Simulation and Analysis of Typical Winter Road Traffic Accidents in China

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***Abstract*—There are many winter road traffic accidents in China, and the Death Toll is on the top in the world for a long time, where, the traffic accidents under the condition of ice & snow road have some special characters. This article take the typical case about traffic accidents of ice & snow road as an example, make the reconstruction analysis for the accidents course applying the "Analysis System for Traffic Accidents V2.0" which is developed independently by the safety research laboratory of Jilin University, and analysis the accident causes from three aspects: people, vehicle, and road. Finally, the preliminary suggestion for countermeasures of the winter traffic safety is given out.**

Keywords-Ice & Snow Road; Traffic Accidents; Accident Reconstruction; Accident Simulation and Analysis

Ⅰ. INTRODUCTION

After the "Road Traffic Safety Law of the People's Republic of China" having been published and implemented in May 1st 2004, the road traffic safety condition in China had improved greatly. However, the whole road safety status is still severe, where, so many traffic accidents are caused by the natural disasters, for example: rain, snow, fog and so on. So, it is essential for us to pay much attention to the traffic accidents caused by above-mentioned, and study its causes and characteristics, and then, puts forward the security strategy and countermeasure.

Ⅱ. CURRENT STATUS OF ROAD TRAFFIC SAFETY IN CHINA

China's economic develops rapidly, especially in the aspect of auto industry and transportation industry since the reform and opening. Until the end of 2009, the private possession quantity of automobiles had extended to more than 76 millions, in which year, Domestic automobile production and sales were 13.79 million and 13.65 million for the first time become the world's automobile production and sales superpower. The same year, China's total length of highways reached to 3.86 million kilometers, of which the expressway reached to 65,000 km.

With the fast increase of the mileage of highway and the vehicle population, road accidents also increased rapidly. In 2009, there were 238,400 road traffic accidents in China, which causing 67,800 people dead, 275,100 people injured, the direct property loss is 910 million Yuan, where, the deadliest month this year is November.

Compared with developed countries, The level of road traffic safety in China is significantly lower. As the vast, there are snow, snow drift, and snow pack in winter in the northeast, northwest, southwest, and other vast areas, which directly cause the frequently traffic accidents, take Harbin as an example, which is the capital city of Heilongjiang province, and the number of accidents and mortality in table 1 and Figure 1.

TABLE 1 HARBIN VARIOUS RANKS HIGHWAY TRAFFIC ACCIDENT SEASON DISTRIBUTION LIST

Season	Freeway		Arterial road		Secondary road	
	number of accidents	percentage	number of accidents	percentage	number of accidents	percentage
Spring	12	10.3	157	24.5	134	27.3
Summer	45	38.8	166	25.9	142	28.9
Autumn	48	41.4	173	27.0	96	19.6
Winter	11	9.5	144	22.5	119	24.2

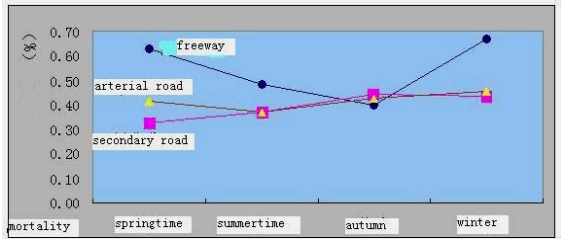

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Figure 1. Harbin various ranks highway traffic accident death rate

Seen from the table 1 and the figure 1 we can know that, the proportion of traffic accidents occurred in winter to which in the whole year is not very high, just 21.97%, but the mortality of traffic accidents is the highest, is 45.15%, which illuminate that the traffic safety situation in winter of cold regions in china is worse, and the proportion of heavy traffic accidents is relatively higher.

Ⅲ. INTRODUCTION OF TYPICAL ACCIDENT

At 13:00 on December 17th, 2003, a truck was moving along the national highway G102 DaDong Street from west to east. One car was moving along national highway G102 DaDong Street from east to west. When the two cars arriving at the G102 k645+600 m, they got an impact at frontal right corner, the head of the truck got a rollover, and stopped in the opposite lane, one occupant was injured; the car were washed down to the left side of the highway slope, three occupants were injured. The scene of the accident as shown in Figure 2 to figure 4(this paper had hide the detail information of the vehicle and the parties in accident for some season) :

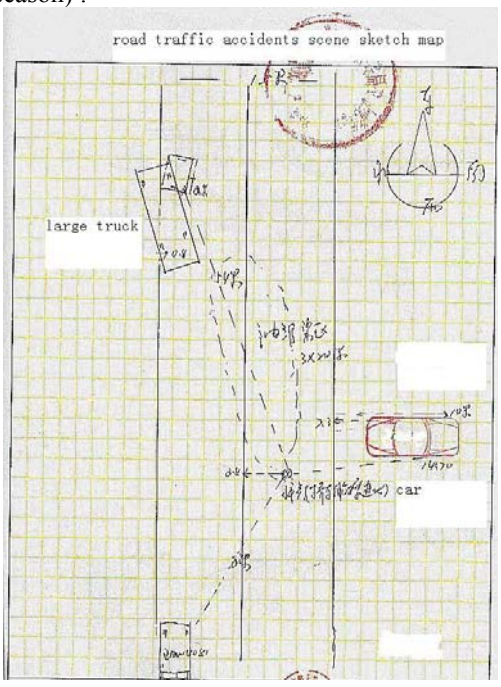

Figure 2. Road traffic accidents scene sketch map

Figure 3. The place of truck after collision

Figure 4. The place of car after collision

Ⅳ. RECONSTRUCTION OF TYPICAL ACCIDENT CASE

The road traffic accident reconstruction (shortened form: accident reconstruction) is one of the important contents in the field of traffic safety, also it is one of the main methods of accidental evaluation. A complete road traffic accident reconstruction contains two parts of accident scene reconstruction and accident course reconstruction. The accident scene reconstruction is based on many kinds of static data (for example: the trace, the damaged cars, the falling objects and so on) left in the accident field, recovering by using different scientific method and technology. The accident course reconstruction is based on the trace investigation, the statement of the parties of the correlative accidents , and make judgement of occurrence and development of the accident using the relative principle of mathematics and physics, whose purpose is to describe and identify the relationship between time and space of accidents, including a series of time and spacial analysis of the three stages of the collision process.

The article combined with the accident scene investigation data and the post survey data, and the accident reconstruction is carried out for the accident course using the “fast analysis system for traffic accidents V2.0” which is developed independently by the safety research laboratory of Jilin University, the main data of accident reconstruction is as shown in the table 2.

TABLE 2 THE DATA OF ACCIDENT RECONSTRUCTION

Item	Truck	Car
weight of vehicle (kilogram)	23200	1725
tread(millimeter)	2000	1532
wheelbase (millimeter)	10000	2502
x-axis of the point of collision (centimeter)	400	215
y-axis of the point of collision (centimeter)	-100	-76
Brake distance after collision(meter)	54	14
direction of slide (degree)	10	-75
direction of vehicle before collision (degree)	2	-170
direction of vehicle after collision (degree)	8	-90
turn velocity before collision (degree)	5	5
equivalent friction coefficient	0.12	0.5

The reconstruction result is that the truck speed is 45km/h to 50km/h, and the car speed is 85km/h to 90km/h.

Ⅴ. ANALYSIS OF TYPICAL ACCIDENT CASE

According the result of accident scene survey, post survey and accident course reconstruction, this paper got the following reasons for the accident.

A. Road Factors

December was snowy time in northern China during the winter, snow and ice in the road pavement can't be removed timely in many roads, the section which the accident occurred in national highway G102 DaDong Street had not been swept, snow pack in the road center had been moved to both sides of the road by the passing cars, the right tire pressured on snow when car passed by, and the left tire pressured in asphalt, so the car had a poor stability, this condition led to driver moved the car to the center of the road pavement (the car was running in the center of pavement in the accident). In addition, when an emergency occurs, the effect of braking or steering measures will be significantly restricted because of the impact of snow and ice in the pavement.

B. Human Factors

According to the relative law, the car speed can not exceed 80km/h in the second-class roads, and it still need deceleration for safe driving under the condition of the bad weather such as rain, snow, fog and so on. In this accident, the over-speeding car is the direct reason for the driver's untimely response, and aggravates the accidental severity.

The truck driver drive fatigued, add to the high speed, which cause the untimely prevention before the accident occurs, and the prevention is also carried out slowly.

C. Vehicle Factors

In this accident, overloading transportation of the truck without any skidproof measure directly causes the bad control.

Ⅵ. CONCLUSION

Most of catastrophic road traffic accidents in China were caused by overspeed, fatigue driving, bus overcrowding, truck overload and so on. Ice & snow road as a disadvantage aggravated the frequency and severity of accidents. From representative case above, we can see that we should improve the safety of ice & snow road traffic from aspects below:

(1) Maintain road and facility of traffic safety in time, clean the snow complying the requirement of safety driving.

(2) Check the vehicles annually, prevent vehicles that were scrapped driving on road, at the same time encourage or force vehicles take some anti-slide step.

(3) Reinforce the education of drivers, enhance the punishment of drunk driving, overspeed, fatigue driving, bus overcrowding, truck overload, especially hold some professional training for snow drive safety.

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