

Golden Proportion and Buddha Halls

- Geometrical Analysis of Myoshinji Buddha Hall Design

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Abstract

The golden proportion exists in the nature, and its properties have been long known in western cultures. The Ancient Greeks used golden ratios on their architecture, which had a strong influence in European architecture. In western architecture we can find the golden ratio on buildings from different period and styles.

In Japanese architecture its not known if the builders knew about the golden section before the encounter with westerners. Some authors believe that the knowledge of the Golden ratio had entered Japan together with Buddhist architecture, through pottery and paints (Yanagi R, 1977) but there is no document to prove it. Japanese Buddhist architecture was imported from China in the 8th Century and its plan composition is based on a modular system apparently with no relation to the western geometrical compositions.

Here we geometrically analyze Myoshinji temple Buddha hall (Butsuden). First we will explain the traditional proportional systems of Japanese Architecture. Than after explaining the historical context and main characteristics of Zen style architecture we will discuss about the use of the golden ratio on the design of the temple.

The Butsuden has a square plan and by geometrically analyzing it we found the existence of the golden ratio, and $\sqrt{2}$ ratio rectangles in the floor plan composition and design of the facades.

Keywords: Golden Proportion, Buddha Hall, Japanese Architecture

1. Japanese Traditional Architecture Proportional Systems

Japanese Traditional Architecture received a strong influence from Chinese architecture. In the 8th century AC Buddhism and timber construction techniques were imported from China. The Japanese choose carefully the techniques and design styles they imported and adapted it to Japanese aesthetic taste. For example the timber construction techniques used to build Buddhist temples in 8th century Japan were used in China to build palaces. Along history new building techniques were imported from China, the Zen sect and its building style were imported in the 12th century.

A characteristic of Japanese architecture is the existence of modular systems and proportional systems. There are two

modular systems the kenmenkiho and the tatami mats that are responsible for the floor arrangement of the building, while the Kiwari is a proportional system that regulates the size of all elements composing the building.

1.1. Modular Systems: Kenmenkiho and Tatami mats

The oldest modular system is called Kenmenkiho. It was introduced together with Buddhist architecture (8th century) and until the end of the Heian period (12th Century) was the main system used to build temples and palaces. The Kenmenkiho consist of the repetition of a core module, called moya, into which verandas, hisashi, are added (fig. 1). The beans that run parallel to the building roof ridge are called ketayuki while the beans perpendicular to the roof ridge are called hariyuki. A building built in the kenmenkiho cannot have more than 3 bays plus the 2 bays of the veranda in the hariyuki direction. However in the ketayuki direction the bays can be added infinitely. Applying this system in the construction of large spaces resulted in very long buildings. A good example is the Sanjusangendo temple, in Kyoto, an incredibly long building with 33 bays length (120m) and only 3 bays (22m) width.

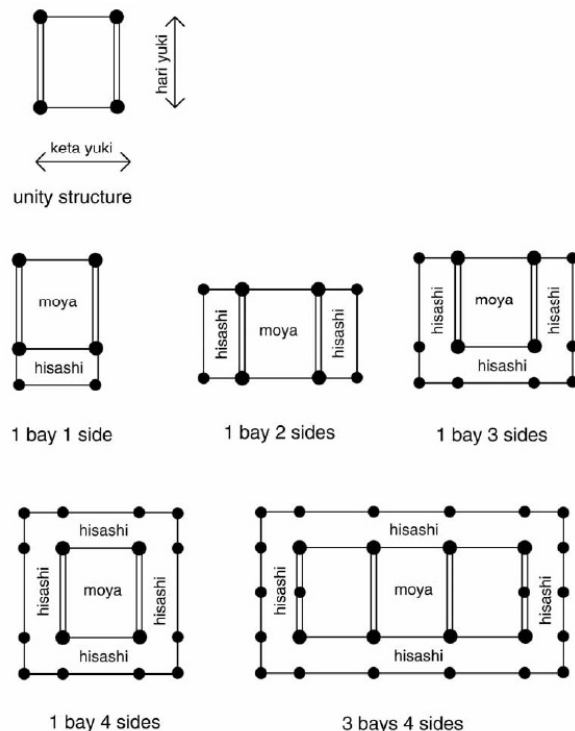


Fig. 1: Kenmenkiho: composing the floor plan by repeating the core (moya) and adding verandas (hisashi) around it.

Due to advances on the building techniques, such as the development of the ceiling, the Kenmenkiho system stopped to be used in residential architecture. In Buddhist architecture after the 12th century the Kenmenkiho system is used in a simplified version, the verandas (hisashi) were not counted separated anymore. For example a temple that before was classified as having a plan composed of 3 bays 4 sides (Fig 1), after the 12th century will be classified as 4 x 5 bays plan.

The tatami mats system developed after the 12th century and replaced the kenmenkiho system in residential architecture. Tatami mats are used until the present day to describe the size of rooms. The development of the ceiling made possible the division of the interior space of the building into rooms. Consequently the modular system changes it focus the room instead of the whole building. The tatami mats size may vary a little from region to region, usually a tatami mat is of 1820mmx910mm, which is considered the minimum space necessary for a person to sleep.

1.2. Kiwari – Dividing the wood

Kiwari literally means dividing the wood. It is a proportional system based on the diameter of the columns and was developed by the carpenters to assure the proportional beauty between each of the parts of the buildings. The first temples were constructed by emperor, but after the 12th century the emperor economical power weakened and the construction of temples became supported by several patrons, aristocrats or generals. Different patrons allowed the development of different building styles, varying with the taste and technical expertise of the carpenter in charge. The carpenters also became more organized and formed groups. Each family of carpenters had it's Kiwari design method, which were recorded in secret Architectural manual books, to guarantee the transition of knowledge to the younger generation (fig 2).

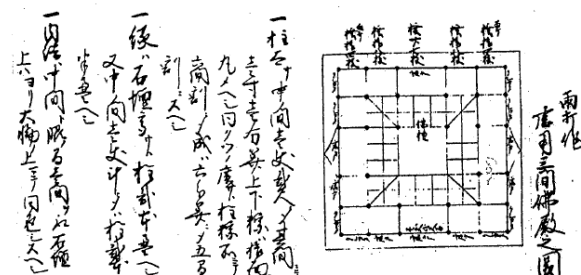


Fig. 2: Shomei – Example of a Secret Architectural Manual Book (Sakaguchi, 2007)

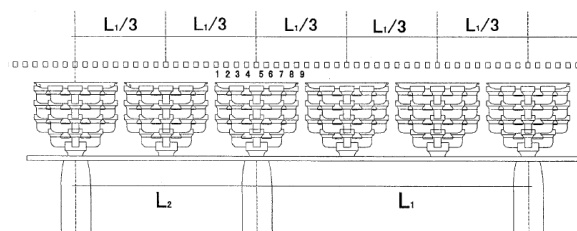


Fig. 3: Application of the Shomei Kiwari system (Sakaguchi, 2007)

The kiwari system consists of proportional rules that regulate all parts of the building (fig. 3); brackets, purlins, space between columns, according to the diameter of the column. In these architectural manual books is also described the appropriate floor plan for each of the different building types (Fig 1). A research by Tohoko University analyses the proportional system of Buddha halls, and how the Kiwari changed through an analyses of different architectural manuals (Sakaguchi, 2007). According to this research Buddha halls had the floor plan square, with the intervals of the corner columns smaller than the central one (fig.3).

2. Zen Style Architecture

Zen Buddhist was introduced during the Kamakura period (1185-1333), when a military government (Bakufu) located in Kamakura got control over the country. This period had a social-political-economical system very similar to the European feudalism. At this period new sects of Buddhism and new building techniques were introduced from China. The Zen Buddhism received special favors from the military government because it was institutionally new and the strictness of Zen discipline also attracted the sympathy of the samurai class.

2.1. Myoshinji Temple

According to the restoration report (1985) The Myoshinjin temple belongs to the Zen Rinzaï sect, which was introduced by Eizai in 1119. The site of the temple was an imperial detached villa of the retired emperor Hanazono. At the age of 40, the retired emperor became a Buddhist monk and transformed his villa into a temple. The construction works of the temple started in 1342.

The Buddha Hall (Butsuden) of Myoshinji temple was re-constructed in 1827. The present building is believed to have the same size and to keep the design of the original building (Hirai, 2010).

2.2. Buddha Hall Floor Plan

The *Butsuden* is placed on a stone platform and has a square plan of 5x5 bays, with the central intercolumniation bigger than the others. As we have seen (fig 2) according to the secret architectural manual books this was the standard plan form for a Zen style Buddha hall. The building in total is a square of 56.26 *shaku* approximately 17.047 meters (1*shaku* is about 0.303 meters). The central intercolumniation is of 15.34 *shaku* and the side intercolumniations are of 10.23 *shaku*. Therefore the side intercolumniation have only 2/3 length of the central intercolumniation. The distance between the brackets is 1/3 of the length of the central intercolumniation, and it works the unit modulating the distance between columns. Modulating the columns by the distance of the brackets is typical of Zen style architecture, and fits the rules described at the Shomei Architectural Manual Book (fig 3). The altar (Zushi), where the Buddha statues are placed, is not on the

center of the building, and is found on the back part of the plan. As we can see on figure 4 the back columns of the Zushi are aligned to the central columns but not to the side columns of the buildings.

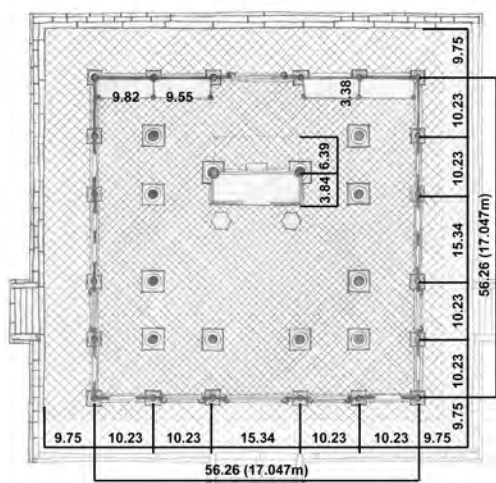


Fig. 4: Myoshinji Buddha Hall (Butsuden) drawing made based on the restoration report.

2.2. Buddha Hall Facade

The Buddha Hall of Myoshinji is one floor high but appears to be a two floors structure (fig 5) because the Mokoshi roof, a decorative roof added under the true roof. "Mo" (裳) literally means skirt and koshi (階) means floor. This decorative roof surrounds the building. The Mokoshi roof does not correspond to any internal division, and gives the impression that there are more stores in the building than it really has. The use of Mokoshi roofs is old and we can find it in pagodas built on the 8th century. The Mokoshi helps to conceal the thick columns giving more lightness to the design of the building, and also make the building look higher than it really is.

The main roof is a hipped-gabled roof, and the gable and of the roof is on the side facade.



Fig. 5: Myoshinji Butsuden Side Facade, Mokoshi roof and Katomado windows, tsumegumi elements typical of the zen style

The Butsuden also shows typical elements of Zen architecture in the design of the facade. For example it has flower shaped windows, called katomado (花頭窓). Originally the brackets or kumimono (組物) were placed only on the top of the columns and the a function similar to an ancient Greek capital. However in the Zen style architecture bracket receives a more decorative function and is also placed in the space between the columns. This kind of bracket is called tsumegumi, literally the filling brackets.



Fig. 6: Myoshinji Butsuden front facade, symmetrical design.

The front facade of the Buddha hall shows a symmetrical design, with the door and windows placed symmetrically from the center of the building. In contrast the elements of the side facades don't have a symmetrical composition.

3. Geometrical Analysis of Myoshinji Butsuden

The Buddha hall of Myoshiji temple as we have showed is a typical example of the Zen style Butsuden. The Kiwari system defines the size of the brackets and purlins in relation to the column, and that the central intercolumniation should be wider than the side ones.

Here we will geometrically analyze the floor plan and facade of the butsuden and search for geometrical relation other than the ones established by the Kiwari.

3.1. Golden Proportion

The altar (Zushi) columns placed aligned to the central front columns but they seem to have no relation with the side columns, and to have been place at random on the back of the hall floor. The floor plan of the Buddha hall is square. If we trace a diagonal of this square and transfer the length of one of the square sides to this diagonal we have a $\sqrt{2}$ -proportioned rectangle. As shown on figure 5 the upper edge of this $\sqrt{2}$ rectangle coincides exactly with the columns that support the altar (zushi). Here we have a geometrical relation to the position in profundity of the altar columns, and that they are not placed aleatory.

If we construct a golden ratio rectangle inside the square floor plan (fig 8) we can see that the edge of the rectangle coincides with the front line of the altar. Here again we found a geometrical explanation for the profundity of the altar, creating a golden ratio rectangular space between the altar and the entrance of the hall.

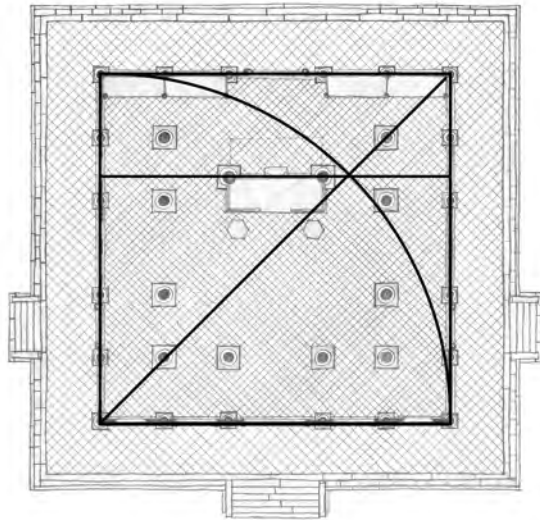


Fig. 7: The position of the back columns of the Zushi is at a $\sqrt{2}$ rectangle distance from the entrance.

and 10). If we superpose the floor plan to the facade we find that the position of the back columns of the zushi coincides with the lower edge of the main roof. Since we have seen that the space between the altar and the entrance is a golden ratio rectangle, consequently in the facade too the part of the facade under the main roof, including the decorative roof can be inscribed into a golden ratio rectangle.

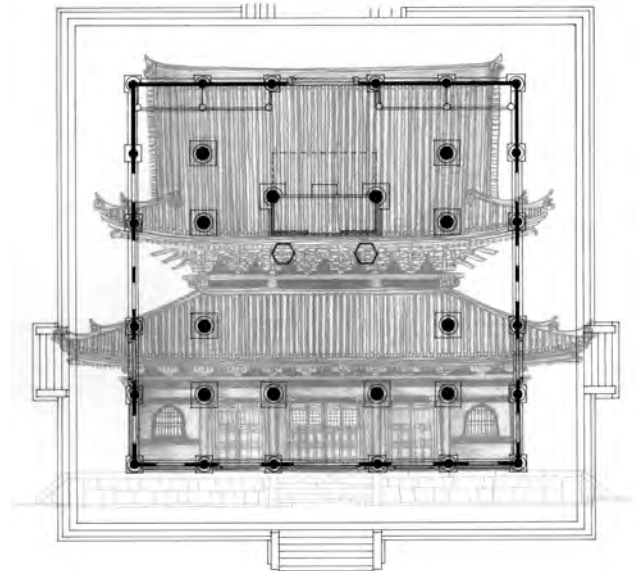


Fig. 9: Comparison between the front facade and the floor plan

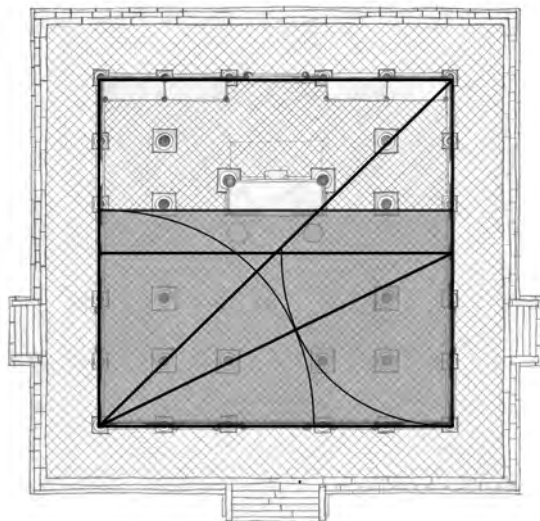


Fig. 8: The front line of the Zushi is aligned with the columns and the space from the front of the Zushi to the entrance is a golden proportion rectangle.

3.2. Relation Between the Design of Facade and Floor Plan

By comparing the floor plan with the facade we can see that the length and height of the building are the same (figures 9

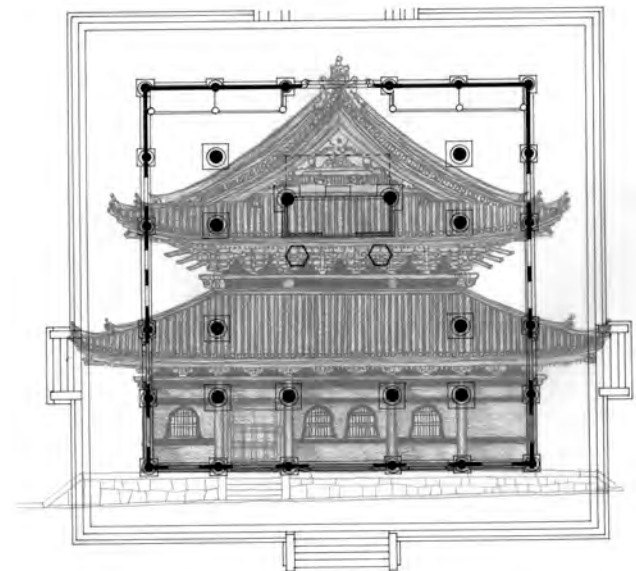


Fig. 10: Comparison between the side facade and the floor plan

The roof of the temple is hipped-gabled and by comparing the floor plan with the side facade we can see that the end of the triangular gable of the roof coincides with the position of the columns supporting the altar and that the profundity of the altar is the same as the depth of the hipped part of the roof. It is also interesting the relation between the two back

columns and the curves of the roof.

3.3. The Power of The Square

The square plan is a characteristic of Zen style Buddha Halls. The square has a mystic meaning in Buddhism. First it is a rigid geometrical form, with all the sides equal and a very strong centrality. Another reason for the mystic meaning attributed to the square may be because it inscribes the swastica (fig. 11). The swastica is a very old symbol, called manji (卍) in Japanese. Manji can also be interpreted as the 10 thousand letters and even now it is used to symbolize Buddhist temples in Japanese maps. The Buddha hall has the same length and high and forms a perfect cube (fig. 12), what may also be related to this mystic meaning attributed to squares in Buddhism.

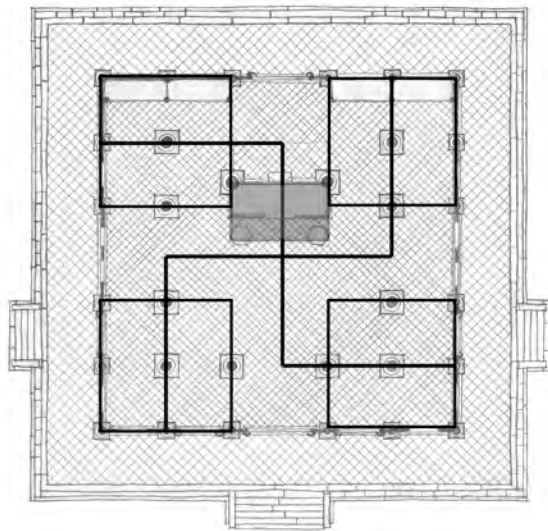


Fig. 11: Relation between the square and Zen Buddhism

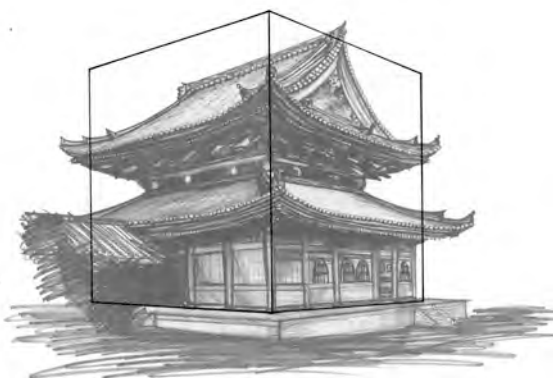


Fig. 12: Volume of the Buddha Hall can be inscribed into a cube.

The Myoshinji Buddha hall was constructed in 1827 many years after the arrival of the Jesuits in Japan. Probably the carpenters of 19th century had knowledge of the golden ratio

mostly due to the Jesuit influence. However as we have seen the design of the temple follows the standards established by the architectural manual books of the Middle Ages, which are anterior, the arrival of the Jesuits.

The existence of golden ratio in the geometrical composition of the floor plan, used to place the altar may signify that carpenters in Japan had knowledge of the golden ratio before the contact with western design techniques. However since the golden ratio is a proportion existent in nature, it may be achieved by coincidence, specially considering that the floor plan is composed by squares.

4. Conclusion

Japanese architecture used proportional system different from western tradition. The Zen style Buddhist halls are characterized by the square floor plan and follow the models established by the Architectural Manual Books, Kiwari. However by a geometrical analysis of Myoshinji Buddha hall floor plan it was possible to find the use of the golden ratio to positioning the altar and defining the high of the main roof. Unfortunately it is not possible to affirm the existence of the golden ratio was intentional. The golden ratio rectangle may be a coincidence because the design composition based in squares. However by this study it became clear that existed more regulating proportional system in the construction of Buddha hall than those determined by the Kiwari.

Bibliographical References

Yanagi,Ryo, 1977. 黄金分割—日本の比例. Tokyo: 美術出版社. [ISBN 4568300339].

Myoshinshi Butsuden Restoration Report 1985, 重要文化財妙心寺仏殿修理工事報告書、昭和60年

SAKAGUCHI Ayumi, ISHIKAWA Akiko, NAGAI yasuo FOWLER,FEI YingQing, IIBUCHI koichi *Study on the Design Method of the Buddha hall of a ZEN Temple in the Early Architectural Manual Books, 2007, Architectural Institute of Japan 日本建築学会東北支部研究報告集. 計画系 (70), pp.129-134,*

Hirai Kyoshi 「妙心寺仏殿の文政再建に関する新知見」 2010 京都府埋蔵文化財論集 第6集—創立三十周年記念誌—、pp387-396