Reduction Program of Accident Risk for Vehicles in High Cross Winds

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Summary

Risk reduction program for vehicles running on highway was proposed. Critical wind speeds at which vehicles can slip into adjacent lane are found by numerical simulation for several types of cars. Then accident probability can be calculated based on probability distribution of local wind velocity. Wind barrier was considered to reduce wind velocity. The wind reduction characteristics due to barrier were found by wind tunnel test. Due to the reduction of wind velocity, car accident risk can be reduced. Total cost in which the installation cost of wind barrier and those cost for car accident were evaluated for each candidate site. Then, decision was made to install wind barrier if and only if the cost can be saved due to wind barrier.

Keywords: side wind, slip, vehicle, risk, wind barrier, wind tunnel test

1. Introduction

Vehicles running at coastal region or valley area sometimes deviates from its desired path because of the strong side wind accelerated by the concentration of flow over the bridges or valleys. Continual compensation of steering wheel against the side wind gives stress to a driver, and then leads to increase of accident risk. Developing a reasonable vehicle protection plan to reduce probability of accident risk, it is firstly required to define the quantitative relations between side wind velocity and driving safety. Main objective of this study is to establish safety criteria for vehicle under side wind. Theoretical and experimental approaches are used to evaluate wind forces acting on vehicles. The second purpose of this study is to design wind barrier and to verify it. Both CFD analyses and wind tunnel tests are performed to find proper geometry of wind barrier. Finally the detail shielding plan is proposed to protect the vehicle running on roads against high side winds. Based on the accident risk analysis vehicles, decision making process for wind barrier installation was proposed.

2. Vehicle behaviour under side wind

2.1 Critical speed for vehicle accident

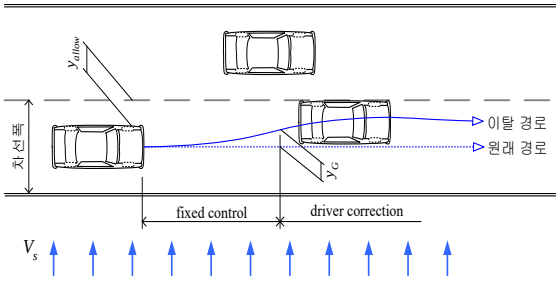

Fig. 1: Plan view of running vehicle on highway

Fig. 1 shows a plan view of vehicle running on highway. y_{allow} and y_G denote marginal distance of a vehicle in lane and slip distance of the vehicle. Then, risk index can be defined as

$$F_Y = \sqrt{\frac{1}{1-Y}} - 1 \qquad (1)$$

in which $Y = 2\,y_G \,/\, y_{allow}$. As can be seen graphically, risk index F_Y increases rapidly right beyond $Y = 0.94$. Therefore,

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