COMPARISON OF CORNICE CONTROL METHODS AT THE BRIDGER BOWL SKI AREA

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Introduction

The formation, structure, and control of cornices in the Bridger Range (near Tozeman, Montana) was studied by Montagne and others (1968). The purpose of this present note is to compare costs and safety of alternative methods of controlling cornices above the Bridger Bowl Ski Area. The methods that were studied are:

A. Drill-Hole Cornice Blasting. The cornice is allowed to mature to a relatively large size. When the hazard appears to be critical, a team of at least three blasters tours to the cornice ridge, sets up belays, drills shot-holes, loads explosives, and detonates an interconnected system of charges. The advantage of this method is that cornice control work can be scheduled for slack work periods. However, there is a significant disadvantage since the cornice is allowed to build up to hazardous size, with possible threat to skiers below if the criticality is misjudged. Also, there is considerable risk to working on large cornices even with the protection of a belay. If "method A" would be used exclusively to control the 1000 m of cornice-forming ridge above the Bridger Bowl Ski Area, the annual cost based on 1976 pricing would be $10,800.[1]

B. Surface Blasting. It is generally agreed that the efficiency of blasting a large cornice is improved if charges are buried in shot-holes. However, it is possible to successfully blast smaller cornices with surface-place charges. The surface blasting technique requires considerably less time than the shot-hole technique. At Bridger Bowl, surface blasting could be incorporated into daily control routes. Although "method B" necessitates a much higher frequency of blasting than "method A", its annual cost, if used exclusively at Bridger, would be $4300, or less than half the cost of "method A". "Method B" also appears to be safer than "method A" since large cornices are not allowed to develop.

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[1] Further details of cost computations are available by writing directly to the author.

C. Routine Skiing and Shovelling. It is common practice at many ski areas to routinely kick-off cornices with skis on the daily control route. At Bridger, a supplementary innovation is for the ski-patrolman to carry a shovel which can be used to break and pry off cornices that are too big to be skied-off safely. If this method would be applied exclusively at Bridger (which has daily access to the ridge-crest), the annual cornice control cost would be $3500.

D. Jet Roofs and Fences. These structures are described by Perla and Martinelli (1976). They have the advantage that they reduce personnel risk. However, installation and maintenance may be a serious problem, and both types of structures can be buried by heavy snow falling without enough wind to clear snow away from the structures. At Bridger, the annual cost of cornice control with snow fence and jet roof was computed to be $5700 and $6100, respectively.

Thus, it appears that the most economical method to control cornices at Bridger is "C", the routine skiing and shovelling-off of cornices. Fortunately, the terrain and access at Bridger lends itself to this method, which may not be applicable at other areas. Nevertheless, ski areas which rely solely on the traditional "method A" should re-examine the costs and safety advantages of the alternatives.

References

Montagne, J., McPartland, J.T., Super, A.B., and Townes, H.W. The nature and control of snow cornices on the Bridger Range, southwestern Montana. Alta Avalanche Study Centre, Misc. Rept. No. 14, USDA Forest Service, Wasatch Nat. For., Salt Lake City, 16 p.

Perla, R.I. and Martinelli, M., Jr. 1976. Avalanche Handbook. US Dept. Agric., Agric. Handbook 489, 238 p.

Discussion

HETHERINGTON: At Whistler, we installed a jet-roof on October 1st and it was buried by November 8th. How high above your snowpack do you mount your jet-roofs?

BURROUGHS: Two to three meters above the ground. Jet-roofs will not work if there is not enough wind to keep them cleared.

NOREM: We tried jet-roofs, but they collapsed from the snow-load.

WILSON: In our heavy snow country, we use U-form metal roofs inclined at a minimum of 33° to shed snow.

KUCERA: It would also help to use a coloured galvanized or annodized finish rather than a standard galvanized finish.

ZYLICZ: Do jet-roofs increase avalanche frequency by redistributing snow on lee slopes?

BURROUGHS: Jet-roofs do not obviate the need for avalanche control on lee slopes.

WILSON: We do not see an increase in frequency at Carson Pass. Preliminary studies indicate that jet-roofs cause furrows on lee slopes, and not the typical smooth slab condition.