

# Comparison of surface current patterns in a meander with a direct canal of water

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**Abstract—** As we know, deby relation with water current velocity is a direct one. Type of rout in water canal and stresses on its current may cause eddy and torque for the current. There are some forcings and stresses dominating variations, phenomena, waves and currents on rivers, seas and other water basins. Sedimentations and coastal destruction are effects caused by debies of water and sediment particles in water canal (for rivers). Surface patterns are different in various water basins. Of course wind is an important stress affecting on surface pattern which we have not considered in this research because of river. In this research, two current patterns would be studied in direct and indirect canal located in a river. In fact in this paper, the importance of centrifugal force in a meander of a river could be evaluated in comparison with its not being exist In regards to damages for coastal zone, particularly.

**Index Terms—** Water current, deby, meander, direct canal, coastal destruction.

## I. INTRODUCTION

Karun River as the biggest watery river basin after reaching to Shoushtar at area of Takht-e-Qeysar and passing of an arc path (meander) passes about one kilometer. The study of flows and sediments debies in this area because of centrifugal force has significant importance. Since in meander of river because of effect of centrifugal force, there are different deby sediments and currents model and have eddy or whirlpool structure so the coastal line destroy in this coastal line and width of river would be extended Studying water currents in different basins such as rivers, straits and bays have been important as a result of valuable matters in scientific features. When a canal of water current is direct without any unstraight, water body moves calmly, only a mild damping rate in time and space. Civil engineer and water engineering problems about a water basin will be resolved studying current, sediment debies and these are related to the environment around water basin; so it is necessary to study and research more and more in water basins like rivers what are in direct effect one human life in coastal cities and ports. Gar-Gar, a crevasse of the Karun river is started in Shoushtar city and connects to Shotteit, another crevasse of the Karun in Band-e-Ghir. The Karun River is the biggest one in Iran [1]. Sedimentation and coastal destruction are two important phenomena about hydraulics of

river; People living around rivers in coastal cities are influenced from these water basins [2]. Of course in the Gar-Gar, two factors cause to decrease sedimentation rate in coastline and then coastal destruction is decreased in coasts of this river. Knowing about methods and ways to protect coasts of river in ports and coastal cities, people would be safe from dangers due to flood and wetland progress into floodplain. In fact turbulence effects and so coastal destruction will be resulted when current has had an eddy form, as is mentioned in [6]. Therefore in the mankind direct canal for Gar\_ Gar with straight rout for water flow in spite of the Shotteit including a meander as an arc of a circle, there is no considerable coastal destruction in it.

## II. MATERIALS AND METHODS

Much study is done with measurements and observation in the case zone (the Karun River). Measuring water currents and sedimentation rates annually are registered. That is, coastal destruction and castling destroy are important that are studied about quality and quantity valuing. Bottom friction and lateral stress as two deccreasant forces on water currents and sediment particles moving in water canals affect negatively. Because water velocity would be weakened and debies would be affected and weakened. Some useful and applied photos about the subject of this research in a direct and an indirect river canal are taken as follow as below.



Fig.1 Route of the Gar-Gar canal straightly



Fig.2 Sinusoidal shape of the Band-E-Mizzan

So current pattern in a meandering water canal would be complicated with damages to coastline while there is no considerable coastal destruction or destroy in a direct water canal without existence of centrifugal force effects.

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### III. TWO FUNDAMENTAL FACTORS

As it was mentioned before in this paper, two main and natural factors around the Gar-Gar which help to decrease sedimentation rate and coastal destruction would be minimized much. First, the direct route of the water canal in Gar-Gar guarantees avoiding any meander for water flowing through it. By this, there wouldn't acceleration for water motion in Gar-Gar. Second, coastal walls in two sides of the Gar-Gar river are made by rock and stone. In fact, rocky walls in two sides of it are fasten to resist against water currents [3]. Therefore sedimentation in coastlines would be minimized as much possible. Fig.4 show stone walls around the Gar-Gar in Shoushtar domain and direct route of it, respectively.



Fig.3 Stone and rocky wall of the Gar-Gar

We could see a calmly laminar profile of current on the surface water in such a direct canal with no meander.

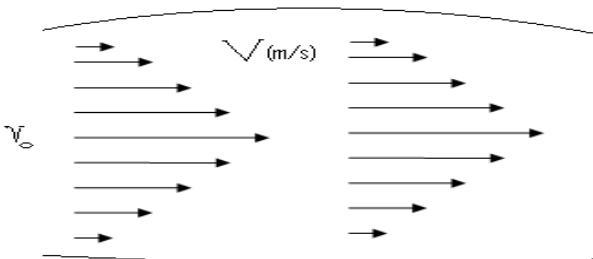


Fig.4 Laminar and calmly current profile of the surface water in a straight canal

Overallly, the picture of surface pattern of currents would be as the following photos on the surface. That is, we could see ripples on it even when wind blowing on.



Fig.5 The surface calm pattern of current for the Gar\_Gar water canal

### IV. TWO TYPE OF RIVER CANALS

The Karun River, as the biggest one in Iran has two branches in some cities of Khuzestan state like Shoushtar named the Shotteit and Gar-Gar ones. The Gar-Gar branch has a direct route of water in spite of the Shotteit with a meander on it. Eddies exist on surface pattern of currents in the Shotteit as a result of centrifugal force; coastal

destruction and sedimentation rate will be increase in this zone. In the Gar-Gar due to directly rout of water current and no stress mechanically on it, we see calm currents in the canal. It could be shown and the applied result would be compared for the above two types of water canal in the Shotteit and the Gar-Gar branches.

### V. DATA ANALYSIS

Measurements in the Gar-Gar River, Shoushtar domain, were done in 2002, 2003, 2004 and 2007 for debies of coastal sedimentation. Deby values in coasts of the Gar-Gar has been studied. Water currents flowing through the river canal transport sediment particles to coastlines. Of course sedimentation so coastal destruction is decreased for Gar-Gar due to not existence meander and with rocky walls. Figure 4(a, b, c & d) shows illustrate sedimentation deby variation during year months in 2002, 2003, 2004 and 2007.

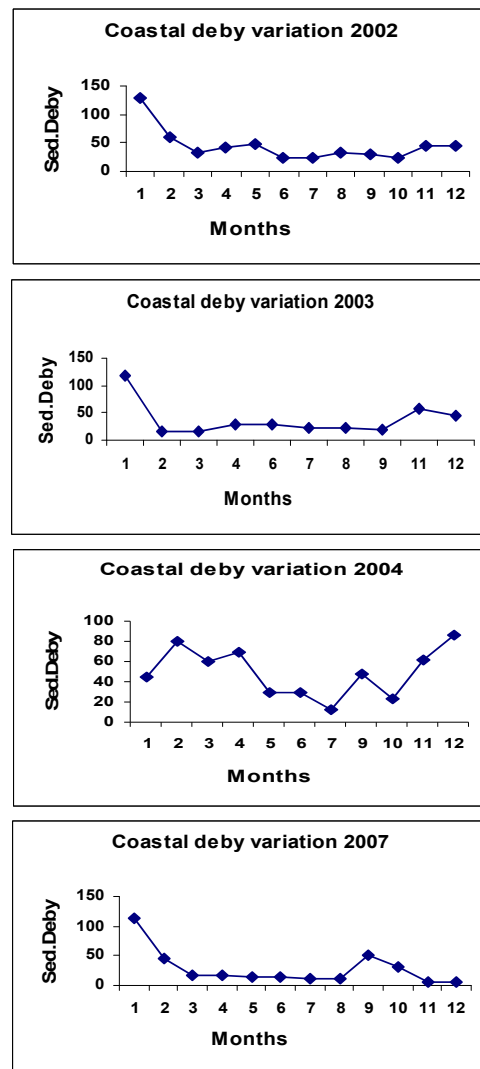


Fig.6 (a, b, c & d) Sedimentation rate in months for 2002, 2003, 2004 and 2007

Concentrating on the diagrams we could get applied results. Using the applied results mentioned a below, hydraulical and hydrological principles important in water structures have been gotten in civil engineering. Shore protection and coast management is a basic and useful in ports and coastal cities. However we should be able to apply

basins of surface water in life in optimum and efficient ways [4]. Surface water on the earth and atmosphere are two components of the double system important for weather change [5].

## VI. CURRENT COUNTERS

Considering the stream speed in river coasts equal to zero and applying primary conditions and the characteristics of component of dominant stream, the speed equal to 0.1 and 0.15, the counter of figure 4 is obtained by software Fluent [4].

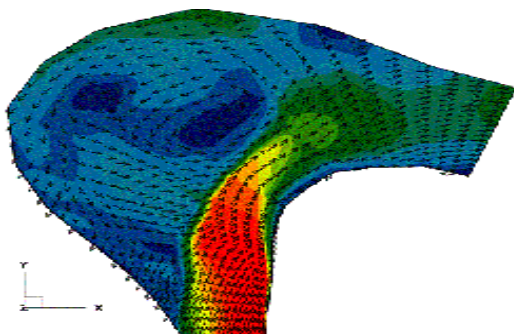


Fig.7 The streams counter of Shotteit River in Shushtar basin.

## VII. RESULT AND DISCUSSION

Study and development of civil engineering and structure architecture are important in using improved water resources for being efficient in life and progressing industry, agriculture and production too. Water and its resources such as surface water can be useful removing some needs of mankind. Programming, management, control and continuing considering about them are water engineering train in improving water resources and using usefulness of the matter. These items under a specialist team will be done more applied. However, avoiding from sweeping away water flowing in canal, penetrating into the coastal walls and water extension to floodplain are some material resulting from an optimum aqua management. River basins as secondary water bodies canal are among lands. If lands around rivers would be stable without slip and river direction is straight, sedimentation rate in coasts of river will be the most little. River basin under conditions that there wouldn't be floodplain, flood so sedimentation wont be considerable. According to the deby profiles, we could see maximum sedimentation deby in March. It is resulted from maximum fall so more water body in canal then. In the meander of river whirlpool or eddies are seen on the water surface, because of centrifugal forces effects from center of path curvature as an arch from a circular path. As a result rotator or secondary streams between two coastal lines in meander lead to transferring of sediments ingredients and increasing of sediment rate, destroying and internal erosion. So establishing resistant and waterproof coastal or rock or stone walls (sheet pile and...) along to coastal line in meander of river in indispensable. Also continues monitoring of streams profile model, reciprocal effect of river streams and coastal lines should studied, evaluated and managed. Other interesting point is that in the meander of river because of

centrifugal and accelerative force, the acceleration of sediment particles and dominant stream would increase, finally vortex secondary streams in river lead to coastal sediment and therefore destroying of coast. In the location under study of this research, establishing the regulative dam Band-E-Mizan and existing water control valves and directing it from that (0,1 of the total stream) to secondary channel and artificial lead to decreasing the amount of sediment rate and coastal destroying. River basins as secondary water bodies canal are among lands. If lands around rivers would be stable without slip and river direction is straight, sedimentation rate in coasts of river will be the most little. River basin under conditions that there wouldn't be floodplain, flood so sedimentation wont be considerable. According to the deby profiles, we could see maximum sedimentation deby in March. It is resulted from maximum fall so more water body in canal then. The most important factors for decreasing sedimentation rate in river basin are as below. We could get useful and applied results from researches like this article such followed notes:

- 1) Direction of setting dam should be straight in ratio to water currents of river for entrance after dam to optimize the efficiency that related to their structure.
- 2) Numbers of windows and gates on setting dam must be appointed correctly to apply exact control water body flowing in river or canal after setting dam.
- 3) Building of setting dam and establishing of the second canal in place of maximum curvature of river is an applied task to decrease the rate of sedimentation and bank erosion.
- 4) Fastening bank lines of river, building of river coastal walls and deepening of the river basin would be useful to avoid happening of flood around river.
- 5) Materials for building of coastal structures must be appointed resistant rather than water.
- 6) Flood currents and sedimentation in the river with high current velocity could be controlled by setting dam creation.
- 7) Superposition of surface waves and secondary flows with dam structure mouths can lead to decrease erosion and make a calm river.

## REFERENCES

- [1] Alleyassin A., (1995), Application of river engineering, Iran.
- [2] Mosaddad S.M. and Akhyani M., (2007), Coastal destroy due to river bending and drift of sedimentation due to piers. In: Proc of the Hydropower2007 International conference, Kandy, Sri Lanka, (2007), pp121-126.
- [3] Mosaddad S.M., Akbari Bidokhti A.A. and Ezam M., (2008), Current modeling considering civil engineering problems building coastal walls. In: Proc of the Fluid Mechanics Asian congress, Daejeon, South Korea, 2008, pp 234-241.
- [4] Delphi M., Mosaddad S. M., (2010), Physical modeling of water current in Karun River, Shushtar domain, Journal of environmental Science and Development, 2010, 4p.
- [5] Shames, H., (1999), Mechanics of Fluids, London, pp: 150-240.
- [6] Samuels, P. et al., (1889), Methodology for conveyance estimation in two-stage straight, slewed and meandering channels, 11p
- [7] Venyagamoorthy, S. and O. Fringer, (2005), Nonhydrostatic and nonlinear waves, Geophys. Res. Let., 32, doi: 10.1029/2005GL023432