Exploration of a Mixed-Use Dual-Layer Control System for the Entire Lifecycle

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Abstract: As China's urbanization enters the era of re-development, the shift from single-purpose development to mixed-use development has become inevitable. The existing land use control system is ill-suited to the complexities of mixed land-use,lacking refined and effective control tools, dynamic feedback mechanisms in development process, and flexible planning and management procedures. In response to the imperative of lifecycle management of mixed-use development, this paper proposes a double-layered system that regulates both land uses and architectural functions. The proposed system includes unit and site layers, clarifying the roles and interfaces required for land use control at different stages of mixed-use land planning and construction management. It helps improve the forward transmission and reverse feedback mechanisms in land use regulation.

Keywords: mixed land use; land use control; full lifecycle; double-layered control

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As the process of urbanization progresses and the quality of urban and rural construction spaces is enhanced in China, the development of mixed-use urban land has become an inevitable trend. Consequently, the traditional land use control system, which was primarily based on single-purpose uses, has shown its inadequacy[1]. The demand for mixed-use development and control aimed at refined management of existing stock is increasingly emphasized.
To effectively regulate mixed-use development, it requires more than just the classification of

mixed-use categories. More importantly, it should involve an interpretation of the essence of mixed-use control from the perspective of the entire lifecycle, encompassing "planning management—land management—building control." Furthermore, it should discuss how to optimize and improve mixed-use control from a systemic construction perspective. Based on this viewpoint, this paper attempts to explore corresponding optimization strategies aimed at the whole process of mixed-use control.

1 Current Features of Mixed-Use Control in Urban Planning in China

1.1 From the Absence of Mixed-Use Control to the Reservation of Paths for Mixed-Use Regulation

In China, land use control has long adopted a tree-like hierarchical zoning classification system[2]. The most typical systems are the "Urban Land Classification and Planning Construction Land Standards (GBJ 137-1990)" issued by the Ministry of Housing and Urban-Rural Development and its subsequent revision, "Urban Land Classification and Planning Construction Land Standards (GB 50137-2011)," hereinafter referred to as "Land Standards." The characteristic of the tree-like classification system is the detailed subdivision of single uses, underpinned by the logic of functional zoning principles from the modernist movement. Clearly, this logic naturally conflicts with the mixed-use development of land.

In 2020, China's Ministry of Natural Resources issued the "Guidelines for the Compilation of City-Level National Land and Spatial Master Plans (Trial)" (hereinafter referred to as "City-Level Guidelines"). These guidelines propose that at the city-level national land and spatial planning level, "in accordance with the main functional positioning and spatial governance requirements, the urban functional layout and spatial structure should be optimized and planning zones delineated." The delineation of planning zones should be "based on the main functional positioning, reflect the planning intent, and be accompanied by corresponding control requirements." Accordingly, in the city-level national land and spatial master plans, planning zones that have a dominant function but incorporate a mix of uses can be used to express the planning's intent for functional layout and spatial structure. This approach, by utilizing optimization tools, overcomes to some extent the issues of overly singular use, rigid land use control, and contradictions with detailed planning inherent in the original planning classification system[3]. However, limited by the national guideline nature of the "City-Level Guidelines," specific regulatory requirements for planning zones have not yet been clearly defined.

In the detailed planning level of national land and space planning, the "Guidelines for the Classification of Land and Sea Use for Land and Space Survey, Planning, and Use Control (Trial)" issued by the Ministry of Natural Resources in November 2023 (hereafter referred to as the "Land and Sea Use Classification") considers the continuity with the original zoning classification system and still adopts a tree-like structure. However, the guidelines also specify that "according to actual management needs, additional mixed land use types and their detailed regulations can be added based on the classification in this guide." This means that localities can add mixed land use types according to actual needs and refine the corresponding regulatory provisions. However, similarly, the national guidelines only provide principled opinions and do not specify the specific mixed land use types and related control requirements.

In summary, at the national level, although the long-standing tree-like land classification has technically led to the absence of mixed-use control, with the rising demand for mixed land

development, the national guidelines under the context of national land and space planning have reserved the possibility of setting mixed uses in the zoning classification system. However, the corresponding regulatory details (i.e., how to set up mixed uses and how to achieve effective control) have not been specified, awaiting further innovation at the local level.

1.2 Exploration of Mixed-Use Control in the "Purpose-Scale" Dual Dimensions

In response to the growing demand for mixed land development, leading urbanization cities such as Shanghai, Guangzhou, Shenzhen, Wuhan, and Xiamen have started to explore differentiated mixed-use regulation based on the national unified land use control system, while also considering the demands of urban construction[4-8]. These explorations are mainly reflected in: clarifying policy guidance that encourages mixed land use development; using positive or negative lists to limit the land uses that can be developed in combination; and providing guidelines on the scale and proportion of mixed-use developments, while allowing some flexibility for discretionary decisions.

Firstly, a common approach is to create new land categories to explicitly allow mixed-use development, increasing the proportion of compatible uses for single-purpose land. For example, new categories such as M0, M4, and C65 have been introduced to meet the needs of emerging industries. Secondly, planning technical documents related to mixed-use development have been established to build regulatory systems with local characteristics. For instance, cities like Shanghai ①and Shenzhen② have set standards through planning technical guidelines, specifying the forms of mixed-use combinations, the proportion of mixed-use land, and the uses allowed for mixed development. Shenzhen has also defined areas where mixed-use development is encouraged and has developed general technical documents on mixed-use regulation. Meanwhile, cities like Wuhan③ and Xiamen④ have introduced management regulations and working plans for mixed-use development, offering guidance through lists of permissible uses, leading uses and their proportions, as well as corresponding management measures.

2 Current Inadequacies of Mixed-Use Control

2.1 Lack of Effective Refined Control Tools

A summary of the basic approaches to mixed-use control at both the national and local levels reveals that existing regulations mainly focus on controlling two key elements: the constituent land uses and their respective scale proportions. This involves specifying which single-use types can make up a mixed-use development for a particular plot of land (and, in some special areas, possibly including a negative list of prohibited uses), as well as setting limitations on the scale or proportion of each individual use within the mixed-use development, forming the basic control conditions for mixed uses. However, in actual development and construction, it is often found that the control of these two elements is far from sufficient to meet the demands for refined management, especially in urban core areas, transit stations, and other locations where there is frequent adjustment of the types and scales of functions within buildings.

2.2 Disconnection from Subsequent Land Development Management Phases

Planning management is only the preliminary phase of mixed-use land development and regulation. The complete lifecycle involves a series of phases, including "planning management—land management—building management," each focusing on different issues. For example, in the planning management phase, the primary focus is on controlling the types and scale proportions of mixed uses, while land management is more concerned with land transfer prices, and building management focuses on real estate ownership registration, among other aspects. Due to the lack of systematic consideration of control elements across the entire lifecycle, planning management becomes disconnected from subsequent phases, lacking effective communication and feedback pathways. As a result, it often passively responds to frequent adjustment requests from land management, building management, and other later stages, challenging the authority and scientific basis of the planning process.

2.3 Planning Management Struggles to Meet the Dynamic Demands of Land Development

In a market economy environment, land development and construction are dynamic processes, while planning preparation and approval procedures are relatively rigid. Faced with complex and dynamic adjustment needs during development, there is a "one-size-fits-all" management issue. The planning preparation content is often extensive, the procedures are cumbersome, and the approval cycles are long, making it difficult to adapt to the dynamic adjustment demands of land development[4].For example, in the 75 land control regulation adjustments announced for the Songjiang District of Shanghai from 2021 to 2023 (Table 1), 13 involved changes to commercial uses, 25 involved increases in public welfare uses, 13 were related to land parcel refinement, 20 were due to unclear planning intentions that required re-planning, and 4 involved a shift from single-use to mixed-use development. About half of the adjustments stemmed from the need for land parcel refinement and the expansion of public welfare land, which have different adjustment scopes and characteristics compared to changes in commercial land or redefinition of land uses. However, if all these adjustments followed the full procedures for land control regulation adjustments, the approval process would take about six months.In summary, the complicated procedures and lengthy timeframes required for land control regulation adjustments cannot keep up with the frequent and differentiated adjustment needs in actual development and construction, leading to high time costs for developers and wasting planning and review resources.

Tab.1 List of regulatory plan adjustment in Songjiang District , 2021-2023

Reason for Adjustment	Main Content of Adjustment	Land Use Nature Before Adjustment	Quantity
Change of Use (mainly involving commercial land)	Increase industrial R&D land	Scientific research and design land, Public green space	3
	Increase residential	Residential land, Industrial land	3
	Increase commercial	Special use land, Agricultural land	2
	Increase industrial land	Industrial land, Commercial land, Re	3

		serve land	
	Decrease mixed commercial-residential	Commercial land, Residential land	1
	Decrease mixed second and third class residential land	Residential land	1
Change of use (mainly involving the increase of public welfare land)	Increase public facilities	Educational land, green space, etc.	21
	Increase green space	Industrial land, residential land	4
Land parcel refinement	Addition of pedestrian path ways and activity areas	Commercial and office land, residential land, cultural land, etc.	4
	Land parcel refinement	Residential land, public green space, industrial land	9
Unclear development intentions during planning	Planned land	Land reserved for future development, Reserved land	20
Encourage mixed use	TOD development	Residential land, commercial and office land, etc.	1
	Mixed commercial and office use	Commercial land, public green space	2
	Mixed research and industrial development	Industrial land	1

Source: Compiled based on the public information from the Songjiang District Planning and Natural Resources Bureau website in Shanghai.

3 Constructing a "Land Use + Building Function" Dual-Layer Mixed-Use Control System

In the past, planning control primarily focused on incremental development activities, with the emphasis on mixed-use concentrated on types of use and their scale proportions. Although relatively extensive, this approach could still meet practical needs. However, as development has moved into a phase where incremental development and stock updates coexist, the existing tools of "use + scale" can no longer adapt to the current complex, dynamic, and differentiated demands of mixed-use control. There is an urgent need to superimpose land use and building function layers to form a refined mixed-use control system that addresses the entire lifecycle. This involves building on the existing land use control by introducing a "building function" dimension to establish a three-dimensional control tool [5]of "land use (and its scale proportion) + building function (and its scale proportion and spatial positioning)."It should be noted that control over building functions cannot be fully achieved through the planning management phase alone, but it is still necessary to establish a guiding framework for controlling building functions during this phase. The significance of this lies in providing a powerful tool for the refined

management of mixed uses, while also supporting coordination between planning management and subsequent phases such as land and building management. Accordingly, the focus of this section is on how existing use control can expand from a single-layer control system to one where land use and building function control coexist, and how to construct new forms of control.

3.1 Enriching the mixed forms of existing land uses, optimizing zoning classification standards

Building on the existing "tree-like" classification system, the traditional vertical zoning classification structure is broken down to create a zoning classification control system oriented towards mixed uses. The main optimization paths include: (1) Allowing single land categories to mix to a limited extent where there is no interference with each other. For example, in 2020, Shanghai issued the "Implementation Rules for Promoting High-Quality Utilization of Industrial Land in Shanghai (2020 Edition)," which increased the proportion of other industrial uses and supporting living facilities to 30% of the total above-ground building volume, with the proportion for retail, dining, dormitories, and other supporting living facilities not exceeding 15% of the total above-ground building volume. (2) Reserving space within the existing classification system for the creation of mixed uses, and allowing single-use major categories (or subcategories) to be downwardly compatible with mixed-use subcategories (minor categories), thus breaking the closed hierarchical logic of the original tree-like system. (3) Establishing general technical guidelines for the appropriate (or inappropriate) mixing relationships between uses, providing a scientific basis for the creation and planning discretion of mixed uses.

3.2 Layering land use with building functions to form composite control guidelines

By overlaying permitted building functions on the basis of land use, a composite control matrix is formed, thereby establishing a guide for the correspondence between uses and functions. This guides the suitability, conditional suitability, or unsuitability of land uses with certain building functions, providing a basis for planning discretion. It is important to note that in the planning management phase, the "Land Use + Building Function" control guidelines still primarily adhere to use control, further restricting building functions based on defined land uses. Based on the use-function guide table, additional restrictive conditions can also be included, such as the upper and lower limits of the area and proportion of building functions allowed under conditional mixed use, or the developable floors, which can be supplemented in the guide table (as shown in Table 2). This guide table can also be considered as part of the technical description for unit planning, translating general guidelines into more specific diagram explanations suitable for the characteristics of different plots, thereby providing guidance for the detailed planning of functions and indices at the plot level.

3.3 Establishing layered building function controls and exploring pathways for permission of functional changes

The "Use-Function" control implies a shift in thinking from a planar to a three-dimensional perspective. Firstly, in terms of functional limitations, land uses mixed on a planar level should be deconstructed into three-dimensional building functions, and spatial guidelines for permitted (or not permitted) development of building functions should be established, thus creating a building layer function control system. Layered control of building functions extends planning control to subsequent phases such as land and building guidance, sets a framework for land sales and

property title establishment, ensures effective transmission of land use and building functions, and reduces the need for planning adjustments caused by disconnections between planning management and subsequent management phases.

It should be noted that in the planning management phase, layered building function control serves only as guidance and a framework. To avoid further rigidity in use control, it is urgent to establish a corresponding relationship between building function changes and the planning approval process, exploring a "Function Change Permit System." This system clearly defines which changes between building functions and to what scale constitute (re)development activities. Accordingly, for functional changes that do not constitute (re)development activities, there is no need to reapply for planning permission or initiate a planning adjustment process[9].Thus, while introducing layered building function controls in the planning phase, a certain degree of flexibility is retained by establishing a function change permit system, achieving a balance between refined control and overly strict regulation.

4 Establishing a Mixed-Use Control Mechanism Aligned with the "Land Use + Building Function" Dual-Layer System

The "Land Use + Building Function" dual-layer control system can, to some extent, meet the demands for refined development and governance of existing land, as well as lifecycle use control. However, the core of establishing and effectively implementing the dual-layer control system lies in creating a control mechanism that is flexible, considers subsequent management phases, and incorporates dynamic feedback between the initial and subsequent phases. This is specifically reflected in the following aspects.

4.1 Layered Management: Establishing a Unit + Plot Detailed Planning and Management System

In most regions of China, mixed-use regulation primarily relies on regulatory detailed planning as a planning tool. This involves using planning diagrams to define the land use type, mixed-use proportions, and development intensity indicators for plots. These indicators serve as the basis for subsequent land transfer contracts, land transfer fee calculations, and real estate registration and title confirmation. However, the diagrams in regulatory detailed planning are often highly rigid and frequently struggle to address uncertainties in land development[10-11]. An increasing number of scholars [12-13] suggest that to address this uncertainty, a dual-level mixed-use regulatory planning system should be established, comprising a "Unit Regulatory Detailed Plan" (hereinafter referred to as "Unit Plan") and a "Plot Regulatory Detailed Plan" (hereinafter referred to as "Plot Control Plan"). Specifically:① The Unit Plan is initiated after the completion of the overall planning and precedes development activities. Its primary objective is to implement the strategic intentions, structural control requirements, and functional layouts outlined in the national land and space master plan. It aims to provide expectations for the city's future development, facilitating development entities in making informed decisions. Therefore, the Unit Plan focuses on determining the dominant functions, total development capacity, and planning baselines [14-15].In terms of mixed-use regulation, the Unit Plan can guide the functional

Tab.2 Permitted mixed building functions (for illustration only)

序号	土地用途 建筑功能	居住用地			公共设施用地		工业用地		
		第一类居住	第二类居住	第三类居住	商贸办公	教科文卫	第一类工业	第二类工业	第三类工业
1	低层独立式住宅	√	√	○	×	○	×	×	×
2	其他低层居住建筑	√	√	○	×	○	×	×	×
3	多层居住建筑	×	√	√	×	○	○	×	×
4	高层居住建筑	×	○	√	×	○	○	×	×
5	单身宿舍	×	√	√	×	√	√	○	×
6	居住小区教育设施 (中小学、幼托机构)	√	√	√	×	√	○	×	×
7	居住小区商业服务设施	○ 规模不超过总规模的 10%，且楼层限于 1—2 层	√	√	√	√	√	○	×
8	居住小区文化设施(青少年和老年活动室、文化馆等)	○	√	√	√	√	○	×	×
9	居住小区体育设施	√	√	√	×	√	○	×	×
10	居住小区医疗卫生设施(卫生站、街道医院、养老院等)	√	√	√	×	√	○	×	×
11	居住小区市政公用设施 (含出租汽车站)	√	√	√	√	√	√	√	○
12	居住小区行政管理设施 (派出所、居委会等)	√	√	√	○	√	√	○	×
13	居住小区日用品修理、加工场	×	√	○	○	○	√	○	×
14	小型农贸市场	×	√	○ 楼层限于 1 层，需与居住建筑采取相应隔离措施，规模不超过 600 m^2	×	×	√	○	×
15	小商品市场	×	√	○ 楼层限于 1 层，需与居住建筑采取相应隔离措施，规模不超过 500 m^2	○	○	√	○	×
16	居住区级以上(含居住区级，下同)行政办公建筑	×	√	√	√	√	√	○	×
17	居住区级以上商业服务设施	×	√	√	√	×	○	○	×
18	居住区级以上文化设施(图书馆、博物馆、美术馆、音乐厅、纪念性建筑等)	×	○	○	○	√	×	×	×
19	居住区级以上娱乐设施 (影剧院、游乐场、俱乐部、舞厅、夜总会)	×	×	×	√	×	○	×	×
20	居住区级以上体育设施	×	○	×	×	√	√	×	×
21	居住区级以上医疗卫生设施	×	○	○	×	√	○	×	×
22	特殊病院（精神病院、传染病院）——需单独选址	×	×	×	×	○	×	×	×
23	办公建筑、商办综合楼	×	○	○ 不应与居住建筑功能共用同一楼层	√	○	○	×	×
24	一般旅馆	×	○	○ 不应与居住建筑功能共用同一楼层	√	○	√	×	×

Note:√ Permitted to set,× Not permitted to set, ○ May or may not be permitted to set, subject to determination by the urban planning management department.

composition of mixed uses, control the overall scale of mixed uses, and manage the structural layout.② The Plot Control Plan is used to regulate and guide land development, focusing on determining specific land uses, mixed-use proportions, and development control requirements. These control requirements are incorporated into land transfer contracts as planning conditions, serving as the basis for land pricing calculations and the foundation for subsequent land management processes.To address conflicts between planning and subsequent phases, the Plot Control Plan can be formulated after the general land development intentions are determined. This allows it to better align with the specific needs of land developers within the regulatory framework established by the Unit Plan, thereby providing support for subsequent management phases and avoiding the uncertainties caused by pre-emptive planning before plot development.The previously discussed "Land Use + Building Function" dual-layer control system

should be introduced at the level of the Plot Control Plan, rather than at the level of the Unit Plan.

4.2 Coordination Mechanism: Establishing a Full-Cycle Linkage Control Chain for Mixed-Use Development

To address the demands of mixed-use development, streamline the control chain, reserve interfaces for subsequent phases during earlier stages, and establish dynamic and phased planning management processes:① In the planning management phase, complete the preparation, implementation, and adjustment of mixed-use plot or regulatory unit plans, specifying the types, total amount, and proportional composition of mixed-use within the plot or unit. These serve as reference points for land transfer conditions. By overlaying building function control guidelines, guidance is provided for three-dimensional development of mixed functions.② The land management phase primarily relies on plot plans. With land transfer as the core activity, it determines the detailed land use, scale indicators, and use proportions for the plot, supporting the signing of land transfer contracts and the evaluation of land transfer fees.③ The construction management phase aims to implement plot planning indicators. Small-scale adjustments that do not constitute (re)development activities only need to be made during the real estate title confirmation process in construction management, with a simple filing in the planning management phase.

To address the characteristics of subsequent phases in mixed-use development and regulation, and in response to the current reality of frequent and large-scale changes in mixed-use practices, it is necessary to deepen the reform of use control and the planning permit system. This includes replacing the existing multi-layered approval mechanism with a joint review mechanism, establishing a coordinated mechanism between planning, land management, and construction management. The mechanism should clarify the corresponding planning control elements and actions for different land management and building management activities. On the basis of defining the constitutive elements of "(re)development activities," it further refines and distinguishes planning control actions. See Table 3.

4.3 Two-Way Interaction: Establishing Forward Transmission and Reverse Feedback Mechanisms for Use Control

The refinement of planning control actions aims to address the "change" demands for differentiated planning control conditions during mixed-use development. This involves establishing a differentiated planning preparation and approval pathway, along with a corresponding management mechanism, that aligns with the full lifecycle of planning, construction, and management.Drawing on Shanghai's experience, operational execution can distinguish between planning levels and project levels to address different scenarios. A three-dimensional planning control system can be formed, comprising comprehensive procedures, simplified procedures, and project-specific procedures [16], with decreasing levels of preparation content, approval steps, and approval timelines.At the same time, a distinction should be made between forward implementation and deepening, and reverse planning adjustments [17].

Specifically, for plots requiring planning adjustments after the completion of regulatory planning, the first step is to determine whether they fall under public-interest land (e.g., public service

facilities, municipal infrastructure, affordable housing) or key development functions (e.g., strategic industries, major projects). For cases that align with planning objectives, do not produce "Not In My Backyard" (NIMBY) effects, involve small-scale changes, or have simple and clear adjustment indicators, the requirements for planning preparation content can be streamlined, approval processes simplified, and processing times for each stage shortened to improve approval efficiency [18].

Based on the specific impact and extent of execution for a project, different procedural and step requirements can be established. For example, these can correspond to comprehensive procedures, simplified procedures, or project-specific procedures. Alternatively, adjustments can be confirmed through the preparation and approval of detailed construction planning, the addition of necessary expert or professional department review processes, or direct confirmation through the planning approval process for construction projects. These differentiated procedural requirements are designed to address diverse "change" demands [16].

5. Conclusion

As urban development in China enters a phase where incremental development coexists with stock renewal, mixed-use land development has become an inevitable trend. The development of mixed-use land involves not only planning management but also multiple management stages, including land and buildings, with significant forward and backward transmission demands between stages. This places higher requirements on planning control.

To address these changes, on the one hand, planning control needs to become more refined, transitioning from the planar governance of land use control to a three-dimensional control system of "land use + building function." However, while pursuing refinement, it is essential to retain flexibility in planning management. By optimizing the existing control system, building function control interfaces can be introduced on the foundation of existing land use controls, enhancing the scientific rigor and standardization of planning discretion when responding to complex mixed-development demands.

On the other hand, it is urgent to explore reforms in use control and planning permit systems to streamline the control chain and achieve effective transmission of planning control to subsequent stages. When there is reverse feedback from subsequent stages, differentiated planning control processes should be designed to address specific needs, endowing mixed-use regulation with greater flexibility to adapt to increasingly complex and dynamic development management requirements.

Tab.3 Management and controls of mixed-use development in subsequent control stages (for illustration only)

	Planning Control Elements				Planning Control Actions [Constitute (Re)development Activities, Require Change Permits]
	Control Methods	Use/Function	Scale	Space	
Corresponding to Land	Plot Planning	Use Subcategories	Rigid Control, Flexible	Planar	For example: Use change or proportion adjustment exceeding 10% (planning

Management			Adjustment		approval)
Corresponding to Building Management	"Use + Function" Dual-Layer Control	Building Function	Flexible Guidance	Three-Dimensional	For example: Adjustment of planar or floor position (filing) Function proportion adjustment not exceeding 10% (filing), exceeding 10% (planning approval) Changes to specific functions within defined scale limits

Notes

① See *Technical Guidelines for Shanghai Regulatory Detailed Planning (2016 Revision).*
② See *Shenzhen City Planning Standards and Guidelines (2021).*
③ See *Wuhan City Planning Land Compatibility Management Regulations (2023).* It should be noted that the concept of mixed-use land differs from that of land compatibility. However, considering that the "partial compatibility" and "full compatibility" categories in the *Wuhan City Planning Land Compatibility Management Regulations refer to minimum* scale proportions of 30% and 100%, respectively, for mixing other land types into the originally planned land use of a plot, these essentially constitute mixed-use land. Therefore, this paper also treats these two categories as relevant regulations concerning mixed-use land.
④ See *Xiamen Mixed Industrial Land Pilot Work Plan (2022).*
⑤ To avoid conceptual confusion, "use" in the text refers to the function corresponding to land use, while "function" refers to the function corresponding to buildings.

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