

THE YAO DAI
Connecting Hangzhou's Past, Present and Future with a
Tramline Promenade

by
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in
M.Architecture - 8.0 credits

Carleton University
Ottawa, Ontario

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YAO DAI



Shu Dong Po (1037-1101AD), also known as Shu shi, Song Dynasty poet, lived in Hangzhou for almost all his life. His poetry has a long history of popularity and influence in China, Japan, and other areas in the near vicinity.

West Lake, usually refers to the West Lake of Hangzhou. West Lake has influenced poets and painters throughout Chinese history for its natural beauty and historic relics, and it has also been among the most important sources of inspiration for Chinese garden designers .

1. Shu dong Po
(1037-1101AD) - << Resting beside west lake after drinking, 1080 AD at Lingan>>, from Song dynasty writing collection, RenMin education publisher, 2005 edition -translated by author

PREFACE

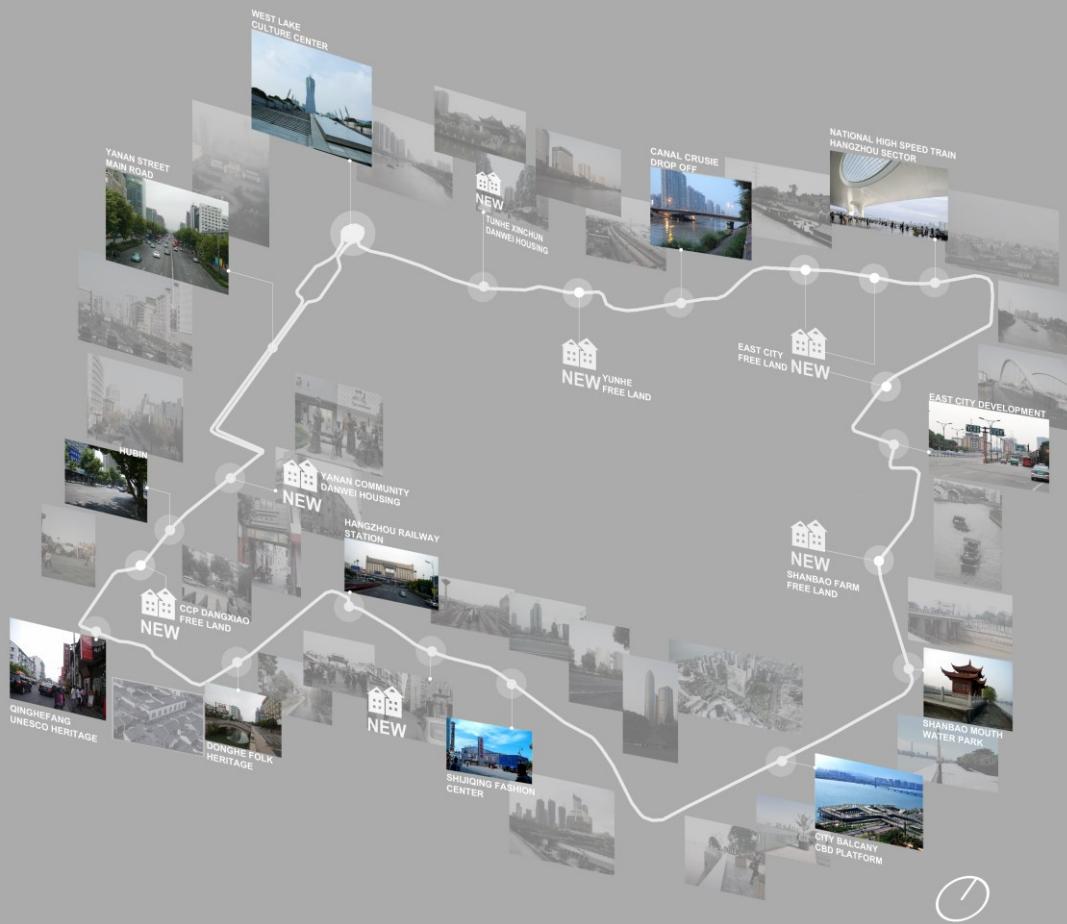
Rest After Drinking at West Lake

*"The surface of the water is like a mirror happily reflecting the sunlight,
The hills are so hollow merging into the silhouette of the view,
Elegant West Lake, you are so beautiful like our beloved Xizi,
Appearing so perfectly and never hesitating to show your beauty"* ¹

1200 years ago, the Song dynasty poet Shu Dong Po composed this beautiful piece expressing his love for Hangzhou's West Lake. Since then, the themes of water, the West Lake, and the strong Chinese identity it embodies, have deeply influenced the development of the culture, politics and urban communities of Hangzhou. The city's identity is inextricably bound to water and the West Lake.

A thousand years later, however -- and given the violent historical events of the past century -- what kind of value and identity should be given to Hangzhou in today's contemporary globalized world? Among all these environmental and social challenges, what is needed in Hangzhou in the 21st century? This thesis will introduce a platform that connects Hangzhou to a confident future.

(Figure P-1)



P-1. Diagram showing major urban nodes to be linked

ACKNOWLEDGEMENTS



M Y S P E C I A L

A P P R E C I A T I O N

TO

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- China Academy of Art, Hangzhou Youth Art Hub, Professor Qing fengyuan
- Hangzhou Library, Hangzhou Zhi sectional Department
- Central University of Finance, Professor Ma Guang Ming

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Introduction

General Introduction

The thesis explores the development of a multimodal transit loop through central Hangzhou. The loop, which I'm calling the *yao dai* or *Tramway Promenade*, incorporates three modes of circulation: 1) a tramline running on a dedicated right-of-way at grade, 2) a bike path running parallel to the tramline, and 3), a linear park and pedestrian walkway. While the configuration of these components varies depending on the location in the city, in most cases, the *tramway promenade* runs parallel to major commercial streets, a half of a block into the adjacent fabric. Positioned as such, the tramline promenade is separated from the rear of the commercial buildings by a laneway or a service road.

Along the majority of its route, the pedestrian paths floats above the tramline as an elevated walkway. In key places, this walkway bridges over the adjacent service road to connect into the rear of the commercial buildings at the 2nd level. Conceived as plazas or nodes along the elevated walkway, these bridging elements can support a range of activities, including restaurant and café terraces. They also open additional opportunities to connect up to the elevated walkway through adjacent buildings.

In addition to augmenting transportation options in the core, the *tramway promenade* is intended to tie together key nodes within central Hangzhou, increasing the city's legibility to both residents and visitors.

These nodes include 1) the historical urban center at the West Lake Heritage District, 2) Wulin Square/Westlake Center at the bend of the Grand Canal, 3) the new CBD along the Qiantang River, 4) and the new East Train Station in the northeast quadrant of the core. Complementing existing road and subway networks, this loop will facilitate new, efficient, pedestrian- and eco-friendly ways of moving through the city. Additionally, the loop is designed to be a significant new piece of infrastructure which is both an amenity in and of itself and a catalyst for the redevelopment of the enclaves of post-war housing blocks (a.k.a., *danwei* housing) within the area enclosed by the loop.

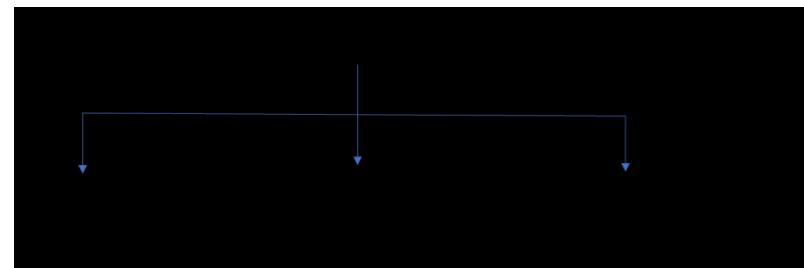
The project capitalizes on a unique moment Hangzhou's growth and evolution. As much of the city's post-war urban fabric is undergoing redevelopment, timing is crucial and opportunities to insert the *tramway promenade* will be limited. Moreover it is the intention of the *tramway promenade* to act as an armature to guide the imminent redevelopment of the *danwei* fabric.

The idea of the *yao dai* is not unique; precedents exist in various forms in cities around the world. Accordingly, similar projects have been analyzed by way of strengthening the proposal and incorporating best practices.

2. Feng Meng
Long,
YushiMingYan-
Words for
enlightenment(Ha-
ngzhou: Renming
edu, 2004
Translated by
author

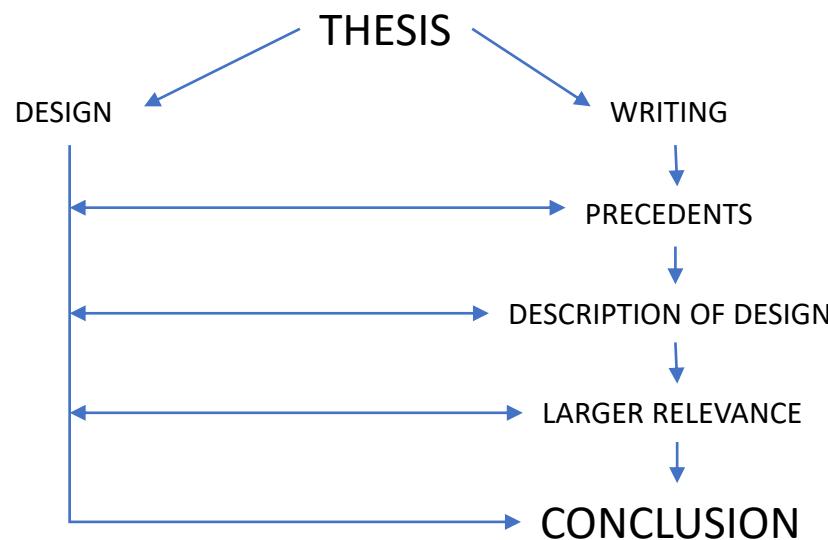
Given the multi-modal structure of the *yao dai*, precedents may be divided among several overlapping categories namely 1) elevated, mid-block pedestrian paths through cities. 2) tram lines on dedicated rights of way, at grade. 3) rear laneways that support “alternative” commercial activity and act as incubators for business and, 4) segregated bike paths through urban areas.

Several aspects of the *yao dai* distinguish it from similar projects. First, unlike many (most) of its counterparts (e.g., New York City’s High Line or the *Promenade Plantée* in Paris), the *yao dai* is not a repurposing of exiting infrastructure. It is both conceived and built from scratch. Secondly – and in large part due to the fact that it will be built new – the *yao dai* combines the various modes of circulation associated with these precedents into a single, integrated system. Thirdly, the tramline promenade is unique with respect to its location within the urban fabric. Envisioned as a boundary between Hangzhou’s residential precincts and the lively commercial arteries that cut through them, the design of the *yao dai* reinforces basic principles of Chinese urban planning by promoting “peacefulness in the midst of chaos” (闹中取静).²



Structure of the Thesis

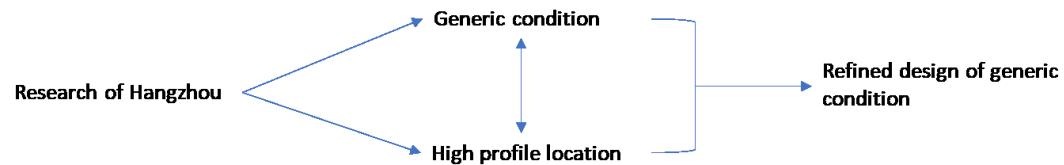
The thesis research consists of a written and a design portion. The written portion covers five topics. After an introduction to the culture and history of Hangzhou, a case is made for the *tramway promenade* and the aspects that make it unique. Chapter 4 examines a variety of precedents while Chapter 5 provides a detailed description of the design of the *yao dai*. Chapter 6 explores how the theories behind Hangzhou's *tramway promenade* might be applied to other Chinese cities. Lastly, the Conclusion addresses how a research project of this nature might contribute to the fields of architecture and urban design.



Research Method

Undertaken in parallel with the written portion, design was both a key form of research and the primary method of developing the *yao dai*. The design process began with general research on the city of Hangzhou (including the physical structure of the city and a review of the transportation and transit infrastructure) followed by the actual design of *yao dai*. This, in turn, was broken into three components: 1) consideration of the route of the *yao dai* at both the scale of the city and of the block, 2) basic consideration of the design of stations at key nodes within central Hangzhou and, 3) in-depth exploration of the design of the individual components or “kit of interchangeable parts” that would comprise the *yao dai*. Detailed consideration of these components was worked out at a “generic,” mid-block location that included a station.

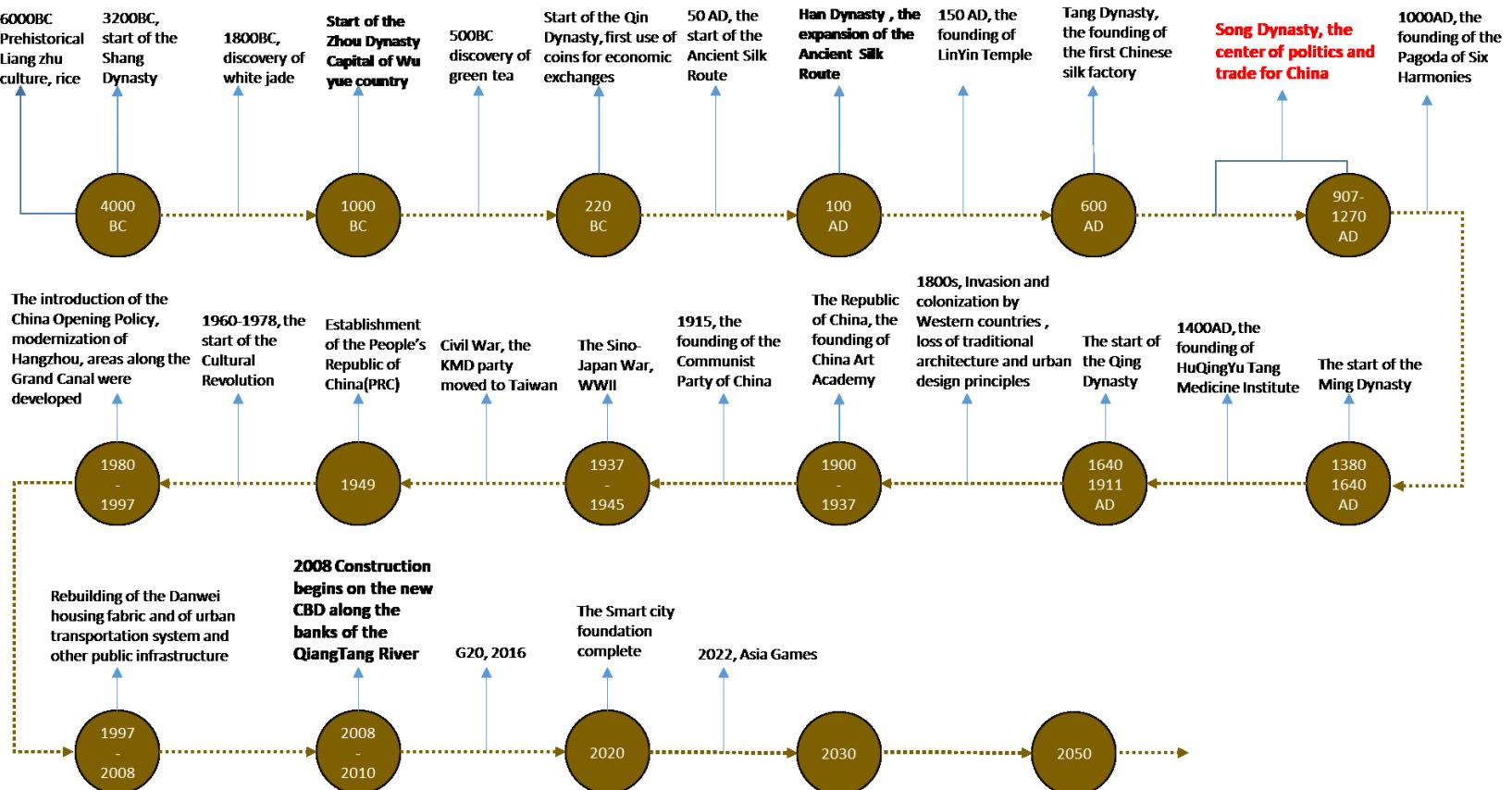
The design method is particularly crucial and significant to the research. Using design as a form of research ensures that the design proposal is flexible and open ended. The iterative consideration of “generic” and “high-profile” locations along the path of the *tramway promenade* enabled me both identify and to hone the adaptability of the various components that comprise the system.



A-1 HANGZHOU FULL VIEW



Brief History of Hangzhou



A-1 B

INDUSTRY & PRODUCT, ECONOMY

Traditional

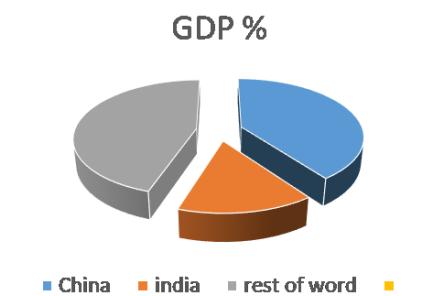
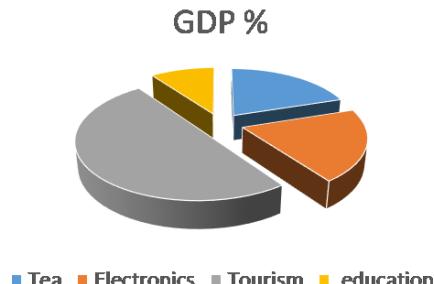
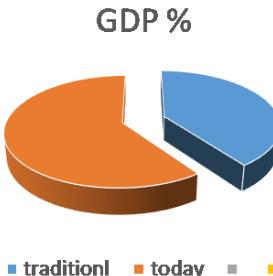
1. Tea
2. Fan
3. Silk
4. Chinese medicine
5. Ceramic China
6. Jade
7. Bamboo products

Today

1. Advanced computer hardware
2. IT
3. Internet service Alibaba
4. Tourism
5. Leisure
6. Food
7. Real estate
8. Rice wine

Major enterprises

1. Alibaba cop.
2. Qingchun Bao Ltd.
3. LongJing Green Tea
4. Zhangxiao quan Ltd.
5. Longxinji fan Ltd.
6. Green Town development
7. Green Town architects
8. Yongtong Development



3. Shui Fa Wang,
*Hangzhou Zhi
introducing
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rainbow bridge is
a sign, QingTang
bridge* (Hangzhou,
2008) Translated
by author

4. Ibid

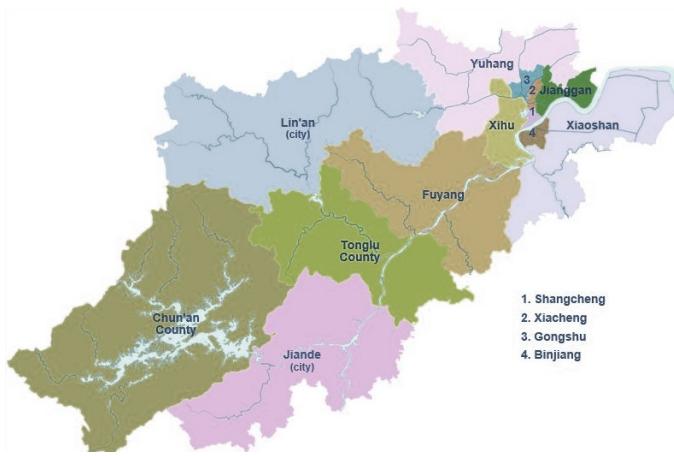
5. ibid

Founded in 4000 BC as the city of Ling An, Hangzhou is one of China's ancient capitals. It is located at the head of Hangzhou Bay, at the “mouth of the Qiantang River”³ which separates Shanghai and Ningbo. (A-2, A-3) Rich in history and culture, Hangzhou grew to prominence as the southern terminus of the Grand Canal. (A-4) It owes much of its prosperity and notoriety to its beautiful natural scenery and to the production of tea and silk, major products traded along the ancient Silk Route to the west. (A-5) The city's West Lake district, its most famous tourist attraction, contains some of the finest examples of Chinese Yuanlin structures.⁴ (A-6, A7)

As the capital of Zhejiang Province, Hangzhou is both rooted in the past and receptive to new ideas, challenges and possibilities. Several of the world's top 500 enterprises are headquartered in the city, including *Alibaba TaoBao* Cooperation, *Geely Automobile* (Volvo industry) and *Green Town* Cooperation (China's biggest developer). “A strong economy and a well-developed tourist industry have helped transform Hangzhou into one of the largest and most prosperous cities in eastern China.”⁵



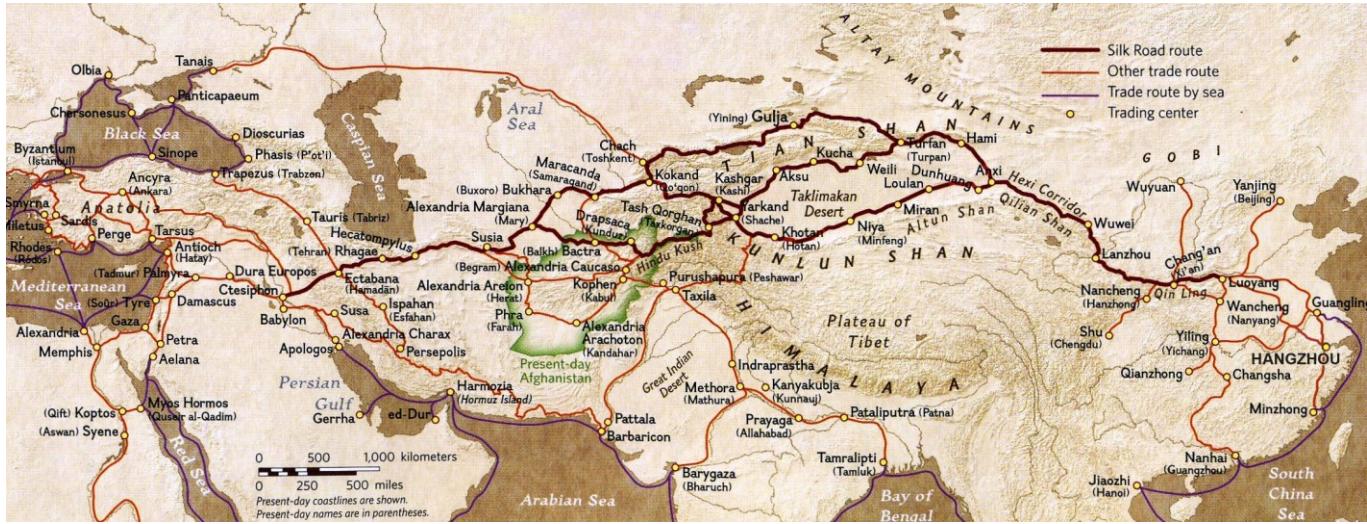
Figure A-2, location of Hangzhou in China



A-3, map of Zhejiang Province and its relation to Qiantang River



A-4, the Grand Canal



A-5 Map of ancient silk route



A-6 view over West Lake



A-7 Huxin Ting Pavilion, Song Dynasty (908AD)

6. FangJian Sheng,
“Hangzhou to 21st
century”, Ministry
Tourism

In part to accommodate growth in the office sector and to “protect the West Lake district from encroachment by office towers, the city is undertaking a new CBD along the QiangTang River.”⁶ (A-8, A-9) As it evolves, the new CBD will be the third in a series of urban centers in Hangzhou, each corresponding to a different waterway, a different economic structure, and a different moment in time. The new CBD will complement the historical center of Hangzhou, located close to West Lake, and a more recent center that developed to the north (at a bend in the Grand Canal). (A-10)



A-8 CBD



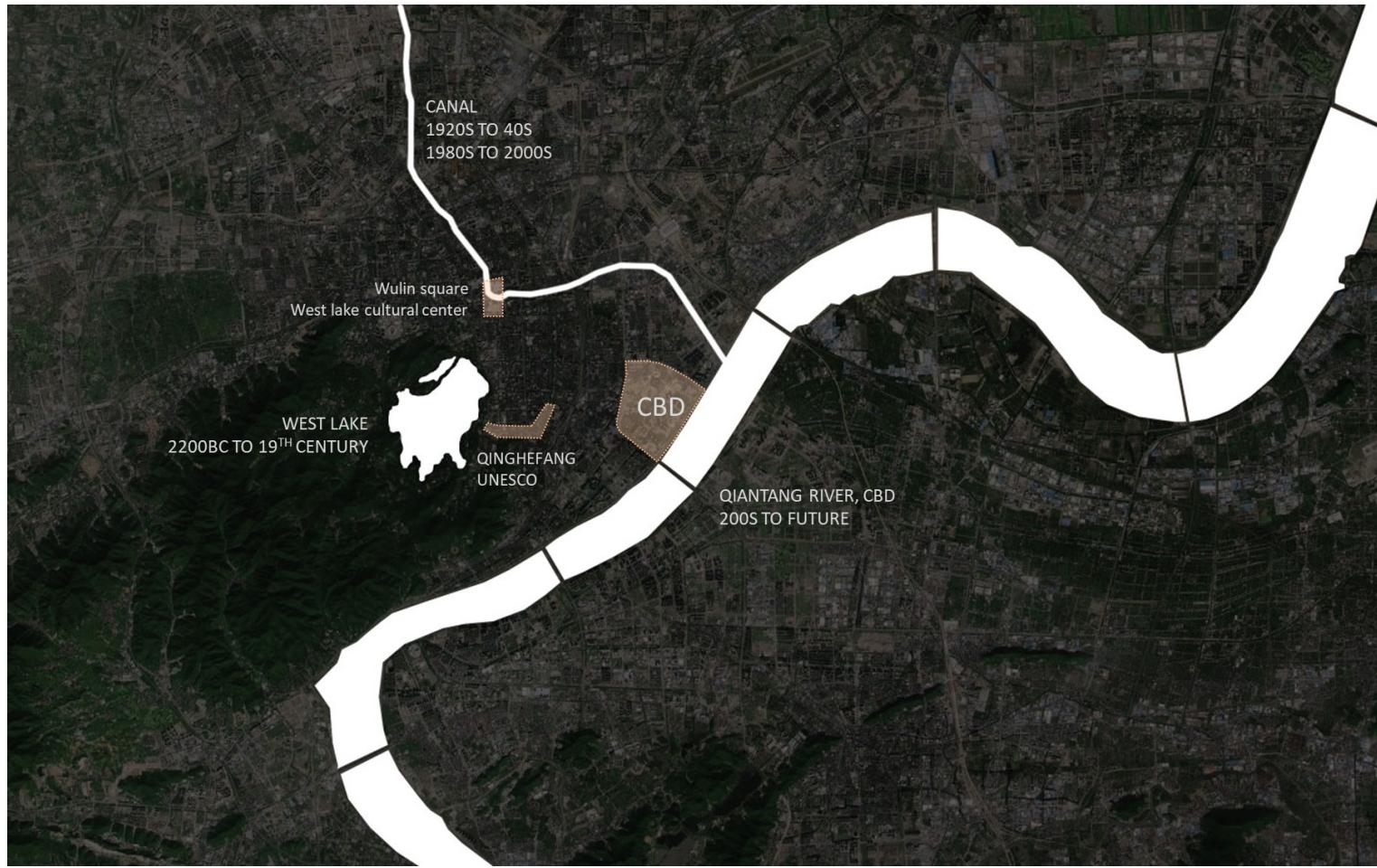
A-9 CBD stage two planning showcase model



A-10 Wulin square at the bend of Canal



Connecting the Past with the Present- A New Transit Loop for Hangzhou



B-1, three moments in urban history of Hangzhou, reflected on map

7. Socialist command economy, heavily based on state owned planned economy compare to market based economy

The urban fabric of Hangzhou evolved in several phases, corresponding to different periods in history. (B-1) From ancient times through the late 19th century, urban development in Hangzhou occurred primarily on the eastern shores of West Lake, in what is the near western side of contemporary Hangzhou. Portions of this area have been preserved and been granted heritage designation, including the QingheFang traditional street. (B-2,3,4)

While no significant development occurred in Hangzhou during the first half of the 20th century (in the Republican period, under the KMD party), numerous factories and *danwei* housing units (B-5) were constructed north and east of the old city in the decades following WWII. This development corresponds to the “socialist command economy”⁷ that operated during the early communist period (1949-1979).

Under the opening policy in the 1980s, a new commercial center appeared about 3 km north of the historic core. Straddling a bend in the Grand Canal, Wulin Square and Westlake Cultural Center became the new urban heart of Hangzhou. (B-6) Office towers, government buildings and retail stores appeared around Wulin Square and along the streets connecting it to the West Lake heritage district to the south (most notably Yan'an Rd.).(B-7,8) Above Westlake Center -- extending as far north as Gongchen Bridge (B-9) -- many of the older factories and *danwei* housing blocks flanking the canal were redeveloped into housing towers. (B.10)



B-2 Qinghefang Birdseye view, looking at Hu qin Yu tang chinese medicine research facility



B-3 Qinghefang street



B-4 Qing yu Tang Entrance



B-5 Danwei housing in Hangzhou



B-6 Westlake Cultural Center



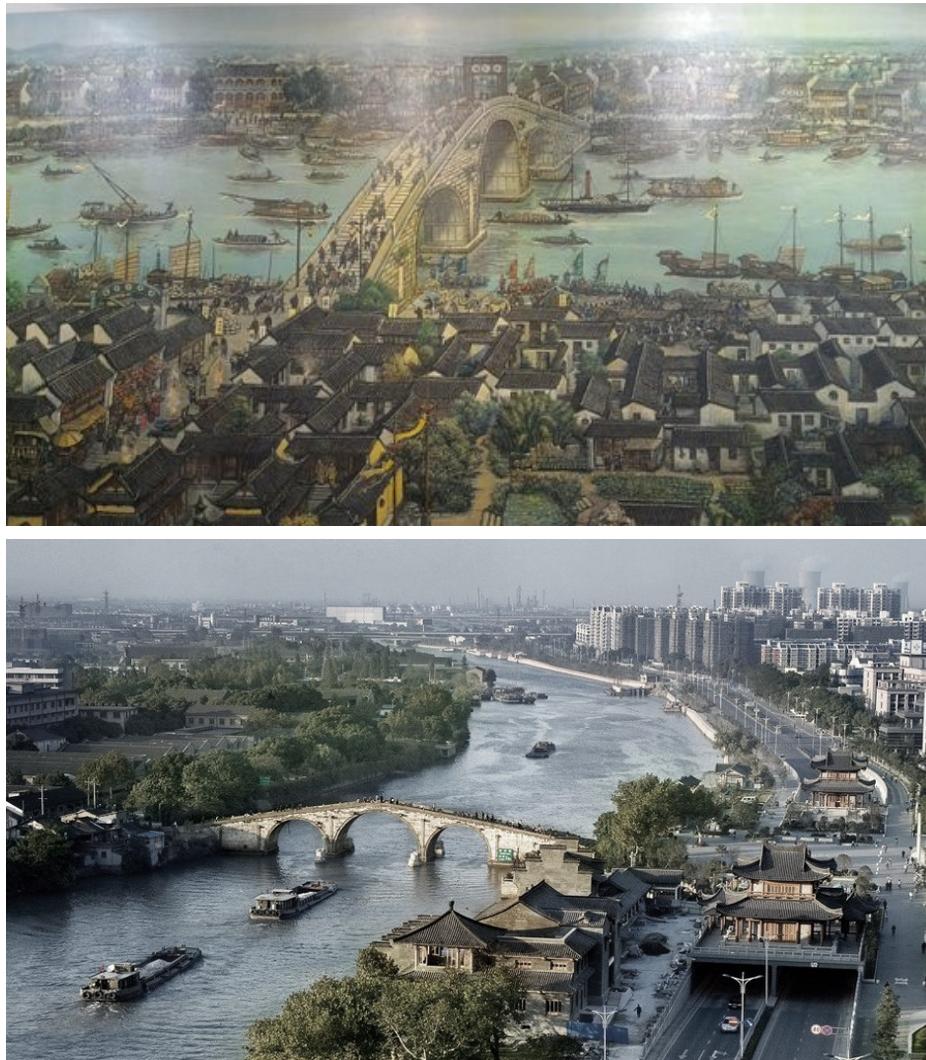
B-7 Yan'an Rd.



B-8 Yan'an Rd. via FengQi Rd. Commercial area



B-9 Gongchen Bridge



B-10 Gong chen Bridge in 19th century above and now, below

With the rapid expansion of the city's economy in recent decades, Hangzhou began shifting its urban center to a new, planned CBD along the QianTang River to the southeast. This area, known as the Qianjiang New Town (or Qianjiang CBD), is connected to West Lake via JieFang Rd. The new CBD is projected to supplant Wulin Square as the center of Hangzhou by 2030. (B-11,12,13) During the same period the West Lake Heritage District has not only increased in popularity as a tourist attraction but has been designated a UNESCO heritage site. Further complicating matters, the city recently completed a major new rail hub (B-14) in the northeast corner of the downtown core. The East Train Station, which connects Hangzhou to the larger Chinese high speed railway (GaoTie) system, is located about 5 km east of Wulin Square and 5 km north of the new CBD, .

The proliferation and shifting of centers in Hangzhou has created challenges, namely the lack of efficient and legible connections between major nodes within the downtown core. Large-scale transportation systems operate according to their own logic and don't contribute to the legibility of the city. For better or worse the system of elevated expressways (Gaojia) only connects the city from south to north and ignores the West Lake and heritage areas. While lines 1 and 4 of the metro system generally follow the proposed path of the tramway promenade, connections are made underground. Systems that use surface streets, like busses, are less efficient. (B-15)



B-11 CBD in relation to old city center and the West Lake



B-12 CBD core area



B-13 CBD looking at Old Center from ShanBao Mouth



B-14 Hangzhou new transit hub, East High Speed Train Center

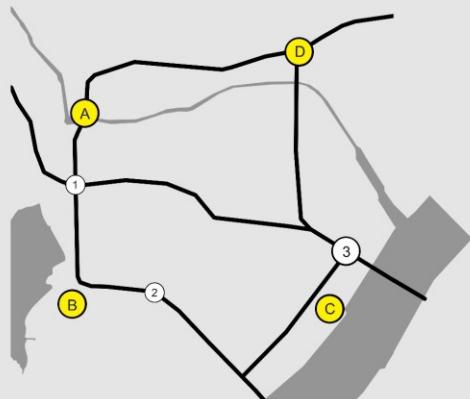
A. OLD CENTER

B. HERITAGE

C. CBD

D. HIGH SPEED TRAIN
NEW EAST CITY

B-15 Diagram
showing existing
transit systems in
relation to Yao Dai
route



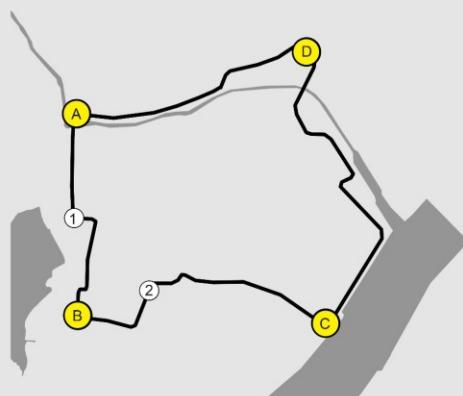
METRO SYSTEM

1. FENGQI ROAD INTERSECTION
2. RAILWAY STATION
3. METRO SHIQING TERMINAL



HIGHWAY SYSTEM

1. CHAOJI HIGHWAY TERMINAL
2. DESHENG EAST QISHI TERMINAL
3. DESHENG NORTHWEST TERMINAL
4. QISHI NORTH TERMINAL



THE YAO DAI SYSTEM

1. FENGQI ROAD
2. TRAIN STATION LOCAL



OVERLAY

1. FENGQI ROAD
2. TRAIN STATION LOCAL

Xizi is also a nickname for the great Chinese beauty Xi Shi. Literally it means Xi Lady. Since the West Lake at Hangzhou was believed to be the legendary incarnation of Xi Shi, thus it is also called Xizi Hu (lake).⁸

8. Dictionary of Asian Mythology,
<https://www.highbearm.com/doc/1069-Xizi.html>

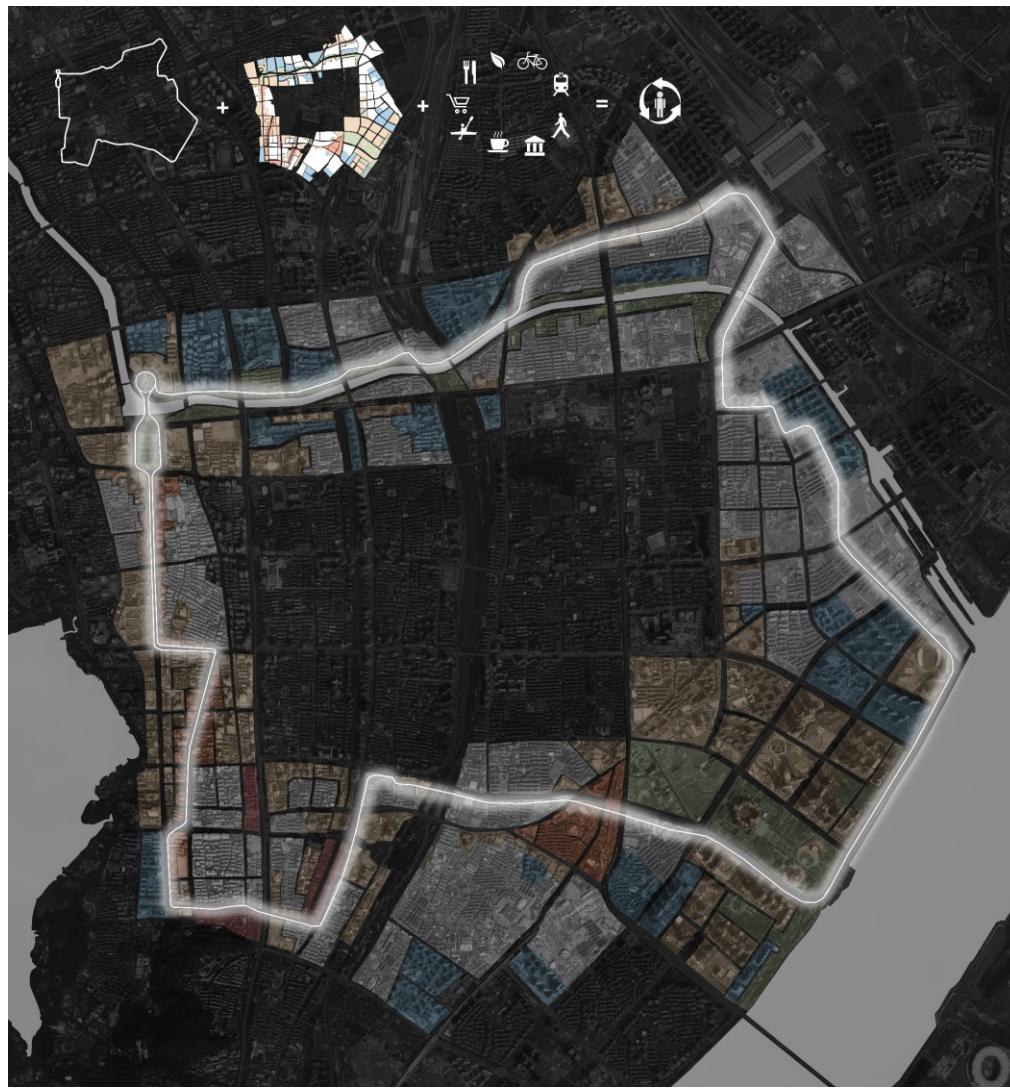
And while many city streets include bike lanes, there is currently no dedicated bike path through Hangzhou. As such, cyclists, pedestrians, bus riders, and most motorists must navigate Hangzhou's complicated network of streets and sidewalks, waiting at lights and stopping at corners. (B-16) While in and of itself, this is not a problem, it would be good to offer a more choreographed experience to those moving between nodes (e.g., covering the 3.6 km from Wushan Square to Wulin Square or travelling the 6 km between West Lake and the new CBD).

Therefore, as proposed, the *Hangzhou Tramline Promenade* or *yao dai* (the name for which was inspired by the silk belt of Xizi) would tie together key points in the urban core, namely: 1) the hub at the bend in the canal (the Westlake Cultural Center, WuLin square and the Yan'an Road shopping street), 2) the QingheFang/West Lake Heritage District (including the area around the old Hangzhou train station), 3) the new CBD and, 4) the East New District (including the new East Train Station and the East City community area). These four nodes, each corresponding to a different period in the city's history, will be connected into a beautiful yet efficient loop. (B-17)

More than a multi-modal transportation route, the *Yao Dai* is envisioned as a continuous green belt through the city. Citizens and tourists alike would use it to more fully engage the city of Hangzhou, experiencing aspects of its rich nature, culture and history as they move through the city.



B-16 busy street in Hangzhou



B-17 YAO DAI route

In addition to supporting existing activities in the neighbourhoods it serves, it will foster new commercial, recreational and interpretative activities. (B-18) It is also envisioned as an armature and catalyst for urban regeneration. Passing through areas that are ripe for redevelopment (e.g., large areas of *danwei* housing), properties along the *yao dai* would be replaced with a mix of “higher performance” residential and commercial uses. (B-19)

Understanding that many of the logistical considerations that will determine the exact alignment of the *yao dai* are beyond the scope of the thesis, the proposal focuses on the design of the *yao dai* as a piece of physical infrastructure. That said, design decisions are predicated on certain assumptions about where and how best to insert this infrastructure into the city. Commensurate with its role as a catalyst for urban regeneration, it makes most sense to locate the *yao dai* in close proximity to, but not directly within, areas of the city that have recently redeveloped. As such, the “generic” approach I’ve taken is to insert the Tramway Promenade a half a block in from major streets, running through what amounts to a gap separating the commercial buildings along these streets and the more private residential areas behind. (B-20)

In various places/cases, however, exceptions are made to this rule. Among the advantages of exploring “non-typical” conditions is the ability to better understand how the various components of the *yao dai* may be called on to adapt to different urban conditions -- in order to build flexibility and adaptability into the design.



TRANSPORTATION



FOOD LEISURE



COFFEE BAR



GREEN SPACE PARK



BIKE ROUTE



WALK ROUTE



SHOPPING FASHION



heritage



WATER SPORTS



RESTAURANT



MUSEUM HERITAGE



WALKING WAY



KAYAKING



BIKING



STORE RETAIL MALL



PARK GREEN SPACE



TRAIN STATION



COFFEE & BAR

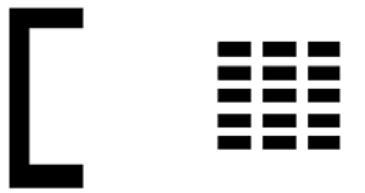
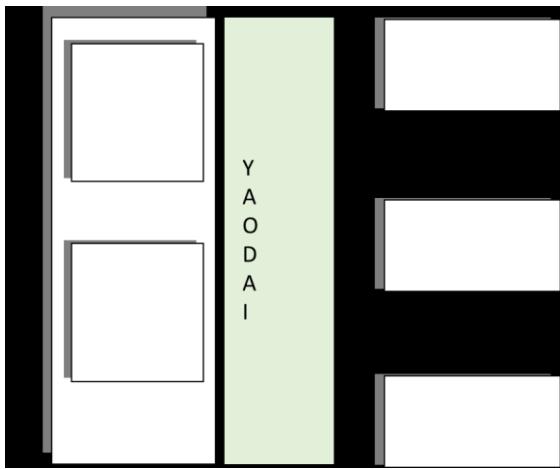


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B-18 Multifunctional platform diagram

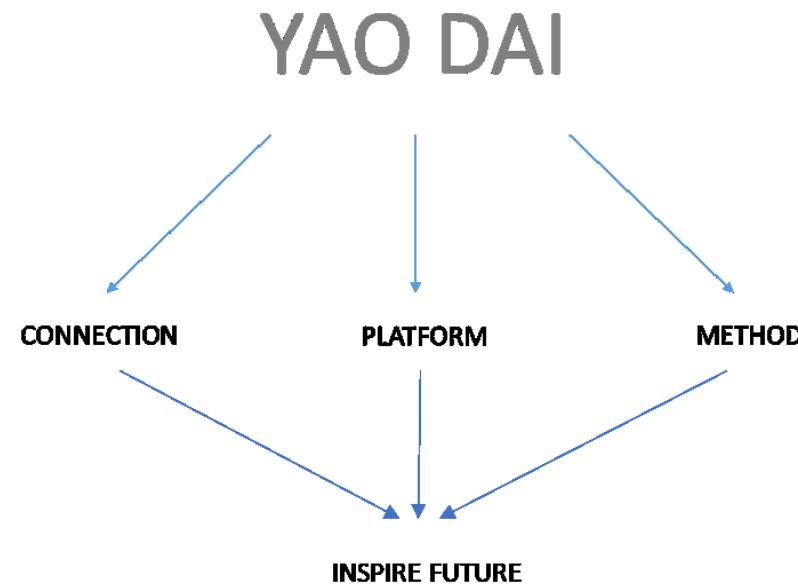


B-19 Re-planned
Housing area



B-20 Diagram, YAO DAI in between commercial and residential (left) The service route diagram(right)

On a macro level, the thesis is trying to demonstrate that by tying the city's past and present together, the *yao dai* will inspire confidence in Hangzhou's future.





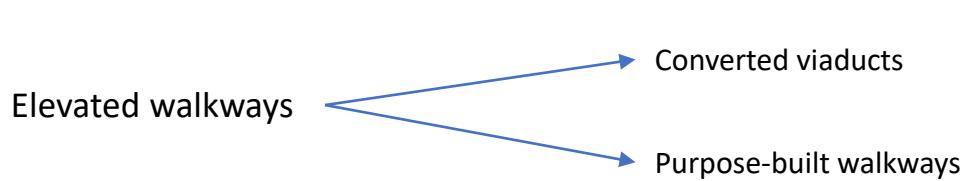
Precedents

Precedents

Early inspiration for the project came from several precedents. Given the various components envisioned for the *yao dai*, these precedents fall into several overlapping categories, namely 1) elevated walkways, 2) repurposed rail rights-of-way also known as “rail trails,” 3) mid-block laneways, 4) linear parks, and 5) at-grade tramlines.

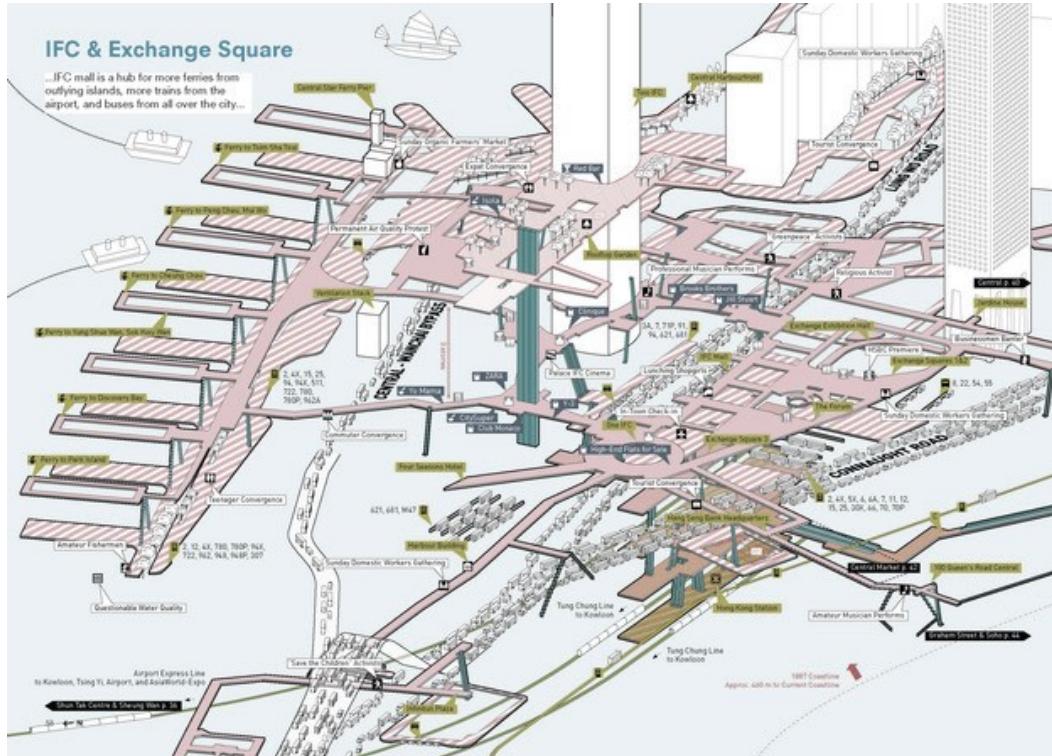
1. *Elevated walkways*

Elevated walkways fall generally into two categories, namely converted viaducts and purpose-built walkways. Examples of the latter run the gamut from the banal to the elaborate, e.g., from utilitarian crossings over intersections in Tokyo, to convoluted, multi-functional networks such as the system of walkways through Hong Kong (see c1 and 2) and the elevated path that winds through the office towers and shopping malls of Shanghai’s Lujiazui. (see c3) Among the more celebrated examples of converted viaducts are the *Promenade Plantée* in Paris and the New York City’s *High Line*.





C1, Elevated walkway in Hongkong



C2, Hongkong walking system diagram



C3, Shanghai Lujiazui area pedestrian bridge

9. Campbell,
Robert "Viaduc des
Arts and
Promenade
Plantée: A Paris
match?".
Boston.com.
accessed June 15th,
2017

10. Ibid

1.a: the Promenade Plantée

The *Coulée verte René-Dumont* – known colloquially as the *Promenade Plantée* -- is a linear park atop an abandoned railway viaduct in the 12th arrondissement of Paris. (see c4)

Inaugurated in 1993, the promenade follows the old Vincennes railway line that connected the Parc de Vincennes with the Place de la Bastille. Beginning with the *Viaduc des Arts* (the former Bastille bridge, c5), it travels east for 4.7 kilometers to the Boulevard Périphérique.⁹

Along the *Viaduc* the park is lifted some 10 m above adjacent urban fabric. As it approaches the Boulevard Périphérique it drops down to grade and splits into two parts, one of which merges into the line of *Le Petite Ceinture* railway. “The *Promenade Plantée* was the world’s only elevated park until the first phase of New York’s High Line was completed in 2009.”¹⁰



C4, Promenade plantée , 12th arrondissement



C5, habitation of the former Bastille bridge

11. F. Green and C. Letsch "New High Line section opens, extending the park to 34th St.". Daily News. accessed June 12th, 2017.

12. Keller, Jared "First Drafts: James Corner's High Line Park". The Atlantic. accessed June 5, 2017.

13. Gregor, Alison "As a Park Runs Above, Deals Stir Below". The New York Times. accessed May 15th, 2017

1.b: The High Line

The High Line is a 2.3-km-long elevated linear park in New York City. It occupies an elevated New York Central Railroad spur called the West Side Line,. (see c6, 7) Designed and led by landscape architecture firm James Corner Field Operations, the design team reimaged the existing – and largely abandoned – piece of infrastructure as an "organic system"¹¹ drawing on multiple fields and professions, including ecological landscaping, urban design, and architecture. The High Line runs up the Lower West Side of Manhattan from Gansevoort Street, (2 blocks from 14th St. and the Meatpacking District), through Chelsea, to the northern edge of the West Side Yards on 34th Street (near the Javits Convention Center). The transformation of the abandoned elevated rail line into an urban amenity has boosted real estate development in the adjacent neighborhoods.¹² (see c8) High-profile residential buildings, hotels and cultural institutions (e.g., the Whitney Museum) have attached themselves to the High Line. "The crime rate around the Javits Center decreased significantly after the second section opened in 2011."¹³ The area is set to transform further as the decking over the West Side Yards is completed and a new office and residential hub appears between 34th and 42nd Streets. In addition to extending the High Line north to connect into (and through) the West Side Yards, the City extended the #7 subway line westward, significantly improving access to and transportation through Manhattan's far west side.



C6, Highline 1



C7, Highline 2



C8, c8, Zaha Hadid designed condominium adjacent to the High Line

1.c: Seoul Sky Park

14. "Seoullo 7017: Urban Asset or Misjudged Vanity Project?". KOREA EXPOSÉ. accessed May 30th, 2017.

15. "Seoul, a city 'with no soul,' builds its own High Line on an old overpass". Washington Post. Accessed June 1st, 2017.

More recently MVRDV Architects transformed an automobile flyover in Seoul, South Korea into a linear park. The Seoullo 7017 Sky Park, also known as the Seoul Sky Park, opened to the public in May of 2017. (see c9,10) Like New York's High Line, the kilometer-long park runs along an elevated highway that closed in 2015. Cutting diagonally across Seoul Station, the park includes gardens, terraces and ecologically themed exhibits that, together, incorporate more than "25,000 plants including 228 different species of trees, shrubs and flowers."¹⁴ (see c11) While the park is the main attraction, the repurposed highway includes shops, galleries, teahouses, a theater, information centers, maintenance booths and restaurants. "At night, the park lights up and can accommodate events and festivals."¹⁵ (see c12) Multiple stairs and elevators were added to connect the highway to the areas of the city through which it passes. Among other things, the Sky Park significantly expands and improves the experience of moving through the city on foot, connecting through areas that were previously inaccessible to pedestrians and difficult to navigate.



C9, The Seoullo 7017 Sky park, Birdseye



C10, The Seoullo 7017 Sky park, perspective



C11, The Seoullo 7017 Sky park, perspective, standing on bridge



C12, The Seoullo 7017 Sky park, night view.

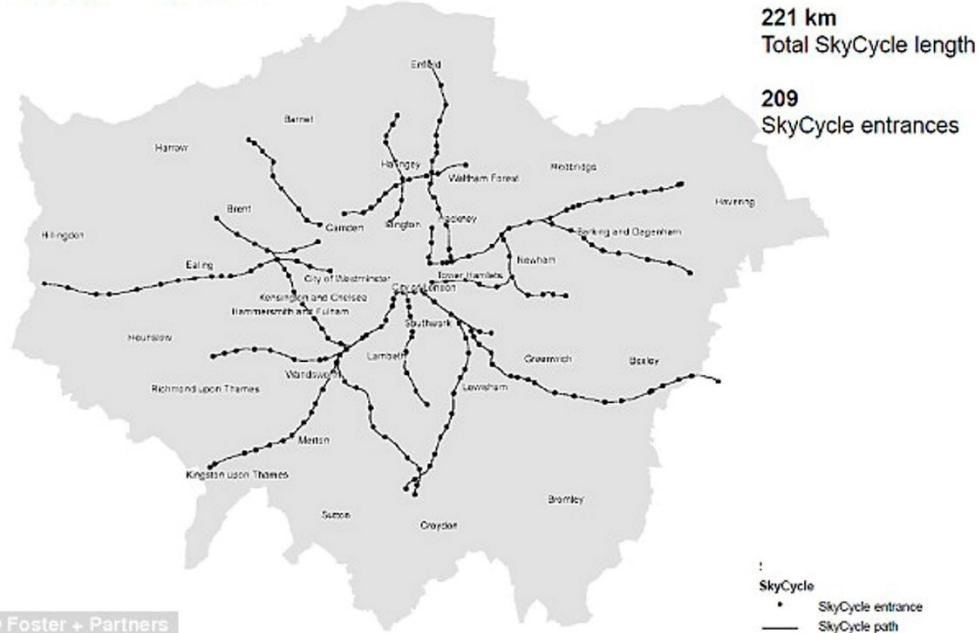
16. Gander,
Kashmira "Plans
for 136-mile
'SkyCycle'
highways above
London's rail lines
to be put forward
for consultation".
The Independent.
accessed June
15th, 2017

1.d.: London Sky Cycle

Multi-use platforms (e.g., pedestrian, transit and cycles) will play a significant role in the future of cities, especially in as much as transit and cycle paths greatly benefit from dedicated rights of way. A forward-thinking example is the Sky Cycle proposal for London.

An entry by Foster + Partners to a virtual competition in 2012, the Sky Cycle is a proposal for public, cycle-based infrastructure for the city of London. Approximately 219 kilometres long including all of its sub-connection, the project envisions a network of elevated cycle paths above train tracks. (see c19) The 15-metre wide pathway would be connected to grade by over 200 accessible ramps across the city. "Sky Cycle was designed to accommodate some 400,000 cyclists during rush hour."¹⁶ If realized, the project would bring a very different cycling experience to London. (see c20) According to London landscapers and urbanists, the city's extensive rail network represents virtually limitless untapped potential for cycle networks. Although quite bit of land is available adjacent to tracks, this is the first comprehensive proposal to elevate cycle paths above them. Whether beside or above the tracks, dedicated rights of way are key to efficient transportation options – just as multi-modal, mixed use streets are key to urban vitality.

SkyCycle Network



C13, Sky Cycle by Norman Foster, route plan diagram.



C14, Sky Cycle perspective

17. Benson Bobrick.
Labyrinths of Iron, a History of the World's Subways.
Newsweek Books, (London 1981).

2. Rail Trails

A “rail trail” refers to a railroad right-of-way that has been converted for use as a hiking, walking and/or cycling trail. Generally this involves pulling up the tracks and retrofitting viaducts to make them safe for cyclists and pedestrians. While the majority of rail trails are found outside of cities, in the past several decades we’ve witnessed numerous attempts to extend them into and through the urban core. In part this reflects the increasing popularity of cycling as a mode of urban transportation.

2.a: *Le Petit Ceinture*

A notable candidate for an urban rail trail is the *Petit Ceinture* in Paris. Other than its eastern portion which connects to the *Promenade Plantée*, it is an on-grade trail that offers a different experience of moving through the city. (see c13) The *Chemin de fer de Petite Ceinture* was constructed as a railway loop inside of the Thiers fortifications (the city’s last set of walls) to provide passenger and freight service between Paris’s main railway stations as well as to supply supplies to the fortifications. Built in stages from 1851 onward, the rail line was, in effect, Paris’ first metro line. “Having peaked during Universal Exposition of 1900, usage began to decline.”¹⁷ Abandoned and largely untouched since its last year of service in 1934, the future of the *Petit Ceinture* is still a matter of debate. Many wish to preserve the remaining stations as part of France’s national heritage, seeing its former path transformed into parks and communal

18. "The wild abandoned railway in the centre of Paris", BBC News, accessed June 5th 2017.

19. Rebecca Burns , Can Atlanta Go All In on the BeltLine? Atlantic Cities, accessed June 8th 2017

20. Garvin, Alex "The Beltline Emerald Necklace". E-Book, Original J, (2004). accessed June 8th, 2017

gardens (access to the unused rail tracks is forbidden, but enthusiasts explore it nonetheless, describing it as a quiet, natural garden space within Paris)¹⁸. (see c14). Others hope that some form of rail service will be reintroduced.

2.b: The Atlanta Beltway

The Atlanta Beltway is another example of an urban rail trail in the making. A former railway corridor encircling the core of Atlanta, Georgia, the Beltway is in the process of being converted into a multi-use trail. (see c15) While several sections are already completed, unfinished portions are open for hiking activities (see c17). Using existing rail easements, the Beltline is designed to improve transportation, operate as a linear (or circular) park, and encourage redevelopment. The long-term vision for the 33-mile (53 km) Beltway includes streetcars or light-rail.¹⁹ (see c16)

"The idea for the Beltline originated with a 1999 master's thesis by Georgia Tech student Ryan Gravel."²⁰ It connects public spaces and neighbourhoods in city, but has also been used for temporary galleries and other art activities. (see c18)



C15, Le petit Ceinture, people walking



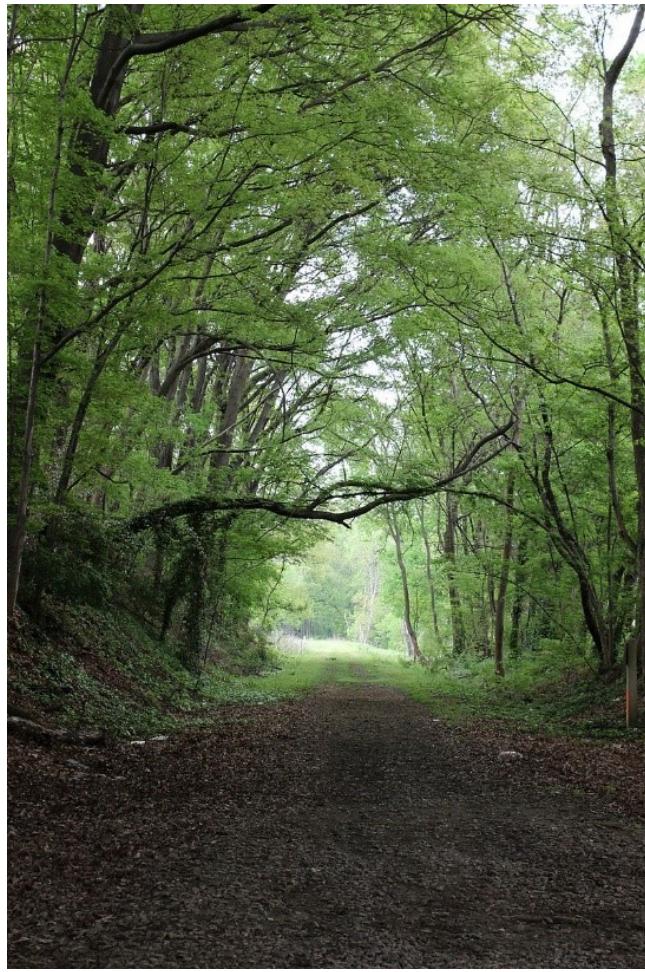
C16, Le petit Ceinture, people enjoy sitting around rail bed.



C17, Atlanta Beltline map



C18, Atlanta Beltline future planning proposal.



C19, Atlanta Beltline, walking trail.



C20, An art installation on Atlanta Beltline

Railway easements are an invaluable urban asset inasmuch as it is extremely difficult to establish dedicated rights-of-way once the urban fabric has been built out. The fact that rail lines appeared relatively early in the modern development of most cities enabled railway companies to establish these rights of way. As cities filled in around them, many on-grade rail crossings were replaced with viaducts and grade-separated crossings to facilitate the fluid movement of different modes of transportation. Given the difficulty in acquiring rights-of-way, the proposal for the *yao dai* is extremely timely – it corresponds to a unique moment in the history of Hangzhou (and other Chinese cities) when large tracts of post-war housing are up for redevelopment. Among other things this obviates the need to bridge over and/or tunnel under existing fabric to establish new transportation routes.

It should be noted that, despite being elevated, both the High Line and the *Promenade Plantée* fall into the category of “rail trails” inasmuch as both were abandoned rail lines. It should also be noted that rail rights-of-way form the basis of numerous urban transportation systems. Many underutilized rail lines were repurposed for highways in the mid 20th century (e.g., Ottawa’s Queensway). More recently underused rail lines have been converted to “transitways,” first for busses and later for light rail. Dedicated rights of way are key to enabling transit to compete with automobiles, for which elaborate networks of limited-access roads were constructed over the course of the 20th century.

2c: Cycling in Chinese Cities

21. Economic and Social Development Statistical Bulletin (in Chinese).
Shanghai Bureau of Statistics China Statistic Press (Beijing, 2011)

Chinese cities are witnessing a major resurgence in bicycle usage – reminiscent of the Communist (pre-Reform) era when everyone used bikes. As bicycle usage predates and vastly outpaced the use of cars for much of the 20th century, roads in many Chinese cities were designed for bicycles. In Mao's era, even government ministers used bikes to conduct official business. Beginning with economic reform in the 1980s (and especially after 2000), however, cars began to dominate roads and former cyclists flocked into the newly constructed subway systems. The scholar, Zhou Li Po, famously observed that:

"when the west was riding bikes, we were still on foot. When the west was driving cars, we were riding bikes. Now that we are driving cars, the west is going back to bikes.²¹ Should we also get back on our bikes?" (c-21 and c-22)

Designers in China are being asked to consider whether bikes should return as a primary mode of transportation and, if so, how bikes and cars might work together. While most primary roads in major cities include segregated bicycle lanes, dedicated paths are better – assuming, of course, that these paths are easy to access and get you where you want to go.

22. Shui Fa Wang,
Hangzhou Zhi
introducing
Hangzhou, rainbow
bridge is a sign,
QingTang bridge
(Hangzhou, 2008)
Translated by
author

A typical example of multi-use path that accommodates cyclists is the West Lake Circle Path in Hangzhou (see c23), which overlaps the old “qingshiban lu” (the road paved with ancient slate or stones). The 5-metre-wide path starts from Duanqiao Bridge on the west side of the lake and follows the old horse path around to the east. Together with the Nanshan road path, it forms a circle around the lake. “More than 200 bike rental stations serve up to 40,000 riders during rush hour.”²² (see c24)



C21, Biking in 1980s China



C22, Biking in today China



C23, people biking at West Lake



C24, Bike rental station at West Lake

23. Bate, Weston, and Melbourne (Vic.) and State Library of Victoria. Essential but unplanned: the story of Melbourne's lanes

24. Melbourne Hidden Laneways, Even the locals find surprises in Melbourne's cobblestone laneways, accessed July 20th, 2017

3. Mid-Block Laneways

However, fixed it is as a piece of infrastructure, there is dynamic aspect to the *yao dai*. This relates to the movement it accommodates, the flexibility and inter-changeability of its components, and the numerous way in which it interacts with the city. As a multi-functional platform, the *tramway promenade* is designed to respond to local conditions along its route. One way is by providing spaces for temporary public use; another is by fostering secondary economic activity along the service road that parallels it. In this respect it is similar to the laneways of Melbourne, Australia, which have become incubators for small businesses that could not afford the rents on the major streets they serve. Modified by local businesses, the lanes and arcades of Melbourne have become both economically and culturally important.

"Most of laneways through Melbourne's central business district were established in the Victorian era for horses and carts."²³ They now support restaurants and other public amenities. Centre Place and DeGrave's Lane are two of the busiest and most significant. Since being pedestrianized the 1990s (in recognition of their heritage value), they have attracted interest in Australia and around the world. Some of the lanes are used by local citizens to showcase art and to stage festival and celebrations.²⁴ (see c25) The laneways are also frequently used as locations by film and television media.



C25, Melbourne Laneways

Building on this, the *yao dai* is designed to be flexible enough to enable residents to modify it according to their changing needs. In this respect it resembles other infrastructure project that accommodate (and foster) a variety of uses. An example is the so-called “BIG U” – a seawall proposal for lower Manhattan designed by BIG architects. The wall is designed to accommodate a variety of different uses along its route .(see C-26)



C26, BIG U NY

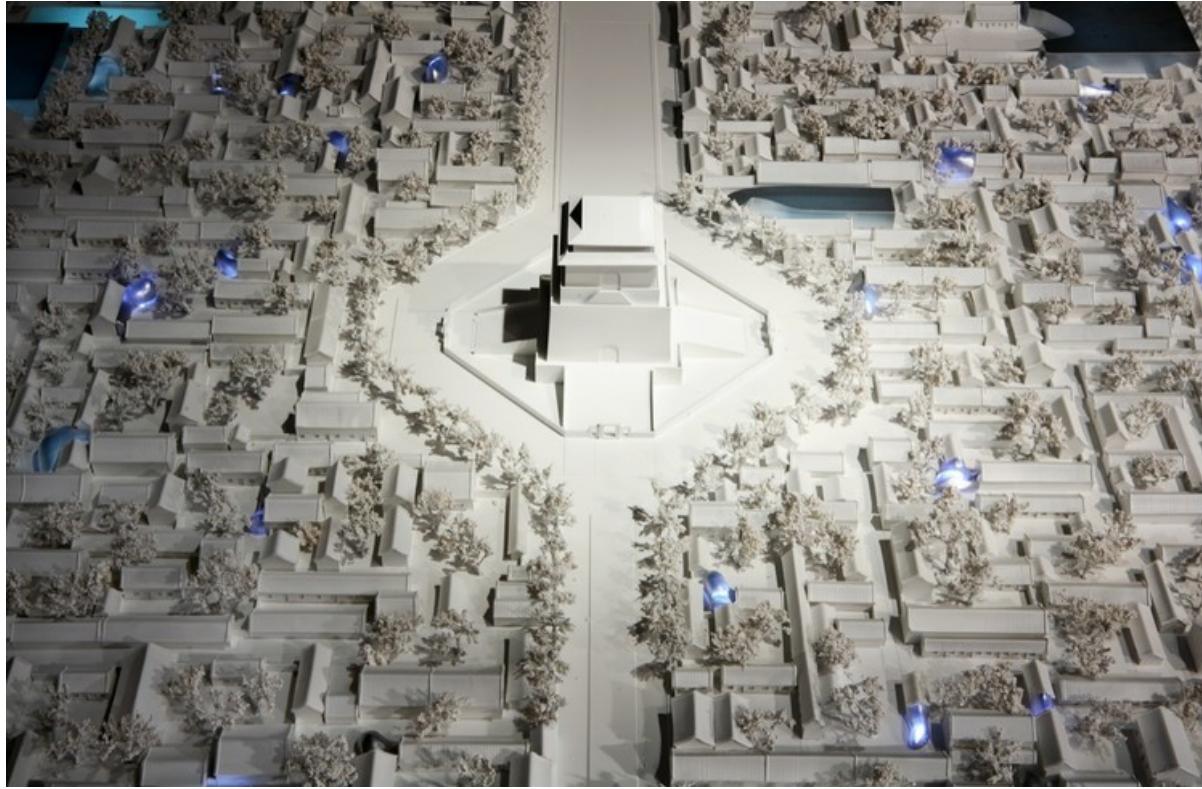
4. Linear Parks

Examples of linear parks include areas of Beijing where ancient walls have been removed. In older areas of the city some of the tighter *hutong* fabric has also been removed to make way for linear parks. (see c27)

Similarly, a number of the fortifications demolished by Louis XIV in Paris in the late 17th century were converted into linear parks (and have since become boulevards). More contemporary examples include the park above Boston's Big Dig, where a major piece of highway infrastructure was buried.

Even where walls remain, the areas along and above them are often used as linear parks. One of the best examples of this is the park atop the wall that encircles the city of Luca, Italy, which functions as a promenade (and bike path). It bears noting that the High Line, the *Promenade Plantée* and Seoullo 7017 also fall into the category of green corridors inasmuch as they are parks as much as pedestrian passageways.





C27, Beijing Hutong area with Blvd cut outs.

25, Paris Public
Transit agency
document,
TramwayT5-3.pdf

26. Note that The
densities of central
Paris and central
Hangzhou are
roughly equivalent.

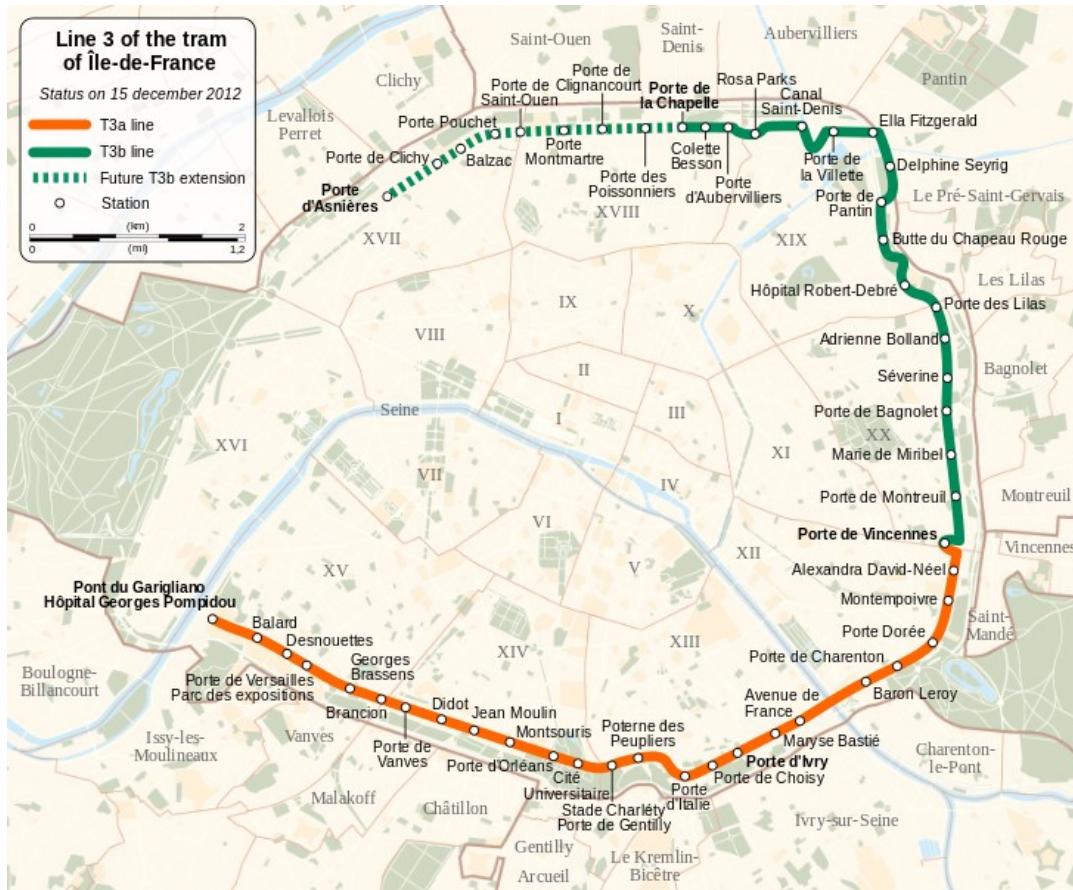
5. On grade tram lines

The success of the *yao dai* will depend on economics and adaptability. Running virtually parallel to *le Petit Ceinture* in Paris is the Tramline 3. It occupies in its own section of an inner ring road around central Paris, connecting the Pont de Garigliano and the Porte de la Chapelle. (see c28,29) An extension of the line to Porte d'Asnières is currently under consideration. Line 3 carried 25 million passengers in its first year of operation and the line was double-tracked between 2009 and 2012 to augment capacity and reliability. The success of the T3 in Paris – a city that is well served by both an extensive metro and regional rail system (RER) -- suggests that a similar tramline loop may be viable for Hangzhou.²⁶ (see C-30)

Examples in Chinese cities include the Guangzhou Haizhu Island Circular New Tram (or YoungTram), which connects major urban nodes in the city. Guangzhou's tramline runs offset to the main routes, allowing the infrastructure to pass through important places simultaneously avoid running into high density chaos. From the Canton Tower Station the tram travels eastward to the Wanshengwei Station, making a total of 10 stops along its 7.7-kilometer (4.8 mi) run.

Both to comply with zoning and for asthenic reasons, the tramline component of the *yao dai* will operate without overhead wires,. The latest 402 Citadis tramcar uses a *hyper coolant* battery system that can recharge at every station. A similar system is used in Shanghai.

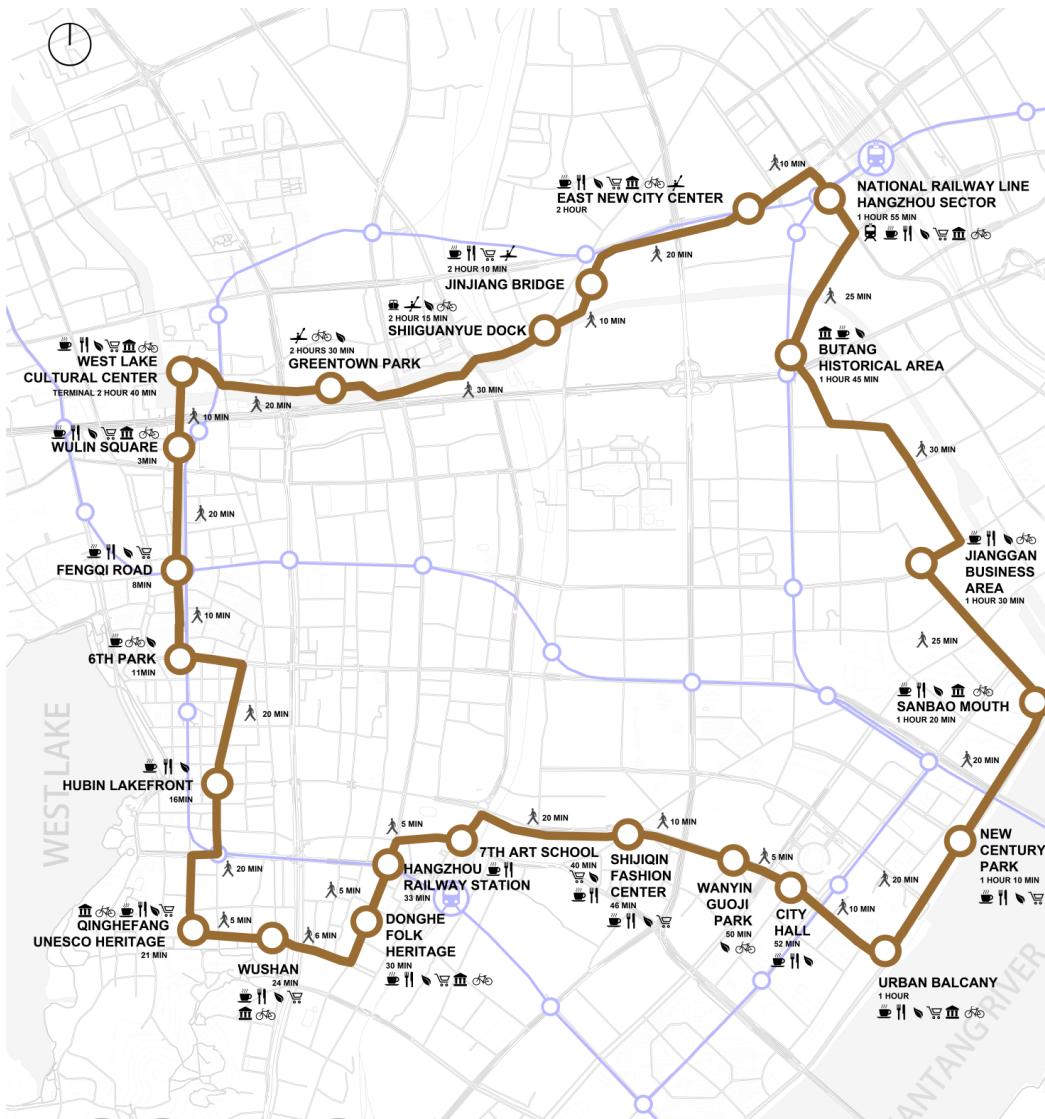




C28, Paris Tramline three plan



C29, Paris Tramline three station



C-30 Overall route map of Yao Dai with all urban nodes and programs

Some Observations on Design Method

Given the Hangzhou's robust population density and tight urban fabric, the decision to elevate the walkway about the tramline makes sense. It will also introduce a unique and efficient way of moving through the city on foot – eliminating the need to wait at intersections to cross streets (among other advantages). It is anticipated that the *yao dai* will encourage, accommodate, and guide the re-development of the city's residential fabric, much of which consists of communist-era *danwei* housing (parallel blocks of 4- and 5-story walk-ups). If the *yao dai* is to be inserted into Hangzhou, however, it needs to be done quickly, before too much more of the city is redeveloped. The proposal is both timely and time-sensitive.

Having made a case for the *yao dai*, in great part based on the viability of precedents, the focus of the thesis shifted to design. The method deployed for the design of the *yao dai* consists of a set of inter-changeable components. (see c30) Taking cues from Sky Garden walkway in Seoul, I determined that the *yao dai* should consist of a “kit of parts,” flexible enough to adapt to different urban condition and to accommodate a variety of public and private programs. As such the design of *yao dai* was rooted in two parallel thought processes: a consideration of the larger urban condition and the design of the components or “kit of parts.” In both cases I drew upon precedents. Decision-making at the urban scale was informed by first-hand experience with the community and an understanding of the history, values and aspirations of contemporary Hangzhou.



This, in turn, informed my thinking about current and future programs. Thirdly I considered what components and characteristics might best enable the *yao dai* to integrate with the existing fabric (e.g, how should it relate to and connect with existing buildings and urban nodes). With the benefit of this exploration I focussed in on the design of the functional and structural components of the system – which I tested against a variety of locations in the city. Finally I refined the components through an in-depth exploration of a .5-kilometer interval of the *yao dai* through a “generic” portion of urban fabric. This short stretch included a transit stop, a street crossing, vertical transportation (stairs and an elevator) and connections between the elevated walkway and adjacent buildings.





Tea Cafe



Sun Deck



Street Market



Flower Shop



Street Library



Fountain



LED Floor



Observatory



Street Exhibition



Green House

C30, The Seoulo 7017 project kit of parts



The design of Yao Dai

Pre-design

The Kit of Parts

The various elements comprising the *yao dai* are treated as a “kit of parts.” These parts can be divided into five categories: 1) green components (including plant materials, containers and beds, green walls), 2) infrastructural elements related to the various modes of transportation, 3) leisure components (benches, food service kiosks, retail and commercial units, etc.), and 4) structural elements, into which vertical transportation and signage have been integrated. The interchangeable systems of planters along the elevated walkway is an example of the system’s flexibility. Planters can be swapped out for a number of other components including canopies, bridges to adjacent buildings, etc.

Cutting a cross-section through the *yao dai* as one moves along it in a clockwise direction (i.e., housing on the left and commercial buildings on the right), components are organized as follows:



Zone 1: Wide Planting Strip/Linear Park (separating the yao dai from adjacent housing) (3m)

- Ginkgo tree, vertical, shady areas
- Sweet Osmanthus (Gui Hua tree), vertical, sunny areas

Zone 2: Bicycle Path (3m, asphalt)

Zone 3: Rail Bed (9m, 12m at station)

- Grass along most of its length (similar to the T3 in Paris)
- concrete at station. (Include 5m middle waiting platform elevated at 290mm)
- Asian River stone gravel, through heritage areas

Zone 4: Tram Platform/Secondary Planting Strip

- Concrete paving (at stations)
- Seating
- Boxwood hedge (except at stations)
- Concrete tensile supports every 10 meters
- Bridge supports at street crossings
- Vertical transportation at stops (elevators and stairs). These are integrated with bridge supports.
- Signage

Zone 5: Elevated Walkway (9m, laminated artificial wood decking)

- Railing on left side of walkway
- Lighting
- Skylights (over secondary planting strip when at station)
- benches/seating
- planting boxes along right side of walkway
- Canopies (at tramway stops)
- Decks connecting elevated walkway with commercial buildings (over service road).
- Observation decks
- Restaurant, bar and coffee house kiosks

Zone 6: Service Road (6m, penetrate asphalt, Singapore made)

Zone 7: Sidewalk (3m, concrete, stone paving at heritage)

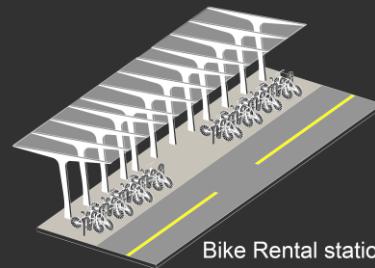
Zone 1: Primary Planting Strip



Ginko

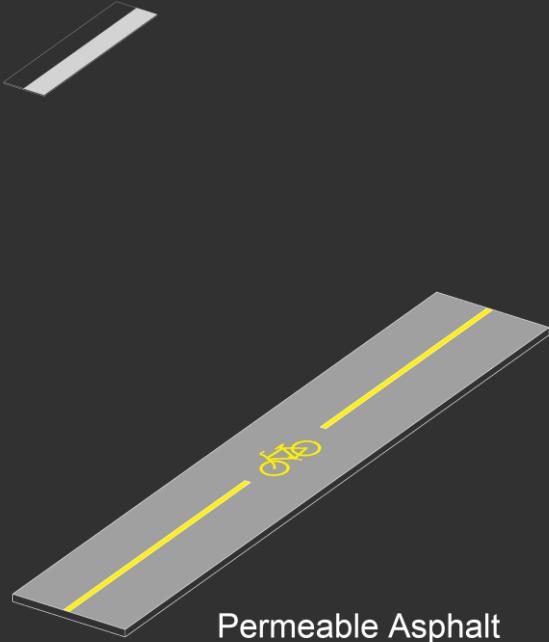


Sweet Osmanthus



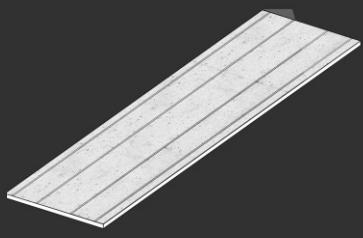
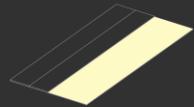
Bike Rental station

Zone 2: Bicycle Path

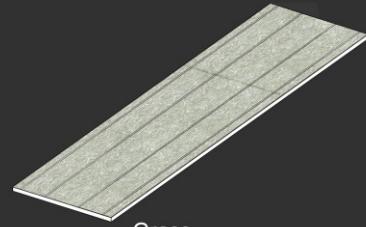


Permeable Asphalt

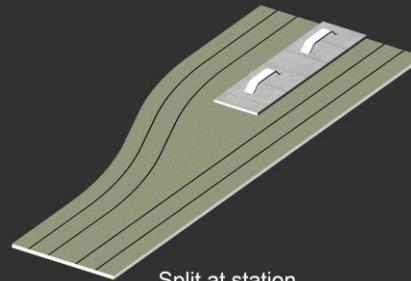
Zone 3: Rail Bed



3000psi Concrete

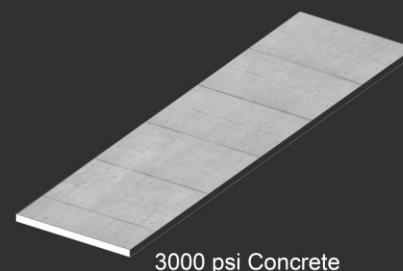
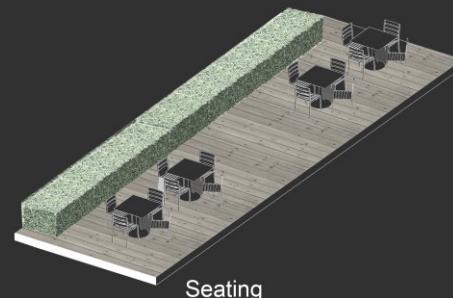
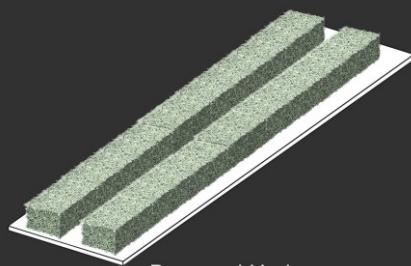
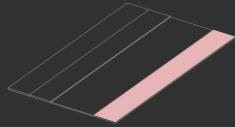


Grass

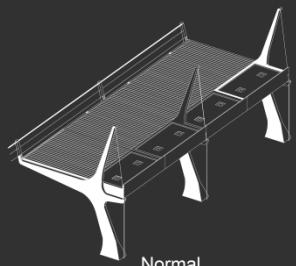
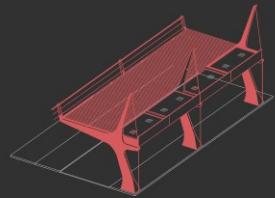


Split at station

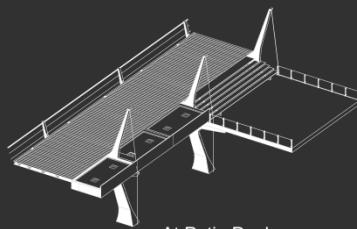
Zone 4: Secondary Planting Strip



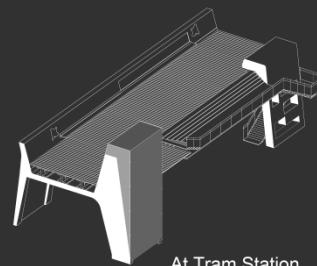
Zone 5: Elevated Bridge



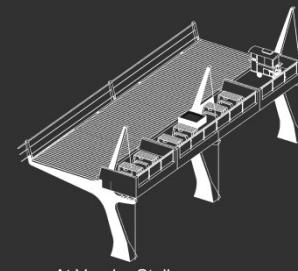
Normal



At Patio Deck

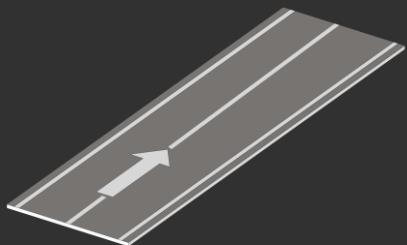
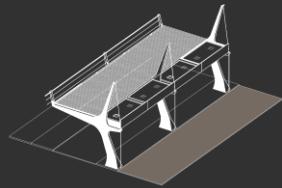


At Tram Station

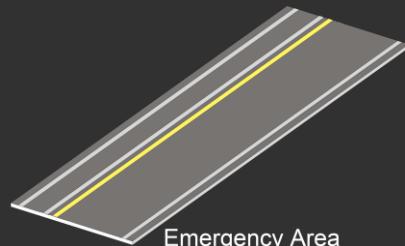


At Vendor Stalls

Zone 6: Service Road



One Way Two Lane

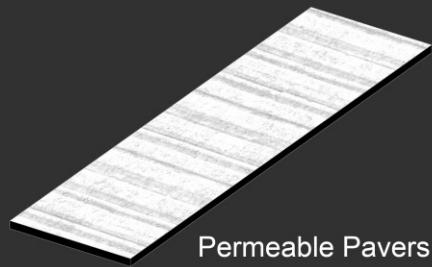
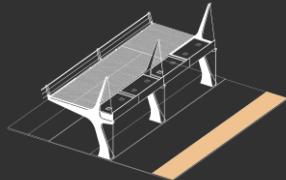


Emergency Area

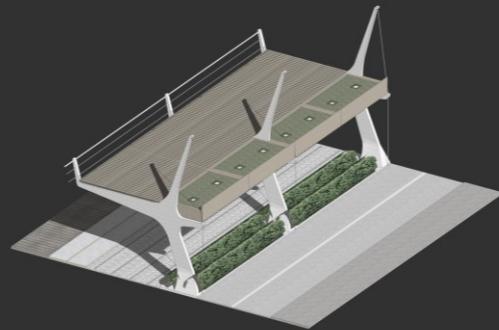
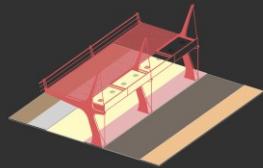


crosswalks

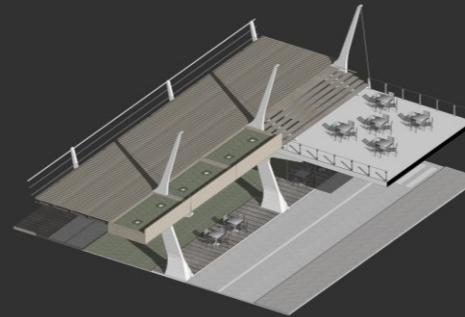
Zone 7: Sidewalk



Combinations and Permutations



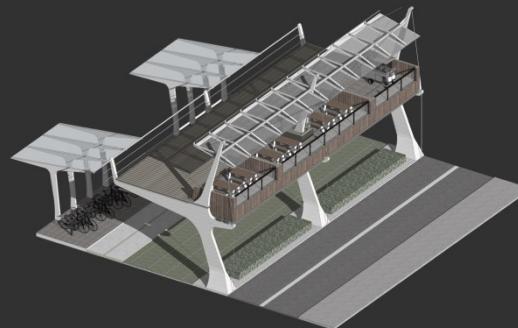
Variation 1



variation 2



Variation 3



variation 4

Primary Parts (see D-10)

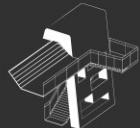
- A. Stairs, on concrete pylon
- B. Elevator at tram stop
- C. Inter-changeable planting pot (see D-12)
- D. Solar skylight
- E. Decking connecting to adjacent commercial building
- F. Elevated walkway decking
- G. Elevated walkway concrete/tensile support
- H. Opposite side elevated walkway railing
- I. Concrete pylon, station screen sign and display
- J. Bench/public seating
- K. Electric /solar run hybrid tram train
- L. Vendor stalls on bridge
- M. Bike rental unit

Secondary parts (see D-11)

- A. Observation deck
- B. Urban mark fountain
- C. Tourist utility / other restaurant pavilion
- D. Lower deck
- E. Under existing highway green wall
- F. Crossing over canal tensile bridge
- G. Under existing highway bridge system
- H. Main road middle block
- I. Main road middle block with Subway Entrance
- J. Skylight tunnel path system
- K. Lighting fixture
- L. Food cart

PRIMARY PARTS

A



STAIRS, ON CONCRETE PYLON, SEE DETAIL 001

B



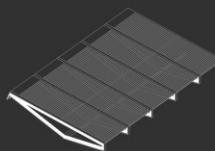
ELEVATOR AT TRAM STOP, SEE DETAIL 002

C



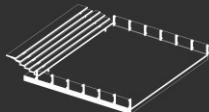
INTER- CHANGEABLE PLANTING POT, SEE DETAIL 003

D



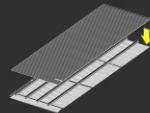
SOLAR SKYLIGHT, SEE DETAIL 004

E



DECKING CONNECTING TO SIDE COMMERCIAL BUILDING

F



ELEVATED WALKWAY DECKING

G



ELEVATED WALKWAY CONCRETE / TENSILE SUPPORT

H



OPPOSITE SIDE ELEVATED WALKWAY RAILING

I



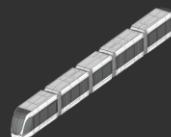
CONCRETE PYLON, STATION SCREEN SIGN AND DISPLAY

J



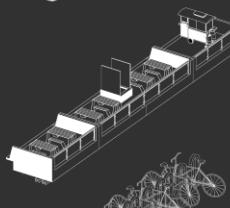
BENCH / PUBLIC SEATING

K



ELECTRIC / SOLAR RUN HYBRID TRAM TRAIN

L



VENDOR STALLS ON BRIDGE

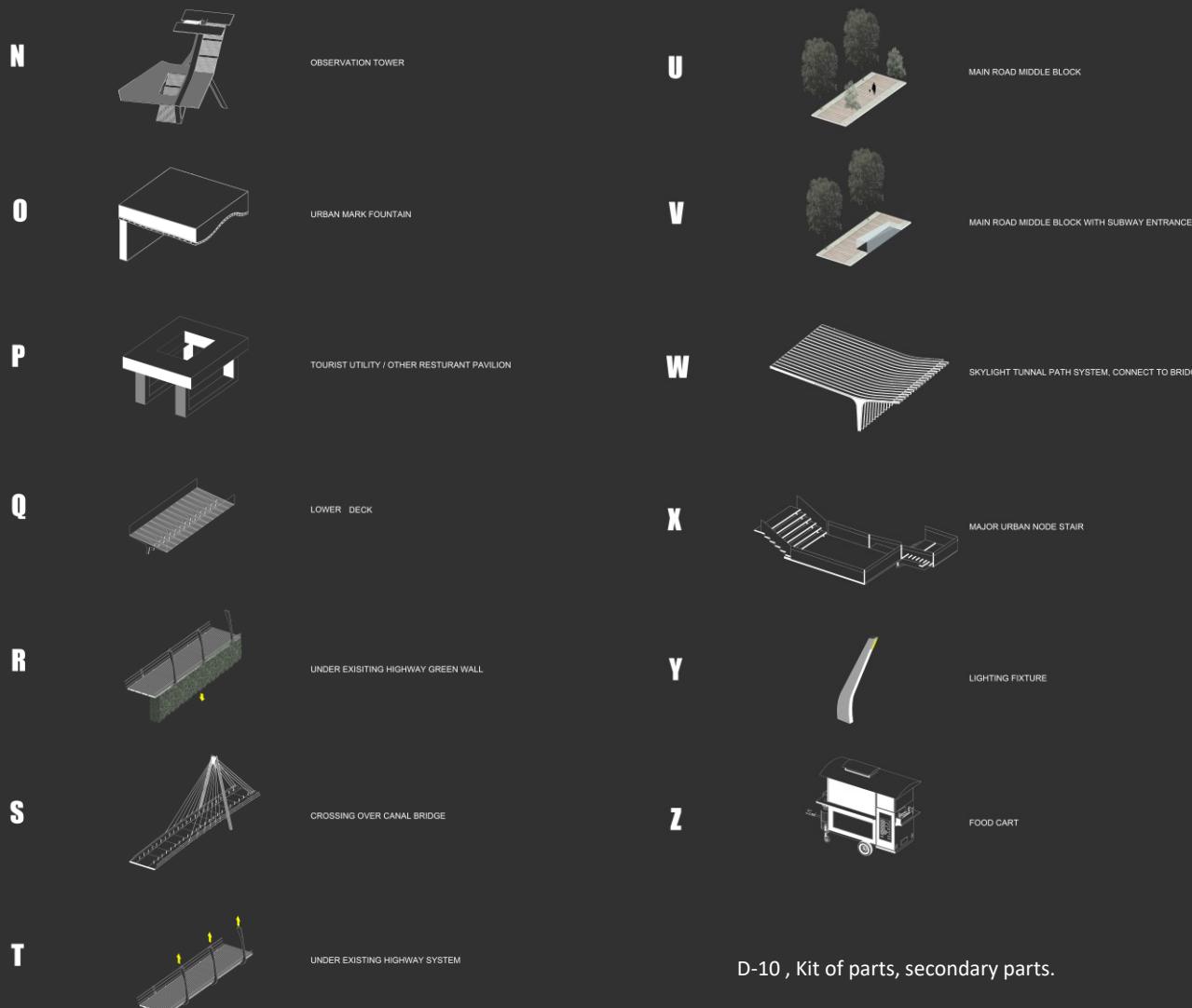
M



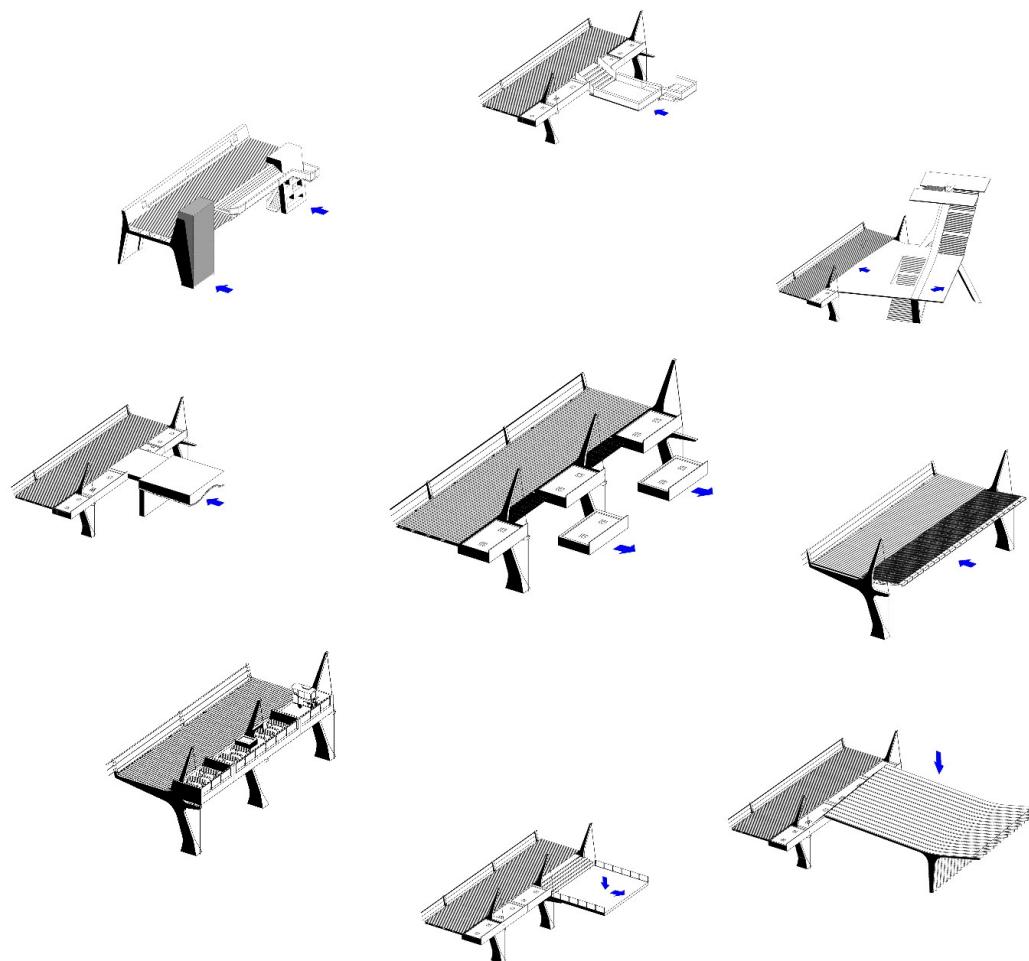
BIKE RENTAL UNIT

D-9 , Kit of parts, primary parts

SECONDARY PARTS



D-10 , Kit of parts, secondary parts.



D-11 , Diagram of inter-changeable parts

Adaptability at the Urban Scale

Depending on its location within the city, components can be selected individually or in groups to adapt the *yao dai* to the adjacent fabric. Although no two points in the city are identical, the system will need to respond to several basic urban conditions in central Hangzhou. These include:

Condition 00: The so-called "generic" or "mid-block" condition (1/2 block in from a commercial street; forming a boundary between commercial and residential areas of the city)

A. typical condition

- Elevated walkway remains disconnected from commercial buildings; planters are used along the edge adjacent to the service road
- Elevated walkway connects to the 2nd level of adjacent commercial buildings; planters are replaced with a bridging element

B. atypical conditions

- where it intersects a cross street (elevated walkway must bridge over street)
- at a tramway stop (platform, seating, signage, vertical transportation, etc.)

Condition 01: Along a main road (e.g., Yan'an Rd.)

- A. mid-block
- B. at an intersection
- C. where it connects with a Metro station

Condition 02: Where the *yao dai* crosses over small waterways (low bridge)

Condition 03: Where it crosses the Grand Canal (suspension bridge, 7m above canal allowing boats to pass freely, also provide observation opportunities)

Condition 04: Where it crosses over and under highways (vertical green walls reduce car emissions from highway, provide extra oxygen).



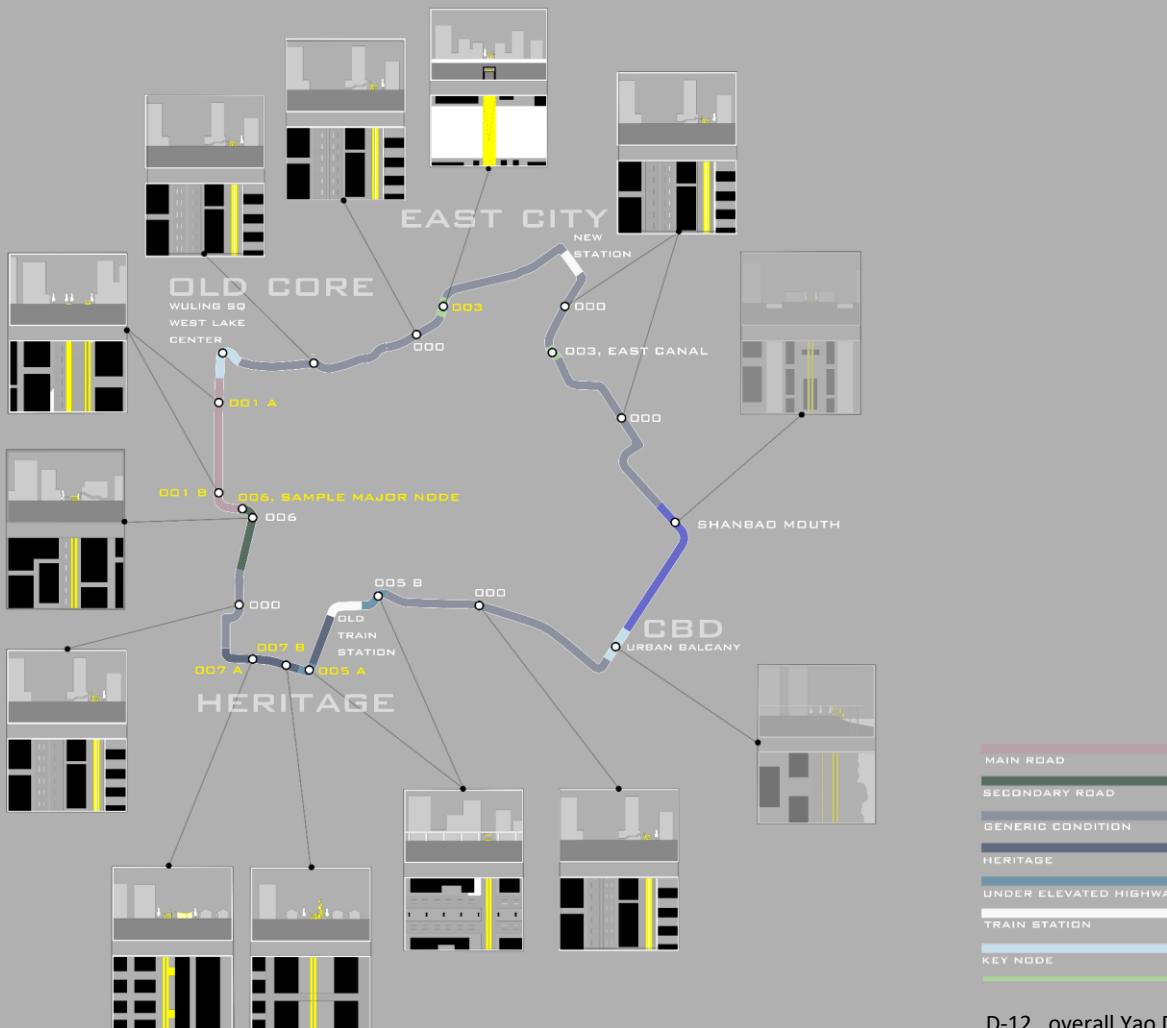
Condition 05: Along secondary roads (food carts and kiosks – to better accommodate and regulate street-food vendors; to improve access for potential customers)

Condition 06: Key urban nodes (plazas, major intersections, transit stop, landmarks, etc.)

Condition 08: Through designated heritage districts.

As detailed design of the entire system was well beyond the scope of this thesis, design efforts were focused on the “generic” condition (condition 01). I’ve identified this as the primary design. That said, decisions made with respect to the “generic” condition were tested elsewhere to assess their adaptability. To this end basic designs were also undertaken for each of the conditions identified above, including Yan'an Road (condition 02), crossing a canal in the Donghe District (condition 03), Daguan Bridge (condition 04), Desheng Bridge (condition 05), Huansha Road (condition 06), a major transit stop (condition 07) as well as a proposal for Qinghefang heritage district (condition 08). I’ve identified these as secondary designs.





D-12 , overall Yao Dai route diagram with different urban conditions

Primary Design:

Condition 00: the Generic Condition

The Seven-Zone System

Along most of its route, the *yao dai* consists of a pedestrian route elevated above an on-grade tramline. In most cases, it runs a half-block in from major streets, just behind the commercial buildings that face onto these streets. As such, the *yao dai* creates a buffer – in the form of a linear park -- between the city's busy commercial arteries and the more private residential fabric behind it. Rather than adapting to the existing fabric, the generic condition applies to areas of the city that are likely to redevelop. As such, these are areas where the city is most likely to adapt to the *yao dai*, i.e., where the tramline promenade is best poised to act as a catalyst and armature for urban redevelopment.

For the purposes of the design exploration, the generic condition was used to formulate the basic configuration and components for the *yao dai* – the blank canvas on which adaptations and modification would be made.

As identified above, the *yao dai* is comprised of contain seven key components. These are divided among seven zones: five horizontally and two vertically.

1. A screen of tall trees adjacent to the residential fabric. These are intended not only to act as a screen and a buffer between the *yao dai* and the residential buildings along it, but to provide shade for the elevated pedestrian walkway.
2. Multi-use bicycle path between the green buffer and the tramway tracks.
3. Tracks for the tramline (two sets of tracks). At stops, the tracks are divided around platforms.
4. Secondary planting strip. This is also the zone into which the support piers are placed. As this is partly covered by the elevated walkway, planting in this zone would take the form of lower shrubs and boxwood hedges. Adjacent to transit stops this zone is also used for vertical transportation (elevators and stairs to access the walkway above).
5. Elevated pedestrian walkway (above zones 3 and 4).
6. Service road
7. Sidewalks separating the service road from the rear of commercial buildings.

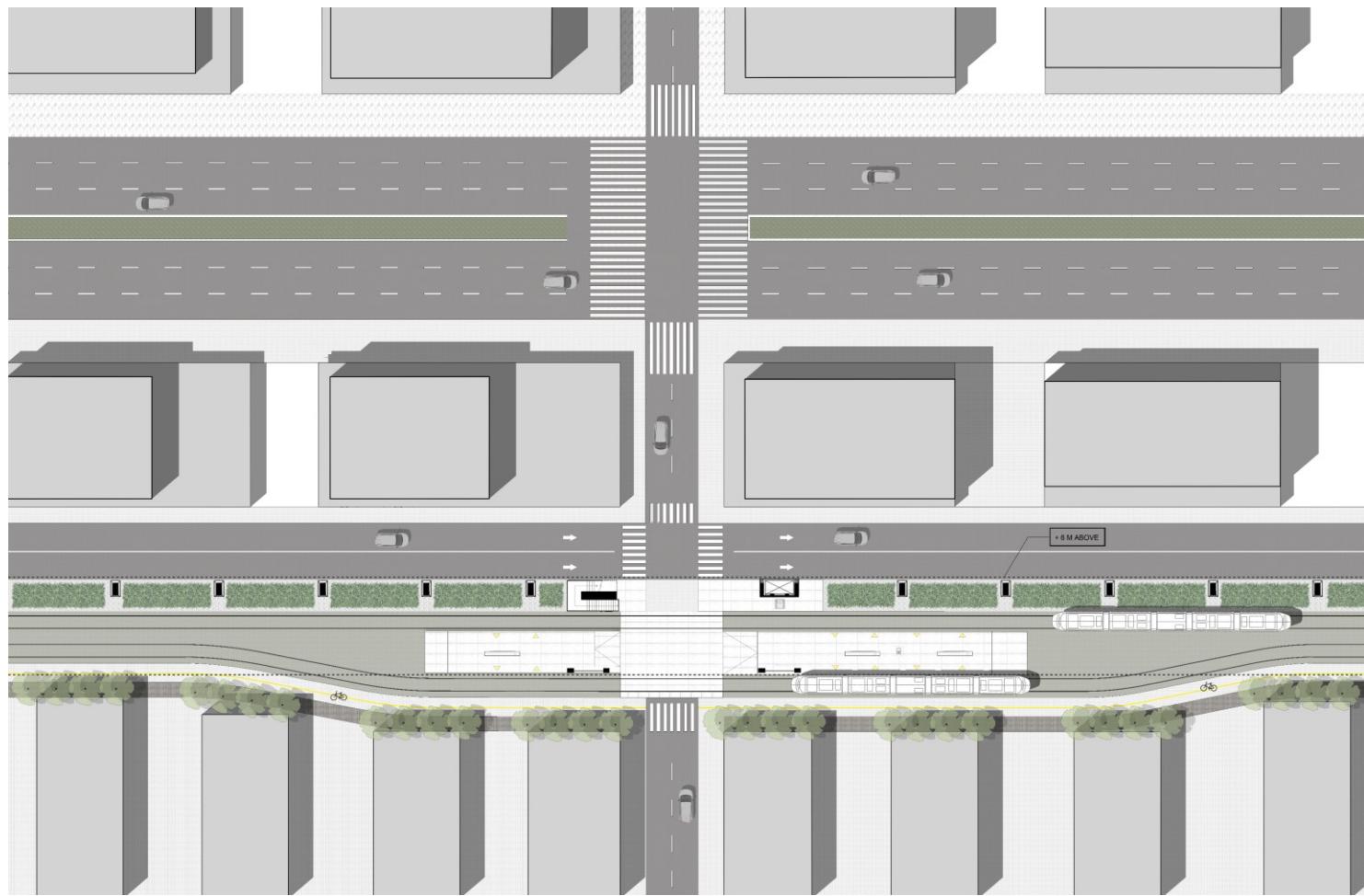
Within the larger “generic” conditions, there are four possible variations. The first variation is the most basic. It exists mid-block and between tram stations. The second variation occurs where the elevated walkway decks over the service road to connect to the rear of the commercial buildings that face on to the arterial street beyond. Variation 3 occurs where the *yao dai* crosses a secondary road. Tram stops occur at some of these crossings and vertical transportation is added to provide access to and from the elevated walkway. At tram stations a central waiting platform is inserted between the tracks. Variation 4 occurs where the elevated walkway is adjusted to accommodate food vendors and a bike rental station is introduced along the cycle path.



Inserting the *yao dai* into the fabric a half a block in from arterial streets enables it to operate on what is, in effect, a dedicated right of way. Stop signs for cars at all cross streets will obviate the need for trams to stop at intersections, which they would be required do along arterial streets. This augments the efficiency of the system without having to resort to elevating (or burying) the trains. The on-grade tram is also easier to access and less expensive to construct and maintain than an elevated line. Moreover, it's much more pleasant to walk along a path above a tramline than to walk below an elevated line.

At grade the 6-meter-wide tramline is flanked on either side by the bike path and service road. Service roads, in the form of mid-block laneways, are unusual within the fabric of Hangzhou and will open up new possibilities for commercial activity as well as providing much-needed service access to the buildings backing on to it. Supports for the elevated walkway occur in the secondary planting strip that separates this service road from the tracks. These supports are generally canted, curved concrete piers with wider bases anchored into ground. They penetrate the elevated walkway about 1/3 of the way in and function as light standards.





D-13 , Condition 00: Generic Condition overall site plan



D-14 , typical Yao Dai bridge plan through core part of Hangzhou

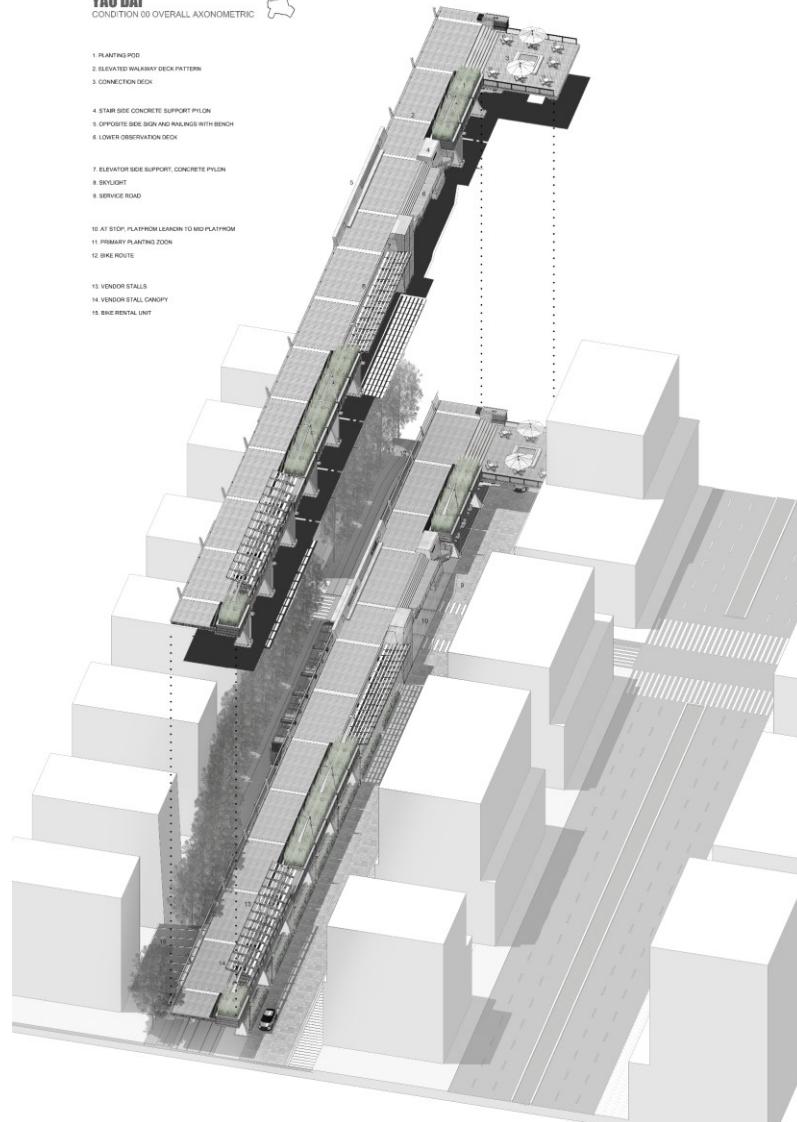


D-15 , Condition 00: Generic Condition, artifact drawing, plan

YAO DAI
CONDITION 00 OVERALL AXONOMETRIC



- 1. PLANTING POD
- 2. ELEVATED WALKWAY DECK PATTERN
- 3. CONNECTION DECK
- 4. STAIR SIDE CONCRETE SUPPORT PYLON
- 5. OPPOSITE SIDE SIGN AND RAILINGS WITH BENCH
- 6. LOWER OBSERVATION DECK
- 7. ELEVATOR SIDE SUPPORT CONCRETE PYLON
- 8. SKYLIGHT
- 9. SERVICE ROAD
- 10. AT STOP: PLATFROM LEANIN TO MID PLATFROM
- 11. PRIMARY PLANTING ZONE
- 12. BIKE ROUTE
- 13. VENDOR STALLS
- 14. VENDOR STALL CANOPY
- 15. BIKE RENTAL UNIT



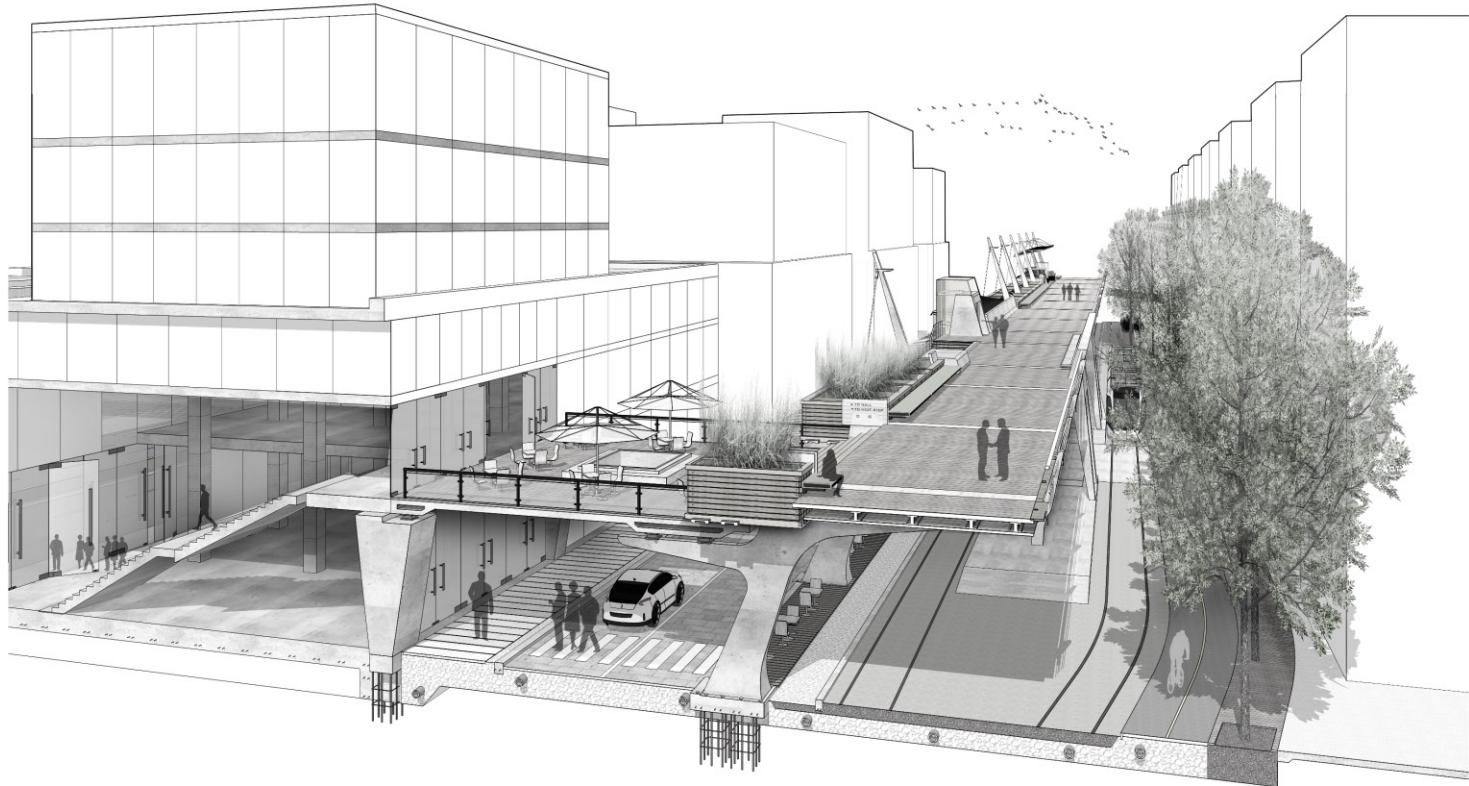
D-16 , Condition 00: Generic Condition axon

Variation 2: connections between the elevated walkway and the commercial buildings

As noted, the elevated walkway offers not only an efficient and extremely pleasant way to move through the city on foot, but offers opportunities to connect to adjacent commercial buildings at the second level. Such connections – which deck over the service road below – could accommodate café seating and other outdoor activities that may be difficult to integrate along the sidewalks of arterials like Yan'an Rd. As such the *yao dai* could foster a second level of commercial in the buildings along routes like Yan'an Rd — which would be difficult to support otherwise. Lower intensity commercial activities may also occur at grade, along the service road, similar to those associated with Melbourne's alleyways.

Where connections to adjacent buildings are made, planter boxes are swapped out for bridging elements. Vertical connections to these bridge decks (and the elevated walkway) can be made through the commercial buildings, connecting directly to the sidewalks along the arterial roads. Such connections would be in addition to stairs and elevators provided at tram stops (see below).

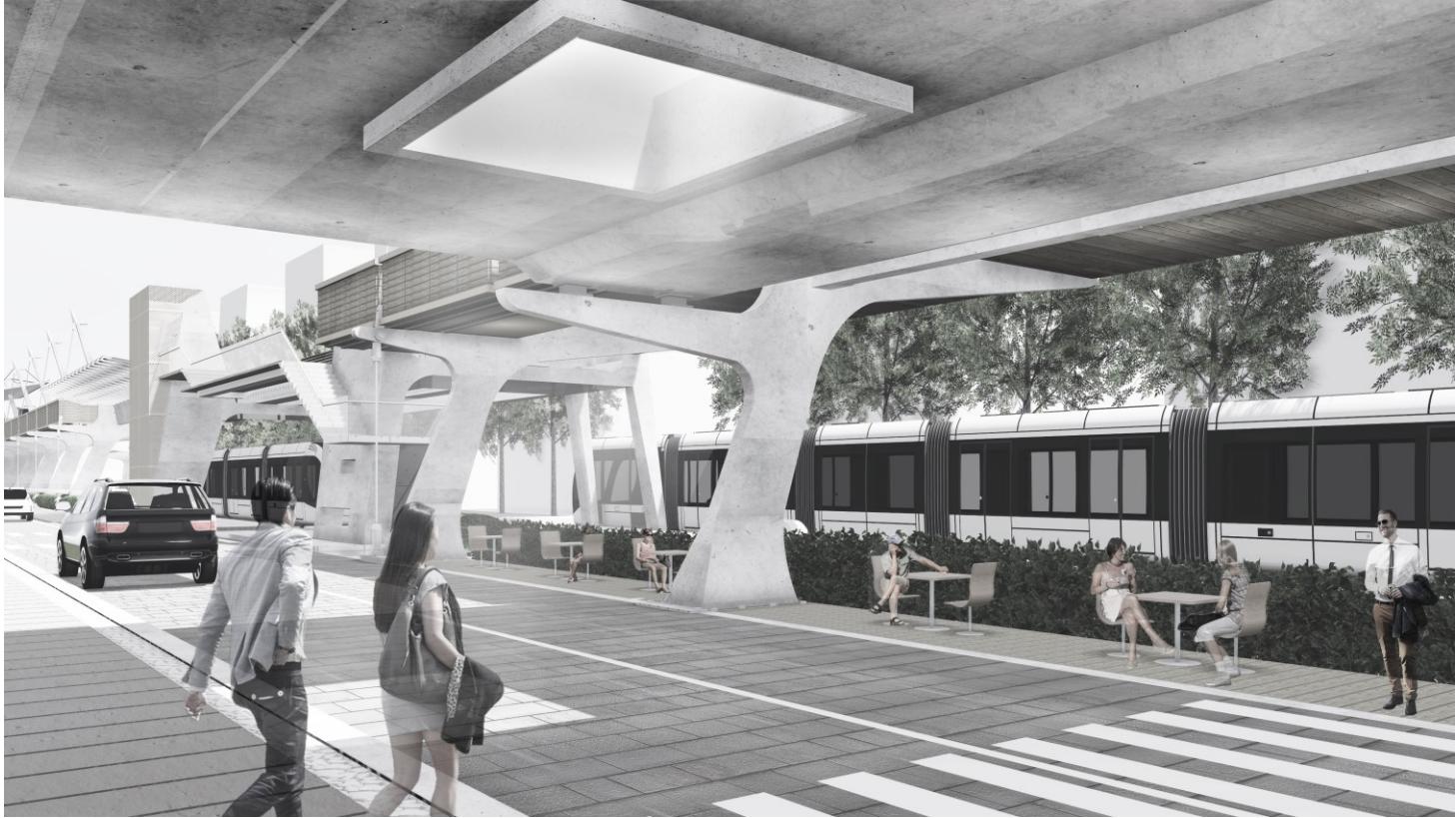




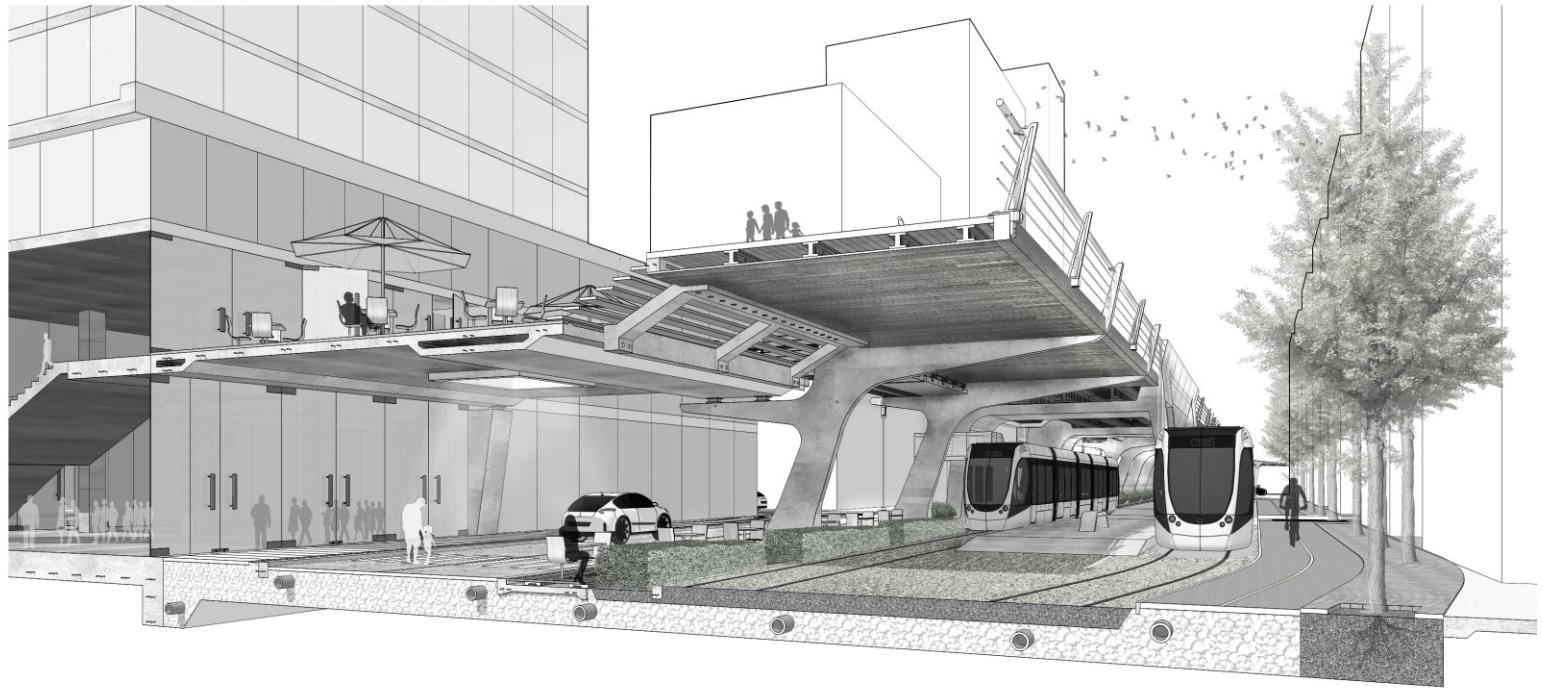
BIRDSEYE PERSPECTIVE

CONDITION 00, VARIATION THREE, ABOVE CONNECTION DECK

D-17 , Condition 00: Generic Condition, sectional Birdseye artifact drawing , at variation 2



D-18 , Condition 00: Generic Condition, render 001, at variation 2



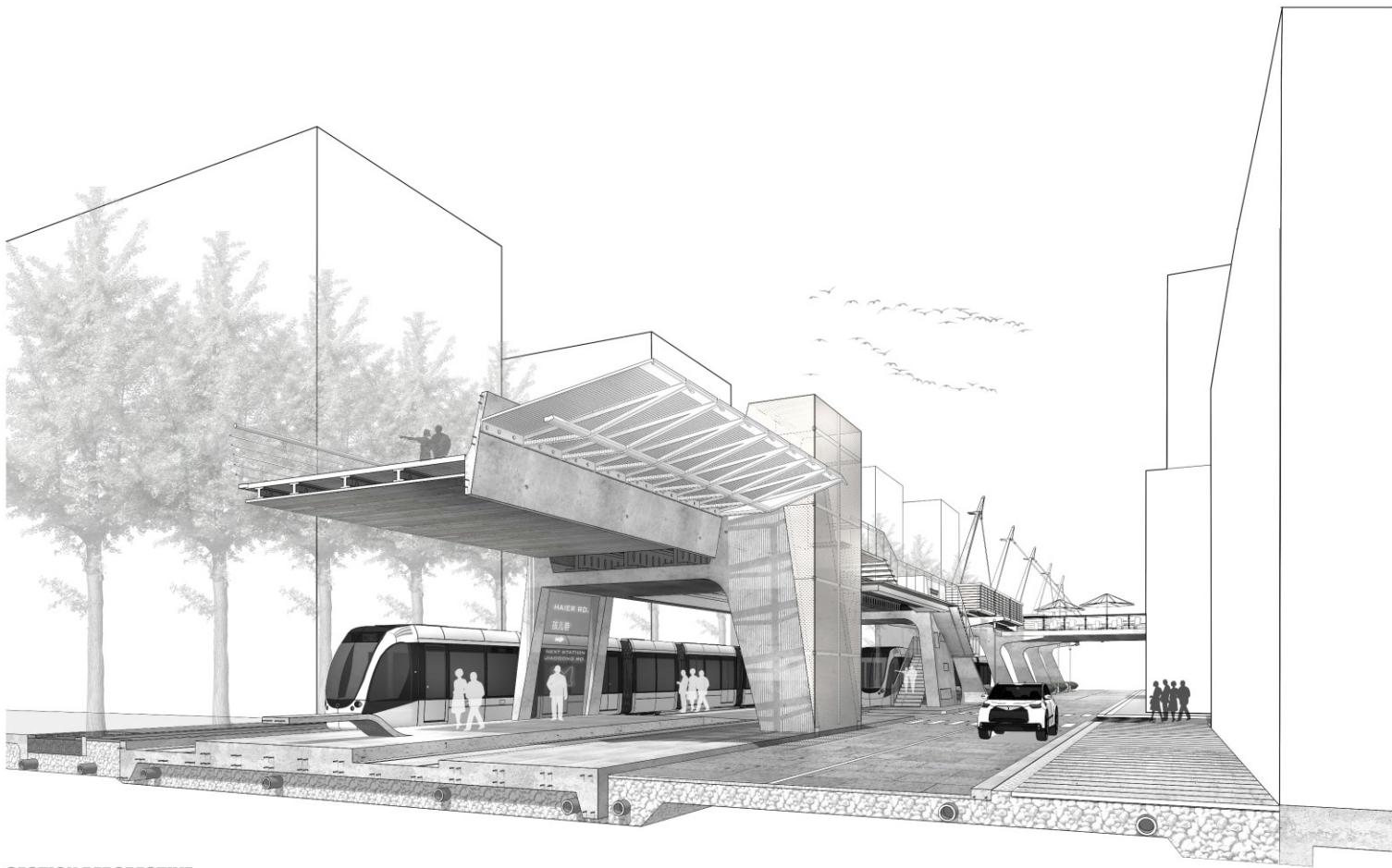
D-19 , Condition 00: Generic Condition, sectional perspective artifact drawing, at variation 2



D-20 , Condition 00: Generic Condition, render 002, at variation 2

Variation 3: tram stations at street crossings

The elevated walkway is accessed at regular intervals by stairs and elevators, which slot into the zone typically occupied by the planter boxes (and the secondary planning strip below). Vertical circulation is provided at all tram stops, which typically occur at intersections. Here the elevator and stairs are located on either side of the cross street, and are integrated into the heavier supports required to span across the road. Above the cross street 5 to 10 meters of planters are removed to make way for signage and a viewing platform, which is integrated into a landing for the stairs. Envisioned an urban landmark, the elevator is encased with perforated metal set into a concrete pier. The tram platform is located between tracks, which divide around it as they approach the intersection.



SECTION PERSPECTIVE
CONDITION 00, VARIATION ONE, AT TRAM STOP

D-21 , Condition 00: Generic Condition, sectional perspective artifact drawing, at variation 3



D-22 , Condition 00: Generic Condition, Birdseye perspective render, at variation 3



D-23, Condition 00: Generic Condition, render 003, at variation 3



D-24 , Condition 00: Generic Condition, render 004, at variation 3

Variation 4: cycle path, bike rental and food vendors above

The concrete supports described above include an arm that supports the planting boxes. As noted, these boxes can be replaced with platforms and a canopy to accommodates stalls for food vendors. Street food, especially “Pianer Chuan” noodles, is extremely popular among Hangzhou residents. This presents challenges, however, as vendors clog sidewalks and block traffic. Designing the *yao dai* to accommodate street food vendors could be a boon for both the city and the *yao dai*.

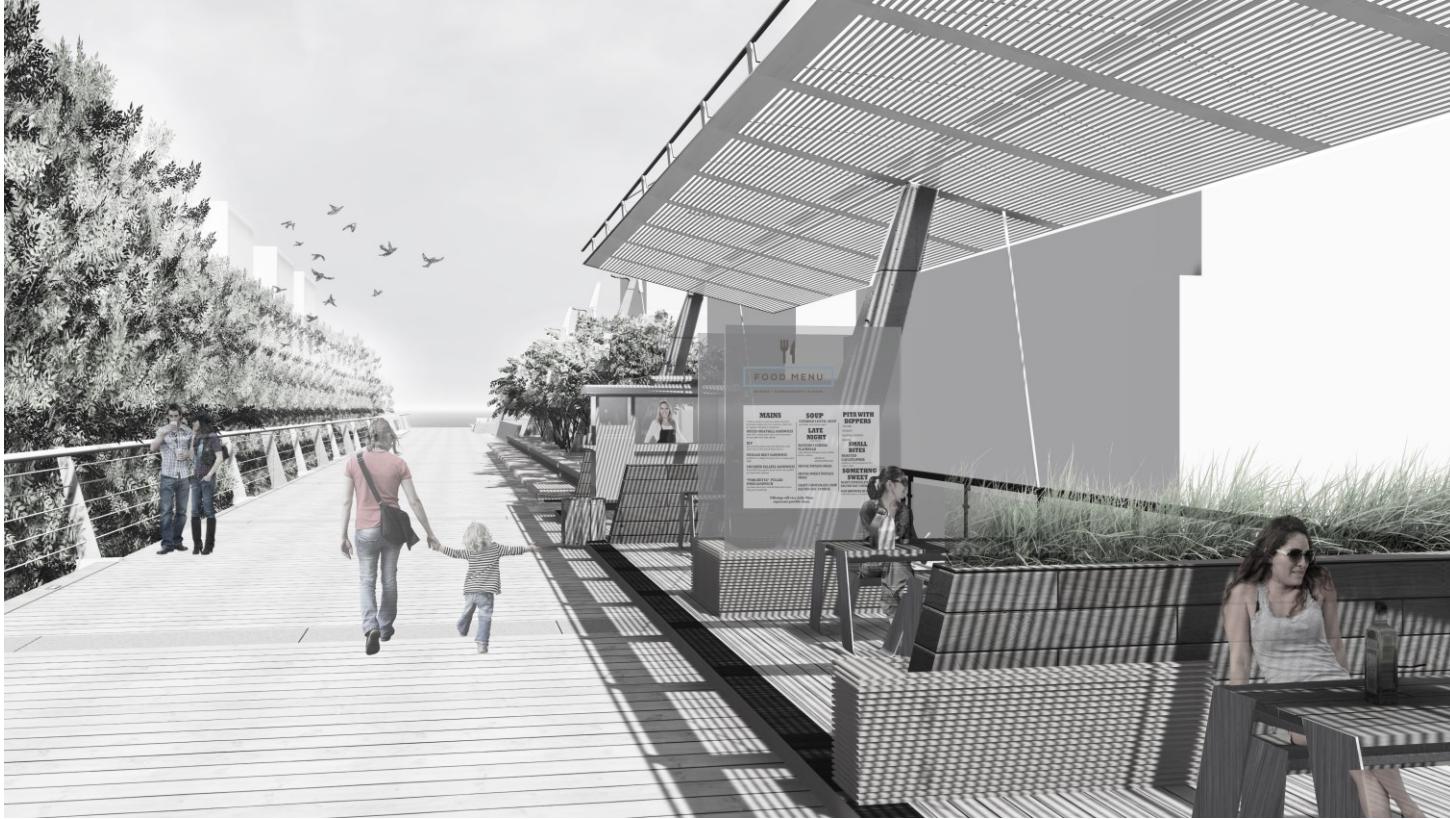
The so-called primary planting strip on the opposite side of the tramline accommodates a continuous row of trees, planted 6 meters apart. These trees provide a continuous wall of green, buffering the adjacent residential buildings from the *yao dai* and shading the elevated walkway. At regular intervals (e.g., at alternating cross streets and at tram stops) the area between the trees would be used for bike rental stations.



D-25 , Condition 00: Generic Condition, render 001, at variation 4



D-26, Condition 00: Generic Condition, Birdseye drawing, at variation 4



D-27 , Condition 00: Generic Condition, rendering 005, at variation 4



D-28 , Condition 00: Generic Condition, rendering 006, at variation 4

Impact

Generally, the generic condition – where the *yao dai* passes between commercial buildings and areas of *danwei* housing awaiting redevelopment -- formed the basis for decisions regarding the design of the system. The mid-block location accommodates the addition of urban amenities and activities without adding unnecessary density to main roads. Design properly, it can both buffers and connect residential areas with the city's commercial arteries, improving the urban experience for residents and visitors alike. (see D-28 B,C)



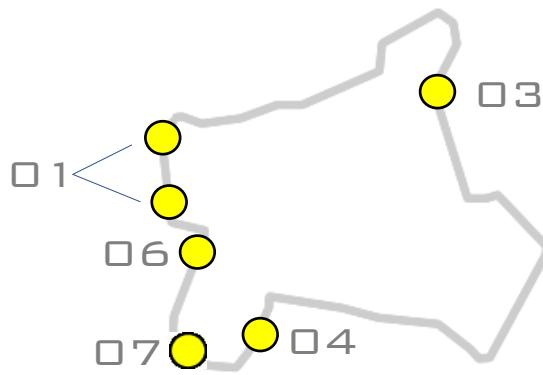
D-28 B, condition 00 Generic condition, theme drawing 01, life on bridge



D-28C, condition 00 Generic condition, theme drawing 02, life at sidewalk and service road

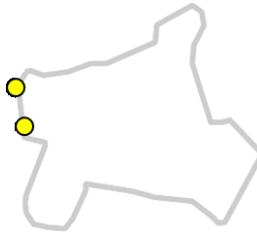
Secondary Design:

testing assumptions against specific locations in the city



● Conditions that are picked for actual design testing

D-29 LOCATION DIAGRAM



These include the Zhejiang People's Provincial Great Hall, the Hangzhou Culture Center, the Victory Theatre, the International Mansion, the Hangzhou Department Store, the Hangzhou Grand Hotel, and the Haifeng Western Restaurant. Numerous shopping malls are also located along this street, including Hangzhou Tower Shopping City, Intime Department Store, Hangzhou Department Store, GDA Plaza, Zhongyin Mall, Jie Bai Mall, Lixing Plaza, Yuanhua Shopping Mall, Carrefour Supermarket.

01. Main Road Condition

At various points along its proposed route the *yao dai* travels directly down a major road. This is referred to as the Main Road Condition. Main roads in Hangzhou are commercial corridors through shopping districts, which also support restaurants, bars and nightlife. A prime example, Yan'an Rd., is six lanes wide and bordered with 10-m wide sidewalks serving numerous “significant commercial and cultural buildings.”²⁷ The traffic lanes, three in each direction, are separated by a median planted with trees.

The challenge of accommodating the *yao dai* along established routes like Yan'an Rd. is to respect the particular characteristics of the existing fabric while preserving the integrity and legibility of the *yao dai*. Rather than elevating the pedestrian walkway above the tramline, the walkway moves to the central median, to which a second row of trees is added to create an allée. Seating and lighting -- similar to those found elsewhere along the elevated walkway – are provided along the length of this allée. The tramline operates along six-meter-wide path on one side of the road, accommodating trams in both directions. Between stops this area is planted with sun-tolerant grass to create a green carpet through the city. This is similar to portions of the T3 in Paris.





Where metro stops occur along the Main Road, stairs and/or escalators would need to be provided to connect the walkway to underground stations. When this occurs at a major intersection (e.g., the Feng Qi Rd. stop along Yan'an Rd.), stairs could also connect the median walkway with the sky bridge that connects four corners. To ensure the overall continuity of the *yao dai*, existing sky bridges could be redesigned to incorporate elements from the kit of parts.





D-30, Condition 01: Main road Condition sectional perspective drawing



D-31, Condition 01: Main road condition, perspective render



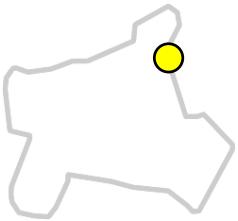
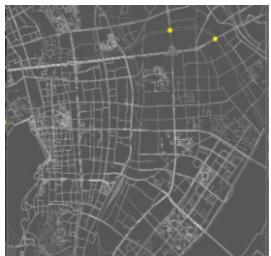
D-32, Condition 01: Main Road Condition, Birdseye view at intercross, image comparison, before below and after above.

02. Crossing Over Small Waterways

The relationship between tramline and the pedestrian walkway will also require additional consideration at other points along its route. At various points the *yao dai* meets small waterways that drain into the Grand Canal. These canals are typically surrounded by heavily vegetated areas that function as oases and greenbelts through busy urban areas. Donghe Village, located 500 meters north of the Qinghefang Heritage Area and surrounded by a cluster of ancient trees, is a typical example of what happens along small canals. Families with children come to these areas to feed the fish and other weekend activities; senior citizens use them on a regular basis for exercise and socializing.

The *yao dai* must enhance, rather than impose itself on, these beautiful urban oases. To this end the tramline is separated from the pedestrian path, both travelling on small streets that run perpendicular to the canal. Separate bridges are made for the two, both in keeping with the design character of the “generic” condition. Along the pedestrian bridge the planter boxes have removed to make way for a lowered platform from which children can feed fish.

As a network of small waterways permeates central Hangzhou, the *yao dai* cannot avoid them. All aspects of the *yao dai* should be designed to enhance the character and support the activities that occur along these historic canals.



03. Crossing the Grand Canal

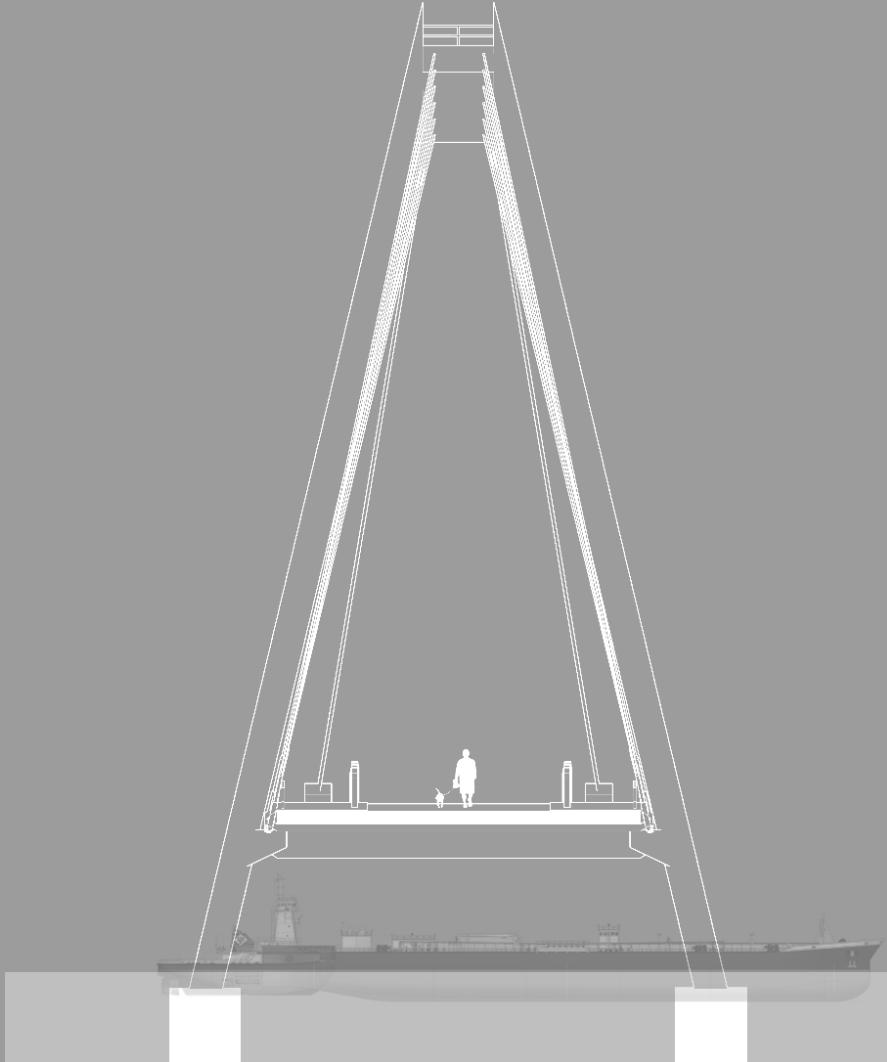
As the *yao dai* is intended to connect with Westlake Center and the East Train Station, it will need to cross the Grand Canal at several points. Because the canal is used by tourist boats and small sailing craft, a minimum of 7m clearance is required. The design of these crossings must also capitalize on the great views of the city that are available from the canal and respect the many parks that run along its banks.

Because the parks along the canal already include pedestrian paths, the decision was made to keep the *yao dai* away (i.e., a block or more into the fabric) from the Grand Canal where it runs parallel to it. At crossings, the walkway and bike path would bridge over the canal while the tramline would tunnel under it. Constructed of concrete, the tunnel would run about 5 meters below the canal bed. As it transforms into a bridge, the elevated walkway would be supported by cables from a tall, angled concrete pier. On either side of the bridge, two grand landmark stairs replace the planter boxes, connecting the bridge with the parks along the banks of the canal. In addition to circulation, the stairs could act as observation platforms, vendor space, and grandstand seating for festivals in the park.

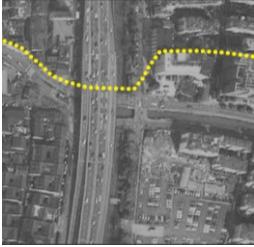




D-33, Condition 03: Crossing the Grand Canal, perspective render

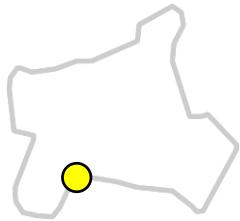


D-33, Condition 03: Crossing the Grand Canal, Tensile bridge section



04. Crossing under elevated highways

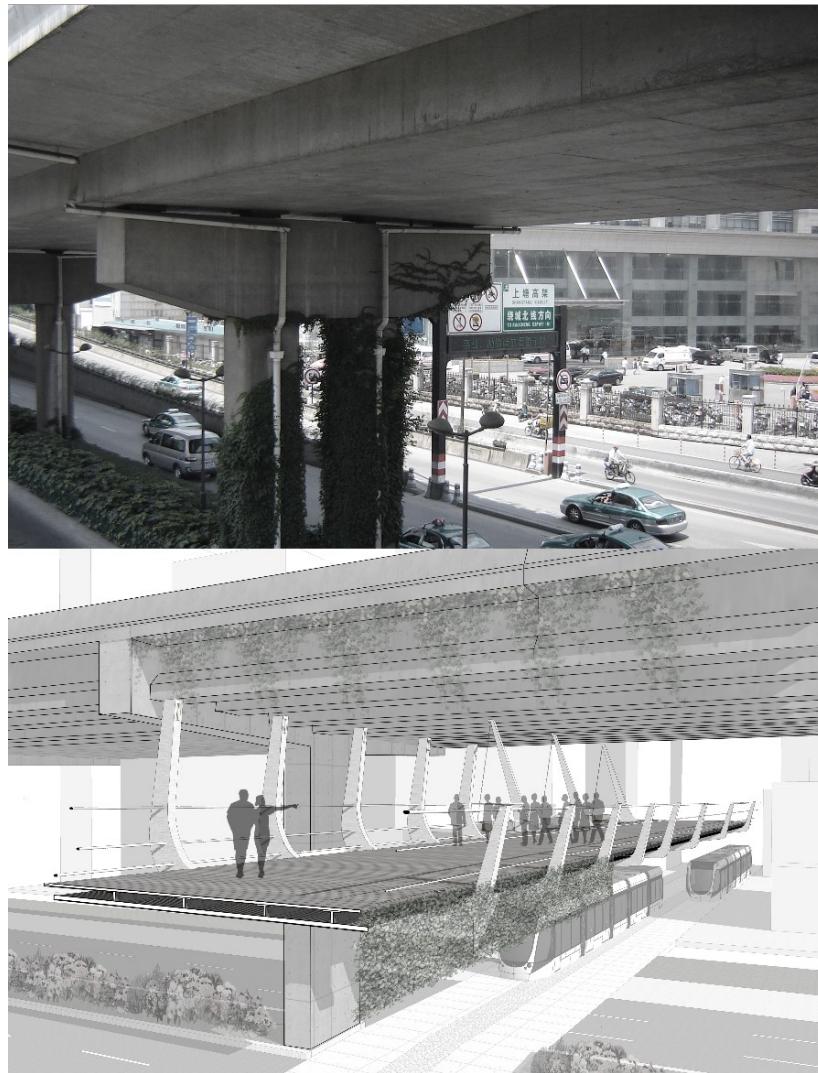
Several elevated expressways cut through central Hangzhou. Frequently located directly above surface streets, these limited-access roadways are accessed through a series of ramps. Grade-separated crossings allow motorized vehicles to move more fluidly than would otherwise be possible.



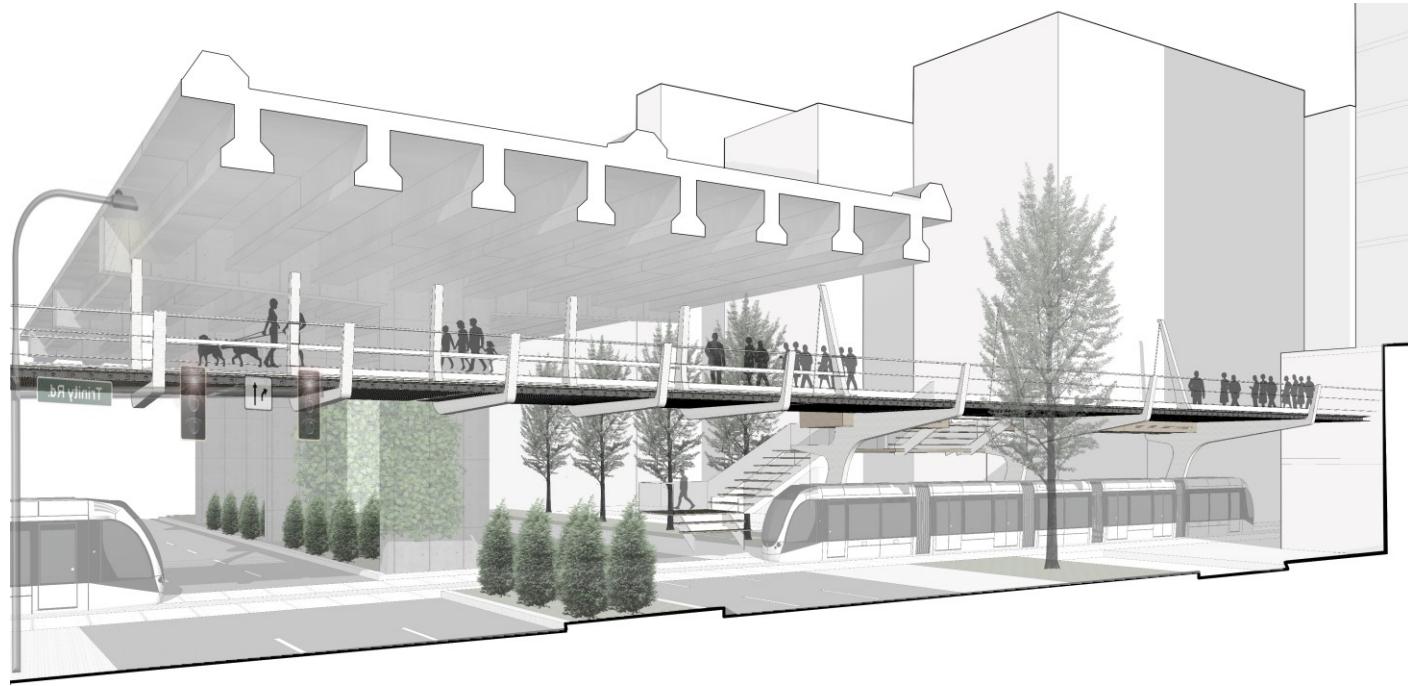
Running north/south through Hangzhou, the Desheng Elevated Highway is the city's major automobile route. It is elevated 10 meters above a parallel avenue. To accommodate traffic below, special tensile supports are used. These supports have been designed to incorporate planters every 5 meters. In addition, green walls run between the supports themselves, accommodating vegetation that would have difficulty surviving in shaded areas below. Receiving 6 or more hours of sunlight each day this green wall deploys emission-diffusing technology, and transforms the elevated highway into oasis through the city.

Building on this, the *yao dai* would incorporate a green wall into its supports where it crosses under the busy highway. It also provides green elements to the underside area of the elevated highway.





D-34, Condition 04: Crossing under elevated highway, before above and after below.



D-35, Condition 04: Crossing under elevated highway, perspective drawing

05. Along Secondary Roads

Making up 60% of Hangzhou's street grid, secondary roads are important to the city. Secondary roads typically consist of four car lanes (two in each direction) banded by 5-meter sidewalks, forming a quieter streetscape with retail, other commercial, and offices.

Daily life along most of these secondary roads of is similar: office workers purchase breakfast as they head to work in the morning, then re-emerge for lunch during the day. Various after-hours leisure options exist and shopping malls, bars and restaurants are in demand. At present, however, high densities contribute to chaotic traffic snarls during rush hours, both in streets and public spaces. Designed to take up the slack, the *yao dai* would help address crowding in these areas..

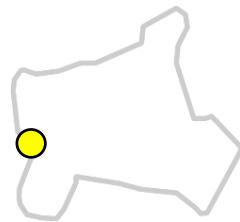
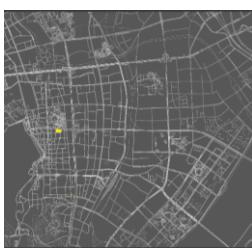
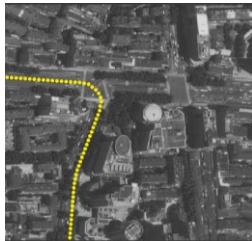
Huan Sha Rd., a typical secondary road in Hangzhou, contains office buildings, restaurants, bars and retail stores. The buildings along it consist primarily of "skirt buildings" -- or low, commercial plinths -- on top of which sit towers. As such, the "generic condition" of the *yao dai* could be modified to work with this condition.

Along secondary streets the *yao dai* maintains its typical configuration, with the pedestrian walkway above connecting to adjacent buildings at various locations. In other locations planter boxes could be swapped out for stalls to accommodate food vendors. Drawing on the "kit of parts" in this way would enable office workers to purchase food conveniently.



In addition, tramline access along secondary roads area would be convenient for several reasons. First, because the *yao dai* connects to residential areas, workers can commute more easily between home and office. Secondly, because many schools and other institutional buildings (hospitals, clinics, etc.) are located along secondary roads, access can be challenging for seniors and children due to congestion. Studies have shown that long elevator waits and slow traffic to school is a daily reality. City wide, area, it takes children an average of 45 minutes to get to school in Hangzhou. New transit and cycle infrastructure at grade, coupled with an elevated walkway, would address traffic issues – especially when it is set back from the road.





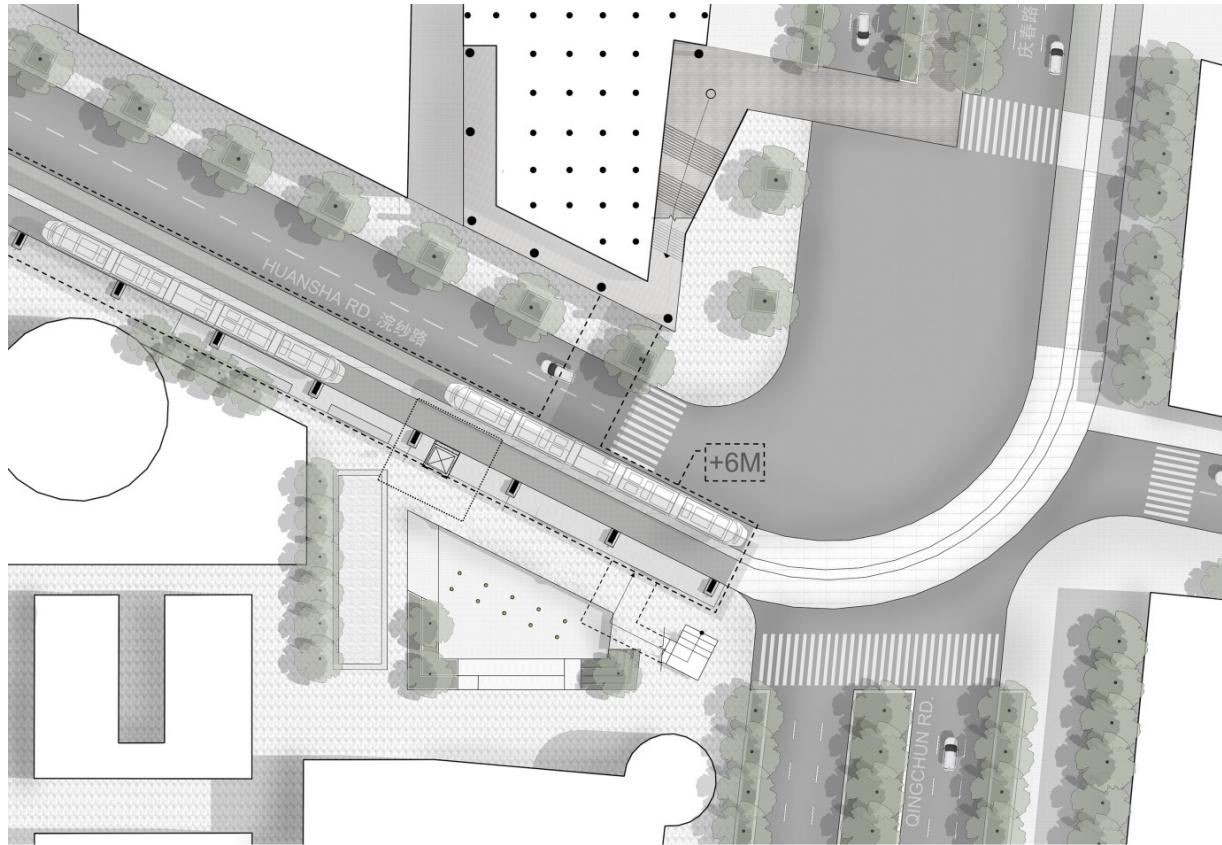
06. Key Nodes

If transit lines and roadways lines are the veins and arteries of a city, major nodes are the organs. As a major new artery, the *yao dai* would contribute to the health and vitality of the city. Key to the *yao dai*'s success are the major nodes that it connects. Since these nodes usually coincide with significant plazas and intersections, the challenge of the Key Node Condition would be integrate the *yao dai* into the existing spaces rather than having to completely re-design them. That said, some of the nodes could use some additional design consideration for which the *yao dai* could be the catalyst.

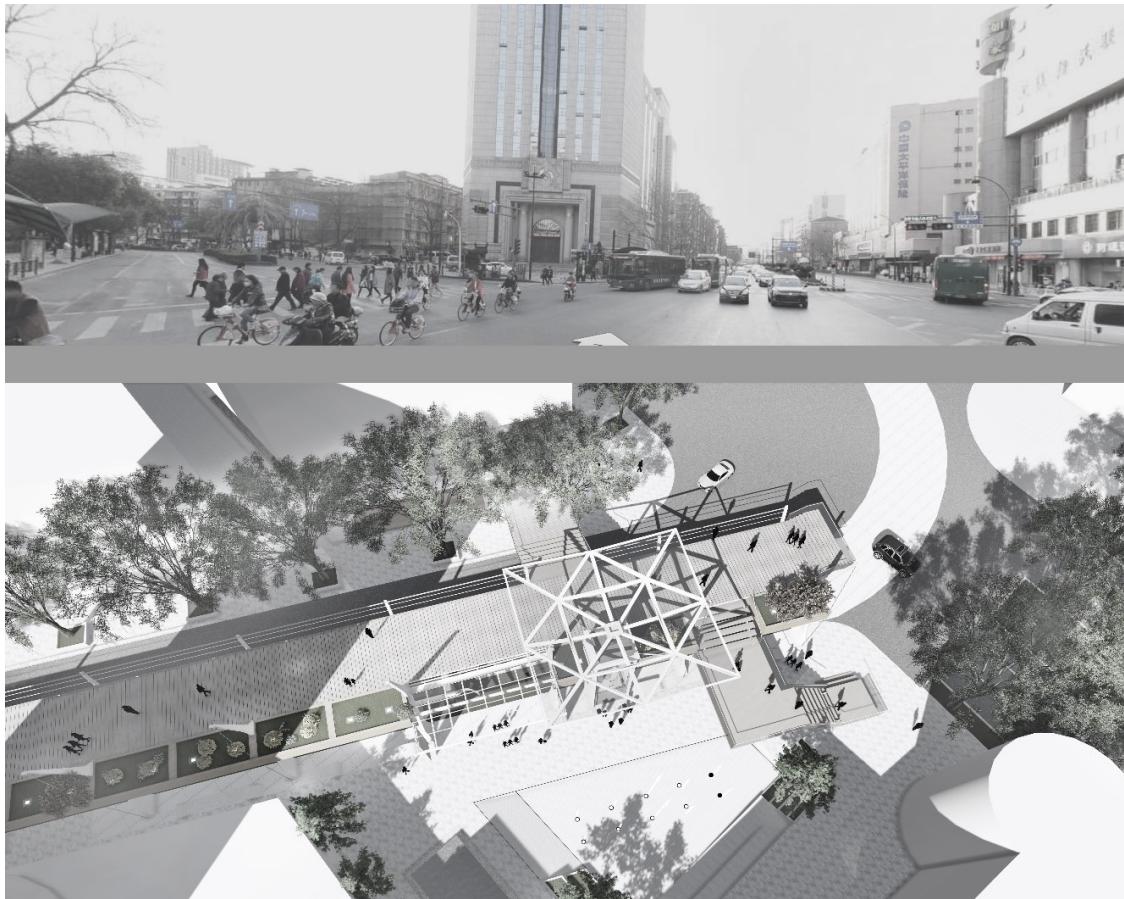
At the southeast corner of Qingchun and Huan Sha Roads, the Huansha Plaza includes a grand water fountain and is surrounded by bank towers and other high rises. It is a highly condensed urban center with significant urban elements. As such, the *yao dai* would incorporate a tram stop at this location as well as a major access point for the elevated walkway.

The generic configuration would work well with a few modifications. The planter boxes between the support columns along the side of the plaza have been swapped out for an elevator and grand stair. These vertical elements, which connect the plaza with the elevated walkway, add another dimension to the plaza. The elevator itself would be a landmark, with a cantilevered canopy that marks a significant bend in the *yao dai*.

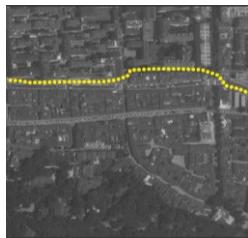




D-36, Condition 06: Key nodes, site plan

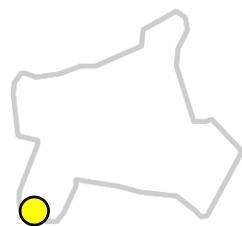


D-37, Condition 06: Key nodes, Birdseye view render



07. Heritage District

The proposed route takes the *yao dai* through two heritage areas: the Qinghefang and Donghe Districts. Condition 07 explores the Qinghefang District. Several studies were conducted to determine how best to modify the *yao dai* to travel through this area.



Qinghefang Ancient Street, a section of Hefang Street, runs along the northern base of Wu Shan Hill about 500 meters from West Lake. Comprising an area of 13 hectares, the street is the best-preserved portion of ancient Hangzhou and is widely considered to embody the historical and cultural character of the city. Qinghefang has been the city's most celebrated street for centuries. During the Southern Song Dynasty (1127 - 1279 AD) Qinghefang's shops, restaurants and teahouses formed the center of the city. Many well-known, centuries-old shops still operate in this ancient street, including Wangxingji Fan Store, Zhangxiaoquan Scissors, Wanlong Ham Stack, Huqingyutang Pharmacy, Baohetang Pharmacy, Zhuangyuan House, Wangruixing, Yiyuanjindian, Jingyangguan and Sheep Soup Restaurant.

In April 2000, the government of Shangcheng District proposed their vision for Qinghefang. Their proposal was to protect the historical buildings of the Ming and Qing Dynasty along this 460m stretch of Qinghefang. The redeveloped street now exudes an atmosphere of its past and is renowned for its street-culture, entertainment, commerce.

It is a popular destination both for residents and visitors from elsewhere in China and beyond. At present, 16 ancient laneways have been preserved, including Zhongshan Middle Road, Hefang Street, Gulou Bay and Gaoyin Lane. Smaller east/west alleyways intersect the primary north/south lanes. Most of the older buildings in the district are in the style of late Qing Dynasty. The well preserved 'four-corner buildings group' is considered to be a masterpiece of ancient architecture and planning.

As this area has been granted UNESCO World Heritage status, it is important to minimize the impact of anything new. As such, the *yao dai* was routed along Gaoyin St., which runs behind and parallel to Hefang St., separating the heritage district from an area of *danwei* housing beyond. As portions of the *danwei* housing are likely to be demolished, Gaoyin St. can be widened to accommodate a continuous green belt to buffer the heritage district from the chaos associated with tour bus parking and tour-group meeting points. This green belt could parallel the *yao dai* toward the housing. Positioned down the new centre of Gaoyin St., the Yao Dai would include six programmatic components, namely, the elevated walkway, retail pavilions, the tramline, the bike path, observation platforms and water gardens.

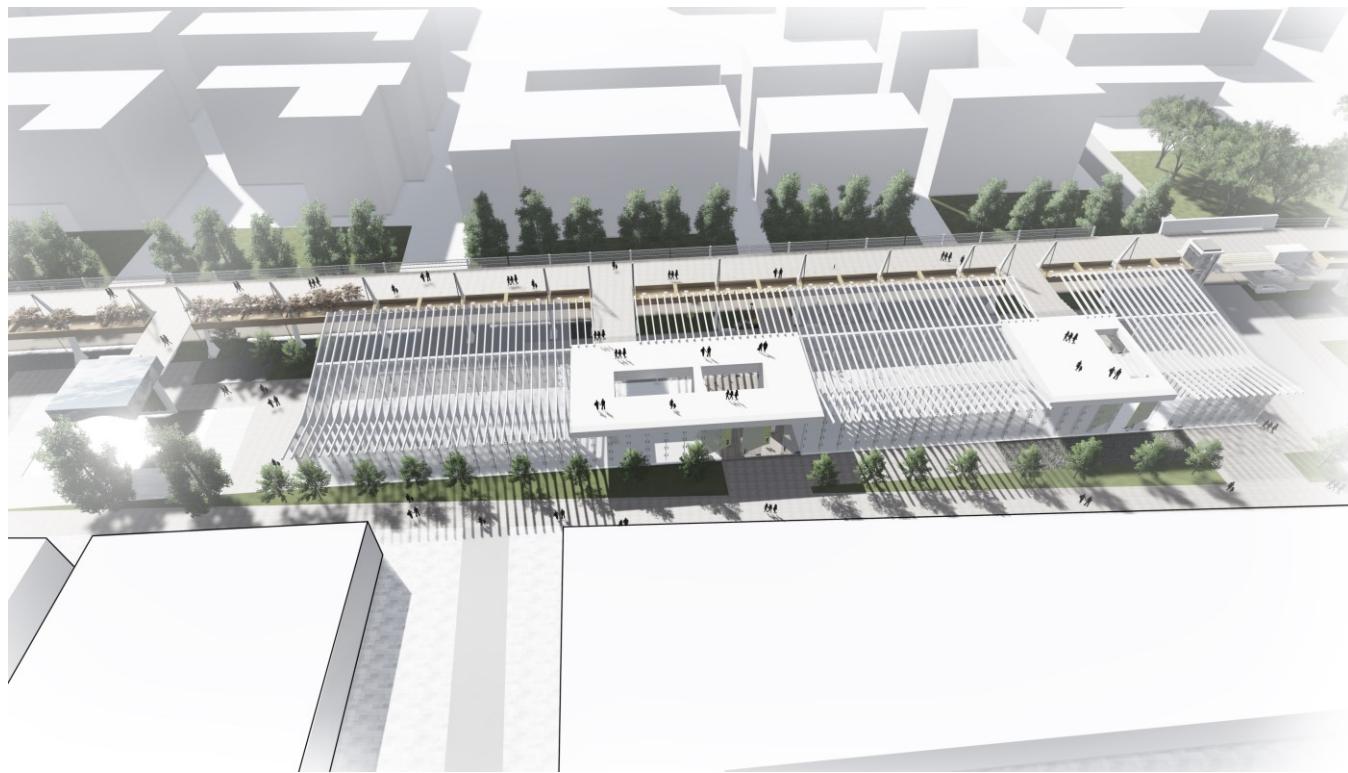
At its western end, the Gaoyin portion of the *yao dai* incorporates a major plaza similar to those at other major nodes. Planting boxes along the middle section of the elevated walkway have been removed to make way for a glass canopy that connects across a lower pedestrian walkway to three glass volumes.

These volumes, constructed of fully transparent spider curtainwall, accommodate tourist information kiosks, bars, coffee houses and other urban activities. The covered path between the tramline and the glass volumes incorporates continuous water gardens to create a quiet alternative to the hustle and bustle of the district as a whole.

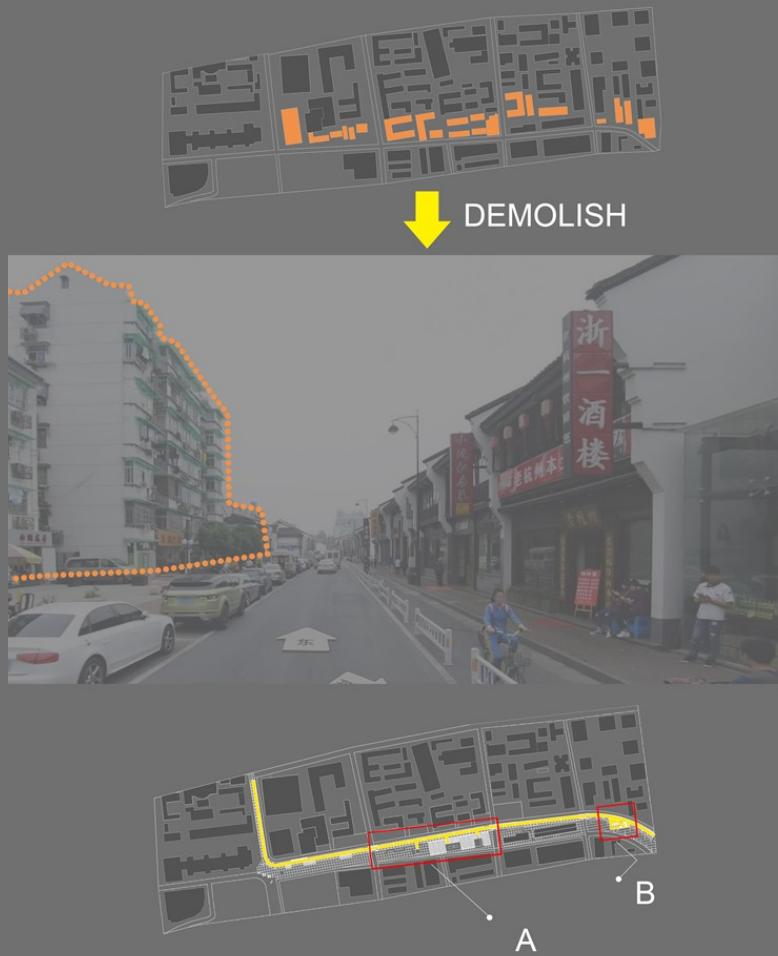
At the eastern end of the complex, planter boxes have been replaced with an observation deck along the elevated walkway, giving tourists an opportunity to take a bird's-eye view of the heritage district.



D-38, Condition 07: Heritage District, site plan



D-39, Condition 07: Heritage District, Birdseye render



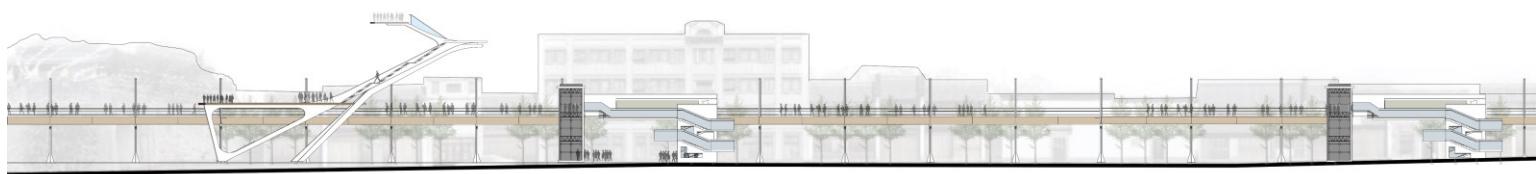
D-40, Condition 07: Heritage District, demolish plan



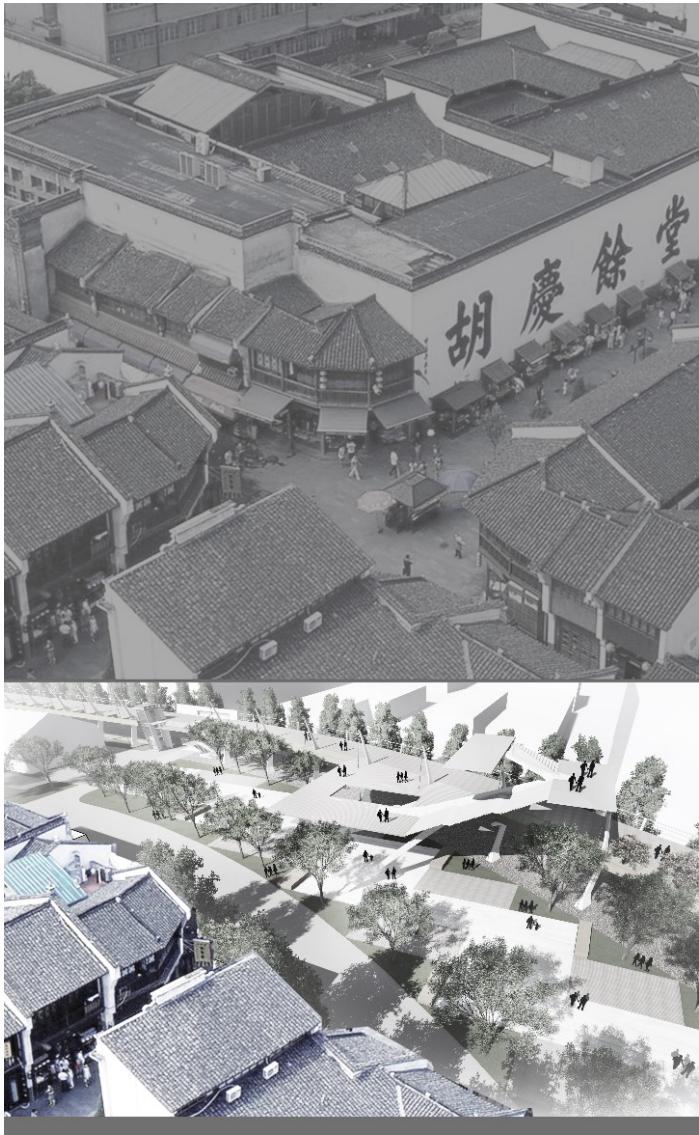
D-41, Condition 07: Heritage District: sectional perspective drawing



D-42, Condition 07: Heritage District, rendering 001



D-43, Condition 07: Heritage District: cross section drawing



D-44, Condition 07: Heritage District, Birdseye view of observation deck



D-45, Condition 07: Heritage District, rendering of observation deck



Context, Relevance, and Contribution to the Discipline

28. Comprehensive National Power is a theory developed by Chinese Wisdom association, have 5 indicators, military, economics, soft power (global influences in culture, education and livelihood condition), environmental sustainability and political advancement.

“Based on its Comprehensive National Power (CNP), the People’s Republic of China has officially become a “developed state.” The country is set to become 75% urbanized by 2030 – a huge leap forward from the current rate of about 55%.”²⁸ Given this meteoric rate of urban growth, better urban models and infrastructural links are crucial – as are improvements on and alternatives to existing high-rise condo communities.

China attracts people from around the globe, not only due to its financial and economic power but also due to the character and vitality of its cities: a mixture of modern and traditional culture. As Chinese cities enter the 21st Century, however, rapid growth presents challenges to urban livelihood and linkages became a complex issue. Issues related to the current model of over-scaled high-rise residential neighbourhoods, for example, must be addressed (e.g., lack of connection between residents). The higher and more vertical the city, the more it will benefit from horizontal connections. As such, multi-modal and programmatically rich infrastructural loops -- as proposed for the *yao dai* -- would benefit most Chinese cities, not just Hangzhou.

Hangzhou is typical of traditional Chinese cities. Like Beijing, it both symbolizes and embodies the history and cultural values of the country. Other kinds of cities, however, exist. Major cities like Shanghai, Tianjin, and Wuhan were small villages up until the middle of the 19th century.



While not part of the traditional core of China, they set the tone for modern Chinese urbanization. In 1848, the French and British colonized the “port areas” of these cities (later known as the concessions), areas that constitute about 70% of their contemporary cores. The urban fabric of these concessions – a hybrid between Chinese and western block and building types – formed the basis on which the modern cities have been built.

In the first half of the 20th century these “modern cities” – largely the so-called “treaty port” cities of the 19th century -- went through a phase of industrialization. The various foreign concessions amalgamated into a single dense core at the heart of the contemporary city. Much of the urban fabric associated with the concessions was demolished from 1980 onward, with the exception of isolated, historically designated fragments such the “Tianjing jie” in Tianjing, the “Yang jie” in Wuhan, and the celebrated areas of Shikumen (lilong) housing in Shanghai.

In 1949, the KMD party lost the Civil War, ending the Republican period in China. Its members were exiled to Taiwan when the Communist Party of China (CCP), took over. The “treaty port” period of these cities officially came to an end on Oct. 1, 1949. The CCP's economic model shifted from trade-based manufacturing to heavy industry, following in the footsteps of the former Soviet Republic. Authorities expropriated the factories and commercial warehouses of the “treaty port” cities, repurposing them for state-directed domestic production.



While most heavy industry was located further inland (liberal, foreign-infused costal cities were largely ignored by the CCP), new industrial fabric was constructed in cities like in Hangzhou, as were vast amounts of *danwei* housing. Cities were organized according to largely self-contained “work units,” each comprised of a factory, housing, schools and communal services.

With the advent of Deng Xiao Ping’s opening policy in the 1980s, “modern cities” have pulled China out of relative poverty, transforming it into the world’s second largest economy. Shanghai and Tianjing, the financial capitals of north and south respectively, underwent rapid growth of urbanization over the past three decades due to Deng’s policy of encouraging foreign investment. Since the 1990s much of the communist-era industrial fabric and *danwei* housing has been replaced by super-high-rise condo towers, the construction of which has not only helped to address housing shortages but contributed to the economy of these cities. Housing and real estate development have played a significant role in China’s economic growth in the past 30 years. The investment in the infrastructure required to support this housing significantly improved the livelihood of citizens by providing clean drinking water, municipal sewage, natural gas, etc. The development of condos supported the construction of schools and retail infrastructure.

Today, cities like Tianjin and Shanghai face difficulties in controlling the proliferation of high-rises associated with rapid population growth.

29. *Economic and Social Development Statistical Bulletin* (in Chinese). Shanghai Bureau of Statistics China Statistic Press (Beijing, 2011), stated that First tier Chinese cities accommodate 67% of China's floating population

30. Ibid

In first tier cities like Shanghai and Beijing, floating Population forming a large cohort of lower class, non-status residents who stand apart from their middle and upper class neighbors.²⁹ Their living conditions are not frequently addressed, as the current housing model does not take them into consideration. Middle class residents are also looking for better working environments and education for their children. Balancing good schools with satisfactory employment is a difficult geographical undertaking. Long elevator waits and traffic congestion is a daily reality. In the greater Shanghai area, for example, "traffic delays result in an average commute time of 45 minutes to school."³⁰ A creative approach to infrastructure (e.g., stacking and bridging between things) would help to address these issues. Mixing offices and schools within residential tower communities would also enable more residents to reach schools, work, and shopping without dropping to ground zero.

On the other hand, tower units are separate from the ground, minimizing contact with the streetscape and city life. Bridging between the street and the sky is important. Due to the growing population density is an issue and the amount of land at grade is severely limited. This forces cities to go higher. Tall condos in urban areas are typically organized into socially and programmatically segregated superblocks. Following Chinese tradition, residential and commercial uses are kept relatively separate, even in cities. Bringing more of the street into the sky – and finding ways to square this with housing preferences -- may help.



31. From Stephen Graham. *Vertical: The City from Satellites to Bunkers*. NYC, NY. Verso (New York, 2016), a geography based theory that believes the future of urban development is mainly about vertical development.

There are practical and logistical issues associated with making new connections, whether vertical, horizontal or social. This is where the *yao dai* comes into play.

*The Relevance of Projects like the *yao dai* for Modern Cities like Shanghai*

The geographic expansion of cities presents major challenges. As such, the 21st century city belongs to sky, or so claims Stephen Graham's "*Vertical Habitat Theory*".³¹ Since a saturated ground plane requires extensive amounts of energy to modify, a better idea would be to explore city's urban design vertically. The *yao dai* is a step in this direction – a new platform for urban life. Its elevated infrastructure accommodates a range of programs complementing, connecting (and offering alternatives) to life at grade. It is also a design catalyst for the buildings that accrete around it, offering opportunities to connect on numerous levels.



Conclusion

Learning about a place I know well, but not so well

This thesis has provided me the opportunity both to give Hangzhou a “new look” and to look at the city in a new way. Having lived in Hangzhou for more than a decade, I came to realize that my anecdotal experiences and assumptions frequently prevented me from digging deeper and ferreting out the challenges facing the city at this point in its evolution. This thesis has allowed me to engage the city more objectively and critically. Despite the accolades Hangzhou receives as a tourist destination (it is frequently described as “paradise on earth”), and despite the important role it has played in Chinese history and culture, Hangzhou also must look forward. Building on its past, it must find innovative and appropriate ways to improve its future.

Similar to the challenge of linking its past to its future is the challenge making physical linkages between the various nodes that now comprise the city of Hangzhou -- nodes that correspond to different moments in the city’s history. As the city grows it is becoming less legible and more difficult to navigate. While the connection between the ancient city center at Westlake (the Qinghefang Heritage District) and the Communist-era center at Wulin Square is relatively straightforward (they are connected by Yan'an Rd.), legible connections have yet to be forged between these two centers and the emerging CBD to the southeast. And while the traditional gateway to the city was the train station near the Donghe District – midway between Qinghefang and Wulin Square – the new station is

located in the far northeast quadrant of the core. The problem of spatial and temporal linkages led me to the idea of the *yao dai*, a multi-functional platform that connects the past with the future. It is envisioned as an armature to guide change.

Doing

Among the challenges associated with designing of the *yao dai* was the need to make it both robust and flexible. What route should it take? What modes of circulation should it accommodate? How should the various components be positioned relative to each other? To the existing urban fabric? What paths should be on grade, below ground, elevated, and why?

Elevating the walkway creates a new ground zero in the city – arguably more compelling as a pedestrian experience than from a tram (for which the structure would be considerably less flexible). The key to its success is providing the community a platform along which to move, live, work, eat, socialize, study, be entertained, discover the city, and experience nature without the distractions of density and traffic. Elevating the walkway (or the tram, for that matter) also presents logistical and programmatic challenges, e.g., how to deal with the space beneath it, how to move people up and down, and how to connect the kinds of activities that occur above with those below. In this regard there is a natural complementarity between the activities along the elevated walkway and those that might occur along the service road.



The third set of challenges relates to the question of how the engineering methods might support the larger social aspirations of the *yao dai*. What value could the *yao dai*, as a significant piece of physical infrastructure, bring to Hangzhou and how capable would it be of responding and adapting to the myriad conditions it encounters along its route? There are two aspects of this: how the *yao dai* relates to the existing conditions and how it acts as a catalyst for change. This is significant inasmuch as so much of the area encircled by the *yao dai* is ripe for redevelopment.

Theory and forward

However challenging, it is important to address the issues outlined above – not only in Hangzhou but in most Chinese cities, which are undergoing unprecedented growth and transformation. New theories and new urban linkages are critical, both physical and social; transportation plays a crucial role in the health of the city. To this end I've attempted to blur the boundaries between architecture, urban design and infrastructure – toward a new theory of "Urban Linkages." From this perspective architecture would provide not (only) crystalized objects but a framework for growth and improvement.

Appendices

闹中取静 (Peacefulness among chaos)

32. *Chinese Chengyu Dictionary English Version*, XinHua edu. (Beijing, 2014)

33. Ministry of Railways 2013, Art.

34. "High-speed rail a vital social good" Global Times 2014-12-15

35. Ibid

"Type of Chengyu in Traditional Chinese. Meaning peacefulness among chaos, it is a spiritual approach of a "perfect living condition" or "state of mind". Chengyu (simplified Chinese: 成语; traditional Chinese: 成語, pinyin: chéngyǔ, lit. "set phrases") are a type of traditional Chinese idiomatic expression, most of which consist of four characters. Chengyu were widely used in Classical Chinese and are still common in vernacular Chinese writing and in the spoken language today. According to the most stringent definition, there are about 5,000 chengyu in the Chinese language, though some dictionaries list over 20,000."³²

高铁 (Gaotie)

"Meaning High-speed rail (HSR) in China.³³ Gaotie is officially defined as passenger-dedicated railways designed to carry multiple unit trains at speeds of 250–350 km/h (155–217 mph) including railways that can be upgraded to 250 km/h service on which trains initially operate at least 200 km/h (124 mph).³⁴ The HSR network extends to 29 of the country's 33 provincial-level administrative divisions, and by year end 2016 exceeded 22,000 km (14,000 mi) in total length. The network is the longest in the world and accounted for about two-thirds of the world's high-speed rail tracks in 2016. The Beijing–Guangzhou High-Speed Railway at 2,298 km (1,428 mi) is the world's longest HSR line in operation."³⁵

高架 (Gaojia)

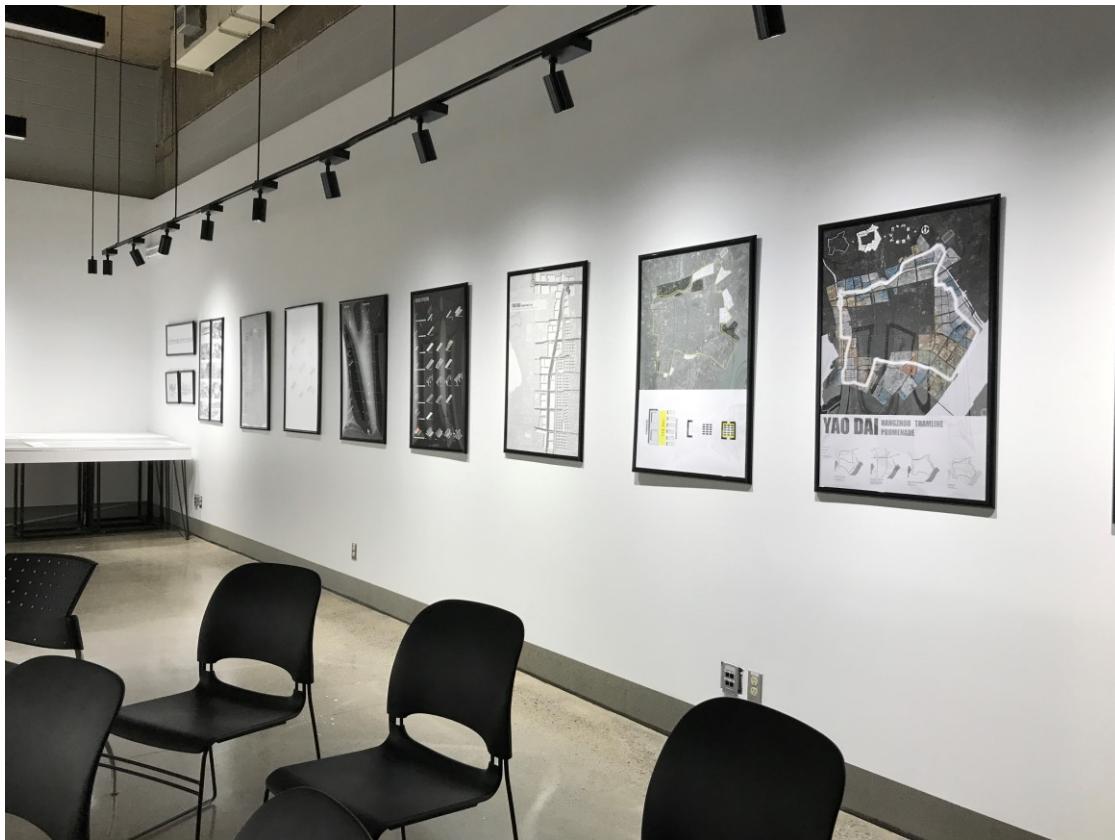
Chinese term of flyover, or elevated cross city highway bridge, Hangzhou for example, contain more than 200 kms of elevated highway system.



E-1



E-2



E-3



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