Avalanche Problem Essentials – Cornice

This document is part of "Decision Making in Avalanche Terrain: a fieldbook for winter backcountry users" by Pascal Haegeli, Roger Atkins and Karl Klassen and provides in-depth background information for on the topic of Avalanche Problem Essentials. For additional background information on the topics covered in the field book visit www.avalanche.ca/cac/decisionmaking

Cornice falls are caused when a mass of wind-deposited snow, which is often overhanging and near a sharp terrain break such as a ridge, breaks off. Because they are so heavy, cornices falls often trigger avalanches on the slope below, compounding the problem for anyone in its path. Even if they do not trigger an avalanche, the hard, dense snow can pose a significant hazard in itself. They are also a hazard from above as they can be difficult to detect from on top of a terrain break and can fall without warning or with light triggers, sometimes breaking farther back than one would expect.

Development

Cornices form when there is sufficient wind to transport falling snow or surface snow. For cornices to form, there must be snow falling during the wind event or there must be loose surface snow available for transport.

Time of the Season

Cornices can form at any time of the season.

Weather Patterns

Cornices typically develop most quickly during or shortly after relatively warm storms with moderate, steady winds when snow is easily moved and highly prone to cohesion. They also form but to a lesser extent in colder conditions, when dryer snow is being transported, when older snow is being transported, and with stronger more variable winds.

Snow Climates

Cornices occur in all snow climates.

Spatial Distribution

Cornices are found only in lee or crosswinded areas. They are most common on the lee side of exposed ridges at higher elevations but can form anywhere that wind moves snow across terrain and a reasonably sharp terrain break exists (e.g. ridges, pronounced convexities with steep slopes below).

Avalanche Activity Patterns

Timing and Persistence

Cornice falls are most common during or shortly after formation of a cornice, before bonds between grains have become strong enough to hold the mass of snow in place. Large cornices on steep terrain or overhanging cornices with little or no support below are more persistent in nature and can fail long after they have formed and after extended periods inactivity.

Size

Small new cornice falls may produce only minor avalanches. However, due to the hardness and high density of the snow involved, larger cornices falls can have significant destructive potential. While most cornice failures are localized, propagation can be impressive when large failures occur.

A major consideration in cornice failure must be the potential for triggering avalanches on the slope below. Even snowpacks with insignificant and deeply buried weak layers can be susceptible to triggering from the impact of major cornice falls.

Spatial Distribution and Variability

Cornice failures are often highly variable in distribution. The nuance of wind and terrain interactions can produce a highly unstable cornice in one area while a place only a few metres away might have no cornice at all or a much more stable cornice.

Triggering

Cornices are susceptible to triggering under wind-loading conditions, especially in the case of recently formed, immature, and poorly supported cornices. Once mature and stronger, common natural cornice triggers are warm temperatures, solar radiation, and rain which weaken the bonds within the cornice or the bond between the cornice and the underlying terrain. Sensitivity is often greatest at the onset of or during periods of rapid fluctuations in temperature or solar radiation.

Human triggers, such as snowmobiles or skiers are common when cornices are newly formed and immature. They can also tip the balance when other factors (such as temperatures, sun, etc.) have increased the sensitivity of older cornices. Human triggered cornice falls are generally triggered directly; that is the trigger generally needs to be applied directly to the cornice. Particular care is required when there is a cleave (a crevasse-like crack in the cornice where it is breaking away from the underlying terrain) and when it is difficult to tell where the underlying terrain ends and the overhanging portion of the cornice begins. Remote triggering is uncommon.

Recognition and Assessment in the Field

Avalanche Activity

Recent or current activity is a good indication if instability. However, a lack of activity should not be taken as a sign of stability; when conditions are conducive to instability, cornices can hang in tenuous balance for extended periods, waiting only for the right trigger to tip the balance.

Snowpack Layering, Tests, and Observations

There are no snowpack observations that be safely used to reliably indicate cornice stability. Testing of cornices is not recommended except in the case of very small cornices with low consequences if something fails. For the most part, any tests on smaller cornices are not a reliable indicator for larger features.

Surface Conditions

Signs of wind transport in the surrounding area are an indication that cornice formation may have occurred where the right terrain exists. On exposed ridge crests the transition from thin, rocky snow cover to more uniform, deeper snow is sign that you are leaving the safety of terra firma and are moving closer to or stepping onto a cornice.

Risk Management Strategies

Timing

Locations prone to cornice formation should be avoided when wind is transporting falling snow or loose surface snow and during periods of rainfall. Overhanging and unsupported cornices should be treated with great caution at the onset of and during significant or rapid fluctuations in temperature or solar radiation.

Human Factors

Cornices are ubiquitous and failure can be unpredictable. Cornice falls can and do occur during periods of fine weather when few or no other concerns exist. When travelling on slopes below in good weather, people tend to not look up and consider conditions on a ridge high above them. Further, the potential for cornice fall to trigger avalanches on slopes below (and the size or propagation potential of those avalanches) is often underestimated.

Terrain

The terrain that promotes cornice development is reasonably obvious and recognizable. If no avalanche is triggered on the slope below, debris from a cornice fall is usually limited in width, generally follows the fall line, and mostly travels along low ground. Minimizing exposure to the likely path of cornice debris by spreading out, going one at a time, moving quickly without stopping, and regrouping off the fall line and on high ground are effective risk management strategies if exposure to a cornice is required or the potential risk is deemed acceptable.

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