STUDY ON THE CAUSAL FACTORS FOR RAPID ROCK WEATHERING AND STABILITY OF THE SAMANALAWEWA DAM

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STUDY ON THE CAUSAL FACTORS FOR RAPID ROCK WEATHERING AND STABILITY OF THE SAMANALAWEWA DAM: A CASE STUDY

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Thesis submitted in partial fulfillment of the requirement for the degree Master of Engineering in Foundation Engineering and Earth Retaining Systems

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DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgment 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 Master Dissertation under my supervision.

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Abstract

When utilizing rocks for a rockfill dam factors such as rate of rock decomposition have to be considered very seriously for long term stability in addition to shear strength governed engineering properties. Generally the rates of natural decomposition of high grade metamorphic rocks are comparably very low; this process can be accelerated due to several reasons such as influence of climatic conditions, lithology and structure. Especially the metamorphic rocks in the regions of tropical climatic conditions tend to weather more rapidly than the rocks in other climatic conditions. This process occurs basically due to the continuous chemical alterations of minerals with the time under heavy rainfall and temperature conditions, which in turn influences the mechanical properties of rocks.

This study aims to investigate the causes of rock weathering and to determine the shear strength parameters of rockfill by estimating uniaxial compressive strength of rocks utilized for the rockfill of Samanalawewa dam to study the present stability of the dam.

Department of Geology, University of Peradeniya supplied test results on geochemical analysis and petrographic study from site investigations in the Samanalawewa dam and appurtenant areas for rocks. Those data had been very valuable for the purpose of this study.

Other investigations such as finding of geotechnical data were carried out by the laboratory tastings. Those tests were carried out myself at Faculty of Engineering, University of Moratuwa and Central Engineering Construction Bureau.

The study begins with a literature review and an interaction matrix, to determine the degree of rock weathering and its relation to the different Physical and Engineering properties of rocks.

The predicted parameters are then analyzed based on the compiled data from aforementioned organizations.

The final results show that the values of factor of safety of the slope stability of the dam have been reduced with grade of weathering. When rockfill of the dam becomes moderately weathered, most of factor of safety values derived are below permissible level. Hence it is recommended to carry out remedial measures against rock weathering as an urgent requirement.

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H M C D Herath

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Notations

English Notations

C	-Cohesion
C´	-Cohesion for effective stress analysis
CW	-Completely Weathered rocks
e	-Void ratio
d_{50}	-Particle size for which50% of the material sample is finer
FERC	-Federal Energy Regulatory Commission(United states)
FR	-Fresh rock
G_s	-Specific gravity of soil
HW	-Highly Weathered rocks
JCS	-Joint wall Compressive Strength
JRC	-Roughness Coefficient
MOL	-Minimum Operating Level
MW	-Moderately Weathered rocks
masl	-mean above sea level
n	-Porosity
NHWL	-Normal High Water Level
NRCS	-Natural Resources Conservation Service(United States)
R	-Equivalent roughness
r_1	-Schmidt hammer rebound on saturated weathered interfaces
r_2	-Schmidt hammer rebound on dry un-weathered rock surfaces interfaces
S	-Equivalent Strength of particles
SHEP	-Samanalawewa Hydroelectric Project

SW	-Slightly weathered rocks
TVA	-Tennessee Valley Authority(United states)
u	-Pore water Pressure
UCS	-Uniaxial Compressive Strength
USACE	-United States Army Corps of Engineers
USBR	-United States Bureau of Reclamation
X	-Rockfill depth

Latin Notations

α	-Completely Weathered rocks
β	-Slope angle of rockfill of dam
γ_d	-Dry unit weight of rock
$\gamma_{wetrock}$	-Wet unit weight of rock
$\gamma_{sat\ rock}$	-Saturated unit weight of rock
$\gamma_{wet\ rockfill}$	-Wet unit weight of rockfill
$\gamma_{Sat\ rockfill}$	-Saturated unit weight of rockfill
$\gamma_{submerged}$	-Submerged unit weight of rockfill
ϕ'	-Angle of Friction for effective stress analysis
ϕ_b	-Basic angle of friction
ϕ_r	-Residual angle of friction
τ	-Peak Shear Strength
σ	-Total normal stress
σ_n'	-Effective normal stress

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