Economic estimation of construction of snow-removing ditches using the amount of snow damage has been made in an urban area of 20.45 km^2. Construction is economical in the commercial district and neighborhood in a year of snow scarcity, and also in years of snow abundance in residential districts.

ACKNOWLEDGEMENTS

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Utilization of snow with a snow compactor

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SUMMARY

In recent years many attempts have been made to utilize snow in the snowy areas of Japan. Among basic technologies for snow utilization, compaction and shaping of snow are important in order to use storage space effectively and to delay snow melt.

A snow compactor with a "screw-feed" system was developed: collected natural snow is compressed by a screw into a solid cylindrical snow column. Extrusion speed of the compressed column is about 60 cm min^{-1} and the productivity of this snow compressor is over 0.5 t h^{-1}.

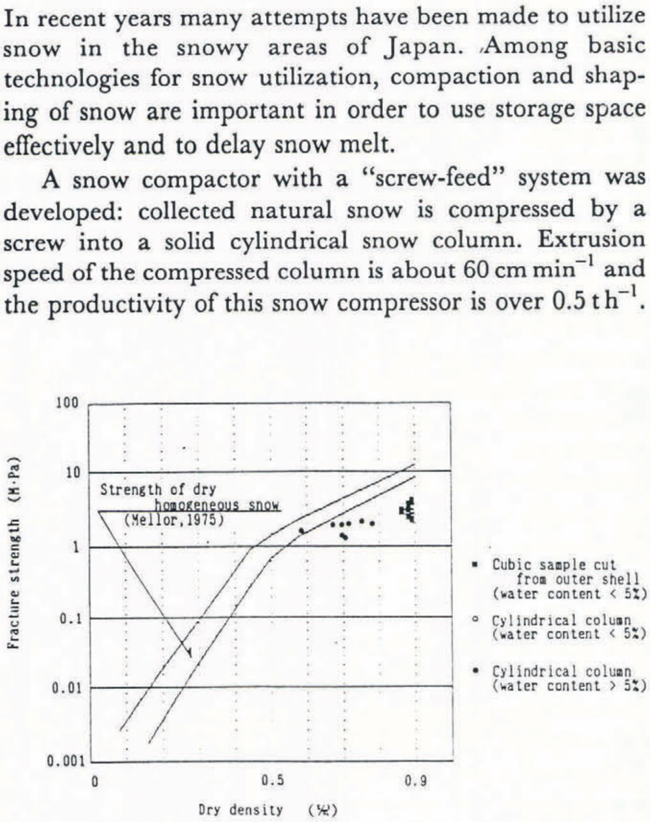

Fig. 1. Compressive fracture strength (samples tested immediately after extrusion).

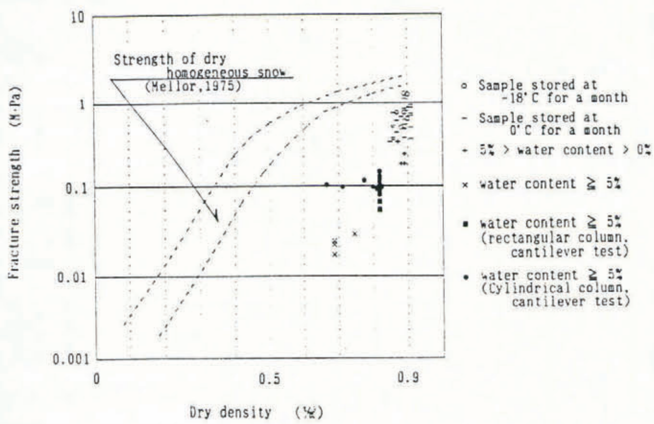

Fig. 2. Tensile fracture strength.

The wet density of the compacted columns is over 790 kg m^{-3}. Pressure at the screw blades is 15–30 kgf cm^{-2} during continuous production of snow columns.

The cross-section of a compacted-snow column is circular or rectangular. The center part of the column, where coarse ice grains are observed, is mechanically weak and thought to be less compacted. The outer shell of the column is more transparent with many small air bubbles.

Wet density of the resultant snow column was measured as 790–940 kg m^{-3}, which is two to four times greater than the original snow density. Water content was about 8% for the natural snow and around 10% for the resultant compacted column.

Results of mechanical test are shown in Figure 1 with dry snow as a reference (Mellor, 1975). Fracture strength increases with decreasing water content. Observed strength of all is less than one half of the dry snow strength. Measured tensile strength is shown in Figure 2. For the snow columns immediately after extrusion, tensile strength decreases with increasing water content. For the stored samples, frozen snow columns show similar strength to the homogeneous dry specimens, and columns stored at 0°C show rather smaller values than frozen ones.

Compacted-snow columns are weak immediately after compression before snow grains have time to bond. Storing the snow columns at 0°C may increase their strength. Mechanical tests indicate that stored columns can be used as building materials (e.g. in snow festivals) or for storage of snow.

ACKNOWLEDGEMENTS

We are grateful to Dr Tadayuki Ohnuma and Professor Katutoshi Tushima, Dr Tsutomu Nakamura and Dr Toshiich Kobayashi for much advice during the test. Thanks are also due to Professor Shunichi Kobayashi and Dr Kaoru Izumi for the use of their cold room and compressive-test machine.

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Geomorphological features and distribution of avalanche furrows in heavy snow regions in Japan

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SUMMARY

Slopes where full-depth avalanches often occur have characteristic features which have not been described in detail. We define an "avalanche furrow" as a steep convergent furrow which on aerial photographs looks like a pattern scratched by a needle. We have researched morphological features of avalanche furrows and relationships between avalanches and avalanche furrows using photo interpretation and field survey of study areas in Hokuriku district, central Japan, and the distribution of avalanche furrows based on interpretation of 1 : 15 000 scale photos in the whole of Japan.

Avalanche furrows usually appear in groups of two to four. Each is composed of smoothly dissected rock. Usually semicircular or U-shaped in section, they are 3–6 m wide and 2–3 m deep, and slightly concave in longitudinal section. Lengths range from several tens to several 100 m, and continue from near the ridge line to valley floor (Fig. 1).

Avalanche furrows appear on 76.8% of slopes where avalanches have occurred. Inversely, traces of avalanches appear in 90.2% of avalanche furrows. Distribution of inclination of avalanche furrows is centered at 35°–50°, while that of non-avalanche furrows where avalanches occurred is concentrated from 30° to 45°. Avalanche furrows are distributed in heavy snow regions of Japan, especially densely in Hokuriku district and the southern part of Tohoku district. They are good indicators of slopes where avalanches will easily occur.

"Avalanche chutes" (Shimokawa, 1980) appear in slopes where avalanches occur, formed by avalanches and distributed centrally in areas where avalanche furrows appear. We have not investigated their genesis, but we concluded from their distribution that they too are formed by avalanching snow.

Fig. 1. Terrestrial photograph of "avalanche furrow".

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Shimokawa, K. 1980. Geomorphic study of avalanche chute in the upper drainage basin of the Tadami River. *Geographical Review of Japan*, **53**(3), 171–188.

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