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Bureau of Reclamation

INFORMATIONAL ROUTING

Memorandum

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Additional tests on the louver fish screen model--Delta-Mendota Canal headworks, California

The tests reported in this memorandum were performed at the request of A. W. Kidder and J. A. Wineland to further define some of the hydraulic characteristics of a louver-type fish screen. These studies are a continuation of the tests that were discussed in the memorandum of January 29, 1954.

AUTHOR

The specific purpose of the tests was to determine the head loss across the louver system for different values of the angle between the line of louvers and the direction of flow and of the angle between the louver slat and the direction of flow, Figure 1. The angle of the line of louvers with the direction of flow was measured in a clockwise direction and will be referred to as the angle α. The angle of the louver slats with the direction of flow was measured in a counterclockwise direction and will be referred to as the angle ϕ. The head loss is expressed in terms of the velocity head based on the average velocity about 5 feet upstream from the line of louvers.

In making the head loss measurements a predetermined discharge was turned into the test flume and the flow depth adjusted with a tail gate so that the depth at the upstream measuring station was 17-3/4 inches, which was slightly less than the height of the model louvers, the elevation of the water surface at the downstream measuring station was then obtained. The upstream measuring station was located at a point corresponding to 5 feet upstream from the start of the line of louvers, similarly the downstream station corresponded to a point 5 feet downstream from the end of the line of louvers. A louver system was next placed in the flume and the upstream water surface adjusted until it was at the same elevation as before, the elevation of the downstream water surface was then determined. The difference or change in elevation was recorded as the head loss for the louver system being investigated. This method of determining the magnitude of the loss, which eliminates channel loss, was the same for all of the louver installations.

The results of the tests have been plotted on Figure 1 as the head loss in velocity heads versus the angle ϕ for four values of angle . The curves show that when is less than 30° the

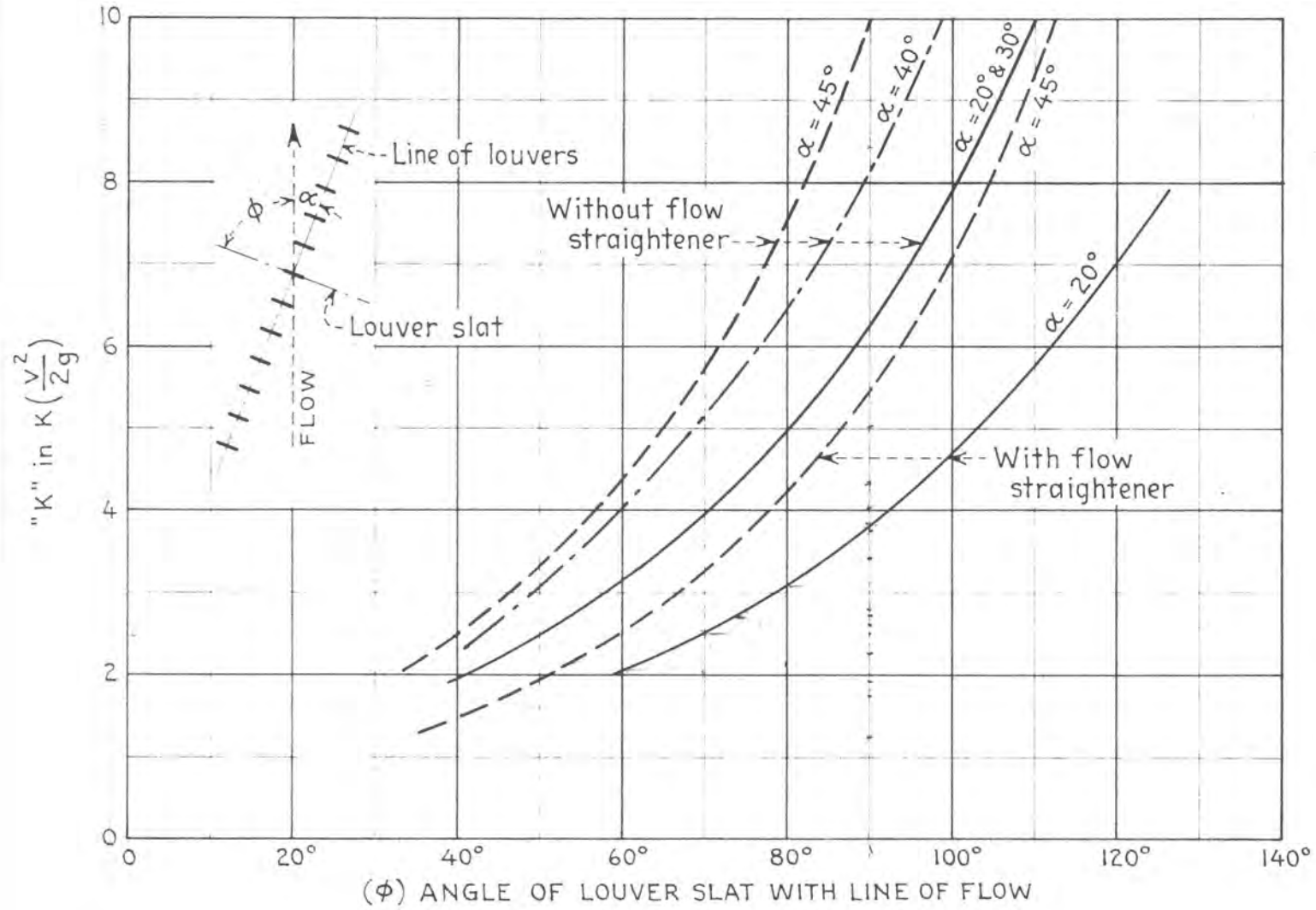
head loss is a function only of angle ϕ. However, as the angle increases above 30°, the loss for any particular value of angle ϕ increases very rapidly. As an example take a value for angle ϕ of 90° where the head loss at angle α of 20° and 30° was about 6.3 velocity heads, when angle α was increased to 40° the loss becomes 8.2 velocity heads and with α equal to 45° the loss was 10 velocity heads.

The greatly increased loss when angle α becomes greater than 30° was thought to be a function of the relative position of adjacent louver slats, Figure 2. The head loss seemed to vary inversely with the ratio B/A, where "B" is the length of slat that is overlapped by the adjacent slat upstream, dimension "B" on Figure 2, and "A" is that portion of the slat that is directly exposed to the flow, dimension "A" on Figure 2. The line-of-louvers that was used for ϕ = 90° and α = 40° had a ratio B/A equal to 1.71 and a head loss of 8.2 velocity heads, when this line-of-louvers was modified so that the ratio was 2.65 the head loss dropped to 6.5 velocity heads, which compared favorably with the head loss when angle α was less than 30°, Figure 2.

For expediency in the model construction and testing all of the above tests were made without flow straighteners on the downstream side of the louvers. In order to substantiate the value of the flow straighteners another series of tests were performed with flow straighteners on the line-of-louvers at α's of 20° and 45°. The flow straightener used at α = 20° was the one described in the January 29, 1954, memorandum and consisted of a straightening vane for every eight louver spaces, the flow straightener for α = 45° also consisted of a vane for every eight louver spaces. The results of these tests were similar to those described in the previous memorandum in that the head loss was reduced approximately 40 percent, Figure 1. Although no investigation was made on the use of a flow straightener at α = 30° the fact that the loss curves for α = 20° and 30° are identical for the louvers without flow straighteners suggests that they would remain the same after the straightener is added.

The February 1954 activity report from the Construction Engineer at Tracy, California, gives the results of tests performed in their testing flume in which a flow straightener design based on the January 29, 1954, memorandum had been installed. The report states that "the problem of head loss still exists, but it is

believed by the engineers that this can be reduced. It should be pointed out that the head loss problem is no more severe now than prior to installation of the vanes." With this installation there was a head loss of about four velocity heads. From the Figure 1 curves for a model installation similar to the Tracy set-up (ϕ = 90°, α = 20°) except that the straightening vanes were spaced one for every eight louver spaces the head loss is approximately 3.8 velocity heads, however when the straightening vanes were removed, leaving only the line-of-louvers, the loss was 6.2 velocity heads.

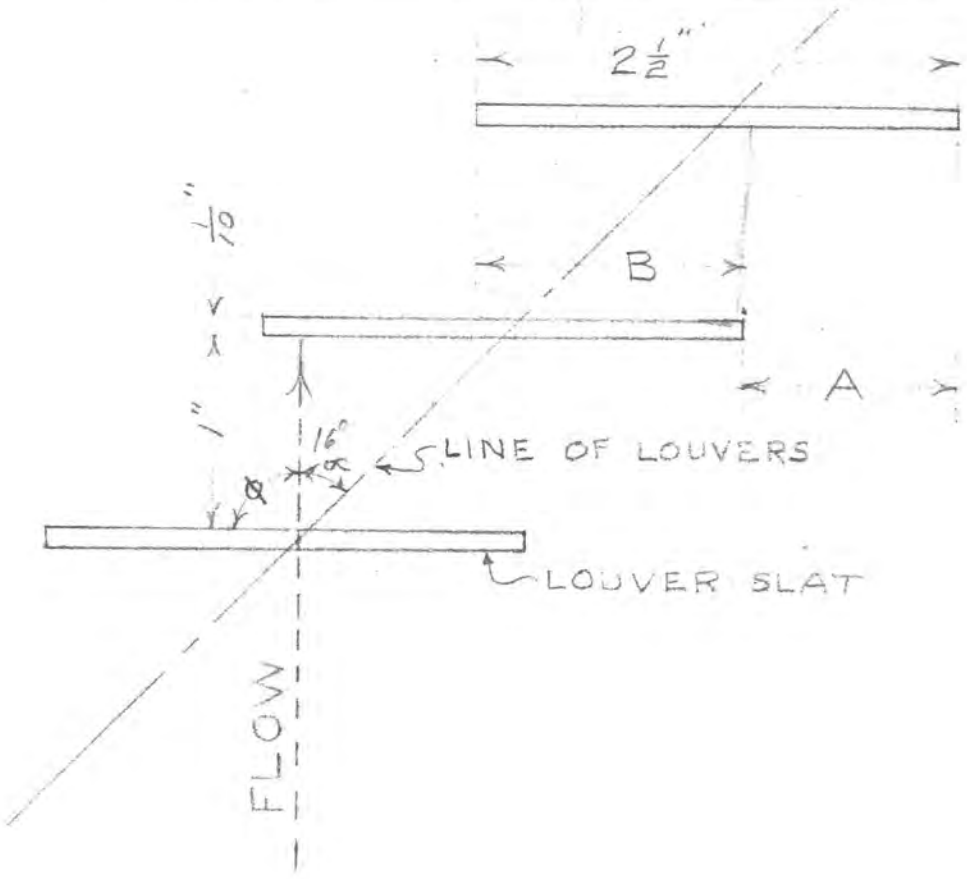


LOUVER FISH SCREEN
HEAD LOSS STUDIES

FIGURE 1

492

FIGURE 2



Φ	α	A	B	B/A	HEAD LOSS
90°	20°	0.40"	2.10"	5.25	6.3 $\frac{V^2}{2G}$
90°	30°	0.64"	1.86"	2.93	6.3 $\frac{V^2}{2G}$
90°	40°	0.92"	1.58"	1.71	8.2 $\frac{V^2}{2G}$
90°	45°	1.10"	1.40"	1.26	10.0 $\frac{V^2}{2G}$
90°	40°*	0.92"	2.58"	2.65	6.5 $\frac{V^2}{2G}$

*SLAT LENGTH INCREASED TO 3½"

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