

SOCIO-CULTURAL SUSTAINABILITY IN TRADITIONAL ARCHITECTURAL TECHNIQUES: COMBINING TRADITIONAL THATCHED ROOF CULTURE WITH MODERN DAILY HOUSEHOLD MANAGEMENT TECHNIQUES

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Summary

This paper aims to examine how the management of traditional technologies presents social frameworks of the sustainability of architecture, particularly, by putting more emphasis on the relationship between technology and people's social and lifestyle circumstances. In Japan, the disappearing thatched house represents the organic and synthetic relationship between its form and the technique, and the social organization involved in its construction. In the design and construction of a new thatched house, we experimented several methods of technology management: approaching the problems not from the physical conditions of the house but from the psychological and symbolic meaning of the house, and demonstrating a new and flexible understanding of the interior climate conditions, and tried to create a new way of making a thatched roof house.

We discovered that the loss of the social background of the thatched roof techniques caused multiple problems in its quality control, and we could examine the potential of everyday minor techniques to fix the problems caused by the contradictions between the condition of thatched house and our contemporary lifestyle. However, there were unpredictable failures and problems, which were only resolved through the support of others in the local community. We recognized that those techniques were closely related to the whole expression of residents' life and to factors in society, and that we have to examine how architectural techniques can operate on different type of social sustainability in our contemporary society.

1. Introduction

Thatched roof, which was one of the oldest and most popular architectural technologies, symbolizes the nostalgic Japanese hometown landscape, and represents the cultural image of Japanese architecture to be unified with its natural environment. Although, by the expansion of urban developments after the World War II, fire protection laws prohibited thatched roof houses in urban areas. Damp areas and grass fields beside lakes and rivers, which supply its material, disappeared. Moreover, with the introduction of western lifestyles since the Meiji era, people became unfound of the inevitable material features of thatched roof house; smoke in the air, bags in reed, and natural ventilation through the roof decreasing insulation efficiency. As a result, thatched roof came to be recognized as an ornamental form expressing the Japanese taste or as a historical heritage. The prefabricated houses with homogeneous performances and forms became more popular, the more thatched roof houses were demolished. One may recognize such declination of thatched roof house as the inevitable and imperative process of technological evolution and the modernization of lifestyle, however, such viewpoint lacks the understanding of the socio-cultural and synthetic aspects of the sustainability in architectural technology.

In the construction of a thatched roof house and in the preparation of materials, all members of the village used to work together and took care of the grass fields in turn, which helped to maintain the communal bond among them and to transmit traditional environmental ideas and knowledge from generation to generation. Thatched roof exemplifies that not only the direct and partial architectural performances but also the effects on the cultural landscape, social organizations and peoples' ways of life are essential to understand the relationship between architecture and its environment. Thus, in order to clarify the meanings of the sustainability in traditional architecture, as well as in order to revive them into our age, we have to evaluate the different kinds of rationality in the social and cultural relationships between their architectural forms and peoples' lifestyle, and between the construction and maintenance technologies and their social and climate conditions with synthetic management strategy.

In this study, I am going to examine my actual design project of a thatched roof house from above viewpoints, and to show what kind of difficulties and possibilities I encountered in reviving traditional technology by appreciating their sustainability. I have tried to reexamine the advantages and disadvantages of the thatched roof construction, and tried to introduce various kinds of ventilation systems, daylight methods, and thermal insulations in order to make flexible and complementing solution. I also worked with the clients to reframe

their understanding of life space to create the most suitable space arrangement for their lifestyle, which is also most energy efficient. Even with various efforts, there are still unexpected problems caused by the natural force, and we are learning that the regionally rational and long term simple technologies are fundamentally rational and applicable to any difficulties.

The renewed interest in sustainability has emerged from our concern and heightened awareness of the potentially fatal destruction of the natural environment resulting from the rapid changes in our society and lifestyles, changes accelerated by the various technological developments since World War II. However, instead of countering to the above technologies with other more advanced ones, I believe that it is important to reexamine the social meaning of technology and the social background which has caused changes in our attitude towards the environment: social organization, cultural foundations and people's lifestyles etc., which are often invisible and psychological. It is said that the formation of people's personal identity and satisfaction with their living conditions is greatly affected by their psychological and habitual attachment to the environment. Thus, passing on traditional techniques and applying them to our contemporary lives is not only a historical issue but also an alternative approach to the idea of sustainability. This approach examines environmental conditions from the standpoint of the quality of our lifestyle instead of a quantity-based value system.

2. Optimality and historicity of technology

There have to be several conceptual shifts in our framework to reexamine the relationship between technology and people's social and lifestyle circumstances in terms of the lifestyle quality:

Firstly, it is necessary to recognize that the values and style of our living conditions have been historically formulated. For example, our demands for the room temperature, lighting and sanitation in our houses; these vary regionally and historically and have been changed according not only to the technological development but also to the social situations.

Secondly, architectural techniques are based on the regional conditions and climate, and in turn, often contribute to the formation and maintenance of local social organization. For example, many architectural rituals, such as the topping-up ceremony (Muneage), have symbolic meanings connected to religions in the society and work as the icons of people's social bonds.

Thirdly, the development of technology is not derived simply from scientific advances in technology but also from the accumulation of its optimality. It is most important to see how the technological optimality criterion transforms in balance with the change of the social and natural environment. Particularly, we have to give more importance to ordinary people's adaptation of architectural forms to their actual daily use. Moreover, people's desire to adapt technologies to their needs represents the socially accepted optimality of the technology.

From the above viewpoint, the traditional techniques are to be recognized not as only vanishing special ones but also as the ones based on common people's simple and popular technologies, which solved problems between human life and his environment in appropriate manners, and was sustained in time reasonably. In this paper, I am going to examine a thatched roof house project, and discuss the limitations and possibilities of the above understanding of the management of traditional techniques.

3. Background of Japanese thatched roof building

The thatched roof is a traditional Japanese architectural technique and has been used in many symbolic buildings; Shinto shrines and rural houses. In this essay I am going to explain about the basics and then about an actual thatched-roof house project. Many architectural scholars have pointed out the organic and synthetic relationship between its form and the technique, and the social organization involved in its construction. A Japanese architectural scholar Ando Kunihiro explains the major characteristics of the thatched roof are firstly its usage of immediate and reusable materials, and secondly the contribution of the owners to its construction. The materials include various kinds of leaves and anything usable for architectural construction, and thatched roofs were used for every kind of building throughout Japan until the Meiji period when tiled roofs were officially permitted for common people. The thatched roof was also popular for its performance in the insulation properties, air permeability, noise absorption and durability against rain. It has been recognized as the building technique most adaptable to the Japanese climate.

The structure of a thatched roof consists of a roof truss, priming and thatch. The roof truss tapers to 45 degrees, and the thatch is laid on the priming from the edge of the eaves to the roof purling by being attached to the priming with ropes and bamboo poles. The roof purling works to protect the thatch from rain and to decorate the whole building in various regional styles. In order to maintain a thatched roof against wind, sunshine and rainfall, thatch has to be refilled every ten years and the whole roof has to be rebuilt every thirty years. To provide for such continuous maintenance, people have had to prepare a grass field (Kayaba) on vacant land, and have taken care of the field with the cooperation of the whole community. People have set strict rules to maintain, cut, carry, store and share the thatch among the community members. This system is used to decide which house is to have its roof renewed, and all members work together on it. Such a mutual help system was based on a work share system, which was sometime supplemented with money and food, and the technique of thatching has been transmitted from generation to generation in the course of such cooperative work. Thus, the systems of thatched roof construction and maintenance were deeply founded on

the mutual help system used in the organization of the village community and its surrounding agricultural industry. The old thatch was not wasted but reused for bedding for cattle and for fertilizer. Roof thatching was not just a simple architectural technique but also a social collaboration generally connected to the life of the village community, and was an example of an organic, efficient total management system in Japanese agricultural society.

After World War II, as a result of the stricter Fire Defense Law, thatched roofs in urban areas and residential areas disappeared. With the introduction of mass housing and the demand for more convenient lifestyles, people, even in farm areas, became detached from the lifestyle of thatched roof houses. Most significantly, the shift in the Japanese economy from agriculture to industry caused a dramatic decline in village populations along with the disappearance of natural water and fields. Thus, the members of village communities could not organize a mutual help system to construct thatched roofs and thus transmit its technology or maintain the grass field. Because of these fundamental changes in the Japanese economy, natural environment, architectural production systems, and people's lifestyles, the culture and techniques of roof thatching are now in a critical condition.

There are various preservation activities going on against the above backdrop of the modernization of society. For example, Ando Kunihiro has pointed out that the preservation of a grass field works simultaneously as the maintenance of a total, balanced eco cycle in suburban areas, and has encouraged collaboration with the Green Tourism movement to revitalize regional redevelopment in a sustainable manner. Also after becoming aware of the Sick House syndrome, people have come to recognize Japanese traditional houses as healthy buildings. The cultural preservation movement accompanied with the tourism industry in each region is also helping to preserve thatched roof buildings as historical and symbolic assets of Japan. However, modern Japanese people's westernized and industrialized lifestyles do not incorporate the original living conditions of a thatched roof house any more, and the thatched roof has come to be used only for ornamental purposes.

4. Research through practical application: designing a thatched roof house

4.1 Primary conditions and problems

I was fortunate enough to work on designing a new thatched house in Nagano prefecture. The site is in a farm area in a national park, which has a more liberal Fire Protection Law than other residential areas. The clients love the thatched house aesthetically, but have several problems living in it. Firstly, they were born and live in cities, and cannot live in the original thatched house style. Secondly, the site is in an area of heavy snow and humidity near a lake, but the clients have physical problems adapting to such climatic conditions. Thirdly, they possess a huge number of books, so they cannot have a traditional Japanese open fire place (*irori*), the smoke from which prevents mold and bugs in the thatch. Fourthly, they only live in the house half a year, and need maintenance-free and energy-efficient architecture. Thus, all of the usual conditions of a thatched house's interior use, maintenance system and the site conditions contradict the client's personal conditions.

Because recent examples of newly constructed thatched houses are rare, there was insufficient data. The thatch, snow and wind load on the roof were not calculated and cleared in order to make structural calculation to define the size of the members. Finally, we decided to design the structure on the safe side in a simple hipped roof style, which was common in that area. In this essay, I am going to explain mainly about the design, construction and maintenance process of the house.

4.2 Designing as a process of finding and solving problems

The most important and effective method of designing and building a thatched house to such conflicting requirements is, I believe, to fully communicate and collaborate with the client at each step of the project. The design is executed not as an aesthetical form making but as a management between the clients' images and realities of their lifestyle. Thus, we started the design process by looking at three questions. Firstly, how could the construction of this house match the image they had of their lifestyle there? Secondly, what was the relationship between the spatial organization of the house and their habitual daily activities? Thirdly, the examination of their sensitivities to the conditions of the interior climate in a thatched house.

To answer the first question, we studied the historical background of thatched roof houses in the world, and discussed how their characteristic form, structure, and space are created in relation to peoples' lifestyles and climatic conditions in various areas. Particularly, we discussed the reasons why thatched houses are recognized as the original form of housing in many cultures, and tried to return to the fundamentals of the clients' living conditions. In the above process, we found that a simple and primary space with minimum functions, usage of local materials, and manually controlled facilities are the common characteristics of those houses, and decided to design the house in similar manner. The main and primal element of a house is a fireplace situated at its center to feed and unite the family members. Then, we decided to have such a symbolic fireplace at the center to express the warm and unified image of a home.

Regarding the second question, which goes along with the first one, we discussed how to distribute various functions and individual activities around the central fireplace to unify family members, and how to divide each area with the minimum barriers to enable to sense each other's presence. The areas where water is used (kitchen, bathroom and toilet), storage areas, and individual private spaces were distributed according to the members' patterns of everyday movement. Also, we tried to find the most important activities in the house. We

put the books and musical amenities around the center, and created various ways for the nature outside to be seen from within each space.

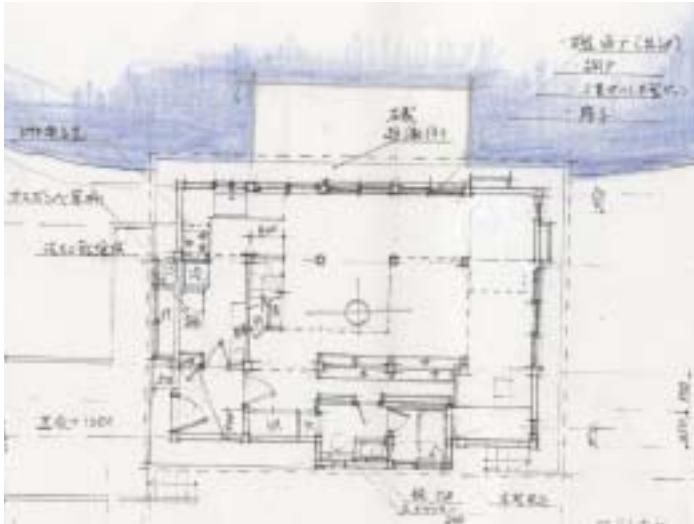


Figure 1 The first floor plan showing the horizontal articulation of spaces around central fireplace and a picture of the bookshelf wall showing an alcove and the vertical articulation of spaces by the inner-bridge and the loft space.

As for the third question, we worked on how to prepare and balance the conditions of heat, air and light in the house. Along with the above psychological and functional divisions of various spaces mentioned above, we had to ensure effective and sufficient heating, and enough ventilation to maintain the thatch, two requirements which often contradict each other. Then, we superimposed the hierarchies between the psychological and the radiation heat distributions in the house. The further the space is from the central fire, the less the radiation heat. The duration of individuals' activities was a lot shorter than that in the central area, and the family preferred to be in closed niche-like space that could be warmed with minimal heat. We, thus, considered that the house does not have to have uniform heating conditions, and tried to create various temperature areas by vertical divisions with partial walls and alcoves, and by horizontal divisions with an interior bridge and a loft. We also created anti-snow walls surrounding the house, which could be erected by hand easily, to increase the protection against the severe winter climate.

Regarding the air flow in the house, we concluded that the thatched house's natural air flow should not be viewed as a negative draft but as a positive natural breeze with aid of other mechanical ventilation systems. In view of this, we decided on two kinds of air flow system; a timely exhaust ventilation for the bathroom and the kitchen, and a constant air breeze to control the humidity and temperature of the whole house utilizing the natural wind around the house which changes strength and direction seasonally. With the bookshelf walls and interior bridge we created a narrow passage connecting an alcove to the water area and the entrance hall, and created an air flow that circulated around the central gathering area and upper loft space.



Figure 2 A section of the house and a picture of back passage, both of which show the passages for the air flow from the top window, loft area, bridge and to the narrow space between the bookshelves.

In traditional thatched roof houses there were smoke roof windows, through which warm air was often evacuated with the smoke. We therefore transformed the traditional roof window into a combination of a chimney and a light well with glass windows which can be opened manually. According to the direction of the wind, we can open the window to let the air circulate around the house effectively. In winter, with a small rotary fan, the ascending warm air circulates down the narrow passage and layers of spaces in the house, and in summer a fresh and cool natural breeze goes through the house. When the clients are absent, with minimum electricity expense, they can maintain healthy for the thatch. The top window is also an important tool to control the light in the house. Usually, the inside space of a thatched roof is a dark storage area hidden by a ceiling. With reflecting panels surrounding the chimney, natural sunshine becomes an indirect and diffused light, which softly lights the inner space of the roof and makes the loft habitable quiet space. Particularly in winter, because of the sunshine is quite weak, the light well works to make the whole interior bright and comfortable.

As I explained above, one important factor in designing was the finding and identifying where the clients' previous lifestyle was in conflict with that required by their new living space in order to create a new type of thatched house. Thus, we firstly approached the problem not from the physical conditions of the house but from the psychological and symbolic meaning of the house in order to reset the basic requirements of their lifestyle. By demonstrating a new and flexible understanding of the temperature, ventilation systems and lighting requirements, we tried to create a new way of making the interior space of a thatched roof house, which had to accommodate the individual conditions of their activities, and be in good balance with the surrounding environment. By modifying traditional architectural forms and by exploiting the power of nature, we could create a balanced, energy efficient, natural and sustainable living environment in the house.

4.3 Construction problems and solutions

We predicted four problems in the construction of the thatched house: firstly, securing a thatching craftsman, secondly, securing enough thatch, thirdly, finding a good contractor who can understand the thatching techniques and coordinate with other building professions, and fourthly, clear and reasonable cash flows and trustable quality control of the whole construction process. Over the course of several months we discovered that these four problems were not manageable individually but rather were related to each other and we became caught in a vicious cycle. Thatching is not used for usual building construction. Because of the scarcity of thatching projects, and for its low proficiency, thatched roof craftsmen work as tinkers independent from general contractors, and have their own project planning and wage systems. The quantity of thatch produced is extremely small and the thatch is not available for sale. It is also quite difficult to join a community's mutual sharing system, and it often takes several years to get the left-over thatch from the cultural property preservation projects of regional public institutions. Thus, the duration and the cost of the project cannot be calculated according to the usual construction estimate system. Despite such severe circumstances, fortunately we could meet a thatched roof craftsman Master M. in the Otari neighborhood area. Master M. introduced a contractor O. Kensetsu, who was involved in traditional architectural preservation work in the Nagano area. Master M. was also in charge of the distribution of thatch in that area, and was able to provide us with unused grass from another project. Thus, we could get through the initial problems by sheer luck.



Figure 3 Master M. thatched from the eave to the top in the traditional manner almost all by himself.

Among the various problems at the construction site, the most serious and consistent one was the miscommunication between the carpenter, whom the client invited from Tokyo, and other craftsman and the contractor. Particularly, because of the difficulties the contractor experienced to control the carpenter and the

thatched roof craftsman, and because both of the craftsmen tended to ignore the architectural drawings through the project, quality control of the project often failed. For example, the carpenter worked in the open air instead of in situ during rainy season to cut the joints and details of the timbers without considering the effect of the humidity of the site in increasing the water content of the wood. The contractor was used to preparing materials in machinery drying and cutting processes, and could not control the carpenter's traditional methods. As a result, in the last part of construction, when the final painting process was going on in a closed heated interior space, mold appeared on the beams and other connecting timbers. It was quite difficult to determine the original cause of the mold, but the effect of the humidity on the timbers during the preparation period seemed to be the mostly serious reason. Eventually, the contractor took responsibility for this problem, and worked to cut off the moldy area, cleansing the parts with bamboo vinegar, and preparing rotary fans to keep the interior dry through the remaining construction process.



Figure 4 The beams which remain the traces of mold and the top light well with reflection boards.

Another problem was the frequent misunderstanding of the details of thatched roof structure by the other participating members. When the thatched roof craftsman began the construction of the roof, there were several changes in the structure of eaves, beam joints, and other connections between the thatch and the timber parts. Only through a series of trial and error at the site by various craftsmen, was each problematic detail fixed. As an architect, I regret not having had sufficient knowledge or experience to have been able to better organize and help the entire project. However, it was quite fortunate that all participating members kept in mind the purpose of realizing a traditional thatched roof house, and through great patience and putting forth their best efforts, they finished the work satisfactorily.

4.4 Maintenance problems and solutions

In the winter right after the construction was completed we had an unusual amount of snow fall and suffered several serious problems. First of all, as the wind was so strong, the snow accumulated on the roof unevenly. In several areas of the roof, the roof snow touched and froze to the high snow on the ground and formed a huge mass of ice at night after melting during the daytime, making the roof load more uneven. The style of the roof was the locally common hipped roof, and was built safely, but only to withstand the usual snowfall. Because of the uneven snow load and the traction from the ice on the ground, the connections in the joints of the beams were broken and gaps appeared between them. There were two more reasons for this breakage of joints. During the construction process, the carpenter decreased the size of the beams and columns according to his experience in Tokyo ignoring the original drawing based on the structural calculation. To compensate for the insufficient size of the central columns, he had to make expansion beam joints between the columns, so the joints could not have enough vertical support from the columns. Another cause for the joint breakage was insufficient snow removal.

In order to fix the joint breakage, we proposed having constriction bands to tie the joints from both sides. However, the carpenter ignored our proposal and simply screwed the beams. Thus, we could only suggest

more frequent snow removal in the snowy season. This series of problems resulted from the client's half-blind admiration of the carpenter as a master craftsman, the carpenter's lack of both experience and knowledge of the local climatic conditions, and our inability to control the carpenter fully.



Figure 5 The simply screwed breakage of the suspended joint of beams.

Another problem was the unexpected insufficient insulation at the edge of the eaves, where, the section of thatch is covered with the eave ceiling. Through the ceiling and the hollow stalk of each piece of thatch cold air permeated into the interior causing cold drafts down the wall. Especially in the kitchen and the alcove for the husband's bed space the cold drafts were problematic. In order to resolve the above problems, we added sufficient insulation to the eave ceiling, and employed two different methods for kitchen and the alcove for the former, a foldable partial ceiling covering the kitchen area, and for the latter a tent made with cloth, in order to prevent the cold draft and to confine the warm air in those areas. Both of them are easy to handle and effective to secure comfortable spaces.



Figure 6 The tent to prevent cold draft in the alcove area. It covers above the bed and keeps the warm air efficiently.

Lastly, in the three years since the project, the decline in the clients' physical ability to maintain the house because of their aging has become apparent, and the simple jobs of building the anti-snow wall and setting the partial ceiling above the kitchen area have become more and more difficult. In the design process, we believed that the physical participation of the clients to maintain the house was essential to increase their attachment to the house and to transform it to suit the clients' lifestyle, and we did not prepare enough for the clients' aging. Even though there is no local support system for their maintenance of the house, through their efforts in collaborating with the local community in cutting and collecting thatch, neighborhood people have started to help with their snow removal.

In the construction process, we discovered that the loss of the social background of the thatched roof techniques caused multiple, serious problems in quality control, and we could examine the potential of everyday minor techniques to fix the problems caused by the contradictions between the condition of thatched house and our contemporary lifestyle. However, there were unpredictable failures and problems caused by human, natural and temporal reasons, which were only resolved through the support of others in the local community.

5. Conclusion

In this paper, I have examined the sustainability of architectural techniques, particularly how we can preserve and apply traditional techniques to our contemporary lifestyle, by focusing on the case of a thatched roof house. The sustainability of the traditional technology based on the sustainable society used to be only possible under the condition of the unification of the organic social system and the various aspects of the architectural technology. We built a new thatched house in a society which is not based on the traditional sustainability any more. Thus, we tried to create a technologically and spatially sustainable piece of architecture by reexamining the idea of lifestyle quality and by utilizing methods of technological management. In other words, in proposing different air conditioning techniques in the architectural design process and in resolving the construction and maintenance problems, we tried various technological methods in order to satisfy the individual and increase the quality of life lived out in the building.

However, we could not simply impose traditional techniques onto the architectural design without thought to the subsequent impact on the resulting lifestyle, and recognized that those techniques were closely related to the whole expression of residents' life and to factors in society. Thus, we had to recognize that we could not really attain the preservation of traditional techniques by repeating architectural forms and technology detached from their sustainable social organization. We have to examine how architectural techniques can operate on different type of social sustainability in our contemporary society. In the project of the construction of thatched roof house, we could discover several possible ideas and methods to be examined further: the idea of a house as a public asset and a social symbol to be taken care of by a community, support for contractors, and maintenance of a grass field as the total preservation of the cultural environment.

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