

Biomimicry of Palm Tree Leaves Form and Pattern on Building Form

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Abstract. This article is a study on biomimicry of palm tree towards a building form. It is to find a suitable form and pattern that can be applied to building shell to ease building maintenance operation beside to enhance the aesthetic value of a building architecture. The research has been carried out by observation and modeling on some various species of palm tree's patterns and forms. The result expectation can be found at the end of this research by producing the best pattern of palm tree that can be adapted to building envelop as the whole form of a building.

1 Introduction

Palm tree is growth without branch evergreen and the leaves with long feathered or fan-shaped. The old leaves scars forming a hard regular pattern on the trunk. The population of this tree normally dominated on sandy soil in tropical climate country. The palm tree is described as well-known with its longevity due to its largely organismal life span by the period over which constituent cells can function metabolically [1]. In addition, this plants. It is also listed in low maintenance landscape category characteristics. It is considered by experimenting the fertilizer requirement, pest control and disease problem. It is famous with self-cleaning tree without trimming, cleaning and cutting any part from the trees. Besides, it has a unique shape of stump, simple lines on leaves for shades and jazzed up textural. These are the characteristic of the palm trees and its leaves bring into architectural styles and modification of the forms and patterns on building shape [2]. There are 32 species of palm trees has been experimented in this research. These palm trees are population in tropical country. In conjunction to find the most suitable pattern and form of palm trees for a building in tropical country; the pattern, form and structure of these palm trees are explored. These trees survived in tropical climate through the form of leaves and it is important to prevent from dehydrated beside of its special texture and character of its structure [3]. These are the species of palm trees populated in tropical country.

2 Methodology through the Identification Form of Tropical Palm Leaves

Seven schools in Kedah were selected as case studies. All data were collected through visual The correlational research has been carried out to identify the common pattern of palm leaf in tropical country. The patterns have been explored to help to identify the identity of tropical palm tree in Asia. The exploration includes patterns, cross section of leaves and the tree structures. Most of the palm

trees have a wide form of leaves. This leaves is supported with a strong bones in the middle jointing one to another [4]. The number of this leaves in a bunch make the trees becoming a shelter and produce an airy shade. The air can flow in between the leaves to avoid from obstruction that can produce a high density of wind load. In addition, some of the species trees reached more than 5 metres height [5]. This species survived with thin stump and less leaves to decrease its loads beside to prevent from falling down. Figure 3 shows the common palm trees pattern, form and structure in tropical country.

3 Finding and Analysis of Palm Leaves Form and Pattern

The palm trees do have a certain character that can be developed into building envelope. The character comes with slope, beam, smooth and flat surface that helped in building cleaning and maintenance. In this, study, there are three (3) characters have been discovered. There are form, pattern and structure. Figure 1 shows the common patterns of palm leaves in tropical country. The higher number of species owns the patterns of palm leaves are the feather shape and followed with the fan shape. The details are followed in Table 1.

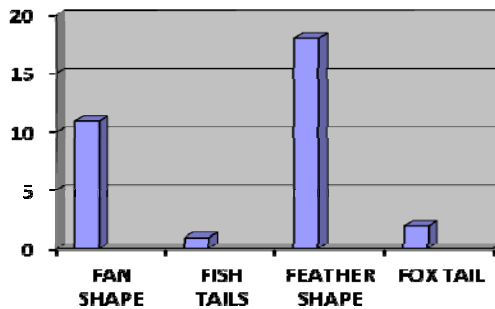








Figure 1: The common pattern of palm leaf in tropical country.

Table 1: The collection of common pattern of tropical palm leaf [6]

FORM	STRUCTURE	NO. OF SPECIES
	Form in round shape. It is combination of many straight structured segments centralised with a rhythm of length. At the end of each segment, it is end up by a sharp form. It is similar with a fan shape.	11
	There 2 parts and mostly are symmetry. These 2 parts jointing at one point and end up with two different directions in same length. It is also a combination of many straight structured segments. In the middle of each part, it is formed in a volume and end with a sharp point. This shape similar to a fish tail.	0
	It is structured with a strong trunk. There are many segments jointing at this trunk with different length and rhythm. These segments end up with sharp point. It is likely to a duck feather.	18
	It is formed with 3 complicated form. The main trunk jointing with the secondary trunk. The secondary trunk is smaller than the main trunk. Each leaf formed like a fish tail combined to this secondary trunk. This palm leaf is obviously different from ordinary palm tree. The overall form is more to a pine tree.	1
	This leaf consist of the combination of ordinary palm leaf segment. However, the pattern on arrangement of these segments swirl on the main trunk. The form known as a foptail.	2
	It is fraction of the segments and jointing at the centre of the leaf. The segment is sharp at the end of it.	0

The well-known palm leaf's pattern that is been mimicry into building form and texture is fan shape. This shape is widely used by adapting the flow and wave of the leaf. Figures 2 and 3 show the common pattern that been mimicry into building envelope.



Figure 2: The common pattern of palm leaf contributes in biomimicry of a building.



Figure 3: The common pattern of palm leaf contributes in biomimicry of a building.

Most of the architects choose to mimicry the palm leaf fan shape and form in building envelope design. This is because the shape of this leaf is form as an umbrella. The segments are jointed to each other to become a shelter. There are flat and smooth surface to facilitate the rain water passage through its slope (Figure 4).

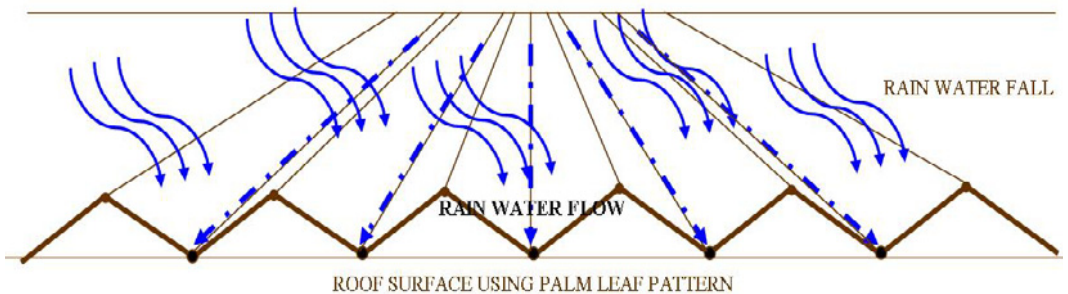


Figure 4: The mechanism of the pattern on building envelope [6]

Figure 5 to Figure 9 show some of the buildings that mimic the palm tree and leaf pattern on the building in Malaysia and some other countries



Figure 5: Kuala Lumpur International Airport



Figure 6: National Mosque Kuala Lumpur



Figure 7: Marine Parade Community Club



Figure 8: Valencia

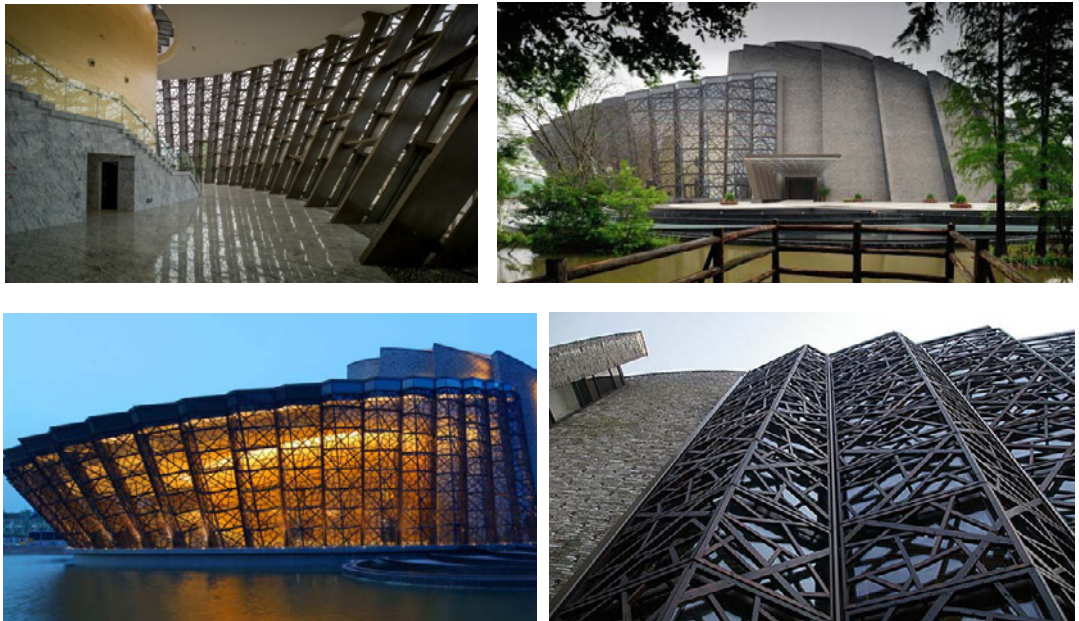


Figure 9: Wuzhen Theater Hall

4 Conclusion

This paper has presented a study focuses on biomimicry of palm tree towards a building form. From the study that has been conducted, it can be concluded that suitable form and pattern that could be utilized to building shell to ease building maintenance operation beside to improve the aesthetic value of a building architecture. The palm trees do have a certain character that can be developed into building envelope. The character comes with slope, beam, smooth and flat surface that assisted in building cleaning and maintenance. The eminent palm leaf's pattern that is been mimicry into building form and texture is fan shape. This shape is extensively used by adapting the flow and wave of the leave.

References

1. D. Akca , A. Gruen (2003), Re-sequencing a historical palm leaf manuscript with boundary-based shape descriptors. ETH, Swiss Federal Institute of Technology, Institute of Geodesy and Photogrammetry, 19th CIPA International Symposium Antalya, Turkey **34** (5): 55-60
2. Gibbons, M. & T. Spanner (1997). *Trachycarpus oreophilus* - The Thailand Trachycarpus.

3. J.L. Araus , K.P. Hogan (1994), Leaf Structure and Patterns Of Photoinhibition In Two Neotropical Palm In Clearing And Forest Understanding During The Dry Season, *American Journal Of Botany*, **81** (6): 726-738
4. Ishak, N.H., Chohan, A.H. & Ramly, A. (2007) Implications of design deficiency on building maintenance at post-occupational stage. *Journal of Building Appraisal*, **3** (2), 115–124.
5. Seeley, I.H. (1986) *Building technology*. Macmillan Education, London, UK.
6. C. Miller, B. Hokanson, *The Artist and Architect: Creativity and Innovation Through Role-Based Design*, *Educational Technology*, **4** (4): 18-27