Turbulence behavior Around Piers, a case study: Shadervan Bridge

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Abstract— Water science develops day to day because water and scientific matters about it are main human needs. Turbulence following currents and wave taking place as a result of effect of topography, lateral friction, structures and obstacles in water canal is required to be studied more. In this paper, an analytical modeling of the phenomenon is done around piers in a case zone on water rout in canal of the Karun river.

Index Terms— Turbulence, modeling, water current, debby.

I. INTRODUCTION

Study of phenomena occurring about water currents and debies in water basin like oceans, seas, rivers and lakes are important to be done under different conditions [4]. Turbulence and internal waves are two physical properties in this field which are generated in water column layers, physical properties gradients (like temperature) and friction of water basin topography and coasts [2].

After measurements in rivers, modeling of water current debies can be done there under lateral friction [3]. In fact knowing the up to date conditions and factors in the Karun river, Shoushtar domain, turbulence modeling and analytical and quality effects on coastline and floodplain will be studied; what could be adapted to other water basins like rivers and groundwaters.

II. KARUN RIVER DEBIES

The Karun is the biggest river in Iran that passes from Khuzestan state cities like shoushtar, Ahvaz and Dezful. It has some meanders on its canal affecting water and sediments particles movement. This phenomenon returns to centrifugal force effect and acceleration from it on water and sediments. Some different structures like dams, bridges and millers in the water canal influence on current trend. Piers in their positions affect on water current rout as an eddy pattern causing erosion and destruction [1]. In fact, turbulent behaviors of water currents debies around the piers destroy them. We can see turbulence and internal waves resulted around the piers in the case zone as in Fig.1 and Fig.2.

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Fig.1 Aero picture from the case study zone

Fig.2 Front picture form the case study zone

III. METEOROLOGICAL AND PHYSICAL PROPERTIES

Atmosphere and fluids (water) are a pair system affecting on each other about parameters and phenomena. Meteorological conditions in Shoushtar influencing on currents and turbulence so internal waves are as in the following table.

TAB.1 METEOROLOGICAL PARAMETERS IN SHOUSTAR

Max. value	Min. Value	Parameter
Dec.-Jan. 66	June 20	Humidity%
November 18.5	Summer 0	Rainfall(day)
July 38.1	January 13.4	temperature(c)

Measuring physical properties of currents in the Karun river canal was done in a regular program during summer and winter 2008, and then averaging them gave the following table of properties.

TAB.2 PHYSICAL PARAMETERS MEASURED IN THE CASE STUDY ZONE

E	g	η	H	P	W	V	U	season
109.54	9.8	0.1	3	1005	0.05	0.1	0.1	summer
140.87	9.8	0.12	3.1	1004	0.05	0.15	0.15	winter

IV. DATA ANALYSIS

Turbulence as a complicated and indirect movement with nonlinear behavior in equations dominant influence on boundaries and obstacles in water body [5]. This effect is

exhibited as erosion and gradually destruction dependent on water debby and sedimentation rate. The model used in turbulent behavior simulation applies Navier-Stokes equations jointing Boussinesque approximation; concisely as the below.

$$\frac{dU}{dt} = -\rho \nabla \rho - 2\Omega \times U = fu_g + fu_I \quad (1)$$

Where U , ρ , f and Ω are current velocity, water density, coriolis and earth angular velocity. Of course in rivers, as small scale that coriolis acceleration isn't considerable because of not being important the earth rotation effect, the last sentence in the left hand of the above formula is zero in this research.

V. SIMULATION RESULTS

Simulation of current and turbulence modeling around the piers in the Karun river, Shoushtar domain, resulted the trend as shown in Fig.3.

Fig.3 Turbulent current velocity around the piers

As we can see in the above picture, velocities are bigger near the pier and this is because of friction between water and the structure in form of lateral stress and this current is as a turbulent behavior. Also running the turbulence closure in the model, streamlines abundance of the currents around the piers in four sides of it in area of fluid in the river width shown in Fig.4.

Fig.4 Stream lines accumulation around the pier

Of course possibility of these stream lines around the piers

based on Pierson Moscowitch function exhibits the pattern of stream existence in space about them in the river width.

Fig.5 Possibility curves for stream lines occurrence around piers in the river width

VI. CONCLUSION AND DISCUSSION

As we know, Water current debies influencing lateral friction would vary and type of eddy as a torque caused by centrifugal force in the meander in adjacent of the piers. The effect of turbulent behavior is sedimentation, destruction and overallly erosion. In fact as following as current moment, internal waves happen and their influence would be observed in the position of the piers as it shown in Fig.3.

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