Transformation of snow damage and its societal background in recent Japan

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SUMMARY

After Japan's rapid economic growth during the past three decades, snow damage characteristics have changed remarkably. Since there has been no considerable change in climatic conditons, the main cause of change is clearly based on social factors. Among many kinds of snow damage, the most serious are those which do any injury to the human body (human body snow damage, HBSD). This paper examines the time-series change of HBSD in the period of 1955–89 and analyzes the societal background of the change.

Two contiguous prefectures, Yamagata and Niigata, in the centre of the snowy area of Japan were taken as case study areas. Over 2000 cases of HBSD reported in local newspapers of each prefecture, the Yamagata-shinbun and the Niigata-nippo, were recorded as sample data.

Some types of HBSD were found to increase with time. These were falls from a roof (RF), accidents caused by snow or ice fallen from a roof or an artificial object (FS), traffic accidents related to snow or ice (TA), accidents caused by snow removal equipment (SR) and falls into waterways (WF). HBSDs decreasing in time included damage caused by avalanches (AV) and destruction or breakage of buildings by snow load or impact force.

The social backgrounds of the transformation of HBSD were discussed and summarized as follows. Increases of TA were undoubtedly related to very rapid extension of motorization in Japan. Both physical and subjective factors, namely, changes in environments of houses and residential areas, and changes in characteristics of inhabitants, such as reduction of family size, depopulation and ageing, were main causes of increase in RF and FS. Increasing mechanized snow removal and man–machine interface problems caused by the spread of snow removal equipment into home use accelerated increases of SR. Some time-series tendency shown in other types of snow damage can be explained similarly from the viewpoint of changing social conditions.

In conclusion, snow damage which becomes the crucial issue in some fields in future might be predicted, and implications for countermeasures are discussed.

Snow removal and de-icing using long flexible heat pipes

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SUMMARY

This paper presents methods newly developed in Japan for snow melting and de-icing, using a long flexible corrugated heat pipe. Use of these methods is rapidly expanding.

Poles for telephone or power lines in snowy areas in Japan have frequently been damaged by winter snow. Heavy snowfall imposes a settlement force on poles and a tension force on support wires. To prevent snow damage to the poles, a flexible corrugated heat pipe, 4 m in length and 26.5 mm in diameter is buried about 2 m into the

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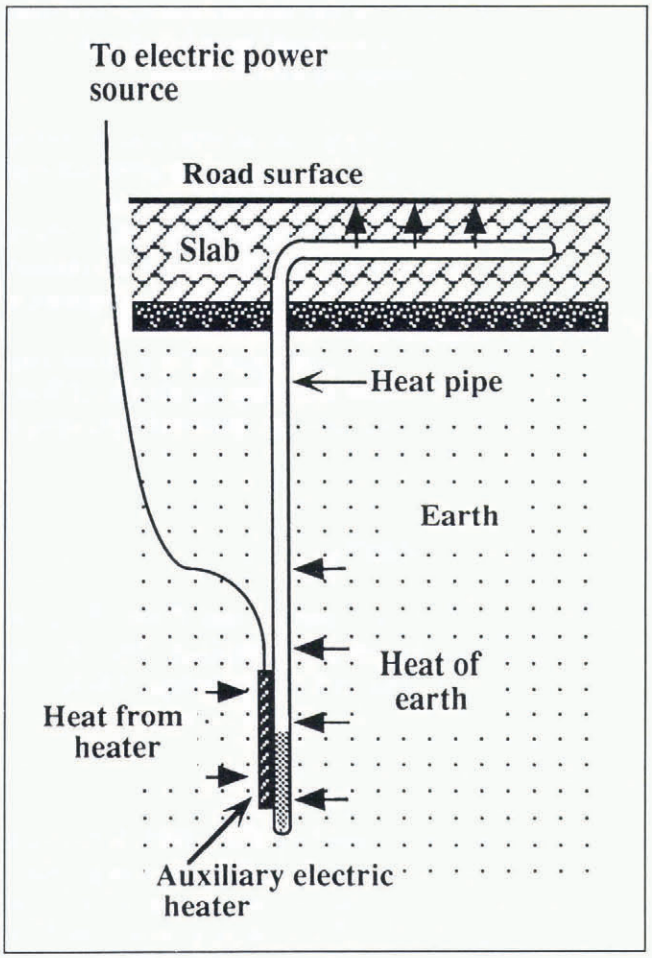

Fig. 1. Hybrid heat-pipe snow-melting system.

earth, with a length of 2 m remaining above the ground along the support wire. The heat pipe extracts about 10 W of heat from the earth at temperatures above about 6°C throughout the winter season, and melts the snow surrounding the support wire. A hollow space with a diameter of about five times that of the heat pipe is formed around the support wire, releasing the tension force. By this method, support wires of telephone poles can be completely protected from snow damage without further equipment or costs.

This system, using only the heat of the earth, requires no running cost. However, in cases of heavy snowfall, it is insufficient, and the cost of construction is higher than for other systems. These shortcomings are solved by a new method of hybrid heat pipe snow-melting system. The key element of the system is an auxiliary electric heater, added to the lower part of the heat pipe (see Fig. 1), which is buried vertically about 7 m into the earth. When snowfall is below 10 cm a day, this system melts snow by using only the earth's heat. On days of heavier snowfall, or extreme cold, the auxiliary heater is activated. The operating cost is several tens of times lower than that of other snow melting systems. Much of the heat source is that of the earth, so this system is very effective at melting snow in relatively small areas such as a door area, passage, small parking lot, etc.

There are many hot springs in snowy areas of Japan. In these districts as well as others, snow removal is a significant task. Waste hot spring water from hotels is used as a heat source for large-scale snow-melting systems. Exhausted waste hot spring water, at above 20°C even in winter, led into a ditch along a road, flows downward. The lower end of a flexible heat pipe about 1 m long is concreted into the bottom of the ditch to extract heat from the water flow. The remaining part of the heat pipe is installed under the road with an inclination angle of several degrees.

A very large-scale snow-melting system with low operating costs has been developed by combining a flexible long heat pipe and a boiler with burners. A U-shaped heat-exchanger jacket is attached to the lower part of the heat pipe. A heating liquid (e.g. solution of ethylene glycol or propylene glycol in water) warmed to about 40°C by a boiler is circulated in the jacket, transferring heat to the heat pipe. The system recently constructed in Japan has a snow melting area of 6200 m^2. The operating cost of the sytem is about one third that of a system on the same scale using electric heating.

These methods will be widely used in the future, not only in Japan, but also in other countries.

Snowmelt runoff analysis using estimated distribution of snow water equivalent

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SUMMARY

A snowmelt runoff model consisting of three submodels has been developed (Koike and others, 1986, 1987; Lu and others, 1989). The submodels, for estimating basin-wide snow water equivalent (SWE), basin-wide snowmelt rate, and runoff, require input of the following variables: meteorological data (e.g. air temperature, insolation,

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