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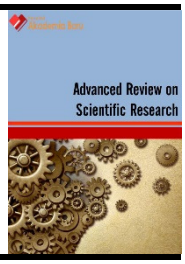

An assessment of user perception towards the need of ecology design for middle income housing in urban context

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ABSTRACT

The purpose of this paper is to propose appropriate sustainable design solution for a suitable housing architectural design that responds towards ecological needs vital for a comfortable home living environment. This paper is vital as there are many arising issue relating to middle income housing development involving comfort quality that need much attention from various parties. Past literature on middle income housing development in Malaysia focuses on limited areas of study. These are quality of communal living in settlements; neighbourhood facilities and its effectiveness; crime prevention through housing design; dwelling support services; policy making on housing ownership; corporate social responsibility on housing development from developer's and buyer's perspective; efficient housing construction system; waste management in residential areas; the increment of housing price and related factors as well as documentation on factors that hinders the implementation of sustainable technology in middle income housing schemes. None of the above literature discusses on how to implement ecological approach in home design. This research analyses the home users' perception from direct observation and questionnaires on two selected case studies of middle income housing located in two major cities in Malaysia's urban context to establish appropriate ecological home design attributes for future referencing. Findings indicate there are four key factors that contributed in the development of ecology housing for the benefit of occupants which are suitable structure usage, placement of building; proper openings, application of building fenestration and appropriate landscape. The established referential guideline design is of benefit for future designers, builders, developer and related authority to build comfortable homes in the future.

Keywords:
Ecology housing, architectural design principles, comfortable living

1. Introduction

Housing can be defined as a place to live according to the specific needs or demands of those who occupies it for comfortable living. Housing also act as a source of luxury, investment and privacy. In the Malaysian context, the housing development sector had transformed significantly since the country gained its independence in 1957 due to the interface between three forces; growing

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population, high rates of urbanisation and growing economy [1]. From the aspect of population growth, statistical data indicates that the Malaysian population had increased almost three times over the past decade from 1970 to 2020 which is from 10.4 million to 28.3 million people. Nonetheless, the major growth is located at urban areas. This is because by year 2000, more than two thirds of the population (61.8%) resides in urban areas due to work opportunities and easy facilities [1]. Regarding this, the housing demand by homebuyers in urban centres had elevated and this raised the public and private sectors' interest to construct more housing projects. However, the private housing developers are the key players whom have considerable influence in the local housing industry to introduce new housing approach in Malaysia [2]. The public sector on the other hand, constructed housing projects which are normally funded by the government based on the allocation from the national budget in accordance to the National Housing Policy guidelines [2]. Their housing schemes are normally self-financed, deposited through would-be buyers, or obtained from the financial market. Even though the Malaysian housing industry is highly controlled by laws, policies and guidelines, it is still seen that housing design lack emphasis on quality in relation to physical design, size and facilities as well as strategic location [3].This is highly due to the rapid production of housing schemes because of high demand from the populace, limited land and space as well due to profit oriented developers that forced the housing design to be limited in exploration and lack of fulfilment in housing quality [3]. More importantly, the socio-cultural needs and comfort of the users are also not well addressed by housing developers especially for the low and medium cost housing type [3]. The objective of this paper therefore, is to establish related design determinants in relation to suitable structure usage, strategic location of building, proper openings and application of building fenestration and lastly, appropriate landscape for the development of ecology housing scheme to promote comfortable living in urban areas. The findings can be applied in future home designs to give better quality of life to the users. For the benefit of this study, the paper will focus on landed double storey terrace housing type under the category of medium cost to cater for middle income group. This is because high demand among middle income group towards the need of housing is gradually increasing namely in high populated urban areas. Before elaborating on the findings from the selected case studies, next section will firstly describe on the meaning of ecology housing followed by the principles of ecology design for human comfort.

2. Literature Review

2.1 Definition of Ecology Design

Ecological design can be defined as any form of design that minimizes environmentally destructive impacts by integrating itself with living processes [4]. In other words, ecology design emphasis on the usage of biodegradable, renewable, and clean elements with low-embodied energy building properties that can give impact to the building occupants, and the environment. In this sense, the adapted building elements need to be selected from natural or minimally processed earth resources. There are also other definitions that may be associated with ecology design such as 'green architecture', 'sustainable architecture', 'deep ecology', 'cosmic design', 'community design', 'low energy architecture' and 'simply designing on site' [5]. In the present era, ecology design must be visually apparent in design thinking and process so that the users of the environment may experience, learn about, and appreciate those processes. This is because ecological design is a crucial component of a sustainable city, not only because of its potential to reduce the ecological impacts of urban life, but also because of its potential to communicate new cultural conceptions of the human relationship to nature [6]. Nevertheless, past scholars' highlights that the principles of ecology design are not well applied in the development of built environment due to lack of knowledge [7]; economic constraint

[8] and inadequate referential resources for references among designers and developers [9]. However, there are no reason for home providers to give excuses because in the millennium era there are various approaches that can be adopted under minimal costs to implement ecological aspects to create better living and sustainable environment which is meaningful and interpretable to local communities.

2.2 Ecology housing design and its influence towards occupants' comfort

Past scholars stated that there are five basic principles of ecology design that can be implemented and applied by many as elaborated below [10]. First, by creating solutions that grow from place. In this sense, built small-scale and direct project scheme, that is responsive to both local conditions and local people. Second, trace the environmental impacts of existing or proposed designs to determine the most ecologically sound design possibility. Third, design with nature by working with living processes and engaging in processes that regenerate rather than depleted. Fourth, shared responsibility in the design process in which everyone is a contributor and participant. Fifth, make nature visible by de-natured environments through making natural cycles and processes visible. This is vital as effective design helps inform us of our place within nature [11]. Involving and participating however need to be equipped with proper design knowledge on ecology, hence any design scheme should adhere to design components comprising of four main aspects. These aspects are – ecology design in terms of building placement, adaptation of appropriate building structure, application of opening or fenestration and landscaping [11].

a) Building placement

The application of ecology design principles need to be fully explored and understand to fulfill the ecological requirements. In terms of building placement there are two aspects which are building orientation and planning layout that need to be adhere [11]. Orientation of buildings play a crucial role in determining the building passive system. This is because building façade may be exposed to sun hence the building interior temperature will be affected by the direct sunlight. For instance, the east and west side of building receive high amount of solar radiation from the sun, thereby opening or fenestration in this division should be reduced. In terms of the floor planning layout, the context of internal and external adaptation need to be considered. For lower floor plans, the opening for the whole area should be emphasized to allow natural ventilation by limiting the usage of enclosed walls. Hence, mechanical cooling system can be avoided and this will reduce the usage of energy in buildings. In designing the layout plan, building elements such as thickness of floor slab, location of entrance and exits, accessibility to interior spaces as well as orientation towards outdoor spaces need to be given consideration as proper placement of building will provide ample lighting and ventilation to the interior spaces [11].

b) Adaptation of appropriate building structure

Ecological design in terms of building structure comprised of interior and exterior elements of building form. The application of suitable and appropriate building structure will not only protect building from rain, direct solar radiation, sky glare or heavy winds but also provide privacy and security [11]. From the aspect of exterior building form, the involved structures are surface of external wall and related fixtures like shading devices and shape of roof structure. According to scholars, when designing it is also advisable to determine the building surface character as it played

an important role for comfort [12]. In other words, the ratio of volume to surface area of a built form is an important indicator to determine the heat gain on the building surface. Type of wall materials and coated paint used will also specify the level of heat gain on external walls [13]. In addition to that, internal ceiling height also may contribute level of comfort in building [14]. In this sense, heated high ceilings would transmit less radiation to occupants compared to lower ceilings. The adaptation of high ceilings also may give cooler comfort to the building interior rather than the usage of lower ceiling. Higher ceiling is seen much appropriate for buildings in hot and humid site. For a large room area, high ceiling is also advisable as the absorbed heat will be distributed throughout the surface of the ceiling and this indirectly reduce the internal temperature of the room [14].

c) Application of opening and fenestration

Opening or fenestration played a vital role for indoor thermal comfort of a building as well as for providing different functions such as for visual view and aesthetical matters. These openings can be in form of windows, sliding doors, or doors and should be located at the frontal and rear façade. High numbers of openings are needed as it allows flow of natural ventilation into and within the building. These openings should also be able to prevent glare, to exclude solar radiation and direct heat as well as to protect privacy of home owners. To achieve this, the opening features need to be modified by using layers to suit different functions like tinted float glass, tempered glass, and laminated glass as well as a variety of coated glasses [15].

d) Landscaping

Landscaping is also an important factor that can improve urban microclimate and outdoor thermal comfort in urban spaces [16]. The use of the green landscape is an important strategy in building design as it may mitigate the urban heat island (UHI) and improve the microclimate [17]. In addition to that, vegetation is also required for acoustics, reduction of pollution, aesthetics and social purposes. Apart from this, the use of landscape may act as shading property mitigate the intense solar radiation in the summer as the overheating is mainly due to the storage of heat by the sunlit surfaces [18]. Moreover, plantation may also act as a screen against high winds and it is advisable for dense vegetation to be located at the building edges to give significant cooling effect. The landscape elements can be represented in terms of indoor or outdoor garden spaces provided within the house compound area.

Referring to the above, these four principles will be used as indicator and criteria to study the case study of double storey terrace housing in the Malaysian context. This is vital to review home owners' perception whether the provided housing design criteria designed by the local architects is sufficient or not to fulfil the standard of ecology homes. Findings from user perception will indicate to what extent the design criteria of ecology homes are well achieved for user's comfort. From the discussed findings, a proposed guideline will be outlined to improve the present condition of ecology homes in Malaysia for future referencing.

3. Methodology

This research will be using case study method where direct observation on the chosen case study will be conducted in parallel with close-ended questionnaire to represent each case study. Interpretivism paradigm is chosen as the research method as it involves researchers and the residents to interpret elements. It is therefore encouraging human involvement into study of interpretation

[19]. To analyse data from observation, method such as semiotic is used as it involves the study of meaning and sign [20]. This method of analysis is considered as an important contribution as it introduces new ways of looking at ecology houses as a system of 'sign' as well as proposing indicators to investigate this matter in depth. Data from observation then is built upon the theories and concepts outlined by Saussure on sign relations, Barthes on levels of signification and Gottdiener on reading the built environment as reliable ways for analysing and understanding the design of ecology homes [21]. To analyse data from questionnaire SPSS method is used and findings are tabulated for discussion. All collected data then is used to propose the best possible design guideline for ecology home to achieve the objective of the study. The research method is divided into two parts.

The first part of the research will be focusing on the observation of physical design attributes representing 2 case study of ecology housing each located in Johor and Selangor. Justification selection of the two-case study are based upon four main criteria. These criteria are- housing scheme that been certified as green building scheme by an established local housing developer, fulfill the middle -income housing criteria in term of selling cost, household ownership income is within the M40 category as well as the land plot and built up area according to size and number of units determined by housing authorities in which built-up area of each unit is between 180-280 square meters. This is important to determine whether the house design fulfils the criteria of ecology homes as outlined by the four indicators sourced from the literature review. These indicators are building placement, adaptation of appropriate building structure, application of opening or fenestration and landscaping. The selected terrace house represents link or row type and of intermediate units. This is because the terrace house is the most prevalent housing typology in Malaysia. The terrace houses share common bearing walls and can be single or multiple stories. The extent of each row cannot exceed 96 meters according to fire department regulations, so a maximum of 16 houses can be constructed in a row. The planning design of housing unit should comprise of a living room and a kitchen on the ground floor. On the second floor, there are the main bedroom at the front and two bedrooms at the back. The selected house however is studied based on its original plan to view the initial design whether it complies to the ecology homes criteria. Homes which had undergone extension are not selected as elements of renovation may affect the findings due to owners' personalization taste and individual interest.

The second part handled on the response of 50 residents to represent each case study based on conducted questionnaire. The justification for number of sampling size respondents were determined referring to number of middle income house unit located in the chosen residential area which are Superlink Courtyard Home Sunway Rahman Putra, Selangor and Licuala Garden Precinct, Setia Tropika, Johor. The sampling size is also determined based upon the benefits of Central Limit Theorem that highlights adequate size of finite population [22]. The respondents are also selected based on age group from various ethnicity with different cultural background. The selected home owners however, represent age group from the elderly (70 years old – 40 years old) category. This is because most of house occupant within this age range are usually pensioner or house wife and often spend most of their time at home [23]. Hence, the utilization of spaces within the home are mostly used 24 hours per day by this type of respondent. The choosing of the resident also is based on their period of stay in the housing units which must be above than 3 years of occupancy. This is because they will be much familiar with the existing home condition. The residents are inquired referring to the indicators developed from the 4 main principles of ecology design- building placement, adaptation of building structure, application of opening or fenestration and landscaping.

4. Findings

4.1 Results from Observation (Superlink Courtyard Homes Sunway Rahman Putra, Selangor and Setia Tropika Johor)

This section discusses on the findings gathered from observation on the two selected case study - Superlink Courtyard Home, Selangor and Setia Tropika, Johor. The observation is conducted referring to four main indicators which are building placement (EI1), adaptation of appropriate building structure (EI2), application of opening or fenestration (EI3) and landscaping (EI4).

4.2 Results from questionaire (Respondent of Superlink courtyard homes Sunway Rahman Putra, Selangor and Setia Tropika Johor)

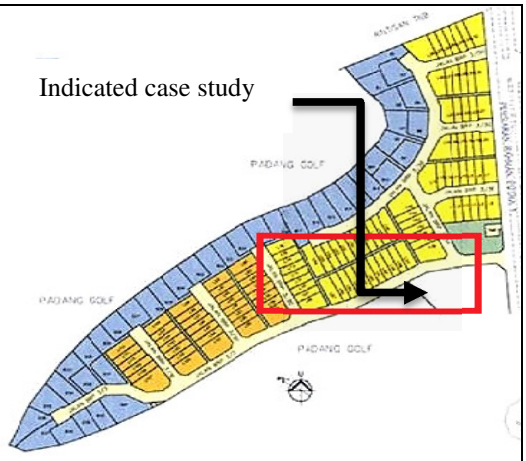
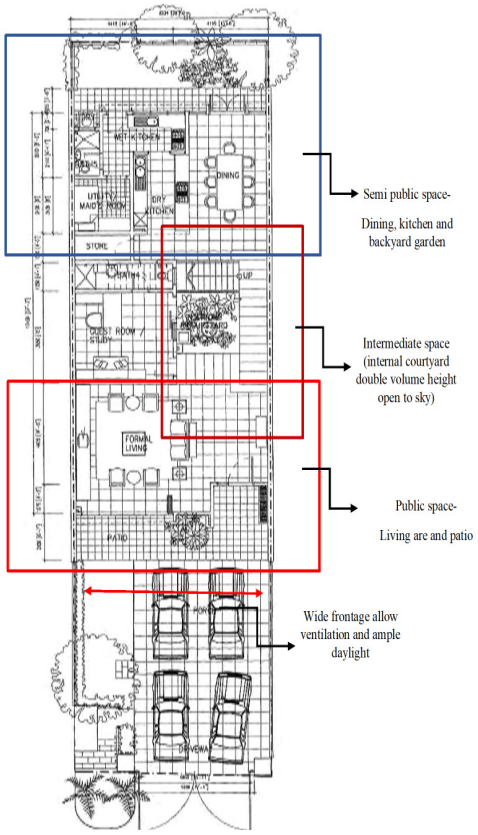
This section discusses on the findings gathered from questionnaire to review the level satisfaction of homeowners and their response on ecology needs on the two-selected case study - Superlink Courtyard Home, Selangor (SCH) and Licuala Garden Precinct (LGP), Setia Tropika, Johor. The questionnaire is conducted referring to three main indicators which are design space arrangement and usage (A1), building placement (A2), adaptation of structure (A3), openings (A4) and landscape features (A5).

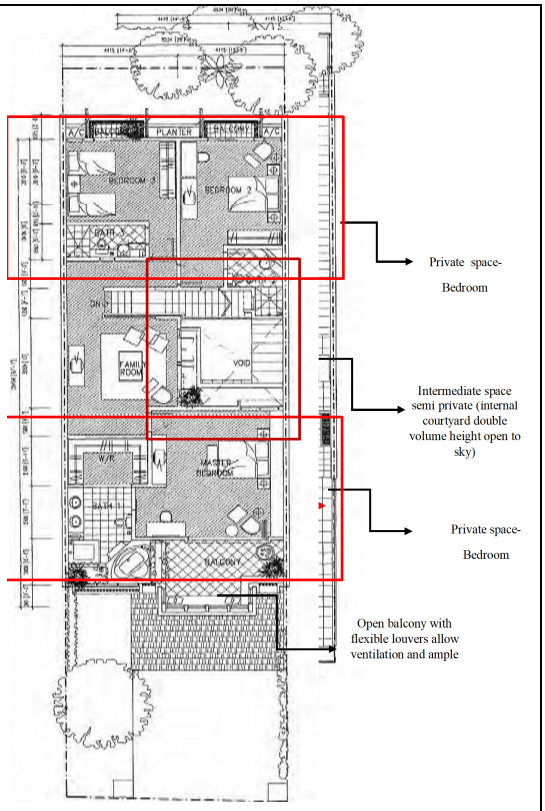
5. Discussion and Recommendation

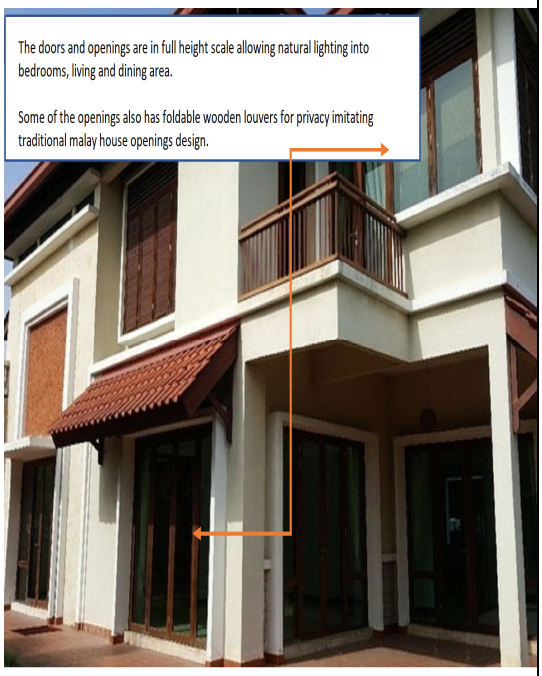
With reference to the above findings from observation and questionnaire, it indicates that each housing estate have different approach in categorizing their development as ecological homes. The SCH case study much applies the ecological concept design on the home unit itself in terms of planning layout as well as form making whereas the LGP case study prefers to portray their ecological ideation in term of master planning layout by introducing green scape like pocket parks and open public gardens rather than focusing on individual units. Regardless of different approaches made by the developers, residents living in both housing estate agrees that the architectural elements provided in each home units are only adequate in which did not fully responsive to the existing climatic context whether in terms of design space arrangement and usage, building placement, adaptation of structure, openings and landscape features.

Table 1
Results from observation

Ecology indicators	**Case study 1- Superlink Courtyard Homes Sunway Rahman Putra, Selangor** The Superlink Courtyard Home is located at Sungai Buloh, Selangor and designed based on the concept of tropical resort. This residence is enclave by tropical landscape garden and the entire residential area encompasses of 21.15 acres of land. The residential area comprises of 112 Superlink courtyard homes and is easily accessible via the highway. It is designed based on gated community system layout for privacy and security. It is a landed property type and comprises of double storey house for middle class ownership. **Figure 1**	 **Fig. 1.** Frontal view of Superlink home

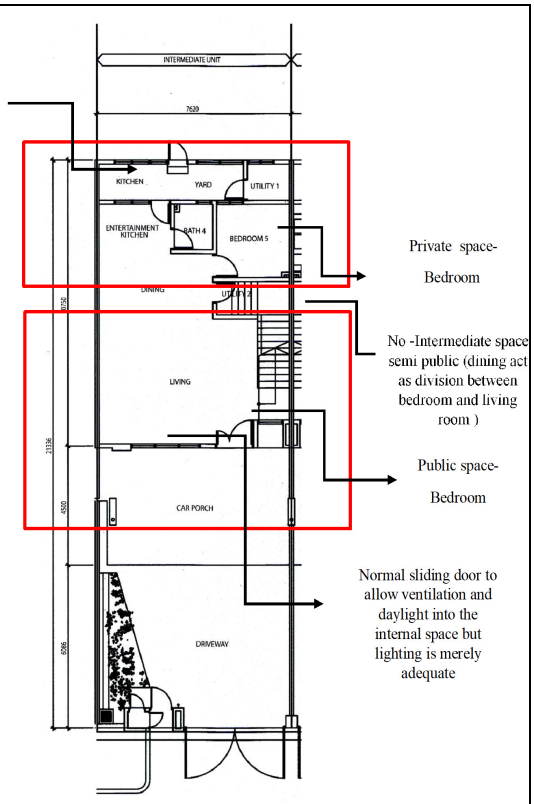
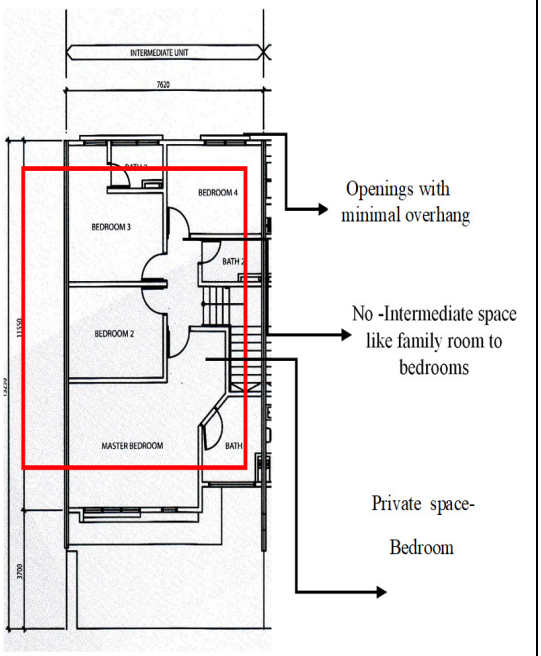
EI 1-Building placement	The location and placement of the house is on a hilly area. The front façade of the housing faces the golf course. It is evident that the orientation of the house is protected and shaded from the sun as the front and back façade are facing the north and south. **Figure 2** Each units of the link house comprised of two storey and is properly zoned and segregated according to specific function. The house is divided into public, semi public and private areas. All public and semi-private areas like porch, living room, dining, kitchen, courtyard and maid room are located at ground floor**. Figure 3** The internal courtyard is strategically located in the middle of the house and open to sky which allows ample lighting and ventilation to the ground and upper floors. Besides act as focal point the internal courtyard also allows cross ventilation whereas the stairwell act as stack ventilation. This gives cooler effect in the house interior. The courtyard provides a visual and physical link to the interior spaces. **Figure 3** Each house has wider frontage compared to normal house which are 6m to 8m in width. This kind of design encourages more cross ventilation and daylighting for a more comfortable inner space. **Figure 3**	 **Fig. 2.** Masterplan of Superlink Courtyard Homes  **Fig. 3.** Ground Floor Plan of Superlink Courtyard Homes

	Private areas like all family hall, bedrooms and attached toilets are at first floor. The upper floors had open balconies to allow natural ventilation to enter the upper floors from master bedroom to the family hall. **Figure 4** The family area is opened to the double volume internal courtyard. The family area is well lit and act as intermediate space to the private spaces .**Figure 4** Every room have its own balcony area. The balcony area however is privately contained with foldable louvers panel. **Figure 4**	 **Fig. 4.** First Floor Plan of Superlink Courtyard Homes
EI 2- Adaptation of appropriate building structure	The housing built form uses post and beam structural system while the walls are made of clay bricks with plaster finishes on both the exterior and interior walls. **Figure 5** As for the roof, it is pitched and the structures are made of hard wood while the roof tiles are made of clay. This gives a tropical resort ambience to the house. In terms of fenestration, the windows used aluminium frames and the house has many openings which allows the air and day light to pass through freely. It is also seen that solar systems are installed to be used especially for hot water system, to reduce the electric consumption of the house and to reduce the green house impact. **Figure 5**	 **Fig. 5.** Rear façade of Superlink Courtyard Homes

	The floors on the ground level are made of porcelain marbles that gives a cool feeling towards the occupants, while timber parquet is used throughout the family area as well as all the bedroom floors. **Figure 6** Each housing units has an individual internal courtyard which maximizes air flow and day lighting penetration into the interior of the house. With all this feature, it is evident that the housing scheme is free from pollutions and has a healthy environment. The internal courtyard faces the dining area and guest bedroom. Hence both areas are well ventilated and bright due to high open window above the double volume space. **Figure 6**	 **Fig. 6.** View at internal courtyard
EI3 - Openings and fenestration	The house has abundance of full height openings to allow good ventilation. This is to promote optimum air flow throughout the house and stack effect within the core centre of the house. **Figure 7** The house adopts the usage of louvered window, consists of parallel slats of veneer wood that open and close like a Venetian blind, usually using a crank or a lever. The openings are covered with deep roof overhangs for shade from direct penetration of sunlight and rainwater.	 **Fig. 7.** Full height openings and door 

E14-Landscaping	As for the landscaping surrounding the house, the entire housing area is being planted with large trees and equipped with a golf course. This made the housing area has a conducive environment filled with vast greeneries, far away from pollutions. With ample individual green areas on each housing units (approximately 60sqm meters) the houses looks comfortable and cosy. **Figure 8**	 **Fig. 8.** View at outdoor garden

Ecology indicators	**Case study 2- Terrace Housing at Licuala Garden Precinct, Setia Tropika ,Johor** Setia Tropika is an integrated modern township in Johor Baru under the development of SP Setia. Sprawling over 740 acres of freehold land, the township is planned to host several types of residential including double-storey garage house, double storey super-link house, double-storey terrace house and twin villas as well as serviced apartment and cluster homes. The Setia Tropika development also comprises of commercial developments. The chosen housing scheme is double storey terrace house at middle class category. **Figure 9**	 **Fig. 9.** Frontal view of terrace house at Licuala Garden Precinct
EI1-Building placement	The location and placement of the houses are on a flatland. The houses are arranged in a row linear type organization. It is evident that the orientation of the house is protected and shaded from the sun as the front and back façade are facing the north and south direction. **Figure 10** The lot sizes for this type of double storey terrace residence is 165 square meters to 200 square meters for intermediate lots and 400 square meters for corner lots. From observation, each unit comprised of two storey and is segregated according to specific function.	 **Fig. 10.** Masterplan of Setia Tropika in which indicated case study showed the Licuala Garden Precinct

	The circulation space within the main areas are constricted since there is no intermediate space to divide the areas for each floor. **Figure 10** Spaces on the ground floor comprises of living room, dining, dry kitchen, utility room and wet kitchen. There is no air well, garden or open courtyard since the built-up area is limited. **Figure 10** Each house has wide porch frontage with normal terrace house height at 4m. This kind of design hence, limits the flow of natural ventilation to the internal space. **Figure 11** The four bedrooms on the upper floors are directly connected with the main staircase by a small corridor. The small corridor act as a transition space but had no opening or visual view to the exterior. Hence, the corridor space may be dark and not well lit once the door entry to the bedrooms are close. **Figure 12**	 **Fig. 11.** Ground Floor Plan of Terrace House, Licuala Garden Precinct  **Fig. 12.** First Floor Plan of Terrace House, Licuala Garden Precinct
EI 2- Adaptation of appropriate building structure	The floors are made of tiles finishes which further enhance the cooling effect. As for the structure of the roof, it uses hard wood structures and glass fibre aluminium roof. There is evidence of passive design especially on the openings where shading devises are used to control glare from sun as well as to fit esthetical purposes. **Figure 13** The design of the houses in this housing scheme is modern and contemporary in outlook inspired by	

	cubes. It is mainly made of ordinary clay bricks finished with plastering on both the interior and exterior walls. The exterior walls of the houses bear various characters through a variety of façade treatments. The designer intention is to optimize sun glare to give a cooler effect to the interior. Figure 12	 **Fig. 13.** View of internal space
EI3 - Openings and fenestration	This particular housing scheme is design in a practical way where the orientation of the houses is suitable to avoid direct sunlight. The openings are less at the front and rear side. Hence, the designer took effort to provide clerestory windows above eye level to provide natural daylighting and ventilation into bedrooms spaces. The clerestory windows are located on high walls, extending up from the roofline and provide privacy. **Figure 14**	 **Fig. 14.** View in room spaces
E14- Landscaping	There is no greenhouse compound surrounding the housing units due to space limitation. The homes design at Setia Tropika features modernistic twist and yet practical for family living. Setia Tropika boasts Green Street concept with lush greenery as streetscape. Figure 15 There is a 12-acre town park at the heart of the township that offers playground, reflexology path, amphitheater and mini parks. Besides the 12-acre park, there are linear park that hosts jogging track and educational gardens, and pocket parks which can be found in each individual seven precinct.	 **Fig. 15.** View at landscape area

Table 2
Results from questionnaire

Findings		Case study	Level of satisfaction %					% Positive respond (total PR)	% Negative respond (total NR)
			1 (NR)	2 (NR)	3 (PR)	4 (PR)	5 (PR)		
A1	Comfortable and cosy interior spaces – public spaces like dining and living area	SCH	-	2	8	35	55	98	2
		LGP	30	45	5	10	10	45	75
A1	Comfortable and cosy interior spaces – private spaces like family area and bedrooms	SCH	-	5	15	10	70	95	5
		LGP	20	50	10	10	10	30	70
A1	Functional spatial arrangement responding to the lighting and ventilation needs in public spaces	SCH	-	5	10	45	40	85	5
		LGP	30	45	15	10	-	25	75
A1	Functional spatial arrangement responding to the lighting and ventilation needs in private spaces	SCH	2	3	10	45	40	95	5
		LGP	25	40	5	15	5	35	65
A1	Appropriate and suitable spaces attributes like internal courtyard/ airwell which contributes to conducive living in interior spaces	SCH	5	-	40	35	20	95	5
		LGP	37	60	3	-	-	3	97
A1	Functional space arrangement between spaces with proper division and hierarchy that provide privacy to homeowners	SCH	10	30	10	10	40	60	40
		LGP	15	45	30	5	5	40	60
A2	Suitable orientation of house unit - did not face direct sun rise and sunset - protected and shaded from sun	SCH	5	5	40	35	15	90	10
		LGP	5	5	15	40	35	90	10
A3	Comfortable with the proportion and sectional height of the interior spaces (eg – low or high ceiling height)	SCH	3	3	9	55	30	94	6
		LGP	2	7	20	55	16	91	9
A3	Comfortable with the materials used for internal wall and flooring at main spaces (living room, dining room, kitchen and bedrooms)	SCH	4	5	20	16	55	91	9
		LGP	2	2	50	35	11	96	4
A3	Comfortable with the provided fixtures like roof overhang, balconies and other fixtures at exterior facade protect from glare, rain, heat and solar radiation	SCH		10	40	30	20	90	10
		LGP	40	30	10	10	10	30	70
A4	Comfortable with the design of openings at public spaces like kitchen, dining and living area	SCH	20	30	10	20	20	50	50
		LGP	15	15	15	15	40	70	50

A4	Comfortable with the design of openings at private spaces like bedroom and family area	SCH	20	30	10	20	20	50	50
		LGP	15	15	15	15	40	70	50
A4	Satisfy with the positioning, numbers and sizes provided for openings at public spaces like kitchen, living and dining area	SCH	4	4	40	30	22	82	8
		LGP	40	30	10	10	10	30	70
A4	Satisfy with the positioning, numbers and sizes provided for openings at private spaces like bedroom and family area	SCH	4	4	40	30	22	82	8
		LGP	40	30	10	10	10	30	70
A4	Satisfy with the provided openings at private spaces like bedroom and family area to protect from glare and direct solar radiation	SCH	-	5	10	45	40	85	5
		LGP	15	45	30	5	5	40	60
A4	Satisfy with the provided openings at public spaces like living, dining and kitchen area to protect from glare and direct solar radiation	SCH	20	30	10	20	20	50	50
		LGP	15	45	30	5	5	40	60
A5	Satisfy with the provided landscape or green area and the area of green scape is adequate in each housing unit	SCH	20	50	10	10	10	30	70
		LGP	37	60	3	-	-	3	97

Many home owners suggested for improvement as they feel that many of the architectural design features are merely for aesthetical purposes, insufficient and not functional. From the questionnaire conducted, the respondent outlined their feedbacks and recommendation as follows for a better performance in residential building.

a) Adaptation of sustainable structure and materials

i) In the current context, structural elements for terrace home design much involved the usage of concrete post beam construction system. Although less can be done to modify the structural system, the roof element is the most important criteria that can be considered by designers in terms of material, construction and durability. Hence, it is recommended if home design adopts pitched roof style namely to cover main spaces like bedrooms compared to flat roof design. This is vital to avoid solar radiation and minimise heat gain trapped at ceiling level. It is preferable if the ceiling height is also increased to allow stack effect design approach. This is important as hot air will rise and allows cold air to sink. The adaptation of stack effect can significantly impact the temperature and air quality in homes. The usage of glass fibre as part of the roof material is also recommended to achieve better thermal comfort within the interior spaces.

ii) Homes should utilize low thermal value construction material with consideration to green material adaptation especially on the exterior with reference to four characteristics – resources that is reusable and recyclable, low or nontoxic for minimal chemical emission for better air indoor quality moisture resistant and energy efficient through passive and active techniques. This is advisable as it

will minimize the heat gain into the interior of the house. Low-emissivity building materials in example include window glass manufactured with metal-oxide coatings as well as reflective thermal insulations and other forms of radiant thermal barriers. This will lessen heat gain on external walls and provide cooler interior spaces.

b) Proper building placement

i) Priority should be given in placement and location of each housing units. In this regard, the house need to be properly orientate by emphasizing (wider) north and south façade, apart from emphasizing on source of breeze while having optimum day light. The east and west façade must have less to no openings to reduce solar intake and to minimize heat gain on east and west wall. By having proper placement of home, it may control the penetration of sun light and heat into the house.

ii) Each housing unit should have a harmonious relationship with its immediate environment. This can be achieved by optimizing site potential by organizing the building on site like saving natural plants to create a pleasant environment, by using the opportunities offered by the neighborhood and respecting the existing site forces. This is vital to reduce the risks of nuisance between the building, the environment and the site.

c) Design space arrangement and usage

Organize interior space effectively and functionally by placing spaces in a hierarchy of wider spaces to narrower spaces, in which basic space layout must be relative to sun path, wind flow and views. The home spaces must fit the owners' usage by means of defining the proximity, size and proportion of the different spaces needed for all activities and equipment. It is also vital to consider the owners' future needs compromising flexible design approach, for potential spatial changes from alteration or extension, and provide proper clearances for replacing or expanding building systems and equipment.

d) Provide proper openings

Place wider openings on the north and south façade to maximise air flow into interior spaces. Doors and windows for a building must be protected against humidity, heat and noise. Openings should also cater for providing safety, material durability and energy efficiency. For example, solid wood is the most suitable material that guarantees good thermal and acoustic insulation. Windows with glazing are also recommended for east and west -facing, which protects from glare and heat gain. Choosing of appropriate glazing will produce suitable thermal performance for the building interior and thermal comfort for the user.

e) Landscape features

Like courtyard other landscape features for limited space such as green roofs, terraces and balconies are also an important component that can be considered as green building approach to create a genuine micro-ecosystem. The components for limited green spaces maybe like vegetation, cleaning plants and shadow plants. By having landscape within the confined spaces, it may reduce heat spots and provide shade. As a result, better air flow will be achieved when heat is minimise which latter allows ample breeze into the house.

In brief, the residents felt that future housing development with ecological approach in mind should portray much consideration to climate and be contextually responsive. To their concern, the concept of ecology should incorporate and integrates a variety of green strategies during the design and construction process as well as throughout the operation of building projects.

6. Conclusion

From the above, it is clearly noted that in designing ecology homes there are four main principles that contributed to the level of wellbeing of the residents- which are appropriate building placement, adaptation of building structure, application of opening or fenestration and landscaping. This however, is seen crucial as it could lead to comfortable living and healthy lifestyle. The Malaysian government including developers and involved housing authorities should put all these into building consideration and work together with home designers and the private sector in providing a better living environment to elevate the household quality of life in terms of comfort and health namely in urban areas.

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