

HYD 1411

BUREAU OF RECLAMATION  
HYDRAULIC LABORATORY

**MASTER  
FILE COPY**

DO NOT REMOVE FROM THIS FILE

HYD-1411

**FILE COPY**

BUREAU OF RECLAMATION  
HYDRAULIC LABORATORY

NOT TO BE REMOVED FROM FILE

File

HYD-  
FILE COPY

Denver 2, Colorado, March 24, 1944.

BUREAU OF RECONSTRUCTION  
WASHINGTON, D. C. 20540  
NOT TO BE REPRODUCED WITHOUT PERMISSION

MEMORANDUM TO CHIEF DESIGNING ENGINEER:

(C. V. Adkins through J. E. Warnock)

Subject: Hydraulic model studies on the Mason City culvert intake - Columbia Basin Project, Washington.

1. In the original design of the Mason City culvert intake chute the vertical side walls converge from the upstream opening to the culvert transition through a reversed curve as shown on figure 1. The floor of the intake chute dropped from elevation 1318.00 at the entrance to elevation 1291.53 at the lower end. The transition from the chute to the culvert was approximately 11 feet long by 5.50 feet high. It varied from a rectangular cross section at its entrance to a parabola at its lower end.

2. The approach for about 70 feet upstream from the opening of the culvert intake was rubble masonry and of the same elevation as the intake crest. The water approached the intake at an angle of approximately 15 degrees to the longitudinal axis of the chute. The structure was designed to handle a flow of 1,000 second-feet at maximum flood conditions. To check this discharge capacity, a 1:30 hydraulic model was constructed in the hydraulic laboratory.

3. Tests with this model showed that the maximum capacity was 840 second-feet. At this discharge, water piled against the side walls of the chute down to the point where the wall curvature reversed. At this point the water left the walls and flowed across the chute in longitudinal waves from both sides. The intersection of these waves caused a fin of water in the center of the chute and resulted in water piling up against the transition head wall. There was also violent whirling and choking in the transition. At discharges above 840 second-feet, water flowed over the transition head wall and the chute walls just above the transition.

4. Experiments to correct the undesirable conditions resulted in a change in the chute design. The reversed curvatures of the chute walls in the first design were replaced by tangents between two curves, different ones at the chute entrance and the same curves as in the original design at the lower end of the chute. The tangents formed an angle of 7 degrees 47 minutes with the longitudinal axis of the chute. The chute head wall at entrance was not raised in the laboratory, but it was recommended that it be raised one foot to provide more free board as shown on figure 2.

5. In the new design the longitudinal waves were greatly minimized. Since the flow was not parallel to the longitudinal axis of the chute, the waves and resulting fin of water in the center could not be completely eliminated. Some whirling still remained in the transition. A flow of 1,000 second-feet was passed through the structure without any flow over the

transition head wall or the chute side walls. The transition and culvert both flowed full at 1,000 second-foot discharge.

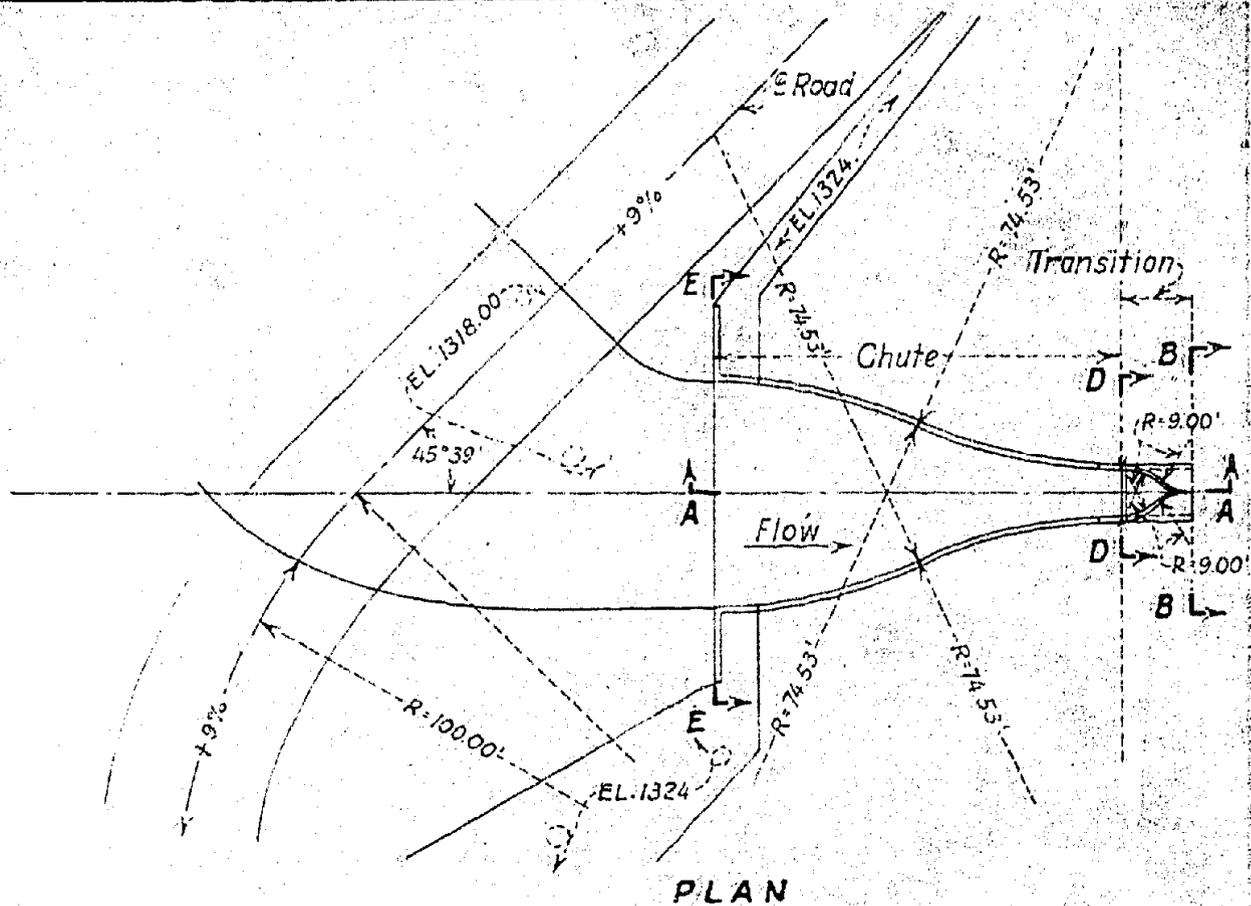
6. The transition was not actually changed in the laboratory. However, for the purpose of improving entrance conditions, it was recommended that the transition roof be raised at the entrance to a height of 7.80 feet above the floor. The roof would drop from this height through a vertical curve to 5.50 feet at the lower end. The parabolic section at the lower end was to remain the same as in the original design.

7. Figure 3 represents the water surface profile from the crest of the chute entrance to a point 100 feet upstream.

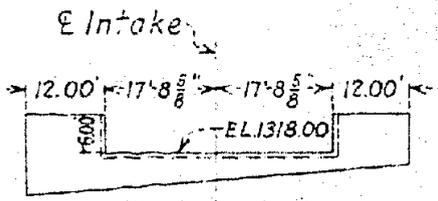
- - -

C. V. Adkins

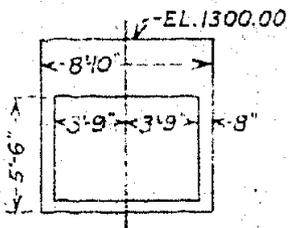
J. E. Warnock



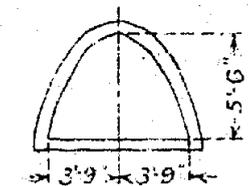
PLAN



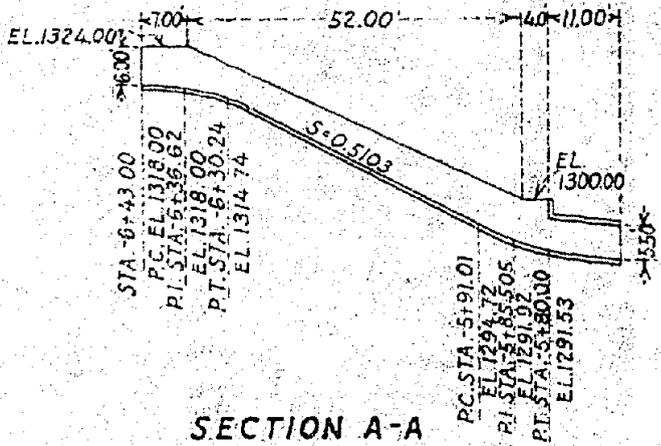
SECTION E-E



SECTION D-D

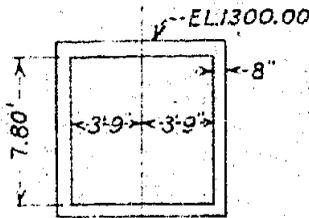
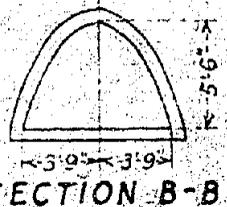
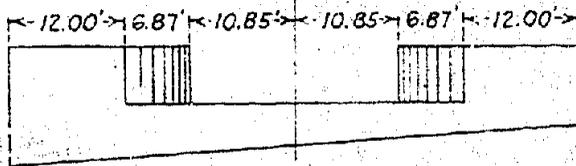
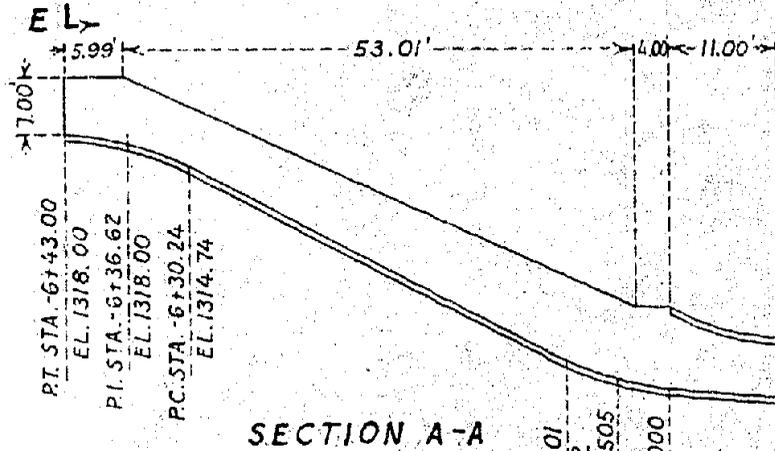
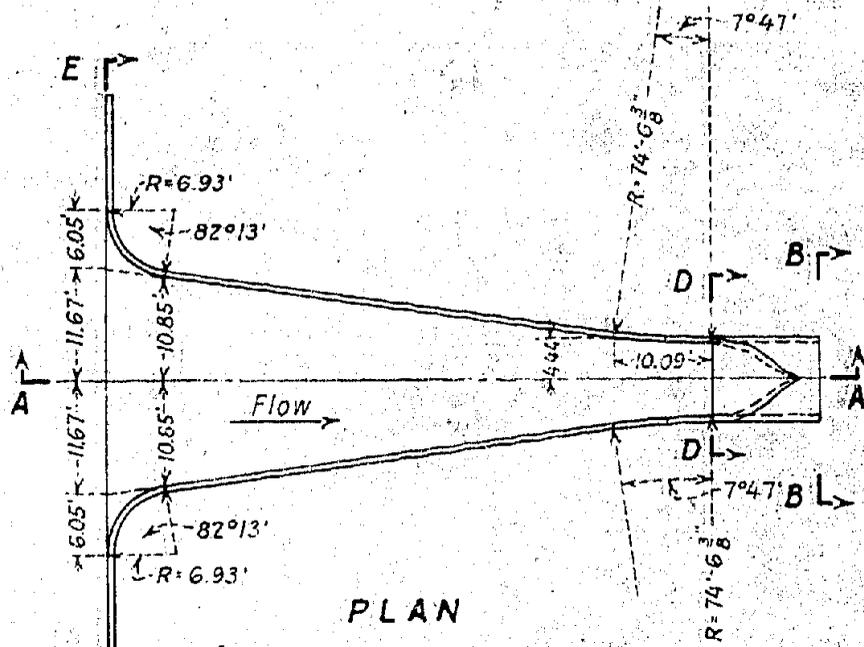


SECTION B-B

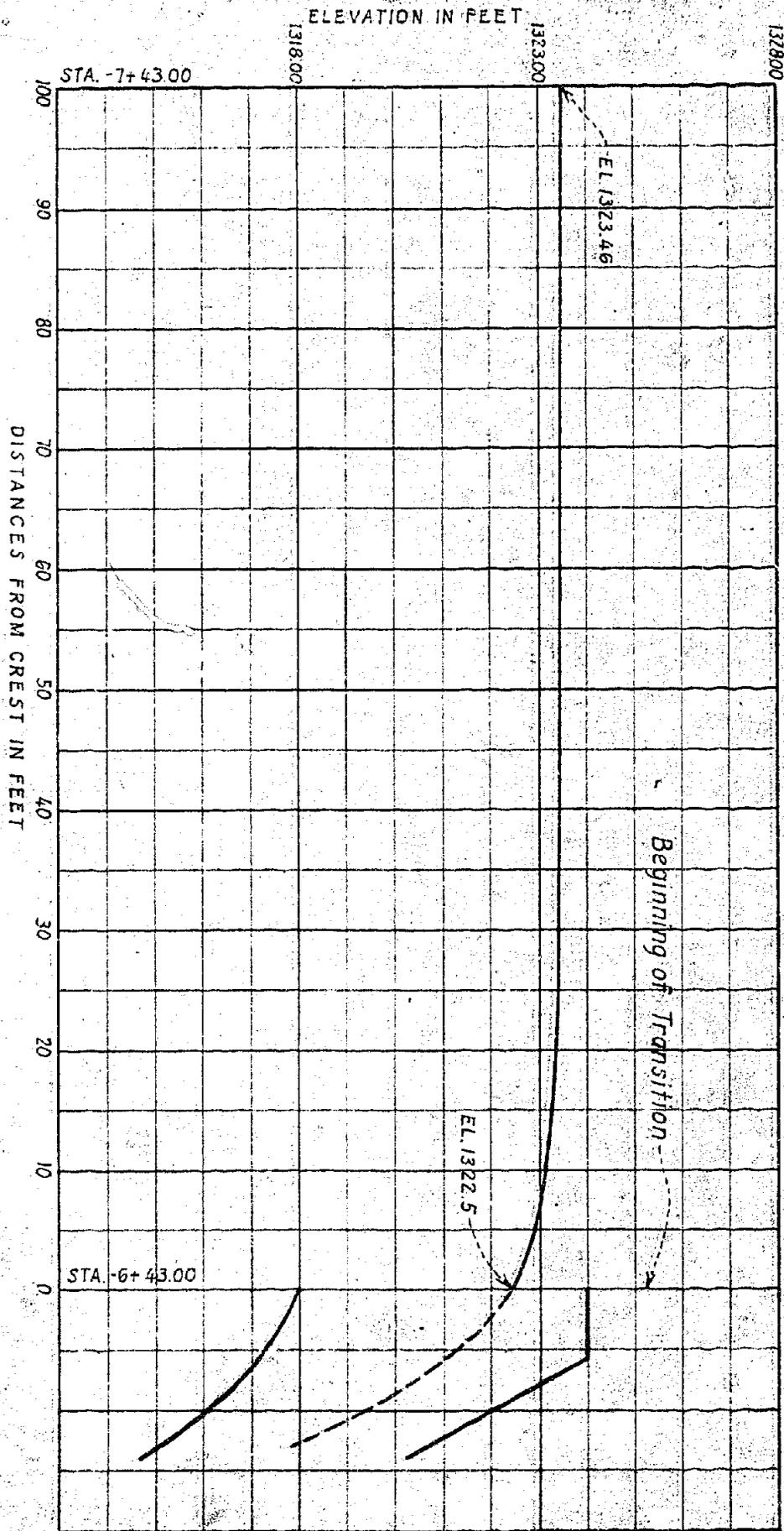


SECTION A-A

COLUMBIA BASIN PROJECT  
 MASON CITY CULVERT INTAKE  
 ORIGINAL DESIGN  
 FEBRUARY 16, 1944



COLUMBIA BASIN PROJECT  
**MASON CITY CULVERT INTAKE**  
 REVISED DESIGN AS DETERMINED  
 FROM A 1:30 HYDRAULIC MODEL  
 FEBRUARY 16, 1944



COLUMBIA BASIN PROJECT  
**MASON CITY CULVERT INTAKE**  
 WATER SURFACE PROFILE FOR REVISED DESIGN  
 AS DETERMINED FROM A 1:30 HYDRAULIC MODEL  
 FEBRUARY 16, 1944