The Appropriate Intensity of Rail Transit Station Area near Historic Districts: A Case Study of Shanghai, Nanjing, Kyoto and Tokyo

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Abstract
Recent urban trends focus on integrated development around metro stations, promoting intensive, three-dimensional land use. This necessitates re-evaluating the redevelopment potential of rail transit stations area of historic districts. However, strict building height controls for urban fabric and heritage preservation challenge increasing development intensity there. Existing research lacks fine-grained quantitative studies on development intensity in such areas. This study first establishes a multi-dimensional intensity index system (building height, density, above/below-ground floor area ratio). Selecting 18 stations in historic areas of Shanghai, Nanjing, Tokyo, and Kyoto, it quantitatively analyses development intensity through multi-path comparisons. This considers precise station accessibility isochrones and spatial relationships to the historic district, aiming to identify suitable development intensity under multi-dimensional balance.

Keywords: Transit Oriented Development,Urban Rail Transport, Historical Blocks, Development Intensity.

1. Development Trends of Suitable Intensity in Historic Districts Around Transit Stations

In recent years, with the rapid development of the global economy and the acceleration of urbanization, the comprehensive development and utilization centreed around urban rail transit—particularly the integration of transit stations and their surrounding areas—has become a significant trend in urban development. This trend is driving transit station areas toward more intensive, three-dimensional, and integrated development. Concurrently, re-evaluating the redevelopment potential of rail transit stations area of historic districts is imperative. However, due to the requirements for preserving the urban fabric and historical landscape, construction and development in these historic districts face strict controls on building heights, posing challenges to enhancing the development intensity around rail transit stations.

Existing studies on the renewal and protection of historic districts around transit stations predominantly focus on directional strategies prioritizing preservation, with limited quantitative analysis. Research on the development intensity of station area spaces has primarily addressed specific planning measures and implementation steps, while the conceptualization of development intensity itself has seen scholars globally explore multi-indicator frameworks to comprehensively assess it. These frameworks often categorize and regulate development based on station hierarchy, types, and spatial layers (e.g., concentric zones). Such approaches provide a reference for this study's subsequent investigation into influencing factors and relationships among indicators of development intensity. In the field of historic district construction and utilization, Western countries began exploring floor area ratio (FAR) transfer or incentive mechanisms as early as the 20th century, while many Chinese cities initiated similar explorations after 2000. However, quantitative studies from the perspective of "suitable intensity" remain scarce, particularly lacking a refined synthesis of the impacts of rail transit stations and historic districts.

This paper addresses the inherent tension between development and preservation in historic districts around rail transit stations. Drawing on case studies of high-density Asian cities such as Shanghai, Nanjing, Kyoto, and Tokyo, the study constructs a multi-dimensional indicator system to measure development intensity, incorporating metrics such as building height, building density, above-ground and underground floor area ratios. By integrating statistical methods with GIS spatial analysis, the research conducts multidimensional comparative analyses of the compiled data to quantitatively identify patterns and regularities in the distribution of development intensity across intra-urban contexts, inter-city comparisons, and different developmental timelines within historic districts adjacent to rail transit stations.

2.. From Unidimensional Indicators to Indicator Clusters

2.1 Concept of Suitable Intensity

In historic districts, the development intensity of rail transit stations is primarily influenced by two factors: first, the constraints imposed by heritage protection planning, which mandates strict adherence to regulatory requirements. Development intensity must be controlled through regulations on building height, volume, and spatial form to maintain the integrity of the heritage character. Second, the surrounding areas of transit stations, due to the agglomeration effect of rail transit, possess higher development potential. Thus, this study defines the “suitable intensity” of station area spaces in historic districts adjacent to rail transit stations as a concept that integrates the impacts of both the historic district and the transit station’s influence zone. The term “suitability” here refers to a framework centreed on rail transit stations, ensuring the protection of historical heritage integrity while simultaneously balancing the development potential of land parcels and the reasonable utilization of economic efficiency. The core connotation lies in establishing refined, parcel-specific construction intensity control standards tailored to the functional positioning and spatial characteristics of different zones, thereby achieving synergistic optimization between heritage conservation and urban development value.

Based on existing studies, the urban space within a 5-minute walking time (approximately 200 meters) from a transit station has been identified as the area most directly influencing pedestrian behaviour. The 10-minute walking radius (approximately 400–500 meters) is recognized as the reasonable walking range and is defined as the direct influence zone, where the station exerts the most immediate impact on land development intensity. Therefore, this study delineates the 5-minute walking isochrone as the core zone and the 10-minute walking isochrone as the influence zone. The research focuses specifically on metro stations where historic districts overlap with the 10-minute walking isochrone, with the study scope encompassing all land parcels within this 10-minute isochrone boundary.

2..2. Construction of Indicator Clusters

Previous studies have predominantly used floor area ratio (FAR) as the primary metric to assess land development intensity. However, in historic districts, development must balance the preservation of unified urban heritage character with compliance to local planning regulations, where underground space development has emerged as a critical direction. Simultaneously, building density and building height are key determinants of architectural spatial form, collectively influencing FAR. Therefore, this study constructs a comprehensive indicator cluster by integrating maximum building height, building density, above-ground FAR, and underground FAR to holistically measure land development intensity.

Land parcels within historic districts must adhere to stringent heritage control requirements. Based on the protective planning frameworks of respective cities, this study categorizes parcels into three hierarchical zones: core conservation areas, construction control zones, and general zones. A differential scoring system (Table 1 [H]) is applied to these zones to enable fine-grained evaluation of heritage impact. This tiered mechanism allows for flexible land development potential across broader spatial scales while maintaining heritage integrity.

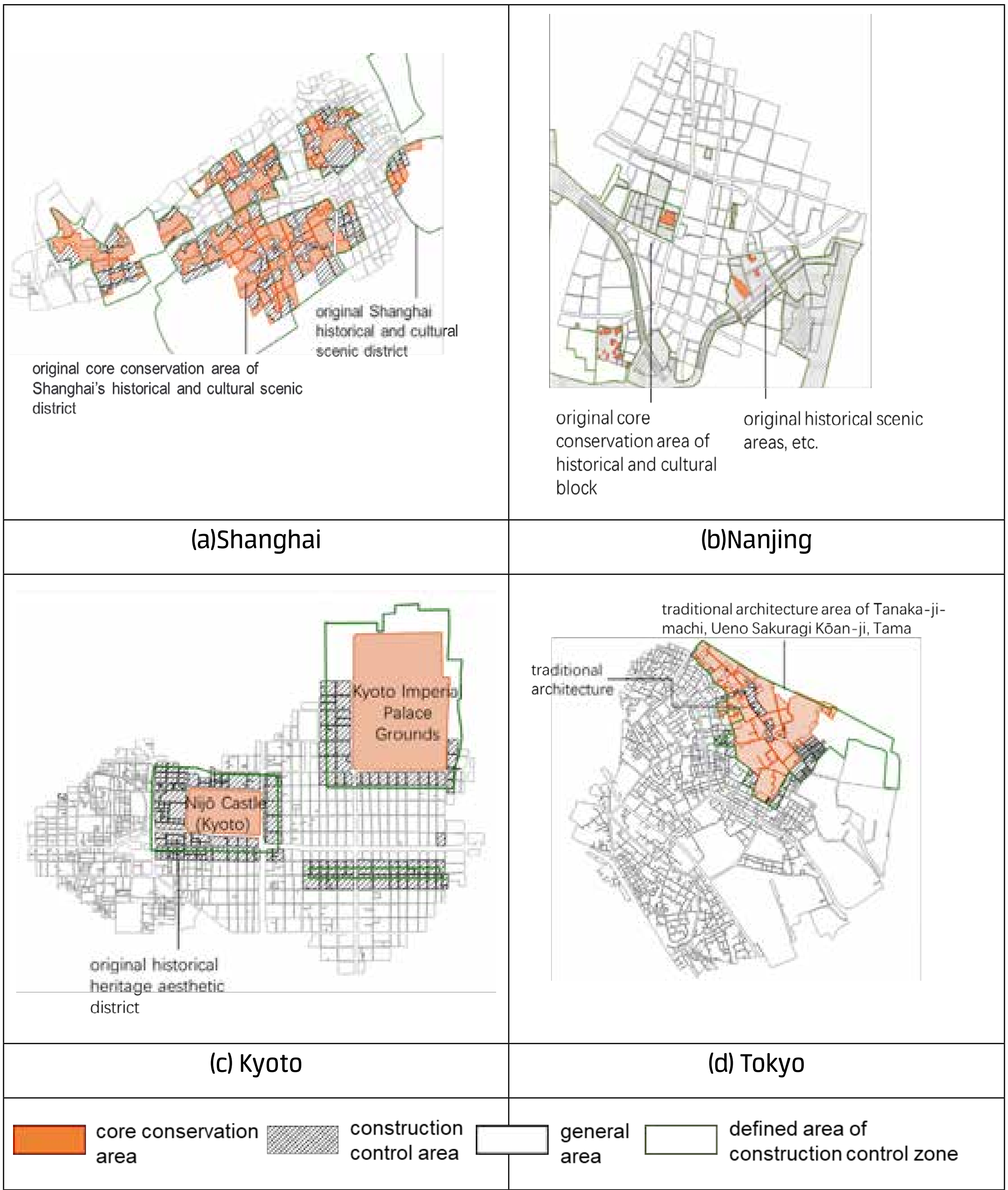


Figure 1. Illustration of core conservation area and construction control zone boundaries in historical cities.

Land parcel development intensity is closely related to both proximity to transit stations and location within heritage zones. In terms of station proximity, rail transit stations significantly influence the functional layout, transportation organisation, and land value of surrounding areas, with the magnitude of each impact correlated to distance from the station. High-intensity, mixed-use development in the core area of rail transit stations has become a societal consensus, as the station's influence intensity and spatial boundary are tightly linked to pedestrian accessibility. Based on existing research, it is generally recognized that the closer a parcel is to a station, the higher its commercial development value and development intensity tend to be. To facilitate cluster analysis in subsequent studies, the authors assigned values to 17 possible scenarios based on the isochrone layers in which the land parcels are located (Table 1 [L]).

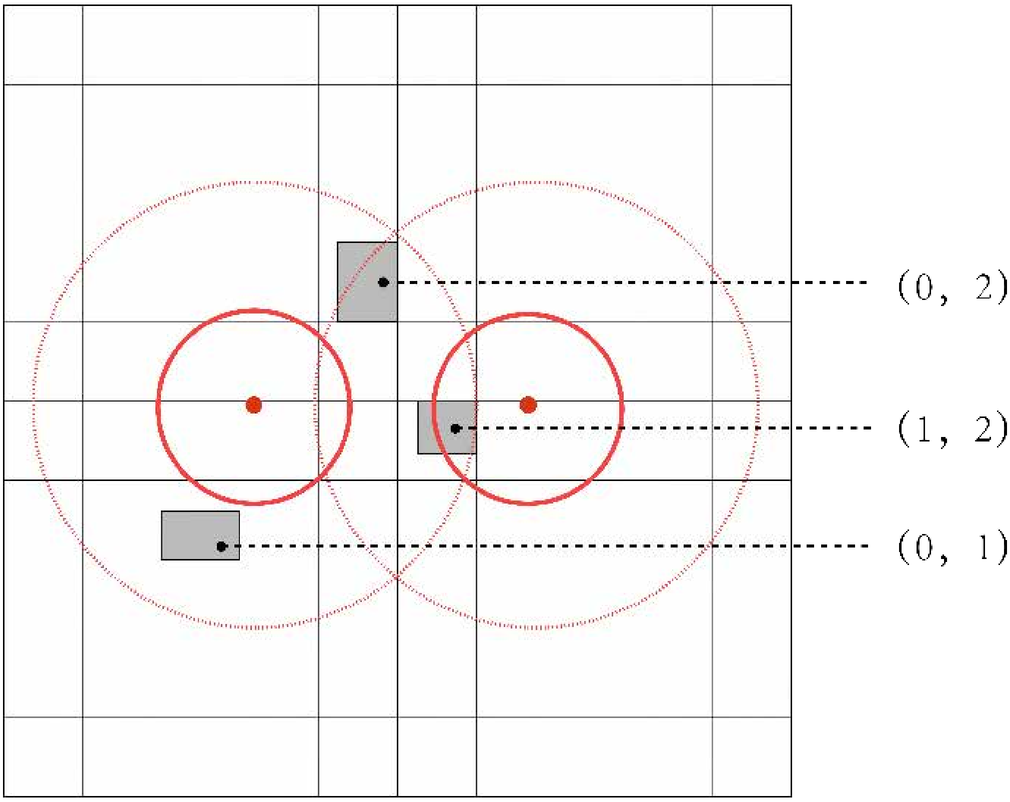


Figure 2. Labeled schematic diagram of spatial relationships between land parcels and station isochrones.

Table 1. A multidimensional indicator system for development intensity in station areas of historical districts.

Category	Specific Feature Value		Unit/Representation	Description	Data Source
Development Intensity-Related Attributes (D)	Maximum Building Height		Meters (m)	Maximum value	Baidu Map and government open data
	Building Density		Percentage (%)	Average value	Baidu Map and government open data
	Above-Ground Floor Area Ratio (FAR)		Dimensionless	Total above-ground floor area divided by parcel area	Baidu Map and government open data
	Underground Floor Area Ratio (FAR)		Dimensionless	Total underground floor area divided by parcel area	Baidu Map and government open data
	Total FAR (Above-Ground + Underground)		Dimensionless	Combined above- and underground FAR values	Calculated from above metrics
Relationship with Heritage Conservation Zones (H)	Located in Core Conservation Area		a		
	Located in Construction Control Area		b		
	Located in General Area		c		
Relationship with Station Isochrone Layers (L)	Located in the 5-minute isochrone of 3 stations	10-minute isochrone of 5 stations	(3, 5)		
		10-minute isochrone of 4 stations	(3, 4)		
		10-minute isochrone of 3 stations	(3, 3)		
	Located in the 5-minute isochrone of 2stations	10-minute isochrone of 5 stations	(2, 5)		
		10-minute isochrone of 4 stations	(2, 4)		
		10-minute isochrone of 3 stations	(2, 3)		
		10-minute isochrone of 2 stations	(2, 2)		
	Located in the 5-minute isochrone of 1 stations	10-minute isochrone of 5 stations	(1, 5)		
		10-minute isochrone of 4 stations	(1, 4)		
		10-minute isochrone of 3 stations	(1, 3)		
		10-minute isochrone of 2 stations	(1, 2)		
		10-minute isochrone of 1 stations	(1, 1)		
	Located in the 5-minute isochrone of 0 stations	10-minute isochrone of 5 stations	(0, 5)		
		10-minute isochrone of 4 stations	(0, 4)		
		10-minute isochrone of 3 stations	(0, 3)		
		10-minute isochrone of 2 stations	(0, 2)		
		10-minute isochrone of 1 stations	(0, 1)		
Land Use Type (U)	Refer to municipal land use planning documents				

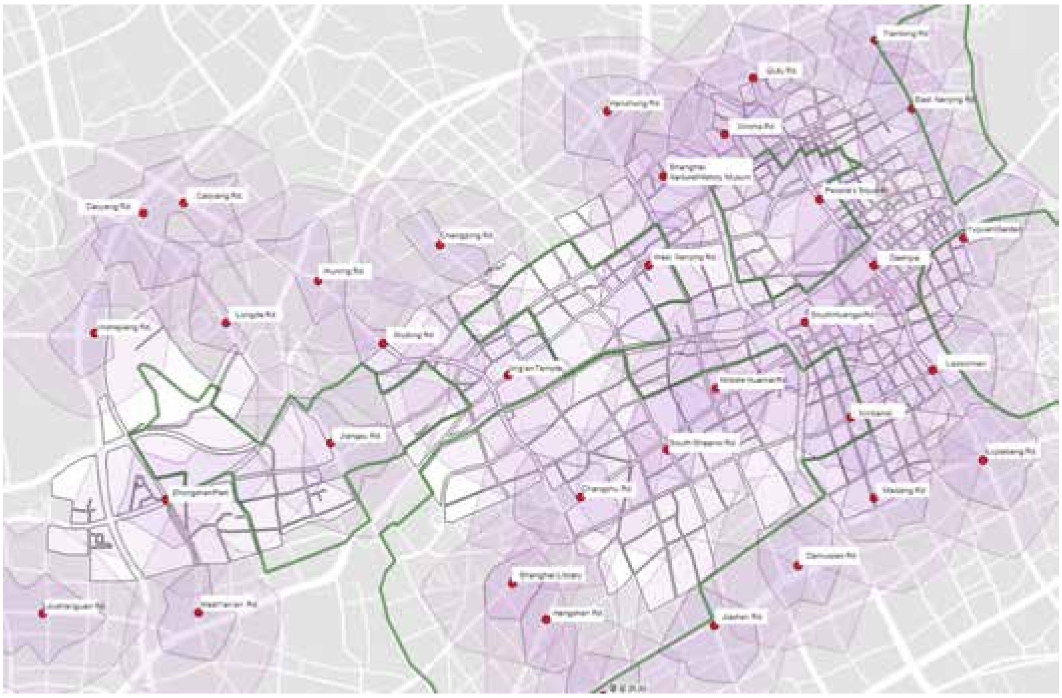
3. Study Object and Methodological Framework

3.1 Study Object

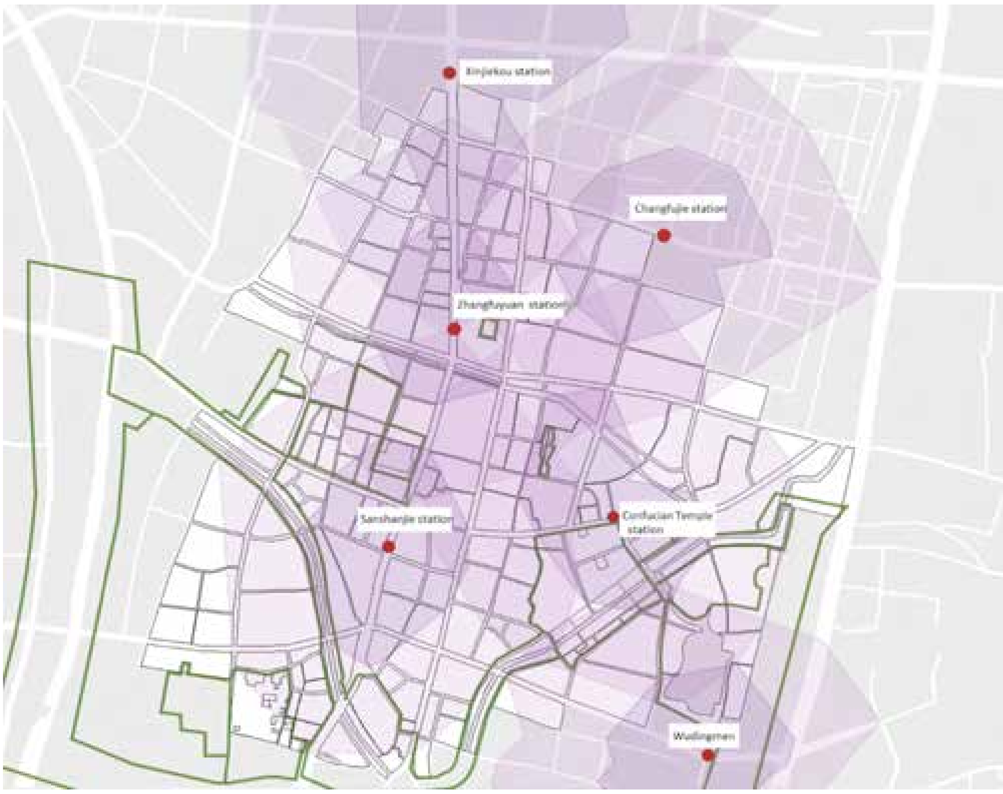
This study selects Shanghai, Nanjing, Tokyo, and Kyoto as case cities due to their shared characteristics of a high-density urban context, mature rail transit systems, and representative historical district conservation practices. The station study scope focuses on central urban areas, encompassing diverse locational relationships with historical districts and varying spatial scales to enhance the specificity of case analysis.

Table 2. Selected rail transit case study sites.

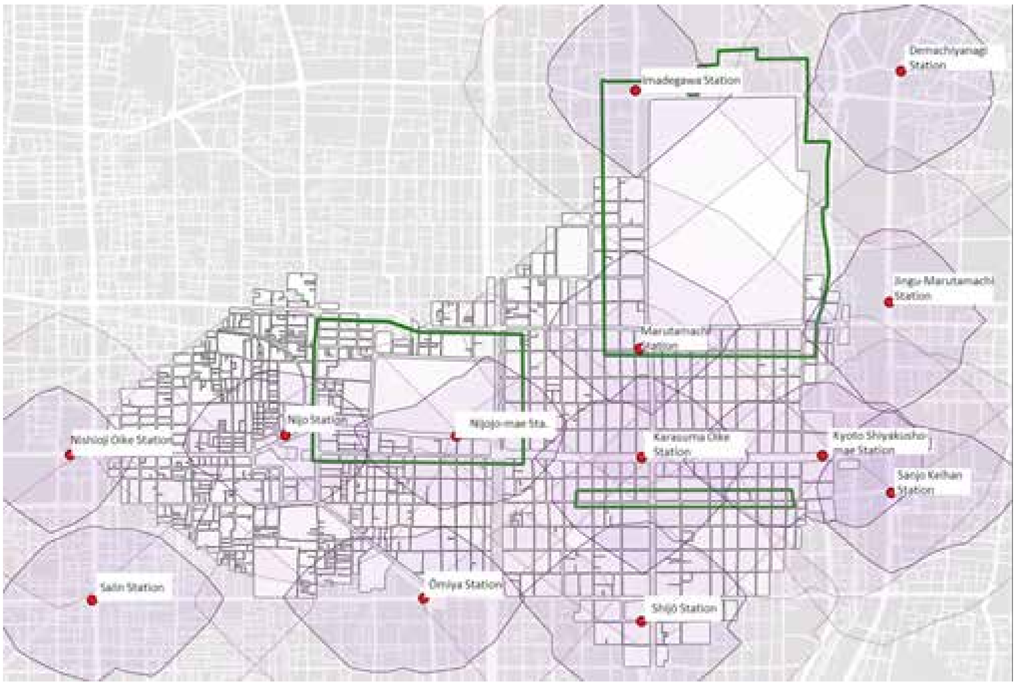
City	Historic District Name	Station	Location within Historic District			Number of Transfer Lines
			Inside	Periphery	Outside	
Shanghai	People's Square Historic Cultural Area	People's Square	√			3
		Dashijie			√	2
	Nanjing West Road Historic Cultural Area	Nanjing West Road	√			3
	Hengshan Road–Fuxing Road Historic Cultural Area	Jing'an Temple		√		3
		Shaanxi South Road	√			2
		New World		√		2
		Huangpi South Road			√	2
	Yuyuan Road Historic Cultural Area	Zhongshan Park			√	3
Nanjing	Southern City Historic Area	Sanshan Street	√			1
		Fuzimiao		√		1
		Zhangfuyuan			√	1
Tokyo	Tanimachi Temple–Ueno–Koyo-en Temple Traditional Architecture Area	Chikko Wood	√			1
		Nezu		√		1
		Toho University			√	1
Kyoto	Historical Heritage-Type Aesthetic Area	Umon Okuie			√	2
		Nijo			√	2
		Nijō-jō Omote	√			1
		Marutamachi		√		1



(a) Shanghai



(b) Nanjing



(c) Kyoto

(d) Tokyo

station | construction control area | 5-minute isochrone | 10-minute isochrone

Figure 3. Study area of case study sites in various cities

3.2 Data Sources
The foundational urban data for Japanese cities in this study are sourced from the PLATEAU open data portal (https://www.mlit.go.jp/plateau/open-data/) of Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT). For Chinese cities, building data were obtained from Baidu Maps, while plot data were derived by importing open-source road network data from OpenStreetMap into ArcGIS for segmentation. Subsequently, metrics such as floor area ratio (FAR) and building density were calculated using ArcGIS.

To account for the temporal influence of construction sequences on the suitability of land development intensity, this study utilized high-resolution satellite/aerial imagery from different historical periods to compare the architectural texture of plots. Specifically, plots exhibiting significant changes in architectural characteristics—such as building height, density, and FAR—were annotated. This enabled the classification and comparative analysis of all plots based on their periods of redevelopment. The historical aerial imagery was sourced from the Geospatial Information Authority of Japan (GSI) (https://service.gsi.go.jp/map-photos/app/), Google Maps, and the USGS Lockheed Martin (Keyhole) satellite imagery archive.

3.3 Methodological Framework
This study conducts a comparative analysis of how multi-station isochrone overlays influence development intensity distribution around historic district transit stations, primarily through the following two pathways:

Pathway 1: Inter-City Comparison
By constructing a multi-city comparative framework, this pathway examines the similarities and differences in development intensity distribution among cities, considering their distinct urban development models and policy orientations. The analysis operates at a macro level to identify patterns influenced by regional contexts.

Pathway 2: Temporal Sequencing Comparison
This pathway employs a dual-time axis analytical framework to integrate the temporal sequence of construction with the cycles of conservation and planning policies. It emphasizes the spatiotemporal evolution of land development intensity, revealing the interactive relationship between urban construction activities and institutional planning mechanisms. This approach provides empirical evidence to elucidate the historical pathways shaping the intensity of land use.

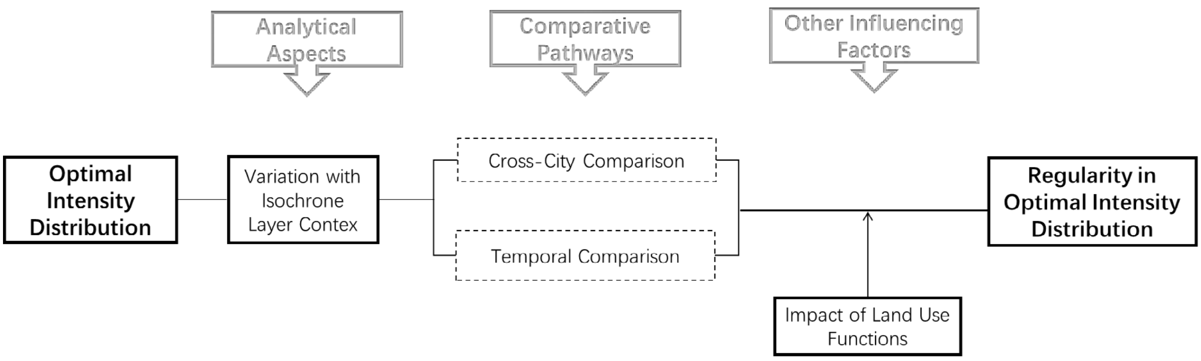


Figure 4. A comparative multi-path analysis framework.

4. Inter-City Comparison: Policy-Oriented Correlation of Development Intensity Distribution
Through comparative analysis of floor area ratio (FAR), maximum plot height, and building density in the vicinity of historical stations in Shanghai, Nanjing, Tokyo, and Kyoto, this study reveals significant spatial differentiation patterns and policy-oriented disparities in development intensity and urban form characteristics across the four cities.

4.1 Floor Area Ratio (FAR) Comparison

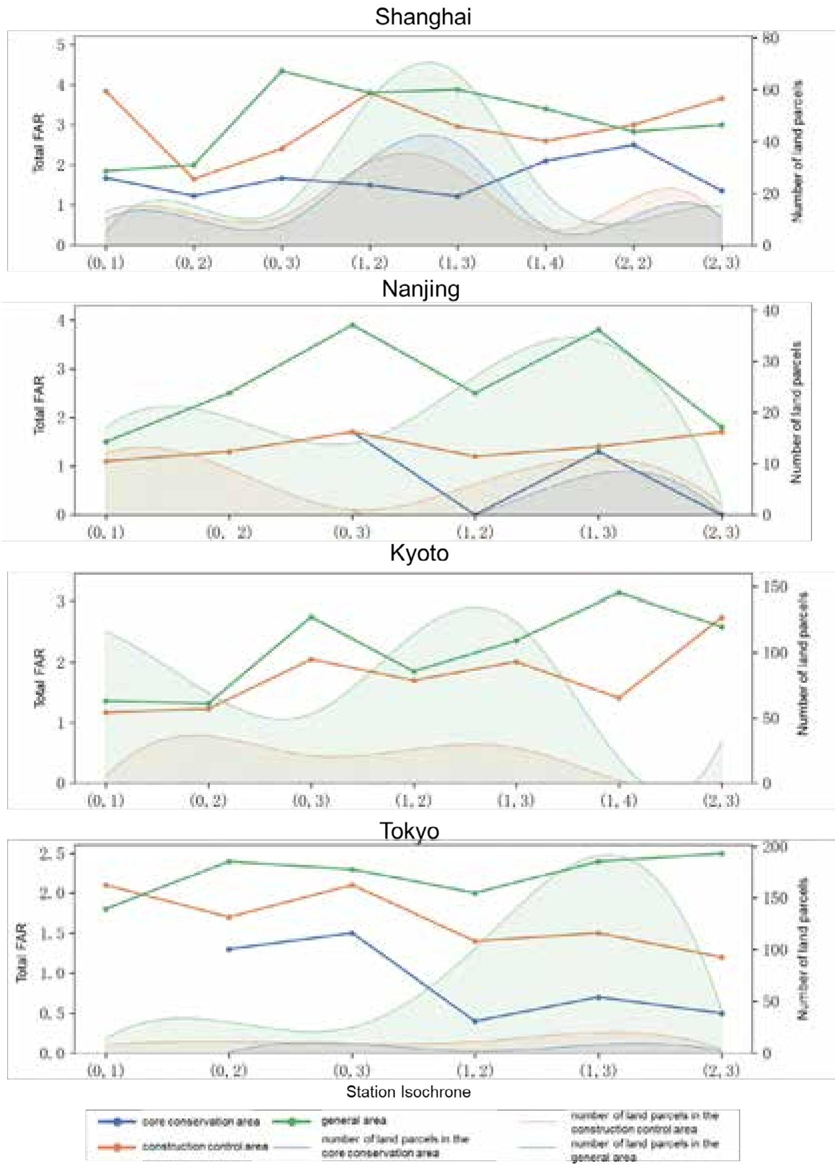


Figure 5. Comparison of floor area ratios (FAR) in four cities.

In terms of absolute FAR values (Figure 5), Shanghai exhibits the highest development intensity, with general areas and construction control zones predominantly ranging between 2–4. Nanjing follows a similar pattern, with general areas also ranging between 2–4, while Kyoto's general areas and construction control zones show lower values (1.5–3), and Tokyo demonstrates the lowest intensity overall (1.5–2.5). These differences reflect Shanghai's rapid urbanization and high-intensity development trajectory.

Spatial distribution patterns in relation to station proximity further highlight policy-driven distinctions. Across all four cities, a gradient variation in FAR is observed within core protection zones, construction control zones, and general areas. In Shanghai, Nanjing, and Tokyo, the disparity between general areas and construction control zones is particularly pronounced. Conversely, Kyoto exhibits a more nuanced gradient, with significant differences only in select regions. This underscores Kyoto's stringent protection strategies for its historical urban core, where cautious regulatory measures effectively mitigate the intensity gap between construction control zones and general areas, ensuring the continuity of the city's historical character.

Additionally, all four cities demonstrate notable FAR peaks in multi-isochrone overlapping areas—specifically, within (0, 3) and (1, 3) time-based concentric zones around stations (Figure 5). These peaks illustrate the cumulative effect of layered development intensity driven by overlapping station influences, highlighting the spatial superposition phenomenon in multi-station contexts.

4.2 Comparison of Maximum Building Heights by Plot

Building height, to some extent, reflects the urban form presented by plots within a city. The magnitude of height differences between areas indirectly indicates the variation in morphological characteristics. In terms of the absolute values of maximum plot heights (Figure 6), plots in Shanghai's General Areas and Development Control Zones, as well as Nanjing's General Areas, are significantly higher than those in Tokyo and Kyoto, predominantly falling within the 60-90 meter range. Furthermore, the height difference between Shanghai's Core Conservation Areas and its Development Control Zones/General Areas ranges between 20 and 60 meters, representing a significantly wider difference. In contrast, the height variation between different zones in Tokyo is within 5 meters, and in Kyoto, it is even less than 3 meters. This analysis reveals/has revealed that within the study areas of the two Japanese cities, morphological differences between different zones are minimal, resulting in a stronger overall visual coherence in the urban landscape. This finding aligns with the actual characteristics of the cities' urban form.

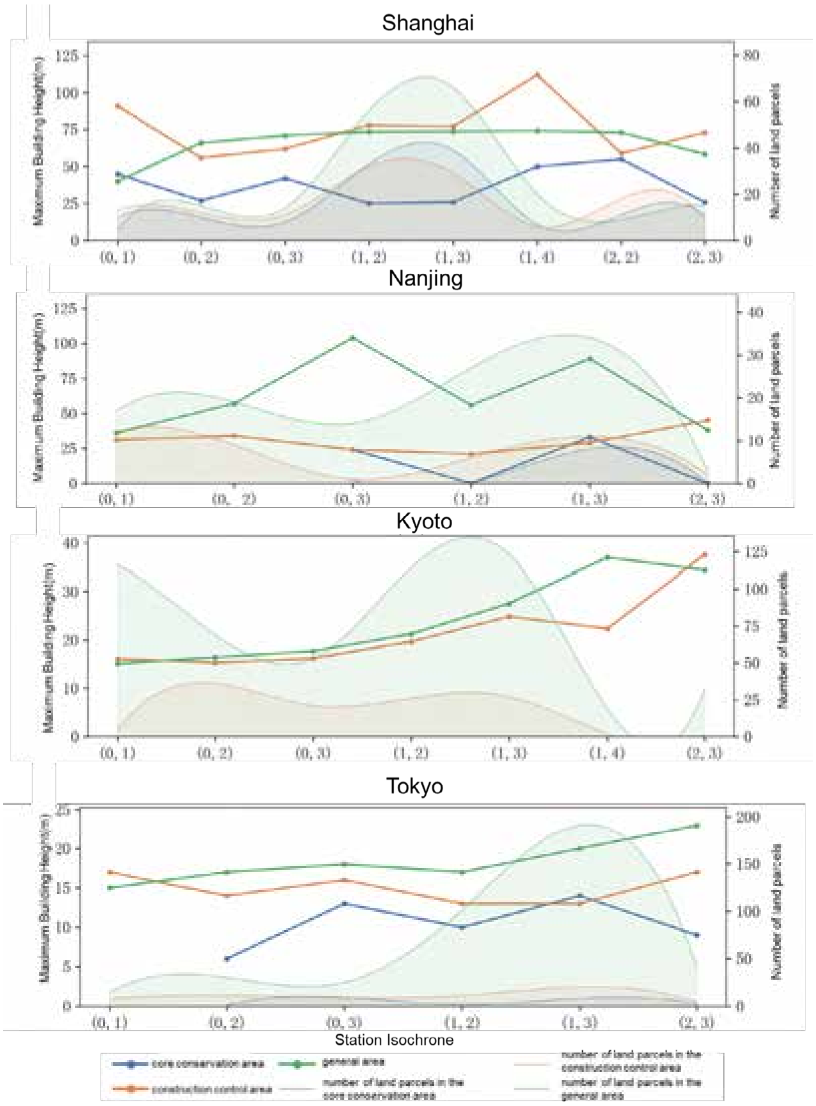


Figure 6. Comparison of maximum building height in four cities.

Regarding trends in building height changes, Shanghai exhibits pronounced fluctuations. Building heights demonstrate a high-low-high-low oscillation pattern as the isochrones expand. This pattern reflects the alternating occurrence of high-density, low-rise buildings and low-density, high-rise buildings during Shanghai's urban development process. Differing markedly from this, Tokyo displays a relatively stable trend in building heights, maintaining levels between 12 and 20 meters with minimal variation. This stability stems from restrictions imposed by historical and cultural preservation policies on both the density and height of land development in Tokyo, resulting in/leading to a limited potential for significant increases in building height. Kyoto's building heights exhibit a gradual upward trend, reaching a maximum of 37.6 meters. Notably, significant height increases occur in areas farther from the core, particularly in zones (1,4) and (1,3). This indicates that as isochrones expand, areas in Kyoto increasingly distant from the core, influenced by multiple stations, are gradually subject to/ experiencing greater development pressure.

4.3 Comparison of Building Density
Building density serves as a critical indicator of urban spatial form and textural characteristics. The Tongji University team led by Zhuang Yu (Zhuang et al., [reference number]) previously conducted empirical research, categorizing sample blocks in Shanghai's central urban area into typical morphological types such as low-rise high-density (historical heritage protection zones), mid-rise medium-density, high-rise low-density, and high-rise medium-density. This classification validated the correlation between building density variations and regional landscape characteristics.

In terms of absolute values (Figure 7), Tokyo and Kyoto exhibit significantly higher building densities compared to Shanghai and Nanjing, consistently maintaining levels between 60–70%. This reflects the spatial strategies of these two Japanese metropolitan areas, which prioritize high-density development to achieve efficient land resource utilization. Notably, the construction of subways has not disrupted the established urban fabric, demonstrating the coexistence of intensive development and preserved historical character.

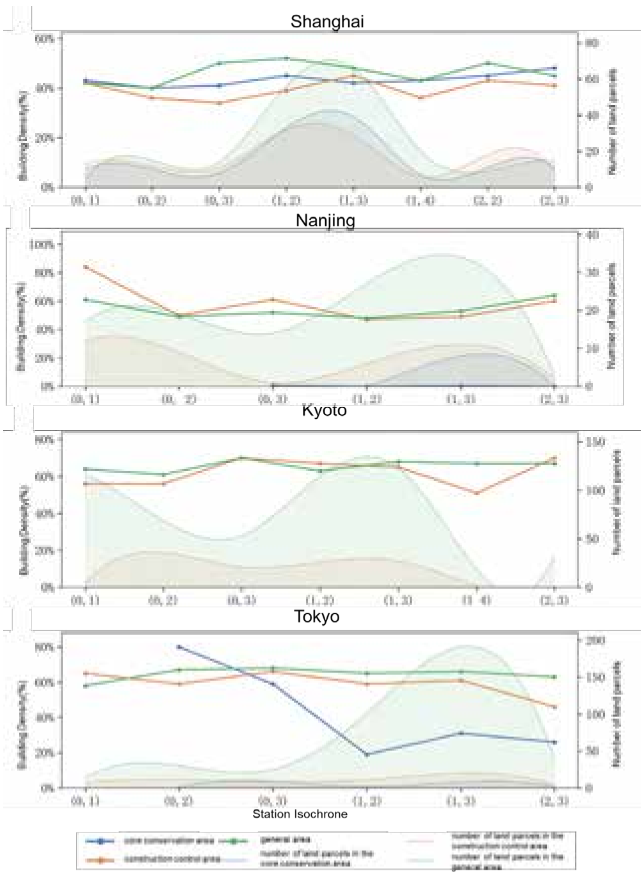


Figure 7. Comparison of building density in four cities.

In terms of density variation trends, Shanghai exhibits marked fluctuations, with significant disparities in building density between core protection zones, construction control zones, and general areas. This spatial differentiation is closely linked to the temporal sequence of urban land development and the dynamic updates of historical preservation policies—divergent development priorities across different periods have resulted in substantial spatiotemporal disparities in building density.

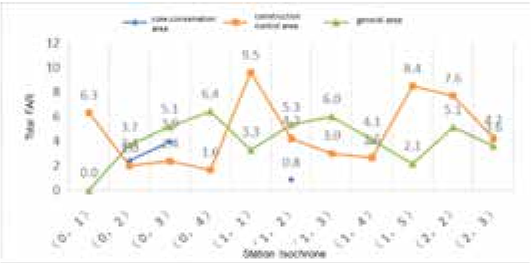
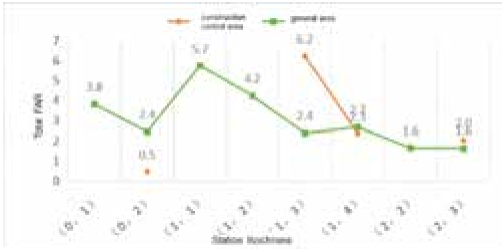
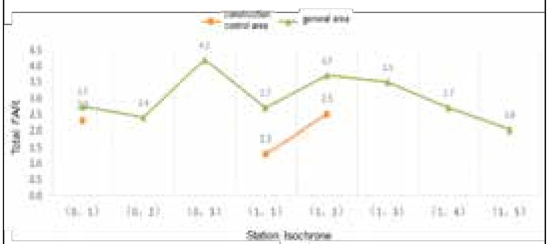
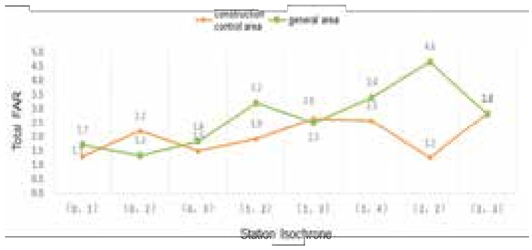
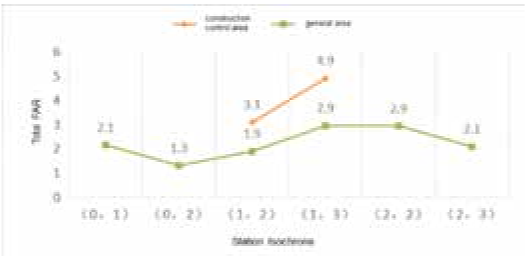
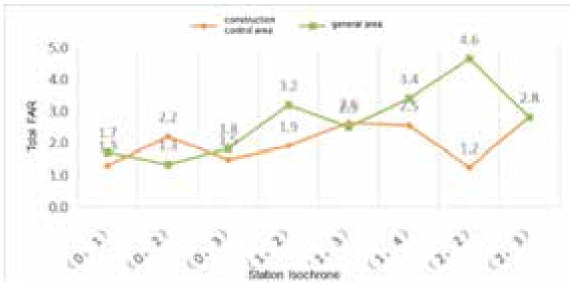
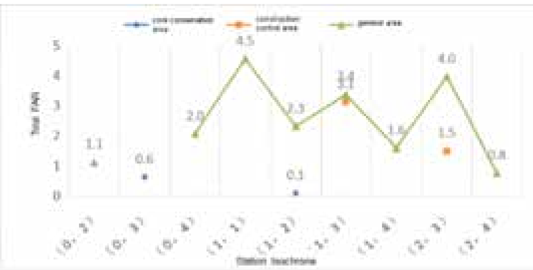
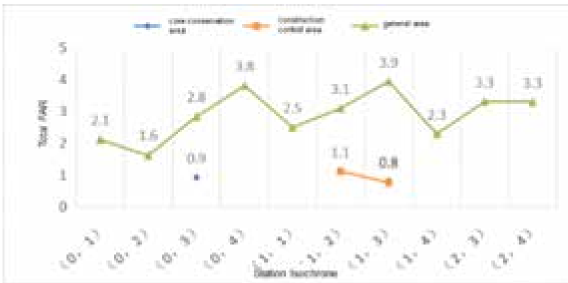
In contrast, Tokyo and Kyoto demonstrate a progressive growth trend in building density. Tokyo reaches a stabilized density of 70% in areas within the (1, 3) isochrone range, reflecting effective control over density thresholds during development. Kyoto's density distribution curve mirrors Tokyo's pattern but achieves stronger overall coherence in preserving the historical street fabric through a gradual, incremental increase in density gradients (Figure 7).

5. Temporal Comparison: Assessment Principles Based on Construction Chronology
The comparative analysis reveals that the chronological relationship between the implementation of conservation planning and rail transit construction timelines in different cities significantly influences the distribution of development intensity in urban blocks surrounding historical station areas.

Table3. A Temporal comparison of development and conservation sequences in case study cities.

	Shanghai	Nanjing	Kyoto	Tokyo
Timeline of Conservation Planning Implementation	1991: Designation of historical character protection zones; 2003: Revised core protection and construction control boundaries under the Shanghai Historical and Cultural Landscapes and Excellent Historic Buildings Protection Regulations.	1984: First Nanjing Historic City Conservation Plan designating Qinhuai River scenic zones as priority protection areas; 2010: Expanded to three historic urban cores, nine historic districts, 22 historic landscapes, and 10 general heritage sites with strict height controls.	1972: Designation of Aesthetic Zones under the Kyoto Urban Landscape Regulation Ordinance; 1973: Designation of Height-Control Zones.	1984: Grassroots preservation initiatives; 2000: Sugamo-Ueno-Sakuragaoka Urban Development Charter established .
Timeline of Station Construction	1993: Line opening; 1996: Station completion.	2005: Opening of Metro Line 1.	1981: Kyoto Subway Uzumasa Line operational; 1997: Opening of the East-West Line.	1969: Kanda and Rootsu Stations operational; 1996: Todai-mae Station operational [Todai-mae Station, 2025-05-04].
Type	Retroactiv0e Conservation Model	Proactive Conservation Model	Proactive Conservation Model	Dual-Track Model
Characteristics	Metro construction preceded conservation planning, leading to significant fluctuations in development intensity. Some areas failed to meet both heritage preservation and station development requirements.	Metro construction followed conservation planning. Post-planning, pre-construction redevelopment led to relatively homogeneous intensity distribution but limited synergistic interaction with stations.	Metro construction followed conservation actions. Restrictive redevelopment in construction control zones ensured landscape coherence, while general areas adapted to station development, reflecting zonal regulation strategies.	Metro construction preceded conservation planning. However, spatial constraints and community engagement mechanisms limited intensity increases in construction control zones, while general areas adapted to station development.

Table 4. Comparative analysis of land parcel intensity distribution across cities and time periods.

City & Model Type	Phases of FAR Distribution Changes	
Shanghai (Retroactive Planning)	 (a) Rail transit construction commencement – Pre-refinement of conservation planning	 (b) Post-refinement of conservation planning
Nanjing (Proactive Planning)	 (a) Conservation planning – Rail transit construction commencement	 (b) Post-rail transit construction commencement
Kyoto (Proactive Planning)	 (a) Conservation planning – Rail transit construction commencement	 (b) Post-rail transit construction commencement
Tokyo (Parallel Development & Conservation)	 (a) Rail transit construction commencement – Pre-initiation of conservation efforts	 (b) Post-initiation of conservation efforts: Concurrent development and conservation

5.1 Retroactive Planning Model
Although Shanghai's historical heritage protection system is relatively comprehensive and detailed by domestic standards, the temporal disarray between conservation and development has led to a "cross-waved" phenomenon in Table 4, where "historical districts" are juxtaposed with "high-rise buildings." Professor Zheng Shiling noted that "over the past two decades, high-rise buildings have been inserted into marginal areas of historical sites in Shanghai, often resulting in urban forms driven by profit rather than heritage, creating a fragmented spatial pattern where new and old structures intersect." Similarly, Professor Zhang Song of Tongji University observed that "Shanghai's old city renewal has never ceased, yet historical preservation has remained intermittent and localized." This inconsistency partly explains why Shanghai had to expand its protection scope and re-designate historical cultural landscapes in later planning stages to mitigate heritage loss.

5.2 Proactive Planning Model
In contrast, Kyoto, a model of Japanese historical cities, employed height zoning to regulate urban form prior to rail transit development (Table 4). This proactive approach ensured that post-development intensity remained within controlled thresholds, gradually adapting to station areas. The result was a harmonious coexistence of modernity and heritage, offering insights for optimizing development intensity in historical station zones:

(1) Proactive Planning Promotes Suitable Intensity Distribution
Kyoto's differentiated regulatory mechanisms—such as height zoning and development strategy zoning—established clear intensity gradients and controllable vertical differences. This framework balanced rail transit development with heritage preservation, enabling functional renewal while maintaining the coherence of historical districts.

(2) Moderate Intensity Gradients Between Zones
Rail transit influenced different zones unevenly: general areas and construction control zones exhibited distinct intensity variations.

However, Nanjing, another proactive model, demonstrated a more homogeneous intensity distribution in redevelopment areas before metro construction. Post-metro opening, development intensity did not align with the expected increase in isochrone overlap around stations. This discrepancy stemmed from Nanjing's rapid expansion during the late 20th to early 21st century, where infrastructure and building projects were concentrated without foresight for rail transit integration. Consequently, existing facilities and subsequent metro systems lacked functional compatibility, leading to missed opportunities for high-potential sites to leverage transit-driven intensity. This temporal misalignment is particularly evident in Nanjing's southern historical districts.

During periods of rapid rail network expansion, strict heritage policies constrained new construction heights, limiting floor area ratio (FAR) growth and weakening synergies between development and stations.

5.3 Dual-Track Model
Tokyo's Sugamo-Ueno-Sakuragaoka area (Yanaka, Ueno, Sakuragaoka) experienced slow redevelopment over 56 years since the Kanda and Rootsu stations opened in 1969. Unlike other regions, its renewal dynamics involved complex interplay of factors. A 1984 community-based preservation initiative marked a turning point, dividing the timeline into two phases:

Pre-Preservation Phase: Road networks primarily guided land use along corridors.
Post-Preservation Phase: Development shifted to the western general areas and the eastern side of the JR railway line, while historical zones (construction control and core protection areas) focused on "reproductive" updates—adaptive reuse of existing structures.

This duality created two intensity-balancing mechanisms: incremental updates and large-scale development. Consequently, regional intensity harmonized across broader zones, and post-mid-development synergies with stations emerged (Table 4).

6 Conclusion and Discussion
6.1 Station Cluster Effect

The findings demonstrate that in urban districts, a certain coupling relationship exists between station isochrone overlap (m, n) and development intensity (FAR, building density, building height).

(1) Positive Correlation Between Development Intensity and Isochrone Overlap
Across all cities studied, development intensity generally increases with the degree of isochrone overlap. For example, as isochrone overlap shifts from (0, 2) to (1, 4), development intensity intensifies accordingly. This trend aligns with Transit-Oriented Development (TOD) principles, emphasizing compact, high-density urban growth driven by dense subway station networks.

(2) Non-Linear Relationships Under Station Cluster Influence
Development intensity data across multiple cities exhibit fluctuating growth patterns and localized peak phenomena. For instance, FAR peaks at (0, 3) and building height peaks at (1, 4). These peaks indicate that development intensity does not follow a simple linear relationship with isochrone layers: an area overlapping a 5-minute isochrone may not necessarily exhibit significantly higher intensity than one overlapping a 10-minute isochrone.

From a spatial geographic perspective, station clusters—comprising multiple stations—generate stronger influence than single stations. Regions such as (1, 3) and (1, 4), where multiple 10-minute isochrones overlap, show substantial intensity fluctuations. This suggests that areas affected by overlapping station clusters possess higher development value and potential. Planners should prioritize these zones when formulating strategies to optimize urban intensity distribution.

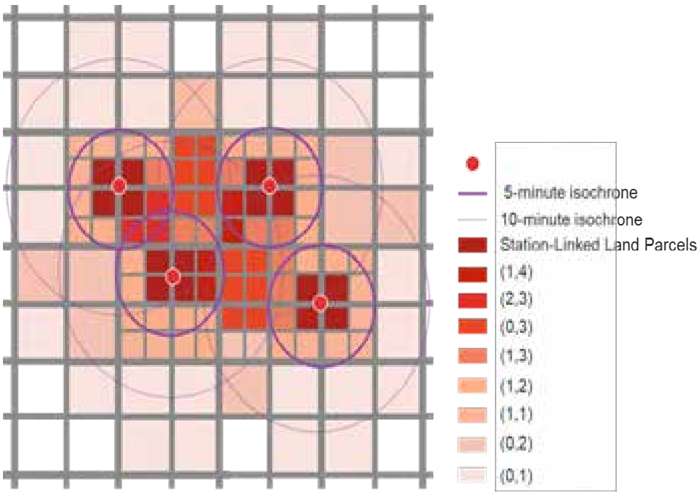


Figure 8. Schematic diagram of intensity distribution in general areas of kyoto.

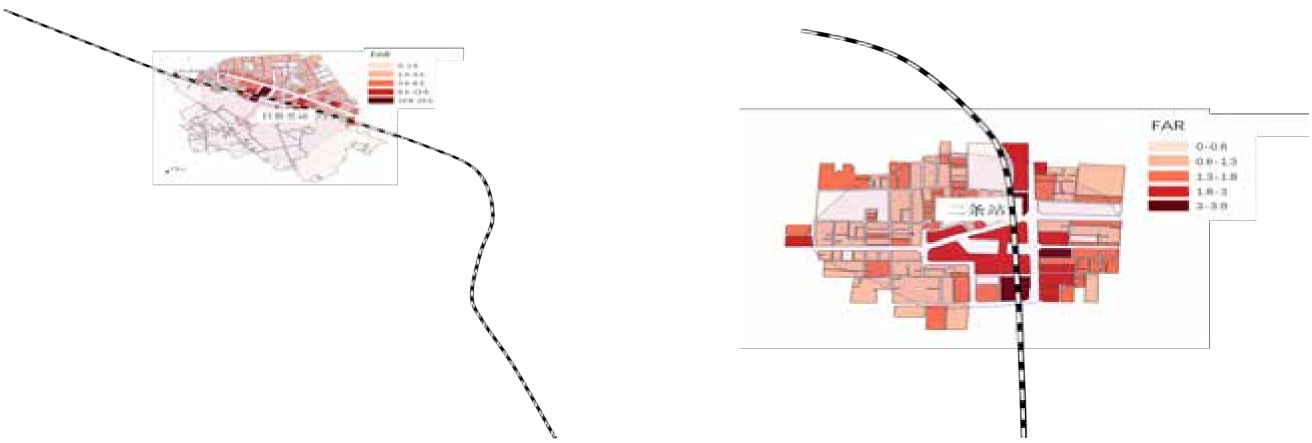
6.2 Formation of Appropriate Development Intensity
Core protection zones in historical districts prioritize heritage preservation, requiring development intensity to balance landscape conservation, functional vitality, and urban transit adaptability. Unlike ecologically protected regions, their regulatory logic emphasizes a dynamic equilibrium between historical context preservation and moderate renewal. Therefore, integrating and coordinating intensity across core protection zones, construction control zones, and general areas is critical. The comparative analysis across multiple cities and regions reveals the following key conclusions:

(1) Differentiated Intensity Gradients Across Protection Hierarchy
The analysis demonstrates a prevalent intensity gradient of "core protection zones < construction control zones < general areas" among historical districts. This pattern is particularly pronounced in Kyoto and Tokyo, where heritage preservation is well-maintained. As isochrone overlap levels escalate from (0, 1) to (1, 4), the disparity in development intensity between control zones becomes more pronounced. For example, in Kyoto, the FAR difference between general areas and construction control zones widens progressively with increased isochrone overlap. This phenomenon highlights that general areas benefit more from station-driven radiating effects, while construction control zones face constraints due to heritage regulations. Additionally, intensity gradients may be influenced by land-use characteristics and policy implementation timelines in specific contexts.

(2) Inter-Zonal Coordination and Overall Balance
The observed intensity gradients between zones enhance flexibility in development distribution around historical stations, enabling an overall balance across core protection zones, construction control zones, and general areas. This balance effectively reconciles conservation and development objectives.

Core Protection Zones: Strict intensity controls are essential to safeguard heritage integrity.
General Areas: Higher FAR or building density can optimize land use efficiency.
Construction Control Zones: A balanced approach is required—limiting intensity to preserve landscape coherence while allowing sufficient development space to avoid over-restriction and promote sustainable urban form.

The balanced relationship also exists within station areas. In individual stations in Kyoto and Tokyo (e.g., Hizuminokita Station in Tokyo, Nijo Station in Kyoto), it was observed that due to the integration of JR lines and subway lines at transfer stations, the presence of elevated tracks leads to significant spatial disparities in development intensity between the two sides. This results in one side exhibiting high-intensity development while the other remains low-intensity, creating a notable floor area ratio (FAR) transfer phenomenon within the station area.



(a) Nippori Station in Tokyo

(b) Nijo Station in Kyoto

Figure 9. The plot ratios on both sides of the special station demonstrate balance within the station area.

(3) Multi-dimensional Index Coordination and Appearance
The analysis above reveals significant regional differentiation in the impact of building density and height on floor area ratio (FAR): in core conservation zones, strict height restrictions constrain development intensity, which is primarily driven by building density. In contrast, in general areas with relaxed height controls, "low-rise podium + high-rise" mixed-use commercial complexes achieve high FAR through vertical expansion.

Diverse morphological mechanisms exist for high-intensity districts across cities. Kyoto attains high FAR via low-rise, high-density layouts, while Shanghai relies on high-rise, low-density configurations to achieve similar intensity levels. This indicates that under different regulatory contexts, multiple balancing pathways and spatial forms for development intensity coexist. Specifically, in general areas within the (0, 3) range, high-intensity development is often realized through "verticalization" strategies—increasing building floors while reducing density. Conversely, in construction control zones constrained by appearance coordination requirements, "horizontal expansion" models (prioritizing building density and limiting height) still achieve intensity balance. These differentiated index combinations signal a shift from single FAR constraints to multi-dimensional index coordination in development regulation.

6.3 Impact of Construction Sequencing on Intensity Distribution

(1) Conservation Planning and Rail Transit Construction Sequencing Determine Regulatory Effectiveness

Comparative analysis of development intensity distribution in updated plots across Shanghai, Nanjing, Kyoto, and Tokyo reveals that plot intensity varies temporally due to differing dominant factors. When conservation planning precedes rail transit construction (as in Kyoto's model), a "pre-defined control framework followed by adaptive development" mechanism emerges. This enables rigid control in conservation zones, moderate construction in buffer zones, and flexible, TOD-oriented development in general areas, forming a gradient model. This proactive coordination between construction and regulation is characteristic of such cities.

Conversely, when conservation planning lags behind rail transit construction (e.g., in Shanghai's study area), some plots in buffer zones already exhibit high-intensity development before designation, while others remain underdeveloped due to earlier construction. This results in stark intensity disparities between buffer zones and general areas, exemplified by adjacent high- and low-rise structures. Such spatial misalignment reflects planning delays and coordination failures. These findings underscore the need for conservation planning to prioritize foresight, comprehensiveness, and integration to avoid reactive regulation. Kyoto's "planning-first, development-adaptive" approach offers a replicable temporal coordination model for cities balancing historic preservation and rail transit expansion.

(2) Plot Differentiation Evaluation Under Temporal Relationships

Plot development intensity arises from long-term interactions of multiple factors, with construction and conservation sequencing as critical variables. Establishing plot classification evaluation principles based on these temporal relationships enables more precise identification of intensity imbalances, facilitating targeted optimization strategies.

(3) Identification of Appropriate Intensity Distribution Patterns

By comparing intensity distribution characteristics across cities with divergent planning and construction sequences and integrating urban appearance analyses, this study preliminarily reveals that "planning-precedence" models better support appropriate intensity distribution. For example, Kyoto's model demonstrates a reasonable intensity gradient between core conservation zones, buffer zones, and general development areas, with buffer and general zones synergizing with rail transit station development.

6.4 Conclusion

As most global cities transition from incremental construction to stock-based renewal, historic districts near rail transit stations face deepening tensions between preservation and development. This study, starting with plot-level zonal assessments and constructing an indicator system through comparative case analysis, identifies four key distribution patterns of development intensity in high-density historic station areas across cities. It elucidates interactive mechanisms among factors such as station size, layered land use, historical appearance protection, and construction sequencing, providing a reference for non-early-stage cities seeking appropriate intensity evaluations.

However, limitations persist: the broad geographic and temporal scope, coupled with restricted access to historical data, necessitate manual data collection. Further refinement is required for underground FAR estimation and the completeness of historical renewal records.

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