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## Traffic safety analysis of intersections between the residential entrance and urban road

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### Abstract

With the rapid expansion of urban space, the urban traffic has become increasingly complex. Difficulty in driving and parking has accordingly become a big trouble for people's daily life. One of the main reasons that cause difficult driving is traffic accident. This paper focuses on intersections between the residential area entrance and urban road which are the specific traffic accident-prone area. After analyzing the different types of intersections between the residential area entrance and urban road, the authors discuss the reasons that cause potential traffic safety hazard in this area and propose preventive measures from the following aspects: the entrance design, the driving management, the parking management, the design of traffic signs, and the consummation of the laws and regulations.

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### 1. Introduction

With private cars quickly entering family, the contradiction of space between car and car, as well as people is constantly aggravated in the residential area. And specially, the safety problems generated at the residential area entrances that are considered as the join point of residential areas and urban roads cannot be ignored. According to statistics (Michael et al., 2000; Pan et al., 2008; Zhao et al., 2012), traffic accidents happened at the intersections and the nearby area account for 40.1% of all the traffic accidents in the USA; the data in Japan, UK, France and China is 33.3%, 33%, 24% and 30%, respectively. These data indicate that the urban road intersections are traffic accident-prone areas. Although there is no detailed statistics about accidents happened at intersections between the residential area entrance and urban road, with the rapid expansion of urban cubical

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space and the increasing complication of traffic environment of residential area entrances, there is increasing trend of traffic accidents in urban road intersections that adjacent to the residential gateway. Therefore, the traffic safety problems at this kind of intersections are worthy of much attention.

## **2. The Type of Residential Area Entrance Adjacent to The Urban Road and the Characteristics of Intersection Accident**

There are two main types of residential area entrance adjacent to urban road (Chen & Zhou, 2007): one is in the city center area or the old urban district. City roads which connect this kind of residential district are relatively narrow and near entrance because of the road expansion or earlier built. Since the traffic volume is larger and the vehicle density is higher in the city center, the traffic environment of the residential area entrance that specially closes to the business district is more complex. Accidents in these areas often have important relationship with short sight and complex traffic flow. The other one is at the entrance of newly-built residential area in the peri-urban areas in recent years. These kind of area always has the following characteristics: these residential areas are mostly designed according to separation of pedestrian and vehicles; the roads inside or outside the district are relatively wide; the view at the connecting area of the entrance and road are relatively open; The density of traffic and people flow on city road is relatively low. Therefore, the speed of the vehicles running on these roads is often higher, which leads to more serious consequence once accidents happen. Inside new district or near the entrance of the new district, the vicious traffic accidents caused by vehicle speeding often occur.

The reason why intersections between residential area entrances and urban road are worthy of deeply research is the high traffic accident rate and the particularity of cause of the accident. From the perspective of traffic safety management, this kind of intersection is different from the common one of urban road. The common traffic intersections must be at least divided into motor vehicle lanes and non-motorized vehicles, no matter whether the intersection has the signal control or not and how the level of the intersecting roads is. Besides, the vehicles in the common intersections have stronger consciousness of traffic safety and can drive carefully. However, intersections between residential area entrances and urban road are coexistence of people and vehicles. In addition, by the influence of the shops and green belt located on both sides of the urban road as well as the randomly walking pedestrians, drivers traveling on the urban road are easy to ignore the pedestrians and vehicles out from the residential quarter, which will easily lead to accidents if the sign at the entrance is not marked.

Although there is no detailed statistics about accidents happened at intersections between the residential area entrance and urban road, this kind of intersection, beyond all doubts, has become an important node of impacting urban traffic. Therefore, an in-depth study must be conducted on this particular intersection in order to improve the safety management level of urban traffic.

## **3. Cause Analysis of Accidents Happened at Intersections Between the Residential Area Entrance and Urban Road**

There are two main reasons of making intersections between the residential area entrance and urban road become the traffic accident-prone area: one is that original planning design is not comprehensive, the other is that management of later stage is not in place.

### *3.1 Design defects of the residential area entrance and nearby roads*

Along with the increase of traffic volume, while expanding transformation of the roads either in central urban area or old peripheral urban area, planning department, in order to make the most of land, make the boundary lines of road much close to residential area entrance, which has caused that the buildings in the residential area

are adjacent to roads and both sides of roads seldom have space for pedestrian crossing. This kind of design typically has serious potential safety hazard: one is that it easily form blind point which is difficult to observe road conditions for the drivers; second it affects the vehicles coming out from community to smoothly blend with the traffic, which will lead traffic congestion to the roads in front of residential area entrance by either turning left or right. In the last few years, to gain the most profits, the developers of residential communities surrounding the urban area have the buildings constructed very near the road, so similar problems cannot be avoided.

According to *General rule of design of civil buildings GB 50352-2005* Article 4.1.5, access point location of vehicle base should conform to the following regulations: in large and medium-sized city, the distance between intersection of the road boundary lines and the intersection of main road should not be less than 70m. However, the general rule does not refer to the intersection of not-main road, which reflect imperfectness in our design specifications. Judging from the development situation of urban transportation, it is a significant pathway to solve the urban mass transit problems by increasing road network density. In addition to main roads, the intersection of residential area entrance and non-main road cannot be ignored, whether from the quantity or from the status in the entire city's transport system. As a result, the safety level of this kind of intersections could be radically improved only by setting standards and performing safety assessment from the planning and design stage, for example, setting the shortest distance between residential area entrance and adjacent road boundary line.

### *3.2 Sight distance of the residential area entrance*

The tall buildings and green belts at the residential area entrance influence the sight of not only the pedestrians and vehicles out of the residential area, also the vehicles on the road, the sight is poor and the drivers near the entrance cannot observe the road condition well. Under the circumstance, conflict easily happened near the entrance and the intersections, which will lead to traffic accidents. According to *Code for Planting Planning and Design on Urban Road* in China, road planning should conform to the standards of sight and clearance of driving. Green belts should adopt lawn or dwarf shrub as much as possible. Meanwhile the factors of hidden danger which influence the safety should be emphasized in the process of green maintenance and periodic maintenance inspection. The tall building and obstacle at the both side of entrance should be controlled strictly especially for the first kind of the residential area entrance in order to ensure the good sight distance.

### *3.3 Lack of traffic safety sign, and lack of supervision of regulation violation*

The traffic accident rate of intersections between residential areas and urban road keeps a higher level that has strong relationship with traffic signs around intersections either deficient or not visible. The design of traffic signs of intersections between residential area entrances and urban road includes the safety sign of residential area entrances and the one on the urban road which intersect with the residential area entrance.

Safe driving sign is set up on the urban road, as shown in Fig.1. In order to warn the driver, a visible traffic safety sign—slow, should be set on the right side of the road where the sign need some distance from residential area entrance. Besides, to ensure vehicles getting in or out of the residence have a good driving sight distance, a no parking sign should be set up not only on the left side of entrance, but also near the intersection of urban road and residence, which can forbid any vehicles to park including no bus stop permitted here.

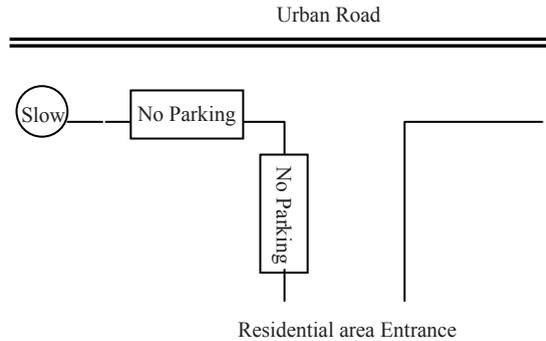


Fig.1 Safe driving sign setting up

For the first kind of intersection, the driver's sight distance is poor due to the residence adjacent to urban road. The drivers coming out of the residential area cannot observe the cars from left hand easily; it is also difficult for the drivers on the urban road to see the condition of vehicles out from the residential area being about to fall into the urban road. And it is essential to install wide angle at the corner of right hand of entrance to eliminate eye corner. In the meanwhile highly visible safe driving warning sign should be set up, such as speed limit sign.

Vehicles in residential are requested for one-way driving as result from the road at the entrance is relatively narrow. It necessary to set a noticeable one-way traffic sign at the residential area entrance adjacent to urban road to avoid the driver who is not familiar going into the residential area in a direction not allowed. In normal conditions, drivers should drive at speed limit in the residential area. Therefore, normally there is a speed limitation sign at the residential area entrance.

In addition, to ensure the traffic safety and traffic convince at the entrance, the shape of entrance can be transformed when conditions allowed, such as, the intersection can be designed like a horn or something like that which will be beneficial for drivers to observe road conditions.

### 3.4 Undisciplined Parking at residential area entrance and the intersection

"Difficulty in parking" is a common problem in urban traffic while vehicle numbers continue to explosion. The phenomenon in residential area of undisciplined parking is serious, especially the entrance of residential area which near the commercial district, attractive hospital, communal facilities. This problem exacerbated traffic accidents of residential area entrance. As shown in Fig.2.

On the mixed running lane or separated running non-motorized lane where it is adjacent to the residential area entrance, if there are vehicles parking, especially those with high car body like oversize cars and vans (As shown in Fig.3), they will block the vision of moving vehicles which is likely to cause traffic accidents or delay time for blending with the traffic. According to the investigations and statistics on the relationship between accident rate and driver's sight distance in America, the rate will decrease while the distance increases<sup>[5-6]</sup>. As a result, it is a significant method to improve urban traffic safety through reinforcing management of parking surrounding residential area entrance and intersection of urban road.



Fig.2 Residential entrance near the commercial district



Fig.3 Entrance both sides parking affect driving sight

As it is stated in Article 63 in the *Regulation on the Implementation of the Road Traffic Safety Law of the People's Republic of China*, stopping within 50 meters of a road intersection is forbidden. It is also stated in Article 56 in the *Regulation on the Implementation of the Road Traffic Safety Law of the People's Republic of China*, temporary parking on the road shall not impede the passage of other vehicles and pedestrians. The government has adopted safety-related laws to regulate the on-road random parking, and at the same time, the departments of transportation (DOT) strengthen their promotion and management, which helps improve the random parking. However, as the residential area roads have not been included into the administration range of DOT. They are currently managed by those property management companies. Currently, there are no laws or official regulations clarifying the responsibility and regulation for parking violations. Though the property management companies have relative regulation, they don't have authority to regulate. Hence, the parking violation situation is still very serious at the residential area (Figure 4). The final solution is to improve the relative laws and regulations. This kind of improvement will not only maintain and improve the city road condition, but also specify the management of residential area parking thus to guarantee the community transportation safety and to improve the living environment.



Fig.4 Residential entrance undisciplined parking

### 3.5 Reverse driving, speeding driving

Roads in residential areas and the residential area entrance are relatively narrow, which are ruled one-way traffic and limiting speed driving. However, property management companies have no authority of administrative penalty and the roads of residential area do not belong to urban road. Therefore, the related provisions of driving in residential areas are ignored and the phenomenon of reverse driving and speeding driving is quite serious. Especially in newly-built residential area, road conditions are relatively good, drivers often drive at high speed, so the malignant traffic accidents often happen because of speeding driving. Area of the residential community entrance, the traffic at where is relatively complex no matter whether it has the design of separation of pedestrian

and vehicles. Especially at the area of intersection between the residential area entrance and urban road, mostly traffic accidents are caused by cars' overtaking, speeding driving and illegal reverse driving.

### 3.6 Legal gaps is the source for illegal driving

In the *Regulation on the Implementation of the Road Traffic Safety Law of the People's Republic of China*, the word "road" refers to highway, urban roads, the private areas allowing social transportation, including the plaza, public parking lots and other places for public to access. However, roads in the residential areas, as nonpublic roads, should be mainly used by residents, not open to the outsiders, and the illegal driving issues in residential areas are still legal gaps. There are no specific laws stating the penalty for the illegal driving in residential area, thus reduce the power of transportation signs inside the community. The over-speed at community entrance is another reason for the high accident rate at community entrance. Especially in some newly-built residential areas, the roads are too wide and there are always over speed driving thus causing the accidents. Also, the entrance accident is also one of the most important reasons for traffic congestion. Therefore, improving the relative laws for residential community transportation, filling gaps in the traffic laws of the residential area, is the most important issue to solve the traffic problems in the city.

## 4. Conclusions

Urban road traffic is the artery of the city. Safe and smooth traffic environment has become one of the most concerned affairs nowadays with the expansion of urban, the complication of urban road traffic and the increasingly daily travel time ratio. The traffic conflicts of the intersection between the residential area and urban road are one of the most important factors to affect the urban traffic, therefore, the traffic safety issues are worth for in-depth research. After analyzing the different types of intersections between the residential area entrance and urban road, the author discusses the reasons that cause potential traffic safety hazard in this area and proposes preventive measures from the following aspects: the entrance design, the driving management, the parking management, the design of traffic signs as well as the consummation of the laws and regulations. It is hoped that the goal of eliminating potential safety hazard and reducing traffic accidents can be achieved by improving the traffic sign surrounding the intersection between residential area and urban road and completing traffic management regulations.

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