UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SLY PARK DAM SPILLWAY HYDRAULIC MODEL STUDIES--SLY PARK UNIT AMERICAN RIVER DIVISION CENTRAL VALLEY PROJECT, CALIFORNIA

Hydraulic Laboratory Report No. Hyd-370

ENGINEERING LABORATORIES BRANCH

DESIGN AND CONSTRUCTION DIVISION
DENVER, COLORADO

May 27, 1953

HYD 370

CONTENTS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Design and Construction Division
Engineering Laboratories Branch
Denver, Colorado
May 27, 1953

Laboratory Report No. Hyd-370
Hydraulic Laboratory Section
Compiled by: L. V. Wilson
Checked by: W. C. Case
Reviewed by: J. W. Ball

Subject: Sly Park Dam spillway hydraulic model studies—Sly Park Unit—American River Division—Central Valley Project, California

PURPOSE

To investigate the hydraulic performance of the double-side channel spillway.

CONCLUSIONS

Preliminary Design

1. Although improvements in flow conditions in the approach channel, at the wing walls, and in the transition section of the spillway were indicated by the model tests, there were no conditions that would result in damage to the structure.

2. The large stagnant flow area along the left bank in the approach channel indicated that more excavation than was necessary had been provided.

3. The shape of the right cut-off wall and backfill is conducive to rough surface flow along the wall.

4. The abrupt transition downstream from the crest caused a standing wave to form in the chute downstream.

Recommended Design

5. The spillway will handle the maximum design flood without submergence. The flow conditions are improved over those for the preliminary design.

6. Areas of flow stagnation will not occur in the approach channel with the reduced excavation in this design.

7. Flow through the more gradual vertical-walled transition section of this design is more uniform than that in the preliminary design.

8. The surface flow along the right wing wall was improved over the preliminary design by the more gradual curvature of this wall.

RECOMMENDATIONS

1. Use the approach channel and vertical walls shown in Figures 5 and 6.

2. Consider omitting the extensions of the spillway downstream crest slopes beyond the end of the overflow section in future similar designs.

ACKNOWLEDGMENT

The improvements incorporated into the recommended design were determined jointly by the Dams and Engineering Laboratories Branches.

INTRODUCTION

Sly Park Dam is in Sly Park Creek about 12 miles east of Placerville, California, Figure 1. The combination earth- and rock-fill dam will be approximately 760 feet long and 190 feet high. The spillway will be an uncontrolled double-side channel type. It will consist of an approach channel, a crest section, and a chute terminating in a flip bucket about 825 feet downstream of the crest. The spillway is designed for a maximum flood of 6,700 cubic feet per second. An outlet works and diversion conduit are provided also. Model studies for the outlet works will be discussed in a separate report.

THE INVESTIGATION

The Problem

The model study was undertaken to determine if the preliminary spillway design was satisfactory for optimum performance. Salient features affecting spillway action were a shallow approach, a warped transition from the spillway to the chute section, and flow along the approach wing walls. The model used in the study did not contain the downstream end of the chute or the bucket as no operating difficulty was expected.

The Model

The model was constructed to a 1:36 scale and included a sufficient length of chute for the water to pass through the critical velocity, Figure 2. Most of the topography was comprised of horizontal wooden bents covered with metal lath and plastered with concrete. The level excavated portion of the approach channel was made of plywood supported by short 2 by 4 columns. Plywood was used to form the portion of the dam adjacent to the spillway. The spillway was shop fabricated, with the floor and channel section formed of sheet metal. The crest and transition warp were formed of concrete to metal templates. The chute was made of plywood secured to the channel section with a flanged joint.

Water was supplied to the model from a centrifugal pump through an 8-inch line. A wire mesh and gravel baffle distributed the water in the forebay. Discharges were measured with a 4-inch standard Venturi meter and reservoir elevations were measured with a point gage in the forebay.

Tests

Water surface profiles were measured along each wall in the transition area for both the preliminary and recommended designs, Figure 3. Calibration data was obtained for a discharge curve on the recommended design, Figure 4. The model was operated through a range of discharges for the preliminary design and subsequent modifications for visual observation.

Test Results

Preliminary design. The approach channel was excavated too far into the left bank opposite the upstream end of the spillway crest, producing a stagnation area along the cut. The flow lines in the channel were shown by photographing confetti traces, Figure 7A. The straight right wing wall with 2-1/2:1 end slope and backfill as shown on Figure 2 produced a rough surface flow along the wall at large discharges, Figures 8A and 9A. The roll in the spillway channel was not symmetrical about the center line at the higher discharges, Figures 8, 9, 11, and 12. This resulted from the different flow distribution approaching the two sides of the spillway. The water flowed normal to the right side of the spillway at a relatively slow velocity, and at angles to the left side at a faster velocity.

Recommended design. The shape of the approach channel was changed to reduce the cut in the bank opposite the upstream end of the spillway crest. The angle of the cut to the center line of the spillway was changed from 35° to 20° and the radius reduced from 100 to 75 feet,

Figure 5. The transition in the chute below the crest section was changed from one with warped walls to one with vertical walls, elliptical in plan, with the downstream slopes of the spillway crest extending downstream to intersect the vertical walls, Figure 6. The left wing wall of the model was not changed from the preliminary design for the tests since the flow conditions adjacent to it were acceptable and any change could be made on the basis of performance of the right wall.

The change in the excavation removed the stagnation area, Figure 7B. The right wing wall modification reduced the rough flow in the approach channel near the downstream end of the spillway crest, Figures 8 and 9.

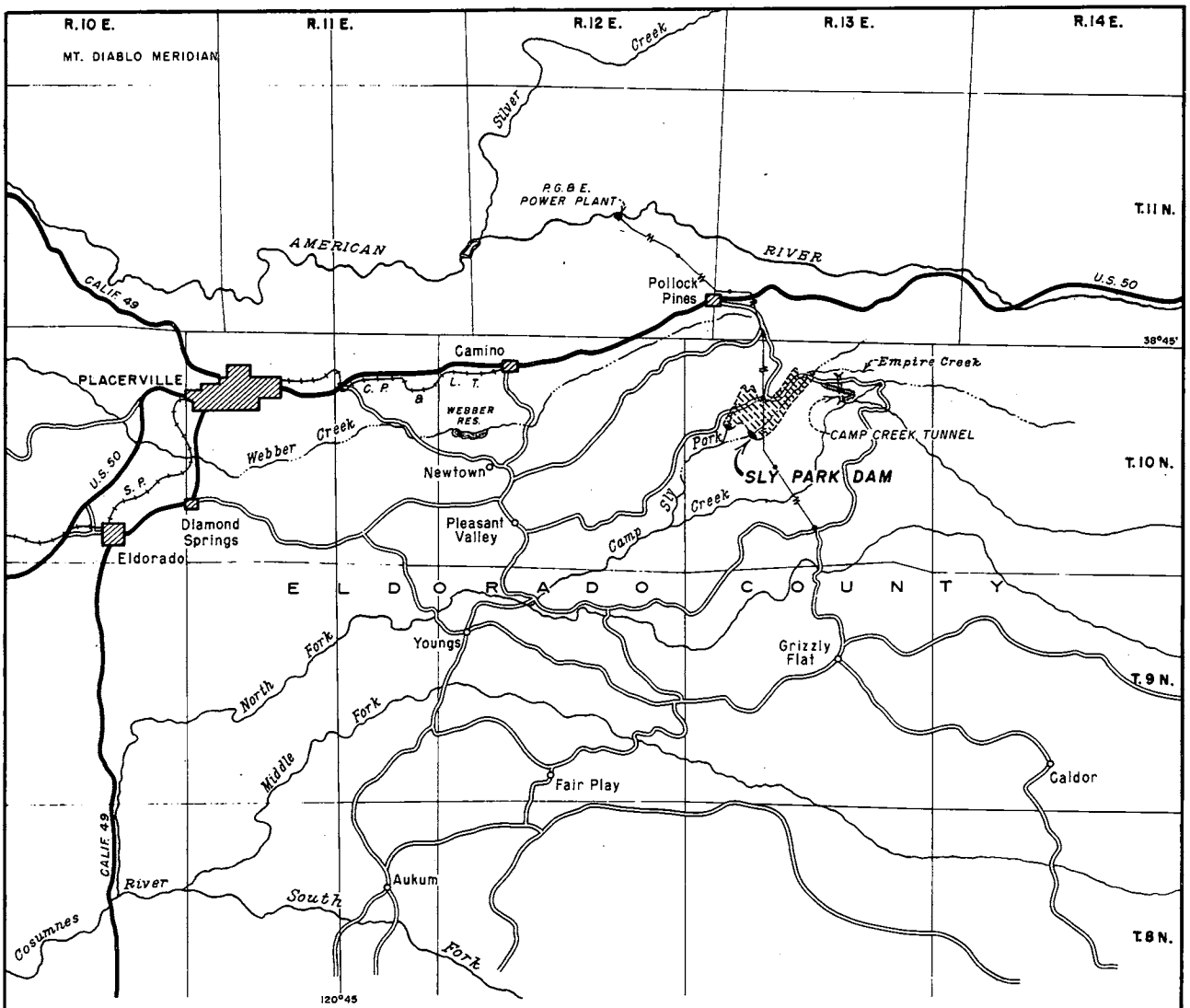
Water surface profiles along the walls for both designs are shown on Figure 3. The preliminary design had more draw-down at the end of the transition with a correspondingly higher standing wave in the chute downstream. The nonsymmetrical roll in the upper end of the spillway caused a higher water surface along the left wall. The flow was slightly more symmetrical in the recommended design, Figure 8, but to obtain full symmetry the shallow approach would have to be deepened to permit uniform flow toward the crest and the additional excavation did not seem justified.

A vertical fin forms in the upstream end of the spillway at small discharges for both designs, Figures 10 and 13, because the tail water escapes without submerging the jets from the spillway corners.

Both designs were capable of passing the maximum discharge of 6,700 cfs without submergence. Irregular wave action momentarily submerged small sections of the crest, but had no over-all effect on the discharge. These waves can be seen in Figures 7B, 8B, and 11. The discharge and coefficient curves for the recommended design are shown on Figure 4.

The extensions of the spillway downstream crest slopes to the vertical walls were removed to ascertain the effect on flow conditions. The performance was satisfactory, Figures 14 and 15. This change was made after the specifications were issued and was not included in the final design.

FIGURE 1
REPORT HYD. 370



INDEX MAP

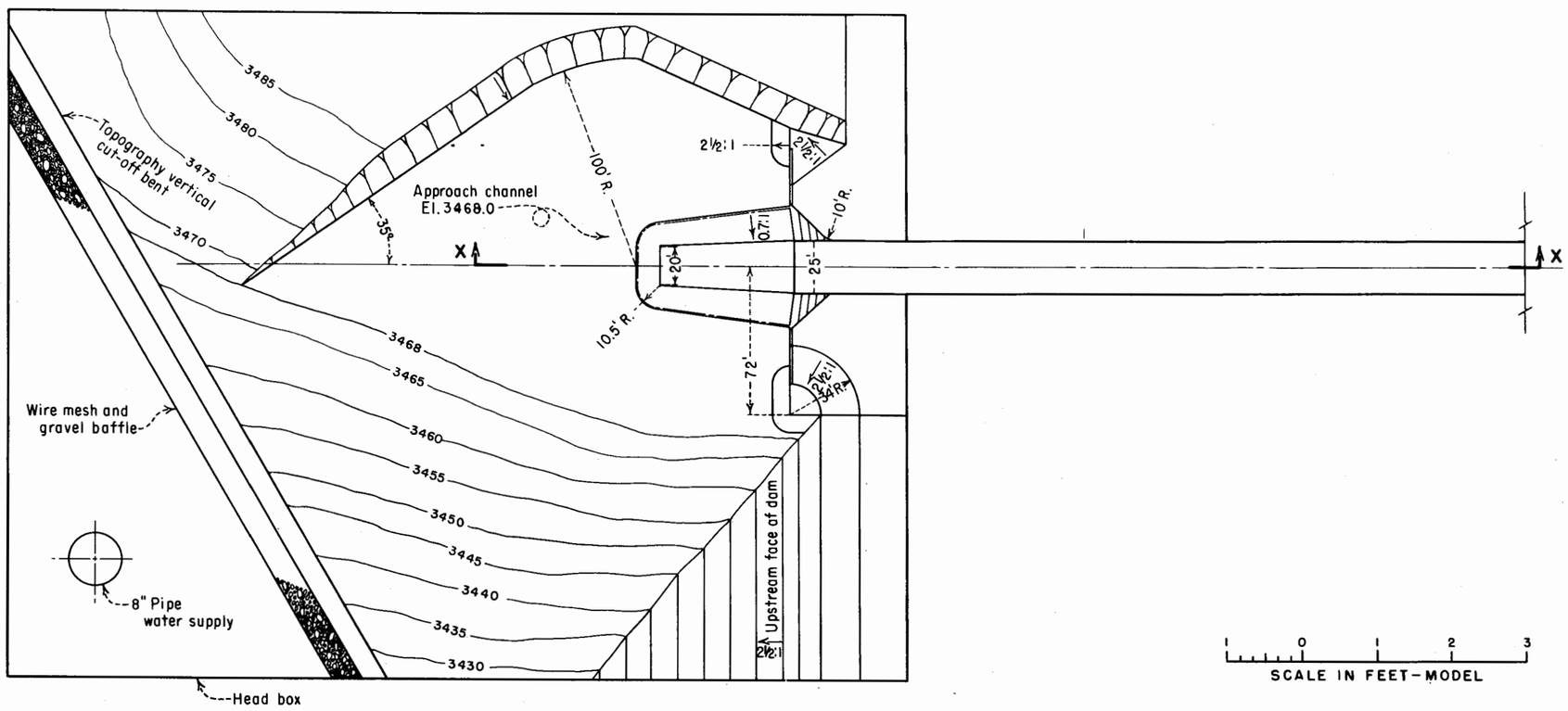
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT - CALIFORNIA
AMERICAN RIVER DIVISION-SLY PARK UNIT

SLY PARK DAM
LOCATION MAP

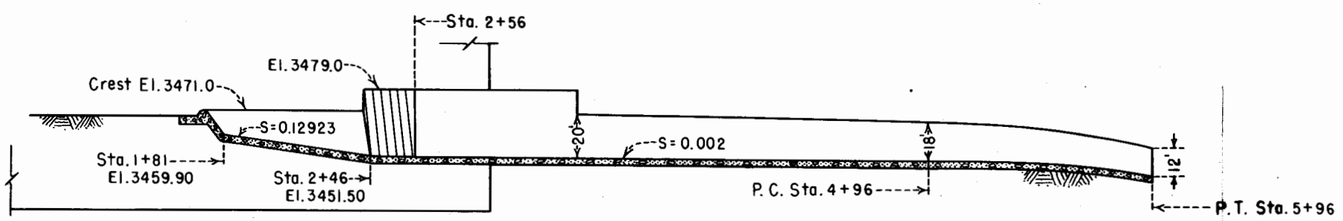
DRAWN W.A.K. SUBMITTED J.J. Hammond
TRACED C.M.A. RECOMMENDED
CHECKED [illegible] APPROVED
CHIEF ENGINEER

DENVER, COLORADO, JULY 25, 1952

540-D-23



PLAN



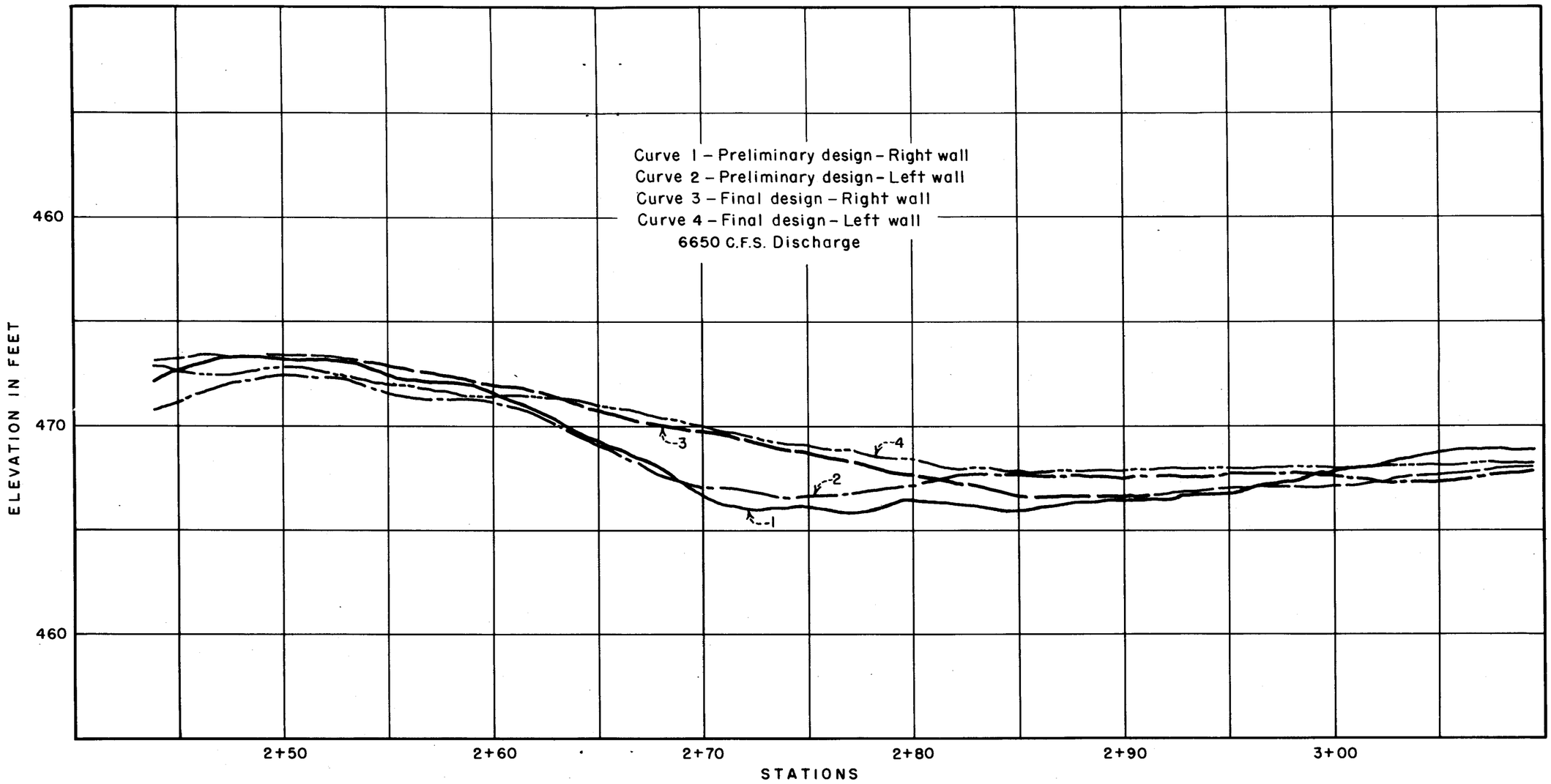
SECTION X-X

MODEL SCALE 1:36

CENTRAL VALLEY PROJECT – CALIFORNIA
AMERICAN RIVER DIVISION – SLY PARK UNIT

SLY PARK DAM
SPILLWAY – PRELIMINARY DESIGN
MODEL LIMITS

417



CENTRAL VALLEY PROJECT – CALIF.
AMERICAN RIVER DIV. – SLY PARK UNIT

SLY PARK DAM

SPILLWAY

WATER SURFACE PROFILES

417

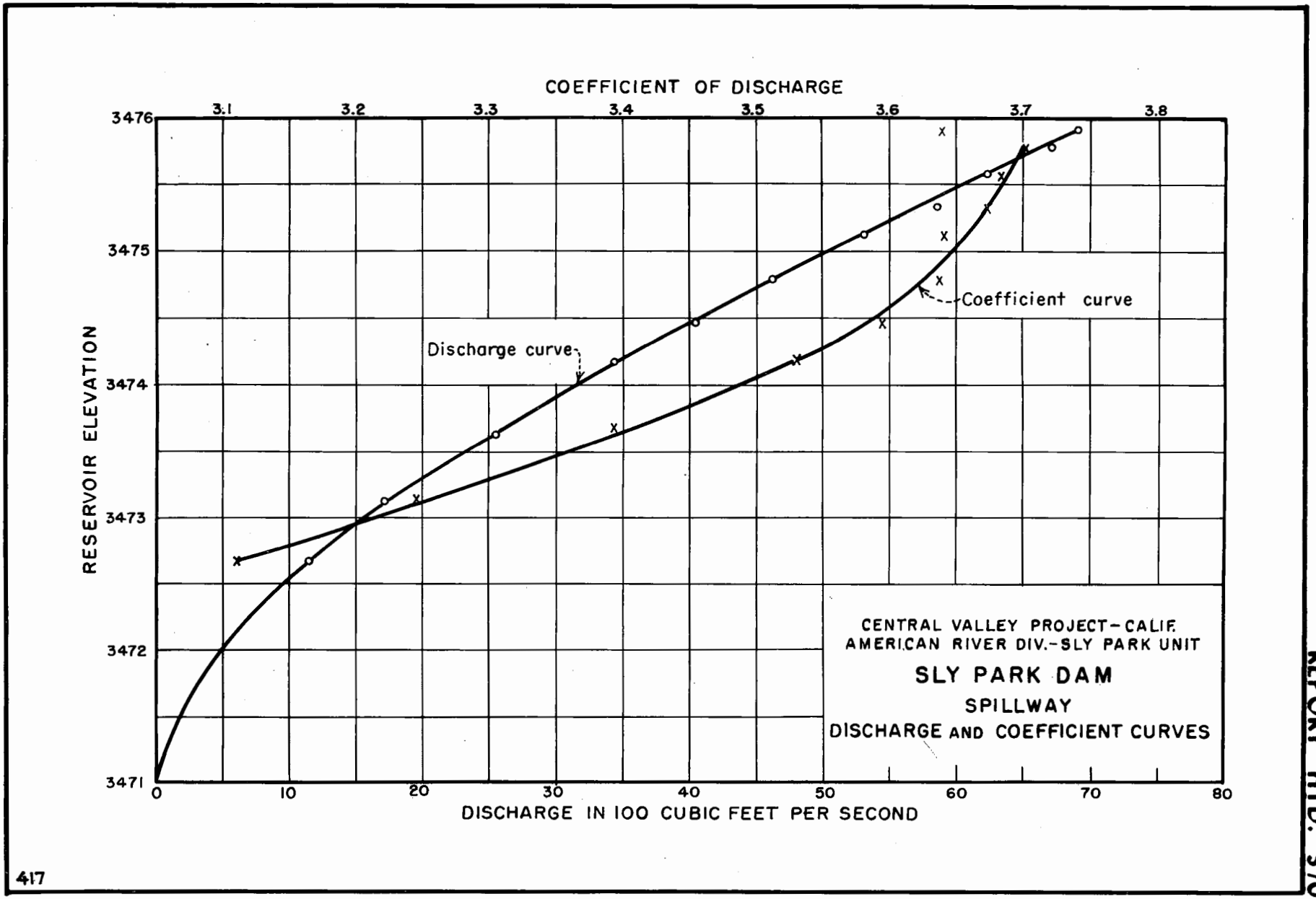


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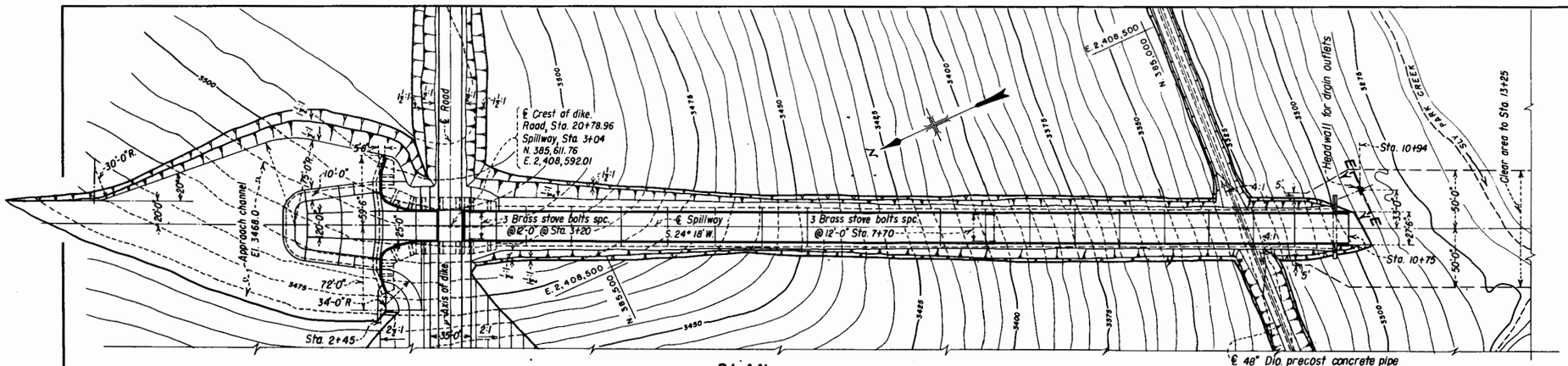
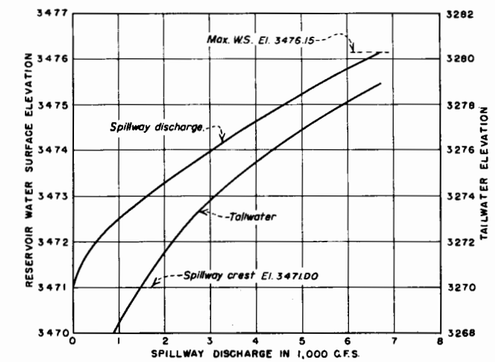
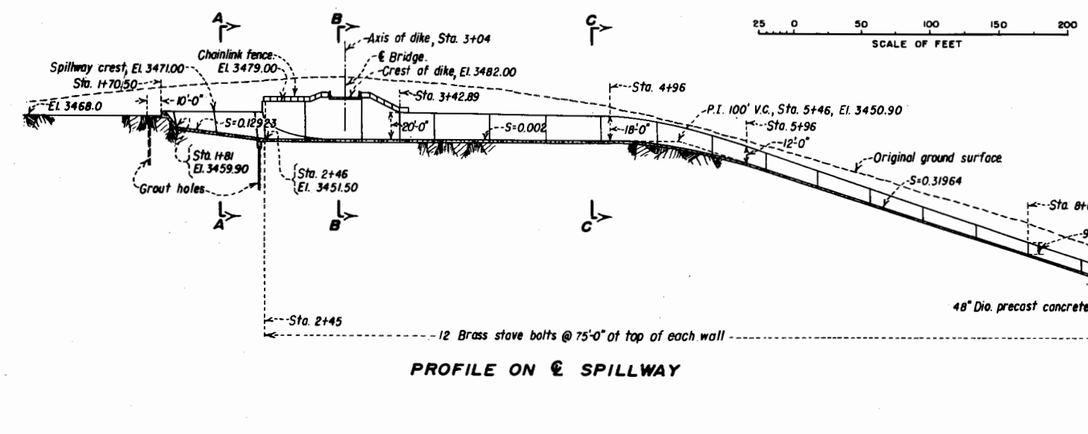
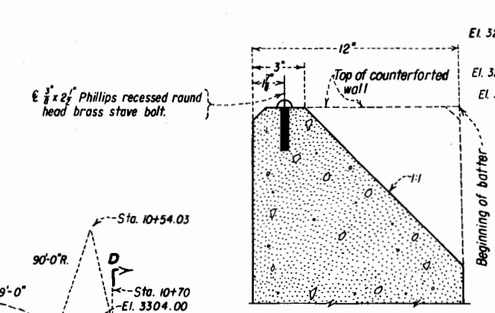
FIGURE 4
REPORT HYD. 370

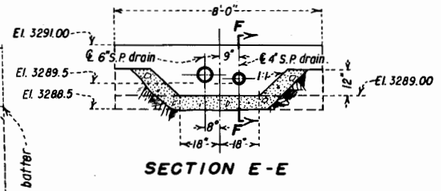
FIGURE 5.
REPORT HYD. 370

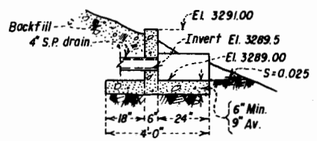


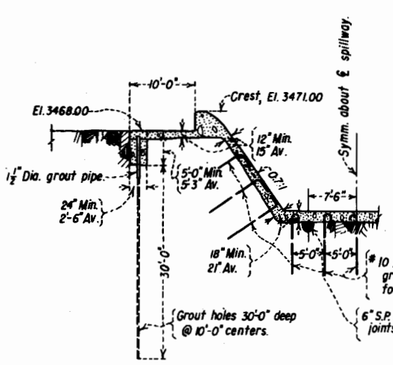


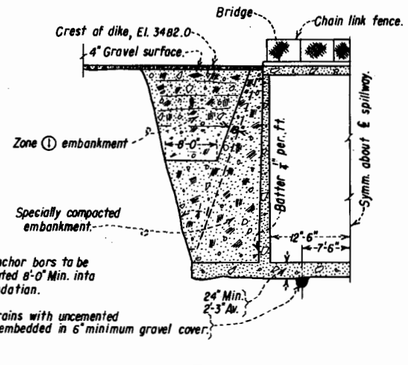


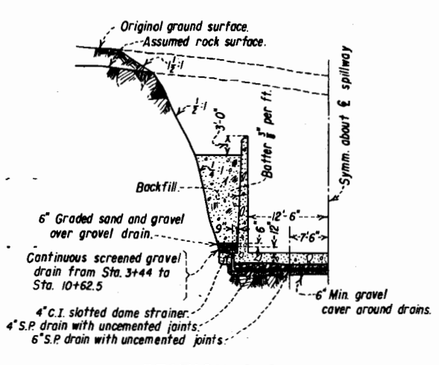


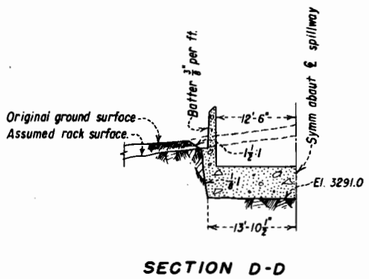












NOTES

Design based on concrete of 3,000 lbs. per sq. inch compressive strength at 28 days.
Reinforcement not shown.
Concrete finishes: Exposed surfaces, F2 and U2; unexposed surfaces, F1 and U1.
Pressure applied to grout holes as directed by contracting officer.

UNITED STATES
DEPARTMENT OF THE INTERIOR
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CENTRAL VALLEY PROJECT - CALIF.
AMERICAN RIVER DIV. - SLY PARK UNIT

SLY PARK DAM
SPILLWAY
GENERAL PLAN AND SECTIONS

DRAWN	V.M.B.	SUBMITTED	H.M. Tabor
TRACED	V.F.M.	RECOMMENDED	J.J. Hammond
CHECKED	A.H.T.	APPROVED	T.W. Kearns, CHIEF DESIGNING ENGINEER

DENVER, COLORADO, DEC. 15, 1952

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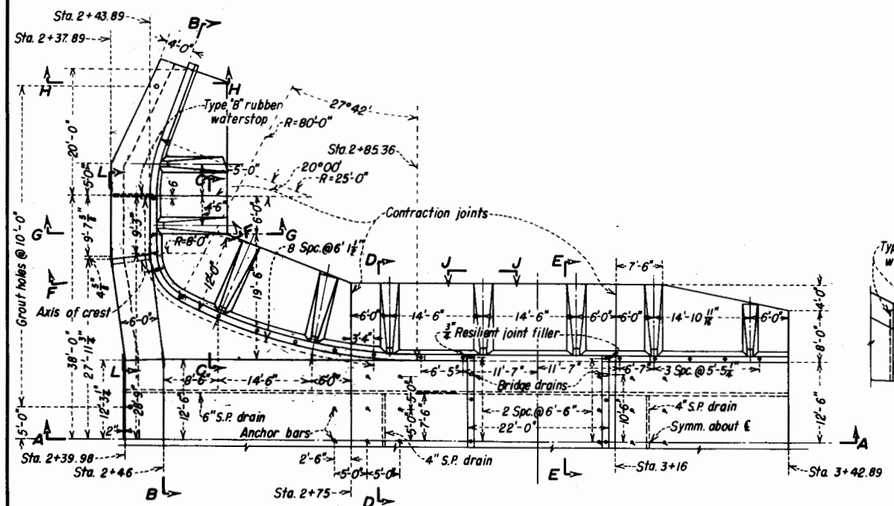
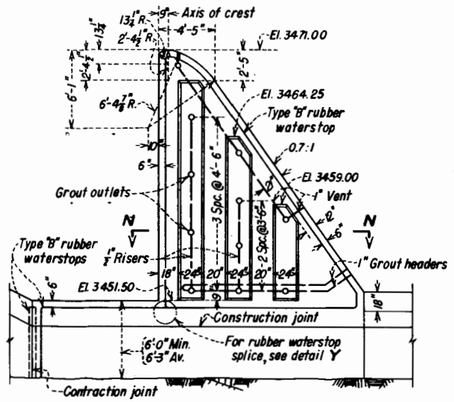
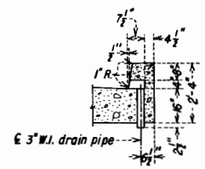


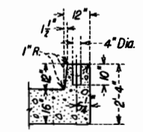
HALF PLAN



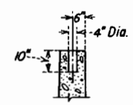
SECTION L-L



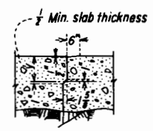
BRIDGE DRAIN DETAIL



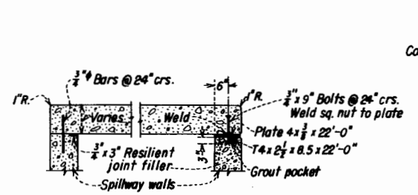
POST RECESS ON BRIDGE



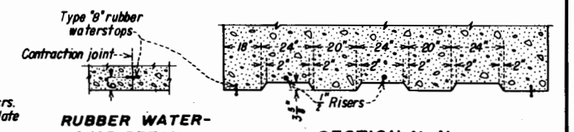
POST RECESS ON WALLS



DETAIL Z

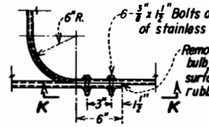


SECTION M-M
BRIDGE SEAT DETAILS

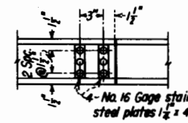


RUBBER WATER-STOP DETAIL

SECTION N-N



DETAIL Y
RUBBER WATERSTOP SPLICE



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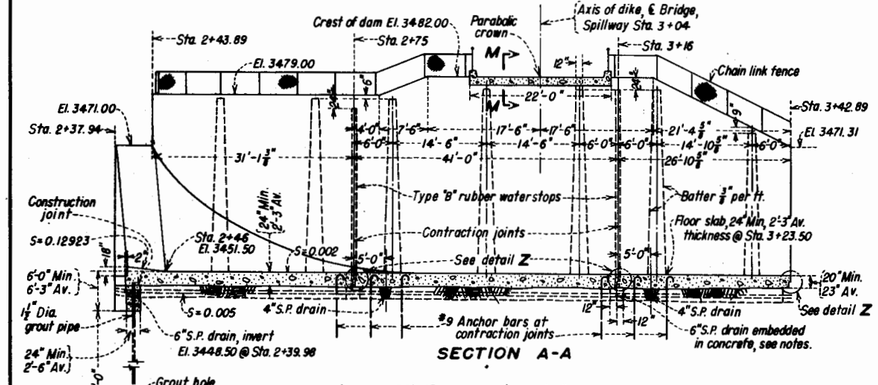

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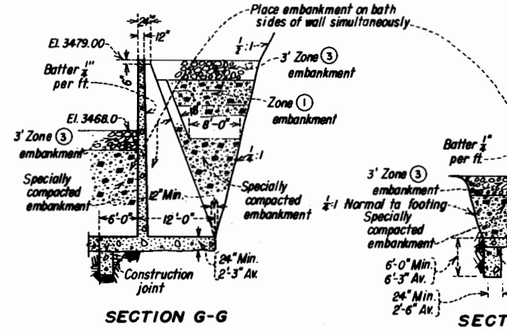

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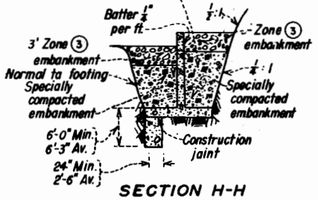

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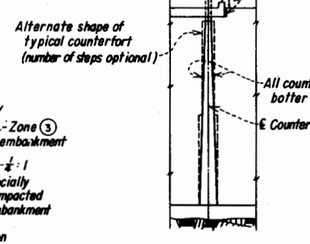

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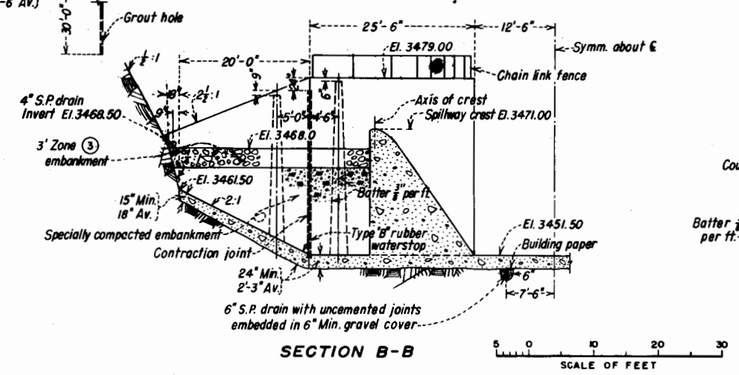

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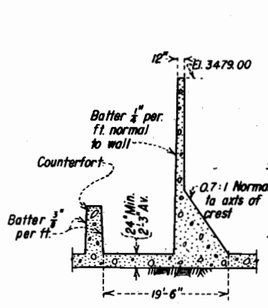

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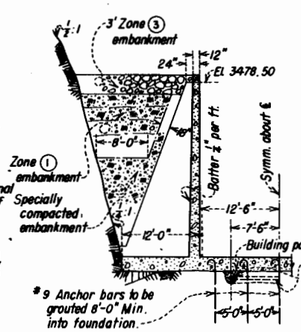

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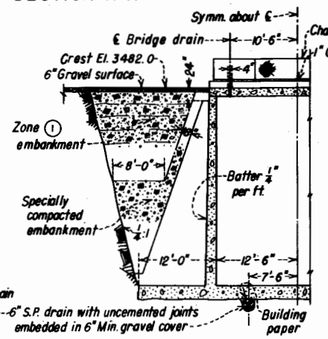

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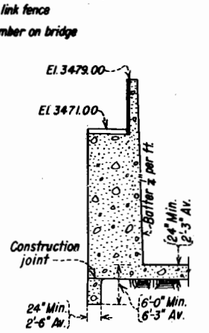

SECTION F-F

NOTES

Design based on concrete of 3000 lbs. per sq. inch compressive strength at 28 days.
Concrete finishes: Surfaces to be covered by backfill, F1 and U1, exposed surfaces, F2 and U2.
Chamfer all exposed corners 3/4" unless otherwise noted.
Apply two coats of sealing compound to one face of all ungrouted contraction joints.
Reinforcement not shown.
6" Longitudinal sewer pipe drains to be embedded in concrete at contraction joints.

SCALE OF FEET 5 0 10 20 30

UNITED STATES
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CENTRAL VALLEY PROJECT - CALIFORNIA
AMERICAN RIVER DIV. - SLY PARK UNIT

SLY PARK DAM
SPILLWAY
STA. 2+39.98 TO STA. 3+42.89

DRAWN J.M.B. SUBMITTED Fred L. Brandt
TRACED R.V.S. RECOMMENDED A. N. Tabor
CHECKED J.H.P. APPROVED D. D. Hammond, CHIEF, DAMS BRANCH
DENVER, COLORADO, DEC. 15, 1952

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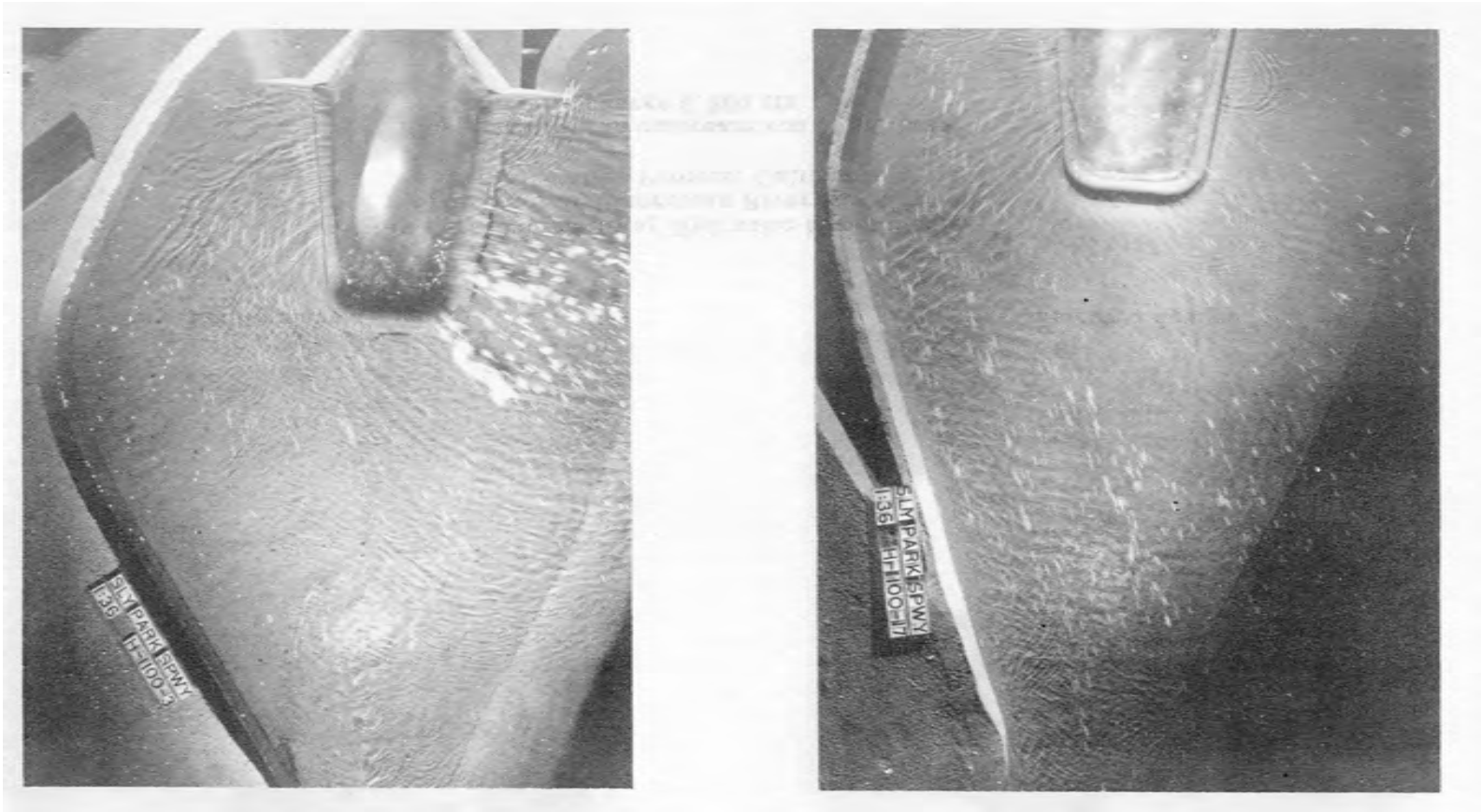


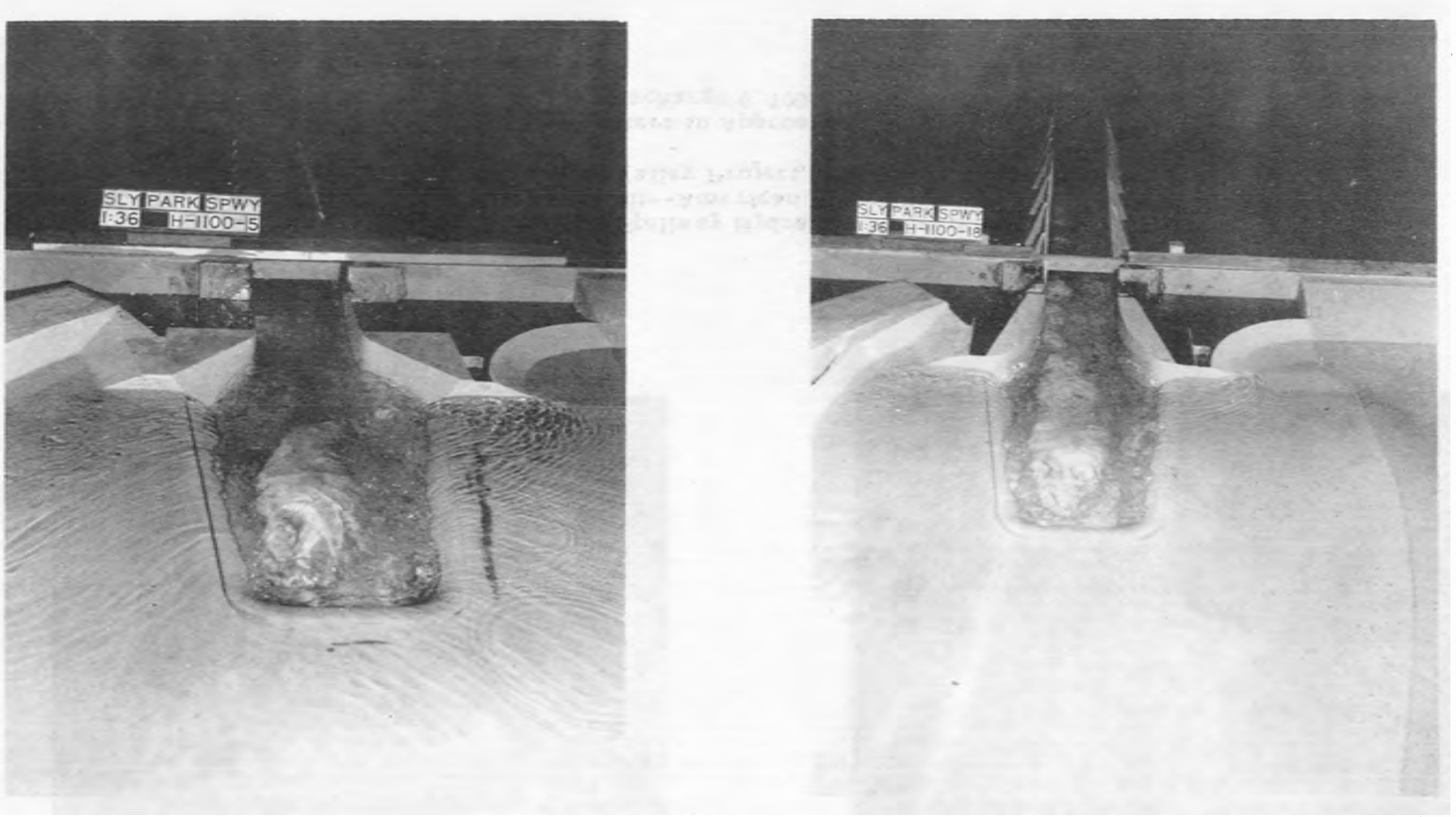
A. Preliminary design

B. Recommended design

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow pattern in Approach Channel
Discharge 6,700 cfs

FIGURE 7
REPORT Hyd-370

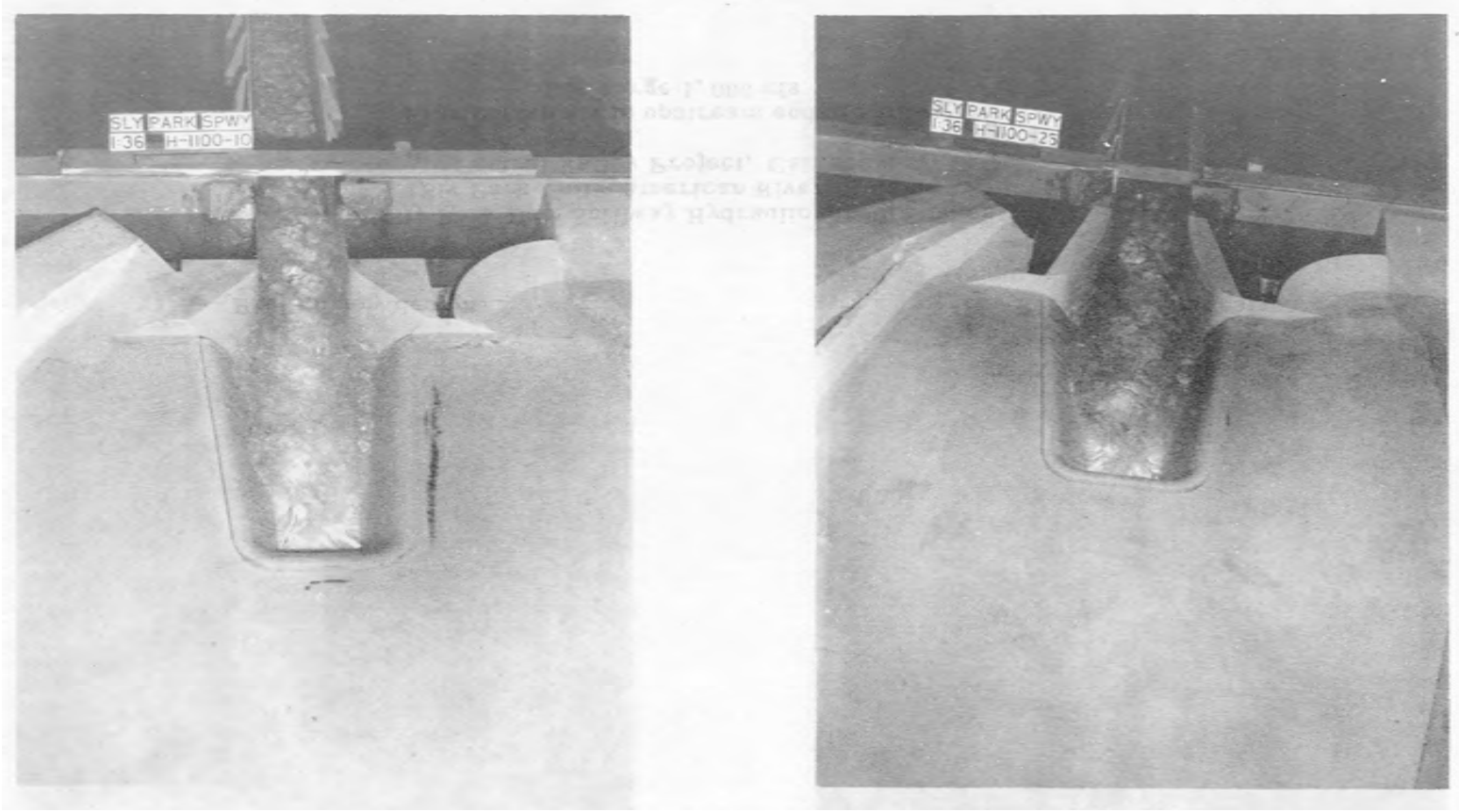


A. Preliminary design

B. Recommended design

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions in upstream end of spillway
Discharge 6,700 cfs



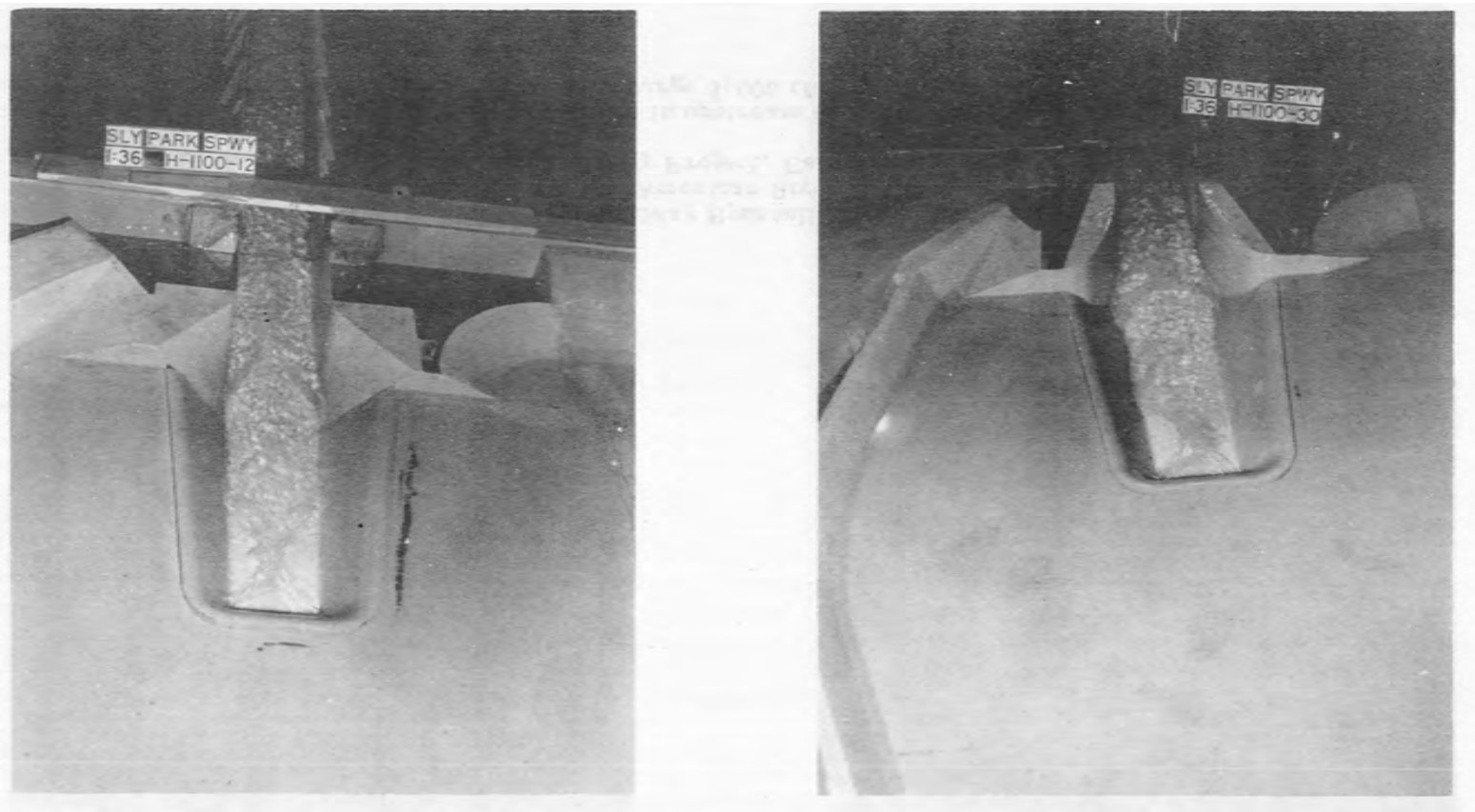
A. Preliminary design

B. Recommended design

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions in upstream end of spillway
Discharge 3,000 cfs

FIGURE 9
REPORT Hyd-370



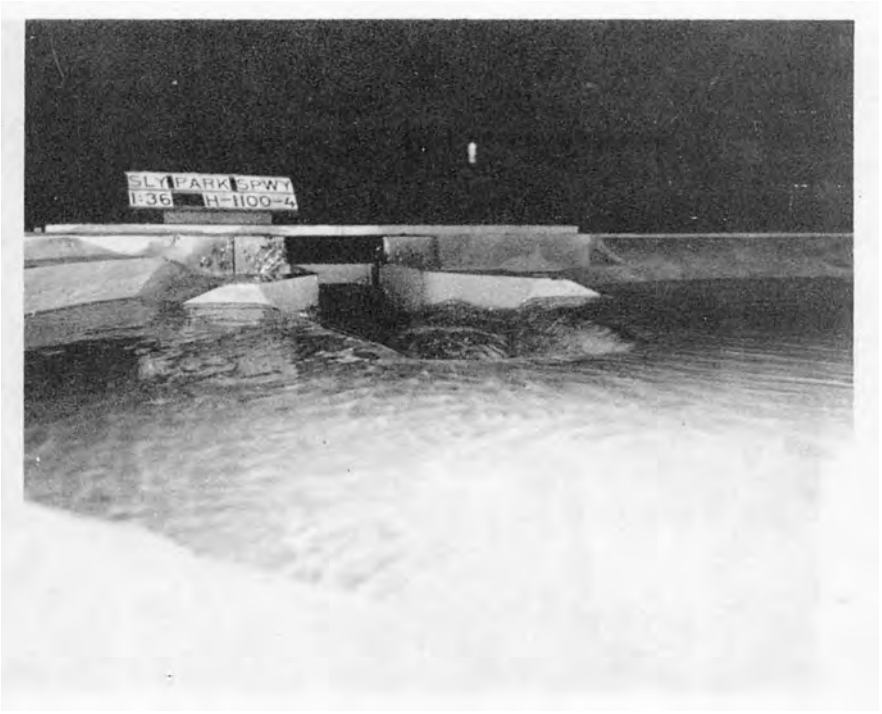
A. Preliminary design

B. Recommended design

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions in upstream end of spillway
Discharge 1,000 cfs

FIGURE 11
REPORT Hyd-370



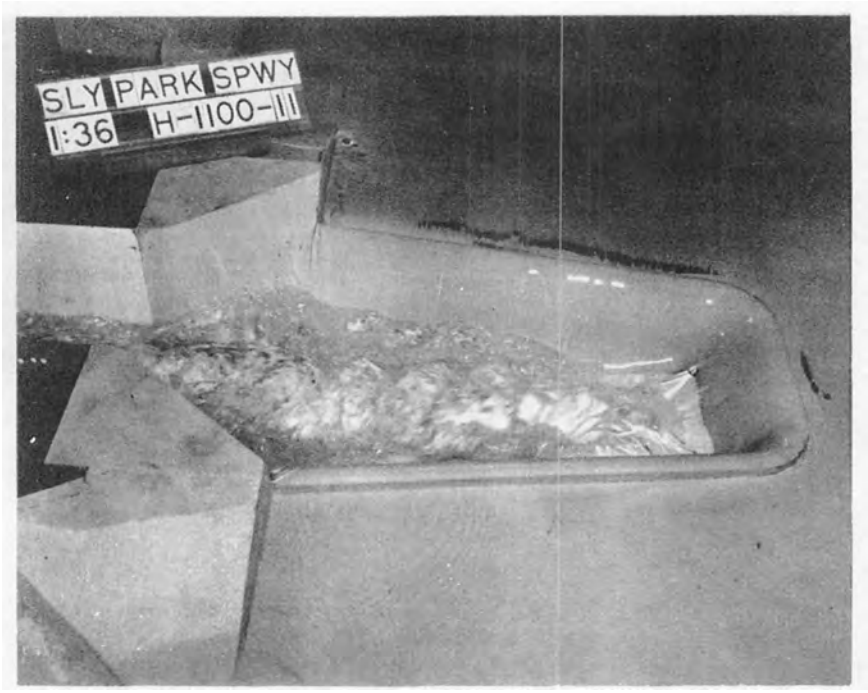
A. Preliminary design

B. Recommended design

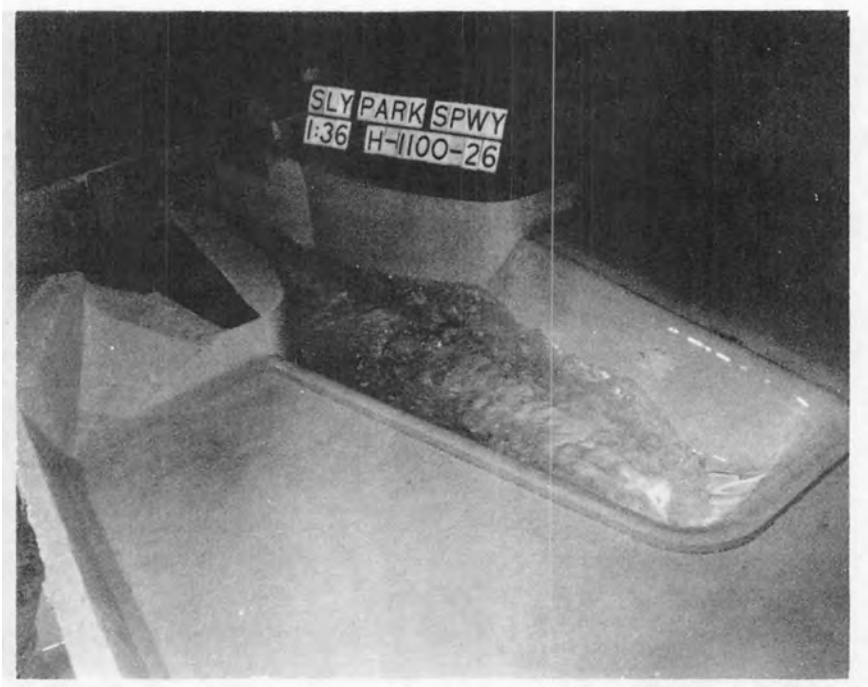
Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions along right side of spillway
Discharge 6,700 cfs

FIGURE 12
REPORT Hyd-370



A. Preliminary design

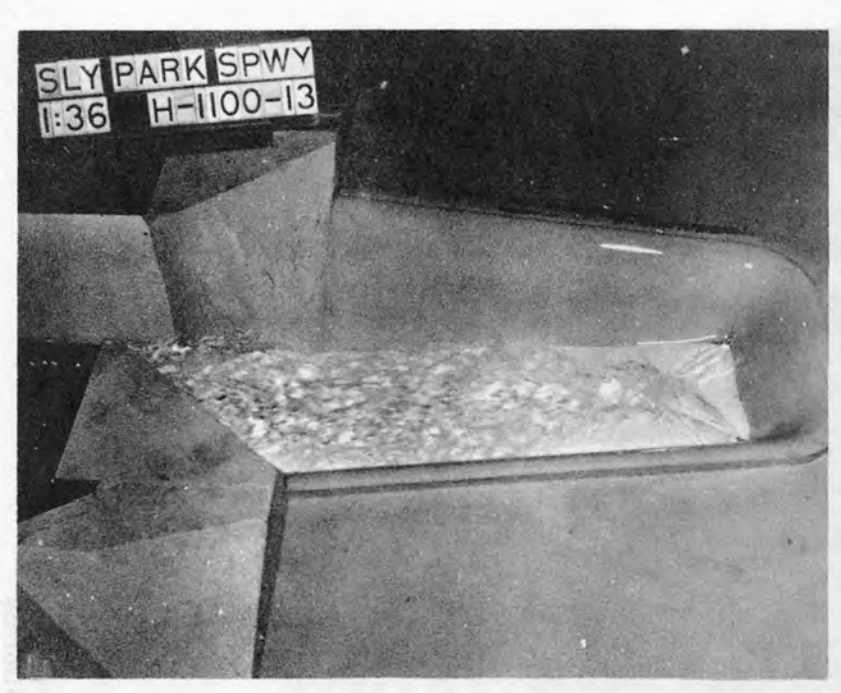


B. Recommended design

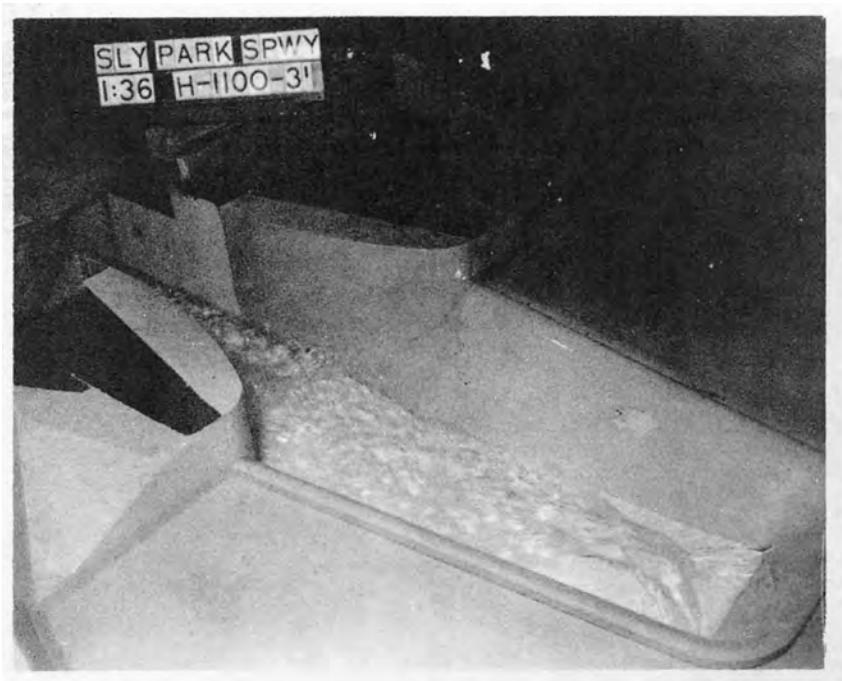
Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions along right side of spillway
Discharge 3,000 cfs

FIGURE 13
REPORT Hyd-370



A. Preliminary design

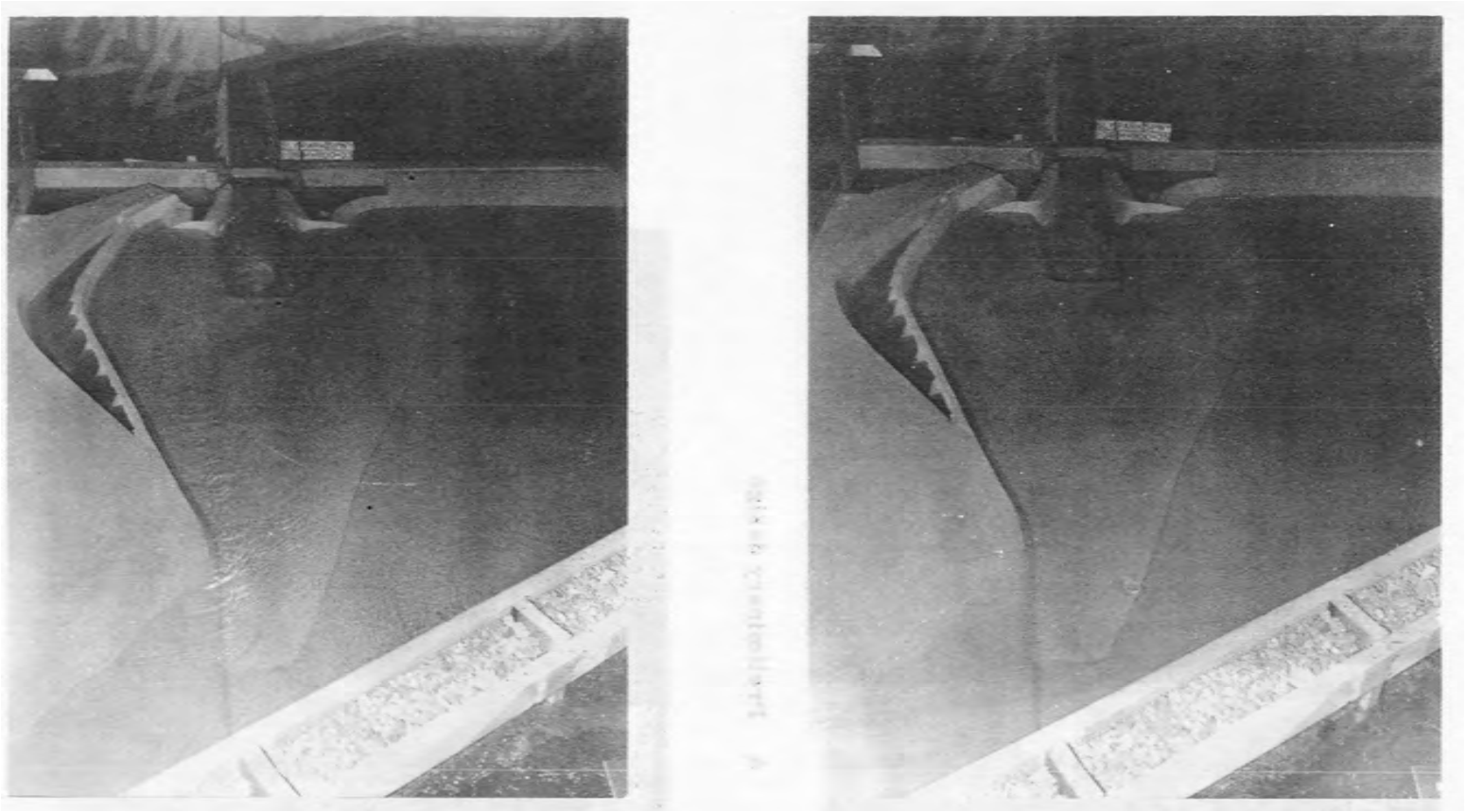


B. Recommended design

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions along right side of spillway
Discharge 1,000 cfs

FIGURE 14
REPORT Hyd-370



A. Discharge 6,700 cfs

B. Discharge 3,000 cfs

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions in recommended design in approach channel

FIGURE 15
REPORT Hyd-370

A. Discharge 6,700 cfs

B. Discharge 3,000 cfs

Sly Park Dam Spillway Hydraulic Model Studies
Sly Park Unit--American River Division
Central Valley Project, California

Flow conditions in recommended design spillway without downstream crest slopes extended to transition walls

Interior - Reclamation - Denver, Colo.