Curve No. 2.—Assumptions *B*, *D*, *E*, *G*, *M* and *P*: Curve No. 2 was prepared in the same manner and under the same assumptions as adopted for Curve No. 1, except that the resultant, reservoir full, instead of intersecting all horizontal joints at the exact extremity of the middle third (Assumption *A*), was required to lie within the middle third a distance of one-fifteenth of the width of the joint (assumption *B*).

This curve, though slightly different in shape from Curve No. 1, also indicates the most economical width of top to be about 13.5% of the height.

Curve No. 3.—Assumptions *A*, *D*, *E*, *G*, *J*, *M* and *P*: Curve No. 3 was derived under the same assumptions as those governing the design of Curve No. 1, except that uplift (Assumption *J*) at all horizontal joints was included. The total uplift was 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.

This curve indicates the most economical width of top for these conditions to be about 16% of the height.

Curve No. 4.—Assumptions *A*, *C*, *F*, *G*, *H*, *M* and *N*: Curve No. 4 was prepared from a section, also designed in accordance with the assumptions used for Curve No. 1, except that in this case the specific gravity of the concrete was taken at 2.33 (Assumption *F*), instead of 2.25 (Assumption *E*), and the resultant was also required to intersect the base at the extremity of the middle third when the reservoir is empty (Assumption *C*). Assumption *C* necessitated a slightly battered up-stream face and the vertical component of the water pressure on this face was added to the forces acting (Assumption *H*).

In this case the most economical width of top appears to be about 12% of the height.

Curve No. 5.—Assumptions *A*, *C*, *F*, *G*, *M* and *N*: Curve No. 5 is the same as Curve No. 4, except that the vertical component of the water pressure on the battered up-stream face (Assumption *H*) was neglected. In this case, alone, the most economical width was found to be zero, but the curve is seen to be nearly horizontal between 0% and 14%, at the latter width involving an increase of material of only ½ of 1 per cent. This curve will apply directly to "Theoretical Type No. 2," by Edward Wegmann, M.Am.Soc.C.E., as it will be noted that the assumptions covering the design of the section are exactly the same as those used by Mr. Wegmann. It might be remarked here that the condition of requiring the resultant to lie within the middle third with reservoir empty is often omitted by engineers, a vertical up-stream face being adopted, unless a batter is required for the condition of limiting toe pressures.

Curve No. 6.—Assumptions *B*, *D*, *E*, *G*, *I*, *M* and *P*: Curve No. 6 was based on the assumptions used in preparing Curve No. 2, except that in this case silt pressure (Assumption *I*) was included. The silt pressure was assumed to be a liquid with a specific gravity of 0.64 in addition to the water pressure, and its depth was assumed as five-tenths of the height of the section.

On account of the silt pressure, the expedient of changing the scale, resorted to in computing previous curves, would apply from the top of the dam to the surface of the silt only. The rest of each section had to be computed separately for each point on the curve.

Assumption *I* seems to lead to a slightly larger economical top width appearing on the curve to be about 15% of the height.

Curve No. 7.—Assumptions *A*, *D*, *E*, *G*, *K*, *L* and *O*: Thus far there has not been taken into consideration the condition of limiting joint pressures (Assumptions *K* and *L*). Curve No. 7 is based on these assumptions. In other respects the assumptions used were the same as for Curve No. 1.

On account of Assumptions *K* and *L*, the expedient of changing the scale, resorted to in computing Curves Nos. 1 to 5, would apply only from the top of the dam to the elevation at which the limiting joint pressures began to govern the design. The rest of each section had to be computed separately for each point on the curve.

The vertical component of the water pressure on the battered up-stream face (Assumption *H*) was neglected in order to simplify the calculations. A comparison of sections 200 ft. high was also used in computing Curve No. 7.

For this curve the most economical width was found to be about 9% of the height. In all probability, to include in the calculations the vertical component of the water pressure on the battered up-stream face would increase the most economical width, as it was seen from Curves Nos. 4 and 5 that it resulted in an increase from 0 to 12 per cent.

Method of Application.—It must be remembered that the curves apply only to dams of constant height throughout their length. In order to obtain the greatest economy, the top width, theoretically, should be a fixed percentage of the height at any point. As a varying width of top is objectionable, for many reasons, a constant width should be adopted which will be somewhat less than that corresponding to the most economical for the maximum height, the amount of such reduction depending on the relative quantity of material contained in that portion of the dam less in height than the maximum.

In order to indicate the amount of such reduction the writer has designed a dam for the profile indicated on Fig. 1 in accordance with the assumptions used in computing Curve No. 3, and found the most economical top width for this dam to be 14% as compared with 16% indicated on Curve No. 3 for the maximum section (100 ft.).

This indicates that very little reduction in top width is necessary unless the variation in height of dam at different points along the profile is considerable.

Conclusion.—The assumptions used herein cover in a general way most of the important conditions usually considered, with the exception of ice thrust. However, as the consideration of overturning force in addition to the water pressure seems to increase the most economical top width, as in the case of uplift and silt conditions (Curves Nos. 3 and 6); and as the consideration of ice thrust, in itself, increases greatly the top part of the section, it seems logical to assume that an economical top width for ice thrust condition would be at least as great as that indicated in Curves Nos. 3 and 6.

It is believed, therefore, that, except for Curve No. 7 (which, however, would probably have been similar to the rest if the vertical component of the water pressure had not been neglected), practically no economy results in selecting a top width for dams of practically uniform height less than about 14% of the height; and that, for some designing assumptions, a width of even 17% involves no sacrifice of economy.

It is true that the assumptions on which these conclusions are based do not consider sliding or vertical shear. It is believed, however, that cases where these considerations affect the shape of the section are the exception rather than the rule. Moreover, in the light of these investigations, as far as they have gone, it is hard to say whether these conditions would require a smaller or a larger top width than indicated in the curves.