

Comprehensive Enhancement and Renovation Strategies for Old Hospitals in Urban Central Areas: A Case Study of Huiai Hospital in Guangzhou

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Abstract. The renovation project of Huiai Hospital in Guangzhou serves as a typical example of comprehensive updating, overall planning, and phased construction for old urban hospitals. It addresses representative and complex issues encountered in the renovation of outdated hospitals. By analyzing cases of renovation in urban center old hospitals, this study identifies the constraints faced in hospital renovation, summarizes the complex issues in the construction of old hospitals, and proposes targeted renovation strategies. These strategies include vertical and horizontal development, establishing transportation interfaces, reorganizing planning structures, integrating regional characteristics, and coexisting of old and new elements. These insights provide a reference for future related hospital construction projects.

Keywords: Old hospitals, Renovation, Phased construction

1. Introduction

In recent years, there has been an increased investment in healthcare infrastructure across various regions, leading to a rapid growth in the number of hospitals. For instance, in Guangzhou, tertiary hospitals are predominantly concentrated in urban central areas such as Liwan District, Yuexiu District, Haizhu District, and Tianhe District. These historic districts have a high number of tertiary hospitals compared to other areas in the city. The long history of development in these central areas has resulted in a concentration of early hospitals, making them major centers for medical services.

As cities continue to develop, hospitals must adapt to the times through self-renewal. While old hospitals in these central areas benefit from various urban advantages, they also face numerous constraints and challenges. These include: (1) Capacity: Increased medical demand in central areas coupled with limitations on land availability for hospital expansion. (2) Quality: Poor building quality of old hospitals, layouts that do not meet current needs, and inadequate supporting facilities. (3) Technology: Advances in medical technology and new concepts such as energy conservation, green buildings, and resilience require new spatial requirements for hospitals. (4) Environment: Changes in the surrounding environment of old districts, such as traffic and environmental issues, exacerbate these constraints. (5) Development: The disorganized historical planning and construction of old hospitals, along with efficiency issues in their layouts, affect their adaptability and future development.

The renovation of old hospitals in urban central areas is influenced by various factors, including land expansion, internal planning updates, and external environment improvement. These issues are often interrelated. The common renovation models for old hospitals include: (1) Comprehensive Planning, Full Renovation, and Phased Construction: This model is used for large hospital areas. It involves expanding the hospital's scale by adjusting land use indicators or acquiring surrounding land, and implementing a phased renovation while the hospital continues to operate. For example, the renovation of the Fangcun Campus of Guangzhou Hui'ai Hospital. (2) Overall Planning and Partial Optimization: This model is applied to medium-sized or large hospitals. It involves local updates and optimization of the existing layout through partial demolition and new construction. This approach helps to shift functional focus and improve the campus layout, as seen in Guangzhou Red Cross Hospital and Guangdong Second People's Hospital. (3) Single-Building Construction: This model involves the construction or renovation of individual buildings within the hospital. It is

often a part of the phased or segmented renovation process due to constraints such as project approval.

Additionally, other renovation models include building new campuses nearby or elsewhere, and optimizing or relocating the functions of the old campus.

2. Planning and Phased Construction Model for Comprehensive Hospital Upgrades in Urban Centers

2.1 Case Study: Renovation of the Fangcun Campus, Huiai Hospital, Guangzhou

Huai Hospital (Guangzhou Medical University Affiliated Brain Hospital), established in 1898 by John Kerr, is the first psychiatric hospital in Asia and a leading mental health institution in China. Located at 36 Mingxin Road, Liwan District, Guangzhou, the Fangcun campus sits on the southern bank of the Pearl River within the new Huadi Ecological City. Covering a total land area of 42,283 square meters, the campus currently includes 48 buildings with a total construction area of 50,250 square meters and 1,200 beds. The renovation plan involves demolishing 41 buildings and retaining 8, with an overall upgrade of the campus. The revised project will have a total construction area of 93,778 square meters, including 55,590 square meters of new above-ground construction, 21,400 square meters of new underground construction, and 16,788 square meters of retained buildings. The number of beds will be reduced to 800. Major new constructions will cover 76,990 square meters and include the Minghui Building, Mingxin Building, Mingze Building, a comprehensive building, and a multi-functional conference hall. The retained area of 16,788 square meters will preserve 9 historical buildings, including Mingai Building and Huiai Building (a municipal cultural heritage unit).

2.2 Issues and Challenges at Huiai Hospital, Guangzhou

Huai Hospital, as a typical example of an urban center's old hospital undergoing comprehensive planning, full renovation, and phased construction, embodies several representative complex issues commonly encountered in the renovation of aging hospitals.

(1) Site Capacity and Service Shortfalls: The hospital occupies 39,856 square meters with an existing building area of 50,000 square meters and 1,200 beds. These figures fall short of modern psychiatric hospital standards. As a tertiary mental health institution in South China, Huiai Hospital must address the inadequacy of current facilities and space.

(2) Surrounding Environment and Traffic Constraints: Located in an old urban center surrounded by residential areas, the hospital faces narrow streets and insufficient parking. The main entrance on Mingxin Road is only 7 meters wide, and the rear entrance is on a 6-meter street. The lack of underground parking exacerbates accessibility issues.

(3) Disorderly Long-term Planning and Construction Chaos within the Campus: The hospital is an old facility that has been developed over a century, with buildings constructed in various periods. The campus features numerous low-rise buildings with low floor area ratios, high building densities, and low green space rates, along with protected historical and cultural buildings. The current structures are relatively low in height, have been in use for a long time, and exhibit poor quality. The internal layout, including floor heights, does not meet the requirements for modern medical layouts and fire safety standards (Fig. 1).

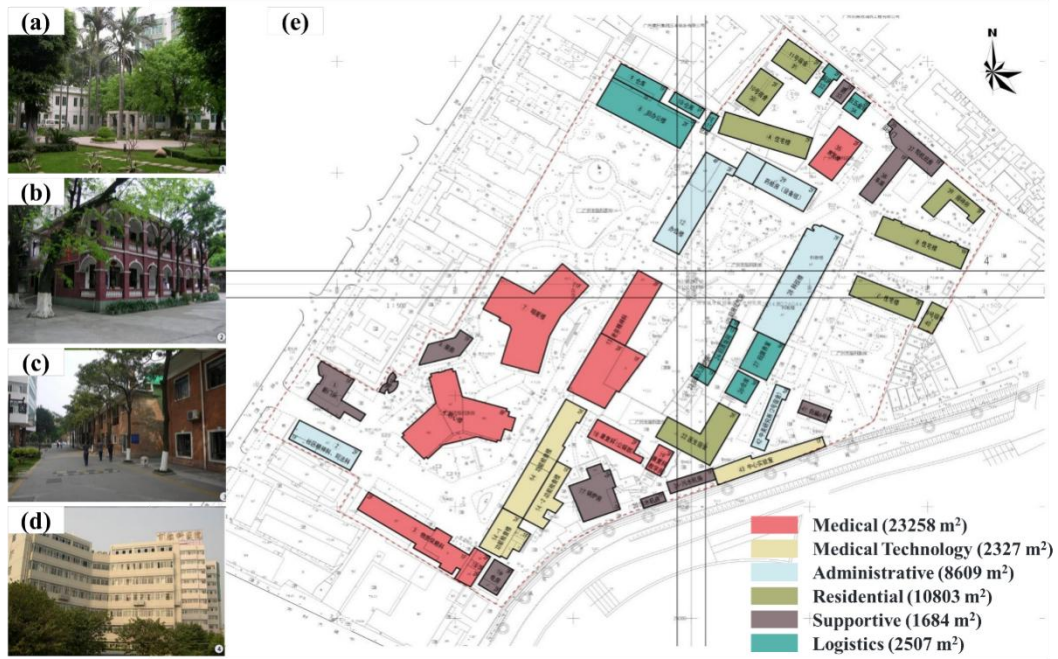


Fig. 1 Current building layout of Huiai Hospital in Guangzhou

The hospital layout lacks overall planning, with only a single linear road traversing all buildings. Currently, there is a mix of pedestrian and vehicle traffic within the hospital, and the flow of patients, staff, daily activities, logistics, and sanitary waste all depend on this main road, making it impossible to effectively separate and manage these different traffic flows (Fig. 2).

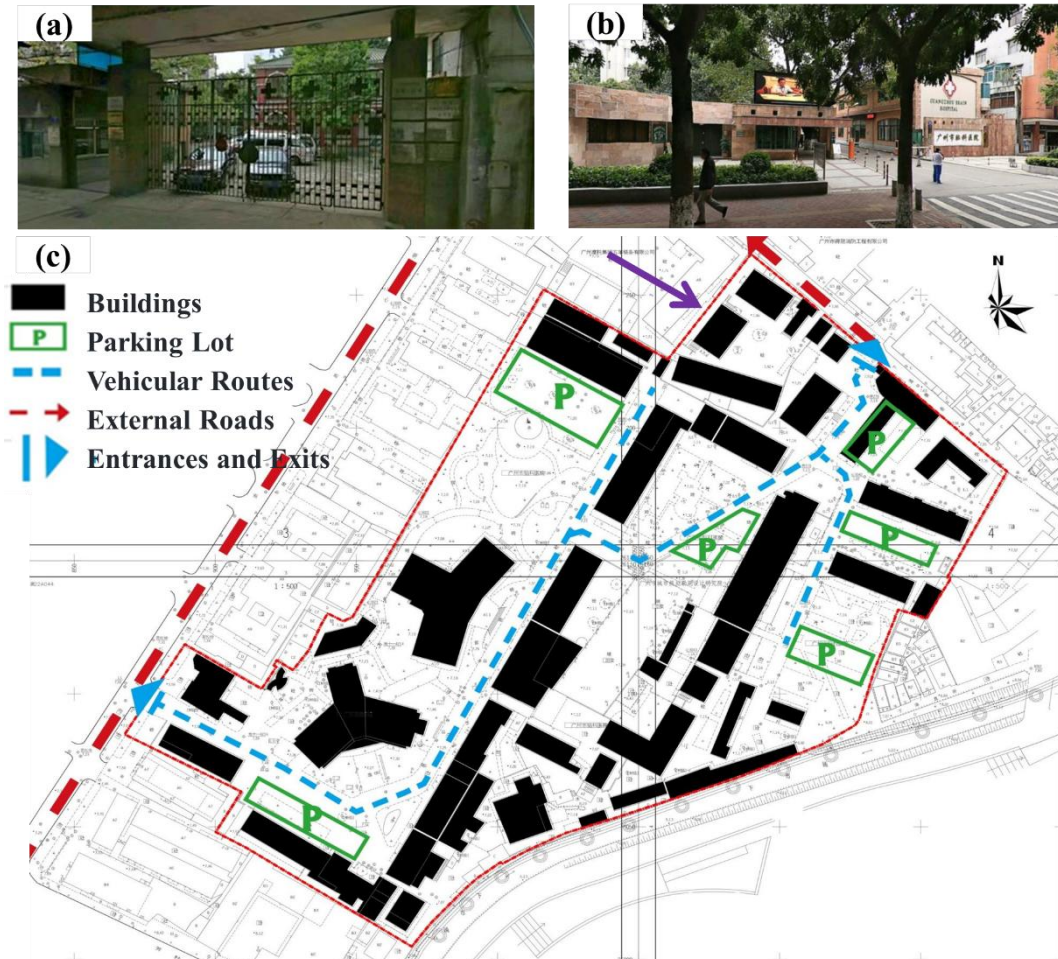


Fig. 2 Current traffic conditions of Huiai Hospital in Guangzhou

(4) Adjustment of Medical Development Direction: The hospital operates two campuses: Fangcun and Jiangcun. Fangcun focuses on public mental health services and research, while Jiangcun handles severe psychiatric cases and rehabilitation. Fangcun requires modernization to accommodate its evolving role and improve space utilization.

(5) Preservation and Utilization of Historical Buildings: The hospital is located on the banks of the White Swan Pond in the southern part of the Pearl River in Guangzhou, at the center of the Huadi Ecological City in the new urban core. It is situated within a key urban development area designed as a “fan-shaped” riverside green core and a linear green space system with Lingnan characteristics, and it faces the central area of the “White Swan Pond Urban Reception Hall” for the public. Guangzhou Hui’ai Hospital is the only large-scale public medical building within this central “fan-shaped” green belt, and the construction of the campus must comply with the landscape planning requirements for the White Swan Pond area (Fig. 3).

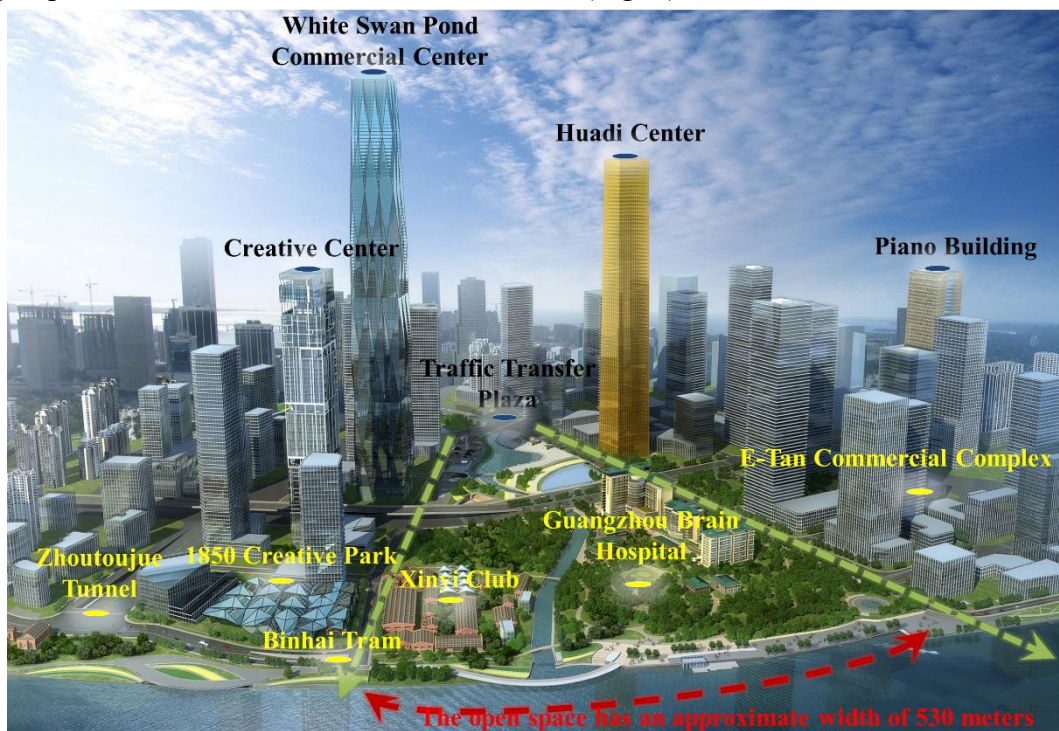


Fig. 3 Planning and control requirements for Guangzhou Huadiwan Ecological City

(6) Sustainability and Emergency Response: The renovation must meet smart hospital and green building standards, ensuring sustainability and readiness for emergency situations.

(7) Operational Continuity During Construction: As a key medical facility in an old urban area, the hospital must maintain normal operations during construction, ensuring stable utilities and environmental protections.

2.3 Urban Central Hospital Renovation and Response Measures

The renovation of the Fangcun campus of Guangzhou Hui'ai Hospital is complex, facing common and unique issues typical in central urban hospital construction. These include: (1) improving construction and hospital functions to meet its designation; (2) preserving and inheriting the historical architectural context of the old district to comply with the planning requirements of the White Goose Pond area; (3) ensuring normal operation during renovation and establishing a sustainable development plan for the future.

(1) Capacity of Constraints and Construction

Central urban hospitals often face limited land and small scale. The typical solution involves reasonable assessment based on constraints, adjusting land use regulations to meet the development

needs, and increasing the construction scale. The design employs a “dual-directional development” strategy: vertical development with high-rise towers and horizontal development by demolishing old buildings and optimizing layouts. This approach aims to create a well-planned medical building layout, enhancing efficiency (Fig. 4).

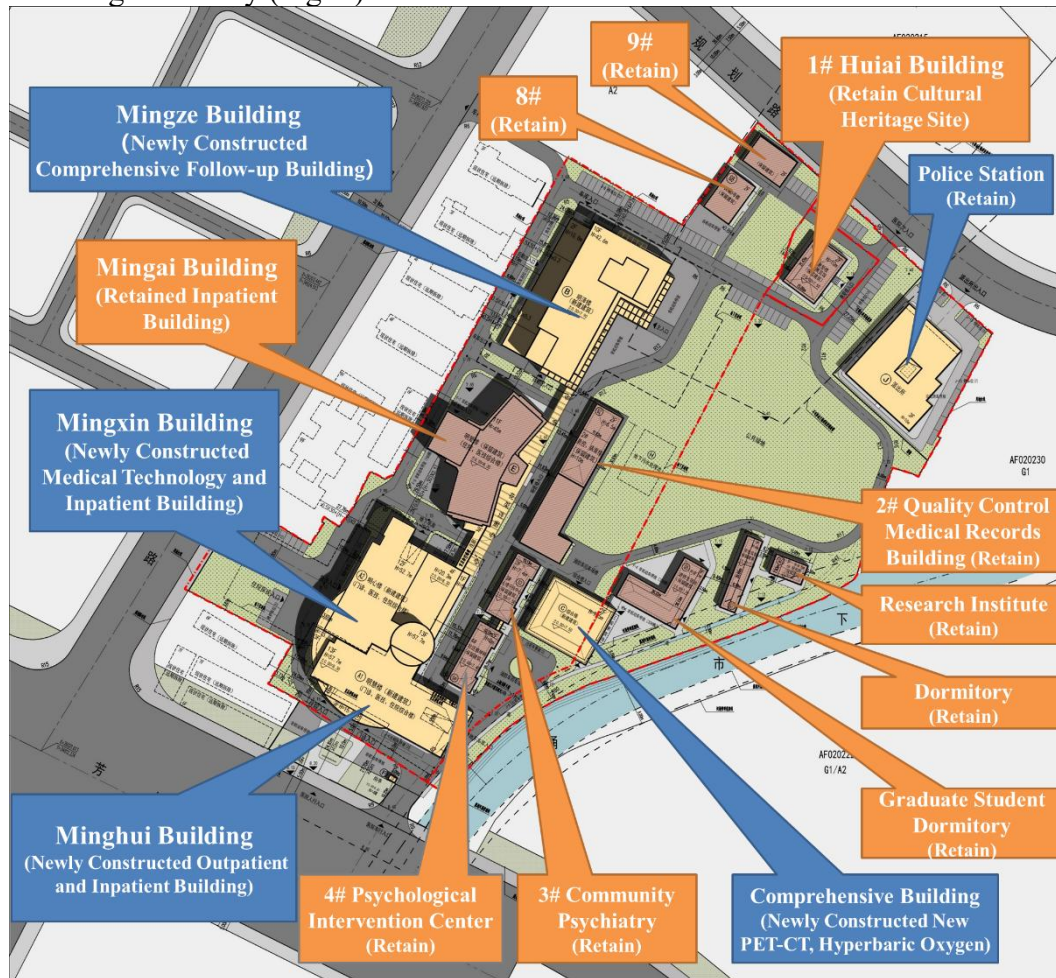


Figure 4: Overall layout plan of Huiai Hospital in Guangzhou

(2) External Environment Coordination with Urban Development

The solution to the external traffic issues of the hospital campus lies in optimizing the traffic flow by integrating the hospital’s planning and layout. This involves designing different functional entrances to address various modes of external traffic, including public transportation, private vehicles, ambulances, and service vehicles. By separating these traffic flows, providing adequate buffers, and ensuring orderly guidance, traffic conflicts can be minimized.

The campus planning expands the hospital entrance plaza to the south, connecting it to the main urban road, Fangcun Avenue. The southern entrance is designated as the primary access point for pedestrian and incoming vehicle traffic, while the western entrance serves as the exit for ambulances and other vehicles. The northern side features separate entrances for logistics and waste management. The campus includes three roadways: an outer ring road for one-way vehicle traffic, a central road for pedestrian traffic, and an elevated hospital corridor linking the main buildings, effectively achieving pedestrian-vehicle separation. Additionally, due to the site’s topography, clean and waste logistics are routed through an underground multi-level system. Furthermore, the overall layout of the hospital must integrate with urban planning roads, public infrastructure, and surrounding residential areas to establish external interfaces, thereby aligning with urban development and minimizing adverse impacts on the city (Fig. 5).

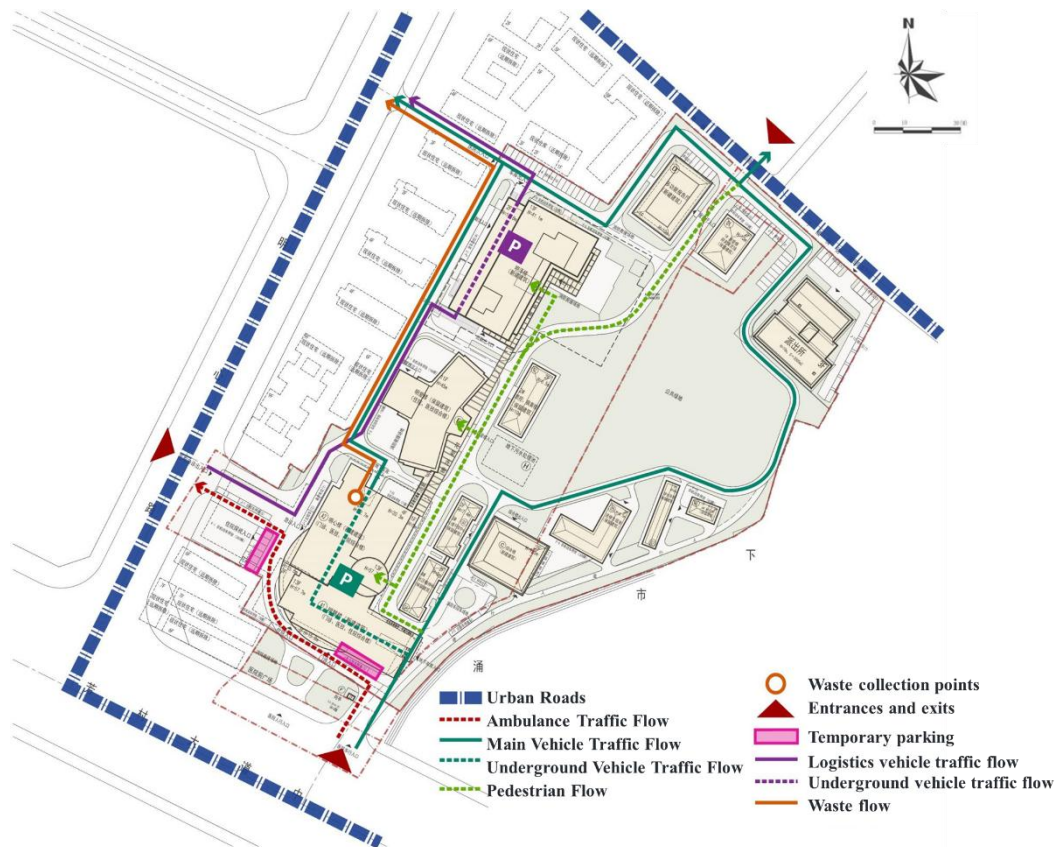


Fig. 5 Traffic flow planning and analysis diagram of Huiai Hospital in Guangzhou

(3) Coordination of New Hospital Planning with Regional Features and Historical Culture

Guangzhou Huiai Hospital has historically used a dispersed layout with unclear functional zoning. The renovation requires a phased approach, retaining the existing layout. The west side is designated for medical use, with historical buildings in the center and an ecological park on the east. The layout uses an “axis and two belts” scheme, dividing the area into medical and park zones, connecting with a historical and cultural axis and integrating new and preserved structures (Fig. 6).

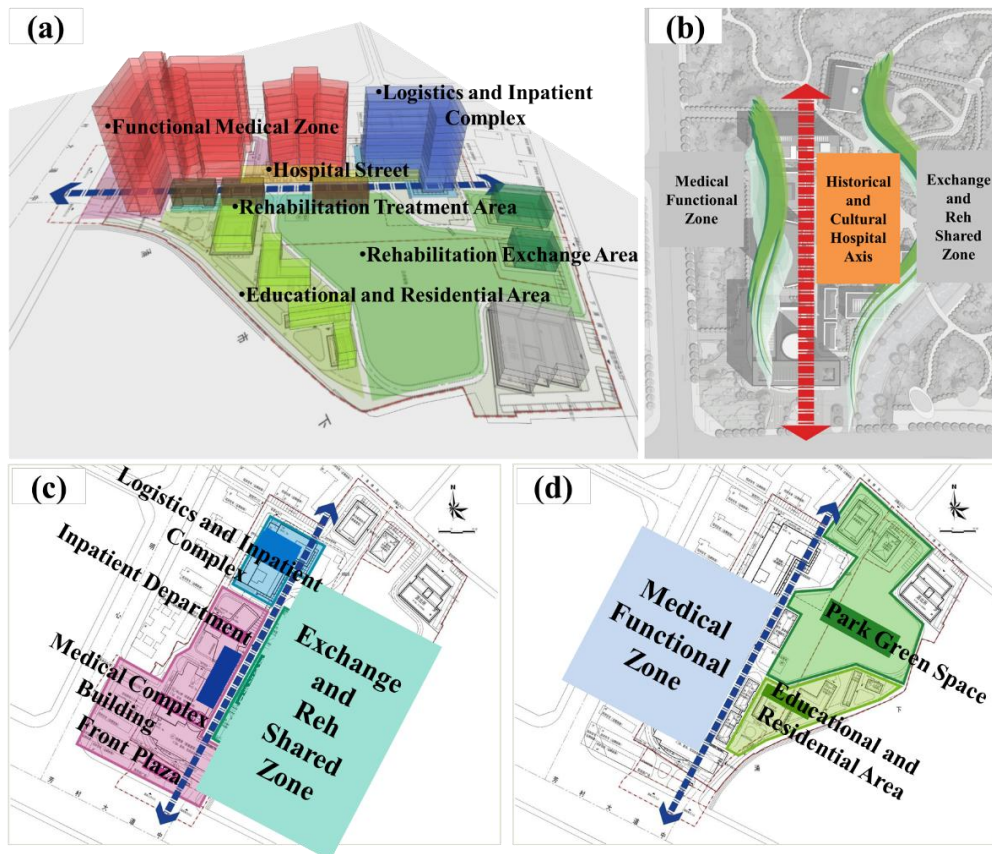


Fig. 6 Planning and structural analysis diagram of Huiai Hospital in Guangzhou

(4) Integration and Optimization of Hospital Functions and Conflict Resolution

The core of hospital design lies in integrating and balancing functional layouts, optimizing internal flow, and resolving conflicts. (1) Function Layout Optimization: Balance medical functions with building locations, addressing key departments and new function needs. (2) Internal Flow and Traffic: Improve efficiency by optimizing connections between new and old buildings, and streamlining medical, patient, and logistics flows. (3) Internal Environment Improvement: Address issues like density and space usability, enhancing areas such as entrances and waiting rooms. (4) Existing Facilities and Support Functions: Resolve issues related to fire systems, parking shortages, and environmental concerns.

(5) Coexistence of Old and New: Construction and Operation Parallel Strategies

One of the greatest challenges in the renovation and transformation of hospitals is the coexistence of the old and the new, as well as the complications arising from simultaneous operations and construction. The comprehensive planning of a phased construction model necessitates a more thorough feasibility planning and implementation assurance analysis.

1) Relocating and Replacing in Stages: Demolish One to Build One, Implement in Phases, Operate While Constructing

Urban central area hospitals often face limited space, making widespread demolition and construction impractical. This requires a ‘demolish one to build one’ approach, where new building functions need to be relocated and utilized before old buildings can be demolished for the next phase of construction. During the construction period, comprehensive measures must be taken to ensure hospital operations and mitigate impacts, which can be achieved through the implementation of strategic approaches. The hospital designs need to investigate and analyze the current conditions and infrastructure, formulate phased implementation plans, and identify operational risk points. For each phase of demolition, new construction, tree relocation, temporary construction fencing, and road building, as well as the operational assurance during construction, scaffolding for preliminary pit supports, and mechanical and electrical systems, medical gas logistics, and wastewater treatment

within the construction area, detailed step-by-step plans must be developed to ensure the smooth operation of the hospital throughout the entire construction process (Fig. 7 and Fig. 8).

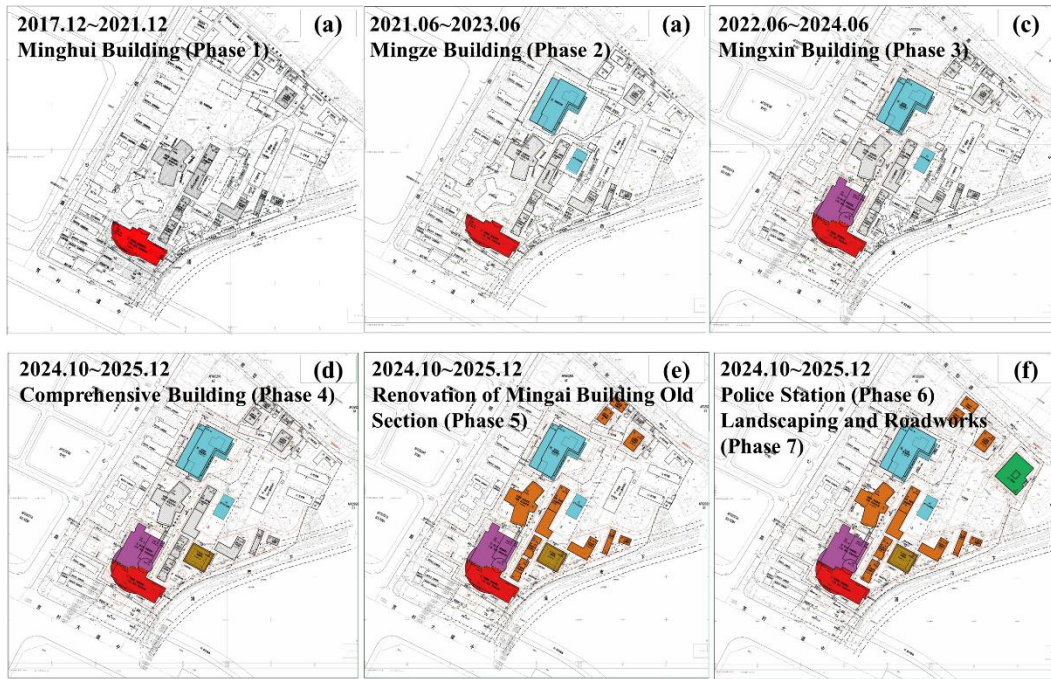


Fig. 7 Schematic diagram of phased construction of Huiai Hospital in Guangzhou

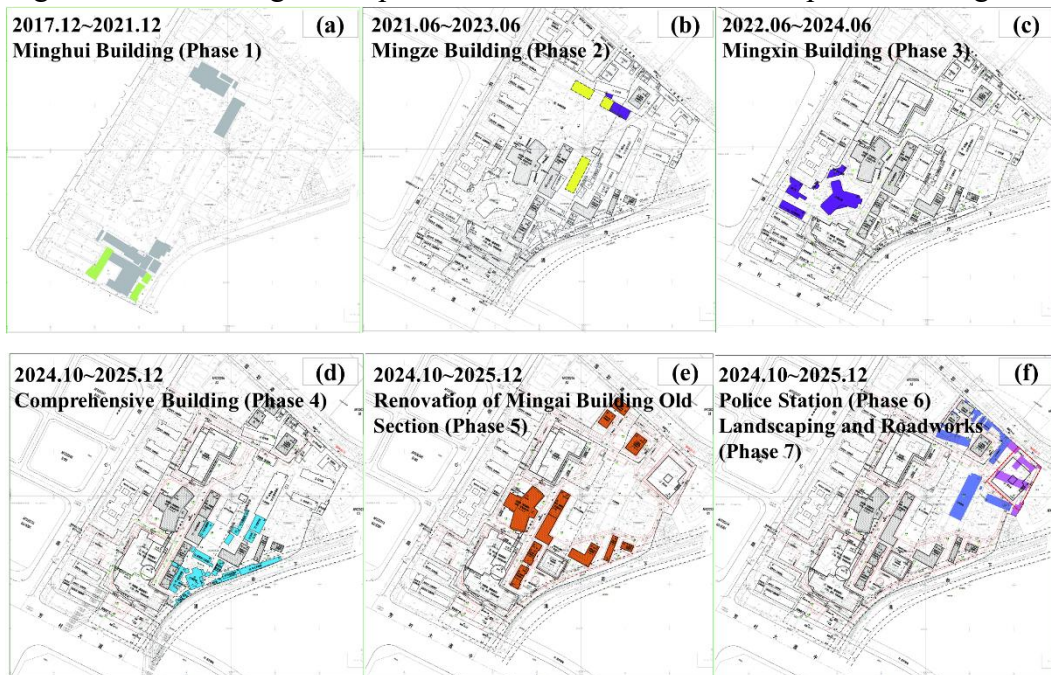


Fig.8 Schematic diagram of phased demolition of Huiai Hospital in Guangzhou

2) Organic Expansion and Optimization: Integrating Regional Characteristics and Historical Traditions

The planning of new hospital buildings should reflect the existing architectural features and historical traditions of the original campus, harmonizing with the traditional texture of regional architecture through organic expansion and optimization. Renovations of heritage and historical buildings should be aligned with functional needs to activate their use, highlighting their unique aspects while ensuring a coordinated development that integrates both old and new structures.

2.4 Present, Development, and Adaptation

The development and modernization of old city central hospitals should integrate the influence of new business models, reflect advancements in modern medical technology, and incorporate the impact of green ecological concepts and low-carbon sustainable development on hospitals. The design must not only meet current usage requirements but also consider the variability of future developments. This includes anticipating the expansion of medical functions, logistics systems, new energy-efficient materials, and prefabricated construction techniques.

Moreover, the evolution of modern medical care requires a thorough consideration of resilient hospital concepts and emergency plans that combine epidemic preparedness and response. For example, the hospital design process should address the need for flexible conversion between infection wards during pandemics and general wards in the post-pandemic period to adapt to changing times.

3. Design Strategies for the Renovation and Modernization of Old Hospitals in Urban Centers

3.1 A High-Level Perspective on External Layers

(1) Preliminary planning should undergo rational verification to adjust the hospital's treatment capacity and construction volume. This should determine the optimal scale and demand for regional development from a planning perspective, balancing the impact on surrounding urban areas and effectively alleviating the excessive treatment load on the urban center hospital.

(2) Based on the assessment of transportation conditions surrounding the hospital and the urban carrying capacity, it is essential to systematically reorganize and optimize the traffic layout of the hospital campus. The integration and utilization of public transport systems should be prioritized, and, where feasible, the establishment of a channelized traffic interchange should be considered. During the design process, factors such as the surrounding traffic impact, effects on residential areas, the influence of metro Transit-Oriented Development (TOD), and parking and supporting needs must be comprehensively evaluated.

(3) The design should align with the existing urban environment, reinforcing the interaction between hospital development and the city, while minimizing the disturbances and impacts caused by the hospital's expansion to achieve mutual benefits.

3.2 Internal Renovation and Optimization

(1) The development of medical functions should be determined based on the primary characteristics and controlling factors of old urban hospitals. An accurate analysis of functional positioning should be conducted to propose reasonable demands.

(2) A comprehensive coordination of the positioning of medical functions and the optimization of the planning layout is necessary, allowing for a systematic and progressive update. Focus should be placed on addressing critical issues during construction, avoiding a reactive approach that only targets immediate problems.

(3) A "people-oriented" refined hospital design should enhance the layout of medical processes and streamline operations. Renovation of the internal environment must focus on details to improve the efficiency and experience of patient visits.

3.3 Coordinating Updates with Tradition, Development, and Adaptation

(1) The old hospital districts in urban centers often retain historical buildings that reflect the evolution of hospital development. When updating and renovating these districts, it is crucial to integrate future functional demands of hospitals while honoring the traditional architectural characteristics of the area. Full demolition should be avoided, and efforts should be made to protect and revitalize historical structures to preserve their cultural significance.

(2) Hospital district updates should use central urban hospitals as a base to effectively leverage the advantageous resources of the urban center, radiating outwards and promoting intelligent healthcare development. This collaborative approach among multiple hospitals can maximize the utility of the urban central hospital district.

(3) By incorporating modern green, low-carbon, and sustainable development principles alongside the concept of resilient hospitals, it is essential to proactively consider long-term sustainability, reserve space for emergency transitions, evaluate the feasibility of integrated design for both peacetime and wartime scenarios, and establish conditions for subsequent upgrades following the renovation.

4. Conclusion

This paper has analyzed and summarized case studies on the renovation and modernization of old hospitals in urban centers. It has identified existing issues in the construction of central urban hospitals, examined the constraints affecting hospital renovation, and clarified complex problems. Based on these issues, renovation strategies have been proposed to provide guidance for future hospital construction.

The design plan for the renovation and modernization of old hospitals in urban centers should cover the entire process, including project initiation, scheme formulation, construction drawing design, construction implementation, operational management, and post-renovation evaluation. The focus of such renovations should address three aspects: city, old, and new. Above mentioned involves a macro-level approach to the coordinated development of the urban healthcare system, a meso-level overall planning scheme that targets the current needs and pain points of hospitals, and a micro-level design that addresses architectural issues and human-centered healthcare details. By considering the characteristics of each hospital construction case, it is crucial to achieve comprehensive, balanced, and practically feasible construction goals and plans.

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