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LANDSLIDE FORCE ANALYSIS USING STOCHASTIC SIMULATION IN EASTERN SAMAR PHILIPPINES

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ABSTRACT

Landslide is one of Eastern Samar most dangerous catastrophes due to many lives casualties and delay transportation once heavy rainfall occurs or may even cause many deaths. This study was conducted to empower the residence in Barangay Maypangdan, Borongan City, Eastern Samar, of how dangerous this landslide may become once the nonstop rainfall occur. Measuring the intensity and duration of the rainfall, this study determined the amount of rainfall that triggers landslide, and the duration of rainfall. By using a simulation model, realistic events can be seen without having to experience a real landslide.

KEYWORD: *Rainfall Triggered Landslide Analysis Method, Stochastic*

INTRODUCTION

Landslides are a serious natural disaster in many countries around the world especially in highland areas during the rainy season (Banphot Nobaew, 2010).A landslide is a natural disaster and at the same time a human act. Landslide remolding can worsen the soil's geotechnical characteristics and lower the rainfall threshold. If rainfall events are separated by long intervals, there may be sufficient time for the soil layer to recover resistance, a process known as slope ripening (Crozier, 1986).Human act can lead to a landslide through the thoughtless overload of a road bordering canyon, constructions done without the proper materials and removal of vegetation cover and deforestation and lastly, farming practices. This disaster has a big effect to the community near the area it can kill, injure people and animals and can destroy the houses and other infrastructures like roads, electricity and also the source of income of the people.

Simulation studies have been conducted to predict possible causes of a natural phenomenon. This study constructed an analysis simulation for landslide to be able to identify when would be the possible time that the landslide may occur according to the rainfall. Researcher used the stochastic method by simulating a random possible amount of rainfall that may analyze statistically, a separate sequence of events in time. This simulation aims to analyze what might be the result of a certain force of rainfall and soil data. This study showed the result of landslide considering the amount of rainfall, duration and intensity.

Landslide Analysis Simulation in particular, is useful in estimating and modifying landslide risk, not merely to estimate the damage of landslide but how the landslide may occur and what is the certain scenario that can produce the landfall. The purpose is to look for the possible scenario and the possible damaged area by looking the amount of rainfall that can trigger a landslide. This simulation or study can forecast what would be the possible incidents that can happen if a heavy rainstorm will occur.

The general topography of Maypangdan, the research locale, is generally plain and its soil type is Catbalogan (Silty)Clay loam. Its existing land uses is classified into four: namely, agricultural area which has a total area of 173 hectares, and; the remaining are the swamps, marshes and mangroves which have a total area of 50 hectares. There are vegetative covered areas, like the logged-over area which has an are

254m and is 10 km away from the community proper, and 20 hectares of a messy forest which is 11 km away from the community proper(Bryg.Maypangdan Council).

Objectives of the Study

This study aimed to:

1. Simulate the occurrence of landslides in Barangay Maypangdan, at varied rainfall estimates.
2. Determine the accuracy of the Simulation model.

METHODOLOGY

System Development

This study used the RAD Model or Rapid Application Development Model in the experimentation and development of the landslide force analysis. This is similar to the incremental model and waterfall model. In the RAD Model, development should be done in a specified time frame (Dhivakaran.JM).The researcher used this model because it is flexible and adjustable to changes, suitable for stochastic method in simulation development and it emphasizes several repetitions of modeling and construction, or code, integration, and test and evaluate the projects in small pieces until the project is done.

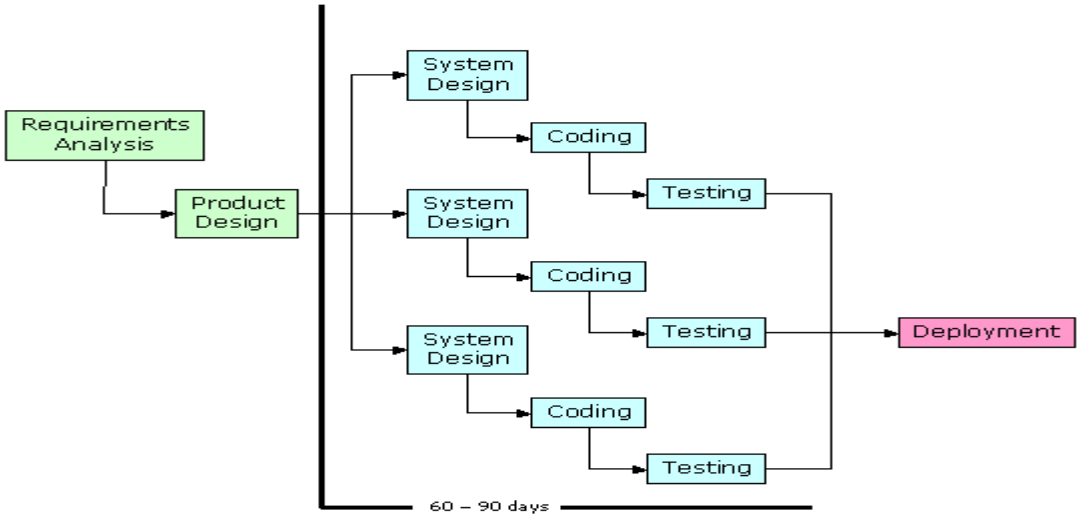

Figure 1 Rapid Application Development

Evaluation

Research Design

Experimental research design was used in the study. A landslide force simulation was conducted with the used of blender and unity application capable of conducting experimental analysis.

Rainfall Triggered Landslides (RTL) analysis methods

An RTL approach operates in terms of triggering and non-triggering events but this boundary is not always sharp. It is often useful to consider a minimum and a maximum threshold. The minimum threshold is the minimum-rainfall which triggers at least a landslide whereas the maximum threshold is the minimum value which always triggers a landslide (Crozier, 1986).

Caine (1980) suggests a general threshold works for time periods between 10 minutes (minimum) and 10 days (maximum).

Based on the analysis in terms of rainfall intensity (I, mmlhr) and duration (D, hr), the relation can be expressed as:

$I=14.82D^{-0.39}$

Every 14.82mm of rain per hour plus a duration of 0.39 hours or 23.4 minutes.(Rainfall as a landslide triggering factor: an overview of recent international research, *po/ernio !vi. &petrucci* 0.)

It was found that a minimum antecedent rain (AR) value of 960 mm was required to trigger debris in Barangay Maypangdan, Borongan City. The most significant ID value to identify landslide triggering storms, once the AR had been met, is:

ID=8mm/1hr*24hrs (5d)

ID means intensity-duration parameter, 8mm rain per hour (intensity) and duration of five days.Millimeter (mm) Hours (hrs.) Days (d)

Shear Stress/Shearing Force

The soil box employed is 220 cm long, 80 cm wide and 100 cm high. Because typical depths of failure in actual slopes are quite shallow, testing was conducted at low effective confining pressure (_3 = 15 _ 50 kPa), (Rolando P. Orense, 2004)

RESULTS AND DISCUSSION

This chapter presents the result and discussion based on the inputs rainfall (a) sample input moderate rainfall (b) sample input heavy rainfall and (c) sample input landslide occurred.

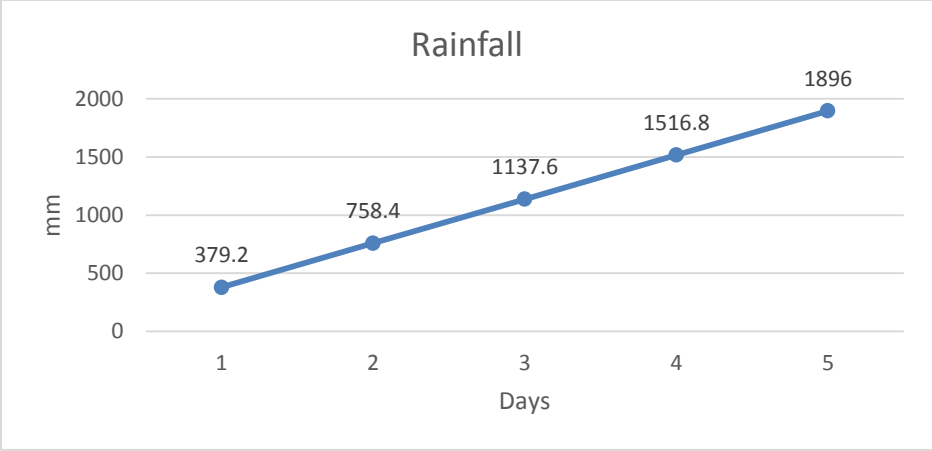

Figure 2 In the Graph above shows the duration and amount of rainfall per day. The left side of the graph is the amount of rainfall per mm, 5 days of duration, and the value of rainfall per day.

Screen Shots

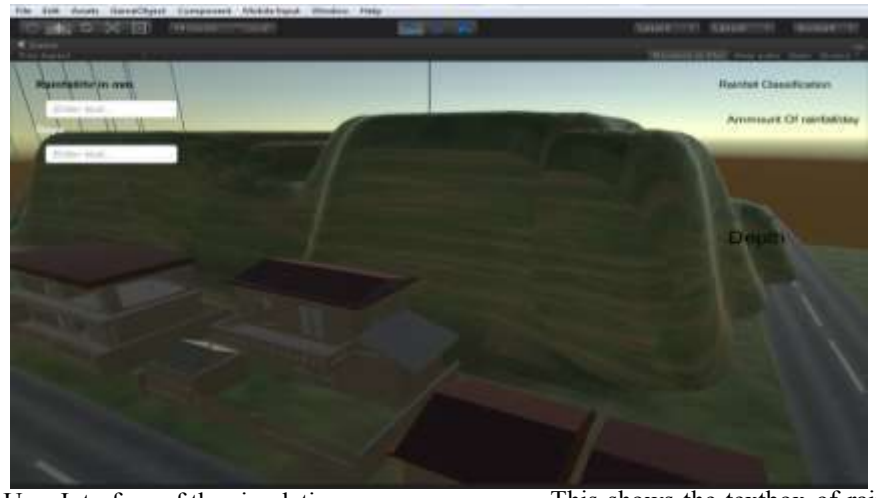

Figure 3 User Interface of the simulation process

This shows the textbox of rainfall, duration and some functions, the amount of rainfall and duration.

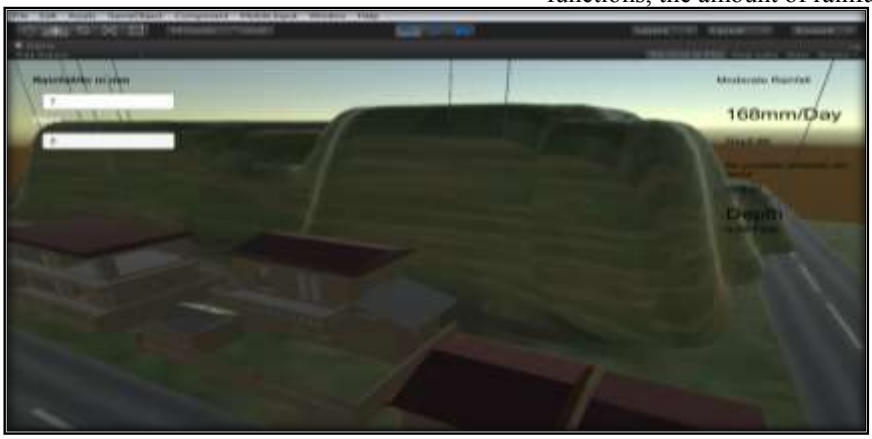

Figure 4 User interface with sample input of moderate Rainfall.

This shows the result of sample input moderate rainfall, rainfall amount in a day and result if the rainfall can trigger a landslide.

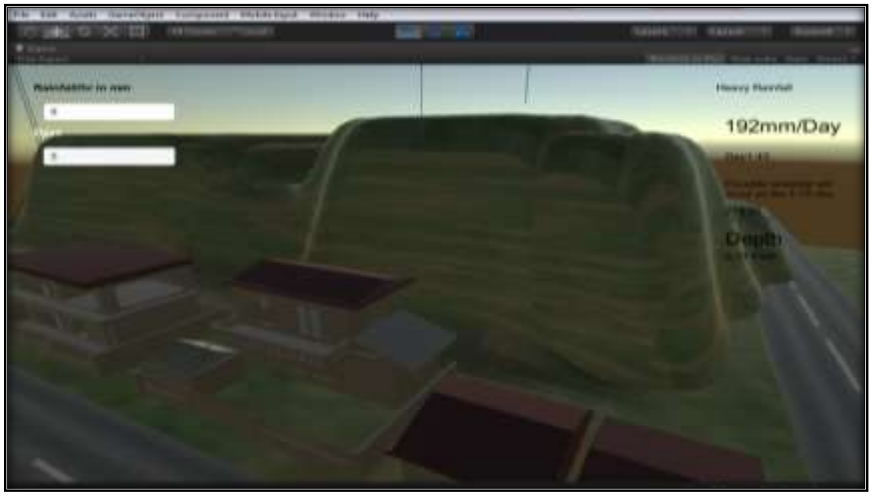

Figure 5 User Interface with sample input of heavy rainfall

This shows the sample input of heavy rainfall and the amount of rainfall that can trigger a landslide

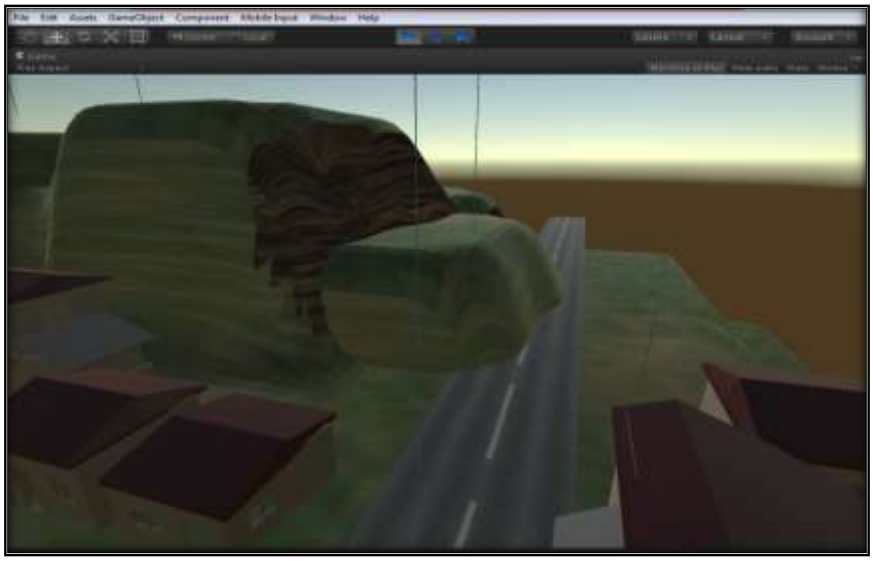

Figure 6 User interface with the landslide occurring

This shows the area that would be damaged if the landslide occurs.

Output/Report Screenshots

Table 1 Simulation result

Input Rainfall(mm)		Input Duration(Day(s))	Result	Possible landslide occur on:
Intensity	Intensity/Day	5Days		
4.3 mm	103.2mm	516mm	No possible landslide	-
6.7mm	160mm	804mm	No possible landslide	-
8.2mm	196.8mm	984mm	Possible landslide	5th day
9.4mm	225.6mm	1128mm	Possiblelandslide	5th day
15.8mm	379.2mm	1896mm	Possible landslide	3rd day

Table 1 shows the calculated rainfall input testing. First, 4.3 mm per hour, 103.2mm per day, 516mm in 5 days and as result no possible landslide occurs. Second, 6.7mm per hour, 160mm per day, at 804mm in 5 days and as a result, no possible landslide occurs. Third, 8.2mm per hour, 196.8mm,at 984mm in 5 days and as a result possible landslide occurs in the 5th day. Fourth, 9.4mm per hour, 225.6mm per day, 1128mm in 5 days and as a result possible landslide occurs in the 5th day. Fifth 15.8mm per hour, 379.2mm, 1896mm per day and as a result possible landslide occurs in the 3rd day.

CONCLUSION AND SUGGESTION

Conclusion

From the study and experiment conducted and the result produced the researcher conclude that:

1. The researcher were able to determine the amount of Rainfall that can cause a debris;
2. The researcher were able to know what day would the landslide will occur,

Suggestion

The researcher recommended the following:

1. Mass volume of soil should be presented, because it's one of the most important factors in the occurrence of landslide;
2. The accurate Slope and elevation of mountain should also be presented, because it is has a large effect, and;
3. Future researcher conducting the same study, are recommended to choose the area that has a fixed data to get the accurate output.

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