IDENTIFICATION OF ROCK WEATHERING BY CONVENTIONAL METHODS AND IMAGE ANALYSIS TECHNIQUES

Gamsavi Kanagasundaram

(228040G)

Degree of Master of Science

Department of Earth Resources Engineering

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Sri Lanka

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Thesis submitted on partial fulfilment of the requirements for the Degree of Master of Science in Earth Resources Engineering

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DECLARATION OF THE CANDIDATE

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters thesis under my supervision.

Name of the supervisor: Dr. A.B.N. Dassanayake

Signature of the supervisor: Date: 27/11/2023

Name of the supervisor: Dr. C.L. Jayawardena

Signature of the supervisor: Date: 29/11/2023

Name of the supervisor: Dr. S.P. Chaminda

Signature of the supervisor: Date: 27/11/2023

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Abstract

Observations on weathering patterns are a crucial aspect of geotechnical analysis, as they allow the determination of site quality for various civil and mining engineering applications. There are traditional methods available to assess weathering and the effect of weathering on rock properties. In this study, selected set of laboratory testing were performed to identify the key properties of rock using representative samples from ongoing three quarry sites. The study reveals that fresh rock samples from all three quarry locations maintained a durability of over 98% through four cycles of the slake durability test. Nonetheless, these same samples exhibited decreased strength, which can be attributed to their mineral composition and internal structural arrangements of rock samples tested. Moreover, the overall findings indicate deteriorating values for the tested rock properties which could possibly be caused by rock weathering. Therefore, an attempt was made to look at using the modern technology how accurately the weathered surfaces can be identified and classified. For this purpose, machine learning (ML) techniques with remotely sensed Unpiloted Aerial Vehicles (UAVs) images were utilized. The analysis yielded an impressive F1 score of 0.88 to classify weathering in general. However, the attempts to classify different weathering grades yielded marginal results. These limitations are primarily due to factors such as the number of bands, the spatial resolution of the UAV sensors, and the availability of training data for the ML algorithm. Nonetheless, this study serves as a promising first step in demonstrating the potential of UAVs and appropriate ML models for the classification of weathering patterns, which can be further optimised and deployed for real-time observations. It is highly recommended that laboratory sample testing be carried out in conjunction with image analysis to ensure a detailed and comprehensive understanding of the test results.

Keywords: Rock properties, Microstructure, Machine learning

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LIST OF ABBREVIATIONS

Abbreviation	Description
ASTM	American Society for Testing and Materials
AIV	Aggregate Impact Value
B	Blue
EDX	Energy Dispersive X-Ray Analysis
G	Green
GCPs	Ground-control points
LAAV	Los Angeles Abrasion Value
ML algorithms	Machine learning algorithms
NIR	Near-infrared
R	Red
RE	Red edge
RF	Random Forest
SEM	Scanning Electron Microscope
XRD	X-Ray Diffraction
UCS	Uniaxial Compressive Strength
UPV	Ultrasonic Pulse Wave Velocity
UAV	Unpiloted arial vehicle
XGB	Extreme Gradient Boosting Machine