Table 3.1 (1)

Air correction table, giving difference, in metres, between vertical length and slant length of sounding line above water surface for selected vertical angles

Vertical length in metres	*Vertical angle of sounding line at protractor (degrees)*																											
	5	*8*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*
1	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.21	0.22
2	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.31	0.33	0.36	0.38	0.41	0.44
3	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.12	0.14	0.16	0.17	0.19	0.21	0.24	0.26	0.28	0.31	0.34	0.37	0.40	0.43	0.46	0.50	0.54	0.58	0.62	0.66
4	0.02	0.04	0.06	0.07	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23	0.26	0.28	0.32	0.34	0.38	0.42	0.45	0.49	0.53	0.57	0.62	0.67	0.72	0.77	0.82	0.88
5	0.02	0.05	0.08	0.09	0.11	0.14	0.16	0.18	0.20	0.23	0.26	0.29	0.32	0.35	0.40	0.43	0.47	0.52	0.56	0.61	0.66	0.72	0.78	0.84	0.90	0.96	1.03	1.10
6	0.00	0.05	0.10	0.10	0.15	0.15	0.20	0.20	0.25	0.30	0.30	0.35	0.40	0.45	0.45	0.50	0.55	0.60	0.65	0.75	0.80	0.85	0.95	1.00	1.05	1.15	1.25	1.35
7	0.05	0.05	0.10	0.15	0.15	0.20	0.20	0.25	0.30	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.75	0.80	0.85	0.90	1.00	1.10	1.15	1.25	1.35	1.45	1.55
8	0.05	0.10	0.10	0.15	0.20	0.20	0.25	0.30	0.35	0.25	0.40	0.45	0.50	0.55	0.65	0.70	0.75	0.85	0.90	1.00	1.05	1.15	1.25	1.35	1.45	1.55	1.65	1.75
9	0.05	0.10	0.15	0.15	0.20	0.25	0.30	0.30	0.35	0.40	0.45	0.50	0.60	0.65	0.70	0.75	0.85	0.95	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.75	1.85	2.00
10	0.05	0.10	0.15	0.20	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.65	0.70	0.80	0.85	0.95	1.05	1.10	1.20	1.30	1.45	1.55	1.65	1.80	1.90	2.05	2.20
11	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.3	2.4
12	0.0	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	1.0	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.6
13	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.9	0.9	1.0	1.1	1.2	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.7	2.9
14	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.9	3.1
15	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.3	2.5	2.7	2.9	3.1	3.3
16	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.5	2.7	2.3	3.1	3.3	3.5
17	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.8
18	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.4	1.5	1.7	1.9	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.5	3.7	4.0
19	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.6	1.8	2.0	2.1	2.3	2.5	2.7	2.9	3.2	3.4	3.6	3.9	4.2
20	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.6	2.9	3.1	3.3	3.6	3.8	4.1	4.4

Source : Manual on stream gauging Volume I Field work, WMO - No. 519

Table 3.1 (2)

Wet-line table, giving difference, in metres, between wet-line length and vertical depth for selected vertical angles

Wet-line length, in metres	*Vertical angle of sounding line at protractor (degress)*																									
	10	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*	*27*	*28*	*29*	*30*	*31*	*32*	*33*	*34*	*35*
1	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.10	0.10	0.11	0.12	0.12
2	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.11	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
3	0.03	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.23	0.24	0.26	0.27
4	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.21	0.22	0.24	0.25	0.27	0.28	0.30	0.32	0.34
5	0.04	0.05	0.06	0.06	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.24	0.26	0.27	0.29	0.31	0.33	0.35	0.38	0.40	0.42
6	0.05	0.05	0.05	0.05	0.10	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.20	0.20	0.25	0.25	0.25	0.30	0.30	0.35	0.35	0.40	0.40	0.45	0.45	0.50
7	0.05	0.05	0.05	0.10	0.10	0.10	0.10	0.15	0.15	0.15	0.20	0.20	0.25	0.25	0.25	0.30	0.30	0.35	0.35	0.40	0.40	0.45	0.50	0.50	0.55	0.55
8	0.05	0.05	0.10	0.10	0.10	0.10	0.15	0.15	0.15	0.20	0.20	0.25	0.25	0.30	0.30	0.35	0.35	0.40	0.40	0.45	0.45	0.50	0.55	0.55	0.60	0.65
9	0.05	0.10	0.10	0.10	0.10	0.15	0.15	0.20	0.20	0.20	0.25	0.25	0.30	0.30	0.35	0.35	0.40	0.45	0.45	0.50	0.55	0.55	0.60	0.65	0.70	0.70
10	0.05	0.10	0.10	0.10	0.15	0.15	0.15	0.20	0.20	0.25	0.25	0.30	0.30	0.35	0.35	0.40	0.45	0.45	0.50	0.55	0.60	0.60	0.65	0.70	0.75	0.80
11	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9
12	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9
13	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0
14	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1
15	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2
16	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2
17	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3
18	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4
19	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.5
20	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.6

Source : Manual on stream gauging Volume I Field work, WMO - No. 519

Table 3.2 VELOCITY TABLE FOR OTT C-31 CURRENT METER

CALIBRATION FOR OTT CURRENT METER

Current meter No. 111039 Type C31 10.001
Type of support cable suspension,
100 kg middle piece

Propeller diameter 125 mm pitch 0.25m
No. 3-113319
Date of calibration January 13, 1992

if $n <$ 0.15 $V = 0.8825\ n + 0.032$
if $0.15 < n <$ 0.29 $V = 0.9778\ n + 0.018$
if $n >$ 0.29 $V = 1.0335\ n + 0.002$

where
n : number of pulse/ time interval (rev/sec)
V : water velocity (m/sec)

Current meter NO. 111039
Propeller NO. 3-113319 Date of calibration:January 13, 1992

unit m/sec

n-value	0	1	2	3	4	5	6	7	8	9
0.0	0.0320	0.1203	0.2136	0.3121	0.4154	0.5188	0.6221	0.7255	0.8288	0.9322
1.0	1.0355	1.1389	1.2422	1.3456	1.4489	1.5523	1.6556	1.7590	1.8623	1.9657
2.0	2.0690	2.1724	2.2757	2.3791	2.4824	2.5858	2.6891	2.7925	2.8958	2.9992
3.0	3.1025	3.2059	3.3092	3.4126	3.5159	3.6193	3.7226	3.8260	3.9293	4.0327
4.0	4.1360	4.2394	4.3427	4.4461	4.5494	4.6528	4.7561	4.8595	4.9628	5.0662
5.0	5.1695	5.2729	5.3762	5.4796	5.5829	5.6863	5.7896	5.8930	5.9963	6.0997
6.0	6.2030	6.3064	6.4097	6.5131	6.6164	6.7198	6.8231	6.9265	7.0298	7.1332
7.0	7.2365	7.3399	7.4432	7.5466	7.6499	7.7533	7.8566	7.9600	8.0633	8.1667
8.0	8.2700	8.3734	8.4767	8.5801	8.6834	8.7868	8.8901	8.9935	9.0968	9.2002
9.0	9.3035	9.4069	9.5102	9.6136	9.7169	9.8203	9.9236	10.0270	10.1303	10.2337
10.0	10.3370	10.4404	10.5437	10.6471	10.7504	10.8538	10.9571	11.0605	11.1638	11.2672
11.0	11.3705	11.4739	11.5772	11.6806	11.7839	11.8873	11.9906	12.0940	12.1973	12.3007
12.0	12.4040	12.5074	12.6107	12.7141	12.8174	12.9208	13.0241	13.1275	13.2308	13.3342
13.0	13.4375	13.5409	13.6442	13.7476	13.8509	13.9543	14.0576	14.1610	14.2643	14.3677
14.0	14.4710	14.5744	14.6777	14.7811	14.8844	14.9878	15.0911	15.1945	15.2978	15.4012
15.0	15.5045	15.6079	15.7112	15.8146	15.9179	16.0213	16.1246	16.2280	16.3313	16.4347
16.0	16.5380	16.6414	16.7447	16.8481	16.9514	17.0548	17.1581	17.2615	17.3648	17.4682
17.0	17.5715	17.6749	17.7782	17.8816	17.9849	18.0883	18.1916	18.2950	18.3983	18.5017
18.0	18.6050	18.7084	18.8117	18.9151	19.0184	19.1218	19.2251	19.3285	19.4318	19.5352
19.0	19.6385	19.7419	19.8452	19.9486	20.0519	20.1553	20.2586	20.3620	20.4653	20.5687
20.0	20.6720	20.7754	20.8787	20.9821	21.0854	21.1888	21.2921	21.3955	21.4988	21.6022

Table 3.3 VELOCITY TABLE FOR NO. 622 PRICE CURRENT METER

METRIC RATING TABLE FOR No. 622 CURRENT METER

VELOCITY IN METERS PER SECOND

Time in Secs.	1 Rev.	2 Rev.	3 Rev.	5 Rev.	10 Rev.	20 Rev.	30 Rev.	40 Rev.	50 Rev.	60 Rev.	70 Rev.	80 Rev.	90 Rev.	100 Rev.	150 Rev.	200 Rev.	Time in Secs.
40	0.027	0.046	0.064	0.094	0.177	0.344	0.512	0.680	0.847	1.018	1.189	1.356	1.527	1.695	2.542	3.389	40
41	0.027	0.046	0.061	0.091	0.174	0.335	0.500	0.664	0.826	0.994	1.161	1.323	1.490	1.655	2.481	3.307	41
42	0.027	0.043	0.061	0.091	0.171	0.326	0.488	0.649	0.808	0.969	1.134	1.292	1.454	1.615	2.423	3.228	42
43	0.027	0.043	0.061	0.088	0.165	0.320	0.475	0.634	0.789	0.948	1.106	1.262	1.420	1.579	2.368	3.152	43
44	0.027	0.043	0.058	0.085	0.162	0.314	0.466	0.619	0.771	0.927	1.082	1.231	1.387	1.542	2.313	3.078	44
45	0.027	0.043	0.058	0.085	0.159	0.308	0.457	0.607	0.756	0.905	1.058	1.204	1.356	1.509	2.262	3.008	45
46	0.027	0.043	0.058	0.085	0.155	0.302	0.448	0.594	0.741	0.884	1.033	1.180	1.325	1.475	2.213	2.941	46
47	0.024	0.043	0.055	0.082	0.152	0.295	0.439	0.582	0.725	0.866	1.012	1.155	1.296	1.445	2.167	2.880	47
48	0.024	0.043	0.055	0.079	0.149	0.290	0.430	0.570	0.710	0.847	0.991	1.131	1.271	1.414	2.121	2.819	48
49	0.024	0.040	0.055	0.079	0.146	0.283	0.421	0.558	0.695	0.829	0.969	1.106	1.247	1.384	2.076	2.761	49
50	0.024	0.040	0.052	0.079	0.143	0.277	0.411	0.546	0.680	0.814	0.951	1.085	1.222	1.356	2.033	2.710	50
51		0.040	0.052	0.076	0.140	0.274	0.402	0.533	0.668	0.799	0.933	1.064	1.198	1.329	1.993	2.658	51
52		0.040	0.052	0.076	0.140	0.268	0.393	0.524	0.655	0.783	0.914	1.042	1.173	1.305	1.957	2.609	52
53		0.040	0.049	0.073	0.137	0.262	0.387	0.515	0.643	0.768	0.896	1.024	1.152	1.280	1.920	2.560	53
54		0.040	0.049	0.073	0.134	0.259	0.381	0.506	0.631	0.753	0.878	1.006	1.131	1.256	1.884	2.512	54
55		0.040	0.049	0.073	0.131	0.253	0.375	0.497	0.619	0.741	0.863	0.988	1.109	1.234	1.850	2.466	55
56		0.037	0.049	0.070	0.131	0.250	0.369	0.488	0.607	0.728	0.847	0.969	1.091	1.213	1.817	2.423	56
57		0.037	0.049	0.070	0.128	0.244	0.363	0.479	0.597	0.715	0.832	0.951	1.073	1.192	1.786	2.380	57
58		0.037	0.046	0.067	0.125	0.241	0.357	0.469	0.586	0.704	0.817	0.936	1.055	1.170	1.756	2.341	58
59		0.037	0.046	0.067	0.125	0.238	0.351	0.460	0.579	0.692	0.802	0.920	1.036	1.149	1.725	2.301	59
60		0.037	0.046	0.067	0.122	0.235	0.344	0.451	0.570	0.680	0.789	0.905	1.018	1.131	1.693	2.262	60
61		0.037	0.046	0.067	0.119	0.229	0.338	0.445	0.561	0.668	0.777	0.890	1.003	1.113	1.667	2.225	61
62		0.034	0.046	0.064	0.119	0.226	0.332	0.439	0.552	0.658	0.765	0.875	0.988	1.094	1.640	2.188	62
63		0.034	0.043	0.064	0.116	0.223	0.326	0.433	0.543	0.649	0.753	0.860	0.972	1.076	1.615	2.155	63
64		0.034	0.043	0.064	0.116	0.219	0.320	0.427	0.533	0.640	0.741	0.844	0.957	1.061	1.591	2.121	64
65		0.034	0.043	0.061	0.113	0.216	0.314	0.421	0.524	0.631	0.728	0.832	0.942	1.045	1.567	2.088	65
66		0.034	0.043	0.061	0.113	0.213	0.311	0.415	0.515	0.622	0.716	0.820	0.927	1.030	1.542	2.057	66
67		0.034	0.043	0.061	0.110	0.210	0.308	0.408	0.506	0.613	0.707	0.808	0.911	1.015	1.518	2.027	67
68		0.034	0.043	0.061	0.110	0.207	0.305	0.402	0.500	0.604	0.698	0.796	0.899	1.000	1.497	1.995	68
69		0.034	0.040	0.058	0.107	0.204	0.302	0.396	0.494	0.594	0.689	0.783	0.887	0.985	1.475	1.966	69
70		0.034	0.040	0.058	0.107	0.201	0.299	0.391	0.488	0.585	0.680	0.771	0.875	0.969	1.454	1.939	70

This table applies when measurements are made with meter suspended by cable. When measurements are made with meter suspended by rod, reduce the tabular velocities by 2 per cent.

6023-10/74-2C TELEDYNE GURLEY, TROY, N. Y., U.S.A.

Table 3.4 TYPICAL CURRENT METER NOTES AND COMPUTATIONS FOR THE MID SECTION METHOD

7-275C (4/61)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

DISCHARGE MEASUREMENT NOTES

Meas. No. 480
Comp. by OFS
Checked by MT

Snake River near Moran, Wyoming

Date July 6 19 64 Party O. F. Sifolar

Width 214 Area 1,140 Vel. 3.70 G. H. 6.70 Disch. 4,220

Method 6-2/.8 No. secs. 23 G. H. change 0 in ____ hrs. Susp. 30.0

Method coef. 1.0 Hor. angle coef. 1.0 Susp. coef. 1.005 Meter No. 217050

GAGE READINGS

Time		Recorder	Inside	Outside
1700	6.72	6.70	6.70	
1705	6.72	6.70	6.70	
1810	6.72	6.70	6.70	
Weighted M. G. H.		6.70		
G. H. correction				
Correct M. G. H.				

Date rated 5-31-62 Used rating for rod ____ susp. Meter 5 ft. above bottom of wt. Tape checked ✓

Spin before meas. OK after OK

Meas. plots ____ % diff. from ____ rating

Wading, cable, ice, boat, upstr., downstr., side bridge ____ feet, mile, above, below gage, and ____

Check-bar, chain found ____ changed to ____ at ____

Correct ____

Levels obtained ____

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%), based on following conditions: Cross section cobbles

Flow even Weather fair

Other ____ Air ____ °F@ ____

Gage OK Water 58 °F@ ____

____ Record removed ____ Intake flushed No

Observer ____

Control clear

Remarks ____

G. H. of zero flow ____ ft.

M5-1-48

Rivers at—

Angle coef. (flow)	Dist. from initial point	Width	Depth	Observation depth	Revolutions	Time in secs.	VELOCITY At point	VELOCITY Mean in vert. (final)	Adjusted for hor. angle coef.	Area	Discharge
	30	5	0		0	40		0		0	0
	40	10	3.40	.2	60	41	5.25	2.79		34.0	95
				.8	50	48	2.33				
	50	10	4.70	.2	80	43	4.13	3.52		47.0	165
				.8	60	46	2.90				
	60	10	5.30	.2	80	43	4.13	3.73		53.0	198
				.8	60	40	3.33				
	70	10	5.80	.2	80	42	4.23	3.82		58.0	222
				.8	80	52	3.42				
	80	10	5.90	.2	80	39	4.53	3.97		59.0	234
				.8	60	39	3.41				
	90	10	5.90	.2	80	39	4.53	3.89		59.0	230
				.8	60	41	3.25				
	100	10	5.90	.2	80	39	4.53	4.04		59.0	238
○				.8	80	50	3.55				
	110	10	6.00	.2	100	48	4.62	4.08		60.0	245
				.8	80	50	3.55				
	120	10	6.20	.2	100	48	4.62	3.98		62.0	247
				.8	60	40	3.33				
	130	10	6.25	.2	100	47	4.72	4.02		62.5	251
				.8	60	40	3.33				
	140	10	6.30	.2	100	48	4.62	3.90		63.0	246
				.8	60	42	3.18				
	150	10	6.70	.2	80	39	4.53	3.82		67.0	256
				.8	60	43	3.10				
	160	10	6.90	.2	80	42	4.23	3.51		69.0	242
				.8	60	48	2.79				
	170	10	6.30	.2	80	42	4.23	3.66		63.0	231
				.8	60	43	3.10				
	180	10	6.10	.2	80	41	4.33	3.87		61.0	236
				.8	60	39	3.41				
	190	10	5.90	.2	80	40	4.43	3.73		59.0	220
				.8	60	44	3.03				
	200	10	5.70	.2	80	42	4.33	3.49		57.0	199
				.8	50	42	2.65				
	210	10	5.20	.2	80	42	4.23	3.60		52.0	187
				.8	60	45	2.97				
	220	10	4.50	.2	80	47	3.78	3.38		45.0	152
				.8	60	45	2.97				
	230	10	3.60	.2	80	59	3.02	2.60		36.0	94
				.8	40	41	2.18				
	240	7.0	1.50	.6	30	46		1.46		10.5	15
	244	2	0		0	40		0			
										1,136	4,203
					1	13	@ 1	800			
○									cust. coef.	1.005	
											4,224

Source : U.S. Bureau of Reclamation, 1984 : Water Measurement Manual 2nd Edition

Table 3.5 VALUES FOR THE COMPUTATION OF THE ROUGHNESS COEFFICIENT

Channel conditions		Values	
Material involved	Earth	n_0	0.020
	Rock cut		0.025
	Fine gravel		0.024
	Coarse gravel		0.028
Degree of irregularity	Smooth	n_1	0.000
	Minor		0.005
	Moderate		0.010
	Severe		0.020
Variations of channel cross section	Gradual	n_2	0.000
	Alternating occasionally		0.005
	Alternating frequently		0.010–0.015
Relative effect of obstructions	Negligible	n_3	0.000
	Minor		0.010-0.015
	Appreciable		0.020–0.030
	Severe		0.040–0.060
Vegetation	Low	n_4	0.005–0.010
	Medium		0.010–0.025
	High		0.025–0.050
	Very high		0.050–0.100
Degree of meandering	Minor	m_5	1.000
	Appreciable		1.150
	Severe		1.300

SOURCE : Cowan, OPEN-CHANNEL HYDRAULICS

Table 3.6 VALUES OF THE ROUGHNESS COEFFICIENT n

Type of channel and description	Minimum	Normal	Maximum
C. Excavated or Dredged			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. Natural Streams			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The *n* value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

SOURCE : Cowan, OPEN-CHANNEL HYDRAULICS

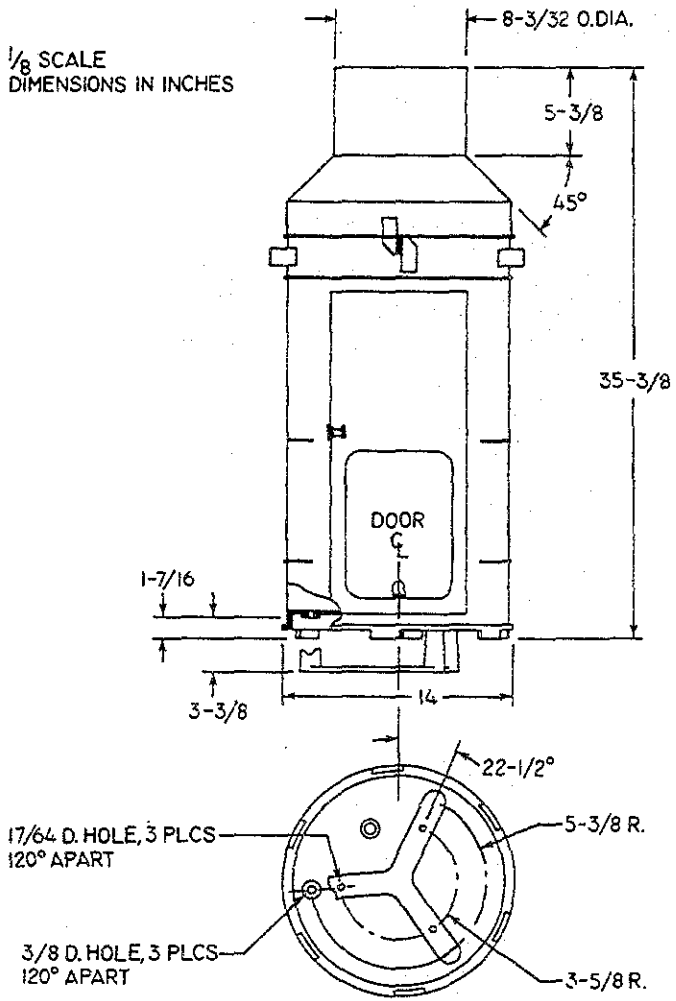


Figure 1. Outline - Universal Recording Rain Gage

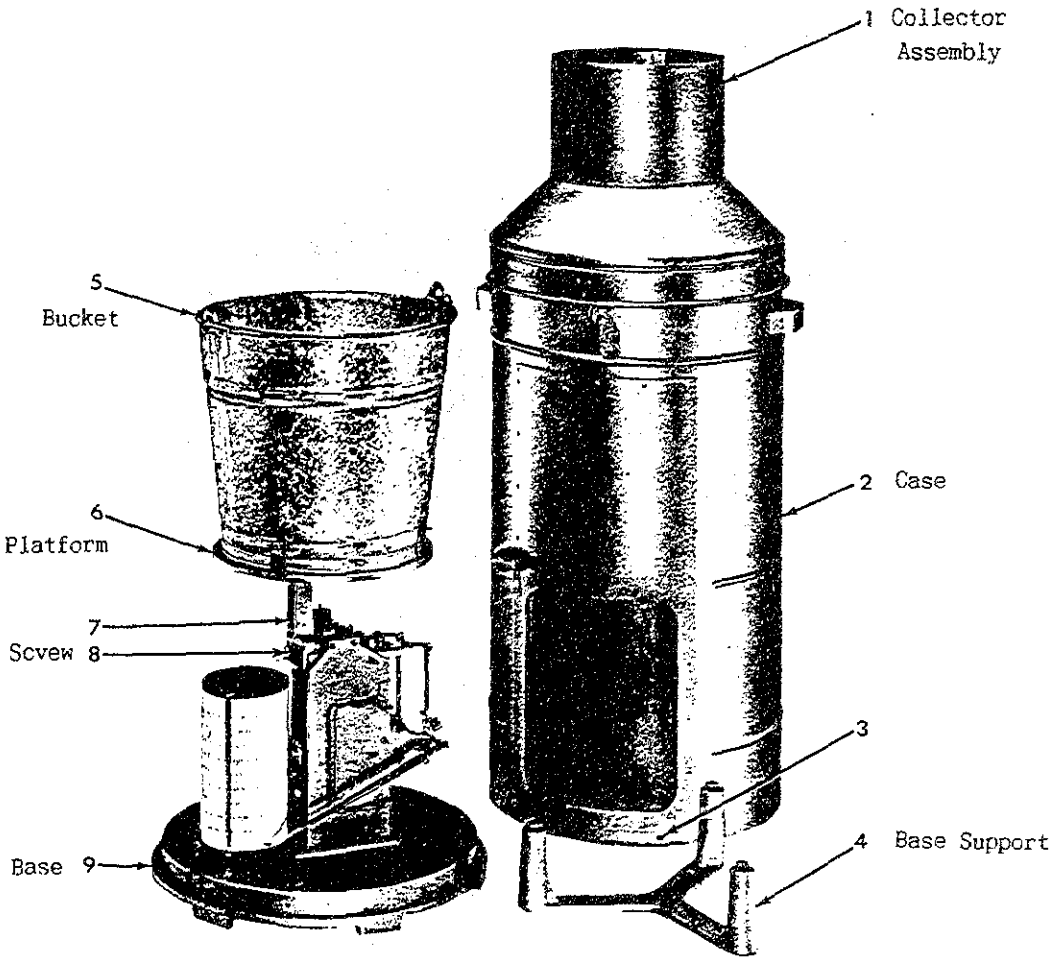
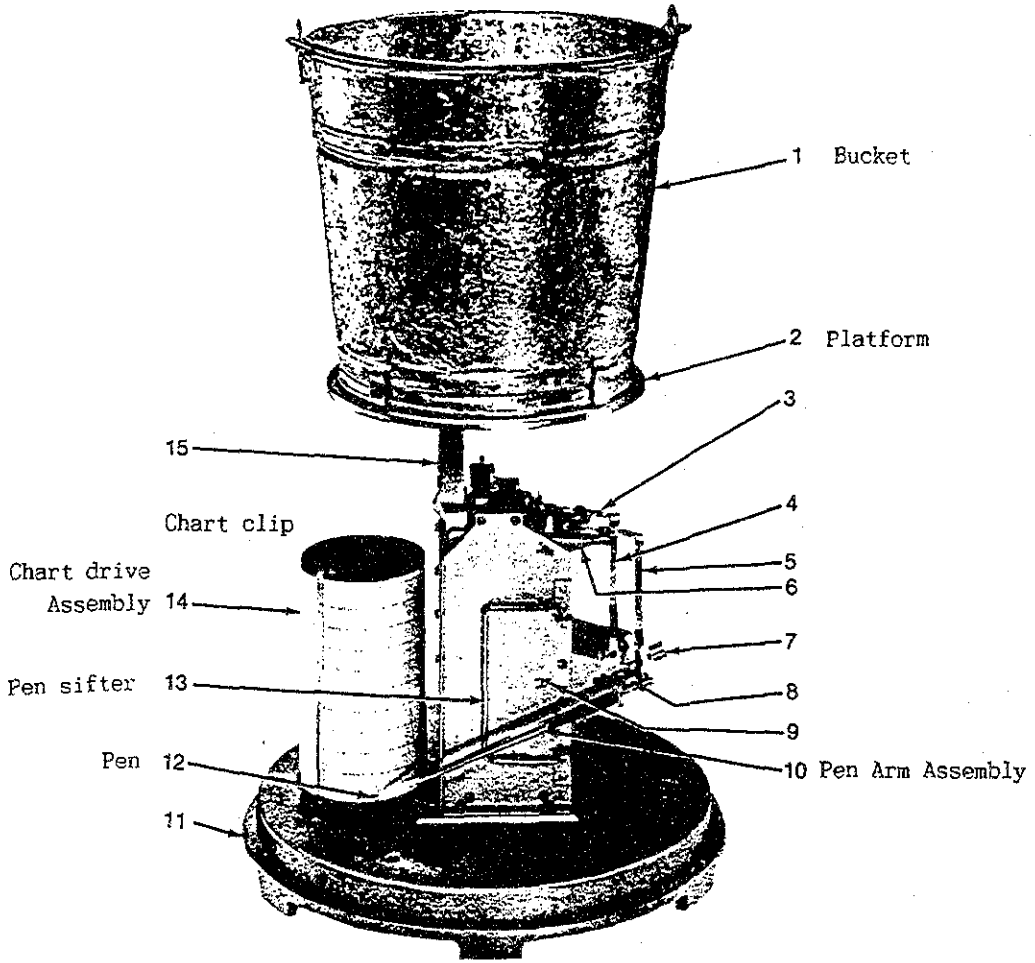
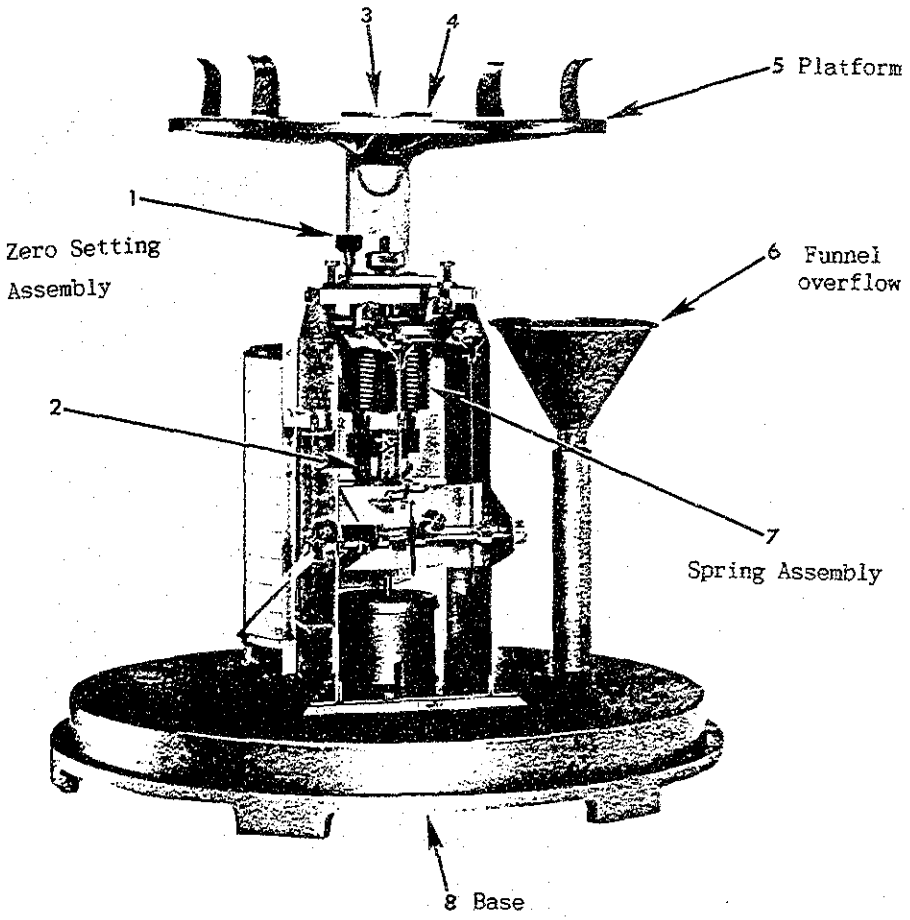


Figure 4. Universal Recording Rain Gage

Fig. 1.1 GENERAL FIGURE OF NO. 5-780 SERIES UNIVERSAL RECORDING RAIN GAUGE, BELFORT (WEIGHING-TYPE)



Rain Gage Mechanism, Front View



Rain Gage Mechanism, Dual-Spring

Fig. 1.2 MECHANISM OF NO. 5-780 SERIES UNIVERSAL RECORDING RAIN GAUGE

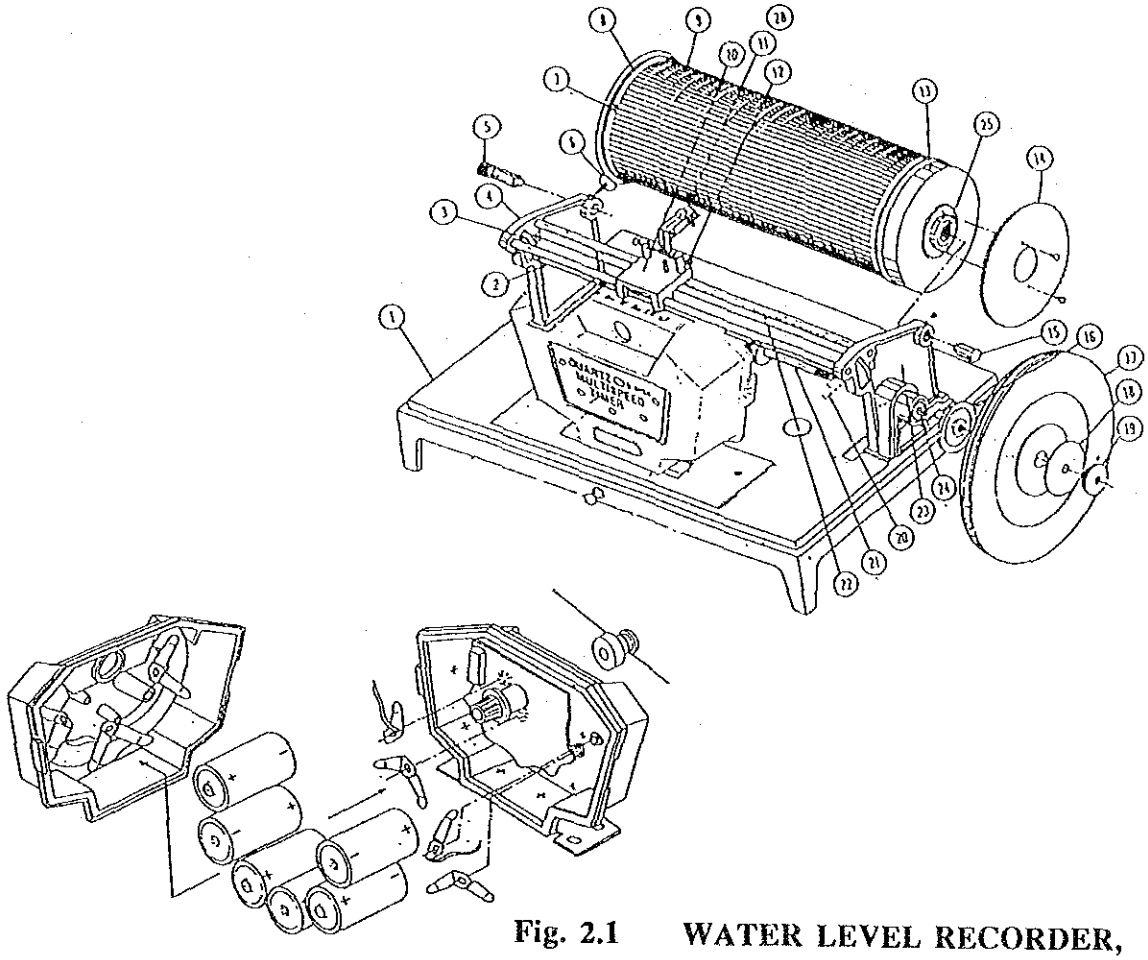


Fig. 2.1 WATER LEVEL RECORDER, TYPE F

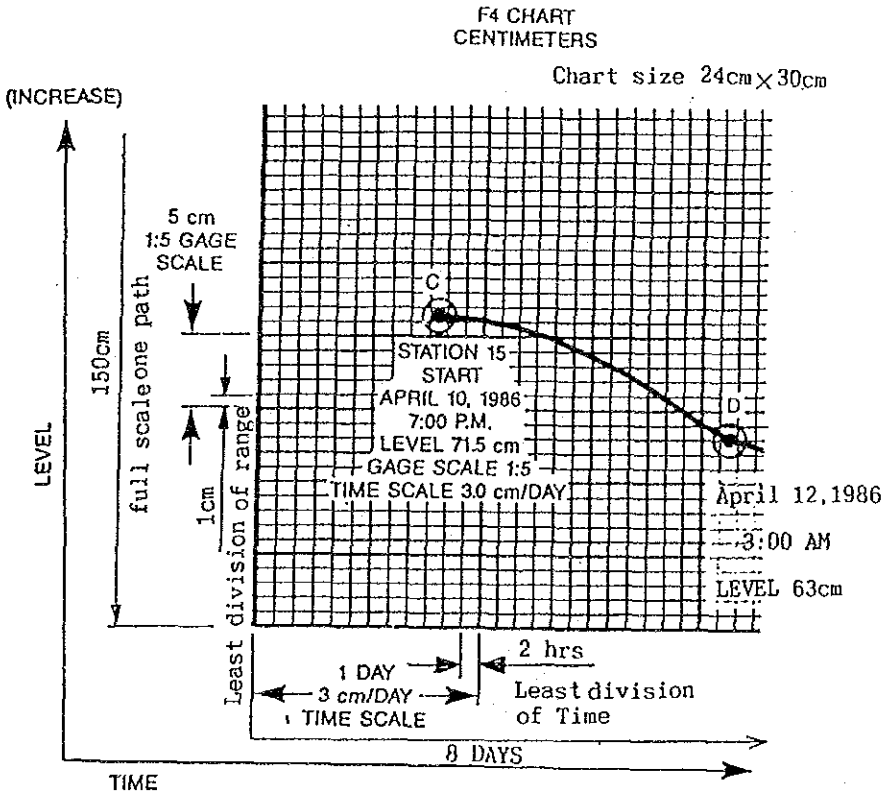
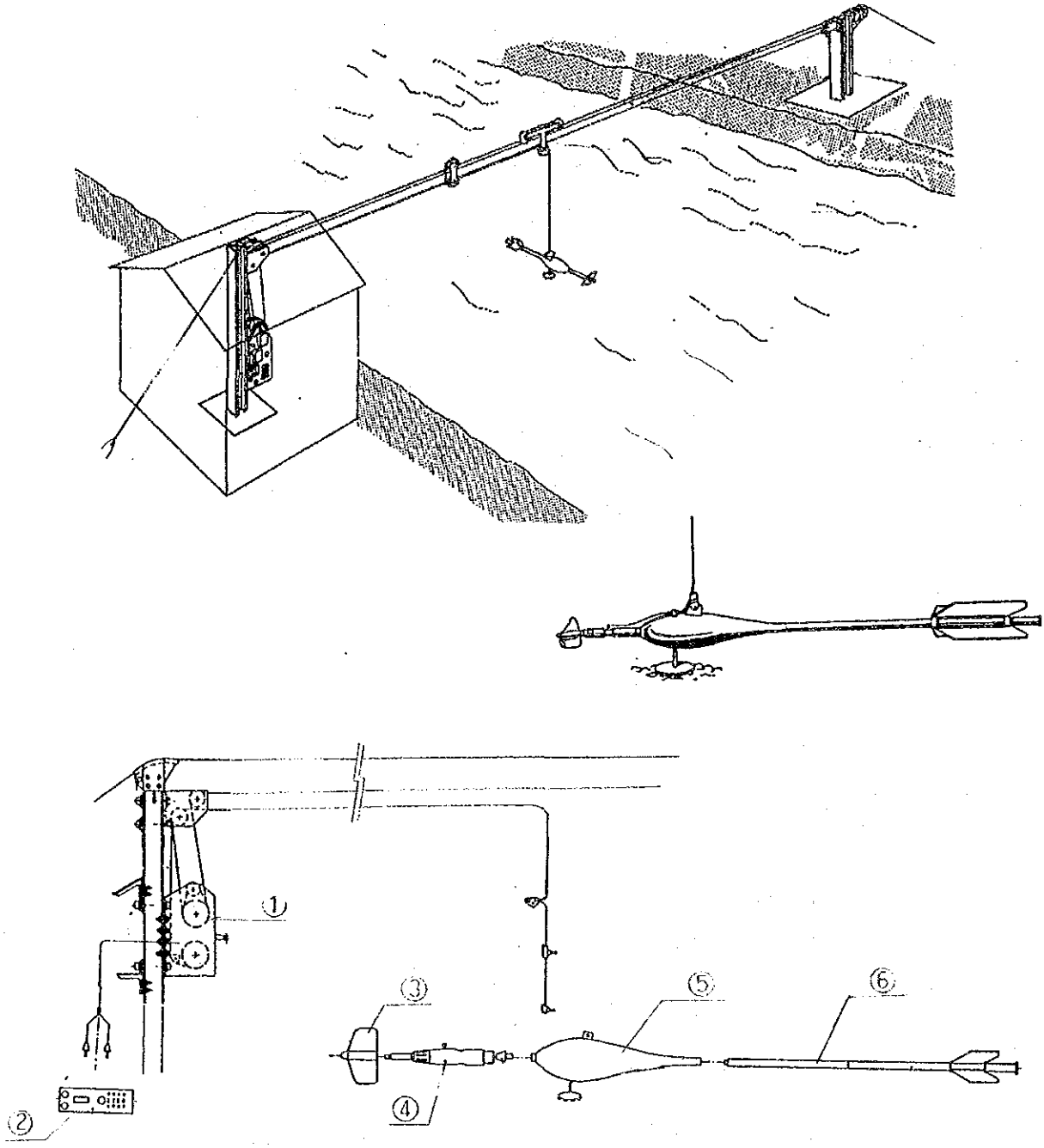


Fig. 2.2 RECORDING CHART OF TYPE F MODEL 68



Combinations with Cable-Suspended Current-meter

① Double drum winch

② Z215 Counter set

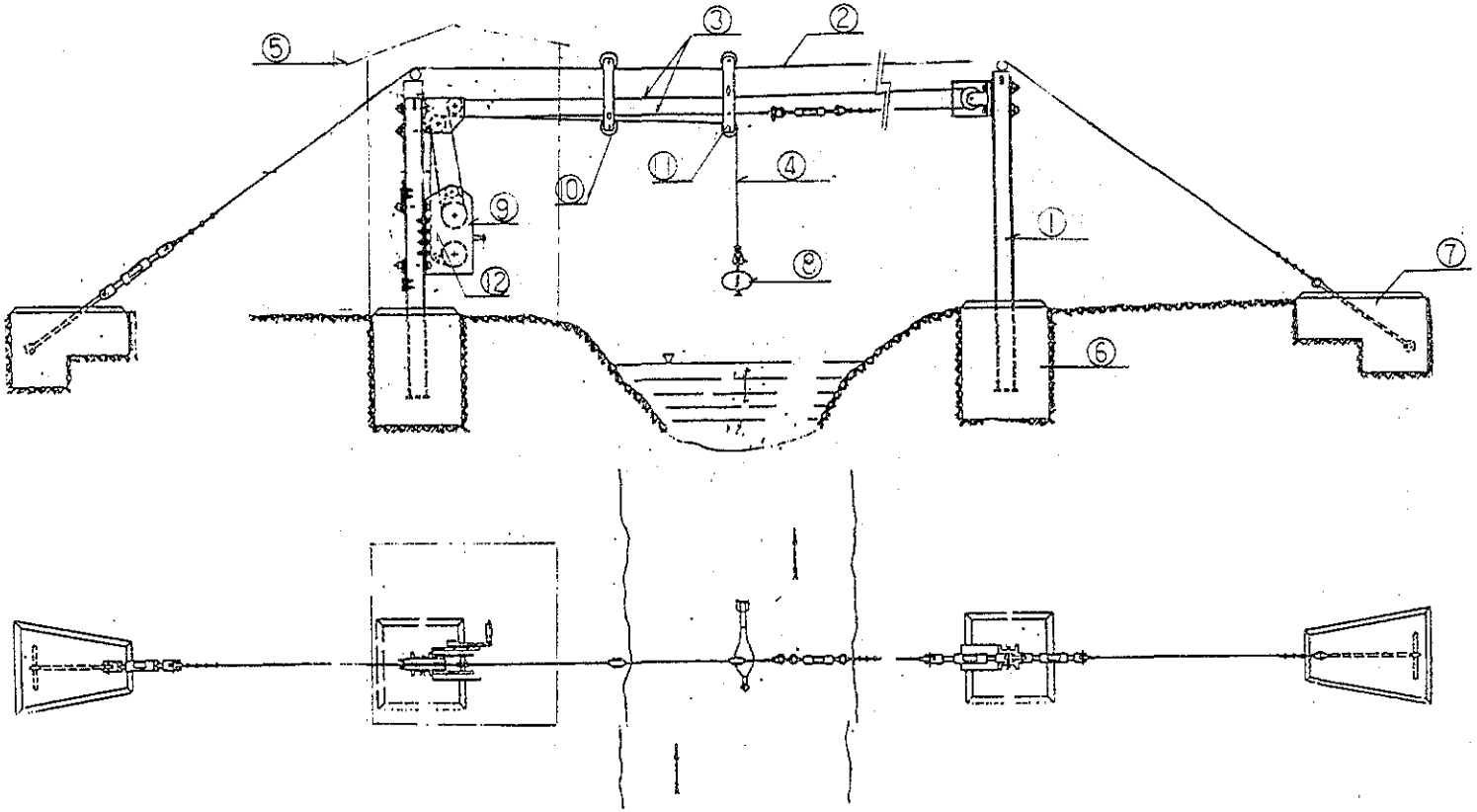
③ Propeller

④ C31 Current meter

⑤ Middle piece

⑥ Stabilizer tail Piece (1.4m)

Fig. 3.1 BANK OPERATION DOUBLE DRUM WINCH CABLE WAY



① Bearing Post

② Track Cable (ϕ 15mm)

③ Tow Cable (ϕ 6 mm)

④ Suspension-Conduction Cable

⑤ Observation house

⑥ Bearing pole foundation

⑦ Anchor block

⑧ Cable-Suspended Current meter with middle piece

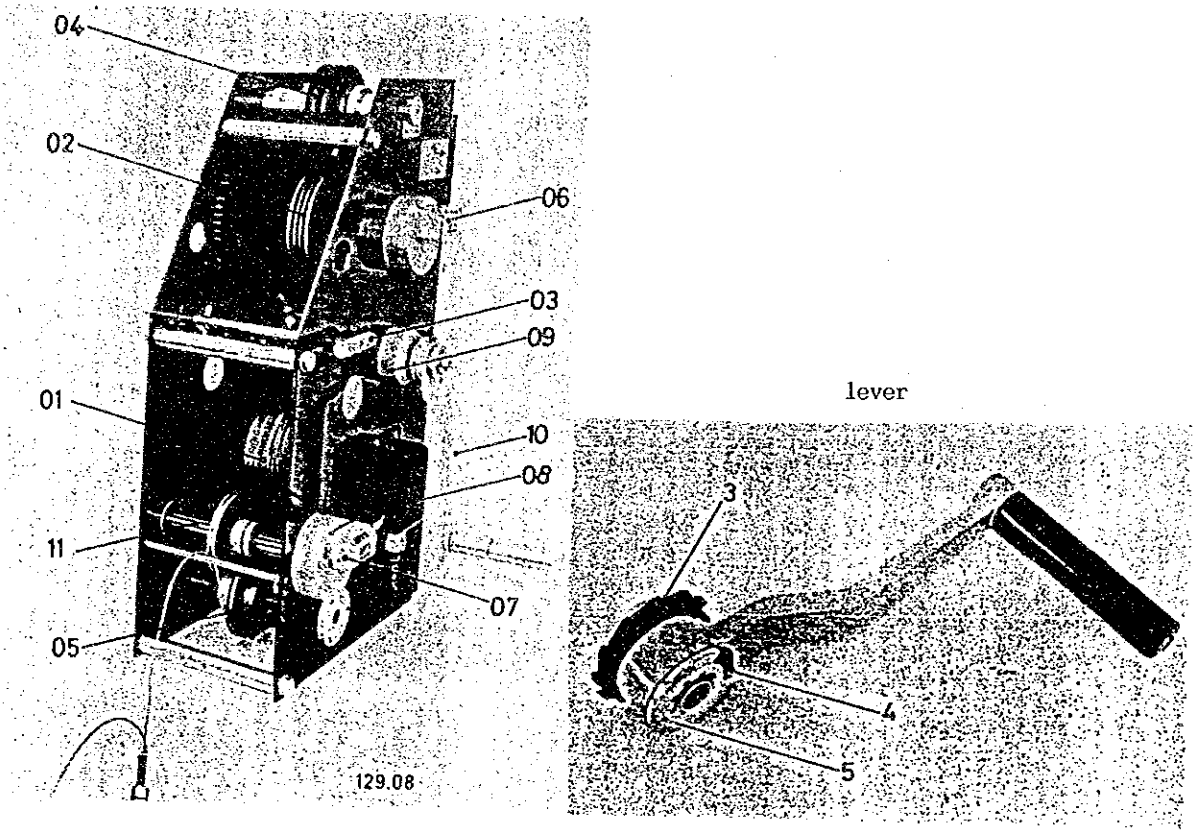
⑨ Double drum winch (100kg)

⑩ Cable Support Pulley

⑪ Trolley

⑫ Distance and depht Counte

Fig. 3.2 DOUBLE-DRUM WINCH CABLE WAY SYSTEM



01 Drum for the suspension-conduction cable

02 Drum for the towing cable

03 Control lever of the horizon tal and vertical displacement

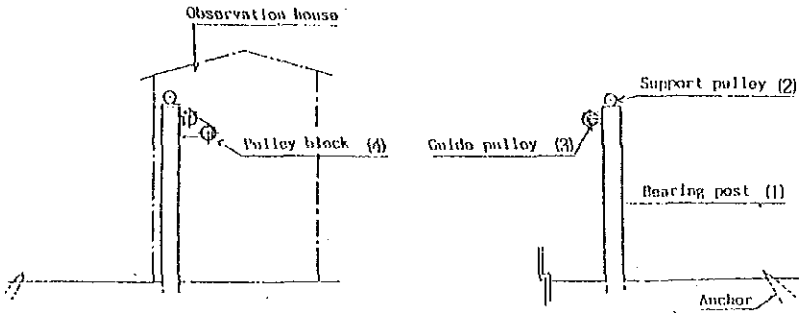
06 Distance counter

07 Depth counter

08 Slip-ring housing

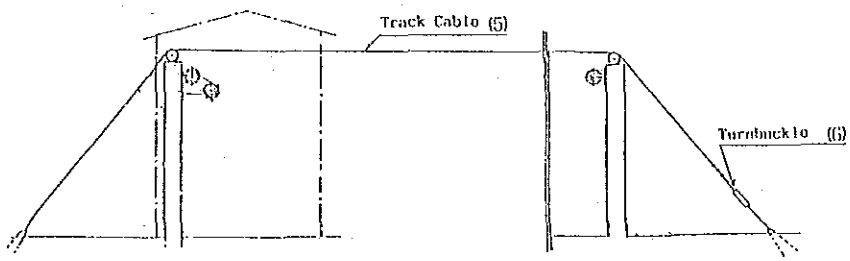
Fig. 3.3 100 KG MECHANICAL DOUBLE-DRUM WINCH

Fig. 3.4 INSTALLATION PROCEDURE OF DOUBLE-DRUM WINCH CABLE WAY



① Election of bearing posts (1)

② Fix support pulleys (2), guide pulley (3) and pulley block (4) to the bearing posts

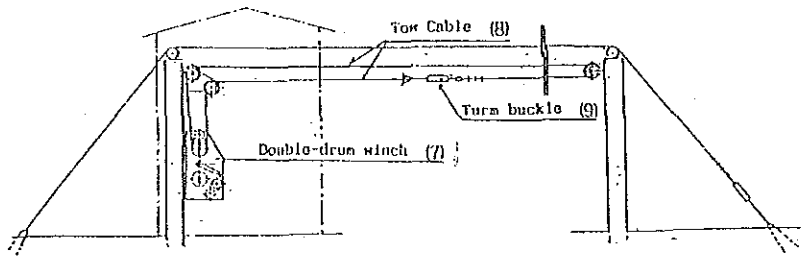


③ Open turnbuckles (6) as far as possible and secure track Cable (5) at both ends

④ Run free end of track Cable across the river to the opposite post

⑤ Tension the Cable to the desired Cable sag, then shape the end into a loop with the Cable crumps

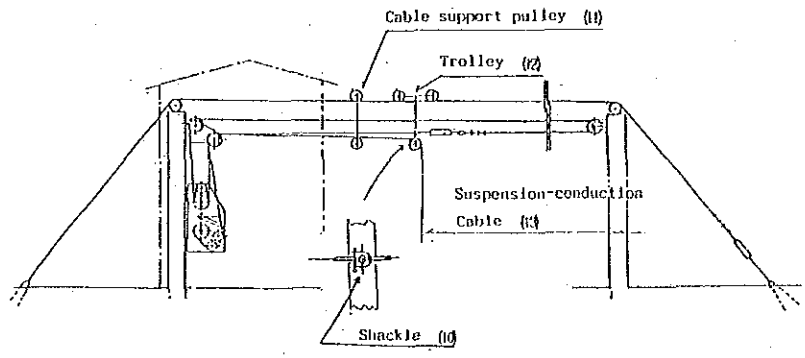
⑥ Cut the projecting end of the Cable at a point which is about 150mm from the last clamp and wrap the Cable with wire at the point of cut so that the strands will not unwist



⑦ Fix the Double-drum winch (7)

⑧ Haul the towing Cable (8) across the river to the opposite bank and arrange it around the guide pulley (3)

⑨ Then run the towing Cable back to the winch post, arrange it on the pulley block (4) and wind it around the Cable-drum of the winch(7) and around the front guide pulley

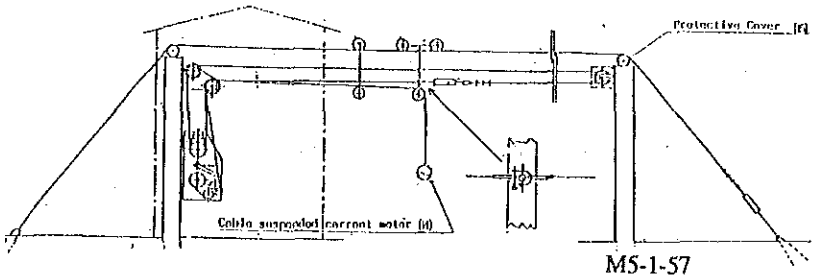


⑩ Fasten the spliced-in fixed Cable thimble to the turnbuckle (9) with shackle (10)
Secure free end of Cable with Cable clamps

⑪ Tension the Cable to the desired Cable sag

⑫ Place trolley (12) and the Cable support pulley (11) on the track Cable and attach lower half of towing Cable to the trolley

⑬ Arrange suspension-conduction (13) Cable over the guide pulley (4)



⑭ Fasten Cable to suspended current meter (14) by means of thimble

⑮ Testing operation to comfom proper function

⑯ After testing, attach protective cover (15) to the opposite post

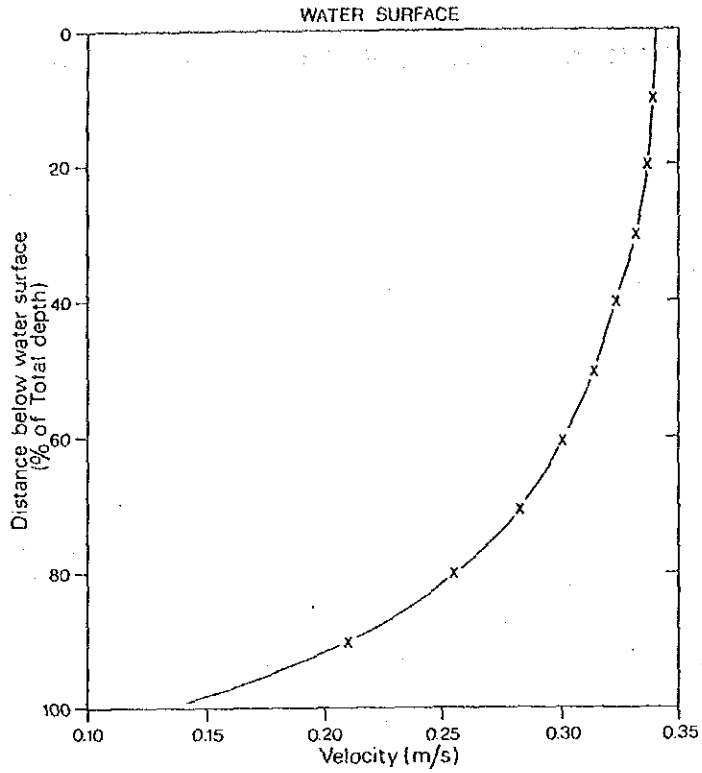
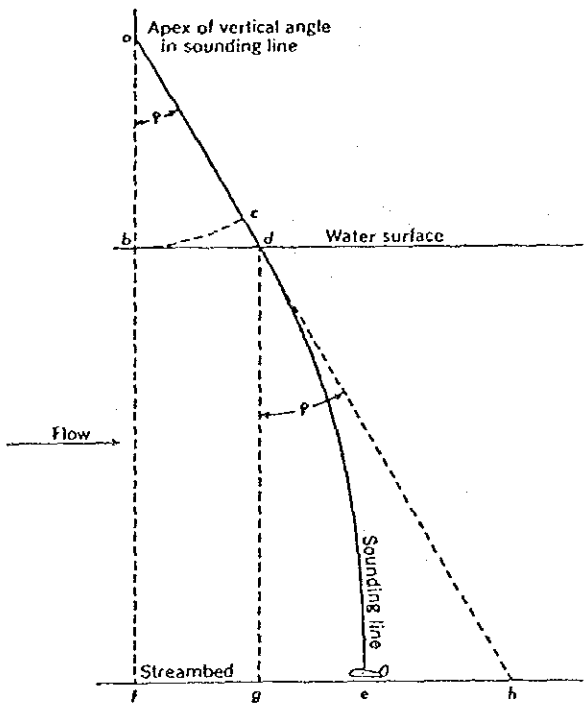
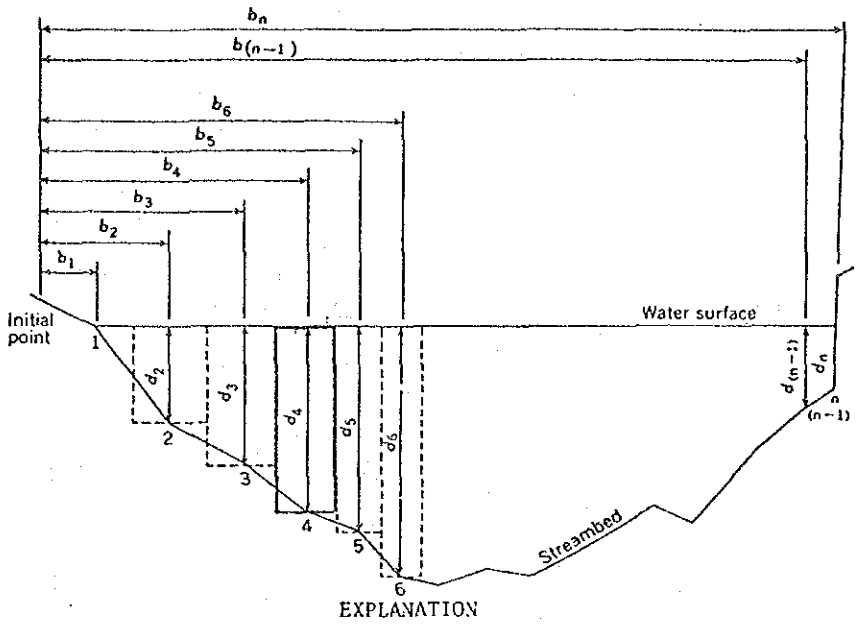


Fig. 3.5 TYPICAL VERTICAL VELOCITY CURVE



Source : WMO, 1980 : Manual on stream gauging Vol. I Field Note

Fig. 3.6 POSITION OF SOUNDING WEIGHT AND LINE IN DEEP SWIFT CHANNELS



EXPLANATION

1, 2, 3,.....n	Observation verticals
b_1, b_2, b_3,.....b_n	Distance, in feet, from the initial point to the observation vertical
d_1, d_2, d_3,.....d_n	Depth of water, in feet, at the observation vertical
Dashed lines	Boundaries of subsections; one heavily outlined is discussed in text

Fig. 3.7 DEFINITION SKETCH OF MIDSECTION METHOD OF COMPUTING CROSS-SECTION AREA FOR DISCHARGE MEASUREMENTS

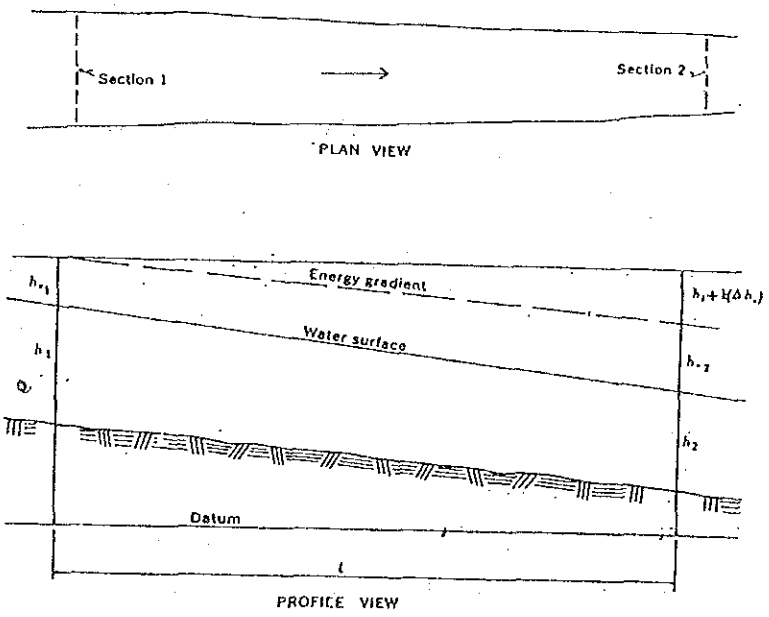


Fig. 3.8 DEFINITION SKETCH OF A SLOPE-AREA REACH

HYDRAULIC COMPUTATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

9-193
Slope-area measurement
December 1960

File _____
Meas. No. _____

Slope-area measurement of Snake Creek near Connell, Wash.
(Miscellaneous site) for flood of Feb. 21, 1956

	1-2	2-3	3-4
Reach between sections			
Length of reach (L), ft	121	90	119
Fall in reach (Δh), ft	0.97	0.55	1.07

Gage height, ____ ft
Discharge[1], 1,380 cfs
Drainage area, 115 sq mi

SECTION PROPERTIES

Section	n	$\frac{1.486}{n}$	a	r	$r^{2/3}$	$K=\frac{1.486}{n} a r^{2/3}$	K^3/a^2		[2] a	[3] q	v
1 Sta. 1-67	.045	33.0	208	3.09	2.12	14,550			1.00	1,380	6.64
2 2-11	.080	18.6	6.1	.68	.77	90	0.196			9	1.31
11-67	.045	33.0	203	3.47	2.29	15,340	876			1,370	6.75
			209.1			15,430	876	.196	1.04		
							842				
3 1-14	.080	18.6	10.0	.77	.84	160		.410		13	1.30
14-68	.045		212	3.83	2.45	17,140	1122			1,360	6.42
68-73	.045		2.6	.51	.64	50		.185		4	1.54
			224.6	-		17,350	1122	.595	1.08		
							1035				
4 2-20	.080	18.6	11.1	.62	.73	150		.274		13	1.17
20-69	.045		193	3.79	2.43	15,480	996			1,360	7.05
69-74	.045		2.8	.55	.67	60		.275	1.10	4	1.43
			206.9			15,690	996	549			
							901				

Weighted conveyance[4] (K_w). [1-2] 14,930 [2-3] 16,360 [3-4] 16,500

FORMULAS

2 $a = \Sigma (K^3/a^2) \div K^3_{total}/A^2_{total}$
3 $q = Q\ (K/K_{total})$
4 $K_w = \sqrt{K_{Upstr.} \times K_{Dwnstr.}}$
5 $h_v = a\ V^2/2g$
6 $\Delta h_v = $ Upstr. $h_v -$ Dwnstr. h_v
7 When Δh_v is positive, $h_f = \Delta h + \frac{1}{2}\Delta h_v$
When Δh_v is negative, $h_f = \Delta h + \Delta h_v$

COMPUTATION OF DISCHARGE

Reach	Assumed Q	[5] h_v	[6] Δh_v	[7] h_f	$s = h_f/L$	$s^{1/2}$	Computed Q $= K_w\ s^{1/2}$
1-2	1,330	Upstr. .636 / Dwnstr. .655	-0.019	0.951	0.00786	0.0887	1,330
2-3	1,320	Upstr. .645 / Dwnstr. .580	.065	.582	.00647	.0804	1,320
3-4	1,460	Upstr. .710 / Dwnstr. .852	-.142	.928	.00780	.0883	1,460

[1] DISCHARGE (by formula) 1,380, or _____

Summary of factors influencing measuring conditions (floodmarks, surge, scour, fill, channel configuration, angle of flow, selection of n, etc.):

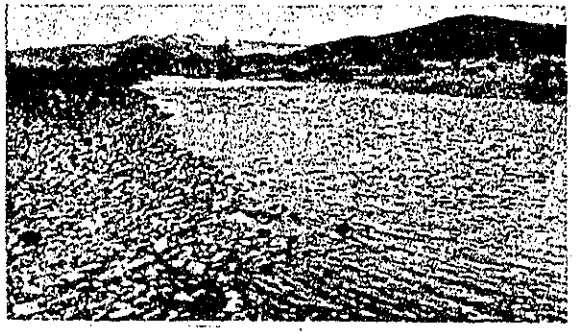
Sheet No. 11 of 13 Sheets. Prepared by E.L.S. Date 3-19-56 Checked by E.G.P. Date 5-14-56

Figure B–20.—Sample slope-area computation, discharge. 288–D–2831.

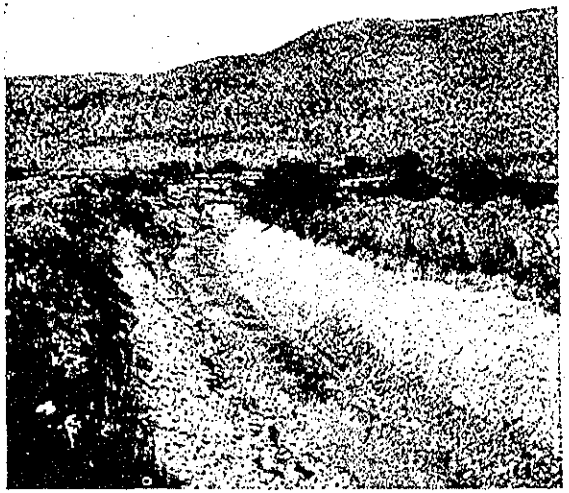
Fig. 3.9 SAMPLE OF SLOPE-AREA COMPUTATION, DISCHARGE

Source : U.S. Geological Survey

(12)



(14)



(15)

FIG. 5-5 (13–15)

12. $n = 0.028$. Cobble-bottom channel, where there is insufficient silt in the water or too high a velocity, preventing formation of a graded smooth bed.
14. $n = 0.030$. Canal with large-cobblestone bed.
15. $n = 0.035$. Natural channel, somewhat irregular side slopes; fairly even, clean and regular bottom; in light gray silty clay to light tan silt loam; very little variation in cross section.

(16)

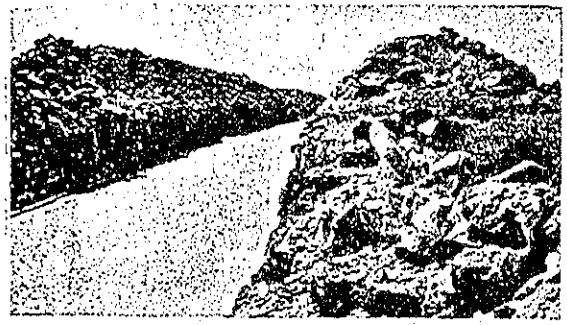
(17)

(18)

FIG. 5-5 (16–18)

16. $n = 0.040$. Rock channel excavated by explosives.
17. $n = 0.040$. Ditch in clay and sandy loam; irregular side slopes, bottom, and cross section; grass on slopes.
18. $n = 0.045$. Dredge channel, irregular side slopes and bottom, in black, waxy clay at top to yellow clay at bottom, sides covered with small saplings and brush, slight and gradual variations in cross section.

Fig. 3.10 (1) PHOTOGRAPH OF TYPICAL CHANNELS SHOWING DIFFERENT n VALUES



(19)

(20)

(21)

FIG. 5-5 (19–21)

19. $n = 0.050$. Dredge channel with very irregular side slopes and bottom, in dark-colored waxy clay, with growth of weeds and grass. Slight variation in shape of cross section for variation in size.

20. $n = 0.060$. Ditch in heavy silty clay; irregular side slopes and bottom; practically entire section filled with large-size growth of trees, principally willows and cottonwoods. Quite uniform cross section.

21. $n = 0.080$. Dredge channel in black slippery clay and gray silty clay loam, irregular wide slopes and bottom, covered with dense growth of bushy willows, some in bottom; remainder of both slopes covered with weeds and a scattering growth of willows and poplars, no foliage; some silting on bottom.

SOURCE : Cowan, OPEN-CHANNEL HYDRAULICS

(22)

(23)

(24)

FIG. 5-5 (22–24)

22. $n = 0.110$. Same as (21), but with much foliage and covered for about 40 ft with growth resembling smart weed.

23. $n = 0.125$. Natural channel floodway in median fine sand to fine clay, none side slopes; fairly even and regular bottom with occasional flat bottom sloughs; variation in depth; practically virgin timber, very little undergrowth except occasional dense patches of bushed and small trees, some logs and dead fallen trees.

24. $n = 0.150$. Natural river in sandy clay soil. Very crooked course, irregular side slopes and uneven bottom. Many roots, trees and bushes, large logs and other drift on bottom; trees continually falling into channel due to bank caving.

Fig. 3.10 (2) PHOTOGRAPH OF TYPICAL CHANNELS SHOWING DIFFERENT n VALUES

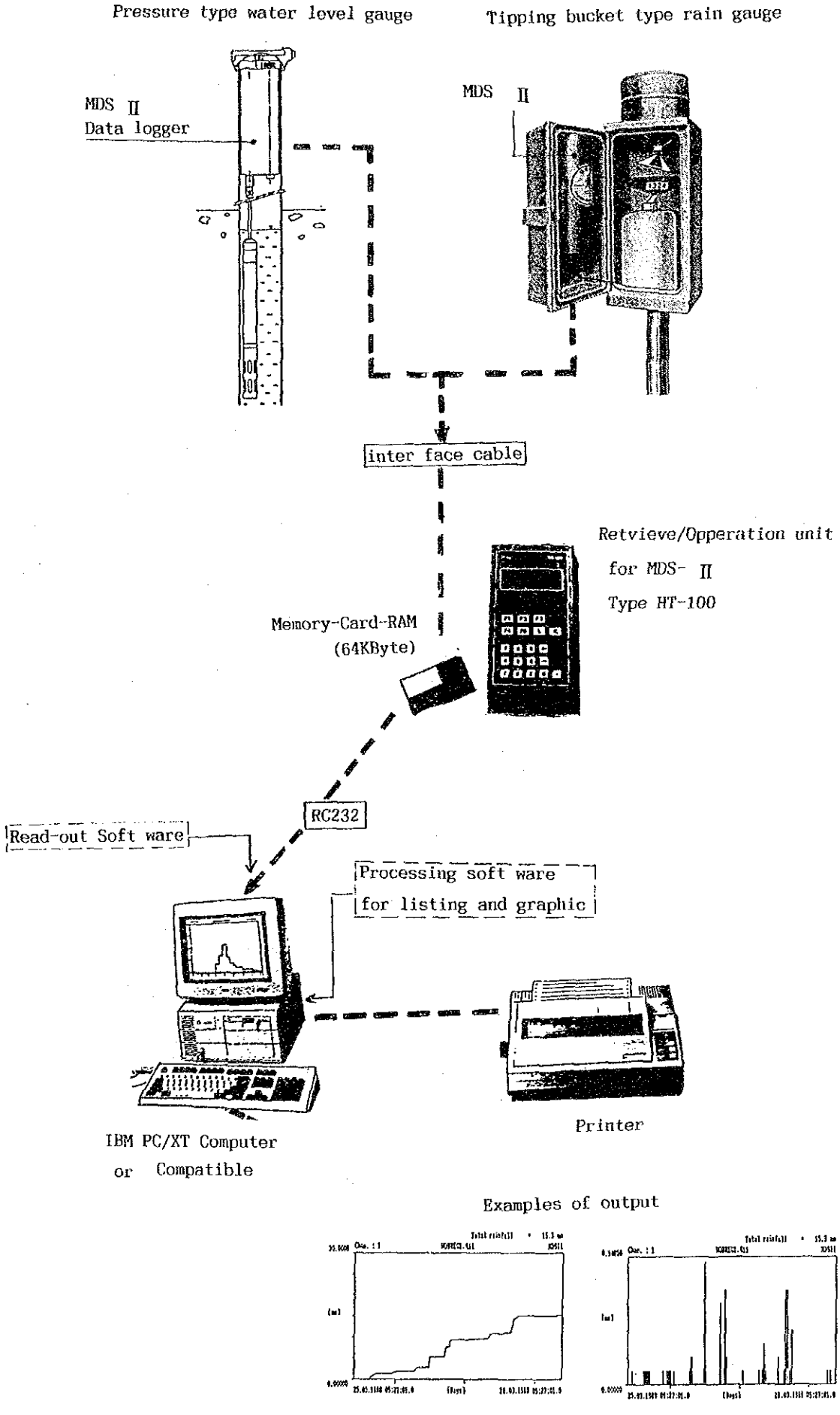


Fig. 5.1 DATA PROCESSING OF DATA LOGGER

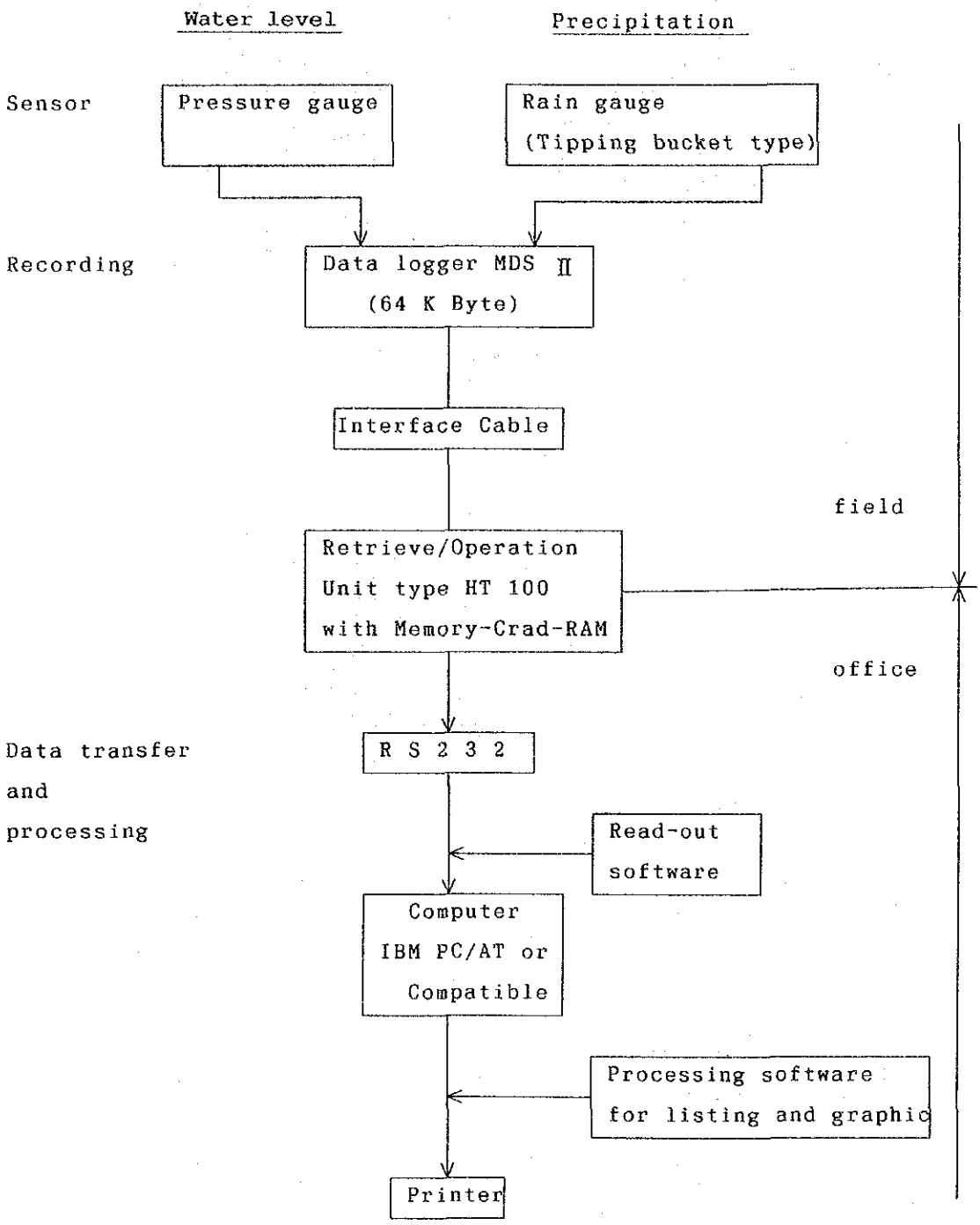


Fig. 5.2 FLOW OF DATA PROCESSING BY DATA LOGGER

Data Recording Form

1. For Precipitation Observation
   - 1.1 Rain Card (existing form)
   - 1.2 Note book for Agrometeorological/Climatological Observation (existing form)
   - 1.3 Surface synoptic observation (existing form)

2. For Water Level Observation
   - 2.1 Staff Gauge Reading (existing form)

3. For Discharge Measurement
   - 3.1 Discharge Measurement Note (existing form)
   - 3.2 Float Measurement Record (new form)
   - 3.3 Calculation Sheet of Float Method (new form)

4. For Sediment Observation
   - 4.1 Sediment Sampling Record (existing form)

श्री ५ को सरकार

Met Form No. CL. 011
Rev. June 1990

जलवायु विज्ञान विभाग

... ...क्षेत्रिय कार्यालय

रेनफल कार्ड (RAINFALL CARD)

केन्द्र (Station)... ... ...

जिल्ला (District) .. ..

केन्द्र नं. (Station No.)

महीना (Month)... ... ...

वर्ष (Year)... ... ...

मिति गते	वर्षा मि. मि.	समय किसिम	मिति	वर्षा मि. मि.	समय किसिम	मिति	वर्षा मि. मि.	समय किसिम
१			११			२२		
२			१२			२३		
३			१३			२४		
४			१४			२५		
५			१५			२६		
६			१६			२७		
७			१७			२८		
८			१८			२९		
९			१९			३०		
१०			२०			३१		
			२१			३२		
जम्मावर्षा			जम्मावर्षा			जम्मावर्षा		

महीना र गते अंग्रेजी तारिखमा लेख्नु पर्छ ।

कैफियत ... ...

... ...

अब्जरभरको नाम र सही

Rain Card

H. M. G. of Nepal
Department of Hydrology & Meteorology
... ... Regional Office

Agrometeorological/Climatological
Observations

NOTE-BOOK

Station Name:
Index No:

Month:
Year:

CL 026
Revised June 1990

Station Name: केन्द्रको नाम:
District: जिल्ला:

Index No: केन्द्रको नम्बर:
Zone: अञ्चल:

Month: महिना:
Year: वर्ष:

Remarks: कैफियत:

....
Observer's Name & Signature
अवलोकनकर्ताको नाउँ र सही

Checked by:
Remarks:

.....
Signature

Copied by:
Remarks:

.....
Signature

DATE: गते MONTH: महिना YEAR: वर्ष

	Observation Time (NST) —> अवलोकन समय (ने. स्था. स.) —>	0845 ०८४५	1145 ११४५	1445 १४४५	1745 १७४५
Temperature	Dry bulb (°C) शुष्क बल्ब तापक्रम				
	Wet bulb (°C) आर्द्र बल्ब तापक्रम				
	Maximum (°C) अधिकतम तापक्रम		×	×	
	Minimum (°C) न्यूनतम तापक्रम		×	×	
	Max after Setting सेटपछिको अ. ता.		×	×	×
	Min after Setting सेटपछिको न्यु. ता.		×	×	
	Dew Point (°C) शित बिन्दु तापक्रम				
Rel. Humidity (%) सापेक्षिक आर्द्रता					
Grass Mini	Temperature (°C) घास न्यु. ता.		×	×	×
	Af. Setting (°C) सेटपछिको घा. न्यु. ता.	×	×	×	
Soil Temperature	0 cm depth (°C) भू. ता. ० से. मी.				
	5 cm depth (°C) भू. ता. ५ से. मी.				
	10 cm depth (°C) भू. ता. १० से. मी.				
	20 cm depth (°C) भू. ता. २० से. मी.				
	30 cm depth (°C) भू. ता. ३० से. मी.				
	50 cm depth (°C) भू. ता. ५० से. मी.				
Wind	Anemometer read एनमो रिडिङ्ग				
	Mean Speed हावाको औसत गति ( )				
	Direction degree (हावाको दिशा (डि))				
Precipitation (mm) वर्षा (मी. मी)					
Dew amount (mm) शित (मी. मी.)			×	×	

Observation Time (NST)—> अवलोकन समय (ने. स्था. स.) —>	0845 ०८४५	1145 ११४५	1445 १४४५	1745 १७४५
Eva. Gauge Read वाष्पिकरण रिड (...:)		×	×	
Eva. Adj Read वाष्पिकरण समायोजन (...)		×	×	
Snow depth (cm) हिउँको गहिराई (से. मी.)				

Duration of Sunshine–
Solarimeter Reading:–

Miscellaneous Meteors: (√ चिन्ह लगाउने)	0845 ०८४५	1145 ११४५	1445 १४४५	1745 १७४५
Rain वर्षा (")				
Drizzle सिमसिमे वर्षा (")				
Shower मुसलधारे वर्षा (")				
Lightning बिजुली चम्केको (")				
Thunder मेघ गर्जेको (")				
Haze तुवाँलो लागेको (")				
Fog कुहिरो लागेको (")				
Frost तुषारो परेको (")				
Hail असिना परेको (")				
Freezing Rain कठ्याङ्ग्रिने वर्षा (")				

Remark:
कैफियत:

... ...
Observer's Signature
अवलोकनकर्ताको सही

Note Book for Agrometeological/climatological observation

H. M. G. NEPAL
DEPT. OF HYDROLOGY & METEOROLOGY
P. O. BOX 406, KATHMANDU, NEPAL

MET Form NO. CL 003
REV. SEPT. 1990

INDEX NO ☐☐☐☐
STATION NAME
YEAR ☐☐ MONTH ☐☐ DAY ☐☐

SURFACE SYNOPTIC OBSERVATIONS

	TIME	BAROMETRIC PRESSURE (hPa)									HEIGHT (GPM) (m)				TEMPERATURE (°C)					HUMIDITY		WIND		CLOUDS			VISIBILITY		WEATHER		PRECIPITATION					
	NEPAL STANDARD TIME (NST)	STT THERMO READING (°C)	BAROMETER READING	INDEX - GRAV - TEMP CORRECTION	HEIGHT DIFFERENCE CORRECTION	STATION PRESSURE (QFE)	SEA LEVEL REDUCTION CONSTANT	SEA LEVEL PRESSURE (QFF)	ALTIMETER SETTING (QNH)	OFFICIAL STATION ELEVATION	GEOPOTENTIAL PRESSURE DIFFERENCE	GEOPOTENTIAL TEMP. DIFFERENCE	INDICATOR FOR 850 OR 700 hPa (±)	950 OR 700 GEOPOTENTIAL HEIGHT	24 HOUR PRESSURE CHANGE	DRY BULB TEMPERATURE	WET BULB TEMPERATURE	MAXIMUM TEMP.	MINIMUM TEMP.	MAX. SETTING	MIN. SETTING	DEW POINT TEMPERATURE	RELATIVE HUMIDITY %	WIND DIRECTION (DEG)	WIND SPEED (KTS)	LOW CLOUD GENERA/COD	MIDDLE CLOUD GENERA/CODE	HIGH CLOUD GENERA/CODE	LOW CLOUD BASE (CODE)	LOW CLOUD AMT (OKTAS)	TOTAL CLOUD AMT (OKTAS)	VISIBILITY (Km)	PRESENT WEATHER (CODE)	PAST WEATHER W_1	PAST WEATHER W_2	PRECIPITATION (mm)	TIME STARTED (NST) (hr. & min)	TIME ENDED (NST) (hr. & min)	DURATION (hr. & min)	MISC. METEORS (CODE)	OBSERVER'S INITIAL
1-4	5-8	9-13	14-17	18-20	21-25	26-30	31-36	37-42	43-46	47-51	52-55	56	57-60	61-63	64-68	69-73	74-78	79-83	84-88	89-93	94-96	97-99	1-3	4-5	6	7	8	9-10	11	12	13-16	16-17	18	19	20-23	24-27	28-31	32-35	36-39	
0245																																								
0545																																								
0845																																								
1145																																								
1445																																								
1745																																								
2045																																								
2345																																								
FOR CLIMAT USE:		MEAN																	Avg. Temp ... °C (Max. + Min)/2			S.V.P. ... hPa					V.P = R.H X S.V.P/100 = ... hPa						Sunshine duration = ... hr (From Form CL 004)					

TIME NST		YYGGi$_w$	IIiii	$i_R i_x$ hVV	Nddff	i_o TTT	$2s_n T_a T_a T_d T_d$	$3P_0P_0P_0P_0$	4 PPPP or 4 o_3 hhh	7wwW$_1$W$_2$	$8N_hC_LC_MC_H$	333	$5s_n T_x T_x T_x$	$2s_n T_n T_n T_n$	$6R_{24}R_{24}R_{24}R_{24}$	8RRRt$_R$	444	$i_E i_S i_W$	OBSERVER'S INITIAL
0245	AAXX											333					444		
0545	AAXX											333					444		
0545	AAXX											333					444		
1145	AAXX											333					444		
1445	AAXX											333					444		
1745	AAXX											333					444		
2045	AAXX											333					444		
2345	AAXX											333					444		

AGRO-MET DATA					
Observation Time (NST)		0845	1145	1445	1745
Grass Minimum (°C)	Temperature				
	After Setting				
Soil Temperature (°C)	0 cm depth				
	5 cm depth				
	10 cm depth				
	20 cm depth				
	30 cm depth				
	50 cm depth				
Anemometer Reading ( )					
Evo. Gauge Reading (mm)					
Evaporation Amount (mm)					
Water Temp (°C)					
Dew Amount (mm)					

NOTE — IN the group of $1s_n$ TFT & $2s_n T_a T_a T_d T_d$, If temp or dew point is +ve or zero use 0 for s_n If temp or dew point is −ve use 1 for s_n

GROUP 5 J_1 $P_{24}P_{24}P_{24}$ — Use 8 for +ve or zero variation of pressure and 9 for −ve variation of pressure for J_1

MISCELLANEOUS METEORS CODE

Drizzle	Rain	Drizz. & Rain	Shower	Ling	Thder	Haze	Fog	Frost	Hail	Snow
/	1		2	3	4	5	6	7	8	9

Surface Synoptic observation

CENTRAL REGIONAL OFFICE

Hydrology Section

STAFF GAUGE READING

River Name_____

Location_____

Station No _____

मिति : २०४७ / जेष्ठ

Date : 1990 / May–June

DATE	TIME		READING		TIME		READING		TIME		READING		TIME		READING		TEMP °C	REMARKS
गते । Day	hr	min	m	cm	hr	min	m	cm	hr	min	m	cm	hr	min	m	cm		
१ । 15																		
२ । 16																		
३ । 17																		
४ । 18																		
५ । 19																		
६ । 20																		
७ । 21																		
८ । 22																		
९ । 23																		
१० । 24																		
११ । 25																		
१२ । 26																		
१३ । 27																		
१४ । 28																		
१५ । 29																		
१६ । 30																		
१७ । 31																		
१८ । 1																		
१९ । 2																		
२० । 3																		
२१ । 4																		
२२ । 5																		
२३ । 6																		
२४ । 7																		
२५ । 8																		
२६ । 9																		
२७ । 10																		
२८ । 11																		
२९ । 12																		
३० । 13																		
३१ । 14																		
... । ...																		

Gauge Reader

Staff gauge reading

Meas. No.... ...
Comp. by ... ...
Checked by... ...

His Majesty's Government
Ministry of Water Resources
Department of Hydrology & Meteorology
CENTRAL REGIONAL OFFICE
HYDROLOGY SECTION
DISCHARGE MEASUREMENT NOTES

Sta No ... ...
... ...
Date... ... ... 20 ... ...19 ... ... Party ... ...
Width... ... ...Area... ... ...Vel... ... ...G. H. ... . Disch... ... ...
Method... ... ...No. secs ... ...G. H. change... .. in... .. hrs. Susp... ... ...
Method coef... ... Hor angle coef... ... Susp coef... Meter No.... ... ...

GAUGE READINGS				
Time		Recorder	Inside	Outside
Weighted M.G.H				
G.H. correction				
Correct M.G.H				

Date rated ... ...
Used rating for rod... ......susp
Meter ... . ft. above bottom
of wt. Tags checked ... ...
Spin before meas ... ...
after... ... Meas. plots... ......%
diff. form ... ...rating. Wading,
cable, ice, boat, upstr; downstr;
side bridge... ... ...feet, mile,
above, below gauge, and... ......
... ... Check-bar
chain found ... ...
Changed to... ... ... at ... ...
Correct ... ...
Levels obtained ... ...

Measurement rated excellent (2%), good (5%), fair (8%), poor (over 8%),
based on following conditions. Cross section ... ...
Flow ... ...Weather... ... ...
Other... ... ... Air ... ...°C at... ... ...
Gauge ... ...Water... ... ...°C at ... ...
... ... Record removed .. .. Intake flushed ... .
Observer ... ...
... ...
Control... ... ...
... ...
Remarks... ... ...
... ...
... ...
G H of zero flow... .. ..M.

1/4

.0 .10 .20 .30 .40 .50 .60 .70 .75

River at-

Angle coefficient	Dist. from initial Point	Width	Depth	Observation Depth	Revolutions	Time in seconds	VELOCITY At point	VELOCITY Mean in vertical	Adjusted for hor. angle or	Area	Discharge

.0 .10 .20 .30 .40 .50 .60 .70 .75

2/4

.0 .10 .20 30 40 50 .60 .70 .75

.0 .10 .20 .30 40 .50 .60 .70 .75

3/4

.0 .10 .20 30 .40 .50 .60 70 .80 .85

Angle coefficient	Dist. from initial Point	Width	Depth	Observation Depth	Revolutions	Time in seconds	VELOCITY At point	VELOCITY Mean in vertical	Adjusted for hor. angle or	Area	Discharge

.90 .92 .94 .96 .97 .98 .99 1.00 .99 .98 .97 .96 .94 .92

0 .10 .20 30 40 50 .60 70 .80 .85 .90

4/4

Discharge Measurement Note

M5-1-70

H. M. G. of Nepal

MINISTRY OF WATER Resources

DEPARTMENT OF HYDROLOGY & METEOROLOGY

Sample collected from.....during month of.....19.....

(River name and place)

Date	Time	Gage Height	Temp °C	No. of Bottles	Time	Gage Height	Temp °C	No. of Bottles	Time	Gage Height	Temp °C	No. of Bottles
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												

(If more the 3 sets of Samples are taken daily, use back of this sheet or another sheet)

Remark

Signed... .....

(observer)

Sediment Samplinng

CALCULATION SHEET OF FLOAT MEASUREMENT (1/1)

Station No.	

Calculated by : _____ Checked by : _____ FILE NO. FM _____

Name of station		Date of Measurement		Started at		Weather	
Measurement Section				Ended at		Wind condition	

	Standard Staff (m)	1st Observation Staff (m)	2nd Observation Staff (m)	difference of W. L. (m)	Distance (m)	Slope of Water surface	Remarks
Start		EL	EL				
Finish		EL	EL				
Average		EL	EL				

Float No.	Line No.	Kind of float	throwing time	flowing time (sec)	Velocity (m/sec)	Adjust Coeff.	Adjusted Velocity (m/sec)	Sectional area (m2)			Devided discharge (m3/sec)	Total discharge (m3/sec)
								Started	Ended	Average		

Float 1
M5-1-72

FLOAT MEASUREMENT RECORD FOR THROWING POINT

Station No.	

FILE NO. FM

Name of Station				Recorded by	
Date of Measurement		Started at		Weather	
		Ended at		Wind condition	
Location of WL					

Float No.	Line No.	Kind of float	throwing time	Water level (m)	Weather condition	Remarks

FLOAT MEASUREMENT RECORD FOR STARTING POINT

Station No.	

FILE NO. FM

Name of Station				Recorded by	
Date of Measurement		Started at		Weather	
		Ended at		Wind condition	
Location of WL					

Float No.	Line No.	Passing time of float	Water level (m)	Weather condition	Remarks

FLOAT MEASUREMENT RECORD FOR FIRST/SECOND OBSERVATION LINE

Station No.	

FILE NO. FM

Name of Station				Recorded by	
Date of Measurement		Started at		Weather	
		Ended at		Wind condition	
Location of WL					

Float No.	Line No.	Passing time of float	Water level (m)	float condition	Remarks

PART 2

INSPECTION AND MAINTENANCE

CONTENTS

PART 2 : INSPECTION AND MAINTENANCE

1. GENERAL

Continuous maintenance is required for stable and reliable operation of the observation system. Failure to periodical maintenance will cause frequent troubles and these systems will finally fulfill no functions. Therefore, continuous maintenance is essential for satisfactory observation system.

The maintenance is classified into INSPECTION, ADJUSTMENT and REPAIR.

The INSPECTION is the most basic item for maintenance and is important to know current condition of instruments and facilities and previously to prevent the possibility of system failures.

The ADJUSTMENT is required for the equipment which shows measured value exceeding a standard value at the time of inspection. Regular calibration is recommended for specific equipment.

Immediate REPAIR is required after finding any faults. In most cases, the faults should be removed by replacing the defected component with spare parts. To shorten time for restoration should be considered principally. Proper and prompt maintenance requires complete procedure manual on maintenance.

Inspection of instruments such as recording rainfall gauge and water level gauge is classified into two types of Inspection, DAILY/WEEKLY INSPECTION and THREE MONTHLY/ANNUAL INSPECTION. The latter is required to be performed closer by well-experienced technicians. The former consists of general checking by part-time inspections. Both of inspections are very important for keeping good condition of the system.

2. INSPECTION SCHEDULE

A periodic inspection is required for maintaining observation system in good condition.

The instruments are made to meet stable operation for a long period without maintenance. However it is recommended that the inspection shall be performed by following maintenance schedule to stably operate the instrument and to previously prevent any fault.

3. PROCEDURE OF INSPECTION

In order to keep good operational condition of instruments and facilities in remote areas, not only patrol by trained technicians but also general checking by observers is very

effective. Daily maintenance and inspection as well as observation which will be carried out by observers are, therefore, most basic and important activities.

The Regional Office is responsible for not only observation but also maintenance of every instruments including surrounding facilities. The field technician should check observer's activities and facilities in every three months and when required in accordance with this Part 2.

Annual inspection will be conducted by the Hydrologist or the Meteorologist in order to grasp overall condition of the station.

3.1 Daily/Weekly Inspection by Observers

The technicians of the Regional Office who are to be in charge should be familiar with operation and maintenance of the instruments and transfer his knowledge to any observers on the job. Then, the observers will correctly execute their daily job at the station by following these manuals;

(1) Manual of Ordinary Rain Gauge for Observers
(2) Manual of Recording Rain Gauge (Weighing-Type Raingauge) for Observers
(3) Manual of Staff Gauge Reading for Observers
(4) Manual of Recording Water Level Gauge for Observers

The observers should inspect every instruments and facilities daily or weekly as specified in the check sheet in order to find out abnormal condition as soon as possible. Whenever they catch such condition, the observers ought to report to the field technician of the Regional Office immediately.

The check sheet filled by the observers should be sent to the Regional office in the beginning of every month.

3.2 Periodical Inspection

The technicians who are dispatched from the relevant section of the Regional Office should examine the condition of the stations in accordance with the check sheet in every three months and every year. In this periodical inspection, they have to check the points explained in Section 4 and, if necessary, they should make some countermeasures and record them by the specified format.

The technicians should review the preceding inspection reports before an inspection trip and confirm at the station if the things mentioned in the report are improved or not.

During their stay at the station, the technicians of the Regional Office and the observers should have opportunity to discuss some problems arising at the station. The meeting will illuminate and encourage the persons in charge.

3.2.1 Three Month Inspection

Three month inspection should be conducted by both field technicians and mechanical technicians of the relevant section of the Regional Office. Mechanical technicians mainly inspect condition of recording instruments and mechanical facilities.

Inspection will be carried out in accordance with the check sheet as attached in this Manual.

Following activities should be also recorded in the check sheet.

i) Replacement of chart, battery and other parts of instruments
ii) Calibration
iii) Repair work
iv) Three month and occasional inspection
v) Other special event

3.2.2 Annual Inspection

The annual inspection for overall checking of stations is required by the hydrologist or meteorologist. They should review the check sheets filled by technicians as well as recording card and chart, and point out check points before their trip.

3.3 Occasional Inspection

Whenever trouble, accident and damage occur at the station due to a big storm, flood, hail, landslide and so on, the observer ought to inform the Regional Office by telephone or other quick way.

The occasional inspection conducted by the field technician and relevant technicians of the Regional Office should be made as soon as they receive such information. They will investigate the condition and causes, and make countermeasures. The result of investigation and countermeasures should be reported to the Central Office by the attached "Occasional Inspection Report".

4. LIST OF INSPECTION ITEMS

Items to be inspected in three month inspection at each observation station are listed and explained in this section.

4.1 Precipitation Gauging Station

Following items will be inspected in the three month inspection by the technicians.

i)	Record	;	Card, Chart, Field notebook
ii)	Instruments	;	Ordinary (Manual) Rain gauge
			Automatic type Rain gauge
			Data logger
iii)	Facilities	;	Observation house or steel case/cover
			Foundation
			Cable line
			Fence
			Access road/ladder
iv)	Stock		
v)	Observers		

Check points to be examined at the precipitation gauging station are as follows.

(1) General

Following equipments should be taken to the field:

- Calibration equipment
- Tools
- Consumables such as chart, battery, pen etc.
- Inspection Manual
- Inspection Check Sheet
- Pencil and Note book

Following items should be clarified in advance of the inspection in the check sheet.

i) Date
ii) Name and code number of the station
iii) Weather condition
iv) Participation for inspection

v) Type of instruments

(2) Record

All recorded data and field notebooks should be checked in these points.

i) No lack of data ?

Confirm that required items on the cards/charts/check sheets are filled up correctly or not, and if lack of data is due to no rainfall or absence of a observer or machine trouble. Period and reason of lack of data should be noted in the check sheet.

ii) No abnormal data ?

Confirm that the abnormal value is correct by comparison of the data obtained from manual gauge and automatic gauge. If there is no other gauge to compare with, check the data of the nearest station.

iii) Are recorded data and description in the cards/charts/field notebooks legible ?

Confirm that a pencil and/or a pen are proper and instruct the observer to fill up them carefully.

iv) Were all data already sent to the Regional Office ?

Confirm that when and which data were submitted to the specific section of the Regional Office without delay.

(3) Instruments

The technicians should inspect maintenance condition of the instruments to be maintained daily by the observers. When some obstacles to the normal operation are found, necessary action should be taken place immediately by the technicians.

Following points will be examined by the technicians.

<u>Ordinary Raingauge</u>

i) Installed horizontally ?

Check the ground condition and confirm that the foundation of the gauge is stable.

ii) No debris or leaves in the collector ?

To get accurate quantity, any obstruction should be removed.

iii) No damage of the collector ?

Even small dent should be repaired.

iv) No leakage or crack of the inner cylinder ?

To be replaced or repaired, when such condition is found.

v) Proper surroundings ?

Confirm that there is no obstruction such as high trees, fences and houses, and grass is trimmed.

Recording Raingauge (Tipping bucket-type/Weighing-type)

i) Installed horizontally ?

Check the level of instrument and confirm if the foundation of the gauge is stable or not.

ii) No debris or leaves in the collector ?

To get accurate quantity, any obstruction should be removed. The tipping bucket should also be clean.

iii) No damage of the collector and tipping bucket ?

Even small dent should be repaired.

iv) Is the recording chart and pen properly set on the drum ?

v) Time and zero adjustment are executed correctly ?

vi) Proper surroundings ?

Confirm that there is no obstruction such as high trees, fences and houses, corn and grass is trimmed.

vii) Battery check ?

Data Logger

i) No damage of the steel case and base ?

When damage is found, check the reason and confirm that the data logger can work normally.

ii) No harmful things inside the steel case ?

Any dust, insects and water are not allowed inside the case.

iii) Battery still working ?

Check battery voltage by a battery voltage indication. When it is lower than 7.5 V, change batteries (in case of MDS II Data logger).

(4) Facilities

Facilities to protect instruments, to maintain circumstance, and to approach instruments should be well maintained daily by observers. The technicians should check their performance for the purpose of sustainable observation and safety operation.

i) Observation house or steel case/cover

Check appearance of a structure protecting instruments and confirm that there is no damage.

Inside of the structure should be dry, clean, and neat any time.

ii) Foundation

Stable and solid foundation is required so that instruments will be always supported horizontally. Clasps at the foot of the legs of the instruments should be also checked.

iii) Cable line

Any damages caused by insects, rats or external force are not allowed.

iv) Fence

Nobody except specified observers is allowed to close to the instruments to avoid troubles caused by these invader.

v) Approach road/ladder

In order to carry out efficient and safe observation, approach road and/or ladder should be kept in good condition.

(5) Activities of observers

Check the observer's operation procedures and, if incorrect manner is found, technicians should instruct and improve their activities.

(6) Stock

Consumables such as cards, chart, notebooks, pencils, pens, batteries and so on should be always stocked and managed by the observers at the station. The technicians should check their items and quantity by an inventory.

(7) Record of repair work or calibration in these three months

Technicians must check the workmanship of repair work and calibration, performed by observers after previous three month inspection. When performance does not satisfy technicians, the observers have to do over again under control of the technician. Other repair work and calibration conducted by technicians or other party should be recorded in the check sheet.

4.2 Water Level/Discharge Station

Following equipments should be taken to the field:

- Calibration equipment
- Tools
- Consumables such as chart, battery, pen etc.
- Inspection Manual
- Inspection Check Sheet
- Pencil and Note book

Following items will be inspected in the three month inspection by field technicians.

i)	Record	;	Card, Chart, Field notebook
ii)	Instruments	;	Staff gauge
			Recording Water Level gauge
			Data logger

iii) Facilities ; Winch
Wire
Cable car
Winch operation house
Anchor block
Water level gauging house
Foundation
Stilling well
Cable line
Fence
Approach road/ladder
Bench mark
Joint box for connection of cable

iv) Stock

v) Observers

Check points to be examined by the observers or the technicians at the water level station are as follows.

(1) General

These items should be clarified in advance of the inspection in the check sheet.

i) Date
ii) Name and No. of the station
iii) Weather condition
iv) Participation for inspection
v) Type of instruments

(2) Record

All recorded data and field notebooks should be checked in these points.

i) No lack of data ?

Confirm that required items on the cards/charts/check sheet are filled up correctly and lack of data is due to no river flow or absence of the observer or machine trouble.

ii) No abnormal data ? / No big difference of reading between staff gauge and automatic gauge ?

Confirm that the abnormal value is correct by comparison of the data obtained from staff gauge and automatic recorder.

iii) Are recorded data and description in the cards/charts/field notebooks legible ?

Confirm that a pencil and/or a pen are proper, and instruct the observer to fill up them carefully.

iv) Were all data already sent to the Regional Office ?

Confirm that when and which data were submitted to the specific section of the Regional Office without delay.

(3) Instruments

The technicians should inspect maintenance condition of the instruments to be maintained daily by the observers and if some obstacles to the normal operation are found, necessary action should be taken place immediately by the technician.

Following points will be examined by the technician.

Staff gauge

i) No slanting or moving

Check fixation of the staff gauge. When the staff is not stable or not vertical, reinforce or reset it.

ii) No damage on the scale ?

In case that the scale is rubbed off by floating blanches and so on and reading is rather difficult, the staff should be replaced.

Float Type Water Level Gauge

i) No discrepancy between staff gauge reading and recording gauge ?

Check float, steel wire, pulley and so on.

ii) No abnormal movement of the float, counter weight, and wire ?

Confirm that there is neither slip nor obstruction between the pulley and the wire.

iii) Are pulleys moving smoothly ?

iv) No damage of the float ?

No crack and no adhered obstruction to the float and wire are allowed.

v) No damage of the steel wire ?

Confirm that there is no fray and no twist in the wire.

vi) No blockage such as debris, sedimentation and leaves in the well and the pipe.

Inspect inside of the stilling well and the intake pipe connecting between river and well.

vii) Is the recording chart and the pen properly set on the drum ?

viii) Are time and zero adjustment executed correctly ?

ix) Battery still working ?

Check battery voltage by a battery voltage indication.

Pressure Type Water Level Gauge

i) No discrepancy between staff gauge reading and recording value ?

Check a probe (pressure sensor)

ii) Is the probe (sensor) under the water ?

The probe is not functioning above the water.

iii) No damage of the probe and the protection pipe ?

Check the probe and the protection pipe and confirm that there is no dirt, no cut, no crack, and no dent.

iv) No blockage such as debris, sedimentation and leaves in the protection pipe for the probe
Inspect inside of the protection pipe for probe.

v) Is the recording chart and the pen properly set on the drum ?

vi) Are time and zero adjustment executed correctly ?

vii) Battery still working ?

Check battery voltage by a battery voltage indication.

Data Logger

i) No damage of the steel case ?

When damage is found, check the reason and confirm that the data logger can work normally.

ii) No harmful things inside the steel case ?

Any dust, insects and water are not allowed inside the case.

iii) Battery still working ?

Check battery voltage by a battery voltage indication. When it is lower than 7.5 V, change batteries (in case of MDS-II data logger).

(4) Facilities

Facilities to protect instruments, to maintain circumstance, and to approach instruments should be well maintained daily by the observers. The field technicians should check their performance for the purpose of sustainable observation and safety operation. The winch for the cable line crossing the river should be actually operated for inspection.

i) Winch

Confirm that the winch can be moved smoothly and there is no dust and no corrosion. Distance meter and depth meter should work correctly.

ii) Pole/Tower/Foundation

Confirm that there is no damage and no corrosion on the steel poles, and no abnormal crack on the concrete foundation.

iii) Wire

Confirm that there is no fray and no twist.

iv) Anchor block

The concrete anchor blocks should be stable.

v) Cable car

The cable car which carries a person for measurement of flow velocity, should be checked carefully in the point of safety drive.

vi) Winch operation house

Check appearance of a structure containing the winch and accessories, and confirm that there is no damage.
Inside of the structure should be dry, clean and neat any time.

vii) Water level gauging house

Check appearance of a structure containing the recording water level gauge, and confirm that there is no damage.
Inside of the structure should be dry, clean and neat any time.

viii) Cable line

The cable line connecting between the probe and the recorder, which is covered by steel pipes or PV pipes should be well maintained to avoid any damage caused by external force, insects, animals, rainfall, and so on.

ix) Approach road/ladder

In order to carry out efficient and safe observation, approach road and ladder should be kept in good condition.

x) Masonry wall/Gabion

Masonry wall/Gabion is required to protect the foundation of instruments and facilities against erosion due to river flow.

xi) Bench Mark

The Bench mark should be fixed steadily so that staff gauge can be calibrated, when required, by surveying from the Bench mark.

(5) Activities of observers

Check the observer's operation procedures and, if incorrect manner is found, technicians should instruct and improve their activities.

(6) Stock

Consumables such as cards, chart, notebooks, pencils, pens, batteries and so on should be always stocked and managed by the observers at the station. The technicians should check their items and quantity by an inventory.

(7) Record of repair work or calibration in these three months

Technicians must check the workmanship of repair work and calibration, performed by observers after previous three month inspection. When performance does not satisfy technicians, the observers have to do over again under control of the technician. Other repair work and calibration conducted by technicians or other party should be recorded in the check sheet.

5. CALIBRATION AND ADJUSTMENT

Minor adjustment may be performed by observers or field technicians. While, adjustment and calibration for some specific instruments and facilities such as rainfall recorder, water level recorder, data logger, winch and so on shall be conducted by well trained mechanical technicians once a year.

Whenever adjustment and calibration are carried out, observers should record executed date, type of instrument, and method on a check sheet of daily inspection and inform the technicians in the periodical inspection.

Followings are examples of minor adjustment ;

(1) Tipping bucket type raingauge

When the amount of tipping bucket is less or more than the amount in the bottom container, the observer should inform the field technician and he will adjust the gauge by turning the screws.

(2) Weighing type raingauge

The balance mechanism of weighing type gauge is sensitive to levelings and friction, so periodic checks and maintenance are necessary. Calibration should be carried out by the field technician at least twice a year or as required. Procedure of calibration with calibration weight can be shown in the manufacturer's "Instruction Manual Catalog Number 5-780 Series Universal Recording Rain Gauge Dec.15,1986".

(3) Water level gauge (float type and pressure type)

Water level gauge of both float and pressure type can be checked by comparison of reading of staff gauge. When rather big difference is found in reading, the observer should request calibration to be executed by the field technician.

6. REPAIR

In most cases, the fault should be removed by replacing the defected component with a spare one. Therefore, the quantity of the spare parts shall always be confirmed and be sure to replenish good spare parts if any defective components are found. The repair work and storing of spares are to be done at the workshop of the Regional Office.

Even minor or major, all repair work should be recorded with their date, location, reason, and executed method.

During periodic and occasional inspection, these items should be reported to the technicians and the technicians will check their workmanship.

7. REPORTING

All record of the inspection should be reported in accordance with the attached check sheets which must be sent to the chief engineer of the Regional Office immediately after inspection in order to take necessary quick action.

Items to be reported by the person in charge are as listed below ;

(1) Observers

i) "DAILY INSPECTION CHECK SHEET for Precipitation Station"
ii) "DAILY INSPECTION CHECK SHEET for Water Level/Discharge Station"

(2) Inspector (field technician)

i) "THREE MONTH INSPECTION CHECK SHEET for Precipitation Station"
ii) "THREE MONTH INSPECTION CHECK SHEET for Water Level/Discharge Station"

(3) Inspector (mechanical technician)

No specified inspection sheet

(4) Hydrologist or Meteorologist

No specified inspection sheet

Note:

Overall information such as basic description, histories and present condition of individual observation station are kept in station description inventory.

Data Recording Form

1. For Inspection of the Station
   - 1.1 Daily inspection check sheet for precipitation station (new form)
   - 1.2 Three month inspection check sheet for precipitation station (new form)
   - 1.3 Daily inspection check sheet for water level/discharge station (new form)
   - 1.4 Three month inspection check sheet for water level/discharge station (new form)
   - 1.5 Occasional inspection report (new form)
2. Station Description Inventory
   - 2.1 Station description inventory for Meteorological station (revised form)
   - 2.2 Station description inventory for Hydrological station (revised form)

DAILY INSPECTION CHECK SHEET
for Precipitation Station

Year Month	

Number of Station						Name of Station					Name of Observer		
Existing?													◯ : exist ✕ : not exist
Item / Frequency	Ordinary Raingauge	Recording Raingauge				Data Logger		House/Case	Foundation	Cable line / Joint box	Fence	Approach	D : Daily inspection W : Weekly " NS : Not specified
	D	W	W	W		NS	NS	W	W	W	W	W	
Day	Weather	Functioning?	Functioning?	Change Chart?	Change Pan	Functioning?	Change battery	No damage?	No damage	No damage?	No damage?	No damage?	Remarks
1	◯												
2	◯												
3	◯												
4	◯												
5	◯												
6	◯												
7	◯												
8	◯												
9	◯												
10	◯												
11	◯												
12	◯												
13	◯												
14	◯												
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16	◯												
17	◯												
18	◯												
19	◯												
20	◯												
21	◯												
22	◯												
23	◯												
24	◯												
25	◯												
26	◯												
27	◯												
28	◯												
29	◯												
30	◯												
31	◯												

Weather ◯ : fine ◑ : fair ◎ : cloudy ● : rain ⊗ : snow ◒ : sleet ◬ : hail ◒ : thunderstorm

Check ✓ : normal or yes △ : less normal but continuous observation is necessary ◯ : to be repaired or calibrated ◎ : under repair

THREE MONTH INSPECTION CHECK SHEET
for Precipitation Station

(Sheet 1 of 3)

Date of Inspection	

Number of Station		Name of Station		Name of Inspector	

Type of Instrument	Name	Recording Gauge	Data Logger	Remarks
	Type			
	Manufacturer			

1 Record		Rain Card	Recording Chart	Instruction
(1) Period of record		~	~	
(2) Period of lack of date				
(3) Reason of (2)	Observer (absence, poor trained)			
	Machine trouble			
	Others			
(4) Date of abnormal date				
(5) Submission of Previous data	Data			
	Period of the data	~	~	

Check Points \ Condition		Normal	Continuous observation by observer is required	Adjustment/calibration was executed by technician	To be calibrated/repaired	Under repair	Note; Check points will be marked with " ✓ ". Instruction
2 Ordinary Gauge	(6) Setting (not slanting?)						
	(7) No obstruction inside?						
	(8) No damage inside?						
	(9) Proper surroundings?						
3 Record-ing Gauge	(10) Setting (not slanting?)						
	(11) No obstruction inside?						
	(12) No damage inside?						
	(13) Chart Setting						
	(14) Pen Setting						
	(15) Time adjustment						
	(16) Zero adjustment						
	(17) Proper surroundings?						

THREE MONTH INSPECTION CHECK SHEET
for Precipitation Station

Check Points \ Condition			Normal	Continuous observation by observer is required	Adjustment/calibration was executed by technician	To be calibrated/repaired	Under repair	Note; Check points will be marked with " V ". Instruction
4 Data Logger	(18) No damage of case?							
	(19) No obstruction inside?							
	(20) Battery							
	(21) Working well?							
5 Facilities	(22) Observation House	door						
		lock						
		window						
		wall						
		roof						
	(23) Foundation							
	(24) Cable line							
	(25) Fence							
	(26) Approach	road						
		ladder						
6 Activities of Observers								

( ) : good

( ) : not bad, but to be trained

( ) : to be trained immediately

( ) : to be replaced

Comment:

THREE MONTH INSPECTION CHECK SHEET
for Precipitation Station

7 Consumables

Items	Present Stock Number	Under Request		Remarks
		Number	Date	
Recording chart				
Cartridge pen				
Battery				
Rain card				
Daily inspection sheet				

8 Record of Repair Work / Calibration in these three months

Date	Location	Person	Action

9 Conclusion

( ) : good operation ( ) : not bad operation ( ) : bad operation	

Above check items were confirmed by :

Inspector

Observer

DAILY INSPECTION CHECK SHEET
for Water Level Station / Discharge Station

Year Month	

Number of Station									Name of Station							Name of Observer			
Day	Frequency	Staff Gauge	Recording		Water level	Gauge	Data	Logger	Winch	Pole/Foundation	Wire	Anchor Block	Carrier	Observation House	Gauge House	Cable Line	Access	Revetment	D : Daily inspection W : Weekly " NS : Not specified
		D	D	W	W	W	NS	NS	W	W	W	W	W	W	W	W	W	W	
	Weather	No damage?	Functioning?	Change Chart?	Change Pan	Change battery?	Functioning?	Change Battery	No damage?	No damage?	No damage?	No damage?	No damage?	No damage?	No damage?	No damage?	No damage?	No damage?	Remarks
1	○																		
2	○																		
3	○																		
4	○																		
5	○																		
6	○																		
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29	○																		
30	○																		
31	○																		

Weather
○ : fine
◐ : fair
◎ : cloudy
● : rain
⊗ : snow
◒ : sleet
◬ : hail
◒ : thunderstorm

Check
✓ : normal or yes
△ : less normal but continuous observation is necessary
○ : to be repaired or calibrated
◎ : under repair

THREE MONTH INSPECTION CHECK SHEET
for Water Level/Discharge Station

Date of Inspection	

Number of Station		Name of Station		Name of Inspector	

Type of Instrument	Name	Recording Gauge	Data Logger	Remarks
	Type			
	Manufacturer			

1 Record		Water Level Card	Recording Chart	Instruction
(1) Period of record		~	~	
(2) Period of lack of date				
(3) Reason of (2)	Observer (absence, poor trained)			
	Machine trouble			
	Others			
(4) Date of abnormal date				
(5) Latest Submission of Data	Date			
	Period of the data	~	~	

		Condition / Check Points	Normal	Continuous observation by observer is required	Adjustment/calibration was executed by technician	To be calibrated/repaired	Under repair	Note; Check points will be marked with " ✓ ". / Instruction
2 Staff Gauge & Cableway		(6) Setting (not slanting?)						
		(7) No damage?						
		(8) No abnormal movement?						
		(9) Pulley, moving smoothly?						
3 Recording Water level recorder	Float type	(10) No damage at float?						
		(11) No damage of wire?						
		(12) Wire, no twist?						
		(13) No blockage of well or pipe?						
	Pressure type	(14) Probe, under water?						
		(15) Probe, no damage?						
		(16) No damage of protection pipe						
		(17) No blockage of protection pipe						

THREE MONTH INSPECTION CHECK SHEET
for Water Level/Discharge Station

Check Points \ Condition			Normal	Continuous observation by observer is required	Adjustment/calibration was executed by technician	To be calibrated/repaired	Under repair	Note; Check points will be marked with " ✓ ". Instruction
3 Recording Water level recorder	(18) Data comparison between recording and Manual reading							
	(19) Pen setting							
	(20) Time adjustment							
	(21) Zero adjustment							
	(22) Battery							
4 Data Logger	(23) No damage of case?							
	(24) No obstruction inside?							
	(25) Battery							
	(26) Functioning?							
5 Winch	(27) Winch							
	(28) Pole/Tower/Foundation							
	(29) Wire							
	(30) Anchor block							
	(31) Cable car							
	(32) Operation House	door						
		lock						
		window						
		wall						
		roof						
6 Facilities	(33) Gauge House	door						
		lock						
		window						
		wall						
		roof						
	(34) Cable line							
	(35) Access							
	(36) Revetment							

6 Activities of Observers	
( ) : good ( ) : not bad, but to be trained ( ) : to be trained immediately ( ) : to be replaced	Comment :

THREE MONTH INSPECTION CHECK SHEET
for Water Level/Discharge Station

7 Consumables

Items	Present Stock Number	Under Request		Remarks
		Number	Date	
Recording chart				
Cartridge pen				
Battery				
Water level card				
Daily inspection sheet				

8 Record of Repair Work / Calibration in these three months

Date	Location	Person	Action

9 Conclusion

( ) : good operation ( ) : not bad operation ( ) : bad operation	

Above check items were confirmed by :

Inspector

Observer

OCCASIONAL INSPECTION REPORT

on (Abnormal Condition, Accident, Other :)

Number of Station			Name of Station		Date of Inspection	
Name of Inspector						
First Report to Regional Office	Date					
	Reporter					
	Method	telephone, telegram, person, other :				
Date/Time of Happening						
Place		instrument, facility, person, other :				
Condition with sketch						
Cause						
Countermeasure						

Above items were confirmed by :

Inspector

Observer

STATION DESCRIPTION INVENTORY (METEOROLOGY)

1. STATION IDENTIFICATION

   1.1 Station number
   1.2 Name of station
   1.3 Type of station
   1.4 Basin name

2. LOCATION

   2.1 Latitude
       Longitude
   2.2 Altitude (A.M.S.L.)
   2.3 Region
   2.4 Zone
   2.5 District
   2.6 Name of village
   2.7 Name of nearest village
   2.8 Name of nearest town/bazar
   2.9 Nearest Post Office
       Distance of Nearest Post Office
   2.10 Nearest Telephone office
        Distance of Nearest Telephone office

3. HISTORY

   3.1 Date of establishment — Recorder :
   3.2 Name of establishment party
   3.3 Date of upgrading
   3.4 Name of upgrading party
   3.5 Frequency of observation — Time/
   3.6 Data available
   3.7 Closing date
   3.8 Reason of closing
   3.9 Maximum daily Rainfall during period of observation

4. ACCESSIBILITY

   4.1 Nearest airport
   4.2 Nearest road-head
   4.3 Direction and walking distance from the nearest road-head to the station (route description)

5. OBSERVER

   5.1 Name
   5.2 Address
   5.3 Date of employment
   5.4 Qualification
   5.5 Main occupation
   5.6 Distance from the residence of observer to the station
   5.7 Name and address of alternate observer
   5.8 Name and address of former observer

6. INSTRUMENTS

6.1 Ordinary rain gauge
- a) Manufacture Name
- b) Type
- c) Height of Instrument

6.2 Recording rain gauge
- a) Manufacture Name
- b) Type
- c) Model
- d) Recorder Number
  Chart drive Number
- e) Recording Strip Chart
- f) Height of Instrument
- g) Manufacture date
- h) Power source

6.3 Available data

a)	Ordinary	From	to
b)	Recorder	From	to
c)	.....	From	to
d)	.....	From	to
e)	.....	From	to
f)	.....	From	to
g)	.....	From	to
h)	.....	From	to
i)	.....	From	to

7. CONDITION OF STATION AT PRESENT

7.1 Date of latest Inspection

7.2 Site

7.2.1	Location	O.K.	( ) need shifting
7.2.2	Others		

7.3 Condition of Station

7.3.1	Approach track	O.K.	( ) needs what
7.3.2	Structure (fence, foundation)	O.K.	( ) needs what
7.3.3	Instrument	O.K.	( ) needs what
7.3.4	Others		

7.4 Others

8. ATTACHMENT

8.1 Location Map
- 8.1.1 Nearest road head to the station (Nearest town)
- 8.1.2 Observer's house to the station and around

8.2 Photograph

STATION DESCRIPTION INVENTORY (HYDROLOGICAL)

1. STATION IDENTIFICATION

- 1.1 Station number
- 1.2 Name of station
- 1.3 Name of river/stream
- 1.4 Type of station
- 1.5 Catchment area
- 1.6 Basin name
- 1.7 Observation item

2. LOCATION

- 2.1 Latitude
  Longitude
- 2.2 Altitude (A.M.S.L.)
- 2.3 Region
- 2.4 Zone
- 2.5 District
- 2.6 Name of village
- 2.7 Name of nearest village
- 2.8 Name of nearest town/bazar
- 2.9 Nearest Post Office
  Distance of Nearest Post Office
- 2.10 Nearest Telephone office
  Distance of Nearest Telephone office

3. HISTORY

- 3.1 Date of establishment
- 3.2 Name of establishment party
- 3.3 Date of upgrading
  - i) With cable way
  - ii) With recorder
  - iii) With sediment sampler
- 3.4 Name of upgrading party
  - i) With cable way
  - ii) With recorder
  - iii) With sediment sampler
- 3.5 Frequency of observation
  - i) Staff gauge
  - ii) Sediment collection
  - iii) Recording chart change
- 3.6 Data available
  - i) Staff gauge from to
  - ii) Recorder from to
  - iii) Sediment from to
- 3.7 If applicable, location of previous sites
  - i) from to
  - ii) from to
  - iii) from to
- 3.8 Closing date
  - i) Staff gauge /open
  - ii) Recorder /open
  - iii) Sediment /open

3.9 Reason of closing
  i) Staff gauge
  ii) Recorder
  iii) Sediment
3.10 Extreme water levels observed during period of operation
  i) Highest
  ii) Lowest

4. ACCESSIBILITY

4.1 Nearest airport
4.2 Nearest road-head
4.3 Direction and walking distance from the nearest road-head to the station (route description)

5. OBSERVER

5.1 Gauge reader
  5.1.1 Name of gauge reader
  5.1.2 Address of gauge reader
  5.1.3 Date of employment
  5.1.4 Qualification
  5.1.5 Main occupation
  5.1.6 Distance from the residence of the gauge reader to the station

  5.1.7 Name of alternate reader
  Address of the reader
  5.1.8 Name of former reader
  Address of the reader
  5.1.9 Others

5.2 Sediment sample collector

  5.2.1 Name of collector
  5.2.2 Address of collector
  5.2.3 Date of employment
  5.2.4 Qualification
  5.2.5 Main occupation
  5.2.6 Distance from the residence of the sample collector to the station
  5.2.7 Name of alternate collector
  Address of the collector
  5.2.8 Name of former collector
  Address of the collector
  5.2.9 Others

6. INSTRUMENT

6.1 Staff gauge

  6.1.1 Total height
  Elevation of 0 m
  6.1.2 Attachment ( ) posts ( ) gauge well
  ( ) rock ( ) bridge
  ( ) masonry wall
  ( ) abutment ( ) others

6.2 Gauge well

6.2.1 Gauge well
- a) Type
- b) Structure
- c) Dimension height/diameter
- d) Others if any

6.2.2 Recorder
- a) Manufacture name
- b) Type
- c) Model
- d) Recorder number
- e) Pulley size
- f) Is pulley connected ( ) directly ( ) through gear
- g) Type of chart used
- h) Manufacture date
- i) Power source
- j) Condition of recorder
- k) Others if any

6.2.3 Intake pipes
- a) Number of intake pipes
- b) Flushing arrangements
- c) Condition of intake pipes

6.3 Pressure gauge

6.3.1 Sensor
- a) Manufacture name
- b) Type
- c) Model
- d) Sensor number
- e) Range of sensor
- f) Manufacture date
- g) Power source
- h) Condition of sensor
- i) Others if any

6.3.2 Recorder
- a) Manufacture name
- b) Type
- c) Model
- d) Recorder number
- e) Type of chart used
- f) Manufacture date
- g) Power source
- h) Condition of recorder
- i) Others if any

6.4 Cable way

6.4.1 General
- a) Type of cable way
- b) Span of cable way

6.4.2 Winch
- a) Type of winch
- b) Manufacture of winch
- c) Model of winch
- d) Winch number
- e) Manufacture date
- f) Condition of winch
- g) Others if any

6.4.3 Cable car
- a) Type of cable car ( ) sitting ( ) standing
- b) Movement by ( ) Powered ( ) Manual
- c) Method of movement by ( ) cable ( ) single-drum winch
  ( ) double drum winch (bank operating)
  ( ) power winch
- d) Condition of cable car

6.4.4 Others
- a) Size of main cable
- b) Condition of main cable
- c) Size of traction/tow cable
- d) Condition of traction/tow cable
- e) Condition of cable marking
- f) Cable support left bank ( ) tower ( ) anchor block
  right bank ( ) tower ( ) anchor block
- g) Type and height of tower

6.5 Others

7. CONDITION OF STATION AT PRESENT

7.1 Date of latest Inspection
7.2 Site
- 7.2.1 Location ( ) O.K. ( ) need shifting
- 7.2.2 Others

7.3 Condition of approach track ( ) O.K. ( ) needs what
7.4 Staff gauge and its structure ( ) O.K. ( ) needs what
7.5 Gauge well
- 7.5.1 Structure ( ) O.K. ( ) needs what
- 7.5.2 Silt clearance ( ) O.K. ( ) needs what
- 7.5.3 Recorder ( ) O.K. ( ) needs what

7.6 Pressure gauge
- 7.6.1 Structure ( ) O.K. ( ) needs what
- 7.6.2 Sensor ( ) O.K. ( ) needs what
- 7.6.3 Recorder ( ) O.K. ( ) needs what

7.7 Cable way
- 7.7.1 Winch ( ) O.K. ( ) needs what
- 7.7.2 Anchor blocks Right ( ) O.K. ( ) needs what
  Left ( ) O.K. ( ) needs what
- 7.7.3 Others (Cable wire & car) ( ) O.K. ( ) needs what

7.8 Others

8. ATTACHMENT

8.1 Location Map
- 8.1.1 Nearest road head to the station (Nearest town)
- 8.1.2 Observer's house to the station and around

8.2 Photograph

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NATIONWIDE HYDRO-METEOROLOGICAL
DATA MANAGEMENT PROJECT

GENERAL MANUAL OF DATA MANAGEMENT

August, 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

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Preface

The Japan International Cooperation Agency (JICA) Study Team for Nationwide Hydro-Meteorological Data Management Project made this manual to assist data management works in the Department of Hydrology and Meteorology (DHM).

In this manual, the word "data management works" indicates the following works concretely:

1) data collection
2) data processing
3) data storing
4) data dissemination
5) data quality control, and
6) progress control.

This manual consists of the following three parts:

1) General Manual of Data Management
2) Procedure Manual of Data Management, and
3) Operation Manual of Data Management

The General Manual presents mainly organization, its roles, general data flow, schedule of data processing and management.

The Procedure Manual states detail work flow and methods of data processing.

The Operation Manual guides how to operate software for data processing. The software includes hydrological data base, meteorological data base, HOMS for determination of rating curve and formulas and vaccine programme.

This manual was made considering former DHM organization valid till in the middle of July 1993, data flow, data processing way, characteristics of river condition in Nepal, and facilities for data processing. Though the new organization of the DHM was enforced from middle of July 1993, the concept of the Manual is still effective.

Since DHM must disseminate reliable data, the management works such as progress control and quality control have to be carried out correctly. Any ideal system does not work well without good management. The reliability of data is not only dependent on good system but also on good management. No reliable data are produced by the system without management.

The quality of data depends also on observation condition, especially the number and accuracy of discharge measurement and the number of cross section survey for hydrological data. DHM should take the enough number of discharge measurement and cross section survey to get reliable rating curve.

The Study Team hopes that this manual will be useful for dissemination of reliable data to Nepalese and development of Nepal through DHM data management works.

Finally, the Study Team would like to express their heartily thanks to DHM for providing so much of help to make this manual.

Nationwide Hydro-Meteorological
Data Management Project

JICA Study Team

August, 1993

1. General

1.1 Objective

This manual was made to disseminate reliable hydrological and precipitation data, especially for developing projects in Nepal, and help to develop Nepal through data management works.

1.2 Scope of Manual

This manual deals with DHM data management works. The observation items for this manual are as follows:

1) precipitation
2) water level in river
3) discharge measurement, and
4) sediment concentration.

1.3 Data Management Regulation

Since meteorological and hydrological data are used as basic data for national planning such as hydropower and irrigation projects, unreliable data make wrong national plan and hence it costs more national budget. Therefore, staffs must be careful to process data for prevention of errors. If observation errors are found, the staff must investigate the cause, make counter plans and carry them out as soon as possible. The staff must guide observers how to observe correctly and teach them the importance of the observation for national planning.

1.4 Definition of Term

1) Precipitation

   The total amount of precipitation which reaches the ground in a stated period is expressed as the depth to which it would cover a horizontal projection of the earth's surface if any part of the precipitation falling as snow or ice were melted.

2) Daily Precipitation

   Daily precipitation is the total amount of the precipitation which reaches the ground in

one day, i.e. from 8:45 AM previous day to 8:45 AM next day.

3) Annual Precipitation

Annual precipitation is the total amount of the daily precipitation within one year.

4) Water Level

Water level is the elevation of water surface of stream, lake or other water body relative to a datum.

5) Daily Mean Water Level

In case of manual gauge, daily mean water level is the mean value observed at 8:00, 12:00 and 16:00 or 17:00 in the same day.

In case of automatical gauge, daily mean water level is the mean value observed at every hour in one day.

6) Annual Mean Water Level

Annual mean water level is the value that total amount of daily mean water level within the whole year divided by total days in the year.

7) Discharge

Discharge is the volume of water which flows through a cross-section. It is expressed as value per unit time.

8) Mean Daily Discharge

Mean daily discharge is the mean discharge value which estimated from the observation values of water level in one day.

9) Annual Mean Discharge

Annual mean discharge is the mean value of daily mean discharge in one year.

1.5 Unit and Minimum Record Value

Unit and minimum record value are as follows.

	Data	Unit	Minimum Record Value
1)	Precipitation	mm	0.1
2)	Water Level	m	0.01
3)	Velocity of Flow	m/s	0.01
4)	Area of Water	m^2	0.01
5)	Discharge	m^3/s	0.01
6)	Unit discharge	$m^3/s/km^2$	0.01
7)	Runoff Depth	mm	0.1
8)	Drainage Area	Km^2	0.1

2. Organization and Roles

2.1 Organization

The DHM consists of three (3) Divisions, five (5) regional Offices and two (2) Sections. These Divisions are Hydrology, Meteorology and Weather Forecasting, and Climatology Divisions. All the Divisions are located in the Central Office at Babarmahal except for Meteorology and Weather Forecasting Division at Kathmandu airport. Two Sections are Administration and Accounts, and Other Technical Services in the Central Office. Regional Offices are Eastern, Central, Western, Mid Western and Far Western Regional Offices. The Eastern Regional Office has a hydrological office and a meteorological office separately, the former is located at Dharan and the latter at Dhankuta. The Central, Western, Mid Western and Far Western Regional Offices, in which both the hydrological section and the meteorological section are combined, are situated in Kathmandu, Pokhara, Birendranagar and Dhangadhi respectively.

2.2 Roles of Central Office

The roles of Central Office are as follows:

1) Planning of Observation network
2) Register of Observation station
3) Final Checking of data
4) Storing original and processed data and information about observation station
5) Dissemination of data
6) Monitoring of Regional Offices
7) Guidance of Regional Offices
8) Supply of necessary equipment, man power and budget to Regional Offices for data management

9) Training

2.3 Roles of Regional Office

1) Installation of observation station
2) Observation
3) Data processing including data checking
4) Maintenance of observation station
5) Guidance for observer
6) Storing of duplicate of observed and processed data
7) Reporting about observation and data processing condition to Central Office

2.4 Responsibilities

(1) Responsibilities of Regional Office Chiefs

1) Maintenance of observation stations under them
2) Data processing until publishing of data book
3) Data storing until publishing of data book
4) Duplicate data storing.

(2) Responsibilities of Central Office

1) Publication of data book every year
2) Training
3) Data storing
4) Data dissemination
5) To assist Regional office for data management

3. Observation Station

3.1 Observation Network

Central Office plans the observation network, studying topographical and meteorological conditions to fit the purpose of the observation.

Central Office also reviews present observation networks regularly.

3.2 Installation and Maintenance

Regional Office installs and maintains observation station following the observation network plan made by Central Office. Especially in the event of serious breakage or malfunctioning, Regional Offices must make counter plan and carry it out as soon as possible. If the Regional Office carries out suitable treatment, DHM can show the importance of observation to the observers and they can observe more carefully.

3.3 Registration

Network Unit in Other Technical Services in Central Office records the information about observation stations on a register, arranges and stores them safely. After registration, Network Unit sends them to related Regional Office by floppy disk as soon as possible.

On this register, following information must be recorded:

1) output of information about object station description from data base
2) photograph of the site
3) drawing
4) results of cross section survey
5) output of discharge measurement record
6) rating curve
7) rating table
8) inspection sheets
9) equipment list
10) repair record

Central Office must check if this information is correct and reviewed every year. If something is changed, Central Office must update register immediately.

3.4 Code Number

3.4.1 Hydrological Station

Each gauging station is basically expressed by the integral number and it shows the river system as follows:

a) 100 to 200 range Mahakali river system

b) 200 to 300 range Karnali river system
c) 300 to 400 range Rapti river system
d) 400 to 500 range Narayani river system
e) 500 to 600 range Bagmati river system
f) 600 to 700 range Koshi river system
g) 700 to 800 range Kankai river system
h) 800 to 900 range Mechi river system

3.4.2 Meteorological Station

The meteorological stations are numbered using four digit identifiers, referred to as an "INDEX NUMBER"; the first two digits indicate the zone that commences from far western region and in which a station is located. The 14 administrative zones [01-14], from West to East with their corresponding assigned.

Zone	Number	Zone	Number
Mahakali	01	Gandaki	08
Seti	02	Narayani	09
Karnali	03	Bagmati	10
Bheri	04	Janakpur	11
Rapti	05	Sagarmatha	12
Dhaulagiri	06	Kosi	13
Lumbini	07	Mechi	14

The last two digits represent the station number within the preceding.

4. Observation

Observer must observe following the observation manual.

5. Data Collection

Regional Offices must collect data as follows.

Type of Data	Collection Term	Collection Method
Manual gauge data	one month	post *
Chart	four months or six months	Staff
Ram card of Data Logger (water level) (precipitation)	four months depends on amount of rain	Staff Staff
Discharge measurement record	every observation	Staff
Information about serious breakage	as soon as possible	Telephone Telegram Technician Observer

* If observer does not send data every month, Regional Office must guide observer to send them every month.

6. Data Processing

Regional Office processes data following Procedure Manual.

7. Report

7.1 Observer

Observer must report the observation result within following term.

1) Manual Record

Observer sends data to Regional Office within one month by mail after observation.

2) Chart Record

Observer submits the chart recorded by automatical gauge to the staff when he comes to the station.

3) Ram Card

Observer does not have to report.

4) Information about serious breakage

If observer finds breakage, he must report the detailed condition to the Regional Office as soon as possible by suitable way such as telephone, telegram, or observer by himself.

7.2 Regional Office Staff

Regional office staff must report the condition of stations and observation by inspection report to Regional Office Chief when he goes to the stations.

The staff must collect data which had not arrived at Regional Office when he visits the station. Before visiting the stations, the staff must investigate which data have not arrived yet.

The staff must collect the recording chart or ram card when he visits the station.

7.3 Regional Office Chief

Regional Office Chief must report the results of observation to other Technical Services Chief in Central Office within the determined term after checking and arranging as follows.

Data	Form	For Data Checking*	For Register**
(1) Original Data			
1) Precipitation	CL o11		End of Aug.
2) Water Level			
- by manual gauge			End of Aug.
- by automatical gauge			End of Aug.
3) Discharge Measurement			End of Aug.
4) Sediment Concentration			End of Aug.
(2) Processed Data			
1) Precipitation		-	End of Aug.
2) Hourly Water Level		-	End of Aug.
3) Staff Gauge Reading		-	End of Aug.
4) Discharge Measurement		End of May	End of Aug.
5) Rating Table		End of May	End of Aug.
6) Sediment Concentration		-	End of Aug.
7) Daily Mean Water Level		End of May	End of Aug.
8) Daily Mean Discharge		-	End of Aug.
9) Sediment transportation		-	End of Aug.

* Regional Office sends data to Central Office by the end of May because of checking of rating curve.

** Regional Office sends all data to Central Office by the end of August for final checking and register.

The Chief also makes annual report about observation and data processing condition for the previous year and submits it to the Director General as follows:

(1) Observation station condition
(2) Observation condition
    1) General condition
    2) Term and cause of data missing
    3) Number of discharge measurement
(3) Data collection condition
(4) Data processing condition
(5) Error condition
    1) Error cause
    2) Counter plan

7.4 Other Technical Services

Chief of Other Technical Services in Central Office must complete the data book from the results of data processing received from Regional Office, after checking and arranging by the end of next observation year.

7.5 DHM

DHM must disseminate reliable data to anybody impartially and timely, because DHM budget is run by the government taxes.

8. Storing

8.1 Central Office

Central Office must store the following information safely forever.

1) Station register
2) Original data
3) Output lists of processed data
4) Processed data in hard disk
5) Processed data in optical disk for back up

8.2 Regional Office

Regional Office must store the following information about the stations safely forever.

1) Duplication of station register
2) Output lists of processed data
3) Duplication of original data
4) Processed data in hard disk
5) Processed data in floppy disk for back up.

8.3 Observer

Observer must store the duplication of observed data forever.

9. Guidance and Monitoring Work

9.1 Monitoring of Observation

(1) Regional Office Chief must monitor the observation work and results at least once a year.

(2) Regional Chief must arrange to guide the observers and staffs if necessary as follows:

   1) In case that there are problems for observation method, the Chief sends staffs to the site and guide how to observe correctly.

   2) In case that there are problems for data processing, the Chief arranges the necessary training to the staffs. If necessary, the chief requests training to the Training Unit in Central Office.

9.2 Monitoring of Observation Station

Regional Office Chief must check the observation station conditions through inspection sheets at least once a year. If necessary, the chief must arrange to repair or reinforce stations.

9.3 Maintenance of Observation Station

Regional Chief must maintain observation stations and equipment to observe correctly.

If observation station is damaged because of flood or any other reason, the Chief must investigate and make the counter plan as soon as possible. In case that the damage is not so serious, the Chief carries out the counter plan. In case that the damage is serious, the chief must report the result of investigation with photograph to Central Office. After checking the result, the Central Office must determine the way to repair, shift or close the station.

10. Correction of Error

Basically, error must not be corrected except for data entry and calculation error and adjustment. Only in case that the cause of error is clear, the Regional Office can correct them.

Error must not be deleted on the original form even if the correct value is clear. Line should be put on the error data and correct value should be written beside them by red ink with the cause of error in the remarks column.

In case of data entry error, it should be corrected as soon as possible.

But other errors must be investigated carefully. If the cause of error is not clear, those errors must not be corrected. Moreover, those errors must not be corrected by interpolating way.

Regional Office must report the summary about the error condition, cause and counter plan to Central Office except for data entry, calculation error and adjustment work.

NATIONWIDE HYDRO-METEOROLOGICAL
DATA MANAGEMENT PROJECT

PROCEDURE MANUAL OF DATA MANAGEMENT

August, 1993

JAPAN INTERNATIONAL COOPERATION AGENCY

CONTENTS

Page

1. Objective

The objective of this manual is to guide how to process and disseminate more reliable data under quality control for the DHM staffs.

2. Scope of Manual

This manual deals with data processing procedures for following records:

1) Precipitation
2) Water level of rivers
3) Discharge measurement, and
4) Sediment concentration.

The concrete data processing works in this manual are registration of data collection, data entry, total, discharge estimation, sediment transportation estimation and register of data into data base including data checking.

3. Structure of Manual

This Manual consists of following four main parts:

1) General information
2) Outline of procedure
3) Actual Procedure
4) Basic knowledge for data processing

(1) General Information

Chapter 1 to 3 deal with general information such as objective, scope and structure of this manual.

(2) Outline of Procedure

Chapter 4 shows the outline of procedure and processing flow for data processing. Referring this chapter, you can understand each element of data processing explained in the chapter 5 to 19.

(3) Actual Procedure

Chapter 5 to 19 guide how to process data concretely from registration of data collection to registration of data into data base.

(4) Basic Knowledge for Data Processing

Chapter 20 deals with the basic knowledge for data processing such as hydrology cycle, rating curve, isohyetal map and so forth.

4. Outline of Procedure

After data collection, they are processed by following procedure:

(1) Register

As soon as the data arrive, they must be recorded on the register and transferred to the staffs for data processing.

(2) Preliminary Data Checking

The staff for data processing must check data preliminarily before processing.

(3) Preparation Work

After preliminary data checking, these data are arranged to enter into computer. For example, the record on chart is duplicated on hourly water level forms including adjustment works to time or manual data.

(4) Data Entry

These data are entered into computer as soon as possible.

(5) Data Entry Checking

After the data entry, entered data are checked if they are entered into computer correctly. In case that data entry error is found, the staff must correct data.

(6) Data Checking

After the data entry checking, they are checked again if they are observed correctly.

(7) Daily Mean Water Level Estimation

Daily mean water level values are estimated from hourly water level or staff gauge reading record.

(8) Entry Data Output

The entered data are printed out and stored into shelves safely and orderly.

(9) Development of Rating Curve

Rating curve is developed from discharge measurement records referring water level records, inspection sheets and other related information.

(10) Rating Table Estimation

Rating table is estimated by the rating curve.

(11) Discharge Estimation

Discharge values are converted from mean daily water level using the rating table.

(12) Overall Checking

The processed data are checked comparing to near gauges.

(13) Sediment Transportation Estimation

Sediment transportation amount is estimated from the discharge and sediment concentration value.

(14) Final Checking

Before registration of data into main data base, well trained and experienced staffs check the processing results finally.

(15) Data Registration

After final data checking, these data are registered into computer. The output lists are also printed out and stored safely forever.

5. Register

1) Record the date of data collection on the register with Nepalese date as soon as data arrive.

2) Transfer these data to the staffs for data processing, after register.

6. Preliminary Data Checking

Check following preliminary points before data entry:

1) Whether station code number is filled in correctly
2) Whether observing data is filled in correctly
3) Whether station name is filled in correctly
4) Whether all items in the form are filled in
5) Whether data are correct or not reviewed by experienced staffs

7. Preparation Work

Carry out the following preparation works for data entry:

7.1 Precipitation Record

The procedures are different depending on the type of recording style as follows:

(1) In case of note book synoptic form or precipitation card.

Duplicate records recorded on note book or synoptic form to precipitation card. Calculate monthly precipitation values from daily precipitation ones and record on that card.

(2) In case of chart

1) Dot manual gauge records on the chart

2) Check the difference between the dot and chart

3) If some adjustment and correction works are necessary referring the result of comparison of chart and the dots, carry out the works by the following procedure.

a. Remedial Measures of a Flat Trace during Pen Reversal:

If a pen records a flat trace during reversal before reaching the upper most ordinate as a result of loose linkage, extrapolate the position of the apex to correct the error. But, this type of data must be designated as a negative entry to denote extrapolated values.

b. Time Correction

If the time correction is necessary, adjust the time on chart shifting the dot until they are fitted.

c. Correction due to Evaporation:

An equivalent amount of loss should be added to each succeeding reading. This amount is equal to the number of scale graduations the pen has tipped down most notably centered at 3 PM, especially when no rain occurred.

d. Correction due to Pen Friction at Time Marks:

Adjustment should be made to the readings after a certain time mark, if the pen did not revert to its position before the time mark.

4) Record the observed data on the hourly form.

5) If there are much difference between manual record and chart, the cause of difference must be investigated carefully. In case that the manual records are doubtful, inspector must guide observer to observe correctly. In case that the chart are doubtful, the cause of error must be investigated at the station. The inspector must make counter plan and carry it out.

(3) In case of ram card

1) Copy the record from the ram card to the computer

2) Print out the hyetograph

3) Dot the manual records on the hyetograph

4) If there are much difference between dots and graph, investigate the cause. In case that manual records are doubtful, inspector must guide observer to observe correctly showing the chart with dots. In case that data logger is doubtful, the cause of error must be investigated at the station, and the inspector must make counter plan and carry it out.

7.2 Water Level Record

(1) In case of manual gauge

Estimate daily mean water level and record it on the form.

(2) In case of chart

1) Dot manual gauge records on the chart.

2) Check the difference between the dots and the chart.

3) If some adjustment and correction works are necessary referring the comparison with chart and dots, following procedures are applied.

a. Time correction

If the time correction is necessary, adjust the time on chart shifting the dots until they fit.

b. Correction due to friction at time mark

Adjustment should be made carrying out to the manual gauge readings after certain time mark, if the pen did not revert to its position before the time mark.

c. Error due to other cause

Sometimes, error occurs because of sedimentation, erosion, slipping between rope and drum, and so forth. In this case, staff must refer the inspection sheet or go to site to investigate the cause and record that condition on chart.

If possible, those errors are corrected by staffs. But basically, deal with these errors as missing data.

(3) In case of ram card

1) Copy the record from ram card to the computer

2) Print out the hydrograph

3) Dot the manual records on the hydrograph

4) If there are much difference between dots and graph, investigate the cause. In case that manual records are doubtful, inspector must guide observer to observe correctly showing the chart with dots. In case that data logger is doubtful, the cause of error must be investigated at the station. The inspector must make counter plan to observe correctly and carry it out.

8. Data Entry

Enter the following data into computer carefully.

1) Daily precipitation
2) Staff gauge reading
3) Hourly water level
4) Discharge measurement
5) Sediment concentration

Actual procedure to enter data into data base is explained in Operation Manual.

Enter data in pairs. One is for entering of data. Another is for reading of data for entry.

9. Data Entry Checking

Entered data must be checked if they are entered correctly. If there are data entry errors, edit them as soon as possible.

There are two steps of data entry checking. In the first step, computer checks data automatically. In the second step, data are checked manually as follows:

(1) First step (By computer)

Computer checks entered data about following items as soon as they are entered.

1) If the entered station number has been already registered into computer or not.
2) If the type of entered data, such as integral number, decimal number or character, is correct or not.
3) If entered data have been already registered on data base or not.
4) If the entered data are within the applied range or not.
5) If there are logical errors or statistical errors.

(2) Second step (Manually)

It is impossible to find all data entry errors by computer because it checks only about above items. After these data are entered, check them also manually as follows.

1) Compare monthly total value between computed and manual one. If those values are same, it indicates that the entered data are correct.

2) In case that monthly total values are not recorded on the form, check one by one referring display or out put list in pairs. One is for reading of recorded value. Another is for checking of processed one.

10. Data Checking

Check data again if data are observed correctly as follows.

10.1 Precipitation

1) Draw hyetograph by computer and find abnormal dot.

2) In case of automatical recorder, compare the shape between hyetograph drawn by processed data and the recorded chart by automatical recorder.

10.2 Water Level

After estimation of mean daily water level, the water level data are checked as shown in chapter 11.

10.3 Discharge Measurement

1) Dot the discharge measurement records on the present rating curve and check if there is not so much difference between dots and curve.

2) Draw gauge Height (H) - Area (A) curve from discharge measurement record and compare with latest one.

3) Draw gauge Height (H) - Velocity(V) curve and compare with latest one.

4) Compare the gauge height between observed by discharge measurement and water level record observation such as staff gauge and automatical recorder.

If any strange results from above checking are found, check the original record.

10.4 Sediment Concentration

If sediment concentration value is unusual comparing to other records, check as follows.

1) If flood occurred or not.
2) If landslide occurred in the upstream or not.
3) Check precipitation record in the upstream.

If any strange results from above checking are found, check the original records.

11. Daily Mean Water Level Estimation

Mean daily water level is estimated from hourly water level or staff gauge reading by computer. Generally, the mean daily water level is estimated from hourly water level records which is different with the value estimated from staff gauge reading records because of observation time in one day. In case that automatical gauge has been installed, it must be estimated from hourly water level.

Actual procedure for estimation by computer is expressed in Operation Manual.

Computer sometimes refuses to store mean daily water level records estimated from staff gauge reading records if there is automatical recorder at the object station. In case that hourly water level records can not be used to estimate daily mean water level because of bad conditions of observation such as sedimentation and any other trouble, enter one daily water level data as dummy data by edit way and store it on data file. Then daily water level records estimated from staff gauge reading can be stored on the file.

After estimating mean daily water level, check them by hydrograph if there are any doubtful records or not.

12. Entry Data Output

After data checking, print them out, arrange and store them in the suitable place.

13. Development of Rating Curve

In this section, actual procedure how to determine rating curve is shown. If you want to know the basic knowledge about the rating curve see chapter 20.

13.1 General

Since it is very difficult to observe discharge continuously, water level is observed instead of it and converted into discharge. The rating table which shows the relation between water level and discharge is used to convert it. Rating curve is the curve which expresses rating table graphically. The rating curve is determined at first and then the rating table is made from the curve.

Because rating curve shows the relation between water level and discharge, the shape of rating curve is dependent on the shape of riverbed, roughness and water surface slope. Ordinarily the rivers in Nepal are steep and have much sedimentation. Such kind of rivers usually change their shape of river bed because of flood and the shape of rating curve must be revised.

To estimate rating curve, the applied term should be determined at first including checking work about discharge measurement records. Then the rating curve is estimated dotting the reliable discharge measurement records on log paper for the suitable term to fit well to the dots.

At least, the difference between observed and estimated discharge value by the rating curve is checked. If the difference of them is more than 10%, the rating curve must be restudied and the discharge measurement records must be checked again.

13.2 Determination of Applied Term

Since the rating curve is changed because of the changing of the river bed shape, the applied term can be determined studying when the shape of river bed is changed. Concretely, try the following four methods and judge referring the results to each other. But the most important point to decide the range is dependent on your experience, correct information at the site and number of discharge measurement record finally.

(1) Dotting of Discharge Measurement Record on Log Paper

Dot the discharge measurement records tying with line in order of observation indicating the serial number and find the shifting points.

If there are former rating curves at the same station, draw the latest one before dotting.

(2) Study on Low Water Level

Ordinarily the low water level is not changed so much if the cross section of the river is not changed, because the low flow is the base flow whose source is ground water and snow melt.

Study the low water level to determine the suitable term as below.

1) Refer the lowest water level in each year.

2) If the lowest water level is changed more than 30 cm, it indicates that the rating curve should be revised.

(3) Study on Cross Section

Study cross sections at the site and find the date at which the river bed has been changed. That date is same with the date the rating curve should be revised. Drawing the height (H) and area (A) curve from the result of survey, that object date can be found easily comparing to each other as follows:

1) Draw the cross section on the section paper with the same scale of X and Y axes.

2) Draw the horizontal lines at intervals of every 20 cm, 50 cm or 1 m on the cross section. That interval is dependent on the maximum water level. Chose it as the continuous H-A curve can be drawn.

3) Calculate the area between next each horizontal lines roughly. The shape of the area can be supposed as trapezium and calculate the area as follows.

$$A_i = h_i \times (a_i + b_i)/2$$

Where, A_i = area (m^2)
h_i = height (m)
a_i = length of base (m)
b_i = length of top (m)

4) Total the below area under the each horizontal lines.

5) Dot the points of height and area on the section paper.

6) Draw the continuous line to fit the dots.

7) Compare each line of each cross section.

8) If the shape is not similar, it indicates that the rating curve should be revised.

(4) Gauge Height and Area Curve

Drawing of gauge height(H) and water area(A) curve on section paper from the discharge measurement records, the date that the rating curve has been changed is sometimes found. But this method must be used carefully, because the site where discharge measurement was taken is not fixed. The results of this way is just for reference.

1) Dot the points from discharge measurement record on section paper with gauge height as Y- coordinate and area as X-coordinate.

2) If you can classify those dots into some groups, that shows the term for rating curve.

13.3 Drawing of Rating Curve

13.3.1 Outline of Rating Curve

Discharge is the function of water level and it is expressed as follows:

$$Q = f(H)$$

Where, Q = discharge
H = water level

Rating curve is the curve that expresses relation between discharge and water level by formula or graph.

In case of formula, that relation is expressed as follows:

$$Q = a(H-b)^n$$

where, Q = discharge (m^3/s)
H = gauge height (m)
a = constant
b = constant
n = constant

In case of graph, it is expressed following the DHM rules as follows.

1) Paper

Since the rating curve is expressed by logarithmic formulas the log paper is used to draw rating curve.

2) Axis

X axis is discharge (Q) with the unit of m^3/s.

Y axis is gauge height (H) with the unit of m.

3) Dots

Discharge measurement records are dotted classified by the signs such as circle, triangle, square, star and so on. For each dot, the serial number of discharge measurement records must be put.

4) Remarks

The applied term, applied range, identified number for station, serial number of the curve, name of person who determines it and developed date must be shown with the curve.

5) Number of Curves

When some rating curves are drawn on the same paper together, the maximum number of them is three.

13.3.2 Determination of Rating Curve

To determine the rating curve, following ways are adopted by DHM.

1) Trial and Error Way by Computer

DHM has the application software, HOMS, to determine the formula for rating curve by trial and error methods. Using this software, the most suitable formula can be determined. HOMS adopts following formula as rating curve.

$$Q = a(H - Ho)^b$$

Where,
- Q = discharge
- H = gauge height
- Ho = zero-discharge stage
- a = constant
- b = constant

(See 13.3.3)

2) Logarithmic Method

Logarithmic method is the way that determines rating curve formula with logarithmic paper graphically. (See 13.3.4)

3) Direct Method

Direct method is the way that determines rating curve by drawing directly referring the dots of discharge measurement record. But this way should not be applied except if there is no computer or calculator, because the result is not always same especially low and high flow range. Also the result depends on the person. (See 13.3.5)

13.3.3 Trial and Error Way by Computer

The actual procedure to operate this programme HOMS is shown in Operation Manual in detail. The outline of procedure is expressed as follows:

1) Make data file by the software, GAUGE.EXE.
2) Operate software, STADIS.EXE, STADIS2.EXE, STADIS3.EXE or STADIS3T.EXE as you like as follows.
3) Assume zero-discharge stage at first.
4) Determine suitable value a and b automatically by computer.
5) If the result is not good, revise the value of Ho and try again.

13.3.4 Logarithmic Method

If the cross section of a stream at the site of a gauge is, or approximates to, a uniform section to which one can roughly fit either a segment of a circle, parabola, rectangle or trapezoid, then this method is more suitable. The discharge can be expressed as:

$$Q = C(G - Go)^n$$

where, Q = discharge
G = gauge height
Go = gauge height corresponding to zero discharge
C, n are constants for any station

Logarithmic form is given by

$$\log Q = \log C + n \log (G - Go)$$

, which is the equation of a straight line whose slope is n and whose intercept on the discharge axis is log C.

It may be emphasised that fitting a mathematical curve of above equation for extrapolation purposes at the upper or lower end of the stage-discharge curve is only possible when the control does not change beyond a particular stage.

(Source : Applied Hydrology KN Mutreja TATA MCGRAW HILL)

13.3.5 Direct Method

1) Dot the discharge measurement record.

2) Draw continuous curve to fit to those dots well.

13.3.6 In Case of Limited Record

If it is impossible to apply above methods because of lack of discharge measurement records, following ways are sometimes tried to interporate. But basically, enough number of discharge measurement records must be taken and try to measure discharge as much as possible to make it.

(1) Slope-Area Method

This method makes rating curve by calculating or interpolating of discharge using Manning formula as follows.

$$Q = A \cdot V$$
$$= A \cdot 1/n \cdot R^{2/3} \cdot I^{1/2}$$
$$= 1/n\, I^{1/2} \cdot A \cdot R^{2/3}$$

where,	Q =	discharge	(m^3/s)
	A =	area of water	(m^2)
	V =	mean velocity	(m/s)
	R =	hydraulic mean radius	(m)
	I =	slope	
	n =	roughness	

Actual procedure is as shown in Chapter 20.5.3,4).

Since the value of I is actually not constant because of varying backwater as a result of an obstruction downstream or high stages is an intersecting stream, to adopt this method, these things must be considered carefully.

(2) Interpolate by Other Application Term

If the low water level is similar, the discharge measurement record in other application term can be used to make rating curve as follows:

1) Pick up the discharge measurement records observed in the almost same low water level application term.

2) Dot the discharge measurement records observed in the object and above application terms on logarithmic paper.

3) Draw rating curve to fit those dots.

13.4 Check of Result

(1) Check the difference

After making rating curve, check the reliability of it comparing to discharge measurement records and estimated discharge values by the rating curve. If the difference is more than 10% revise the rating curve again.

(2) Check the high flood range

It is difficult to measure discharge in high flood term and rating curve must be extended up to maximum water level to estimate discharge. Even if it is extended by correct mathematical way, it is sometimes dangerous to use it in high flood range.

Check the rating curve in high flood range carefully as follows.

1) If the constant value n for rating curve formula is bigger than 3, review the rating curve.

2) Check the discharge value in high flood range by slope -area method. (See 20.5.3,4)

3) Check the shape of river bed if the rating curve fits it.

4) Check if the shape of rating curve in high flood range is fitted to former one. The shape of cross section in the upper part is seldom changed due to flood and present rating curve is usually similar to the former one in the high flood range.

(3) Check the low flow range

Check if the point at which the discharge value becomes zero is same with the lowest river bed height.

14. Rating Table Estimation

Rating table is estimated from rating curve and arranged with the fixed form first.

Although the interval of gauge height for that form is 0.01 m, that for entry into data base is 0.1 m.

The starting point of gauge height must be lower than minimum observed water level. If possible, it should start from the probable minimum water level.

The ending point of gauge height must be higher than maximum observed water level.

The actual procedure to enter rating table into computer is shown in Operation Manual. The entered data must be checked by dotting those points on rating curve from output list.

After checking it, arrange and store the list safely.

15. Discharge Estimation

Discharge is estimated as follows:

1) Check if mean daily water level records have been estimated correctly. If the mean daily water level is estimated by staff gauge reading records in spite of automatical recorder records, the daily mean water level must be estimated from hourly water level record.

2) Estimate daily mean discharge from daily mean water level and rating table by computer. The actual procedure to estimate it is as shown in Operation Manual.

3) Draw hydrograph by computer and check if the shape is strange, especially high flood range

4) After checking, print out the results, arrange and store them safely.

16. Overall Checking

Overall checking is the checking way to find error comparing to the results of near gauges to each other. Sometimes, errors can be found comparing to each other, even if the data checking has been completed.

Since average values of area in basin are used to analyze hydrology, instead of point observed data, overall checking is useful.

16.1 Precipitation Data

(1) Comparing of Hyetograph

Since the condition of precipitation is ordinarily similar at near stations, the error is sometimes found as follows:

1) Compare to the hyetograph to each other.
2) Compare to observed record to each other.

(2) Drawing of Isohyetal Map

Isohyetal map can be drawn joining isometric amount of precipitation like contour line shown in 20.6.3. The amount of precipitation is changed continuously. If the abnormal value is dotted comparing to near gauges, it is difficult to draw continuous line and the abnormal value can be found easily drawing the isohyetal map.

16.2 Water Level Data

(1) Comparing of Hydrograph

Water flows from upper stream to lower reaches. The hydrograph at upper stream should be similar to down stream hydrograph. Comparing to the hydrograph to each other in the same basin, the abnormal value sometimes can be found.

(2) Comparing of Hydrograph and Hyetograph

Since the origin of flows is precipitation, the shape of hydrograph must be related to the shape of hyetograph. Comparing to each other, the abnormal value can be found.

But they are not sometimes similar to each other because of time lag, evaporation, infiltration, topographical condition and distribution of precipitation. You must investigate the abnormal value carefully applying this method.

16.3 Discharge Data

Since some amount of precipitation is lost on the way to river because of evaporation and under ground water, the total annual amount of precipitation should be less than that of discharge. Using this relation, the precipitation and discharge in basin are checked by run-off coefficient as follows.

1) Estimate annual precipitation

2) Estimate areal mean annual precipitation in the upper stream basin from the station by isohyetal map or thiessen method. Outline of these method is shown in 20.6.

3) Estimate annual total run-off depth.

4) Estimate run-off coefficient as follows:

$$C = D/R$$

where, C = run-off coefficient
D = annual total run-off (mm)
R = annual total areal precipitation (mm)

5) If the value of C is bigger than 1, investigate the cause carefully. In case that observation network is not good to catch areal mean value, C sometimes becomes bigger than 1.

6) Judge if the coefficient is reasonable comparing to the standard value as follows.

Type of area	Runoff coefficient, C
Urban	0.3-0.5
Forests	0.05-0.2
Commercial and Industrial	0.9
Parks, Farms, Pastures	0.05-0.3
Asphaltor concrete pavement	0.85

(Source : Applied Hydrology P502 KN Mutreja TATA MCGRAW HILL)

7) Compare to the previous coefficient value. If the land use has not changed, coefficient should be similar to the previous one.

17. Sediment Transportation Estimation

Sediment transportation is estimated to multiple sediment concentration to daily mean discharge by computer. Actual procedure is shown in Operation Manual.

18. Final Checking

Finally, well experienced engineer checks the processed data before registration on computer. Well experienced engineer checks data approximately by following materials:

1) Rating curve
2) Hydrograph
3) Run-off coefficient, and
4) Isohyetal map.

Following materials are also used to check for reference.

1) Staff gauge reading record
2) Hourly water level record
3) Rating curve
4) Precipitation record
5) Discharge measurement record

19. Data Registration

After final data checking, processed and original data are registered and stored safely as follows: