Date of Submission	10th February 2015

IPL New Project Proposal Form 2015

1. Project Title:

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

2. Main Project Fields - (1) Technology Development
   B. Hazard Mapping, Vulnerability and Risk Assessment
3. Name of Project leader :

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Core members of the Project

Eng. (Ms)E M T M Ekanayake – B.Sc (Hons) (Earth Resource Engineering)

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. 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 this problem and also carrying out appropriate improvements for the rock fall hazard assessment by introducing appropriate Rockfall Hazard Rating System which was originally developed by the Oregon State Highway Division (Pierson et al. 1990).

5. Background Justification:

In recent years series of rock slope failures occurred in hill country roadways and railways as a result of exceptionally heavy rainfall. These slides caused some loss of life and a significant amount of property damage. Rockfalls are generally initiated by combination of climatic and physical changes that causes a change in the forces acting on a rock in slope. These are pore pressure increases, infiltration, erosion of surrounding material during heavy rain storms, changing of interface frictional capacity, freeze-thaw processes in cold climates, chemical degradation or weathering of the rock, root growth or leverage by

roots moving in high winds. Therefore, evaluation of susceptibility to rock slope failures adjacent to roads and railways in mountainous regions presents a special challenge to engineering geologists and civil engineers.

6. Study Area:

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

7. Project Duration: Three years (July, 2015 to July 2018)

8. Resources necessary for the Project and their mobilization

Item	Description of Personnel and Facilities	Cost USD	Mode of Contribution
1	Laboratory facilities: CECB laboratory	3,000	By CECB
2	Field Activities	2,000	By CECB
3	Special training on probabilistic method of assessment in rock slope engineering applications and practicing	10,000	Through a research grant
	Total USD	**15,000**	
	Total grantee contribution USD	5,000	By CECB
	Total expected through funding	10,000	Through a grant

9. Project Description:

   It is neither possible nor practical to detect all potential rockfall hazards or susceptibility of rockfall by any techniques currently in use in rock engineering. In terms of rockfall hazard assessment, one of the most widely accepted is the Rockfall Hazard Rating System (RHRS) developed by the Oregon State Highway Division (Pierson et al. 1990). The method is indicating various judgment matrices but it does not clearly define a method of assigning individual weights by prioritizing the significance. It is also noted that this is a two-dimensional analysis and these dimensions refer to a 1-metre thick slice through the slope. It is also important to recognize that this analysis considers only force equilibrium and assumes that all forces pass through the centroid of the wedge. In other words, moment equilibrium is not considered in this analysis. Therefore, the proposed research considers determining some in-situ properties such as interface friction, lineaments friction, facture indexes and weathering condition of the rock. Friction along a joint, bedding plane or other discontinuity is governed by the macro and micro roughness of a surface. Macro roughness is the degree of undulation of the joint. Micro roughness is the texture of the surface of the joint. Therefore, design of rock slopes needs to reconsider the impacts of micro and macro features in slope. This involves a series of calculations in which each

significant parameter is varied systematically over its maximum credible range in order to determine its influence upon the factor of safety. Therefore, such approach provides a useful means of exploring a range of possibilities and reaching practical decisions on some difficult problems.

10. Work Plan/Expected Results:

July-December, 2015:	Identification of sampling locations and field work
January 2016- December 2016:	Laboratory and Field testing, data collection, back analysis; Numerical evaluation of data
January 2017 to December, 2017:	Development of advanced method of assessments, conducting in-situ testing, back analysis and modeling of case studies; verification and sensitivity assessment.
January, 2018- June 2018:	Finalizing the design approaches for evaluation and design of cut slope stabilization in roadway and railways in hill country slopes.

11. Deliverables/Time Frame:

January 2016- December 2016:	Laboratory and Field testing, data collection, back analysis; publishing preliminary observations
January 2017 to December, 2017:	Evaluation of the sensitivity of the results and publication of detail findings
January, 2018- June 2018:	Conducting one day seminar on design parameters for rock slope stabilization design approach for roads

12. Project Beneficiaries:

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.

13. References

1. 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.
2. M A S N Mallawarachchi, E M T M Ekanayake, S S I Kodagoda and A A Virajh Dias; Comparison of soil modulus E50 of residual soil slope failures in two different rainfall zones ; World Landslide Forum 3; Beijing, China, 2014.
3. H M J 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.