

## CHARACTERISTICS OF TOD GUIDANCE SYSTEM AND ENHANCEMENT STRATEGIES IN CHINA

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As urbanization progresses, the rapid growth of urban population size and the surge in demand for land will lead to continuous urban development and spatial expansion. In the last century, the motor-oriented development model adopted by many cities in Western developed countries has induced a series of urban problems [1, 2], including traffic congestion, air pollution, energy overload consumption, social differentiation and land waste. In this context, the concept of "New Urbanism", which advocates compact, high-density, diverse, mixed and sustainable development, has emerged [3, 4], of which Transit-oriented Development (TOD) is an important component. TOD is a type of urban development that maximizes the amount of residential, commercial, and recreational space within walking distance of public transportation; it emphasizes a close symbiotic nesting relationship between urban form and public transportation, and it is a concept that has been developed by the American architect Peter Calthorpe in his book *The American Metropolis of the Future: Ecology-Community-American Dream*. The TOD model has been used by many cities around the world [5-8] and has played a crucial role in promoting intensive urban development [9, 10], enhancing urban vitality and transportation synergy [9, 11, 12], and promoting low-carbon travel [1, 10].

Many cities in China are now vigorously developing urban public transportation to improve urban transportation services. It is urgent to explore how to scientifically guide the development of station areas, promote the efficient and high-quality construction of station-integration, improve the spatial quality and human-oriented experience of the city, and thus achieve sustainable urban development. Cities in North America have undergone a transformation from sprawling development to smart and intensive development, in which the TOD model has played a significant role. Therefore, this paper adopts an inductive and case study approach, firstly, to analyze the characteristics of the current TOD guidance system in China, and at the same time, to analyze the experience of North American cities in order to provide a reference for China's practice.

### 1 China's TOD Guidelines

The preparation of TOD guidelines in China is still in the preliminary exploration stage. At the national level, only one TOD guideline has been prepared for each of the three spatial categories: city as a whole, rail line area or integrated hub area, all of which are group standards with limited legal effect (see Table 1). In terms of content, all three guidelines have constructed an overall framework for clear planning, design and development guidance based on the division of station types and multi-level influence scope delineation, and the content is relatively complete, but the *Guidelines for Planning and Design of Facilities Space around Urban Rail Transit Stations* do not cover land use, development intensity control and urban morphology and landscape shaping, etc. Meanwhile, the *Guidelines for Planning and Design of Areas along Urban Rail Transit Lines* and the *Guidelines for Development Planning of Passenger Hub Areas* mostly adopt qualitative

descriptions, with fewer specific quantitative indicators and graphic control, which may reduce the operability of the guidelines.

In terms of local cities, only Chengdu City has prepared a comprehensive TOD guideline *Urban Design Guidelines for the Integration of Rail Transit Yards and Stations in Chengdu City* at present, while *Chongqing City's Guidelines for the Articulation of Rail Transit Stations in Chongqing City* prepared in 2019 focuses more on the traffic organization of rail transit areas (see Table 1). In general, the two guidelines are relatively complete in terms of guidance content, but they can be further optimized and improved in terms of understanding local cities' own conditions and development demands, the TOD concept and its significance to local development, quantitative guidance and control, flexible and variable development and public participation.

Table 1 List of China's TOD-related guidelines

Level / City	Guideline Name	Year	Keywords
National level	Planning and design guidelines for areas along urban rail lines	2015	Public transportation support, leading urban structure, three-level spatial guidance scope, station classification, urban center structure, differentiated intensity control, function mixing, commuting distance control, transit pilot area, traffic corridor layout, potential parcel analysis, function priority optimization principle, traffic connection, pedestrian system guidance, rail facilities and line control, planning preparation and management process, preparation results composition
	Passenger Hub Area Development Planning Guidelines (Draft for Comments)	2021	Passenger hub classification, core area + expansion area + impact area, mixed functions, thematic study on development scale requirements, pedestrian priority, traffic connection, station-city integration, integrated construction of above-ground and underground space, interface with higher planning, appropriate development intensity, outcome requirements
	Spatial Planning and Design Guidelines for Facilities in Areas Surrounding Urban Rail Transit Stations (Draft for Comments)	2021	Station classification, traffic connection, station accessory space, distribution space, public service space, municipal space, implementation process, bus priority, transfer distance control, pedestrian network construction, quantitative control
Chengdu	Urban Design Guidelines for the Integration of Rail Transit Yards and Stations in Chengdu	2018	Positioning integration, industrial development, mixed functions, open and coherent urban form, vibrant and open space, intensive underground space, people-oriented slow walking system, preparation of results requirements
Chongqing	Chongqing Rail Transit Station Articulation Guidelines	2019	Special guidelines, pedestrian connection, bus connection, bicycle connection, temporary shuttle connection, motor vehicle exchange connection, signage system, station classification

Source: by author

## 2. North American Cities' TOD Guidelines

In this paper, we use the terms "TOD Guidelines", "TOD Guides", "TOD Handbook" (Handbook/Guidebook) or "TOD Guidelines" to refer to the development of TOD. Guidelines", "TOD Guidelines", "Handbook/Guidebook" or "TOD Design"

were used as keywords to search for city-level guidelines documents in domestic and international search engines, and the final 15 North American and 5 domestic TOD-related guidelines were used as the basic data for the analysis of this paper.

In general, the TOD guidelines for North American cities are characterized by a wide geographical coverage, a long-time span, and outstanding focus.

In terms of coverage area and time span, the cities in the United States that have prepared TOD guidelines cover the East Coast and West Coast regions, and there are also guidelines in the island territories (Honolulu, Hawaii); meanwhile, cities in central and eastern Canada have also carried out related work. The late 1990s and the early years of the 21st century were the time when the number of guideline preparation results was high. After the completion of the TOD design guidelines for San Diego, California, USA, led by Peter Calthorpe in 1992, many cities faced with development dilemmas and actively adopted the TOD development model, which contributed to the widespread development of related guidelines.

In terms of focused content, site type delineation and key elements of control and guidance are the main points of general concern in the guidelines. On the one hand, most guidelines emphasize differentiated development strategies for different site area characteristics, which can better accommodate local characteristics and development conditions. For example, in the TOD Guidelines of Atlanta, USA (2010), based on the location, urban function and form, and land use characteristics of the site, the site area is divided into seven types, such as urban core, town center, commuter town center, neighborhood station, arterial corridor, special area destination, and distribution station, which provide a basic type framework for specific development or design strategies. On the other hand, these guidelines generally specify the characteristics that TOD site areas need to have in terms of land use characteristics, development intensity, pedestrian environment, traffic organization, and street space, reflecting quantitative control and human-centered characteristics. For example, the City of Persepolis' TOD Design Guidelines: A Basic Guide to Transportation Construction in Indianapolis uses the Lot Development Criteria Table to propose control indicators for building height, lot coverage and building setbacks, while specifying the design principles and methods for various elements of street space at the pedestrian scale, including frontage, street interface, trees, furniture, public art and water bodies.

In addition, some of the guidelines also give full consideration to public participation, social equity and the long-term development of the site area, emphasizing that the development of the site area should focus on the synergy of multiple interests, promote mixed housing construction and community inclusion, and adapt to the long-term development of the site area by continuously updating the content of the guidelines, which helps to improve the operability of the guidelines and maximize the comprehensive social effects.

Table2 List of TOD guidelines for North American cities

Nation	City	Guideline Name	Year	Keywords
USA	San Diego	City of San Diego Land Guidance System: TOD Design Guidelines	1992	Clear definition, functional mix, walkable environment, differentiated guidance between areas, long-range planning, incorporation of environmental assessment, response to zoning and urban standards, special plans (public services and infrastructure investment and financing plans)
		Master Plan: TOD Design Guidelines	2011	Continuation of previous version, site location selection, site characteristics, residential and commercial density, relationship to surrounding land use, quantitative control
	Austin	TOD Guideline	2006	Site classification, service targets, development longevity, special study support, public participation
		TOD Guidelines - A Resource Manual for Good Urban Design		Integration with other transportation, evidence support, social effects, fiscal measures, self-review checklist
	Atlanta	TOD Guideline	2010	Interface with other plans, case studies, site classification, compact and dense development, diverse land uses,

				integrated public realm, non-traditional parking, quantitative indicators, innovative zoning
	Sacramento	A guide to TOD	2009	Site classification, quantitative controls, flexibility of guideline framework, land use for community character, mobility and accessibility, open space and municipal facilities, land use assessment, roles and responsibilities
	São Paulo	St. Paul Central Corridor TOD Guidebook	2011	Public infrastructure, corridor development strategies, stand-alone station area plans, development supplemental studies, design elements
	Persepolis	TOD Design Guidelines: The Essential Guide to Transit Construction in Indianapolis	2018	Site Types, Lot Development Development Standards Table, Smaller Building Setbacks, Detailed Design Guidelines, People Oriented
	Edmonton	TOD Guidelines	2012	Differentiation Strategies, Land Use and Intensity, Building and Site Design, Public Realm, Smaller Building Setbacks, Street Network, Complete Streets, Site Areas, Site Neighborhoods
	Denver	TOD Design Guidelines	2012	Active edge, mixed-income housing, defensible space, interface with zoning, site organization, compact and mixed, high-quality pedestrian environment, street network connectivity, parking management, public participation, case studies
	Honolulu	TOD Design Guidelines, Special Areas	2019	Street facade transparency, setback control, parking control, sidewalk design, quantitative control, development incentives
Canada	Ottawa	TOD Guide	2007	Interface with other standards, scope of application, site types, land use, layout, built form, walking and cycling, vehicles and parking, streetscape and environment, housing priority policies, station-city integration, quantitative control, people-oriented, landscape vision
	Calgary	Transit Oriented Development Policy Guidelines	2004	Transit-supportive land use, increased density, pedestrian connections, all-season design, vibrant streets, station classification, community collaboration
		TOD Practice Manual	2004	Land use, promoting density, pedestrian connections, urban design, compact development, parking management, integrated places, adapting to the market, public participation, long-term vision
	Winnipeg	Transit Oriented Development Handbook	2018	Evidence supports, integrated benefits, high density development, mixed use, high quality pedestrian environment, vibrant centers, parking strategies, public leadership, site selection, evaluation, battlefield design, site types, urban parks and open space, transit/town squares

Source: by author

### 3. Implications for the preparation of urban TOD guidelines in China

#### 3.1 Differentiated guidance strategy according to local conditions

The diversity of TOD site areas is an important feature of urban development and is closely related to the heterogeneity of functions and spaces within the city. The design guidelines for TOD site areas need to fully understand the natural environment, development stage, location conditions, traffic conditions, land use and spatial form of the target city and other factors that influence the reasonable setting of TOD site type delineation criteria and the multi-level spatial scope threshold of the site surrounding areas. On this basis, the differentiated guiding strategies of different site areas in terms of planning and design elements are refined. For example, the TOD Guide issued by the city of Atlanta, USA, innovatively proposes a TOD Zoning Overlay District (TOD) model based on the characteristics of TOD sites and the surrounding community, which provides detailed guidance on various elements in the zoning district and effectively enhances the applicability of the guide; for example, the guide of Sacramento city divides the TOD site area into downtown area For example, Sacramento's guidelines divide TOD site areas into five categories: downtown, urban center, employment center, residential center, commuter center, and high-frequency transit corridor, and use a table to specify quantitative guidance indicators for each category in three main areas: land use, transportation, open space, and municipal

facilities. The localized design guidelines can add uniqueness to the guidelines and also better adapt to the differences in demand for development within our cities.

### **3.2 Strengthen evidence support and quantitative control guidance**

The formulation of guidance strategies based on realistic evidence will be more realistic, and the control and guidance of key elements through quantitative indicators can effectively improve the operability of TOD guidelines. On the one hand, many cities in North America have conducted extensive case reviews of TOD development practices in existing areas during the preparation of TOD guidelines, which have summarized the key elements of TOD control and formed the basis for specific strategies, such as Austin and Atlanta in the United States. On the other hand, many guidelines provide detailed quantitative guidance on neighborhood scale, development intensity, building setbacks, slow traffic, street space scale and appearance, and public plazas. In Winnipeg, Canada, the Transit-Oriented Development Manual specifies the range of built-up density values for the area around the site and establishes the principle of increasing with the volume of traffic passengers; at the same time, in order to facilitate the shaping of a compact, high-density human environment, the manual also establishes recommended values for neighborhood size (maximum length of 122m or perimeter of 488m) and recommended values for sidewalks that guarantee peaceful traffic (by residential areas, multifunctional major neighborhoods, and high-density urban centers). Although China's national-level "Guidelines for Planning and Designing Facilities Space around Urban Rail Transit Stations" has certain quantitative index guidelines for the traffic connection, station affiliation, distribution and retention, public services and municipal public space around rail transit stations, it still lacks content on land use, development intensity and street quality. For this reason, local cities should further increase the analysis of existing foreign cases and research evidence in the process of preparing their own TOD guidelines, and actively learn from relevant experience, while meeting their own city characteristics and development needs of quantitative control points.

### **3.3 Human scale and perception design guidance**

Generally speaking, the concept of "people-oriented" runs through all TOD guidelines in North America, and the main strategies are based on residents' travel experience, focusing on three aspects: spatial delineation based on slow walking characteristics, emphasis on slow walking right-of-way and design to enhance comfort. In terms of spatial extent delineation, with a threshold of 5min to 10min walking, the TOD-oriented Policy Guidelines of the City of Calgary, Canada, adopt 600m around the site planning area as the planning and design guiding area, and give the potential guiding area to the road network characteristics around the site. The San Diego General Plan: TOD Design Guidelines continues the main content of the first version of the guidelines in 1992, and further defines the "core space - secondary area" guideline at 402m (¼ mile) and 340ha (840 acres) according to the characteristics of residents' travel. In terms of right-of-way, many North American guidelines emphasize the priority of the right-of-way for pedestrians and cyclists, and are designed to provide a safe and continuous slow-moving environment. For example, the City of Ottawa's TOD Guidelines emphasize the need to reduce or limit the number of sidewalk separations in transportation planning, and that parking lots should be placed behind buildings to minimize disturbance to pedestrians. In terms of enhancing comfort, the TOD Design Guidelines: Basic Guidelines for Transportation Construction in Indianapolis provides detailed guidelines on the physical components of various spaces, including streets, public/private space buffers, courtyards, bicycle and car parking, etc., reflecting a thorough consideration of people's feelings of use. In the future, the preparation of local TOD guidelines in China should also focus on promoting slow transportation and enhancing walking and cycling experience, organizing the planning and design guidance of land use, transportation, landscape, municipal and other elements.

### **3.4 Promoting Broad and Positive Social Effects**

In addition to the desire to make cities more sustainable through the TOD model, many city guidelines also emphasize the broader, positive social effects that can be achieved through more rational planning and design under this model, mainly in terms of equitable transportation access, housing equity, and crime prevention. For example, the City of Austin's guidelines emphasize the promotion of greater opportunity through equitable transit-oriented development and the consideration of "intermediate housing" and subsidized housing in site areas, while the City of Ottawa's guidelines specify the principle of locating the highest density mixed-use housing as close as possible to rail stations. Due to the complexity of traffic and pedestrian flow in the TOD site area, the city of Edmonton, USA has also specified urban design and environmental design crime prevention principles in its TOD guidelines, including specific design principles for surveillance, accessibility and activity. In general, we should shift our traditional perceptions and consider the TOD model not only as a pure and effective tool for smart development, but also for its positive and negative spillover effects. Therefore, local cities in China should also target TOD development as an effective way to alleviate specific social problems in accordance with the actual problems of their own cities in the guideline preparation process, fully learn from international advanced experience, conduct thematic studies, and scientifically develop corresponding planning and design control or guidance strategies.

### **3.5 Strengthen organizational management and promote public participation**

The implementation of efficient and precise TOD concepts and plans requires systematic organizational management and broad consensus support. Many cities in North America have guidelines that specify specific initiatives for organizational management, public participation, and financial financing for the development of public transit station areas. In terms of organizational management, the City of Wimborne's TOD guidelines identify the need for public leadership throughout the lifecycle of a site area, with multi-sectoral collaboration and innovative tools to complement and enhance planning efforts and facilitate implementation effectiveness. The City of Sacramento has even defined in detail in its guidelines the detailed roles and responsibilities of six main entities, including the regional government commission, city and county governments, private developers, the State Department of Transportation, and utility commissioners, in supporting the regional vision, transportation advancement, site planning and specification, detailed element enhancement or design, internal consistency, and leadership, to jointly promote TOD efforts. In terms of public participation, North American cities emphasize promoting the integration of residents' opinions into the preparation of TOD guidelines and the whole process of planning and construction of TOD areas through diverse forms of participation (e.g. focus interviews, workshops, public hearings, etc.), typical cities include the cities of Austin and Denver in the United States. In terms of financial measures, some cities have proposed centralized financial financing programs in consideration of the limited local government finances, which provide positive suggestions for economic support for TOD project development. For example, the financial financing measures mentioned in the U.S. City of Austin guidelines specifically include fund support, direct user-provided fees, debt instruments and bonds, and credit assistance. In the future, it is also necessary for our local TOD guidelines to include organizational management and public participation elements in the guiding principles or recommendations to provide comprehensive guidelines to guarantee the implementation of specific work.

## **4. Conclusion**

In the dual context of rapid growth of public transportation scale and smart urban development needs in China, the promotion and application of public transportation-oriented development model is of practical significance. However, how to better promote local TOD-related work and achieve efficient and high-quality urban development requires systematic and scientific guidance. This paper summarizes the advanced experience of the existing TOD guidelines in North America,

and provides a positive reference for local cities in China to further develop local TOD guidelines and carry out specific planning and construction work. However, it is worth emphasizing that the development background, scale and density, development stage and social demands of foreign cities are quite different from those of China, so it is still necessary to fully analyze and explore the applicability and transformation possibilities of these experiences in the future, and continue to explore and develop differentiated and characteristic TOD guidelines that meet the specific needs of local cities in China.

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