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Analysis of Pedestrian Characteristics in Urban Integrated Transportation Hub Station

Na Cheng[1], Pei Jiang[2],* Zhongkun Du[1], Xinlu Ma[2]

1. Chongqing City Integrated Transportation Hub (Group) Co., Ltd, Chongqing 400074, China.

2. Chongqing Jiaotong University，CQJTU, Chongqing 400074, China.

Abstract: As the theoretical research of pedestrian walking environment planning for safety, efficiency and comfort has become a hot research topic in recent years, the analysis of pedestrian characteristics in integrated traffic hub stations has become an indispensable content in the research of pedestrian flow. Research on pedestrian characteristics can help improve the hub The service level of the facilities in the station. In view of this, this article analyzes the pedestrian path selection, behavior walking characteristics, queuing characteristics and waiting characteristics in the hub station. The analysis results can provide a reference for the optimization of the facility layout in the hub station.

Keywords: Urban Traffic; Hub Station; Pedestrian Characteristics

Introduction

The planning and construction of integrated traffic hubs has therefore attracted widespread attention from the industry. In recent years, with the rapid increase in people's travel, more and more problems have arisen in the operation of integrated transportation hubs, and the available space within the hub has decreased sharply. How to organize and guide the pedestrian flow within the hub reasonably and effectively to improve the hub The efficiency of the station's traffic has become a hot topic for discussion and research among industry insiders and scholars. In the hub, pedestrians are the main body of all activities, and various facilities need to meet the needs of pedestrian walking and other activities. This requires managers to fully grasp the activity status of pedestrians in the hub, the distribution situation, and the interior of the hub under different crowd densities. The state of use of the facility [2].

1. The significance of analyzing pedestrian characteristics

The research on pedestrian characteristics is highly pertinent. Pedestrian traffic characteristics are affected by many factors. Different scenes and different groups of people will affect the behavior of pedestrians in the station. The behavior of pedestrians in the same scene is not the same. By analyzing the behavior of pedestrians in the hub station, the law of pedestrian flow is better. It is of great significance to grasp the rules of pedestrian flow in the hub station.

In recent years, with the increase in passenger traffic, the pressure on transportation hubs has increased, and the problems that have arisen are also increasing. For this reason, many domestic scholars are committed to the research of integrated traffic. Among them, the use of computer simulation technology to simulate pedestrians inside the hub has become a research hotspot, and the research of pedestrian characteristics is an indispensable part of pedestrian simulation modeling. At the same time, it is also an important basis for model verification and simulation results evaluation.

2. Spatial constraints of pedestrian path selection

Path selection is an important decision-making behavior of pedestrians. On the ground, the path of pedestrians is almost unrestricted, and path selection is very random. In the hub, due to the limitation of circulation, the pedestrian macro path is

basically fixed, and there is no need to make complex macro-level path selection. Pedestrians only need to make partial adjustments to the path according to the determined activity chain. In addition, the choice of pedestrian paths inside the hub is also constrained by space. In the hub, due to the limitations of physical facilities such as walls, pedestrians' vision is limited to a small area, and the information that pedestrians can obtain is limited. At this time, pedestrians' familiarity with the environment directly affects the rationality of their decision-making.

3. Research on Pedestrian Behavior Characteristics

Foreign research on pedestrian behavior characteristics has progressed rapidly in just a few decades, and it has shifted from the initial macroscopic characteristics research to the more complicated pedestrian microscopic characteristics research. The research on the characteristics of pedestrians in the hub has also gone from the original pedestrian flow organization and management, emergency evacuation to the analysis of the behavior characteristics of individual pedestrians.

Domestic research on pedestrian models is mainly based on existing foreign models and improvements for different application scenarios. Most of them are based on cellular automata models and are mainly used in emergency evacuation and pedestrian crossings. On the one hand, there are relatively few studies on pedestrian modeling in transportation hubs. At present, these applications are based on the characteristics of my country's traffic and specific application scenarios to improve the existing models to improve the effectiveness of the model.

3.1 Analysis of pedestrian speed characteristics

Speed is an important indicator reflecting the characteristics of pedestrian traffic. Under the same environmental conditions, individual differences determine the changes in its speed characteristics. Free speed refers to the walking speed of pedestrians in a non-crowded state, that is, when the pedestrian's walking space is not restricted and is not interfered by other factors. The difficulty of free speed measurement is to determine whether the pedestrian is in a free walking state.

In scientific research, it is often necessary to study the influence of different experimental conditions on the experimental results. For this reason, it is necessary to scientifically analyze the experimental data to identify the impact of various experimental conditions on the experimental results. ANOVA is to deal with this type of Effective method of problem.

3.1.1 Gender factors

Physical condition is an important factor that affects pedestrian speed. Male speed is generally higher than female speed. In order to verify whether gender has a significant influence on speed, the speed in the upward and downward directions of the horizontal passages and stairs in the integrated hub can be determined by gender. A one-way analysis of variance for influencing factors shows that gender has a significant impact on pedestrian speed.

3.1.2 Facility factors

Comparing the speed and distribution of pedestrians on the horizontal passage and stairs, it can be found that the speed of pedestrians in the horizontal passage is higher than the speed at the stairs, and the fitting effect of the normal distribution of the speed of pedestrians on the stairs is worse than that of the horizontal passage. The type of facility has a certain influence on the walking speed of pedestrians, and the speed of pedestrians on stairs is more obvious than individual differences in horizontal passages. A one-way analysis of variance was carried out on the speed of men and women with the type of facility as the influencing factor, indicating that the type of facility has a significant impact on the speed of pedestrians.

3.1.3 Other factors

In addition to gender and facility types, there are many factors that affect pedestrian speed, which are often difficult to measure. Pedestrians' walking speed decreases with the decrease of their fitness level, and because their fitness level cannot be measured, in related studies, the influence of age on speed is usually used to replace the effect of fitness level. Due to differences in regional culture, the behavior of pedestrians in different regions shows differences. Researchers generally

believe that the minimum acceptable space for Asians is lower than that for Americans and Europeans. In addition, the purpose of pedestrian travel has a certain impact on the speed of pedestrians. In view of the difficulty of measuring such influencing factors, no further discussion will be made.

3.2 Overview of pedestrian behavior

The various behaviors of pedestrians can be regarded as a decision-making process. Decision-making can be a macroscopic view of a certain behavior as a whole, or it can be microscopically penetrated into every small link. Therefore, clarifying the decision-making process of pedestrians is the basis for studying pedestrian characteristics. From a psychological point of view, the decision-making process of pedestrians is a complex process of real-time information interaction with the environment. In this process, pedestrians obtain information from the environment for selection and processing, and then make decisions.

3.2.1 Decision-making layer

The strategic level is the macroscopic grasp of pedestrians' behavior within the hub, that is, at this level, macro decisions are made. Pedestrians determine the activities that need to be carried out in the hub according to their own travel purposes. Some of these activities are necessary, such as purchases. Some of the tickets are arbitrary, and this series of activities constitutes a collection of pedestrian activities. It can also be said that what the strategy layer has to do is to decide whether to make a certain activity or not.

3.2.2 Tactical layer

At the tactical level, pedestrians arrange the time sequence of various activities according to their actual conditions according to the set of activities determined by the strategic level, forming an activity chain, and at the same time, the macro path of pedestrians inside the hub is generated.

3.2.3 Operation layer

The operating layer is the pedestrian's specific completion of the walking process from the starting point to the ending point, during which some of the pedestrian's micro characteristics are displayed.

4. Analysis of pedestrian walking characteristics

4.1 Turning characteristics

When turning inside the hub, pedestrians tend to walk close to the inner side of the curve with the shortest path. Pedestrians are concentrated on the inner side of the curve, which makes the inner pedestrian denser and the outer pedestrian more scattered and less dense.

4.2 Obstacle avoidance characteristics

Pedestrians avoid obstacles and other pedestrians to generate microscopic movement trajectories. Pedestrians' trajectories inside the hub are more complicated than road traffic. The goal of pedestrians is to walk on the shortest path while avoiding collisions with obstacles and other pedestrians.

4.3 Analysis of the characteristics of pedestrian queuing

Pedestrian queues include two types: ordered queues and unordered queues. Ordered queues often appear in service windows or specific areas where there are staff to maintain order. Disordered queues often appear at the bottleneck of various passages and other walking facilities.

Conclusion

This paper analyzes the pedestrian path selection, behavior walking characteristics, queuing characteristics and waiting characteristics in the hub station, considering the pedestrian turning characteristics, obstacle avoidance characteristics, pedestrian queuing characteristics and waiting characteristics, etc.; because the research object is thinking and active Pedestrians, research work is more complex and uncertain than vehicle traffic, this paper still has many deficiencies in the research of pedestrian traffic characteristics inside integrated traffic hubs.

References

[1] Jia Hongfei, Yang Lili, Tang Ming. Pedestrian flow characteristics analysis and simulation model parameter calibration in an integrated traffic hub[J]. Transportation System Engineering and Information, 2009, 9(005):117-123.

[2] Zheng Nan. Research on Pedestrian Evacuation Characteristics and Optimization of Urban Rail Transit Integrated Hub Station [D]. Beijing Jiaotong University, 2018.

[3] Yang Xiaoxia. Research on the dynamic characteristics and evacuation of pedestrian flow in subway hub station based on social force model[D]. Beijing Jiaotong University, 2017.