Research and Application of Urban Landscape Planning in Slow-moving System—Based on the Design of Wujin District in Changzhou

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2013
Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou

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Date: 2013/05/19
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Content

Abstract ................................................................. I

Chapter 1: Introduction .................................................. 1
  1.1 Research background and significance .................................................. 2
  1.2 Slow-moving system ................................................................. 3
    Definition of slow-moving system .......................................................... 3
    Research gap ....................................................................................... 3
  1.3 Introduction to the problem ......................................................... 4
    Research background--Changzhou ....................................................... 4
    Wujin District .................................................................................... 5
    Study area & Delimitations ................................................................... 7
  1.4 Aim ................................................................................................. 8
  1.5 Research questions ......................................................................... 9
  1.6 Thesis Outline ............................................................................... 10

Chapter 2: Research on slow-moving system .................. 11
  2.1 Relevant theoretic researches on slow-moving system ....................... 12
    New urbanism ................................................................................... 12
    TOD theory ...................................................................................... 13
    Compact city ..................................................................................... 15
    Green traffic .................................................................................... 16
  2.2 Planning rules of slow-moving system in various cities ................. 18
    Shanghai ........................................................................................ 18
Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou

Hangzhou ......................................................................................................................... 18
Conclusion .......................................................................................................................... 20
2.3 Research on slow-moving system in China .................................................................. 21
   Definition of slow-moving system .................................................................................. 21
   Elements of slow-moving system .................................................................................. 21
   Construction method of slow-moving system ............................................................... 21
   Conclusion ...................................................................................................................... 22
2.4 Implications for China’s slow-moving system development .......................................... 24
   The necessity of building slow-moving system ............................................................. 24
   Compromising fast and slow-moving traffics ................................................................. 24
   Slow environment should pay attention to the subjectivity of the people ...................... 24

Chapter 3: Case study ...................................................................................................... 25
3.1 Hong Kong .................................................................................................................. 26
   Analysis of slow-moving system in Hong Kong ............................................................. 27
   Construction of slow-moving network .......................................................................... 28
   Building of slow-moving facilities .............................................................................. 31
   Slow-moving landscape construction ......................................................................... 33
3.2 Copenhagen ................................................................................................................ 35
   Background introduction ............................................................................................... 35
   Slow-moving network construction .............................................................................. 36
   Slow-moving landscape design .................................................................................... 41
   Building of slow-moving facilities .............................................................................. 44
3.3 Summarization& Analysis .......................................................................................... 47
   Compositions of Slow-moving System ......................................................................... 48
   Slow-moving network construction .............................................................................. 49
   Slow-moving Landscape Construction ....................................................................... 52
   Slow-moving Facilities ................................................................................................. 52
Chapter 4: Design principle

4.1 Slow-moving network construction
- Construction of slow-moving way
- Section design of slow-moving way

4.2 Slow-moving landscape design
- Street landscape
- Natural and ecologic slow-moving landscape

4.3 Building of slow-moving facilities
- Bicycle parking facilities
- Public bicycle rental facilities
- Illumination and road signs on slow-moving ways
- Pedestrian crossing facilities

4.4 Summary

Chapter 5: Design proposal

5.1 Study area analysis
- Location
- Road network
- Traffic analysis

5.2 Design proposal
- Slow-moving network
- Traffic calming measures
- Bicycle rental points planning

5.3 Design proposal of Wuyi Street
- Illustration plan
- Land use
- Traffic analysis
Abstract

With the rapid development of motor vehicles in our country, a lot of traffic and environmental problems are triggered. As a result, more and more cities begin to focus on sustainable traffic development. Slow-moving traffic has also become people's focus of interest, though many domestic scholars have proposed various methods for slow-moving system construction with many of them put in practices in many cities, the main research direction is the traffic function and operation mechanism of slow-moving system rather than the environmental construction of that, so researches on slow-moving landscape, slow-moving facilities and their relation with the neighboring land use remain insufficient.

Standing at the visual point of urban planning and design, taking into account the relation between slow-moving system and urban life, this thesis attempts to thoroughly eliminate citizens' difficulties and troubles in slow-moving, meet their slow-moving requirements such as safety, convenience and comfortableness as well as available slow-moving ways. By satisfying these requirements, it also aims to finally achieve the goal of free slow-moving and to develop a set of planning and construction methods for building slow-moving system in Wujin District.

Proceeding from the three perspectives of slow-moving network, slow-moving landscape and slow-moving facilities, this thesis summarizes the key points and defects of existing theoretical knowledge through literature review. Moreover, by in-depth analysis of some typical cases, methods for slow-moving construction are deduced. Finally, based on the actuality of Wujin District, giving consideration to its natural, historical and cultural resources, methods for slow-moving system construction are applied to the core area of Wujin District.

Through the research in this paper, it is expected to eliminate the gaps between traffic planning and urban design, and to shift the attentions on the traffic planning of slow-moving system to the design of slow-moving space and environment, while specific design methods are also proposed here. Academically, this thesis is also anticipated to take a positive impact on the future discussions of slow-moving system construction.

Keywords: Slow-moving system, Slow-moving network, Slow-moving landscape, Slow-moving facility, Walking system
Chapter 1: Introduction

Chapter one is the introduction chapter, the Background; problems; possibilities will all be illustrated. A brief introduction to the design part is also contained in chapter one. The last part is the methods and main framework of the whole thesis. This chapter is the brief introduce of the whole thesis. The readers can get the outline of those most important contents of the whole thesis and know what is the thesis is about easily after reading the introduction chapter.
1.1 Research background and significance

Urbanization is the basic requirement and inevitable result of the rapid economic development. Ever since the arrival of post-industrial era, cars have been widely used and popularized in an unexpected degree. Even they give us a lot of convenience in long-distant traveling, but after experiencing excessive traffic jams, some cities in foreign countries are gradually attaching importance to slow-moving traffics that thereby went through the following course: development → decline → rehabilitation. In China, Sunan Region, represented by Suzhou, Wuxi and Changzhou (hereinafter referred to as SXC for short), has been undergoing drastic changes in its original urban and rural landscapes due to the rapid urbanization. Some areas in these cities are still in a transformation period in terms of urban traffic structure, and cars are gradually occupying the urban area, consequently difficulties in parking and moving begin to emerge. This has not only bought continuing pressure onto the limited urban road construction, but also constrained people’s freedom and peace when walking on the street. Building urban slow-moving system is of great significance to the reasonable optimization of traveling structure and the prerequisite for guiding healthy and harmonious development of urban traffic, It is about healthier ways of getting around communities ways that improve the individual's health through more activity: the few minutes’ walk to the transit stop or station or the pleasant bicycle trip to the store. It attempts to find ways of improving the health of communities through lowering traffic flow and its accompanying pollution and safety hazards.

Presently, the use proportion of public transport and bicycles exceeds that of cars, but landscape design or facility installation mainly takes the needs of motor vehicles into consideration. The deficiency in slow-moving traffics and neglect of humanized use demand lead to fewer and fewer people using slow-moving traffics. In the context of extremely unreasonable distribution of road use right by vehicles and people, traffic accidents may easily occur with the victims of pedestrians and non-motor vehicle users mostly.

Recently, many scholars begun to research slow-moving system construction methods from traffic level and relevant practice in many cities, It is expected to effectively ease the conflicts between people and vehicles relying on providing independent and continuous traffic network to pedestrians and cyclists. But there is still lack of research in slow-moving landscape, slow-moving facilities and the relationship between slow-moving network and surrounding land use.

Apparently in such development context, researches on urban slow-moving traffic from the point of view of an urban designer and explorations of "slow-moving cities" "oriented by human beings" are of great and important significance.
1.2 Slow-moving system

Definition of slow-moving system

Slow-moving system refers to urban bicycle traffic, pedestrian system and relevant supporting facilities. Slow-moving traffic in China was firstly proposed by the Shanghai Urban Transport White Paper which was enacted in 2002, and it consists of traffics walking and cycling.

The goal of slow-moving system is to eliminate the dilemma of slow-movers and meet people's demands in safety, comfortableness and freedom. According to these demands, many scholars (Zhao xiaonan, 2010; Zhang chun, 2011) have summarized three elements of building slow-moving system: They are slow-moving network, slow-moving landscape and slow-moving facilities.

**Slow-moving network**: It is the structure framework of slow-moving system. The road network include cycling, walking. It is the fundamental element to provide people roads for walking and bicycling.

**Slow-moving landscape**: It covers all spaces used by pedestrians and cyclists. The space not only includes the network itself, but also includes network's surrounding environment. It also meets the slow-movers needs in “sight-seeing”.

**Slow-moving facilities**: General term for all facilities which have certain functions for pedestrians and cyclists. It is to meet the slow-movers’ needs in “use”.

Therefore, slow-moving network is a starting point of these three elements in building slow-moving system, and then combined with the slow-moving landscape and slow-moving facilities, together to promote the quality of slow-moving system.

So, this paper will research from these three aspects.

Research gap

Presently only a few theoretical researches on slow-moving system were performed in our country, yet they are lacking of a systematic theoretical support. The major resources are the traffic rules enacted by each city and the dissertation researches by scholars. Currently the researches in our country mainly focus on the perspective of urban traffic planning by concentrating on the slow-moving network construction, and ignore the slow-moving landscape and slow-moving facilities. Because of the lack of good coordination and corporation among these three elements, the existing slow-moving system has not achieved the desired effect.
1.3 Introduction to the problem

Research background—Changzhou

Sunan Economic Circle (Suzhou-Wuxi-Changzhou) reveals relatively fast economic development and urbanization and is densely populated. With the constant enhancement of urban development level, irrational design and constructions in traffic are accumulated, which has further intensified the conflicts between motor cars and pedestrians. Sunan Economic Circle, centered by Changzhou, consists of other cities like Suzhou, Wuxi and Yixing and is populated with over 150 million people.

Changzhou is located in the central area of the rich and beautiful Yangtze River Delta Region as well as the south part of Jiangsu Province. It is north to Yangtze River, south to Taihu Lake, and close to Shanghai and Nanjing with the same distance.

As one of the birthplaces of Yangtze Civilization and Wu Culture, Changzhou is full of many places of interesting and profound historical culture, possessing one national 5A scenic site and nine national 4A sites. Following Beijing, Changzhou is the second city providing preference to public traffic users—building Bus Rapid Transit (BRT) in Jan. 1, 2008, making it a pioneer in terms of BRT in Jiangsu Province. According to the traffic network planning by Planning Department and Construction Department, Changzhou is going to build a Rail Transit of Line 1 and 2 with a total length of 53.92km.

The traffic building in Changzhou city has always been an important issue. As the urban area expands, traffic problems are getting more and more serious, most of which are required to be solved

![Map of Changzhou](image1-2.png)

Image1-2: Map of Changzhou. There are five lines Shanghai-Ningbo, Beijing-Shanghai high-speed rails, Shanghai-Ningbo rails, Shanghai-Ningbo Highway, and Beijing-Hangzhou Canal going through it.
immediately. Simply relying on construction of slow-moving ways and expansion of motor vehicle ways, these problems can not be effectively solved. Instead, multiple elements like land use, slow-moving landscape, slow-moving facilities and so on should all be taken into consideration. Now it is the best opportunity to introduce slow-moving system.

Wujin District

Wujin District, governed by Changzhou city, covers an area of 1266 square km and is populated with nearly 1 million registered residents and another 1.6 million permanent residents. Wujin District currently is undergoing the transformation of urban traffic structure. As the number of private cars sores, difficulties in parking and smooth driving gradually emerge. Not only continuous pressures are posed on the limited urban traffic road, but also people’s peace and freedom of walking on the street are deprived. Currently Wujin District has not built with complete slow-moving system. Despite great improvement in overall public traffic service level, there is still a large room to be improved in terms of gearing between bus stations and slow-moving systems. Through the analysis
Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou

above, apparently construction of slow-moving system in Wujin District is urgent.
Study area & Delimitations

The design component of the thesis is limited to a physical area of Wujin district. I chose the core area with 15 square kilometers in Wujin district. One new metro line and one BRT line will intersect at this area. The area is currently consisting of residential and commercial land. And there are lots of scenic spots in this area. Even some places have slow-moving network, the rest area of Wujin District have many problems, like lack of systematicness in slow-moving network, low quality of slow-moving environment, single-purpose land usage and so on.

Wujin is selected as the study and design area not only because of its current status and problems, but also due to its unique cultural and natural resources which provide some resource advantages to the construction of slow-moving system landscape. Moreover Wujin is still in a preliminary stage in terms of car market occupation, so the conflicts between cars and slow-movers are not drastic and the road system has not been consummated. Thus in such context, it is essential to come up with a relatively consummated road system convenient to slow-movers and a delightful slow-moving environment. Therefore, I chooses Wujin District as the study area.
1.4 Aim

Main aim: The aim of this thesis is to propose a design for a slow-moving system taking into account the historical and cultural resources in Wujin district, based on the slow-moving network, slow-moving landscape, slow-moving facilities which found in Hong Kong and Copenhagen.

The aim is to synthesize a slow-moving model suitable for China and specifically Wujin district. The problems were outlined according to the three elements which include in slow-moving system: slow-moving network, slow-moving landscape, and slow-moving facilities. The aim is to address each of these issues according to the slow-moving system, from lessons learned from Hong Kong and Copenhagen case studies as well as from previous research outlined in the literature review. Taking into account local historical and cultural resources, strategies for developing each of the slow-moving network, slow-moving landscape, and slow-moving facilities should be implemented to the furthest extent possible.

The ultimate goal is to design and built environment which reduces car dependency. To encourage mass-transit use as opposed to the current focus on private car use, easy access for pedestrians should be promoted.

• Contribution to the field

This thesis aims to fill the gap between transportation and urban design in researching slow-moving system. While previous research have stopped at recommending slow-moving strategies for transportation, they have not looked at the slow-moving space and environment, and the possibility of implementing the principles on a specific site, this thesis makes a practical application of the research in the form of a design proposal. The wish is to provide a different point of view. It is made from the point of view of an urban designer, to visualize slow-moving system. This thesis can be seen as an experiment in how design principles could be used and adapted to a historic district like Changzhou. On an academic level, it is also hoped that this thesis can contribute to the discussion of slow-moving system.
1.5 Research questions

According to the research objectives, the main research question is to provide a design plan for the construction of slow-moving system in Wujin District, Changzhou City.

Main research question: Design proposal

How can the concept of slow-moving system and its related urban design principles of the slow-moving network, slow-moving landscape, slow-moving facilities, be used in the urban design of a historical district in Changzhou?

This question is answered by practical application of the theory of slow-moving system and slow-moving network, slow-moving landscape and slow-moving facilities in the form of a design proposal.

Sub-question 1: Hong Kong and Copenhagen case study

What are the aspects of a successful slow-moving system in Hong Kong and Copenhagen, analyzed according to the principles of the slow-moving network, slow-moving landscape and slow-moving facilities?

The case study will look specifically at urban design aspects of the built environment that relates to slow-moving network, slow-moving landscape and slow-moving facilities. The purpose of the case study is to synthesize a set of general design principles for the design of the Changzhou case.

Sub-question 2: Wujin new town case study

How can the design principles found in the literature review and case study be adapted to the local context of Wujin district in Changzhou? Before directly implementing slow-moving system design principles in Changzhou, certain local aspects must be considered. This question will address aspects of Wujin district, such as current road system, green resource, that must be considered when making a design proposal. Some of the existing characters of Wujin district may need to be preserved in future developments.
1.6 Thesis Outline

This paper consists of six chapters totally.

Part 1 is the introduction part which mainly proceeds from the definitions of slow-moving systems, allows readers to understand the research aims and significances by introducing the current status in Wujin District, Changzhou City, then specifies the research scope and methods, and finally states the research content.

Part 2 first of all introduces the relevant theories, then summarizes and classifies the practices of slow-moving systems in foreign cities, next introduces the origin of slow-moving system, then analyzes the traffic rules and regulations for slow-moving system construction in all cities of China and domestic scholars' researches on slow-moving system, based on which the domestic research focus and deficiencies are put forward. Next, suitable practices will be identified and utilized in our country.

Part 3 is the case study. In this chapter the cases of Hong Kong and Copenhagen are studied. This part culminates in the synthesizing of design principles to be used for the design proposal. Finally a comparative analysis between these cities and Wujin District is performed so as to find suggestions and measures for the slow-moving system construction in Wujin District.

Part 4 is one of the core parts of this paper. According to the research analysis in the previous parts, the objectives for constructing slow-moving system are summarized here, based on which the constructive elements of slow-moving traffic are proposed, that is, constructions of slow-moving network, slow-moving landscape, slow-moving facility.

Through the summary in part 4 and determination of the design principles, Part 5 will apply the design methods and thoughts into the practices in Wujin District, Changzhou City. In this part, the design in Wujin District will be introduced in detail.

Part 6 is the conclusion part of this paper. In this part, the theoretical defects in the practical design of this research and improvements to be made in future studies are proposed.
Chapter 2: Research on slow-moving system

Through sorting and organizing literatures such as books, periodicals and information on government websites, this chapter summarizes and analyzes the slow-moving system and relevant theories both at home and abroad. By comparison between different theories, useful theoretic basis to this paper is identified. Moreover, the focus and ignored points in the present researches on slow-moving system in our country are also concluded.
2.1 Relevant theoretic researches on slow-moving system

New urbanism

- Background of new urbanism

The infinite suburbanization in western country has given rise to varied social problems such as "growth crisis", "non-urbanization" and so on (Renne, J.L., Curtis, C. and Bertolini, L., 2009), which thereby accelerate the development of new urbanism. In the end of 1980s, "new urbanism" brought vast reflections on the excessive suburbanization and became one of the major methods of city planning at that time. New urbanism aims at "terminating the extension of suburbanization", and on the basis of traditional communities replaces the less appealing suburbanization mode by incorporating the modern living features and fusing with the local characteristics (Zhou Bing, 2000).

- Main concepts and features of new urbanism

To some extent, new urbanism is the extension of the theory of neighborhood unit" proposed by Clarence Perry in 1930 with the basic elements of neighborhood, sub-region and corridor. In Charter of The New Urbanism published by The Congress for the New Urbanism in November 1999 in Los Angeles, the planning theory and connotation of new urbanism had been further identified, making it no more a slogan but with practical planning guidelines(Renne JL, Curtis C and Bertolini L, 2009). The core idea of new urbanism planning and design is paying attention to regional planning, emphasizing treating and solving problems from the perspective of regional integrity; be human-oriented, building agreeable environment to support human beings' social living; the ideal mode for community planning is: compact neighborhoods with mixed functions and pedestrian-friendly setting; sub-regions with appropriate features; and functional and artistic corridors that can well combine the natural environment with the man-made communities to form a sustainable integrity(Zhou, B., 2000). At the level of city planning, new urbanism objects absolute partition by function and single function of a large area, and advocates functional diversity and improvement in each region (particularly the neighborhood unit) (Renne, J.L., Curtis, C. and Bertolini, L., 2009). To this end, new urbanism put forward few basic principles that are also the most fundamental characteristics of new urbanism planning and design (Peter Katz, 1994).

(1) Principle of compactness
Enhance the vitality of blocks and the utilization of land and infrastructures through increasing population density.

(2) Principle of pedestrian-friendliness
The distance between public activity space and public infrastructures and that between bus stations and residence should be pedestrian-friendly. More people can be encouraged to choose walking as the travel means.

(3) Principle of function diversity
Within the area of neighborhood or the pedestrian area centered by
bus stops, stores, service centers, green land, primary and middle schools, activity centers and chances of employment should be
provided as many as possible so as to support the living manner
dominated by walking and public traffic.
(4) Principle of affordability
Through compact development and enhancing the use ratios of land
and infrastructures, city management organizations can then afford
the development cost. At the same time, residences of different types
and prices can be offered in the community so that families from
different social classes can afford the house.

- Enlightenments from new urbanism

In spite of the fact that new urbanism emerged in the context of
the suburbanization in the United States which may differ a lot with
our country in terms of the practical national situation, yet new
urbanism is of great significance to the construction of slow-moving
system in our country. In the previous chapters, it has mentioned
that the existing problems in Wujin, Changzhou city is single function
of most land, over long distance between different functional areas
that are disadvantaged to pedestrians. The pedestrian-friendliness,
mixed function, diversified traffics and convenience advocated by
new urbanism show important reference value to the design of
urban space, particularly the design of space environment.

TOD theory

TOD mode is one of the representatives of new urbanism. It is also
categorized in the following features: compactness, pedestrian-friendliness, composite functions and environment
protection.

- Theoretic background

Peter Calthorpe, an American architectural designer, initiated the
theory of TOD (Transit-Oriented Development) in the book *The Next
American Metropolis: Ecology, Community and the American Dream*
published in 1993 (Liu Dongfei, 2003). The book defined TOD as
follows: TOD is such a mode aiming at building a community
centered by bus stops and major commercial centers with a radius of
approximately 2000 ft (600 M). The public facilities of TOD are
diversified, including residence, commercial service, entertainment
and open space. The major tenet of TOD is to create a
pedestrian-friendly environment so that users can go wherever they
want on foot. Therefore, the public facilities in the community can
meet the residents’ daily needs, reducing their reliance on cars.

- Design principles

There are no specific requirements on site selection for TOD design.
It can be built based on reconstruction of an old city or on an idle
and vacant space. However, it should be built along the existing or
coming public traffic routes (John L. Renne, 2009). Moreover, the size
and area of TOD will also vary with the sites, but generally the size
will be limited to an area with a radius of 10 min’s walking (Wang
Xiaoyuan, 2010). Design of TOD community contains the following elements:

1. **Composite land use pattern**
   In TOD community, land use is diversified and there are enough functional areas to meet people’s daily needs (Liu Dongfei, 2003). More specifically, the land use proportions are: public facilities 5%~15%; commercial area and other places that can provide chances of employment 10%~70%, residence 20%~80%. However, the location of TOD is a key factor influencing these proportions. For example, if TOD is built in neighbor unit, then the residence may take larger proportions than other land uses. Or otherwise commercial land and office buildings may take a larger proportion (John L. Renne, 2009).

2. **Residential diversity**
   Residential diversity of TOD is mainly reflected in the following three perspectives: diversified residential, diversified housing grades and diversified residential purposes. Through residential diversity, different residents' needs can be satisfied, and more people can be invited to join in TOD mode.

3. **Streets convenient for walking and cycling**
   In TOD community, environment-friendly bicycle and pedestrian ways should be built in the shape of grid network to connect with the various public facilities, so that residents can shuttle among different functional areas. In addition to building roads with good accessibility, in order to guarantee residents' safety, vehicle speed should be limited within 15mile/h (approx. 25km/h), while the width of roads generally range between 8 and 10 ft (2.5-3M).

4. **Convenient commercial and public facilities**
   Commercial center should be contained in every TOD community and generally next to bus stops. According to the sizes of commercial centers, different facilities should be built. Besides, other basic service facilities such as kindergartens, post offices, polices, fire-fighting and government services should also be provided. Additionally, public space is also essential and indispensable. TOD should also provide various green lands to the residents and workers therein, so that people can gather together for entertainment and experience the relaxed and comfortable life in the community.

### Enlightenments from TOD mode

From the previous analysis, it can be concluded that TOD mode is more suitable for the design and planning of small areas. The design elements contained therein can only be used by people in the TOD community and such community is also less continuous with the surrounding area. Thereby TOD mode can not be applied to design and planning of large cities. However, by contrast, the urban TOD mode is more consistent with the relevant theories of slow-moving system. Many design methods of urban TOD are consistent with the planning of slow-moving system. Though the planning of slow-moving system should take into account the long and short-distance traveling means, its ultimate goal is to provide a pedestrian-friendly city with highly developed public traffic and consummated public facilities. Consequently, the mode of mixed land use, pedestrian and cyclist-friendly streets, convenient commercial and public facilities are very important to the construction of slow-moving system.
Compact city

• Meaning of compact city

In 1990, CEC (Commission of the European Communities) put forward the concept of "compact city" in the Green Paper published in Brussels. Later many scholars came up with the features of "compact city", yet none of the definitions on "compact city" was widely accepted.

Breheny defined that "compact city" is aiming at promoting re-development of cities and revival of downtown area; protecting farmland, restricting excessive development of rural area; reaching higher urban density and land use with mixed functions, giving priority to development of public traffic and particularly focusing on urban development at the nodes of public traffic (Breheny, 1997).

Compared to the dispersed urban space development mode, many scholars argued that compact city is a spatial strategy conducing to effective achievement of sustainable urban development (Jenks, M., Elizabeth, B. and Katie, W., 1995). Such "compact urban" pattern should also be promoted (Newman P, 1995).

• Main points of compact city theory

Compact city is developed based on public traffic, walking and cycling. It is an approach for achievement of sustainable development. "Compact city" theory consists of the following parts:

(1) High-density urban development

Compact city theory advocates the development mode of high-density land use in order to accommodate more urban activities, enhance the use efficiency of public facilities and reduce the input in urban infrastructure construction while controlling urban extension, protecting suburban environment and shortening traffic distance.

(2) Mixed land use

Through the mode of mixed land use, compact city mixed the land use of residences, working places, entertainment and public facilities together to reach the goal of reducing commuting distance. In this case, it is possible to reduce the requirement on traffics and energy-consumption, reinforce interpersonal connection and form desirable community environment.

(3) Giving priority to development of public traffic

Compact city theory stresses the protection of urban environment and the reduction of car use. Therefore it is necessary to give priority to the development of public traffic and create a convenient and efficient urban public transport system.

• Enlightenments from "compact city" theory

"Compact city" theory is a thought for urban space development. Since it emerged in Europe, the culture, politics, and urban development states may be different from those in China, but the essential idea advocated by it is worthy of our reflection. To address the problems in urban development of our country, the decentralized concentration based on compact city is undoubtedly a space planning method with great reference value.
Green traffic

- **Background of green traffic**
  Similar to compact city, green traffic also has no wildly-accepted definition by now. It is a concept and a practical goal as well, a view based on sustainable development traffic and an approach for achieving sustainable traffic. By incorporating the urban design methods of comprehensive traffic calming area, cycling promotion activities, and new urbanism, green traffic has been an important development field in traffic engineering. It is in the hope of reducing environment pollution through alleviating traffic congestion, promoting social equity and reasonable use of resources and finally reaching the goal of environment-friendly urban traffic.

- **Meaning of green traffic**
  Green traffic is a harmonious traffic means reaching harmony between traffic and environment, traffic and future, traffic and society, traffic and resources (Yang Xiaoguang et al., 2006). It is a "traffic means advantaged to urban environment and a traffic idea for completion of social economic activities" (Wang Jingxia, 2001). Previous literatures also summarized that green traffic is an overall framework with the perfect combination of "accessibility and orderliness; safety and comfortableness, energy-efficiency and low pollution". In 1994, Chris Bradshaw put forward Green Transportation Hierarchy in 1994, and arranged the green traffic tools in order of priority. The goal of such order arrangement is to give priority to the green traffic means--walking and cycling as well as public traffic.

- **Main concepts of green traffic**
  The basic guideline of green traffic is being human-oriented. Its guideline is mainly reflected in the following four perspectives (Han Sunsheng, 2004):
  
  (1) Appropriate green traffic technology
  From a macro perspective, urban traffic system consists of two networks: supply and demand. The traffic state of a city is totally depending on the matching degree between the two. At the technical level, emphasis has been given to public traffic, at the same time environment, resources and safety issues are also in an important position. In order to build a green traffic system, technologies in various fields are needed, including technologies related to transportation itself, fuels, vehicles and engineering construction and so on.

  (2) Human-oriented urban and traffic planning
  Green traffic should take the traffic means used by the majority as the measurement dimension. Public traffic and walking have better accessibilities than motor vehicles. They can also enhance human beings’ activity frequencies rather than the speed of motor vehicles.

  (3) Public participation
  Selection of green traffic tools is a decisive question involving both the traffic and living qualities. People in the community should reach common agreement and re-examine the value of human being, eventually choosing green traffic as one of their living manners.
Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou

• **Enlightenments from "green traffic"**

Green traffic is a comprehensive system involving urban traffic policy making, overall city planning, scientific and advanced transportation management means. It covers a larger area than slow-moving system, yet its focus remains the traffic issues and traffic means. It is aiming at reaching green travel through professional traffic strategies.

• **Conclusion**

The theories introduced above though involve different fields and design methods, regardless of their goals of restricting the expansion of suburbanization, reducing urban pollution and dispersion of urban functional area, the ultimate goal is to advocate the development of walking, cycling and public traffic means, which is in consistence with the final goal of slow-moving system. Therefore, I make a comparison between the four theories and slow-moving theories with the goal of finding some recommendations to the construction of slow-moving system.

Through comparison of the backgrounds, similarities, and differences of varied theories, the enlightenments on the construction of slow-moving system are identified.

<table>
<thead>
<tr>
<th>Name of theory</th>
<th>Development background</th>
<th>Similarities</th>
<th>Differences</th>
<th>Enlightenments</th>
</tr>
</thead>
<tbody>
<tr>
<td>New urbanism</td>
<td>Suburbanization expansion</td>
<td>Object absolute partition by function pedestrian-friendliness</td>
<td>Different design standards and areas</td>
<td>Planning of mixed functions Importance of pedestrian space environment</td>
</tr>
<tr>
<td>TOD mode</td>
<td>Suburbanization expansion</td>
<td>Public-traffic-oriented, provide communities with pedestrian-friendly distances from one functional area to another</td>
<td>Community planning for small areas</td>
<td>Combination of regional planning and public traffic routes, provide diversified commercial public devices</td>
</tr>
<tr>
<td>Compact city</td>
<td>Dispersed urban functional area</td>
<td>Centralized urban development Give priority to public traffic</td>
<td>Suitable for development of small urban area</td>
<td>Decentralized regional planning</td>
</tr>
<tr>
<td>Green traffic</td>
<td>Traffic congestion, serious traffic problems</td>
<td>Give priority to walking and cycling</td>
<td>Mainly research the traffic measures and methods</td>
<td>To be human-oriented, take into account the pedestrian and cyclists’ needs</td>
</tr>
</tbody>
</table>
2.2 Planning rules of slow-moving system in various cities

Shanghai

In 2007, the definition by Shanghai slow-moving System Plan contains meanings of two perspectives: firstly, "slow-moving traffic is an independent traffic means indispensable for gearing with other traffic means, and secondly "slow-moving traffic is not merely a traffic means, but also an important component of urban living system" (Shanghai Municipal People's Government, 2002). The Plan proposes to build over 300 slow-moving cores distributed in the downtown area of Shanghai and decades of slow-moving traffic safety areas--safety islands. The core objective of urban slow-moving traffic service is to build three types of urban charming areas: urban attraction core, urban vitality core and urban harmony core through design of slow-moving system. Moreover, inside the slow-moving island, by making use of the pedestrian facilities on the express ways, major and secondary ways, as well as the few non-motor vehicle ways paralleling with the major roads, a relatively independent and safe slow-moving traffic space can be offered to short-distance travel (Shanghai Municipal People's Government, 2002).
Hangzhou

In 2008, Hangzhou has adopted Hangzhou Slow-moving Traffic System Plan and formulated a development strategy of giving priority to development of public traffic: slow-movers first, advocating slow-moving traffic means, implementing "separated ways for fast and slow moving traffics" on the basis of safety, efficiency and equity; consummating the integrated travel means of "public traffic plus slow moving". This plan particularly focuses on slow-moving system planning on the scenic spots and the river networks in the urban area of Hangzhou, pays attention to improving slow-movers' use of environment and facilities, and proposes different action plans for the central area, riverside area and scenic area. Presently the slow-moving system in Hangzhou City has been in construction (Gu zhifa and Guo xuebing, 2009).
Conclusion

By reviewing the existing slow-moving system plans and measures in several cities, it has been discovered that China now put much emphasis on slow-moving systems. Nevertheless, the research methods in these cities are mostly taking pedestrian ways and non-motor vehicles as the framework of the slow-moving networks to divide cities into different areas that are connected by slow-moving plus public traffic. Yet the ultimate goal is to release the traffic pressure and to measure the effectiveness and reasonability of slow-moving system by safety and accessibility. Despite the truth that the construction of the framework of slow-moving systems has built, few citizens can truly use them because the plans remain in the stage of traffic construction, and failed to incorporate the landscape design.
2.3 Research on slow-moving system in China

In recent years, many experts and scholars realize that the problems faced by slow-moving system cannot be solved simply relying on Transportation Department; instead, reflections should be performed from more perspectives to find out the factors for slow-moving system construction. Therefore, more urban designers are joining in traffic design, but most researches are shallow and superficial as they failed to study the design as per the features of slow-moving system landscape. The following chapters review the relevant literatures by dividing them into three parts: definition of slow-moving system, characters of slow-moving system, and elements of slow-moving system.

Definition of slow-moving system

Shi Xudong (2009) summarized that slow-moving system is the general term of walking, cycling and non-motor vehicles’ traffic system and its supporting software and facilities. Zhu Lifang (2002) argued that slow-moving system should develop cross-disciplinary approaches for traffic way planning and create a traffic environment landscape behavior and psychology. The traffic way planning approaches should be employed in all stages of city planning, particularly in the stages of controlling and constructive detailed plans. By doing these, the road facilities can be humanized with aesthetic values and practicability. So, slow-moving system is a system aiming at meeting slow-movers’ needs. Like Xiong Wen’s (2008) opinion, he identifies the research thread of human-oriented space for slow-moving planning, follows the technical route of "human orientation and space integration", defines the slow-moving road use right of "transportation of man rather than vehicles", and gives priority to the slow-movers’ safety and convenience rather than vehicle speed in order to improve slow-moving on secondary ways.

Elements of slow-moving system

Xu Kaitao (2009) thought that two elements should be considered when we build the slow-moving system, firstly to guarantee the safety of slow moving, then provide convenience and comfortable slow-moving environment to users and finally to enhance the artistic quality of environment in slow-moving system (including building design, dimensions, patterns, colors, and materials etc.). After finishing the construction of slow-moving system framework, more users will be attracted by comfortable environment. As long as more people walk and cycle in cities, the vitality and atmosphere of a city will be gradually improved. His opinion is similar to Zhang Chun and Wang Weihua’s (2011), but they have further detailed it, they classified the slow-moving system from functions and put forward the element features of slow-moving systems with different functions. Meanwhile, they have discussed the key points for slow-moving system planning and design from the macro (slow-moving network, public traffic system, medium (function mix-use, distance reduction of commuting ways, and increase of public service centers and facilities), and micro (municipal way
design and building design) perspectives. So, elements of slow-moving system can be concluded as these three aspects: slow-moving network, slow-moving landscape and slow-moving facility. In the view of urban designers, slow-moving elements should take humanity into account, Shi Xudong and Kong Linglong(2009) argue that slow-moving system construction should simultaneously pay attention to the four aspects: macro value orientation, material physical construction, spiritual cultural construction, management implementation and complete fusion with the urban macro development strategy. Moreover, it has also been proposed that construction of slow-moving city requires "skeleton" (spatial construction), "flesh and blood" (interior function) and "skin" (external facilities).

**Construction method of slow-moving system**

Through the analysis of the elements of slow-moving system, many scholars put forward methods to construct slow-moving system, firstly, with respect to the level of construction of slow-moving network: Ding Hairu(2011) argued that slow-moving network should combine with the green network as the foundation of slow-moving system construction, proceeding from building green space and slow-moving street. Small-city living pattern themed features of natural ecology and slow-moving urban life will adapt to slow-moving system. Through building green space and green transportation, an organic, sustainable, and slow-moving living pattern meeting people's normal needs can be provided. Then, because there are a lot of paths in slow-moving network, how to divide them is also a key problem. Yao Wenqi(2010) argued that reasonable density of slow-moving ways is the foundation of slow-moving network design. She divides paths into four levels: Corridor (motor vehicle primarily), distribution channel (vehicle speed limit), connection channel (non-motor vehicle primarily) and leisure way (pedestrian primarily), in this way giving slow-moving network a better environment.

Secondly, the level of construction of slow-moving landscape, it is the key point of construction of slow-moving system (Sun Jun, 2007). Slow-moving space design was incorporated into human-oriented city design policies and technical framework. It is expected to, taking the people's physical and safety needs, behavioral and psychological needs, as well as cultural and aesthetic needs as the basis, further reach the goal of regulating city development direction, resume the lost charm of cities in the construction process and create a small cities with diversified living atmospheres, convenient traffics, abundant rest room, distinct features and agreeable environment, and advantaged for living and relaxation. Except for humanized aspect, we also need to give people a good vision in slow-moving space, Liu Wei (2012) suggested that landscape green belt on the road sides should be considered to improve the existing situation, protect the natural landscape and add new plants, then the two of which integrate with each other to form new natural landscape and green corridor, contributing to construction of green slow-moving system.

**Conclusion**

According to the researches stated above, apparently over the years
many scholars have gradually expanded their visions to the environmental perspective in their research. Giving consideration to slow-movers' use requirements, it has been identified that only a comfortable environment can attract more people to use slow-moving system.

My paper is much enlightened by Liu Wei's view of incorporating natural resources and ecologic landscape to slow-moving system, the fusion of which will further enrich the landscape of slow-moving network, and connect the natural resources in different districts of a city together.

Hereby it is argued in this paper to truly construct, implement and put in use of slow-moving system, construction of slow-moving environment is indispensable, whereas slow-moving environment requires better layouts and humanized public spaces to supplement each other.
2.4 Implications for China’s slow-moving system development

After interpretation of the development course of slow-moving system, it can be perceived that the whole course is arising from the conflicts between slow-moving traffic and motor vehicles. Different measures and solutions were adopted as per the social situation in different eras, yet they all aimed at providing better use environment to slow-movers. Through the studies above, the following lessons can be drawn:

The necessity of building slow-moving system

Slow moving, as an ancient travel means, is used the most widely. From the emergence of horse carriages to the popularization of motor vehicles, people are gradually aware of the great significance of providing slow-moving space. As time changes, the needs of slow-moving has been increasing. Whereas our country is in a high-speed development stage in terms of motor vehicles, the changes occurring in western countries undoubtedly alarmed us. Since slow-moving is the major travel means in China, establishment of slow-moving system should be the primary solution to traffic problems.

Compromising fast and slow-moving traffics

In the development course of slow-moving system, either separation of pedestrians and vehicles or coexistence of the two is for eliminating the conflict between fast and slow-moving traffics. Judging from the practices, these two theories feature their own advantages and disadvantages, but we can conclude that to regulate fast and slow-moving traffics reasonably is the preferred solution to elimination such conflicts. Only by equally balancing the benefits of the two, can they achieve better and common development. By contrast, the mode of separation between pedestrian and motor ways may take more advantages in a small open space.

Slow environment should pay attention to the subjectivity of the people

The establishment of slow-moving system should meet various needs, not only provide enough space of road, but also consider the user’s demand. And s slow landscape as well as slow-moving facilities should be built with well coordination.

Though the results of the theoretical study is not enough, the next section will, through case study, find out more design basis and the methods of slow-moving system construction.
Chapter 3: Case study

By literature review in the previous chapters, we have a general understanding on the development of slow-moving system and relevant theories. However, the theoretical system can not represent the development situation of every city and may have some differences with the actuality. Only by analysis of the practical cases on slow-moving system both at home and abroad, it is then possible to give feasible recommendations to the development of slow-moving system in Wujin District, Changzhou City. As mentioned in the previous chapters, construction of slow-moving system consists of the three compositions of slow-moving network, slow-moving landscape and slow-moving facilities. Therefore, this chapter performs a study on Hong Kong and Copenhagen from these three perspectives. Then by comparative analysis between these cities and Wujin District, relevant recommendations and measures for slow-moving construction are provided.
3.1 Hong Kong

Though Hong Kong is a conservation-oriented city with less land yet numerous people and vehicles, it still provides a vast ecologic system with vast green land despite the limitations in land use and extremely dense buildings. Moreover, Hong Kong has successfully applied slow-moving system, making it a representative city in terms of the mode of public traffic plus pedestrian traffic. In Hong Kong, only 10.5% citizens take driving as the primary traffic means, and over 53% people use public traffics and 36% cycle or walk. In this chapter, the existing slow-moving system in Hong Kong will be analyzed, and the reasons for its success are summarized.

Hong Kong consists of Hong Kong Island, New Territories, Kowloon and outlying islands. Covering an area of about 1070 square kilometers, Hong Kong now is populated with about 7 million people. The main business area in Hong Kong only occupies 78 square km, which is about 7% of the total land area of Hong Kong. New Territories, with an area of 980 square km, is equivalent to 91% of the total area of Hong Kong. Kowloon is a peninsula located in the northern of Hong Kong, Tsim Sha Tsui on which is a place that tourists will definitely visit. Outlying islands consist of 24 islands (Liu Haitao, 2011).
Analysis of slow-moving system in Hong Kong

Hong Kong is a coastal and hilly city. Since most of the areas in Hong Kong are hills and ocean, the land use planning mainly focuses on the several strip-shape areas along the hills and mountains. The built-up areas are only about 2-3 km wide. Thus the built-up areas in Hong Kong only accounts for 25% of the total area there. In such context, the rail transit there should be built along the corridors where buildings and densely-populated areas are gathering, in this case the rail transit and land use will be highly fused (Liu, H. T. and Zhou, T., 2011).

The successful slow moving system in Hong Kong has been duplicated by many cities both at home and abroad. Its success can be ascribed to many reasons. In this chapter, from the slow-moving network, landscape, and facilities, the reasons for its success are analyzed.
Construction of slow-moving network

Provision of consummated slow-moving network can encourage more people to walk and cycle, which is also the prerequisite for slow-moving system construction. Planning convenient traffic network can allow people to go to different destinations easily. In the following content, the features of slow-moving network planning in Hong Kong will be summarized:

• Simple and efficient road system

Hong Kong has been built with a simple road system. According to the statistics in 2003, Hong Kong has been built with a total road length of 1934km, a road density of 1.75km/km², per capita road 2.8km, and a road network density 6.9 km/km². In the past 20 years, the average speed of vehicles in CBD region has always been above 25 km/h, and 30 km/h in other areas (Liu Haitao, 2011).

• Combination of slow-moving system with the surrounding area

Hong Kong has also been built with an efficient public traffic network. In its urban planning, railway is taken as the backbone of traffic network.

The high-density building area is fused with the railway stations, accordingly enhancing its economic profit. Besides, consummated pedestrian route system has also been built to go through the high-density area. Therefore, the public can reach most of their destinations at ease. Seeing from Hong Kong’s planning figure of urban rail line, it can be observed that the traffic routes generally start from HK Island and Kowloon and end in New Towns. Through such means, the traffic flow rate of rails will be most efficient. The slow-moving network planning in Hong Kong generally follows two rules to reach the maximal synchronization of public traffic and land use:

Rail lines all go through the urban strategic development area.
Land-use planning is appropriately adjusted in accordance with rail transit construction (Liu Haitao, 2011).

By adjusting or changing the purpose of land use and development intensity, intensive land use is reached. Through the virtuous circulation of mutual restriction between urban rail transit and land use planning, the following two advantages are achieved:
Reinforce the connection between New Towns and the mother city of Hong Kong and Kowloon, build a new urban pattern, construct a urban structure with large-scale network and nodes, form a urban pattern depending on rail transit and a living style closely fusing with rail transit.

Due to the high-density development surrounding the subway stations, heavy passenger flow is formed. For example, Tseung Kwan O Rail Line was built according to the development and construction of Tseung Kwan O area. Due to the close combination of land use and rail track, the regions surrounding the 5 subway stations has been populated with around 290 thousand people, making the population in Tseung Kwan O increasing from 10 thousand to 340 thousand.

**Connectivity of pedestrian network**

In addition to the combination of rail tracks with the surrounding land, the subway stations are also linked with the underground floor of the surrounding buildings, forming a development mode of "station plus property" that achieves fusion of subway stations and surrounding properties. Within the range of 600-1000m's walking, high-density and diversified buildings are constructed. From the figure, the properties along the rail ways and the floor areas of the buildings can be observed (Liu Haitao, 2011).

<table>
<thead>
<tr>
<th>Name of rail track</th>
<th>Office/(ten thousand ㎡)</th>
<th>Shopping mall/(ten thousand ㎡)</th>
<th>Residential / (unit)</th>
<th>Others/(ten thousand ㎡)</th>
<th>Total Gross Floor Area(million ㎡)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown Line</td>
<td>23.4</td>
<td>29.9</td>
<td>31366</td>
<td>29.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Airport express</td>
<td>61.1</td>
<td>30.7</td>
<td>28473</td>
<td>29.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Tseung Kwan O Rail Line</td>
<td>0.5</td>
<td>10.5</td>
<td>30414</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>East rail line</td>
<td>6.7</td>
<td>11.3</td>
<td>4771</td>
<td>11.3</td>
<td>0.7</td>
</tr>
<tr>
<td>West rail line</td>
<td>4.1</td>
<td>14.3</td>
<td>18652</td>
<td>6.1</td>
<td>1.5</td>
</tr>
<tr>
<td>Ma on shan line</td>
<td>6.5</td>
<td>10686</td>
<td>6.1</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Light rail transit</td>
<td>5.3</td>
<td>9108</td>
<td>50.3</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>96.1</td>
<td>108.8</td>
<td>133470</td>
<td>50.3</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Development purpose and floor areas of the properties along the subways in Hong Kong

By high-density development around the rail way stations, the properties are utilized for different purposes, including residence, working, commerce and entertainment etc. A high-efficient living mode of "clothing, food, housing, and traveling" has been formed around the rail way stations.

An important factor for the success of "station plus property" mode is: the buildings within the radiation range of subway stations are connected by reasonable pedestrian systems, making the originally loose and isolated individual buildings form a network centered by the subway stations. Moreover, through the well-designed road sign in the stations, the heavy traffic flow from the stations is shunted, accordingly reducing the pressure of roads and guaranteeing citizens' safety as well. Citizens can reach shopping places, office buildings and residential areas conveniently on foot, thereby their dependence on motor vehicles were reduced.
Building of slow-moving facilities

- Seamless transfer facilities

Through the unique design and construction of rail transit transfer stations in Hong Kong, more convenient traffic means are provided. These stations guarantee not only the convenient shift between different rail lines, but also the seamless transfer to different traffic means. Through building the stations of different traffic means together, comprehensive regional traffic hubs are constructed.

Besides, many stations have also been built with transfer facilities for citizens to transfer to subways from private cars (mode P+R). Developed and convenient transfer facilities are one of the important reasons for the success of rail transit in HK. Through seamless transfer facilities, the accessibility of rail transit has been improved, and the properties and public traffic near the subway stations become more appealing.
• **Humanist design of the entrances and exists for rail transit station**

Through close connection between subway exit/entrance and the surrounding shopping malls, hotels and residence areas, pedestrians can shuttle among these areas easily. Most of the stations in Hong Kong are shielded with platforms, bridges and tunnels, accordingly achieving separation between pedestrians and vehicles, seamless transfer and human-oriented subway exit/entrance design. For example, the subway station of Causeway Bay is built with six exits, allowing passengers to reach the surrounding buildings and squares through different exits fast: Exit A leads Time Square, Exit D to Sogo Department Store, and Exit E to Hotel Berlin. As another example, the subway station of Hong Kong is directly built under the building of International Financial Center, offering much convenience to people working there. People can also transfer to another station named Central Station through escalators (Liu Haitao, 2011).
Slow-moving landscape construction

Through the previous analysis, it can be concluded that Hong Kong reached the goal of building a successful slow-moving system through street landscape design, clear and perspicuous road signs, afforestation and environment construction, provision of orderly street facilities, re-pavement of pedestrian ways, and improvement of road signs, sufficient illumination and addition of public artistic factors.

• **Most of the pedestrian space is planted with green plants**

Including the ground, street flyover, and any places that we can see. Located in the subtropical area, Hong Kong has abundant tree varieties. Coupled with the delicately-designed seats, lamp posts and other facilities, people can not only be satisfied in needs, but also gain a kind of visual enjoyment (Zhao Xiaonan, 2010).

• **Detailed processing and construction of pedestrian space**

All the elements of pedestrian ways, such as the shapes, sizes and materials of the railings and seats, have all reflected people’s use requirements.

Pedestrian ways are built with elevators wherever there are flyovers, and conveyors are also provided for horizontal long-distance walking, achieving faster and more comfortable walking experience. In the management of pedestrian space, "human-oriented" concept can be clearly observed. For example, at the crossroad, the signal of pass (green light) is also hinted with sounds, offering convenience to the blind. Safety islands are built in the middle of road on the zebra crossing.
• **Consideration of scale in pedestrian space**

Buildings in Hong Kong are highly dense and roads are very narrow. However, people never feel depressed when walking on the street. This is mainly because of the planners adopted double scales in design, including the urban scale and small scale serving the pedestrian space around buildings. Through the delicate stages under the buildings, gardens and seats, people can have a relaxed feeling when walking in such environment. Besides, in order to soften the boundaries of buildings and enlarge the space between buildings and pedestrian space, horizontal green belts are built at the bottom of buildings, weakening the sense of dimensions between pedestrians and buildings.

**Decoration and pavement of pedestrian ways**

In most of the cities in China Mainland, zebra crossings usually paved with colorful and patterned floor tiles. In fact, the major function of floor tile is anti-slippery. On the pedestrian ways in Hong Kong, the floor tiles used are red or gray ones which are simple and plain in appearance yet very functional.
3.2 Copenhagen

Background introduction

Copenhagen, located in eastern Denmark, is the largest city in northern Europe. As Denmark’s capital, Copenhagen is also the political, economic, and cultural center of Denmark. Copenhagen City covers an area of 89.6 km². According to the data of Danish National Bureau of Statistics, the total population in Copenhagen reached 546 thousand in 2012, and may increase to 637 thousand by 2025. With the number of bicycle exceeding the number of population, 36% citizens commute relying on bicycles, saving 90000t carbon emission every year, whereas the city is aiming at reaching 50% of cyclists to the total population (Jiang, Y., Chen, Y. L., Zhang Y. F. and Xie, J., 2012). Copenhagen is known as the "kingdom of bicycle" and the "Paradise of pedestrians". Its success is definitely not a coincidence. Before 1960, Copenhagen was totally a city of motor vehicle. Ever since the construction of first pedestrian way-- Ostergade, Copenhagen is undergoing changes every year. Its efforts made to offer more spaces to cyclists and pedestrians are known to everyone. Now we can see that Copenhagen is a very charming and attractive city. What it has achieved can be ascribed to the construction of an improved slow-moving system and its attention given to humanity.

This chapter will analyze the slow-moving system in Copenhagen from the three perspectives of slow-moving network, slow-moving landscape and slow-moving facilities in order to identify the measures adopted by the city, know more about the development strategies of its urban space, and realize how to attract more people to join in slow-moving system.
Slow-moving network construction

The traffic network layout of Copenhagen has been following "five-figure planning" since 1947, which means the urban area extends in five directions. The downtown and peripheral areas are connected by the five radial lines (Liu, H. T. and Zhou, T., 2011). Land use is closely connected with the traffic planning. By now, "five figure planning" is still effectively implemented in Copenhagen.

- Cycle network

Copenhagen is built with consummated cycle network which does not only enjoy long history, but also from local features in technical style. Its cycle network can be divided into three forms: exclusive cycle route, green cycle route and express cycle route. In the following content, the features of these three networks will be analyzed one by one.
**Exclusive cycle route**

Exclusive cycle route is the most common and widely distributed network among these three ways. As early as 1960s and 1970s, cycle network was formed in this city preliminarily. In 1934, Copenhagen was built with exclusive cycle routes as long as 134km (Pucher, J. and Buehler, R., 2007) and reaching 360km in 2010. Moreover, in the downtown area, the cycle routes are connected with the pedestrian network.

Cycle routes in Copenhagen are usually built outside along pedestrian ways with a standard width ranging between 2 and 2.5m. In recent years, in order to alleviate the traffic jams, Copenhagen has further enlarged the width to 3-4m (Jiang, Y., Chen, Y. L., Zhang Y. F. and Xie, J., 2012).

![Image3-11: Bicycle network in downtown area of Copenhagen](image)

Red ways are existing ways or ways planned to be built, blue ways are ring road exclusive for bicycles, and gray ones are pedestrian ways.

Picture source: Urban space and traffic - strategies and practices in Copenhagen
Green Cycle Route network

In 2001, the government enacted "Green Cycle Route Plan" which planned to build 22 bicycle green routes with a total length of 110km each. According to the plan, the routes selected are independent from the busy trunk lines of the cities, go across open spaces such as parks and coastal areas, and offer convenience to access to major places of interesting. In addition to the provision of cycle routes, the route is also built with pedestrian ways.

Green plants are used to separate the ways in order to reinforce the feeling of entertainment. Crossing with the motor vehicle routes are also avoided as much as possible. Besides, for some special situations, specific solutions are also provided. If the cycle routes cross with ordinary routes, signs of "bicycle first" are built. By these means, bicycles on green cycle routes can run safely, smoothly and comfortably. By 2010, 42km of the green route has been finished. Two bridges exclusively for bicycles are also constructed and put in use. Currently the green network has almost covered the whole city (Jiang, Y., Chen, Y. L., Zhang Y. F. and Xie, J., 2012).
Express cycle route network
Brian Hansen, the principal of the traffic planning bureau of Copenhagen, said that we have done a good job, but we are expecting to do better. He and his team perceived the potential of the citizens in the suburban area where many citizens still use cars or public traffics to reach the downtown area.

Therefore, in 2012, Copenhagen municipal government, together with the surrounding 22 towns, proposed to cooperate together to build 26 express cycle routes with a total length of 3000km.

Express cycle route mainly focuses on connecting the suburban residential area with the office places, schools and bus stops at the shortest distance, encourage people to commute by bicycles for long-distance traveling over 10km. The first express cycle route was built in April 2012, connecting Copenhagen and Albertstlund. This route is for Danish people to commute between the downtown and suburban areas through cycling. The other two express cycle routes are planned to put in use this year.

Image3-13: Planning of express cycle route
Picture source: http://www.cycling-embassy.dk/
• Pedestrian street and space

As introduced previously, the development of slow-moving system in Copenhagen is based on its first pedestrian way. Despite much disputes about the pedestrian way during its initial construction, the truth proved that the re-construction was very successful. Currently the traffic flow was greatly increased, reaching over 8000 person-time every day and favored by more and more citizens. The urban area has developed from a traffic-crowded place to a peaceful, yet vibrant and human-oriented place.

Since then, pedestrian ways are gradually built into systematical and consecutive network; motor vehicles were gradually eliminated from the city. In 1966, the number of pedestrian ways increased to 5 and areas forbidding the pass of motor vehicles reached 960 thousand m² which was 6 times of that in 1962 (Sun, T., Wang, X. J. and Dong, K., 2003). At the same time, other streets and lanes in downtown area have also restricted the pass of motor vehicles in order to encourage walking and cycling. Eventually a pedestrian area covering an area of 1km² was formed in downtown area. This area consists of over 28 pedestrian ways and lanes to restrict motor vehicles.

Image3-14: The development of pedestrian space in Copenhagen

Picture source: Heavily-loaded public space - visiting experience of pedestrian space in Copenhagen
40 years’ experience has proved that such reconstruction is well received among people as it pays more attention to the priority of pedestrians and cyclist, focusing on the function of relaxation and entertainment instead of traffic diversion. The reconstruction mainly employs the following few methods: first of all, the pedestrian area only permits the public traffic tools to enter and restrict the pass of motor vehicles. However, this is not achieved by traffic signals or rules, but rather by a variety of means such as speed reduction, and motor way width decrease, e.g., letting the public traffic to share the ways with motor vehicles. As the pedestrians, cyclists and motor vehicles are sharing the same space, the overall slow-moving condition has been improved. This shared space is mostly built near the places where people may cross the street most possibly such as subways stations and shopping malls. This shared space is expanded in order to accommodate more pedestrians and retail business activities. The branch streets connecting with the trunk ways are reconstructed into blind-end street, making these places become idea locations for communication and entertainment. Besides, through reconstructing the parking space into areas for relaxation, while controlling the number of parking vehicles, the urban spaces are reserved for other functions.
Slow-moving landscape design

The successful implementation of slow-moving system in Copenhagen can not be simply ascribed to the construction of network. As introduced before, in order to create natural landscape for cyclists, many green networks are constructed in Copenhagen. In addition, for the sake of a better cycling environment, great importance has also been attached to bicycle maintenance. For example, even in the cold winter after heavy snow, 70% of bicycle users still travel by bicycle, which, to a large extent, can be ascribed to the timely removal of snow on the road. According to the rules of road maintenance in Copenhagen, snow removal on cycling ways enjoys priority and such removal shall be finished before the peak traffic time in the morning. In addition, the effective prevention of the interference on cycling way from urban construction activities is another importance task of the cycling way maintenance. For the construction of subway and buildings, the surrounding motor vehicle ways are closed, yet the cycling routes remain open to bicycles. Through a variety of management practices, the cycling environment and the cyclists’ interest are guaranteed in all circumstances.
In the area forbidding the access of motor vehicles, the pedestrian ways occupy 1/3 and the other 2/3 is urban open space such as square. In accordance with Jan Gehl’s theory, only those necessity activities are finished within the point-to-point linear space, while the spontaneous and social activities are casual and uncertain, so urban space design should take such uncertainties into consideration. Compared to other urban roads, though the pedestrian ways are different essentially, the key for promoting social activities is to attract people to stay in a place for some time for relaxation or sightseeing. Therefore, the entertainment and diversity of slow-moving space influence people’s use of slow-moving system. Only good landscapes can provide a colorful activity space. To build the slow-moving system through the slow-moving landscape in Copenhagen is not just simply for meeting people’s needs, urban public activities like "staying for a while" in the open space is increasing gradually. In the following 30 years, the number of people with no needs of shopping multiplies, citizens of different ages, occupations and classes come to the open space to find whatever activities suitable for them. To this end, the landscape design in Copenhagen is mainly reflected in the following three perspectives:

- **Sky**

Sky is an ever-changing and unique natural view in pedestrian space. It provides diversified sceneries and sunlight to people with seasonal alternation, while these are very important for outdoor activities. The traditional buildings in Copenhagen are low buildings with about 4 floors, accordingly the streets can be shined by sunlight all the time and pedestrians are provided with sky views everywhere. This is an important reason for people walking on streets.

- **Ground**

In the slow-moving area in Copenhagen, both the motor vehicle ways and pedestrian routes are decorated with different pavement materials to differ in functions and reinforce the sense of territories of slow-moving space. Speaking the pavement of slow-moving routes, generally the materials and pavement methods used in the middle ages are employed: bar-shaped stones are paved in the middle of road, and on one/both side(s) of the roads, a 30cm-wide stone belt is built for baby strollers or ladies wearing high-heel shoes or kids playing rollers. On the squares, similar bar-shaped stones are paved to form different patterns depending on the areas and purposes of the squares. Of course, in some key locations and squares, there are delicately-designed patterns created by professional designers, and these patterns have already been landmarks, generating a strong sense of place.

- **Building elevation**

Building elevation has a direct impact on the entertainment and diversity of slow moving. The ground floors in Copenhagen are mostly stores, cafes, restaurants, galleries, and small exhibition halls which are the key part of building elevation and play a very important role for forming interesting and attractive street views. Delicately-designed windows will also attract people's attention and slow down
their moving speed, making them feel relaxed and pleasant. One of the distinctive features of the traditional buildings on pedestrian route is using many pilasters and niches to create a 3D effect. These small spaces with corners become people’s favorite locations of staying. Pedestrians are provided with more chances of staying, accordingly increasing the quantity and style of social activities.

Building of slow-moving facilities

One important reason for the successful construction of slow-moving system in Copenhagen is the various measures adopted by the government in order to encourage the use of slow-moving system. Slow-movers can experience a lot of advantages while using the slow-moving system:

• Pedestrian crossing facilities at crossroad

In order to provide a safe, convenient and comfortable crossroad to slow-movers, Copenhagen adopts a series of measures to emphasize the user-friendliness and priority of slow-movers at crossroad, including blue street-crossing belt for bicycles, front-set waiting area for bicycles, stop line for bicycles and signal lights exclusive for bicycles that will turn green in advance etc.. Through these seemingly insignificant personalized measures, the safety, convenience and comfortableness for cyclists to cross the street have been greatly enhanced.

Image3-19: Blue street-crossing belt for bicycles(left), front-set waiting area for bicycles (right)
Picture Source: Revival strategy of urban cycling in the context of motorization--a case study of Copenhagen

Image3-20: Stop line for bicycles at crossroads in Copenhagen
Picture Source: Municipality of Copenhagen; http://www.copenhagenize.com/
Bicycle green-wave signal

Another unique feature designed for cycling is the green-wave signal. In order to reduce the waiting time of bicycles and increase the average speed of bicycles, the traffic corridor with heavy traffic of bicycles employs cycling signal linkage control, achieving the effect of green wave and accordingly reducing the cyclists’ delaying at crossroads significantly. In 2004, the application of green wave on the main trunk line of Nørrebrogade achieved very good effects. During the peak commuting hours, the government set signal linkage at 13 crossroads for bicycles based on a speed of 20km/h.

After the implementation of "Green Wave", the cycling speed along Nørrebrogade has been enhanced from 15.5 km/h to 20.3km/h. Such design allows the slow-movers to favor cycling better than motor vehicles and the speed of slow-moving has been further increased.

Image3-21: Bicycle green-wave corridor in Copenhagen
Picture Source: Municipality of Copenhagen;
• Bicycle parking

In order to encourage more users of bicycles and provide a more convenient parking environment, Copenhagen government adopts three measures: firstly, to reconstruct the existing motor vehicle parking areas in residential and office areas into bicycle parking place, and at the corners of pedestrian ways, bicycle parking facilities are built. Secondly, on commercial streets, store owners along the streets spontaneously build bicycle parking racks on the vacant space of pedestrian ways. Thirdly, for newly constructed project, the government regulates that the commercial projects shall provide bicycle parking facilities at the ratio of 0.5 parking lot/post. As for newly constructed residential area, bicycle parking lots shall be built at the ration of 2.5 lots/100 ㎡ (Copenhagen Bicycle Account 2010).

Image3-22: The motor vehicle parking spaces in Copenhagen was reconstructed into bicycle parking place(left), parking facilities are built at the corner of pedestrian ways(right).
Picture Source: Revival strategy of urban cycling in the context of motorization—a case study of Copenhagen

• Public bicycle rental system

The developed bicycle rental system in Copenhagen is also greatly favored by the natives and tourists. First of all, the government gave much support. The first public bicycle rental project was launched in 1995. Currently there are 10 rental places, offering over 2000 bicycles to the public (John Pucher, Ralph Buehler, 2007). In addition to the "urban bicycle" project launched by government, some service industries there also offer bicycles to the public. For example, some hotels in Copenhagen provide free bicycle rental service to their guests. Through the efforts made in different perspectives, bicycle rental system has been further improved.
**Bicycle sign information system**

The sign system consists of two parts: First of all, hardware— in Copenhagen, signs of cycling routes and bicycle parking places can be seen everywhere easily. Moreover, along the cycle routes, sign poles are built to reinforce the direction. From the poles, the distances to the major places of interesting in Copenhagen are marked.

Secondly, the government vigorously promotes cycling system and invites citizens to use the existing cycling facilities through distributing free maps and humanized cycling navigation maps on websites. Through websites, citizens can search the cyclist route from places of departure to destinations.

**3.3 Summarization & Analysis**

Based on the detailed introduction and analysis of the slow-moving system in Hong Kong and Copenhagen, it can be learned that the correct evaluation and the long-term efforts of local government and departments are indispensable. This chapter summarizes the construction of the slow-moving systems in the said two cities, and refines the various means proposed thereof, thus laying basis for putting forward the construction approaches for slow-moving system in the next section. The writing structure goes as follows: firstly to make divisions for the contents involved in the construction of slow-moving systems of the two cities; secondly, to perform analysis on the construction elements of the slow-moving system, including slow-moving network, slow-moving landscape, and slow-moving facilities.
Compositions of Slow-moving System

This paper mainly intends to make analysis on the pedestrian systems and non-motor vehicle traffic systems in Hong Kong and Copenhagen. On one hand, pedestrian traffic system is relatively independent from non-motor vehicle traffic system; but on the other hand, they share some commonness whether in facilities or in space. Pedestrian system is mainly composed of sidewalk, pedestrian street, walking lanes, pedestrian overpasses, and pedestrian tunnels, etc.; while non-motor vehicle system mainly consists of non-motor vehicle driveways, non-motor vehicle parking facilities, non-motor vehicle rental facilities and other elements. However, in terms of distribution of right of roads upon cross sections, slow-moving street crossing planning (including plane street-crossing at road sections, street-crossing at intersections, and three-dimensional street-crossing), traffic calming measure formulation, gateway settings and management, etc., integrated co-ordination and determination are needed for pedestrian system and non-motor vehicle system.

For slow-moving system, analysis needs to be conducted based on slow-moving network, slow-moving landscape, and slow-moving facilities. The so-called “network” of the two cities mainly include the municipal road pavement, non-motor vehicle driveways and slow-moving exclusive ways with independent rights of roads, as well as other linear elements; "landscape" mainly refers to the landscape design of space involved in slow-moving network; "facility" means slow-moving street-crossing facilities, bicycle rental service points, bicycle parking sites, traffic calming measures and other point-like elements. Both the two cities inter-connect and coordinate the “network”, landscape”, and “facilities” to comprise the municipal slow-moving systems.

![Schematic Diagram of Slow-moving System](image.jpg)

Image3-23: Schematic Diagram of Slow-moving System
Picture source: By author
**Slow-moving network construction**

For case study, analysis is made on the factors that the slow-moving network needs to satisfy, which are summed up as:

- **Giving easy access to public transport nodes.**

Path arrangement of slow-moving network is not only the basic need for slow-moving system, but also constitutes the major form for inter-connecting slow-moving spaces. At the intersections between slow-moving and motor traffic, slow-moving nodes come into being, for which, the municipal public system needs to be well-accessible, as this is the basis for effective operations of slow-moving network. Although the approaches for building slow-moving network by the two cities are differed, there is a common aim, i.e. to make slow-moving smoother and continuous.

![Image](image3-24.png)  
**Image3-24: Sketch for Relationship between Slow-moving Network and Slowing-moving Facilities**  
*Picture source: By author*
• **Layout of Cycle network**

Link with key destinations at city level and/or at local level.

There are two network types: the first type is mainly intended to enable slow-movers to reach the intended destination rapidly (i.e. routes are direct and allow for traveling with high speed), which is also called as commuting-oriented slow-moving network, such as the express cycle route in Copenhagen, which mainly serves the group who need to arrive at destinations rapidly. Such network arrangement should avoid detour to greatest extent, and priority should be given to efficiency; while another type is non-communicating slow-moving network layout including entertainment, leisure, shopping and so on, such as the green lanes of Copenhagen, which need for agreeable environment, safety, accessibility to various regions, and more importantly, comfortableness (as shown in the figure).

The primacy of slow-moving network has to be highlighted for both the two network arrangements. Besides, public space and walkways also need to be accessible to the slow-moving system.
• **Walking Network Layout**

Both Hong Kong and Copenhagen have their instinct uniqueness, for which, three points have to be taken into account:

Consistency of pedestrian network: for example, Hong Kong makes the pedestrian overpass and underground passages accessible to the surrounding buildings and square for the effect of integrity and connectivity of pedestrian system, as Yang Gail put it, “walking, first of all, should be a traffic means and a moving way”.

Pedestrian network needs to pass through areas that people stop and stay. For example, it has to go through living areas, and there have to be active areas surrounded which can attract walkers to stop by (Invitations to stop and take part in the activities along the route). For example, Copenhagen attaches importance to connecting walkways with the surrounding leisure square and green space, and taking into account of surrounding environment while constructing pedestrian network.

• **Network division**

Slow-moving routes are divided into different parts. Those areas with frequent slow-moving activities are categorized as primary slow-moving area, such as the business slow-moving area and pedestrian plaza in Copenhagen. Therefore, through an analysis on Hong Kong and Copenhagen, the slow-moving network is composed of three elements, i.e. “points” — slow-moving nodes, "lines"—slow-moving routes, and “planes”—slow-moving areas.
Slow-moving Landscape Construction

The slow-moving landscapes of Hong Kong and Copenhagen are mainly divided into two aspects: commuter path landscape and leisure path landscape.

First of all, for commuter path landscape, priority should be given to the visual requirements of slow-movers. Essentially, the landscape design of slow-moving passages attached to city roads should achieve the effect of separation of road alignment, ramps, and motor vehicle lanes, continuity, smoothness, naturality, and visual excellence of greening and other soft and hard landscape, which are also needed to be accessible to surrounding environment, so as to attract the slow-movers to stop by. Thus, outstanding landscape with clear outline is needed along the road to achieve the effect of color coordination and style unification.

On the other hand, recreational landscape is mostly arranged along the coastline and surrounding the green space, which dominated with rectangular and linear shapes, such as the green cycle route in Copenhagen, on either side of which are surrounded by lush tree to form a space with beautiful environment. Besides, the sidewalks along the coastline are also a perfect combination of leisure environment and slow-moving systems.

Slow-moving Facilities

Through analysis of the two cases, it can be seen that the construction of slow-moving facilities plays a significant role for the effective operation of slow-moving systems. Slow-moving facilities enable slow-movers to travel more conveniently and comfortably. The design of slow-moving facilities should be built from the user-friendly perspective, giving full consideration of people’s needs. The construction of slow-moving facilities of the two cities can be divided into several parts: bicycle access facilities, public bicycle rental facilities, slow-moving roads and lighting facilities, and pedestrian street-crossing facilities, etc..

Based on case analysis in this chapter, a clearer structure is figured out for the construction of slow-moving system. Upon the design points put forward in this chapter, the detailed methods of slow-moving system construction will be suggested in the next section.
Chapter 4: Design principle

In light of the research of foreign and domestic slow-moving theories as well as the case analysis both at home and abroad in the preceding parts, the tenet of building slow-moving system is to pay attention to the subjectivity of human, and regard human beings, urban environment, natural environment, cultural historical environment as a whole. In the construction of slow-moving system, slow-moving network should be taken as the clue. By slow-moving ways, special landscape, environmental facilities and public facilities are connected together, and the interaction among them is also discussed. In the previous chapters the compositions of slow-moving system have been analyzed, that is, slow-moving network, slow-moving landscape and slow-moving facility, and in this chapter, the methods for slow-moving system construction are presented.
4.1 Slow-moving network construction

Slow-moving network construction in this chapter is from inside out and step by step: firstly, establishment of slow-moving network which depend on different traveling features; then according to the different type of slow-moving network give detail section design of path, and combine with the surrounding natural resources such as rivers, green land to create leisure slow-moving routes; and finally optimization of the design at the joints of slow-moving traffic and motor vehicle ways.

Construction of slow-moving way

• Slow-moving way organization

The previous chapter mainly deals with the analysis of slow-moving way which can be generally divided into commuting way and leisure way. This chapter will provide some suggestions for the construction of each type of way. Based on the division and functions of slow-moving area as well as the traveling means, some strategies are given for planning.

Table 4-1:

<table>
<thead>
<tr>
<th>Commuting way</th>
<th>Types of traveling</th>
<th>Features of traveling</th>
<th>Implementations</th>
<th>Planning strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within slow-moving area</td>
<td>Short traveling distance and great advantages in slow-moving</td>
<td>Slow-moving way within the area</td>
<td>Short-distance slow-moving commuting</td>
<td></td>
</tr>
<tr>
<td>Neighboring slow-moving areas</td>
<td>Medium traveling distance, mainly pass through collector roads, branch roads and traffic arteries repeatedly</td>
<td>Slow-moving way within the area + Inter-area slow-moving way</td>
<td>Short-distance slow-moving commuting + public transport</td>
<td></td>
</tr>
<tr>
<td>Separated slow-moving areas</td>
<td>Long-distance travel, pass through urban expressway and main roads, obstructing slow-moving significantly</td>
<td>Slow-moving way within the area + Inter-area slow-moving way</td>
<td>Slow-moving + public traffic + slow-moving</td>
<td></td>
</tr>
<tr>
<td>Leisure way</td>
<td>High requirements on slow-moving environment, also requires good supporting facilities.</td>
<td>Slow-moving exclusive way</td>
<td>build along riverside and scenic area, connect with parks, scenic spots and vast green land</td>
<td></td>
</tr>
</tbody>
</table>
Commuting way

The construction of slow-moving commuting network should be directed by the space distribution required by commuting between workplace/school and residences. It should connect the main residential areas, school area and work area and avoid crossing expressways and trunk roads with full consideration of gearing with public traffic, offering agreeable and convenient slow-moving ways to the surrounding residences and enhancing the proportions of slow-movers while going to school or workplace. Based on the commuting distance and the traveling types analyzed in the above table, commuting ways can be categorized into three types: firstly slow-moving corridor: connect the various functional areas and main serves, secondly, slow-moving passage, serving the middle and long-distance slow-moving traveling; thirdly slow-moving collector-distributor way, meeting the demand of short-distance traveling, and oriented by rail transit stations and public facilities to gear with public traffic. No matter what type of slow-moving commuting way it is, it should meet the following design principles:

Function-oriented, non-stop and convenient;
Safe and continuous, well-connected to form a network;
Convenient access, give priority to public transport.

Leisure way

Leisure way should combine with natural resources such as green land and water systems. Slow-moving leisure way can be built along the green belt land shape to provide places of entertainment and leisure to slow-movers. In accordance with the functions, leisure ways can be divided into long-distance slow-moving network for fitness keeping and short-distance slow-moving network for daily relaxation.

Long-distance leisure network primarily serves slow-moving activities for recreation and fitness, thus are built along the waterfront green area. Short-distance leisure network mainly serves the purpose of daily walking and strolling, thus are built along open spaces such as rivers, green land, parks and squares.
Section design of slow-moving way

Comfortable and safe width of the cycling path
A safe and comfortable cycling environment is important to attract cautious cyclists, the young, old, and women. The width of the bicycle path determines both flow, risk of conflict, and user profiles. Generous width is important to create a comfortable cycling experience. Narrow bicycle paths not only make overtaking difficult and are stressful for the cyclists but also increase the risk of accidents among cyclists. So a comfortable safety path needs enough wide bicycle paths, it can give cyclists margin and increase the pleasure of riding.

Standard bicycle path width
A good bicycle path should increase the social pleasure of cycling, so give the space for two cyclists to keep up a conversation is necessary, thereby bicycle paths of minimum 220 cm width make it possible. But, if a third cyclist should be able to overtake them, the width must be 280cm.

Possibility for overtaking
Minimum width of bicycle ensuring safely overtaking another bicycle is 190 cm. “Tricycles are the Lorries of cycling and need extra wide cycle paths not to block the bicycle-traffic. They can carry both goods and people and should be accommodated well into the bicycle environment” (Hermansen, et al.). Exceptions- minimal version: According to the traffic engineering manual: “The minimum width of a path is 130cm” (China institute of highway traffic engineering manual editorial board, 1998).
• **Section design of commuting way**

Instructions on the section design of various slow-moving ways based on its classification:

<table>
<thead>
<tr>
<th>Types of way</th>
<th>Capacity</th>
<th>Section optimization guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow-moving corridor</td>
<td>731 vehicles/H</td>
<td>non-motor vehicle way is 4M-6M wide, accommodating 3 bicycles running parallel; Pedestrian way net width ≥ 3m; Motor vehicle and non-motor vehicle ways are separated by hard materials.</td>
</tr>
<tr>
<td>Slow-moving passage</td>
<td>602 vehicles/H</td>
<td>non-motor vehicle way is 3M-4.5M wide, accommodating 2 bicycles running parallel; Pedestrian way net width ≥ 2m; Motor vehicle and non-motor vehicle ways are separated by fences.</td>
</tr>
<tr>
<td>Slow-moving collector-distributor way</td>
<td>Low capacity</td>
<td>non-motor vehicle way is 2M - 3M wide, and bicycles may overtake. Pedestrian way net width ≥ 2m; Separation measures to be determined by the specific conditions</td>
</tr>
</tbody>
</table>

![Image4-2: Section design of commuting way](image)

**Image4-2: Section design of commuting way**
• **Section design of leisure way**

Section design of leisure way shall be based on the width of existing ways when the minimal section is larger than 1.5m; when the road section (D) 1.5m<D<3m, the way can be taken as pedestrian way only; when 4m<D<6 m, slow-moving integrated way can be built, and when D>4m, slow-moving integrated way can be built with separation from pedestrian way by colorful pavement.

<table>
<thead>
<tr>
<th>Types of way</th>
<th>Standard section diagram</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure way</td>
<td><img src="image" alt="Standard section diagram" /></td>
<td>639 vehicles/H</td>
</tr>
<tr>
<td></td>
<td>Separate pedestrian way and non-motor vehicle way by pavement</td>
<td></td>
</tr>
<tr>
<td>Slow-moving integration</td>
<td><img src="image" alt="Standard section diagram" /></td>
<td>497 vehicles/H</td>
</tr>
<tr>
<td>Pedestrian way only</td>
<td><img src="image" alt="Standard section diagram" /></td>
<td>Low capacity</td>
</tr>
</tbody>
</table>

### Design of slow-moving nodes—intersections

**• Existing problems**

The traditional design of intersections mainly meets the demand of motor vehicles in order to enhance the efficiency of motor vehicles, accordingly leading to distribution imbalance between motor vehicles and slow-movers.

**• Dangerous situation for slow-movers**

When right-turning cars collide with cyclists going straight ahead, it is the most dangerous situation for bicycles. Because cars easy to overlook both traffic lights, other cars, bicycles, and pedestrians when they are busy turning. In addition, the angle which bicycles coming is difficult to detect.

**• Design of intersections**

**Put median at intersection**

The exiting area of intersection should receive particular attention in safety, with an immediate continuation of the physical separation and fully painted lanes. Use a median running directly to the bike-box, provides a physical barrier between cars and bicycles up to the crossing. Painted bicycle markings alert cars and guide cyclists inside the intersection then keep cars out. This is the most important measure to ensure safety for cyclists along the streets.
**Increasing bicycle visibility at intersection**

Clear visibility is directly affecting the possibility of accident between motor vehicles and cyclists at intersections. Methods to increase the visibility in the intersection can be listed as follow:

First of all, there must never be any visual objects around the intersection, such as, planting, commercial activities and so on, in this way, cars, bicycles and cyclists can see each other clearly.

Then, in order to be aware the presence of bicycles, a bright bicycle-indicative color should be painted across the intersection, it also can guide cyclists across the intersection.

Thirdly, in light-regulated intersections, colored bicycle boxes of bicycles should be placed in front of right turning cars, approximately 6-8 seconds before the cars. This method not only gives the turning cars an opportunity to see the cyclists before the signal turns green but also makes bicycles more visible in the intersection- gives them a head start.
Reduce the speed of the motor vehicle in the intersection

Speed reduction can give cyclists better safety guarantees at crossings. There are two types of initiatives:

- The use of a raised pavement in the whole crossing
- A continuous sidewalk on sides
- The use of paint/symbols at crossing

Depend on different situation these initiatives can be use alone or in combinations.
4.2 Slow-moving landscape design

In light of the analysis in the preceding chapter, we can conclude that slow-moving ways can be divided into commuting and leisure ways, therefore construction of slow-moving landscape can also be classified as street landscape and natural landscape accordingly. This chapter will propose different landscape design methods as per these two types of slow-moving ways.

Street landscape

Street landscape refers to the landscape in the space along the slow-moving ways and aims at fusing slow-moving with urban life, and allowing people to feel the charm and interest of slow-moving space. In order to meet the above requirements, street landscape should be characterized in the following features: good accessibility, and no influence on the connectivity of slow-moving ways; attractive and appealing, including the multi-functional streets along the slow-moving ways, diversified building surface with proper colors, and street plazas etc.. Through the above requirements, slow-movers can be provided with diversified visual contacts. Their requirements in shopping and going to world can also be satisfied, while their needs in entertaining, relaxing and exercising can also be met as well. Therefore, this chapter will discuss slow-moving landscaped design from these perspectives:
Street landscape with mixed functions

Street blocks with mixed functions can provide more activities, which can thereby shorten slow-movers' time in walking or cycling visually and psychologically. To build attractive street landscape requires taking the following points into consideration.

1. Provide necessary conditions to allow people to be involved freely, make slow-movers feel that they are one part of public activities. Therefore, a pedestrian way with enough width is needed in order to increase public activities, and then slow-movers can easily notice the urban life and activities around them, and thereby stop their travel and join in interaction with others nearby.

2. Moderate space enclosure to form positive spaces and reinforce slow-movers' senses of safety and territory; Compliance with boundary effect, space boundary shall be regarded as the focus of design, while the connection between the spaces inside and outside the boundaries shall be reinforced. Through positive interactions, the social activities in public spaces can be increased, while the vitality of slow-moving space can also be enhanced. Every possible effort should be made to provide bag-shaped space and intermediary spaces, thereby the vitality and dynamics of public spaces will be generated from the edges.
③ Built humanized space, divide the space through trees, plants and pavements on the ways, create an agreeable slow-moving space.

④ Pay attention to details, first of all choose safe and beautiful pavement materials that are easy for walking; details can not only influence slow-movers' vision, but also enhance the identifiably of slow-moving street landscape and leave people deep impression.

⑤ Provide rest facilities. The prerequisite for public space to attract more slow-movers is enough facilities for rest and entertainment. Thus first of all there should be enough seats and tables built in varied shapes for people's reading, chatting and sunbath. In addition to the physical chairs and tables, other sceneries such as steps, memorial stones and sculptures can also be built to draw people's attention during rest. The rest facilities can be on road sides or corners to provide a larger rest space.

⑥ Provide supporting materials. Standing still is also a kind of slow-moving activity. People may choose to stay at corners, entrances or similar places or lean on something such as buildings, poles and lamp poles to gain some psychological support. Therefore, in a place for slow-movers to stop and stay, the facets should not be over smooth and supporting facilities should be provided as well.
• **Color design of street buildings**

Color design of street does not simply mean the colors of buildings. A macro and systematic visual angle should be employed to regard the whole street as a whole in color study. Street colors can be divided into natural colors and artificial colors depending on the object natures. Natural color refers to the color of plants, sky, rivers, mountains, while artificial colors refer to those of buildings, bridges, roads, squares and urban sculptures etc..

The design of street color should take the surrounding information of the street into consideration and make plans by taking them as a whole to reinforce the sense of hierarchy of buildings and enhance the attraction of slow-moving landscape. According to the location of streets, different design methods can be employed. Usually street positions are divided into ordinary site, key site and critical node: for the ordinary site, traffic demand is relatively low and it may play a less important role in terms of traffic in the whole city, accordingly the building shapes are plain yet cover very large area, thus the color control on such street is particularly important. In terms of choice of colors, great emphasis should be given to harmony to represent the integrity and design concept of this section.

Streets at key site accommodate high traffic flow and are also very functional while playing the role of decorating urban landscape. At such site, there are intense buildings that are almost built at the same time, such as commercial district. Key sites should not only have harmonious colors, but also need some additional colors as ornament to emphasize the importance of such sites, so bright colors can be used to create a relaxed and lively character, creating a space atmosphere consistent with their functional features.

Critical nodes are in excellent locations which not only have metro stations and other public transport hubs, but also are built with building complex integrating business, residence and work together. Therefore a more delicate color design should be performed at such sites. Colors should be designed from the five perspectives: building walls, roofs, ceilings, doors and details (Yang, C. H., 2008). Among these five elements, the external wall takes the largest area and directly contacts with people's vision, making its color so important that it may directly determine the basic color of the building. Thus it is a very important object in street color design and planning. Roofs and glass constitute the auxiliary colors in color gradation. They should be consistent with the basic color in hue, brightness and saturation despite the permission of moderate adjustments. Doors and details are decorative colors as they cover smaller areas. And their colors can be much different with the basic color in order to highlight the key parts of building or play the role of ornament. Besides, providing the truth that the artificially temporary colors on buildings, particularly the ads planning that also takes a great impact on the street colors and landscape, they should also be in consistence with the building colors.

In urban street color design, it is impossible to reach unification of all hues as this is
really unpractical. The most important design principle is to reach harmony between two neighboring streets and continuity in color landscape. Moreover, color design is also used for define the subordinating relationship of buildings by taking the natures of different buildings into consideration. Color design of buildings with street frontage should comply with the following principles (Wu, W. and Liu, H. H., 2006):

(1) From large to small in design
(2) Color selection be in consistent with the traditional color, i.e., use colors with low saturation yet high brightness.
(3) Color matching of building facades mainly refers to brightness contrast.
(4) The physiological mechanisms of human eyes determine that people want to observe full hues. Thus in color design, by adjusting the brightness and saturation of different hues or adding some decorative colors, it is possible to reach unification and diversification of colors.
(5) Colors of the same function and similar hues mainly play the role of coordination. Color contract and coordination is contradictory and inter-dependent in color design. How to well deal with their relationship is the key for color design. The theory and principle of color design should be taken as an important approach to achieve a unified yet diversified, contradictory yet inter-dependent color landscape with unique local features.
Design of building facades at ground floor

After delicate and creative design of the ground floors of buildings, people will have different experience by taking different points of view. Four points for the design of building facades at ground floor are summarized here:

Scales and rhythms
The building facades at ground floor actually serve the slow-movers. Thus the design should consider what slow-movers see during their moving. When slow-movers travel at the speed of 3km/h, an interesting and compact vision should be presented in front of them. They are supposed to see units with narrow interfaces and many street frontages. Therefore, ground floor buildings should be built with many units and street frontages in order to give slow-movers more experience and spaces (Gehl, J., 2010).

Transparency
If slow-movers can see the commodities inside the windows or the activities inside buildings, then the charm of slow-moving can also be enhanced. Because there are diversified visual experience, slow-movers can be attracted and thereby slow down or even stop to enjoy the urban life shown in the window, offering a delicate and humanized vision to urban space. As long as slow-movers feel that there is something worthy of their attentions, they will be willing to stop.

Textures and details
Building facades with good views should feature diversified textures, well decorated with good materials and diversified details.

Building appearance and rhythm
In the design of the building appearance and facades, the ground floor building should also feature vertical connections partially. With such vertical connections, slow-moving will be funnier, and slow-movers may feel that the slow-moving distance appears to be shortened. Oppositely, building facades with long-distance horizon can visually extend the distance and make people feel boring visually.
Natural and ecologic slow-moving landscape

Natural and ecologic slow-moving landscape mainly refers to the slow-moving ways built based on natural and ecologic systems. Such path should well combine the natural geographical environment such as swamps, streams, rivers, lakes, mountains, terrain, and woodlands. Slow-moving corridors should also be built in order to connect public open spaces with green corridors to form integrate and continuous urban spatial environment.

Such kind of landscape should follow natural and ecological principles to well fuse slow-moving landscape and natural landscape, while elements such as trees and water bodies should also be added to the slow-moving landscape.

To sum up, design of natural ecologic landscape design should always insist to ecology-friendly principles. Slow-moving network should be based on the natural features and textures and well combine with the natural water bodies and green environment. Moreover, construction of natural slow-moving landscape should also take the following points into consideration:

- **Integration into the natural ecological landscape**

  In order to achieve better integration between slow-moving system and natural ecology, emphasis should be given to the utilization of natural ecological landscape to incorporate trees, water sceneries and other natural landscape into slow-moving environment, so that slow-movers can feel fresh and have a close contact with the nature in walking or cycling. This does not only meet citizens' demand of getting closer with the nature, but also conduces to building ecology-friendly, healthy and agreeable slow-moving landscape.

- **Compliance with the original landscape**

  Compliance with the original landscape requires that the construction of slow-moving landscape should minimally influence the original landscape in order to preserve the original features and styles of a city. Compliance with the original landscape means well fusion with natural water environment and preservation of original vegetation landscape rather than arbitrary change of the natural landscape. In this way, slow-movers can be much closer to the nature, breath in fresh air, slow down their traveling, and interact with the nature. Finally ecologic, healthy and agreeable slow-moving landscape can be built.

- **Combination with natural water environment**

  Blue coastal waterways are the greatest charm of slow-moving landscape. So slow-moving construction should reserve and combine with natural water environment as much as possibly in landscape design. First of all it is necessary to ensure that there are enough natural resources on both banks. Then through the design of river banks, slow-movers can have close contact with water landscape. Green plant belts can be built along the riverside and the plants should be local
species in order to maintain its original landscape. Rivers banks should be built with natural green slope in order to achieve distinct and diversified natural landscape, and to protect or reconstruct the ecologic system and biological communities along riverside.
4.3 Building of slow-moving facilities

Bicycle parking facilities

A good slow-moving system should provide a lot of parking options to cyclists, “from short stays to long stays, from on street parking to highly protected parking within parking structures and finally bicycle parking that can be placed in buildings that promote bicycling, educate and inspired for bicycling topics” (Hermansen, et al.).

In order to invite more people to use cycling, we should provide a positive cycling-environment, make people not only have a secure parking place, but also provide convenience to cyclists, so bicycle parking facilities should always be placed where people are and where people want to go.

- A safe and convenient location

Bicycle parking places should prevent bicycles from being stolen. Special staff can be arranged to keep an eye on and manage the bicycles if possible. Or otherwise the public is the best supervisor who can also prevent bicycles from being stolen or damaged. Therefore, bicycle parking places should be built in public space within the public’s vision, such as the space along slow-moving ways, around small retail stores and so on. Places beyond the public’s visions should not be selected.

![Image4-11: A safe and convenient location for bicycle parking](Mexico_City_Gehl_toolbox)
• **Convenience**

In order to create a good cycling environment to cyclists, the bicycle parking places should be convenient for access. A complex, crowded, chaotic parking place will reduce cyclists' enthusiasm in cycling. Therefore convenience of bicycle parking should always follow one principle: parking places should be available no matter where cyclists are or plan to go. This means that parking places should be available in the middle of slow-moving ways and at the destinations. Moreover, the distance between the parking place and the destinations should be as short as possible. Cyclists' acceptable pedestrian distance depends on the time of parking: for short-time parking (less than 2h), a pedestrian distance of 15m will be acceptable, for a whole-day parking (2-13h), 30m acceptable, long time parking/overnight (more than 12h), then maximally 100m acceptable. Moreover, bicycle parking places should be accessible easily and directly, providing convenience to cyclists' parking.

**All-weather:** bicycle parking places should be roofed if possible in order to prevent bicycles from rains. Besides, the passage from main buildings to the parking places should also be shielded with rain covers or something. This will provide convenience to cyclists while walking from the parking places to buildings.

**Visibility:** The bicycle parking places should be built in an easily visible location so that cyclists' can see them easily.

**Independence:** Parking places should be well combined with the surrounding environment without any influence on cyclists' traveling and activities. Based on the above analysis, some suggestions are given to temporarily parking and long-time parking hereinafter:

1. **Temporary parking facilities:** A temporary parking facility does not need much space and simple parking racks can be used. Cyclists in temporary parking usually have high requirements on the distance between parking places and the destinations, so the parking place should be convenient in both exit and entrance.
② **Long-term parking facilities:** as for cyclists requiring long-time parking, they can accept a longer distance between the parking place and destinations. However, the bicycles should be highly secured there. Usually long-term parking facilities are more complicated in building than short-time parking ones. In general, long-term parking facilities can be built indoors or in a semi-roofed place. There are two methods to guarantee the safety of bicycles. One is to arrange work staff to watch the bicycles and this can be applicable in busy commercial places with heavy passenger flows. The other is restricting irrelevant people from entrance relying on existing facilities, such as the parking places inside a residential community.

**Public bicycle rental facilities**

Public bicycle rental facilities is a good supplementation to the slow-moving traffic tools and extends the starts and terminal ends of public traffic service. Public bicycle rental facilities should be built as per the following principles:

① Give a systematic consideration to the rules of rail transit, BRT and normal public traffic, waterway traffic to optimize the whole public traffic system.

② Combine with critical traffic nodes, such as rail transit exchange sites, bus stations, pedestrian shopping area, tourist attractions, etc.

③ Be in harmony with the land use and surrounding buildings, take no influence on the surrounding buildings and well gear with the cycling way inside the slow-moving system;

④ Economical use of land and keep the bicycles in order.

The following sites are preferred to be rental place: main entrance and exit of residential area, inside large communities, main entrance and exit of scenic spots and schools, and major traffic stations etc..

**Illumination and road signs on slow-moving ways**

- **Illumination on slow-moving ways**

Illumination on slow-moving ways mainly include: illumination facilities on cycling and pedestrian ways in order to enhance the pedestrians and cyclists' safety and comfortableness in traveling. So, in the setting of illumination facilities, the primary factor to be considered is safety which requires taking the brightness and height of the illumination tools into consideration. The illumination brightness on cycling way is different from that on pedestrian way. The former is usually controlled within 5-10Lx to illuminate not only the pedestrian way but also half of the motor vehicle way so as to allow the cyclists to see the road and surrounding environment clearly, whereas illumination brightness on pedestrian ways can be lower, avoiding choosing over bright lights which may make pedestrians feel dazzling.

Brightness of illumination tools also depends on the location of lamp. For example, in crossing area such as crossroads, end of the street, the building entrance and exit, brightness is preferred to be larger. Yet in commercial area where set with ads and other illumination tools, then the brightness can be reduced.

In addition, illumination design in slow-moving system should be humanized and
identifiable. For illumination tools with larger sizes, it is necessary to weaken their obtrusive feeling by ads or other accessories.

- **Slow-moving signs**

  In relation to motor traffic, slow-moving system requires less system construction work, and ordinary traffic facilities can not be used there. Therefore, each city should have a unique and special sign system to attract more users. A clear sign system should be able to guide pedestrians and cyclists to find their ways, rest places and bicycle parking place quickly. Slow-moving sign system should also be able to offer information about more possible routes, and walking maps can be provided properly so that pedestrians can know their positions, direction of destinations and time to getting the destinations. Besides, signs should be include information of the major surrounding public facilities, while banks, postal offices, hotels and restaurants etc should also set signs to guide slow-movers.

  The most important thing is slow-moving signs should be brief, concise, instructive and easy to understand. Generally internationally universal signs and marks can be used in order to provide convenient to foreign tourists.

**Pedestrian crossing facilities**

The pedestrians crossing facilities can be divided into plane crossing facilities (like zebra crossing) and 3D crossing facilities (like overcrossings), yet their design should insist to the following principles:

**Principle of security**

Crossing facilities are built for eliminating or at least alleviating the conflict between pedestrian and vehicles on one hand, on the other hand providing a safer crossing choice for vulnerable groups including the old, kids, the disabled and so on.

**Principle of convenience**

The type, site and interval distance of crossing facilities can be determined based on the convenience degree of street crossing. They should well coordinate with the entrance or exit of residential communities, bus stations and the entrance or exit of business area.

**Principle of comprehensive use**

Crossing facilities is not only an important traffic space, but also a kind of public space which can be utilized comprehensively. In particular, 3D street-crossing facilities can be combined with commercial development and advertising to make the slow-moving space more diversified and interesting.

**Setting of zebra crossing**

Setting of crosswalks should also take the motor vehicle users and pedestrians’ safety and convenience into consideration. First of all, settings of pedestrian crossing should give consideration to the whole road, based on which the number of zebra crossing can be determined. Besides, the planning of pedestrian crossing facilities should well coordinate with the surrounding facilities. For example, zebra crossing should
maintain certain distance with the bus station to avoid over crowded prevention by buses.

When the width of motor vehicle ways is larger than 16m, then two-step crossing is supposed to set: when pedestrians cross half of the way, they can stop and wait at the safety area for the next green light to cross the rest half way. Safety area can be formed by central dividing strips or otherwise fences. Compared with one-step crossing, two-step crossing can enhance the capacity and traffic of crossroad, enhance the green signal rate of trunk road, reduce pedestrians' one-step crossing distance, and offer convenience to the old and the vulnerable group.

On the main and secondary roads, the distance between two zebra cross should be 250-300m. However, at the same time, we should notice that zebra cross should not be built in the following situation: firstly in the area with poor vision such as curves and longitudinal slopes, and secondly places with much vehicle turnings, and finally bottleneck section.

The width of zebra crossing is preferably less than 3m. Yet such width may be increased by 1m each time depending on pedestrians' needs and the capacity. Zebra crossing may afford a capacity of 2700 person/h (green light).m (Yuan, J.X., 2010).

• 3D crossing facilities

The design of 3D crossing facilities should meet the needs of urban landscape and well coordinate with the surrounding buildings in terms of architectural landscape. Moreover 3D crossing facilities should also serve the cyclists and pedestrians. For pedestrians, 3D crossing facilities should offer convenience to pedestrians to reach the surrounding area, so its entrance and exist should closely connected with the surrounding buildings. Besides, such facilities also well serve the old, kids and the disabled, thus escalators or elevators should be built. By reducing body energy consumption, more people will be attracted to use 3D crossing facilities. 3D pedestrian crossing facilities also include underground passages in addition to overcrossing. Underground passages should also connect with the surrounding business area to drive the underground business development, and connect with the rail transit by using clear sign system which can guide people to different destinations.

By contrast, the 3D overcrossing for cyclists should take the following points into consideration: cycling and motor vehicle ways should be absolutely separated, the purpose of overcrossing is not crossing the street, but allow cyclists to pass in a relatively higher speed, thus there should not be any barriers in the middle of overcrossing, and no zebra crossing as well.

For the 3D crossing facilities shared by non-motorized vehicle users and pedestrians, the width of walking passage should not be less than 3.7m. Underground passages should be illuminated to ensure the security of slow-movers.
4.4 Summary

Based on the existing theoretical conclusion in Chapter 2 and the practical case analysis in Chapter 3, detailed design methods are concluded in this chapter. A slow-moving system construction method suitable for Wujin District is worked out. Under the guidance of construction principles, traffic network division and organization strategies, slow-moving landscape design thought and slow-moving facilities construction requirements are proposed. Taking slow-moving network as the foundation and backbone of the whole construction, commuting slow-moving ways and leisure slow-moving ways are generated--route organization and cross section design, followed by network optimization, slow-moving node construction--the detailed design of crossroads and pedestrian crossing facilities.

Slow-moving landscape design thought is related with slow-moving network design through building street landscape, creating special artificial landscape and using natural landscape skillfully. As for the street landscape design, through mixed function construction, street charm can be reinforced. Moreover, color and facet design of street buildings can reinforce visual effect.

Moreover, special artificial landscape can bring dynamic landscape to slow-moving ways. Enhancement of the fun of slow-moving landscape is mainly proceeded from theme landscape and historical cultural landscape. Skillful use of existing natural landscape should be in consistence with the original landforms, combining with the natural water body with protection of the existing vegetation landscape.

Slow-moving facilities should meet humanized requirements, comply with the principle of beautiful appearance and agree with the characters of construction sites. Slow-moving facilities should not only be qualified in safety, comfortableness and accessibility, but also comply with the principle of beautiful appearance, that is, to pay attention to diversification and unification, color and materials, rhythm and rhyme, symmetry and balance. Finally slow-moving facilities should agree with the characters of construction sites in order to make slow-moving facility to be a beautiful landscape of cities.
Chapter 5: Design proposal

This chapter presents the design proposal which according to the fourth chapter’s design principle. It is done based on the design principles concluded by literature review and studies of successful case. Design proposal consists of two parts: firstly, presentation the whole structure of slow-moving system in study area, in this part will show master planes of slow-moving network and public bicycle rental points in the whole site, and suggestion of the traffic calming measures in this site; then next part is a introduction of detailed design proposal of one specific street which is possible to be changed within the study area of this research, and use this street as an example to instruct other street rebuilt.
5.1 Study area analysis

Location

The study area is located in the core part of Wujin Town, have 15 square kilometers, on a bordered by the Gehu River in the northeast.

Wujin is selected as the study and design area not only because of its current status and problems, but also due to its unique cultural and natural resources which provide some resource advantages to the construction of slow-moving system landscape.

Image 5-1: Wujin district boundary

Image 5-2: Study area

There are a lot of interesting spots, Squares and attracting Commercial Street.
Road network

Study area surroundings consist of the three arterial roads and one express way, so, boundaries may be issued with noise pollution. Then, there are three arterial roads and one secondary road connecting to Changzhou City. Yanzheng boundary road (Wuyi Road) bears large traffic flow, and it is a commercial street but fail to attract many visitors, which was selected to illustrate the detail design proposal of slow-moving system.
Traffic analysis

There are 4 metro lines in planning, three BRT line and two light rail transit lines in Wujin district. Several new lines are under planning and construction. Then there one BRT line and one metro line intersect in the study area. So the study area has a good public traffic basis, which is an advantage for build the slow-moving system.

Image 5-5: Map of traffic station
There are in totally of eight Metro stations and one BRT station in the study area, and stations are mainly in the Huayuan Road, which consist of commercial and resident area beside the Huayuan road.

Image 5-6: Map of Metro lines and BRT lines
• Current problems—Lack of systematicness in slow-moving network

Motor ways invade and occupy the slow-moving ways: there is no effective separation between slow-moving ways and motor ways; motor ways can occupy other ways easily, so sometimes motor vehicles are parked on pedestrian ways freely, this is not permit in China, and it is resulting in fragmentation of slow-moving space.

Such kind of situation will not only influence the ongoing and continuity of slow-moving activities, but also reduce slow-movers' interest on using slow-moving ways.

Image5-7: Unconsummated slow-moving supporting system: The lack of slow-moving facilities brings much inconvenience to users. Priority should be given to the needs of slow-moving and an overall consideration should be given to the conflicts between slow-moving space and motor vehicle parking in order to actualize personalized design of slow-moving space.

Image5-8: Over narrow slow-moving ways: unreasonable distribution and setting of motor ways and pedestrian ways, and insufficient width of pedestrian ways in some area.

Image5-9: Discontinuity in ways: slow-moving ways are incomplete, discontinuous and non-unified in width. Some crossings between slow-moving ways and motor ways are not well constructed.
As seen from the maps and pictures, many ways in Wujin District are ends, negatively influencing pedestrians' accessibility.

Image 5-10: Unconsummated slow-moving supporting system:
The lack of slow-moving facilities brings much inconvenience to users. Priority should be given to the needs of slow-moving and an overall consideration should be given to the conflicts between slow-moving space and motor vehicle parking in order to actualize personalized design of slow-moving space.

Image 5-11: Break-off in ways
As seen from the maps and pictures, many ways in Wujin District are ends, negatively influencing pedestrians' accessibility.
5.2 Design proposal

In this part the whole area reconstruction planning will be stated from three aspects: slow-moving network, traffic calming measure and bicycle rental points planning.

Slow-moving network

Design concept: In the previous chapter the construction design principle of slow-moving network has been introduced. A small scale network is good for slow-moving network connection, and the network enables good connection within in the region and among different slow-moving districts. According to the existing road system and methods mentioned in the previous chapter, here the following methods are used to improve the existing road network in the Wujin District, specifically including: Encryption with city branch road network; Using plot, Shared community slow-moving network; Construction of slow-moving lanes along the green belt and waterfront.

![Diagram of slow-moving network concepts](image5-12)

![Diagram of slow-moving improvement schemes](image5-13)
• **Pedestrian network**

Provision of a safe, high-connectivity pedestrian network is the premise of construction of pedestrian network; Secondly, leisure and entertainment functions should be provided to attract slow-movers to stay, so the plan will lead to a pedestrian network which combined with park green spaces and waterfront, then through different design methods to improve the safety of pedestrians. According to the above requirements, the addition of pedestrian way network mainly include: The pedestrian priority road; Leisure walking lanes in park and green belt; Waterfront leisure walking lanes.

Image5-14: Pedestrian traffic network diagram
• **Pedestrian network**

The walking street network in the proposal uses four different street types. Through building these four walking street types, the pedestrian way can then have a good connectivity and different functions. Road sections will be shown on the coming pages.

**Pedestrian priority road**

These types of pedestrian roads are mainly settings on the branch of the city road. It needs to ensure the continuity of walking space, avoid high speed motor cars and roadside parking to interfere with pedestrian flow. So using traffic calming and other methods can decrease the speed and connection of motor cars.

**Plot internal shared road**

In order to increase the connection of walking network, add internal shared roads to the plots which have been completed; mainly choose internal fields that can lead to different city roads and residential area, through the establishment of shared network can increase the connection of slow-moving system, also can reduce the detour distance.

**Leisure pedestrian way**

Through using urban green space and landscape resources, a walking space combined with the pleasant scenery and agreeable environment can be created.

**Waterfront leisure pedestrian way**

Using the urban water resources to build friendly waterfront walk lanes. It can be set along the Waterfront shoreline or build wooden path along the water. It depends on different situations. But no matter use which way to set walking lane, we should maintain the original nature landscape.
Bicycle network

Depend on the construction principle of bicycle network which analysis in previous chapter, I built four types bicycle network for different demands, they are Slow-moving corridor, Slow-moving passage, Slow-moving collector-distributor way and slow-moving leisure way.

- Slow-moving corridor: This type of network is dependent on urban main road construction, provides relative coherent and capacious bicycle traffic space, it is the core backbone of bicycle network.
- Slow-moving passage: Parallel to the main road or secondary road which link to main road.
- Slow-moving collector-distributor way: Built in city branch which serve for citizens go to different residential area.
- Slow-moving leisure way: Connect parks, green lands and waterfront spaces.
Traffic calming measures

Based on the motorized development in Wujin district, the use of traffic calming measures should mainly give consideration to the balance between pedestrians and motor vehicles. In principle, it should be mainly applied to secondary artery roads and branch roads where pedestrians are heavy. However, whereas the concentration of vehicles and pedestrians in urban core areas and the distinct conflicts, it may also be applied to some artery roads. But for most of the artery roads, traffic calming measures are not preferred. The conflicts between pedestrians and motor vehicles are mainly alleviated through crossing facilities.

Giving consideration to the acceptability of the newly-emerged slow-moving, the plan proposed in this research is limited to the residential area. The residential area in the planning district is divided into four clusters, and "calming community" planning scheme is worked out based on analysis of the position and traffic features of each cluster.

The common features of such calming community are a higher requirement on traffic safety and calming, and traffic ways should be decrease the number of cars drive through these areas. At the entrances of such community, calming measures focusing on vehicle quantity reduction are used, whereas inside the community speed-reduction predominates. Now select the four traffic calming measures implemented in different regions as seen in the right figure, I use four letters to represent to per measures, in the following pages will show the location of every calming measures used in these communities.
**R1 calming community**

R1 calming community has Changgou River system inside, which therefore provides good conditions for implementing calming measures. Coupled with the distribution of slow-moving system, the quality and safety of leisure network can be enhanced. On the street neighboring to the water in the residence cluster, Speed bumps and textured road surface will be used to highlight pedestrians’ position and to guide citizens to use the daily short-distance leisure network system.

The south side of the calming community is Changhong road viaduct, Wuyi Road in the east, both of which are artery roads with heavy vehicle traffic. Therefore, at the entrance of the residential cluster, Speed bumps are built to reduce the vehicle speed and to increase the safety of pedestrians and cyclists. Calming community is the main residential area, while it is also a gathering place of pedestrians. Therefore, to build Speed bumps and textured road surface on the crossway and green land can effectively reduce vehicle speed while enhancing the position of pedestrian and bicycle traffic.
• **R2 calming community**

R2 calming community consists of south, west and north three residential areas that surround Xintiandi parkland. The east and the west are cut by a commercial area. The east residential area has a better ecologic environment. Therefore, the roads connecting residential area, land and water area are built with textured surface, while a good slow-moving environment which well combines ecology with pedestrian can be created. Moreover, the position of slow-moving traffic should be stressed to guide people to enter the part in the west.

In the south of R2 residential cluster, there is a large space for commerce and office use, which will then result in through traffic. At the entrance to the business district, traffic circle can be built to enhance the safety of traffic. On both sides of the garden street, its traffic function should be weakened, and traffic calming facilities can be introduced to reduce vehicle speed and shunt the vehicle flow. The west side of western residential area is Wuyi Road, which is the artery road, Huanyua Street in the east and Changhong Road in the south. Due to the large vehicle speed, Speed bumps and raised intersection can be built at the entrances. Combining with the water system, textured road surface can also be built for reduction of motor vehicle speed and enhancement of the road right of pedestrians and cyclists. Accordingly the safety of the residential cluster can further be enhanced.
R3 calming community

R3 calming community is next to Yancheng Scenic Sport in the north, and in the north there is a large space for commerce and office use, which will then result in through traffic. At the entrance to the business district, traffic circle can be built to enhance the safety of traffic. At the same time, inside the calming community, raised intersection and traffic circle can be built at the location with lower traffic flow.
• **R4 calming community**

R4 calming community is diversified. Its north and south are mixed land use for commerce and office, which will then result in through traffic. The residential area is next to the commercial land use, so the implementation environment of calming traffic is unilateral. Speed bump and textured road surface can be built on the roads connecting residential area and commercial area to encourage pedestrian traffic instead of motor vehicles. The community is next to the political center of the city, and there is heavy through traffic flow. Thus at the entrance of the roads to the calming neighborhood, Speed bump can be built, accordingly enhancing the safety of slow-moving inside the cluster.
**Bicycle rental points planning**

The planning according to 200-300m service radius, combined with the residential area, bus stops, leisure facilities and public points to hierarchical layout. According to usage number and intensity, the bicycle rental points are divided into two levels, level 1 rental points, mainly built with rail site, BRT stations and large-scale public facilities layout, the size of its vehicles parked at around 40 units; Secondary point, combined with bus stations, residential area, recreational facilities, vehicles parked at around 20 units.
5.3 Design proposal of Wuyi Street

Because there are a lot of street in the Wujing core area, so, I choose one of them to shows the detail design proposal of Specific Street. This street is between the Wujing government and Yancheng scenic spot, it not only bears large traffic flow, but also a lot of people walking or bicycling through this street because of its surrounding land use, so, give a safety environment is a prerequisite of design proposal. How to balance the large traffic flow and slow-mover’s need, and construct an attractive street is a big problem.

In my design proposal, this street use the design principle which described in previous chapters, it not only provide current commute function, but also connect to surrounding green land, water landscape and commercial area, it give enough space for people stay and communication. Though the design of green land and attractive building façade to invite people to enjoy the slow-moving.
Illustration plan

The design seeks to implement a reduction in use of private vehicles which will lead to improved overall carrying capacity of the street, new inviting and welcoming open spaces which will transform the street use and street culture; as well as space and facilities for bicyclists, making this form of transport safe and attractive. While infrastructure for pedestrians and bicyclists are improved, new public transport will offer alternative ways of reaching major events, improving the urban realm and stimulating public life.

Image5-36: Plan of Wuyi street
Land use

This map shows the land use of the design proposal. After reconstruction of this area, the current industrial area will change to commercial use, and choose part of residential area (close to street) to mix-use or commercial area. The design principles regarding diversity has been used to create a higher degree of connection and attractive street compared to the surrounding developments. Commercial uses are concentrated near the street. The mixed-use blocks are made up of podiums with commercial functions in the bottom floors and office towers on top, they formed a leisure square to let people stay and relax. Along some of the business streets mixed-use is proposed on the ground floor of buildings. Further out are mainly residential areas and government office. Because this area near the Yancheng park, so, the green area should echo with it. In the south eastward of the street is a large area reserved for green park, and, The north green area is a landscaped park, providing calm areas as well as room for playgrounds and other sport activities. These two large open green spaces are also connecting with the water landscapes. Public squares are placed in the centre of mix-use building.
Traffic analysis

The street network in the proposal uses two street types. The main street in this area are consist of four car lanes, each side have their bicycle lane and pedestrian.

Secondly, there is not car lane in the travel and commercial area, only have bicycle and pedestrian.

Sections will be shown on the next page.
• **Section of Street (A-A)**

Proposal aimed to transform the street, from a impassive traffic road to a cultural boulevard that increase the quality of life for the growing local residential and working communities, draw in visitors and encourage economic and social regeneration of surrounding area.

![Section of rebuilt Wuyi street](image5-40: Section of rebuilt Wuyi street)
• **Crossing design**

Crossing type 1: Through reduce the vehicle turning radius to decrease speed of motor car and use different color and material in the crossing to show the position of bicycle and pedestrian, use bike box on freehold to crossing street gives the bicycler priority in crossing street, in this way not only ensure the safety of slow-mover, but also add the connection of slow-moving way.

Crossing type 2: There are four ‘Zebra crossing’ in Wuyi road, and the average minimum distance between crossings are 200m. Use different material in crossing to alarm motor cars.
Bus station design

There is one bus station in Wuyi road; it is located at the middle of the road. In design proposal, the bus station will be like bay style: through compress green space (pedestrian), non-motor vehicle ways around behind it, in this way reduce the impact of the vehicle and ensure people’s safety.

Image5-42: Plan of bus station

Image5-43: Bus station in Wuyi street
Landscape analysis

The aim is to let street become an active and livable area in city life, where the spirit of the place should inform the new urban experience.

This area tells a story about heritage, tradition and pride, but is also about dynamics and change. The distinctive character of the place is created through the meeting of the many diverse experiences and activities taking place within the same local area.

The proposals illustrate how it is possible to create the framework for urban density, and illustrate which functions and activities should be integrated, in order for street to become an exciting, dynamic and innovative area.

It should inform both buildings and the urban realm, assuring the connections, focus points, proximity, density, cohesion and function of the area. The principal structures that will establish the connection and potential for variation through a continuing process.

Landscape spaces consist of four parts: Public green square, Street Park, entrance space of Yancheng scenic spot and corner square. These spaces design along the street, serves recreation/leisure purpose to slow-mover.
5.4 Conclusion

Construction of slow-moving system first of all need consistent and well-connected road space as well as humanized slow-moving facilities. Therefore, design of slow-moving system in the core area of Wujin District should be built based on reasonable slow-moving paths. Through construction of commuting ways and leisure ways, slow-movers' varied demands can be satisfied, accordingly offering possibilities to slow-moving life.

In the details of the street design, due to the heavy traffic of motor vehicles, the street life becomes dull and boring. Slow-movers should be highly concentrated in case of any injury from the cars, so they have no time to notice the surrounding environment. Coupled with the fact that wide sidewalk is mostly occupied by cars for parking, the original street life loses its charms.

Therefore, the design proposed here is to change the existing traffic planning centered by motor vehicles, enhance the position of slow-moving system in urban traffic and guarantee the convenience and comfortableness of slow-moving system. Next through reinforcing the land use of the buildings next to the street and the mixed functions, the artistic features of slow-moving environment can be enhanced, specifically including building design, dimensions, forms, colors and materials etc. In order to attract people to join in the team of slow-movers, thereby it is expected to improve the vitality and atmosphere of a city, forming a virtuous cycle.
Chapter 6: Thinking of the application of slow-moving system in Wujin

Urban slow-moving system is in fact a very complicated systematic project involving the designs, users, manager and constructors of urban traffic. Due to the limitations in the author’s personal ability, literatures, difficulties and research time, this paper only gives a shallow and exploratory research on the construction of slow-moving system. Whether the research conclusion is helpful to the development of slow-moving system, to some extent depends on people’s obedience to the relevant traffic rules. To build a perfect, high-quality urban slow-moving traffic, further construction implementation and assessment work are also need. Some suggestions for these two perspectives are given here:

Guarantee to implementation

Reinforce planning implementation and control
Strengthen the gearing between the overall urban planning and the comprehensive traffic, reflect the planning content in the master plan. At the same time, the plan mentioned here can also be applied to various travel transport planning. In particular, reinforce the implementation of the planning content in urban design.

Grantee implementation in construction
At the construction level, tasks listed as the conditions for land right transfer shall be finished by the investors, while the construction work not included in the recent urban construction plan can be
Research and Application of Urban Landscape Planning in Slow-moving System —Based on the Design of Wujin District in Changzhou

sponsored by government appropriation. At construction design level, this plan should be taken as the prerequisite of the master plan. Designers should be engaged in specific construction drawing design, and the design results should be reviewed by relevant government authorities to judge if it is in line with the master plan.

**Improve the relevant guarantee policy**
Build and improve the relevant policies on slow-moving system, prepare "pedestrian system design and guideline", and incorporate local government or department rules to grante the plan, construction and management of slow-moving system with law.

**Intensify the publicity of "low-carbon" idea**
While reinforcing the construction of slow-moving system, publicity and guidance should be given to people to encourage them using public traffic and slow-moving system. By gradually changing people's view of traveling, a healthy and comfortable slow-moving system and urban environment can be established.

**Assessment mechanism**

Slow-moving traffic is closely related to people's daily life. The implementation result can be reflected by users' experience. Therefore, assessment of slow-moving system after construction is very important, which is also the basis for making improvement of slow-moving system.

For example, Copenhagen, the capital city of Denmark, attaches importance to the continuous assessment to improve the slow-moving traffic environment. Since the implementation of the first slow-moving way in 1962, after over 40 years, it becomes a famous city known for its slow-moving system, helping it to achieve the transformation from a vehicle-oriented city to a human-oriented one. Pedestrian space increased from 15000 square meters in 1962 to 100000 square meters in 2000, making people who prefer to stay in large cities increased by 4 times. In the process, the analytical method used is public space and public life (in short PSPL), that is, by analyzing the changes of public space and public activities, the slow-moving space is assessed and improved. The development of Copenhagen street development experienced four phases:
Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou

**Car-oriented stage:** the street space was occupied by small cars and the pedestrians were confined to narrow sidewalks.

**Shopping activity-centered stage:** Pedestrians walking on street were increasing, more and more people come to shopping and appreciate the products shown in the windows.

**Rich culture state:** Some new activities begin to emery, people stay to communicate with each other, such effect extended to the neighboring district.

**Space identification stage:** some streets and squares have been endowed with new meanings and are memorized by people like the landmarks of the city.

It is recommended to use PSPL to implement rolling assessment on the finished projects in Wujin District, and gradually improve the slow-moving environment.

Assess the public space features, such as section of streets and square, dimensions, numbers and quality of slow-moving activities, and assessment of security, comfortablyness, and delightfulfulness of the space.

Investigate the quantity and features of public activities, including moving (slow-moving traffic flow and features) and staying (flow and features of staying), and perform investigations on the users of public space, understand the satisfaction degree on public space and relevant recommendations for improvement.

Perform correlation analysis on public space and public activity characteristics, and assess the flexibility, security, and attractiveness.

Image 6-3: Assessment process diagram
Work out plans for further improvement of public space based on the assessment results.

Due to the fact that cities in our country are in different urbanization stages with the reference cities, the follow-up studies should focus on the methods and mechanism suitable for the existing slow-moving development in our country, carry out in-depth researches on the transformation between slow-moving traffic and other traffic means and the equal development of the two and formulate the detailed rules and norms in combination with city planning.
Summary

Slow-moving system is not only a traffic means, but also a very important component of urban activities. Slow-moving system is to achieve people-to-people and face-to-face communication, to release the pressure of urban life and to enable people to experience the amazing urban life as a basic and indispensable carrier for various activities. Through building beautiful, agreeable and highly humanized slow-moving environment, emotional communication among citizens can be reinforced. At the same time, citizens' life safety and urban citizens' display of creativity can also be promoted. Slow-moving system can further support the development of urban leisure shopping, tourism sightseeing, cultural and creative industries, and finally enhance the overall charm of a city.

The purpose of this study is to give more consideration to slow-movers. Proceeding from the visual angle of urban design, through multi-discipline researches, and referring to relevant experience, methods for slow-moving system construction are researched. Some feasible design methods combine traffic planning with urban design, which is innovative in the field of slow-moving traffic.

As for the theocratic research, this paper introduced the components of slow-moving system, listed relevant researches in the west countries, summarized a suitable approach for construction and design of slow-moving system, proved the importance of slow-moving system’s fusion with the surrounding environment, and demonstrated that the construction of slow-moving system should surround the three elements of slow-moving network, slow-moving landscape and slow-moving facilities. These three elements are equally important and indispensable. Only by unified and coordinated development of the three elements, it is possible to design truly attractive system to citizens. The main content of slow-moving system design mainly includes the following aspects:

• **Slow network should connect the city landscape nodes**

The layout of slow-moving system should be combined with the surrounding land use, while going through the development area of a city, the slow-moving system should also connect the sparsely deployed landscape resources to form a green slow-moving network.
• **Design of slow-moving landscape and its combination with slow-moving network**

Slow-moving landscape should be designed as per the features of slow-moving network. Slow-moving commuting network should focus more on construction of street landscape to form distinct street views so as to attract pedestrians to stay. As for slow-moving leisure ways, usually the system should go through the various attractions. Therefore the landscape design should be in consistent with natural ecologic principle, reduce artificial landscape, and allow slow-movers to have close contact with the nature.

• **Slow-moving facilities should be humanized**

Slow-moving facilities take a significant position in design of slow-moving system design. Its design should be reasonable, functional and most importantly, meet people's humanized design. Both the bicycle renting centers and the parking places should start from users' convenience and meet their psychological needs. The slow-movers will be willing to use bicycles and citizens will be attracted to use slow-moving system.

In empirical studies, this paper introduces the experience of slow-moving system in Hong Kong and Copenhagen. This research involves the selection and network planning of slow-moving traffic routes, slow-moving landscape construction, and researches of slow-moving facility and space environment. These researches are of some directional significance to slow-moving construction in our country. Through analysis, this paper presents the practical methods for the design, offering an empirical basis to planning of slow-moving system.

However, being limited by the author's personal strength, the information acquired, the research difficulties and time, this paper studies the planning methods and implementation strategy of slow-moving system just from a theoretical perspective. Despite the application study in the central area of Changzhou City, it still has some gaps with systematic slow-moving system.

This paper, proceeding from the view point of urban planning, performed a preliminary and tentative study on the construction and spatial elements of slow-moving system, yet it fails to provide reasonable forecast on its traffic attributes and traffic capacity.
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Research and Application of Urban Landscape Planning in Slow-moving System
—Based on the Design of Wujin District in Changzhou


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