Study on Safety Guarantee Measures for the Same-direction Separated Subgrade Section

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Abstract. In the reconstruction and expansion of the expressway, due to factors such as resource utilization of original roads, economic applicability, adaptation to local conditions, and construction organization, the method of reconstruction and expansion and widening is restricted. The widening method of half-width utilization of the original road and half-width newly built in the same direction is adopted, forming the separated subgrade section in the same direction. Based on the implementation plans of different expressway reconstruction and expansion projects, this paper analyzes and studies the characteristics of the same-direction separated subgrade section, from the aspects of the safety guarantee principle, the design of safety facilities, and the same-direction separated subgrade section with interchanges. The reasonable measures safety protection was proposed to promote the smooth flow of expressway traffic and improve driving safety. It is of certain guiding significance for the design of safety facilities in the same-direction separated subgrade section of expressway reconstruction and expansion projects.

Keywords: Expressway reconstruction and expansion; The same-direction separated subgrade section; Safety guarantee measures; The design of safety facilities.

1. Introduction

With the rapid development of China's economic society, the gradual improvement of the expressway network, the rapid increase in traffic volume has led to the shortage of the transportation capacity of the expressway constructed in the early stage and the serious decline in service level. The problem of the mismatch of the role of the city has become more and more prominent, and it has been unable to meet the needs of the sustainable development of economic society and urban-rural construction. The method of reconstruction and expansion is an important measure to solve road congestion and improve road capacity.

The design plan of the reconstruction and expansion project must not only meet the overall requirements of scientific development and economical transportation, but also meet the requirements of overall planning, coordinated development and engineering technology, so as to maximize the social benefits of the project. At present, the commonly used reconstruction and expansion forms are divided into two-sided widening and unilateral widening. In the process of expressway reconstruction and expansion, it is necessary to comprehensively consider factors such as the utilization of old road resources, economical applicability, adapting measures to local conditions, and construction organization guaranteeing methods. Expansion and widening methods are restricted. When encountering water source protection areas, historical cultural relics areas, crossing railways, super-large bridges, and using existing interchanges, the whole or part is restricted by the widening method, and the method of separating and widening in the same direction is often adopted. This article combines two-way eight-lane expressway reconstruction and expansion project examples, from the perspective of safety facility design, analyzes how to ensure the driving safety of the same direction separated subgrade section.

2. The characteristics of the same-direction separated subgrade section

The same-direction separation and widening are generally the same-direction half of the original road, half of the new construction, the same direction traffic flow is divided into two, an uncrossable

obstacle between the same direction roadways is invisibly set up. Vehicles need to choose a lane before entering the separated subgrade section. At present, the speed limit signs of the two-way eight-lane expressway reconstruction and expansion usually adopt the combination of lanes and vehicle types, that is, the two inner lanes are passenger car lanes, and the outer two lanes are for trucks, the driving speeds of the four lanes are also inconsistent.

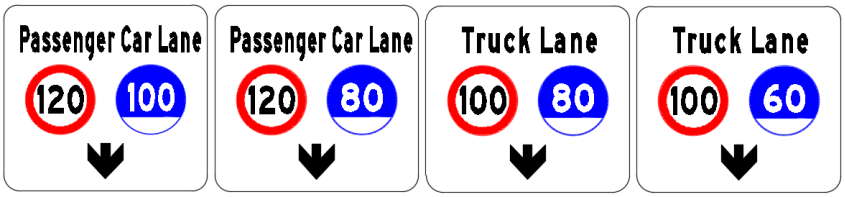

Fig. 1 Combined speed limit signs for lane and vehicle types

Drivers who have not planned the driving route in advance or unfamiliar with road conditions will feel uncomfortable or even panic when they pass the same-direction separated subgrade section. They subconsciously slow down the speed, change lanes to drive on the outer lane, and pick up the mobile phone to inquire about the navigation, calling for inquiries, and other actions that are not conducive to safe driving. In particular, it will cause the worry of small passenger car drivers that driving on the inner road will miss the highway exit.

3. The principles of the safety guarantee of the same-direction separated subgrade section

Before entering the same-direction separated subgrade section, the prompt and driving guidance are necessary to remind the driver to make judgments and choices in advance. For the reminder of the separated subgrade, there is no need to explain what is a separated subgrade. It is reminded by patterns and texts that the road ahead is separated and then merged. If drivers go their own way, and there will be no mistake by choosing the driving lane. The easier it is to understand, the better it is for driving safety. Generally, the following principles should be followed:

(1) The safety guarantee of the separated subgrade section should be continuous, transitive and systematic, requiring coordination and cooperation of multiple safety facilities;

(2) The sign information should convey information to drivers in colors, shapes, characters, graphics, etc., so that it can be quickly recognized and accepted concisely, clearly, and clearly. It will help drivers who are not familiar with road conditions to make a right choice;

(3) It has good driving guidance, indicating the direction, shape and contour of the separated subgrade section;

(4) The guardrail setting of the separated subgrade section and the buffer function of the separated end should be strengthened to ensure the smooth flow and driving safety in the separated subgrade transition section.

4. Design of safety facilities for general same-direction separated subgrade section

The safety facilities installed in front of the separated subgrade section and the separated transition section mainly include traffic signs, traffic markings, guardrails, buffering facilities, sight guidance facilities, etc . Perfect safety facilities can not only ensure the safety and smooth flow of the expressway, but also have positive effects such as beautifying the traffic environment and improving the psychological state of drivers. The safety protection measures formulated for the same-direction separated subgrade are as follows:

(1) Setting up the separation subgrade advance notice and signs in advanced 2km, 1km, 500m before entering the separated subgrade and the separation starting point, which is used to forecast the separated subgrade ahead;

(2) Setting horizontal deceleration markings corresponding to the positions of the separated subgrade advance notice signs to remind drivers to pay attention to driving safety. When entering the separated subgrade section to the completely separated subgrade section, the prohibition of crossing the dividing line is set, and the diversion markings and guide arrows are also set for separation subgrade transition section;

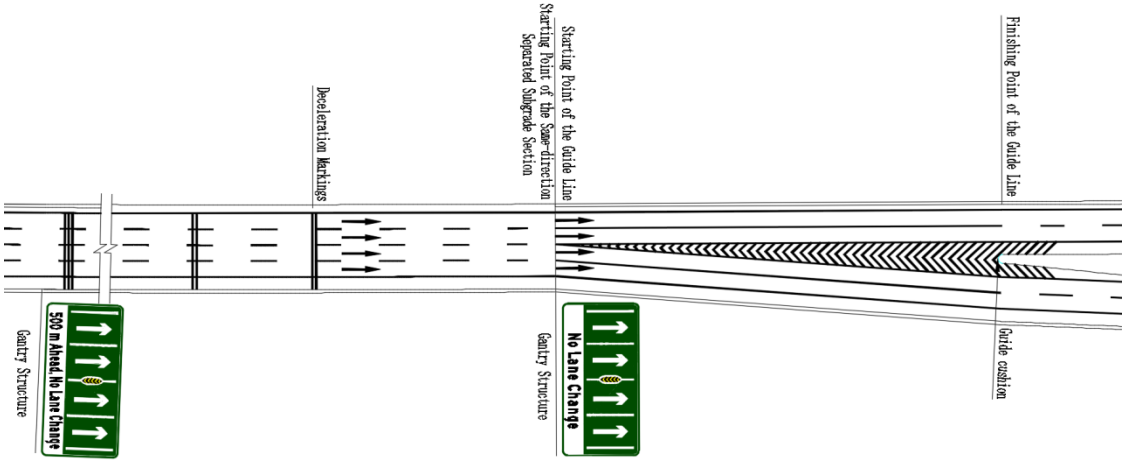

Fig. 2 Layout of safety facilities for the same-direction separated subgrade section

(3) In order to further strengthen the traffic guidance, protruding road signs or intelligent traffic guidance systems can be installed on the outside of the edge of dividing line and in the diversion marking area, and traffic elastic columns can be set in the diversion marking area;

(4) The roadside guardrails on the separated subgrade section should be continuously installed, and TS-level oriented anti-collision pad at the end of the separated subgrade should be set, which is with yellow and black elevation marks on the front side of the vehicle;

(5) In order to enhance driving safety, joint management with highway law enforcement agencies can be conducted, and offenders can be captured.

5. The design of traffic signs for interchange exits of the same-direction separated subgrade section

When the reconstruction and expansion project encounter the need to set up interchanges in the section of the super large bridge that crosses the railway, the widening method of half using the original road and half of the newly built is often adopted. The separated subgrade section forms by the remained central separation belt of the super bridge, and an interchange on the outside of the separated subgrade is set up. As a result, drivers who need to drive out of the interchange at the interchange must choose the driving lane before the separated subgrade section. Before the forecast of separated subgrade section, the guide signs should set the straight direction information on the inner two lanes, and the straight direction information on the outer two lanes and the exit information of the expressway ahead.

Fig. 3 Lane indication sign for the same-direction separated subgrade section (A, B, C and D are Location informations)

As an expressway interchange exit is set up in the separated subgrade section, it is reminded that the pattern of the separated subgrade needs to be modified. It cannot be set according to the plan of no interchange to prevent drivers from missing the expressway exit.

The signs of interchanges exit forecast are generally set at 3km, 2km, 1km, 500m and the reference point before the reference point of the interchange exit. When encountering a separated subgrade section, it is necessary to set the exit notice sign in advance and advance the reference point to the starting point of the separated subgrade section. That is, before the starting point of the main line separated section in the same direction, the name of the intercommunication exit will be announced to guide the vehicles leaving the expressway from the intercommunication to enter the outer two lanes in advance. At the same time, the vehicles should drive in accordance with the combined speed limit signs of lanes and types of vehicles.

The maximum speed limit is 100km/h when vehicles entering the two lanes outside the separated subgrade section. Except for vans, the rest are mostly small cars that drive off the high-speed demand. Because the interchange exit notice information has been set before the separated subgrade, except that the starting point of the separated subgrade section is far away from the interchange exit, generally only 1km, 500m and exit notice signs are set at the reference point of the interchange exit.

6. Conclusion

The safety protection measures for the same-direction separated subgrade section is a systematic project. Different separated subgrade sections are formed according to the functional positioning of the project, the road area environment and other restrictive factors. The complete safety facilities such as path guidance signs, separated subgrade prompt signs, road guides, flow markings, guide arrows, deceleration markings, raised road markings, and guardrail protection are set up to improve the driving safety of the separated subgrade section. When conditions permit, it is recommended to set the route guidance signs and the separated subgrade prompt signs as active reflective signs, and set up variable information signs before the same-direction separated subgrade sections to release road traffic information in real time.

When the reconstruction and expansion project is implemented in the same-direction separated subgrade section, it is necessary to track the operation effect in real time, and further improve the relevant facilities based on the driving experience feedback from the expressway management unit, law enforcement agency and drivers to improve the applicability and safety of the same-direction separated subgrade section.

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