SNOW-AVALANCHE PROTECTION MEASURES PUT TO TEST IN SEVERAL AVALANCHE CYCLES IN NW- AND N-ICELAND IN MARCH 2026

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ABSTRACT: In response to catastrophic avalanche accidents in Icelandic settlements in 1995, a government programme was initiated to build protection measures for settlements at risk. More than 70 snow avalanches have hit deflecting and catching dams and braking mounds in Iceland since the start of the programme, giving valuable knowledge on the effectiveness of different types of protection structures and avalanche dynamics. Most recently, severe avalanche cycles on 15–19 and 23–27 March 2026 involved snow avalanches that impacted braking mounds in Bolungarvík and at Seljalandshlíð in Ísafjörður, both in NW-Iceland. Three avalanches hit braking mounds below Innra-Bæjargil and an avalanche flowed along the entire length of the 700-m-long deflecting dam below Skollahvilft at Flateyri in NW-Iceland. Avalanches hit deflecting dams below Jörundarskál and Strengsgil in N-Iceland and were successfully deflected. Finally, an avalanche was stopped by a catching dam and flowed along a deflecting dam at Patreksfjörður in NW-Iceland. None of the avalanches overran the protection measures, and nobody came to harm. No avalanches were released from a starting area with snow supporting structures in Hafnarhyrna in Siglufjörður during these cycles when several avalanches, some large, were released from neighbouring avalanche paths with similar aspects. It appears likely that the protection measures prevented snow avalanches from reaching the respective settlements in both Patreksfjörður and Siglufjörður in this case. The avalanches that have impacted braking mounds, deflecting dams and catching dams in Iceland provide important empirical data about the effectiveness of avalanche protective structures. Rapidly moving fluidized fronts have overflowed dams in two cases, causing damage. In addition to improving the safety of inhabitants, the protection structures reduce the frequency of evacuations. It is clear that widespread evacuations would have been ordered in the March 2026 avalanche cycles if the protection measures that have been implemented in Iceland during the last quarter century had not been in place.

KEYWORDS: Avalanche protection measures, avalanche dams, avalanche cycles

1. INTRODUCTION

Snow avalanches have caused many catastrophic accidents and severe economic losses in Iceland since the country was first settled in the 9th century (Jóhannesson and Arnalds, 2001). Several times throughout history, catastrophic avalanches have claimed numerous human lives in towns and villages. In response to two avalanche accidents claiming 34 lives in Súðavík and Flateyri in 1995, a government programme was initiated to construct protection measures for settlements at risk. More than 70 snow avalanches have hit deflecting and catching dams and braking mounds in Iceland since the start of the programme (Jóhannesson et al., 2019).

This paper builds on a paper that was published in the 2024 ISSW proceedings, in which the avalanche situation in Iceland and the government programme for constructing protection measures was described in addition to lessons learned from avalanches impacting avalanche protective structures in Iceland in January 2020 and March 2023 (Jóhannesson et al., 2024). Avalanche cycles in March 2026 added to the history of avalanches interacting with protection structures in Iceland. It is likely that avalanches would have reached the settlements in the towns of Siglufjörður and Patreksfjörður if protection structures had not been in place.

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https://doi.org/10.15788/1790098806

2. AVALANCHES ABOVE THE TOWN OF SIGLUFJÖRÐUR IN MARCH 2026

Numerous dry slab avalanches fell in the Tröllaskagi peninsula in N-Iceland as well as in the Westfjords during an avalanche cycle in March 15–19 2026. These avalanches were in the range from medium to large, with some of them falling close to settlements, including areas where protection measures have been constructed. The weather causing the cycle was characterized by strong winds from NNW–NE and heavy snowfall. The avalanche conditions became especially problematic in the northernmost part of Tröllaskagi peninsula where the town of Siglufjörður is located in a fjord surrounded by steep mountains. Locally, the precipitation was especially intense with wind from N which is associated with snow accumulation in the avalanche release areas above the settlement.

Luckily, no big avalanche catastrophe has occurred in the town of Siglufjörður. However, in 1919, a large avalanche killed nine people in a settlement that used to stand on the other side of the fjord. According to the official avalanche risk assessment for Siglufjörður (Fig 1), avalanches threaten a large part of the town. Avalanches are especially frequent from the mountainside above the southernmost part of the settlement, originating in the gullies Syðra- and Ytra-Strengsgil and the bowl Jörundarskál. In some cases, they have caused severe damage to houses, and one avalanche is reported to have reached farther than the coastline in the early 20th century before houses were built in this area. Since the avalanche protection programme started, extensive structures have been built in the mountain above the town, including deflecting dams, supporting structures and catching dams (Fig. 2).

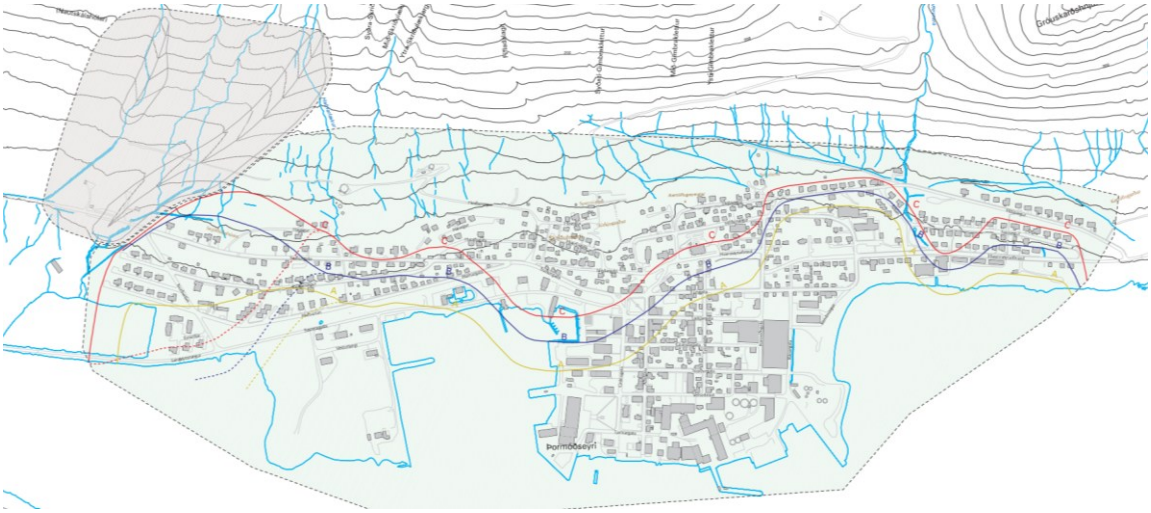


Figure 1: Avalanche hazard map of Siglufjörður from the year 2002 taking into account the deflecting dams in the southern part of town but not supporting structures and catching dams that have been constructed since then.



Figure 2: Avalanche protective structures in Siglufjörður, deflecting dams, supporting structures and catching dams.

During the March avalanche cycle of 2026 in Siglufjörður, a few avalanches were released above the southernmost part of the town, hitting the two deflecting dams called *Stóri-Boli* and *Litli-Boli (Fig. 3),* which are 18 m and 15 m high, respectively. It was difficult to estimate exactly how many avalanches

were released due to poor visibility during the snowstorm. The avalanches were deflected by the dams and came to a stop below the lower ends of the dams. The flow marks reached up to more than half the height of the dams in some places but the avalanches did not overflow the dams. The avalanches would most likely have reached, or at least threatened, the settlement if the dams had not been in place.

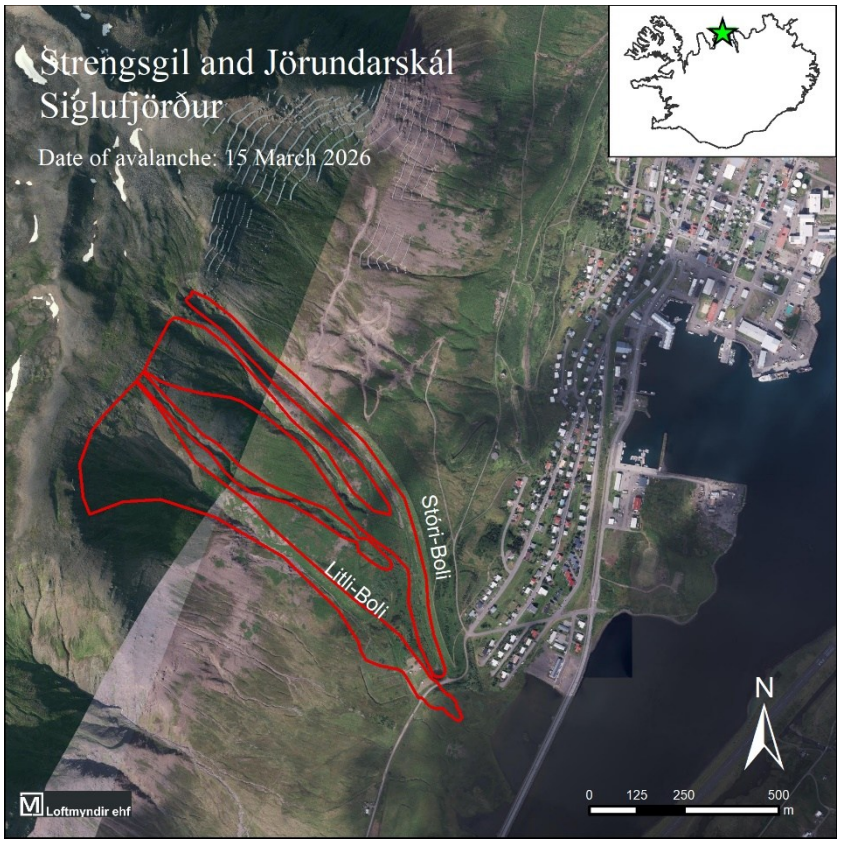


Figure 3: Outlines of one or more avalanches hitting the deflecting dams called Stóri-Boli and Litli-Boli.

A combination of snow supporting structures and catching dams, as well as the deflecting dam Kálfur, protects other parts of the town, north of Strengsgil (Fig. 2). Supporting structures cover a large portion of potential starting areas of Hafnarfjall above the central part of Siglufjörður town, and no avalanches were released in these areas. Numerous avalanches were, however, released in neighboring avalanche paths with similar or the same aspects and release heights. In some places, cracks were observed in the snow cover between the rows of supporting structures as well as small slumps starting below one row and stopping on the next one farther down, indicating widespread weak layers in the snow in the starting areas with structures. Therefore, it is considered quite possible that the supporting structures prevented the initiation of avalanches above the main town.

Permanent avalanche defense structures do not only add to the safety of inhabitants in avalanche-prone areas and decrease the likelihood of damage to structures, but they also contribute to less frequent evacuation of houses and buildings. It is likely that, in the absence of the protection measures, hundreds of inhabitants would have been evacuated during the snowstorm with the associated trouble, cost and insecurity.

3. AVALANCHE HITTING DAMS AT PATREKSFJÖRÐUR IN MARCH 2026

An avalanche fell above the settlement in Patreksfjörður on 26 March 2026 (Fig. 4) and hit a catching dam with substantial run-up (Fig. 5) . The avalanche was the largest in this avalanche path since 1958,

and the dam most likely prevented the avalanche from reaching houses in an area where the 1958 avalanche caused considerable damage.

The avalanche fell in a brief easterly storm affecting the Westfjords. New snow had accumulated earlier in March but the earlier winter months were characterized by little snow. On the morning of 26 March, the wind picked up to a speed of 30 m/s on top of the mountain Brellur above Patreksfjörður. At noon, an increase in precipitation caused a severe blizzard. Snow accumulated rapidly in the release zone and the avalanche had already fallen by 3 pm., though the exact timing is not known due to poor visibility.

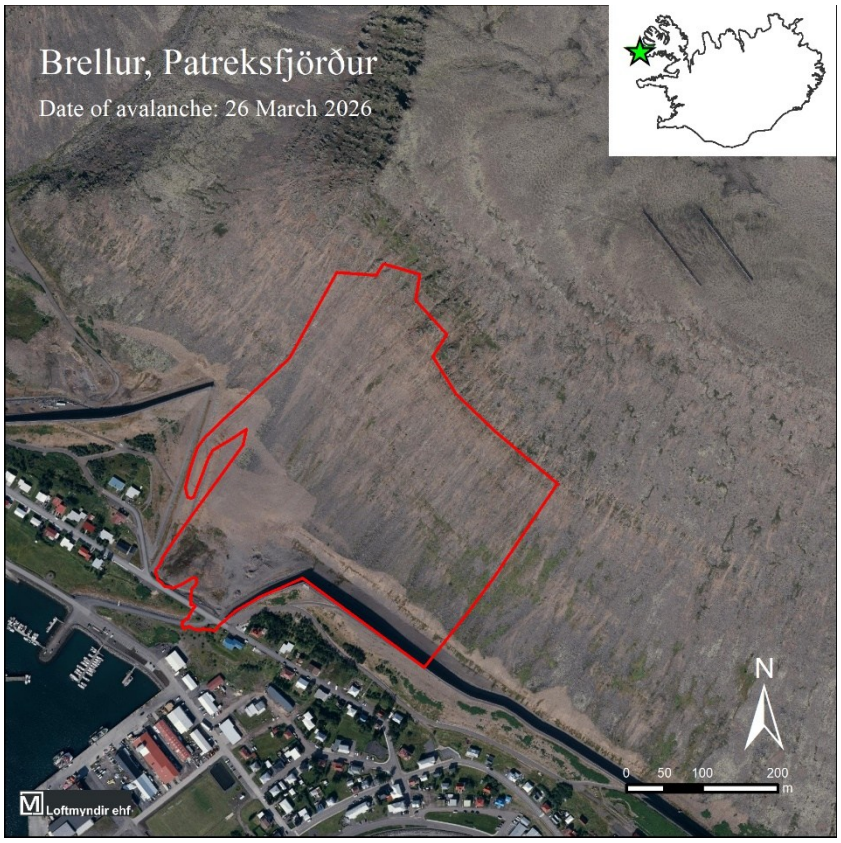


Figure 4: Outline of a 400-m-wide avalanche that hit a catching dam and flowed along a deflecting dam above the town of Patreksfjörður on 26 March 2026.

Evacuation of houses in this area used to be quite common, due to the proximity of the houses to the mountain slope, and the often rapid onset of conditions for avalanches large enough to threaten the town. It is one of the most active avalanche paths above a settlement in Iceland.

The avalanche was about 400 m wide and hit a 200 m wide section of the catching dam. Part of the avalanche flowed along a deflecting dam, and stopped about 30 m beneath a road within the village. The road had been closed due to avalanche danger when the blizzard started. No houses were evacuated due to the newly constructed avalanche dams, which protected the houses but not the road.



Figure 5: Avalanche catching dam in Patreksfjörður after being hit with an avalanche in March 2026.

4. OTHER AVALANCHES HITTING PROTECTION STRUCTURES IN MARCH 2026

The largest avalanches to hit protection structures in March 2026 were those described above in the towns of Siglufjörður and Patreksfjörður. Avalanches also impacted avalanche protection structures in a few other areas, although it is considered unlikely that they would have reached the respective settlements without the structures. In Flateyri, construction work is ongoing, improving the defenses that have been in place since 1997. In 2020, the fluidized parts of two avalanches overflowed the dams (Jóhannesson et al., 2024), initiating a new project where braking mounds are being constructed above the catching dams. In March 2026, an avalanche fell from the Innra-Bæjargil avalanche path and hit some of the new braking mounds but did not reach the deflecting dam farther down. Another avalanche was released from the bowl Skollahvilft that flowed along a deflecting dam without without significant run-up. In Ísafjörður and Bolungarvík, avalanches also reached braking mounds that were constructed above avalanche dams with the aim of slowing down avalanches before they hit the dams.

5. CONCLUSIONS/DISCUSSION

The number of avalanches interacting with snow supporting structures, braking mounds, deflecting dams and catching dams continues to rise in Iceland providing important data on the effectiveness of avalanche protective structures. It is considered likely that avalanche protection measures prevented avalanches from reaching into settlements in at least two cases in March 2026. The structures improve the safety of inhabitants in avalanche-prone towns, and they also contribute to less frequent evacuation of houses.

Avalanche protective structures do not provide 100% safety, and during the most extreme avalanche cycles, evacuations and other precautionary measures beneath the structures are planned.

ACKNOWLEDGEMENTS

The IMO snow observers and other avalanche specialists in Siglufjörður, Patreksfjörður, Bolungarvík and Ísaförður, Gestur Hansson, Þröstur Reynisson, Jóhann Hannibalsson, Magni Hreinn Jónsson, Sigríður Sif Gylfadóttir and Örn Ingólfsson, made many of the observations reported in this paper.

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