VALIDATION OF THE ROCK QUALITY TUNNELING INDEX, Q-SYSTEM, IN UNDERGROUND MINE TUNNELING ON A SOUTH AFRICAN PLATINUM MINE

by

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DECLARATION

All the information gathered including the literature survey and underground q-observations done in this thesis were compiled by myself. The fall of ground statistics were obtained when completing the mines code of practice and was further modified into a presentable format. All the interpretation and concluding remarks were completed by myself to substantiate the work. I thus declare that this thesis which I am submitting to the University of Pretoria for the Master's degree, represents my own work and has never been submitted by me to any other tertiary institution for any degree.

ABSTRACT

The South African mining industry has been dominated by experts on stope and tunnel support design for gold mines in the last 50 years. Little work to date has been done on the Bushveld Complex Platinum and Chrome Mines. Many questions still remain to date how to properly design support in a quasi-static environment using geological characteristics as an indicator and design tool. Many believe empirical means are best to establish design criteria for the Platinum and Chrome Mines. The question remains how to go about establishing a sound empirical approach to generate reliable design criteria.

In the platinum-mining environment poor rockmass support interaction has been associated with highly jointed and low friction rockmass structures, as well as the fall out of blocks between support units, where highly persistent vertical jointing is present.

This thesis will provide a simple approach in analysing existing critical rockmass parameters and provide information with an empirical validation method based on Barton's Rock Tunneling Quality Index, Q, for rockmass conditions found on a typical South African Platinum mine.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

PLATE DESCRIPTION

I. 10 Level Crosscut No. 9-Shaft – Impala Platinum – 640m below surface

PLATE 1	Photo showing typical joint spacing, infilling, joint roughness (i.e. undulating)
PLATE 2	Pegmatite vein with sympathetic jointing
PLATE 3	Photo showing typical joint spacing, infilling, joint roughness (i.e. Undulating, planar)
PLATE 4	Photo showing tunnel profile with no support installed
PLATE 5	Dyke intruded with altered infilling, joint roughness (undulated)
PLATE 6	Hangingwall at wide section, keyblock fallout's, joint angle at 70 degrees from the horizontal. Hangingwall supported with 12mm diameter shepherd crooks, 1,8m long, typical spaced 1m apart
PLATE 7	Section with relative low angle (i.e. 50 degrees) sympathetic jointing with Cross-jointing intersection close to a fault plane Perpendicular discontinuous jointing between main joint system – Could be related to inherent stresses from fault planes
PLATE 8	Section with relative low angle (i.e. 50 degrees) sympathetic jointing with Cross-jointing intersection close to a fault plane Perpendicular discontinuous jointing between main joint system – Could be related to inherent stresses from fault planes
PLATE 9	Tunnel 4,8m wide at this section
PLATE 10	1,8m long, 12mm diameter, shepherd crooks installed at the normal 1m spacing. Little jointing is found at this wide section
PLATE 11	Tunnel profile, with only eyebolts installed. Again limited amount of jointing found
PLATE 12	Tunnel profile, with only eyebolts installed. Limited amount of jointing found
PLATE 13	Joint spacing, infilling and joint roughness (undulating)

II. 23 Level Incline No. 14-Shaft – Impala Platinum – 1054m below surface

PLATE 28 Internal angle of friction measured on site at 35 degrees

TERMINOLOGY

Aperture	The perpendicular distance between adjacent rock surfaces of a discontinuity
Block size	Rock block dimensions resulting from the intersection of joint sets and resulting from spacing and orientation of the individual sets
Critical Bond length	That minimum bonded length of a particular tendon and grout combination that develops a pull-out resistance equal to that of the tensile strength of the tendon
Filling	Material that separates the adjacent rock surfaces of a discontinuity and that is usually weaker than the parent rock.
Joint	A break in the rock of a geological origin, not man made, along which there has been no visible displacement or movement.
Joint Set	A group of joints, which run parallel to each other
Joint System	If joint sets intersect they form what is called a joint system.
Persistence	The discontinuity trace length observed in an exposure Termination in solid rock or at other discontinuities reduces persistence. Describing the areal extent or size of a discontinuity within a plane
Random Joints	Joints which do not have the same orientation as the joint sets observed. They are not visible for long distances, only a couple of centimeters or perhaps meters
Rockbolt	Generic term for all types of inflexible rock reinforcement units, as well as to the process of rock reinforcement (e.g. Roofbolting)
Rock mass	In-situ rock, composed of small or large pieces of solid rock limited by discontinuities
Rockfall	Loosening or failure of rock from the rock mass

Rock reinforcement	The installation of rockbolts, cables or any other type of element in a rock mass to reinforce and mobilize the inherent strength of the rock, so that the rock becomes self-supporting. The rock reinforcement element is installed inside the rock mass, that is, it forms part of the rock mass
Roughness	The inherent surface roughness and waviness relative to the mean plane of the discontinuity
Seepage	Water flow and moisture visible in individual discontinuities or in the rock mass as a whole
Shotcrete	This is a mixture of cement, aggregate and water which is pumped pneumatically through a nozzle onto walls of an excavation to form a bonded coherent layer. It may contain admixtures, additives and fibres or a combination of these to improve tensile, flexural and shear strength, resistance to cracking
Tendon	Includes the generic "rockbolt", plus flexible forms such as "cable anchor"
Wall strength	The equivalent compression strength of the rock adjacent to the surface of a discontinuity