© 2016 IJSRSET | Volume 2 | Issue 6 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Bed Resistance Investigation for Manning's and Chezy's Coefficients

Bashir Muhtar[1], Manal M. A. Albayati[2]

[1]Student, Department of Civil Engineering, Infrastructure University Kuala Lumpur Malaysia
[2]Lecturer, Department of Civil Engineering, Infrastructure University Kuala Lumpur Malaysia

ABSTRACT

Weirs, notches flumes and gates have been used for ages to determine discharges in open channels. In this study, laboratory experiments were conducted to investigate the coefficient of discharge for different beds and then comparing Chezy's and Manning's coefficients. Using two different slopes, five different discharges and three kinds of roughness. Based on the investigation, it was discovered that discharge coefficient ranges between 0.4 to 0.9. Coarse aggregates were found to have an effect on discharge coefficient and manning was found to decrease with increase in discharge and velocity. Velocity increase with the flow under the unsubmerged condition for the corresponding roughness coefficient decreases with the increase velocity. Vegetative roughness coefficient tends to remain constant and rises as the submergence starts to occur.

Keywords: Velocity, Discharge Coefficient, Flow Resistance, Open Channel Flow

I. INTRODUCTION

Flow resistance on rough and inclined beds has been a challenge in hydraulics. The resistance to flow in open channels is as a result of viscosity propulsion or pressure force created on wet surfaces. The various types of obstacles and roughness present on the bed and sides of rivers increase roughness in flow path, cause loss of water energy, slow the flow and raise the river surface. The coefficient of flow resistance is considered as the main factor in the simulation modes of natural waterways the coefficient is a function of velocity, depth and type of bed roughness.

The original scope of this research is based upon fluid mechanics under pressure as it impacts the natural aspect of living for many centuries ago. These water resource projects and hydraulic engineering works have been developing rapidly throughout the world, thus prediction of water roughness coefficient is becoming an importance criteria for the design of hydraulic related structure like open channel, and dam structure.

The result of the experimental study were presented and shown that the effect of surface roughness coeffient of the conditions tested, the discharge decreased as roughness coefficient increase, it shows smoother surface is having lower roughness coefficient and less retarding effect on the water flow, higher flow rate is produced.

The method of calculating coefficients reflecting the resistance from the roughness of flow profile is the most important issue in using these relationships: these coefficients are respectively recognizes as the Chezy roughness coefficient (c), the Manning roughness coefficient (n), and Darcy-Weisbach coefficient and determining these coefficients has been a subject of considerable interest for hydraulic engineers. (T.W. Lau and N.R. Afshar, 2013). Manning equation has been identified as the most appropriate formulae to represent the open channel flow application. It was found that the discharge increases as the roughness coefficient decrease for a given slope and channel bed surface. The channel slope and surface roughness appears to be the main factor in determining the roughness coeffient and a material with uneven or irregular surface increase the roughness coefficient. Larger grain size gravel having higher roughness coeffient (T.W. Lau and N.R. Afshar, 2013)

In this study, the objective is to carry out viable experiments in an open channel laboratory to ascertain the varying values of discharge coefficient and to determine the values of Manning and Chezy's constants using the actual determined coefficient of discharge for different types of beds and to evaluate the impact of different bed types on the velocity profile.

II. METHODS AND MATERIAL

In order to see through the success of this experimental case study, all the materials are to be collected which include well weirs, grass, fine sand and coarse aggregate beds of which were be sieved to the desired sizes. To achieve the object of this study, the experiments will be performed in the Hydraulics laboratory of Civil Engineering Department of Infrastructural University Kuala Lumpur (IUKL). The experiments were conducted in rectangular transparent sided flume. The channel is associated with a water supply system and a stainless steel tank with a capacity of 600 Gallon calibrated in liters for measurement of discharge and a movable gauge for measurement of flow depths in the channel. The flume has a length of 6 meter, 600mm width, and 600mm depth. Water flow rate 1500 liter per minute at 15m head. Electrical inverter diver control for flexible and accuracy water flow and speed control system for water centrifugal motor pump.

In carrying out the appropriate investigations, weirs were used to observe and record data. The desired working area for this experiment is 3m, three types of roughness were created by fastening the particles of 2.36mm size of normal and manufactured sand fine aggregates, coarse aggregate and grass on the inclined surface consisting of flat surface. For every type of weir used, the collected data differs and noted as observation of flow measurements. Such data are essential in the design of artificial open channel. By the use of graphs and figures, further analysis of the carried out experiment can also be done appropriately.

To begin the experiment, the channel was set to desired slope. In order to reduce the occurrence of error and provide a wider range of investigation, a minimum of four runs is considered for this experiment with each type of bed and weir, which will then be assessed and computed in accordingly. For each run normal depth will be measured with the movable point gauge after the flow become uniform. As previously mentioned, at each run or repeat of the experiment, the flow rate of water, height or head of water above the weir, will be recorded and tabulated accordingly for an easier assessment. Some images of the experiment are shown in figure 1 and 2

- **Literature Review**

Discharge coefficient is defined as the ratio of the mass flow rate at the discharge end of the channel to the theoretical discharge rate. There are many ways of determining the discharge coefficient in a hydraulics laboratory. The common ones being the use of weirs, flumes, sluice gates and notches. In practice, the structures used for flow measurements should be accurate precise, economical and also easy to use to install, operate and maintained. In any given artificial open channel design such as dam construction, irrigation canal and even pavement drainage, it is necessary to take into considerations the importance of discharge rate and velocity of which coefficients are based upon. Scenarios of naturally existing channel characteristics are recreated in a laboratory in order to observe the nature of discharge coefficient and resistance exerted by the channel beds as well as make accurate artificial open channel designs. Weirs allow flow water to be diverted to a structure that is calibrated, thus allowing flow rates to be measured as a function of depth of flow through the structure. Coefficients of discharge are customarily used in making assessments of artificial or natural conduits and water bodies so as to carry out constructions related to hydraulics and water engineering. Habitually, the bed layering of conduits in terms of materials, texture, roughness and even cohesion influences the discharge coefficient values determined. Based on previous related researches, it is evident that the main focus is basically comparing the coefficients of discharge of different coarse aggregate beds of varying sizes while making further comparisons on the aggregate roughness using Manning's and Chezy's coefficient.

The resistance exerted on vegetation is usually classified by relative flow depth to the height of vegetation (Ree 1949). For intermediate flows were the depth of flow is greater than the height of vegetation, Ree and palmer (1949) presented a set of graphical-format design curves for different retardance classes. For the most open-channel flows, the formation of a uniform flow is accompanied by upstream or downstream transitions. The cross section of the testing flume consists of different roughness. The computation of the composite roughness has been thoroughly reviewed by Yen (1992). The vegetative resistance varies with the flow depth or the degree of submergence.

An experimental study was conducted using artificial roughness to investigate the variation of vegetation resistance with stage for unsubmerged and submerged conditions. The vegetal drag coefficient is converted into the roughness coefficient with the aid of Manning's equation. Velocity increases with the flow under the unsubmerged condition for the corresponding roughness coefficient decreases with the increase velocity. Vegetative roughness coefficient tends to remain constant or rise as the submergence starts to occur. (FU-Chun Wu and H.W Shen 2000)

In open channel, the manning formula has been widely used to determine roughness coefficient. It also is most frequently used in the computation of open channel flows (Wu et al., 1999; Kirby et al., 2005). Manning's formula is an empirical parameter that applies to uniform flow in open channels and is a function of velocity, cross sectional area and slope of channel. It also includes the components of surface frictional resistance, form resistance, wave resistance and resistance due to unsteadiness Flow (Yen 1991).

As an alternative to other resistance coefficients, Manning's formula was established in 1885 by an Irish Engineer Robert Manning and later published in (Manning, 1891) It has been developed and modified over time, which consequently becomes preferable to engineers in the carrying out frictional constant calculations and practical applications. The formula mathematically written as;

$$V = \frac{1}{n} x\, R \frac{2}{3} x\, S \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (1)$$

- With V = mean velocity
- R = Hydraulic radius
- S = slope of energy line
- n = Manning's constant.

Another considered resistance coefficient is the Chezy's formula, which is regarded as the first uniform-flow formula upon which Manning extended from. Chezy's formula is an empirical formula that relates water discharge to dimensions of channel and water slope surface, which is directly proportional to velocity. As flow velocity in channel increases, the Chezy's factor also increases. Chezy's formula takes into measure flow conductance or efficiency hence making it difficult to assess.

A French hydrologist, Antoine Chezy in 1769 after reviewing the general, developed the Chezy's formula laws and theories of Bernoulli and Torricelli, which Cornelius Velson from Amsterdam in 1749 and Albert Brahams from Hannover, Germany in 1757 were working on. The formula Chezy developed is not only the first, but also the most lasting formula (Fadi, 2004). The approximate character of Chezy's equation for uniform flow in an open channel is widely acknowledged which can be seen from the numerous formulae for the Chezy's coefficient quoted in the literature of (Leliavsky 1959; Chow, 1959).

The Chezy's formula is expressed in terms of velocity as follows:

$$V = C\sqrt{RS} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where V = mean velocity (m/s)

R= hydraulic mean depth (m)

S = slope of energy line

And C = Chezy's resistance factor ($m^{1/2}$/s).

Sun and Shiono, (2009) have investigated experimentally, the flow resistance in a straight compound channel with and without one-line emergent vegetation along the floodplain edge, with simulated rigid vegetation using a constant roughness in which stream-wise velocities and boundary shear stresses were determined. They were able to come up with a formula for friction factors for with and without vegetation cases respectively by using vegetation density and channel geometry based on friction factor method. Even though the formula was developed by simulating only emergent vegetation, it may be used to predict the stage-discharge rating curve in a vegetated channel. Hydraulic resistance of open-channel and overland flows results from viscous and pressure drag over the wetted perimeter. In vegetated watercourses, this drag may be conceptually divided into three components, namely, soil grain roughness, form roughness, and vegetative roughness. A horsehair mattress is used in the experimental study to simulate the vegetation on watercourses. Test results reveal that roughness coefficient reduces with increasing depth under the unsubmerged condition. However, when fully submerged, the vegetative roughness coefficient tends to increase at low depths but then decrease to an asymptotic constant as the water level continues to rise. (FU-Chun Wu and H.W Shen 2000)

M. Greco, D. Mirauda and A. Volpe Plantamura (2013) studied on Manning's roughness through the entropy parameter for steady open channel flows in low submergence. The objective of the work, therefore, is to investigate the direct dependence of Manning's roughness on the entropy parameter in the case of low depth and submergence. The experimental tests were carried out on a free surface flume of 9 m length and with a cross section of 0.5 x 0.5 m. The distance of 4 m was chosen.

- **Research Methodology**

The main focus is basically comparing the coefficients of discharge of different coarse aggregate beds of varying sizes while making further comparisons on the aggregate roughness using Manning's and Chezy's coefficient. In this case study, there is an expansion whereas not only the coarse aggregate is used, but grass and fine aggregate beds while also observing the roughness coefficients . The considered flow of water in this experimental research will be steady flow. The beds which are to be used provides a wider and more precise investigation of similar research objective although naturally, the beds might consist of different types of materials of varying particle sizes.

- **Materials**

Figure 1 : Showing the vegetation bed in the channel

Figure 2 : showing Gravel bed in the flume

Once the discharge coefficients and the resistance factors were obtained an analysis was the done. The data obtained from these experiments may be applicable to small open channels like small rivers, canals and streams. Steady flow will be used in this research and slope will be kept at a constant value of one. Most of the previous works relevant to this research paper have mainly focused on Manning and Chezy's coefficient, as they are main coefficients used in open channel hydraulics.

Weirs can be said to be a barrier placed along a water path or channel which alters the flow characteristics of the fluid liquid in order to carry out relevant experiments and take measurements of volumetric rate of water or liquid flow in an open channel. Also, weirs are overflow structures built in different shapes or containing distinctive crests perpendicular to the direction of water/fluid flow through the open channel. For weirs, there is a crest which are edges to which the water flows above once place in the open channel flow which creates a nappe (overflowing sheet or surface of water through the channel) and notches are openings to which the flowing water moves through in the open channel.

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Weirs are notches or gaps over which fluid flows. The lowest point of structure surface or edge over which water flows is called the crest, whereas the stream of water that exits over the weir is called the nappe. The head-discharge relationship then allows for quick evaluation of flow rate or serves as a hydraulic control point for subsequent gradually varied flow computations. Sharp-crested and broad-crested are the most widely used in treatment plant operation. In addition to suppressed and contracted weir types, weirs are also distinguished as either sharp-crested or broad-crested. Broad-crested weirs have crests that extend horizontally in the direction of flow far enough to support the nappe and fully develop hydrostatic pressures for at least a short distance. Some of the merits of using weirs in an open channel with flowing water or fluid, there will be accuracy of measurements when determining a wide range of flows and provide more accurate discharge ratings than other types of overflow structures. The weirs are portable, adjustable and easy to built or construct which might be used in combination with turnout and division structures. Due to the nature of the used open channel, the disadvantages of weir is that relatively large head is required for larger open channels and that the water has to be kept clean from suspended particles which might affect the measurement accuracy.

- **Broad Crested Weir**

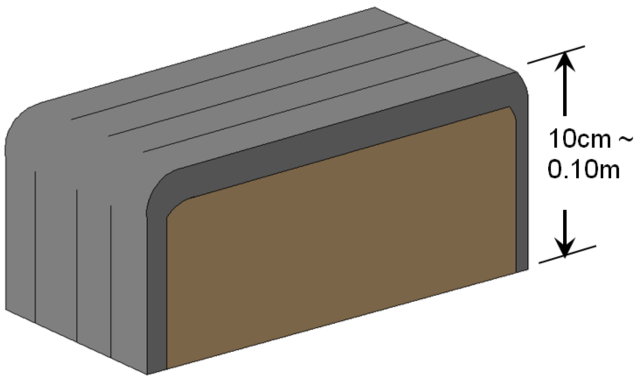

Figure 3: Diagram of a broad crested weir

Shown above in this diagram, a broad crested weir is a horizontal crest with adequately long direction of flow for supporting the overflowing sheet surface of water or nappe. In other words, there are flow structures over which streamlines or water flow run parallel to each other for a short distance in such a way that the hydrostatic pressure distribution is being assumed when controlling the apparatus.

- **Types of fluid flow**

- Steady flow: The type of flow in which the fluid characteristics like velocity, pressure, density, at a point do not change with time is called steady flow. For a steady flow discharge is constant. In other words, the flow velocity does not change with respect to time at a given location. For most hydraulic calculations, this assumption is reasonable.
- Unsteady flow: the type of flow in which the fluid characteristics like velocity, pressure, density etc.at a point change with time is called unsteady

flow. For unsteady flow discharge varies with time.

- Uniform flow: The type of flow, in which the velocity at any given time does not change with respect to space, is called uniform flow. For a uniform flow cross-sectional area is constant.
- Non-Uniform flow: The type of flow, in which the velocity at any given time changes with respect to space, is called non-uniform flow. For non-uniform flow cross-sectional area varies

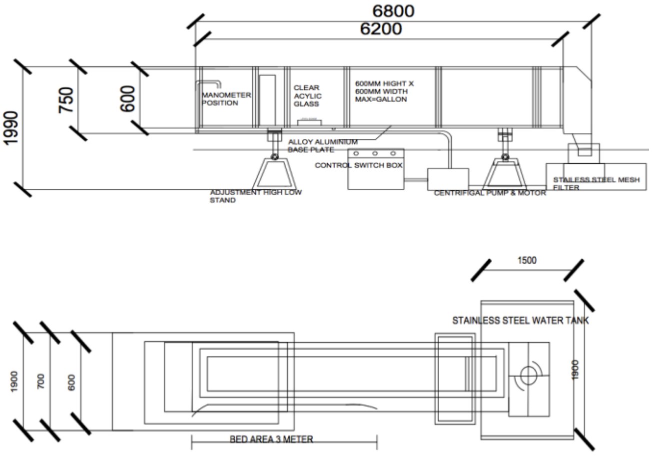

Figure 4 : Schematic Diagram Of Experimental Setup

III. RESULTS AND DISCUSSION

The analysis procedure was categorized to investigate the influence of discharge on Chezy's and Mannings roughness coefficient. A comparison between the manning roughness and Chezy's coefficients for the tested bed materials obtained experimentally were presented. When recording the observed data required for the target assessment, it is critical that the values obtained are of an accurate range. Having carried out the experiment, it advantageous that the observed data are properly acquired for correct computation and achieve the project target. The tables below show the different readings and results that were observed during the laboratory experiment. While recording the data needed for the target evaluation, it is basic that the qualities acquired are of a precise range. Having done the experiment, it beneficial that the observed data are appropriately obtained for right reckoning and accomplish the venture target, the tables below shows the data obtained with calculation for the experiment.

Table 1: Readings for Gravel bed

Run	Q (m^3/s)	H	B	H^3/2	A	P
1	0.00417	0.05	0.6	0.01118	0.03	0.7
2	0.00472	0.06	0.6	0.014697	0.036	0.72
3	0.00528	0.08	0.6	0.022627	0.048	0.76
4	0.00694	0.1	0.6	0.031623	0.06	0.8
5	0.0075	0.12	0.6	0.041569	0.072	0.84
6	0.00833	0.14	0.6	0.052383	0.084	0.88

V	R	Cd	C	n
0.0167	0.0429	0.0252	0.360	0.0428
0.0186	0.05	0.0257	0.3722	0.0448
0.0173	0.0632	0.0207	0.3077	0.0609
0.0167	0.075	0.0178	0.2722	0.0749
0.0163	0.0857	0.0159	0.2482	0.0876
0.0179	0.0955	0.0162	0.2585	0.0889

Analysis for Resistance Coefficients For Gravel Bed

Rectangular weir was used for the experiment. The flume has a length of 6 meter, 600mm width, and 600mm depth. Water flow rate 1500 liter per minute at 15m head. Electrical inverter diver control for flexible and accuracy water flow and speed control system for water centrifugal motor pump.

Gravel Bed

Manning's constant (n) is equal $= n = \frac{R^{2/3} \times S^{1/2}}{V}$ ... ... (3)

Run 1: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0429^{2/3} \times 0.05^{1/2}}{0.0167} = 0.0428$

Run 2: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.050^{2/3} \times 0.05^{1/2}}{0.0186} = 0.0448$

Run 3: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0632^{2/3} \times 0.05^{1/2}}{0.0173} = 0.0609$

Run 4: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.075^{2/3} \times 0.05^{1/2}}{0.0167} = 0.0749$

Run 5: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0857^{2/3} \times 0.05^{1/2}}{0.0163} = 0.0876$

Run 6: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0955^{2/3} \times 0.05^{1/2}}{0.0179} = 0.0889$

The Chezy's coefficient will finally be:

Chezy's coefficient (C) is equal $= \frac{V}{\sqrt{RS}}$ ... ... (4)

Run 1: $C = \frac{V}{\sqrt{RS}} = \frac{0.0167}{\sqrt{0.0429 \times 0.05}} = 0.360$

Run 2: $C = \frac{V}{\sqrt{RS}} = \frac{0.0186}{\sqrt{0.05 \times 0.05}} = 0.3722$

Run 3: $C = \frac{V}{\sqrt{RS}} = \frac{0.0173}{\sqrt{0.0632 \times 0.05}} = 0.3077$

Run 4: $C = \frac{V}{\sqrt{RS}} = \frac{0.0167}{\sqrt{0.075 \times 0.05}} = 0.2722$

Run 5: $C = \frac{V}{\sqrt{RS}} = \frac{0.0163}{\sqrt{0.0857 \times 0.05}} = 0.2482$

Run 6: $C = \frac{V}{\sqrt{RS}} = \frac{0.0179}{\sqrt{0.0955 \times 0.05}} = 0.2585$

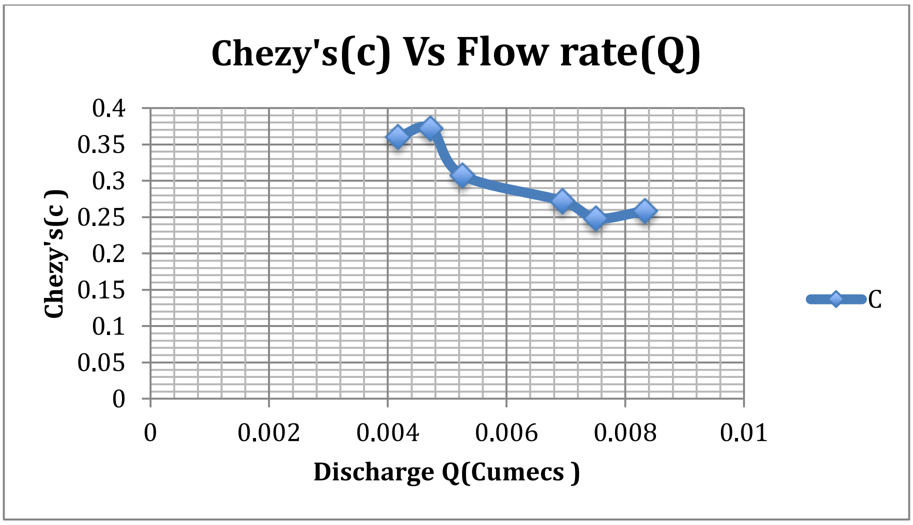

Figure 5: Graph of Chezy's (c) against Discharge (Q) of water using rectangular weir

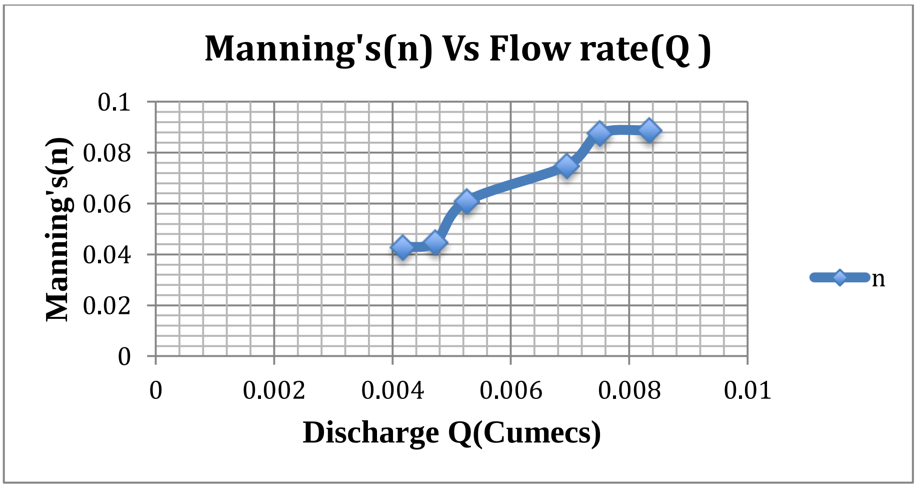

Figure 6 : Graph of Mannings (n) against Discharge (Q) of water using rectangular weir

Table 2: Sand Bed Reading using Rectangular weir

Run	Q (m^3/s)	H	B	H^3/2	A
1	0.00417	0.021	0.6	0.003043	0.0126
2	0.00472	0.026	0.6	0.004192	0.0156
3	0.00525	0.033	0.6	0.005995	0.0198
4	0.00694	0.037	0.6	0.007117	0.0222
5	0.0075	0.052	0.6	0.011858	0.0312
6	0.00833	0.068	0.6	0.017732	0.0408

P	V	R	Cd	C	n
0.642	0.0397	0.0196	0.0927	1.2668	0.41
0.652	0.0429	0.0239	0.0902	1.2417	0.4323
0.666	0.04191	0.0297	0.0781	1.0873	0.5119
0.674	0.0450	0.0329	0.0793	1.109	0.5101
0.704	0.0375	0.0443	0.0557	0.7966	0.7467
0.736	0.0368	0.0554	0.0477	0.6983	0.8843

Manning's constant (n) is equal $= n = \frac{R^{2/3} \times S^{1/2}}{V} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$

Run 1: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0196^{2/3} \times 0.05^{1/2}}{0.0397} = 0.41$

Run 2: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0239^{2/3} \times 0.05^{1/2}}{0.0429} = 0.432$

Run 3: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0297^{2/3} \times 0.05^{1/2}}{0.04191} = 0.5119$

Run 4: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0329^{2/3} \times 0.05^{1/2}}{0.0450} = 0.5101$

Run 5: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0443^{2/3} \times 0.05^{1/2}}{0.0375} = 0.7467$

Run 6: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0554^{2/3} \times 0.05^{1/2}}{0.0368} = 0.8843$

The Chezy's coefficient will finally be:

Chezy's coefficient (C) is equal = $\frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (\mathbf{4})$

Run 1: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0397}}{\sqrt{\mathbf{0.0196} \times \mathbf{0.05}}} = 1.2682$

Run 2: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0429}}{\sqrt{\mathbf{0.0239} \times \mathbf{0.05}}} = 1.241$

Run 3: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.04191}}{\sqrt{\mathbf{0.0297} \times \mathbf{0.05}}} = 1.087$

Run 4: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0450}}{\sqrt{\mathbf{0.0329} \times \mathbf{0.05}}} = 1.1095$

Run 5: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0375}}{\sqrt{\mathbf{0.0443} \times \mathbf{0.05}}} = 0.796$

Run 6: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0368}}{\sqrt{\mathbf{0.0554} \times \mathbf{0.05}}} = 1.241$

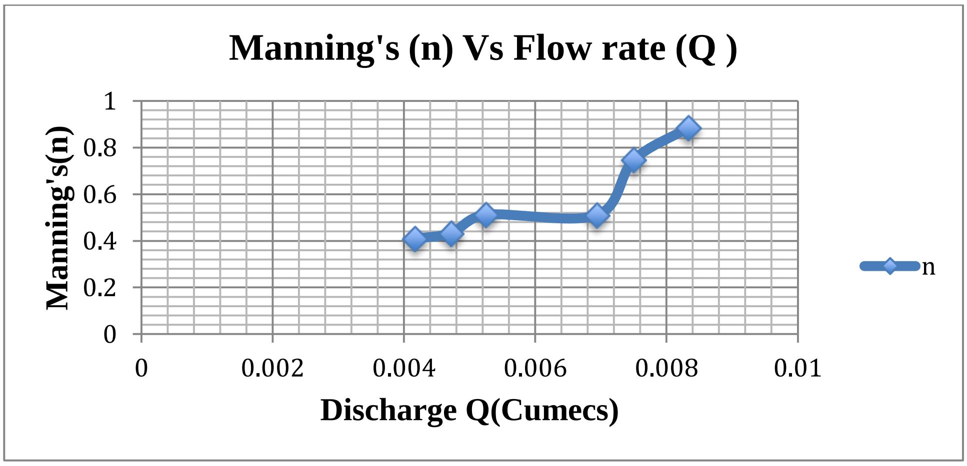

Figure 4.5 Graph of Mannings (n) against Discharge (Q) of water using rectangular weir

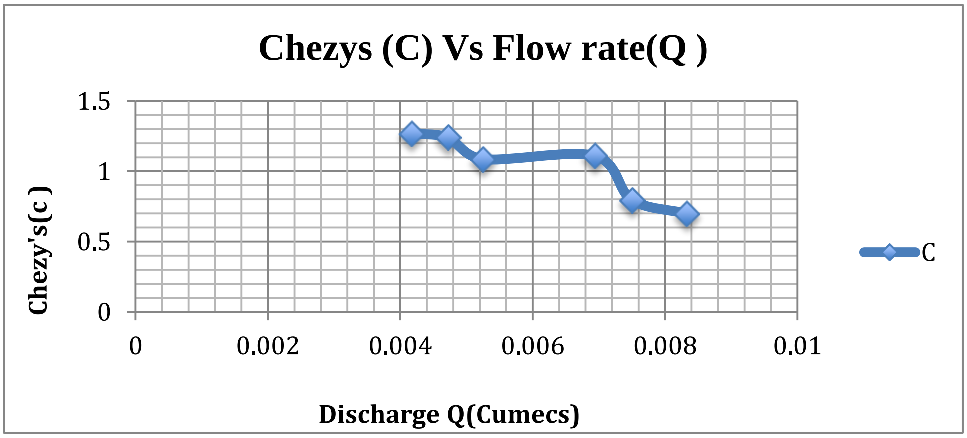

Figure 4.6 Graph of Chezy's (c) against Discharge (Q) of water using rectangular weir

Table 3: Vegetation Bed Reading using Rectangular weir

Run	Q (m^3/s)	H	B	H^3/2	A	P
1	0.0005	0.023	0.6	0.003488	0.0138	0.646
2	0.00067	0.031	0.6	0.005458	0.0186	0.662
3	0.00083	0.037	0.6	0.007117	0.0222	0.674
4	0.001	0.042	0.6	0.0086074	0.0252	0.684
5	0.00117	0.046	0.6	0.011517	0.0306	0.702
6	0.0015	0.053	0.6	0.015813	0.0378	0.726

V	R	Cd	C	n
0.0362	0.0214	0.0809	1.1086	0.4751
0.0360	0.0281	0.0693	0.9611	0.5740
0.0374	0.0329	0.0658	0.9213	0.6138
0.0397	0.0368	0.0656	0.9246	0.6232
0.0436	0.0436	0.0573	0.8190	0.7251
0.0521	0.0521	0.0535	0.7778	0.7857

Manning's constant (n) is equal = $n = \frac{R^{2/3} \times S^{1/2}}{V}$ … … … … … … … … … (3)

Run 1: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0214^{2/3} \times 0.05^{1/2}}{0.0362} = 0.4751$

Run 2: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0281^{2/3} \times 0.05^{1/2}}{0.0360} = 0.5737$

Run 3: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0329^{2/3} \times 0.05^{1/2}}{0.0374} = 0.6138$

Run 4: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0368^{2/3} \times 0.05^{1/2}}{0.0397} = 0.6239$

Run 5: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0436^{2/3} \times 0.05^{1/2}}{0.0382} = 0.7243$

Run 6: $n = \frac{R^{2/3} \times S^{1/2}}{V} = \frac{0.0521^{2/3} \times 0.05^{1/2}}{0.0397} = 0.7857$

The Chezy's coefficient will finally be:

Chezy's coefficient (C) is equal = $\frac{\mathbf{V}}{\sqrt{\mathbf{RS}}}$ … … … … … … … . . (**4**)

Run 1: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0362}}{\sqrt{\mathbf{0.0214} \times \mathbf{0.05}}} = 1.1086$

Run 2: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0360}}{\sqrt{\mathbf{0.0281} \times \mathbf{0.05}}} = 0.9611$

Run 3: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0374}}{\sqrt{\mathbf{0.0329} \times \mathbf{0.05}}} = 0.9213$

Run 4: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0397}}{\sqrt{\mathbf{0.0368} \times \mathbf{0.05}}} = 0.9246$

Run 5: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.0436}}{\sqrt{\mathbf{0.0436} \times \mathbf{0.05}}} = 0.8190$

Run 6: C $= \frac{\mathbf{V}}{\sqrt{\mathbf{RS}}} = \frac{\mathbf{0.052}}{\sqrt{\mathbf{0.051} \times \mathbf{0.05}}} = 0.778$

The estimations of discharge coefficient as well as resistance coefficient were carried out based on the result and analysis of acquired data. There is a direct proportionality of water discharge with coefficient of discharge in the case of fine aggregates and grass. An increase of discharge causes increase in coefficient of discharge. For the case of coarse aggregate 20mm, there was an inverse proportionality whereas increase in discharge causes decrease in estimated coefficient of discharge, which is due to the roughness, and size of materials. The coefficients of resistances were determined using both Manning's roughness coefficient as well as Chezy's resistance factor. Values observed for the Manning's constant were smaller compared to Chezy's determined values. The variations of graphs are quite similar for all the different types of beds, with gravel bed having the highest roughness followed by the sand, the vegetation bed with the least. Manning's equation is the most commonly used open channel flow equation. The roughness component, C, is typically assumed to be constant over the full range of flows and is represented by a Manning's roughness value, n. These n-values have been experimentally determined for various materials and should not be used with fluids other than water. From the charts demonstrated above, it is seen that, Chezy's constant increases when actual discharge increases. While Manning's constant decrease when actual discharge increases. This demonstrates that the higher the release esteem, the higher the Chezy's constant and the other way around. Not at all like Manning's constant, have the higher had the discharge esteemed, the lower the value of Manning's. This suggests that Chezy's constant conversely corresponding to Manning's constant. The above charts for release against Mannings and Chezy show in detail, the relationship between real release vs Mannings and Chezy. These comparisons of resistance coefficients are made from observations or viewpoint as there has not been any clear ascendancy of formulae over others (Yen 2002).

IV. CONCLUSION

In the present study the effects of Manning's roughness n, Chezy's coefficient, bed slope S, and depth y; using a rectangular weir was performed. An empirical relationship is obtained to estimate the variation of calculation parameters and roughness coefficient. Experiments were carried out on Open Channel in the Hydraulic Laboratory, to determine Discharge Coefficients by using three (3) different materials (Gravel bed, Sand bed and artificial vegetation bed). The summary of the conclusions is shown below. By achieving the cardinal objectives of this experimental research, the carried out investigation is a success. Summarized conclusions are as follow

1. The depth of water y increases as the channel bed slope S decreases.
2. For a given bed slope S, depth of water increases as the roughness n, increases.
3. Influence of roughness on depth of water y, increases with the slope.
4. Manning's constant decreases as the actual discharge increases.
5. Based on the investigation, coefficient of discharge is directly proportional to water discharge for rectangular weir, while using the actual discharge of water, roughness or resistance coefficients namely Manning's and Chezy's constant were considerably acquired for the different types of bed materials.

Determined values of Manning's constant were observed to be smaller than Chezy's constant with indirect variations of values. Furthermore, Chezy's constant although easier to assess, Manning's constant is considered to be more adaptable due to the abundant of researches carried out and the preference of its smaller values. Manning's equation has been identified as the most appropriate formulae to represent the open channel flow application. The vegetative roughness coefficient tends to remain constant or rise as the submergence start to occur. The vegetal drag coefficients are converted into the roughness coefficients with the aid of manning's equation. The proposed model can be practically applied to evaluate the roughness coefficient corresponding to different depths of flow. The discharge decreased as roughness coefficient increase, it shows smother surface is having low roughness coefficient and less retarding effect on the water flow.

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