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UNITED STATES

DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

MEMORANDUM TO CHIEF DESIGNING ENGINEER

PRELIMINARY REPORT -- LABORATORY TESTS OF PROPOSED DESILTING EQUIPMENT FOR THE ALL-AMERICAN CANAL

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TECHNICAL MEMORANDUM No. 430.

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(Price $1.00)

PRELIMINARY REPORT -- LABORATORY TESTS OF PROPOSED DESILTING EQUIPMENT FOR THE ALL-AMERICAN CANAL.

SUMMARY.

Plan number 1 of the proposed designs for desilting works includes scrapers which push the settled silt into sludge trenches and sluice-pipes placed below the floor of the settling tanks. A 1-to-3 model of a section of a trench, sluice-pipe, and scraper was constructed and operated, and showed the feasibility of the general arrangement. The tests also revealed certain characteristics of the silt.

Tests are now being made with a much larger piece of equipment, which represents, full-size, a portion of the proposed scraping device. No trenches or sluice pipes are included in this model. The apparatus can be arranged to study scraping action in which the silt is pushed along in front of a scraper placed normal to the direction of travel, or to investigate the action of a scraper inclined to the direction of motion and which displaces the silt laterally, as a snow-plow.

The last mentioned tests, of the full-size scraper, are expected to show the power required for scraping at several speeds, and with varying amounts of silt. It is also planned to study various designs of the scraper blade which may give better scraping or require less power for operation. Various angles of the diagonal scraper will be investigated.

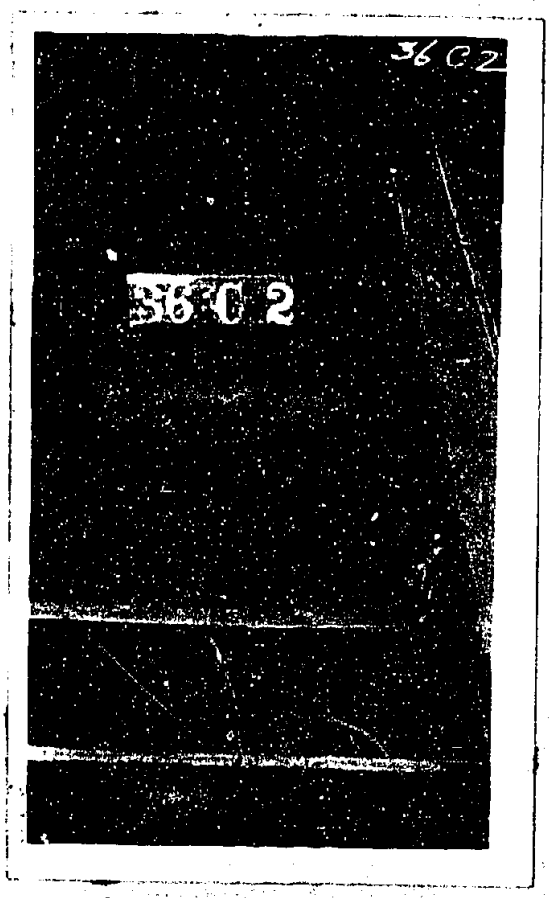
PROJECT.

Plan No. 1 for the desilting works calls for rectangular settling tanks with parallel sludge trenches and sluice pipes just below the floor (Figure 1). A scraper moving forth and back across the tank dumps the silt which it accumulates into the successive trenches, which are somewhat as shown in Figure 2. As the silt is dumped into the trench, a valve in the sluice pipe is opened and water flows from the desilting tank into the trench, through the orifices, into the pipe, and so on back to the river below the dam, carrying with it the load of silt which has been dumped into the trench by the scraper.

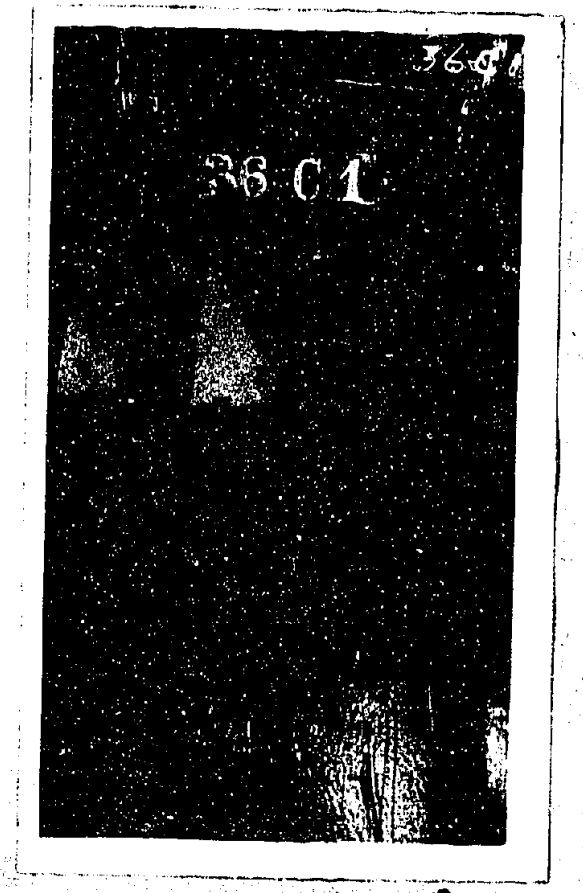
MODEL

A 1:3 model of a section of trench which included 3 orifices, was built in the Denver hydraulic laboratory of the Bureau, and a scraper was arranged to push silt into these orifices. The whole process was carried on under water, and a definite flow through the orifices as well as along the sluice pipe, insured that dumped material would be carried on in a manner similar to that in nature. The scraper was pulled by a tackle and a small hand windlass, and ice-scales were included to give an approximate value of the forces required to scrape the silt.

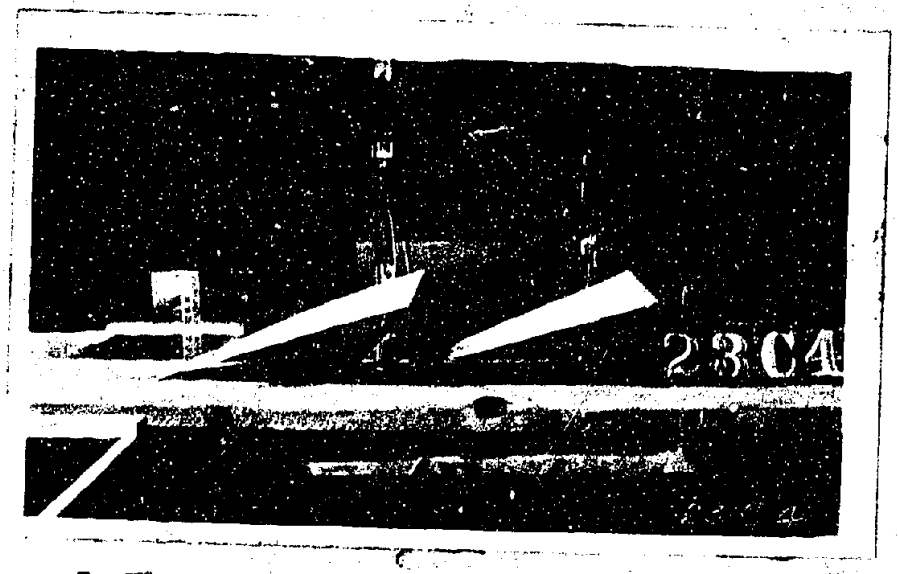
Photograph A. shows the trough and the scraper. The trough is in the background, just behind the identification number, and the three orifices, of revised design, may be seen. The scraper is in the middle-ground; when scraping silt it travels from foreground to background of the picture. Photograph B shows the sheet metal vanes



A Scraper and Orifices



C Looking down on orifices. Revised design



B View of parts of orifices. Original design.

1:5 SCRAPER MODEL

which formed the original orifices according to the design of Figure 2.

TESTS AND RESULTS.

Tests were conducted somewhat as follows: The scraper was drawn back and a weighed quantity of silt was spread on the area in front of the scraper by working it through a submerged screen. The scraper was then pulled toward the trench and the silt was pushed into the orifices. During this operation, water was flowing through the orifices, and through the pipe to which the orifices were connected. The pull on the scraper was noted from the spring balance readings; the velocity of the scraper was given by readings of time versus distance, and the time required for each orifice to clear of silt was also noted.

The tests showed that the trench-and-sluice-pipe scheme is entirely feasible. The proposed funnel-shaped entrances, as in Figure 2 were found not entirely satisfactory; silt remained in the corners and on the flattest side of the orifice funnels, and would not scour off. The funnels were then changed to those shown in Figure 3 and photograph C, which are square in plan and have steeper side slopes than the original design.

Attempts were made to plug the orifices by dumping large quantities of lumpy silt into the funnels, and allowing this to stand overnight. The openings invariably cleared after a slight head on the orifices was created.

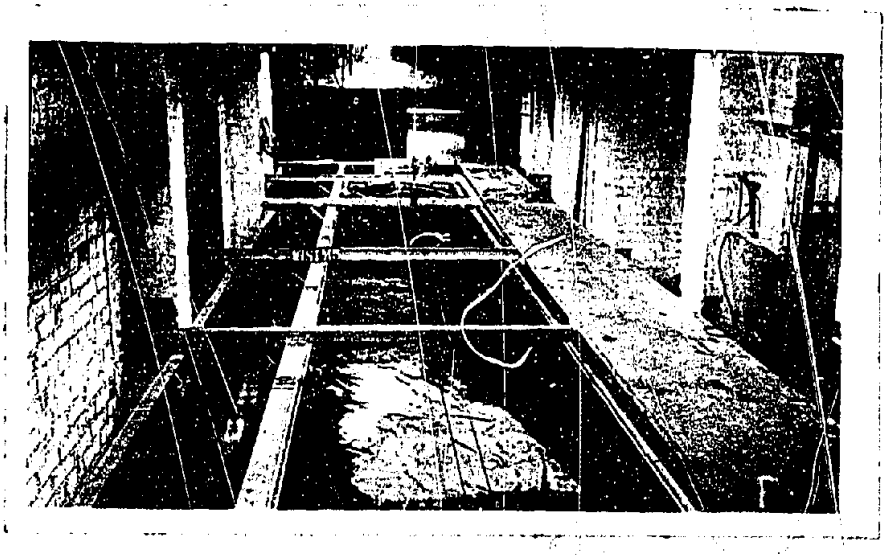
As a further precaution, four types of priming tubes were built into the orifices, and investigated in connection with the plugging tests. They were found to assist somewhat in the clearing of the orifices, but were not essential. Those pipes may be seen in photograph C.

The force required to move the scraper was measured in the model, but because of the small size of the model and the abnormal conditions of operation -- heavy deposit of silt, and short distance of travel -- the results were inconsistent and were not felt to be indicative.

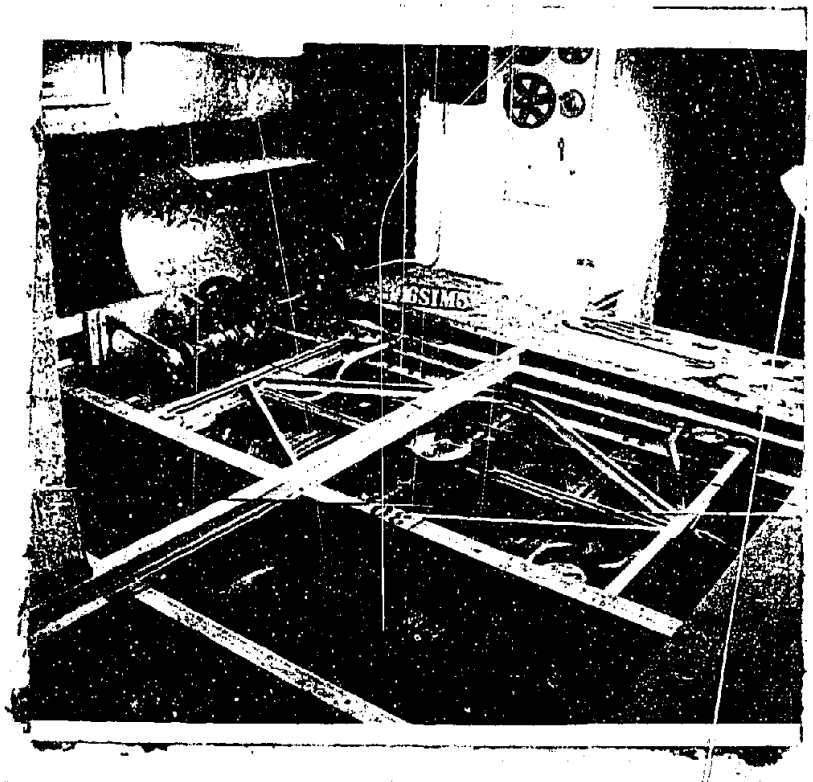
FULL-SIZE MODEL.

After the small model had shown the feasibility of the silt disposal scheme, it was thought that a larger scraper -- a 1:1 model of part of a scraper -- would be of value in showing the power required for scraping.

The full size model consists of a carriage running on I-beam rails placed above a 35 ft. long tank; a 4 ft. long scraper, 20" high, is suspended below the carriage, and reaches to within an inch of the bottom of the tank. A sideboard at each end of the scraper confines the scraping action to the 4 ft. wide strip covered by the scraper. The carriage and scraper are moved forth and back in the tank by a cable winding on a drum which is driven by a 3 hp motor. The drum is driven through gears which may be varied to give 4 speeds of the carriage from 5 to 42 ft. per minute. The pull on the carriage was measured by a 3,000 lb. Chatillon spring dynamometer.



View along tank showing rails and scraper carriage in background. Diagonal scraper in place.



Close-up of scraper carriage and pulling mechanism.

1:1 SCRAPER MODEL

TESTS AND RESULTS.

The floor of the tank was covered with silt which was scraped smooth at the level of the bottom of the scraper blade. More silt was then dumped between the sideboards of the scraper, the scraping blade was clamped 1/2-inch above its lowest position, and then pulled along the tank. Thus, silt was spread in a layer 1/2-inch deep. The scraper blade was then removed, and replaced at the front end of the sideboards, with its lower edge down to the lowest position. Everything was now ready for a run; as the scraper was pulled along, the 1/2-inch layer of material was gradully accumulated in front of the scraper blade. Time, distance, and pull were measured at frequent intervals and recorded.

This procedure was followed for speeds of 5, 16, 27, and 42 feet per ~~second~~ minute, and for silt depths of 1/2, 1, and 1-1/2-inch.

Results of tests made with this scraper do not warrant any conclusion regarding power requirements at present; many variables seem to enter into the problem and much more work will be required. Ultimately, these tests should enable accurate estimates of power, and should materially improve the design.

DIAGONAL SCRAPER

The above described scraper has been replaced by an 8ft. long scraper which can be set at various angles to the line of travel. This scraper represents one of a group of scrapers to be mounted on a radial arm in a round tank. Rotation of the arm works the settled silt toward the center of the tank, where it is sluiced out.

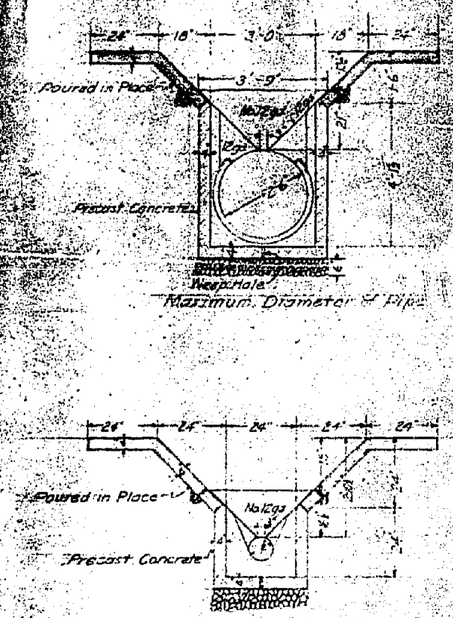
TESTS AND RESULTS.

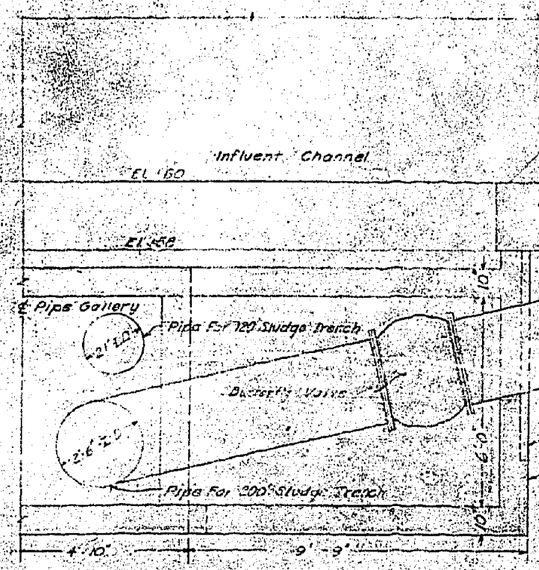
For the diagonal scraper tests, the bed of silt on the floor of the tank was levelled by the scraper, and the excess silt removed. A windrow of silt was then dumped along the tank, somewhat away from the center-line. The scraper blade was then pulled along the tank, displacing the silt as it progressed, in the manner of a snow-plow. During all tests the silt was completely submerged.

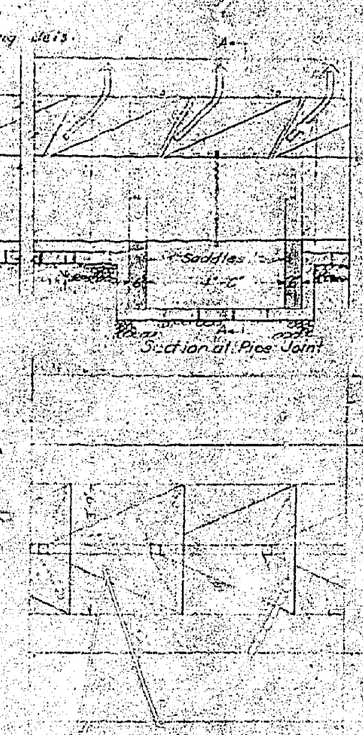
Measurements were made of the speed of the scraper, the force required to pull it, the shape and size of the silt windrow, and the path of the silt. The path of the silt was observed by burying a small pebble to which was attached a thread and a cork float, in the windrow, and observing its position before and after the scraper passed.

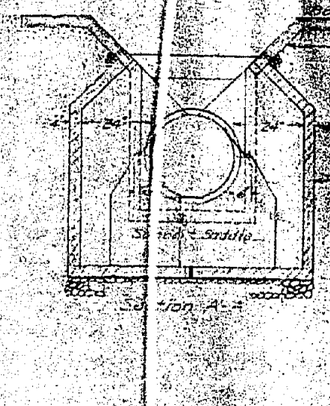
These tests will yield data about the force required to pull the scraper at various speeds and with various amounts of silt, will indicate which scraper angle is the best, and will thus make possible an estimate of the power requirements for this type of desilting plant.

COLORADO RIVER
N
Mass concrete dam
Top El. 192.0
Note: Upstream sheet piling ties into rock at both ends of Dam. Downstream piling ties into rock at east end only.
REINFORCED CONCRETE OVERFLOW DAM - 752' LONG
35' Steel sheet piling
20' Wooden sheet piling
6" Concrete slab El. 154.0
Note: Bottoms of intake canal, Outlet channels and all levees except those of All-American canal and others indicated are paved with 6" gravel and 12" rock riprap. All levee slopes 1½:1
Right bank
Possible training wall of loose rock
20' Wooden sheet piles
Center of sludge pipe outlets El. 161.0
Four sludge pipes
9" Conc. slab
Training wall of loose rock
Sluiceway - 6 gates 7'x16' - Sill El. 162.0
Capacity 12,000 c.f.s., W.S. El. 180.0
24' Wooden sheet piling
Intake - 6-21'x5.5' Radial gates
Capacity 15,000 c.f.s., El. 311.7±0
Trash rack, Top El. 190.0
Fill, covered with 12" riprap
Top of Riprap El. 171.0
Rock dump levee to El. 190.0
Note: over flow earth dam
Concrete face
INTAKE
CANAL
TANK No. 1
TANK No. 2
TANK No. 3
TANK No. 4
Sludge trenches
Pipe gallery
Stilling pool
Spillway
Capacity 3000 c.f.s.
TANKS NOT ADDED
POSSIBLE FUTURE CONSTRUCTION
ALL-AMERICAN DAM - 4,000' LONG
IMPERIAL DIVERSION DAM





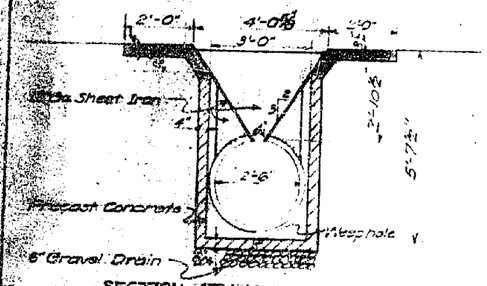




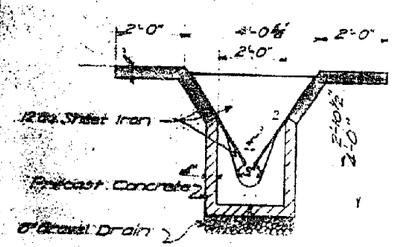
Note: Similar sludge collection scheme to be used on PLAN NO. 2.

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BOULDER CANYON PROJECT
ALL-AMERICAN CANAL SYSTEM - CALIFORNIA
IMPERIAL DAM AND DESILTING WORKS
PLAN NO. 1
SLUDGE TRENCHES

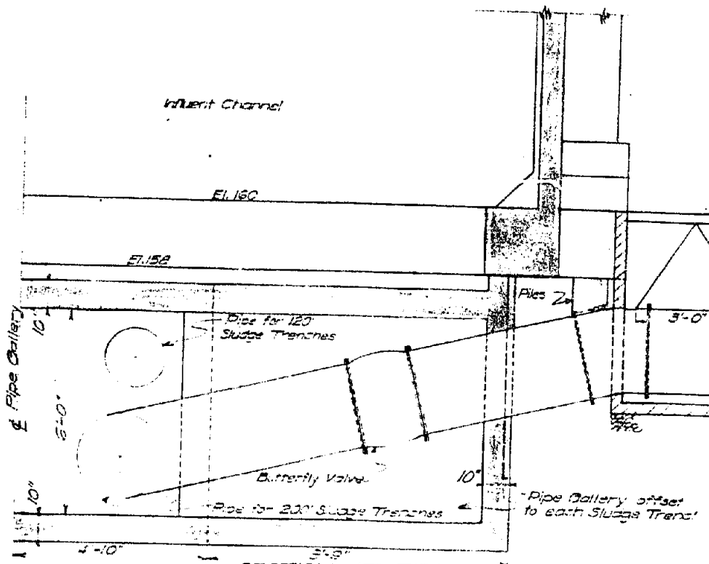
SUBMITTED:
RECOMMENDED:
APPROVED:
DATE: JULY 1934



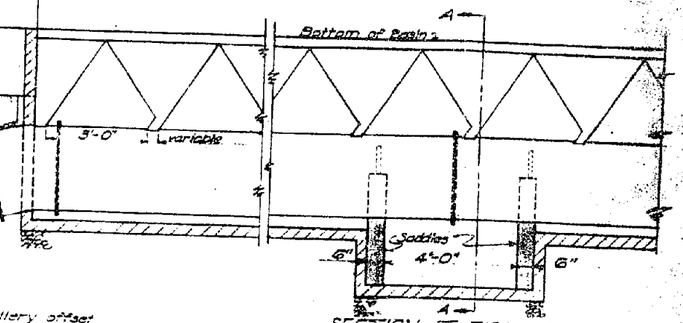
SECTION AT MAXIMUM DIAMETER OF PIPE



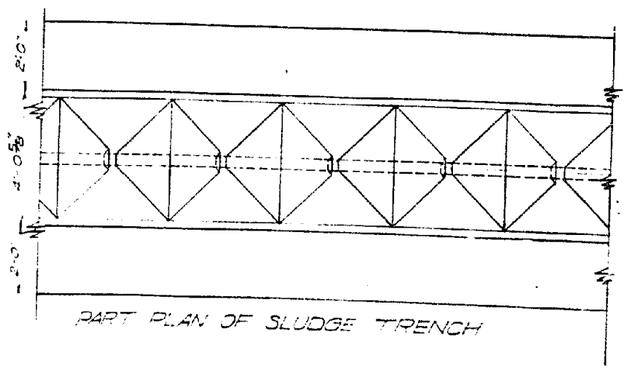
SECTION AT MINIMUM DIAMETER OF PIPE



SECTION AT PIPE GALLERY



SECTION AT PIPE JOINT



PART PLAN OF SLUDGE TRENCH

Scale in Feet

1 2 3 4 5 6 7 8 9 10

ALL AMERICAN
IMPERIAL
PLAN
SLUDGE
Drawn: A.J.L.
Traced:
Checked:

MEMORANDUM TO CHIEF DESIGNING ENGINEER
(J. B. Drisko, Assistant Engineer)
(Under direction of E. W. Lane,
Research Engineer)

Subject: Progress Report.

Progress Report - Model Studies of Uplift Pressure under the proposed Imperial Dam.

There is now under construction in the Denver hydraulic laboratory of the Bureau, a 1:50 scale model of a section of the proposed Imperial Dam, which will be used to investigate the uplift pressures under the dam. The model will be placed on a pervious foundation of material brought from the Imperial site; the pressure at points well beneath the dam and upward pressures on the dam and apron will be measured by a group of about 1126 piezometers placed at critical points in the pervious material. Seepage quantities will be measured for various conditions of headwater and tailwater.

Permeability measurements of material from the Imperial site will also be made, in order to enable prediction of the amount of seepage to be expected under the actual dam.

The parallel and supplementary studies made with the electric analogy equipments are an interesting phase of the model work. The analogy equipment was used to determine the proper dimensions of the model, and will be used later to check the results of the seepage tests.

Progress Report - Model studies of Sluice Gates for the Imperial Dam.

A 1:40 scale model of the proposed sluice gates for the Imperial Dam, according to plan S-3, with radial gates, has been constructed in the Denver hydraulic laboratory of the Bureau, and is ready for testing. A casual test has shown the design to be eminently satisfactory. Further studies will determine the permissible shortening of the downstream apron, will show what type of sill or baffle, if any, is needed on the apron, and will furnish useful data regarding flow through the gates, coefficients of discharge and so forth.

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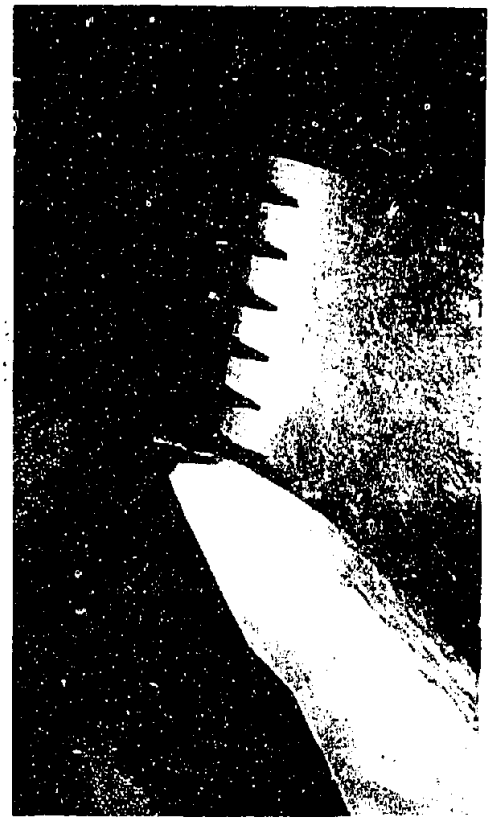

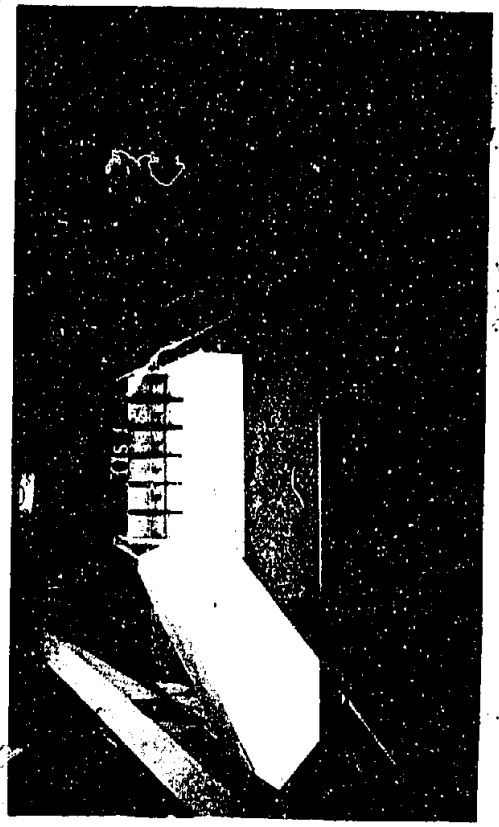

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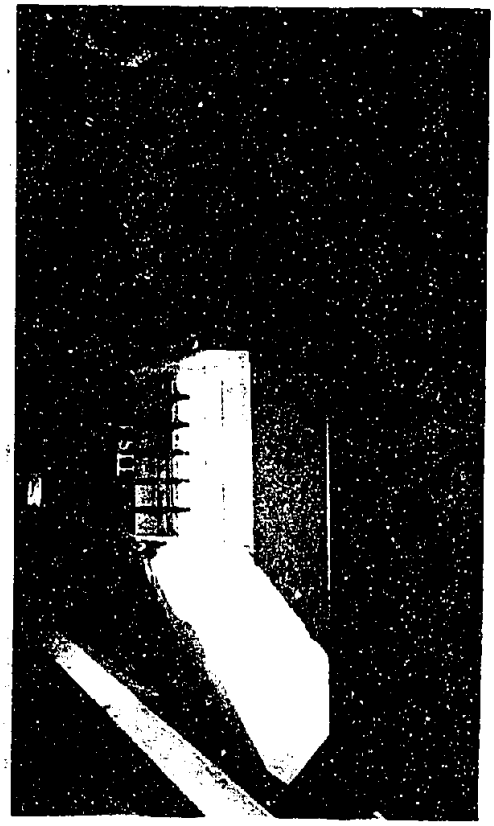
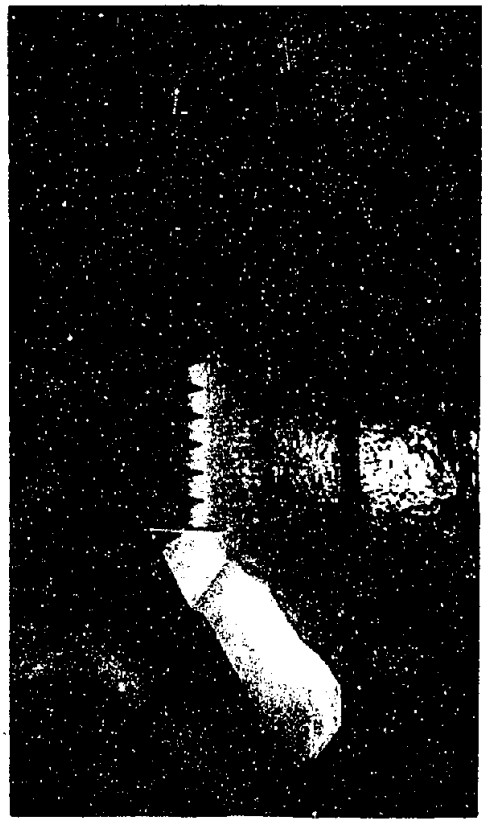


Model before run



ORIGINAL DESIGN ** IMPERIAL SLUICE GATES