Report on the Introduction of Design-Build System into Public Works in Japan

March 2001

INTRODUCTION

Eight years have past after the release of a report titled "Urgent Necessity of the Diversification of Tendering Methods" in the May 14 issue of "Ronten (controversial point)," Yomiuri Shinbun, in 1993, and introducing the design-build system into public works project is beginning to be officially discussed in Japan. This causes me mixed emotions.

This report has the following three objectives:

1) Removal of the shortcomings of the deep-rooted custom in Japan's construction market which demands that design and construction for public works be carried out by different companies; and clarification of the necessity of a new system which enables the optimal and fair tender be conducted to ensure that high-quality structures are constructed in a cost-effective way and without delay;
2) Clarification of the fact that the traditional design/bid/build for public works projects created a problem in which the owners bear all the risks and responsibilities while the successful bidders (e.g. construction contractors and consultants, surveyors, and geological surveyors) enjoy low-risk and high-return; and
3) Clarification of the fact that the introduction of the design-build system into public works projects in Japan will have bidders face a serious condition in that they have to allocate responsibilities and risks with the owners.

In short, the successful bidders will no longer be able to enjoy the advantages of the longtime custom where the owners satisfy their convenience. In parallel with this, it will be necessary to drastically change the payment methods for design and construction. This report has been prepared based on the confidence that such changes are essential for restoring the credibility of the construction and management systems in Japan and for reviving the international competitiveness of Japan's construction industry.

I thank the members of the "Committee on the Introduction of the Design-Build System" and people of the related ministries and agencies, who gave unstinting dedication, and valuable advice and proposals for solving this difficult issue, and the members of the Secretary including Mr. Atsushi Fukazawa (Director for Engineering Affairs of the Secretariat of Minister of Land, Infrastructure and Transport) who enthusiastically provided support.

March 2001
Committee on the Introduction of the Design-Build System
Chairman
Masahiko Kunishima

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Note: Since this report has been finalized under the responsibility and authority of the chairman, some of the descriptions may differ from the opinions of each committee member.

CONTENTS

1 Fundamentals of the design-build system

In public works projects, it is important that the contractors be selected in a fair manner and that structures with good quality be constructed in a cost-effective way and without delay. The owner must choose the best method to achieve this objective from various tendering methods with due consideration given to the characteristics of the project.

At present, design for public works projects in Japan is usually carried out either by the owner or competitive design firms selected by a tender. In addition, it has been a principle that construction works should be carried out by construction contractors chosen by a different tender in order to encourage competition among the bidders.

Prior to the execution of projects, the owner must identify what sort of structures will be needed (what sort of works will be carried out); disclose information on the projects to obtain consensus from the public; and prove the necessity of the projects.

Although it has been a practice to select design firms and construction contractors by different tenders, design-build may be the best option for both the public and the owner for some projects. Proposals by the Central Council on Construction Contracting Business in February 1998 also emphasize the importance of introducing the design-build. In foreign countries, design-build is already used for some public works projects.

A Report on the Applicability of the Design-Build System for Public Works Projects (issued by Japan Society of Civil Engineers in June 1998), which incorporates the results of studies commissioned by the Ministry of Construction (now Ministry of Land, Infrastructure and Transport) and Japan Highway Public Corporation, points out the following potential advantages and disadvantages with respect to the introduction of this method:

◆ Potential advantages of the design-build system

1. All responsibilities are born by a single party.
2. Coordination activities by the owner can be reduced.
3. Design and construction periods can be overlapped, which allows the project period to be reduced.
4. Phased construction can save time.
5. Since construction contractors, which are the specialist of structure construction, involve in design from the beginning, cost and time can be reduced.
6. Design can be smoothly changed, since the designer and the contractor are the same.
7. Risks related to design can be transferred to the successful contractors.

8. Final project cost can be predicted at early stages of projects (It is less likely that the final cost will become unpredictable due to frequent additional works).

◆ Potential disadvantages of the design-build system

1. Design-builder cannot predict the final cost until the commencement of construction.
2. Since design-builders tend to focus on profit-making, the quality and performance of structures could be disregarded if the contract is either on a GMP[1)] or lump sum[2)] basis.
3. Check and balance function is difficult to work. It may difficult for the owner to be deeply involved in important issues related to design and construction, such as decision making and understanding of the status.
4. Since the design specification is not clear at the early stage of the project, cases could occur where the completed structures do not meet the owner's requirements and conflict among the related parties is caused.
5. Since the owner cannot be deeply involved in the project, there could be cases where the completed structures do not satisfy the standard required by the owner.
6. The design requirement must be finalized prior to selecting design-builders. Otherwise it is extremely difficult to alter the requirements at the late stage of the project. Even if it is possible, the cost could be considerably increased.
7. The extent of the integration of design and construction is totally dependent on the capability of the selected design-builders.
8. It could be difficult for the owner to understand the reason for the extension of the work period.

Note 1: GMP is short for guaranteed maximum price. A GMP project is executed based on the concept of a cost-plus-fee contract with a limited amount of payment. In this type of contract, the amount paid to the contractor by the owner does not exceed the preset upper limit, even when the costs and fees increase.

Note 2: A lump sum contract is executed on a single payment basis. The total amount paid by the owner is fixed regardless of changes in work items.

In order to introduce the design-build system into public works projects in Japan, the Committee studied the types of project suitable for this method; proper tendering procedures; and measures against problems related to the introduction of the method.

What was studied by the Committee is a design-build system for projects, in which a single contractor or a single joint venture carries out both design and construction, and the design and construction contracts are signed at the same time. Unlike the traditional bidding system where the contracts for design and construction are separated, the area delegated to the successful bidder is large in this bidding method. It is needless to say however that the there are still roles and responsibilities fulfilled by the owner. The possible procedure for design-build projects is shown in

Figure 1.1

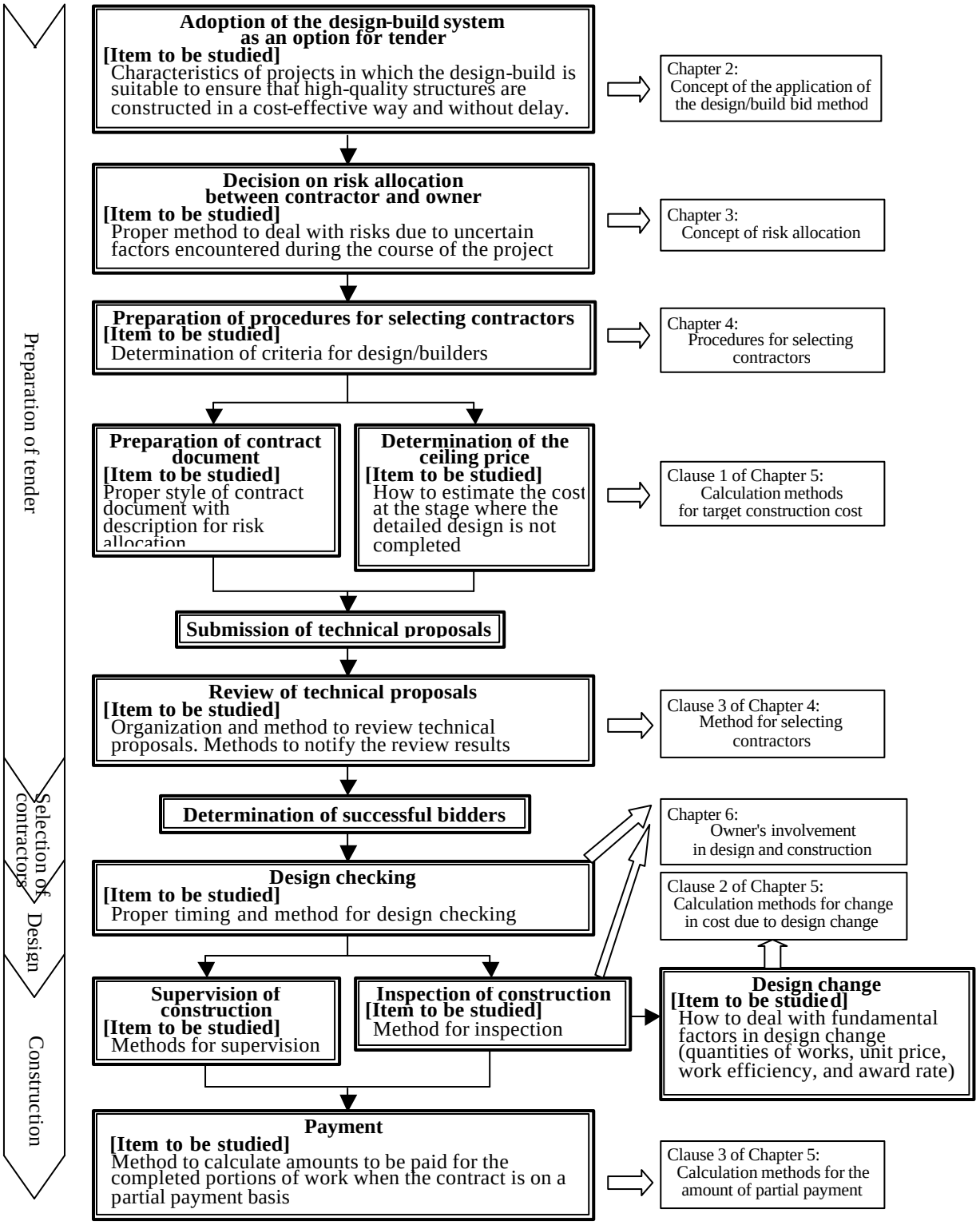


Figure 1.1 Procedure for the design-build system

2 Concept of the application of the design-build system

2.1. Scope of application

(1) Types of projects suitable for the design-build system

The design-build system is suitable for projects in which a single contract for design and construction is beneficial. Although it depends on the conditions and risks involved (uncertain factors: refer to 3.1 for definition), this method, in general, can be applied to the following types of projects:

[Type 1]

Projects in which although there are several options for construction methods, the assistance of engineers with expertise in construction is essential at the design stage, since the design may be considerably different, depending on the method adopted and thus the owner cannot select the best option.

The examples of this type include bridges requiring advanced construction technologies; shield tunnels whose construction methods are rapidly advancing; and projects requiring technologies whose intellectual property rights belong to private companies.

[Type 2]

Mechanical and electrical installation works in which design and equipment production cannot be done by different companies.

The examples of this type include the installation of flood gates and garbage incineration plant equipment in which the manufacturer's know-how is cumulated.

[Type 3]

Projects which have a tight schedule for completion and do not allow the tender for construction to be conducted after the completion of design (excluding the cases where the specifications are not yet available at signing of the contract and negotiations between the owner and the contractor are necessary for preparing them).

The examples of this type include the construction of roads for large-scale events and rehabilitation work after disasters.

[Type 4]

Projects in which detailed design is not necessary for design document for the tender. The examples of this type include minor bank protection projects, in which standardized drawings will

suffice for the tender.

This report excludes discussion on this type of projects, since the simplified tendering method has been already in practical use for them.

(2) Types of projects not suitable for the design-build system

Since it is likely that problems could occur if the design-build system is used for the following cases, it is advisable that this system not be used for these cases for the time being:

1) Cases where the commencement date of the project is not yet decided since land acquisition is not completed
2) Cases where risks to be born by the contractor are considerably large
3) Cases where the project scale is small and the costs incurred by the bidders for technical proposals are considerably large
4) Cases where the owner cannot clarify the concept for the performance and the specification required of the structures

2.2. Time of application

Once design-build projects are identified, it is necessary to decide at which design phase the design-build should be procured. Design has the following phases:

1) Phase in which the required performance and function of structures are decided
2) Phase in which the fundamental items of structures (e.g. location and design conditions) are decided
3) Phase in which most of the basic specification of structures (e.g. shapes) are decided
4) Phase in which detailed specifications for the methods of construction are decided

In each phase, the owner must clarify 1) the standard of design that it demands, and 2) the extent of discretion that the contractor can exercise in the design.

2.3. Type of contract

As shown in the last part of this clause, there are three types of construction contract defined by the civil law. There are large differences between commissioning contract and contracting contract, including the extent of the owner's involvement in the project. For design-build projects, it is very important to understand these differences. It is generally said that design tends to be carried out under a commissioning contract and construction under a contracting contract. Of design works, basic design, which requires careful negotiations between the owner and the contractor, particularly tends to have the aspects of commissioning, while detailed design, which specifies the details for

construction based on the results of the basic design, tends to have the aspects of contracting.

Design for Phase 3) mentioned in clause 2.2, which requires careful negotiations between the owner and the contractor, tends to be carried out under a commissioning contract, while the others under a contracting contract. This means that design works have two different types of contact, so it is essential to check the contents of the contract in details. Phase 4) can be a contracting contract, since the basic design is almost finalized at this stage.

[Types of contract defined by the Civil Law]

- Article 643 : Commissioning
  Commissioning becomes effective where one of the parties concerned commissions the acts of law to the other, and the latter agrees to do so.
- Article 632 : Contracting
  Contracting becomes effective where there is an agreement in which one of the parties concerned promises the other to complete a designated work and the latter makes payment to the former for the work completed.
- Article 656 : Quasi-Commissioning
  Statements of this clause (Clause 10: Commissioning) shall be applied to the commissioning of clerical works, which are not the acts of law.

3 Concept of risk allocation

3.1. Types of risks dealt in the report

Construction projects involve various risks, since they cannot be separated from natural problems (e.g. geological conditions) and personal problems (e.g. land acquisition). Since these risks could cause delay of work and cost overrun, appropriate measures must be taken. In this chapter, risks are defined as unpredictable factors which are encountered after contract award and which could result in delay of work and cost overrun (including additional design cost), and effective risk allocation methods in design-build projects are discussed.

It should be noted here that this chapter deals with risks which will be encountered by the owner and the contractor in the course of the project, and that the owner shall remain liable for damage to third parties due to accidents after the commencement of service, even if the contract states that the contractor is responsible for the risks.

3.2. Fundamentals of risk allocation

(1) Risk allocation for design/bid/build projects

In projects where a separate tender for design and construction is issued, the owner is responsible for risks arising at the design stage, since the contractor is not involved in design. Risks arising in the course of construction can be predicted when the design is completed, so risks of this type are also born by the owner who approved the design. In general, when situations different from those anticipated in the initial design are encountered, the design is changed. It can be said in this case that design change is equal to bearing responsibilities for the risks. Figure 3.1 shows the concept of risk allocation for this case.

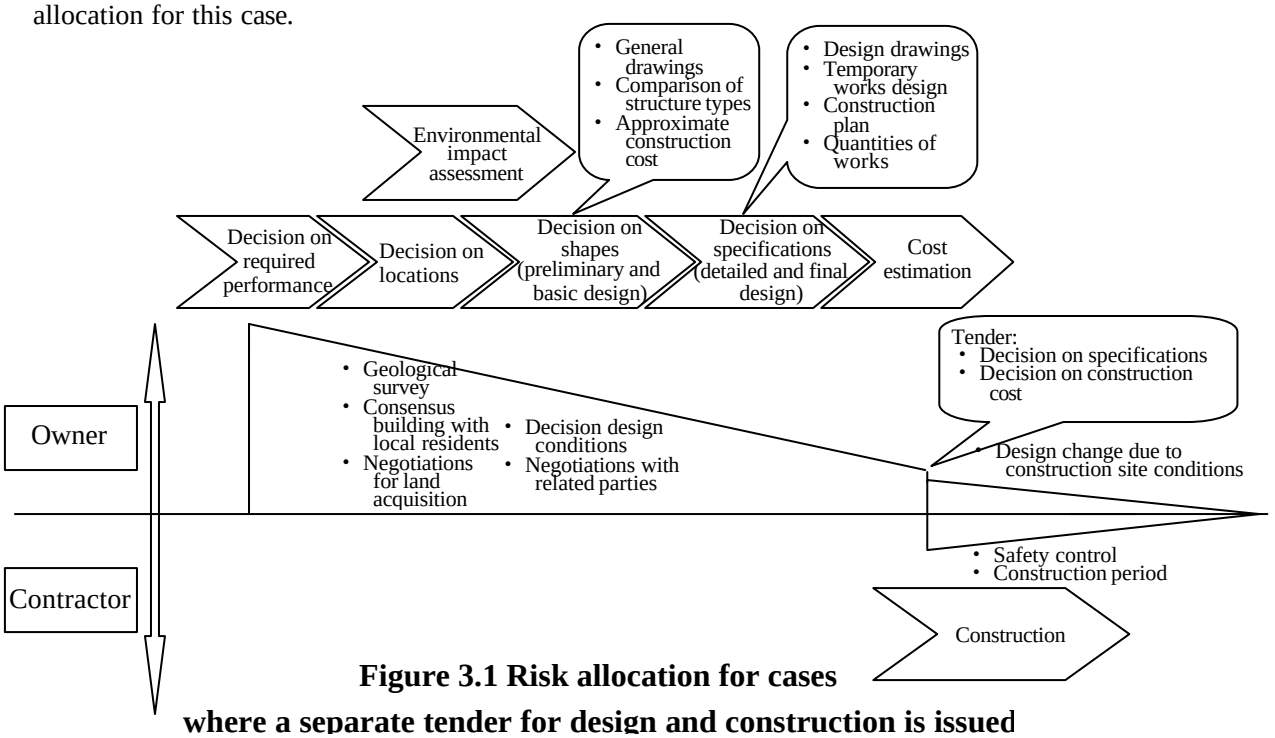


Figure 3.1 Risk allocation for cases where a separate tender for design and construction is issued

(2) Risk allocation for design-build projects

In projects where a separate tender for design and construction is issued, the owner bear most of the risks. In design-build projects, on the other hand, the successful contractor carries out both design and construction, so a careful consideration is necessary for risk allocation in this type of projects.

Particularly, contractors should keep in mind that they can no longer enjoy low-risk (no-risk) and high-return and expect the owners to ensure their convenience.

The important items for design-build projects are as follows:

1. It is necessary to identify possible risks and their characteristics and decide how to allocate the risks between the owner and the contractor.
2. In principle, the contractor is responsible for risks arising in the course of the project, since it carries out both design and construction.
3. Where the contractor cannot bear all the risks, part of them may be born by the owner.
4. Risks to be born by the owner must be specified in the contract document.
5. It must be clarified whether the documents provided to the contractor at the time of tender and before signing the contract are used for design conditions or for information only.

In principle, the contractor shall bear responsibilities for the risks which may be encountered in design-build projects. The owner, however, shall bear unpredictable risks such as devastating natural disasters, inflation, and legal revision. The design-build bidding method shall not be used for projects involving risks which are likely to cause extension of construction period and excessive cost overrun.

It is generally said that it is not appropriate to have contractors bear risks arising from the revision of technical specifications, land acquisition, and reconciliation with the local residents and related parties. The extent of other risks which can be born by contractors may change in the future, when measures to avoid risks (e.g. insurance system) are established.

Methods for risk allocation shall be specified in the contract document. The concept for risk allocation in design-build projects is shown in Figure 3.2

Note 1: Contract document includes i) contract clauses, ii) standard specification, iii) particular specification, iv) drawings, and v) pre-bid conference document and document replying to questions.

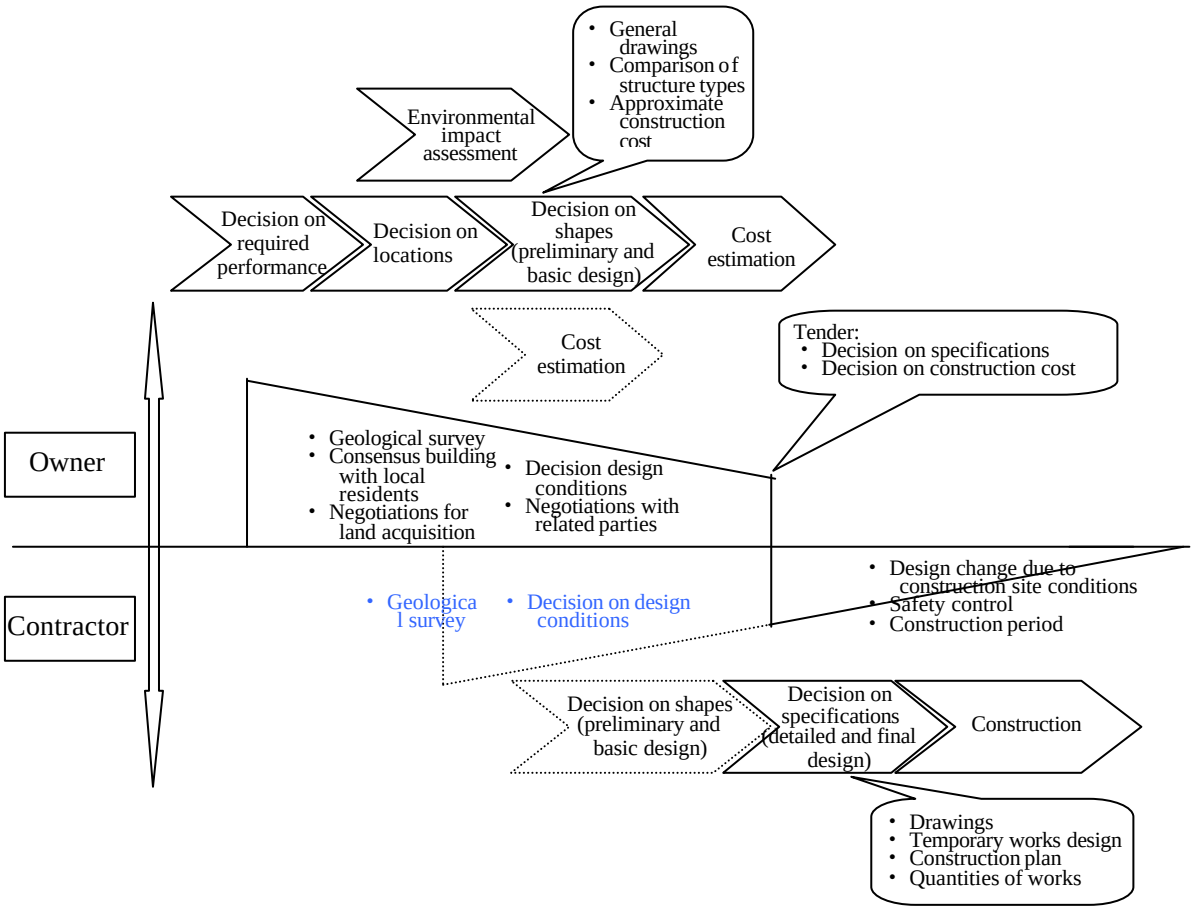


Figure 3.2 Risk allocation for design-build projects

3.3. Identification of risk types and risk allocation

In each project, it is necessary to identify risks and investigate their characteristics to obtain information with which to determine whether it is appropriate to have contractors bear the risks.

(1) Identification of risk types

In order to identify risks, it is necessary first to classify the technical characteristics, natural and social conditions, management characteristics, and other features of factors which could cause risks, and then to study them in relation to specific examples. Table 3.1 gives examples of factors which could cause risks.

Table 3.1 Examples of factors which could cause risks

Classification	Sub-classification	Factors which could cause risk
Technical characteristics	①Construction method etc.	Differences in performance due to the construction method selected, machinery failure, fluctuation in material quality etc.
	②Others	Technical proposal for construction methods etc.
Natural conditions	①Water seepage and ground water	Occurrence of water seepage, effects of ground water on excavation etc.
	②Foundation ground	Soft soil, number and depth of underground floors, effects of foundation ground on piles etc.
	③Roads for project, and work yard	Site conditions (e.g. works in river, sea, and steep locations), restrictions on roads for project and work space etc.
	④Meteorological conditions (including oceanographic phenomena)	Effects of rainfall, snowfall, winds, temperature, waves etc.
	⑤Others	Effects of geological conditions (e.g. landslide), water flow in rapid river, sea currents, consideration for wildlife etc.
Social conditions	①Underground obstacles	Removal and relocation of underground structures hampering construction works
	②Construction in the vicinity of existing structures	Existence of railways, roads, and overhead powerlines in service and existing structures which require special cautions to prevent damage due to the project
	③Noise and vibration	Measures to protect local residents from noise and vibration
	④Water pollution	Measures to protect water environment from pollution
	⑤Roads for project, and work yard	Restriction on roads for projects (e.g. restriction on the use of existing roads for material delivery), and restriction on work space (e.g. works beneath road deck panels and viaducts)
	⑥Work activities using roads in service	Work activities requiring traffic regulations on roads in service
	⑦Others	Measures against other problems than noise, vibration, and water pollution; waste disposal; relocation of utilities, such as gas and water pipes, and electric cable conduits; measures against radio wave interference etc.
Management characteristics	①Coordination with adjoining work areas	Coordination of progress with the adjoining work areas and other projects
	②Measures for local residents	Measures to protect residents living in areas near the project
	③Coordination with related parties	Coordination with related administrative bodies
	④Progress control	Measures for restriction on and revision of construction period and progress due to construction method change etc.
	⑤Quality control	Complexity of quality control (e.g. demand for high-standard quality control)
	⑥Safety control	Dangerous work activities (e.g. high place work activities, night work activities, and underwater work activities)
	⑦Others	Emergency rehabilitation after disasters
Others	①Force majeure	Deformation of ground due to earthquakes etc.
	②Human-induced errors	Errors in design and cost estimation
	③Revision of laws and specifications	Design change due to revision of ordinances, laws, specifications and guidelines; and construction cost change due to revision of the taxation system
	④Others	Nonfulfillment of contract, labor dispute etc.

(2) Characteristics of risks

In order to comprehend the characteristics of risks, three factors are used in this section: extent of risks, solvability, and predictability. The definition of these factors is given in Table 3.2.

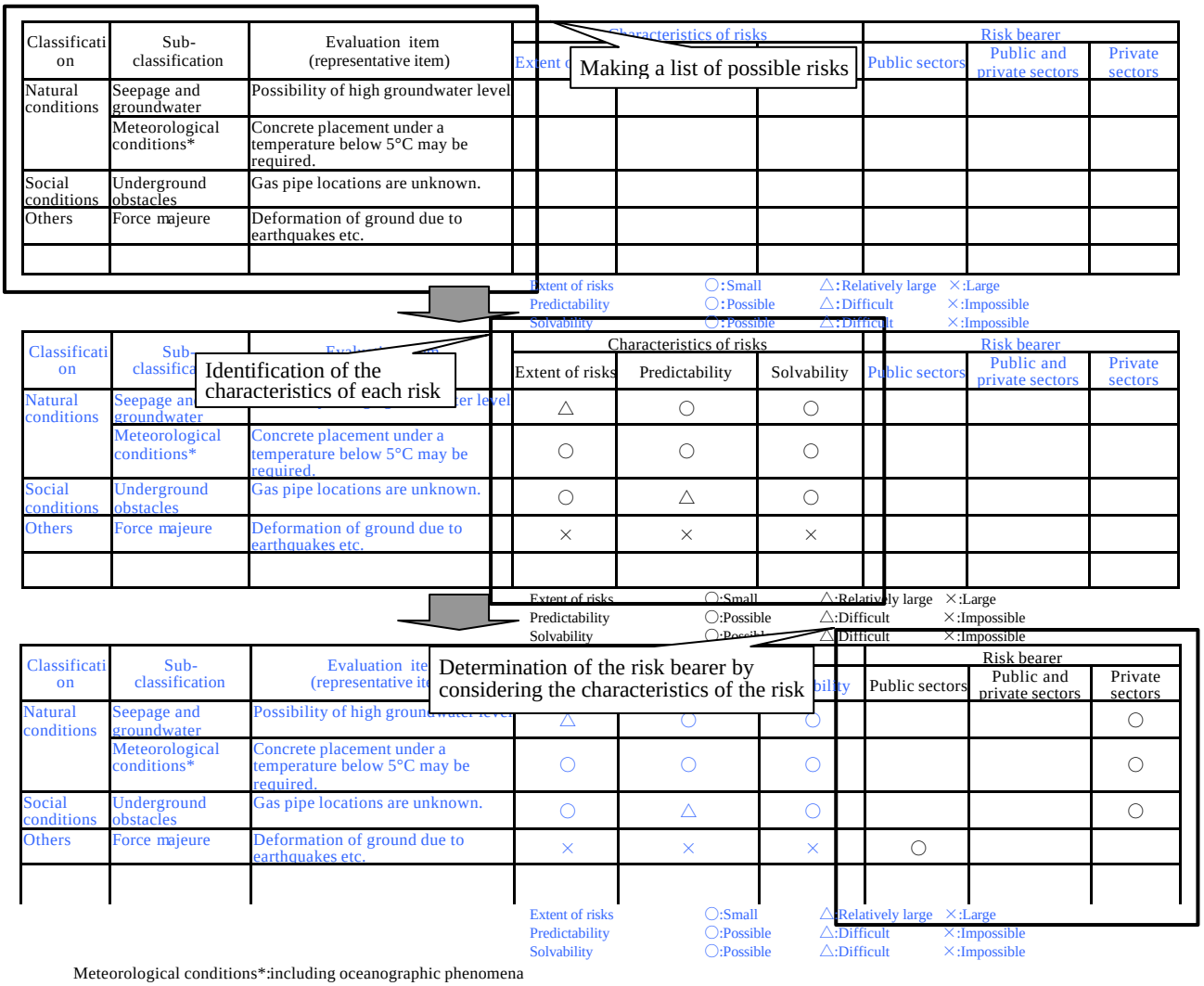
Table 3.2 Characteristics of risks

Extent of risks	Necessary costs and work period to cope with risks
Predictability	Extent of risks that can be predicted in advance
Solvability	Extent of difficulties in taking necessary actions before and after the occurrence of risks

(3) Risk allocation

This section discusses, for each type of risk, whether it is appropriate that the risk be born by the contractor. The risk bearer is determined with reference to the aforementioned "characteristics of risks." In general, it is difficult for contractors to bear risks, if the extent of the risks is large, and the predictability and solvability of the risks are low. In the opposite case, it is considered that the contractor can bear the risks.

Risk allocation table



Meteorological conditions*:including oceanographic phenomena

Figure 3.3 Procedure for determining risk allocation

4 Procedures for selecting contractors

4.1. Types of contractors

Technical capabilities of construction-related companies in Japan, at present, are classified as shown in Table 4.1.

Table 4.1 Technical capabilities of construction-related companies in Japan

Type of company	Type of technical capabilities
Contractors with in-house design departments	Companies with in-house design departments and with experience in design and construction for both civil and building projects.
Contractors without in-house design departments	Companies with technical capabilities only for construction.
Construction consultants	Companies with experience in design for civil projects. Some construction consultants have experience in construction supervision as well.
Architectural design offices	Companies with experience in design and supervision of building projects.

The restrictions (e.g. law), to which design and construction for public works projects in Japan are subjected as of March 2001, are shown in Table 4.2.

Table 4.2 Restrictions on design and construction set by laws etc. (as of March 2001)

Classification	Restriction set by laws etc.
Execution of construction	Contractors must be registered in accordance with the Construction Business Law.
Execution of civil works design	Although not subjected to laws, design of civil works need to be done by registered consultants.
Execution of building works design	Design of building works need to be done by parties registered as registered architect's offices, in accordance with the Licensed Architects Law.

Design-build projects must be awarded to companies with technical capabilities in both design and construction. Types of companies that can be a design-builder are classified in Table 4.3.

Table 4.3 Types of companies that can be a design-builder

Type of contract awardee	Configuration of design-builder	Problem
Construction companies	Construction companies with in-house design departments	• There are no institutional problems at the moment. • Design-builder for a building project needs to be a registered architect's office.
Construction companies (subcontractor of consultant or architectural design office)	Construction companies + consultant (or architectural design office)	• It is necessary to investigate whether it is appropriate to use a tender condition requiring the clarification of for which works subcontractors will be used. • Design-builder for a building project needs to be a registered architect's office.
Joint venture of design companies and construction companies	Consultant (or architectural design office) + construction companies	• Since traditional joint ventures are responsible only for construction, new systems are required.
Consultant or architectural design office (subcontractors of construction companies)	Consultant (or architectural design office) + construction companies	• Consultants and architectural design offices need to be registered as designated construction companies. • It is necessary to investigate whether it is appropriate to use a tender condition requiring the clarification of for which works subcontractors are used.

Construction companies with in-house design departments can be design-builders without problems related to the current institutional systems. However, it is thought desirable that a design-builder be a joint venture consisting of construction companies and either construction consultants or architectural design offices (e.g. consortium), since this allows the project to be properly executed with clear responsibilities of the companies in charge of design and those in charge of construction. Studies on this issue need to be carried out as soon as possible, to establish a proper system for design-build projects. It is also necessary to study the types of contract awardees other than those shown in Table 4.3.

4.2. Qualifications required of companies and engineers

Qualifications required of companies and engineers for design-build projects are as follows:

1) With respect to design, registered consulting engineers or engineers certified by private organizations or with satisfactory experiences shall be used for civil works projects, and registered architectural design offices or licensed architects shall be used for building projects.
2) With respect to construction, contractors shall be companies registered in accordance with the Construction Business Law, and have qualifications for competitive bidding equivalent to those for public works projects required by the owner.

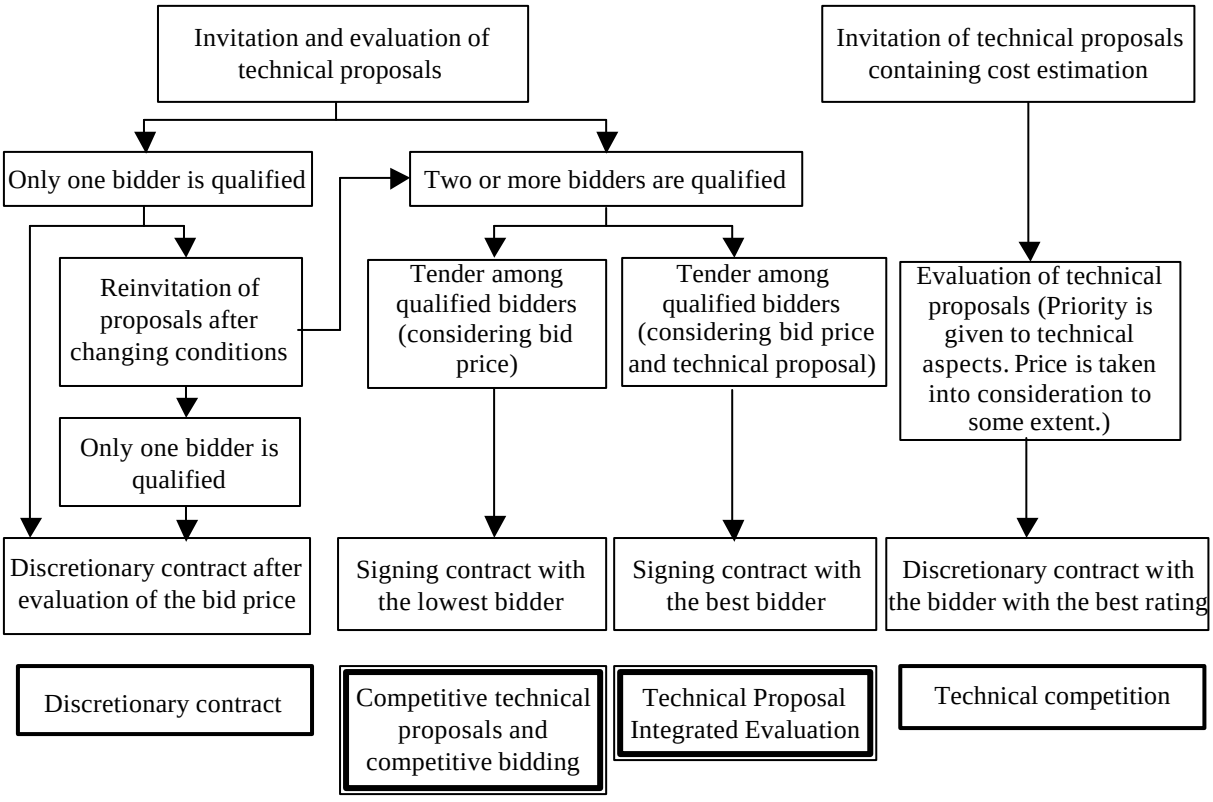
Since the principle contractor or the principle joint venture is responsible to the owner for design and construction risks in design-build projects, competent engineers with adequate qualifications for both design and construction need to be used.

4.3. Method for selecting contractors

(1) Bidding method

It is likely in design-build projects that requirements (e.g. specifications and performance) and risk allocation are not clear at the time of tendering. Some of the design-build projects by the U.S. Federal Government, involving unclear conditions and high risks, use a tender method in which the owner negotiates with the bidders on the contents of technical proposals and the bid price.

There are four types of bidding methods for design-build projects: Technical Proposal Integrated Evaluation, Competitive technical proposals and competitive bidding, Technical competition, and Discretionary contract. "Technical competition" and "Discretionary contract" are already used in Japan for special public works projects. For the time being, however, it is thought that 'Technical Proposal Integrated Evaluation" and "Competitive technical proposals and competitive bidding" are appropriate for design-build projects.



(2) Procedures for selecting contractors

1) Procedures for technical appraisal

In principle, technical appraisal for bidders shall be conducted in accordance with the following:

i) Technical appraisal procedures shall be conducted in conformity with a bidding method which accepts VE proposals at the time of tendering.

ii) The period for preparing technical proposals shall be determined according to their scope and contents.

iii) Effective pre-bid conference shall be conducted to have the bidders fully understand the intention of the owner and the concept of design.

iv) The owner shall conduct hearings to thoroughly understand the contents of the technical proposals from the bidders.

v) The appraisal process shall be transparent and unbiased.

The appraisal criteria, in principle, shall be as follows:

i) Technical proposals shall meet the requirements (e.g. fundamental performance and design conditions) given at the time of bid notification.

ii) Technical proposals shall be in conformity with the required workmanship, safety, cost-effectiveness, technical plans, and execution system.

2) System of the owner for technical appraisal

The owner shall establish a proper in-house system for technical appraisal. The appraisal shall be conducted in a transparent and unbiased manner. If the appraisal cannot be appropriately conducted by the in-house system alone, external experts, construction consultants, or architectural design offices shall be employed.

Where high-level technical judgment is required in the process of the technical appraisal, a special committee consisting of experts from academic and other sectors shall be formed. In this case, it is necessary to clearly define, in advance, the organization, roles, and duties, of the committee; methods to deal with the appraisal results; requirements for the committee members (qualifications, duties, pledges etc.). In order to ensure the transparency and impartiality of the appraisal, the names of the committee members and the items of the appraisal, in principle, shall be disclosed in advance.

5 Calculation methods for ceiling price and concept for design change

5.1. Calculation methods for ceiling price

For design/bid/build projects, detailed design is first conducted to obtain the quantities of works, and the ceiling price is then calculated using the quantities. On the other hand, design-build projects require a careful attention when calculating the ceiling price, since the tender is issued before finalizing the quantities of works.

The ceiling price for design-build projects is calculated by either method A alone or the combination of methods A to C (see below for the details of methods A to C), depending on the characteristics of the projects. It is important to specify in the contract how to deal with the differences between the approximate quantities for cost estimation and the actual quantities calculated after project completion. For the time being, the design cost shall be calculated using a method in accordance with the current cost estimation standard. The proper expense ratio shall be studied through trial use.

[Method A: Cost estimation using approximate quantities of works]
The ceiling price is calculated based on the approximate quantities of works, which are obtained from a preliminary design. This method is applicable to projects in which the design can be conducted by the owner alone using standardized methods.

[Method B: Cost estimation based on standardized design or records for previous projects of similar kinds]
The ceiling price is calculated based on either standardized design or records for previous projects of similar kinds, or both. This method is applicable for constructing structures for which there are standardized design and records of similar structures, and which are not likely to be subjected to design change due to site conditions.

[Method C: Cost estimation for reference purpose]
The ceiling price is determined by first letting the bidders submit cost estimations for reference and then evaluating them. This method is applicable for the part or whole of the projects in which it is difficult to use design conducted by the owner using standardized methods.

5.2. Calculation methods for change in cost due to design change

In design-build projects, the contractor, in principle, bears all responsibilities and risks related to design. Therefore, design is not changed unless the owner requests to do so. Design may be changed if cases arise in which it is thought that risks should be born by the owner: they include cases where it is necessary, after signing the contract, to significantly change the specifications issued at the time

of tendering because of the site conditions (e.g. climate, ground, and environment) and the performance required of structures, and cases where unexpected buried cultural properties are encountered during excavation.

The change in cost due to design change must be calculated by taking into consideration such factors as the quantities of works (both estimated and actual quantities), unit price, and work efficiency, and by using methods and procedures different from those for design/bid/build projects.

Table 5.1 compares the method to calculate cost change due to design change for design-build projects with that for design/bid/build projects.

Table 5.1 Comparison of methods to calculate construction cost change due to design change

	Design/bid/build Projects	Design-build projects
Change in quantities of works	Difference between the actual quantities in completed works and estimated quantities at the time of tendering.	Difference between the actual quantities in completed works and quantities based on design approved by the owner
Unite price and work efficiency	Values determined by the owner are used.	[Method A] Values determined by the owner are used. [Method B] Values are determined by referring to the unit price submitted by contractors at the time of tendering and signing the contract. For new items which are created due to design change and whose unit price were not given at the time of bidding and signing the contract, the owner asks the contractor to submit their unit price.
Award rate	Contract price ÷ ceiling price	[Method A] Award rate cannot be used since the tender is issued before finalizing the detailed specifications. [Method B] Contract price÷ceiling price [Method C] (Contract price)÷(amount estimated by the owner based on design conducted by the contractor)

The unit price and work efficiency are, in principle, calculated based on method A. Method B is applied to cases where there are no unit price and work efficiency determined by the owner, or the unit price and work efficiency calculated by the contractor are considered appropriate.

In most of the design-build public works projects overseas, payment to the contractor by the owner is made by either monthly payment or progress payment, and it should be noted that this is completely different from traditional public works projects in Japan, in which a separate tender for

design and construction is issued and payment is made by paying 30 to 40% of the contract sum as advance payment with the remainder (including the cost change due to design change) paid upon completion of the project.

In design-build projects, it is important that the process and progress of design and construction be professionally reviewed, inspected, evaluated and accepted by both the owner and the contractor. It is therefore thought that monthly payment or progress payment is appropriate for this type of projects.

5.3. Calculation methods for the amount of partial payment

In design/bid/build projects which are financed by bonds issued by the national government, partial payment at the end of a fiscal year is made by calculating the quantities completed in reference to the design carried out by the owner. On the other hand, since the design for design-build projects is finalized by the contractor, there remains a problem with respect to the accuracy of the calculation of completed quantities based on which payment is made. The proposed methods for calculating completed quantities are as follows:

[Method A] The completed quantities submitted by the contractor is approved after appraisal by the owner.

[Method B] The completed quantities is determined in such a way that values submitted by the contractor are first appraised by the owner and then multiplied by a fixed value (e.g. 90%).

[Method C] The owner calculates the completed quantities based on design carried out by the contractor.

It should be noted here that method A could cause overpayment, and method C could result in excessive burden on the owner. At present, it is thought that method B is the most appropriate.

6 Owner's involvement in design and construction

6.1. Concept and phases of involvement

In order to construct structures with the quality required by the owner, the owner must clarify the contents and scope of the requirements for design and workmanship prior to signing the contract. In design-build projects, it is desirable that the extent of discretion that the contractor can exercise be as large as possible. However, it is necessary for the owner to remain involved in and in control of all the phases of design and construction by such activities as meetings, instruction provision, supervision, inspections, acceptance, appraisal, and payment.

In design-build projects, the contract (including construction cost) is signed before design is finalized. This means that methods and procedures for the revision of construction cost due to design change by the owner are completely different from those for traditional design/bid/build projects.

In design-build projects, the owner involves in three phases of the design process: technical proposals from the bidder, execution of design, and the final stage of design. During construction, the owner supervises, inspects, and appraises whether the construction is in conformity with the design, to ensure the required quality.

If damage to third parties is caused during or after construction, the owner cannot escape its responsibilities even if the damage is due to defect of the design conducted by the contractor. This means that due consideration must be given to the terms and conditions on contingency and indemnity.

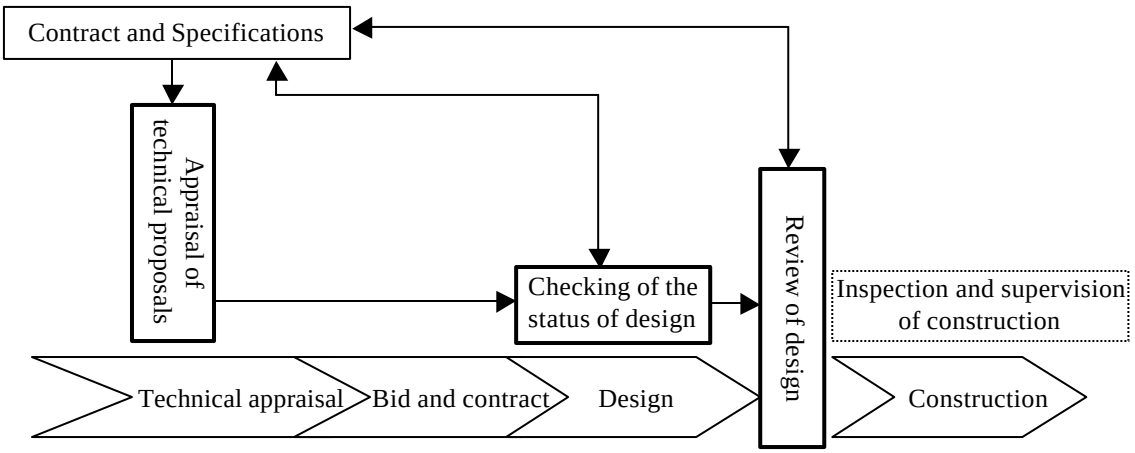


Figure 6.1 Involvement of the owner in design-build projects

6.2. Confirmation and approval of design

Since in design-build projects, design and construction are carried out by a single contractor and the cost is determined in advance, it is thought that the successful contractor tends to carry out a design which allows the construction cost to be minimized. If this tendency goes to such an extent that the quality could be affected (negligence of quality required by the contract) and safety could be deteriorated, the owner needs to take necessary action to prevent this.

Therefore the owner must 1) ensure, at the time of singing the contract, that information as detailed as possible (e.g. design conditions, requirements, design-related items to be confirmed and the times when such items must be confirmed, items to be negotiated, actions to be taken in the event of doubts) is included in the contract document, and 2) after the signing the contract, monitor whether construction is carried out in conformity with the requirement in the contract. In addition, it is necessary to determine in advance the periods necessary for negotiations and confirmation.

When the conformity with the requirements cannot be confirmed by the owner alone either technically or physically, external experts, construction consultants, or architectural design offices need to be employed.

(1) Confirmation during design stage

In order to eliminate the necessity of redesign, the contractor must submit plans for the time of design status checking, and the extent and contents of items to be confirmed to the owner for approval. Design status checking shall be conducted based on the submitted plans. When items which are not in conformity with the design conditions and requirements are found, the owner shall instruct the contractor to rectify them. The instruction shall be given in writing and include reasons why rectification is necessary. If the owner's instruction is not proper or its appropriateness is doubtful, the contractor shall inquire of the owner in writing.

Conditions (including design conditions) in principle shall not be changed by the owner. If change is inevitable, costs arising therefrom shall be calculated using the same methods and procedures as those at the time of tendering. If this is difficult, the construction cost after design change shall be calculated based on the revised design.

(2) Confirmation at the final stage of design

Design shall be reviewed by the owner upon completion. The responsibilities for the contents of the design, in principle, shall be born by the contractor. This means that the contractor is liable for design which is not in conformity with the contract requirements, regardless of whether or not the owner recognizes the nonconformity and issues instructions to rectify it. The owner, however, shall

approve items which, at the time of the review, have been found to be in conformity with the requirements, and be liable for the responsibilities for design change which arises thereafter.

6.3. Actions to be taken in case of differences of opinion between the owner and the contractor

At the time of signing the contract, the contract document does not necessarily identify all specifications. Where the specifications and standards are ambiguous, it is thought that the owner tends to opt for safer design and the contractor tends to opt for cost-effective design. If the owner and the contractor have different opinions and do not reach an agreement, the decision shall be made by third parties such as a committee consisting of academic experts.