

Declaration

I, Kalaka Nashel, do hereby declare that this work was produced by me, with valuable assistance from various people from Kansanshi Mine and within the School of Mines. I therefore declare that, to the best of my knowledge, this document, ably supervised by **Professor Radhe Krishna**, has never been submitted anywhere else, except to the University of Zambia for the award of Masters of Mineral Sciences (M.Min.Sc). All works of other persons have been duly acknowledged.

Researcher Scholar Signature.....

Date.....

Clear Certificate of approval

This dissertation of Nashel Kalaka is approved as the fulfilment of the requirement for the award of the degree of Masters of Mineral Sciences in Mining Engineering by the University of Zambia.

External Examiner: Professor.....

Signature:

Date:

Supervisor: Professor R. Krishna

Signature:

Date:

Internal Examiner: Professor M.W. Chanda

Signature:

Date:

Internal Examiner: Dr. A. Ahmed

Signature:

Date:

Dedication

This work is dedicated to my beloved family. For sure, you have been through thick and thin to see me to where I am today. You may not know the joy that I derive from you. Your efforts have not been in vain but will soon come to fruition.

Most important of all, I thank **GOD THE ALMIGHTY** for guiding me throughout the journey and for proving to me that He is the source of my strength, knowledge and refuge. Indeed, *“I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong, neither yet bread to the wise, nor yet favour to men of understanding, nor yet favour to men of skill; **but time and chance happens to them all**” (Ecclesiastes 9:11).*

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A number of individuals have made important contributions in the form of critical comments, detailed discussions or the provision of specific data. It would be impractical to list all of these individuals but the most significant contributions were made by **Professor Radhe Krishna**. I would like to sincerely thank him for the material and support rendered to me throughout the development of my research.

I would also, further want to thank Professor Mutale Chanda for his heart-felt and made many valuable suggestions for improvement and comments on each section of this research.

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ABSTRACT

The objective of this research was to characterise the rockmass to determine appropriate support system for the decline with the 4.5m height and 4m wide in highly aquifer strata, recharging the water flow of 18, 000 cubic meters per day. As a result production targets reduced due to excessive water coming from subsurface strata or water bearing structures.

This study reviewed the most used universally classification methods in the mining and tunneling systems for support design purpose, such as the Rockmass rating (RMR) and Q-System. The design methodologies that were used in this research involved site visits, geotechnical mapping to determine structural orientation on the portal position, core logging and software application to determine effective support system.

The data obtained in the mapping exercise was subsequently used to analyze the differences in rock mass conditions in areas of different formation. The rockmass was divided into domains of similar characteristics and into the expected formations of similar rock properties. The study established that, the support systems should be both passive and active (hybrid support). Besides in this research it is established that, the use of mesh wires and shortcreting constitutes the major portion of passive support. While cable bolts, rock bolts constitutes active support.

The study concluded that, the method of applying rockmass characterisation using either the Q-system or rockmass rating proved to be a quick, easy and effective methodology to determine appropriate ground support design for any ground conditions. Recommendations provided to design support system were based on the results obtained from rock mass characterisation using the Q-system and rockmass rating.

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