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Analysis and Modeling of Landslide Surface with Geometrical Hydrology and Slope Stability: Case Study Ekbatan Watershed Basin, Hamedan, Iran.

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ABSTRACT

The idea Present in this research is a physical model for analyzing the relationship between shapes of slope (including the width of slope and the curving of the terrain) the reaction of hydrology and slope stability. This model includes three dimensions Geometry for compound slope, one model hydraulic for stability and other is for slope stability on the base extreme slope. The model hydraulic is made up of continues rivers and the shape of Senatic equation Darcy is obtained and also include the effect Topography slope the shape of plan and Curve profile Length. By changing these two topographies, nine main shapes for analysis the effect of hydraulic and the effect of those on the slope stability are used the results obtained except the roof slope the properties of slope topography the control of also controlled. (Plan shape and roof curving) and surface ground water slope also controlled. This process cause hydrological effect change and instability on slopes. According to the result obtained when the profile of slope is changed from convex to concave the stability of slope decreases. Also when the shape of plan slopes from convergent to divergent changes; the stability in many profiles section increases.

Key words: slope shape, profile length, slope stability and compound slope.

Introduction

The reactions of a slope in respect to the rain cause the relation between saturation and un-saturation results in the over land flow. In regard to the dynamic effect of a slope extremely depends on the shape of the plan and curve terrain and the angle of the slope. The water under ground in the compound slope (un constant) are needed [17]. usually for analysing three dimensions water underground model three dimension of Richard are used and solving this equation is difficult. For solving this problem Trochal in 2002-2003, model with least dimension are developed. By using these models they can change the shapes of the slope radically and the subsurface flow can be analyzed more over these models can change the width of the slope and morphology of three dimensions are taken into account.

So when we become familiar with those properties and factors, it will be possible for us to study the effects of them on deposit load process in drainage basin. On the other hand, in some basin which doesn't have deposit measuring stations, we could present suitable models through which estimating deposit load Process will be Possible [9]. Some researchers, for example Patton and Backer [13] and Shimano have divided the type of process by means morphometric rules and also have presented the drainage basin features in quantative and qualitive form. Tomas and Benson Said in a definite region which has similar climate and physiographic features, making connection between basins area and annual torrent (Flood water) average is possible. Blytch, Rodda, Stall and fok researches results have proved the Strong Connection between water discharge and river bank by Straheler technique. Morisawa [12] and Patton and Backer [13] respectively have used the number of first class (First rate) river and waterway length to make connection with discharge in Apalash Plateau and central Texas. Patton [14] Shows Slope increase effect on concentration time decrease and also mentions that this factor finally results in increasing torrents (flood waters). According to Carlston and Trainer, there is a reverse connection between drainage and base Current of river in east of united State and Putamak river basin while this Factor is in Contact whit annual torrent average. Ekerman also can present an equation which has high determination Factor by means of multi variable logarithmic regression method and some

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physiographic features of the basin to predict annual torrent average of drainage basin in Scotland. Jinse and Pinter make connection between eight Factors as water discharge area, height and length of main waterway and deposit load; they could present four logarithmic models for four types of climate. So it seems obvious that if we determine the morphometric factors which affects on deposit transport Capacity we will be able to present the most suitable deposit estimating model by means of morphometric features. In addition in this research we are trying to develop the three dimension morphology of the slope the effect of hydrology of compound and stability of those are analyzed. Why study a mass movement in the world is important, Ramakarishnan and Dai [2], method of study for recognition in a landslide area in a small area in Nilgiris Kothajiri based GIS (DEM). Ortophoto maps were prepared by means of aerial Ortophoto regional 1:8000. Layers of information and maps were Ortophoto, topography, land use, slope, soil, Lithology, topography and drainage network. These layers were divided by a combined GIS and finally to 4 regional study areas (areas with very high landslide risk, high, medium and low). The rainfall is a very important factor in the occurrence of topographic surface landslide to sue. Chance occurrence of slope landslide is increased with increasing intensity. Finally, the results showed that 6/64 percent of the actual landslides with high-risk areas are consistent over the 6/64 of a shallow will take place landslide surface or in the future high-risk areas. Baldieviezo [1] El Triunfo in the field using four-variable model based on slope, direction, and drainage patterns and land cover using remote sensing of topography and the results provided were severely affected by the landslide slope and is land.

Seczuk and Gardner in India introduced a systematic method for unstable slopes provided prone to slip. Parameters studied were the slope, drainage, slope gradient, direction and land use / vegetation.

Wang and colleagues [19] slip Yudonghe investigated in West Hubei Province in China. Weak zones, growth failure, slope downward geological layer and water penetration were considered as the most important factors in the landslide. Slope instability was analyzed by the method of Back Propagation Neural Networks (BPNN). The results of this analysis showed that the estimated slip Yudonghe currently is in a stable condition Pierluigi and Brandolini.

Materials and Methods

For analyzing the shape of Geometry of compound slope that also the profile of unflattened terrain and plan of inconstant terrain. One model shape of Geometry three dimension slopes is needed. In fact the profile of length controls the change in speed of flow and the shape of slope controls the concentration of subsurface flow especially in the entrance of the slope [18].

Geographical Situation of the under Study region:

Ekbatan dam drainage basin is 10 Kilometers for From the north- east of Hamedan and has 22155 ha expanse and is Situated in geographical limitation of $48°28'14''$ to $48°41'3''$ of eastern longitude and to $34°45'5''$ of northern latitude in Central Zagros. Maximum height of this drainage basin From Sea level is 3580 m. According to the Climatic data which Ekbatan dam Station presents (1366-1386), average of annual temperature of region is $+12.35℃$, the coldest month of year is Bahman (February) with average temperature of $2.3℃$ and the hottest month of year is Mordad (August) with average temperature of $23.4℃$.

Rainfall average of the region is 313mm in a year. On the basis of Ambrotermic curve of dry months of a year is Ordibehesht (April) till Shahrivar (July). Region climate on the basis of Ambereje method is middle of half dry Cold and half humid. There is three hydrometry Stations of Ekbatan dam, Ebero and Yalfan in this basin. Most Stones of the region are penetrative granite, metamorphic shiest and hornfels and Fourth period alluvium.

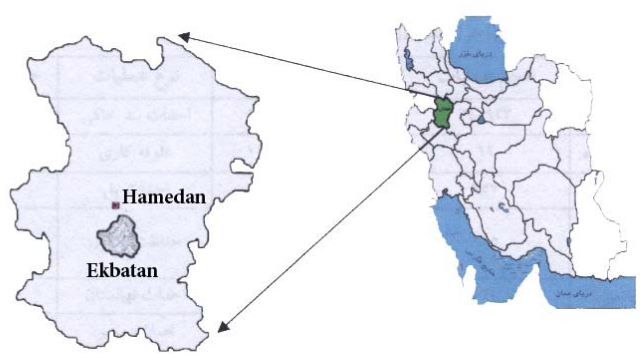

Fig. 1: Geography Situation Ekbatan Dam Watershed.

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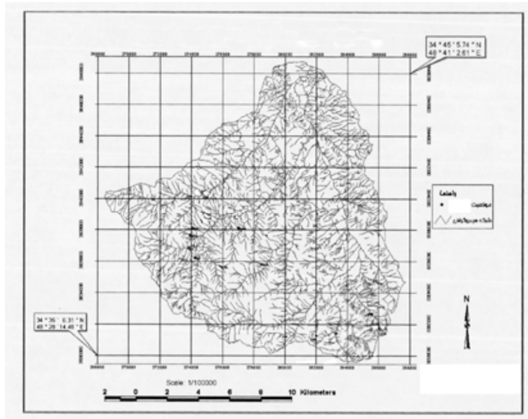

Fig. 2: drainage map of Ekbatan Dam

Geometry model slope:

The most complete model three dimensions for analyzing shape compound slope is Evans model that the relation of mathematics between the length, width and height in this model.

$$Z(X,Y)=E+H(1-{}^{x}/_{L})n+WY2 \quad (1)$$

That in this equation Z is the height X is the Length measured. In Low Y is the horizontal space of slope in vertical on Length E is the minimum height of the basically H is the difference height between the point of the entrance and the width of the slope.

L-length of the whole slope.

N -parameter curve of the Profile

W- Parameter of the shape slope.

In this way by changing these two parameters 9 shapes for the slope are obtained that are shown in the figure 3.

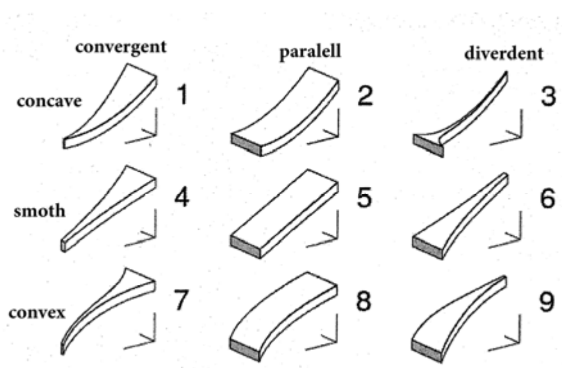

Fig. 3: Hydrology shape of the slope

The process of water flow in the soil and the formation of water level in the slope depend on the shape of the slope and the properties of hydraulic region. The Complete process is the Richard equation and solving this equation is difficult [8] for overcoming this problem recently fan and Bras [6] by presenting a tributary capacity and this equation has decreased the tributary capacity Therefore the most capacity of slope(Sc)is equal to fan $\propto$ [6].

$$Sc(x) = w(x)\ d\ (x)f \quad (2)$$

That it relates:

w- Width of the slope that each xd (x) depth of the soil in each x, f- porosity is effective. Actually the relation (2) affects the plan slope from the width changes and the effect profile length fnsm the depth of the soil is analyzed

Now by using the alternative of water depth H instead of the depth of soil, the moderate Scale of Supplement of actual slope S (xt) is equal to:

$$S\ (x, t)\ w\ (x)\ h\ (x, t)\ f \quad (3)$$

On other side having the scale of storage slope the scale of under water flow by using the equivalent change that has been obtained Darcy can be estimated. Actually in each Slope (Slope region) the syntonic equation is the most simple equation in math's and it is the most simple water flow under surface is shown.

$$Q=KS\frac{S}{F}\frac{\partial Z}{\partial X} \quad (4)$$

Those ks direction of hydraulic porosity of soil on the other side the dependable equation is equal to

$$\frac{\delta s}{\delta t}+\frac{\delta \varphi}{\delta x}=N(t)W(x) \quad (5)$$

That N the quantity of over flow water (vertical flow) in the region full of water: Now it is accordingly related to (H, 5) and solve relation (1) some store slope are given below

$$S(x)=\frac{fl}{nk_{sH}}\left[1-\frac{X}{L}\right)^{1-x} \; NA(x) \quad (6)$$

And at last for comparing the hydrology condition

$$\sigma(x)=\frac{s(x)}{s_{\theta}(x)} \quad (7)$$

It is obvious that the new relation is dimension less and for the whole slope it can used. In this way the whole parameter is analyzed again. In addition in this research each slopes equal to 100 meter accompanied by hydraulic 0.0001 meter in each second. The daily rain fall is 10 millimeter and the length of each d× is equal to 0.5 meter is taken into account Actually after nominating topography parameter in each slope some whole water storage and the actual water storage of slope (by using software Mat lab) in three different slopes are estimated that the results are shown in figure 2 As it is seen although all the hydrologic parameters in the slopes (ks, f, N ,L ,dx)are the same but due to some changes the geometrical slope shapes all the slopes the hydrological behavior are different fnsm the actual slopes and it is shown in(Figure 4).

The Analysis of figure 4 shows that the slope with the plan of convergent slope (1, 4, 7) and the concave profile slope (1,2,3) is the biggest region that have much water. While part of the exit slope number 1(profile concave and shape Convergent) has full of water while slope number 9 (profile convex and shape) are found with very less water.

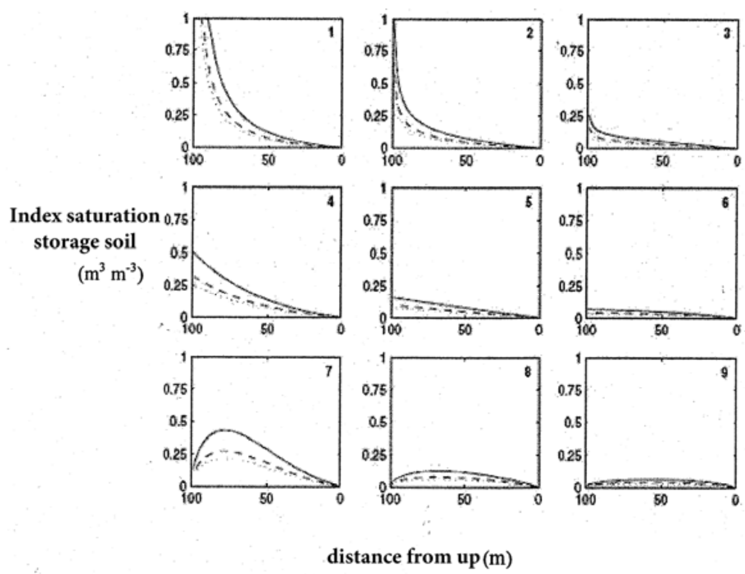

Fig. 4: changes in the hill slope storage (the surface of water underground) I the different slope (dots)

Slope 10 degrees .lines dots.

Slope 20 degrees and straight line

Slope 30 Linner

4- model base slope.

The study of slope stability base is equated double the base (FS) factor

The slope. Talebi et al and his coworkers (2208) for the equation below has estimated the average amount for the base (Fs) in the slope that with the actual condition of rainfall and it has been seen that

$$FS=\frac{1-\sigma(X)\left(\frac{pw}{p}\right)\cos^2 B(x)\,dx \tan\phi}{{}_{o}^{l}\!\int \sin B(X)\cos B(x)\,dx} \quad (8)$$

By using the related equation (10) some average Fs for different kinds of slopes are estimated (Figure 3)

By analyzing (Figure 3) we know that from 9slopes. Slope convergent has less resistance and during average rainfall, there is a great possibility of damage. The most resistance is concerned to convex slope and it is due to the changes in shape the region of water Source increases in the exit of slope. This effect is Seen in the concave slope, thus in a limited plan the slope convex usually there is less hill slope storage kinds of slope.

Shape 4: Average measurement for 9slope in the angle of slope (20°, 30° and 36°)

Result:

The model that are given in this research is a physical model that are made of three dimension hill slope with sine tic Darcy equation and is used for add hill slope stability. At the beginning of the profile length three concave shapes are needed. Smooth, curve and the plan shape slope have three types.

Parallel and they are divided .and they can have q natural shapes. According to the results obtained the hill slope mentioned above have the hydrologic properties, so that although the shape of hill slope are close to concave (divergent) to convex (Convergent) actually these are discussed that among the conditions of topography in addition to the hill slope stability some other profile and the shape of plane also controls the process of hydrologic hill slope and for stability and un-stability plays a vital role.

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