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1. Introduction

1.1 Brief Project Description

Enormous changes have occurred in Chinese cities since the economic reform of 1978, especially in east-coast areas, accompanied by urban population growth, urban/rural ratio, economic decentralization, and the like. Hangzhou is a large city on the lower Yangtze River Delta (Liu, Yue, & Fan, 2011). Due to its striking economic growth, urban sprawl, and large population, I chose Hangzhou’s growing urban area Jiubao for a case study. In this creative project, I will apply transit-oriented development principles to solve the issues caused by urban sprawl in Jiubao.

Figure 1. Zhejiang Province in China
1.2 The Importance of Applying TOD in China

Traffic pressure is a major feature of modern cities. On the one hand, transportation planning focuses on car-oriented design and building increasingly wider roads, which encourage people to drive. On the other hand, wider roads do not solve the traffic jam problems, and instead cause more traffic issues. People prefer to drive rather than walk, bicycle, or take public transportation.

Historically, Asian cities have been examples of transit-oriented development because of their fine-grain mixed-use plans, pathways for pedestrians and cyclists, and sufficient public transportation services on major roads. In most Chinese cities, people are used to shopping at corner grocery stores, walking to shopping malls, socializing in nearby open spaces, and taking public transportation instead of driving.
In a way, development density is already high in most Chinese cities. Mixed land use is common, and public transportation is more developed than in the United States. However, the recent ascendancy in car ownership and rising incomes are jeopardizing the historical transit-oriented urban form and giving rise to a car-oriented form. First, the increasing number of people owning automobiles in major, fast-growing Asian cities makes them more car-oriented and hostile to pedestrians and cyclists. Second, the transit systems are not conveniently connected with other surrounding circulation systems. Last, most Chinese new growth areas lack developed connectivity systems to take full advantage of the existing high-density, public transportation, and mixed-uses. Many transit stations and nearby land uses lack decent synergetic connections, leaving much of the high-density residential area dysfunctional. Therefore, promoting TOD in Chinese cities is essential to preventing the damages caused by car-based societies.

1.3 Reasons for Selecting Jiubao as an Example

As capital of Zhejiang, one of the most developed provinces in China, Hangzhou is known for its rapid urban growth, free bicycle rental system, and high-priced housing. Jiubao, a growth area of Hangzhou, has developed rapidly in recent years. At this stage, Jiubao is a typical and critical city growth area in Hangzhou. Its growing economy offers multiple transportation opportunities. It is a service center for the eastern region, has many strong industrial parks, and offers potential for real estate development. The area is an ideal location for research. This application of TOD in Jiubao intends to apply TOD methods to a new
growth area to achieve higher land-use efficiency, increase diversity of land use, enhance quality pedestrian environment, strengthen transit performance, and improve resident access to essential services. Applying TOD in Jiubao can be an exemplary role model for other areas to follow in solving critical urbanization issues.
2. Problem Statement

By applying TOD principles in Jiubao, I will develop a design method to help resolve the urban sprawl issues in China. The main goal of the research is to test TOD principles in a new growth area, develop a pedestrian-friendly community, and promote a less car-oriented lifestyle in China. This project would also serve as an example for other areas concerned with urban sprawl.

2.1 The Subproblems

1. What are urban growth areas and related issues in China?

2. What are TOD and the main TOD problems in China?

3. What are the characteristics of transit villages?

4. Based on site analysis and findings, what is the best solution to connect traffic systems at the town scale and within the transit center?
5. According to case studies and literature review, what are the characteristics of land use in TOD principles?

6. What are the examples of streetscape in hierarchy traffic settings?

7. Since the original land use on the site is agriculture, is it possible to preserve farmland as cultural landscape preservation and urban agriculture in horizontal and vertical forms? What are the examples of community gardens in an urbanized environment, both in and out of China?

2.2 Assumptions of Project

To achieve the benefits of applying TOD in Jiubao, the following assumptions made:

1. Government is willing to invest in TOD in Jiubao.

2. Residents are willing to give up their cars and prefer public transportation.

3. A Metro line and Metro stations will be built on site, and Hangzhou Public Transportation Authority plans a BRT along Xiasha BLVD.

4. The population growth pattern will continue in Jiubao.

5. With rapid urbanization, the agricultural land will be taken in the future for urban development.
2.3 Delimitations

1. This project is an alternative to Jiubao’s existing plan. It is a conceptual plan, developed from 2005 site conditions, and will not actually be carried out.

2. This project does not include funding, cost estimates, and construction.

3. This project is based on Chinese Planning Practices, and design scopes will only consider Chinese new growing areas.

4. The plan will only design a portion of blocks in Jiubao, not an entire town.

5. The project does not make specific temporary housing arrangement for displaced current residents.

Chinese planning practices follow and coordinate planning with multiple departments, including Ministry of Transportation and Communications, National Development and Reform Commission, Ministry of Land and Resources, and the like. In China, the planning is made from “top to bottom,” which means lack of feedback from the local and consideration from people. The planning is developed from “large” scale and usually does not use charrettes to involve local residents in the design process. Due to the weakness of planning management, planners cannot realize the problems from the site, so the planning map and the reality could be totally different. The planning direction is not stable but always changing. From China’s political condition, each session of the government would change the planning made by the last government because it is part of the government’s achievement evaluation and appraisal system.
3. Literature Review

3.1 Theoretical Background

3.1.1 Urban Growth in China

During the development process in major Chinese cities, satellite towns and new development zones have begun to merge to solve the shortage of land and space. These urban growth areas share certain features:

- **Land Use.** Urban growth areas, in general, change from rural areas to small towns, generating urban sprawl. In addition to commercial housing, there are still a large number of farmer-occupied houses and affordable housing. Since most land was originally farmland and belonged to the government, it is not necessary to consider land ownership and community support for new construction.

- **Population.** During the rapid development of urban space, emerging cities absorb a large number of migrants. These areas accept populations moving out from city centers, such as when employees follow relocating
urban enterprises. Affordable housing and low cost of living also attract residents from overcrowded urban centers.

3.1.2 Transit-oriented Development Design Principles

Transit-Oriented Development (TOD) refers to mixed-use, relatively intense development concentrated within a 2,000-foot radius around a transit station and oriented to transit riders with pedestrian- and cycle-friendly environments (Calthorpe, 1993). Today, TOD provides other benefits besides capturing increases in land value.

Figure 3. Typical TOD Diagram (Calthorpe, 1993)

In his book *The Next American Metropolis: Ecology, Community, and the American Dream* (1993), Peter Calthorpe articulates the following TOD urban design principles:

- Organize growth on a regional level to be compact and transit-supportive.
- Place commercial, housing, jobs, parks, and civic uses within walking distance of transit stops.
• Create pedestrian-friendly street networks that directly connect local destinations.
• Provide a mix of housing types, densities, and costs.
• Preserve sensitive habitats and high-quality open spaces.
• Focus building orientation and neighborhood activity around public spaces.
• Encourage infill and redevelopment along corridors within existing neighborhoods.

To sum up the design principles above, a successful TOD should be mixed-use, within walkable distance, and in an efficient location that connects the transit service with adjacent communities.

3.1.2.1 Transit Station

In the past, the St. Pancras Station in London, Penn Central in New York, and Gare de l’Est in Paris were the leading landmarks of social, economic, and cultural forces, and showrooms for advanced engineering and architecture. The key of today is “seamless journey” (Thorne, 2001). The concept is to make the travel experience more efficient and welcoming. Another trend is to solve the complex interconnections among different modes of transport, such as Lehrter Bahnhof in Berlin, Transbay Center in San Francisco, and Kowloon Station in Hong Kong.
In Brian Edwards (1997) and Martha Thorne (2001) discuss Kowloon Station as a good example to incorporate heavy rail, light rail, bus, and taxi facilities. The new rail link will be a 34-km route, and Kowloon Station is the largest on the route. Kowloon Station will serve transportation needs but also contribute to the region’s identity. The functions are organized by floors:

- Basement level two--light rail
- Basement level one--drop-off roads and in-town check-in for airport passengers
- Ground level departure floor, associated with taxis, buses, and private car parking
- Upper two levels--entries from the surrounding developments and Kowloon Station Square (Thorne, 2001)

In this case study, the station is taking care of travelers and services rather than just a place for trains and becomes a good example of solving complex interconnection problems.

Figure 5. Section Low-case through Lehrter Bahnhof (Ferrarini, 2005)
Figure 6. Model of Kowloon Station (Edwards, 1997)

Figure 7. Axon of Kowloon Station (Thorne, 2001)
3.1.2.2 Traffic System

- Pedestrian and Bicycle System

Walking is an important daily activity in Chinese tradition. Even with rising car ownership, people still walk to grocery stores, nearby parks, and visit friends and relatives within short distances. In this project, pedestrian routes play an essential role in TOD principles and transit village Design. Mees (2010) poses that every transit user is also a pedestrian. Therefore, pedestrian paths should be located from all streets, and the primary destination would be the commercial core and transit stops.
Biking can be a major alternative to automobiles for travelling short distances. Increased cycling improves health and urban environment. Also, it reduces traffic congestion and car ownership. In a TOD plan, important destinations--such as core commercial areas, transit stops, parks, open spaces, schools, and other communities--should be linked by bike routes (Calthorpe, 1993).

Figure 9. Minimum Sidewalk Dimension (Griffin, 2004)

Figure 10. The Minimum Shared-use Walkway with Bike Path (Griffin, 2004)
• Local Bus System

Pail Mees (2010) discusses the importance of bus networks as extensions of subway systems. Comparing Toronto and Melbourne, revealed that Toronto’s much smaller rail system outperformed Melbourne’s large network, by using bus systems to extend its reach. Key success factors of the bus system include high frequencies, long operation time, and bus-to-bus transfers. Besides a long strike in 1989 and the 1990 recession, the most critical reasons for decreased patronage are decreased service frequencies and ignorance of connections between the subway and other transit modes. In another example, Ottawa’s bus network makes it one of least car-oriented cities in the English-speaking world by introducing region-wide fares to the city. It built bus-only lanes on busy streets and made an agreement with the government to eliminate their free parking. The region-wide bus network leads to increasing patronage and mode sharing and makes Ottawa a public transport success story.
Figure 12. San Fernando Valley East-West Bus Rapid Transitway, Los Angeles (Guren Associates, 2009)

Figure 13. Euclid Avenue Bus Transit Corridor in Cleveland, Ohio (Miller, 2011)
• Circulation System

This creative project divides streets into three main categories: arterial, collector, and subcollector (see figure 14). The arterials are the two main boulevards, which connect communities to urban cores and highways and provide Bus Rapid Transit. Collectors, as the principal traffic roads within the site, carry the high-volume traffic from arterial streets to the lower-order streets. They are the main automobile-oriented streets. Subcollectors are relatively low-volume streets and provide passages to access streets. They offer on-street parking and create a comfortable environment for cycling and walking.

Figure 14. Hierarchies of Streets (American Society of Civil Engineers et al., 1990)

3.1.2.3 Mixed-use Transit Village

The idea of a transit metropolis developed from the pedestrian-oriented “garden city,” which city planner Ebenezer Howard introduced in 1898. The transit
village is a compact and mixed-use community, centered around the transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more (Bernick & Cervero, 1997). Generally, the transit village extends from the transit station a quarter mile or 5-minute walking distance. The transit village provides more choices in how to travel, where to live and work, places to go, and how to spend one’s free time. By bringing commuters and shoppers to the transit node with mass transportation, transit villages present the possibility of seamless travel experience by transit service connection. In many ways, transit villages enhance mobility and environment, develop pedestrian friendliness, provide alternative options in travel experience, and improve public safety.

Figure 15. Station Area Planning Zones (Griffin, 2004)

Since this creative project is located in China, it is essential to look beyond the United States borders for examples. Among the world’s great transit metropolises--such as Stockholm, Singapore, and Tokyo--nearly all suburban
communities are oriented to train stops. Bringing the community close to the transit stop encourages people to take mass transportation. In addition, most urban design includes large open spaces, ecological preserves, and farms. Compared to many U.S. cities, residents in these three cities enjoy a high standard of living.

Mixed-use is a major character of a transit village and TOD principles. It provides options for convenient daily services, balancing job and living, and reducing car travel. It requires a certain amount of core commercial areas, public facilities, and residential housing. Peter Calthorpe (1993) also mentioned mixed-use can be achieved in vertical ways.

<table>
<thead>
<tr>
<th>USE</th>
<th>NEIGHBORHOOD TOD</th>
<th>URBAN TOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>10% - 15%</td>
<td>5% - 15%</td>
</tr>
<tr>
<td>Core/Employment</td>
<td>10% - 40%</td>
<td>30% - 70%</td>
</tr>
<tr>
<td>Housing</td>
<td>50% - 80%</td>
<td>20% - 60%</td>
</tr>
</tbody>
</table>

Figure 16. Percentage of Land Use (Calthorpe, 1993)
Doctor Zhang presents differentiated density based on researches of TOD models in Hong Kong, Taipei, and Shanghai. Figure 18 show that the density decreases as the distance increases from the transit station.
3.1.2.4 Traffic-free Zone

A traffic-free zone simply discourages the use of private vehicles and encourages public transportation. The primary argument against traffic-free zones is that cars move from the main street to adjacent streets and increase traffic issues along those roads. However, studies by Pushkarev and Zupan (1975) shows that the amount of vehicles depends on the amount of available spaces. The survey indicates that when the speed drops below eight miles per hour, people prefer other kinds of transportation. Therefore, traffic-free zones will not create new traffic jam problems.
Traffic-free zones can attract more people, which means more opportunities for business development, high density, and land value capture. It enhances identity community and creates sense of place. Also, a traffic-free zone provides a safe environment for kids to play and an attractive place to rest. Reducing the number of cars contributes to reducing noise and air pollution and car accidents.

Figure 20. Ten good reasons to create traffic-free zones (Brambilla & Longo, 1977)

Transitway is a compromise between completely traffic-free zones and the need for shopper and commuter transportation systems. Only local shuttles are allowed in this district. Therefore, shoppers and commuters, coming into the town by car, use local shuttles to travel between parks, housing, and transit stops.
3.1.3 How to Make Transit-Oriented Development Happen

To move TOD from paperwork to construction level, we must view TOD in terms of both functional characteristics—density, mix of uses, level of transit service, street connectivity—and descriptive benchmarks—location efficiency, mix of choices, value capture, and place making (Dittmar & Ohland, 2004).

- **Location Efficiency.** First, TOD requires sufficient customers within walking distance to support the transportation service to run efficiently. Using research data, which analyze numbers of factors—such as income, household size, net residential density, transit accessibility, quality of the pedestrian environment, and the existence of neighborhood retail—this study found that higher density led to less driving. Second, with constant income and household size, successful elements of a TOD plan would provide a comfortable environment for pedestrians and bicyclists, plus improve transit stop accessibility.

- **Mixed Land Use.** One characteristic of TOD is mixed-use development, which combines commercial, office, residential, and transit. With mixed land use, these communities provide convenient daily services within walking distance, so cars are not needed for every trip.

- **Mixed Income.** A neighborhood built on TOD principles should provide a range of housing options for mixed income residents, so they can find homes to meet their current needs. Typical mixed-income residential
options range from renting a single room (approximately $100 per month) to a one-family apartment (approximately $1000 per month). This combination accommodates a wide range of residents, from single student or blue-collar worker, to migrants, and married professional couples.

- **Value Capture.** Capturing land value should be an essential objective of TOD, which allows people to enjoy an affordable lifestyle and desirable quality of life. TOD also lets communities gain the benefits from their good work. To add value to the development, the neighborhood should provide frequent and high-quality transit service, good connectivity between transit stops and the surroundings, and beautification of the environment, thus absorbing the attention to financial returns.

![Figure 21. Land Value Market Principles (Zhang & Liu, 2007)](image)

- **Place-making.** Identity is key to distinguish the landscape. The urban economic development should integrate with the native landscape to
maintain the continuation of traditional landscape (Liu & Chen, 2005). Sadly, less attention has been paid to making places attractive and pedestrian-friendly. Healthy and convenient pedestrian environments can easily turn pedestrians into transit riders. The roles of transportation stations and places in neighborhoods are vital elements in TOD. As a basic requirement for a transit stop, it should be a junction point in a road network. At the same time, it attracts activity and is a desired place to live, open shops, or locate workplaces.

3.1.4 TOD Adoption in China: Possible New Design Principles

From table 1, cited from Chen, Yin and Ye (2008), it is easy to find the characters of Chinese cities that are in favor of applying TOD. For instance, high density, large population, and gathered living tradition guarantee ridership. Although car ownership is rising in major cities, automobiles have not occupied the leading position.
<table>
<thead>
<tr>
<th>Item</th>
<th>Location</th>
<th>Metropolis in China</th>
<th>Cities in the US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character</td>
<td></td>
<td>Rapid urban sprawl; strong urban core; ample resources; new projects</td>
<td>Steady city development; urban decay; redevelopment projects</td>
</tr>
<tr>
<td>Urban Sprawl Mode</td>
<td></td>
<td>High density, radiant development from the center</td>
<td>Low density; suburbanization</td>
</tr>
<tr>
<td>Mobility Development</td>
<td></td>
<td>Less dependent on automobiles</td>
<td>Automobile-oriented</td>
</tr>
<tr>
<td>Planning</td>
<td></td>
<td>Government-guided</td>
<td>Market-guided</td>
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<tr>
<td>Settlement</td>
<td></td>
<td>Gathered family Living</td>
<td>Distributed family living</td>
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<tr>
<td>Land Ownership</td>
<td></td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Public Participation</td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 1. Comparison of Urban Development between China and the U.S. (Chen, Yin, & Ye, 2008)

During the late 1990s, China began to apply TOD in Beijing, Shanghai, and Hong Kong. Hong Kong 2030 Planning Vision and Strategy adopted an integrated approach to deal with land use, transportation, and environment protection. Planning for new railways should be integrated with land zoning to optimize development opportunities around railway stations and depots, and consider public transport interchanges. Walking distance between railway stations, major housing, employment, commercial, cultural facilities, and other activity nodes of high pedestrian flow should be less than 500 meters apart, and all facilities and nodes should be inter-connected with well-planned pedestrian walkway networks. The TOD in Hong Kong increases patronage and financial revenue, making the system self-sustaining (The Government of Guangdong, Hong Kong & Macao, 2011). However, we must still face the challenges in China. In some
cases, people misinterpret TOD as “traffic-oriented development.” Most of the projects lack continuing transit extension networks and should address the connectivity of transit systems, including bus, bicycle, and rail. In addition, there is tremendous room for land use efficiency improvement. Therefore, in China, the main targets of TOD are not ridership and density improvement. Instead, it aims to develop a hierarchy of transit systems, improve transit service, and increase land use efficiency and diversity.

Figure 22. Development clusters around the railways stations in Hong Kong (The Government of Guangdong, Hong Kong & Macao, 2011)
3.2 Urban Agriculture

When I was a child during the 1990s, it was easy to access community gardens. Most families owned a small amount of farmland in 1981, and agriculture was the main financial and nutritional source for their sustenance. However, with economic development and urban sprawl, farmland degenerated, and farmers lost their jobs and began working in the cities. Today, because of scarce urban land, food safety issues, and the desire for nature, farmland becomes a dream for people who live in the concrete jungle, but for some, it represents only a pleasant memory.

In China, agriculture is breaking back into the metropolis with three types of urban farming. First, large-scale farmland is usually located in suburban areas, produces organic food, and cooperates with restaurants. Also, as tourism
industry, these farmlands plant fruit trees and ornamental flowers for people to pick their food directly from trees and enjoy nature. In this case, the owners live off the land, and consumers are more like visitors, rather than daily participants. Second, farms temporarily occupy vacant land, scattered throughout urban settings. They are the scale of community gardens and are usually managed by low-income families who plant crops to support their food supply. These families often include casual laborers. To some extent, the land is not open to the public since it seems like land enclosure behavior based on first-come, first-served structure.

Finally, successful TOD offers private small yards, balconies, and roof gardens for residents to plant small plots. People who support farming, horticulture, and food safety issues would like to build their own gardens. This type of farming is popular within urban environments because of its scale, convenient access, and high participation. In addition, the books Urban Farms (2012) and Carrot City (2011) discuss the great opportunities of edible schoolyards and community gardens. Urban agriculture improves public health and environment, provides jobs and education opportunities, and even becomes a new social anchor for the community.
Figure 24. Temporary farmlands occupy vacant land in urban China (China Binhai New and High-Technology, 2010)

Figure 25. Roof garden in the Ray and Dagmar Dolby generation Medicine Building, San Francisco (Killory & Davids, 2012)
3.3 Precedent Studies

In the following paragraphs, I will review three precedents which share similarities with my project. First, Transbay Transit Center District Plan in San Francisco focuses the traffic connections around the transit center and surrounding landscape while providing design principles for multi-choice transportation. Second, I will discuss transit-oriented planning in Curitiba, Brazil. Curitiba’s transportation system is a successful example for promoting transit-oriented development concepts around the world. Third, Shenzhen University Metro Station in Guangdong Province, China focuses on how to connect the Metro Station and campus.

Precedent 1: Transbay Transit Center District Plan, San Francisco

Background

The Transbay Transit Center District spans approximately 145 acres, between Rincon Hill and the Northern Financial District. Currently, the Plan Area consists of office, retail, residential, and institutional uses.

Figure 26. Plan Area Boundary and Surrounding Neighborhoods (San Francisco Planning Department et al., 2009)
Project Overview

The 2009 Transit Center District Plan (TCDP) envisions the Transbay Terminal Area as the heart of new downtown. The plan intends to shape and direct the growth of downtown to a desired location so the future Transbay Transit Center will be a dynamic hub, which serves those who work, live, and travel through downtown San Francisco.

With a roof park the Transbay Transit Center will be a significant landmark and provide open space within downtown San Francisco. The park will play a critical role in new city development and become a destination for travellers, local residents, and commuters with high-quality transit service (San Francisco Planning Department et al., 2009).
Design Principles

Instead of re-planning the land and space, the Plan seems to improve the land use, urban form, public spaces, and circulation based on the existing condition for the future needs. To make San Francisco a livable and unique city, it is critical to keep place-making in mind. Therefore, the plan is considering the following concerns:

• Creating livable public space by ensuring sunlight, sufficient green space, service accessibility, and attention to building details.
• Creating comfortable pedestrian environments.
• Establishing essential relationships between city-scale environment and natural settings, and connections between residents, visitors, and the place.
• Designing graceful places for people to socialize, pause, and enjoy.
• Developing comprehensive plan for sustainability, including the basic land use and transportation requirements but also considering natural and energy systems.
• Planning successful transportation, which supports and enhances community smart growth and the district’s livability with sufficient and appropriate capacity, infrastructure, and resources.

(San Francisco Planning Department et al., 2009)
The Transbay Transit Center

The Transbay Transit Center will integrate bus and rail systems. On the roof level, a 5.4-acre park will provide a multifunctional place for pause, activity, and education for locals and transit users. The expansive roof area with thick soil provides opportunity to plant large, healthy trees and shrubs. This seamlessly connects with the building. The park will absorb carbon dioxide from automobile exhaust, collect and clean water, and create a downtown habitat for birds, butterflies, and other insects. Stormwater runoff from the park and building will be collected in a wetland at the east side of the park and used as grey water in restrooms.

Designed with curve paths, the park offers rich experiential settings. Topographically, the design creates mounded vegetated hills to decrease the distinction between roof and ground. And domed architectural skylights allow daylight into the terminal below (PWP Landscape Architecture, 2009). The zoning map shows the passive and active spaces, which provide environments for different rhythm activities.
Figure 29. Functional Zoning Diagrams (PWP Landscape Architecture, 2009)

Figure 30. Section through the Transbay Transit Center (Pelli Clark Pelli Architects, 2009)
Figure 31. Ecology System Diagram (PWP Landscape Architecture, 2009)

Figure 32. Water Treatment Diagram (PWP Landscape Architecture, 2009)
Related Plans and Data

- *Environmental Impact Report (EIR).* This is used to evaluate environmental effects of the proposed Transit Center District Plan project.

- *San Francisco General Plan.* This will lead the public action and decision in terms of the city’s general development. Among the topical elements, the Urban Design, Transportation, and Recreation and Open Space elements are the most relevant to the plan.

- *San Francisco Planning Code and Zoning Maps.* These establish specific standards for land use, buildings, and related issues of their performance (e.g. height, development intensity, parking, etc).

- *Transbay Redevelopment Plan.* This overlaps with the Transit Center District Plan and sets goals and objectives for the project area.

- *Mayor’s Interagency Transbay Working Group Report.* This involves key stakeholders and provides critical recommendations.

(San Francisco Planning Department et al., 2009)

Conclusion

The *Transit Center District Plan* (2009) provides the vision and strategies to guide the creation of this new heart of the city. It will affect those who live and work in downtown, but also commuters, visitors, and other key stakeholders.
Precedent 2: Transit-Oriented Development in Curitiba, Brazil

Background

The City of Curitiba is the capital of the Parana State of Brazil. The population of the whole Metropolitan region is 2.7 million, of which 1.6 million inhabit in the city area, with the density of 49 inhabitants per hectare (Poudenx, 2008). The bus system in Curitiba plays an important role in making the city more livable. Since the 1970s, Curitiba has integrated public transportation planning into the overall city plan (IECEI-Local Governments for Sustainability, 2011).

Curitiba’s BRT Development

Public transportation in Curitiba is an excellent example for its affordability for customers, prepay stations, and the influence on residential, business, and recreation areas (IECEI-Local Governments for Sustainability, 2011). In 1965, officials adopted a new plan to avoid unchecked development and congested streets. The plan intends to develop future growth along the desired corridors in a linear form instead of radiating all directions from the core. It also provides mass transit along the corridor as the primary transportation mode in the city and produces a high volume of transit ridership. TOD in Curitiba implies that housing, commercial, and major outdoor spaces should be built in high-density areas and adjacent to transit facilities. With pedestrian-friendly community, low air pollution BRT system, and fewer car parking spaces, Curitiba has successfully achieve reduction of overall travel of its residents (IECEI-Local Governments for Sustainability, 2011).
The Bus System Design

- **Minibus.** Minibus routes run through residential neighborhoods and take passengers to central business districts (CBDs).

- **Bus Rapid Transit (BRT).** This operates five main arteries leading into the center of the city.

- **Bus Station.** The bus stop is a cylindrical, clear-walled tube station with turnstiles, steps, and wheelchair lifts (Goodman, Laube, & Schwenk, 2005). The pre-boarding fare payment and simultaneous loading and unloading of passengers eliminate bus-waiting time and become more efficient.
Figure 33. The Tube Bus Station in Curitiba (Hobbs, 2005)

Figure 34. Developments along Curitiba BRT Corridors (Cervero, 2011)
Conclusion

The success of Curitiba’s BRT has shifted car transportation to bus travel. Around 70% of Curitiba’s commuters use the BRT to travel to work, resulting in congestion-free streets and pollution-free air for the 2.2 million inhabitants of greater Curitiba (Goodman, Laube, & Schwenk, 2005). The system can guarantee a high quality of life and preserve open space as long as it provides the accessibility of parks, bikeways, and public transport.

The system currently includes 390 bus routes and 2,000 vehicles, serving 2.1 million riders daily. In one BRT lane, 10,000-20,000 passengers can board each time, with a maximum 40,000 passengers on busy roads. Now, 85% of Curitiba’s population is using BRT, which is 50 times the amount of travelers 20 years ago. The successful factors of BRT in Curitiba are bus priority lanes, free transfers between routes, pre-board fare system, information displays, and traffic signal priority (IECEI-Local Governments for Sustainability, 2011).

Precedent 3: Shenzhen University Metro Station, China

Background and Problems

Shenzhen University (SZU) comprises two campuses, Liyuan and Xili, occupying 2.9 total square kilometers of land area. The Liyuan campus is 1.44 square kilometers and includes north and south campus. Shenzhen University has about 34,000 fulltime students and 2580 faculty. SZU Metro Station is located in the northern corner of the campus. It is the nearest metro station to the campus, but
is underused and does not provide an efficient transportation service because of the following reasons.

- **Inefficient station location.** The distance between the station and the northern campus gate, which is the nearest gate to the metro station, is 500 meters (1640 feet). The distance to the residence halls and academic buildings are more than 1,500 meters and 1,000 meters respectively. Therefore, the average walking time from campus to station is more than 20 minutes, which is double the 10-minute comfortable walking distance.

- **Inappropriate Connectivity System.** Buses go through the main and western gates but lack connection to the metro station takes at least 8 minutes. Walk to the station from bus stops. In addition, the system is devoid of bicycle and electric-bicycle stations.

Figure 35. Existing Shenzhen University Inventory (Shenzhen University, 2010)
Design Program

- **New Campus Shuttle System.** It will connect the main academic buildings, residential areas, and campus gates with the metro station. The shuttle runs the same frequency with the metro and stops in the metro station.

- **New Campus Gate.** To achieve the goal of efficient transit system, the plan intends to add another gate in the eastern part of the campus, which decreases the average walking time by 9-15 minutes. It will enlarge the 15-minute walking area form the metro station. (Jin, Zhang, Chen, & Song, 2011)

Figure 36. Bus route plan and new gates (Jin, Zhang, Chen, & Song, 2011)
Figure 37 The proposed walking and cycling areas by adding new eastern gate (Jin, Zhang, Chen, & Song, 2011)

Metro Transit Center Redesign. To create a better transit system, the proposed plan considers the Academic Exchange Center and redesigns the horizontal connections. First, the proposed plan will connect the elevation of 20.5 meters and 15.5 meters with the Academic Exchange Center where establish international partnerships, develop educational program, and organize abroad training courses. Second, the parking lot in elevation of 15.5 meters will be replaced by retail and transportation space, moving the parking to the Academic Exchange Center.
Figure 38. Existing transit connection diagram (Jin, Zhang, Chen, & Song, 2011)

Figure 39. Proposed transit connections plan (Jin, Zhang, Chen, & Song, 2011)

Conclusion

The plan to improve the performance of this SZU Metro Station indicates the importance of an efficient ground connection system. It creates a comfortable
walking environment, but also emphasizes convenient and efficient connections among shuttle, bicycle, and metro station.

3.4. Project Introduction

3.4.1. Background

Jiubao, located in the eastern part of Hangzhou, was originally a desolate farmland. To decentralize the pressure of the urban core and develop growth areas, the government has brought forward a plan that aims to expand the city of Hangzhou to the east and promote travel to the west. Therefore, Jiubao has been receiving increasing attention in public facilities construction, housing development, and marketing and commercial plans. From an economic perspective, Jiubao takes full advantage of this best connection location. It is 13 miles from Hangzhou’s urban central district and 1.5 miles to Qianjiang New Central Business District.

The 1,293-acre (5.23 km²) creative project site is located in the southern part of Jiubao. According to city planning strategy, it will have a #1 line metro, transit center, and trading markets in the future. Also, it will have multiple housing options, retail types, and green spaces connectivity.

Major development has taken place in the seven years leading up to 2012, with the introduction of the transit center, metro line, housing developments, and the addition of 27,000 in new registered population. However this development has
not been efficient, especially with land uses and transit connections. This creative project proposes a new development strategy starting from site conditions in 2005. The resulting design proposal serves as an example of a TOD model for quickly urbanizing areas like Jiubao.

Figure 40. Jiubao Google Aerial Map in 2005

Figure 41. Jiubao Google Aerial Map in 2012
3.4.2 Map Data

Figure 42. Map of Six Main Core Districts in Hangzhou Subdivisions

Figure 43. Site Location within Hangzhou Urban Boundary
3.4.3 Biophysical Data

Figure 44. Social Data (Ruan, 2011)
From the charts above, I conclude that most of the population is low-income, low-educated migrants who work in Jiubao and Jianggan district where Jiubao belongs. The major careers are labor workers, service personal, and small business owners. Because of the imbalance between where people work and live, providing a good quality of life for low-income migrants is difficult.

3.4.4 Applying Transit-Oriented Development in Jiubao

3.4.4.1 Land Use
As described earlier, the closer to the transit center, the higher density. The land use near the transit center is primarily high-rise apartments with shops the street level. Farmer housing will be located in the eastern part of the site, which is near a fishfarm located outside of the project boundary. Low-density residential communities are located in the central area. Besides a green corridor across the site, the proposal also adds open space and educational land use for schools.

3.4.4.2 Transit Center
Offering a comfortable pedestrian environment, the transit center will be the hub for local shuttle, bicycle, long-distance transportation, and the Metro system. The upper levels will provide commercial, office, and parking space to meet the future needs. Providing exits from the bypass to the transit center attracts passengers to stop by and enter the site rather than driving past. This enhances outsiders’ connections with the site. The unique shape of the Transit Center will also attract people’s attention from the surroundings. Locating the shuttle
station, bus terminal, and bicycle station around the Transit Center, the proposed design enables people to conveniently explore the site via public transportation, walking, or bicycling.

3.4.4.3 Transit System

In this project, the pedestrian paths are in three different settings. Sidewalks along the collectors share outdoor dining and bike lane space. Trails in green spaces and parks feature natural-looking pathways and aim to attract more people to stop by, stay, and explore nature. Pedestrian paths within the neighborhoods offer opportunities to improve communication between neighbors and enhance community identity.

This bicycle system basically goes through green spaces, community gardens, and central park and connects main residential areas with transfer facilities, commercial districts, and workplaces. It aims to encourage people to travel by bikes. The plan also provides a bicycle-renting system, which residents can use for free. On automobile-oriented roads, vegetation buffers will separate bicycle lanes from car roads and sidewalks. In environmental settings, trails will be along pedestrian paths and direct people exploring nature.

The shuttle system routes pass through the residential neighborhood with convenient stops and take passengers to the transit center, central park, and other daily service facilities. The shuttle terminal is located at the intersection of
Xiasha Blvd (the east-west arterial road along southern edge of the site) and collectors. There are two main reasons for this site selection. First, the location provides convenient transfer with BRT. Second, it would have enough riders because it is adjacent to farmer housing, and comparably low car ownership among farmers means they are one of the main groups using public transportation.

The car-oriented roads will only exist in certain areas. Besides the two boulevards, major two-way car roads are around Central Park and Metro stations. The plan also provides one-way roads with street parking.

This plan promotes a ticket-free transfer system with a citizen ID for further development. The residents could apply for an ID and deposit 200 yuan ($30) at a transit service center for bike-sharing use. With this card, users can check in and check out the bicycle, and record the bike using time and bike-docking station (Shaheen, Zhang, Martin, & Guzman, 2011). When riders use the ID, they receive 10% off the ticket when boarding the shuttle and prepaying before entering the BRT station. It is convenient to achieve less waiting time and more efficient travel. For visitors, the transit center also provides a temporary card option.
Figure 45. Multi-position bike station in Hangzhou, China (Metrobike. LCC, 2013)

Figure 46. Bicycle Locker Machine
3.4.4.4 Urban Agriculture

The 2005 aerial map (see figure 40) shows over 80% of the land is agricultural. This will become a feature in my TOD plan for Jiubao. Agricultural roads around Jiubao have formed along the creeks and irrigation ditches in Hang Jia Hu Plain. Resulting settlements developed into water village type development (see figure 44). Water villages in flat topography tend to follow a grid pattern with high density in suburban areas.
The main crop in Zhejiang is rice paddy, which needs water to grow, explaining why this agricultural land formed along irrigation ditches. In the 2005 map (see figure 40), certain roads were perpendicular to the creeks and cut the farmland into patches. This pattern is shared with most plain water villages. Therefore, to preserve this cultural feature, this project will keep the pattern in the eastern farmland area adjacent to a fish market.
3.4.4.5 Open Spaces

Community Gardens

Located between low-density communities, community gardens will provide an agricultural feature. Due to its environmental factors, open space between high-density communities will offer places for strolling, rest, exercise, and the like.

Central Park

In the Central Park, the design presents different dynamic settings. From east to west, first, people enjoy an entry garden, which provides different paths for bicycles and pedestrians lined with light posts. A social zone will provide shaded farm stalls and a sunken café plaza with outdoor seating areas. The center will be a small lawn welcoming visitors from the north and south entries. Next will be an event area where sponsors will hold an autumn event. Inspired by Chicago’s Millennium Park, an LED screen will also have an interactive water feature. Last but not least, shading and seating areas provide a small pond and platform.
Besides these gathering spaces, there are also scattered semi-public spaces in dense vegetation zones.

Figure 50. Central Park Conceptual Plan

3.4.5. Inventory and Analysis

3.4.5.1 General Characteristics

Most land on site has been used for agriculture (figure 50), except the farmer-occupied houses and roads. Creeks on the eastern and western boundaries could be used for irrigation. With few roads through the site, accessibility is limited. In Hangzhou Planning Strategies for Jiubao development, Jiubao will build one transit center for long-distance bus service, metro stop, and public transportation, plus a bypass through the site and continuing to the new CBD across Qianjiang River.
Figure 51. Farmland and Major Waterway Diagram
Figure 52. Farmland and Creek on Site in 2012

Figure 53. Figure Ground
3.4.5.2 Circulation Analysis

Jiubao is located in a heavy traffic zone. Within a short distance, highways connect to Shanghai, Ningbo, and Kunming, and a freeway around the Hangzhou urban boundary. These advantages could justify Jiubao becoming a future transit village.

In 2005, automobile ownership was low in Jiubao and few roads on site were car-oriented and paved. Most country paths are for walking and bicycling. From historical perspectives, the roads were developed along small creeks and ditches because Jiubao was a plain water village. Now, the roads are perpendicular to the creeks and Xiasha Boulevard that provides a BRT route (see figure 54). This project will locate a local shuttle terminal along Xiasha Boulevard to connect with BRT when possible, unique circulation patterns will be preserved in farming areas.
Figure 54. Transportation Diagram in Regional Scale

Figure 55. Figure Ground
3.4.6. Goals and Objectives

1. Increase urban density
   - Centralize transit building, core commercial, and offices in the project.
   - Develop mixed land uses in close proximity, including office, residential, retail, and civic uses.
   - Provide multiple housing options to meet various needs.

2. Provide multi-modal transportation system
   - Improve public transportation level of service to encourage people to access daily needs without a car.
   - Locate the transportation center near the intersection of the bypass and Main Street.
   - Design effective transit systems on site, offering bicycle rental, local shuttle, car, and metro options, plus convenient transfers.
   - Create walkable environment for pedestrians.
   - Place shuttle stops, bicycle stations, and public services in efficient locations to serve locals, commuters, and visitors.
   - Provide another Metro station because the average distance between two Metro stations is 3,937 feet (1,200 meters) in suburban areas.
   - Take full advantage of BRT on the south arterial.
• Offer park-and-ride service for residents needing to travel outside and to attract people from the bypass to work and shop in the community.

• Offer long-distance bus service connecting with other districts and provinces.

3. Provide public open space

• Create a Central Park where people can play, socialize, and rest.

• Design a garden strip across the community for schools to educate people to grow their own food.

• Keep some of the farmland for jobs and culture preservation, and develop multiple types of urban agriculture involving buildings, such as balcony farming and green roofs.
4. Methodology

4.1 Design Guidelines

Mixed Land Use

In this creative project, land use includes retail and residential mixed-use, commercial cores, office, education, open space, parks, community gardens, and public facilities, which includes the transit center. In residential areas, to meet the needs of migrant workers, young couples, and new settlers, Jiubao plans to provide different scales of housing choices while still maintaining the quality of life. The residential options include farmer, commercial, and other housing, mixing affordable, low-rent, and resettlement choices.

From Wang’s research on community zoning (2005), average population of a neighborhood is beyond 3,000, and Hangzhou could achieve 5,000 in some high-density areas. From the planning and census research, a government-managed community usually has basic facilities such as clinics, schools, sports fields, and commercial centers. A community usually consists of 1-3 neighborhoods. In this
project, one neighborhood will mix low-density and high-density housings and provide open space for between 4,000-6,000 residents. One community includes two neighborhoods. Schools serve 600-meter radius to ensure optimum student population and safe walking distance.

**Determining the Best Location(s) for Transit Stops**

Transit Center and Metro Station

By analyzing the circulation to determine a location that will cover most of the site within 500-meter walking distance, the most efficient location for the transit center is at the intersection of Main Street and the bypass. Then, within the principle of a half-mile radius walking circle, the plan will decide the locations for one other metro station and a shuttle terminal that will most benefit residents. By studying the plan for Shenzhen University Metro Station, it is reasonable to locate shuttle stops within 500 meters of essential places (school, retail center etc.) and metro stations.

Shuttle Station and Stops

Because of the half-mile walking distance principle and low car ownership among farmers, the shuttle station will be located near the eastern side of the site, by the farmers’ housing and along Xiasha Blvd. It transfers people from BRT to local shuttle and also provides bicycle parking and rental. Shuttle stops will be 600 meters apart and serve the major residential areas. Also, considering child safety, stop locations will be adjacent to schools.
Bicycle Stations

Bicycle stations offer parking, repair and tire inflating. Every shuttle and BRT stop will equip a bicycle station for people to transfer from riding to bicycling. More bicycle stations located along the public green corridor will allow people to park and rest.

Creating Walkable Communities and Green Corridor

First, the plan will prioritize pedestrian and bicycle friendliness by providing convenient access to daily services and creating a walkable community. It also emphasizes a green 200-foot-wide corridor that provides habitat for wildlife and recreation for local residents. To keep its agriculture function, the project considers a strip of community gardens, connecting two natural stream zones and residential areas. The New York Restoration Project (NYPR) records parks and gardens and educates kids and adults, which can be a good reference for my community garden. Second, by studying TOD in Curitiba and creating a working-friendly environment, the plan considers bicycle, shuttle, metro, and BRT transit modes, which benefit commuters, create free-transfer with a prepaid card, and enhance the experience of “seamless journey.” These strategies aim to enhance the quality of the living environment.
Housing Development

The major housing types will be 6-floor low-density apartments and 18-floor high-density apartments. To ensure all spaces receive adequate sunlight, the distance between two 6-floor buildings is 81 feet to support gardens and open space, and 25 feet for passages. The distance between two 18-floor high-rise apartments is 244 feet. The first floor will be retail and commercial space, and the two buildings will share a second flat floor to divert people. Housing around the boundary of the neighborhood will be arranged along streets, and inner housing layout is based on the principle of “maximum land use efficiency” to achieve enough units and population for an ideal 3,000-5,000 resident neighborhood.

Parking garages will be located underneath housing along the streets. The car ownership in Hangzhou City is 33.3%. In this project with applying TOD principles, the design will achieve 15% car ownership and provide parking space
for visitors. In the future, this design promotes “city car” for its low CO₂ emission, affordable price, and minimum parking space. One stackable car, designed by MIT, is a folding type of urban vehicle (see figure 59). It is controlled by “Robert wheel,” which includes a driver motor, steering motor, suspension, and braking (Urbanist, 2012).

Figure 57. Environmental strategies for a residential building (Mario Cucinella Architects, 2008)
Figure 58. Section of Underground Parking in Cherokee Mixed-Use Lofts (K., 2011)

Figure 59. High-Density Unit Layout
Figure 60. Low-Density Unit Layout
Placemaking

Placemaking is the heart of a community. It inspires people, provides desired public spaces, improves a community environment, and reflects the needs of people who use it. Placemaking is a critical strategy in Transit-Oriented Development. The transit center and Central Park will be key characters of this creative project.
Transit Center

The transit center features a hierarchical transportation system integrated with the building. Drawing from the San Francisco Transbay Plan case study, the transit station will accommodate metro, park-ride, and long-distance bus interchange. In a vertical view, it provides different levels of connections and outdoor spaces for people. Learning from Kowloon Station, Hong Kong, and Suzhou Center, China, I will also emphasize the outdoor green space on each floor.

Figure 62. Sky Garden in Suzhou Center (SWA, 2013)
Central Park

Located in a transitway zone between two metro stations, Central Park will create the main outdoor recreation area for the site. In the plan, Central Park features an entry garden, a sunken plaza with café dining area, farm booths, a great lawn with an LED screen for outdoor activities, and a small pond with shaded seating areas. The park provides respite, recreation, and social spaces for transit users and local residents. Central Park is also essential in place-making, because residents will identify the community with it.
Street System

The plan provides two-way and one-way streets. One-way streets go north and south, and two-way streets travel east-west. As an extension of first-floor retail, space along sidewalks on both types of streets is used for outdoor dining and selling goods.

There are two types of two-way streets. One type of two-way street is 76 feet wide with two drive lanes, green median, bicycle lanes, and sidewalks. The other
two-way streets offer two drive lanes plus two shuttle lanes, one travelling in each direction. These are 82 feet wide to accommodate cars, shuttles, and bicycles with sidewalks on both sides (see figures 90 and 91).

One-way streets also provide two types. One has a single drive lane but two shuttle and bicycle lanes with sidewalks. The other has two drive lanes, two bicycle lanes, and sidewalks (see figures 88 and 89).

Pedestrian streets also have two types. Inner pedestrian paths connect different residential areas within a neighborhood range. These paths are 60 meters wide and have a single sidewalk, bicycle lane, and vegetation areas.

Figure 66. A live-work community in China which protects and restores the site's unique ecological systems (SASAKI, 2012)
The other type of pedestrian street will emphasize social and commercial functions. It features outdoor dining and evening markets selling inexpensive and local goods. The street is 84 feet wide, including a 48-foot wide dining island along the center, but the street still has wide bicycle lanes, sidewalks, and outdoor dining areas on both sides (see figure 92). These pedestrian streets usually are around commercial centers, community boundaries, and farmland to serve the communities.

Figure 67. Dinning Island Street Example (Cherry & Nagle, 2009)
4.2 Data

Hangzhou Planning Strategy
The Strategy below in figure 64 indicates future development opportunities for Jiubao. Jiubao is located in a Core Group for residential area in the Planning Strategy.

![Figure 68. Hangzhou Planning Strategies (Hangzhou Urban Planning Bureau, 2002)](image)

Geographic Maps
These maps in figures 40 and 41 show comparison between 2005 and 2012 in patterns of circulation, land use, and density.
Data on Social Issues

To better understand the site and calculate needed areas for each type of land use, research will explore population, income, employment conditions, and individuals’ registered birthplace and education background. Also, since the proposed project will preserve food supply, it demands to know the productivity of existing agricultural land.

Quantitative data analysis discovers basic information about Jiubao, such as the project’s area, population growth, average income, and age. To explore more, it is critical to collect qualitative data to understand site identity and cultural landscapes.

4.3 Field Research

Place Observation

Photographing the site helps to understand how people use the open space and spend free time, what the cultural landscapes are, and how planning influences individuals’ lives. Because most of the residents in rental housing are not native inhabitants, I will observe the site during workdays, holidays, and weekends when these individuals travel back to their hometowns.
4.4 Conclusion

Based on the precedent studies and literature reviews, I make a conclusion about the findings. The project addresses ecological issues related to two creek natural zones that protect local habitat and agricultural land that provides a green corridor. The social issues are mainly raised by population growth. The project considers the distribution of different housing options, public service locations, and open spaces.

From the precedents, I learned the methodology to develop a plan to connect different scales of transportation and secondary areas around the transit center. My final project will be a transit-oriented area plan for Jiubao, which emphasizes the transit center within complex transport interchanges, and a Central Park for social activity needs. To distinguish this Chinese city-based planning from other TOD, the design will preserve partial original agriculture land for education and food supply. In this case, I will analyze the transportation opportunities, challenges, natural resource advantages, and land use. Through inventory and analysis, the plan will develop a new land use map showing different density zones, plus a design for a transit center area and central park, which help people enjoy a better quality of life environment.
5. Result

5.1 Conceptual Design Process

First, to achieve the goals and objectives above, the conceptual design locates the multi-modal Transit Center/Metro Station at the intersection of the bypass and Main Street. Second, the design places the other Metro Station at the eastern edge of the site and the local shuttle terminal on Xiasha Blvd. Within a 600-meter walking distance, these three transit facilities could best serve this new growing sub-district. The area between the two Metro Stations is used for open space development, attracting people from surroundings for social gatherings, rest, and play. Main Street will play a significant role in the plan because it connects two Metro Stations, Central Park, natural zones along creeks, and different urban settings.

Other considerations will lead to my next step.

1. Minimize bike intersections with road for safety.
2. Limit the number of intersections with the two boulevards to avoid slowing vehicular traffic.
3. Eliminate unnecessary roads and avoid planning a car-oriented community.

4. Reserve Main Street for pedestrian and bicycle only.

5. Connect the two creeks with Main Street to provide a corridor for pedestrians, bicyclists, and wildlife.

6. Use walking distance to determine density of housing distribution with higher density closer to the transit center and boulevards.

7. Locate most farmland along the eastern side and connect with the creek zone to transition from urban setting to natural environment and fishfarm.

8. Design green spaces and community gardens on site.

Figure 69. Conceptual Design Development Diagram
Land Use

In this project, applying Zhang’s density theory in these following diagrams will determine the housing types, transportation routes, and facility and green space locations.

Figure 70. Land Use Conceptual Plan

School locations. Due to its best service range (600-meter radius), the circles show the coverage of each school. According to data of the 6th Census, 0-14-year old are 11.93% of population, and the youth in each community number around 1,200.

Neighborhood and Community Development

Based on the planning practice of a neighborhood and a government-organized community, the design will show development plan for neighborhoods and communities.
Transit System

Based on land use and neighborhood plans, the shuttle system will develop an inner loop system for the site. On one-way and two-way streets, the route goes through residential areas, commercial zones, and near schools. The bicycle and pedestrian systems will follow most streets and greenways.

5.2 Schematic Design Process

Land Use and Transit System

To develop a better connection between the west and east and achieve the goal of having gardens for every neighborhood, the land use map adds green corridors to create new connections. Changes are made to other diagrams and plans according to the final land use plan.
Figure 71. Land Use Plan

Figure 72. Community Plan
Figure 73. Neighborhood Plan

Figure 74. School Location Plan
Figure 75. Shuttle System Plan

Figure 76. Bicycle Route Plan
Figure 77. Pedestrian Route Plan

Central Park

Figure 78. Central Park Master Plan
Figure 79. Perspective View of Central Park from West

Figure 80. Perspective View of Central Park from East
One Community Housing Development

Figure 81. One Exemplary Housing Development Plan

Figure 82. Neighborhood Perspective View One
Figure 83. Neighborhood Perspective View Two

Figure 84. Green Space in High-rise Apartment
Figure 85. Elevation of residential towers showing parking garage, shuttle, and bicycle system
Transit Center

Figure 86. Transit Center Plan
Figure 87. Perspective View from East

Figure 88. Perspective View from Southwest
Figure 89. Section of Transit Center
5.3 Street Diagrams and Perspectives

Figure 90. Section of One-way Street without Shuttle Lane
Figure 91. Section of One-way Street with Shuttle Lane
Figure 92. Section of Two-way Street without Shuttle Lane
Figure 93. Section of Two-way Street with Shuttle Lane
Figure 94. Section of Dining Island
Figure 95. Perspective of Two-way Street with Shuttle Lanes

Figure 96. Perspective of Dining Island
6. Conclusion

This creative project applies TOD principles in Jiubao, a new growing suburb of Hangzhou. During the past decade, it has faced many urbanization problems. The site has many advantages, such as transportation opportunities (boulevard, city bypass, and metro line) and continuing growing housing and commercial development. According to the limitations of current Chinese planning practice, most planning does not consider individual perspectives. Within TOD principles, case study, and previous planning research, the design focuses on land use development, transit facility location, street systems, placemaking, and community development.

This project encourages less driving and aims to improve pedestrian experience, create pedestrian-friendly community, and better transit connectivity. With mixed land use plan, this design has a more diverse environment to live, work, and play, while improving land use efficiency. According to density principles in TOD and analyzing data and planning research, neighborhood and community plans are designed based on land use. Following this regional planning scale,
more detailed planning and diagrams are generated. Shuttle, bicycle, and pedestrian systems implement the transit planning. To illustrate one community development on site, the design provides a housing plan in detail, which includes high and low-density residential areas, one school, and green corridor. The location is adjacent to a commercial center and Central Park. Within these elements, this housing plan is exemplary. Central Park and the transit center play important roles in placemaking, which could become future landmarks.

The project adds knowledge to the field of landscape architecture in the area of TOD for new growing areas in China similar to Jiubao. Although there are several research studies about TOD in China, most are theoretical and few practices include many design elements in one sub-district area. The design explores the interchange and cooperation of multi-transit system, green corridor system, and low and high-density housing development.

The Future
Without rapid growing use in automobile, it helps to solve environmental pollution and traffic congestion. By reducing car ownership, it saves parking space and improve land use efficiency. With decreasing in car travel trip, people intend to use public transportation and bicycle, which help develop community identity and sense of place. This project design could potentially serve as an
example that would solve urbanization issues in new growing areas of China. The particular community plan could serve as a model for other communities throughout the cities experiencing similar problems.
Bibliography


