

A Study of natural material used of Tai-Lue house in Chang Kham, Phayao, Thailand and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos

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Abstract: This research aimed 1) to study natural material used in Tai Lue house in Chang Kham, Phayao, Thailand, 2) to study natural material used in Tai Lue house in Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos, and 3) to analyze and summarise a natural material used of Tai-Lue houses in Chang Kham, Phayao, Thailand and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos. There are 5 steps of research: 1) study documents, previous picture of Tai-Lue house and related research and site survey (interview and record) in the areas and focus on natural material used of Thi-Lue houses and type, the technique of the materials of Tai Lue house in Ban Yuan including Moo No. 1 (Ban Sop Wan), Moo No. 2 (Ban Sop Wan), Moo No. 3 (Ban Yuan) and Moo No. 4 (Ban Mang), in Chiang Kham, Phayao, Thailand and Tai Lue houses in Ban Na Yang Tai, Nam Bak, Luang Prabang, Lao People's Democratic Republic; 2) Classify a data of natural material used by sustainable materials methodology of Chris Dancy; 3) Analyzed natural material used and style and technique of Thi-Lue houses; 4) present an analyzed data by exhibition and exchange an idea of natural material used with a local people in ChangKham, Phayao; 5) summarise and recommend natural material used in Tai Lue houses in Chang Kham, Phayao, Thailand and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos in order to suggest be a guideline on natural material used in the Tai Lue house of Chiang Kham, Phayao in the future. Research findings showed that the study of natural material used in Tai Lue house in Chang Kham, Phayao, and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos found that it has 5 materials of natural material used; wood (teak), Bamboo, Cogon grass, Dipterocarpaceae leaves (local leave) and water reed in ChangKham, Phayao, Thailand and found that it has a significant material and fibrous organic material; Bamboo as a roof of the house and straw mixed with a clay known as cob in Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos. Technical details and style of natural material used in order to be a guideline for Tai-Lue house and local people in Chang Kham, Phayao..

Keywords: Natural materials, Tai-Lue house, Chang Kham, Phayao, Baan Nayangtai, Laos.

1. Introduction

Tai-Lue is one of the Tai groups that live in Xishuangbanna (South of Yunnan) in China. The outstanding identity of Tai-Lue is their own language, traditional dress, local house, cultural and traditional events. Tai-Lue in Chang Kham, Phayao, Thailand and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos originally shifted from Xishuangbanna, China due to a civil war. One part of Tai-Lue moved to the north of Luang Phabang in Laos. One part of Tai-Lue in Xishuangbanna shifted to Chiang Kham, Phayao in the north of Thailand over a hundred year. [1]

Tai-Lue in Nayangtai, Lueng Prabang emigrated due to the threat of the war. Anoluc V [1] described that the group of Tai-Lue has the original location in China, close Tibet and then moved to the southeast of China due to empowerment of a king of China. The settlement of Tai-Lue located in JomJang district and Veiang Phu Ka in Lueang Nam Ta and move to Pak Bang in Udon Chai and shifted to other place to find a suitable place and rich resource for secure living. Tai-Lue in Ban Na Yang has outstanding residential buildings classified into 2 types: 1) houses are buildings that are used for permanent residence of people. It related to the traditions, beliefs, and daily life in general 2) Hut is a temporary building. It is in a farm and garden areas. The building has basic elements and simple schematic. There are no complex elements of the building. It is a normal hut for sitting and eating. There also has other building, but it could not live such as a tobacco kiln, henhouse, and pig stall, etc.

Especially, the type of the houses was built in different characteristics and had many meanings that reflect beliefs, traditions, culture, and construction method. [1]

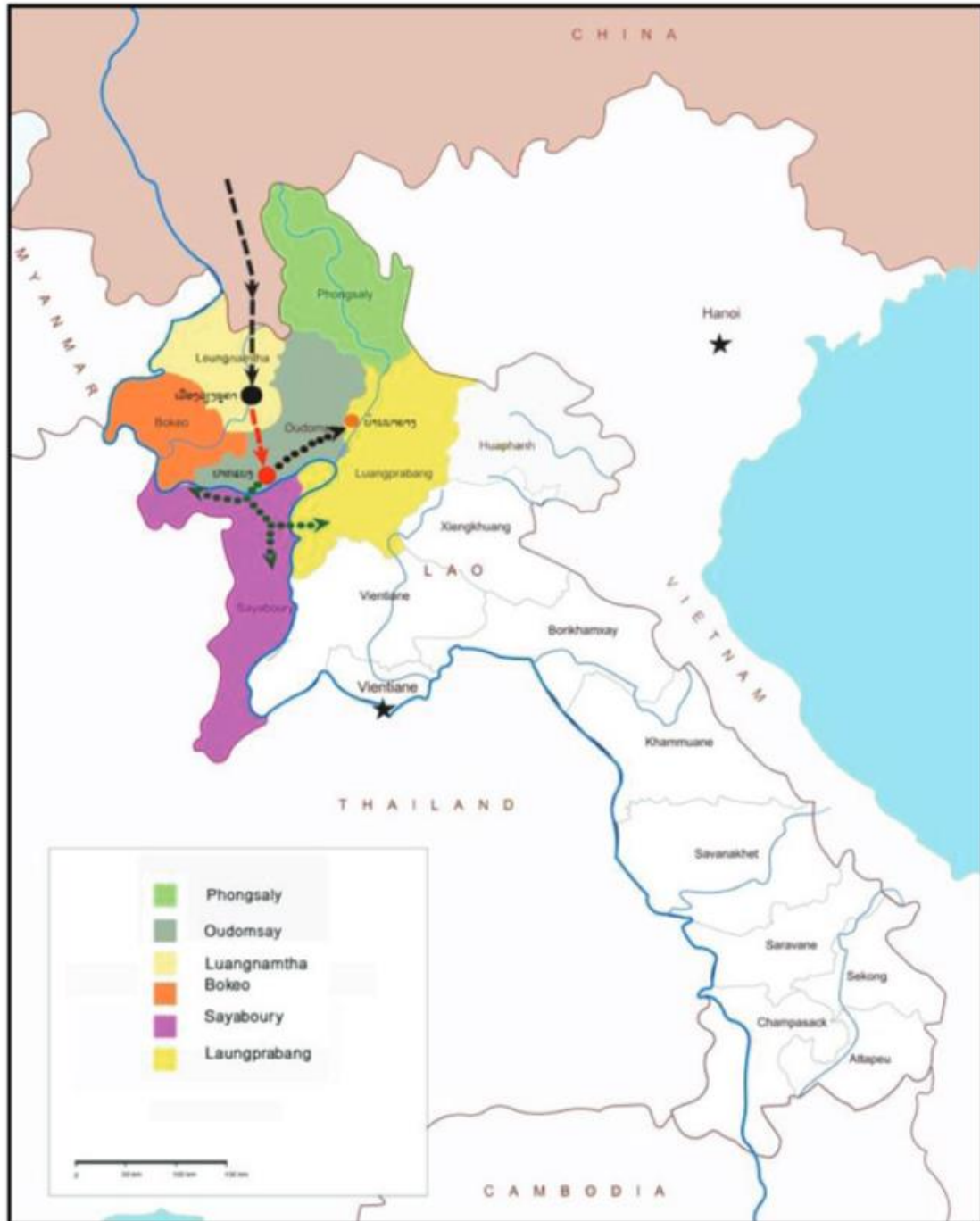


Figure 1 the emigration map of Tai-Lue from Xishuangbanna to other parts [1]



Figure 2 A Town Plan of Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic. [1]



Figure 3 Tai-Lue house in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic



Figure 4 A tobacco kiln in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic.

Tai-Lue in Chiang Kham is an ethnic group who fled from war and emigrated from Mueang Phong, Muang Mang, Muang Yuan, Muang Man, and Muang Ou from Xishuangbanna in China, and then came to Tha Wang Pha, Nan Province, Thailand and moved to Chiang Muan Phayao Province, Thailand. Finally, Tai-Lue people migrated to Chiang Kham, Phayao, Thailand for setting up a village. There has significant arts, culture, traditions, and beliefs including art and craft works and wisdom, lifestyle, dress, and language that reflect the ethnicity of Tai-Lue people that have been passed down for centuries.[2] Characteristics house of the Tai people who live in southern of Yunnan in China, Eastern Burma, Laos, Northern of Vietnam, and Northern of Thailand, They are all the same group that has many cultures including setting up villages and building houses with some similar parts. Sookkree [2] described

the style of the Tai-Lue house in Meaung Ou, Lao People's Democratic Republic, and vernacular architecture case studies of Tai-Lue house that have native or natural materials used to building and living in different contexts. It shows that various natural materials are used in Tai-Lue house. The study of natural materials of Tai-Lue house in Chang Kham, Phayao, Thailand and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos aims to study the natural materials used in the Tai-Lue house in order to conserve and lead to future development and application of natural materials used for the Tai-Lue community in Chiang Kham, Phayao, Thailand.

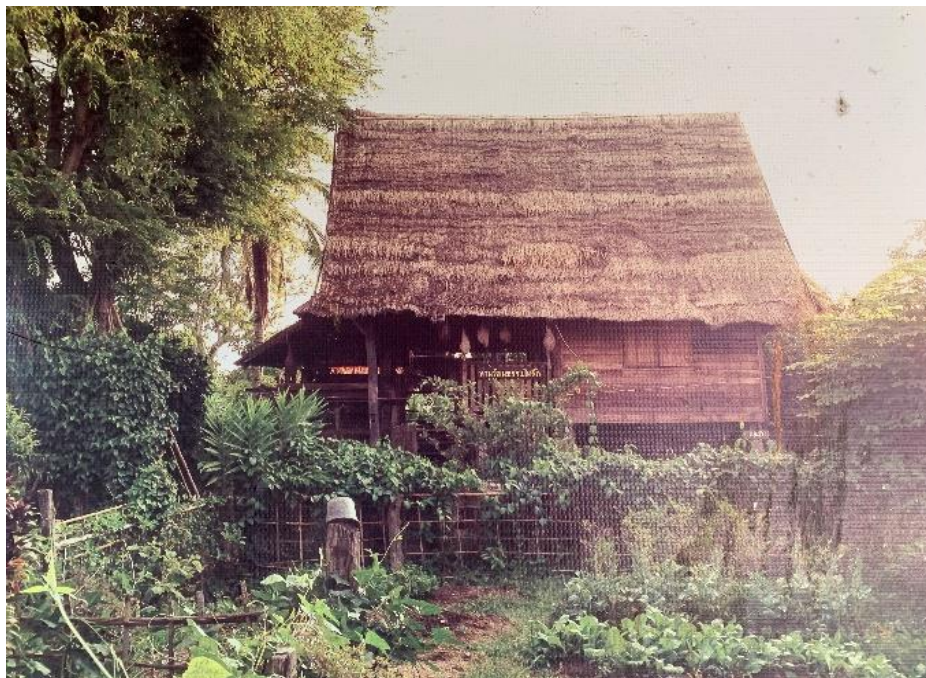


Figure 5 Tai-Lue house in Chiang Kham, Phayao, Thailand

2. Objective

1. To study natural materials used in Tai-Lue house in Chiang Kham, Phayao, Thailand.
2. To study natural materials used in Tai-Lue house in Ban Na Yang Tai, Nam Bak, Luang Prabang, Lao People's Democracy.
3. To summarize natural materials used in Tai-Lue house, in Chiang Kham, Phayao and Tai-Lue house in Ban Na Yang Tai, Nam Bak, Luang Prabang Province, Lao People's Democratic Republic.

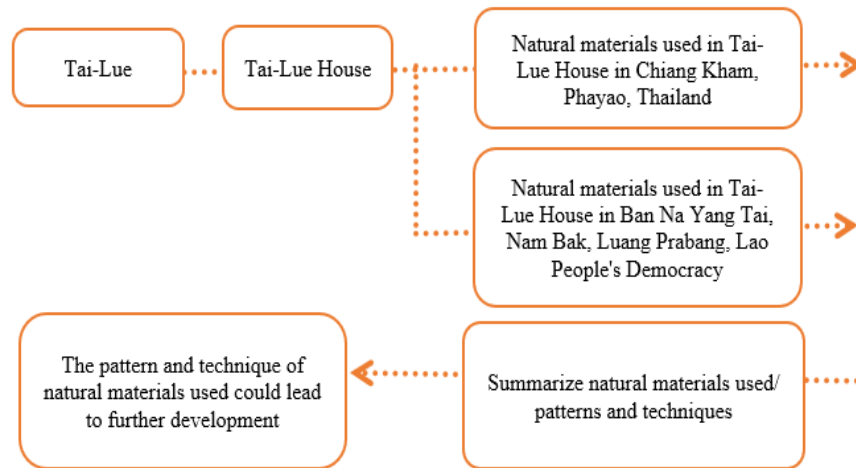
Hyphothesis and Conceptual Framework

This research is qualitative research to study and collect natural materials used as well as the wisdom of the use of natural materials and techniques in both areas and summarize natural materials used of Tai-Lue house. The conceptual framework of the research includes the theory of natural, local materials used at present. The pattern and technique of natural materials used could lead to further development.

This research study two main points:

1. Natural materials used in Tai-Lue house in Chiang Kham District, Phayao Province and Tai-Lue house in Ban Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic, It focusses on material characteristics and current local application of materials.
2. Using natural materials of Tai-Lue house in both areas to find patterns and techniques that could be further applied.

Table 1 The conceptual framework of the research



3. Literature Review

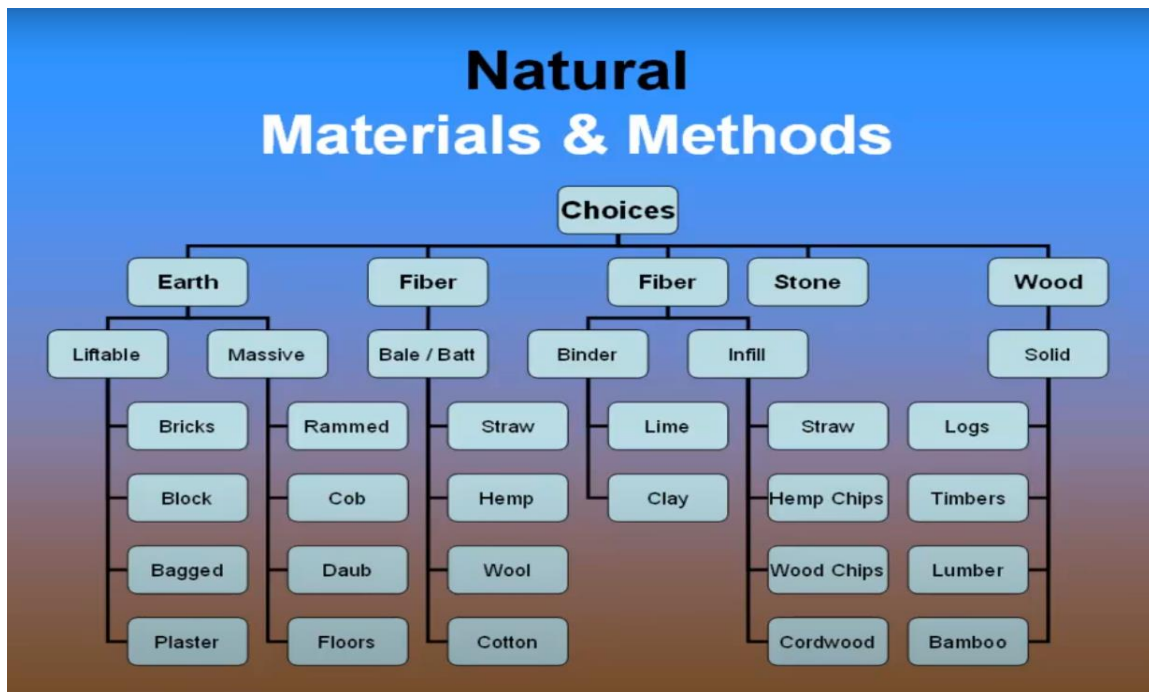
Natural materials are materials of natural origin, can be used unchanged and there may be some changes in value and usage. The paper mulberry is one of the local materials in the northern of Thailand to make a paper. In the Central of Thailand, the water hyacinth is woven into a product of decorations, and reeds are made into products such as mats, handbags. A local material of The Northeast of Thailand, silk is woven into a piece to make garments and utensils. A local material of the Southern, Shells are often used to make utensils and jewelry and *Lepironia articulata* uses to weave a bag, a box, a mat for sitting.

Moreover, the use of natural materials could be used in diverse areas as construction, biofuels, clothing, healthcare, and packaging.[3] Earth and bamboo are still commonly used for construction in many parts of the world such as cob house in the Southwest of England and The Fujian tulou in China as UNESCO World Heritage Site and [4] and it also close to sustainable design.

“Sustainable natural building materials and methods include adobe bricks; compressed earth blocks; earthbags; natural plasters: rammed earth; cob; wattle and daub; earthen floors; straw bale; prefab straw bale panels; fiber batts; clay and lime binders; light clay straw; hempcrete; hemp with lime or clay binder. cordwood masonry; stone with and without mortar; log and timber frame wood or bamboo construction; earthships; thatch; living roofs; and living walls. Sweat equity and local natural materials can help you build debt-free. Small, creative, carefully constructed buildings can also be better for the environment than conventional construction.” [5]

“The common materials of natural building many types, there is clay sand when it mixed with water and straw known as cob or adobe. Other materials used in natural building are earth, wood (Cordwood or timber wood frame/post-and-beam), straw, bamboo, and rock” [6] and Chris Dancey's Natural Materials Concept Theory (2012) classified materials into five main categories as 1) Earth include minerals, rocks, soil, and water. these are the naturally occurring materials found on Earth. It could be liftable as bricks, block, bagged and plaster and massive as rammed, cob, daub and floors 2) Fiber as bale/batt as straw, hemp, wool, and cotton 3)Fiber consists binder as lime, clay and Infill as straw, hemp chips, wood chips and cordwood. 4) Stone 5) Wood as logs, timber, lumber, and bamboo. [7]

Table 2 Chart of Natural Materials and Methods by Chris Dancey



4. Method

A. Data collection

The data was collected by historical and current information from first and middle-class documents, including relevant information and collect old photos of Tai-Lue house in Chang Kham, Phayao, Thailand, and Baan Nayangtai, Mueang Nambak, Luang Phabang, Laos. The data was collected by interviews and field surveys of the communities.

B. Survey study

The data was collected from the residents or owners of Tai-Lue house by using a semi-structured questionnaire and a visual survey and searching for the use of natural materials in a traditional Tai-Lue house, Chiang Kham, Phayao. It was explored with pictures and find the use of natural materials in the house, explore only the Tai-Lue house to find out about natural materials used to categorize the materials. The main question points were as follows;

1. Using natural materials of five main categories of Chris Dancey's Natural Materials Concept Theory
2. Pattern, techniques of natural materials

C. Data organization and synthesis

It was compiled from information on the history of the use of natural materials of Tai-Lue house and was sort data on the physical aspects of the technique of using natural materials to classify the materials in Tai-Lue house.

D. Data analysis

It was analyzed by the data from the synthesized data and conducted by interviewers and the surveyed site. There is physical data on the technique of using natural materials in Tai-Lue house to classify the natural materials used.

F. Exhibition

It was exhibiting and showing information on the use of natural materials in Tai-Lue house. It is present in the exhibition of natural materials used in the house by presenting information with images, diagrams, or photos for easy understanding. It will be an exhibit and exchanging attitudes at the Tai-Lue community in Chiang Kham, Phayao, and it also will present to experts and researchers.

G. Conclusion

Summary of the study results based on all information that showed the history and background of the material used. It was a descriptive tool and style, details, and technique of using natural materials including summarizing the results and suggestion of natural materials used in the community in Chang Kham, Phayao, Thailand.

5. Research Results

The research focused on 2 areas in Thailand and Laos. It consists 4 sub-district such as Tai-Lue houses in Baan Yuan including Moo No. 1 (Ban Sop Wan), Moo No. 2 (Ban Sop Wan), Moo No. 3 (Ban Yuan), and Moo No. 4 (Ban Mang), Chiang Kham, Phayao and Baan Nayantai, Mueang Nambak, Luang Phabang, Laos. The data source scope was an old picture, books, the internet, interviews, and surveys from the communities. The content scope focused on using of natural materials in Tai-Lue house and the pattern or techniques of natural materials in Tai-Lue house. The time scope was one year for the research. By surveying method and eye screening are used for searching natural materials of Tai-Lue house. It was exploring only the traditional Tai-Lue house to find the use of natural materials. Classification of the materials of Chris Dancey has used to categorization the natural materials used. A survey of 100 houses in Baan Yuan and 5 Tai-Lue houses in Baan Nayantai were classified by using the method and the chart of natural materials of Chris Dancey. It was found that there have 2 traditional Tai-Lue houses and 2 temporary huts in Chiang Kham, Phayao and found over 80 Tai-Lue houses that using of natural materials in Baan Nayantai, Mueang Nambak, Luang Phabang, Laos. But it was collected only 5 houses due to no entry permitted.



Figure 6 field survey of Tai-Lue house in Baan Nayantai, Mueang Nambak, Luang Phabang, Laos



Figure 7 using of natural materials in Tai-Lue house in Baan Nayantai, Mueang Nambak, Luang Phabang, Laos.



Figure 8 Using natural materials of Tai-Lue house in Chiang Kham, Phayao

Using natural materials of Tai-Lue house in Chiang Kham District, Phayao

The Surveyed site in Ban Yuan consists of Moo No. 1 (Ban Sop Wan), Moo No. 2 (Ban Sop Wan), Moo No. 3 (Ban Yuan), and Moo No. 4 (Ban Mang), in Chiang Kham, Phayao, Thailand. It found that there have two traditional Tai- Lue houses and two temporary huts in Chiang Kham, Phayao. There are using natural materials for houses and buildings. It was found that natural materials used in Ban Yuan that are varied in use of the house including textile dyeing hut and temporary agricultural hut and rice fields, temporary residences, and temporary buildings for various activities such as events and traditional events.

House No.1 (Building No.1) found that the majority of the material is wood for timber frames, timber plank, and timber tile for roofing. House No. 2 (Building No.2), found that natural materials used to use the Cogon grass roof and shifted to a concrete tile roof. Moreover, it also found a temporary hut for natural indigo dyeing of textile fabric in house No. 2 that it uses the grass roof and bamboo for the structure of the hut. It also found that there uses a dry grass combine with the house wall for textile retail shop. Moreover, it found that the significant material is dry Phluang leaf for roofing known as a leaf of *Dipterocarpus tuberculatus* tree in the temporary building No. 3 (Building No.3). Dry Phluang leaf for roofing is usually built for festival events of Tai-Lue. Other parts of the building (Building No.4) uses a bamboo mat for a ceiling, wall, and door decoration and found interesting material for a mat that was made by water reed.

Table 3 Using natural materials in Tai-Lue house in Chiang Kham District, Phayao.

No.	Type of building	Natural Materials				
		Earth	Fiber	Fiber	Stone	Wood
1	The House No.1	-	-	-	-	Timber, Timber plank Timber tile
2	The House No.2	-	Grass	-	-	Timber, bamboo
3	The temporary building No.3	-	Dry Phluang leaf (<i>Dipterocarpus tuberculatus</i>)	-	-	bamboo
4	Other parts of the building	-	Grass, water reed	-	-	-

Natural materials used of Tai-Lue house in Chiang Kham, Phayao, it was found that 2 types of material: 1) Wood and 2) Fiber.

The first type consists of wood as teak for a wall and building structures of Tai-Lue house and wood roof tile as roofing materials and bamboo is used for temporary building structures as the main wall of Tai-Lue house and mat for decorative elements such as wall cladding or other decorative elements. The second type consists of grass, leaf, and water reed. It has a variety of natural materials used and found that bamboo is the most material used in Tai-Lue house, compared to the above materials.

Table 4 Classification of natural materials used in Tai-Lue house in Chiang Kham District, Phayao

Natural Materials	Type of building used	Characteristic and pattern of use
Wood	Wall	The wooden wall size is 15-20 centimeters, and it overlaps about 1-3 centimeters. The wooden walls are placed horizontally and vertically.
	tile roof	The wooden roof has a size of 30-45 centimeters and overlaps about 20 centimeters, alternating between the layers
Bamboo	Structure	They are White bamboo with a diameter of 5-10 cm and the length depends on the building.
	Wall	A strip of bamboo for weaving as twill weave patterns (over two strands of warp and under two). Using White bamboo weave together until a sheet as size 1 x 3 meter or as required. It can be used to close various parts
	Decoration (Mat)	
Grass	Roofing	It is grass roof, size 0.7-1 m. x 2 m. and overlapping 20-30 cm. and was attached roof structure by a strip of bamboo for tying or wire.
	Wall	
Dry leaves	Roofing	The size of the leaf is about 30-40 centimeters. Attach the leaves to the bamboo with a strip of bamboo for tying. The Size is 0.7-1 m. X 2 m. and overlap 20-30 centimeters by attaching to the building structure and wall by a strip of bamboo for tying or wire.
	Wall	
Water reed	Floor	weave together until a sheet as twill weave patterns (over two strands of warp and under two) it Can be placed in various parts.
	Ceiling	

Using natural materials of Tai-Lue House in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic.

By Field surveyed of Tai-Lue houses found a significant material and technique of material used. The majority of natural materials in the Tai-Lue House are wood, bamboo, rattan, grass, and clay. All most of the Tai-Lue houses in Baan Na Yang Tai has covered by a bamboo roof that places on a bamboo structure roof and attached the bamboo roof with the house structure by a rattan (palm). A technical roof of the house is using strips of split bamboo and an attached roof by thin bamboo-stripes. Moreover, the ceiling of the Tai-Lue houses has placed by a strip of split bamboo. Especially, it found that grass and straw mixed with mud and clay on bamboo structure on the wall of a tobacco kiln.

Table 5 Using natural materials Tai-Lue house in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic.

No.	Type of building	Natural Materials				
		Earth	Fiber	Fiber	Stone	Wood
1	The House No.1		Rattan (Palm)			Wood, bamboo
2	The House No.2		Rattan (Palm)			Wood, bamboo
3	The House No.3		Rattan (Palm)			Wood, bamboo
4	The House No.4		Rattan (Palm)			Wood, bamboo
5	Agriculture Building No.5	Clay and Mud	Grass and Straw			bamboo

All the surveyed Tai-Lue house found that the main material is wood and bamboo for the roof and floor of the house and uses a rattan attached to the roof structure.

Natural materials used of Tai-Lue house in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic, it was found that three types of materials:





- 1) wood, 2) fiber, and 3) Earth





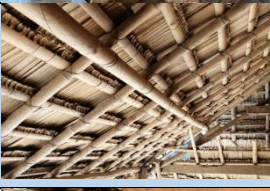




The first type is wood as teak. It consists of wood for building structures such as a wood pillar, wall, plank, stair, and bamboo for temporary flooring and roof covering. The second type is natural fiber as grass, straw, and rattan (palm). Almost, it uses for the wall of the building. Moreover, the last type of natural material used is earth as clay and mud that were mixed by grass and straw. It is the natural building material is made from subsoil, water, fibrous organic material (typically straw). It is known as Cob or Cobb. It found that a part of the wall of the tobacco kiln to keep the heat of the kiln steadily. Furthermore, it has a variety of natural materials used as wood, fiber, and earth and it found that the bamboo is the most material used in Tai-Lue house in Baan Na Yang Tai.

Table 6 Classification of natural materials used in Tai-Lue house in in Baan Na Yang Tai, Nam Bak, Luang Prabang Province Lao People's Democratic Republic.

Natural Materials	Type of building used	Characteristic and pattern of use
Wood	Wall	The wooden wall size is 15-20 centimeters, and it overlaps about 1-3 centimeters. The wooden walls are placed vertically.
	Structure	Teak is the majority of the structure of the house for main structure as a pillar, roof structure, floor.
Bamboo	Structure	They are White bamboo with a diameter of 5-10 cm and the length depends on the building.
	Tile roof	White bamboo was soaked in river. It uses only the section of White bamboo that the head of the tile for attaching the structure and that strips of split bamboo with a diameter of 10-12 cm.
	Wall	A strip of bamboo for weaving as twill weave patterns (over two strands of warp and under two). Using White bamboo weave together until a sheet for the wall.
Rattan	Structure	for attaching the roof structure
Earth (Mud)	Wall	It is mixed with clay or mud and put on grass and straw and attach to the wall structure of the tobacco kiln. The thickness of the wall mixed with clay has 20 centimeters.
Grass and straw	Wall	

Table7 Summarizing natural materials used in Tai-Lue House

Materials	Area	Structure	Photography reference
Wood	Chiang Kham	Wall	
		Structure	
		tile roof	
	Baan Na Yang Tai	Wood	

		Structure	
Bamboo	Chiang Kham	Structure	
		Wall	
		Decoration (Mat)	
	Baan Na Yang Tai	Structure	
		tile roof	
		Wall	
Grass	Chiang Kham	Roofing	
		Wall	

	Baan Na Yang Tai	Wall		
Dry leaves	Chiang Kham	Roofing /Wall		
Water reed	Chiang Kham	Floor		
		Ceiling		
Earth (Mud)	Baan Na Yang Tai	Wall		

The table shows that it has a total of 6 materials of natural materials used. In Chiang Kham, Phayao found five materials used as wood (teak), bamboo, Cogon grass, Dipterocarpaceae leaves (local leave), and water reed. Furthermore, in Baan Nayangtai, it has two materials used as bamboo for the roof structure, roof tile, and wall. Interestingly, the bamboo roof structure was made with a strip of split bamboo and attached bamboo roof by thin bamboo-strips. Moreover, it found Cob building for tobacco drying. It was made by organic materials as water, subsoil or clay, and straw and grass. It will be a significant material and fibrous organic material for sustainable materials in the future due to available materials in both areas.



Figure 10 Bamboo is the significant material as a roof of the house in Baan Nayangtai, Nambak, Luang Phabang, Laos.



Figure 11 a straw and grass mixed with clay for the wall of tobacco kiln

7. Discussion

In conclusion, it showed that the study of natural material used in Tai Lue house in Chang Kham, Phayao, and Baan Nayantai, Mueang Nambak, Luang Phabang, Laos found that it has three types of materials: 1) wood 2) fiber 3) Earth by Chris Dancey's Natural Materials Concept Theory [7]. It has five natural materials: wood (teak), Bamboo, Cogon grass, Dipterocarpaceae leaves (local leave), and water reed in Chiang Kham, Phayao, Thailand.

In Baan Nayantai, Mueang Nambak, Luang Phabang, Laos, found that it has two natural materials used. It has a significant material and fibrous organic material; Bamboo as a roof of the house and straw mixed with a clay known as a cob in Baan Nayantai, Mueang Nambak, Luang Phabang, Laos. The natural material used in Tai Lue house depends on a material, a location, geography, and local wisdom. Moreover, the details and the pattern of the material could be applied for a guideline of the architectural design of the Tai-Lue house in Chang Kham, Phayao.



Figure 12 presented by the exhibition of natural materials



Figure 13 the exhibition of research in Chiang Kham, Phayao

Furthermore, it could be developed natural materials used for natural materials adaptation of Tai-Lue house in Chiang Kham, Phayao. Natural materials used in Tai-Lue house of local wisdom could be improved and developed the architecture program of the University of Phayao and practice the materials used, technique and style for a lifelong learner. It found important issues that could be further researched in natural materials and material

development a guideline the design of natural materials in the Tai-Lue community in Phayao. It could be developed to new research of material and material innovation. There are four suggestions for the future as follows as

Plan 1: Bamboo materials in architecture that could be developed in the creation of new natural materials of architectural design for the local community.

Plan 2: Developing a research topic of bamboo, Earth, and leaves. It could further develop in materials such as bamboo fabrication for roofing and earth innovation for architectural design and interior decoration.

Plan 3: Upgrading bamboo processing for commercial.

Plan 4: Developing Tai-Lue learning center by natural materials used such as bamboo, grass, and bamboo base on local wisdom and the community-made in order to be a learning center of natural materials in Chiang Kham, Phayao.

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