Exploring Historical Shop-House and Townhouse Vernacular Architectural Design and Elements as a Solution for Successful Passive Low Energy Housing

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ABSTRACT: Malaysia's hot humid climate raises problems in the shading, cooling and ventilating of its buildings. The rapid development of its urban areas and the corresponding increasing land cost resulted in developers capitalizing and maximizing on development potentials. The construction of high density box-like houses which often require additional mechanical means of cooling and ventilation to reach an acceptable comfort level for its occupants is increasingly becoming the norm for these developers.

This paper explores the passive low energy design and architectural elements of the traditional shop-house and townhouse typology commonly found in the urban centers of Malaysia particularly in the historical city of Malacca, which address the hot and humid climate of the country. The long and narrow building plots commonly found in these historic urban areas raise issues in ventilating and lighting of the internal areas of these houses. The design solutions and elements commonly found in these buildings can be incorporated in today's modern housing in order to achieve a successful passive low energy house.

Conference Topic: 08 Vernacular Architecture: Sustainability Lessons from the Past
Keywords: design, architectural elements, materials, thermal comfort

1. INTRODUCTION

Malaysia sustained strong economic growth in the 1970's due to its exports and political stability. This created many job opportunities in the city centers, which as a result lead to the rapid migration of the rural classes to urban areas in search of jobs and a better quality of life. This population migration created a demand in affordable housing and the urban areas were quickly filled by developers who were eager to cash in on the demand. Large tracks of land were cleared to construct townhouses or what is locally referred to as 'terrace houses'. To maximize on development potential, these housing estates are usually planned in grid-like sections with multiple rows of identical terrace houses built within each section.

The urban planning of these estates did not take into consideration sun path or prevailing wind directions. This factor combined with the lack of climatic design consideration in the design of the buildings and the heat island effect resulted in houses that require additional mechanical means of cooling and ventilation to reach an acceptable comfort level for their occupants.

However within the older quarters of these urban centers are traditional vernacular terrace houses and shop-houses that were built almost a century ago which are today still occupied with minimal integration of mechanical facilities to aid thermal comfort. Additional mechanical facilities are unnecessary as the internal environment of these buildings is sufficiently pleasant.

The objective of this paper is to explore the architectural design elements of these traditional vernacular urban terrace houses and shop-houses as a solution for a successful passive low energy terrace house. The selection of these buildings as the focus of this objective is due to the similarity between them. The parallels that can be drawn are as follows,

- High-density urban location.
- Similar lot sizes.
- Continuous repetitive units that are located adjacent to one another in a block configuration.
- Building types and characters

This paper also tries to emphasize the usage of certain architectural elements that may help to better portray the Malaysian identity for these buildings.

2. RESEARCH METHODOLOGY

The research method used for this paper will be undertaken in 2 parts. The division will be as follows;

Part 1 (at submission of draft paper)

- Identify the issues in the existing terrace houses that give raise to thermal discomfort.
- Analyze the design and detail elements of the traditional vernacular terrace houses and shop-houses to help understand their effect in the cooling of these buildings.
- Conclusion and recommendation based on the facts obtained in the above analysis.

Part 2 (upon approval of paper for presentation to conference)

- Comparative study of these two building types based on a case study that looks at
  - i) Data collection and analysis of the indoor air temperature taken in these building types,
  - ii) Calculation of ventilation opening sizes in these building types,
  - iii) Design detail and elements.
- Conclusion and recommendation based on the facts obtained in the above analysis and case studies.

3. THE TERRACE HOUSE

Malaysia's Uniform Building By-Law 1984 describes the 'terrace house' as any residential building designed as a single dwelling unit and forming part of a row or terrace of not less than 3 such residential buildings. [1] (Refer to Figure 1)

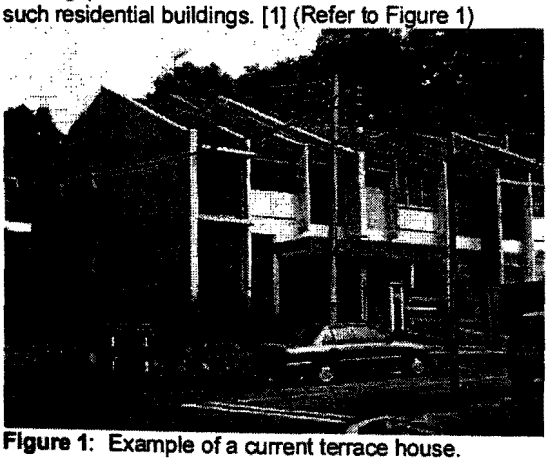

Figure 1: Example of a current terrace house.

The regulation also states that the minimum requirement for natural ventilation and lighting of a habitable room in a residential or business premise via windows should have a total area of not less than 15% of the clear floor area of such a room and have openings capable of allowing free uninterrupted passage of air of not less than 10% of such floor area. [2]

The typical sizes of these houses are between 6600mm and 7200mm, with 22500mm to 24000mm in length. These narrow, long box-like lots, limit the ventilation openings only to the front and back facades of these houses.

3.1 Issues

The key factors in creating thermal discomfort in the terrace house are,

- Poor ventilation and air circulation due to minimum opening dimension and quantities.
- Lack of permanent openings that allows ventilation once windows are shut in the evenings.
- Glazed windows that allow direct penetration of sunlight and radiant heat into houses.
- Lack of high-level openings to help ventilate building through stack effect.
- Insufficient emphasis in the layout plans for the incorporation of internal courtyards, courtyard or air-well to promote natural lighting and ventilation.
- Compact layout that only allows ventilation openings to occur at the front and back facades of these houses. (Refer to Figure 2a
- and 2b)
- Insufficient roof overhangs to provide shade into the interior spaces.
- Inappropriate selection of building materials used in the construction of these houses such as,
  - Cement and sand brick walls - heats up during the day and requires a long time to dissipate the retained heat.
  - Concrete roof tile – absorbs and retains heat.
  - Sealed ceilings that do not allow hot air to escape.

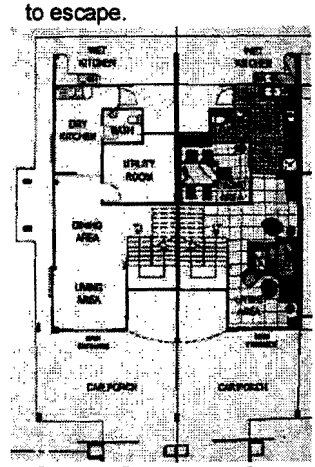

Figure 2a : Ground floor plan of a terrace house (Plan taken from Maricc Commercial Services Website)

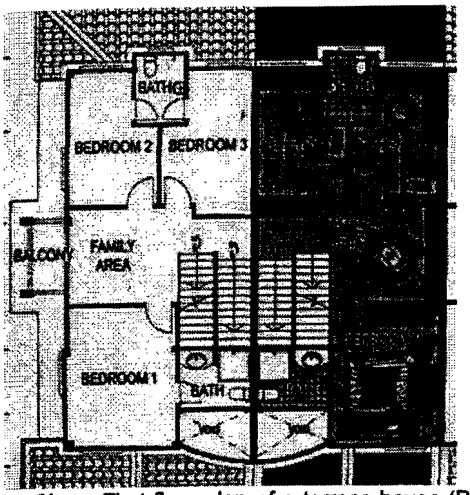

Figure 2b : First floor plan of a terrace house (Plan taken from Marico Commercial Services Website)

4. TRADITIONAL VERNACULAR SHOP-HOUSES AND TERRACE HOUSES

The shop-house is a building in which commercial activities take place on the ground floor and private accommodations are located on the upper floor. This building typology was brought in by migrant Chinese workers from southern provinces of China to Malaysia in the 1800's. Changes were made to the original building typology in order to adapt and suit the local hot and humid climate. The vernacular terrace house is a derivative of this building typology. (Refer to Figure 3a and 3b)

A typical traditional terrace house has one-storey with a street-level porch in front. Usually, this type of building has big entrance doors with timber bars locked into the door head, metal-bar and louvered panel windows; and a few openings. The building is often designed in a symmetrical organization in which the entrance door is located in the middle with windows on both sides. Depending on the tenant's wealth, the terrace house sometimes has glazed tiles at the base of the front walls. Like the shop-house, the terrace house uses brick, plaster, concrete and timber as major materials. [3]

Like the new terrace houses that are built today, these shop-houses and traditional vernacular terrace houses are built in continuous repetitive units forming a block with long narrow lots. The sizes of the lots vary between 6600mm and 7200mm in width and 21000mm and 30000mm in length.

However unlike the new terrace houses which are constructed in a society that is surrounded with numerous mechanical means to assist thermal comfort, the shop-house and traditional vernacular terrace house design incorporated many subtle features to create thermal comfort for its inhabitants. Over more than a century later, these shop-houses have succeeded in standing the test of time. Many are still being used in their original state without the aid of additional mechanical means other than a ceiling fan to assist the cooling of its internal spaces.

Figure 3a : Example of a traditional shop-house.

Figure 3b : Example of a traditional vernacular terrace house.

In analyzing the design elements of these traditional vernacular buildings, it can be derived that the factors that contribute to the thermal comfort of these buildings can be categorized into 2 parts,

1. Elements that directly contribute through its design.
2. Factors that indirectly contribute to the cooling of the building.

4.1 Direct factors

4.1.1 Facade fenestrations

Although there are many different types of opening and window designs that can be found in the vernacular shop-houses and terrace houses, the common factors in the design of these fenestrations are,

- The use of operable louvered shutters, which can be adjusted to allow airflow while limiting the sunlight penetration. (Refer to Figure 4)

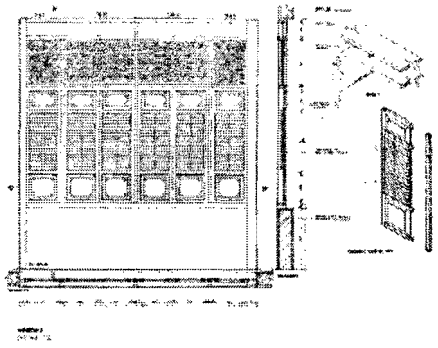

Figure 4 : Detail of operable louvered shutters (Drawing taken from CORE Archives)

- Permanent openings which are located above windows and at high levels to encourage the flow of air at all times can be found on both internal and external walls. (Refer to Figure 5)
- Minimal use of glass as infill panels in windows. (Refer to Figure 6)

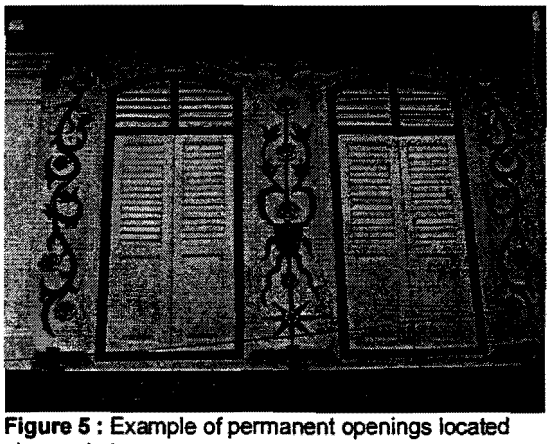

Figure 5 : Example of permanent openings located above windows.

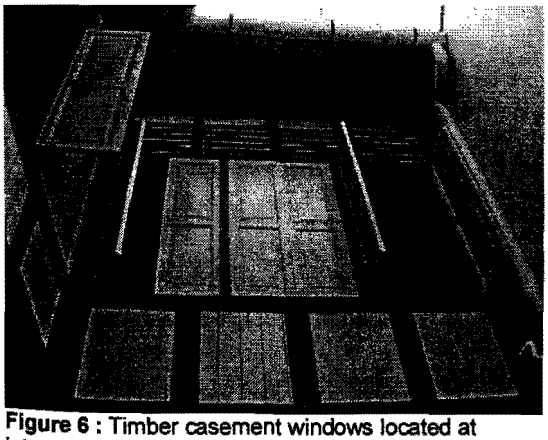

Figure 6 : Timber casement windows located at internal courtyard area.

4.1.2 Roof

As a solution to the scorching sun and torrential storms common to the South-East Asian region, building traditionally have pitched roofs with deep overhangs to provide shade to the interior areas and are steeply pitched to assist quick rainwater run offs. The common features of these vernacular shop-houses and terrace houses are,

- Long roof eaves forbid the direct penetration of sunlight, which will create radiant heat into the interior spaces.
- The use of a jack roof in the design combined with a lack of a flat horizontal ceiling in the room below helps dissipate the raising hot air through a stack effect.

4.1.3 Courtyards and Air well

The layout of these buildings covers the entire lot area; leading to buildings that are deep and narrow in plan. Courtyards and air wells are introduced into the plans to break up the spaces. (Refer to Figure 7a and 7b)These buildings were also built before the introduction of piped domestic water and a feature of these courtyards and air wells is the water well, the primary source of water for domestic use for the individual buildings. Many of these shop-houses also harvest rainwater through roof run offs, which are kept in troughs in the air wells. The advantages of the above features are,

- Help introduce light and ventilate the interior areas.
- Evaporative cooling as a result of storage of rainwater harvested for domestic use, which are kept in troughs in these air wells.

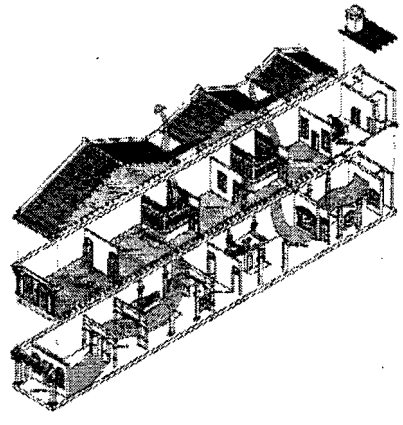

Figure 7a : Deep plan that is broken up by courtyards that aid ventilation and introduce natural daylight. (Drawing taken from CORE Archives)

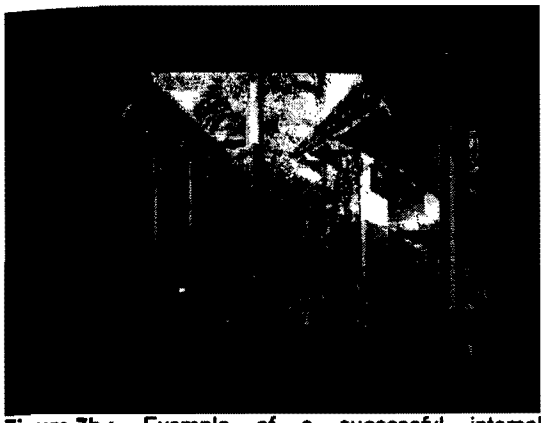

Figure 7b : Example of a successful internal courtyard.

4.1.4 Covered five footway

A mandatory feature that was imposed by the colonial British rulers in the late 1800s, the 'five footway' was a continuous covered pedestrian walkway linking the front of these shop-houses. In the traditional vernacular terrace house, this feature evolved into a covered entrance portico. This covered feature of 1500mm to 3000mm created,

• Deep overhangs which provide shade to the entrance and create a conducive area for browsing and socializing. (Refer to Figure 8)

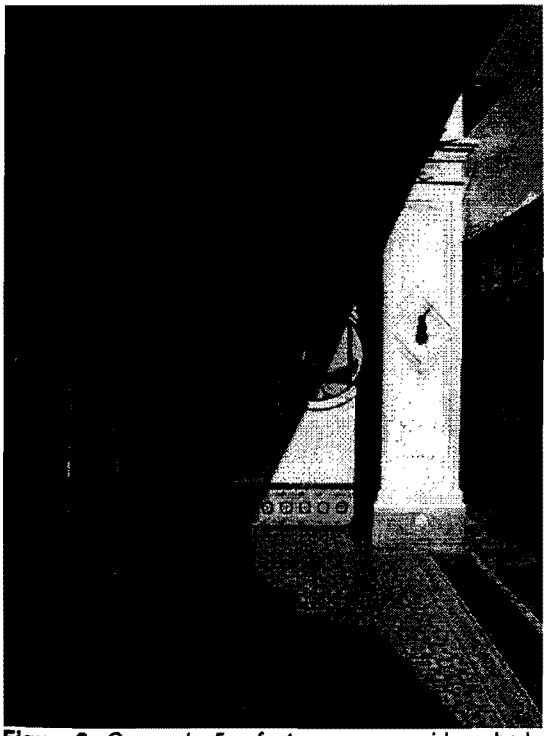

Figure 8 : Covered five-foot ways provide shade similar to deep roof overhangs.

4.2 Indirect factors

4.2.1 Building materials

These buildings are constructed of materials that were easily available. The main structure was constructed of brick, timber, and concrete. The obvious advantages of using these materials other than ease of availability are,

- Brick load bearing walls - Thickness of the walls as well as the nature of the material used helped delay radiant heat transfer into the interior areas.
- Clay roof tiles - Clay is an ideal material for roof as it is by nature a bad conductor of heat. As a result the internal temperature of a house is cooler, thus contributing positively to the thermal comfort of the occupants in the building.
- Timber floor boards – Enable flow of air through gaps between the floor boards.

5. CONCLUSION

Based on the analysis of the traditional shop-house and vernacular terrace house the following conclusions can be derived,

1. Poor planning and selection of building materials have resulted in homes that require additional mechanical means to achieve thermal comfort levels.
2. If sufficient consideration is given to design details and elements, inexpensive solutions can be realized to achieve satisfactory thermal comfort levels in the terrace house.
3. While the construction of houses utilizing cement brick for walls, concrete roofing tiles, and standard floor to ceiling height may help make today's homes more affordable to the purchasers; the need to ensure thermal comfort for the occupant must be emphasized.
4. The integration of the vernacular low-energy elements into these new houses will doubtlessly help create a sustainable home that is climatically comfortable to the inhabitants.
5. The vernacular features of the shop-house and traditional terrace houses have helped create a thermally comfortable and sustainable building.

6. RECOMMENDATIONS

Since Malaysia's economic down turn of 1997, the purchase of real estate has become a buyer's market. Developers must not only offer good designs but innovative solutions to be competitive. The integration of low energy solutions has become an important consideration in the purchase of property today as buyers become increasingly aware on the rising cost of utilities and the corresponding deterioration of the environment. The integration of the vernacular low energy elements into these new houses will

doubtlessly help create a sustainable home that is climatically comfortable to the inhabitants. As such the following recommendations should be considered,

1. The introduction and enforcement of stricter guidelines that emphasize the inhabitants' thermal comfort by the local authorities is necessary.
2. Considerations must be made towards the design of future terrace houses to ensure their sustainability.
3. Developers should sometimes put profit and gain as a secondary matter and the quality of the products their priority. Producing housing that is not satisfactory will also result in a lack of buyers.
4. Further studies or research must be conducted to uncover the best solutions to tackle this issue. This study should also consider components that aid in portraying the Malaysian culture and identity. The components found in the shop-houses, such as the timber stripped louvers and the carved stone fenestrations, are the typical local elements.

ACKNOWLEDGEMENT

REFERENCES

[1] Associate Professor Dr. A. Ghafar Ahmad (1998) *Southern Chinese Architecture*, www.hbp.usm.my/conservation/MainConservation.htm

[2] Uniform Building By-Law 1984, International Law Book Services

-The CORE Centre measured drawing collection, Faculty of the Built Environment, University of Malaya, Kuala Lumpur, Malaysia

-Marico Commercial Services Website

BIBLIOGRAPHY

-Anthony Too (1998) *The Chinese shophouse*, The Encyclopaedia Malaysia, Archipelago Press, pp 90-91

-Lim Teng Ngiom (1998) *The Melakan townhouse*, The Encyclopaedia Malaysia, Archipelago Press, pp 92-93

-David G. Kohl (1984) Chinese Architecture in the Straits Settlements and Western Malaya: Temples, Kongsi and Houses, Heinemann Education Books (Asia) Ltd. Kuala Lumpur.

-Ismail Said, Raja Nafida Raja Shahminan, and Rajeh Salleh (1999) *Reintroduction of Ventilation Components for Terrace Houses in Malaysia*, The Third International Symposium on Asia Pacific Architecture, April 7-9 1999, Honolulu, Hawaii

-Syed Zainol Abidin Idid (1995) Pemeliharaan Warisan
Rupa Bandar, Badan Warisan Malaysia