THE POWDER FASCINATION

Enjoying Winter Snow Sports Safely

A NEW APPROACH

Avalanche Risk Management

Mike Wiegele
Helicopter Skiing

In search of perfect powder
“The more information you collect, the better and safer your judgement and decisions will be in the field”

THE POWDER FASCINATION

ENJOYING WINTER SNOW SPORTS SAFELY

A Paper Prepared By: Mike Wiegele

A professional approach to safe travel in high mountain backcountry, practiced for over 40 years.

THE BEST DAY OF MY LIFE

The fascination of powder skiing comes in many different forms; it is a spectacular display of beauty, tranquility, power and force.

My powder fascination comes from the day to day, moment to moment changes; the utter unpredictably and diversity caused by the elements. There is nothing more beautiful than the effect the sun, moon, and clouds has, from the early morning glow to the majestic yellow, pink and red horizon behind a mountain ridge at sundown. The uninhibited exhilaration I get from my skis floating from side to side down a pure, glistening snowflake laden slope is unmatched from anything else I’ve ever experienced.

My powder fascination also stems from the fascination of others. I never get tired of hearing people claim “this was the best day of my life”.

With this joy and excitement we must always be aware of the inherent risk mother nature poses in the backcountry. I believe strongly in the education, preparation and practice of traveling safely through the backcountry and making safety a number one priority.

The following is a brief outline of an effective systematic approach for safe travel in the backcountry of large, high alpine, glaciated mountain areas called “The 5 Step Checklist of Information Collected”. It is my hope the information and procedures laid out in this paper help shape a better international standard of safety and practices throughout the industry.

Respectfully,

Mike Wiegele

ADVENTURE TOURISM, HOSPITALITY, RECREATION & SPORTS

AVALANCHE FORECASTING FOR LARGE MOUNTAIN AREAS – A PROTOCOL FOR SNOW STABILITY ASSESSMENT –

THE PRACTITIONER

Mike Wiegele

GOAL & PURPOSE

Operators and ski guides are practitioners in the field and have a responsibility to provide a safe and enjoyable experience to clients and employees. As such, we as practitioners are faced with safety practices in order to achieve our goal. Within the mechanized ski industry, a standardized, effective risk management and loss prevention plan, including a rescue plan, needs to ensure safe travel within avalanche terrain.

Mike Wiegele Helicopter Skiing (MWHS) employs a proven 5 Step Checklist system for snow stability rating and avalanche danger forecasting. This helps in better decision making for safe terrain selection and guiding procedures on a particular slope. The ability to travel safely in avalanche terrain relies on early detection, forewarning and methodological gathering of information of avalanche danger prior to heading into the mountains.

The 5 Step Checklist approach is a joint venture between ski guides and research professor Bruce Jamieson. The checklist has been an ongoing system formulated and molded by a professional team at MWHS, Canadian Ski Guide Association, University of Calgary and industry experts, especially devised by Mike Wiegele. The purpose of the checklist is to provide a systematic approach for safe travel in the backcountry of large, high alpine, glaciated mountain areas.

THE LAW & LEGAL LIABILITY: DEFINING RESPONSIBILITY & DUTY OF CARE

As a practitioner, you must understand how The Canadian Court of Law perceives responsibility and legal liability. They state any person, individual, organization, community or government who promotes and carries out a high risk activity where a person can get either injured or killed, which is foreseeable or preventable, has a duty of care and is responsible to provide the current highest standard of safety (Cloutier, M., 2000, pg 13). You must adhere to the law. Failure of this is subject to legal scrutiny and potentially prosecution in the event of an accident or loss.

THE ORGANIZATION

The organization and management team must consist of a well-structured, formally trained and experienced certified personnel with a track-record of safety.

SAFE TERRAIN SELECTION IN THE ALPINE




Selecting known low hazard, low risk slopes less prone to avalanche is key when the stability rating is poor or in question.

SAFE TERRAIN SELECTION IN THE TREES




On overcast and cloudy days, choose safe terrain in the trees. One should also keep the alpine conditions and avalanche paths in mind.

THE 5 STEP CHECKLIST

FOR SNOW STABILITY EVALUATION RATINGS AND WEATHER FORECASTING SYSTEMS
– WARNING – EARLY DETECTION – PREVENTION –

FOR AVALANCHE RISK MANAGEMENT

PLANNING YOUR DAY USING THE '5 STEP' CHECKLIST

A snow stability and weather forecasting assessment team works closely together and follows the details from the '5 Step' Stability Assessment List as well as from the observations made by the ski guiding group during the day in the field. From this exchange of information, the team is able to learn from each other and answer all questions.

Each person should become familiar with the '5 Step' Forecasting System in detail, using the same check list to ensure the information is relayed and interpreted in a systematic and reliable manner.

The checklist should be followed methodically with consideration given to each item. It is important to measure all contributing factors, their impact, their effect and how they each relate and interact within the complex behaviour and stability of the snow pack - either strengthening, deteriorating or maintaining the present stage. It is also important to note what changes may occur overnight or in the weeks to come as new gliding layers are developed.

THE FORECASTER SERVES THE TEAM

After completing the assessment, the forecaster, along with the team, should brainstorm the various details that may have an impact to the snowpack layers and conclude on an agreed stability rating, terrain selection and guiding procedure. The forecaster (a senior lead guide) is someone who is well-organized and willing to lead the thought process as well as liaise between team members.

The two most important functions and jobs for the forecaster are:

1. To compile information
2. To keep communication flowing and share any new information found

The three most important tools are:

1. The 5 Step Checklist
2. The collection of information and communication of this information to other Lead Guides
3. The documentation and appropriate storage of the information

THE 5 STEP CHECKLIST

NATURE WORKS IN A VERY SECRETIVE, COMPLEX, PECULIAR AND PHENOMENAL WAY

PLANNER – USING THE '5 STEP' CHECKLIST

No matter what our knowledge, nature works in a very secretive, complex, peculiar and phenomenal way. More often than not, leaving us to her mercy. She is a moving target at best. The 5 Step Checklist came about in our continuous search to be one or two steps closer dealing with such an unpredictable force.

The checklist is an indispensable tool in preparation for the detailed forecaster. Every member of the team will do well to monitor the progress of the contributory functions to the snowpack profile. Without a plan you are putting yourself and others at risk and may likely end up in an avalanche with potentially fatal consequences. Using the checklist from the start of each day is the ground work that prepares you for each step in the field. The beginning of the day is the most important part of your work.

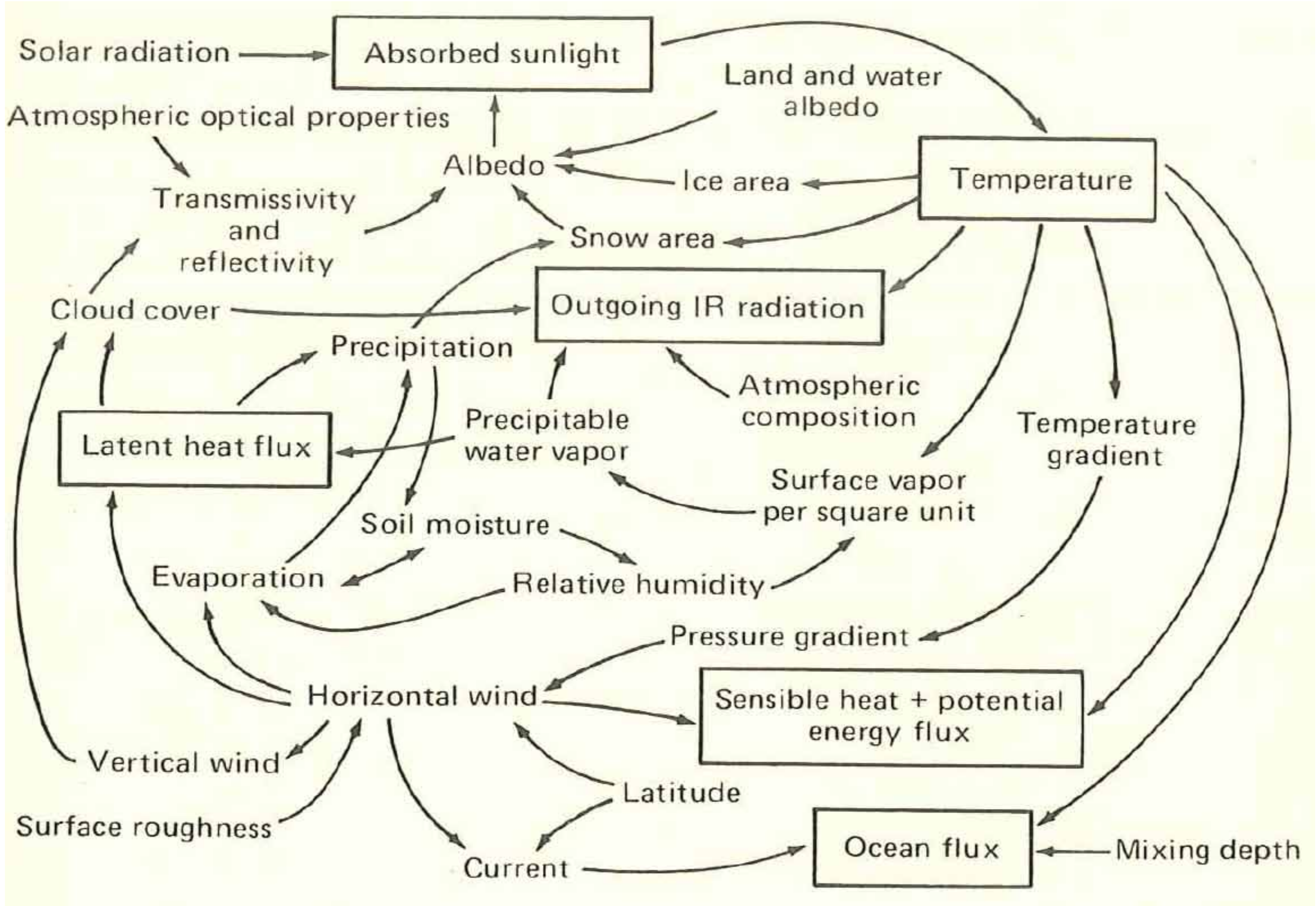
Despite one's years of experience and practice, a ski guide's success comes from preparation, not half measures and good luck. As the old saying goes, "the harder I work the more luck I seem to have".

"Every little detail is important"

TEAM WORK

Imperative to the collection of data is the communication and sharing of knowledge. While out in the field, it is key for ski guides to investigate and monitor snowpack stability with continuous shear tests, field observations and to communicate findings with other guides. Pooling of information between team members increases safety, awareness and overall assessment of the stability.

Our Professional Ski Guides



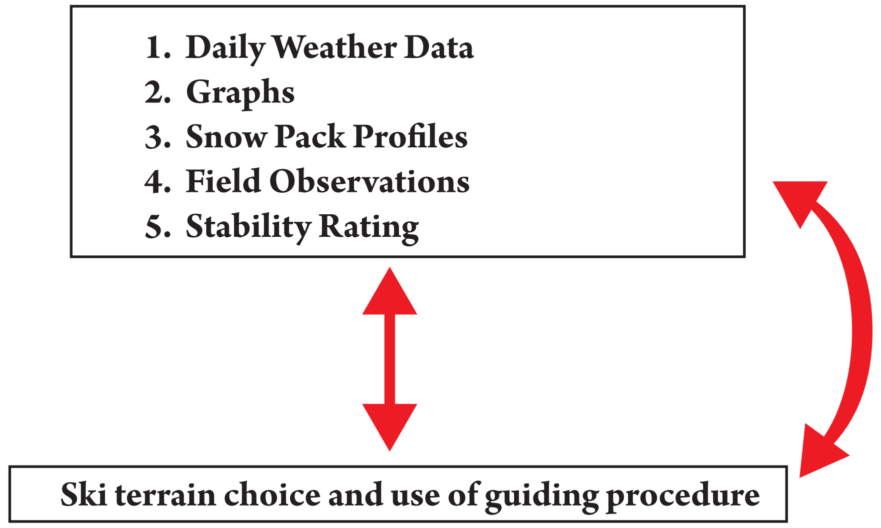
A model of the weather and climate machine illustrating it's complex and intricate feedback mechanisms. The influence of several of the feedback processes are comparable in magnitude but opposite in direction. It is clear that variations in the energy input parameter at the top left may affect several of the meteorological parameters within the machine (Kellogg and Schneider, 1974).

THE 5 STEP CHECKLIST

A METHOD FOR MANAGING AVALANCHE RISK

Following the 5 Step Checklist is a systematic and organized thought process. One must focus on each detail and the effect the main contributory factors may have on the snowpack and mountain range.

THE 5 STEP CHECKLIST



STEP 1

DAILY WEATHER DATA COLLECTION

The very first thing is to collect the weather data to see how it has changed and how it may influence the snow quality in both strength or deterioration. All factors are interrelated and interact with each other; furthermore, it is imperative to account for all areas.

Often one facet may override other categories. For instance, high humidity can severely change the strength of the snowpack by saturating the pack with water particles or very low humidity can cause hardness and brittleness in the snowpack, weakening the stability in a completely different manner.

Daily weather changes are important to record. The records are used for Step 2 - Graphs with Tidal Times, with the main contributory factors and power players in snow stability and avalanche risk.

DAILY WEATHER DATA

	Cariboo	Monashee
2000 m		
3000 m		

Mtn. Wind

Date .... Avalanche Forecaster ....

☐ 1. Freezing level .... DPS .... Visibility ....

Bar.P. .... Ceiling .... ft. Sky ◯

	Blue River 2240′	Mt. St. Anne 6300′	Hroch peak 8500′	Upper level 9000′ Pr. George	Upper level 9000′ Kelowna	Upper level 9000′ Port Hardy
☐ 2. Temperature						
☐ 3. Humidity						
☐ 4. Precip./NS						
☐ 5. H2O mm						
☐ 6. Density Kg/M³						
☐ 7. Ht. of Snow						
☐ 8. Settlement						
☐ 9. Wind speed						
☐ 10. Wind direction						
☐ 11. Wind run 24hr						
☐ 12. Solunar cycle	High			Mod.		

☐ 13. Load Calculation

Wind run/30 ________

Hn water mm ________

Load Total ________

Max Wind Gust

Hroch ________ Time ________

St Anne ________ Time ________

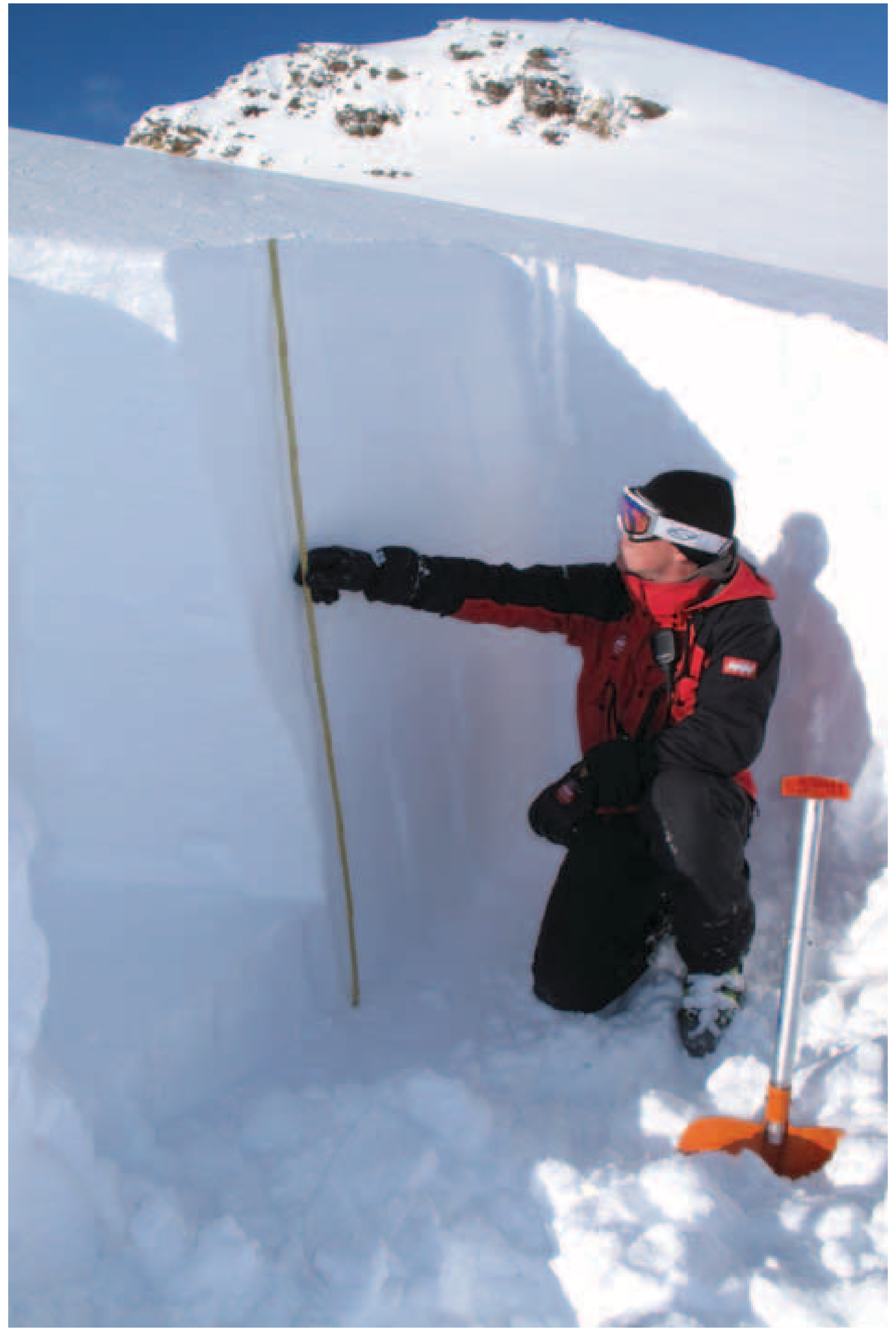
☐ 14. Daily Avalanche Forecast Stability

Alpine	N	S	E	W	Treeline	N	S	E	W	Below TL	N	S	E	W
Storm					Storm					Storm				
Old					Old					Old				
Deep					Deep					Deep				

☐ 15. Overall Stability Rating

Alp	
TL	
BTL	

Last lift .... Heli# .... Pilot .... Lead Guide ....



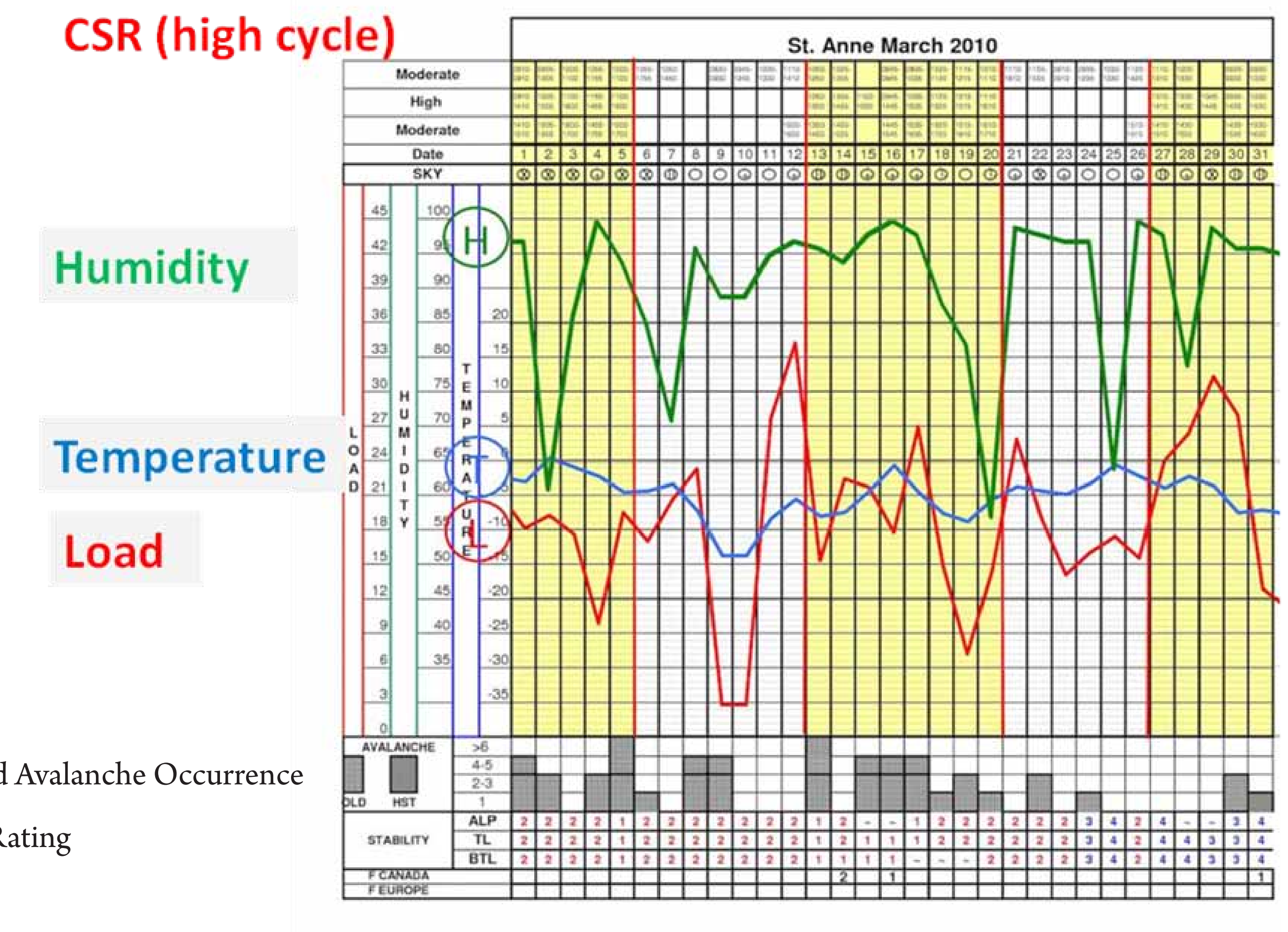
Dig down to the lowest gliding layer. Measure shear.

STEP 2

GRAPHS WITH TIDAL TIMES

MWHS has developed a graph plotted with the factors of humidity, temperature and load. The chart shows how the tidal times correlate and how the maximum inflow of cosmic and solar radiation occurs in the high cycle noted by date and time related to the Tidal Chart.

Note: The graph also represents the historical background of the winter season, starting with the first snowfall. It should be noted and kept in mind that storm activities in high alpine terrain including how heavy wind and turbulence builds and shapes the snowpack of various depths.

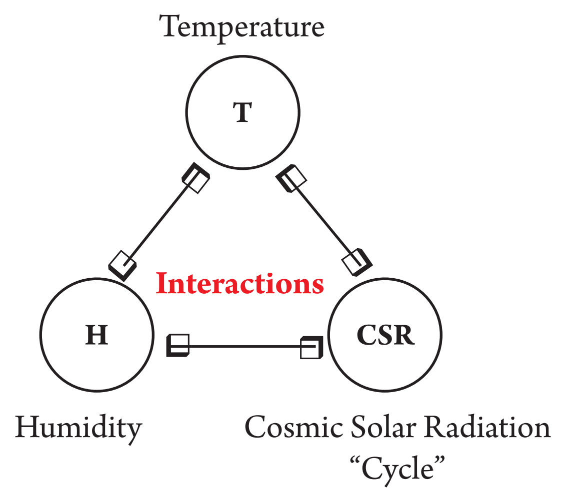


Correlated Avalanche Occurrence

Stability Rating

❒ Small } Trends	❒ Moderate Cycle
❒ Large	❒ High Cycle

MAJOR
CONTRIBUTING FACTORS TRIANGLE



COSMIC SOLAR RADIATION

Cosmic radiation is made up from charged particles such as protons and helium that originate from the sun and the wider universe. Numerous known contributory factors, such as in the triangle, have a major rapid impact on snowpack stability. Other elements have not been discovered yet.

Entering the Earth's atmosphere close to the speed of light, these high-energy protons crash and interact with atoms and molecules from gases in the atmosphere. This invisible yet powerful collision can happen many times. In a thousandth of a second, there might be thousands or millions of "secondary" cosmic rays. This is called an "air shower" of cosmic rays.

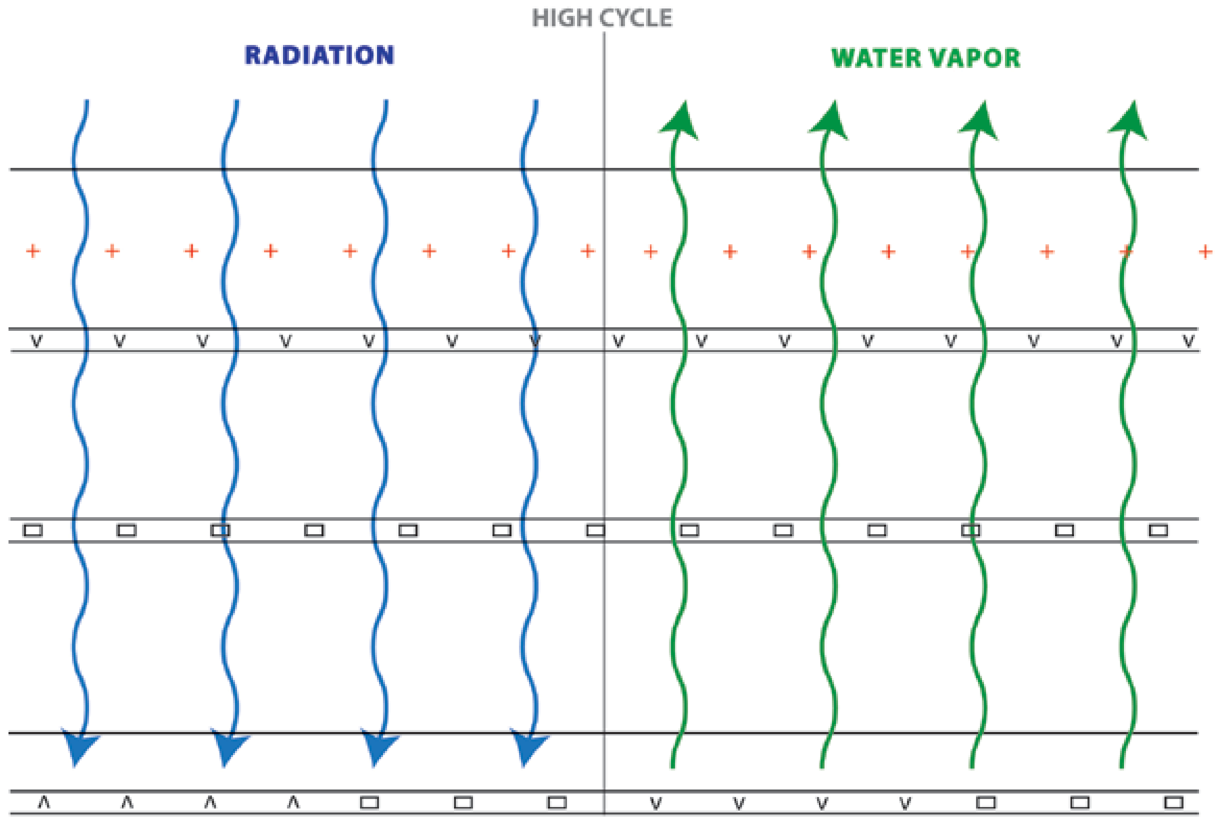
The "air shower" of cosmic rays penetrates deep into the earth's surface, embedding itself into snow, ice and rock.

It is through the process of penetration that the radiation weakens the snowpack. As observed, a snowpack may lift during the atmospheric pressure in high cycle. Essentially radiation enters the snowpack, melting tiny particles of snow and emitting water vapor in the process. The water vapor then seeps back up to the snowpack surface, further deteriorating the strength and stability of the snowpack, thus increasing the probability of snowpack failure and for natural or skier triggered avalanches.

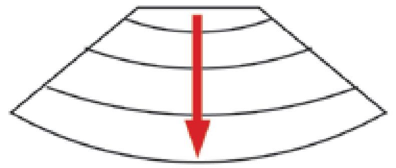
On their own, each of the main contributory factors affect snowpack stability and deterioration. However, when all three factors are present, the risk of snowpack failure is at its highest, and the probability of large scale avalanches increases.

Note: We have observed worldwide over the past 40 years that most large scale avalanches that run the width and length, those that create new paths in mature forests , ice falls and fatalities occur during high cycle. Not giving full consideration to the high cycle may be the missing link in many snow stability assessments.

COSMIC SOLAR RADIATION



A snow layer may lift during atmospheric pressure during high cycle. Snowpack is now saturated with water vapor causing downward tension.



The water vapor then returns to the surface, deteriorating the strength of the snow layers and ice, causing tension and creeping of snowpack - more so in high cycles - increasing the probability of snow pack failure and for natural of skier interference avalanches

Forecasted natural occurrence

To do a full profile look for undisturbed snowpack surface

STEP 3

SNOWPACK PROFILE

SNOWPACK PROFILE – SHEAR TESTS – A FULL PROFILE TEST

It is essential to conduct a thorough snowpack profile, "the pit", by digging a hole from the surface of the snowpack to the ground. Investigate and look for any potential gliding layers existing in the snow-pack. Perform 3 to 5 tests on each gliding layer and assess each layer with the 1 to 7 MWHS rating system (please refer to page 34). This practice is to be carried out on all elevations and exposures.

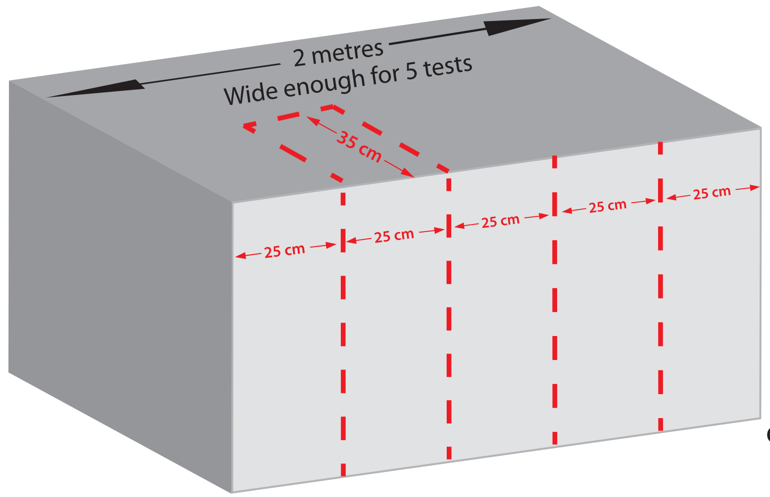
The major, most dangerous gliding layers are depth hoar, surface hoar, hard surfaces, ice, suncrust, wind pressed, rain, melt freeze and upside down powder. Dig to the lowest gliding layer in the snowpack and monitor the stability rating of the known gliding layer existing throughout the winter. Examine the snow profile slab hardness by pushing your bare fingers (naked finger test) in the layers and look for space between layers.

SHOVEL SHEAR TEST

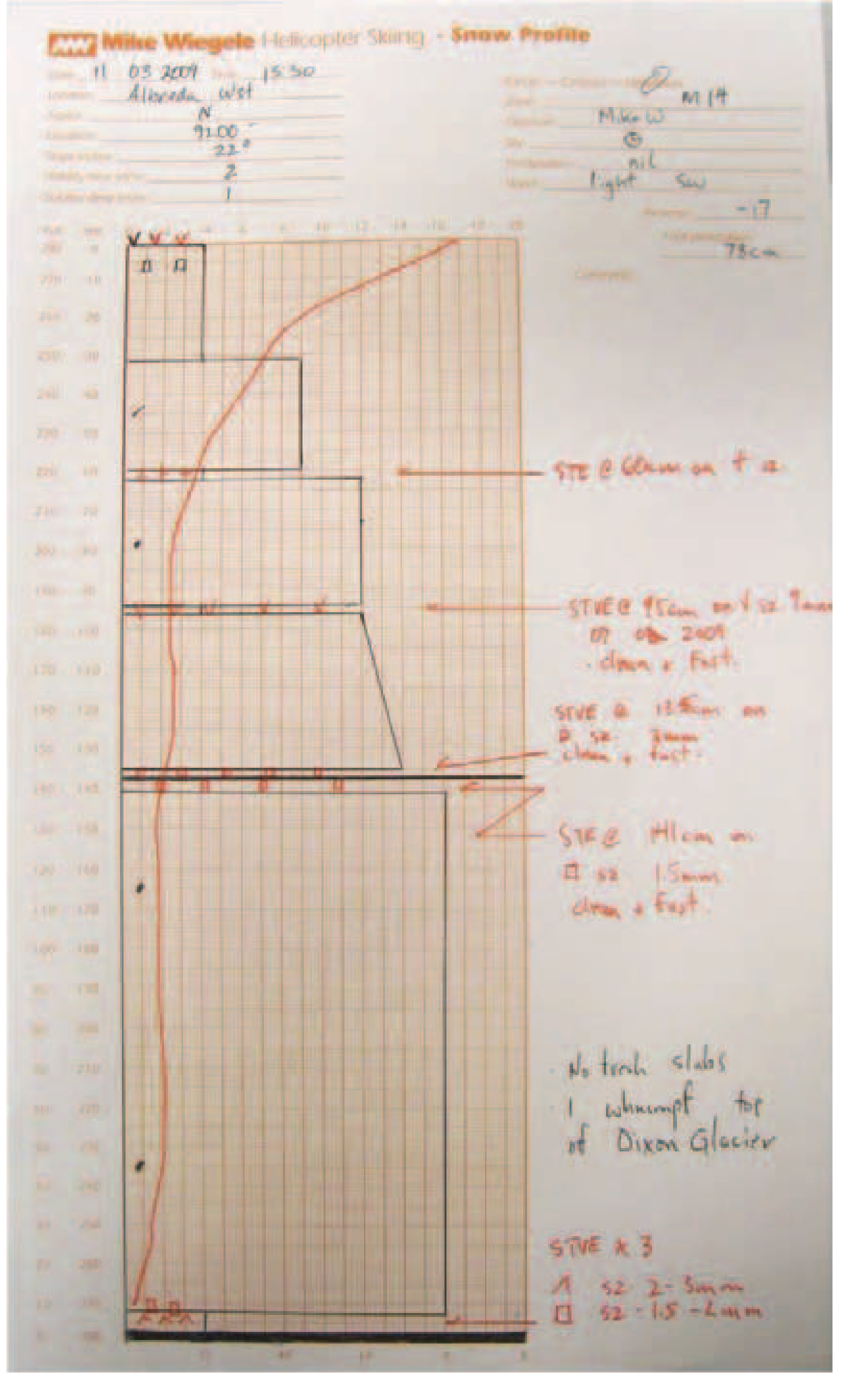
The Avalanche Handbook.p.133-134. David McClung & Peter Schaerer

The principle objective of the shovel shear test is to locate weak layers. The shovel shear test is prepared by cutting a vertical column of snow to a depth below suspected weak layers. The shear force is applied by inserting the shovel blade behind the column and pulling in a downslope direction until a failure occurs.

A snow shovel with a blade at least 250 mm wide (not curved) is the principle tool. A saw with a blade length of at least 300 mm is a use-ful addition, but may be substituted with the tail of a ski, a section of a collapsible probe, or a string.



SNOWPACK PROFILE



MAJOR GLIDING LAYERS SYMBOLS

Crusts	
Depth Hoar	∧
Surface Hoar	∨
Facets	□
Graupel	
Low Density	+

Note: Search for avalanche gliding layers. Look for one or more of any of these glide layers that might be in the snowpack. Dig down to the ground/glacier surface as a major gliding layer might exist on the ground.

THE TEST PROCEDURE INCLUDES:

1. **Cutting the column:** A fresh vertical wall is exposed in a snow profile observation pit and soft snow at the surface is removed. The cross section of the column – 0.3 to 0.4 m in the downslope direction and about 0.25 m across the slope – is marked on the new surface. The cross section is slightly trapezoidal, with the front wider than the back. A trench, wide enough to allow the insertion of the saw for cutting the back side, is dug at the side of the column. A narrow cut (usually conveniently triangular in shape) is made at the other side of the column. The backside of the column is cut vertically and the cutting tool (saw) left at the bottom for depth identification. The backcut should not be deeper than about 0.7 m and it should end in medium hard or hard snow if possible. (Note: A longer column could fail in bending at its base, causing weak layers near the surface to be over-looked.)

2. **Application of force:** The shovel is inserted into the backcut. A pull force is applied in the downslope direction by holding the shovel handle with both hands.

3. **Locating a weak layer:** The column shears in a smooth plane when a weakness exists. When no weak layers are present, the column usually breaks obliquely at the lower end of the backcut. The observer marks the location of the weak layer at the rear wall, then measures the distance from the snow surface or the ground. After the test, the type and size of snow grains in the shear plane can be determined. Because grains responsible for weaknesses (for example, surface hoar) often stick to the underside of the sheared-off column, it is advantageous to turn the column upside down to inspect the grains.

4. **Repetition:** A second, lower column is tested by repeating steps 1 to 3 when weak layers are suspected below the first column.

5. **Recording shear strength:** The magnitude of the force required to cause a failure is estimated and recorded. The strength may be estimated when the column is tested for the presence of weak layers. However, a separate test on a previously identified weak layer (the column should not be longer than the shovel blade) is more reliable.

Shovel shear test is the most reliable test for stability rating to rate the potential for an avalanche occurance. The rating is from 1 to 7.

Mushroom test with a ski pole followed by a mushroom hand test. Below is a ski cut test on a small slope. Results and observations are then recorded.

THE 15 MINUTE STABILITY TEST

Based on the MWHS 1-7 Rating System, the 15 minute Shovel Shear Test is a quicker version of the Full Shovel Shear Test used by practitioners in known terrain where previous testing has occurred.

Dig down past the lowest gliding layer and identify the following to determine the shear:

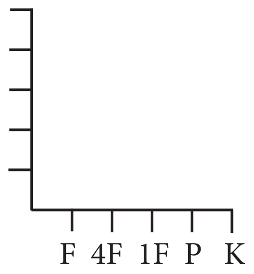
1. New snow load
2. Weak gliding layer
3. Open space between layers
4. Hardness
5. Changes in snowpack

Classic tree mushrooms

It is important to investigate and record stability ratings on various elevations in the field: Alpine, Tree Line and Below Tree Line to assess the danger at all elevations and exposures. Calculate and estimate the snowpack stability in avalanche potential slopes in high alpine glacier terrain, that are inaccessible to take measurements, nor are visible in many occasions due to poor weather, fog, clouds, snow, and winds. It is important to calculate snow stability on opposing slopes that may avalanche naturally and travel into the valley floor of helicopter pick-up areas. This can pose exposure to skiers crossing this path or beneath.

3.1. TERRAIN ASSESSMENT

❒ ALP - TL - BTL

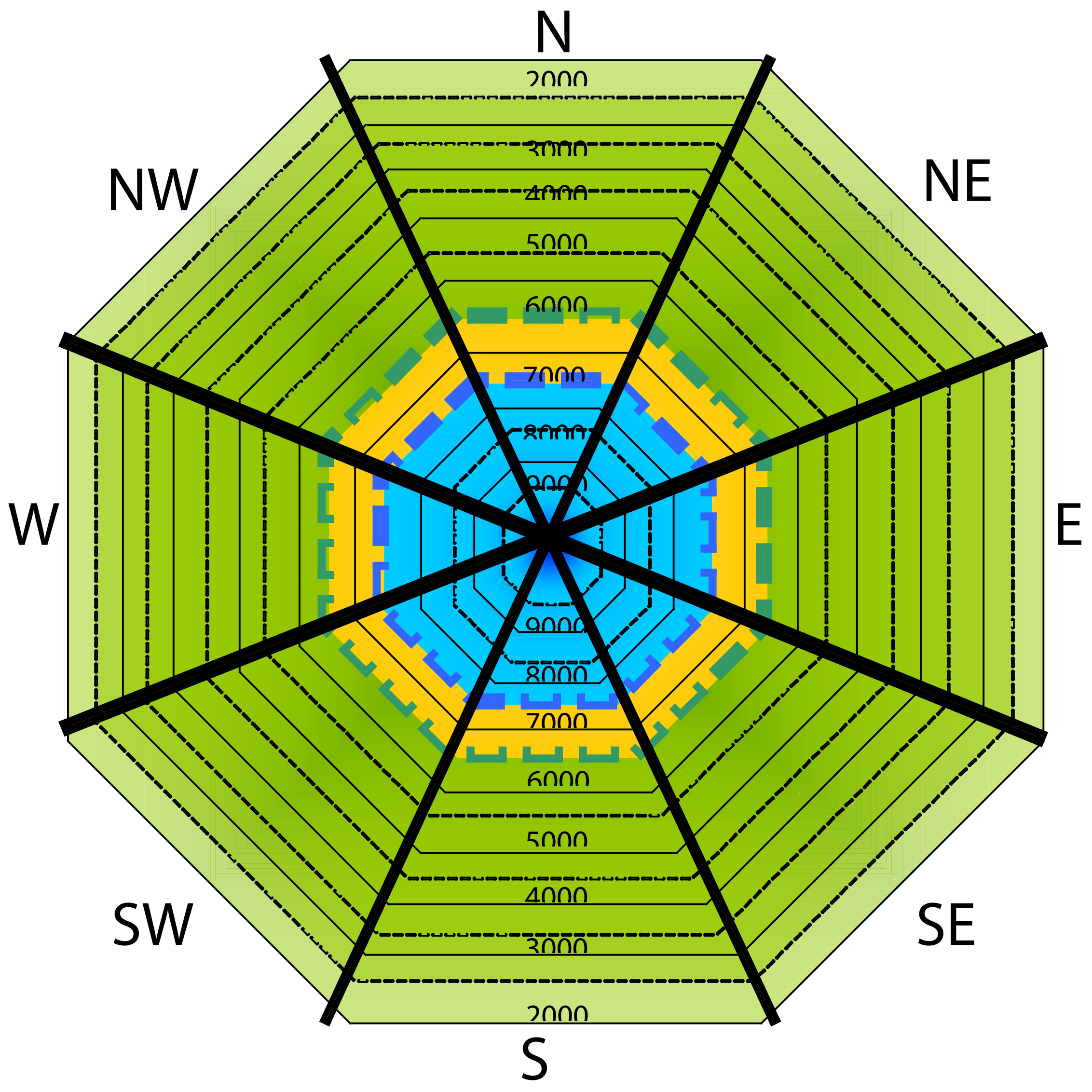


❒ New Precipitation ____________________
❒ Storm Snow ____________________
❒ Elevations ________❒ Exposure __________

❒ **Description of Gliding Layer** __________
❒ **Depth of Gliding Layer** ____________
❒ **Critical Load on Gliding Layer** ________
❒ **Shears** ______________________

Alpine - ALP
Tree Line - TL
Below Tree Line - BTL

❒ Wind _____Temperature_____Humidity_____



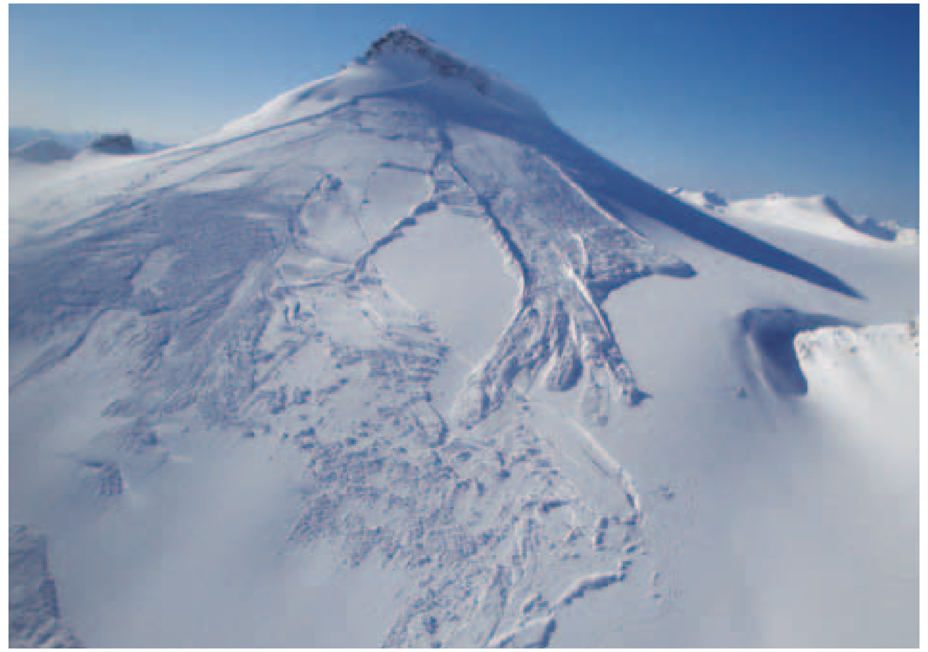
❒ New Precipitation
❒ Storm/Snow
❒ Snow Transport by Wind
❒ Sun Effect
❒ SHEARS

Note: *Avalanche failure in elevations*

WIND DIRECTION AND SPEED

Light ❒ < 20 km
Moderate ❒ 20 – 40 km
Strong ❒ 40 km >
Gust ❒

FIELD OBSERVATIONS OF NATURAL ACTIVITY



STEP 4

FIELD OBSERVATIONS
LOOKING FOR CLUES

FIELD OBSERVATIONS – A thorough field observation notes any natural avalanche activities and how they have been triggered by noting: exposures – elevation – depth of crown fracture – distance of travel – and size of avalanches. This alerts the practitioner of early warnings of danger of any other potential avalanche failure that may occur on similar slopes. A natural avalanche may be an isolated occurrence or a trend that practitioners should be aware of. All natural avalanches should be recorded, studied, and analyzed.

4.1 NATURAL TRIGGER	DATA TO RECORD
❒ Natural Avalanches 24 hrs, 48 hrs or longer - estimate	❒ Elevation – exposure
❒ Ice Fall	❒ Foot Penetration
❒ Cornice Fall	❒ Ski Penetration
❒ Rock Fall	❒ Snow Surface Wind Effected Snow Drifts – Pockets Slab Forming - Alpine
❒ Tree Fall	
❒ Mushrooms	
	❒ Gliding Cracks
	❒ Surface Snow Cracks

Field observations of any natural activity should be recorded and communicated to the base and all guides immediately when observed. Obtain confirmation of message received.

❒ Date ______________ ❒ Time ______________
❒ Location ______________________________
❒ Elevation ____________ ❒ Exposure ____________
❒ Width ______________ ❒ Length ____________
❒ Depth of Crown ________________________
❒ Estimated Load _________________________
❒ Gliding Layer Type ______________________
❒ Wind ___ ❒ Temperature ___ ❒ Humidity _____
❒ Cause of Failure ________________________
❒ Avalanche Rating ________________________

FIELD OBSERVATIONS OF NATURAL ACTIVITY

STEP 5

STABILITY RATING WITH SHEAR TEST & OBSERVATIONS

SKI TESTS AND SLOPE STABILITY RATING - Ski tests on slopes are to verify the snow stability forecast rating – to be carried out during the day. Tests are to be done on safe, short slopes that can produce an avalanche no larger than class 1-1.5 in size while avoiding terrain traps.

5.1 PRIMARY TEST FOR CONSIDERATION

❒ 1. Natural occurrence – field observations from point 4, check for natural activities
❒ 2. Ski Cut Test - fracturing/slide cracks on test slopes; each turn is a test
❒ 3. Shovel Shear Tests by Practitioner
❒ 4. Sympathetic trigger by – helicopter – skiers descent
❒ 5. Whumphs – slope settlement by skiers weight – sudden collapse
❒ 6. Hand Shear Test – Results – Densities – Mushroom Tests – Examine gliding layer
❒ 7. Slab density and hardness test with fist and finger (naked finger test)
❒ 8. Foot Penetration - with & without skis, note the strength of snowpack layer

5.2 SECONDARY TEST

❒ 1. Rutschblock (R.B.)	} Can be unreliable and inconsistent in certain situations. The use of shovel shear tests are recommended.
❒ 2. Compression	
❒ 3. Explosives	

STEP 5

STABILITY RATING WITH SHEAR TEST & OBSERVATIONS

5.3 CLASSIFICATION SHEAR TEST RATING FROM 1 – 7 (USING SHOVEL SHEAR TEST)

	Very Easy	Easy	Easy Moderate	Moderate	Moderate Hard	Hard	Very Hard
Symbol	VE	E	EM	M	MH	H	VH
	1	2	3	4	5	6	7

Note: When making a shear test & rating: Use the rating by number. This lessens the chance for misinterpretation of stability.

FIELD OBSERVATIONS THAT OVERRIDE STABILITY RATING:

1. Natural avalanche activity take precedence over any test results.
2. Snowpack characteristics with unfavourable structure.
3. Whumpfs indicate a space in the snowpack that is settling. Thus causing an avalanche given the right terrain, resulting in decreased stability.
4. Isolated natural avalanches may occur even when stability for the area is good. (For regional and larger forecast areas)

SHOVEL SHEAR TEST CONSIDERATIONS:

1. Quality of Shear : Clean Shear or Uneven Surface / Break
2. Gliding Layer Types : Persistent weak layers
3. Layer Hardness / Density
4. Location
5. Aspect
6. Elevation

DEFINITIONS:

1. **Increased Shovel Shear Resistance:** Use for qualifying the stability rating from 1 - 7. (If you are not pulling hard, it is not a hard shear) With minimum resistance, stability is likely not a '4'.
2. **Natural avalanches:** Avalanches triggered by weather events such as snowfall, rain, wind, temperature changes, etc.
3. **Heavy Load:** A cornice fall, a compact group of people, a snowmobile or explosives.
4. **Light Load:** A single person or a small cornice fall.
5. **Isolated terrain features:** Extreme terrain, steep convex rolls, localized dispersed areas (pockets) without readily specifiable characteristics.
6. **Specific terrain features:** Lee slopes, sun exposed aspects.

Certain snowpack characteristics: Shallow snowpack with facetted grains, surface hoar, crust, persistent weaknesses & identified weaknesses. To rate a shear test as **"very hard"** you have to use strong resistance and pull very hard. If you are not pulling hard then it is **"moderate"**.

Examine Gliding Layer: When cutting the back off the block and it pops out with little effort it is **"very easy"**. Look at the sheared surface and check to see if quality of shears is clean, uneven, or hard. A shovel shear test is most reliable in comparison to other tests.

Shovel shear test on a regular route class-1 avalanche potential only or prior to entering class 2-5 potential terrain.

Make 3 to 5 tests if you are unsure of type of shear especially when stability rating is 4 or lower as risk is higher.

On test 4 and 5, apply uninterrupted focus on final rating decision. Recent natural avalanches nearby overrule all other tests.

FAILURE DESCRIPTION FOR SHOVEL SHEAR TEST

		Field Observations		
Stability Rating	**Comment on Snow Stability**	**Natural Avalanches :** (Excluding avalanches triggered by icefall, cornice, rock fall, ect.)	**Triggered Avalanches** (Including avalanches triggered by icefall, cornice, rock fall, ect.)	**Shovel Test**
1 Very Poor	Snow pack is unstable	Widespread Natural & Sympathetic avalanches	Widespread triggering of avalanches by light loads	**Very** Easy Shears
2 Poor	Snow pack is unstable	Natural Avalanches : in areas with specific terrain features or certain snowpack characteristics	Avalanches maybe triggered by light loads in MANY areas with sufficiently steep slopes	**Easy** Shears
3 Poor-Fair	Snowpack is variable (natural activity has slowed)	Areas with specific terrain features (Steep bowl, lee load aspects + convex roles) and with specific snowpack characteristics can produce Natural avalanches	Skier Triggering possible with light loads	**Easy** Moderate Shears
4 Fair	Snowpack varies considerably with terrain often resulting in local unstable areas	Very isolated natural activity in specific terrain features such as steep and unsupported slopes	Skier Triggering remains possible	**Moderate** Shears
5 Fair-Good	Snowpack is mostly stable	Natural avalanches possible only from large loads i.e. ice falls and large cornices	Skier triggering unlikely but possible in isolated areas with specific terrain features or with heavy loads	**Moderate /** Hard Shears
6 Good	Snowpack is stable	Natural Activity Unlikely	Avalanches may be triggered by heavy loads in isolated terrain features	**Hard** Shears (Must Pull Hard)
7 Very Good	Very Stable Snowpack	No Natural Avalanches Expected	No Results from heavy loads such as large cornice falls or heavy loads in isolated terrain features	**Very Hard** Shears (Or No Results)

NOTE: Increased Shovel Shear Resistance

Shovel Shear Test	**VE**	**E**	**EM**	**M**	**MH**	**H**	**VH**
Stability Rating	1	2	3	4	5	6	7
	VP	**P**	**P-F**	**F**	**F-G**	**G**	**V-G**

STEP 5

STABILITY RATING WITH
SHEAR TEST & OBSERVATIONS

5.4 LEAD GUIDES SUMMARY - PM DAILY REPORT LIST FROM DATE:

❒ Area Runs Skied		
❒ Observations	ALP	1 2 - 3 4 5 - 6 7
❒ Stability Status	TL	1 2 - 3 4 5 - 6 7
❒ Snow Profile Pack	BTL	1 2 - 3 4 5 - 6 7
❒ Concerns		
❒ Elevations		
❒ Exposure		
❒ Locations		
❒ Other		

Note: Prior to making your stability rating, you must substantiate your findings with current factual information.

5.5. LEAD GUIDE AM DISCUSSIONS – COMMENTS ON SAFETY

- ❒ Stability Analysis – Information Exchange ______________________
- ❒ Avalanche Research ______________________
- ❒ C.A.A.Exchange______________________
- ❒ Useful information (List) of Field Observations ______________________
- ❒ Others ______________________
- ❒ Concerns ______________________

5.6. STABILITY RATING FOR AVALANCHE FORECAST

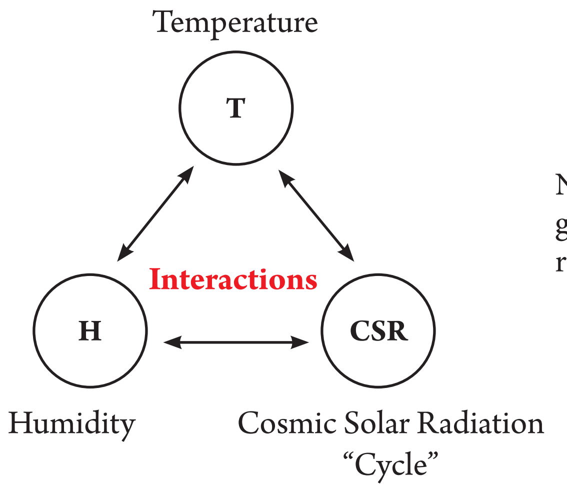
Is based on the following:

5.7. DAILY WEATHER DATA. DETAILS - RAPID CHANGE "STEP 1"

5.8. CONTRIBUTORY FACTORS "STEP 2"

Graph Cycle - Sudden Changes

MAJOR
CONTRIBUTING FACTORS TRIANGLE



Note: Temperature and humidity might be in favour of good stability but can be over-ridden by cosmic solar radiation.

5.9. SNOWPACK PROFILE SHEAR TESTS. QUALITY? RESULTS? "STEP 3"

1 - Search for gliding layers
2- Depth of layer
3 - Shear result
4 - Load

Date of Last Profile ______________ Location ___________________

- Observe the strength, deterioration or dormant condition of the snowpack by continuous monitoring and testing. Be aware of prolonged and delayed action.

5.1.1. CRITICAL LOAD OF PRECIPITATION – WIND CALCULATIONS

- On top of gliding layer (slab) 30-50 cm up – from low density to slab forming to pencil hardness.

STEP 5

STABILITY RATING WITH
SHEAR TEST & OBSERVATIONS

5.1.2. FIELD OBSERVATIONS "STEP 4"

- Observe for wind transported snow of uneven deposits from 50 cm to 2 m.
- Of recent natural avalanche activities occurring – in elevation, exposure, location and steepness in ALP – TL - BTL. Running path – deposits
- Wide spread avalanche activities.
- Isolated activity: search for isolated, potential avalanche areas – type of slope more likely to fail. Investigate why isolated activity failure occurred.
- Be aware that for the majority of the winter season, the alpine terrain is not visible and inaccessible due to poor weather.

5.1.3. SKI TEST RESULTS "STEP 5"

On small, steep rolls 28º and up, mushrooms. Test space in class 1 potential only (on regular routes). Not on larger avalanche potential slopes.

5.1.4. SKI GUIDE DAILY FIELD OBSERVATION REPORT

STABILITY RATING

Shovel Shear Test	VE	E	EM	M	MH	H	VH
Stability Rating	1	2	3	4	5	6	7
	VP	P	P-F	F	F-G	G	V-G

Safe route selection to avoid hazards such as avalanche slopes and cornices

Skiing with comfort, fun, and safety

PUTTING KNOWLEDGE INTO PRACTICE

TERRAIN SELECTION & GUIDING PROCEDURES

STABILITY RATING – Concluding all possible findings of information is to assist the practitioner in decision making for safe travel in avalanche terrain.

Analyze all pertinent information of the 5 Step Avalanche Forecasting System – stability rating for all avalanche potential slopes - elevations – exposures - locations. Analysis and decision making is to be completed in an organized, systematic approach and thought process and applied to terrain selection and guiding procedures.

1. TERRAIN SELECTION: STABILITY RATING – ELEVATIONS – EXPOSURES – LOCATIONS

Question: What is the stability rating? Conclusion? Decision?

ALP (7,500-11,600 ft)				
N	S	E	W	
				Storm
				Old
				Deep

TL(6,500-7,500 ft)				
N	S	E	W	
				Storm
				Old
				Deep

BTL (2,230-6,500 ft)				
N	S	E	W	
				Storm
				Old
				Deep

1.1 TERRAIN SELECTION

❒ *Regular Route in very easy (VE) and easy (E) shear test with critical load*

Questions to be asked:

1. Where Are the Weaknesses?
2. What is a Critical Load? 30 cm plus Overload? Wind transported snow? Variable depths? Wind activity 12 hrs – 24 hrs
3. What impact or effect are the Contributory Factors having on snowpack deterioration, strengthening or prolonged present stage?
4. What is the potential outcome?
5. Slab formation from storm snow or deep slab effect?
6. What type of Terrain – Elevations, Exposures, Shape, and Steepness?
7. Is there a large snow cornice above – potential for avalanche slopes or mushroom rocks.

Notes: Give special consideration to high-alpine, glaciated terrain(our highest is 11,600 ft) with 5,000 to 6,000 vertical foot drops. This terrain may be exposed to fierce weather conditions such as high wind and cold temperatures (-15 to -30 degrees Celsius)

PUTTING KNOWLEDGE INTO PRACTICE

TERRAIN SELECTION & GUIDING PROCEDURES

1.2 COMMON "TERRAIN TRAPS" AND DANGERS

1. Cliffs – rock or ice
2. Trees
3. Gullies
4. Unsupported slopes – type of slopes more likely to fail
5. Exposure to higher opposing mountains
6. Avalanches crossing skiable terrain from alpine or through forest
7. Snow cornices

1.3 GUIDING PROCEDURES AND CONSIDERATIONS

1. Terrain selection is based on stability ratings of potential avalanches and consequent dangers.
2. What are the Guiding Procedures and Practices during current stability ratings?
3. Safe favorable routes?
4. Are there any terrain traps – cliffs, trees, gullies – near skiing route?
5. Be aware of skiers going beyond given safe boundaries, unaware or ignorant of backcountry mountain hazards and dangers.
6. Be aware of individual skiers unintentionally skiing beyond given boundaries – influencing other skiers in the group. Skiing out of boundaries is a constant threat.
7. Practice precise guiding procedures when a gliding layer is present in snowpack with critical load on steep terrain. Be sure to position yourself in a safe location.
8. Select slope with a low angle, avoid exposure of terrain traps, with no more than one person at a time. It is important to wait until the slope is clear before the next person can follow.
9. Best practices need to be applied. These are subject to the stability rating. Your options are to avoid an avalanche slope, limit one person at a time, ski-cut from the top down, or select less hazardous terrain.
10. In stability rating 1 to 4, ski-cut each 30° + slope and proceed cautiously with precise guiding procedures and avoiding burial traps.
11. Take into account unexpected and unusual avalanche mass travelling in flat terrain outside traditional boundaries.

2. FIELD DECISION MAKING - **Review all "5 Steps" from the beginning to assure considerations are given to each point!!!**

❒ Zone
❒ Mountain
❒ Skiing Descent Route
❒ Type of Skiing Route
❒ Reconfirm Stability in Field in Elevations – exposures, area
❒ Communicate with Other Lead Guides
❒ Report All Field Activity & Observations

PUTTING KNOWLEDGE INTO PRACTICE

TERRAIN SELECTION & GUIDING PROCEDURES

COMMUNICATION

2.1. Communication is a mandatory responsibility of all Lead Guides – after storms, after first and second runs – 1 to 2 (VP to P) stability. Must reconfirm stability.

2.2. The exchange of new findings and observations is a critical component of safe guiding.

2.3. It is essential that any results of ski cuts, slope tests, profile observations, weather anomalies (changes) and observed activity be shared with all Guides immediately when it occurs.

2.4. Discuss confidence or suspicion of snow stability in unfavorable slopes or with major gliding layers, especially when avalanche potential exceeds class 2 in size.

Always call on fly-by with other Guides

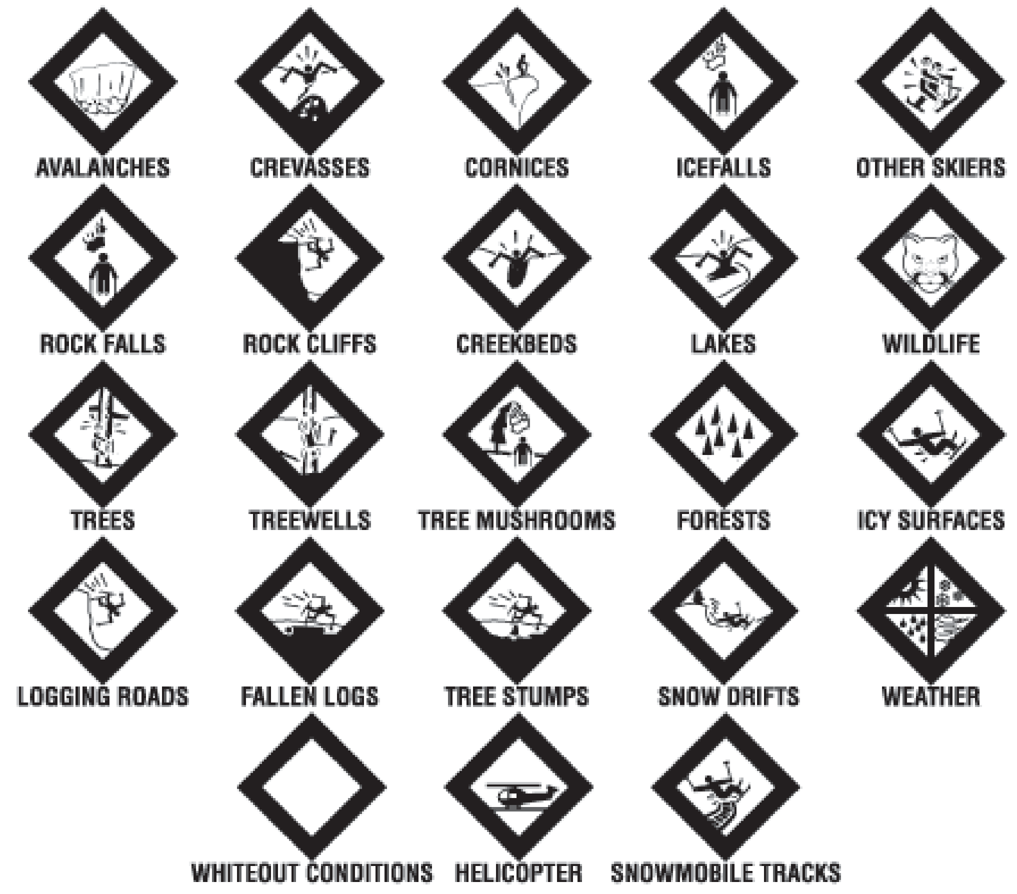
Substantiate your good or bad feelings with information and facts
Substantiate your confidence with factual, measured information, not perception

Do not venture out into avalanche terrain unless the slope is assessed using 5 Step Avalanche Forecasting System

WARNING

High alpine mountain and wilderness backcountry skiing under any condition may cause serious bodily injuries and sometimes death. At all times use extreme caution when skiing in the backcountry as well as when approaching, entering and exiting the helicopter. Anyone taking part in helicopter back-country skiing activities assumes the risk inherent with such sporting activities. Any of these hazards exist in many different variations, shapes and forms in backcountry skiing terrain on any given run.

HAZARDS



The first step to safety is recognizing potential hazards. Some of the hazards are easily recognizable and obvious, others may be hard to detect. By following basic guiding procedures together we can reduce the risk. Please refer to our safety and guiding procedures in the Hazard Awareness Booklet.

ACCREDITATION

Thank you to all those people worldwide who have dedicated their entire life to promote and teach mountain safety as well as those who have lost their lives while doing it. All those people left a lasting impression that inspired me for continuous development as well as fine tuning the 5 Step Avalanche Forecasting System. Our mission, purpose and goal continue to be to save lives.

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DISCLAIMER:

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