Snow Fences Improve Highway Safety

RONALD D. TABLER
Principal Research Hydrologist,
Rocky Mountain Forest and Range
Experiment Station,
Forest Service, USDA
Laramie, Wyoming

Included in PUBLIC WORKS for August, 1972, was the article, "Studying the Problem of Drifting Snow," which discussed the work done by Dr. Tabler and his associates as they studied the problems of blowing snow and the effectiveness of snow fences in its control. This article supplements that article and serves as an overview of Wyoming's new approach to snow control.

THE recently constructed section of Interstate 80 between Laramie and Walcott in southwest Wyoming was opened to traffic in October, 1970. Because the location of the new facility was as much as 20 miles distant from the old road (US 30), there was little beforehand knowledge of blowing snow conditions. The Wyoming Highway Department thus chose to gain a year's experience with snow removal problems before building snow fences.

Winter precipitation along the highway averages about 9 inches water equivalent, and nearly all of it is drifted by the strong winds typical of Wyoming's high plains (mean elevation about 7,500 feet). The rangeland vegetation (shortgrass and sagebrush) provides only a limited amount of natural storage for wind-blown snow. It soon became evident that, without fencing, snow removal costs in some areas would be excessive.

The Wyoming Highway Department knew that our research project at Laramie had spent 11 years studying blowing snow and the use of snow fences to increase usable water yields from windswept watersheds. They felt that our recent research results could help assure an efficient snow fence system for Interstate 80. We eagerly accepted this opportunity for a large-scale test of our ideas, and agreed to design snow fence systems for the highest priority locations — those which had significant drifts reaching the pavement during the 1970-71 winter. To protect these sites, we engineered about 60,000 feet of snow fence, which was built over the past two summers at a cost of approximately $485,000.

Innovations in Fence Design

Our most important contribution was a method to estimate the storage capacity required at each fence site. The method is based on the concept of "transport distance," defined as the distance a snow particle must travel before it completely sublimates (evaporates). For the climatic conditions prevailing along the Laramie-Walcott section of I-80, this distance averages about 4,000 feet. Knowing this distance and the mean winter precipitation, we estimated average annual snow transport to be about 1,500 cubic feet water equivalent per foot of width perpendicular to the wind. Preliminary calculations indicated that two rows of 12-foot tall fence, in tandem with one row of 8-foot fence, would be required to provide this much capacity.

Because our earlier research had shown tall fence to be much more

■ **SNOW fence really makes a difference. Observe how an informational sign was all but submerged in drifted snow (above) in January, 1971, but stands free and clear in February, 1972. Snow has been trapped by a fence.**

Reprinted from PUBLIC WORKS MAGAZINE, August 1973

efficient than shorter ones, in terms of construction cost per unit volume of storage, 12-foot tall fences were used as the main line of defense (comprising about 70 percent of the total fence length).

A new fence configuration was designed by Wyoming Highway Department engineers, using our criteria for heights, permeability (50 percent), inclination angle (15°) and bottom-gap (about 15 inches).

Where possible, fences were placed so as to use topography to enhance storage capacity. In some locations, a fence could be placed so as to provide as much capacity as two or even three rows of fences in level terrain.

Fences were carefully oriented perpendicular to prevailing wind directions. Accurate determinations were made from aerial photographs showing alignment of natural drift features. Wind angles and drift orientation were also verified by on-the-ground measurements.

In addition to these new aspects, all the generally recognized criteria in the literature were used to determine proper spacing between tandem rows of fences, as well as distances of fences from the right-of-way.

Performance

Performance of the new fence systems has been excellent throughout their first two years. Although precipitation during the 1972-73 winter has been about 130 percent of the estimated long-term mean, protected cuts have remained essentially free of snow drifts. The original estimates of the amount of blowing snow arriving at fence sites have proven to be accurate, demonstrating the utility of the transport-distance concept.

The capacity of the new standard-plan fence is about twice as much as originally anticipated. Although studies of the capacities of fences of different heights are still underway, it presently appears that a single 12-foot fence, in tadem with an 8-foot fence, would be sufficient to contain all the blowing snow over an average winter. Highway Department engineers believe construction costs can be amortized in only a few years by the savings in snow removal costs.

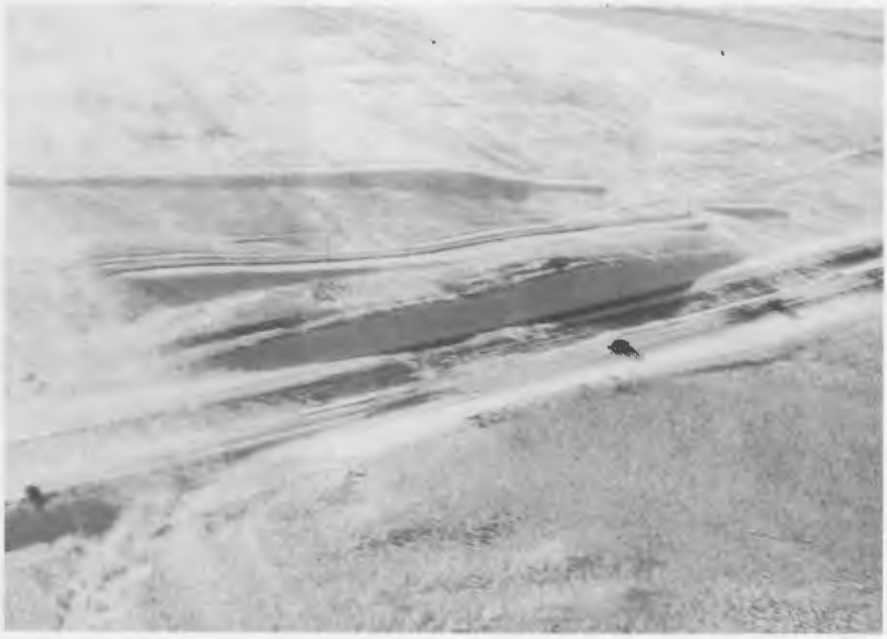
An important new discovery has been the dramatic improvement in visibility downwind of the fences during ground blizzards, as documented by 48 rolls of 16-mm movie film.

Slush and ice formation on the road surface are also significantly reduced behind fences, due to diminished drifting across the road.

These results have led the Wyoming Highway Department to use our methods and criteria to design an additional 40,000 feet of snow fence for second-priority sites, including those where poor visibility, rather than snow accumulation, is the principal problem.

This has been a very brief overview of Wyoming's new approach to snow control, which serves as an exceptional example of how the timely application of research results is saving dollars as well as lives. □□□

■ **WYOMING'S standard-plan snow fence is 12 feet tall and will withstand a 100 mph wind. With treated sills and anchors, its anticipated life is about 25 years. In photo below, effect of a dual-fence system at a former trouble spot is evident.**



References

Tabler, R. D., "Design of a Watershed Snow Fence System, and First-Year Snow Accumulation." Western Snow Conference (Billings, Montana, April, 1971) Proceedings 39:50-55.

Tabler, R. D. and Schmidt, R. A., Jr., "Weather Conditions that Determine Snow Transport Distances at a Site in Wyoming." UNESCO/WMO/IAHS International Symposium on Role of Snow and Ice in Hydrology Proceedings (Banff, Alberta, Canada, September, 1972). In press.

Tabler, R. D., "Evaporation Losses of Wind-Blown Snow, and the Potential for Recovery." Accepted for presentation at the 41st Annual Meeting, Western Snow Conference, (Grand Junction, Colo., April, 1973).