ESSENTIAL ELEMENTS IN THE DESIGN OF DAMS.

JOHN S. FIELDING, C.E., TORONTO.

ARTICLE VIII.

Table A gives the values of area, weight, adhesion S.S.F. stability mom. and O.S.F. for Fig 24ª (similar to Fig. 24 shown on page 208), for dams having a height of ten feet, with bases varying from two feet to ten feet.

The area varies from 10 to 50 square feet.

The weight varies from 1,400 to 7,000 pounds.

The adhesion varies from 910 to 4,500 pounds.

The S.S.F. varies from .2912 to 1.4552.

The stab. mom. varies from 1,866 to 46,666 ft. lbs.

The O.S.F. varies from 1.78 to 3.628.

The pressure on the face remains constant at 3,125 lbs.

Table B we omit at present because it deals with Fig. 25, which takes account of the vert. pressure of the water.

Table C gives values of Fig. 26ª (similar to Fig. 26 on page 207), and the variation in the values may be seen by reference thereto.

Table D gives variation of values in section Fig. 28 which, with dc or ae equal to 1 ft., or 2 ft., approaches very nearly to a scientific profile section, but changes as dc or ae is increased, until the section corresponds to Fig. 26. In this table the width of base ab equals bc in all instances, the variation being in the width of top dc and height of back face ae.

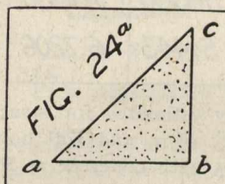

TABLE A.

bc = 10 FT. WEIGHT OF CONCRETE = 140 lbs. COEF. FRICTION = .65

PRESSURE = bc^2 x 31.25 = 3125 lbs. OVERTURNING MOM. = 10416 FOOT LBS.

VALUE OF ab	2 FT.	3 FT.	4 FT.	5 FT.	6 FT.	7 FT.	8 FT.	9 FT.	10 FT.
AREA, SQ. FEET	10	15	20	25	30	35	40	45	50
WEIGHT IN LBS.	1400	2100	2800	3500	4200	4900	5600	6300	7000
ADHESION IN LBS.	910	1365	1820	2275	2730	3185	3640	4095	4500
S.S.F.	.2912	.4368	.5824	.728	.8736	1.0192	1.16486	1.3104	1.4552
STAB. MOM.	1866	4200	7466	11666	16800	22800	29866	37800	46666
O.S.F.	.178	.4032	.658	1.120	1.6128	2.188	2.866	3.628	4.482

O.S.F.

In any solid profile the overturning stability increases rapidly as the sliding safety-factor is increased.

The overturning stability and the stability against sliding are nearly uniform in a rectilinear section with a base of .4 of the height. As will be seen by reference to Table C, however, the safety factors O.S.F. and S.S.F. are very small.

The O.S.F., given is with fulcrum at the toe of dam, and as a heavy pressure cannot be delivered to a knife-edge in this manner, a fixed amount should be taken from all values of O.S.F. given, and if this were done, the section with base .5 of the height, would more nearly fulfil the conditions for equality of O.S.F. and S.S.F. for a rectilinear section.

Now, such a section would require to be carefully built, since it would have a very limited amount of excess strength, and it would become very desirable to secure close mathematical calculations for the stresses in such a wall, and to locate as nearly as may be done the point of delivery upon the sub-base of the overturning resultant.

Erratum on Page 209.

Adhesion = 65/100 = vertical pressure = 137,500 should be,

Adhesion = 65/100 (vertical pressure) = 137,500.

By reference to the table C it will be seen that the value of the O.S.F. increases rapidly from this point, until at section with base .9 of height, the O.S.F. is twice the S.S.F., and the need of close calculation for the overturning resultant decreases correspondingly until with a base, .8, .9, or 1.0 the height, no one would care anything about the resultant line of pressure.

With a satisfactory factor against sliding, any dam will be secure against overturning, and the use of extreme mathematical refinement in determining the section of a dam would appear to be a direct result of using too low a factor of safety against sliding.

In table C the underlined values only of S.S.F. can be considered satisfactory.

In table A none of the values of S.S.F. are satisfactory, and not until the base ab is equal to about 1.6 bc will the value of S.S.F. 2.329 be satisfactory.

In table D all excepting the first two figures have a satisfactory value of S.S.F., being 2.2 and over.

It will be noted that in all figures of table D, the base is equal to the height. The varying values of different proportions of width of base to height for each of these three figures from 28ª to 28ᵏ may be given at some future date, but would take up too much space for present article.

Efficiency of a Dam.

The efficiency of a dam depends mainly upon the site. In the Sodom Dam one pound of mass holds back 126 pounds of water. In the Periar Dam one pound holds back 1,260 pounds of water.

Once the site is chosen the Engineer has mainly to deal with pounds pressure on the face of the dam, since one mile of water against a dam will give precisely the same pressure as one foot.

Efficiency of a Unit of Mass.

Assume a dam to have a S.S.F. of 2, and a coefficient of friction of .65, then the efficiency of a unit of the mass will be represented by $\frac{200}{65} = 3.076$ to 1, i.e., 3.076 lbs. of mass being necessary to hold back one pound of pressure.

Now, any two designs of solid walls or profiles presenting a vertical face to the water, and having the same values of S.S.F. and coefficient, will show a similar ratio of 3.076 to 1 for efficiency of mass, so that any known rule for estimating the pressures in a mass of masonry does not in any way increase the efficiency of a unit of the mass.