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Labrary Investing of Convergece Angle and its Effect on Hydraulic Parameters of Dam's Reservoi Inlet and Study of Progresive Velocity of Delta Through Reservoir

[1]Roozbeh Aghamajidi, [2]Amir Abbas Kamanbedast and [3]M. Shahosseini

[1]Islamic Azad University, Khozestan Branch,
Chief Supervisor of Mahab Ghods Consolidation Engineering, Iran
[2]Department of Water Engineering, Islamic Azad University, Ahwaz Branch, Iran
[3]Islamic Azad University, Shoshtar Branch, Iran

Abstracts: In this study; Sediment movement through Reservoirs is studied as function of different factors Such as; flow, Sediment particles, Geometery of River and Shape of Resorvirs. In this Research; It was assummed That movement velocity of sediment amount, is only function of Discharge variations, River sediment outcome, Water depth, Convergence angle of Reserveir Inlet. Moreover, Specific Data of basic action of Delta (at specific station) have been Studied and measured Carefully. Besides, with Using Dimension Analysis and study Results of exprement, It has relvead that linear Regressoon with Multy Dimensions of Delta movement toward Reservoine could been estimated carefully. This formlua consist of five parameters Such as; sepration angle, Time, Dischage, sediment Discharg and waterDepth as well. Due to weak predictibility ofFormula at first stages of progress, One expotential Model for this stage were utilized and work as modified coefficient. And finally had been test carefully thus. Combined model accompany modified linear Regression model had been analized. Statistical analysis of combined Model Shows that average and Variance index Values against relaive difference are 0/99 and 0.139 which is accuracy symbol & degree of Model.

Key words: Laboratory Expriment · Sedimentation · Dam's Reservoire · Delta progresive movement

INTRODUCTION

It has estimated that cumulting of Sediment at Reservoir were decreased 1% annully. When water move so close to Reservair, Sediment velocity and values ofTransported Sediment volume were declined quickly (near Inlet point).

There fore, almost amount of sediment volume were. Settled down through Reservoire. Coarse Sediment particles which are known as Sediment load, are setteled and Delta are formed naturally. very fine particles company flow were moved and, more or less, disstributed through almost all zones of Reservoise [2]. Delta profile could be separate in three distinguishable parts as below;

- Intial or uplstream Section of Delta.
- Volume of of cumulative coarse particles suchas: bebble, Sand or gravel. This zone are begun from Reservoire and continued to peak point of Delta crest which connect to delta toe. This section is known as delta face. This profile are gragually change and move to steeper slope (close to exposed angle of particles).
- The last section include very fine material which be seen at Lower layeres of Delta toe and the Seetion are formed [3].

Exprmental study and Nnmerical Investigation in this feild is always relat of to the suspended sediment, turbidity Current and Sediment load has not effective role in this section. Exprimental studyies due to sediment load have been done by different Scientist suchas: Hetels and parleer [4] fanand Morris [5] Red lcire [3] sheietal [5]. Almost all Expriments were Run at long Rectangolar Flume with Sudden opening Condition. Besides, Generally, Geometric and angle of Intet of River s, Change gradvally. Just only very few study were conducted about gradually opening. In their Research, It has been attemptted, Effect of convergence angle under hydraulic condition and different sediment movement due to delta progrss will be studied Carefully.

Corresponding Author: Roozbeh Aghamajidi, Islamic Azad University, Khozestan Branch,
Chief Supervisor of Mahab Ghods Consolidation Engineering, Iran.

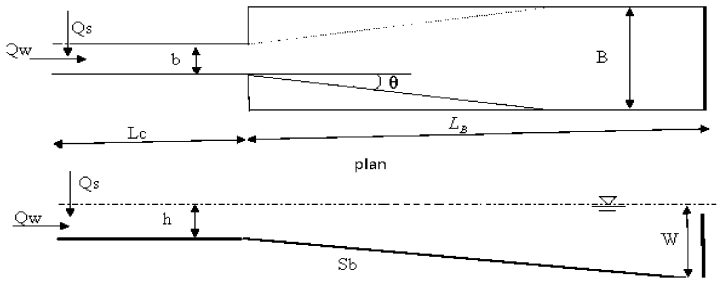

Fig. 1: Plan and profile of flume

MATERIALS AND METHODS

Expriment at one longitudal flume were test. Dimension of flome are 16 meter lenght, 60 cm Dopth, 1 meter width. Graph (1) shows plan and profile of Exprimental flume. First section is used as River with 5 meter lengtht, with is 16cm, depth is 60cm and bottom slope is about 2%.

Water source system and sediment injector are installed at upstream of flume. water Discharge Entering are Controlled with one Regulating valve. Sediment injection is used at every 0.5 meter from top of Chanel with. Electrical and mechanical device. Sediment particles type is sellis with average diameter equal to(D50= 1mm). Uniformity Coeticient equal to 1.88 and finally GS= 2.65.

In order to Regulate water depth of reservoire, pick point at Down stream of channel is used which is consisting of one Rectangular spill way with ability of Height Regulating and equppied with one redial regulate spill way.

Q_S : Sediment of discharge,
L_c : Length of channel,
Qw : Water discharge,
L_B : Resevoire length,
B : Width
W : Water depth of reservior,
B : Channel width,
S_B : Slope,
θ = Angle of opening

Dimensional Analysis: It has been assummed that, Effective factors at progresive lenght of Detta (x) is included, water Discharge (Qw), sediment Discharge (QS); water surface at Reservoire (w), width of Reservoire, River width (b), average e sediment particles (D50), angle of opening Inlet of Reservoire θ, bottom slope of Reservoire (SB), Sedimat specific density (ps), specific density of water (p), synematic viscoucityof water and time (T). This following Dimensionless formula and. Numbers were Concluded as below:

$$\frac{X}{W} = F\left(\frac{Q_S}{(gW^5)^{0.5}}, \frac{Q_W}{(gW^5)^{0.5}}, \frac{b}{W}, \theta, \frac{t}{(W/g)^{0.5}}, \frac{b}{d_{50}}, S_B, \frac{b}{B}, \frac{\rho_s}{\rho}, \frac{\mu}{\rho . g^{0.5} . W^{1.5}}\right) \quad (1)$$

Due to some values. Such as. b/D_{50} =160, S_b =.02, $PS/P = 2.65$ $b/B = 0.163$ are fixed in the test period, It could been able to ignore them. In addition, minimum values of parameter which show viscoucity Effect is:

$$\mathrm{Re}\, w = \frac{p . g^{0.5} w^{1.5}}{m} = 870$$

in which:

Thir valine is equal to. Reynolof Number of flow (59500) and show that flow is Compeletly Turbulent and Effect af nscousity is very low to consider, so, It has been driven as below:

$$X^* = F(Q_S^*, Q_W^*, W^*, \theta, T^*) \quad (2)$$

In this Study, Investigation of Different parameters such as flow and sediment, Depth of water, angle of openinig at Initial section of Reseveir at Different time, velocity and sckeme of basic movement of delta had been analyized carefully.

Expriment and Runs: Accoding to the Dimension analysis and studying different factors on the Delta development, some Expriments are regulated and programmed.

Tests include three different angle: 9.2, 11.5 and 15.4. degree; three water discharge. 4.5,9,18 (lit /s); three different sediment Discharges 45,90,130 (gr/lit) and there water depth 45,50,55 and totally, 45 expriments were run.

More over; to start, after regulating inlet discharge and depth at reservoir, sediment with specific discharge injected to upstream of cancel and Record began.

At sutable time step, when delta reach to specific point (station). All data were measured and record carefully with using specific devices, finally, profile changing and profil were conducted particurally.

It needs to add, water surface and profile pararelly at develop time of delta have been changed and were measured. observation and formation of delta has been recorded at rigth side of chanels.

DISSCUSSION AND CONCLUSION

Figure (2) illustrates depth of sediment with continous line and water depth(h) with dash line at different time and station which have been studied.

In the Exprimnt maximum water height and minimum sediment discharge are exit. delta would reach to end of transitionchanel. After 208minutes, (in experiment number 35 with maximum velocity and convergence angle = 11.5 degree) which maximum water depth and sediment discharge are observed.

Delta would arrived to end of chanel (time in equal to 5minutes), other condition of arrival time for different condition of discharge and sediment are located between 57 minutes to 202 minutes.

Exposed angle of sedimemt particles at submerged conditions and through different stages of progres were studied finally, it had been estimated between 30 to 40 degree.

In order to show better quantility and quality of water depth, flow discharger and time, one independent formula are used which demonstrates developing length as function, thus, the best liner regression of basic movement of delta are driven as below:

$$X^* = \alpha W^* + \beta Q_W{}^* + \gamma Q_S^* + \mu T_b^* + \delta T_b^{*2} + \phi\theta \qquad (4)$$

Difference between developed length and observed length $(\lambda = \frac{x^*bp}{x^*bq})$ are shown at Figure (3):

In which:

X^*bp = calculated developed lenght

It has been seen that observed and measured data at middle and end of length are so close to each other, But, at beginning stages, progresive length for almost of modelsdata is higher than laboratory results.

Due to weak predictibility of linear function at beging period of delta developing (x*b<1), another model wasInstalled.

Inorder to achieve new model: firstly, Due to time of movement for each experiment, one expotential function $(X_b{}^* = \eta.T_b{}^{*2} + \varphi.T_b{}^*)$ had used. Ceofficient of μ,φ are influenced by, angle of convergence, water depth, flow Discharge and sediment concentration. More over; optimized vakues were determined and finally the following Equation have driven as below:

Table 1: Cofficients of liner function

ϕ	$\delta \times 10^{-9}$	$\mu \times 10^{-4}$	γ	β	α	Coefficient
-4.059	-3.9	2.7	11.05	7.375	-0.379	Base

Table 2: Coffication values

μ'	γ'	β'	α'	ضرایب
-1.01	-2.93	-2.59	1.187	η ($\times 10^{-7}$)
0.42	4.02	3.32	0.039	φ ($\times 10^{-3}$)

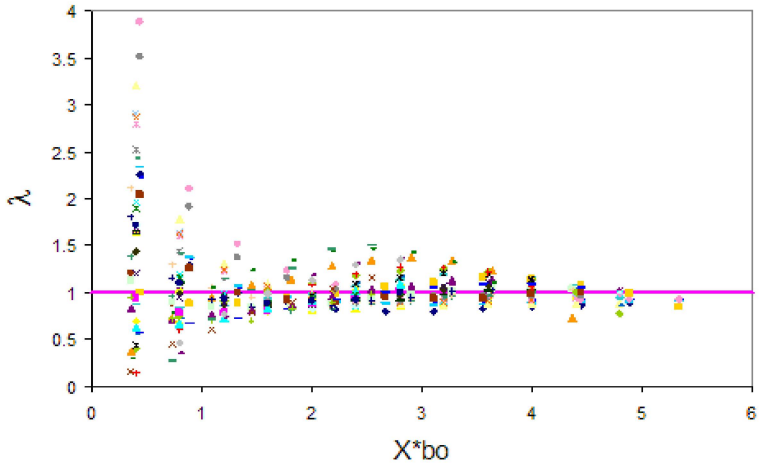

Fig. 2: Sample of sediment profile and water depth at different stage of detta development (Run24, with minimum velocity)

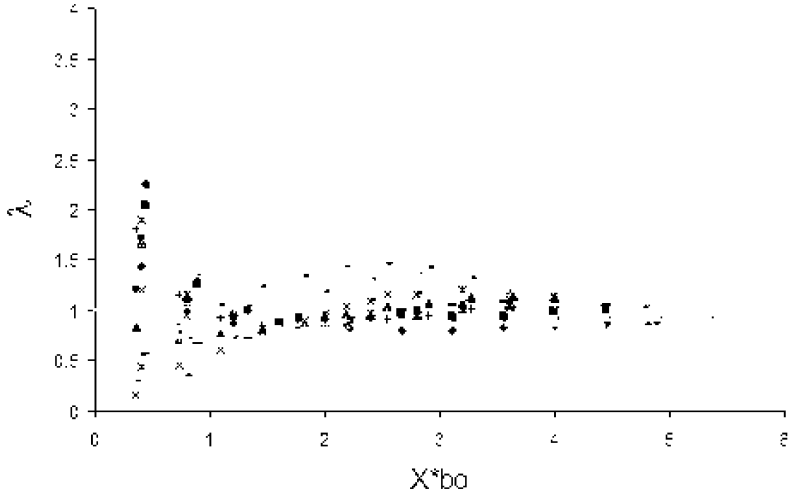

Fig. 3: Conparsion between relation progress length of observed and measured data –linear function

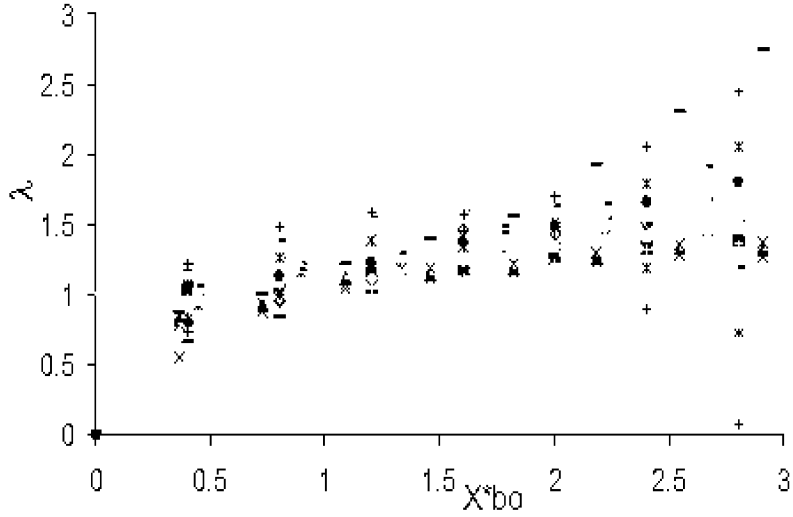

Fig. 4: Comporisam between relative length and calculated length from Delta Expetional Model

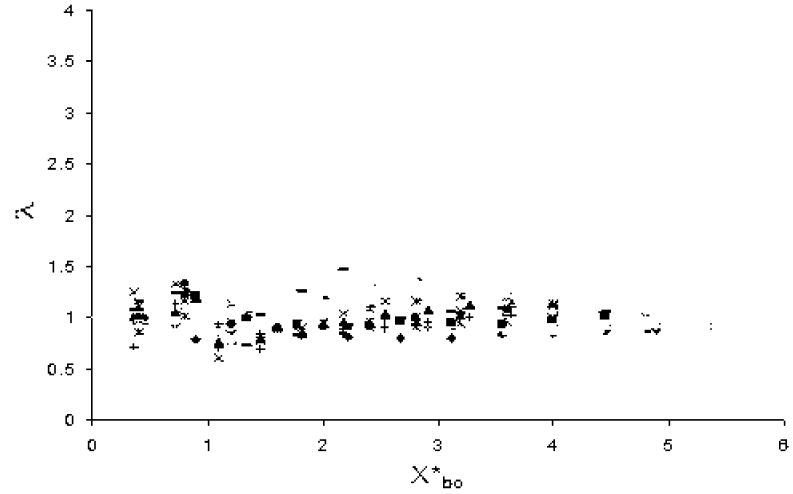

Fig. 5: Changes and vanations relative differences between basic progresive length of detta through observed values-combined model

$$X^* = \eta T^{*2} + \varphi T^* \quad (5)$$

$$\eta = f_i(W^*, Q_W{}^*, Q_S^*, \theta) = \alpha_i' W^* + \beta_i' Q_W + \gamma_i' Q_S^* + \phi'\theta, i = 1,2 \quad (6)$$

$$\varphi = f_i(W^*, Q_W{}^*, Q_S^*, \theta) = \alpha_i' W^* + \beta_i' Q_W + \gamma_i' Q_S^* + \phi'\theta, i = 1,2 \quad (7)$$

Estimated values of of η,φ are shown at Table (2). Besides, evaluation of this model for forward are as Figure (4).

It is need to be considered; this formula are not suitable for length less than 1, withexptantiol values. for better results; exptantiol linear fuction developed carefully.

Figure (5) showes combined Model for longitiudal profile of Delta at average and varanic of λ is respectively 979, 0.132. In other hand, at %95 probility percentage range, λ Is change form 0.74 to 1.32 which show acceptable function of model. this formul a could be able distribute to other condition.

CONCLUSIONS

- With using dimesional analysis, one equation, as multi variable liner Reggaerssion in field of basic movement of delta, provides. this formula is function of 5.paramers such as; angle of convergenco, time balance discharge, sediment concentation and water depth.
- According to week predictibility of linear formula at beging length of movement $(X_b^* < 1)$, one Expontatiol model $X_b^* = \eta . T_b^{*2} + \varphi . T_b^*$ are used for each expriment.
- Combind model with lineaer reggression and expetntial model are used at beging step of process and will developedthrough other section of experment.
- Staticial analysis show that average and variavce of relative differece of λ are equal to 0.79 and 0.132. in other word, λ at probilility level of 95 %, is moved from 0.74 to 1.34 and it showes that this process is very high Efficancy for model.

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