BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

ANALYSIS OF SLOPE STABILITY USING LIMIT EQUILIBRIUM METHODS

CASE STUDY: TORORO CEMENT STONE QUARRY

BY

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ABSTRACT

Lime stone extraction has been practiced in the Eastern region of Uganda especially Tororo district. The method of mining used is quarrying however this forms a hanging wall of about 91m high which may become unstable with time. Therefore slope stability analysis was performed to assess the slope deformation, state of stresses at critically instable failure zones, different failure modes and safe & functional design of excavated slopes using the Limit Equilibrium method. The purpose of slope stability analyses by Limit equilibrium is not only to assess the overall stability of retaining wall, but also including redesign and reduce on the hanging wall of Tororo cement Stone quarry so as to reduce on chances of wall collapse, avail safe working conditions to workers. Slope/W and Seepage/W programs were used under Geo-studio software to analyses ability of the slope. The research was aimed at study of stability of slopes using Limit Equilibrium Methods (LEM), at the same time study the different failure mechanism which may arise in the quarry. The purpose of this project is to assess the overall stability of retaining walls and redesign the quarry so as to reduce on chances of slope failure to avail safe working conditions to workers and machines.

Based on parametric studies it can be concluded that slope angle plays a major role on slope stability. Safety factor varied from 0.77 to 1.53 for varying slope angle of 35^0 to 75^0

Also increasing the height of the slope, decreased the factor of safety indicating less stability. Therefore, it is recommended to maintain the overall slope angle not steeper than 55 degrees in the quarry. It's also recommended that for improving the reliability of model results, calibrations of models with actual field conditions may be taken of through piezometric monitoring and measurement of slope moments in varying geo-mining condition at different quarry sites.

Declaration

I KYOZIRA PHIONA, Reg. No BU/UG/2012/104 hereby declare that this research project is my original work except where explicit citation has been made and it has not been presented to any Institution of higher learning for any academic award.

Sign: .....

Date: .....23rd..... May. 2016

Approval

This is to certify that the research project under the title "analysis of slope stability using limit equilibrium methods" has been done under my supervision and is now ready for examination

Mr. TUGUME WYCLIFFE

Department of Mining and Water Resources Engineering

Sign: .....

Date: .....

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DEDICATION

I dedicate this final year project proposal report to all my family members; Mum; Ms. Nabirye Beatrice, Brother Migoli James Fred, Sister Tagonza Lydia Letisha for mentoring and the financial support they offered me.

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ACRONYMS

FOS Factor of safety

GPS Global positioning system

LEM Limit equilibrium method

UCS Uniaxial compression strength

RQD Rock quality designation

Cm centimeters

RMR Rock Mass Rating

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CHAPTER ONE: INTRODUCTION

1.1. Back ground

Slope stability analysis is an important factor for planning and design of slopes in surface mining methods. This results into stabilization of working areas, extend on the life of a mine and reduce on costs which may occur as a result of instability (Bye & Bell, 2001).

The overall slope for quarries range 45^0-60^0 (Duncan, 2005), however, at Tororo cement quarry the angle is 75^0 due to impurities contained in the ore of the slope wall. As a result of neglecting the standards of slope design in mines, slope failure results. Slope failures are natural geo-hazards that occur as material move downwards due to gravity and shear stresses exceeding the shear strength. Other factors that lead to such hazards are presence of water, vibrations due to blasting and rapid snow melting and processes. Problems arising from slope stability have been faced by mine workers in the history of mining and construction (roads, tunnels).

For that case Tororo cement quarry is to be analyzed for stability. Tororo Cement Limited is the largest manufacturer of cement in Uganda, producing an estimated 1.8 million metric tons annually (Mugabe, 2015). In July 2015, it began a US$25 million expansion to increase annual production to 3.0 million metric tons (Odeke, 2015). With this expansion, it shows that there is need for more lime stone reserves. Limestone mining has been carried out at Tororo quarry using quarrying method of extraction but not practicing the proper standards of slope design. This creates a high hanging wall at the quarry which puts the workers and machines at a risk of slope failure.

Due to the above and the increased demand for engineered designs, mine sites have led to a need for an understanding of the methods of slope stability analysis, stabilization methods to solve slope failure issues. Stabilization involves realistic methods modelled, which must be understood, in a special way; interpretation of the rock properties, hydrogeological conditions and the geology of the area are key points in the analysis of the slope stability.

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