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URBAN ROAD NETWORK PLANNING IN HAI PHONG TOWARDS ECO- CITIES

SUMMARY OF DOCTORAL THESIS
SPECIALTY: INFRASTRUCTURE ENGINEERING

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A. INTRODUCTION

1. Rationale of the study

The currently rapid urbanization all over the world, especially in the developing countries seems to have been accompanied by the over-exploitation and overuse of natural resources. The construction of Eco-Cities (CEC) has been increasingly developed around the world as a trend of urban development which is targeted at by many countries.

Among lots of the global trends of urban development, Hai Phong along with many large cities in Vietnam choose CEC as its policy. The policy is given to the 14th Hai Phong Party Committee Resolution on developing and managing Hai Phong city from now to 2025 with a vision towards 2050.

To meet the target, urban road network planning is considered as an important foundation to CEC. From this practical situation, the study, named **"Urban road network planning in Hai Phong towards Eco-Cities"** makes a great contribution to constructing the Eco- Cities (EC) in Hai Phong and being as a reference for other cities in Vietnam.

2. Objectives of the study

Propose urban road plans (URNP) in Hai Phong towards Eco- Cities.

3. Scope of the study

+ **Objectives of the study:** urban road network.

+ **Scope of the study:** The administrative boundaries of Hai Phong, except Cat Hai and Bach Long Vy Insular District. The time of the study lasts to 2025, under the adjustments of Hai Phong's general construction.

4. Aims of the study

The study includes five main aims: (i) Providing an overview of urban road network planning towards Eco- Cities around the world and in

Vietnam and in Hai Phong city; (ii) Synthesizing the theoretical basis, legal basis and some lessons on URNP towards EC in Hai Phong; (iii) Presenting the views and principles and identifying the criteria of URNP towards EC in Hai Phong; (iv) Zoning Hai Phong under the certain characteristics; (v) Applying Hai Phong transport demand forecasting model into Hai Phong, then proposing solutions on URNP towards EC in Hai Phong.

5. Methodology

Five methodologies are applied in this study including: (i) Survey research; (ii) General analysis research; (iii) Inheritance research; (iv) Expert research; (v) Forecasting research

6. Scientific and practical significance

+ **Scientific significance:** The study helps complete the scientific basis in the field. Moreover, it also provides the important knowledge on URNP towards EC which will be a reference to teaching and researching.

Practical significane: The study synthesizes the basis information of URNP towards EC which provide database for the urbal planners and managers to apply into planning and building EC in Vietnam. It is a reference to the construction of urbans with environmental protection, sustainably urban development.

7. Findings of the sudy

The study offers three new findings including:

(i) The thesis proposes 5 groups with 25 criteria in URNP towards EC in Hai Phong;

(ii) The thesis gives city zoning proposal. Hai Phong is divided into 3 different regions with its own characteristics, including: the old urbans,

the "newly-developing" areas, the towns and rural areas. Zoning will help provide suitable solutions on URNP towards EC for each specific characteristic;

(iii) The thesis proposes to integrate URNP towards EC with 5 types of planning, including (Socio-economic master plan; Land use planning; General urban planning; Urban transport planning; Transportation planning). The thesis applies a 4-step model for forecasting transportation demand which aims to propose effective solutions on URNP towards EC in Hai Phong.

8. List of terms

Some terms like urban, intergrated planning, ecological footprint, green urbans, urban ecosystem, a master planned urban development, urban road, urban transport planning, public transport and Eco- Cities are systemically synthesized in the study. **Eco- Cities**: According to World Bank, Eco- Cities are defined as cities that create economic opportunities for their citizens in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and global public goods, such as the environment, for future generations.

9. Organization of the study

The study is designed with three main parts: *Part 1:* The general background of urban road network planning towards Eco- Cities. *Part 2:* The scientific basis of URNP towards EC in Hai Phong. *Part 3:* The urban road plans in Hai Phong towards Eco- Cities.

CONTENT

CHAPTER 1: THE OVERVIEW OF URBAN
ROAD NETWORK PLANNING TOWARDS ECO- CITIES

1.1. The overview of URNP towards Eco- Cities in the world.
1.1.1. The history of Eco- Cities development

It is said that Eco- Cities were originated from Garden Cities. The rapid development of garden cities broke out into many different branches: Green Urban, Eco- Cities, Sustainably Development Urban.

In 1975, Richard Register established a non-profit organization called Urban Ecology in Berkely, California, the U.S. The term **Eco-city** which has been popular around the world was introduced by Richard Register in 1979. Urban Ecology further advanced the movement when they hosted the first International Ecocity Conference in Berkeley, California in 1990. The conference focused on urban sustainability problems and encouraged over 800 participants from 13 countries to submit proposals on best practices to reform cities for a better urban ecological balance. Vietnam has aslo some cities following this trend such as Hoi An, Hai Phong, Da Lat, Phong Dien town, Thai Nguyen City, Hanoi…

1.1.2. URNP towards EC in some Europe cities.

Europe is a long-standing development area where is considered as a cradle of **"Garden Cities"** with many innovative cities in urban development such as Paris (France), Stockholm (Sweden), Copenhagen (Denmark), Freiburg (Germany), London (UK). etc. The road network planning also has a development process through y many different stages. The road network planning mainly comes from a central core and gradually spreads to different areas which makes the road network exist in a synthetic form: a fan-shaped area with a star ray, a chess-boarded area like Rome - Italy and Toulouse – France.

1.1.3. URNP towards EC in some cities in North America

North America is a young continent with lots of innovations in which scientists point some views on building Eco-Cities. Some typical Eco-cities include: San Francisco, where exists plenty of rapidly development space, has applied lots of breakthrough solutions for sustainable development; Vancouver in Canada is one of the ten most livable cities in the world during five consecutive years; Curitiba in Brazil is regarded as a city with a fairly complete transport system that connects well between urban planning and traffic planning in the process of renovation and development.

1.1.4. URNP towards EC in some cities in Asia

In Asia, this movement has taken place strongly in some leading coutries such as Singapore, China, Korea, Japan…

1.1.5. General assessments on URNP towards EC around the world

According to some statistic figures in some cities, the study gives some following data:

Table 1.1: Solutions to buiding EC in some countries over the world

City	URNP with urbanization strategies	URNP with land use	Road network management	Public and non-motorized transportation	Ecological environment
Copenhagen	X	X	X	X	X
Freiburg	X	0	X	X	X
Curitiba	X	X	0	X	X
SanFrancisco	X	X	X	X	X
Singapore	X	X	X	X	X
Seoul	X	X	0	X	X
X: Clear solution;	0: Unclear solution				

Therefore, the solution towards URNP with land use attracted 5 in 6 cities and that towards road network management is 4 in 6 cities. All the cities are implemented these solutions effectively.

1.2. The overview of URNP towards Eco- Cities Vietnam.
1.2.1. An overview of urban system in Vietnam

From 1990 until 2019, the rate of urbanization in Vietam increased rapidly, from 20% to 38%. In 2019, Vietnam has 833 cities, in which there are 5 direct-controlled municipalities which are considered as the most important factors to promote national socio-economic development.

1.2.2. The overview of URNP towards Eco- Cities Vietnam

Initial orientation to Eco-cities has been settled, however, in Vietnam, there have no the real Eco-cities which ensure their standard qualifications. Only few cities like Hanoi, Ho Chi Minh, Da Nang, Can Tho, Hoi An, Da Lat, Phong Dien, Thai Nguyen are on the way to set up Eco-Cities.

1.2.3. General assessments on URNP towards EC in Vietnam

In reality, Vietnam has not had any "real" Eco-cities with their standards. That may come from the lack of technical and social infrastructure, the seriously polluted environment, the low amount of land, the lack of experienced experts, the lack of green trees.

1.3. The situation of URNP in Hai Phong

1.3.1. About Hai Phong

- An overview of the natural conditions of Hai Phong city
- Current socio-economic situation
- History of Hai Phong city development planning

Hai Phong city planning was implemented from the first day of its establishment - the early days of An Bien hamlet to the planning period

in 2007 Decision No. 1448 / QD-TTG dated September 16, 2009. That shows that Hai Phong has had planning very early. Development orientations have been adjusted and updated regularly, only during the war against the French and against the US, the urban development planning was interrupted.

1.3.2. The situation of transport in Hai Phong

- Current situation of external traffic in Hai Phong city
- Current situation of urban traffic in Hai Phong city
- Current demand for travel

1.3.3. The basic characteristics of the road network in Hai Phong.

The process of Hai Phong's development has been affected by many factors such as: natural characteristics, ecological system characteristics, socio-economic characteristics, population distribution, and people's living habits. From the above factors, Hai Phong city road network is divided into 3 main zones:

- Zone 1 – the old urbans
- Zone 2 – the newly-developing" areas
- Zone 3 – the towns and rural areas

1.3.4. Climate changes affect URNP in HaiPhong

1.4. Some topic-related research.

1.4.1. Some foreign scientific research projects

- Important research by some international organizations such as WB, ADB
- Research of world scientists

1.4.2. An overview of research in Vietnam.

- Some thesis related to URNP
- Some dissertations related to EC and sustainable development.
- Some research topics

1.5. The research directions

Based on the research objectives of the thesis and the current limitations of Hai Phong city as well as the orientation in Hai Phong City's tourism planning towards EC, the thesis should address the following issues:

- Systematizing the scientific basis on URNP towards EC.

- Clarifying the characteristics of Hai Phong city as well as the road network for each area to have orientations in the planning of road network development towards EC.

- Giving a consistent viewpoint and principle of URNP towards EC to give the suitable solutions with the specific characteristics of the city.

- Developing a number of criteria for URNP towards EC in Hai Phong city to serve as the ground for the management and implementation of the planning.

- Applying the model of traffic forecasting in Hai Phong city, in order to propose a suitable URNP solution to Hai Phong city towards EC.

- Proposing a number of URNP solutions to Hai Phong city towards EC corresponding to the characteristics of developed areas.

CHAPTER 2: SCIENTIFIC BASIS OF URNP TOWARDS EC IN HAI PHONG

2.1. Theoretical basis of URNP towards EC

2.1.1. Criteria for Eco-cities

At present, in Vietnam, there are no legal documents prescribing the criteria for developing Eco-cities. However, in the world, some organizations including WB, Australia's Urban Ecology Organization; The UK's Eco-city criteria, International Eco-city standards (IES) have givein some views on the relationship between EC and green cities and

sustainable cities; as well as the criteria of EC.

Through research on EC's criteria of international organizations and countries around the world, the thesis synthesizes 12 criteria, of which urban traffic appears with this following priority: walking, bicycle, public transport by tram or subway, public transport by bus, car;

2.1.2. Principles of building EC

Principles of building EC have been mentioned by some international organizations and scientists such as: Urban Ecology; WB; Prof. Le Huy Ba ... The thesis provides 10 principles of building an eco-city. This will be an important basis for the thesis to research and give proposals to Hai Phong city.

2.1.3. Requirements on URNP towards EC

- *The roles of urban road network*: (1) Road network for passenger and cargo transportation; Road network with socio-economic development; (2) Road network with urban technical infrastructure system; (3) Road network with landscape and environment

- *Basic requirements of urban road network towards eco-city:* (1) URNP is suitable urban spatial form; (2) URNP is suitable for urban land use planning; (3) URNP is suitable for urban scale; (4) EC helps minimize ecological footprints.

2.1.4. URNP's criteria towards green cities and sustainable development

Many scientists and organizations have proposed criteria for URNP towards green urban areas and sustainable development such as Assoc. Luu Duc Hai's research, PhD. Vu Anh's research, Circular 01/2018 / TT-BXD, KOICA, PhD. Nguyen Thi Nga's research, Prof.Dr.KTS. Do Hau's research ... It shows that URNP towards a sustainable city and towards a green city has the proposed criteria. Sustainable urban areas,

green cities and EC also share many similar criteria. In the thesis, the author shows that there are 22 criteria based on 4 contents associated with the planning of the road network development: urban planning, transportation, urban environment and traffic demand management. These criteria will be an important framework for proposing URNP criteria towards EC in Chapter 3.

2.1.5. Some factors influencing URNP towards EC

These factors like natural conditions, socio-economic conditions, climate change, the development of science and technology, urban and human development policies have great effects on URNP.

2.1.6. Some methods of forecasting travel demand

Travel demand forecasting plays an important role in URNP. There are many methods of forecasting travel demand such as: Extrapolation method, Fratar method (USA), Detroit method (Detroit city of USA), Gravity method, also known as 4-step modeling method which are applied in the thesis:

Step 1: Generate and attract trip

Regression analysis is a statistical method in which the mean value (mean) of one or more random variables is predicted based on the conditions of other (calculated) random variables.

The general regression model involves:

$$Y_i = a_i + p_1X_1 + P_2X_2 + \ldots + P_nX_n + S_i \qquad (2.2)$$

Of which:

+ Y_i = the number of itineraries arising in i; a_i = real number; $p_1 \ldots p_n$: = regression coefficient; $X_1 \ldots X_n$ = random variable (variables representing a factor affecting the number of trips such as population, household ...; S_i = correction coefficient (balance); a_i, p_l, $p_2 \ldots P_n$, S_i are determined by regression method.

Step 2: Trip Distribution Model

The most common method to determine the journey distribution is to use Gravity mode, which specifies the number of journeys between the origin and the destination as a function of inbound and outbound calculation (OD attribute) and travel cost between them.

$$T_{ij} = P_i \cdot \left[\frac{A_j F_{ij} K_{ij}}{\sum_j A_j F_{ij} K_{ij}} \right] \tag{2.3}$$

Of which: T_{ij}: Itinerary from region i to region j; P_i: Total journeys arising from region I; A_j: Number of journeys absorbed into region j; F_{ij}: Impedance coefficient, usually a function inversely proportional to the travel time between i and j; K_{ij}: The socioeconomic adjustment coefficient for journeys originating from i and to region j, usually is 1.

Step 3: Modal Split Model

The most popular method is the Logit model.

The general formula is:

$$P_i = \frac{e^{U_i}}{\sum_j e^{U_j}} \tag{2.4}$$

Of which:

+ P_i: Ability to choose method i; U_i: The utility function of the method i, the function has the form;

$$U_i = \alpha + \beta_1. X_1 + \beta_2. X_2 + \ldots + \beta_n. X_n$$

+ With: $X_1 \ldots X_n$, are the attribute variables depending on model i.

+ α is a constant; β_1, β_2,…, β_n are the coefficients representing the components it incorporates in utility functions. This constant, coefficients can be determined by regression method.

Step 4: Trafic Assignment

To assign traffic on traffic networks use the function BPR (Bureau of

Public Roads) which is a function of traffic delay used commonly. The variables used in this function are traffic volume, traffic capacity α, β. The formula for the traffic delay function is as follows:

$$T = T_0 \left[1 + \alpha \left(\frac{V}{C} \right)^{\beta} \right]$$

(2.6)

Of which: T_o = Free Flow Trip Time; V= Link Trip Flow; C=Link Capacity; α, β = Parameter

Thanks to the advantages of TransCAD software, the thesis has applied this software to forecast the transportation demand in Hai Phong city. On that basis, the thesis proposes a number of URNP solutions for Hai Phong city.

2.2. Legal basis in URNP towards EC in Hai Phong

- The development orientation of creative innovation has been mentioned in many legal documents such as: (i) Conclusion No. 72-KL / TW; (ii) Resolution No. 45-NQ / TW on construction and development of Hai Phong city to 2030, with a vision to 2045; (iii) Some action programs.

- Orientation of urban transportation in some planning such as: (i) Transportation planning of Hai Phong city to 2020 with a vision to 2030; (ii) Adjustment of the master plan of Hai Phong city to 2025 with a vision to 2050; (iii) Adjustment of the master plan of Hai Phong city to 2035, with a vision to 2050:

- According to the orientation of Resolution No. 20 / NQ-HDND, the areas already planned under Decision 1448 / QD-TTg dated September 16, 2009 will basically remain. Orientation of planning adjustment until 2035 inherits and develops into a multi-center urban city, including 2 economic belts, three landscape corridors, three key cities and new urban centers.

2.3. Some experience.

2.3.1. Experience from other countries.

- Vancouver City, Canada.

- TianJin City, China.

2.3.2. Experience in Vietnam.
- Ecopark, Hung Yen.
- Hoi An City.

CHAPTER 3: URNP TOWARDS EC IN HAI PHONG CITY
3.1. Viewpoints and principles of the study
3.1.1. Viewpoints of the study

The thesis shows 6 points of view including: i) URNP towards EC must be considered from **"integration"**; ii) **"Optimization"** of land use in URNP; iii) The concept of **"balancing"** urban ecosystems is aimed at reduce emissions into the environment; iv) The view of "**giving priority**" to developing the network of public transport, bicycle, walking should be formed in a complete system with high service and coverage; v) "**Clean energy**" in transport is mainly used; vi) Towards the development of a **"low carbon"** city in transport.

3.1.2. Principles of the study

The thesis proposes 8 URNP principles towards EC: (i) Must be associated with the master plan for urban development and suitable with the urban spatial structure. (ii) Must be integrated with other plans, especially land use planning. (iii) Must be based on the forecast of urban transportation demand. (iv) Must be formed a unified and synchronous system between the internal road network and the external road network; among the terrestrial, overhead and underground road networks. (v) Must be consistent with urban ecosystems. (vi) Must be consistent with the structure of urban transport. (vii) Must adapt to climate change. (viii) Must minimize ecological footprints.

3.2. Proposing the criteria of URNP towards EC in Hai Phong City

The thesis proposes 5 groups of criteria with 25 following specific criteria:

- *Group of criteria for URNP towards Urban Planning*: (P.01) Road network density for public transportation/ urban construction land area; (P.02) Road network density for bicycle and walking/ urban construction land area; (P.03) Road network density for motorized transportation/ urban construction land area; (P.04) Traffic intersection density; (QH.05) Ratio of traffic land / urban construction land area; (QH.06) Ratio of the land area of the bicycle road network and the walking road / urban construction land; (QH.07) Area of traffic land/ person; (QH.08) Area of bicycle, walking/ person.

- *Group of criteria for URNP towards Vehicles*: (V.01) Number of car ownership per person; (V.02) Number of bike own/ership per person; (V.03) Proportion of trips using public transport in total trips; (V.04) Ratio of bicycle and pedestrian in the total means of transport.

- *Group of criteria for URNP towards Urban Environment*: (E.01) Ecological footprint in traffic; (E.02) Area of planting green trees in the road network / total area of the road network; (E.03) Proportion of vehicles using clean fuel; (E.04) Rate of using renewable energy technology in lighting.

- *Group of criteria for URNP towards Urban Traffic Demand Management*: (M.01) Vehicle management and emissions from traffic transport; (M.02) Strategy in developing urban transport with a reasonable development structure; (M.03) A shared ticket using for public transport; (M.04) Developing policies to determine congestion charges; (M.05) Developing policies to determine parking fees; (M.06) Provide subsidy policy on price of clean fuel.

- *Group of criteria for URNP towards Science and Technology:* (S.01) Using technology in urban network planning; (S.02) Using smart traffic technology in the road network management and operation; (S.03) Ratio of using environmentally friendly technology and recycled materials / total amount of materials in the road network construction.

In a total of 25 criteria for URNP towards EC in Hai Phong city, there are 9 dissertation criteria which are inherited from domestic and foreign organizations and scientists. There are 16 new criteria that the thesis proposes to apply to Hai Phong city.

The adjustment to the master plan up to 2025 with a vision to 2050 mentions 3 criteria. Some criteria have been identified in the current normative standards but have not yet been applied to the Hai Phong city master plan. Almost other criteria have not mentioned to construction recommendations to apply in the next period.

3.3. Zoning proposals in URNP towards EC in Hai Phong.

3.3.1. The basis for zoning

The thesis synthesizes a number of important basis for zoning URNP: (i) Based on the current status of the road network; (ii) Based of orientation of landscape architectural areas; (iii) Based on population density; (iv) Based on natural conditions; (v) Based on administrative boundaries; (vi) Based on socio-economic conditions; (vii) Based on ecosystem; (viii) Based on climate change conditions.

3.3.2. Zoning proposals

The thesis proposes, in the field, Hai Phong City is divided into 3 subdivisions: (i) Zone 1: **"old urbans";** (ii) Zone 2: "**Newly-developing**" areas; (iii) Zone 3: **"towns and rural areas"**
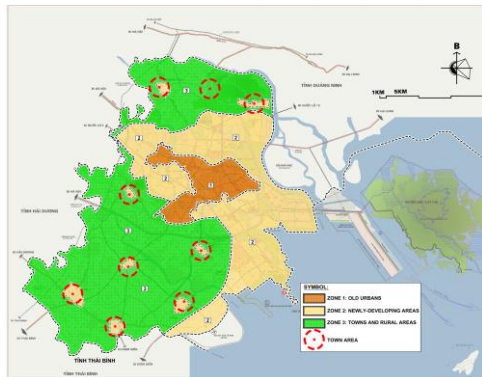
Figure 3.2: Zoning proposal

3.4. Some solutions for URNP towards EC in Hai Phong City.

3.4.1. Integrating URNP with the plans.

The URNP in Hai Phong have been mentioned in various planning projects. Based on the current conditions and the scientific basis, the thesis proposes a solution that is in the process of planning the road network development, it is necessary to integrate 5 types of planning on time and contents of urban road network planning.
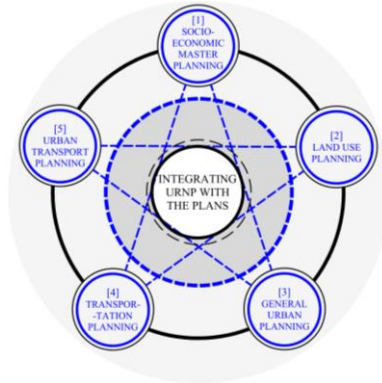

Figure 3.5: Proposal to integrate URNP

3.4.2. Applying the 4-step model for forecasting transport demand in in URNP towards EC in Hai Phong city.

To forecast the transport demand, it is necessary to follow 3 phases: input data preparation stage, 4-step forecasting model application stage, output completion stage *(see figure 3.6).*
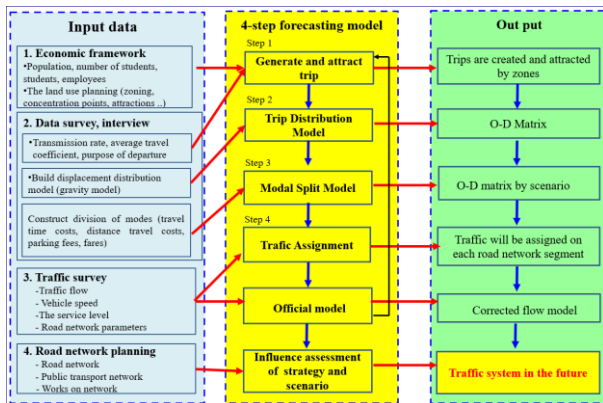

Figure 3.6: Transport demand forecasting diagram

a. ***Zoning, building and simulating transportation network:*** *Hai Phong*

is divided into 158 regions. Of which, 113 regions are based on administrative boundaries, land use planning; 12 regions are neighboring localities; 25 are industrial zones, 8 are towns.
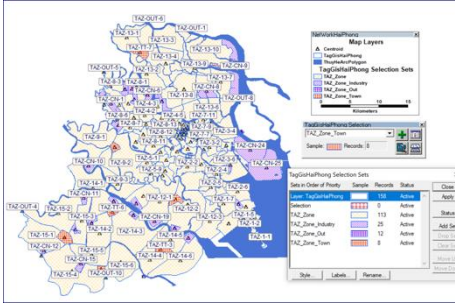

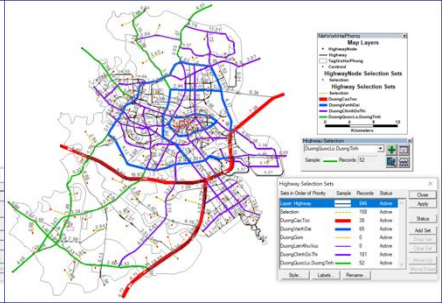|	
Figure 3.7: Traffic Zoning in Hai Phong City	*Figure 3.8: Length of some roads*

The need to generate and attract from 158 regions is shown through the origin-destination (O-D) matrix. From this O-D matrix the traffic will be concentrated to the center of the region (centroid) and then will form virtual links. Road network is built based on the current status and general planning orientation of Hai Phong city until 2025.

b. ***Cruise distribution:*** A common method to determine the trip distribution is to use an attractive distribution model.

c. ***Method devision***

According to the development orientation of the public transport use rate in 2025, Hai Phong city is expected to be 10%. The most common method used is the Logarithmic model.
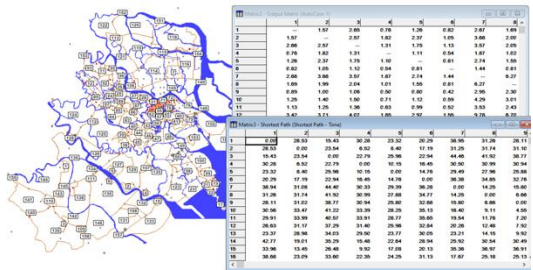

Figure 3.9: Itinerary matrix among regions

Result: Determine the number of itineraries from each region to another which are organized by different traffic patterns.

3.4.2.2. Travel assignment

To assign traffic on traffic networks, people often use BPR (Bureau of Public Roads) which is a function of traffic delay commonly. The two parameters α and β used to be taken into account by the thesis are 3.59 and 0.4. After being put into the model, the results of traffic distribution on the road network are shown *(see Figure 3.10).*
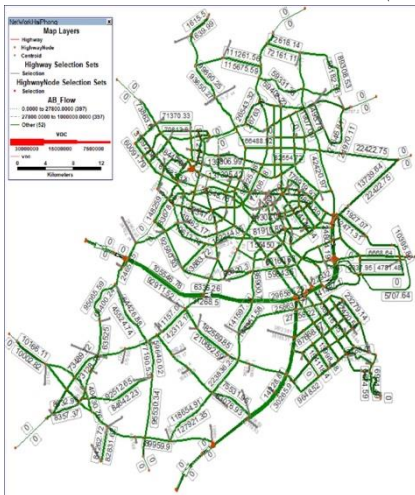

Figure 3.10: Traffic distribution on the road network

Figure 3.11: Traffic distribution in the Central

3.4.3. Proposals on URNP in Hai Phong

Based on the current characteristics of the road network, the current population and the urban development orientation of Hai Phong city, the thesis proposes the overall road network structure. Applying the above structure to URNP towards EC in HAi Phong, the thesis provides some proposals on the road network on large-scale public transport, the specific motorized traffic network (*see Figure 3.16; 3.17*).
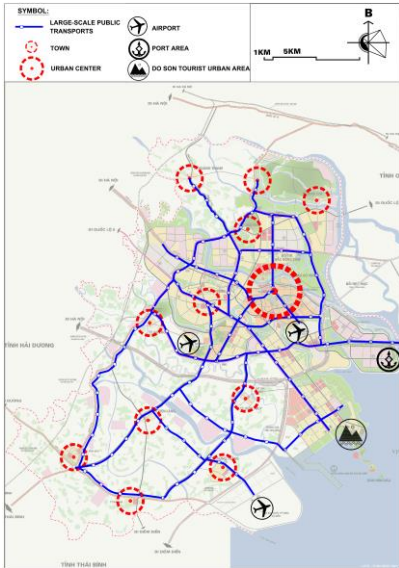
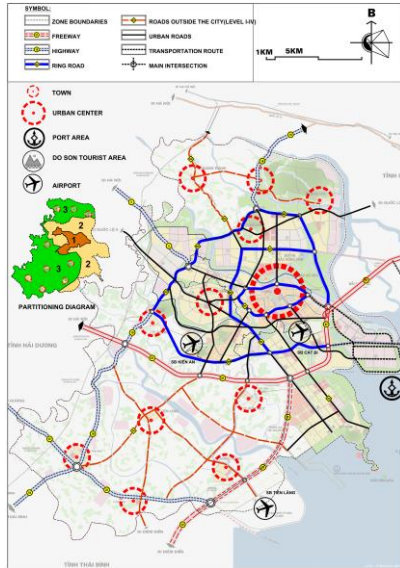*Figure 3.13: Proposals on road network for large-scale public transport*

Figure 3.14: Proposals on the main road network

3.4.4. Proposals on URNP for each zone.

The thesis proposes solutions for 3 different regions:

a. Zone 1: In addition to the solution URNP for public and motorized traffic, the thesis proposes the road network for cycling, walking in the central area and improving the road network in the direction of priority for public transport, bicycle, walking and motorized traffic limitation.

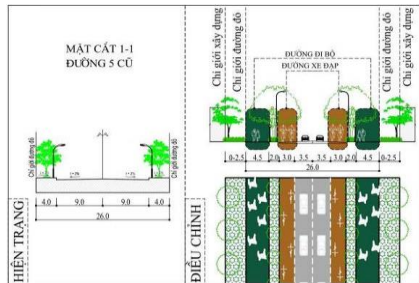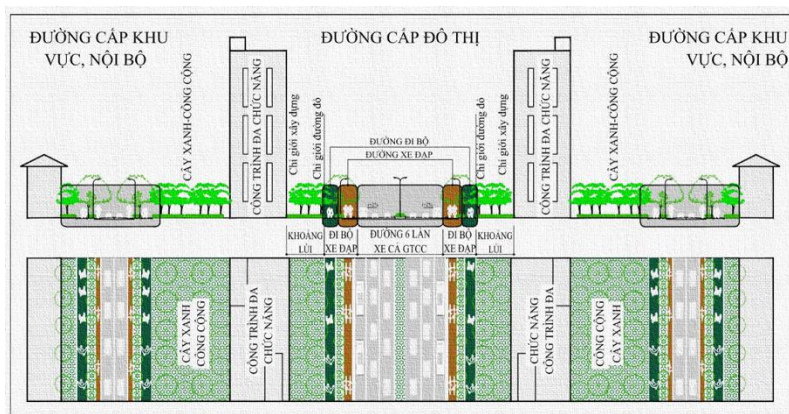*Figure 3.15: URNP proposal on walking and cycling*

Figure 3.16: Proposal on improvement of the old NH5 cross-section

- Difficult access public transport (**RAPT**): Apart from the solution to the public road network and the bicycle walking path, the solution for the motorized road network is to develop the urban-level road network in the form of **"3-axis road".**

Figure 3.18: Proposal on 3-axis road structure

b. Zone 2: Zone 2 is a new area where population density is not high, road network has not been completed as planned. URNP solutions synchronously implement with a priority to develop public transport, bicycle, walking, and limit personal traffic.

c. Zone 3: With its outstanding features, zone 3 is the development area along the corridor of NH10, NH37; NH5; Provincial Road No. 5, 352, 354 ...URNP solutions meet the requirements of axial connection and development requirements in the process of the rural area into an urban area.

3.5. DISCUSSION OF RESEARCH FINDINGS

3.5.1. Discussion on criteria of URNP towards EC in Hai Phong City.

- The thesis shows 6 viewpoints and 8 principles of URNP towards EC in Hai Phong.

- The thesis proposes 5 groups of criteria with 25 specific criteria in implementing URNP towards EC. The proposal has just ended at criteria without digging deeply into quantitative research on these criteria. That may also a space for further research in the same concern.

3.5.2. Discussion on the zoning and application of the 4-step model of traffic demand forecasting in URNP towards EC in Hai Phong city.

In the thesis, Hai Phong City is divided into 3 subdivisions with specific solutions for each zone: (i) Zone 1: **"old urbans";** (ii) Zone 2: "**Newly-developing**" areas; (iii) Zone 3: **"towns and rural areas"**

The thesis has applied a 4-step model in forecasting transportation demand for Hai Phong city. On that basis, it proposes the suitable road network. The collection of data requires a relatively long time with a large budget. The thesis has used some traffic demand survey data by the Department of Transport of Hai Phong City. Because the data source used to run the model is incompleted, the dissertation has not shown the mode of traffic classification structure, which is also an open space for further research.

3.5.3. Discussion on some solutions to URNP towards EC in Hai Phong.

The thesis proposes to integrate URNP towards EC with 5 types of planning, including:

(i) Socio-economic master planning;

(ii) Land use planning;

(iii) General urban planning;

(iv) Urban transport planning;

(v) Transportation planning.

Planning Law No. 21/2017 / QH14 of the National Assembly mentioned the integration and then Decree 37/2019 / ND-CP also guided the planning law. However, both of them did not mention how to integrate, what should be integrated. The dissertation mentions the integration problem in URNP and provides more specific integration contents related to URNP. However, to implement this content, it is necessary to conduct further researchs.

The thesis proposes the structure of overall road network in Hai Phong city. Based on the traffic model, the thesis has assessed the level of congestion and calculated the ability to meet the road network in the period of 2025. Thank to this, solutions to improve and develop the road network are presented.

The thesis proposes specific solutions for 3 zones. Among them, the proposal to develop bicycle and pedestrian network around the historic core area and solutions for "RAPT" areas are in great concern; the proposal to rehabilitate the road network in this area in the structure of the 3-axis road is also described in the section.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The road network planning towards eco-cities is one of the new projects in Vietnam. With the given research objectives, the thesis has achieved some basic results as follows:

1. An overview of URNP towards EC of some typical cities in the world and in Vietnam. Based on it, the author draws some core problems, general trends of the cities. The dissertation has synthesized a number of domestic and foreign studies related to URNP towards EC,

systematized the history of formation and planning stages of Hai Phong city. Thanks to these, the thesis synthesizes the basic characteristics of the road network of Hai Phong. This is the basis for proposing solutions on URNP towards EC.

2. The thesis systematizes the criteria and principles of building EC, synthesize the requirements in URNP towards EC and synthesize the criteria of URNP towards EC which share the same features with eco-cities such as green urban areas, sustainable urban development. Besides, the thesis also provides theoretical basis, legal basis and lessons learned which are considered as an important foundation to propose principles, criteria and solutions in the Hai Phong City towards EC.

3. The thesis presents 6 viewpoints, 8 principles and 5 groups of 25 criteria in URNP towards EC in the city

4. Based on the orientation of landscape architectural regions; population density; natural conditions, socio-economic conditions and administrative boundaries, the thesis proposes zoning Hai Phong city into 3 different regions ("old urbans"; "Newly-developing" areas; "towns and rural areas") according to its own characteristics in order to have appropriate solutions on URNP.

5. The thesis proposes to integrate URNP with 5 types of planning, including socio-economic master planning; Land use planning; Urban general planning; Urban transport planning; Transport planning. The thesis has applied a 4-step model for forecasting transportation demand which aims to propose effective solutions on URNP towards EC in Hai Phong.

The result of the thesis is to synthesize the basic content of theory, practice, and to model the information technology application in URNP towards EC. It also presents some new proposals for Hai Phong city. Hopefully, the results in the thesis will contribute to building eco-cities in Vietnam in general and Hai Phong city in particular.

RECOMMENDATIONS

1. For urban transport planning: It is necessary to base on the views, comply with the principles and criteria of urban transport. In the planning, adjustment of general planning, subdivision planning, detailed planning, Hai Phong needs to apply principles and criteria for overall and detailed planning solutions. It is necessary to apply model and information technology in traffic demand forecasting to evaluate the traffic planning plan.

2. For research and teaching: The thesis is the first step in researching URNP towards EC. The thesis shows the necessary to the application of model and information technology in urban planning in a comprehensive way. Building textbooks, teaching modules in schools related to EC, ecological transportation should be paid more attention. Research and issue publications to disseminate knowledge about EC and ecological transport should be published widely.

3. For management:

Recommendation to the Ministry of Construction: Issue a circular "Guidelines for Eco-cities development planning" in which the core is the criteria and targets for building EC. Supplementing content related to URNP towards EC in the normative standards should be implemented.

Recommendations to urban authorities: if there are no documents guiding the construction of EC, the authorities should actively conduct research, visit and learn the experience from other cities and countries. And when legal documents are ready, the authorities will immediately prepare action plans and specific construction plans for each city.

LIST OF SCIENCE RESEARCH WORKS

Scientific article:

1.   Than Dinh Vinh (2016), "*Access to traffic in eco-urban areas".* Journal of Architecture and Construction Science, Hanoi University of Architecture, July 22, 2016, ISSN:1859-350X.

2.   Than Dinh Vinh (2019), "*Development of road network in line with the ecological urban spatial structure".* 2019 International Scientific Workshop on Architecture and Construction, ISBN: 978-604-67-1457-6.

3.   Than Dinh Vinh (2019). "*Experience in road network development planning towards eco-city in the world".* Journal of Architecture and Construction Science, Hanoi Architectural University, No. 35 September 2019, ISSN: 1859-350X.

4.   Than Dinh Vinh (2019). "*Criteria for road network development planning towards eco-cities in Vietnam".* Journal of Architecture and Construction Science, Hanoi Architectural University, No. 35 September 2019, ISSN: 1859-350X.

Textbook:

5.   Pham Trong Manh, Nguyen Manh Hung, Than Dinh Vinh, (2017). Textbook *"Urban transport planning".* Construction publisher, 2017. ISBN number: 978-604-82-2105-8.