Management Plan for Preserving the Yoyogi National Stadium as a Living Heritage

Japan Sport Council
June 2019

Cover Photo: Interior view of the Second Gymnasium of the Yoyogi National Stadium

Support for this publication was provided by the Getty Foundation through its Keeping It Modern initiative.

The Getty Foundation

Notes

1. This document is the report of “Project for drafting the Management Plan for Preserving the Yoyogi National Stadium as a Living Heritage.” With the Japan Sport Council (hereafter, JSC) as key administrator, surveys were conducted from January 2018 to March 2019. The surveys and the management plan drafting were done on the assumption that the Yoyogi Stadium would be managed with an eye toward receiving a third party’s recognition for its cultural value, such as inscription on the World Heritage List and designation as an Important Cultural Property.
JSC received a grant from the Getty Foundation, a non-governmental organization in the United States which supports conservation of heritage sites internationally. The Japan Cultural Heritage Consultancy was contracted to create the report on behalf of JSC.

2. The surveys were conducted in collaboration with the following research laboratories and individual: Saikaku Toyokowa laboratory at Chiba University; Manabu Chiba and Naoto Nakajima laboratories at the University of Tokyo; Yoshiyuki Yamana laboratory at Tokyo University of Science; and Keisuke Fujii, Professor Emeritus of the University of Tokyo. The survey team consulted with Ms. Sheridan Burke who is an expert on heritage conservation and management in Australia.

3. Survey team members and the Japan Cultural Heritage Consultancy did the writing. The Japan Cultural Heritage Consultancy edited and compiled them into the comprehensive report.

4. The copyrights for all photos and figures included in this report are owned by authors and JSC unless otherwise specified.

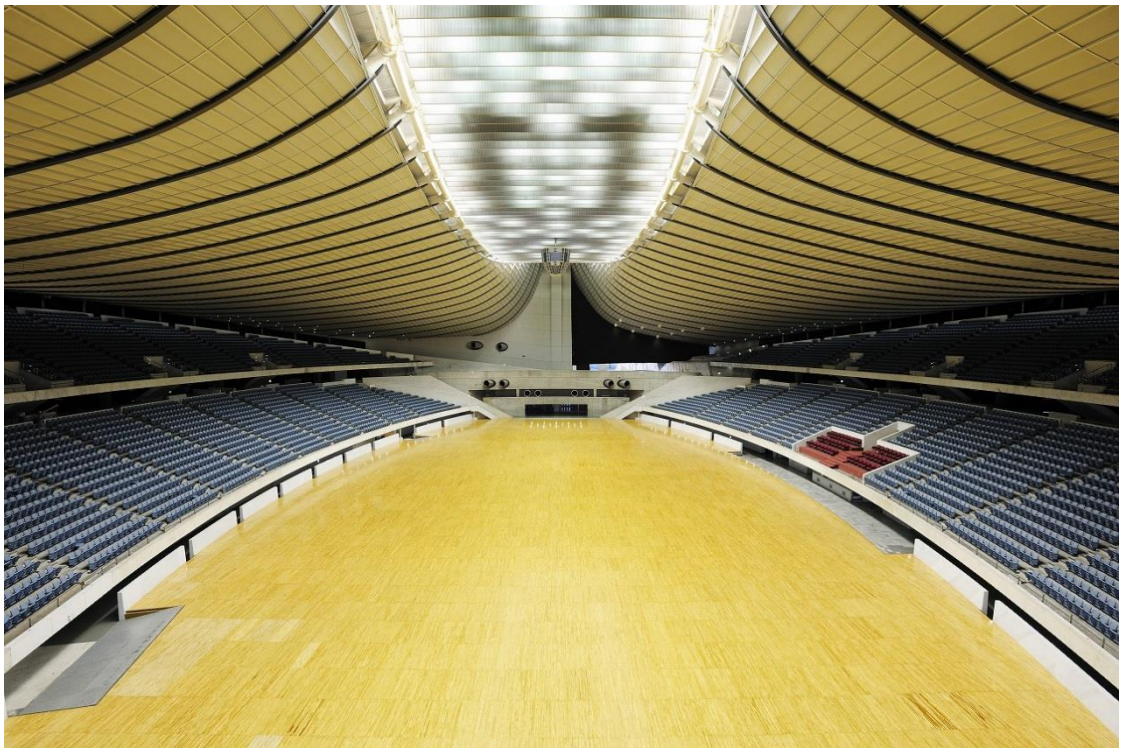
Aerial view of the Yoyogi National Stadium (the time of completion in September, 1964)

Aerial view of the Yoyogi National Stadium (January, 2015)

Exterior view of the First Gymnasium (under construction between 1963 and 1964)

Exterior view of the First Gymnasium (2011)

Interior view of the First Gymnasium (the time of completion in 1964)

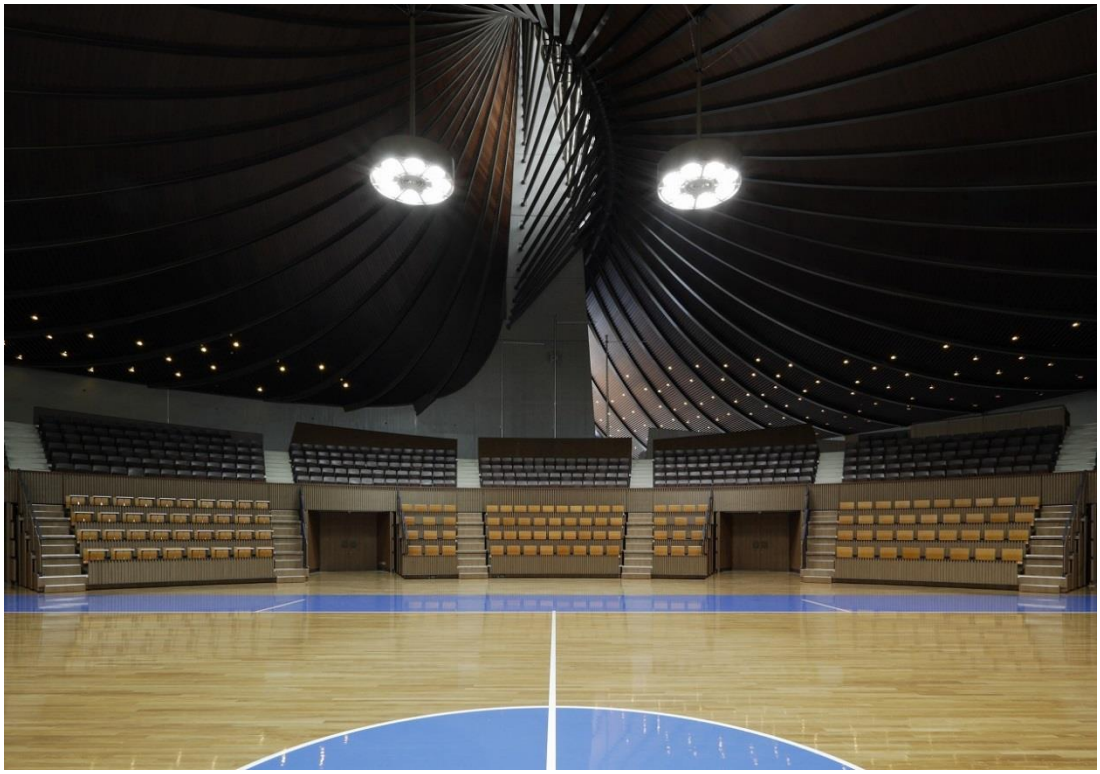


Interior view of the First Gymnasium (April, 2012)

Exterior view of the Second Gymnasium (under construction between 1963 and 1964)

Exterior view of the Second Gymnasium (July, 2012)

Interior view of the Second Gymnasium (the time of completion in September, 1964)



Interior view of the Second Gymnasium (November, 2010)

Contents

Outline of the Project

Tange Kenzo (1913-2005) is a leading Japanese architect and urban planner who established a unique architectural style by combining elements of traditional Japanese architecture with modern Western architecture. After World War II, he designed a number of public buildings symbolizing a revitalized post-war Japan and worked extensively in urban planning worldwide, becoming known as “Tange of the World.” In recent years, a number of exhibitions on Tange’s work have been held in Japan, and his architectural documents and materials have been collected at Harvard University. Thus, Tange’s architectural achievements have been widely researched and he has drawn attention internationally as an architect representing the 20th century.

Constructed in 1964, the Yoyogi National Stadium (hereinafter, the Stadium) is one of Tange’s outstanding works and is widely recognized as one of the world’s masterpieces of 20th-century architecture. This enormous facility has a dynamic appearance and exceptional internal space, imparting a sense of excitement and joy to both athletes and spectators. This was achieved through a unification of the bold suspended roof structure, centered on a steel-framed cable that was newly developed at that time, and the concrete structure of the spectator seating that supports it. In addition, the structure achieved remarkable integration in the roof design by pursuing traditional a Japanese style in the roof structure imbued with a modern spirit, making full use of leading-edge 20th-century technology. The Stadium distinguished Tange as a world-famous architect and contributed to the recognition of Japan as a world leader in science and technology, along with the introduction of the Shinkansen bullet train in the same year, 1964. The Stadium stimulated younger architects of the time and provided immeasurable motivation to Japanese architects to situate themselves at the front line of architecture throughout the world. It provided considerable influence in post-war Japan and other Asian countries, as well as in international architecture circles. After the Olympics in 1964, the Stadium was utilized as a venue for various sports and other cultural events such as music concerts, and it has continued to play a leading role in Tokyo sports and culture.

The Stadium will be used as one of the venues for the Tokyo Olympic and Paralympic Games in 2020 and will continue to attract world attention as an example of modern architecture with cultural value inherited from the Olympics of 1964.

The purpose of this project is to communicate the historic and cultural value of the Stadium, while continuing to utilize it in the future and to promote its appeal as modern architecture in the light of the concept of living heritage. Moreover, we will study the related documents and history of the site and formulate a policy and management plan for the Stadium 55 years after its construction.

Objectives of the document

This report aims to clarify the historic and cultural values of the Stadium and to identify its present state of conservation and issues for protection and utilization. In addition, the objective is to then design a basic policy for management in order to communicate the

value of the Stadium, while continuing to utilize it in the future.

The plan shall become a basis for the future management plan and shall play an important role in representing the concept of management and utilization of the Stadium as a 20th-century modern architectural heritage site.

Role of this document

This document contains basic items that are conventionally included in a Japan's standard conservation and management plan of heritage building. At the same time, it incorporates elements of conservation management planning ideas supported by the Getty Foundation through its Keeping It Modern initiative, including grantee workshops on this methodology organized by the Getty Conservation Institute.

If and when the Yoyogi National Stadium is designated as an important cultural property under the Japanese Law for the Protection of Cultural Properties in the future, it is advisable to draw up a conservation and utilization plan in accordance with the Law.

Structure of the document

This report is comprised of three chapters.

Chapters 1 and 2 refer to the outline of the building, the background of its construction, and the history from site selection through to completion in 1964. The history of building repair work is outlined as well.

Chapter 3 discusses the comprehensive protection policy for the Stadium and its surroundings in line with its historic and cultural values. Identifying factors potentially affecting the stadium and its surrounding environment on the basis of condition analysis, it considers an appropriate extent of the buffer zone to set up, presents landscape simulations, and provides basic information for a policy of periodic and systematic monitoring of the site.

Chapter 1

Overview of the Yoyogi National Stadium

Chapter 1

Overview of the Yoyogi National Stadium

1-1. About the buildings

(1) Name

Yoyogi National Indoor General Stadium

(The official name at the time of completion)

First Gymnasium

Second Gymnasium

Administrative and auxiliary buildings

(This is what Kenzo Tange called "*michikukan*". Their top surface is also called "promenade".)

(2) The date of completion

September 5, 1964

(3) Venue

2-1-1 Jinnan, Shibuya-ku, Tokyo

(4) Owner

Incorporated Administrative Institution Japan Sport Council

Agency address: 2-8-35 Kita-aoyama, Minato-ku, Tokyo

(5) Basic building information

	First Gymnasium	Second Gymnasium	Auxiliary and Administrative Buildings
Structure	Reinforced concrete structure; partly steel-framed structure		–
Number of stories	Two stories above ground, two stories under ground	One story above ground, one story under ground	–
Roof structure	Suspended by cables and steel members		–
Building area	14,426 m^2	3,872 m^2	–
Gross floor area	28,754 m^2	6,947 m^2	5,139.93 m^2
Others	Important artworks by Taro Okamoto		

- The Stadium was selected by DOCOMOMO Japan in 1999 as "Architecture of the Modern Movement in Japan" and has been registered under the name "Yoyogi National Indoor General Stadium."
- In 2017 the Stadium was also selected by ICOMOS Japan as one of the "Twenty of the 20th Century Heritages in Japan". It was registered as "a masterpiece of large-scale architecture."

Fig. 1-1 Aerial view of the Yoyogi National Stadium

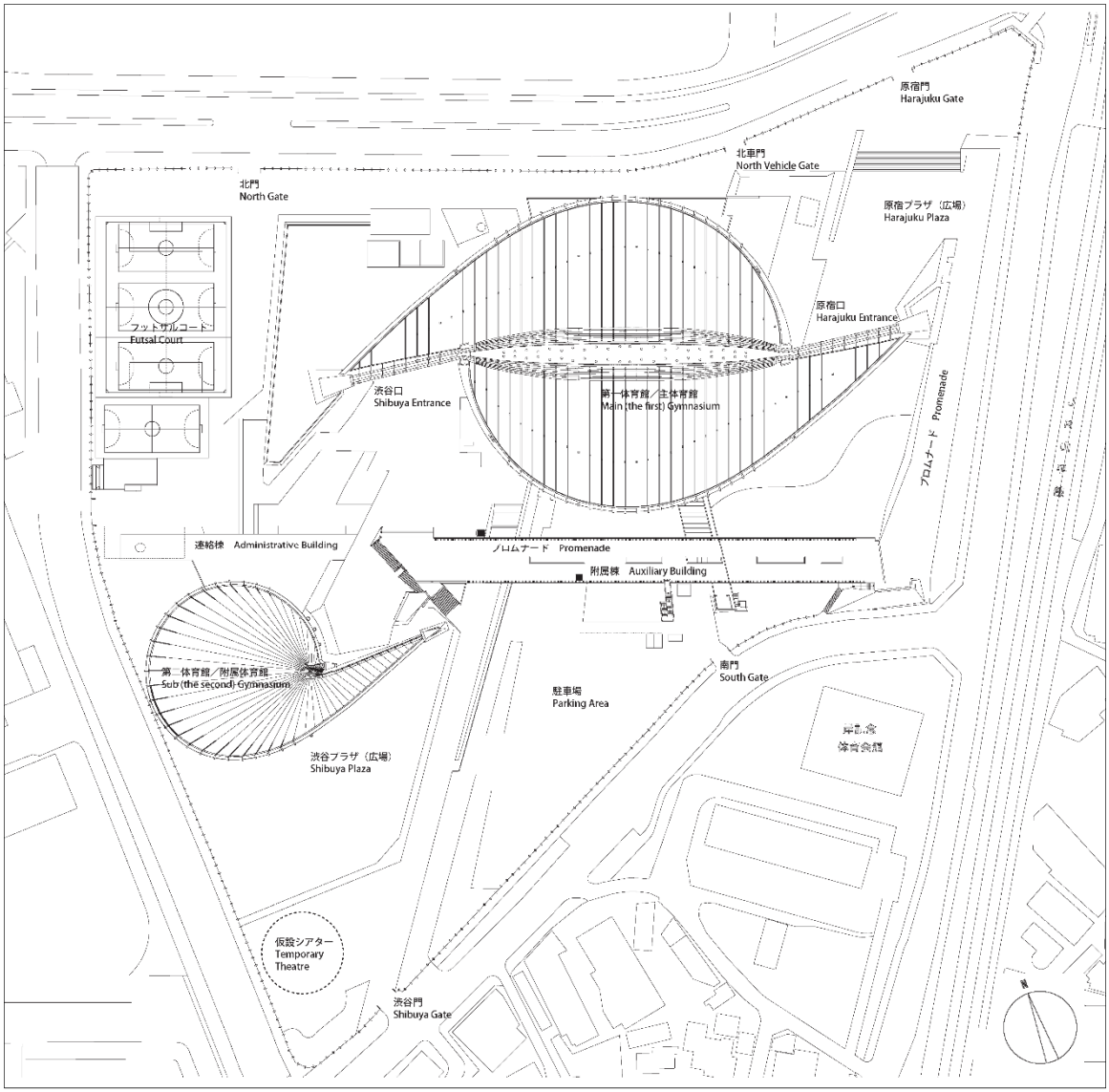


Fig. 1-2 Yoyogi National Stadium: name of buildings

1-2. Summary of the surroundings of the Yoyogi National Stadium

Yoyogi Stadium is located roughly in the center of Shibuya Ward in Tokyo. The Stadium area is at an elevation of around 34 meters. The area surrounding Shibuya station to the south, on the other hand, is at an elevation of around 15 meters. Thus, there is a shallow slope from the Stadium down to Shibuya Station.

The premises of the Stadium are surrounded by four streets. Prefectural road No. 413, also known as Inokashira Street, runs along the north side. This road was improved for the Games of the XVIII Olympiad, held in Tokyo in 1964.

Within the premises, there are the First Gymnasium, the Second Gymnasium, the Auxiliary and Administrative Buildings, futsal courts, and a parking lot.

The First Gymnasium is on the northern and eastern part of the premises. The futsal courts are on the western side of the First Gymnasium, and the Auxiliary Building is on the southern side. The Auxiliary Building connects the First Gymnasium and the Second Gymnasium. Its top surface is utilized as a promenade. A temporary building had been standing on the southern edge of the premises, but it was removed in April 2019.

Within a one-kilometer radius, there is Harajuku station to the northeast and Shibuya station, which is a terminal station of several major railroads, to the south. In addition, there are rich green spaces such as Meiji Jingu (Naien) and Yoyogi Park spreading out to the north of the premises. The area centering on Shibuya station, south of the Stadium, has been revitalized. The NHK (Nippon Hoso Kyokai) Broadcasting Center adjoining the Stadium on the west is planning to construct a new building from 2020 through 2036.

Furthermore, there are a number of large-scale construction projects planned for the area through 2036. Thus, various types of spaces around the Stadium are in proximity to each other and form a distinctive landscape of bustle and peace in coexistence.

Fig. 1-3 Yoyogi National Stadium and its surrounding (satellite photo)

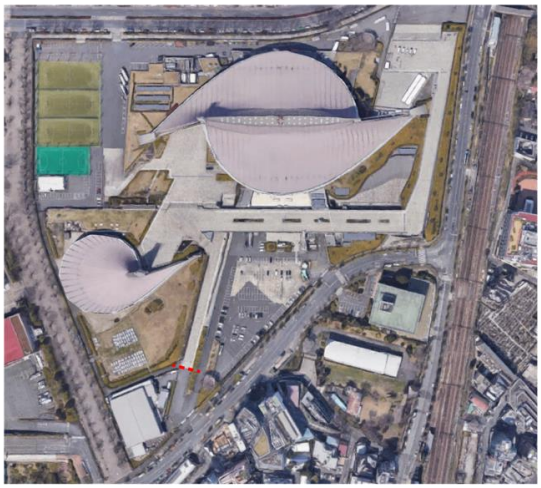


Fig. 1-4 Yoyogi National Stadium (satellite photo)

Chapter 2

Historical survey findings from the Yoyogi National Stadium

Chapter 2.

Historical survey findings from the Yoyogi National Stadium

2-1. Outlines of the survey

(1) Survey terms

January 26, 2018 through May 31, 2019

(2) Categories of archival documents and locations

Archival documents collected through the survey are grouped into the following seven categories in accordance with location of collections:

National Archives of Japan and Tokyo Metropolitan Archives

1) Archival documents related to Shibuya and the Yoyogi Military Drill Ground in the Meiji, Taisho and early Showa periods.
2) Archival documents from the time of construction of Washington Heights, which was established by the GHQ after WWII.
3) Archival documents recording the process of hosting the 18th Olympic Games in Tokyo.
4) Archival documents recording the process of appointing Washington Heights as the location for Yoyogi stadium and the Olympic Village.
5) Archival documents recording the process of appointing Tange, Tsuboi and Inoue as designers for Yoyogi Stadium.

National Archives of Modern Architecture, Agency for Cultural Affairs, Kawaguchi Laboratory, Institute of Industrial Science, the University of Tokyo, and Hasemi Laboratory, Waseda University.

6) Archival documents related to designing, supervising and constructing Yoyogi Stadium.

Shimizu Corporation

7) Archival documents owned by the construction company

(3) Collection of documents

Below is a list of the collected research documents for each of the seven categories mentioned above:

1) Archival documents related to Shibuya and the Yoyogi Military Drill Ground in the Meiji, Taisho and early Showa periods.

Previous research

- Yoshida, Ritsuto. 2011. *Dai kyu sho, Shibuya shuhen no Gunjitekikukan no keisei*. Ueyama, Kazuo ed. *Rekishi no naka no Shibuya ni Shibuya kara Edo, Tokyo he*. Yuzankaku.

2) Archival documents from the time of construction of Washington Heights, which was established by the GHQ after WWII.

Archives

- Washinton・Haitsu no Setsuzoku Chiiki no Dokushin Heisha, Shukusha Kensetsu Hantai no tameno Seigan (Shibuya-ku PTA). (1954, February 27). *Shugiin Gaimu Iinkai No. 11*.
- Washinton Haitsu ni okeru Hausumeido Mondai. (1954, May 26). *House of Representatives Labor Relations Commission No. 27*.

・ Washinton・Haitsu Shuhen no Ryokan・Fuki Mondai. (1955, November 1). *Sangiin Naikaku Iinkai hei No. 5*.

Official reports

・ Design Banch Japanese staff. Shoko-sho Kougei Shido-sho ed. 1948. *Dependents Housing*. Gijutsu Shiryo Kanko kai.

Newspaper articles

・ Washinton Haitsu ka: Bei Taishikanin no Kyojuchi. (1951, July 29). *Asahi Shinbun*.
・ Washinton Haitsu Mondai Kaiketsu: Shoko, Gunzoku kyuhyaku ga nyukyo, Dokushin shukusha hantaiundo ni shushifu. (1955, November 23). *Asahi Shinbun*.
・ Shibuya-ku no Koso: Shikichi hanbun ni sogochosha, Nokoriha gakko no shikichi ni Washinton Haitsu ato. (1958, December 28). *Asahi Shinbun*.
・ Entotsu no soko kara jinkotsu Washinton Haitsu nai de. (1959, April 11). *Asahi Shinbun*.

Previous research

・ Koizumi, Kazuko, Takayabu, Akira, Uchida, Seizo. 1999. *Senryogunjutaku no kiroku (jo/ge)*. Seiunsha.
・ Ueda, Jiro. 1950 .*Shichugun kazokujutaku zufu*. Gihodo.
・ Akio, Satoko. 2009. *Washintonhaitsu: GHQ ga Tokyo ni kizanda sengo*. Shinchosha.

3) Archival documents recording the process of hosting the 18th Olympic Games in Tokyo.

Archives

・ Kokkai Gijiroku. Web site: http://kokkai.ndl.go.jp/SENTAKU/index.htm
・ Dai Juhachi-kai Orinpikku Taikai Tokyo Shochi ni kansuru Ketsugi. Retrieved April 15, 1958, from Kakugi Kettei, https://rnavi.ndl.go.jp/politics/entry/post-30.php.
・ Dai Juhachi-kai Orinpikku Kyogi Taikai Senshumura oyobi Yakuin Shukusha no Yochi Kakuho nitsuite (Irai). (1959, May 2), Retrieved from Monbusho Gengisho, Buntaiun Dai Kyuju-yon go. https://www.digital.archives.go.jp/

Official report

・ Tokyo-to. 1965. *Dai juhachi kai Orinpikku Kyogi Taikai Tokyo-to Houkokusho*.
・ Orinpikku Tokyo Taikai Soshiki Iinkai. 1966. *Dai juhachi kai Orinpikku Kyogi Taikai Koshiki Houkokusho.*
・ Monbu-sho. 1965. *Orinpikku Tokyo Taikai to Seifukikantou no kyoryoku*.

Newspaper and magazine articles

・ Asahi Shinbun Web site: https://database.asahi.com/index.shtml
・ Saiga, Izumi. (1960, March). Orinpikku Tokyo Taikai no Shisetsu Keikaku nitsuite. *Shin Toshi*.

Previous research

・ Katagi, Atsushi. 2010. *Orinpikkushithi Tokyo 1940-1964*. Kawadeshobo shinsha.
・ Koshizawa, Akira. 2014. *Tokyo toshikeikaku no isan Bosai, Fukko, Orinpikku*. Chikumashobo.

4) Archival documents recording the process of appointing Washington Heights as the location for Yoyogi stadium and the Olympic Village.

Archives

・ Kokkai Gijiroku. Web site: http://kokkai.ndl.go.jp/SENTAKU/index.ht

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- Orinpikku Tokyo Taikai ni okeru Senshumura Yochi Kakuho ni tsuite (Kyoetsu). (1960, May 14), Retrieved from Monbusho Gengisho, Zattai Dai Ju go. https://www.digital.archives.go.jp/

Official report

- Orinpikku Tokyo Taikai Soshiki Iinkai. (1965). Shiryo-shu 7 Shisetsu-bu.

Newspaper and magazine articles

- Senshumura ni Tsukaitai Beigun Asaka Kyanpu to Washinton・Haitsu Tokyo Gorin Chotatsu-cho ni Moushiire. (1959, June 4). *Asahi Shinbun*.
- Washinton Haitsu wo Gorin no Senshumura ni: Shibuya-ku ni Yuin Junbi i. (1959, July 29). *Asahi Shinbun*.
- Asahi Shinbun Web site: https://database.asahi.com/index.shtml
- Horiuchi, Kyoichi. (1962, January). Orinpikku Shisetsu no Junbi Jokyo. *Shin Toshi*.

Previous research

- Ueyama, Kazuo. 2009. *Tokyo Orinpikku to Shibuya, Tokyo*. Oikawa, Yoshinobu ed. *Tokyo Orinpikku no shakai keizaishi*. Nihon Keizai Hyoron Sha.
- Tange, Kenzo and Fujimori, Terunobu. 2002. *Tange Kenzo*. Shin Kenchiku Sha.

5) Archival documents recording the process of appointing Tange, Tsuboi and Inoue as designers for Yoyogi Stadium.

Archives

- Washinton Haitsu Okunai Sogo Kyogijo Kensetsu Kyogikai Iin no Ishoku ni tsuite (Irai). (1961, April 11), Retrieved from Monbusho Gengisho, Buntaiun Dai Kyuju-san go. https://www.digital.archives.go.jp/
- Kokuritsu Okunai Kyogijo Kensetsu Sekkeisha Senko Iinkai no Kaisai ni tsuite (Shijo). (1961, November 24), Retrieved from Monbusho Gengisho, Buntaiun Dai Ni Hyaku Yonju Roku go. https://www.digital.archives.go.jp/

Official report

- Monbu-sho. 1965. *Orinpikku Tokyo Taikai to Seifukikantou no kyoryoku*.

Previous research

- Toyokawa, Saikaku. 2016. *Tange Kenzo*. Iwanami Shoten.

6) Archival documents related to designing, supervising and constructing Yoyogi Stadium

Archives

- Okunai Sogo Kyogijo Kensetsu Sekkei Itaku ni tsuite. (1962, March 28), Retrieved from Monbusho Gengisho, Buntaiun Dai Kyuju Hachi go. https://www.digital.archives.go.jp/
- Okunai Sogo Kyogijo Kihon Sekkei Setsumeisho. (1962, March 20). *Kensetsu Kogaku Kenkyukai*.
- Okunai Sogo Kyogijo no Kihon Sekkei ni tsuite. (1962, May 2), Retrieved from Monbusho Gengisho, Buntaiun Dai Hyaku Sanju Ni go. https://www.digital.archives.go.jp/
- Tange, Tsuboi, Inoue. Okunai Sogo Kyogijo Kihon Sekkei no Keika to Yobo. (1962, May 8)
- Okunai Sogo Kyogijo no Kensetsu ni tsuite: Shinbun Happyo shite yoroshiika, ukagaimasu. (1962, May 10), Retrieved from Monbusho Gengisho. https://www.digital.archives.go.jp/
- Okunai Sogo Kyogijo Sekkei Itaku ni tsuite

(Shijo). (1962, May 15), Retrieved from Monbusho Gengisho, Buntaisu Dai Kyuju Hachi go. https://www.digital.archives.go.jp/
- Okunai Sogo Kyogijo Keikaku Tsuchi Teishutsujo no Dairinin Inin oyobi Toshi Keikaku-ho ni kiteisareta Kyoka Shinseisho Teishutsu ni tsuite. (1962, October 5), Retrieved from Monbusho Gengisho, Buntaiun Dai Ni Hyaku Niju Nana go. https://www.digital.archives.go.jp/

Official report
- Kanto chiho Kensetsu-kyoku Eizen-bu. 1964. *Kokuritsu Okunai Sogo Kyogijo Seko Kiroku.*

Newspaper and magazine articles
- Kokuritsu Okunai Sogo Kyogijo Kihon Sekkei dekiagaru. (1962, May 12). *Yomiuri Shinbun*.
- Sekai de hatsu no Tsuriyane Gorin Okunai Sogo Kyogijo no Kihon Sekkei. (1962, May 12). *Mainichi Shinbun*.
- Kaichi, Negishi (Kensetsu-sho). (1965, April 9). Kokuritsu Okunai Kyogijo no Seko: Shu toshite Tsuriyane no Seko (1)-(4). *Kenchiku-kai*.
- Tokyo Orinpikku 1964. (1964, October). *Shin Kenchiku*. pp. 115-173.
- Kokuritsu Okunai Sogo Kyogijo no Kiroku: Pureriminari- dezain kara Tanjo made. (1965, January). *Kenchiku Bunka*. pp. 73-136.

Previous research
- Toyokawa, Saikaku. 2012. *Gunzo toshiteno Tange Kenkyushitsu*. Omu Sha.
- Toyokawa, Saikaku ed. 2013. *Tange Kenzo to Kenzo Tange*. Omu Sha.

2-2. Background on the construction of Yoyogi Stadium

(1) The history of Yoyogi: from the Late Edo Period to the establishment of the gymnasium

From the Late Edo Period to the end of the Meiji Period (late 19th century to the 1910s)

In the late Edo period, today's Yoyogi district was a border area of Edo City, where samurai residences were built to defend the castle. Among them, the residence of a feudal lord name "Ii" was the largest one, which stood where the Meiji Jingu shrine (Naien) stands now. Around it, agricultural fields extended over the area (Fig. 2-1).

At the beginning of the Meiji period, the feudal lord's residence was confiscated and sold by the Meiji government. The map from 1880 (Fig. 2-2) shows that most of Yoyogi district, including the residence of "Ii," had become farms and fields. Then, the land of "Ii" was purchased by the Imperial Household and converted into the Minami-toshima Imperial Estate in 1889. Agricultural fields still existed around the Imperial Estate.

The Imperial Estate, which included a large garden inherited from the residence of "Ii," was so verdant and scenic that the imperial family, including Meiji Emperor, often visited. Meanwhile, in 1909, the large Yoyogi Military Drill Ground was founded in the area next to Minami-toyoshima Imperial Estate to the south, where the Yoyogi National Stadium and Yoyogi Park stand today (Fig. 2-3). For context, the former Aoyama Military Drill Ground, established in 1887, had become too small and was supposed to be the site of exposition in 1912. Then, the Japanese military wanted to build a new drill ground in Yoyogi twice as large as the Aoyama Ground.

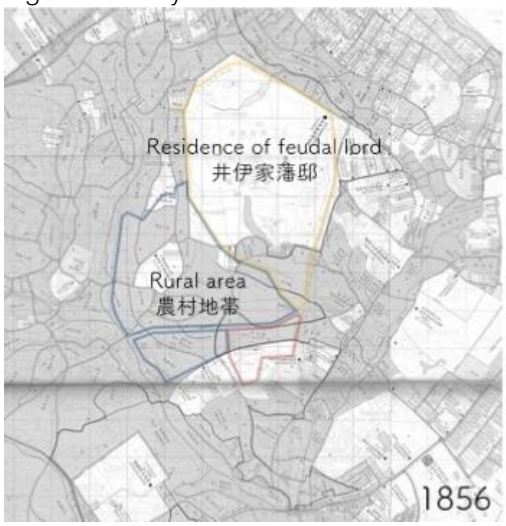


Fig. 2-1 Yoyogi in 1856

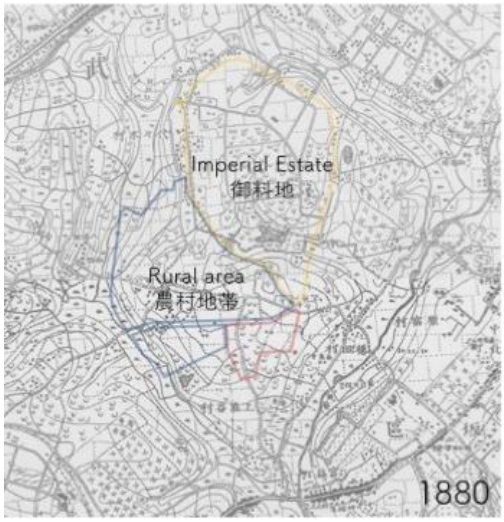


Fig. 2-2 Yoyogi in 1880

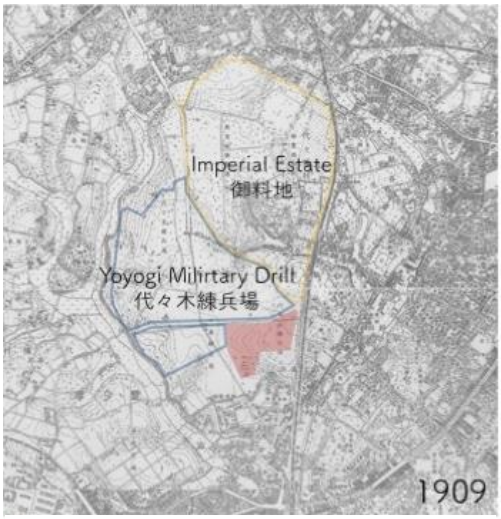


Fig. 2-3 Yoyogi in 1909

From the Taisho Period to the Early-Showa Period (1910s to 1945)

Following the deaths of Emperor Meiji in 1912 and his Empress, Shoken, in 1914, a plan to found the Meiji Jingu to enshrine them in Tokyo emerged. As a result, it was decided that Meiji Jingu would consist of two parts, Naien in Yoyogi and Gaien in Aoyama. Naien, which holds shrine buildings in an artificial forest, was created in 1920 at the site of the Minami-toyoshima Imperial Estate (Figs. 2-4, 2-5 and 2-6).

Gaien, which consists of a memorial museum and sports facilities, was established at the former site of the Aoyama Military Drill Ground in 1926. After the completion of Naien and Gaien, the connecting passages between them, including Omote-sando, were designated as Scenic Zones to preserve the landscape around Meiji Jingu, which received the first Scenic Zone designation in all of Japan. Thus, Yoyogi, as well as Aoyama, became sacred places in Tokyo.

Fig. 2-5 Meiji jingu around 1920
(*Meiji jingu zouei shi*, 1930)

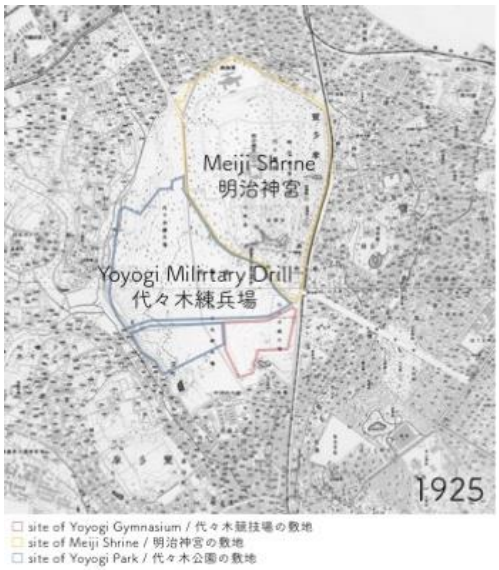


Fig. 2-4 Yoyogi in 1925

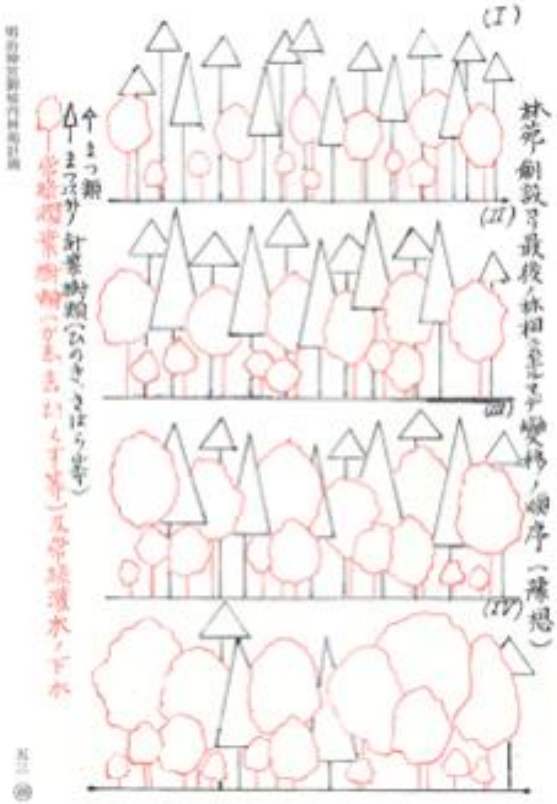


Fig. 2-6 Transition diagram of forest in Naien
（*Meiji jingu gokeidai rinen keikaku,* 1921）

Fig. 2-7　Funeral of Empress Shoken in Yoyoygi（*Shoken kotaigo on taisogi shimatsu,* 1915）

Yoyogi Military Drill Ground was used as a temporary venue for the funeral of Empress Shoken in 1914 (Figs. 2-7 and 2-8). After the funeral, the temporary buildings were demolished, and a memorial stone was erected at the place where the main building for the coffin had been built. This stone exists even today, continuing the memory of the funeral for posterity (Fig. 2-9).

In 1917, after the funeral, Yoyogi Military Drill Ground started to be used as a parade ground (Figs. 2-11 and 2-12). Military parades were held in the presence of the Emperor Showa almost every year until the end of WWII, and Yoyogi became a central military site in Tokyo as well as a sacred place.

Fig. 2-8　Layout plan of Empress Shoken Funeral (*Taisogi kankei bunsho shoken kotaigo taisogi kankei shorui 23-1,* owned by National Archives of Japan)

Fig. 2-9　Memorial stone of Empress Shoken's funeral
(Photo taken in 2013)

Fig. 2-10 Military parade in Yoyogi Military Drill Ground
(*Tairei shogi oyobi tairei kanpeishiki shashincho*, Army Ministry, 1929)

Fig. 2-11 Layout plan of military parade in Yoyogi Military Drill Ground in 1938
(*Koubun bikou* in 1937, owned by National Institute for Defense Studies)

From the Late Showa Period to the Present (1945-2018)

In Meiji Jingu (Naien), the main shrine building was destroyed in air raids in April 1945, at the end of WWII. Despite a severe fiscal situation after the war, Meiji Jingu received a significant amount of donations, and the main shrine building was rebuilt in 1958.

As for the land of the military drills, it was confiscated by the U.S. Armed Forces and used as a housing complex called Washington Heights (Fig. 2-12). With the Tokyo Olympics in 1964, the site of Washington Heights was returned to the Japanese government. As a result, the Yoyogi National Stadium was built in the southwestern portion of the site, and the remainder was used as an athlete's village, reusing the U.S. Army's housing (Fig. 2-13).

Three years after the Olympics, in 1967, Yoyogi Park was opened at the former site of the athlete's village, and the NHK Broadcasting Center was built on the south part of it. Since then, no other large-scale developments have appeared in Yoyogi.

As shown above, Meiji Jingu (Naien), the Yoyogi National Stadium, and Yoyogi Park were built in the twentieth century, and Yoyogi district has become a historical, cultural area, which serves precious green and common spaces in Tokyo (Fig. 2-14).

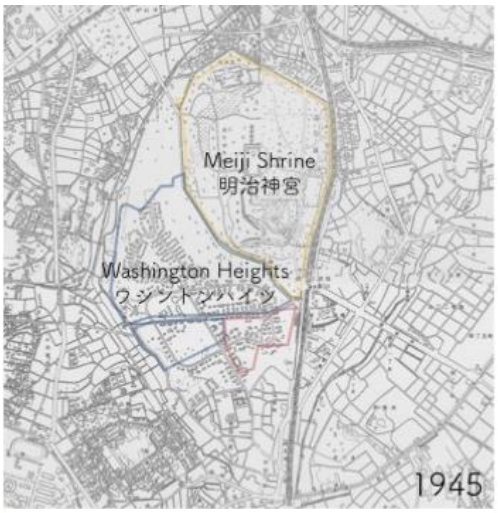


Fig. 2-12 Yoyogi in 1945

Fig. 2-13 Yoyogi in 1970

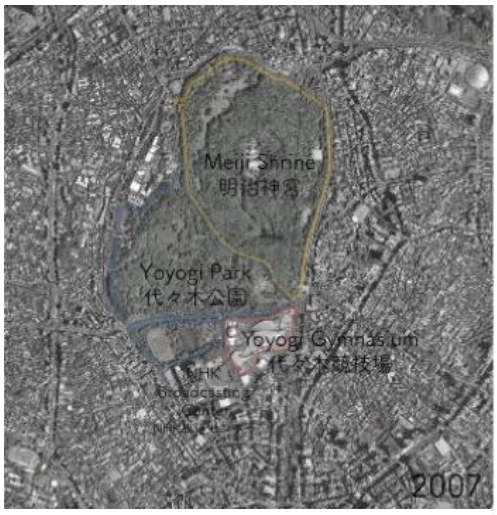


Fig. 2-14 Yoyogi in 2007

(2) The site selection process

From the standpoint of politics and diplomacy, when planning to host the 1940 Olympics, or officially the Games of the XII Olympiad, Japan initially intended to build gigantic facilities comparable to those used in the 1936 Olympics in Berlin, in order to enhance its national prestige and the power of the Empire of Japan. However, the site selection for the main stadium and the swimming competition underwent many twists and turns.

Moreover, the worsening situation of the Sino-Japanese War eventually led the Japanese government to cancel the hosting. The Games themselves were also ultimately canceled. Thus, the 1964 Olympics marked a significant turning point for post-war Japan, which had gone through a war defeat. They symbolized Japan's return to the international stage with a pacifist ideology. It was a remarkable event, because Japan succeeded in negotiating with the U.S. military over returning the vast requisitioned land in central Tokyo. This heritage site is layered with inscriptions of Japan's path throughout the twentieth century. The Yoyogi Military Drill Ground of the Japanese army was a symbol of Japan's militaristic hegemony over Asia. The U.S. Armed Forces' occupation followed that period. Then it was a symbol of success in hosting the Olympic Games as a pacifist nation. It should be mentioned, however, that one of the intentions behind the U.S. government's decision to return the site was to cool down the anti-American feelings among the Japanese citizens. Interestingly, one can observe the difference in attitude between the central and local governments on this matter. Having been too loyal to its principle of following the U.S.'s lead, Japan's central government was not an assertive negotiator vis-à-vis the U.S. military, whereas the municipal Shibuya Ward government negotiated bravely and tenaciously, ultimately winning the site's return.

In the context of the economic history, the development of transportation infrastructure contributes to a modern state's increased productivity. In Japan, the smooth transportation of goods held great significance before and after the war. The military drill site also functioned as a venue for showcasing the latest military equipment and weapons, such as airplanes, also a symbol of productivity. During the post-war economic rehabilitation period, traffic congestion due to an increase in vehicles became a major urban issue. Infrastructure development supported the high economic growth Japan experienced between the mid-1950s and the early 1970s. Large events encouraged consumer spending and significantly contributed to boosting domestic demand. However, special demand due to the Olympics benefitted only the Tokyo city center, leaving the eastern downtown underprivileged.

Lastly, from the perspective of urban planning history, in the process of developing radial and loop traffic, Oyama Kaido (also known as National Route 246) became the most important arterial road for Tokyo, the imperial capital and military headquarters. Aoyama Military Drill Ground, Yoyogi Military Drill Ground, Komazawa Military Drill Ground, and Komazawa green space were set up along the road. The "Tokyo metropolitan highway development plan" was developed before WWII and sought to rearrange the urban structure through radial and loop roads. The military drill grounds marked in the plan were replaced by the construction sites for the national stadiums: for example, Yoyogi Stadium and Komazawa Stadium.

The delicate, close relationship between the construction of large facilities and transportation infrastructure was revealed when the planned site for the athlete's village was changed from Asaka to Yoyogi. The Tokyo Metropolitan Government demanded that the Cabinet officially decide that Radial Road No. 4 and Loop Road No. 7 would be completed and the Yoyogi Park would be established as a forest park before the start of the Olympics. Developing artery roads and securing green spaces in the city center were extremely difficult without holding a national government-led megaevent. Some would argue that urban planning officials took advantage of the Olympics; however, it was indispensable to develop radial and loop roads and secure green spaces in Tokyo, from political, military and industrial standpoints before the war. Responding to population concentration, economic development, and automobile society after the war was practically unfeasible without the pretext of extending cooperation with the military or for the sake of the Olympics.

Various stakeholders, including the Shibuya Ward Government, the Japan Broadcasting Corporation (NHK), Kishi Memorial Gymnasium, and the Ministry of Education, Science, Sports, and Culture, jumped at the opportunity to claim new uses of the former Yoyogi Military Drill Ground after the release of American requisition. Each asserted a different view, undermining the authority of cabinet decisions and urban planning decisions. This enterprise left a shadow on the process of the urban center rearrangement. The legacy of the failed urban rearrangement is apparent in Harajuku Gate and Shibuya Gate Plazas; the original design intentions have not been respected, and profit-making facilities, like a temporary theater, occupy the spaces.

Nonetheless, one can appreciate that the vast area of the former military site in the city center, Yoyogi field, has been regenerated as a forest park, attracting various public facilities. One could argue that it gave the area a unique character, distinct from other parts of Tokyo. For instance, Marunouchi is a significant business district, Shinjuku is where skyscrapers are concentrated, and Ikebukuro is a bustling commercial district.

Reiko Tomita, who participated in designing the Yoyogi National Stadium under Tange, testified that Tange always had the city in mind when creating a building and foresaw that the construction of Yoyogi Gymnasium would change the whole town of Shibuya.

(3) Contributors

a. Kenzo Tange. Architect

The Modern Movement in Architecture and the discussion over tradition

Kenzo Tange was born in Osaka in 1913. When Tange was a student in the Department of Architecture at Tokyo Imperial University in the late 1930s, he remarked that Tokyo Teishin Hospital, which was built in a style influenced by Early Modernism introduced from Europe to Japan in the late 1920s, was nothing more than a sanitaryware. It implied that his attitude toward the “white box” of modern architecture was very different from that of other students, who showed a keen interest in it. However, for Tange, Le Corbusier was exceptional among other modern architects. Tange thought he was a genius and designed a building resembling Le Corbusier’s works for his diploma design in 1938.

In 1940, Tange published an article on Le Corbusier and Michelangelo in a magazine discussing the roles played by artists. In 1951, after visiting Piazza Campitrio and Foro Romano in Rome, both designed by Michelangelo, Tange pointed out that Michelangelo’s architecture was designed on a scale of gods, like Ancient Roman architecture, while Gropius's architecture was designed on a human scale.

From the 1930s to the 1950s, many modern architects visited Japan and admired Japanese classical architecture. German architect Bruno Taut, for example, highly appreciated the Katsura Imperial Villa, while criticizing the Nikko Toshogu because of its decorative appearance. His calling Ise Shrine a “Parthenon” pleased Japanese architects. Walter Gropius, who taught architecture at Harvard University, visited Japan in 1954 and admired Japanese houses, as they had all the indicators of modern architecture, and he found Eastern spirituality in Ryoan-ji. However, Tange repulsed Gropius’ evaluation of Japanese architecture

Later, Tange met photographer Yasuhiro Ishimoto and was shocked by his photographs, which captured the Japanese classical architecture from a new point of view. Ishimoto studied architectural photography in Chicago and took pictures of the Katsura Imperial Villa in the 1950s. His trimming method permitted him to extract from the Katsura Imperial Villa the beauty of the horizontal and vertical composition. In 1960, Tange and Ishimoto published a photo book titled "KATSURA" with MIT press. In the foreword, Tange said that the book “looked at Katsura destructively,” in contrast to the conventional interpretation of the building.

Tange's works in the 1950s can be divided into the following two categories: at one end, those strongly influenced by the Katsura Imperial Villa, and those that are extremely powerful, like the *Jomon* arts, at the other end. A typical example of the former is Tange’s house in Seijo, in a suburb of Tokyo. It is a two-story wooden house with *pilotis*, indicating that Tange had carefully studied the slender proportion of the Katsura Imperial Villa. He applied this proportion to concrete constructions as well, for example, in the main hall of Hiroshima Peace Memorial Park. He decided on that design by combining a series of basic dimensions based on the “Tange *modular,”* modeled after Le Corbusier’s. The difference between the two was that the latter aimed at harmonizing architecture with a human body scale, while the former intended to control the whole city including architecture on a unified scale.

Regarding his Jomon-like works, Tange completed the Sogetsu Kaikan with a compelling design, in contrast to the delicate architecture of the Katsura Imperial Villa. Tange himself also designed the chairs in the Sogetsu Kaikan. They are reminiscent of earthen figurines made in the Jomon period, even though they are made with the advanced technology of molded plywood.

The proposal for memorial facilities on the subject of war and peace

In 1942, Tange applied to a competition sponsored by the Architectural Institute of Japan and published his plan for the Greater East Asia Co-Prosperity Sphere Memorial Hall. He proposed it be built at the foot of Mt. Fuji to pray for the souls of students who died in the war. The design integrated a Japanese-style large roof and a Western European-style square plaza. In 1944, he won in a competition for the Japanese Culture Hall in Bangkok with a large roof design as well.

Tange won first place in the competition for Hiroshima Peace Memorial Park in 1949. He used, however, *pilotis* here instead of the large roof design.

Tange conceived of several urban designs using axes before and after the end of WWII and implemented those plans in various projects. In 1968, he designed a memorial plaza on the summit of a mountain in Awaji Island for the students who died in the war. Here, contrasting with his former horizontal urban axes, the vertical axis of the tower connects heaven and earth.

An urban core for modern society

Since Japan suffered extensive devastation from air raids during the war, many prefectural and municipal government buildings needed to be constructed in post-war Japan. Tange devoted himself to planning public office buildings that would be suitable to the post-war democracy and completed the Tokyo Metropolitan Government Office in 1958. In the same year, he designed the Imabari City Hall with an office building and a public hall both made of solid concrete walls without pillars inside. Le Corbusier's works in India and P. L. Nervi's UNESCO Headquarters strongly influenced the designs.

Furthermore, after several public office building projects, Tange completed the Kagawa Prefectural Government Office in 1958. This building is regarded as a compilation of his works in the 1950s. At that time, Japanese architects studied the high-rise structures of office buildings and admired American skyscrapers made of steel frames (e.g., designs by Ludwig Mies van der Rohe and SOM). However, in Japan in those days, it was impossible to make rustproof iron frames; thus, Tange used exposed concrete as a material and a balcony structure to control the influence of rainwater and sunshine. Such a Japanese-style design saw its culmination in this construction.

In the meantime, Tange was surprised at the low level of European technology when he visited the construction site of the *Unité d'habitation* in Marseille in 1951. Even though Le Corbusier advocated the efficient mechanized production of pre-cast concrete, most of the work there was done manually. In 1959, Tange designed the Kurashiki City Hall using pre-cast concrete to a large extent.

Ingenious combination of structure and mechanical design

Tange completed several public office

buildings in beam-column structure, based on a horizontal-vertical grid. At the same time, he concentrated on the realization of curved shell structures. In the competition for the Memorial Cathedral for World Peace in Hiroshima, held in 1948, Tange proposed a cathedral design with a rib-reinforced shell structure. His proposal had some similarities with the Church of Saint Francis of Assisi (Igreja de Sao Francisco de Assis), designed by Oscar Niemeyer.

In 1951, Tange completed the Hiroshima Children's Library in collaboration with structural engineer Tsuboi Yoshikatsu. As a library for children, it was constructed in a shell structure in the form of a basic funnel (or morning glory) that was 20 meters in diameter. Two years later, in 1953, Tange and Tsuboi completed the Ehime Prefectural Hall with a roof in the form of a cut sphere. Used for multipurpose, it is a shell structure of 50 meters in diameter. However, constant sound problems in the hall required later additional work to install sound absorption equipment.

After the acoustic troubles of the Ehime Prefectural Hall, Tange and Tsuboi were challenged to realize a hyperbolic paraboloid shell (HP shell), which was more complicated than the spherical shell. In 1957, they developed the Sumpu Kaikan (Former Shizuoka Convention Hall), which had a square plan. The roof of the gymnasium was constructed in an HP shell in the shape of a square of 54 meters on one side. This time, acoustic problems were overcome by mounting many ribs inside the roof.

In 1961, Tange and Tsuboi made another shell structure on the Totsuka Country Club House. The roof was in the shape of an inverted half-cylinder, 47 meters in length and supported by six columns. It is reminiscent of the design of Chandigarh by Le Corbusier. The design of a curved roof jointed with large glass surfaces required detail examination. This experience was later applied to the details of the glass of Yoyogi Stadium.

In 1965, Tange and Tsuboi challenged themselves with the design of overlapping eight HP shells for St. Mary's Cathedral (Tokyo Cathedral). At the beginning of designing, the pre-cast concrete structure was examined. It was found that casting ribbed cast-in-place concrete could reduce the weight of the entire building; hence, the cast-in-place concrete was adopted. Stainless steel plates used for the outer walls succeeded in emphasizing the beautiful geometric surface of the HP shells.

Futuristic urban design

In 1958, Tange published an article on the eight-story Tokyo Metropolitan Government Building, proposed an extension plan to build a skyscraper, and appealed to the need for redevelopment of the heart of the city in response to the economic development. Critics were just beginning to point out the bottleneck problems due to lack of infrastructure in the central area of Tokyo, such as overcrowding and traffic congestion.

In 1960, Tange, who was serving as a visiting professor at MIT, gave his students a design assignment to make residential facilities for 25,000 people above the Boston Bay. One idea proposed by students was a triangle mega-structure integrating the highway and high-rise residences. This proposal was later refined by the Tange studio and formally presented at the World Design Conference held in May 1960. Then, Tange started planning for a new downtown above Tokyo Bay, as an independent project of his studio.

On January 1, 1961, Tange appeared in an NHK TV show and talked about his "Tokyo Plan 1960." He argued that the problem of population concentration in Tokyo should be resolved with technology to further economic development.

After the success of the Tokyo Olympics in 1964, Tange published the Tsukiji Plan in a magazine in 1967. As an embodiment of the Tokyo Plan 1960, he proposed a three-dimensional city that would be suitable for an information-oriented society. This idea was later realized in the Yamanashi Culture Hall. Even though the building was much smaller than the Tsukiji Plan, it was equipped for various functions, including a broadcasting station, newspaper bureau, and offices, and was designed to be extended as needed. The Yamanashi Culture Hall could be called one of the symbols of the Metabolism Movement, just like the Nakagin Capsule Tower, designed by Kisho Kurokawa.

On the other hand, Tange created more than 100 maps for land development in 1967, together with geologist Shinzo Kiuchi and others. These maps included many beautiful illustrated images, adapting the visual expression invented by Otto Neurath. One reason why Tange engaged in map creation was to help specialists in various fields understand the status of land in Japan in order to discuss Japan's future with images as a common language. The Tokaido Shinkansen bullet train had come into operation at that time, and in consequence, Tokyo-Osaka began to be perceived as one area (so-called the Tokaido Megalopolis). Later, Tange oversaw the design of the Festival Plaza for the Osaka World Expo as a general producer and succeeded in visualizing the high economic growth of post-war Japan.

Yoyogi National Stadium: Integration of the five key phrases

Five key phrases describe the works of Tange Kenzo. First, the modern movement in architecture and the discussion over "tradition"; second, symbols situated between life and death; third, urban core for modern society; fourth, the collaboration between structure and equipment; and five, futuristic urban design. Yoyogi Stadium integrates the best of these five points. Therefore, it is considered to be one of his most outstanding works.

The Stadium is located to the south of Meiji Jingu and was developed to be integral to Yoyogi Park. Forming an oasis in central Tokyo, it functions as a core facility and attracts various cultural-related events. There are two ways to access the stadium: from Shibuya side, enjoying the bustling scenery of the ever-developing city at the back; or from the Meiji Jingu side, feeling the solemn scenery with the tranquility of the shrine at the back.

The appearance of each gymnasium is characterized by stately traditional roofs made of steel sheets. The mode of expression contrasts, for example, with the suspended roof structure of Munich Olympic Stadium, made of transparent membranes supported by light structures. It is closely related to the first aspect mentioned above, the modern movement in architecture and the discussion over "tradition."

Features of the interior view of the gymnasia include their triangle-shaped (like the Chinese character for eight "八") ceiling and top lighting. Tange used the same combination of triangle-shaped ceiling and top lighting in the

RC or SRC structure for the WHO Headquarters Competition in 1961, the residential buildings in Tokyo Plan 1960 in 1961, and St. Mary's Cathedral in 1964. For Yoyogi Stadium, it was realized by a suspended roof structure. The effect of the top lighting leads visitors to look to the heavenly world, which embodies the symbol located between life and death, the number two key phrase mentioned above.

The stadium stands on the slope from Harajuku to Shibuya and combines a large and small gymnasium. Here Tange proposed "Michikukan," namely a promenade that would organically connect the two gymnasia and receive a large audience from the Harajuku Gate. As a result, the zoning was realized by utilizing the topographical level difference of the site. The level of the Shibuya Gate is an area for the athletes' activities. The level of the second floor is an area for administrative work. The third-floor level, which is equal to the Harajuku Gate, is an area for large audience activities. "Michikukan" promotes a smooth movement of more than 10,000 spectators and makes the "urban core" suitable for modern society.

Yoyogi National Stadium was realized by integrating state-of-the-art technologies in structure and mechanics. It introduced a large-span suspended structure regarded as civil engineering technology into a large space building and adopted Japan's first seismic dampers. It also achieved indoor air conditioning with jet nozzles, based on air-conditioning experiments using a 1/30 model.

b. Yoshikatsu Tsuboi, Structural engineer

Yoshikatsu Tsuboi was born in Tokyo in 1907 and graduated from Tokyo Imperial University in 1932. He was appointed a professorship at Tokyo Imperial University in 1937 after having worked as a building maintenance engineer at Wakayama Prefectural Office and an assistant professorship at Kyushu Imperial University. He created many remarkable works as a structural engineer, and he was a pioneer in researching shell structures. After his death, the International Association for Shell and Spatial Structures established the Tsuboi Award in honor of his commemorable career.

The first encounter between Tsuboi and Tange dates back to the 1940s. Tange first met Tsuboi when he was trying to create a small shell structure to be included in his proposal for Hiroshima Children's Library. They created several shell structures at various scales after this scheme. They finally made an unprecedented achievement by realizing a suspended roof structure for the Yoyogi National Stadium. This section outlines the development of their collaborative work in chronological order.

- Proposal for a competition for Hiroshima Memorial Cathedral for World Peace (rib-reinforced shell structure, designed in 1948)
- Hiroshima Children's Library (funnel-shaped shell structure, designed in 1951, constructed from May 1952 to June 1953)
- Ehime Prefectural Hall (spherical shell structure, designed in 1952, constructed from 1952 to October 1953)
- Sunpu Hall (HP shell structure, designed from March 1956 to February 1957, constructed from March 1957 to

October 1957)

- Imabari Municipal Auditorium (folded plate structure, designed from January 1957 to July 1957, constructed from August 1957 to October 1958)
- Totsuka Country Club (inverted semi-cylindrical shell structure, designed from December 1960 to March 1961, constructed from April 1961 to December 1961)
- Gymnasium of Kagawa (suspended structure, designed from April 1962 to October 1962, constructed from April 1963 to December 1964)
- St. Mary's Cathedral (consists of eight HP shells, designed from December 1961 to December 1962, constructed from April 1963 and December 1964)
- Memorial of War Dead Students, Youth Plaza (HP shell tower, designed in 1962 and constructed by 1966)
- Kuwait Sports Centre (lightweight membrane structure, designed 1969-1970)

Analysis of the built examples of shell structures and suspended roof structures during post-war Japan

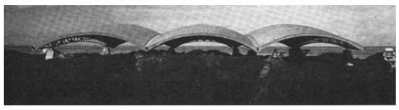
According to Tsuboi, after the end of World War II in 1945, the development of shell structures in Japan began in earnest. Indeed, reinforced concrete with steel shell structures became popular after the war, especially in the 1950s. However, many small shell structures were already built, laying half buried under the ground, and were used as bullet-proofed aircraft chambers before and during the war. Some spherical shell structures for storage purposes had already been built too. Since the Great Kanto Earthquake in 1923, researchers have gauged the seismic performance of Japanese reinforced concrete structures. Japanese building regulations require building structures to meet criteria to resist double the amount of seismic and wind loads of the requirements of European or American standards.

Tsuboi classified post-war building structures constructed after the war into five categories: spherical shell, ellipse paraboloid shell, hyperbolic paraboloid shell, folded plate structures, and suspended roof structures. They could also be divided into three categories by their structural type: reinforced concrete shells, three-dimensional steel trusses, and suspended roof structures, which mainly apply ropes. These structures were generally selected for their required construction time and economic reasons. As span grows larger (area=span), construction costs per square meter become more expensive proportionally. As span grows larger, suspended roof structures become more cost-effective, followed by steel structures, and finally reinforced concrete (including pre-cast concrete) structures.

Tsuboi classified post-war Japanese shell structures and suspended roof structures that had been constructed into the above five categories, giving ten examples of them. Their architectural approaches gave some oriental impressions. Of them, the Gymnasium of Niigata was damaged by the Niigata Earthquake in 1964. Nevertheless, the damage was small enough for the structure to be restorable. Therefore, it proved that the seismic performance of shell structures could be highly regarded.

A Spherical Shell 球形殻
・愛媛県民館(RC) Gymnasium of Ehime

B Ellipse paraboloid shell 楕円放物面殻
・東北電力八戸火力発電所上屋(S)
Big roof of Tohoku Electric Power Co.
Hachinohe Thermal Power Station
・大石寺(RC) Taiseki-Temple
・香川県立体育館(PS) Gymnasium of Kagawa



C Hyperbolic Paraboloid Shell 双曲放物面殻
・新潟市体育館(S) Gymnasium of Niigata
・東京都駒沢オリンピック公園体育館(RC)
Gymnasium of Komazawa
・東京カテドラル聖マリア大聖堂(RC)
St. Mary's Cathedral

D Folded plate Structure 折版構造
・群馬ミュージックセンター（RC）
Gunma Music Center

E Suspension Roof 吊り屋根
・国立屋内総合競技場
National Indoor Stadium Main Gymnasium
・国立屋内総合競技場付属体育館(共にS)
National Indoor Stadium Sub Gymnasium

A Spherical Shell

・Gymnasium of Ehime (RC)

B Ellipse paraboloid shell

・Big roof of Tohoku Electric Power Co. Hachinohe Thermal Power Station (S)
・Taiseki-Temple (RC)
・Gymnasium of Kagawa (PS)

C Hyperbolic Paraboloid Shell

・Gymnasium of Niigata (S)
・Gymnasium of Komazawa (RC)
・St. Mary's Cathedral (RC)

D Folded plate Structure

・Gunma Music Center (RC)

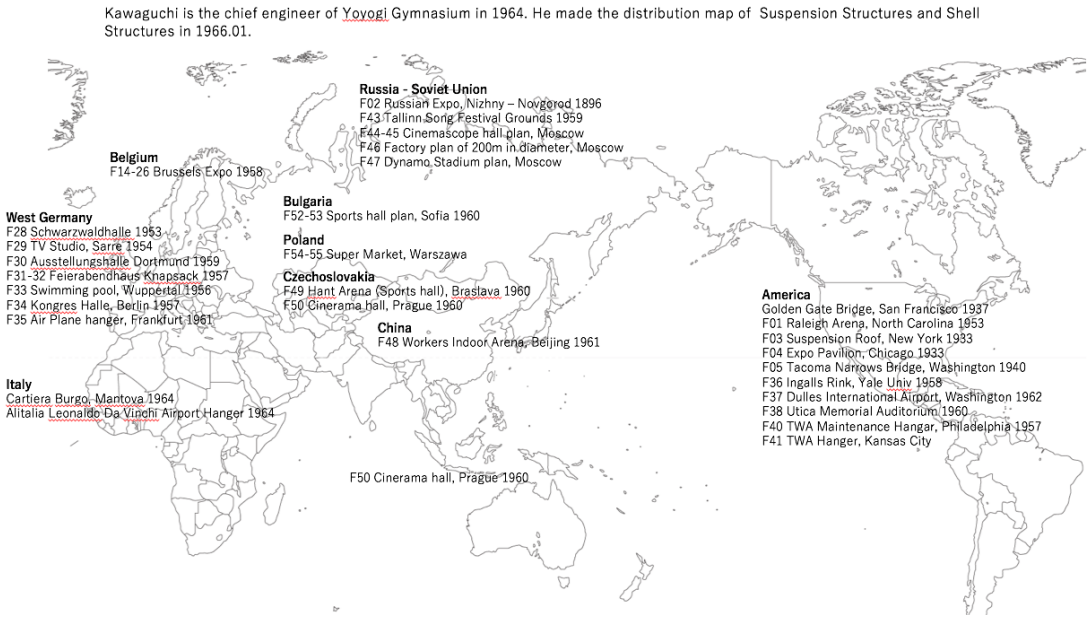
E Suspension Roof

・National Indoor General Stadium, First Gymnasium (S)
・National Indoor General Stadium, Second Gymnasium (S)

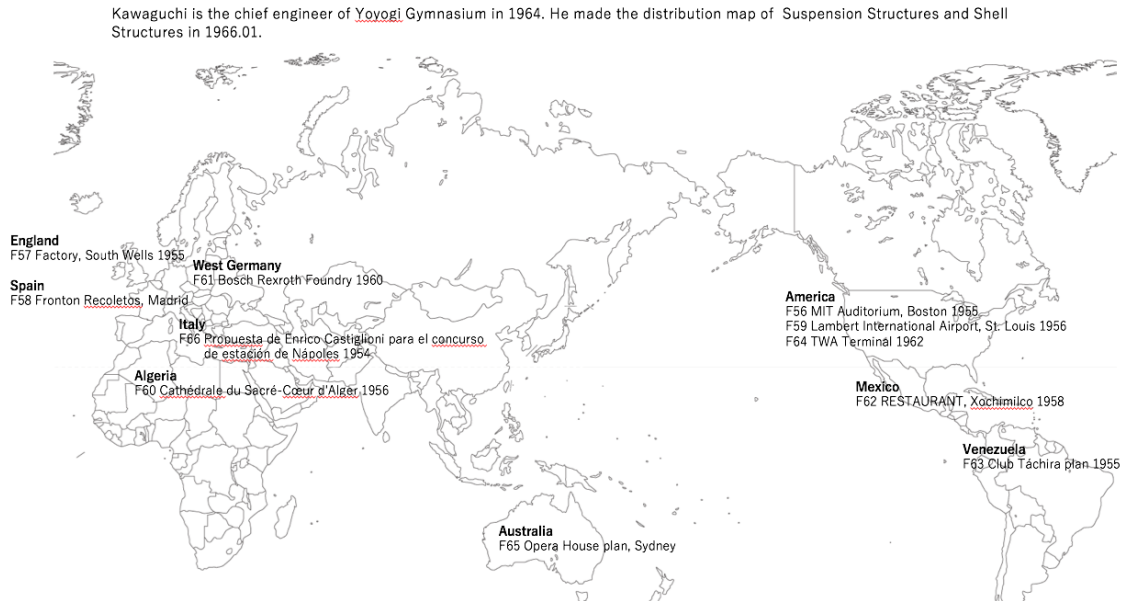
An analysis of worldwide, built examples of shell and suspended roof structures in the twentieth century

While Mamoru Kawaguchi sought the origin of suspended and shell structures among the built examples in Germany and France, he grouped built and unbuilt examples by country from across the world and reviewed them.

Kawaguchi referred to the Brussels International Exposition in 1956 as the peak of the development of suspended structures; he said, 'suspended structures were displayed on parade; it was a bold attempt to maximize the potential of forms that can be created by suspended structures.'



Distribution of suspension structures designed by Mamoru Kawaguchi in the world (January 1966)



Distribution of suspended shell structures designed by Mamoru Kawaguchi in the world (January 1966)

Further, he also concluded that the origin of the boom in the development of suspended structures in Brussel derived from Germany, and there was an accumulation of careful engineering experiments behind it. He looked not only into Spain, Italy, and the United States but also into socialist countries, such as middle Europe, the Soviet Union, and China. Although the practices in the socialist countries were not as extravagant as the ones in the capitalist countries, their attempts were politically organized, and their efforts were embodied in simple, honest structural forms, as a result of a quest for the structural rationality and economy that suspended structures could have.

Kawaguchi theorized three common trends in the development of shell and suspended structures as listed below. He expressed his view on the suspended structure of the Yoyogi National Stadium as it had reached the term of iii) free or complex surfaces in its creation.

i) Changes in boundary
ii) Combination of curved surfaces
iii) Free or complex surfaces

Modern architecture: Japanese tradition and the influence of locality

Mamoru Kawaguchi, who was the substructural engineer for the design of Yoyogi National Stadium, described the influence of Japanese tradition and locality on the overall design.

> *Although Tange explained why and how he applied the suspension roof system to Yoyogi Stadium, he never talked explicitly about what sort of architectural forms he pursued in his design. Many who visit the stadium complex, however, say that they sense something Japanese in its appearance. In his writings, Tange talks of his design criteria only in rationalist terms, but the outcome of his design has a strong essence of local tradition. A similar situation may be observed in the design of the Kagawa Prefectural Government Building.*
>
> *This Japanese feeling or atmosphere may be due to Tange Kenzo's being a Japanese architect. A simple comparison might help us understand the situation. Eight years after Tange built Yoyogi National Indoor Stadium for the Tokyo Olympics in 1964, Frei Otto and his colleagues constructed a stadium for the 1972 Munich Olympics. Both Tange's and Otto's stadiums were designed using the principle of suspension systems, and both design teams no doubt tried to make the most of the tension principles for their stadiums, albeit with different results.*
>
> *In Munich, the structural mechanisms of the cable networks are directly expressed. The possibility of tension principles took form, giving a strong impression of the technology. It may be regarded as an international design, or a global design, since the same design principle can be applied to stadiums built anywhere in the world.*
>
> *Tange's design for Yoyogi Stadium is quite local, giving a strong impression of something Japanese, or more specifically, providing an atmosphere of the grand roofs of traditional Japanese architecture. We may say that Yoyogi's design could only come from Tange, who was Japanese, whether or not he willfully intended it as a national expression.*

The design of Yoyogi National Indoor Stadiums has not aged in the half century since its completion. It still stands as a timeless monument and is well appreciated by architects all over the world.

c. Uichi Inoue, Mechanical and service engineer

Dr. Uichi Inoue was born in 1918 and graduated from Tokyo Imperial University in 1944. Since joining Taisei Corporation in 1946, he engaged in mechanical and service engineering. He taught at Waseda University from 1953 to 1989. He continued his long-term profession even after his retirement. He was an expert in mechanical and service engineering in Japan and a pioneer in dealing with modern architecture.

The design of Yoyogi Stadium was the first collaborative work between Tange and Inoue. Inoue proposed an air-conditioning system using a jet stream. After repeatedly experimenting with air flows by using a 1:30 study model, he was convinced that natural ventilation without the cooling system could maintain a satisfactory indoor environment in October when the Olympic Games were held.

Tange and Inoue again collaborated on the creation of the Osaka Expo Festival Plaza after Yoyogi. They invented an air-conditioning system to create a comfortable environment around spectators' seats located right under the space frame that was exposed to the blazing sun. Inoue was also in charge of controlling air cushions covering the space frame.

2-3. The design process

(1) Selecting the designers: Tange, Tsuboi, and Inoue

The government selected Kenzo Tange, Yoshikatsu Tsuboi, and Uichi Inoue as the team of designers for Yoyogi Stadium for the following three reasons. First, the Ministry of Construction at that time was too busy to do it, because it was constructing the U.S. Armed Forces quarters in Chofu on the outskirts of Tokyo (budget: JPY 8 billion). Second, the order system was not separated for the basic and detailed designs in those days. Finally, the three designers were considered capable of implementing the project. However, given the frequency of academic cliques, the selection committee likely adopted the opinion of Hidetoshi Kishida, who was a professor at Tokyo University. The addition of Inoue, who taught at Waseda University, to the design team could also be a result of a consideration to balance academic cliques.

(2) The budget and specifications of the basic concept and later changes

The Ministry of Education anticipated JPY 2 billion to cover the budget for the Olympic pool at the basic concept stage, while the Ministry of Finance evaluated it to be JPY 1.3 billion. However, as the design process advanced, the budget increased to JPY 2.8 billion. After negotiations, the Ministry of Finance agreed to increase the budget to JPY 2.2 billion at the end of the basic design period. Tange's direct appeal to Kakuei Tanaka – then an influential politician – also had an effect, and the budget finally reached JPY 3.06 billion at the time of the pool's construction.

The specifications of the Olympic pool also changed over time. The capacity of the first gymnasium was expected to be 40,000 people in the 1960s. However, it compressed to 25,000 people, then to 16,000 as the considerations proceeded, and then to 12,000-15,000 because of budget balancing by the time of completion of the basic design. At the time of construction, the capacity had reduced to 11,593 people, roughly one-third of the initial idea.

(3) The budget and specifications of the detailed concept and its change afterward

The axis forming the base of the design of Yoyogi Stadium was decided at the basic design stage. The shape of the large roof was selected from among the following three types: one-way-direction, leaf, and pole. A single main wire was used for the latter two types. However, Tange, Tsuboi, and others tried to consider all suspended structures existing around the world in order to invent a new type of suspended roof. The process of the challenge they set for themselves can be found in National Archives documents.

(4) The plan and structure after the completion of the detailed design

At the end of the detailed design stage, the main wire of the first gymnasium was doubled. The idea of "*Michikukan*" was also proposed at that stage. It solved the issue of the elevation differences of the site from Harajuku to Shibuya, resulting in an organic connection between the large and small gymnasiums.

2-4. Construction process

(1) Site progress

The construction process of the two stadiums was divided into several phases: piling, concreting, shuttering, reinforcing, and suspending roofs over the Main (First) and Sub (Second) Gymnasiums. The key characteristics of this construction process were quick construction and difficult roofing. The Ministry of Construction initially estimated a minimum of twenty-two months for the construction; however, it was necessary to shorten it to nineteen months to meet the deadline for the opening ceremony of the Olympic Games. The main contractors Shimizu Corporation and Obayashi Corporation, together with their sub-contractors, made it possible to keep firm commitments to this project.

Kawaguchi, who was the sub-structural engineer, explained the ingenuities of inventing the semi-rigid suspended roof structure and the introduction of viscoelastic dampers. The roof structure of the First Gymnasium, which contained three types of cables (for main, hanging, and bracing), was expected to be revised and altered as work progressed on site. Kawaguchi had invented a suspended, semi-rigid structure for the site and succeeded in clarifying the construction process in order to solve the more complicated issues. An anti-gale damping system was introduced to the roof structure. Because the roof of the First Gymnasium was extensive yet lightweight (less than 100 kg per $1m^2$), a careful structural assessment was required in designing against wind load. For this reason, viscoelastic dampers were fitted according to the results from wind-tunnel tests, which had revealed positive effects of dampers against dynamic wind effects over the roof structure.

Research has resulted in two types of findings, summarized in two aspects.

First, it revealed that any precise construction method controlling the movements of the three types of cables (for main, hanging and bracing) were not indicated in the finalized drawings and the structural assessment just before the final idea of a semi-rigid, suspended roof structure was proposed on site.

Second, hundreds of drawings were revised and produced during the construction phase, as confirmed by the remaining documentation related to design alterations. Historical materials, especially ones held at the National Archives of Japan, revealed a process of alterations to meet various requirements raised by the clients, who were also users, including Japan Basketball Association, Japan Swimming Federation and NHK Broadcasting Centre. Such adaptation work seemed to increase due to a lack of sufficient discussion with the building users and insufficient time for finalizing the detailed designs that resulted from prolonged negotiations over the return of Washington Heights.

Finally, Kawaguchi summarized the construction process of Yoyogi Stadium as follows.

> *The structural system of the First Gymnasium consists of the following three subsystems:*
>
> 1. *Two hanging roof systems between the main cables and the periphery of the gymnasium*
> 2. *The central structure comprised of the main cables, main columns, and underground struts that treat the load from the roof systems like a*

suspension bridge would

3. *The outer structure in which the forces from the roof and the weight of the grandstand are balanced*

In an earlier stage of design study, we found that the roof surface could not be constituted by a simple cable network with a logical, smooth force flow in it because of the complicated shapes of the boundaries (main cable, back-stay, and concrete periphery). So, we developed a suspension roof surface consisting of hanging members with some bending rigidities (referred to as the "semi-rigid hanging system"). We then established the fundamental equations for the semi-rigid hanging system, which was not available anywhere in the world. Those equations had to be solved using finite difference techniques with a hand-held calculator. The distribution of the tensile forces and bending moments of the hanging members, as a result of these calculations, are shown. The results of computer calculations conducted a few years ago are also shown. We were glad to confirm that the two results agreed in a practical sense.

A structural design study revealed that the present structural system was very flexible compared with other structural systems of standard stiffness. The structure was flexible, especially during the construction processes and it called for the special design of important details. One such detail was the connection between the main cable and hanging members. A connection named a "Saturn Ring Joint" was developed to accommodate the significant three-dimensional changes in the relative angles of those members. The relative locations of the hanging members and main cable at their intersections are rigidly secured using this joint, while their relative directions are changed without resistance. The Saturn Ring Joints for the main central cables are visible inside the building and on the backstays outside.

Another structural feature of the First Gymnasium is that the roof is equipped with a damping system against violent winds. The structure had to be designed carefully against wind effects because of the large scale of the roof and its low weight (less than 100 kilograms per square meter). A series of wind-tunnel tests and a study on the dynamic effects of wind on the roof structure were conducted, and we found no reason for concern.

However, the building might need to function as a shelter for sufferers in case of a disaster because it is a national property. This idea drove us to design a damping system for the roof that might control the movements of the roof due to unexpectedly violent gales. Six oil dampers were fixed to the column top of each end of the central span, as three units in double layers. Tange told us that the device was essential to the structure, and he wanted the oil dampers to be visible from outside; thus, they were painted red.

The Second Gymnasium has a diameter of 65 meters in the plan. The

basic structural principle of this Gymnasium is similar to that of the First Gymnasium. The inner structure of this building is a "main pipe" running from the top of the single column to the anchorage, inscribing a helical curve. From the main pipe, a series of hanging trusses run down to the peripheral concrete to form the curved roof.

The space between the main pipe and column is framed by a group of lattice tubes, which produces a sculptural configuration with an excellent aesthetic effect. Thanks to the sufficient curvature of the roof and the great depth of the roof trusses, the roof of the Second Gymnasium is more rigid than that of the First Gymnasium, meaning no bracing cables are needed.

Unlike the First Gymnasium, the Second Gymnasium has no backstay. Significant bending occurs in the column and the ground beam connecting the column base and anchorage. The column and ground beam were pre-stressed using a post-tension system to avoid possible cracking due to significant bending moments and preserve the stiffness and durability of the structural members.

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2-5. History of the Stadium after the completion

(1) History of repair works

The history of maintenance and repair of the Yoyogi National Stadium from its completion to the present is summarized as follows.

Table 2-1 History of the Yoyogi National Stadium Maintenance and Repair

1964	completion
1981	roof repainting (1st gymnasium), courtyard repair (1st gymnasium), etc.
1983	roof repainting (2nd gymnasium), exterior concrete wall repair (2nd gymnasium), etc.
1984	exterior concrete wall repair (1st gymnasium)
1993	roof repainting (1st gymnasium, 2nd gymnasium)
1994	sub-pool repair
1995	survey and repair of main wiring
1999	air conditioning installment (1st gymnasium), roof repair (2nd gymnasium)
2000	water tank and circulation piping repair (2nd gymnasium)
2001	ceiling lighting facility repair (1st gymnasium), competition floor repair (1st gymnasium)
2003	general survey of buildings and facilities, exterior wall repair (1st gymnasium), double-layered glass installment (1st gymnasium), diving board removal (1st gymnasium) roof repair: heat-insulating coating (1st gymnasium)
2004	general survey of buildings and facilities, exterior wall repair (1st gymnasium), double-layered glass installment (1st gymnasium), diving board removal (1st gymnasium)
2005	double-layered glass installment (2nd gymnasium), asbestos removal (Auxiliary Building)
2006～2007	asbestos removal (1st gymnasium, 2nd gymnasium), survey work: soundness of main ropes (1st gymnasium)

The enormous documents archives of the Japan Sport Council (JSC) revealed that its maintenance and repair work relating to Yoyogi National Stadium could be divided into five periods: first period (1981–1985), second period (1992–1995), third period (2003–2007), fourth period (2008–2012), and fifth period (2013–2017). In this chapter, the history before the first period is described in Section 1, and maintenance and repair work during each of the five periods are summarized in Sections 2–6; in Section 7, we analyze what kind of maintenance and repair work has been conducted to secure the value of Yoyogi National Stadium for future generations by focusing on its roof, exterior, and interior.

1. Before the first period

1-1. From completion to 1977

Yoyogi National Stadium was completed in September 1964, then used as a competition venue for swimming and basketball in the Tokyo Olympic Games in October. After the Olympic Games, it was used for the All Japan Intercollegiate Basketball Championship and National Swimming Championship. The gymnasium was then opened up to the general public as an ice skating rink.

Table 2-2 is an interior finish table of Yoyogi National Stadium created by Construction Ministry at the time of completion.

Table 2-2 Interior Finishes

Room/Area	floor	baseboard	wall	ceiling	notes
Entrance hall	porcelain tile	bare concrete	bare concrete	general: aluminum expand metal casing: aluminum plate casting (integral color)	
1st gymnasium arena	limestone	bare concrete, tessera	bare concrete, tessera		
1st gymnasium diving pool	color mortar, line tile	-	rough-surfaced color mortar		
1st gymnasium stands（upper and lower stands）	mortar	mortar	-		
1st gymnasium concourse (north and south)	porcelain tile (round shape)	polishing white limestone (*kansui*)	polished white limestone (*kansui*)	general: flame-retardant plywood casing: aluminum plate casting (integral color)	
2nd gymnasium arena	cherry wood flooring	wood	plywood		
2nd gymnasium stands	mortar	mortar	-	bare concrete	
2nd gymnasium lobby	porcelain tile (round)	*kitagi* rust stone	*kitagi* rust stone	-	
VIP room	mortar	polished white limestone (*kansui*)	plaster coat	plaster coat	
VIP passage	mortar	polishing white limestone (*kansui*)	plaster coat, washing-finished white limestone (*kansui*)	plaster coat	
VIP toilets	porcelain tile (round)	-	polished white limestone (*kansui*)	cloth	
N. S. lobby	vinyl floor tile	polished limestone (*kansui*)	polished limestone (*kansui*)	plaster coat	
Cafeteria	vinyl floor tile	polishing limestone (*kansui*), plywood	polished limestone (*kansui*)	plaster coat	

Officers' waiting room	mortar	polished white limestone (*kansui*)	plaster coat	plaster coat	
Sub-pool	porcelain tile	terrazzo block	polished limestone (*kansui*)	long board	Interior of sub-pool treated in same manner as main pool
Meeting room	vinyl floor tile	polished white limestone (*kansui*)	plaster coat, polished limestone (*kansui*)	plaster coat	
Meeting room	vinyl floor tile	polished white limestone (*kansui*)	plaster coat, polished limestone (*kansui*)	plaster coat	
Administrative Office	vinyl floor tile	mortar, V.P.	wood, plaster	cloth, V.P.	
F.I.B. general manager room	vinyl floor tile	mortar, V.P.	wood, plaster	cloth, V.P.	
Telephone rooms	vinyl floor tile	mortar, V.P.	wood, plaster	cloth, V.P.	
Electric room	mortar	mortar	mortar	mortar	
Cloaks	porcelain tile	mortar, V.P.	mortar, V.P.	cloth, V.P.	
Toilets	porcelain tile	-	semi-porcelain tile	cloth, V.P.	
Storage	mortar	mortar	mortar	mortar	

Ministry of Construction, Kanto Regional Construction Bureau, *Yoyogi National Stadium Construction Record*, 1964, p.8

On July 11, 1977, Kenzo Tange, the architect who designed the stadium, submitted a paper entitled "request for maintenance improvement and urgent countermeasure for roof rust of Yoyogi National Stadium," summarized in the following four points:

(1) The function and quality of the stadium have been rapidly deteriorating, and this will lead to a critical situation. The stadium is an important national building constructed at national expense, so the current status is regrettable.
(2) Some Japanese and foreign architects, as well as foreign ambassadors and ministers, criticize that its maintenance has not been not properly conducted at all and it will be ruined.
(3) There is an institutional and systematic defect of its maintenance and management.
(4) Normally, we should secure a respectable budget for building maintenance. The budgetary measures for the stadium have not been sufficient so far.

In response to Tange's harsh criticism, National Stadium commented as follows:

Insufficient cleaning: The stadium is always

cleaned by professional cleaning company under the supervision of our staff, so what Tange says is not true.

Aesthetic problems, including standing signboards: We use the minimum of standing signboards necessary for management such as direction boards, and they do not spoil the beauty of the site.

Glass damage: We conduct repair work every time glass damage occurs, but it takes almost three months to obtain the materials because they are custom-ordered products. In the meantime, we take emergency measures.

Unsightly kiosks and ticket booths on the premises: There is no problem about kiosks and booths, since they exist for the users and we minimize their impact.

Illuminance reduction of lighting: The illuminance had been reduced gradually by aging, so we exchanged some floodlights in the first gymnasium on the occasion of an international ice skating competition in January 1977, and its illuminance is now more than 1,000 lx. We conduct illuminance measurements regularly and try to maintain the floodlights.

Not using refrigeration for ice hockey as a cooling device for the second gymnasium: We use a cooling device only upon request of users, with the actual costs covered by the users. Therefore, we do not use the cooling device normally.

Electrical scoreboards: Their malfunction was repaired on the occasion of the national swimming competition which took place in August 1977.

Roof rust: The roof has been repainted almost every year from 1968 to 1978.

Later, a condition survey was carried out by Koji Kamiya, Masamitsu Nagashima, and Mamoru Kawaguchi, who had been the main members of design team. This survey included rust research of structural materials under the roof and main wires and subsidence measurement. Following their assessment, the survey members proposed repair of bare concrete external walls, functional recovery of the oil damper, underpinning of the anchor blocks, and installation of waterproofing and drainage facilities.

Yoyogi National Stadium facility repair draft plan (August 3, 1978)

On August 3, 1978, the sixth National Stadium advisory committee was held, and the "Yoyogi National Stadium facility repair draft plan" was proposed. The committee summarized the causes of its management failure in the following four points:

(1) aging materials and functions (interior and exterior finishing deterioration, facility equipment deterioration, etc.)
(2) use changes (installation of new facilities caused by utility changes from Olympic Games venues to multipurpose stadium, etc.)
(3) delay of safety measures to save labor (defect in anchor blocks, oil damper, and central monitoring device, etc.)
(4) effect of works hastily done (540 days) (e.g., settlement of banking and defects in stone wall, etc.)

The committee set objectives of repair work as the following: (1) ensuring security of the users; (2) maintaining functions; (3) improving utility efficiency; (4) promoting

seismic capacity; and (5) protecting the beauty of the site and its landscape as an urban facility. On these bases, the committee conducted surveys, after which they were able to organize the various defects and problems requiring fixing into the categories:

Level A: defects and problems of high emergency requiring swift repair

Level B: defects and problems concerning safety and utility efficiency that need to be repaired

Level C: defects and problems concerning management and operation that need to be improved

They estimated the total cost for repair works to be 41 billion yen.

On February 1, 1979, the seventh National Stadium advisory committee was held and it was reported that the Diet had not budgeted for Yoyogi National Stadium facility repair draft plan. It was also reported, in the meantime, that the budget for special repair works expenses was approved for the following: (1) repair work of louver sash in the first and second gymnasium; (2) repair work of anchor blocks in the first gymnasium; and (3) disaster prevention work.

Table 2-3 Yoyogi National Stadium facility repair draft plan (annual) dated August 3, 1978

Item	Overall plan	A	B	C
Costs for temprary works	138,652	70,572	48,758	19,322
Construction	1,577,141	1,051,840	450,896	74,405
Machine work	937,360	170,440	372,780	394,140
Electrical work	951,817	542,037	395,287	14,493
Subtotal	3,604,970	1,834,889	1,267,721	502,360
Miscellaneous cost	360,497	183,489	126,772	50,236
Total	3,965,467	2,018,378	1,394,493	552,596
Administrative fee	152,813	77,780	53,738	21,295
Total	4,118,280	2,096,158	1,448,231	573,891
1979	120,000	120,000	0	0
1980	200,000	200,000	0	0
1981	400,000	400,000	0	0
1982	900,000	900,000	0	0
1983	996,158	476,158	520,000	0
1984	998,231	0	928,231	70,000
1985	503,891	0	0	503,891

2. First period: FY1981 – FY1985

2-1. Maintenance and repair work in the fiscal year 1981

In fiscal year 1981, repair work on Yoyogi National Stadium started in earnest. The details are listed below:

Construction: entrance square paving, courtyard repair (First Gymnasium), shower room repair (sub-pool), parapet repair (Gymnasiums), steel fence and fittings painting, wood fence and fittings painting, work regarding concrete pole repair, etc.
Electrical work: transformer replacement, seismic countermeasures, emergency lighting repair, work related to concrete pole repair, etc.

2-2. Maintenance and repair work in fiscal year 1982

In fiscal year 1982, the following work was carried out:

Construction: entrance hall and dressing room repair, sub-pool repair, repair of dressing room for tennis players, exterior repair, main wires repair, monitor roof repair, etc.
Machine works: skating rink machine repair, sub-pool repair, dew-proofing in trench, drain pipe repair, etc.
Electrical work: low-voltage distribution board repair, panel board repair, power board repair, arena lighting repair, etc.
Additional work (construction): royal box floor repair, press room and snack bar repair, metal fittings repair (First Gymnasium)
Additional work (machine work): luminaire ballast repair (Second swimming pool)
Additional work (electrical work): water supplying pipe repair (sub-pool)

2-3. Maintenance and repair work in fiscal year 1983

In fiscal year 1983, the following work was carried out:
Construction: exterior bare concrete repair (Second Gymnasium), interior repair (Second Gymnasium, Auxiliary Building), roof repair (Second Gymnasium, Auxiliary Building), metal fittings replacement, kiosk repair, etc.
Machine work: piping repair in trench and pit, automatic controller repair, east and west air conditioning repair, cast iron supporting-member repair for incoming pipe, main pool and diving pool facility repair, etc.
Electrical work: cubicle repair, oil switch replacement, power transformation monitoring panel replacement, underwater lighting removal, cable rack repair, air conditioning repair of south cafeteria, etc.
Additional work (construction): royal box floor repair, press room and snack bar repair, metal fittings repair (First Gymnasium)
Additional work (machine work): luminaire ballast repair (Second swimming pool)
Additional work (electrical work): water supplying pipe repair (sub-pool)

2-4. Maintenance and repair work in fiscal year 1984

In fiscal year 1984, the following work was carried out:

Construction: exterior bare concrete repair (First Gymnasium), exterior aluminum spandrel and sash repair (First Gymnasium), concourse floor repair (First Gymnasium), interior repair (Second Gymnasium, Auxiliary Building), curing, special temporary construction, etc.
Machine work: air conditioning maintenance of arena (Second Gymnasium), air

conditioning duct maintenance (Second Gymnasium), exhaust duct maintenance (Second Gymnasium), piping repair (Second Gymnasium), wiring replacement (Second Gymnasium), duct piping replacement of monitoring room (Second Gymnasium), etc.
Electrical work: loudspeaker device repair, lighting rod repair (First Gymnasium), generator vent pipe repair (First Gymnasium), etc.

2-5. Maintenance and repair work in fiscal year 1985

In fiscal year 1985, the following work was carried out:

Construction: exterior concrete repair of west exterior, chimney and parapet (Second Gymnasium, Auxiliary Building), exterior aluminum spandrel and sash repair facing Harajuku Gate (First Gymnasium), concourse floor tile, wall and ceiling repair (First Gymnasium), anchor block repairs (First Gymnasium), etc.
Additional work: north lobby waterproofing (First Gymnasium), ceiling repair (First Gymnasium), north and south lobby smoke-eliminating work (First Gymnasium), etc.

3. Second period

3-1. Maintenance and repair work in fiscal years 1992–1994

In fiscal years 1992–1994, the following works were carried out: extension of north lobby and east ramp (First Gymnasium), extension of west ramp (First Gymnasium), interior repair, installation of temporary toilets, west plaza repair, top light repair, installation of children's pool, etc.

In fiscal year 1994, repair work on the second swimming pool and Second Gymnasium and additional work was carried out.

4. Third period: FY2003 – FY2007 (period of the First Medium-Term Strategy)

In conducting maintenance and repair work in the third period, JSC's project team (staff from various sections to reconcile different opinions of the facility manager and users) worked to achieve the objectives of the Medium-Term Strategy, carrying out the following work:

First Gymnasium: roof repair and exterior materials repair, including aluminum sash (2013); safety investigation on increased suspension load (2004); passage floor repair on the second floor (2004); asbestos removal (2004–2007); interior materials replacement (2007); water section equipment replacement (2007); and toilet extension (2007).

Second Gymnasium: repair of uneven ground under the eaves (2005); asbestos removal (2006); interior materials replacement (2007); and water section equipment replacement (2006).

5. Fourth period: FY2008 – FY2012 (period of the Second Medium-Term Strategy)

Maintenance and repair work during the fourth period can be divided into two categories: (1) maintenance for the safety of users; and (2) maintenance for the elderly and the handicapped and for the convenience of users. The details are listed below:

Maintenance for the safety of users: column and wall reinforcement for seismic

strengthening (First Gymnasium); seismic strengthening of devices and pipes associated with large video equipment and air conditioning replacement (First Gymnasium); seismic capacity improvement (Auxiliary Building); and toilets repair (Second Gymnasium).

Maintenance for the elderly and the handicapped and for the convenience of users: installation of toilets, stands, and two outdoor elevators for the handicapped (First Gymnasium); flagstone leveling; passage installation for the handicapped; installation of toilets and stands for the handicapped (Second Gymnasium); toilet repair for indoor pool users; and maintenance of VIP rooms, dressing rooms, and royal boxes (First Gymnasium, Second Gymnasium).

6. Fifth period: FY2013 – FY2017 (period of the Third Medium-Term Strategy)

Maintenance and repair work during the fourth period can be divided into three categories: (1) maintenance for the safety of users; (2) user-oriented maintenance; and (3) maintenance on the basis of questionnaire surveys of event sponsors. The details are listed below:

Maintenance for the safety of users: large shutter apparatus replacement (First Gymnasium); raising futsal safety net; non-slip maintenance in the indoor pool; non-slip stairs repair (First Gymnasium); floor repair (Second Gymnasium); entrance fittings damage repair (First Gymnasium); and floor damage repair (First Gymnasium).

User-oriented maintenance: conversion from machinery rooms to event rooms (First Gymnasium); installation of cooling water facility in the indoor pool; ticket booth repair in Harajuku Gate (First Gymnasium); improving drainage performance of pool dressing rooms and shower rooms (First Gymnasium); toilet door repair (First Gymnasium); toll parking expansion; broadcast equipment replacement (First Gymnasium); bench repair (Second Gymnasium); signboard repair; and line grass and artificial grass repair of futsal courts, etc.

Maintenance on the basis of questionnaire surveys of event sponsors: ticket booth repair in Harajuku Gate (First Gymnasium); toll parking expansion; toilet replacement (First Gymnasium); arena floor repair (First Gymnasium); large air conditioning equipment replacement (First Gymnasium); stand replacement (Second Gymnasium); and removal and installation of large speaker equipment (First Gymnasium, Second Gymnasium).

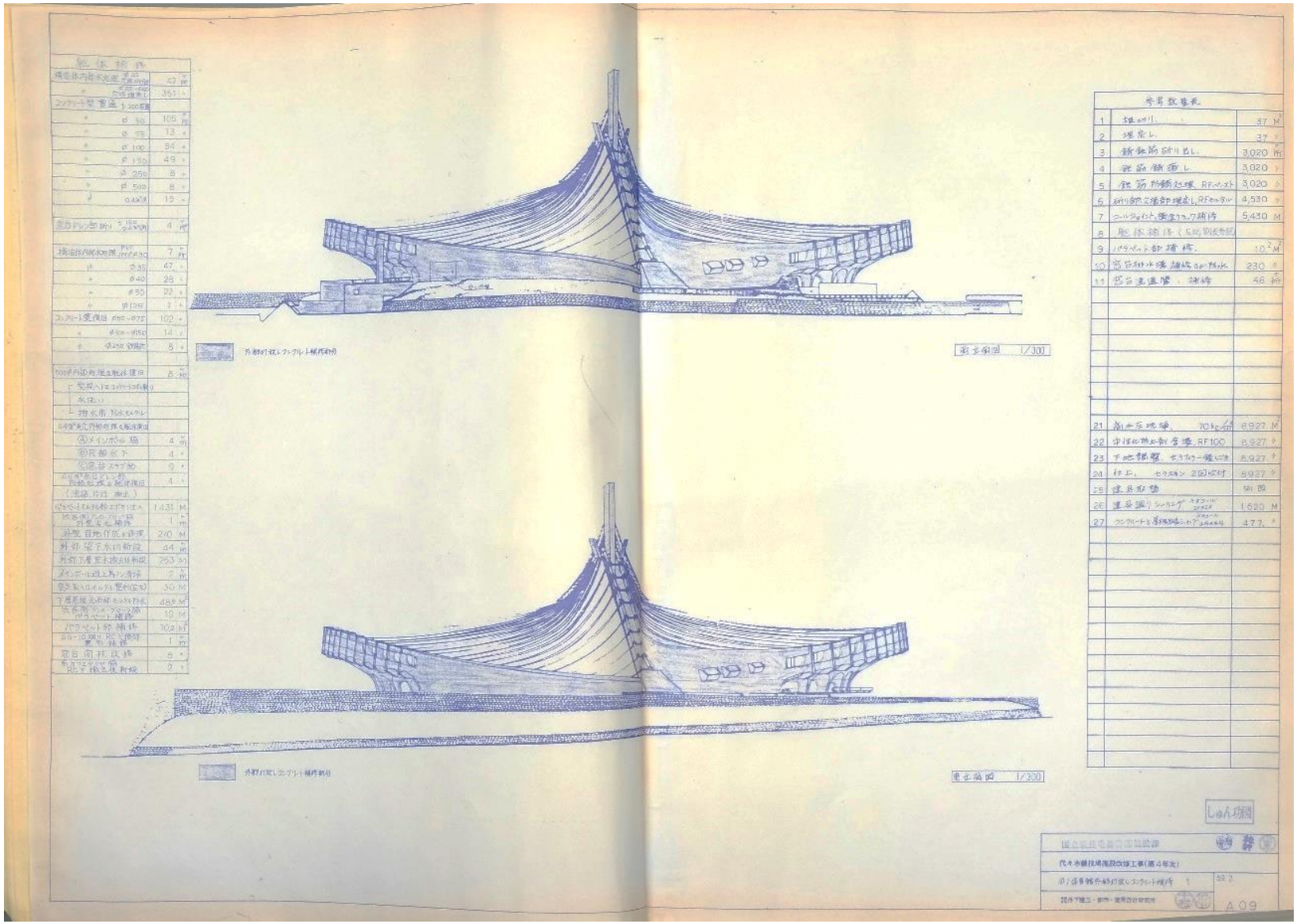


Fig. 2-15 Yoyogi National Stadium maintenance and repair works (the 4th year)
"The First Gymnasium exterior reinforced concrete walls repair 1" February 1984

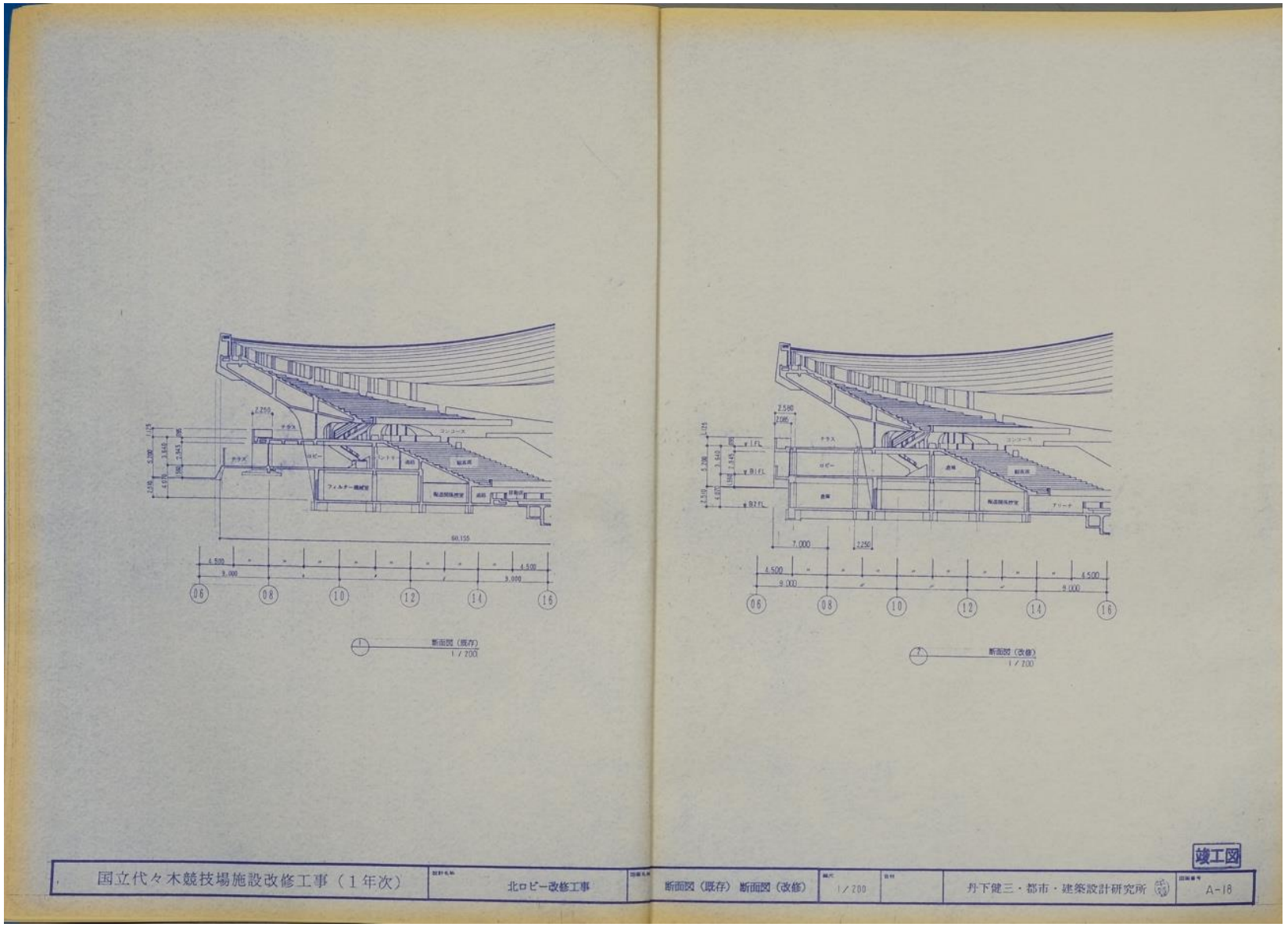


Fig. 2-16 Yoyogi National Stadium maintenance and repair works (the 1st year)
"North lobby repair, sections A-18" (left: existing condition, right: repair) 1992

(2) Outline of the repair projects for improving the seismic resistance of the first gymnasium and other facilities (2017 to 2019)

Background to the repair projects

Yoyogi National Stadium had undergone major repairs several times before, but none of them included a full-scale seismic reinforcement. In preparation for the 2020 Tokyo Olympics and Paralympic Games, JSC decided to complete a seismic resistance improvement project for Yoyogi National Stadium based on the Act for the Promotion of Renovations for Earthquake-Resistant Structures.

TANGE Associates conducted a seismic diagnosis and survey from 2010 to 2012, and Kawaguchi & Engineers made a basic plan for the seismic resistance improvement in 2014. Then, a joint venture group of TANGE Associates and a design firm called Kume Sekkei developed basic and detailed designs. On the premise that the Yoyogi National Stadium would be conserved and utilized in the future as a historic building, keeping the exterior and interior appearances largely intact became a priority in the basic plan and the basic and implementation designs. The removal and renewal of the impediments of various facilities were planned, in addition to strengthening parts of the buildings.

Commencing repair projects

An open competition for seismic resistance repair projects was advertised in 2017. The bid by Shimizu Corporation for Yoyogi First Gymnasium (in reinforced concrete, two stories, two stories underground), Auxiliary Building (in reinforced concrete and steel, two stories underground), and Connecting Building (in reinforced concrete, one story underground) was accepted, and a contract was made with JSC for the seismic resistance repair project, including work on the electricity and machinery facilities. Kume Sekkei became responsible for construction management. The planned construction is from December 19, 2017, to September 30, 2019. After people working at the JSC moved out of the Auxiliary Building, the repair work started. That project is to be completed while the JSC continues its regular works there.

After the work started, additional orders arrived, including changes toward impediment removal and security strengthening to meet the requirements as a venue for the 2020 Tokyo Olympic and Paralympic Games. Further, the need for renovation to outdated facilities, such as electricity and machinery, the repair to the retaining stone wall in the exterior, and the painting of roofs and outer walls emerged after work commenced, and their implementation was ordered.

The principle of strengthening Yoyogi First Gymnasium

The seismic diagnosis proved that while the main cable did not have any problems, the lower structure and main tower did not meet the aseismic strength standard in X- and Y-directions. The foundation ground and piles of the main tower also fell short of the required strength against lifting and sinking.

To correct these issues, it was decided to install quake-resistant walls in the backyard area, thicken the walls from the inside, add piles to the foundation of the main tower, and install wing walls. In determining the location of the quake-resistant wall, the arena and spectator seats area were avoided, and the backyard was selected, to ensure minimum impact to the original design.

The suspended steel would also be strengthened since it partly did not meet the aseismic strength standard. Seismic measures for the non-structural members, including the strengthening of a partition wall and the removal of a specific ceiling, were also planned.

The principle of strengthening the Auxiliary and Connecting Buildings

The seismic diagnosis revealed that the Auxiliary Building (the pool and connecting areas) does not meet the aseismic strength requirement in X- and Y-directions, and the Connecting Building (the administrative area) does not meet the aseismic strength requirement in Y-direction.

To strengthen the pool area it was decided to use the outer transom wall of the existing double wall to be a quake-resistant wall by clogging, to remove the wall in the western part and install a quake-resistant wall and piles, and to use a retaining wall in the eastern part as a quake-resistant wall. Also, for the connecting area of the Auxiliary Building, the earthquake-resisting elements are to be increased, for example, by newly installing quake-resistant walls and removing walls in the eastern part. The independent part of the triangular meeting room is to be integrated into the connecting area, and measures are to be taken for preventing a fall of the slant cantilever beam and protecting against impingement. In the connecting building, the earthquake-resisting element will be increased as well, and the addition (in steel construction) will be integrated into the whole.

The room for the cleaning staff that was added after the completion of the original construction is to be integrated into the First Gymnasium, and its concrete block wall is to be removed. The space for the cooling facility, which was also a later addition, will connect to the First Gymnasium at the floor level of the mezzanine.

Furthermore, the connecting parts of each building block and area need expansion joint installment and repairs.

The contents of the repairs

The main projects to be implemented:

1. Wall repairs
    i) add quake-resistant walls and thicken walls
    ii) strengthen 80mm partition walls by using continuous fiber sheet
    iii) remove concrete block walls
    iv) repair cracks in the reinforced concrete wall
2. Piles installment and foundation strengthening
3. Ceiling repairs
    i) remove specific ceiling
    ii) supplement lacking parts of suspended steel
4. Expansion joint repair or installment
5. The strengthening of the double slab under the spectator seats by continuous fiber sheet
6. Building restructuring in the pool and connecting areas
7. Arena floor repairs
8. Electricity facilities repairs
9. Machinery facilities repairs
10. Retaining wall repairs
11. The painting of the roof
12. The painting of outer walls

Among the above works, points 1–6 and 10 are for seismic resistance. Points 10–13 are additional orders after the commencement of the projects.

Followings are outlines of each work.

1. Wall repairs

i) Add quake-resistant walls and thicken walls

First Gymnasium: Newly install quake-resistant walls at 7 locations; Thicken quake-resistant walls around the arena at 58 locations.

Auxiliary building (pool area): Newly install quake-resistant walls at 4 locations; After demolishing part of the building and installing steel pipe pile, restructure the building, including its foundation.

ii) Strengthen the partition wall by using continuous fiber sheet

Provide crack prevention measures by using a continuous fiber sheet for the 80mm partition wall of the first gymnasium so that the building materials do not fall during earthquakes.

iii) Remove and strengthen concrete block wall

Change the concrete block wall (CB wall) of the first gymnasium, auxiliary building, and connecting building into other types of wall, such as drywall. However, for the wall where the artwork by Taro Okamoto is displayed, keep the existing CB wall, make a hole in the slab, and fix the carbon fiber anchor (CF-anchor) to lateral reinforcement inside of the CB wall to supplement the weak fixing status of the upper parts.

iv) Repair cracks in RC walls

Survey the cracked parts of the first gymnasium, auxiliary building, and connecting buildings, including any post-crack movement. Thereafter, provide repairs via 1) sealing method, 2) epoxy resin method, 3) U-cut seal filling method (flexible epoxy resin method), and 4) filling method.

2. Install piles and strengthen the foundation

Cast-in-place concrete piles are used for the first gymnasium, and steel pipe piles are used for the auxiliary and connecting buildings. For places that cannot be accessed by heavy machinery, use the TBH method (tone boring hole method, or reverse-circulation method); however, when installing piles, removing and recovering parts of slabs, gas ducts, and walls will be necessary to carry in devices.

First Gymnasium

Cast-in-place concrete piles (outdoor: earth drill method)

800–1,600ϕ-22 piles: 30m

Cast-in-place concrete pile (outdoor: TBH method)

800–1,200ϕ-11piles: 30m

Cast-in-place concrete pile (indoor: TBH method)

800–1,500ϕ- 32 piles: 22m

Auxiliary building (pool area)

Steel pipe piles with wings

267.4ϕ（wing 500ϕ）-20 piles: 23m

Connecting building

Steel pipes pile with wings

267.4ϕ（wing 750ϕ）-2 piles: 33m

3. Ceiling repairs

i) Remove the specific ceiling

Make the ceiling of the first gymnasium arena (11,247m^2, 35 m in height) into a non-suspended ceiling by supporting it with existing steel frame. Components are to be removed and re-installed later.

ii) Supplement the lacking parts of suspended steel

Strengthen member sections that the suspended steel of the first gymnasium is lacking.

a. Strengthen the member section of steels

to enhance the seismic resistance

b. Adjust gaps between laterally braced steel beams

4. Expansion joint repair or installment

Restructure the building frame since there are problems with the existing expansion joints installed at the connecting parts of the First Gymnasium, Second Gymnasium, Auxiliary Building, and Connecting Building; for example, clearance is not ensured.

5. The strengthening of the double slab under the spectator seats by using a continuous fiber sheet.

Strengthen the double slab under the spectator seats by making an opening and providing continuous fiber sheets from the inner side so that the building will not fall during an earthquake. For this process, 144 openings are needed as the inside of the double slab is separated by girders.

6. Building frame restructuring in the pool and connecting areas

Dismantle the existing building frame of the section joining the pool and connecting areas of the auxiliary building, install piles, and then reassemble the frame with quake-resistant walls in order to improve earthquake resistance.

7. Arena floor repair

Remove the existing floor of the arena, install the 130 mm structure by using the existing steel frame base and floor, and make the floor suitable for sports games.

8. Electricity facilities repair

1) Remove and re-install electricity facilities
2) Change the lighting to LED
3) Renew large speakers in the arena
4) Renew cables

9. Machinery facility repair

1) Remove and re-install pipes
2) Renew the air-conditioning facility in the first gymnasium
3) Renovate the machinery facility toilets, following the change of its layout
4) Renew pipes
5) Renew ducts and fans in the monitor roof of the First Gymnasium

10. Retaining wall repair

- Dismantle the stone-piled wall on the east side, which retains the soil at a 30-degree slope, as it is not earthquake resistant. Install an L-shaped structure and restore the stone piles.
- Dismantle the stone-piled retaining wall on the south side, which measures 40 m in length and 14 m in height, as it is liable to collapse in case of an earthquake. Make a four-story structure and restore the stone piles.

11. The painting of the roof

Remove the present thermal barrier paints from the roof of the first gymnasium, as the color has faded. Apply a thermal barrier paint, whose color the test showed did not change.

12. The painting of the outer wall

Remove the out-wall's paint with micro-ceramic material. At the time of completion, the wall originally had a bare concrete finish, but the coating has been repeatedly made. The same paint is to be freshly reapplied in the same method.

A consideration of design significance and cultural property value during the process of repairs

The repair projects are conducted with respect to the design of the building's inside and

outside, and the principle is to pass down the building as it is to the future generations. Since they are repairs to a historical building, efforts are made to conserve as much as possible even on the parts that need to undergo changes for strengthening and utilization reasons.

The principle is to reuse dismantled members and conserve the finishing materials for the form and finish of the ceiling, retaining stone wall and the air duct made of piled stone at the First Gymnasium.

Members cannot reuse certain parts, such as the interior of the VIP room and its hall, the wooden walls at the north and south part of the connecting and auxiliary buildings, and the outside staircases. A survey is conducted in advance so that the structure and appearance can be recreated with the same design, materials, and methods as before.

Consideration is given not to affecting the existing design when it comes to the parts needing changes, the addition of new functions, or impediment removal, such as in spaces and floor finishes of the concourse on the first floor for wheelchair users, pebbles on the outside promenade, and handrails.

Photo 2-1 Wall repair (thickening the wall by newly adding a bearing wall)

Photo 2-2 Wall repair (Reinforcing a concrete block wall)

Photo 2-3 Pile installment and base reinforcement work

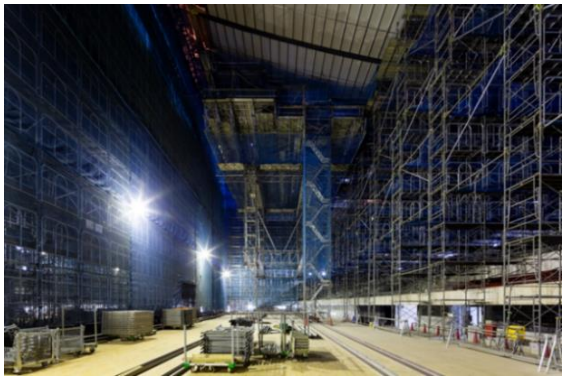


Photo 2-4 Ceiling renovation

Photo 2-5 Expansion joints

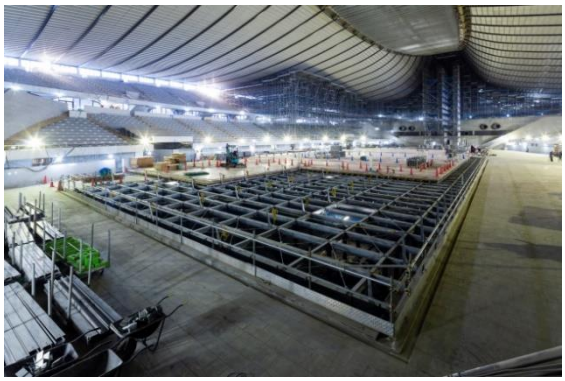


Photo 2-6 Arena floor renovation

Photo 2-7 Restructuring the building frame of the area around the pool and connecting spaces

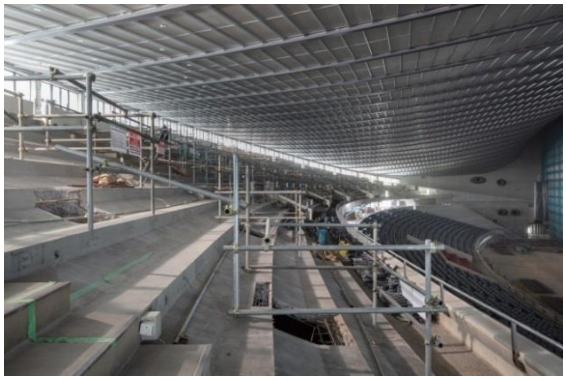


Photo 2-8 Installing continuous fiber sheet to the double slab underneath the spectator seats

Photo 2-9 Retaining wall renovation

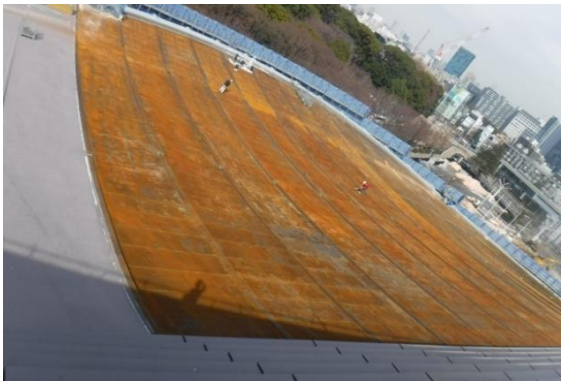


Photo 2-10 Repainting the roof

2-6. Significance of the Yoyogi Stadium

(1) Features of the Stadium

The National Indoor General Stadium, which is called Yoyogi National Stadium today, was built on a part of the former site of Washington Heights, a United States Armed Forces housing complex. The stadium was used for swimming and basketball competitions in the October 1964 Olympic Games in Tokyo. Since then, the Stadium has been widely used by the public for sporting, cultural, and artistic events.

In April 1961, the Sports Department of the Ministry of Education, Science, Sports, and Culture organized a preparatory council to build the general indoor stadium on the premise that the site of Washington Heights would be returned to Japan. It appointed roughly 80 council members, who reviewed the basic concept. The negotiation for the return of Washington Heights, however, proceeded with difficulties, and the stadium venue itself underwent reconsideration. On October 25, the cabinet finally decided to construct a general indoor stadium at the Washington Heights venue. The committee met to select architects for the stadium on November 13 and 20 and chose Kenzo Tange, Yoshikatsu Tsuboi, and Uichi Inoue.

The construction site is located in the southeastern corner of the land, which had been a military drill ground for the Imperial Army of Japan until the end of World War II and Washington Heights after the war. It has a gentle slope to the south and is set against a backdrop of the thick forest of Meiji Jingu, a Shinto shrine. Design work was done in collaboration between Kenzo Tange and his office, called URTEC, which oversaw architecture, the Yoshikatu Tuboi Office, in charge of structure, and the Uichi Inoue Office, which led mechanical and service design. The Kanto Regional Office of the Ministry of Construction supervised the work and construction companies Shimizu Corporation and Obayashi Corporation implemented it. Primarily, the First Gymnasium was built by the Shimizu Corporation, while the Second Gymnasium was built by the Obayashi Corporation.

The First Gymnasium is composed of circles and sine curves, which was similar to a yin-yang shape in the plans. Its main span is 126 meters long, and its side span is 44 meters; a maximum of 120 meters makes the sectional span. The highest point of the main cable, where the saddle is, is as high as 27.523 meters above ground, and the sag of the main cable is 9.653 meters (in the middle). The roof is formed with many hanging cables running from the main cables to the periphery of the stadium stands; bracing cables are knitted through the hanging cables at right angles to give rigidity to the roof surface and pre-tension to the whole roof structure by tensioning them. In other words, the roof has a stable rigidity by maintaining a moderate curvature from hanging cables across the two main poles at 126 meters apart. The suspending trusses from the main cables to the edge of the stadium stand hold them steadier with bracing cables that intersect at right angles. It is a dynamic internal space where athletes and spectators can feel united. That sentiment is created by the synchronicity between a concaved outline, which is typical of a suspended roof plain, and the moderate incline of the stands and the natural light coming down through the top lights fitted in between the two main cables. Seismic dampers were installed, the first attempted in Japan, to control any movements of the roof

surface caused by gales. The gross floor area of the First Gymnasium measures 1,1676,413 m^2 on the second basement floor, 5,639.556 m^2 on the first basement floor, 6,074.095 m^2 on the ground floor (lower stand), 2,375.162 m^2 under canopies, 4,122.088 m^2 on the first floor (upper stand), and 3,766 m^2 for the arena. It has two stories and two basement floors, and its structure is reinforced concrete and a high-tensioned suspended roof. Additionally, the First Gymnasium has 50 guest seats, 10,570 standard seats, and 973 movable seats, resulting in 11,593 seats total. The First Gymnasium m is equipped with the main pool, a diving pool, and a diving platform.

The Second Gymnasium faces the Shibuya side entrance of the First Gymnasium. The main structure is composed of a cone-shaped reinforced concrete stand at a diameter of 65 meters and a steel suspended roof. A cantilevered pole stands at the perimeter of the stand; the main cable curls down, sprawling and stretching to the anchor block behind the main pole, passing halfway through it. The suspended members that form the roof structure are attached at the periphery of the stand and gather centripetally at the main pole, with their top sections connected to the main cables. The gross floor area of the Second Gymnasium measures 3,075.505 m^2 on the first basement floor, 905.832 m^2 under the canopy of the first basement floor, 2,599.722 m^2 on the ground floor, 88.8 m^2 under the canopy on the ground floor, and 1,368 m^2 for the arena. The Second Gymnasium has 50 guest seats, 3,181 standard seats, and 314 movable seats, offering 3,545 seats in total.

The Auxiliary Building is a rectangular cuboid of about 300 meters long east to west and has two floors underground. The rooftop (at the same level as the Harajuku entrance) forms an area called the promenade, which Tange called *michikukan,* connecting the First and Second Gymnasia as well as the Harajuku and Shibuya Gates. The western edge of its second basement floor has a sub-pool and related rooms; the first basement floor has an office, board members' room, an emergency room and the like. The gross floor area of the auxiliary building measures 1,971.700 m^2 on the second basement floor, 428.851 m^2 under the canopy of the second basement floor, 2,890.921 m^2 on the first basement, and 195.551 m^2 under the canopy of the first basement floor.

Stadium users fall into one of three types: spectators, athletes and officials, and members of the Imperial Family and other VIPs. Spectators access the stadium either from National Railway Harajuku Station (now JR Harajuku Station) or from Shibuya Station. The entrance of the first gymnasium is situated close to the Harajuku Gate, which receives a large number of spectators. Inside the First Gymnasium, there is nothing to obstruct visitors' views, which allows them to find their seats and evacuate easily in case of an emergency.

Next, the athletes and the Olympic officials enter from the Shibuya Gate by car or bus and access the Auxiliary Building (the second basement floor level). Since the arena of the First Gymnasium is on the second basement floor and the Second Gymnasium is in the first basement, the circulation reserved for the athletes and officials does not cross paths with the one for spectators.

Lastly, the VIPs enter by car from the Shibuya Gate, and proceed northward in the direction of Meiji Jingu and access the driveway in the second basement floor of the Auxiliary Building.

Then, they walk up a straight staircase to the first basement floor of the First Gymnasium and go straight to the VIP room, and then to the royal box.

Yoyogi National Stadium has undergone several projects, such as asbestos removal, the installment of barrier-free facilities, earthquake resistance improvement and ceiling enforcement, to ascertain safety and increase user convenience. During the process, the Japan Sports Promotion Centre, the owner of the gymnasium, ensured that original materials were used to the maximum degree possible, the artwork of artists like Taro Okamoto was carefully conserved, and the design philosophy of the creators, including Tange, was respected. Half a century after the construction, it was decided that the First Gymnasium was going to be used for the handball competition in the coming 2020 Olympic Games in Tokyo, and for wheelchair rugby and badminton competitions in the Paralympic Games.

(2) The cultural value of the Stadium

The overall cultural value of Yoyogi National Stadium and its site can be summarized as follows.

(2)-1 Historic Value

Yoyogi National Stadium is a symbol of recovery from the devastating war damage Japan's capital city Tokyo suffered. At the same time, it is a symbol of international exchange and peaceful diplomacy through sports.

The Yoyogi area was at the periphery of the city of Edo in the Early Modern period. It held the residences of upper-ranked samurai, which were surrounded by the vast agricultural area of Musashino field. By the end of the Meiji period, or the beginning of the twentieth century, a military drill ground (Yoyogi Military Drill Ground) for the Japanese Imperial Army was founded on a large area that encompasses the current stadium site. In the Taisho period (1912 – 1926), Meiji Jingu's naien – or inner precinct – was created in the area adjacent to the military drill ground. After the war, however, the drill ground was replaced with Washington Heights, the U.S. Armed Forces housing complex, which was created at the expense of the Japanese government and deemed a symbol of the Allied Forces' occupation of Japan.

After the 1964 Olympic Games, the stadium has been used not only for sporting activities, but also for cultural and artistic events. It has established a firm position as a cultural base in the global city of Tokyo.

To summarize, the site engraves the memory of the significant events the nation experienced over the twentieth century: 1) the Japanese army's expansion into the Eurasian continent, 2) the U.S. military's occupation, 3) International cooperation and Japan's hosting of the Olympic Games, and 4) a site for cutting-edge cultural and artistic activities. The Stadium and its site symbolize the peaceful nationhood and economic recovery that post-war Japan aimed to achieve.

(2)-2 Architectural Values

(2)-2-I Function

Yoyogi National Stadium has maintained its function as a sports facility to this day.

(2)-2-ii Spatial structure, design approach, and design features

<u>Urban Core</u>

In 1951, not long after the end of the Second World War, the 8th Congrès Internationaux d'Architecture Moderne (CIAM) was held in Hoddesdon, near London. The theme for the session was “the Heart of the City”; the central issue for Western European architects and urban planners was how to rehabilitate the urban cores that had been devastated by bombings. Many of the urban designs by the participating Western European architects were backward-looking, reimagining the squares of the medieval cities.

Tange participated in this conference, bringing with him panels of Hiroshima Peace Memorial Park, on which he was working. In the paper, “The Core: Its Social and Historical Background,” he discussed how a population-drawing urban core should be in modern societies and considered the history of Japan’s urban spaces. Later, Tange made considerable efforts at realizing his idea of the urban core in various occasions; their traces can be found in his works, such as the former building of Tokyo Metropolitan Government and *A Plan for Tokyo 1960*.

Yoyogi National Stadium is a rare example of a successful formation of a venue, where people can gather as one in an urban core, such as Tokyo’s Shibuya-Harajuku area. It is representative of Tange’s work on urban cores, materializing how to take advantage of topographical-level differences.

Separating pedestrians and automobiles and using topographical-level differences to create a people-gathering venue in an urban core is also apparent in *A Plan for Berlin* (1963), by TEAM X, which comprised a group of European architects who were active in the 1960s. Since the 1950s, the idea of the urban core has been an important worldwide trend in urban design. Yoyogi Stadium is a remarkable example of comprehensively envisaging a city and its architecture.

Silhouettes and interior views

Until the nineteenth century, large-scale buildings in East Asia, including Japan, were constructed according to Buddhist architecture, and a number of them remain today. Many were wooden constructions with tiled roofs on shallow curves. In other words, large roofs with stately, shallow curves were important elements of the Japanese style of architecture.

In the nineteenth century, Western architectural technologies were introduced to Asian countries. Many large constructions were built using concrete and steel frames in the twentieth century. However, many were completely detached from local traditions and historic landscapes. The suspended structure used in the western architectural expression of roofs was characterized by its lightness using a semi-transparent membrane.

The silhouette of the suspended structure of Yoyogi Stadium is stately, which contrasts with the Olympic stadium in Munich. Furthermore, the reinforced concrete stands appear to be lifted off the ground, and the boundary condition of the tensile roofs of the stadiums is determined by the three-dimensional curvilinear form of its stands. The silhouette of Yoyogi Stadium appears to be a heavy roof and light stands, which makes it an outstanding example of twentieth-century architectural cityscapes.

The characteristic features of the interior of Yoyogi Stadium’s first and second gymnasia are dynamic cross-sections in the shape of the Chinese character eight (八) and top lighting.

The Pantheon's top lighting is a feature from the pre-Christian era that connected the sacred world and the earthly world. Tange included top lighting in the stadium, making excellent use of the suspended structure's two main wires and semi-rigidity. It not only solved the issue of releasing the water vapor coming from the pool but also gives a dynamic, symbolic interior view, evoking a feeling of sublime for the vertical connection between heaven and earth.

In the context of the "tradition" debate

When overviewing the introduction and developments of modern architecture in Japan in the twentieth century, there was always a debate over what was the right distance between modern architecture and Japanese tradition. For instance, the *Teikan* Style, which combines a Japanese-style roof and a Western-style body, was required of the entrants of the design competition for the Tokyo Imperial Museum in 1931. Kunio Maekawa, Tange's teacher, ignored the requirement and proposed a design plan for a modern architectural form with a flat roof. His work was not selected for any prizes. In the design competition for the Greater East Asian Co-Prosperity Sphere Memorial Hall in 1942, Kenzo Tange proposed a giant war memorial modeled after the gable roof of Ise Shrine to be built at the foot of the Mount Fuji, and it won first prize. After World War II, Tange no longer used Japanese-style expressive roofs, instead featuring in his designs proportional pilotis and mezzanines, and won the competition for Hiroshima Peace Memorial Park. Among the three buildings in the park, he aimed to express a powerful Ise-style architecture in the exhibition hall at the center and make a delicate *kiwari* expression in the style of Katsura Imperial Villa in the main hall.

Paralleling the evolution of Tange's designs, many architects sought to interpret the traditions of Japanese architecture. For example, Japanese architect Sutemi Horiguchi and German architects Bruno Taut and Walter Gropius praised the Katsura Imperial Villa, all finding some essence of modern architecture in the building. Tange, however, did not agree with their interpretations; he went against the conventional interpretation of the "traditional elements," namely the roof, which was considered a signature element. Instead, he interpreted the Katsura Imperial Villa in his own way and sought to reconstruct a traditional proportion, using contemporary materials and techniques. Amid the "tradition" debate in Japan around 1955-56, Tange designed various buildings with reinforced concrete, such as the Kagawa Prefecture Government Office with a deliberately visible beam-and-column structure, the Kurashiki City Hall in a solemn Azekura style using precast concrete, and the Imabari City Hall using a large-scale folded-plate structure. In sum, Tange created an architectural grammar while radically reinterpreting the Japanese tradition.

Yoyogi Stadium is highly acclaimed for realizing a temple-like architecture that is stately with a large roof while also using then-cutting-edge structural and facility technologies. It showcases a bold suspension structure while remaining consistent with the tradition debate of the 1950s.

The actualization of the large roof by integrating design, structure, and facilities

From the 1950s onward, the development of air-conditioning technology made the integration of design, structure, and facilities a critical issue, especially when building a large facility with ample space. Such integration has also been an essential theme in works from the

end of the twentieth century onwards by world-class architects, such as Norman Foster and Renzo Piano. In this respect, Yoyogi Stadium is the best example of the design-structure-facility integration from the 1960s.

Festive nature

The site where this stadium is built is on the south side of Meiji Jingu, and it used to be a military drill ground for the Japanese Imperial Army. Soon after the war ended, the occupying Allied Forces confiscated the land and created Washington Heights, a housing complex for the U.S. Armed Forces. Later, the Japanese government and the U.S. military reached an agreement to turn the site into a venue for the Olympic Games' swimming and basketball competitions. Yoyogi field was once a symbolic venue for Japan's hegemonic imperialism, and then it represented the war defeat and occupation. After that, it metamorphosed into a venue for peaceful festivities, drawing people from all over the world for sports.

Therefore, it is a site that speaks of the turbulent history of Japan throughout the twentieth century. It also carries a high degree of festiveness as it will be used for the handball competition in the 2020 Olympic Games in Tokyo.

(2)-2-iii Materials

As for the exterior paint of the stadium, the part of the reinforced concrete wall, which was initially bare has been painted, because the degradation and air pollution had tarnished it. Thermal barrier paint was applied to the iron plates of the suspended roof, in the same color, at the time of completion, but the paint faded, giving the roof a reddish tone. The ongoing repairs aim to bring back the original color to the roof, and thermal barrier paint whose color would last for a long time has been re-applied. On the exterior floor, the pavement stones formerly used for streetcar roads have been reused, inscribing a part of the urban remodeling history. Moreover, the stone wall on the southwestern corner of the premises is now under large-scale reinforcement construction to improve the structure's earthquake resistance. It is planned that the area's materials will be reused as much as possible.

(2)-3 The value of the site as a cultural property

The property area is located in the southwest part of the former Yoyogi Military Drill Ground. That part of the land has substantial topographical level differences, and the section between the parts where the main and sub stadiums stand now is lowest. The northern boundary of the site largely coincides with the formerly existing road that ran east to west when it was the military site. That road was also used when it was Washington Heights.

The buildings on the property area are the first gymnasium, close to the Harajuku Gate to the north, the second gymnasium, in the northwestern side of the premises, and the auxiliary building, which connects the two. The surrounding outdoor space has Olympic Plaza in the northwestern corner, Harajuku Plaza near the Harajuku Gate, Shibuya Gate-side Plaza on the southwestern side of the area, and a parking area in the southeastern part. These areas are connected three-dimensionally by the promenade, also called *michikukan*, which is the rooftop of the auxiliary and administrative buildings.

Olympic Plaza has been used for various purposes from 1965 onwards, including a kids' pool, outdoor ballgame field, tennis courts, and event venue. From 2011 onward, futsal courts were established and have since been in use.

Harajuku Plaza is an open space that receives people entering from JR Harajuku Station (formerly National Railway Harajuku Station) heading toward the stadium. According to the site plan for the stadium, Harajuku Plaza was going to be directly accessible by a crossover bridge from the Meiji Jingu side; however, that plan did not materialize.

Shibuya Plaza is located at the cross point of the flow of VIPs, athletes and officials, and management vehicles. Shibuya Public Hall and the NHK (Nippon Hoso Kyokai: Japan Broadcasting Corporation) stand on the opposite side of Shibuya Plaza. At the time of completion, the plaza was composed of a vast lawn space and car-waiting station. It was an impressive urban landscape. A temporary theater had occupied the space since 2006, but was removed in June 2019.

Between 2000 and 2013, a temporary live house stood on the first parking area. The space has been converted back into a parking area, as at the time of completion.

The former pavement stones of the Tokyo metropolitan streetcar roads are being reused as the finishing material for "*michikukan",* which connects the plazas and the parking area. The stones were made available for the Stadium, following the abolishment of the streetcar line. This active utilization of materials continues the legacy of the modern history of Japan.

The Stadium site is on the hilltop, in contrast to Japan Railway Shibuya Station (formerly National Railway Shibuya Station) at the bottom of the valley. It is designed so that as one walks up the slope through the crowded shopping area of Shibuya, one finds the hall of the Olympic Games standing on a sacred, pure hill against the background of Meiji Jingu.

The landscape within the property area is mostly composed of lawn surfaces. They serve as the base of the First and the Second Gymnasia, giving a sophisticated feeling to the scenery of the stadium. There are significantly fewer trees in the compound, compared to the similar kinds of facilities, which bring an inorganic, stony landscape reminiscent of an ancient Western city.

Hiroshima Peace Memorial Park, which was completed in 1954 and is considered to be another masterpiece of Tange, contains characteristics of the site plan and open space of Yoyogi Stadium. The facilities of the park are concentrated in the southern edge of the premises so that the tens of thousands of people who gather for the annual memorial ceremony face the Genbaku Dome that stands across the river. Tange aimed to create a space where the main and the east buildings of Hiroshima Peace Memorial Museum would stand, and the people could gather to pray for peace as they face the Genbaku Dome, which symbolizes the other world.

There are three commonalities between Hiroshima Peace Memorial Park and Yoyogi Stadium, in terms of site plans and open space. First, they both find a sacred place, or an otherworldly symbol on the outside of their sites, and a strong axis is drawn from those places. The components of the site align along the axis. Second, they are both located in city

centers, and their site plans are designed so that tens of thousands of people can gather and flow through the facility smoothly. Third, neither site focuses on soft-scapes, most commonly in the form of tall trees, instead showing bare concrete and inorganic landscapes. However, the topographical level differences that Yoyogi site has, unlike Hiroshima, are accentuated by lawns and are used as the foundation of the Yoyogi buildings.

In summary, the first and second gymnasia, auxiliary and administrative buildings, plazas, parking area, "*michikukan"*, and lawn surfaces all reflect the architect Kenzo Tange's urban design philosophy.

(3) Value of the Yoyogi National Stadium and its maintenance and repair work

(3)-1 Spatial composition, Design approach, and design features

Silhouettes: large roofs and exterior reinforced concrete walls

The large roofs and exterior reinforced concrete walls are essential parts of the silhouettes of the First Gymnasium and the Second Gymnasium.

Roofs: The first painting repair work of the roofs was conducted four years after the completion of the Stadium. The large roofs experienced rusting and water leakage often, requiring repair several times. To solve this, Shimizu Corporation proposed a new repair method for the water leakage, using a vinyl chloride-based sheet in place of the conventional method of coating the roof with a film of waterproofing, citing the following advantages: (1) its waterproofing efficiency is superior to the conventional method; (2) its durability is superior, especially with respect to ultraviolet degradation; (3) its countermeasures for the swelling effect are easier; and (4) the urethane materials used in the conventional waterproofing method are often damaged by crows. Despite the stated advantages of the vinyl chloride-based sheet, however, the conventional waterproofing coating method had to be reused; the elegant silhouettes have been spoiled without the steel plate overlap, which would have been obscured by the alternative method.

The waterproof coating that had been painted on during previous repairs had detached and many steel plates had become corroded. Therefore, all the old waterproofing was removed and the steel plates repaired; the roofs were the repainted with anticorrosive coating and fluororesin antiheat paint. The roof repair work ended in March 2011. JSC chose the color by comparing samples with color photos taken at the original completion.

Walls: Repair work reinforcing the exterior concrete walls started in 1982. Most parts of the walls were composed of complicated curves and they could be polluted easily. Accordingly, the repair work was conducted in the following order: excavation and back-filling; rusted rebar chipping, rust removal, and antirust treatment; refilling and molding of chipped parts; cold joint-and-crack repair; water treatment inside the structure; parapet repair; window drain repair and waterproofing; window communicating tubes repair; high-pressure water washing; neutralization inhibitor impregnation; concrete substrate preparation and finishing; fittings exchange and fittings sealing; sealing between concrete walls and roof; and slab opening reinforcement. The finishing process involved applying CeraSkin twice.

Interior space of Gymnasiums

Repair works of the Gymnasiums' interior can be classified into three categories: (1) ceiling repair, (2) arena repair, and (3) stands and approach repair.

Ceiling repair: On the back side of roofs, asbestos was used for heat insulation, and the tiles were 68cm distant from the ceiling finish materials. At the time of completion, asbestos was considered a normal material; however, its toxicity was soon after pointed out. As a result, asbestos in the First Gymnasium and the Second Gymnasium was removed from August 2006 to August 2007. In this work, all ceiling boards were removed, and tall scaffolding was set up from the floor and stands to the roof. Obayashi Corporation, in charge of this work, found that it was difficult to remove all the asbestos by hand, and they decided to use the high-cut method, shooting dry ice particles under high pressure. Also, the ceiling allocation was revised to the original design, which could not had been actualized at the completion to shorten the work period.

In 2014, the Building Standards Law was revised to include "specific ceiling regulation of large ceiling," which requires ceilings over six meters high and 200m^2 to take measures to prevent moving and dropping. The First Gymnasium ceiling is 19 meters high at its lowest point and covers an area of 10,000m^2, and the Second Gymnasium is 11 meters high at its lowest point and covers an area of 3,700m^2. Therefore, JSC discussed appropriate countermeasures with Tokyo Metropolis. As a result, JSC decided to remove hanging bolts of ceiling-finish materials and to fix new frames sustaining them to the steel roof beams directly; this work will be completed in fiscal year 2019.

The ceiling repair work in 2007 and in 2014 did not make any changes to the Gymnasium interior spaces, only preserved them, emphasizing their original design concept more clearly.

Arena repair: The Second Gymnasium was originally designed as basketball court, but it has been used for various sports competitions and events venues. Accordingly, there has been no change of application in the Second Gymnasium arena, and its original interior space is preserved.

Stands and approach repair: There have been several instances of repair work in the approach connecting entrance and the stands of both the First and Second Gymnasiums, including toilets and stands for the handicapped installed in 2010 in consideration of barrier-free access.

Auxiliary Building and Gymnasium auxiliary rooms

The Auxiliary Building, the primary function of which is the smooth operation of two Gymnasiums, has two zones: the west zone for connecting and the east zone for the auxiliary building. There are also auxiliary rooms in the First and Second Gymnasiums, including VIP rooms, kiosks, and cafeterias, that are essential for gymnasium event operations.

These rooms have been repaired several times. For example, waiting room interior repairs and sub-pool repairs were conducted as additional work in fiscal year 1993. Most parts of the floors, baseboards, walls, and ceilings have been replaced, and they will be changed as needed in the future.

Seismic repairs of the Auxiliary Building are now being conducted (fiscal year 2019), as

removal of concrete block partition walls, expansion joint repairs to maintain appropriate intervals, and similar repairs.

"*Michikukan*" and plazas

The outdoor space of Yoyogi National Stadiums divided into four areas: Harajuku Plaza (approx. 6,000m^2) in the east, Shibuya Plaza (approx. 2,600m^2) in the south, Olympic Plaza (approx. 4,500m^2), and the parking area in the south.

Among them, Shibuya Plaza, Olympic Plaza, and the parking area have been used in various ways. For example, the Muscle Theater was standing in Shibuya Plaza from 2007 to 2011, which was replaced by another temporary construction in 2012 and stood there until early 2019. Olympic Plaza had a children's pool (1965–2000), outdoor ball game grounds and tennis courts (1964–2002), futsal courts (2011–present), and dressing rooms (2011–present).

Harajuku Plaza and the Promenade play important roles as an open spaces, welcoming many visitors from Harajuku station and completing the experience. The maintenance work has all been conducted in consideration of conserving the landscape; toilets were installed underground in 1997, and the waiting rooms and ticket booths were hidden by plants. In consideration for aging visitors and accessibility for the handicapped, repair work in those plazas included flagstone leveling and installation of handicap-accessible passages and elevators.

Building skeleton structure

In October 1977, Mamoru Kawaguchi, a structural engineer of Yoyogi National Stadium, conducted a study on the building's skeleton structure and found rusting of structural members under the roof and main wires rusting due to ground subsidence and other factors; subsequently, he requested (1) exterior bare concrete repair, (2) oil dumper maintenance, (3) underpinning of the anchor blocks, and (4) installation of waterproofing and drainage equipment.

Exterior bare concrete repair: Kawaguchi suggested mortar repair and overall coverage with tile spray and to avoid neutralization caused by air pollution.

Oil dumper maintenance: Because of the decision that the First Gymnasium roof should have stiffness as a shell structure and because short secondary members were easier to handle, steel plates 4.5mm thick were used as roof materials. The roof load is about 60kg/m^2, so oil dumpers were installed to prevent the roof from moving in the case of an unanticipated large storm. The oil dumpers have been inspected overall every 20 years and have been working well enough that they have not needed to be exchanged until now.

Underpinning of the anchor blocks: In considering the permanent use of the gymnasium, as well as recent earthquakes, Kawaguchi suggested that the anchor blocks should be supported by piles and required underpinning.

Installation of waterproofing and drainage equipment: Rainwater flowed into the anchor blocks underground and left flooded because drainage was insufficient. Accordingly, it was suggested that flowing water should be stopped thoroughly and automatic drainage equipment should be installed.

Each of the four repairs above was conducted after FY1982. Also, the main wiring of the First

Gymnasium was investigated in FY1995 by removing its backstay casing and filling mortar, judging by sight, and checking the decay of wires by electromagnetic wave. In FY2019, the following work was carried out: (1) increasing the thickness of the main tower walls to improve seismic performance; (2) installation of 66 piles for improving proof stress; (3) strengthening the stands slab with continuous fiber sheeting to prevent it from falling; (4) strengthening the First Gymnasium's hanging steel frame by adjusting the intervals of transverse stiffener; and (5) strengthening the Second Gymnasium's hanging steel frame by adjusting the buckling length, etc.

(3)-2 Changes of operation management body and continuity of maintenance and repair work

Yoyogi National Stadium is now managed and operated by the Japan Sport Council (JSC), an agency managed under the Medium-Term Objectives affiliated with Ministry of Education, Culture, Sports, Science and Technology.

After the Tokyo Olympic Games in 1964, Yoyogi National Stadium, then belonging to the Ministry of Education, Science, Sports and Culture, was managed by National Stadiums, a government-affiliated corporation established in 1958. From 1986, the stadium was managed by a new government-affiliated corporation, the National Stadiums and School Health Center of Japan, an integration of National Stadiums and the School Health Association of Japan. The purpose of the integration was to increase use of the facilities and to adjust the burden borne by beneficiaries [and] promote management efficiency. This allowed a freer operation of the facilities, such as conducting diverse, revenue-generating activities.

Through the reorganization of the government ministries in 2001, the Ministry of Education, Science, Sports and Culture became the Ministry of Education, Culture, Sports, Science and Technology, having been integrated with the Science and Technology Agency. To separate the operational and service departments from the central government as a part of administrative reforms of the late 1990s, the Japan Sport Council was established as an independent administrative institution in 2003, inheriting the business of the National Stadium and School Health Center of Japan, which had been operating the stadium until then. The mandate of JSC includes appropriate and effective management of the sports facilities it establishes.

The history of the operation management body can be divided into three periods: the first period (1964–1986), the second period (1986–2003), and the third period (2003–present). Although the operation management bodies have changed over the three periods, the Yoyogi National Stadium has always been primarily a sports facility. However, increasing requests during the second and the third periods for the operation management bodies to increase use of the facilities and to adjust the burden borne by beneficiaries [and] promote efficiency of management resulted in an increase in its use as an event facility. This transition, as a consequence, changed the buildings' way of being accordingly.

As mentioned above, Kenzo Tange, the architect of the stadium, was concerned about the stadium's state of conservation and in 1977 submitted a "request for maintenance improvement and urgent countermeasures for roof rust of the Yoyogi National Stadium." This led to an initial facility survey and, in response to this, the introduction of budgetary measures for maintenance and repair work.

In 2003 and 2007, during the third period, additional facility surveys were conducted, and the resulting maintenance and repair works were implemented in three phases: the First Medium-Term Strategy (2003–2007), the Second Medium-Term Strategy (2008–2012), and the Third Medium-Term Strategy (2013–2017). A report entitled "Performance Report on First Medium-Term Strategy (2003–2007)," formulated by the JSC in 2008, said, "JSC has formulated a maintenance and repair plan from a long-term perspective, in order of priority given by considering building aging, safety, and efficient management after repair work, on the basis of surveys." Among for concrete measures, it included these: "(1) repair works of dangerous spots, (2) repair works for improving user service, and (3) repair works necessary for business development, taking account of degree of urgency."

As shown in Table 2-4, the history of maintenance and repair works can be divided into six stages by considering the period division of operation management body: the first maintenance and repair work stage (1981–1985); the second maintenance and repair work stage (1992–1995); the third maintenance and repair work stage (2003–2007 in the First Medium-Term Strategy); the fourth maintenance and repair work stage (2008–2012 in the Second Medium-Term Strategy); the fifth maintenance and repair work stage (2013–2017 in the Third Medium-Term Strategy); and the sixth maintenance and repair work stage (from 2018–present in the Fourth Medium-Term Strategy).

The first maintenance and repair work were implemented after the initial completion of the stadium; since then, maintenance and repair work has been done about every ten years on the basis of a survey investigation. However, the fourth stage of maintenance and repair work was conducted without an interval after the third stage of maintenance and repair work because removing the asbestos was a matter of emergency. In this way, the stadium has been repaired on a continual basis and its good condition has been maintained as a whole until now.

(3)-3 Physical changes made by maintenance and repair work

The design of the stadium has been largely respected and maintained, as repair works were conducted in a planned manner according to the survey results. However, some physical changes were made through the second and third phases of maintenance and repair work in consequence of the growing pressure upon the managing body to use it as an event venue to increase use of the facilities and to adjust the burden borne by beneficiaries [and] promote management efficiency.

As Table 2-5 shows, almost half of the maintenance and repair work did not involve any visible physical changes. However, the number of work orders conducted for responding to new demands was twenty-eight for the First Gymnasium, nine for the Second Gymnasium, eight for the Auxiliary Building, twenty-seven for the outdoor facilities, and two for the entire facility. Such work included the new construction of an outdoor sports facility, and the installment of handrails, emergency stairs, outdoor elevators, and slopes for the handicapped responding to new laws for barrier-free access. These facilities were either temporary or recoverable, causing no significant physical changes. The works were conducted in consideration of the design and

did not negatively impact the value of the stadium permanently. Also, there was new construction of office spaces, storage, and facilities for efficiency improvement, but they were installed in the basement with the same consideration and respect for the architect's design and did not involve any major physical changes.

However, in the outdoor zone, there had been some physical changes: soon after the completion, a children's pool was installed in the Olympic Plaza and used for some time; in addition, a large tent was installed to be used as an event space during the second and the third periods. Moreover, a temporary theater was built within the compound in 2002 in response to high pressure for commercial use of the land, disturbing views of the whole stadium, especially from the main approach.

After 1976, the First Gymnasium continued to be used mainly as sports facility in three forms: skating rink, swimming pool, and floor. However, installment of multipurpose floor in 1980 dramatically improved its usage and economic efficiency. The Second Gymnasium's main use was also as a sports facility, but began to be used as an event facility as well as early as 1970.

First Gymnasium was used as a swimming pool in summer and a skating rink in winter until 1997, and temporary wooden floors were installed in spring and autumn. When a new international swimming pool was established elsewhere in Tokyo in 1993, First Gymnasium ended its role as a swimming competition venue. After March 1998, it ceased to be used as a public pool, too. However, the structure of pool remains in consideration of its effect on the whole structure, above which steel structure floors are built. However, the diving boards, which had been kept as a symbol of the Gymnasium, were finally removed in 2002, because they disrupted the spatial use as an event venue. This removal improved the first gymnasium's utility value but partially reduced its internal spatial value, which represented its original usage as a pool. Also, some seats were removed when new wheelchair spaces were established for barrier-free access, which disturbed the sequential curves of the stands, but the wheelchair spaces can be removed as they are placed in the original structure.

To sum up, the Yoyogi National Stadium has always been primarily a sports facility, but the pressure to increase use of the facilities grew from 1986 because of changes in the mandate of the operation management body, which led to the stadium being better equipped as a facility for events other than sports-related performances. Although its original value as the 1964 Olympic swimming pool was somewhat decreased by the removal of diving boards and so on, it maintains its original "silhouette and internal view," and there has been no permanent change that significantly reduces its exterior value; thus, it maintains fluidity within the outer space of the "urban core." Moreover, the large silhouette of the roof and the internal space within, which was created by integrating design, structure, and practical facilities, have been sustained thanks to the constant maintenance and repair work of roof surfacing.

Table 2-4 Maintenance and Repair Work on the Yoyogi National Stadium

operation management body	Maintenance and repair work period	Fiscal year	the number of years since completion	work title
National Stadium	1st phase of maintenance and repair works	1979	15	survey work
		1981	17	1st year work
		1982	18	2nd year work
		1983	19	3rd year work
		1984	20	4th year work
		1985	21	5th year work
National Stadium and School Center of Japan	2nd phase of maintenance and repair works			survey work
		1992	28	1st year work
		1993	29	2nd year work
		1994	30	3rd year work
		1995	31	4th year work
Japan Sport Council	3rd phase of maintenance and repair works (1st Medium-Term Strategy)	2003	40	survey work
		2004	41	1st year work
		2005	42	2nd year work
		2006	43	3rd year work
		2007	44	4th year work
Japan Sport Council	4th phase of maintenance and repair works (2nd Medium-Term Strategy)	2007	44	survey work
		2008	45	1st year work
		2009	46	2nd year work
		2010	47	3rd year work
		2011	48	
		2012	49	4th year work
Japan Sport Council	5th phase of maintenance and works (3rd Medium-Term Strategy)	2013	50	1st year work
		2014	51	2nd year work
		2015	52	3rd year work
		2016	53	4th year work
		2017	54	5th year work
Japan Sport Council	6th phase of maintenance and works (4th Medium-Term Strategy)	2018	55	1st year work
		2019	56	2nd year work

Table 2-5 Maintenance and Repair Work by Purpose

Purpose of Work	aging restoration	efficiency improvement	safety assurance	response to demands	total
1st gymnasium	79	42	19	28	168
2nd gymnasium	37	10	5	9	61
Auxiliary building	21	10	5	8	44
Outdoor facilities	26	12	0	27	65
Entire facility	6	3	14	2	25
Total	169	77	43	74	363

Chapter 3

Management policy for the Yoyogi National Stadium

Chapter 3.

Management Policy for the Yoyogi National Stadium

3-1 Present state of conservation and issues of the Stadium

This section discusses an outline of the present state of the Yoyogi National Stadium and its surrounding environment. It then describes factors affecting the conservation of the stadium as a cultural heritage property, categorized by five kinds of pressure: development, environmental change, natural disasters, visitors, and other.

(1) Present state of conservation and issues of the Stadium and the surrounding environment

The Stadium

The bodies responsible for management and operation of the Yoyogi National Stadium changed since its completion in 1964:

- Phase 1 (1964 through 1986): National Stadium as special public corporation;
- Phase 2 (1986 through 2003): National Stadium and School Health Center of Japan;
- Phase 3 (2003 to present): Japan Sport Council

From the time of its construction until today, the main purpose of the stadium has been use as a sports facility.

In the phases 2 and 3, the pressure upon the management body "to increase use of the facilities and to adjust the burden borne by beneficiaries [and] promote management efficiency" grew. In response to this, its use expanded to hosting cultural events, in addition to sporting events. The use and management of the facility has changed in accordance with demand.

Since its completion, Yoyogi National Stadium has continuously undergone various minor repair works. The integrity of the building structure itself has largely been kept intact, despite some changes including installation of elevators and some addition on the north side of the First Gymnasium. The original form and appearance have been largely maintained.

Presently, the stadium is undergoing conservation work for seismic resistance improvement and installation of barrier-free facilities, in preparation for the 2020 Tokyo Olympic and Paralympic Games; some detachable ramps for wheelchairs and the handicapped will be installed in the stadium, employing methods reversible methods.

As asbestos was included in the original building material, before it was known to be a carcinogen. Once it was found to be harmful, removal work was initiated immediately, as it was conducted from August 2006 through September 2007; the Second Gymnasium was closed from August 2006 to March 2007 and the First Gymnasium from January 2007 to September 2007 while the material was removed from the ceiling.

For over fifty years and continuing today, the stadium has been in continual high operation for sporting events, as well for such entertainment as concerts and cultural activities, without any serious problem.

As its operations have expanded, the managing body has updated its disaster-damage mitigation measures such as the establishment of evacuation routes in accordance with the new functions to ensure the safety of visitors, attendees, and stadium staff.

Recognized as a representative work designed by a team of world-famous architects headed by Kenzo Tange, Yoyogi National Stadium has been appropriately maintained and managed in light of today's architectural standards, and with respect to its historical and cultural significance as well as its artistic value.

Surrounding environment

The stadium stands in the middle of an area where there are high-rise commercial and residential buildings. In particular, the south and the east sides of the stadium (Shibuya side) face what has long been a bustling urban district, and redevelopment of the area has been accelerating. The especially outstanding NHK Broadcasting Center, built in 1972 on the west side of the stadium, is scheduled to be reconstructed beginning in 2020. The eastern side of the stadium is congested with commercial buildings; however, their visual impact on the stadium is relatively limited, as the stadium rests on a hilltop, while the commercial buildings are on the bottom or on the slope of the hill. On the northern side, Yoyogi Park still provides the rich greenery it did in the past; however, the landscape around Harajuku Station has changed due to development.

(2) Factors affecting the Stadium as a heritage site

Developmental pressures

The stadium is located in an urban setting, and various scales of developments are planned in the surrounding area, some of which will be within potential buffer zone. These developments might have a negative impact on the views of the stadium and general landscape of the area.

In the area surrounding the stadium, especially within a radius of around 500 meters, there are a number of large-scale construction projects planned for 2019 through 2036 including the following:

- Plan for construction of a large-scale complex at the "Shibuya Scramble Square" (The first phase of the construction completes in November, 2019; and the second phase in 2027. The highest building is to be 76-meter-high and it rises 13 stories above the ground.)
- Construction of the new 90-meter-high NHK Broadcasting Center (construction starts from fall, 2020 through 2035)
- Residential building construction as part of the Shibuya Ward Government Reconstruction Project (The construction completes in late September, 2020. The highest building is to be 143-meter-high and it rises 39 stories above the ground.)

- New development projects planned in Shibuya Ward
- Urban Infrastructure Improvement Project, etc.

Environmental pressures

At present, there has been no sign of damage caused by environmental pressures (e.g., atmospheric pollutants) that might negatively impact the value of the stadium. There are no urgent issues affecting the stadium and its surroundings. However, periodic monitoring should continue, and appropriate actions are required in accordance with the status of the impacts.

When damage occurs, appropriate actions will be required according to local basic policies for disaster prevention. The following three pressures might have some impact on the stadium:

- Atmospheric pollution
- Solar radiation
- Automobile gas emissions

Natural disasters

There have been no large natural disasters that have had a direct impact on the stadium. Natural disasters with some likelihood of occurring in the vicinity of the stadium in the future include typhoon and flooding, fires, disasters caused by precipitation, secondary disasters (water pollution and soil contamination caused by precipitation), and earthquakes.

As earthquake countermeasures, both the 1st and Second Gymnasiums have had seismic resistance improvement work done that will be completed by 2020, before the start of the Tokyo Olympic and Paralympic Games.

Appropriate actions, in case that damage does occur, will be required in accordance with the local basic policy on disaster prevention and remediation in the case of the following:

- Typhoons and floods
- Fire
- Disasters induced by heavy rain
- Earthquakes

Visitor pressures

Since the Tokyo Olympic Games in 1964, Yoyogi National Stadium has added various functions to be effectively used as a multipurpose athletic facility. In the 1980s, it began operating as a cultural facility as well, and became useful not only for sports but also for musical and cultural event performances.

It currently hosts a large number of sporting competitions and cultural events throughout the year, boasting high numbers of running days, occupancy rates, and numbers of visitors. The stadium will be used as one of the venues for the Tokyo Olympic and Paralympic Games in 2020; therefore, intensive visitation and increasing numbers of visitors are expected. To establish visitor reception measures, the following points should be examined:

- Annual number of visitors and facility users, increasing rate of visitor numbers, and annual facility running rate
- Number of seats and the maximum capacity for accommodating visitors
- Residential population within the potential buffer zone; daytime population

The stadium will be used after the 2020 Tokyo Olympic and Paralympic Games as an arena

for sports and as a multipurpose space for cultural activities, as before. Thus, the following three points might count as pressures having some impact on the stadium:

- Installation of universal access for the disabled
- Use of the stadium to increase revenue as an event venue (including installation of temporary buildings in empty spaces)
- Installation of temporary parking lots on the premises in expectation of an increased number of visitors and users

Other kinds of pressures

The stadium is located in a very busy commercial area of Tokyo, where a large number of people are always gathered. It could be a potential target for terrorist attack, as well as for antisocial acts such as graffiti and vandalism.

- Terrorist attacks
- Vandalism

Table 3-1 Annual running days and running rates of the Stadium < ( ) shows running rate (%) >

	2009	2010	2011	2012	2013
1st gymnasium	268 (73.4)	287 (78.6)	249 (69.2)	320 (82.6)	300 (82.1)
2nd gymnasium	302 (99.0)	233 (76.4)	253 (69.3)	312 (85.4)	312 (85.4)
Olympic plaza *1	241 (66.0)	230 (63.0)	156 (42.7)	347 (95.0)	344 (94.2)

	2014	2015	2016	2017
1st gymnasium	312 (85.4)	329 (90.1)	330 (90)	82 (22.4)*2
2nd gymnasium	324 (88.7)	311 (85.2)	307 (84)	77 (21.0)*2
Olympic plaza *1	329 (90.1)	351 (96.1)	350 (95.8)	350 (95.8)

Table 3-2 Annual visitor numbers to First and the Second gymnasiums (unit: person)

	2009	2010	2011	2012	2013
1st gymnasium	1,100,907	1,223,176	1,144,862	1,214,454	1,252,208
2nd gymnasium	302,837	237,550	232,164	283,899	279,556
Olympic plaza *1	554,348	413,299	328,601	70,676	91,550

	2014	2015	2016	2017
1st gymnasium	1,452,903	1,527,572	1,518,390	301,488*2
2nd gymnasium	310,962	334,689	359,822	83,021*2
Olympic plaza *1	110,765	119,726	120,522	119,272

* Annual operation days and rates for the first and second gymnasiums include both sports and general usage.

* Olympic Plaza has been operating as futsal courts since 2011.

*1 Olympic Plaza was operational from 2009 to 2011, and has been used as futsal courts since 2012.

*2 Seismic retrofitting work on the first and second gymnasiums began in July 2017, and they are still closed.

3-2. The significance of the Shibuya-Harajuku area from a city-planning point of view

(1) The designation of a scenic district and its significance

The system for designating scenic districts was based on the 1919 City Planning Act. Scenic districts are districts or zones that seek to maintain the scenic beauty of cities.

Before 1945, or the end of World War II, scenic district management was based on the Ordinance for Controlling Scenic Districts. After a new city planning act was formulated, it became possible for local governments to establish the necessary regulations for maintaining urban scenery in terms of the construction of buildings, housing developments, the felling of trees and bamboo, and other activities.

The scenic district designation system was the only mode for conserving green spaces before the war. The scenic district system was the only urban green area conservation regulation until the passing of the Act on Special Measures Concerning the Preservation of Traditional Scenic Beauty in Ancient Capitals and the Act on the Conservation of Suburban Green Zones in the National Capital Region in 1966.

Such regulations were also possible through the designation of Scenic Forest Conservation Areas based on the Forest Act, but that approach was considered inadequate. Therefore, the Scenic district system was created to preserve beautiful urban landscapes.

The area around Meiji Jingu (Yoyogi) was designated as the first scenic district in 1926, a significant fact in city planning history. After this designation, the number of scenic districts reached 464 across Japan by 1940.

Meiji Jingu's designated scenic district covers an area that extends 18 meters beyond each side of the main approach (Omotesando), western approach (Nishisando), accessway, and gate of Gaien-Aoyama. The purpose of the scenic district designation is to keep the scenery intact and show reverence for the Jingu.

The designation of Meiji Jingu Scenic District also regulates the landscape of the Dojunkai Aoyama apartments. According to a description in the historical docume, “although a part of the western approach (Nishisando) is the Yoyogi Military Drill Ground, almost all other areas are roads and residential lots. Most of the scenery is in the orderly tree-lined main approach (Omotesando), western approach (Nishisando), accessway, and Jingu Gaien, which contains stately and refreshing facilities.” The Yoyogi Military Drill Ground was recognized as “disparate land use” in the scenic area.

The construction of loop roads and land readjustment during war-damage reconstruction

1) The construction of loop roads

Meiji-dori Street (Loop road No.5), which passes through Yoyogi Park, was constructed on the basis of a city planning designation in 1921 before the Great Kanto Earthquake in 1923. After the earthquake, war-damage reconstruction was completed. In 1927, Tokyo’s suburban road network was designated, and it was what the current arterial road system was based on.

2) The land readjustments of war-damage reconstruction

After the Great Kanto Earthquake, the area to the west of the Yamanote Line loop railway was developed, and the number of people who use Shibuya Station increased. A plan for developing Shibuya Station square and the streets around it was adopted in 1932. Although similar plans were developed for Shinjuku, Ikebukuro, and Otsuka as city planning projects, only the plans for Shinjuku were carried out.

The Shibuya Station area was later developed as a war-damage reconstruction project [Tokyo city planning No.8-1 area and No.8-2 area land readjustment of war-damage reconstruction]. At the same time, the east-west running radial road No. 22 (Route 246, 50 meters wide), the north-south running Meiji-dori street (Loop road No. 5, 30 meters wide), Miyashita Park (formerly an open space, created after evacuation), and Mitake Park (site of the former residence of Prince Nashimoto) were newly designated. Linear green spaces created with the land readjustment along Yamanote-Line are significant assets in the Shibuya and Harajuku areas.

The Tokyo Olympics Facility Plan and city planning

1) The Tokyo Olympics Facility Plan

In the 1964 Tokyo Olympics facility plan, the swimming competition was regarded as the second most important event after athletics. As a result, a stadium with a capacity of 40,000 spectators was considered necessary. The site for a stadium with that capacity required several hectares of land. After parts of Jingu Gaien, Kita no Maru Area of the Imperial Palace, Washington Heights, Shinjuku Gyoen, Fukutoshin, and Komazawa Park were nominated as candidate sites, Washington Heights was selected as the build site for the swimming competition facility.

The site would also be used as an athlete village, a stadium during the Olympics, and a forest park after the Games. A vertical connection between both sides of No. 23

radial road (Inokashira Road, which starts at the Omotesando-Meiji Road crossing) was also discussed in the case of the site being used as a park. The northern part of the site was planned to be a quiet forestry park, while the southern part was going to be a recreational area. The No. 23 radial road (25-35 meters wide and 1412 meters in planning length) was one of twenty-something road building projects related to the Olympics.

The park area per citizen in Tokyo at the time was only 10% of the average of foreign cities. Thus, the creation of Yoyogi Park (forest park) would increase the average value to 0.1m^2 per citizen (a 20% increasing). Eika Takayama (Professor Emeritus at the University of Tokyo) saw the opening of the Metropolitan Expressway as a new opportunity to observe Tokyo. In Takayama's essay, he recognized that the opportunity to experience city center greenery through the Metropolitan Expressways No. 1 and No. 4, which stretched from Hanada Airport to Hatsudai (near Shinjuku), was a vital part of people's daily life.

2) The Construction of the Over Bridge

For spectators, the main points of entry to the stadium are the Shibuya Gate and the Harajuku Gate. An overbridge crossing Radial Road No. 23 was planned for the Harajuku Gate. However, after the completion of the stadium in 1964, the plan to build the overbridge was replaced with grand steps, which would be built later. At the time, Tange lamented that the overbridge was unlikely. Although there is now a footbridge connecting the stadium block and Harajuku Station, building the original overbridge proposed by Tange Lab should be revisited.

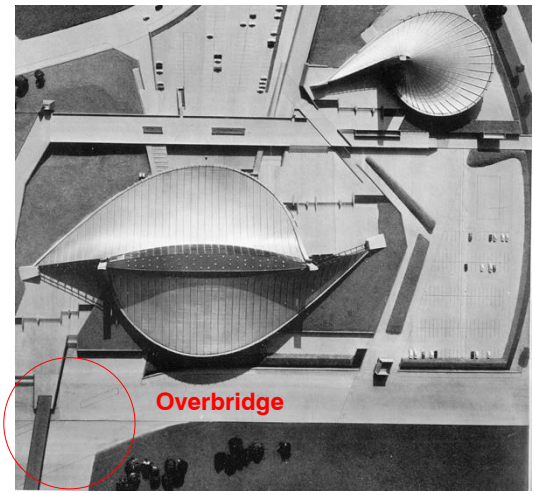


Fig. 3-1 Site plan of Yoyogi Stadium
Excerpted from *Shinkenchiku* in Mar. 1963

3) The Construction of the Olympic Bridge

The Olympic Bridge in front of Harajuku Station is also a part of the 1964 Olympics legacy. At the time, the primary access from Omotesando to Meiji Jingu was the Jingu Bridge, built in 1920. However, to ensure accessibility to the Yoyogi National Stadium (the primary venue for swimming competitions), the Olympic Bridge was built in August 1964.

Fig. 3-2 Olympic Bridge
(Source: http://tomagazine.jp/news/599/)

Summary: The significance of Yoyogi Stadium site in terms of city planning

The significance of the Yoyogi Site to the city

The site of Yoyogi Stadium used to be the residence of the Ii Family and a part of the Imperial Estate. Meiji Jingu was built on the site in 1920. The rural area surrounding Meiji Jingu became a Military Drill Ground and then a location for the 1964 Tokyo Olympics. This site plays an important role in maintaining sacred spaces and green areas in Tokyo, responding to the needs of each era. Also, this site is significant in urban history, because it was the first scenic district designation in Japan.

Thus, the "setting" of Yoyogi Stadium shows the unique history of city planning in Japan, and its value needs to be preserved.

The relationship between the site and the city (the spatial structural value)

Welcoming the many spectators flowing into the site from Shibuya Gate and Harajuku Gate, Yoyogi Stadium was designed to be a space "where enthusiasm peaks and all become one." While plazas, pathways, and *michikukan*, or promenades, together create a sense of tension between the first and second stadiums, the goal of the design was to emphasize festivity while ensuring a smooth flow of people. External spaces (voids) were an inevitable part of the installation, enhancing the festivity experienced inside of the buildings. Thus, the spatial structure of the site (the relationship between the buildings and their external space) should also be part of the conservation.

The pavement for Shibuya Gate was planned to begin at the site boundary in the original 1964 plan. The existing pavement covers only a part of what was planned, showing the discrepancy between reality and planning.

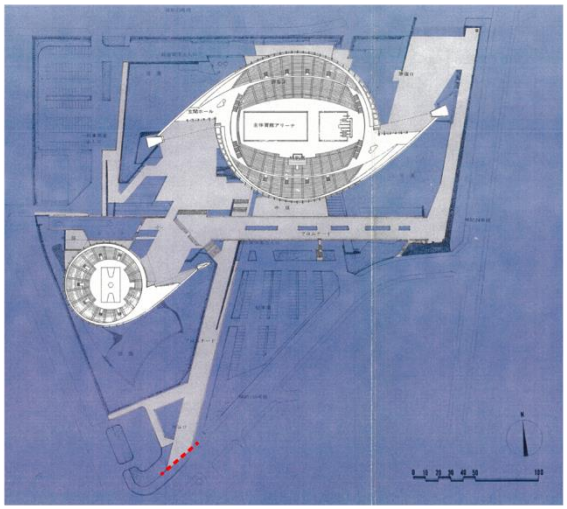


Fig. 3-3 Site plan of Yoyogi Stadium 1964.10

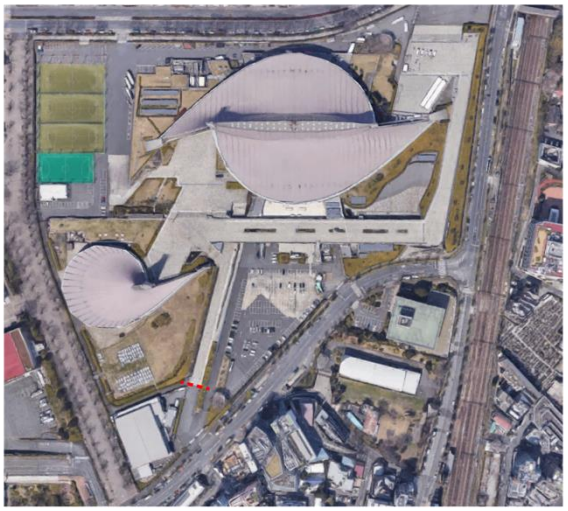
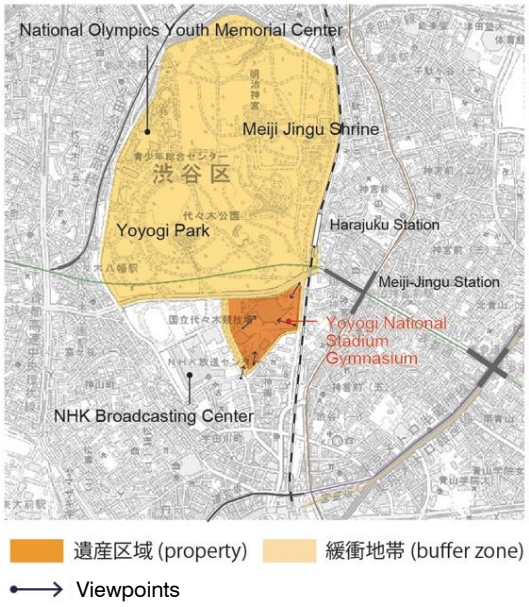


Fig. 3-4 Current Yoyogi Stadium（Source: Google Map）

(2) Preferable Buffer Zone

This chapter aims to examine what would be the preferable buffer zone for Yoyogi Stadium from among multiple possibilities. The site of Yoyogi Stadium is under high development pressure due to the bustling Shibuya Station area nearby. The Shibuya Station area is one of the sub-centers of Tokyo, and many retail stores are located in the Harajuku area, near it.

Possible Buffer Zone 1



＜Area＞

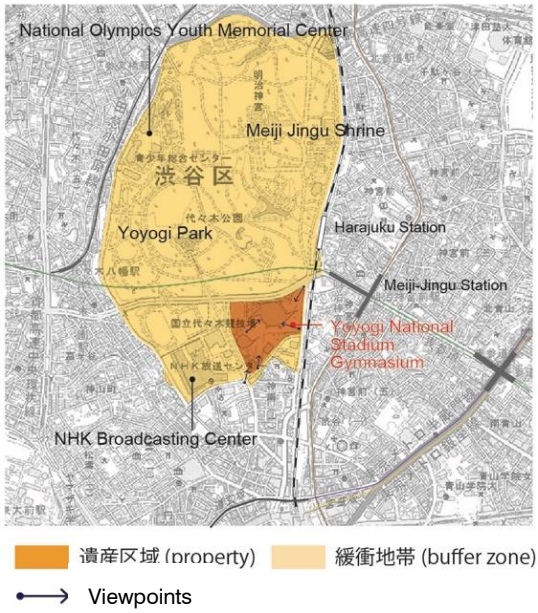
Property area: Yoyogi Stadium

Buffer zone: the area around Yoyogi Stadium, Meiji Jingu, part of Yoyogi Park, Harajuku Station

＜Concept＞

This buffer zone is organized by large areas (lots) owned by shrines, public, and quasi-public agencies. The areas occupied by private properties are excluded. The designation of this buffer zone is considered the minimum level of landscape control.

Possible Buffer Zone 2



＜Area＞

Property area: Yoyogi Stadium

Buffer zone: Yoyogi Stadium, Meiji Jingu, Yoyogi Park, NHK Broadcast Center, Harajuku Station

＜Concept＞

This buffer zone is based on the existing scenic district. The entire area of Yoyogi Park and Meiji Jingu is included in the zone. The scenic district regulations control activities in this zone. However, the east side of the JR rail tracks and the southern part of the property are inadequately regulated.

Possible Buffer Zones 1 and 2 are described on the basis of the existing site regulations. However, the development situation around the site has generated the following problems.

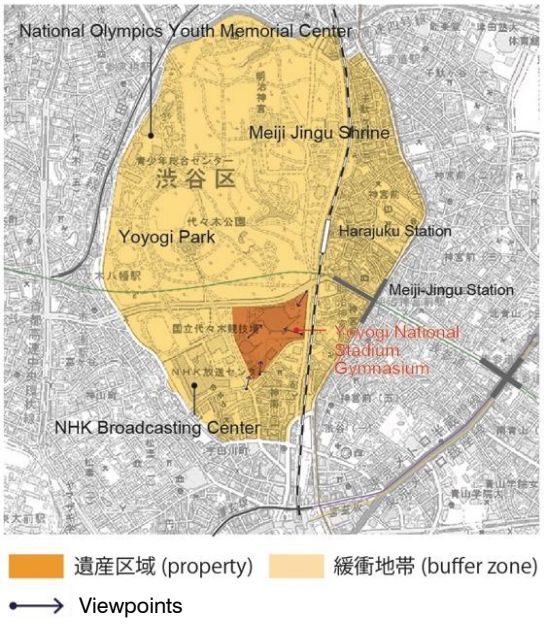
① There is potential for development in the Shibuya Station area, where there is no designated height control. There is a possibility that new development would block the vista from Harajuku Station.

② There is a possibility that new development along Meiji-dori Street (loop road No. 5) will block the vista from Shibuya Station.

③ It is necessary to discuss the boundary of the buffer zone considered the “setting.” The boundary needs to be discussed when the concept of the “field of Yoyogi” is emphasized.

Possible Buffer Zone 3 is proposed in consideration of the points mentioned above.

Possible Buffer Zone 3



＜Area＞

Property area: Yoyogi Stadium

Buffer zone: Yoyogi Stadium, Meiji Jingu, Yoyogi Park, NHK Broadcast Center, from the southern part of Yoyogi Park to Workers Welfare Hall, the area between JR line and Meiji-dori Street (loop road No. 5).

＜Concept＞

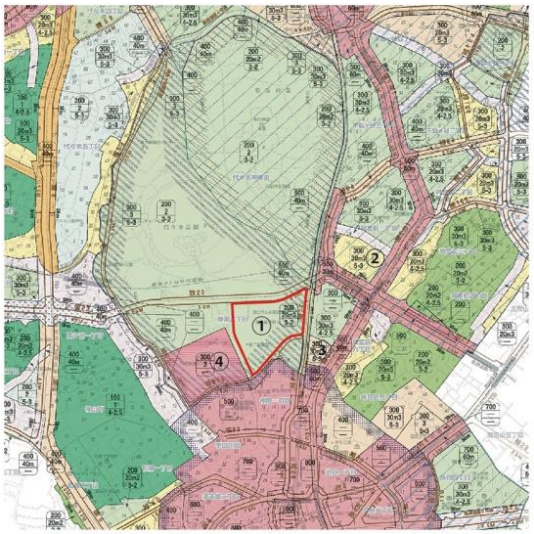
Considering the entire field of Yoyogi (plateau) as the setting of Yoyogi Stadium, the boundary of the buffer zone should include the entire area. This buffer zone can control the risk of damaging the vistas of the site from both Harajuku Gate and Shibuya Gate.

<Problems in designating Buffer Zone 3>

Buffer Zones 1 and 2 are based on existing regulations, while Buffer Zone 3 includes private properties. City planning regulations should be considered to create a buffer zone as Possible Buffer Zone 3.

<Existing regulations>

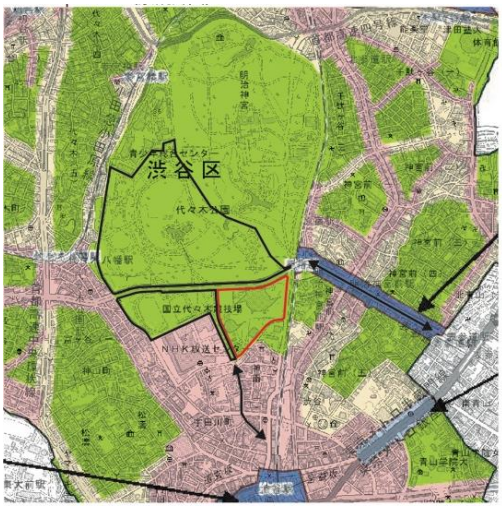
The area of Buffer Zone 3 is controlled by the following regulations on urban planning:

☐ **Zoning**	☐ **Scenic district**
	
The site is designated as a category Ⅱ mid/high-rise oriented residential zone (building coverage ratio: 60%, floor-area ratio: 200%, semi-fire protection district). *NHK Broadcasting Center is designated as a commercial zone (building coverage ratio: 80%, floor-area ratio: 300%)	Yoyogi Park and Meiji Jingu are designated as category Ⅱ Scenic Districts, and Meiji Jingu is designated as a category Ⅰ Scenic District. Meiji Jingu is also designated as a special green space conservation area. Activities are regulated in a special green space conservation area.

☐ **Height district**

The site is designated as a category Ⅱ height district (maximum height 20m). There is no height limit in the southern area of the site.

☐ **Landscape Plan**

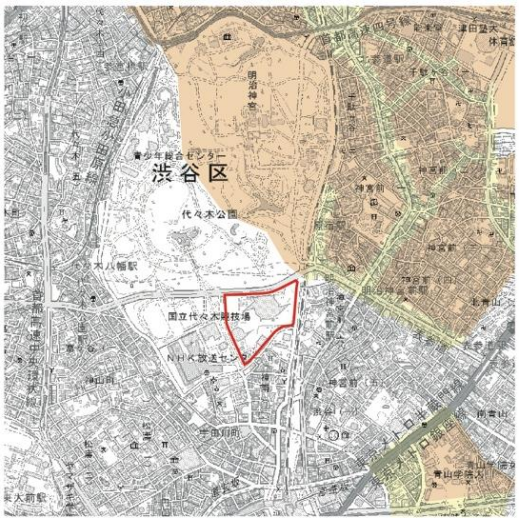


Yoyogi park area is designated as a public facility of landscape importance. Koen-Dori Street and the Omotesando Street area are also public facilities of landscape importance. The roadside area of Omotesando Street is designated as a special scenic development zone. Notification is needed when construction, alterations in the appearance of the building, or structuring happens in the area.

☐ **Urban park**

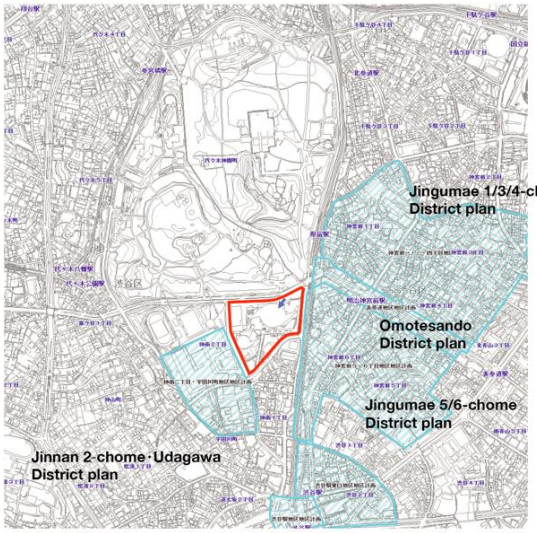
The site of Yoyogi Stadium is included in the public park designated by city planning. However, the area is regulated by Urban Park Law, because the site is not opened as a park.

☐ **Education-oriented area**



Meiji Jingu and the area to the north of Omotesando Street is designated as a category Ⅰ education-oriented area and a category Ⅱ education-oriented area.

☐ **District Plan**



Jinnan 2 Chome･Udagawa District Plan:

"Create a comfortable landscape that harmonizes with the neighboring Yoyogi park."

Jingumae 5/6 Chome District Plan:

"Create a comfortable urban housing area that harmonizes with commercial entities and business."

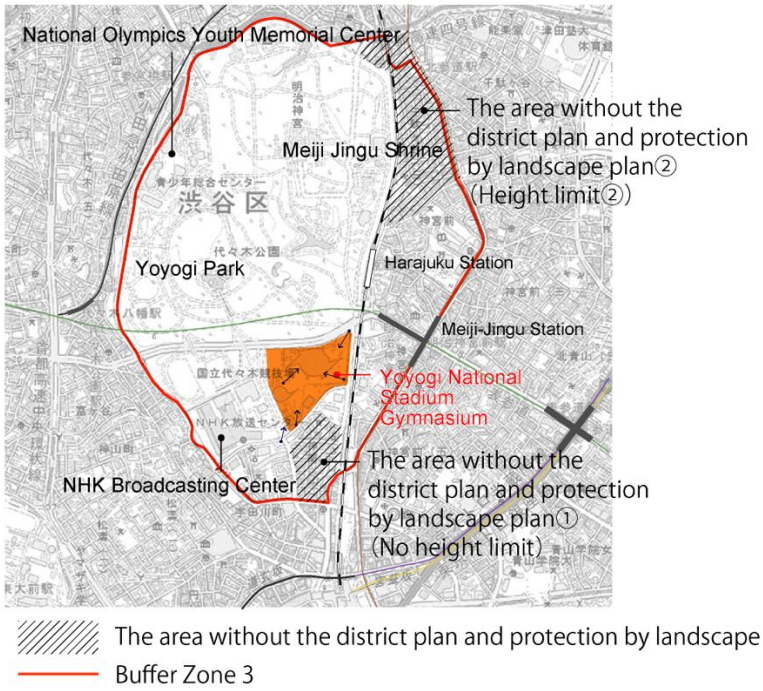
Jingumae 1/3/4 District Plan:

"Promote greening, rooftop greenery, and wall greening in the area to create an urban environment that harmonizes with the forest of Meiji Jingu and Omotesando Street."

Omotesando District Plan:

Regulate inappropriate usage of the area and promote its growth as a commercial area that harmonizes with the residential area.

<Area that is not protected by the law



1. The area without district plans or protection from landscape plans (southern area):

In the southern part of the heritage area, where there is no height regulation, the Jinnan 2 chome Udagawa areas are covered by district plans. In the district plan area, the public can negotiate with developers. In areas that are not covered by the district plan, there are few chances to discuss with developers.

2. The area without the district plan or protection from landscape plans (eastern area):

There are height limits in the area. Moreover, in areas covered by the district plan, the public can discuss with developers. In areas that are not covered by the district plan, there is little chance to discuss with developers.

The following methods can help control problematic developments.

- **Height District**: Create a new height district area around the Shibuya Station area to conserve the vista of the site. However, it may be complicated considering the current situation of development pressure.
- **District Plan**: Create a new district plan for the area, where there is no district plan, to provide an opportunity to discuss the landscape around the site.
- **Special Scenic Development Zone:** Update the landscape plan and add a new Special Scenic Development Zone.
- **Scenic District**: Expand the current scenic district to conserve the landscape of Meiji Jingu and Yoyogi Park.
- **Re-zoning**: Downsize the total floor area ratio to conserve the landscape of the site. It may be difficult considering the current situation of development pressure.

Stakeholders

Stakeholders and their distribution in Buffer Zone 3 are as follows. In the northern and western areas, there are shrines and public sectors, except NHK.

In the eastern area, although there are some public facilities, almost all the properties are owned by private sectors. Controlling new development and the landscaping of the property is difficult. Buffer Zone 3 can provide an opportunity for negotiation and regulation.

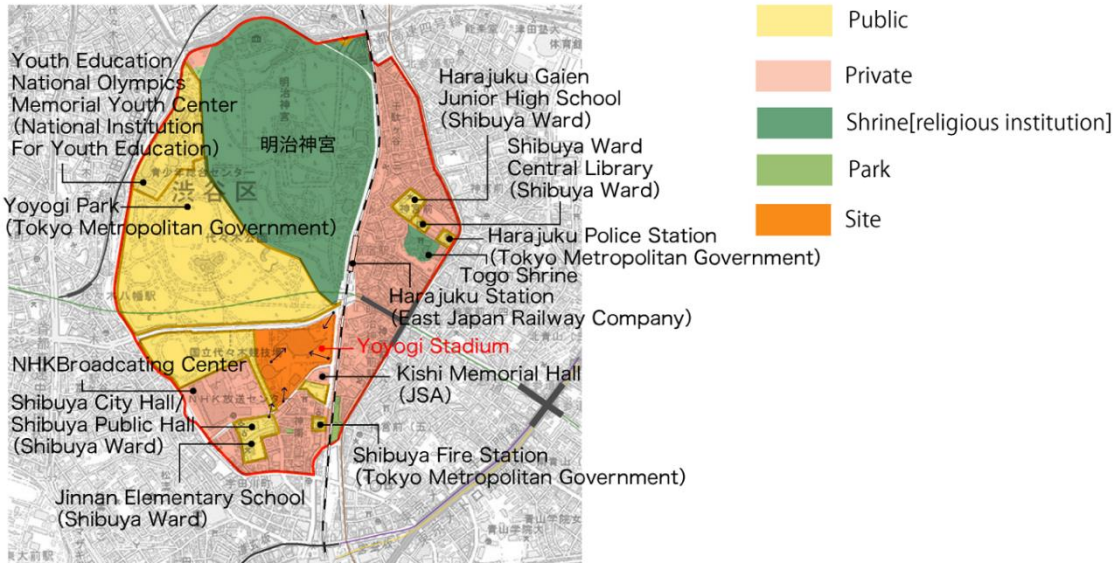


Fig. 3-5 Stakeholders and their distribution in Buffer Zone 3

Category	Name of facility	Owner
Public entity	National Olympics Memorial Youth Center	National Institution for Youth Education (governing agency: Ministry of Education, Culture, Sports, Science and Technology
	Yoyogi Park	Tokyo Metropolitan Government
	Metropolitan Police Department Harajuku Branch	Tokyo Metropolitan Government
	Shibuya Fire Station	Tokyo Metropolitan Government
	Shibuya Ward Office/Shibuya Public Hall	Shibuya Ward Office
	Jinnan Elementary School	Shibuya Ward Office
	Harajuku Gaien Junior High school	Shibuya Ward Office
	Shibuya Ward Central Library	Shibuya Ward Office
Private entity	NHK Broadcasting Center	Japan Broadcasting Corporation
	Kishi Memorial Gymnasium	Japan Sports Association
	Harajuku Station	East Japan Railway Company
Others	Meiji Jingu	Meiji Jingu (Shinto shrine) (Religious Institution)
	Togo Shrine	Togo Shrine (Religious Institution)

3-3. Landscape simulation

(1) Viewpoint setup looking toward the Yoyogi National Stadium

The space around the Yoyogi National Stadium site is diverse; it includes the area around Shibuya Station (which is undergoing redevelopment and is surrounded by high-rise buildings), the spacious Meiji Jingu (which is a rare natural oasis in central Tokyo), the Harajuku area, and Omotesando (a crowded avenue known for its flagship stores with luxury brands).

Thus, the view of the Yoyogi National Stadium varies substantially depending on where the viewpoints are set.

There are also risks that the view could be lost because of future urban development, and how such risks arise is just as diverse as the areas in the background.

To investigate the landscape risk to the view of the stadium, the following five viewpoints were set up on the basis of the designer's plan, the distinctive background, and the experiences of many people since its completion to simulate the landscape as per known development plans. Efforts have also been made to verify the effect of future development in the surrounding area on the views (below):

A. View along the line of movement of distinguished guests (starting at Shibuya Gate) against the green background of the Meiji Jingu
B. View of the approach to the stadium from the very busy Harajuku Station
C. View from the southwest intersection (the Shibuya Ward Office, in front of the Shibuya Public Hall, and Koen-dori), looking toward the entire site
D. View eastward from the promenade (Tokyo area), connecting the first and second gymnasiums
E. View westward from the promenade (Tokyo fringe areas), connecting the first and second gymnasiums

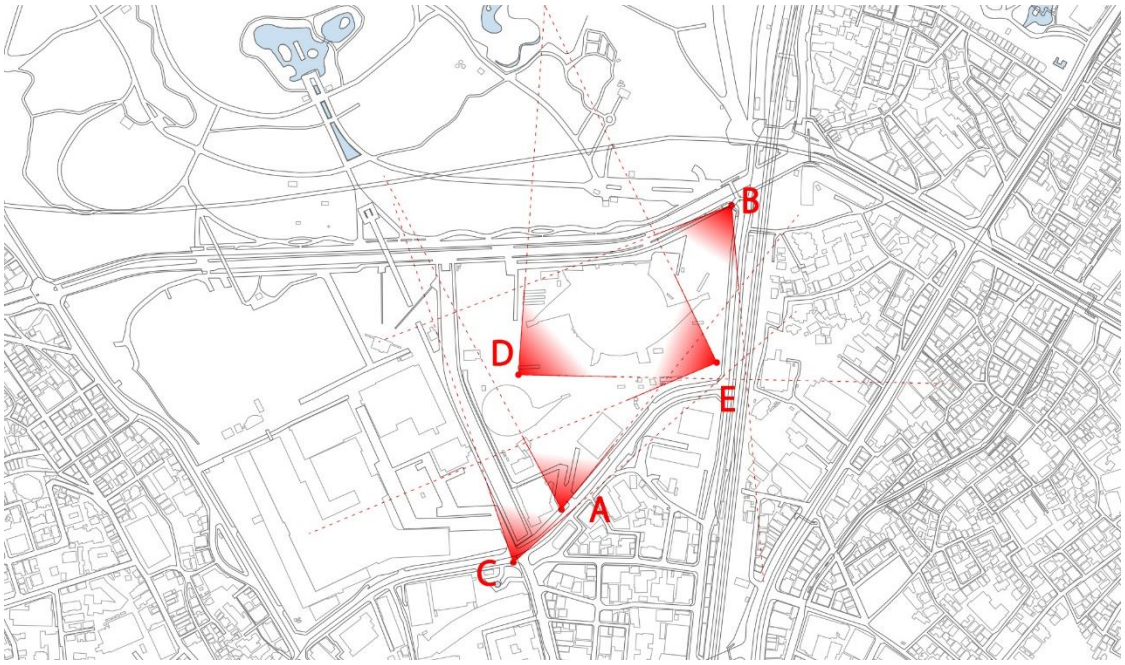


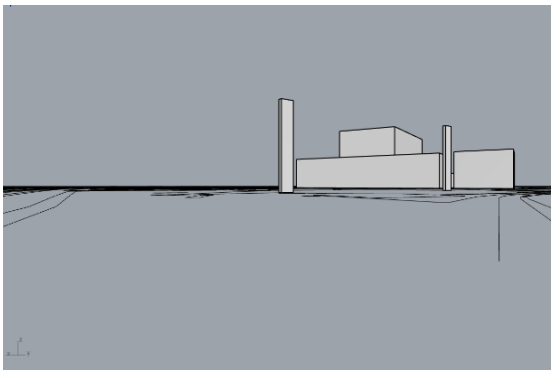
Fig. 3-6 Viewpoints setup looking toward the Yoyogi National Stadium

(2) Creating landscape simulation

First, 1) photograph the Yoyogi Stadium from the specified viewpoints. At the same time, record the positions, orientations, and elevations of the photographing points (Fig. 3-7) create a 3D model by referencing the planar shapes and height of planned new buildings based on the available development plans of the surrounding area. Set the viewpoints using 3D software based on the positions, orientations, and camera angles recorded in 1) and generate the perspective views of the model created. 3) Collate the photographs taken in 1) with the perspectives generated in 2) to create composite images. Finally, 4) check and adjust the front-rear relationship of objects in the images.

Fig. 3-7 Measurements for photographing directions

① Taking photos and recording photographing positions and orientations



② Creating the 3D model

③ Collating photographs and the 3D model

④ Adjusting the front-rear relationship of objects in the images

Fig. 3-8 Procedure for creating landscape simulation

(3) Characteristics of respective viewpoint settings and landscape simulation

A. View along the line of movement of distinguished guests (starting at Shibuya Gate) against the green background of the Meiji Jingu

Fig. 3-9 (a) Landscape simulation

Fig. 3-10 (b) Current view (November 2018)

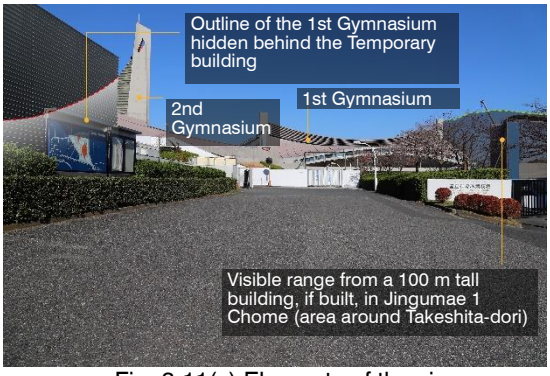


Fig. 3-11(c) Elements of the view

The simulation view Fig. 3-9 (a) is what would be immediately visible after passing through the Shibuya Gate along the path used by athletes and distinguished guests to access the site. The first and second gymnasiums are visible in their entirety along the approach axis line, though the second gymnasium is partially blocked by temporary building on the south side (The temporary building shown in the photo at the northeast corner of the intersection was nonexistent when the gymnasium was completed. The building was removed in April 2019, and another new temporary building has been constructed

which is blocking much of the view of both gymnasiums). As a result, it may become necessary to modify the shape of the temporary building to ensure entire views of the gymnasiums.

The black area to the right of the first gymnasium indicates the potential visibility range of a 100-meter tall building, if built, in the Jingumae 1 Chome area where Takeshita-dori is situated. The development of the surrounding area could partially affect the visibility of the outline of the first gymnasium. However, the vast area behind the curve connecting the two main pillars of the first gymnasium and the outline of the second gymnasium belongs to the Meiji Jingu. Therefore, the probability of this view being affected is low.

If another viewpoint “A” is set up closer to the gymnasiums along the approach axis line from the original viewpoint A, where the pavement transitions from asphalt to the stones of the Metropolitan tram car rails, the temporary building is not likely to be visible depending on its size. A future investigation is necessary as the location is currently under construction and photographing it is not possible.

B. View of the approach to the Yoyogi National Stadium from the very busy Harajuku Station

Fig. 3-12 (a) Landscape simulation

Fig. 3-13 (b) Current view (November 2018)

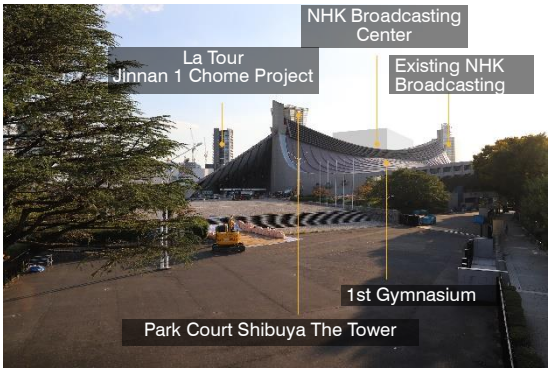


Fig. 3-14 (c) Elements of the view

The landscape simulated Fig. 3-12 (a) is the view from the pedestrian overpass on the traffic line approaching the stadium from Harajuku Station. Many spectators will take this approach for stadium events. The second gymnasium is hidden behind the first gymnasium, but the structural components—such as the main pillars and cables of the first gymnasium—are highly visible, and the suspended roof and its characteristic curve are also clearly visible.

In the background are 1) recently completed high-rise condominiums (La Tour Jinnan 1 Chome Project), 2) the NHK Broadcasting Center scheduled for construction between 2026 and 2036 (maximum height of 90 m), and 3) a high-rise condominium project scheduled for construction adjacent to the Shibuya Ward Office (Park Court Shibuya The Tower). The buildings behind the stadium may considerably impact the visibility of the outline of the first gymnasium, although visibility will be dependent on the color and types of exterior materials used in constructing these buildings.

C. View from the southwest intersection (the Shibuya Ward Office, in front of the Shibuya Public Hall and Koen-dori), looking toward the entire site

Fig. 3-15 (a) Landscape simulation

Fig. 3-16 (b) Current view (November 2018)

Fig. 3-17 (c) Elements of the view

The simulated view Fig. 3-15 (a) is the northward view when standing at the southwest corner of the intersection (in front of the Shibuya Public Hall, currently being rebuilt). Similar to the view from viewpoint A, the development in the Jingumae area to the right of the first gymnasium may affect the visibility of its outline. The temporary building shown in the photo at the northeast corner of the

Fig. 3-18 Open landscape

intersection was nonexistent when the gymnasium was completed. The building was removed in April 2019, and another new temporary building has been constructed which is blocking much of the view of both gymnasiums, and the open and gently sloping landscape of the gathering place connecting the two gymnasiums at the time of completion is hardly visible.

D. View eastward from the promenade (Tokyo city center area), connecting the first and second gymnasiums

Fig. 3-19 (b) Current view (November 2018)

Fig. 3-20 (c) Elements of the view

This is the view from the promenade, an open space, where the entrances to the first and second gymnasiums face each other and point toward the center of Tokyo. Because the viewpoint has been set very close to the building, a wide field angle is necessary to view the entire building. The view from this point only includes the first gymnasium, with the entire gymnasium and shapes of respective elements clearly visible. Visible in the background are the skyscrapers of Nishi Shinjuku, most notably the Tokyo Metropolitan Government Office building on the left and high-rises covering 100 m in the Aoyama area on the right side of the gymnasium. The developments in these areas are naturally assumed to affect the view, but the extent of the effect is expected to be limited, as most of the background is the site of the Meiji Jingu, as it is for viewpoint A.

E. View westward from the promenade (Tokyo fringe areas), connecting the first and second gymnasiums

Fig. 3-21 (b) Current view (November 2018)

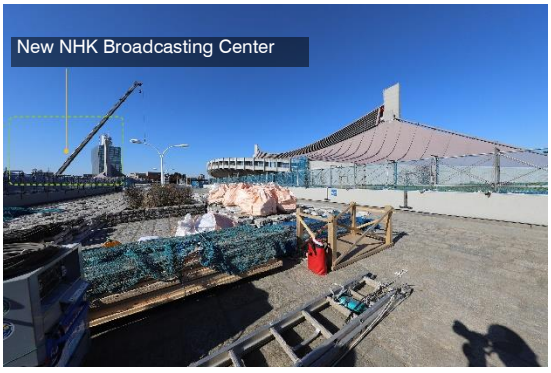


Fig. 3-22 (c) Elements of the view

This is the view when standing in the promenade; it is the same as viewpoint D except for looking westward (Tokyo fringe area), with a wide field of view to include most of the two gymnasiums. Behind the first gymnasium is the Meiji Jingu site; therefore, development of the surrounding area is not expected to affect the view of the gymnasium significantly, but the development to the west of the site—centering on the new NHK Broadcasting Center—will mostly overlap with the line of sight to the second gymnasium; Furthermore, it is expected to substantially affect visibility of that building.

3-4. Policy for the protection

(1) State of conservation management

Yoyogi Stadium was built in September 1964 as one of the stadiums prepared for the Tokyo Olympic Games. It was firstly used for indoor swimming pools and basketball courts. After the Olympics, the Stadium has been continued to be used with necessary maintenance, repair or modification along with the usage expansion to not only sports but cultural events like music concert. In the compound, the first and second gymnasiums with the connecting building (auxiliary facility) in the center, there are futsal courts in the Northeast part, a temporary building in the South part, and parking areas.

The repair works for the buildings started since 1981 fiscal year. Some works including aseismic repairs are currently undergoing, such as painting of the roofs and exterior concrete walls for the first and second gymnasiums, facilities' modification and interior finishing. Various kinds of works have been carried on the buildings: ordinary maintenance, safety measures for visitors, and improvements for aged person or physically disabled person, while the value of the Stadium like exterior and interior appearance of the original structures have been kept till today. That can also be said about the ongoing works. In principle, the building appearance both exterior and interior will be preserved in the good condition after the completion of the works.

Partly reconstruction works are undergoing in the exterior area by keeping Tange's "michikukan" idea, i.e. taking advantage of topographical level difference.

Specification of each part after ongoing works are shown as below:

Exterior Appearance

- **Roof painting (for the first gymnasium)**
  Removal of the weathered existing painting on the roofs and newly heat insulating coating (without a large change of the color)
- **Exterior wall painting**
  Complete removal of the layered existing paintings on the exterior walls and re-painting by the same material in the last one, i.e. spraying CELLASKIN which contains grinding crushed pottery waste

Interior Appearance

- **Wall modification**
  - Repair of the existing walls (for the first gymnasium and auxiliary facility)
    - Setting anti-seismic walls and increasing the wall thickness
  - Reinforcing the partition walls by fiber sheets (for the first gymnasium)
    - Attaching carbon fiber sheets on the partition walls 80mm thick to prevent occurrence or expansion of crack
  - Removal of the concrete brocks' walls and reinforcing works (for the first gymnasium and auxiliary facility)
    - Removal of the existing concrete brocks' walls and replaced it to dry masonry walls etc.
  - Repairing the RC walls (for the first gymnasium and auxiliary facility)
    - Crack repairing

· **Ceiling modification (for the first gymnasium)**

Reinforcing the ceiling

· **Arena floor modification (for the first gymnasium)**

Removal of the exiting floorings and changing it to floors covering material composed of polyvinyl chloride for sports

Structure

· **Reinforcing the slabs under the spectator stands (for the first gymnasium)**

Winding fiber sheets around the double slabs under the floor

Foundation

Based on the result of seismic diagnostic, adding new piles and reinforcing the foundation (for the first gymnasium)

Other: Exterior Area

· **Repairing retaining walls**

Dismantling the existing stone retaining walls, and construction of a new L-shaped structure and stone wall

All damaged parts observed on the buildings before the works will be restored, to recover the sound condition after the completion.

(2) Basic policies for management

Yoyogi National Stadium, built in September 1964, is a state-funded sporting facility to achieve the objective described in the Article 3 (*) of the Act on the Japan Sport Council.

It was built as a venue for swimming and basketball competitions at the Tokyo Olympics, which were held later in 1964. Since its construction, it has undergone several repair and improvement works, as it became necessary to use the facility for more diverse activities. Some changes were made to the interior of the first gymnasium; for instance, the original swimming pool was removed and replaced with flooring, and a section of the arena was modified to create space for wheelchairs. Changes were kept as minimal as possible to enable the continued use of the facility. Despite such partial changes, the building frame has been kept intact. Along with its function as a sporting arena, the elements determining the value of the stadium, such as the outer and inner appearance of the buildings and its original suspended-roof structure, have been conserved to this day. Value elements include “large roofs with stately and slow curbs” and “the large space created by the dynamic, ‘八’-shaped cross section.” After the Olympic Games, new facilities such as futsal courts and temporary theaters were built within the compound. This was done without compromising the original concept of spatial use, i.e., the “arrangement of buildings along the axis” and “the creation of *michikukan* taking advantage of topographical level difference,” which has also been maintained to this day.

In such manners, repair and improvement works have been conducted on the exterior and the buildings over the years. In spite of some changes, the shapes of the features have remained largely intact. It is safe to say that the architect Tange’s philosophy has been kept alive since the construction.

For these reasons, the basic policies for maintaining the property, which is based on

securing convenience as a sports facility for users, are set as follows:

“To achieve the objectives set out in Article 3 of the Act on the Japan Sport Council”

“To preserve the original outer design (shape) of the Yoyogi Stadium as the time of completion”

“To preserve the large inner space created using the distinctive, pillar-less structure”

“To preserve the original structural system (suspended roof structure)”

“To preserve the *michikukan* created taking advantage of the topographical level differences”

“Not to build new constructions within the compound that can impact the landscape, in consideration for ensuring the view to the buildings of the stadium. Temporary constructions, however, are not subject to this policy.”

“Not to add functions that could potentially damage the value of buildings as sports facilities”

(*) The Article states, in its essence, that the objective of the Japan Sport Council is to contribute to the promotion of mental and physical welfare of the people of Japan, and for that purpose, the Council establishes and operates sports facilities in an appropriate and effective manner and provides supports necessary for sports promotion.

3-5. Monitoring

For the purpose of securing protection of the value of the Stadium, periodic and systematic monitoring shall be implemented by setting up appropriate monitoring indicators from the standpoints shown below.

Note: These monitoring indicators and methods shall be established in the future when the definite buffer zone is delineated, at which time some restrictions on building heights and outdoor advertisements will be imposed.

Subject	Monitoring points	Method	Contents
Protection and management	Budget to maintain the Stadium (restoration and conservation)		Securing the budget and costs of repairs, conservation and maintenance of the Stadium
	Number of reported damages to the Stadium, with details	Implementation of regular patrols to assess the soundness of the Stadium and the structure	Assessing reported damages (cracks in concrete, stability of stone walls, and leaking) to the Stadium
	The appearance of the Stadium (with/without deterioration and disruption)	Fixed-point photography on the appearance of the Stadium and implementation of regular patrols	Assessing whether the physical integrity of the Stadium is secured.
Impacts of development	Impacts of public works	Number of applications and acceptance for public works conducted surrounding the Stadium (within the buffer zone)	Counting number of accepted applications and details submitted
		Observation of the factors affecting negative impacts on the landscape (Fixed-point photography on the landscape)	Noting disqualified buildings and their corrective status
		Conducting Heritage Impact Assessment (HIA) for the development planned around the Stadium and its buffer zone	Assessing the impacts of development on the view toward the Stadium and requesting changes to unacceptable the development projects

	Impacts of private developments	Number of development projects being conducted and planned around the Stadium (including the buffer zone)	Noting the number of applications and their content in relation to laws and regulations
		Number of notifications made, as required under the landscape ordinance	Counting number of the notifications required under the landscape ordinance
		Number of controls over outdoor advertisements in violation	Assessing the substances of the violating outdoor advertisements and their corrective status under the landscape ordinance
		Number of existing disqualified buildings which are providing negative impacts on the views to the Stadium, and their corrective status	Understanding the factors imposing negative impacts on the landscape (Fixed-point photography on the landscape)
		Conducting HIA for development planned around the Stadium and its buffer zone	Understanding the impact of development on the view to the Stadium
Impacts of environmental pressures	Climate change-induced abnormalities	Annual amount of precipitation and local heavy rain occurrence	Understanding the impacts of climate change on the Stadium area
	Global warming	Soundness of vegetation	Assessing the status of overgrowing and withered trees within the premises of the Stadium through fixed-point photography and regular patrols
		Temperature on the inside and outside of the Stadium	Assessing the impact of the heat-island phenomenon to the site
Impacts of natural disasters	Damage caused by typhoons and flooding	Soundness of the Stadium and its structures	Assessing impacts of typhoons and flooding on the Stadium by observing the points of the Stadium and status of the disruption
	Earthquakes	Soundness of the Stadium and its structures	Assessing impacts of earthquakes on the Stadium by observing the points of the Stadium and

			status of the disruption
	Impacts of the aforementioned natural disasters on landscape	Number of damaged properties within the buffer zone	Assessing the number of damaged properties
	Impacts of fires on the Stadium and its landscape	Number of fires	Counting the number of fires breaking out within the buffer zone
		Number of inspections for fire prevention facilities	Inspecting fire prevention facilities in the Stadium
		Number of firefighting trainings and disaster drills implemented	Implementing firefighting training and disaster drills
Pressures of visitation and tourism	Impacts of increasing visitors on the Stadium and its premises	Number of visitors and facility users	Counting number of visitors and facility users
		Number and frequency of sporting events and concerts	Counting events and understanding the frequency of sporting events and concerts
		Average time spent per visitor and user	Assessing the average time spent per visitor and user
		Number of parking spaces for visitors and users and their capacities	Counting the number of parking spaces for visitors and users, understanding their capacity and the average number of vehicles using the spaces
		Daytime population within the Stadium and surroundings; vehicle traffic (Fixed-point photography)	Noting the daytime population within/around the Stadium, vehicle traffic
Visitor reception	Appropriately communicating the value of the Stadium	Number and frequency of lectures and seminars on the Stadium	Counting number of lectures and seminars on the Stadium
		Number of trainings for volunteer guides and staff	Counting number of trainings and seminars for volunteer guides and staff in order to communicate the value of the Stadium appropriately

		Promotional activities for the Stadium driven by private entities	Counting the promotional private activities conducted, and understanding the content of the activities
		Planning and installation of interpretation boards (Interpretation boards for disabled individuals are included as well)	Getting aware of the status of plans to install interpretation boards
	Visitor direction in event of emergency	Preparing script for evacuation, training relevant local officials in evacuation guidance, and collaborating with local organizations	Safe guidance for visitors and facility users in the event of an emergency visitors and facility users guide when emergency
	Providing information on the Stadium	Amount of information provided through pamphlets and official website	Assessing the amount and content of information provided through pamphlets and official website
		Number of newly published guidebooks and pamphlets on Stadium	Counting number of newly published guidebooks and pamphlets on the Stadium
		Number of visitors to the official website	Counting the number of visitors to the official website

Monitoring cycle or data collection frequency and the authority responsible for monitoring shall be considered in the future on consultation with the property owner.