Arctic Snowfences—A Big Solution For a Big Problem

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ABSTRACT

This paper presents a history of arctic community snowfencing projects in North America and the successes and some of the problems encountered. Construction methods and responses from communities employing arctic snowfences are also reviewed.

INTRODUCTION

Arctic communities are often inundated with large snowdrifts, some three to five metres deep, that bury homes and obstruct streets (Figure 1). Combating these large snowdrifts requires more than the brute force of snowclearing equipment, which is an expensive short-term solution. The first permanent arctic snowfence (i.e. four to six metres tall) used to reduce snowdrifting in communities in arctic regions of North America was installed at Wainwright, Alaska in 1982 by the North Slope Borough Government. Since that time, tall snowfences have been installed to reduce snowdrifting in the community of Point Hope, Alaska and they are currently being installed at Baker Lake, Northwest Territories. A demonstration snowfence has also been installed at Cambridge Bay, N.W.T., by the Territorial Government.

Figure 1: Severe snowdrifting conditions often experienced in Arctic communities.

BACKGROUND

In the late 1970's, six communities in Alaska were assessed for snowdrift severity and prioritized for snowfencing projects (Figure 2). Wainwright, Alaska was the pilot community and received nearly 800 m of 4.5 m high vertical wood slat snowfencing in 1982. After the first winter, the snowdrift collected by the snowfence was surveyed in May 1983 (Chronic, 1983) and was noted to have collected over 234,000 m^3 of snow in a drift that was up to 5 m deep and extended downwind of the fence by over 90 m. The density of the snow was 514 kg/m^3 and the snowdrift contained the equivalent of over 120 million litres of water. People in Wainwright were sceptical of the snowfence before it was installed; however, an appreciable reduction in snowdrifting in the community year after year, prompted the construction of an additional 800 m of fencing to expand the protected areas of the community. A few years later, approximately 1300 m of wood snowfencing, four to five metres high, was installed in Point Hope, Alaska. Removable gates were installed to provide summertime access to important waterfront areas.

Figure 2: Aerial view of Wainwright, Alaska, showing numerous large snowdrifts.

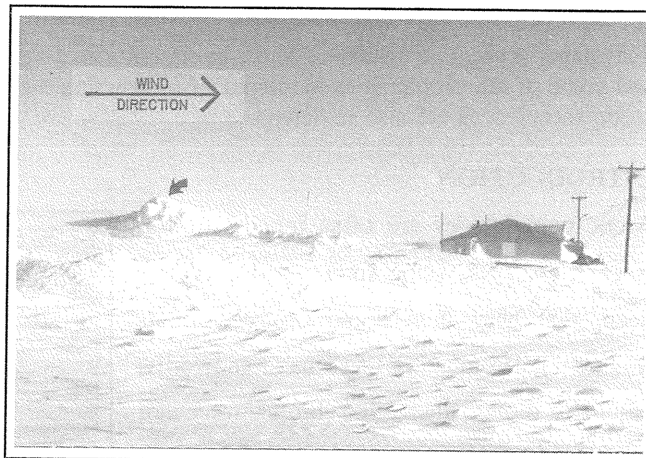

Figure 3: Snowberms alleviate some drifting problems, but require maintenance.

The arctic snowfencing concept was introduced to Canada's north in Baker Lake, N.W.T., in 1987. A feasibility study undertaken for the Government of the Northwest Territories (Waechter, 1987) assessed the potential use of snowdrift control measures such as rock filled gabions, snowberms (Figure 3), snowfencing and others. When cost, performance and other factors were evaluated, arctic snowfencing proved to be the most viable solution to help reduce a snowclearing budget of just under one-half of a million dollars. It was clearly impractical to use approximately 22 rows of standard 1.2 m high snowfence, which would have the same snow storage capacity as a single 5 m high arctic snowfence. The design measures employed for determining the snowfence location, height and structural design were also included in the feasibility study.

In December 1989, a 5.5 m high by 110 m long demonstration snowfence was installed for one winter by the territorial government (Figure 4) and subsequently assessed in February 1990 (Williams, 1990). A substantial snowdrift had collected two months after the fence was installed (Figure 5) and simple measurements of the amount of snow blowing along the ground indicated that approximately 80% of the snow approaching the fence was being collected before it reached the community (Note effects in Figure 6). The demonstration fence was constructed with steel pipe piles for the posts and rows of 1.2 m high plastic fencing were layered to create the tall temporary snowfence. Melt water run-off was an earlier concern; however, erosion problems did not materialize in the spring/summer. In its single winter of use, the demonstration snowfence convincingly showed how well drifting snow can be prevented from entering a community. A permanent snowfence was installed in place of the demonstration snowfence in 1990/91 with more fencing planned for construction in 1991/92.

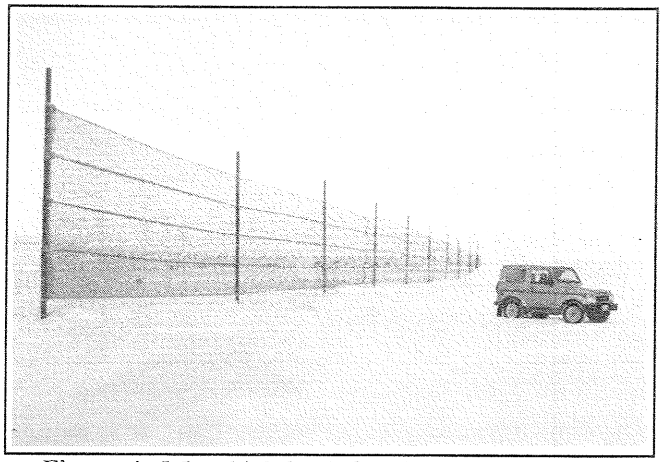

Figure 4: 5.5 m high by 110 m long demonstration snowfence in Baker Lake, N.W.T.
Photo courtesy of Malcolm MacPhail - GNWT

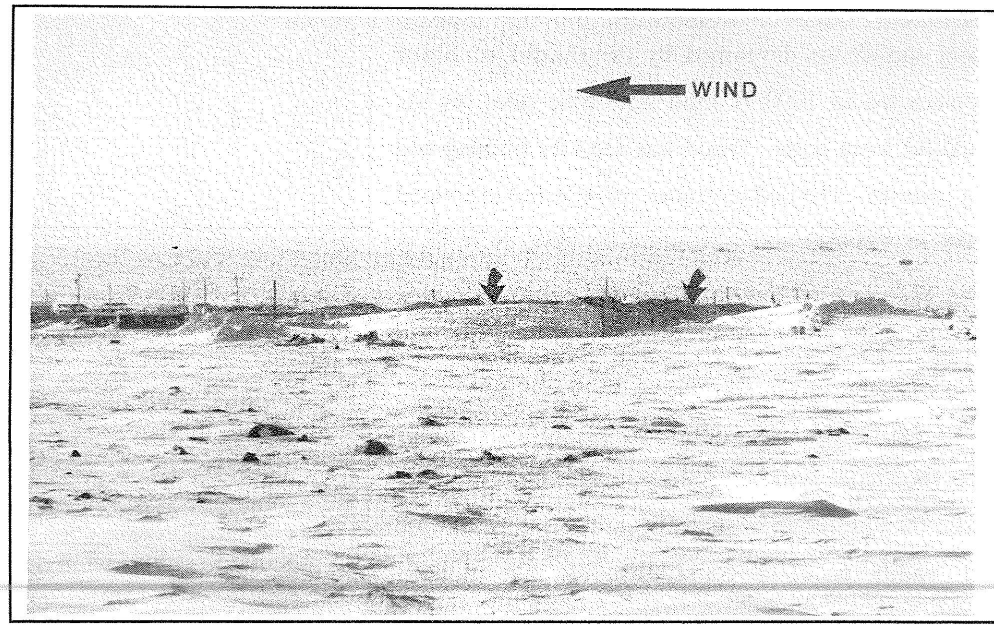

Figure 5: Distant view of the same 5.5 m high snowfence, two months later. Note the large snowdrift downwind of the fence.

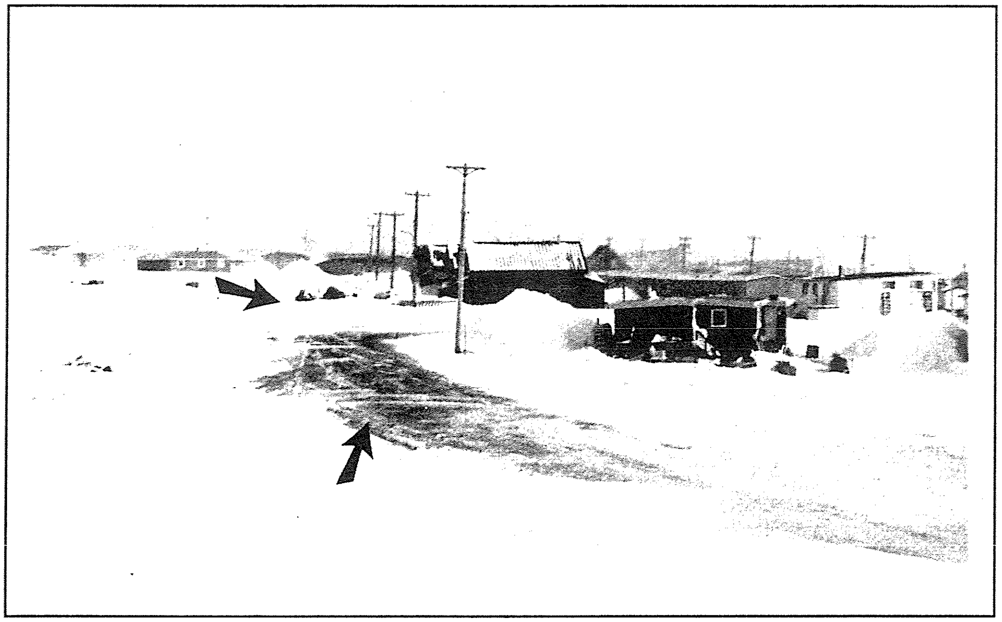

Figure 6: View downwind of demonstration snowfence. Note wind scoured road (protected by snowfence) and snow covered road (unprotected).

CONSTRUCTION METHODS

The permanent snowfences in Alaska were constructed of wood foundations, framing and vertical slats. Wind and structural loads were considered as well as geotechnical issues (e.g. permafrost). The permanent snowfence developed by the Hamlet of Baker Lake and constructed in 1990/91 used steel pipe piles for the foundation and the main posts. Wood was used for framing and for the facing material. The demonstration snowfences examined in Baker Lake in 1989/90 and in Cambridge Bay, N.W.T. in 1990/91, were short-term demonstration projects and used steel pipe piles for the main posts and plastic fencing for the fascia material. The demonstration snowfence in Baker Lake was replaced with a permanent fence; however, the Cambridge Bay demonstration snowfence will be used again during the 1991/92 winter. Plastic fencing requires good mounting details as wind damage can readily occur if connections are not properly designed or installed (Figure 7).

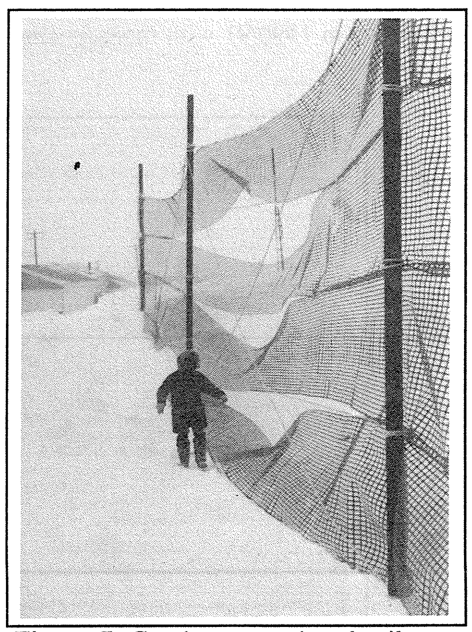

Figure 7: Good construction details are required to reduce wind damage.

Good mounting details for plastic fencing includes the use of wood battens to secure the fence material to the posts. Figure 8 shows how plastic fence material was securely sandwiched between a wooden batten and a steel post for the Cambridge Bay demonstration snowfence. Worm gear clamps secured the wooden battens to the post. Vertical layers of plastic fencing must also be joined together to prevent the wind from separating the layers of fence material. A successful detail for this joint in a temporary fence, was to overlap the rows of plastic fencing by several centimetres and then weave a polyethylene rope through the holes in the overlapped section of plastic fence. These ropes were also used to tension the fence. Joints in the plastic fence material also occurred where the ends of fencing were joined to create a continuous fence. Two sections of fence were firmly spliced together by overlapping the fence material by 20 - 30 cm and weaving wooden battens through the holes in the overlap. Figure 9 shows this detail and the use of polyethylene rope to connect horizontal layers of plastic fence material.

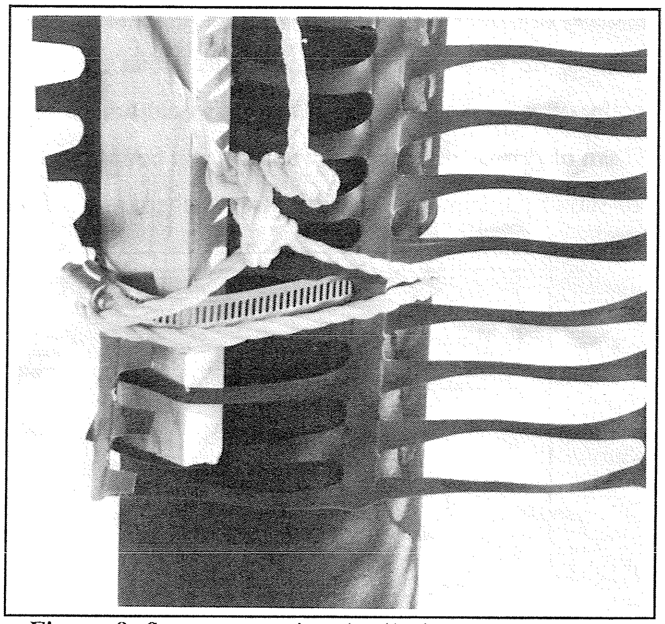

Figure 8: Secure mounting details for plastic fencing.

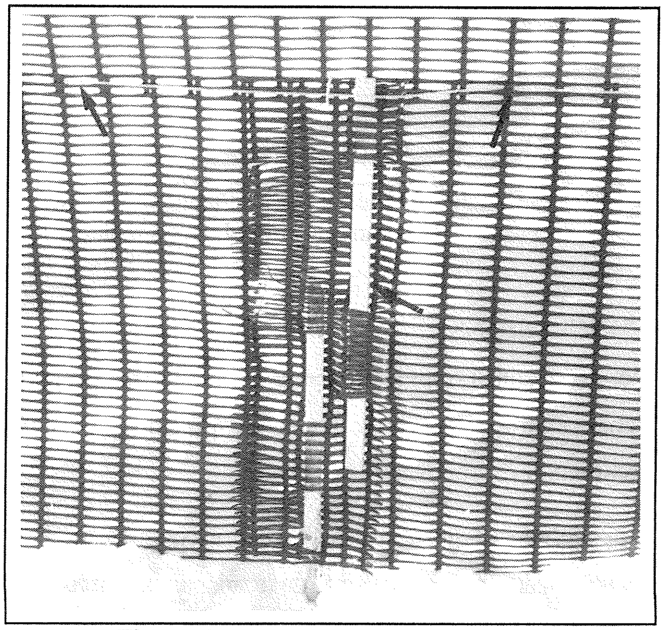

Figure 9: Fence splices using wooden battens and polyethylene rope.

COMMUNITY RESPONSE

Arctic snowfencing has proven to be an effective means of reducing the severity of drifting within northern communities. Many positive comments from residents of Wainwright, Alaska have been documented on a video tape. Positive feedback has also been received from Cambridge Bay, N.W.T., and the community is interested in constructing additional snowfencing in the future. In Baker Lake, N.W.T., where approximately 200 m of permanent snowfence is currently in place, comments from the community have been favourable. In May '91, Mayor Garry Smith indicated that there were several houses on the windward side of Baker Lake with snowdrifts that only reached the window sills. Local experience is that in previous years (before the snowfence was constructed) snowdrifting nearly always reached the eaves of these same houses. These visual observations attest to the success of the fence, especially considering that this past winter's snowfall was 20% higher than the 24 year average for Baker Lake. The mayor feels that the community has benefited from the snowfence as it has collected a large volume of snow that would otherwise have drifted into the community. As a result, over 900m of permanent arctic snowfencing will be installed in Baker Lake in 1991/92. The photograph in Figure 10 shows the leeward snowdrift at the Baker Lake permanent snowfence, during early winter.

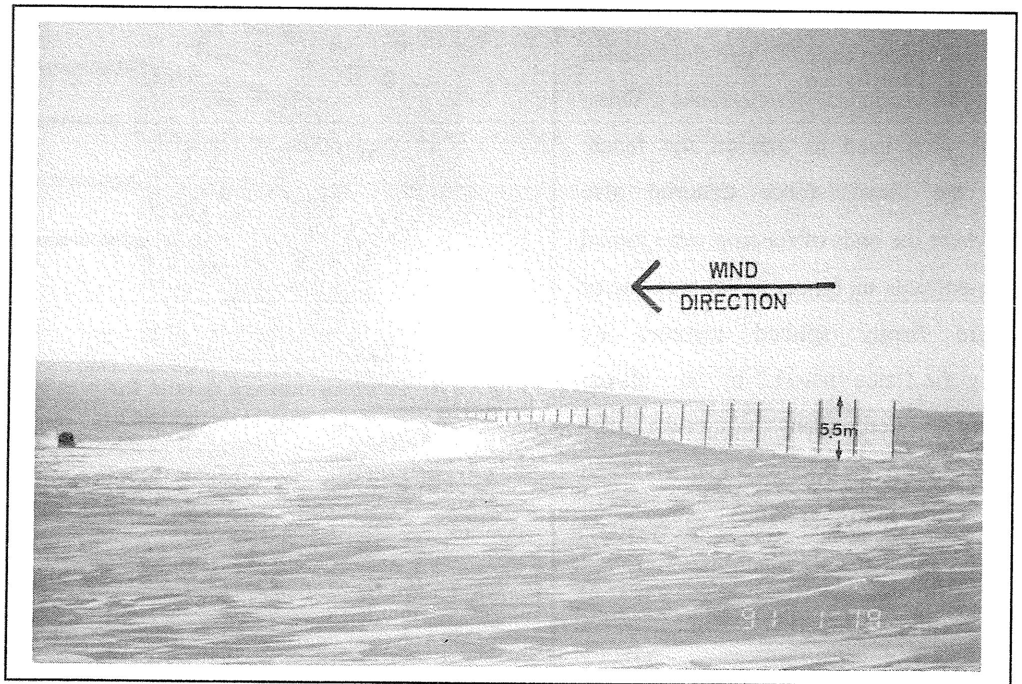

Figure 10: View of the permanent 5.5 m high Baker Lake snowfence and snowdrift. Note the truck to the left for scale. *Photo courtesy of Mayor Garry Smith.*

CONCLUSIONS

Results obtained from arctic snowfences constructed to provide snowdrift protection for communities in North America, prove them to be a successful method of snowdrift control with many potential benefits for arctic communities. The benefits include:

- Reduced snow clearing costs for communities;
- Reduced snowdrifting on roads, thus improving conditions for circulation of vehicles, which is especially important for emergency and essential services;
- Reduced snowdrifting around buildings, thus improving access to and use of buildings;
- Improved safety and quality of life;
- Short term local employment is provided; and
- Collected snow is available to provide/augment a fresh water supply.

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