

Research and Analysis of Passenger Flow Constraints in Urban Rail Transit

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Abstract. In order to overcome the constraint of large passenger flow in urban rail transit management, an innovative research idea has been proposed. The constraint conditions of passenger flow are analyzed and studied. First of all, the background of this paper is introduced in detail. The passenger flow data of some key lines in Beijing urban rail transit are given. Secondly, the constraint model of urban rail transit passenger flow is introduced. Because of the diversification of urban rail transit development, the variables of its constraints are also diversified. The integration of urban rail transit is well prepared. Third, the data of urban rail traffic flow in some of China's mega cities are given. The passenger flow of urban rail transit is analyzed in detail. Finally, the main image factors of urban rail transit are analyzed in detail. From the scope of land use, land development TOD plot ratio and development of urban rail traffic team constraint has made the detailed analysis of passenger flow, for the urban rail traffic safety and efficient integration operation lay the foundation.

Keywords: constraint; Passenger flow; Urban Rail Transit; Management.

1. Introduction

Due to the nature of land use for the integration of the urban rail company, over the past 10 years, the urban land use spatial layout, great changes have taken place in the land according to the use of the nature of the partition function is more clear, originally mixed by replacement or adjustment of the land, the old strengthen the function of business, office, financial activities, residential and industrial migration to the peripheral new city. Old town land use adjustment and enhancing the social and economic activities, especially the increase of residential land, population increase, outsourcing makes the increase of travel between the new and old, assumes the centrality and the tidal traffic characteristics. Analysis shows that the tidal phenomenon is due to the expansion of urban land to peripheral process, in the residential land to development at the same time, jobs and peripheral area caused by public facilities is not yet perfect [1][2].

As in the northern suburb of the construction of the Asian game's village nearby deshengmen residential area in the north were over million hectares in size, wangjing, suburb and huilongguan are large residential areas, wangjing planning resident population from 500000 to 800000, the current residential area in a population of about 300000 people; Tiantong residential district planning population 25. Sixty thousand people are now living in a population of 70,000: the planning population is 110,000, and there are now 60,000 residents [3][4]. Because there is no proper placement and public facilities, most of these characters of land use area is given priority to with living function, time and space distribution of travel changes, day travel peak duration greatly lengthened, the main traffic corridor tidal characteristics has become increasingly obvious. The distribution of passenger flow is inseparable from the nature of land use, population structure, employment structure and service level of urban rail transit system [5][6]. Near the huilongguan, for example, gathered a large number of affordable housing and ordinary commodity housing prices are relatively cheap, lead to a surge in the number, and people live mainly working-class, travel purpose mainly is to work, so the urban rail traffic congestion at peak no sooner or later [7].

In the course of one year of operation of Beijing chenggang line 13, it has brought great convenience to the residents of the urban area and the northern new district, and the passenger flow has gradually increased [8]. However, as the aggregation effect of urban rail transit gradually appear, one after another along the development and construction of more than 60 kinds of large residential area, especially in the northern section of line 13 successively built ShangDeJiaYuan, contemporary city, honest home, rich spring garden, best of times, the pioneer of silicon valley, Dan beautiful maple,

senna villa, xin garden, east city, such as more than 30 buildings is in the hundreds of thousands of square meters, gathered more than the population into large residential area, no. 13 rail line makes a surge in passenger flow[9].

Especially in commuting travel peak time, urban rail transit traffic crowded, crowded, rather than go to work time is scarce, passenger flow of urban rail traffic capacity with a large number of surplus, demand, form the characteristics of the average daily passenger flow distribution unevenly. From the survey data shows, according to the statistics to longtzer station, huilongguan station at 7:00 and early HuoYing stand more than 80% of passenger travel for the purpose of the work, and other time almost no passengers, passenger flow at a certain time, certain direction to form the characteristics of high aggregation [10].

2. The Concept of Management Constraint

2.1 Development Subject and Development Object Diversification

First of all, the original land of urban rail transit and the newly acquired land can be developed comprehensively. Urban rail transit enterprises can take advantage of their own land, comprehensive development of both the urban rail transit station area, also can negotiate purchase of adjacent land, or apply to the local government for new supplies of land comprehensive development. Secondly, urban rail transit transport enterprises can either develop themselves or cooperate with other market entities. At present, the state has no uniform rules on the model of cooperative development, and it is not clear about the equity composition and land price requirements of the project company. Development subject and development object diversification [11].

2.2 Land Management is Diversified

According to the policy, if the land for the implementation of comprehensive development is in conformity with the allocated catalogue, it can still be provided by means of allocation; If the transfer or change of purpose no longer conforms to the catalogue of allocated land. In addition to transfer, agreement transfer, use nature also can adopt national authorization management pattern, the authorization management of land, urban rail transit enterprises within the use fixed number of years can be evaluated and (in) in accordance with the law, lease, or in the group company directly under the enterprise, transfer between holding company, joint-stock enterprises [12].

2.3 Comprehensive Management Differentiation

According to the state file, the same urban rail transit construction projects after deducting yard land, comprehensive exploitation and land consolidation by a single station average size does not exceed 50 hectares of control, a few stations comprehensive development land scale of no more than 100 hectares. This provision has practical implications. It is understood that a number of cities in the development of urban rail transit in the development of a blind development, such as a slightly larger high-speed railway station to build "high-speed railway new city". At present, there are 36 high-speed railway new cities planning or building on the main high-speed rail network in China. Among them, 20 have proposed to develop business center and high-end service industry. There are 11 new "city centres" to be built. For example, the western new town of changchun, with a planned area of 13 square kilometers, is planned to be 9.27 square kilometers, and Guangzhou city plans 220 hectares of high-speed railway. Therefore, it is necessary to control the local movement of the city to prevent the spread of the abuse of land.

2.4 Integration of Urban Rail Transit Management

Land comprehensive development is in the service of the urban rail transit construction, the construction of urban rail transit is objective, comprehensive development is the auxiliary means, this determines the relationship between urban rail transit has special requirements for specific areas of land comprehensive rights. First of all, on the basis of policy, urban rail transit construction and land

bidding, the tender land comprehensive development rights at the same time, new urban rail transit project, the winning bidder and acquire land comprehensive development rights; New urban rail transit project have been identified investment main body, but did not determine land comprehensive exploitation, comprehensive exploitation and land supply by way of bidding, auction and quotation, and will unify lianjian lines of urban rail transit station, engineering and related planning conditions, urban rail transit construction requirements as the prerequisite of the land; Second, city and county land and resources department should be obtained and the comprehensive development of land use rights sign land comprehensive development and utilization of agreement, expressly agreed upon urban rail transit station, line engineering should be prior to land comprehensive development projects, otherwise will not be able to go through the formalities for examination and approval of land, housing and registration.

2.5 Integration of Urban Rail Transit Management

Land comprehensive development may be provided at one time or in installments, and the land price shall be determined according to the market price at the time of transfer. Supply of land can piece, piece of land supply shall be carried out according to the actual circumstance of urban planning and points, according to the relevant provisions of the land use and, nuclear transfer decision or paid use contracts.

To encourage land for urban rail transit to the ground, comprehensive utilization of underground space stereoscopic development, policy allowed under the premise that conform to the planning, compatible with a certain proportion of other functions, and can be layered to set up the right to use construction land. The right to use the construction land that is set up in a separate layer is in line with the catalogue of the allocated land, and the land use procedures can be handled according to the allocation method; If it is not in conformity with the catalogue of land transfer land, it may handle the formalities for paid land in accordance with the agreement.

3. Subway Passenger Flow

Line upward direction, the maximum early peak passenger flow section of Shanghai stadium station - xujiahui station this section, passenger flow of 39745 by time, downlink traffic top section of the people's square station - huangpi road station section, passenger flow of 26549 by time, TDD early peak time reflects the # 1 has two direction serious imbalance of passenger flow. Morning rush hour is the largest passenger flow upward direction section for lujiazui station - henan road station this section, passenger flow of 26974 a time, a maximum 26894 section of passenger flow downward direction by time, only 7.6% more than the uplink traffic, reflects the balance of TDD no.2 has passenger flow. The passenger flow peak is mainly composed of commuter travel, and the differences in passenger flow characteristics reflect the differences in the distribution of living and working positions along the first and second lines. The constraints of large passenger flow.

Take the urban rail transit line 1 of the sea as an example, the line of line 1 and its extension are connected with xujiahui commercial center with a large number of jobs. Another section extends to the outer ring, along the urban rail transit construction before more for agricultural land, after the completion of line 1 main development for residential land, and a large number of residents of jobs in the city center, also to form the tides traffic phenomenon. Urban rail transit line 2 is mainly through the city center, its traffic increased reflects its population to the city center spatial reorganization, along the development and construction quantity is more, jobs and live distribution is uniform, Shanghai urban rail transit network along the differentiation of the nature of land use and the large-scale development of land for residential properties in for urban rail transit transportation passenger flow at the same time, also cause passenger flow space-time distribution imbalance.

Such as changchun railway line 3 lake road station, because of it surrounding the fukang village, fung wah mei garden, 7 point such as the lake garden residential area, at 7:00-8:00 early during peak hours, the number of 465 people, and attract quantity is only 88 people, passenger flow uneven coefficient of 1.58. Time distribution, as a result of the residential district residents generally for the

working class, its main purpose is to go to work, travel and nature of the surrounding land use mainly residential property site, in the early produced by residents to go out to work at peak passenger flow number is larger, and attract the quantity is small, showing evident in the tidal traffic characteristics. On the spatial distribution, the land use nature of the site is different, and there are different restrictions on the total daily passenger volume of the site. In terms of the per capita travel rate, the per capita travel rate of commercial land is the highest, the residential land is second, and the industrial land is the smallest.

Nearby such as Changchun station mainly include trademark department, China wholesale market, such as primavera underground mall in commercial buildings, combined with the Changchun railway station on the city's foreign travel, make the Changchun railway station, passenger traffic of 7290 person-time, lake road station due to the residential area development in recent years also provides a stable, have also reached 2574 passengers, and surrounding land use property is given priority to with industrial property of jiefang standing passengers was only about 493 people. In spite of changchun city rail line 3 in after the completion of passenger flows has been in a stable state, but its off-peak hours and few parts of the site traffic, peak time "tidal phenomenon" and other problems are still significant. Passenger flow space-time distribution imbalance causes traffic facilities utilization lake road forward two forward road in silicon fluid street street WeiMing street to change the status quo of the tidal passenger flow, need to condition, the evil shall tuning of nature of land use on different sites, implements the dynamic integration of planning, and according to the present quantitative differences between the two sides, timely interaction adjustment, nature of the urban rail transit construction and land use in order to achieve both coordination and balance.

4. Analysis of the Constraint Factors of Passenger Flow in Urban Rail Transit

4.1 The Analysis of the Restriction of Passenger Flow by Land use Scope

The land use scope is the regional connection, traffic construction, economic activity and population in the space agglomeration performance. Range of geographical differences to make urban land use in the social and economic activities in the stream of people or the displacement of the logistics and the scope of the urban land utilization layout to determine the beginning and the end of the empty asked displacement point, which constraints the traffic travel range of the spatial distribution of urban land use and transport system feedback loop between mutual relationship. Scope of land use structure decided to urban transportation demand, the improvement of traffic facilities, in turn, the range of change of land use development strength and development model, both mutual stimulation until into balance or an external fierce element involved. The analysis of the restriction of passenger flow by land use scope.

At the same time, it is a dynamic development process between the land use scope and the transportation system. Only by maintaining coordinated development can the circulation of good parts be formed and vice versa. Different modes of land use in different cities have different characteristics of traffic patterns, which are determined by the function of transportation in the city. Transportation is a function of land use scope, and city tower residents' travel occurrence, attraction and traffic pattern are basically a function of narrow distribution of land use. Different types of land use and different types of transportation demand. The passenger flow demand of industrial land is the fixed time period, during which the passenger flow is concentrated and the peak is formed. The traffic demand of commercial land is non-fixed period, and the peak of weekend and holiday is the peak of the holiday. There is no or only small peak, and the traffic demand is relatively balanced. The residential land directly restricts the traffic volume, and the peak hours are high, and the passenger flow is more balanced during off-peak hours.

Hong Kong experience shows that urban rail transit construction of urban rail transit stations within 500 meters of service radius cover population (including the resident population and jobs) is the key to restrict orbit operation passenger flow, the greater the population there is in site covers, rail passenger flow is guaranteed fl10l. The mode of land development determines the traffic generation and attraction, and determines the passenger volume of urban rail transit to some extent. In many

developed countries in order to seek to improve the overall urban layout and fundamentally solve the problem of housing, to the peripheral zone relief support centre of the city population and industry, regional planning a massive new district, in a big city periphery to form large, commuter traffic flow caused by urban commuter traffic and road congestion, commuter breakdown phenomenon. Therefore, these cities are very heavy traffic system development, and solve the urban traffic problem as a long-term strategic task. For example, the Tokyo metropolitan area of Tokyo, which has a radius of 401 (the number of people commuting to the city centre per day in 1Tl) is 139. Forty thousand people, up to 360,000 in 1990 and 1.6 times in 25 years.

In order to solve the long-distance commuting traffic flow, the planning and construction in order to solve the Tokyo metropolitan Tokyo lost between urban and suburban new town transportation needs for the purpose of urban rail transit line (some rush out of the garden city line) and other urban rail transit lines, the city of Tokyo in 1965 in 1995 to 1995 km, the development of urban rail transit in 1994 mortar are passenger has reached 36.5 million, urban rail traffic in all the traffic transportation share rate has reached 56%. Among them, the east line in rural urban construction and the rural urban more (planning area of 5000 hectares, planning a population of 400000 people, about status quo of the resident population has reached 530000 people) planning reflects the integrated facilities along the development of urban rail traffic demand constraint. The average daily passenger flow of urban rail transit is directly proportional to the relationship between the development area and the resident population. The average daily passenger flow rate of urban rail transit is basically linear correlation with the living population along the route, and its correlation coefficient is 0.9839; It is also basically a linear correlation between the land development area along the line, and its correlation coefficient is 0.9261.

4.2 Analysis of the Influence of Land Development Volume Rate on Passenger Flow

The volume rate is the most commonly used indicator for land use intensity. Because of the urban rail transit can greatly improve the traffic in the area of point accessibility, site surrounding area by the sheer force of urban rail transit cohesion formed city new economic growth point, makes a lot of business, office and residential development to concentrate in the region, has caused the high intensity of land development in the region.

Hong Kong in the Hong Kong planning standards and guidelines "in special provisions: near the high capacity transportation hub for the high-density residential development, housing development density should be on and the railway station and distance increases with the decrease of public transport interchange. In a white paper on urban development, Singapore mentions the ratio of high intensity development in urban rail transit stations and surrounding areas. Tokyo in the "third Tokyo long-term development plan" with particular emphasis on: combined with the orbital station business center at all levels to strengthen the height of the land use... Regional high strength development of urban rail transit station is in line with the urban land market economic laws. The underlying explanation is: after the introduction of urban rail transit station in a location due to improve accessibility, condition of land for development of the relative increase, condition of development intensity is also relatively improving good location. According to the experience of urban rail transit development in Hong Kong, the high-volume rate brings the concentrated passenger flow to urban rail transit.

Hong Kong use high-density development model, and through the government control of the land is strong, strengthen the coordinated development of urban rail transit and land use planning, consciously improve track site surrounding land development intensity, make the land layout along the orbit around clusters of urban rail transit site form, build high density in urban rail transit station nearby apartment buildings, greatly increase the rail stations within 500 m service radius cover population size. According to the survey, in the choice of joint operation of urban rail transit, most people choose to walk, followed by bicycle and bus, so the greater the population there is in site within the scope of coverage on foot, urban rail transit passenger flow is guaranteed. It can be seen that this kind of development is not only beneficial to the passenger flow organization, but also can meet the social needs and drive the higher economic benefits.

Different types of urban rail transit stations have different degree of constraint on the development intensity of surrounding real estate. From Shanghai urban rail transit line 3 different types of buildings surrounding the site deposition rate with changing trends, distance to the site to transfer the change of the slope, the largest hub district site description of urban rail transit transfer hub area of real estate development strength constraint; At the same time, the public activity center, transferring hub area, mature community, the peripheral area of urban rail transit site for building development intensity have a common constraint rule, that is, the farther away from the urban rail transit site, building development intensity drops in form of slowing down. The site and adjacent land use intensity of urban rail transit is the highest, from the track site to the periphery.

From the Beijing urban rail transit line 13 surrounding distribution can clearly see that the building volume rate of urban rail transit line 13 buildings with accumulation effect of each site surrounding buildings within the constraints of land use around much and plot ratio is higher. The average plot ratio of buildings along the line 13 is 2.84, with an average plot ratio of 2.47 and 21 (the average plot ratio of the buildings in 111 is 2.96 and 2.26 for the buildings with the average capacity of 2km). The average volume ratio of the buildings along the eight-way line is 2.2, and the average volume of buildings within 2km is 2.36. It can be seen from the figure that, with the addition of the distance from the site, the overall volume rate has decreased to 651. It can be seen that within 300m range of urban rail transit, high-strength development should be done to develop the gross volume.

Along the urban rail transit, especially the land surrounding the site the increase of volume rate can increase on finite covers an area of resident population and jobs, and attract more passenger flow of production and life, particularly surrounding rail site for high strength development, helps to convert the level of traffic on the ground to the vertical direction, is conducive to efficient traffic organization.

4.3 Development of the Influence of TOD on Passenger Flow

TOD refers to the "development mode guided by public transport". The public transport is mainly refers to the railway station, airport, subway, light rail and other rail transit and bus lines, and then to the site as the center, 400 ~ 800 meters (5 ~ 10 minutes' walk) in order to establish the central square radius or the city center, its characteristic is to work, commerce, culture, education, living for a "mixed use", such as TOD's main way is through land use and transportation policies to coordinate the development process of city traffic and land the contradiction of insufficient. A period, people of "traffic guide Development" (TOD, Transit Oriented Development) the accurate meaning of the word did not seriously think, just literally be simple to understand: a kind of urban Development pattern, city to develop there, opened the road to get there first, road ahead, this is the traffic guide Development. This is similar to the "Service orientation Development" (SOD, Service Orient Development), which is also popular in China in recent years. The most prominent phenomenon is the development of the city and the new city government. Or the new administration center moved there first. Both of them are based on the land development model of "land use of transportation/service facilities", which is a one-sided understanding of "TOD". Development of the influence of TOD on passenger flow.

TOD mode development mainly by highway, railway, highway and urban rail transportation line, etc, the number of axial lengths, Angle, direction, and stretching speed directly city different external form, and decided to form a phased development characteristic during the period of the city. Therefore, the change of TOD mode has important constraints on the integration of urban rail companies. The development experience of many foreign cities proves that the construction of urban mass rapid urban rail transit will produce effective urban axial pull power, thus promoting the formation of TOD mode. Specific role is: the urban rail transit is mainly through the site constraints on urban space form, along the track of each site constitutes the development of urban spatial extension axis, attachment formed along the axis of the continuity of the extension or high-density dotted along the axis, rail lines and the axis of the urban space form development.

So-called axial extension along the rail line mainly refers to relying on the large capacity city fast urban rail transit system arrangement of urban housing and jobs, so by finite extension shaft, can

avoid envelops extension of city; Along the axis arrangement of land development at the same time, inevitably increase in flow rates, but for the formation and development of passenger corridor provide a good condition, and the formation and transport of passenger corridor of intensive construction, is bound to improve land transportation accessibility, to further promote the virtuous circle of the city. Research shows that urban rail transit of each site accessibility almost unanimously, so the ring will land arrangement pattern along the urban rail transit line in turn, form along the urban rail transit "bead chain" of land development space; Layout of urban rail transit in urban area, average station spacing is small, the adjacent site after the extension of surrounding land use will be together, form a continuous strip along the urban rail transit line extension, and in the suburbs of city new district or station spacing generally larger, such a case would be a dot density extend along the urban rail transit line. The characteristics of urban rail transit will help change the urban development pattern of single center circle, to form a finger structure and multi-center network structure is relatively perfect urban structure has the very good guide, can be appropriate to the construction and the urban space development in urban rail transit network, make the city space form multiple core focus by single dot concentration gradually change, and by now "booth pie" disorderly spread into orderly development axis along the city's main directional expansion.

Using the mobility and convenience of urban rail transit to promote the construction of urban sub-centers, thus decentralizing the function of the central area of large cities and reducing the pressure of downtown. Singapore's planning and design of urban rail transit line itself is through the planning and development institutions close cooperation and work together to complete, as a result, formed the focus of development, traffic corridor. With all the operation of urban rail transit station, along the urban rail transit network in the corridor of inverted "T" shape the development and utilization of the establishment of the system of the city to further strengthen the "ring structure" typical linear mann, a satellite city of Paris valle from Paris. France in the 1960 s under the premise of accelerated development of urbanization, after careful TOD planning and design, the rapid development in the short term, the priority to the development axis, pearls of discontinuous city, to guide the development of the city traffic, the generalization of built space reasonable division of the traffic system and city of cohesive groups.

Table 1. Three major factors constrain passenger flow

Site	Land area	Volume rate	TOD
XZM	0.58	0.90	0.76
GM	0.52	0.88	0.83
WJ	0.55	0.89	0.78
PGY	0.59	0.71	0.90

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