Date of Submission	30th March, 2019

IPL Project (IPL 200) Annual Report 2018

1 January 2018 to 31 December 2018

1. **Project Title:**

An Assessment of the Rock fall Susceptibility Based on Cut Slopes Adjacent to Highways and Railways.

2. **Main Project Fields -** Technology Development
Category B. Hazard Mapping, Vulnerability and Risk Assessment

3. **Name of Project Leader** : **Ms. H.M.J.M.K. Herath -** B. Sc.(Special Science degree in Geology), M. Sc (Water Resources Management)

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Core members of the Project

Eng. J A D N A Jayasooriya,	B.Sc(Hons) (Civil Eng); PG. Dip (Transport Eng-reading)
Eng.(Ms) S. S. I. Kodagoda	B.Sc (Hons)Eng, M. Eng., CEng,- Geotechnical Engineer
Eng.(Ms) L K N S Kulathilake,	BScEng(Hons)- Earth Resources Engineer)
Eng. A A Virajh Dias	B.Sc (Civil Eng); CEng, PG.Dip; MASCE, MIESL

4. **Objectives:**

Rock fall from cuts slopes adjacent to roadway and railways are significant during heavy rains in mountainous terrains. The main objective of the project is

- Recognition of the Gravity of rock fall hazard from cut slopes adjacent to highways and railways during heavy rainfalls
- Carrying out appropriate improvements for rock fall hazard assessment by introducing appropriate Rockfall Hazard Rating System (RHRS)

5. **Study Area**:

Two locations along Kandy – Nuwara Elliya highway, Sri Lanka and two locations along Sri Lanka railway Main line (Colombo to Badulla, Sri Lanka)

6. **Project Duration**:

Five years (July, 2015 to July 2021)

7. Report

7.1 Progress in the project:

The evaluation of instability potential of rock slopes are fairly questionable and important and understanding of associated issues related to geological characteristics of overhanging rocks slopes to be evaluated accordingly. Various forms of failures due to non-engineered road construction were studied (Herath, et al., 2014) in hill country of Sri Lanka.

The study has been proposed various combination of pair wise comparison approach for the evaluation of geological stability of overhanging rock slopes which will immensely support to improve narrative of significance. Some of the categories are similar to Brawner's and Wyllie's while decision making approach for scoring in geological terms are new due to consideration of mutually dependences. New approach of rock fall hazard rating evaluation is studying based on field observations and recorded road side slope failures. In this situation geological factors or evidences will be considered further as a singular factor. The initial phase of the study concludes the rating and scoring of evidence still depend on valued judgment but minimize the avoidance of minimum dependences of other factorial significance is given below.

Pair 1: Dipping and Slope Height (DSH)
Pair 2: Block Size and Rock Character (BRC)
Pair 3: Persistence and Joint Density (PJD)
Pair 4: Weathering Discontinuity and Aperture Sizes (DAS)
Pair 5: Rock Friction and Weathering State (RFWS)
Pair 6: Cutting Plane and Block Movement Direction (CPBMD)
Pair 7: Overhang and Fall History (ODH)

7.2 Planned future activities or Statement of completion of the Project

January 2019 – December 2019 : Numerical evaluation of data, Laboratory and Field testing, data collection (Phase 2 activity) – on going

July 2019 to December, 2019 : Field testing, data collection and sample study for wedge based failure
Development of numerical rating of RHRS with known and visible samples

Jan 2020-Dec 2020 : Development of advanced method of assessments, conducting in-situ testing, back analysis and modeling of case studies; verification and sensitivity assessment.

January, 2021- June 2021 : Finalizing the design approaches for evaluation and design of cut slope stabilization in roadway and railways in hill country slopes.

7.3 Beneficiaries of Project for Science, Education and/or Society

The beneficiaries of this project would be the road trace designers, engineering consultant and other professionals, academics, planners and people residing in landslide prone areas in the hill country of Sri Lanka.

7.4 Results (resent Outputs):

The proposed rating mechanism for geological factors of the RHRS is based on an evaluation of geological stability of overhanging rock slopes in 7 different pairwise categories summarized as a Combined Rating Criteria for Geological Evidences for Rockfall Hazard System above. This system is supported to give the narativeness of decision making in geological factors.

8. Publications (Journal Papers and conference Papers)

1. H M Janaki, M K Herath, S S I Kodagoda and A A Virajh Dias; Shallow Modes of Slope Failure in Road Earth Cuttings in Sri Lanka; World Landslide Forum 3; Beijing, China, 2014.
2. “Empirical Relationships of Elastic Modules and Uniaxial Strength of Intact Metamorphic Rocks of Sri Lanka”; Proceeding of the International Conference of Geotechnical Engineering(ICGE) 10th – 11th August 2015 in Colombo, Sri Lanka; PP 515 -518; Authors were E M T M Ekanayake , H M J M K Herath and A A Virajh Dias; ISBN 978-955-1411-01-5.
3. “Pairwise Comparisons of Geological Evidences in Rockfall Hazard Rating System (RHRS) for the Evaluation of Road based Potential Slopes Failure in Sri Lanka” Proceeding of the CECB Symposium 2018, Colombo, Sri Lanka; PP 246-256; Authors were H M J M K Herath , J A D N A Jayasuriya and A A Virajh Dias; ISBN 978-955-1802-01-1.

9. References

1. Brawner, C. O., & Wyllie, D. C. (1975). Rock Slope Stability on Railway Projects. In Proc., American Railway Engineering Association Regional Meeting, Vancouver, B. C., American Railway Engineering Association, Washington, D.C., 8 pp
2. Brawner, C. O. (1994). Rockfall Hazard Mitigation Methods, Participant Workbook, NHI Course No. 13219. U.S. Department of Transportation, Federal Highway Administration, Publication No. FHWA SA-93-085.
3. Pierson, L.A., Davis, S.A. and Van Vickle, R. 1990. Rockfall Hazard Rating System Implementation Manual. Federal Highway Administration (FHWA) Report; FHWA-OR—EG-90-01. FHWA, U.S. Department of Transportation.
4. Russell, C. P., Santi, P., & Humphrey, J. D. (2008). Modification and statistical analysis of the Colorado Rockfall Hazard Rating System: Report No. CDOT-2008-7, 139 pp.