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ORIGINAL ARTICLE

Effect of body inclination on leakage from homogenous mundane Dam with revetment upside

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ABSTRACT
With the aim of optimizing the use and storage of homogeneous earth dams to control runoff is to be constructed. One of the main causes of degradation of these structures is leaking from the hull. Seepage , infiltration or slow moving water through the soil mass .showed that by increasing the diameter of the gravel , reducing the hydraulic gradient and seepage velocity decreases and thus the outflow of the dam falls. The data obtained from a dimensional analysis of the relationship of the leakage through the dam coefficient $R^2 = 0.878$ *was obtained in a homogeneous state.*
Keywords: *Revetment diameter, homogenous mundane dam, experimental model, leakage from body*

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INTRODUCTION

Mundane dams are most usual small dams.For establishing of such dams, it is possible to use local materials. [1] Water leakage and way of its control in mundane dams, is one of most important problems which should be sepecially considered in exploitation by experts. Knowledge about effects of various parameters which affects on the leakage can help so much for fast solving of such problems. In general, for problems related to leakage, mundane stack can be considered as continous environments which have numerous continous pores. Therefore leakage is inevitable and Debby should be calculated accurately for optimizing the pass Debby. [2] Water leakage in mundane dams and its control way, is the effective step and is one of most important problems which should be considered by experts. [3] Sufficient knowledge about basical rules helps experts to prevent of occurrence of serious problems in leakage control and select best type of leakage control system. Up to now, researchers and experts have performed effective studies about relation of leakage and its control in mundane dams, but considering that each dams have special geometry and specific material. Occurred problems, especially in relation with its leakage, include special items. Upside inclination of mundane body of dams and spalls, are protected against strokes due to lake waves so as prevent form gradual erosion. Most usual layers over these dams, is application of spalls and they have specifics which are not aerated against surface flows and they resist against powerful forces due to waves in foul conditions.

Most usual factors in deterioration of mundane dams cause internal erosion events and leakage from body.Researches show that almost 30 percent are deteriorated because of leakage[2]. Leakage from body and also from beneath of dam are some of important factors in deterioration of mundane dam. In 1968, [4] provided a list of 600 dams which were deteriorated or caused incidents or even catastrophes. They proposed that most of deterioration of mundane dams included of contact of leakage free surface with downside of dam or creation of internal scouring by leakage flow inside the dam.

Dams are frequently badly damaged in earthquakes without an uncontrolled release of water taking place. This may be partly because irrigation dams are sometimes full for only a couple of weeks per year. For the Nihon-kai-Chubu earthquake in 1983 damage equivalent to failure was defined as follows [5]

- sliding of slope
- longitudinal crack more than 50 mm wide

- transverse crack
- crest settlement more than 300 mm
- leakage of water

To reduce energy leakage flow in saturated earthen dam several measures shall be takenwhich include use of a clay core, horizontal drains, sealing shields on the foundation of construction, condition and uniformity of grain size and density at the interface between soil layers and etc[6].

One method to maintain the safety of the Earth dams against seepage is to cover with riprap.

Foster et al [4] conducted a comprehensive study on dams, which found almost 30% of the damage done by the seepage Chapuis andAubertin [3]. For reduction of leakage flow energy of saturation in mundane body dams, there are various solutions which include: Application of clay core, horizontal canalization, establishment of dam buffer beneath foundation, considering grain condition and mundane uniform or compressibility in layer limits, etc.in which revetment on upside dam also can be used for reduction of leakage from the body. Numorouf obtained properties of homogenous mundane dam section by advanced mathematic relationships:

After a series of assumptions he concluded to this result:

$$q = \frac{k \times h^2}{[L + \sqrt{L^2 + (\frac{h^2}{3})}]} \quad (1)$$

q= passing Debby from width unit (m^3/s)
k=permeability of mundane (m/s).
h=Height of water behind the dam.
L=Dam length

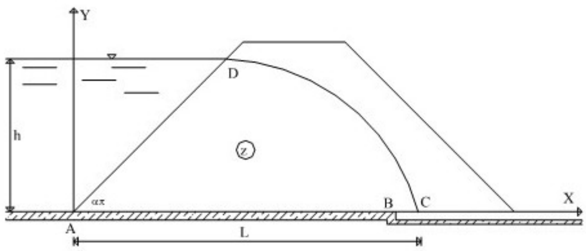


Figure 1: Numouroph's supposed section

After a series of assumption, he concluded that first equation has not so much engineering applications, so for simplification, he assumed (L/h (10)) and supposed π/2 for upside angle. And therefore he introduced a relative big error in equatioin. According to mentioned error, for reduction of errors and for compensating of shortcomings, it seems that for calculation of leakage through dam, more studies are needed. For reduction of such errors and compensating of shortcomings, (Merrandi et al , 1383) used software Seep-w to analyze Numouroph's model in controlling of homogenous mundane dams and they showed that this model does not give a proper approximation of passing debby and it has not enough accuracy for such calculations so they preposed their own suggestions.

Their suggestions are as follow:

Results obtained from passing debby is a function of parameters such as, h, cotα , cotβ and ratios of h/H and X/L and they presented relation no 2 which shows passing leakage from dam body.

$$Ln[\frac{q}{kh}] = -0.503 - 0.317\cot\alpha + 0.024\cot\beta + 0.763Ln[\frac{h}{H}] - 1.145(\frac{X}{L}) \quad (2)$$

q= passing Debby from width unit (m^3/s),k=permeability of mundane (m/s),h=Height of water behind the dam,H=Height of dam,L=Length of dam, cotα=downside angle, cotβ=upside angle,x= horizontal distance of canalization from upside of dam(m)

And they concluded: Ratio of increasing rate of passing leakage from dam body is increased as downside inclination and h/H amplitude increase. Ratio of increasing rate of passing leakage from dam body is increased as upside inclination and X/L amplitude increase.

Nazari Giglou and Zeraatparvar [8] were conducted many researches on the physical andgeometric factors of seepage problem on earth dams. They presented a simplified methodtoestimate seepage

through earth dams under steady-state conditions.Since effect of riprap arrangement and slope on seepage in homogeneous earth dam not been
considered yet, in this study this effect has been investigated.

MATERIALS AND METHODS

It is not possible to obtain relations for hydraulic events directly from realtions among fluid flow and present theories such as mass, energy or momentum conservation. In such problems, it is tried for extracting mathematic relation for such events; at first all of required variables for creation of such event should be specified. [9].General equation includes 10 variables. After calculation by Bakingham theorem, equation no.2 and no. 3, as modes with and without revetment respectively, were obtained:

$$f(\frac{h_2}{h_1}, \frac{Q}{\sqrt{g \times h_1^5}}, \frac{\mu}{\rho.\sqrt{g}.h^{\frac{3}{2}}}, \frac{b}{h_1}, \frac{d_m}{h_1}, S, Fr \quad (3)$$

h= Upside water height,dm= variable diameter of spalls in upside,h2=downside water height ,Q=downside output water Debby ,b= width of crest of dam,g=gravity, V=Average output water speed from downside,ρ= mass per volume unit (density), μ= dynamic viscousity, S=δh/δx dam inclination, in which δh is dam length variation and δh is dam height

Physical model

To study about revetment and inclination effect on leakage flow from homogenous mundane dam body, a physical model of mundane dam was established in a model in hydraulic labratoray of civil engineering group in Azad Islamic university in Dehdasht unit, as it is shown figure 1.

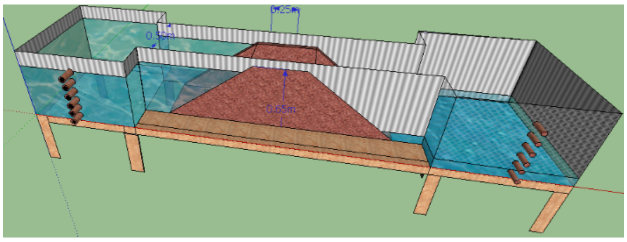
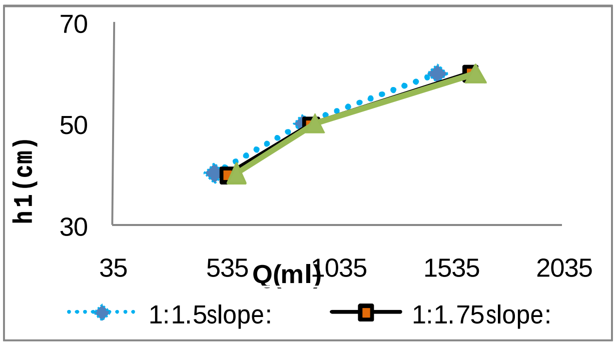


Figure3: general viewpoint:

Physical model body of model from galvanized iron and dam foundatioin from homogenous material are clay type:



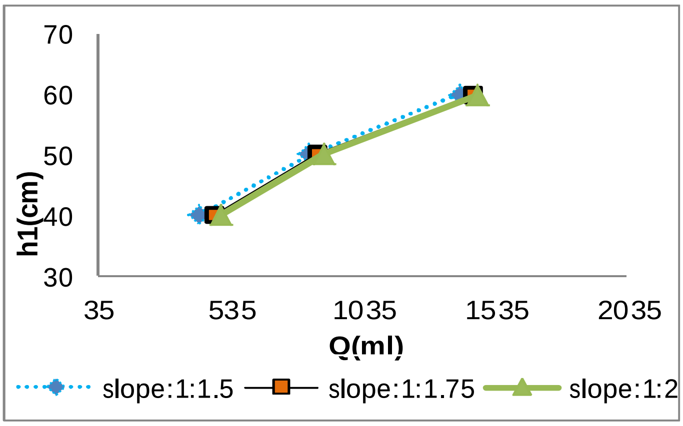
Graph 1:Comparison of outflow of the dam with stone(d50:2 cm)

Revetment diameter (cm)	Dam crest Length (cm)	Dam width (cm)	Dam height (cm)	Sides' inclination (-)	Number of built dams
2	50	25	60	1:1.5	1
3	50	25	60	1:1	2
4	50	25	60	1:2	3

For performing any experiment before starting, steps are illustrated. Therefore according to the aim of such research, following experiments were presented and studied.

1. Variation of height in upside of dam
2. Variation of inclination in upside and downside of dam
3. Variation of revetment diameter on body above upside of dam

Now, according to mentioned context, it is possible to explain experiments. At first, experiment condition of water in usual and without revetment is considered. Water in upside of dam was fixed in height of 60 cm and after full saturation of soil and establishment of leakage in downside, graded shaft and also by a timer for measuring time, passing leakage was measured. In such measurement, for increasing of accuracy equivalent to +_5ml was used. In each measurement, 20 minute time was considered and measuring was extended until output Debby reached to equilibrium (fixed) state. To obtain Debby (output water volume) it was devided by 20 minute. Then , Water of upside was reduced to height of 40 and 50 cm by application of pores embedded in Model body and type of measurement in such height 60 cm.



Graph 2: Comparison of outflow of the dam with stone (d50 :3cm)

Before starting of next step, water in tank of upside was discharged and revetment with average diameter 2cm, on body of dam with organized arrangement was executed. Steps in such stage were the same as execution in mode without revetment. In following, this experiments of 3 and 4 cm were repeated.

To accomplish of experiments, whatever was done for dam with inclination of 1:1.5 was repeated for dam with inclination of 1:1.75 and 1:2 and then obtained results were noted. Expriment steps are presented in appendix.

Then, results by statistical software of SPSS19 were analyzed and leakage line for whole network was illustrated.

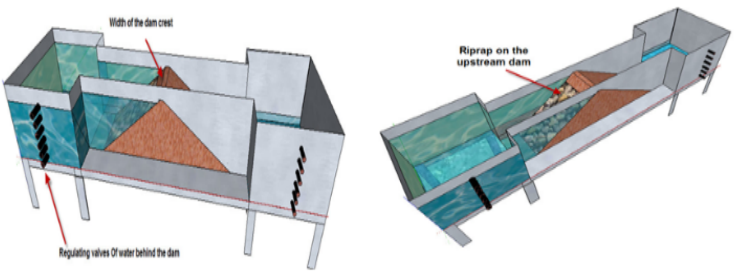
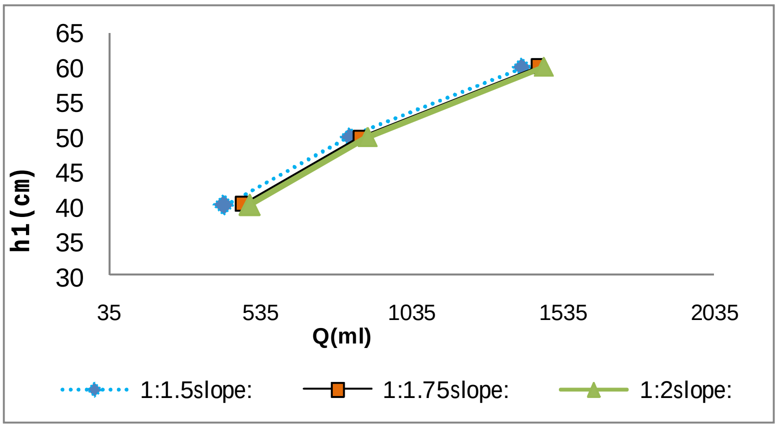


Figure 4: Running the tests

Analysis

Output debby form dam body

Obtained data from all dams was entered in software Excel and data was compared according following plot.



Graph 3: Comparison of outflow of the dam with stone(d50 :4 cm)

1. As revetment diameter increases, creep length cause decrease of debby from the body according to Leyn theorem.
2. Reduction of dam inclination causes increases output Debby from body in both mode of with and without revetment.
3.There is a direct proportion between upside height and output debby from body of dam. As height of upside water increases, output Debby increases, vice versa.

Analysis by software

According to number of variables, multiple regressions, which estimates amount of one dependent variable from few independent variable, is used. In mode of with and without revetment, numerous experiments were performed to obtain best covering curve of samples. Table 2, 3 and relation no5 and6, show obtained result form regression.

Table 2: Correlation coefficients and statistical variation

Signifi can				Standard error of estimate Statistics	r Been adapted into	r^2	r	Mod el	Test mode
	Sig. F Chang e	df	Changes F						Riprap
0.014	0.000	2	7.014	0.037	0.00004052	0.862	0.878	3	

Criterion variable $\frac{Q}{\sqrt{g.h_1^5}}$

Table 3: Regression coefficients are standardized and non-standardized conditions. Scree

	T	Standardized coefficients	Standardized coefficients are not					
Significa nt		Beta	Standar d error	B	Fixed values of predictor variables	Model	Template	Test mode
0.000	20.277	-	0.000	- 0.002	Constant	3	Step by Step	With riprap
0.000	- 6.077	0.558	0.000	- 0.003	$\frac{d_m}{h_1}$			
0.000	- 7.725	- 0.556	0.000	- 0.001	S			
0.014	2.648	0.244	0.017	0.046	Fr			

According to tables2 and 3, correlation coefficient is 0.862 which shows high accuracy of regression and as a result shows high accuracy of suggested equation no 5. According to table 3 and considering column B, equation no 5as suggested relation is presented as follow:

$$\left(\frac{Q}{\sqrt{g.h_1^5}}\right) = 0.002 - 0.003\left(\frac{d_m}{h_1}\right) - 0.001(s) + 0.046(Fr) \quad (4)$$

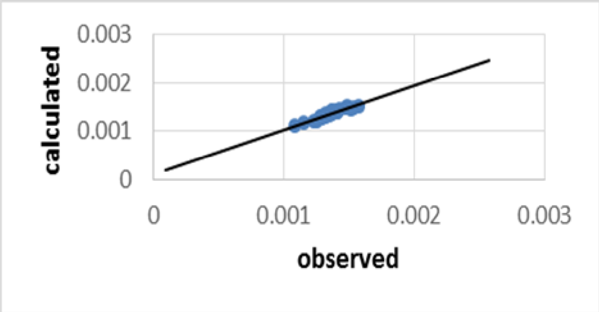


Chart 2: compares the regression equation and the observed values in the riprap

RESULTS AND DISCUSSION

1. Considering theorem of Lane, as revetment diameter increase, water creep length causes reduction of Debby from the body.
2. There is a direct proportion relation between upside water height and output Debby from dam body. As height of upside water increases, output Debby increases, vice versa.
3. as d_m/h_1 increasing associated with inclination of $\frac{Q}{\sqrt{g.h_1^5}}$,-7.01 was changed , which shows by increasing of revetment diameter , passing leakage from body of dam will be highly reduced respect to previous state.
4. As, upside water height increases and inclination decclerated, passing Debby from body of dam increases and as revetment diameter increases, passing Debby from body of dam reduced.
5. As output Debby from body of dam ($\frac{Q}{\sqrt{g.h_1^5}}$) increases, Froud's number (Fr) will be increased.
6. So, results show that debby is a function of effective parameters such as Fr,h_2/h_1, S, $\frac{V}{\sqrt{gh_1}}$, $\frac{d_m}{h_1}$, $\frac{b}{h_1}$

$$\left(\frac{Q}{\sqrt{g.h_1^5}}\right) = 0.002 - 0.003(\frac{d_m}{h_1}) - 0.001(S) + 0.046(Fr)$$

This relation shows amount of passing leakge in homogenous with revet cover by coefficient of R^2=0.878

REFERENCES

1. Manna MC, Bhattacharya AK, Choudhury S, Maji SC, 2003. Groundwater flow beneath a sheet pile analyzed using six-nodded triangular finite elements. IE(I) Journal.. 84:234-241.
2. Middlebrooks TA, 1953. Earth dam practice in the United States. Trans Am Soc Civ Eng. 118: 697- 722.
3. Chapuis RP, Aubertin M, 2002. A simplified method to estimate saturated and unsaturated seepage through dikes under steady-state conditions. Canadian Geotechnical journal. 38: 1321-1328.
4. Foster M, Fell R, Spannagle M, 2000. A method of assessing therelative likelihood of failure of embankment dams by piping. CanadianGeotechnical Journal. 37(5) : 1025-1061.
5. Gosschalk EM, Severn RT, Charles JA, Hinks JL, 1994. An engineering guide to seismic risk to dams in the United Kingdom, and its international relevance. Soil Dynamics and Earthquake Engineering. 13: 63-179.
6. Chuanfang KE, Yong H, 2010. Study on anti-seepage effect of Xiongjiagang earthrock dam based on cut-off wall schemes. Science Innovation Academic Frontier online journal. 134(4): 548–552.
7. Vafaeian M, 1998. Earth dams. In: Jahad Daneshgahi Press, 6st edn. Esfahan, Iran (In Persian).
8. NazariGiglou A, Zeraatparvar A, 2012. Seepage estimation through earth dams.Journal of Basic and Applied Scientific Research. 2(8):7861-7865.
9. Shafaei Bajestan M, 2010. The Basics and Applications of physical- hydraulically modeling. In: Shahid Chamran University Press, 2st edn. Ahvaz, Iran (In Persian).

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