INFLUENCE OF MECHANICAL AND AGGREGATE PROPERTIES OF ROCK ON POWDER FACTOR IN ROCK BLASTING

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DECLARATION OF THE CANDIDATES AND SUPERVISORS

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ABSTRACT

Quarry metal is a widely used material in any large scale construction industry. Though demand for quarry metal substantially increased due to recently emerged large infrastructure development projects in Sri Lanka such as highway and port city, profit margins of the quarrying has drastically reduced due to high powder factors recorded in recent rock blasting activities of local quarries. Most possible reason for realizing high powder factors could be the introduction of various new explosive agents such as water-gel in to the local mining industry. Importance of analysing the influence of mechanical and aggregate rock properties on powder factor arises in this context to allow seeking suitable rocks those incur minimum blasting expenditure during the production stage. Outcomes of the project can be used to predict powder factor which could be achieved in blasting operations of a certain rock even before starting the quarry operations to minimize its production cost in the long run.

Eight quarries operates under the close supervision of qualified Mining Engineers were selected for this study to ensure blasting geometry and configurations have being properly managed during the realized powder factor data recorded time period. Random core samples were obtained from each quarry site and they were tested for Density, Uniaxial Compressive Strength (UCS) and Tensile Strength. Similarly, random aggregate samples were taken and performed the Aggregate Impact Value (AIV) test. Rock Mass Rating (RMR) was determined for each quarry using UCS values and other field data obtained at the site. Explosive consumption and drilling records for recent six month were obtained from each quarry for the calculation of powder factor.

Powder factor was plotted against each selected rock property and regression analysis was performed on test results to understand their standalone influence. The only realized best fitting model for the Powder Factor was AIV according to the regression analysis and it is very closely following the quadratic model. Rock property test results and past records of few other quarries were used to validate formulae obtained in this research. Explosive cost and production cost of all the quarries analysed for the same six months period. Results revealed that the production cost is a function of explosive cost since other costs on drilling, machineries and labour are usually incur relatively fixed costs in nature. Hence it can be concluded that the aggregate rock properties, especially Aggregate Impact Value (AIV) influence on powder factor of blasting and furthermore affects economics of the quarry production. More importantly, combined formula derived in this research can be used predicting powder factor of a fresh rock before conducting any blasting activity.

Keywords: Aggregate Impact Value (AIV), Powder Factor in blasting, metal quarrying

DEDICATION

I dedicate this research work to the Sri Lankan mining industry which uplifted my living standard, provided me qualifications plus recognition and continuously energized me to thrive my career thus far.

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TABLE OF CONTENTS

Page

Declaration of the candidates and supervisors i

Abstract iii

Dedication iv

Acknowledgement v

List of figures ix

List of tables xi

List of abbreviations xiii

List of Appendices xiv

1. CHAPTER 01: INTRODUCTION 1

1.1 Sustainability of Sri Lankan metal quarry industry 1

1.2 Research problems 2

1.3 Objectives 3

1.4 Method of tackling 3

1.5 Significance of the research and expected outcome 4

2. CHAPTER 02: LITERATURE REVIEW 6

2.1 Powder factor in rock blasting 6

2.2 Various properties of rocks 7

2.2.1 Chemical properties of rocks 7

2.2.2 Physical properties of rocks 7

2.2.3 Mechanical properties of rock masses 8

2.2.4 Aggregate rock properties 8

2.3 Rock properties focused in the research 8

2.3.1 Density 9

2.3.2 Uniaxial Compressive Strength (UCS) 9

2.3.3 Tensile Strength 11

2.3.4 Aggregate Impact Value (AIV) 13

2.3.5 Rock Mass Rating Value (RMR) 14

2.3.6 Rock Quality Designation index (RQD) 16

2.4 Surface rock excavation using bench blasting 18

2.4.1 Free face 19
2.4.2 Bench height 19
2.4.3 Blast hole diameter 19
2.4.4 Burden (B) 20
2.4.5 Spacing 21
2.4.6 Hole angle (α) 22
2.4.7 Subdrill 23
2.5 Powder Factor 24
2.5.1 Definitions and expressions 24
2.5.2 Definition of powder factor 25
2.5.3 Explosives 25
2.5.4 Volume calculation in rock blasting 27
3. CHAPTER 03: METHODOLOGY 29
3.1 Identification of the locations 29
3.2 Data and sample collection 30
3.3 Sample preparations and testing procedures 30
3.3.1 Testing for Density of rock 31
3.3.2 Testing for Uniaxial Compressive Strength (UCS) of rock 32
3.3.3 Testing for Tensile Strength of rock 34
3.3.4 Testing for Aggregate Impact Value 35
3.3.5 Defining Rock Mass Ratings for quarries 37
4. CHAPTER 04: RESULTS AND DISCUSSION 38
4.1 Statistical analysis of data 38
4.2 Statistical interpretations 38
4.3 Powder Factor versus Specific Gravity relationship 39
4.3.1 Linear model 40
4.3.2 Quadratic model 40
4.3.3 Cubic model 41
4.4 Powder Factor versus Uniaxial Compressive Strength relationship 42
4.4.1 Linear model 43
4.4.2 Quadratic model 43

4.4.3 Cubic model 44
4.5 Powder Factor versus Tensile Strength relationship 45
4.5.1 Linear model 46
4.5.2 Quadratic model 47
4.5.3 Cubic model 48
4.6 Powder Factor versus Aggregate Impact Value relationship 49
4.6.1 Linear model 51
4.6.2 Quadratic model 52
4.6.3 Cubic model 53
4.7 Powder Factor versus Rock Mass Rating relationship 54
4.7.1 Linear model 55
4.7.2 Quadratic model 56
4.7.3 Cubic model 57
4.8 Pearson correlation analysis between each variable 57
4.9 Multiple Regression Analysis 58
4.10 Powder factor versus explosive cost variation analysis 60
5. CHAPTER 05: CONCLUSION AND RECOMMENDATION 63
5.1 Conclusion 63
5.2 Recommendation 64
6. REFERENCES 66
7. APPENDICES 68
Appendix A: Quarries site locations in Western Provincial map 68
Appendix B: Quarries selected for the research and collected data 69
Appendix C: GSMB Mining licensing process 85

LIST OF FIGURES

	Page
Figure 2.1: Failure load test configuration	11
Figure 2.2: Rock Quality Designation evaluation method	16
Figure 2.3: Bench blasting parameters (Muhammad, 2009)	19
Figure 2.4: Staggered drilling pattern in bench blasting	21
Figure 2.5: Square drilling pattern in bench blasting	22
Figure 2.6: Rock breaking mechanisms of vertical and inclined blast holes	22
Figure 2.7: Back fill bore hole to soft seam in bench blasting	23
Figure 2.8: Problems of soft seam off bottom in bench blasting	24
Figure 2.9: Explosive Classification (Dick, 1983)	26
Figure 3.1: Measuring core samples for density	31
Figure 3.2: Core drilling machine used for core sample preparation	32
Figure 3.3: Core sample cutting machine	33
Figure 3.4: Uniaxial Compressive Strength testing apparatus	33
Figure 3.5: Prepared sample for Tensile Strength test	34
Figure 3.6: Aggregate Impact Value testing apparatus	36
Figure 4.1: Powder factor vs. Specific Gravity (Linear Model)	40
Figure 4.2: Powder factor vs. Specific Gravity (Quadratic Model)	41
Figure 4.3: Powder factor vs. Specific Gravity (Cubic Model)	41
Figure 4.4: Powder factor vs. Uniaxial Compressive Strength (Linear Model)	43
Figure 4.5: Powder factor vs. Uniaxial Compressive Strength (Quadratic Model)	44
Figure 4.6: Powder factor vs. Uniaxial Compressive Strength (Cubic Model)	45
Figure 4.7: Powder factor vs. Tensile Strength (Linear Model)	47
Figure 4.8: Powder factor vs. Tensile Strength (Quadratic Model)	48
Figure 4.9: Powder factor vs. Tensile Strength (Cubic Model)	49
Figure 4.10: Powder Factor vs. Aggregate Impact Value (Linear Model)	51
Figure 4.11: Powder Factor vs. Aggregate Impact Value (Quadratic Model)	52
Figure 4.12: Powder Factor vs. Aggregate Impact Value (Cubic Model)	53
Figure 4.13: Powder Factor vs. Rock Mass Rating value (Linear Model)	55
Figure 4.14: Powder Factor vs. Rock Mass Rating value (Quadratic Model)	56

Figure 4.15: Powder Factor vs. Rock Mass Rating value (Cubic Model) 57
Figure 4.16: Explosive cost / m^3 vs. Powder factor variation 61
Figure 5.1: Comparison of Quadratic and Cubic models of Pf vs. AIV 64
Figure 7.1: Front working face view of Quarry no 01 69
Figure 7.2: Access ramp and side view of the quarry no 02 71
Figure 7.3: Part of the access ramp and working benches of the quarry no 03 73
Figure 7.4: View of quarry metal loading point and a ramp of quarry no 04 75
Figure 7.5: View of current blasting face of quarry no 05 77
Figure 7.6: View of partially excavated cliff of the quarry no 06 79
Figure 7.7: View of Single high bench in the operating face of quarry no 07 81
Figure 7.8: Front view of the location currently been mined at quarry no 08 83
Figure 7.9: License categories 85

LIST OF TABLES

Page

Table 2.1: Permissible Aggregate Impact values 13

Table 2.2: Rock Mass Rating system 15

Table 3.1: Locations of metal quarries selected for the research 30

Table 4.1: Calculated density values 39

Table 4.2: Results of Uniaxial Compressive Strength tests 42

Table 4.3: Applied load for Tensile Strength tests 45

Table 4.4: Calculated tensile strengths 46

Table 4.5: Results of AIV Test 50

Table 4.6: Aggregate Impact Values 50

Table 4.7: Validation of results for existing quarries using quadratic model 53

Table 4.8: Validation of results for existing quarries using cubic model 54

Table 4.9: Calculated RMR Values 55

Table 4.10: Correlations of Pf, SG, UCS, TS, AIV, RMR in “Minitab” output 58

Table 4.11: “Minitab” output for correlation analysis 58

Table 4.12: “Minitab” output for variance analysis 59

Table 4.13: “Minitab” output for statistical significance 59

Table 4.14: Cost Analysis for Explosive usages in selected locations 60

Table 4.15: Summery of test results 62

Table 7.1: Explosive consumption and drilling geometry data for Quarry No 01 69

Table 7.2: Field data sheet for RMR calculation in Quarry No 01 70

Table 7.3: Explosive consumption and drilling geometry data for Quarry No 02 71

Table 7.4: Field data sheet for RMR calculation in Quarry No 02 72

Table 7.5: Explosive consumption and drilling geometry data for Quarry No 03 73

Table 7.6: Field data sheet for RMR calculation in Quarry No 03 74

Table 7.7: Explosive consumption and drilling geometry data for Quarry No 04 75

Table 7.8: Field data sheet for RMR calculation in Quarry No 04 76

Table 7.9: Explosive consumption and drilling geometry data for Quarry No 05 77

Table 7.10: Field data sheet for RMR calculation in Quarry No 05 78

Table 7.11: Explosive usage and drilling geometry data for Quarry No 06 79

Table 7.12: Field data sheet for RMR calculation in Quarry No 06 80
Table 7.13: Explosive usage and drilling geometry data for Quarry No 07 81
Table 7.14: Field data sheet for RMR calculation in Quarry No 07 82
Table 7.15: Explosive usage and drilling geometry data of Quarry no 08 83
Table 7.16: Field data sheet for RMR calculation in Quarry No 08 84

LIST OF ABBREVIATIONS

Abbreviation	Description
ANFO	Ammonium Nitrate with Fuel Oil
CEA	Central Environmental Authority
GSMB	Geological Survey and Mines Bureau
UCS	Uniaxial Compressive Strength
AIV	Aggregate Impact Value
RMR	Rock Mass Rating
ACV	Aggregate Crushing Value
RQD	Rock Quality Designation
Pf	Powder factor
DS	Divisional Secretariat
IML	Industrial Mining License
AML	Artisanal Mining License
TNT	Tri Nitro Toluene

LIST OF APPENDICES

Appendix	Description	Page
Appendix A	Quarries site locations in Western Provincial map	68
Appendix B	Quarries selected for the research and collected data	69
Appendix C	GSMB Mining licensing process	85