Acoustical Design and Characteristics of the Harmony Hall Fukui

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abstract: The Harmony Hall Fukui, sponsored by the Fukui Prefectural Government, was completed on September 3, 1997. The facilities composed of three blocks: Main Hall Zone, Recital Hall Zone, and Administrative Office Zone. This paper reports on the acoustical design and results of acoustical measurements of the two concert halls.

INTRODUCTION

The Harmony Hall Fukui was constructed on a spacious site of about 67,000 m² located 4km south of Fukui City. The facilities were designed in three functional zones in the same level; namely the Main Hall Zone in the western part of the site, the Recital Hall Zone in the eastern part, and Administrative Office Zone in the central part. Plan of The Harmony Hall Fukui is shown in Fig. 1.

The Main Hall, which seats 1,456 persons, is designed as a concert hall with a shoe-box configuration. Seats behind the stage are also allocated for the chorus, when required. The space offers a sense of intimacy and oneness between the stage area and the audience area.

The Recital Hall is designed as a small hall seating 610 persons. The seats surround the stage with staggered balconies, creating what may be called a "mini arena" configuration.

A rehearsal room capable of accommodating an entire orchestra is located to the side of dressing room area near the Main Hall.

The rehearsal room is actually designed to serve as a dressing room as well.

In the central Administrative Office Zone, six music practice rooms of varying sizes are allocated to provide additional rehearsal space.

FIGURE 1. 1st.Plan of The Harmony Hall Fukui

ACOUSTICAL DESIGN

Noise and Vibration Prevention System: Noise and vibration control were studied from the early stage of architectural design, and fundamental requirements such as the location of the machinery room were introduced into the building design.

Sound Insulation: The zoning of the facilities mentioned above has afforded a great advantage for sound insulation between the halls. High performance sound insulation structures with floating walls were introduced in three of the six music practice rooms according to the room arrangements.
Room Acoustical Design:

[Main Hall] The room shape was studied by a computer simulation technique during the design stage, and the details of the walls and ceilings were studied by means of 1/10 scale model experiments before starting the construction work. Fig. 2 shows an example of the distribution of early reflections over the seating area in four time periods, 0–30 ms, 30–60 ms, 60–90 ms and 0–90 ms, respectively, after the arrival of sound. In order to achieve a diffuse sound field both in the early reflections and reverberent sound, bridgework elements with irregular pitch were installed on the side and rear walls. (Fig. 3). In Japan, public concert halls in regional cities are often used for miscellaneous programs such as meetings, ceremonies and lectures. In order to obtain good speech articulation in the sound system, a sound absorbing curtain system hanging from the ceiling and covering the side and back balconies around the stage was introduced.

[Recital Hall] The unique layout of the balconies around the stage heightens the audience’s feeling of proximity to the stage. In consideration of the even wider range of uses of a small hall, three types of systems with varying absorbencies were introduced in the hall, namely, a hanging curtain around the stage, interchangeable board panels with reflective finishing on one side and absorptive finishing on the other side around the stage walls, and the same type of panels behind the side walls of the front part of the balcony.

ACOUSTICAL CHARACTERISTICS

Air-conditioning noise is attenuated below NC15 for the two concert halls, NC20–25 for the rehearsal room and music practice rooms, thus satisfying the target levels of acoustical design. The reverberation time of the Main hall without an audience is shown in Fig. 3. As shown in the figure, the reverberation time in the empty space without curtains is 2.2 s at 500 Hz and 1.7 s at 500 Hz when the curtains are fully extended. The variable range of 0.5 s is attained for the reverberation time. The reverberation time of the Recital Hall without an audience in various configurations is shown in Fig. 4. The reverberation times variable from 1.7 s to 1.1 s at 500 Hz; that is, it can be varied by 0.6 s by the use of different systems. The results obtained for the Speech Transmission Index (STI) of the Main hall with fully extend curtains show a value of 0.52–0.67 over the audience area, and those of the Recital hall show a value of 0.60–0.64 when adjustable systems are used.