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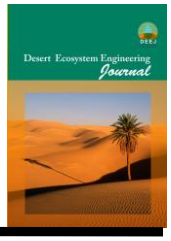

Investigation of the Impact of Bridge Structures on the River Route on the Hydraulic Behavior of the Flow (Case study: Velian River)

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Extended Abstract

Introduction: As the main source of water and life for humans and other creatures, rivers may sometimes bring about destruction and irreparable damage. Therefore, it is necessary to study the hydraulic properties of the flow and the riverbed's area to set a safe zone for human activities around it. On the other hand, constructions built along the river's route such as bridges, weirs, superstructures, etc. alter the river flow's hydraulic behavior, which, in turn, could make changes in the riverbed. Thus, this study sought to examine the implementation of a hydraulic model of the Valian River and its results and to investigate the role of bridges (Chandar, Eskol Darreh, Ajin Dojin, and Velian) in the riverbeds' natural conditions. The study area for designating the river's bed limit and riparian zone included the upstream of Eskol Darreh village, all the routes which pass along the Eskol Darreh, Velian, Ajin Dojin, Khorvin, and Chandar villages, and finally, the entrance of Kordan River at the downstream of Chandar village. The length of the main river is about 17.5 km, whose upstream coordinates located, according to the UTM coordinate system, at 485090 east and 3990600 north, and its downstream coordinates are located at 481050 east and 3977000 north.

Material and Methods: To simulate the river under study, hydraulic parameters were taken into account, including the flood discharge with different return periods, Manning coefficient, the river's geometry in the form of cross sections, and the data regarding the constructs built along the river's route. Moreover, the flow's hydraulic conditions were simulated and the necessary hydraulic analysis over the studied periods was performed using the HEC-RAS model. According to the applicable laws, the flood zone is designated under the river's natural conditions in terms of 25-year flood discharge. In this study, the final riverbed's limit was designated by identifying the hydraulic bed and considering the effect of morphological, legal, riverbed land use, and socio-economic studies. The riparian zone is normally located at a certain distance away from the riverbed, which was considered 4 meters for the Valian River.

Also, the water surface profile was calculated for the constant flow mode according to the standard step-wise method using the Hec_Ras software. The calculations were performed based on solving one-dimensional energy equations (Bernoulli equation). The Manning equation was also used to calculate the energy loss in successive periods. Furthermore, other types of losses such as the periods' expansion and contraction coefficients were taken into account, and the momentum equation when applied for periods when fast variable currents occurred (in mixed currents, including a combination of supercritical and subcritical currents, hydraulic jump, the current passing through the bridges' underpasses and the junction of branches, etc.). In addition, this model can also analyze the effects of river-related constructs such as bridges, culverts, weirs, lateral weirs, and organizing

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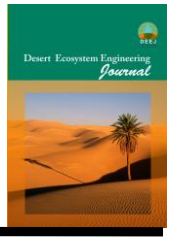

constructs discussed in this study. Taking the possibility of developing a GIS model for the study area, By having and according to the width of the river bank mapping, some cross sections were prepared along the river from the main route and the flood plain, designated at certain distances away from each other based on the mapping of the river's edges using topographic maps with appropriate accuracy (scale 1: 500) and GIS software, including the GeoRas and the ArcGIS software.

Results: Zoning the floods in the Valian River with different return periods, this study compared the natural conditions of the river before and after the construction of bridges using a one-dimensional HEC-RAS model. The studied river was modeled in its current status under its natural conditions for floods with different return periods, including the 2, 2.33, 5, 10, 25, 50, 100, 200, 500, and 1000-year periods. The study's results suggested that the constructed bridges had the greatest influence on the water's cross-section flow and surface width, and the slightest effect on the water's level and the balance of energy gradient. According to the results of the analysis performed on floods with a 25-year return period, it is recommended that due to its greatest amount of alterations at the cross-section current and the water's surface width, Eskol Darrah's bridge be considered the highest priority in terms of management decisions and that the Valian bridge be the last priority in this regard.

Discussions and Conclusion: When trying to designate the final riverbed's limit for the Valian River in the study area, it was found that the trenching nature of the river's bank, the alteration of the riverbed's limit to facilitate the installation of rappers, the narrowed cross-section of the river, and the erosion potential had changed the river's flood zone under its natural conditions. The results of water level analysis indicated that with an increase in return periods, the river's flow rate and the flood level increased. Moreover, it was found that compared to natural conditions with a 25-year return period, the river's longitudinal profile increased at its current status at the bridges due to the increase in the narrowness of the river's cross-section.
On the other hand, as the flow's section has been narrowed at the bridges, eighter end of the bridges has been eroded and the water level has increased there. Moreover, the comparison of the natural and current conditions of the areas surrounding the bridges revealed that the Froude number has decreased with the changes made in the flow's velocity and an increase in the water depth. Moreover, the presence of bridges in the flow's route has led to an increase in free flow's width and surface, and a decrease in the Froud number and the flow's velocities in the 25-year return period. However, all of these parameters vary for the Valian bridge. Therefore, considering minor differences between the parameters in natural versus current conditions of the bridge, it appears that eighter the bridge has no influence on the flow's characteristics or its modeling is erroneous. Taking the slight difference between parameters derived from modeling the bridge under natural and current conditions, the greatest and slightest effect of the bridge on the hydraulic parameters was found in the Eskol Darrah bridge and the Valian bridge, respectively. Furthermore, the highest amount of difference in the flow level was observed in the Eskol Darrah bridge (53.67), and lowest amount water level was found in the Valian bridge.

Keywords: The River's Hydraulic Model, Return Period, Free Water Surface Width.