Atelier sur l'étude et la gestion des risques de glissement de terrain au Canada

Workshop on landslide hazards and risk management in Canada

Hull, Québec ; November 16-18, 2001

Summary

INTRODUCTION

Geological Survey of Canada hosted an invitational ***Workshop on Landslide Hazards and Risk Management in Canada*** in Hull, Quebec, on 16-18 November 2001 (http://sts.gsc.nrcan.gc.ca/landslides/workshop/home.asp). The workshop was designed as a crucial step in the development of the multi-agency **Canada Landslide Loss Reduction Program** – a new program initiated to mitigate losses due to landslides.
Workshop objectives were:

- to build on the experience of other countries where similar programs have already been implemented,
- to engage stakeholders in defining the state of our knowledge of landslides and landslide hazards in Canada,
- to identify gaps in that knowledge, and
- to establish priorities for future activities.

Fifty people from across Canada attended the workshop, representing industry (26%), academia (16%), provincial (12%), and federal (47%) governments. The majority of attendees were active landslide specialists but also included were specialists from the fields of emergency preparedness, the insurance industry, and transportation safety. Invited keynote speakers from USA, Italy, France, and Norway shared their experiences, challenges, and successes in building their national landslide hazard programs and gave an important international perspective on approaches to landslide loss reduction. Keynote speakers representing Quebec and British Columbia presented the problems associated with landslide hazards in the two most landslide-prone regions of Canada -- the Cordillera and the St. Lawrence Lowlands, while an additional keynote speaker discussed landslide hazards from the point of view of the insurance industry. The workshop addressed three themes in breakout groups and plenary sessions, these being (1) landslides mechanisms and processes, (2) landslide mapping and hazard characterisation, and (3) landslide risk and mitigation. The results of these discussions, briefly summarised below, represent an important national consensus on the state-of-knowledge of landslide hazards in Canada and an agenda for future action in reducing landslide losses.

LANDSLIDE MECHANISMS AND PROCESSES

State of knowledge and gaps

- Failure mechanism is much better understood than the post-failure behaviour of landslides.
- Prediction of run-out distances and time of failure are key elements in terms hazards and risk.
- Debris flows: Climatological and meteorological conditions, prediction the run-out distance and when it will occur, development of pore water pressure pre and during motion.
- Topples and rockfalls: Relatively well understood, "rockfall shadow angle" developed for preliminary hazard assessments.
- Landslides in permafrost: Very little is known, impacts of climate change and forest fire.
- Retrogressive landslides: Transformation into retrogressive debris or earthflows, prediction of maximum retrogression distance in bedrock, climatic trigger.
- Rockslides and rapid gravitational movements (e.g. rock avalanches): seismic triggering, rock mass characterization, post-movement mechanics.
- Collapse and lateral spreading: Very little is known.

Other important issues

- Climate data: Canadian climate network insufficient.
- Tools: Detailed geological maps (material and hydrogeological properties) required.
- Monitoring: Insufficient data from landslide monitoring.

Short-term priorities:

- To investigate landslides in permafrost, especially with regard to pipelines;
- To focus on the retrogression prediction of earth flows.
- To better understand the flow mechanisms, flow paths, and run-out distance for rockfall avalanches and debris flows.
- To study impacts of erosion of shorelines and rivers (e.g. Red River Basin), and seismic loading of rock slopes.
- To improve communication and coordination between technical communities and the public.
- To review best practices internationally, and develop some guidelines for best practices nationally, comparable to the Canadian Engineering Foundation Manual.

Long-term priorities:

- To undertake regional studies of landslides which would lead to a better understanding of links to regional geology and landslide modes.
- To better understand the impacts of climate change and the role of El Nino on landslide occurrence.
- To develop physical modelling for a better understanding of transport mechanisms of flows and undrained collapse of soils.
- To develop and verify numerical tools.

- To establish a “Canadian Network of Geo-hazards". This network could be a "Canadian Landslide Society" or a "Landslide Division" within the Canadian Geotechnical Society.

LANDSLIDE MAPPING AND HAZARD CHARACTERIZATION

Mapping

- 3 type of mapping: 1) Inventory maps, 2) Hazards maps, 3) Risk maps.
- Scale: Depends on the risk involved or on the value and the distribution of the elements at risk. Landslide mapping activity should also consider different time scales.
- Important role of surficial and bedrock maps: Additional information on key landslide parameters, database combined with GIS multi-layer concept.
- Validity and liability: Mapping based on a reliable inventory process.

Database

- Purpose: Research, outreach, or catalogue? Primarily informative, raise awareness about landslides”.
- Reliability, availability, and continuity: Information on sources is essential.
- What should be in it? Landslide type, magnitude, date and time of occurrence, location, damage and losses, trigger processes, mode of failure, material involved and its properties, illustrative material (e.g. photographs), and reference information or a contact for additional information.
- Communication: Accessing the database.

Needs for Standards

- Mapping : No real standardized procedures exist, some regulations (Quebec, B.C., Alberta and Ontario): B.C. Municipal Act, B.C. Forest Practices Code, B.C. Ministry of Transportation and Highway, National Energy Board.
- Slope stability analysis: No need for standards, except protocols for specific landslides (e.g. sensitive clays or debris flows).

Education/public

- Need for formalized public education program on landslides was clearly identified.
- Use existing initiatives and networks (e.g. NGO, Canadian Geoscience Council).
- The program should involve all levels (federal, provincial, municipal, school board).
- Objective: to develop the awareness of landslides.

Important gaps and issues

- Adequacy of maps and access to data, data checking and data validation.
- Concerns regarding qualifications and experience (skillset) of people undertaking terrain mapping.
- Need for best practice type of procedures as guidelines not standards.
- Development of detailed legal framework for risk assessment.
- Learn from Norway, Italy, USA to create our own landslide inventories.

- Concerns about continuity and ability to maintain a landslide database after the initial enthusiasm at the start, long-term usefulness.

LANDSLIDE RISK AND MITIGATION

Landslide Risk Assessment (LRA)

Consensus of the definition of risk ; Risk = Probability of hazard x Consequences of Event

- Situation in Canada: We are just starting LRA: B.C. Hydro, Hydro-Québec, Ministry of Transportation in Québec, Railway and pipeline companies, Highways (Alberta), forest industry (B.C.)
- Quantitative Risk Analysis and alternatives tools:
  - Limitation = "probability", i.e. assigning numerical probability values to non-recurring events like landslides.
  - Useful because numerical and good for communicative purposes.
  - Existing tools and alternatives: Geology maps, Quaternary dating, and aerial photographs; Canadian Standards Association's Standard on Risk Management (CAN/CSA #Q850-97); Concept of landslide magnitude/frequency; Landslide databases and inventories; Records of losses and damages; Computer programs; Using expending tools of GIS and hazard maps; Best = Professional judgement.
- Requirements:
  - Must be integrated to a national standard framework, a guide work to produce risk maps and hazard maps, and publication of proposed methods.
  - Experience, backed with basic skills.
  - High quality field data.
  - Team effort because of all the variables involved.
  - History of previous landslides as documented in an inventory or database.

Acceptable risk

- Premature to have a harmonized acceptable risk in Canada.
- A need for some harmonization of standards.
- It is a social and political matter: role of owners and politicians, rather than engineers and geoscientists.

Landslides and Climate Change

- Uncertainties remain about the direct impacts of climate change on landslide occurrence.
- The greatest impacts in permafrost (ongoing).
- Glacier retreat with effects on landslide activity is also a good indicator of ongoing climate warming.
- Higher probability of extreme events, which will increase landslide risks.
- Suggestion: a good temporal landslide inventory and database needed.

Role of stakeholders

- Owners: The group that assumes much of the liability.
  - Should also take some of the responsibility for the landslide database and inventory, as well structural mitigation.
  - Should consider involvement in non-structural monitoring warning systems.
  - Should keep funding and carrying out some of the landslide risk assessments.
  - Should develop Emergency Preparedness Plans (EPPs).

- Consultants: Identified as the sector that carries out most landslide risk assessments and designs most of the structural mitigation.
  - Should provide important feedback to all the other groups.
  - Should become more involved in university-liaison research and should provide small grants for specific landslide research projects.

- Academia: This group is involved primarily in basic and applied research, both in engineering and geoscience, in addition to graduate and undergraduate education.
  - Good ability to criticize objectively what's happening in the industry
  - To conduct fundamental research that advances science (very simplistically).
  - Should become involved with structural engineers, who, although dealing with different materials, are very experienced in risk assessment.

- Provincial: Provincial agencies already play important roles, which should be reinforced.
  - Responsible for non-structural mitigation, such as by-laws, regulations and guidelines, Emergency Preparedness Plans (EPPs) and enforcement aspects of public safety.
  - Responsible for establishment of standards covering earthquake engineering design, floodplain mapping, landslide hazard zoning, and regional probability mapping.
  - Should continue to found various mitigation works, such as floodplain dyking, debris flow containment structures, snow avalanche deflection berms.
  - Responsible for provision of fundamental data. May also be custodian of databases (shared with federal).
  - Should provide funding for research and provide technical support.
  - Should co-ordinate activities with the federal government to avoid duplication of effort.
  - Responsible for the safety and maintenance of their own infrastructure.

- Federal: The Federal government has an important coordination role, fundamental and applied research role, and a funding role.

- To provide guidelines, standards and establish legislation and enforcement to protect the public.
- To provide funding for research and provide technical support.
- Responsible for provision of fundamental data. May also be custodian of databases.
- The Geological Survey of Canada is identified as the agency that should play the coordination role in landslide hazard identification and mapping.
- Responsible for the safety and maintenance of their own infrastructure.
- Responsible for national emergency preparedness plans (EPPs).
- Should be involved in the mapping of hazards, and in some cases, the funding of structural mitigation works.
- Responsible for more national and regional studies and to provide a co-ordinating role with provincial authorities carrying out more local and regional scale studies.
- The Canadian Standards Association has a very important role to play with regard to terminology.

➢ Others:
- Regional Districts or local governments: To co-ordinate hazard studies in specific problem areas, and have some powers for code enforcement.
- Canadian Geoscience Council: To raise issues as research priorities in the earth sciences.
- Canadian Geotechnical Society: To disseminate results of landslide hazard studies and to organise geotechnical conferences.
- Insurers: To help the landslide community in the evaluation of risks and may be enforcing proper risk control measures.
- Citizens: To be more involved in hazard awareness (e.g. home-owners associations).

Recommendations – Landslide risk and Mitigation

➢ Education: A greater need was expressed for public education increasing their awareness of hazard, probability, and risk.

➢ Mitigation: A need was expressed to establish non-structural mitigation strategies (e.g. the new Quebec legislation).

➢ Knowledge: A greater need was expressed for the collection of more data, monitoring of existing landslides and unstable slopes and assessment of changes, therefore greater ability to warn and more diligent by assessing the hazards properly.

➢ Research: A greater need was expressed to increase research, teaching and promoting better engineering, therefore increasing our ability to reduce risk and vulnerability and building resilience. At the same time, we are cautioned not to reinvent the wheel.

➢ Communication: A greater need was expressed to communicate results, share experience and expertise (nationally and internationally), and organise conferences.

- Collaboration: A greater need was expressed for closer collaboration within the landslide community, but also outside. We can learn from other nations and cultures.

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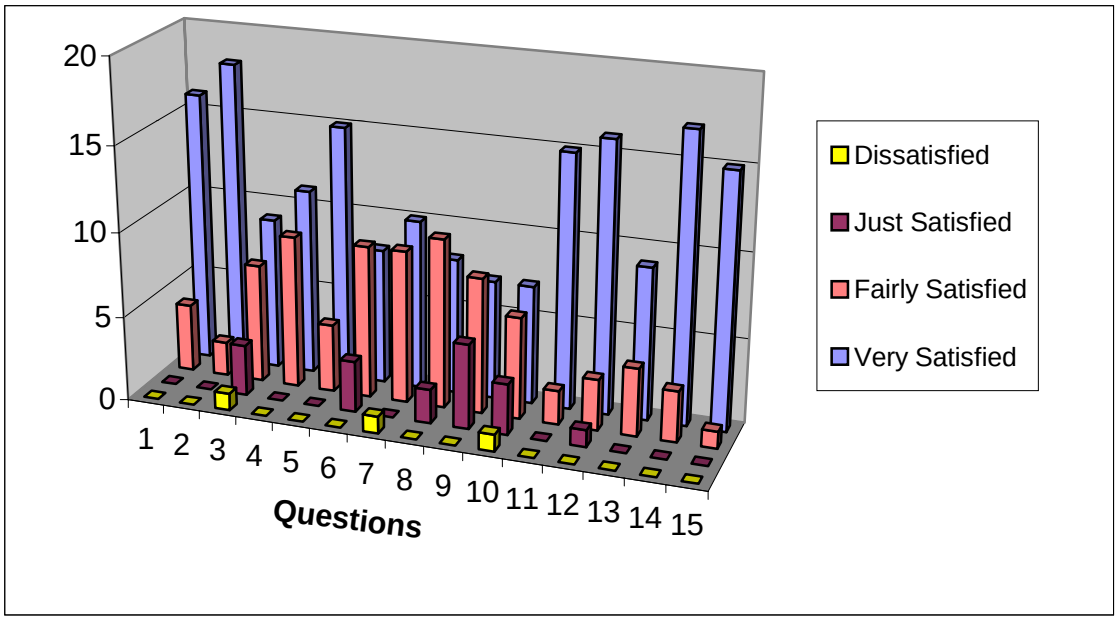
Êtes-vous très satisfait (1), moyennement satisfait (2), peu satisfait (3), ou pas du tout satisfait (4) concernant…? / *Are you very satisfied (1), fairly satisfied (2), just satisfied (3) or dissatisfied (4) regarding…?*

1. Format de l'atelier / *Workshop format* ( )
2. Nombre de participants / *Number of participants* ( )
3. La répartition des participants selon les divers secteurs (université, industrie, Provinces, fédéral, autres) / *Distribution of participants within in each sector (academia, industry, provinces, Federal, others)* ( )
4. Le temps consacré aux conférenciers invités versus aux groupes de discussion / *Time ratio between keynote speakers and breakout groups* ( )
5. La qualité des présentations / *Quality of keynote presentations* ( )
6. La durée des groupes de discussions / *Time dedicated to breakout groups* ( )
7. Le rôle des présidents des groupes de discussions / *Role of chaipersons in the breakout groups* ( )
8. Le format et la durée des sessions plénières / *Format and duration of Plenary sessions* ( )
9. Le type et le nombre de questions dans les groupes de discussions / *Type and number of questions in the breakout groups* ( )
10. Le format et la durée de la session de clôture / *Format and duration of the wrap-up session* ( )
11. Service d'interprétation simultannée / *Simultaneous interpretation Service* ( )
12. Service technique audio-visuel / *Audio-visual technical service* ( )
13. L'excursion au glissement de Lemieux / *Field trip to Lemieux landslide* ( )
14. La qualité des repas / *Quality of meals* ( )
15. Qualité des chambres à l'hôtel / *Quality of hotel rooms* ( )

Results



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