Study on the Indigenous Building Materials of Traditional Houses in Myanmar

Cho Oo*,1, Saburo Murakawa2, Kyosuke Sakaue3, Daisaku Nishina4, Yasuo Koshikawa5 and Atsushi Yakushijin6

1 Senior Lecturer, Department of Arch., Yangon Institute of Technology, Myanmar
2 Professor, Graduate School of Engineering, Hiroshima University, Japan
3 Professor, School of Science and Technology, Meiji University, Japan
4 Associate Professor, Graduate School of Engineering, Hiroshima University, Japan
5 Research Associate, Graduate School of Engineering, Hiroshima University, Japan
6 Takenaka Corporation, Japan

Abstract

In this paper, a study on the various indigenous materials used for the construction of the traditional houses of Myanmar is made. The aim of the study is to collect the basic data for further study about the influences and effects of the use of indigenous building materials on the human comfort inside of the house in correlation with the environment and weather condition. Detail investigation is made on the villages of some races; Bamar, Mon, Shan and Inn-thar.

The authors show the type of structure of house in Myanmar and characters of the investigated houses based on the fieldworks and questionnaire, which are located at ten traditional villages and a new developed town. Various kinds of wood and bamboo used for construction materials and leaves and grasses used for roofing are shown as the common indigenous materials. Actual conditions of the indigenous materials used for structure, roofing, flooring and walling in each village and new town are clarified.

Keywords: Myanmar; houses; traditional houses; building material; indigenous material

1. Introduction

In this paper, a study on the various indigenous building materials used for the construction of the traditional houses of Myanmar is made. The importance of the study on the indigenous building material is that the use of the different building materials have greatly influenced on the human comfort and on the design characteristic of the house. The uses of different building materials create different conditions of interior atmosphere such as the changes of temperature, ventilation, solar radiation, glare, heat absorption, moisture penetration, etc. The aim of the study is that the collected facts, figures and results will be used as one of the actual basic data for further study about the influences and effects of the use of indigenous building materials on the human comfort inside of the house and in correlation with the environment and weather condition. The study emphasizes on the various kinds of indigenous building materials and their different ways of use in Myanmar. Detail investigation is made on the villages of some races (Bamar, Mon, Shan and Inn-thar).

All Myanmar races inclusive of Bamar, Mon, Shan and Inn-thar, commonly used the indigenous building materials for their houses. Various kinds of locally produced wood are used for flooring, walling and framing structure. Materials such as bamboos, canes, palms and grasses are also favorably used for wall, roof and binding or cordage materials. All kind of indigenous building materials are commonly used for their traditional houses because:

- The materials are commonly found in their own localities and environment.
- Ready-to-use indigenous products are easily available and these building materials can also be collected and produced by themselves.
- Though not durable, they are reasonably cheap or within an affordable price range.
- People have awareness that locally produced natural building materials are most suitable for adaptation to the extreme weather condition of the respective region.

2. Type of Structure of House in Myanmar

The common people houses in Myanmar can be classified into six types based on their building material used. The six types of house can be categorized into four classes due to the status and economic situation of the occupant. The four classes of house generally reflect their
Generally, Class B, C and D houses are built traditionally and they have not been influenced by modern concepts much yet. So the study emphasizes on these traditional houses.

It is mentioned that there are about over 6.3 millions houses, amongst them mixed wood-bamboo houses, mixed bamboo-thatch houses and wooden houses constitute about 54%, 26% and 15% respectively. The mixed wood-bamboo house is found to be the commonest type of houses in Myanmar. The pucca and semi pucca types are the minority with only 3.2% (Source: 1983 population census, Burma). It is quite conspicuous that the majority of the houses in Myanmar are mixed wooden and bamboo houses.

As an example, the following study was made in December 1990 in six townships where Bamar race is in the majority, in the central part (hot and dry area) of Myanmar. Detail study and investigation on the building material was made in 147 villages of six townships (Cho Oo, 1990). The result of the field study shows that the percentage of the mixed wooden and bamboo houses is 70.4% and highest (see Table 2).

### Table 1. Classification of the Type of Houses and Categorization of Classes

| No. | Type of Houses according to the Different Building Materials | Class |
|-----|-----------------------------------------------------------|-------|
| 1   | Pucca house                                              | Class A |
| 2   | Semi Pucca house                                         | Class B |
| 3   | Wooden house                                              | Class C |
| 4   | Mixed Timber & Bamboo house                              | Independent building material used |
| 5   | Mixed Bamboo & Thatch house                              | Class D |
| 6   | Others (Earthen wall, Slate roofing, Laterite stone wall house etc.) | |

*Pucca house: masonry house, brick house and stone house on concrete block house

### Table 2. The Building Material Used of Some Bamar Villages in the Central Part of Myanmar

| Township                | No. of Villages Studied | No. of Houses | Mixed Wooden & Bamboo | Wooden | Bamboo & Thatch | Brick & Others |
|-------------------------|-------------------------|---------------|-----------------------|--------|-----------------|---------------|
| 1 Kyauk-Padaung         | 67                      | 8,752         | 5,814                 | 668    | 2,232           | 38            |
| 2 Bagan/Nyaung U        | 31                      | 4,188         | 3,101                 | 154    | 917             | 16            |
| 3 Myingyan              | 18                      | 3,374         | 2,255                 | 89     | 1,012           | 18            |
| 4 Na-hto-gyi            | 8                       | 1,476         | 998                   | 18     | 453             | 7             |
| 5 Taungtha              | 9                       | 1,088         | 783                   | 20     | 281             | 4             |
| 6 Ma-hling              | 14                      | 1,410         | 1,324                 | 77     | 29              | 2             |
| Total No.               | 147                     | 20,228        | 14,275                | 956    | 4,972           | 85            |

Data of Field Survey December 1990

3. Outline of the Investigation

3.1 Studied areas and method of the investigation

Five areas were selected as the detail investigation. These areas are located in Yangon Division, Bago Division and Shan State where are shown in Fig. 1. From these areas, the authors have selected eleven villages that use indigenous building material and one developing lot at suburb area of Yangon City in order to compare among the traditional villages. These eleven villages belong to class C or D according to Table 1. North Dagon, new town extension area, which is developed by Yangon City Development Committee in 1992. The majority of race in each village is shown in Table 3.

The houses at the both villages of Nampang and Nampang Zeba composed of minor Inn-thar race are built in the Inle Lake, but the houses of Nampang Zegon are built on the land beside the Inle Lake.

At these villages the authors carried out the field study in June 2000 - April 2001. Some items of the investigation are as follows:

Regional Environment, Characteristics of the Villages, Characteristics of Household and Life Style, Traditional Dwelling House, Indoor and Outdoor Thermal Environment, etc., and Characteristics of Water Use.

From these studied results, this paper shows the typical features of the houses and the materials used in the houses based on the fieldworks and questionnaire.
The questionnaire survey was carried out in February and March 2001 by the investigators who visited to each house of ten villages and of a new town. They asked for the main person of household to answer the items of questionnaire. We got 50 replies from the houses in each village and new town, as shown in Table 3.

3.2 Attribution for the studied households

The situations at the studied households are shown in Table 4. The average family size in each is about 4 to 6 persons per household. North Dagon located in new town extension area of Yangon City is the highest income among the eleven studied areas. The mean income on one household in the ten traditional villages is about 7,400 to 11,000 Kyats. These are low income levels.

The occupations of persons who keep the family budget are shown in Fig. 2. The specific characteristics of the surrounding environment, in which the studied villages lie, have an influence on the occupations.

The farmer accounts high ratio in the villages of Lower Shandegyi and Talokkon, at where the rice is harvested two times a year, because of the good networks of trenches for irrigation. The farmers in the village of Hti Thein Ywe grow vegetables and fruits by the utilization of cooling climate on the highlands and the good supply of spring water. The villages of Nampan and Nampan Zeba, locating on the Inle Lake, are occupied more than 50 % by farmers and fishermen. In case of the farmers, they grow tomatoes, etc. on the floating lands in the Inle Lake. The majority in the new town of extension area of Yangon City, North Dagon, gets their living by working at offices. Therefore, they get much more income than the people who live in the traditional villages.

4. Characters of the Investigated Houses

As an example of traditional house in the villages of Barmar, Mon, Shan and Inn-thar races, floor plan and elevation are shown in Fig. 3 - Fig. 6. The outlines of these houses are shown in Table 5.

The majority of the traditional houses in the villages are built of mixed bamboo and timber. On the building materials, the authors discuss the next chapter. In this chapter, some typical features of the houses in the studied villages are discussed.

The pass-aged years of houses when were built in the studied villages are shown in Fig. 7, as percentage of each housing age category. The villages of Lower Shandegyi, Talokkon and Hti Thein Ywe, at where the people of working on the land are high ratio, are a little high percentage of under 10 years for housing age excluding the new town area such as North Dagon.

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**Table 3. Investigation Area for Questionnaire**

| Region                  | Division/State | Village       | Race                  | Collected |
|-------------------------|----------------|---------------|-----------------------|-----------|
| Traditional Village     | Yangon Division| Padagyi       | Bamar                 | 50        |
|                         |                | Nyaung Waing  | 50                    |
|                         |                | Lower Shandegyi| Mixed Bamar and Mon   | 50        |
|                         |                | Talokkon      | Mon                   | 50        |
|                         | Bago Division  | Taposan       | Mon Race              | 50        |
|                         | Shan State     | Hpaya Thonezu | 50                    |
|                         | Inle Lake Area | Hti Thein Ywe | Shan Race             | 50        |
| Urban Area              | Yangon Division| Nampan, Nampan Zeba | Inn-thar Race | 50        |
|                         |                | Nampan Zegon  | 50                    |
|                         |                | total         | 550                   |

* Nampan and Nampan Zeba are counted as one village, Nampan.

**Table 4. Family Attitudes**

| Family Attribute | Income[^2] [Kyats/month] |
|------------------|--------------------------|
| Padagyi          | 8,800                    |
| Nyaung Waing     | 7,700                    |
| Lower Shandegyi  | 7,400                    |
| Talokkon         | 8,600                    |
| Taposan          | 9,200                    |
| Hpaya Thonezu    | 9,600                    |
| War Pyar         | 11,000                   |
| Hti Thein Ywe    | 9,900                    |
| Nampan           | 9,900                    |
| Nampan Zegon     | 9,600                    |
| North Dagon      | 18,000                   |

[^1] Mean Value of 10 Traditional Villages
[^2] $1 = 400$ Kyats (Dec. 2000)

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**Fig. 2. The Occupation of Person Who Keep Family Budget**
The housing ages in the village of Hpaya Thonezu are high percentage of 30 years over.

Some typical features of housing in the studied villages are shown in Table 6. The people living in the four villages of Yangon area have high ratio of one story house, also have small floor areas. As for the type of floor and the height of the flooring, like as the houses of other tropical countries, the traditional houses are commonly provided with the raised flooring. The earthen floor is widely used for ground floor in the two stories house. In case of the village of Nampan, the height of the flooring is the highest among the traditional villages, because they have to keep the open space for increasing the water level of the Inle Lake on the rainy season. These open spaces under flooring are used as the tie-up boats. The raised floor not only prevents the moisture penetration in the hot-humid weather but also protects the hot sunshine in the hot-dry weather. The whole space of under the high raised floor (che-tan-she) serves well as an extra living and working space for the family. In the hot-humid area the room upstairs of the raised-floor house is clean and dry for family and in the hot-dry area the space under the raised-floor is cool and airy during daytime.

5. Building Materials of Traditional Houses
5.1 Various kinds of building materials

(1) Wood used as constructional materials

Table 7 shows the main timbers that are selected from most suitable timbers in Myanmar for constructions and for houses. The species in the list possess the essential quantities of strength and durability and all are obtainable.
in large sizes. The commonest used durable timbers in Myanmar are Teak, Pyinkado, Padauk, Thitya and Ingyin. Timber such as In, Kanyin, Aukchinza and Thabye are also popularly used though not much durable.

Also, many palms and wooden poles shown in Table 8 are used for construction of traditional houses in Myanmar. They are cheaper than durable timber posts. Especially class D houses use palm and wooden poles for their house posts instead of durable wood due to their income.

(2) Bamboo used as constructional materials

Bamboo occurs in very large quantities in most of the forest in Myanmar. Bamboo is widely used as building materials for wall, floor, roof, and binding cordages and even as structural posts, beams, rafters, purlins, etc. Bamboo favorably used as building materials in Myanmar are shown in Table 9. Bamboo is manufactured into a variety of roofing material. However, bamboo roofing is usually practiced in the dry areas in the middle of Myanmar. As we couldn’t find out the houses roofed over with bamboo in the studied villages, this paper makes no mention of the detail of bamboo roofing.

(3) Leaves and grasses used for roofing

In Myanmar, wide variety of roofing materials are used, such as C.G.I. sheets, corrugated asbestos cement sheets, Mangalore tiles, clay tiles, wooden shingles, leaves, grasses, bamboo, etc. Bamboo, palm, and thatch are made uses of as roofing materials since times and memorial. Amongst all the roofing materials, those that are made with the indigenous raw materials are most commonly used because they are cheap, affordable and easily available. Moreover they are easy to handle. Local builders and carpenters are quite skillful in using it. Consequently, the majority of the Myanmar houses about 80.2 % are roofed with leaves, grasses, bamboo and thatch.

The leaves and grasses that can be easily collected and manufactured into roofing materials are those that are found abundantly in the area. If the period of durability is too short, it is not economical. The leaf and grass materials that last for about 3 to 5 years are most favored.
The commonly used leaves and grasses for roofing materials are listed in the Table 10.

### Table 10. Various Kinds of Leaves and Grasses Used for Roofing

| Common Name | Botanical Name | Uses |
|-------------|----------------|------|
| 1 Theke * (Thatch grass) | Errianthus gamaicensis | Wild tall grasses can be found all over Myanmar. Roof lasts for 2 to 6 years. Roof gradient should not be kept less than 27 degrees. |
| 2 Kyan (Sugarcane leaves) | Officinarum | Widely use in Inle area and central part of Myanmar where sugarcane are plentiful. Roof lasts for about 2 years. Roof gradient should not be kept less than 30 degrees. |
| 3 Taung-htan* (Livistona palm) | Livistona rotundifolia | Widely use in the hot-dry and hot-wet area where the Livistona palm are plentiful. Roof lasts for about 3 years. Roof gradient should not be kept less than 30 degrees. |
| 4 Dani * (Nypa palm) | Nypa fruticans | Very commonly used in delta and tidal estuaries. Durable and lasts for 2 to 4 years. Dani roof withstands heavy rain and are popularly used in the heavy rainfall areas. Roof gradient should not be kept less than 25 degrees. |

*are commonest roofing materials in Myanmar

5.2 Materials used for houses in the studied villages

(1) Material used for structure

The results of questionnaire survey on 50 houses in each village are shown in Fig. 8. The study shows that mixed wood-bamboo houses and wooden houses are majorities in all eleven places. It is one of the clear evidences that majority of traditional houses of Barmar, Mon, Shan and Inn-thar races are built with indigenous building materials. This is one of the reasons why the study emphasizes on the “Indigenous Building Material of the Traditional Houses of Myanmar”.

Among the Myanmar constructional woods shown in Table 7, Teak, Pyinkado, Padauk, In and Kanyin are commonly and popularly used for houses of the studied areas.

For the post of houses and fences the qualities required are great durability and resistance and in the case of piles, resistance to shear and split. No timber, not even Teak, is absolutely immune from attack by white ants, but Pyinkado, Teak, Thitya/Ingyin etc. shown in Table 7 will resist them for many years. Therefore, these species are popularly used for the ground contact wood in the studied areas.

In case of the timber piles used for the house built in the water such as Inn-thar’s houses of the Inle Lake, the essentials of the timber used are the power of resistance to decay when exposed to alternate wetting and drying. Pinle-kanazo, Pyinkado and Thitya/Ingyin are generally superior when partly submerged and partly exposed to the air. In case of Inn-thar’s house of the Inle Lake, Pyinkado and Teak are widely used. Padauk and Thitya/Ingyin are also used in some houses in the Inle Lake.

As for the palms and poles shown in the Table 8, Kabaing (Myaw) and Madama are widely used in the studied area. Because they are hand fairly durable and the size is suitable for house posts, beams and rafters. Besides compare with the square timber posts they are reasonable cheap on within an affordable price range and easy to get from the local market. Kabaing (Myaw) is also widely used Inn-thar’s houses of the Inle Lake.

(2) Material used for roofing

The materials used for roofing in the studied areas are shown in Fig. 9. Leaves and grasses are still used widely in the traditional villages excluding some areas.
Also, Fig. 9 shows that on one hand, C.G.I. sheet is commonly used in North Dagon, War Pyar and Hti Thein Ywe villages. According to the development project at North Dagon, new town extension area of Yangon, Development Committee distributed and sold the C.G.I. roofing sheet for the dwellers for the purpose of fire protection. Shan old villages of War Pyar and Hti Thein Ywe used to thatch grass; Thatch that can be found in surrounding areas. However these villages now close to Taunggyi town and they were adopted as parts of Taunggyi town. Consequently C.G.I. roofing sheets are easily available in the local market. On the other hand, palm leaves are widely used for roofing in Taposan, Hpaya Thonezu and Talokkon villages because Taung-htan palm leaves are abundantly found in their surroundings and ready-to-use products of palm roofing material are also easily available. Nypa palm leaves, Dani, are widely used in Padagyi and Nyaung Waing where are located at the mouth of the Bago River, because Dani are abundantly found in delta and tidal estuaries in their surroundings. The villages of Lower Shandegyi and Talokkon where located on the way to Bago from Yangon used both of Taung-htan and Dani palm leaves. Almost houses in Inle area including Nampan village are Thetke (Thatch roofing), but they are now changing to use C.G.I. or Kyan (Sugarcane leaves). Sugarcane leaves for roofing can get easily in the surrounding areas.

As mentioned above, Thetke (Thatch grass), Taung-htan (Livistona palm) and Dani (Nypa palm) are widely used and most popular roofing materials all over Myanmar. Therefore, these three popular types of roofs are discussed more detail in this paper.

(a) Thetke roofing (Thatch roofing)

Thetke are turf durable grass and it lasts reasonably well. Thetke grasses are reaped and each small bunch is folded at its base and tied onto a bamboo stick, which is about 120 cm to 180 cm long and 46 cm wide. Each bamboo stick thus covered and tied with the Thetke leaves is called a “Thetke byit” as shown in Fig. 10. When roofing the overlap of the Thetke byit is kept about 5 cm. The thin split bamboo strip (Hnee) is used to fix or tie the Thetke byit on to the bamboo common rafters called as Achin-wa.

The roof gradient should not keep less than 27 degrees.

(b) Taung-htan roofing (Livistona palm)

The leaf of the Taung-htan are formed into a very large rounded fan-shape, so palm leaf byit is not very neat and flat like that of Thetke and Dani byit. The size of a Taung-htan byit is 120 cm or 180 cm long and 50 cm wide as shown in Fig. 11. The stalk of the individual leaf is cut off then forming into byit by fixing it onto the split bamboo stick. Some use the individual leaf for roofing instead of forming into byit. There is no hard and fast rule as to how much the overlap should be kept.

With reasonable overlap Taung-htan leaf roof last for 2 to 3 years, however such type of roofing is used not only in the dry areas but also heavy rainfall areas. The roof gradient should not be kept less than 30 degrees.

(c) Dani roofing (Nypa palm)

Nypa palm is good source of palm sugar and its matured leaves are good roofing materials. Dani leaf blades are folded onto the thin split bamboo sticks. Each Dani byit is about 120 cm to 137 cm long sometimes 180 cm long and about 30 cm wide, as shown in Fig. 12. When roofing Dani byit are used overlapping must be at 23 cm intervals. They are tied with bamboo strip onto the common rafters. The technique of roofing and fixing are similar to that of the Thetke roofing. Dani roofing should not be kept less than 25 degrees gradient. Dani roofing withstands heavy rain and are popularly used in the heavy rainfall areas.

(3) Material used for flooring and walling

For the construction, timber flooring is commonest in Myanmar. Bamboo flooring is also popular in villages. As for walling works bamboo is commonest and secondly timber are used. As shown in Fig. 13 and Fig. 14, timber and bamboo are used in majorities for flooring and walling in the studied areas.

For flooring and walling In, Kanyin and Thingan though not particularly ornamental, are suitable for low cost houses and warehouses (See Table 7). Teak, Pyinkado, and Padauk are very good and extensively used both as flooring and walling. The results of field study indicated that Pyinkado, In, Kanyin, Teak and Padauk are likely to use in.

The common types of wood walling construction are printing walling, weather boarding, butt jointed and splinted and trellis work. The wooden floor construction of printing strip, parquet and grilled floor are also common in Myanmar. The above-mentioned wood works are so commonly practiced world wide that they need not to be discussed here in this paper.

As mentioned in section 5.1, bamboo is widely used as walling materials all over Myanmar. Tin-wa, Wani-pa, Hmyin-wa, and Wa-phyu are commonly used bamboo for walling (See Table 9), Tin-wa is the most popular for walling. Various types of bamboo wall are used in the traditional houses in Myanmar. If crude oil is applied annually the bamboo wall lasts for 5 to 50 years depend on the condition of direct weather exposed and different kinds of bamboo used. The various types of bamboo wall used in Myanmar are as follows:
Bamboo mat wall (woven crushed bamboo mat), Trellis split bamboo grid wall, Split bamboo nailed into grid or pattern wall and Vertically woven split bamboo wall. These main patterns are shown in Fig. 15 - Fig. 18.

6. Conclusion

The majority of the traditional houses are built with the indigenous building materials in Myanmar. The local and traditional manufacturing methods of building materials and their traditional ways of use are widely practiced in the rural Myanmar. Depend upon the type of houses, length of spans, interval of posts, roofing gradient, height of building, the size and design are much influenced by the building materials used. Besides, weather and climate conditions are much diversified from one region to another. So the dwellings have to be designed and have to choose the appropriate building materials to suit the climate of the locality it is built. Moreover, from the economical point of view, the consideration for the choice of building materials has to be reasonably cheap or within an affordable price range.

Amongst the different kinds of indigenous building materials, timber and bamboo are the most widely used in Myanmar. Among the two materials, the timber is the most popular one. So far no other building materials are as readily available or versatile. Besides, bamboo is the most appropriate material for the building components such as roofs, floors, walls, mats, posts, binding cordages, etc.

Although the technology for building materials has been developing very fast, worldwide, Myanmar races are still using local products of indigenous building materials for their traditional houses. This situation may be considered that one is the economic condition of the rural people of a developing country, the other is that they have awareness about the locally produced natural building materials are most suitable for their health and adaptation to the extreme weather condition of their regions.

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