

## Application and Evaluation of Simple Road Safety Facilities on Rural Road

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**Abstract:** This study was concerning about the typical transportation safety issues of rural road at the present time in China. A demonstration project was implemented with a section of rural road in western area of Beijing, which introduced a series of new-type road safety facilities, which were deemed to be more suitable for local traffic conditions. Those facilities were suggested and conducted on the sample road, comparison and analysis of relevant indexes of pre-and-post demonstration project were adopted, conduction shown that the simple road safety facilities performed well in this project and achieved our expectation. Also, the local residents showed their satisfaction. In conclusions, these simple road safety facilities will improve the traffic safety situation of rural roads.

**Key words:** Demonstration project, evaluation, rural road, simple road safety facilities, traffic engineering

### INTRODUCTION

Rural road is a part of Chinese road network, which is the major channel of transportation in country side, an important infrastructure. China has paid a lot of attention on rural road development, the construction of rural roads has been considered as one of the major measures of “Material conditions of improving construction new socialist new countryside” (CPC Central Committee, 2005). In the context of such a big development, the national rural road have a rapid growth, with gradually rise of technical level, conditions of roads are continued to improve, and increased the depth of accessibility. The rural traffic became more connective to their daily life so that objectively lead to a higher social demand of traffic safety, but the fact shown that the current rural traffic safety is not optimistic (Li, 2008; Yu, 2006; Yang, 2005; Lin, 2006). To build safer rural roads became a big issue of improve the level of road traffic safety, reduce the number of road accidents and casualties in rural areas, protection for the road users and local residents along the rural road. Traffic safety researchers have done a lot of exploratory work intended to improve road traffic safety in rural areas (Ji, 2007; Zheng, 2005; Wu and Yong, 2007).

According to the limitation of money and natural conditions, rural roads in China were lack of safety facilities while construction that may directly or indirectly cause traffic accidents. This paper introduced a series of new-type road safety facilities which are implemented on a section of demonstration road, with a multiple perspective evaluation of the results.

### DEMONSTRATION PROJECT

**Demonstration road profiles:** The demonstration project was implemented with a section of rural road in western area in Beijing. The section road was a country level road with length 3.3 km, which connect with a local town and another country road, the only channel connecting to the outside world. The road level is 3, the roadbed width is 7.5m, road surface width is 6m, asphalt concrete pavement, with Least squares curve radius of 13, and maximum longitudinal slope is 10.47%, shown as Fig. 1.

Before the demonstration project implemented, there were no direction signs or warning signs established on the road section. Road safety facilities only applied as delimited indicating lines and stone masonry retaining walls applied on some turning sections.

As the demonstration road located at a village which next to an operating coal mine, the amount of traffic is larger than normal rural road, the major components of traffic are tracks, which take 80% of the whole.

**Safety issues:** It was a typical mountain road in rural area, which built between a mountain and a valley. At the point of view of road safety, the geographical conditions cause two kinds of potential troubles, bad length of sight by the mountain side and the deep valley on the road side, once vehicles rush out of the pavement that may causes very serious accident.

Most attention was paid on the safety issues of those coal trucks which operating on the dimensional road. Firstly, those coal tracks are mostly in bad conditions, even some of those do not have a license plate. Secondly,



(a)



(b)

Fig. 1: Views of demonstration road

the break failure while long time break. Furthermore, there were many bands on the road which cause bad sight, and coal trucks are relatively wide compare to the pavement, that may cause many virtually scratch accidents.

Furthermore, an activity center is located along the demonstration road side, where it is through the village. There were no warning sign or speed limit facilities implemented at this section, which will lead safety threat to local villagers.

**Simple road safety facilities:** Measures to Curve Sections: For the sharp bends road sections: warning signs were set on both sides; convex mirror and small stone markings were set in middle. In order to improve the road safety at night, protrusions with inverse reflection characteristics are embedded in the small stones vibration markings.

**Measures to danger sections on road-side:** Alert concrete piers are set on the outer side of the curve road, road side rocks and bar-shaped stones alert stakes are set on the straight sections.

**Measures to village roads:** After the reform, not only the warning signs are set at the head of village road, but also stone pavement is set.

**Change support method of signs:** In order to save the space of installation of traffic sign columns and reduce cost, almost half of the traffic signs on the demonstration road have set on the road side cliff.

**Using warning signs:** According to the characteristic of the demonstration road, traffic signs on the road were designed for coal tracks.

## RESULTS

**Subjective evaluation-by local villagers:** After the demonstration project construction, a survey is conducted among the local villagers. The sample of this survey was focused on thirty to forty year old male drivers, which are more experienced drivers, and generally have at least secondary education, also are very familiar with the demonstration road. The survey contains kinds of vehicle models such as: coal trucks, vans, cars, agricultural vehicles and motor bikes.

The result shown that most of drivers felt the road is safer after the demonstration project constructed. Almost all drivers understand those simple graphical signs, but only 17% of the samples felt they could understand those more complex graphical signs. Therefore, simple graphical signs are more understandable and suitable for the country side traffic; also, text can be added on those complex signs which could make more understandable. Results also shown that 92% of the samples could see those signs installed on cliff; 88% of the samples did avoid the small stones centric vibration marking while driving in curve road sections; all the drivers could see those protruding signs on vibration marking, and recommended the convex mirrors could help drivers see the truck that came towards opposite direction; 92% of the samples felt the road side rocks and bar-shaped stone alert stakes did enhance safety; all the drivers did slowdown when driving through the stone road entering village.

**Subjective evaluation-by traffic safety experts:** The survey has completed 142 questionnaires which were sent to road safety experts in China.

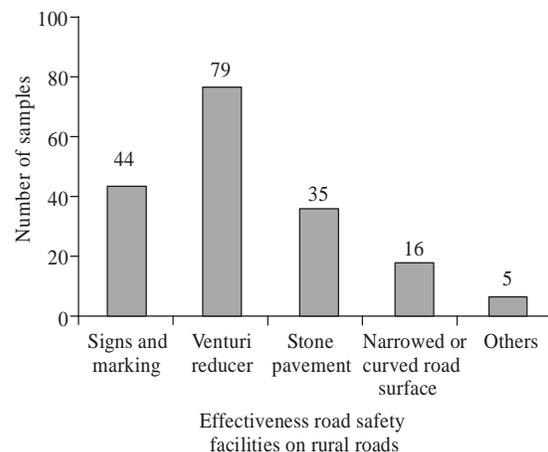


Fig. 2: Experts' survey on speed limit

89% of the experts believe those simple safety facilities for rural road are feasible, that are suitable for local conditions, using local material, easy for construction, and meets economic and practical issues. The dissenting experts felt the simple facilities are not meeting the standard specifications.

For the question of which safety facility is better for speed limit, results shown as Fig. 2. Other facilities including deceleration zone, lights, high limit doors or width piers, etc.

Also, problems were indicated by the experts. Firstly, the simple road safety facilities that used on the demonstration road are compromise choice that restricted to the lower levels of economic and social local conditions, but demands in improvements of traffic safety level. Hence, as long as condition allows, rural roads should use standard and mature traffic safety facilities. Secondly, the major concept of designing and setting a simple road safety facility is “fit local conditions”, but while designing it should not be copy straightly or using same function at all the place, that will increases cost instead and counterproductive. Thirdly, for the rural area that relatively lack of economic and social development, simple traffic safety facilities could be use for a period of time. But it is necessary to do research works in depth on this issue, in order to improve the standardizations extent and such facilities can actually improves in tips, warning and protection functions.



(a)



(b)

Fig. 3: Curve road section before and after demonstration project



(a)



(b)

Fig. 4: Village road section before and after demonstration project

#### Evaluation of small stones centric vibration marking:

Investigations are implemented on the demonstration road after the project construction, researchers observed the situation of vehicles occupation on the inverse lane. Figure 3 shows the road conditions before and after the project construction.

Observational data indicate that, the small stones centric vibration markings were little impact for speed where the curve road with mountain inside, but effectively improved the problem of vehicles drive on the opposite line on the road. On the demonstration road section, the small stones markings also help to reduce speed, those medium vehicles have reduced 6% and cars have reduced 3% before project construction.

#### Evaluation of rock pavement:

For evaluate the result of how the rock pavement help to reduce the vehicle speed, researchers observed the road at the village section. Figure 4 shows the road conditions before and after the project construction.

It was visibly help to reduce the driving speed on towards direction to rock pavement, compare to that before the demonstration project construction, but limited impact with the direction on left the rock pavement.

Hence the stone pavement are setting in the middle and rear of those vehicle speed controlled zones, which the vehicles are driving on the leaving direction of the controlled zones, that could meet the purpose of reduce vehicle speed.

### **CONCLUSION**

The rural road demonstration project was taking place in western area in Beijing, China. The project design and implemented road safety reform measures that target on typical safety problems on selected road sections, with principle of safety and economy. Through the subjective evaluation of local residents and traffic safety specialists, comparison of objective observation that before and after the demonstration project carried out, results shown the project gives a satisfaction consequent, which meets our expectations, also proves that the simple safety facilities are practicable as transition measures on rural road in China.

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