World Applied Sciences Journal 15 (2): 279-284, 2011
ISSN 1818-4952

Numerical Investigation of Angle and Geometric of L-Shape Groin on the Flow and Erosion Regime at River Bends

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Abstracts: Investigating the features and flow behavior and related component is one of the complex phenomena that make using of software inevitable. Groin is simple hydraulic component that used for organizing the rivers in bend or direct way and erosion control and protecting of shores. In this project by using Flow-3D software, the numerical model of flow pattern was prepared around a groin. This research with applying different model of turbulence flow, including various Froude numbers and by setting 4 L-shaped single groins with charging john angle in 4 situation of 30,45,60,75 degree related to flow direction in 180 degree bend and 18,20,22,25 lit/s discharges and constant depth of 12cm in clear water conditions, has studied the effect of these model on flow speed changes by second flow and vortex flow around groin. this investigation showed that range of maximum speeds and vortex flows and scouring were occurred in maximum amount in 75 and in minimum amount in 30.in different degrees with increasing Froude number, speed rate in groin head is also increased and scouring depth is also increased with increasing scouring depth. Numerical results are compared with other researcher studies in flow pattern field and scouring around L-shaped groin that hasn't well agreement.

Key words: Flow pattern % Scouring depth % L-shaped spur dikes % Flow-3D software and groin angle

INTRODUCTION

River engineering, specially, control of offshore and programming is one of most important, field of hydraulic engineering. Some processes and program in order to convey water into suitable way are called. River programming erosion at outside core of river make a lot of troubles for river and in take structures spur dike is very simple hydraulic structure which has great use of bend or straight path of flow streams. Fig (1). In order to determine scour depth near groin, some knowledge and study are needed to exact depth of erosion could be calculated subsequently. In contrast of to many studies for better understanding of flow regime of river bend, it's necessary to investigate about secondary flow, longitude and cross sectional velocity more carefully. Besides, power of secondary flow and turbulently of flow and less studied; therefore, study of flow regime ground L-shape spur dike of river bends location. Fig(2).

It's had tried (In this paper) numerical study of angle effect and geometric date of grains and their influence flow regime of 4 location of 180° degree bend. Studied scientifically to achieve this purpose, 4 different discharges are modeled too. Numerical models (C.F.D) are work at actual size condition and for determination velocity of turbulent flow and bed scouring here been utilize. In the paper flow-3 D software which is my complete and suitable for complicated flows here my stable applied. Kohnel *et al.* [1] studied scoring regime around one spur dike with different angle of 45°, 90, 135°, according to his work best design of grain is for spar dike at 135° degree location. Finally, they found out erosion potential of bed near off shear is minimum. Lein *et al.* [2] investigated flow condition at 90° degree bend, result shows that basic velocity near outside wall: has been increased normally. In other words, because of side movement of longitude momentum by secondary flow; velocity through, outside wall is more than inner side. Masjedi *et al.* [3] studied effect of, nose shape effect of:

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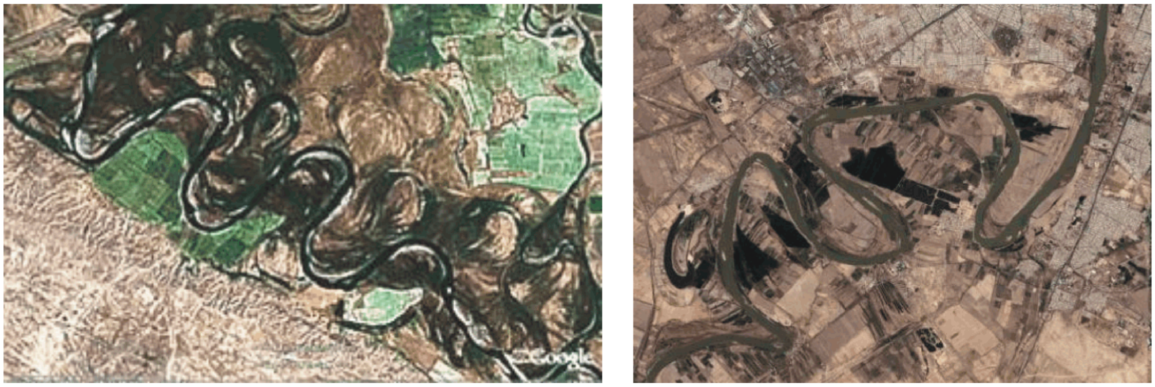

Fig. 1: Sample of meandering in Karoon River

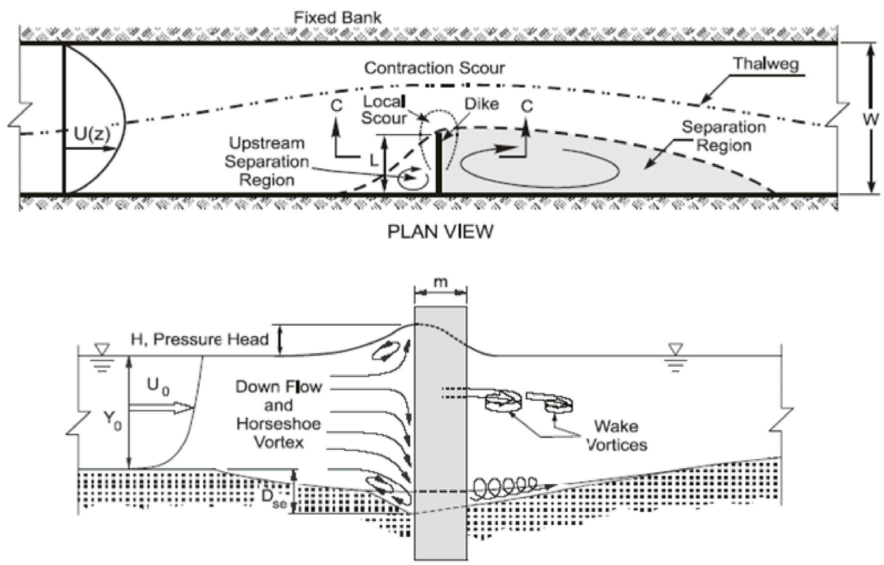

Fig. 2: Schematic of hydraulic flow of around a spur dike

T-shape-spur dike on: Scouring depth of 180° bend with tree: spur dike shape %. (such as: straight, semi-cylinder and: triangular) with experimental tests. Masjedi *et al*. [4] studied investigation on the time development of local scour at a spur dike is presented. Spur dikes have been used extensively for erosion control in the outer bank of river bends. Experimental investigation on scouring and determination of depth of scouring are among the most important issues in spur dike designation. The overall objective of the research is to study the temporal development of the scour for a spur dike. The study was conducted using a 180° laboratory flume bend with a relative radius of R/B = 4.67 operated under clear-water conditions. The median size and geometric standard deviation of bed material were equal to d_{50}= 2 mm and Fg = 1.7, respectively. Tests were conducted using one spur dike with 110 mm length in position of 60° under four flow conditions. In this study, the time development of the local scour around the spur dike plates was studied. The effects of various flow intensities (u_*/u_*c) on the temporal development of scour depth at the spur dike were also studied. The time development of the scour hole around the model spur dike installed was compared with similar studies on spur dikes. The results of the model study indicated that the maximum depth of scour is highly dependent on the experimental duration. It was observed that as flow intensities (u_*/u_*c) increases, the scour increases. Measuring time and depth of scouring based on experimental observation, an empirical relation was developed with a high regression coefficient of 97. Zhang *et al.* [5] tried to instigate turbulent flow and flow. Regime around rigid-straight spur dike with using laboratory test and numerical way through clear water condition. Turbulent model which had been utilized is K-, model. As a result, It's would clear that K-, Turbulent model is my suitable for turbulent condition simulation.

Table 1: Descriptions of flume

No	Length of Inlet channel(m)	Length of outlet (m)	Curve Radius (m)	Length of core (m)		Channel width (m)	Radius (m)	Height of chard (m)	Curve angle (deg)	Discharge (lit/s)
				Outer	Inner					
	9.10	5.5	2.81	9.77	7.88	0.6	4.68	0.45	180	25

Table 2: Descriptions of data in simulation

Location in bend	Information-data (Q:l/s,L:cm)			
Position 30°	*Q=18l/s,L=6 cm*	*Q=20,L=6*	*Q=22,L=6*	*Q=25,L=6*
	Q=18,L=9	*Q=20,L=9*	*Q=22,L=9*	*Q=25,L=9*
	Q=18,L=12	*Q=20,L=12*	*Q=22,L=12*	*Q=25,L=12*
	Q=18,L=15	*Q=20,L=15*	*Q=22,L=15*	*Q=25,L=15*
Position 45°	*Q=18,L=6*	*Q=20,L=6*	*Q=22,L=6*	*Q=25,L=6*
	Q=18,L=9	*Q=20,L=9*	*Q=22,L=9*	*Q=25,L=9*
	Q=18,L=12	*Q=20,L=12*	*Q=22,L=12*	*Q=25,L=12*
	Q=18,L=15	*Q=20,L=15*	*Q=22,L=15*	*Q=25,L=15*
Position 60°	*Q=18,L=6*	*Q=20,L=6*	*Q=22,L=6*	*Q=25,L=6*
	Q=18,L=9	*Q=20,L=9*	*Q=22,L=9*	*Q=25,L=9*
	Q=18,L=12	*Q=20,L=12*	*Q=22,L=12*	*Q=25,L=12*
	Q=18,L=15	*Q=20,L=15*	*Q=22,L=15*	*Q=25,L=15*
Position 75°	*Q=18,L=6*	*Q=20,L=6*	*Q=22,L=6*	*Q=25,L=6*
	Q=18,L=9	*Q=20,L=9*	*Q=22,L=9*	*Q=25,L=9*
	Q=18,L=12	*Q=20,L=12*	*Q=22,L=12*	*Q=25,L=12*
	Q=18,L=15	*Q=20,L=15*	*Q=22,L=15*	*Q=25,L=15*

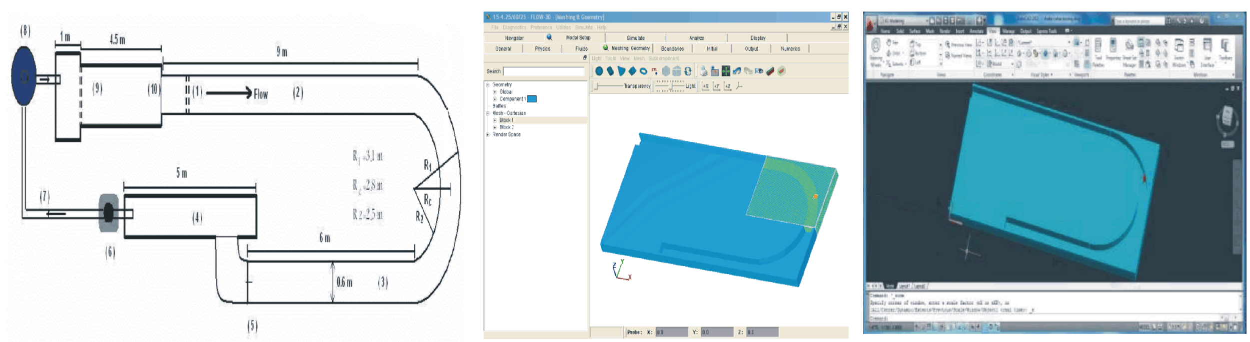

Fig. 3: Simulation model of spur pike L-shape in physical and software

MATERIALS AND METHODS

Geometric shape of model has been designed with using flow-3D and AutoCAD software. At this shape; spur dike have been located at 4 different angle (30°-45°-60°-75°) at core with 180° degree. Moreover, mesh generating has been done at each experiment and Run completely. For initial condition it has assumed. That flood is clear water at 20°centigrade degree. Table 1 and Fig 3 show that descriptions of flume (physical model in Islamic Azad University) and Simulation model.

Also for simulation in software use many location and different data in physical model. Table (2).

DISCUSSION

By changing location of spur dike to upstream at stable Froude condition; velocity and turbulence of flow near of spur dike increased near spur dike structure here been increased rapidly gradually this trend had continued to 75 degree, location and suddenly, it's moved up word. Besides, velocity and turbidity are minimized at 30 degree location. According to the results; maximum velocity; near 75° degree location is completely obvious. Besides; it need to add; the blue zone behind the spur dike shared that flow velocity is decreased because of contact to the spur dike.

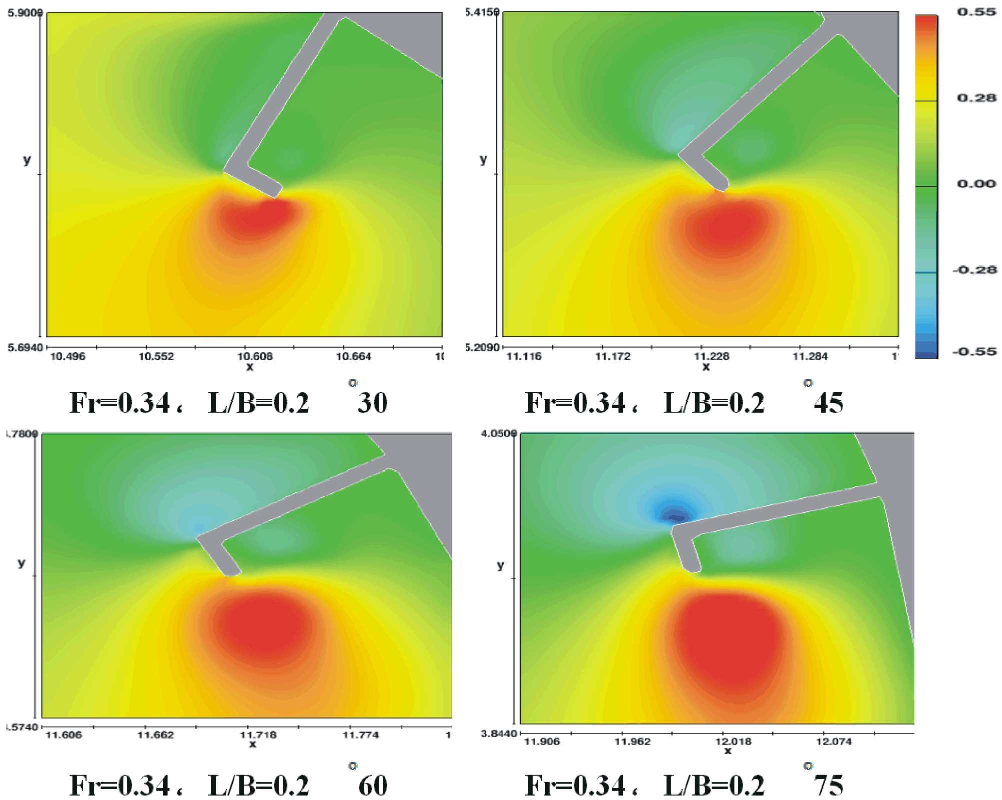

Fig. 4: Change of velocity around spur dike (L) shape
L/B = 0.2, fr=0.34 of different position (30, 45, 60, 75 degree).

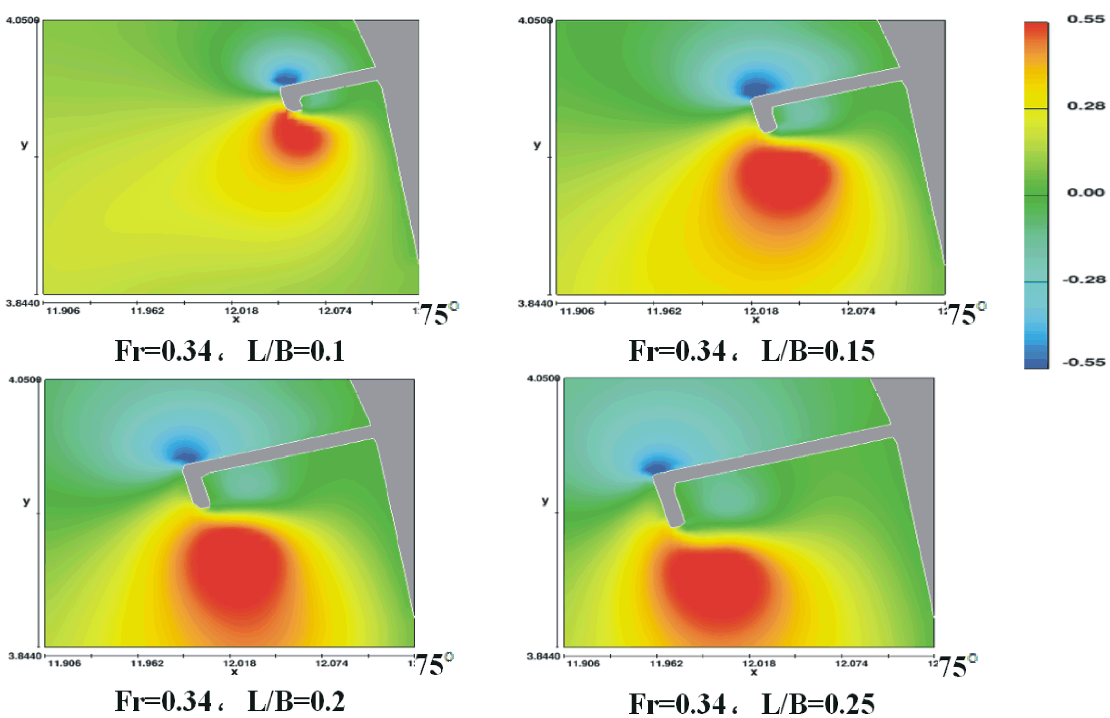

Fig. 5: Change of velocity with length of spur dike (L) shape
L/B =0.1, 0.15, 0.2, 0.25-fr=0.34 of position 75 degree

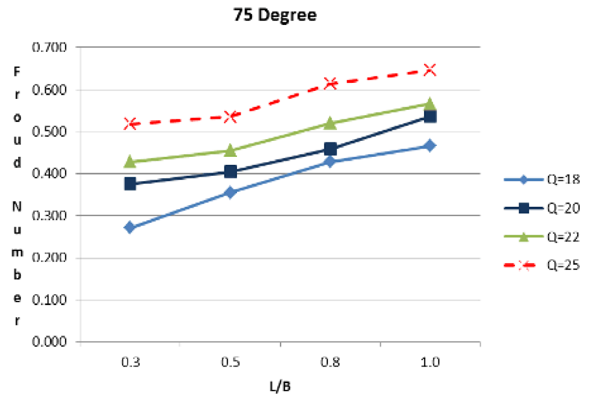

Fig. 6: Change of Froude with length of spur dike (L/B) shape position 75 degree

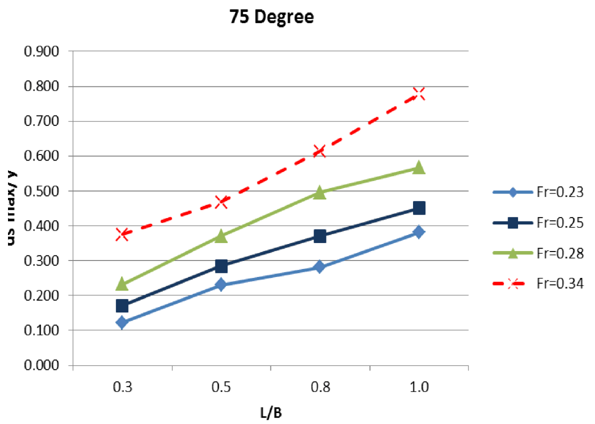

Fig. 7: Change of ds (max/y) with length of spur dike (L/B) shape fr=0.23-0.34 of position 75 degree

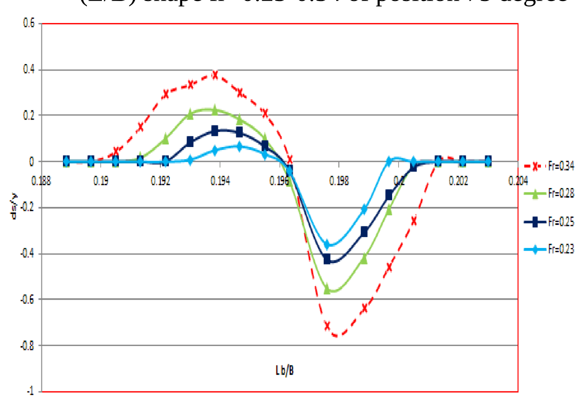

Fig. 8: Figure of bed longidual profile in canal fr=0.23-0.34 of position 75 degree

The blue zone opposites of flow stream illustrated that velocity is negative. Figure (4); show change of velocity around spur pike (L) shape with L/B = 0.2, fr=0.34 of different position (30, 45, 60, 75 degree) and figure (5); change of velocity with length of spur dike (L) shape L/B =0.1, 0.15, 0.2, 0.25-fr=0.34 of position 75 degree.

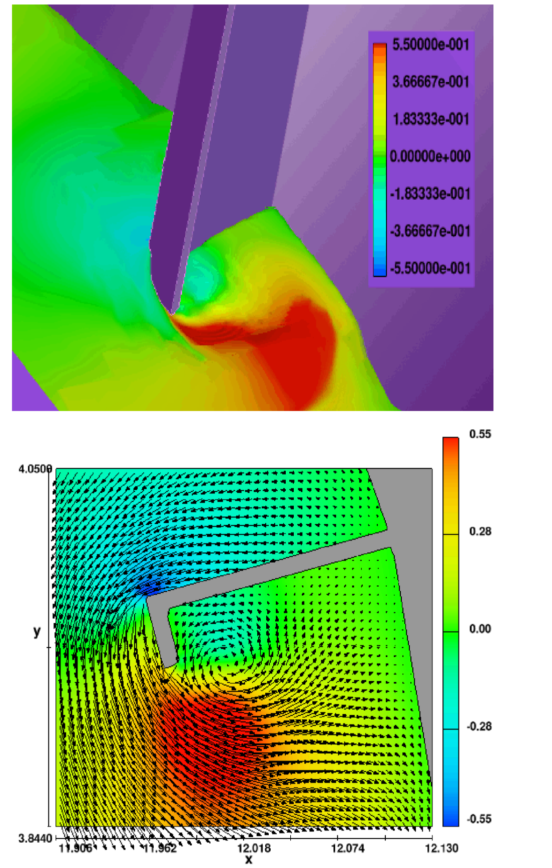

Fig. 9: Change of velocity around spur dike (L/B) shape (3D) L/B = 0.25, fr=0.34 of position 75 degree

Change of Froude and d_s(max) with length of spur dike (L) shape in Position 75 degree shows in Fig 6,7.

In fig (7), location of spur dike is constant and in this flow, change of ds (max/y) with length of spur dike is decreasing.

Vortex flow near spur dike and also turbulently is completely showed. Screw vertex behind groin and wall has been trapped. Flow near water surface and near wall is remained vortex flow and were diverted to the canal and scoring wall subsequently increased. However; one port of flow stream has been more to the grain nose very quickly and go to downstream.

CONCLUSION

- with spur dike location changing from 30 degree angle to the 75 degree, vortex flow, flow velocity and maximum velocity.
- Maximum velocity near grain nose has been increased with water surface parallels.

- When discharge increased, zone of flow velocity around spur dike nose increased naturally.
- When length and body of spur dike (length/ width: L/B) increased, vertex flow and maximum zone of velocity have been increased.
- Turbulent model of k-ε is suitable software (in flow-3D) for simulation zone of flow at downstream and turbulence formation near spur dike.

ACKNOWLEDGEMENTS

The author would like to thank: Islamic Azad University, Ahvaz branch for supporting me.

REFERENCES

1. Kohnle, R.A., C.V. Alonso and F.D. Shields, 1999. Geometry of scour holes associated with 90-degree spur dikes, Journal of Hydraulics Engineering, 125(9): 972-978.
2. Lien, H.C., T.Y. Hsied and J.C. Yang, 1999. Bend-Flow Simulation Using 2d Depth-Averaged Mode, Journal of Hydraulic Engineering, 125: 10.
3. Masjedi, A., M. Shafai and P. Rahnavard, 2010. Reduction of Local at Single T-Shape Spour Dike Whit Wing Shape in a 180 Degree Flume Bend, World Applied sciences Journal, 8(9): 1122-1128: 1818-4952.
4. Masjedi, A., M. Shafai Bejestan and A. Moradi, 2010. Experimental study on the time development of local scour at a spur dike in a 180° flume bend. Journal of Food, Agriculture and Environment, 8(2): 904-907.
5. Zhang, H., H. Nakagawa, K. Kawaike and Y. Baba 2009. Experiment and simulation of turbulent flow in local scour around a spur dyke, International Journal of Sediment Research, 24(1): 33-45.