Development of Landslide Risk Assessment Technology and Education in Vietnam

Planned and proposed by close collaboration of four member organizations of ICL in Vietnam and in Japan

1. Institute of Transportation Science and Technology
   Doan Tam

2. ICL Headquarters
   Kyoji Sassa

3. Forestry and Forest Product Research Institute
   Hirotaka Ochiai

4. Japan Landslide Society
   Toyohiko Miyagi
Major Investigation Area

- Possible NR No.3 and High Speed Railway
- Route selection to avoid landslide disasters
- Hai Van Pass, Hai van Station Along NR NO.1
- Ho Chie Minh Route NR NO.2
- ITST-Da Nang Branch
The Project for Development of Landslide Risk Assessment Technology and Education in Vietnam

**Overall Objective**
Social implementation of the developed landslide risk assessment technology and early warning system will contribute to the safety ensuring of transportation arteries and residents in mountainous communities in Vietnam.

**Project Purpose**
Landslide risk assessment technology to reduce landslide disasters along main transport arteries and on residential areas is developed, and education and capacity development for the effective use of this technology is implemented in Vietnam.

**Outputs**
1. Landslide risk slopes will be identified by wide-area landslide mapping.
2. Landslide hazard assessment technology will be developed based on soil testing and landslide computer simulation.
3. Landslide risk evaluation by monitoring and early warning system will be developed.
Contribution to landslide risk reduction through the development of new landslides risk assessment technology suitable for Vietnam and its social implementation together with necessary capacity development

Ministry of Transport (MOT)
Project Director: Ngo Thinh Duc (Vice Minister of MOT)
Promotion and Supervision of the Project Implementation

Institute of Transport Science and Technology (ITST)
Project Manager: Doan Tam (Director of ITST)
Coordination and Management of the Project

Vietnam Landslide Association for Transport (in process)
President: Doan Tam (Director of ITST)
Cooperation with other organizations and individuals

Integrated Research Group (G1)
Development of Landslide risk assessment technology and Education
Leaders: Sassa, Tam, Miyagi, Tien, Quang, Ochiai and Vinh
• Planning and coordination of research, Implementation of integrated research, Capacity development
• Organization of symposia, workshops, research meetings, publication and information dissemination

Wide-area landslide mapping & Landslide risk identification (G2)
Leaders: Toyohiko Miyagi, Dinh van Tien (ITST)

Soil testing & Computer simulation of landslide initiation and motion (G3)
Leaders: Kyoji Sassa, Lam Huu Quang (ITST)

Landslide monitoring & Development of early warming system (G4)
Leaders: Hirotaka Ochiai, Huynh Dang Vinh (ITST)
Ho Chi Minh Route and National Road No. 1 are the most important infrastructure for Vietnamese development and life lines for communities along the roads.

Large and active landslide along the HCR

Landslide at risk in HCR

Guard Rail

Cracks

Landslide Road No. 1

Person
Landslide disasters threatening local communities

Examples in Son La

Damages houses (up) and Roads (bottom)
Landslide mapping and risk evaluation based on air photo interpretation and AHP method. Example of route selection to avoid landslides.
Landslide mapping by interpretation using satellite photos “IKONOS” in Pakistan

Hatian in Pakistan
After 2005 Kashmir earthquake.

Risk by AHP method

Legend
Degree of Hazard
Very High
High
Moderate
Slight
Very Slight
Active landslides

0 2 4 6 8 km
Technological Development to identify landslide moving area and also precursor stage of landslides under forests. Digital surface models in different periods from air photos or laser scanners will be compared. Slope movement areas will be identified by pattern matching (PIV) of images.
Development of landslide hazard assessment

New undrained dynamic loading ring shear apparatus will be developed to study large scale landslides in Vietnam. So far 600 kPa (30 m depth) is the upper limit of undrained condition. 3000 kPa (150 m depth can be tested in the new apparatus)
Assessment of the initiation and motion of landslides triggered by rainfalls and earthquakes.

\[ \text{am} = (W + F_v + F_x + F_y) + (\Delta x + \Delta y) + R \]

\(a\): acceleration, \(m\): mass of soil column, shear resistance (R) include the effects of pore pressure (U) and normal stress (N)
1000 persons were killed by a large scale rapid landslide triggered by a long rainfall and a very small earthquake in Philippines.

A, B: Pore pressure increase and earthquake loading.
A: no failure at all.
B: local failure (red point)

Middle (C, D, E): Development of landslide block and its motion

Bottom:
Left: air photo
Right: computer simulation
Landslide experiments to study landslide mechanism and parameters of early warning in tropical soils under a very heavy rainfall in the central Vietnam.

This photo is landslide experiment on natural slope. We will do this experiment in model flume with rainfall simulators.
Development of early warning landslides
Landslide risk reduction through the involvement and education of residents in communities
HCR No. 1 Landslide site with active landslide and a precursor stage of landslide
HCR No.2 Landslide site with a community at risk
HCR No.3 Landslide (the largest and expanding landslide)
Landslides in Hai ban Pass (5) and near by landslides along NR No.1
Landslides threatening National Railway (1) and debris flow deposits in the upper slope
Landslide at the Hai Van Station of the National Railway