



Temperature Reduction at Housing Scheme towards Sustainable Development

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Abstract: Landscape design can support in temperature reduction for housing development and also can contribute to the beautification of surrounding. It is a way in supporting the notion of sustainable development. Since the increase of temperature issues have been ubiquitously reflected to our environment; greenhouse Chlorofluorocarbon gasses (CFC) and urban heat effects, it is imperative to control or make improvement on our care of the planet. Therefore, instead of installing air-conditioning inside a house, landscape design is strongly recommended. It is a long-term cost effective and environmental approach to minimize the consumption of energy as well as reduce surrounding temperature simultaneously. This research is a study of tree planting as a landscape design at housing scheme as natural indoor temperature control. This is a way that offers benefits towards sustainable development

Keywords: Landscape Design; Temperature Control; Housing Development

1. Introduction

Industry Conformist way of housing development involves a lot of wastages and creates hazardous environment to the society. Therefore, the adoption of sustainable development can help in reducing virgin resources consumption to optimum level and there are methods towards sustainability. Climate change has been recognized as the notable environmental problems that the sustainable development's agenda faces in 21st century. The 100-year linear increase of surface temperature (1905-2005) is 0.74°C (Galvin, 2006; Gullett, Evans, Robinson, & Hatchwell, 2014). This warming has been shown to affect many natural system based on observational evidence includes notable changes of climate, increased run-off and changes in both terrestrial and marine ecosystem. Moreover, the presence of excess greenhouse gases such as chlorofluorocarbon (CFC), carbon dioxide (CO₂) and others also contributes part of global climate changes. Chlorofluorocarbon is the waste of air conditioner; it cannot be filtered completely or absorbed by organisms. Conversely, it accumulate

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with other greenhouse gases in atmosphere present a powerful warming effect due to their heat trapping ability and long residence time in the atmosphere (Che Husin, Mohd Zaki, & Abu Husain, 2019; Omer, 2008). Hence, prior to central heating and air-conditioning, home design and landscaping performed a natural way of controlling temperature and it is a way of sustainability. Without the invention of mechanical heating and cooling system, mankind was dependent upon their ability to construct or modify their environment for comfort. Using natural instinct, mankind thrive for sustainability, to adapt; to alter of some harsh condition by channeling the landscape materials ("A sustainable material world," 2017; Uyarra & Gee, 2013; Zhang, Provis, Reid, & Wang, 2014). Different landscaping techniques can be used to influence microclimates resulting in energy savings. On average, a well-designed landscape provides enough energy savings to return the initial investment in less than 8 years (Design, 2018; Hayden, Cadenasso, Haver, & Oki, 2015; Shashua-Bar, Pearlmutter, & Erell, 2009). Accordingly, a proper landscape design should often takes a few considerate steps on climate, site, and design to accomplish the principles by the way fulfil client's requirements. Practically, landscape design can be clarified as organizing and enriching outdoor space by implementing plants and structures in an agreeable and useful relationship with the natural environment.

As the concept of sustainability is gaining acceptance, this means achieving sustainability must through environmental aspects, social needs, and also through economic accountability (Harris, 2012; Kara, 2013; Mohamed, Hilmi, Wee, & Chen, 2015). As such, to carry out sustainable development, housing scheme needs a landscape design that can support its notion. The general community, which is probably the most important stakeholder in sustainable development, must also actively involve or participate in the solutions by modifying their behaviour patterns. At present, public or community perception of landscape design is need of encouragement because of the environmental impact. Therefore, housing scheme must be an important agenda for any developer.

2. Literature Reviews

Tree add something to the house and can give the surrounding a shades from sunlight. For the sake of saving energy, sun protection display an important role when hot temperature can be neutralized significantly by planting a tree and minimize the using of air-conditioner (Conway & Vander Vecht, 2015; Domingos, Guarda, Gabriel, & Sanches, 2019; Duursma *et al.*, 2010). Besides that, exposure to the sun not merely increase heat generated from exposed surfaces but also reduces the working ability of people. Normally, people feel most comfortable in the following conditions: shade, no air movement, air temperatures between 21°C - 27°C, and relative humidity between 30 percent and 65 percent (Li *et al.*, 2010; Toe, 2013; Wang, Liu, Song, & Liu, 2015). The balancing of the comfort zone is automatically broken, when air temperatures rise or direct exposure to the sun. Hence, instead of installing air-conditioning, one approach to overcome this situation is planning the outdoor location with the respect to sun location and also applied suitable methods to lower the surrounding temperature.

Approximately two trees shade the west-facing exposure of a house and one tree shade the east-facing exposure reduced annual energy use for cooling by 10 to 50% and peak electrical use up to 23% (Domingos *et al.*, 2019; Sawka, Millward, Mckay, & Sarkovich, 2013; Sh. Ahmad, 2012). Consequently, a well-strategically planning landscape can reduce the demand of air-condition and instead of generate sizeable electricity usage for cooling houses in a hot weather. Fundamentally, weather cannot be controlled by human being, but a systematic design planning indicates how to cast shade, channel winds, and reduce surrounding house moisture (Lin, Matzarakis, & Hwang, 2010; Tan, Wong, & Jusuf, 2013). Therefore, saving energy approaches become a crucial character not only to reduce the bills and sitting for a comfortable place as it can improve the environmental quality and cut down the pollution.

Thus practitioners, stakeholders and policy-makers that plan and develop the housing scheme should acknowledge the importance of tree planting. Hence, the encouragement and strategize ways to implement the sustainable development in terms of reducing temperature in a natural way should be on the local community agenda.

3. Research Methodology

In this research, an experiment method is employed to achieve the objective which is to study a landscaped house effect on the indoor and outdoor temperature. Outdoor temperature is fixed at around car porch area, while the indoor temperature is located at living room. For this experiment, there are 8 houses are suitable selected and readings are collected for 8 days. Each day is separated into 7 sections which is to measure the related temperature from 8:00 am, 10:00 am, 12:00 pm, 14:00 pm, 16:00 pm, 18:00 pm and 20:00 pm. Separation of time is an extremely important factor in this experiment. It shows any differences of indoor and outdoor temperature within landscaped houses and non-landscapes house among these selected time period.

Moreover, these 8 houses are selected to represent each orientation, which are 2 houses are faced to east, and 2 houses are faced to west, as well as south and north respectively. This factor considers the orientation of sunrise and sunset which are varying in temperature especially morning and evening period (Schweitzer & Erell, 2014; Tan *et al.*, 2013; Wang *et al.*, 2015). In the research, east orientated house is affected by sunrise factor in the morning period and conversely for west orientated house. A major consideration in designing an experiment is the method used to change independent variable in order that any consequential changes in the dependent variable can be measured (Jin *et al.*, 2014; Rossiter & Smith, 2018; Wang *et al.*, 2015). There are 5 constraint taken into account to ensure the data obtained is valid. The 5 constraints are:

- i. Location of house
- ii. House Orientation
- iii. Type of house
- iv. No air-conditioner available
- v. Place to measure temperature

In this experiment, Parit Raja, Batu Pahat are chosen as the location of houses and all of the 8 houses are terrace houses.

4. Result & Discussion

The issues on climate had become a notable environment issue nowadays. Moreover, unmanageable waste at construction site, poor housing landscape, river management and unsustainable housing planning are also issues that community experienced for decades (Ramakrishna, Jignesh & Anup, 2020; Wong, 2011). Hence, one of the action is implementing landscape within residential house area which can counter the issue on sustainable development. However, implementing a landscape house is not a simple matter, there should be understanding of some general landscape knowledge before implementing it such as microclimates, pros and cons of

landscape and suggestion of plants (Kroeger, McDonald, Boucher, Zhang, & Wang, 2018; Tengberg *et al.*, 2012). These knowledge to ensure the optimization of the benefits offered by landscape.

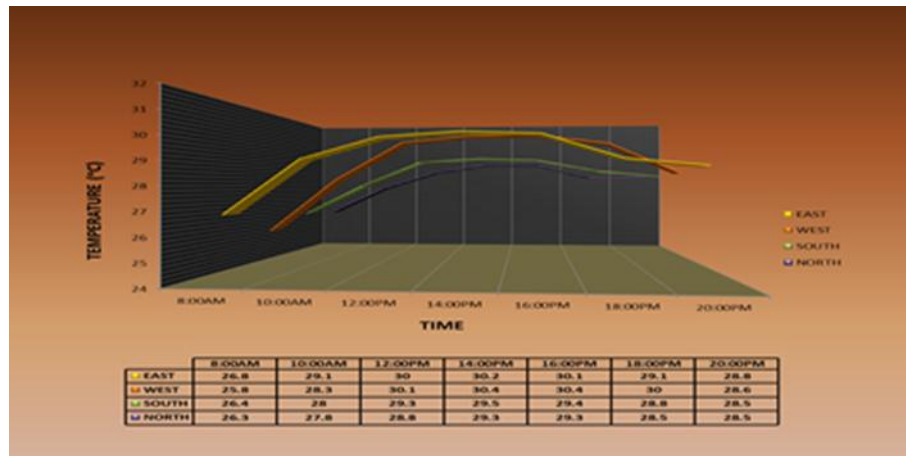


Figure 1: Outdoor temperature between four orientations

Figure 1 shows the outdoor temperature between four orientations (east, west, south and north) at landscape house. From the graph, yellow stands for east, orange stands for west; there is a very significant circumstance, due to the sunrise issue, east's temperature is higher than others side during the morning period and reached 26.8°C at 08:00a.m as well as 29.1°C at 10:00a.m. Conversely, west's temperature is higher during evening that period. There is another condition in the graph, where north temperature is obviously cooler than other orientations, even more the outdoor temperature always do not over 30°C. It shows that the north orientation house able to offer a cool condition better than others orientations.

On the other hand, other results showed the landscaped house can reduce the heat gain and able to maintain indoor temperature at thermal comfort environments. In addition, the north orientation clearly display more low temperature than other orientations. The results show that landscape house able to reduce the indoor temperature and outdoor temperature respectively from 0.5 °C to 4°C, which is cooler than non-landscape house. Landscape house able to reduce the indoor temperature and outdoor temperature respectively with mature trees that are 4 to 6°F (2 °C to 3°C) cooler than non-landscape house (Conway & Vander Vecht, 2015; Domingos *et al.*, 2019)[37-41]. Based on the result displayed, there are at least 1°C lower down the indoor and outdoor temperature if compared to non-landscaped house. Deduction of temperature become even more obviously especially during afternoon period. The main reasons is evapotranspiration process is undergoes around the plants and water evaporation and plants 'transpiration makes the temperature become cooler (Hayden *et al.*, 2015; Nguyen, Schwartz, & Dockery, 2014). It is evidenced in the results displayed and it is a positive results to show the differences of the temperature.

Nowadays, majority of the people highlighted landscape design as a painting to enhance and emphasis a place aesthetics appearance by adding ornamental features and plants (Abdullah, Kanniah, & Ho, 2018; Hall, Handley, & Ennos, 2012; Wu, Xiao, & McPherson, 2008)[44-46]. However merely planting and decorating is not landscaping. A well-conceived landscape design should be considered in having four important criteria consists of aesthetical, economical, functional, and environmental respectively [47-48]. Therefore, by carefully design the tree planting as landscape, it should reflect the benefits it offers to the society, economy and environment.

In addition, trees shading as landscape design also affect the outdoor temperature since it can directly block the sun exposure towards house area. Besides that, from the results, it identifies the north orientation house is subject to lower temperature as compared to other's orientation. Moreover, the result demonstrates the north side's house definitely cooler than other orientation. This is because of the effect of the sunrise and sunset, where during the morning period, east side gets more sun, conversely from west side during evening period. Hence, the planning and development of housing scheme should be able to address this in order to avoid the effect of heat and this is economically beneficial.

5. Conclusion

The high ambient temperature, wind control, and water usage all affect energy consumption and this consumption can be modified to some extent through landscaping. However, estimating energy savings from appropriate landscaping is difficult due to many climatic and environmental variables. Besides that, global warming, greenhouse effect, and also some pollution can be addressed significantly by well-designed landscape, coupled with create an aesthetic mother nature. Therefore, a proper and critically planned landscape design is needed since it is not only display a beautiful view to people, it also aimed at achieving energy saving as it reduces the destructive action towards the earth and comply with the sustainable development agenda.

According to data analysis and result displayed, the landscaped house able to reduce heat gain as compared to non-landscaped house. This objective is obtained through experiment and the result showed that the landscaped house significantly can alter the indoor temperature as well as outdoor too.

In a nut shell, a landscaped house not only provides aesthetic vision, however simultaneously control indoor and outdoor temperature. It might be a small contribution to the environment, but if every house owner is rather to give a hand to address climatic changes nowadays, it will be more effective especially in resolving the urban heat island issues. In the meantime, landscaped is able to neutral the carbon dioxide content and maintain the ecosystem as well and therefore the sustainable development's agenda is followed.

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