HARMONIZATION BETWEEN ARCHITECTURAL COMPONENTS WITH NATURAL FOREST ENVIRONMENT THROUGH FORM, COLOR, TEXTURE FOR RESEARCH AND EDUCATION FOREST IN MALAYSIA

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ABSTRACT

The impact of the COVID19 pandemic has raised awareness regarding the vital role of forests as "environmental cleaners" that purifies our living environment. Public education in forest sustainability is a must whereby the Research and Education Forest would be the best medium to achieve this target. Although many researches have been conducted on forest conservation, studies on architectural design factors associated with the sensitivity of natural forest ecosystem remains enclosed. Hence, this study aims to investigate the significant correlation between the design elements of form, colour, texture and the harmonization of architectural components with natural environment in Research and Education Forest. The Pearson Correlation analysis revealed that all selected design elements correlated positively with the harmonious design factors on the architectural components. Meanwhile, the regression analysis also verified the proposed model statistically and the results proved that character of form, juxtapose of colour and feeling of texture are affecting the harmonization of architectural components. The findings conclusively determined that the design harmonization has a crucial impact on the architectural components in Malaysia's Research and Education Forest.

Keywords: *forest ecosystem, architectural design, harmony with nature, design elements*

INTRODUCTION

The COVID 19 pandemic had affected a significant reduction in environmental pollution by humans as well as increasing better levels of air and water quality. It should be emphasized that the moment humans stop polluting during the total lockdown, the forests are cleaning up the environment. Without forests, the air quality would unlikely be better as per the records shown in Paris, Madrid, Milan, Rome as well as Kuala Lumpur, Penang, Johor Bahru and Kota Kinabalu. Therefore, forest conservation must be given attention by all parties with the immediate effect to enforce the community's awareness on the importance of forest sustainability which could only be achieved by the harmonization of architectural components. Indeed, the Research and Education Forest is the obvious medium that

functions as an outdoor classroom to cultivate awareness. In line with that, this study focuses on the identified design elements of form, colour, texture and the harmonization of architectural components with natural forest environment.

Humans have been living in harmony with nature since the existence of civilization. This harmonious interaction between the two provided a remarkable impact to the environment since their survival depended on each other. Moreover, harmony is also associated with sustainability where the goal is to respect the environmentally sensitive areas, while conducting efficient management from every aspect. Ideally, the combinations of architecture, science, and humanities with natural environment towards sustainable development would be the noble design knowledge and conservation practice. It will produce a long-term positive effect as well as providing overall protection for Mother Nature (Milosevic, 2004; Chen & Wu, 2009; Shebek, et al., 2020). Hence, according to Mohd Kher & Syuriaty (2021) harmonized design approach is vital in associating the architectural components with the natural ecosystem. Therefore, this study aims to investigate the significant correlation between the design elements of form, colour, texture and the harmonization of architectural components with the natural environment at the Research and Education Forest. To accomplish the aim, harmonization is an essential attribute in this study. It is shown by National Institute for Environmental Studies Japan (2021) who has also conducted the research and program on 'harmonization with nature', where it take the measures for conservation of biodiversity and the sustainable use of ecosystem services, which are essential for establishing a society in harmony with nature with purpose is to mainstream biodiversity, promote transformative change as well as to improve natural capital by sustainable use of biodiversity.

HARMONIZATION OF ARCHITECTURAL COMPONENTS

Natural forests are fragile and have a very sensitive environment as stated in the Garis Panduan Perancangan Pemuliharaan dan Pembangunan Kawasan Sensitif Alam Sekitar (KSAS), Hutan Simpan Kekal by PLANMalaysia (2017) where designers and the relevant parties involved should optimize the ecosystem's functionality. Attaining sustainable development for a sensitive forest ecosystem in Research and Education Forest with the application of harmonized design approach is the ultimate achievement for this study. Additionally, enhancing the understanding on how to deal with the design process that involves natural forest areas in a sustainable and efficient way is also required. This is because fulfilling the users and natural environment's needs are a necessity (Nassauer & Opdam, 2008; Musacchio, 2009).

From the forestry perspective, most studies are focused on forest production, forest management, wildlife conservation and environmental issues; meanwhile, from the architectural perspective most of the related studies are on the "Design with Nature" with the general site's contextuality, as well as recreational forest's usability. Hence, the studies on architectural design factors that are associated with the sensitivity of natural forest ecosystems remains enclosed, particularly on the architectural design approach that fits with the sensitivity of the forest ecosystem in Research and Education Forest. Thus, Mohd Kher & Syuriaty (2021) stated that harmonized design approach requires a suitable application of design elements which blends with forest settings.

As a whole, the affecting factors for the harmonization of architectural components are the association of design factors via harmonious character of form, juxtaposition of colour and feeling of texture; and the forest factors as shown in Figure 1.

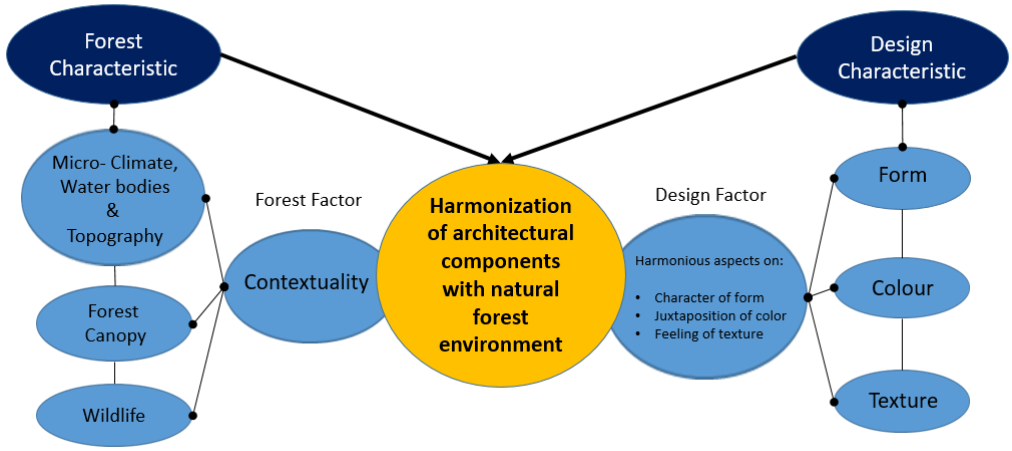

Figure 1: Factor affecting the harmonization of architectural components

THE IMPORTANCE OF HARMONIZED ARCHITECTURAL COMPONENTS FOR A SUSTAINABLE FOREST ENVIRONMENT

Harmony exists in nature and man-made environments. According to Peter & Olukayode (2017), during early man's existence, there is a closeness to natures' relationship. Inspired by that, harmony creates comfortability, suitability and serenity. Frank Lyod Wright worshiped the natural environment in his architectural works and others famous architects – Le Corbusier, L. Mies Van Der Rohe, A. Aalto, E. Saarinen – were involved in the study and discussion on nature and design, extending and deepening the concept of harmony from the point of view of environmental sustainability as well as enhancing its social, cultural, ecological, aesthetic and other humanistic values (Shebek, et al., 2020). In design, the principle of harmony can be described as unity in diversity, the belonging of one thing with another (Hatch Design, 2021; Lomas & Xue, 2022), whereas in the context of harmony with the forest environment, the composition of design element should abide by the needs of natural forest entities such as flora, fauna and other natural resources, so the harmonization of architectural components is to uphold the importance of forest sustainability. This above instances was supported by Gould & Hosey, 2006; Shebek, et al., 2020 on the application of harmony principles through the consistent use of design elements with the consideration of the forest ecosystem. Therefore, this will produce a harmonious ambience via connection and integration of architectural components with the natural forest environment.

FOREST CHARACTERISTIC

Malaysia's forests currently covers 55.3% or 18.28 million hectares of total land area and the country is committed to maintain 50% of its forest area which is covered by tropical rainforests that makes its existence unique, while filled with an extremely complex ecosystem surrounded with the precious essence of nature (Izaidah, 2015; Whitmore, 1975). The commitment to preserve its biological diversity and conserve the natural habitats shown by the establishment of National Forestry Act 1984 (Amended 2006) which divided the Permanent Reserve Forest into various functional classes to protect and control all types of activities and every form of development in forest areas (Jabatan Perhutanan Semenanjung Malaysia, 2019; Mohd Kher & Syuriaty, 2019). Subsequently, the National Forestry Policy 1978 (Revised 1992) has classified forest into four broad categories which include Production Forest, Protection Forest, Research and Education Forest and Amenity Forest. This study emphasises on the Research and Education Forest which function for research, education and conservation of biological diversity (National Forestry Policy 1978 (Revised 1992). Indeed, Research and Education Forest is considered as important part of the natural forest of Malaysia and the difference from others forest categories is on the functionality. Apparently, Research and Education Forest's physical characteristic is a microcosmic of Malaysia's natural forest.

In Malaysia, dipterocarp forests are the most common forest type and rich in species even by global rainforest standards (Jabatan Perhutanan Semenanjung Malaysia, 2019; Sime Darby, 2017; Ashton, et al., 2015). Nowadays, most of the lowland dipterocarp forests in the vicinity of urban areas has turned into recreational forests for tourism purposes and the most unfortunate is the land is converted into residential and commercial use. Hence, there is a need to establish the Research and Education Forest especially at the fringes of urban areas for the survival of the natural forest, particularly for public research and educational purposes. Therefore, Sultan Idris Shah Forest Education Centre (SISFEC) has been chosen for this study to further investigate the impact of selected design element on the harmonization of architectural components with lowland dipterocarp forests.

The main character of the lowland dipterocarp forest is thick and dense, evergreen and has large broad-leaved trees. Generally, it is a four-layered lowland dipterocarp forest namely the emergent layer, the canopy, the understory and the forest floor where each layer receives different levels of sunlight so there are different types of fauna available (Saw, 2010). In relation to the vegetation factor, trees density with high value 'banir' roots as well as undergrowth with ethnobotanical value has highly potential for research and education purposes. In term of micro climate, it is hot and humid all year round, with rain throughout the year whereby Saw (2010) specified the annual rainfall at >2000 mm, with no distinct dry season. The excessive rainfall and high humidity can cause the outdoor floor surface conditions or architectural components to be easily mossy and at risk of being slippery. Similarly, on exposed wall surfaces, it is at risk of being easily cracked, mossy and dirty.

DESIGN CHARACTERISTIC

Design elements are the fundamentals when developing the architectural design. In ensuring a good relationship with natural forest environment, the application of design elements must respect the forest ecosystem as well as the visual appearance of natural forest environment. In architectural design, Ching (2007) pointed out that conceptual elements of architectural design are point, line, plane and volume. Furthermore, there are seven elements of design that designers can apply namely line, colour, shape, form, value, space, and texture (Gatto, et al., 2011). Additionally, Stankovic, et al., (2018) defined when conceptual elements become visible, they have shape, size, color, light and texture. However, the application of design elements in the forest are dependent on the forest characteristic, contextuality as well as site suitability. Hence, for this study, based on the existing architectural design component found in site study (SISFEC) that blends with the natural forest environment, the selection of design element that has been identified are form, colour and texture. The detailed description on the selected design elements are as follow:

ELEMENT OF FORM

Understanding the characteristic of form is an important basis in developing architectural components, where every detail of the form requires special consideration, especially within a sensitive forest ecosystem. Stankovic, et al., (2018) illustrated that form in architecture is not only related to space and the activity that occurred within this space, but the character of the additive process as well as the number and dimensions of the elements being attached will define whether the identity of the initial form is altered or retained. However, according to Ching (2007), forms can retain their regularity even when transformed dimensionally or by the subtraction or addition of elements. Thus, the form's character needs to be determined for its specific design requirement that responds to the forest characteristic to acquire a strong relationship between the form and the harmonization of architectural components with the natural character of forest environment.

ELEMENT OF COLOUR

From the architectural point of view, Bell (2008) explained that colour is an expressive component in architectural design and can be utilized to highlight the building character in producing unity and balance, or it can be intentionally differentiated to charge or highlight that might influence the route where individuals react to their surroundings and can upgrade a state of mind of quiet or euphoria. This was further strengthened by Tarajko-Kowalska, 2012; Manav, 2017; Yilmaz, 2017 where architects are frequently talking about creating an integral visually comfortable colour environment for architectural and natural objects of the city. However, Bos, (2008); Thorpert, et al., (2018) argued that while implementing the concepts of organizing city's colour environment, there is limited research about colour formation in natural forest areas on architectural components. Accordingly, this study has emphasized on the influence of colour in the configuration of architectural components within the forest environment. In order to pursue the relationship between colour and the harmonization of architectural components with natural character of forest environment, the juxtaposition of colour should be determined due to its strong affection on the forest scenery.

ELEMENT OF TEXTURE

Texture can be referred to the quality of surface and can create mood of an object such as smooth, rough, coarse, medium and fine which could also be real or implied. Real texture are those surfaces that we can touch and feel in its natural existence. Implied texture are the work of art for a surface that are simulated to imitate natural material or new surface. From architectural viewpoints, material's texture is an integral part of architectural environment perception and quality evaluation (Wang, et al., 2020). Le Corbusier's series of concrete design has demonstrated the important role of material texture in architecture (Rasmussen, 1959). Meanwhile, Ashihara, 1970; Hesselgren, 1972 has emphasized the role of material texture in architectural design, but did not mention how to perceive or evaluate the differences in texture. Theoretical research on the texture of building materials are focusing on the fundamental properties of the texture of materials (Ohno, 1984), their composition technology (Borch, 2004) and the application of visual expression (Niebrzydowski, 2019). Hence, the feeling of texture and its function to the overall arrangement of architectural components within the forest environment should be determined to enhance a meaningful effect in the context of design visibility.

STUDY SITE

The Sultan Idris Shah Forest Education Centre (SISFEC) is the newest Research and Education Forest in Malaysia and managed by Universiti Putra Malaysia. It is chosen due to its characteristic for being a model of the lowland dipterocarp forest in Malaysia. Located at Ayer Hitam, Puchong, Selangor within an area of about 1200 hectares, the forest reserve is one of the most valuable areas of remaining lowland dipterocarp forest in the highly urbanized Selangor state. From the aerial photo (Figure 2), the forest is obviously surrounded by housing and commercial development, where the facilities' complex was well organized in their space planning. The most significant fact about this forest reserve is its complete cycle of ecosystem, well-functioning range in wildlife species and unique features inside the forest such as a "blue lagoon", streams, historical site, an "Orang Asli Settlement" and etc. (Rancangan Pengurusan dan Pembangunan Hutan Simpan Ayer Hitam, 2016-2025).

Figure 2: Location of study area

IDENTIFICATION OF DESIGN ELEMENTS IN ARCHITECTURAL COMPONENTS AT SISFEC

Below are the major types of architectural components and the application on design elements found in SISFEC. As a result from the detailed observation at SISFEC, this study looks into the most significant design elements that had been applied namely form, colour and texture. Figure 3 shows the identification of form, colour and texture on architectural components. Buildings are the dominant components developed in the forest area, supported by other landscape components.

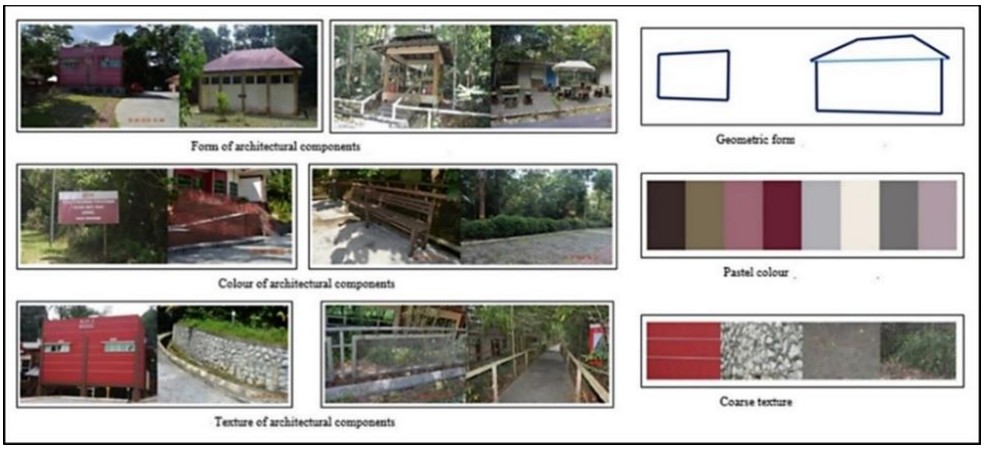

Figure 3: Identification of form, colour and texture

Based on assessment, it was identified that the type of forms are mostly geometric-square, rectangles and some of them are circles. In the meantime, the colour shows a combination of dark red, brown, grey, white and earthier colours. However, the contrasting colours still appear in certain components such as the main building façade, signboard and bollard. The overall textures are coarse and rough, especially on the roads, retaining walls, pavement, stairs and railing. Besides that, fine texture can be found on the building walls, fences and benches.

SELECTION ON THE PARAMETER OF ARCHITECTURAL DESIGN ELEMENTS

The parameter of the selected architectural design elements are determined as follows: form is defining a desired space with multi descriptive characteristics such as organic, geometric, three dimensional, fluid, solid and etc. Meanwhile, these characteristics can be enhanced by using other elements such as line and shape to produce “the character of form”. Colour significantly creates a mood, presents a hierarchy, even convey the true emotion by its dynamism, or from its wide range of characteristic like cool, contrasting, pastel, primary, calming, loud, subdued, bright and others to have “the juxtaposition of colour”. Texture is helping in describing the details of the architectural components by its sense of touch for example smooth, glossy, coarse, dull, pebbly, slimy, reflective and others which will lead to the “the feeling of texture”. Together, the parameter of architectural design elements are “the character of form”, “the juxtaposition of colour” and “the feeling of texture”.

METHODOLOGY

This study was conducted using the quantitative method with a structured questionnaire given to the selected users at SISFEC. The users were asked on their perception regarding the design elements and the design harmonization with forest environment. The data was analysed using SPSS 21 for the Correlation analysis and Multiple Regression analysis to explore the relationship between the design elements and the harmonization with forest environment. In addition, this study applied simple random sampling. The main criteria of selecting the respondent would be for the user to have on site experience with SISFEC. This simple random sampling was conducted by checking the attendance record who have conducted activities in SISFEC previously, as well as the future users who have made their reservations. A sampling size of 150 was determined based on the suggestion by Roscoe 1975 who stated that a sample size greater than 30 and less than 300 is suitable for most behavioural studies (Sekaran & Bougie, 2016). This is also in line with the minimum numbers of 150 respondents according to Pallant (2005). As evidenced, visual perception is a prerequisite for the specific group of respondents to contribute their strategic thinking towards the existing architectural design components that manifested the harmonious environment of SISFEC. The measurement of harmonized level shows the statistical expression of quantitative relationship between the variables which was set out in the structured questionnaire (Syuriaty, et al., 2020).

RESULT AND DISCUSSION

The selected design elements; form, colour and texture were tested as the variables in the analysis on the association and affecting aspects. Data analysis included Correlation analysis and Multiple Regression analysis where the hypothesis was tested by the Pearson Correlation, and the Multiple Regression analysis provides the information about the model as a whole. The mathematical solution is an effective way to deliver the best justification by providing equations referring to the problem on how design harmonization can be achieved and the relationship between design elements and the harmonization with natural forest environment. It also influences the design elements towards architectural harmonization with natural forest environment based on the harmonized design approach. The outcome from the analysis are as follow:

Correlation analysis is used to examine the relationship between the sets of independent variables and its contribution to the dependent variable through the evaluation of relationship between the applications of design elements on the architectural components towards the level of harmonization. Pearson Correlation Coefficient Test was used to explore the relationship among the variables and to describe every independent variable is correlated to a dependent variable. Correlation coefficients can range from -1.00 until +1.00. The value of -1.00 denotes a perfect negative correlation and the value of +1.00 denotes a perfect positive correlation, while the value of 0 denotes a lack of correlation. The main procedure of the correlation analysis is the two-tailed test statistical significant range from 0.01 - 0.0001.

Table 1: Relationship between design elements with the harmonization of architectural components

Design elements		**Form**	**Color**	**Texture**
Harmonization of architectural components	Pearson correlation	0.781**	0.675**	0.623**
	Sig. (2 -tailed)	0.0001	0.0001	0.0001

**. Correlation is significant at the 0.01 level (2-tailed)

The results in Table 1 shows the Correlation results to answer the hypothesis on the relationship between the applications of design elements through parameter: the character of form, the juxtaposition of colour and the feeling of texture on the architectural components with natural character of forest environment. In order to verify the significant correlation between the independent variables (application of design elements: form, colour and texture) and the dependent variable (the harmonization of architectural components with natural character of forest environment), a list of hypothesis was formulated and the results are shown in Table 2.

Table 2: Summary of Correlation analysis between Independent Variables and Dependent Variable

	Hypothesis	*r*	P	Result
H1	There is positive relationship between characters of form and the design harmonization with natural forest environment.	0.781**	P<0.05	Very strong significant
H2	There is positive relationship between juxtaposition of colour and the design harmonization with natural forest environment.	0.675**	P<0.05	Strong significant
H3	There is positive relationship between feelings of texture and the design harmonization with natural forest environment.	0.623**	P<0.05	Strong significant

Regression analysis was performed after determining the overall relationship between the independent variables and dependent variable. This analysis is to test further on the contribution of each design elements and formulate an equation that represents the prediction towards the influence of design elements to the natural forest environments. The result would be the formulation for harmonization of architectural components from the respected independent variables. Moreover, the influence of the independent variables have been set to formulate the mathematical formula where Multiple Regression analysis was applied to determine the variance of each design element. The recommended model was performed by determining the collective effect of the independent variables, namely the character of form (X1), the juxtaposition of colour (X2) and the feeling of texture (X3) towards the overall perceived of the equivalent between architectural components and the natural forest environment.

The model is as the following:

Harmonization of architectural components = β + β1 character of form (X1) + β2 juxtaposition of colour (X2) + β3 feeling of texture (X3)

where,

Harmonization of architectural components = the harmonious of design elements with natural forest environment

β = constant

The model summary is shown in Table 3 indicates that R value is 0.836, where R2 for the selected design elements in this model is 0.699.

Table 3: Model summary of Multiple Regression analysis between Dependent Variables and Independent Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.836[a]	0.699	0.665	0.498

a. Predictors: (Constant), texture, form, colour

Table 4 shows the results from the Multiple Regression analysis for each of the design element. It revealed that the character of form is the most influential parameter in determining harmonization of design elements with natural forest environment where every unit of change on this element is associated with a 0.526 change in the increase of the harmonious architectural components. Meanwhile, every unit of change in juxtaposition of colour parameter is related to a 0.189 change in the increase of harmonious architectural components. The positive value is contributing to the positive impact in increasing the harmonious architectural components, as well as the feeling of texture parameters with a 0.235 value.

The beta values represent the unique contribution of every variables and formulate the final equation model as follows:

Harmonization architectural components = 0.296 + 0.526 character of form + 0.189 juxtaposition of colour + 0.235 feeling of texture

Table 4: Summary of Multiple Regressions analysis

	B	t	p
(Constant)	0.296	0.982	0.335
Character of form *(X1)*	0.526	3.533	0.002
Juxtaposition of color *(X2)*	0.189	1.242	0.225
Feeling of texture *(X3)*	0.235	2.003	0.056

Based on the result from the contributions of selected design elements to the harmonization of architectural components with natural forest environment, the discussion were made on the relationship as follow:

THE RELATIONSHIP BETWEEN THE CHARACTER OF FORM AND HARMONIZATION OF ARCHITECTURAL COMPONENTS WITH NATURAL FOREST ENVIRONMENT

Analysis in determining the relationship between the character of form and harmonization of design has revealed the following: Pearson Correlation result as in Table 1 is ($r=0.781$ at $p=0.0001<0.05$) and the hypothesis testing in Table 2 shows there is a very strong positive significant relationship between the character of form and harmonization of architectural design components with the natural character of forest environment. Distinctly, form is the most prominent design element which accentuates the character of the architectural components in the forest. Therefore, the element of form on architectural design in natural forest has a major impact on the design harmonization with natural forest environment.

THE RELATIONSHIP BETWEEN THE JUXTAPOSITION OF COLOUR AND HARMONIZATION OF ARCHITECTURAL COMPONENTS WITH NATURAL FOREST ENVIRONMENT

Results from the analysis on the relationship between colour and the harmonization of design is shown in Table 1 where the correlation coefficient is ($r=0.675$ at $p=0.0001<0.05$) and Table 2 has proven the hypothesis that there is a strong positive significant relationship between the juxtaposition of colour and harmonization of architectural design components with natural character of forest environment. Consequently, colour is an important design element that highlights the appearance of the architectural components in the forest and for landscape appreciation. Therefore, the element of colour on architectural design in natural forest has an impact on the design harmonization with natural forest environment.

THE RELATIONSHIP BETWEEN THE FEELING OF TEXTURE AND HARMONIZATION OF ARCHITECTURAL COMPONENTS WITH NATURAL FOREST ENVIRONMENT

Indeed, the analysis on the relationship between texture and harmonization of design as shown in Table 1 indicated the correlation coefficient is ($r=0.623$ at $p=0.0001<0.05$) and hypothesis result in Table 2 signified there is a strong positive significant relationship between the feeling of texture and harmonization of architectural design components with natural character of forest environment. Hence, the role of texture has the contribution to the harmonization of design components with natural forest environment. Therefore, the element of texture on the architectural design in natural forest have influence on the design harmonization with natural forest environment.

From the summary of the Correlation analysis results and the hypothesis in Table 2, it clearly showed the strength and direction of selected design elements for the architectural components are significantly correlated. The Correlation Coefficient value is between the range of ($r=0.623$ at $p<.05$ until $r=0.781$ at $p<.05$). These results indicated a significant positive and strong relationship between Independent Variables and Dependent Variable.

The strongest association of Independent Variable is the character of form with the r value of (0.781). It is followed by the juxtaposition of colour (r=0.675) and the feeling of texture (r=0.623). This result is a manifestation of the design character in the architectural component which has a crucial impact on the harmonization with forest environment. It is pertinent to stress here, as shown in Table 4 and the final equation that showing the influence of the selected design elements, namely form, colour and texture had given a huge impact towards the environment of SISFEC. It has also become a fundamental aspect in designing the architectural components at the Research and Education Forest in Malaysia.

Taking a closer look, the results of the Multiple Regression analysis in Table 3 showed a value of r square (0.699) to almost 70% of the variation towards the harmonization of architectural components in the natural forest environment. Overall, these numbers predicted a positive impact on harmonized design elements towards increasing the harmonious architectural components with the forest environment from the changes on the character of form, the juxtaposition of colour and the feeling of texture.

THE KEY CONSIDERATION ON HARMONIOUS DESIGN ELEMENTS TOWARD CONSERVATION OF THE ECOSYSTEM IN THE NATURAL FOREST ENVIRONMENT

The user perception are essential in exploring the association of architectural components with natural forest environment due to the experience and expectation of the specific user of SISFEC are critical as to conform with the specific requirement of natural forest ecosystem. Therefore, this study recommend key consideration for the architectural components that harmonized with the natural forest in Research and Education Forest which is useful to the architectural design practice.

HARMONIOUS OF FORM

Form is the most influential element, especially during the design process and the implementation (construction stage) of architectural design components where its arrangement and composition significantly affects the natural pattern of forest environment. Furthermore, the findings of this study also revealed the element of form that corresponds with the natural patterns and the sensitivity of the forest ecosystem which determined the architectural components is in harmony with the natural forest environment. The character of form plays an important role in minimizing structural disturbances as well as optimizing the sustainable environments in natural forest. Thus, it is emphasized that harmonious of form determined the most contribution to the sustainability of natural forests, through the character of form and its sensitivity with the ecosystem. This is because natural forest need precise site planning where the selection of appropriate forms of building and structure will minimize tree felling and site clearing. Furthermore, special measures such as reducing cut and fill with the application of retaining walls is to reduce encroachment and the use of stilts for major engineering structure can minimize the destruction of forest areas. In short, harmonious of form plays an important role in conserving biodiversity which contributes to the stabilization of the forest ecosystem.

HARMONIOUS OF COLOUR

In a natural forest, the colour diversity of flora and fauna shows the energy of the natural environment where the quality of colours is genuine. So, the beauty of forest scenery should not be disturbed by any circumstances, including the development of architectural components. In terms of harmonized relationship, the colours are more on the visual effect of architectural components with the natural beauty of the forest, where the colour influence is enormous in ensuring the harmony of colour composition in the architectural components with natural forest environment. Several colour combinations require the recognition of main colours to determine the visual relationship between colours. Therefore, the application of harmonious colour on architectural components should be more naturalistic, where the percentage of coherence and juxtaposition of colour elements with forest environments should be higher rather than contrasted, since only a small number is needed in some spaces within the forest areas. Thus, the ambience of naturalness from the unique colour of flora and fauna will be further enhanced even though there is a colour composition between man-made structures and nature.

HARMONIOUS OF TEXTURE

Textures of architectural components refer to the visual quality of natural or artificial materials which generate sensibility. The visual appearance on architectural components depends primarily on the surface colour and texture. Therefore, the application of texture on architectural surfaces must be balanced with the natural forest environment because the texture in nature is beautiful and stands out with its own uniqueness. Thus, the harmonious texture clearly illustrates the feeling of closeness with the forest ambience even with the presence of architectural components around. Texture has the ability to build sensational feelings that “mark” a certain area in the architectural components as well as complimenting the unique characteristic of the natural forest scenery. Consequently, the careful selection of texture could avoid chaos at the forest scenery.

The summary of key considerations on the importance of harmonious design elements for the conservation of a sustainable Research and Education Forest that also can be applied in other natural forest in Malaysia are as follow:

1. To minimise the disturbance of natural resources by applying the harmonious of form on the architectural component in the forest,

2. To avoid chaos and confusion by enhancing the visual quality with charm and serenity of the forest ambience by applying the harmonious of colour and texture.

3. To ensure safe development with new positive interactions between architectural components and natural forest environment,

4. To respect the sensitivity of the natural forest as well as to conserve the essences of well-functioning ecosystem for the research and educational purposes.

CONCLUSSION

Harmonization plays a vital role in providing a clear direction for forest conservation when it requires the appropriate application of architectural design that fulfill the necessity of forest ecosystem. The analysis revealed that harmonization of form, colour and texture has a crucial impact on the architectural design in Research and Education Forest. Thus, this study will help the stakeholder to understand on the important of harmonious architectural design in a natural forest environment. Furthermore, it will be a guidance for the planner, landscape architect, architect and designer to produce an inclusive and good quality design which in line with Research and Education Forest's that boost awareness among the public on the important of forest for our survival. For future researches, it is recommended to study further details on the application of materials and construction method that response to the harmonious form, colour and texture as part of the architectural design practice towards the establishment of sustainable Research and Education Forest in Malaysia. In conclusion, this study has proven that the harmonization of architectural design components will contribute to the forest sustainability. Finally, the sustainable forest ecosystem will benefit all mankind, the end users can elevate their knowledge and appreciation of the richness of flora and fauna, the management can strategically monitor the ascent of the nature diversification and the forest itself will optimize her true potential as a green lung of the earth.

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