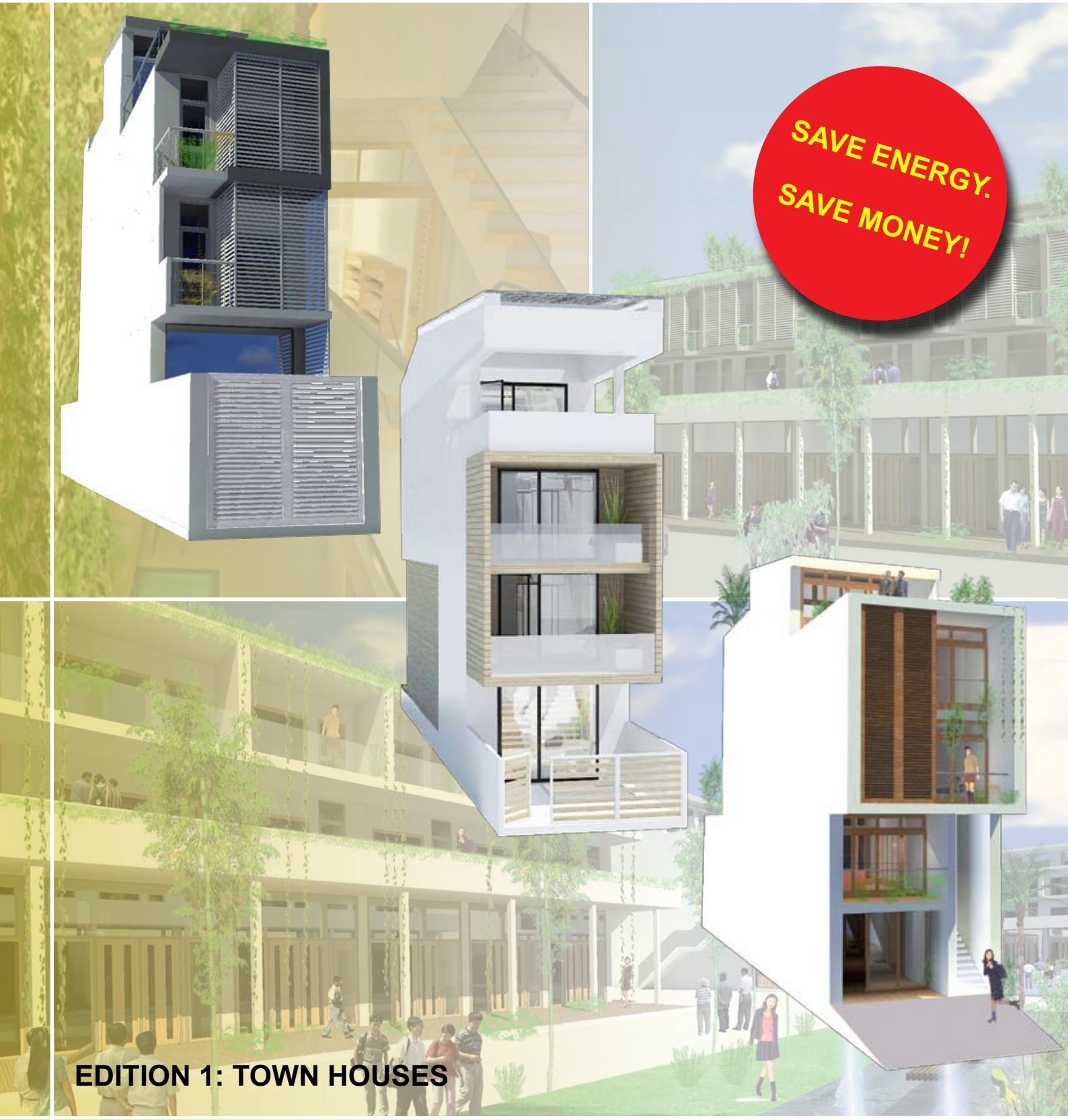
Handbook for Green Housing

CLIMATE-ADAPTED AND ENERGY-EFFICIENT BUILDING SOLUTIONS FOR HO CHI MINH CITY



EDITION 1: TOWN HOUSES

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HANDBOOK FOR GREEN HOUSING

REDUCE YOUR ENERGY COSTS

RAISE YOUR LIVING STANDARD

PROTECT THE ENVIRONMENT

Preface

This handbook is the result of the working group on "climate-adapted housing and energy-efficient buildings" within the Megacity Research Project TP. Ho Chi Minh funded by the German Ministry of Education and Research as part of special research initiative "Future MegaCities – MegaCities for Tomorrow".

In the light of climate change, resource depletion and the really impressive economic development in Vietnam, energy-efficiency becomes one of the cornerstones to secure economic and social success in this booming economy. Since Vietnam will be very much affected by the impacts of climate change, the introduction of mitigation and adaptation measures towards climate change is particularly pressing and urgent.

Out of the three sectors mostly contributing to the energy consumption and greenhouse gas emissions in Vietnam - that are industry, transport and the buildings - buildings is the sector that is most involved within the daily life of the ordinary Vietnamese people.

Currently people, particularly the urban population of Vietnam's metropolis, are experiencing a significant improvement of their living standards. New values are formed and life concepts, with new aspiration and new possibilities are set into place. Danger is that issues of sustainability and long-term benefit crucial for the society and mankind are neglected, when making decisions how to define the new status achieved.

On the other hand, people experience increasing prices for daily needs, among them energy and other resources. And prices can be expected to rise further. Also, the impacts of climate change become more obvious, but are often put aside, when making decisions on personal behavior and consumption.

In this handbook we will show, that there are often smarter ways of doing things when designing buildings. These approaches usually don't cost money, but offer multiple - personal and common - benefits. Then we will discuss measures that allow owners of buildings to save significant money in the medium – and long run.

We also strongly believe that values do change in Vietnam like everywhere else. The people, who demonstrate commitment towards more sustainable solutions will lead the society in future and will hence earn wealth and recognition. It is now the time for developers and building owners to be at the forefront of this movement.

Clearly, also politics and administration will be pushing the topics in future and they have already started to do so with several strategic initiatives.

Of course, architectural design, building and living in buildings does require more than the simple optimization of energy performance. That is why we work in an interdisciplinary team of researchers in the larger context of the Megacity Research Project TP. Ho Chi Minh: Dr. Michael Waibel (photo: right side) from the University of Hamburg, contributes as a social scientist and as expert for policy development, Christoph Hesse (photo: left side) from the Darmstadt University of Technology serves the team regarding aspects of architectural as well as constructive design and Dr. Dirk Schwede (photo: middle) from energydesign Shanghai contributes on topics of energy efficiency as well as indoor comfort.

Please bare with us, if there is something missing in this initial edition, or if you have a different view on things. It is the first edition and we invite everyone to drop us a line and to help to make the following more powerful and effective.

HCMC-design-handbook@ energydesign-asia.com

Dr. Do Tu Lan
Deputy Director General
Urban Development Agency
Ministry of Construction

Climate change has become a global concern; every community, every citizen should be aware of the risks related to this. Even small contributions can create significant incentives to respond to climate change and make the living environment of mankind better. This idea comes from the point of view of an expert team from several German universities within the Megacity Research Project TP. Ho Chi Minh.

Ho Chi Minh City is the largest city in Vietnam and it is likely to be seriously affected by the impacts of climate change. To react to this, German scientists have developed the "Handbook for Green Housing". Various measures are introduced to increase energy-saving related to the town house, the most common housing typology with over 60% of all residential buildings in Vietnamese cities. Thereby, the Handbook for Green Housing has not only taken into account many traditional housing features, but also included contemporary high-tech ideas. By providing various hints, this product is highly attractive for Vietnamese house owners.

Although this is just a small-size study for such a big metropolis, it might have national-wide impact if millions of families in Ho Chi Minh City and other cities apply the research results presented. In this way, the Handbook for Green Housing has the potential to significantly contribute to the urban environment in particular and to the whole sustainable urban development of Vietnam, and on global scale, in general.

Dr. Phuong Hoang Kim
Deputy Director General
Science & Development Department
Ministry of Industry and Trade

The Vietnamese National Energy Efficiency and Conservation Programme is pleased to introduce to you the "Handbook for Green Housing", with solutions for adaptation to the climate and energy efficiency for buildings in Ho Chi Minh City. The combination of traditional culture, Vietnam's feng shui and modern design has been investigated and synthesized by a team of architecture and energy professionals of the Megacity Research Project TP. Ho Chi Minh through aspects such as geography, hydrology, climate, landscape and social science.

With a view to building a house with solutions to mitigate environmental damage, make the best of the sun and wind as well as to limit natural disadvantages, this handbook will introduce climate adaptation measures in architectural design, structure processing and techniques concerned. Besides, the understanding of researchers of spiritual and emotional needs of Vietnamese families will give you hints for a beautiful house, not only on the outside or the reasonable use, but also aesthetic sense in every living corner, relationships with the natural surroundings.

The house is a place to keep family memories, a place to relax and enjoy life; it is also a wordless statement to show the sophistication of the owner. Let your house tell future generations about a "Green" life.

Quach Hong Tuyen
Deputy Director
Department of Construction
Ho Chi Minh City

The global climate change leaves nobody unaffected, but Vietnam is among the countries worldwide most exposed to the risks of climate change. Ho Chi Minh City is particularly endangered, from sea level rise as well as from flooding. Green housing is one of the solutions to adapt to climate change and to mitigate greenhouse gas emissions. However, in Vietnam, this concept has not meet much interest, so far.

The DoC has collaborated with the Megacity Research Project TP. Ho Chi Minh the DoC to issue this "Handbook for Green Housing". This is regarded as one important product in response to climate change in the HCMC. This is the first result of our cooperation with valuable contributions and manifold efforts from the authors. Within this handbook traditional housing design patterns have been analyzed, which are often much better adapted to local climate conditions. Based on this, modern analytical tools have been applied to increase energy-efficiency.

This handbook consists of 12 chapters referring to key issues. The DoC is glad to contribute one chapter consisting of a summary of recommendations what to do and what not to do related to house construction. This has been added with illustrative photos for a better understanding. The recommendations can be utilized by households or construction companies.

1 Introduction: Save energy. Save money!.....8-11

- energy prices
- life-time view
- the bigger picture

2 Design principles.....12-19

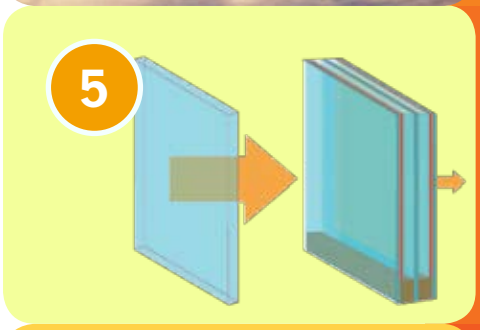
- space composition
- building assembly
- use and program

3 Sun protection and shading 20-25

- selection of colors and materials
- constructive shading
- shading systems

4 Ventilation and cooling.....26-29

- natural ventilation
- mechanical ventilation
- hybrid - getting the best of both



5 Building envelope construction.....30-33

- glazing systems
- insulation

6 Hot water for little money.....34-37

- save water
- solar water heater

7 Attitudes and actions of users.....38-43

- potentials of behaviour change
- ideas for each room in the house
- turn your roof terrace into a garden

8 Efficient equipment.....44-47

- air conditioning
- energy efficient lighting
- house appliances

9 Construction methods and environmental friendly materials.....48-51

- building structure and durability
- walls, floors and roof
- health and well-being
- environmental impact

10 Flooding prevention.....52-55

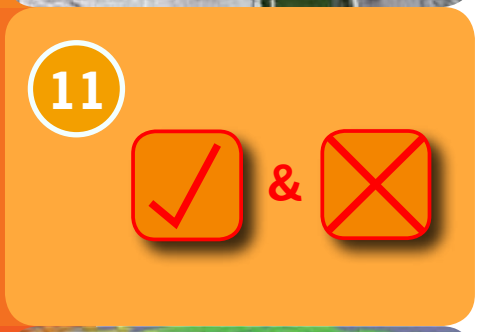
- elevation above flood level
- dry flood proofing constructions
- wet flood proofing constructions
- other techniques

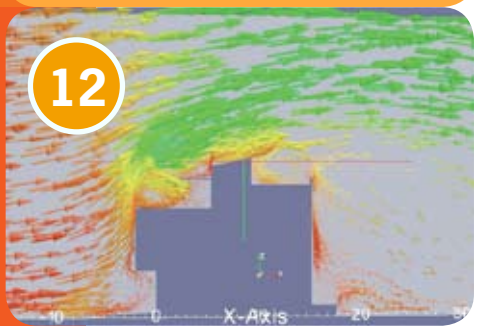
11 Overview: Do's and Don't.....56-61

- importance of ventilation and setback areas
- role of patios and greenery
- importance of functional kitchen layout

12 Resources.....62-65

- product information
- references
- content & cooperation partners





1 Introduction: Save energy. Save money!

Dear Reader,

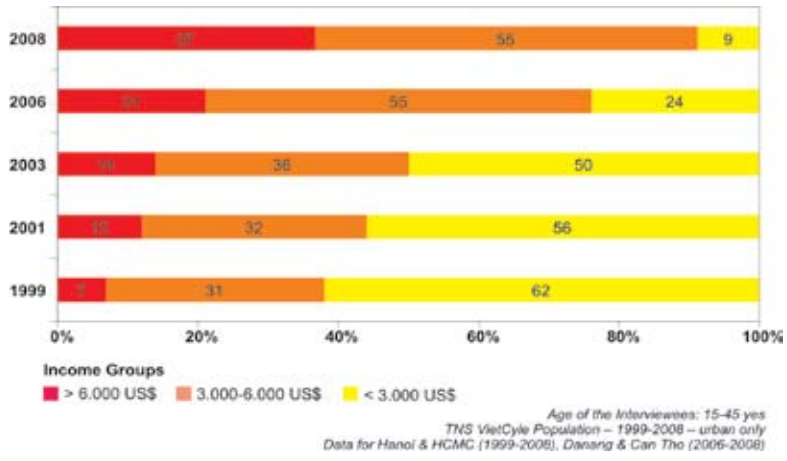
in Vietnam in the past few years we have experienced increasing energy prices and we have to expect that the prices will continue to rise in the years to come. This seems to be hard for the people living in Vietnam, but please be aware that energy is still very cheap - compared to, for example, Germany.

In Germany prices are currently at 5,000-6,000 VND per kilowatt-hour and studies suggest a further rise by another 60% in the coming decade. There is no reason why energy prices in Vietnam won't increase to the same extent or even more.

When energy prices are raising it is time to think about how to save energy in future. All investment into energy saving must be assessed with increased energy prices in mind. Energy savings can be realized in several ways. The best is to avoid consuming energy in the first place.

This you can do easily, if you invest in energy efficient home appliances such as refrigerators, washing machines, LCD TVs, microwave ovens or LED lamps. The biggest electricity consumption in households however is usually spent for air conditioning. Even if prices for energy-efficient air conditioner are 20-30 percent higher than for regular products, the additional investment is retrieved by energy saving in a few years only. However, how much you

Development of household incomes in the biggest Vietnamese cities, 1999-2008 (Source: TNS Vietnam 2009; Design Waibel 2009)



Save energy: don't waste your money (Source: Hesse 2009)

have to spend on air conditioning only party depends on the efficiency of the equipment you use, but much more on your behavior and the design of your building. This handbook shall help you to design a building in which you feel comfortable with low energy cost for conditioning.

The second biggest source for electricity consumption on household level is energy used for domestic hot water generation. In this case, solar water heaters provide a cheap and viable alternative to electrical water heaters with a wide range of products available on the Vietnamese market. Investments in solar hot water heaters are retrieved by energy saving in Vietnam in between four and six years only. In all these cases, with the increase of energy prices in the future, you will get your money back earlier through energy saving. - And please be sure that energy prices will rise.

Besides energy saving as an economic investment in the future, it makes your family more independent from power shortage and network blackouts, which is a value as such, because it adds quality to your life. You also do make a contribution to solve the future problem of Vietnam and of mankind. It might not pay, but a secure and peaceful world will allow you and your children to enjoy the achievements of progress with much more confidence and pride.

The following symbols will highlight important points within the Handbook for Green Housing:

Hints

Save Money

Pay Attention
(Typical source of a problem)

Do-it-Yourself

Energy- and climate efficient neighbourhood (Source: Hesse 2010)

Modern Town Houses

This edition of the handbook focuses on the common modern town house typology, as this typology is still the most widespread building type in Ho Chi Min City. For this reason we regard this housing typology as an ideal starting point to explore and to promote potentials for energy saving in Ho Chi Min City and other areas of Vietnam. This specific housing typology has developed over the past decades and also in times when no means for mechanical ventilation were available.

Town Houses are usually four to five stories high, very narrow to the street side and deep to the back. Traditionally they provided space for the extended Vietnamese family and business in the ground floor rooms. Presently, the ground floor is often used as living room and increasingly as a parking space for the vehicle of the family, as well.

Aims

The compilation of guidelines within this publication is expected to raise awareness and capacity in Ho Chi Minh City and the whole of Vietnam. The handbook also presents product information, new technologies and the results of scientific research.

Target Group

This handbook is written for everyone, who is reflecting about buildings – as owner, buyer, architect, developer or builder. It shall help the stakeholders in their specific role to build better buildings and also to understand and to communicate, how to make buildings more climate-adapted, more energy-efficient as well as more sustainable and more valuable.

Owners will learn how to specify and to define a good building for themselves and for their services providers. Further, buyers will understand better how to assess buildings in terms of energy cost and comfort performance. Architects and builders will be supported to fulfill the demand for climate-adapted and energy-efficient solutions in their future work.

1. Low Rise – High Density building forms

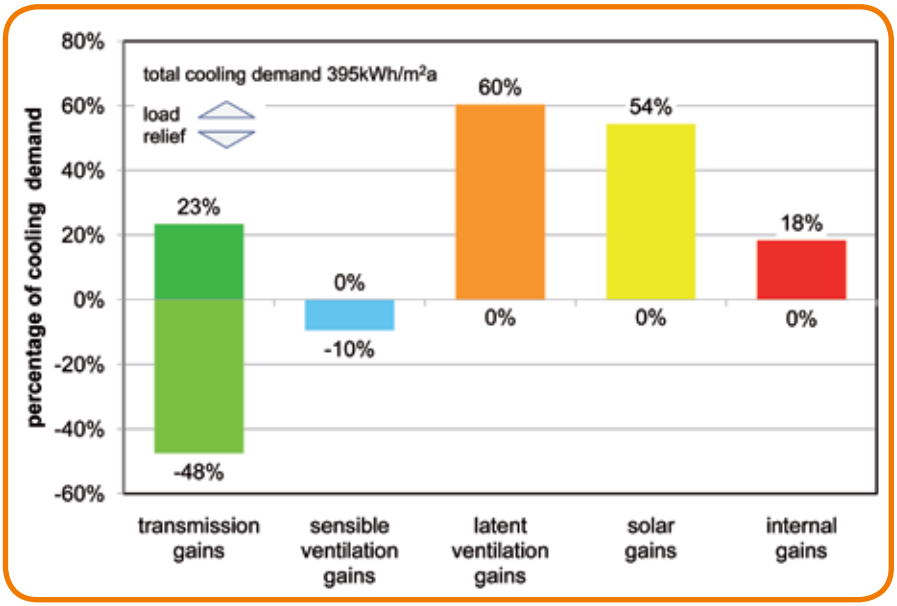
2. Mixed-use for commercial, working, and residential

3. Constructive shading devices

4. Green public spaces and fresh air corridor

Modern town house in Ho Chi Minh City (Source: Hesse 2009)

The simulated cooling energy demand profile shows that latent ventilation gains (humidity in the air) and solar gains are responsible for the energy the largest part of the energy cost for cooling, on the other hand transmission through the walls and windows is effective relief for the energy balance and the energy bill. The annual cooling demand of 395 kWh/m²a translates into energy cost of 250,000 DONG in case common air conditioners (EER = 2.3) are used, and into 150,000 DONG if efficient air conditioners (EER = 3.6) are used.



Cooling demand of a typical town house, when mechanically conditioned (simulation result; Source: Schwede 2009)

2 Design principles

Energy efficient form of a town house (Source: Hesse 2011)

Introduction

The following design principals for a new generation of town houses will help to increase the sustainability and life span of your building. Especially low- tech solutions will prevail for the vast majority of design suggestions in this publication. Due to the financial capability and local construction materials and techniques, all design ideas are feasible within an appropriate pay back time.

Building form and orientation

The form and orientation of your town house are essential. In general, the amount of surface that is exposed to direct sun radiation should be as small as possible. On the one hand the short façades should be oriented in north-south direction (see right). On the other hand the adjacent buildings should protect the long compartment walls.

1. The short façades should be oriented in north-south direction

2. East and west façades are protected by adjacent buildings

3. Overhangs, louvers and balconies provide constructive shading

4. Double shell roof for shading and natural air ventilation

In cases where it is not possible to shade the east and west façades in this way, secondary spaces like staircases, stores or bathrooms should be located here. Additionally, the walls could be split into two layers with space in between to allow internal air circulation. Furthermore, the east and west façades should have only a few small openings.

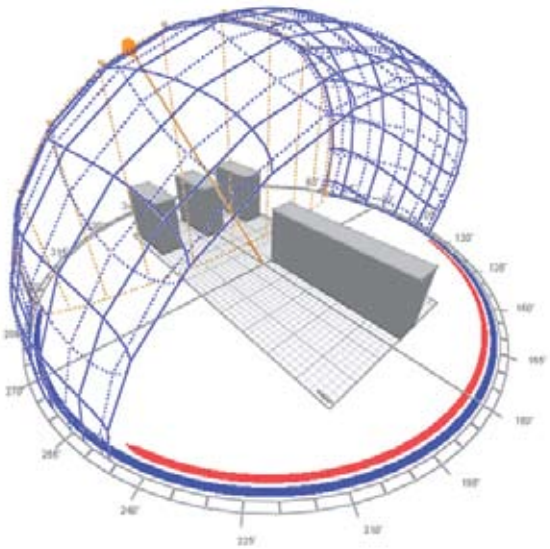
By flowing these design principles most direct solar radiation is left to the roof and south façade. Therefore, the form and design are especially important. As demonstrated in the section on the lower right, these parts of the building should be covered by a heat buffer zone. For the ground floor overhangs and louvers provide constructive shading. At the upper levels loggias and balconies block the heat by thermal air movements before it enters into the indoor spaces.

At the roof different design principle can be executed. Solar panels or reflecting double shell materials can be used as active sun protection. Green roof constructions and bright surface materials are sufficient alternatives for passive sun protection. Rough textures provide self-shading and also multiply the surface area for cooling down during the night.

Building openings

The design of your house should include the benefits of natural ventilation as much as possible. The floor plan should allow cross-ventilation of all living spaces. In cases of a conflict between sun direction and prevailing outdoor wind direction the orientation of the house can be adjusted between 0-30 degrees without losing the cooling effect of a breeze.

Since the prevailing wind flow in Ho Chi Minh City is from southeast during the dry season and southwest during the wet season, the building



Sun path and orientation of a town house in HCMC (Source: Schwede 2011)

Heat buffer zone of the town house (Source: Hesse 2011)

1. South façades: constructive shading with balconies, loggias, overhangs and double skin

2. Roof: Shading with paneels and double shell constructions with air ventilation

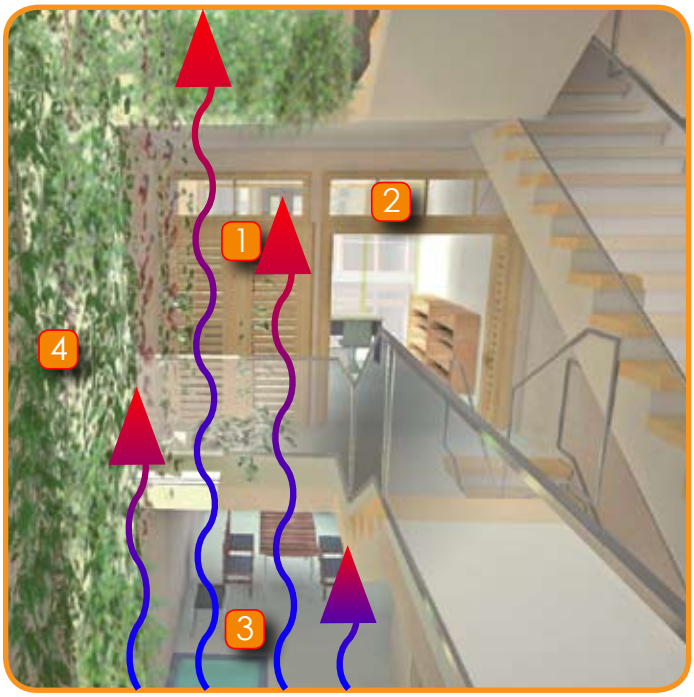
3. North façades: light building materials for cooling off faster at night

4. Basement: cistern tanks for rain water storage and active cooling of the ground floor

can be slightly reoriented towards these directions. To achieve an optimal advantage of natural ventilation the façades should have openings, doors and windows as large as possible. However, this has to go along with an effective protection against the penetration of solar radiation. Also rain, insects and air pollution have to be kept away from interior spaces.

Inlet openings should be located on the windward side at a low point of the room. Whereas outlet openings should be located on the leeward side at a higher point of the room. If both were placed on a higher level, as we can observe in many houses in Ho Chi Minh City, the air would certainly move but the user of the room would not experience the cooling effect.

You should avoid designing rooms with single-side openings only. Particularly, the long and narrow building form of the town house is heavily depending on cross-ventilation. It should be possible that depths up to 15 meters can be naturally ventilated. As seen in the picture on the right, a small air space or atrium can certainly contribute to increase the ‘stack effect’ additionally.



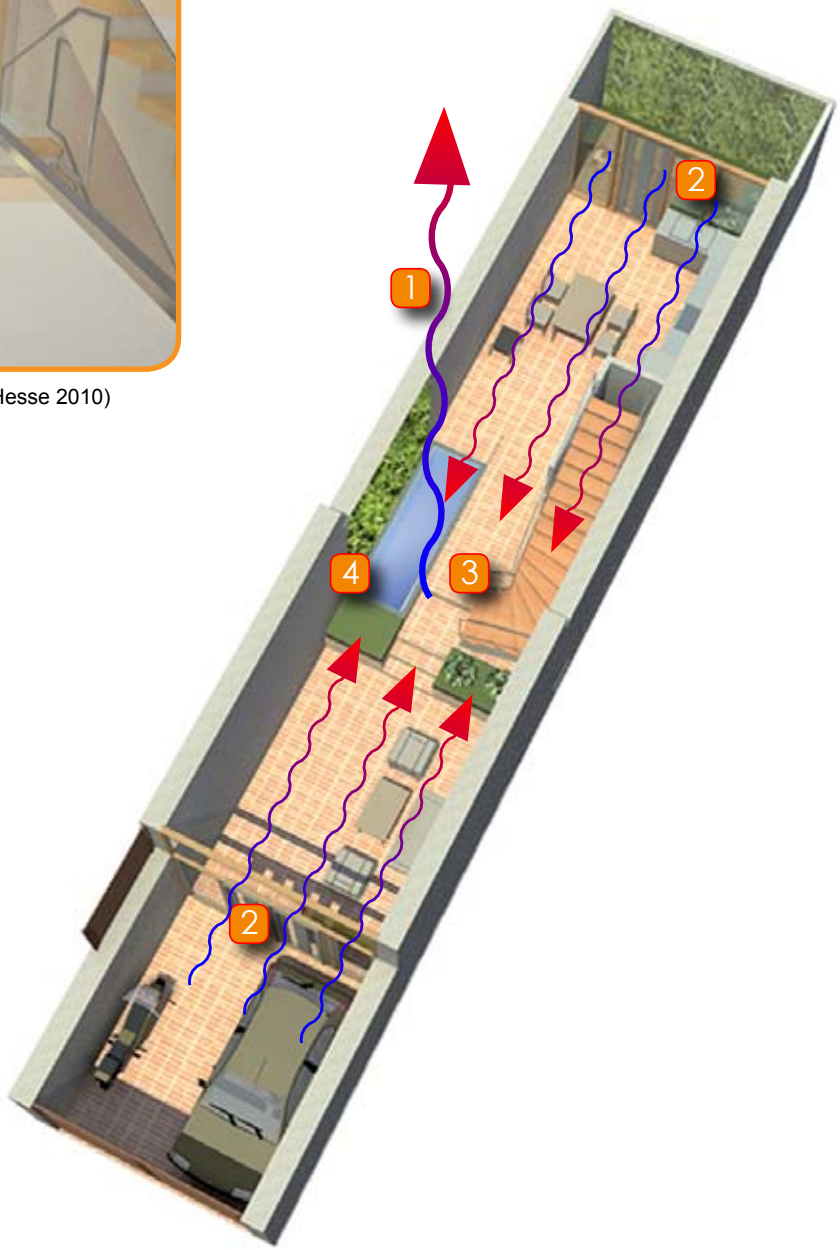
Interior green air shaft of the town house (Source: Hesse 2010)

1. Air shaft for natural vertical circulation

2. Openings for cross ventilation

3. Water basin supports the cooling effect by evaporation (adiabatic cooling)

4. Green wall with vegetation also supports the cooling effect by evaporation



Ground floor plan (Source: Hesse 2010)

Internal space composition

The spatial composition of the rooms follows the relationship between use and heat load. All spaces that are primarily occupied during the day should be located in the northern part of the house.

The kitchen and dining room, working spaces like home offices and rooms for the children should be situated here. These rooms do not necessarily need to be protected by the heat buffer zone like the ones at the south façade. Moreover, it is recommended to reduce the constructive weight of the exterior walls to achieve a faster cooling down effect during the night.

The kitchen and bathrooms which usually produce additional heat and

moisture should be separated from the living areas and arranged to the leeside of the building or the atrium in order to dissipate the exhaust air directly to the outside.

The layout of the room composition divides the house into six independent zones that can be air-conditioned separately. Each zone can be cooled to a temperature favoured by its users. However, the house is designed to be most pleasant when a natural breeze flows through the interior.

The main intention is to minimize the use of air-conditioning in order to save energy and money. The air-shaft, placed in the very heart of the building, accelerates the existing air movement and draws it up to the rooftop.

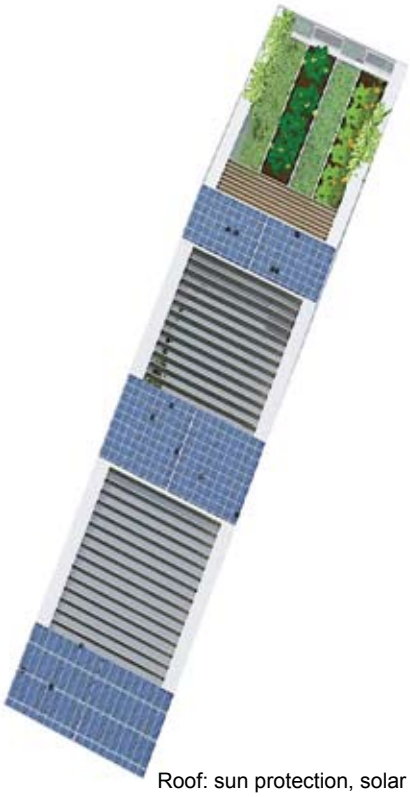
A little water basin on the ground floor (please refer to picture below and on page 15) as well as vegetation on the wall of the atrium support the cooling effect by evaporation (adiabatic cooling).

Multifunctional ground floor plan
(Source: Hesse 2011)

Second floor: living and working
(Source: Hesse 2011)

Ground floor perspectives demonstrating the flexible use for living (left), shops or offices (right) (Source: Hesse 2011)

Third floor: living and roof terrace
(Source: Hesse 2011)



Roof: sun protection, solar panels
and garden (Source: Hesse 2011)

Variation of town house type with closed heat buffer zone (Source: Hesse 2011)

Hints

• Keep the building surface that is exposed to direct sun radiation as small as possible

• Create a heat buffer zone to protect your house against overheating

• The most important design rule is to allow sufficient air movement in the building

• The floor plan must allow cross-ventilation

• Avoid closed partition walls, which are rectangular to the wind direction

• The floor plan should divide the house into independent zones that can be air-conditioned separately, if needed

1. Apartment 1 for one family

2. Apartment 2 for one family

3. External entrance for apartment 2

4. Green roof terrace

Variation of town house type for two families with seperated entrances (Source: Hesse 2011)

Do-it-Yourself

• You should located all rooms that are primarily occupied during the day into the northern part of the house

• Place a little water basin on the ground floor and vegetation on the wall of the atrium to support the cooling effect by evaporation

Pay Attention

• Avoid designing rooms with single-side openings only

• Moveable blinds or shutters are essential, but need to be used carefully, since they might obstruct natural ventilation

Save Money

• Following the main design principles will help to reduce the thermal load of the building enormously without producing extra costs or even operational expenses

• The main intention is to minimize the use of air-conditioning in order to save energy and money

1. Shops and offices

2. Exterior access balcony

3. Apartments

4. Green roof terraces

Variation of the town house typology as row house with exterior access (Source: Hesse 2011)

3 Sun protection and shading

1. Constructive shading with balconies, loggias and overhangs
2. Shading of the roof terrace
3. Sun protection with panels and double shell constructions for air ventilation
4. Green wall and light building materials for cooling off faster at night

Sun protection and shading of the town house (Source: Hesse 2011)

Introduction

Solar gains always are cooling loads in Ho Chi Min City climate. Therefore buildings and rooms need to be protected from the sun. Solar gains are effective on the building in three ways. Firstly, through transparent openings, such as windows, door and skylights. Secondly, through the opaque building part through conduction from the heated outside surface to the interior of the building. Thirdly, by ventilation with overheated air from heat islands around the building. All three ways can be reduced by smart design and indoor temperature and cooling costs can be reduced effectively by passive means.

Design Principles

The sun path is rather uniform in Ho Chi Min City with only minor variations between summer and winter month. The sun starts in the morning in the east, rises fast to a high position above and sets in westerly direction. This allows fixed and constructive shading system to be used.

Traditionally buildings in tropical climate employ ventilated screens with some distance in front of light and ventilation openings to allow moderate lighting and sufficient air flow while reducing the solar gains effectively through shading and convective heat loss.

Also, overhangs in form of roofs and balconies are often used to protect the south and also the north façade from the sun.

Protection of the east and west façade requires vertical system either in form of vertical screens or moveable sun shades, if transparent openings cannot be avoided by design of the layout of the building.

If possible buildings should be oriented to make optimal use of these principles with opening to the South and to the North, but mostly closed to East and West. Since moveable systems are more expensive and require more maintenance in operation, constructive shading should be preferred in a robust energy-efficient design concept.

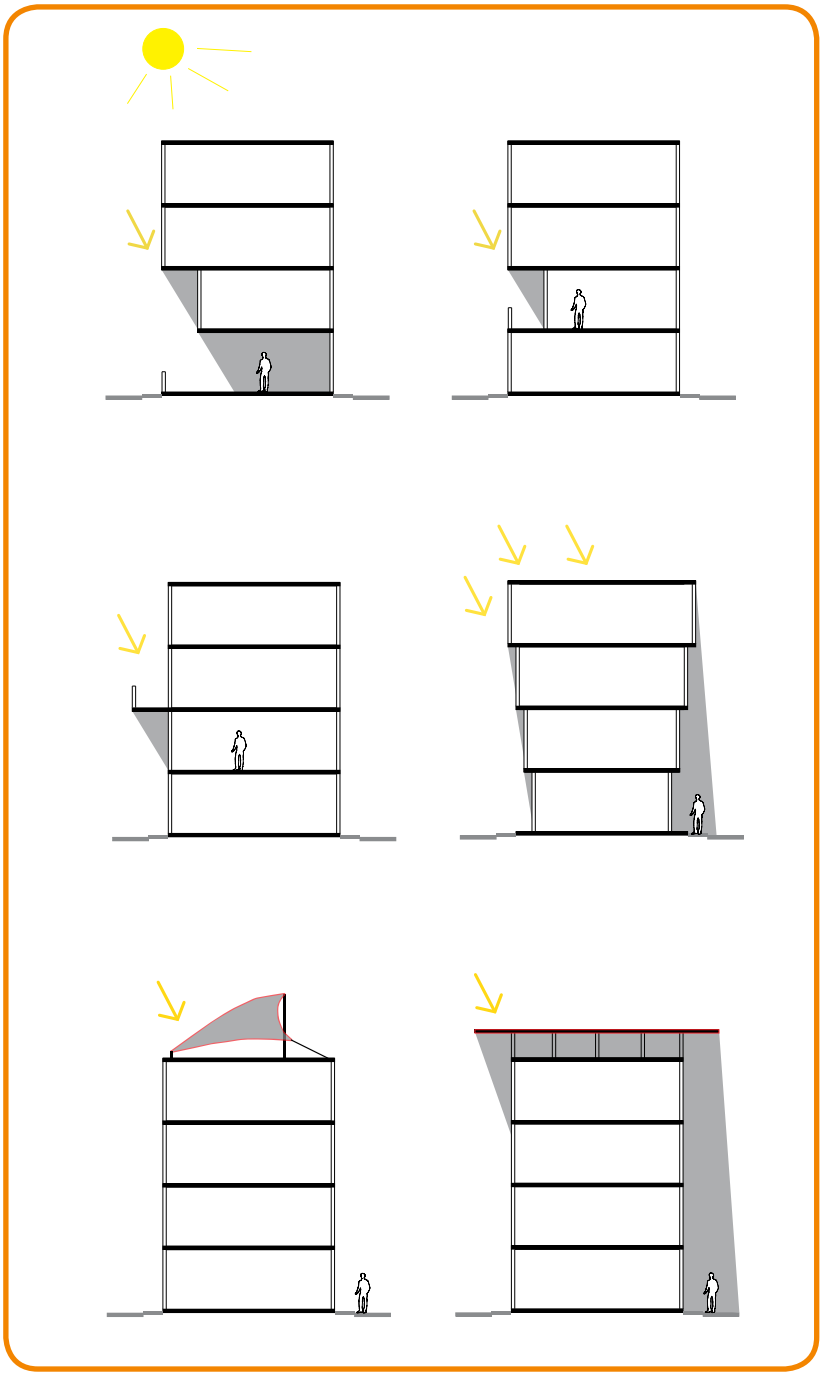
It is always better to use external shading, not to let the sun coming into the room in the first place. Internal shading does not serve the purpose. If the building does not exceed a certain height, and wind loads are not significant, external shading is the best choice. Fixed constructive systems do also perform under wind and should hence be used.

In order to avoid heat gains through opaque building parts three principles are to be used.

The first is shading: external building parts shall be shaded through screen, trees, vegetation or other building parts and buildings. This will reduce the amount of heat reaching the building.

The second principle is to use light colors for the outside surfaces in order to reflect the light, rather than to heat the wall.

The third is the reduction of conduction through the wall. This can be achieved through double layered wall constructions, with an air gap to interrupt the heat conduction, or



Constructive sun protection methods (Source: Hesse 2009)

Examples of constructive shading in town houses and apartments
(Source: Waibel, 2011; Schwede, 2010)

through material with low heat conductivity, such as insulation material or aerated concrete.

The heating with overheated air can be reduced by generating a favorable microclimate around your building by using light colors, plants and if possible water features.

Hints

• shade outdoor spaces in front of windows and ventilation openings.

• use light colors for pavement and plants in front and behind your house.

• use light reflective colors for external walls and especially the roof to avoid heating of building parts in the sun.
• use material with low conductivity and capacity to expel heat gains and not to conduct heat gains to the inside.

Heat buffer zone behind the facade
(Source: Hegger, TU Darmstadt 2007)

Pay Attention

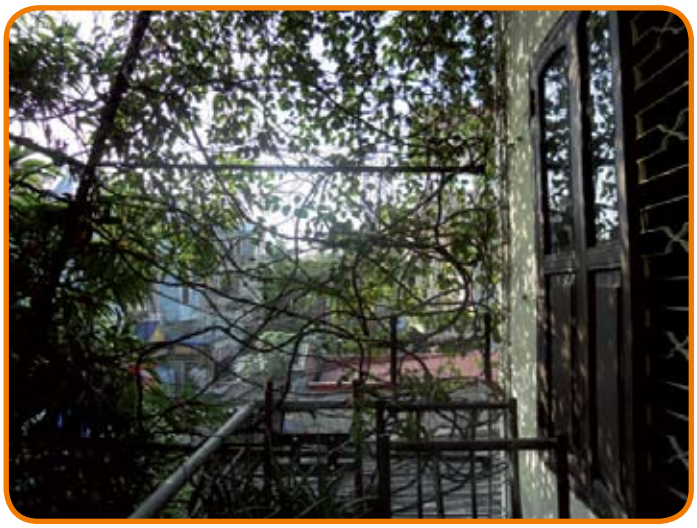
• Shading might influence daylight supply inside. Shading should not exclude daylight to be used, but only reduce heat gains from the sun. However extensive daylight and oversized windows, as there are sometimes used in modern designs, are not appropriate for the climate in Ho Chi Min City.

• Shading should not reduce ventilation capability, make sure that shading elements allow for ventilation and day lighting.

• avoid overheating of unused rooms of your house, the heat will travel to occupied areas and cause discomfort and cooling loads. Make sure that exposed spaces, such as the staircase shaft are shaded and ventilated effectively.

Do-it-Yourself

• plants and greenery in the surroundings of your building will reduce the air temperature outside through shading and evaporation. Cooler air around the building will reduce the thermal loads on the building and will provide cooler air for the ventilation. Extensively plant trees and bushes in the front yard, the back garden.



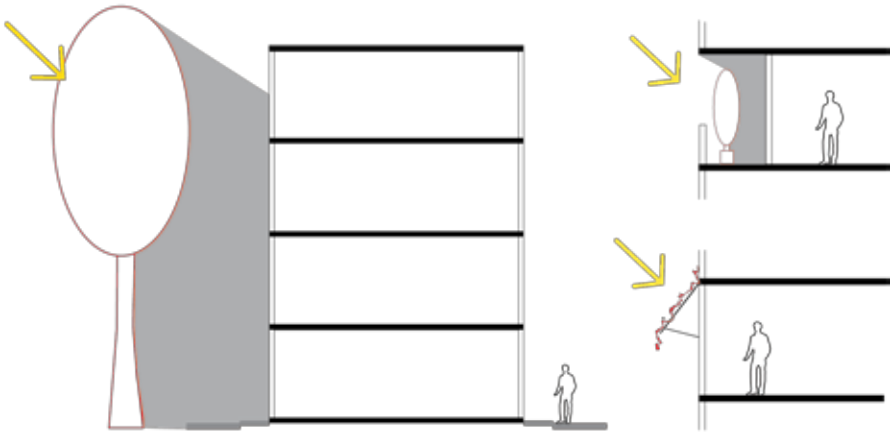
Plants and greenery at the balcony (Source: Linh 2010)

Save Money

• Constructive shading is robust and effective to reduce the cooling loads inside.

• Daylight is most effective and comfortable for lighting, make sure shading, ventilation and daylight is possible.

• Always close the shades, when you are not at home.



Green façade concepts (Source: Hesse 2009)

Solar pavilion with full sun protection TU Darmstadt / Germany
(Source: Hegger, 2007)

Heat buffer zone
(Source: Hegger, 2007)

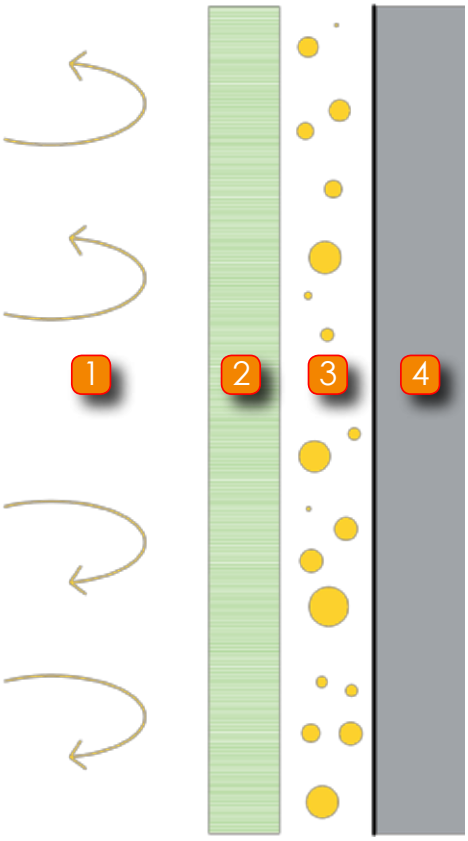
Green façade technology
(Source: Browne 2004)

1. Heat radiation (outside)

2. Vertical greenery

3. Space for air circulation

4. Wall (inside)



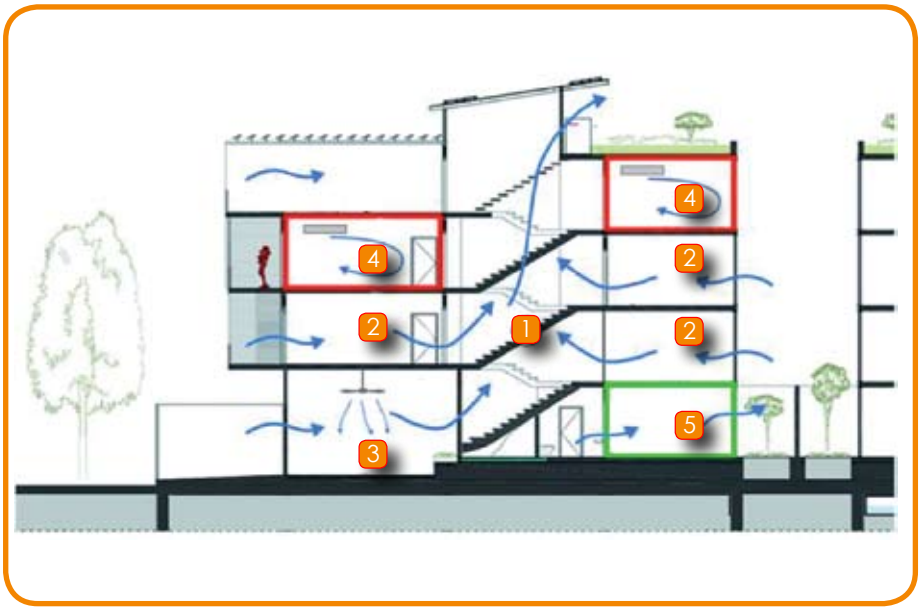
Construction detail (Source: Hesse 2011)

Sun shutters
(Source: TUD archives, 2008)

Example from Chile
(Source: Browne, 2004)

Example form HCMC
(Source: Waibel, 2011)

4 Ventilation and cooling



Natural ventilation of the town house (Source: Schwede, Hesse 2010)

1. Free air path to allow natural ventilation

2. Operable windows for cross ventilation

3. Air draft induced by fans

4. Closed zones with mechanical cooling

5. Separate air path in zones with loads

Introduction

Buildings in the tropical climate, such as in Ho Chi Min City, are ventilated for three reasons. Firstly to supply fresh air from the outside. Secondly to remove used air, moisture, odors and potentially harmful substances from the inside. Thirdly because a moderate air movement can create comfort in occupied spaces.

In naturally ventilated and otherwise unconditioned buildings therefore a moderate airflow is good and always helpful to create thermal comfort and indoor air quality. This is true in Ho Chi Min City in most of the time.

However in conditioned spaces, where the indoor air is treated through mechanical systems air exchange with the outside should be controlled and reduced as much as possible not to lose the energy previously applied for conditioning. The hygienic fresh air demand of occupants in homes and also the air exchange to remove used air and odors from the building is rather low compared to the air flow in naturally ventilated buildings. For air quality reasons it is not necessary to maintain a large natural airflow all of the time.

Design Principles

Since natural ventilation is a very effective, energy-efficient and often pleasant way to create comfort in homes in the hot and humid climate, this mode should be made possible by design also in new buildings and utilized as much as possible.

Large ventilation openings and a free air path through a shaft to drive the air flow needs to be designed, but this air path needs to be able to be shut in times mechanical conditioning is utilized. Zoning of the building into conditioned and not conditioned areas in a hybrid venti-

lation concept is a good way to secure and to maximize comfort in an energy-efficient manner.

Where air draft cannot be achieved naturally, moderate air movement can be driven by fans to create and to enhance thermal comfort. This is true in situations with natural ventilation and also when cooling is operated.

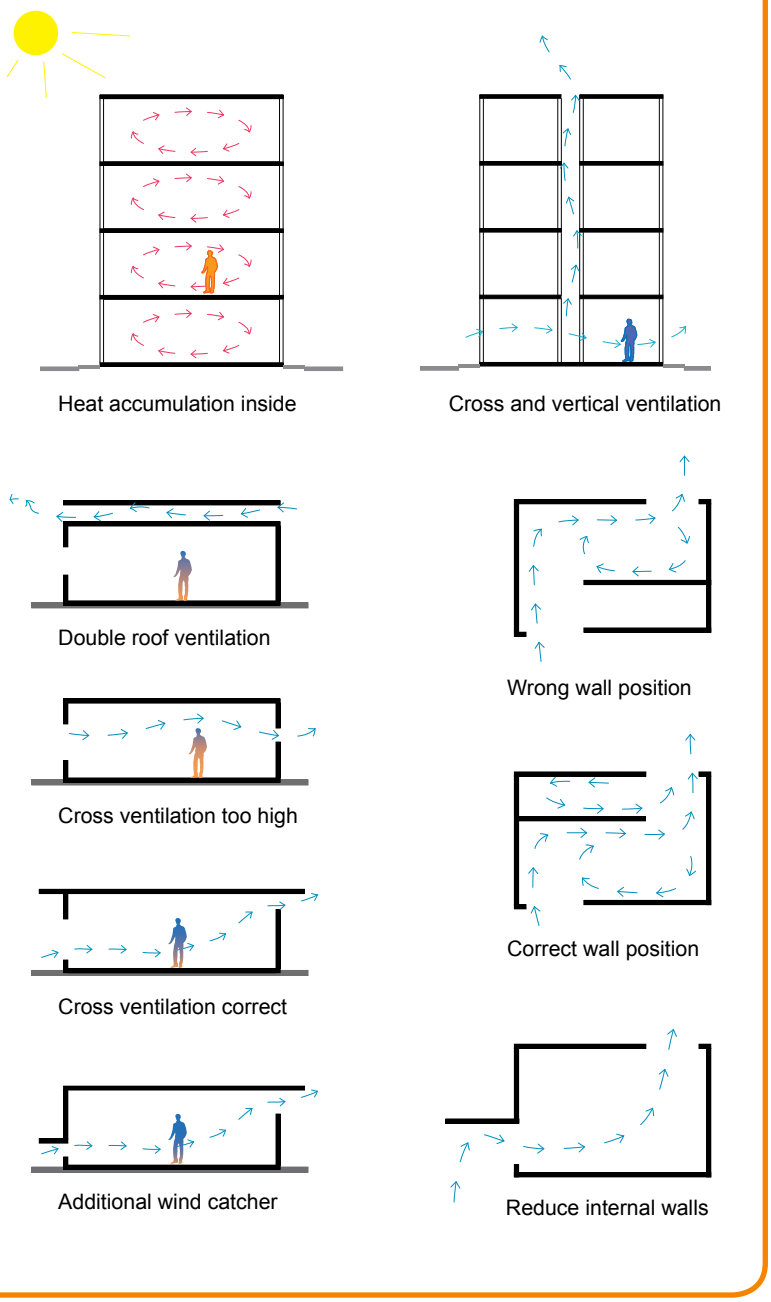
In modern buildings occupants will choose to use mechanical means of cooling. These must then be able to be controlled to meet the demand where it is needed. Energy-efficient equipment should be chosen. These are cooling systems with a high performance.

Hints

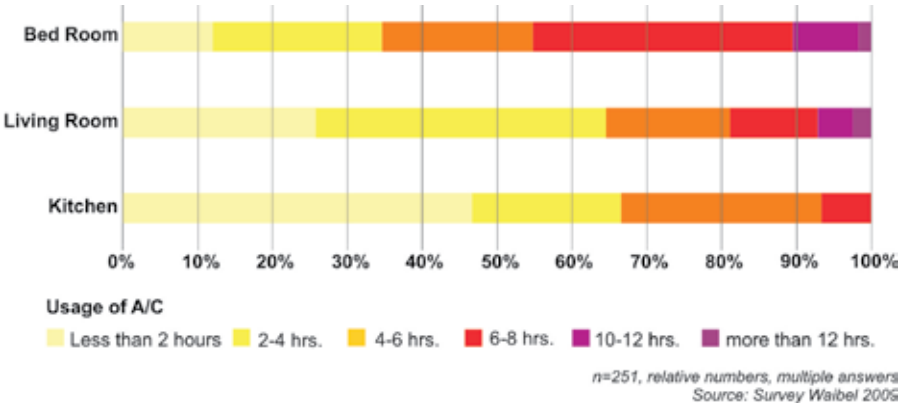
Natural ventilation

• for natural ventilation design windows and doors that are easy to open and to close. These must be large enough for sufficient air flow, but must be able to be closed tightly, when conditioning systems are in use.

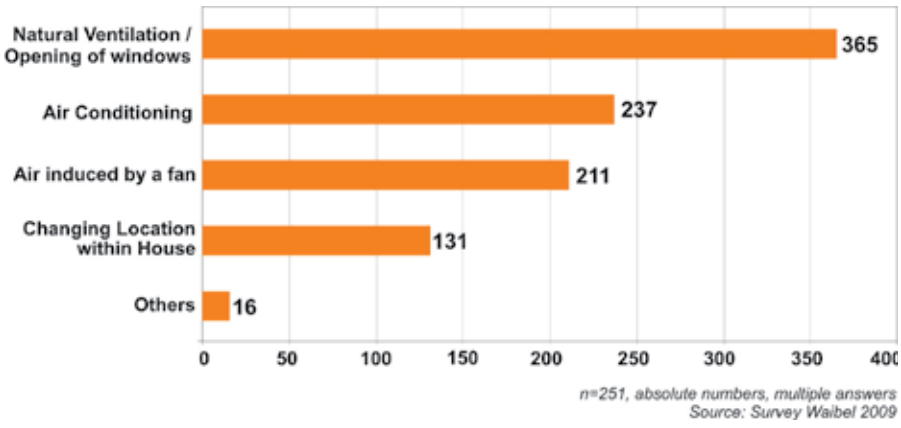
• reduce the natural air exchange between inside and outside, seal façade openings and construction.



Constructive methods of natural ventilation (Source: Hesse 2009)



Conditioning times in HCMC residential buildings (Source: Waibel 2009), A/C is mostly turned on within the bed room and actively operated by the occupants, when needed



Conditioning modes in HCMC residential buildings (Source: Waibel 2009), Natural ventilation still is the most popular mode of conditioning

Reduction of Loads

• Separate zones with high loads through internal separations walls and individual ventilation paths.

• Arrange zones with moisture loads, odors and harmful substances at the end of the air path. Design kitchens, wet rooms and other zones with loads with natural or mechanical exhaust.

• Size of rooms should be reduced through internal operable doors and separations.

• Material selection application of odorless materials and reduction of other sources of harmful substances and dust inside.

Demand Orientation

• Conditioning systems shall be designed to be operated to the demand, so that they can be switched on when needed and don't use energy, when not needed.

• Exhaust fans in wet rooms and kitchens should be designed to operate to the demand.

• Connect exhaust fans to the light switch and shut the opening tightly, when not in use.

1. Cross ventilation

2. Vertical ventilation

3. Top-hung window

4. Folding shutters

Design methods for cross ventilation inside (Source: Hesse 2010)

Interior design

• Use cool material inside, material with high thermal capacity and large conductivity will provide a cool and pleasant feeling inside.

Do-it-Yourself

• Plants and greenery in the surroundings of your building will reduce the air temperature outside through shading and evaporation. Cooler air around the building will reduce the thermal loads on the building and will provide cooler air for the ventilation. Extensively plant trees and bushes in the front yard, the back garden.

• Use fans (eg. ceiling fans, or wall mounted fans) to induce air draft. Also when air is conditioned moderate air draft is supporting thermal comfort. Provide fans as semi-natural and energy-efficient way of comfort conditioning.

• Create spaces in your home to “find” comfort without conditioning. These are shaded places with natural air draft, cool material and light and comfortable furniture.

Pay Attention

• Air tightness of windows, doors and the wall construction is crucial to control the air exchange between inside and outside. Doors and windows must shut tightly and all gaps, cracks and joints need to be sealed.

• Air tightness of seals at windows and doors needs to maintained. Seals must be regularly replaced to secure their function.

• Ventilation openings must be designed to be operable, they must be easy to reach and to operate. They must used daily.

Save Money

• Never ever operate your air conditioning with open windows and doors. Always close doors and internal separations to only condition the space you need to use,

• Operate your air conditioning to your demand, only use it, when you are using the room,

• Never cool set your air conditioning to too low temperatures

• Operate shading and sun shutters first, to reduce the cooling demand inside.

5 Building envelope construction

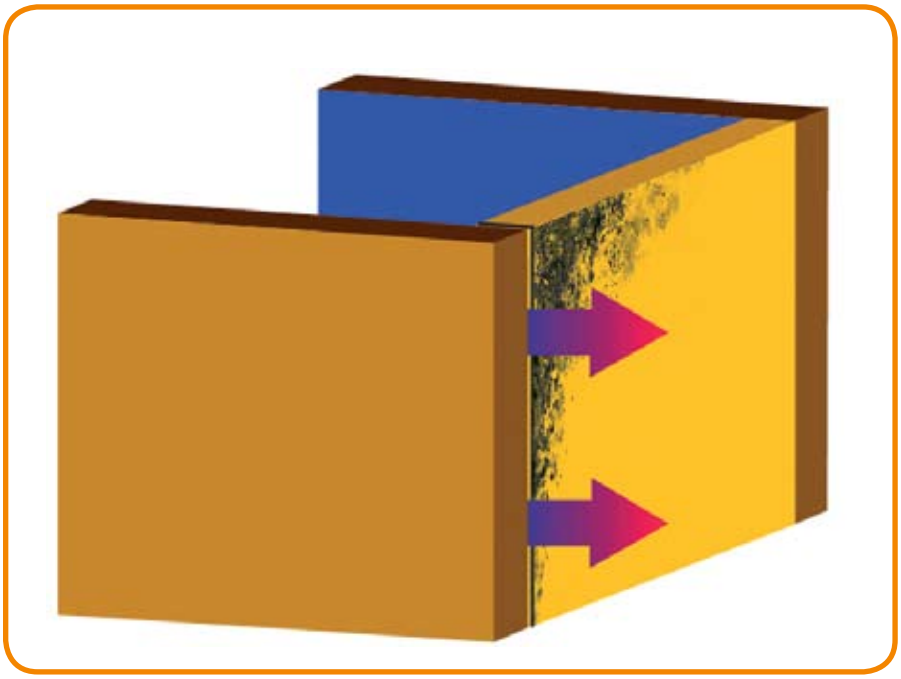
Introduction

The external envelope of a building separates the inside from the outside. It thereby protects the space inside from the influences of the physical environment, such as wind, heat, cold and rain and also other environmental events, such as flooding or sand storm. It gives privacy by protecting form views and keeping speech inside and noise outside. It also provides security from burglary and housebreaking, and protects the property of the owners.

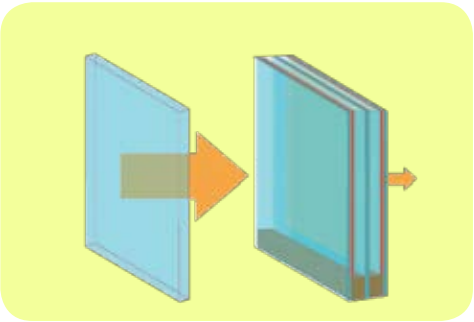
At the same time, the envelope needs to be designed to connect inside and outside for people, light, view, air and other things that are essential for the experience of the building.

Not at least, the building envelope is the face of the building, it surely serves the aesthetics and often it is designed to represent the status of the owner.

Building parts always support many of these functions and therefore they have to be designed considering all



Air path through gaps in the joint between wall, cold air convection cool the wall and causes unhealthy mildew and building damages (Source: Hesse 2010)



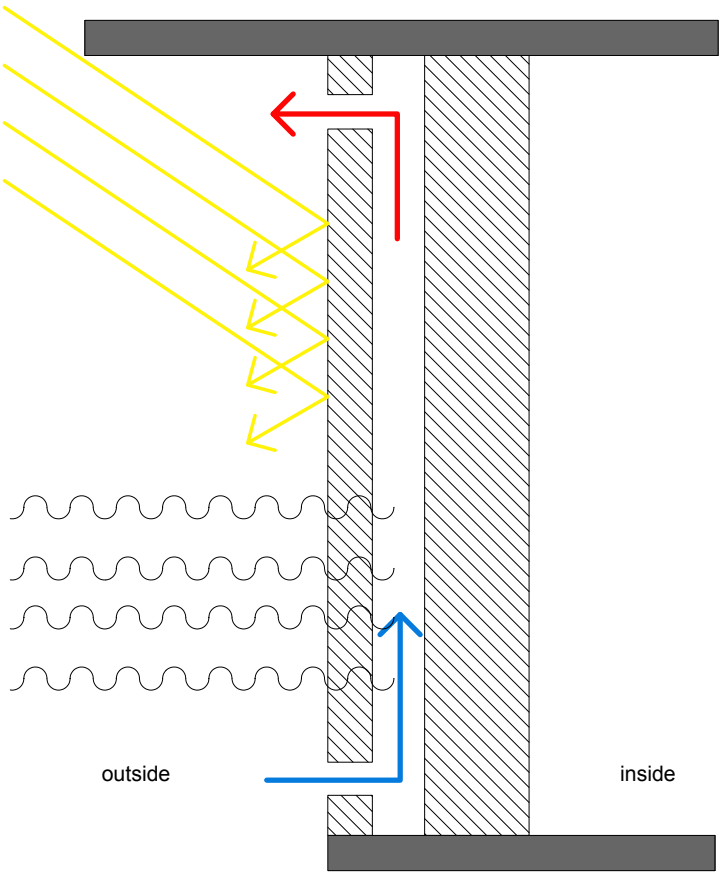
these requirements. Also, how the building parts are fitted together is determined for the function.

For example, a gap between a window frame and the wall is a weak point for wind, water intrusions and noise, even, if the building parts themselves are of high quality. Robust design of joints and good workmanship is most essential for well-functioning of the building.

Design principles

Air tightness
When building zones are cooled mechanically ventilation should be controlled. Joints of building parts should then be reduced and sealed carefully. The building should be built to maintain air tightness.

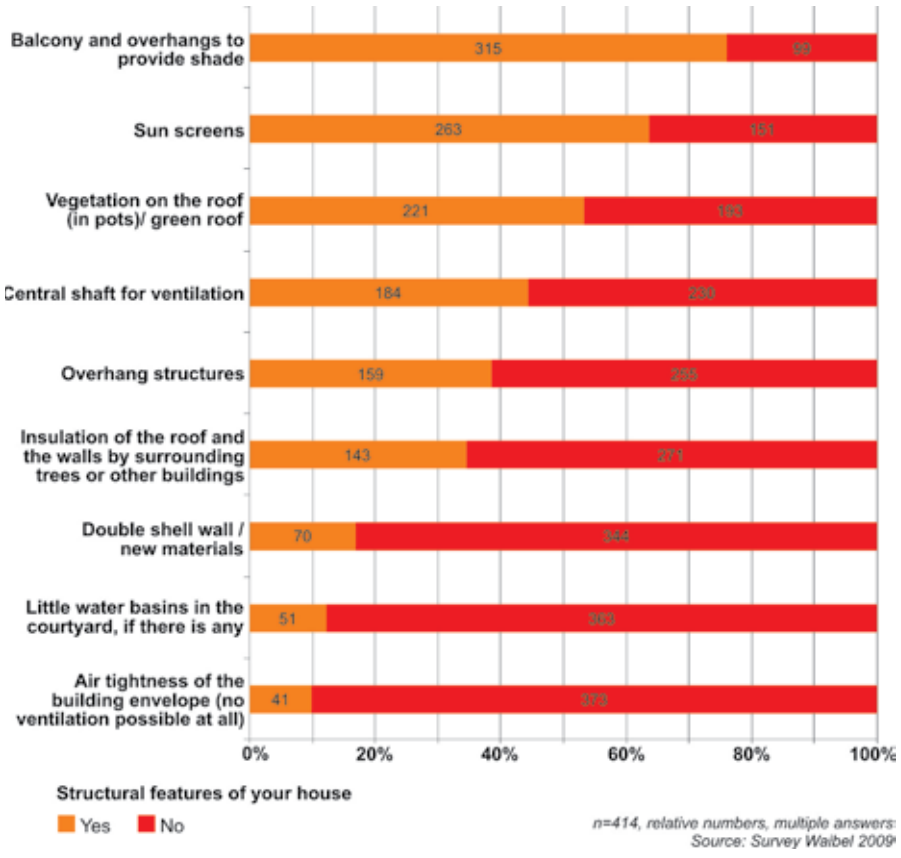
Insulation
Conduction of heat from the outside to the inside should be reduced. Material with low conductivity, such aerated concrete or lightweight bricks should be used as wall-building material. Alternatively insulation layer can be fitted in the structure,



Double-shell building envelope, to shield the sun, ventilated to prevent the heat from entering into the building (Source: Hesse 2009)

Example from a new urban development in HCMC (Source: Waibel 2010)

Town house under construction, light brick is used as insulation (Source: Waibel 2010)



Survey results about structural features of new town house projects (Source: Waibel 2009)

these then must be protected not to be damaged by water or other physical influences.

Moisture and humidity
In Ho Chi Min City climate air humidity is high and heavy rain does occur frequently. Therefore, the external building envelope should be designed to sustain moisture and humidity. Fluid water should be lead away effectively from the building envelope by constructive protective means.

Particularly, when the interior of a building is cooled to low temperatures (which should be avoided for energy-efficiency reasons), condensation of humidity in the structure shall be avoided by air- and water-vapor tight layers on the warm side of the insulation. The tightness of this layer must be maintained carefully.

Shading and screens
Since solar gains account for a large part of the cooling demand, impact of solar radiation on the building should be reduced as much as possible. Therefore, ventilated screens, overhangs and other constructive shading should be fitted to shade transparent and opaque building parts. For this purpose also additional ventilated roofs of the roof garden or the yard can be used.

Shade must always be designed to be ventilated to transport heat away from the building effectively.

Glazing
There are glazing systems with various functions. Some glazing systems protect from heat or cold, some are designed to kept solar radiation outside, while letting light in. In former times, tainted glazing was used or glazing was mirrored, today more sophisticated systems are available, which enables sun protection, natural light and view at the same time.

Pay Attention

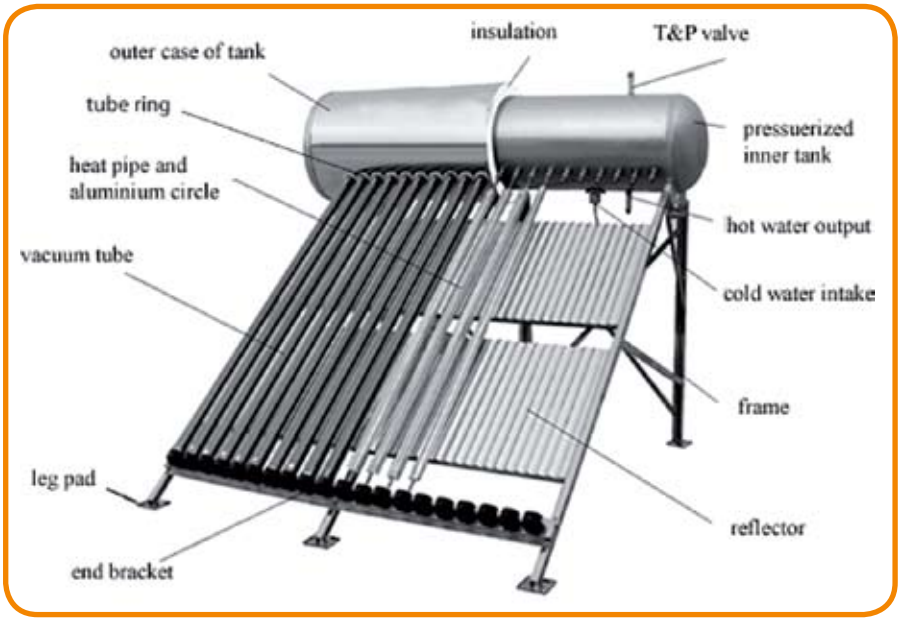
• The joints of building parts will determine the function of the building envelope, pay attention that the workmanship is neat and joints are tight for water, wind, dust and noise.

• Glazing systems are highly functional elements of the building envelop. Pay attention, when selecting glazing systems for solar protection in the design and make sure that the windows that are specified are installed during construction.

• Under hot and moist climate conditions such as in Vietnam special care must be taken to understand the building physical behavior and interaction of layers and building parts, when designing the building envelope.

Green facade (Source: Waibel 2010)

6 Hot water for little money



Components of a solar water heating device (Source: Nhien 2010)

The Principle

Solar Water Heaters (SWH) are operating under the principle of natural convection and the effects of optical glass to absorb solar energy, to convert it to heat and simultaneously traps solar heat.

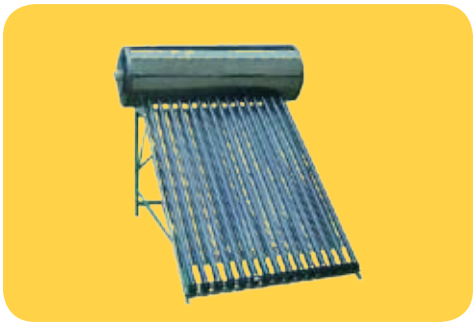
The major component of SWH is the solar collector. This is a device, which absorbs the incoming solar radiation, converts it into heat, and transfers this heat to water flowing through the collector.

Cold water from the lower part of the storage tank is going through the solar water heater where sunlight is transformed into heat that warms the water. The warmed water reenters at the upper part of the storage tank. This process occurs continuously until the average temperature in the tank is as same as the temperature of the water absorbed in the device. The generated hot water does not depend on the environment temperature that depends on your ability to absorb heat energy equipment with radiation sunlight.

There are three main types of heat pipes:

1) The plastic pipe type.
   It is cheap but the heat efficiency is not very high. However, this type can be used in the tropical climate of South Vietnam.
2) The glass vacuum tube.
   It has an average price, but it has been less frequently installed, so far.
3) The copper tube type.
   It is highly efficient and durable, but more expensive.

SWH performance of glass vacuum tube is recorded as higher than the SWH flat plate, but the pressure resistant, heat-shock tolerance and mechanical strength is not as good as SWH flat plate.



Design principles / Installation

• The system must be put in place to get the sun and it should not be hidden by other things.

• The system must maintain a stable water supply.

• As medium to transport the hot water, PPR plastic pipes should be used. But also metal pipes and in some cases - if the pipes are not too long - PVC also offer sufficient quality to secure the flow of hot water.

Hints

• Choose solar water heater with standard DIN EN 12975 and ISO 9459-5.

• You should install the solar collector to the south west angling 15 degrees is best, about 25-30 degree angle above the horizontal.

• Select an average volume of insulation in accordance with the quantity of people in the family to use. Systems with a capacity of about 200 liters should sufficient to serve a family of 5 people.

• Design the output pipe as short as possible.

• One day after installation, users should carefully check the entire system again. If if it is leaking, the seller is obliged to repair it immediately.

Examples of solar water heater use in HCMC (Source: Cüce 2011)

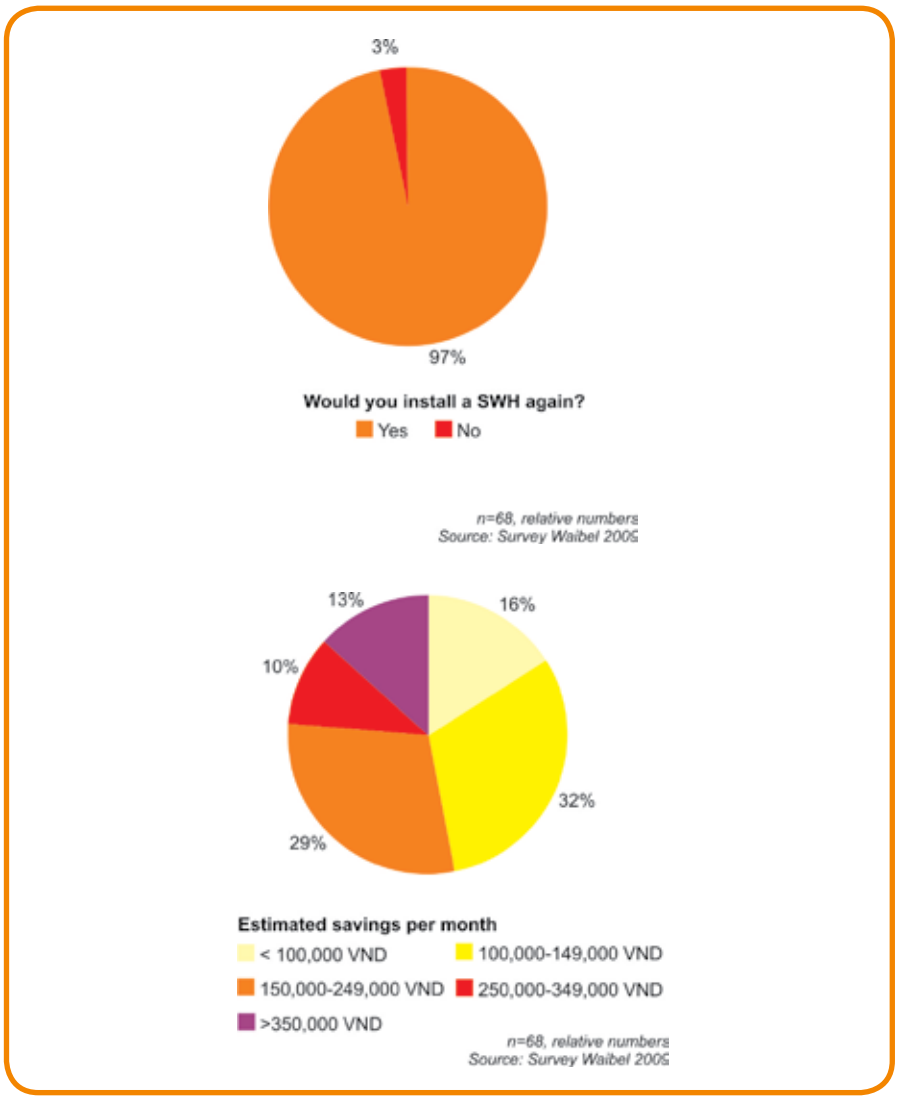
Pay Attention

• In South Vietnam, the tropical climate can provide hot water for 365 days. The sub-tropical climate predominant in Northern Vietnam cannot achieve such a total security. To improve this situation, the users should consider to select a SWH with a larger capacity to store hot water in case there is no sunlight for longer period of days.

What shouldn't be done

• Do not use the pump directly at the tank insulation. If pumping directly, following things can happen: the break of the vacuum tube of energy tank or cold water goes down to the output way of the insulation tank.

• If there is the danger, that water inside the system is contaminated or polluted, you should not the use solar water heater anymore but exchange thewater. Otherwise you risk corrosion of the water tank, this can affect a stainless steel tank.



Survey results concerning the installation of solar water heating technology (Source: Waibel 2009); The overwhelming majority of the people, who possess a solar water heater would install it again; The survey shows that people, who have a solar water heater, mostly save between 100,000 and 250,000 VND per month

Save Money

• The application of solar water heaters can save about 944 kWh per household (average household of 4 people).

• Pay back time is usually only about 4.4 to 5.6 years, it can even go down to 2 years (for a device with 150 litres capacity) under optimal conditions.

• The use of solar water heaters contributes directly to reduced power consumption during the peak hours.

Alternative solar water heater systems (Source: Nhien 2010)

7 Attitudes and actions of users

Introduction

Let's take a look at what changes you can make in your house on a room by room basis.

Although energy efficient appliances, environmental friendly building materials, and the overall building structure are great ways to reduce your environmental impact and maximize savings, key changes in user behaviour can have a huge and lasting impact both on the environment and on your wallet.

Simple changes in individual user behavior are some of the easiest steps you can take and, when combined, they can have an enormous overall impact. Ultimately, how green your house is depends on you.

The kitchen

The kitchen is one of the busiest rooms in the house and therefore one of the areas with the biggest energy and water use.

However, there are many simple ways to change kitchen habits and help conserve resources.

Energy saving possiblities in a typical kitchen (Source: Live & Learn 2011)

1

Wash dishes in a tub filled with warm soap water and rinse them in a tub filled with cold water. This easy change could reduce your kitchen water use by half.

Reuse the water used to wash fruits and vegetables to water your garden and plants.

2

Reuse all plastic bags either for storage or as trash bags.

Keep two trashcans: one for organic material and one for all other waste (if possible separate paper and plastic for further reuse and recycling).

Reuse organic material to help fertilize your plants and garden.

3

Use the smallest pot necessary when cooking as smaller pots take less time to heat up.

Put a lid on pots when heating water. This traps the heat and helps food cook quickly.

4

Check to see if your refrigerator door seals well. Take a piece of paper and close the refrigerator door on it. If you can pull it out easily then you need to reseal the door or clean the seal.

5

Dust the refrigerator's condenser coils once a month. They are normally located at the back or bottom of the refrigerator. Unplug the refrigerator before cleaning.

6

Leave space between the refrigerator and the wall and place it away from heat sources. This helps the refrigerator need to work less and therefore use less energy.

Allow food to cool down before you put it in the refrigerator and cover all the food and liquids.

Steps to reducing your environmental impact in your living room (Source: Live & Learn 2011)

The living room

The living room is the central hang-out area for friends and family and the bedroom is a place of comfort.

In both areas, there are many easy steps you can take to reduce your environmental impact while maintaining the same level of comfort and utility.

1

Use a fan and feel up to 3°C cooler.

Fans use less energy than an air conditioner and reduce energy consumption. Turn fans off when you are not in the room.

2

Close shutters and blinds during the day to help keep your house cool. Sunlight coming in through windows without shades can be the cause of up to 20% of your energy bill.

3

Leave your windows open instead of using A/C when it's cool outside.

4

Unplug electronics when not in use or use a power strip as a central "turn off" point for all electronics.

Stand-by power, the energy that is used when appliances are turned "off" but left plugged in, can account for up to 10% of your home energy use.

5

Use task lighting and natural light as opposed to full-room lighting.

Place lamps in the corners of each room to help reflect light and minimize lighting energy costs.

6

Turn off all lights, air conditioners, fans and power strips whenever you leave the room.

The bed room (Source: Live & Learn 2011)

The bed room

1

Place your air conditioner away from direct sunlight. Set your air conditioner to a higher temperature. Try to keep it at or above 26 ˚C.

For each 1°C increase in air conditioner temperature, you can save 7% in energy. Check to make sure it is the correct size for the room when buying a new air conditioner.

2

Never install your air-conditioner directly above the position of your head during sleeping time. It's unhealthy. You should install the air conditioner above your window at the side of your bed. Use the sleep mode and set your air conditioner to switch off half an hour after you go to bed.

Turn the air conditioner completely off when you are out of the house, even if it is only for a short while.

3

Change your light bulbs to LEDs or CFLs (compact fluorescent). CFLs provide the same amount of light as regular bulbs, use one-fourth the energy and last up to 10 times longer, potentially saving you up to 66% energy over their lifetime. LEDs will save you even more.

4

Charge your mobile phone as soon as you get home instead of leaving it plugged in all night.

5

Paint the walls of each room with a light color. Darker walls absorb light and require more lighting, and therefore more energy, in order to light the room.

Your bathroom offers much potential to save energy (Source: Live & Learn 2011)

4

Install a low-flow shower head and save approximately three litres of water every time you shower. If you cannot find a low-flow shower head, simply do not turn your water to full pressure.

5

Buy toilet paper that uses recycled paper and does not include bleach.

The bathroom

The bathroom is one of the largest sources of water use in a house.

Simply by being aware of our water use habits and by making small changes, we can save water and money as well as help protect the environment.

1

Turn off the faucet when brushing your teeth, washing your face, or shaving. This can save 7-12 litres of water per minute.

2

Check for faucet leaks and immediately repair any found. A single faucet that leaks one drop per second can waste over 945 litres per month not to mention the added energy costs.

3

Install a solar water heater if possible. If not, only turn your water heater on for 5-7 minutes at a time and turn off when not in use.

Electricity used to heat water is one of the largest sources of energy use in a household.

Bathroom (Source: Live & Learn 2011)

Make good use of your roof terrace! (Source: Linh 2010)

Make your roof or balcony into a green area by planting a garden.

Green roofs are a great place to grow your own vegetables and are known to have a significant environmental impact on your building, your house, and your city.

Green roofs and courtyards

- Reduce the temperature both through out the city and in your house, decreasing your household energy consumption and saving you money.
- Decrease levels of CO, NO2, O3, PM10, and SO2,
- Reduce CO2 emissions,
- Last twice as long as a normal roof.

Plants in the house are another great way to moderate temperature, improve air quality, reduce energy costs and create a better living environment.

Visit a website to learn how to plant vegetables on your terrace or balcony:

http://rausach.com.vn
http://khuyennongvn.gov.vn

Green courtyard in front of the kitchen (Source: Linh 2010)

8 Efficient equipment

Introduction

The amount of energy used for mechanical services in your house depends to a large extent on the quality of appliances, their technical state and also the fit between your needs and their performance.

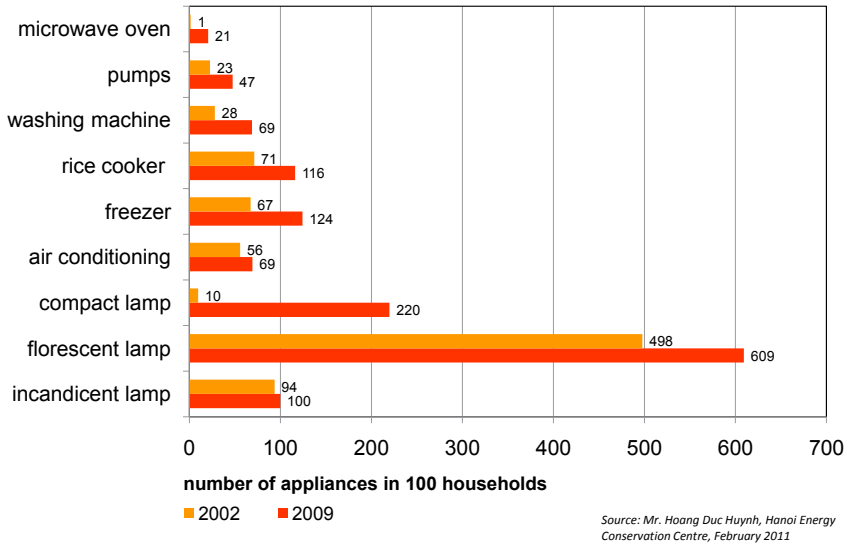
Some appliances are better than other, when they are built, due to the design and the technology used. In some cases efficiency deteriorates in operation due to lack of maintenance and wrong operation. When appliances run longer or different than required, they consume more energy and hence are inefficient.

The number of electrical appliances in your house is constantly rising and each piece of equipment consumes more energy and increases the cost, even if energy-efficient appliances are used.

Labeling Schemes

Energy saving by selecting energy-efficient appliances is easy, when you know how to identify efficient equipment. Energy-efficiency can be compared based today based on label capacity and performance.

However, a more obvious energy efficiency labeling scheme for the main home appliances such as light



Increase of number of electrical appliances in 100 households in Vietnam. With the number also energy consumption rises no matter how efficient these devices are (Source: Mr. Hoang Duc Huynh, Hanoi Energy Conservation Centre, February 2011)

bulbs and lighting ballast, air conditioning units and domestic hot water heaters are currently introduced in Vietnam, too. Such schemes are well-known and effective in many countries around the word. There will be two types of labels in Vietnam:

(1) comparative label, to compare performance of different units.

(2) certification labels, to identify best performers on first sight. At the same time, the program intents to disqualify appliances, in case they do not reach a minimum performance.

But also the way you use and place the equipment will help to save energy:

• Don't use too many light bulbs, since it does not make you see better.

• Place the condenser unit of conditioning systems in a shaded, cold and well ventilated place, so that it can expel the heat efficiently.

• Limit the operation time of electrical hot water heaters, there is no use to keep water hot all day if you only take a shower in the morning. Regular maintenance is very important to operate appliances efficiently and to keep them in a good state, for a long time.

Examples of the Vietnam Energy Label
(Source: Nhien 2011)

Hints

When you buy household appliances for your home make sure:

• Think twice before buying new appliances

• To choose the most suitable for your purpose

• That the device is able to be controlled to your needs

• That is can be switched on, when it is needed and switched off, when not needed

• That is does not consume energy in stand-by mode

• Always look for appliances with energy rating (or at least energy specification)

• Always chose a high energy rating and label performance

• Make sure you know how to use it, read the instructions for optimal operation

• Ask and discuss energy-efficiency with the sales person and the installation company

• Maintain your equipment well (change and clean filters, etc.)

Do-it-Yourself

• Use electrical appliances wisely

• Fit timers to reduce operation times

• Change filters of conditioning and ventilation systems in regular terms (it is easy and effective to save energy cost)

Pay Attention

A good way to find high performing appliances is to look for energy labels. In the past, American and European energy-efficiency labels could be found in Vietnam for electrical appliances. The Vietnamese Government has now introduced a own labeling scheme, which is more adapted to the local conditions.

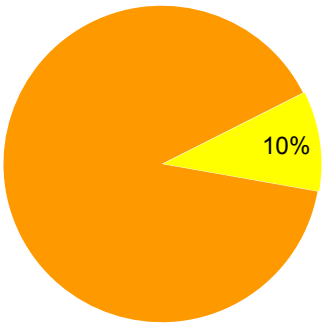
However it is still in the process of being developed (Vietnam Energy Star Label), but labels for fans and light bulbs and labels for air conditioning units, heaters for domestic hot water and other house appliances will be introduced in next couple of years. Don't wait, but be wise before.

Save Money

Did you know that an energy-efficient light bulb does consume about 70% less electricity? That can result in savings of your total energy bill of 10% or about 55.000 VND. This is in average about 0.5% of the available household income.

Since there is no energy-efficiency labeling yet for air conditioning, the EER rating (energy-efficiency rating) in the specification is instructive to assess the energy efficiency of the air-conditioning device.

There are products in the Vietnamese market readily available with efficiencies in the range of 2.3 to 3.6. (source: Pilot Program on Energy Performance Labeling and Minimum Energy Performance Standards for Air-Conditioners, Report on Task 3, March 2009).



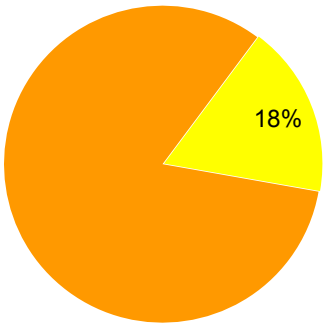
energy cost saving of total monthly energy bill through more efficient **lighting technology**

conventional 536.200VND/month
energy-efficient 481.400VND/month

source: Schwede, 2011
calculation from simualtion results

With an average electricity consumption of 370kWh/month the energy bill is about 536.200 VND/month in a house with low-efficient lighting equipment 10% or 55.000 VND energy cost can be saved, through installation of energy-efficient lighting. With an average available household income of 10.000.000VND (500US$), this accounts for about 0.5% of the available household income. (Source: Schwede 2011)

Compact florescent lamp and incandescent lamps (Source: Schwede 2011)



energy cost saving of total monthly energy bill through more efficient **air conditioning units**

EER = 2.3 536.200VND/month
EER = 3.6 442.000VND/month

source: Schwede, 2011
calculation from simualtion results

With an average electricity consumption of 370kWh/month the energy bill is about 536.200 VND/month in a house with low-efficient room-AC-units 17% or 94.000 VND energy cost can be saved. With an average available household income of 10.000.000VND (500US$), this accounts for about 1% of the available household income.
(Source: Schwede 2011)

9 Construction methods and environmental friendly materials

introduction

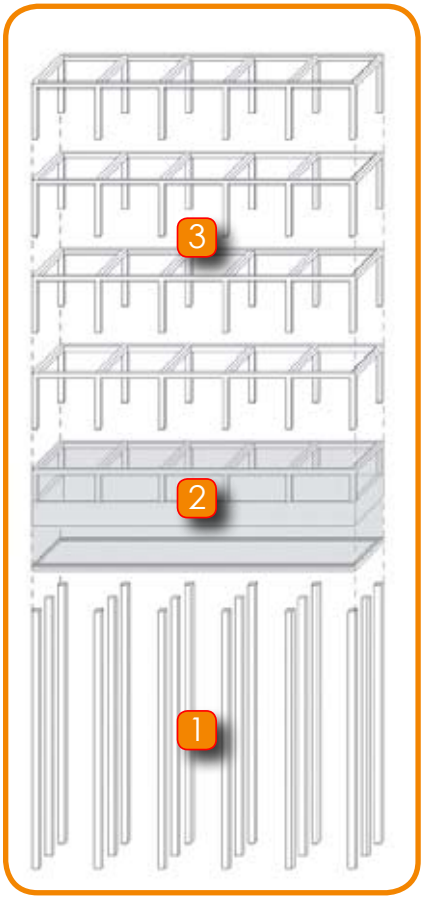
There is an enormous potential in rethinking the construction methods and use of materials of your town house. The following suggestions should help you to increase the quality and life span of our building, while saving energy and money.

Design Principles

Choosing the tradition of the skeleton frame as the supporting structure you get the possibility of being free and flexible in creating the floor plan as well as approaching a basis of an economical and ecological system. The frame should be regarded as some kind of three-dimensional construction kit to make your living space universal and individual at the same time.

By standardizing the process it is possible to lower the costs enormously. Adjusting the frame back and forward allows construction methods of cantilevers that provide a simple way of sun protection. Shaped and staggered like terraces overhangs like balconies or canopies are extremely effective.

In order to keep cool temperature inside, stressing the air-conditioning system less and preventing a temperature gradient, the infill of the skeleton framework comes along with an insulation layer. As a consequence mould formation on the walls is prevented, which otherwise could be harmful to your health.



Skeleton structure of the town house
(Source: Hesse, 2009)

1. Foundation piles

2. Water proof floor slab (white tank)

3. Skeleton frame work

The walls of the town house are made of bricks without any chemical substances or harmful evaporation. Improving this traditional building material can easily fulfil modern aspirations.

There are environmental friendly bricks made of clay or fly ash in Vietnam. The fly-ash-brick consists of 50 percent soil, 20 percent sand, 10 percent cement and consolidator. Not only the materials reduce your costs, also the method of producing the product is efficient. The brick doesn't have to be burnt at large energy use so there is no emission of carbon dioxide. With a low consumption of energy it only has to be pressed and dried over two weeks.

Examples of different fly ash bricks
(Source: The Modern Green 2010)

The material bamboo can be used in several ways. shutters, blinds, doors and the frames of the windows can be made of this advantageous material. In compressed form it is an extremely tough and durable material and can even be used in bathrooms or outside.

The advantages are convincing. It has got an outstanding growth rate, it is a local wood meaning it is available at low cost and has less impact of carbon emission on the environment resulting from a short transport. Bamboo absorbs carbon dioxide in huge amounts and produces more oxygen than most other plants.

Bamboo floor panel by The Bamboo Factory, Vietnam
(Source: www. thebamboofactory.com)

Be aware that there can be a huge difference between qualities of windows. The ordinarily used aluminium framed window with one layer windowpane is one of the biggest temperature leaks in the house. By choosing a wooden frame with a double or even triple-glazed window the cool air inside can be kept at a constant temperature. Also the aluminium as the main material of the frame can cause several problems. Mainly it exchanges temperature very well transmitting heat into the inside. Although it is completely recyclable it requires a massive amount of energy to be produced. During the production of 1 kilogram aluminium, 8,5 kilogram carbon dioxide are being released.

Section of window
(Source: Euro-window, HCMC, Vietnam)

In former times and still today tainted and mirrored glazing was applied to keep the sun out. Today glazing systems can also be equipped with invisible coatings, that are effective to reduce the solar gains to the room, while letting natural light in. The heat gain through the windows must be observed when ordering windows, particularly if constructive shading is not effective.

1. Top-hung window

2. Insulated frame

3. Double glazing

A key aspect of sustainable building material is to minimize the use of toxic chemicals. You should avoid the risk of harmful outgases from plastics, paints, varnishes, carpets, formaldehyde-infused wood. For the coating of the walls, we recommend water-based paint without chemical thinner. Alternatively, shiny-polished stucco is cheap and makes maintenance much easier. You can clean the wall with a sponge and it can last for years without repainting.

Remember, an eco-house in not just about low energy, it should be about easy maintenance. Of course, there are also nontoxic plastics that are useful. For instance roof tiles can be made out of recycled lightweight plastics.

A very special “material” is the living plant. It can be attached on the exterior to help creating a buffer zone casting shadow and preconditioning the inflowing air and in the interior alongside the airflow by adiabatic cooling. Within a highly polluted city like Ho Chi Minh the advantages are obvious. The living plants drain the fine particles out of the air converting carbon dioxide to oxygen and bringing out cleaner air. The overall increased utilization of green leads to a more healthful climate in the city for all.

Hints

• Choose a basic frame work construction that allows free and flexible floor plans

• Design canopies or balconies that provide shade

• Use a double shell construction in cases where constructive shading is not possible

• Creating larger openings for windows and doors for better cross ventilation

• Use local building materials like fly ash bricks or compressed bamboo

• Minimize the use of materials with toxic chemicals

• Use constructions methods and materials that are easy to maintain and durable

1. Green wall and balcony plants

2. Vegetables and herbs

3. Green roof construction

4. Sun protection panels

5. Solar or photovoltaic systems

6. Trees, bushes and bamboo

Productive green roof garden (Source: Hesse, 2011)

Do-it-Yourself

• Prove the gaps between the walls and the windows. Leaking air means leaking energy and also leaking money. There are several eco-friendly sealing foams available which are considered sustainable not only by their feature to improve the energy footprint but also by their composition consisting of renewable or recycled substances.

• Use plants for shading, cooling, filtering and oxygen production

Section of a typical town house (Source: Hesse, 2011)

Pay Attention

• Take care that cantilevering components are insulated in order to avoid thermal bridges.

• Keep in mind that when dividing the house into separate cooling zones, you also might have to work with its varying construction demands.

• Take care of keeping the house in the main part open-spaced for natural ventilation; you have to keep the air-conditioned parts insulated on the other hand.

• It is important to use thermal insulting walls or windows even inside of your house.

1. Water proof basis of the skeleton structure

2. Wall made of fly ash bricks

3. Facade insulation system

4. Bamboo floor and wall panels

5. Double glazing insulation window

6. Non-toxic paint

7. Productive green roof garden

10 Flooding Prevention

Introduction

Flooding events have increased in terms of frequency and intensity in Ho Chi Minh City in the recent years. The urban hydrogeology regime is not only affected by tidal flooding, but also by increasing heavy rain events and flooding from upstream areas.

However, HCMC's environmental threats are mostly the result of both climate change and urban development. Houses and neighbourhoods are often not properly designed to ensure onsite rain water retention respectively infiltration and to provide an effective sewer system to drain high peaks of water. The increase of impervious soil coverage by the rapid urbanization on former retention and infiltration areas lead to a reduced drainage and storage capacity for flood and
rain water. A high groundwater level and an insufficient and mostly polluted sewer system cause backwater and retard the water run-off. Flooding disperses the wastewater from sewerage, which causes water pollution, epidemic diseases, damage to houses and infrastructures. Flooding due to tide also causes salinity intrusion, which damages crops and plants.

Options for flooding prevention
Generally, the problem of flooding has to be tackled effectively on a larger scale (city and regional-scale) with a well-balanced strategy of different engineered options like the construction of dykes and embankments, or the protection of wetlands and flood plains. However, in the following some basic options are given on how to adapt to flooding at the scale of buildings and neighbourhoods.

	Neighborhood Scale	Building Scale
 Elevation above flood level	Raising the level of alleys and/ or building blocks	Levelling the basement/ ground floor of the house
 Dry flood proofing constructions	Permanent (dykes) or temporary (flood walls) water defences	Permanent or temporary water proof floors
 Wet flood proofing constructions	Water resistant streets with floodsafe escape routes	Water resistant ground floors with temporary uses
 Other techniques		Dyke and drainage pipe Water pump

Overview on suggested flood protection measures (Compilation: Eckert 2011)

Raising the level of alleys and/ or building blocks

The elevation of complete neighbourhoods or building blocks by land filling is a common practice for new housing developments in HCMC. Within existing neighbourhoods you can raise the level of alleys, if the roadbed at your place is lower than the main streets, or lower than typical flood levels.

Elevated street and newly protected street in District 8 of HCMC
(Source: Waibel 2011; Druskath 2011)

Pay Attention

You should discuss with authorities to do this activity legally and properly following design codes and technical requirements. Water from elevated streets and blocks run off to the surrounding areas and will affect neighbouring housing areas even more.

Do-it-Yourself

Levelling the basement/ ground floor of the house

If your house's basement or ground floor are lower than the main street, or typical flood levels, it is possible to raise the basement to a flood-safe level. You can do it by yourself but it is cost-intensive and you should make sure that the used materials are water resistant. Pay attention to backwater from the sewer system.

1. Lifted ground level

2. Ramps and stairs

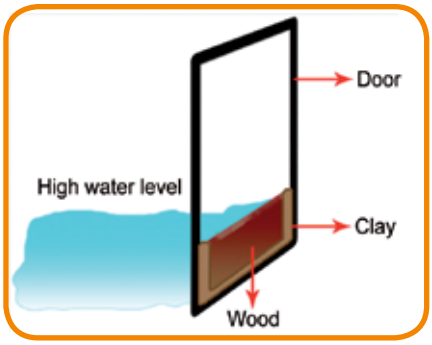
3. Shaft for flooding protection

Examples for basic individual adaptation (Source: Waibel 2011; Druskath 2011)

Save Money

Materials	Price (VND)
plank	~10,000-20,000/plank
sanbag	~50,000-100,000/bag
cement	~ 50,000-70,000/bag
brick (A)	~110,000/m²
gravel	~75,000/load
adhesive/glue	under 100,000/item

Costs for flooding protection materials (Source: Hang 2010)



Basic design to protect from water-intrusion (Source: Hang 2010)

Permanent/ temporary defences
Elevated water fronts and dykes are effective options to protect from floods permanently. However, they are cost-intensive, need a good planning and can only be implemented by city authorities. Mobile flood protection walls can be easily implemented at already built-up water fronts and can be installed by the local community in case of flooding.

Mobile flood protection walls made of dam beam systems for public realm (Source: IBS 2010)

Permanent and mobile sealing of openings (Source: ICPR 2002/www.floodpanel.com)

Permanent or temporary water proof floors
Ground floors and basements could be sealed by permanent or by mobile flood/ water resistant walls to prevent seepage. They should cover a height of at least 50 cm above the typical flood level. Permanent sealings limit the access to the building.

Ground floors could be temporary sealed by flood-proof doors/ gates. However, they are cost-intensive and need a regularly check for a proper function.

Do-it-yourself

Placing obstacles to prevent water from coming in is a cheap and suitable solution for every household. By using wooden planks or other obstacles, you can install these at the doorsteps. Adhesive can be used to install these items to fit into door frames. It is suggested to use children's wax to fill all gaps. Other possibilities to prevent floods are sandbags, stones, cement, and bricks.

Closed flood gates and opening of flood gates at the ground floor at HafenCity Hamburg

Pay Attention

- The adhesive should be detachable and reusable after use.
- Sandbags, stones, cement, brick might have bad impacts to the exterior of the house.

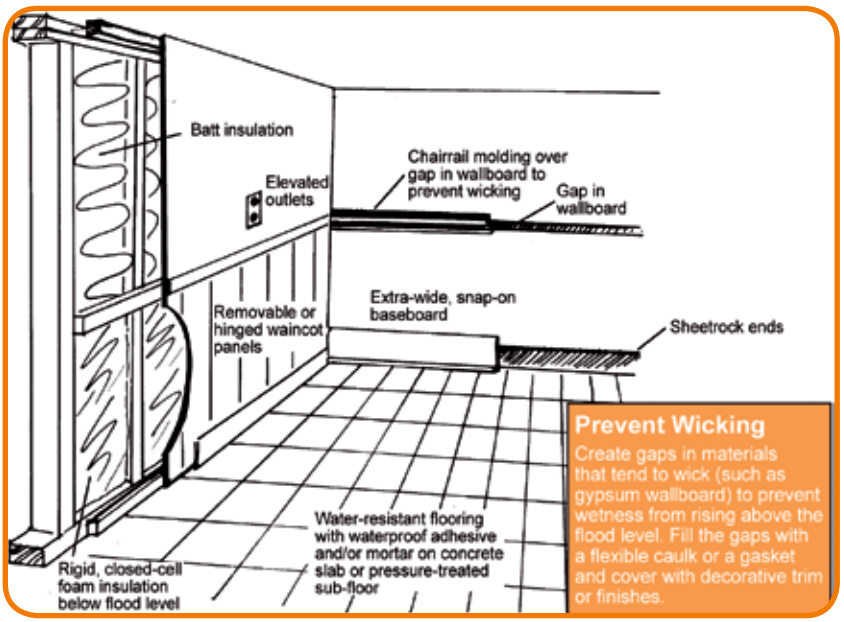
Water resistant streets with floodsafe escape routes
Streets and alleys can be constructed as temporary canals, which will store rain water during high peaks. Streets and sidewalks are not usable during flood events. Therefore, additional emergency ways on flood-safe level are needed.

Water resistant ground floors with temporary uses
Water resistant ground floors (tiling on ground and walls, electricity above flood level) with temporary uses might be flooded without any serious damage.

Permanent emergency service ways

Dyke and drainage pipe
You might build a dyke outside the house to prevent flooding. A drainage pipe is useful, if the flooding water comes up from internal manhole.

Water pump
Using a water pump is necessary if the neighbourhood is protected by a dyke, but flooding water from internal drainage system rises up during high-tide periods. A water pump used by community should be a good means to pump up water from neighbourhoods out to canals of rivers.



Wet flood-proofed walls and floors (Source: www.lsuagcenter.com)

Tubes to allow the water to flow off (Source: Hang 2010; Waibel 2011)

11 Overview: Do’s and Don’ts

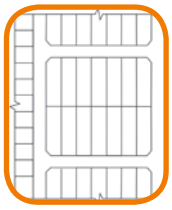
Introduction

In the following, you will find an overview of things you should pay regard to and things you should avoid in terms of climate-adapted and energy-efficient buildings related to town houses in Ho Chi Minh City.

Some of the aspects mentioned do not lie into the responsibility of you but of the local administration or developer companies. If you perceive wrong-doings do not hesitate to communicate them to the relevant agency.

Recognized experts from our cooperation partner, the HCM Department of Construction, have compiled the contents of this chapter.

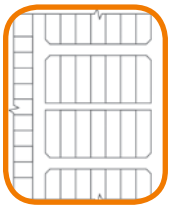
Don’t do it!



No local service corridor, no ventilation.

The messy overbuilding over a patio leads to insufficient ventilation and no convection air.

Do it!

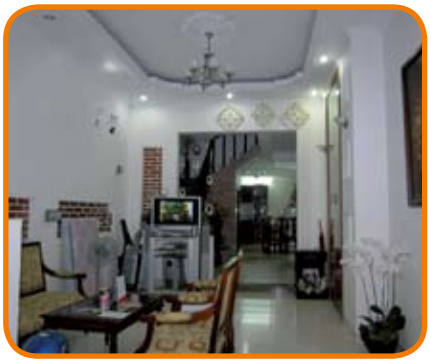


There is a local service corridor allowing ventilation between two array blocks, allowing good convection and ventilation.

By having a patio natural ventilation is increased.

Don't do it!

Theses houses do not provide over logias, balconies and sun screens. This results in increased solar heat intakes and subsequently a higher air conditioning demand.



If you don't have a patio, you get no natural light, you have to use artificial light during daytime and contribute to the waste of energy.

Do it!

These houses provide over logias, balconies and sun screens. The consequences are less solar heat intake, better air conditional efficiency and less energy waste.

A patio allows for natural light and good ventilation.

Don't do it!

With no set back area, no trees and covered patio, the houses easily get hot and contribute to a inhomogeneous urban design.

Do it!

These row houses have a setback area. Further, trees do contribute to a good micro-environment.

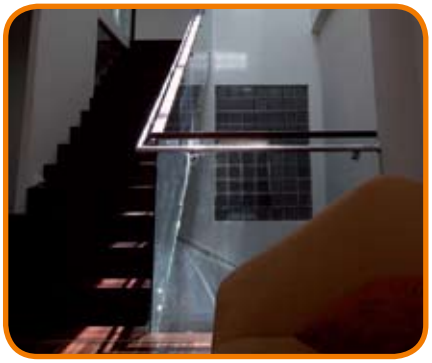
Trees on the sidewalk provide shade for the streets and pavements, reduce temperature and increase landscape value.

Besides, trees also provide additional benefits such as:

- shading of parking area along the street
- small green area could be a civic place with many community activities.

An area, which has many trees, could support business work of street vendors. In this way, many people have the chance to make use of this area and to contribute to the increase of urban vibrancy.

Don’t do it!



This patio inside lack trees, plants or a small water basin for cooling.

Roofs with no solar water heater.

Do it!

Patios with trees and green area create a good microenvironment.

You should install a solar water heater whenever it is possible.

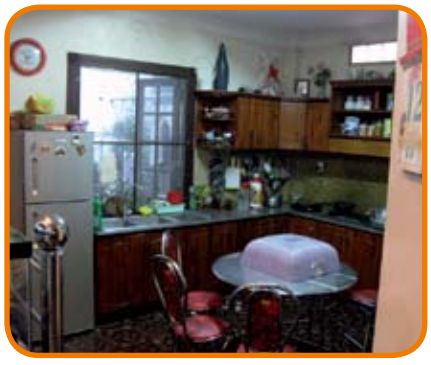
Don’t do it!

Utilizing glasses on display and air conditioning using.

Support equipment as high power such as: cooker hood.

Do it!

The combination between glass and wall-green will decrease the inside temperature.



Limit power consumption.

Don’t do it!

This picture schows, that Too many high power lights are used, which is leading to a waste energy consumption.

Do it!

You should use energy saving light bulbs.

Sources of all pictures in Chapter 11: Department of Construction, TP HCM.

12 Resources

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Going Green: A garden inside a town house (Source: Linh 2010)

Cooperation Partners

- Department of Construction (DoC), HCMC
- Vietnam Urban Development Agency (VUDA) of Ministry of Construction (MoC), Hanoi
- Housing Bureau of Ministry of Construction (MoC), Hanoi
- Ministry of Industry and Trade (MoIT), Hanoi
- Local architecture offices: NQH Architects, HCMC & Arch. Lai The Duy, HCMC
- Ho Chi Minh City University of Architecture (HCMUARC)

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Download Options

Web-site of the Megacity Research Project TP. Ho Chi Minh:

in Vietnamese language:
http://www.tu-cottbus.de/projekte/de/megacity-hcmc/urban-development/overview/2011_edition_Handbook_for_Green_Housing_VN.pdf

in English language:
http://www.tu-cottbus.de/projekte/de/megacity-hcmc/urban-development/overview/2011_edition_Handbook_for_Green_Housing_ENG.pdf

Web-site of the Vietnam National Energy Efficiency Program (VNEEP):

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in English language:
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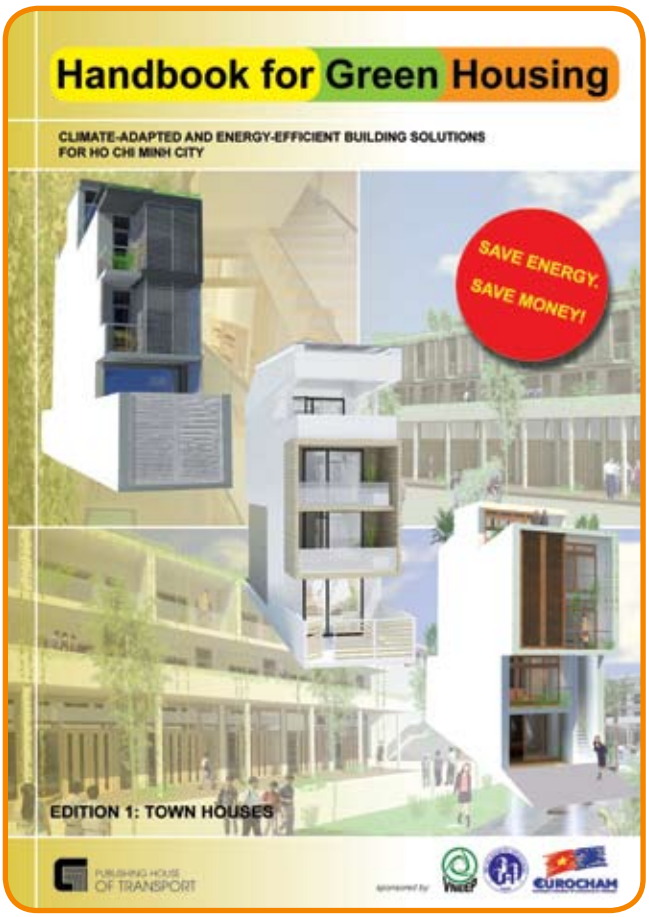

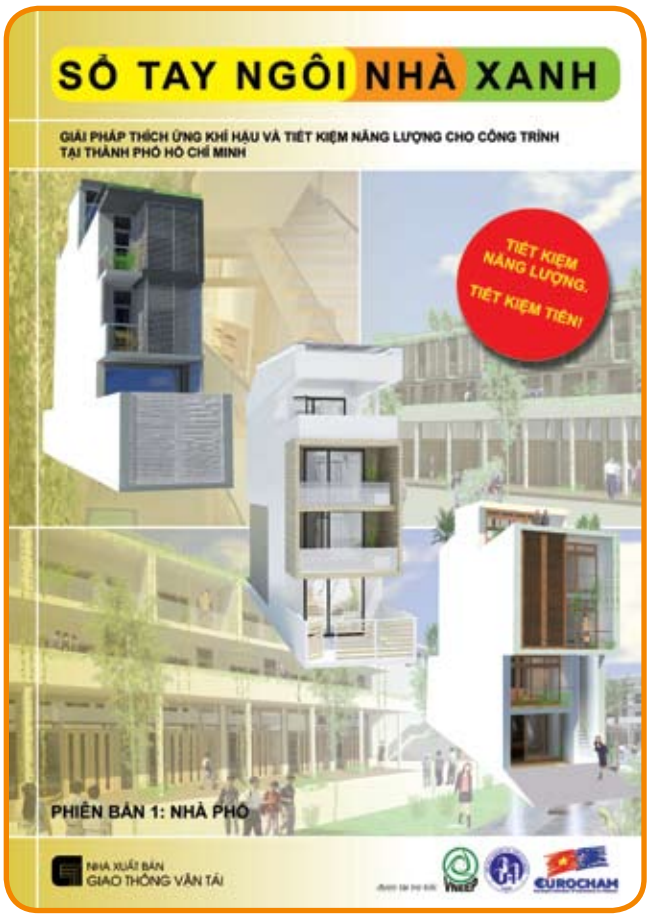

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Quyết định số 51/2011/QĐ-TTg: Quyết định quy định danh mục phương tiện, thiết bị phải dãn nhãn năng lượng, áp dụng mức hiệu suất năng lượng tối thiểu và lộ trình thực hiện do Thủ tướng Nguyễn Tấn Dũng ký ngày 12/9/2011, 5 pages.

Nghị định số 73/2011/NĐ-CP: Nghị định quy định xử phạt vi phạm hành chính về sử dụng năng lượng tiết kiệm và hiệu quả do Thủ tướng Nguyễn Tấn Dũng ký ngày 24/8/2011, 29 pages.

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