Broken Symmetry of Spatial and Temporal Design in Japanese Temple

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Acoustics of a Japanese Buddhist temple is investigated. We have measured listening levels, subsequent reverberation times, inter aural cross-correlation functions with various sound source positions following the traditional rites of Buddhism and found several characteristics, especially the long subsequent reverberation time BEHIND speakers. Much would be expected also in measurements with symmetry-breaking sound source positions, in Christian churches, concert halls and opera houses.

Key words: Buddhism, temple, wood, stress, violin, sound post, ACF, IACC, broken symmetry

1. INTRODUCTION

Architectural acoustics of Japanese Buddhist Temple has similar to string instruments in western music. Fig. 1-a) is alter of SEISYOJI temple, Ishikawa, Japan. Just under there is a column (Fig. 1-b) quite similar to "sound post" installed in body of a violin (Fig. 2). The floor board of alter is called "KAGAMI ITA" which means "mirroring board" or "REFLECTION BOARD" and the surface of it is coated with Japanese lacquer and polished, just like the surface of a violin. Also from the backside the floor is supported at the basement with a post without any use of wedge. This is also quite similar to the cases of western string instruments.

a)

b)

Fig.1 a) Alter of "SEISYOJI" TEMPLE" and
b) at the basis just under the alter; sound post in temple.

Fig. 2 An example of bridge and sound post in at violin

Buddhist temples' alter table, called "KYOZUKUE" is quite heavy and pressed the floorboard from upside. The sound post pushed the floor at a distance from beneath. Two vertical forces in opposite directions are adapted to the "REFLECTING BOARD" and the floor warped just like letter " S ". This "seemingly static", but much stressed condition is quite similar to that of a violin; the vibration of four strings are transmitted to the frontal board through a "BRIDGE" with some pressure from upward. The frontal board is also pushed from beneath by the sound post, and there is a letter- " S " -like distortion inside the board. Although the RESULTANT FORCE in each direction is totally ZERO, there are many stresses and tensions within the violin instrument. Although the detail is not still known, in the Japanese wooden temple it certainly affects to the acoustic of the space and time inside.

Thus, to let the "TEMPLE-INSTRUMENT" vibrate, traditional Buddhism had investigated characteristics and effective patterns of sound making as "traditional rites".

2. MEASUREMENT, RESULT AND DISCUSSION

2.1 Structure of a Japanese wooden Buddhist temple in Jyodo-Shinshu style

Fig. 3 is the outward appearance of JYOSHINJI temple in Nagoya, Japan. JYOSHINJI is a temple with long tradition of Buddhist orchestral music (GAGAKU HOU-E); present temple was built in 1895 just after the serious earthquake (NOBI JISHIN) by TAKENAKA-GUMI (Takenaka corporation) by Jion HAZUKA (1838-1912).

Fig. 3. Outward appearance of JYOSHINJI temple, Nagoya, Japan

Fig. 4-a) and b) are the inward of the JYOSHINJI temple. Although built with wood and the structure is quite different from Christian church, alter of Buddhist temple has some similarity to western cathedral. At the both sides of the alter("NAIJIN") are two side chapels ("YOMA"). There is a pulpit for sermon, mainly in Japanese language, called "KOUZA" which usually set at the left-front to the alter (See Fig. 4-a).

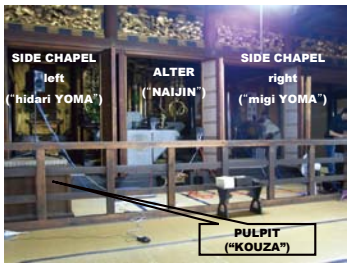

Fig. 4-a) Alter, side chapels and pulpit of JYOSHINJI temple

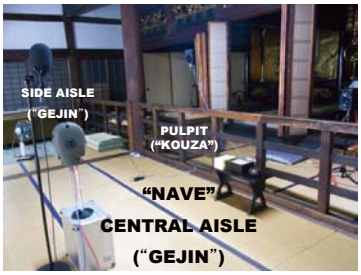

Fig. 4-b) Central and side aisles of JYOSHINJI temple

Fig. 5 is a bird view of the sound sources and receiving point; positions of microphones. S (source) 1, 4 and 4' are on the central axis and could be regarded SYMMETRY-KEEPING positions. S1 and S4 the speaker's direction is toward the alter and S4' toward the aisle. A sound-source position most commonly seen in preceding studies is S4; source at the CENTER and direction is OUTWARD. Also many acoustic measurements in concert halls and opera houses have similar source position, symmetric and the sound travels towards the audience. But such source location DOES NOT EXIST within BUDDHISTS TRADITIONAL RITES AND RITUALS.

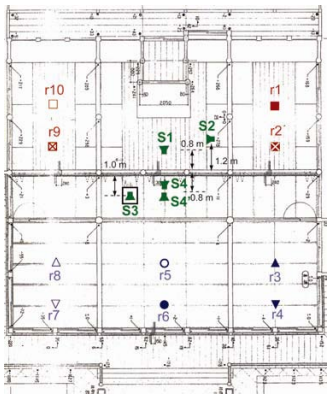

Fig. 5 Location of the sound sources and sound receiving points in JYOSHINJI temple

On the other hand, S1 and S4 are the traditional positions of Monks. Both are called seating positions for "CHOSEI" it means "TUNING MONKS" and all the people in the temple would follow the pitch of this tuning monk's singing at the beginning of every ceremony. S4 is for everyday rites and S1 is for big ceremonies, such as HO-ON-KOU, memorial rites to SHINRAN (1173-1263), the founder of JYODO-SHINSYU school.

Source positions S2 and S3 are quite different from that of S1, S4 and S4'. They are positioned out of the central axis. The directions of the speakers are OUTWARD (S3) and SIDEWAYS (S3) at these positions; in such positions and directions, SYMMETRY of the sound field is INTENSIONALLY BROKEN.

The source position (and direction) S2, off-centered toward the RIGHT, INSIDE the alter, is the seat for the Monk of the highest rank, called "DOUSHI", and in the rituals people follow the voice of this "DOUSHI". This DOUSHI's position S2 is, to some extent, similar to the BISHOPS's stall in Christian churches. The source position S3, also off-centered toward the LEFT, OUTSIDE the alter, is seat for the SERMON, called "KOUZA" for the believers and sermons are spoken in Japanese language here. This position is also quite similar to that of PULPIT, where the sermons are held in the local languages, e.g. Italian, Germany, French, English etc where the holy prayers within the alter is in LATIN, and

INWARD until 1965, at the occasion of the SECOND VATICAN ECUMENICAL COUNCIL (Concilium Oecumenicum).

2.2Set-up for the measurement

We have used a pair of microphones installed into a dummy head in order to measure binaural parameters in the ACF and IACC analysis (Fig. 6).

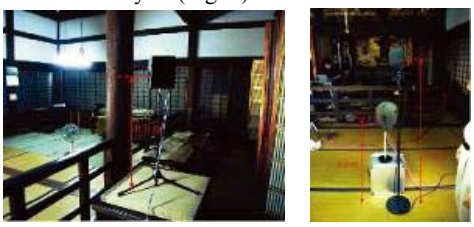

Fig. 6 L) Sound source and R) microphone at the measurement. The height of the speaker and dummy head is 0.9m.

2.2 Results and discussion

Fig. 7-a) is the listening levels within Joshinji temple with the sound source position S1, and Fig. 7-b) is the subsequent reverberation time T_{sub} there respectively [1]. Squares, circles and triangles in the graphs correspond to the sound receiving positions showed in Fig. 5 with the same mark.

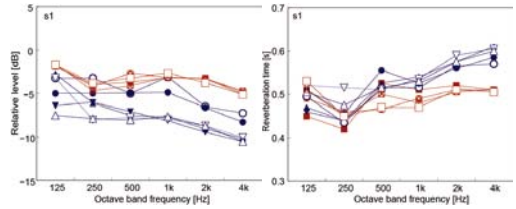

Fig. 7-Left) Relative sound level and Right) T_{sub} in Jyoshinji Temple with the sound source position S1

Here the points and lines drew in RED lines are the sound receiving positions INSIDE THE ALTER and that of BLUE are outside; at the AISLE. Note that inside is the seating positions for monks and the aisle is for the ordinal people. The curves are rather flat but in general the low frequency components conserved more than that of high frequency in the measurement of listening level.

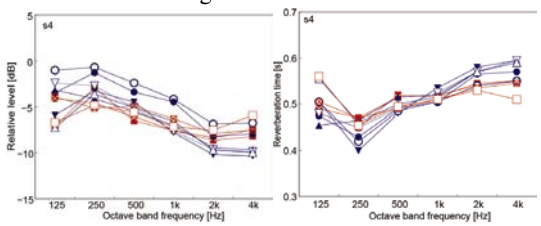

Fig. 8-Left) Listening level and Right) T_{sub} in Jyoshinji Temple with the sound source position S4

There is a fence between the alter is called "YARAI" and represents A RIVER between LIVING and DEAD; the monk's seats are on the side of Buddha and naturally means the world of DEAD, and the sound there is colored RED at the graphs, and the aisle, seats for believers are the world of ALIVE and the sound there is colored in BLUE.

Although the listening levels inside the alter, the world of DEAD, is stronger, the values of T_{sub} at the aisle, the world of the LIFE in the Buddhism's meaning, is apparently longer than that of inside the alter.

This tendency is not occasional, but observed in every measurement with "traditional" source positions at this Jyoshinji temple. Fig. 8-a) and b) are the listening levels and T_{sub} with the sound source position S4.

In the cases of S1 and S4, the monks' face is toward alter and only the back of him is seen from the outside; from the world of ALIVE, but the believers listen longer T_{sub} than that of inside the alter. MONKS' VOICE LASTS LONG MUCH MORE IN BEHIND. This is fundamental characteristic of this Japanese wooden Buddhist temple.

Fig. 9-a) and –b) are the listening levels and T_{sub} with the sound source position S4, the seat of "DOUSHI" (Bishop).

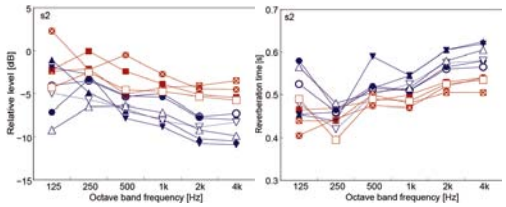

Fig. 9-Left) Listening level and Right) T_{sub} in Jyoshinji Temple with the sound source position S2

Although the seating position broke the symmetry of space, the fundamental characteristic, more subsequent reverberation time in backside, is conserved here also. In real ceremonies, following monks to the bishop, who seat just behind him should sing together with the top and the acoustic characteristic observed here is quite reasonable also from practical rite's point of view.

Fig. 10-a) and –b) are the listening levels and T_{sub} with the sound source position S3, "KOUZA" (PULPIT) the seat for sermon ("SEKKYOU").

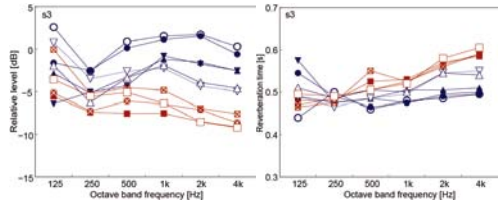

Fig. 10-Left) Listening level and Right) T_{sub} in Jyoshinji Temple with the sound source position S3

An apparent difference of Fig. 10-a) from Fig. 7-a), 8-a) and 9-a) is in the high frequency area of BLUE lines and dots; in the aisle, where is the seats for living believers.

The physical sonic wave transfers directly from the PULPIT to the audience up to the high frequency components. In the other cases most of the sound power transferred to the audience is in low frequency. It suggests a sense of solemnity, dignity and even divinity. But here, in the sermon, the characteristic of sound field is different. In the traditional mission ("FUKYO") of this Jyodo Shinsyu school, a "Buddhist Sermon MONO-OPERA" called "FUSHIDAN SEKKYO" (Fig. 11) is performed on this PULPIT ("KOUZA") and the acoustic characteristic here observed guarantees dynamic possibility of expression.

Fig. 11 Traditional "FUSHIDAN SEKKYO"

from the PULPIT ("KOUZA"), Mankakuji Temple, Noto, Japan.

On the other hand, we can not observe such remarkable characteristics from the measurement with source position s4'.

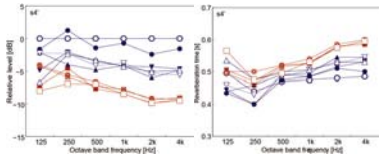

Fig. 12 Left) Listening level and Right) T_{sub} in Jyoshinji Temple with the sound source position S4'

The measurement of IACC in this temple also suggests how carefully this temple is designed, used for long years, and many reformations are done through the course of everyday religious ceremonies both in the temple architecture.

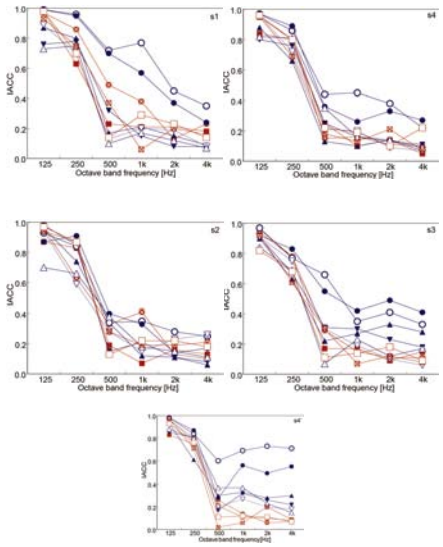

Fig. 13- IACC in Jyoshinji Temple with the sound source position

S1, S2, S3, S4 and S4'

Values at low frequencies are nearly equal to 1.0 and rapidly fall down, at round 500 Hz, near to 0. In data of S1 and S3 the blue lines and dots remain in rather high value at higher frequencies. It tells that in these cases the sound listened at the aisle --- world of LIFE --- has much more ambience and hence they would have MEDITATING atmosphere. To good contrast, within alter such tendency is very little; this tells that alter --- the world for DEAD, and also seats for MUSIC MONKS --- are less meditative but suitable for playing and ensemble.

Such dynamical characteristics would be never observed from the data of S4'.

Without such point of view, we can not observe the reality of Buddhist ceremony, music and performance. This also shows a rich possibility of the method we have used here, for the study of religious ceremonies, music and even theater.

We have possibility to observe many similar characteristics in western architecture.

Most important is BREAKING of SYMMETRY; in a religious ceremony, Christian Mass for example, consists of many small parts with different speaking and reading position, directions and the characters of voices. Through the course of history, they had accomplished refinement and reached to completed style. From this point of view also, the change in Catholic church at the SECOND VATICAN ECUMENICAL COUNCIL is quite revolutionary. In opera houses also there are many methods for resonance with the use of symmetry breaking.

3. CONCLUDING REMARK

In this paper we have observed the relationship between the religious meaning and the acoustics within a temple, and churches in its consequence. But the acoustics are ruled by the lows of nature and quite similar phenomena are seen within the tradition of concert halls and opera houses. Every (good) brass instrument player is quite careful about the stage arrangement and seating position. Any good opera conductor knows and teaches to singers the importance to change the singing direction between in the ARIA and RECITATIVO; to make the spoken language clear to the audience, "speech-singing" should have sideway direction. Such "SPATIAL" technique in music and opera has much to do with physical and cognitive acoustics. The key is how to break the symmetry for the targeted expression.

REFERENCE

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