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Column

Sustainability of High-rise Buildings

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Today, there is a growing demand for realizing sustainable societies and cities. What role should high-rise buildings play in this process? At first glance, “high-rise buildings” and “sustainable society” do not seem to coexist. High-rise buildings are more costly to construct, maintain, manage, repair, and demolish than ordinary buildings and consume more energy. In addition, in a society with an ever-declining population, the places where huge buildings can sustainably exist are likely to be limited. However, a vast number of high-rise buildings have already sprung up around the world: more than 100 years have passed since the first skyscraper was built in Chicago in the late 19th century, and half a century has passed since the 147-meter-high Kasumigaseki Building was completed in Japan. Even if we limit the number of high-rise buildings to 150 m or taller, the number of high-rise buildings worldwide exceeds 7,000. In urban areas, high-rise buildings have become part of the everyday landscape. In other words, there is a need to extend the service life of high-rise buildings to realize a sustainable society. In this column, I would like to summarize the arguments for the sustainability of super high-rise buildings and discuss their prospects. The number of high-rise buildings worldwide has increased rapidly over the past 20 years. The number of buildings over 150 meters high jumped from 1,000 in 1999 to 7,000 today, about seven times that number. This means that the number of aging buildings will increase rapidly. Understandably, there is an urgent need not only to create high-rise buildings but also to understand how to maintain and manage them to make them sustainable properly. When considering the sustainability of high-rise buildings, it is crucial to evaluate them from three key perspectives: ‘Economic,’ ‘Environmental,’ and ‘Social.’ Therefore, let us look at the main issues in considering high-rise buildings from each perspective.

Sustainability of high-rise buildings from an economic perspective

Sustainability from an economic perspective requires sound building management with reduced life cycle costs. By systematically performing routine inspections, maintenance, and periodic repairs, a building's service life can be extended, reducing maintenance costs and lowering life-cycle costs. It is said that the cost of an ordinary building, from completion to demolition, is three to four times the cost of construction, and the higher the building is, the greater this cost becomes. The higher the building, the greater the cost.

It is also pointed out that the cost of large-scale repairs for tower condominiums is higher than for ordinary condominiums. The repair of Elsa Tower 55 (completed in 1998) in Kawaguchi City took twice the price and twice the time of a typical condominium. In the case of condominiums for sale, it takes time and effort to build consensus for rebuilding and large-scale repairs. If such opportunity costs are included, the cost will be enormous, so it is essential to reduce life-cycle costs.

Sustainability of high-rise buildings from an environ-mental perspective

Reduction of Environmental Burden

To curb global warming, reducing the burden on the environment by reducing carbon dioxide emissions is necessary. To this end, the basic premise is not to scrap and build but to use existing stock to achieve longevity. However, as the number of floors in a building increases, energy consumption, including utilities, increases. A comparison of energy consumption per floor area in office buildings shows a two-fold difference between a low-rise building with one or two floors and a building with about 20 floors. Therefore, energy conservation, use of renewable energy, and improvement of resource conservation and recycling performance are required through facility improvements.

Recently, certification systems that comprehensively evaluate the environmental performance of buildings, such as LEED in the U.S. and CASBEE in Japan, have become popular. An example of a skyscraper that has been repaired is the Empire State Building, which was retrofitted for energy savings and achieved LEED Gold certification. A high rating can secure tenants and maintain high real estate values. This will also lead to reduced life cycle costs, as mentioned earlier.

High-rise buildings as Historical Buildings

The “aging” of high-rise buildings is often seen in negative terms, such as deterioration and obsolescence. However, a positive assessment of building aging can also be an essential perspective to support the longevity of high-rise buildings. A high-rise building with historical value would potentially enhance its asset value and the city's overall quality.

Many American skyscrapers have been designated as U.S. National Historic Landmarks. The Woolworth Building (completed in 1913 and designated in 1966), the Chrysler Building (completed in 1930 and designated in 1976), the Empire State Building (completed in 1931 and designated in 1986), and other iconic New York City high-rise buildings are considered historic resources. However, transmission and observation towers are also registered as tangible cultural properties in Japan, not high-rise buildings. Starting with Nagoya TV Tower (completed in 1954, registered in 2005), Beppu Tower (completed in 1957, registered in 2007), Tokyo Tower (completed in 1958, registered in 2013), and Kobe Port Tower (completed in 1963, registered in 2014) have been registered. The Nagoya TV Tower was designated as an Important Cultural Property in 2022.

The Kasumigaseki Building, the first building in Japan to exceed 100 meters, celebrated its 50th anniversary in 2018. In other words, it fulfills one of the requirements for registered tangible cultural properties under the Cultural Properties Protection Law. Registration as a cultural property is expected to support the longevity of high-rise buildings.

Sustainability of high-rise buildings from a social perspective

In addition to maintaining and managing hardware, the system for maintaining and managing a high-rise building is equally essential. Inadequate management and systems for high-rise buildings can lead to increased damage in the event of a disaster, as well as building deterioration and slum conditions if maintenance and repairs are not properly carried out.

Establishment of a system for disasters and other emergencies

High-rise buildings have inherent disaster risks. In the Great East Japan Earthquake, considerable shaking of upper floors caused by long-period seismic motion caused elevators to stop and furniture to topple over. In addition, the 2017 high-rise apartment fires at Grenfell Tower in London and The Torch in Dubai are still fresh in our minds, and many issues remain regarding evacuation procedures in high-rise buildings.

While creating systems for disaster response in high-rise buildings has become an urgent issue, specific initiatives are also emerging. The residents' association has formulated a disaster prevention plan on Shibaura Island in Minato Ward, home to 10,000 residents in 4 high-rise condominium buildings of approximately 4,000 households. It is preparing to communicate information and guide evacuations in a disaster. In addition, to address the "high-rise refugee problem" of people being left behind on upper floors due to elevator stoppages, they stockpile supplies (water, food, simple toilets, etc.), assuming they will stay home during a disaster. High-rise buildings require electricity to operate emergency elevators, water and sewage pumps, etc., so they must also be prepared for long-term power outages. The Minato Ward Association for Disaster Prevention in High-rise Residential Complexes in Minato Ward, which consists of approximately 8,500 households living in high-rise condominiums, including Shibaura Island, is working to secure fuel for emergency private power generators that can generate power for a week for 50 high-rise condominium buildings. This case is significant not only for a building itself but also for a community-wide effort to respond to disasters.

Another emergency issue is the risk of rescuing people who are suddenly ill in a high-rise building. A survey conducted in Toronto, Canada, found that the higher the residential floors, the lower the survival rate of residents suffering cardiopulmonary arrest. This is because it takes longer for emergency crews to reach the patient. In high-rise buildings, it will be necessary to establish a system that enables workers and residents to receive first-aid treatment.

Long-term management of high-rise condominiums

In recent years, many wealthy foreigners have purchased high-rise condominiums in Japan for investment purposes or the upper floors of tower condominiums as inheritance tax planning. If they regard them as short-term investment targets, they may be indifferent to issues such as future large-scale repairs and rebuilding.

It is easy to imagine that the problem would be even more severe for high-rise condominiums, where most units are for sale, and the number of unit owners is inevitably large, given the difficulties in reaching a consensus for repair or reconstruction.

A high-rise building can be considered a city in a sense. Management within the building and its continuity will be critical to overcoming the problems associated with having a city within a town.

From “sustainable buildings” to “sustainable cities

Kiyoshi Mutoh, a structural engineer and one of the fathers of Japanese skyscrapers, once said in 1979, "High-rise buildings should work with urban planning, and the significance of architecture is to serve society. In other words, I believe that the time has come to

systematically restrict the height and location of buildings and plan the entire city while considering the adverse effects of high-rise buildings. Now that the adverse effects of skyscrapers, such as sunlight and radio interference, are beginning to appear, it may be necessary to redevelop the city while considering how the town should be."

Now, more than 40 years after Muto's words, what are the "adverse effects of high-rise buildings" on cities? There are, of course, problems with sunlight and scenery, but above all, there are various problems caused by aging. In addition to ensuring the sustainability of existing high-rise buildings, the city's sustainability must be enhanced as the population continues to decline. If we translate Muto's phrase "redevelop the city while considering how the town should be" into the present, it would be a time to think about how sustainable cities should be and redevelop and manage cities.

Is a city that relies excessively on high-rise buildings a sustainable city at that time Of course, many argue that high-rise buildings effectively make cities more compact and densely populated. Moreover, the skyscrapers themselves are fruits of human wisdom and ingenuity. In time, technological and institutional advances will make dramatic progress in extending the longevity of high-rise buildings. However, it is unwise to build new high-rise buildings without a clear vision for the future. In a region with a declining population, the places where high-rise buildings can be sustained economically, environmentally, and socially will be pretty limited. It is time to rethink the relationship between :high-rise buildings" and "urban sustainability".