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

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Abstracts: In this study, Sediment movement through Reservoirs is studied as function of different factors such as: flow, Sediment particles, Geometry of River and Shape of Reservoirs. In this Research, It was assumed that movement velocity of sediment amount, is only function of Discharge variations, River sediment outcome, Water depth, Convergence angle of Reservoir 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 experience, It has relread that linear Regression on Multiply Dimensions of Delta movement toward Reservoir could be estimated Carefully. This formula consist of five parameters such as: separation angle, Time, Discharge, sediment Discharge and water Depth as well. Due to weak predictibility of formula at first stages of progress, One exponential 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 analyzed. Statistical analysis of combined Model Shows that average and Variance index Values against relative difference are 0/99 and 0.139 which is accuracy symbol & degree of Model.

Key words: Laboratory Experment · Sedimentation · Dam's Reservoir · Delta progresive movement

INTRODUCTION

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

Therefore, almost amount of sediment volume were settled down through Reservoir. Coarse Sediment particles which are known as Sediment load, are settled and Delta are formed naturally. Very fine particles company flow were moved and, more or less, distributed through almost all zones of Reservoir [2]. Delta profile could be separate in three distinguishable parts as below:

- Initial or upstream Section of Delta.
- Volume of of cumulative coarse particles such as: pebble, Sand or gravel. This zone are begun from Reservoir and continued to peak point of Delta crest which connect to delta toe. This section is known as delta face. This profile are gradually change and move to steeper slope (close to exposed angle of particles).
- The last section include very fine material which be seen at Lower layers of Delta toe and the Section are formed [3].

Experimental study and Numerical Investigation in this field is always relat of to the suspended sediment, turbidity Current and Sediment load has not effective role in this section. Experimental studies due to sediment load have been done by different Scientist suchs: Hotels and parler [4] fanand Morris [5] Red leire [3] sheitel [5]. Almost all Experiments were Run at long Rectangular Flume with Sudden opening Condition. Besides, Generally, Geometric and angle of Intet of River's, Change gradually. Just only very few study were conducted about gradually opening. In their Research, It has been attempted, Effect of convergence angle under hydraulic condition and different sediment movement due to delta progress will be studied Carefully.

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MATERIALS AND METHODS

Experiment at one longitudinal flume were tested. Dimension of flume are 16 meter length, 60 cm depth, 1 meter width. Graph (1) shows plan and profile of Experimental flume. First section is used as River with 5 meter length, with is 16 cm, depth is 60 cm 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 Channel with. Electrical and mechanical device. Sediment particles type is sells with average diameter equal to(D50=1 mm).

Uniformity Coefficient equal to 1.88 and finally GS= 2.65.

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

Q_w : Sediment of discharge,  
L_C : Length of channel,  
Q_w : Water discharge,  
L_R : Reservoir length,  
B : Width  
W : Water depth of reservoir,  
B : Channel width,  
S_b : Slope,  
θ = Angle of opening

time (T). This following Dimensionless formula and Numbers were Concluded as below:

\[
\frac{X}{W} = F\left(\frac{Q_S}{gW^0.5}, \frac{Q_W}{gW^0.5}, \frac{b}{W} \theta, \frac{t}{(W/g)^{0.5}}, \frac{b}{d_{50}}, \frac{b}{B}, \frac{\rho_s}{\rho}, \frac{\mu}{\rho g^{0.5}W^{1.5}}\right)
\]

(1)

Due to some values. Such as. \( \beta_{d_{50}} = 160, \ S_b = 0.02, \ \eta = 1.25, \ \eta = 0.163 \) are fixed in the test period. It could been able to ignore them. In addition, minimum values of parameter which show viscosity Effect is:

\[
\text{Re}_w = \frac{\rho g^{0.5}w^{1.5}}{m} = 870
\]

in which:

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

\[
X^* = F\left(\frac{Q_S^*, Q_W^*, W^*, \theta, T^*}{g}\right)
\]

(2)

In this Study, Investigation of Different parameters such as flow and sediment, Depth of water, angle of opening at Initial section of Resevoir at Different time, velocity and scheme of basic movement of delta had been analyzed carefully.

Experiments and Runs: According to the Dimension analysis and studying different factors on the Delta development, some Experiments 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 suitable 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 particulary.

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

**DISCUSSION 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 Expriiment 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 sediment 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 quantity 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:

$$X^* = \alpha W^* + \beta Q^*_w + \gamma \theta^*_w + \mu \theta^*_w + \delta \theta^*_w + \phi \theta$$

(4)

Difference between developed length and observed length ($\lambda = \frac{X^*_b}{X^*_b h}$) are shown at Figure (3):

In which:

$X^*_b$ = calculated developed length

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 was installed.

Inorder to achieve new model: firstly, Due to time of movement for each experiment, one experontial function ($X^*_b = \eta \theta^*_w + \phi \theta^*_w$) had used. Ceofficient of $\mu, \phi$ are influenced by, angle of convergence, water depth, flow Discharge and sediment concentration. More over; optimized values were determined and finally the following Equation have driven as below:

<table>
<thead>
<tr>
<th>Table 1: Coefficients of liner function</th>
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<tbody>
<tr>
<td>$\phi$</td>
</tr>
<tr>
<td>-4.059</td>
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</tbody>
</table>

<table>
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<tr>
<th>Table 2: Cofficient values</th>
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<tbody>
<tr>
<td>$\mu'$</td>
</tr>
<tr>
<td>-1.01</td>
</tr>
<tr>
<td>0.42</td>
</tr>
</tbody>
</table>

Fig. 2: Sample of sediment profile and water depth at different stage of delta development (Run24, with minimum velocity)
Fig. 3: Comparison between relation progress length of observed and measured data – linear function

Fig. 4: Comparison between relative length and calculated length from Delta Exptional Model

Fig. 5: Changes and variations relative differences between basic progressive length of detta through observed values-combined model
\[ X^* = \eta T^* + \varphi T^* \]  
(5)

\[ \eta = f_i(W^*, Q_{w*}, Q_{s*}, \theta) = \alpha W^* + \beta Q_{w*} + \gamma Q_{s*} + \delta \theta, i = 1, 2 \]  
(6)

\[ \varphi = f_i(W^*, Q_{w*}, Q_{s*}, \theta) = \alpha W^* + \beta Q_{w*} + \gamma Q_{s*} + \delta \theta, i = 1, 2 \]  
(7)

Estimated values of \( \eta, \varphi \) 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, with exptapolation values. for better results, exptantiol linear fuction developed carefully.

Figure (5) shows combined Model for longitudinal profile of Delta at average and varanic of \( \lambda \) is respectively 979, 0.132. In other hand, at %95 probability percentage range, \( \lambda \) 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 dimensional analysis, one equation, as multi variable liner Reggaersion in field of basic movement of delta, provides. this formula is function of 5 paramters such as; angle of convergenco, time balance discharge, sediment concentration and water depth.
- According to weak predictility of linear formula at beging length of movement (\( x_0^* < 1 \)), one Exponentil model \( x_0^* = \eta x_0^* + \varphi x_0^* \) are used for each experimnt.
- Combeld model with lineaer regression and expential model are used at beging step of process and will developedthrough other section of experimnt.
- Stattical analysis show that average and variance of relative differerce of \( \lambda \) are equal to 0.79 and 0.132. in other word, \( \lambda \) at probability level of 95 %, is moved from 0.74 to 1.34 and it shows that this process is very high Efficency for model.

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REFERENCES