AVALANCHE NEWS NO. 10

OCTOBER 1982

EDITORIAL NOTE

The intention of AVALANCHE NEWS is to assist communication between persons and organizations engaged in snow avalanche work in Canada. Short articles cover reports of accidents, upcoming and past events, new techniques and equipment, publications, personal news, activities of organizations concerned with avalanche safety, education and research. Contributions are expected from the readers.

Avalanche News is issued three times per year, usually in January, June, and October. There is no subscription fee. Requests for copies and notifications of changes of address should be sent to the publisher.

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AVALANCHE NEWS

Canadian Avalanche Association, 3904 West 4th Ave., Vancouver, B.C., V6R 1P5

OCTOBER 1982, No.10

AVALANCHE INVOLVEMENTS

In the summer of 1982, seven avalanche accidents involving a total of 20 mountain climbers were reported in Canada. Five of the climbers were killed. The most serious accident occurred on June 11, 1982 at Mount Logan in the Yukon when seven members of a party were caught by an avalanche which hit their camp. Three died in tents buried by snow. Five accidents occurred in Jasper National Park and one in the Bugaboo Mountains, all during the month of August.

The accidents of the summer bring to nine the number of people killed in avalanches in Canada during the avalanche year from October 1, 1981 to September 30, 1982.

SECOND SYMPOSIUM ON APPLIED GLACIOLOGY

AUGUST 23-27, 1982, HANOVER, NEW HAMPSHIRE, U.S.A.

The symposium covered a wide range of topics on all aspects of snow and ice research. Much of the reported work, particularly with respect to snow, consisted of theoretical papers unsupported by data. However, a number of papers from the conference may be of interest to avalanche workers. These are detailed below.

Avalanche Dynamics and Flowing Snow

T. Lang and J. Dent: Friction between surface and flowing snow.

> The paper describes experiments on the relation between shearing resistance and speed for friction of snow on snow.

J. Dent and T. Lang: A Bingham model for flowing snow.

> The application of a computerized model which attempts to simulate the tendency of snow to "lock-up" in the runout zone.

B. Schieldrop: A contribution to avalanche dynamics:

> A formal and an exact solution of the Voellmy/Perla two-parametric equation of motion.
>
> This is a mathematical treatment of the avalanche dynamics model used by many consultants. The author deals formally with entrainment and curvature effects to evaluate their expected effects on avalanche motion.

D. McClung and P. Schaerer: Determination of avalanche dynamics friction coefficients from measured speeds.

The paper focuses on mathematical and physical difficulties in the Perla/Voellmy model and shows these by using field data.

S. Bakkehøi, U. Domaas, and K. Lied: Statistical analysis of extreme snow avalanche runout based on topographic parameters.

This paper discusses avalanche runout distances based solely upon a statistical analysis of avalanche topographic parameters. This is an extension of previous work reported at the Ft. Collins symposium in 1979.

Avalanche Control

R. Perla and K. Everts: Avalanche control by helicopter bombing.

The paper presents a statistical analysis of avalanche control success in Banff National Park. The paper uses the Canadian size classification to gauge the avalanche activity. The results show that control efficiency is not necessarily improved by use of larger explosive charges.

Blowing Snow

P. Föhn and R. Meister: Distribution of snowdrifts on ridge slopes: Measurements and theoretical approximations.

The paper presents field studies of the distribution of wind deposited snow on the lee side of a mountain crest. Simple theoretical models were used to predict the distributions seen in the data.

Acoustic Emissions

R. Sommerfeld and H. Gubler: Snow avalanches and acoustic emissions.

This paper reviews and summarizes results of prediction of slope stability using acoustic emissions. Points of agreement and disagreement between results from Colorado and Switzerland are detailed.

C. Rosé: Seismic moment, stress drop, strain energy, dislocation radius, and location of seismic acoustical emissions associated with a high alpine snowpack at Berthoud Pass, Colorado.

The paper summarizes results in determining the spatial location of acoustic noises in connection with slope stability.

Metamorphism

R. Brown and E. Adams: On the use of mixture theories to model heat and mass transport in a mountain snowpack.

E. Adams and R. Brown: An evaluation of temperature gradient metamorphism of a dry snowpack.

These two papers offer theoretical treatments of aspects of temperature gradient metamorphism.

Other Papers of Interest

1) Two theoretical papers on shock waves in snow by Brown, Sata and Brown.
2) A paper by Larsen, McClung and Hansen dealing with measurements of snow creep pressures on an avalanche defense structure.
3) A paper by Ambach and Eisner which focuses on deformation properties of firn.
4) There were a number of papers relating to snow hydrology applications.

The proceedings of the conference will be published as Volume 4 of the Annals of Glaciology, which may be ordered from:

Secretary General
International Glaciological Society
Lensfield Road, Cambridge CB2 1ER
England

The cost is 12£ and the publication is expected for mid 1983.

Dave McClung

AVALANCHE AWARENESS COURSES

REPORT OF THE EDUCATION COMMITTEE

At the first general meeting of the Canadian Avalanche Association on May 5, 1982 in Revelstoke, a need was expressed to assist groups or persons actively engaged in, or interested in, teaching avalanche information courses for the back country user. A working group, known as the Education Committee, was formed at the time. Members of the committee are: Brian Weightman (representing the Canadian Ski Patrol System); Ron Matthews (representing the Alpine Club of Canada); Tony Daffern (presently the Alberta Mountain Council); Garry Walton (presenting the British Columbia Institute of Technology); and Clair Israelson and Chris Stethem (representing the Canadian Avalanche Association). At that time the objective of developing guidelines for course content was established.

At a further meeting held on June 9, 1982 at the Alpine Club of Canada in Canmore, Alberta, the B.C.I.T. two day Avalanche Information Course and the C.S.P.S. Introductory Avalanche Course were reviewed. The content of the courses was discussed and it was resolved that a general outline for introductory level courses would be written by fall 1982. A long term goal of developing guidelines for advanced level courses was also discussed. Clair Israelson was assigned to begin this task.

Since that time a draft of the introductory level course guidelines has been prepared. A seminar will be held at the Lake Louise Inn on November 13 and 14, 1982, for any person currently teaching or interested in teaching back country information courses. At the seminar the participants will present the various subjects outlined in the guidelines and the group will discuss content and teaching techniques. The seminar will provide all with an opportunity to exchange ideas, to discuss course content and to arrive at the best possible courses for the back country user. All persons engaged in teaching back country information courses are encouraged to attend. Interested persons should contact the Canadian Avalanche Association, 3904 West 4th Avenue, Vancouver, B.C., V6R 1P5, telephone (604)-732-4829. The fee for attending the seminar is $20.00.

The Education Committee has defined the Introductory Avalanche Awareness Course as follows:

Course Objective

At the end of the course students should be able to:

1) Identify the basic hazardous situations.

2) State the methods of enhancing personal and group safety in avalanche terrain.

3) Perform effectively in a search and rescue situation in the back country and assist in an organized rescue.

Training Technique

A two part course:

1) A minimum of seven hours classroom training, on one day or on three to four nights.

2) A one day field session during which the key points of classroom discussion are illustrated.

Key Note

Instructors are urged not to get lost in technical detail. RECOGNITION and AVOIDANCE of the hazard is the key message.

Chris Stethem

AVALANCHE COURSES

B.C.I.T./N.R.C.

Avalanche training courses for professions are organized this winter by the British Columbia Institute of Technology. The courses have been designed to meet the needs of operations concerned with avalanche safety, for example, ski areas, ski guiding, highway operations, railways, and mining operations, and are offered in two levels. Level I is an introductory course; Level II is an advanced course which stresses applications. The courses planned for the winter of 1982-1983 are:

Transportation and Industry

Level I

November 29-December 3, 1982	Creston, B.C.
December 6-10, 1982	Creston, B.C.

Course fee is $250.00

Level II

December 13-17, 1982	Creston, B.C.

Course fee is $250.00

Ski Operations

Level I

December 12-18, 1982	Whistler, B.C.
January 9-15, 1983	Creston, B.C.
January 16-22, 1983	Jasper, Alberta

Course fee is $350.00

Level II

December 4-11, 1982	Whistler, B.C.
January 9-16, 1983	Jasper, Alberta

Course fee is $400.00

Avalanche Control

January 9-13, 1983 Lake Louise, Alberta

Course fee is $250.00

This course was specially designed to meet the needs of operations using explosives in avalanche control.

No avalanche terrain course will be offered this season because the demand of the industry requires that such a course be offered only every second year.

Courses in avalanche hazard evaluation beyond Level II are planned, but in the winter of 1982-1983 will be held on an in-house basis only. A Level III course might be offered in the winter of 1983-1984 if the results of the coming trial course are positive and the demand from industry and individuals warrants it.

Ski operation avalanche courses are pre-requisites for the guide courses of the Association of Canadian Mountain Guides.

Detailed information, brochures and registration forms may be obtained from: Avalanche 1982-1983, Industry Services Department, British Columbia Institute of Technology, 3700 Willingdon Avenue, Burnaby, B.C., V5G 3H2, telephone (604)-434-5734, local 637.

People interested in the courses are advised to register early because the courses that are not filled with a minimum of 20 participants two weeks before the starting date may be cancelled.

AVALAUNCHER DEVELOPMENTS

Avalanche Control Systems has produced a new tailfin which has a larger payload tubing diameter. The payload tubing has an inside diameter of 55 mm and is made of a stronger, lighter plastic which is not as brittle in cold temperatures. The tailfin itself is shorter but maintains the same fin surface with a little more feathering on the leading edges to cause rotation of the projectile. The firing pin tube is now tapered which may eliminate problems caused by the firing pin not being centered. The big advantage of the new tailfin is a reduction in cost due to a modified pouring technique. Costs in Canada are:

Number of Units	Cost/Unit
0-449	$4.80 (U.S.)
450-899	$4.30 (U.S.)
900-	$3.80 (U.S.)

Du Pont Canada is in the process of pouring a number of experimental avalauncher payloads of the new diameter which will be test fired at Whistler Mountain in early November. Results of these tests will be printed in the next Avalanche News.

CONEX will have 1 kg avalauncher payloads available in 30 units per case, F.O.B. Ladner, for $10.30 (CAN.) per payload. If the total order through CONEX is more than 100 cases then the price will drop to $9.70 (CAN.) per payload.

Roger McCarthy

EQUIPMENT

Slope Clinometer

Simple clinometers are available at low cost for those who are interested in measuring the incline of slopes and relating it to snow stabilities. OFF BELAY (P.O. Box 728, Renton, WA, 98057, U.S.A.) offers an "Avalanche Slope Angle Guide" for $2.98 (U.S.) plus $0.20 postage. This clinometer is a plastic card that can also be used in the identification of snow layers and has a millimetre grid for classification of snow crystals.

Aerial Avalanche Search

The rescue group of the Allgau in Germany has developed a helicopter mounted receiver to be used in the search for avalanche victims who carry a transceiver. The equipment containing two receivers is attached to the winch of the rescue helicopter and lowered to a distance of about two (2) metres above the snow surface. The signal from the transmitter buried in the snow is audible through earphones and is displayed on a small screen.

The equipment allows a coarse search in a short time and is applicable in hazardous situations such as in gullies, on steep slopes, when secondary avalanches can be expected, and on very large avalanche deposits.

Information supplied by Peter Fuhrmann.

MOUNTAIN WEATHER FORECAST

The Pacific Weather Centre of the Atmospheric Environment Service has changed the format of the Mountain Weather Forecast. These changes will affect avalanche safety operations that must use the Mountain Weather Forecast for their avalanche hazard forecasts and decisions about closures of roads, ski runs, avalanche control, helicopter flights, and staff assignments. The proposals for the future of the Mountain Weather Forecast were discussed in meetings between Jack R. Mathieson, Regional Director and Gary E. Wells, Officer In Charge, Pacific Weather Centre; Geoff Freer (representing highway operations); Roger McCarthy (representing ski areas); Jeff Boyd (representing helicopter ski operators); and Peter Schaerer (representing the Canadian Avalanche Association).

Beginning in November 1982 the Mountain Forecast Guidance (as it is now called) will consist of a synopsis and Regional forecasts.

The synopsis will contain more information than the synopsis of the public weather forecast. It will describe the location and movement of systems, troughs, and high pressure areas and contain an outlook with respect to freezing levels, wind and precipitation.

The Regional forecasts will be generated in two steps:

a) A prediction of freezing levels, mountain top wind, and snowfall by the computer for selected locations. A location selected for a spot forecast must have at least ten years of climate observations and make available daily observations on real-time.

b) Verification with real-time observations in the Region and the actual weather situation by a skilled meteorologist.

By special arrangements the users may also obtain the upper level observations from a weather office.

A principle problem is the distribution of the Mountain Forecast Guidance. Users equipped with a Telex may receive it directly from the Pacific Weather Centre. The Mountain Forecast Guidance is available at the local weather office where it can be obtained with a telephone call. Future means of communication might include television.

Recommendations to Users

1) Those who do not recieve the Mountain Forecast Guidance in written form, for example by Telex, should prepare a form that can be filled out daily when the forecast is obtained. The form should have space for the synopsis and a space for the Regional guidance as follows:

Region .....

Date, Time	Freezing Level	Mountain Top Wind	Snowfall Amount
.....	.....	.....	.....
.....	.....	.....	.....

2) Make adjustments for the local area, based on past experience and the synopsis.

3) Observe the sky, barometer, temperature, wind and precipitation continuously and compare with the synopsis.

4) Make notes about the accuracy, level of satisfaction, and desired changes of the Mountain Forecast Guidance.

The regular users of the Mountain Weather Forecast in avalanche hazard forecasting will be invited to a discussion of their experiences with staff of the Atmospheric Environment Service either during the winter or at the end of the winter.

The November 1, 1982, 0400 hours, Mountain Forecast Guidance is shown as a format example of the Telex printout.

HWY REG KAM
JXHWY REG KAM
AES WEA VCR NOV. 1 1156
FPCN50 CWVR 011200
MOUNTAIN FORECAST GUIDANCE FOR COASTAL BRITISH COLUMBIA ISSUED BY ENVIRONMENT CANADA AT 4AM PST MOUNDAY 01 NOVEMBER 1982
FOR TODAY AND TUESDAY.
THE NEXT SCHEDULED FORECAST GUIDANCE WILL BE ISSUED AT 4PM TODAY 01 NOVEMBER 1982

SYNOPSIS:

A RIDGE OF HIGH PRESSURE WILL BUILD ALONG THE COAST TODAY AND WILL RESULT IN FAIR WEATHER FOR MOST LOCALITIES. A PACIFIC FRONTAL SYSTEM ALONG 150W THIS MORNING WILL TRACK EASTWARDS TOWARDS THE BC COAST. THIS SYSTEM WILL GIVE RAIN AND SNOW TO THE NORTH COAST OVERNIGHT AND TUESDAY. ONLY CLOUD IS EXPECTED FOR THE SOUTH COAST SINCE THE SYSTEM IS EXPECTED TO SLOW AS IT APPROACHES THE COAST ON TUESDAY.
FREEZING LEVELS RANGING FROM 1300 METRES IN THE SOUTH TO 800 METRES IN THE NORTH WILL RISE ON TUESDAY BY 300 TO 500 METRES WITH THE APPROACH OF THE FRONTAL SYSTEM.

SOUTH COAST MOUNTAINS

	FREEZING LEVEL	MOUNTAIN TOP WIND		SNOWFALL AMOUNTS
TODAY..	1200 METRES	NORTHWEST	15KPH	NIL
TONIGHT..	1400 METRES	SOUTHWEST	10KPH	NIL
TUESDAY ..	1600 METRES	SOUTH	15KPH	NIL

VANCOUVER ISLAND MOUNTAINS

	FREEZING LEVEL	MOUNTAIN TOP WIND		SNOWFALL AMOUNTS
TODAY..	1300 METRES	WEST	10KPH	NIL
TONIGHT..	1500 METRES	SOUTH	15KPH	NIL
TUESDAY ..	1700 METRES	SOUTH	25KPH	NIL

SKEENA MOUNTAINS

	FREEZING LEVEL	MOUNTAIN TOP WIND		SNOWFALL AMOUNTS
TODAY..	900 METRES	WEST	15KPH	NIL
TONIGHT..	1000 METRES	SOUTHWEST	25KPH	5 CMS
TUESDAY ..	1300 METRES	SOUTHWEST	35KPH	25 CMS

AES WEA VCR NOV. 1 1201

MOUNTAIN FORECAST PROGRAM - 1982-1983

Submission by
G.E. Wells, Officer In Charge, Pacific Weather Centre

The Mountain Weather Forecast Guidance will be issued November 1, 1982, from the Pacific Weather Centre. Some changes have been made to the format in an effort to increase the utility of the forecast:

1) In recognition of the different climatological regimes, the Mountain Forecast Guidance will be split into two bulletins: one for the coastal mountain regions and one for the interior mountain regions.

2) Each bulletin will contain a synopsis along with a detailed forecast of freezing level, mountain top wind, and expected snowfall accumulations.

3) The forecasts will be issued at 0400 PST and 1600 (4 PM) PST. The early morning forecast will cover the periods:

Today...	4 AM to 6 PM
Tonight...	6 PM to 6 AM
Tomorrow (next day)...	6 AM to 6 PM

The afternoon forecast will cover:

Tonight...	4 PM to 6 AM
Next Day...	6 AM to 6 PM
Next Night...	6 PM to Midnight

4) The synopses in the bulletins will be much more technical this year including: positions of weather systems (lows, fronts, upper troughs, etc.); their expected movement and development; and associated weather and wind conditions. In addition, the forecast trend of the freezing level will be included.

5) All forecasts will be transmitted on the AES teletype communications to AES weather offices and to users connected to the circuit. In addition, as in previous years forecasts can be obtained directly from a dial-in Telex system at the Pacific Weather Centre. For further information, on connection to these systems, please contact the Pacific Weather Centre.

6) Atmospheric Environment Service weather offices have staff who are trained in the adaptation of the Mountain Forecast Guidance to the particular mountain forecast region in their area. With their detailed knowledge of local conditions and influencing factors, these offices can provide consultation services for fine-tuning the Mountain Forecast Guidance issued by the Pacific Weather Centre.

7) Following is a list of telephone numbers of Atmospheric Environment Service offices participating in the Mountain Forecast Program:

LIST OF ALL WEATHER OFFICES IN BRITISH COLUMBIA

PARTICIPATING IN THE MOUNTAIN FORECAST PROGRAM

November 1, 1982

OFFICE	TELEPHONE	OPEN HOURS (local time)
CASTLEGAR	365-3131	0630-1630
KAMLOOPS	376-0727	0700-1700
KELOWNA	765-6598	0445-0015
PENTICTON	492-0539	0700-1700
PORT HARDY	949-6559	0700-1700
PRINCE GEORGE	963-7552	0400-2330
TERRACE	635-3224	0710-1710
VANCOUVER	273-2345	24 HOURS
VICTORIA	656-3131	24 HOURS
PACIFIC WEATHER CENTRE	732-4298	24 HOURS

(The Pacific Weather Centre is the main contact during hours when the local weather offices are closed).

FILM

An Avalanche Awareness Program

Presented by the Alberta Mountain Council

This twenty minute film presentation was developed by the Alberta Mountain Council as a vehicle for introducing mountain travellers to the problem of avalanches. It briefly details the history of Canadian avalanche problems, outlines how avalanches threaten modern travellers, and details ways in which one can begin to understand the complex nature of avalanche hazard. The film outlines what to do in avalanche terrain and dramatically demonstrates techniques a party might use to quickly rescue a buried victim. This concise, fast moving program was produced by R.W. Sandford with the co-operation of the Alpine Club of Canada and the National Park Warden Service. The program was funded by the Alberta Parks, Recreation and Wildlife Foundation.

Copies of the film in either 16 mm colour or video tape colour will be available at cost price through the Alpine Club of Canada, P.O. Box 1026, Banff, Alberta, TOL 0C0, telephone (403)-762-4481.

Peter Fuhrmann

PUBLICATIONS

The Avalanche Review is a new monthly publication for the avalanche community. The first issue will be published in October 1982.

Each issue of The Avalanche Review will contain a special column for discussing current topics, innovative ideas, or unusual observations; easy to read summary articles of pertinent theoretical work; a calendar of events; and up-to-date news on "what's happening in avalanchology"! Articles by specialists and 'generalists' will address feature topics each month, like instrumentation, artificial control, forecasting, rescue, past and present research, mountain weather, as well as a gamut of other subjects that affect our understanding of snow and avalanches.

The Avalanche Review will be published monthly throughout the winter and will cost $1.75 (U.S.) per issue or $8.00 (U.S.) per year.

THE AVALANCHE REVIEW
P.O. Box 20247 - Broadway
SEATTLE, WASHINGTON 98102

Sue A. Ferguson
Publisher

AVALANCHE MOTION ANALYSIS USING A POCKET CALCULATOR

A remarkably simple and clearly formulated version of the avalanche motion equation appeared in recent years (Perla et al., 1980) and has become the basis of a computer program for avalanche velocity and runout analysis (Perla and Cheng, 1979). This note presents an application of the same algorithm using a Texas Instrument TI 58 or TI 59 calculator, but in principle may be used with other programmable desk calculators. The attached program listing (Appendix) may be of use to avalanche protection workers who do not have a ready access to a full size computer or who wish to conduct calculations in the field.

The program functions in exactly the same way as the Perla and Cheng (1979) Fortran version and the reader is therefore referred to that article for the relevant formulas. To use the program, carry out the following steps:

1) Divide the avalanche path into uniform segments; measure path angle and length in each.

2) Store friction coefficient μ in Memory Register 1.

3) Store turbulence coefficient M/D in Register 2.

4) Ensure Register 6 is 0 (velocity register).

5) Start program by pressing Reset, R/S.

6) Input slope angle of first segment in ^{o}.

7) Input length of first segment in m.

8) The calculator prints back the angle and length to confirm correct input and then prints the calculated velocity at the end of the segment.

9) Repeat Steps 6 and 7 for the following segments.

10) The calculator checks for runout being reached. When it is, the calculator returns the runout distance in m instead of the length of the last segment, then flashes "9999" on the display to indicate that the run has been completed. Pressing R/S resets the calculator for a new run.

If the user does not have a thermal printer, he should replace the instruction "Print" wherever it occurs in the listing (five times) by "R/S", for output to be shown on the display.

Figure 1 shows, by way of example, the analysis of an avalanche path north of Howe Sound. An analysis using the parameters μ = 0.15, M/D = 1100, as recommended by Buser and Frutiger (1980) for maximum runout dry slab avalanches results in an extremely pessimistic runout estimate. The assumption μ = 0.3, M/D = 1000 is more realistic in this case, although still quite conservative.

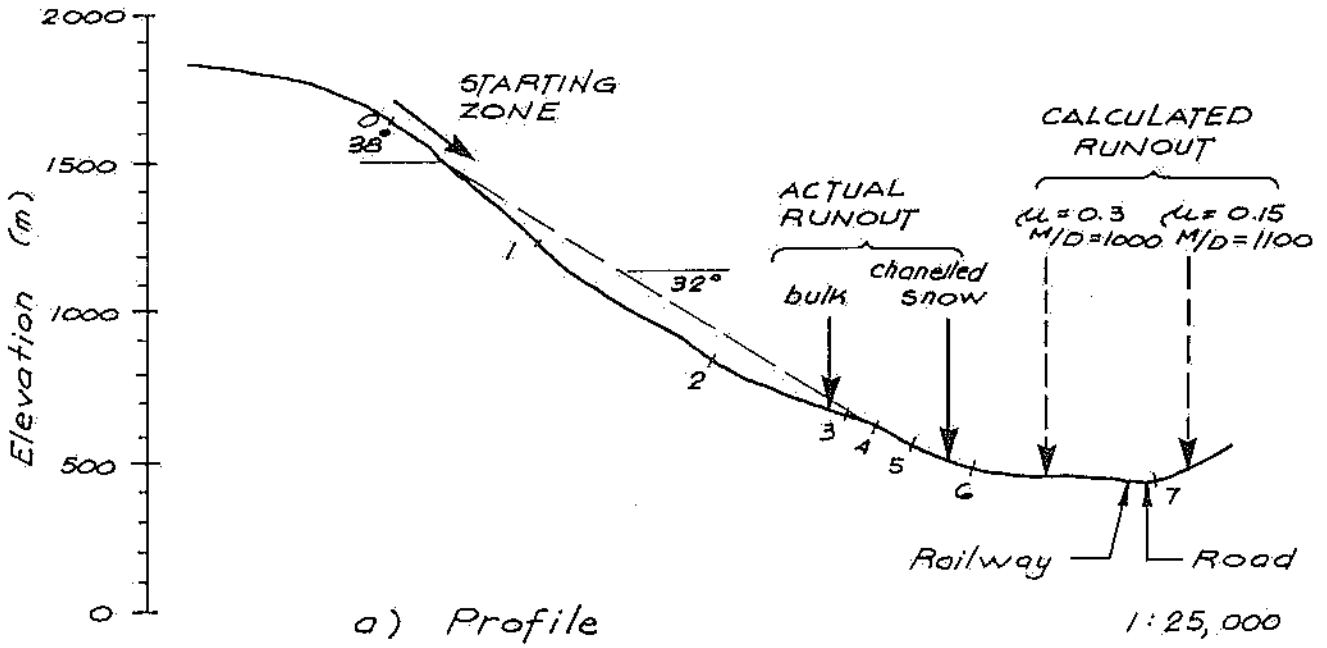
Readers with questions concerning the use of the program should contact the author: Oldrich Hunger, Thurber Consultants, Ste. 100 - 1281 West Georgia Street, Vancouver, B.C., telephone (604)-684-4384.

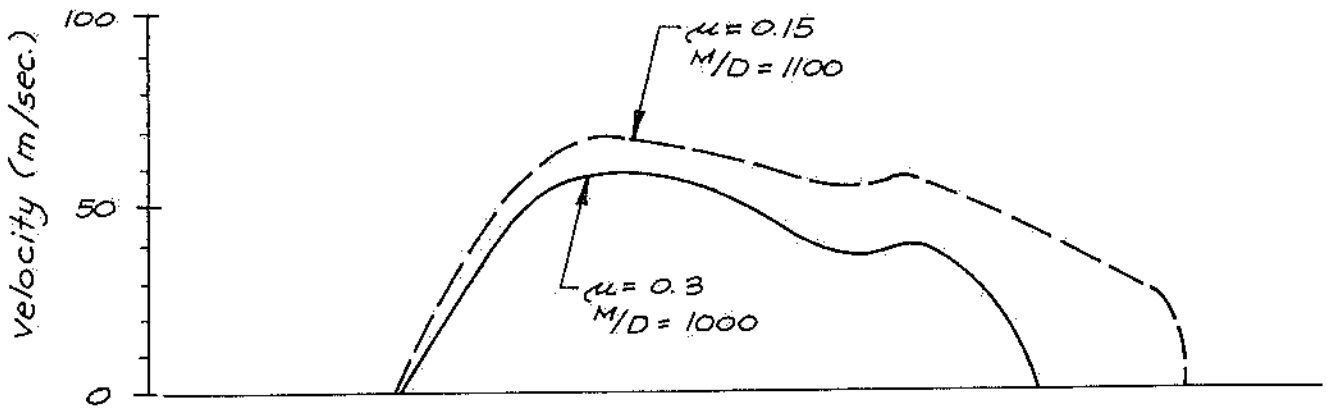
References:

Buser, O. and Frutiger, H., 1980. "Observed maximum runout distance of snow avalanches and the determination of the friction coefficients." Journal of Glaciology, Vol. 26, pp. 121-130.

Perla, R. and Cheng, T.T., 1978. "Numerical computation of avalanche motion." National Hydrology Research Institute Paper No. 5.

Perla, R., Cheng, T.T. and McClung, D.M., 1980. "A two parameter model of snow avalanche motion." Journal of Glaciology, Vol. 26, pp. 197-207.





b) Calculated velocity and runout

FIGURE 1 Analysis of an avalanche path north of Howe Sound, B.C.

APPENDIX

PROGRAM LISTING:

```
000  43 RCL
001  03  03
002  42 STO
003  08  08
004  25 CLR
005  09  9
006  93  .
007  08  8
008  01  1
009  65  ×
010  53  (
011  91 R/S
012  42 STO
013  03  03
014  38 SIN
015  75  -
016  43 RCL
017  01  01
018  65  ×
019  43 RCL
020  03  03
021  39 COS
022  54  )
023  95  =
024  42 STO
025  04  04
026  25 CLR
027  43 RCL
028  06  06
029  65  ×
030  53  (
031  43 RCL
032  08  08
033  75  -
034  43 RCL
035  03  03
036  54  )
037  39 COS
038  95  =
039  42 STO
040  06  06
041  25 CLR
042  02  2
043  94 +/-
044  65  ×
045  91 R/S
046  42 STO
047  07  07
048  55  ÷
049  43 RCL
050  02  02
051  95  =
```

store previous slope angle

calculate α and store in Reg. 4

correct velocity for change in slope

calculate β and store in Reg. 5

```
052  42 STO
053  05  05
054  43 RCL
055  04  04
056  65  ×
057  43 RCL
058  02  02
059  65  ×
060  53  (
061  01  1
062  75  -
063  43 RCL
064  05  05
065  22 INV
066  23 LNX
067  54  )
068  85  +
069  53  (
070  43 RCL
071  06  06
072  54  )
073  33 X²
074  65  ×
075  43 RCL
076  05  05
077  22 INV
078  23 LNX
079  95  =
080  76 LBL
081  11  A
082  29 CP
083  77  GE
084  12  B
085  43 RCL
086  03  03
087  98 ADV
088  99 PRT
089  43 RCL
090  02  02
091  55  ÷
092  02  2
093  65  ×
094  53  (
095  01  1
096  75  -
097  43 RCL
098  06  06
099  33 X²
100  55  ÷
101  43 RCL
102  04  04
103  55  ÷
```

velocity formula

test if runout reached

yes

calculate runout and print

TRIAL PROBLEM(Perla & Cheng, 1979):

μ = 0.35, M/D = 1000

```
104   43  RCL
105   02   02
106   54   )
107   23  LNX
108   95   =
109   98  ADV
110   99  PRT
111   25  CLR
112   42  STO
113   06   06
114   25  CLR
115   09    9
116   09    9
117   09    9
118   09    9
119   91  R/S
120   81  RST
121   76  LBL
122   12    B
123   94   +/-
124   42  STO
125   06   06
126   98  ADV
127   43  RCL
128   03   03
129   99  PRT
130   43  RCL
131   07   07
132   99  PRT
133   43  RCL
134   06   06
135   99  PRT
136   81  RST
```

clear Reg. 6 for a new run

flash 9999 to indicate the avalanche has stopped

no

calculate velocity and print

1st segment:

33.3 - slope (°)
372. - length (m)
36.33816593 - velocity (m/sec)

2nd segment:

36.4
384.
47.43424326

24.4
348.
39.2107917

20.9
336.
30.41595911

23.3
348.
27.10402662

20.9
346.
22.65729463

last segment:

14.5 - slope (°)

230.0190836 - runout (m)

FROM:

Snow Avalanche Section
Ministry of Transportation
and Highways
940 Blanshard Street
VICTORIA, B.C.
V8W 3E6