

A Study on Client's Decision-Making in Construction Phase of Building Projects in Japan

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Abstract: In building project, client needs to decide many things, and clients cooperate with architects, supervisors, general contractors and other consultants. Especially in construction phase, clients often make a decision. However, client's decision-making in construction phase often makes some kinds of risk. This paper aims to clarify the reality of client's decision-making in construction phase. First, client's decision-making is defined by laws and standards. Second, the questionnaire revealed the current status of client's decision-making in 4 works. Third, Fishbone diagram shows the factors of client's decision-making in four works. Finally, it was modeled how client's decision-making in construction phase affects the post-process of 4 works.

Key words: Client, Decision-making, Construction phase, Building Standards Act, Fishbone diagram

1. INTRODUCTION

1.1. Background and Research Objects

In building project, client needs to decide many things, and clients play a key role in them. Clients cooperate with project members to make a decision in building project. Clients often make a decision in construction phase for various reasons, and that often makes some kinds of risk.

For example, Chan and Kumaraswamy (1997) [1] indicated that one of common causes of delays is client-initiated variations. Odeha and Battaineh (2002) [2] indicated that owner interference and slow decision-making by owner were among the top ten most important factors of delay. According to Assaf and Al-Hejji (2006) [3], their field survey of clients, consultants and contractors clarified that the most common cause of delay identified by all the three parties was "change order". In addition, Sambasivan and Soon (2007) [4] pointed that client-related factor had an impact on the time overrun and Contract-related factors such as change orders (changes in the deliverables and requirements) and mistakes and discrepancies in the contract document resulted in cost overrun.

Thus, Client's decision-making in construction phase is a big uncertainty factor in the project, but it has not been clarified the reality of it in Japan.

This paper aims to clarify the factor of client's decision-making in construction phase in Japan. It also aims to analyze these factors of decision-making and the influence on post-process.

1.2 Research Methods

The research method is as follows.

- 1) Analyze Japanese laws and standards related to client's decision-making in construction phase and reveal the definition of it.
- 2) Take the questionnaire and reveal the current status of client's decision-making involved in reinforcement work, steel work, exterior work, and equipment work.
- 3) Based on the questionnaire results, analyze the factors and the influence on post-process of decision-making in 4 works.

2. Positioning of "act of deciding things"

2.1 Law and Standards

According to Koma (2008) [5], Fig. 1, presents the relationship between laws, standards and project plans. In Japan, laws provide for project plans, and standards are referenced to create project plans. There are three main laws related construction projects in Japan, Building Standards Act, Act on Architects and Building Engineers, and Construction Business Act. In addition, there are several standard specifications of construction work and standard forms of contract in Japan. In this chapter, we analyzed Japanese laws and standards related to client's decision-making in construction phase and revealed the definition of it.

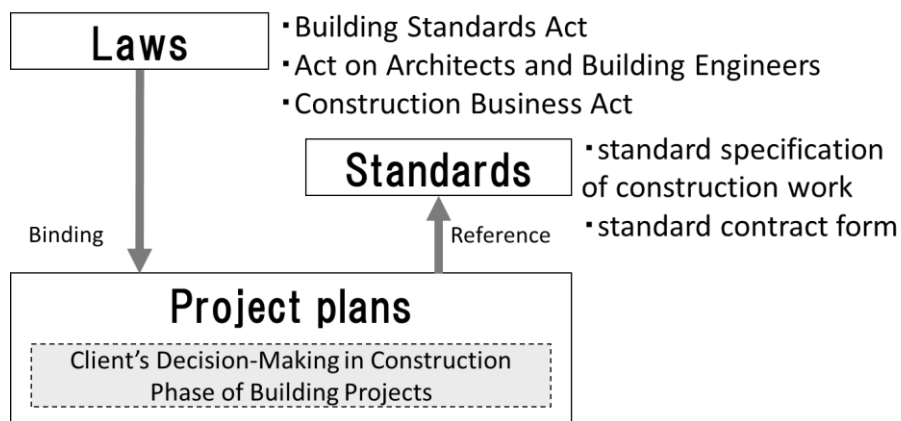


Fig. 1 Laws, Standards, and Project Plans

2.2 Laws [6]

According to the Building Standards Act, construction work cannot be done without the design of architects. In addition, if client want to build the building of a certain scale or larger, client need to submit the application for building confirmation to building official. Building official check and approval building plans such as zoning, building coverage and sun shadow regulations, and building regulations such as structure, durability, fire protection. Furthermore, except for minor changes defined by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), if client want to change the plan, client need to submit the application for the changes before starting the construction works of them.

2.3 Standards

Notification No.15 of the MLIT [7] defines detail design which is reasonable to do in construction phase. In construction phase, based on the drawings, architect shall advice to client about the selection of construction materials, facility equipment, color, pattern, shape. In addition, based on the drawings, supervisor considers whether contractor's proposal about construction materials and equipment conforms to the drawings.

According to Standard Forms of Contract in Public Construction Work [8], if there are errors, omissions, and uncertainty in the drawings, contractor shall point out, and client shall make corrections or changes. Furthermore, client can make architect change the drawings as required.

2.4 Classification of Client's Decision-Making in Construction Phase

Based on the results of these surveys, the definition of the client's decision-making in construction can be shown as in Fig 2. These are largely classified into ① design change and ② detail design which is reasonable to do in construction phase. Among them, ① design changes are classified into 1) Change what has already been determined, and 2) Correction of errors, omissions and uncertainty. Except for minor changes, client needs to submit the application for these changes before starting the construction works of them.

In ② detail design which is reasonable to do in construction phase, client can select them in construction phase after clarifying in drawings. However, if these changes have an influence on building structure, building cost or schedule, client needs to submit the application for them or to change the contracts with project members.

In addition, both ① design change, ② detail design which is reasonable to do in construction phase are defined as design, and regarding client, there is only procedure provision in laws and standards. Furthermore, it is unclear what is decided at the construction phase.

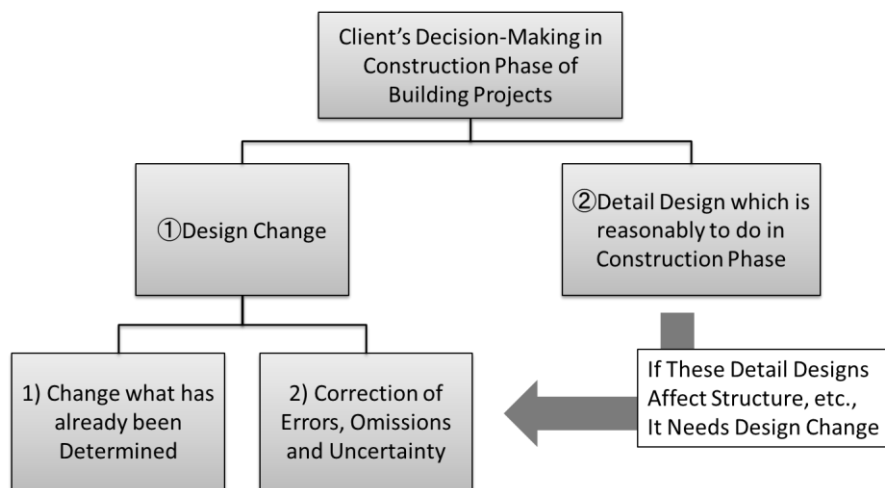


Fig.2 Classification of Client's Decision-Making in Construction Phase

3. The Current Status of Client's Decision-Making in Construction Phase

3.1 Literature Survey

According to References [9] [10], Japanese general contractor makes out a construction schedule when preparing the general construction plan. At this time, the general contractor identifies selected parts of construction materials, equipment, colors, patterns, and shapes specified in the drawings. General contractor also finds errors, omissions, and uncertainty in the drawings. Based on the construction schedule, general contractor decides the deadline of decision-making considering the ordering period and the review period. Despite the fact that client performs decision-making, it is the general contractor that precisely understands what things there are and what the deadline of the decision-making is. Project members discuss and agree on the deadlines submitted by general contractor. In other words, if decision-making is delayed for some reasons, it may affect part or entire post-process.

3.2 Hearing and Questionnaire Survey

The hearing survey was conducted with engineers involved in building projects (3 architects, 3 construction managers, 2 general contractors, 3 subcontractors). The survey shows the cases of client's decision-making which are directly and indirectly related to reinforcement work, steel work, exterior work, equipment work. In addition, the survey also includes factors and the influence on post-process of decision-making in 4 works.

The reasons why 4 works were chosen are as follows: (1) Both reinforcement work and steel work are important construction related to building structure. When design changes occur, client needs to submit the application for building confirmation again and have a big impact on the project. Kim and Furusaka (2014) [11] indicated that design changes affect steel fabrication. (2) Exterior work and facility work correspond to detail design which is reasonable to do in construction phase. (3) Tamura, Fujii, Katada, and Furusaka (2015) [12] showed that 2 works of building structure, the exterior work and the facility construction are related to each other, and adjustment between each works is necessary. For example, in the case of reinforced concrete construction, drawings of skeleton are prepared after adjustment with drawings of exterior work and facility work. If there is a significant change in one of these works, that change affects the other works, and one cannot be determined unless one is decided [13].

We also took the questionnaire about the current status of client's decision-making involved in 4 works. The questionnaire was an open-ended question method and composed of three questions as below. (1) What kind of client's decision-making is there? (2) What factors of decision-making are there? (3) What influence of decision-making is there? The sample was restricted to people in construction project and the respondents were belonged to clients, developers, architects, and general contractors. A total of 78 questionnaires was distributed by e-mail and 14 samples were collected. Although the collection rate is 18%, this survey is aimed at collecting cases more widely, and we judged that the purpose was reached because actually collected more than 40 cases.

3.3 Reinforcement Work

It is rare for client to instruct directly to reinforcement work. However, client often has an indirect influence on reinforcement work about the space and design such as the floor plan and the position of the beams. Therefore, this section shows the cases of client's decision-making related to reinforcement work.

1) Change of floor plan

According to the survey, the position of partitions or windows is changed due to the change of floor plan.

The factor of this case is that client has not clearly decided the use of each room in design phase. Based on the floor plan which client decides in construction phase, it is changed to the position of the partition or the window accurately. Another factor is that building user such as office tenant is not decided, or client's organization changes.

As the influence on post-process, there is an influence on the order delay of the reinforcing bars due to the change. In addition, changing the size and use of the room affect lighting performance and arrangement, the room air conditioning load change, and that has an influence on equipment work.

2) Difference between Pamphlet and drawings

According to the survey, in the case of condominium projects, if there is a discrepancy between the pamphlet and drawings, drawings are corrected to fit the brochure.

The factor of this case is that the pamphlet used to contract with resident is more important than drawings, and when there is a discrepancy between the pamphlet and drawings, the brochure takes precedence. In addition, developer often contracts with the resident based on the pamphlet before drawings are completed, and it can cause this case.

As the influence on post-process, if significant change occurs such as greatly changing the position of the beam, after confirming the structure calculation again, client needs to submit the application for the changes, and it causes a great impact on construction schedule.

3.4 Steel Work

As with reinforcement work, client rarely decides and instruct steel work directly, but client often has an indirect influence on steel work. Particularly, steel work has a larger risk of delay than reinforcement work because steel work requires long ordering period and welding of secondary member.

1) Change of floor plan

According to the survey, as in the reinforcement work, the use of the space is not decided in design phase, and the client changes floor plan in construction phase.

The factor of this case is that client does not clearly decide the use of each room in design phase, and client's organization or building user such as office tenant is not decided.

As the influence on post-process, as with reinforcement work, these changes affect steel work and equipment work. In addition, positions of the secondary member for installing partitions, exteriors and equipment are difficult to change after ordering steel frame. Therefore, it is necessary to decide the specification as soon as possible.

2) Building user's requirement

According to the survey, the structure may change due to demand from building user such as office tenants. For example, if it is decided that a lawyer's office enters as a tenant in construction phase, it is necessary to reinforce the floor so that it can endure a large number of books.

The factor of this case is that as with ① change of floor plan, building user such as office tenant is not decided in design phase.

The influence on the post-process is also the same as ① change of floor plan.

3.5 Exterior Work

Client's decision-making in the exterior work corresponds to "the selection of construction materials, facility equipment, color, pattern, shape" in detail design which is reasonable to do in construction phase defined by Notification No.15 of the MLIT. Client is concerned directly with decision-making about exterior design such as color and shape of tiles and curtain walls.

1) Selection of color, material, and design of exterior

According to the survey, client select materials, colors, patterns, and shapes of tiles, stones, casts, sash, and curtain walls in construction phase.

The factor of this case is that the designer cannot determine the specification in design phase because it is difficult for client to determine exterior design only from drawings. Therefore, general contractor prepares samples of material or full-size mock-ups of exterior in construction phase, and client actually decides their design from samples and mock-ups. In addition, because exterior supplier cannot be decided in design phase, it is also one of the factors that client decides the exterior design in construction phase.

As the influence on post-process, there is an influence on the order delay of exterior work. In addition, changes of the exterior weight and fastener fitting have an influence on reinforcement work and steel work.

2) Change of exterior work accompanying problems in ordering

According to the survey, there are some cases that the order cannot be placed for any reason. For example, the material specified in design phase at supplier side.

The factor of this case is that architect does not grasp the current status of suppliers, and exterior supplier cannot be decided in design phase. There is a limit that architect decides detail specifications of exterior on the drawings because each supplier have different performance and quality for each.

The influence on the post-process is also the same as ① Change of color, material, and design of exterior.

3.6 Equipment Work

As in the case of exterior work, client's decision-making in equipment work corresponds to "the selection of facility equipment," in detail design which is reasonable to do in construction phase defined by Notification No.15 of the MLIT. In equipment work, clients affect it in two ways. First, client directly makes decisions about the position, number and performance of equipment. Second, client indirectly concerns the change of equipment as a result of changes of floor plan and design.

1) Client's selection of equipment

According to the survey, client decides the position, number and performance of equipment such as lighting, air conditioning, outlets and LAN in construction phase.

The factor of this case is that it is difficult to decide detailed specifications of equipment in design phase because client does not decide them exactly then. Therefore, in construction phase, client decides detailed specifications taking into consideration the specific use and usability of equipment.

As the influence on post-process, there are not only the influence on equipment work, but also delay and additional construction cost to redo equipment piping in reinforcement work and steel work.

2) Building user's requirement

According to the survey, building user's requirement affects position, number and performance of equipment.

The factor of this case is that building users are often decided in design phase. In order to respond to the demands of building users in construction phase, there are some cases that an extra sleeve is assumed in drawings of design phase.

The influence on the post-process is also the same as ① client's selection of equipment.

3) Change of equipment by change of floor plan

According to the survey, there are instances where equipment changes may occur as change of floor plan. In this case, client does not directly make a decision, but client affects the use of equipment indirectly through deciding the size and use of the room.

The factor of this case is that client does not clearly decide the use of each room in design phase.

The influence on the post-process is also the same as ① client's selection of equipment.

4) Change of facilities due to insufficient accuracy of design books

According to the survey, equipment may be changed due to inconsistency between drawings of architectural design, structure, and equipment, and it may cause expansion of sleeves and pipe spaces for air conditioning, water supply and drainage.

The factor of this case is that equipment suppliers cannot be decided in design phase. In addition, there are some cases that it is too short to prepare drawings in design phase.

The influence on the post-process is also the same as ① client's selection of equipment.

3.7 Summary of Survey Results

The results of the survey revealed the difference of client's behavior between 4 works.

In reinforcement work and steel work, clients do not decide and instruct the number of reinforcement and performance of a steel member directly. However, clients affect these works indirectly. In design phase, sometimes, clients do not decide certain use of space because they want to follow a trend or they have not decided tenant yet. In this case, clients decide these things in construction phase and that makes changes the positions of partitions and piping sleeves in reinforcement work and steel work.

In exterior work, it is reasonable to decide color and material of exterior in construction phase because clients cannot judge from only drawings whether the design is good. General contractors make mock-up for clients to check the design and clients decide or change the design detail directly.

In equipment work, clients affect it in two ways. In case that it is reasonable to decide it in construction phase, clients decide the position, number, and performance of equipment directly. On the other hand, in the case that client decides the use of space in construction phase, the use and size of the room determine the required position, number and performance of equipment.

In addition, there are two reasons why client postpones decision making to construction phase. The first case is when client fails to make a decision in design phase and postponed the decision. In this case, because the needs of client are changed or building users are not decided, client postpones decision-making. such as floor plan, position of partition, and details of equipment to construction phase. Secondly, it is difficult for client to confirm with drawings. There is a limit in the expressing exterior design or use and usability of equipment in detail only with drawings. Therefore, samples of material or full-size mock-ups of exterior if prepared in construction phase, and client actually decides their design from samples and mock-ups.

4. Analysis of Client’s Decision-Making in Construction Phase

4.1 Analysis of Factors

Based on the results of various surveys, we applied the Fishbone diagram analysis in order to analyze the factor of employer’s decision-making. Fishbone diagram is the tool for identifying the root causes of the problem, which was “client’s decision-making in construction phase” in this paper. Fishbone diagram as shown in Fig. 3 has 3 main causes (project member, building type, building element) and 42 secondary causes. Details of the main causes are shown below.

1) Project members

Based on the results of surveys, the ability, experience, environment, and policy of not only client but also architect, supervisor, and constructor are the factors that client makes a decision in construction phase. Taking client as an example, the factors are changed by the difference in the organization such as whether client is sophisticated or specialized, whether client is public or private, or size of organization. In addition, the factors are also changed by the difference of client’s requirement, whether the needs of client is decided, or whether real confirmation is needed.

2) Building type

There are different factors depending on building types such as condominium, office, hotel and shopping mall. This is because not only what to decide changes, but also the nature of building user changes in each building type. Taking the office as an example, there are some factors such as the fact that office tenants are not decided in the design phase, changes in tenants, and additional requirements from the tenants in the construction phase.

3) Building element

In 4 works targeted for the survey, there are some characteristic factors such as change of floor plan in reinforcement work and steel work, selection of exterior design in exterior work, and selection of the required equipment in equipment work. Taking a change of floor plan as an example, there are some factors that the use of each space and the size itself of each space are not decided in design phase, and the organization of client or building user in each space is not decided, and their additional requirement arises in construction phase.

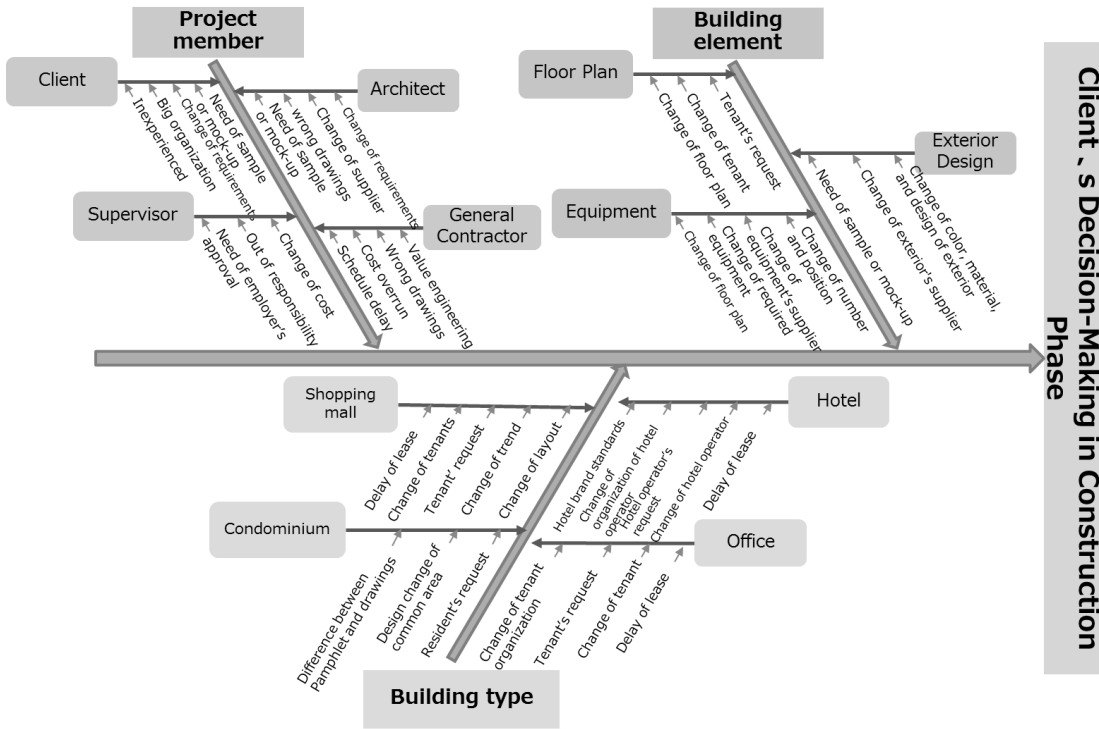


Fig.3 Fishbone Diagram of Client's Decision-Making in Construction Phase

4.2 Analysis of the Influence on Post-Process

Based on the results of various surveys, it was modeled how client's decision-making in construction phase affects the post-process of 4 works as shown in Fig 4. Details of this model are as follows.

1) Client's characteristic decision-making in 4 works

As shown in Fishbone diagram, we picked up characteristic factors such as change of floor plan in reinforcement work and steel work, selection of exterior design in exterior work, and selection of the required equipment in equipment work.

2) Relationship between each works

Selection of exterior design affects exterior work directly, and selection of required equipment also affects equipment directly. In the other hand, change of floor plan affects reinforcement or steel work and equipment work indirectly. .

3) The influence on post-process

Upon client's decision-making, until the order of reinforcing bar or the steel work, there is coordination of interface between 4 works. However, after ordering of them, exterior work and equipment work make a decision in accordance with structural specification.

In this way, especially the change of floor plan in construction phase affects not only reinforcement or steel work, but also exterior work and equipment work, which has a great influence on post-process. In addition, if coordination of exterior work and equipment work is not completed before the ordering of the reinforcing bar or steel frame, there is a possibility that exterior and equipment required by client may not be obtained. Furthermore, if client forcibly construct exterior and equipment required, there are some problems such as welding of secondary members in construction site and it places a heavy burden on constructors.

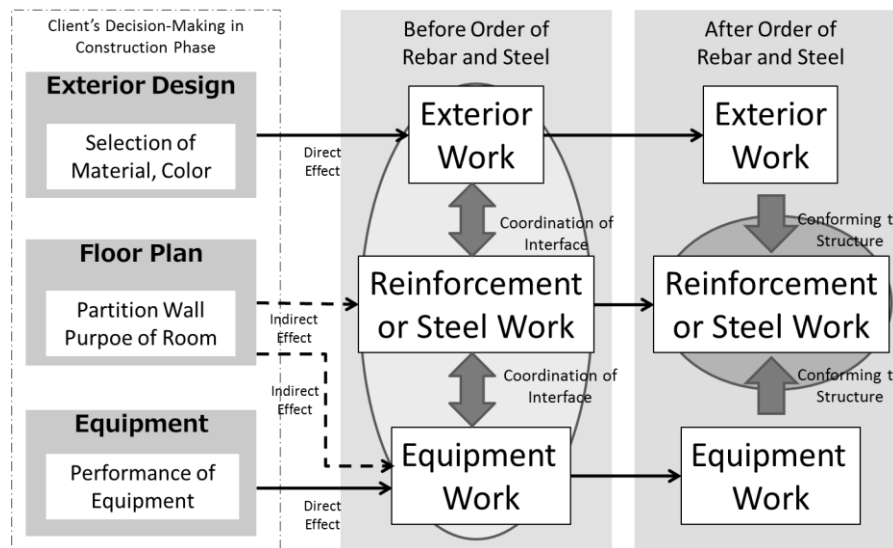


Fig.4 the Influence of Post-Process

5. Conclusion

Through surveys and analysis in this research, various problems concerning client's decision-making in construction process were clarified. Based on laws and standards, it is essentially that drawings are completed in design phase by architect. In fact, however, client postpones these decisions for various reasons to construction phase and finally makes decisions at their own responsibility while cooperating with designers, supervisors, and constructors.

Our future prospects are to clarify the reason the project member, including client cannot make a decision by the end of design phase in accordance with the actual situation.

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