THE ECONOMICAL TOP WIDTH OF NON-OVERFLOW DAMS.

A PAPER to be presented before the American Society of Civil Engineers on January 5th, 1916, by Mr. Wm. P. Creager, treats of the most economical width of top of the commonly accepted type of section of solid, gravity, non-overflow dams. The writer believes it to be the general opinion of engineers that the section with a zero top width, namely, a triangular section, contains the minimum area consistent with fixed assumptions; and that the adoption of a definite width of top for a roadway or other purpose is made at a sacrifice of economy. Presumably, for this reason, many dams have been built with tops as narrow as 5% of the height. This investigation, however, shows that the most economical width of top for usual designing assumptions is not zero, but lies generally between 10 and 17% of the height, according to the assumptions used in the design. As the difference in the volumes of sections, having quite a wide range of top widths, is very small compared with the uncertainty of many of the designing assumptions, the paper may be considered of academic rather than of economic interest.

It is just this point in particular, however, which the writer brings out, namely, that his investigations, as far as they have been carried, indicate: (1) That there is little or no economy in the adoption of extremely narrow tops; and (2) that exceptionally wide tops may be used, if desired, with comparatively little sacrifice of economy.

The curves shown on Fig. 1 cover seven sections, designed under different assumptions. They indicate, for each the most economical width of top, in terms of height, and the relative areas of sections having other top widths. The assumptions used have been designated by letters, and are as follows:

Location of Resultant—

A.—Resultant, reservoir full, to intersect all horizontal joints at the exact extremity of the middle third; except near the top before the down-stream face departs from the perpendicular, where the resultant lies within the middle third.

B.—Same as *A*, except to intersect at a point within the middle third a distance equal to one-fifteenth of the width of the joint.

C.—Resultant, reservoir empty, to intersect all horizontal joints at the exact extremity of the middle third; except near the top, before the up-stream face departs from the perpendicular, where the resultant lies within the middle third.

D.—Resultant, reservoir empty, to have no influence on the design of the section.

Forces Considered—

E.—Weight of concrete; assumed specific gravity, 2.25.

F.—Weight of concrete; assumed specific gravity, 2.33.

G.—Horizontal component of water pressures.

H.—Vertical component of water pressures on the battered up-stream face.

I.—Horizontal silt pressure; silt assumed to be a liquid with a specific gravity of 0.64 in addition to the water pressure. Depth of silt five-tenths of the height of the section.

J.—Uplift on all horizontal joints. Total uplift assumed to be represented by a triangle, the unit uplift equal to five-tenths of the hydrostatic pressure due to the total head of water at the up-stream side diminishing uniformly to zero at the down-stream side.

Joint Pressures—

K.—Limited to 9 tons per sq. ft., at the down-stream face.

L.—Limited to 11 tons per sq. ft., at the up-stream face.

M.—Joint pressures not considered.

Up-stream Face—

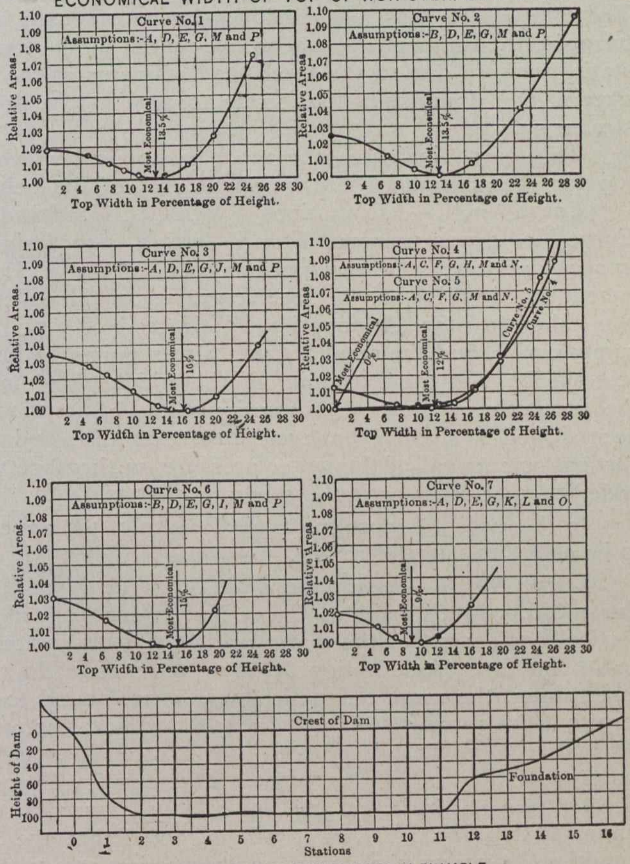
N.—Battered to conform to Condition *C* only.

O.—Battered to conform to Condition *L* only.

P.—Vertical throughout.

Curve No. 1.—Assumptions *A*, *D*, *E*, *G*, *M* and *P*: In starting the investigation of this subject, a design was made for a section 200 ft. high, with a top width of 10 ft. The assumptions used in the design are indicated by the letters. This section, or any part thereof, can be changed to suit other heights by simply changing the scale to which it is drawn, as all weights and forces vary as the square of the height, and both the moment of stability and the moment of overturning vary as the cube of the height.

ECONOMICAL WIDTH OF TOP OF NON-OVERFLOW DAMS.



PROFILE OF DAM SITE USED IN EXAMPLE.

Fig. 1.

All the dimensions of the top 40 ft. of this section were then multiplied by 2.5, resulting in a section 100 ft. high, with a top width of 25 ft. The area of the resulting section was then computed as being the area of a dam 100 ft. high, with a top width of 25% of the height.

The top 50 ft. of the original section was then multiplied by 2.0, resulting in a section also 100 ft. high, but with a top width of 20% of the height.

In this way a number of sections were produced, each 100 ft. high, but having different widths of top. The relative areas are plotted on Curve No. 1 as ordinates and the top widths in percentages of the height as abscissas.

It will be noted from this curve that the most economical top width of sections designed in accordance with these assumptions, is about 13.5% of the height.