Journal of Architecture and Construction
Volume 1, Issue 1, 2018, PP 21-35

Study the Process of Variation of Resistance Coefficients in Non-Uniform Flows

Kaveh Ostad-Ali-Askari[1*], Saeid Eslamian[2], Vijay P. Singh[5], Nicolas R. Dalezios[6], Ali Hasantabar-Amiri[7], Alexander H.-D. Cheng[9], Shayan Shafei[1], Ali Reza Babaei Baghbaderani[1]

[1]Department of Civil Engineering, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran.*
[2]Department of Water Engineering, Isfahan University of Technology, Isfahan, Iran.
[5]Department of Biological and Agronomical Engineering &Zachry Department of Civil Engineering, Texas A and M University, 321 Scoates Hall, 2117 TAMU, College Station, Texas 77843-2117, U.S.A.
[6]Laboratory of Hydrology, Department of Civil Engineering, University of Thessaly, Volos, Greece & Department of Natural Resources Development and Agronomical Engineering, Agronomical University of Athens, Athens, Greece.
[7]Department of Civil Engineering, Lenjan Branch, Islamic Azad University, Lenjan, Isfahan, Iran.
[9]Department of Civil Engineering, University of Mississippi , United States.

***Corresponding Author:** Dr. KavehOstad-Ali-Askari, Department of Civil Engineering, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran. Emails: Koa.askari@khuisf.ac.ir , Kaveh.oaa2000@gmail.com*

ABSTRACT

The actual fluid flow in the waterways is in contrast to the ideal fluid flow with the creation of shear stresses and on the one hand the amount of these stresses depends on the physical properties of the fluid and the flow behavior and on the other hand depends on the physical characteristics of the waterway, So, these characteristics affect the environmental resistance against the fluid passing through the environment. The exact measurement of the frictional force of the source of the shear stresses is not feasible, and this has led to many investigators to approximate estimate the resistance level. As a result, investigations were applied to optimize the coefficients in transactions governing the flow of open and close channels. Although the experiments showed that the use of uniform flow resistance coefficients for non-uniform flows are usable, But they all confirmed the necessity of modulating the coefficients for non-uniform flows and here, assuming that the being non-uniform in the passing flow on smooth surfaces or interstitial surfaces is hydraulically the formation and growth of the boundary layer, It was attempted to investigate the probable deviation of the manning resistance coefficient in non-uniform flows relative to their amount in uniform flows and The result of the research showed that the resistance coefficients in non-uniform flows were less than uniform flows and the necessity of correction of the resistance coefficients in culverts and dewatering channels.

Keywords: *Boundary Layer, Resistance Coefficient, Manning Coefficient, Non-Uniform Flow*

INTRODUCTION

The purpose of this study is to investigate the effect of boundary layer growth on the amount of passing discharge from box culverts and rectangular and trapezoidal channels and to calculate the process of variation of resistance coefficients against non-uniform flow and compare it with the coefficients provided for uniform flows.

One of the main factors causing non- uniform flow in the waterways is the formation and growth of the boundary layer in the vicinity of the solid surface. First of all, we should consider the boundary layer theory and relations presented in this field, and then we use the relations in studying the behavior of flow.

The presentation of the boundary layer theory by Prof. Prandtl in 1904 can be regarded as the beginning of the dramatic changes in the field of fluid mechanics, Since the actual fluid is viscous, a layer of this fluid adheres to the solid surface and, as a result of the collision of moving fluid particles with fluid particles sticking to the surface decrease their velocity, and, finally, these changes in velocity is adjacent to the surface of the velocity gradient in the direction of perpendicular to the axis of flow, this gradient starts from the adjacent solid surface at zero speed and continues to reach the maximum velocity. Gradient height refers as the velocity of the thickness of the boundary layer. So, the thickness of the boundary layer is the distance from the solid surface to the point at which the fluid particles have maximum velocity. Within the boundary layer, shear stresses are tangible and cannot be ignored, it is clear that due to the formation of a velocity gradient in this layer, shear stresses are formed and the drag force acting on the surfaces also results from the formation of the boundary layer on them, it can be supposed ideal fluid with high precision outside of this layer. Inside the boundary layer, the flow can be laminar, interstitial, and turbulent, that the type of flow is a function of the point Reynolds, and depending on the flow of inside of the boundary layer, different relationships exist to estimate the thickness of this layer and the amount of stress, and consequently the amount of drag force.

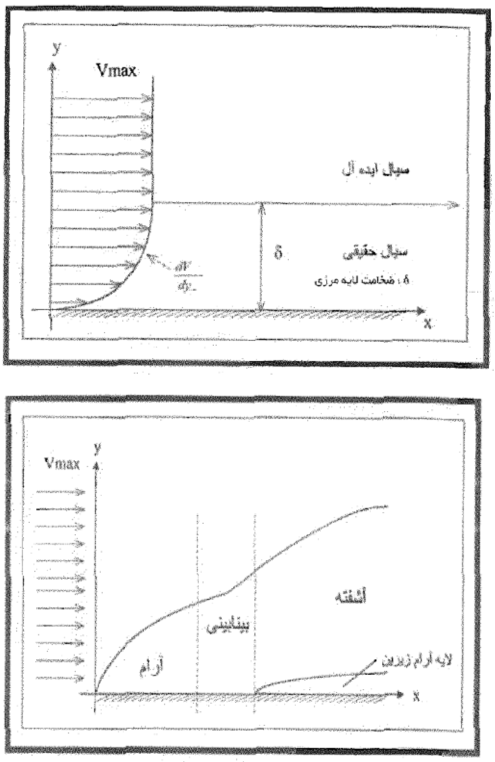

Figure1(A, B). *Boundary Layers formed on the floor of channel*

In the open channels, the stages of the formation of the boundary layer are as follows, and the following figures 1 indicate the boundary layers formed on the floor of channel from the dewatering site to downstream, and for the walls of the channel, the same boundary layers can be drawn that In the case of a wide channel, the boundary layers formed on the walls will have little effect on the velocity and passing discharge diagrams.

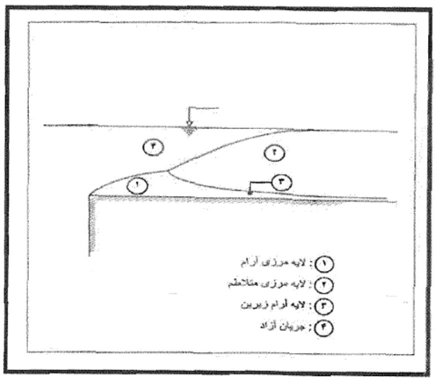

Figure2. *The Relationship between the Reynolds Number*

Transition in the boundary layer from the laminar flow to the turbulent flow depends to many factors that most important of them are the point Reynolds number (in the investigated site), the amount of turbulent flow outside the boundary layer and the amount of roughness of solid surface. Of course, the phenomenon of the transition is an intermittent process and it begins with the occurrence of minor disturbances, and this continues until the flow is completely collapsed and the motion of particles gets irregular and random. The figure 2 below shows the relationship between the Reynolds number and $\frac{\delta}{\sqrt{\frac{\nu . x}{V_{max}}}}$ hat adjust by Hansen. It can be seen that the numbers are less than 3.2×10^{5}, the gradient of the graph is constant and from this point a sudden change in gradient is caused. To illustrate the effect of turbulent flow, we define the percentage of it.

Percentage of being turbulent is the average time ratio of the amount of velocity component at a given point to the average time velocity at that point. The effect of the turbulent flow is also illustrated by subarea and Scrum Stats research's. In the region between the two curves, the flow may be laminar or turbulent at any given moment. Due to the many factors involved in the transmission phenomenon, one can not specify a particular Reynolds number as the boundary of flow transformation from laminar to turbulent. The roughness of the surface causes the transition from a laminar flow into the turbulent, and even heating the environment or solid surface also accelerates the transition. However, the range of the Reynolds number in the transitional area varies in different sources and according to the most reliable sources, number 500,000 is known as the beginning of the transitional period or the end of the laminar region and the number 600,000 is known as the end of the transitional period or the beginning of the turbulent region.

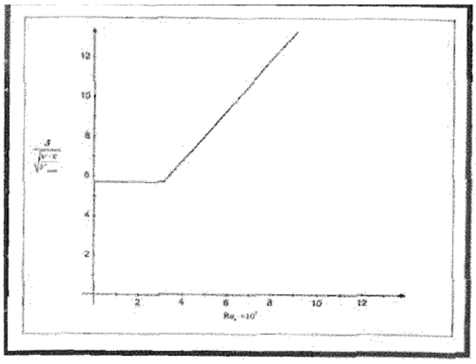

Figure3. *The Relationship between the Reynolds Number and delta*

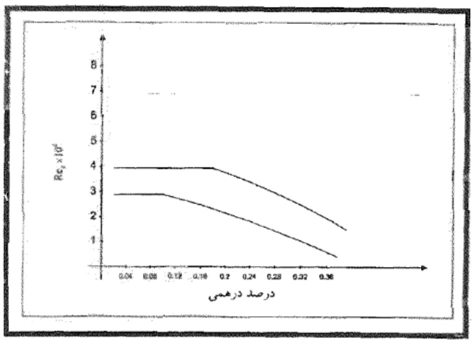

Figure4. *The Relationship between the Reynolds Number and Turbulent Percentage*

If $Re_x \leq 5\times10^5 \rightarrow$ the boundary layer is laminar $\rightarrow$

$$\delta = \frac{5\chi}{Re_x^{0.5}}$$

If $Re_x \geq 6\times10^5 \rightarrow$ the boundary layer is turbulent $\rightarrow$

$$\delta = \frac{0.37\chi}{Re_x^{0.2}}$$

Often, the interstices are ignored because of their short length, but in long channels, the entire boundary layer can be considered as turbulent, because the length of the laminar area will be negligible against the length of the turbulent area.

In addition to the 3 main areas mentioned, we should refer to another region, and it is a laminar underlying layer formed under a turbulent boundary layer and the flow is laminar. The thickness of this layer is a criterion for determining the roughness and fineness of a surface hydraulically that the comparison criterion is as follows:

Smooth surface

$$if \quad \delta' > 3\,k_s$$

Interstitial surface

$$if \quad 0.12\,k_s \leq \delta' \leq 3\,k_s$$

Rough surface

$$if \quad \delta' < 0.12\,k_s$$

In the above relations, k_s the height of roughness of surface and δ' the thickness of the lower layer is obtained from the following equation.

$$\delta = \frac{11.6\,\nu}{U_*}$$

The velocity distribution in the turbulent area consists of 4 parts. The linear distribution of the velocity in the lower laminar layer, the uncertain distribution of the velocity in the buffer zone, the logarithmic distribution, and finally the exponential distribution, which accounts for 80% of the total thickness of boundary layer, therefore it can be approximately known that the distribution of velocity in the entire turbulent area is exponential and the general relation of velocity distribution in this region is as follows:

$$\frac{V}{V_{max}} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

All relations presented in the context of the boundary layer are based on the assumption of non-slipping flow on the surface.

First, we study the limiting states of the flow, and then expand the discussion for the open channels, since a closed section can geometrically act both in open and closed manner, from a hydrodynamic point of view, it is clear that the relations governing the open flow behavior are the same relations that govern the closed flow behavior that takes a different form, and this change in form is due to the difference in existing conditions in two open and close modes.

The above limit modes are the boundary of the flow transform from close to open as described below.

We assume that the passing water level of culvert is free and is exposed to the atmospheric pressure, or, in other words, the culvert has an open function, and from now it is called mode 1.

The flow is approximately covered by the entire culvert section, and we know that the gradient and the maximum allowed velocity in ordinary culverts are negligible, and we can show the input velocity to the channel in the opening of the input that has the uniform distribution with V_{max}, below figure represents the mode one:

We now consider a mode in which the flow completely fills the channel, but the upper surface of the water runs parallel to the upper edge of the culvert, or, in other words, the water does not hold on the upper lip, which makes it possible know pressure at passing flow levels is same as atmospheric pressure.

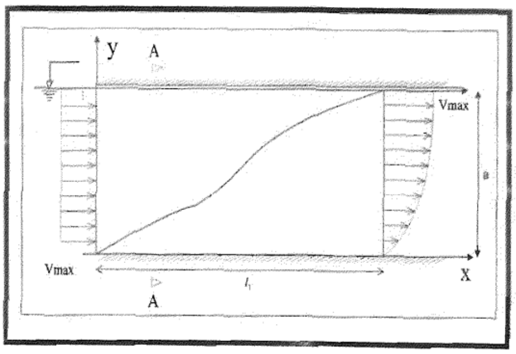

Figure5. *The Water Surface Profile Slope*

The current mode is called the mode two, the following figure shows the mode two: Practically, the probability of occurrence of each of the two above-mentioned modes is low but it can study from the theoretical point of view, these two modes occur when the water surface profile slope in the mirage is equal to the slope of the culvert.

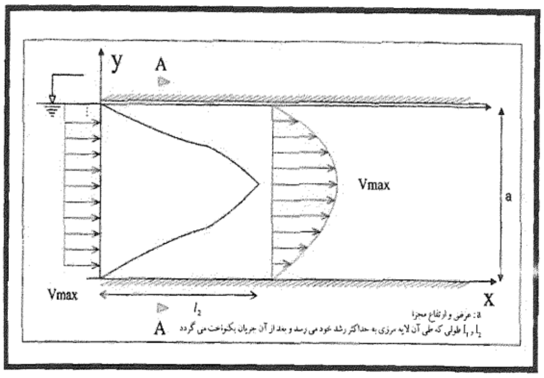

Figure6. *The Water Surface Profile Slope*

Culvert is box type (a*a) with length of L. The surface of the culvert body hydraulically is smoother interstitial, which is assumed to be true for metal culverts and even concrete culverts. The growth rate of the boundary layer formed on the horizontal and vertical surfaces at each section of culvert is equal and the symmetry is maintained, and the length of L is such that the boundary layers can reach their maximum growth ($L> l_2$, $L>l_1$).

As seen in the figure of mode one, the boundary layer begins to grow from the beginning of the culvert (the floor surface of and the walls), and after passing through the laminar and interstitial areas, it enters the turbulent area and to the end of the channel this behavior of the flow is dominant. The turbulent boundary layer can grow to the surface of the water, so the maximum thickness of the boundary layer is equal to **a**, and the maximum thickness of the boundary layer formed on the walls is equal to a/2.

Because of the durability of the channel, the length of the laminar and transitional boundary layer against turbulent boundary layer is tangible and is usually neglected in the calculations of the laminar and transitional regions, and it is assumed that the turbulent boundary layer has been formed and grown from the very beginning of the culvert that by assuming that the computational drag force is slightly greater than the actual value and there are correlations to correct the Drag coefficient that is not mentioned.

In the mode two, the boundary layer is formed from the beginning of the culvert (the floor surface, the ceiling and the walls) and after passing the laminar and transitional regions reach to the turbulent area that extends to the end of the channel, in this mode the maximum thickness of The boundary layer formed on four faces equals to a/2. In the mode two, as in mode one, one of laminar or transitional regions are neglected due to their negligible length in front of the turbulent area, so the growth of the boundary layer begins from the beginning with the turbulence of the layer.

After the boundary layer reaches its maximum growth, after the length of l1 in the first mode and after the length of l2 in the second mode, the flow becomes uniform and the flow conditions are completely stabilized and no change in the flow behavior is observed and the velocity distribution curves is displayed in both modes.

The velocity distribution in both two modes is two-arc and undergoes changes in two directions, so if the direction of flow, v, x is the velocity of the point in progress (u=w=0 other components are zero-speed), in this mode dv/dz and dv/dy is not zero.

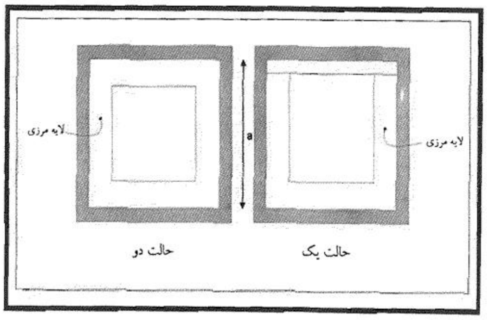

Figure7. *The Turbulent Boundary Layer*

$$\frac{dV}{dy} \neq 0 \qquad \frac{dV}{dz} \neq 0$$

As stated above, in the bulk of the thickness of the turbulent boundary layer, the velocity distribution is exponential, and it is generally assumed that the velocity distribution totally is exponential thickness, so the equation governing on the process of point velocity changes is as follows:

$$\frac{V}{V_{max}} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

In this equation

Y: distance from solid surface

δ: thickness of boundary layer in the given point

V: point velocity

V_{max}: maximum possible velocity

We know that the thickness of the turbulent boundary layer is, according to the recommendation of the Bellasius, obtained from the following relation:

$$\delta = \left\{\frac{0.37\,x}{Re_x^{\left(\frac{1}{5}\right)}}\right\}$$

In this equation

δ: thickness of turbulent boundary layer

x: distance of given location from the beginning of the channel

Re_x: point Reynolds number

Now, lengths of the l2, l1 that were previously introduced are simply computable, and at the ordinary temperature for water the relations for water present on the next page.

The following relationships can be used to find l_1, l_2, in which these relations there are two unknown l_1 (or l_2), and an in view of the exponentially of the above equations, it is not easy to determine relations in terms of l_1 (or l_2) and a, but if we consider the degree of significance of the terms of the above relations or the sensitivity of the above equations by changing their variables, we find that the term V_{max} versus l_1 (or l_2) and a, is less important.

$$a = \frac{0.37\,l_1}{(Re_{l_1})^{1/5}} = \frac{0.37\,l_1}{\left(\frac{V_{max} \times l_1}{\nu}\right)^{1/5}} = 0.023\,\frac{l_1^{4/5}}{V_{max}^{1/5}}$$

$$l_1^{4/5} = \frac{a.V_{max}^{1/5}}{0.023} \quad \Rightarrow \quad l_1 = 111.64\;a^{5/4}.V_{max}^{1/4}$$

$$\frac{a}{2} = \frac{0.37\,l_2}{(Re_{l_2})^{1/5}} = \frac{0.37\,l_2}{\left(\frac{V_{max} \times l_2}{\nu}\right)^{1/5}} = 0.023\,\frac{l_2^{4/5}}{V_{max}^{1/5}}$$

$$l_2^{4/5} = \frac{a.V_{max}^{1/5}}{2 \times 0.023} \quad \Rightarrow \quad l_2 = 46.94\;a^{5/4}.V_{max}^{1/4}$$

We know that the maximum velocity allowed in ordinary culverts is from 1.5 to 2.5 m / s, due to the fact that they are prevented from scouring down the culvert and sometimes there are culverts with a high slope and velocity that at the bottom of them De-energizing structures are used, which are not at all reasonable and cost-effective.

Given the fact that in discharge, there is control plane for the maximum flow velocity, we can consider the expression V_{max} equal to one in the range of the above velocity. To be more applicable, the existing coefficient relationships are moderated to some extent, and eventually we will have:

$$l_1 = 133\,a^{5/4}$$

$$l_2 = 56\,a^{5/4}$$

The above relations represent the exponential relationship of l_1 (or l_2) and a, and with the presence of a, we can obtain the numerical value of l_2, l_1. In addition, the above equations can be used in addition to the box culverts for pipe culverts (a=D) and rectangular and trapezoidal channels.

If we divide the obtained relations, the ratio of l_1 to l_2 will be greater than 2, which is due to the exponential of the initial relations and may seem a bit far from the logic, which indicates a low growth rate of the boundary layer in a mode 1 to mode 2, so that the boundary layer formed in mode 1 is more smooth and with less slope than the base level, and therefore the thickness of displacement that will calculate in the future will have a lower growth rate (lower slope) than mode 2.

$L_1/l_2=2,38$

From the above ratio, it can be concluded that the resistance of the channel one to the flow is much less than that of the second channel. We know that moving fluid particles on a straight line can only have tangential acceleration. Now, we imagine that consuming the energy (which is generated by the boundary layer) will bend the previous flow line, in the current situation, fluid particles are affected by inertia in addition to tangential acceleration, centric acceleration or normal acceleration over the flow line, although the new tangential acceleration is not necessarily equal to the previous tangential acceleration. Therefore, the vertical acceleration and its amount are affected by the resistance to flow and the presence of vertical acceleration can be considered as the main factor in the change of pressure. But if we compare the above-mentioned conditions with modes 1 and 2, then we find that, according to the definition of the limiting state, the distribution of pressure is hydrostatic in both modes, so the above conditions appear in another way, and it is increasing in overall losses and consequently dropping the passage discharge.

Here we briefly discuss the thickness of the displacement and the resulting relations.

If the passing fluid is through the culvert of ideal fluid, and we want the mass discharge passing through the culvert in these conditions would be equal to the state of the actual fluid flow in the culvert, then the culvert cross section could be reduced and the displacement level of each of the surfaces(Vertical and horizontal surfaces) to the initial location of that surface, is called thickness of the displacement, and display it with δ_*, so this thickness is not physically existence and is completely hypothetical, and its mathematical interpretation is as follows.

$$\delta_* = \int_0^{\delta}\left(1-\frac{V}{V_{max}}\right)dy$$

V expresses the point velocity from the solid surface to height δ, and d_y represents the integral direction in the height of the culvert, and is, as a rule, converted to the d_z for vertical surfaces.

In the laminar boundary layer, the proposed velocity distribution is usually used by Prenatal:

$$\frac{V}{V_{max}} = \frac{3}{2}\left(\frac{y}{\delta}\right)-\frac{1}{2}\left(\frac{y}{\delta}\right)^3$$

And in the turbulent boundary layer, the exponential velocity distribution that mentioned before, has been used, which, if inserted in the equation δ_*, eventually results in the amount of displacement thickness for a laminar and turbulent boundary layer.

laminar boundary layer

$$\delta_* = 0.375\delta$$

Turbulent boundary layer

$$\delta_* = 0.125\delta$$

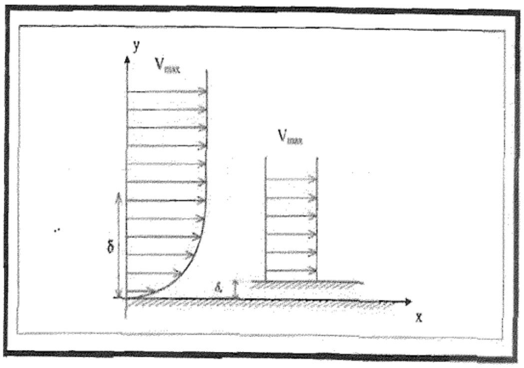

Figure8. *Turbulent Boundary Layer*

We obtain the displacement thickness as a function of L, it should be noted that the thickness of the displacement for the vertical and horizontal surfaces is considered to be the same and is accordance with fact and the most important factor that causes the growth rate of the boundary layer to vertical surfaces would less than horizontal surfaces is the weight of passing fluid.

$$\delta_* = 0.0025\,L^{4/5}$$

This relation was obtained with previous assumptions and given the low importance of velocity term (at low velocity), where L is the initial distance of the channel to the point under consideration (here it is the total length of the culvert).

The passing discharge has a direct linear relationship with the cross-sectional area of the channel. According to the concept of displacement thickness, we can find the effective cross-section in the first and second modes, which we have for mode one:

$$L < l_2 \Rightarrow A_I = a^2 - 0.0075\, a\, L^{4/5}$$

$$l_2 < L < l_1 \Rightarrow A_I = 0.875\, a^2 - 0.0025\, a\, L^{4/5}$$

$$L > l_1 \Rightarrow A_I = 0.75\, a^2$$

And in mode 2, effective cross-section is:

$$L < l_2 \Rightarrow A_{II} = a^2 - 0.01\, a\, L^{4/5}$$

$$L > l_2 \Rightarrow A_{II} = 0.75\, a^2$$

As we can see, the above equations are simple functions of an and L, and with the involvement an and L, an effective cross section A_I and A_{II} can be calculated and compared with a_2 that is the total cross section. Finally, the actual discharge is obtained from the product of the maximum discharge in the ratio of effective cross-sectional area to the total cross-sectional area.

$$Q_{real} = \left(a^2 \times V_{\max}\right) \cdot \left(\frac{A_I}{a^2}\ or\ \frac{A_{II}}{a^2}\ or\ \frac{A_{III}}{a^2}\right)$$

In order to extend the subject to other probable conditions, we present relationships as A_{III} that are true for y<a (y flow depths to the floor of channel) and A_I is also a special case of general relationships of A_{III}. Of course, there are six distinct relationships for A_{III} that here we can refer to them as two main equations:

$$L < l_1\ ,\ L < l_2 \Rightarrow A_{III} = a.y - 0.0025a\, L^{4/5} - 0.005y\, L^{4/5}$$

$$L > l_1\ ,\ L > l_2 \Rightarrow A_{III} = a.y - 0.0025a\, l_1^{4/5} - 0.005y\, l_2^{4/5}$$

Four other relationships can also be used for interstitial modes and when $l_1 > l_2$ and or $l_2 > l_1$. With respect to A_I and A_{II}, the graphs are given which represent the trend of changes in the effective surface of the flow relative to the changes in the growth of the boundary layer along the path, and finally, the drawn curves are analyzed.

According to the drown graphs, it can be concluded that the process of variation of the flow resistance coefficients against flow follow of such graphs. In other words, the amount of these coefficients assumed to be constant in a uniform and non-uniform flow is changed in a non-uniform flow mode and is not fixed, typically, for these coefficients, the table is based on the material of the channels, which is used for uniform and non-uniform flows. In recent years, there have been numerous measures to calculate the trend of these numbers variations for non-uniform flow, and we know that discharge calculate from flow Sheri or Manning relations strongly depend on the amount of resistance coefficients and the exact determination of the numerical value is very important, according to previous graphs we can mention following equation for y<a:

$$n = \frac{\left(1 - \frac{\delta}{8y}\right) R_h^{2/3} . S_f^{1/2}}{(1-k).V}$$

δ: thickness of boundary layer at given point

V: average velocity of flow at given section

K: the ratio of effective cross-section to total cross- section

S_f: frictional slope

R_h: hydraulic radius

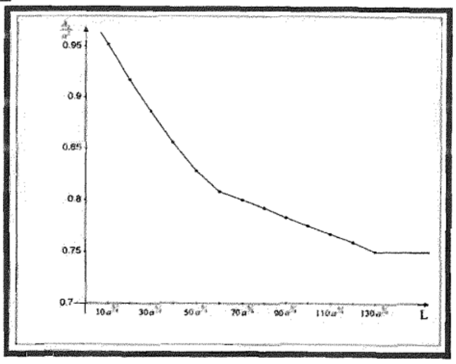

Figure8. *The Flow Resistance Coefficients against flow*

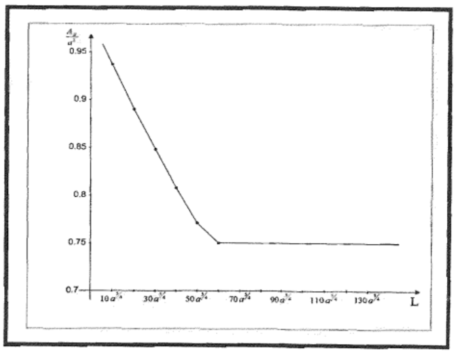

Figure9. *Ratio in Non-Uniform Flows*

Conclusion and Result

The ratio $\frac{\left(1 - \frac{\delta}{8y}\right)}{(1-k)}$ is 1 in uniform flow and is constant. If the value of this ratio in non-uniform flows varies depending on the non-uniformity of the flow between 0.88 and 1, then we conclude that n value in the non-uniform flow is less than that of the uniform mode and the rate of this decrease could be up to 12%. Of course, a careful examination of the process of changes requires extensive testing. Given the existing empirical relationships for converting the Manning coefficient to the Sheri coefficient or the Darsi-Vaisbakh coefficient, we can also study the changes in these two coefficients.

REFERENCES

[1] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Study of sensitivity of Autumnal wheat to under irrigation in Shahrekord, Shahrekord City, Iran. International Journal of Agriculture and Crop Sciences, 8 (4), 602-605.

[2] Shayannejad, M., Akbari, N., Ostad-Ali-Askari, K. 2015, Study of modifications of the river physical specifications on muskingum coefficients, through employment of genetic algorithm. International Journal of Development Research, 5(3), 3782-3785.

[3] Ostad-Ali-Askari, K., Shayannejad, M. 2015, The Reviews of Einstein's Equation of Logarithmic Distribution Platform and the Process of Changes in the Speed Range of the Karkheh River, Khuzestan province, Iran. International Journal of Development Research, 5(3), 3786-3790.

[4] Ostad-Ali-skari, K., Shayannejad, M., Ghorbanizadee-Kharazi, H. 2015, Assessment of artificial neural network performance and exponential regression in prediction of effective rainfall, International Journal of Development Research, 5(3),3791-3794.

[5] Shayannejad, M. Akbari, N. and Ostad-Ali-Askari, K. 2015, Determination of the nonlinear Muskingum model coefficients using genetic algorithm and numerical solution of the continuity. Int. J. of Science: Basic and Applied Research, 21(1),1-14.

[6] Ostad-Ali-Askari, K., Shayannejad, M. 2015, The Study of Mixture Design for Foam Bitumen and the Polymeric and Oil Materials Function in Loose Soils Consolidation. Journal of Civil Engineering Research, 5(2), 39-44. DOI: 10.5923/j.jce.20150502.04

[7] Sayedipour, M., Ostad-Ali-Askari, K., Shayannejad, M. 2015, Recovery of Run off of the Sewage Refinery, a Factor for Balancing the Isfahan-Borkhar Plain Water Table in Drought Crisis Situation in Isfahan Province-Iran. American Journal of Environmental Engineering, 5(2): 43-46. DOI: 10.5923/j.ajee.20150502.02

[8] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Developing an Optimal Design Model of Furrow Irrigation Based on the Minimum Cost and Maximum Irrigation Efficiency. International Bulletin of Water Resources & Development, 3(2), 18-23.

[9] Ostad-Ali-Askari K. Groundwater. Horoufchin publisher, First Edition, 2015. ISBN: 978-600-7419-33-5. Isfahan, Iran.

[10] Shayannejad M, Ostad-Ali-Askari K. Modeling of solute movement in groundwater. Kankash publisher. First edition, 2015. ISBN: 978-600-136-256-9. Isfahan, Iran.

[11] Shayannejad M, Ostad-Ali-Askari K. Optimization and its application in water resources management. Kankash publisher. First edition, 2015. ISBN: 978-600-136-248-4. Isfahan, Iran.

[12] Ostad-Ali-Askari K. Nitrate pollution in groundwater. Horoufchin publisher, First Edition, 2015. ISBN: 978-600-7419-23-6. Isfahan, Iran.

[13] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Presenting a Mathematical Model for Estimating the Deep Percolation Due to Irrigation. International Journal of Hydraulic Engineering, 4(1), 17-21. DOI: 10.5923/j.ijhe.20150401.03.

[14] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Usage of rock fill dams in the HEC-RAS software for the purpose of controlling floods. American Journal of Fluid Dynamics, 5(1), 23-29. DOI: 10.5923/j.ajfd.20150501.03.

[15] Ostad-Ali- Askari, K., Shayannejad, M. 2015, The effect of heterogeneity due to inappropriate tillage on water advance and recession in furrow irrigation. Journal of Agricultural Science, 7(6), 127-136.

[16] Shayannejad, M., Ostad-Ali-Askari, K. 2015, Effects of magnetized municipal effluent on some chemical properties of soil in furrow irrigation. International Journal of Agriculture and Crop Sciences, 8(3), 482-489.

[17] Ostad-Ali-Askari K, Shayannejad M, Golabchian M. Numerical methods in groundwater. Kankash publisher. First edition, 2015. ISBN: 978-600-136-276-7. Isfahan, Iran.

[18] Ostad-Ali-Askari, K., Shayannejad, M. 2015, Optimal design of pressurized irrigation laterals installed on sloping land. International Journal of Agriculture and Crop Sciences, ISSN 2227-670X. 8(5), 792-797.

[19] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, Jahangiri A.K, Shabani A.H, Environmental Hydraulics of Open Channel Flows. Kankash Publisher. First Edition, 2015. ISBN: 978-600-136-303-0.

[20] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, Navab-Pour B. 2016, Comparison of solution of Saint-Venant equations by characteristics and finite difference methods for unsteady flow analyzing in open channel. International Journal of Hydrology Science and Technology, 6(3), 9-18.

[21] Ostad-Ali-Askari K, Shayannejad M, Eslamian S, et al. 2017, Deficit Irrigation: Optimization Models. Management of Drought and Water

Scarcity. Handbook of Drought and Water Scarcity, Taylor & Francis Publisher, USA. Vol. 3. 1th Edition, pp: 373-389.

[22] Shayannejad M, Ostad-Ali-Askari K, Eslamian S, et al. 2017, Development of a new method for determination of infiltration coefficients in furrow irrigation with natural non-uniformity of slope. Sustain. Water Resour. Manag., 3(2): 163-169.

[23] Shojaei N, Shafaei-Bejestan M, Eslamian S, Marani-Barzani M, P. Singh V, Kazemi M, Ostad-Ali-Askari K. 2017, Assessment of Drainage Slope on the Manning Coarseness Coefficient in Mountain Area. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(1): 33-40.

[24] Bahmanpour H, Awhadi S, Enjili J, Eslamian S, Ostad-Ali-Askari K. 2017, Optimizing Absorbent Bentonite and Evaluation of Contaminants Removal from Petrochemical Industries Wastewater. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(2): 34-42.

[25] Shayannejad M, Eslamian S, Gandomkar A, Marani-Barzani M, Amoushahi-Khouzani M, Majidifar Z, Rajaei-Rizi F, Kazemi M, P. Singh V, Dehghan SH, Shirvani-Dastgerdi H.R, Norouzi H, Ostad-Ali-Askari K. 2017, A Proper Way to Install Trapezoidal Flumes for Measurements in Furrow Irrigation Systems. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(7): 1-5.

[26] DehghanSh, Kamaneh S.A.A., Eslamian S, Gandomkar A, Marani-Barzani M, Amoushahi-Khouzani M, Singh V.P., Ostad-Ali-Askari K. 2017, Changes in Temperature and Precipitation with the Analysis of Geomorphic Basin Chaos in Shiraz, Iran. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(2): 50-57.

[27] Eslamian S, Mirabbasi-Najafabadi R, Ostad-Ali-Askari K. Advance Engineering Statistics (Simulation and Modeling of Uncertainty and Sensitivity Analysis). Kankash Publisher. First Edition, 2017. ISBN: 978-600-136-359-7. Isfahan, Iran.

[28] Ostad-Ali-Askari K, Shayannejad M. 2016, Flood Routing in Rivers by Muskingum's Method with New Adjusted Coefficients. International Water Technology Journal, IWTJ, 6(3): 189-194.

[29] Godarzi A, Eslamian S, Ostad-Ali-Askari K. Water in Literature Aspects (Social and Cultural Aspects). Publication of Tehran Municipality. First Edition, 2016. ISBN: 978-600-439-096-5. Tehran, Iran.

[30] Ostad-Ali-Askari K, Eslamian S, Shayannejad M, et al. Groundwater Hydrodynamic. Horoufchin Publisher. First Edition, 2016. ISBN: 978-600-7419-53-3. Isfahan, Iran.

[31] Ostad-Ali-Askari K, Shayannejad M, Ghorbanizadeh-Kharazi H. 2017, Artificial Neural Network for Modeling Nitrate Pollution of Groundwater in Marginal Area of Zayandeh-rood River, Isfahan, Iran. KSCE Journal of Civil Engineering, 21(1):134-140. Korean Society of Civil Engineers. DOI 10.1007/s12205-016-0572-8.

[32] Shayannejad M, Ostad-Ali-Askari K, Ramesh A, Singh V.P., Eslamian S. 2017, Wastewater and Magnetized Wastewater Effects on Soil Erosion in Furrow Irrigation. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(8): 1-14. http://dx.doi.org/10.20431/2454-6224.0308001.

[33] Shayannejad M, Soltani-Toudeshki A.R, Arab M.A, Eslamian S, Amoushahi-Khouzani M, Marani-Barzani M, Ostad-Ali-Askari K. 2017, A Simple Method for Land Grading Computations and its Comparison with Genetic Algorithm (GA) Method. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(8): 26-38.

[34] Mohieyimen P, Eslamian S, Ostad-Ali-Askari K, Soltani M. 2017,Climate Variability: Integration of Renewable Energy into Present and Future Energy Systems in Designing Residential Buildings. International journal of Rural Development, Environment and Health Research(IJREH), 1(2): 18-30.

[35] Shayannejad M, Ostad-Ali-Askari K, Eslamian S, et al. 2017, Flow Hydraulic Investigation of the Wastewater on the Soil and Magnetic Field Effects in This Field. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(3): 1-15.

[36] Shayannejad M, Eslamian S, Singh V.P., Ostad-Ali-Askari K, et al. 2017, Evaluation of Groundwater Quality for Industrial Using GIS in Mountainous Region of Isfahan Province, Koh-Payeh, Isfahan, Iran. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(3): 24-37.

[37] Eslamian S, P. Singh V, Ostad-Ali-Askari K, R. Dalezios N, Yihdego Y, et al. 2017, Assessment of Aridity Using Geographical Information System in Zayandeh-Roud Basin, Isfahan, Iran. International Journal of Mining Science (IJMS), 3(2): 49-61.

[38] Askari Z, Samadi-Boroujeni H, Fattahi-Nafchi R, Yousefi N, Eslamian S, Ostad-Ali-Askari K, P. Singh V, R. Dalezios N. 2017, Prediction Comparison of Flow Resistance in Channels with Rounded and Angular Coarse Rough Beds. American Research Journal of Civil and Structural, 3(1): 1-15.

[39] Ghane M, Alvankar S.R., Eslamian S, Amoushahi-Khouzani M, Gandomkar A, Zamani E, Marani-Barzani M, Kazemi M, Soltani M, Dehghan SH, P. Singh V, Ostad-Ali-Askari K, HaeriHamedani

M, Shirvani-Dastgerdi H.R., Zalaki-Badil N. 2017, Sensitivity Analysis of Runoff Model by SWAT to Meteorological Parameters: A Case Study of Kasillian Watershed, Mazandaran, Iran. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(10): 1-20.

[40] Shayannejad M, Abedi M.S., Eslamian S, Ostad-Ali Askari K, Gandomkar A, Cheng A, et al. 2017, The Contribution of Artificial Charging in Optimal Exploitation of Water Resources, Isfahan, Iran. International Journal of Mining Science (IJMS), 3(3): 9-20.

[41] Eslamian S, Ostad-Ali Askari K, et al. 2017, Guidelines to Optimal Design of Furrow Irrigation Based on Plants, Soil and Furrow Specifications. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(4): 20-39.

[42] Eslamian S, Gandomkar A, Khademolhoseiny A, Ostad-Ali Askari K, et al. 2017, The Study on the Geo-Morphism Related Characteristics of Shiraz Geomorphic Basin, Fars Province, Iran. International Journal of Mining Science (IJMS), 3(4): 10-23. DOI: http://dx.doi.org/10.20431/2454-9460.0304002

[43] Eslamian S, Ostad-Ali Askari K, P. Singh V, R. Dalezios N, Yihdego Y, Matouq M. 2017, A Review of Drought Indices. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(4): 48-66. DOI: http://dx.doi.org/10.20431/2454-8693.0304005.

[44] Ghasemi-Zaniani M, Eslamian S, Ostad-Ali Askari K, P. Singh V, R. 2017, Irrigation with Waste Water Treated by Constructed Wetlands. International Journal of Research Studies in Agricultural Sciences (IJRSAS), 3(11): 18-34. DOI: http://dx.doi.org/10.20431/2454-6224.0311002.

[45] Zalaki N, Zohoorian-Pordel M, Bornaa R, Neisi H, Eslamian S, Ostad-Ali-Askari K, P. Singh V, et al. 2017, Assessment of Anthropogenic Influences on the Micro-Climate of Wetland Ecosystems: The Case of Hoor-Alazim Wetland in Iran. International Journal of Mining Science (IJMS), 3(4): 34-51. DOI: http://dx.doi.org/10.20431/2454-9460.0304004.

[46] Hasheminasab S.A, Pirnazar M, Hasheminasab S.H, ZandKarimi A, Eslamian S, Ostad-Ali-Askari K, P. Singh V, R. Dalezios N. 2017, Fire Risk Potential Checking in Forests using Fire Risk Model. International Journal of Constructive Research in Civil Engineering (IJCRCE), 3(4): 67-75. DOI: http://dx.doi.org/10.20431/2454-8693.0304006.

[47] Ostad-Ali-Askari K, Eslamian S, Namadi A, Ghane M, Gandomkar A, DehghanSh, Etebarian M.R, P. Singh V, R. Dalezios N. 2017, Reinforcing Liquefied Weak Soils Using Eco-Friendly Synthetic Polymers. International Journal of Emerging Engineering Research and Technology, 5(7): 30-42. http://ijeert.org/v5-i7#prettyPhoto

[48] Ostad-Ali-Askari K, Eslamian S, C. Crusberg T, P. Singh V, R. Dalezios N, et al. 2017, A Study on Optimization Solutions and Causes of Corrosion in Water Reservoirs. International Journal of Emerging Engineering Research and Technology, 5(10): 1-21.

[49] Ostad-Ali-Askari K, Eslamian S, C. Crusberg T, P. Singh V, R. Dalezios N, et al. 2017, Qaleh - Jouq Watershed Park Executive Meteorological Phase Studies, Kermanshah Province, Iran. International Journal of Emerging Engineering Research and Technology, 5(10): 41-59.

[50] Ostad-Ali-Askari K, Eslamian S, C. Crusberg T, P. Singh V, R. Dalezios N, et al. 2017, Investigation of Wetland Performance for Sewage Treatment in Rural Areas. International Journal of Emerging Engineering Research and Technology, 5(11): 36-54.

[51] Ostad-Ali-Askari K, Eslamian S, C. Crusberg T, P. Singh V, R. Dalezios N, et al. 2017, The Executive Phase of Flood Water Control Plan of Kangavar City, Kermanshah Province, Iran. International Journal of Emerging Engineering Research and Technology, 5(11): 1-20.

[52] Abbasova, D., Eslamian, S., Nazari, R., 2017, Paleo-Drought: Measurements and Analysis, Ch. 34 in Handbook of Drought and Water Scarcity, Vol. 2: Environmental Impacts and Analysis of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 665-674.

[53] Yihdego, Y., Eslamian, S., 2017, Drought Management: Initiatives and Objectives, Ch. 1 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 1-26.

[54] Tuncok, I. K., Eslamian, S., 2017, Drought Management Strategies in Water-Stressed/Water-Scarce Regions, Ch. 5 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 97-154.

[55] Reinstädtler, S., Islam, S. N., Eslamian, S., 2017, Drought Management for Landscape and Rural Security, Ch. 8 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 195-234.

[56] Dalezios, N. R., Eslamian, S., 2017, Drought Assessment and Management for Heat Waves Monitoring, Ch. 9 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian

S. and Eslamian F., Francis and Taylor, CRC Press, USA, 235-260.

[57] Kruse, E., Eslamian, S., 2017, Groundwater Management in Drought Conditions, Ch. 11 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 275-282.

[58] Araghinejad, S., Hosseini-Moghari, S.-M., Eslamian, S., 2017, Reservoir Operation during Drought, Ch. 12 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 283-292.

[59] Eslamian, S., Khosravi, B., Sayahi, M., Haeri-Hamedani, M. 2017, Crises Management Planning and Drought Management Plans, Ch. 13 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 293-304.

[60] Halbac-Cotoara-Zamfir, R., Eslamian, S., 2017, Functional Analysis of Regional Drought Management, Ch. 14 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 305-328.

[61] Zahraei, A., Saadati, S., Eslamian, S., 2017, Irrigation Deficit: Farmlands, Ch. 16 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 343-358.

[62] Amiri, M. J., Eslamian, S., Bahrami, M., Yousefi, N. 2017, Deficit Irrigation: Greenhouse, Ch. 17 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 359-372.

[63] Ostad-Ali-Askari, K., Shayanejad, M., Eslamian, S., Zamani, F., Shojaei, N., Navabpour, B., Majidifard, Z., Sadri, A., Ghasemi-Siani, Z., Nourozi, H., Vafaei, O., Homayouni. S.-M.-A., 2017, Deficit Irrigation: Optimization Models, Ch. 18 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 373-390.

[64] Eludoyin, A. O., Eludoyin, O. M., Eslamian, S., 2017, Drought Mitigation Practices, Ch. 19 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 391-402

[65] Irshad, S. M., Eslamian, S., 2017, Politics of Drought Management and Water Control in India, Ch. 22 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 447-460.

[66] Pati, R., Eslamian, S., 2017, Drought Management for Horticultural Crops in India, Ch. 23 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 461-482.

[67] Khan, S., Eslamian, S., 2017, Ch. 25 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 495-526.

[68] Sedaei, L., Sedaei, N., Cox, J. P., Dalezios N. R., Eslamian, S., 2017, Forest Fire Mitigation under Water Shortage, Ch. 26 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 527-550.

[69] TorabiFarsani, N., Neto de Carvalho, C., Eslamian, S., 2017, Education Program for Drought, Ch. 27 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 551-566.

[70] Nazif, S. and Tavakolifar, H., Eslamian, S., 2017, Emergency Drought Consequence Plan, Ch. 30 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 640-658

[71] MohseniSaravi, M., Shabazi, R., Eslamian, S., 2017, Coping with Drought- Ch. 31 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 659-673

[72] Eslamian, S., Mohri-Isfahani, E., Mahdavi, A., Rajaei-Rizi, F., Marzi-Nouhedani, M., Ghasemi-Zanyani, M., Dehghani, S., Hosseini-Teshnizi., S. Z., Esmaeili, F.,Shojaei, N., Ghane, M., Hasantabar-Amiri, A., 2017, Integrated Water Resources Management Under Water Scarcity, Ch. 32 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 675-695.

[73] Aghaei, A., Eslamian, S., Dalezios, N. R., Saeidi-Rizi, A., Bahrebardar, S., 2017, Drought and Dust Management, Ch. 33 in Handbook of

Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA, 696-705.

[74] Eslamian, S., Dalezios, N. R., Singh, V. P., Adamowaski, J., Mohamadifard, S., Bahmani, R., Eskandari, S., Zomorodian, M., Arefeyan, A., Dehghani, S., Aghaesmaeili, M., Shahbazi, M., Amoushahi, M. T., Yousefi, N., Namdi, A., 2017, Drought Management: Current Challenges and Future Outlook, Ch. 34 in Handbook of Drought and Water Scarcity, Vol. 3: Management of Drought and Water Scarcity, Ed. by Eslamian S. and Eslamian F., Francis and Taylor, CRC Press, USA.

[75] Eslamian, S., Davari, A., and Reyhani, M. N., 2017, Iranian QanātsAn Ancient and Sustainable Water Resources Utilization, Ch. 9, in Underground Aqueducts Handbook, Ed. By Angelakis A. N. et al., Taylor and Francis, CRC Group, 123-150.

[76] Khan, S., and Eslamian, S., 2017, Managing Drought through Qanāt and Water Conservation in Afghanistan, Ch. 22, in Underground Aqueducts Handbook, Ed. By Angelakis A. N. et al., Taylor and Francis, CRC Group, 385-402.

[77] Wessels, J. I., Vardakos, S., Weingartner, H., Eslamian, S., Angelakis, A. N., 2017, Underground Aqueducts: Past, Present, and Future Trends, Ch. 29 in Underground Aqueducts Handbook, Ed. By Angelakis A. N. et al., Taylor and Francis, CRC Group, 491-510.

[78] Dalezios, N.R., Tarquis, A. M. and Eslamian, S. 2017: Droughts. Chapter 5, in book: Environmental Hazards Methodologies for Risk Assessment and Management. Editor: Dalezios, N. R., International Water Association Publishing, London, UK, 177-210.

[79] Dalezios, N. R. and Eslamian, S, 2017, Environmental Hazards Methodologies for Risk Assessment and Management, Ed. By Dalezios, N. R., IWA Publishing,

[80] Bazrkar, M. H., Adamowski, J., Eslamian, S., 2017, Water System Modeling, in Mathematical Advances Towards Sustainable Environmental Systems, Ed. by Furze, J.N., Swing, K., Gupta, A.K., McClatchey, R., Reynolds, D., Springer International Publishing, Switzerland, 61-88.

[81] Bazrkar, M. H., Zamani, N., Eslamian, S., Eslamian, A., Dehghan, Z., 2015, Urbanization and Climate Change, Handbook of Climate Change Adaptation, Ed. By Leal Filho, W., Springer, 619-655.

[82] Chen, Z., Ngo, H. H., Guo,W, and Eslamian, S., 2015, Water Shortages, in Urban Water Reuse Handbook, Ch. 1, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 3-14.

[83] Boogaard, F. and Eslamian, S., 2015, Water Reuse and Sustainable Urban Drainage Systems, in Urban Water Reuse Handbook, Ch. 4, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 37-44.

[84] Shah Naqvi, S. A. A., Sultan, A., and Eslamian, S., 2015, Water Quality Issues in Urban Water, in Urban Water Reuse Handbook, Ch. 8, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 99-112.

[85] Kumar Singh, Ch., Jha, N., and Eslamian, S., 2015, Reuse, Potable Water, and Possibilities, in Urban Water Reuse Handbook, Ch. 9, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 113-126.

[86] Kohansal, M. M., Saadati, S., TarkeshEsfahany, S., and Eslamian, S., 2015, Urban Water Reuse in Industry, in Urban Water Reuse Handbook, Ch. 11, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 137-148.

[87] Kumar, M., Chidambaram, S., Ramanathan, A. L., Goswami, R., and Eslamian, S., 2015, Criterion, Indices, and Classification of Water Quality and Water Reuse Options, Urban Water Reuse Handbook, Ch. 13, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 163-176.

[88] Eslamian, F., Eslamian, S., and Eslamian, A., 2015, Water Reuse Guidelines for Agriculture, Urban Water Reuse Handbook, Ch. 14, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 177-186.

[89] Eslamian, A., Eslamian, F., and Eslamian, S., 2015, Water Reuse Guidelines for Industry, Urban Water Reuse Handbook, Ch. 15, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 187-194.

[90] Eslamian, S., Eslamian, F., and Eslamian, A., 2015, Water Reuse Guidelines for Recreation, Urban Water Reuse Handbook, Ch. 16, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 195-200.

[91] Banjoko, B. and Eslamian, S., 2015, Environmental Impact Assessment: An Application to Urban Water Reuse, Urban Water Reuse Handbook, Ch. 20, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 229-242.

[92] Amiri, M. J., Eslamian, S., Arshadi, M., and Khozaei, M., 2015, Water Recycling and Community, Urban Water Reuse Handbook, Ch. 22, Ed. By Eslamian, S., Taylor and Francis, CRC Group, USA, 261-274.

[93] Ferdaush, J., Noor Islam, Sh., Reinstädtler, S., and Eslamian, S., 2015, Ethical and Cultural Dimension of Water Reuse, Urban Water Reuse Handbook, Ch. 24, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 285-296.

[94] Bazrkar, M. H., Zamani, N., and Eslamian, S., 2015, Evaluation of Socioeconomic Impacts of Urban Water Reuse Using System Dynamics Approach, Urban Water Reuse Handbook, Ch.

28, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 331-340.

[95] Mujere, N. and Eslamian, S., 2015, Blackwater System, Urban Water Reuse Handbook, Ch. 33, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 393-404.

[96] Abu-Ghunmi, L., and Eslamian, S., 2015, Graywater, Urban Water Reuse Handbook, Ch. 34, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 405-420.

[97] Eslamian, S., Amininezhad, S. M., and Amininejad, S. M., 2015, Contamination Warning System, Urban Water Reuse Handbook, Ch. 39, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 481-488.

[98] Crusberg, T. C., and Eslamian, S., 2015, Choosing Indicators of Fecal Pollution for Wastewater Reuse Opportunities, Urban Water Reuse Handbook, Ch. 42, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 511-520.

[99] Boogaard, F. and Eslamian, S, 2015, Wastewater Monitoring, Urban Water Reuse Handbook, Ch. 48, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 583-586.

[100] Mujere, N., and Eslamian, S., 2015, Urban Wetland Hydrology and Water Purification, Urban Water Reuse Handbook, Ch. 50, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 603-616.

[101] Nazif, S., and Eslamian, S., 2015, Urban Wetland Hydrology and Changes, Urban Water Reuse Handbook, Ch. 51, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 617-640.

[102] Banjoko, B., and Eslamian, S., 2015, Phytoremediation, Urban Water Reuse Handbook, Ch. 53, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 657-702.

[103] Rivas Hernández, A., Rivas Acosta, I., and Eslamian, S., .2015, Treatment Wetlands: Fundamentals, Urban Water Reuse Handbook, Ch. 54, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 703-716.

[104] Rahman, A., and Eslamian, S., 2015, Rainwater Tanks as a Means of Water Reuse and Conservation in Urban Areas, Urban Water Reuse Handbook, Ch. 60, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 797-808.

[105] Qian, Q., and Eslamian, S., 2015, Groundwater Recharge and Unconventional Water: Design and Management Criteria, Urban Water Reuse Handbook, Ch. 61, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 809-816.

[106] Saket, R. K. and Eslamian, S., 2015, Use of Wastewater for Hydroelectric Power Generation, Urban Water Reuse Handbook, Ch. 63, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 827-838.

[107] Eslamian, S., Amininezhad, S. M., Amininejad, S. M., Adamowski, J., 2015, Application of Nanotechnology in Water Reuse, Urban Water Reuse Handbook, Ch. 64, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 839-844.

[108] Goodarzi, E., Ziaei, L. and Eslamian, S., 2015, Recycled Water in Basin and Farm Scales, Urban Water Reuse Handbook, Ch. 65, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 855-858.

[109] Perez Sierra, J. A. and Eslamian, S., 2015, Water Reuse in Coastal Areas, Urban Water Reuse Handbook, Ch. 67, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 867-874.

[110] Noor Islam, Sh., Reinstädtler, S., and Eslamian, S., 2015, Water Reuse Sustainability in Cold Climate Regions, Urban Water Reuse Handbook, Ch. 68, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 875-886.

[111] Rina, K., Eslamian, S., Tyagi, G., and Singh, N., 2015, Feasibility Studies for Water Reuse Systems, Urban Water Reuse Handbook, Ch. 71, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 909, 926.

[112] Salequzzaman, MD., Tariqul Islam, S. M., Shiddiquzzaman, M., and Eslamian, S., 2015. Climate Change Adaptation and Water Reuse, Urban Water Reuse Handbook, Ch. 75, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 969-980.

[113] Kumar Goyal, M., Singh, V., and Eslamian, S., 2015, Impact of Climate Change on Drinking Water, Urban Water Reuse Handbook, Ch. 76, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 981-1006.

[114] Hamdy, A. and Eslamian, S., 2015, Sustainable Reuse and Recycling of Treated Urban Wastewater, Urban Water Reuse Handbook, Ch. 80, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 1039-1054.

[115] Thakur, J. K., Karmacharya, S., Singh, P., Gurung, D., and Eslamian, S., 2015, Water Reuse Products in Urban Areas, Urban Water Reuse Handbook, Ch. 81, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 1055-1070.

[116] Eslamian, S., Sayahi, M., and Khosravi, B., 2015, Conjunctive Use of Water Reuse and Urban Water, Urban Water Reuse Handbook, Ch. 82, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 1071-1078.

[117] Irfan, Z. B., and Eslamian, S., 2015, Urban Water Reuse Policy, Urban Water Reuse Handbook, Ch. 83, Ed. By Eslamian, S., Taylor and Francis, CRC Group, 1079-1096.

[118] Vafakhah, M., Eslamian, S. and Khosrobeigi Bozchaloei, S., 2014, Low-Flow Hydrology, in Handbook of Engineering Hydrology, Ch. 20, Vol. 1: Fundamentals and Applications, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 433-453.

[119]Cox, J. P., Shaeri Karimi, S. and Eslamian, S., 2014, Optimum Hydrometric Site Selection, in Handbook of Engineering Hydrology, Ch. 22, Vol. 1: Fundamentals and Applications, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 471-483.

[120]Eslamian, S. and Motevallian, S. S., 2014, Sustainability in Urban Water System, in Handbook of Engineering Hydrology, Ch. 27, Vol. 1: Fundamentals and Applications, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 549-562.

[121]Noor Islam, S., Karim, R., Noor Islam, A., and Eslamian, S., 2014, Wetland Hydrology, in Handbook of Engineering Hydrology, Ch. 29, Vol. 1: Fundamentals and Applications, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 581-605.

[122]Gargouri-Ellouze, E. and Eslamian, S. 2014, Application of Copulas in Hydrology: Geomorphological Instantaneous Unit Hydrograph and Intensity Index of Infiltration Frequency, in Handbook of Engineering Hydrology, Ch. 1, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 1-18.

[123]Mujere, N. and Eslamian, S. 2014, Climate Change Impacts on Hydrology and Water Resources, in Handbook of Engineering Hydrology, Ch. 7, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 113-126.

[124]Farzaneh, M. R., Eslamian, S. and Mirnezami, S. J. E. 2014, Climate Change: Uncertainty, Impact, and Adaptation, in Handbook of Engineering Hydrology, Ch. 8, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 127-146.

[125]Goodarzi, E. and Eslamian, S. 2014, Dam Risk and Uncertainty, in Handbook of Engineering Hydrology, Ch. 9, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 147-171.

[126]Fakhri, M., Dokohaki, H., Eslamian, S., Fazeli Farsani, I. and Farzaneh, M. R. 2014, Flow and Sediment Transport Modeling in Rivers, in Handbook of Engineering Hydrology, Ch. 13, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 233-275.

[127]Matouq, M., Al-Bilbisi, H., El-Hasan, T. and Eslamian, S. 2014, GIS Applications in a Changing Climate, in Handbook of Engineering Hydrology, Ch. 15, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 297-312.

[128]Noor Islam, S., Gnauck, A., Voigt, H.-J. and Eslamian, S., 2014, Hydrological Changes in Mangrove Ecosystems, in Handbook of Engineering Hydrology, Ch. 18, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 353-373.

[129]Kałuża, T. and Eslamian, S. 2014, Impact of the Development of Vegetation on Flow Conditions and Flood Hazards, in Handbook of Engineering Hydrology, Ch. 21, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 415-449.

[130]Rahman, A., Haddad, Kh. and Eslamian, S. , 2014, Regional Flood Frequency Analysis, 2014, in Handbook of Engineering Hydrology, Ch. 22, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 451-469.

[131]Vafakhah, M. and Eslamian, S. 2014, Regionalization of Hydrological Variables, in Handbook of Engineering Hydrology, Ch. 23, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 471-499.

[132]Chowdhury, R. K. and Eslamian, S. 2014, Statistical Parameters Used for Assessing Hydrological Regime, in Handbook of Engineering Hydrology, Ch. 26, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 537-551.

[133]Mujere, N. and Eslamian, S. 2014, Impact of Urbanization on Runoff Regime, Chowdhury, R. K. and Eslamian, S. 2014, Statistical Parameters Used for Assessing Hydrological Regime, in Handbook of Engineering Hydrology, Ch. 29, Vol. 2: Modeling, Climate Changes and Variability, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 605-615.

[134]Gaaloul, N. and Eslamian, S., 2014, Artificial Recharge Experiences in Semiarid Areas, in Handbook of Engineering Hydrology, Ch. 2, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 17-49.

[135]Amininezhad, S. M., Amininejad, S. M., and Eslamian, S., 2014, Disinfection of Water and Nanotechnology, in Handbook of Engineering Hydrology, Ch. 3, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 51-64.

[136]Shaeri Karimi, S., Yasi, M., Cox, J. P., and Eslamian, S., 2014, Environmental Flows, in

Handbook of Engineering Hydrology, Ch. 5, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 85-104.

[137]Eslamian, S., Malekian, R., and Amiri, M. J. 2014, Environmental Nanotechnology, in Handbook of Engineering Hydrology, Ch. 6, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 105-118.

[138]Deiminiat, A., and Eslamian, S., 2014, River Managed System for Flood Defense, in Handbook of Engineering Hydrology, Ch. 14, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 299-314.

[139]Deiminiat, A., Hassan Shojaee Siuki, and Eslamian, S. 2014, Tourism and River Environment, in Handbook of Engineering Hydrology, Ch. 20, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 401-419.

[140]Green, C. and Eslamian, S., 2014, Water Governance, in Handbook of Engineering Hydrology, Ch. 24, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 461-483.

[141]Eslamian, F. and Eslamian S., 2014, Water Pollution Control Using Low-Cost Natural Wastes, in Handbook of Engineering Hydrology, Ch. 25, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 485-499.

[142]He, Ch., Zhang, L., Zhang, X., and Eslamian, S., 2014, Water Security: Concept, Measurement, and Operationalization, in Handbook of Engineering Hydrology, Ch. 28, Vol. 3: Environmental Hydrology and Water Management, Ed. By Eslamian, S., Francis and Taylor, CRC Group, USA, 545-554.

[143]Fakhri, M., Farzaneh, M. R., Eslamian S. and Nazari, R., 2013, Wind speed regionalization under climate change conditions, Chapter 10, New Developments in Renewable Energy by H. Arman & I. Yukcel, 215-236.

[144]Nazari, R., Khanbilvardi, R., Hoyos, S., and Eslamian, S., 2013, Freshwater Demands and Storages, Encyclopedia of Crises Management, Sage Publication.

[145]Eslamian, S., 2012, Forecasting, Encyclopedia of Energy, Salem Press, USA, 461-464.

[146]Eslamian, S., 2012, Iran, Encyclopedia of Energy, Salem Press, USA, 708-713.

[147]Eslamian, S. and Nazari, R., 2012, Nebraska, Encyclopedia of Energy, Salem Press, USA, 889-893.

[148]Nazari, R., S. Eslamian and R. Khanbilvardi, 2012, Water Reuse and Sustainability, Chapter 11, in Ecological Water Quality-Water Treatment and Reuse by K. Voudouris and D. Vousta, 241-254, Intech.

[149]Eslamian, S. S., Gilroy K. L. and R. H. McCuen, 2011, Climate Change Detection and Modeling in Hydrology, Ch. 5 in “Climate Change –Research and Technology For Adaptation and Mitigation” Edited by J. Blanco and H. Kheradmand, InTech, 87-100.