Design of Large Concrete Walls Without Crack-inducing Joints — Tokyo College of Music Naka-Meguro Daikan-yama Campus —

目地無し打ち放し長大壁面の設計 — 東京音楽大学　中目黒・代官山キャンパス —


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Synopsis

The new campus of the Tokyo College of Music is located between the neighborhoods of Naka-Meguro and Daikan-yama (**Fig. 1**). Considering the location, the authors designed reinforced concrete exterior wall finishes that are in harmony with the surrounding buildings and greenery and that inherit the history and culture of the area.

Structural Data

Structure: reinforced concrete structure
Site Area: 8,538 m^2
Width: 24.0 m
Building Area: 5,543 m^2
Gross Floor Area: 17,720 m^2
Owner: Tokyo College of Music
Designer: Nikken Sekkei Ltd. and Toda Corporation Ltd., a Joint Venture for Design of Tokyo College of Music New Campus
Contractor: Toda Corporation Ltd.
Construction Period: Oct. 2016 – Jan. 2019
Location: Kami-Meguro, Tokyo, Japan

Fig. 1 New campus and its surrounding neighborhoods

Fig. 2 External appearance for the Naka-Meguro area

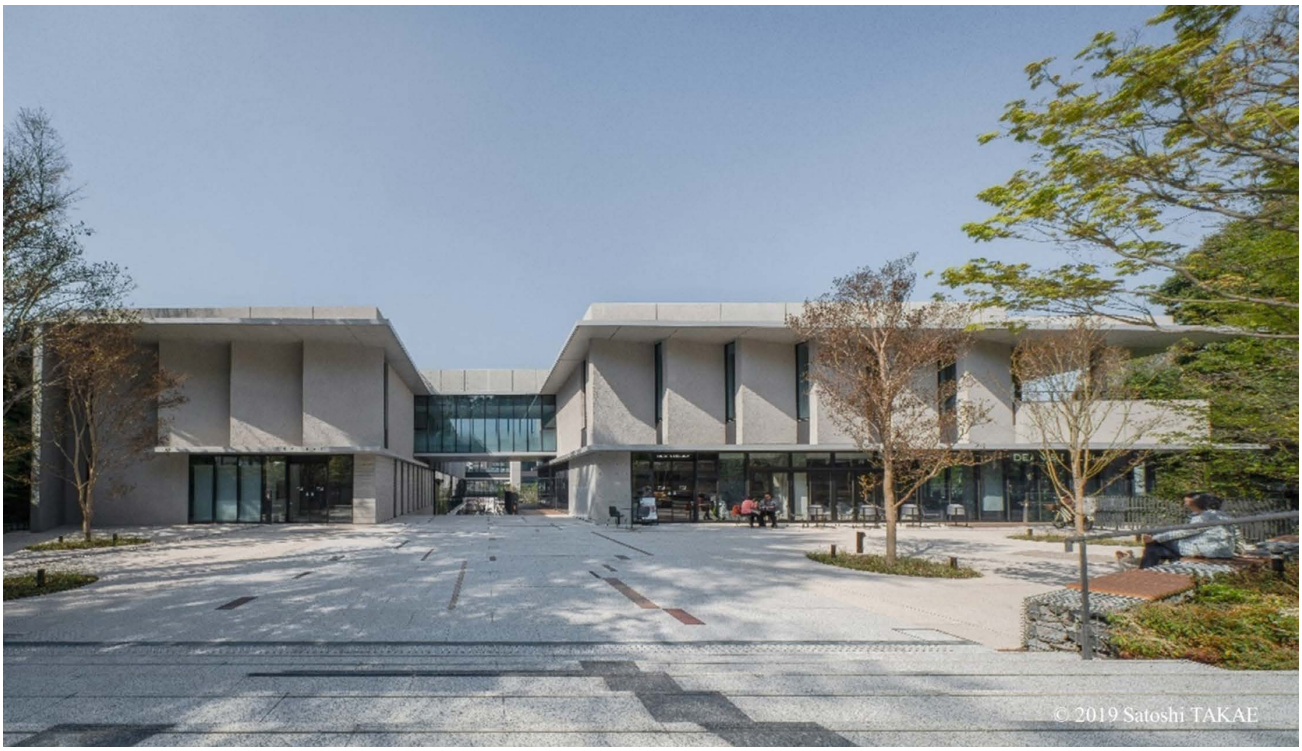

Fig. 3 External appearance for the Daikan-yama area

1. Design Concept

The design of the new campus of the Tokyo College of Music is based on the concept of a music college within greenery in harmony with the surrounding city. In an environment full of greenery, the authors included two streets where people from the surrounding city can freely stroll through the campus, with the goal of introducing a flow of people through the campus by connecting the neighborhoods of Naka-Meguro and Daikan-yama (**Figs. 2** and **3**). In the center of the campus, a music hall, lesson rooms, and other facilities are arranged around a courtyard known as the "Music Forest" (**Fig. 4**). This inner garden was designed to be a place where "towns," "students," and "music" can meet and exchange in various ways.

2. Design Inspired by Music

In this project, music is expressed in the architecture such that there is acoustic design both inside and outside the building. Inside, a functional design for the best acoustic performance was achieved based on several computational simulations considering the balance among the shape, volume, and sound absorption and reflection of each room (**Fig. 5**). Outside, sound is expressed by using a special exterior finishing for the building form. This unique design with sound as its form connects the two neighborhoods and softly beckons within, achieving a liveliness that is unique to such a music academy.

3. Façade Design

The façade facing the north–south street (that runs

Fig. 4 "Music Forest" inner garden

Fig. 5 A lesson room

Fig. 6 Bridge without expansion joints

through the building consists of walls known as "Reflect Walls." These are a juxtaposition of reinforced concrete walls, aluminum curtain walls, and sashless glass in that order from the upper floors downward (**Fig. 4**). The reinforced concrete walls are rotated by 7° about the vertical axis for optimal acoustic performance. This also allows students to see others performing through the resulting gaps between the walls.

4. Structural Design

In this architectural project, concrete is used effectively to provide appropriate functions for the music college and to harmonize the building with the surrounding environment.

The building is designed as a robust reinforced concrete structure with shear walls to ensure both sound insulation and earthquake resistance. Furthermore, the design is resistant to the unbalanced one-sided earth pressure due to the 11-m topographic height difference at the site, and the design has high seismic performance.

A common design was adopted inside and outside the building. It consists of inclined walls with each wall slope determined based on acoustic performance; this lends itself to the architectural expression of sound for the music college.

For the superstructure, the building is divided into two distinct areas that are connected by a bridge on the third floor (**Fig. 6**). On the other hand, the bridge has no expansion joints, leading to a continuous structure with a 500-mm-thick flat slab.

Fig. 7 Entrance hall (second floor)

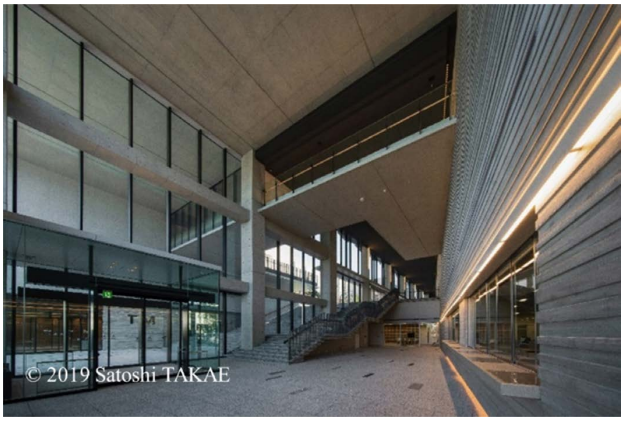

Fig. 8 Entrance (first floor)

The main façade was constructed with shear walls that are up to 600 mm thick to ensure sound insulation and seismic performance. This façade is expressed rhythmically by randomly placed slit-shaped openings, while providing an explicit load transfer path through the staggered reinforced concrete shear walls.

5. Design of Large Wall for Atrium

In the atrium space of the entrance lobby, a 40-m-long and 12-m-high wall is finished with cedar formwork with no crack-inducing joints to create an impactful space (**Figs. 7** and **8**). TCM Hall is located in the space inside of this wall (**Fig. 9**). The wall reinforcement was carefully planned so that the horizontally oriented uneven surfaces are not divided by control joints. Admixtures (both shrinkage-reducing and expandable) were added to this part of the concrete, and limestone was used as the aggregate to help realize an extremely low shrinkage rate. In the measurement of shrinkage rate performed in advance, it was confirmed that the admixtures halved the shrinkage strain to between −500μ and −600μ and gave an expansion strain of between +300μ and +500μ.

To blend in with the surrounding natural environment, the outer walls of the first floor were also designed with concrete using uneven cedar board formwork. During construction, multiple mockups were produced with different concrete mixes to examine the shrinkage rate, color, and ease of removing the formwork. To prevent formwork assembly mistakes, the cedar board formwork was brought to the site as factory-made panel units and built in to improve construction quality.

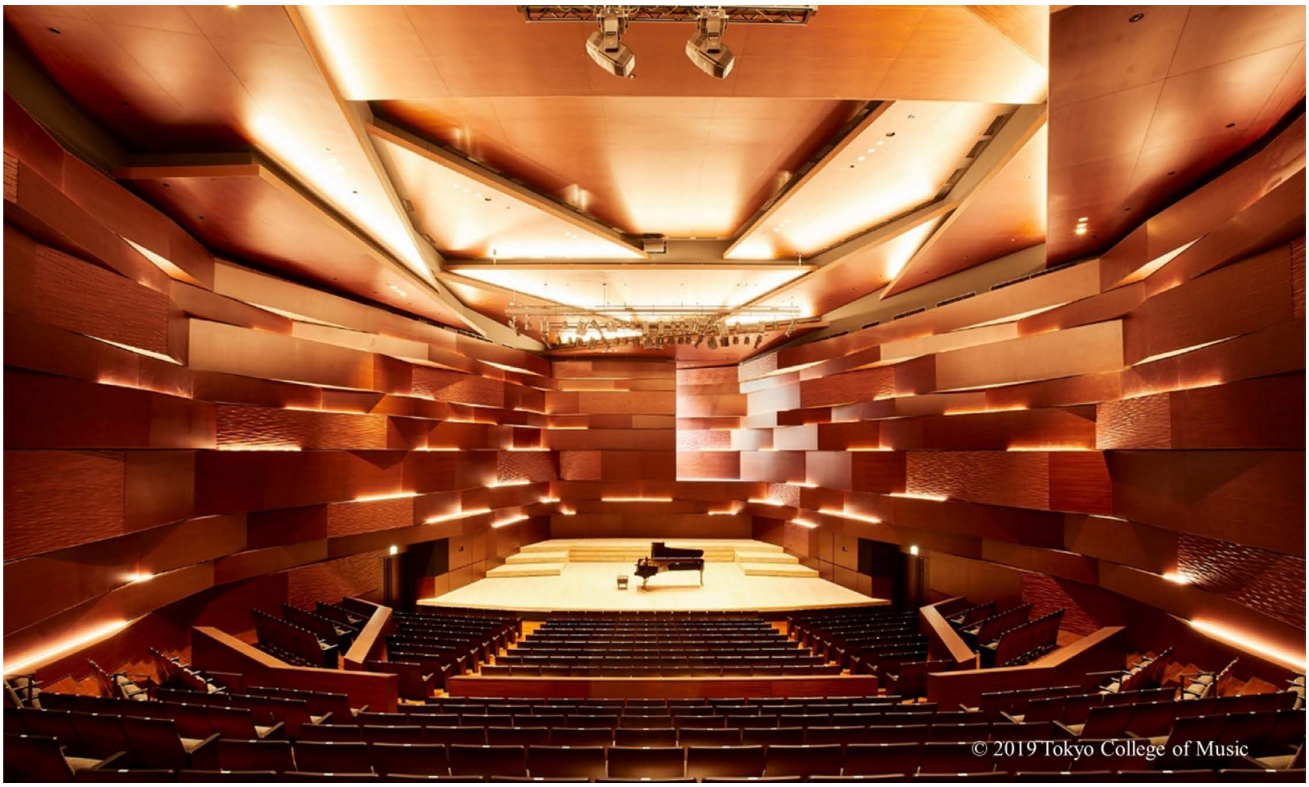

Fig. 9 Interior space of TCM Hall

概　要

本計画は，音楽大学としての機能と周辺環境への調和のため，コンクリートを有効活用した建築計画である。耐力壁を有する強度型の鉄筋コンクリート造として計画することで，遮音性・防振性の確保に加えて，敷地の高低差によって生じる片土圧への抵抗や高い耐震性能を確保している。

建物内外の共通するデザインとして，音響性能から決定した傾斜した壁面のデザインを随所に適用し，音をカタチとして表現して，音楽大学らしい建築としてまとめている。地上では 2 つのゾーンに分かれた建物を，エキスパンションジョイントを設けず渡り廊下で一体化，連続性を持たせた設計や，ファサードにスリット状の開口部をランダムに設けることでリズミカルな表現とし，千鳥配置の RC 耐力壁架構として明快な力の流れを実現した。エントランス吹き抜けでは，長さ40 m の大壁面を，ひび割れ誘発目地を設けずに，杉板型枠仕上げとして，迫力のある空間を実現した。