Tendency of the occurrence of vehicles unable to climb (stuck vehicles) on winter roads

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1. Introduction

Photo 1: Vehicles becoming unable to climb hills

The authors are conducting research to organize the causes and challenges associated with vehicles that become unable to climb hills on winter roads that should be shared around Japan and to set the direction to overcome the challenges specifically with improvements to road structures. In this fiscal year, the authors started analyzing data and conducting on-site interviews in areas where the first vehicle becomes stuck to organize the characteristics of locations where vehicles become unable to climb hills. This paper introduces conditions found through these activities and the outline of future activities.

2. Trend of onset seen in data

The basic trend found was based on an analytical tool for the onset of vehicles becoming stuck (2010–2016) within the Hokuriku Regional Development Bureau (figure 1). The stuck vehicles occur most frequently in January accounting for 47% of all. Among road conditions, compacted snow accounts for 63% of all. Among vehicle types, large vehicles account for 72% of all. Much of the tire data remain unclear, but the authors identified that stuck vehicles probably wore studless snow tires without chains.

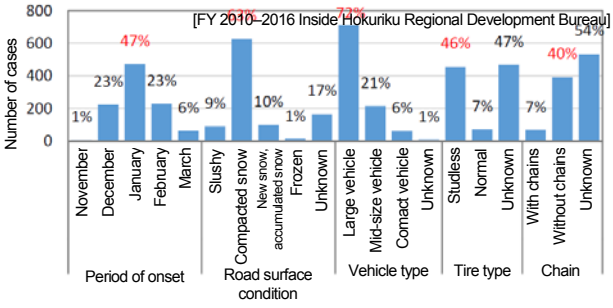

Figure 1: Basic trend of the onset of vehicles becoming stuck

3. Tendency of onset found through hearing

Since the authors could not find a direct cause of vehicles becoming stuck, they conducted interviews at eight stations of the Hokuriku Regional Development Bureau to find the causes, including detailed road structures and road management at the sites of onset.

The authors found that the causes of vehicles becoming stuck included road structures associated with slowing down (e.g., longitudinal slopes, long gradients, and sharp curves), as well as the conditions described below.

1) Condition of road surface: While compacted snow accounted for 63% of all road conditions in figure 1, the snow often contained large amounts of moisture, such as softly compacted snow and slush, which were categorized as compacted snow. These road conditions were associated with large driving resistance and often caused conditions, such as tires not grabbing the snow, inability to control the vehicle with the steering wheel, spinning tires, and the inability to restart moving.

2) Weather factor: Vehicles tend to become stuck when the amount of snowfall increases, and the removal of compacted snow becomes slow. In the case of Yuzawa, vehicles start to experience difficulty driving or starting when the hourly amount of snowfall exceeds 10 centimeters.

3) Human factor: Vehicles coming from other prefectures tend to be wearing no chains. Vehicles are sometimes without chains because the roads around mountains are equipped with snow-melting pipes and therefore enter the mountains without chains.

4. Future direction of the study

The authors are going to identify the causes of slowing down, weather factors, and human factors found from the interviews by mountain areas, inland areas, and coastal areas, which exhibit different road surface conditions, and organize the causes of the onset of stuck vehicles in a tree-form diagram (figure 2). The authors are specifically going to identify details of the factors that require on-site precautions in regard to the factor of slowing down, including the merging sections of climbing lanes, areas where drivers tend to become unaware of longitudinal slopes, and overpasses where snow cannot be removed and become narrowed down.

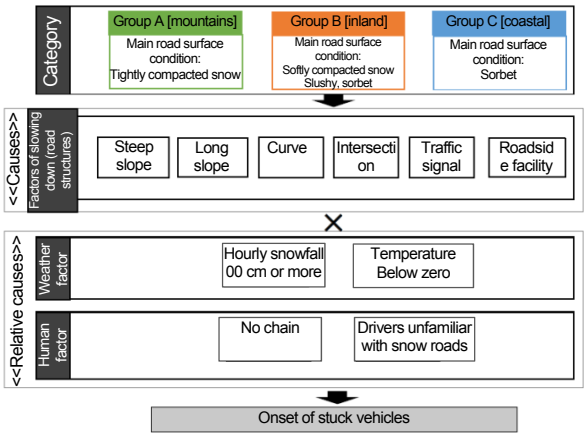

Figure 2: Causes of the onset of stuck vehicles (image of the organization)

The authors are going to identify the trends to the onset of stuck vehicles in other regions (regional differences) using the Hokuriku data as a reference during the next fiscal year.