1. Project Title

   Research on vegetation protection system for highway soil slope in seasonal frozen regions (IPL-132)

2. Main Project Fields

   Mitigation, Preparedness and Recovery

3. Name of Project leader:

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Core members of the Project: Names/Affiliations:

   Dr. Fawu Wang, Shimane University, Japan

   Dr. Ying Guo, Northeast Forestry University, China

   Dr. Chengcheng Zhang, Northeast Forestry University, China

4. Objectives:

   This study aims to establish a comprehensive vegetation protection system for highway soil slope in seasonal frozen regions. The system will be of benefit to regional environment green along the highway, and the highway slope stabilization.

5. Study Area:

   A major highway in China’s Heilongjiang Province, Jiamusze to Harbin of Tong-San Expressway is selected as the study area.

6. Project Duration
7. Report

1) Progress in the project:

Through on-site sampling and laboratory experiments, the basic physical indicators of the soil, such as density, permeability coefficient, particle composition were obtained. Through triaxial test, for soil and root-soil, the variation of the cohesion, internal friction angle, deformation modulus varying with density, moisture, freezing-thawing cycles was got. For three kinds of plant: turf, Lespedeza, Amorpha, through the data analysis of the moisture in different depth, using the theory of plant physiology, meteorology, soil physics, both the distribution of root system in cutting slope and the law of moisture migration and distribution under the joint action of plant roots and freeze-thaw was got. Through shape analysis of root combining with site direct shear tests of root-soil, the mechanical mechanism of plant roots protecting the slope was got. Through light penetration testing, combined with temperature measurement data, field distribution of slope body’s temperature and shear strength were got, combining with soil mechanics theory and triaxial test results, the relationship between the shear strength and soil moisture was got. Using the theory of soil physics, heat transfer, combining with the monitoring data of slope body’s temperature and moisture, in different plant cover condition and different slope depth, the law of moisture distribution changing with the temperature was got.

2) Planned future activities or Statement of completion of the Project

Through the derivation of slope’s safety factor, which is based on the effective stress, the impact of physical, mechanical and geometry parameters on slope stability was analyzed further. Based on strength Less finite element, the safety factor under different coverage conditions and in the most unfavorable season was got. Through saturated un-drained ring shear test and residual strength ring shear test, the variation of physical parameters in sliding process was studied. Based on remote sensing data and meteorological data, through the study of relationship between vegetation indices and meteorological factors, mathematical model between vegetation index and temperature, precipitation and sunshine was built, then meteorological factors was anti-derivated. Combining with the terrain elevation data and plant growth characteristics, for Amorpha, Lespedeza and seabuckthorn, evaluation system of plant adaptive growth was established, and conduct space adaptability evaluation.

3) Beneficiaries of Project for Science, Education and/or Society (15 lines maximum)

This can accumulate experience for soil slope landslides in cold regions, especially for soil cutting slope in seasonal frozen regions.

This can provide technical support for slope protection, can restore the ecological
destruction caused by roads construction as soon as possible, also can significantly reduce the project cost and maintenance cost.

This can promote the development of cross-disciplinary, and accumulate experience for artificial slope engineering, as well as disaster reduction and prevention in high latitude seasonal frozen regions.

4) Results:

- Landslides in cold regions in the context of climate change,.Springer.2013. ISSN:1431-6250
  Ying Guo, Wei Shan, Hua Jiang, Yuying Sun, Chengcheng Zhang. The impact of freeze-thaw on the stability of soil cut slope in high-latitude frozen regions. PP.85-99

- IAEG XII - Engineering Geology for Society and Territory.1.9 session: Environmental and engineering geological problems in permafrost regions in the context of a warming climate
  Ying Guo, Wei Shan, Chengcheng Zhang, Hua Jiang. Landslide Mechanism and Its Shallow Soil Moisture of Soil Cut Slope in Seasonal Frozen Regions

- WLF3- C7 Sessions: Landslides in cold regions
  Ying Guo. The effect of plant roots on the stability of soil cutting slope in seasonal frozen regions