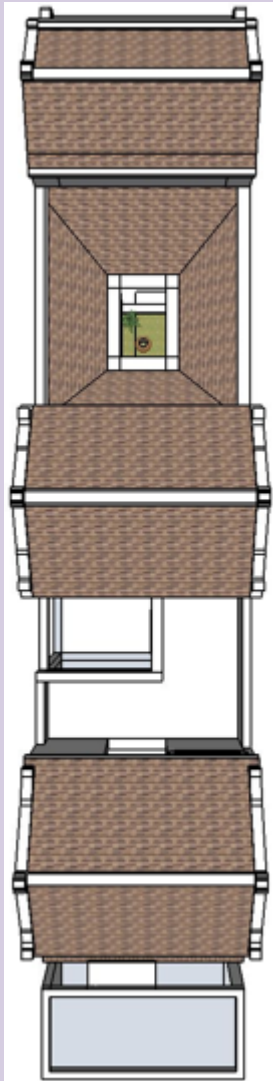




Graduate School of Life and Environmental Sciences
University of Tsukuba



STUDY ON THE THERMAL ENVIRONMENT AND RESIDENTS' BEHAVIOR IN THE COURTYARD OF TRADITIONAL TUBE HOUSES IN HANOI, VIETNAM.

Presenter : LE KHANH LY
Student ID : 201225032
Supervisor : 村上 暁信

Master's in Environmental Science
Graduate School of Life and Environmental Sciences
University of Tsukuba

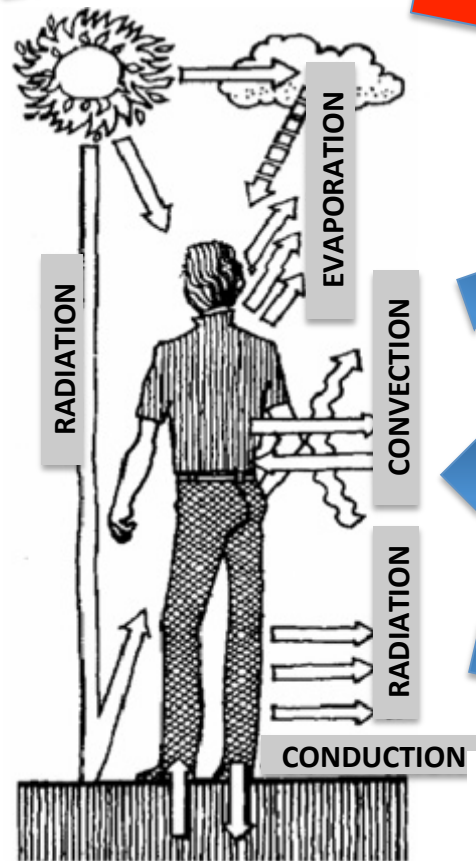
THERMAL COMFORT IN TRADITIONAL HOUSE IN THE WORD

- *Thermal comfort in Deachung of Korean traditional house (2008)*
- *Thermal comfort in Malay house (2012)*
- *Thermal comfort in Chinese shop house in Malaysia (2009)*

**CHARACTERISTICS
of Vietnam
traditional house**

HOW AFFECTS?

Personal factors
**Metabolic rate
(activity)
Clothing**



Environmental factors
**Air temperature
Humidity
Radiation
Air velocity**

**Thermal Exchange between the Human Body
and its Environment**

(source: www.archinology.com)

- In center of Hanoi, Area: 91ha, covering 10 wards
- Population: 66,660, density of around 840 people/ha (2011)
- 800 years of history, became a national historical relic (designated in 2001)
- Conservation and restoration are identified



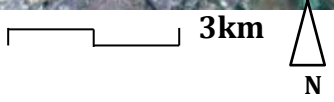
Vietnam map



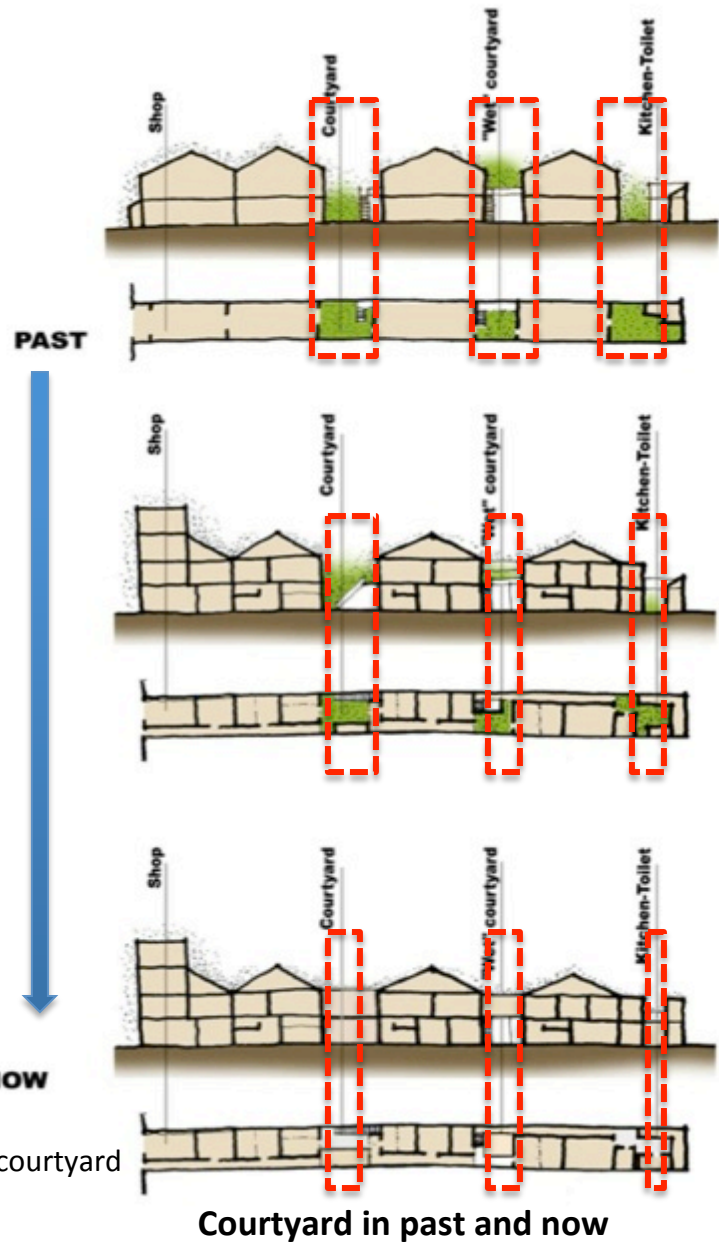
Hanoi Old Quarter

French Quarter

Thang Long Old Castle



Hanoi Satellite map



Courtyard is a characteristic of Hanoi ancient tube house but now it's disappearing cause replaced by new building.

It is necessary to assess relationship of resident behavior and thermal environment of courtyard in Hanoi tube house to provide the basis for conservation this space or not.



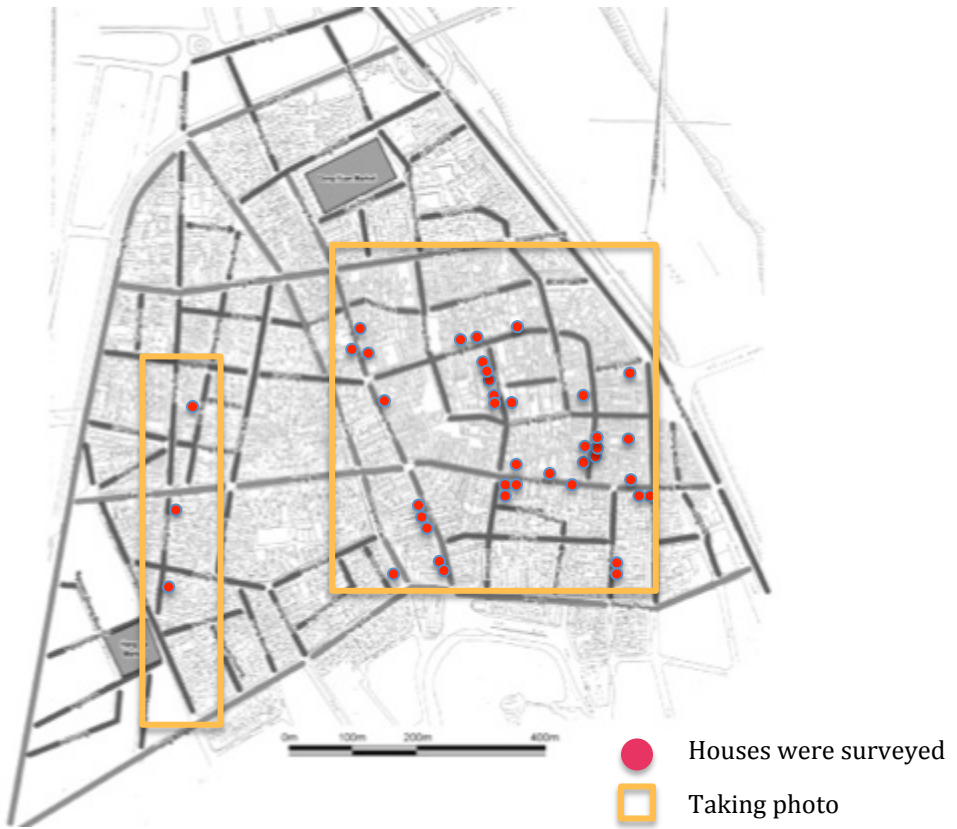
Courtyard in ancient house

- **TO CLARIFY THE RELATIONSHIP BETWEEN THERMAL ENVIRONMENT AT THE COURTYARD AND THE RESIDENT'S BEHAVIOR**

FIELD SURVEY TO COLECT DATA FOR TYPICAL CHARACTERISTICS OF ANCIENT TUBE HOUSES.

✓ Conduct to survey for ancient tube houses in Hanoi Old Quarter (taking photos)

50 Houses were suveyed with 227 households



STUDY SITE OBSERVATION

NARROW ALLEY IN THE HOUSES HAVE A LOT OF HOUSE HOLDS



19 Hang Duong 19 Hang Ngang 12 Phat Loc 18 Hang Duong 20 Bat Su 114 Hang Bac

GREEN TREE AND HAVING TRADITIONAL MATERIAL IN COURTYARD ARE VERY SCARCELY



114 Hang Bac 6 Dinh Liet 87 Ma May

COURTYARD IS A COMMON YARD WITH A LOT OF ACTIVITIES IN THE HOUSE HAVE MANY HOUSE HOLDS

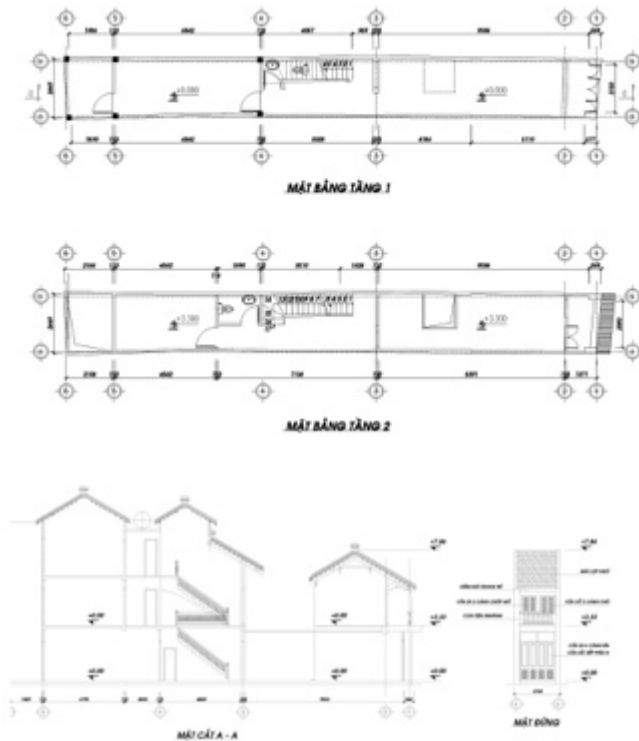


20 Bat Su 27 Hang Buom 78 Hang Dao 33 Hang Dieu

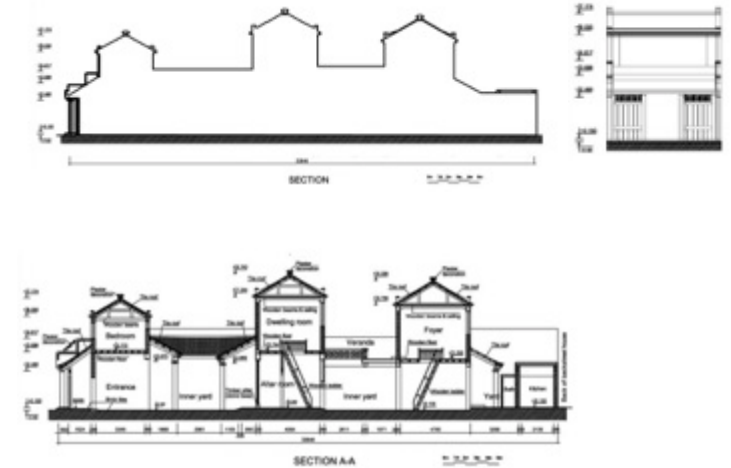
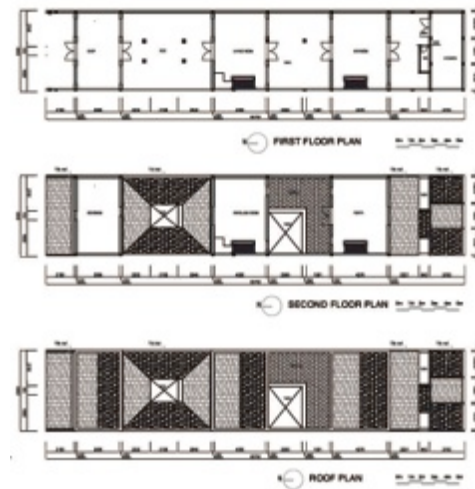
Houses in Hanoi Old Quarter on 3rd July to 28th August (by Le Khanh Ly)

FIELD SURVEY TO COLECT DATA FOR TYPICAL CHARACTERISTICS OF ANCIENT TUBE HOUSES.

- ✓ Synthesizing map and material related to characteristic of Hanoi ancient tube houses: collected drawings including plans, cross sections and data of building materials



AutoCad drawings of 70 Mamay
(by LeKhanhLy)



AutoCad drawings of 87 Mamay
(source: Hanoi ancient house Department)

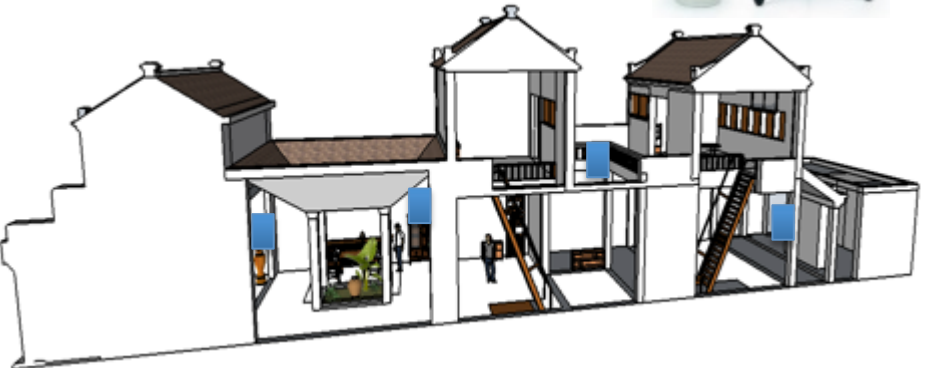
FIELD SURVEY TO COLECT DATA FOR TYPICAL CHARACTERISTICS OF ANCIENT TUBE HOUSES.



OBSERVATION OF RESIDENTS' BEHAVIOR BY INTERVAL CAMERA

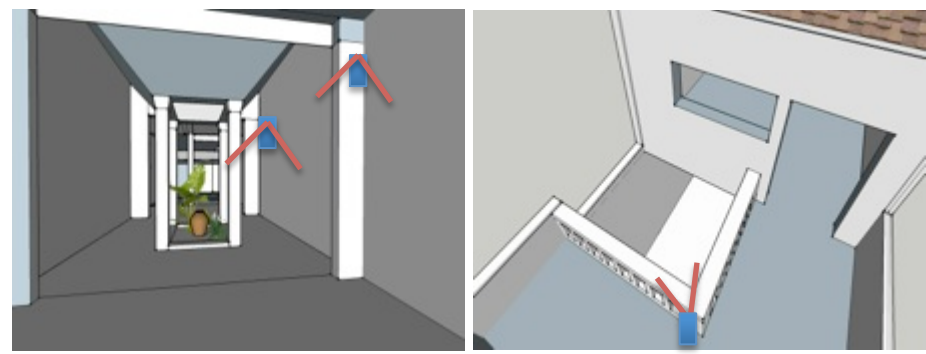
8 Houses were set up interval camera on 3rd July to 28th August



✓ Using INTERVAL CAMERA (RECOLO) to record the human activities in the ancient tube houses.



  Interval camera (RECOLO)



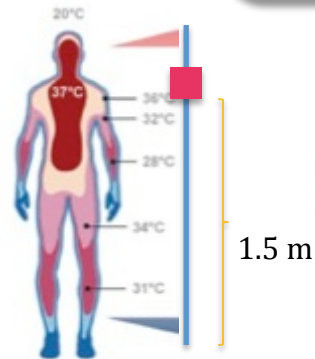
FIELD SURVEY TO COLECT DATA FOR TYPICAL CHARACTERISTICS OF ANCIENT TUBE HOUSES.

OBSERVATION OF RESIDENTS' BEHAVIOR BY INTERVAL CAMERA

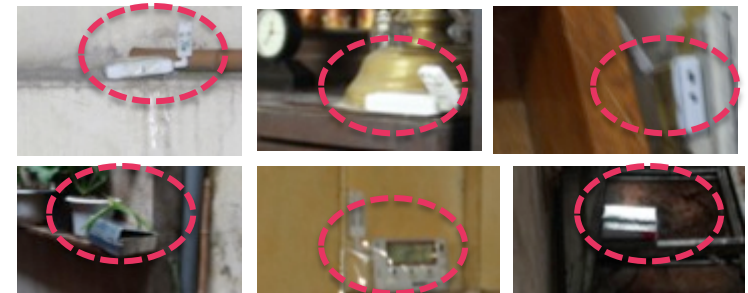
FIELD SURVEY TO COLLECT DATA OF TEMPERATURE, HUMIDITY, HOURLY SUNLIGHT, SOLAR RADIATION, WIND SPEED.



- Indoor measurement
- Courtyard measurement
- Outdoor measurement
- Courtyard



- ✓ Collect data of Hourly sunlight, solar radiation and wind speed from *Hydro Meteorological Data Center*.
- ✓ Using Temperature Data loggers (Temperature and Humidity Recorder) in ancient tube house.



Set up equipment location

○ ■ Temperature Data Loggers

FIELD SURVEY TO COLECT DATA FOR TYPICAL CHARACTERISTICS OF ANCIENT TUBE HOUSES.

OBSERVATION OF RESIDENTS' BEHAVIOR BY INTERVAL CAMERA

FIELD SURVEY TO COLLECT DATA OF TEMPERATURE, HUMIDITY, HOURLY SUNLIGHT, SOLAR RADIATION, WIND SPEED.

INTERVIEW INVESTIGATION

Items	Contents
Periods	2013/7/3~ 2013/8/28
Surveyed	Residents living in Hanoi Ancient tube houses
Methods	Answer questionnaire
Effective replies	100 people answer questionnaire

INVESTIGATION SUMMARY

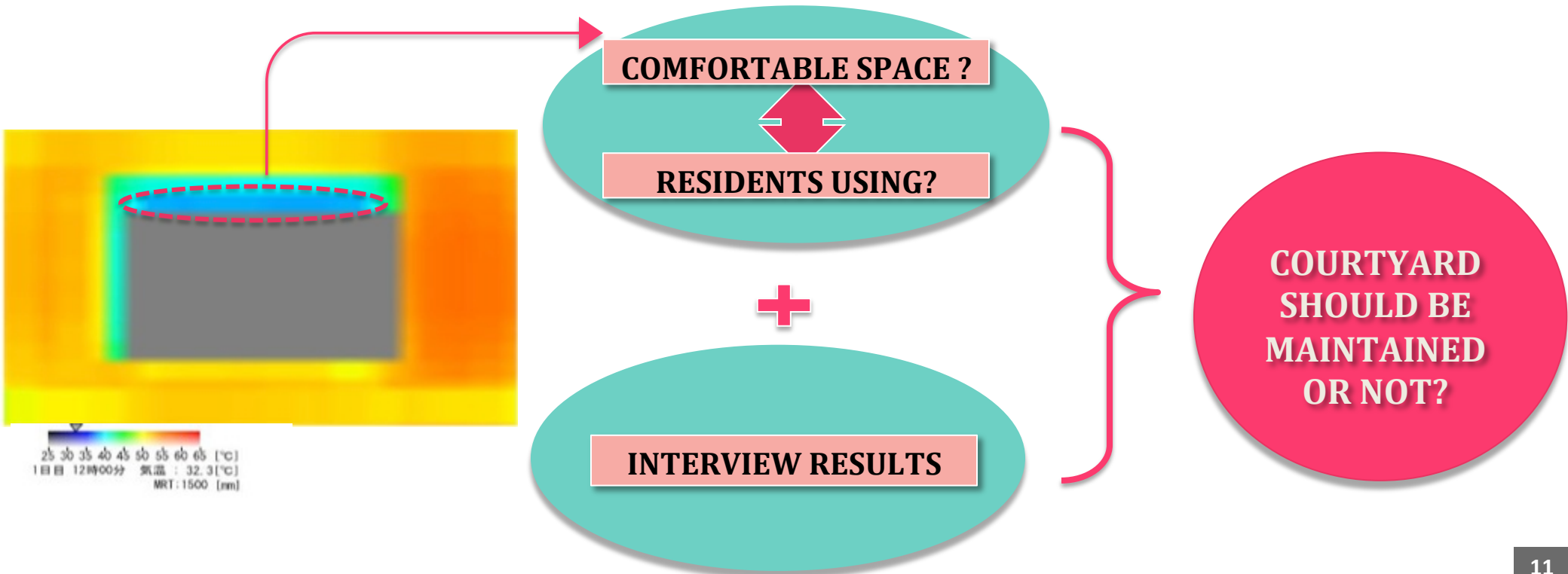
No	Group of contents
1	Resident general information (gender, age, name, address)
2	House's general information
3	Electricity consumption in the house
4	Current status of courtyard
5	Courtyard utilization
6	Resident desires about their houses, their courtyard (preserve, restore, renovate, replace)

QUESTIONNAIRE CONTENTS

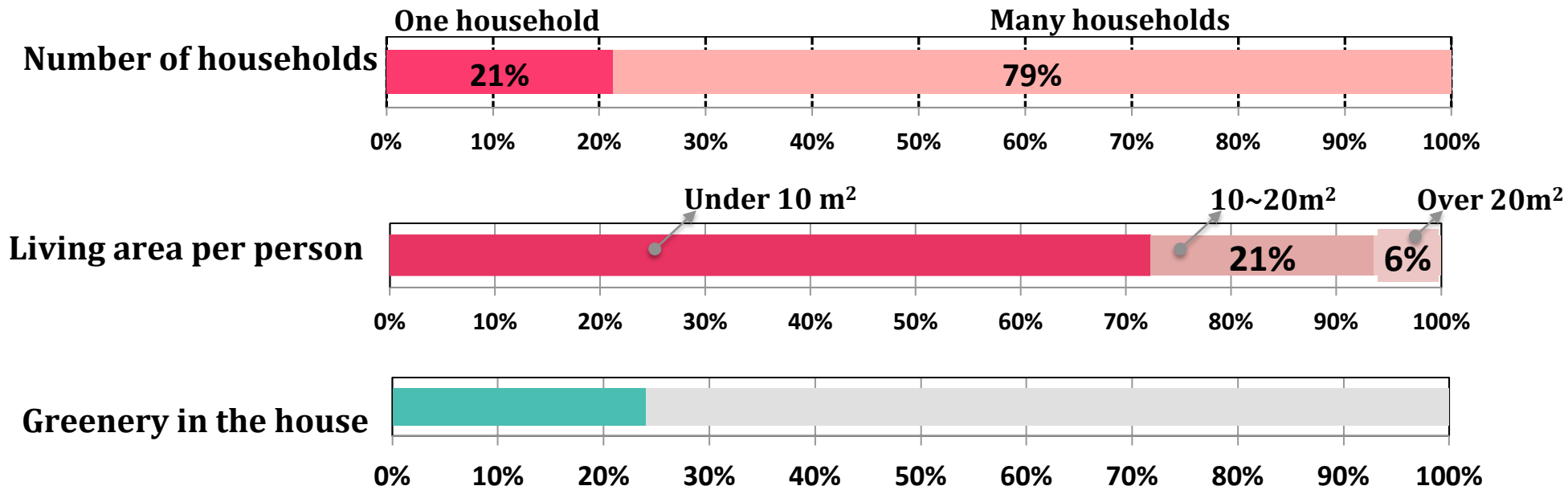
CREATING 3D CAD MODEL FOR SURVEYED TUBE HOUSES AND SURROUNDING AREA

SIMULATION OF THERMAL ENVIRONMENT IN ANCIENT TUBE HOUSES BY THERMO RENDER

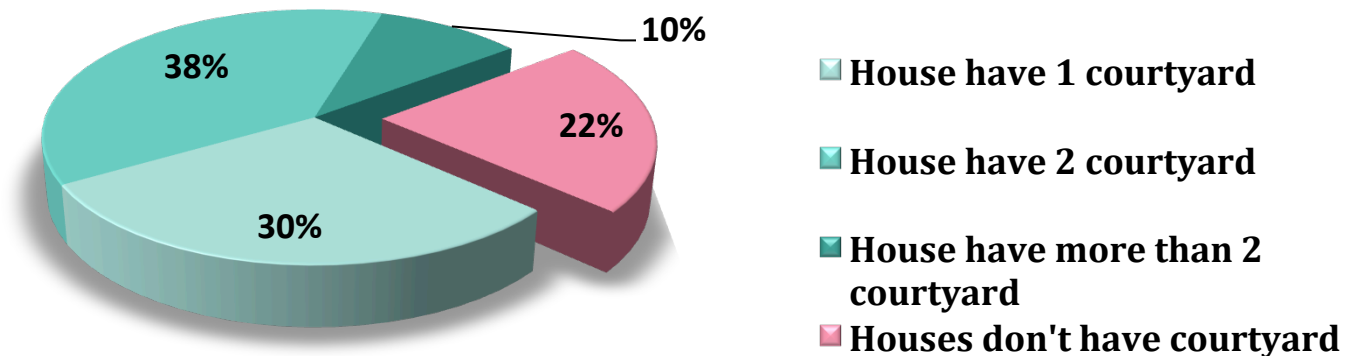
ANALYSIS THE RELATIONSHIP OF RESIDENT BEHAVIOR AND THERMAL ENVIRONMENT IN COURTYARD OF THIS TUBE HOUSE



LIVING CONDITION

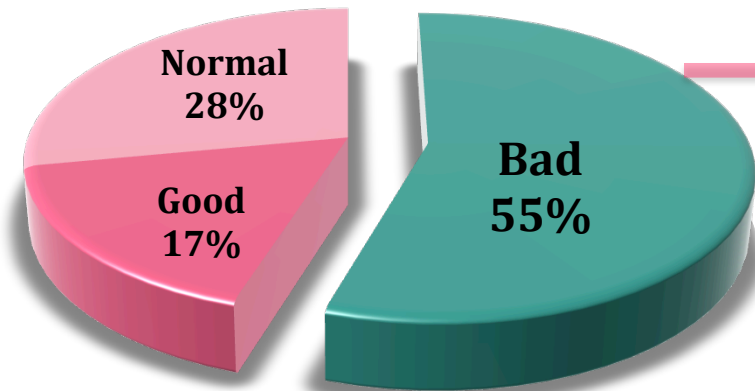


Number of Courtyard in the house

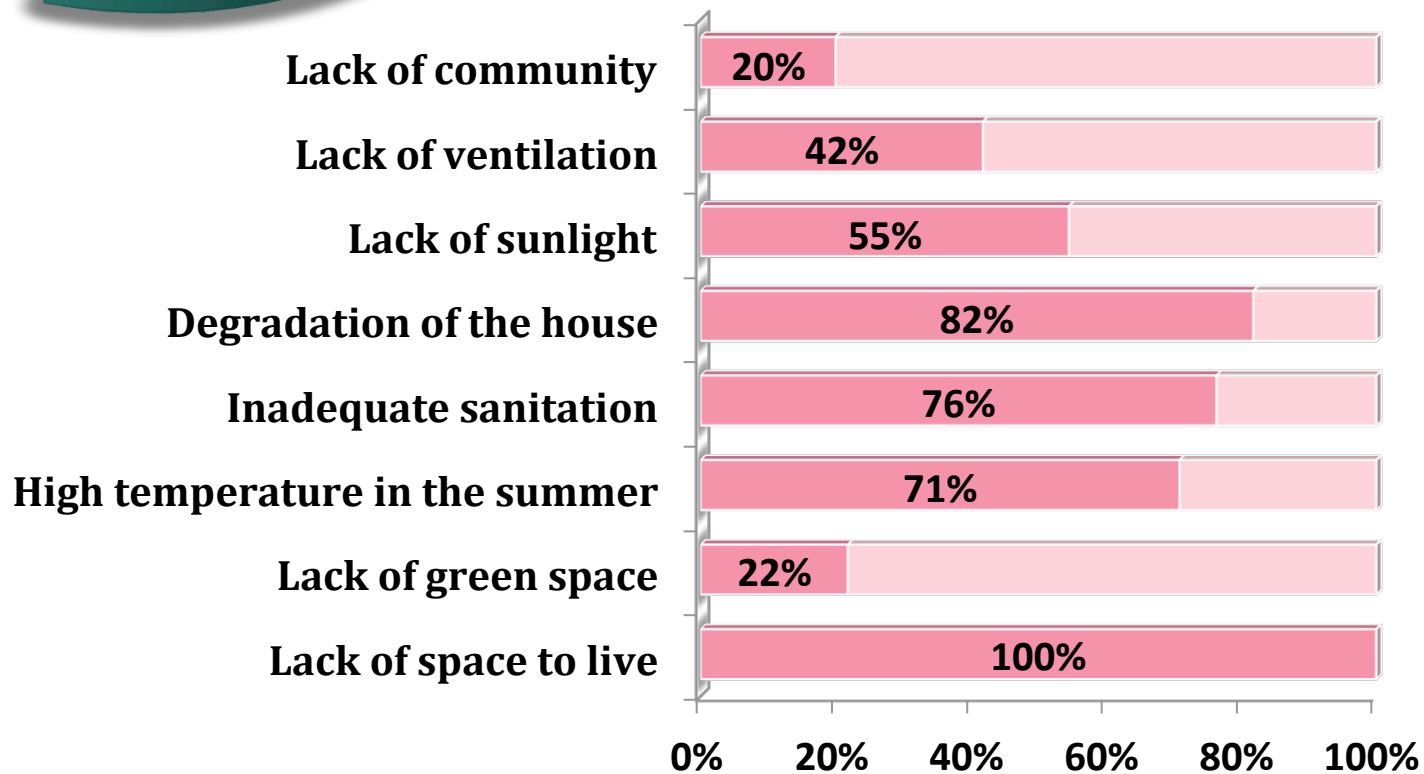


LIVING CONDITION

RESIDENTS' SELF-PERPECTIVE

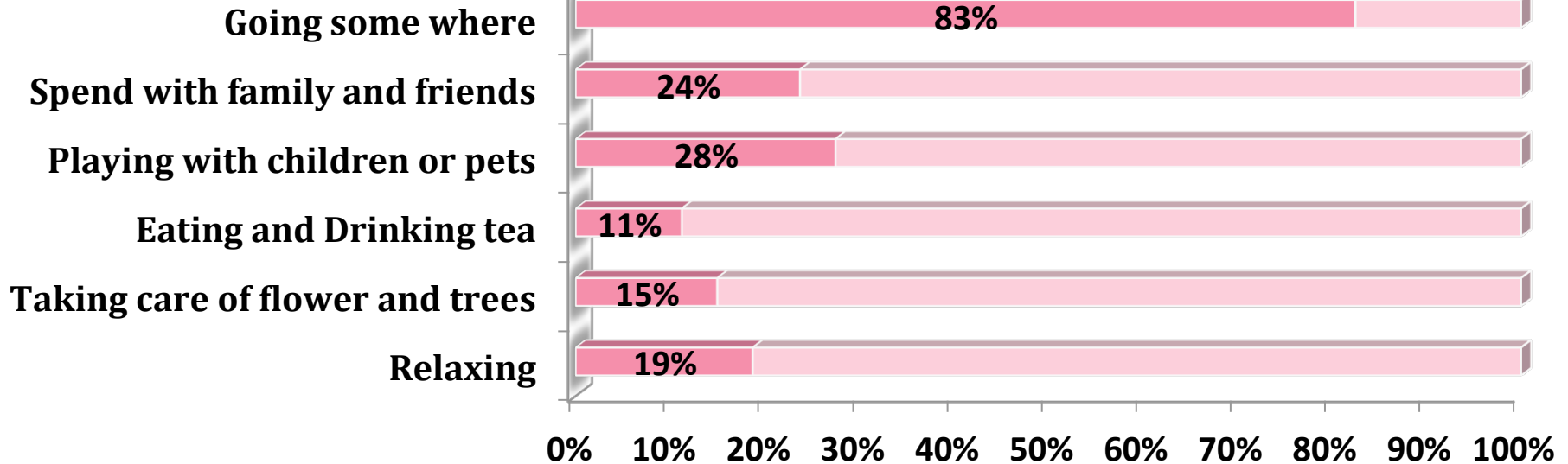


REASONS FOR BAD EVALUATION

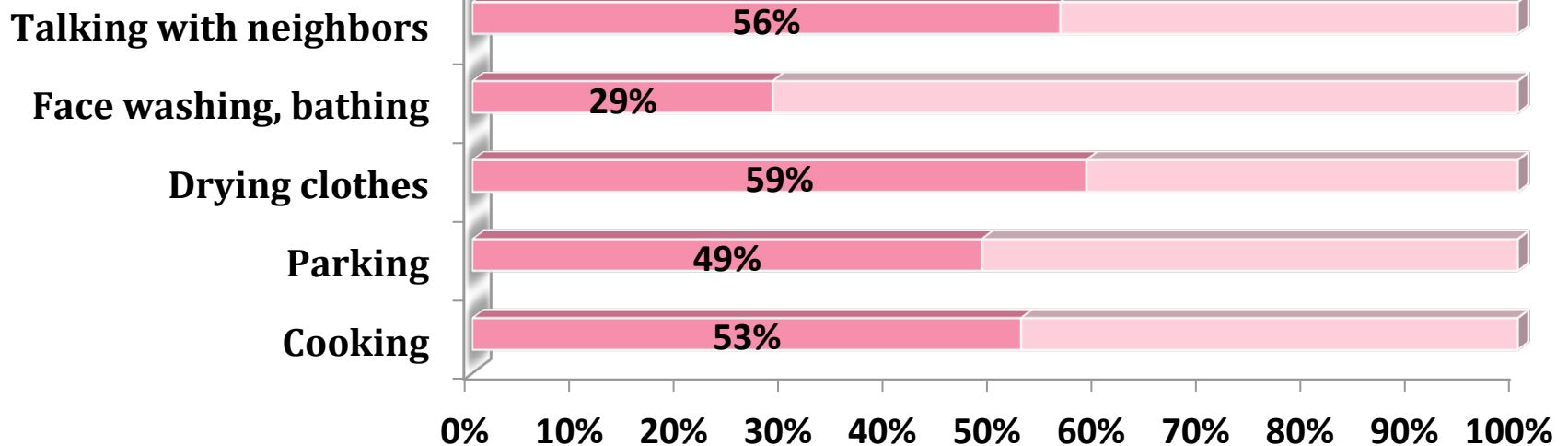


COURTYARD UTILIZATION

TYPE 1: ACTIVITIES ACCORDANCE WITH ORIGINAL FUNCTION OF COURTYARD

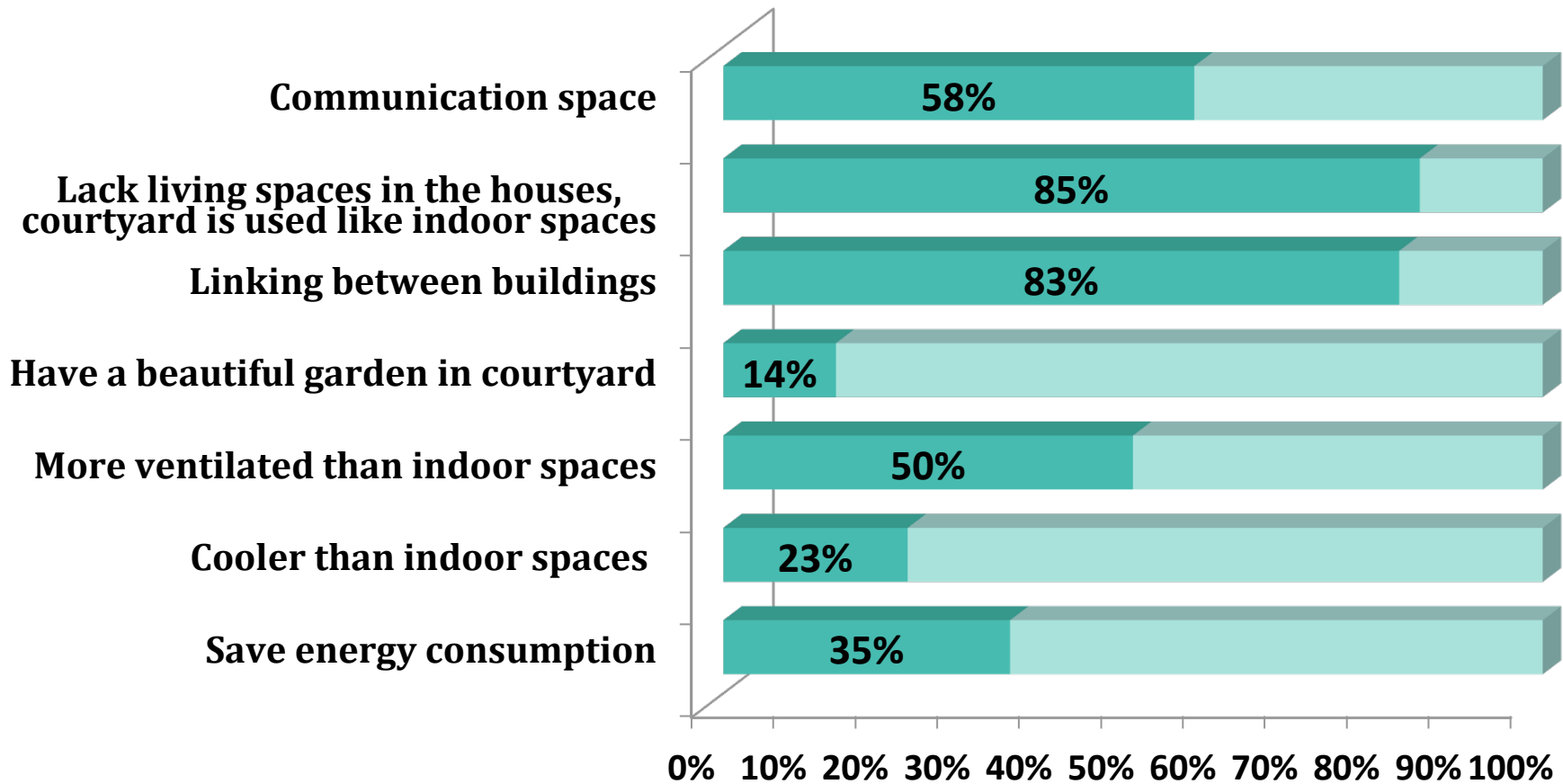


TYPE 2: ACTIVITIES ACCORDANCE WITH NEW FUNCTION OF COURTYARD



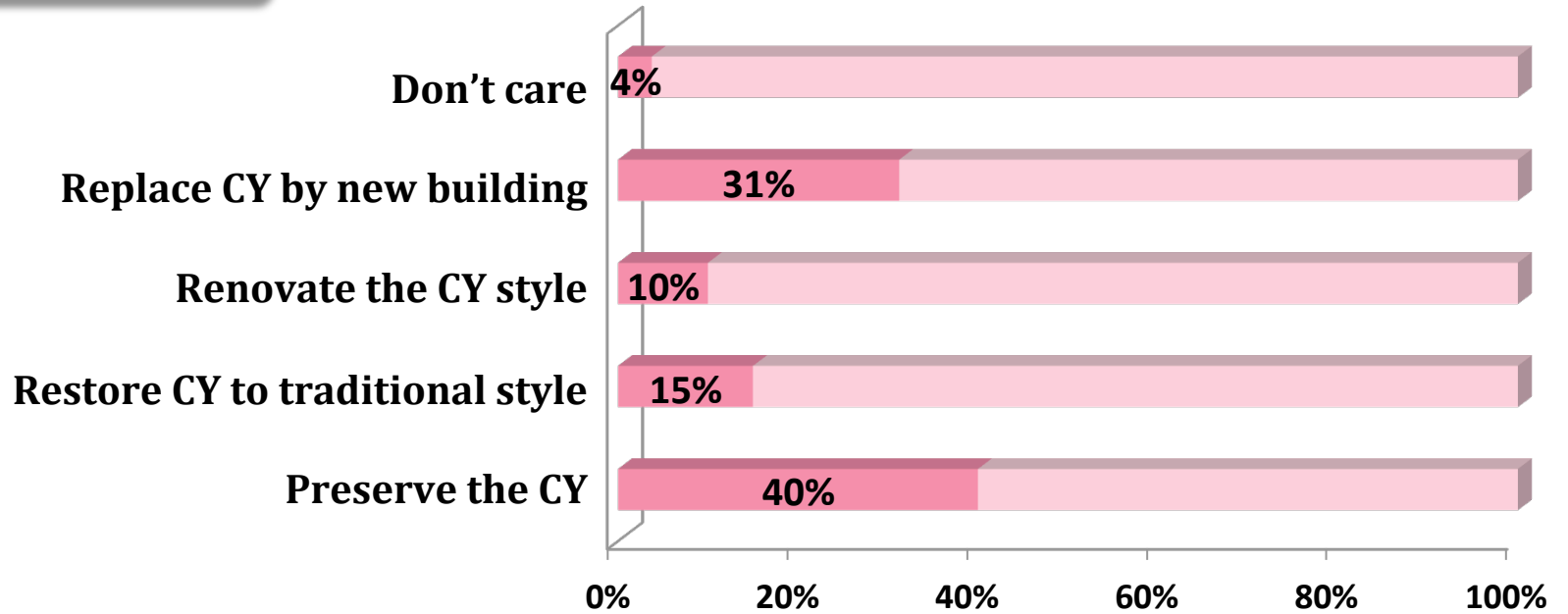
COURTYARD UTILIZATION

REASONS WHY RESIDENTS USE COURTYARD ON PREMISES

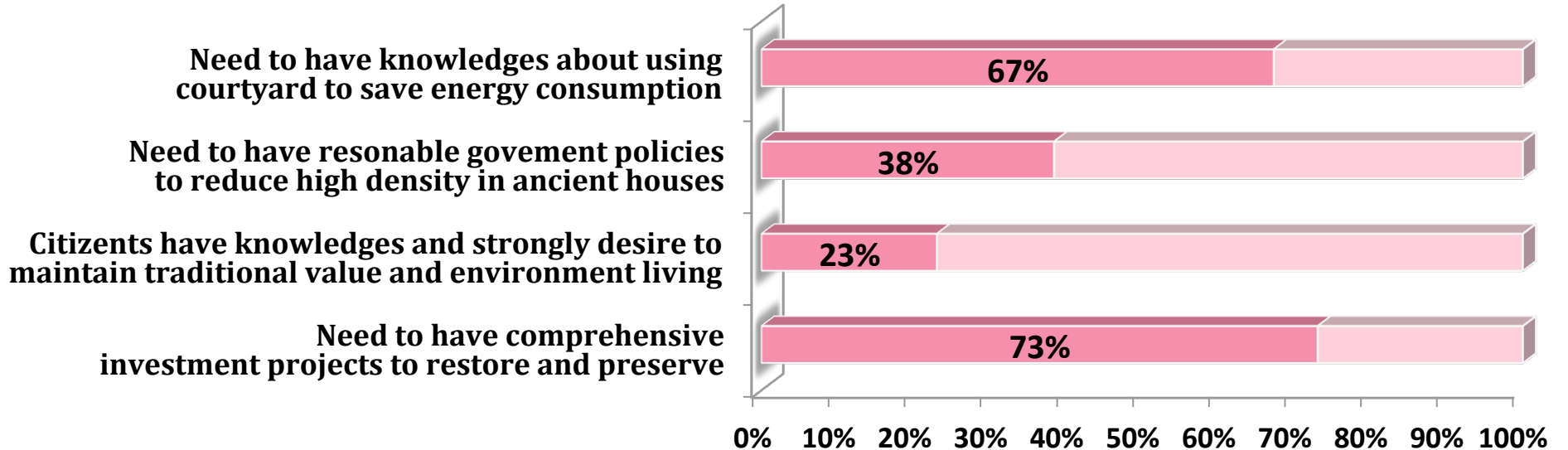


RESIDENTS' DESIRES

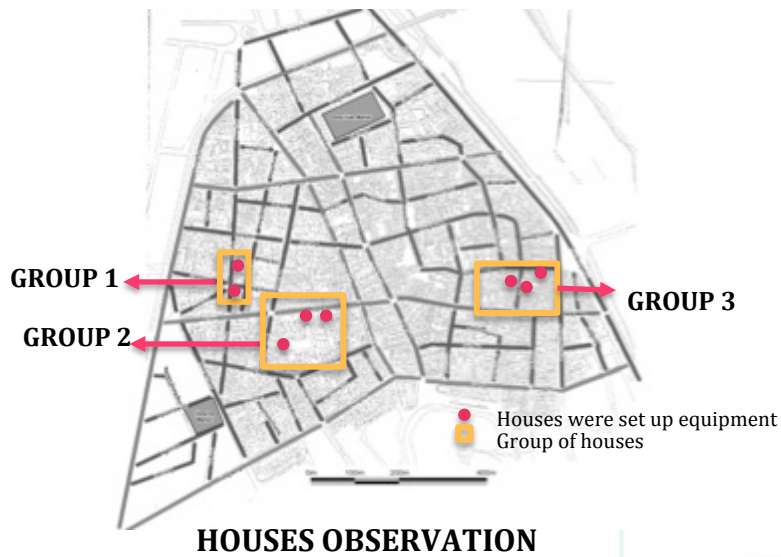
RESIDENTS' DESIRES ABOUT COURTYARD



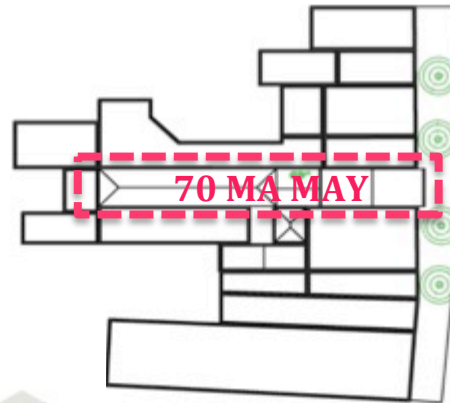
RESIDENTS' IDEAL: HOW TO PRESERVE OR RESTORE COURTYARD



MAKE 3D- CAD MODEL BY VECTOR WORK SOFTWARE



GROUP OF HOUSES	TIME SET UP EQUIPMENT
Group 1: 20 Bat Su, 7 Hang Dieu	2013/7/22~ 2013/7/29
Group 2: 114 Hang Bac, 176 Hang Bac, 33 Hang Dieu	203/7/30~2013/8/6
Group 3: 87 Ma May, 70 Ma may, 32 Phat Loc	2013/8/12~2013/8/19




3D- CAD MODEL OF GROUP 3- MAMAY AREA
(by Le Khanh Ly)



MAKE 3D- CAD MODEL BY VECTOR WORK SOFTWARE

N_o 32 PHAT LOC ALLEYN_o 70 MAMAY STREETN_o 87 MAMAY STREET

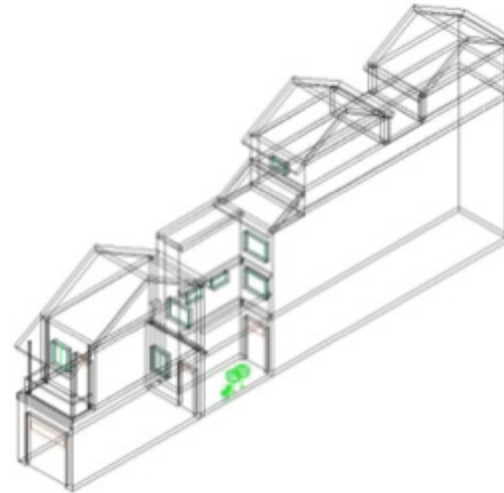
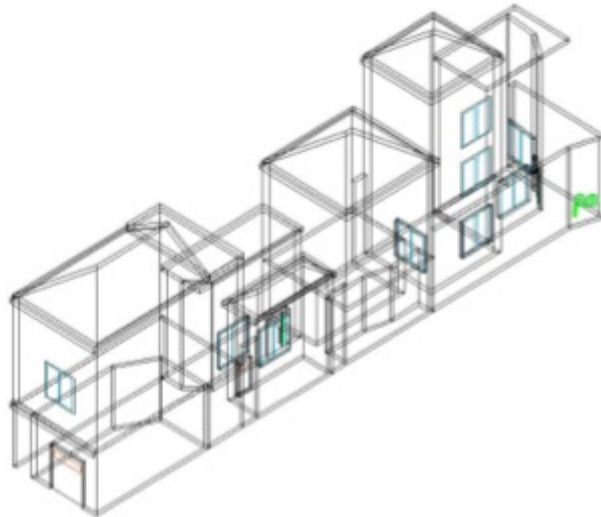
PLAN


 Courtyard

 Courtyard

 Courtyard

PERPECTIVE



CONDITIONS

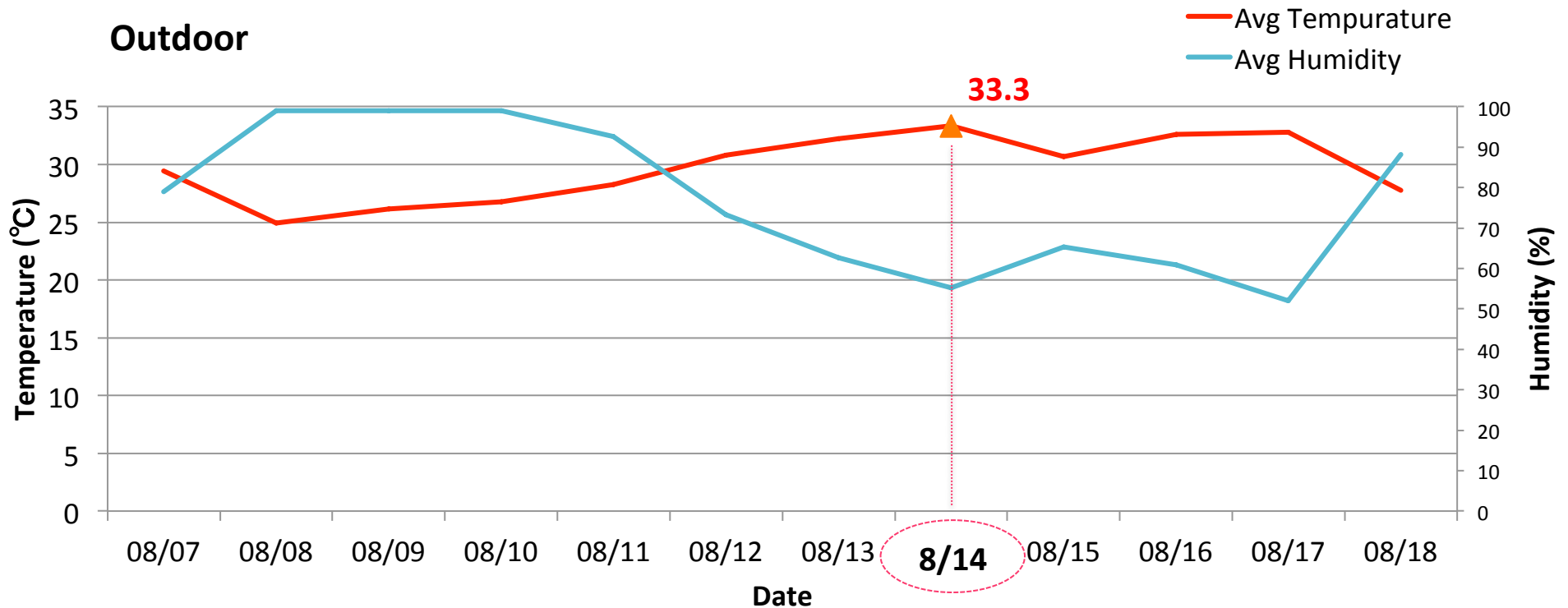
- Has 8 house hold (40 people)
- Courtyard became the alley to approach the buildings
- Most of material of this house is new material.

- Has 1 house hold (5 people).
- 1 CY between 2 buildings.
- Material of the house is mix between traditional material and new material.

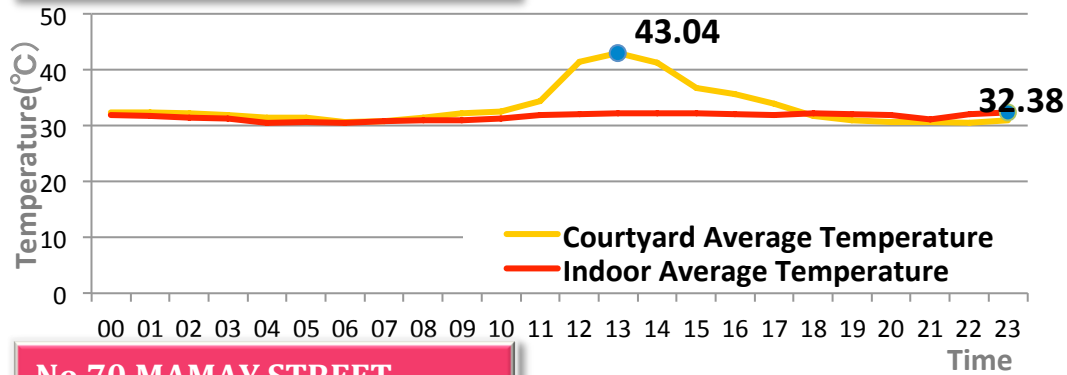
- Original ancient house, became museum for tourist.
- 2 CY between 3 buildings.
- Most of material in this house is traditional material

TEMPERATURE AND HUMIDITY FROM MEASUREMENT DATA

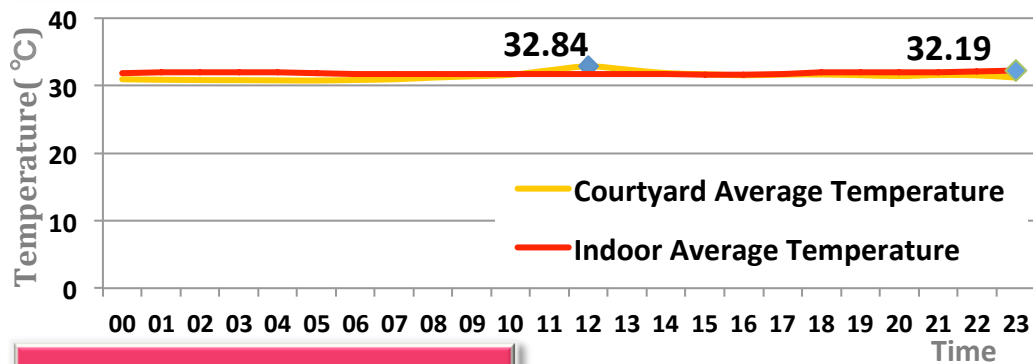
Items	Contents
Time set up equipment	2013/8/12~ 2013/8/19
Setup Temperature Data Loggers	- Above ground level: 1.5m - 1 equipment in courtyard, 1 in living room
Address	70 MaMay, 87 MaMay, 32 Phat Loc in Ma May Block Street



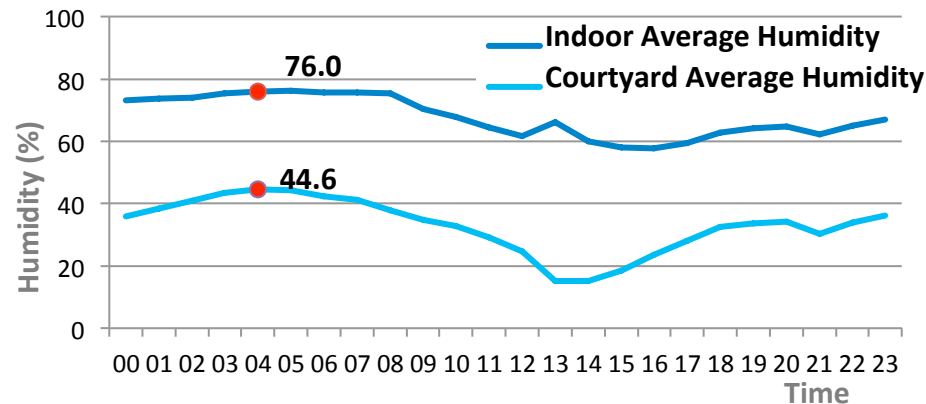
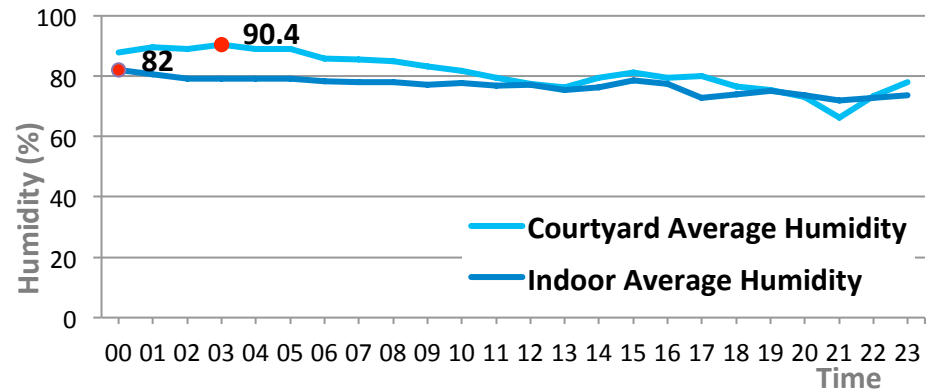
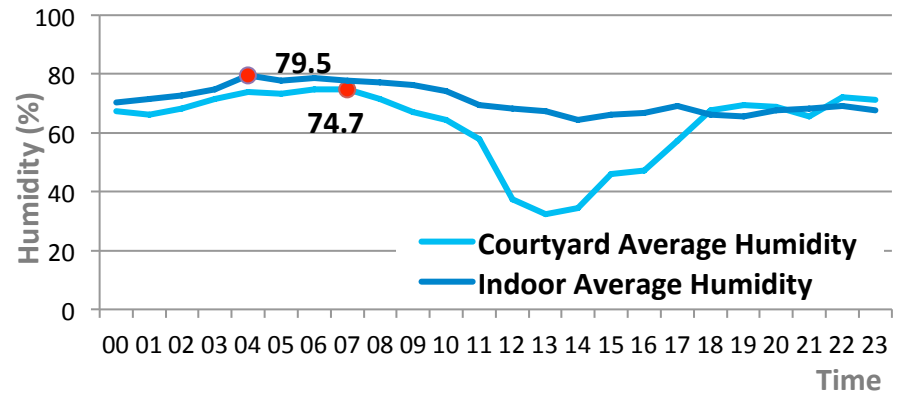
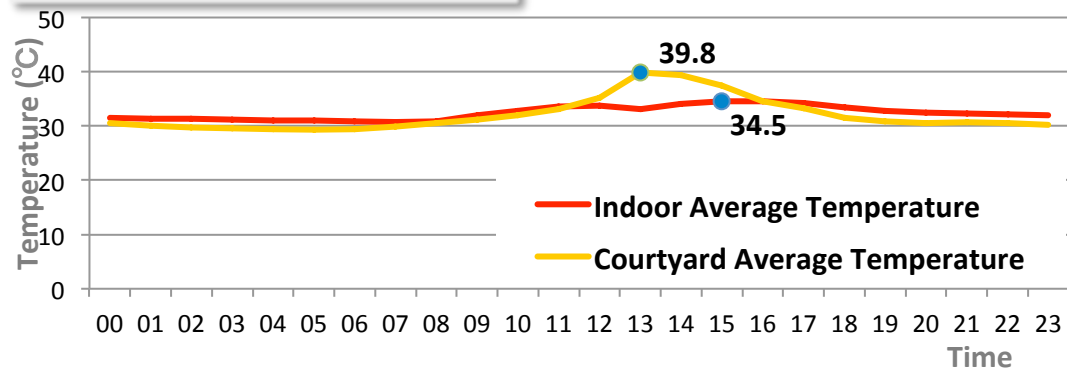
No 32 PHAT LOC ALLEY



No 70 MAMAY STREET



No 87 MAMAY STREET



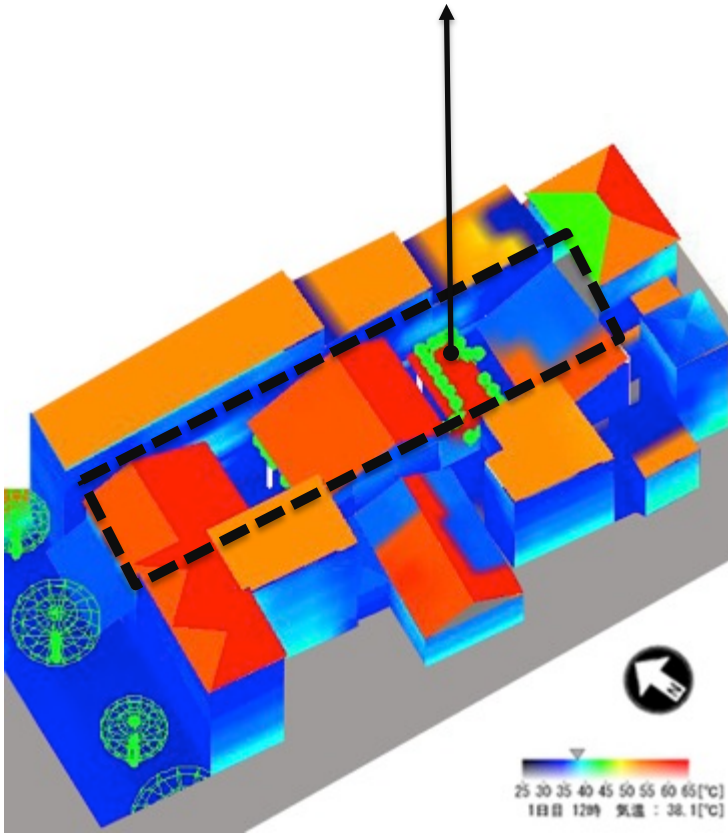
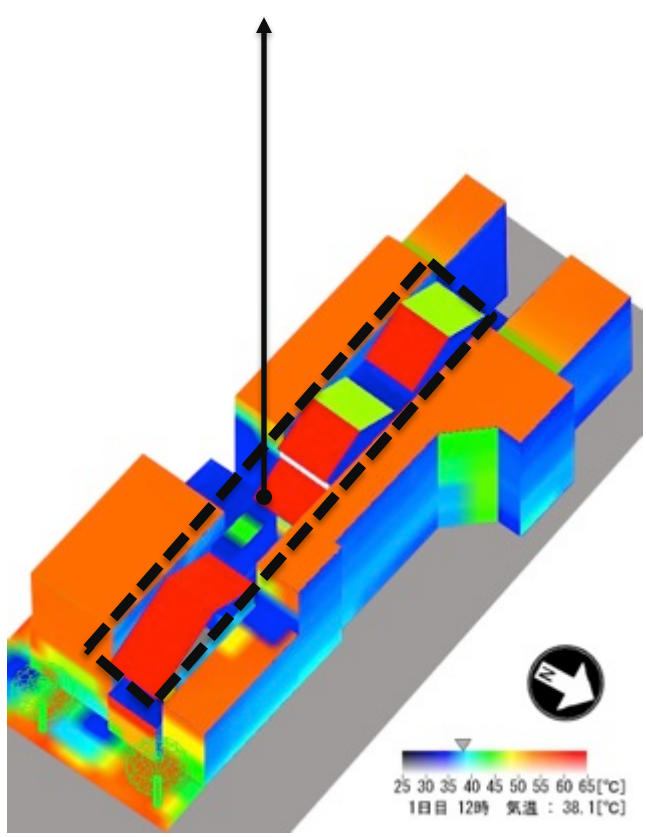
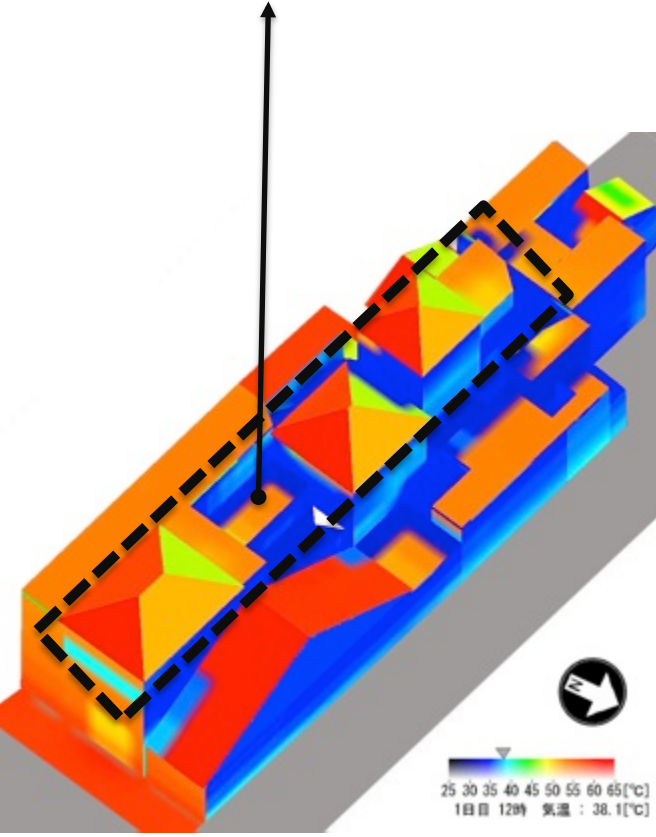
Hourly temperature and humidity of 3 houses on 14th August

MAKE THERMAL MODEL BY THERMO RENDER SOFTWARE

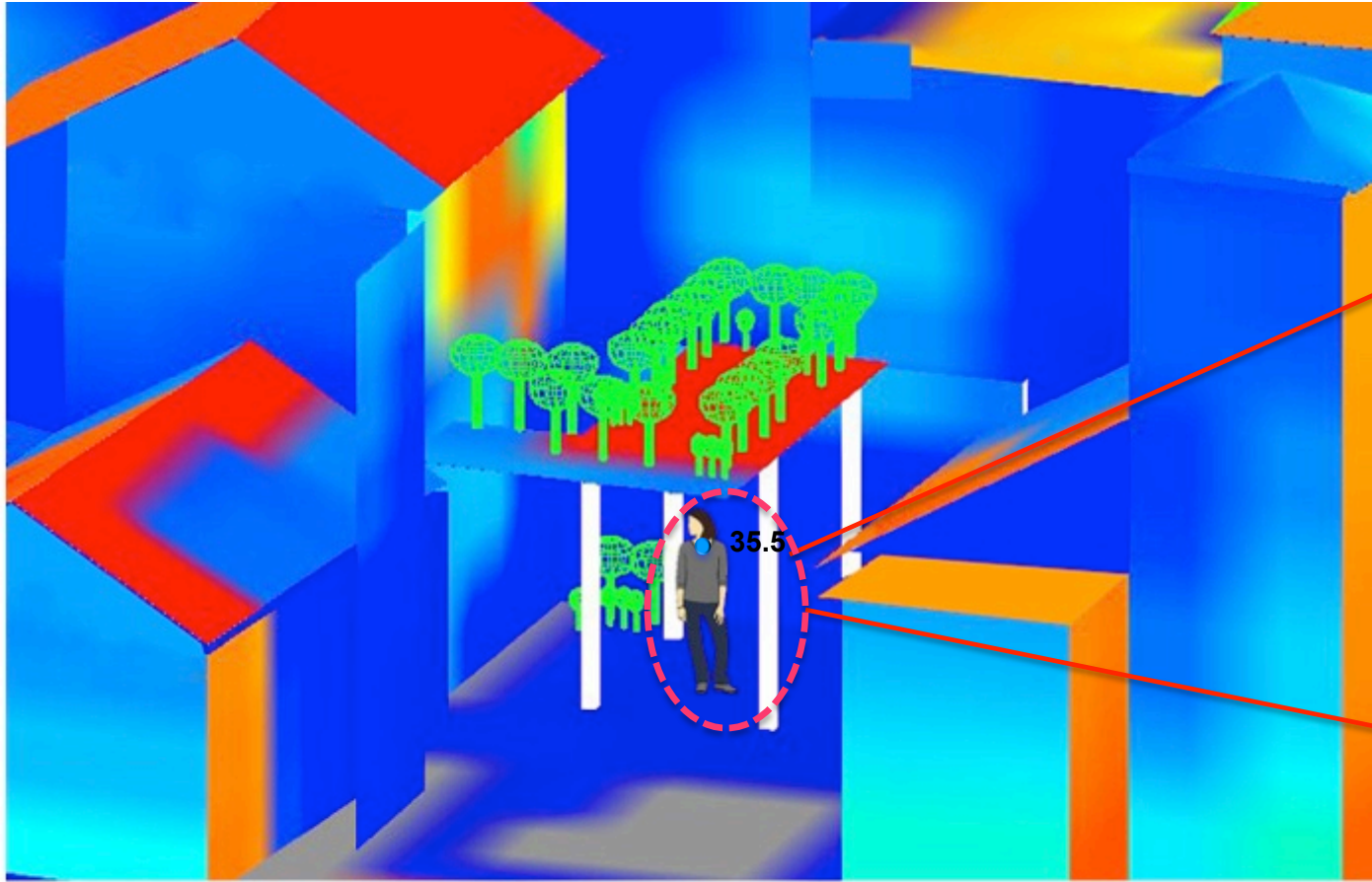
32 PHAT LOC

70 MA MAY

87 MA MAY



12h00 14th August - SURFACE TEMPERATURE OF THREE HOUSES

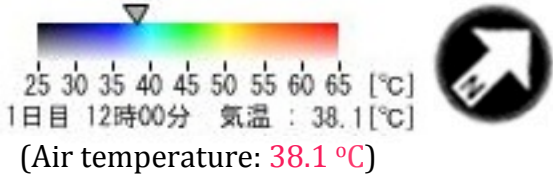


Prepare for cooking



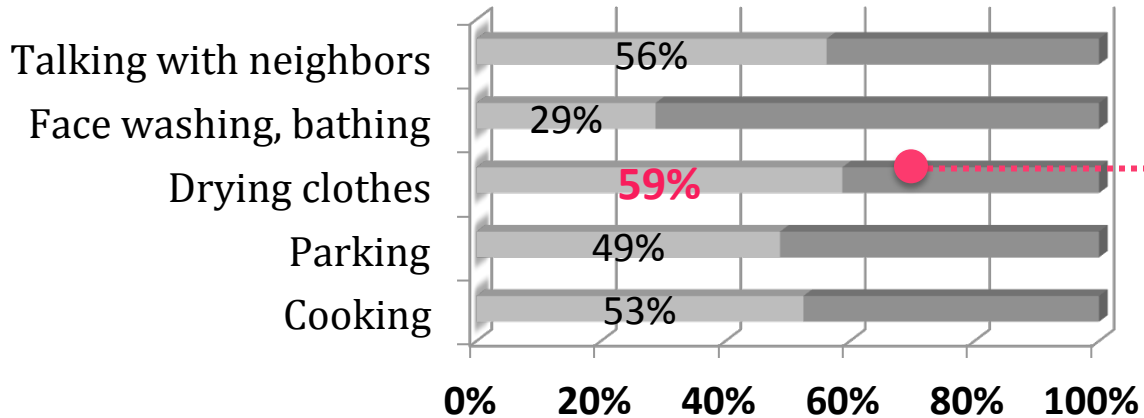
Tourist takes a photo

12h00 14th August -
In courtyard- 87 Ma May

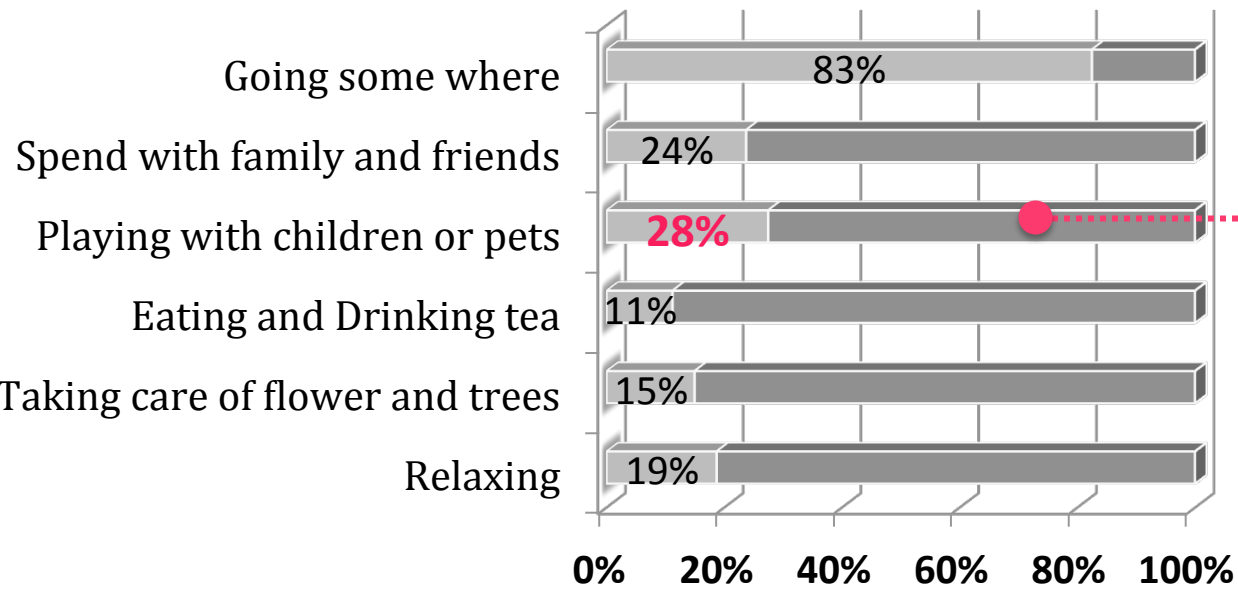


PEOPLE ENJOY IN THE COOLER AREA OF THE COURTYARD

**COURTYARD IS VERY NARROW, HAVE A LOT OF SHADOW ON THIS AREA.
DEPEND ON TYPE OF RESIDENTS ACTIVITIES, THE SHADOW IS COMFORTABLE OR NOT.**



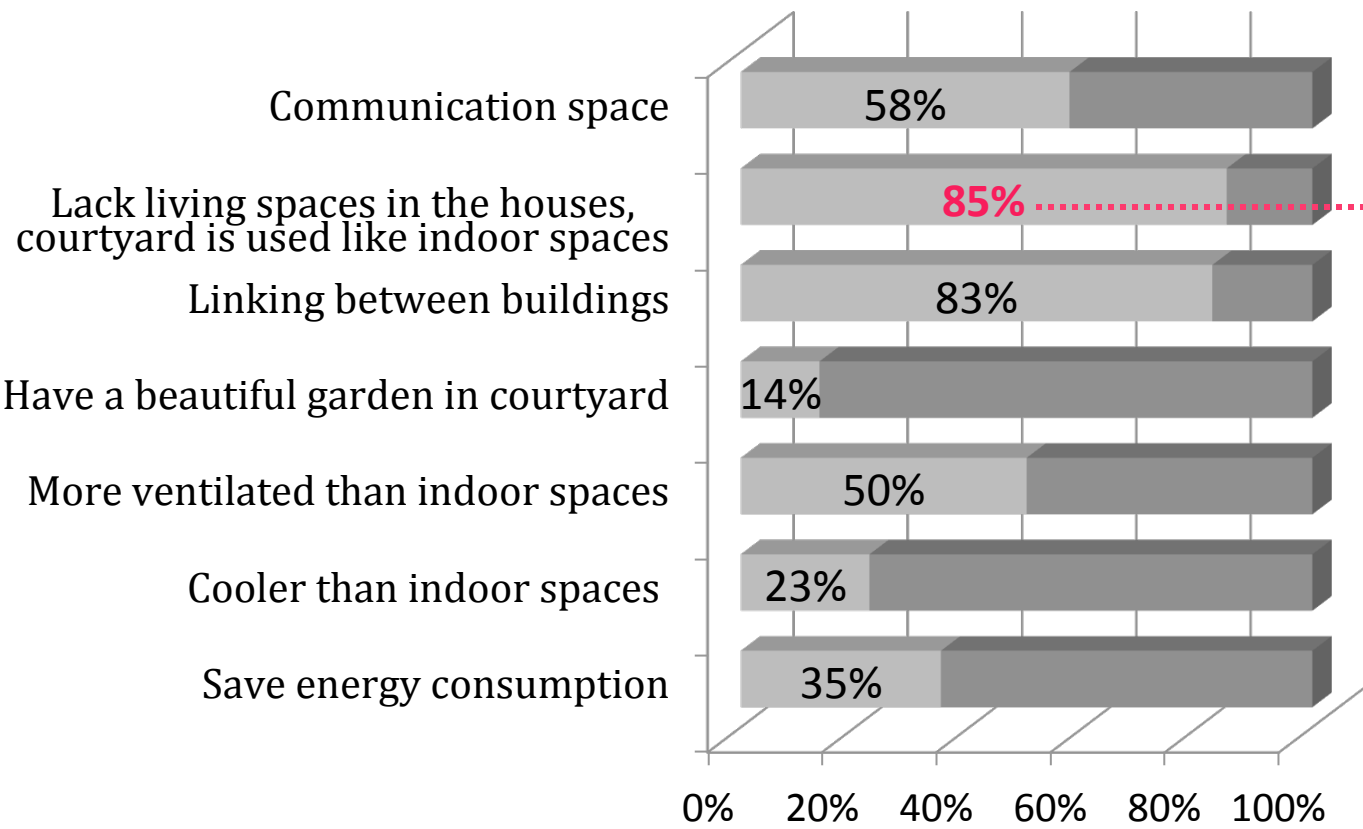
**Drying clothes need sunlight
(photo at 78 Hang Dao)**



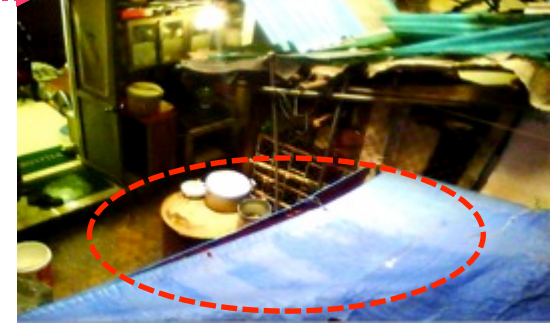
**Playing with children under the shadow
in courtyard (photo at 87 Ma May)**

A LOT OF HANOI OLD TUBE HOUSES HAVE MANY HOUSEHOLDS, A LOT OF INDOOR ACTIVITIES IN COURTYARD.

REASONS WHY RESIDENTS USE COURTYARD ON PREMISES



Personal cleanliness



Temporary bathroom and WC



cooking

INTERVAL CAMERA: Resident behavior at courtyard in 20 Bat Su

NO	PERIOD	WORK
01	DEC /2013	<ul style="list-style-type: none"> Continuing simulation of 8 ancient tube houses by Vector Work software, and make a Thermal Render model. Continuing analysis Interval Recorder result to clarify relationship of residents' behavior and Thermal environment characteristics.
02	JAN/2014	<ul style="list-style-type: none"> Complete assessment relationship between residents' behavior and thermal environment Conclusion and propose some solutions for courtyards.
03	FEB ~ APR/2014	<ul style="list-style-type: none"> Complete the research paper.
04	MAY/2014	<ul style="list-style-type: none"> Final presentation

- 1) Verbeek, Peter-Paul; Slob, Adriaan (Eds.),2006, *Shaping Sustainable Relations Between Consumers and Technologies*, XVI, 409 p.
- 2) Kim, Dowon Lee. 2008.*The influent of wind flows on thermal comfort in the Daechung of traditional Korean house.* Pp 21-25. (<http://www.sciencedirect.com>)
- 3) Miyoko SHIMOKAWA, Tetsuo TEZUKA, 2012. *A study on a relationship between cognition of greenery environment in residential area and energy- saving lifestyle in Japan*
- 4) Richard J.de Dear, Gail S. Brager . 2002. *Thermal comfort in naturally ventilated buildings: revisions to ASHRAE Standard 55.* Pp 551-556 (<http://www.elsevier.com/locate/enbuild>)
- 5) Ramli. 2012. *Re-adaptation of Malay House Thermal Comfort Design Elements into Modern Building Elements – Case Study of Selangor Traditional Malay House & Low Energy Building in Malaysia.* pp 19-23 ([http:// 10.5829/idosi.ijee.2012.03.05.04](http://10.5829/idosi.ijee.2012.03.05.04))
- 6) Tetsu Kubota. 2009. *Thermal comfort in traditional Malay house.* In lecture “Sustainable Architect”, Hiroshima University.
- 7) To Kien .2008. *Conservation pressing task and new documentation of old tube houses in Hanoi Old Quarter through the case of No. 47 Hang Bac Street house, Journal of Architecture, Planning and Environmental Engineering (Transactions of AIJ), Tokyo, No.624.*
- 8) Hoang Huu Phe & Nishimura. 1990. *"Historical environment & housing conditions in "36 old streets" Quarter of Hanoi". Bangkok.*
- 9) To Kien. 2008. *Old tube house and neo tube house in Hanoi: comparative study on identify and topology.* International conference on East Asian Architectural Culture, Kumamoto University.
- 10) Y.Xiong, 2007,*the impact of exterior environmental comfort on residential behavior from the insight of building energy conservation: A Case study on Lower Ngau Tau KOK estate in Hong Kong, 2nd PALENC conference and 28th AIV Conference on Building Low Energy Cooling and Advance Ventilation Technologies in the 21st Century*



Thank you for your attention !

