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The Birth and Development of High-Rise Buildings in Japan: Focusing on the Historical Development of Height and Floor Area Ratio Regulations

Akihiko Osawa†

Department of Architecture, Toyo University, Japan

Abstract This paper reviews the history of the birth and development of the skyscraper in Japan, mainly from the perspective of the legal system, and presents the following points: 1) After 1919, building height was limited to 31 m or less, which continued after the war and defined the skyline of Japan's major cities; 2) The 31-meter height limit became a problem during rapid economic growth. With the development of tall building construction technology, the height limit was eliminated, and skyscrapers were born in Japan in the 1960s; 3) Later, the number of skyscrapers increased more rapidly in the post-bubble period after the collapse of the bubble economy in the 2000s than in the boom years of the 1980s, when the floor-area ratio was relaxed for economic uplift and urban renewal. The number of skyscrapers increased rapidly against the backdrop of the deregulation of the floor-area ratio.

Keywords High-rise Building, Height Restriction, Floor Area Ratio, Relaxation of Restrictions

†Corresponding author:
Akihiko Osawa
E-mail: osawa030@toyo.jp

1. Introduction

A vast number of skyscrapers are springing up all over the world. As of the end of 2018, there were 4,299 skyscrapers with a height of 150 m or more, 75% of which were completed after 2000 (CTBUH database). This trend is similar in Japan. In Tokyo, there are 140 buildings over 150 meters in height, 82% of which were completed after 2000 (as of 2020, according to the Annual Report of Building Statistics, Tokyo Metropolitan Government). It would not be an exaggeration to say a skyscraper boom exists in Japan and the world. However, the history of the skyscraper in Japan is only about half a century old, compared to the skyscraper that originated in Chicago in the late 19th century and developed in New York. Why was the birth of the skyscraper so late in Japan, and why has the construction of super-tall buildings increased since the 2000s? To understand the background, it is necessary to unravel the historical development of the building regulations. This paper aims to provide an overview of the birth and development process of the skyscraper in Japan, mainly from the perspective of building regulations.

2. The Era of the 31-Meter Height Limit

2.1. High-Rise Buildings before the 31-meter Height Limit

As the Edo period (the era of feudalism) ended and entered the modern era, buildings began westernizing. In 1894, the Mitsubishi Ichigokan was completed in Marunouchi, now known as the CBD of Tokyo. It was a three-story brick office building with an eave height of approximately 50 feet (15 meters). Marunouchi's red-brick office buildings lined Babasaki-dori Avenue, and the area became known as “Itchou London” (this means an avenue like the streetscape of London). In the Taisho period (1912-1926), the construction of high-rise buildings using steel-frame, reinforced concrete, and steel-reinforced concrete (SRC) construction increased due to the economic boom triggered by World War I and the development of reinforced concrete (RC) construction technology. Japan's first steel-frame buildings were only about three stories, but later, the trend toward high-rise construction progressed, with seven- and eight-story buildings being built.

2.2. Height Limit by Urban Area Building Law

In 1919, the Urban Building Law, the predecessor to the current Building Standard Law, was enacted, and the enforcement order stipulated a height limit of 65 shaku (approx. 20 m) for residential areas and 100 shaku (approx. 30.3 m) for commercial and industrial areas. “Shaku” is a traditional Japanese measurement system originally came from old China. In 1931, 100 shaku was replaced by 31 m and 65 shaku by 20 m. These height restrictions were intended for three purposes: sanitation (lighting and ventilation), security (prevention of urban



Figure 1. The Rows of 31 m height Buildings along Gyoko-dori Avenue in Marunouchi. (Ishiguro, Keisho (2001). Meiji Taisho Showa Tokyo Photo Aggregation, Shinchosha, Japan, p.53)

disasters), and traffic (balance between people's access to buildings and traffic facilities such as roads). The fact that "traffic" is listed as one of the objectives indicates that height restrictions controlled a building's volume when there were no floor-area ratio restrictions. The 65 shaku (20 m) was determined as the height at which a four-story to five-story residence could be built, referring to height limits in Paris and other foreign countries. The 100 shaku (31 m) was derived from 1) the Former Tokyo Marine Insurance Building and the Marunouchi Building(under construction at the time) 2) the height limit stipulated in the draft Tokyo City Building Ordinance and the London Building Act; 3) a round number; and 4) the limit for firefighting activities (e.g., the reach of ladders). However, there was no mention of seismic resistance.

2.3. High-rise Buildings under the 31m Height Limit

Although the 100shaku (31 m) regulation was established without a clear rationale, its operation over the next 50 years resulted in the Marunouchi Building, the Osaka Gas Building, and other buildings that characterized the era (Figure 1). Steel construction (or steel-framed reinforced concrete) and elevators made it possible for buildings to be high-rise, and together with the floor rental system and core system, this promoted an increase in the rentable ratio and effective use of floor space. In particular, 31-meter buildings were being constructed in the Marunouchi district, consolidating its position as a business center in Tokyo. The rows of buildings along Gyoko-dori Avenue, which connects Tokyo Station and the Imperial Palace and is 73 meters wide, were called "Itchou New York" (this means an avenue like the streetscape of Manhattan in New York). At this time, the Woolworth Building and other 200-meter skyscrapers were already constructed in New York City, and the Empire State Building (381 m high) and the Chrysler Building (300 m high) were under construction. These 31-meter-high buildings in Tokyo are far from those in New York City. However, the 31-meter height limit defined the skylines of the major cities in Japan.

3. The Birth of the Skyscraper

3.1. Adverse Effects of the 31-meter Height Limit

The demand for office buildings increased with the economic recovery after World War II, and buildings became larger in scale to maximize floor space within the 31m height limit. The floor-area ratio of the Marunouchi Building, built before World War II, was 645%. Still, during rapid economic growth, some 31-meter buildings, such as the Otemachi Building and the Hibiya Mitsui Building, were constructed at a ratio of over 1,000%. In the 1950s, problems with the 31-meter height limit became apparent. Two issues can be pointed out. The first is that the height limit has reduced the quality of the building. To secure a large floor area while keeping height under control, more and more buildings were built with a lower floor height to gain more floors or with more basement floors. In addition, when buildings with a large floor area are built within the height limit, they inevitably extend horizontally. The more the building fills the site, the more light is lost in the office space, and the less comfortable the workspace becomes. Another issue is the impact on the urban environment. Building to the full extent of the site reduces the number of sidewalks, plazas, and parking spaces around the buildings. It was also pointed out that the increase in floor space would increase the number of people and vehicles going in and out of the building, contributing to traffic congestion.

3.2. Phantom Tokyo Station Skyscraper Project

Momentum grew for the construction of skyscrapers, but the construction technology needed to be improved. Because Japan is an earthquake and typhoon-prone country, it was necessary to establish the wind and earthquake-resistant technology required to realize sky-scrapers; conventional rigid structures made of SRC could not be used to build safe high-rise buildings. In 1958, the president of Japan National Railways, Shinji Sogo, the father of the Shinkansen bullet train, proposed a plan to rebuild Tokyo Station Building into a 24-story skyscraper (Figure 2). The following year, a research committee led

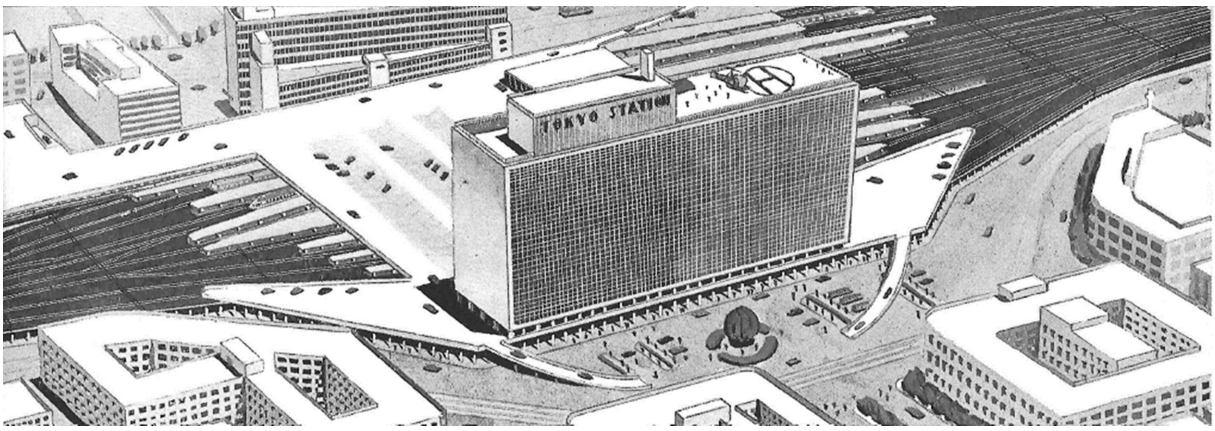


Figure 2. Phantom Project to Rebuild Tokyo Station into a 24-story Tall Building in 1958. (Yawata Iron & Steel Co., Ltd. (1962) Quarterly Column, No.3, Yawata Iron & Steel Co., Ltd., Japan, p.33)

by Kiyoshi Muto, a leading structural engineer and professor at the University of Tokyo, was established to study the project from the perspective of earthquake-resistant design. As a result, in 1962, a report titled "Research on Appropriate Design Seismic Intensity of Buildings: A New Approach to Skyscrapers" was prepared. It became clear that, it would be possible for tall buildings to construct with superior earthquake resistance by introducing a "flexible structure" that would allow the building to shake slightly to release force rather than a "rigid structure" that would prevent the building from shaking.

3.3. Introduction of a Floor Area Ratio Regulation

With the prospect of high-rise building technology, the movement to abolish the 31-meter height limit began in earnest. First, in August 1962, Ichiro Kouno, Minister of Construction, mentioned eliminating the height limit, and the Ministry of Construction started a study of law revisions. In July 1963, the Building Standards Law was revised to abolish height restrictions of 31 m or 20 m and introduce floor-area ratio restrictions (creating a floor-area district system). This was a method of restricting the floor-area ratio (the ratio of total floor area to site area) of buildings to balance the total floor area with the supply and processing capacity of roads, water, sewage, and other infrastructure within the city. When introducing the floor-area ratio restriction, the system was designed with reference to regulations in foreign cities. In New York City, the Zoning Code was amended in 1961 to shift from conventional setback regulations to floor-area ratio restrictions. This revision also introduced the plaza bonus system, which relaxed the floor-area ratio if a plaza was created on the site(Figure 3). In Japan, the Specific District System was established based on this system. In 1964, Tokyo designated floor-area districts, and within Loop Road No.6 and the Arakawa Spillway, floor-area ratios were set in increments of 100% up to a maximum of 1000%, and height restrictions of 31 m or 20 m were

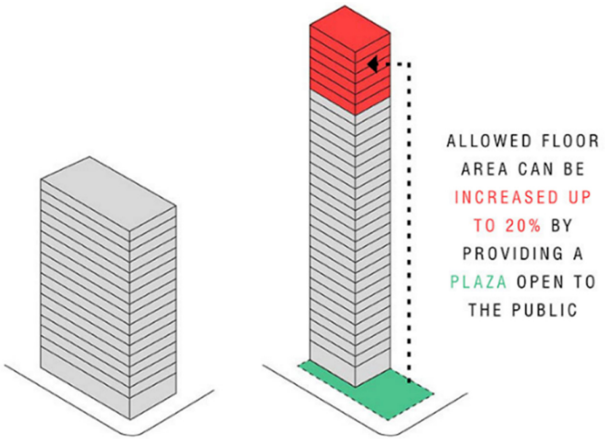


Figure 3. Plaza Bonus System in New York Zoning Code. (New York City Government Website, https://www.nyc.gov/site/planning/plans/pops/pops-history.page)

eliminated. A maximum of 1000% was designated only in Marunouchi District and Nishi-Shinjuku District. The introduction of the floor-area ratio system nationwide had to wait until 1970, when the law was revised. The elimination of the 31-meter height limit, along with advances in high-rise construction technology, ushered in the era of the sky-scraper in Japan.

3.4. Birth and Development of Skyscrapers over 100 m

Although the plan to reconstruct the Building of Tokyo Station disappeared spontaneously, the 156-meter-high Kasumigaseki Building was constructed in 1968 based on the technology developed in the study process(Figure 4). A group led by Kiyoshi Muto, who chaired the earlier study committee, was in charge of the structural design, which resulted in the realization of Japan's first high-rise building over 100 meters tall. The building was twice as tall as the Hotel New Otani, the tallest building in Japan until the Kasumigaseki Building was built, and 72% of the site was open space. In 1968, when the Kasumigaseki Building was completed, Japan's economic growth rate



Figure 4. Kasumigaseki Building. (Kajima Corporation Website, https://www.kajima.co.jp/news/digest/jan_2005/kajimakiko/kiko.htm)

reached a record annual rate of 12.4%, surpassing West Germany (at the time) and ranking second only to the United States in gross national product (GNP). The Kasumigaseki Building, which ushered in the era of the super high-rise, was seen as a savior that would free urban space from the yoke of the 31-meter height limit. The skyscraper was accepted as a symbol of Japan's growing economy, ushering in the era of skyscrapers. The World Trade Center Building in Hamamatsu-cho was built in 1970 at a height of 162 meters. In 1971, the Keio Plaza Hotel (180 m) was completed in Nishi-Shinjuku District, and in 1974, the Sumitomo Shinjuku Building (210 m) and the Shinjuku Mitsui Building (224 m) set new records. Ten years after the Kasumigaseki Building was built Sunshine 60 (240 m) in Ikebukuro was completed in 1978. Elevator speeds were further increased as building height records were broken. It had to wait until the Tokyo Metropolitan Government Building (243 m) was completed in 1991 to take the title of the highest building in Japan from Sunshine 60. After that, it was surpassed by the Yokohama Landmark Tower (296 m) in 1993. From Kasumigaseki Building to Yokohama Landmark Tower, the tallest buildings in Japan were built using the Specific District System, which deregulates the floor area ratio. 20 years later, in 2014, the Abeno Harukas (300 m) in Osaka followed; in 2023, the Azabudai Hills Mori JP Tower (330 m) further broke the record in 2023. These two buildings were constructed using the Special Urban Revitalization District, which will be explained later.

4. The Skyscraper Boom due to the Deregulation

4.1. Skyscraper Boom in Tokyo

There are more than 200 skyscrapers over 150 meters in Japan, of which approximately 60% are concentrated in Tokyo. 1,251 buildings over 60 meters tall have been constructed in the 23 wards of Tokyo (as of the end of 2020, Figure 5). Building Standard Law defines tall buildings to be over 60 meters. 38% (481 buildings) are over 100 meters tall. In terms of the construction period, more skyscrapers were built after 2000 than during the bubble period, accounting for 62.5% (831 buildings) of the total(Figure 6). Three-quarters of the world's skyscrapers were made after the 2000s; the same trend can be seen in Japan.

4.2. High-Volume Skyscrapers

While skyscrapers over 300 m are being actively constructed overseas, only two buildings in Japan exceed 300 m: Abeno Harukas and Azabudai Hills Mori JP Tower, and the 390-meter-high Torch Tower is scheduled for completion in 2027. One reason is the height restrictions imposed by the Civil Aeronautics Law over broad areas in central Tokyo. In Japan, more emphasis has been placed on getting floor area ratios (building floor area) than height. A review of floor area ratios (simply dividing the total floor area of a building by the site area) for high-rise buildings over 60 meters shows that

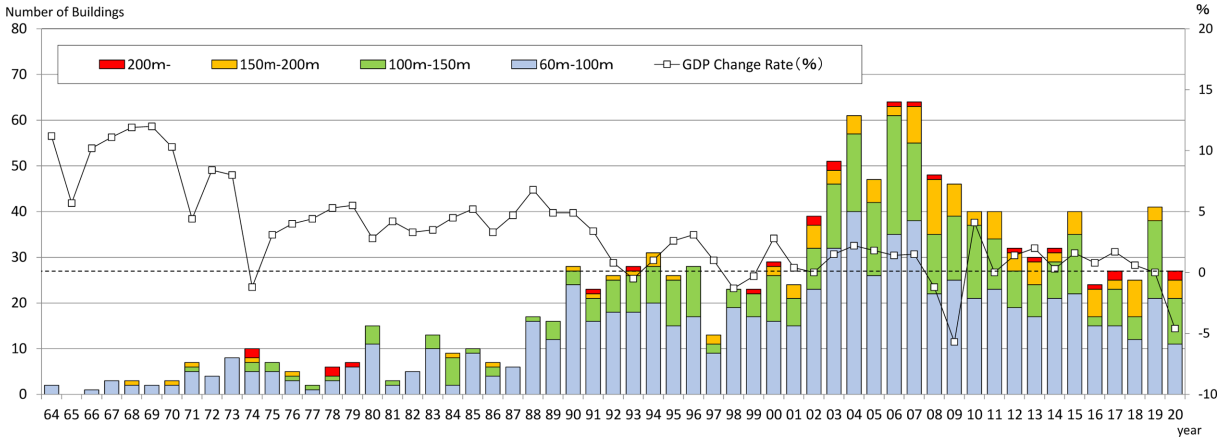


Figure 5. Trends in the Number of High-rise Buildings Exceeding 60 m in Tokyo (Made from Annual Report of Building Statistics of Tokyo Metropolitan Government).



Figure 6. Change of Skyline in Marunouchi District from 2002 to 2014. (Photo by the author)

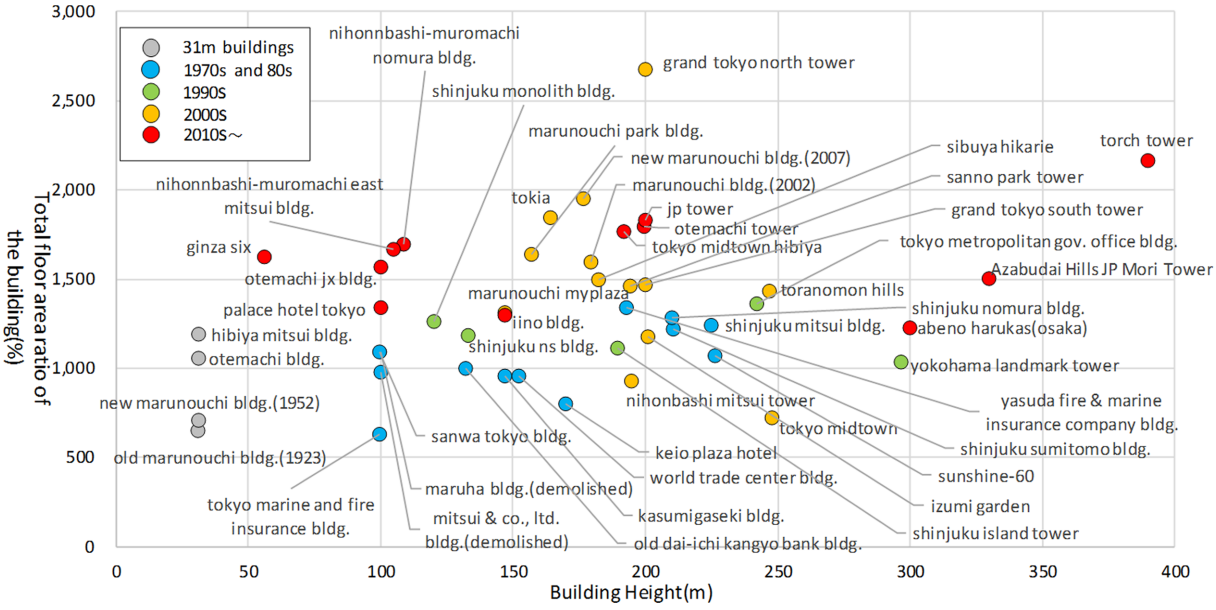


Figure 7. Height and Floor Area Ratio of Major High-rise Buildings in Tokyo

the average floor-area ratio of high-rise buildings constructed from the end of the 1980s through the post-bubble period was approximately 600%. On the other hand, most of those built since the 2000s exceed 800%, about 1.5 times higher than before. About three-quarters of the buildings with floor-area ratios of over 1,000% were completed after 2000. Figure 7 shows the relationship between the height and total floor-area ratio of skyscrapers in Tokyo, and a comparison of buildings of similar height indicates that the floor-area ratio of buildings built after the 2000s is higher. In other words, buildings have "grown fat." Skyscrapers have encouraged the concentration of urban functions in the city center and increased the floor-area ratio in Tokyo

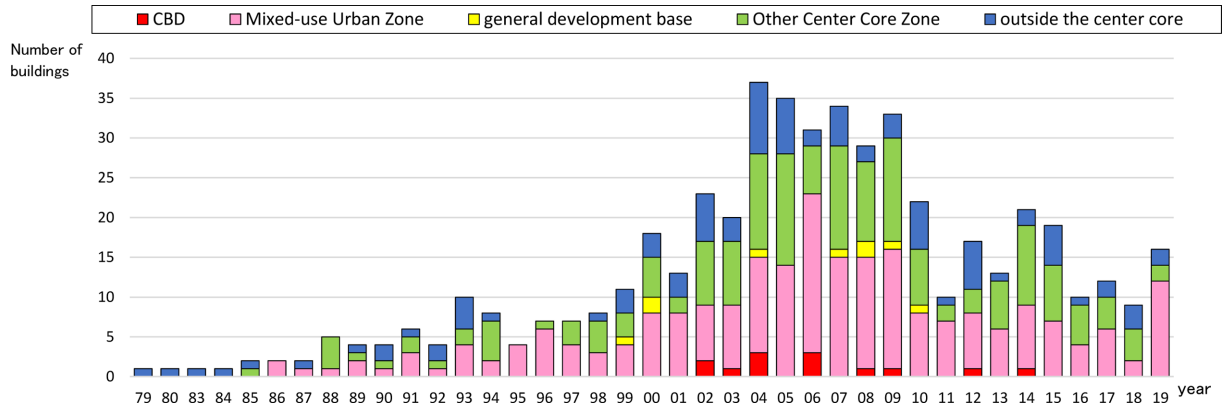


Figure 8. Trends in the Number of High-Rise Residential Buildings of 20 Stories or More in Tokyo Wards (Made from Database of Real Estate Economic Institute and Annual Report of Building Statistics of Tokyo Metropolitan Government).

4.3. Floor Area Ratio Relaxation that Boosted the Construction of Skyscrapers

The rapid increase in skyscrapers since the 2000s has been attributed to various floor-area ratio relaxation measures to encourage urban development using private capital and ingenuity. After the collapse of the bubble economy, to encourage urban development using private capital and ingenuity ratio relaxation measures were developed to boost the economy and urban renewal through liquidating real estate. In addition to the expansion of conventional deregulation programs, new deregulation programs were also created. In particular, the Special Urban Revitalization Districts introduced in 2002, allows for substantial floor area ratio deregulation based on proposals from private-sector developers. While the floor area ratio relaxation under the Specific District System was 1.2 to 1.5 times, most Special Urban Revitalization Districts are more than twice as large. As developers can significantly increase the floor area ratio, the Urban Revitalization District has been used to build skyscrapers in metropolitan areas.

4.4. Diversification of Public Contribution Functions as a Condition for Floor Area Ratio Relaxation

The floor-area ratio relaxation system has encouraged the effective use of land and the creation of public contribution functions such as public open space. open spaces were created at the foot of high-rise buildings, bringing sunshine and greenery to the densely populated cities. The types of public open space required for floor-area mitigation have diversified over time. Plaza-like and sidewalk-like open spaces and corridors, atriums, rooftop gardens, courtyards, etc., were considered open spaces.

On the other hand, public contributing functions other than open space also became subject to the floor-area bonus. The following were also subject to floor area ratiorelaxation: the supply of housing in hollowed-out urban centers, parking lots, cultural facilities, childcare support facilities, the reconstruction of aging condominiums, environmentally friendly buildings, the preservation of historical buildings, disaster prevention-related facilities, and greening of buildings, including rooftop greening and wall greening. The floor area ratio relaxation system was positioned to resolve urban issues by creating various public functions through private development.

4.5. Increase in High-Rise Residences

A lot of high-rise residential buildings are also constructed since the 2000s. The expansion of the floor area ratio bonus system for housing supply, combined with the growing demand for urban living and technological innovations in high-rise RC construction, has encouraged the construction of high-rise residential buildings and has contributed to the recovery of the resident population in urban centers. There are 510 high-rise apartment buildings, 20 stories or more, in Tokyo 23-wards. About 80% of them were built in the 2000s and are located in the central area of Tokyo (Figure 8)

Looking at the population change (according to the national census) for about 20 years from 1995 to 2015, while the population of Tokyo wards as a whole remained at 1.2 times, it increased significantly to 2.2 times in Chuo Ward and 1.7 times in Chiyoda Ward and Minato Ward, indicating that the population has returned to the city center due to high-rise condominiums

Conclusions

No skyscrapers existed in Japan until the 1960s because building height had been limited to 31m from 1919 to the 1960s. As construction technology for skyscrapers advanced during rapid economic growth, the height limit was lifted, and the Kasumigaseki Building was completed in 1968, ushering in the era of skyscrapers. Construction of sky-scrapers has been particularly active since the post-bubble period of the 2000s, boosted by the relaxation of the floor area ratio. However, Japan has already entered a phase of population decline, with a population of 127 million in

2015 estimated to decline by 30% to 88 million by 2065. This means the demand for floor space will gradually shrink. To realize sustainable cities, it is necessary to set the total floor area from a long-term perspective. Of course, skyscrapers are undoubtedly effective in times of contraction when compact cities are required. However, it is time to consider optimizing total floor space in the city based on the city's future shape and floor demand rather than quantitative expansion and maximizing individual developments.

References

Osawa, A. (2015) World history of high-rise buildings. Kodansha Publishing, Tokyo, Japan. (In Japanese)