GRSP/MOT Speed Management Pilot Project in China

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Abstract:
Speeding and inappropriate speed are recognized as major contributory factors in both the number and severity of traffic crashes in most of the countries in the world including China. Working together with the Research Institute of Highway (RIOH) of the Ministry of Transport (MOT), Global Road Safety Partnership (GRSP) carried out a 4- year speed management project in China during 2008-2011.

The project was divided into 2 phases: phase I – speed management situational survey at 6 different road segments in Beijing and Guangxi Province; phase II – implementation and evaluation of speed management Intervention countermeasures at G103 highway in Beijing.

The objectives of the project are: a) to better understand the speed related problems on the selected road sections; b) to implement the international good practice on speed management based on the local needs; c) to use low engineering cost countermeasure to reduce speeding rate and improve the safety on the selected road section.

The before-after comparison shows that low cost engineering countermeasures make spot speed reduce by 5 km/h for mean speed and 7km/h for V85 (85 percentile speed) approximately on general road section; for pedestrian crossings, the corresponding figure is about 7 km/h and 12km/h.

Keywords: highway, traffic safety, speed management, speed limit, evaluation

Background

Speeding (drive exceed the posted speed limit) and inappropriate speed (even if drive within posted speed limit, the speed may be inappropriate for the prevailing traffic, road or weather conditions) are universally recognized as major contributory factors in both the number and severity of traffic crashes. Speed management is considered as a very important measure to improve road safety. However, increasing the law compliance rate and reducing the unsafe speed on the road are not easy; it is still one of the largest challenges to the road safety professionals worldwide. Developed countries have built up many good practices, experience in road safety and speed management, which can be used in other countries. An example of this is the *Safe-System Approach* in Australia. [1]

Along with rapid motorization in China, speeding and inappropriate speed is one of the primary contributors of road traffic crashes. According to the official data released by the Ministry of Security (MPS), approximately 10,000 people killed in road crashes related to speeding per year. When the number of road crashes reached a peak in 2004, speed related fatalities were up to 18,000 during the year. By reviewing the crash data of the last 5 years, it was found out that speeding-related crashes and injuries account for 10% in total number of road crashes and related injuries; while for fatal crashes it is around 14%. Speeding-related crashes are more serious in terms of fatality per crash as opposed to other types of crashes - it accounts for about 14% of the total road fatality in 2010, which was the higher than other types of crash [2]. The charts 1 and 2 below show the number and percentage of the speeding related road crashes, fatalities and injuries during 2001-2010 in China. (Data source: annual report for road traffic crashes issued by ministry of public security, China)

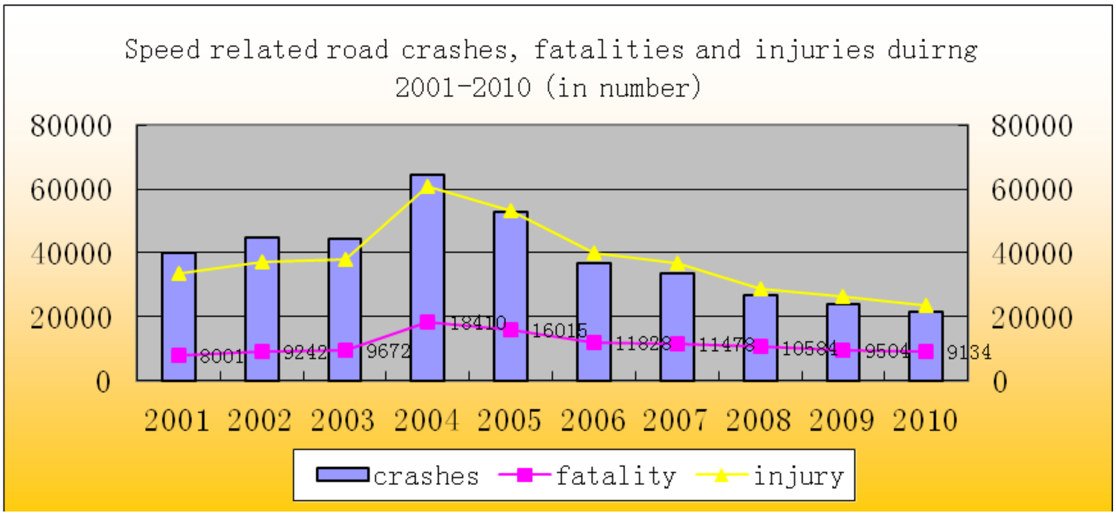

Chart 1 Speed related road crashes, fatalities and injuries during 2001-2010 (in number)

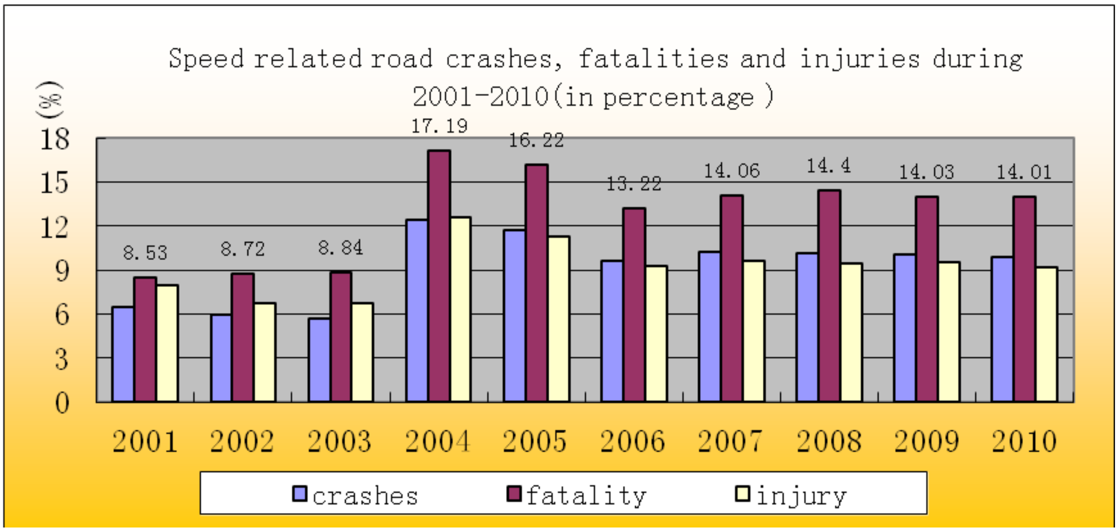

Chart 2 Speed related road crashes, fatalities and injuries during 2001-2010 (in percentage)

In China, due to lack of technical standard and operational guidelines, many speed related issues exist. For example, inappropriate speed limits were set up on the roads (either too high or too low). The Figure 1 below shows the posted speed limit on an express highway, which for passenger cars is 30km/h and for other vehicles is 20km/h; while the Figure 2 shows the two different speed limit signs posted at the same road section without any explanation, it is hard to understand if they are setting up for different lane or different type of vehicle.

Figure 1 Too low speed limit on expressway

Figure 2 Ambiguous speed limit signs

Other speed management issues include but are not limited to: 1) the speed limit signage is not visible and/or informative enough; 2) speed enforcement is not strong and effective; it is not combined with the engineering countermeasures and public education campaign; 3) very little evaluation of the effectiveness has been done on the engineering countermeasures taken on the road.

The Research Institute of Highways (RIOH) of the Ministry of Transport (MOT) and the Global Road Safety Partnership (GRSP) carried out a 4- year speed management in China during 2008-2011. The project partners include the Road Safety Research Center (RSRC) under the Institute of Highway (RIOH) of the Ministry of Transport (MOT), the local road administration agencies and local traffic polices in Beijing and Guangxi province.

Main Activities

The project was divided into 2 phases: phase I – speed management situational survey at 6 different road segments in Beijing and Guangxi Province; phase II – implementation and evaluation of speed management Intervention countermeasures at G103 highway in Beijing.

The project aims to understand the problems related to speed on different roads; design and implement the targeted solutions; adapt the international good practice on speed management and use low cost engineering countermeasures to address local problems; conduct the outcome evaluation after the construction to understand the effectiveness of the countermeasures; and change the behaviors of the road users and reduce speed related fatalities and injuries on the pilot road.

Situational Survey

Six road sections with different technical classifications and functions were selected for situational survey. The total mileage is more than 400 kilometers. The table 1 blow lists the survey roads. Spot speed data were collected at more than 100 survey sites by using Pneumatic tubes. More than 500 questionnaire interviews were conducted at roadsides, toll gates, or service areas to understand road user viewpoints and attitudes on speed management related issues. Road crash data and road design materials were also acquired and compiled. Comprehensive analysis was conducted from aspects of speed distribution, speed limit and speeding, speed and safety and road users' attitudes toward speed management.

Table 1 Situational Survey Road Sections

Province	Route	Station	Length	Technical Class	Function
Beijing	G109	K51-59	8km	Class II	Rural collector and distributor

Beijing	G109	K75-84	9km	Class II	Rural collector and distributor
Beijing	Shuidan	Whole route	10km	Class II	Suburban collector and distributor
Beijing	G103	K26-50	24km	Class I	Suburban arterial
Guangxi	Nanyou	Whole route	180km	Expressway	Rural expressway
Guangxi	G323	Luzhai-Pingle	170km	Class II/III	Rural collector and distributor

Main Findings of the Situational Survey

The following general information was found from the situational survey:

- ✓ Speed Limits were set up inappropriately on some of the road segments (either too low or too high);
- ✓ Speeding seemed notable especially on the roads with good geometric alignment; highest crash numbers related to speed was on the section with best geometric alignment;
- ✓ Up to 77 percent of the vulnerable road users (VRUs) interviewed in Beijing felt the speed through villages were too fast; 90 percent of pedestrians and bicyclists (both at Guangxi and Beijing) felt necessary to control speed though towns/villages;
- ✓ On one of the chosen roads in Beijing, about 70 percent of the crashes occurred at intersections mainly due to high speeds and drivers driving too close each other or not yielding appropriately;
- ✓ Through towns, most crashes involve pedestrians and cyclists;
- ✓ On the Nanyou expressway in Guangxi Province, it was also found that if the posted speed limit is 80km/h, almost all V85 speed at the surveyed spot are higher than the posted speed limit. On the Luzhai-Pingle two-way two-lane rural road in Guangxi, if the posted speed limit is 60km/h with fine road geometry and good road condition, the V85 speed of the drivers would reach to 80km/h at the most survey spots. Since in most cases the speed limits are set based on the road design speed in China, we think it would be necessary to have a national speed limit review to ensure they are set rationally for the different road functions and conditions.

Pilot Program at G103 in Beijing (Class I Highway)

Based on the findings of the situational survey (phase I), a 25km long road segment of G103 (Section K26-50, Class I highway) in Beijing was selected for improvement.

This road section is located in flat area; the general geometric alignments are preferably good without noticeable sharp curves, steep grades and constricted sight distance. It is a two-way four lanes (part of stretch has six lanes) road; the traffic at opposite direction are physically divided by iron fence, median with vegetation or concrete barriers. The figure 3, 4, 5 and 6 blow show the typical road condition of at different sections of the between K26-50 of the G103 Class I highway. Area along the road has dense populations with many towns or villages. High density of accesses or intersections is a notable characteristic. Main intersections are controlled by signals while small intersection and accesses are controlled by stop/yield signs.


Figure 3 Typical cross-section for K26-30 Figure 4 Typical cross-section for K30-39


Figure 5 Typical cross-section for K39-41 Figure 6 Typical cross-section for K41-50

The default speed limit (no speed limit sign posted along the road) for the G103 highway is 80km/h except at the speed zones. Six speed zones were set along the 25km road section with the posted speed limit of 60km/h. During the situational survey, the traffic and speed data were collected at four cross sections: 3 at the 80km/h road sections and 1 at the 60km/h speed zone. Pneumatic tubes were used to collect data on spot. The survey data shows that the average mean speed for the three 80km/h cross sections was 66km/h and the average V85 speed (85 percentile) was 80km/h; while the mean speed and V85 speed at the in 60km/h speed zone were 71km/h and 87km/h respectively. 76% vehicles drove over speed at the speed zone, which means that speed zone did not significant effect on speed control compared with other sections

There were 190 crashes occurred in the road section from Jan. 2006 to April 2010, causing 42 persons killed and 213 injured. The average casualty rate per year kilometers is 2.37 persons/year kilometer, which much higher than other similar roads.

During the pilot program, pre & post intervention surveys were conducted for the purpose of evaluation. Pre-intervention survey was conducted in October 2010 to identify the specific spots for improvement and to set up the baseline for the outcome evaluation; post-intervention survey was conducted in November 2011 - one month after engineering countermeasures were implemented. Pneumatic tubes were used to collect traffic and speed data at multiple cross sections.

Based on the findings of the pre-intervention survey, The low cost engineering countermeasures were implemented by the project at the several specific road sections, one roundabout junction (K28.1) and two unsignalized pedestrian crossings (Yulinzhuang - K38.5 and Matou - K43). Different engineering countermeasures were implemented to address the specific problems at spot.

The problem found at the road sections and speed zones include speeding rate was high; some of the speed limit signs at the speed zone had either poor visibility (obscured by trees or other objects) or not informative enough. The countermeasures taken at the road sections include adjustments of speed limit signs, horizontal speed pavement markings, transverse speed pavement markings, peripheral speed pavement markings were implemented (as shown of figure 7, 8, 9, 10, 11 below) in order to reduce the travel speed of the drivers.

Figure 7 Extension of speed limit sign posts   Figure 8 Horizontal Pavement Marking

Figure 9 Peripheral Pavement Marking

Figure 10 Transverse Pavement Marking

A colorful skid resistance pavement was put at one of the speed limit zones as the "gate" with the speed limit (60km/hour) posted on the ground in order to make the speed zones more visible and informative as shown of the figures 11 and 12 below:

Figure 11 "Gate" at the beginning of the speed zone   Figure 12 Speed limit sign on the ground

The main problems found at the roundabout junction (K28.1) were the motor vehicles and non-motor vehicles were not effectively separated, and some of the motor vehicles drove in opposite direction when bypass the junction.

The countermeasures taken at the roundabout include poles installed to separate non-motor vehicles from motor vehicles; "YIELD" and "STOP" signs and markings are installed; channelization on pavement are modified with the installation of poles as shown of figure 13,14 and 15 below:


Figure 13 channelization on pavement modified with poles
Figure 14 poles to separate non-motor vehicles from motor vehicles

Figure 15"YIELD" and "STOP" signs and markings installed

Since villages nearby, the main problem found at the non-signal controlled pedestrian crossings (Yulinzhuang - K38.5 and Matou - K43) were a) there were many pedestrians crossing the road. Since the junction was non-signal controlled, the high vehicle speed put the pedestrians at risk; b) the lines at pedestrian crossing were poorly maintained – hard to see especially at night.

The countermeasures taken at the two pedestrian crossings include speed reduction markings, colored pavement, graphic signs of pedestrian crossing, color-painting for pedestrian crossing, reflective road studs were used (as shown of figure of 16,17, 18 and 19 below) to make drivers aware of different road environment ahead and to slow down the speed.


Figure 16 pedestrian crossings with colored anti-skid pavement
Figure 17 pavement figure markings and horizontal speed pavement markings
Figure 18 retro reflective road studs
Figure 19 pavement character markings and horizontal speed pavement markings

Results:

The post-intervention survey was taken during November 2011 which was one month after the construction to make the before and after data comparison for evaluation. The survey time and locations are basically matched with the time and locations in the pre-intervention survey. However, there was no control group selected for evaluation due to the time and budget restraints of the project. The following are the main outcome of evaluation:

At Road Sections and speed zones

Table 2 below shows the vehicle speed at before and after different types of speed reduction pavement markings implemented. It shows the transverse pavement marking is most effective and followed by the peripheral pavement marking.

Table 2. Vehicle speed before and after various speed reduction pavement markings implemented

	Before		After		change			
	Mean Speed	V85 Speed	Mean Speed	V85 Speed	Mean Speed		V85 Speed	
horizontal (four sites)	60.7	77.6	58.4	72.6	-2.3	-3.8%	-5.0	-6.5%
transverse (one site)	72.5	86.9	65.7	79.5	-6.8	-9.4%	-7.4	-8.5%
peripheral (two sites)	64.5	78.2	60.5	71.0	-4.0	-6.1%	-7.3	-9.3%
average	65.9	80.9	61.5	74.3	-4.3	-6.4%	-6.6	-8.1%

In general the outcome of the countermeasures is positive. Based on the before and after data comparison, it is found out that the mean speed on the pilot road was reduced around 4.3km/h (6.4%); while the V85 speed was reduced around 6.6km/h (8.1%).

At the Roundabout

The table 3 shows the changes at the roundabout after the countermeasures implemented:

Table 3. Changes at the roundabout after the countermeasures implemented

	Before	**after**	**Change (%)**
percentage of non-motorized vehicles not	**90%**	**55%**	**-38.9%**

using its path			
percentage of motorized vehicles not using its path	**42.86%**	**10%**	**-76.7%**
Mean speed of the turning vehicles (km/h)	**38**	**27.6**	**-27.4%**
V85 speed of the turning vehicles (km/h)	**51**	**35.4**	**-30.6%**

Vehicle speeds of passing through the road section and the pedestrian crossing

The vehicle speed was measured at both 150 meters upstream of the pedestrian crossings and at spot of pedestrian crossings. The table 4 blow shows the average spot speed statistics of before and after implementation for Yulinzhuang and Matou pedestrian crossings.

Table 4 spot speed statistics of before and after implementation at the pedestrian crossings

position	before		after		change			
	Mean speed (km/h)	V85 (km/h)	Mean speed (km/h)	V85 (km/h)	Mean speed (km/h)		V85 (km/h)	
150 meters upstream of pedestrian crossings	60.2	75.2	56.1	68.3	-4.1	-6.8%	-6.9	-9.1%
pedestrian crossings	60.9	77.2	54.1	65.1	-6.8	-11.1%	-12.1	-15.7%

The outcome shows that at 150 meters upstream of the pedestrian crossings, the mean speed was reduced by 4.1km/h (6.8%); while the V85 speed was reduced by 6.9km/h (9.1%). The result is even better at the spot of pedestrian crossings, the mean speed was reduced by 6.8km/h (11.1%); while the V85 speed was reduced by 12.1km/h (15.7%). This may be attributed to the comprehensive countermeasures conducted by the project at the upstream of the pedestrian crossing including the warning signs and various speed reduction pavement markings.

Conclusion

The project is one of few projects in China which adapted international good practices on speed management. The principles of “multi-sector involvement” and “evidence based decision making” were used when carried out the project.

The low engineering countermeasures (such as channelization, speed reduction pavement markings, barriers) were used to reduce the travel speed of vehicles and to improve safety on the pilot highway in Beijing. Before-after data comparison shows that the countermeasures make spot speed reduce by 4.3 km/h for mean speed and 6.6km/h for V85 (85 percentile speed) on the general road section; for pedestrian crossing, the corresponding figure is about 6.8 km/h and 12.1km/h. Although it is hard to give 100% credit to this project for the change made as there is no control group data collected, they are most likely the contributors for the change as no other interventions taken on the targeted spots at the same period of time.

However, speed management cannot only rely on the engineering countermeasures, other activities such as enhanced speed enforcement together with public education campaign are very much necessary.

Due to limited surveyed sites and lack of new crash data (time was too short for us to collect the new crash data when the survey was conducted), the evaluation outcome is subject to uncertainty. Though we need more data and time to evaluate the program, the pilot is successful with no new crash fatality since the implementation.

Acknowledgement

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