

MINISTRY OF EDUCATION AND TRAINING

MINISTRY OF CONSTRUCTION

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HO CHI QUANG

**ARCHITECTURAL SPATIAL ORGANIZATION IN
INFILL DEVELOPMENT OF RESIDENTIAL HIGH-
RISE BUILDING IN HANOI HISTORIC INNER CITY**

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PREFACE

1. Reason of choosing topic

After boundary expansion in 2008, the Hanoi urban general plan to 2030 with a vision to 2050 was approved by the Prime Minister in Decision 1259/QĐ-TTg dated July 26, 2011, in which Hanoi capital was targeted to become a special urban area in the capital region the core as the historic inner city of Hanoi.

Residential high-rise buildings are an integral part of a civilized and modern urban area, contributing to being of the face of Hanoi capital. However, due to over-urbanization and overheat in economic development, persisting shortcomings and delays in implementing legal regulations on urban management and architectural planning. The current status of the HHIC requires improvements in living conditions, housing renovation for residents who have lived here by many generations, abiding to the national housing development program and that of Hanoi; reconstruction, and supplementation of public functions, trees and technical infrastructure, education, healthcare, etc.

On the other hand, hundreds of old residential buildings from the 60s-70s, scattering around HHIC in old residential, dormitory areas, are in dangerous deterioration. It requires urgent renovation and reconstruction to be in accordance with the urban special grade criteria of the city, ensuring safety for residents and creating beauty for the city. This, however, has not been executed so far.

In reality, the infill development of residential high-rise buildings in HHIC is quite arbitrary with many violations of planning due to various factors, including huge effects from of rapid yet unsustainable urbanization and development. The construction of residential high-rise buildings in HHIC needs to be researched scientifically to provide specific control principles and criteria on planning zoning, architectural spatial organization, and protection of urban morphology in HHIC. Urban reconstruction and renovation, creation of living environment for people in HHIC has limited land fund but very high economic development potentials, posing urgent requirements in the architectural spatial organization, strict control of the construction of residential high-rise buildings in HHIC.

Therefore, the topic of architectural spatial organization in infill development of residential high-rise building in HHIC together with specific studies on architectural spatial organization, factors of urban architecture, planning and management to ensure sustainable development, environmental protection and social security is essential with great scientific significance and practical values.

2. Research objectives:

Proposing solutions to architectural spatial organization in infill development of residential high-rise building in HHIC in the direction of sustainable development

3. Research targets:

- Proposing viewpoints and principles for architectural spatial organization and identification of urban development morphology and zoning of land areas capable for infill development of residential high-rise building in HHIC.

- Constructing criteria, supplementing, and perfecting standards and

regulations for architectural spatial organization in infill development of residential high-rise building in HHIC

- Proposing models and solutions to architectural spatial organization in infill development of residential high-rise building in HHIC to meet sustainable development

4. Research subjects and scope

- Research subjects: architectural space in infill development of residential high-rise building

- Research scope:

+ Spatial scope: within the area of HHIC;

+ Time scope: to 2030 with vision towards 2050 according to Hanoi General Plan.

5. Research methodology:

A combination of the following basic research methods was applied including Survey method, fieldwork method; Synthesis and analysis method; Expert method; Modeling method

6. Scientific and practical significance of the topic

Theoretically:

- Synthesize theoretical bases on planning, architecture and select world experience in residential high-rise buildings to have appropriate adaptations in HHIC.

- Develop basic views and principles for architectural spatial organization in infill development of residential high-rise buildings in HHIC as a premise for the development of criteria, models, and solutions.

Practically:

- Contribute the perfection of mechanisms and policies for the development of planning and architecture; supplementation and correction of legal regulations, norms, and standards for housing for local residents in HHIC; serve as a reference in the development of construction planning standards in HHIC;

- Serve as a reference for planning/architecture majors on residential high-rise buildings in a sustainable manner with climate change adaptation, heritage protection and smart cities. Contribute to completing the adjustment of the Hanoi urban general plan, zoning planning and the establishment of regulations on architectural management of Hanoi city in accordance with the actual situation.

- Establish new solutions to architectural spatial organization in infill development of residential high-rise buildings in HHIC; Create not only values for Hanoi but also applications in other localities at home and abroad.

7. New contributions of the dissertation

- Assessing current situation of architectural spatial organization of residential high-rise buildings in form of infill development in HHIC; limitations, difficulties and unique conditions that affect the architectural spatial organization.

- Systematizing scientific and theoretical basis on architectural spatial organization of residential high-rise buildings in form of infill development in HHIC. Supplementing, developing and selectively inheriting scientific theoretical

foundation, practice and new viewpoints, principles about Architectural spatial organization of residential high-rise buildings in form of infill development in HHIC with the assurance of sustainable development; associating national cultural identity in architecture and urban morphology, renovating urban utilities; connecting with TOD, underground system, etc.

- Recognizing architectural morphology and zoning areas with capable infill development of residential high-rise buildings and identifying the boundaries of HHIC to develop residential high-rise buildings.

- Identifying viewpoints and principles for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC in the orientation of sustainable development.

- Building criteria for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC. Proposing to add and perfecting a number of relevant standards and norms that are new studies on specific for urban authority to permit and investors to make and implement their projects as prescribed by law.

- Proposing model for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC.

- Proposing solutions to architectural spatial organization of residential high-rise buildings in form of infill development in HHIC including sustainable adaptive planning solutions, Architectural solutions groups; Solutions of architectural spatial organization associated with national cultural identity; Organization, renovation and management of architectural space and landscape spaces of construction streets.

8. Dissertation structure

In addition to the introduction, conclusions and recommendations, discussions, references, appendices, the dissertation consists of three chapters:

Chapter I: Overview of architectural spatial organization of residential high-rise buildings in HHIC and some cities in the world (39 pages)

Chapter II: Scientific basis for architectural spatial organization in infill development of residential high-rise buildings in HHIC (36 pages)

Chapter III: Architectural spatial organization in infill development of residential high-rise buildings in HHIC. (70 pages)

9. Some definitions and concepts

Introduction of concepts and terms used in the dissertation related to research: architectural spatial organization; residential high-rise buildings and constructions; historic inner city; sustainable development; urban morphology; infill development in the city

CONTENTS

CHAPTER I: OVERVIEW OF ARCHITECTURAL SPATIAL ORGANIZATION OF RESIDENTIAL HIGH-RISE BUILDINGS IN HANOI HISTORIC INNER CITY AND SOME CITIES IN THE WORLD

1.1 Overview of the architectural spatial organization of HHIC

1.1.1. Summary of the establishment and development of Hanoi urban area

Over 10 centuries (from 1010-2020) the establishment and development of Hanoi has been associated with the process of urbanization. The HHIC includes the ancient citadel, the Old Quarters, and the French quarter. Over the years, such areas have been identified as the core and the cultural - political - economic center of Hanoi. In 2008, with the Resolution on adjustment of administrative boundaries, Hanoi capital area became more than 3,300 square kilometers, which is the premise for building new urban areas and development of HHIC.

1.1.2 HHIC:

Contents of boundaries, functions, strategic orientations, population in accordance with the 2011 Hanoi urban general plan and practice.

1.1.3. Urban – architectural morphology transformation of HHIC

Overview of the urban – architectural morphology transformation through the periods of the French colonial period (1884 - 1945), the period of socialist construction (1954-1986), the Doi Moi period (from 1986 - present)).

1.2 The current situation of architectural spatial organization of residential high-rise buildings in HHIC

1.2.1 The establishment and development of residential high-rise building architecture in Hanoi

Overview of establishment and development of residential high-rise building architecture in Hanoi in various periods: Housing architecture before 1954; Architecture of apartments in the period 1954 - 1986; residential high-rise building architecture from 1986 to present and the orientation to strongly develop residential high-rise building to implement the national housing development strategy.

1.2.2 The current situation of architectural spatial organization of residential high-rise buildings in HHIC.

General situation

According to report of the Hanoi People's Committee submitted to the Prime Minister in September 2019, 13.5% of Hanoi's population was living in residential buildings. Hanoi city had nearly 2,600 residential buildings, accounting for 58% of the total number of residential buildings in the country

In which, the new residential buildings consisted of 845 commercial ones and 174 resettlement ones. In the HHIC, there were more than 90 residential high-rise building constructed since 2000, most of which were in the form of infill development.

Regarding old residential buildings, 1579 residential buildings, including 1,273 houses of residential buildings and 306 old independent buildings with a scale of 2-5 floors mainly built from 1960-1992 (211 in Ba Dinh District, 99 in Hoan Kiem District, 415 in Dong Da District, 244 in Hai Ba Trung District) were in dangerous deterioration. They all were divided into groups. Specifically, Group 1 consisted of collective buildings with many residential buildings, with an area of 2-10 ha; Group 2 mentioned clusters of 5-7 old dormitories built for officials of several ministries and agencies. Group 3 was collection of independent and single residential buildings,

mainly infill development in urban areas. This is the subject of the study. The dissertation outlined some general inadequacies and difficulties in population relocation and urban reconstruction.

Research, survey, and practical assessment of residential high-rise projects in the form of infill development in HHIC

The dissertation surveyed and assessed several residential high-rise building projects built from 2005 to present (18 projects) in HHIC to evaluate the practical architectural spatial organization (Dong Da, Ba Dinh, Hai Ba Trung, Hoan Kiem, Tay Ho districts).

In general, the mentioned residential high-rise buildings had common characteristics of being in infill development without connection to the overhead and the underground space, very few additional contributions, improvement to urban utilities; lacking of green land fund, high construction density, simple architectural space

The dissertation specifically assessed each residential high-rise building project in terms of spatial planning organization, architectural function organization, residential apartments, construction technology, construction materials, the application of technology to identify existing problems.

Some existing problems about spatial and urban environmental planings

+ *Unbalanced use of land for construction of residential high-rise buildings*

+ *Residential high-rise buildings with urban infrastructure*: only ensured infrastructure within internal boundaries with no connection to reduce the load on the urban infrastructure. (In fact, there were no regulations requiring additional utilities, urban infrastructure reconstruction)

+ *Construction planning norms applied to residential high-rise buildings in HHIC*: still insufficient, for example, the construction planning norms in QCVN 01:2008 and 01:2019 mainly focused on the new urban areas. Norms for existing urban areas were still general and allowed the application of ~70% of new urban standard, especially in terms of distances between the buildings and the neighboring works, the entrance and the fire protection works. There was no local construction standards and norms for four districts of in HHIC.

Some shortcomings of architectural spatial organization of residential high-rise buildings in HHIC

+ No requirements to meet sustainable development in architectural spatial organization

+ Lack of harmony and connection with the existing space of historic inner city

+ *About living facilities and public utilities*: public space; utilities, elevators, parking basements; fire safety, fire prevention; safety of life and health; soundproof structure; living space, etc.

Assessment of urban technical infrastructure system

Basic assessment of electricity supply, water supply, drainage, traffic. The current infrastructure system in the historic inner city was upgraded and improved a lot by the People's Committee of Hanoi, which was feasible enough to serve the existing

population. However, weaknesses in terms of public transport and water drainage were still encountered.

Assessment of construction techniques and materials of residential high-rise buildings

About residential building classification, quality and utilities of apartments

Circular 31/2016/TT-BXD of the Ministry of Construction was stipulating the classification and recognition of apartment buildings. However, the classification criteria were still general, not specific to the architectural, planning and technical criteria. Therefore, it led to many different interpretations and applications, causing unsecured quality of buildings.

1.2.3 Comments :

The comments on planning: Hanoi urban general plan is currently in the form of a growing urban area associated with the expansion of urban land areas, and dispersion of residential units and residential high-rise buildings to its periphery area and satellite urban units. Such a spread will result in insufficient funding to invest in urban development especially at urban of special level. Therefore, it is necessary to research and build solutions for balanced and sustainable development.

Regarding the architectural spatial organization of resident high-rise buildings: in addition to some achievements, in general, the architecture is still monotonous, patchy, not harmonious with the regional landscape and fails to integrate element of national identity in architecture and open spaces associated with urban publicity. There is not yet a system of criteria for residential high-rise buildings to be suitable with HHIC. The classification and assessment of specific spatial functions, standards and regulations for residential high-rise buildings are not appropriate. Most of residential high-rise buildings occupy large construction density, causing the lack of land fund for urban facilities, traffic, playgrounds and parks for children and the elderly in accordance with regulations in HHIC. Very few works meet standards of green constructions or green energy and contribution to the common urban infrastructure and utilities. Residential high-rise buildings have not been associated with solutions related to urban transport improvement such as TOD, TIA. The current urban morphology is broken, accordingly.

1.3 Overview of the architectural spatial organization of residential high-rise buildings in the inner cities of some cities in the world

The dissertation studies the historical process of residential high-rise buildings and experience in architectural spatial organization, planning, functional structure of residential high-rise buildings in some major cities in the world with the trend of infill development in the inner cities of Barcelona - Spain, Paris – France; New York - USA; Singapore, Seoul-Korea; Japan; Beijing-China; Hong Kong.

1.3.3 Comments:

The architectural spatial organization of residential high-rise buildings in inner city, urban centers around the world depends on the views of urban authorities on land and urban use in each stage of development and growth. Infill development of residential high-rise buildings in urban areas is very feasible when the growth

perspective is associated with increased population density on the existing land area (compact urban area). In such urban morphology, residential high-rise buildings are mainly invested and encouraged in the urban center to condense and concentrate activities, practices, and residences of urban residents in a small area. for sustainable urban development, balance of economy, environment, culture, and society. With some outstanding advantages in practice, Asian countries with similar culture and climate conditions to Vietnam (Singapore, Hong Kong, China ...) tend to apply infill development of residential high-rise buildings in urban centers. This comes from their limited land, urban planning that the compact urban principle with residential high-rise building in the inner city often in the form of mixed and multi-functional buildings. It reduces the density of land occupation, reserve urban land for trees, urban parks and public utilities.

1.4 Overview of scientific studies related to the architectural spatial organization of residential high-rise buildings in HHIC

Researches include doctoral theses, master's theses, many books, scientific research topics and seminars at home and abroad. The authors have proposed many models and solutions for planning, architecture, as well as solutions to spatial organization of residential areas, urban residential buildings in different fields and from different perspectives, which are very good references. However, such studies were carried out quite a long time ago and proposed relevant orientations only. They did not provide concrete concepts on architectural spatial organization of residential high-rise buildings in form of infill development in HHIC. Also, there were no evaluations and studies from theory to practice, specifically for residential high-rise buildings in HHIC.

1.5. General assessment and issues to be researched and solved

1.5.1 Overall assessment of architectural spatial organization of residential high-rise buildings in form of infill development in HHIC

The reality of urban development in Vietnam and abroad shows that residential high-rise buildings are an indispensable component in urban areas, creating urban appearance, unique architectural space, promoting socio-economic development. In addition to the outstanding advantages, there are still some shortcomings in the construction and management of architectural and landscape space, planning and architectural design. HHIC is mostly represented by small streets with small houses and constructions associated with the street-style business. While the designs of high-rise buildings mostly focuses on constructions, without sufficient attention to the overall urban area in terms of harmony and compatibility ratio between high-rise buildings and surrounding space.

Regulations on management of planning and high-rise architecture in the historic inner city of Hanoi generally apply to high-rise buildings. Therefore, it is necessary to add specific conditions and criteria for construction of residential high-rise buildings in determining the number of floors, maximum height, functional control, population with high-rise buildings, to supplement regulations on space management, urban landscape architecture.

For the work of replacing old and scattered residential buildings in HHIC, it is very necessary to improve living conditions for urban citizen, to have architectural and planning solutions and breakthrough policies in order to addressing the construction of high-rise buildings in inner city. It will facilitate the attraction of investment, socialization. At the same time, the requirement of effective urban management in association with cultural and space reservation must not be forgotten.

Legal documents and regulations must be perfected with the principles: restricting and controlling infill development of residential high-rise building in Hanoi inner city while still allowing the construction in some locations in case such constructions and locations satisfy criteria of urban sustainable development. Therefore, it is required to identify criteria on architecture, traffic, infrastructure, landscape, safety and utilities, land use coefficient of locations to be filled with residential high-rise building in a very synchronous manner.

1.5.2. Issues that need to be researched and solved

From the general overview, the current situation of residential high-rise buildings in form of infill development in HHIC, the dissertation will focus on researching and solving the following issues:

1. Research and evaluate a few residential high-rise buildings in form of infill development in HHIC
2. Research and analyze theories, build scientific and practical bases, influencing factors for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC
3. Develop viewpoints and basic principles for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC until 2030 with a vision towards 2050, including:
 - Identifying urban development morphology and zoning of land areas capable of infill development of residential high-rise buildings in form of infill development in HHIC
 - Building a system of criteria for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC, including: Proposing a system of criteria; Proposing supplementation and completion of several regulations on planning and architecture
 - Building a model of architectural spatial organization of residential high-rise buildings in form of infill development in HHIC, including basic structure; a method to classify quality and standards for each grade of residential high-rise buildings in form of infill development in HHIC; organizational model
 - Proposing solutions to architectural spatial organization of residential high-rise buildings in HHIC, including: Sustainable adaptive planning solutions; Architectural solution group; Solutions of architectural spatial organization associated with national cultural identity; Organization, renovation and management of architectural space and landscape.

CHAPTER II: SCIENTIFIC BASIS FOR ARCHITECTURAL SPATIAL ORGANIZATION IN INFILL DEVELOPMENT OF RESIDENTIAL HIGH-

RISE BUILDINGS IN Hanoi historic inner city

2.1. Legal bases

Hanoi capital is a special level urban area. The management, development, and construction of residential high-rise buildings in HHIC must ensure compliance with legal regulations, standards and specifications and be specified in urban planning project, architectural management regulations, urban design, etc.

Legal provisions: Law on Urban Planning 2009; Construction Law 2014; Capital Law 2012; Law on Cultural Heritage 2013; Law on Housing 2014; Law on Architecture 2019; Relevant decrees and circulars.

System of standards and norms: National technical regulation on Construction Planning QCXDVN 01: 2008 and version QCXDVN 01:2019; QCVN 04:2011/BXD-National Technical Regulation on Housing and Civil Works; QCVN 06:2010/BXD - National Technical Regulation on Fire Safety for Houses and Works; TCVN 9255:2012 Performance standards in buildings - Definitions, methods for calculating area and spatial indexes (ISO 9836:2011); TCXDVN 4319:2012 Housing and public works - Basic principles for design; TCXDVN 264:2002 Housing and public works - Basic principles for building construction to ensure access by disabled people

Planning and regulations on spatial development and residential high-rise building development in HHIC

Urban planings: Hanoi construction general plan until 2020. Decision No.108/1998/QĐ-TTg; General planning on construction of Hanoi capital until 2030 with a vision towards 2050 Decision No. 1259/QĐ-TTg dated July 26, 2011; Detailed planning of Hoan Kiem, Ba Dinh, Dong Da and Hai Ba Trung districts in 2000; Detailed planning of Hoan Kiem Lake area and its vicinity; Construction management charter according to the detailed planning of Hoan Kiem Lake and its vicinity No. 45/QĐ-UB dated January 6, 1997; A number of zoning plans that are expected to be issued for 2021-2030: H1-1A, H1-1B, H1-1C; H1-2; H1-3; H1-4.

Regulations on management of architecture planning: Regulation on management of architectural planning of Hanoi Old Quarter No.6398/2014/QĐ-UBND; Regulation on management of general architectural planning of Hanoi city No.70/2014/QĐ-UBND; Regulation on management of planning and architecture of Hanoi Old Quarter No.24/2015/QĐ-UBND; Regulation on management of planning and architecture of residential high-rise buildings in historic inner city No.11/2016/QĐ-UBND

Urban and housing development bases: National urban development program for the period 2012 - 2020 No.1659/2012/QĐ-TTg; Housing development program in Hanoi for the period 2012 - 2020 and orientation to 2030 No. 996/2014/QĐ-TTg;

2.2. Theoretical foundation

The dissertation researches architectural spatial organization of residential high-rise buildings closely related to sustainable urban development, urban architectural landscape and connection with urban space. Therefore, it is necessary to use

theoretical bases, models related to urban, urban design, renovation and embellishment, including: Theory on sustainable urban development; Theory on compact cities, sustainable compact cities; Remarkable models and theories on urban planning and architecture related to architectural spatial organization of residential high-rise buildings in HHIC; Theory on the architectural spatial organization; sustainable development architecture; Theory on conservation, embellishment and promotion of heritage values

2.3. Practical basis and lessons

2.3.1 Practical basis

The dissertation summarizes some practical characteristics of existing resident high-rise buildings in HHIC that have important influences: construction location; form of architectural space; characteristics of spatial organization, apartment functions; possibility of infill development.

2.3.2 Lessons

Lesson 1: About spatial organization and planning

HHIC is not going to unsustainable development for economic benefits. In order to balance economic development and protection of HHIC morphology, creating an environment and living comforts for people, it is required to have innovative perspectives and orientations to adjust the Hanoi general plan until 2030 with models and urban planning criteria suitable for the new era and context. The compact city model in the inner cities of Japan, Singapore, and Hong Kong can be applied to allow the increase of height of the works, exploit the underground space to reduce the density of construction on the ground. This will help to save the land fund insufficient targets such as tree land, public and cultural space and especially increase land fund for housing, medical and educational purposes. In the urban center, the public transport system, including subways, railways, and buses, is arranged, and properly planned in connection with commercial centers, offices, schools, museums, hospitals, crowded places. As a result, many countries allow to increase the use coefficient of land and the height of constructions at intersections with large transportation load.

- It is necessary to overcome the disadvantages of residential high-rise buildings in terms of connecting overhead space, ground in the area and urban underground space. It is suggested to selectively apply Japanese experience on development of residential high-rise buildings association with TOD hubs to develop HHIC with transportation hub for further and larger network of transportation.

- With the reality of Hanoi, it is necessary to review the responsiveness of the urban infrastructure in historic inner city to require residential high-rise buildings to have addition, renovation and reconstruction in harmony with urban infrastructure, underground space planning in the area. There should be requirements for each residential high-rise building project on the ability to connect underground space as a way of adding technical infrastructure.

- It is necessary to evaluate and specifically determine the prohibited and restricted areas and areas in which residential high-rise buildings are allowed.

Residential high-rise buildings are only allowed in land legible and qualified land areas with specific requirements for HHIC.

Lesson 2: About architectural organization of residential high-rise buildings

- It is necessary to have architectural solutions for residential high-rise buildings from international experiences in handling and transforming architectural space of residential high-rise buildings and apartments in accordance with practical requirements, bringing high living values. Architectural space, building structure must be diversified from vertical plane to horizontal plane.

- The policy of the Law on Architecture on national cultural identity in architecture must be employed. It is not an easy task. But from the experience of China, Japan, and Middle Eastern countries, it is possible to gradually build an architecture with national identity.

- Research and supplement open space closely connected with urban landscape and architectural space of residential high-rise buildings, public open space (in a narrow sense, it is the setback, the surrounding space or in the broader sense it is the open space of a housing project as internal playground, car parking area and garden) connected to the existing area. It must harmonize regional architecture and morphology without disrupting the existing urban structure

Lesson 3: About architectural function organization

- Land fund in HHIC is limited with a very high real estate value, which requires to save land. According to the experience of New York, Tokyo, to be compatible with land value, the architectural function of residential high-rise buildings must be of high standards, overcome shortage of green areas - parks, sport areas, distance between works, garages.

- It is from Vietnamese traditions, living practices, and anthropometrics to build functions that are appropriate with identity but suitable for a modern civilized lifestyle.

- It is necessary to inherit the achievements and experiences of quite successful residential high-rise buildings from 2016 up to now; optimize the use and diversify the form, area, and level of living standards

Lesson 4: About the use of new construction technology and materials

- Residential high-rise buildings need to use advanced construction science technology such as steel structure, high aperture truss, tunnel with many floors and new materials to ensure aesthetic values while bringing sustainability and environmental protection. Sustainable architecture, urban green growth and safety must be available.

- Structure of residential high-rise buildings must satisfy the conditions of response to climate change and natural disaster prevention

Lesson 5: about digital technology application, smart building, digitization

With the orientation of turning Hanoi into a smart city, residential high-rise buildings must be equipped with advanced and future-oriented technology. The trend of digitization and smart building management is inevitable.

Lesson 6: About the strict management of urban architectural space in HHIC

- *Protecting the existing space*: it is the lesson from Beijing in preserving historic inner city. It is required to preserve and protect the morphology of particular spaces such as lakes and valuable landscapes; conservation and embellishment areas, especially areas of historical and revolutionary relics (Ba Dinh political center area, Thang Long Imperial Citadel, Old Quarters, Hoan Kiem Lake area and surrounding areas, the Temple of Literature and other religious and belief relics); high-rise buildings are not allowed in the conservation area; no negative impact to unique space of HHIC should be allowed.

- *Height management*: Height is controlled by planning; In some specific positions, heights are determined depending on the viewing angles, the location of the work, the influence of the building on the surrounding area.

- *Scale control*: in each area, the scale of work is determined in accordance with the ability and responses of infrastructure in that area and specific land lot.

- *Functional control*: Hong Kong experience could be applied to strictly control population density and land use coefficient with orientation of mixed ratio, apartments

- *Completing existing high-rise buildings*: there is many high-rise buildings in the historic inner city. It is necessary to consider in a holistic way. The architectural spatial organization of residential high-rise buildings needs to be consistent with the existing high-rise buildings to supplement and complete urban architectural space.

2.4 Factors affecting the architectural spatial organization of residential high-rise buildings in form of infill development in HHIC

- Natural conditions, climate, hydrology and geology;
- Economic, cultural and social conditions;
- Demand for housing development and living habits of urban residents;
- Characteristics of HHIC in terms of planning and land use criteria;
- Urban technical infrastructure;
- Conservation of historical and cultural heritage, natural conservation;
- Conditions for ensuring national security.

CHAPTER III: ARCHITECTURAL SPATIAL ORGANIZATION IN INFILL DEVELOPMENT OF RESIDENTIAL HIGH-RISE BUILDINGS IN HHIC

3.1. Viewpoints and principles in architectural spatial organization of residential high-rise buildings in form of infill development in HHIC

3.1.1 Viewpoints

- (1) Sustainable development.
- (2) Preserving and promoting the values of national cultural identity in architecture.
- (3) Ensuring safety for people and works against adverse impacts caused by nature or man;
- (4) No negative impact on urban morphology, historical-cultural relics, valuable architectural works, and ecological environment.
- (5) Applying science, high and new technology suitable to Vietnam's reality;

3.1.2 Principles

Principle 1: Ensuring sustainable development

Principle 2: Ensuring the inheritance of traditional architectural values and national cultural identity

Principle 3: Preserving and promoting urban morphology in HHIC

Principle 4 Building a contemporary image and creating urban accents

Principle 5: Controlling the height of the buildings

Principle 6: Supplementing and renovating public spaces and urban utilities

Principle 7: Combining modern elements with tradition, selectively absorbing the world's elite; applying advanced science and technology, new technology suitable to Vietnam's reality.

3.2. Identifying urban development morphology and zoning land areas capable of residential high-rise building in the form of infill development in HHIC

3.2.1. Determining the morphology of urban development in HHIC

Being associated with urban development morphology in HHIC, identifying important landscape roads

- Strictly controlling the development of high-rise buildings, reducing construction density

- Preserving characteristics and old urban structure, protect and promote the landscape values of typical cultural - historical - religious works representing the development periods of the capital. (Thang Long cultural heritage, relics, the Olde Quarters, ancient villages and typical traditional craft villages; valuable architectural works);

- The old residential buildings, old degraded houses are prioritized to renovate and rebuild to improve living conditions, control the construction density and height, and add more urban functions.

3.2.2. Zoning land areas capable of residential high-rise building in the form of infill development in HHIC.

Based on legal regulation and practice, the historic inner-city area will be divided into 7 zones with 4 clearly defined types:

(1) *Prohibited areas for residential high-rise buildings*: Zone A1- Ba Dinh political center; Zone A2- Thang Long Imperial Citadel Heritage Area; Zone A3- Old Quarter; Partition A5- Hoan Kiem Lake and its vicinity

(2) *Restricted and strictly controlled areas for residential high-rise buildings*: Zone A4- Old Quarters

(3) *Areas with possibility of residential high-rise buildings*: Zone A6- West Lake area and its vicinity (except for the area 50m from water surface of West Lake - max 12m high); Zoning A7 (ability of infrastructure, and the impact on the Temple of Literature A7a must be considered); The old apartments and collective houses of group 3 in HHIC;

(4) *Some special locations to consider*:

- + In important locations with outstanding urban landscapes

- + In some main scenic roads: According to the main roads and streets: Van Cao - Lieu Giai - Nguyen Chi Thanh; Hoang Hoa Tham; Giang Vo - Lang Ha; Hoang

Cau; Liberate, release, free; Ring road 1 (Nguyen Khoai - Tran Khat Chan - Dai Co Viet - Dao Duy Anh - De La Thanh).

3.3. Building criteria for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC

3.3.1. Select criteria groups

05 groups of criteria are selected: (1) Planning; (2) Architectural spatial organization; (3) Energy saving, environmental protection; (4) Preservation and promotion of regional architectural spatial morphology (5) Supplementation of architectural morphology, public space and urban utilities.

3.3.2. Proposed criteria

05 groups of criteria including 30 component criteria are proposed as follows:

(1) *Criteria on planning*, including 12 component criteria: Selection of location, construction site; Conditions of construction land; Construction density; Population density; Land use coefficient; Population size; Public open space; Building height; Traffic; Public green space; Urban image building; Urban highlight.

(2) *Criteria on architectural spatial organization*, including 06 component criteria: residential building structure; Spatial organization; Architecture shaping; Utilities; Sustainable architecture; Cultural identity in architecture

(3) *Criteria on Conservation and promotion of regional architectural spatial morphology*, including 03 component criteria: Conservation, Construction control, Promotion of regional architectural spatial morphology.

(4) *Criteria on energy saving; environmental protection*, including 05 component criteria: Energy saving, Renewable energy, Construction materials, Architecture for smart cities, Environmental sanitation

(5) *Criteria on Supplementation and Renovation of public space and urban utilities*, including 04 component criteria: Traffic, Urban Utilities, Public Space, and Trees.

3.3.3. Proposals to supplement and complete a number of regulations on planning and architecture

To National Technical Regulation- Construction planning QCVN- 01:2019/BXD

- *It is proposed to adjust 08 urban planning indicators*: Construction density; Land use coefficient; Requirements for functional zones, urban subdivisions and centers; Requirements on underground construction space planning; Requirements on underground construction space planning; Requirements on functional zones, urban subdivisions and centers; Requirements on technical infrastructure planning

- *It is proposed to adjust Table 2.10 QCVN- 01:2019/BXD*: adjust the maximum net construction density of commercial and service land lots and mixed-use land lots according to the area of the land lot and the height of the building

To National Technical Regulation – Residential buildings QCVN 04:2019/BXD

It is proposed to adjust 02 points on: Parking area; Foundation and foundation structure, basement structure and underground engineering system

3.4. Architectural spatial organization model of residential high-rise buildings in form of infill development in HHIC

3.4.1 Basic structure: The model of architectural spatial organization of residential high-rise buildings in form of infill development has many groups of interactive component spaces, associated with the outside space of the building, both independent and functional, creating "Characteristics of residential buildings in form of infill development in the inner city":

- + Main part: public communication, commercial service, residential area.
- + Extension: improve urban utility in the area within 500~800 m radius; urban TOD center, urban underground technical space

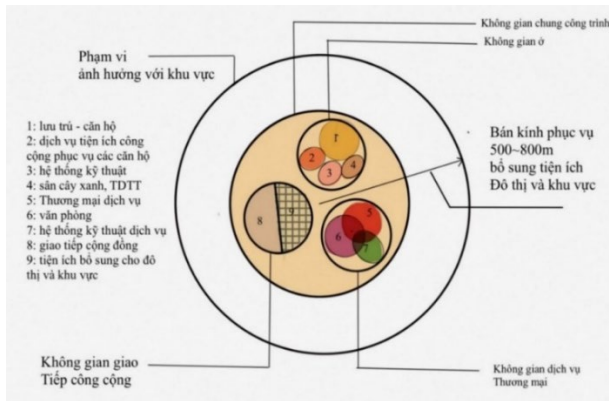


Figure 3.1 Basic structure of Architectural spatial organization model of residential high-rise buildings in form of infill development in HHIC

3.4.2. Proposed spatial organization model

3.4.2.1 Arrangement of functional spaces

Spatial organization of residential high-rise buildings need to be in balance and harmony between 04 factors: (1) Sustainable development (2) Vertical planning applying criteria of sustainable compact city morphology; (3) Applying advanced technical systems towards smart cities; (4) Complementing, combining, renovating and developing the underground part, connecting with each other and with the urban underground public system

Organization of functional spaces includes foundation; body, roof; underground; public open space and urban connection. Arrangement of functional spaces for public services, commercial services, housing and technical systems; traffic-garage is according to specific usage requirements.

Architectural spatial organization of residential high-rise buildings to ensure sustainable development:

The dissertation proposes specific requirements and additionally recommends the authorities to supplement the process: "Assessment of project sustainability" to determine whether the project can be allowed or not.

Vertical planning and application of compact criteria

The dissertation proposes the requirements and criteria for planning and architectural organization to apply the compact city model along with appropriate planning solutions and technology management methods as the basis for building the criteria residential high-rise buildings in form of infill development in historic inner city. This aims at intensive development of urban planning by quality rather than extensive development by area as the current situation is.

Applying advanced technical systems towards smart cities

The application of science and technology, digital transformation is proposed in the dissertation.

Complementing, combining renovation and development of underground works, connecting with each other and with the urban public underground system

It is proposed to build mixed-function residential high-rise buildings in combination with renovation and development of underground works, connecting with each other and with the urban public underground system. Hanoi needs to supplement the orientation of intensive urban development and close link with the development of residential high-rise buildings in the inner city. It is proposed to assess the traffic impact for TIA projects (Transport/Traffic Impact Assessment) when building residential high-rise buildings in HHIC.

3.4.3 Classification of quality and standards for residential high-rise buildings

The land in the center of Hanoi is of very high value. Therefore, the infill development of residential high-rise buildings must have high quality, modern technical system according to the model with 04 factors mentioned above to overcome and compensate. The dissertation proposes the criteria for Classification (grades A, S1, S) and standards for the model organization of residential high-rise buildings that are suitable for the specific characteristics of HHIC.

3.5. Solutions to architectural spatial organization model of residential high-rise buildings in form of infill development in HHIC

3.5.1. Sustainable adaptive planning solutions

Satisfying (1) Requirements on sustainable adaptation; (2) Conditions for the land area used for construction of residential high-rise buildings; and (3) The proposed planning criteria as follows:

a) *Land use*: residential land or mixed land. It is proposed to use residential land unit of 15m²/person

b) *Population density*: average residential land is 15-28m²/person in special grade urban areas. Therefore, the dissertation proposes a population density of about 300~600ng/ha in the unit land in HHIC.

d) *Construction density*: The construction density in HHIC needs to be lower than that prescribed in norms of QHXD 01:2019; land area under 3000m², buildings with 12 stories high will be reduced by 5~20% less than planning standards.

c) *Population size*: average 30 m² of floor/person, minimum residential area is 12 m² of floor/person

d) *Building height*: strictly controlled according to the proposal, QH-TKDT...

e) *Land for trees*: about 3-4 m²/person by 2025; about 6 m²/person in 2030, 8-10m²/person in 2040. It is to add space for parks, vertical gardens, rooftop gardens and empty floors; technical floors to supplement green areas.

g) *Traffic*: Ensure access and connection of traffic according to the criteria proposed by the dissertation; regional connection in the radius of 500-800m; Combining urban underground space planning. It is proposed to connect underground work of high-rise buildings together; organize the exploitation and development of land fund in areas with metro stations and public traffic stations. Traffic impact to TIA must be assessed

h) *Add urban utilities*: to contribute to reducing the load for the area within a radius of 500m, sport facilities, playgrounds of ~0.2-0.3m²/person; public communication space of ~0.3-0.5m²/person.

+ *A cohesive solution for residential high-rise building to be consistent with urban space*

- Harmonization requirements.
- Architectural spatial organization associated with urban space.
- Requirements to be identified as particularly important urban highlights

+ *Solution to underground space organization*

Integrating functions with technical infrastructure: it is proposed that infill development of residential high-rise buildings should be arranged to integrate functions within a radius of 500-800m or 10 minutes walking from public transport intersections and integrate public transport axis into the structure of the area. Proposing the organization and exploitation of underground space.

- Requirements on organization of underground architectural space
- Requirements on construction structure: it needs suitable solutions for urban underground planning to determine a suitable foundation structure options either raft foundation, bored pile, or Barrett

+ *Integrating functional spaces of residential high-rise buildings in form of infill development with urban utilities*

It is to arrange public utility spaces and social infrastructure in the work itself to serve local population; creating open and airy space from floor to floor at the foundation floor floors, connecting public space to local space; ensuring the connection between the project's campus and public spaces such as streets, traffic safety

+ *Solutions to innovate the engineering system of buildings in the orientation of green works, smart cities and digital transformation*

- Orientation of green works.
- Smart cities and digital transformation.

+ *Proposing preferential policies with integrated spaces as supplementation for urban areas*

It is necessary to develop a policy to reward construction volume for high-rise buildings with contributions to the urban areas, refer to the Regulation on

architectural planning of the existing central area of Ho Chi Minh City

3.5.2. Architectural solutions

+ *Solution on architectural form and style:*

The dissertation proposes specific solutions, architectural spatial organization of residential high-rise buildings in for form of infill development needs to have a relationship of landscape and culture in each location, each subdivision A4,A6,A7, some instructions suitable for the existing urban morphology.

+ *Architectural solutions to adapt to climate change*

Architectural proposals are suitable with climatic factors of HHIC limitations so that residential high-rise buildings have no negative effect to the area.

+ *Solutions to vertical spatial organization*

Solutions to vertical spatial organization of high-rise building, contributing to the image of the city, so it should be created in good visible locations. Special attention should be paid to the silhouette, the necessary depressions for air circulation, the emphasis on height, architectural form, rhythm.

+ *Strictly control the vertical space of residential high-rise buildings in HHIC:*

The dissertation proposes specific regulations to control in accordance with HHIC

+ *Exploiting the elements of trees and water surface in open spaces and public spaces outside residential high-rise buildings*

+ *Solution to combine functional spaces*

- Requirements;

- Regarding the use function: residential high-rise buildings consist of 5 parts: underground work, community public work, commercial work & other functions, apartment work, technical work.

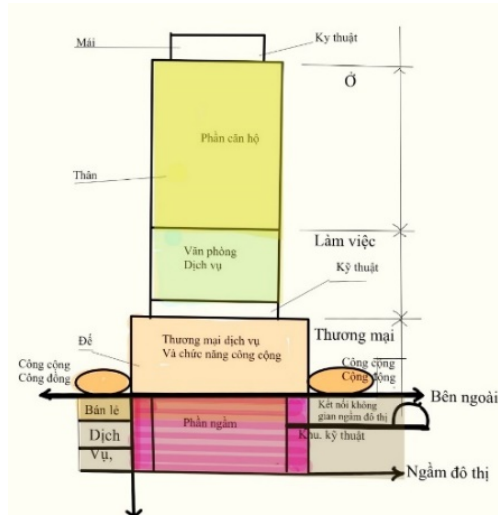


Figure 3.1. Illustration of use functions of residential high-rise buildings

+ **Some spatial complex models:** Mixed-use residential buildings in connection with commercial and service areas in urban areas; Combine with additional urban utilities; Combine TOD clues; Combine to create open –community space; Combined street traffic system; Combined to create urban landscapes and green parks; Combine with urban underground space.

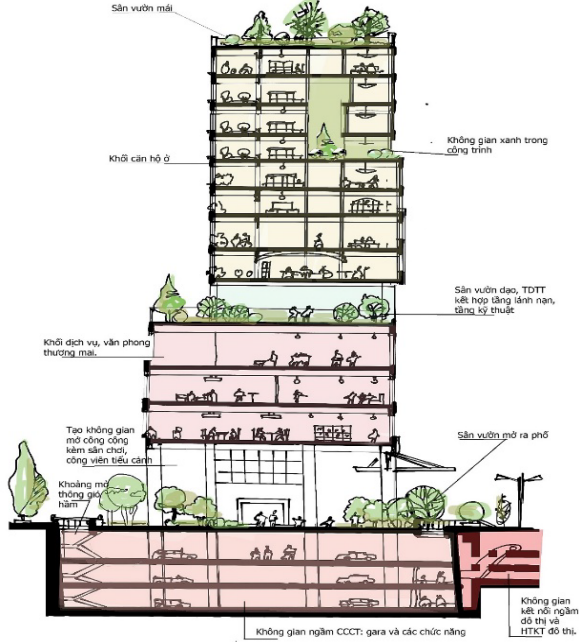


Figure 3.2. Multi-functional integrated mixed-use residential high-rise building model.

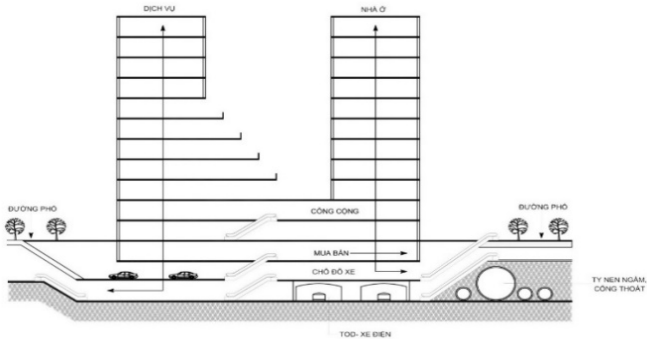


Figure 3.2. Model of residential high-rise buildings with integrated urban utilities + **Solutions for organizing cubes and building facades**

Residential high-rise building architecture reflects the function and represents the cultural, artistic and social context at the time of construction. Suggested solutions are as follows

- *General requirements*;

- *Determining the viewing angle and control height of cube*: The dissertation proposes to use the critical angle of 60° as specified in Construction Technical Regulations No. 439/BXD-CSXD 1997.

- *Facade shapes*: instructions to overcome the advantages and disadvantages and common shapes Plates (plates; Towers (blocks); foundation step. However, the dissertation suggests that in HHIC, foundation step should be recommended to suit narrow spaces. It is to consider in the relationship between the ratio of street height and road width.

+ ***Solution to transition with surrounding space***

Methods are proposed to handle transitions for residential high-rise building to be suitable with HHIC and infill development.

+ ***Solution of Silhouette rooftop architecture of residential high-rise buildings***

Architectural works make an important contribution to the urban morphology, directly affecting the urban landscape. The contour of the high-rise architecture forms the contour of that urban area. This dominant contour represents socio-political, cultural, religious and traditional urban identity. The dissertation proposes:

- a) Several methods of processing the top of high-rise buildings to create rich silhouettes
- b) Control silhouettes

3.5.3. Solutions to organize architectural space associated with national cultural identity

+ ***Requirements: Solutions to connect and harmonize with regional and local identity***

The dissertation sets out requirements, analyzes important characteristics, slices each content into 04 elements that make up architectural value, including (1) spirit, (2) function, (3) material technique conditions and (4) artistic images based on the basic requirements of architecture that are appropriate, sustainable, aesthetic and economic. The dissertation also gives specific methods to add or attach local and national identities to the architectural morphology of the base of residential high-rise buildings on the existing streets of HHIC. It is divided into 3 steps and specific instructions

3.5.4. Organizing, renovating and managing landscape architectural space of streets

+ ***Organizing and renovating existing streets***:

- Solutions to preserve the existing urban morphology

- Promoting regional architectural spatial morphology;
- Solution to control the architectural landscape of the street.

+ ***Managing architectural space of streets with residential high-rise buildings***

- General requirements;
- Managing architectural space of streets.

3.6. Discussion on research findings

3.6.1. Discussion on viewpoint and principles

The thesis introduces 05 viewpoints and 07 principles with the orientation of sustainable development and compliance with legal regulations. Simultaneously, development goes with selective inheritance based on scientific theory, practical basis of planning and architecture, creating a new breakthrough for architectural spatial organization of residential high-rise buildings in HHIC, creating a balance between economic, cultural development and environmental protection.

a) Novelty: The dissertation solves the problem of Hanoi that is the city so far has not been able to balance economic development, real estate and sustainable urban development. Viewpoint 1 "*sustainable development*" is the most important pillar to build a model. This is the basis to propose solutions to architectural spatial organization to enable the construction of residential high-rise buildings in form of infill development in HHIC with strict conditions and criteria. Perspective 3 focuses on the human-centered orientation and the protection of the natural environment as the core. Viewpoint 5 takes advanced scientific and technical theories to thoroughly solve the difficult and frustrating reality of Hanoi capital as well as large cities in Vietnam. It has remained unsolved so far in construction of residential high-rise buildings in urban centers, renovation of degraded resident buildings. This is a new approach.

Principle 6 "*Adding and improving public space and urban utilities*" is a completely new approach that transforms the orientation of distributed planning to compact city planning, adjusting the construction density to save the land use for trees and utilities; increasing the population density index to save and effectively exploit land fund. If implemented, the construction of high-rise architectural works in urban areas is very effective, contributing to the addition of new structures, technical infrastructure systems and underground space to existing urban areas. It also is solving the problem of infrastructure overload, adding utilities to the area by the radius, increasing the frequency of serving the people, adding insufficient planning indicators of Hanoi instead of exploiting urban utilities. Principle 5 "*Controlling the height of building*" aims to preserve and promote the morphological value of architectural space in the historic inner city, through controlling the height of buildings by a limited angle together with the assessment of silhouette with the dominant contour layers of the controlled city. It is to ensure that the existing urban structure cannot be broken (currently control of the silhouette is inadequate). This is

a new point of high theoretical and managerial values of the dissertation that has not been studied previously.

b) Balance and sustainability:

It is to create the highest service for individuals and communities; private and public; traditional and modern lifestyle; identity and internationalization. It is the sustainable development in combination with practical findings and scientific bases to reach the point of viewpoint 2: "Ensuring the safety of people and structures against adverse impacts caused by nature or humans"; application of advanced science and new technology suitable to Vietnam's reality. (Principle 7) creates a balance between the public and the private. It is to add and expand space from public, semi-public to semi-private, private so that the public activities will not be affecting the apartment blocks.

c) In line with the orientation of green growth and digital transformation:

The dissertation proposes models of residential high-rise buildings in form of infill development in association with sustainable urban development, smart building models towards the digital transformation of Science and Technology 4.0. It is demonstrating a vision consistent with the trend of sustainable urban development and urban planning according to international standards.

3.6.2. Discussion on zoned area with possibility of constructing residential high-rise buildings in form of infill development in HHIC

From the practical overview and scientific basis, the dissertation divides the historical inner city into 07 partitions to analyze and evaluate the possibility of permitting the construction of residential high-rise buildings based on inheriting the General Plan regulations. It is completely feasible. It is stricter than the Regulations on management of high-rise buildings in HHIC (11/2016/QD-UBND) to preserve the existing urban morphology without overloading the urban infrastructure.

3.6.3 Discussion on making new criteria for architectural spatial organization of residential high-rise buildings in form of infill development in HHIC

With 05 groups of criteria (1) Planning; (2) Architectural spatial organization; (3) Energy saving, environmental protection; (4) Preservation and promotion of regional architectural spatial morphology (5) Supplementation of architectural morphology, public space and urban utilities with 30 component criteria. It is a new study on specific standards for licensing of urban management agencies and formulation and implementation of projects in accordance with regulations by investors.

3.6.4 Discuss on adding and completing standards and norms

If adjusted as proposal, it will create great effects for sustainable urban development and supplement necessary urban utilities for Hanoi citizen; creating the foundation for the construction of urban underground space.

3.6.5. Discussion on practical effectiveness of the proposed solutions to Hanoi

The solution clearly proposes details, indicators, clears the controlled zones, and

possible location for buildings. It is proposing solutions to combine residential high-rise building in form of infill development and organizing traffic and exploiting urban underground space; adaptive planning solutions; planning indicators, height control; Solution to integrate functions with technical infrastructure and urban utilities; Solutions to vertical space organization, building facade organization; rooftop architecture and Silhouette of the building; Renovating and organizing street space in which residential high-rise buildings are located. The dissertation specifically proposes the architectural spatial organization associated with national cultural identity with very scientific methods.

The proposals are based on very specific and practical science. If they are integrated in national and international legal norms, standards and regulations, Hanoi authorities at all levels will have enough grounds to accept guidelines, approve projects and effectively manage urban areas. The consulting units have clear instructions for authoring the design. Investors and managers have accurate and effective investment standards and orientations.

Moreover, in addition to the theoretical value, proposed solutions are completely applicable and immediately solve the problems and bottlenecks for the handling of old apartment buildings and the reconstruction of too old and unsafe apartment buildings in Hanoi inner city. Although many seminars and projects have been organized so far, there is still no way to remove it.

3.6.6. About the applicability of research findings to other inner cities with similar conditions

The dissertation is researched and inherited, integrated from scientific theory, practical lessons on development of urban planning and architecture in the world and in Vietnam. Therefore, model, criteria, and solutions can be widely applied in cities with similar conditions at home and abroad. However, the solution needs to be considered and evaluated depending on the influence conditions to suit the locality.

CONCLUSION AND RECOMMENDATIONS

Conclusion

1. Residential high-rise buildings are an integral part of modern civilized urban areas, contributing to architectural appearance of Hanoi capital. The construction of residential high-rise buildings in the form of infill development in HHIC is feasible and highly valuable in terms of urban development. However, it is necessary to control conditions; ensure sustainable development, strictly comply with regulations on urban development morphology of urban development, the zoning of the land area capable of constructing residential high-rise buildings, the cultural identity of the area, the environment. The study of architectural spatial organization of residential high-rise buildings in the form of infill development in HHIC is extremely necessary and close to current requirements as well as in the future.

2. In practice, it is to discover nature and shortcomings need to be improved and supplemented in order to have a basis for architectural spatial organization of residential high-rise buildings in the form of infill development in HHIC: adjusting Hanoi planning projects; Architectural management regulations with high predictability, meeting demand, applying modern theories of architectural planning (compact city, underground development, TOD, ecological protection, smart growth, national cultural identity, etc.). It is necessary to revise the regulations and standards of construction planning of residential buildings; supplementing the classification criteria and model of infill development for residential buildings.

3. The architectural spatial organization of residential high-rise buildings in the form of infill development in HHIC needs to adhere to 05 viewpoints and 07 principles, suitable for urban development morphology, zoning of areas capable of constructing residential high-rise buildings to meet 05 groups of criteria including 30 component criteria. Based on the spatial organization model, the solution to architectural spatial organization of residential high-rise buildings in the form of infill development in HHIC will include: A group of sustainable adaptive planning solutions; Architectural solution group; Solutions to combine architectural spatial organization of residential high-rise buildings in the form of infill development with national cultural identity; Solutions for organizing, renovating and managing street landscape and architecture space.

Recommendations

1. In addition to putting the theory, research findings and proposals into practice of HHIC, it is recommended to expand the scope of research in the whole capital of Hanoi.

2. Ministry of Construction is recommended to perfect relevant institutions and laws; amend or issue standards or regulations for architecture of residential high-rise buildings to strictly control architectural planning of urban centers nationwide.

3. Hanoi People's Committee is recommended to review and adjust the Hanoi urban general plan No. 1259/2011/QĐ-TTg which has revealed many problems that greatly affect the socio-economic development of Hanoi capital; create incentive mechanisms for sustainable development projects. Organize the adjustment of zoning plans, separate urban designs for historic inner city.

4. The Government is recommended to develop legal regulations to supplement the process of "TIA Traffic Impact Assessment" and "Sustainability Assessment of Projects" before considering granting construction permits to residential high-rise buildings in inner city of grade II and higher cities.

LIST OF SCIENTIFIC WORKS OF RELATED AUTHORS

SCIENTIFIC ARTICLE

1. Ho Chi Quang, (2013) *Improving the quality of life in the low-cost residential buildings*, Architecture Magazine - Vietnam Association of Architects, Hanoi. ISSN 0866-8617
2. Ho Chi Quang, (2020) *National cultural identity in architecture of urban residential buildings*, Architecture Magazine - Vietnam Association of Architects, Hà Nội. ISSN 0866-8617
3. Ho Chi Quang, (2020) *Architecture of residential high-rise buildings in Hanoi historic inner city: current situation and development orientation*, Vietnam Architecture Magazine, Hà Nội. ISSN 0868-3768.

SCIENTIFIC WORKS

4. Ho Chi Quang (2016), Research and evaluate the social housing system in big cities from 2005 to present. Proposing an organizational model for planning, architectural space and exploitation and use of social housings in accordance with the orientation of a green - sustainable urban, Head of Ministry-level KTSN Project - MOC, 2016