Review

A Study of the Design Method of Miruk-Jõn Hall Kumsan-Sa Temple in Korea—Through a Comparison with the Kiwari Method

Byungjin Kim 1,2,*, Masaki Koiwa 3 and Takesi Nakagawa 3

1 Waseda Research Institute for Science and Engineering, Waseda University, Tokyo 169-0051, Japan
2 Department of Architecture, Faculty of Engineering, Musashino University, Tokyo 135-8181, Japan
3 Faculty of Science and Engineering, Waseda University, Tokyo 169-0051, Japan; koiwa@waseda.jp (M.K.);
nakag@waseda.jp (T.N.)
* Correspondence: moray78@naver.com; Tel.: +81-80-4165-5261

Abstract: It is considered that it is difficult to build a well-constructed building without proportional or dimensional relationships of precise parts, so it is estimated that Korea has some sort of numerical determination method now. Also, in China there is “Ying Zao Fa Shi: 『営造法式』” of technical books and it is doubtful that there is no similar technology in Korea with the same architectural flow, given that there are ways to decide “Kiwarisho: 木割” in Japan. Therefore, focus on this point and aim to clarify the dimension determination method of Miruk-jõn Hall Kumsan-sa Temple using analysis method of each proportional method in Japan.

Keywords: Kiwari; Korean traditional building; temple architecture; construction scale; complete number system

1. Introduction

South Korea and Japan, both located in East Asia, constructed wooden buildings that had many similarities, owing to their interactions with China in ancient times. In particular, their temple architecture incorporated these similarities and developed different characteristics over the ages, leading up to what we see now. These changes possibly occurred because of the development of elaborate structural systems and design techniques, while the overall external form, that is, the shape of the roof and the way in which the wooden structure transmits load, was maintained.

When one considers these similarities and differences, one’s research is hampered by the fact that few ancient buildings remain in Korea, and many of the technical documents no longer exist. In the case of traditional architecture, the column spacing configuration (pillar diameter and the distance between each column) in particular is fundamental not only to the construction process, but also to planning the structure and the form of the building. The design technique for determining the column spacing configuration has been clarified in Japanese Kiwari (木割) [1–5] research but remains unclear for Korean architectural history.

However, it would have been difficult to construct a building of any size without some kind of adjustment to the overall proportional relationship between the components or to the dimensions of each part. Hence, it is likely that Korea had some method of determining dimensions. Additionally, considering the existence of Chinese technical books, such as the 『営造法式: Yingzao Fashi』 [6], and Japanese methods, such as Kiwari, it is possible to assume that Korea, which followed the same architectural flow, had similar techniques for determining dimensions. Therefore, this study focuses on the fact that there is no comparative analysis of the structural and proportional relationships between different parts of a whole building in Korean and Japanese traditional architecture. It focuses particularly on the Miruk-jõn Hall of the
Kumsan-sa Temple in Korea, which has a multi-story architecture. This study analyzes its dimensioning method using Japanese Kiwari to determine how the proportions and dimensioning methods differ between the two countries. It also examines the reasons for these differences and discusses Korean design methods. The authors believe that this will significantly contribute toward the study of comparative architectural history between Japan and Korea. In addition, buildings need to be analyzed for the sustainability of cultural properties.

**Analysis of the Research Object**

Miruk-jon was chosen as the object of research because there is no document in Korea that describes the techniques of dimensioning. This makes it necessary to analyze the existing buildings in Korea. This building has a special shape, that is, the appearance of a hall (堂 (1)) that differs from similar buildings in Japan [7–10]. Without some kind of design technique, it is difficult to plan such a building. Furthermore, it is also highly representative of the Korean peculiarity. By analyzing this, the authors can identify the carpentry technique that was unique to Korea at that time. An analysis of the dimensions of the Miruk-jon Hall has not been conducted before. Hence, the authors begin with an analysis of the structure, followed by an analysis of the dimensions.

Miruk-jon is a three-storied building (the comparison with the pagoda is shown in Section 2), and the pillar spacing is five ken (2) (bays) for the first story, five ken for the second story, and three ken for the third story. In the second story, both Hatamas (the last interval between pillars) are narrowed. The last interval between pillars is narrower in the two-tiered structure, and the question arises as to what the standard was for the five- and three-ken structures at the time of planning. It is particularly difficult to grasp the relationship between the dimensions of the building components, because the first and second layers of the five front pillars and the third layer of the three front pillars are planned as a single unit without breaking. To clarify this, the authors put the Korean designing method on the chopping block for analysis by using the method of determining each dimension, which is said to have been used as a design technique in Japan. It should be noted that most of the studies that have analyzed the dimensions of old Korean architecture have been based on the complete number system (Kansusei 完数制), and none of them have examined various techniques as comprehensively as this study (3). In other words, as a research method, the authors specifically take the dimensions (unit: mm) of each part from the survey report of Miruk-jon and clarify various aspects, such as the design technology of Miruk-jon, which has remained unknown till now and differs from the Japanese Kiwari method.

In Korea, the minimum standard size for a Buddhist temple is three ken (bays) at the front and three ken at the side (three ken × three ken), and there are a few five ken × five ken and seven ken × seven ken buildings. In the case of buildings larger than three ken × three ken, there are many buildings with different pillar spacings for the front and sides (five ken × four ken, five ken × three ken, seven ken × five ken, seven ken × three ken). This may be because in the Taung-jon Hall (Buddhist temple) in Korea, the front of the building is more important than the sides, so the scale of the front is larger than that of the sides. This is perhaps because the principle of the ancient Chinese pillar configuration of “Moya” (the central space under the main roof of the hall)– “Hisasi” (eaves), described in the so-called “Kenmenkhou” technique, was followed in Korea even after the Middle Ages. Moreover, the front five-bay configuration is a three-bay four-sided hall consisting of a Moya with four sides and Hisasi, but the two sides of the core bay have side bays that are too narrow for the core bay, and nearly all the side ends become Hisasi, in which case the three bays consisting of a core bay and side bay become the building’s Moya [8,11–14].

The Miruk-jon Hall of Kumsan-sa Temple (reconstructed in 1635, National Treasure No. 62) is in Gimje-si, Jeollabuk-do in the southern region of Korea (Figure 1). The Miruk-jon Hall is a unique, three-story Buddhist temple. The his-
tory of the building can be found in the records of “Jinpyojonganzo (眞表傳簡條)” and “Kandongpungakbalyonsusokkizo (關東楓鉢淪石記條)” in the documents on the Miruk-jón Hall, “Kumsan-sa Temple magazine (金山寺誌)”, and “The Heritage of the Three States (三國遺事)” (4). In each of these records, there are references to the Miruk-jón Hall in the first year of Baekje’s reign (Baekje BubWang: 599), but it is unclear when exactly the hall was built. It is known that the building was destroyed by fire in 1597; reconstructed in 1635; repaired in 1748, 1897, 1926, 1938, and 1962; and that the roof frame was dismantled and repaired in 1975. The building has a tablet inscribed with Dejabozon (大慈寶殿) on the first story, Yongwhajioe (龍華之會) on the second story, and Miruk-jón (彌勒殿) on the third story. All of these mean “World of Buddha” (Buddha’s doctrine).

Figure 1. Miruk-jón Hall, Kumsan-sa Temple.

2. Consideration of the Structure

First, as mentioned earlier, this paper adopts the method of analyzing Korean buildings using Japanese technology, so the Japanese names of the components are given priority, and the Japanese, Korean, and English explanations of each component are organized in Figure 2. From now on, instead of the name of the material, we use the notation name (lower case letter) given in Figure 2.

| Japanese | Korean | English | Notation in this paper |
|----------|--------|---------|------------------------|
| ChooMa   | Eokan  | Core bay | -                      |
| WakiMa   | Hyeopkan | Side bay | -                      |
| SuminoMa | Toekan | Half-sized side bay | -                      |
| Nuki     | Inbang | Penetrating tie beams | a                      |
| Kasiranuki | Chungbang | The horizontal head penetrating tie beams | b |
| Himuki   | Sanginbang | A neck penetrating tie beam which extends through a pillar | c |
| Gagyo    | Oemogdori | The beam which supports a rafter | d |
| Tanuki   | Seokkarae | Rafter | e |
| Daito    | Judu | The support which secures the top of the column to the base of the bracket | f |
| Daito Tosiri | Judu Haba | Underside of Daito | g |
| Makito   | Soro     | A piece which secures and supports the intersecting pieces of the bracket | h |
| Makito Tosiri | Soro Haba | Underside of Makito | i |
| Makito Tohata | Soro Gub | Side of Makito | j |
| Hijiki   | Janggyeo | A support placed underneath the entire purlin lengthwise | k |
| Daiwa    | Pyongbang | Bracket set supporting beam | l |
| Kumimono | Gongpo   | Bracket set | m |
| NokiNoDe | -       | Distance from pillar to end of roof | n |

Figure 2. List of architectural terms (5): Figures A1–A3.
Figure 3 shows that the Miruk-jōn Hall is not a pagoda structure with a Shinbashira (the central pillar of a pagoda) at the center of the building, but is a hall structure, including the roof style. In Korea, the styles distinguished by the entablature are Dapo (Tumegumi: A complex bracket style which is both on top of each pillar and in between pillars) and Jusimpo (Amagumi: A bracket situated directly above a pillar).

First story: pillars are round, untreated natural wood pillars.

Second story: pillars are round, standing on a beam (Tunagibari: tie beam) that is connected to a pillar (Tukahasira: short pillar standing between the beam and the ridge).

Third story: the pillar is also round, with one to three through-pillars. For the sake of convenience, we refer to these through-pillars as triple pillars in this study.

Among the major Buddhist temples in Korea, the two buildings with more than three stories are the Miruk-jōn Hall and the Palsang-jōn Hall of the Beopjusa Temple (a five-story hall rebuilt in 1626, National Treasure No. 55). The latter has a Sorin (a metal pinnacle) of a pagoda on the roof, a Shitenbashira (four pillars placed around a Buddhist altar), and a Shinbashira (the central pillar of a pagoda), as shown in Figure 4, suggesting that the building was converted from a pagoda to a hall (Figure 5). The cross-sectional structure shows that the three-story pillars are Irigawahasira (pillar of the sanctum of a temple) and the five-story pillars are through-pillars (the four heavenly pillars) of the Shinbashira, and each story is narrower by a half. Since the structure of this building, which creates a degression up to the third story, is similar to that of the Miruk-jōn Hall, it is possible to suppose that the similar part of Miruk-jōn was changed from a structure up to the third story of the five-story pagoda. There are no wooden pagodas in Korea, but there are stone pagodas. However, they are different in material, scale, and structure, and so they are not subject to comparative analysis in this study.

Figure 3. Floor plan and A–A cross-section of Miruk-jōn Hall [15].
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Figure 4. Palsang-jõn Hall, Beopjusa Temple.

Figure 5. A–A cross-section of Palsang-jõn Hall, Beopjusa Temple [16] (6): Figures A4–A8.

Analysis of the Decreasing Rate

With respect to the tapering of the building, the Palsang-jõn Hall of Beopjusa and the Miruk-jõn Hall, which have the appearance (tapering) of a pagoda, are built with a short pillar standing between a beam and roof ridge and eaves. A Tukahasira (short pillar standing between a beam and roof ridge) on top of a Tunagibari (a beam and a roof ridge), or the method of narrowing each layer by half, is characteristic of Korean multistory buildings, and there are no buildings with the same structure in China or Japan. The Dulesi Guanyinge (China), the Fogongsi Shijiata (China), and the five-storied Pagoda Houryuji (Japan) have distinct floors, while the Korean Miruk-jõn Hall and the Palsang-jaõn Hall of Beopjusa are multistory constructions (having a continuous integral construction system) without floors.

However, the Korean continuous integral construction system is a structure that partially exists in Japan; for example, Gondo Hudoin. In China too, there is Chanzhuzao in 「営造法式 (Yingzao Fashi)」, which has a similar structure to that of the Miruk-jõn Hall, though there is no actual structure that exists. This is perhaps because the techniques did not emerge in the Middle Ages in Korea but have existed since ancient times.

Based on the diminishing rate of the Palsang-jõn Hall and Miruk-jõn Hall, it is evident that they are similar to Japanese pagodas (five-storied pagodas, three-storied pagoda). The numerical values of the total interstable dimensions of the first, second, and third stories of the Shomei (近明三重塔) three-storied pagoda correspond to the numerical value of the first, third, and fifth stories of the five-storied pagoda (Figure 6)
(7). From Figure 6, it is evident that the three-storied Miruk-jön Hall is similar to the three-storied Ichijouji pagoda and the five-storied Saisho-in pagoda (the three- and five-story parts).

Compared to Japanese pagodas, the difference between the two becomes greater from the third story onward, and the Palsang-jön Hall, Beopjusa, shows an elevation plane with a high rate of tapering. In the case of the two-story halls, the rate of tapering is generally high, with only the Kakhwang-jön Hall, Hwaom-sa, being slower and closer to the rate of tapering of the Shomei pagoda.

The Miruk-jön Hall is a pagoda hall with a diminished structure, and the interior is thought to have been built in an ancient style. It is assumed that the pagoda was built before the transformation from a five-story pagoda to a three-story pagoda and then to a two-story pagoda (the roof style and other features were changed, but the structural form remained the same).

Figure 6. Decrease rate of each building [15–23].

The proportions between the pillars to create the tapering will be discussed later, in the section on proportional dimension analysis.

3. Basic Unit Scale from the Numerical Values of Each Part: Construction Scale Study

The core distance between columns (Figure 7), the internal method between columns (Figure 8), and the diameter of each column (Figure 9) were obtained from the survey report of the Miruk-jön Hall. The values obtained from these figures were used for analysis (8). In traditional Korean architectural history research, there are two theories regarding construction scale and standard design dimensions.

Figure 7. Dimensions between pillars (distance from core to core), unit: mm [15].
1. When setting column spacing, it is convenient for both construction and planning purposes to plan in multiples of the construction scale; thus, this was the method used to analyze the column spacing (analysis based on the figures in the survey report).

2. In the Korea-type wooden building method, the width of the elbow is the basic unit, and the width of the member and the width of the Nuki (penetrating tie beams) is the same, which is called Sujangpok (修装幅). This is a method for finding and analyzing wood width. The construction scale was considered based on the method mentioned above.
3.1. Consideration of Pillar Spacing and Pillar Diameter

As an ancient design technique of Japanese architecture, “Kansusei (完数制) (9)” is considered as a system in which the column spacing is an integral multiple of the interval scale (module; ① in Section 3). It remains to calculate the construction scale of the target; the dimensions of each part described in the survey report are shown in Figures 7 and 9.

First, the scale used in Korea in the past was as follows: Dang scale, 290.8 mm; Han scale, 221.19 mm–230.28 mm; Goryeo scale, 356.33 mm; Goryeo Joyoung scale, 307.85 mm–310.72 mm; Joseon scale, 310 mm; Sejong scale (1418–1450), 312.4 mm; Gyeongguk-daejeon record, 312.1 mm; Yeongjo reform scale (1750), 312.2 mm; the late Joseon Dynasty (1902), 303 mm. However, the Korean scale differs slightly from one researcher to another. Thus, no clear conclusion has been reached (10), and the method of calculating the construction scale in the Korean survey report also differs from one researcher to another. When the construction scale is calculated from the distance between pillars, 308.4 mm is the closest value to the scale, but this value is not the construction scale, because it is not an integer multiple from each pillar spacing [7,24,25].

If we find the number of columns that are complete at the top and bottom of each column diameter and pillar spacing of each story, the width of the column diameter varies considerably (as well as the natural materials). Therefore, we analyzed the correlation between the pillar diameter and the column spacing. All the pillar forms have a lower part that is thicker than the upper part, but the difference between the lower and upper dimensions is not a fixed number. Figure 7 shows the pillar spacing as the core distance, while Figure 8 shows the internal distance between the pillars’ respective top and bottom portions. A constant and significant scale cannot be calculated from this figure. Hence, no proportional relationship could be determined between the column spacing and the column diameter in the plan of Miruk-jön that could lead to the setting of dimensions. Since there is no constant proportional relationship between the pillars, it is unlikely that the correlation between the pillars was used as an important factor in creating a gradual decrease.

3.2. Examination between Each Member

Figure 10 shows an examination of the standard dimensions of the components of a building. In the figure, the shaded area indicates the integer multiple and fractional multiples.

First, when we examined the relationship between the dimensions of each member based on the diameter of each pillar, we found that for the first-story pillar diameter, j was the most common, with 16 integer multiples out of 24 items, and for the second-story pillar diameter, f (W) had 23 integer multiples out of 36 items. In the case of the third-story pillar diameters, a (H), b (W), l (H), g, and h (H) were multiplied by an integer in 6 out of 10 items.

The overall percentage of integer multiples from the first or third-story column diameters in the building was particularly low. Based on this result, including the contents of Section 3.1., it is unlikely that the column diameter was the reference member, and there is a need to analyze the intermember proportions more deeply.

From the figure, the following items are evident: a (W), a (H), c (W), e (W), h (W), k (W), k (H), j, and i. Among these, a (H), h (W), j, i, and k (H) are mostly multiples, while a (W), c (W), e (W), and k (W) are a mixture of integer multiples and fractions. A fractional multiple means equal differentiation, which means the possibility of a standard dimension when planning a member.

Items a (W), c (W), and k (W) have the same dimensions (150 mm), and 21 of the 30 comparison items have integer or fractional multiple relationships. The result for a (H), h (W), and k (H) was 16; for i it was 17; and for j it was 18. From these results, we could analyze the fractional value of each number, as shown in Figure 10.
Figure 10. Proportional relationship between members.
In the first analysis from the late Joseon Dynasty (303 mm) (Figure 11), the number of items corresponding to integer multiples, fractional, and so on from each component was small, and there were many variations in the values. It is hence assumed that the old scale was used even during modern repairs.

If we analyze a (W), c (W), and k (W) based on the same dimension (150 mm), the fractions of the column spacing would be 30 4/5, 26 11/15, 22 1/3, 21 1/3. When converted to a denominator, the numbers 30 12/15, 26 11/15, 22 10/15, 21 10/15 become 15 equal parts. Similarly, looking at e (W), which had many multiples, 25 2/3, 22 5/18, 18 8/9, 18 1/3, and 18 1/18 become 25 12/18, 22 5/18, 18 16/18, 18 6/18, and 18 1/18, which is 18 equal parts.

From j (44 mm), there are many integer multiples and few that fit when equated. From e (W) (180 mm), none of the numbers are multiples, and all the numbers that fit are fractional multiples. Korean e (rafters) are basically round and differ from Japanese e (rafters), which are constructed with rectangular cross-sections and are the standard for the Siwari (11).

As a result of examining the multiple values of 150, 300, and 450 mm, we obtained a mixture of integer and fractional multiples. However, a closer look at the values confirmed that 150 is the standard among fractional multiples rather than 300 mm and 450 mm. Note that 308.4 mm is a value obtained from method (1) in Section 3, as described above, and there are few integer and fractional multiples from each item.

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**Figure 11.** Fractionalization of each size.

If we analyze a (W), c (W), and k (W) based on the same dimension (150 mm), the fractions of the column spacing would be 30 4/5, 26 11/15, 22 2/3, 21 2/3. When converted to a denominator, the numbers 30 12/15, 26 11/15, 22 10/15, 21 10/15 become 15 equal parts. Similarly, looking at e (W), which had many multiples, 25 2/3, 22 5/18, 18 8/9, 18 1/3, and 18 1/18 become 25 12/18, 22 5/18, 18 16/18, 18 6/18, and 18 1/18, which is 18 equal parts.

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As a result of examining the multiple values of 150, 300, and 450 mm, we obtained a mixture of integer and fractional multiples. However, a closer look at the values confirmed that 150 is the standard among fractional multiples rather than 300 mm and 450 mm. Note that 308.4 mm is a value obtained from method (1) in Section 3, as described above, and there are few integer and fractional multiples from each item.
3.3. Consideration of 150 mm

In examining the proportional relationship between each member, we would like to focus on an integer multiple of 150 mm. The 150 mm dimension of a (W) (tie beam width) is called Sujangpok, which is one of the standards in Korean architecture. In Korean architectural design technology, it is considered the closest to the Kiwari method, which uses the proportional relationship between parts to determine the dimensions of each.

Sujangpok (12) is a method of determining the width of other members based on the width of the lowest piece of wood, called Jihuku (Figure 12). In other words, when the width of Jihuku is determined, it becomes the width of Sujangpok, and the width of Kosinuki, Hinuki, Hijiki, etc., are made equal to it.

Figure 12. Sujangpok of Taeung-bojŏn Hall, Kaeam-sa Temple.

3.4. Sujangpok

In the research and survey reports on Sujangpok (Taeung-jŏn, Chamdang-am Hermitage, Sŏnun-sa; Taechŏkkwang-jŏn Hall, Kilim-sa; Taeung-bojŏn Hall, Naeosa-sa) in Korea, there is no example of Sujangpok being the standard size of the whole building. From the analysis, it was found that the Sujangpok of Taechŏkkwang-jŏn Hall, Kilim-sa was almost equal to the building scale (306 mm). For Taeung-jŏn, Chamdang-am Hermitage, Sŏnun-sa, the proportional relationships between members was analyzed from Sujangpok, and it was found that there were few places with integer and fractional multiples. When calculating the construction scale of Taeung-bojŏn Hall, Naeosa-sa, variations occurred, and an average value of 307.170 mm was extracted. From Sujangpok, there are fewer places than Miruk-jŏn where each member is an integer multiple and an equal multiple. The method of considering the criterion scale is Taeung-bojŏn Hall, Gosan-sa: calculated from between the pillar spacing, Taeung-bojŏn Hall, Neungga-sa: different from Sujangpok and the numerical value calculated from between the pillar spacing, Taeung-jŏn, Sudŏk-sa: calculated from between the pillar spacing and Taeung-bojŏn Hall, Yeongeun-sa average value between the pillar spacing is extracted.

In the case of Palsang-jŏn Hall, Beopjusa, which is similar in shape to Miruk-jŏn, the construction scale is 303 mm, and Sujangpok is not specifically discussed in this report. In the reports analyzed, Sujangpok is commonly found, but the construction scale is different.
Considering the results so far, it can be said that Miruk-jön, like other buildings, was not planned based on the diameter of each member, but it is most likely that the size system of each part was determined according to the proportional relationship based on Sujangpok.

4. Conclusions

The results of the above analysis can be summarized as follows.

1. The structure of the Miruk-jön Hall is a continuous integral construction system, and it is confirmed that there is a similarity when the decreasing rate of the appearance is compared with the Japanese pagoda. Considering that the decreasing rate is a factor that determines the shape of a multistory building, it is important to determine the column spacing.

As there is no proportional relationship between the columns, it is assumed that the dimensions were derived directly from the construction method. In general, the structure of the pagoda seems to have been modified in the process of converting the multistory pagoda into a Buddhist temple. In this respect, the five-story Palsang-jön Hall, Beopjusa seems to have inherited the structure of the pagoda and changed only the use and type of the building.

2. In the Miruk-jön Hall, the analysis of various dimensions from the scale of each period does not detect integer values. Additionally, when the construction scale was analyzed based on the proportion between the pillar spacing and pillar diameter, there was a large variation in the values, and it is not possible to extract a constant value. It is possible that the plan was not mainly based on the proportional relationship between the column spacing and diameter.

3. When the proportional relationship of each member was analyzed based on the column diameter, there were few comparison items that were integer multiples or fractional. By analyzing the proportional relationship between each member, the unit dimension of the a (W) (Nuki width (150 mm)) was determined. In Korea, the a (W) (Nuki width) becomes Sujangpok, which is like the Japanese Kiwari method of determining the width of a member. Miruk-jön’s Sujangpok is different from other buildings, in that it can be used as a reference value for the entire building through intermaterial analysis. From the column spacing, it can be noted that the common denominator of equality is 15. From the study of 150 mm, it can be inferred that the basic unit scale was set to 15 mm, and the dimensions were specified by doubling or fractionalizing.

The construction scale was examined from the comparative analysis of each part of the entire building, but it is more likely that the a (W) (Nuki width) has a proportional relationship as the standard unit dimension of the building.

The above is an in-depth analysis of the Miruk-jön Hall, a building of high cultural heritage value, in order to enhance its sustainability.

In summary, the column spacing and column diameter may have been determined using different criteria. The a (W) (Nuki width) is known as Sujangpok in Korea, but in the past, Sujangpok was not analyzed as a reference size for buildings, and the focus was on the construction scale. However, Miruk-jön is likely to have used Sujangpok as the basic unit (module) through a comparative analysis of the proportions of the components. It is also important to consider the possibility that the 150 mm figure was created during the repair of Miruk-jön, which has been carried out several times in the past and was stylized.

From the analysis of the exterior of the building, wherein a gradual decrease is evident, it was confirmed that Miruk-jön was in the stage of being transformed into a hall, adopting the form of a pagoda. Since there is no detailed record of the repair work, further investigation is needed.
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Appendix A

(1) A temple (hall) is basically a single-story building with only one roof and no central pillar in the center of the building. A pagoda is a multISTORY building with more than one floor and has a central pillar in the center of the building.

(2) The meaning of “Ken (間)” in Korea is a standard for length, area, and space, and when combined with the fact that it is also a concept used as a unit of a structure, it can be said to be a highly significant component. It is also important to analyze the scale of construction and the principles of construction design based on actual measurements as a positive interpretation of the design techniques of Korean remains [26].

(3) Conventional research on traditional Japanese architecture has roughly systematized it into the Kansusei system (完数制) for ancient architecture, the Siwarise system (枝割制) for medieval architecture, and the Kiwari method (木割法) for postmodern architecture. Although the Kiwari method is a postmodern design method, it partially encompasses the characteristics of ancient and medieval architecture and is important for an overall view of the design methods of traditional Japanese architecture [5,27,28].

(4) [15].

(5) Position of each member [15].

Figure A1. Position of Ken, ChuoMa, WakiMa, SumminoMa.
Figure A2. B–B cross-section of Figure A1 (red part).

Figure A3. Tosiri, Tohata (Daito, Makito).

(6) Floor plan of Palsang-đôn Hall, Beopjusa Temple [16].

Figure A4. First story.
Figure A5. Second story.

Figure A6. Third story.
Figure A7. Fourth story.

Figure A8. Fifth story.
Figure 6 shows the ratio of the length of each floor based on the total length of the first floor. The ratio shown in Figure 6 can explain the tapering of each floor.

In Korea, the term “construction scale (造営尺度)” is generally used for the ansusei system (完数制).

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