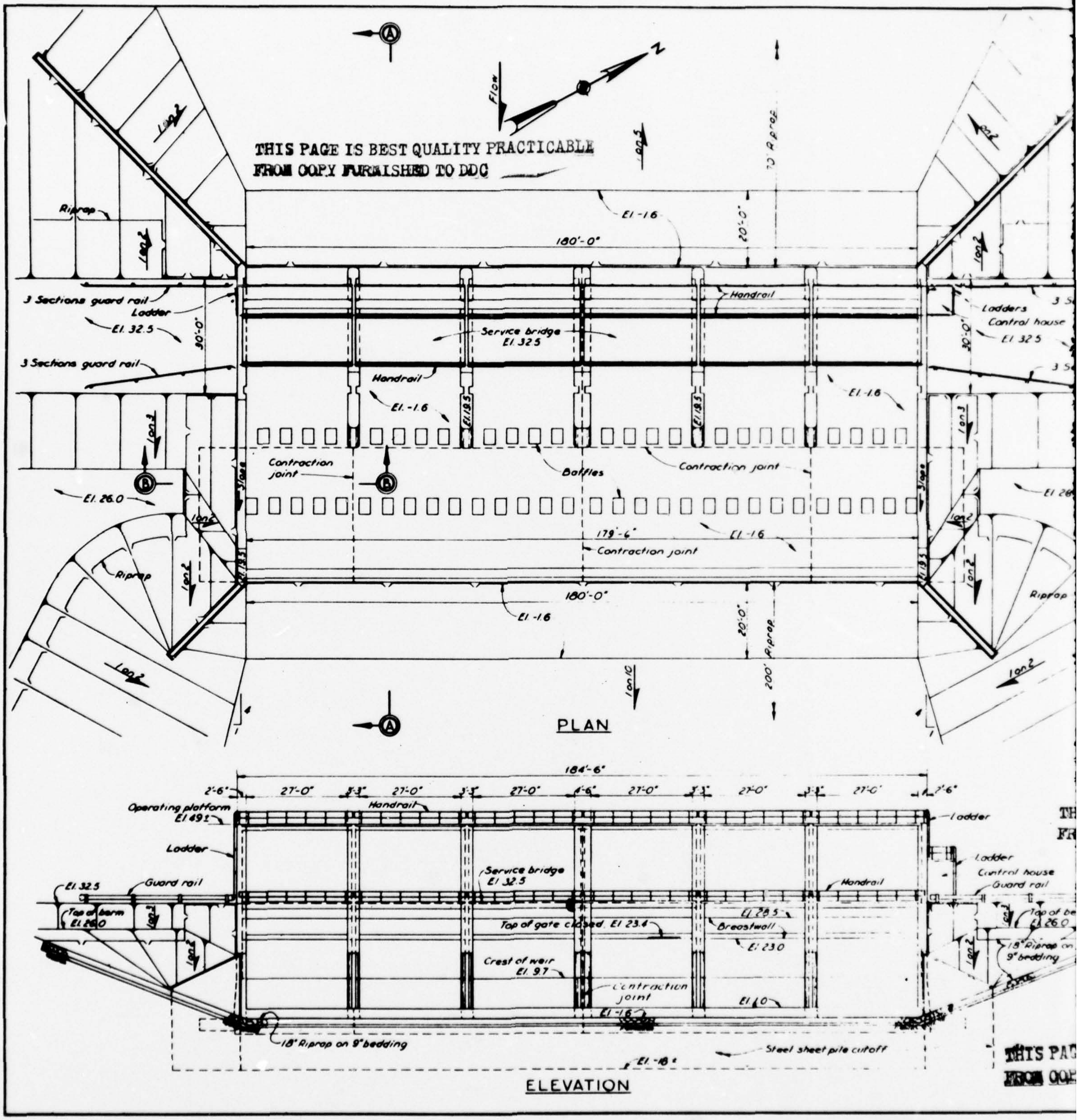


a. Type 19 design stilling basin

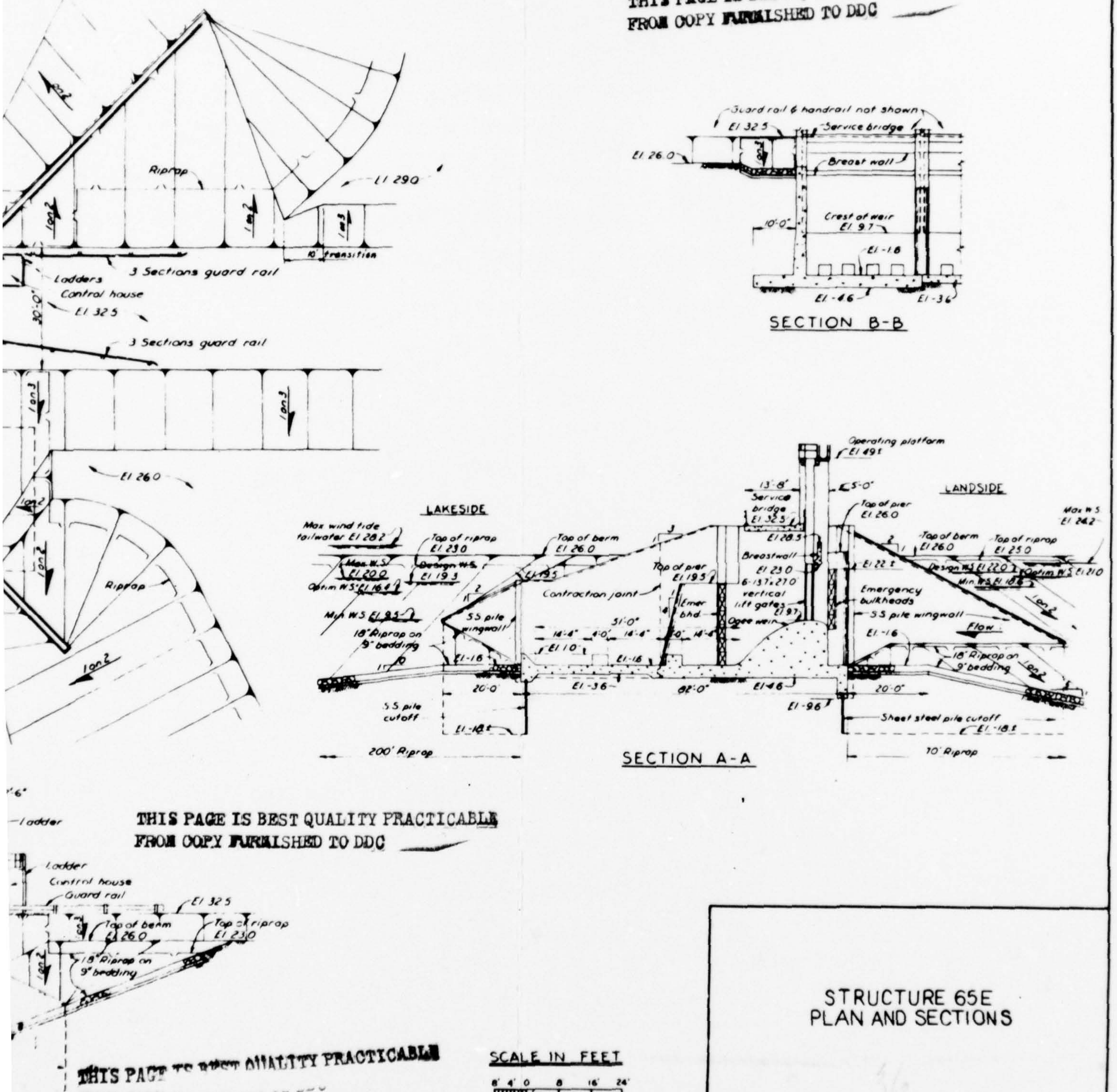


b. Type 25 design stilling basin

Photo 7. Design flow conditions in Structure S-65B, headwater el 40.0, tailwater el 35.7, 14,000 cfs


Flow
N
Riprap
3 Sections guard rail
Ladder
El. 32.5
3 Sections guard rail
Service bridge
El. 32.5
Handrail
El. -1.6
180'-0"
20'-0"
30'-0"
Contraction joint
Baffles
El. 26.0
179'-6"
Ladders
Control house
PLAN
184'-6"
Operating platform
El. 49±
Guard rail
Top of berm
El. 26.0
Top of gate closed El. 23.4
Breastwall
Crest of weir
El. 9.7
18" Riprap on 9" bedding
Steel sheet pile cutoff
ELEVATION

1



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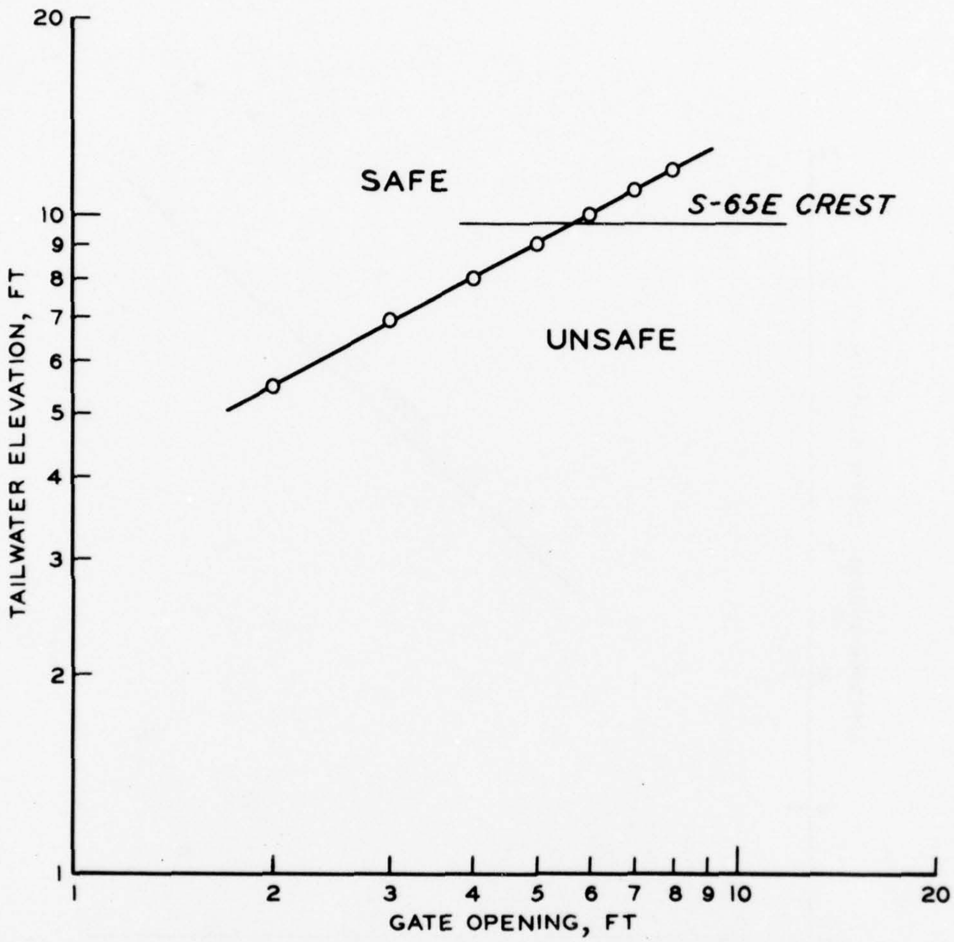
FROM COPY FURNISHED TO DDC

STRUCTURE 65E
PLAN AND SECTIONS

2

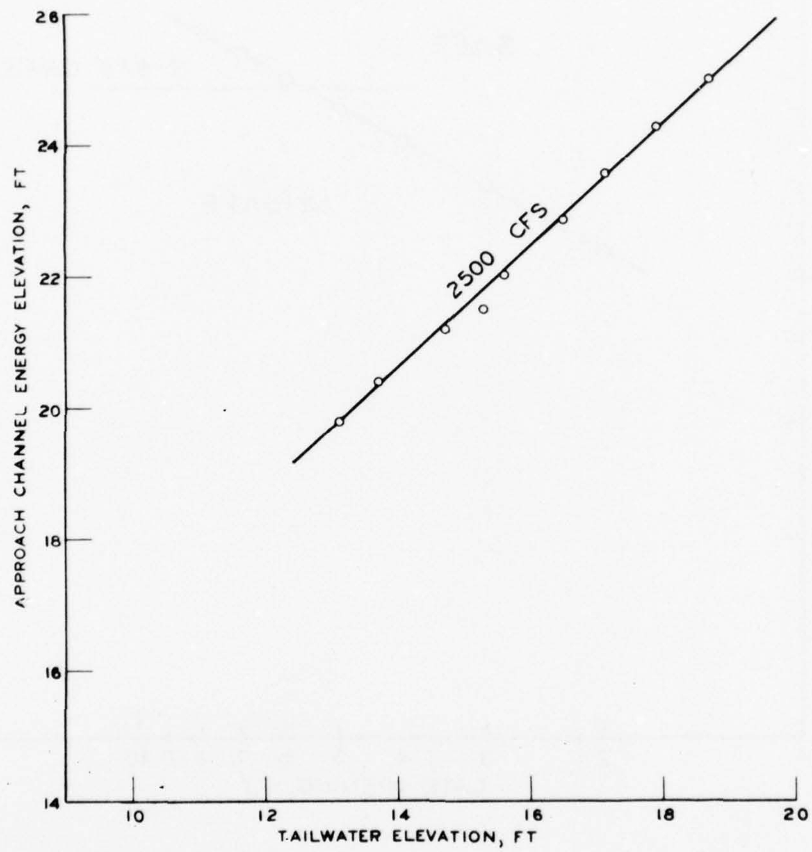


SPRAY CURVE S-65E

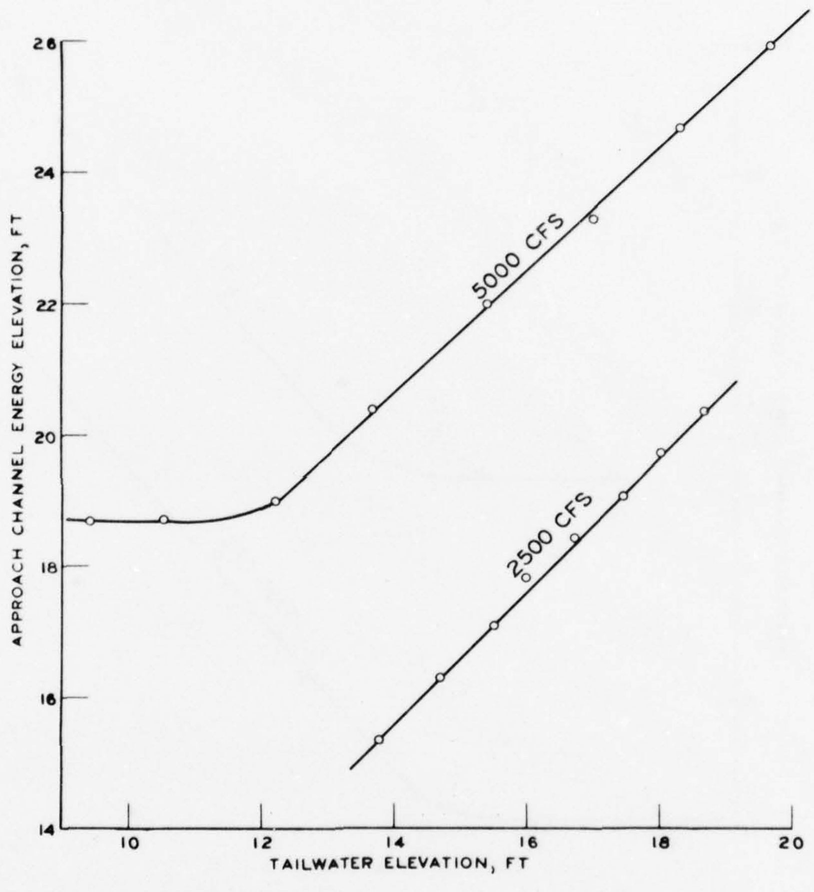
GATE OPENING VERSUS
TAILWATER TO PRODUCE SPRAY

MINIMUM OPERATING CONDITIONS

PLATE 2



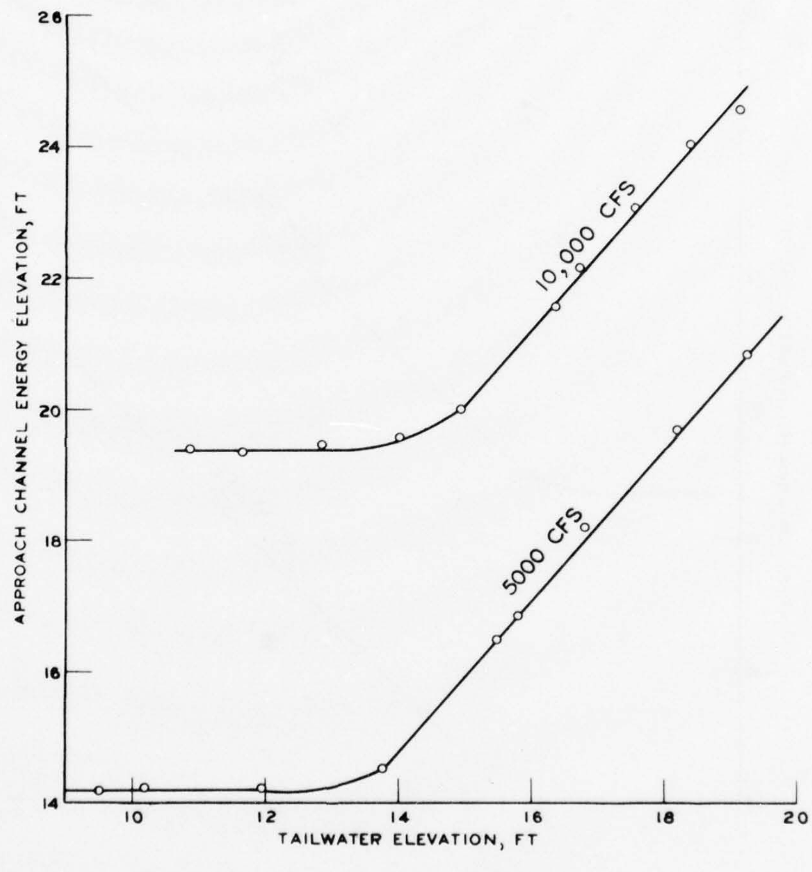
KISSIMMEE RIVER S-65E
CALIBRATION DATA
ONE-FT GATE OPENING



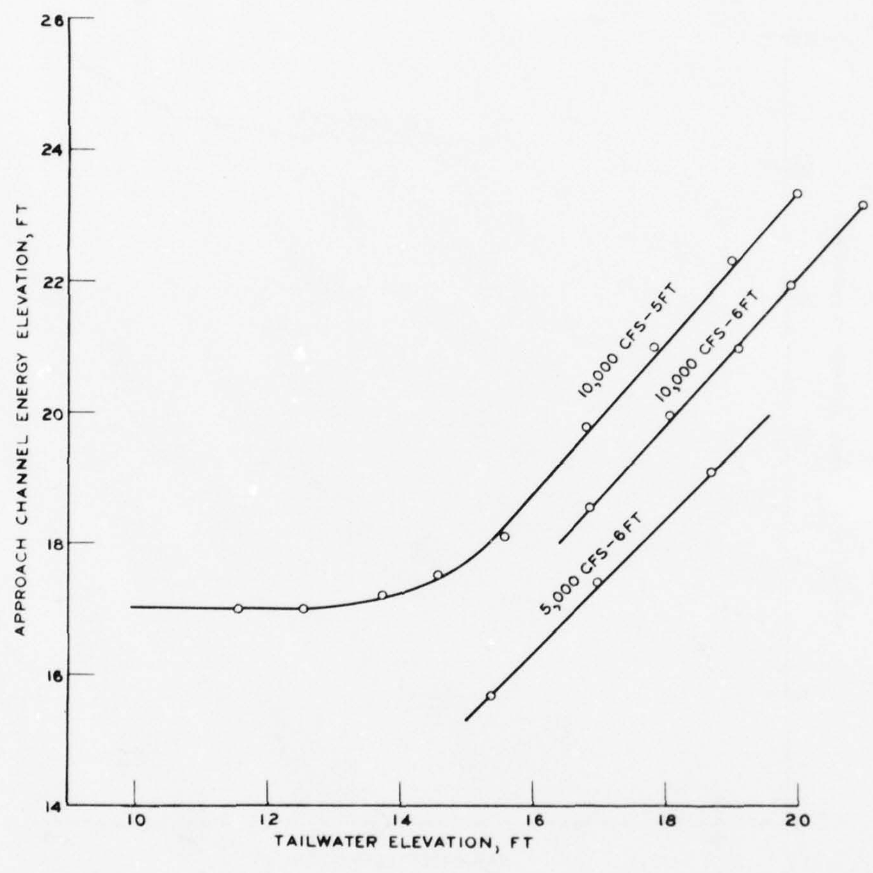
KISSIMMEE RIVER S-65E

CALIBRATION DATA

TWO-FT GATE OPENING

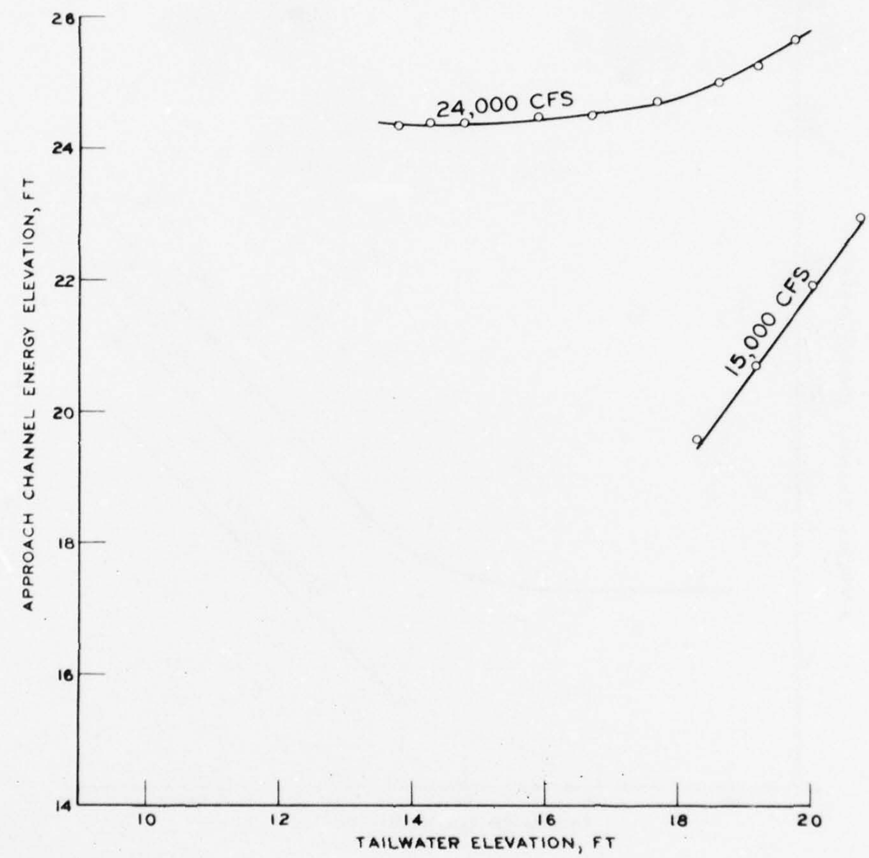


KISSIMMEE RIVER S-65E
CALIBRATION DATA
FOUR-FT GATE OPENING

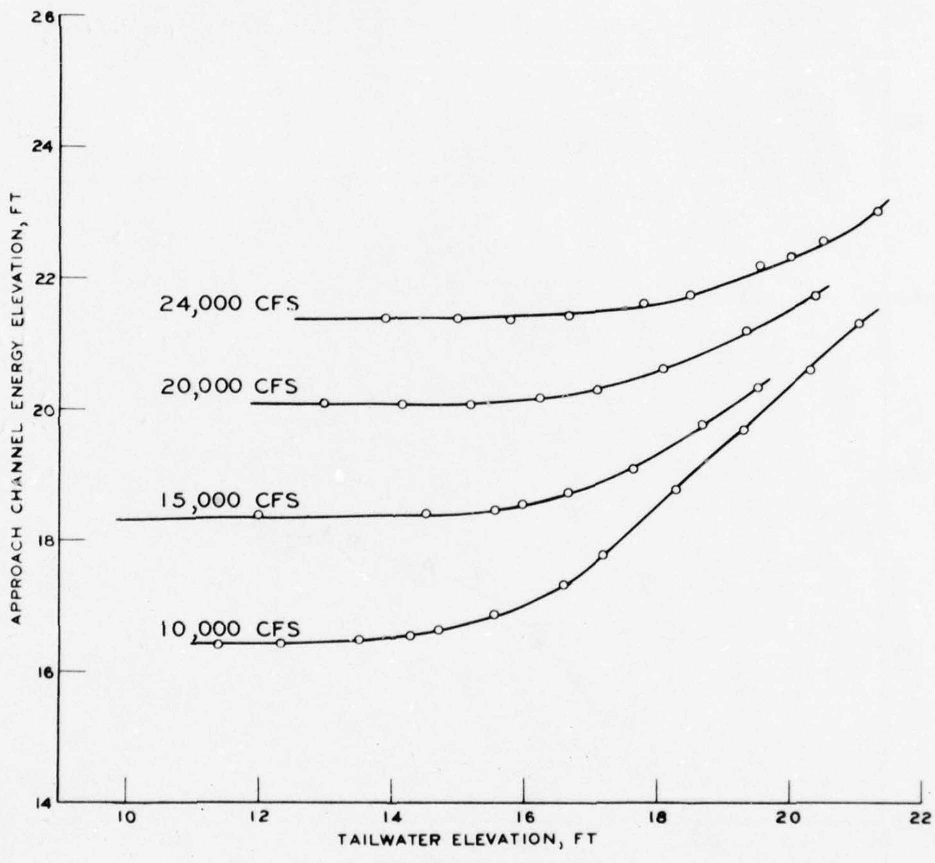


KISSIMMEE RIVER S-65E

CALIBRATION DATA
FIVE-AND SIX-FT
GATE OPENING



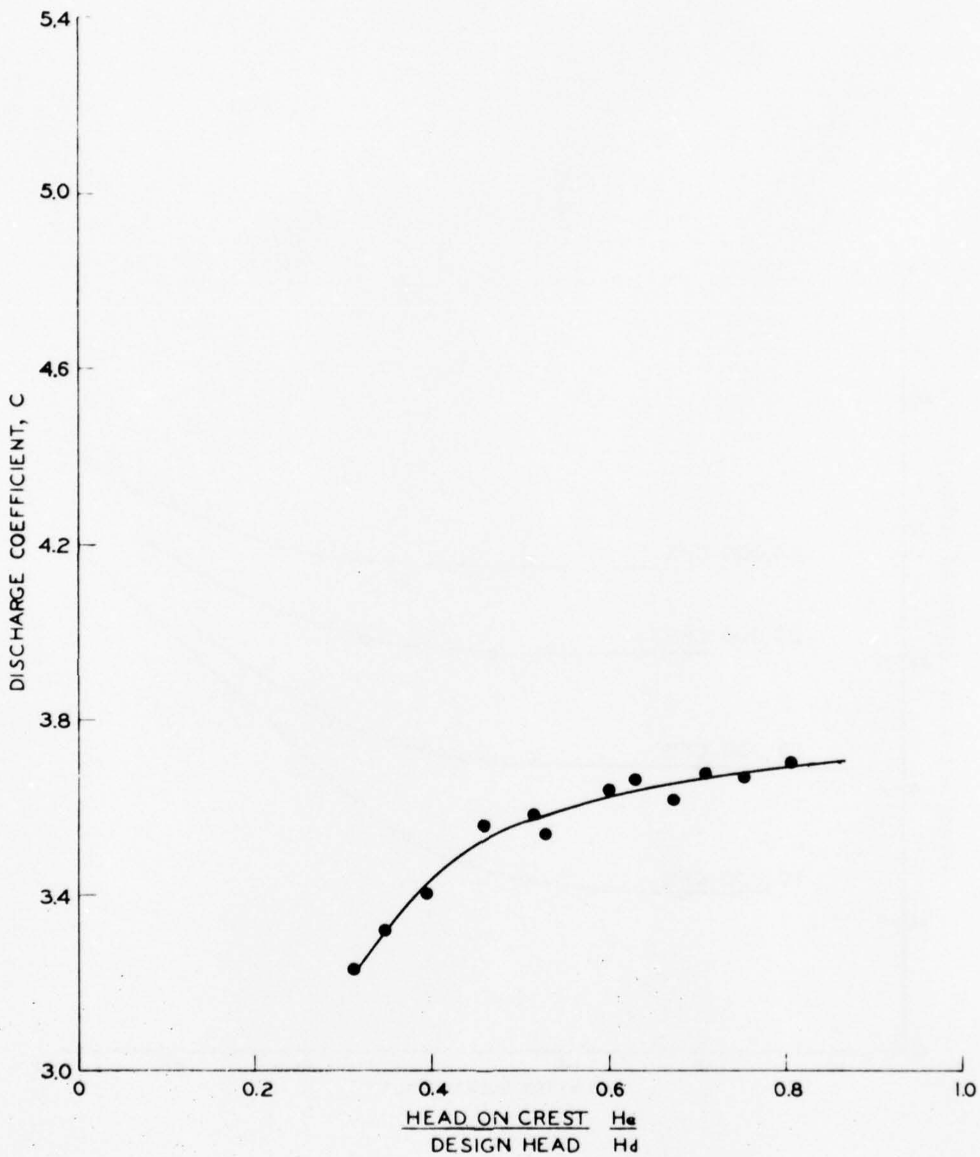
KISSIMMEE RIVER S-65E
CALIBRATION DATA
EIGHT-FT GATE OPENING



KISSIMMEE RIVER S-65E

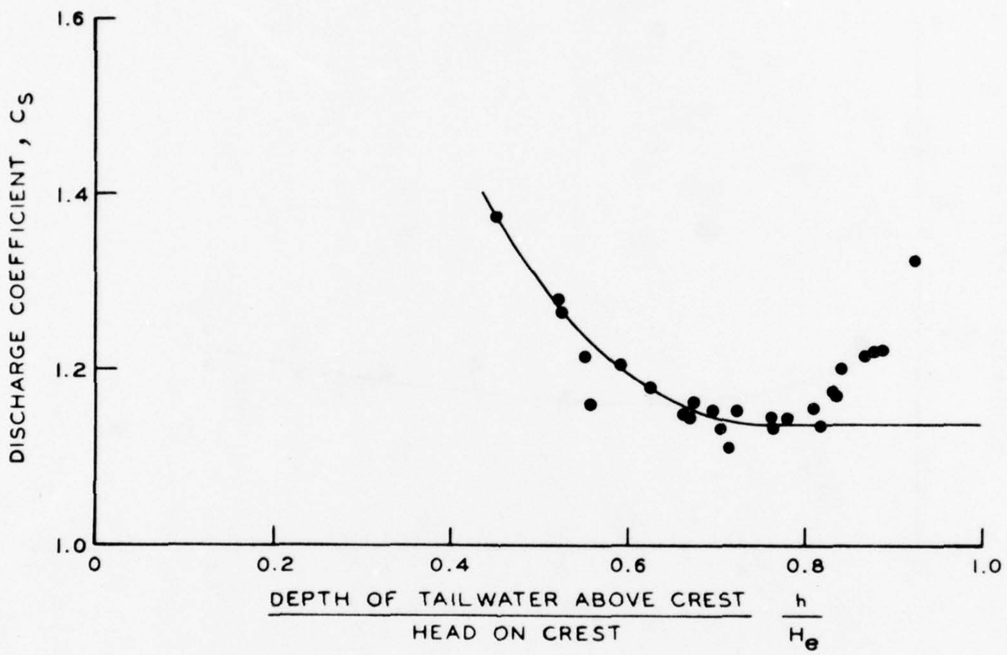
CALIBRATION DATA

UNCONTROLLED FLOW



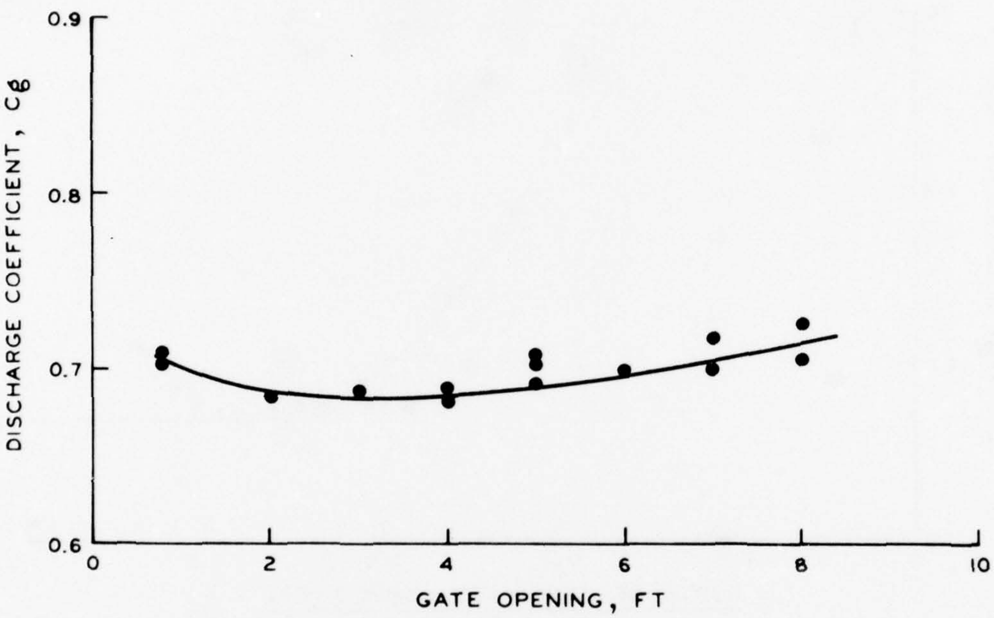
KISSIMMEE RIVER S-65E

FREE
UNCONTROLLED FLOW



KISSIMMEE RIVER S-65E

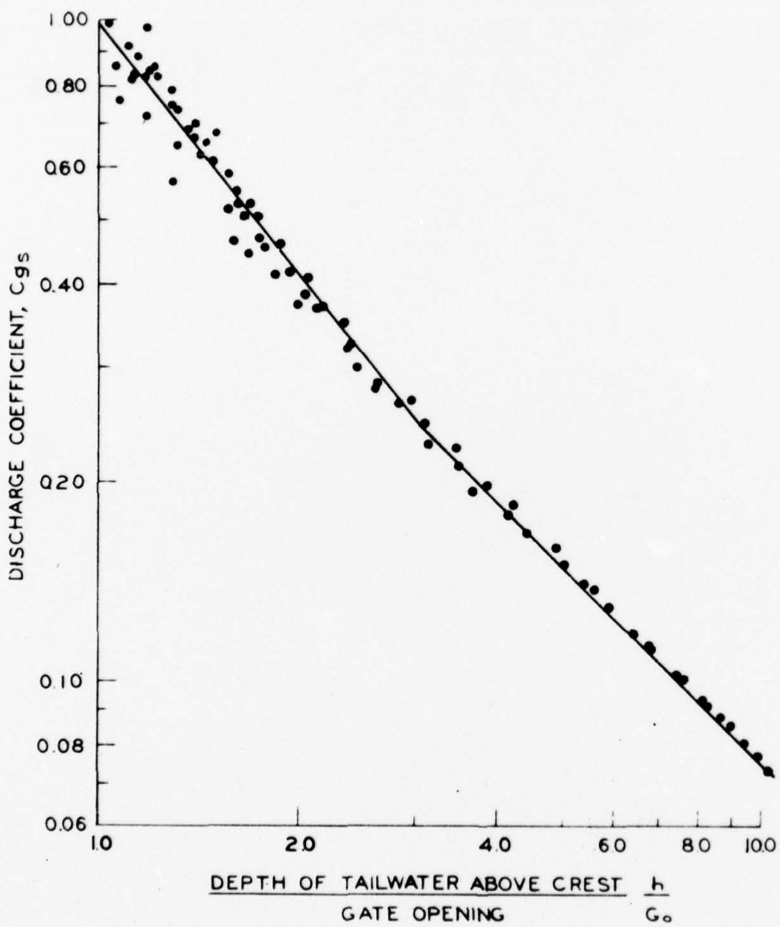
SUBMERGED UNCONTROLLED FLOW



KISSIMMEE RIVER S-65E

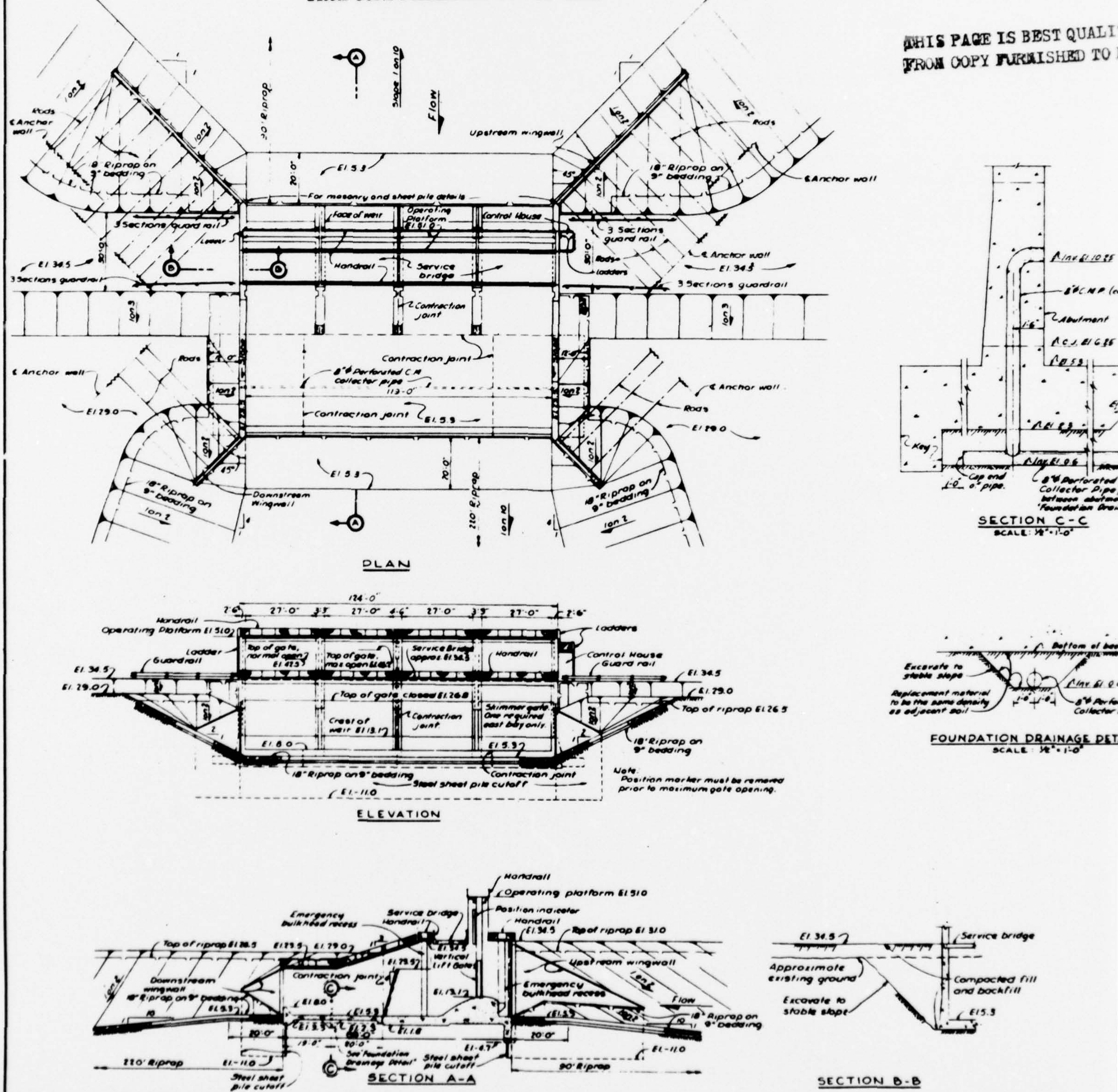
FREE CONTROLLED FLOW

PLATE 11

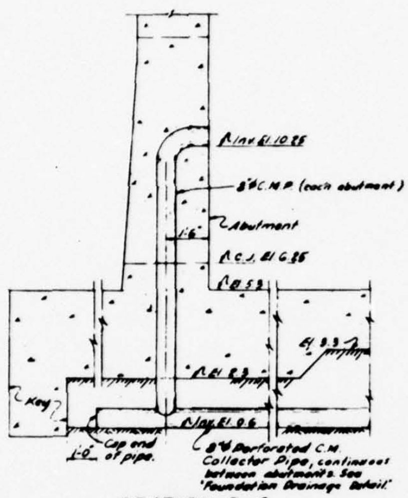


KISSIMMEE RIVER S-65E

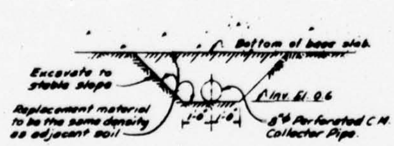
SUBMERGED CONTROLLED FLOW


Upstream wingwall
Flow
Slope 1 on 10
90' Riprap
18" Riprap on 9" bedding
℄ Anchor wall
Rods
El. 5.3
For masonry and sheet pile details
Face of weir
Operating Platform El. 51.0
Control House
3 Sections guard rail
Handrail
Service bridge
Contraction joint
8" ⌀ Perforated C.M. Collector pipe
113'-0"
Downstream Wingwall
220' Riprap
PLAN
124'-0"
Operating Platform El. 51.0
Ladders
Guardrail
Top of gate, normal open
Top of gate, max open
Service Bridge
Control House
Top of gate closed El. 26.8
Crest of weir El. 13.1
Skimmer gate. One required east bay only.
Top of riprap El. 26.5
Steel sheet pile cutoff
El. -11.0
Note: Position marker must be removed prior to maximum gate opening.
ELEVATION
Handrail
Operating platform El. 51.0
Position indicator
Emergency bulkhead recess
Vertical lift Gates
Upstream wingwall
Downstream wingwall
See Foundation Drainage Detail
Steel sheet pile cutoff
SECTION A-A
Service bridge
Approximate existing ground
Compacted fill and backfill
Excavate to stable slope
SECTION B-B
Abutment
Key
Cap end of pipe.
8" ⌀ Perforated Collector Pipe
SECTION C-C
SCALE: ½" = 1'-0"
Excavate to stable slope
Replacement material to be the same density as adjacent soil
FOUNDATION DRAINAGE DET
SCALE: ½" = 1'-0"

1

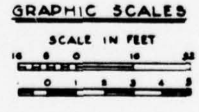


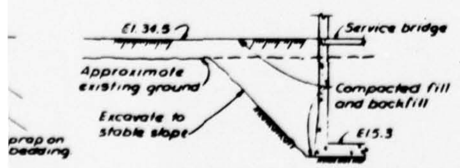
SECTION C-C
SCALE: 1/2" = 1'-0"



FOUNDATION DRAINAGE DETAIL
SCALE: 1/2" = 1'-0"

GRAPHIC SCALES



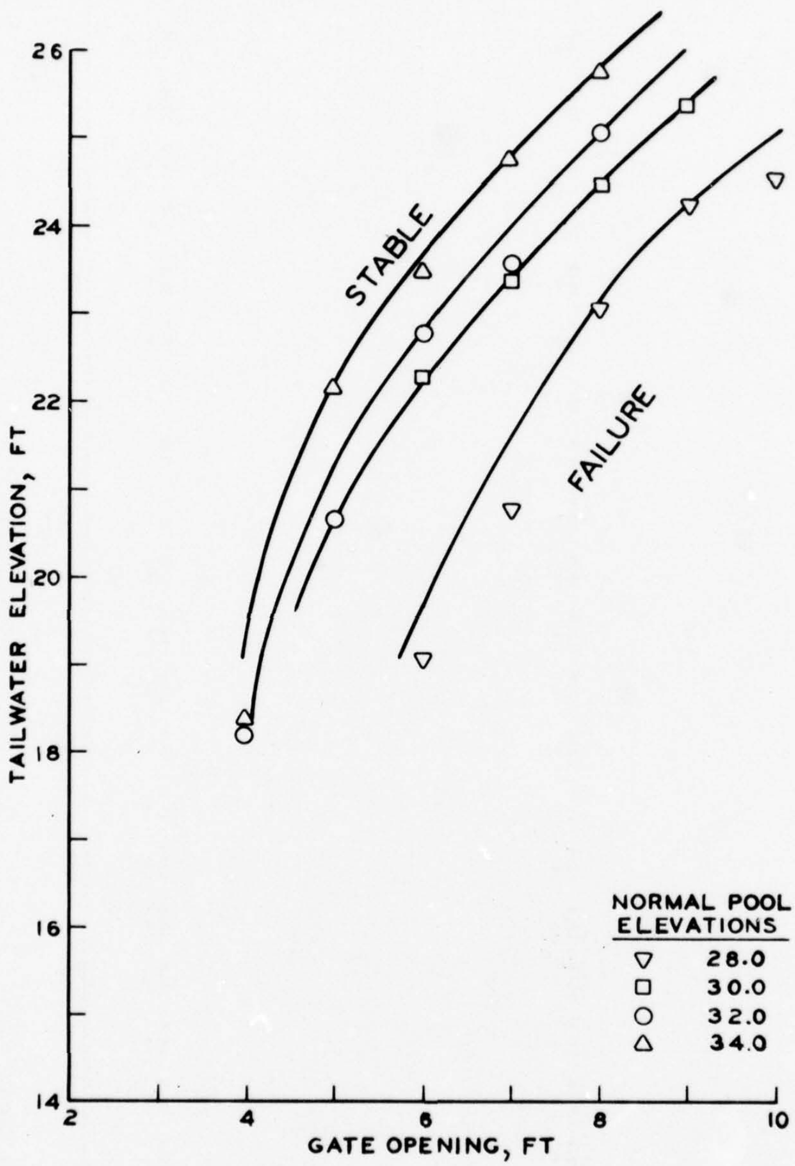


SECTION B-B

SPILLWAY PLAN AND SECTIONS
STRUCTURE 65D

PLATE 13

1 2



KISSIMMEE RIVER S-65D

GATE OPENING AND TAILWATER REQUIRED TO DISPLACE RIPRAP

PROTOTYPE

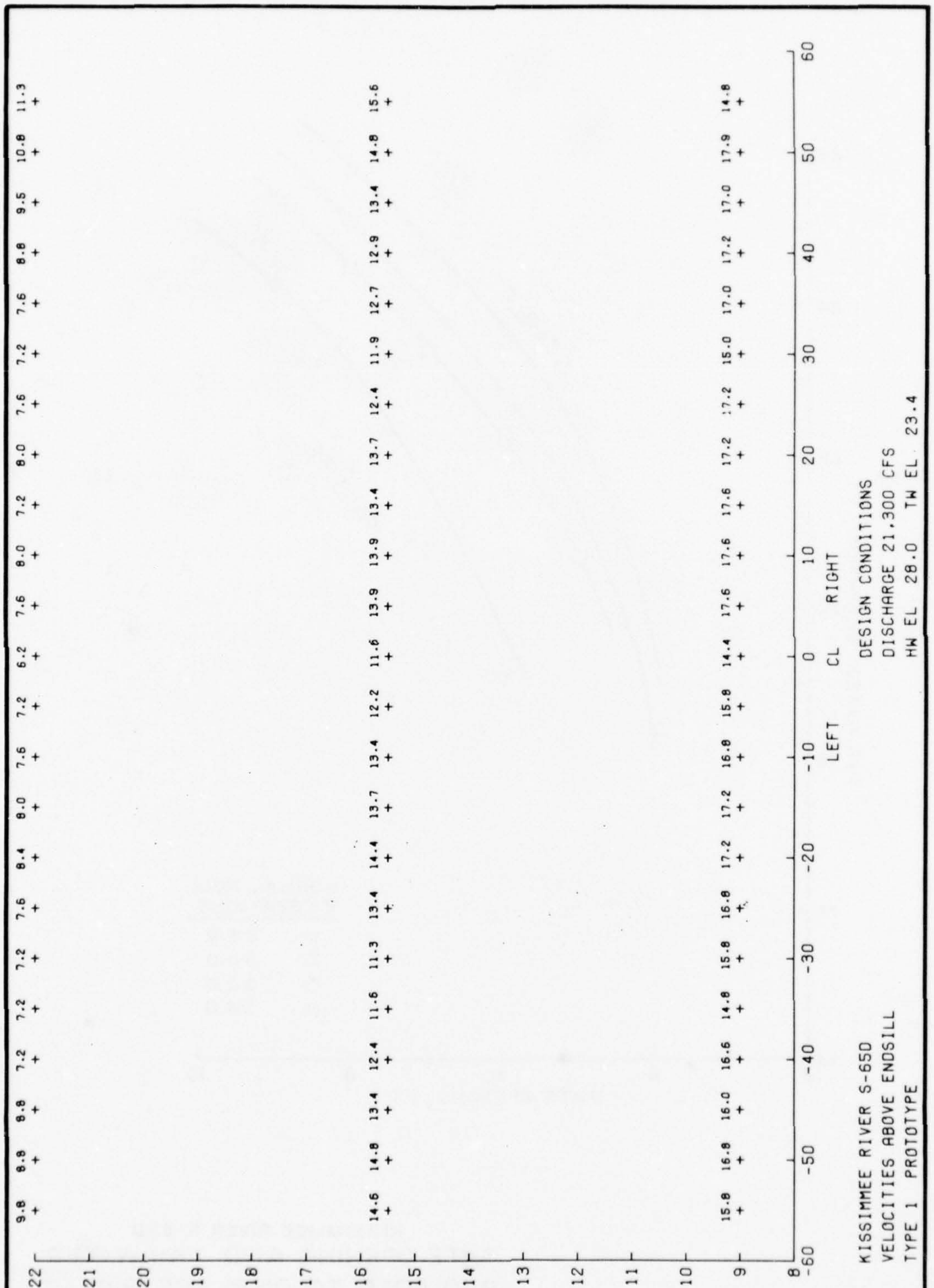
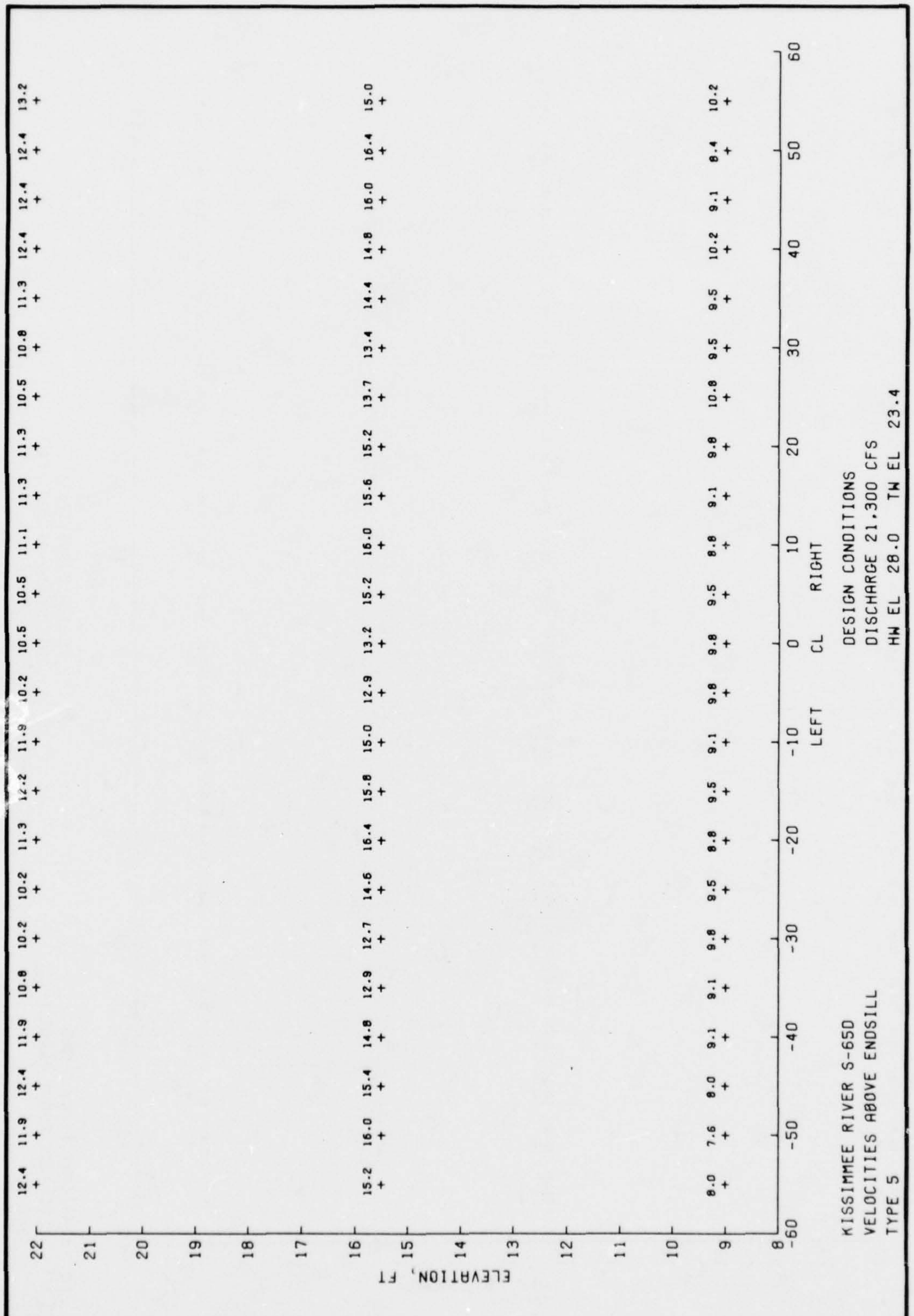

KISSIMMEE RIVER S-65D
VELOCITIES ABOVE ENDSILL
TYPE 1 PROTOTYPE
DESIGN CONDITIONS
DISCHARGE 21,300 CFS
HW EL 28.0 TW EL 23.4
ELEVATION, FT
LEFT
CL
RIGHT

PLATE 15


KISSIMMEE RIVER S-65D
VELOCITIES ABOVE ENDSILL
TYPE 5
DESIGN CONDITIONS
DISCHARGE 21,300 CFS
HW EL 28.0 TW EL 23.4
ELEVATION, FT
LEFT CL RIGHT
-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
12.4 11.9 12.4 11.9 10.8 10.2 10.2 11.3 12.2 11.9 10.2 10.5 10.5 11.1 11.3 11.3 10.5 10.8 11.3 12.4 12.4 12.4 13.2
15.2 16.0 15.4 14.8 12.9 12.7 14.6 16.4 15.8 15.0 12.9 13.2 15.2 16.0 15.6 15.2 13.7 13.4 14.4 14.8 16.0 16.4 15.0
8.0 7.6 8.0 9.1 9.1 9.8 9.5 8.8 9.5 9.1 9.8 9.8 9.5 8.8 9.1 9.8 10.8 9.5 9.5 10.2 9.1 8.4 10.2

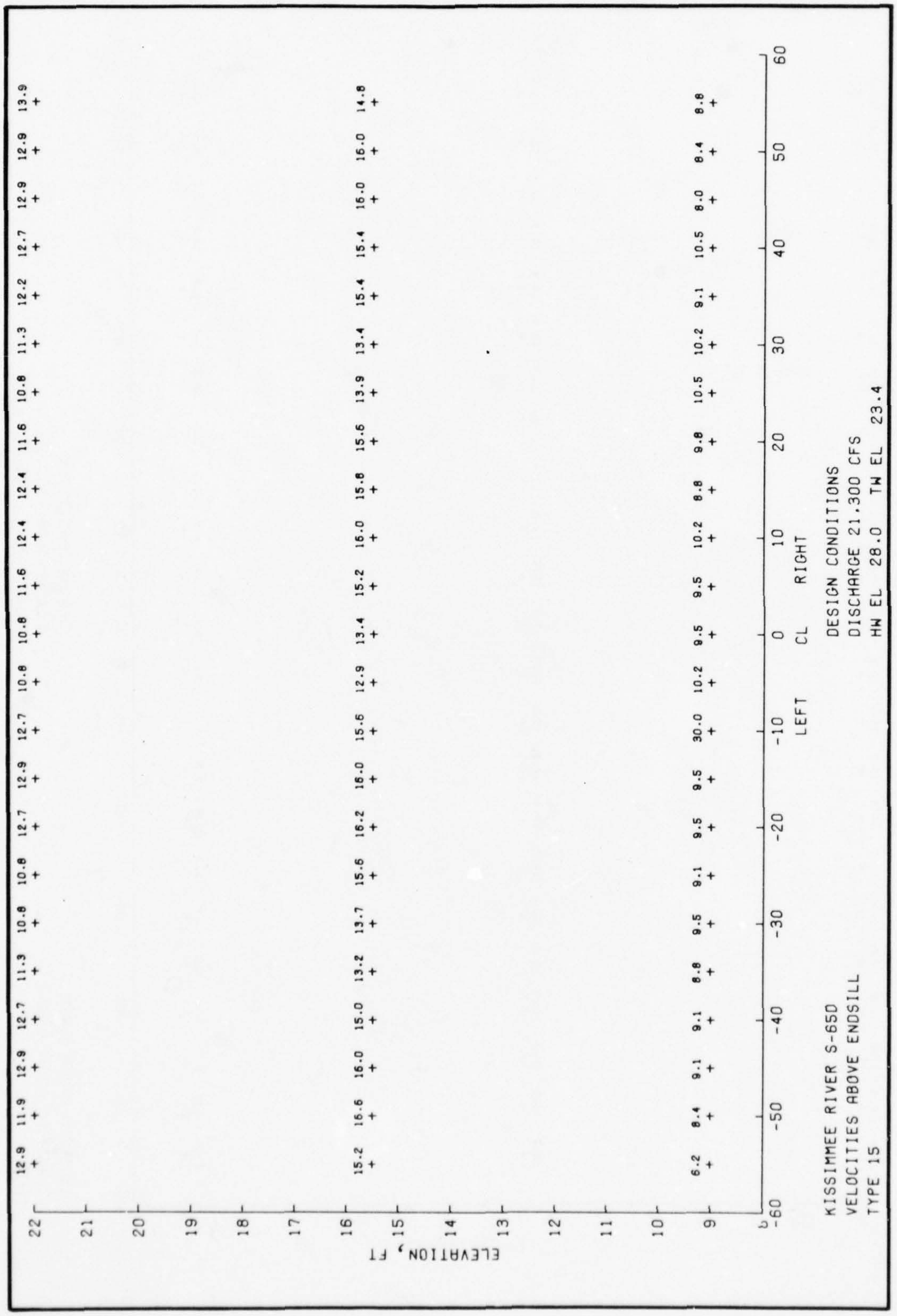
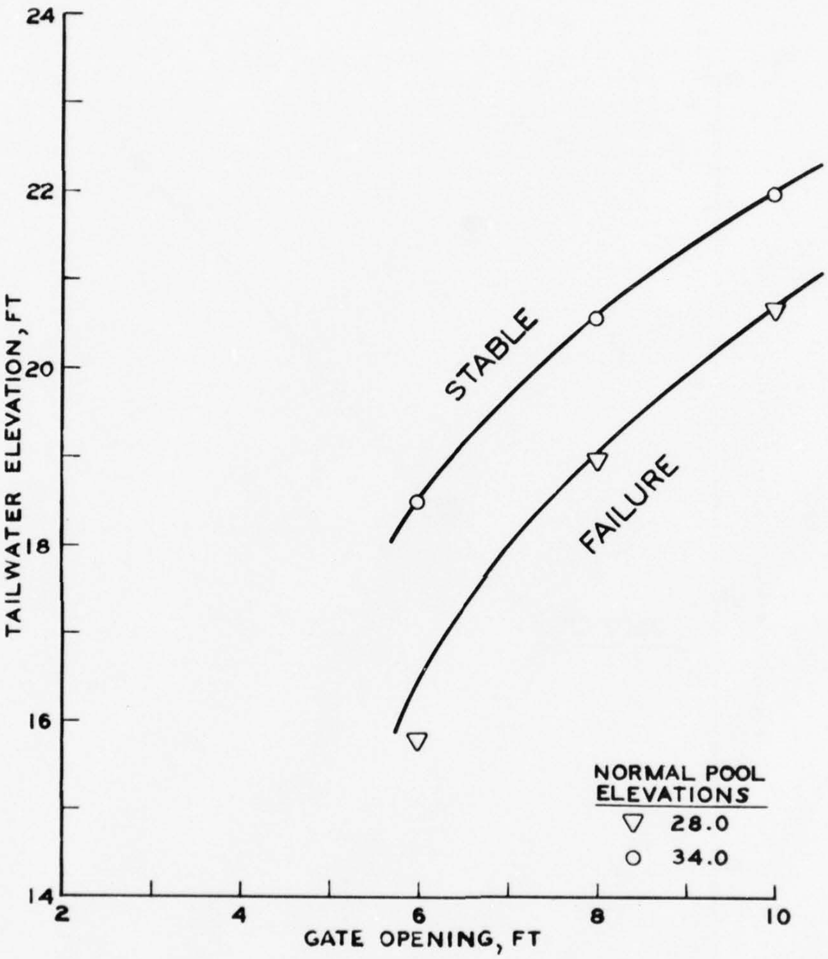

KISSIMMEE RIVER S-65D
VELOCITIES ABOVE ENDSILL
TYPE 15
DESIGN CONDITIONS
DISCHARGE 21,300 CFS
HW EL 28.0 TW EL 23.4
ELEVATION, FT
LEFT
CL
RIGHT

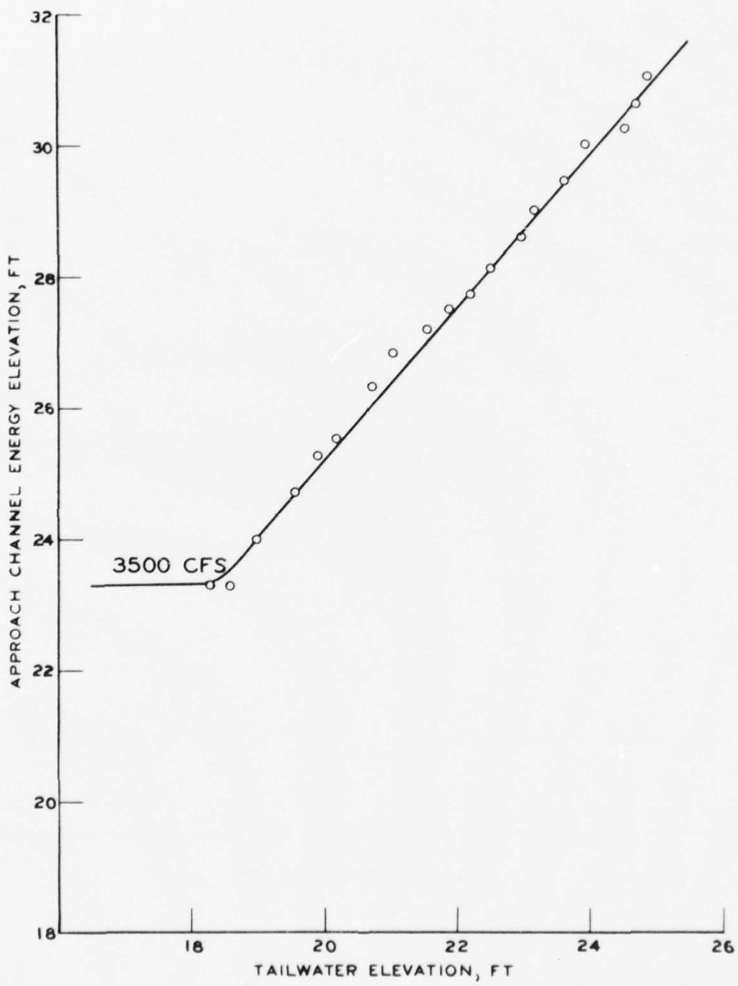
PLATE 17



KISSIMMEE RIVER S-65D

GATE OPENING AND TAILWATER REQUIRED TO DISPLACE RIPRAP

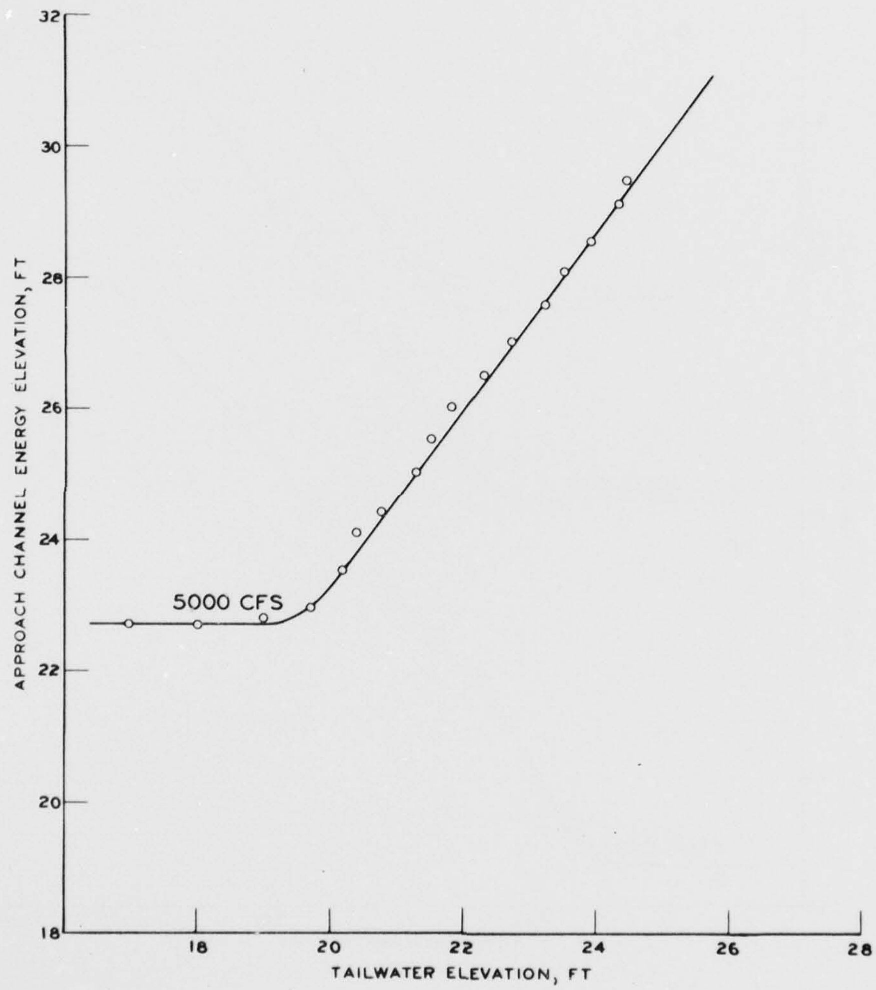
TYPE 5 STILLING BASIN



KISSIMMEE RIVER S-65D

CALIBRATION DATA

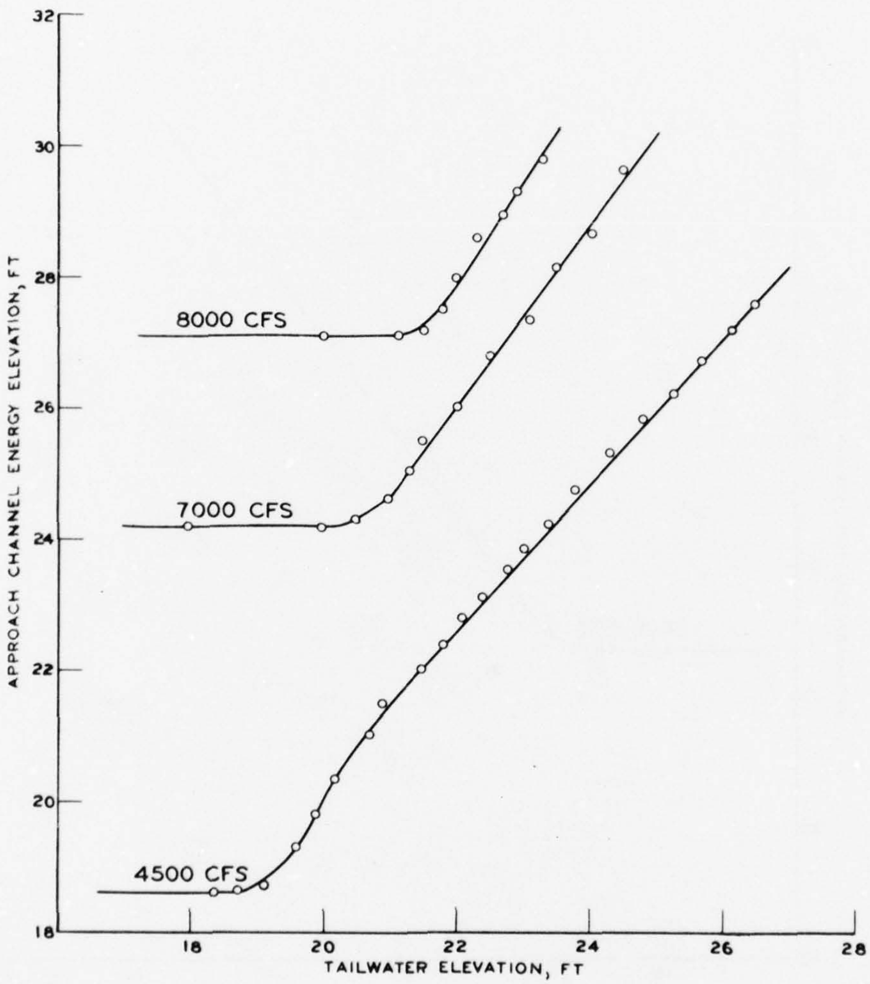
TWO-FT GATE OPENING



KISSIMMEE RIVER S-65D

CALIBRATION DATA

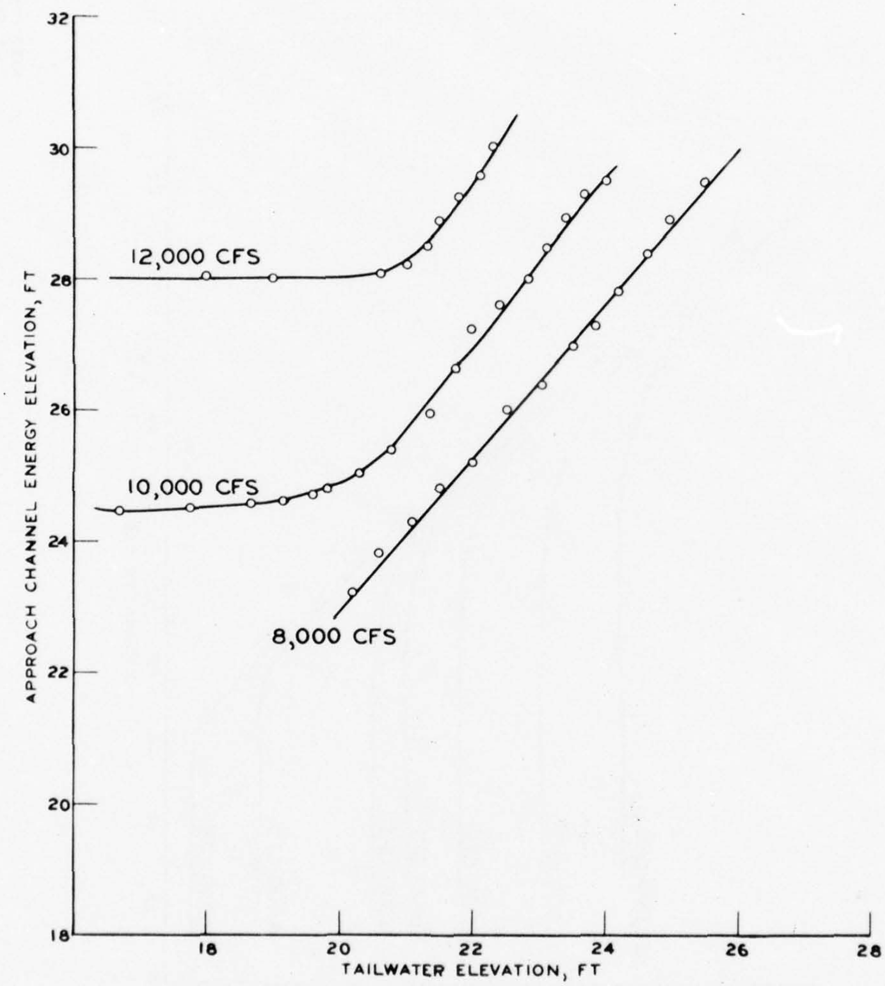
THREE-FT GATE OPENING



KISSIMMEE RIVER S-65D

CALIBRATION DATA

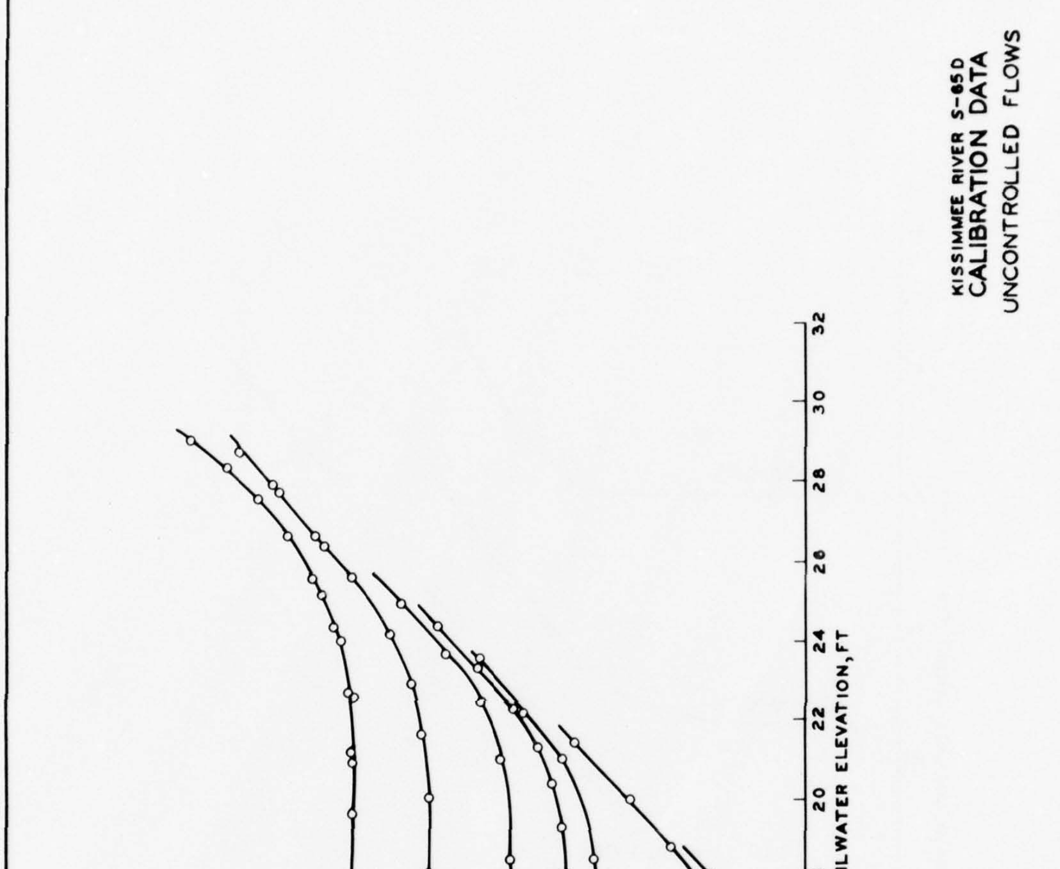
FOUR-FT GATE OPENING



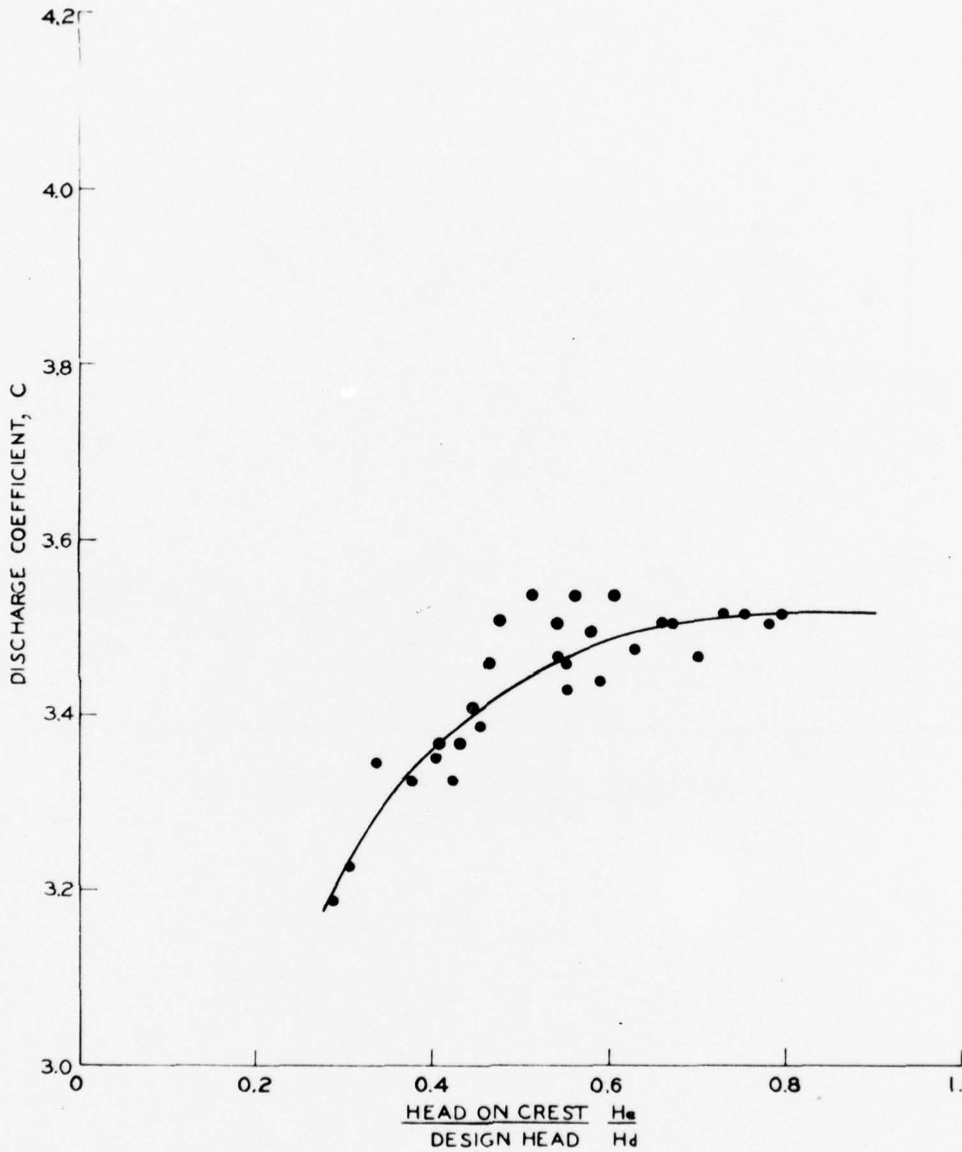
KISSIMMEE RIVER S-65D

CALIBRATION DATA

SIX-FT GATE OPENING

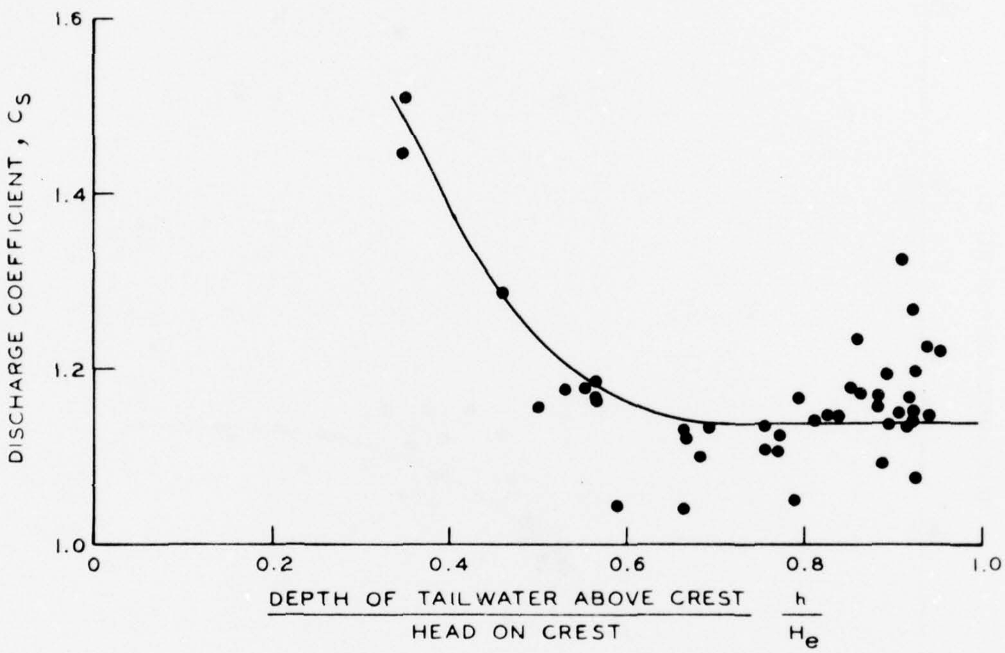


KISSIMMEE RIVER S-65D
CALIBRATION DATA
UNCONTROLLED FLOWS



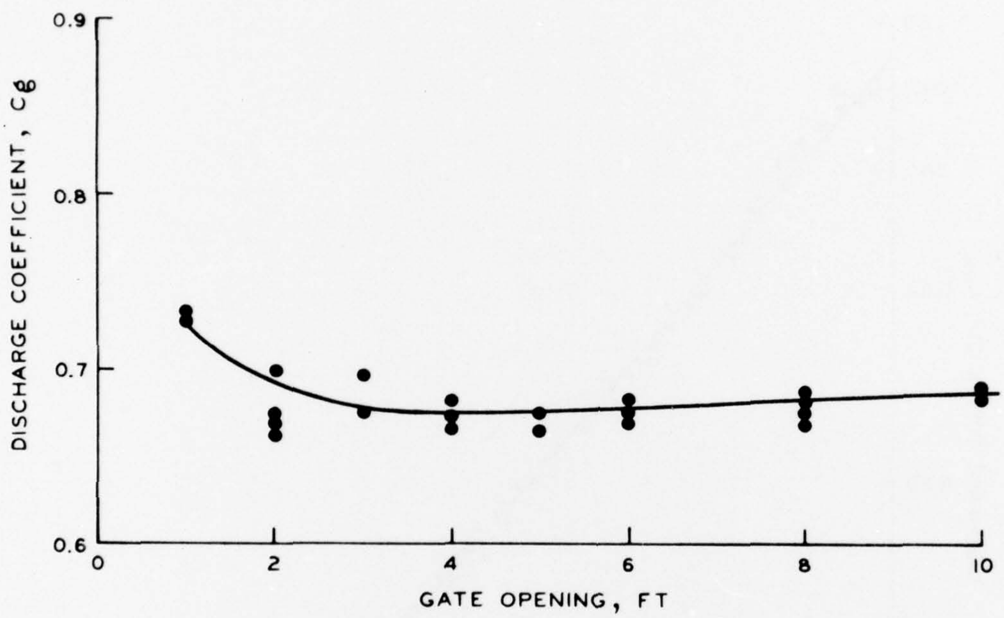
KISSIMMEE RIVER S-65D

FREE
UNCONTROLLED FLOW



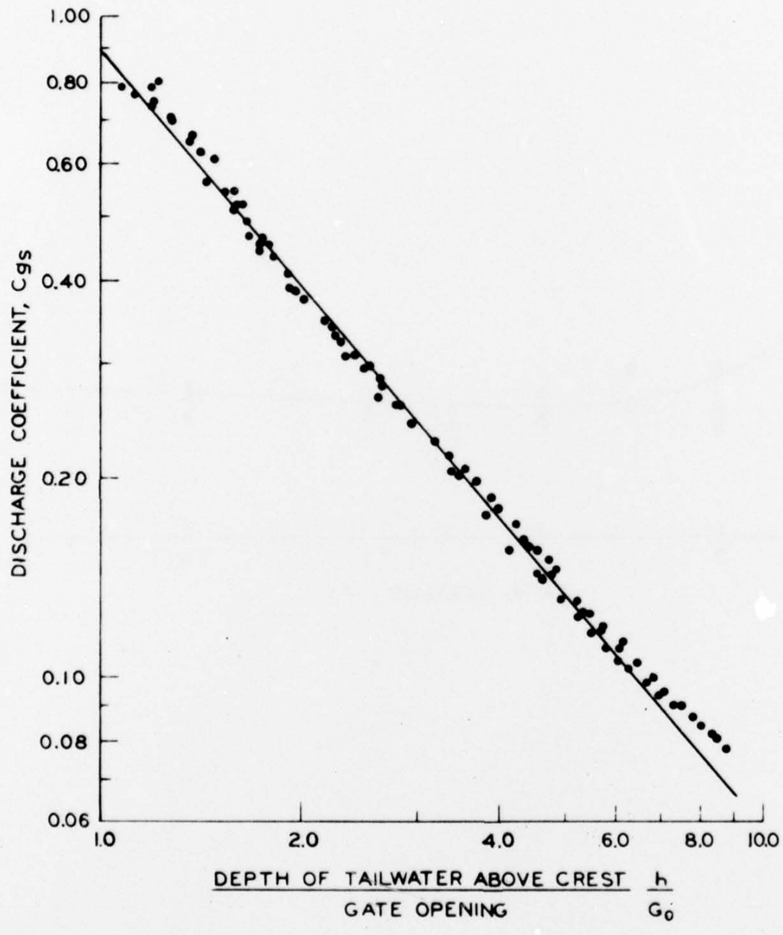
KISSIMMEE RIVER S-65D

SUBMERGED UNCONTROLLED FLOW



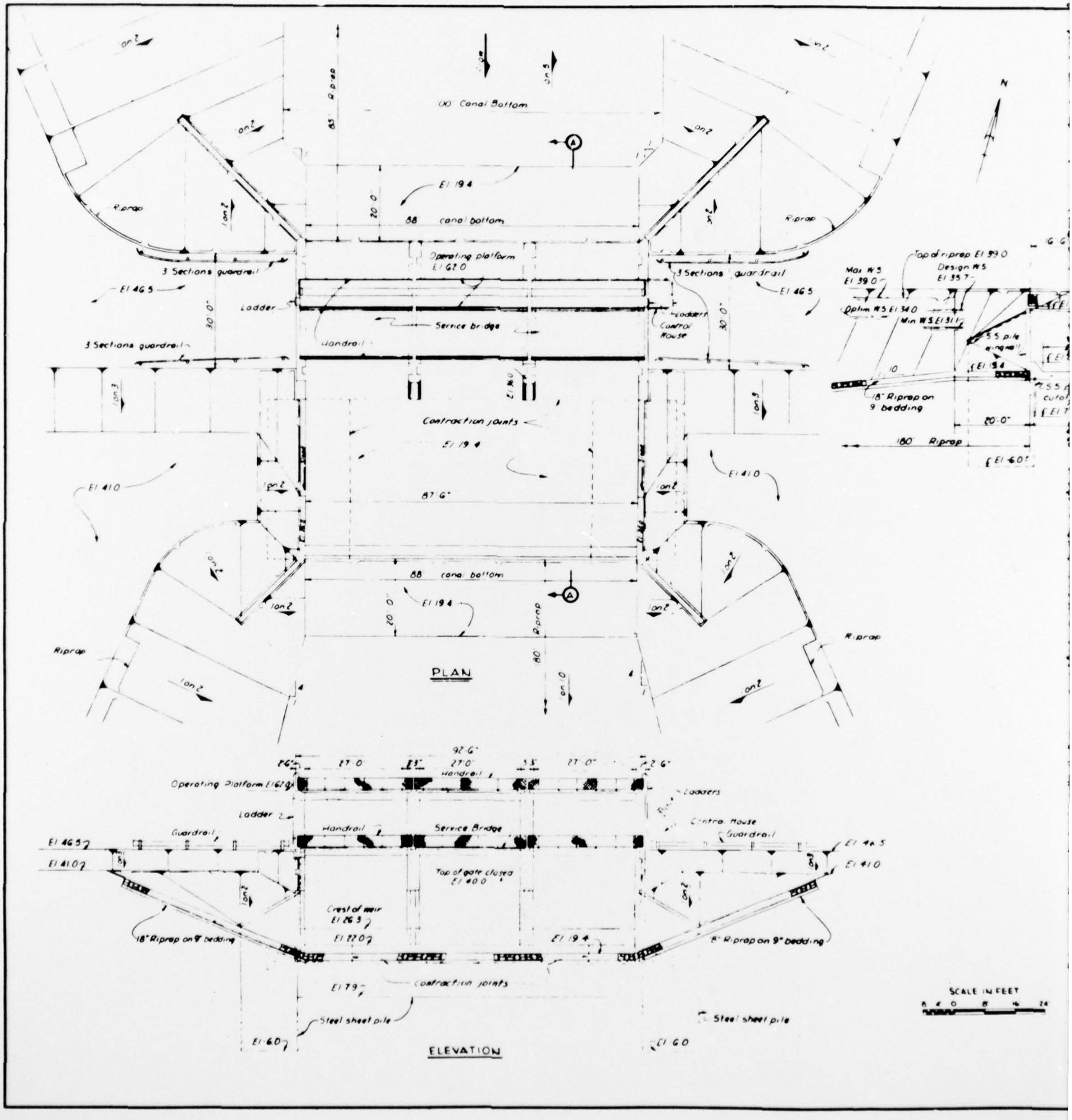
KISSIMMEE RIVER S-65D

FREE CONTROLLED FLOW

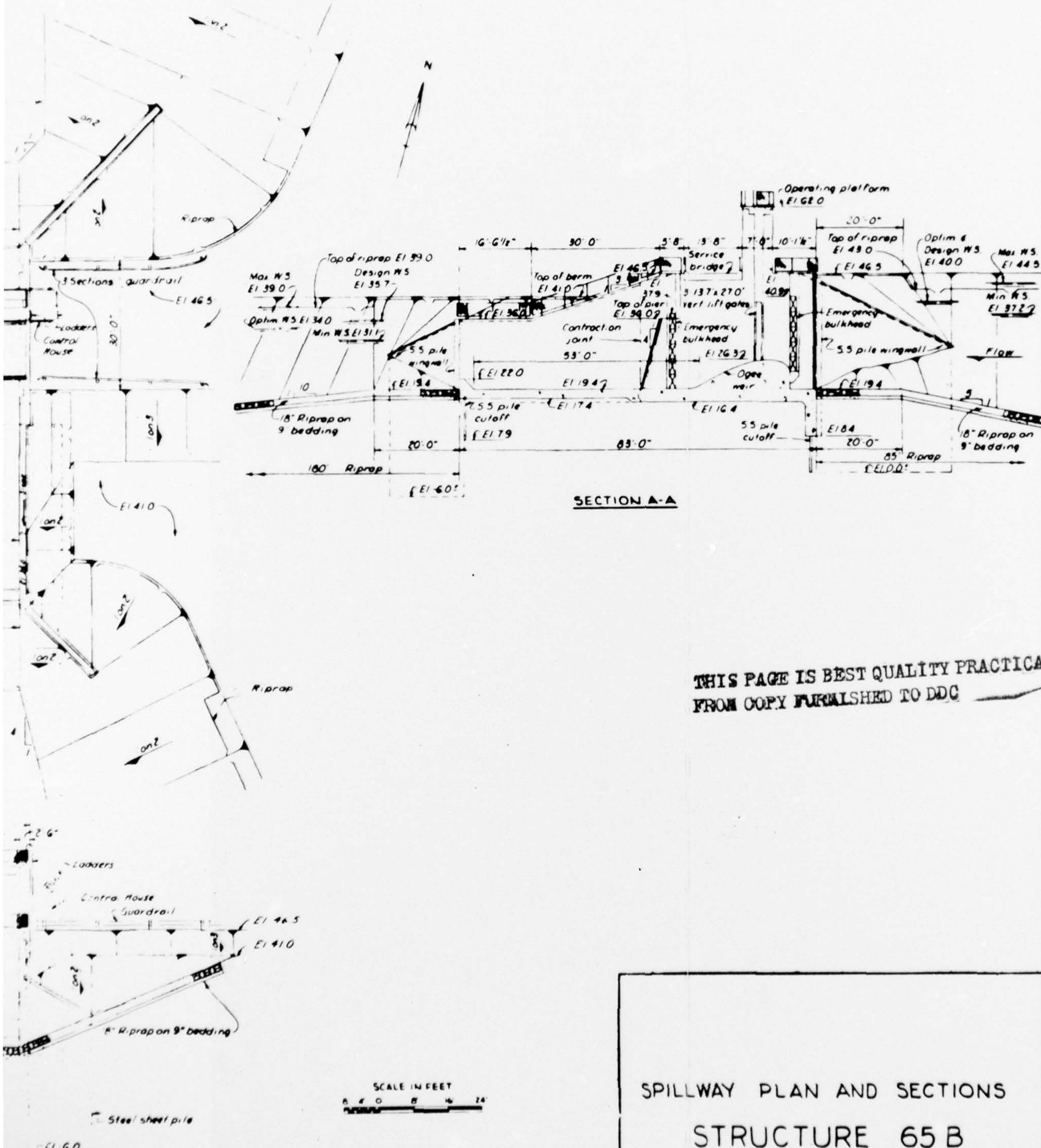


KISSIMMEE RIVER S-65D

SUBMERGED CONTROLLED FLOW


100' Canal Bottom
85' Riprap
El 19.4
20.0'
88' canal bottom
Operating platform El 62.0
3 Sections guardrail
El 46.5
Ladder
Service bridge
Handrail
Control House
30.0'
Contraction joints
El 19.4
87'6"
El 41.0
Riprap
PLAN
1 on 2
1 on 3
1 on 0
Max W.S. El 39.0
Top of riprap El 39.0
Design W.S. El 35.7
Optim W.S. El 34.0
Min W.S. El 31.1
18" Riprap on 9" bedding
20.0"
180' Riprap
92'6"
27'0"
Operating Platform El 62.0
Ladders
Ladder
Handrail
Service Bridge
Control House
Guardrail
El 46.5
El 41.0
Top of gate closed El 40.0
Crest of weir El 26.3
El 22.0
El 19.4
18" Riprap on 9" bedding
Contraction joints
El 7.9
Steel sheet pile
El 6.0
ELEVATION
SCALE IN FEET

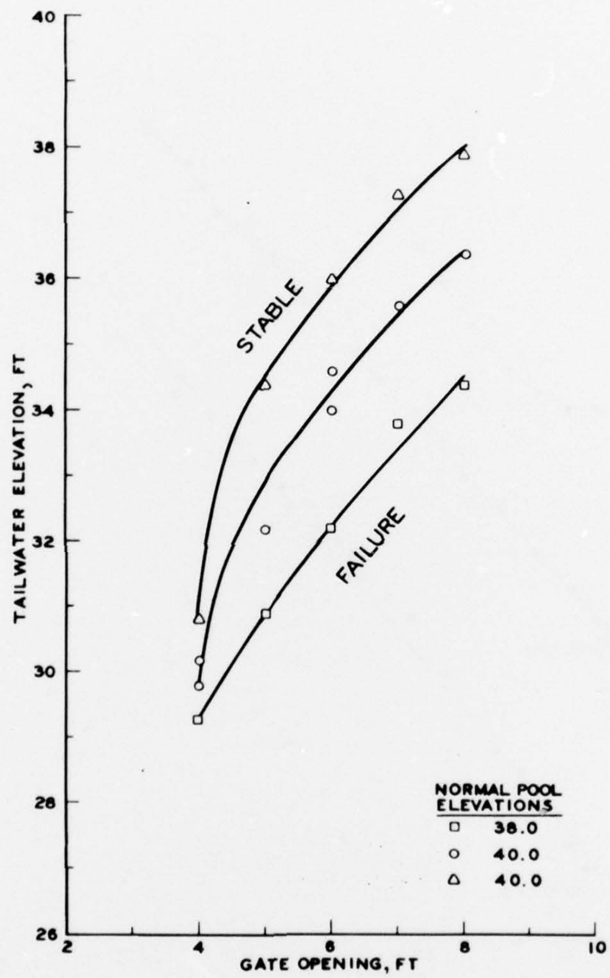
1



SPILLWAY PLAN AND SECTIONS

STRUCTURE 65 B

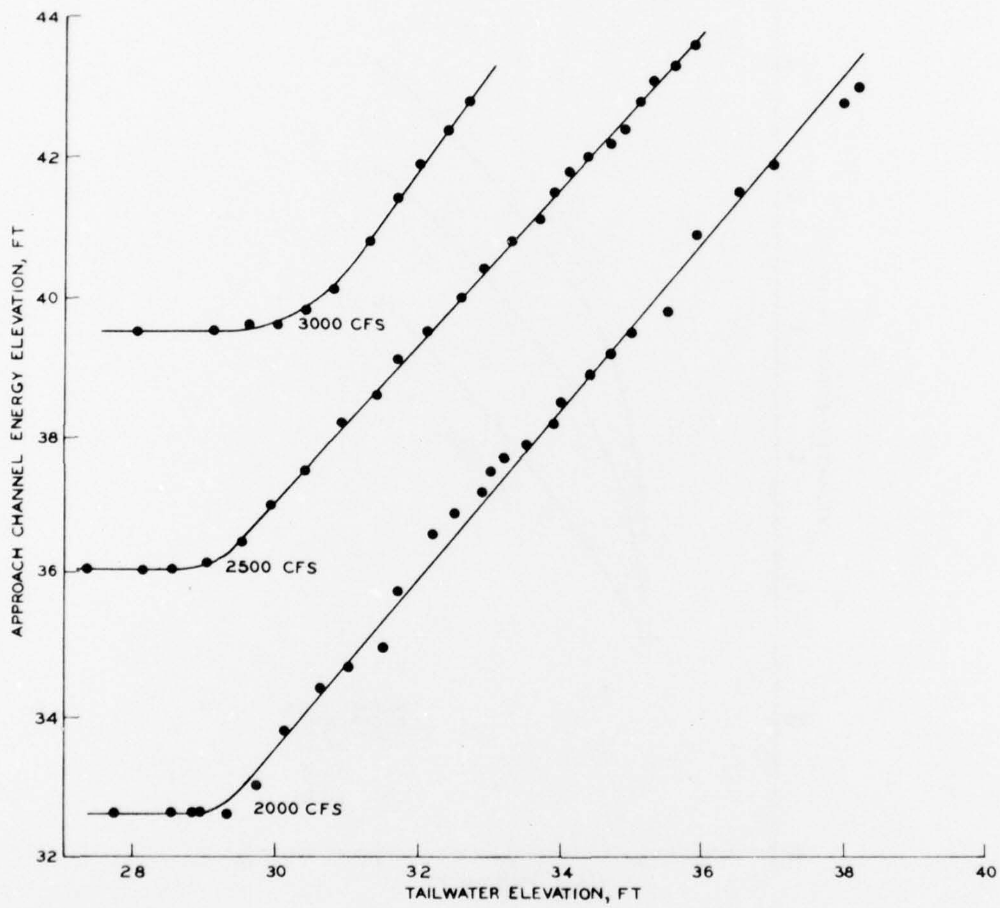
1 2



KISSIMMEE RIVER S-65B

GATE OPENING AND TAILWATER REQUIRED TO DISPLACE RIPRAP

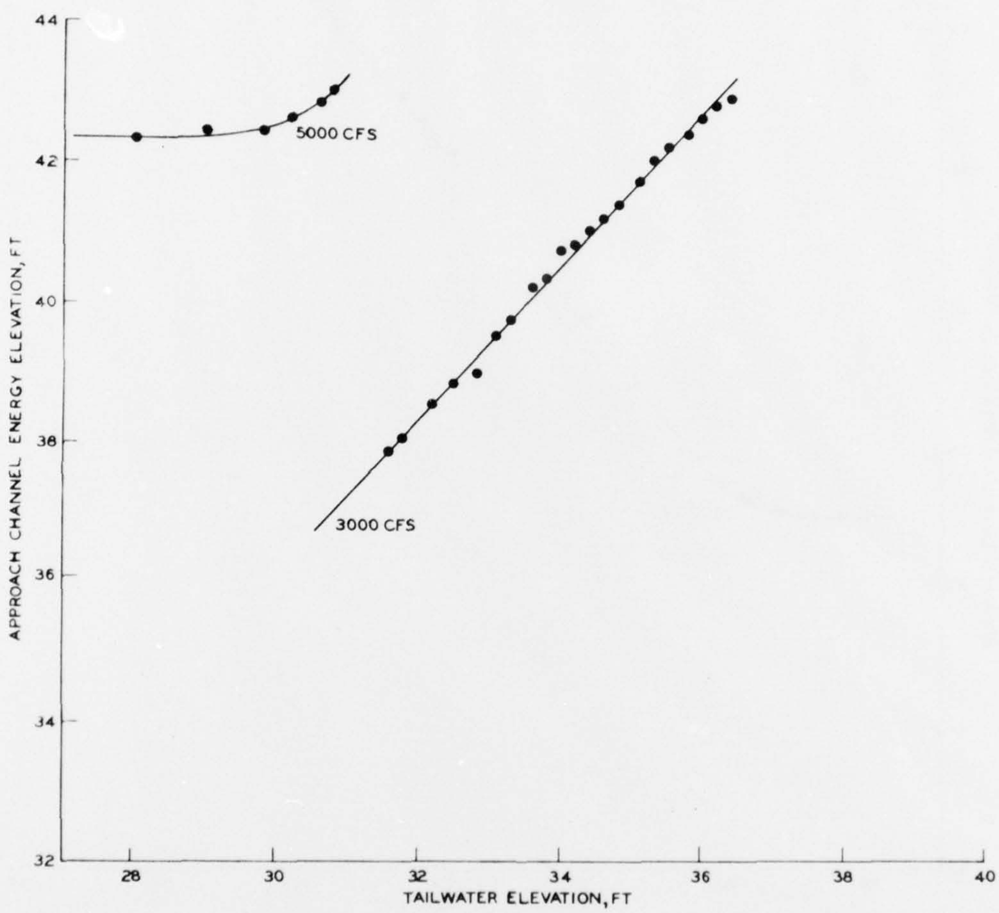
TYPE I PROTOTYPE



KISSIMMEE RIVER S-65B

CALIBRATION DATA

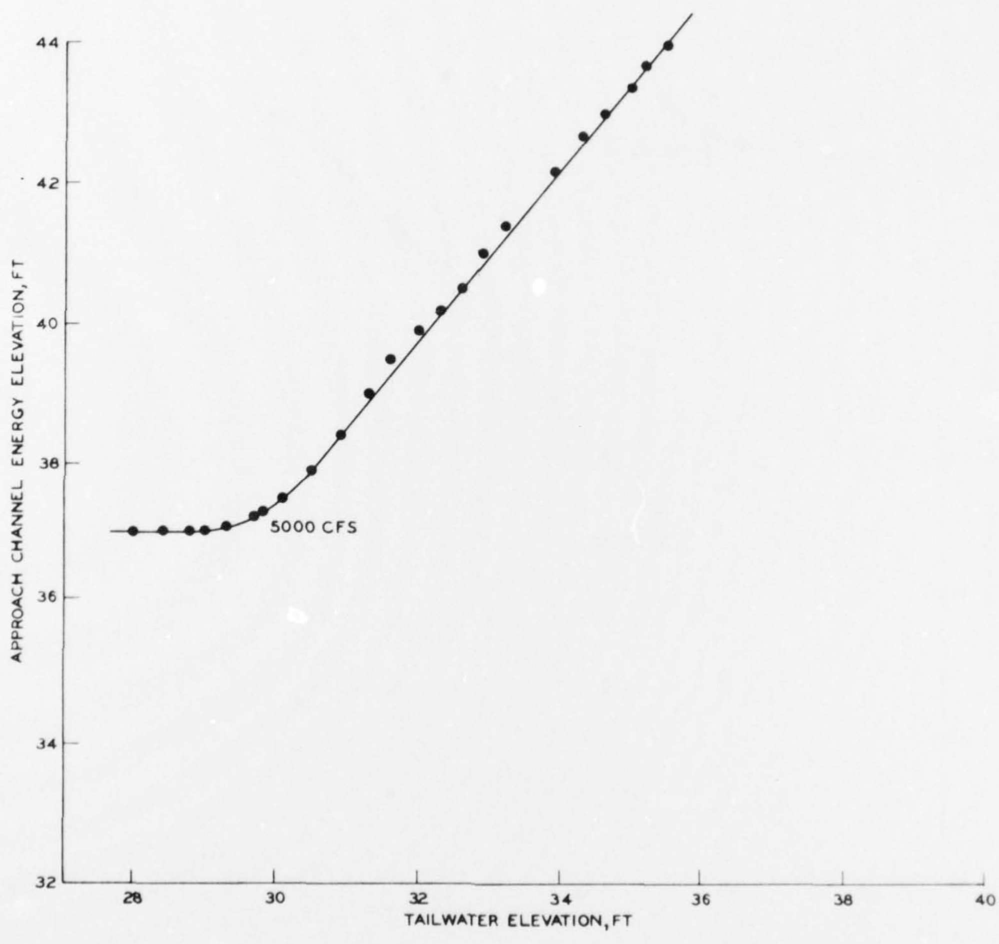
TWO-FT GATE OPENING



KISSIMMEE RIVER S-65B

CALIBRATION DATA

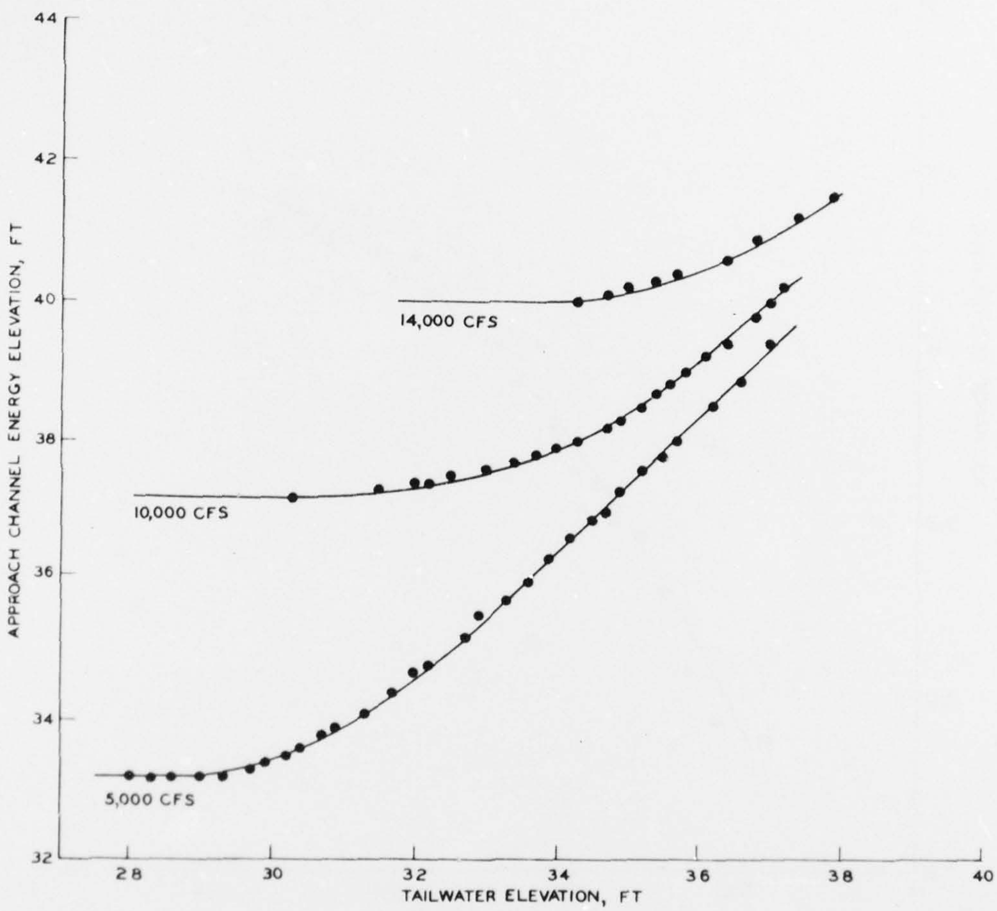
THREE-FT GATE OPENING



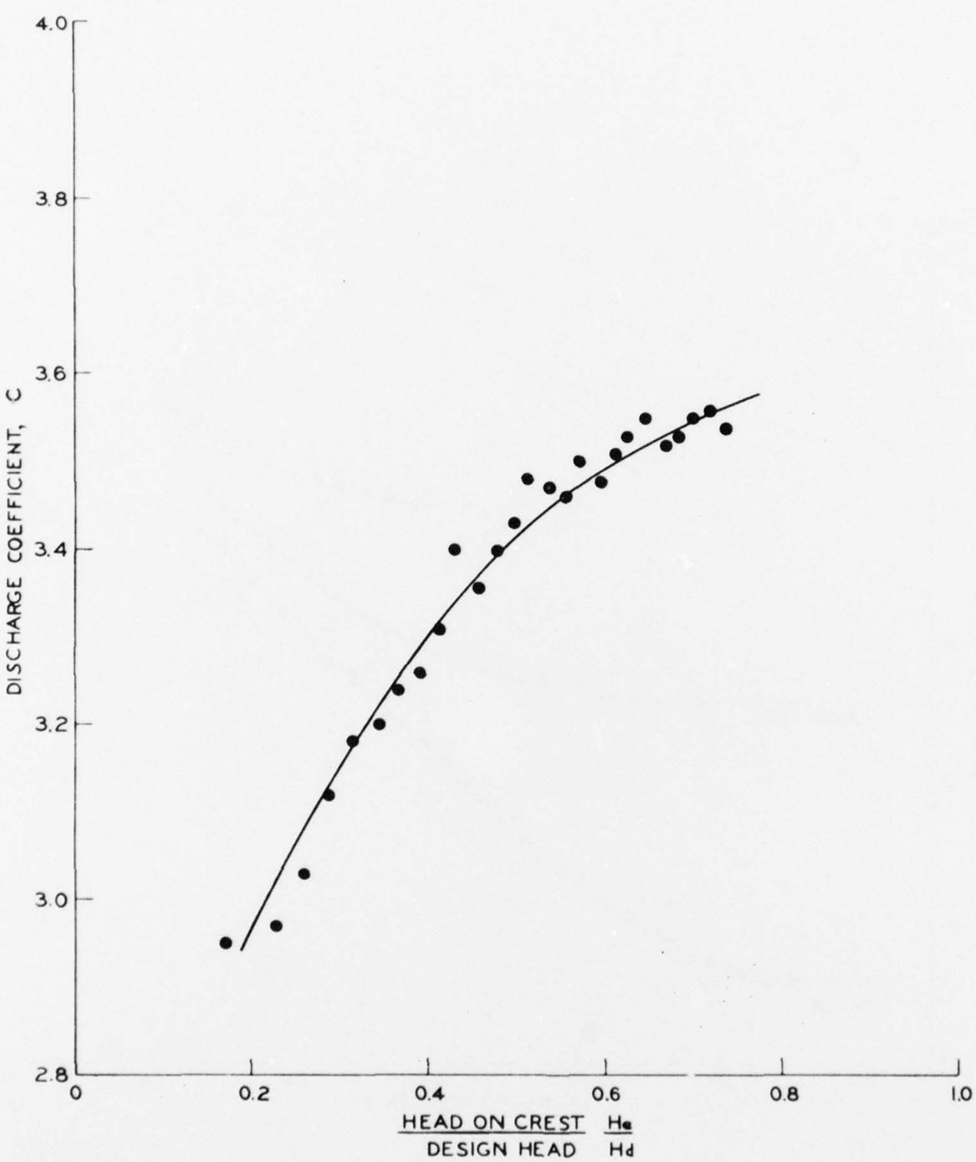
KISSIMMEE RIVER S-65B

CALIBRATION DATA

FOUR-FT GATE OPENING

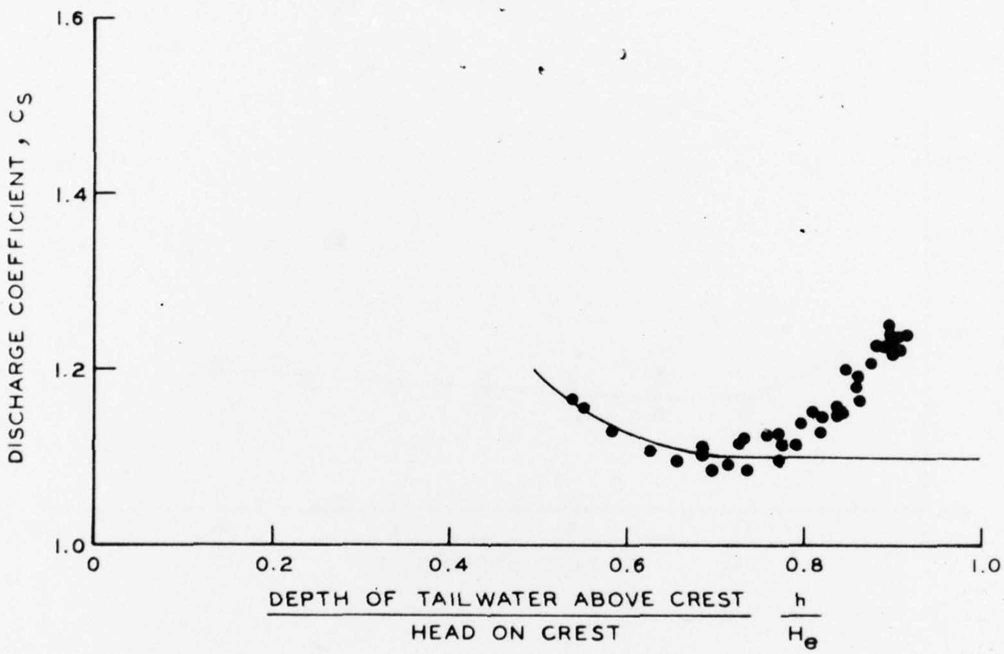


KISSIMMEE RIVER S-65B
CALIBRATION DATA
UNCONTROLLED FLOW



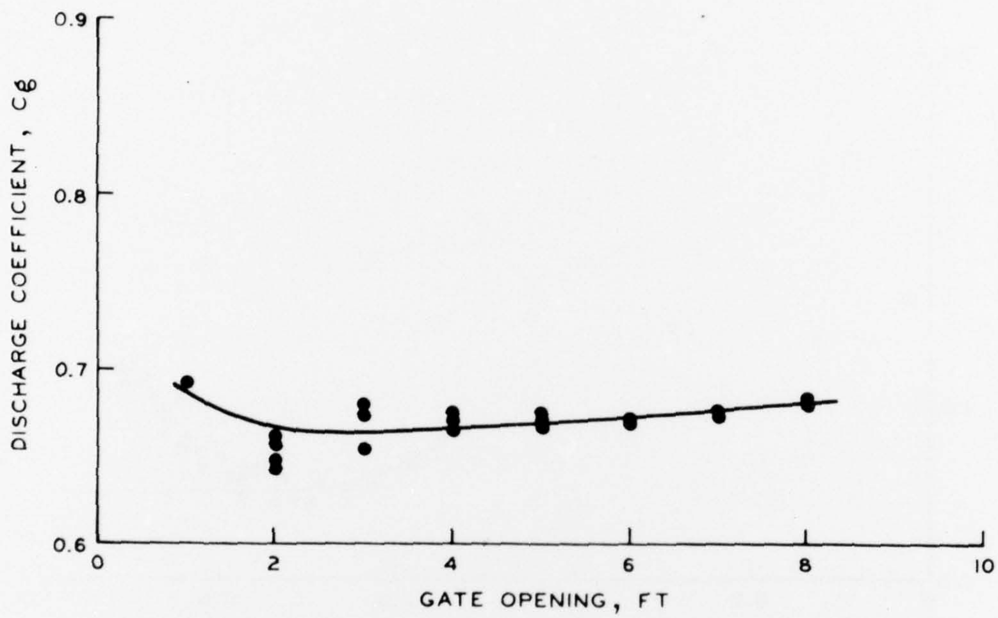
KISSIMMEE RIVER S-65B

FREE UNCONTROLLED FLOW



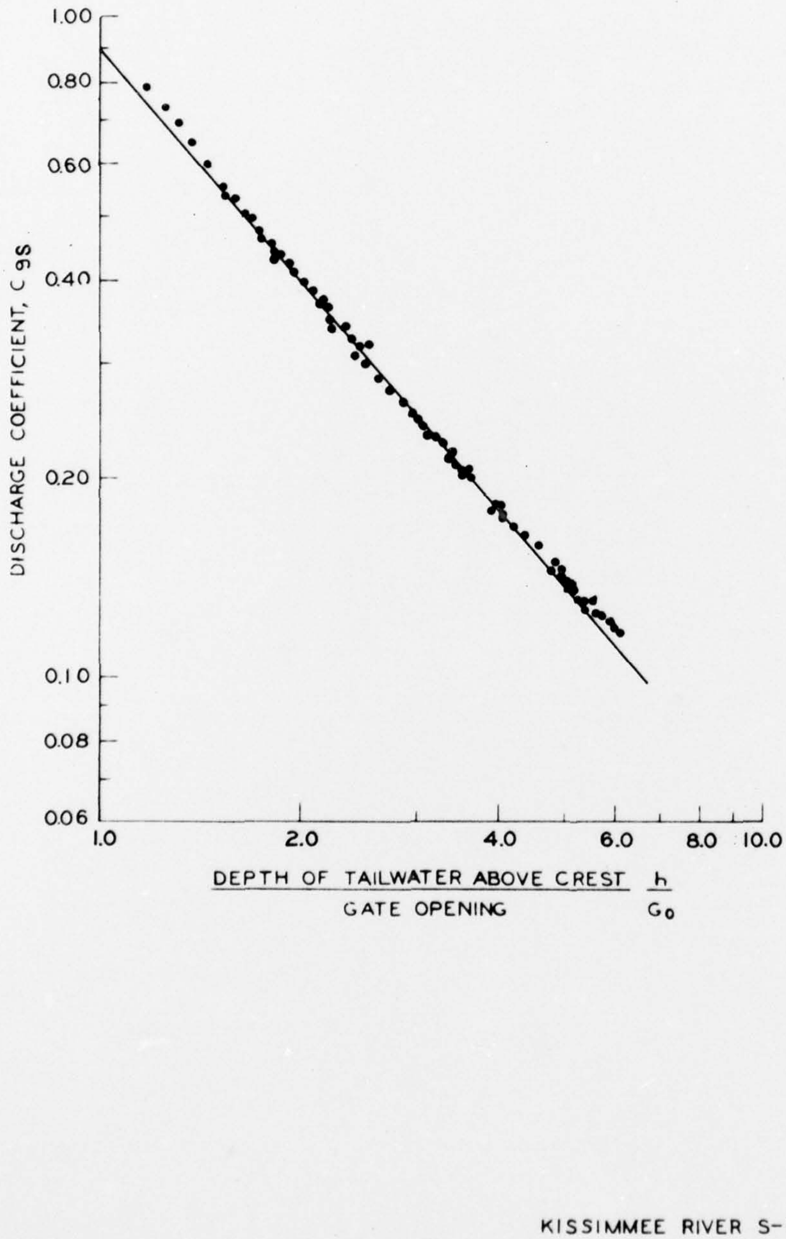
KISSIMMEE RIVER S-65B

SUBMERGED UNCONTROLLED FLOW



KISSIMMEE RIVER S-65B

FREE CONTROLLED FLOW



KISSIMMEE RIVER S-65B

SUBMERGED CONTROLLED FLOW

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Turner, Herman O
Kissimmee River structures, Central and Southern Florida Flood Control Project; hydraulic model investigation / by Herman O. Turner, Jr., Glenn A. Pickering. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1979.
29 p., 37 leaves of plates : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; HL-79-4)
Prepared for U. S. Army Engineer District, Jacksonville, Jacksonville, Fla., and South Florida Water Management District, West Palm Beach, Fla.

1. Central and Southern Florida Flood Control Project. 2. Control structures. 3. Flood control -- Florida. 4. Hydraulic models. 5. Kissimmee River. I. Pickering, Glenn A., joint author. II. South Florida Water Management District. III. United States. Army. Corps of Engineers. Jacksonville District. IV. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; HL-79-4.
TA7.W34 no.HL-79-4