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# TOWARDS A SUSTAINABLE PLAN FOR NEW TUBE HOUSES IN VIETNAM

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**Phan Anh Nguyen | Regina M.J. Bokel | A.A.J.F. van den Dobbelsteen**

TU Delft

In Vietnam, the history of cities can easily be seen through their urban patterns, landscapes and housing typologies. Most recently, the economic reform in 1986 has resulted in huge impact on the Vietnamese society. The rapid economic growth and privatisation of the market has resulted in the appearance and significant development of the “new tube house” which soon became the most dominant housing type in Vietnam. Hanoi, the capital city of Vietnam, has a long history and also is very rich in architectural styles and typologies which are reflected in its urban pattern. However, there is no actual clear boundary in urban scale as the new tube houses are scattered all over the city and they are adapted differently to the contexts. This paper aims to investigate how the traditional urban tube houses in Hanoi transformed into the new tube house and, on the other hand, present the results of a survey conducted in Vietnam on how these houses respond to the Vietnam local climate and perform in terms of energy consumption.

#### **Keywords**

housing, energy efficiency, climate design, Vietnam, urban pattern

#### **How to Cite**

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## INTRODUCTION

Vietnam, a small country in Southeast Asia, has undergone a lot of changes in its history, which includes different wars against Eastern and Western invaders as well as the development of a socialist society. Governments in different periods had their own significant impact on the whole country both economic as well as social aspects. Architecture and urban planning are not an exception. In Vietnam, the histories of cities can easily be seen in their urban patterns, landscapes and housing typologies. Traditional Vietnamese architecture has been influenced by Chinese architecture which can clearly be seen from the pagodas, temples and the traditional tube houses in the ancient quarters. In the colonial period (1858 -1945), Vietnam adopted the French urban planning system and many French style buildings. After the colonial wars, many old apartment blocks were built, inspired by the Soviet Union in the early years of the Communist Era<sup>1</sup>. Most recently, the economic reform in 1986 called “Doi moi” has had a huge impact on Vietnamese society. The rapid economic growth and privatisation of the market has resulted in the appearance and significant development of the “new tube house” which soon became the most dominant housing type in Vietnam. The spontaneous development of this housing type helped to solve the housing shortage in the context of urbanization and modernization. In time, each housing typology evolved and adapted to societal changes aiming to meet the demand of housing quality and quantity.

Hanoi, the capital city of Vietnam, has a long history and is therefore very rich in architectural styles and typologies which are reflected in its urban pattern. There are various areas within the city that have distinctive characters. However, for new tube houses, there is no clear boundary in the urban scale as they are scattered all over the city and adapted differently in their contexts. Because of their dominance, regardless of their advantages and disadvantages, the new tube houses will continue to play a significant role in the near future. This paper investigates how the traditional urban tube houses in Hanoi transformed into the new tube house. The housing stock also needs to face the challenge of becoming sustainable, provide a healthy living environment and reduce its energy consumption. The responsibility lies not only in new buildings but also in the existing houses. Nevertheless, little is known whether this new urban housing typology, the new tube houses, offers adequate living conditions for the occupants and can adapt to climate change.

## METHODOLOGY

The urban planning does have a considerable influence on housing typology, characteristic and performance. On the other hand, as a dominant feature of the urban fabric, a change in housing type can have impact on the city level. Therefore, understanding the current condition of the housing stock, requirements of a sustainable home can help in forming a sustainable plan of a city. This study investigates the energy upgrade potential of contemporary new tube houses in Vietnam through refurbishment activities and hence the sustainable development of the city.

The first part of this study explores how houses have transformed through time and adapted to societal and economic changes in different historical periods. New tube houses are compared to the traditional ones to see how this specific typology has evolved.

The second part focused on how the new tube houses performed in term of indoor environment, energy performance and the potential to improve such performance through renovation. This part includes an interview .The interview has 3 main parts. The first section focuses on the household’s composition and housing character. In the second part, respondents were asked about their living experiences including indoor environment and energy consumption. The final section questioned the interviewees about their attitude and their refurbishment needs for sustainable housing. This interview did not intend to generalise the result for the whole tube house type but to provide general ideas to discuss and to support the implementation of the follow-up questionnaire. Due to this reason, there were no more than 12 interviewees that took part in this survey. The respondents were chosen in such a way that they maximise the variety in location, housing age and occupants’ background.

## HOUSING IN THE HANOI URBAN AREAS

Hanoi, the capital city of Vietnam consists of seven different architectural areas, see figure 1: (I) Imperial citadel; (II) Old quarter; (III) French quarter; (IV) Neighbourhood built before 1986; (V) Private housing built after 1986; (VI) New urban areas built recently and (VII) less urbanized areas<sup>2</sup>. Most of the areas are residential areas except for the Imperial citadel (I). It can easily be noted that Hanoi has expanded its urban city boundary considerably over time.



FIGURE 1 Different areas in Hanoi

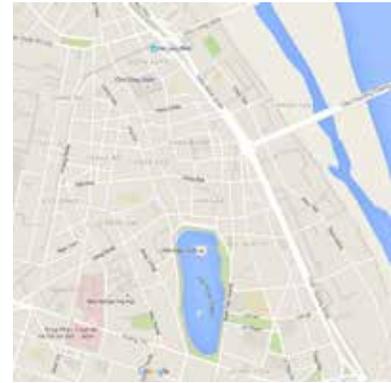


FIGURE 2 Plan of the Old quarter in 1987 (left) and 2016 (right)

Until the late 19<sup>th</sup> century, the city of Hanoi was still ruled by the feudal empire. The city consisted of two main parts: the imperial citadel for the royal family and the old quarter for the citizens. The old quarter served as residential area as well as a place for the people to do business, trade the goods by the banks of the Red river. The old quarter streets were also known as the “36 streets of Hanoi” which represented 36 different administrative units called “Phuong”. The main streets were designed on the east-west axis that connects the citadel and the river bank in order to promote trade. The urban pattern of the Old quarter has not changed much since the late 19<sup>th</sup> century as illustrated in figure 2.

The housing type was the traditional tube house. The character of a traditional tube house included: very small front (2-4 meter) and a depth varying from 20 to 50-60 meter; in general 2 storeys high. Inner courtyards were employed to enhance daylight and natural ventilation and were used for outdoor activities. The front areas on the ground floor were used as shops. There are different explanations for the extremely narrow front of the traditional tube house. One of which is that it was the result of a division of inheritances. Another hypothesis proposed that the houses had initially been developed from the market stalls a long time before the streets came into existence<sup>3</sup>. Kien, in 2008<sup>4</sup>, stated that the narrow width was due to the act of the feudal government that taxed the households by their houses' front width. As the settlement increased in population, the houses extended inwards and formed the tube-like houses. The urban pattern of the Old quarter can still be recognised, nowadays. However, although most of the houses still retain their tube shape, not many of them are in their original form but have transformed into the new tube houses. Figure 3 below illustrates a traditional tube house in old quarter of Hanoi which retains parts of its in original form (the front two-storey blocks). The rear three-storey parts were renovated in 2003.



FIGURE 3 Traditional tube house. Number 47 Hang Bac Street, Hanoi

The French came into Vietnam in the late 19<sup>th</sup> century and they have had a huge impact on the Vietnamese society, including its urban form and architecture. During the French colonial years, the extension of Hanoi was well planned and built. French colonial buildings have various styles and were constructed at a large scale. The French colonial quarter brings to the city a unique landscape in Asia and great opportunities for developing tourism and business<sup>5</sup>. In the period of 60 years (1885-1945), two areas of the French quarter were built adjacent to the Old quarter. The first area is located to the west of the Old quarter which includes the area of the imperial citadel and its surrounding and the second area is located to the South of the Old quarter. The first urban plan of Hanoi was designed in 1900 by Henri Vildieu, then in 1924 by Ernest Hebrard, in 1934 by Louis-Georges Pineau and for the last time in 1943 by Henri Cerutti<sup>6</sup>. With the intention of transforming Hanoi into the centre of the Indochina peninsula, the French architects aimed to plan the city in a complete western style with a checker pattern wide streets and French style buildings. There were three main building types: the public office buildings for the French government, the villas for the French officers and the street houses for the Vietnamese officers<sup>7</sup> as shown in figure 4.

After the French colonial period, the Vietnamese socialist government was established. In the 31-year period from 1954 to 1985, housing policy did not allow privately owned houses in the North, including Hanoi. Houses were built by the government and distributed to the state employees in the cities with extremely low rent<sup>8</sup>. These state housing consisted mainly of 3 to 5-storey apartment blocks with communal kitchens and toilets. The government maintained a monopoly on urban planning and housing design in order to provide citizens with equal living conditions and avoid social differences<sup>9</sup>. However, these apartment blocks were claimed to be poorly maintained and provided little comfort and inadequate living conditions for the occupants<sup>10</sup>. Nowadays, these blocks still exist and have lots of problems such as illegal expansion, low living condition, lack of public spaces and so on<sup>11</sup>. Figure 5 illustrates the planning and current condition of the old apartment blocks in Kim Lien area, Hanoi.

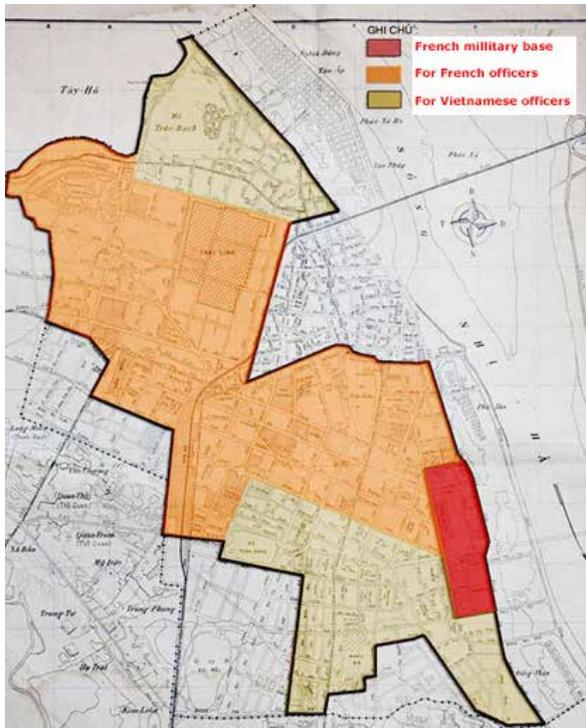


FIGURE 4 Plan of the French quarter

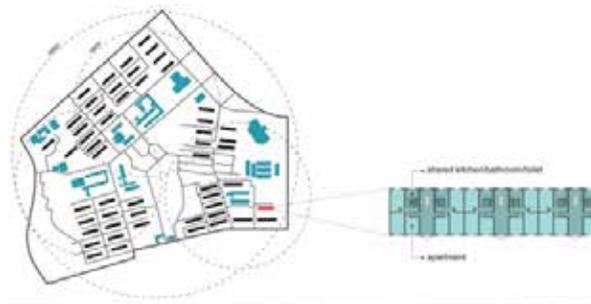


FIGURE 5 Apartment blocks in Kim Lien area, Hanoi

Most recently, the economic reform “Doi Moi” in 1986 has made considerable impact on the social and economic development of the cities. The privatisation of the market allowed people to do business, and especially buy and sell houses. People from the countryside migrated to the big cities to look for job opportunities and better social services. Big cities became more densely populated and a lot of pressure was put on the demand for quantitative and qualitative good housing. In order to adapt to the population boom, the number of available houses increased. The new tube house appeared and soon became the most dominant housing typology in Vietnam, accounting for about 75% of the total housing stock. Therefore, despite its advantages and disadvantages, this housing typology will continue to play significant role in the next few decades<sup>12</sup>.

A report of the national census and housing survey in 2009 indicated that there was a huge improvement in the housing supply due to the higher construction rate. However, the requirement of the housing demand in big cities was not yet met. As a result, it was more important to provide enough housing rather than providing better living condition in terms of indoor environment, health and safety<sup>13</sup>. On the other hand, the energy sector in Vietnam has to ensure an adequate energy supply and minimise energy-related environmental impact. According to the overview of the primary energy demand and supply balance for the 1997-2025 period, both policy makers and planners agree that energy demand will soon outweigh and even double the domestic supply by 2025<sup>14</sup>. Accounting for more than 31% of total energy consumption in 2012, the residential sector has been addressed as one of the most important sectors that can potentially reduce the total energy consumption in Vietnam<sup>15</sup>. In 2013, the Ministry of Construction has issued the National technical regulation on energy efficient buildings<sup>16</sup> (QC:09/2013/BXD) as an effort to improve the energy performance of the building sector. However, this regulation does not apply to small scale residential houses, such as the new tube houses. Hence, this paper aims to investigate the characteristics of row house, the most important housing typology, in terms of its environmental and energy performance. In order to support this contemporary housing type in its adaptation to reach a lower energy demand and an increased sustainability of the housing sector.

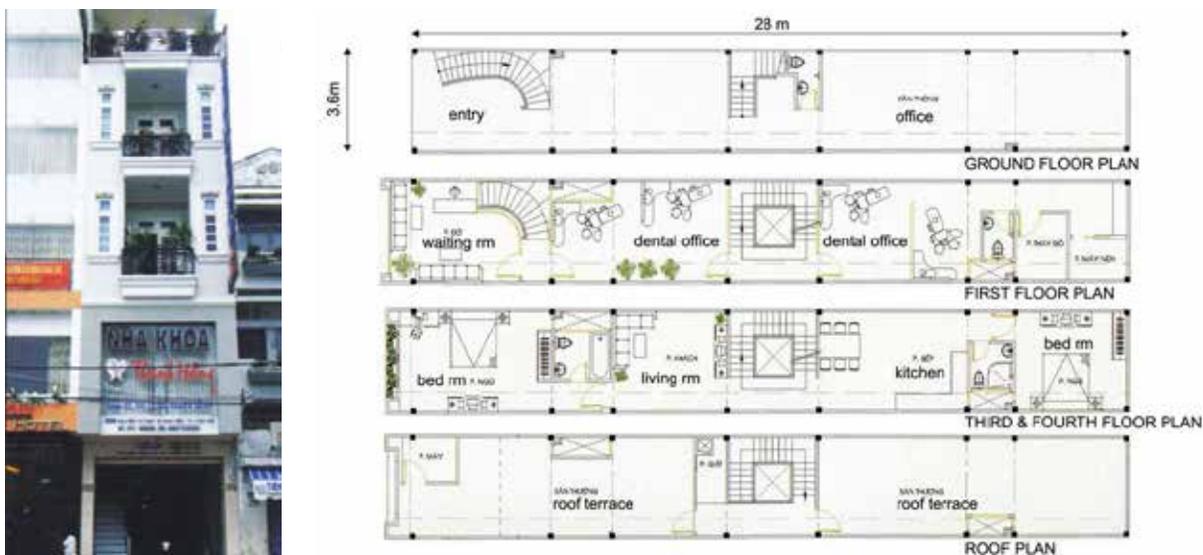


FIGURE 6 New tube house. House no. 138, Nguyen An Ninh street.

## TRADITIONAL TUBE HOUSE AND NEW TUBE HOUSE

The traditional tube houses have been studied by many researchers because of its historical value. Researchers investigated their history, urban planning, architecture, conservation methods, living experience of occupants and so on. On the contrary, the new tube houses did not attract attention of academic scholars until recently, when the question of sustainability arose.

In his study in 2008, Kien tried to compare several features of the traditional tube house and the new tube house as shown in table 1<sup>17</sup>.

	TYPE IDENTITY	TRADITIONAL TUBE HOUSE	NEW TUBE HOUSE
1	Construction period	16-19 Centuries	From late 1980s
2	Settlement pattern	Attached	Attached
3	Average plot size	3.5m x35m	4.5m x 20m
4	Tube-form layout	Yes	Yes
5	Tube-form façade	No	Yes
6	Front shop	Mostly yes	Mostly yes
7	Inner courtyard	Yes	Yes/No
8	Number of storey	1-2	3-5
9	Building materials	Ceramic roof tiles, wood beams, brick walls, plaster	Reinforced concrete bearing frame, brick walls, plaster
10	Number of households	Mostly multiple	Mostly single
11	Number of residents	Ca. 10	Ca. 3-7
12	Ownership	Multiple/single	Mostly single
13	Privacy	Little	Yes
14	Financing	Difficult	Convenient
15	Construction permit	Restricted	More freely

TABLE 1 Comparison of the traditional tube houses and the new tube houses

A new tube house layout is presented in figure 6. Compared to the traditional tube house, the new tube house has better privacy and is more convenient for financing and privatisation. However, the new tube house is not as sustainable as the traditional one. As the attached houses are generally designed by owners and builders but not by architects<sup>18</sup>, many times the owners and builders do not even follow urban regulations creating chaotic street façades and urban landscapes<sup>19</sup>. It is also noted that, due to the location and historical value in the Old quarter, construction, demolition or refurbishment process of the traditional tube houses is far more complex than that of the new tube houses.

## INTERVIEWEES' RESPONSES AND DISCUSSION

### HOUSING CHARACTERS

Results presented in this paper are taken from twelve interviews of people who are currently living in their own attached row house in Hanoi (except for interviewee 8 who lives in a shared rented house of college students). Among the twelve interviewees, four people's house were built 20-30 years ago, which is the first 10 years after the economic reform, four houses were built in the next 10-year period, and four were built within the last ten years. The broad range and equal distribution of housing age increased the responses' variety. The number of occupants living in each house ranges from one person to five persons (typical Vietnamese household composition of three generations living together in one house).

The average number of floors is four while according to the construction law, the maximum number of floors of a tube house is five. Vietnamese people tend to make the most of the land by building on the whole plot and maximise the number of floors. There are some common characters of the houses in terms of construction. The houses were all built with a reinforced concrete frame, as were the floor slabs and flat roofs. External walls are brick walls, thickness ranging from 110-200 millimetres, no insulation and the transparent windows are single glazed. Among the twelve responses, none of them indicated the existence of an inner courtyard. Only two houses, built the last five years, were recorded to have a light-well (interviewee 3 & 9). Recently built houses seem to be built with more consideration of the indoor environment.

### INDOOR ENVIRONMENT

Interviewees were asked about their living experiences and how they assess the indoor environment of the houses for the three aspects: daylighting, thermal comfort and natural ventilation (see table 2). It is remarked that most of the interviewees were quite satisfied and highly rated their housing performance in terms of daylighting and natural ventilation. It is even more surprising since inner courtyards were not reported to be inside those houses. Nine out of twelve interviewees' responses rate the daylighting as "good" or "very good". No bad experience was recorded and half of the responses indicate that natural ventilation is good. Only one interviewee reported bad natural ventilation in his house. However, since occupant's perception is very complicated and is difficult to measure, certain conclusion on the indoor environment quality of these houses requires more in-depth research. Initial attempts were made to try to understand this phenomenon. One of the explanations is that the houses have two openable façades to enhance daylighting and natural ventilation (interviewee 1,2,3,4,5,8 & 10). It is also important to note the role of urban planning and the surrounding areas. Many house are located in urban areas where streets are at least as wide as 11 metres (interviewee 1,2,3,4,5,9,10) and there are cases that houses are not obstructed for 50 metres (interview 6 & 11). Interviewee 7, whose house located in a small alley with only one openable façade, claimed indoor natural ventilation as bad.

It is more complicated when it comes to the thermal comfort aspect. Interviewees did not rate the thermal performance of their house as good as that of daylighting and natural ventilation. One third of the respondents said their houses were bad in maintaining its indoor temperature. Only two people gave a positive reply. According to the interviewees 1,8,9, the reason behind the poor performance is due to the orientation of the houses (West and South West). Interviewee 3 claimed thermal environment in his house is very bad and explained that because the adjacent houses were not built, his house is more exposed to the sun in summer while external walls are only 110 millimetres thick in order to maximize inner living spaces. Interview 4 noted that the thermal performance varied between different zones in the houses. The rooms which are located on the top floors are much hotter in summer and provide little comfort while the rooms which are closer to the ground are cooler and are regarded as better living spaces. On the other hand, interviewee 10, whose house also has the main façade face on the South West, rated his house as “good” in terms of offering thermal comfort. He stressed that the good outcome is thanks to the shading provided by the urban trees and the big apartment blocks located on the other side of the street during the hottest hours. In general, it is noted that house orientation and the exposed area to the sun are the two most important factors for the thermal performance of the houses.

INT. NO.	DAYLIGHT	THERMAL	NATURAL VENTILATION	ORIENTATION	SURROUNDING	EXT. WALL THICKNESS (MM)	WINDOW
1	Very good	Bad	Neutral	SW (-)	Wide street, 2 façade	110 (-)	Single glazed glass (-)
2	Good	Good	Good	NE	Wide street	220	2 layers, wood & glass
3	Very good	Very bad	Very good	NW	Wide street, adjacent houses not yet built (-)	110	Single glazed glass
4	Very good	Neutral	Neutral	NW	Wide street, 2 façade	220	Single glazed glass
5	Good	Good	Good	SW (-)	Wide street	220 (+)	Wooden (+)
6	Good	Neutral	Neutral	SE (+)	Wide street	110	Single glazed glass
7	Neutral	Neutral	Bad	NE	Small alley (-)	220	2 layers, wood & glass
8	Good	Bad	Good	W (-)	Wide street	220	2 layers, wood & glass
9	Good	Bad	Good	SW (-)	Wide street, adjacent houses not yet built (-)	220	Single glazed glass
10	Neutral	Good	Neutral	SW (-)	Wide street, shaded all the time (+)	220	Single glazed glass
11	Good	Neutral	Good	SE (+)	Wide street	220	Single glazed glass
12	Neutral	Good	Neutral	SW (-)	Small alley, more shade (+)	110	Single glazed glass

TABLE 2 Summary of indoor environment assessment and housing characteristics  
 (-): Housing characteristic that has a negative influence on the indoor environment  
 (+): Housing characteristic that has a positive influence on the indoor environment

## ENERGY CONSUMPTION

Electricity is the primary energy as recorded in all 12 houses while half of the people still used gas as fuel for cooking. Respondents also claimed that they had changed or they wanted to switch from using gas to electricity for cooking because of safety reasons. The main equipment that consumes a large amount of energy are the air-conditioner and the electrical water heater which appear in all twelve interviewees' houses. There are three houses that have a solar hot water system and that system was claimed to successfully provide hot water over the majority of the year and only during a short time in winter; an auxiliary electrical water heater is needed. All the responses indicate a careful use of electricity to save energy but eight of the interviewees still think they have to spend too much money on energy. Interviewee 1,3,4 noted that they have spent a lot more energy than usual for air-conditioning to keep the indoor temperature stable because of their small babies. It is important to remark that energy consumption also largely depends on the lifestyle, special needs of each household.

## HOUSING REFURBISHMENT

Apart from the four interviewees who just recently built their houses, only three persons had their houses refurbished in the last 10 years, the rest did not renovated houses or just had small maintenance or redecoration. Details of three refurbishment cases were summarised in table 3 where the owners shared the same reason that their family were expecting new member(s) (marriage or having babies) so they needed extra space and better living conditions. Interviewee 1 stated shading devices were added to the house south west façade as an effort to prevent overheating in summer. Interviewee 5 installed a new solar hot water system in his house during an intensive refurbishment in 2015. Both of the above refurbishment cases claimed to work well. Interviewee 12 also had a major refurbishment in 2010 when adding a whole new floor on top of the old house. As this led to more rooms, he was also happy with the better thermal performance of the house but he claimed that the daylight was worse. From these 12 cases, the main reason for intensive renovation was to expand living spaces. This fact raised the possibility to upgrade energy performance through refurbishment activities.

INT.NO.	YEAR OF REF.	REASON FOR REF.	MAJOR WORK OF REFURBISHMENT	EFFECTS	COST (EURO)
1	2014	Moving in vacant space Need better environment for baby	Add shading device Add facilities (air-conditioner, electric water boiler) Add extra spaces (toilet & storage)	Better thermal performance Less glare issue from SW windows	4,000
5	2015	Repair major damage	Add solar hot water system Re-equip service system (electric and plumbing network) Add air-conditioner Repair damage in floor and walls	Saving energy for water heater Eliminate leakage in floor and walls	15,000
12	2010	Need more spaces for new family member (marriage)	Add a whole new floor	More living spaces Better thermal performance Less daylight	N/A

TABLE 3 Summary of major refurbishment activities in last 10 years

When asked about priority in the refurbishment decisions, respondents indicated that the most important factor was to improve the indoor environment. Half of the responses put that factor on top and four others chose it to be the second priority. While other categories varied among the responses, energy consumption did not attract people's attention, ten people said it was their least priority when considering a refurbishment decision. In general, although energy efficiency is not one of the priorities of the occupants, there is still a chance that houses can reduce a considerable amount of energy consumption because improving the indoor environment is still the most important refurbishment need.

## CONCLUSION

The history of Vietnam had a lot of effect on urban planning and architecture in cities of Vietnam and in Hanoi in particular. Urban areas and their housing types reflect the character and ideology of the various periods. Urban houses themselves have their own distinctive character in the different historical periods and adapt, again, to the contemporary challenges. Most recently, the economic reform of 1986 started the introduction of the “new tube houses” which then became the most dominant housing type in the whole country, accounting for about 75% of the total housing stock<sup>20</sup>. Therefore, the existing “new tube houses” have an important role in planning more sustainable housing and energy preservation. A recent survey, conducted in March 2016 in Hanoi, investigated the new tube houses' character and their potential for energy upgrade. The results indicate that the thermal performance of a third of the existing houses is unsatisfactory and people state that they spend a lot of energy on cooling and heating the spaces. Although the Vietnamese occupants do not include the energy upgrade in their refurbishment priority list, there are still chances to reduce the environmental impact of the current housing stock. The most important factor for a refurbishment plan is an improvement in the indoor environmental quality which, with a little incentive, could be combined with measures that also reduce the energy demand. A follow-up questionnaire on a larger scale is planned to get more insights.

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## Image Sources

Figure 1: To K., "Tube House and Neo Tube House in Hanoi: A comparative study on Identity and Typology". *Journal of Asian Architecture and Building Engineering (JAABE)* 7 (2008): 255-262.

Figure 2: a. Centre des archives d'outre-mer, Aix-en-Provence, extrait du dossier Programme a realiser sur les fonds d'emprunt de 1 500 000 F (indoggi//6365, dossier no 12).

b. Google map image, taken on 20/3/2016.

Figure 3: Phan Anh Nguyen, "Environmental design strategies of vernacular dwellings in central Hanoi". Master degree dissertation, University of Nottingham, United Kingdom (2011).

Figure 4: Quoc B. Tran, "French quarter architectural form and conservation method" (in Vietnamese). *Ashui*, March 24, 2012, accessed on March 20, 2016, <http://ashui.com/mag/chuyenmuc/kien-truc/6511-hinh-thai-kien-truc-khu-pho-phap-o-ha-noi-va-phuong-phap-bao-ton.html>

Figure 5: Michael Cerrone, "KTT 2.0 – Vietnamese Soviet housing district, Hanoi, Vietnam". Master degree graduation project, TU Delft, (2014).

Figure 6: Ly T.P., "A critical regionalist approach for housing design in Vietnam: Socio-environmental organisation of living spaces in pre- and post-reform houses". (PhD diss., Queensland University of Technology, 2012).

Table 1: To K., "Tube House and Neo Tube House in Hanoi: A comparative study on Identity and Typology". *Journal of Asian Architecture and Building Engineering (JAABE)* 7 (2008): 255-262.

Table 2: Phan Anh Nguyen.

Table 3: Phan Anh Nguyen.