

CURRENT STATUS OF MAINTENANCE OF THATCHED ROOFS IN SHIKOKU

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ABSTRACT:

The use of the traditional Japanese construction method, "thatched roofing," is steadily declining despite its considerable environmental performance. Here, thatched roofs in Shikoku were re-roofed without subsidies to clarify preservation of these roofs. We conducted a hearing survey with officers of the city engaged in activities related to the traditional Japanese construction method and obtained opinions on the maintenance method of thatched roofs and the implemented policies in the city. Thatched roof maintenance is possible without subsidies by maintaining and managing roofs that have existed for generations, and thatching replacement, such as procuring thatched roofs independently. Policy implementation, such as increasing the number of thatched-roof events and increasing the subsidy rate for thatched-roofing work, positively impact residents. Three teahouses were re-roofed as demonstration during a workshop. We confirmed the records of traditional construction methods and established the measures of roofing that can be adapted. For durability, the traditional construction method to firmly fix thatched roofs to the base and minimize the influence of rainwater were followed, screws and reinforcing bars were used, and the roof slope was changed. Furthermore, new technology increases the durability of the roof and prolong the number of years before re-roofing is required.

KEYWORDS: Thatched roof, sustainable resource, Chado

1 INTRODUCTION

Grass is sometimes used as a material for thatching walls and roofs. One such grass is *Imperata cylindrica*, or Cogon grass. Thatching has existed as a construction method in various parts of Japan since BC.

Using LC(Life Cycle) system analysis, according to Naoki, the amount of carbon fixation per hectare in grasslands is approximately 8,514 tCO₂/year [1]. In addition to their role in fixing carbon, grasslands also serve as habitat for unique organisms, who in turn play a role in maintaining biodiversity. Moreover, a 2014 study by a Danish research institute performed a life cycle assessment (LCA) of the environmental impact of thatched roofs from pampas grass and reeds growth, thatch field management, thatch transport, and construction. Results showed that, even if domestic and overseas transportation energy is included, these values are negative [2].

After the thatched structure is taken down, the old thatch can be used as fertilizer in the fields. Ando stated, "When re-roofing, the large amount of old thatch produced is decayed to a moderate degree, with a large amount of soot from the hearth adhering to it, making it a great fertilizer." He also noted that "old thatch from roofs are better as a fertilizer than freshly cut thatch applied directly to mulberry fields" [3].

However, the use of thatched roofs are on the decline. According to a questionnaire survey conducted by Takamido, Takahashi, and Shigematsu, 71.4% of structures in Miyamachō had thatched roofs in 1945, but this number dwindled to only 23.7% by 1986. In addition, a questionnaire survey was conducted on the reasons households had changed from thatched to tin roofs, with 38% of respondents indicating that thatch was hard to acquire, and that it was difficult to find help to install thatched roofing. However, it has become clear that good quality thatch and neighbors that are willing and able to lend a hand, which were easy to obtain in the past, have declined due to labor shortages and changing times (Table.1) [4].

In addition, tiled roofs became the trend around 1930. Furthermore, rapid economic growth, chemical fertilizers, and mechanization due to the modernization of agriculture reduced grassland values.

However, in European countries, the environmental performance of thatched roofs is being reassessed, with thatched roofing still being used in modern buildings. This is especially true in the Netherlands, where some 2,000 to 2,500 structures are outfitted with new thatched roofs annually. These structures include public buildings and housing complexes, in addition to alone standing houses. Below is an example (Figure 1).

In Japan, there is also an environmental-based movement underway to preserve thatched roofs, with

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methods suitable to contemporary lifestyles, the environment, and resources.

In this study, we focused on Shikoku, where the numbers of craftsmen and thatched buildings are declining rapidly. We clarified what kind of measures are currently being taken where frequent re-roofing is not possible, and examined possibilities and issues involving the use of thatch in modern society moving forward.

Table 1: Reasons for changing thatched roofs [4]

The reason for using galvanized steel (Multiple answers up to 3 out of 12)	Respondent households (129) (%)
Can't get thatch	23
If you change it, you won't have to worry about fires	20
No help when reroofing	15
It is more durable to replace	9
Community of thatched dependency is falling apart	7
The change fits the modern lifestyle	4
The sense of life has become urban	3
No time to reroof	2
Started doing jobs other than agriculture and forestry	2
Cheaper to change	2
Financially comfortable	1
Others	12



Figure 1: Dutch thatched roof

2 METHODS

A hearing survey with related parties and a construction method survey at the construction site of active craftsmen were conducted. The surveys were conducted between 2019 and 2022. The hearing survey was conducted on all the subjects who are currently involved in the maintenance of thatched roofs, i.e., the owner, craftsman, and government. Specifically, the survey was conducted on two houses and four residents namely: Ino Town, Kochi Prefecture, Kumakogen Town, and Ehime Prefecture. The houses were re-roofed with active Kabuki craftsmen and without subsidies. One of the masters (Yusuhara Town, Kochi Prefecture) and two local governments (Miyoshi City, Tokushima Prefecture and Seiyo City, Ehime Prefecture) were working on the preservation of thatched roof in the cultural property

department in Shikoku. In the construction method survey, there was only one active thatched-roof craftsman in Shikoku. Therefore, the construction process performed on the thatched roof of the three buildings (Yasuo Chado, Katahira Chado, Koyamati Chado) by the Yusuhara craftsman was recorded in video, and drawings were constructed by an actual measurement. The changes from the traditional construction method were confirmed. The survey area is shown in the Figure 2 below.

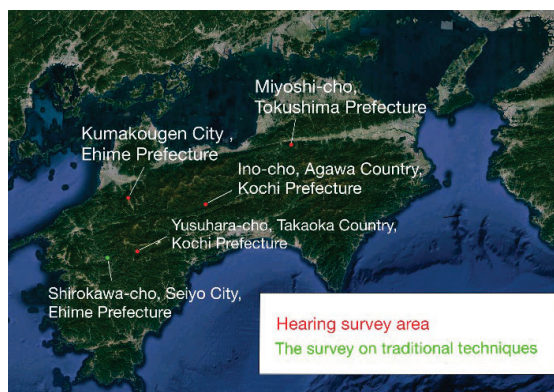


Figure 2: The survey sites

3 HEARING SURVEY

3.1 OWNERS WHO CONTINUE TO RE-ROOF THATCHED HOUSES

In a previous study [4], reasons that justify the decrease in thatched roofs were "I cannot get thatched roofs" and "I do not have any help when changing the thatched roofs." The two houses that had their homes re-roofed had personally prepared a thatched roof (Figure 3), and spent several years collecting thatched material, saving the material, and re-thatching. In addition, the owners were foresters by profession, and had experience in re-thatching with aid from the village. They also aided craftsmen by assisting their families when re-roofing at a home rice field.



Figure 3: Kayaba

3.2 THATCHERS IN YUSUHARA

The only active thatched-roof craftsmen who inherited traditional techniques in Shikoku are the craftsmen in

Yusuhara Town. We interviewed one of the masters regarding the people who often go to the site among the members, and Table 2 outlines our findings. Here, *tego* refers to craftsmen who gather the thatch and *jibashiri* refers to those who clean it. Professional proficiency increases as one moves to the left-hand side of the table. All of them, including their masters, make a living from agriculture, and the average number of thatched-roof jobs is three or four per year. The types and sizes of buildings they re-roof vary from small buildings such as *Chado* to main buildings of about 200 m², Kaya uses Yoshi from Watarase Retarding Ground in Tochigi Prefecture (Figure 4). Unlike Japanese pampas grass, this grass grows in water from May to September, and is harvested after being dried during the dry conditions of October. Although the cost is higher if transportation costs are included, the overall stretch is longer than the local pampas grass and can cover a large area. It is also excellent in durability, hence it is economical in the long run.



Figure 4: Reeds at Watarase Reservoir in Tochigi Prefecture

Table 2: Careers of craftsmen in Yusuhara Town

	craftsman K	apprentice A	apprentice B	apprentice C	apprentice D	apprentice E
position	master	corner roofing	flat roofing	needle picking	tego	jibashiri
age	70's	late 50's~early 60's	late 50's~early 60's	40's	40's	40's
gender	man	man	man	man	man	man
birthplace	Yusuhara	Yusuhara	Yusuhara	Yusuhara	Yusuhara	Yusuhara
profession	agriculture	agriculture	agriculture	agriculture	agriculture	agriculture

Table 3: Miyoshi City Cultural Assets

Thatched facility as a cultural asset						
	district	name	kinds	scale(m ²)	remarks	reroofing
1	Otiai	Nagaoka's	Main house	232.0	Recurrent construction: Cultural properties open facility	2010
2		Fusho	Main house	63.9	Recurrent construction: Tourist old private house stay	2011
3		Seiko	Main house	203.0	Recurrent construction: Tourist old private house stay	2012
4		Udoku	Retirement room	126.0	Recurrent construction: Tourist old private house stay	2013
5		Yukyo	Main house	200.0	Recurrent construction: Tourist old private house stay	2014
6		Yukyo	Retirement room	110.0	Recurrent construction: Tourist old private house stay	2014
7		Ungai	Main house	146.0	Recurrent construction: Tourist old private house stay	2014
8		Soten	Retirement room	79.9	Recurrent construction: Tourist old private house stay	2014
9		Tanzai	Main house	248.0	Recurrent construction: Tourist old private house stay	2015
10		Ten-ippo	Main house	240.0	Recurrent construction: Tourist old private house stay	2015
		subtotal		1648.8		
11	Sugeoi	Kone's	Main house	169.0	National important cultural property	2009
12	Turui	Kimura's	Main house	291.0	National important cultural property	2007
13	Turui	Kimura's	Retirement room	169.0	National important cultural property	Iron plate

3.3 CULTURAL PROPERTY-RELATED DEPARTMENT

There are many thatched-roof buildings in Miyoshi City and Seiyō City that are making advanced efforts regarding thatched roofs. In Miyoshi City, under the historical scenic maintenance and improvement plan, thatched roofs were secured to cover the amount required for re-thatching 17 thatched-roof buildings (Table 3). Residents were hired to collect thatched roofs. In case of a surplus of the thatched roof, the building material was sold outside the city. As a future policy, the city is planning to continue its current thatch cutting activities, providing events where local elementary and junior high school students and others who do not know about thatch can learn more about this resource. Premised on a desire to preserve thatched roofs, the city shared its opinion that it would like to continue the maintenance of thatched roofs, using this as a catalyst for the prosperity of the local community and to attract migrants from other regions. In Seiyō City, there are more than 10 thatched-roof teahouses, which are common property in the village. Teahouses are a place of customs for "intangible folk cultural properties for which measures, such as creating records, should be taken." At that time, a mechanism was created to assist the cost for Kaya and others. In addition, in August 2014 a regional development group held an exchange between residents of urban areas and local residents at Yasuo Chado, the aim of which was to utilize thatched roofs as a symbol of farming villages. Using vacant houses and abandoned farmland, the group is busy with revitalization efforts that center on holding migrant exchange meetings, mainly for people living in urban centers.

4 CURRENT THATCH CONSTRUCTION METHODS

The construction method used in the re-roofing work of three buildings (Yasuo Chado, constructed in 2019; Katahira Chado, constructed in 2020; and Koyamachi Chado, constructed in 2021) in Shirokawa-cho, Seiyō City, was implemented by the aforementioned master of Yusuhara Town. The method was plotted based on interviews with craftsmen and actual measurements (Figure 5, 6, 7, 8). Due to the traditional technique of the right person in the right place, the construction method slightly differed depending on conditions such as the amount of kaya gathered and the skill of the builder even in the construction of the three teahouses of the same scale that we witnessed. There have been some changes from traditional methods. First, reinforcing bars were used for the top oshiboko (pressed bamboo) on which the ridge is placed (or Iribanachi [Yokotake at the top of the eaves] depending on the construction) (Figure 9). In addition, the inside of the house and the first Iribanachi were connected by a number line (Figure 10). All of them are particularly strengthening the members that received the load. When fastening the thatched roof to the rafters, instead of rice straw, a thinner and stronger sisal rope was used to improve workability and durability (Figure 11). In addition, we tried to follow the traditional Ehimeroofting method of fixing the rope to the kaya bundle in the corner

without penetrating the rope into the hut so that water is not used when fastening the corner (Figure 12). The construction method was selected with consideration of performance improvement and regional characteristics. Next, we summarize the differences in the items noted below for the three Chado.

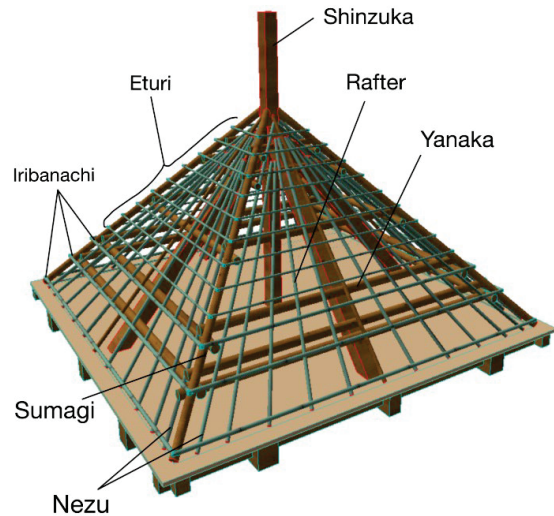


Figure 5: Names of roof trusses



Figure 9: Reinforcing bars are used for the top shavings that support the water bottle



Figure 10: Connecting the Yanaka and the first Iribanachi with a number line



Figure 11: Using a sisal rope as a substitute

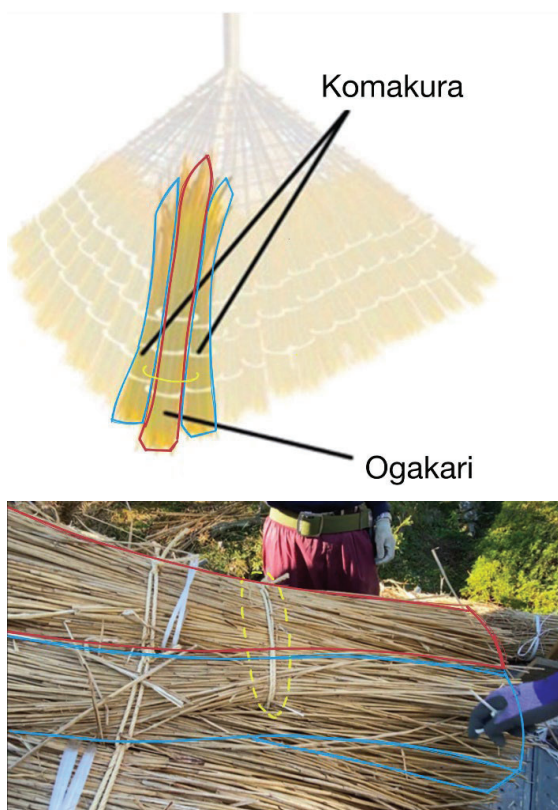


Figure 12: Fixing mackerel tuna bundle

4.1 THATCH THICKNESS

A thatch thickness of 560 mm was recorded for Katahira Chado, which was re-roofed in 2020. This was the only record of thatch thickness exceeding 500 mm. This was thicker than the roofs of other Chado when it was first re-roofed, likely because the site where it was built has better sun exposure than the sites of the other two Chado. Both Yasuo Chado and Koyamachi Chado are flanked by mountains and trees. Just as with the thatch-roofed main house, which had a hearth, thatch is not moisture-resistant and will rot faster if it is not kept dry. For this reason, the thatch of the Katahira Chado, which receives good sun

exposure, remained thick. Yasuo Chado and Koyamachi Chado have similar site conditions, but the thatch on Yasuo Chado grew thinner.

4.2 THATCH MATERIALS

All thatch is made from pampas grass or reeds. There is no difference between the two but, as the area is characterized by plentiful rain, Craftsman K said, “Rather than removing the undergrowth, we will leave it and bring the thatch with the undergrowth on to the outside. This will prevent the rain from penetrating.” Thatch roofing naturally has a water-conducting effect, but as the years pass, the thatch becomes thinner, and rainwater begins to penetrate. This undergrowth will fill the gap and prevent leaks.

4.3 EAVES/CEILING

There are two types of ceilings: joist ceilings where the ceiling is closed off with boards, and decorative attics where the beams are left exposed. These differences do not in any way affect the durability of the roof; the joist ceiling prevents birds and animals from entering the roof, while the decorative attic emphasizes ventilation and promotes the drying of the thatch. Hence, each type presents some advantages and disadvantages.

4.4 BASE MATERIAL

The base material consists of a lattice-like structure made of bamboo and rafters and is made at lengths of approximately 200–400 mm or less. Since wood is more durable than bamboo, when bamboo is used, six pieces are used per interval, while for wood, only five are used. For Yasuo Chado (girder line length: 2,133 mm) nine cedar posts are used, while for Katahira Chado (2,193 mm) one cedar post is positioned in the center, surrounded by eleven bamboo posts. For Koyamachi Chado, nice bamboo posts were used, but those had a thicker diameter than the ones used for Katahira Chado, and the interview survey revealed that this was because the craftsmen believed that the robustness would be sufficient.

4.5 MUNESHIMAI

Since the tin originally used for the muneshimai of Yasuo Chado was peeling off, this was repainted the original color. Bamboo and cedar bark were used on the muneshimai of Katahira Chado and Koyamachi Chado. However, as these could not be reused, muneshimai were created using water jars provided by local residents. Because these jars have such wide mouths, they are filled with thatch bundles. The culture of using recycled materials on the muneshimai runs deep.

4.6 ROOF SLOPE

Thatch does not leak because the thin, straw-like strands have a water-conducting effect and thus serve as an effective roofing material. However, if the slope of the roof is too gentle, rainwater will collect in the gaps of the thatch, allowing rot to establish. Based on the slopes of the three buildings, it is thought that a thatched roof slope of 45° or more is preferred.

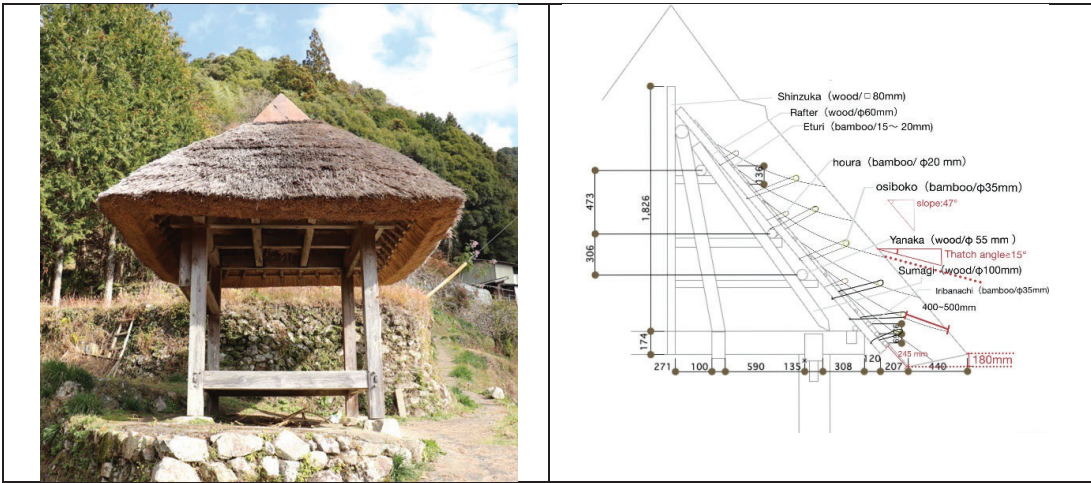


Figure 6: Yasuo Chado

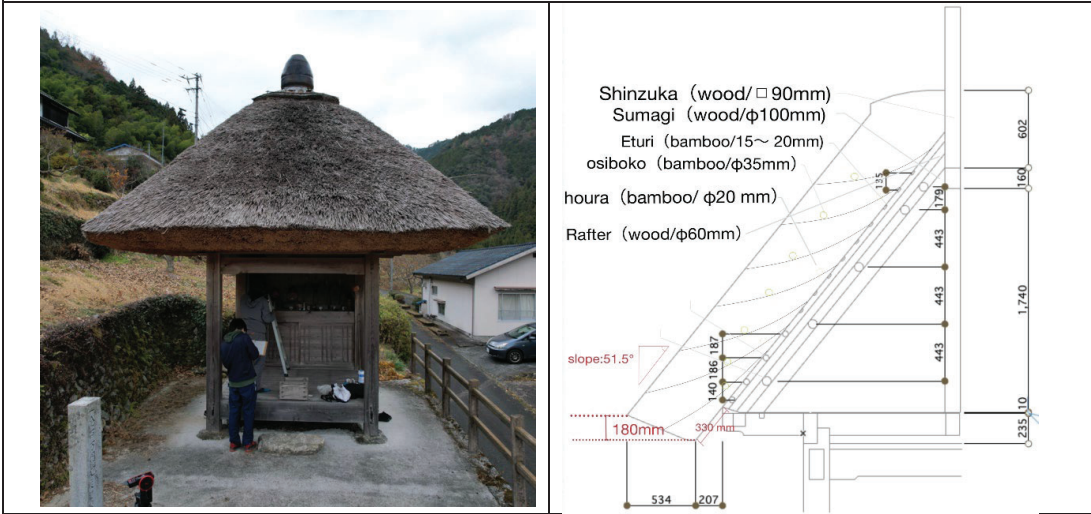


Figure 7: Katahira Chado

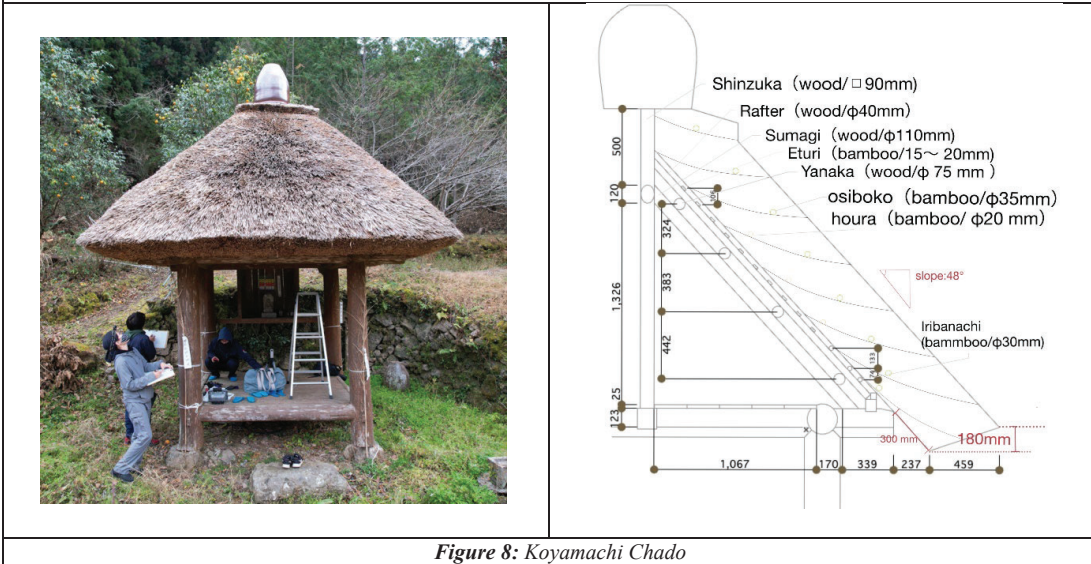


Figure 8: Koyamachi Chado

5 CONCLUSIONS

With clarity on the information on thatched roofs, owners, craftsmen, and governments are exploring and practicing methods of maintaining and organizing thatched-roof buildings with consideration that modern thatched roofs, materials, and craftsmen are limited. Considering the situation of the owner who faces challenges in re-roofing frequently, the craftsmen have devised their construction method to improve durability, reduce the frequency of repairs, and tried to replace the material as much as possible. Moreover, present Shikoku craftsman methods can be applied to thatched roofs anywhere in the country, and if these methods can be properly disseminated, we believe that they can greatly contribute to the maintenance of thatch.

In the future, the conditions necessary for growing thatch suitable for roofing require clarification. This is because if thatch, which serves as the chief material of thatched roofs, cannot be harvested, properly maintaining such roofs becomes impossible.

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