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Manning Roughness Coefficient Study on Materials Non Cohesive with Using Entropy to Open Channel Flow

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Abstract *:* Application of entropy in open channel models presenting relevant aspects of theoretical issues and practical useful for cross-sectional velocity distribution. The ratio between the average velocity and the maximum depends on the local morphology. Recent research has suggested formulation Manning roughness, n, based on the ratio and the ratio between the position where the velocity is zero and the maximum, y_0/y_{max}, the flow depth of the flow regime. Based on the experience of stable flow, analysis entropy dependence on n parameters, and M for flow depth, proposes an equation y_0/y_{max} to know the bed channel roughness coefficient. The results showed a good linear relationship between estimate *n* and n entropy calculation and n with the bedform. Obtained from linear regression analysis of the data relationships flume $n_{calculate} = 0{,}5803 n_{etropi} + 0{,}010$ with good correlation (R^2 = 0.864) using the entropy parameter $\Phi(M) = 0.8197$, while for the data in a natural channel $n_{calculate} = 0.754\, n_{etropy} + 0.006$ with good correlation ($R^2 = 0{,}877$) with $\Phi(M) = 0{,}914$. It also has a fault tolerance (0.005 to 0.293)%, which is still below the tolerance.

Keywords: *Entropy models, Manning's Roughness; Steady flow, Laboratory Flume*

I. INTRODUCTION

River flow forecasting is a very important step in order to improve management policies directed to the use of water resources as well as for mitigation, prevention and defense measures against environmental degradation (Greco et al., 2014). In addition, knowledge of the velocity distribution in the cross section of the river is fundamental in hydraulic modeling of the river, sediment and pollutant transport, channel design, river training work and hydraulic structures as well as in the manufacture of curves rating (Greco et al., 2014; Mirauda et al ., 2011b). In relation to the resistance to flow and velocity distribution in alluvial channels is a complication of the two problems. Firstly due to changes in the bedform and second a result of certain conditions of the majority of sediment transport particles acted as a suspension. On the alluvial of bed channels that are not fixed it will change its geometry and dimensional characteristics continuously as a result of the interaction between the flow and the channel bed (Yang & Tan, 2008; Singih, 2000).

In hydraulic engineering, flow resistance coefficient or the Manning roughness coefficient is an important parameter in forecasting the flow in the channel, designing hydraulic structures, the calculation of the distribution of velocities, sediment transport and accuracy in the determination of the energy loss (Bilgil&Altun, 2008; Samandar, 2011; Azamathulla et al., 2013).

In addition, the flow in open channels is limited to the aspect ratio of the width - depth three-dimensional , and wall shear stress are not evenly distributed around the wet cross-section. This is due to the free surface and the secondary flow (Guo & Julien, 2005; Azamathulla et al., 2013). Problems in separating the bed shear stress and the sidewalls are very important in almost all studies on open channel flow in this laboratory flume studies (Guo & Julien, 2005). Boundary shear stress distribution in hydraulic equation concerning the problem of resistance to the flow and sediment transport, (Javid & Mohammadi, 2012). Method forcorrecting the sidewall (Johnson, 1942; Keulegan, 1938; Julien 1995; Yang & Lim, 1998; Mohammadi, 2004; Javid & Mohammadi, 2012).

A Mathematical model, which is derived from the application of the theory of information entropy maximization on the data collected, used to evaluate the flow field and calculate waterdischarge (Chiu, 1987,1988 & 1989; Chiu & Said, 1995; Chiu & Hsu, 2006; Moramarco & Singh, 2010, Mirauda et al., 2011b ; Greco et al., 2014).

Velocity distribution entropy, In fact, requires assessment on one parameter, M, which it can be obtained through knowledge of the ratio of the average flow velocity and maximum. In addition, the rules allow the natural flow well enough about the reliability of geometric irregularities and normal flow regime (Greco, 1998; Chiu et al., 2005; Burnelli et al., 2008). Application of the entropic profile in river flows also given to good results even for practical purposes.

In order to determine the velocity distribution in the cross section and provide acceleration on the method of calculation of the flow of water and reduce the calculation time of the survey and (Greco & Mirauda, 2004; Mirauda et al., 2011a, b). And also modeling the two-dimensional velocity distributions for open channel flow (Marini et al., 2011). Furthermore, the ratio between average velocity and maximum, Φ (M), it appears to be highly dependent on the riverbed morphology with uniform flow. This shows that the investigation of the entropy parameter depends on the hydraulic and geometric characteristics of the cross section of the river (Moramarco & Singh, 2010, 2011).

Therefore, the study of bed roughness with speed theory of entropy, the proposed formulation in *n* Manning roughness, based Φ (M) and the position in which the velocity of each. The purpose of this paper is the first to investigate the Manning roughness coefficient on entropy parameters in the case of low flow regimes with materials sands.

II. MATERIALS AND METHOD

2.1. Relationship Roughness (*n*) Manning and Entropy Parameters (M)

The average velocity, $\overline{U}_{\mathrm{rerata}}$ mean and Umaximum velocity, Umax, open channel flow cross section can be expressed in terms of entropy (Chiu and Said, 1995), as Equation (1)

$$\overline{\mathrm{U}} = \Phi\,(\mathrm{M})\mathrm{U}_{\max} \text{ ....} (1)$$

which Φ (M) can be described in the form of Equation (2)

$$\Phi\,(\mathrm{M}) = \left(\frac{\mathrm{e}^{\mathrm{M}}}{\mathrm{e}^{\mathrm{M}}-1} - \frac{1}{\mathrm{M}}\right) \text{ ....} (2)$$

where M expressed entropy parameter (Chao and Lin Chiu, 1988; Moramarco and Singh ,2010; Greco et al., 2014). Eq. (1) shows that $\overline{\mathrm{U}}$ and $\mathrm{U}_{\max}$ together can determine Φ (M)and then the entropy parameter M. It should be pointed out that $\mathrm{U}_{\max}$ represents the maximum value in the data set of velocity points sampled in the flow area during velocity measurement (Chiu & Said 1995; Greco et al., 2014) The vertical where umax is sampled is defined, henceforth, as the y axis (Chiu 1989).

The average velocity on a steady flow in open channel can be estimated by using the Manning formula as Equation (3)

$$\overline{\mathrm{U}} = \frac{1}{n}\mathrm{R_h}^{2/3}\mathrm{S_f}^{1/2} \text{ ....} (3)$$

Where n is the Manning roughness coefficient, $\mathrm{R_h}$ is the hydraulic radius and $\mathrm{S_f}$ is the energy slope. Instead, to determine the maximum velocity the cross section, $\mathrm{U}_{\max}$, along the y-axis are assumed to be perpendicular to the bottom, modified logarithmic rule under water (dip) for the velocity distribution in open channel flow uniformly smooth, proposed by Yang et al. (2004), as Equation (4)

$$\mathrm{u(y)} = u_*\left[\frac{1}{\kappa}\ln\left(\frac{y}{y_0}\right) + \frac{\alpha}{\kappa}\ln\left(1-\frac{y}{h}\right)\right] \text{ ....} (4)$$

Which $u_* = \sqrt{g\,R_b S_f}$ is the shear velocity (g = acceleration of gravity); κ is the von Kármán constant equal to (0,41); y_0 is the distance at which hypothetically velocity is equal to zero; α is the correction factor on the condition of the flow, which depends only on the ratio between the relative distance to the location of the maximum velocity of bed channel, $y_{\max}$ and flow depth (h) along the y-axis, which $\mathrm{U}_{\max}$ location.

Location maximum velocity, based on the hypothesis that the dip phenomenonwith Yang et al. (2004 ; Moramarco & Singh, 2010) can be obtained by separating the Eqs. (4) and differentiation du/dy = 0, which gives the result in Equation (5)

$$\frac{y_{max}}{h} = \frac{1}{1+\alpha} \text{ ....} (5)$$

Experimental study by Greco and Miraudа (2002) have shown that, for channels on various forms of cross-section, the maximum velocity is below the free surface of about 20 ÷ 25% of the maximum depth. This result was also confirmed from the values y_{max} collected in experimental trials of this work and is shown in Fig. (1), which y_{max} is a function of water depth (h)

$$U_{max} = \frac{\sqrt{g\,R_b S_f}}{\kappa}\left[\ln\left(\frac{y_{max}}{y_0}\right) - 0{,}4621\right] \text{ ....(6)}$$

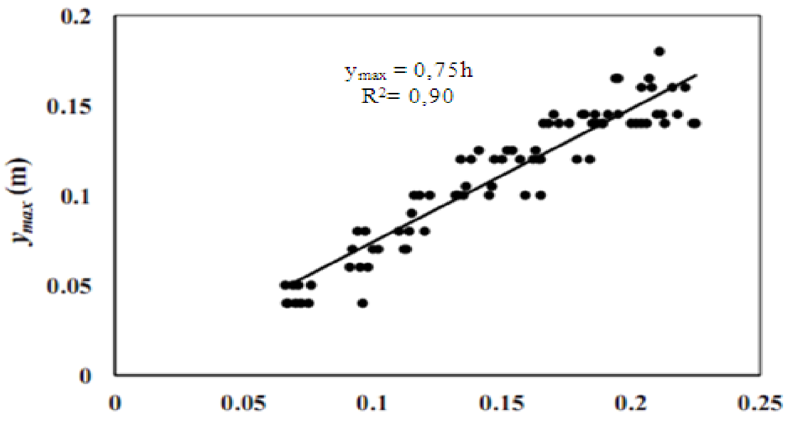


Fig.1. TheRelationship between the Location of the MaximumVelocity and maximum y and Depth (Mirauda&Gerco, 2012)

By replacing Equation (3) and (1) into Equation (4). it is possible to derive a relationship as Equation (7).

$$\left(\frac{e^{M}}{e^{M}-1} - \frac{1}{M}\right) = \frac{\frac{1}{n}{R_h}^{2/3}{S_f}^{1/2}}{\frac{\sqrt{g\,R_b S_f}}{\kappa}\left[\ln\left(\frac{y_{max}}{y_0}\right)-0{,}4621\right]} \text{ or } (M) = \frac{\frac{1}{n}{R_h}^{1/6}\sqrt{g}}{\frac{1}{\kappa}\left[\ln\left(\frac{y_{max}}{y_0}\right)-0{,}4621\right]} \text{ ....(7).}$$

which allows to connect Φ (M) with hydraulic and geometric characteristics of the flow. Finally, from Equation (30) Manning n roughness values obtained as Eq. (8)

$$n = \frac{{R_h}^{1/6}\sqrt{g}}{\Phi\ (M).\frac{1}{\kappa}\left[\ln\left(\frac{y_{max}}{y_0}\right)-0{,}4621\right]} \text{ ....(8)}$$

Equation (8) which concluded on the calculation of roughness (n) Manning by using the value of Φ (M) as well as calibrate the value of $\left(\frac{y_{max}}{y_0}\right)$. In fact, to determine Φ (M) in each test and the application of Manning n value, which is obtained by Eq. (3) into Eq. (8), to obtain $\left(\frac{y_{max}}{y_0}\right)$, as it has been studied by Gerco et al. (2014) and Mirauda and Gerco (2012) the importance of the ymax is equal to ¾ of water depth (h), as in equation (9).

$$\frac{y_{max}}{y_0} = \frac{3}{4}\frac{h}{yo} \text{ ....(9)}$$

so that Equation (31) can be written in the form of Equation (10)

$$n = \frac{{R_h}^{1/6}\sqrt{g}}{\Phi\ (M).\frac{1}{\kappa}\left[\ln\left(\frac{3}{4}\frac{h}{yo}\right)-0{,}4621\right]} \text{ ....(10)}$$

yo value is near the channel bed which is assumed as the value of equivalent roughness (k_s). There is no clear consensus on the definition k_s and not surprisingly, there are a variety of various values of ks values' ($1{,}25d_{35} \leq k_s \leq 5{,}1d_{84}$) has been proposed (Van Rijn, 1982). However Millar (1999) has found that there was no significant difference between using the d_{35}, d_{50}, d_{84} or d_{90}. In this study, ks suggested by Casey (1935), Shields (1935), Straub (1954) will be used is as Equation (11)

$$k_s = d_{50} \text{ ....(11)}$$

andyo =0,003k_s

2.2 PerformanceModel

Performancemodelsusedtomeasure the accuracyofthe model. Inthispaper, the performance ofthe modelis usedto determine thedegree ofcorrespondencebetweenthe actual datawiththe results offorecastingusedmeasure ofcorrelation coefficient, with theformulain Equation(15).

$$R = \frac{\sum xy}{\sqrt{\sum x \sum y}} \ldots\ldots\ldots\ldots(12)$$

Where$x = X - \bar{X}$, Xisthe actualdischarge, $\bar{X}$is the averagevalue ofX, $y = Y - \bar{Y}$, Yis adebitor asimulation resultof forecasting, $\bar{Y}$, is the averagevalue ofthe Yvalueof correlationcan be seen in**Table 1.**

Table1ValueCorrelation Coefficient

Correlation Coefficient (R)	interpretation
0	There is nolinear relationship
0 < R ≤ 0,25	veryweakcorrelation
0,25<R≤ 0,5	correlationenough
0,50<R≤ 0,75	strong correlation
0,75<R≤ 0,99	verystrongcorrelation
1	perfect correlation

Cource :Soewarno, 1995

The mediansquare error(mean square error, MSE).MSEis a measure ofthe accuracy ofthe modelbysquaringthe errorforeachpointof data inadata setandthenobtainthe averageormedian valueof thesum of the squares. The formulationofMSEasEquation(13)

$$MSE = \frac{\sum_{i=1}^{N}(y_i - \hat{y_i})^2}{N} = \frac{\sum_{i=1}^{N} e_i^2}{N} \ldots\ldots\ldots\ldots(13)$$

where$y_i$isthe actual valueof data, $(\hat{y_i})$ isthe value ofthe results offorecasting, Nis the numberof dataobservations, and$e_i$isper-point errordata.Then useda common procedureerrorcalculatingper-point data, which for thetime seriesfollowedformulationis: data =pattern+errorsfor easy, error(error) is written withan e, the datawiththe datapattern ofXandX.In addition, the*subscript i*(i =1,2,3, ..., n) are included toshowthe datapointto-i, sowritten$e_i = X_i - \bar{X}$If youjustwant to know themagnitude ofthe errorregardless of thedirectionit iscalledabsoluteerrororo$e_i = X_i - \bar{X}$Anothercriterionis theaccuracy ofthe modelorNashSutcliffeModelEfficiencyCoefficient (NSE) by Nash and Sutcliffe (1970). Nashgivesagood indicationformatchingof 1:1betweensimulationsandobservations. Formulationof NashasEquation(14).

$$NSE = 1 - \left[\frac{(Q_{obs} - Q_{sim})^2}{(Q_{obs} - \bar{Q}_{obs})^2}\right] \ldots\ldots\ldots\ldots(14)$$

WhereQ_{obs}areobservational data, $\bar{Q}_{obs}$is the averagefromobservational dataand$Q_{sim}$is the value ofthe simulation results.NSEvalue criteriacan be seenin Table(2).

Table 2.CriteriaValueEfficiencyModelNashSutcliffeCoefficient (NSE).

Nilai *Nash Sutcliffe Model Efficiency Coefficient* (NSE).	Interpretasi
NSE > 0,75	good
0,36 <NSE ≤ 0,75	satisfy
NSE ≤ 0,36	Not satisfy

Source : Motovilov et al., 1999.

Normal distribution calculation performed to perhitung prediction accuracy using the average normal faults (MNE), namely:

$$MNE = \frac{100}{N}\sum_{i=1}^{N}\frac{\left|X_{ci} - X_{mi}\right|}{X_{mi}}, \ldots\ldots\ldots\ldots(15)$$

2.3. Experimental data

The experimental tests were carried out in the Hydraulics Laboratory of Bandung Institute of Technology, on a free surface flume of 3,0 m length and with a cross section of 0,1 x 0,4 m2 (Fig. 1a), whose slope can vary from 2/300 % up to 4/300 %. at a distance of 1 from the upstream timber bulkhead installed upstream so that the sand does not exit. An example of a sample of sand with a maxsimum grain diameter of 0,45 mm to 0,85 mm. Picture design can be found at Fig.2

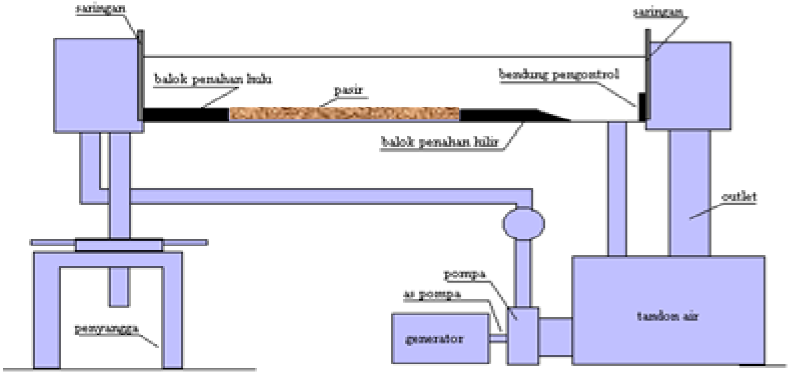


Figure2. Flume Conditions along with AdditionalEquipment used

III. Results and Discussion

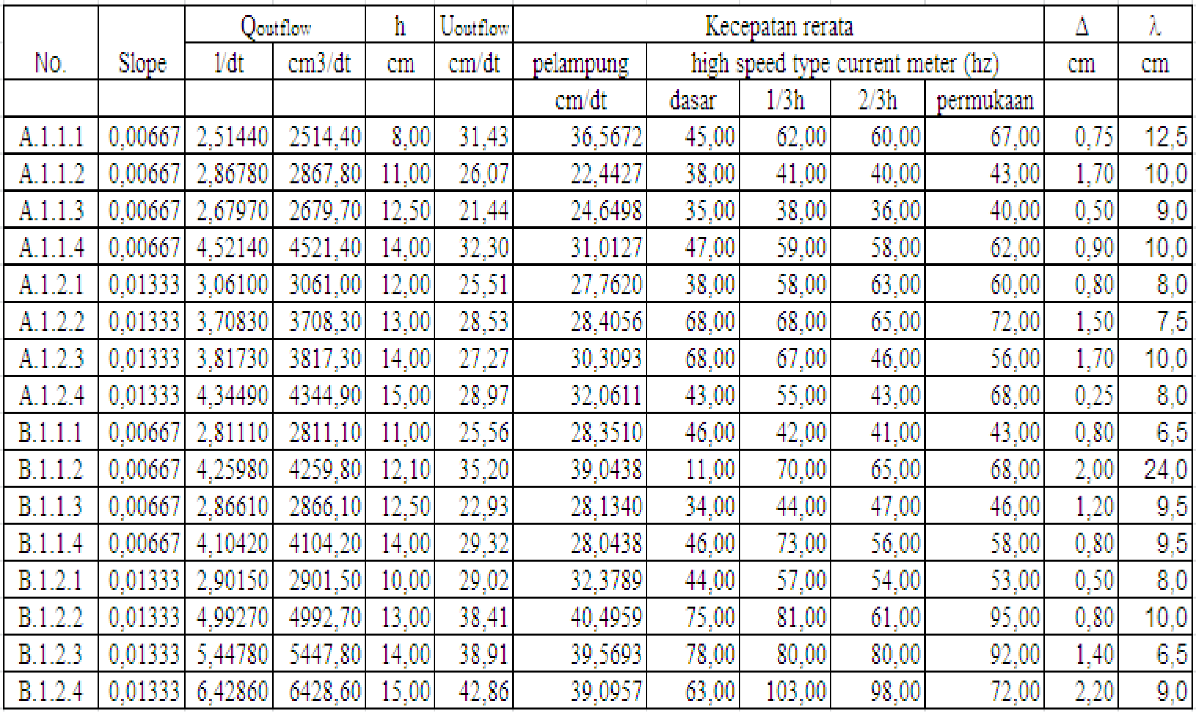
3.1. ExperimentalData analysis

The data used for the analysis of experimental results of Choo et al. (2011) and Greco et al. (2014) as in Table (2).

Table 3 Results of Linear Regression Analysis between U_{rerata} and U_{max}

Data Source	**Data**	**Relationship Equation**	**Φ (M)**	**R^2**
Laboratory	Abdel=Ael,F.M(1969)	$U_{mean} = 0{,}8657\ U_{max}$	0,8657	0,9998
	Govt. of W. Bengal(1965)	$U_{mean} = 0{,}8197\ U_{max}$	0,8197	0,9987
	Chyn, S.D(1935)	$U_{mean} = 0{,}8521\ U_{max}$	0,8521	0,9998
	Costello, W.R.(1974)	$U_{mean} = 0{,}8667\ U_{max}$	0,8667	0,9998
	Greco el al. (2014)	$U_{mean} = 0{,}7314\ U_{max}$	0,7300	0,8840
River	Mahmood, et al. (1979)	$U_{mean} = 0{,}911\ U_{max}$	0,9110	0,999
	Shinohara, & Tsubaki, (1959)	$U_{mean} = 0{,}882\ U_{max}$	0,8820	0,992
	Leopold, L.B.(1969)	$U_{mean} = 0{,}914\ U_{max}$	0,9140	0,999
	Greco el al. (2014)	$U_{mean} = 0{,}702\ U_{max}$	0,7060	0,8957

Table 4Results of Laboratory Experiments.



		Qoutflow		h	Uoutflow	Kecepatan rerata					Δ	λ
No.	Slope	l/dt	cm3/dt	cm	cm/dt	pelampung	high speed type current meter (hz)				cm	cm
						cm/dt	dasar	1/3h	2/3h	permukaan		
A.1.1.1	0,00667	2,51440	2514,40	8,00	31,43	36,5672	45,00	62,00	60,00	67,00	0,75	12,5
A.1.1.2	0,00667	2,86780	2867,80	11,00	26,07	22,4427	38,00	41,00	40,00	43,00	1,70	10,0
A.1.1.3	0,00667	2,67970	2679,70	12,50	21,44	24,6498	35,00	38,00	36,00	40,00	0,50	9,0
A.1.1.4	0,00667	4,52140	4521,40	14,00	32,30	31,0127	47,00	59,00	58,00	62,00	0,90	10,0
A.1.2.1	0,01333	3,06100	3061,00	12,00	25,51	27,7620	38,00	58,00	63,00	60,00	0,80	8,0
A.1.2.2	0,01333	3,70830	3708,30	13,00	28,53	28,4056	68,00	68,00	65,00	72,00	1,50	7,5
A.1.2.3	0,01333	3,81730	3817,30	14,00	27,27	30,3093	68,00	67,00	46,00	56,00	1,70	10,0
A.1.2.4	0,01333	4,34490	4344,90	15,00	28,97	32,0611	43,00	55,00	43,00	68,00	0,25	8,0
B.1.1.1	0,00667	2,81110	2811,10	11,00	25,56	28,3510	46,00	42,00	41,00	43,00	0,80	6,5
B.1.1.2	0,00667	4,25980	4259,80	12,10	35,20	39,0438	11,00	70,00	65,00	68,00	2,00	24,0
B.1.1.3	0,00667	2,86610	2866,10	12,50	22,93	28,1340	34,00	44,00	47,00	46,00	1,20	9,5
B.1.1.4	0,00667	4,10420	4104,20	14,00	29,32	28,0438	46,00	73,00	56,00	58,00	0,80	9,5
B.1.2.1	0,01333	2,90150	2901,50	10,00	29,02	32,3789	44,00	57,00	54,00	53,00	0,50	8,0
B.1.2.2	0,01333	4,99270	4992,70	13,00	38,41	40,4959	75,00	81,00	61,00	95,00	0,80	10,0
B.1.2.3	0,01333	5,44780	5447,80	14,00	38,91	39,5693	78,00	80,00	80,00	92,00	1,40	6,5
B.1.2.4	0,01333	6,42860	6428,60	15,00	42,86	39,0957	63,00	103,00	98,00	72,00	2,20	9,0

Table 5 Results of Calculation Manning with the Bedform

Q (l/dt)	h(m)	R(m)	u1(m/dt)	Slope	Fr	u*	u/u*	d_{50}	n	n_p
2,51440	0,08	0,26	0,314	0,007	0,355	0,072	5,055	0,001	0,0196	0,0166
2,86780	0,11	0,32	0,261	0,007	0,251	0,085	2,646	0,001	0,0367	0,0166
2,67970	0,13	0,35	0,214	0,007	0,194	0,090	2,726	0,001	0,0354	0,0166
4,52140	0,14	0,38	0,323	0,007	0,276	0,096	3,241	0,001	0,0298	0,0166
3,06100	0,12	0,34	0,253	0,013	0,232	0,126	2,207	0,001	0,0438	0,0166
3,70830	0,13	0,36	0,285	0,013	0,253	0,130	2,178	0,001	0,0443	0,0166
3,81730	0,14	0,38	0,273	0,013	0,233	0,135	2,240	0,001	0,0431	0,0166
4,34490	0,15	0,40	0,290	0,013	0,239	0,140	2,289	0,001	0,0421	0,0166
2,81110	0,11	0,32	0,256	0,007	0,246	0,085	3,343	0,000	0,0290	0,0152
4,25980	0,12	0,34	0,352	0,007	0,323	0,089	4,389	0,000	0,0175	0,0152
2,86610	0,13	0,35	0,229	0,007	0,207	0,090	3,112	0,000	0,0311	0,0152
4,10420	0,14	0,38	0,293	0,007	0,250	0,096	2,931	0,000	0,0329	0,0152
2,90150	0,10	0,30	0,290	0,013	0,293	0,114	2,831	0,000	0,0344	0,0152
4,99270	0,13	0,36	0,381	0,013	0,336	0,131	3,094	0,000	0,0312	0,0152
5,44780	0,14	0,38	0,389	0,013	0,332	0,135	2,924	0,000	0,0330	0,0152
6,42860	0,15	0,40	0,429	0,013	0,353	0,140	2,791	0,000	0,0345	0,0152

n = Manning roughness values calculate; n_p = Manning roughness values with bedform

n with parameter estimation results can be seen in the graph entropy

3.2Comparison with Experimental Data

Calculate the prediction accuracy by using the average normal faults (MNE) as Equation (15)

Table 6. Function Error on the Value of n Manning

n ent M(Φ)=0,866	n	n bed	error Function		n ent M(Φ)=0,820	error Function		n ent M(Φ)=0,852	error Function	
0,021	0,0196	0,0166	0,094	0,154	0,023	0,155	0,154	0,022	0,111	0,154
0,040	0,0367	0,0166	0,085	0,548	0,042	0,146	0,548	0,040	0,102	0,548
0,038	0,0354	0,0166	0,074	0,533	0,040	0,134	0,533	0,039	0,091	0,533
0,031	0,0298	0,0166	0,036	0,444	0,033	0,094	0,444	0,031	0,052	0,444
0,056	0,0438	0,0166	0,272	0,622	0,059	0,344	0,622	0,057	0,293	0,622
0,050	0,0443	0,0166	0,124	0,626	0,053	0,188	0,626	0,051	0,142	0,626
0,055	0,0431	0,0166	0,281	0,616	0,058	0,353	0,616	0,056	0,301	0,616
0,053	0,0421	0,0166	0,262	0,607	0,056	0,333	0,607	0,054	0,282	0,607
0,034	0,0290	0,0152	0,173	0,477	0,036	0,239	0,477	0,035	0,192	0,477
0,025	0,0175	0,0152	0,408	0,135	0,026	0,487	0,135	0,025	0,431	0,135
0,042	0,0311	0,0152	0,338	0,511	0,044	0,413	0,511	0,042	0,360	0,511
0,033	0,0329	0,0152	0,000	0,539	0,035	0,057	0,539	0,033	0,016	0,539
0,042	0,0344	0,0152	0,224	0,559	0,045	0,293	0,559	0,043	0,244	0,559
0,035	0,0312	0,0152	0,125	0,514	0,037	0,188	0,514	0,036	0,143	0,514
0,035	0,0330	0,0152	0,076	0,540	0,037	0,136	0,540	0,036	0,093	0,540
0,033	0,0345	0,0152	0,049	0,561	0,035	0,005	0,561	0,033	-0,034	0,561

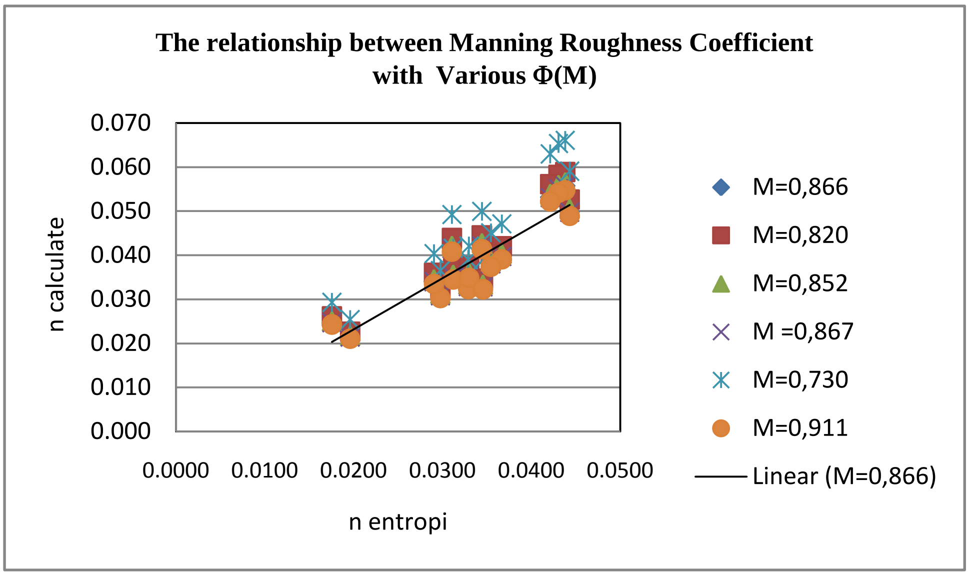


Figure 3. Relationship Between Manning Coefficient between nCalculation and n Entropy

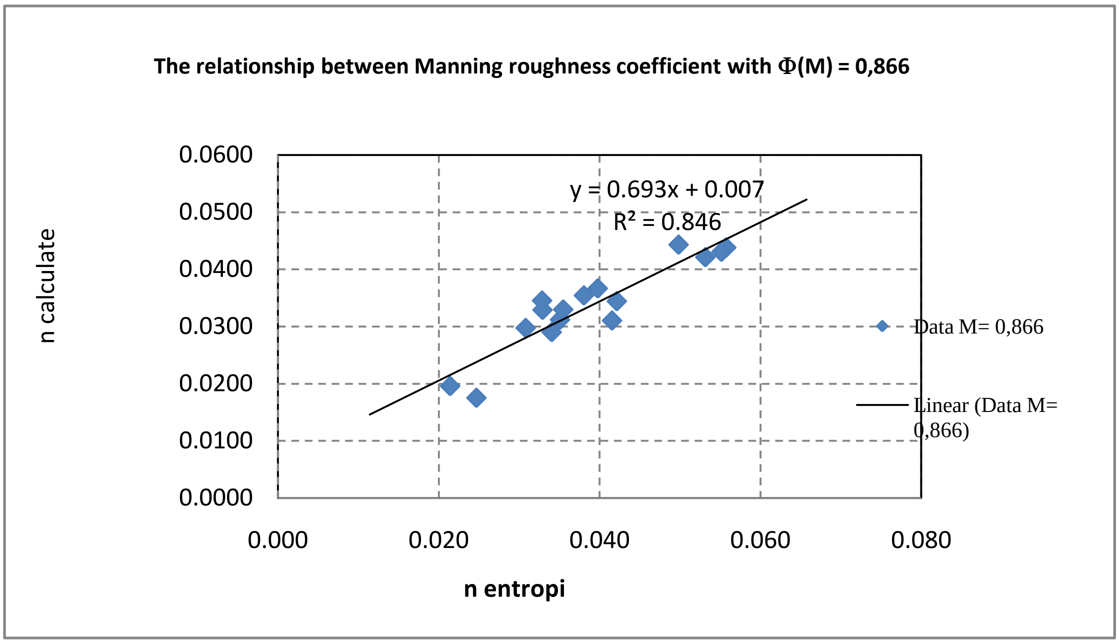


Figure 4. Linear Relationship between the Manning coefficient n entropy and n calculate

The next calculations carried Tabelaris

Table 7The Results of Calculations with DifferentValuesΦ (M)

Data Source	Data	Relationship Equation *n*	Φ (M)	R^2
Laboratory	Abdel=Ael,F.M(1969)	$n_{hitung} = 0,693 n_{etr} + 0,007$	0,8657	0,846
	Govt. of W. Bengal (1965)	$n_{hitung} = 0,5803 n_{etr} + 0,010$	0,8197	0,864
	Chyn, S.D(1935)	$n_{hitung} = 0,682\ n_{etr} + 0,007$	0,8521	0,846
	Costello, W.R.(1974)	$n_{hitung} = 0,694\ n_{etr} + 0,007$	0,8667	0,846
	Greco el al. (2014)	$n_{hitung} = 0,584\ n_{etr} + 0,006$	0,7300	0,846
River	Mahmood, et al. (1979)	$n_{hitung} = 0,729\ n_{etr} + 0,0067$	0,9110	0,846
	Shinohara&Tsubaki(1959)	$n_{hitung} = 0,7058\ n_{etr} + 0,0067$	0,8820	0,846
	Leopold, L.B.(1969)	$n_{hitung} = 0,754\ n_{etr} + 0,006$	0,9140	0,877
	Greco el al. (2014)	$n_{hitung} = 0,5649\ n_{etr} + 0,0067$	0,7060	0,846

Source Data : Results Calculate

The results are plotted in Table (7) and Figure (3) and (4) and showed a good acceptance pda good roughness coefficient of using entropy as well as with the bedform. Relationships between variables in both methods showed a good correlation with the variation of entropy parameters Φ (M) = 0,706 to 0,911 for the natural river that gives the correlation value of R^2 = 0.846 to 0.877. While in the laboratory flume entropy parameter value Φ (M) = 0,730 to 0,867; with a correlation value of R^2 = 0,846 to 0,864.

Therefore, at low depth or low regime, the use of Eq. (10) together with the assumption verified y_{max} in ¾ h from the bottom of the channel, will provide a better assessment and faster than the Manning roughness against perhitung on Moramarco and Singh (2010) with a constant value at y_0, and the observed values of y_{max}, it will be difficult to be evaluated in field measurements. Furthermore, important to be underlined that is how, with a regime of low or shallow depth, giving effect to the parameter M on geometric and hydraulic characteristics of the flow, and provide valid results through analysis performed on the experimental data presented here.

IV. Conclusion

- Effect of resistance form can not be ignored, meaning that large more and more roughness value relative basis, the value of the Manning roughness coefficient (n) small more and more thus obtained a large flow rate
- Application entropic on the velocity profile to the river, can be used in evaluating the flow rate, reducing the time and trouble in the fluvial control and monitoring activities.
- In addition, the formulation of n Manning roughness, which is based on entropy parameter (M), and the ratio between the position where the velocity is zero and the maximum velocity, y_0/y_{max} , which could be useful to overcome the uncertainty in the evaluation of the resistance parameters, especially the existence of roughness relatively large.
- The value ko = 0.003 ks will result roughness coefficient values were close to the results on the basis of materiality sand.
- The analysis shows how y_0/y_{max} dependence on bed roughness value h/yo in promoting the Manning roughness n, through the formulation proposed by Moramarco Singh (2010) and modified by considering ymax for ¾ of water depth (h). The results of that impose on the relationship between entropy and the parameters of hydraulic and geometric characteristics of the flow.
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