

Analysis of the Impact of Road Traffic Safety Facilities on Traffic Safety

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Abstract: The development of the national economy is closely tied to infrastructure construction. In recent years, China has seen a significant increase in the number and scale of road construction projects, aimed at facilitating the flow of goods and enabling convenient travel for the masses. However, this surge in road construction also raises concerns about road traffic safety. Road traffic safety facilities play a crucial role in warning and protecting against traffic accidents. To ensure their effective implementation, this paper analyzes the essence of road traffic facilities and their impact on traffic safety. By identifying challenges in the application of traffic safety facilities and adhering to safety facility application principles, suggestions are proposed to enhance traffic safety management.

Keywords: Road traffic safety; Facilities; Impact; Principles; Safety recommendations

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1. Introduction

In recent years, China has witnessed a steady rise in automobile ownership, accompanied by a concerning increase in road safety accidents. These accidents pose a significant threat to social security management and the well-being of individuals. Statistics on road safety accidents indicate that many of these incidents are attributed to road conditions and drivers' psychological factors. To address these challenges, China has been intensifying efforts to enhance the construction of traffic safety facilities. These facilities aim to provide warnings to drivers, promote safe driving habits, and ultimately reduce traffic accidents^[1]. However, despite these efforts, there are still numerous issues hindering the effective application of road traffic safety facilities in China. There is a pressing need to further optimize road traffic safety facilities to ensure the safety of traveling and reduce accidents.

2. The connotation of road traffic safety facilities

Road traffic safety facilities are integral to ensuring smooth and safe traffic flow while optimizing road

conditions and the overall traffic environment. These facilities are constructed in strict accordance with traffic laws and regulations and encompass various types, each serving a specific purpose ^[2]. Firstly, there are facilities designed to prevent safety accidents, such as guardrails along roadsides, traffic islands, speed bumps, and flyovers. These structures aim to mitigate the risk of accidents and enhance overall road safety. Secondly, traffic restriction signs play a vital role in guiding and warning traffic. This category includes traffic signs, traffic signal control systems, and other devices used to regulate traffic flow ^[3]. These facilities provide essential information and serve as a basis for law enforcement for both pedestrians and vehicles. Lastly, there are traffic facilities aimed at enhancing the efficiency of road transportation, such as freight car stations, bus stops, and highway service areas. These facilities cater to the needs of different modes of transportation and contribute to smoother traffic operations.

3. Analysis of the impact of road traffic safety facilities on traffic safety

3.1. Traffic markings

Traffic markings serve as critical guides for safety on roads, ensuring both pedestrians and vehicles adhere to safety norms. Consequently, it's imperative for the traffic safety management department to routinely maintain these markings to uphold their effectiveness. Regular maintenance is essential to prevent alterations in the color, width, and shape of the markings, as these changes can diminish their ability to guide and warn drivers effectively. Insufficient adhesion between markings and the road surface can cause them to peel off, obstructing drivers' vision and potentially leading to accidents ^[4]. Accurate placement of marking lines is crucial to prevent hazards such as improper lane splitting, which can contribute to accidents. Moreover, an illogical distribution of traffic markings or uneven application can compromise their visibility at night, posing a safety risk.

3.2. Traffic isolation

Traffic isolation is a crucial aspect of road infrastructure for ensuring safety. Isolation barriers offer easy maintenance and aesthetic appeal, making them widely utilized on roads. They facilitate the separation of pedestrians and vehicles, thereby enhancing the operational efficiency of road traffic. Isolation barriers come in various forms, including welded mesh, isolation walls, and green belts. These barriers can be strategically placed based on road traffic conditions and surrounding environments to create a coordinated traffic layout. It is important to ensure that the barriers blend seamlessly with the road surroundings, thereby guiding drivers without obstructing their vision ^[5].

3.3. Anti-glare facilities

In the setup of road traffic safety features, incorporating anti-glare measures is crucial for reducing or preventing the blinding effects of vehicle lights, especially during nighttime travel. Anti-glare facilities can range from green belts to artificial devices like anti-glare nets. When driving, the glare from vehicle lights can severely impede visibility, making it challenging to see the road ahead, particularly at higher speeds. This heightened glare poses a significant risk of accidents. Anti-glare facilities serve to counteract this risk by blocking glare from vehicles in both directions, allowing drivers to maintain a clear horizontal field of vision and reducing the impact on their ability to see the road.

3.4. Guardrails

Guardrails are crucial safety features that guide both pedestrians and vehicles, helping them navigate roads safely. These guardrails primarily serve to limit the trajectory and range of vehicles, preventing them from straying

outside the safety zone or off the road's edge. This helps mitigate the risk of vehicle rollovers and falls, thereby reducing the occurrence of traffic accidents ^[6]. Guardrails also play a vital role in protecting the driver's personal safety and preventing injuries in the event of a collision. It is essential to carefully design guardrail placements to align precisely with the road's direction, ensuring they provide accurate guidance and prevent confusion.

4. Problems in road traffic safety facilities

4.1. Poor quality of guardrails

Roadside protection is crucial for reducing the frequency of traffic accidents and minimizing their impact. While guardrails are the primary method of roadside protection, they mainly serve as a warning for traffic safety and do not fully address the issue of vehicles veering off the road ^[7]. In some cases, the materials used for guardrail construction may be relatively weak, such as railing plates with insufficient rigidity or stone piers built with less durable materials. When vehicles collide with these guardrails at high speeds, it can result in significant damage, causing vehicles to breach the roadside barrier or allowing parts of the guardrail to penetrate into vehicles.

4.2. Unstandardized traffic marking

Unclear markings are a prominent problem on many roads, affecting vehicle operation. Currently, some road sections lack obvious center lines, or the existing center lines are unclear. Additionally, there are instances where roadway markings are noticeably faded and require prompt maintenance. These conditions can disrupt drivers' adherence to traffic operation rules, resulting in vehicles straying beyond the center line or crossing lanes, posing safety hazards ^[8]. Furthermore, inadequate sight distances in certain areas coupled with the placement of dotted lines can lead to unsafe conditions. The improper marking approach increases the risk of accidents.

4.3. Unreasonable road isolation facilities

The absence of dividers in road traffic creates numerous safety hazards and increases the likelihood of accidents, especially at highway turning points. Without dividers, these turning locations become unclear, leading to a significant number of vehicles crossing lanes, which greatly heightens the risk of traffic accidents.

4.4. Lack of marking at road intersections

Road traffic intersections are prone to safety accidents, especially when lacking clear traffic safety signs and markings. Without these visual cues, vehicles may become confused, hindering the flow of traffic. Additionally, if there are no effective control measures in place, vehicles may enter the intersection without yielding to others as required by safe driving laws. This can lead to traffic accidents, particularly when vehicles are traveling at higher speeds, exacerbating the risk of serious hazards ^[9].

5. Principles of road traffic safety facilities application

Road traffic safety facilities must be constructed according to reasonable principles to enhance their quality and effectiveness.

5.1. Guardrail installation

When installing guardrails, it is essential to consider the specific location requirements. For instance, roads with

high embankments exceeding 3 meters may require waveform beam guardrails, while those exceeding 8 meters should use reinforced versions ^[10]. Similarly, bridges should feature reinforced waveform guardrails with central dividers. At intersection crossings and bridge abutments, strengthened guardrails are necessary to prevent vehicle impacts. In areas with three-dimensional traffic, reinforced guardrails and continuous central dividers help prevent lane breaches and accidents.

5.2. Marking principles

Road markings must be set up to ensure standardization and conformity. Main lane edges should feature solid lines, 20 cm wide, while lane demarcations can utilize 15 cm wide dotted or solid lines. Additionally, road guide lines, including pedestrian crossings and arrows, should be placed at three-dimensional traffic entrances, exits, and toll island locations. Smooth transitions between lanes are essential to prevent sharp turns. Moreover, the placement of road studs must be scientifically determined; improperly positioned road studs can impede the movement of bicycles and other non-motorized vehicles. Adjusting the height of road studs and enhancing adhesion between them and the road surface can mitigate this issue.

5.3. Anti-glare facility installation

Anti-glare facilities are crucial for mitigating the effects of vehicle light glare. These facilities typically include anti-glare plates, sheds, and other devices. Although the green isolation zone in the middle of the road is not considered a professional anti-glare facility, it still helps reduce glare. Anti-glare plates can be strategically placed in the central isolation position, using materials like glass fiber-reinforced plastic or steel plates with spacing controlled between 50 to 100 cm. Connecting these plates to the guardrail through connectors improves drivers' visual experience and ensures consistency with the surrounding environment.

5.4. Setting up warning signs

Road traffic safety facilities, including traffic signs, play a crucial role in providing clear road information to drivers, guiding traffic flow, and promoting safe passage. Setting up road traffic signs should adhere to several principles. Firstly, signs must be highly visible, ensuring quick information capture by participants and enhancing their attention. Moreover, signs should be easy to read, employing clear content and a combination of text and symbols. Compliance with unified traffic sign standards is essential for simplicity and clarity. Secondly, sign placement should reflect the actual traffic situation, ensuring harmony with the traffic environment. Lastly, if signs contain remote characters, they should include pinyin to prevent ambiguity.

6. Suggestions for the installation of road traffic safety facilities

Constructing road traffic safety facilities is crucial for providing effective guidance and warnings to drivers and pedestrians, ensuring road safety and standardization. It involves strengthening control over the materials and locations of traffic safety facilities to ensure their effectiveness in reducing traffic accidents.

6.1. Ensuring the standardization of design

It is crucial to adhere to national and regional traffic safety standards when setting up road traffic safety facilities. Designing and constructing these facilities must strictly follow relevant guidelines to ensure they are effective. They should be optimized based on factors like road location, terrain, and grade to ensure safety. Traffic safety facilities should meet the needs of road users, providing clear guidance and warnings for drivers and pedestrians. All signage information should be simple, clear, and easy to understand. Establishing unified

standards in line with traffic safety management promotes consistency and facilitates future adjustments, enhancing overall traffic safety measures from a planning perspective.

6.2. Controlling material quality

It is essential to ensure the reliability of the materials used and enhance material control enhance the effect of material control when installing road traffic safety facilities. This involves strengthening the management of construction materials, selecting materials based on project characteristics, and focusing on quality supervision. Before procuring materials, it is essential to conduct thorough investigations into procurement, transportation, and construction aspects to ensure effective material control throughout the process.

6.3. Scientific setting of speed limit

Setting speed limits is crucial in the installation of road traffic safety facilities as most accidents are caused by speeding. Therefore, managing speed limits is essential in ensuring traffic safety. For provincial highways, the maximum speed should be capped at 90 km/h, while secondary roads should have a limit of 60 km/h. Highways with speeds exceeding 60 km/h can implement multi-lane speed limits based on their design. Special road sections should consider factors like the surrounding environment, the geometric characteristics, and the pavement conditions when determining speed limits.

6.4. Optimize the traffic junction isolation zone

In road traffic planning, it is essential to carefully consider the spacing and layout of intersections, taking into account road conditions and functional requirements such as the placement of isolation zones. Analysis of transportation patterns and accidents shows that intersections placed too closely together can lead to increased lateral interference and higher accident risks. Therefore, when positioning isolation zones at intersections, it is vital to minimize the distance to ensure smooth traffic flow and safety.

7. Conclusion

In conclusion, road traffic safety facilities play a crucial role in traffic safety management. It is essential to recognize their significance and address existing issues and deficiencies in their construction. By adhering to construction principles and developing a scientific optimization strategy, road safety facilities can effectively guide and warn drivers, contributing to overall traffic safety management efforts.

Disclosure statement

The author declares no conflict of interest.

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