

# **A Basic study on geological risk reduction in Japan public works**

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## **ABSTRACT:**

In recent years, as the finance of the national and local governments becomes severe in Japan. The government construction investment has been decreasing, and now it is reduced by 48.9 percent from its peak. People's cost consciousness is also rising due to cut in the construction investment. The public works project in Japan is under severe conditions due to the budgetary cutback. Responding to this situational change, the government has started implementing the cost structural reform of public works" used for the whole government in 2003. This reform describes reconsideration of all processes of the public works project from cost viewpoints. However, "the viewpoints from the geological feature" are not specifically described. Geological conditions influence effectiveness and/or efficiency at any stage of life cycles of public works, conception, design, construction, and maintenance. In this study, thus, setting "reduction of the geological risk in public works" as the ultimate goal, an attempt is made to study a possibility of lowering the geological risk by introducing geological engineering advisor and concept of GBR (Geotechnical Baseline Report), developed and applied in a large-scaled underground construction project in the U.S. Here, geological risk is defined as a possibility of cost increase and/or project delay caused by poor or insufficient treatment of geological conditions. It is observed that the public client and the contractor have her/his own worry about payment associated with design document change: "Paying too much" and "Paid enough?," respectively. It is concluded that introduction of geological engineering advisor is expected to reduce the public client's worry and that concept of GBR is expected to reduce the contractor's worry.

**KEYWORDS:** geologic risk management, geological engineering adviser, geotechnical baseline report

## **1. RESEARCH BACKGROUND**

In recent years, as the finance of the national and local governments becomes severe. As shown in Figure 1, the government construction investment in Japan was in the peak in 1995 with an increase from around 1985. Since 1996, however, it has been

decreasing. Now, it is reduced by 48.9 percent from the peak. People's cost consciousness is also rising due to cut in the construction investment. The public works project in Japan is under severe conditions due to the budgetary cutback.

Responding to this situational change, the government developed a wide range of programs to

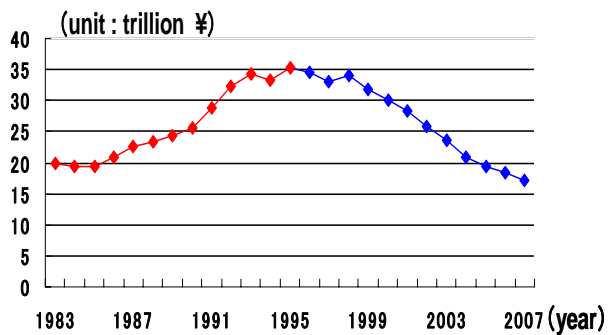


Figure 1: The change of the government construction

cut cost of the public works. The government develops guidelines and tackles the reduction of the cost and the efficiency improvement actively. A representative guideline is “the cost structural reform of public works” used for the whole government in 2003.

This reform describes reconsideration of all processes of the public works project from cost viewpoints. However, “the viewpoints from the geological feature” are not specifically described.

Geological conditions influence effectiveness and/or efficiency at any stage of life cycles of public works, conception, design, construction, and maintenance.

At construction stage, poor geological risk management can cause cost increase or project delay. In Japanese public works, not a few risks occur related to geology are occurring.

## 2. RESEARCH OBJECTIVES

First, we set "the reduction of the geological feature risk in public works" as the ultimate goal of the research. As this study objective, then, we will try to "study a possibility of lowering the geological risk by introducing geological engineering advisor and GBR."

GBR is the abbreviation of geotechnical baseline reports, and it has been used for a large-scale tunnel

construction in the U.S. to clarify risk share between the owner and the contractor.

We define geological risk as a possibility of cost increase and/or project delay caused by poor or insufficient treatment of geological conditions.

## 3. PRACTICES OF CONVENTIONAL GEOLOGICAL RISK MANAGEMENT IN JAPANESE PUBLIC WORKS

We conducted literature reviews and interviewed practitioners to understand actual practices of geological risk management and their consequences.

It is found that the conventional geological risk management is usually based on the “minimum” geological survey. Therefore, contract conditions have to be changed very often. Thus, many requests for change are submitted from the contractor. Design document changes are done by negotiation between the owner and the contractor.

Thus, projects are started from an optimistic recognition of geological risk. The difference between the assumed conditions and the actual conditions are dealt with through the design document changes.

The Japan Geotechnical Consultant Association (JGCA) has been studying improvement of practices of geological risk management. The JGCA raises the following five reasons for the current practice starting from optimistic risk recognition and taking reactive measures after problems are found:

- 1) Unclear concept of body of knowledge of geological risk,
- 2) Insufficient data on geological risk,
- 3) Undeveloped quantification method of geological risk,
- 4) Unclear status of a person in charge of geological risk, and
- 5) Undeveloped profession of geological engineer to support the public client.

Watanabe pointed out that Japanese public client had been required to implement a huge amount of public works “perfectly,” that is, to execute the given budget neither too much nor too little, to complete the works within the fiscal year, and to deal with the auditing “safely” so that no controversy is generated. In Japanese public works percentage of completion of design documents is generally low. Unspecified customer’s requirement can be interpreted as a means to implement a huge amount of works within the fiscal year.

The current practice starting from optimistic risk recognition and taking reactive measures after problems is considered a means to satisfy the perfectionism required for the public client.

#### 4. PROBLEMS OF THE CONVENTIONAL PRACTICES OF GEOLOGICAL RISK MANAGEMENT IN JAPAN

Recently, however, the conventional approach is facing a difficulty. Especially in local governments, request for increase in contract value by the change of design is becoming difficult to be accepted by the client.

Furthermore, this approach has inherent problem. The both public client and contractor have worries about payment associated with these design document changes (Figure 2).

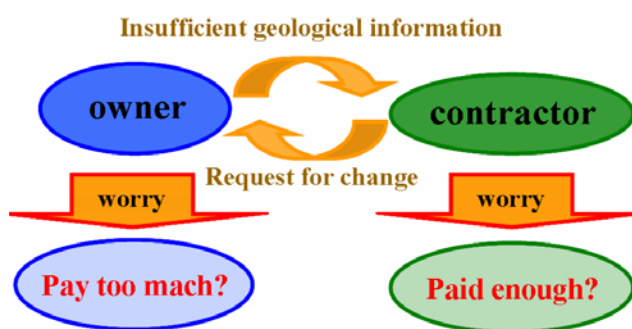


Figure 2: Inherent problem in conventional geological risk management

The contractor is always worried if the owner pays enough at the end of project. In overseas construction market, contractors are required to submit claims with strict quantitative accounts. In Japanese public works, increase in contract value is often dealt with through budgeting for other construction works; thus, the strict quantitative account is not necessarily required. Moreover, “flexible” payment method is sometimes employed associated with design document change. That is, the contractor does not obtain sufficient payment in the case of tight budget and recover the shortage in the case of sufficient budget.

The owner feels if they are paying too much. This is because they often do not have a sufficient level of engineering knowledge to judge contractor’s request for increase in contract value. It is considered that these two worries have been reduced by designated competitive bidding and Dango, a method of deciding the winner by negotiation among contractors.

Thus, reducing the two worries by designated competitive bidding and Dango will be more difficult. Thus, a new method has to be developed. One of them is to improve owner’s capability of geological risk management. We believe that introduction of geological engineering advisor to the public owner is an effective solution.

#### 5. WEAKNESS OF DANGO SYSTEMS

Watanabe pointed out the weakness of the dango systems (Watanabe 2006). There is no alternative system to them which can achieve virtuous circle of certainties when competition among contractors becomes hard.

When the dango is not agreed, the structural indeterminacy is actualized. Since the uncertainty of contractor’s business increases, the contractor would have to take measures to reduce the business uncertainty. The actualized structural indeterminacy

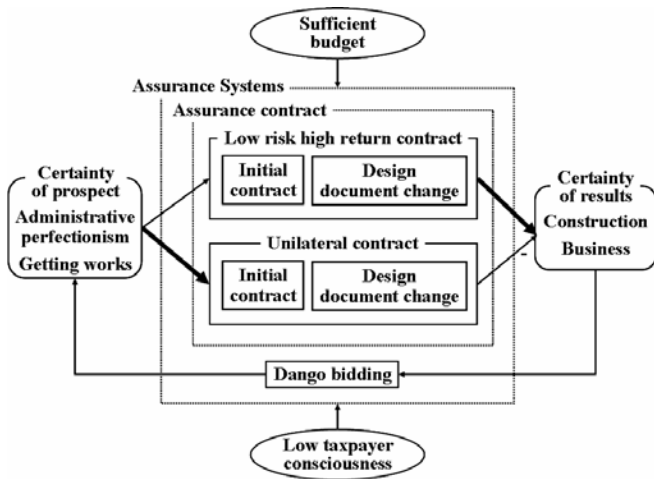


Figure 3 Structure and performance of dango systems

and the existing artificial indeterminacy induces and enables contractors to take “easy” measures such as sacrificing quality of works or cutting labor wage.

If such easy measures are frequently taken, speculative nature of contractor business rapidly increases. As a result, there is a possibility that the quality of works is lowered and construction labor accidents frequently occur. In another word, users and construction workers would have to accept the above-mentioned “unsound” risk. Increase in speculative nature of contractor business and unsound risk sharing is fragility of the dango systems under hard competition among contractors.

The two environmental changes of enhancement of taxpayers’ consciousness and loss of sufficient budget are now possibly exposing the fragility of the dango systems.

## 6. INTRODUCTION OF GEOLOGICAL ENGINEERING ADVISOR

Conventionally, the geological survey only provides the data for the design. Actually, problems incurred from poor geological risk management can occur at any stage of the project.

Thus, a good geological engineering advisor is

expected to do timely and appropriate advice.

Of course, the advisor is also expected to judge if the request for change submitted from the contractor is justified or not and to do proper management promptly, too.

Public owner’s worry is expected to reduce by introducing the geological engineering advisor.

## 7. GEOTECHNICAL BASELINE REPORT

However, the contractor’s worry may not be reduced without improving the relationship between the owner and the contractor even if the geological engineering advisor is introduced.

Therefore, we will discuss effectiveness of introducing concept of the GBR.

GBR is to establish a contractual statement of the geotechnical conditions anticipated to be encountered during underground and subsurface construction.

Using this contractual document, the owner side provides detailed geological related information to the contractor.

It makes risk share between the owner and the contractor specific and clear and makes the both parties understand importance of geological risk management.

In the U.S., the following idea is historically understood: “if all bidders can base on their estimates on a well defined set of site conditions with assurance that equitable reimbursement will be made when changed conditions are encountered, the Owner will receive the lowest reasonable bids with a minimum of contingency unknowns.”

The following observation is also made: “the greater the investment in exploring, clearly communicating, and disclosing the subsurface conditions, the lower the final cost of the project.”

## 8. INTRODUCTION OF CONCEPT OF GEOTECHNICAL BASELINE REPORT

GBR should be introduced consistently with the contractual document between the public owner employer and the contractor. It is expected that the risk which each should be taken becomes clear.

Thus, the contractor's worry is expected to reduce because the contractor also can know who should take what type of risk.

In other words, the owner and the contractor do business on an equal foot. Introduction of GBR would be expected to lead to more efficient geological risk management.

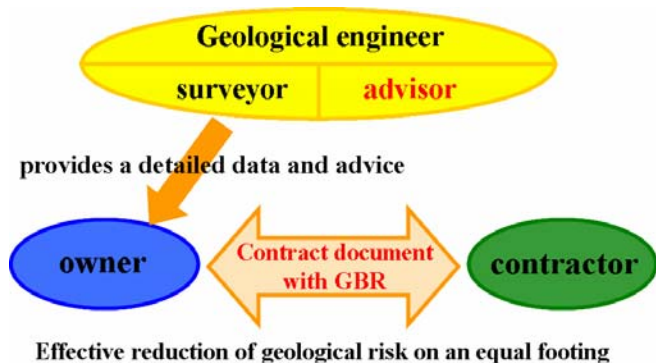


Figure 4 New geological risk management with GBR

## 9. CONCLUSIONS

By clarifying the position of geological engineer dealing with project risks related to geology and creating and introducing the profession of engineering advisor, the owner's worries about not being able to judge requests for change submitted from the contractor and about too much payment towards them are expected to reduce.

Introduction of the GBR of clarifying the risk sharing between the owner and the contractor is expected to reduce the contractor's worry about insufficient payment and to increase a possibility of

conducting the entire business in the equal footing.

These two measures are expected to lower geological risk, cost increase and project delay.

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