

# Study on Optimization of Urban Road Environment and Pedestrian-Vehicle Diversion Based on Factor Analysis

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## *Abstract*

*With the Continuous Improvement of Living Standards, Many Families Choose to Buy Cars as a Means of Transportation, and the Number of Cars in Cities Has Greatly Increased, Which Has Brought Great Pressure to Urban Traffic. with the Improvement of People's Requirements for Living Environment and Quality of Life, the Traditional Traffic Design Model of Residential Area Can No Longer Meet the Demand. the Mode of Traffic Separation between People and Vehicles Has Become a Main Traffic Mode in Cities. It is the Focus of Current Research to Make Residents Enjoy a Quiet and Peaceful Atmosphere While Ensuring Traffic Efficiency. Based on Factor Analysis, This Paper Makes a Concentrated Analysis of the Main Influencing Factors of Road Traffic Accidents, and Puts Forward Different Traffic Organization Modes and Strategies for People and Vehicles in Traditional Residential Areas and Residential Areas with Integrated Road Network, Which Provides Reference for Creating Humanized Residential Areas and Formulating Urban Road Planning and Design and Traffic Management Measures. Only by Dividing the Urban Roads Reasonably Can We Ensure the Safety of Residents and Build a Harmonious Environment.*

**Keywords:** *Road traffic, Residential areas, Diversion of people and vehicles*

## **I . Introduction**

With the accelerating process of motorization, private cars are becoming more and more popular, people's travel becomes more and more convenient, vehicle traffic has become the leading role in the city, and the conflict between people and vehicles is becoming increasingly serious [1]. Due to the squeeze and occupation of motor vehicle traffic, urban pedestrian life is monotonous, closed or even disappeared, and traffic accidents and traffic pollution are also common [2]. Large scale urban emergency evacuation often involves a large number of evacuation objects (pedestrians, vehicles, etc.). However, the existing road facilities are difficult to cope with the rapid increase of traffic demand for people and vehicles in a short time. At the same time, the conflict between people and vehicles at intersections makes the evacuation process more complex [3]. With the improvement of people's requirements for living environment and quality of life, the traditional residential traffic design mode can no longer meet the demand [4]. The relationship among road, automobile and human needs to be further organized. Roads should not only meet the traffic needs of cars and pedestrians, but also not damage the safety, communication needs and landscape environment of residents in the community. At present, the internal traffic system of many residential areas is still a mixed traffic organization form, and there is a problem of mutual interference between traffic and pedestrians [5]. Therefore, the use of pedestrian and vehicle diversion design can not only reduce the interference of pedestrian and vehicle, but also effectively solve vehicle congestion and reduce safety risks.

The mode of pedestrian and vehicle diversion has become a main traffic mode in cities. Under the guarantee of traffic efficiency, it is the focus of current research to make residents enjoy a quiet and peaceful atmosphere [6]. With the continuous improvement of living standards, many families choose to buy cars as means of transportation, and the urban car ownership has increased significantly, which has brought great pressure to urban transportation [7]” “Pedestrian vehicle diversion” mainly includes two objectives: one is the separation of cars and pedestrians, to ensure that the areas with frequent slow traffic activities are not disturbed by a large number of

motorized traffic. Second, the car can run in a suitable driving environment to avoid the impact of pedestrian's sudden behavior on driving and improve the traffic operation efficiency. The traffic condition of residential area is directly related to the convenience and personal safety of residents [8]. In the face of these traffic problems, the state has put forward a series of new policies, and has given some solutions to the problem of pedestrian vehicle diversion [9]. The emergence of a large number of cars in residential areas has changed the psychological feelings of residents towards traditional residential areas, which involves the relationship between roads, cars and people [10]. Based on the factor analysis method, this paper analyzes the main influencing factors of road traffic accidents, and puts forward different traffic organization modes and Strategies of pedestrian and vehicle diversion in traditional residential areas and integrated road network residential areas, which provides reference for the creation of humanized residential areas, urban road planning and design, and the formulation of traffic management measures.

## **II. Discussion on Traffic Organization Mode of “Separation of People and Vehicles” in Residential Area**

### ***A. Design Features of Pedestrian Vehicle Separation***

Most of the roads near the residential area are of mesh structure, which can meet the opening of cars and keep the residential area quiet to the maximum extent. According to the road requirements, the roads need to be dredged, and the locomotive runs slowly and the main and chronic roads. This setting needs to reflect the differences and highlight its leading functions. Generally speaking, the separation of people and vehicles is to completely separate the flow of people and vehicles on the road, and the driving and walking do not interfere with each other, including various roads. This measure has played a great role in the traffic pressure of the city. The road network in traditional residential areas is mostly square grid layout, and almost all the roads at all levels are provided with entrances and exits with different functions of plots. In this type of residential area, the choice of road traffic direction is relatively diverse, but the traffic flow is inconvenient to control, and crossing traffic is unavoidable. Cars and pedestrians shuttle on every road in disorder. In a residential area where people and cars are constantly moving, the speed will be reduced to the lowest, and the parking time will be increased unconsciously. The more cars there are, the longer the parking time will be, the greater the impact on the people behind, and the greater the difficulty of parking.

One of the great advantages of people-vehicle separation community is that people-vehicle separation, so that vehicles can travel more safely and quickly, shorten parking time and reduce the parking pressure of residents. Close to the convenience service facilities in the residential area and the second development road of the rest square, it is suggested that the whole road be paved with hard woven fabric, which can limit the speed and form a distinctive slow-moving axis to create a rich and comfortable activity atmosphere in the residential area. The intersection between the slow-moving axis and the motor vehicle road adopts street flower beds, which is suitable for the slow-moving atmosphere of the axis. In order to give full play to the advantages of pedestrian-vehicle separation design, when it is applied to residential quarters, it is necessary to ensure the effective separation of pedestrian and traffic lanes in physical space, design different routes, signs and markings for residential roads, and select a three-dimensional system or a plane system to effectively separate pedestrians and vehicles according to the actual situation [11]. In a residential area where people and vehicles are mixed, cars are easy to hit pedestrians. People walk on the same road as cars, and people can easily scratch cars. The biggest advantage of traffic diversion is that the car can directly hear the underground parking lot, or stop at the parking apron outside the community. Residents in the community, cars are completely separated from residents, which greatly improves people's personal safety.

### ***B. Design Form of Pedestrian Vehicle Diversion***

For residential quarters in different geographical locations, the applicable traffic organization design schemes are different, especially for built quarters, which cannot be designed completely according to the traffic planning scheme of newly-built residential quarters. It is necessary to determine the road design scheme in the quarters based on the actual situation and meeting the management requirements, so as to effectively control the traffic

flow. Most of the roads in the residential area are semi-circular or square. The general driving roads are set at the peripheral edge of the residential area, which surrounds the residential area. Another way is to form a ring road in the residential area and extend to the entrance of the unit when some branch roads are set. This design can completely separate the driving roads from the pedestrian roads, and form separate systems to meet the traffic demands of different groups of people and reduce the probability of car accidents. Pedestrian-vehicle separation organizes pedestrian and vehicle traffic in two independent and interrelated spaces. The vehicle route is isolated from the residents' activity space in various ways, or the negative space between buildings will be used for driving, or the three-dimensional diversion will be used to introduce the vehicle into the underground space [12]. In residential district, the road traffic organization form is mostly similar to semi-enclosed type and pocket type. Generally, the carriageway is arranged on the periphery of the district, forming an enclosed form for the district, or forming an inner ring inside the district, and then spreading to the unit entrance of each residential building through some smaller roads with end-to-end road network design. This design can effectively separate pedestrian lanes from traffic lanes, and form their own independent systems, which can not only meet the traffic demands of different groups of people, but also reduce the contradiction between people and vehicles. The framework of urban road traffic safety early warning system is shown in Figure 1.

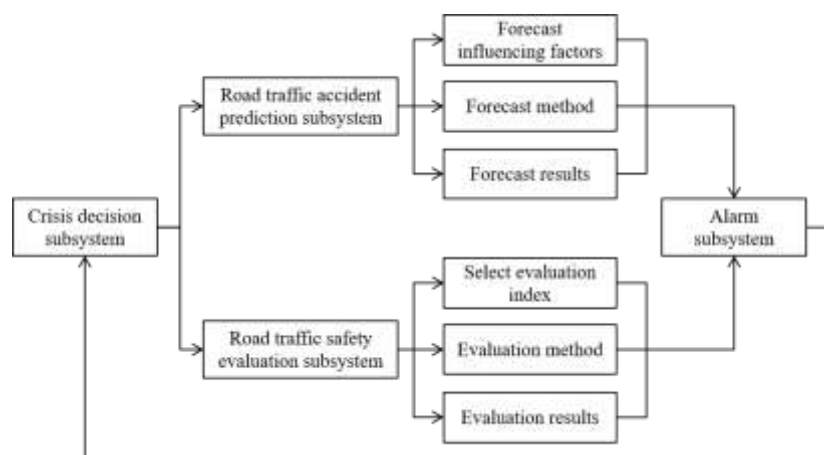


Fig.1 The Framework of the Urban Road Traffic Safety Early Warning System

In the residential area where people and vehicles are separated, the underground garage is used, which makes the people and vehicles in the residential area completely separated, and will generally alienate the neighborhood. Nowadays, many communities use the ground floor of real estate as the parking garage, so that motor vehicles directly enter the underground garage to meet the demand for parking, but it also reduces the communication between neighbors. As roads, urban roads and urban traffic trunk roads have the same function of meeting the material circulation in residential areas, providing people with access to residential areas, and serving as a channel for people, materials and the outside world in residential areas. However, in many cases, roads in residential areas have different characteristics from urban traffic arteries. Besides meeting the transportation capacity, roads are the most densely used places for residents. Urban roads are the most convenient way and direct place to trigger residents' activities. Secondly, making full use of the surrounding space of roads can be used as outdoor activity venues, combining residents' community leisure activities with the surrounding areas of roads, and avoiding occupying construction land for opening up special activity venues can make the construction land of residential quarters more economical and reasonable. In order to improve the safety and convenience of people and vehicles in residential areas, it is necessary to classify the roads in residential areas. That is to say, based on the road environment foundation, the grade is divided, the driving route of motor vehicles is effectively planned, warning signs are set, and the number of sidewalks can be increased when necessary to ensure that the actual operation needs can be met.

### III. Urban Road Environment and Optimization of Pedestrian Vehicle Diversion

The road network in traditional residential areas is mostly square grid layout, and almost all the roads at all levels

are provided with entrances and exits with different functions of plots. In this type of residential area, the choice of road traffic direction is relatively diverse, but the traffic flow is inconvenient to control, and crossing traffic is unavoidable. Cars and pedestrians shuttle on every road in disorder, and traffic noise, potential safety hazards and other problems are common, which also makes the street space of residential area desolate, empty and lack of life atmosphere. As a linear open space, roads and surrounding spaces have very long boundaries, which easily attract residents to move. However, the basic function of roads is traffic. When residents' activities occupy and hinder road traffic, roads cannot perform their basic functions, and chaos will arise. In the specific planning and implementation process, many factors such as the location, land use function, layout form, traffic structure, construction funds and so on of the base should be considered, and the appropriate form of passenger-vehicle diversion should be selected, either one or both [13]. The traditional residential area generally adopts the grid road network, which will lead to serious congestion when the traffic flow is large, and the integrated road network will help to reduce the congestion problem in the residential area during the peak period.

Merged road network residential areas generally adopt crescent-shaped streets or dead ends. By eliminating transit vehicles passing through residential areas, residential areas can be connected with parks, bus stops, commercial areas and community facilities through some endless and tortuous low-grade roads, thus facilitating slow-moving activities in residential areas. Figure 2 shows the modeling process of short-term traffic flow.

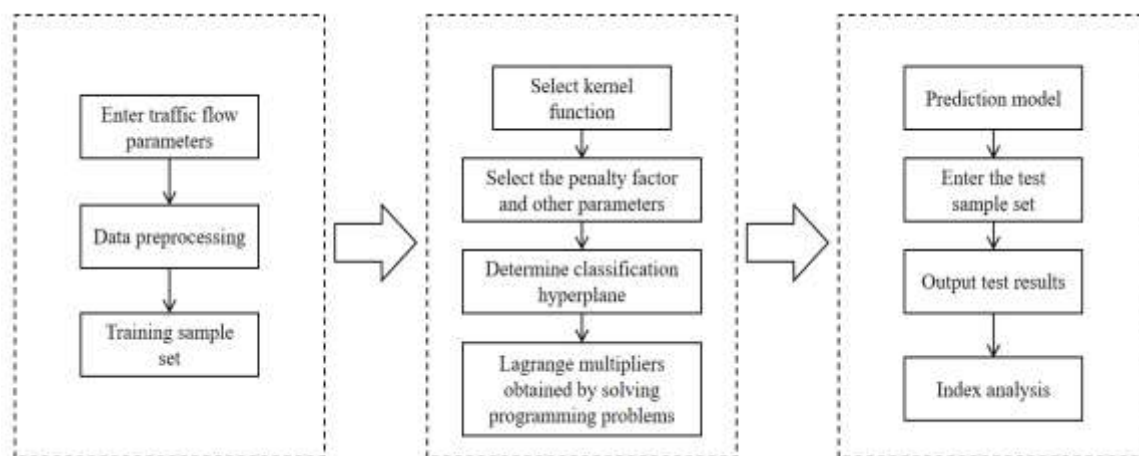


Fig.2 Traffic Flow Modeling Process

Assume that  $x_i \in R^n$  is a factor that affects urban road traffic flow, and  $y_i$  is the predicted value of urban road traffic flow. The urban road traffic flow prediction model based on factor analysis is to find the relationship between  $x_i$  and  $y_i$ :

$$f : R^n \rightarrow R \quad (1)$$

$$y_i = f(x_i) \quad (2)$$

In the formula:  $R^n$  is a factor that affects urban road traffic flow. According to the theory of factor analysis, the establishment of urban road traffic flow model seeks to establish the following expression:

$$f(x) = \sum_{i=1}^k (a_i - a_i^*) K(x, x_i) + b \quad (3)$$

In the formula:  $x$  is the factor that affects the traffic flow,  $x_i$  is the  $i$ -th sample among the  $k$  samples,  $K(x, x_i)$  is

the kernel function, and the kernel function adopts the radial basis function, as shown in the following formula:

$$K(x, y) = \exp\left[-\frac{\|x - y\|^2}{2\sigma^2}\right] \quad (4)$$

Different from the problems faced by traditional residential areas, such as relatively difficult traffic flow control, transit vehicles passing through residential areas, etc., residential areas with integrated road network gradually enter people's field of vision. On the basis of the current road network, according to the road traffic demand, the roads in the area are classified into five categories: bus corridor, inter-group motor vehicle lane, intra-group motor vehicle lane, slow leading road and slow dedicated road. Urban streets are often only used as a means of communication. Cars become the owners of streets and people become accessories of street life. If the road bus corridor in the community is a tram corridor, it is necessary to make the inter-group motorway service cross-group motor vehicles, and the intra-group motorway service the motor vehicles within the group to arrive, while the slow-moving main roads and slow-moving special roads mainly serve the slow-moving traffic. The real street in the residential area is a place of communication, which is a stage for people to live little by little. As a linear structure in residential areas, streets connect different nodes into a continuous landscape sequence, and then add people's activities, which evolves into the real life axis in residential areas. The entrance and exit of the plot should be coordinated with the road function. The entrance and exit of the garage should be set along the two types of motor vehicles, and the entrance and exit of the pedestrian should be set along the bus corridor, the slow leading road and the slow dedicated road. By combing the road functions and setting the layout of entrances and exits, the motor vehicle streamline and the slow-moving streamline will be relatively separated on the plane, which has higher safety.

#### IV. Conclusions

The biggest purpose of traffic diversion is to reduce the conflict between people and vehicles and to create a safe, comfortable and dynamic living environment for residents while ensuring the efficiency of car dealers, so that the streets in the community can serve the people more. On the whole, in order to share the road space of residential area fairly and restore the life breath and vitality of the road space, it is more realistic to adopt more coexistence methods. The concept of separation of people and vehicles is not only limited to the special traffic planning, but also can guide the road network layout and land use layout in the overall urban planning and all kinds of detailed planning at lower levels to a certain extent, and provide the basis for urban road construction design as well as traffic management measures. The realization of the design of separating people from vehicles has greatly improved our life, and it is of great help to clear the roads in the community, and it is also of great help when parking. In order to ensure the rationality of the final scheme and meet the actual traffic demand, it is necessary to determine the characteristics of this design based on the actual situation, and do a good job in the comprehensive distribution and coordinated design of various elements. Only by implementing the concept of separation of people and vehicles from planning to construction and management can we create a more humane residential environment and shape a beautiful and livable city.

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