Christopher P. Borstad

CONTACT INFORMATION

Department of Civil Engineering
The University of British Columbia
1984 West Mall
Vancouver, B.C. Canada V6T 1Z2
www.geog.ubc.ca/avalanche

Cell: (640) 760-5202
cborstad@civil.ubc.ca

EDUCATION

The University of British Columbia

Ph.D. Candidate, Civil Engineering

- Research topic: Deformation and fracture mechanics of alpine snow associated with slab avalanches
- Advisor: Professor David M. McClung (Geography)
- Committee members:
  - Professor Emeritus Sidney Mindess (Civil Engineering)
  - Professor Reza Vaziri (Dept. Head, Civil Engineering)
  - Associate Professor Erik Eberhardt (Earth and Ocean Sciences)
- Completed 18 credits of coursework in Civil Engineering, Materials Engineering, Statistics

M.A.Sc., Civil Engineering — December 2005

- Thesis: Dynamics Modeling of Extreme Speed Profiles of Dry Flowing Avalanches
- Advisor: Professor David M. McClung
- Completed 18 credits of coursework in Civil and Mechanical Engineering, Mathematics, Geography, Earth and Ocean Sciences

Colorado State University

B.S., Physics, Minor in Mathematics — May 2002

RESEARCH EXPERIENCE

The University of British Columbia

Doctoral Research — 2006-Present

- Conducted winter field work over three seasons in collaboration with avalanche technicians and wardens of Parks Canada
- Fractured snow samples in a cold laboratory using a universal testing machine and determined the dependence of the sample response on density, strain rate, temperature, sample size and hardness
- Developed a scaling relation for snow strength based on dimensional analysis and quasi-brittle fracture mechanics
- Filmed laboratory and in situ fracture tests with a high speed camera and calculated crack propagation speed and deformation patterns using particle tracking software

- Developed a thin blade snow penetrometer for repeatable and objective index measurements of snow strength and Young's modulus
- Implemented quasi-brittle tensile fracture and damage mechanics models in a finite element code to simulate laboratory fracture experiments
- Mentored two full-time student assistants over the course of two winter field seasons

Master's Research 2003-2005

- Surveyed avalanche terrain and identified extreme runout positions of avalanche paths in two mountain ranges
- Combined empirical runout distance and speed data to constrain the selection of friction coefficients
- Modeled avalanche flow using dynamics model DAN
- Reprogrammed several modules within the DAN model to utilize empirical speed data

Research Interests

Current and future research interests include:

- Fracture and damage mechanics of snow and ice
- Field and laboratory studies of snow and ice mechanical properties
- Numerical modeling of fracture and damage in snow and ice, including crack initiation and propagation problems and inverse problems using observational data
- Creep fracture and viscoelastic fracture mechanics
- Multiscale modeling and parameterization of small scale material physics in large scale simulations

Refereed Publications

Borstad, C.P. and D.M McClung (2010). Numerical modeling of quasi-brittle fracture initiation and propagation in snow slabs. Submitted to *Cold Regions Science and Technology*, December 2010.

Borstad, C.P. and D.M McClung (2010). Thin blade penetration resistance and snow strength. In revision, *Journal of Glaciology*.

McClung, D.M. and C.P. Borstad (2010). Probability distribution of energetic-statistical strength size effect in alpine snow. Submitted to *Probabilistic Engineering Mechanics*.

- Fractured 28 homogeneous snow samples in a cold lab for statistical analysis, created graphic schematics of data sources

Borstad, C.P. and D.M. McClung (2009). Sensitivity analyses in snow avalanche dynamics modeling and implications when modeling extreme events. *Canadian Geotechnical Journal* **46**(9):1024-1033, doi:10.1139/T09-042.

Flaa, John P., Michel, Steve B. and Chris Borstad (2009). Building a reliable snare cable for capturing grizzly and American black bears.

Ursus **20**(1):50-55, doi:10.2192/08GR002R2.1.

- Analyzed failure data from laboratory tests, calculated Weibull parameters and survival curve for snare load capacity

Refereed Conference Proceedings

Borstad, C.P. and D.M. McClung (2009). Size Effect in Dry Snow Slab Tensile Fracture. *Proceedings of the 12th International Conference on Fracture*, Ottawa, Canada, 12-17 July 2009, 10 pp.

Non-refereed Publications

Borstad, Chris and David McClung (2008). Slab fracture at 1900 Frames Per Second - Experimental Methods. *Proceedings of the 2008 International Snow Science Workshop*, Whistler, B.C. Canada, 21-27 September, 2008.

Borstad, Chris (2008). Uncertainty and Input Sensitivity in Avalanche Dynamics Models. *Avalanche.ca* **84**:61-63.

Selected Abstracts - Oral Presentations

Borstad, C.P. and D.M. McClung (2010). *Numerical modeling of fracture propagation in slabs.* International Snow Science Workshop, Lake Tahoe, CA, 17-22 October, 2010.

Borstad, C.P. and D.M. McClung (2010). *Deformation analysis of the propagation saw test.* International Snow Science Workshop, Lake Tahoe, CA, 17-22 October, 2010.

Borstad, C.P. and D.M. McClung (2009). *Size dependence of snow slab tensile strength and competing theoretical explanations.* 2009 Annual Meeting of the Northwest Glaciologists, Vancouver, B.C. Canada, 23-24 October, 2009.

Borstad, C.P and D.M. McClung (2009). *Size Effect in Dry Snow Slab Tensile Fracture.* 12th International Conference on Fracture, Ottawa Canada, 12-17 July, 2009.

Borstad, C.P. and D.M. McClung (2008). *Slab Fracture at 1900 Frames Per Second - Experimental Methods.* International Snow Science Workshop, 21-27 September, 2008, Whistler, B.C., Canada.

Borstad, C.P. and D.M. McClung (2006). *Speed Calculations of Extreme Dry Snow Avalanches Using a Dynamics Model.* International Workshop on Snow Avalanches, 30 October-2 November, 2006, Vancouver, B.C., Canada.

Borstad, C.P. and D.M. McClung (2006). *Dynamic Modeling of Speed Profiles of Extreme Dry Snow Avalanches.* American Geophysical Union Joint Assembly, Baltimore, MD, 23-26 May, 2006.

Selected Abstracts - Posters

Borstad, C.P. and D.M. McClung (2010). *Thin blade penetration*

resistance as a proxy for the strength and elastic modulus of snow. AGU Fall Meeting, San Francisco, CA, 13-17 December, 2010.

Borstad, C.P. and D.M. McClung (2010). *A paint scraper hardness gauge.* International Snow Science Workshop, Lake Tahoe, CA, 17-22 October, 2010.

McClung, D.M. and C.P. Borstad* (2006). *Size Effects in Slab Avalanche Fractures.* International Snow Science Workshop, Telluride, CO, 1-6 October, 2006 (*presenting author).

Borstad, C.P. and D.M. McClung (2006). *Dynamic Modeling of Speed Profiles of Extreme Dry Snow Avalanches.* International Snow Science Workshop, Telluride, CO, 1-6 October, 2006.

Professional Experience

Glaciology mass balance surveying
Field assistant — Coast Mountains, British Columbia
- Wedge glacier — July 2007
- Bridge glacier — April 2006
- Place glacier — April 2005

Canadian Avalanche Association — Revelstoke, B.C. Canada
Professional Operations Level 1 Avalanche Course — January 2005

NASA Cold Lands Processes Experiment
Field Assistant — Winter 2003

Professional Development

UBC Faculty of Graduate Studies
Graduate Pathways to Success Seminars
- Tools for Transition — June 2010
- Applying Successfully for Career Opportunities — May 2010
- Crafting Your Funding Application — December 2009

UBC Centre for Teaching and Academic Growth
Course Design Intensive — Fall 2009
Graduate Instructional Skills Workshop — Summer 2008

Canadian Avalanche Association
Continuing Professional Development Seminars — 2008,2009

Teaching Experience

GEOB 374: Natural Hazards Analysis
Guest Lecture — UBC, 2 Dec. 2010
- Classification of slope failures, strain softening and strain localization in fracture of earth materials

GEOG 374: Statistics in Geography
Teaching Assistant — UBC, Winter 2009
- Laboratory teaching of statistical methods using R and Excel

- Marking of assignments and exams

GEOB 102: Introduction to Geographical Biogeosciences - Climate and Vegetation

Teaching Assistant UBC, Fall 2009

- Tutorial leadership, assignment and exam marking
- Course covers circulation and characteristics of air and water, energy and water cycles, global climate, hydrology, human impacts

GEOG 316: Geography of Natural Hazards

Co-Lecturer UBC, Fall 2008

- Taught course in a team-teaching format in collaboration with Prof. David McClung and Dr. Pascal Haegeli
- Taught physical characteristics, causal mechanisms and human impacts of earthquakes, landslides, avalanches and forest fires

GEOG 408: Snow and Ice Processes

Sessional Lecturer UBC, Fall 2007

- Taught formation and growth of snow in the atmosphere; distribution and transport of snow on the ground; snow metamorphism; avalanche terrain, triggering, forecasting, flow dynamics, runout and impact; glacier formation and motion; sea ice formation; climate change and the cryosphere
- Developed new course webpage using WebCT, developed new lecture notes and slides, led two field trips

CIVL 215: Civil Engineering Fluid Mechanics 1

Teaching Assistant UBC; 2004,2005,2006

- Led tutorials to review course material, assisted students with homework, marked exams and assignments

MECH 2: Integrated 2nd year Mechanical Engineering

Teaching Assistant UBC, Fall 2004

- Taught question-and-answer sessions related to homework assignments, facilitated student presentations on class projects, provided technical writing assistance for student reports

Academic Advancement Center

Physics and Calculus Tutor CSU, 2002-2003

- Assisted students from low income or first-generation backgrounds and students with disabilities

Teaching Interests

Current and future teaching interests include:

- Fracture mechanics of geophysical materials
- Field and laboratory methods in snow science
- Snow mechanics and avalanche dynamics
- Risk analysis of natural hazards

Service

Session Chair, 12th International Conference on Fracture
Scaling Laws and Size Effects, Session 4
- Ottawa, Ontario Canada, 17 July 2009

Jared Stanley Memorial Mountain Safety Lecture
Organizing Committee 2005-Present

Mountain Equipment Co-op Staff Training
Field Leader February 2009

Graduate Student Society, UBC
Councillor, Civil Engineering 2005-2007

Civil Engineering Graduate Students Society, UBC
Various council positions 2003-2008

Sustainability Ambassadors Initiative, UBC
Sustainability Ambassador 2004-2005

Awards

The University of British Columbia
- Jared Stanley Memorial Scholarship, 2005
- International Partial Tuition Scholarship, September 2004 and January 2005
- International Graduate Tuition Scholarship, August 2003
- Graduate Entrance Scholarship, 2003

Computing Skills

Programming languages
- Python
- C++
- Visual Basic

Analysis
- `oofem` finite element software
- ANSYS finite element software
- TEMA particle tracking software
- R statistical computing
- MATLAB
- DAN avalanche/landslide model

Graphics
- Pylab/Matplotlib
- CorelDRAW
- GIMP
- Grapher 6, 7
- GNUplot

Office Applications

- LaTeX
- Microsoft Office 97/2000/2003/2007
- OpenOffice 2.0, 3.0