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The Kasumigaseki Building's Planning and Technology: Japan's First Skyscraper from the Viewpoint of Renewal

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Abstract

The Kasumigaseki Building is Japan's first large-scale skyscraper, and it has undergone three renewals in total. This study analyzes the previous renewal works done on the building, and it aims to obtain knowledge that can be utilized in the maintenance of skyscrapers in the future. One of the characteristics of the Kasumigaseki Building renovation work was that it didn't need major earthquake-resistant reinforcements. In addition, the extra space that was left in the floors that held the air conditioning equipment was effective for the renewal. Moreover, the existing honeycomb beams allowed pipes to be easily installed above the ceilings when making major updates to the air conditioning systems. Another benefit was "the lateral plumbing unit" that was developed for the toilets in the Kasumigaseki Building. It eliminates the need for piping to be run down to the lower floors because the piping is positioned above floor level.

The introduction of prefabrication in this building made it easier to dismantle and renovate old components during renovations. Although prefabrication is now commonplace, at the time its use marked the Kasumigaseki Building as being ahead of its time, and in fact there is little difference between the technologies used in its construction and construction technologies used today. For this reason, when viewed from the perspective of building preservation, one major characteristic of the Kasumigaseki Building is the fact that the interior fixtures and other elements do not need preserving. This makes the building easy to renovate. When viewed as a today's office building, we can surmise that the decision to renewal rather than reconstruction was made from a management point of view because the cutting-edge planning and technology that went into its construction—planning that assumed it would require renewals in the future—were elements of the building that held universal value.

Keywords: prefabrication, high-rise building, renovation, conservation, office building

1. Introduction

When we visit the Kasumigaseki Building today, its façade impresses us with its historic personality, yet this building shows a special freshness even among contemporary office buildings (Figure 1). Built in 1968 and widely considered to be Japan's first modern office skyscraper, it has endured well and been significantly improved by three major renewals, retaining its best assets and charm while upgrading and updating outdated components. The first renewal (1989–1994), notable for being the country's first-ever skyscraper renovation, upgraded equipment renovations and the office floors. The second renewal (1991–2005) involved exterior surface work and the renovation of the common space of the lower floors. In the most recent renewal (2006–2009), improvements of the external spaces, expansion and renovation of the lower commercial floor, and existing retroactive construction were carried out.

2. Building diagnosis before renewals

Diagnosis investigations of the Kasumigaseki Building were conducted 10, 15, and 20 years after initial construction. Ten years after its completion, increasing maintenance costs suggested that the building would soon need an equipment overhaul. The 20-year check found corrosion of the plumbing, problems maintaining the air conditioning system, and frequent and complicated problems with the aging wiring. The exterior curtain wall had an aesthetic problem—corrosion of the aluminum panels and deterioration of the seals—that needed addressing. In addition to its physical issues, there were also functional ones, and it needed to be improved to meet the demanding standards of the times. (Saito, 1990)

3. The first renewal work

Figure 1. Appearance of the current

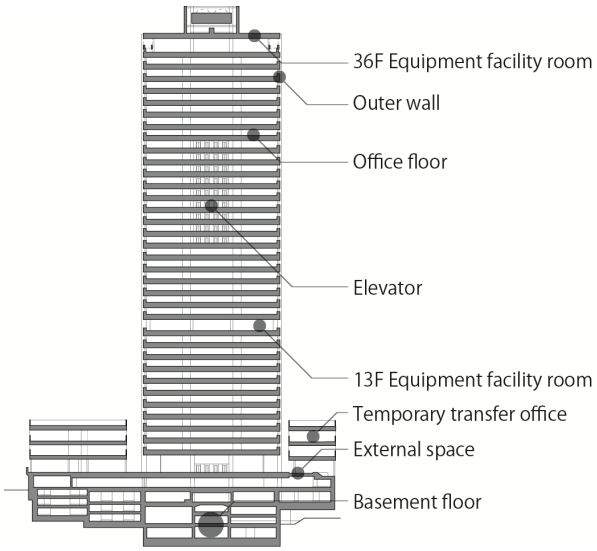

Figure 2. Main parts of the first renewal phase.

Kasumigaseki building. (Mitsui Fudosan, 1994)

3.1 Construction summary

In October 1986, 20 years after the building's construction, a building renewal committee was set up with the aim of renovating the Kasumigaseki Building to an example of excellence that could better serve the highly information-oriented society. The conceptual goal of the renewal was to make it a "prestige office" and improve the building to contemporary standards without losing the status that the Kasumigaseki Building had maintained for two decades. In March 1989, the outline of the renewal project was published with a budget of approximately ¥30 billion (the construction cost was ¥16 billion yen) (Figure 2). The companies responsible for the renewal work were Kajima and Mitsui Construction corporate bodies as the center, the construction company of initial construction, and the organization that participated in diagnostic investigations. The construction began in June 1989 with the renewal of the facility system, followed by the construction of temporary relocation offices for the tenants. In 1991, renovation of the office floors and the moving of tenants began, and in June 1994, the whole process of renewal work, which had taken five years, was completed. (Kawakami, 2014)

3.2 Equipment renovations

In 1989, the renewal started with the removal of existing boilers and the installation of new boilers for district heating system. The rapid expansion of electronics in business (e.g., computers, FAX machines, etc.) had keeping up with the office automation a major issue. The building's initial capacity was 15VA/m^2, but by installing new electric shafts in the corridor panels of the core part, that was increased to 45VA/m^2—triple its original capacity. After completing connections to the electric power supply from the new shaft, the electric equipment inside the existing shaft was removed, and the existing shaft was updated to a one dedicated to an information system corresponding to a LAN system (Figure 3).

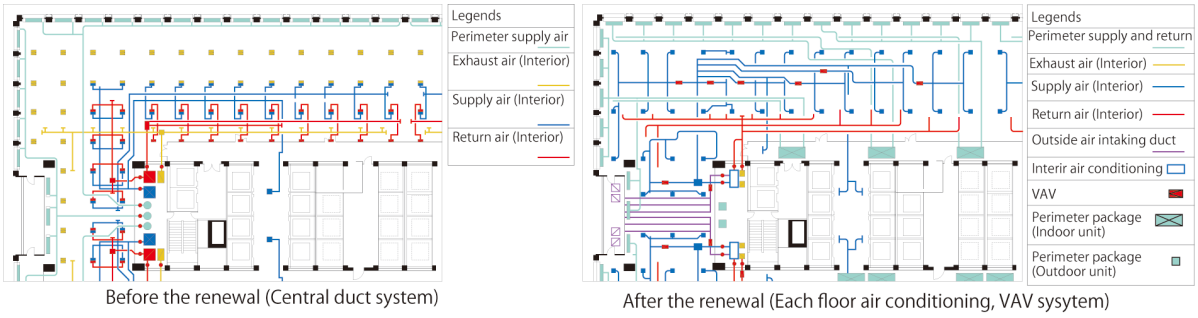

Figure 4. Air conditioning duct plan view before and after the first renewal. (Mitsui Fudosan, 1994)

The original air conditioning and ventilation equipment was a central duct system that operated with ten-story layers handled as one unit, but that was changed so that each floor has a unit system allowing the air conditioners to be controlled separately for each floor. In addition, a variable air flow rate (VAV) system was adopted that could automatically change the air volume according to the usage situation of office automation (OA) equipment, etc. (Figure 4). (Mitsui Fudosan, 1994)

3.3 Office floor renovation

With respect to the office space, interior finishes such as the floors and ceilings were fully renewed with upgraded products (Figure 5, 6). Since the original ceiling used a 3.2 m modular line type system still in use today, the new system ceiling basically used the same system. The floor finish was upgraded from the original PVC carpet to the tile carpet that is now popular. The ceiling height (2,640 mm) remained unchanged even after installing OA floor system, as the original construction had allowed extra space above the ceiling that accommodated the floor's increase of 80 mm. The depth dimension of the window perimeter was deep since the induction units of the air conditioning had been built along the window, but the space under the window expanded by 160 mm and occupants' comfort was improved by the removal of the induction unit with the renewal of the air conditioning system (Figure 7). The necessary construction period per floor was about 4 months, and it was requested that the construction must be completed within a fixed construction period of 16 weeks per floor to avoid compromising the tenants' relocation schedule. (Mitsui Fudosan, 1994)

For the renewal of special floors, layout changes were made on the 36th floor and the 13th floor, which held equipment facility rooms (Figure 8). As requirements for the air-conditioning equipment

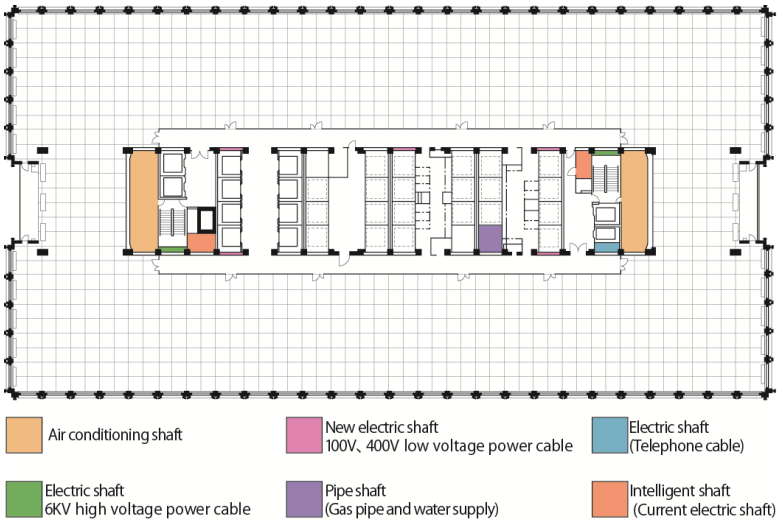

Figure 3. Renewal plan for the equipment shaft. (Mitsui Fudosan, 1989-1994)

room were sharply reduced by the new floor-specific air conditioning upgrade, half of the space on the 13th floor was developed as a new office. The 36th floor, used as a provisional relocation office at the time of tenant relocation work, became a general office space after the renewal. The common spaces on each floor, interior finishing of the corridors, and the elevator lobbies were redesigned (Figure 9); additionally, the elevator was updated to a group-management system with learning function. The interiors of the toilets were refurbished and converted to restrooms, and the sanitary equipment was also updated to the latest technology, including the piping unit. (Mitsui Fudosan, 1994)

Figure 5. Office floor during construction. (Mitsui Fudosan archive)

Figure 6. Office floor after the renewal. (Mitsui Fudosan archive)

Figure 9: Elevator hall on the office floor before renewal (left) and after (right). (left: Mitsui Fudosan, 1994. right: Mitsui Fudosan archive)

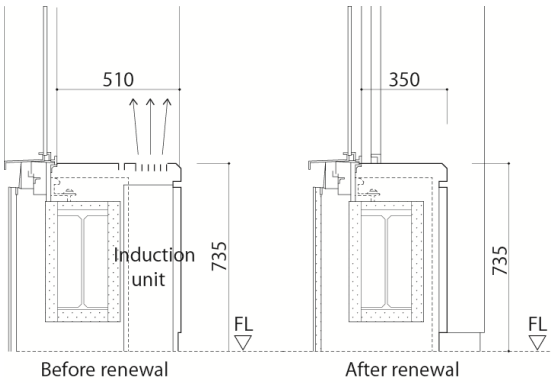

Figure 7. Change under the windows before and after the first renewal. (Mitsui Fudosan, 1994)

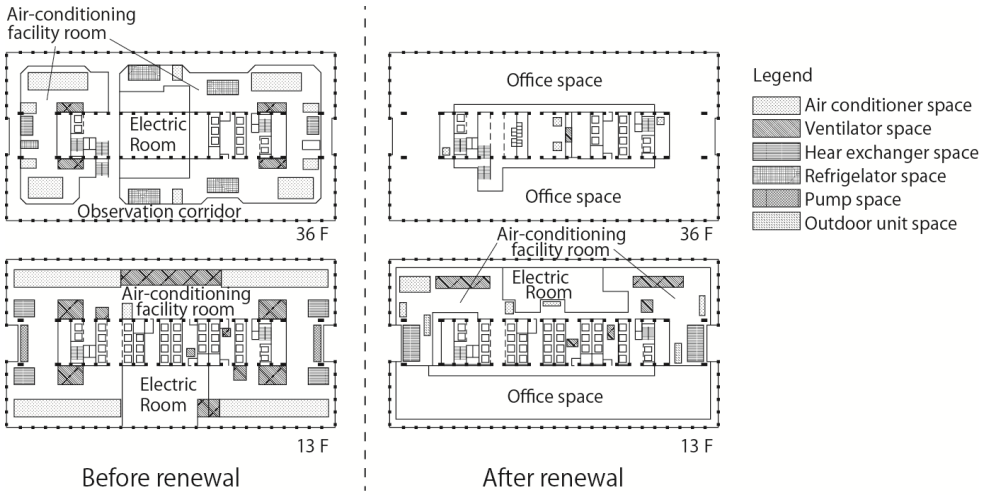

Figure 8. Changes before and after the renewal of air-conditioning facility rooms. (Mitsui Fudosan, 1994)

3.4 Tenant relocation work

It is a characteristic of Kasumigaseki Building renewal that relocation of the tenants in stages to a temporary location outside the building was done during office floor renovations. For the tenants' convenience, to control costs, and to avoid changing tenant's telephone numbers, two provisional transfer offices were constructed east and west but still on the premises (Figure 10). In addition, the 36th floor (the former facility room) and the 4th floor (which had become vacant) were also used as temporary relocation offices, allowing accommodation four floors of tenants at a time. Construction of the temporary relocation offices began in 1990; tenant relocation and renovations of the office floors began in 1991; and the two-and-a-half year relocation ended with the final floors of tenants returning in 1993. The floor plan of the temporary relocation offices was similar to those of the main building to simplify recreating the layout. (Mitsui Fudosan, 1989-1994)

Renovation of office floors was scheduled to construct up to four floors at the same time, in three stages, because the air conditioning facility rooms were located on the 13th and 36th floors (Figure 11). Only the work on floors 14–23 started from the upper floor because the existing air conditioning in that zone came from the air conditioner on the 13th floor; the update to the new system had to be carried out maintaining the air conditioning to the floors not undergoing renovation at that time. To avoid mass relocations at the same time in the three days of the weekend, construction of the two adjacent floors advanced one week apart. Also, since the piping of the existing induction unit was behind the ceiling of the lower floor, it was necessary to work on the next floor in the middle of the construction period of the floor under construction. (Uchida, 1992)

There were many cases where tenants tried to improve the office environment according to relocation work. In principle, the lender bears the expense of temporary relocation and restoration to the original level, and environmental improvement work at the request of the tenant is done at the tenants' expense as optional construction.

3.5 Outer wall refurbishment

Aluminum corrosion observed in the curtain wall was problematic in appearance, so it was decided to address it with washing. Additionally, since the primary seal of the metal parts was remarkably deteriorated, the seals were repaired and updated. In the location on the 13th floor that had previously been needed for the air conditioning system but was to be converted to office space, the original exterior was composed of aluminum panels and louvers and no window; the louvers were removed and

Figure 10. East(left) and west (right) provisional transfer office buildings. (Mitsui Fudosan archive)

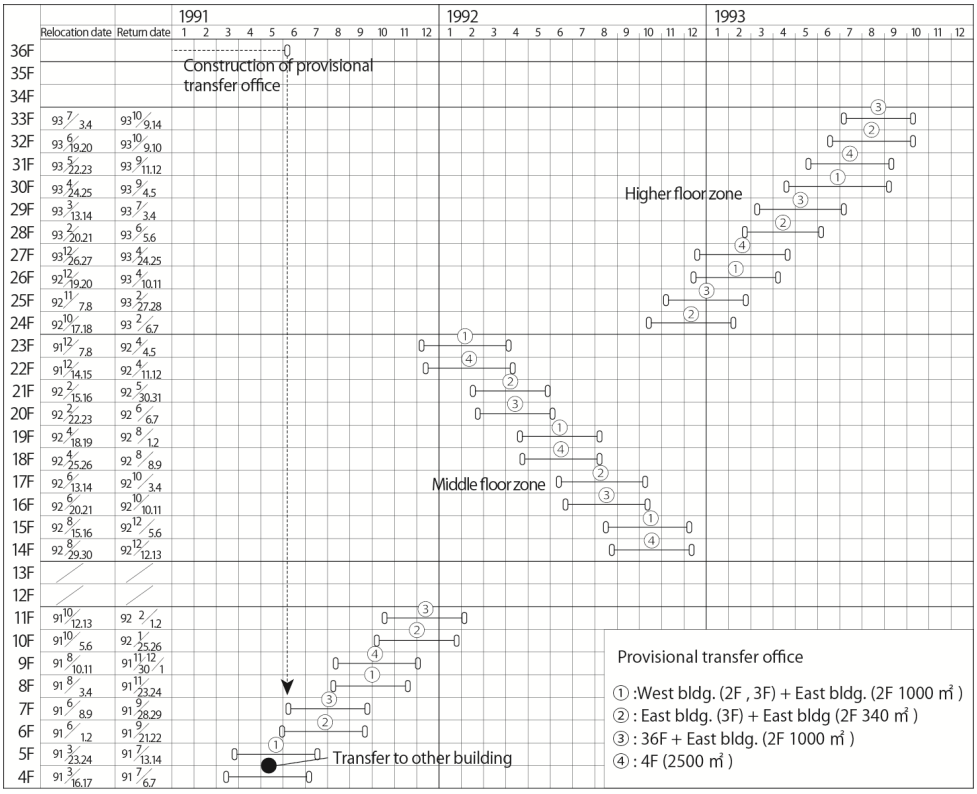

Figure 11. Scheduling for occupants' relocation. (Mitsui Fudosan, 1994)

Figure 12. Opening work by rotary water jet method. (Mitsui Fudosan, 1989-1994)

aluminum sashes installed. At this time, considering that the setback design was an important feature of the appearance of the Kasumigaseki Building, the sash line was left as it was. (Mitsui Fudosan, 1994)

3.6 Construction technique

Continuing office operations during renovation makes it necessary to minimize noise, vibration, and dust. Drilling work for the facilities was carried out following the establishment of the electric trunk line, but thanks to a research and development carried out by Kajima Corporation before the renewal construction of the Kasumigaseki Building, a rotary water jet construction method was applied that could crush only concrete, leaving existing rebar, conduit, etc., in place, which reduced problems with noise and vibration (Figure 12). (Mitsui Fudosan, 1994)

4. Secondary renewal work

The second period of renewal work was primarily aimed at modernization, in terms of design and function, of the common area of the first floor and the lobby floor and painting the outer wall. The construction period was from March 1999 to October 2001. The marble on the wall of the interior around the ground-floor entrance was cleaned and retained, and the tiling of the floor where there was conspicuous damage was updated to a contemporary design stone. The ceiling was partly elevated to improve the illuminance and the escalator to the lobby level widened to create a bright entrance hall. A slope was added to solve the level difference in the “Galleria” beside the elevator hall that had served as a small gallery space for many years. The lobby, which featured a public space without a security gate, was retained as a desirable feature, though updated during the renewal. Although the lighting and the ceiling design were greatly changed and updated to a bright, contemporary design, the original wall marble and casting aluminum bracket lighting fixtures remained original (Figure 13).

The outer wall painting work was intended to preserve the performance of the aluminum panels and

Figure 13. The lobby before renewal (left) and after renewal (right). (Mitsui Fudosan archive)

Figure 14. Exterior wall painting with full-circumference scaffolding. (Mitsui Fudosan, 1999-2015)

restore the original appearance and coloring of aluminum finish, but fluoropolymer paint used to improve weather resistance. Trial painting was carried out on the actual curtain wall, and stakeholders familiar with the building's appearance helped select the color closest to the original. To ensure quality and shorten the renovation period, the exterior painting was carried out using temporary scaffolding encircling the entire circumference (Figure 14). (Mitsui Fudosan, 1999-2015)

5. Third renewal construction

5.1 Renovation of the commercial area

The redevelopment district plan that began in 2004 comprised the Kasumigaseki Building and the adjacent site. Accordingly, to revitalize the lower floors, the third renewal work aimed to expand and remodel mainly the first- to third-floor commercial areas integrally with the external space. In addition, the other major construction planned included an existing retroactive construction due to expansion. The renewal design was by Nihon Sekkei, the firm that designed the original building, and Kajima Corporation was again responsible for implementing the design and construction, starting in 2006 and completing the effort in 2009. Renovating the plan of the external flow line made it possible to add access to the lobby floor entrance directly from the subway station, and the plaza hiding in the adjacent building became a central square that opened completely to the main street. The first floor and the lobby floor renovations included an entrance to a new ground-floor food court and new landscape elements. In addition, a wind laboratory was added to the lobby floor entrance. The ground floor shop area was expanded and became a commercial area combined with restaurants in the

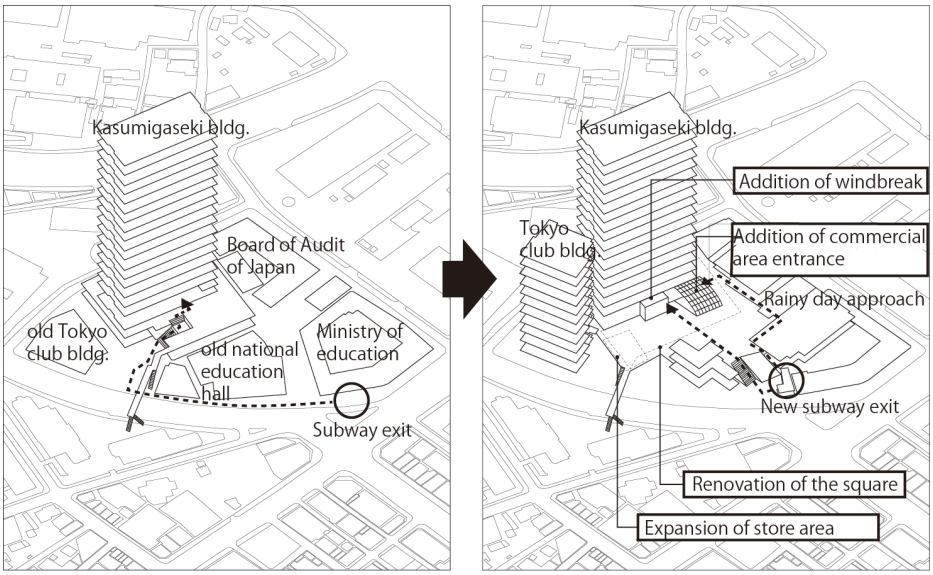

Figure 15. Outline of the third renewal plan. (Mitsui Fudosan, 1999-2015)

adjacent building (Figure 15). (Kajima Design, 2009)

5.2 Existing retroactive construction

Since the Kasumigaseki Building was built before regulations on skyscrapers were developed, there were components that did not conform to today's structural standards. Due to the expansion of the low-rise area, incompatibility with sections of the Building Standard Law and the Fire Service Law was occurred. Existing retroactive construction was implemented from 2007 to 2011 to solve these problems. While no retroactive remediation on the structure of the high-rise building was requested, it was carried out to optimize fire protection and evacuation—specifically, formation of fire-protection zones for the high-rise areas and floor areas, as well as smoke-exhaust measures for special evacuation staircases. In addition, the whole building was upgraded to meet evacuation safety standards since smoke-exhaust equipment had not been installed in the whole building. Thus, existing retroactive construction work was carried out in detail.

6. Plan and technology seen from renewal

Renewal of the Kasumigaseki Building did not address the building's large earthquake-resistant reinforcement since it was originally designed to be as safe as possible based on dynamic computer analysis at the time of construction. On the other hand, as the facility equipment were renewed numerous times, it was effective for renewal that the air conditioning machine room was originally designed with a space margin. Moreover, in order to make major updates such as the air conditioning system, the existing honeycomb beams worked favorably for the installation of piping behind the ceiling (Figure 16). The "sideways drain piping unit" of the toilet, developed for the Kasumigaseki Building, had the benefit of eliminating the need for construction on the lower floor because the drain pipe did not penetrate the floor slab. A carry-in lift had been installed in the balcony at the center of the short façade. This was for disaster evacuation and to protect the façade design, but it also assisted significantly in lifting materials and equipment during renewal (Figure 17).

Architect Takekuni Ikeda who led the design of the Kasumigaseki Building mentioned that progress of information socialization was more than expected, but also he said that they had planned at the time of construction in anticipation of future renewal (Anonymous, 2004). Specifically, prior to the Kasumigaseki Building, most buildings were handled almost exclusively through on-site production and construction, but introducing efficiency thorough prefabrication into the original construction also eased the renovations' processes of dismantling and updating during renewal. Although prefabricated production has since become common, the Kasumigaseki Building was ahead of its time, making it an exemplar of "contemporary architecture" with only small technical-level differences with today's office buildings. Therefore, from the conservative viewpoint of the building, one of its major features is that it allows upgrades, updates without preservation of interior decoration except the structure and its iconic exterior, making renewal easier.

Figure 16. Air conditioning update work using existing sleeve. (Mitsui Fudosan, 1989-1994)

Figure 17. Carry-in utility lift. (Mitsui Fudosan, 1989-1994)

7. Conclusion

One of the reasons why the Kasumigaseki Building was not torn down and rebuilt but renewed was that it has the honor and inherent value of having been the first skyscraper in Japan and thus a symbolic existence for the owner Mitsui Fudosan. However, when comparing it to today's office buildings, it is evident that its pioneering plan, materials, and innovations at the time of construction in anticipation of future renovations and technologies are of universal value. Thus, it was like an easy decision by management to renew rather than replace. Today, many early-built skyscrapers are in need of renewal. The know-how of renewal, maintenance, and management from the changes carried out so far in the Kasumigaseki Building provide a benchmark for the future renovation and continued use of skyscrapers.

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