Climatic Conditions Causing Snow Accretion on Shinkansen Bogies

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1. Introduction

Shinkansen trains operating in snow area have snow accretion countermeasure, like body mount system, to prevent from heavy snow accretion. However, shapes of the car bogies are complicated and then snow accretion easily occurs. When the deposited snow and ice on the bogies falls off the car, it can damage facilities. At present, snow removing operations are performed at stations to prevent such damages. In order to effectively implement such operations, it is necessary to predict the volume of snow accretion, which causes problems of trackside facilities, from climatic conditions.

2. Outline

In this study, by using data of snow accretion amount on sides of the bogies measured at a Shinkansen station, we analyzed the relationship between these snow amounts and the number of damage cases presumably caused by snow falling from trains. This enabled us to determine the snow accretion amount of high probability of snow fall damage. Subsequently, we analyzed the relationship between air temperature and precipitation along the Shinkansen track line, and proposed an predicting method of the snow accretion amount based on the air temperature and precipitation.

3. Test results

We divided the snow accretion into 9 classes and examined the percentage of the number of trains that presumably caused damage by the snow falling off to the number of trains that had snow accretion in each class (Fig. 1). It was clarified that when the snow accretion amount exceeded 0.06m^3, the damage occurrence percentage was increased, although the number of trains was small in such class.

As a result of statistically analyzing of weather conditions when snow accretion amount exceeds 0.06m^3, the average air temperature *Ta* of the time when the surveyed train was running near the weather observation point, was under -3.5 °C (Fig. 2). It was indicated in Fig. 3 that a positive relationship between the snow accretion amount (*V*) and the average value (*W*) of cumulative precipitation for 11 hours before the time when the surveyed train was running near the weather observation point. Thus the following regression formula was obtained:

$V = 0.0285 + 0.0114 \times W$ ($Ta \leq -3.5$ °C)

In the surveyed track line, this formula enables us to estimate of snow accretion amount (*V*) from the air temperature (*Ta*) and the precipitation (*W*). Using this formula, it can be assisted in determination whether snow removal operations is necessary or not.

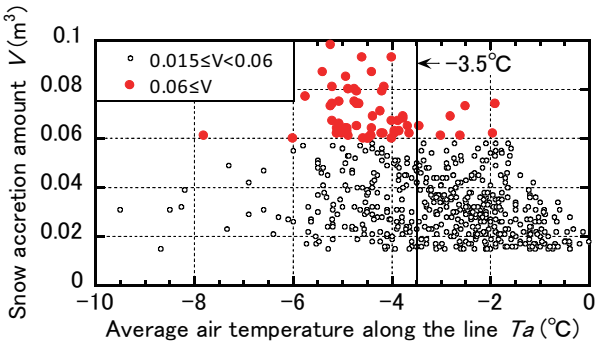

Fig. 2 Relationship between average air temperature along the track line and snow accretion amount

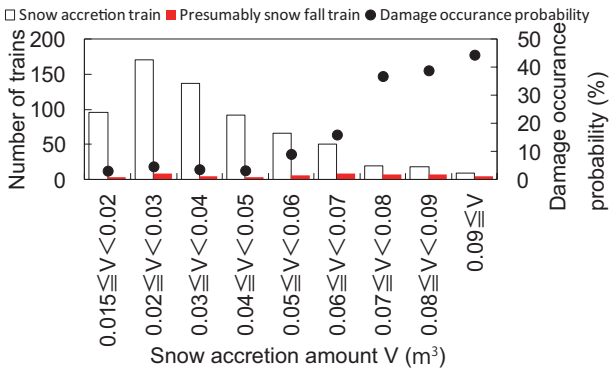

Fig. 1 Relationship between snow accretion amount and damage occurrence probability

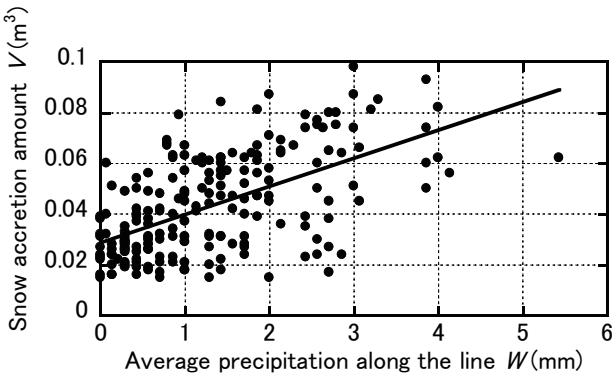

Fig. 3 Relationship between snow accretion and average precipitation along the line (for cumulative 11 hours) which has average air temperature below -3.5 °C