Study on the Function and Applicability of Traffic Calming Measures in Urban Residential Areas

Yuan CHEN
College of Traffic & Transportation, Chongqing Jiaotong University, Chongqing, 400047, CHINA

Abstract: From the speed hump, raise pavement, wave road and the three different types of traffic calming measures, this paper chooses a residential area measured in the field, using the cameras and radar speed gun test cell through various measures of speed changes of the vehicles, in order to measure the deceleration and the pros and cons of noise pollution based on the comparison, and the applicability of various measures to launch the research. The results show that the shape of the road surface is suitable for the large residential area, the deceleration zone is suitable for the import and export of the residential area, and the elevation of the road surface is suitable for connecting the road intersection with the residential area.

Keywords: Traffic quiet; Measures features; Adaptability

1. Introduction

Traffic calming was born in the 1820s in Germany [1], has now become an important part of the overall transport strategy in many European countries [2]. Traffic quiet refers to through a series of hardware facilities (such as physical measures, etc.) and soft infrastructure (such as policies, legislation, technical standards, etc.), to reduce the negative effects on the living environment of a motor vehicle, change the reckless driving to human driving behavior, improve the pedestrian environment and non-motor vehicles, so that the road be coordinated development of various functions in order to achieve traffic safety, livable [3]. Traffic calming domestic and foreign scholars have carried out a lot of research, but does not have a system for the comparison of the specific features of its various measures, how to set up the most effective measures where they are most needed, it will becalming a new directionof the development of traffic.

Residents as the people living area, the road linking the bottleneck sections of [4], vehicles and pedestrians, vehicles and vehicles, non- motor vehicles and motor vehicles are at the same time and space. This paper analysis of the measures in reducing driving speed, increased noise pollution and emissions performance situation, set for the residential area traffic calming facilities use recommendations, to enhance the quality of living, to create and landscape, the humanities, the harmonious traffic modernization of harmony in the city, which has a good meaning.

2. Measures Selection and Technical Route

Traffic calming measures reduce the driving speed, on the one hand through the visual illusion phenomenon to the driver caused by psychological pressure, and causes the subjective reduce of driving speed, on the other hand is the common physical measures, mandatory forced drivers to slow. Considering the visual illusion phenomenon of measures to achieve its function by driver's subjective influence more, difficult to quantitative evaluation of various measures of function, so the choice of common physical speed limit measures were: measure 1 speed hump, measures 2 raise pavement and measures 3 wave road. Three calming measures are mandatory forced drivers to slow down traffic and produce different degrees of reduced traffic quickly and increases noise pollution and emissions, three measures vary in width and height, but also belong to vertical type reduction measures, therefore the comparison, analysis and the advantages and disadvantages of the three measures, for new roads and areas of traffic calming measures has certain reference significance.

In order to reduce traffic speed and noise pollution, the model is used to calculate the advantages and disadvantages of each measure, and to determine the applicability of the model. The technical route is shown in Figure 1.

3. Research on the Function of the Quiet Measure

3.1. Quiet measures of spacing

Considering the two traffic peaceful measures distance is too close, its function will influence each other, when car entered the first slow down measures driving speed drops, because too close to the second slow down measures, the

vehicle has not yet returned to normal speed needs to slow down again, this case is difficult to separate the test the various functions of different types of measures. In order to ensure the mutual influence between the elimination measures, now the formula is as follows:

$$\frac{V_t - V_0}{2a} = S \tag{1}$$

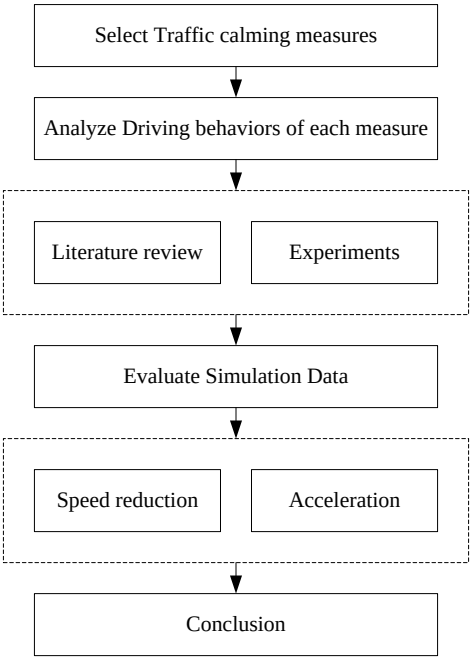
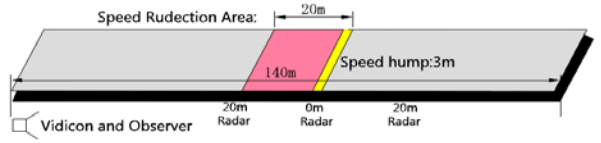


Figure 1. Technical route

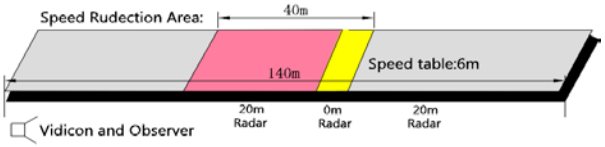
Type: V_t sections to limit driving speed, the average vehicle speed, take 50 km/h. As the minimum speed, namely vehicles meet with slow down measures speed, to get 30 km/h; Average acceleration for the car, and take the 2.286 m/s2. S is the minimum interval distance between the measures, the minimum is 27m.

3.2. Speed limit function research

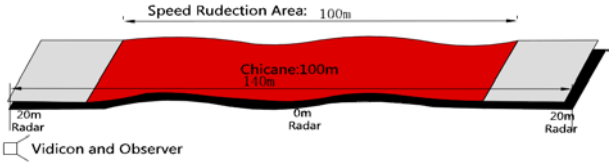
Choose a residential area for experiments, and before calming measures placed the camera records the vehicle acceleration and deceleration process, before measures 20m, 0m after 20m with speed measuring radar speed gun, Settings as shown in Figure 2:



(a) Speed hump



(b) Speed table



(c) Chicane

Figure 2. Data acquisition equipment installation diagram

According to the above equipment installation method, velocity observation of passing vehicles during flat peak period of time. Each peaceful measures after observing multiple sets of data processing, eliminating unreliable data. Video observation found in the vehicle close to the peaceful measures of the impact zone have significant deceleration phenomenon, through measures at the lowest speed, then began to accelerate, the process experimental results with the radar speed gun matches. After multiple sets of observation data collation, vehicles running through the road of peaceful measures when conditions are shown in Table 1:

Table 1. Speed limit of all kinds of measures

Speed	Speed hump	Speed table	Chicane
Average	32.14	33.15	33.29
Standard Deviation	4.203	4.214	4.156
Range	27.9-36.3	28.9-37.4	29.1-37.4

3.3. Noise pollution research

Road traffic noise is mainly produced in the running process of the vehicle, the impact of a wide range, lasted for a long time, associated with the road longitudinal slope, pavement materials, surface rough degree, vehicle type, driver's driving behavior and other factors. Analysis of different types of quiet measures, noise pollution level is due to the formation of interaction between vehicle and road. According to the "Sound Environmental Quality Standard (GB3096-2008)", determining the traffic calming facilities applicable to various types of areas, noise emission formula as follows:

$$\begin{aligned}\sigma &= \left\{\frac{1}{T}\int_0^T \left[a(t) - a_{av}\right]^2 dt\right\}^{\frac{1}{2}} \\ &= \left\{\frac{1}{T}\int_0^T a(t)^2 dt - (a_{av})^2 dt\right\}^{\frac{1}{2}}\end{aligned} \tag{2}$$

Type: $a(t)$ Is the acceleration in the t time; a_{av} for the average acceleration; T for the vehicle travel time;
Analysis of the three kinds of quiet measures and according to its function to sort .1 indicates the speed limit function is best, minimum noise pollution, and so on. Three kind of measures function sort situation is as shown in Table 2:

Table 2. Threekind of measures function Sort situation

	Speed hump	Speed table	Chicane
Speed	3	2	1
Acceleration noise	3	2	1

4. The Applicability of the Measures of Tranquility

From the speed limit, noise pollution of speed hump, raise pavement and pavement waveform three calming measures of comparative analysis, found in the speed limit function, under the same road environment and vehicle speed, the effect of the waveform road is the best, and the effect of speed hump is the worst. When the vehicle through measures to slow down, the waveform road noise pollution minimum noise, when speed hump produced largest, and with rate limiting's function phase match, indicating that the vehicle is running at low speed, which is able to produce less noise.

The density of population of the urban residential area is big, pedestrians crossing the road at a high frequency and probability of road vehicle conflict, in residential choice appropriate traffic calming measures, reducing vehicle speed, to improve the safety of pedestrians, can reach the pedestrian environment, traffic calming ultimate goal of "people-oriented". This paper from speed hump, raising the pavement and pavement waveform three measures rate limiting function and noise pollution research, found that when the rate of decline, the noise of the motor vehicle also decreased, so in the urban residential areas should be considering speed, noise restrictions, cost and other variety of factors, choose the most suitable calming measures, this paper puts forward the following several suggestions:

(1) In the surrounding residential areas connected intersection select measures to raise the road surface, the intersection of the interior surface elevation, and the use of colored pavement, to remind the driver passing through intersections subjectively more attention to the surrounding situation and slow down;

(2) In the residential area of import and export, using low cost and deceleration zone, continuous multi-group settings to reduce vehicle speed;

(3) For large area of internal roads, speed limit signs in conjunction with waveform pavement, pavement using colored surface, can make motor vehicle speed falls below the speed limit.

5. Conclusions

City motor vehicle ownership continues to rise, bringing more traffic accidents. Large living area inside or connected to the residential area of the external roads converging gradually becomes road traffic accident prone locations. Led by "people-oriented" traffic development strategy, traffic calming measures need to be more efficient use to play a role of reducing the speed, limit traffic flow, and so on. This paper through studying the function and its adaptability of domestic three kind of the most common traffic calming measures, combined with the characteristics of urban residential areas, put forward the proposal to be suitable for the residential different location of measures to set up the view of improving living area's traffic safety level. Further promoting traffic calming

References

[1] Sebesta S., "Continued Evaluation of Microcracking in Texas," Report to FHWA/TX-06/0-4502-2, Texas Department of Transportation, November 2005.

[2] Carmen Hass-Klauetal.Civilized Streets a guide to traffic calming[M].Brighton:Environmental & Transport Planning 10 Clermont Terrace,2002.

[3] Theyse H.L., De Beer M., and Rust F.C., "Overview of South African Mechanistic Pavement Design Method," No. 1539, Transportation Research Record, 1996, pp. 6-17.

[4] Shen Junjiang, He Baohong. Small and medium-sized city residents travel characteristics analysis and traffic development countermeasures study [J]. Highway engineering, 2011, 4 (1) : 123-126.