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Simulating Sedimentation Status of Ebrou River of Ekbatan Dam in Hamedan Using GSTARS 2.1 Mathematical Model

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1-Introduction

Today, quasi-two-dimensional mathematical models are effective solutions which are increasingly used for hydraulic flow and river sedimentation (Bayazidi, 2017).

Examining the transversal distribution of river sediments, Zahiri et al. (2018) used the quasi-two-dimensional GSTARS 2.1 mathematical model and the numerical solution of the Navier-Stokes differential equations on the Gharasu River to conclude that the two-dimensional model well estimated the transversal distribution of the flow rate.

Oda (2019) used numerical modeling to model and investigate multiphase sediment transport and scouring reach as well as coastal Morphodynamic variations and demonstrated that the multiphase numerical model performed well in most simulation scenarios of sediment transport and scouring reach, suggesting the model can be used to eliminate empirical data constraints.

Lai et al. (2019), investigating the flow and sediment transport capacity, used a three-dimensional open surface channels model as well as the flow and suspended sediment equations to conclude that the model provided a good consistency between the flow and sediment with empirical data.

2-Methodology

The Ebrou River lies in the watershed of Ekbatan Dam southeast of Hamadan city. In this study, river profile was outlined using topographic map of 1:2000 scale in ARC-GIS environment by HEC-GEORAS extension, Google Earth images, surveying operations and longitudinal and transversal profile data provided by the Hamedan's Water Directorate in 2005. Then the central line of the flow, coastlines and the meander of the Abrou river were examined and the cross sections were acquired via field visits and surveying operations over a 12 km range while the relevant variations were examined by comparing the transversal data from 2005 and sections acquired in 2018 along with longitudinal profiles and water surface elevation. In this study, after the model was calibrated by river hydrographic data, the GSTARS 2.1 software was used to examine the

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quality of sedimentation in longitudinal profiles as well as cross sections for bedrock and hydrographical conditions, sedimentation phenomenon and river erosion for a 13-year interval from 2005 to 2018, and then the above-mentioned cases were simulated, compared and evaluated based on the available data using longitudinal and transversal profiles of the river.

3- Results and Discussion

By implementing the model with the topalite sediment transfer formula, Using the Toffaleti sediment transport formula, it was found that the observational water level profile and the water level profile calculated by the model were consistent and the general variations trend in both diagrams was the same, indicating the acceptable accuracy of the Toffaleti's modeling of flow transfer. Results from comparing the sediment transport equations suggested that the Young and Toffaleti equations (1996) better conformed with the conditions than observational data, while the remaining sediment equations including the Meyer-*Peter and Müller* (MPM) *equation*, produced the highest error. Therefore, the GSTARS 2.1 model showed that the Toffaleti equation most conformed with the river.

Studies have suggested that the river cross section had experienced significant morphological variations from 2005 to 2018, changing from a V-shaped state to a U-shaped state, which is due to the erosion and sedimentation process in the Abrou river of Ekbatan dam and small but highly-frequent floods, causing degradation and bankcutting. An examination of the river cross section indicates that erosion on the left bank is higher than on the right bank, suggesting that waterway asymmetry had increased since 2005 compared to 2018, and riverbed tilting had occurred.

4- Conclusion

Examining the results from the implemented model, it was found that the Gstars 2.1 model could be used to simulate longitudinal and transversal profile changes of the river. This study confirmed a good consistency between longitudinal and transversal profiles with the model, as the results from simulating and calculating erosion and sedimentation using the Gstars model 2.1 were found to be at an acceptable level during the certain interval. Results from implementing the Gstars 2.1 mathematical model and analyzing the model sensitivity to changing hydraulic and sediment parameters suggested that the model had the highest sensitivity to the sediment transport function, and the correct selection of the sediment transport function greatly contributed to the correct estimation and simulation of sediment volume.

Using the sediment transport functions, it was determined that compared to other sediment transport functions, the Toffaleti and Young functions estimated the level of sediments with smaller errors; however, because the grading range is within the

applicable range of Toffaleti equation (clay, silty and sandy bed), thus, this equation was opted for simulation. Using the Toffaleti function to examine the river sedimentation process, it was found that this model can be used to study the sedimentation mechanism in other rivers across the country.

Keywords: Numerical simulation, Yang equation,Manning,coefficient, Ekbatan Dams.

5-References

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