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MELAKA TRADITIONAL HOUSE AS A GALLERY WITH INTERIOR COURTYARD: ANALYSING VISITORS' FEEDBACK TOWARDS ENVIRONMENTAL IMPACT

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Abstract— This study aims to critically analyse the multifaceted impact of courtyard environments on the interior architecture climates of traditional Melaka houses, particularly in Merlimau. It emphasises the environmental consequences of courtyard design in Malay traditional housing in Melaka. Nonetheless, in this innovative era, courtyard design is one of the most essential aspects of house construction today. In Malaysia, global warming impacts the interior spaces of traditional Malay houses. It will explore how natural light, ventilation,

Malay houses, environmental, indoor thermal comfort, Melaka

and thermal regulation from courtyards contribute to occupant comfort and well-being. Furthermore, the study will propose innovative design methodologies to integrate these environmental benefits into contemporary residential architecture, ensuring that modern houses respect traditional practices, enhance energy efficiency, and promote sustainable living. The target respondents, those who visited this house, were given questionnaires as part of the quantitative approach, and the findings were analysed using SPSS and PLS-SEM. The main findings show that a traditional Malay house's courtyard is an important component of its environmental features, improving the thermal comfort of its interior focusing on Demang Abdul Ghani House's courtyard design. The findings are intended to help interior architects practice sustainable indoor design, conservators preserve traditional houses, and developers develop designs for the courtyard environment, influencing the interior spaces.

I. Introduction

A courtyard is a confined space seen in the sky and usually surrounded by a structure [1]. Courtyards are a common and traditional construction feature used by traditional and modern designers. A key component of both Eastern and Western architectural designs is courtyards. Whether the architecture is ancient or modern, courtyards are an integral part of it. For example, a courtyard is a common opening architectural design element in tropical

constructions or house due to its social, cultural, and environmental benefits. According to it, openings are common in all houses and constructions, which are intended to enhance natural lighting, air movement, and wind flow for thermal comfort [8]. Courtyards have important social and environmental impacts because they provide private, open space all around the structure [2][7]. However, environmental elements in every country can impact courtyard design, whether in traditional or modern houses. Malaysia's climate, for example, is tropical, with high temperatures and humidity, as well as significant rainfall throughout the year.

II. Literature Review

Traditional housing design has taken into account environmental considerations to produce comfortable and sustainable living spaces. Courtyards have long been an essential architectural component in traditional housing designs, particularly in tropical climates, due to their environmental, physical, and cultural benefits. Courtyards have been an important part of sustainable and comfortable housing designs, particularly in traditional settings, because they include these environmental, cultural, and aesthetic qualities.

A. Environmental

The environment is an array of directed and patterned interactions between items and people. The environment is structured and does there exist independent of humanity and the planet's natural conditions [3]. These physical environment interactions are primarily spatial, which means that goods and people are connected by separation in and by space. Meaning that items and people are related through separation in and by space.

B. Courtyard

There is no predefined layout for the courtyard. A house's courtyard might be rectangular, square, circular, or curvilinear [4]. The basic courtyard design evolved over time to meet various environmental

considerations such as terrain, size limits, and so on. When creating new courtyard shapes, keep the structure's direction and purpose in mind. Furthermore, the courtyard design might be fully enclosed (four sides), semi-enclosed (three sides), or merely two sides. During this time, courtyards were commonly employed in multi-storey structures or residences.

C. Thermal Comfort

Thermal comfort is defined as decreasing heat absorption by the body from the environment through solar radiation or warm air to maintain a constant body temperature of around 37°C [5][8].

D. Asses Psychological Impact

The psychological effects of indoor courtyards in traditional Malay houses and modern buildings with courtyard layouts are substantial and varied [6]. Courtyards give natural air, brightness, and a connection to nature, which can help relieve stress and improve mood, adding to occupants' overall well-being.

It also serves as social places for interactions between family members and neighbours [7], which promotes family bonding community participation, which are important for psychological health and social cohesion.

The design of courtyards frequently allows for private outdoor places to be concealed from the public, giving occupants a sense of security and seclusion that benefits their mental health [7]. Traditional courtyard houses frequently represent cultural beliefs and customs, creating a sense of identity and belonging among occupants.

III. Math and Equation

A. Site Study

Demang Abdul Ghani's house is in Merlimau, Melaka. Demang Abdul Ghani bin Penghulu Abdul Majid owns the house. The house is about 121 years old. The house was constructed from a variety of woods, including merbau, chengal, and jati, all of which are recognized for their durability. It

was built on a 1, 350m^2 property with an internal courtyard.

This study examines the effect on the environment of Melaka's traditional houses with interior courtyard architecture. Melaka traditional house courtyard design may be evaluated for its environmental impact by evaluating thermal comfort, air quality, and energy efficiency.

B. Data Collection and Analysis

This study uses Likert's 5-point scale, with options including "strongly disagree," "disagree," "neutral," "agree,"" and "strongly agree." Questionnaires were provided and completed to assess the environmental effects of courtyard design in traditional Melaka houses, with 35 valid questionnaires collected after three weeks of distribution on site. All questionnaire data will be evaluated using descriptive statistics and independent sample t-test procedures to determine the difference between the analysis of various background variables and research variables.

C. Demographic

The demographic reveal that male respondents (60%) are more encouraged to answer the questionnaire than female respondents (40%). The respondents age group of 18-29 years old was the majority group in this study with 62.9%, while the age group of 30-39 years old had the fewest respondents (37.1%), and those aged 49-60 years old did not reply to this online questionnaire. Most respondents in this research (97.1%) were Malay, followed by Indian (2.9%), Chinese (0%), and others (0%).

The frequency distribution and descriptive analysis are calculated using mean measurements. Mean is the average of the Likert Scale from 1 to 5, as 1-Strongly Disagree, 2 -Disagree, 3 - Neutral, 4 - Agree and 5 - Strongly Agree. The equation for mean is as Equation (1).

$$Mean(x) = \frac{\sum_{i=1}^{n} xi}{n} \quad (1)$$

where:

n = number of items in the sample populations
i = Population means
xi = the total of all scores presents in the population
Σ = the sum of all values in a set

In descriptive statistics, to validate, the standard deviation represents the degree of scatter or dispersion of the data points with respect to their mean. For an approximately normal data set, the values within one standard deviation of the mean account for about 95% (value ±2). Thus, in this study, the standard deviation is used to access the closeness of measurements to the true value as Equation (2).

$$S = \frac{\sqrt{\Sigma(x-\bar{x})^2}}{(n-1)} \quad (2)$$

where:
S = population Standard Deviation
$\sum$ = means "the sum of"
n = number of data points in the population
x = each value from the population
$\bar{x}$ = population mean

IV. Results and Model

The purpose of this research is to study the relationship between thermal evaluation, general knowledge, environmental impacts of courtyard design, courtyard design, and integration strategy in the context of the environmental effects of courtyard design in Melaka traditional houses.

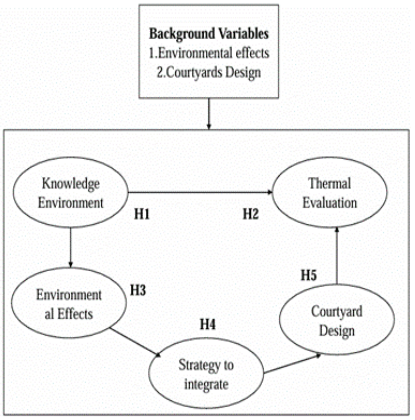

Figure 1: Model and Hypothesis

This approach method can help determine how the dimensions' interactions and influences work. This study suggests the following hypotheses, H1-H5 as shown in Figure 1, based on the planned research and framework below:

i) Comparing the research dimensions of different background variables

ii) Correlation of influence between research dimensions

A. Analysis of Environmental Effects of Courtyard Design

Independent sample t-tests for the environmental effects of courtyard design in Melaka traditional houses for various indicators as tabulated in Table 1 revealed significant differences between environmental effects in Melaka traditional houses in terms of thermal comfort evaluation, general knowledge, environmental effects of courtyard design, courtyard design and integration strategy. Respondents who have been there are more likely to agree that courtyard design surpasses other indicators' experiences. Differences in the environmental effects of courtyard design in Melaka traditional houses were examined.

Table 1: T-test Analysis

Indicators	Mean	Std. Dev.	T-Value
Evaluation of thermal comfort	0.442	0.408	0.416
General knowledge	0.494	0.444	0.416
Environmental effects	0.616	0.481	0.401
Courtyard design	0.70	0.870	0.058
Strategy to integrate	0.458	0.870	0.070

Table 2: Path Analysis Verification

Path Analysis	Path Coefficient	T-value	P-value	Hypothesis
CD & STI	0.253	0.2185	0.029	H1 valid
EECD & STI	0.672	4.278	0.000	H2 valid
EVT & EECD	0.461	0.664	0.507	H3 valid
EVT & GK	0.907	1.756	0.079	H4 Valid
GK & CD	0.481	2.183	0.029	H5 Valid

B. Path Analysis Verification

Path analysis is used to investigate and clarify model verification. The route analysis evaluates the value of t to determine whether the hypothesis is accepted. Table 2 indicates that H1, H3, and H4

are statistically significant (p-values < 0.507). The t-value is <4.278 and the p-value is >0.05, indicating that H3 does not reject the null hypothesis. A p-value of 0.05 indicates that no influence was seen. As a result, all the study's hypotheses are valid. Table 3 and Figure 2 show the PLS-SEM route analysis model.

Table 3: Intermediary Effect Verification

Independent Variables	Intervening Variables	Dependent Variable	Direct Effect	Indirect effect	VAF	Hypothesis
STI	GK	EECD	0.139 (t=1.756)	0.181 (t=4.278)	55%	H3 Valid

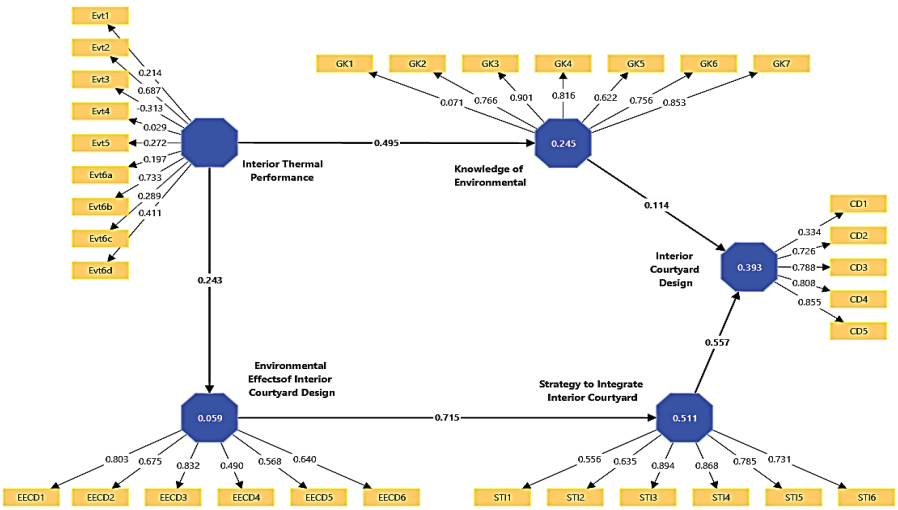

Figure 2: Path Analysis Image of Environmental Effect of Courtyard Design

C. Intermediary Effect Verification

Table 2 shows the t-value of the indirect impact can also be used to determine the test for the intermediary effect. A t-value greater than 1.96 indicates the existence of an intermediate effect. The Variance Accounted For (VAF) number can be used to determine the size of the intermediary effect. A VAF of less than 20% suggests a minor intermediary influence. Meanwhile, 20% < VAF < 80% suggests a partial intermediary effect. So, VAF larger than 80% indicates a broad intermediary

impact. In this study, GK serves as an intermediate between STI and EECD. The indirect impact value is 0.181, and the t-value is 4.278, both statistically significant. As a result, the H3 idea has been validated. Thus, GK serves as a partial intermediate in the impact of STI on EECD.

V. Conclusion

Based on data analysis, the researcher discovered that the environmental effects of courtyard design are significantly influenced by the desire to engage in traditional Melaka the house experiences. To conclude the present portion, the PLS and SPSS analysis gives useful information on the significance and efficiency of the proposed model relationship. The aim of this research is to identify the factors that determine the environmental effects of the courtyard in a Melaka traditional house using structural equation modelling in PLS. This study was undertaken to better understand the association between thermal evaluation, general knowledge, environmental consequences of courtyard design, courtyard design, and integration strategy. In the proposed model, that two elements influence analysing the environmental effects of courtyard design, namely general knowledge and environmental effects of courtyard design. Furthermore, the researcher claims that environmental factors can alter the courtyard design and interior of that house historically.

A. Novelty

This study has produced novelty in the fields of interior architecture in findings on the environmental effects of interior courtyard design in heritage traditional Malay house. The findings have revealed that the courtyard brought benefits to the interior houses by well responding to the tropical climate such as reducing hot temperature, bring air movement and to lower air humidity resulted a thermal comfort of the surrounding interior of the house.

B. Recommendation

Courtyards integrated into traditional houses have the potential to significantly improve the built environment's environmental sustainability. It improves thermal comfort and air purity. The extension of courtyards into traditional houses in Melaka, Malaysia, was explored in terms of occupant perception and satisfaction, design, comfort, function, and use. The study showed those who embrace the courtyard, which is incredibly important in terms of spatial design, comfort level, use, and functional features in traditional houses.

VI. Acknowledgement

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