

Collaboration between Architects and Contractors in Former Japanese Building Construction Projects

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Abstract

Collaboration between design and construction is widely required to confirm building qualities. In the West, project delivery systems vary intending collaboration between design and construction. On the other hand, people in Japanese projects have traditionally had a collaborating relationship between design and construction such as the design-build process. We aim to consider the background, purposes, factors and methods of such collaboration between design and construction in Japan. In this way, this paper deals with two famous Japanese architects, Mayekawa Kunio and Togo Murano, who designed many projects in the middle of the twentieth century. Each of them collaborated with contractors in characteristic methods. Mayekawa Kunio's method is a good example of the "engineering collaboration method," and Murano Togo's method is a good example of the "architectural collaboration method." We examine two of their real projects based on interviews and related documents and drawings, and then, show their methods of collaboration between architects and contractors.

Keywords: architects, contractors, collaboration, sharing roles and responsibilities, building construction process

1. Introduction

Traditionally, collaboration between design and construction has been an important aspect of Japanese building construction projects. However, professional specialization and the strictness of the legal system have brought about a significant change in this relationship. Therefore, we aim to consider the background, purposes, factors, and methods of such traditional collaboration between design and construction in Japan. To this end, this paper shows the actual conditions of collaboration between architects and contractors in former Japanese building construction projects. We examine how architects and contractors shared roles and responsibilities and, during the building construction process, communicated with each other through analysis of two real former projects. As mentioned in the next chapter, these issues vary across projects according to the objects of collaboration.

Furthermore, if we examine the above issues in the context of modern-day Japanese building construction projects, it appears that these issues vary according to not only the objects of collaboration but also to the kind of organization to which an architect or an engineer belongs to and the time at which they join a project. In Japan, some large design firms employ both architects and engineers, while many other design firms employ either architects or engineers. Furthermore, many general contractors have in-house design teams, employing many “Kentikushi”s and engineers permanently. (“Kentikushi” is a government-recognized qualification of designers in Japan and means “architects and building engineers.”) If architects and engineers work for the same design firm, they may start collaborating with each other at an early stage in project. Architects and engineers in the in-house design teams of general contractors may also collaborate with construction engineers in the design stage. However, if the architects and engineers belong to separate organizations, how do they communicate with the architects and engineers of other organizations? In the case of no communication, what problems occur with regard to the quality confirmation of buildings?

2. Research Framework

2.1 Two Typical Collaboration Methods

In building construction projects, the architects responsible for the architectural design collaborate with structural and environmental engineers. Therefore, these architects and engineers constitute the “design team.” Furthermore, many Japanese general contractors have in-house design teams such as the above, employing many architects and engineers permanently. General contractors also employ engineers who are in charge of site work management, as done in the Western system. Furthermore, special contractors employ engineers who participate in the design process. Therefore, these architects and engineers, employed by general contractors and special contractors, constitute the “construction team.” By the above, we assume two models as typical methods of collaboration between architects and contractors in Japan (Fig. 1). In the first method, architects participate in much of the construction process compared to the usual. In the second, contractors participate in much of the design process.

Collaboration methods of architects and contractors are categorized as method 1 and 2 according to their design contents, which are the objects of collaboration. In method 1, architects are more concerned with the engineering quality than with the scope of service generally assumed. Engineering quality is the main purpose of engineering design, which includes the safety of buildings, functionality, and constructability. Therefore, we call method 1 the “engineering collaboration method.” In method 2, contractors are more concerned with the architectural quality than with the scope of service generally assumed. Architectural quality is the main purpose of architectural design, which includes the form and concept of buildings. Therefore, we call method 2 the “architectural collaboration method.”

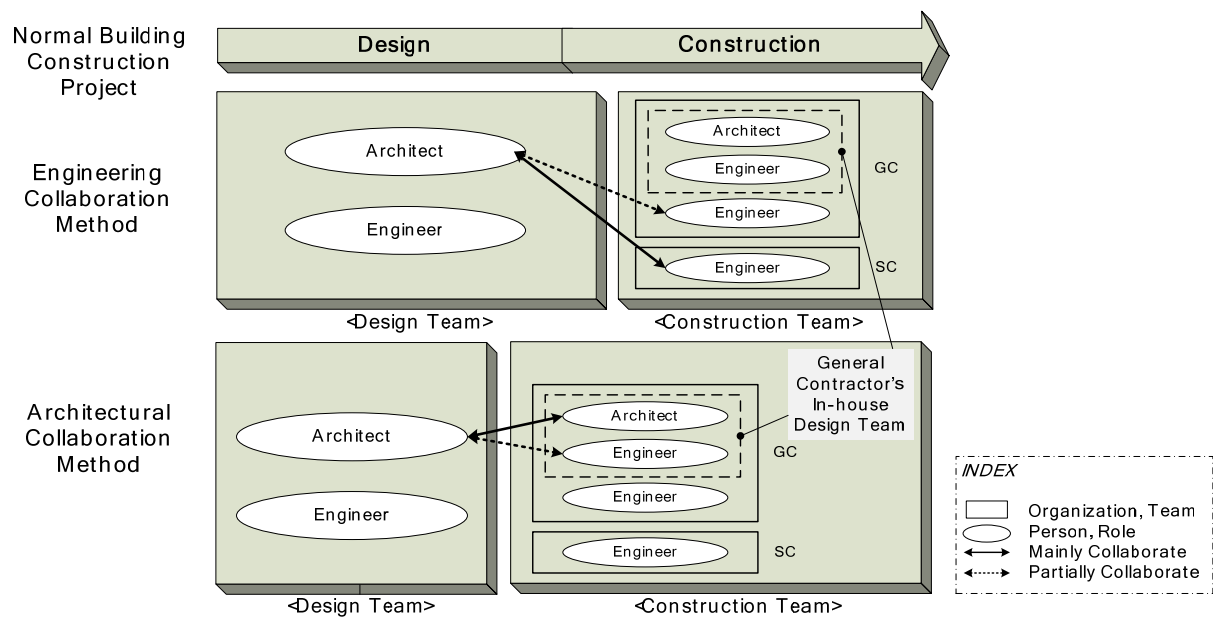


Figure 1: Typical Methods of Collaboration between Architects and Contractors in Japan

Stating in detail, in method 1, architects mainly collaborate with the engineers employed by special contractors and partly collaborate with the site work management staff of general contractors. In the design-build process in Japan, contractors usually prepare shop drawings and fabrication drawings, prepare construction plans and books on construction essentials, and manage the site work. However, in this method, architects prepare detailed drawings near shop drawings and participate in the construction process, which includes preparing construction plans and books on construction essentials and manage the site work. Therefore, the design team collaborates with special contractors who actually execute work in the design stage. Moreover, the design team which is more concerned with design and construction takes charge of the adjustment of architects and contractors. On the other hand, in method 2, architects mainly collaborate with architects from the general contractors' in-house design team and partly collaborate with engineers of in-house design teams. In the design-bid-build process in Japan, contractors are usually selected after the design development is completed, and contractors do not participate in the design process before a tender is issued. However, in method 2, contractors are already selected at the beginning of the design process; they participate in preparing preliminary design drawings and working drawings. Following this, the contractors participate in the architectural design process, support embodiment of architects' intentions, and execute the

engineering design in order to achieve design intentions. Thus, the design team collaborates with a general contractor, who draws up the construction plans and takes charge of the site work management, in the design stage. Moreover, the construction team (the general contractor's in-house design team), which is more concerned about the design and construction, takes charge of the adjustment of architects and contractors.

2.2 Research Methods

To study concretely, this paper deals with the real projects of two famous Japanese architects, Mayekawa Kunio (his method exemplifies the engineering collaboration method) and Murano Togo (his method exemplifies the architectural collaboration method). Following this, we consider the collaboration between architects and contractors from the following two viewpoints: "organizations and sharing of roles and responsibilities" and the "building construction process." We show the organizations that participated in each project, the relationship between the organizations, and the manner in which they share roles and responsibilities. Subsequently, we survey the collaboration in the building construction processes. We examine the Tokyo Metropolitan Art Museum and the Kyoto Takaragaike Prince Hotel, undertaken by Mayekawa and Murano respectively. We have chosen these projects for our study for two reasons: First, the preserved data on them are abundant and usable. Second, we can conduct sufficient number of interviews with the architects and contractors who were involved in the projects owing to their availability. Using the above, we closely examine the collaboration between architects and contractors.

3. Case 1: Project led by Mayekawa Kunio (Engineering Collaboration Method)

3.1 Overview of Object

Mayekawa Kunio (1905-1986) was one of a Japanese modernist architect. One of his characteristic design methods was the technological approach which aimed to promote the development and sharing of fundamental building technology and endorse stoic and fastidious plastic design. Consequently, through the collaboration with specialist contractors, Mayekawa's original tiled panels system, weatherability steel, and architectural precast concrete (PC) were developed. Mayekawa's original tiled panel system entails fixing tiles to forms before placing concrete and unifying them so as to prevent the tiles from falling.

The Tokyo Metropolitan Art Museum (1975) is a public art museum located in Ueno Park, Tokyo. The building elements involving close collaboration on design and construction are the structure of concrete, of which architectural concrete forms a part; the ceiling of architectural PC; the tile on the wall surface, which partly adopted Mayekawa's original tiled panel system; and the doors and windows, which partly used weatherability steel based on the technological approach.

3.2 Research Results

3.2.1 Organizations and Sharing of Roles and Responsibilities

The organizations that were involved in the Tokyo Metropolitan Art Museum project and the sharing of roles and responsibilities are mentioned below (Fig. 2).

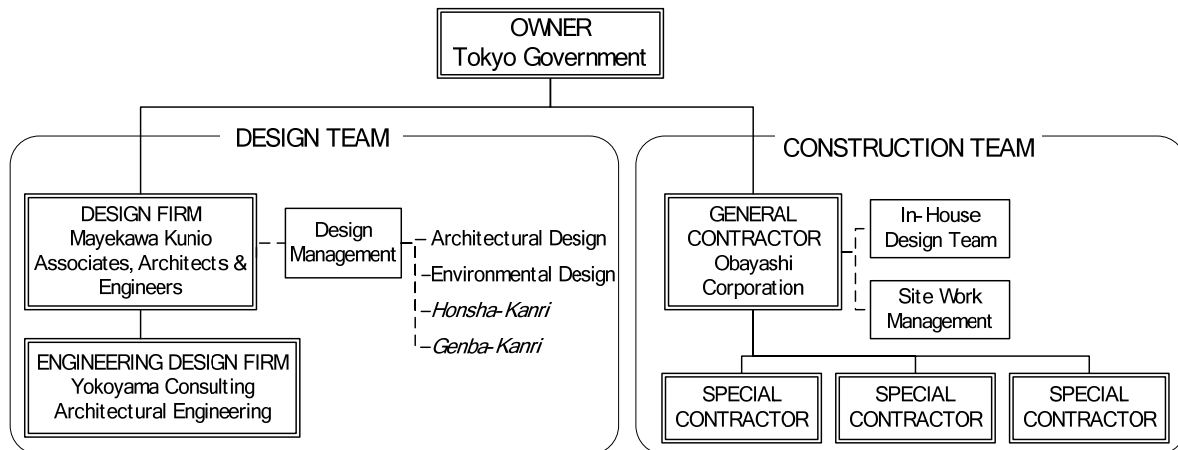


Figure 2: Organizations involved in the Tokyo Metropolitan Art Museum Building Construction Project

This project was commissioned by the Tokyo Metropolitan Government, the architect were from Mayekawa Kunio Associates, Architects & Engineers, and the general contractor was Obayashi Corporation.

Representatives of the Education Bureau of the Tokyo Metropolitan Government resided at the construction site permanently as the owners and participated in site meetings and approved design change.

Being a design firm, Mayekawa Kunio Associates, Architects & Engineers were responsible for the design management, architectural design, and environmental engineering. Mayekawa undertook the supervision. Furthermore, he inspected and gave directions around the construction site, and took the final decisions on important elements such as the arches of the sunken garden, sashes, and color arrangements. Yokoyama Consulting Architectural Engineers also participated in the project and took charge of structural engineering. In the construction stage, they carried out “Kanri” by dividing themselves into *Honsha-Kanri* and *Genba-Kanri*. *Honsha-Kanri* (in Japanese, “Honsha” means head office, and “Kanri” is a concept which includes “supervise” and “inspect”) were in charge of the detailed design about unspecified parts, and of the design change in the design office. Two persons took charge of the *Honsha-Kanri*: one (A1) was responsible for the exchanges between Mayekawa and the *Genba-Kanri*, and the attendance in regular site meetings. The other (A2) was responsible for making drawings under A1’s directions and for communicating with A1. The *Genba-Kanri* (in Japanese, “Genba” means construction site) permanently resided at the construction site and made arrangements with the owner; examined and approved shop drawings, books on construction essentials, and site work management plans; and issued site instructions. Two persons were in charge of the *Genba-Kanri*. One (A3) took charge of the exchanges between the

owner and the *Honsha-Kanri*; managed the process of preparation of drawings in the design office so that they are appropriate for construction; gave instructions to contractors; and approved shop drawings. The other (A4) was responsible for collating drawings and executing work.

From Obayashi Corporation, approximately 30 were responsible for site work management. Moreover, a draftsman permanently resided at the construction site and made shop drawings. Specialist contractors signed the subcontract with Obayashi Corporation and participated in the project. Some of these contractors collaborated with the architects in the design stage.

3.2.2 Building Construction Process

The collaboration in the building construction process of the project is shown as follows (Fig.3).

In the schematic design stage, materials and construction methods that required collaboration with specific specialist contractors were chosen (for example, Mayekawa’s original tiled panel system and architectural precast concrete PC). Therefore, in the design development stage, specialist contractors participated in the examination of the details and constructability of these materials and forms. Moreover, the architects prepared details near shop drawings.

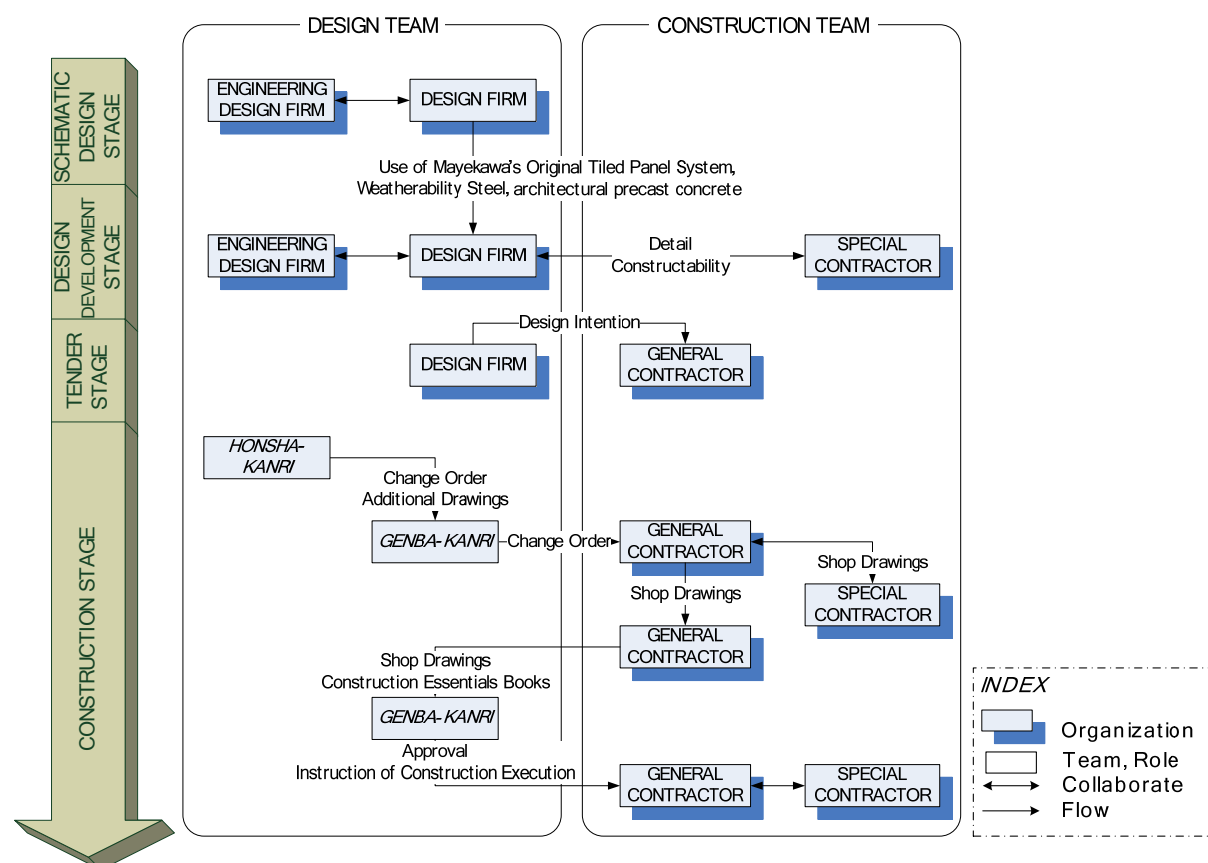


Figure 3: Building Construction Process of the Tokyo Metropolitan Art Museum Building Construction Project

From the tender stage to commencing the execution of the structural works, the architects explained the design intentions such as important design parts and cautionary measures to be taken during execution of work, to the site work management staff of Obayashi Corporation. Moreover, the architects showed the contractors the building in which Mayekawa's original tiled panel system was used in order to familiarize the contractors with this system.

In the construction stage, the owner and persons in charge of the *Genba-Kanri* and the site work management staff of the general contractor permanently resided at the construction site, so that anything that required examining could be addressed every day. The contents of the examination by *Genba-Kanri* persons and the site work management staff were reflected in the shop drawings and were shared. Moreover, regular site meetings about work progress, etc. were held once a week, and in which the owner, the *Honsha-Kanri* persons, the *Genba-Kanri* persons, and the site work management staff participated.

Instructions on design change from the owner, such as use of rooms, were transmitted to the *Genba-Kanri* persons with a change order. They informed the *Honsha-Kanri* persons about the changes and requested additional drawings. The *Genba-Kanri* persons explained the additional drawings to the owner and obtained informal consent. They then transmitted the information regarding the changes to the site work management staff.

When a draftsman of Obayashi Corporation and specialist contractor prepared the shop drawings, the *Genba-Kanri* persons evaluated “whether design intentions are correctly reflected in the shop drawings,” and approved the shop drawings. In some elements such as weatherability steel sashes, Mayekawa approved the shop drawings. In addition, the site work management staff checked whether the shop drawings made by specialist contractors suited the construction budget, and the *Genba-Kanri* persons approved them. Moreover, the site work management staff obtained the owner’s approval for important drawings, which cost a large amount of money, such as that of Mayekawa’s original tiled panel system.

The *Genba-Kanri* persons checked the books on construction essentials, which the contractors had summarized before the execution of the construction, regarding whether design intentions were achieved when the work was carried out. After the approval from the *Genba-Kanri* persons, the work could begin.

Furthermore, the *Genba-Kanri* persons supervised the placing of concrete. They checked staff charts of the site work management staff, the test results regarding forms, steel reinforcement, etc. that the specialist contractors had submitted. One day before placing concrete, the *Genba-Kanri* persons gathered the site work management staff and specialist contractors, and conducted a simulation in order to deepen contractor’s understanding of roles and responsibilities, procedures, and notes. On the day of laying concrete, the *Genba-Kanri* persons checked the time left for ready-mixed concrete and supervised the placing of concrete.

3.3 Collaboration between architects and contractors

From the above, the features of collaboration between the architects and contractors in the building construction project led by Mayekawa are as follows.

The first feature is that the specialist contractors participated in the examination of the characteristic design elements from the design stage, and the collaboration continued into the construction stage.

The second feature is that after architects showed their design intentions, they examined the construction and technology with the contractors (the general contractor and the specialist contractors). To achieve design intentions faithfully, both architects and contractors examined the shop drawings, books on construction essentials, and site work management plans and carried out shop inspection. Moreover, the *Genba-Kanri* persons conducted a simulation and supervised the construction execution of Mayekawa's original tiled panel system and placing concrete.

The third feature is that the *Genba-Kanri* persons, who permanently resided at the construction site, played the role of adjusting and mediating communication between the *Honsha-Kanri* persons, the site work management staff, and specialist contractors. The *Genba-Kanri* persons informed the *Honsha-Kanri* persons regarding the determination matters at the construction site, and managed the process of making drawings in the design office. Furthermore, the *Genba-Kanri* persons informed the site work management staff about design change, checked whether design intentions were correctly reflected in the shop drawings, and approved them. They also approved books on construction essentials and site work management plans and issued written instructions.

4. Case 2: Project led by Murano Togo (Architectural Collaboration Method)

4.1 Overview of Object

Murano Togo (1891-1984) is also a Japanese modernist architect. He called the parts that he designed freely as per the owner's requirements and design conditions "one percent of Murano": he completely dedicated himself while designing the details of such parts.

The Kyoto Takaragaike Prince Hotel (1986, the present Grand Prince Hotel Kyoto) is located in Takaragaike in Northern Kyoto. The building elements involving close collaboration on design and construction are the outer walls of the low-layer building, on which natural stones were stuck on the three-dimensional phase; the ceiling and wall of banquet halls, which are the main parts of the hotel; and the window-sills, which form part of the characteristic design of the upper-layer building.

4.2 Research Results

4.2.1 Organization and Sharing of Roles and Responsibilities

The organizations that participated in the Kyoto Takaragaike Prince Hotel building construction project and sharing roles and responsibilities are as follows (Fig. 4).

The Kyoto Takaragaike Prince Hotel building construction project was commissioned by SEIBU Railway; the architects were from Murano & Mori Architects; and the general contractor was Takenaka Corporation. Takenaka Corporation also took charge of environmental engineering.

At the beginning, the project was to progress by the design-build process involving Takenaka Corporation. However, Murano & Mori Architects participated in the project as per the requirement of the owner, SEIBU Railway. Earlier, SEIBU Railway had requested Murano & Mori Architects to design the Prince Hakone (1978) and the Grand Prince Hotel New Takanawa (1982). In these projects, too, the general contractor was Takenaka Corporation.

Murano & Mori Architects took charge of the architectural design and structural engineering, and the staff prepared the drawings and scale models, as a design firm. Murano himself inspected the site, drew sketches, examined drawings and scale models, and arranged with the owner. A design chief from the design firm, who conceptualized almost all projects at Murano & Mori Architects, mediated the communication between Murano and the architects and assisted Murano. In the construction stage, for the *Zumen-Kanri*, five architects participated in the project from Murano & Mori Architects and resided at the construction site permanently. At Murano & Mori Architects, the staff called *Zumen-Kanri* (in Japanese, “*Zumen*” means drawings) took charge of preparing architectural drawings, making up a schedule of shop drawings and mockups and their examination, and approval and arrangements in the construction stage. An architect, who had resided permanently at the site of Grand Prince Hotel New Takanawa project, became the chief of the *Zumen-Kanri*. However, those in charge of architectural design and structural engineering remained in the office and prepared the drawings of unspecified parts as per the design chief’s instructions.

From Takenaka Corporation, approximately ten architects, structural engineers, and environmental engineers, who belonged to the in-house design team of Takenaka Corporation, shared the design from the beginning of the project. Moreover, the chief of the in-house design team of the Grand Prince Hotel New Takanawa (henceforth the New Takanawa design chief) received Murano’s offer and participated in the project. He grasped Murano’s intentions and conveyed them to other architects and engineers in the in-house design team. In the construction stage, the site work management staff included a draftsman, architects, structural engineers, and the New Takanawa design chief of the in-house design team, who permanently resided at the construction site. They examined constructability and compatibility and then prepared detailed drawings. Moreover, they judged which parts of the building required time and money (because the owner might deem final performance important, or Murano & Mori Architects might design preponderantly), and which parts could be advanced rationally or should be decided earlier. Further, they managed cost distribution and progress of making drawings.

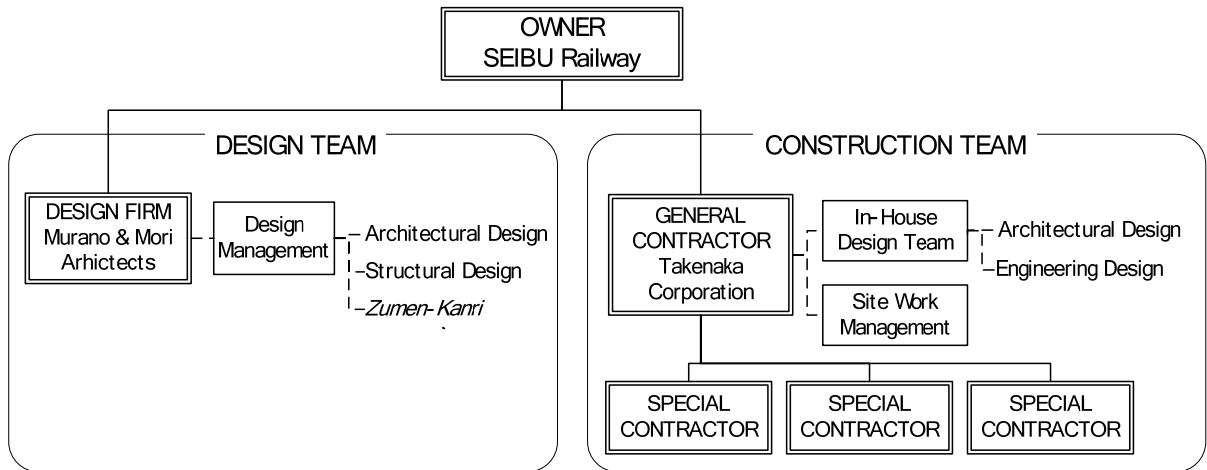


Figure 4: Organizations involved in the Kyoto Takaragaike Prince Hotel Building Construction Project

4.2.2 Building Construction Process

The collaboration in the building construction processes of the project is as follows (Fig.5).

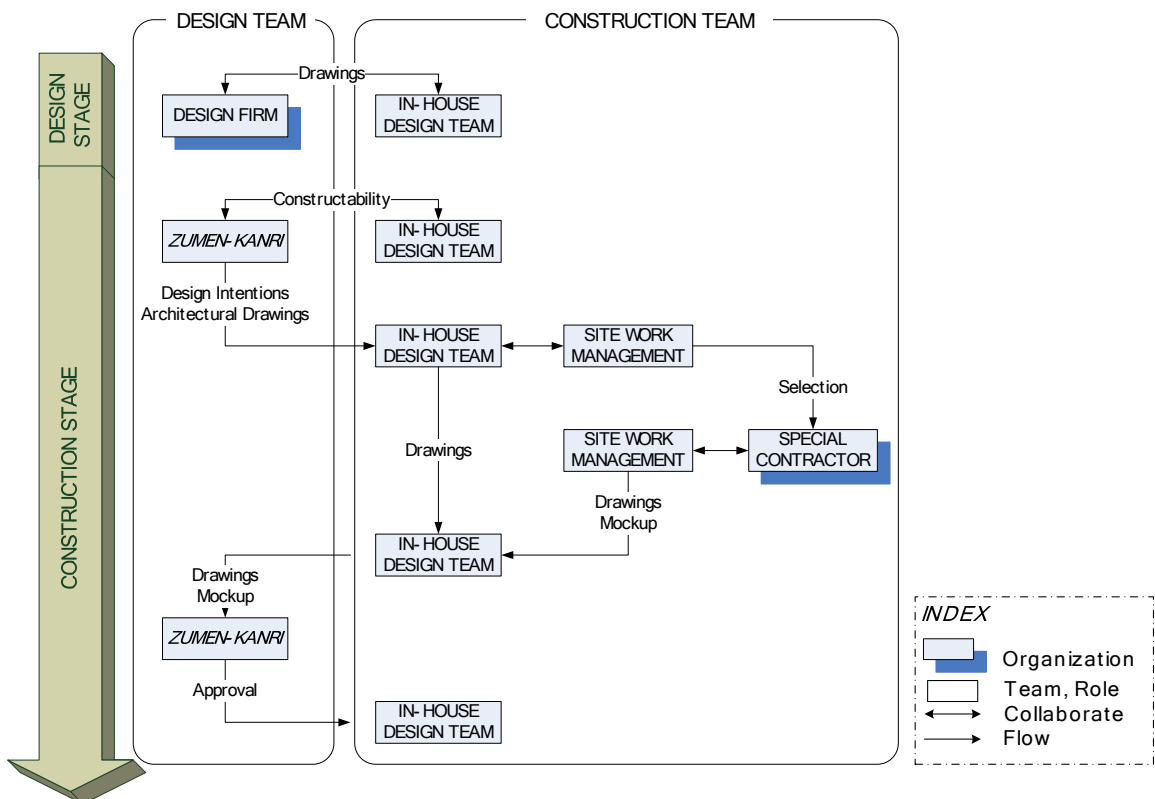


Figure 5: Building Construction Process of the Kyoto Takaragaike Prince Hotel Building Construction Project

In the design stage, Murano drew the sketches and the architects of Murano & Mori Architects prepared the drawings, which were drawn to scale but did not have dimension. Moreover, clay models were made and were corrected by Murano. The in-house design team of Takenaka Corporation understood these intentions, and they considered the design condition, examined construction methods and cost, and then prepared the drawings. Murano & Mori Architects corrected these drawings and also prepared the drawings. Such exchanges were repeated.

In the construction stage, the *Zumen-Kanri* persons of Murano & Mori Architects, the in-house design team of Takenaka Corporation, and site work management staff permanently resided at the construction site. Therefore, in addition to regular site meetings, they had site meetings almost every morning and at any instance of dispute.

In Murano & Mori Architects, under the design chief, they made drawings of the portions that were not examined sufficiently in the design stage and submitted them to the *Zumen-Kanri* persons at the construction site. The *Zumen-Kanri* persons interpreted these drawings, put in characteristic details of Murano & Mori Architects, and then prepared the architectural drawings. At this time, they consulted with the in-house design team of Takenaka Corporation about constructability, if needed. The *Zumen-Kanri* persons sent the architectural drawings and conveyed design intentions to the architects of the in-house design team. They also showed them the details about forms and materials and explained to them how to use the materials (for example, the form of curves of eaves, and the curved surface of marble columns). The elements of buildings, which Murano & Mori Architects designed in the past, were frequently used for illustration. Regarding these, the in-house design team and the site work management staff of Takenaka Corporation examined the most rational methods according to the construction situation and selected an expert specialist contractor.

On the basis of the above examination, and in order to support the examination of parts that should be decided at an early stage, the in-house design team of Takenaka Corporation prepared the drawings (including full-size drawings). They also made structural drawings considering the joints and detailing, and adjusted shop drawings. The draftsman of the general contractor and specialist contractors prepared the shop drawings, and if required, made mockups. The in-house design team examined them to check whether they reflected design intentions and were achievable. Further, the *Zumen-Kanri* persons examined and edited them accordingly. The above exchange was repeated. The *Zumen-Kanri* persons approved using mock-ups and samples (for example, colors and texture, such as wood and paint materials) in addition to shop drawings. In the case of outer walls of the low-layer building, specialist contractors prepared full-size drawings on the floor of the outer walls of the low-layer building. They placed the actual sandstone material on them and examined the alignment of the stones. The *Zumen-Kanri* persons examined this as well.

4.2.3 Collaboration between architects and contractors

From the above, the features of collaboration between the architects and contractors in the building construction project led by Murano are as follows.

The first feature is the organization of architects and contractors. The in-house design team of the general contractor began the examination with Murano & Mori Architects in the design stage, and the collaboration continued into the construction stage.

The second feature is that the contractors (the in-house design team of the general contractor, site work management staff, and specialist contractors) collaborated with the architects in the examination of embodiment and circumstantiation of design intentions, after the architects showed “what they would like to achieve.” Architects examined from the architectural design perspective, and the in-house design team of the general contractor examined the functionality and constructability, which included the expenses and time required for completion. Following this, they decided on the design by communicating with each other. Particularly in the construction stage, the *Zumen-Kanri* persons examined and approved drawings and mockups prepared by the contractors.

The third feature is that the in-house design team of the general contractor played the role of adjusting and mediating communication between architects, site work management staff, and specialist contractors. The in-house design team of the general contractor conveyed design intentions of architects to the site work management staff and the specialist contractors. The team also communicated the demands of the site work management staff or specialist contractors regarding the construction execution to architects.

5. Conclusions

This paper presented two typical methods of collaboration between architects and contractors in Japan: the engineering collaboration method and the architectural collaboration method. Subsequently, as concrete examples of these methods, this paper examined former Japanese building construction projects led by Kunio Mayekawa and Togo Murano, and showed the methods of collaboration between architects and contractors in each project. Furthermore, the results of this paper revealed the features of collaboration between the architects and contractors, which are the interesting issues of comparison between Japanese and Western project delivery systems: what design team and construction team examine regarding engineering quality and architectural quality; who in the construction team participates in the design process; and who plays the role of adjusting and mediating between the design team and construction team.

In the U.S.A. and the U.K. two methods of collaboration between design and construction have become popular. One of them is the design-build process. The other is the bridging method used in the U.S.A. and/or the novation process used in the U.K. However, we have not fully grasped the actual features of these methods. For example, we are not sure whether people aim to collaborate between design and construction as Mayekawa and Murano or they try to restructure the traditional ways of risk sharing, such as the construction period and cost and, to separate stakeholders into schematic design and subsequent process. As forecasted in this time, they have come to collaborate aiming at better risk management in the U.S.A. and the U.K. On the other hand, formerly in Japan, the collaboration aimed to satisfy owners and confirm the quality of buildings after the general contractors had borne all risks. However, Japanese general contractors have been unable to bear such

huge risks as was done previously. Therefore, collaboration with the explicit sharing of risks among people in building construction projects is henceforth necessary. For example, comparing the Japanese and Western change order systems and showing the differences between the two with regard to the sharing of roles and responsibilities may be useful in resolving the above issues. Thus, we will be able to conduct further study about them by examining real projects.

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