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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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ABSTRACT OF "STUDIES OF CRESTS FOR OVERFALL DAMS," BULLETIN 3, PART VI - HYDRAULIC INVESTIGATIONS BOULDER CANYON FINAL REPORTS

by

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Denver, Colorado,
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UNITED STATES
DEPARTMENT OF THE INTERIOR
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Branch of Design and Construction
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Subject: Abstract of "Studies of Crests for Overfall Dams," Bulletin 3, Part VI, Hydraulic Investigations - Boulder Canyon Final Reports.

1. Introduction

Intermittently during the past ten years, experiments have been performed and material collected for Bulletin 3, Part VI, of the Boulder Canyon Final Reports entitled, "Studies of Crests for Overfall Dams." The studies were instigated in 1931 by Mr. E. W. Lane and have been continued periodically since that time as slack periods in the laboratory have permitted. The testing has been completed and a draft of the bulletin submitted to the editors, but publication will be postponed until after the national emergency. Since the information in this bulletin is in constant demand by this office, as well as other Government agencies, the more important figures, tables, and accompanying examples have been reproduced for limited distribution at this time. The following condensation contains only the most essential design information covered in the bulletin; therefore care is advised in its use.

2. Extent of material included in condensation

The principal phases of spillway design included in this abstract are as follows:

(a) Determination of the shape of overflow section required to fit the lower nappe of the overfalling stream for any practical condition of design. This will be the most economical as well as the most efficient shape of section on which subatmospheric pressures will be small or nonexistent. Sharp-crested weirs were tested in the laboratory, representing dam sections with vertical upstream faces, sloping upstream faces, and also with overhangs and offsets on the upstream face (types A, B, C, and D, respectively, figure 1).

(b) Study of deviations of nappe shapes due to velocity of approach. The variation of the nappe shape with the velocity of approach is illustrated in figure 2. Bazin covered a portion of this field, but his experiments were not sufficiently extensive to completely analyze this effect.

(c) Determination of the coefficients of discharge for dams with vertical, sloping, overhanging, and offset upstream faces.

This information was obtained from suppressed weirs, two feet in length, ground to a knife edge. The nappe-shape coordinates are expressed in terms of the total head on the weir, and other values are expressed in dimensionless terms wherever possible. The coefficients of discharge herein were computed from the total head above the high point of the lower nappe surface; thus they apply to the resulting ogee section and not to the weir proper.

3. Symbols

The following is a list of symbols as used throughout the bulletin with reference to figures 3, 4, and 5:

Q - Total discharge, second-feet.

q - Discharge per foot of crest, second-feet.

W - Width of test channel at gaging section, feet.

L - Length of test weir, feet.

A - Area of flow cross section at gaging section, square feet.

V_a - Average velocity of approach, feet per second.

h_a - Average velocity head of approach, feet.

h_s - Observed head above sharp crest of weir (measured at gaging station), feet.

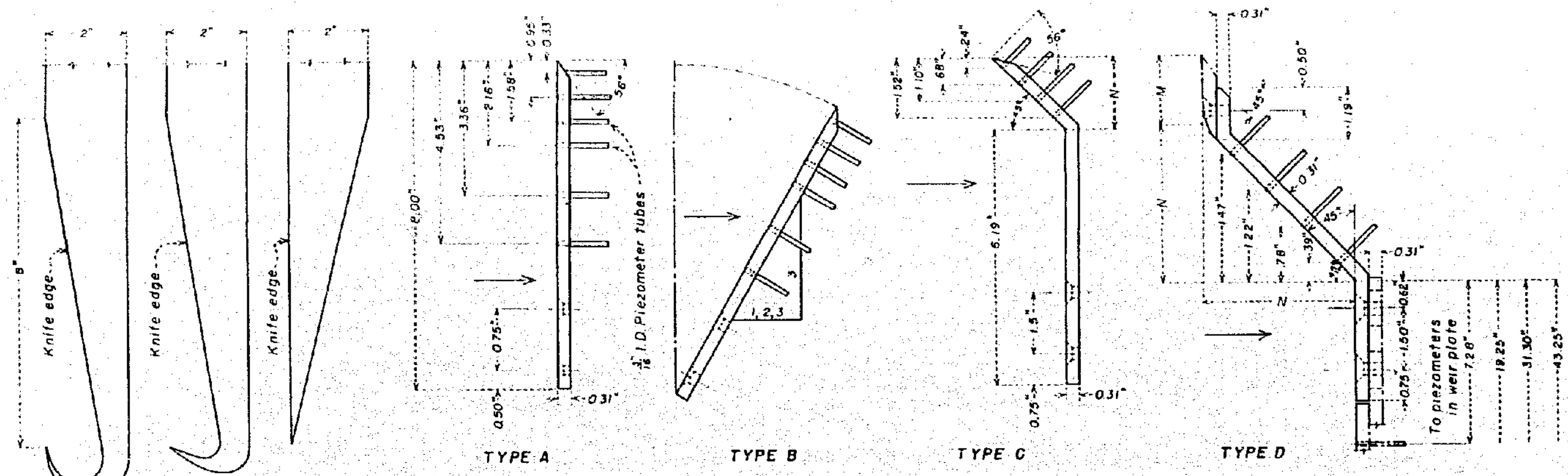
$H_s = h_s + h_a$ - Total head above sharp crest of weir, feet.

E - Maximum distance lower nappe rises above sharp crest of weir, feet.

h_o - Observed head above high point of lower nappe, feet.

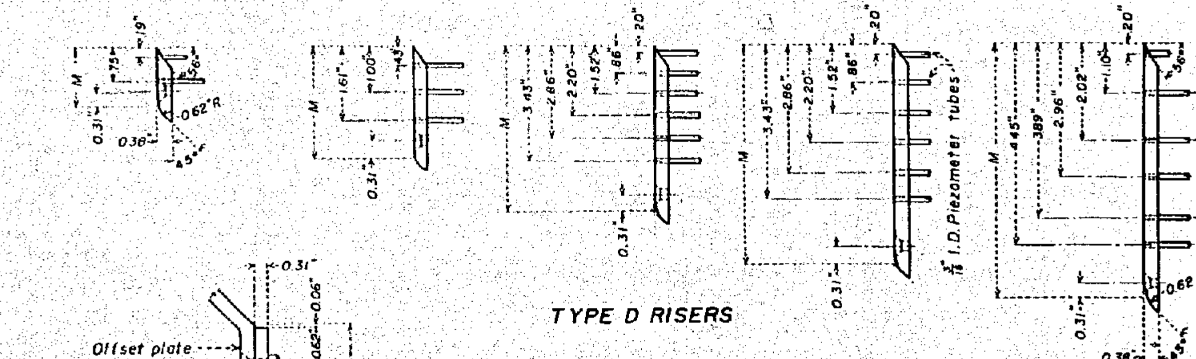
$H_o = h_o + h_a$ - Total head above high point of lower nappe, feet.

FIGURE 1



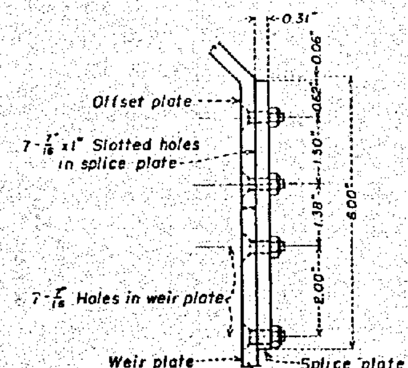
HOOK POINTS STRAIGHT POINT

TYPE A TYPE B TYPE C TYPE D



TYPE D RISERS

SECTIONS OF CREST TYPES



SECTION SPLICE PLATE

SUMMARY OF DIMENSIONS FOR TYPES C AND D

DIMENSIONS IN FEET

TESTS	M	N
70-1 to 75-4	0.078	0.156
76-1 to 79-4	.156	.156
80-1 to 85-6	.312	.156
86-1 to 93-1	.390	.156
94-1 to 100-1	.078	.312
101-1 to 106-2	.156	.312
107-1 to 109-4	.312	.312
110-1 to 115-6	.078	.078
116-1 to 120-2	.156	.078
121-1 to 131-1	.234	.078
132-1 to 141-1	.312	.078
142-1 to 149-1	.390	.078
150-1 to 159-1	0	.153
160-1 to 170-1	0	.076
171-1 177-1	0	.305

UNITED STATES
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BUREAU OF RECLAMATION
BOULDER CANYON PROJECT

BOULDER DAM HYDRAULIC EXPERIMENTS

DETAILS OF WEIR PLATES AND UPPER COORDINOMETER POINTS

DRAWN. O.S.Y. SUBMITTED
TRACED. E.F.J.-L.B.H. RECOMMENDED
CHECKED. APPROVED.
DENVER, COLORADO — JUNE 17, 1942

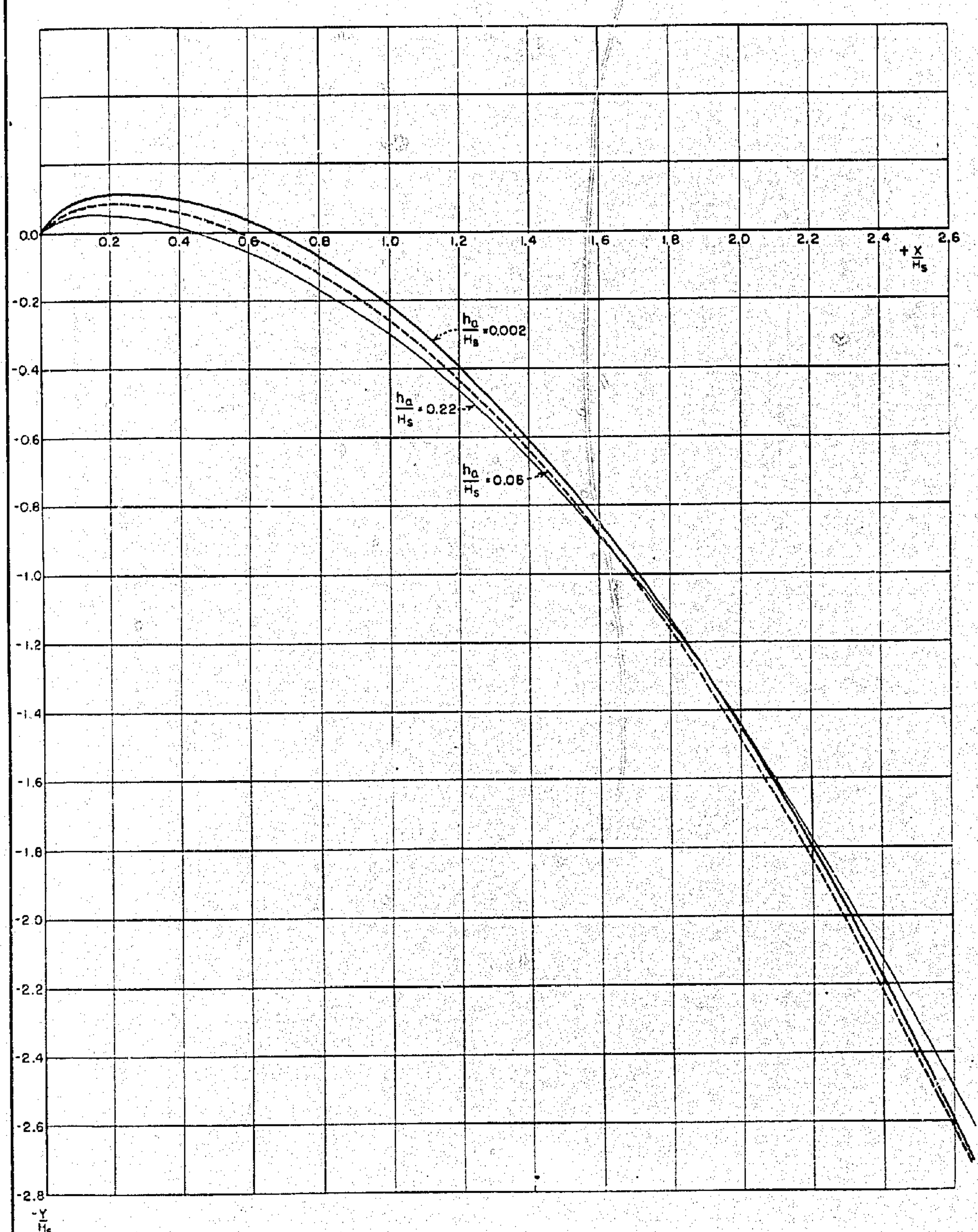


FIGURE 2 - TYPICAL LOWER NAPPE SHAPES SHOWING EFFECT OF VELOCITY OF APPROACH

FIGURE 3

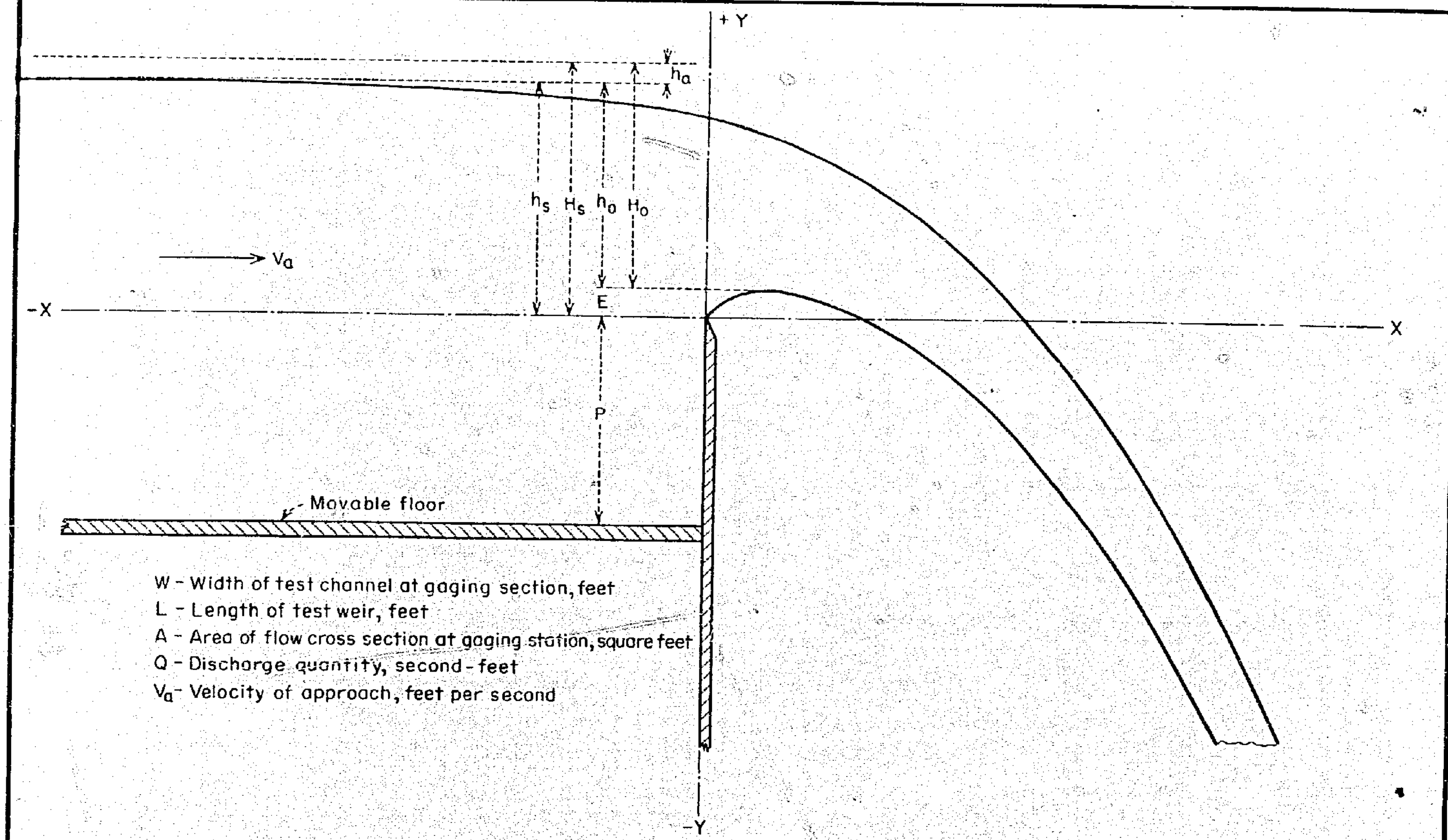


FIGURE 3 - PRINCIPAL ELEMENTS OF THE OVERLOW CREST FOR DAMS WITH VERTICAL UPSTREAM FACE

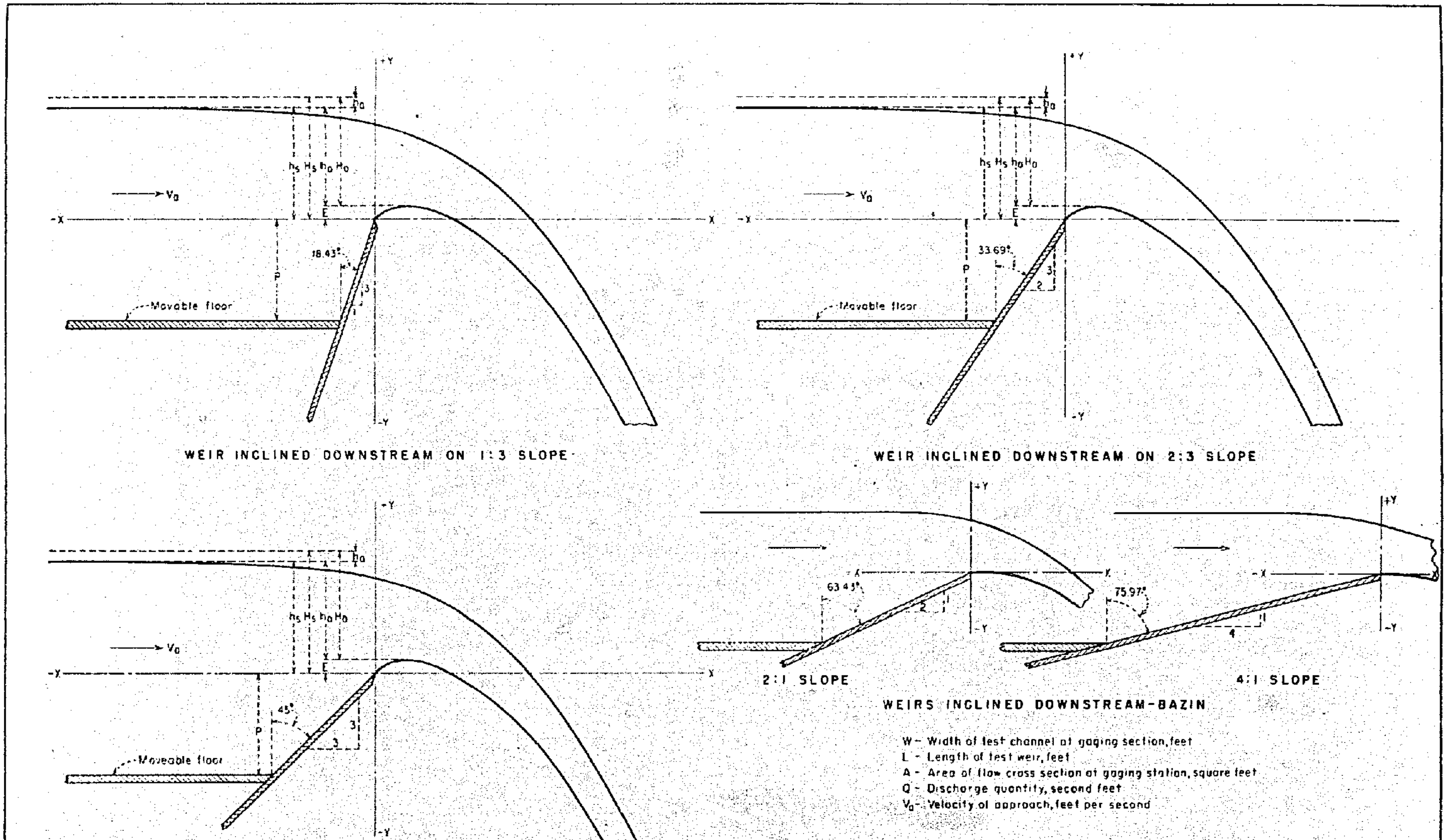


FIGURE 4 - PRINCIPAL ELEMENTS OF THE OVERFALL CREST FOR WEIR INCLINED DOWNSTREAM

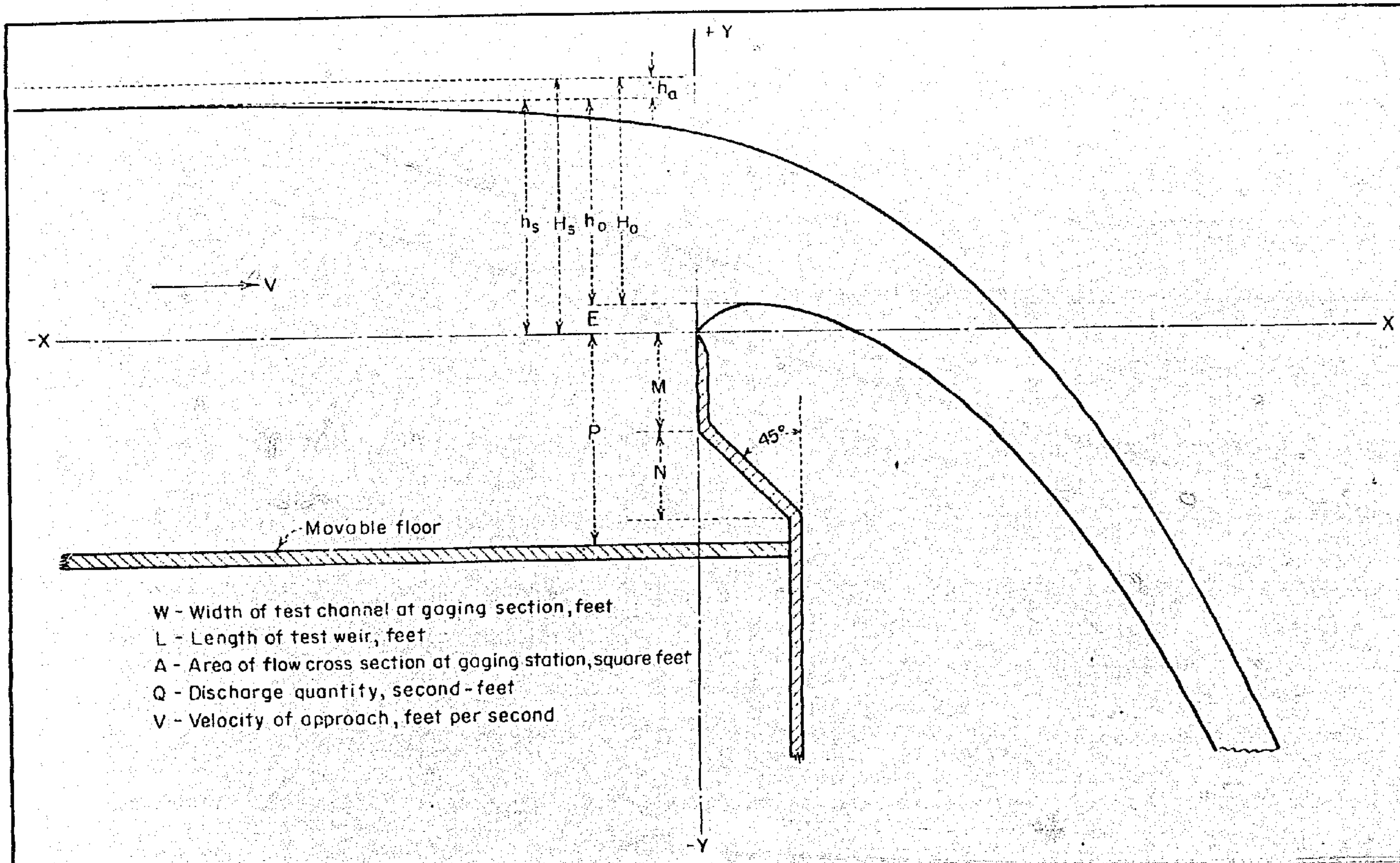


FIGURE 5 - PRINCIPAL ELEMENTS OF THE OFFSET OVERFALL CREST

P = Depth of approach floor below sharp crest of weir, feet.

N - Horizontal or vertical displacement on overhang and offset weirs, feet.

M - Height of riser on offset weirs, feet.

$C = \frac{Q}{LH_o^{3/2}}$ - Coefficient of discharge for ogee section.

4. Nappe-shape profiles

Coordinates for profiles of the lower and the upper nappe shapes, expressed in terms of unit head, are included in the following tables for various values of $\frac{h_a}{H_s}$.

Lower nappe coordinates table	Upper nappe coordinates table	Type of weir
1	9	Vertical upstream face
2	10	Sloping 1:3 downstream (18.43° with vertical)
3	11	Sloping 2:3 downstream (33.69° with vertical)
4	12	Sloping 3:3 downstream (45° with vertical)
5	13	Sloping 2:1 downstream (63.43° with vertical) Basin
6	14	Sloping 4:1 downstream (75.97° with vertical) Basin
7	15	45-degree overhang weirs
8	*	45-degree offset weirs with risers

*Use upper nappe-shape coordinates for vertical-face weir.

One would expect to obtain the same nappe-shape profiles for a 45-degree offset weir with reasonably high riser as for the weir with vertical upstream face. This is not entirely true, as the type of flow is different on the two weirs. It was observed that the lower nappe surface, during the experiments on the vertical weir and on the three weirs tested sloping downstream, was smooth, having a glassy appearance during runs in which the head was not excessive or the approach channel too shallow. On the contrary, the nappe surfaces produced by the offset and the overhang weirs were in some cases smooth but never glassy. In every arrangement tested, spiraling ropes played back and forth across the weir, making it difficult to traverse the lower nappe surface. These were small for the lower heads but became proportionately larger and greater in number for the higher discharges. The ropes formed at the weir and broke into spray a short distance downstream. The roughness of the nappe surfaces indicated that some energy dissipation occurred before the water left the weir and also that the resistance of the air to the rough surfaces was greater than it would have been to the smoother surfaces produced by the vertical weir. For these reasons the nappe shapes from the offset weirs do not coincide with those from the vertical weir. It so happened that the lower nappe surfaces from all offset weirs could be combined (table 8). The conclusions from the tests, as summarized in the bulletin, state that "Overflow sections with plain upstream faces are conducive to stable flow conditions, whereas those with offsets and breaks in the upstream face are not, although many of the latter sections are in existence and appear to be giving satisfactory service. One point is definitely certain, however, and it is that spillway sections should not be designed with values of $\frac{M}{N}$ equal to less than 0.5 unless this value is zero. For values greater than zero and less than 0.5, flow conditions are extremely unstable from offset sections."

The upper nappe-shape coordinates, shown in tables 9, 10, 11, 12, 13, 14, and 15, are not as dependable as those for the lower surface, as other factors may alter them. The upper surface of a sheet of water flowing over a dam is exposed to the atmosphere and may be altered by wind, air currents, or by the absorption of air by the water. When water, exposed to air, reaches a velocity of approximately 20 feet per second, air is entrained. As the velocity increases, the absorption is more pronounced, and air actually mixes with the water. C. W. Thomas[1] found, while taking measurements on a long, steep, irrigation wasteway, that water flowing at a depth of approximately 8 feet absorbed 50 percent of air, by volume, from the atmosphere for a velocity of 80 feet per second. The upper nappe-shape coordinates, therefore, represent only the ideal case where air is not considered. These experimental upper coordinates, however, may be used as a

[1] Thomas, C. W., "Progress Report on Studies of the Flow of Water in Open Channels with High Gradients," July 27, 1938, U.S.B.R. Report Hyd. 35.

TABLE 1

OVERFALL DAM CREST EXPERIMENTS

WEIR WITH VERTICAL UPSTREAM FACE

COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

h_a/H_s → / X/H_s ↓	Y/H_s: 0.005	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180	0.200
0.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.010	+0.0150	+0.0146	+0.0142	+0.0128	+0.0134	+0.0130	+0.0126	+0.0122	+0.0119	+0.0115	+0.0110	+0.0106	+0.0100	+0.0090	+0.0080	+0.0070
0.020	0.0290	0.0275	0.0265	0.0255	0.0250	0.0242	0.0235	0.0228	0.0220	0.0210	0.0200	0.0186	0.0180	0.0160	0.0150	0.0133
0.030	0.0395	0.0388	0.0375	0.0362	0.0350	0.0335	0.0320	0.0310	0.0300	0.0286	0.0270	0.0255	0.0240	0.0220	0.0202	0.0187
0.040	0.0490	0.0477	0.0460	0.0450	0.0440	0.0420	0.0400	0.0390	0.0380	0.0360	0.0340	0.0320	0.0300	0.0280	0.0258	0.0240
0.050	0.0575	0.0559	0.0540	0.0525	0.0510	0.0490	0.0470	0.0455	0.0440	0.0419	0.0398	0.0375	0.0355	0.0325	0.0300	0.0280
0.060	0.0650	0.0630	0.0605	0.0588	0.0570	0.0550	0.0530	0.0515	0.0500	0.0473	0.0447	0.0420	0.0400	0.0363	0.0340	0.0315
0.070	0.0710	0.0678	0.0650	0.0642	0.0625	0.0602	0.0580	0.0560	0.0540	0.0520	0.0500	0.0460	0.0435	0.0400	0.0375	0.0345
0.080	0.0755	0.0745	0.0720	0.0695	0.0670	0.0650	0.0630	0.0608	0.0585	0.0552	0.0540	0.0500	0.0470	0.0430	0.0400	0.0370
0.090	0.0820	0.0796	0.0765	0.0742	0.0720	0.0695	0.0670	0.0645	0.0620	0.0597	0.0575	0.0538	0.0500	0.0460	0.0422	0.0390
0.100	0.0860	0.0838	0.0810	0.0785	0.0760	0.0735	0.0710	0.0682	0.0655	0.0629	0.0602	0.0562	0.0520	0.0480	0.0446	0.0407
0.110	0.0900	0.0876	0.0850	0.0820	0.0790	0.0765	0.0740	0.0712	0.0686	0.0658	0.0630	0.0582	0.0543	0.0500	0.0460	0.0420
0.120	0.0940	0.0912	0.0880	0.0852	0.0825	0.0798	0.0770	0.0742	0.0715	0.0685	0.0655	0.0602	0.0560	0.0510	0.0470	0.0434
0.130	0.0975	0.0945	0.0915	0.0882	0.0850	0.0822	0.0795	0.0766	0.0736	0.0703	0.0670	0.0620	0.0566	0.0518	0.0480	0.0440
0.140	0.1000	0.0972	0.0940	0.0910	0.0880	0.0850	0.0820	0.0788	0.0755	0.0721	0.0686	0.0638	0.0580	0.0530	0.0482	0.0442
0.150	0.1025	0.0994	0.0960	0.0930	0.0900	0.0868	0.0835	0.0802	0.0770	0.0735	0.0700	0.0642	0.0588	0.0540	0.0494	0.0446
0.160	0.1045	0.1016	0.0980	0.0950	0.0920	0.0882	0.0845	0.0812	0.0780	0.0748	0.0716	0.0658	0.0595	0.0543	0.0490	0.0450
0.170	0.1065	0.1034	0.0995	0.0965	0.0935	0.0898	0.0860	0.0828	0.0795	0.0757	0.0720	0.0660	0.0598	0.0542	0.0490	0.0448
0.180	0.1080	0.1049	0.1010	0.0975	0.0945	0.0908	0.0870	0.0835	0.0800	0.0765	0.0730	0.0668	0.0600	0.0541	0.0485	0.0440
0.190	0.1095	0.1062	0.1020	0.0989	0.0958	0.0916	0.0875	0.0840	0.0805	0.0772	0.0739	0.0670	0.0600	0.0540	0.0482	0.0434
0.200	0.1106	0.1072	0.1030	0.0998	0.0965	0.0922	0.0880	0.0848	0.0815	0.0778	0.0740	0.0670	0.0599	0.0540	0.0480	0.0436
0.210	0.1115	0.1082	0.1040	0.1005	0.0970	0.0925	0.0880	0.0850	0.0820	0.0781	0.0742	0.0663	0.0598	0.0528	0.0478	0.0425
0.220	0.1120	0.1086	0.1040	0.1008	0.0976	0.0930	0.0885	0.0852	0.0820	0.0781	0.0742	0.0661	0.0590	0.0530	0.0467	0.0417
0.230	0.1120	0.1087	0.1045	0.1011	0.0980	0.0932	0.0885	0.0852	0.0820	0.0781	0.0741	0.0660	0.0580	0.0520	0.0460	0.0403
0.240	0.1120	0.1089	0.1050	0.1015	0.0980	0.0930	0.0880	0.0848	0.0816	0.0778	0.0740	0.0650	0.0577	0.0510	0.0450	0.0390
0.250	0.1120	0.1089	0.1050	0.1012	0.0975	0.0928	0.0880	0.0845	0.0810	0.0767	0.0726	0.0640	0.0568	0.0500	0.0440	0.0380
0.260	0.1120	0.1087	0.1045	0.1010	0.0976	0.0925	0.0875	0.0836	0.0800	0.0760	0.0720	0.0635	0.0567	0.0487	0.0424	0.0365
0.270	0.1120	0.1084	0.1040	0.1005	0.0970	0.0920	0.0870	0.0832	0.0795	0.0752	0.0710	0.0620	0.0545	0.0478	0.0416	0.0355
0.280	0.1115	0.1082	0.1040	0.1000	0.0960	0.0910	0.0860	0.0820	0.0780	0.0740	0.0700	0.0610	0.0535	0.0460	0.0400	0.0340
0.290	0.1110	0.1077	0.1035	0.0995	0.0955	0.0905	0.0855	0.0815	0.0775	0.0729	0.0683	0.0598	0.0520	0.0447	0.0380	0.0320
0.300	0.1105	0.1067	0.1020	0.0980	0.0940	0.0892	0.0845	0.0802	0.0760	0.0718	0.0673	0.0580	0.0503	0.0433	0.0364	0.0300
0.310	0.1100	0.1062	0.1016	0.0972	0.0930	0.0880	0.0830	0.0790	0.0750	0.0705	0.0660	0.0570	0.0490	0.0418	0.0350	0.0288
0.320	0.1090	0.1052	0.1008	0.0962	0.0920	0.0870	0.0820	0.0776	0.0735	0.0688	0.0642	0.0565	0.0477	0.0400	0.0330	0.0270
0.330	0.1080	0.1042	0.0995	0.0948	0.0900	0.0850	0.0800	0.0760	0.0720	0.0671	0.0623	0.0552	0.0458	0.0380	0.0310	0.0250
0.340	0.1070	0.1030	0.0980	0.0932	0.0885	0.0835	0.0785	0.0742	0.0700	0.0652	0.0604	0.0520	0.0440	0.0360	0.0290	0.0230
0.350	0.1060	0.1018	0.0965	0.0918	0.0870	0.0820	0.0770	0.0728	0.0685	0.0636	0.0586	0.0500	0.0420	0.0340	0.0270	0.0207
0.360	0.1040	0.1000	0.0950	0.0902	0.0856	0.0802	0.0750	0.0710	0.0670	0.0620	0.0570	0.0480	0.0397	0.0320	0.0249	0.0180
0.370	0.1025	0.0975	0.0930	0.0882	0.0835	0.0788	0.0735	0.0692	0.0650	0.0599	0.0548	0.0458	0.0373	0.0297	0.0220	0.0160
0.380	0.1010	0.0958	0.0910	0.0862	0.0816	0.0762	0.0710	0.0668	0.0625	0.0574	0.0524	0.0437	0.0353	0.0274	0.0200	0.0130
0.390	0.0990	0.0945	0.0890	0.0842	0.0795	0.0747	0.0690	0.0646	0.0600	0.0550	0.0500	0.0410	0.0328	0.0248	0.0177	0.0106
0.400	0.0970	0.0926	0.0870	0.0820	0.0770	0.0720	0.0670	0.0625	0.0580	0.0530	0.0480	0.0388	0.0303	0.0220	0.0144	0.0080
0.410	0.0945	0.0901	0.0845	0.0798	0.0750	0.0695	0.0640	0.0600	0.0560	0.0509	0.0458	0.0360	0.0280	0.0197	0.0120	0.0067
0.420	0.0920	0.0878	0.0820	0.0772	0.0725	0.0672	0.0620	0.0575	0.0530	0.0480	0.0430	0.0340	0.0250	0.0164	0.0090	+0.0025
0.430	0.0900	0.0856	0.0800	0.0750	0.0700	0.0648	0.0595	0.0550	0.0505	0.0452	0.0400	0.0310	0.0220	0.0140	0.0060	0.0000
0.440	0.0870	0.0828	0.0775	0.0727	0.0680	0.0622	0.0565	0.0522	0.0480	0.0425	0.0370	0.0280	0.0195	0.0115	+0.0030	-0.0014
0.450	0.0845	0.0801	0.0745	0.0697	0.0650	0.0595	0.0540	0.0495	0.0450	0.0395	0.0340	0.0250	0.0163	0.0080	0.0000	0.0060
0.460	0.0820	0.0773	0.0715	0.0667	0.0620	0.0568	0.0515	0.0468	0.0420	0.0367	0.0316	0.0220	0.0136	0.0042	-0.0038	0.0093
0.470	0.0790	0.0746	0.0690	0.0640	0.0590	0.0535	0.0480	0.0432	0.0390	0.0335	0.0280	0.0183	0.0100	-0.0010	0.0064	0.0120
0.480	0.0760	0.0716	0.0660	0.0610	0.0560	0.0508	0.0455	0.0408	0.0360	0.0306	0.0253	0.0155	0.0060	-0.0020	0.0100	0.0160
0.490	0.0735	0.0691	0.0636	0.0585	0.0535	0.0478	0.0420	0.0372	0.0325	0.0272	0.0220	0.0120	+0.0022	-0.0050	0.0140	[illegible]
0.500	0.070	0.066	0.060	0.055	0.050	0.044	0.039	0.034	0.030	0.024	0.018	0.008	-0.001	0.010	0.018	0.023
0.520	0.064	0.060	0.054	0.048	0.042	0.038	0.032	0.027	0.022	0.017	0.012	+0.001	0.008	0.018	0.025	0.030
0.540	0.056	0.052	0.048	0.041	0.036	0.030	0.025	0.020	0.015	0.010	+0.004	-0.006	0.017	0.026	0.034	0.039
0.560	0.048	0.044	0.039	0.034	0.028	0.022	0.017	0.012	+0.007	+0.002	-0.004	0.015	0.025	0.035	0.042	0.046
0.580	0.040	0.036	0.031	0.025	0.020	0.014	+0.009	+0.003	-0.002	-0.007	0.013	0.024	0.034	0.044	0.050	0.058
0.600	0.032	0.028	0.022	0.017	0.012	+0.006	0.000	-0.005	0.010	0.016	0.022	0.032	0.045	0.052	0.059	0.064
0.620	0.024	0.019	0.013	+0.008	+0.002	-0.002	-0.009	0.014	0.020	0.026	0.031	0.042	0.052	0.062	0.068	0.072
0.640	0.014	-0.010	+0.004	-0.001	-0.007	0.012	0.016	0.023	0.028	0.034	0.040	0.051	0.061	0.071	0.078	0.082
0.660	+0.004	0.000	-0.006	0.012	0.016	0.023	0.028	0.033	0.038	0.044	0.050	0.060	0.071	0.081	0.088	0.091
0.680	-0.006	-0.011	0.017	0.022	0.028	0.033	0.038	0.043	0.048	0.054	0.061	0.070	0.081	0.092	0.098	0.101
0.700	0.016	0.021	0.028	0.033	0.038	0.044	0.049	0.054	0.059	0.065	0.071	0.081	0.091	0.102	0.108	0.111
0.720	0.027	0.032	0.038	0.044	0.049	0.054	0.060	0.065	0.070	0.076	0.082	0.092	0.102	0.112	0.118	0.122
0.740	0.038	0.043	0.049	0.054	0.060	0.066	0.072	0.076	0.081	0.087	0.093	0.103	0.114	0.124	0.130	0.132
0.760	0.050	0.055	0.061	0.066	0.072	0.078	0.083	0.088	0.092	0.098	0.106	0.115	0.125	0.135	0.141	0.145
0.780	0.062	0.066	0.072	0.078	0.083	0.089	0.095	0.100	0.104	0.110	0.116	0.127	0.137	0.146	0.152	0.154
0.800	0.074	0.078	0.084	0.090	0.096	0.102	0.108	0.112	0.117	0.122	0.128	0.139	0.150	0.159	0.164	0.166
0.820	0.086	0.091	0.097	0.102	0.108	0.114	0.120	0.125	0.130	0.136	0.142	0.152	0.162	0.171	0.177	0.178
0.840	0.098	0.103	0.110	0.116	0.121	0.127	0.133	0.138	0.142	0.148	0.154	0.164	0.176	0.184	0.189	0.189
0.860	0.112	0.116	0.122	0.128	0.134	0.140	0.146	0.151	0.156	0.162	0.168	0.178	0.188	0.197	0.202	0.202
0.880	0.125	0.130	0.136	0.142	0.148	0.154	0.159	0.164	0.169	0.175	0.181	0.192	0.207	0.210	0.215	0.215
0.900	0.138	0.143	0.150	0.156	0.162	0.168	0.173	0.176	0.183	0.189	0.196	0.206	0.216	0.226	0.228	0.228
0.920	0.152	0.157	0.164	0.170	0.176	0.182	0.188	0.192	0.197	0.203	0.210	0.220	0.230	0.238	0.242	0.241
0.940	0.167	0.172	0.179	0.184	0.190	0.196	0.202	0.207	0.212	0.218	0.224	0.234	0.244	0.253	0.255	0.254
0.960	0.182	0.187	0.193	0.199	0.206	0.210	0.216	0.221	0.226	0.232	0.238	0.249	0.258	0.268	0.270	0.268
0.980	0.198	0.202	0.208	0.214	0.220	0.226	0.231	0.236	0.242	0.248	0.254	0.264	0.274	0.283	0.284	0.283
1.00	0.214	0.218	0.224	0.230	0.236	0.242	0.247	0.252	0.258	0.264	0.270	0.279	0.290	0.300	0.299	0.298
1.05	0.256	0.260	0.266	0.272	0.278	0.283	0.288	0.293	0.298	0.304	0.310	0.320	0.330	0.349	0.339	0.337
1.10	0.300	0.304	0.310	0.316	0.320	0.325	0.330	0.335	0.340	0.346	0.352	0.357	0.372	0.382	0.373	0.377
1.15	0.345	0.349	0.354	0.360	0.365	0.370	0.375	0.380	0.384	0.390	0.396	0.406	0.417	0.426	0.426	0.417
1.20	0.393	0.397	0.402	0.407	0.412	0.417	0.422	0.427	0.432	0.438	0.443	0.451	0.463	0.471	0.466	0.460
1.25	0.443	0.447	0.452	0.457	0.462	0.467	0.472	0.476	0.481	0.486	0.492	0.501	0.513	0.520	0.514	0.504
1.30	0.495	0.499	0.504	0.508	0.513	0.516	0.522	0.526	0.531	0.537	0.543	0.553	0.563	0.568	0.561	0.551
1.35	0.550	0.554	0.558	0.562	0.567	0.571	0.576	0.580	0.585	0.591	0.596	0.606	0.616	0.619	0.611	0.600
1.40	0.606	0.610	0.614	0.618	0.623	0.626	0.632	0.636	0.641	0.646	0.650	0.660	0.670	0.672	0.662	0.650
1.45	0.664	0.668	0.672	0.677	0.682	0.686	0.690	0.694	0.699	0.703	0.708	0.716	0.730	0.726	0.714	0.702
1.50	0.724	0.728	0.733	0.737	0.741	0.746	0.750	0.754	0.758	0.763	0.769	0.784	0.784	0.784	0.769	0.764
1.55	0.786	0.789	0.795	0.799	0.803	0.807	0.811	0.815	0.819	0.824	0.830	0.843	0.843	0.842	0.827	0.817
1.60	0.850	0.854	0.860	0.864	0.867	0.870	0.874	0.875	0.883	0.889	0.895	0.904	0.904	0.904	0.896	0.874
1.65	0.917	0.921	0.926	0.930	0.934	0.938	0.941	0.946	0.950	0.955	0.961	0.970	0.968	0.964	0.946	0.935
1.70	0.987	0.991	0.996	0.998	1.002	1.006	1.010	1.014	1.019	1.023	1.027	1.037	1.034	1.026	1.008	0.996
1.75	1.058	1.062	1.066	1.070	1.074	1.078	1.082	1.086	1.090	1.093	1.096	1.104	1.102	1.090	1.074	1.060
1.80	1.132	1.136	1.140	1.144	1.147	1.152	1.156	1.160	1.164	1.167	1.169	1.176	1.174	1.164	1.148	1.127
1.85	1.207	1.211	1.216	1.220	1.224	1.228	1.232	1.236	1.241	1.245	1.248	1.252	1.246	1.226	1.216	1.196
1.90	1.287	1.290	1.293	1.297	1.301	1.306	1.310	1.315	1.320	1.322	1.325	1.329	1.320	1.300	1.286	1.266
1.95	1.368	1.371	1.375	1.378	1.382	1.387	1.392	1.396	1.401	1.403	1.406	1.408	1.398	1.374	1.361	1.337
2.00	1.451	1.455	1.460	1.464	1.467	1.472	1.476	1.480	1.485	1.486	1.488	1.490	1.480	1.461	1.439	1.411
2.05	1.536	1.540	1.544	1.548	1.551	1.556	1.560	1.564	1.568	1.570	1.572	1.574	1.562	1.530	1.516	1.486
2.10	1.621	1.625	1.630	1.634	1.638	1.642	1.645	1.649	1.653	1.657	1.662	1.660	1.648	1.614	1.600	1.564
2.15	1.706	1.712	1.716	1.721	1.726	1.730	1.734	1.738	1.742	1.747	1.750	1.746	1.732	1.699	1.682	1.646
2.20	1.798	1.802	1.807	1.812	1.816	1.820	1.825	1.830	1.834	1.836	1.838	1.834	1.820	1.785	1.766	1.728
2.25	1.890	1.895	1.901	1.906	1.910	1.914	1.918	1.922	1.927	1.926	1.926	1.920	1.906	1.872	1.854	1.810
2.30	1.986	1.990	1.996	2.001	2.006	2.008	2.012	2.016	2.020	2.019	2.018	2.012	1.994	1.962	1.942	1.896
2.35	2.081	2.086	2.092	2.097	2.102	2.105	2.108	2.112	2.116	2.116	2.115	2.106	2.088	2.054	2.032	1.984
2.40	2.179	2.183	2.188	2.193	2.198	2.202	2.206	2.209	2.212	2.212	2.212	2.200	2.180	2.147	2.124	2.074
2.45	2.280	2.284	2.288	2.294	2.299	2.302	2.306	2.310	2.312	2.312	2.312	2.298	2.276	2.240	2.216	2.165
2.50	2.384	2.388	2.394	2.400	2.406	2.408	2.410	2.412	2.414	2.414	2.416	2.394	2.371	2.334	2.313	2.257
2.55	2.490	2.495	2.501	2.508	2.514	2.514	2.516	2.516	2.516	2.516	2.516	2.492	2.468	2.430	2.408	2.350
2.60	2.602	2.606	2.611	2.617	2.622	2.622	2.621	2.620	2.620	2.614	2.606	2.593	2.568	2.525	2.503	2.444
2.65	2.712	2.717	2.723	2.728	2.732	2.731	2.728	2.728	2.727	2.674	2.724	2.696	2.668	2.674	2.601	2.540
2.70	-2.824	-2.829	-2.836	-2.840	-2.844	-2.840	-2.836	-2.836	-2.835	-2.832	-2.828	-2.800	-2.770	-2.720	-2.698	-2.637

TABLE [illegible]

OVERFALL DAM CREST EXPERIMENTS - [illegible] INCLINED UPSTREAM ON 1:3 SLOPE
COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s
18.43° WITH VERTICAL

h_a/H_s \ X/H_s	Y/H_s															
	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180	0.200
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.018	+0.016	+0.016	+0.014	+0.013	+0.012	+0.011	+0.011	+0.010	+0.010	+0.010	+0.009	+0.008	+0.008	+0.007	+0.006
0.020	0.026	0.026	0.025	0.025	0.024	0.023	0.022	0.022	0.021	0.020	0.018	0.017	0.016	0.016	0.013	0.010
0.030	0.036	0.034	0.033	0.032	0.031	0.031	0.030	0.029	0.028	0.027	0.026	0.024	0.023	0.021	0.018	0.016
0.040	0.042	0.042	0.040	0.039	0.038	0.038	0.037	0.036	0.035	0.034	0.033	0.030	0.029	0.028	0.023	0.018
0.050	0.048	0.048	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.036	0.034	0.031	0.026	0.021
0.060	0.054	0.052	0.051	0.050	0.049	0.049	0.047	0.046	0.045	0.044	0.043	0.040	0.038	0.034	0.030	0.024
0.070	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.051	0.050	0.049	0.047	0.044	0.041	0.035	0.033	0.027
0.080	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.047	0.044	0.040	0.036	0.028
0.090	0.066	0.065	0.063	0.063	0.062	0.060	0.058	0.057	0.056	0.055	0.053	0.050	0.047	0.042	0.038	0.030
0.100	0.069	0.067	0.066	0.065	0.064	0.063	0.061	0.060	0.058	0.057	0.056	0.052	0.049	0.044	0.039	0.032
0.110	0.072	0.070	0.068	0.067	0.066	0.065	0.064	0.063	0.061	0.060	0.058	0.054	0.050	0.046	0.041	0.032
0.120	0.074	0.072	0.070	0.069	0.068	0.067	0.066	0.064	0.062	0.061	0.059	0.056	0.052	0.047	0.042	0.034
0.130	0.076	0.074	0.072	0.071	0.070	0.069	0.068	0.066	0.064	0.063	0.061	0.057	0.053	0.048	0.043	0.034
0.140	0.078	0.076	0.074	0.073	0.072	0.071	0.069	0.068	0.066	0.064	0.062	0.058	0.054	0.048	0.044	0.034
0.150	0.080	0.078	0.076	0.075	0.073	0.072	0.070	0.069	0.067	0.065	0.063	0.059	0.055	0.049	0.044	0.034
0.160	0.082	0.079	0.077	0.076	0.074	0.073	0.072	0.070	0.068	0.066	0.064	0.060	0.056	0.050	0.044	0.033
0.170	0.082	0.080	0.078	0.077	0.075	0.074	0.072	0.071	0.069	0.067	0.064	0.060	0.056	0.050	0.044	0.033
0.180	0.083	0.081	0.079	0.078	0.076	0.075	0.073	0.071	0.069	0.067	0.065	0.060	0.056	0.050	0.044	0.032
0.190	0.084	0.082	0.079	0.078	0.076	0.075	0.074	0.072	0.070	0.068	0.065	0.060	0.056	0.050	0.044	0.031
0.200	0.084	0.083	0.079	0.078	0.076	0.076	0.074	0.072	0.070	0.068	0.065	0.060	0.056	0.050	0.044	0.030
0.210	0.085	0.083	0.080	0.079	0.077	0.076	0.074	0.072	0.070	0.068	0.065	0.060	0.056	0.050	0.043	0.029
0.220	0.085	0.083	0.080	0.079	0.077	0.076	0.074	0.072	0.070	0.068	0.065	0.060	0.055	0.049	0.042	0.028
0.230	0.085	0.082	0.080	0.079	0.077	0.076	0.074	0.072	0.069	0.067	0.064	0.059	0.054	0.048	0.041	0.027
0.240	0.084	0.082	0.080	0.078	0.076	0.075	0.073	0.071	0.068	0.066	0.064	0.058	0.054	0.048	0.040	0.025
0.250	0.084	0.082	0.080	0.078	0.076	0.075	0.073	0.071	0.068	0.066	0.063	0.058	0.053	0.047	0.039	0.024
0.260	0.084	0.082	0.079	0.079	0.076	0.074	0.072	0.070	0.067	0.065	0.062	0.057	0.052	0.046	0.038	0.022
0.270	0.084	0.081	0.078	0.076	0.074	0.073	0.071	0.069	0.067	0.065	0.062	0.056	0.051	0.044	0.036	0.020
0.280	0.083	0.080	0.076	0.076	0.074	0.072	0.070	0.067	0.065	0.063	0.061	0.056	0.050	0.043	0.034	0.016
0.290	0.083	0.079	0.076	0.075	0.073	0.071	0.069	0.067	0.064	0.062	0.059	0.054	0.049	0.042	0.033	0.018
0.300	0.082	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.063	0.061	0.058	0.052	0.047	0.040	0.031	0.016
0.310	0.080	0.077	0.075	0.073	0.071	0.069	0.066	0.064	0.062	0.060	0.057	0.051	0.046	0.038	0.029	0.012
0.320	0.079	0.076	0.073	0.071	0.069	0.067	0.066	0.063	0.060	0.058	0.056	0.049	0.044	0.036	0.027	0.009
0.330	0.078	0.074	0.072	0.070	0.068	0.066	0.064	0.061	0.058	0.056	0.053	0.047	0.042	0.034	0.024	0.006
0.340	0.076	0.073	0.070	0.068	0.066	0.064	0.062	0.059	0.056	0.054	0.051	0.045	0.040	0.033	0.023	0.004
0.350	0.074	0.071	0.069	0.067	0.065	0.063	0.060	0.057	0.054	0.052	0.049	0.043	0.038	0.030	0.021	+0.001
0.360	0.072	0.070	0.067	0.065	0.063	0.061	0.058	0.055	0.052	0.050	0.047	0.041	0.036	0.028	0.018	-0.001
0.370	0.071	0.068	0.065	0.063	0.061	0.059	0.056	0.053	0.050	0.048	0.045	0.039	0.034	0.026	0.016	0.004
0.380	0.070	0.066	0.063	0.061	0.059	0.057	0.054	0.051	0.048	0.045	0.042	0.036	0.032	0.023	0.014	0.007
0.390	0.068	0.064	0.061	0.059	0.057	0.055	0.052	0.049	0.046	0.043	0.040	0.034	0.029	0.021	0.011	0.010
0.400	0.065	0.062	0.059	0.057	0.055	0.052	0.049	0.046	0.043	0.040	0.037	0.031	0.026	0.016	0.008	0.014
0.410	0.063	0.060	0.056	0.055	0.052	0.050	0.047	0.044	0.041	0.038	0.034	0.028	0.024	0.015	0.006	0.016
0.420	0.060	0.058	0.054	0.052	0.050	0.047	0.044	0.041	0.038	0.035	0.031	0.026	0.020	0.012	+0.003	0.020
0.430	0.058	0.055	0.052	0.050	0.048	0.045	0.042	0.039	0.036	0.032	0.028	0.022	0.018	0.010	0.000	0.023
0.440	0.056	0.052	0.049	0.047	0.045	0.042	0.039	0.036	0.032	0.029	0.025	0.019	0.014	0.006	-0.002	0.026
0.450	0.053	0.050	0.046	0.044	0.042	0.039	0.036	0.033	0.029	0.026	0.022	0.016	0.011	-0.003	0.006	0.030
0.460	0.050	0.047	0.043	0.041	0.039	0.036	0.033	0.030	0.026	0.023	0.019	0.012	0.008	0.000	0.010	0.033
0.470	0.047	0.044	0.040	0.038	0.036	0.033	0.030	0.027	0.023	0.020	0.016	0.009	0.006	-0.004	0.014	0.037
0.480	0.044	0.041	0.037	0.035	0.033	0.030	0.027	0.023	0.019	0.016	0.012	0.006	+0.001	0.008	0.017	0.040
0.490	0.041	0.038	0.034	0.031	0.030	0.027	0.023	0.020	0.016	0.012	0.008	+0.001	-0.003	0.011	0.020	0.044
0.500	0.038	0.035	0.031	0.029	0.026	0.022	0.020	0.016	0.012	0.009	-0.005	-0.002	0.006	0.014	0.024	0.048
0.520	0.031	0.028	0.024	0.022	0.019	0.016	0.013	0.009	+0.006	-0.001	-0.003	0.004	0.014	0.021	0.032	0.056
0.540	0.024	0.021	0.017	0.015	0.012	0.009	+0.006	+0.001	-0.003	-0.007	0.011	0.018	0.021	0.030	0.039	0.065
0.560	0.016	0.014	0.009	0.007	+0.004	-0.001	-0.003	-0.008	0.012	0.016	0.020	0.026	0.031	0.038	0.049	0.072
0.580	+0.008	+0.006	+0.001	+0.002	-0.004	-0.008	0.017	0.017	0.021	0.025	0.030	0.036	0.040	0.047	0.059	0.080
0.600	-0.001	-0.003	-0.005	-0.011	0.013	0.017	0.021	0.025	0.029	0.034	0.039	0.045	0.050	0.056	0.066	0.089
0.620	0.009	0.012	0.016	0.019	0.022	0.026	0.030	0.035	0.039	0.044	0.048	0.053	0.059	0.066	0.076	0.098
0.640	0.018	0.021	0.026	0.029	0.032	0.036	0.039	0.044	0.048	0.054	0.059	0.065	0.069	0.076	0.086	0.107
0.660	0.028	0.031	0.035	0.038	0.041	0.045	0.049	0.054	0.059	0.064	0.069	0.075	0.080	0.086	0.096	0.117
0.680	0.036	0.041	0.045	0.049	0.052	0.056	0.060	0.065	0.069	0.074	0.079	0.085	0.090	0.097	0.107	0.127
0.700	0.046	0.052	0.056	0.059	0.062	0.067	0.071	0.076	0.080	0.085	0.090	0.097	0.101	0.108	0.117	0.138
0.720	0.059	0.064	0.067	0.071	0.074	0.078	0.082	0.087	0.091	0.097	0.102	0.108	0.112	0.119	0.128	0.149
0.740	0.071	0.075	0.079	0.082	0.086	0.090	0.094	0.098	0.102	0.108	0.114	0.119	0.122	0.131	0.140	0.159
0.760	0.083	0.088	0.090	0.095	0.098	0.101	0.106	0.110	0.114	0.120	0.126	0.131	0.135	0.142	0.151	0.170
.780	.094	.098	0.102	0.108	0.109	0.115	0.117	0.122	0.126	0.132	0.138	0.145	0.147	0.154	0.162	0.181
0.800	0.108	0.111	0.115	0.119	0.122	0.126	0.130	0.136	0.139	0.145	0.151	0.156	0.159	0.166	0.174	0.193
0.820	0.119	0.124	0.128	0.131	0.134	0.138	0.142	0.147	0.152	0.158	0.163	0.168	0.172	0.178	0.187	0.204
0.840	0.132	0.137	0.142	0.145	0.148	0.152	0.156	0.160	0.164	0.170	0.176	0.180	0.184	0.191	0.199	0.216
0.860	0.145	0.151	0.156	0.159	0.162	0.166	0.170	0.174	0.176	0.184	0.189	0.193	0.197	0.204	0.211	0.228
0.880	0.159	0.164	0.170	0.173	0.176	0.180	0.184	0.188	0.192	0.198	0.203	0.207	0.211	0.217	0.224	0.240
0.900	0.174	0.178	0.184	0.187	0.190	0.194	0.197	0.201	0.206	0.211	0.216	0.220	0.224	0.230	0.237	0.252
0.920	0.188	0.194	0.198	0.202	0.206	0.209	0.212	0.216	0.219	0.224	0.229	0.234	0.238	0.244	0.251	0.265
0.940	0.203	0.208	0.213	0.217	0.220	0.224	0.227	0.231	0.234	0.239	0.244	0.248	0.252	0.258	0.264	0.278
0.960	0.218	0.224	0.228	0.231	0.234	0.238	0.242	0.245	0.248	0.253	0.257	0.262	0.266	0.272	0.278	0.292
0.980	0.233	0.238	0.244	0.247	0.250	0.253	0.256	0.259	0.262	0.267	0.272	0.276	0.279	0.286	0.292	0.305
1.000	0.248	0.254	0.259	0.262	0.265	0.269	0.272	0.275	0.277	0.282	0.286	0.291	0.296	0.300	0.306	0.319
1.050	0.290	0.295	0.300	0.303	0.306	0.309	0.312	0.314	0.316	0.320	0.324	0.329	0.334	0.339	0.344	0.355
1.100	0.333	0.338	0.343	0.346	0.348	0.351	0.354	0.357	0.359	0.363	0.366	0.370	0.374	0.380	0.383	0.392
1.150	0.379	0.384	0.387	0.391	0.393	0.396	0.398	0.401	0.403	0.406	0.409	0.414	0.417	0.422	0.425	0.431
1.200	0.426	0.432	0.436	0.439	0.441	0.443	0.446	0.447	0.449	0.452	0.455	0.459	0.463	0.467	0.468	0.472
1.250	0.479	0.484	0.487	0.489	0.491	0.493	0.494	0.496	0.498	0.501	0.503	0.506	0.510	0.514	0.514	0.516
1.300	0.532	0.536	0.539	0.541	0.543	0.545	0.546	0.548	0.550	0.551	0.552	0.555	0.560	0.562	0.562	0.562
1.350	0.547	0.591	0.593	0.596	0.597	0.599	0.600	0.602	0.602	0.604	0.604	0.605	0.611	0.613	0.611	0.605
1.400	0.646	0.647	0.649	0.651	0.652	0.653	0.654	0.656	0.657	0.655	0.659	0.660	0.664	0.665	0.661	0.657
1.450	0.706	0.707	0.709	0.710	0.710	0.711	0.712	0.713	0.714	0.715	0.718	0.717	0.718	0.717	0.714	0.708
1.500	0.767	0.770	0.772	0.772	0.772	0.771	0.770	0.772	0.773	0.774	0.774	0.776	0.775	0.775	0.768	0.757
1.550	0.833	.834	0.836	0.836	0.835	0.835	0.835	0.835	0.834	0.834	0.834	0.837	0.835	0.829	0.823	0.814
1.600	0.899	0.899	0.901	0.900	0.899	0.898	0.897	0.898	0.899	0.899	0.899	0.896	0.897	0.889	0.881	0.871
1.650	0.969	0.968	0.968	0.967	0.966	0.965	0.964	0.964	0.963	0.963	0.963	0.962	0.960	0.950	0.941	0.929
1.700	1.036	1.033	1.036	1.035	1.034	1.033	1.031	1.030	1.029	1.026	1.026	1.026	1.023	1.012	1.000	0.989
1.750	1.105	1.103	1.106	1.104	1.102	1.102	1.101	1.099	1.097	1.096	1.096	1.091	1.086	1.076	1.065	1.051
1.800	1.182	1.181	1.178	1.177	1.175	1.174	1.172	1.170	1.168	1.165	1.163	1.159	1.155	1.142	1.131	1.116
1.850	1.260	1.256	1.253	1.251	1.249	1.247	1.245	1.243	1.240	1.237	1.234	1.229	1.224	1.212	1.199	1.166
1.900	1.338	1.332	1.329	1.326	1.323	1.321	1.319	1.316	1.315	1.310	1.306	1.299	1.294	1.288	1.273	1.254
1.950	1.415	1.412	1.408	1.405	1.402	1.399	1.396	1.392	1.388	1.385	1.381	1.375	1.367	1.357	1.343	1.328
2.000	1.479	1.492	1.487	1.484	1.481	1.478	1.474	1.470	1.467	1.461	1.457	1.449	1.442	1.432	1.419	1.401
2.050	1.579	1.572	1.565	1.562	1.558	1.556	1.551	1.547	1.543	1.540	1.538	1.528	1.520	1.509	1.496	1.479
2.100	1.652	1.654	1.647	1.642	1.637	1.634	1.631	1.627	1.622	1.619	1.616	1.606	1.594	1.589	1.576	1.558
2.150	1.748	1.736	1.731	1.727	1.722	1.719	1.715	1.711	1.706	1.703	1.699	1.691	1.682	1.672	1.657	1.640
2.200	1.836	1.828	1.819	1.815	1.810	1.807	1.803	1.798	1.793	1.790	1.786	1.776	1.769	1.759	1.742	1.723
2.250	1.930	1.920	1.910	1.906	1.901	1.897	1.892	1.888	1.883	1.880	1.875	1.868	1.859	1.845	1.829	1.811
2.300	2.026	2.017	2.006	2.000	1.995	1.991	1.987	1.982	1.977	1.973	1.969	1.961	1.952	1.938	1.921	1.901
2.350	2.123	2.110	2.101	2.096	2.090	2.086	2.081	2.076	2.071	2.067	2.063	2.054	2.046	2.033	2.012	1.992
2.400	2.220	2.202	2.198	2.193	2.138	2.183	2.178	2.174	2.169	2.164	2.159	2.150	2.141	2.128	2.106	2.082
2.450	2.322	2.310	2.301	2.296	2.290	2.285	2.280	2.275	2.270	2.266	2.261	2.251	2.240	2.223	2.201	2.176
2.500	2.420	2.415	2.403	2.398	2.392	2.387	2.381	2.376	2.371	2.366	2.361	2.351	2.339	2.327	2.298	2.272
2.550	2.531	2.519	2.509	2.508	2.497	2.492	2.486	2.481	2.475	2.470	2.465	2.454	2.441	2.421	2.396	2.368
2.600	2.636	2.624	2.613	2.608	2.602	2.597	2.591	2.586	2.579	2.574	2.568	2.556	2.542	2.520	2.496	2.466
2.650	2.742	2.730	2.713	2.713	2.708	2.703	2.697	2.691	2.684	2.678	2.672	2.660	2.644	2.620	2.597	2.566
2.700	2.850	2.834	2.829	2.823	2.817	2.810	2.803	2.797	2.791	2.784	2.777	2.765	2.749	2.724	2.699	2.666
2.750	2.959	2.947	2.937	2.931	2.925	2.915	2.912	2.906	2.899	2.892	2.885	2.871	2.855	2.827	2.801	2.768
2.800	[illegible]	3.057	3.047	3.041	3.035	3.023	3.022	[illegible]	3.008	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 3

OVERFALL DAM CREST EXPERIMENTS - WEIR INCLINED DOWNSTREAM ON 2:1 SLOPE
COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s
33.69° WITH VERTICAL

h_a/H_s → / X/H_s ↓	Y/H_s 0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.009	+0.009	+0.008	+0.008	+0.007	+0.007	+0.006	+0.006	+0.006	+0.007	+0.006	+0.006	+0.004	+0.004	+0.003
0.020	0.018	0.015	0.014	0.014	0.014	0.014	0.013	0.013	0.012	0.012	0.011	0.010	0.009	0.008	0.007
0.030	0.023	0.022	0.021	0.021	0.020	0.020	0.019	0.019	0.018	0.018	0.017	0.015	0.014	0.012	0.011
0.040	0.029	0.028	0.027	0.027	0.026	0.025	0.024	0.024	0.023	0.023	0.021	0.020	0.018	0.016	0.014
0.050	0.034	0.033	0.032	0.032	0.031	0.030	0.029	0.029	0.028	0.027	0.026	0.024	0.022	0.020	0.017
0.060	0.039	0.039	0.037	0.036	0.035	0.035	0.034	0.033	0.032	0.031	0.030	0.027	0.026	0.023	0.020
0.070	0.043	0.042	0.041	0.040	0.039	0.039	0.037	0.036	0.035	0.035	0.034	0.031	0.029	0.026	0.023
0.080	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038	0.037	0.034	0.032	0.029	0.026
0.090	0.050	0.049	0.048	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.039	0.037	0.034	0.032	0.028
0.100	0.053	0.052	0.050	0.050	0.049	0.048	0.046	0.045	0.044	0.043	0.042	0.039	0.037	0.034	0.030
0.110	0.055	0.054	0.053	0.052	0.051	0.050	0.048	0.047	0.046	0.046	0.044	0.041	0.039	0.036	0.032
0.120	0.057	0.056	0.054	0.054	0.053	0.052	0.050	0.049	0.048	0.047	0.046	0.043	0.040	0.037	0.034
0.130	0.059	0.058	0.056	0.055	0.054	0.053	0.052	0.051	0.049	0.048	0.047	0.045	0.042	0.039	0.035
0.140	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.048	0.046	0.043	0.040	0.036
0.150	0.061	0.060	0.059	0.058	0.057	0.056	0.054	0.053	0.052	0.051	0.049	0.047	0.044	0.041	0.037
0.160	0.062	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.053	0.052	0.050	0.047	0.044	0.041	0.038
0.170	0.063	0.062	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052	0.050	0.048	0.045	0.042	0.038
0.180	0.063	0.062	0.061	0.060	0.059	0.058	0.056	0.055	0.053	0.052	0.050	0.048	0.046	0.042	0.039
0.190	0.064	0.063	0.062	0.061	0.059	0.058	0.056	0.055	0.054	0.052	0.050	0.048	0.045	0.042	0.038
0.200	0.064	0.063	0.062	0.061	0.059	0.058	0.055	0.055	0.053	0.052	0.050	0.048	0.044	0.041	0.038
0.210	0.064	0.063	0.062	0.061	0.059	0.058	0.056	0.055	0.053	0.052	0.050	0.047	0.044	0.041	0.037
0.220	0.063	0.062	0.061	0.060	0.058	0.057	0.056	0.054	0.052	0.051	0.049	0.046	0.044	0.040	0.036
0.230	0.063	0.062	0.061	0.060	0.058	0.056	0.054	0.053	0.051	0.050	0.048	0.046	0.043	0.039	0.035
0.240	0.062	0.061	0.060	0.059	0.057	0.056	0.054	0.052	0.050	0.049	0.047	0.045	0.041	0.038	0.035
0.250	0.061	0.060	0.059	0.058	0.056	0.054	0.052	0.051	0.049	0.048	0.046	0.044	0.040	0.037	0.034
0.260	0.060	0.059	0.058	0.056	0.054	0.053	0.051	0.050	0.048	0.047	0.045	0.043	0.039	0.036	0.032
0.270	0.059	0.058	0.057	0.055	0.053	0.052	0.050	0.048	0.046	0.045	0.043	0.041	0.037	0.034	0.030
0.280	0.058	0.057	0.056	0.054	0.052	0.050	0.048	0.047	0.045	0.044	0.042	0.039	0.036	0.032	0.029
0.290	0.056	0.055	0.054	0.052	0.050	0.049	0.047	0.046	0.044	0.042	0.040	0.037	0.034	0.030	0.027
0.300	0.055	0.054	0.052	0.050	0.048	0.047	0.045	0.044	0.042	0.040	0.038	0.035	0.032	0.028	0.024
0.310	0.053	0.052	0.050	0.049	0.047	0.046	0.044	0.042	0.040	0.038	0.036	0.033	0.029	0.026	0.023
0.320	0.051	0.050	0.048	0.047	0.045	0.044	0.042	0.040	0.038	0.036	0.034	0.031	0.027	0.024	0.020
0.330	0.049	0.048	0.046	0.044	0.042	0.041	0.039	0.038	0.036	0.034	0.032	0.029	0.025	0.022	0.018
0.340	0.046	0.045	0.044	0.042	0.040	0.039	0.037	0.036	0.034	0.032	0.030	0.027	0.023	0.020	0.015
0.350	0.044	0.042	0.042	0.040	0.038	0.037	0.035	0.034	0.032	0.030	0.028	0.025	0.021	0.017	0.013
0.360	0.042	0.041	0.040	0.038	0.036	0.035	0.033	0.031	0.029	0.028	0.026	0.022	0.018	0.015	0.011
0.370	0.040	0.039	0.038	0.036	0.034	0.032	0.030	0.029	0.027	0.025	0.023	0.020	0.016	0.012	0.008
0.380	0.037	0.036	0.036	0.033	0.031	0.030	0.028	0.026	0.024	0.023	0.021	0.017	0.013	0.009	0.006
0.390	0.035	0.034	0.033	0.031	0.028	0.027	0.025	0.024	0.022	0.020	0.018	0.014	0.010	0.006	+0.002
0.400	0.033	0.032	0.030	0.028	0.026	0.025	0.023	0.021	0.019	0.017	0.015	0.012	0.007	+0.004	0.000
0.410	0.030	0.029	0.028	0.026	0.023	0.022	0.020	0.018	0.016	0.014	0.012	0.009	0.004	0.000	-0.003
0.420	0.027	0.026	0.025	0.022	0.020	0.019	0.017	0.015	0.013	0.011	0.009	0.005	+0.002	-0.002	0.006
0.430	0.024	0.023	0.021	0.020	0.017	0.016	0.014	0.012	0.010	0.009	0.007	+0.003	-0.002	0.006	0.010
0.440	0.021	0.020	0.019	0.017	0.014	0.013	0.011	0.009	0.007	0.005	+0.003	-0.001	0.005	0.009	0.014
0.450	0.018	0.017	0.016	0.014	0.011	0.010	0.008	0.006	+0.004	+0.002	0.000	0.004	0.009	0.013	0.017
0.460	0.015	0.014	0.013	0.011	0.008	0.006	0.004	+0.002	0.000	-0.002	-0.004	0.008	0.012	0.018	0.020
0.470	0.012	0.011	0.010	0.007	0.004	+0.003	+0.001	-0.001	-0.003	0.006	0.007	0.011	0.015	0.020	0.024
0.480	0.008	0.007	0.006	+0.004	+0.001	-0.001	-0.002	0.006	0.007	0.009	0.011	0.015	0.019	0.024	0.028
0.490	0.005	+0.004	+0.002	0.000	-0.002	0.004	0.005	0.005	0.010	0.012	0.014	0.018	0.021	0.028	0.032
0.500	+0.001	0.000	-0.001	-0.004	0.006	0.008	0.009	0.012	0.014	0.016	0.018	0.022	0.026	0.032	0.036
0.520	-0.006	-0.008	0.009	0.012	0.014	0.016	0.017	0.019	0.021	0.023	0.026	0.030	0.034	0.040	0.045
0.540	0.014	0.016	0.017	0.020	0.022	0.023	0.024	0.027	0.030	0.032	0.034	0.038	0.043	0.048	0.052
0.560	0.023	0.024	0.026	0.028	0.031	0.033	0.034	0.036	0.038	0.041	0.043	0.047	0.052	0.056	0.060
0.580	0.031	0.033	0.034	0.037	0.040	0.042	0.043	0.046	0.046	0.049	0.052	0.056	0.061	0.065	0.068
0.600	0.041	0.042	0.043	0.046	0.049	0.052	0.052	0.054	0.056	0.059	0.062	0.066	0.070	0.074	0.078
0.620	0.050	0.051	0.053	0.056	0.059	0.061	0.062	0.064	0.066	0.069	0.071	0.075	0.080	0.084	0.087
0.640	0.061	0.062	0.063	0.066	0.068	0.070	0.072	0.074	0.076	0.079	0.081	0.085	0.089	0.094	0.097
0.660	0.071	0.073	0.074	0.077	0.079	0.081	0.083	0.085	0.087	0.089	0.091	0.096	0.100	0.104	0.106
0.680	0.082	0.084	0.085	0.087	.089	.092	.094	.096	.098	.100	.102	.106	.110	.114	.117
0.700	0.094	0.095	0.096	0.098	0.100	0.103	0.106	0.107	0.109	0.112	0.114	0.117	0.120	0.124	0.127
0.720	0.106	0.105	0.107	0.110	0.112	0.114	0.116	0.119	0.121	0.123	0.125	0.127	0.132	0.135	0.138
0.740	0.116	0.118	0.119	0.122	0.124	0.126	0.126	0.130	0.132	0.136	0.137	0.140	0.143	0.146	0.149
0.760	0.128	0.130	0.131	0.134	0.136	0.138	0.140	0.142	0.144	0.146	0.148	0.152	0.155	0.158	0.161
0.780	0.141	0.143	0.144	0.146	0.148	0.150	0.152	0.154	0.156	0.158	0.160	0.164	0.166	0.170	0.173
0.800	0.153	0.155	0.156	0.159	0.161	0.163	0.165	0.167	0.169	0.171	0.173	0.176	0.179	0.182	0.186
0.820	0.167	0.168	0.169	0.172	0.174	0.176	0.178	0.180	0.182	0.184	0.186	0.189	0.192	0.194	0.197
0.840	0.180	0.182	0.182	0.186	0.188	0.190	0.192	0.194	0.196	0.198	0.199	0.202	0.204	0.208	0.210
0.860	0.194	0.196	0.196	0.199	0.201	0.203	0.205	0.207	0.209	0.211	0.213	0.216	0.218	0.221	0.223
0.880	0.208	0.210	0.211	0.213	0.216	0.217	0.219	0.221	0.223	0.225	0.227	0.229	0.231	0.234	0.237
0.900	0.222	0.224	0.225	0.228	0.230	0.232	0.233	0.235	0.237	0.239	0.242	0.245	0.246	0.248	0.251
0.920	0.236	0.239	0.239	0.242	0.244	0.246	0.247	0.249	0.251	0.253	0.255	0.257	0.260	0.262	0.265
0.940	0.252	0.253	0.254	0.256	0.258	0.260	0.262	0.264	0.266	0.268	0.269	0.272	0.275	0.277	0.280
0.960	0.266	0.268	0.269	0.272	0.274	0.276	0.277	0.279	0.280	0.282	0.284	0.287	0.289	0.292	0.294
0.980	0.282	0.283	0.284	0.287	0.289	0.291	0.292	0.294	0.296	0.298	0.299	0.302	0.305	0.307	0.309
1.000	0.297	0.299	0.300	0.302	0.304	0.306	0.307	0.309	0.311	0.313	0.314	0.318	0.320	0.322	0.326
1.050	0.339	0.340	0.341	0.343	0.344	0.346	0.347	0.349	0.350	0.352	0.355	0.356	0.359	0.361	0.364
1.100	0.384	0.386	0.386	0.387	0.387	0.388	0.389	0.391	0.392	0.394	0.395	0.398	0.401	0.402	0.404
1.150	0.431	0.432	0.433	0.434	0.434	0.435	0.435	0.436	0.437	0.439	0.440	0.442	0.445	0.444	0.447
1.200	0.480	0.481	0.481	0.482	0.482	0.482	0.482	0.483	0.483	0.484	0.484	0.486	0.487	0.489	0.491
1.250	0.529	0.530	0.530	0.531	0.532	0.532	0.532	0.533	0.533	0.534	0.534	0.535	0.535	0.536	0.537
1.300	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.584	0.584	0.583	0.583
1.350	0.637	0.637	0.636	0.636	0.636	0.636	0.635	0.635	0.634	0.634	0.634	0.633	0.633	0.632	0.632
1.400	0.694	0.693	0.692	0.692	0.691	0.691	0.690	0.690	0.689	0.689	0.688	0.687	0.686	0.685	0.683
1.450	0.752	[illegible]	0.751	0.751	0.750	0.750	0.750	0.749	0.747	0.746	0.745	0.745	0.741	0.739	0.735
1.500	0.814	0.814	0.813	0.812	0.811	0.810	0.808	0.808	0.808	0.807	0.805	0.800	0.797	0.794	0.790
1.550	0.877	0.877	0.876	0.875	0.874	0.873	0.872	0.871	0.869	0.867	0.865	0.860	0.855	0.852	0.846
1.600	0.941	0.941	0.940	0.939	0.938	0.937	0.935	0.933	0.931	0.929	0.927	0.921	0.916	0.910	0.904
1.650	1.008	1.007	1.005	1.004	1.003	1.002	1.000	0.998	0.996	0.994	0.991	0.985	0.979	0.970	0.963
1.700	1.076	1.075	1.073	1.071	1.069	1.068	1.066	1.064	1.062	1.060	1.057	1.049	1.042	1.033	1.023
1.750	1.146	1.146	1.143	1.141	1.138	1.137	1.136	1.133	1.130	1.127	1.124	1.116	1.108	1.097	1.086
1.800	1.218	1.216	1.213	1.210	1.207	1.208	1.205	1.203	1.200	1.197	1.193	1.184	1.175	1.163	1.151
1.850	1.291	1.289	1.284	1.283	1.281	1.279	1.277	1.274	1.271	1.268	1.264	1.253	1.246	1.232	1.216
1.900	1.367	1.364	1.360	1.358	1.356	1.356	1.353	1.350	1.346	1.342	1.338	1.327	1.317	1.303	1.283
1.950	1.445	1.442	1.439	1.437	1.434	1.432	1.429	1.426	1.423	1.419	1.415	1.401	1.391	1.378	1.354
2.000	1.525	1.522	1.518	1.515	1.511	1.509	1.506	1.503	1.500	1.496	1.491	1.476	1.465	1.450	1.428
2.050	1.606	1.604	1.600	1.596	1.592	1.592	1.586	1.582	1.576	1.574	1.569	1.553	1.541	1.524	1.502
2.100	1.693	1.688	1.682	1.677	1.672	1.669	1.666	1.662	1.657	1.652	1.647	1.633	1.619	1.600	1.578
2.150	1.780	1.773	1.766	1.761	1.755	1.751	1.748	1.743	1.738	1.733	1.727	1.712	1.696	1.679	1.653
2.200	1.869	1.861	1.855	1.847	1.841	1.837	1.833	1.828	1.822	1.816	1.809	1.793	1.778	1.759	1.736
2.250	1.959	1.951	1.946	1.936	1.929	1.925	1.921	1.918	1.908	1.902	1.896	1.878	1.861	1.843	1.817
2.300	2.052	2.043	2.034	2.027	2.019	2.016	2.012	2.005	1.998	1.991	1.986	1.966	1.948	1.925	1.904
2.350	2.146	2.138	2.130	2.122	2.114	2.110	2.105	2.097	2.089	2.082	2.074	2.056	2.036	2.016	1.992
2.400	2.242	2.234	2.226	2.217	2.209	2.204	2.199	2.191	2.168	2.176	2.169	2.147	2.126	2.107	2.081
2.450	2.343	2.334	2.325	2.317	2.376	2.308	2.298	2.289	2.280	2.272	2.264	2.243	2.221	2.201	2.173
2.500	2.447	2.437	2.427	2.415	2.409	2.404	2.399	2.389	2.379	2.371	2.362	2.339	2.316	2.297	2.269
2.550	-2.554	-2.543	-2.531	-2.523	-2.514	-2.508	-2.501	-2.492	-2.481	-2.477	-2.462	-2.437	-2.415	-2.396	-2.366

TABLE 4

OVERFALL DAM CREST EXPERIMENTS - WEIR INCLINED UPSTREAM ON 3:3 SLOPE
45 DEGREES
COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

X/H_s \ h_a/H_s	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180
	Y/H_s														
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.004	+0.004	+0.004	+0.004	+0.004	+0.004	+0.004	+0.004	+0.004	+0.004	+0.003	+0.003	+0.003	+0.003	+0.003
0.020	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.005
0.030	0.012	0.012	0.012	0.012	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.010	0.009	0.008
0.040	0.016	0.016	0.016	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.014	0.013	0.012	0.012	0.011
0.050	0.020	0.019	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.017	0.017	0.016	0.015	0.014
0.060	0.023	0.023	0.022	0.022	0.022	0.022	0.021	0.021	0.021	0.020	0.020	0.020	0.020	0.019	0.018
0.070	0.026	0.026	0.025	0.025	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.020	0.019
0.080	0.029	0.029	0.029	0.028	0.028	0.027	0.027	0.027	0.027	0.026	0.026	0.025	0.024	0.023	0.021
0.090	0.032	0.032	0.031	0.031	0.030	0.030	0.029	0.029	0.029	0.028	0.028	0.027	0.026	0.024	0.023
0.100	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.029	0.028	0.026	0.025
0.110	0.037	0.037	0.036	0.036	0.035	0.035	0.034	0.034	0.033	0.033	0.032	0.031	0.030	0.028	0.026
0.120	0.039	0.039	0.038	0.038	0.037	0.037	0.036	0.036	0.035	0.035	0.034	0.033	0.032	0.029	0.028
0.130	0.040	0.040	0.039	0.039	0.038	0.038	0.037	0.037	0.036	0.036	0.034	0.033	0.032	0.030	0.028
0.140	0.041	0.041	0.040	0.040	0.039	0.039	0.038	0.038	0.037	0.037	0.036	0.033	0.034	0.031	0.029
0.150	0.042	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.037	0.036	0.035	0.034	0.032	0.029
0.160	0.043	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.038	0.037	0.036	0.036	0.032	0.030
0.170	0.044	0.043	0.042	0.042	0.041	0.041	0.040	0.040	0.039	0.039	0.036	0.037	0.035	0.034	0.030
0.180	0.044	0.043	0.042	0.042	0.041	0.041	0.040	0.040	0.039	0.039	0.038	0.037	0.034	0.032	0.030
0.190	0.044	0.043	0.042	0.042	0.041	0.041	0.040	0.040	0.039	0.039	0.038	0.037	0.036	0.032	0.029
0.200	0.044	0.043	0.042	0.042	0.041	0.041	0.040	0.040	0.039	0.038	0.036	0.037	0.035	0.032	0.029
0.210	0.044	0.043	0.042	0.041	0.041	0.041	0.040	0.040	0.039	0.038	0.037	0.036	0.034	0.031	0.028
0.220	0.043	0.043	0.042	0.042	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.035	0.034	0.030	0.027
0.230	0.042	0.042	0.041	0.041	0.040	0.039	0.038	0.038	0.037	0.037	0.036	0.035	0.033	0.029	0.026
0.240	0.042	0.041	0.040	0.040	0.039	0.038	0.038	0.037	0.036	0.035	0.034	0.033	0.033	0.025	0.025
0.250	0.041	0.040	0.039	0.039	0.038	0.037	0.036	0.036	0.035	0.035	0.034	0.032	0.030	0.027	0.024
0.260	0.040	0.039	0.038	0.038	0.037	0.036	0.035	0.035	0.034	0.033	0.032	0.031	0.029	0.026	0.023
0.270	0.038	0.037	0.036	0.036	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.027	0.024	0.021
0.280	0.037	0.037	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.029	0.028	0.027	0.025	0.022	0.020
0.290	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.030	0.029	0.028	0.027	0.026	0.024	0.020	0.019
0.300	0.034	0.033	0.032	0.032	0.031	0.030	0.029	0.028	0.027	0.026	0.025	0.024	0.022	0.018	0.016
0.310	0.032	0.031	0.030	0.030	0.029	0.028	0.027	0.026	0.025	0.024	0.023	0.022	0.020	0.016	0.013
0.320	0.030	0.029	0.028	0.028	0.027	0.026	0.025	0.024	0.023	0.022	0.021	0.019	0.011	0.014	0.011
0.330	0.028	0.027	0.026	0.026	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017	0.013	0.012	0.008
0.340	0.025	0.025	0.024	0.023	0.022	0.021	0.020	0.019	0.018	0.017	0.016	0.015	0.013	0.010	0.006
0.350	0.022	0.022	0.021	0.021	0.020	0.019	0.016	0.017	0.016	0.015	0.014	0.012	0.010	0.007	0.004
0.360	0.020	0.019	0.018	0.013	0.017	0.017	0.016	0.015	0.014	0.013	0.011	0.010	0.006	0.006	-0.002
0.370	0.018	0.017	0.016	0.016	0.015	0.014	0.013	0.012	0.011	0.010	[illegible]	0.007	0.005	+0.002	-0.001
0.380	0.016	0.016	0.014	0.013	0.012	0.011	0.010	0.009	0.008	0.007	0.006	0.004	+0.002	0.000	0.004
0.390	0.012	0.011	0.010	0.010	0.009	0.008	0.007	0.006	0.005	0.004	+0.005	-0.001	-0.001	-0.003	0.006
0.400	0.009	0.009	0.008	0.007	0.006	0.006	0.005	0.004	+0.003	-0.002	0.000	-0.002	0.004	0.006	0.003
0.410	0.005	0.006	0.004	0.004	+0.002	+0.003	+0.002	+0.001	-0.001	-0.002	-0.003	0.005	0.006	0.003	0.012
0.420	+0.006	+0.002	+0.001	+0.001	0.000	-0.001	-0.001	-0.003	0.004	0.006	0.006	0.009	0.010	0.012	0.016
0.430	[illegible]	-0.001	-0.002	-0.005	-0.005	0.004	0.004	0.006	0.007	0.009	[illegible]	0.011	0.013	0.015	0.019
0.440	-0.006	0.004	0.004	0.006	0.006	0.007	0.008	0.010	0.011	0.012	0.015	0.014	0.016	0.018	0.022
0.450	0.007	0.008	0.008	0.009	0.010	0.011	0.011	0.013	0.014	0.015	0.016	0.018	0.019	0.022	0.025
0.460	0.010	0.011	0.012	0.013	0.014	0.015	0.015	0.017	0.018	0.019	0.020	0.022	0.025	0.025	0.029
0.470	0.014	0.015	0.015	0.016	0.017	0.018	0.018	0.020	0.021	0.022	0.024	0.025	0.026	0.028	0.032
0.480	0.018	0.018	0.019	0.020	0.021	0.022	0.022	0.024	0.025	0.027	0.028	0.029	0.030	0.032	0.035
0.490	0.022	0.023	0.022	0.024	0.025	0.026	0.026	0.028	0.029	0.030	0.031	0.033	0.034	0.036	0.037
0.500	0.026	0.027	0.027	0.028	0.029	0.030	0.030	0.032	0.033	0.034	0.035	0.037	0.038	0.040	0.042
0.520	0.034	0.035	0.036	0.037	0.037	0.038	0.034	0.040	0.041	0.042	0.043	0.045	0.046	0.048	0.050
0.540	0.043	0.044	0.044	0.046	0.046	0.047	0.047	0.049	0.050	0.051	0.052	0.053	0.054	0.056	0.058
0.560	[illegible]	0.053	0.053	0.054	0.055	0.056	0.056	0.057	0.058	0.059	0.060	0.062	0.063	0.065	0.066
0.580	0.062	0.063	0.063	0.064	0.065	0.066	0.066	0.067	0.068	0.069	0.069	0.071	0.072	0.074	0.077
0.600	0.072	0.073	0.073	0.074	0.075	0.076	0.076	0.077	0.077	0.078	0.075	0.080	0.081	0.084	0.085
0.620	0.078	0.083	0.083	0.084	0.085	0.086	0.086	0.087	0.087	0.088	0.088	0.090	0.091	0.095	0.095
0.640	0.093	0.094	0.094	0.095	0.096	0.096	0.096	0.097	0.098	0.098	0.099	0.100	0.101	0.103	0.105
0.660	0.104	0.105	0.105	0.106	0.106	0.106	0.106	0.107	0.108	0.109	0.109	0.110	0.111	0.113	0.115
0.680	0.116	0.116	0.116	0.117	0.117	0.118	0.118	0.119	0.119	0.120	0.120	0.121	0.122	0.124	0.126
0.700	0.126	0.127	0.127	0.128	0.128	0.128	0.129	0.130	0.131	0.132	0.132	0.133	0.133	0.136	0.137
0.720	0.138	0.139	0.139	0.140	0.140	0.141	0.141	0.142	0.142	0.143	0.143	0.144	0.144	0.147	0.149
0.740	0.150	0.151	0.151	0.152	0.152	0.153	0.153	0.154	0.154	0.156	0.155	0.156	0.156	0.158	0.160
0.760	0.162	0.163	0.163	0.164	0.165	0.166	0.166	0.167	0.167	0.167	0.167	0.168	0.168	0.170	0.172
0.780	0.175	0.176	0.176	0.177	0.178	0.179	0.179	0.179	0.179	0.179	0.179	0.180	0.181	0.182	0.185
0.800	0.188	0.189	0.189	0.190	0.190	0.191	0.191	0.192	0.192	0.192	0.192	0.193	0.194	0.196	0.198
0.820	[illegible]	0.202	0.202	0.202	0.203	0.204	0.204	0.204	0.204	0.204	0.204	0.206	0.207	0.208	0.208
0.840	0.214	0.215	0.215	0.216	0.217	0.218	0.218	0.218	0.218	0.218	0.218	0.214	0.218	0.221	0.222
0.860	0.226	0.229	0.229	0.230	0.231	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.234	0.237
0.880	0.243	0.244	0.244	0.243	0.243	0.245	0.245	0.245	0.246	0.245	0.245	0.242	0.246	0.248	0.249
0.900	0.257	0.258	0.258	0.259	0.259	0.260	0.260	0.260	0.260	0.260	0.260	0.261	0.262	0.262	0.264
0.920	0.273	0.273	0.272	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.274	0.275	0.276	0.276	0.279
0.940	0.288	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.290	0.292	0.291	0.288
0.960	0.304	0.305	0.305	0.305	0.306	0.306	0.306	0.306	0.306	0.306	0.306	0.306	0.306	0.307	0.307
0.980	0.319	0.319	0.319	0.319	0.319	0.319	0.319	0.320	0.320	0.320	0.320	0.320	0.320	0.330	0.321
1.000	0.336	0.336	0.336	0.336	0.336	0.336	0.336	0.337	0.337	0.337	0.337	0.337	0.337	0.337	0.337
1.050	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.376	0.376	0.376	0.376	0.375	0.374	0.376
1.100	0.423	0.423	0.422	0.422	0.422	0.422	0.422	0.422	0.422	0.421	0.421	0.420	0.419	0.417	0.416
1.150	0.469	0.468	0.467	0.456	0.466	0.464	0.465	0.465	0.463	0.463	0.462	0.467	0.462	0.467	0.460
1.200	0.519	0.516	0.514	0.514	0.513	0.512	0.511	0.510	0.509	0.508	0.506	0.506	0.505	0.506	0.505
1.250	0.569	0.567	0.564	0.563	0.562	0.561	0.560	0.558	0.557	0.556	0.554	0.554	0.554	0.554	0.550
1.300	0.622	0.620	0.617	0.616	0.614	0.613	0.611	0.610	0.608	0.607	0.606	0.604	0.606	0.601	0.597
1.350	0.677	0.675	0.672	0.671	0.669	0.667	0.666	0.664	0.662	0.660	0.658	0.653	0.655	0.651	0.647
1.400	0.735	0.731	0.728	0.726	0.724	0.722	0.720	0.719	0.717	0.714	0.713	0.711	0.706	0.702	0.698
1.450	0.791	0.788	0.784	0.782	0.780	0.778	0.776	0.775	0.773	0.771	0.769	0.767	0.764	0.757	0.751
1.500	0.849	0.845	0.842	0.841	0.839	0.837	0.835	0.832	0.831	0.829	0.828	0.828	0.818	0.811	0.806
1.550	0.909	0.907	0.904	0.902	0.901	0.899	0.897	0.896	0.892	0.889	0.886	0.882	0.877	0.868	0.861
1.600	0.972	0.970	0.967	0.965	0.963	0.961	0.959	0.957	0.954	0.952	0.949	0.942	0.937	0.927	0.919
1.650	1.039	1.036	1.032	1.030	1.027	1.025	1.022	1.020	1.018	1.016	1.013	1.006	0.999	0.988	0.979
1.700	1.106	1.103	1.100	1.098	1.095	1.093	1.090	1.088	1.086	1.083	1.079	1.071	1.063	1.050	1.039
1.750	1.176	1.173	1.170	1.168	1.165	1.162	1.159	1.156	1.153	1.150	1.147	1.138	1.130	1.115	1.101
1.800	1.248	1.245	1.241	1.238	1.235	1.232	1.229	1.226	1.223	1.220	1.216	1.208	1.196	1.177	1.165
1.850	1.320	1.318	1.315	1.312	1.309	1.305	1.301	1.298	1.294	1.291	1.287	1.276	1.265	1.245	1.229
1.900	1.395	1.393	1.390	1.387	1.382	1.379	1.375	1.372	1.368	1.365	1.361	1.349	1.336	1.313	1.294
1.950	1.474	1.470	1.466	1.462	1.458	1.454	1.450	1.446	1.442	1.438	1.434	1.422	1.409	1.384	1.363
2.000	1.552	1.549	1.545	1.541	1.537	1.532	1.527	1.523	1.518	1.514	1.509	1.495	1.482	1.454	1.433
2.050	1.635	1.631	1.627	1.622	1.617	1.612	1.607	1.601	1.596	1.590	1.585	1.570	1.557	1.525	1.505
2.100	1.718	1.714	1.710	1.705	1.700	1.695	1.689	1.683	1.676	1.670	1.665	1.646	1.633	1.603	1.579
2.150	1.801	1.798	1.794	1.789	1.785	1.778	1.772	1.766	1.759	1.753	1.746	1.729	1.712	1.680	1.654
2.200	1.889	1.885	1.880	1.874	1.864	1.862	1.856	1.849	1.842	1.836	1.828	1.810	1.791	1.756	1.728
2.250	1.980	1.977	1.969	1.962	1.955	1.948	1.941	1.933	1.925	1.921	1.914	1.890	1.872	1.834	1.808
2.300	2.071	2.066	2.061	2.053	2.045	2.037	2.029	2.022	2.015	2.008	2.001	1.979	1.957	1.914	1.889
2.350	2.167	2.161	2.156	2.147	2.138	2.130	2.121	2.114	2.104	2.097	2.089	2.067	2.046	2.005	1.976
2.400	2.262	2.256	2.250	2.241	2.232	2.222	2.214	2.205	2.196	2.187	2.178	2.157	2.136	2.092	2.060
2.450	2.359	2.355	2.347	2.337	2.327	2.317	2.307	2.297	2.288	2.280	2.271	2.248	2.227	2.182	2.150
2.500	2.460	2.454	2.445	2.437	2.426	2.416	2.404	2.394	2.384	2.376	2.364	2.340	2.320	2.276	2.244

TABLE 5

FROM BAZIN'S WEIR EXPERIMENTS
WEIR INCLINED DOWNSTREAM ON 2 TO 1 SLOPE
63.43 DEGREES WITH VERTICAL
COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

Y/H_s

X/H_s \ h_a/H_s	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.003	0.003	0.003	0.003	0.002	0.002	0.002	+0.002
0.020	0.007	0.006	0.005	0.005	0.004	0.004	0.008	0.003
0.030	0.009	0.008	0.007	0.006	0.006	0.005	0.005	0.004
0.040	0.011	0.010	0.009	0.008	0.007	0.006	0.006	0.004
0.050	0.013	0.012	0.011	0.009	0.008	0.007	0.006	0.005
0.060	0.015	0.013	0.012	0.011	0.010	0.008	0.007	0.006
0.070	0.017	0.016	0.014	0.013	0.012	0.010	0.009	0.007
0.080	0.019	0.018	0.016	0.015	0.014	0.012	0.010	0.008
0.090	0.020	0.019	0.018	0.015	0.015	0.013	0.011	0.009
0.100	0.022	0.020	0.019	0.017	0.015	0.013	0.011	0.009
0.110	0.023	0.021	0.019	0.017	0.015	0.013	0.011	0.009
0.120	0.024	0.022	0.020	0.018	0.016	0.014	0.012	0.010
0.130	0.025	0.023	0.020	0.018	0.016	0.014	0.012	0.010
0.140	0.026	0.023	0.021	0.018	0.016	0.014	0.012	0.010
0.150	0.027	0.025	0.022	0.020	0.017	0.015	0.012	0.010
0.160	0.028	0.025	0.023	0.020	0.017	0.015	0.012	0.010
0.170	0.029	0.026	0.023	0.021	0.018	0.015	0.012	0.010
0.180	0.029	0.026	0.023	0.021	0.018	0.015	0.012	0.010
0.190	0.029	0.026	0.023	0.021	0.018	0.015	0.012	0.010
0.200	0.028	0.026	0.023	0.020	0.017	0.015	0.012	0.010
0.210	0.028	0.025	0.022	0.019	0.016	0.014	0.011	0.009
0.220	0.028	0.025	0.022	0.019	0.016	0.014	0.011	0.009
0.230	0.028	0.025	0.022	0.019	0.016	0.013	0.010	0.008
0.240	0.027	0.024	0.021	0.018	0.016	0.013	0.010	0.008
0.250	0.026	0.023	0.020	0.017	0.014	0.012	0.009	0.007
0.260	0.025	0.022	0.019	0.016	0.014	0.011	0.008	0.006
0.270	0.024	0.021	0.018	0.015	0.012	0.010	0.008	0.006
0.280	0.023	0.020	0.017	0.014	0.011	0.009	0.007	0.005
0.290	0.022	0.019	0.016	0.014	0.011	0.009	0.006	0.004
0.300	0.021	0.018	0.016	0.013	0.010	0.008	0.005	0.003
0.310	0.021	0.018	0.015	0.012	0.009	0.006	0.004	0.002
0.320	0.020	0.017	0.014	0.011	0.008	0.006	0.003	+0.001
0.330	+0.019	+0.016	+0.013	+0.010	+0.007	+0.004	+0.002	+0.000
0.340	+0.018	+0.015	+0.012	+0.009	+0.006	+0.003	+0.001	-0.001
0.350	0.017	+0.014	+0.011	+0.008	+0.006	+0.002	0.000	-0.002
0.360	0.015	+0.012	+0.009	+0.006	+0.003	-0.001	-0.001	-0.003
0.370	0.014	+0.011	+0.008	+0.005	+0.002	0.000	-0.002	-0.004
0.380	0.012	+0.009	+0.006	+0.003	+0.001	-0.001	-0.003	-0.006
0.390	0.011	+0.008	+0.005	0.002	-0.001	-0.004	-0.006	-0.008
0.400	0.009	+0.006	+0.003	0.000	-0.003	-0.006	-0.007	-0.009
0.410	0.008	+0.005	+0.002	-0.001	-0.004	-0.006	-0.008	-0.010
0.420	0.006	+0.003	0.0[illegible]	-0.003	-0.006	-0.008	-0.010	-0.012
0.430	0.004	+0.001	-0.004	-0.005	-0.007	-0.009	-0.011	-0.013
0.440	+0.002	-0.001	-0.004	-0.007	-0.009	-0.011	-0.013	-0.015
0.450	0.000	-0.003	-0.006	-0.009	-0.011	-0.013	-0.015	-0.017
0.460	-0.002	-0.006	0.008	-0.010	-0.012	-0.014	-0.016	-0.018
0.470	0.003	0.006	0.009	0.012	0.014	0.016	-0.018	0.020
0.480	0.005	0.008	0.011	0.014	0.016	0.018	0.020	0.022
0.490	0.007	0.010	0.013	0.015	0.017	0.019	0.021	0.023
0.500	0.009	0.012	0.015	0.018	0.020	0.022	0.024	0.026
0.520	0.013	0.016	0.019	0.022	0.024	0.026	0.028	0.030
0.540	0.018	0.021	0.023	0.025	0.027	0.029	0.031	0.033
0.560	0.022	0.025	0.028	0.031	0.033	0.035	0.037	0.039
0.580	-0.027	0.030	0.033	0.036	0.038	0.040	0.042	0.044
0.600	-0.032	-0.035	-0.038	-0.041	-0.043	-0.045	-0.047	-0.049
0.620	0.037	0.040	0.043	0.045	0.047	0.049	0.051	0.053
0.640	0.043	0.046	0.049	0.052	0.054	0.056	0.058	0.060
0.660	0.049	0.052	0.055	0.057	0.059	0.061	0.063	0.065
0.680	0.054	0.057	0.060	0.063	0.065	0.067	0.069	0.071
0.700	0.061	0.064	0.067	0.070	0.072	0.074	0.076	0.078
0.720	0.067	0.070	0.073	0.075	0.077	0.079	0.081	0.083
0.740	0.073	0.076	0.079	0.082	0.084	0.086	0.088	0.090
0.760	0.081	0.084	0.086	0.088	0.090	0.092	0.094	0.096
0.780	0.087	0.090	0.093	0.095	0.097	0.099	0.101	0.103

X/H_s \ h_a/H_s	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070
0.800	-0.093	-0.096	-0.099	-0.101	-0.103	-0.105	-0.107	-0.109
0.820	0.100	0.103	0.106	0.109	0.111	0.113	0.115	0.117
0.840	0.108	0.111	0.113	0.115	0.117	0.119	0.121	0.123
0.860	0.115	0.118	0.121	0.123	0.125	0.127	0.129	0.131
0.880	0.123	0.126	0.128	0.130	0.132	0.134	0.136	0.138
0.900	0.131	0.134	0.136	0.138	0.140	0.142	0.144	0.146
0.920	0.138	0.140	[illegible]	0.145	0.147	0.149	0.151	0.153
0.940	0.147	0.150	0.152	0.154	0.156	0.158	0.160	0.162
0.960	0.155	0.158	0.160	0.162	0.164	0.166	0.168	0.170
0.980	0.163	0.166	0.168	0.170	0.172	0.174	0.176	0.178
1.000	0.172	0.175	0.177	0.179	0.181	0.183	0.185	0.187
1.050	0.196	0.198	0.200	0.202	0.204	0.206	0.206	0.210
1.100	0.220	0.222	0.224	0.226	0.228	0.230	0.232	0.234
1.150	0.245	0.248	0.250	0.252	0.254	0.256	0.259	0.250
1.200	0.272	0.276	0.277	0.279	0.281	0.283	0.285	0.287
1.250	0.298	0.301	0.303	0.305	0.307	0.309	0.311	0.313
1.300	0.328	0.331	0.333	0.335	0.337	0.339	0.341	0.343
1.350	0.358	0.360	0.362	0.364	0.366	0.368	0.370	0.372
1.400	0.387	0.391	0.393	0.395	0.397	0.399	0.401	0.403
1.450	0.419	0.421	0.423	0.425	0.427	0.429	0.431	0.433
1.500	0.451	0.453	0.455	0.457	0.459	0.461	0.463	0.465
1.550	0.484	0.486	0.488	0.490	0.492	0.494	0.496	0.499
1.600	0.518	0.421	0.423	0.425	0.427	0.429	0.531	0.533
1.650	0.553	0.554	0.556	0.558	0.560	0.562	0.564	0.566
1.700	0.589	0.591	0.593	0.595	0.597	0.599	0.601	0.603
1.750	0.625	0.627	0.629	0.631	0.633	0.635	0.637	0.639
1.800	0.663	0.664	0.666	0.668	0.670	0.672	0.674	0.676
1.850	0.703	0.705	0.707	0.708	0.710	0.712	0.714	0.715
1.900	0.743	0.744	0.746	0.748	0.750	0.752	0.754	0.756
1.950	0.782	0.784	0.786	0.788	0.790	0.792	0.794	0.796
2.000	0.825	0.828	0.830	0.832	0.834	0.836	0.838	0.840
2.050	0.868	0.869	0.871	0.873	0.875	0.877	0.879	0.880
2.100	0.912	0.913	0.915	0.917	0.919	0.921	0.923	0.925
2.150	0.957	0.958	0.960	0.962	0.964	0.966	0.967	0.968
2.200	1.003	1.004	1.006	1.008	1.010	1.012	1.013	1.014
2.250	1.051	1.052	1.054	1.056	1.058	1.059	1.060	1.061
2.300	1.100	1.102	1.103	1.104	1.106	1.107	1.108	1.109
2.350	1.150	1.152	1.153	1.154	1.155	1.156	1.157	1.158
2.400	1.200	1.202	1.203	1.204	1.205	1.206	1.207	1.208
2.450	1.249	1.251	1.253	1.254	1.255	1.256	1.257	1.258
2.500	1.300	1.301	1.302	1.303	1.304	1.305	1.306	1.307
2.550	1.351	1.352	1.352	1.354	1.355	1.356	1.357	1.358
2.600	1.403	1.406	1.407	1.408	1.409	1.410	1.411	1.412
2.650	1.458	1.459	1.460	1.461	1.462	1.463	1.464	1.464
2.700	1.513	1.514	1.515	1.516	1.517	1.518	1.519	1.520
2.750	1.569	1.569	1.570	1.571	1.571	1.572	1.573	1.573
2.800	1.626	1.626	1.627	1.628	1.629	1.630	1.631	1.631
2.850	1.683	1.683	1.684	1.685	1.685	1.686	1.687	1.687
2.900	1.740	1.740	1.741	1.741	1.742	1.742	1.743	1.743
2.950	1.798	1.798	1.799	1.799	1.799	1.800	1.800	1.800
3.000	1.859	1.859	1.859	1.859	1.859	1.859	1.859	1.859
3.050	1.918	1.918	1.918	1.918	1.917	1.917	1.917	1.917
3.100	1.980	1.979	1.979	1.978	1.977	1.977	1.976	1.975
3.150	2.042	2.042	2.041	2.040	2.040	2.039	2.038	2.038
3.200	2.105	2.104	2.103	2.102	2.101	2.100	2.099	2.098
3.250	2.168	2.167	2.166	2.165	2.164	2.163	2.162	2.160
3.300	2.231	2.230	2.229	2.227	2.226	2.224	2.223	2.222
3.350	2.295	2.294	2.292	2.291	2.290	2.289	2.287	2.286
3.400	2.360	2.359	2.357	2.356	2.355	2.353	2.352	2.351
3.450	2.427	2.426	2.424	2.423	2.422	2.421	2.420	2.419
3.500	2.493	2.491	2.490	2.488	2.487	2.486	2.484	2.483
3.550	2.560	2.558	2.556	2.554	2.553	2.551	2.549	2.548
3.600	2.627	2.626	2.623	2.621	2.619	2.617	2.614	2.612

TABLE 6

FROM BAZIN'S WEIR EXPERIMENTS
WEIR INCLINED DOWNSTREAM ON 4 TO 1 SLOPE
75.97 DEGREES WITH VERTICAL
COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

Y/H_s

X/H_s \ h_a/H_s	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.002	0.002	0.002	0.002	0.001	0.001	0.001	+0.001
0.020	0.003	0.003	0.002	0.002	0.002	0.001	0.001	0.001
0.030	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
0.040	0.004	0.004	0.003	0.003	0.003	0.002	0.002	0.002
0.050	0.005	0.005	0.005	0.004	0.005	0.003	0.002	0.002
0.060	0.006	0.006	0.006	0.005	0.004	0.003	0.002	0.002
0.070	0.006	0.006	0.005	0.004	0.004	0.003	0.003	0.002
0.080	0.006	0.005	0.006	0.004	0.003	0.003	0.002	0.001
0.090	0.006	0.006	0.005	0.004	0.002	0.002	0.002	+0.001
0.100	0.008	0.008	0.005	0.004	0.003	0.002	0.001	0.000
0.110	0.006	0.005	0.004	0.003	0.002	0.001	0.000	0.000
0.120	0.005	+0.005	+0.004	+0.003	+0.002	+0.001	0.000	-0.001
0.130	0.004	+0.003	+0.002	+0.002	+0.001	+0.001	0.000	0.001
0.140	0.003	+0.003	+0.003	+0.003	-0.002	-0.002	-0.002	-0.002
0.150	0.002	+0.002	+0.002	+0.002	-0.003	-0.003	-0.003	0.003
0.160	+0.001	-0.001	-0.002	-0.002	-0.003	-0.003	-0.004	0.004
0.170	0.000	-0.001	-0.002	-0.003	-0.003	-0.004	-0.004	0.006
0.180	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	0.007
0.190	0.003	0.003	0.004	0.004	0.005	0.008	0.007	0.008
0.200	0.004	0.005	0.006	0.006	0.007	0.007	0.008	0.009
0.210	0.005	0.006	0.007	0.007	0.008	0.008	0.009	0.010
0.220	0.006	0.007	0.007	0.008	0.009	0.010	0.011	0.012
0.230	0.008	0.009	0.009	0.010	0.011	0.012	0.013	0.014
0.240	0.010	0.011	0.011	0.012	0.013	0.014	0.015	0.016
0.250	0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018
0.260	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020
0.270	0.014	0.015	0.014	0.017	0.018	0.019	0.020	0.021
0.280	0.015	0.016	0.017	0.019	0.020	0.021	0.022	0.023
0.290	0.017	0.018	0.019	0.020	0.022	0.023	0.024	0.025
0.300	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027
0.310	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029
0.320	0.023	0.024	0.026	0.026	0.028	0.029	0.030	0.031
0.330	0.026	0.026	0.027	0.028	0.030	0.031	0.032	0.033
0.340	0.028	0.029	0.030	0.031	0.032	0.034	0.035	0.036
0.350	0.030	0.031	0.032	0.033	0.035	0.036	0.037	0.038
0.360	0.031	0.032	0.034	0.035	0.036	0.037	0.039	0.040
0.370	0.033	0.034	0.036	0.037	0.038	0.039	0.041	0.042
0.380	0.036	0.037	0.039	0.040	0.041	0.042	0.044	0.046
0.390	0.038	0.040	0.041	0.042	0.044	0.045	0.047	0.048
0.400	0.041	0.042	0.044	0.045	0.046	0.047	0.049	0.050
0.410	0.043	0.044	0.046	0.047	0.048	0.049	0.051	0.052
0.420	0.045	0.046	0.048	0.049	0.051	0.052	0.054	0.055
0.430	0.047	0.049	0.050	0.052	0.053	0.055	0.056	0.058
0.440	0.050	0.051	0.053	0.054	0.056	0.057	0.059	0.060
0.450	0.052	0.054	0.055	0.057	0.058	0.060	0.061	0.063
0.460	0.055	0.057	0.058	0.060	0.061	0.063	0.064	0.065
0.470	0.058	0.060	0.061	0.063	0.064	0.065	0.067	0.069
0.480	0.061	0.063	0.064	0.066	0.067	0.068	0.070	0.072
0.490	0.063	0.065	0.066	0.068	0.070	0.072	0.073	0.075
0.500	[illegible]	0.068	0.070	0.072	0.073	0.075	0.077	0.079
0.520	0.072	0.074	0.076	0.079	0.079	0.081	0.083	0.085
0.540	0.073	0.080	0.082	0.084	0.085	0.087	0.089	0.091
0.560	0.084	0.086	0.088	0.090	0.092	0.094	0.096	0.099
0.580	0.091	0.093	0.095	0.097	0.099	0.101	0.103	0.106
0.600	0.096	0.100	0.102	0.104	0.106	0.108	0.110	0.112
0.620	0.104	0.106	0.109	0.111	0.113	0.115	0.118	0.120
0.640	0.112	0.114	0.116	0.118	0.120	0.122	0.124	0.126
0.660	0.118	0.120	0.123	0.125	0.127	0.129	0.132	0.134
0.680	0.126	0.128	0.130	0.132	0.135	0.137	0.139	0.141
0.700	0.133	0.135	0.138	0.140	0.142	0.144	0.147	0.149
0.720	0.140	0.142	0.145	0.147	0.150	0.152	0.155	0.157
0.740	0.148	0.150	0.153	0.155	0.158	0.160	0.163	0.165
0.760	0.154	0.158	0.161	0.162	0.166	0.168	0.171	0.173
0.780	0.164	0.166	0.169	0.171	0.174	0.176	0.179	0.181

X/H_s \ h_a/H_s	0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070
0.800	-0.173	-0.175	-0.177	-0.180	-0.183	-0.186	-0.188	-0.190
0.820	0.181	0.184	0.186	0.189	0.191	0.194	0.196	0.198
0.840	0.189	0.192	0.194	0.197	0.199	0.202	0.204	0.207
0.860	0.198	0.201	0.203	0.206	0.208	0.211	0.213	0.216
0.880	0.207	0.210	0.212	0.215	0.217	0.220	0.222	0.225
0.900	0.216	0.219	0.221	0.224	0.226	0.229	0.231	0.234
0.920	0.224	0.227	0.229	0.232	0.235	0.238	0.240	0.243
0.940	0.234	0.237	0.239	0.242	0.244	0.247	0.249	0.252
0.960	0.245	0.247	0.250	0.252	0.254	0.256	0.259	0.261
0.980	0.255	0.257	0.260	0.262	0.264	0.266	0.269	0.272
1.000	0.265	0.267	0.270	0.272	0.274	0.276	0.279	0.281
1.050	0.290	0.295	0.295	0.298	0.300	0.303	0.305	0.308
1.100	0.317	0.319	0.322	0.324	0.327	0.329	0.332	0.334
1.150	0.345	0.347	0.350	0.352	0.354	0.356	0.359	0.361
1.200	0.373	0.375	0.378	0.380	0.383	0.385	0.388	0.390
1.250	0.403	0.405	0.408	0.410	0.413	0.416	0.418	0.420
1.300	0.434	0.436	0.439	0.441	0.443	0.445	0.448	0.450
1.350	0.465	0.467	0.470	0.472	0.475	0.477	0.480	0.482
1.400	0.498	0.500	0.503	0.505	0.508	0.510	0.513	0.515
1.450	0.530	0.533	0.538	0.538	0.541	0.544	0.546	0.549
1.500	0.566	0.568	0.570	0.572	0.575	0.577	0.579	0.581
1.550	0.602	0.604	0.607	0.609	0.611	0.613	0.616	0.618
1.600	0.638	0.640	0.642	0.644	0.647	0.649	0.651	0.653
1.650	0.675	0.677	0.679	0.681	0.684	0.686	0.688	0.690
1.700	0.715	0.717	0.719	0.721	0.723	0.725	0.727	0.729
1.750	0.752	0.754	0.756	0.758	0.761	0.763	0.765	0.767
1.800	0.792	0.795	0.797	0.799	0.801	0.803	0.805	0.807
1.850	0.833	0.835	0.836	0.838	0.840	0.842	0.843	0.846
1.900	0.874	0.876	0.878	0.880	0.881	0.883	0.885	0.887
1.950	0.916	0.918	0.920	0.922	0.924	0.926	0.928	0.930
2.000	0.958	0.960	0.962	0.964	0.966	0.968	0.970	0.972
2.050	1.003	1.006	1.008	1.010	1.012	1.014	1.017	1.019
2.100	1.049	1.051	1.053	1.055	1.058	1.060	1.062	1.064
2.150	1.096	1.098	1.100	1.102	1.104	1.108	1.109	1.110
2.200	1.143	1.145	1.148	1.150	1.152	1.154	1.157	1.159
2.250	1.193	1.195	1.197	1.199	1.202	1.204	1.206	1.208
2.300	1.243	1.245	1.247	1.249	1.251	1.253	1.255	1.257
2.350	1.292	1.294	1.296	1.298	1.299	1.301	1.303	1.305
2.400	1.344	1.346	1.347	1.349	1.350	1.352	1.353	1.355
2.450	1.395	1.397	1.399	1.400	1.401	1.403	1.404	1.406
2.500	1.447	1.449	1.450	1.452	1.453	1.455	1.456	1.458
2.550	1.500	1.501	1.503	1.504	1.506	1.507	1.509	1.510
2.600	1.555	1.556	1.557	1.559	1.560	1.561	1.562	1.563
2.650	1.610	1.611	1.613	1.614	1.615	1.616	1.618	1.619
2.700	1.666	1.667	1.659	1.670	1.671	1.672	1.674	1.675
2.750	1.723	1.724	1.725	1.728	1.727	1.728	1.729	1.730
2.800	1.779	1.780	1.781	1.782	1.782	1.783	1.784	1.785
2.850	1.837	1.838	1.839	1.840	1.841	1.842	1.843	1.844
2.900	1.897	1.898	1.899	1.900	1.901	1.902	1.903	1.904
2.950	1.958	1.959	1.960	1.961	1.962	1.963	1.964	1.965
3.000	2.022	2.023	2.024	2.025	2.026	2.027	2.028	2.029
3.050	2.089	2.089	2.089	2.089	2.090	2.090	2.091	2.091
3.100	2.152	2.153	2.153	2.154	2.154	2.155	2.155	2.155
3.150	2.219	2.219	2.219	2.219	2.220	2.220	2.220	2.220
3.200	2.286	2.286	2.286	2.286	2.285	2.285	2.285	2.285
3.250	2.352	2.352	2.352	2.352	2.352	2.352	2.352	2.352
3.300	2.421	2.421	2.421	2.421	2.420	2.420	2.420	2.420
3.350	2.490	2.490	2.490	2.490	2.489	2.489	2.489	2.489
3.400	2.561	2.561	2.561	2.561	2.560	2.560	2.560	2.560

TABLE V

OVERFALL DAM CREST EXPERIMENTS

WEIR WITH 45-DEGREE UPSTREAM [illegible] (X/N = 0)

COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

h_a/H_s → / X/H_s ↓	Y/H_s 0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140
0.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.010	+0.0470	+0.0423	+0.0376	+0.0330	+0.0300	+0.0270	+0.0240	+0.0213	+0.0186	+0.0160	+0.0144	+0.0117	+0.0092
0.020	0.0640	0.0593	0.0546	0.0500	0.0460	0.0420	0.0380	0.0350	0.0320	0.0290	0.0261	0.0202	0.0161
0.030	0.0756	0.0707	0.0658	0.0608	0.0572	0.0536	0.0500	0.0469	0.0418	0.0378	0.0346	0.0262	0.0229
0.040	0.0840	0.0723	0.0746	0.0700	0.0657	0.0614	0.0572	0.0530	0.0488	0.0445	0.0415	0.0363	0.0284
0.050	0.0920	0.0872	0.0826	0.0740	0.0733	0.0696	0.0640	0.0595	0.0550	0.0505	0.0472	0.0405	0.0356
0.060	0.0985	0.0938	0.0891	0.0848	0.0797	0.0749	0.0700	0.0653	0.0606	0.0560	0.0527	0.0460	0.0373
0.070	0.1045	0.0997	0.0949	0.0900	0.0847	0.0794	0.0740	0.0694	0.0648	0.0602	0.0564	0.0493	0.0404
0.080	0.1100	0.1047	0.0994	0.0942	0.0891	0.0840	0.0790	0.0740	0.0690	0.0640	0.0600	0.0520	0.0428
0.090	0.1150	0.1093	0.1036	0.0980	0.0930	0.0880	0.0830	0.0777	0.0724	0.0670	0.0628	0.0545	0.0448
0.100	0.1193	0.1135	0.1078	0.1020	0.0967	0.0914	0.0860	0.0807	0.0754	0.0700	0.0657	0.0570	0.0471
0.110	0.1225	0.1167	0.1109	0.1052	0.0998	0.0944	0.0890	0.0833	0.0776	0.0720	0.0678	0.0584	0.0488
0.120	0.1260	0.1200	0.1140	0.1080	0.1026	0.0972	0.0918	0.0859	0.0800	0.0742	0.0698	0.0600	0.0503
0.130	0.1288	0.1227	0.1166	0.1105	0.1049	0.0993	0.0936	0.0879	0.0820	0.0760	0.0712	0.0617	0.0514
0.140	0.1313	0.1252	0.1191	0.1130	0.1072	0.1014	0.0955	0.0895	0.0836	0.0776	0.0723	0.0620	0.0523
0.150	0.1335	0.1274	0.1213	0.1153	0.1090	0.1027	0.0963	0.0903	0.0843	0.0784	0.0733	0.0630	0.0530
0.160	0.1350	0.1290	0.1230	0.1170	0.1108	0.1042	0.0977	0.0918	0.0853	0.0790	0.0739	0.0637	0.0534
0.170	0.1368	0.1306	0.1244	0.1182	0.1116	0.1049	0.0983	0.0921	0.0859	0.0798	0.0745	0.0640	0.0535
0.180	0.1382	0.1321	0.1260	0.1200	0.1130	0.1060	0.0990	0.0926	0.0863	0.0800	0.0747	0.0640	0.0533
0.190	0.1400	0.1335	0.1270	0.1204	0.1135	0.1068	0.0997	0.0931	0.0865	0.0800	0.0746	0.0635	0.0532
0.200	0.1405	0.1343	0.1281	0.1218	0.1145	0.1072	0.0998	0.0932	0.0866	0.0800	0.0743	0.0630	0.0528
0.210	0.1418	0.1350	0.1285	0.1220	0.1146	0.1072	0.0997	0.0930	0.0863	0.0797	0.0740	0.0625	0.0518
0.220	0.1420	0.1353	0.1286	0.1220	0.1143	0.1066	0.0990	0.0925	0.0860	0.0795	0.0737	0.0620	0.0513
0.230	0.1420	0.1353	0.1286	0.1219	0.1141	0.1063	0.0985	0.0918	0.0851	0.0786	0.0727	0.0610	0.0506
0.240	0.1418	0.1351	0.1284	0.1218	0.1138	0.1058	0.0977	0.0912	0.0846	0.0780	0.0720	0.0600	0.0493
0.250	0.1418	0.1351	0.1284	0.1216	0.1132	0.1048	0.0968	0.0900	0.0835	0.0770	0.0710	0.0590	0.0480
0.260	0.1417	0.1346	0.1275	0.1204	0.1122	0.1040	0.0958	0.0892	0.0824	0.0760	0.0699	0.0578	0.0467
0.270	0.1416	0.1344	0.1272	0.1200	0.1115	0.1030	0.0946	0.0876	0.0811	0.0745	0.0686	0.0567	0.0452
0.280	0.1410	0.1337	0.1264	0.1190	0.1106	0.1022	0.0938	0.0871	0.0804	0.0736	0.0677	0.0558	0.0439
0.290	0.1402	0.1327	0.1252	0.1178	0.1092	0.1006	0.0920	0.0853	0.0786	0.0720	0.0660	0.0540	0.0419
0.300	0.1396	0.1317	0.1238	0.1160	0.1077	0.0994	0.0910	0.0840	0.0770	0.0700	0.0640	0.0520	0.0400
0.310	0.1380	0.1302	0.1224	0.1147	0.1063	0.0979	0.0895	0.0824	0.0753	0.0683	0.0625	0.0510	0.0382
0.320	0.1375	0.1293	0.1211	0.1130	0.1047	0.0964	0.0880	0.0810	0.0740	0.0670	0.0612	0.0496	0.0362
0.330	0.1360	0.1277	0.1194	0.1110	0.1027	0.0944	0.0860	0.0791	0.0722	0.0653	0.0592	0.0470	0.0339
0.340	0.1342	0.1259	0.1176	0.1093	0.1009	0.0925	0.0840	0.0772	0.0704	0.0635	0.0572	0.0445	0.0315
0.350	0.1326	0.1242	0.1159	0.1075	0.0990	0.0905	0.0820	0.0752	0.0684	0.0615	0.0551	0.0422	0.0289
0.360	0.1307	0.1225	0.1143	0.1060	0.0975	0.0886	0.0800	0.0731	0.0662	0.0593	0.0529	0.0400	0.0267
0.370	0.1290	0.1207	0.1124	0.1040	0.0953	0.0866	0.0780	0.0708	0.0636	0.0565	0.0502	0.0377	0.0244
0.380	0.1270	0.1185	0.1100	0.1015	0.0929	0.0843	0.0757	0.0685	0.0613	0.0540	0.0477	0.0350	0.0217
0.390	0.1248	0.1161	0.1076	0.0990	0.0903	0.0816	0.0730	0.0660	0.0590	0.0520	0.0453	0.0320	0.0188
0.400	0.1225	0.1137	0.1049	0.0962	0.0876	0.0790	0.0703	0.0633	0.0563	0.0493	0.0424	0.0296	0.0153
0.410	0.1202	0.1115	0.1028	0.0940	0.0853	0.0766	0.0680	0.0606	0.0536	0.0464	0.0396	0.0260	0.0127
0.420	0.1180	0.1093	0.1006	0.0918	0.0829	0.0740	0.0650	0.0579	0.0508	0.0435	0.0369	0.0232	0.0101
0.430	0.1150	0.1062	0.0974	0.0886	0.0798	0.0710	0.0622	0.0550	0.0478	0.0405	0.0337	0.0200	0.0067
0.440	0.1120	0.1033	0.0946	0.0860	0.0770	0.0680	0.0590	0.0510	0.0460	0.0380	0.0310	0.0170	0.0042
0.450	0.1097	0.1006	0.0915	0.0823	0.0735	0.0647	0.0560	0.0488	0.0416	0.0345	0.0276	0.0136	+0.0008
0.460	0.1060	0.0973	0.0886	0.0800	0.0710	0.0620	0.0530	0.0458	0.0386	0.0315	0.0243	0.0100	-0.0023
0.470	0.1034	0.0943	0.0852	0.0762	0.0674	0.0586	0.0497	0.0425	0.0353	0.0280	0.0208	0.0063	0.0059
0.480	0.1000	0.0910	0.0820	0.0730	0.0640	0.0550	0.0460	0.0387	0.0314	0.0240	0.0172	+0.0036	0.0092
0.490	[illegible].0960	0.0872	0.0784	0.0696	0.0606	0.0514	0.0423	0.0350	0.0277	0.0206	0.0137	0.0000	0.0120
0.500	0.093	0.084	0.075	0.066	0.057	0.048	0.039	0.032	0.024	0.017	0.010	-0.004	0.016
0.520	0.085	0.076	0.067	0.058	0.049	0.040	0.032	0.025	0.018	0.010	+0.003	0.012	0.024
0.540	0.077	0.068	0.059	0.051	0.047	0.033	0.023	0.016	+0.009	+0.001	-0.006	0.020	0.032
0.560	0.066	0.059	0.050	0.042	0.033	0.024	0.015	+0.006	0.000	-0.008	0.016	0.028	0.037
0.580	0.059	0.050	0.041	0.033	0.024	0.015	+0.006	-0.002	-0.010	0.017	0.024	0.037	0.042
0.600	0.049	0.041	0.033	0.024	0.015	+0.006	-0.003	0.011	0.019	0.026	0.033	0.046	0.058
0.620	0.039	0.031	0.023	0.014	+0.005	-0.004	0.013	0.021	0.029	0.036	0.043	0.056	0.068
0.640	0.029	0.021	+0.012	+0.003	-0.006	0.016	0.023	0.031	0.039	0.047	0.053	0.066	0.077
0.660	0.018	+0.009	0.000	-0.008	0.017	0.026	0.034	0.042	0.050	0.058	0.064	0.076	0.087
0.680	+0.006	-0.002	-0.010	0.018	0.027	0.036	0.045	0.053	0.061	0.068	0.074	0.087	0.098
0.700	-0.006	0.013	0.022	0.030	0.039	0.048	0.056	0.064	0.072	0.080	0.086	0.098	0.109
0.720	0.017	0.025	0.033	0.042	0.051	0.060	0.068	0.076	0.084	0.092	0.098	0.110	0.119
0.740	0.029	0.037	0.045	0.054	0.063	0.072	0.080	0.088	0.096	0.105	0.109	0.121	0.131
0.760	0.042	0.050	0.058	0.066	0.075	0.084	0.092	0.100	0.108	0.116	0.122	0.133	0.142
0.780	0.054	0.062	0.070	0.079	0.088	0.097	0.106	0.113	0.121	0.128	0.134	0.145	0.154
0.800	0.066	0.075	0.084	0.092	0.101	0.110	0.119	0.126	0.133	0.141	0.146	0.157	0.166
0.820	0.080	0.089	0.098	0.106	0.115	0.124	0.132	0.139	0.146	0.152	0.158	0.170	0.179
0.840	0.093	0.102	0.111	0.120	0.129	0.138	0.146	0.153	0.160	0.168	0.173	0.184	0.192
0.860	0.107	0.116	0.125	0.135	0.143	0.151	0.160	0.167	0.174	0.182	0.187	0.196	0.205
0.880	0.121	0.130	0.139	0.148	0.157	0.166	0.175	0.182	0.189	0.196	0.200	0.211	0.219
0.900	0.136	0.145	0.154	0.163	0.172	0.181	0.190	0.197	0.204	0.210	0.215	0.224	0.232
0.920	0.152	0.161	0.170	0.178	0.187	0.196	0.204	0.211	0.218	0.226	0.230	0.239	0.246
0.940	0.167	0.176	0.185	0.194	0.203	0.212	0.220	0.227	0.234	0.241	0.245	0.254	0.261
0.960	0.182	0.191	0.200	0.209	0.218	0.227	0.235	0.243	0.250	0.256	0.260	0.269	0.275
0.980	0.199	0.207	0.215	0.224	0.233	0.242	0.251	0.258	0.265	0.272	0.276	0.284	0.291
1.000	0.215	0.224	0.233	0.242	0.250	0.258	0.266	0.274	0.282	0.290	0.293	0.300	0.307
1.050	0.260	0.268	0.276	0.284	0.292	0.300	0.308	0.316	0.324	0.332	0.335	0.342	0.346
1.100	0.306	0.313	0.321	0.328	0.336	0.344	0.352	0.360	0.368	0.375	0.378	0.383	0.386
1.150	0.352	0.360	0.368	0.375	0.382	0.389	0.396	0.404	0.412	0.419	0.421	0.426	0.429
1.200	0.403	0.410	0.417	0.423	0.430	0.437	0.443	0.450	0.457	0.465	0.467	0.471	0.475
1.250	0.456	0.463	0.470	0.476	0.481	0.486	0.492	0.499	0.506	0.512	0.514	0.515	0.518
1.300	0.512	0.518	0.524	0.530	0.535	0.540	0.544	0.549	0.554	0.560	0.562	0.565	0.564
1.350	0.569	0.574	0.579	0.585	0.589	0.593	0.598	0.603	0.608	0.612	0.613	0.616	0.613
1.400	0.630	0.634	0.638	0.642	0.646	0.650	0.653	0.657	0.661	0.664	0.665	0.668	0.664
1.450	0.692	0.695	0.698	0.702	0.705	0.708	0.710	0.713	0.718	0.719	0.719	0.720	0.717
1.500	0.756	0.758	0.760	0.762	0.764	0.766	0.769	0.771	0.773	0.776	0.776	0.776	0.771
1.550	0.823	0.824	0.825	0.827	0.828	0.829	0.830	0.832	0.834	0.835	0.835	0.834	0.828
1.600	0.892	0.892	0.893	0.894	0.894	0.895	0.896	0.896	0.896	0.896	0.895	0.894	0.885
1.650	0.960	0.960	0.961	0.962	0.962	0.962	0.962	0.961	0.961	0.961	0.958	0.954	0.947
1.700	1.032	1.032	1.033	1.033	1.033	1.032	1.031	1.029	1.027	1.026	1.023	1.019	1.012
1.750	1.108	1.108	1.108	1.108	1.106	1.104	1.102	1.099	1.096	1.093	1.089	1.081	1.074
1.800	1.183	1.183	1.182	1.181	1.179	1.177	1.174	1.171	1.168	1.164	1.159	1.150	1.142
1.850	1.260	1.259	1.258	1.256	1.253	1.250	1.248	1.244	1.240	1.236	1.231	1.220	1.211
1.900	1.340	1.338	1.336	1.333	1.330	1.327	1.324	1.320	1.316	1.313	1.306	1.293	1.282
1.950	1.424	1.420	1.418	1.413	1.410	1.407	1.405	1.399	1.395	1.393	1.382	1.366	1.356
2.000	1.509	1.506	1.501	1.496	1.492	1.488	1.483	1.478	1.473	1.468	1.461	1.446	1.431
2.050	1.595	1.591	1.587	1.582	1.576	1.570	1.564	1.559	1.554	1.548	1.540	1.524	1.507
2.100	1.683	1.679	1.675	1.670	1.663	1.656	1.649	1.642	1.636	1.630	1.622	1.605	1.585
2.150	1.777	1.767	1.762	1.758	1.751	1.744	1.736	1.729	1.722	1.718	1.707	1.688	1.665
2.200	-1.865	-1.859	-1.853	-1.849	-1.840	-1.837	-1.824	-1.817	-1.812	-1.807	[illegible]	-1.772	-1.746
2.250	[illegible]	[illegible]	1.948	1.940	1.931	1.922	1.914	[illegible]	1.898	1.890	1.879	1.856	1.826

TABLE 8

OVERFALL DAM CREST EXPERIMENTS

WITH [illegible] 45-DEGREE OFFSET AND RISERS

COORDINATES OF LOWER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

FOR $\frac{P}{H}$ = 0.5 to 5.0

$\frac{X}{H_s}$ \ h_a/H_s	Y/H_s 0.002	0.010	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.012	0.014
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.010	+0.017	+0.016	+0.016	+0.015	+0.014	+0.014	+0.013	+0.012	0.012	+0.011	+0.010	+0.009	0.008
0.020	0.029	0.028	0.027	0.026	0.026	0.025	0.025	0.024	0.022	0.021	0.020	0.017	0.014
0.030	0.041	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.028	0.024	0.020
0.040	0.050	0.049	0.047	0.045	0.043	0.042	0.041	0.040	0.039	0.037	0.035	0.030	0.025
0.050	0.059	0.057	0.055	0.053	0.052	0.050	0.048	0.048	0.046	0.044	0.041	0.035	0.029
0.060	0.066	0.063	0.061	0.059	0.057	0.056	0.055	0.053	0.051	0.049	0.046	0.039	0.032
0.070	0.072	0.069	0.067	0.065	0.063	0.061	0.060	0.058	0.056	0.054	0.050	0.043	0.035
0.080	0.077	0.074	0.072	0.070	0.068	0.066	0.064	0.062	0.060	0.058	0.054	0.046	0.038
0.090	0.082	0.079	0.077	0.075	0.073	0.070	0.068	0.066	0.064	0.061	0.057	0.049	0.041
0.100	0.087	0.085	0.082	0.079	0.077	0.074	0.071	0.069	0.067	0.064	0.060	0.053	0.042
0.110	0.091	0.088	0.085	0.082	0.079	0.076	0.074	0.072	0.069	0.066	0.062	0.053	0.044
0.120	0.095	0.092	0.089	0.086	0.083	0.080	0.076	0.074	0.071	0.069	0.064	0.054	0.044
0.130	0.098	0.095	0.092	0.089	0.086	0.083	0.079	0.076	0.073	0.070	0.065	0.055	0.045
0.140	0.100	0.097	0.094	0.091	0.088	0.085	0.081	0.078	0.075	0.072	0.067	0.056	0.045
0.150	0.102	0.099	0.096	0.093	0.089	0.086	0.083	0.080	0.077	0.073	0.068	0.057	0.046
0.160	0.105	0.102	0.098	0.095	0.092	0.088	0.084	0.080	0.076	0.073	0.068	0.057	0.046
0.170	0.106	0.103	0.099	0.096	0.093	0.089	0.086	0.082	0.078	0.074	0.069	0.058	0.047
0.180	0.108	0.105	0.101	0.097	0.094	0.091	0.087	0.083	0.079	0.074	0.069	0.058	0.047
0.190	0.109	0.106	0.102	0.098	0.095	0.092	0.088	0.084	0.080	0.075	0.069	0.058	0.047
0.200	0.110	0.107	0.103	0.099	0.095	0.091	0.088	0.084	0.080	0.075	0.069	0.058	0.047
0.210	0.111	0.108	0.104	0.100	0.096	0.092	0.088	0.083	0.078	0.074	0.068	0.057	0.046
0.220	0.112	0.109	0.105	0.101	0.096	0.092	0.088	0.083	0.078	0.074	0.068	0.057	0.046
0.230	0.113	0.109	0.105	0.101	0.096	0.092	0.088	0.083	0.078	0.074	0.068	0.056	0.044
0.240	0.113	0.109	0.105	0.100	0.095	0.091	0.087	0.082	0.077	0.073	0.067	0.055	0.043
0.250	0.114	0.110	0.105	0.100	0.095	0.091	0.087	0.082	0.077	0.072	0.066	0.054	0.042
0.260	0.114	0.110	0.105	0.100	0.096	0.091	0.086	0.081	0.076	0.071	0.065	0.053	0.041
0.270	0.114	0.109	0.104	0.099	0.095	0.090	0.085	0.080	0.075	0.070	0.064	0.052	0.040
0.280	0.113	0.109	0.104	0.099	0.094	0.089	0.084	0.079	0.074	0.069	0.063	0.051	0.039
0.290	0.112	0.108	0.103	0.098	0.093	0.088	0.083	0.078	0.073	0.068	0.062	0.049	0.036
0.300	0.112	0.107	0.102	0.097	0.092	0.087	0.082	0.077	0.072	0.066	0.060	0.047	0.034
0.310	0.111	0.106	0.101	0.096	0.091	0.085	0.080	0.075	0.070	0.065	0.059	0.046	0.033
0.320	0.110	0.105	0.100	0.095	0.089	0.083	0.078	0.073	0.068	0.063	0.057	0.044	0.031
0.330	0.109	0.103	0.098	0.093	0.087	0.081	0.076	0.071	0.066	0.061	0.055	0.042	0.029
0.340	0.107	0.102	0.097	0.092	0.086	0.080	0.074	0.069	0.064	0.060	0.053	0.040	0.027
0.350	0.106	0.100	0.095	0.090	0.084	0.078	0.072	0.067	0.062	0.057	0.051	0.038	0.025
0.360	0.104	0.098	0.093	0.088	0.083	0.077	0.071	0.066	0.061	0.056	0.049	0.036	0.023
0.370	0.103	0.098	[illegible]	0.086	0.080	0.074	0.068	0.063	0.058	0.055	0.047	0.034	0.021
0.380	0.101	0.096	0.090	0.084	0.078	0.072	0.066	0.061	0.056	0.051	0.044	0.031	0.018
0.390	0.099	0.094	0.088	0.082	0.076	0.070	0.064	0.059	0.054	0.048	0.042	0.029	0.016
0.400	0.096	0.090	0.085	0.080	0.074	0.068	0.062	0.056	0.051	0.046	0.039	0.025	0.011
0.410	0.094	0.099	0.083	0.077	0.071	0.065	0.059	0.054	0.049	0.043	0.037	0.024	0.011
0.420	0.092	0.087	0.081	0.075	0.069	0.063	0.057	0.052	0.047	0.041	0.034	0.021	0.008
0.430	0.088	0.082	0.077	0.072	0.066	0.060	0.054	0.049	0.044	0.038	0.031	0.018	0.005
0.440	0.086	0.080	0.075	0.070	0.063	0.057	0.051	0.046	0.041	0.035	0.028	0.015	+0.002
0.450	0.083	0.077	0.072	0.067	0.060	0.054	0.048	0.043	0.038	0.032	0.025	0.012	-0.001
0.460	0.080	0.075	0.070	0.064	0.057	0.051	0.045	0.040	0.035	0.029	0.022	0.009	0.004
0.470	0.077	0.072	0.065	0.060	0.054	0.048	0.042	0.037	0.032	0.026	0.019	0.006	0.007
0.480	0.074	0.069	0.063	0.057	0.051	0.045	0.039	0.034	0.028	0.022	0.016	+0.003	0.009
0.490	0.071	0.066	0.060	0.054	0.047	0.041	0.035	0.030	0.025	0.019	0.012	-0.001	0.014
0.500	0.068	0.065	0.057	0.051	0.045	0.039	0.032	0.026	0.020	0.015	+0.008	0.005	0.018
0.520	0.060	0.054	0.049	0.044	0.037	0.031	0.025	0.019	0.013	+0.007	0.000	0.012	0.024
0.540	0.053	0.048	0.043	0.038	0.031	0.024	0.017	0.011	+0.005	-0.001	-0.008	0.020	0.032
0.560	0.045	0.040	0.034	0.028	0.022	0.016	+0.009	+0.003	-0.003	0.009	0.015	0.028	0.041
0.580	0.036	0.031	0.025	0.019	0.013	+0.006	0.000	-0.006	0.012	0.018	0.024	0.037	0.050
0.600	0.027	0.022	0.016	0.010	+0.003	-0.003	-0.009	0.015	0.021	0.027	0.033	0.046	0.059
0.620	0.018	0.015	+0.007	+0.001	-0.006	0.012	0.018	0.024	0.030	0.037	0.043	0.056	0.069
0.640	+0.008	+0.003	-0.003	-0.009	0.016	0.022	0.028	0.034	0.040	0.047	0.053	0.066	0.079
0.660	-0.002	-0.008	0.014	0.019	0.025	0.032	0.039	0.045	0.051	0.058	0.064	0.076	0.088
0.680	0.012	0.018	0.024	0.030	0.037	0.043	0.049	0.055	0.061	0.066	0.074	0.087	0.100
0.700	0.023	0.029	0.035	0.041	0.040	0.055	0.061	0.067	0.073	0.079	0.085	0.098	0.111
0.720	0.034	0.040	0.046	0.053	0.059	0.065	0.072	0.078	0.084	0.090	0.096	0.109	0.122
0.740	0.045	0.051	0.057	0.064	0.071	0.078	0.084	0.090	0.096	0.102	0.108	0.121	0.134
0.760	0.057	0.064	0.071	0.078	0.084	0.090	0.096	0.102	0.108	0.114	0.120	0.133	0.146
0.780	0.069	0.076	0.083	0.089	0.095	0.102	0.108	0.114	0.120	0.126	0.132	0.145	0.158
0.800	0.082	0.089	0.096	0.102	0.109	0.116	0.122	0.128	0.134	0.140	0.146	0.158	0.170
0.820	0.094	0.101	0.108	0.115	0.121	0.128	0.134	0.140	0.146	0.153	0.159	0.171	0.193
0.840	0.107	0.114	0.121	0.128	0.134	0.140	0.147	0.154	0.161	0.167	0.173	0.184	0.195
0.860	0.121	0.128	0.135	0.141	0.148	0.155	0.161	0.168	0.175	0.181	0.187	0.198	0.209
0.880	0.135	0.142	0.149	0.155	0.162	0.169	0.175	0.182	0.189	0.195	0.200	0.211	0.222
0.900	0.150	0.156	0.162	0.169	0.176	0.183	0.190	0.197	0.204	0.210	0.215	0.225	0.235
0.920	0.164	0.171	0.178	0.184	0.191	0.198	0.204	0.211	0.218	0.225	0.230	0.240	0.250
0.940	0.179	0.186	0.193	0.199	0.206	0.213	0.219	0.226	0.233	0.240	0.245	0.254	0.265
0.960	0.195	0.201	0.207	0.214	0.221	0.228	0.235	0.242	0.249	0.255	0.260	0.269	0.278
0.980	0.210	0.217	0.224	0.230	0.237	0.244	0.250	0.257	0.264	0.271	0.275	0.284	0.293
1.000	0.226	0.233	0.240	0.246	0.253	0.260	0.267	0.273	0.279	0.286	0.291	0.300	0.309
1.050	0.268	0.274	0.280	0.287	0.294	0.301	0.308	0.315	0.322	0.328	0.332	0.341	0.350
1.100	0.311	0.318	0.325	0.331	0.338	0.345	0.351	0.358	0.365	0.371	0.375	0.383	0.391
1.150	0.355	0.362	0.367	0.376	0.383	0.390	0.396	0.402	0.408	0.415	0.419	0.427	0.435
1.200	0.404	0.411	0.418	0.424	0.430	0.437	0.443	0.449	0.455	0.461	0.465	0.474	0.483
1.250	0.453	0.460	0.467	0.473	0.480	0.486	0.493	0.498	0.503	0.509	0.513	0.521	0.529
1.300	0.506	0.513	0.518	0.524	0.531	0.538	0.545	0.550	0.555	0.559	0.563	0.572	0.581
1.350	0.560	0.566	0.572	0.578	0.585	0.592	0.598	0.602	0.606	0.611	0.615	0.623	0.631
1.400	0.617	0.623	0.629	0.634	0.640	0.646	0.652	0.657	0.662	0.666	0.669	0.676	0.683
1.450	0.677	0.682	0.687	0.692	0.698	0.703	0.709	0.713	0.717	0.721	0.724	0.731	0.738
1.500	0.739	0.743	0.747	0.752	0.757	0.762	0.767	0.771	0.775	0.779	0.782	0.787	0.792
1.550	0.802	0.806	0.810	0.815	0.819	0.823	0.827	0.831	0.835	0.839	0.840	0.843	0.846
1.600	0.868	0.871	0.874	0.878	0.882	0.886	0.890	0.893	0.897	0.900	0.900	0.900	0.900
1.650	0.935	0.936	0.939	0.943	0.948	0.953	0.957	0.959	0.961	0.963	0.962	0.960	0.958
1.700	1.002	1.004	1.006	1.009	1.013	1.017	1.021	1.023	1.025	1.027	1.045	1.021	1.017
1.750	1.073	1.075	1.077	1.080	1.083	1.086	1.089	1.090	1.091	1.092	1.090	1.085	1.080
1.800	1.148	1.150	1.152	1.154	1.156	1.158	1.160	1.160	1.160	1.160	1.157	1.150	1.143
1.850	1.228	1.229	1.230	1.231	1.231	1.231	1.231	1.231	1.231	1.231	1.228	1.221	1.214
1.900	1.308	1.308	1.308	1.308	1.308	1.309	1.307	1.307	1.305	1.304	1.300	1.293	1.286
1.950	1.392	1.392	1.392	1.392	1.390	1.388	1.385	1.383	1.381	1.379	1.375	1.368	1.361
2.000	1.479	1.477	1.475	1.474	1.470	1.467	1.464	1.461	1.458	1.455	1.452	1.446	1.438
2.050	1.564	1.563	1.561	1.559	1.556	1.552	1.544	1.544	1.539	1.534	1.531	1.524	1.517
2.100	1.651	1.649	1.647	1.644	1.639	1.635	1.631	1.626	1.621	1.615	1.612	1.603	1.596
2.150	1.739	1.736	1.733	1.730	1.725	1.720	1.715	1.710	1.705	1.700	1.695	1.686	1.677
2.200	1.830	1.826	1.822	1.817	1.812	1.807	1.802	1.797	1.791	1.785	1.780	1.770	1.760

TABLE NO 9

OVERFALL DAM CREST EXPERIMENTS

WEIR WITH VERTICAL UPSTREAM FACE

COORDINATES OF UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

X/H_s \ h_a/H_s	Y/H_s: 0.002	0.020	0.040	0.060	0.080	0.100	0.120	0.140	0.160	0.180	0.200
-4.000	+0.990										
3.900	0.990										
3.800	0.990										
3.700	0.990	+0.974	+0.958								
3.600	0.990	0.974	0.958								
3.500	0.990	0.974	0.958	+0.934	+0.911						
3.400	0.990	0.974	0.957	0.934	0.910						
3.300	0.990	0.972	0.955	0.932	0.910						
3.200	0.990	0.972	0.954	0.932	0.910	+0.878					
3.100	0.989	0.971	0.953	0.932	0.910	0.877					
3.000	0.988	0.970	0.952	0.931	0.910	0.876	+0.844	+0.812			
2.900	0.988	0.969	0.950	0.930	0.910	0.876	0.844	0.812			
2.800	0.987	0.968	0.950	0.930	0.909	0.874	0.843	0.811			
2.700	0.986	0.968	0.949	0.929	0.909	0.873	0.842	0.811			
2.600	0.985	0.966	0.948	0.928	0.908	0.872	0.841	0.810			
2.500	0.984	0.966	0.947	0.928	0.908	0.872	0.841	0.810	+0.782		
2.400	0.983	0.965	0.947	0.927	0.907	0.871	0.840	0.809	0.781		
2.300	0.982	0.964	0.946	0.926	0.906	0.871	0.840	0.809	0.780		
2.200	0.981	0.963	0.945	0.925	0.905	0.870	0.839	0.808	0.779	+0.760	+0.743
2.100	0.980	0.962	0.944	0.924	0.904	0.870	0.839	0.808	0.778	0.760	0.742
2.000	0.979	0.961	0.943	0.923	0.903	0.869	0.838	0.807	0.777	0.758	0.741
1.900	0.978	0.960	0.942	0.922	0.903	0.869	0.838	0.807	0.776	0.758	0.740
1.800	0.977	0.959	0.941	0.922	0.902	0.868	0.837	0.806	0.776	0.757	0.739
1.700	0.976	0.958	0.940	0.920	0.901	0.868	0.837	0.806	0.775	0.756	0.738
1.600	0.974	0.956	0.939	0.920	0.901	0.867	0.836	0.805	0.774	0.755	0.737
1.500	0.972	0.955	0.938	0.919	0.900	0.866	0.835	0.804	0.773	0.754	0.736
1.400	0.970	0.954	0.937	0.918	0.899	0.865	0.834	0.803	0.771	0.753	0.735
1.300	0.967	0.952	0.936	0.917	0.898	0.864	0.833	0.802	0.770	0.752	0.734
1.200	0.964	0.949	0.934	0.916	0.897	0.863	0.832	0.801	0.769	0.751	0.733
1.100	0.961	0.946	0.931	0.914	0.894	0.861	0.831	0.800	0.768	0.750	0.732
1.000	0.958	0.944	0.929	0.911	0.892	0.859	0.829	0.799	0.767	0.749	0.731
0.900	0.952	0.938	0.924	0.907	0.890	0.856	0.827	0.798	0.765	0.747	0.730
0.800	0.947	0.934	0.920	0.902	0.885	0.850	0.822	0.795	0.763	0.745	0.727
0.700	0.940	0.926	0.913	0.896	0.880	0.846	0.820	0.793	0.761	0.742	0.724
0.600	0.930	0.918	0.907	0.890	0.873	0.840	0.816	0.790	0.759	0.740	0.721
0.500	0.921	0.910	0.898	0.882	0.865	0.832	0.808	0.783	0.755	0.736	0.718
0.400	0.911	0.899	0.887	0.872	0.856	0.823	0.800	0.777	0.750	0.731	0.713
0.300	0.899	0.886	0.873	0.858	0.844	0.812	0.791	0.770	0.744	0.726	0.707
0.200	0.883	0.871	0.859	0.844	0.830	0.800	0.780	0.760	0.735	0.718	0.700
-0.100	0.866	0.853	0.840	0.826	0.812	0.784	0.766	0.748	0.724	0.708	0.692
0.000	0.845	0.832	0.819	0.804	0.790	0.764	0.748	0.732	0.710	0.696	0.682
+0.100	0.820	0.806	0.793	0.780	0.767	0.740	0.726	0.713	0.693	0.680	0.667
0.200	0.790	0.778	0.765	0.752	0.738	0.717	0.703	0.690	0.671	0.660	0.650
0.300	0.765	0.742	0.730	0.718	0.706	0.686	0.673	0.660	0.644	0.636	0.627
0.400	0.714	0.702	0.690	0.680	0.669	0.650	0.637	0.625	0.610	0.603	0.595
0.500	0.670	0.658	0.645	0.634	0.624	0.608	0.596	0.583	0.570	0.564	0.558
0.600	0.619	0.606	0.594	0.584	0.575	0.558	0.546	0.533	0.523	0.518	0.512
0.700	0.560	0.548	0.536	0.528	0.519	0.500	0.490	0.480	0.470	0.465	0.460
0.800	0.494	0.482	0.470	0.462	0.453	0.440	0.429	0.418	0.410	0.404	0.400
0.900	0.425	0.412	0.400	0.390	0.380	0.368	0.359	0.349	0.340	0.335	0.330
1.000	0.344	0.332	0.320	0.310	0.300	0.290	0.280	0.270	0.263	0.258	0.253
1.100	0.252	0.241	0.230	0.222	0.213	0.200	0.194	0.188	0.180	0.175	0.170
1.200	0.153	0.144	0.134	0.127	0.120	0.108	+0.102	+0.096	+0.088	+0.083	+0.078
1.300	+0.048	+0.039	+0.030	+0.024	+0.018	+0.005	0.000	-0.005	-0.012	-0.016	-0.021
1.400	-0.067	-0.074	-0.080	-0.086	-0.091	-0.104	-0.108	0.112	0.120	0.125	0.130
1.500	0.190	0.195	0.200	0.205	0.210	0.220	0.225	0.230	0.240	0.244	0.245
1.600	0.317	0.322	0.328	0.332	0.336	0.349	0.352	0.355	0.362	0.366	0.370
1.700	0.450	0.456	0.461	0.466	0.470	0.481	0.484	0.488	0.496	0.498	0.501
1.800	0.597	0.601	0.605	0.608	0.612	0.622	0.626	0.630	0.636	0.638	0.641
1.900	0.750	0.754	0.75	0.761	0.764	0.770	0.774	0.779	0.783	0.786	0.790
2.000	0.905	0.908	0.911	0.916	0.920	0.925	0.928	0.930	0.934	0.936	0.937
2.100	1.080	1.082	1.085	1.086	1.088	1.090	1.092	1.095	1.092	1.092	1.095
2.200	1.255	1.264	1.273	1.272	1.270	1.271	1.268	1.265	1.264	1.262	1.260
2.300	1.450	1.458	1.465	1.464	1.462	1.460	1.452	1.445	1.442	1.438	1.433
2.400	1.652	1.661	1.670	1.666	1.662	1.658	1.649	1.640	1.630	1.625	1.620
2.500	1.865	1.872	1.880	1.876	1.872	1.860	1.850	1.840	1.826	1.818	1.810
2.600	2.090	2.090	2.090	2.086	2.082	2.068	2.057	2.046	2.025	2.016	2.008
2.700	2.322	2.317	2.312	2.304	2.296	2.278	2.264	2.250	2.223	2.214	2.207
2.800	2.554	2.546	2.538	2.526	2.516	2.492	2.476	2.460	2.434	2.422	2.410
2.900	2.790	2.778	2.767	2.754	2.740	2.719	2.701	2.680	2.655	2.644	2.632
3.000	3.032	3.021	3.010	2.995	2.980	2.958	2.939	2.910	2.892	2.881	2.870
3.100	3.285	3.272	3.260	3.245	3.230	3.208	3.192	3.160	3.145	3.132	3.120
3.200	3.540	3.529	3.515	3.502	3.490	3.462	3.447	3.418	3.406	3.394	3.385
3.300	3.803	3.792	3.780	3.766	3.762	3.725	3.714	3.690	3.676	3.664	3.654
+3.400	-4.074	-4.062	-4.050	-4.040	-4.030	-4.008	-3.994	-3.972	-3.956	-3.946	-3.940

TABLE 10

OVERFALL DAM CREST EXPERIMENTS - WEIR INCLINED DOWNSTREAM ON 1:3 SLOPE
18.43° WITH VERTICAL
COORDINATES OF UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

Y/H_s

h_a/H_s \ X/H_s	0.002	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180
-4.000	0.987	0.973	0.962	0.950	0.940	0.929	0.919	0.908	0.897	0.885	0.862	0.838	0.814	0.790
3.900	0.987	0.973	0.962	0.950	0.940	0.929	0.919	0.908	0.897	0.885	0.862	0.838	0.813	0.790
3.800	0.987	0.973	0.962	0.950	0.940	0.929	0.919	0.908	0.897	0.885	0.862	0.837	0.812	0.790
3.700	0.986	0.972	0.961	0.950	0.940	0.929	0.918	0.907	0.896	0.885	0.862	0.837	0.811	0.790
3.600	0.986	0.972	0.961	0.950	0.939	0.928	0.917	0.906	0.895	0.884	0.862	0.836	0.810	0.790
3.500	0.986	0.972	0.961	0.950	0.939	0.928	0.917	0.905	0.895	0.884	0.862	0.836	0.810	0.790
3.400	0.986	0.972	0.961	0.950	0.939	0.928	0.917	0.905	0.894	0.883	0.861	0.836	0.810	0.789
3.300	0.986	0.971	0.961	0.950	0.939	0.928	0.917	0.905	0.894	0.883	0.861	0.835	0.809	0.789
3.200	0.986	0.971	0.960	0.949	0.938	0.927	0.916	0.905	0.894	0.883	0.861	0.835	0.808	0.788
3.100	0.986	0.971	0.960	0.948	0.938	0.927	0.916	0.905	0.894	0.883	0.860	0.834	0.808	0.788
3.000	0.986	0.970	0.959	0.947	0.937	0.926	0.915	0.904	0.893	0.882	0.860	0.834	0.807	0.787
2.900	0.986	0.969	0.958	0.946	0.936	0.925	0.914	0.903	0.892	0.881	0.859	0.833	0.806	0.785
2.800	0.986	0.969	0.958	0.946	0.936	0.925	0.914	0.903	0.892	0.881	0.859	0.832	0.805	0.782
2.700	0.986	0.969	0.958	0.946	0.936	0.925	0.914	0.903	0.892	0.881	0.859	0.832	0.804	0.781
2.600	0.986	0.969	0.958	0.946	0.936	0.925	0.914	0.903	0.892	0.881	0.858	0.831	0.904	0.781
2.500	0.986	0.968	0.957	0.946	0.936	0.925	0.914	0.903	0.892	0.881	0.858	0.831	0.803	0.780
2.400	0.985	0.968	0.957	0.945	0.935	0.924	0.913	0.902	0.891	0.880	0.857	0.830	0.803	0.780
2.300	0.984	0.967	0.956	0.944	0.934	0.923	0.913	0.902	0.891	0.879	0.856	0.829	0.802	0.779
2.200	0.983	0.966	0.955	0.943	0.933	0.923	0.913	0.902	0.890	0.878	0.854	0.828	0.801	0.778
2.100	0.982	0.965	0.954	0.942	0.932	0.922	0.912	0.902	0.890	0.878	0.853	0.827	0.801	0.776
2.000	0.980	0.963	0.953	0.942	0.932	0.922	0.912	0.902	0.890	0.877	0.852	0.826	0.800	0.774
1.900	0.979	0.962	0.952	0.942	0.932	0.922	0.912	0.902	0.890	0.877	0.852	0.826	0.800	0.772
1.800	0.977	0.960	0.951	0.941	0.932	0.922	0.912	0.902	0.890	0.877	0.851	0.828	0.800	0.770
1.700	0.973	0.959	0.950	0.940	0.931	0.921	0.911	0.901	0.889	0.876	0.851	0.826	0.800	0.768
1.600	0.970	0.957	0.948	0.939	0.930	0.920	0.911	0.901	0.889	0.876	0.850	0.825	0.800	0.766
1.500	0.966	0.954	0.946	0.936	0.929	0.919	0.910	0.900	0.888	0.875	0.850	0.825	0.799	0.762
1.400	0.963	0.952	0.945	0.937	0.928	0.919	0.910	0.900	0.888	0.875	0.849	0.824	0.798	0.760
1.300	0.960	0.949	0.942	0.935	0.926	0.917	0.908	0.899	0.967	0.874	0.848	0.823	0.797	0.758
1.200	0.957	0.944	0.938	0.932	0.924	0.915	0.906	0.897	0.885	0.872	0.847	0.822	0.796	0.754
1.100	0.952	0.940	0.935	0.930	0.921	0.912	0.903	0.894	0.882	0.870	0.846	0.820	0.794	0.750
1.000	0.949	0.937	0.932	0.926	0.918	0.909	0.900	0.891	0.880	0.868	0.845	0.819	0.792	0.746
0.900	0.943	0.931	0.926	0.920	0.912	0.904	0.896	0.887	0.876	0.865	0.842	0.817	0.791	0.742
0.800	0.938	0.927	0.921	0.914	0.906	0.898	0.890	0.882	0.872	0.861	0.840	0.815	0.789	0.738
0.700	0.931	0.920	0.914	0.908	0.901	0.893	0.885	0.877	0.867	0.857	0.838	0.811	0.785	0.732
0.600	0.923	0.911	0.906	0.900	0.893	0.885	0.877	0.869	0.860	0.850	0.830	0.806	0.780	0.729
0.500	0.913	0.902	0.897	0.891	0.884	0.876	0.868	0.860	0.851	0.842	0.824	0.800	0.775	0.722
0.400	0.900	0.891	0.886	0.880	0.873	0.865	0.858	0.850	0.842	0.833	0.815	0.792	0.769	0.715
0.300	0.887	0.878	0.873	0.867	0.860	0.853	0.846	0.839	0.830	0.821	0.803	0.781	0.759	0.707
0.200	0.870	0.861	0.856	0.850	0.844	0.837	0.830	0.823	0.815	0.807	0.790	0.770	0.749	0.698
-0.100	0.852	0.842	0.838	0.833	0.827	0.820	0.814	0.807	0.799	0.791	0.774	0.755	0.735	0.687
0.000	0.830	0.820	0.816	0.812	0.806	0.800	0.794	0.787	0.779	0.771	0.755	0.737	0.718	0.672
+0.100	0.803	0.795	0.791	0.786	0.780	0.774	0.768	0.762	0.755	0.748	0.734	0.716	0.697	0.656
0.200	0.773	0.765	0.761	0.756	0.751	0.745	0.739	0.733	0.727	0.720	0.706	0.688	0.670	0.633
0.300	0.737	0.728	0.724	0.719	0.714	0.709	0.704	0.699	0.693	0.687	0.674	0.656	0.638	0.606
0.400	0.696	0.687	0.683	0.678	0.675	0.670	0.665	0.660	0.654	0.648	0.635	0.617	0.599	0.572
0.500	0.649	0.641	0.638	0.634	0.629	0.624	0.619	0.614	0.608	0.602	0.589	0.573	0.566	0.532
0.600	0.596	0.587	0.584	0.580	0.575	0.570	0.565	0.560	0.555	0.549	0.537	0.521	0.505	0.488
0.700	0.536	0.527	0.524	0.520	0.516	0.511	0.506	0.501	0.496	0.490	0.479	0.465	0.447	0.432
0.800	0.469	0.460	0.457	0.454	0.449	0.444	0.439	0.434	0.429	0.423	0.411	0.398	0.385	0.371
0.900	0.396	0.388	0.384	0.379	0.375	0.370	0.366	0.361	0.356	0.351	0.341	0.328	0.315	[illegible]
1.000	0.316	0.308	0.304	0.300	0.295	0.290	0.285	0.279	0.275	0.271	0.262	0.249	0.236	0.228
1.100	0.229	0.219	0.216	0.213	0.208	0.202	0.197	0.191	0.186	0.181	0.171	0.161	0.151	0.149
1.200	0.134	0.126	0.121	0.116	0.111	0.106	+0.101	-0.095	+0.090	+0.085	+0.076	+0.068	+0.060	+0.060
1.300	+0.030	+0.022	+0.016	+0.013	+0.008	-0.002	-0.004	-0.009	-0.016	-0.020	-0.030	-0.035	-0.036	-0.056
1.400	-0.082	-0.090	-0.095	-0.099	-0.105	-0.110	0.116	0.120	[illegible]	0.131	0.141	0.141	0.141	0.159
1.500	0.203	0.210	0.215	0.219	0.224	0.229	0.234	0.239	0.244	0.249	0.256	0.257	0.256	0.251
1.600	0.332	0.338	0.342	0.346	0.351	0.356	0.361	0.365	0.369	0.373	0.380	0.378	0.376	0.367
1.700	0.468	0.475	0.477	0.480	0.485	0.489	0.494	0.498	0.501	0.504	0.510	0.507	0.503	0.492
1.800	0.612	0.618	0.620	0.621	0.626	0.630	0.634	0.638	0.640	0.642	0.646	0.640	0.634	0.628
1.900	0.766	0.768	0.769	0.769	0.773	0.777	0.781	0.785	0.786	0.787	0.789	0.783	0.776	0.768
2.000	0.927	0.927	0.927	0.927	0.931	0.934	0.937	0.940	0.937	0.934	0.927	0.926	0.925	0.920
2.100	1.091	1.088	1.090	1.032	1.095	1.097	1.100	1.102	1.102	1.102	1.102	1.094	1.086	1.078
2.200	1.266	1.265	1.266	1.267	1.269	1.271	1.273	1.275	1.274	1.273	1.270	1.262	1.253	1.243
2.300	1.453	1.453	1.452	1.450	1.452	1.454	1.456	1.457	1.455	1.449	1.440	1.437	1.433	1.418
2.400	1.648	1.647	1.646	1.642	1.642	1.641	1.640	1.639	1.637	1.636	1.630	1.626	1.619	1.601
2.500	1.856	1.852	1.848	1.843	1.842	1.841	1.840	1.838	1.836	1.833	1.827	1.819	1.810	1.793
2.600	2.072	2.066	2.063	2.060	2.058	2.055	2.053	2.050	2.046	2.042	2.034	1.824	2.014	1.996
2.700	2.292	2.288	2.283	2.278	2.276	2.273	2.271	2.268	2.263	2.258	2.248	2.236	2.221	2.201
2.800	2.515	2.513	2.509	2.505	-2.501	2.497	2.493	2.488	2.482	2.475	2.461	2.446	2.431	2.409
+2.900	-2.747	-2.741	-2.738	-2.735	-2.730	-2.725	-2.720	-2.715	-2.707	-2.699	-2.682	-2.664	-2.646	-2.620

TABLE 11

OVERFALL DAM CREST EXPERIMENTS - WEIR INCLINED DOWNSTREAM ON 2:3 SLOPE
33.69° WITH VERTICAL
COORDINATES FOR UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

X/H_s \ h_a/H_s	Y/H_s 0.002	0.020	0.030	0.040	0.060	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180
-4.000	+0.981	+0.969	+0.958	+0.947	+0.936	+0.925	+0.912	+0.899	+0.886	+0.873	+0.853	+0.832	+0.805	+0.778
3.900	0.980	0.969	0.958	0.947	0.936	0.924	0.912	0.899	0.886	0.873	0.853	0.832	0.805	0.778
3.800	0.980	0.969	0.958	0.947	0.936	0.924	0.912	0.899	0.886	0.873	0.852	0.831	0.804	0.776
3.700	0.980	0.969	0.958	0.947	0.936	0.924	0.912	0.899	0.886	0.873	0.852	0.831	0.803	0.775
3.600	0.979	0.968	0.957	0.946	0.935	0.924	0.912	0.899	0.886	0.873	0.852	0.830	0.802	0.773
3.500	0.979	0.968	0.957	0.946	0.935	0.924	0.912	0.899	0.886	0.873	0.852	0.830	0.801	0.772
3.400	0.979	0.968	0.957	0.946	0.935	0.924	0.912	0.899	0.886	0.873	0.851	0.829	0.800	0.771
3.300	0.978	0.966	0.956	0.945	0.935	0.924	0.912	0.899	0.886	0.873	0.851	0.828	0.799	0.770
3.200	0.978	0.965	0.955	0.945	0.935	0.924	0.912	0.899	0.886	0.873	0.851	0.828	0.799	0.770
3.100	0.977	0.964	0.954	0.944	0.934	0.923	0.911	0.898	0.886	0.873	0.851	0.828	0.799	0.770
3.000	0.977	0.963	0.953	0.943	0.933	0.923	0.911	0.898	0.886	0.873	0.850	0.827	0.798	0.769
2.900	0.977	0.963	0.953	0.943	0.933	0.923	0.911	0.898	0.886	0.873	0.850	0.826	0.797	0.768
2.800	0.977	0.963	0.953	0.943	0.933	0.922	0.910	0.898	0.886	0.873	0.850	0.826	0.797	0.767
2.700	0.977	0.963	0.953	0.943	0.933	0.922	0.910	0.897	0.885	0.872	0.849	0.825	0.796	0.766
2.600	0.976	0.962	0.952	0.942	0.932	0.922	0.910	0.897	0.885	0.872	0.848	0.824	0.795	0.766
2.500	0.976	0.961	0.952	0.942	0.932	0.922	0.910	0.897	0.884	0.871	0.847	0.823	0.794	0.764
2.400	0.976	0.961	0.952	0.942	0.932	0.922	0.910	0.897	0.884	0.871	0.847	0.822	0.792	0.762
2.300	0.974	0.960	0.951	0.941	0.932	0.922	0.910	0.897	0.884	0.871	0.846	0.820	0.791	0.761
2.200	0.974	0.960	0.951	0.941	0.931	0.921	0.909	0.896	0.883	0.870	0.846	0.820	0.790	0.760
2.100	0.973	0.960	0.951	0.941	0.931	0.921	0.909	0.896	0.883	0.870	0.845	0.819	0.790	0.760
2.000	0.972	0.959	0.950	0.940	0.930	0.920	0.908	0.895	0.883	0.870	0.845	0.819	0.789	0.759
1.900	0.970	0.957	0.948	0.939	0.930	0.920	0.908	0.895	0.883	0.870	0.844	0.817	0.788	0.758
1.800	0.970	0.954	0.946	0.937	0.929	0.920	0.908	0.895	0.883	0.870	0.843	0.816	0.787	0.757
1.700	0.968	0.952	0.944	0.936	0.928	0.920	0.908	0.895	0.883	0.870	0.843	0.816	0.786	0.756
1.600	0.964	0.950	0.943	0.935	0.928	0.920	0.908	0.895	0.882	0.869	0.842	0.815	0.785	0.754
1.500	0.960	0.946	0.940	0.933	0.927	0.920	0.907	0.894	0.881	0.868	0.841	0.814	0.783	0.752
1.400	0.958	0.943	0.937	0.931	0.926	0.919	0.906	0.893	0.880	0.867	0.841	0.814	0.783	0.751
1.300	0.953	0.940	0.935	0.929	0.924	0.918	0.905	0.892	0.879	0.866	0.840	0.814	0.782	0.749
1.200	0.949	0.938	0.933	0.927	0.922	0.916	0.903	0.890	0.877	0.864	0.839	0.814	0.781	0.747
1.100	0.942	0.933	0.928	0.923	0.918	0.913	0.901	0.888	0.876	0.863	0.839	0.814	0.780	0.745
1.000	0.937	0.928	0.923	0.918	0.913	0.907	0.896	0.884	0.872	0.860	0.837	0.813	0.777	0.741
0.900	0.930	0.921	0.917	0.912	0.908	0.903	0.892	0.881	0.870	0.858	0.834	0.810	0.775	0.739
0.800	0.921	0.913	0.909	0.905	0.901	0.897	0.886	0.875	0.864	0.853	0.831	0.808	0.771	0.734
0.700	0.913	0.905	0.902	0.898	0.894	0.890	0.880	0.870	0.860	0.849	0.828	0.808	0.766	0.729
0.600	0.903	0.896	0.892	0.888	0.884	0.880	0.871	0.861	.852	0.842	0.820	0.798	0.761	0.723
0.500	0.892	0.883	0.880	0.876	0.873	0.869	0.860	0.851	0.842	0.833	0.812	0.790	0.754	0.718
0.400	0.879	0.870	0.867	0.864	0.861	0.858	0.850	0.842	0.833	0.825	0.803	0.780	0.744	0.708
0.300	0.862	0.857	0.854	0.850	0.846	0.842	0.835	0.827	0.820	0.812	0.790	0.768	0.734	0.699
0.200	0.845	0.839	0.836	0.832	0.829	0.825	0.819	0.812	0.806	0.799	0.777	0.754	0.722	0.689
-0.100	0.825	0.819	0.816	0.812	0.809	0.805	0.799	0.793	0.787	0.780	0.760	0.739	0.708	0.677
0.000	0.802	0.796	0.793	0.789	0.786	0.782	0.777	0.772	0.767	0.761	0.741	0.720	0.692	0.663
+0.100	0.775	0.769	0.766	0.762	0.759	0.755	0.751	0.746	0.741	0.736	0.717	0.698	0.672	0.646
0.200	0.743	0.738	0.735	0.731	0.727	0.723	0.719	0.714	0.709	0.704	0.689	0.673	0.649	0.625
0.300	0.708	0.700	0.697	0.693	0.690	0.686	0.682	0.677	0.673	0.668	0.655	0.641	0.620	0.598
0.400	0.666	0.660	0.656	0.652	0.648	0.644	0.641	0.637	0.633	0.629	0.617	0.604	0.586	0.568
0.500	0.620	0.612	0.609	0.605	0.601	0.597	0.594	0.591	0.588	0.585	0.573	0.561	0.546	0.531
0.600	0.568	0.561	0.558	0.554	0.550	0.546	0.543	0.540	0.537	0.534	0.524	0.515	0.500	0.486
0.700	0.509	0.502	0.499	0.495	0.492	0.488	0.486	0.483	0.481	0.478	0.468	0.458	0.445	0.432
0.800	0.444	0.439	0.436	0.432	0.428	0.424	0.422	0.419	0.417	0.414	0.405	0.396	0.384	0.371
0.900	0.371	0.368	0.364	0.360	0.356	0.351	0.349	0.346	0.344	0.341	0.333	0.326	0.313	0.301
1.000	0.290	0.288	0.285	0.281	0.277	0.273	0.270	0.267	0.264	0.261	0.255	0.248	0.236	0.224
1.100	0.202	0.198	0.195	0.192	0.189	0.186	0.183	0.181	0.179	0.177	0.170	0.165	0.152	0.140
1.200	0.108	+0.102	+0.099	+0.096	+0.093	+0.090	+0.088	+0.086	+0.084	+0.081	+0.076	+0.070	+0.060	+0.050
1.300	+0.003	0.000	-0.003	-0.006	-0.009	-0.012	-0.015	-0.017	-0.019	-0.021	-0.026	-0.031	-0.040	-0.049
1.400	-0.108	-0.111	0.114	0.117	0.120	0.123	0.125	0.126	0.128	0.129	0.133	0.137	0.145	0.155
1.500	0.227	0.230	0.233	0.235	0.237	0.239	0.241	0.242	0.244	0.245	0.250	0.254	0.260	0.265
1.600	0.353	0.356	0.359	0.361	0.363	0.365	0.367	0.368	0.370	0.371	0.373	0.375	0.379	0.382
1.700	0.488	0.491	0.492	0.493	0.494	0.495	0.497	0.499	0.501	0.502	0.503	0.505	0.506	0.508
1.800	0.628	0.630	0.631	0.631	0.632	0.632	0.634	0.636	0.638	0.640	0.641	0.641	0.642	0.642
1.900	0.779	0.781	0.782	0.782	0.782	0.782	0.783	0.784	0.785	0.786	0.786	0.786	0.787	0.787
2.000	0.935	0.936	0.937	0.937	0.937	0.937	0.939	0.940	0.941	0.942	0.941	0.939	0.937	0.935
2.100	1.100	1.099	1.100	1.100	1.100	1.100	1.100	1.101	1.102	1.102	1.099	1.098	1.093	1.091
2.200	1.273	1.273	1.273	1.275	1.273	1.273	1.273	1.273	1.273	1.273	1.271	1.266	1.264	1.260
2.300	1.450	1.450	1.450	1.450	1.450	1.450	1.450	1.449	1.449	1.448	1.446	1.444	1.439	1.433
2.400	1.642	1.642	1.642	1.641	1.640	1.640	1.640	1.639	1.639	1.638	1.634	1.629	1.619	1.609
2.500	1.844	1.843	1.843	1.843	1.842	1.842	1.840	1.838	1.836	1.834	1.826	1.819	1.806	1.795
2.600	2.056	2.053	2.053	2.052	2.051	2.050	2.049	2.047	2.045	2.043	[illegible]	[illegible]	2.002	1.985
2.700	2.274	2.269	2.267	2.265	2.263	2.261	2.261	2.260	2.260	2.259	2.242	2.224	2.204	2.153
2.800	2.498	2.495	2.492	2.489	2.486	2.432	2.480	2.477	2.475	2.472	2.465	2.438	2.416	2.394
+2.900	-2.729	-2.723	-2.719	-2.715	-2.711	-2.706	-2.703	-2.700	-2.697	-2.693	-2.677	-2.661	-2.637	-2.613

TABLE 12

OVERFALL DAM CREST EXPERIMENTS - WEIR INCLINED DOWNSTREAM ON 3:3 SLOPE
45 DEGREES
COORDINATES FOR UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_e

	Y/H_e													
h_a/H_e \ X/H_e	0.002	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.120	0.140	0.160	0.180
-4.000	+0.980	+0.963	+0.958	-0.949	+0.942	+0.934	+0.919	+0.904	+0.889	+0.874	+0.849	+0.824	+0.796	+0.758
3.900	0.980	0.963	0.956	0.948	0.941	0.933	0.918	0.903	0.888	0.873	0.849	0.824	0.796	0.767
3.800	0.979	0.963	0.956	0.948	0.941	0.933	0.918	0.903	0.888	0.872	0.848	0.823	0.795	0.766
3.700	0.979	0.963	0.955	0.947	0.939	0.931	0.917	0.902	0.887	0.872	0.848	0.823	0.796	0.766
3.600	0.979	0.963	0.955	0.947	0.939	0.931	0.917	0.902	0.887	0.872	0.848	0.823	0.794	0.764
3.500	0.979	0.963	0.955	0.947	0.939	0.931	0.916	0.901	0.886	0.871	0.847	0.822	0.793	0.763
3.400	0.978	0.963	0.955	0.947	0.939	0.930	0.916	0.901	0.886	0.871	0.846	0.821	0.792	0.763
3.300	0.978	0.963	0.956	0.947	0.939	0.930	0.916	0.901	0.886	0.871	0.846	0.820	0.792	0.763
3.200	0.976	0.963	0.955	0.947	0.939	0.930	0.916	0.901	0.886	0.871	0.845	0.819	0.791	0.763
3.100	0.975	0.963	0.955	0.947	0.939	0.930	0.916	0.901	0.886	0.871	0.844	0.817	0.790	0.762
3.000	0.974	0.964	0.956	0.947	0.939	0.930	0.915	0.900	0.885	0.870	0.843	0.816	0.789	0.762
2.900	0.972	0.963	0.955	0.946	0.938	0.929	0.915	0.900	0.885	0.870	0.842	0.814	0.788	0.761
2.800	0.971	0.963	0.955	0.946	0.937	0.928	0.914	0.899	0.885	0.870	0.842	0.813	0.787	0.761
2.700	0.970	0.963	0.955	0.946	0.937	0.926	0.914	0.899	0.884	0.869	0.841	0.812	0.786	0.760
2.600	0.968	0.963	0.954	0.945	0.936	0.927	0.913	0.898	0.884	0.869	0.841	0.812	0.786	0.760
2.500	0.966	0.963	0.954	0.944	0.935	0.925	0.911	0.897	0.883	0.868	0.839	0.810	0.786	0.760
2.400	0.964	0.962	0.953	0.944	0.935	0.925	0.911	0.897	0.883	0.868	0.839	0.810	0.786	0.760
2.300	0.963	0.960	0.951	0.942	0.933	0.924	0.910	0.896	0.882	0.868	0.839	0.810	0.785	0.759
2.200	0.962	0.960	0.951	0.942	0.933	0.923	0.909	0.895	0.881	0.867	0.838	0.809	0.784	0.759
2.100	0.960	0.958	0.949	0.940	0.931	0.922	0.908	0.894	0.880	0.865	0.837	0.808	0.783	0.758
2.000	0.958	0.956	0.948	0.939	0.930	0.921	0.907	0.893	0.879	0.864	0.836	0.808	0.783	0.758
1.900	0.956	0.953	0.945	0.937	0.929	0.920	0.906	0.892	0.878	0.863	0.835	0.807	0.783	0.758
1.800	0.954	0.951	0.943	0.935	0.927	0.919	0.906	0.891	0.877	0.862	0.834	0.806	0.782	0.758
1.700	0.951	0.948	0.941	0.933	0.926	0.918	0.904	0.890	0.876	0.862	0.833	0.805	0.781	0.758
1.600	0.948	0.945	0.938	0.930	0.923	0.916	0.902	0.888	0.875	0.861	0.832	0.805	0.781	0.758
1.500	0.945	0.941	0.934	0.927	0.920	0.913	0.900	0.887	0.874	0.861	0.832	0.803	0.780	0.757
1.400	0.941	0.938	0.932	0.925	0.918	0.911	0.899	0.886	0.874	0.861	0.832	0.803	0.779	0.756
1.300	0.938	0.933	0.928	0.922	0.916	0.910	0.898	0.885	0.873	0.860	0.832	0.803	0.779	0.755
1.200	0.932	0.929	0.924	0.918	0.912	0.906	0.895	0.883	0.871	0.859	0.831	0.802	0.779	0.755
1.100	0.926	0.923	0.918	0.913	0.908	0.903	0.892	0.880	0.869	0.857	0.830	0.802	0.778	0.753
1.000	0.920	0.917	0.913	0.908	0.904	0.899	0.888	0.877	0.866	0.854	0.826	0.801	0.777	0.752
0.900	0.913	0.909	0.905	0.901	0.897	0.893	0.883	0.872	0.861	0.850	0.825	0.800	0.776	0.750
0.800	0.906	0.902	0.899	0.895	0.892	0.888	0.878	0.868	0.858	0.848	0.824	0.800	0.776	0.750
0.700	0.898	0.893	0.890	0.886	0.883	0.879	0.870	0.861	0.852	0.843	0.821	0.798	0.773	0.748
0.600	0.887	0.884	0.881	0.877	0.874	0.870	0.863	0.855	0.847	0.839	0.817	0.794	0.770	0.745
0.500	0.876	0.872	0.869	0.866	0.863	0.860	0.853	0.846	0.839	0.831	0.811	0.790	0.765	0.740
0.400	0.862	0.858	0.856	0.853	0.850	0.847	0.841	0.834	0.828	0.821	0.802	0.783	0.760	[illegible]
0.300	0.845	0.842	0.839	0.836	0.833	0.830	0.825	0.820	0.815	0.810	0.792	0.774	0.752	0.750
0.200	0.825	0.822	0.820	0.817	0.814	0.811	0.807	0.803	0.799	0.796	0.778	0.761	0.741	0.721
-0.100	0.802	0.799	0.797	0.795	0.793	0.790	0.787	0.783	0.779	0.775	0.760	0.745	0.727	0.708
0.000	0.776	0.771	0.770	0.768	0.767	0.765	0.762	0.759	0.756	0.752	0.739	0.726	0.710	[illegible]
+0.100	0.748	0.743	0.742	0.741	0.740	0.739	0.737	0.734	0.731	0.728	0.715	0.701	0.688	0.674
0.200	0.716	0.711	0.711	0.710	0.709	0.708	0.706	0.703	0.700	0.697	0.686	0.673	0.662	0.650
0.300	0.679	0.675	0.674	0.673	0.672	0.670	0.668	0.665	0.663	0.660	0.650	0.640	0.630	0.620
0.400	0.638	0.635	0.634	0.633	0.632	0.630	0.628	0.626	0.623	0.620	0.611	0.601	0.592	0.583
0.500	0.593	0.589	0.588	0.586	0.585	0.583	0.581	0.579	0.577	0.574	0.566	0.558	0.550	0.542
0.600	0.541	0.538	0.537	0.535	0.533	0.531	0.529	0.526	0.524	0.521	0.515	0.508	0.500	0.491
0.700	0.481	0.478	0.477	0.475	0.474	0.472	0.470	0.467	0.465	0.462	0.456	0.450	0.445	0.439
0.800	0.417	0.413	0.413	0.412	0.411	0.410	0.407	0.404	0.401	0.398	0.393	0.388	0.383	0.378
0.900	0.346	0.342	0.341	0.340	0.339	0.338	0.336	0.334	0.332	0.329	0.325	0.321	0.317	0.312
1.000	0.268	0.265	0.264	0.262	0.261	0.259	0.258	0.256	0.255	0.253	0.249	0.244	0.242	0.239
1.100	0.182	0.178	0.177	0.176	0.175	0.175	0.172	0.170	0.169	0.167	0.163	0.159	0.159	0.159
1.200	+0.086	+0.082	+0.082	+0.081	+0.080	+0.079	+0.078	+0.077	+0.076	+0.075	+0.072	+0.068	+0.070	+0.072
1.300	-0.016	-0.019	-0.020	-0.020	-0.021	-0.021	-0.022	-0.023	-0.024	-0.026	-0.028	-0.030	-0.026	-0.021
1.400	0.127	0.129	0.130	0.131	0.132	0.132	0.133	0.133	0.133	0.133	0.135	0.136	0.131	0.125
1.500	0.246	0.246	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.247	0.248	0.249	0.243	0.236
1.600	0.372	0.372	0.372	0.371	0.371	0.370	0.371	0.371	0.372	0.372	0.370	0.367	0.363	0.359
1.700	0.500	0.500	0.500	0.500	0.500	0.499	0.499	0.499	0.499	0.499	0.496	0.493	0.491	0.488
1.800	0.639	0.639	0.639	0.639	0.639	0.639	0.639	0.639	0.639	0.639	0.634	0.629	0.626	0.620
1.900	0.782	0.781	0.781	0.780	0.780	0.779	0.780	0.780	0.780	0.780	0.776	0.771	0.766	0.761
2.000	0.935	0.932	0.932	0.932	0.932	0.931	0.931	0.931	0.931	0.931	0.925	0.919	0.913	0.908
2.100	1.101	1.097	1.097	1.096	1.095	1.094	1.094	1.094	1.094	1.093	1.086	1.079	1.071	1.062
2.200	1.278	1.274	1.272	1.269	1.266	1.263	1.263	1.263	1.263	1.265	1.254	1.245	1.036	1.227
2.300	1.465	1.459	1.456	1.453	1.450	1.447	1.445	1.443	1.441	1.439	1.431	1.422	1.410	1.397
2.400	1.652	1.648	1.646	1.643	1.641	1.638	1.636	1.634	1.631	1.629	1.619	1.609	1.591	1.578
2.500	1.851	1.845	1.841	1.839	1.837	1.835	1.832	1.829	1.826	1.823	1.811	1.796	1.779	1.760
2.600	2.061	2.053	2.050	2.047	2.044	2.041	2.037	2.032	2.027	2.022	2.008	1.993	1.969	1.945
2.700	2.275	2.261	2.259	2.256	2.254	2.251	2.247	2.242	2.237	2.232	2.216	2.200	2.171	2.141
2.800	2.494	2.479	2.477	2.474	2.472	2.469	2.465	2.460	2.456	2.460	2.435	2.416	2.382	2.349
+2.900	-2.721	-2.703	-2.701	-2.698	-2.695	-2.692	-2.687	-2.681	-2.675	-2.669	-2.650	-2.631	-2.597	-2.565

TABLE 13

FROM BAZIN'S WEIR EXPERIMENTS
WEIR INCLINED DOWNSTREAM ON 2 TO 1 SLOPE
63.43 DEGREES WITH VERTICAL

COORDINATES OF UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

Y/H_s											
h_a/H_s — X/H_s	0.002	0.02	0.04	0.06	0.07	h_a/H_s — X/H_s	0.002	0.02	0.04	0.06	0.07
-3.500	+0.969	0.961	0.950	0.941	+0.937	-0.500	+0.831	0.828	0.824	0.821	+0.819
3.400	0.968	0.959	0.950	0.940	0.935	0.400	0.816	0.813	0.809	0.805	0.803
3.300	0.967	0.957	0.948	0.938	0.933	0.300	0.798	0.795	0.791	0.787	0.785
3.200	0.966	0.956	0.947	0.937	0.932	0.200	0.778	0.775	0.771	0.768	0.766
3.100	0.965	0.955	0.946	0.936	0.931	-0.100	0.755	0.751	0.748	0.744	0.742
3.000	0.963	0.954	0.944	0.935	0.930	0.000	+0.728	0.724	0.721	0.717	0.715
2.900	0.961	0.952	0.943	0.934	0.929	+0.100	0.696	0.693	0.690	0.687	0.685
2.800	0.959	0.950	0.941	0.932	0.928	0.200	0.662	0.659	0.655	0.652	0.650
2.700	0.957	0.948	0.939	0.930	0.926	0.300	0.624	0.620	0.616	0.612	0.610
2.600	0.955	0.946	0.937	0.928	0.924	0.400	0.580	0.577	0.574	0.570	0.569
2.500	0.952	0.943	0.935	0.926	0.922	0.500	0.531	0.528	0.525	0.522	0.520
2.400	0.950	0.942	0.933	0.925	0.921	0.600	0.474	0.470	0.467	0.463	0.461
2.300	0.948	0.940	0.931	0.923	0.919	0.700	0.411	0.408	0.405	0.402	0.400
2.200	0.944	0.936	0.929	0.921	0.917	0.800	0.342	0.339	0.335	0.332	0.330
2.100	0.941	0.934	0.926	0.919	0.915	0.900	0.267	0.263	0.260	0.256	0.254
2.000	0.938	0.931	0.923	0.916	0.912	1.000	0.185	0.181	0.176	0.172	0.170
1.900	0.935	0.928	0.920	0.913	0.909	1.100	+0.095	0.091	0.086	0.082	+0.080
1.800	0.930	0.923	0.916	0.909	0.905	1.200	0.000	-0.004	-0.009	-0.013	-0.015
1.700	0.927	0.920	0.912	0.905	0.901	1.300	-0.105	-0.108	-0.112	-0.115	0.117
1.600	0.923	0.916	0.909	0.902	0.898	1.400	0.214	0.217	0.220	0.223	0.225
1.500	0.919	0.912	0.905	0.898	0.894	1.500	0.334	0.337	0.340	0.343	0.344
1.400	0.913	0.906	0.900	0.893	0.890	1.600	0.460	0.463	0.466	0.469	0.470
1.300	0.908	0.902	0.895	0.889	0.886	1.700	0.591	0.594	0.596	0.599	0.600
1.200	0.902	0.896	0.889	0.883	0.880	1.800	0.730	0.733	0.736	0.739	0.740
1.100	0.895	0.889	0.884	0.878	0.875	+1.900	0.875	0.876	0.878	0.879	0.880
1.000	0.889	0.884	0.878	0.873	0.870	2.000	1.026	1.028	1.029	1.031	1.032
0.900	0.880	0.875	0.870	0.865	0.862	2.100	1.190	1.190	1.190	1.190	1.190
0.800	0.870	0.865	0.860	0.855	0.852	2.200	1.363	1.362	1.361	1.360	1.360
0.700	0.860	0.855	0.851	0.846	0.844	2.300	1.542	1.540	1.538	1.536	1.535
-0.600	+0.845	0.843	0.838	0.834	0.832	2.400	1.730	1.726	1.723	1.719	1.717

TABLE 14

FROM BAZIN'S WEIR EXPERIMENTS
WEIR INCLINED DOWNSTREAM ON 4 TO 1 SLOPE
75.97 DEGREES WITH VERTICAL

COORDINATES OF UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

Y/H_s											
X/H_s \ h_a/H_s	0.002	0.02	0.04	0.06	0.07	X/H_s \ h_a/H_s	0.002	0.02	0.04	0.06	0.07
-3.500	+0.934	0.931	0.928	0.925	0.923	-0.500	+0.766	0.762	0.758	0.754	+0.752
3.400	0.933	0.930	0.927	0.924	0.922	0.400	0.749	0.746	0.742	0.739	0.737
3.300	0.931	0.928	0.925	0.922	0.921	0.300	0.730	0.726	0.723	0.719	0.717
3.200	0.929	0.926	0.923	0.920	0.919	0.200	0.708	0.705	0.702	0.699	0.697
3.100	0.927	0.924	0.921	0.918	0.917	-0.100	0.685	0.681	0.677	0.673	0.671
3.000	0.926	0.923	0.920	0.917	0.915	0.000	0.658	0.654	0.651	0.647	0.645
2.900	0.923	0.920	0.917	0.914	0.912	+0.100	0.627	0.623	0.619	0.615	0.613
2.800	0.921	0.918	0.915	0.912	0.910	0.200	0.592	0.588	0.584	0.580	0.578
2.700	0.918	0.915	0.912	0.909	0.907	0.300	0.551	0.547	0.544	0.540	0.538
2.600	0.914	0.911	0.909	0.906	0.905	0.400	0.503	0.499	0.495	0.491	0.489
2.500	0.912	0.909	0.906	0.903	0.902	0.500	0.451	0.447	0.442	0.438	0.436
2.400	0.908	0.905	0.903	0.900	0.899	0.600	0.393	0.388	0.384	0.379	0.377
2.300	0.904	0.902	0.899	0.897	0.896	0.700	0.330	0.326	0.321	0.317	0.315
2.200	0.901	0.898	0.896	0.893	0.892	0.800	0.259	0.254	0.249	0.244	0.242
2.100	0.898	0.895	0.892	0.889	0.888	0.900	0.178	0.173	0.168	0.163	0.161
2.000	0.894	0.891	0.888	0.885	0.884	1.000	+ .092	0.087	0.082	0.077	+0.074
1.900	0.890	0.887	0.884	0.881	0.880	1.100	-0.002	-0.007	-0.012	-0.017	-0.020
1.800	0.886	0.883	0.880	0.877	0.875	1.200	0.103	-0.008	-0.013	-0.018	0.121
1.700	0.881	0.878	0.875	0.872	0.870	1.300	0.212	0.217	0.223	0.228	0.231
1.600	0.876	0.873	0.870	0.867	0.865	1.400	0.327	0.332	0.338	0.343	0.346
1.500	0.871	0.868	0.865	0.862	0.860	1.500	0.448	0.452	0.457	0.461	0.463
1.400	0.864	0.861	0.858	0.855	0.853	1.600	0.572	0.576	0.581	0.585	0.587
1.300	0.857	0.854	0.851	0.848	0.846	1.700	0.705	0.709	0.714	0.718	0.720
1.200	0.848	0.845	0.842	0.839	0.837	1.800	0.846	0.850	0.853	0.857	0.859
1.100	0.840	0.837	0.833	0.830	0.828	1.900	1.000	1.003	1.006	1.009	1.011
1.000	0.830	0.827	0.823	0.820	0.818	+2.000	1.161	1.164	1.166	1.169	1.170
0.900	0.819	0.815	0.812	0.808	0.806	2.100	1.328	1.331	1.334	1.337	1.338
0.800	0.807	0.804	0.800	0.797	0.796	2.200	1.507	1.509	1.511	1.513	1.514
0.700	0.793	0.789	0.786	0.782	0.780	2.300	1.692	1.694	1.695	1.697	1.698
-0.600	0.780	0.776	0.772	0.768	0.766	2.400	1.885	1.886	1.887	1.888	1.888

TABLE 15
OVERFALL DAM CREST EXPERIMENTS
WEIR WITH 45-DEGREE UPSTREAM OVERHANG (M/N = 0)
COORDINATES OF UPPER NAPPE FOR DIFFERENT VALUES OF h_a/H_s

X/H_s \ h_a/H_s	Y/H_s 0.002	0.02	0.04	0.06	0.08	0.10	0.12	0.14
-3.500	+0.995	+0.972						
3.400	0.994	0.972						
3.300	0.994	0.972						
3.200	0.994	0.972	+0.949	+0.925				
3.100	0.994	0.972	0.948	0.924	+0.908	+0.886	+0.858	+0.831
3.000	0.994	0.972	0.948	0.923	0.907	0.885	0.858	0.831
2.900	0.994	0.971	0.947	0.922	0.906	0.884	0.857	0.831
2.800	0.994	0.971	0.945	0.921	0.905	0.884	0.857	0.830
2.700	0.993	0.970	0.945	0.921	0.904	0.882	0.856	0.830
2.600	0.993	0.970	0.945	0.920	0.902	0.881	0.856	0.830
2.500	0.993	0.969	0.945	0.920	0.901	0.880	0.855	0.830
2.400	0.993	0.969	0.944	0.919	0.900	0.879	0.855	0.829
2.300	0.993	0.969	0.944	0.919	0.900	0.878	0.854	0.829
2.200	0.992	0.968	0.943	0.918	0.899	0.877	0.853	0.829
2.100	0.992	0.968	0.943	0.918	0.898	0.876	0.853	0.829
2.000	0.992	0.968	0.943	0.917	0.897	0.875	0.852	0.828
1.900	0.992	0.967	0.942	0.916	0.896	0.875	0.852	0.828
1.800	0.991	0.967	0.942	0.915	0.894	0.873	0.851	0.828
1.700	0.991	0.966	0.942	0.914	0.893	0.872	0.851	0.827
1.600	0.990	0.966	0.942	0.913	0.892	0.871	0.850	0.827
1.500	0.988	0.965	0.939	0.912	0.991	0.870	0.850	0.826
1.400	0.987	0.964	0.939	0.912	0.890	0.869	0.849	0.828
1.300	0.982	0.961	0.938	0.911	0.889	0.868	0.848	0.825
1.200	0.979	0.960	0.937	0.910	0.889	0.867	0.845	0.823
1.100	0.976	0.956	0.934	0.909	0.887	0.865	0.842	0.819
1.000	0.970	0.951	0.931	0.908	0.885	0.861	0.838	0.815
0.900	0.966	0.947	0.927	0.905	0.880	0.856	0.833	0.810
0.800	0.960	0.941	0.922	0.901	0.877	0.853	0.830	0.807
0.700	0.953	0.934	0.915	0.896	0.872	0.848	0.825	0.802
0.600	0.947	0.928	0.908	0.888	0.866	0.843	0.818	0.793
0.500	0.938	0.918	899	0.880	0.859	0.836	0.811	0.786
0.400	0.928	0.908	.889	0.871	0.850	0.828	0.803	0.778
0.300	0.914	0.895	0.878	0.861	0.840	0.818	0.793	0.768
0.200	0.898	0.879	0.862	0.846	0.827	0.806	0.782	0.758
-0.100	0.882	0.863	0.845	0.829	0.811	0.791	0.768	0.745
0.000	0.860	0.842	0.825	0.809	0.792	0.772	0.751	0.730
+0.100	0.832	0.815	0.799	0.784	0.769	0.752	0.733	0.714
0.200	0.803	0.786	0.870	0.754	0.739	0.724	0.708	0.692
0.300	0.767	0.751	0.736	0.721	0.707	0.693	0.678	0.663
0.400	0.724	0.709	0.695	0.680	0.667	0.654	0.643	0.632
0.500	0.676	0.661	0.647	0.635	0.622	0.611	0.601	0.591
0.600	0.622	0.607	0.594	0.582	0.570	0.559	0.550	0.541
0.700	0.562	0.547	0.554	0.522	0.511	0.501	0.492	0.483
0.800	0.496	0.481	0.469	0.458	0.446	0.436	0.429	0.422
0.900	0.422	0.407	0.394	0.383	0.373	0.365	0.358	0.351
1.000	0.338	0.327	0.315	0.302	0.294	0.267	0.280	0.273
1.100	0.248	0.237	0.226	0.215	0.208	0.202	0.197	0.192
1.200	0.149	0.138	0.129	0.120	0.114	0.108	0.103	+0.098
1.300	+0.038	+0.030	+0.022	+0.015	+0.012	+0.008	+0.003	-0.002
1.400	-0.078	-0.087	-0.094	-0.097	-0.102	-0.105	-0.106	0.007
1.500	0.208	0.215	0.220	0.222	0.222	0.222	0.222	0.222
1.600	0.347	0.353	0.355	0.352	0.352	0.351	0.350	0.349
1.700	0.500	0.501	0.499	0.492	0.492	0.490	0.486	0.480
1.800	0.650	0.652	0.652	0.650	0.645	0.638	0.630	0.622
1.900	0.810	0.812	0.812	0.811	0.804	0.793	0.780	0.767
2.000	0.983	0.982	0.980	0.975	0.960	0.946	0.935	0.924
2.100	1.160	1.157	1.152	1.147	1.130	1.115	1.100	0.985
2.200	1.350	1.141	1.333	1.325	1.308	1.292	1.277	1.262
2.300	1.544	1.535	1.523	1.508	1.495	1.479	1.460	1.441
2.400	1.750	1.737	1.723	1.707	1.688	1.669	1.650	1.631
2.500	1.960	1.947	1.932	1.915	1.892	1.870	1.860	1.830
+2.600	-2.170	-2.157	-2.141	-2.122	-2.101	-2.079	-2.055	-2.031

starting point from which the designer may make allowances for other influences.

5. Relation of E to velocity of approach

In the design of overflow sections it is necessary to interchange heads from those observed on the weir, h_s and H_s, to those above the crest of an ogee section, h_o and H_o, figure 3. This is made possible by the curves on figures 6A and 7A on which $\frac{E}{H_s}$ is plotted with respect to $\frac{h_a}{H_s}$ for all weirs tested.

6. Discharge coefficients

The coefficients of discharge for the various weirs tested are plotted with respect to the dimensionless ratio $\frac{H_o}{P + E}$ on figures 6B and 7B. These coefficients are not for the sharp-crested weir but for the equivalent ogee section outlined by the shape of the lower nappe. As the value of P + E decreases (or as the velocity of approach increases) the coefficient of discharge decreases rapidly. The curves have been carried to the practical limits of applicability. For greater values of $\frac{h_a}{H_s}$ and $\frac{H_o}{P + E}$ than shown by the curves on figures 6 and 7, critical velocities were approached in the test channel.

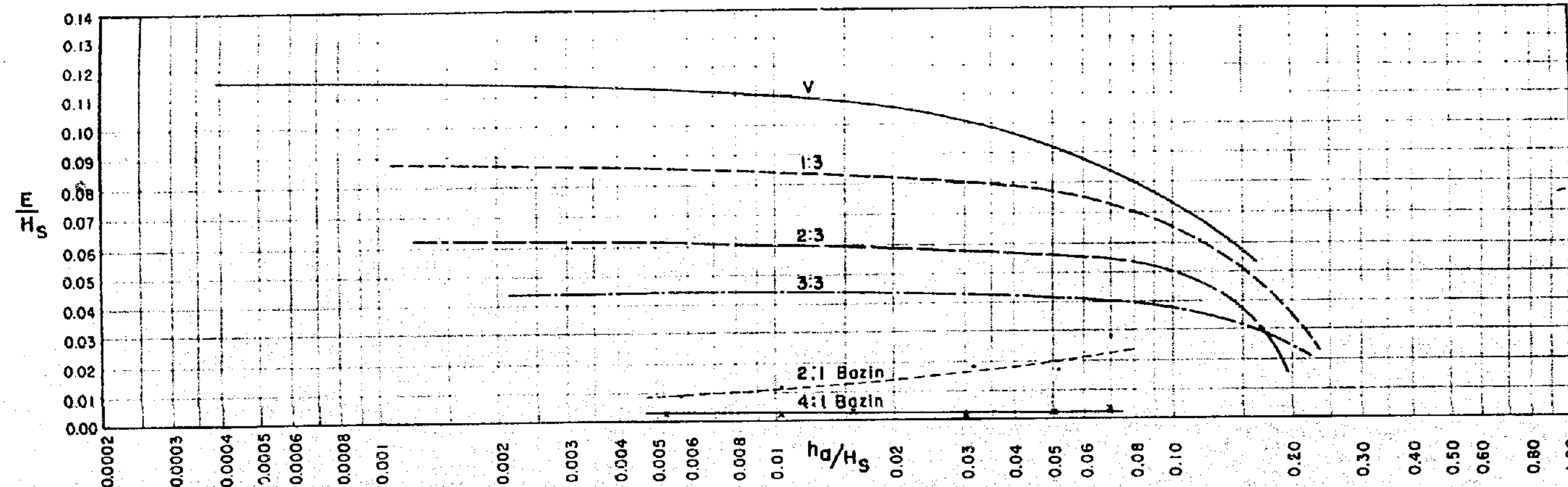
7. Design of an overflow dam section with vertical upstream face

With the foregoing information, it is possible to design the most economical overflow dam for practically any field condition. It will be so designed that for maximum designed head on the spillway the face of the overflow section will fit the lower profile of the overflowing sheet of water with little or no subatmospheric pressure between the sheet of water and the face of the spillway.

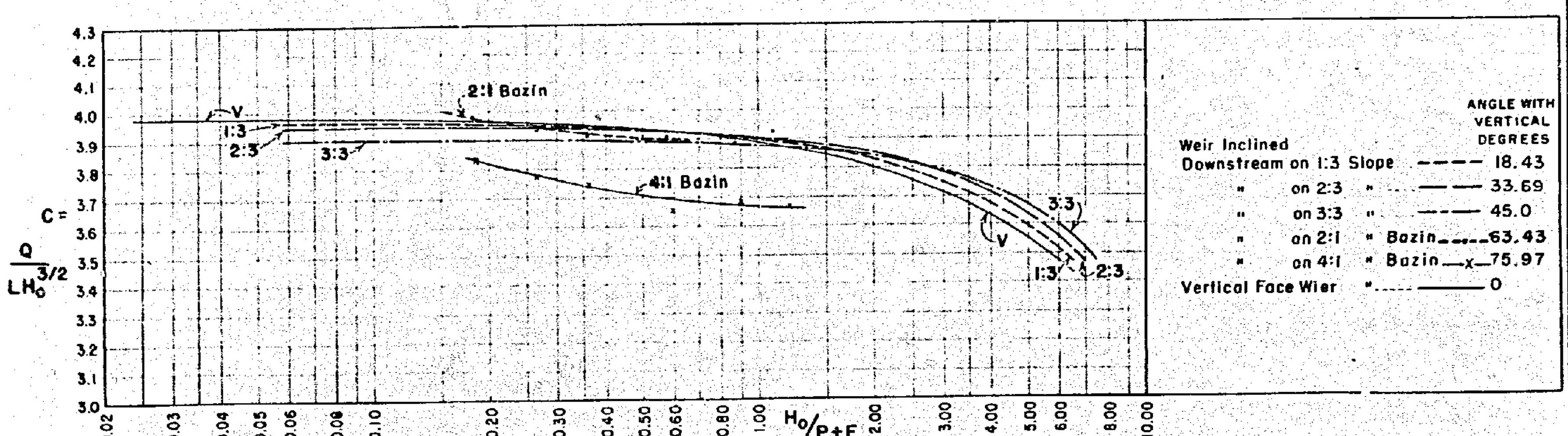
Example 1

Given a maximum water surface at elevation 1000 for a total discharge of 75,000 second-feet with the average approach floor at elevation 880. Determine crest elevation and coordinates for shape of overflow section for a crest length of 250 feet.

This problem is solved by successive approximations. First, as-



A - RELATION BETWEEN h_a/H_s AND E/H_s



B - RELATION BETWEEN $H_o/P+E$ AND C

FIGURE 12 - COMPARISON OF "E" AND "C" VERTICAL AND SLOPING WEIRS

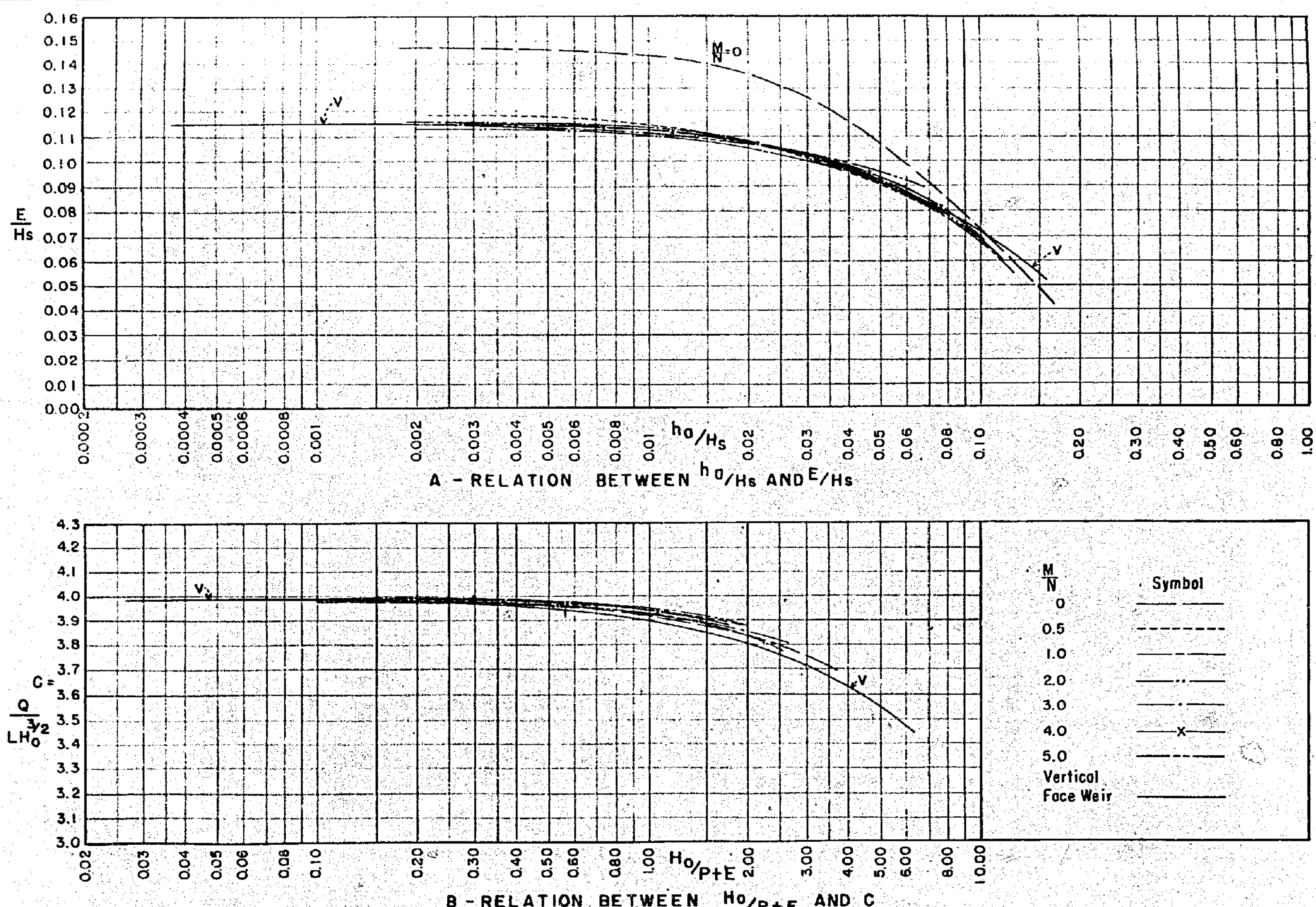


FIGURE 7 - COMPARISON OF "E" AND "C" - VERTICAL, OVERHANG AND OFFSET WEIRS

sume a coefficient of discharge $C = 3.75$. From the expression $Q = CLH_o^{3/2}$

$$H_o^{3/2} = \frac{75,000}{3.75 \times 250} = 80.00,$$

and

$$H_o = 18.57 \text{ feet.}$$

Then

$$P + E = 120.00 - 18.57 = 101.43 \text{ feet}$$

$$\frac{H_o}{P + E} = \frac{18.57}{101.43} = 0.183, \text{ and from figure 6B, } C = 3.96.$$

With this new value of C,

$$H_o^{3/2} = \frac{75,000}{3.96 \times 250} = 75.76 \quad \text{and} \quad H_o = 17.90 \text{ feet.}$$

$$P + E = 120.00 - 17.90 = 102.10 \text{ feet.}$$

$$\frac{H_o}{P + E} = \frac{17.90}{102.10} = 0.175 \text{ and from figure 6B, } C = 3.96.$$

It has now been established that the value of $H_o = 17.90$ and the coefficient of discharge $C = 3.96$. The crest of the spillway is then 1000 - 17.90 or elevation 982.10.

To determine H_s and $\frac{h_a}{H_s}$, first assume $H_s = H_o = 17.90$ feet. Then the approximate value of h_a is computed as follows:

$$H_s + P = 120.0 \text{ feet (approximate depth of approach),}$$

$$q = \frac{75,000}{250} = 300 \text{ second-feet per foot of width,}$$

then

$$V_a = \frac{300}{120} = 2.50 \text{ feet per second (velocity of approach).}$$

Hence,

$$h_a = \frac{V^2}{2g} = 0.097 \text{ feet} \quad \text{and} \quad \frac{h_a}{H_s} = \frac{0.097}{17.90} = 0.0054.$$

From figure 6A, $\frac{E}{H_s} = 0.1125$.

Now,

$$H_o + E = H_s \quad \text{or} \quad 17.90 + 0.1125\,H_s = H_s,$$

and

$$H_s = \frac{17.90}{0.8875} = 20.17 \text{ feet (first approximation).}$$

To obtain a more accurate value of V_a the approach depth $h_s + P$ should be used which is also $H_s + P - h_a$ or $120.0 - 0.097 = 119.90$. $V_a = \frac{300}{119.90} = 2.51$ feet per second. Hence,

$$h_a = 0.098 \quad \text{and} \quad \frac{h_a}{H_s} = \frac{0.098}{20.17} = 0.0049.$$

From figure 6A,

$$\frac{E}{H_s} = 0.113.$$

$$H_o + E = H_s \quad \text{or} \quad 17.90 + 0.113 H_s = H_s$$

and

$$H_s = \frac{17.90}{0.887} = 20.18 \text{ feet.}$$

Now $\frac{h_a}{H_s} = \frac{0.098}{20.18} = 0.0049$, which agrees with the previous step.

The final values are $\frac{h_a}{H_s} = 0.0049$ and $H_s = 20.18$.

In cases where the depth of approach $P + E$ is small (figure 6), more approximations will be needed to reach the final value of $\frac{h_a}{H_s}$ and H_s.

Referring to table 1, values of $\frac{X}{H_s}$ are chosen (depending on the point spacing desired) and corresponding values of $\frac{Y}{H_s}$ are tabulated for $\frac{h_a}{H_s} = 0.0049$. Interpolation is necessary, and the results are shown in column 2, table 16. Solving for X and Y from columns 1 and 2, respectively, the coordinates for the overflow section, columns 3 and 4, are obtained. Column 5 expresses the values of Y in feet of elevation. The points are shown plotted on figure 8.

The design of the downstream face of the overflow section beyond the ogee profile depends on the stability of the structure and characteristics of the stilling pool at the toe of the spillway section.

TABLE 16

COORDINATES FOR OVERFLOW SECTION (Example 1)

$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X (3)	Y (4)	Y Elevation (feet) (5)
0.000	0.0000	0.00	0.00	979.86
0.050	+0.0569	1.01	+1.15	981.01
0.100	0.0852	2.02	1.72	981.58
0.150	0.1014	3.03	2.05	981.91
0.200	0.1093	4.04	2.21	982.07
0.250	0.1109	5.05	2.24	982.10
0.300	0.1091	6.05	2.20	982.06
0.350	0.1045	7.06	2.11	981.97
0.400	0.0954	8.07	1.93	981.79
0.450	0.0829	9.08	1.67	981.53
0.500	0.069	10.09	1.39	981.25
0.600	+0.031	12.11	+0.63	980.49
0.700	-0.018	14.13	-0.36	979.50
0.800	0.075	16.14	1.51	978.35
0.900	0.140	18.16	2.83	977.03
1.000	0.215	20.18	4.34	975.52
1.200	0.394	24.22	7.95	971.91
1.400	0.607	28.25	12.25	967.61
1.600	0.851	32.29	17.17	962.69
1.800	1.133	36.32	22.86	957.00
2.000	1.452	40.36	29.30	950.56
2.200	1.799	44.40	36.30	943.56
2.400	2.180	48.43	43.99	935.87
2.600	-2.603	52.47	-52.53	927.33

8. Determination of wall heights on overflow dam section

A common mistake in practice is to underdesign the confining walls of a spillway. It is difficult in some cases to foresee the various factors which determine the necessary height of spillway walls, such as diagonal waves propagated by piers, waves created at different gate openings, unsymmetrical flow produced by unequal approach conditions on the two sides of a spillway, unpredictable air currents, and waves due to unsymmetrical gate operation. The latter condition can be eliminated by operating the gates in a symmetrical manner. If all gates cannot be opened an equal amount, then

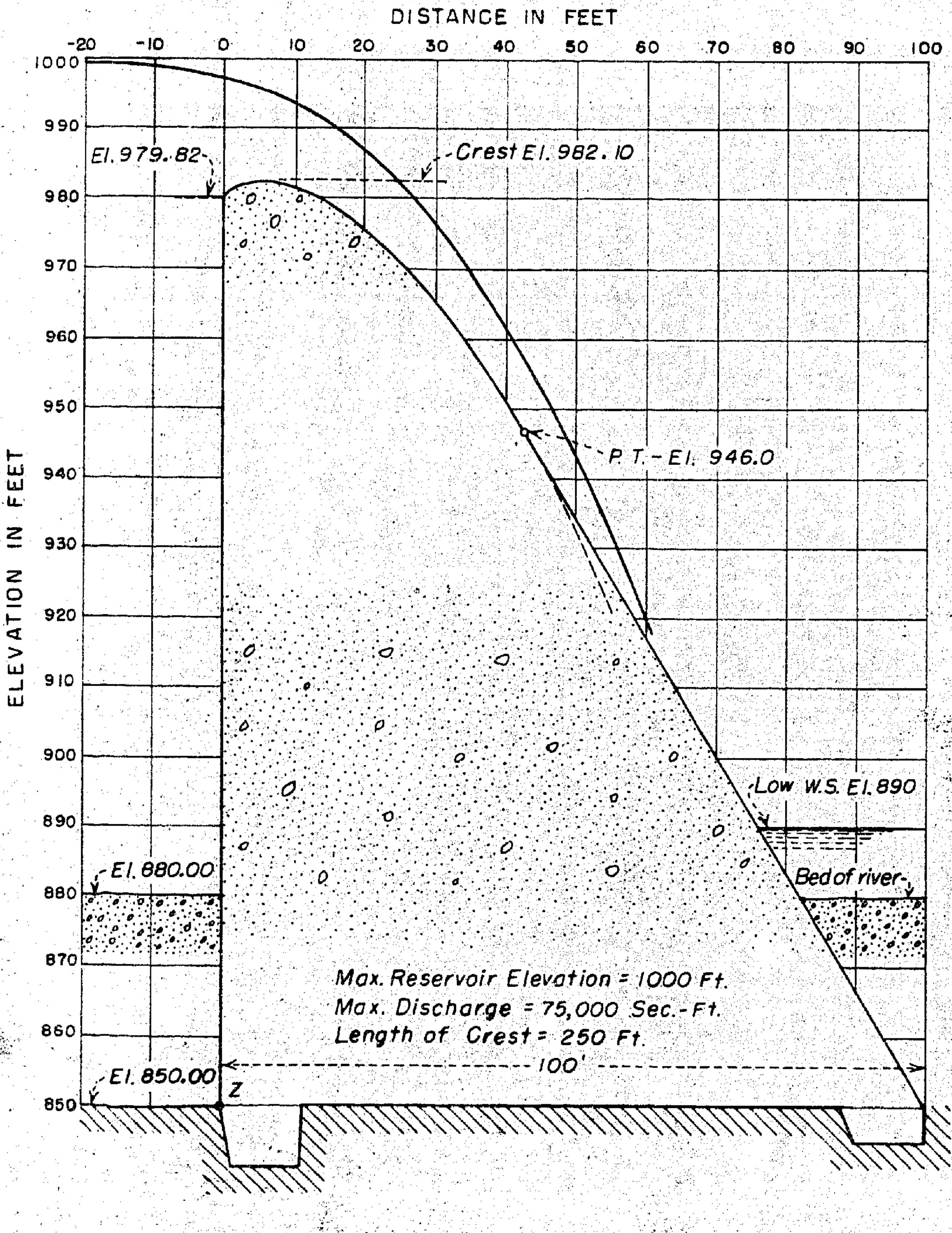


FIGURE 8 - RESULTS OF EXAMPLES 1 AND 2
VERTICAL-FACE WEIR

those that are opened should be chosen so as to produce a symmetrical pattern of flow. The extent of the effect of the remaining factors to produce waves in a spillway can be determined satisfactorily only by a model study.

Example 2

Determine the wall heights for the overfall dam section as designed in example 1.

As H_s and $\frac{h_a}{H_s}$ have already been determined in example 1, it is merely necessary to choose values of $\frac{X}{H_s}$ from table 9 and read corresponding values of $\frac{Y}{H_s}$ for $\frac{h_a}{H_s} = 0.0049$. The tabulation is shown in table 17.

TABLE 17

COORDINATES FOR UPPER SURFACE (Example 2)

$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X (3)	Y (4)	Y Elevation (feet) (5)
-1.000	+0.956	-20.18	+19.29	999.11
0.600	0.928	12.11	18.73	998.55
-0.300	0.897	- 6.05	18.10	997.92
0.000	0.843	0.00	17.01	996.83
+0.200	0.788	+ 4.04	15.90	995.72
0.400	0.712	8.07	14.37	994.19
0.600	0.617	12.11	12.45	992.27
0.800	0.492	16.14	9.93	989.75
1.000	0.342	20.18	6.90	986.72
1.200	+0.152	24.22	+ 3.07	982.89
1.400	-0.068	28.25	- 1.37	978.45
1.600	0.318	32.29	6.42	973.40
1.800	0.598	36.32	12.07	967.75
2.000	0.905	40.36	18.26	961.56
2.200	1.256	44.40	25.35	954.47
2.400	1.653	48.43	33.36	946.46
2.600	2.090	52.47	42.18	937.64
2.800	2.553	56.50	51.52	928.30
+3.000	-3.030	+60.54	-61.15	918.67

Columns 3 and 4 were obtained by multiplying the values in 1 and 2 by H_s or 20.18. The points for the upper surface are also shown plotted on figure 8. This curve represents the actual water surface as obtained in the experiments with near-perfect approach conditions and with little or no air absorption in the sheet of water. The amount of freeboard needed above this curve, as stated previously, depends on the particular problem. Wave heights are difficult to predict. The expansion of the sheet of water due to air entrainment increases as the water accelerates, but it can be estimated with a reasonable degree of accuracy. In this connection, reference is made to a study by R. Ehrenberger,[2] to actual field observations by C. W. Thomas,[1] and an analysis by V. L. Streeter.[3]

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[2] Ehrenberger, R., "Flow of Water in Steep Chutes with Special Reference to Self-Aeration." Translated by E. F. Wilsey, October 1937, U.S.B.R. Report, Hyd. 29. From the German in Osterreichischen Ingenieur und Architekten-vereines No. 15/16 and 17/18, 1926.

[3] Streeter, V. L., "Second Progress Report on Studies of the Flow of Water in Open Channels with High Gradients," October 13, 1938, U.S.B.R. Report, Hyd. 40.

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9. Design of an overfall section with sloping upstream face

With material for the vertical, 1:3, 2:3, 3:3, 2:1, and 4:1 sloping weirs, it is possible to design the economical and efficient overfall section for a dam with one of these slopes or any intermediate downstream slope.

Example 8

Design the overfall section of a low, concrete, gravity dam with crest at elevation 180.0, for a maximum discharge of 200,000 second-feet. The approach floor is at elevation 155.0; the crest is 1,200 feet long; and the upstream face of the dam is on a 0.75:1 slope.

The solution is handled similarly to example 1.

$$H_o = \sqrt[2/3]{\frac{Q}{CL}}$$

Assuming $C = 3.80$,

$$H_o = \sqrt[2/3]{\frac{200,000}{3.80 \times 1200}} = \sqrt[2/3]{43.86} = 12.44 \text{ feet (approx.)}$$

and

$$\frac{H_o}{P + E} = \frac{12.44}{25} = 0.498.$$

From figure 6B a more accurate value of $C = 3.91$ is obtained for a slope of 0.75:1 or 36.87 degrees from the vertical.

Repeating this operation with the new value of C,

$$H_o = \sqrt[2/3]{\frac{200,000}{3.91 \times 1200}} = \sqrt[2/3]{42.63} = 12.20 \text{ feet,}$$

and

$$\frac{H_o}{P + E} = \frac{12.20}{25} = 0.488.$$

From figure 6B the coefficient of discharge remains 3.91 for the above value of $\frac{H_o}{P + E}$.

The next step is to find the values of h_a and H_s.

$$q = \frac{Q}{L} = \frac{200,000}{1200} = 166.67 \text{ second-feet per foot of crest,}$$

then

$$V_a = \frac{q}{P + h + H_o} = \frac{166.67}{25 + 12.20} = 4.48 \text{ feet per second}$$

and

$$h_a = 0.312 \text{ feet (true velocity head of approach).}$$

To determine H_s first assume that $H_s = H_o$, then

$$\frac{h_a}{H_s} = \frac{0.312}{12.20} = 0.0256.$$

From figure 6A, $\frac{E}{H_s} = 0.051$ for the above value of $\frac{h_a}{H_s}$ and a weir sloping downstream 36.87 degrees with the vertical.

$$H_o + E = H_s = 12.20 + 0.051\, H_s$$

and

$$H_s = \frac{12.20}{0.949} = 12.86 \text{ feet (first approximation).}$$

A more accurate value of $\frac{h_a}{H_s}$ now equals $\frac{0.312}{12.86} = 0.0243$.

From figure 6A, $\frac{E}{H_s}$ remains at 0.051. The true value of H_s is then the same as above, or 12.86 feet,

$$\frac{h_a}{H_s} = 0.0243$$

and

$$E = 0.051 \times 12.86 = 0.656 \text{ feet.}$$

With these values and tables 3 and 4, the coordinates for the overfall section can be determined. It is necessary in this case to interpolate between values in the two tables, as the upstream slope of the overfall section is 36.87 degrees. The coordinates have been tabulated in table 18 and are shown plotted on figure 9A.

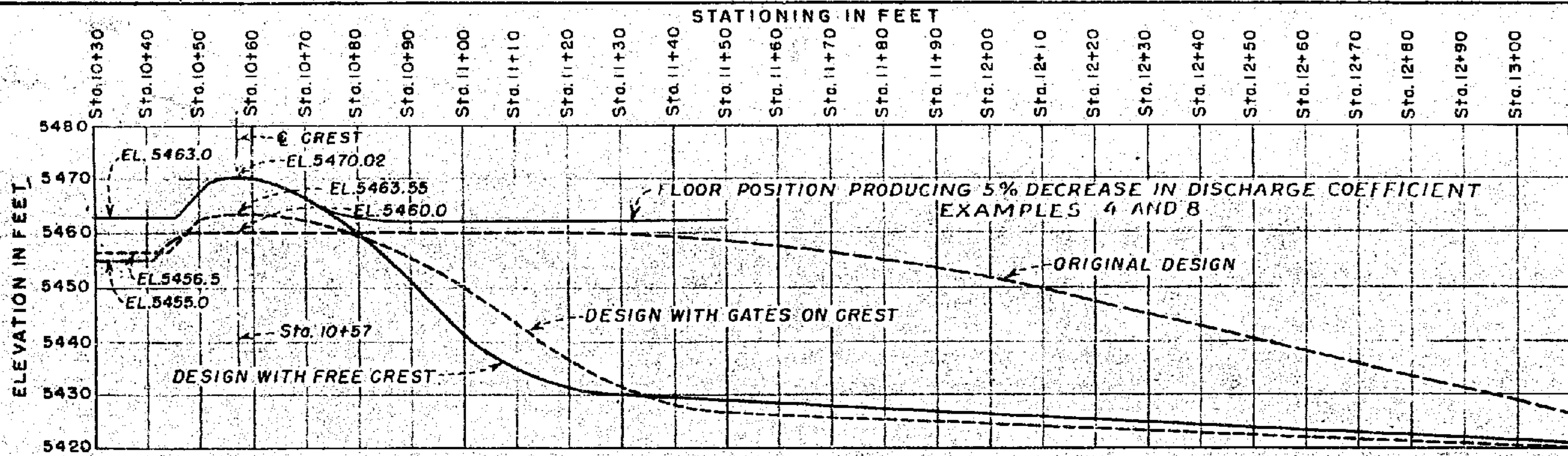
If the upper surface coordinates are desired, these can be obtained in the same manner from tables 11 and 12.

10. Design of overfall section with shallow approach channel

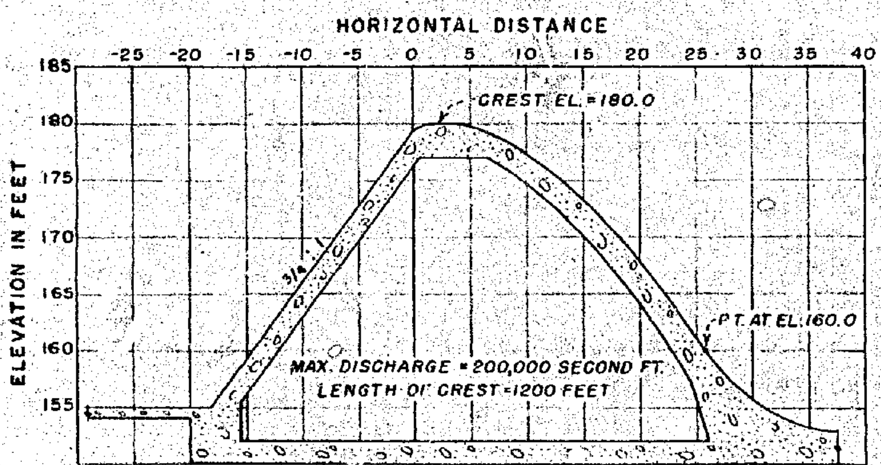
In the design of spillways for earth dams, the approach channel is usually shallow to minimize the cost of the required excavation. This type of spillway is quite common, and the design of the overflow section has been difficult because of the many unknown factors involved. With the foregoing information, however, safe designs may be performed with considerable increase in efficiency of the spillways.

Example 4

Figure 10 shows a plan and section of an earth dam spillway with



B - RESULTS OF EXAMPLES 4, 5 AND 8



A - RESULTS OF EXAMPLE 3

FIGURE 9

RESULTS OF EXAMPLES 3,4,5 & 8

WEIRS SLOPING DOWNSTREAM

TABLE 18

COORDINATES FOR OVERFLOW SECTION (Example 4)

$\frac{X}{H_s}$	$\frac{Y}{H_s}$			X	Y	Y Elevation (feet)
	33.69° weir	45° weir	36.87° weir		36.87° weir	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.000	0.000	0.000	0.000	0.00	0.00	179.28
0.050	+0.032	+0.018	+0.028	0.64	+0.36	179.64
0.100	0.050	0.034	0.046	1.29	0.59	179.87
0.150	0.059	0.041	0.054	1.93	0.69	179.97
0.180	0.061	0.042	0.056	2.31	0.72	180.00
0.200	0.062	0.042	0.056	2.57	0.72	180.00
0.220	0.061	0.042	0.056	2.83	0.72	180.00
0.250	0.059	0.039	0.053	3.22	0.68	179.96
0.300	0.051	0.032	0.046	3.86	0.59	179.87
0.350	0.041	0.021	0.035	4.50	0.45	179.73
0.400	0.029	+0.008	0.023	5.14	0.30	179.58
0.450	+0.015	-0.008	+0.009	5.79	+0.12	179.40
0.500	-0.002	0.027	-0.009	6.43	-0.12	179.16
0.600	0.044	0.073	0.052	7.72	0.67	178.61
0.700	0.097	0.127	0.105	9.00	1.35	177.93
0.800	0.157	0.189	0.166	10.29	2.13	177.15
0.900	0.226	0.258	0.235	11.57	3.02	176.26
1.000	0.301	0.336	0.311	12.86	4.00	175.28
1.200	0.481	0.514	0.490	15.43	6.30	172.98
1.400	0.692	0.727	0.702	18.00	9.03	170.25
1.600	0.940	0.968	0.947	20.58	12.18	167.10
1.800	1.212	1.240	1.220	23.15	15.69	163.59
2.000	1.517	1.543	1.524	25.72	19.60	159.68
2.200	1.850	1.877	1.858	28.29	23.89	155.39
2.400	-2.222	-2.246	-2.229	30.86	-28.66	150.62

a net crest width of 77.0 feet, crest elevation at 5460.0, approach channel at elevation 5455.0, and maximum reservoir at elevation 5500.0. In tests, the coefficient of discharge in the equation $Q = CLH_0^{3/2}$ was a constant of 2.85 for all heads. Substituting values in the equation for the maximum discharge,

$$Q = 2.85 \times 77 \times 40^{3/2} = 55,520 \text{ second-feet.}$$

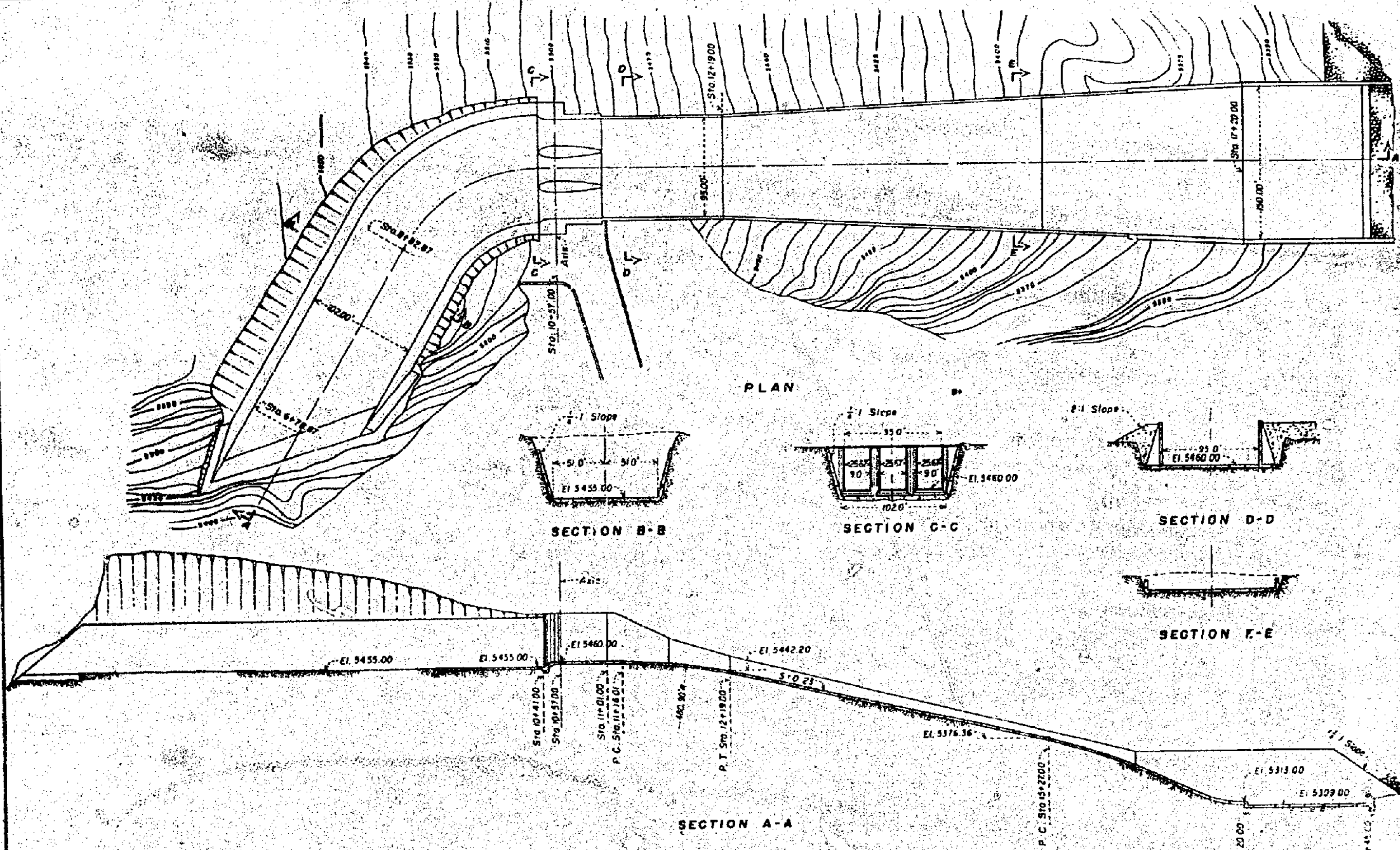


FIGURE 10
SPILLWAY USED IN EXAMPLES 4 to 5

Using the more recent data, a saving is indicated by either raising the crest or by maintaining the crest at the same elevation and reducing the width of the spillway.

In the case of raising the crest, assuming a free overflow section (without gates) with a width of 95.0 feet, the new crest elevation can be obtained by solving for the head, H_o.

Assuming $C = 3.60$ for the new overflow section, with a 45-degree slope on the upstream face,

$$H_o^{3/2} = \frac{Q}{CL} = \frac{55,520}{3.60 \times 95.0} = 162.34$$

and

$$H_o = 29.75 \text{ feet.}$$

For stable flow conditions $\frac{H_o}{P + E}$ should not exceed the value of 5.0. In the original design $\frac{H_o}{P + E} = \frac{40}{5}$ or 8.0, which will result in undulating waves in the approach channel for the higher discharges. These waves, in turn, will produce an unsteady flow in the spillway. The result will not be serious, but the design is not sound from an hydraulic standpoint.

To avoid this condition, the approach depth in this example will be chosen at 7.0 feet below the crest.

Then,

$$\frac{H_o}{P + E} = \frac{29.75}{7} = 4.25.$$

Entering the 3:3 curve on figure 6B with this value, $C = 3.725$.

Substituting the new value of C in the first equation,

$$H_o^{3/2} = \frac{55,520}{3.725 \times 95.0} = 156.89$$

and

$$H_o = 29.09 \text{ feet.}$$

The final value of

$$\frac{H_o}{P + E} = \frac{29.09}{7.0} = 4.16,$$

the value of C remains at 3.725, and thus H_o = 29.09 feet.

Before establishing the crest elevation it is necessary to determine the friction loss in the approach channel for maximum discharge. It will be assumed that the approach depth is

$$h_o + P + E = 29.09 + 7.0 = 36.09 \text{ feet}$$

and the coefficient of roughness, n, for the approach channel is 0.020. Then the average velocity of approach,

$$V_{a_1} = \frac{55,520}{36.09 \times 111.02} = 13.86 \text{ feet per second,}$$

and the hydraulic radius

$$r = \frac{36.09 \times 111.02}{102 + 2 \times 37.20} = 22.71.$$

Substituting these values in the Manning formula,

$$S = \left(\frac{V_{a_1} n}{1.486\, r^{2/3}}\right)^2 = \left(\frac{13.86 \times 0.020}{1.486 \times 22.71^{2/3}}\right)^2 = 0.000541 \text{ foot}$$

loss per linear foot of channel. Neglecting the entrance loss and considering the channel 1,650 feet long, the total friction loss is

$$h_f = 0.000541 \times 1,650 = 0.893 \text{ foot.}$$

This establishes the crest at

$$5500.0 - 29.09 - 0.89 = 5,470.02 \text{ feet}$$

and the approach floor at 7.0 feet lower, or 5,463.0 feet, as shown on figure 9B.

The next step is the design of the overflow shape.

$$q = \frac{Q}{L} = \frac{55,520}{95.0} = 584.4 \text{ second-feet per foot of crest,}$$

$$V_{a_2} = \frac{q}{P + E + H_o - 8?} = \frac{584.4}{7.0 + 29.09 - 0.89} = 16.60 \text{ feet per second,}$$

and

$$h_a = \frac{v^2}{2g} = 4.284 \text{ feet (velocity head of approach).}$$

Assuming $H_s = H_o$ as in the previous example,

$$\frac{h_a}{H_s} = \frac{4.284}{29.09} = 0.147.$$

Entering the 3:3 curve on figure 6A with the above value of $\frac{h_a}{H_s}$, $\frac{E}{H_s} = 0.032$.

$$H_o + E = H_s = 29.09 + 0.032\, H_s$$

and

$$H_s = \frac{29.09}{0.968} = 30.05 \text{ feet (first approximation).}$$

A new value of $\frac{h_a}{H_s} = \frac{4.284}{30.05} = 0.143.$

From figure 6A, $\frac{E}{H_s} = 0.033.$

$$H_o + E = H_s = 29.09 + 0.033\, H_s$$

and

$$H_s = \frac{29.09}{0.967} = 30.08 \text{ feet (final)}$$

and

$$\frac{h_a}{H_s} = \frac{4.284}{30.08} = 0.142 \text{ (final).}$$

With the last values of H_s and $\frac{h_a}{H_s}$, the coordinates for the shape of the overflow section are obtained from table 4. These are listed in table 19 and are shown plotted on figure 9B by the heavy, full line.

TABLE 19

COORDINATES FOR FREE OVERFLOW SECTION WITH SHALLOW APPROACH CHANNEL (Example 4)

$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X Feet (3)	Y Feet (4)	X Station (feet) (5)	Y Elevation (feet) (6)
0.000	0.000	0.00	0.00	10+51.59	5468.94
0.030	+0.010	0.90	+ 0.30	52.49	5469.24
0.060	0.020	1.80	0.60	53.39	5469.54
0.090	0.026	2.71	0.78	54.30	5469.72
0.120	0.032	3.61	0.96	55.20	5469.90
0.150	0.034	4.51	1.02	56.10	5469.96
0.170	0.035	5.11	1.05	56.70	5469.99
0.180	0.036	5.41	1.08	10+57.00	5470.02
0.190	0.036	5.72	1.08	57.31	5470.02
0.200	0.035	6.02	1.05	57.61	5469.99
0.250	0.030	7.52	0.90	59.11	5469.84
0.300	0.022	9.02	0.66	60.61	5469.60
0.350	+0.010	10.53	+ 0.30	62.12	5469.24
0.400	-0.004	12.03	- 0.12	63.62	5468.82
0.450	0.019	13.54	0.57	65.13	5468.37
0.500	0.038	15.04	1.14	66.63	5467.80
0.540	0.054	16.24	1.62	67.83	5467.32
0.600	0.081	18.05	2.44	69.64	5466.50
0.700	0.133	21.06	4.00	72.65	5464.94
0.800	0.194	24.06	5.84	75.65	5463.10
0.900	0.262	27.07	7.88	78.66	5461.06
1.000	0.337	30.08	10.14	81.67	5458.80
1.100	0.419	33.09	12.60	84.68	5456.34
1.200	0.506	36.10	15.22	87.69	5453.72
1.300	0.603	39.10	18.14	90.69	5450.80
1.400	0.709	42.11	21.30	93.70	5447.64
1.500	0.818	45.12	24.61	96.71	5444.33
1.600	-0.936	48.13	-28.15	10+99.72	5440.79

It can be seen from figure 9B that raising the coefficient of discharge from 2.85 to 3.725, together with removing the piers, made it possible to raise the crest 10.0 feet, eliminated 8.0 feet of rock excavation in the approach channel, and at the same time improved flow conditions by placing the approach floor at 7 feet below the crest instead of 5 feet, as in the former design.

It so happens that the spillway that was chosen for this problem has three fixed-wheel gates at the crest for controlling the flow. In the above problem, the overflow section was considered as a free crest without piers, and the coordinates in table 19 apply only for this condition.

The jet produced by partial gate openings may skip over the above profile, depending on the type of gate and on the condition of operation. Although the head may be the same in both cases, for full or partial gate opening, the lower surface of the jet need not be the same even though no contraction exists at the lower surface. The explanation is that the stream lines are horizontal and parallel as they leave the gate for the small gate openings; on the contrary, the stream lines are neither horizontal nor parallel for flow over the section at full gate opening but have components in a downward direction. It is therefore advisable to design the upstream portion, of an overflow section with gates, as in example 4, and design the downstream portion to fit the lower side of the jet issuing from a small gate opening, as illustrated in the next section.

11. Design of overflow section with shallow approach channel and gates on crest

As stated previously, the important portion of an overflow section, so far as efficiency is concerned, is that part upstream from the crest. By flattening the downstream portion, the coefficient will not be decreased seriously, providing submerged flow does not occur.

Example 5

Redesign the overflow section in example 4 to accommodate three vertical slide gates on the high point of the crest with pier widths of 9.0 feet, as shown in figure 10. The maximum reservoir remains at elevation 5500.00, the maximum discharge is 55,520 second-feet, and the net length of crest is 77.0 feet.

Assuming $C = 3.35$, which is about 10 percent less than in example 4,

$$H_o^{3/2} = \frac{55,520}{3.35 \times 77.0} = 215.24$$

and

$$H_o = 35.92 \text{ feet.}$$

Choosing the approach floor at 7.0 feet below the overflow crest, the approach depth will be 35.92 + 7.0 = 42.92 feet.

The average velocity of approach is then

$$V_{a_1} = \frac{55,520}{42.92 \times 112.73} = 11.47 \text{ feet per second,}$$

and the hydraulic radius

$$r = \frac{42.92 \times 112.73}{102 + 2 \times 44.24} = 25.40.$$

Assuming $n = 0.020$, as in the former example,

$$S\ell = 1650 \left(\frac{V_{a_1} n}{1.486\, r^{2/3}}\right)^2 = 1650 \left(\frac{11.47 \times 0.020}{1.486 \times \overline{25.40}^{2/3}}\right)^2 = 0.527 \text{ feet.}$$

The crest elevation will then be at

$$5500.00 - 35.92 - 0.53 = 5463.55 \text{ feet,}$$

and the approach floor at about 7.0 feet lower, or elevation 5456.5.

The design of the upstream portion of the overflow section is similar to that in the above example except the net crest length is used in this case.

$$q = \frac{Q}{L} = \frac{55,520}{77.0} = 721.04 \text{ second-feet per foot of crest.}$$

$$V_{a_2} = \frac{q}{P + E + H_o - S\ell} = \frac{721.04}{7.0 + 35.92 - 0.53} = 17.01 \text{ feet per second.}$$

$$h_a = 4.498 \text{ feet.}$$

Assuming $H_s = H_o$,

$$\frac{h_a}{H_s} = \frac{4.498}{35.92} = 0.125.$$

Entering the 3:3 curve on figure 6A with this value, $\frac{E}{H_s} = 0.035$.

$$H_o + E = H_s = 35.92 + 0.035\,H_s$$

and

$$H_s = \frac{35.92}{0.965} = 37.22 \text{ feet (approximately).}$$

A new value of $\frac{h_a}{H_s} = \frac{4.498}{37.22} = 0.121$.

From figure 6A, $\frac{E}{H_s} = 0.036$.

$$H_o + E = H_s = 35.92 + 0.036\,H_s$$

and

$$H_s = \frac{35.92}{0.964} = 37.26 \text{ feet,}$$

the final value of $\frac{h_a}{H_s} = \frac{4.498}{37.26} = 0.121$.

Entering table 4 with the last value of $\frac{h_a}{H_s}$, the coordinates for the overflow section upstream from the crest are obtained. These have been tabulated in the upper portion of table 20.

The downstream surface will be designed to fit the shape of the theoretical trajectory of the center line of the jet issuing from a one-foot gate opening at maximum head. Two factors of safety are involved in this assumption: First, the theoretical trajectory should be flatter than the actual, due to air resistance; and second, it is improbable that the spillway will ever be operated at full head with a one-foot gate opening.

The stream lines will issue from the gates horizontally under a maximum head of

$$5500.00 - 5464.05 = 35.95 \text{ feet.}$$

This head will develop a velocity of

$$V = C_v \sqrt{2 g H_o} = 0.98 \times 48.09 = 47.13 \text{ feet per second.}$$

TABLE 20

COORDINATES FOR OVERFLOW SECTION WITH SHALLOW APPROACH CHANNEL AND GATES ON CREST (Example 5)

	$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X Feet (3)	Y Feet (4)	X Station (feet) (5)	Y Elevation (feet) (6)
	0.000	0.000	0.00	0.00	10+49.92	5462.17
	0.030	+0.011	1.12	+0.41	51.04	5462.58
	0.060	0.020	2.24	0.75	52.16	5462.92
	0.090	0.027	3.35	1.01	53.27	5463.18
	0.120	0.033	4.47	1.23	54.39	5463.40
	0.150	0.035	5.59	1.30	55.51	5463.47
	0.180	0.037	6.71	1.38	56.63	5463.55
Crest	0.190	+0.037	7.08	+1.38	10+57.00	5463.55
			Trajectory computations			
		Crest	0.00	0.00	10+57.00	5463.55
			3.00	-0.07	60.00	5463.48
			6.00	0.26	63.00	5463.29
			9.00	0.59	66.00	5462.96
			12.00	1.04	69.00	5462.51
			15.00	1.63	72.00	5461.92
			18.00	2.35	75.00	5461.20
			21.00	3.20	78.00	5460.35
			25.00	4.53	82.00	5459.02
			30.00	6.52	87.00	5457.03
			35.00	8.88	92.00	5454.67
			40.00	11.60	10+97.00	5451.95
			45.00	14.68	11+02.00	5448.87
			50.00	18.12	07.00	5445.43
			55.00	21.93	12.00	5441.62
			60.00	26.10	17.00	5437.45
			65.00	30.63	22.00	5432.92
			70.00	35.52	27.00	5428.03
			75.00	40.78	32.00	5422.77
			80.00	-46.40	11+37.00	5417.15

Treating the issuing jet in the same manner as a projectile, the following equations are applicable when the initial velocity is in a horizontal direction,

$$X = vt \quad \text{and} \quad Y = \frac{1}{2} g t^2.$$

Substituting the value of t from the first equation into the second,

$$y = \frac{1}{2} g \left(\frac{X}{v}\right)^2 = 16.1 \left(\frac{X}{47.131}\right)^2 = 0.00725 x^2.$$

The origin of these coordinates will be taken at the crest of the overflow section or, specifically, station 10+57.00 and elevation 5463.55 feet. By assuming values of X and solving for Y, the lower portion of table 20 was obtained. The values from table 20 are shown plotted on figure 9B by a dash line. It will be noted that the overflow section is flatter for flows at small gate openings and maximum head than for the free crest but not nearly so flat as the original design.

The saving that can be effected by use of the more efficient overfall shapes depends on various factors, such as the topography, type of material to be moved, and general profile of spillway. The purpose of the above examples was not necessarily to show a saving in construction costs on this particular spillway but to illustrate the possibilities now available with the new information contained in this bulletin.

12. Design of overflow dam section with overhang on upstream face

The procedure for determining the coordinates for a section with an overhang on the upstream face is the same as was used for the weir with vertical upstream face except for the use of different tables and curves. Example 1 is repeated with an overhang on the upstream face of the dam.

Example 6

Given a maximum water surface elevation of 1000 for a total discharge of 75,000 second-feet, with the average approach floor at elevation 880. Determine crest elevation and coordinates for shape of overflow section with crest length of 250 feet and a 45-degree overhang on upstream face having a vertical dimension of 7 feet.

From figure 7B, the coefficients of discharge for the vertical and overhang weirs nearly coincide. Therefore, C will be assumed as 3.96, which was the final value obtained in example 1. Also, from the same source, H_o = 17.90 feet and P + E = 102.10 feet. The high point on the crest remains the same as in the first example (elevation 982.10) and the velocity of approach h_a = 0.097.

Assuming $H_s = H_o$,

$$\frac{h_a}{H_s} = \frac{0.097}{17.90} = 0.0054.$$

From figure 7A, $\frac{E}{H_s} = 0.146$.

$$H_o + E = H_s \quad \text{or} \quad 17.90 + 0.146\,H_s = H_s$$

and

$$H_s = \frac{17.90}{0.854} = 20.98 \text{ feet (first approximation)}.$$

A more accurate value of the velocity of approach, V_a, is $\frac{75{,}000}{(120.0 - 0.097)250}$ = 2.50 feet per second.

$$h_a = 0.097 \quad \text{and} \quad \frac{h_a}{H_s} = \frac{0.097}{20.96} = 0.0046.$$

From figure 7A, $\frac{E}{H_s} = 0.147$.

$$17.90 + 0.147\,H_s = H_s$$

and

$$H_s = \frac{17.90}{0.853} = 20.98 \text{ feet}$$

which agrees closely with the previous steps.

$$\frac{h_a}{H_s} = \frac{0.097}{20.98} = 0.0046$$

which is the same value obtained in the previous step and

$$\frac{h}{H_s} = \frac{7}{20.98} = 0.334.$$

Table 21 shows the coordinates for the lower nappe surface, obtained by using the final values of H_s, $\frac{h_a}{H_s}$, and table 7 which is for dams with an overhang on the upstream face.

TABLE 21

COORDINATES FOR OVERHANG OVERFLOW SECTION (Example 6)

$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X (3)	Y (4)	Y Elevation (feet) (5)
0.000	0.000	0.00	0.00	979.17
0.050	+0.0905	1.05	+1.90	981.07
0.100	0.1173	2.10	2.46	981.63
0.150	0.1315	3.15	2.76	981.93
0.200	0.1385	4.20	2.91	982.08
0.250	0.1396	5.24	2.93	982.10
0.300	0.1370	6.29	2.87	982.04
0.350	0.1298	7.34	2.72	981.89
0.400	0.1196	8.39	2.51	981.68
0.450	0.1067	9.44	2.24	981.41
0.500	0.090	10.49	1.89	981.06
0.600	+0.046	12.59	+0.97	980.14
0.700	-0.008	14.69	-0.17	979.00
0.800	0.069	16.78	1.45	977.72
0.900	0.139	18.88	2.92	976.25
1.000	0.218	20.98	4.57	974.60
1.200	0.405	25.18	8.50	970.67
1.400	0.631	29.37	13.24	965.93
1.600	0.892	33.57	18.71	960.46
1.800	1.183	37.76	24.82	954.35
2.000	1.508	41.96	31.64	947.53
2.200	-1.863	46.16	-39.09	940.08

For comparative purposes the coordinates from table 21 have been plotted, together with those of example 1 for the vertical-faced dam, on figure 11. The resulting shape for the overhang section is shown as a dotted line, while the shape for the vertical-faced dam is indicated by a full line. The shapes of the two sections are considerably different although both were subjected to the same head and approach conditions.

13. Design of overflow dam section with offset in upstream face

Example 7

Given the same conditions as in problem 6 but, in addition to the 7-foot offset, a 12-foot riser is specified on the upstream face of the overflow section. Determine crest elevation and coordinates for shape of the overflow profile.

From figure 7B the coefficient-of-discharge curve for $\frac{M}{N} = 1.71$ practically coincides with the one for the vertical and the overhang weirs in the upper portion. Therefore, the coefficient of discharge will be taken as 3.96, the same as for problems 1 and 6.

From problem 1 the final value of $H_s = 20.18$, $h_a = 0.098$, and $\frac{h_a}{H_s} = 0.0049$ for the vertical-faced section.

Commencing with these values, $\frac{E}{H_s} = 0.114$ (from figure 7A) for a value of $\frac{M}{N} = 1.71$.

$$H_s = H_o + E = 17.90 + 0.114\,H_s = \frac{17.90}{0.886} = 20.20 \text{ feet.}$$

and

$$\frac{h_a}{H_s} = \frac{0.098}{20.20} = 0.0049$$

which agrees with the former value.

With $H_s = 20.20$ feet, $\frac{h_a}{H_s} = 0.0049$, and table 8, the coordinates for the downstream face of the above offset overflow section can be computed. These are listed in table 22 and are shown plotted by a dash line on figure 11. This profile follows the one for the vertical-faced dam in the upper region but departs from it as the curve progresses.

TABLE 22

COORDINATES FOR OFFSET OVERFLOW SECTION (Example 7)

$\frac{X}{H_s}$ (1)	$\frac{Y}{H_s}$ (2)	X (3)	Y (4)	Elevation of Y in feet (5)
0.00	0.000	0.00	0.00	979.82
0.05	+0.058	1.01	+1.17	980.99
0.10	0.086	2.02	1.74	981.56
0.15	0.101	3.03	2.04	981.86
0.20	0.109	4.04	2.20	982.02
0.25	0.113	5.05	2.28	982.10
0.30	0.110	6.06	2.22	982.04
0.35	0.104	7.07	2.10	981.92
0.40	0.094	8.08	1.90	981.72
0.45	0.081	9.09	1.64	981.46
0.50	0.066	10.10	1.33	981.15
0.60	+0.025	12.12	+0.50	980.32
0.70	-0.025	14.14	-0.50	979.32
0.80	0.085	16.16	1.72	978.10
0.90	0.152	18.18	3.07	976.75
1.00	0.229	20.20	4.63	975.19
1.20	0.407	24.24	8.22	971.60
1.40	0.619	28.28	12.50	967.32
1.60	0.869	32.32	17.55	962.27
1.80	1.149	36.36	23.21	956.61
2.00	1.478	40.40	29.86	949.96
2.20	-1.829	44.44	-36.95	942.87

[redacted]

[redacted]

[redacted]

FIGURE 11

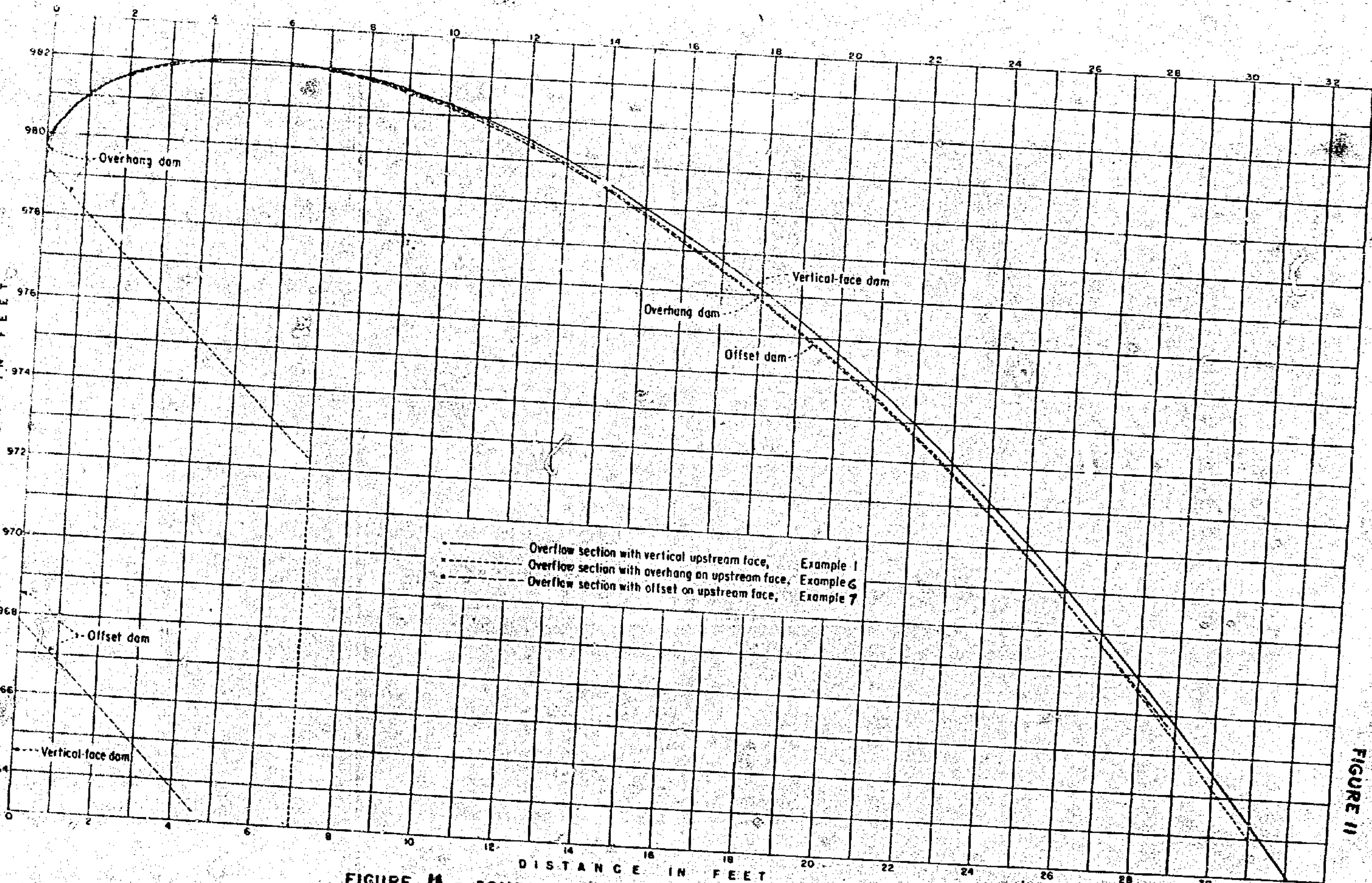


FIGURE 11 - COMPARISON OF RESULTS, EXAMPLES 1, 6 AND 7