School Facilities that Built a Classroom Group of Wall Structures in an Open Space
— Toho Gakuen School of Music —

学生が集う開放的な空間の上に壁式構造の教室群を構築した学校施設
— 桐朋学園大学音楽学部 —


*

**

***

* Yukio KORI: NIKKEN SEKKEI LTD.
郡　幸雄：(株) 日建設計
** Toshihiko KOUNO, P.E.Jp: NIKKEN SEKKEI LTD.
向野　聡彦，技術士（建設部門）：(株) 日建設計
*** Mari IDA: NIKKEN SEKKEI LTD.
井田　茉利：(株) 日建設計
Contact: koori@nikken.jp

Keywords: school of music, heterogeneous grids, narrow column, PCa
DOI: 10.11474/JPCI.NR.2018.59

Synopsis
This paper presents a plan for a college of music in a typical low-rise suburban city. The building was planned with three levels: two above ground and one underground. On the second floor, lesson rooms (the main function) were placed freely according to the program. The second-floor structure adopts a wall-type reinforced concrete (RC) frame with an L-shaped wall arranged for each classroom. On the first floor, the authors arranged lounges and offices for students and formed a campus to serve as a center for interactions. The room for louder ensembles was placed on the underground floor, where the sound insulation is better. The first floor and the first basement floor are made of a rigid frame with earthquake-resistant walls.

Fig.1 Toho Gakuen School of Music (appearance)

Structural Data
Location: Chofugaoka, Chofu-shi, Tokyo
Site Area: 3,305.22m^2
Building Area: 1,942.89m^2
Total Floor Area: 5,828.91m^2
Number of Stories: 1 basement level, 2 stories above ground, 1 penthouse level
Maximum Height, Eaves Height: 11.29m, 10.75m
Structure: RC structure, wall RC structure
Owner: Toho Gakuen School of Music
Designer: Nikken Sekkei Ltd.
Contractor: Shimizu Co.

Fig.2 Toho Gakuen School of Music (interior view)

1. Introduction

This project involves the Toho Gakuen School of Music in a low-rise built-up suburban area. Because of the heightened consciousness of ambient noise and sound insulation, many music college facilities employ a style in which the exterior appears as a closed box and the interior lesson rooms are lined up along central corridors, much like jail cells. It is ironic that the learning places of a creative activity resemble those used elsewhere for solitary confinement. The authors were charged with overcoming this style and establishing the presence of a music college with flexibly arranged lesson rooms.

The building has three floors: two above ground and a basement. The practice rooms were laid out flexibly on the second floor without being uniformly scaled or on a base line. The span of a practice room was reflected in its appearance, and the volume was broken down to make space for differently sized pocket gardens on the premises. Practice rooms for ensembles were placed in the basement for more-efficient sound absorption by arranging the hallways along with a sunken garden.

As a result, the walls of the second floor and basement were laid out on an uneven grid. By implementing columns at the crossings of this uneven grid, the first floor has completely different spaces than the second floor and the basement. The first floor below the second floor brings a feeling of seamless continuity toward the neighboring surroundings instead of isolating it from the vicinity.

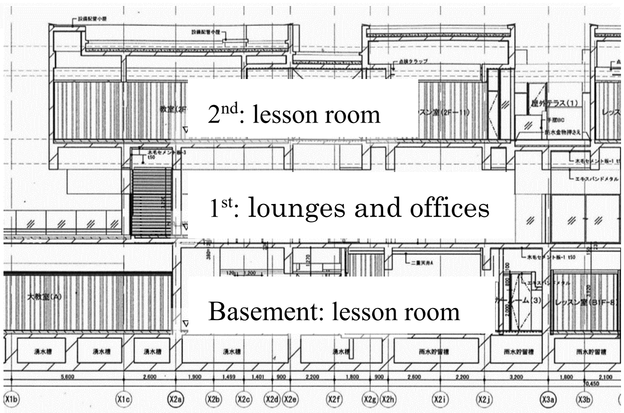

Fig.3 Sectional view

2. Outline of Structural Plan

(1) Objective in Adopting RC Construction

Reinforced concrete (RC) was adopted as the structural type for this building because heavy and dense concrete is an ideal and economical material for structures as well as for building floors and the sound insulation walls that are essential for a music college. Furthermore, the concrete structure itself served a double purpose in this plan as much as possible, acting as both sound insulation walls and shield walls. We pursued a new rational minimal aesthetic that values the texture of concrete. Concrete is also an ideal material for acoustically reflective diffusion. Therefore, the concrete structure was used for sound insulation walls and exposed at some appropriate locations where as an acoustic reflector/diffuser in this plan.

(2) Outline of Structural Design

The basement and first floor were planned as a Ramen structure with earthquake-resistant walls, based on a wall thickness of 400mm and placing earthquake-resistant walls around the lesson rooms and the offices. On the second floor, a wall-type RC structure with a wall thickness of 200mm was adopted, with the walls forming an “L” shape around each lesson room. On the second floor and in the basement, the lesson rooms are located on heterogeneous grids. On the first floor, the authors arranged 230mm square RC columns with 9-mm-thick square steel pipe as formwork protection to create a piloti-like space as a campus in which students can gather, while maintaining structural continuity.

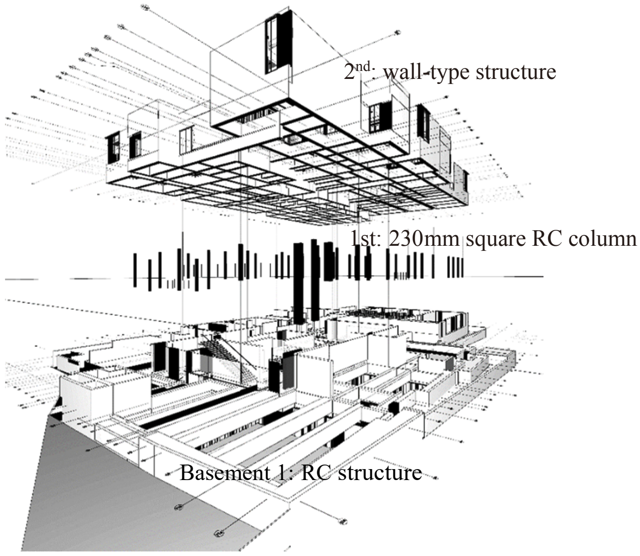

Fig.4 Sectional view

The beam set of each floor was planned to be consistent with the composition of the building space. In particular, the floor beams of the second floor and the Roof Floor were mostly customized to appear on the ceiling surface, and the plan was advanced by repeating model verification using a three-dimensional model of the building for gathering and the width of the beam from the initial stage of the plan. The floor beams on the second floor are based on a beam width of 400mm and a formation of 1,200mm, and the lines at the lower end of the beam are aligned. In addition, the floor beams on the roof floor were constructed with roof beams and slabs with a beam width of 220mm at the parts required by the building. Each lesson room and corridor constitutes a knitted quadrangle, and the slab level and the beam lower-end level were set according to the architectural design. Because the second floor adopts a wall-type structure, each side room circumferential beam with a beam width of 300mm at the top.

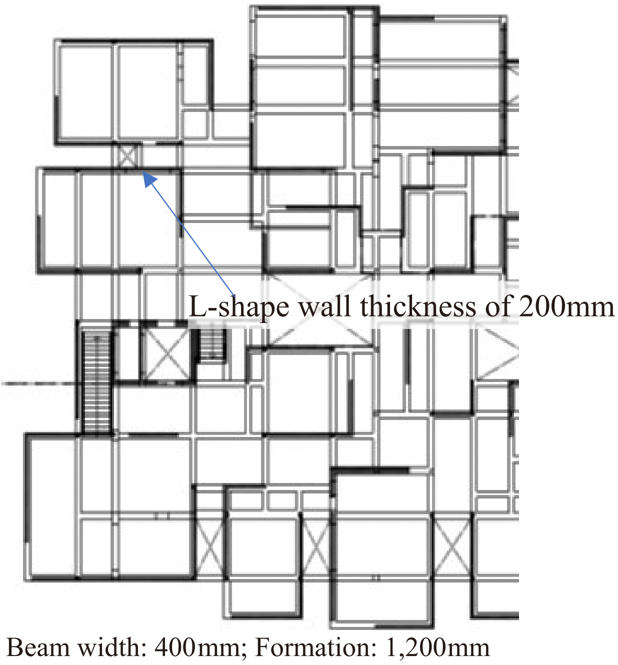

Fig.5 Second floor (beam plan)

In the design of the column positioning, different heterogeneous grids on the second floor and the first basement were superimposed on the building information model and the columns were arranged at the intersection points with the corridor width adjusted. In doing so, as far as the situation permitted, we adjusted the hallways and windows prospects to work.

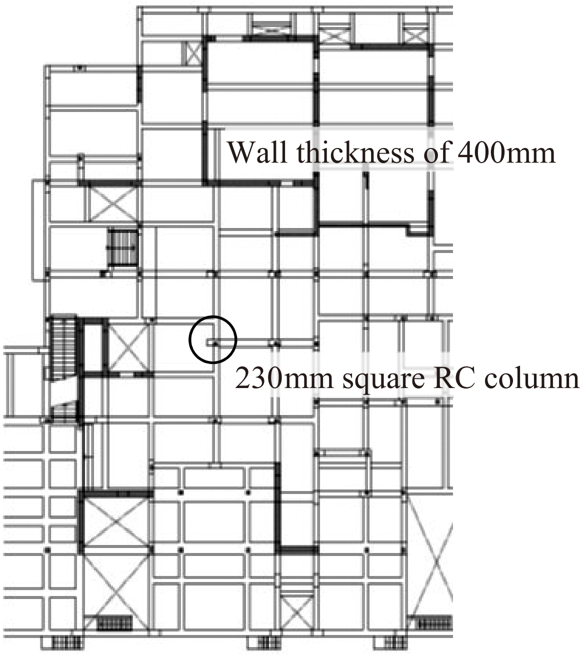

Fig.6 First floor (beam plan)

3. Outline of Construction

(1) Construction of Fine Columns with an External Shape of 230mm

We arranged as narrow a column as possible on the first floor where a piloti-like space connects, so that the line of sight can extend from inside to outside. The column has a minimum cross-sectional size that provides a minimum of reinforcing bars and a cross section, assuming a 250mm rectangular steel pipe serving as formwork at the outer peripheral part. This column was designed as a 230cm square RC column using FC 60 high-strength concrete; inside the main column of 4 D25, a spiral strip of D 10 was arranged. The high-strength concrete was made as a precast (PCa) column manufactured at a factory. The square steel pipe was used as formwork, finishing material, and for reserve capacity. A construction test confirmed the filling property of the concrete. Rebar fogging was confirmed by a factory production inspection.

The PCa column was constructed by inserting the splicing sleeve before concrete casting on the first floor and inserting the main stem into the sleeve before injecting the grout later. By this construction method, it was possible to reduce the concrete join around the column, maintain the fog of the PCa column main stem, and avoid drilling in the square steel pipe.

Fig.7 Confirmation of rebar accuracy before concrete casting

Fig.8 Confirmation of concrete filling on site

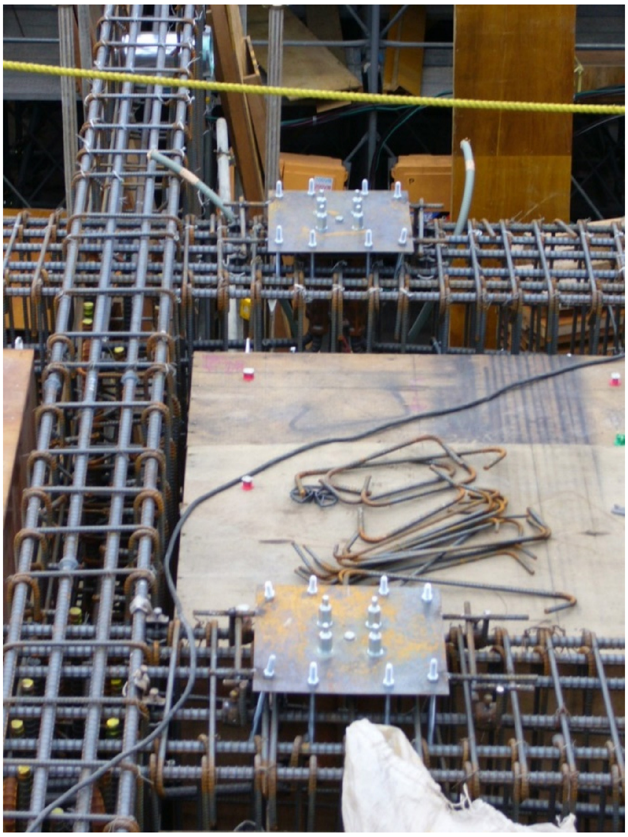

Fig.9 Construction

Fig.10 230mm RC column construction completed

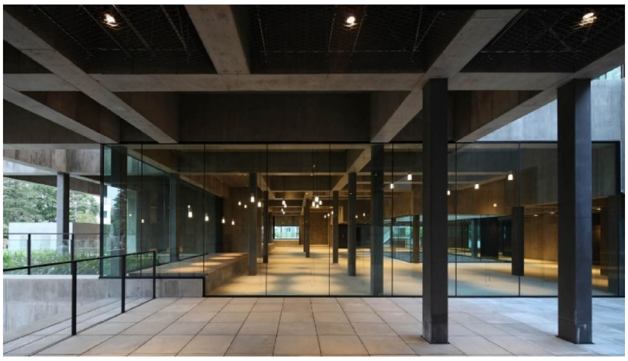

Fig.11 First-floor entrance

(2) Controlling Concrete Cracking

This building has many 200-mm-thin RC walls, and there was concern of cracking after construction. As a countermeasure, by using limestone aggregate, the drying shrinkage ratio of the concrete was reduced to 600μ or less. At the same time, the authors planned to widely distribute any concrete cracks that occur because of a differing shrinkage ratio by arranging the reinforcement both longitudinally and laterally.

4. Conclusion

In this building, the second floor (consisting of a group of classrooms for which noise shielding performance is required) adopts a wall-type structure that provides an effective acoustic environment, the first-floor seeking to withdraw visibility were adopted a rectangular steel pipe with a width of 250mm. The framework plan was constructed according to the characteristics of the building plan on each floor. The one-column arrangement is designed to support different beam spaces between the first basement floor and the second floor, utilizing the three-dimensional building model, by considering the axial force at the common intersection of the basement first floor and the second floor. We explored using coarse column positioning.
This project won the Award of the Japan Concrete Institute in 2015.

概　要

調布市に建つ郊外型低層市街地における音楽大学。建物計画は，低層市街地に建つ建物として地上 2 階，地下 1 階の三層に抑えた建物としている。 2 階には，主機能であるレッスン室を，均等スパンや通り芯と言った拘束に囚われることなくプログラムに合わせて自由に配している。 2 階の構造形式は教室ごとに L 字型の壁を配した壁式鉄筋コンクリート架構を採用している。

1 階は学生のためのラウンジや事務室など非音響空間を配し，交流の拠点となるキャンパスを形成し，地下 1 階はより大きな音を発するアンサンブル室を設けた。不均質なグリッドに乗った壁体群が存在する 2 階と地下 1 階に挟まれた 1 階には，異なる不均質なグリッドの交点に柱を据えることで， 2 階や地下 1 階とは全く異なった空間を生み出した。 1 階の柱は，視線が内部から外へと抜け，ピロティ状の空間が繋がるように，出来るだけ細い柱とした。 1 階と地下 1 階は，耐震壁付きラーメン架構としている。