

**MINISTRY OF
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HA NOI UNIVERSITY OF ARCHITECTURE

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**SPATIAL PLANNING OF
A COMPAC CITY UNIT IN HA NOI**

DOCTORAL THESIS SUMMARY

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INTRODUCTION

1. Reason for choosing this topic

Recently, in many urbans, the type of residence such as old quartier, old building, new building areas have changed quickly in terms of population growth rate, building rate and building height. That is the development of a compact city.

In the world, the development type of compact city unit with complex high buildings which is organized in space and function with service radius of 500m (equivalent with 10 minute- walking) is more popular. This type of city with its transit-oriented development (TOD) is the compact city unit (CCU) which has contributed to the urban development.

In fact, the development of Ha Noi city has shown that, in total development land area, 80% is used for apartment buildings and 20% is used for offices, trading centers and services. The development scale is diversified from the building scale, building complex scale to urban area scale. In the area of 4 city's center districts, the project scale is small around 5 hectares and in theory, it does not satisfy the conditions of a CCU.

On the other hand, the development in a compact city is quite high but does not create an organized, nice and special space; The living quality is not high due to the increasingly densed population that causes overload for the infrastructures such as traffic, water supply, drainage, public areas and green parks and creating difficulties in urban and population management... Moreover, the eco-environment and sustainable development has not been mentioned yet in the space development of a compact city.

The Ha Noi development plan 2030 mentions the compact development following TOD form. It proposes that the construction and land use density in the 4 city's center districts is higher than other areas in the country. However, the theory of a comapact city unit is not yet fully recognized and even not yet agreed. Similarly, there is not complete research of a CCU and not yet a CCU

unit built; thus, this doctoral thesis on “Spatial organization of compact city in Ha Noi” is needed.

2. Research purpose

- To propose a model and spatial planning for a CCU that can be applied for the actual urban development context of Ha Noi city.

3. Object and scope of research

- Object: Spatial planning for a CCU

- Scope of research: Ha Noi city according to the General Planning of Ha Noi (especially the 3 districts of Dong Da, Hai Ba Trung and Hoang Mai).

- Time of research: toward 2030 and visioned 2045.

4. Method of research

1. Survey methodology, 2. Map overlay method using GIS, 3. Statistic Method, 4. Systematic method, general analysis. 5. Expert consultation method.

5. Contents

1. Perception of the essence and connotation of the CCU concept which is the continuous development of the neighborhood theory in the new context.

2. Assessment of the current spatial planning of Ha Noi city in terms of the compact trend.

3. Gathering the scientific bases and experiences of the leading countries on CCU.

4. Developing points of view and principles for spatial organization of the CCU in accordance with the needs of urban development in the direction of sustainability of Ha Noi city.

5. Elaborating a system of evaluation criteria for space organization of the CCU in accordance with the needs of urban development in the direction of sustainability of Ha Noi city.

6. Proposing a model and spatial organization plan of a CCU in accordance with the sustainable development conditions of Ha Noi city.

6. New contributions of the thesis

- Completing the concept of CCU in accordance with the development direction of Ha Noi city.

- Systematizing the CCU in the world in accordance with the development conditions of Ha Noi.

- Supplementing an assessment tool of the compact unit space in accordance with the development direction in a criterion system.

- Proposing principles, models and solutions for the CCU in accordance with the development conditions of Ha Noi.

7. Scientific and practical significance

1. Scientific significance:

The scientific significance of the research is the theory supplement for the urban planning major of Viet Nam, specifically:

- The concept and connotation of the CCU, the proper cognition about the important role of the CCU to the development of Ha Noi city in accordance with the urban development direction in the world.

- Research tool for the CCU is the evaluation criterion system of the spatial structure of Ha Noi.

2. Practical significance:

Proposing the principles, models and solutions oriented in space organization of the compact unit in accordance with the development conditions of Ha Noi city with practical value:

- Applying in the planning consultancy for renovation and new construction according to the model of the CCU in Ha Noi and can be referred to other cities.

8. Concepts and terms used in the Thesis

1. Neighborhood Unit: It is a basic urban functional area serving the residential needs such as: housing clusters; public – service works; green areas serving daily and regular needs of the community within 500m area; traffic roads

(roads from the regional zones to the housing clusters) and parking of the residential unit with the scale of 20 000 people [28].

The residential unit is based on the theory of the neighborhood unit for the residential planning at the beginning of the 20th century with its autonomy and ideal living environment regarding the society and administration services [Clarence Perry]. Another name for neighborhood unit which is popularly used in socialist countries is a micro district. Micro district is the residential area of 10-60 hectares but not bigger than 80 hectares. Its border is the main urban traffic roads, natural landscape and natural obstacles. The distance among the entrances of the micro district is not longer than 300 m. The distance of public works such as schools, neighborhood parks is 500 m.

2. City Unit: the city unit is developed from the neighborhood unit (micro district), residential unit, new residential zones are the evolution in accordance with the development orientation of the post-modern urban city with the complex functions planned and built to meet the needs of the post-modern urban cities in space and functions. City unit is a concentrated residential zone or trading center with its transformation model suitable for the urbanization process. The city unit can be considered as a basic spatial unit of urban spatial structure that not only meets the function of serving the daily needs of the urban area such as public service works within a radius of 500m but also undertakes other functions as commerce, services, and administration of the city. In terms of space, city unit is a place that gathers many construction works in the form of continuous urban space. In terms of administrative management, city unit is a basic administrative unit (equivalent to the ward level) to facilitate the management. [96].

3. Compact City Unit: the CCU is developed and supplemented from the theory of city unit and has higher population density and concentration with many operational functions such as housing, trade, services, production, administration and construction space that are exploited and developed according to both high-rise and underground space, the buildings are closely

spaced, reserved for open space, water surface plants, and urban space integrated with urban transportation, in which pedestrian and bicycle lanes are prioritized [Author, 2024].

9. Thesis structure

The Thesis includes the introduction, research content in 3 chapters and recommendation conclusion. Chapter 1: Overview of CCU in the world and the current spatial planning according to the compact city direction in Ha Noi. Chapter 2: Methodology and scientific rationale for spatial planning CCU in Ha Noi. Chapter 3: Models and solutions for spatial planning of a CCU in Ha Noi and discussion.

THESIS CONTENT

CHAPTER 1. OVERVIEW OF THE COMPACT CITY UNIT IN THE WORLD AND THE CURRENT ACTUAL SPATIAL ORGANIZATION FOLLOWING THE COMPACT CITY DIRECTION IN HA NOI.

1.1. Overview of the compact city unit in the world

1.1.1. Context forming the compact city unit

The model of CCU, especially the sustainable one, is formed to meet the needs of new residential model direction in line with the global context that is threatened by the challenges of climate change and resource depletion.

1.1.2. Compact city unit model

The CCU model is characterized by high-density construction of mixed land use with space that is prioritized for pedestrians, human scales, and integration with urban public transportation systems such as buses, automobiles and railways, depending on the transport infrastructure conditions of each model [81]. The CCU is developed based on public transport (TOD) which is special case of the CCU model [69.34].

1.2. Actual spatial planning according to the compact direction in Ha Noi

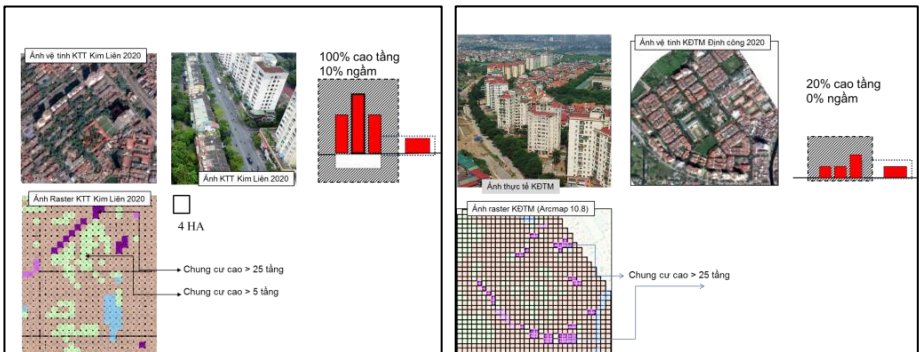
1.2.1. Actual construction of residential areas following the compact direction

1.2.2. Survey on the current situation of organizing the neighborhood unit according to the compact direction

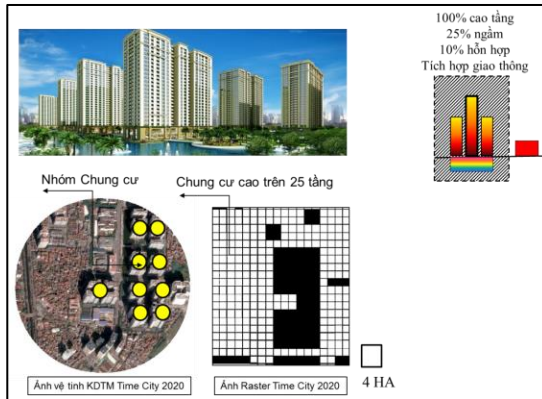
For the buildings built according to the model of microdistrict, neighborhood unit consisting of apartment buildings not exceeding 5 floors that were renovated and embellished into high-rise apartment buildings of 25-30 floors

1.2.3. Building new urban areas following the compact tendency

The neighborhood unit has changed the look of the city by their high-quality high-rise apartment buildings with the service facilities such as shops, supermarkets, houses, parking lots and high-rise buildings with self-contained apartments and elevators and the recent appearance of high apartment buildings over 25-34 floors. The new residential zones recently follow the orientation of mixed functions and developing works both above and below ground such as the case of Times City.



Picture 1. 10 Survey and assessment according the compact development at Kim Lien buildings 2010-2020. Picture 1.12 Dinh Cong new residential zone 2010-2020 (source: author 2023)



Picture 1. 13 Survey and assessment of compact development orientation in Time City

03 buildings, the new residential zones are selected among the 08 buildings, the new residential zones of 03 districts:

Kim Lien building and Dinh Cong residential zone follow the form of filling-in, developing in high-rise spaces, high-capacity factor and construction rate at old buildings areas of the city. The compact area is 1.8 hectares and 4.8 hectares respectively. The new residential zone, Times City, develops in high-rise spaces, the capacity and construction rate are high in areas with existing urban boundaries. The compact area is 13.7 hectares

1.3. The studies related to the published topic

Other studies related to the published topic including: Scientific research topic on the sustainable CCU model in Viet Nam in 2018, planning and management basis for the formation of urban architecture in Ha Noi City, the process of forming and transforming the old residential buildings in Ha Noi from 1954 to 2000, organizing urban architectural space and proposing mechanism and policies for renovation and embellishment of old residential buildings in Ha Noi in 2010. Research on planning and planning management for the renovation of old residential buildings in Ha Noi. Summary of the 10-year model of Ha Noi new residential zones in the period of 2000-2010, and the Doctoral theses such

as New residential zones from the original theory to practical variation in 2018, Spatial organization in traffic-oriented development-TOD area for Ha Noi center in 2023, Planning of new residential zones in Ha Noi in the direction of low carbon in 2024.

CHAPTER 2. METHODOLOGY AND SCIENTIFIC RATIONALE FOR SPATIAL PLANNING OF COMACT CITY UNIT IN HA NOI

2.1. The perception of compact city unit in accordance with the development conditions of Ha Noi city.

The concept of CCU is firstly understood as the compact and development concentrated on the functions and urban space meeting the needs of urban development and management. Thus, the CCU is a combination of 3 perspectives: Use function (operating environment), Spatial morphology (artificial environment) and Ecological space (natural environment)

2.2. Approaching method and research procedure

2.2.1. Approaching method

2.2.1.1. Urbanism approach

Urbanism of CCU means directing to the multi-functional model, increasing non-motorized traffic, reducing the dependence on motorized transportations, reducing emissions, adaption and autonomy in energy.

2.2.1.2. Urban sociology approach

Approaching the urban sociology of the CCU shall ensure the appropriate and diverse communication space, human proportion space, provision of community communication space, and economic space for all classes of the population.

2.2.1.3. Ecology approach

Ecology approach is the CCU that aims at creating the balance in ecology environment for the best living and most convenient conditions and good social

relations. The most important object of the urban ecosystem is the people. Therefore, the approach to urban ecology is to find a mechanism for regulating or conditionally adjusting the social environment towards the goal of creating a balance with the natural ecological environment and social ecology.

2.2.2. Research procedure

2.3. Legal basis

The changes in regulations of land use quota in the urban planning also reflects the compact spatial development direction in legal documents of the government throughout many periods.

In Ha Noi, the mechanism encourages high-rise buildings on both sides of the ring roads, roads toward the city center, etc. As a result, the spatial structure of CCU created in accordance with the road routes hectares contributed to promoting the compact development. In addition, there are also limitations to the ability to provide green spaces, social infrastructure, parking lots by region and tend to increase travel distances.

2.4. Theory basis of the compact city unit

2.4.1. The theory of neighborhood unit in accordance with the compact trend.

The neighborhood unit is developed based on the neighborhood unit theory of Clarence Stein, Henry Wright and Clarence Perry in 1923. The work named residential unit ((Unite d'Hectaresbitation) was initially designed and built by architect Le Corbusier in Marseille, France in 1930. But when the neighborhood unit with its works developed horizontally, the residential unit (Unite d'Habitation) develops the functions of housing, services, kindergartens, schools, entertainment, and social communication, in a vertical direction. It is clearly a form of development according to the compact trend.

The neighborhood unit is vertically compressed and is distanced from each other, the 1st floor is left empty to free up the ground, to create a large open space for plants, and to increase the natural ventilation efficiency for the whole area. At the same time, motorized traffic is specially organized, so as not to affect

pedestrians as well as the living environment of the whole area.

However, the neighborhood unit is made just for living so it creates the all-in-one urban units which have similar architecture due to the industrial manufacture resulting in lacking of local specialties...At the same time, it is difficult to adapt to the rapid changes of a modern city. [81,97]

2.4.2. Theory of the compact city unit

2.4.2.1. High residential density characteristic of the compact city unit

High residential density is a characteristic of the CCU. The residential density is calculated by the ratio of the total population to the land area of the CCU, excluding green space utilities, roads and social infrastructures. Residential density is different from population density, which is calculated on the ratio of the total population to the natural area of the city.

2.4.2.2. Urban transport integration characteristic

The traffic system, public transports of the CCU is integrated with the complex function areas which shortens the travel distance because each travel shall meet more objectives (working, shopping, entertaining, servicing), the demand for cars will also be decreased and therefore reducing the demand for parking lots. The characteristic of integrating space with the transport system of the CCU model contributes to reducing the infrastructure investment costs and reducing CO2 emissions. The cost of investment and maintenance of transport infrastructure, energy, water supply, and wastewater drainage systems are therefore reduced.

2.4.2.3. Diversification characteristic of the compact city unit

An important factor in CCU is the mixed land use, with the characteristic of a post-modern city by Jane Jacobs such as architecture and housing must be diversified in both history and forms, the more productive in space the more attractive and the design meets the needs of many groups of inhabitants and users.

Planning a combined development area by integrating commercial and

service functions with housing in the same building or between works at the closest distance. These advantages are often not available when planning single-purpose residential areas.

A new approach in urban spatial planning in the context of shortage in urban development land funds in general and the central area in particular is the 3-dimensional master plan. That means the planning of underground exploitation along with the development of high-rise space. The underground space also has many functions and is closely linked to the above-ground spaces, buildings and connected to the public transportation system.

2.4.2.4. The compact city unit creates an environment encouraging more walkers

Another characteristic of the CCU is to create the walking routes directing to the center of the area with interactive activities, where gathering buildings with diverse functions and a pedestrian-friendly landscape environment. This enhances the dynamics of the city center and streets with the support of the public transport system.

2.4.3. The development of a compact city unit in the direction of sustainability

The direction of the theory of CCU model is to increase the quality of ecological environment but ensuring the economic and social development. Recent studies on the urban farming, urban forest, urban ecology, ecological urban planning have suggested the development strategies for green space by establishing a green infrastructure in order to enhance the ecological quality of the CCU [86,90,101].

2.5. Practical basis

2.5.1. Natural condition and climate

The research area shares the same weather with Ha Noi, affected by the monsoon climate with two seasons: hot and cold weather.

The hydrologic regime is affected by To Lich river system, Lu river, Nhue river and the system of the 04 main air-conditioning lakes: Linh Dam, Dinh

Cong, Dam Hong and Thanh Liet.

The assessment of ecological benchmarks in 03 district showed Dong Da district having the highest level of exceeding the ecological benchmark, followed by Hai Ba Trung district and Hoang Mai district. Thus, for districts as Dong Da and Hai Ba Trung in general, there is a lack of ecological water surface green space system, causing ecological imbalance, so it is necessary to add more ecological functional factors. As for Hoang Mai district, there is an opportunity to develop structures linked to the green space and water surface in the suburbs to balance the ecology.

2.5.2. Socio-cultural and population characteristics

The average increase of the city is 50,000 people/year, the direction is to decrease the residential density and increase the average area. However, the change is not balanced. Dong Da, Hectaresi Ba Trung, Hoang Mai districts are the districts with the highest growth. The growth rate of construction space of Hoang Mai district is the highest, followed by Dong Da district and Hai Ba Trung district from 2010-2020.

2.5.3. Economic, technical and technological factors

The growth rate of vehicles in Ha Noi 2013-2018: cars of all kinds increased quite high by 10.2%/year, of which the number of cars hectaresd a very high growth rate, hectaresving a great impact on the urban spatial structure and transport infrastructure.

Construction and development of Ha Noi multi-functional urban area, commercial services, offices, transport infrastructure, parking lots, exploitation of high-rise space and underground space for public activities...

2.6. Lessons learnt from international and Vietnam's experiences

2.6.1. Lessons from Vietnam

2.6.1.1. Nha Trang city

In 2012-2018, Nha Trang city developed in the form of non-structured direction, taking the space approaching the sea so limiting the view and wind

ventilation. The city developed the space in the compact direction with high construction density and close distance between each work.

2.6.1.2. Ho Chi Minh city

Ho Chi Minh City tended to develop in the compact form of clusters of compact works and to develop the new residential unit compactly constructed in areas with clean land fund instead of overall structure. Therefore, it created the selected space, unstructured distributed routes affecting the quality of the ecological environment, and putting pressure on social infrastructures, green parks, and urban traffic.

2.6.2. From international experiences

2.6.2.1. In England

The CCU prioritizes the development of high-rise buildings, the increase in population density, functions of commerce, culture, offices, retail, entertainment at the points along the urban railways. [139].

2.6.2.2. In France

Low level of emission of the CCU satisfies the requirements in efficient usage of energy, of mixed land and biodiversity protection; encouraging sustainable traffic, reducing the land fund for parking lots and roads while developing the pedestrian and bicycle lane system [46].

2.6.2.3. In Hong Kong

The CCU aims to maximize the rate of population and employment in the surrounding areas, along the routes with high traffic capacity, in order to implement the strategy of creating Hong Kong with a high-density urban space [111].

2.6.2.4. In America

The urban areas encourage the increase of land use factor for the projects developed at the points greatly approaching the important traffic nodes to create the urban development modes that attach to the public transports. [46].

2.6.2.5. In Japan

The compact city units are divided into 3 kinds to re-structure the urban space in the compact direction which are: the center CCU, residential zone, the CCU that can approach the city center or residential area center or having the functions of a city center within serving distance, and the CCU at the center area or the residential area center.

2.6.2.6. In Germany:

The city unit model as Quartier Vauban was built as a sample for a living environment without cars, the area was designed for short trips or high density, the heating systems by subzone run by re-cycle energy and there are many different levels of populations.

2.6.2.7. In Canada:

The CCU makes it easier for walking and biking for many people; allows the new green spatial system to save on and enhance the use of energy, electricity, water and construction materials; adding the urban farming into the urban; creating diversified housing communities.

CHAPTER 3. MODELS AND SOLUTIONS FOR THE SPATIAL PLANNING OF COMPACT CITY UNIT IN HA NOI AND DISSCUSION

3.1. Points of view and principles of the spatial planning of compact city units

3.1.1. Points of views

Developing the compact city unit ensures the principle of harmony between the benefit and cost of the environment, economy and society of urban development in accordance with the modern urban development direction, adapt to the climate changes and the natural conditions and economic characteristics, society and culture of Ha Noi city.

3.1.2. Principles

3.1.2.1. General principles

1. Determining the suitable scale and level of the CCU in accordance with each urban area; city center, city, suburb of Ha Noi city.

2. Establishing a harmony connection of the city space and natural environment to contribute creating the local unique characters of the CCU.

3. Focusing on the functional and spatial integration factors as well as the diversity of natural and social ecosystems of the CCU.

4. Designing the space based on the principle of the human scale.

3.1.2.2. Detail principles

1. Compact level: The compact level is made due to 2 main factors of residential density in 1 square meter and the total floor area.

2. Function: The diversity of the CCU represents the diversity of the land use functions, (residents, offices, commerce's, production, communities) in both vertical and horizontal directions (high-rise and underground levels).

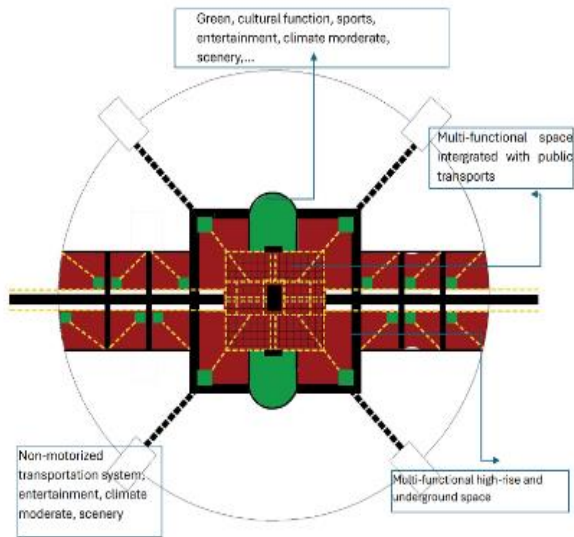
3. The urban architectural space includes: (1). The structure of the construction space such as size of the land lot, the setback for each urban block; (2). The structure of the front's width and the building's height; (3). The land use function for each area and each lot 4. Parking lot, building architecture, plants and advertisement board, ...

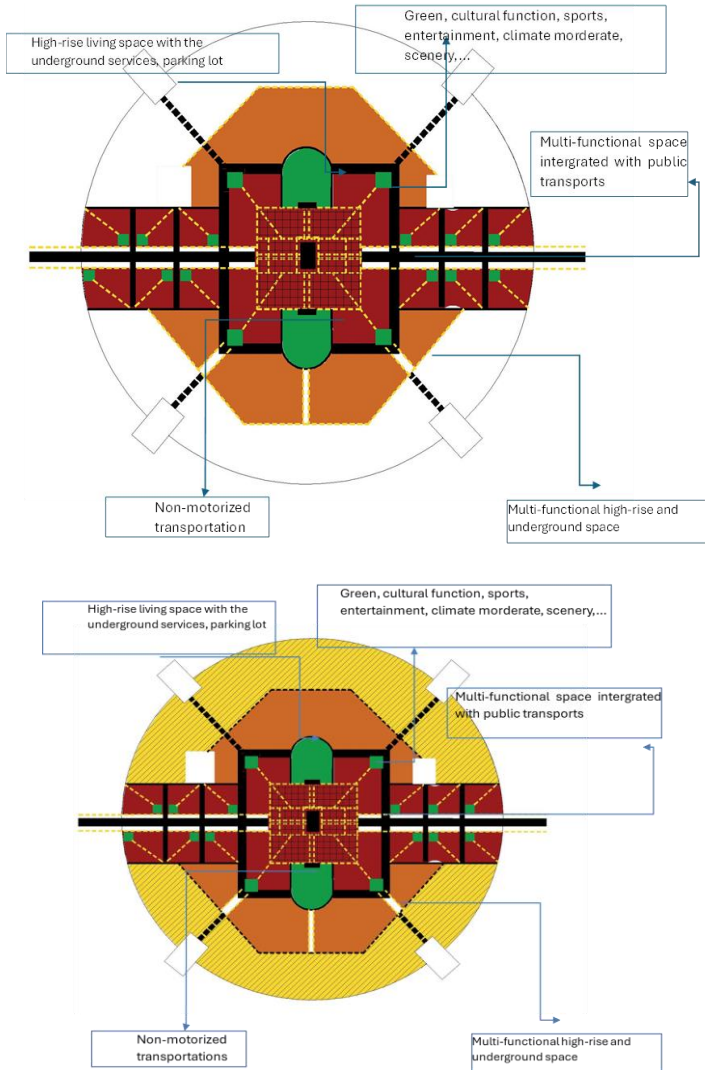
4. Traffic access: The CCU focuses on solutions to improve the accessibility for pedestrians and non-motorized vehicles. The principle of linkage to create a complete and regular linkage network in terms of the distribution of activities and links by motorized vehicles and walking and bicycles for the convenience.

3.2. The compact city unit model in accordance with the development conditions of Ha Noi

The CCU is firstly the combination of these 3 perspectives: 1. Usage function (operating environment), 2. Spatial form (artificial environment) and 3. Ecological space (natural environment). Of which, in general, the compaction (or compact level) forms the basic characteristic of the compact city and

presented by these indexes: 1. The size of the population and the density of population on residential land. 2. High and mixed (multi-functional) land use. 3. The form of concentrated urban space. 4. Open space (green and community space – natural and social ecology), 5. Energy efficiency (sustainable development). 6. Traffic accessibility (convenient connection).





Picture 3.3 The CCU at high, average and low level

3.3. Assessment criteria system on the spatial structure of the compact city unit in Ha Noi

3.3.1. Spatial criteria

3.3.1.1. Population and land scale

The population scale is around 20 000 to 30 000 with the area size which is ½ size of the residential unit of 30 hectares, the diameter of 500m is suitable for the development conditions of Ha Noi.

3.3.1.2. Residential density

In order to catch the development in compact direction, according to the thesis's point of view, the residential density of Ha Noi should increase to the threshold of 300 houses/ hectare, at least 250 houses/ hectare.

3.3.1.3. Compact level

The thesis proposes the total floor area from 3-10 with three levels:

(1). High compact level with the total floor area from 8-10 with the form of high-rise architecture and the underground space taking 100% of the area. Those are the compact city units located at the center area with synchronous development of infrastructure and social infrastructure.

(2). Average compact level with the total floor area from 6-8 with the form of high-rise architecture and underground space taking 100% of the area. Those are the compact city units located at the center area.

(3). Low compact level with the total floor area from 3-5 with the form of high-rise infrastructure taking 50% of the area. Those are the compact city units at the suburb areas that develop mixed housing and social infrastructure.

Table 3. 1 Spatial criteria

A	Space	Description	Total point	Classification		
				Good	Average	Low
1	Population scale	Total population scale (people)	20000-30000	30000	25000	20000
		Point	50-100	100	80	50
2	Area scale	hectare	30	30	30	30
		Point	100	100	100	100
3	Residential density	house/hectare	200-300	300	250	200
		Point	65-100	100	85	65
4	Land use factor	time	3_10	8_10	5_8	3_5
		Point	65-100	100	85	65
4.1	High-rise building rate	% floor area/total area	50-100%	100%	80%	50%
		Point	35-100	100	70	35
4.2	Underground space	% floor area/total area	10-30%	30%	20%	10%
		Point	40-100	100	80	50
TOTAL			200-400	400	310	200

3.3.2. Functional criteria

Thus, for the compact city units, depending on each particular situation, it must satisfy the integral requirements of at least 02 functions: Living and working or all 3 functions living – working – entertaining. Following is the rate of multi-functional mixed land use of living - working – commerce, service and the equivalent entertainment which shall equivalently be different. Of which, the working - commerce, service and entertainment function is largest in the case of TOD or the city center and mixed function of commerce and service. Regarding the social infrastructure, the CCU must ensure the criteria of full-service system such as education (kindergarten, primary school, lower secondary schools), healthcare, culture and sports, and commerce (markets) to meet the basic living needs of residents

Table 3. 2 Mixed functional criteria

B	Mixed functions	Description	Center/Mixture	Mixed housing, housing
B.1	Multi-functions	300	300	150
1	Rate of other land types beside housing	<small>other land floor total area/total floor area</small>	45-60%	30-45%
	point	200	200	80
2	Number of land types	<small>or area/total a</small>	<small>commerce, service, office, garage</small>	<small>commerce or office or service</small>
	point	100	100	70
B.2	Social infrastructure	300	440	260
1	Primary school	radius (m)	<500m	<500m
	Point	45	45	30
2	Secondary school	radius (m)	<500m	<500m
	Point	30	30	20
3	Park	radius (m)	<500m	<500m
	Point	45	45	30
4	Flower garden		<300m	<500m
	Point	45	45	30
5	Green market		<500m	<500m
	Point	30	30	20
B.3	Urban facilities	300		
1	Trade center	300	<500m	500-1000m
	Point	45-100	45	30
2	Hospital	30	<500m	500-1000m
	Point	50-100	100	50
3	Hotel	30	<500m	500-1000m
	Point	50-100	100	50
	TOTAL	900	740	410

3.3.3. Criteria on urban traffic

Connecting all types of traffic is an important criterion, creating favorable conditions for residents to access the CCU as well as to contact outside the CCU. The compact space system integrated with urban traffic is divided into 4 types for 3 traffic systems; railways, buses, and roads at gateways and the connections of the CCU. The CCU connects with urban transportation to meet the requirements of reducing travel distance, shortening the time and creating multi-purpose transportations, contributing to reducing emissions and energy use per capita. Traffic connection consists of 2 criterias: one is the optimal access distance within 10 minutes walking (about 500m) and 1000m for cycling, and the other is the population density of the CCU can access the urban transports,

the higher the population density, the higher the integration ability because the large number of users.

Table 3. 3 Criteria on urban traffic

C	URBAN TRAFFIC CONNECTION	Description	Evaluation		
			good	average	qualified
1	Urban traffic	Distance between the main junction point	Distance 300M	Distance 500M	Distance 1000M
	point	20-100	100	60	20
2	Traffic connection	% population connecting with the public traffic <500m	Railway & road	Road & bus	Road
	point	25-100	100	50	25
3	Reduce distance and dependence on motorized transport	% population connecting with non-motorized transport <500m	walking, cycling connecting 100% public works	walking, cycling connecting 50% public works	walking, cycling connecting 20% public works
	point	30-100	100	50	30

3.3.4. Criteria on sustainable development

Table 3. 4 Criteria on sustainable development

	Sustainable development	DESCRIPTION	EVALUATION		
			good	fairly good	acceptable
D.1	Ecological structure				
1	Drainage conditioning	Lake area/natural	10% area	5% area	3% area
	Point	50-70	70	50	30
2	Entertainment	Layout of entertainment space	regularly	often	not often
	Point	30-70	70	50	30
3	Biodiversity	Biodiversity design	high	low	acceptable
	Point	30-50	50	30	20
4	Park area	Ecological thresho	minimum	average	threshold
	Point	60-100	60	80	100
5	Vertical park	green layer	100%CT	70%CT	50%CT
	Point	40-60	60	50	40
6	Green pavement	green path + bicycle	100% pavement	75% pavement	50% pavement
	Point	30-50	50	40	30
7	Conservation	conservation solution	good	average	acceptable
	Point	50-100	100	50	30
8	Approach of disadvantaged groups	Design suitable space	good	possible	limited
	Point	50-100	100	50	20
D2	Ecological threshold	CO2 Balance	+++	+	-
	Ecological balance	O2 Balance	+++	+	-
Point	200%	200	100	0	
D3	Adaptability				
1	Risk level	Construction rate (roof and pavement surface ratio)/total area%	55%	65%	85%
	Point	20-100	100	60	20
2	Adaptability	park and flower g	45%	35%	15%
	Point	20-100	100	60	20
3	Adaptability	Efficiency	low	average	high
	Point	30-100	100	70	30
	TOTAL	800	800	500	300

3.4. The organization direction of the compact city unit in accordance with the development conditions of Ha Noi city

3.4.1. Zoning to apply the model and principles of spatial organization of a CCU in Hectaresnoi

3.4.1.1. City center

The historical center zone with high density of spatial structure, small proportion of open space and decentralization.

3.4.1.2. City

City view, average and high average density of spatial structure, high density in some areas due to convenient traffic, large proportion of open space and centralized in some specific parks.

3.4.1.3. Suburban of city

Suburban of city view with the advantage of urbanized rural landscape. The outskirts have the advantage of having the scenery of the urbanized countryside. The urban space, therefore, has a low average construction density, except for some areas with high density due to traffic convenience, large proportion of open space and concentration in some specific parks, green space limiting the urban development.

3.4.2. The factors affecting the spatial organization of the compact city unit in typical regions of Ha Noi

3.4.2.1. Urbanization rate

The urbanization rate of the districts at the south of Ha Noi is zoned by the distance to the center. According to the general planning of Ha Noi, the spatial exploitation is directed in accordance with the population structure with the intention of decreasing the population number in the center area and increasing and attracting the new residents in the expanded development area and the suburbs. As a result, the urban space is centralized in a basin structure, the farther away from the center, the higher the urban space, the closer to the center, the lower the urban space.

3.4.2.2. *Traffic connection*

The urban traffic of the 03 southern districts is divided into 3 zones: a zone combined a diverse type of transportation (roads, railways and buses), a zone with the advantage in public transport, a zone with disadvantage in the public transports.

3.4.2.3. *Sustainable development*

Dong Da and Hai Ba Trung district are in the historical center area with the perfect system of parks and flower gardens, one part of the northern area of Hai Ba Trung district is an old quarter area, French street with value in architecture and scenery. Hoang Mai district locates in the area with To Lich, Lu and Nhue river and with many canals and lakes, it can be said that the area has natural scenery, the richest canal and river system in the extended inner-city urban.

3.4.3. Classifying the compact city units in accordance with the development conditions of Ha Noi:

Classifying the compact city units in order to determine the space organization of the CCU in accordance with the development conditions of Ha Noi. Classification of the compact city units is a combination of the variants of the CCU by 4 groups of criteria sets with 7 parameters with 3 ranges (from high to low compact), (Table 3.6, Table 3.7).

3.4.4. Organizing the CCU by zones

The results of zoning applying the solution of spatial planning of the CCU are a synthesis of urbanization zoning, traffic zone and ecological zone (Table 3.6).

Table 3. 5 Applying the principles of spatial organization of CCU by zones

Factors	Specific zoning	City center	City	Suburban of city
1. Urbanization		Limited	Rather convenient	Convenient
Đống Đa district		- - -	- -	
Hai Bà Trung district		- - -	- -	
Hoàng Mai district			++	+++
2. Quỹ đất Land fund		Limited	Rather convenient	Convenient

Factors	Specific zoning	City center	City	Suburban of city
Đông Đa district		---	-	
Hai Bà Trưng district		---	-	
Hoàng Mai district			++	+++
3. Traffic integration		Less convenient	Convenient	Very convenient
Đông Đa district		---	-	
Hai Bà Trưng district		---	-	
Hoàng Mai district			++	+++
4. Sustainable development		Less convenient	Convenient	Very convenient
Đông Đa district		---	-	
Hai Bà Trưng district		---	-	
Hoàng Mai district			++	+++
'Boundary condition'		Conditional development	Controlled development	Most suitable for development
Classification of the CCU		CCU TOD CCU CCU HH	CCU TT CCU HH	CCU in HH

1. Urbanization level

- (---): Controlling population growth,
 (-): Controlling population growth in accordance with infrastructure,
 (+): Controlling population growth in accordance with infrastructure,
 (+++): Encouraging development in the suburbs to reduce pressure in inner city
 (+): Encouraging urbanization to connect urban and outskirts the

3. Traffic connection

- (---): Current structure, complicated traffic, big cost
 (-): Big investment cost on infrastructure
 (+): Deploying current inter-regional network, Metro
 (++) : Deploying current inter-regional network, Metro
 (+/-): Limited connection

2. Land stock

- (---): Area with small land scale, conversion
 (-): Area with average land scale, conversion
 (+): Land fund for the renovated new residential zone
 (++) : Land fund for the renovated and newly built new residential zone
 (+/-): New land fund
 4. Sustainable development
 (---): Exceed ecological threshold at high level
 (-): Exceed ecological threshold
 (+): Well ecological structure connection
 (++) : Diversified ecological structure
 (+/-): Diversified ecological structure connection, ecological damage

3.4.5. Solution on spatial organization of renovation and new construction of the CCU in accordance with the development conditions of Ha Noi

3.4.5.1. Solution on the renovation and justification of the compact city unit in Ha Noi

The CCU to be renovated locates in the center and suburb in order to enhance the quality of housing, entertainment and working area of the residents. The solution on spatial organization must ensure:

1. Developing the CCU with the scale > 4 hectares at the center of the city.

2. Spatial forms: 04 compact levels, the total floor area from 3-8.

3. Land use function: Over 30% for commercial land, not allowed over 50% for housing for a single income group, less than 15% for the single functional block.

4. Connection: connecting the CCU with the city traffic, public transport. The public works can be reached by walking or cycling. The connection includes roads, cycle and pedestrian lanes.

5. Ecological environment: The green area takes 25-45%. The green space and water surface is designed which is open for vertically approaching and deploying the green space due to limited land fund and ensures the diversification.

3.4.5.2. Solution for new construction of the CCU in Ha Noi

The CCU locates at the suburb or outskirts and ensures the autonomy on employment opportunities, comfortable living space and quality ecological environment. The solution for new construction of the CCU must:

1. Develop the CCU with the scale over 30 hectares at the suburb and outskirts.

2. Spatial forms: consisting of 2 compact levels. The total floor area is from 6-10.

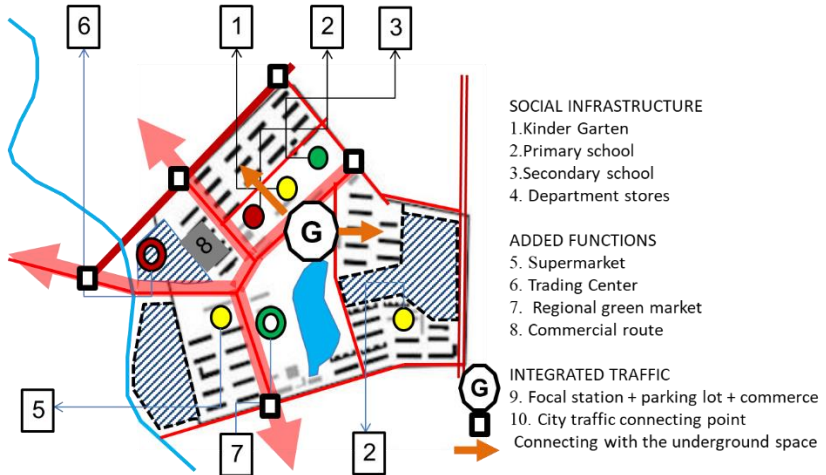
3. Land use function: over 20% for commercial land, not more than 50% for a single income group in order to ensuring the diversification of house types.

4. Connection: the traffic network must be organized ensuring the ability to connect with the motor vehicles especially the public heavy vehicles

5. Ecological environment: 25-45% for the green area. Creating ecological corridor at the rivers, water ways and water reservoirs and multi-functional parks.

3.5. Illustration of the spatial organization of the compact city unit in Ha Noi

3.5.1. Spatial organization for the renovated compact city CCU



Picture 3.12: Illustration of the current spatial connection structure, renovated space

3.5.2. Spatial organization for new construction of the compact city unit



Picture 3. 19 Illustration of the natural ecological structure and diversified culture

3.6. Discussion

1. Awareness of the concept of the CCU: The concept and connotation of the CCU in line with the urban development practice of Ha Noi which have been clarified in the thesis. The theoretical basis for the spatial planning of the CCU is considered, evaluated, inherited and supplemented in accordance with the theoretical trend of the times

2. Building a criteria system on defining the spatial structure in accordance with the model of the CCU in Ha Noi and can be used for reference for other cities.

3. Solution on the spatial organization of the CCU in Ha Noi. Principles on spatial organization in Ha Noi. Principles on spatial organization in order to direct the development of the CCU of renovated and newly constructed one in accordance with the development conditions of Ha Noi according to the specific areas of the city with their special characteristic; Thus, the variants of the CCU

are made.

4. The research proposed a method of assessing the spatial structure of the CCU using GIS tools and open image remote sensing databases, which is an evidence-based planning method at the urban unit scale, overcoming the administrative limitations of the current data.

5. The CCU is foreseen as a new type of neighborhood, city unit in coming years in the big cities of Viet Nam. The old apartment buildings, residential units and new residential zones shall be transferred from single function with low density, equally distributed social structures, to the compact city units with mixed spatial structure and compacted at high density, high land use factor and high-rise development, integration with the city traffic, public transports, priority on walking and bicycle lanes, with rich and cultural ecological environment deploying the space above, on and underground to enhance the microclimate condition.

6. The need for in-depth research on compact city units in Ha Noi has an identity and is in line with the modern urban development trend of many countries around the world. Therefore, the CCU should be still studied at a level that is both comprehensive and specific to find an accurate model that can be applied to each stage of Ha Noi 's development and to ensure the sustainability of Ha Noi city.

CONCLUSION AND RECOMMENDATION

CONCLUSION

The research has clearly clarified the nature of the CCU and the chance of using it in the actual development conditions of Ha Noi. Building a criteria system to define a structure on the CCU. Proposing principles, models and solutions direction for the CCU and the ability of using it in accordance with the actual development conditions of Ha Noi city.

RECOMMENDATION

To build a policy regime in order to implement the CCU in the coming

periods of Ha Noi. To build legal documents in order to replicate and appreciate the CCU. To supplement and expand the application research for other big cities. To continuously study and build the methods, to survey the city using GIS and remote sensing databases in planning. To support the theoretical studies and planning methods on community, on modern neighborhood zones in accordance with the theoretical trend of the times./.

SCIENTIFIC WORKS OF THE AUTHOR RELATED TO THE THESIS TOPIC

❖ Scientific articles

1. Lê Kiều Thanh (2018), “**Model and development management of the compact city unit in Viet Nam**”, Planning journal number 94, ISSN 1859-3054, page 44.

2. Lưu Đức Cường, Lê Kiều Thanh (2018), “**Opportunity and challenge on the sustainable development of the compact city unit in Viet Nam**”. Planning journal number 94, ISSN 1859-3054, page 21.

3. Lê Kiều Thanh (2020), “**Current situation and forecast of the compact city unit model in Viet Nam**”. Planning journal number 106. Planning journal. ISSN 1859-3054, page 30.

❖ Scientific research topic

4. Lê Kiều Thanh (2021), “**Summary report on sustainable compact city unit model in Viet Nam**”. The scientific research topic at ministry level.