PEASANT'S DWELLING DESIGN AND SIMULATION ANALYSIS OF WIND FIELD FOR THE NORTHEAST OF THAILAND

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Abstract

In Thailand, a farmer's income is not stable, so it is a heavy burden to build a suitable and comfortable house for his family. Sufficiency economy philosophy (SEP), stresses that everyone should live with moderation. The philosophy aims to harmonize the mode of development with individual circumstances step by step. Based on SEP and farmer's situation, the authors propose a design concept based on incremental and reasonable enlargement for peasant's dwelling. Wind field simulation analysis using Flovent software showed that ventilation of the proposed dwelling gave more advantages than a normal dwelling at a lower cost. The new concept of architectural design combined with the use of ecological material would lower the building cost in favor of sustainable development for peasant's dwellings.

Keywords: Architectural design, peasant's dwelling, wind field, sustainable development

Introduction

In the old days, when peasants wanted to build a house, they usually started with a temporary structure until they had enough capital to build a more permanent structure with appropriate material. In contrast, along with modern technology development and the improvement in living standards nowadays, the peasants have gradually lost the power to build dwellings for themselves. Houses were previously built with local resources, mutual help and wisdom. Now circumstances are such that money is need for everything. A loan to build a house seems acceptable and unavoidable for people in the low-income group, especially the peasants who occupy the main proportion of Thai society.

The King of Thailand, H.M. Bhumibol Adulyadej, has reminded Thais to adopt a balanced development mode to daily life gradually in order to improve the living standards of Thais in a sustainable manner since 1974. *He said:*

"Economic development must be done step by step. It should begin with the strengthening of our economic foundation, by assuring that the majority of our population has enough to live on... Once reasonable progress has been achieved, then we should embark on the next steps, by pursuing more advanced levels of

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economic development. Here, if one focuses only on rapid economic expansion without making sure that such a plan is appropriate for our people and the condition of our country, it will inevitably result in various imbalances and eventually end up as failure or crisis as found in other countries"(Sathirathai and Piboolsravat, 2004).

This is known as sufficiency economy philosophy. The philosophy has become the guideline of sustainable development for the country.

If we were to define sufficiency living, it means independent living in an economic and uncomplicated manner that causes the minimum harm to the environment; rural people in the past seemed to live in harmony with the natural environment more than urban people. However this idea at present has perhaps changed. The tremendous rise of consumption in the villages is a phenomenon that has gradually risen, especially after the green revolution in the 1960s. The main problem in the rural development of every country is poverty, which needs job opportunities and education to solve it. To apply or encourage the self-sufficiency concept to the peasants, firstly the background problem should be understood. The concept will be acceptable only in a condition; it must be affordable, because everyone wants a house that is free of debt or at the minimum amount they could afford to pay back. From this requirement, dwelling construction in the rural areas should be ecological, economical and exercisable in practice.

Objective, Concept, Method and Scope of Study

Objective

This study proposes a peasant's dwelling design and construction guideline as one alternative for the application of SEP based on a combination of traditional wisdom, natural and local resources, and contemporary way of rural living, especially for the hot humid climate in the northeast of Thailand. It aims to seek after a realistic way to build peasant's house, which must be ecological, economical and exercisable in practice.

Incremental and Reasonable Enlargement Concept

As a house for rural conditions, it should at least provide the occupants with all necessary requirements: a functional living space that is designed based on the living pattern of people in a farming community, comfort, security, economy, as well as aesthetic appeal. So, in order to save the initial cost, time and labor of the owner, the dwelling design and construction should be based on an incremental and reasonable enlargement concept. What is the incremental and enlargement concept? That is said that peasants may build their dwelling by stages according to their affordability. The house can be incomplete or built as a shelter with a scale or size depending on available resources and each family's condition, but the occupants may move in and live normally. When they have affordability, they may continue to build other part of the dwelling. Of course, during the whole process, the living function should not be influenced, dwelling appearance should be integrated and beautiful.

Methods

1. Flovent software (Flomerics Group PLC, Hampton Court, U.K.) is a computational fluid dynamics (CFD) software that predicts 3-dimensional airflow, heat transfer and contamination distribution in and around buildings. In the study, it was used to simulate and analyze the wind field, which was one of the main factors that influence natural ventilation and the occupant's comfort in the proposed dwelling, and to compare the result with the typical dwelling style now found in this area.

2. According to the design, a real dwelling would be built in a village of Roit-Et province. Ecological materials[3] which were

[3] *Generally, ecological materials are the ones that are nontoxic, nonpolluting, sustainable and renewable They are produced with low energy, environmental impact, social costs and readily recyclable or renewable when their life spans of service are over.*

accorded with SEP were mainly used in the building, such as bamboo wattle and daubed wall, wood framework; the feasibility was checked that the design was combined with ecological material in order to ensure sustainable development of peasant' dwelling.

From the proposed design, simulation of Flovent and experimental building, the study aims to set up a primary principle on the application of SEP in peasant's design and construction, and a guideline for improvement of the indoor environment to reach the highest comfort level efficiently through natural ventilation.

Scope of the Study

The research principally selects a site in the northeast of Thailand (Isan) to study. Due to the fact that people are mostly farmers, in public view, the area is relatively poor and isolated from the other parts of Thailand. In the past, farmers grew rice only for daily consume, and traditionally relied on rain and floodwater. Most farmers occupied small and medium pieces of land. Hence level of productivity was low.

The government has developed jasmine rice species for export since 1970, which causes the cultivation of jasmine rice popularly in Isan. Therefore its price is higher than glutinous rice and the peasant's living has improved greatly.

Nowadays, local people spend a lot of money in buying a new pick-up truck, a tractor or rebuilding a bigger house. Concrete house and expanding of granary as tractor parking space is normally seen. Most of them are built or bought in loan. So, out of harvesting area, many of them go to big cities to find jobs to pay back the debt and return to their hometown for the next farming season.

In order to illuminate the situation of Isan in depth, the survey took place during February 28th to March 3rd 2006 at Ban Ku Ka Sing village, which was one of the highest amounts of household in debt from Agriculture Bank in Isan. It locates in Suwannaphum district of Roi Et province. Random example survey was adopted in the investigation, 200 questionnaires were sent out, and 99 percent of them were returned. The people who answered the questions were mostly husbands or wives, 69 males and 129 females. Among them, only 4 families (about 2 percent) lived without debt, 66 families (33 percent) were in debt because of house repair and construction; 27 families (13.5 percent) were because of pickup truck and tractor purchase; 96 families (48 percent) were owing to other reasons, such as children's education, health care; while 5 families (2.5 percent) were unwilling to providing any information.

Based on the situation, Isan area was selected to apply the concept and design, and an experimental building using ecological material would be built in Ban Ku Ka Sing village.

Principle of Peasant's Dwelling Design Based on SEP

The following proposed design is not a new approach for a modern peasant's dwelling, but it is an idea for living in accordance with regional reality by using local and reasonable resources with a simple and rational floor plan to arrange the space at maximum capability. In order to reach some requirements, such as comfort, security, economy and aesthetic appeal, according to incremental and reasonable enlargement concept, the following criteria have been used:

1) Sustainable enlargement: The house can be easily developed after a given period or even enlarged from the original design when capital, time and material are available.

2) A minimum scale: House has not been designed on a larger scale for a Thai family; the minimum space is provided to meet the basic living demand in order to lower the cost.

3) Flexibility: The house is easy to develop according to the growing family, the first floor may be enclosed or leaved open, the second floor may be enveloped partly, but still maintains the same function and space relationship.

4) Ventilation: Two buildings with shaded opening are arranged in L shape manner and connected by a corridor, in order to allow natural ventilation for cooling especially in summer at its maximum level.

5) Completeness: Not only exterior

appearance, but also its function is complete in every incremental stage.

Primary Structure of I-shape

Based on SEP, the primary structure is composed of a 60 m^2 I- shape that has been designed with moderate dimensions, and which should have the benefit of easy assembly or flexible arrangement in the future. This I-shape house is suitable for a new family of a husband and wife, with or without a small child. The first floor basically consists of multi-purpose space, cooking space, toilet, and washing space. The second floor consists of a terrace and a bedroom. Other temporary structures or walls, which enclose the ground floor as living space or storage space can be simply added to this rectangular structure. Later, this primary structure can be developed or enlarged to over 120 m^2 of L- shape with a semi-open and open space in the courtyard (Figure 1).

Reasonable Enlarged Structure of L-shape

Later, when the number in the family increases, typically with two children and a grandparent, or the capital resources are available, the house can be expanded by adding new a structure (Figure 2). The two buildings are connected with a roof-cover terrace. In this design, the separated L structures are favorable for flexible enlargement and construction with independent cross-ventilation and openings. The total amount of expansion is also flexible. With the completion of the new structural frame, even without walls, the space under the roof can be used for the family's working, dining, and living space. From a rural perspective, the completion of the structural frame is regarded as an almost complete house. When it is completed, the new structure can be optionally used for another two bedrooms or a bedroom and one living space, while the first floor is used for multi-purpose activities.

Future Increment of Proposed Dwelling

The L-shaped house in its final stage is completed when the first floor of the new building is enveloped with a wall. The main living room is connected with a semi-open corridor and outdoor recreation space. A room next to the main living room can be used as a new kitchen. A bedroom for the elder, who usually dislikes using stairs, can be added later and the old cooking space can turn into a storage room for keeping farming tools or a craft work space, perhaps where a grandmother can work with her silk weaving. Multi-purpose space on the ground floor of the old structure then can be changed into a parking space for the family's pick-up truck or agricultural engines. The main living room, semi-outdoor and out-door space can be integrated to a bigger space for greeting guests when a religious or family ceremony takes place (Figure 3).

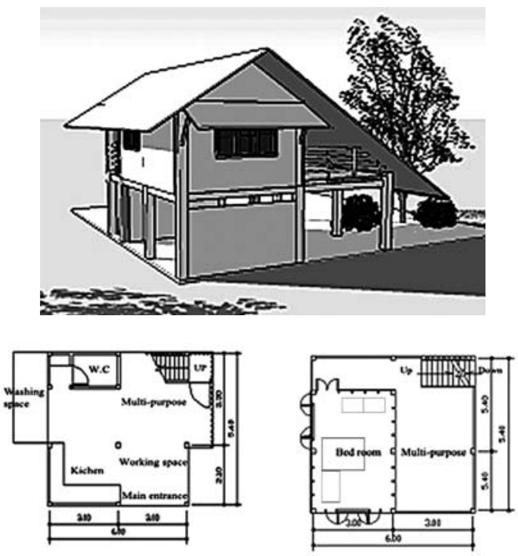

Figure 1. Floor plans and interior view of primary structure

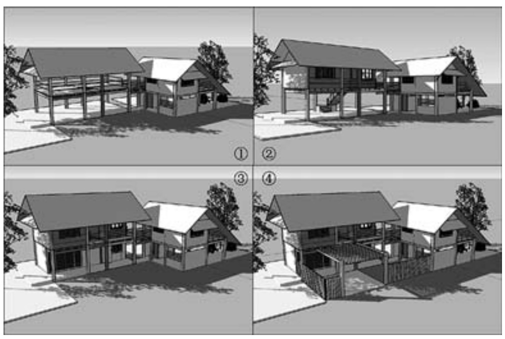

Figure 2. Incremental and reasonable enlargement by stages

Simulation of Indoor Wind Environment

Importance of Studying Indoor Wind Environment

Air movement can increase the convective and evaporative heat transfer rates of human body. The study of Khedari *et al.* (2000) reveals that air movement can make people accept a higher range of temperature (Table 1). One would feel cooler and more comfortable at a higher wind speed. Based on the thermal comfort range and effect of air movement upon the study of Khedari *et al.* (2000) and Lechner (2004) (Table 2[4]), we realize the analysis of indoor wind environment is very important. The wind field should distribute well proportionally in a good design of dwelling then people can live there comfortably. Through setting up a model and analyzing with Flovent software, distribution of wind field will be laid out. After modulating and improving, the design can reach a satisfied effort to lower room temperature through airflow, which is a passive cooling solution to be adapted for the local climate.

Designs and Condition of Calculating Region

From setting up a model of the experimental house using Flovent software, the model has solar protection with passive cooling. The front elevation is facing north. The model is composed of two structures that are connected with a corridor. The second floor of the main structure is composed of a bedroom and a semi-open

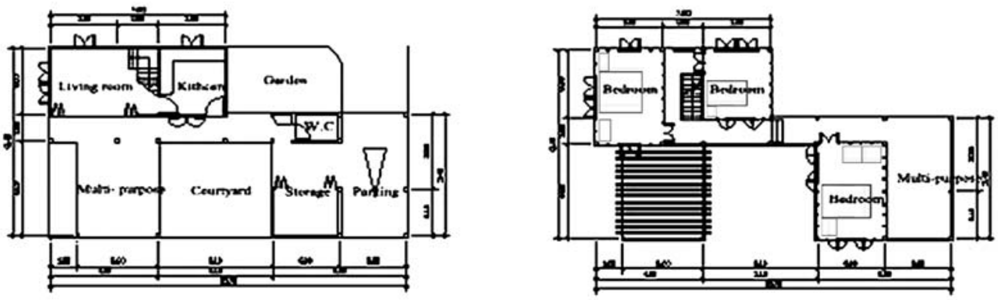

Figure 3. Alternative of floor plan and function arrangement in the future

Table 1. Cooling effect of air movement

Wind speed (m/sec)	Acceptable temperature range (°C)
0.2	27.0-29.5
0.5	28.5-30.8
1.0	29.5-32.5
1.5	31.0-33.8
2.0	31.2-36.0
3.0	31.6-36.3

[4] *Lechner, Norbert. Heating, Cooling, Lighting: Design Methods for Architects, the authors have found two editions; one is translated and published in Chinese, the other is the 2nd edition in English.Chinese edition has been revised carefully, so the data has been adopted from the Chinese edition.*

living space (Figure 4(a-b)). During the analysis of the indoor wind environment by the computer simulation, the scale of the calculating region is based on the minimum influence of the boundary to the simulated object, basically close to the outer open space. In practical computer analysis, the speed is limited, and if the calculating boundary is vast, the calculating quantity is dense, which may cause a convergent and inaccurate result. Thus the length, width, and height of the calculating region are set at 50 × 50 × 20 m, and the model is placed at the center of the regional ground level.

Plotting of Grid Line

The plotting of the grid lines that appear in the calculating region of this software displays the intricate level of the model and the amount of information that needs to be calculated (Figure 5); the more dense or small the grid size illustrates, the more likely it is to get accurate CFD calculations, but it must also be combined with other parameters and their distribution over the computational domain. The grid lines of this model use the latus rectum and non-uniformity system. In this particular modeling it is computationally costly to use a fine grid throughout the flow field. Thus the grid lines of the model appear to be refined in the area of the building's walls and outlets.

Designs and Establishment of Boundary Conditions

Other conditions for the boundary are set

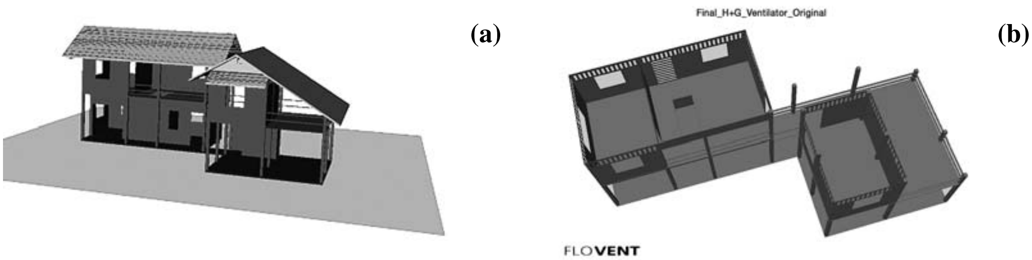

Figure 4. (a) Flovent analysis model
(b) Isometric view of the second floor

Table 2. Air velocities and thermal comfort

Air velocity (m/sec)	Equivalent temperature reduction (°C)	Effect on comfort
0.05	0.0	Stagnant air, slightly uncomfortable
0.20	1.1	Barely noticeable but comfortable
0.40	1.9	Noticeable and comfortable
0.80	2.8	Very noticeable but acceptable in certain high-activity areas if air is warm
1.00	3.3	Upper limit for air-conditioned space
2.00	3.9	Good air velocity for natural ventilation in hot and humid climates
4.60	5.0	Considered a "gentle breeze" when felt outdoors

as follows:

- Outdoor temperature: 30°C[5]; outdoor radiation temperature: 30°C.
- Condition of outdoor wind field: accounting for the model's highest point which is 6.6 m, and to decrease the calculating quantity, the outdoor wind environment is designed and established as a well-proportioned wind field, the wind speed is 2.5 m/s[6], flowing from the south towards the north.
- Outdoors air pressure: one air pressure; Inner surface and outer surface are designed as smooth surfaces (The same conditions also apply to the model of the conventional dwelling).

Result of Simulation Analysis

Indoor Horizontal Wind Field Selected Point and Criteria

To measure distribution of the indoor horizontal wind field, four levels of height interfaces of the main structure or the east building: 0.80, 1.60, 3.65, and 4.45 m are selected. The heights are set according to the average height of human figure in the northeast region by sitting, and standing on the first floor and on the second floor respectively.

Analysis of Horizontal Wind Field Simulation

At the height interface of 0.8 m from the

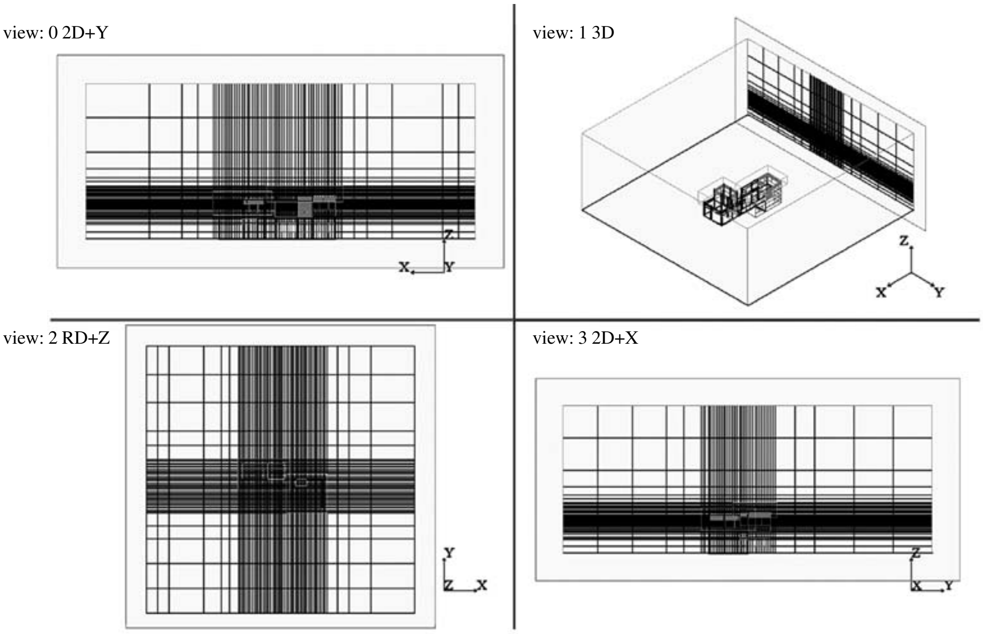

Figure 5. Grid system illustrations

[5] General character of the northeast of Thailand has high temperature almost all over the year; the temperature in any month is not lower than 18°C. In winter and summer the average temperature is 23.95°C and 28.90°C, respectively. So, taking account of the upper limit of temperature, outdoor temperature is limited to 30°C.

[6] In Khon Kaen province which lies in northeast of Thailand, monthly average wind speed is varied from 2.45 m/s to 1.75 m/s (measured in 2004), and yearly wind speed is about 2.15 m/s ,according to the data processing sub-division,Climatology division,Meteorological department on 11th May, 2005 (Table 3). Although the research stresses on the northeast part, its result can be applied in other part of Thailand; at the same time, the actual dwelling will be built on a farmland out of a village, the wind at the site is stronger than in village; moreover, if the wind speed of outdoors is defined lower, the experimental effort is not obvious. Taking account of these facts, the wind speed in wind field simulation is defined to 2.5 m/s.

Table 3. Average wind speed

Month	Detected point								Mean
	0100	0400	0700	1000	1300	1600	1900	2200	
	SP								
January	4.20	3.60	3.50	5.00	4.90	5.20	3.80	4.00	4.30
February	3.70	3.80	3.50	5.20	5.30	5.60	3.80	3.70	4.30
March	3.90	3.40	3.50	4.70	6.40	6.80	4.70	4.00	4.70
April	4.60	3.20	3.30	4.30	4.70	4.8 0	4.60	3.50	4.10
May	4.30	3.10	4.20	5.60	5.80	6.70	4.00	4.20	4.70
June	4.00	3.70	4.30	6.40	6.10	6.20	4.50	3.70	4.90
July	2.40	3.00	2.60	4.30	4.80	4.60	3.50	2.60	3.50
August	3.40	3.20	3.50	5.30	5.70	5.20	3.60	3.50	4.20
September	2.40	2.90	2.80	5.00	4.90	4.20	2.60	2.80	3.50
October	3.30	2.70	2.90	5.50	6.30	4.50	2.50	2.90	3.80
November	3.60	3.10	3.60	5.70	6.00	5.50	3.60	4.20	4.40
December	3.50	2.90	4.00	5.30	6.80	4.60	3.80	4.40	4.40
MEAN	3.61	3.22	3.48	5.19	5.64	5.33	3.75	3.63	4.23

Table derived from the data processing sub-division, Climatology division, meteorological department, 11th May 2005
SP = Speed (SP) unit: Knot, 1 knot ≈ 0.5 m/s
Year: 2004, Station: Khon Kaen

ground, the wind speed is low at areas near the open window reaching only about 0.5 m/s. The main proportion of the wind appears along the east-west side of the right structure, which is a corridor and parking space (Figure 6(a)).

At the height interface of 1.6 m or the standing position on the ground floor, the region of higher wind speed is still concentrated on the above-mentioned area. The speed of the wind field centered near the intake can reach up to 1.5 m/s; while the average speed in most regions is between 0.5 - 1.5 m/s, except in the parking space where the speed is mostly more than 1.5 m/s. In the corridor and the west side structure, the wind speed is low, between 0.10 - 0.40 m/s. Wind speed in the covered way that connects the two structures is high, more than 2.0 m/s in the area close to the corner of the L-shape (Figure 6(b)). However if it is away from the center, the wind gradually decreases its speed from 1.5 to 0.5 m/s.

At the height interface of 3.65 m or the sitting position on the second floor, the speed in the rooms is low; the wind flows from the corridor and along the sides of the wall. For areas close to the wall, the speed can reach 0.90 m/s, but is mainly concentrated on 0.10 - 0.50 m/s in the most regions. The wind speed near the open door and window of the west structure and the building corner is higher than the main building, and can reach 2.0 m/s at the center of the region, then gradually decrease to 1.0 m/s. The wind speed on the terrace is the highest, about 2.3 m/s in most regions (Figure 6(c)).

When the height interface is 4.45 m or the standing position on the second floor, the wind speed in every room increases when compared with the previous heights. In the areas near the windows, the wind speed can reach about 1.75 m/s in more than one-third of the region of the east bedroom while wind speed can reach 0.9 m/s or higher in about half of the room. Wind speed of more than 1.75 m/s can be obtained in half of the semi-open living room. In comparison, the speed in the corridor and the west bedroom is low, mostly between 0.9 and 1.0 m/s. One reason comes from the 1.2 m long eave that blocks out the wind. The change of wind speed is obviously seen in the terrace zone, where the wind speeds on the east and the west sides are higher, between 1.5 and 2.2 m/s, while the speed in the middle of the terrace is about 1.0 m/s (Figure 6(d)).

Comparison with the Wind Field of Conventional Dwelling

Through Figures 7, 8, when the height interface is 3.65 m or the sitting position on the second floor, the wind speed in the proposed dwelling is obviously higher than in a conventional dwelling, because the zone where the wind speed is under 0.2 m/s is less than one-third and is spread out, while the zone in the conventional dwelling with the same wind speed is about one-half and is tightly concentrated. The zone of proposed design where the wind speed can reach 0.9 m/s is larger than the one in the conventional dwelling and the area is also centralized. With the 4.45 m interface of the proposed design, the wind speed in the east bedroom and living room is higher around the openings in the walls and windows; meanwhile distribution of the wind field is well proportioned with the speed around 1.3 - 2.3 m/s[7]. In a hot region like Thailand, it is appropriate to have a wind speed for natural ventilation that can make people feel comfortable. However, wind speed of the stair is low, only 0.2 - 0.4 m/s.

In the conventional dwelling, the wind speeds near open windows are higher than other

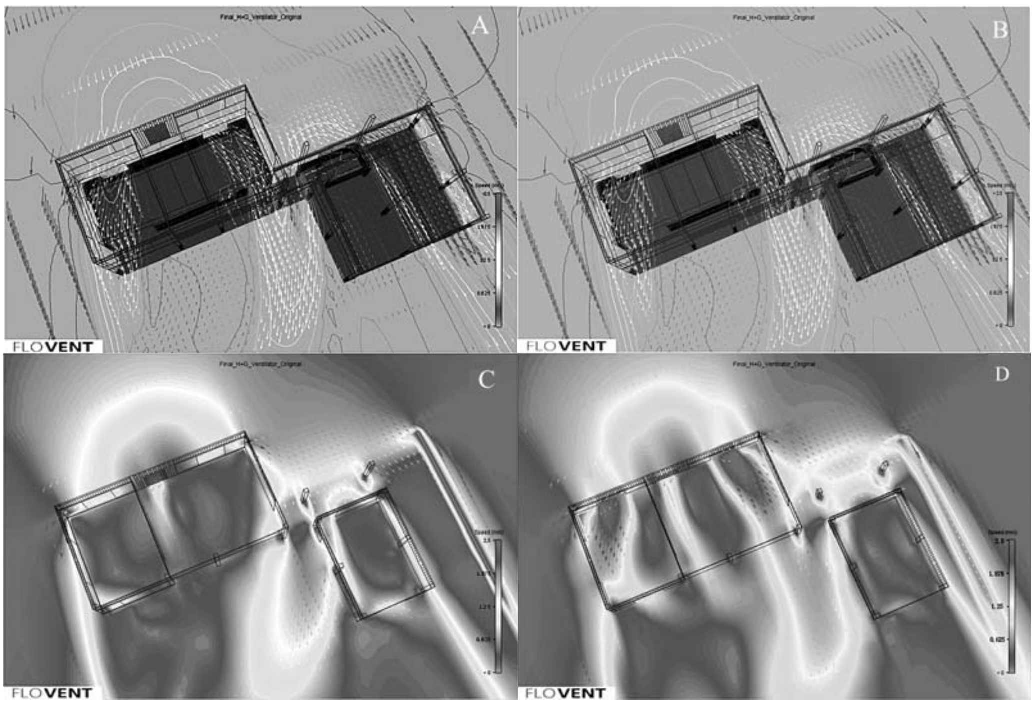

Figure 6. Wind field distribution in different height interfaces (a) H = 0.8, (b) H = 1.60 (c) H = 3.65, (d) H = 4.45

[7] *An indoor airspeed of 1.5 - 2.0 m/s, comfort ventilation is applicable in regions and seasons when the outdoor maximum air temperature does not exceed about 28 - 32°C, depending on the acclimatization and comfort expectations of the population. (Givoni, 1998)*

areas, about 2.0 m/s, but the distribution of the wind field is not well proportioned. The wind speed on the second floor is between 1.1 and 2.0 m/s in one-third of the zone but the in-let wind field at the window area presents a separate pattern. Basically, the indoor wind speed can be maintained at 0.6 m/s.

From the analysis of the wind field in the proposed dwelling compared with the conventional dwelling, we can assume that its distribution can be more advantageous than in the conventional dwelling, because it can sufficiently meet the demand for the dwelling's ventilation. The first floor of the proposed dwelling is 2.5 m floor-to-ceiling high (2.85 m with wooden beams and floor supportive structure), while the second floor is 2.65 m high (including roof support beams), thus the total height of this building is 5.5 m. In the conventional dwelling, to improve a house's ventilation, local people normally fix the height of each floor at 3.0 m or higher, so that the walls are at least 6.0 m high in total. Obviously, the proposed dwelling is not higher than the conventional dwelling, but the effect of ventilation is even more advantageous for the occupant than the conventional dwelling. At the same time the proposed dwelling can save some building materials and lower the construction cost.

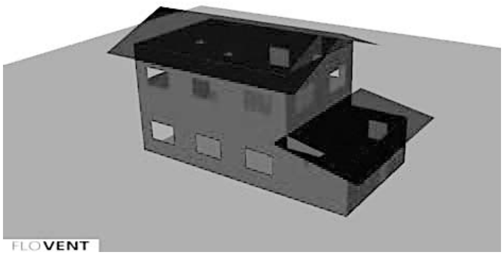

Figure 7. Primary design of conventional dwelling

Distribution of Horizon Wind Field After the Modulation

According to the above-mentioned results of the wind simulation, it is found that the west room in proposed design is used as a bedroom; a window should be added on the south wall at the opposite position from the north wall for cross-ventilation purposes, which will improve the indoor wind speed and form draught. Obviously, the whole of wind field in west room has a great change; the zone exceeding 1.0 m/s is added remarkably. But if the room is to be used for storage or as a grain depot, a window should not be added to minimize air humidity (Figure 9).

Based on the concept of incremental and reasonable enlargement concept, the second floor of the L-shape structure may be comprised of a bedroom and a semi-open living room. With the enlargement of the family, the house could be transformed; the primary semi-open living room can be enclosed into a multiple-purpose room. After expansion, the distribution of the wind field on this floor will change (Figure 10).

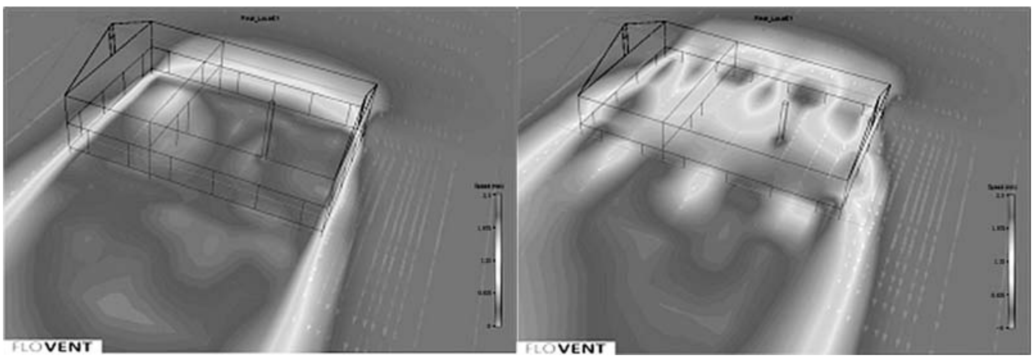

Figure 8. Wind field distribution in conventional dwelling H = 3.65 m (Left), H = 4.45 m (right)

Before enclosure, the distribution of the wind field is long and narrow with the wind speed more than 1.0 m/s in most parts of the semi-open area and exceeding 1.5 m/s in the central zone. After the enclosure, the wind speed in the corridor is more than 1.0 m/s, but appears stronger around the opening in the wall. The wind speed has not noticeably changed in the east bedroom, while in the southeast and southwest corners with windows and voids, all the wind speeds are more than 1.0 m/s, and mostly exceed 1.5 m/s. Before and after the enclosure with the wall, the wind field on the right side of the second floor's semi-open space does not obviously change. After the enclosure, the speed of over 2.0 m/s decreases in the central wind field, but in other parts still exceeds 1.0 m/s.

From the analysis of the indoor wind environment, the terrace on the second floor that connects the two structures can effectively be utilized to provide a comfortable recreation space for its occupants.

Practical Application of Proposed Design

In real life, sustainable architecture[8] cannot survive in our society only by working with ecological materials. It is more important to maximize sustainability to build affordable house.

The following materials are used in the proposed design:

- Recycle materials refer to wood for structural frame and floor;
- Renewable materials refer to bamboo and part of daub component.
- Industrial materials refer to concrete post, metal sheet, gypsum board and brick;

These materials are mainly chosen because of their practical usage in local condition with reasonable price.

Traditional bamboo wattle and daub technique is applied in the wall enclosure of proposed dwelling (Figure 11). Component of

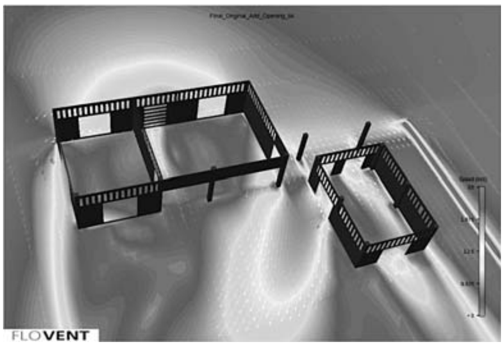

Figure 9. Wind field distribution after adding a window in the west room (H = 3.65 m)

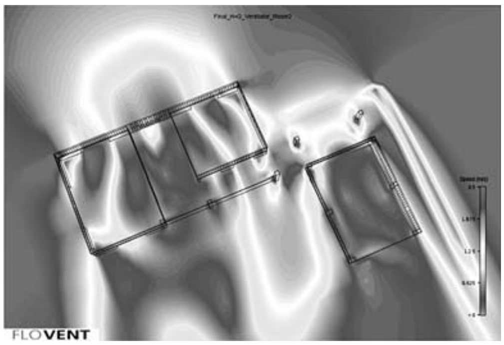

Figure 10. Wind field distribution after modify the design by adding a small bedroom (H = 4.45 m)

[8] *The word "Green", "ecological" and "sustainable" at the beginning were mostly used in ecology field. But after 1990s when architects interested in the relationship of building with environment, these words commonly appeared in architectural field. The definition of sustainable architecture or green architecture, is defined as an architecture term that is not consumptive of the natural resources of the planet, or architecture that is suitable for its location and climate, passive building and so on In summary sustainable architecture refers to the building that is concerned with environment, ecological system and sustainable of natural resources. The erection to building approaches would less impact environment and create healthy living atmosphere that benefits for occupants. Deeper meaning includes that building can heal nature for the world to maintain the next generation existing well.*

daubing has improved by the authors, which concentrates on the use of local and natural resources, such as earth, lime, sand, sticky rice porridge, Bong[9] powder and fiber from plant. The wattle and daub wall is cheaper than wood or brick wall. From thermal evaluation of the proposed wall, its indoor temperature is similar with wood while indoor relative humidity is low, but the most outstanding character is economical, ecological and exercisable (Phusanam and Wang, 2007).

Through using these materials, the dwelling has been built in Ban Ku Ka Sing, Roi-Et province in 2007 (Figure 12). Wind field of the experimental dwelling is improved and it has better ventilation than other common dwelling. Moreover, building cost of the whole dwelling is decreased, which accords with the SEP theory. Of course, at the beginning we have emphasized on using ecological, economical and exercisable material, as well as using local resources in order to reach sustainable development goal. But such materials used in the dwelling must not give people the impression of poverty. When we try to use the ecological materials and combine with modern design to build peasant's dwelling, we will not exclude the modern industrial material that can be recycled and be adapted for local life; only this, proposed design combined with ecological material could be utilized and popularized.

Conclusions

At present, some ecological materials have still used in rural dwellings. However, besides fulfilling basic demands for contemporary living, they still need various facilities to attract public attention; elements of modern architectural design to improve the dwelling's aesthetic appeal and sense of modernity. The method of combining modern design with traditional style and materials based on the thought of *"the same old stuff with a new label"*, hopes to attract people's attention by appearance and make a difference from the

Figure 11. Installation of the woven wall in experimental building

Figure 12. Various phase of experimental dwelling construction: mainframe, covered roof, fixed wall completed floor

[9] Bong (Scienctific name: Persea kurzii in Lauraceae Species) its name is called differently in each region as Pong, Mong, Mee and Yang Bong. Mostly found in forest of the northeast and a part of the north. The plant is easy to grow in high moisture environment. Its wood is good for firewood, making daily use tool, which is durable in one level. Its bark is mixed with sawdust for making incense. In construction the bark or resin of Bong used to daub lower part of wooden post to prevent weevil, termite and ant from climbing up to the house. Bong in the old time was used as an additive like cement.

old impression of lack of development and poverty. Modern design to stimulate the popularization of peasant's construction under SEP is a significant approach in making progress and gaining public acceptance. This proposed design proves the feasibility and efficiency of SEP application in peasant's construction by using an incremental and enlargement concept. Analysis of wind field simulation by Flovent illuminates that ventilation of the proposed dwelling is more advantageous than the conventional dwelling. The design, which combined with local and natural resources, results in a cost efficient dwelling, is in accordance with sustainable development for contemporary rural living. Of course, the design is not only suitable to the climate and living condition in the northeast of Thailand, but also may be applied and popularized in other parts of Thailand.

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