iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 Issue: IV Month of publication: April 2023

DOI: https://doi.org/10.22214/ijraset.2023.51251

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Prediction of Coefficient of Discharge for Oblique Sharp Crested Weir using ANN Model

Vidhi Umale
8th Semester, B.E Civil Engineering Department, K.D.K College of Engineering Nagpur, India

Abstract: The application of artificial neural networks for solving complex civil engineering problems is of huge importance. This paper presents some of the positive aspects of the neural network's model that are used for the determination of the coefficient of discharge of oblique sharp crested weir. Sharp crested weirs are used to measure flow rate and control upstream water surface in irrigation canals and laboratory flumes. The main advantages of such weirs are ease of construction and capability of measuring a wide range of flows with sufficient accuracy. ANN models have been developed to predict the discharge coefficients of oblique sharp-crested weirs for free flow cases using Borgheiet al.'s experimental data.
Keywords: Oblique sharp crested weir; ANN; Discharge coefficient; Discharge measurement.

I. INTRODUCTION

Especially in the field of irrigation and drainage engineering, sharp-crested weirs are widely used for measuring flow. In case of limited channel width when higher discharge is required at a relatively lower head use of an oblique weir is advantageous over the normal weir. Oblique alignment of the weir increases the effective weir length beyond the channel width which consequently increases the efficiency of the weir. A weir is basically an obstruction in an open channel flow path. When the water level downstream of the weir is above the crest level of the weir, then the weir is said to be submerged weir, the accuracy of measurement should not be expected at this point.

A range of measurement techniques was developed by Boss (1989) and USBR (1997). Thin-plate weirs are commonly used as measuring devices enabling an accurate discharge measurement with simple instruments. The commonly used cross sections of sharp-crested weirs are rectangular, trapezoidal, and triangular. Because of the large loss of accuracy, designing thin-plate weirs for submergence should be deliberately avoided. However, submergence may happen unexpectedly or may be temporarily necessary.

Rectangular sharp-crested weirs are of three types: (a) fully contracted, (b) partially contracted and (c) full width. If the channel width is restricted, different types of weir change from type (a) to (c). With the limitation of channel width, when the amount of discharge increases, the head of water upstream of the weir increases. However, there is a disadvantage to this kind of weir, because the higher water head means higher channel walls which are more expensive.

Borghei et al. (2003) conducted an experiment in a rectangular concrete channel of length 6600mm, width 520mm, and height 800mm. The bed slope of the channel was taken as 0.005. A standard sharp-crested weir made up of plexiglass of different heights and lengths were used. Discharge was kept between the range 0.00845m^3/s,and 0.037 m^3/s. The experimental data set comprises a total number of 95 runs for free flow. Experiments for free flow cases were conducted on weirs of different weir lengths (520, 595, 672, 728, 801, 876, 1030,1175mm) in eight sets. Each set corresponds to a weir height (511, 505, 506, 503, 505, 460, mm) have been used to conduct experiments in seven sets. Oblique weir is the most general case in which the weir is aligned at an angle of θ with respect to the channel axis (Fig.1).

Ayaz and Mansoor (2018) developed ANN model to predict the discharge coefficient of oblique sharp-crested rectangular weir by using Borghei et al. (2003) experimental data. In the present study, ANN models have been developed to predict the discharge coefficient of oblique sharp-crested weir for free flow.

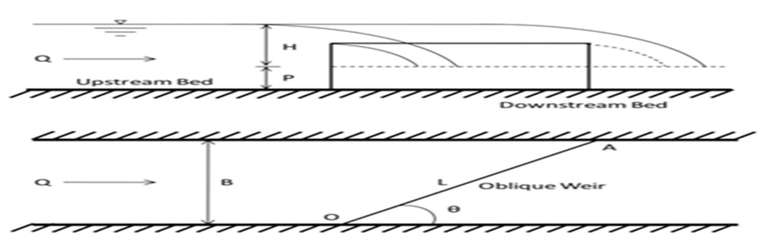


Fig.1Sectional elevation and plan of oblique weir (free flow)

TABLE I.
Ranges of geometric and flow variables (Borghei et al., 2003).

Variables	Unit	Values (Free flow)
Oblique angle (θ)	∘	0-64
Discharge (Q)	m^3/s	0.008-0.037
Weir length (L)	mm	520-1175
Channel width (B)	mm	520
Weir height (P)	mm	460-511
Water head (H)	mm	40-106
Water head (H)	mm	-
Number of runs	-	95

II. THE FORMULA FOR FLOW MEASUREMENT

The general discharge formula for flow measurement for weirs is:

$$Q = CH^n$$

where Q is discharge, H is the head of water above the weir crest, n is a constant that depends on the weir geometric type and C is a variable depending on the weir type and flow characteristics.

For a general rectangular sharp-crested weir, n is equal to 1·5 and C is expressed as

$$C = \frac{2}{3} C_D \sqrt{2gL}$$

where C_d is the discharge coefficient, L is the effective weir length and g is the gravitational acceleration.

$$c_d = a + b\frac{H}{P}$$

in which P is the weir height, and a and b are numerical coefficients to be found experimentally.

The standard Formula for Rectangular oblique sharp- created weir for calculating discharge coefficient is given by Borghei et al. (2003).

$$Cd = 0.0611 + (0.075 - 0{,}611\beta)\frac{H}{p} - 0.075\beta\left(\frac{H}{P}\right)^2$$

III. ARTIFICIAL NEURAL NETWORKS (ANN) – BASIC CONCEPT

An artificial neural network (ANN) is an information-processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. Marijana Lazarevskai give detail application on ANN in civil engineering. Neurons are arranged in layers, including an input layer, hidden layers, and an output layer. There is no specific rule that dictates the number of hidden layers. The function is established largely based on the connections between the elements of the network. In the input layer, each neuron is designated for one of the input parameters. A detail description on neural computing and basic concepts of ANN is available in Zurada (1990) and Schalk off (1997).

The network learns by applying the back-propagation algorithm, which compares the neural network simulated values with the actual values and calculates the estimation errors. (Fig.2) Shows the data set in the network is divided into a learning data set, which is used to train the network, and a validation data set, which is used to test the network performance. In the present study, the neural network fitting tool of MATLAB 7.5 was used.

After training the network, verification is conducted until the success of the training can be established.

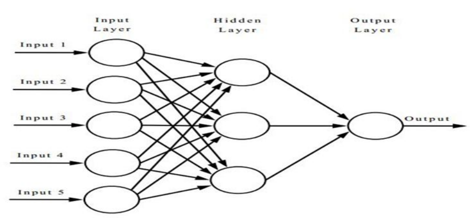


Fig.2 Model of artificial neuron

The artificial neuron receives the input signals and generates the output signals. Every data from the surrounding or an output from other neurons can be used as an input signal. The model for an artificial neuron is shown in (Fig. 3).

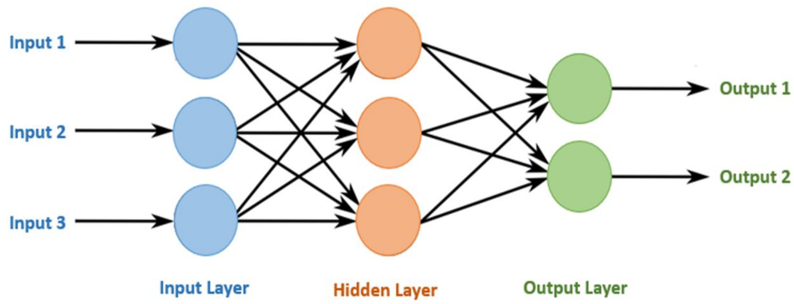


Fig. 3 Model of one layered artificial neural network

IV. DEVELOPMENT OF ANN MODEL

Weir length (L), Weir height (P), and Water Head (H) are the three main factors that affect the Coefficient of Discharge (C_d) of a oblique sharp-crested weir. The primary goal of this research is to develop of ANN models using three different networks Levenberg Marquardt, Bayesian Regularization, Scaled Conjugate Gradient to predict the Coefficient of discharge (C_d) for an oblique sharp-crested weir. A detailed description about the training of neural networks using Levenberg–Marquardt algorithm is available in Hagan et al. (1996) and Hagan and Menhaj (1994).Every model consists of three layers input layer, hidden layer, and output layer. There are three neurons in the input layer and one neuron in the output layer. Fitting tool further randomly divided the experimental data as 70% for training 15% for validation and 15% for testing. Water head (H), weir height (P), and weir length (L) have been used as inputs corresponding to three neurons of input layer while the discharge coefficient (C_d) as output to the ANN models. A flow chart explaining execution of work is shown below in (Fig. 5). The performance results of all three models are shown in Table 2,3 and 4.

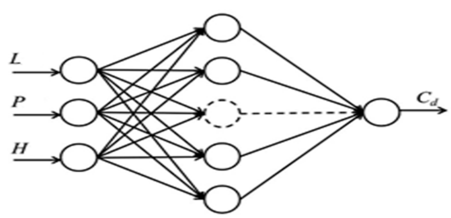


Fig. 4 ANN model (free flow)

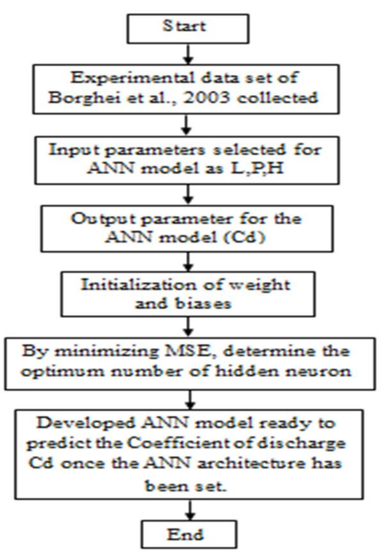


Figure. 5 Flow chart for ANN model for prediction of coefficient of discharge,

Table 2. Prediction of Coefficient of discharge by ANN model developed by Lavenberg Marquardt Method algorithm and percentage error between C_d& C_{dann}:

L=520mm
B=520mm
P=511mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
106.2	0.033	0.634	0.634	0.000
100.2	0.030	0.632	0.631	0.00
95.1	0.028	0.631	0.629	-0.32
84.7	0.023	0.629	0.628	-0.16
78.3	0.021	0.627	0.627	0.00
72.2	0.018	0.626	0.626	0.00
68.3	0.017	0.625	0.625	0.00
62.4	0.014	0.625	0.623	-0.32
57.4	0.01	0.622	0.622	0.000
50.6	0.010	0.621	0.620	-0.11
47.7	0.009	0.621	0.619	-0.21
44.0	0.008	0.621	0.619	-0.32

L= 595mm
B=520mm
P= 505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
100.3	0.035	0.645	0.644	-0.155
93.9	0.032	0.644	0.645	-0.311
90.6	0.030	0.640	0.640	0
87.1	0.028	0.638	0.637	0
82.3	0.026	0.636	0.635	-0.157
76.1	0.023	0.634	0.632	-0.157
70.4	0.020	0.630	0.629	-0.158
65.6	0.018	0.629	0.627	-0.159
61.6	0.016	0.627	0.625	-0.159
57.5	0.015	0.626	0.623	-0.481
49.7	0.012	0.621	0.620	0
42.8	0.009	0.618	0.619	0.165

L= 672mm
B= 520mm
P= 506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
94.7	0.036	0.625	0.622	-0.482
91.0	0.033	0.623	0.627	0.637
88.1	0.032	0.622	0.622	0
82.9	0.029	0.620	0.618	-0.323
74.6	0.025	0.620	0.618	-0.323
71.0	0.023	0.621	0.617	-0.648
67.8	0.021	0.618	0.617	-0.162
62.4	0.019	0.617	0.617	0
59.3	0.017	0.616	0.616	0
50.3	0.013	0.615	0.614	0
45.8	0.011	0.614	0.613	-0.163
41.3	0.010	0.613	0.612	-0.163

L=728mm
B=520mm
P=506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
91.2	0.035	0.608	0.612	0.653
85.2	0.032	0.609	0.608	-0.164
79.2	0.029	0.610	0.607	-0.494
75.2	0.026	0.608	0.607	-0.164
71.1	0.024	0.609	0.607	-0.329
67.6	0.023	0.609	0.607	-0.164
63.7	0.021	0.609	0.608	0
57.1	0.017	0.610	0.609	0
54.2	0.016	0.610	0.609	0
50.1	0.014	0.610	0.609	0
46.0	0.012	0.610	0.608	0
40.9	0.010	0.610	0.608	0

L=801mm
B=520mm
P=503mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
89.1	0.036	0.580	0.58	0
82.4	0.032	0.586	0.586	0
77.2	0.029	0.588	0.588	0
72.6	0.027	0.591	0.586	0.853
67.7	0.024	0.593	0.593	0
64.9	0.023	0.595	0.594	-0.168
61.9	0.021	0.597	0.595	-0.336
56.5	0.018	0.598	0.598	0
55.3	0.018	0.599	0.599	0
50.0	0.015	0.602	0.601	-0.166
46.7	0.014	0.603	0.603	0
41.4	0.012	0.606	0.606	0

L=876mm
B=520mm
P=505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
95.0	0.036	0.569	0.568	-0.176
82.2	0.035	0.578	0.571	-1.225
79.7	0.033	0.577	0.574	-0.522
76.4	0.031	0.577	0.577	0
70.2	0.027	0.581	0.581	0
66.0	0.025	0.583	0.584	0.171
59.8	0.022	0.587	0.587	0
58.4	0.021	0.591	0.589	-0.339
54.3	0.019	0.592	0.592	0
53.1	0.018	0.593	0.593	0
46.1	0.015	0.598	0.598	0
40.9	0.012	0.599	0.600	0.166

L=1030mm
B=520mm
P=505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
77.3	0.036	0.555	0.554	-0.180
75.6	0.035	0.558	0.558	0
74.4	0.034	0.561	0.560	-0.178
72.0	33.24	0.566	0.564	-0.354
67.8	0.030	0.569	0.570	0.175
64.9	0.028	0.573	0.573	0
61.1	0.026	0.576	0.576	0
57.2	0.024	0.582	0.579	-0.518
52.5	0.021	0.583	0.583	0
50.4	0.020	0.586	0.585	-0.170
46.8	0.018	0.588	0.588	0
41.1	0.015	0.594	0.593	-0.168

L=1175mm
B=520mm
P=460mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
69.6	0.034	0.542	0.542	0
68.0	0.033	0.544	0.544	0
65.7	0.031	0.547	0.547	0
62.8	0.030	0.552	0.552	0
60.7	0.028	0.554	0.555	0.180
57.4	0.026	0.559	0.559	0
55.1	0.025	0.562	0.567	0.881
52.6	0.023	0.566	0.566	0
50.3	0.022	0.571	0.570	-0.175
47.1	0.020	0.575	0.575	0
42.9	0.017	0.582	0.581	-0.175
-	-	-	-	-

Table 3. Prediction of Coefficient of discharge by ANN model developed by Bayesian Regularization Method algorithm and percentage error between C_d& C_{dann}:

L=520mm
B=520mm
P=511mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
106.2	0.033	0.634	0.640	0.94
100.2	0.030	0.632	0.629	-0.48
95.1	0.028	0.631	0.624	-1.12
84.7	0.023	0.629	0.622	-1.13
78.3	0.021	0.627	0.628	0.16
72.2	0.018	0.626	0.635	1.42
68.3	0.017	0.625	0.640	2.34
62.4	0.014	0.625	0.644	2.95
57.4	0.01	0.622	0.642	3.12
50.6	0.010	0.621	0.628	1.11
47.7	0.009	0.621	0.618	-1.80
44.0	0.008	0.621	0.600	-0.98

L=595mm
B=520mm
P=505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
100.3	0.035	0.645	0.648	0.462
93.9	0.032	0.644	0.642	-0.311
90.6	0.030	0.640	0.641	0.156
87.1	0.028	0.638	0.641	0.468
82.3	0.026	0.636	0.644	1.242
76.1	0.023	0.634	0.653	2.909
70.4	0.020	0.630	0.664	5.120
65.6	0.018	0.629	0.673	6.537
61.6	0.016	0.627	0.678	7.522
57.5	0.015	0.626	0.680	7.941
49.7	0.012	0.621	0.668	7.035
42.8	0.009	0.618	0.638	3.134

L= 672 mm
B= 520mm
P=506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
94.7	0.036	0.625	0.623	-0.321
91.0	0.033	0.623	0.618	-0.809
88.1	0.032	0.622	0.615	-1.138
82.9	0.029	0.620	0.617	-0.486
74.6	0.025	0.620	0.614	-0.977
71.0	0.023	0.621	0.617	-0.648
67.8	0.021	0.618	0.621	0.483
62.4	0.019	0.617	0.629	1.907
59.3	0.017	0.616	0.632	2.531
50.3	0.013	0.615	0.623	1.284
45.8	0.011	0.614	0.622	1.286
41.3	0.010	0.613	0.604	-1.490

L= 728mm
B=520mm
P= 506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
91.2	0.035	0.608	0.609	0.164
85.2	0.032	0.609	0.602	-1.162
79.2	0.029	0.610	0.599	-1.836
75.2	0.026	0.608	0.598	-1.672
71.1	0.024	0.609	0.600	-1.5
67.6	0.023	0.609	0.603	-0.995
63.7	0.021	0.609	0.607	-0.329
57.1	0.017	0.610	0.614	0.651
54.2	0.016	0.610	0.616	0.974
50.1	0.014	0.610	0.615	0.813
46.0	0.012	0.610	0.609	-0.164
40.9	0.010	0.610	0.594	2.693

L= 801mm
B=520mm
P= 503mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
89.1	0.036	0.580	0.586	1.023
82.4	0.032	0.586	0.584	-0.342
77.2	0.029	0.588	0.584	-0.684
72.6	0.027	0.591	0.587	-0.681
67.7	0.024	0.593	0.595	0.336
64.9	0.023	0.595	0.596	0.167
61.9	0.021	0.597	0.601	0.665
56.5	0.018	0.598	0.609	1.806
55.3	0.018	0.599	0.611	1.963
50.0	0.015	0.602	0.615	2.113
46.7	0.014	0.603	0.614	1.791
41.4	0.012	0.606	0.604	-0.331

L=876 mm
B=520mm
P= 505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
95.0	0.036	0.569	0.579	1.727
82.2	0.035	0.578	0.578	0
79.7	0.033	0.577	0.578	0.173
76.4	0.031	0.577	0.578	0.173
70.2	0.027	0.581	0.579	-0.345
66.0	0.025	0.583	0.581	-0.344
59.8	0.022	0.587	0.585	-0.341
58.4	0.021	0.591	0.587	-0.681
54.3	0.019	0.592	0.590	-0.338
53.1	0.018	0.593	0.591	-0.338
46.1	0.015	0.598	0.593	-0.843
40.9	0.012	0.599	0.588	-1.870

L =1030mm
B= 520mm
P= 505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
77.3	0.036	0.555	0.557	0.359
75.6	0.035	0.558	0.559	-5.187
74.4	0.034	0.561	0.560	-0.178
72.0	33.24	0.566	0.562	-0.711
67.8	0.030	0.569	0.567	-0.352
64.9	0.028	0.573	0.570	-0.526
61.1	0.026	0.576	0.574	-0.348
57.2	0.024	0.582	0.578	-0.692
52.5	0.021	0.583	0.583	0
50.4	0.020	0.586	0.585	-0.170
46.8	0.018	0.588	0.588	0
41.1	0.015	0.594	0.588	-1.020

L= 1175mm
B=520mm
P= 460 mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
69.6	0.034	0.542	0.531	-2.071
68.0	0.033	0.544	0.537	-1.303
65.7	0.031	0.547	0.540	-1.296
62.8	0.030	0.552	0.549	-0.546
60.7	0.028	0.554	0.556	0.359
57.4	0.026	0.559	0.566	1.236
55.1	0.025	0.562	0.571	1.576
52.6	0.023	0.566	0.576	1.736
50.3	0.022	0.571	0.577	1.039
47.1	0.020	0.575	0.573	-0.349
42.9	0.017	0.582	0.582	-4.488
-	-	-	-	-

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Table 4. Prediction of Coefficient of discharge by ANN model developed by Scaled Conjugate Method algorithm and percentage error between C_d& C_{dann}:

L=520mm
B=520mm
P=511mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
106.2	0.03	0.634	0.646	1.86
100.2	0.03	0.632	0.645	2.02
95.1	0.02	0.631	0.645	2.17
84.7	0.02	0.629	0.645	2.48
78.3	0.02	0.627	0.644	2.64
72.2	0.01	0.626	0.643	2.64
68.3	0.01	0.625	0.642	2.65
62.4	0.01	0.625	0.639	2.19
57.4	0.01	0.622	0.635	2.05
50.6	0.01	0.621	0.628	1.11
47.7	0.00	0.621	0.624	0.48
44.0	0.008	0.621	0.619	-0.32

L= 595mm
B=520mm
P= 505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
100.3	0.035	0.645	0.637	1.883
93.9	0.032	0.644	0.636	2.044
90.6	0.030	0.640	0.635	2.047
87.1	0.028	0.638	0.637	2.668
82.3	0.026	0.636	0.633	2.053
76.1	0.023	0.634	0.631	1.584
70.4	0.020	0.630	0.629	1.748
65.6	0.018	0.629	0.627	1.594
61.6	0.016	0.627	0.625	1.44
57.5	0.015	0.626	0.621	0.966
49.7	0.012	0.621	0.613	-0.163
42.8	0.009	0.618	0.602	-1.827

L= 672mm
B= 520mm
P= 506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
94.7	0.036	0.625	0.624	-0.160
91.0	0.033	0.623	0.623	0
88.1	0.032	0.622	0.623	0.160
82.9	0.029	0.620	0.644	3.726
74.6	0.025	0.620	0.623	0.481
71.0	0.023	0.621	0.623	0.321
67.8	0.021	0.618	0.623	0.802
62.4	0.019	0.617	0.623	0.963
59.3	0.017	0.616	0.623	1.123
50.3	0.013	0.615	0.621	0.966
45.8	0.011	0.614	0.620	0.967
41.3	0.010	0.613	0.617	0.648

L= 728mm
B=520mm
P= 506mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
91.2	0.035	0.608	0.613	0.815
85.2	0.032	0.609	0.613	0.652
79.2	0.029	0.610	0.613	0.489
75.2	0.026	0.608	0.614	0.975
71.1	0.024	0.609	0.615	0.975
67.6	0.023	0.609	0.616	1.136
63.7	0.021	0.609	0.617	1.296
57.1	0.017	0.610	0.620	1.612
54.2	0.016	0.610	0.621	1.771
50.1	0.014	0.610	0.622	1.928
46.0	0.012	0.610	0.623	2.086
40.9	0.010	0.610	0.624	2.086

L= 801 mm
B=520 mm
P= 503 mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
89.1	0.036	0.580	0.593	2.192
82.4	0.032	0.586	0.592	1.013
77.2	0.029	0.588	0.592	0.675
72.6	0.027	0.591	0.592	0.168
67.7	0.024	0.593	0.597	0.670
64.9	0.023	0.595	0.593	-0.337
61.9	0.021	0.597	0.594	-0.505
56.5	0.018	0.598	0.596	-0.335
55.3	0.018	0.599	0.597	-0.335
50.0	0.015	0.602	0.599	-0.500
46.7	0.014	0.603	0.600	-0.5
41.4	0.012	0.606	0.602	-0.664

L= 876mm
B= 520mm
P= 505mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
95.0	0.036	0.569	0.576	1.215
82.2	0.035	0.578	0.576	-0.347
79.7	0.033	0.577	0.578	0.173
76.4	0.031	0.577	0.580	0.517
70.2	0.027	0.581	0.584	0.513
66.0	0.025	0.583	0.588	0.850
59.8	0.022	0.587	0.594	1.178
58.4	0.021	0.591	0.596	0.838
54.3	0.019	0.592	0.602	1.661
53.1	0.018	0.593	0.603	1.658
46.1	0.015	0.598	0.612	2.287
40.9	0.012	0.599	0.613	2.283

L=1030 mm
B= 520mm
P= 505 mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
77.3	0.036	0.555	0.543	-2.209
75.6	0.035	0.558	0.545	-2.385
74.4	0.034	0.561	0.547	-2.559
72.0	33.24	0.566	0.550	-2.909
67.8	0.030	0.569	0.558	-1.971
64.9	0.028	0.573	0.563	-1.776
61.1	0.026	0.576	0.561	-2.673
57.2	0.024	0.582	0.580	0
52.5	0.021	0.583	0.591	1.353
50.4	0.020	0.586	0.596	1.677
46.8	0.018	0.588	0.605	2.809
41.1	0.015	0.594	0.617	3.727

L= 1175mm
B=520mm
P= 460mm

H:mm	Q:m³/s	C_d	C_{dann}	% Error
69.6	0.034	0.542	0.592	8.445
68.0	0.033	0.544	0.585	7.008
65.7	0.031	0.547	0.575	4.869
62.8	0.030	0.552	0.563	1.953
60.7	0.028	0.554	0.554	0
57.4	0.026	0.559	0.540	-3.518
55.1	0.025	0.562	0.531	-5.838
52.6	0.023	0.566	0.520	-8.846
50.3	0.022	0.571	0.511	-11.74
47.1	0.020	0.575	0.497	-15.69
42.9	0.017	0.582	0.479	-21.50
-	-	-		-

Percentage error is determined between C_d and C_{dann} will determined for all the three ANN models shown which in Table 4,5 and 6.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

TABLE 4.
Percentage error between theoretical coefficient of discharge and predicted coefficient of discharge by (Levenberg Marquard algorithm).

L:mm	B:mm	P:mm	Maximum Error:%	Minimum Error:%
520	520	511	-0.32	0.00
595	520	506	-0.48	0
672	520	506	0.63	0
728	520	506	0.65	0
801	520	503	-0.853	0
876	520	505	-0.522	0
1030	520	505	-0.518	0
1175	520	460	0.881	0

TABLE 5.
Percentage error between theoretical coefficient of discharge and predicted coefficient of discharge by (Bayesian Regularization Method).

L:mm	B:mm	P:mm	Maximum Error: %	Minimum Error: %
520	520	511	3.12	0.16
595	520	506	7.94	0.15
672	520	506	1.90	-0.32
728	520	506	-2.69	0.162
801	520	503	2.11	0.336
876	520	505	-1.87	0
1030	520	505	-5.187	0
1175	520	460	-4.488	0.359

TABLE 6.
Percentage error between theoretical coefficient of discharge and predicted coefficient of discharge by (Scaled Conjugate Method).

L:mm	B:mm	P:mm	Maximum Error: %	Minimum Error: %
520	520	511	2.65	-0.32
595	520	506	2.66	-0.16
672	520	506	3.72	0
728	520	506	2.08	0.48
801	520	503	2.19	-0.5
876	520	505	2.287	-0.34
1030	520	505	3.727	0
1175	520	460	-21.503	0

V. COMPARISON BETWEEN C_D AND C_{DANN} PREDICTED BY LAVENBERG MARQUARDT METHOD

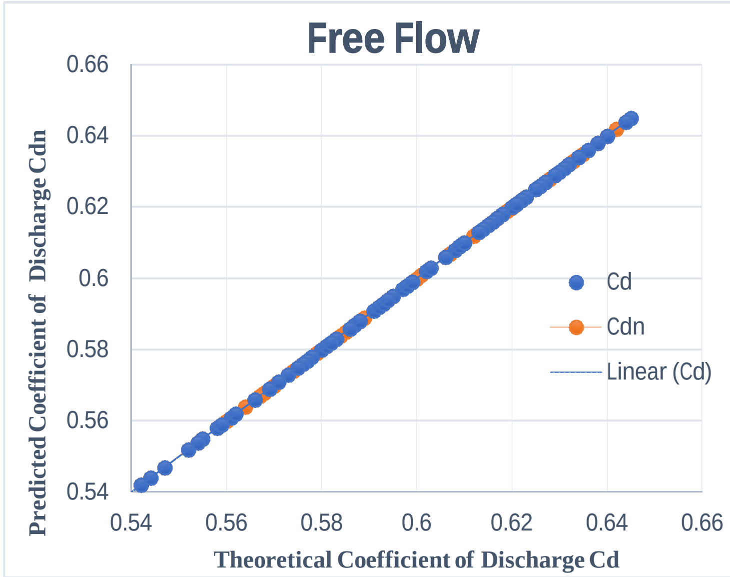


Fig 5. Graph between theoretical coefficient of discharge and predicted coefficient of discharge.

VI. DISCUSSION ON PERFORMANCE RESULTS

Using experimental data of free flow, we developed ANN model's by using three algorithms available in matlab, Levenberg Marquardt, Bayesian Regularization, Scaled Conjugate Gradient.

ANN model developed by above three algorithm, model developed by Levenberg Marquardt algorithm is the best to predict the Cd_{ann}, as seen in following table percentage error of Levenberg Marquardt algorithm is between ± 0.881%.

Method's	% Error
Levenberg Marquardt	0.881 to 0
Bayesian Regularization	7.94 to 0.15
Scaled Conjugate Gradient	-21.50 to 0

VII. CONCLUSIONS

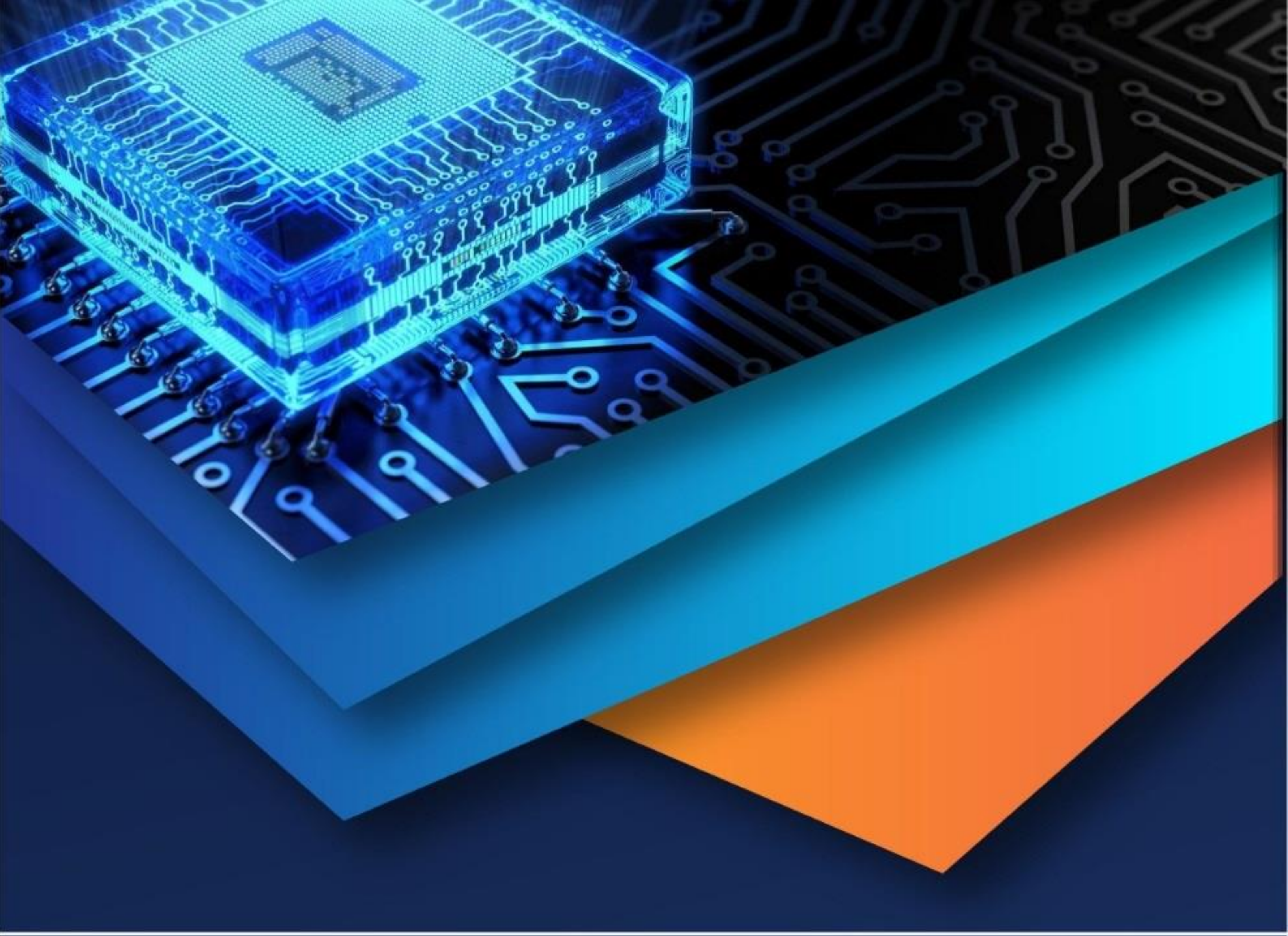
1) The Levenberg Marquardt, Bayesian Regularization, Scaled Conjugate gradient algorithms are used in this study to develop the ANN models to predict the coefficient of discharge for oblique sharp crested weir's for free flow using experimental data of Borghei etal.(2003). The percentage error between the therotical coefficient of discharge and predicted coefficient of discharge is between±0.881%.
2) It is concluded that the ANN model developed by Levenberg Marquardt method is accurate and recommended for prediction of coefficient of discharge as percentage error between therotical coefficient and predicted coefficient of discharge is in the range of ±0.881%.
3) Modern multidisciplinary fields like artificial neural networks are a good illustration of how to solve a variety of engineering challenges that conventional modelling and statistical approaches were unable to address.

NOTATION

C_d Theoretical coefficient of oblique weir.
C_{dann} Predicted coefficient of discharge
H Head over weir.
L Oblique weir length
P Oblique weir height
B Channel width
Q Discharge
θ Oblique weir angle

REFERENCES

[1] Bos, M.G., (1989), Discharge Measurement Structures. International Institute for Land Reclamation and Improvement)ILRI), Publication 20, Wageningen, Netherlands.
[2] Hagan, M.T., Menhaj, M., 1994. Training feed-forward networks with the Marquardt algorithm. IEEE Trans. Neural Netw. 5 (6), 989–993.
[3] Schalkoff, R.J., 1997. Artificial Neural Networks. The McGraw Hill Companies, Inc., New York.
[4] Hecht-Neilson, R., 1987. Komogorov's mapping neural network existence theorem. Proceedings of the Internal Conference on Neural Networks, IEEE Press, New York 3, 11–13.
[5] Borghei, S.M., Vatannia, Z., Ghodsian, M., Jalili, M.R., 2003. Oblique rectangular sharp-crested weir. Water Marit. Eng. 156 (WM2), 185–191.
[6] MdAyaz ,Tailb Mansoor, Available - 19 October 2018, Discharge coefficient of Oblizue Sharp Crested Weir For Free And Submerged Flow Using Trained ANN Model , pp. 01-21.
[7] Marijana Lazarevskai dr., Milos Knezevic, Meri Cvetkovska, Ana Trombeva-Gavriloska, Application of artificial neural networks in Civil Engineering ISSN 1330-3651(Print), ISSN 1848-6339 (Online).



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY