Table of Values of the Coefficient c in Formula l cH Deducted from Actual Practice.

Values of c adopted: Class I., 15; Class II., 12; Class IA., 18. Boulder vs. gravel from 6 to 9.

No.	Class	Rivers Name	Work	Weir Type	H	l	$\frac{l}{c=h}$	Remarks
1	1	Ganges	Narora	B	13	145	11	At time of failure without rear apron.
		"	"	"	"	170	13	As originally constructed.
		"	"	"	"	200	15.4	As restored.
2		Jumna	Okhla	A	13	200	15.4	l=base of fore apron only
3		Chenab		A2	13	125	9.6	Previous to failure.
					"	200	15.4	l=contour less projection of rear curtain below puddle.
4		Jhilam	?	A2	10	160	16	Exclusive of deep rear curtain.
		"			"	223	22.3	Inclusive of deep rear curtain.
5	"	Indus	Jamrao	A2	8	123	15.2	Rear wooden piling included.
6	11	Sôn	Dehri	A	10	123	12.3	Contour of fore apron base without curtains.
7	'	Penner	Sangam	A2	10	110	11	Excluding wells } av. 13.3
					"	156	15.6	Including wells }
8	"	"	Adimapoli	A2	8.5	100	11.7	Excluding wells } av. 13
					"	122	14.3	Inclusive wells }
9	111	Nile	Assiut	Regulator	2 55	60.5	23	Including iron sheet piling.
10		"	Ibramiya	"	3 25	65.5	20	" " "
11		"	Zifta	"	13	200	15.4	" " "

(1) When failure took place, that portion of the rear apron which was puddled was carried away by cross currents. The weight is very deficient.

(2) The Okhla anicut has a horizontal base, without any

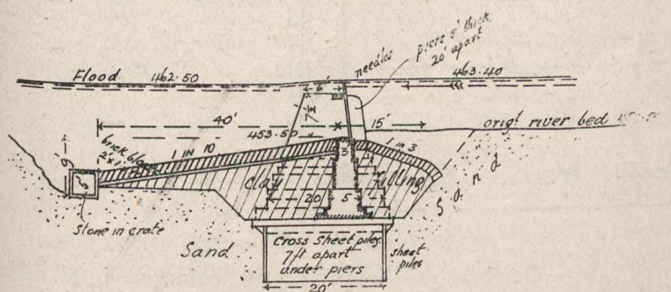

Fig. 23.—Sidnai Needle Weir.

vertical curtain projection whatever; rear apron not being stanch is omitted from count.

(3) This weir stood many years before actual failure took place.

(4) The very deep rear curtain is excluded as clearly superfluous.

(7 and 8) The circular wells used in the Madras Presidency are not strictly water tight curtains, and so a mean between the value obtained by their inclusion with that by their exclusion would fairly represent their actual value.

It will be seen that in cases 1 and 3, failure took place when l was reduced to about 10 H. The factor of safety in adopting 15, is, therefore, 1½.

An example of the design of a 20 foot high overfall weir on boulders and gravel formation was given in Engineering News, of October 1st. It is of the "Granite Reef" diversion weir. "Salt River" project, of which the Roosevelt dam is the main feature. This design, which has stood the test of actual trial, is extremely valuable as an object lesson, from which a reliable value for the coefficient c, for river beds formed of boulders and gravel can be deduced. The estimated length of creep amount to 84 feet, which divided by the head 20 feet gives a coefficient c=4.2. The peculiarity of the section consists in the floor being almost entirely relieved of hydrostatic pressure by spaces 3 inches wide, being purposely left between the 10 foot square concrete blocks which form the surfacing of the floor. This arrangement, by shortening the base length, effects considerable reduction in the pressure area on the drop wall. Such a device, however, would not be practicable when pure sand form the foundation, as it would inevitably be blown up through the interstices and washed away, causing the floor to collapse. The fore-curtain wall is likewise pierced by openings, with the alleged object of reducing the hydrostatic pressure below the weir by allowing the water a free passage. This idea is purely chimerical, the only possible effect of the openings will be simply to completely nullify the utility of the fore-curtain, as providing an additional length of creep. In the diagram of area pressure, the outlet not being quite free a reduced pressure of 1½ feet is allowed at the rear end of the floor, tapering to nil at the extremity.

In Fig. 25, while retaining the general characteristics of the original profile, the following modifications have been introduced:

1st. The safe value of c is taken as 6, the hydraulic grade is, therefore, 1 in 6, instead of 1 in 4, or 4.2 as formerly.

2nd. A rear apron 50 feet in length is provided.

This inexpensive increase in base length enables the section of the drop wall to be reduced, as not only is the upward hydrostatic pressure considerably lessened, but the horizontal water pressure is likewise reduced, the depth of water against the wall being 15 instead of 20 feet. In addition to this the base length of the solid part of the weir can now be lengthened from 32 to 40 feet, affording a much needed increase in this direction.

The thickness of the loose concrete slabs in the talus is increased from 1½ to 2½ feet for the first 30 feet of length

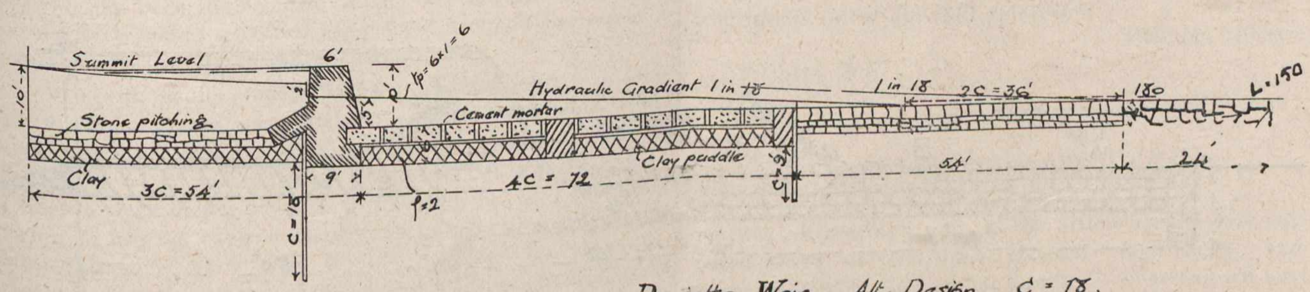

Fig. 22. Damietta Weir, Alt. Design C = 18.

C-18 H=10

(9) There is a doubt whether 2.55 metres represents the maximum possible head to which this work is subjected.

Deductions made from the above table are as follows:

For sands of Class I., c=15.4 (taken as 15), there being remarkable unanimity in this figure, and C the multiplicand of CH for AP works out as 100, as shown in paragraph 8.

For sands of Class II., c is a few points over 12, which latter value will be taken as the safe coefficient. The corresponding value of C in this case will be by deduction 75.

For the Nile Class I., c will be taken as 18, and for boulders and gravel c=from 6 to 9.

as the thickness of 18 inches given in the original is deemed decidedly insufficient for security.

The value of C of 4.2 or 4 is taken as a bais equlbrium value, for safety it should be increased to 6, as has been done in Fig. 25. We shall, therefore be justified in adopting this as a safe value for a boulder and gravel river bed, this practical example affording the necessary datum from which a reliable value for c can be deducted.

The alternative sections will cost less than the original and be much more stable.

(To be continued.)