

Positive Interaction between Transportation Hub and Urban Space in Mega-city Redesign the Generation of Urban Design Strategies at Shanghai West Railway Station

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Abstract: With the high-speed intercity passenger transportation gradually entering people's lives, the definition of intercity railway transportation has been changing. Meanwhile, high-speed intercity passenger service station and the surrounding areas are still stuck in outdated facilities and chaotic image. The essay focus to figure out what is the positive interaction between transportation hub and urban space. It aims to provide people available and affordable transportation not only with traffic and infrastructure planning, but also with outstanding urban design quality and its Social Dimension. As the rapid development of China's mega-cities, Shanghai has a dominant role in transportation in the Yangtze River Delta region. Through the description of current situation between urban space and transportation hub at Shanghai West Railway Station, the redesign intends to put forward the challenges that Shanghai West Railway Station will face at present and in the future development, evaluate the transformation of the old city with concrete examples, design and bring forward the corresponding strategies in six aspects: space, transportation, function, form, ecology and the connection to the surrounding area, determine a more appropriate and more extensive updates and development from multiple angles on the basis of a variety of factors so as to improve the vitality of the region gradually. On this basis, this paper will make an objective analysis on how to enhance the quality of the environment around the station and along the railway and improve the split urban space caused by the rail lines, thus creating a more effective system design mode to make sustainable development in Shanghai West Railway Station area.

1. Introduction

1.1 Background

High-speed railway features in Shanghai West Railway Station transportation. Therefore, how to enhance the quality of the environment around the station and along the railway and improve the split urban space caused by the rail lines has become station designer and urban designer's common concern (Figure 1).



Figure 1. Current situation of Shanghai West Railway Station and its surrounding urban space

1.2 Research object

Formerly known as Zhenru Station, Shanghai West Railway Station is 5km west from Shanghai Railway Station, 196km from Hangzhou Railway Station, and 1458km from Beijing Railway Station. It is an integrated transport hub of intercity rail transport, urban rail transport and urban public transport. With the two functions of external transport and urban transport, it plays an important role in the transport network planning of Shanghai and the Yangtze River Delta region (Figure 2). Due to the above mentioned reasons, it is in urgent need of urban design from the city functionality, accessibility, connectivity, etc. Urban designers should make full use of the constraints and opportunities in railway and station reconstruction, think about how to improve the overall environmental quality of the region, enhance the links and transfer between the railway station area and urban rail transport, give guidance and make control of urban form so as to build up the overall image of Shanghai Zhenru area as the city's sub-center.

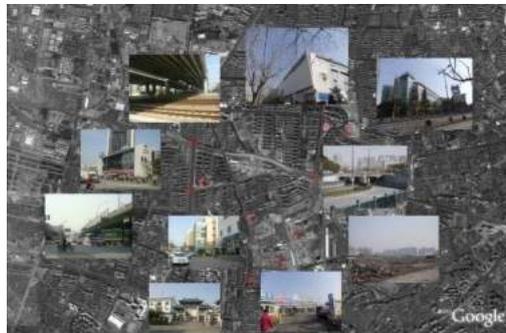


Figure 2 .Shanghai West Railway Station land plan and the major functions of its surrounding area

1.3 Situation analysis

1.3.1 Current situation of transfer efficiency

Through field research, it has been found that Shanghai West Railway Station transfer lines are very complex and inconvenient to connect urban public transport. Pedestrians often have to go across the entire West Railway Station area to transfer (Figure 3), which forms a certain impact on traffic efficiency.



Figure 3. Shanghai West Railway Station Transfer Situation Analysis

1.3.2 Current situation of urban space

Most of Shanghai West Railway Station surrounding area is occupied by residential district and the commercial is underdeveloped. But it plays an important role in boosting the development of Zhenru sub-center. It has the advantage of making high-end talents gathering and circulating. In addition, Caoyang Road is now the focus of commercial zone. So it is worth considering the possibility of the urban space replacement for business functions or mixed residential and commercial use so as to promote the interaction between traffic space and urban space.

1.3.3 Current situation of surrounding commerce

Shanghai West Railway Station External Commercial is arranged around the station and is quite dispersed. Some business is proposed in the underground passage, but the planning commercial proportion is not large. Compared with Shanghai Railway Station and Shanghai South Railway Station, Shanghai West Railway Station hasn't formed an effective commercial space. Because business once was used as a cargo terminal and near the industrial area, the surrounding businesses are mainly some large building material and agricultural products market, thus forming a citywide logistics center (Table1).

Table1. Surrounding commercial comparison of Shanghai Railway Station, Shanghai South Railway Station, Shanghai West Railway Station

site	Shanghai Railway Station	Shanghai South Railway Station	Shanghai West Railway Station
Internal business	Corridor type layout, waiting to buy, easy to use	Around the layout, purchase before the waiting, more convenient	Not available
external business	Scattered layout, popular feeling, more chaos, traditional business model, ground-based business	Concentrated layout, popularity decreased, feeling clean, modern business model, underground business	Scattered layout, less popular, feeling cluttered, traditional business model, ground-based business

2. Problems raised

2.1 Immensity of passenger flow between urban transit and rail interchange

The passenger flow between urban transit and rail interchange at Shanghai West Railway Station is important. If not organized well, it can easily lead to crowd congestion. When the train arrives, there will be a large number of passengers evacuating from the station to different directions in a short time. There will be very long queue of passengers buying urban transport tickets at this time and thus cause the congestion of the channel (Figure 4). Concourse level should be set up at urban transport station to solve the problem of too many passengers buying tickets and the organization of passenger flow. In addition, the setting of concourse level at urban transport station can also reduce the impact of convergence between railway and urban transport.



Figure 4. Zhenru sub-center traffic demand forecast

2.2 Lack of convergence in transfer modes

At the area of Shanghai West Railway Station, traffic problems are embodied in the following aspects: first, the public transport station is very dispersed and the waiting area is too small; second, the subway station is set away from the street; third, the social vehicle parking spaces are insufficient to cope with the future railway passengers; fourth, the taxi drop-off area is too crowded and in disorder; fifth, the current setting of tunnel cannot meet the needs of residents on both sides of the railway; sixth, illegal operation vehicle control deficiencies.(Table 2)

Table 2. Shanghai West Railway Station area travel choice proportion

Travel mode	Travel proportion	Travel times (million/d)	Converted into trips(PCU/d)
Public transport	Rail transit 30%	14.4	9.4
	Ground public transport 20%	9.5	6.2
Passenger car taxi included	25%	7.8	5.1
Walking and Cycling	25%	7.8	
Total	100%	31.2	5.1

2.3 Lack of vitality in city nodes

Either at the Square or in the waiting room of Shanghai West Railway Station, the green landscape is more focused on the flow of distribution, which makes the urban space lack of a pleasant, attractive environment for people to stay, thus leading to the low urban vitality (Figure 5). Because Shanghai West Railway Station originally featured in cargo transport, the flow of people is low, the surrounding commercial is underdeveloped and the commercial node is not obvious. There are food square and seafood market, but they are not closely linked to Shanghai West Railway Station. The author believes that setting up a number of commercials in such areas as Shanghai West Railway Station will play a good role in enhancing the city's vitality.

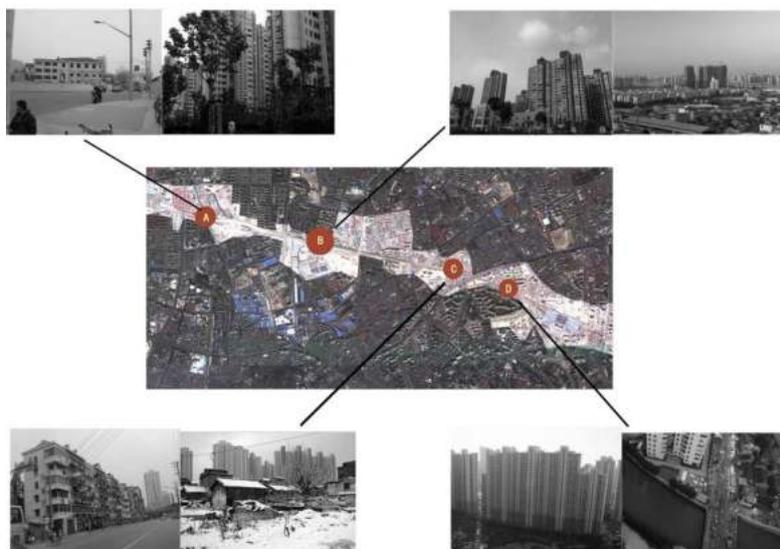


Figure 5. Insufficient urban vitality near railway station area

2.4 The issues of split urban space by railway

Railway Station Square is an endpoint of urban space. The square and the train station are generally separated by the closed façade of the station. Urban space comes to an end at this place. This will cut the continuity of the urban space and the railway line will link to another city. The train track set results in the uneven development on both sides of the track at the urban station area, which split the balance around the line (Figure 6). In north part of the West Station area, traffic is heavy, small plants and small-scale shantytowns creates noise, pollution and harsh environments. The West Station area, the supporting station and hotels are in the south part. The status quo is that the north and south channels are not convenient enough to meet the needs of the residents living on both sides. In the city the railway station area cuts the connection of different regions bluntly, which is not conducive to the common development of the surrounding area; meanwhile the surrounding areas near the train station also become the forgotten space, which deepens the barrier effect of railway lines. The expectation of the design is by redefining the railway lines around the functional space (cultural, recreational facilities), to establish a moving platform which links north to the south, to achieve a balanced development of the north and south. Meanwhile, the flow of people brought by railway and the future

subway can activate the surrounding areas, including commercial and cultural facilities.



Figure 6. Impact of rail lines on the city uneven development on both sides

2.5 Lack of consideration for future traffic circle development

Shanghai has come to a stage of urban rapid development. There are more and more exchanges between Shanghai and other Yangtze River Delta cities; the people in some medium and small cities in the surrounding areas also expressed the integration requirements. As the central city, Shanghai's radiation on the surrounding area has been further strengthened. However, the railway system of Shanghai metropolitan traffic circle bears very low flow of passengers, which is far below the level of international metropolis. Due to the limitations of administrative divisions, comprehensive transportation planning of the overall urban planning in Shanghai is only confined to Shanghai city administrative area. Yangtze River Delta is lack of regional development planning agency; transport system connection is poor, and lack of integration. Through the development of commuter rail, breaking through the limit of traditional administrative divisions, achieving the regional linkage, it is very necessary to guide Shanghai metropolitan traffic circle to healthy and orderly development. With Shanghai to metropolitan development, urban space expands. Shanghai will be integrated with its surrounding cities and form a new large metropolitan area. It is very necessary to have a fast transport in the process of Shanghai's developing into metropolis. Obviously, public transport is lack of adequate capacity in supporting Shanghai's metropolis expansion. Rapid rail and commuter rail will be the inevitable choice for the large city to develop into metropolis¹.

3. Design

On the basis of planning, Zhenru area will integrate regional resources, establish Shanghai Zhenru sub-center at Cao Yang Road and Zhenru rail cargo terminal area, which will focus on the

¹ Compared with other international metropolis, the railway at Shanghai metropolitan traffic circle only borne the flow of passengers into the center 1.4% of that in Tokyo, 19.4% of that in Paris, 10% of that in New York. If calculating the number of travelers per capita, it is only 0.001 times/person, less than 1% in Tokyo, 2.73% of London, 4.95% of Paris, 3.62% of New York, even lower than Los Angeles. International Metropolis traffic circle railway traffic statistics, 2010

development of modern logistics industry, construct business office area, large logistics enterprises, hotel service area and low dense cultural facilities. Core area of Zhenru area is located in Caoyang Road and Zhenru freight yard. The land area is about 144 hectares. The vision of total gross floor area of commercial office will be limited within 1.8 million square meters. The planned construction features in resource allocation centers with modern logistics services, international trade procurement, and new-element market. Regional headquarters of large enterprises, market centers, R & D Centers, purchasing centers, investment centers and settlement centers from domestic and foreign companies are introduced and developed. Pedestrian Street is an important part of urban space and a concentrated expression of the city's geographical features. The commercial and financial center axis of the sub-center will be extended from Caoyang Road to the South Square of West Railway Station, and the commercial and financial viability of the sub-center will be spread to the north of West Railway Station through the setting of commercial axis at West Railway Station area. At the same time, this will create a good commercial atmosphere at eastern plots, thus forming a three-dimensional business climate.

The strategy of Zhenru sub-center planning horizontal and vertical axes, north-south double should be continued; the development of West Railway Station area in the sub-center future planning position should be strengthened; Treating West Station as the support center so as to spread the vitality to the northern urban areas (Figure 7).



Figure 7. Spatial form analysis at Zhenru area

4. Strategy generation

Facing the market, railway station should not only make full use the advantage of its speed and safety, but also improve the comfort of traveling and efficient travel route so as to increase its competitiveness. Meanwhile, as part of the city, the railway terminal in urban development should also play a promoting role in enhancing the city's openness and sharing.

The author conducts practical investigation on China's major railway terminal and areas and makes strategy analysis, comes up with the following improving strategies and preliminary design conception.

4.1 Space: Design strategy of urban spatial structure

4.1.1 Convergence of split urban space caused by rail lines

In urban spatial structure design strategy, designer should find the urban problems and impact on the design of the station area traffic brought by the rail lines. First it is the split of urban space by rail lines. Suture will be the way to deal with the split. In addition to the existing planning, design helps to suture the spatial texture of the city. Design of transit elevated line mainly provides the passage for taxis and private cars.

The vehicle will unload the passengers and leave at 15m layer. Passengers who will get off from north to south should go through 15m layer and check in at 10m layer to the waiting room, through the business district and then check in. So entering the station separately from both sides can help to avoid the confusion of crossing the line, and traffic can be more efficient (Figure 8).

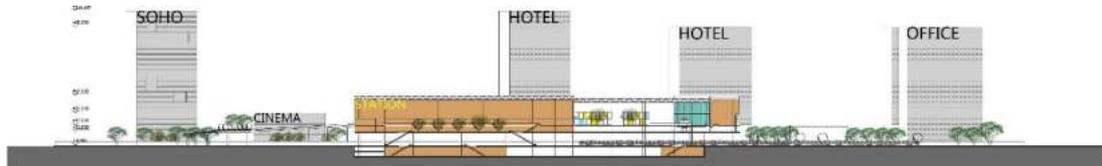


Figure 8. Suture the split of urban space by rail lines

4.1.2 Improvement strategy of urban vitality

(1) Public space

The setting of elevated walking path provide means of crossing for the leisure people along the ecological leisure axis in the west (Figure 9). Meanwhile, this viaduct not only has traffic function, but also has been set many ecological vegetation and gathering points according to its own leisure characteristics. Such as the viewing leisure platform along the rail lines. Ecological axis is also connected to many public buildings and hotel buildings. Functional combination of this compound will attract different crowd, probability of occurrence of sporadic behavior will also increase.

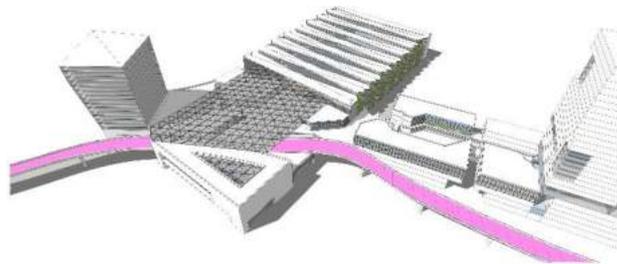


Figure 9. Elevated walking path

(2) Commercial cluster

The main commercial factors that will influence the development of railway station are:

First, flow elements. The flow of people at large railway station include the flow of arrival, departure, transit, the flow of people who meet passengers, surrounding residents and non-passenger flow. Second, traffic elements. Large railway stations are also the distribution center of buses and taxis. Railway stations, together with light rail and subway, form an urban traffic switching center; third, cultural elements. As the doors and windows of the city, large railway stations landmark and are bound to reflect the city features and city culture. Fourth, regional characteristics. Different positioning of the city in railway transportation will also lead to the difference of commercial space at railway stations.

To develop the railway station area, more importantly, government should base on the location of the

station in the city, combine with the foundation of regional business, the flow of passengers and actual level of demand, with excellent consumer environment and convenient traffic condition, form commercial centers which can not only attract passengers but also urban civilians. This is the most fundamental driving force to turn transport hub into economic hub, so as to integrate the railway station into the city (Figure 10).

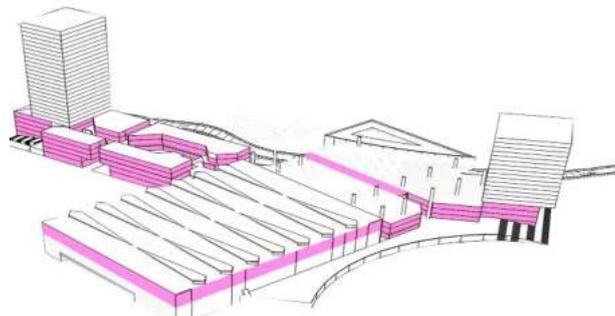


Figure 10. Commercial integration

4.1.3 Generation strategy of urban spatial structure

(1) Leisure eco-axis to increase the vigor of Taopu River on the west, set the boat dock, art industrial park, increase the spatial quality along the river, set ecological platform across the railway line and establish a continuous pedestrian system. Thus form a leisure eco axis which connects north and south(Figure11).



Figure11. Ecological axis plan

(2) Commercial viability axis extend the sub-center business climate, set 10min walking laps throughout Taopu Road to West Station North Square. In the north, the City Square is the endpoint of the axis. The sub-center commercial viability will be radiated to the northern regions.

- (3) Office financial axis set centralized office and financial area on the eastern side of the railway, improve the regional competitiveness and vitality of Zhenru sub-center. Establish close ties between centralized office area and Zhenru sub-center by the elevated setting (Figure 12).

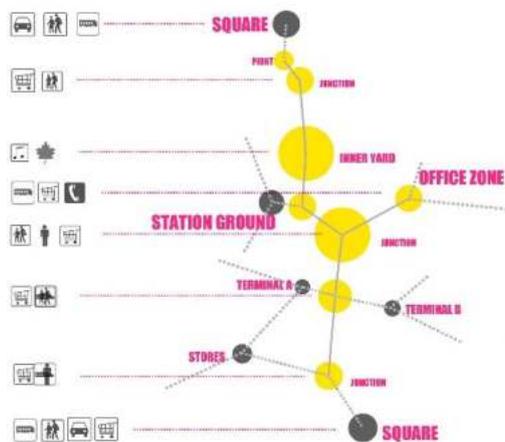


Figure 12. City functional integration strategy

4.1.4 Urban function integration strategy

In planning, the concept of multi-functional and three-dimensional concept will be used. Not only function layout will be done in the horizontal level but also functions will be superimposed in the vertical space. The commercial and office functions will be integrated in the planning and arranged in the highest value of the land plots in the south and east side, consisting of a series of commercial office building. Due to the focus on the development of high-capacity commercial and business office space, a portion of green space is preserved. Green belts will be set along the city's main road. Open Green Park will be set in the promoter region, thus forming density space and increasing environmental quality. As the growth ridge 3-D commercial Pedestrian Street is throughout commercial buildings. This street starts from subway station R3 line terminal, including ground floor, first floor and basement commercial pedestrian shopping space. Community-based street layout will be set along the street to gather popularity and create living atmosphere. This layout fully reflects the value of the land, so that the overall value of land development will reach the maximum in the permitted plot ratio, while maintaining the high quality of the urban environment (Figure 13).



Figure 13. City functional decomposition

4.2 Transport transportation system design strategy

4.2.1 Zero transfer strategy

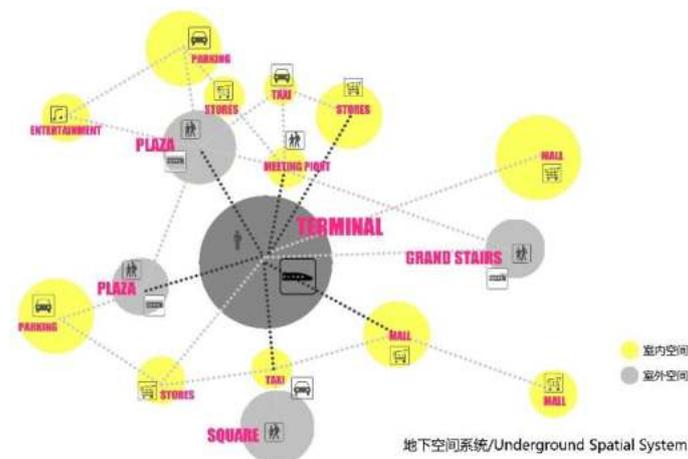
Efficient transfer is critical in railway station design. We have been very profitable in the previous data collection. In this design, we focus on the efficiency of transport interchange.

4.2.2 Spatial design strategy for highly dense passenger flow

From a large number of case studies², we can see that the design of underground space in urban railway station area is crucial, because the arrival floor of the train and subway is located underground (Figure 14). The crowd here will disperse to their destination, so enormous flow of people will be gathered here. Because of this, three main sunken plazas and two secondary ones are set. North-South Railway Station Squares and the sunken plaza which is directly connected to the station are the core area to evacuate the flow of people. So it is very important to set vertical guidance to guide the flow of people. Meanwhile, enormous flow of people can also become the potential consumers. Surrounding basements are also connected with the underground throughout the whole station. So the garage use and functional links are also highly integrated (Figure 15).



Figure 14. Shanghai West Railway Station city design floor plan



² Such as the Paris transfer center at the Paris North Train Station, Berlin central train station in Germany, the author notes

Figure 15. High-density space design strategies and spatial integration

4.2.3 Regional transport integration strategy

Planning through 3-D transport network will separate various traffic flows in different channels and levels, especially the traffic and vehicle separation (Figure 16). On the basis of this, encryption will be done to the road network density. The dense road network can bear it without having to increase the burden of high-grade roads. High-grade road only needs to take the transit and distributed passengers, so as to improve the traffic situation.³

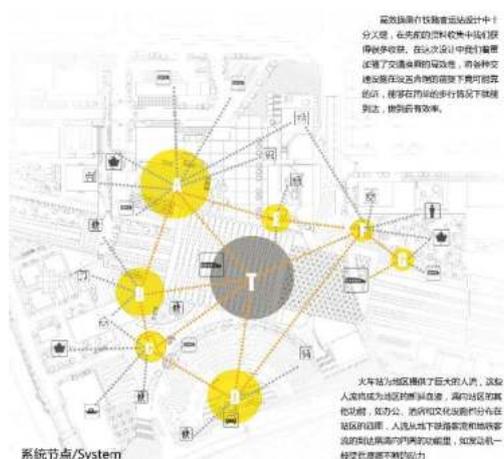


Figure 16. System nodes and urban complexes

4.3 Ecological aspects: people-oriented

Good ecological environment is not only an important constraint to the urban transport development, but also constitutes an important part to the railway station landscape space. In this regard, Shanghai South Railway Station provides a good reference: large green setting not only increases the vitality of the city, but also makes the scale of the entire South Station area closer to people's scale, promotes the vitality of the entire region.

4.4 Contact with the surrounding area: giving full play of the leading role of the city's sub-center

The transition of traditional railway station to transport complex and a variety of modes of transport agglomeration has the geographical advantage and high accessibility which has a strong guiding role to the development of the surrounding area (Figure 17).

4.4.1 Impact on the form of the land layout

According to the circle theory, within 600m around the public transport spots, mixed development of high strength can be achieved, showing Business-Hotel-Residential layout structure. The railway station complex is different from a general public transport station. The developing model has

³ In domestic city center railway station area road network, the secondary roads, especially the branch roads are of low ratio. At the central area of China cities, the ratio of secondary and branch roads with main roads in railway station area is far inferior to that in foreign countries. The road density at railway station area in the urban central district in China is comparatively low. The total road density in China is only 1/3-1/4 of that as in Europe, Japan and South Korea. China Urban Planning and Design Institute, Beijing, 2000

its own characteristics. For example, a large number of railway plots are scattered around, which split the city greatly; it is difficult to form very upscale business hotels or residential areas due to the large flow of people around.

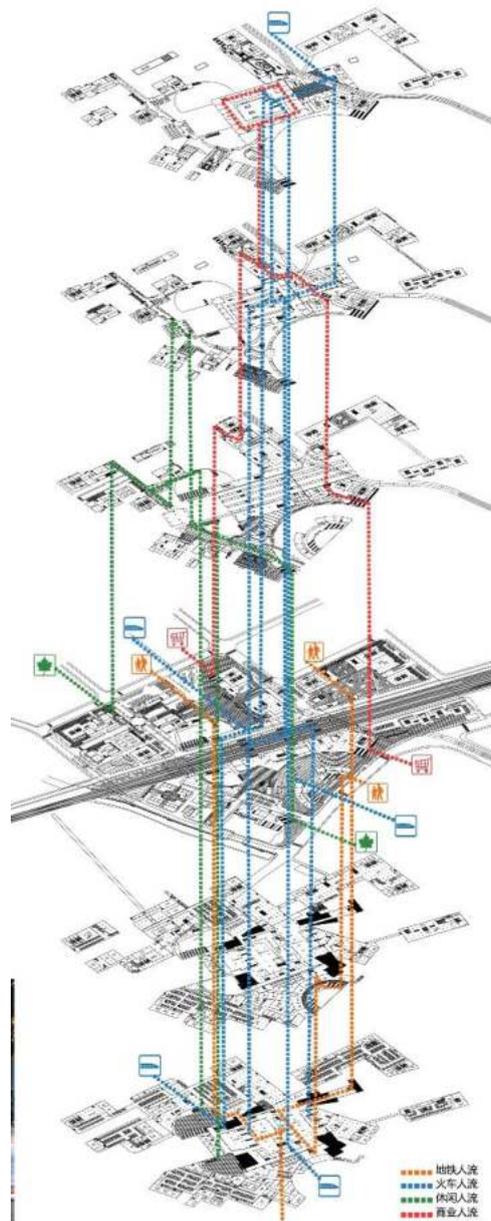


Figure 17. Vertical space planning

4.4.2 Impact on the state of agglomeration of the development

There is a high correlation between means of transport and land use. Bearing capacity of infrastructure is an important measurement of redevelopment strength around the railway station complex and traffic distribution capability is one of the key evaluations. A high density land use can promote the development of public transport, while low-density land use will promote the popularity of cars.

Meanwhile, different transportations will play a strong reaction to urban land use. Large-capacity public transport has the most significant influence on land development.

4.4.3 Railway station becoming the extension of urban space

The interior design is an organic part of city design, so city activities should not stop outside the station elevation. From the city's aspect, contemporary large railway station interior by the visitors.

Although the establishment of railway station complex has a significant impact on the surroundings, using the station project to help urban development is a complex process. Research shows that the successful development of the station area also depends on many other basic conditions, such as a vibrant local economy, idle land, healthy capital market, developed transportation network, strong public investment, etc. Only when these factors are complete, construction projects as a catalyst can really play a role. To achieve successful catalysis, perfect hub functions and rational planning of the surrounding areas are only part of the conditions, the development in reality will also depend on local conditions and improve continuously.

5. Conclusion

It is a systematic and complicated process to transform the traditional railway station which splits urban space to a comprehensive transportation hub which creates a positive interaction between traffic space and urban space. The author makes a case study on the generation of urban design strategies at Shanghai West Railway Station in order to illustrate the possibility of realizing a positive interaction between railway station traffic space and urban space (Figure 18). The highly integrated complex of urban business and traffic architecture will make more traffic activities occur. Meanwhile, in this highly integrated system, the surrounding areas of the plot will also be vitalized.



Figure 18. Positive interaction between railway station area and urban space

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