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Research on the treatments of the long downhill in the highway

Xiaofeng Du

School of Civil Engineering, Chongqing Jiaotong University, Chongqing 400074, China.

Abstract
According to the long downhill security hidden danger existing in the highway, combined with the long downhill treatment engineering of an expressway, from two aspects of management and engineering treatment measures and solutions are put forward.

Keywords: Highway; Long downhill; Treatment

1. Introduction

Because of the influence of terrain, environment, road and other factors, in the road design, it is inevitable that there will be a long and steep downhill section, which has a certain impact on the vehicle driving. Vehicles on the road, often due to continuous braking causing brake failure, driver fatigue, overloading of vehicles and so on, which cause rear end collision, falling cliff and other major traffic accidents.

The maximum longitudinal slope cannot be used as a complete design control index, which must be considered of the longitudinal slope length for the vehicle. The critical slope length is expressed as a maximum length of a load carrying vehicle driving on a specified upper ramp without a reasonable reduction or deceleration to a permissible range. For certain ramp, if the length is less than the provisions of the "critical" value, on the one hand it can make the truck in the appropriate speed range and reasonable operation, and it does not have a greater interference to other vehicles and railway capacity is guaranteed. On the other hand, it can avoid the traffic accident caused by the speed difference and it is also good for the economic efficiency of the vehicle. Therefore, it is necessary to limit the slope length of the large longitudinal slope. In this paper, according to the highway project, it aims at the security hidden trouble in the long downhill highway and puts forward some measures and methods.

2 Research Status

The safety hazard caused by the long descent has been paid more attention by domestic experts, some scholars have carried on the thorough research to this. Based on the theory of vehicle dynamics and the theory of vehicle driving, Fu Zisha built the model of the operation speed of the vehicle on the basis of the dynamic performance and the downhill braking performance of the vehicle, and the influence of the long steep section of the road on the vehicle is studied [1]. Hu Gonghong, *et al*. have investigated and analysed the several highway in the west of the mountain highway and the measures of a long downhill security engineering are studied. They also put forward some measures to improve the safety performance of the road [2]. Based on the actual braking failure accident data, Ma Liang *et al*. analyzed the various factors of the vehicle running characteristics and built the model of predicting the occurrence probability of braking failure accident. The results show that the model can effectively predict the brake out of control accident in the highway continuous long downhill section [3]. According to the current situation of the highway section of our country, Ma Yuchun *et al*. selected the safety management examples of the section of the highway and summarizad the cause of the accident with the analysis of the accident records. And they proposed some measures to improve the safety performance of the long downhill section from the linear design, traffic engineering and other aspects [4]. Zhu Zongyu has found that the main line of the long distance downhill section of the deceleration lane is prone to traffic accidents. In addition to the vehicle overspeed driving, brakes, slippery rain and snow and other factors, it is also related to the main line of horizontal and vertical surface and the deceleration lane of geometric design [5].

3 Engineering Survey

The length of a section of the project from K296+760 (design elevation 3032.533m) to K361+140 (design elevation 1574.046m) is 61.739km, the elevation is 1458.487m and the average longitudinal gradient is 2.36%. It is the continuous long longitudinal slope and the long and steep vertical section of the line is shown in Figure 1.

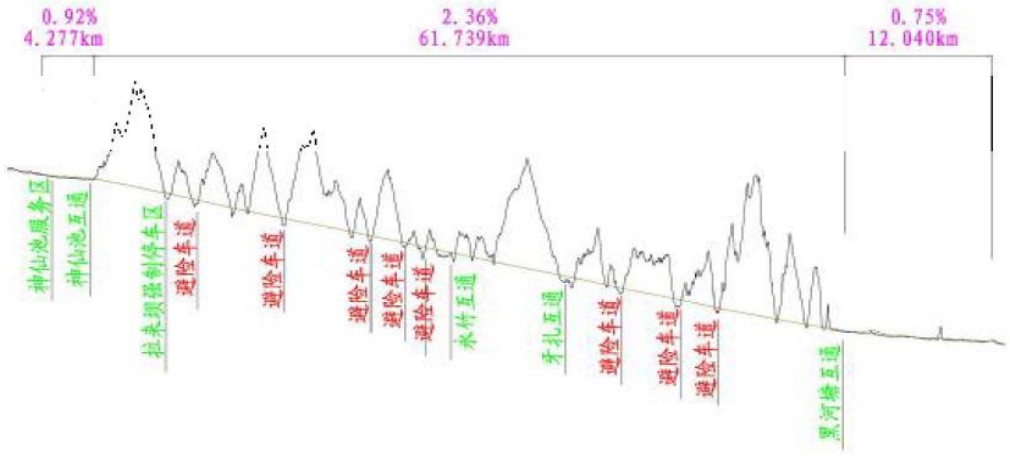

Fig 1: The Long and Steep Vertical Section

4 Treatment Measures

In view of the long downhill section of the project, this paper mainly put measures from the management and engineering to ensure the safety of vehicles in the long downhill section.

Management aspects include the law enforcement, facilities and education. The part of law enforcement includes the strengthening of the management of overloading and mandatory parking overhaul, etc. The part of facilities includes setting water area and inspection area, etc. The aspects of education include strengthening the past truck driving safety publicity and education and so on. Among them, these areas should be set at a reasonable location.

Engineering aspects include traffic signs, deceleration facilities and hedge facilities. Traffic signs refer to set the speed limit signs, front road signs, sharp warning signs and accident prone signs. Deceleration facilities include setting deceleration markings, surface treatment, thin pavement and so on. The reduction zone should be set in the appropriate position in the downhill slope. And hedging facilities include the establishment of hedge lane and parking areas. The areas should be set up in the proper position of roadside.

Especially in transportation facilities, the project in conjunction with other experiences in engineering project put forward the suitable marking design for the project.

4.1 Traffic Engineering Facilities Defects

According to experience and investigation, the analysis shows that the design of the traffic engineering facilities is one of the important reasons leading to the frequent and serious consequences of continuous downhill. The main design defects include three aspects.

(1) There is a lack of systematicness in the flag settings.
(2) There is a chaos in marking settings.
(3) Barrier protection level is lower.

4.2 Mark System Settings

Considering the shortcomings of the domestic traffic engineering facilities and the practical characteristics of the project, the design principle of the project sign system is put forward in this paper.

(1) The overall layout of the traffic signs should be set up.
(2) The traffic signs should provide the correct and timely information to the users of the highway, and avoid the overload of information.
(3) The location of the traffic signs should be calculated separately according to the categories of the signs. It also should take full account of the characteristics of the driver's feeling, recognition and understanding, according to the operating speed and reflect the time to determine the appropriate set of settings.
(4) It should be fully considered of the impact of the visual identity of the highway (e.g., lighting facilities, monitoring facilities, etc.) and the construction of the road structure (such as telephone, door frame, etc.).
(5) It should highlight the risk of a continuous downhill road section by means of a sign system.

4.3 New Materials and New Technology Marking Application

In recent years, with the rapid development of highway construction in our country and the continuous application of new materials, new technology and new craft, road marking has changed from the original function of identification to the direction of more functional and user-friendly gradually.

In order to improve the driver's alertness and attention, visual illusion, thin-layer pavement, vibration marking and new marking are set in continuous downhill sections. They also can control the speed of the vehicle and take the initiative to guide the driver safe driving. In order to make the marking fully play its role and make up for the adverse effects of the long downhill, the project used the following markings.

(1) Stereo Visual Illusion Markings

Stereo visual illusion markings can be arranged on the roadside or driveway. The stereoscopic markings set in the

center make people feel that there is not less than the roadside obstacles chassis.

The markings set in the roadside let people feel that there are roadside obstacles toward the lane, causing the driver alert. In theory, the effect of three-dimensional visual illusion markings should be more ideal.

(2) Thin Layer Paving

The effect of thin layer paving is similar to visual illusion markings and it can play the function of lowing speed and warning. It is set in the road and it can have a warning effect mainly through the color of the light, light of the paint and the vibration of the vibration. And the thin layer paving is a collection of coarse grain size binding agent with high friction coefficient and it can reduce the sideslip accidents. So the effect is better in the front of the curve.

(3) Vibration Markings

Vibration markings are used in the continuous downhill. In some tunnel the lane edge line uses solid yellow line vibration marking, which is used to forbid the vehicles to change the lane. Once the vehicle is across, the vehicle has a clear sense of vibration, reminding the driver. The survey shows that vibration markings are similar to visual illusion markings, they can help control the speed effectively, but they also affect driving comfort. And in the case of the car running, the wear rate is high.

5. Summary

When the vehicle runs on the long downhill section of highway, the driver should keep a clear sense of safety and the vehicle should have a reasonable load in order to ensure the safe driving of vehicles. The traffic management department should be responsible for the real-time monitoring and management of the various sections of the road and keep road maintenance timely. And safety warning signs should be set in the area where there are many accidents. From multiple perspectives, we should summarize the long downhill treatment scheme and make continuous innovation on the basis so that we can eliminate the potential safety hazard caused by the long descent and ensure the driving safety.

6. Reference

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