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THE INFRASTRUCTURE AND ENVIRONMENT IN THE OLD TENEMENTS IN HANOI

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Introduction

Housing is an essential need for existence and development of the society, especially in large cities such as Hanoi. Over the past 40 years, the housing issue has always been given attention; millions of square meters of housing have been built, contributing to meet the urgent need of housing of the citizens. Over decades of being used in the circumstance of the rapid increase of the population, the limited investment in maintenance and upgrading the housing and utilities has led to the degradation of the housing quality and living environment in the old tenements of the city.

1. Database and method of research

Recently, Hanoi Department of Natural Resources, Environment and Housing has carried out an investigation and survey on the utilities and environmental quality in 10 tenements of Hanoi, comprising Thành Công, Kim Liên, Trung Tự, Giảng Võ, Nghĩa Tân, Quỳnh Mai, Tân Mai, Tương Mai, Thượng Thanh and Văn Chương tenements. The survey was carried out in three typical buildings of each quarter, totally consisting of 1603 apartments with nearly 7300 inhabitants living in a total housing area of 57,303m² in these 10 quarters. In each quarter, air quality was measured at 8 locations, waste water samples were collected at 6 locations consisting of manholes, branch sewers and main sewers. The physico-chemical parameters of the waste water determined comprised: pH, electrical conductivity, temperature, suspended solid content, dissolved oxygen content, BOD₅, COD, NH₄, H₂S, E, Coliform, total Coliform.

The characteristics of the utilities and environment in the old tenements in Hanoi are presented below on base of the data collected during the field survey and sample analysis.

2. As regards utilities of tenements

• Water supply system

According to the original design, the tenements are provided with water pipe supply according to the following principle: the water is pumped from the underground water pipe system to various floors along vertical lines arranged in auxiliary parts of the apartments. The fact shows that this mode of water supply causes many limitations:

- The water supplied to the tenements is pumped about 2 hours/day (40-50 liter /capita /day), meeting only 40-50% of the present domestic water demand.
- The pipeline systems in the tenements have been much damaged after nearly 40 years of use.

To overcome this situation, 90% of the population living in tenements have installed new pipe systems outside the building, along the corridors and pump the water themselves from the main pipe (on the ground floor) to their own tanks for storage. These private tanks are built, installed on the roof, in the annexed or extended parts of the apartments, with capacity commonly below 1m³ (Table 1).

Table 1. Percentage of households having water tanks of different capacities

Tenements	Capacity of water tanks		
	< 1 m ³	1-2 m ³	> 2 m ³
Kim Liên	95	4	1
Trung Tự	68	27	5
Giảng Võ	95	5	0
Thành Công	85	14	1
Nghĩa Tân	90	8	2
Tân Mai	90	10	0
Tương Mai	60	32	8
Quỳnh Mai	74	21	5

This situation has caused unaesthetic view of the area, increased load on the buildings, difficulty for water use control and has led to the waste of water. This is one of the major weak points of the utility system in the old tenements still existing in Hanoi.

- **Drainage system**

The original drainage systems of the apartment buildings surveyed are mostly designed as follows:

- The domestic waste water (of bathing, cooking, etc.) from various floors flows down through vertical pipe lines to the $\Phi 200$ -400 mm sewers, then to the $\Phi 1000$ -1500 underground sewer system of the city.
- The sanitary water flows down through vertical pipelines (often together with the domestic waste water) to the septic tanks. The waste water is treated locally by settlement and natural decomposition of the excrement and organic matter. After being treated, the waste water flows from the septic tank through $\Phi 400$ mm underground sewers to the $\Phi 1000$ -1500 mm main sewer of the quarter.
- The rain water is collected from the roof by $\Phi 125$ ceramic pipes installed vertically on the wall down to the manholes where they are connected with the domestic waste water pipeline, or discharged directly to the drainage channel together with the surface water.
- The surface water outside the buildings is put into open or covered channels (with average dimension of $\Phi 200 \times 400$), conducted to the manhole before flowing into the main drainage system of the city).

At present this drainage system has been much damaged, in particular as follows:

- 100% of domestic and sanitary waste water pipelines made of ceramic are now broken, cracked and leaked out through connections.
- 100% of ceramic storm drainage pipelines have been damaged. Moreover, as the underground sewer systems are often blocked, 70% of the storm water overflows on the ground.
- Many annexed parts of the buildings are built above the underground sewer system; therefore the unclogging of the sewers is difficult and is rarely carried out. As a consequence, the sewer pipes are filled with sludge, that decreases their cross sectional area by 30-40% against the original one.
- Most of septic tanks are overlain by annexed structures, hampering the regular dredging. The septic tanks in tenements are 20-30m³ in capacity and have been used for a long time without regularly dredging, so their decomposition capability has decreased. On the other hand, due to the lack of knowledge, many households discharge waste water containing soap, detergents into the septic tanks, thus killing and decreasing the digestion capacity of anaerobic bacteria.

Some septic tanks which are full and not dredged have caused the waste to flow back into the sewers and manholes even during the dry weather (building B5 of Kim Liên tenement, Thượng Thanh tenement). During the rainy days, the problem becomes much more serious. The wastes from the septic tanks together with the rain water follow the sewer pipes and open channels and overflow on the surface in the tenement. In some places the septic tanks have been broken and are only temporarily grouted, affecting greatly the daily lives of the people. (Thượng Thanh tenement, E1 building of Văn Chương tenement). In some tenements, as the septic tanks are damaged without repair, the residents of the first floor have built tanks on the underground floor to discharge directly the human wastes and wastewater through the holes on the ground floor (building B3-Nghĩa Tân tenement).

In the Thượng Thanh tenement the septic tanks and drainage system have not been operating for a long time. The residents have built themselves a combined drainage system for rainwater, domestic waste water and untreated sanitary waste water. The drainage channels are often filled and clogged with sludge and rubbish; especially the manholes are often damaged and clogged.

The ceramic rain water and domestic waste water drainage pipelines in the apartments of some tenements have been replaced by plastic pipes. But the unclogging of underground sewer pipelines, septic tanks and surface water drainage channels has not been improved. As a consequence the environmental pollution is still serious. During the rainy period, days-long flooding often occurs in the tenements.

- **Domestic power supply system**

The field survey shows some strong points and weak points of the domestic power supply systems in the tenements as follows:

- 100% of households are provided with power continuously 24/24h during the day;

- The electricity is supplied directly from the power lines in the tenements, through individual electricity meters to each household. The cable lines are of sufficient cross sectional area (2x8 or 2x10) and are safely protected in PVC pipes.

The facts show that about 70% of households still use the original power wiring system and about 90% of households use external wiring systems. Only about 10% of households have rehabilitated appropriately the whole wiring system, ensuring safety. The originally designed wiring systems took into consideration only the minimum use electricity for lightling for some simple appliances. Now the demand for electricity has increased with the use of modern, high capacity appliances, making the original wires overloaded, many wire sections have been burned and the sheath has no more been insulated ability, causing danger for users. The way of connecting the wires directly from the source to each household of the existing system which consists of too many wires affects the esthaetic view of the urban area.

3. Environment quality in the old tenements

- **Present status of waste water**

The waste water from apartment buildings is conducted to the main sewer of the quarter and from there further to the waste water disposal system of the city (discharged to ponds, lakes, canals, rivers).

The waste water is at the temperature from 24 to 29 °C and pH being neutral (about 7.0), within the range permissible for discharge into receiving water bodies.

The suspended solid contents of waste water are rather high, exceeding the permissible limit according to TCVN 5945-1995 and are much different from quarter to quarter (Table 2). Especially in Văn Chương, Thanh Chương, Thượng Thanh, Quỳnh Mai quarters, the suspended solid content is 3 - 4.7 times exceeding the permissible limit.

The sewer systems of tenements have great amount of sludge, reducing the cross section area of the sewers. If the system is not dredged, the sewers will be clogged.

Table 2. Suspended solids contents of the waste water in tenements.

Tenements	SS (mg/l)
Kim Liên	291 – 300
Giảng Võ	209 – 230,7
Trung Tự	280 – 300
Thành Công	162 – 171
Nghĩa Tân	125 – 132
Văn Chương	430 – 472
Thượng Thanh	383 – 401
Tương Mai	226 – 250
Quỳnh Mai	371 – 395
Tân Mai	300 – 310
Permissible limit according to TCVN 5945 – 1995	≤ 100

The discharge of waste water from tenements to receiving water bodies such as ponds, lakes, canals may affect the lives of aquatic species, such as reducing the field of view, decreasing the light intensity, affecting the photosynthesis process and leading to the reduction of dissolved oxygen content in the water.

There is much organic matter in the domestic water, which is the most common source of pollution. Analytical data show that the dissolved oxygen concentrating in the waste water is very low, varying within 0.01-0.2 mg/l, even nearly zero in some waste water samples collected from underground sewers in Giảng Võ, Văn Chương. The process of decomposition of organic matter in the waste water storage and circulation systems (man holes, sewers) takes place mainly in anaerobic condition, giving the waste water in the sewers the deep black color. The final products of this process are H₂S and CH₄ gases which give unpleasant odor, affecting greatly the air quality in the tenements, especially near the manholes and sewers. The waste water in the tenements has H₂S content 1.5 - 6 times, the NH₄ content exceeding 1.5 - 4 times the standard limits for waste waters before being discharged into the drainage system of the city (Table 3).

Table 3. Results of DO, H₂S, NH₄ analysis in waste water

Tenements	Indicators		
	DO (mg/l)	H ₂ S (mg/l)	NH ₄ (mg/l)
Kim Liên	0,1 - 0,1	3,4 - 3,7	2,6 - 2,85
Giảng Võ	0,0	2,5 - 3,0	1,16 - 1,2
Trung Tự	0,1 - 0,2	1,44 - 2,1	1,49 - 3,1
Thành Công	0,01 - 0,02	1,78 - 1,97	1,7 - 1,92
Nghĩa Tân	0,01 - 0,03	1,9 - 2,2	2,1 - 2,7
Văn Chương	0,0	2,3 - 2,81	3,4 - 4,15
Thượng Thanh	0,4 - 0,84	5,01 - 5,9	0,58 - 0,75
Tương Mai	1,01 - 1,6	3,8 - 4,5	0,1 - 0,2
Quỳnh Mai	0,5 - 0,98	4,83 - 5,6	0,3 - 0,4
Tân Mai	0,65 - 1,1	3,9 - 5,4	0,17 - 0,23
Permissible limit according to TCVN 5945 – 1995	≥ 0,3	≤ 1	≤ 1

The two indicators BOD₅ and COD, similar to sediment contents, are of high value in comparison with the permissible limit for waste water (Table 4). These two indicators are of relatively high values in waste water samples collected at the locations of the sewers near the places which generate organic wastes (market places, restaurants, temporary waste piles). The too high organic matter content in the waste water

slows down the purification process and changes it gradually to anaerobic decomposition as the oxygen is depleted. These places become those with stagnant water with no living organisms.

Table 4. Results of COD and BOD₅ analysis

Tenements	Indicators	
	COD (mg/l)	BOD ₅ (mg/l)
Kim Liên	260 – 290	118 - 120
Giảng Võ	265 – 291	159 - 180
Trung Tự	115 – 126	69 - 81
Thành Công	154 – 166	136 - 181
Nghĩa Tân	107 – 115	65 - 72
Văn Chương	213 – 231	119 - 136
Thượng Thanh	201 – 215	133 - 147
Tương Mai	290 – 309	183 - 215
Quỳnh Mai	240 – 255	137 - 152
Tân Mai	250 – 272	140 - 155
Permissible limit according to TCVN 5945 – 1995	≤ 200	≤ 100

Table 5. Results of Coli analysis

Tenements	Indicators	
	Total Coli (per 100ml)	Fecal Coli (per 100ml)
Kim Liên	$7.1 \times 10^6 - 9.7 \times 10^6$	$5.2 \times 10^5 - 7.8 \times 10^5$
Giảng Võ	$7.2 \times 10^6 - 9.5 \times 10^6$	$3.4 \times 10^5 - 6.1 \times 10^5$
Trung Tự	$6.7 \times 10^6 - 7.9 \times 10^6$	$4.1 \times 10^4 - 6.2 \times 10^4$
Thành Công	$1.1 \times 10^6 - 1.9 \times 10^6$	$7.3 \times 10^5 - 9.1 \times 10^5$
Nghĩa Tân	$2.5 \times 10^5 - 3.2 \times 10^5$	$1.8 \times 10^4 - 2.4 \times 10^4$
Văn Chương	$7.8 \times 10^6 - 10.1 \times 10^6$	$5.1 \times 10^5 - 6.1 \times 10^5$
Thượng Thanh	$2.3 \times 10^6 - 3.5 \times 10^6$	$5.8 \times 10^5 - 6.7 \times 10^5$
Tương Mai	$7.1 \times 10^5 - 8.5 \times 10^5$	$5.2 \times 10^4 - 6.2 \times 10^4$
Quỳnh Mai	$5.3 \times 10^5 - 5.8 \times 10^5$	$4.1 \times 10^4 - 4.7 \times 10^4$
Tân Mai	$6.0 \times 10^5 - 6.9 \times 10^5$	$5.0 \times 10^4 - 5.9 \times 10^4$
Permissible limit according to TCVN 5945 – 1995	≤ 10 ⁴	≤ 10 ⁴

The amount of microorganisms in the waste water is expressed by indicator F. Coliform and total coliform. The actual values of these indicators exceed the permissible limits by tens to hundreds times (Table 5), proving that the waste water has high fecal content because the sewers are broken, the septic tanks are overflowed, and the human wastes are discharged directly into the drainage system. The direct discharge of waste water from the tenements into receiving water bodies (ponds, lakes, canals, rivers) will cause serious pollution of the surface water resources in these areas.

- **Present status of the air quality**

a. Thermo-hydrographic conditions

To increase the living spaces which used to be too small, the households on the ground floor often build annexed structures to occupy the land; those on the higher floors make use of the balconies to build auxiliary structures which extend out into the air, making the structure of the apartments different from the original design.

The design standard is too low, the construction techniques and construction materials are poor, leading to the very low heat inertia in the apartments. The survey data show that the maximum difference in air temperature between the inside and outside of the buildings is 2.9°C , with small difference between parts of the building with different structural characteristics and time of use. This proves that the microclimatic conditions in the apartments are controlled by the climatic conditions outside the building.

The high air humidity together with great heat radiation makes the apartments hot and muggy in summer and very cold in winter. Due to annexation and extension of apartments without following any plan, the rooms are shielded off, the natural wind velocity in the rooms is very low ($v < 0,2\text{m/s}$) during most of the monitoring time.

b. Air pollution and odor

The air pollution in the apartments is due to the following main causes: cooking; the leaks in the septic tanks and sewer systems; long accumulation of solid wastes, odor emission from ditches, channels, ponds and public wastes dump sites, insecticides and tobacco; diffusion of dust from construction sites. Among the air pollution sources the most endangering is the odor from the leaks in sanitary systems, the stinking odor (H_2S gas) from the solid wastes, sewers, ponds, canals around the quarter and the odor from cooking in the households.

The cooking in the apartments is mainly done by using coal stoves, kerosene stoves, gas stoves, electric stoves and in some cases firewood and leaves. Many households use 1-3 ways of cooking at the same time. Air pollution due to cooking is an imperative and difficult problem. Most of the people living in tenements are of low and average income, therefore the use of primitive combustibles such as firewood, coal, kerosene etc., is common. The kitchens in apartments are too small and have no waste gas absorption system that causes smell and serious pollution by gases such as CO , SO , NO_2 , CO_2 , H_2S ... during the cooking time.

Reports of the people show that 70% of apartment households complain about the unpleasant odor from the cooking and from the sanitary systems. This dictates that the sanitary conditions and the environment in the tenements are very poor.

• Present status of solid waste management and collection

The solid waste collection work in the tenements consists of: collection of wastes from households, collection of wastes in the streets, stacking in temporary piles or in containers, and transportation by trucks to the landfills of the city.

The tenements of Hanoi are not only the residential places of the people, but also the places for business and production. Besides, in the tenements there are also public facilities such as administrative offices, enterprises, market places, schools etc. Therefore,

+ The sources of solid wastes are diverse and existing everywhere in the quarter.

+ The wastes are diverse in composition, of which organic matters account for about 70% (vegetables, leaves used for wrapping cakes, rice, left-over food, etc.), rubbish and inorganic substance (earth, sand, glass, plastic, etc.) about 30%. The wastes with high organic matter content are quickly decomposed, if discharged indiscriminately they will emit unpleasant odor, affecting the air quality and becoming the habitat of disease transmitting species such as rat, insects, etc.

+ The volume of solid wastes in the tenements is not stable among time spans in the day and among the days in the week, depending on the living activities of the residents, causing difficulties for the collection. Accumulation of wastes still occurs.

+ Many people living outside the tenements come here to be engaged in business and production, forming temporary market places. These places are sources of organic wastes which are discarded indiscriminately on the sidewalks, the roads and in the sewer systems.

As regards the method of solid wastes collection, solid wastes are collected by manual method combined with mechanical one. The wastes generated in the households are put in waste bins, baskets, plastic bags, then carried and put into URENCO's hand carts at the specified time. The hand carts operated by the URENCO employees are also used for collecting the wastes generated in the public places such as the sidewalks, the roads, the drainage channels along the sidewalks, the market places etc. Then the wastes are carried to the specified places, stacked in temporary piles or loaded on specialized trucks and transported to the landfill of the city.

The collection is usually made twice a day in the morning and the evening. However, this frequency is not reached in some places. Wastes are still seen to be discarded indiscriminately around the buildings, thrown to the roads, play grounds, etc.

The locations selected by the URENCO staff for temporary piling of wastes before loading on the trucks are usually in front of, behind or beside public facilities (market places, schools, offices, enterprises).

In each of tenements are arranged some temporary containers and waste bins with capacity 0.5-6m³. These containers are placed mainly at public facilities, without cover and are the habitat of rats, and insects which transmit infectious diseases, affecting the environment in the tenements.

Conclusion

Through over 40 years of use, the utilities of the tenements in Hanoi have been seriously degraded; the quality of the environment is not up to sanitary standards. It is necessary to adopt a comprehensive investment plan for rehabilitation and upgrading to ensure efficiency, in the mean time to improve the environment in the old tenements.

The program for rehabilitation and reconstruction of degraded and damaged apartment buildings is being given special attention, compatible with the development of new urban areas. There is also compatibility between new construction and repair and maintenance of old housing, with the aim to attain sustainable urban development and enhance the effective use of the land and housing budgets. With the experiences learnt from the previous management models and measures to deal with damaged and degraded apartment buildings, Hanoi Department of Natural Resources, Environment and Housing, under the direction of the People's Committee of Hanoi city has worked out policies and taken measures to maintain and develop housing budget, such as socializing the housing issue, raising funds, building new apartment living quarters to replace the old one and in-place resettlement, education and enhancing the role of the residents in ensuring the quality of apartment buildings.

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