Survey of the Actual Conditions of Wood Processing for Reusing Ise-jingu Shrine's Old Materials

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ABSTRACT:

The purpose of this paper is to understand the actual reprocessing conditions of old wooden materials during the periodic reconstruction at Ise-jingu Shrine Shikinen Sengu in Japan. In particular, we investigated the current methods and the meaning of "wood scraping" technology applied to a wood surface. In this paper, "wood scraping" refers to a technique of shaving off the aged layer of the wooden part of a building to produce a new wood surface.

In this paper, among the allocated old materials that were distributed during the year 2013 Shikinen Sengu ceremony, we examined the reprocessing and "wood scraping" of Ise Grand Shrine's old materials that fulfilled a total of four rotating roles, which are from the ridge pillars (Munamochi-bashira) in the main shrine building of the inner shrine \rightarrow Ujibashi Eastern side Torii (divine gateway) \rightarrow Sekijuku Torii \rightarrow Ikuta Shrine Torii. We observed the process as much as possible, interviewed the person in charge of construction, confirmed the building drawing, and reviewed the specification and shape.

KEY WORDS: Wood Scraping, Reusing old Wooden Materials, Repairing

INTRODUCTION

This paper surveys the state of timber reprocessing for reusing old wooden materials in the current Ise-jingu Shrine Shikinen Sengu in Japan. Specifically, it aims to clarify the purpose and method of the "wood scraping" technology being used for wooden surfaces currently.

In this paper, wood scraping refers to the process of physically shaving off the wood surface on structures using only planes and chisels when repairing or relocating wooden structures or reusing old materials. When reusing old materials in wooden structures, wood scraping is mainly employed to provide the solidification and processing necessary to withstand fatigue. This is done by shaving sections in which aging has occurred owing to natural phenomena such as rotting and wind erosion. When performing overhauling or reconstruction using old materials, the wood surface is re-carved and blended with new materials. It is considered that this renews the visual impression of old structures. Hideo Yoshioka, a cultural property architectural repair technician, stated, "Tt seems there are many cases in which old materials can be re-carved and used for producing new wood surfaces. As evidenced by the reconstruction of Ise-jingu Shrine (Ise Grand Shrine), the tradition of revering new architecture may be expressing itself in these ways.1)".

However, wood scraping is rarely used in modern Japan. It can be understood that this technology is not used in repairing work in cultural properties and construction sites, where the authenticity of materials is highly valued. Processes such as painting wood surfaces, trace investigations based on repair history, and using original materials are favored over wood scraping. Furthermore, in the case of both ancient structural repair and civil construction involving relocation, there is a strong tendency to value and utilize aging wood surfaces of old materials $^{2)}$.

On the other hand, at Ise-jingu Shrine, which is the subject of this study, the sanctuary is rebuilt once every 20 years, as symbolized by Shikinen Sengu. Moreover, there is a sense of beauty that values what is new. Furthermore, there are historical records showing that in the 13th century, there was a custom for allocating old materials to the Shinto priests in the old building, who appeared one after another along with Shikinen Sengu. In the 15th century, old materials used to be bestowed upon shrines in the neighbouring regions³). In modern times, the traditional custom of bestowing old materials to surrounding shrines in the region continued, and old materials were allocated to sanctuaries. Requests were made from shrines throughout the country to use old materials for recovery work during earthquake disasters or rebuilding construction.

However, the actual state of wood scraping in terms of how old materials are being processed and reused in the locations where they are bestowed has hardly been surveyed. Therefore, the survey conducted once every 20 years at Shikinen Singu is a precious opportunity to clarify the use of this technology in the modern age.

Based on the above, in this paper, we surveyed the reprocessing of raw materials and how wood scraping played a total of four roles as part of the allocation of raw materials during reconstruction at the 62^{nd} Shikinen Sengu in 2013. Repeatedly reusing them for ridge pillars in the main shrine building of the inner shrine \rightarrow Ujibashi Eastern side Torii (divine gateway) \rightarrow Sekijuku Torii \rightarrow Ikuta Shrine Torii. We surveyed the records and reference documents and conducted a hearing survey of the circumstances behind this custom of reusing old materials. Furthermore, we created reprocessing sites at Sekijuku Torii and Ikuta Shrine Torii, held a hearing with construction representatives, and examined the specification and form based on the architectural documents.

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¹⁾ Reference No. 2. p. 324

²⁾ Reference No. 10

³⁾ Reference No. 3

1. HISTORICAL BACKGROUND BEHIND THE REUSING OF OLD MATERIALS

1.1 From Main Shrine Building Ridge Pillars to Ujibashi Torii

We shall first provide a historical overview of Ujibashi and the Ujibashi Torii. Ujibashi is a wooden arched bridge spanning the Isuzugawa River that flows around the inner shrine of Ise-jingu Shrine, and the large torii. There is one placed at the East and West entrances, the Ujibashi torii that are the subject of this paper. Currently, the ridge pillars of the main building of the inner shrine are being reused on the Eastern side tori. The ridge pillars on the main building of the outer shrine are being reused on the Western side tori. These will be constructed one year after the Shikinen Sengu.

It can be surmised from historical records that around the 13th-14th Century Ujibashi bridge were built by Yoshinori Ashikaga, 6th Generation Commander of the Muromachi Shogunate, in the 6th year of the Eikyo period (1434). It became dilapidated with the passing of time, was partly washed away by floods, storms, and fire damage also frequently occurred. Each time, it was rebuilt through the solicitation of monks and the people in authority at the time4). For this reason, before the Meiji era, the period for the rebuilding of the Ujibashi bridge may not necessarily match that for rebuilding based on Shikinen Sengu⁵). On the other hand, there is an oral tradition that states the starting point for the Ujibashi torii was Toyotomi Hideyoshi building large torii in the East and West side while constructing a major bridge in the 19th year of the Tensho era (1591)⁶. We mentioned before that, until the modern age, the construction period for Ujibashi did not match that of Shikinen Sengu, and torii were not necessarily rebuilt to match the reconstruction of Ujibashi. As it was continually repaired based on the situation, the fact was that the rebuilding periods for Ujibashi and the torii did not necessarily match⁷). Furthermore, as in the "Collection of Pictures Depicting Ise Shrine Visits in Various Locations" published in the 9^{th} year of the Kansei era (1797) , it appears that the main building and old building coexist. The Shinto scholar Masayuki Nakanishi pointed out that, "it can be considered that the move to reuse the ridge pillars of the old building in torii has advanced particularly since the Meiji era where the swift demolition of the old building after Sengu was commonly practiced."8)

The first appearance in the reference literature that can confirm the reuse of the main building ridge pillar old materials in the Ujibashi torii in my humble opinion, is the September edition of the Ise-jingu Shrine PR magazine "Mizugaki" in the 29th year of Showa(1954). "Completion of rebuilding of Ujibashi Torii – the torii situated on the East and West of the Ujibashi bridge has been reconstructed to look very new. The Ujibashi Torii has availed itself of the ridge supports (omitted) of the previous main building in the inner shrine or outer shrine, and this relates to the inner shrine section on the East side and the outer shrine section on the West side⁹)". From this, we know that the reconstruction of the Ujibashi tori, in accordance with the 59th Shikinen Sengu in the 28th year of Showa (1953), was carried out through the reuse of the old materials from ridge supports. Furthermore, the expression "has availed itself of" suggests that there is a custom of using old materials from ridge supports, and from this we can assume that it is possible that this was used for the reconstruction at the time of the Shikinen Sengu, the previous time in the 4th year of Showa(1929, 58th time), or the time before that, the 14th year of Meiji (1909, 57th time).



Figure 1. Ujibashi Torii in Ise city, 1931 Chusei-do "The great album of Japanese scenic spots and customs" (1931)



Figure2. Ujibashi Torii in Ise city, Mar. 2015

22nd year of Meiji. " Masayuki Nakanishi "Large bridges of Uji" Reference No. 8, pp.253-256

⁷⁾ op.cit., pp.267-269

⁹⁾ Reference No. 6, pp.52-53

⁴⁾ Reference No. 8, pp.240-251

⁵⁾ Masayuki Nakanishi points ot that "There have only been the two examples of Genroku and Meiwa of the Shikinen and Ujibashi reconstruction being aligned since the modern age (omitted) This has often being carried out due to an emergency situation, such as delapidation, damage or being washed away. In a strict meaning, it is no exagggeration to say that the Shikinen repair began in the

⁶⁾ op.cit., p.254

⁸⁾ op.cit., pp.267-269

1.2 From Ujibashi Torii to Sekijuku Torii

Next, we shall explain the historical overview and circumstances regarding bestowal of the torii (hereafter "Sekijuku Torii") built on the Eastern fork in Sekijuku, Kameyama-shi, Mie Prefecture, after old materials were bestowed from the Ujibashi Torii. A detailed survey regarding this was conducted regarding this case, which can be found in "Tokaido Sekijuku Eastern Fork Ichino Torii Okihiki Commemorative Edition,"¹⁰ published in the 27th year of Heisei (2015).

Sekijuku is the 47th post town out of the 53 stations of Tokkaido and is the main the branching point from Isebetsukaido, which is the pilgrimage road from the Kansai area to Ise-jingu Shrine. The Sekijuku Eastern Fork is to the entrance to this Isebetsukaido. Currently, it is the doorway to the Ise Shrine and is dominated by torii constructed using reused materials from the Ujibashi torii along with nightlights and road markings. The existence of this torii in the Eastern Fork can be confirmed from an illustrated book drawn at the end of the 18th Century. In addition to the "Collection of Pictures Depicting Ise Shrine Visits in Various Locations" and "Collection of Pictures from Various Locations in Tokkaido," a Tokkaido 53 station series Ukiyo-e print by Hiroshige Utagawa in the 19th Century depicts the existence of the abovementioned torii¹¹⁾. Records regarding the reconstruction of the Eastern fork torii can be confirmed from the "Account Book for the Daijingu Ichino Torii Reconstruction Entries" published in the second year of the Kaei period (1849). This is surmised to have been carried out in conjunction with the 54th Shikinen Sengu in the same year¹²). Furthermore, there are records that in the first year of the Meiji period (1868), the torii was reconstructed along with a Yohaisho (a place to worship from afar) in the Eastern fork, in accordance with a visit from the Meiji Emperor; however, there is no reference to bestowing old materials from the Ujibashi torii.¹³⁾

The first bestowal of old materials from the Ujibashi torii to the Sekijuku torii was the reconstruction accompanying the 58th Shikinen Sengu in the 4th year of Showa (1929). As written in the "Seki-cho Historical Record" in the Kameyama City Museum Archives in the 8th year of Showa (1933), "In the case of the imperial visit by the Meiji Emperor"..."(preceding omitted) the large torii was built on the first year of Meiji (1868) when the Emperor visited the East, and after sixty years had passed and it became depleted, they used old materials from Jingu Gozenmiya. There was a raising ceremony on January 21st in the sixth year of Showa(1931)." This is considered to be the oldest record¹⁴).

In the month of June in the 27th year of Showa (1952), after the Second World War, a truck collided with the torii, destroying it. Materials from the storage of Ise-jingu Shrine were used to build a temporary torii ¹⁵). In the 32nd year of Showa (1957), the temporary torii was removed, and it was rebuilt using the old materials of the Ujibashi torii from the 58th Shikinen Sengu in the 28th year of Showa (1953) ¹⁶. After this reconstruction, since the 50th year of Showa (1975), primary records, e.g., the grant application to the shrine, have been stored in Kameyama City. Moreover, the custom of old materials being bestowed

approximately one year after the Ise-jingu Shrine Shikinen Sengu, and the re-processing, "okihiki" and completion work being carried out six months after that, has continued until this day¹⁷. [Fig.3]



Figure 3. The "okihiki" ceremony in Kameyama City, May 2015 'Tokaido Sekijuku Eastern Fork "Ichino-Torii" Okihiki Commemorative Edition in the 27th year of Heisei' (2015)

1.3 From Sekijuku Torii to Ikuta Shrine Torii

The trigger for the old materials from the Sekijuku torii being used in the torii of the Ikuta Shrine in Chuo-Ku, Kobe City, Hyogo Prefecture, was the Great Hanshin-Awaji Earthquake. One year and three months ater the 61st Shikinen Sengu took place in Ise-jingu Shrine, the Great Hanshin-Awaji Earthquake struck in the month of January in the 7th year of Heisei (1955). Ikuta Shrine was in the center of the Sannomiya district in Kobiya City, which, being close to the epicenter of the earthquake, suffered serious damage. The haiden (front shrine) collapsed; the romon (tower gate) leaned over; and the stone "second torii," lanterns, and fence fell over¹⁸. [Fig.4] Based on requests from war and disaster sites, Ise-jingu Shrine had been allocating materials from old buildings to various areas up to that point as well¹⁹⁾. In "Mizugaki," published in May of the same year, an article was published that described the "surplus materials going to the Hanshin-Awaji earthquake disaster sites" and how the surplus materials after Shikinen Sengu were sent to Kobe City, Nishinomiya City, Awajishima, and Osaka Prefecture²⁰⁾

The haiden of Ikuta Shrine was rebuilt using the cutting-edge technology at that time. It was erected on pillars using ultrahighstrength concrete-filled steel pipes and on brackets reusing existing wooden "To-kyo" and hut frames²¹). Furthermore, the stone "second torii," which was inside the boundaries at the time of the earthquake, collapsed owing to the earthquake and the constituent parts, such as the pillars nuki (penetrating tie beams) and kasagi (top beam), were crushed, making it difficult to reconstruct through repair²²).

At Ikuta Shrine, the Chief Priest of the previous generation, Ryojiro Kato, also served as an Ise-jingu Shrine Sengu committee member and Vice President of the Association of Shinto Shrines.

¹⁰⁾ Reference No. 12

¹¹⁾ op.cit., pp.31-35

¹²⁾ op.cit., pp.40-41

¹³⁾ "Seki-cho Historical Record" is a summary of the administrative documents regarding the preservation of the historical traces of Seki-cho (One area of current Kameyama City) from the end of the Taisho era to the start of the Showa era. Op.cit. p. 41

¹⁴⁾ Op. cit. p.42

¹⁵⁾ Reference No. 11, p.24

¹⁶⁾ Op. cit. p.24

¹⁷⁾ Reference No. 12

¹⁸⁾ Reference No.4, pp.10-17

¹⁹⁾ In addition to the building alocation to Atsuta shrine destroyed during the Second World War, it is known there was a bestowal etc. to the Kotoshironushi shrine in Okushirishima, destroyed by fire in the Hokkaido Toho-oki earthquake. (Reference No. 1, Reference No. 7, p.24)

²⁰⁾ Reference No. 7, p.57

²¹⁾ Reference No. 4., pp.130-140

²²⁾ op.cit., pp.86

He has deep ties with Ise-jingu Shrine. In terms of the recovery after the Second World War, the old materials from the 59^{th} Shikinen Sengu in Ise-jingu Shrine were granted to the Kitashukueiya to build the amulet reception counter²³).



Figure 4. The broken "second torii" of Ikuta Shrine "Record of Ikuta shrine recovery from Great Hanshin-Awaji earthquake"(2000)

From the above circumstances, we can surmise that even in the disaster recovery effort after the Great Hanshin-Awaji earthquake, the bestowal of old materials from the Ise-jingu Shrine Shikinen Sengu was desired for rebuilding the "2nd torii." However, as mentioned before, when the Great Hanshin-Awaji earthquake struck one year and three months after the Ise-jingu Shrine Shikinen Sengu, it is considered that the main allocation of the materials from the old shrine buildings was already complete. For this reason, it was not possible to directly bestow the old materials from Ise-jingu Shrine required for rebuilding the torii. However, there were old materials in the torii that had an ancient and honourable origin, reusing the inner shrine ridge pillars. These are the old materials used for rebuilding Sekijuku Easter fork torii.

However, old materials that have been used for over sixty years to construct main building ridge pillars and Ujibashi torii to Sekijuku torii have greatly deteriorated in terms of both pillars and Kasagi (top beam). Therefore, a proposal was made by the Design Department of the Osaka Head Office of the Takenaka Corporation, who were in charge of the design, to reinforce the pillars with steel pipes and fiber-glass reinforced plastic (FRP)²⁴⁾. The pillars were split vertically in two and the internal rotten areas carved out. They were then reinforced with FRP, and steel pipes were inserted within the hollow section. In the same way, the Kasagi (top beam) were split lengthwise into two. After digging out the rotten section, the insides were reinforced with glass fiber and epoxy resin. A lightweight reinforcing rib was installed with the resin version, and the gap was reinforced by filling it with FRP.

Therefore, 20 years later in the 20th year of Heisei (2015), the torii was reconstructed again using the old materials from the

Sekijuku torii rebuilt along with the 62nd Shikinen rebuilding of the Ise-jingu Shrine.

2. CURRENT STATE OF REUSE OF OLD MATERIALS

2.1 From Main Building Ridge Pillars to Ujibashi Torii

Currently, the part dimensions of the Ise-jingu Shrine main building have not been clarified, but there are a well-known series of studies, including the restoration drawings by Toshio Fukumura. According to Fukuyama, in the "Main Building Wooden Dimension Garden Construction Regulations", which was introduced as a record of the form before the Kanshou area, the main building was "longitudinally 3 jo 6 shaku 6 sun(approximately 11080mm)", its span was 1 jo 8 shaku (approximately 5454mm), and the dimensions of the ridge supports were "total length 3 jo 3 shaku 5 sun (approximately 10150mm), root end 2 shaku 5 sun (approximately 758mm), tip end 2 shaku 2 sun(approximately 667 m m)"²⁵⁾. Furthermore, Masayuki Nakanishi said, "Today, for the East and West large torii, we took the ridge supports from both old buildings and carved out a height of 34 shaku 7.5 sun (approximately 10530mm), length of 18 shaku (approximately 5454mm), and a diameter of 1.4 sun (42mm), with those from the inner shrine being moved inside (East) and those from the outer building being moved outside (West)²⁶." The "height" can be considered to be the total length of the modern day ridge supports, including the footing. "Length" is considered to show the dimensions between the torii pillars, and has attracted focus as a dimension point equal to the span of the main building.

As the ridge supports reused for the Ujiwabashi torii were earth fast posts, it is thought that the root section, where rotting had progressed, were excluded, and they were rebuilt and processed for the torii. The current Ujibashi torii is in the form of a "Shinmei torii", and has a white wooden finish due to its Cypress solid wood material. The Kasagi (top beam) is laid on the two pillars, and the lower section is hardened with tie beam materials. There are documents suggesting that the height was approximately 7.4m²⁷), but based on the height of the Sekijuku torii, to be described later, this was approximately 7.7m. After excluding the footing of the ridge supports, it was further embedded by around 1.5m, and this is considered to be the height of the torii after the Kasagi(top beam) is added²⁸⁾. In terms of the surface carving, if an even 0.7 jo (21mm) is carved around the circumference of the holding pillar, it will have a carving with a diameter of 1.4, but the details are unclear. The parts other than the Ujibashi torii pillars, such as the ridge beams and penetrating tie beams, used new rather than reused materials.

2.2 From Ujibashi Torii to Sekijuku Torii

During the reconstruction of Sekijuku Torii in the 27th year of Heisei (2015), the reprocessing site was reproduced and drawings were viewed using CAD. In this reconstruction, all parts from the pillars, ridge beams, and penetrating tie beams of Ujibashi torii were bestowed.

²³⁾ Reference No. 5. p.36

²⁴⁾ op.cit. 21) pp.131-134

²⁵⁾ Reference No. 13, pp.155-172

²⁶⁾ op.cit. 4) pp.240-251

²⁷⁾In the Nihon Keizai Shinbun newspaper on October 3rd 2014, it stated that "according to the Jingu admin office handling Ise-jingu Shrine clerical matters, the height of each of the torii is approximately 7.4 meters". (Reference No.9)

²⁸⁾ If the total length of the supporting pillars is 34 shaku 7.5 sun (approximately 10.5m), the length excluding the footing of 6 shaku 6 sun (approximately 2m) is 28 shaku 1.5 sun (approximately 8.5m), and additionally if the footing of 5 shaku (approximately 1.5m) is removed, the pillar height shall be approximately 7m, and given the kasagi (top beam) joining hozo of 1 shaku, added to the kasagi (top beam), this makes about 7.4m-7.7m.

Wood surface finishing was performed using a finish cutter on a plane after shaving the wood surface as a whole using apparatus such as a grinder. Approximately 3–4 mm of the wood surface was carved out simultaneously. After carving out the surface that had turned grey over the 20 years that had passed, a bright wood surface appeared. Fine cracks appeared all over the pillar's surface. As it was difficult to remove traces of the aging that had infiltrated the cracks, greying cracks were found amongst the bright wood surface, presenting an aspect unique to the reused materials. [Fig.6] This did not stand out when viewed from a distance, and according to the survey we conducted, the reason for shaving this was that it had been white wood since it was standing in Ise. Thus, when reconstructing this, it seemed natural to return the wood surface to its beautiful, white wood state²⁹).



Figure 5. Sekijuku torii in Kameyama City, Apr. 2015



Figure 6. Wood scraping of Sekijuku torii, Apr. 2015

In the drawings, the height of the torii was 7740 mm, its footing was 1,714 mm, the kasagi (top beam) height was 760 mm, the penetrating tie beam height was 520mm, and the pillar diameter was 690 mm. When measuring the total length of the pillars from the plan, it was approximately 8,750 mm, of which 7,000 mm represents the inside of the torii. Furthermore, 4,130 mm from the lower pillar section is covered with steel pipes with a diameter of 650 mm and thickness of 9.5 mm, with a section of 2,400 mm from the ground being represented by steel pipes³⁰. [Fig.7] Sekijuku torii is constructed on a general road through which

ordinary passenger vehicles can pass. When it was rebuilt in the 50th year of Showa (1975), an H steel root coil was installed with the aim of preventing collisions or destruction from accidents. However, in consideration of the background, in the 7th year of Heisei (1995), it was reinforced with a steel pipe that virtually had the same diameter as the pillar. [Fig.5] Furthermore, as the pillar root section had deteriorated the most, the area around the steel pipe was filled with wood to fill the gap with the comparatively sound parts. Furthermore, the length between the pillars was 5,454 mm at the top section of the pillar, which is exactly 18 shaku. When reconstructing the torii, the rotten sections of the reused materials were reinforced by filling them with wood, and the existing mortise of the pillars and kasagi (top beam) was used as is. From the above, it can be concluded that it is necessary to consider wood scraping and shrinking due to aging. However, we can see that the Sekijuku torii virtually follows the dimensions of the old materials from Ujibashi torii.



Figure 7. "East Fork Torii Reconstruction Cross-Sectional Drawing" (2014)

Furthermore, a specification diagram was found (hereafter "Sekijuku torii specification diagram") when the Sekijuku torii was reconstructed in the 7th year of Heisei (1995) in Kameyama City. This is a summary plan, but it outlines the dimensions of the kasagi (top beam), penetration tie beams, and pillars, and we know that wood was shave-finished to 9 mm across the surface. All the parts were reused and wood scraping was performed. Additionally, the length of the pillar materials was 8,520 mm, and as part of this, the materials of the deterioration in the lower section was 1,500 mm, the pillar root section diameter was 650 mm, the kasagi (top beam) height was 770 mm³¹). [Fig.8] Compared with the drawing plans for the 16th year of Heisei (2014), the pillar diameter and pillar length were 30 mm and 230mm smaller, respectively, but the size of the kasagi (top beam) and penetration tie-beams were virtually the same. Even when the differences in the carve-out thickness are considered, the fact that the pillar materials in the 7th year of Heisei (1995) are different is attributed to the year and shrinkage. Deterioration

²⁹⁾ The hearing survey with staff of Kameyama City Civic Culture Section on April 11, 2015

³⁰⁾ Kameyama City Civic Culture Section (2014) Cultural Promotion Department, Machinami Cultural Property Department "East Fork Torii Reconstruction Cross-Sectional Drawing"

³¹⁾ Kameyama City Civic Culture Section (1995) "Sekijuku Torii Specification Diagram"

due to aging differs, and this changes the size of the exclusion and shaving of rotten materials³²).



Figure 8. "Sekijuku Torii Specification Diagram" (1995)

2.3 From Sekijuku torii to Ikuta shrine torii

Similarly, in the reconstruction of the Ikuta shrine torii in the 17th year of Heisei (2015), the reprocessing site was reproduced and the drawings for implementation were viewed using CAD. Additionally, a survey was conducted involving the design and construction representatives. For this reconstruction as well, all the materials from the pillars, ridge beams, and penetration tie beams from the Sekijuku torii were bestowed.



Figure 9. Wood scraping of Ikuta Shrine Torii, Aug. 2015

In terms of the finishing of the wood surface, the bestowed old materials were all hand-carved using a plane. An arm was attached to the platform and blade of the plane, in accordance with the diameter of the column, and a plane processed in the shape of an inner-rounded plane was used. Plane processing was performed manually by a carpenter. Cracks in the wood surface were observed when reusing materials from the Ujibashi tori. In the Sekijuku tori, they were observed in an even broader range with the passing of time. These cracks were filled with new cypress wood. [Fig.9] The plane was used 20–30 times until the greying surface of the wood surface could no longer be seen; however, in some areas, the grey layer was particularly deep or it was difficult for the blade of the plane to enter, making the work

more troublesome than initially expected. Generally, the plane did not slide as well as with new materials, and manual processing required more physical strength. Thus, occasionally, a cord was attached to the plane and pulled by two people. The shaving thickness was around 3–4 mm.



Figure 10. comparison of the colour of surface left: new material, right: old material

Surfaces on which the wood scraping was applied were bright and smooth. A visual comparison of these surfaces with the new material revealed that there were some areas that seemed to be more tinged with brown when finished. [Fig.10] When we asked the reason for performing wood scraping, the objective stated was to clean the dirt from the surface of the wood surface in order to make the old materials look like the new materials.

As previously explained, in the case of the Sekijuku torii, it was built with steel pipes inserted in the lower section of the pillar as a measure to prevent contact damage from automobiles. However, when dismantling this for the purposes of reconstruction, the rotting wood section within the steel pipes was particularly extreme. Thus, it was judged that approximately 4,000 mm of the section from the steel pipe to the footing could not be reused and was thus excluded. The insides of the reused pillars were also particularly rotten, and the pillars were split lengthwise. The rotten section was carved out using a grinder and chisel, and it was then filled with wood. The Ikuta Shrine torii was built within the boundaries of the shrine; therefore, measures to prevent contact damage from automobiles were unnecessary. For this reason, its external appearance was completely restored to a white wood aspect. The actual method was to insert the 1500mm top section of a steel pipe with a diameter of 318 mm and length of 3500 mm within the pillar, process the 2000-mm section below to the footing using cypress 120 prism new materials in a fan shape, fix it with epoxy resin, and create a column covering the steel pipe in the form of laminated wood³³⁾. This was then delivered with brass joints inserted in the joins between the existing materials and laminated materials. Furthermore, the kasagi (top beam) were fiercely depleted on the East side, and wood was placed internally in a surface layer with approximately 30-mm thickness in a box shape. In the Sekijuku torii, the fallen leaves in the neighboring Eastern site provide a dense cover to the kasagi (top beam), and this is considered to have affected the state of the kasagi (top beam).

³²) The hearing survey with staff of Takenaka Corporation and Kandagumi Corporation on Ougust 20, 2015

³³⁾ Takenaka Corporation (2015) Ikuta shrine Second Torii Renovation Plan Diagram

The total height of the torii on the plans was approximately 7450mm, and the pillar diameter was 660mm-680mm for the existing section and approximately 690mm for the laminated section, with the kasagi (top beam) height was 772mm, and penetrating tie-beam height was 508mm. Each of them was 10–20 mm smaller when compared to the Sekijuku torii. Furthermore, the total length of the pillar, including the footing of the steel pipe, was approximately 7470 mm, with the original material length of 4470 mm and the length of the laminated material section being 2000 mm.[Fig.11]



Figure 11. "Second torii of Ikuta shrine Renovation Plan" (2015)



Figure12. Ikuta shrine torii in Kobe City, 2017

3. RESULTS AND DISCUSSION

In our historical survey of old material reuse, we showed that when old materials were reused from the ridge pillars of the main building of Ise-jingu Shrine in the Ujibashi torii, at least in the 4th year of Showa (1929), the reconstruction accompanied the Ise-jingu Shrine Shikinen Sengu. Furthermore, this reconstruction with the Ise Jjingu Shikinen Sengu in the 4th year of Showa (1929) was also confirmed to be the first time old materials were bestowed from the Ujibashi torii to Sekijuku torii. The trigger for the reuse of old materials from Sekijuku torii to Ikuta shrine torii was shown to be the reconstruction after the Great Hanshi-Awaji earthquake in the 5th year of Heisei (1993).

What we have learned about old material reuse technology in the modern age has been described in Table 1. As the reconstruction of the Ujibashi torii from ridge pillars in the Isejingu Shrine main building was done with a different purpose, there is a sense that it was re-carved to reprocess the materials. However, the Sekijuku torii used the bestowed old materials as is for the tori, without much reconstruction. The wood surface was carved out by removing 2-3 mm of the surface layer with a grinder and plane. For this reason, this reconstruction was closer to relocation than reuse of old materials, and it is considered that the materials virtually followed the dimensions of the Ujibashi torii. When reconstructing at Ikuta Shrine using the old materials from the Sekijuku torii, 60 years had passed since they were used as ridge pillars in the main building of Ise-jingu Shrine. Moreover, this was the third reuse, which was reflected in the difficulty that arose in construction owing to rotting and deterioration of the materials. However, wood surface finishing is the refined manual work of craftsmen, and wood scraping was performed by processing the plane aligned to the diameter of the cylinder. We learned from the survey that in the case of both the Sekijuku torii and Ikuta shrine torii, emphasis was placed on making the outward appearance look new and creating cosmetic beauty.

Furthermore, the dimensions of all the constituent parts comprising the torii became smaller every time they were moved, and this reflects the influence of wood shrinkage and wood scraping over the years. For the pillars, as there was deterioration of the footing in Ujibashi torii due to the fact that it was constructed using earth fast posts made of solid wood and rotting within the steel pipes as a result of the external steel pipe reinforcements at the Sekijuku torri. By 2014, they had decreased to almost half the length of the original materials used in Ikuta Shrine. Moving forward, if the reuse of old materials from these torii can be inherited, while it may be difficult owing to site restrictions, improvements in the reinforcement method may be desirable, particularly in the case of the Sekijuku torii. It may be worth investigating such methods as the internal reinforcement seen in the case of the Ikuta Shrine torii or in the abolition of the earthfast post format.

In conclusion, I shall discuss future issues. The old materials from the ridge pillar of the Ise-jingu Shrine old building were reused with the inner shrine section going to the torii on the East side of Ujibashi and then being reused again in the Sekijuku tori. The outer shrine sections were reused in the torii standing on the West side of Ujibashi and then in Shichiri-no-watashi in Kuwana City, Mie Prefecture. In this paper, we were not able to complete the reproduction of the reprocessing site in Shichiri-no-watashi but were able to proceed with the analysis of records, such as drawings and a survey. A more detailed survey is required in relation to the historical circumstances behind the reuse of old materials from the ridge pillars in Ise-jingu Shrine, for which only an overview was provided in this paper.

Table 1.	Torii	specifica	ations f	for reuse	of Ise-	jingu	Shrine	main
t	uildin	g ridge p	illar m	aterials	(1993	~ 201	5)	

	Ujibashi torii	Sekijuku torii	Ikuta Shrine Torii	
Pillar width	650~700 ^{a)}	650~ d) 690	655~680 ^{f)}	
Kasagi (top beam) height	770~ ^{a)}	760~ d) 770	752~772 ^{f)}	
Penetrating tie-beam height	a) 520~	d) 520	f) 505~508	
Pillar total length	a) 8520~	d) 8520~ 8750	$7300 \sim f)$ 7575 $(2014$ original materials $= 4470)$	
Torii height	7400~ b) 7770	7740~ d) 7770	7118~ f) 7450	
Dimensions between pillar heads	c) 5454	d) 5454	f) 5456	
Shaved width when processing	c) ~21	e) 3~4	g) 3~4	
Bark carving construction method	Machining	Joint use of machine and plane (mainly machines)	Plane	
Pillar specification	Solid word earthfast posts	Solid wood +external steel pipe reinforcements	1995 : Solid wood + epoxy resin + external steel pipe 2014 : Solid wood + laminated wood + internal steel pipe	

X All figure units are in mm.

 a) Surmised from "Sekijuku Torii Specification Diagram" (1995)
 b) Surmised from "Sekijuku Torii Specification Diagram" (1995)
 and article from the Nihon Keizai Shinbun newspaper on October 3rd 2014

c) Surmised from "Large Bridges in Uji"(1995) by Masayuki Nakanishi

d) Surmised from "East Fork Torii Reconstruction Cross-Sectional Drawing" (2014), and "Sekijuku Torii Specification Diagram" (1995)

e) Surmised from "Sekijuku Torii Specification Diagram"

(1995), and a site survey and

hearing

f) Surmised from "Second torii of Ikuta shrine Renovation Plan Drawing" (2015) and "Second Torii Improvement Construction Procedure" (1995)

g) From a site survey and hearing

ACKNOWLEDGEMENTS

We received the support from a large number of people when writing this paper. We would like to express particular gratitude towards the Kameyama City Civil Cultural Division, Ikuta shrine, Takenaka Corporation and Kandagumi Corporation for so readily permitting our surveys. This work was supported by KAKENHI (16H06911).

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