Chapter 13
Research on Transfer Design of the Subway Station Buildings

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Abstract The distribution of transfer station affects the operation of the rail transit network, thus it affects the whole city traffic. Through analysis and research on multiple international metropolitan underground rail transit transfer station cases, this article starts from the interchange station layout form, the transfer mode and transfer efficiency. It discusses the method of urban underground rail transit transfer station design and finds that the layout form of interchange station decided to the passenger transfer way, for different forms of transfer way lead to different transfer time and the transfer way influent the transfer efficiency.

Keywords Subway station buildings • Transfer mode • Transfer flow • Transfer efficiency

13.1 Construction and Development of Urban Underground Rail Transit Transfer Station

With the development of city and the increasingly perfect of the urban rail transit, the subway operation mileage, the subway line and the number of subway station‘s increasing, the number of transfer station is also increasing. In 2004, the number of transfer station in London is 65. It rises to 35 % and the number of the transfer station sum up to 100 seats in 2012. So far, the largest number of transfer station city is New York, the number of the transfer station sum up to 111 seats in 2012.

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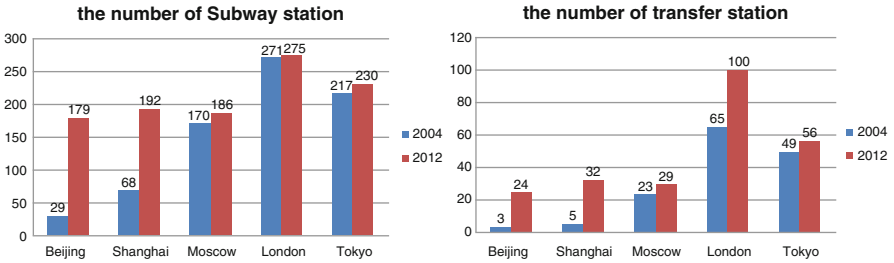


Chart 13.1 Related statistics on part of the urban subway construction all over the world (*compared with 2004 and 2012*)

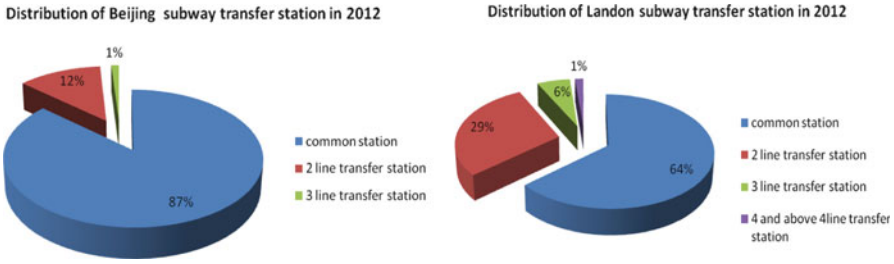


Chart 13.2 Related statistics on transfer station in Beijing and Landon (*compare with 2004 and 2012*)

Chinese subway construction is in the development stage, so the speed of transfer station increasingly is particularly significant. By the year 2004, number of transfer station from Beijing and Shanghai is insufficient ten seats. In 2012, the number of transfer station in Beijing rises to more than 20, and that in Shanghai rises to more than 30. Transfer stations are greatly increasing in recently, the number of transfer station from Beijing and Shanghai increased seven times and 5.4 times. By the year 2015, Beijing subway line will reach 19; wire network transfer station will reach 74 seats, more than that in 2012 years and increase about 2.1 times in 3 years, and increase 35 times than that in 2004. With the increase of urban subway lines, the subway by two line transfers, gradually developed into three wire transfers, even four wire transfers, some cities even have five line transfers, transfer station number increased sharply. With the number of transfer station rising, subway interchange stations play an important role in the subway network (Charts 13.1 and 13.2).

13.2 The Distribution of Underground Rail Transit Transfer Station Based on the Overall Urban Planning

With the aggregately construction of the subway network, the line between network nodes – transfer station – continues to increase, and transfer station in the rail transit network is playing more and more important role. Interchange station acts on improving the efficiency of urban residents traveling [1].

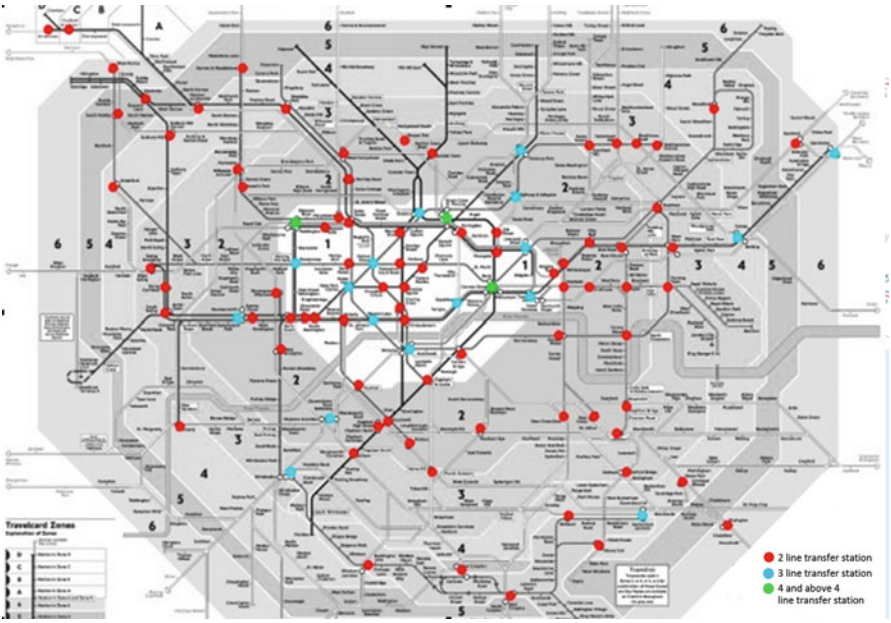


Fig. 13.1 Distribution of transfer station in London

The distribution of transfer station bases on the planning of urban design, and transfer stations form to node which is intent distributing in the city's important area and the core zone such as the urban traffic, commerce, culture, information, entertainment center and so on in urban underground traffic network. Underground rail transit construction abroad started early, and the distribution of transfer station closely based on the urban planning [2]. Subway in London form into loop radial and 12 subway lines across the city's six areas. Transfer stations were constructed at the intersection and contacts the rail transit network and covers the whole city (Fig. 13.1).

The construction of Underground rail transfer station in China bases the urban planning. Take Beijing as an example, Beijing subway carried out "a ring and second lines" construction planning in the early time. The transfer stations were distributed in DongCheng district and XiCheng district of the city center, and were set in line interchange, connecting with the urban areas. In the twenty-first century, Beijing subway is developing rapidly. At this time, the construction of transfer station in Beijing is closely attached to the "underground space development and planning of center area in Beijing (2004–2020)". The subway line will reach "three-ring, four cross, five longitudinal and seven radiation" totally 19 lines, including 73 seats transfer station by 2015.

Transfer can realize the transfer, contacting by surface cover replace the point line. Reasonable transfer station will promote the urban traffic system operating efficiently.

13.3 Layout Form of Urban Underground Rail Transfer Station Decided to Transfer Mode

The layout and graphic design of the underground space of transfer station is very important to rail transit function in the network, at the same time, different layout decides to transfer distance and transfer time even influences transfer efficiency.

13.3.1 Layout of the Underground Rail Transit Line Influence the Layout form of Transfer Station

Layout of urban underground rail transfer station should consider the rail transit network planning, the construction sequence and mixed form, transfer station transfer passenger flow and the traffic, business development and the location of the project summary and so on various factors. Among them, the layout of the underground rail transit line plays an important role to transfer station layout form. The layout of underground rail transit line should combine with city function, using of city resources reasonability, coordinating of urban space layout, making rail transit and city combine as an organic whole, and then to get reasonable transfer station layout form.

13.3.2 The Transfer Station Layout Form

For single transfer station, the mode number of transfer station relates with the number of subway line. the layout form of two line transfer station profile to "+" type, "T" type, "L" type and "=" type in accordance with the relationship with platforms (Fig. 13.2). For three lines transfer station, there are a variety of other

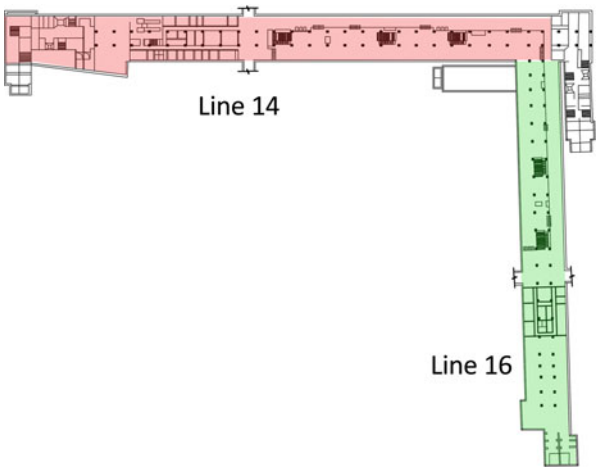


Fig. 13.2 SanLuJu transfer station scheme

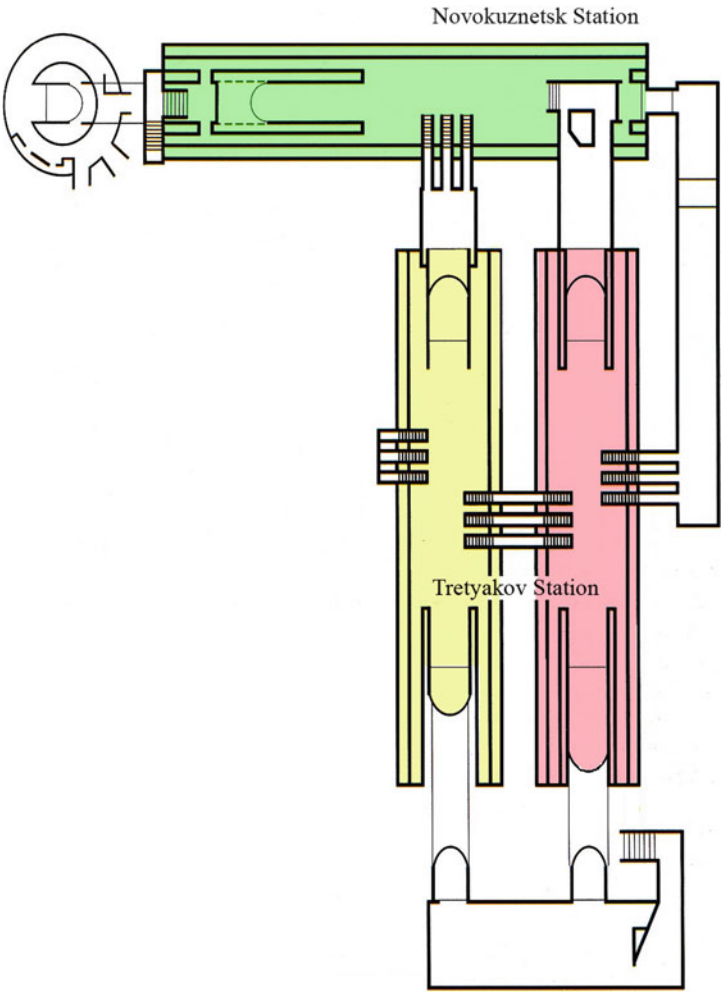


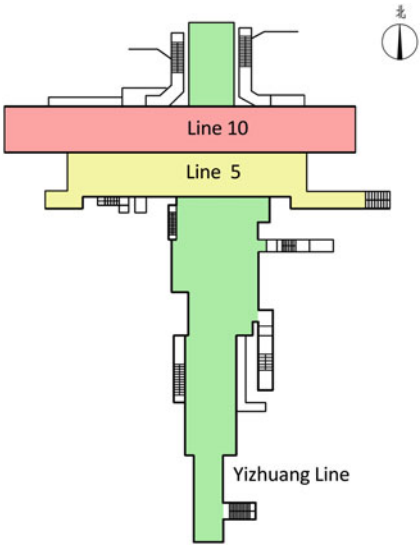
Fig. 13.3 YaKeFu transfer station scheme

forms basing the two lines, such as "△" type, "*" type, "F" type (Fig. 13.3), "H" type (Fig. 13.4), and four line transfer station "□" type (Fig. 13.5) and so on.

13.3.3 Influence of Transfer Station Layout Form to Transfer Modes

The transfer station layout form decided to transfer mode. Different transfer mode is suitable for different transfer station layout.

Fig. 13.4 SongJiaZhuang transfer station scheme



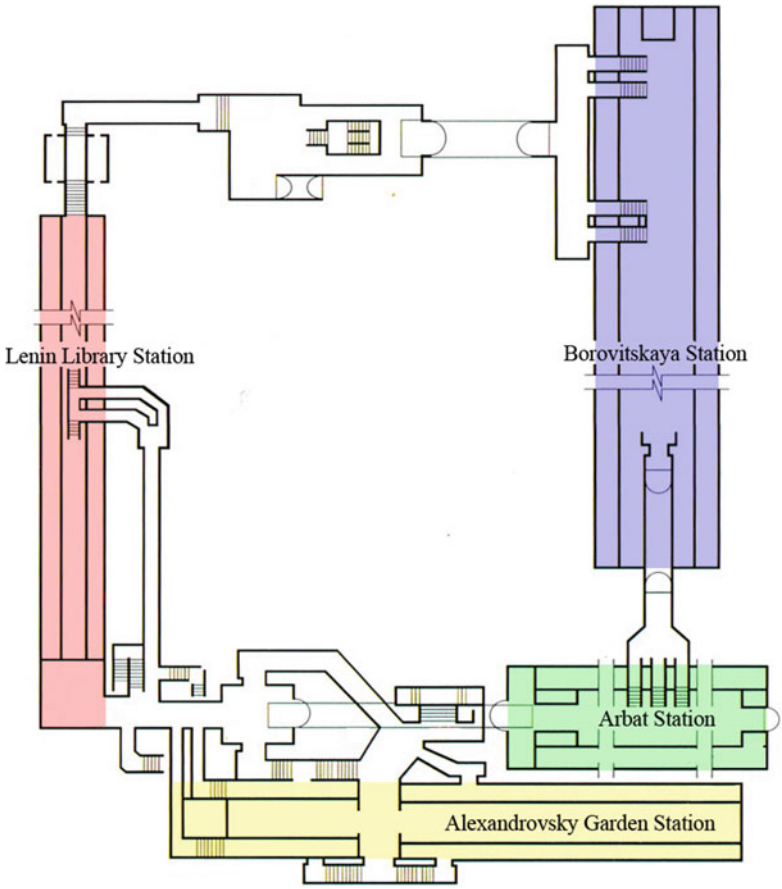


Fig. 13.5 Moscow Alexander Garden transfer station scheme

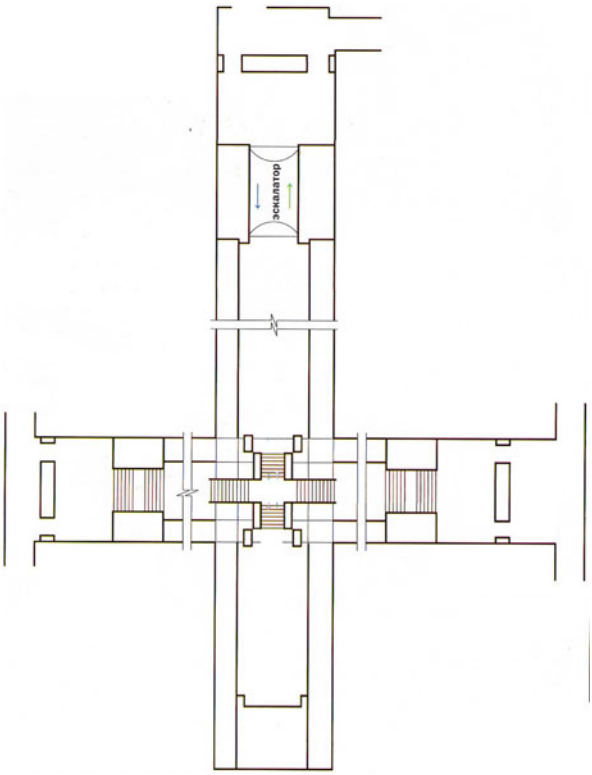


Fig. 13.6 Central hall transfer layout plane

Transfer mode can be divided into different kinds of forms corroding different angles. On the basis of transfer position, it can be divided into the central hall transfer (Fig. 13.6), the hall end transfer (Fig. 13.7), middle and end combination transfer (Fig. 13.8) and According to the transfer form, it can be divided into same hall transfer (Fig. 13.9), bridge transfer, porch transfer and combination with middle bridge and porch transfer. Bridge transfer means transfer through the bridge crossing the orbit, which is a kind of common transfer forms that widely used in Moscow subway stations. Its transfer distance is shorter, causing less transfer time. Porch transfer are used for vertical transfer, which using the end of the channel mutual to transfer in two line hall, and the transfer distance is a bit long, casing transfer time less. Combination with middle bridge and porch transfer is a more complicated transfer form, which generally applied in three lines and four line mutual transfers.

Fig. 13.7 Hall end transfer plane layout

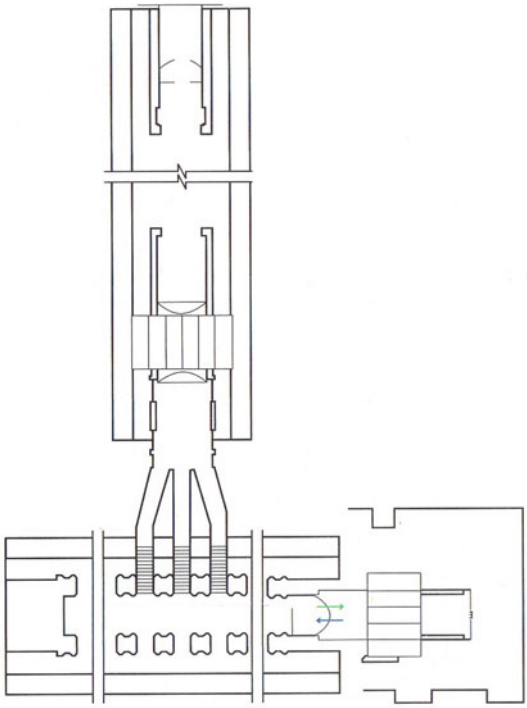
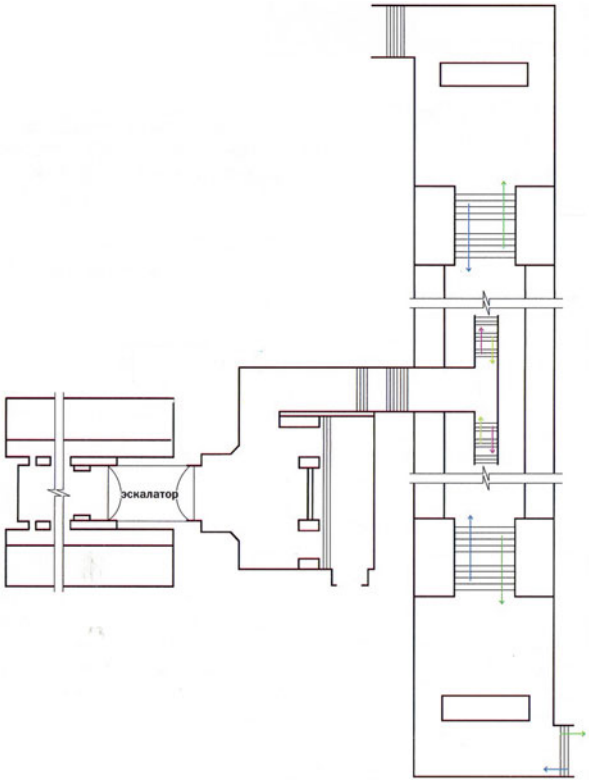


Fig. 13.8 Middle and end combination transfer plane layout



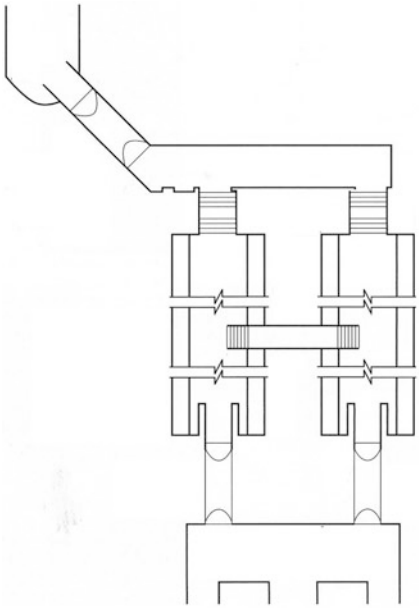


Fig. 13.9 Combining with hall change layout

13.4 Influence Factors of Transfer Efficiency

In the railway traffic transfer station design, improve the transfer efficiency is one of the main points, while there are many factors affects the efficiency of transfer, such as the transfer station space layout form; Change the channel, the staircase and ramp forms, scale and direction; Transfer guide logo design and layout; The design of the transfer line; Transfer space design, etc [3].

13.4.1 Transfer Station Space Layout Form

Traffic hub of the space layout form decided to interchange way, decided to change to the mouth position. Change to the mouth in the central hall general central or ends. Measure transfer station layout form, interchange way to transfer the stand or fall of position and mouth standard is transfer time, layout form, interchange way and the transfer of the mouth is designed to position to minimum distance, change to the shortest time. Common transfer station layout form, interchange way and the relationship between the transfer time see Table 13.1.

Through the Table 13.1 we can see, different layout forms combined with different directions and the ways have important influence on the length of transfer time [3]. In general, the two wire transfer, as a result of "=" type "+" type can form part of the passenger flow, so under the situation of the same transfer from equilibrium time traffic, its transfer efficiency in order to "=" type, "+" type, "L"

Table 13.1 The layout form of metro interchange station, the interchange way and interchange time

Line	Layout form	Name	Transfer mode	Transfer line	Transfer time	Evaluation
Two line transfer	"="	Kitay-gorod in Moscow	Transfer with hall	Line 6 – line7	15 s	Shortest
			Central bridge	Line 6 – line7	40 s	Short
			Porch	Line 6 – line7	2 min 40 s	Shorter
	"+"	Lama Temple in Beijing	Fringe porch	Line 2 – line 5	40 s	Short
	"T"	Kuznetsky Most in Moscow	Fringe porch	Line 7 – line 1	3 min	Shorter
	"L"	Oktyabrskaya in Moscow	Fringe porch	Line 6 – line 5	2 min	Shorter
Three line transfer	"F"	Kiyevskaya in Moscow	Fringe porch	Line 5 – line 4	East 2 min 30 s	Shorter
			Fringe porch	Line 5 – line 4	West 5 min 20 s	Longest
	"F"	Kiyevskaya in Moscow	Fringe porch	Line 3 – line 5	East 1 min 40 s	Short
			Fringe porch	Line 3 – line 5	Bridge 2 min 30 s	Shorter
	"F"	Kiyevskaya in Moscow	Middle stair	Line 4 – line 3	East 4 min 40 s	Longer
			Middle stair	Line 4 – line 3	West 5 min	Long
	"H"	Song JiaZhuang in Beijing	Fringe porch	Line 5 – Line YiZhuang	1.5 min	Short
	"H"	Song JiaZhuang in Beijing	Fringe porch	line 10 – line YiZhuang	1.5 min	Short
	"H"	Song JiaZhuang in Beijing	Central bridge	Line 5 – line 10	0.5 min	Shortest
Four line transfer	"□"	Alexandrovsky Sad in Moscow	Central bridge	Line 3 – line 9	2 min 10 s	Shorter
			Fringe porch	Line 3 – line 4	3 min 10 s	Shorter

type and "T" type, in the three lines above transfer, while, the passenger transfer agreement, the transfer efficiency of the shortest transfer time is the highest.

13.4.2 Transfer Mode and Transfer Time

Transfer station transfer modes with the platform mainly include transfer, node transfer, station hall transfer, channel transfer and mixed transfer and several ways. With the platform is to transfer the passengers off directly after the other side to walk to the platform, waiting for the train. Node, the station hall and channel transfer respectively is refers to the transfer passengers get off use floor escalator (nodes), transfer hall, transfer channel to another platform waiting. And hybrid transfer is a fusion of several transfer way in front of the comprehensive change.

In a variety of transfer mode in the comparison, with the platform transfer can greatly simplify the transfer line, is the ideal transfer way, but to wire network planning, circuit design, train operation organization the demand is higher, and the cost is expensive. Node, station hall, channel transfer is the present domestic rail transit commonly used transfer organization way, convenience from high to low arrangement with the platform is: One-platform-interchange > node transfer > channel transfer > station hall transfer.

13.4.3 The Influence of the Transfer Time

In general, the interchange station layout form, transfer modes, transfer line between various factors are closely related. The transfer between items reflects on the influence of time. And the length of the transfer time has a direct link with the transfer efficiency. Under construction in Beijing BaiShiQiao transfer station scheme for patients (Figs. 13.10, 13.11, and 13.12) [4], the designer is based on different BaiShiQiao transfer station layout form, transfer mode, transfer streamline design, this paper combined with the city's comprehensive factors to consider, to form the perfect design.

Of course, the interchange station layout forms need to be affected by many factors in practice, including travel passengers characteristics, transfer facilities, transfer station operation situation, the transfer station space environment quality, etc. But the transfer station itself, transfer station space layout, transfer mode, transfer time, its layout form of passenger transfer efficiency of the influence is no doubt. In these main factors determine the premise, combined with other factors can be determined from comparison of various transfer station integrated transfer evaluation.

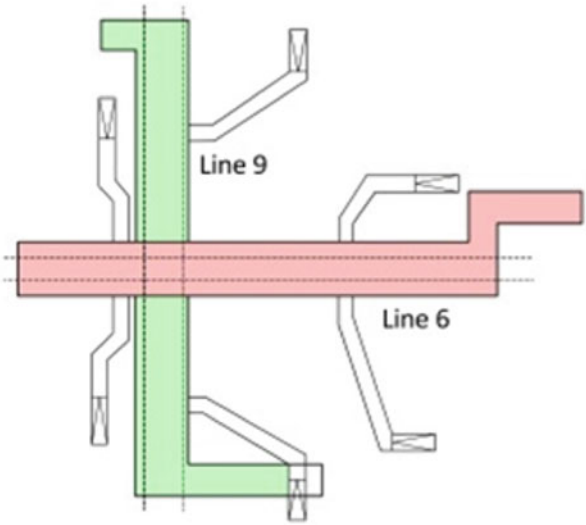


Fig. 13.10 BaiShiQiao transfer station "+" type scheme

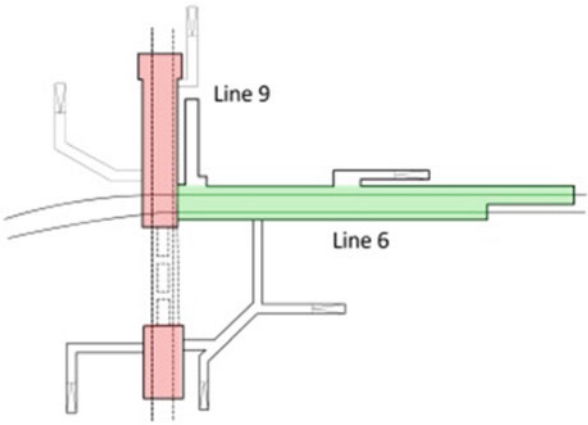


Fig. 13.11 BaiShiQiao transfer station "T" type scheme

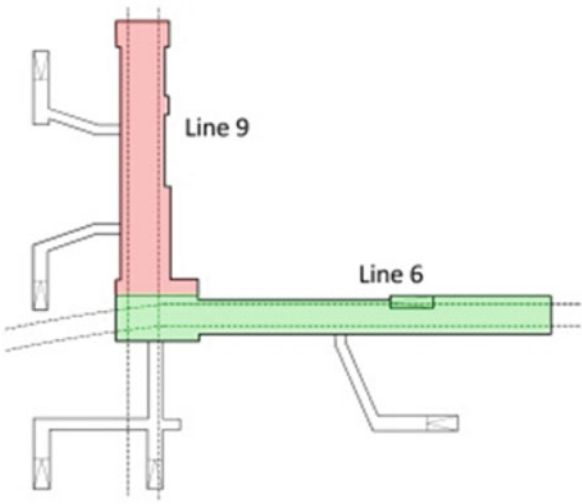


Fig. 13.12 BaiShiQiao transfer station "L" type scheme

13.5 Conclusion

In the metro transfer station construction practice, we can see the metro transfer station quick and efficient transfer design mainly embodied in the following: (1) the interchange station location and layout closely combined with city planning. (2) the way to optimize the design, make full use of the same hall, the same transfer and other high efficient transfer form, the transfer distance is short, transfer time less optimization scheme; (3) transfer station transfer streamline design is reasonable and change to the flow of a single, clear and do not cross.

There are various layout forms and transfer modes in rail transport hub station . But no matter what methods should be to meet the demand for passenger travel, it must ensure there is enough transfer efficiency and convenience. Paying attention the transfer efficiency of passenger flow in rail transport hub is one of the important directions in urban rail transit construction transfer station design and planning.

References

1. Wang Bo, Li Xiaoxia An Shuanzhuang (2010) Analysis on transfer passenger flow characteristics and station design of urban rail transit [J]. Urban Rapid Rail Transit 02:55–57
2. Dong Yuxiang (2012) Research on Russia Metro Transfer Station underground space design [J]. Huazhong Archit 01:6–10
3. Bao Ning (2009) The study of the urban subway transfer station design [D]. Beijing Jiaotong University, pp 16–23
4. Kang Yuehua (2009) Study on transfer schemes on Baishiqiao Station of Beijing Metro [J]. Railw Stand Design 10:38–40