

# A PROPOSAL OF CONSTRUCTABILITY REVIEW IN THE BASIC DESIGN STEP FOR DESIGN-BUILD PROJECTS

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**ABSTRACT** : The orders of Design-Build Delivery System (DBDS) in a large and public construction project have been increasing. Single Source Responsibility (SSR) for design and construction, which contributes to quality improvement of design and construction, has been performed. The DBDS performs SSR for design and construction, but, it has not maximized effect because of the dissatisfied alternative analysis procedures which are based on constructability evaluation and the information system in the design step. In this research, Constructability Evaluation Factors (CEFs) that must be evaluated, investigated, and reflected in the basic design step for design-build projects. The CEF proposed and the business process of each conductor has been systematized. To propose constructability evaluation factors, first classify drawing information by the constructability evaluation sphere. CEFs must be proposed to evaluate factors according to interference among work items. Second, applicable CEFs must be classified by preference ranking and weight. Third, the values of constructability factors in accordance with building elements and work items, need to be calculated. Finally, the CEFs proposal will support rational decision making, design cost reduction, and quality improvement through the values for constructability of building elements and work items.

*Key word* : Design-Build delivery system, business process, basic design, Constructability review

## 1. INTRODUCTION

Recently, from the government the design-build delivery system(DBS) is applies to attain the aim which is an efficient use of national budgets through 'Construction technology Development Plan' and 'turnkey Activation plan'. DBS is Single Source Responsibility (SSR) for design and construction, which contributes to reduction an cost and a term of construction, quality improvement of design and construction and development of an new technic.

But, the contractor grant permission exaggerated design rather to be claim to design of architect in DBS in the basic design step because a successful bid. In construction document step, for reduction an cost and a term of construction, raise an constructability a design change is become accomplished frequently by contractor.

After all, because neither draw a blueprint satisfactory for constructability, cost, performance in architecture design step nor evaluate standard for constructability, cost, performance in design review, it has not maximized effect.

Therefore, this study suggests the design business-process in the basic design and the plan of constructability review in design review for Design-build projects.

## 2. THE RANGE AND METHOD OF THIS STUDY

this study suggests the plan of constructability review in design review for Design-build projects. Consequently, this study suggest constructability review business-process by analyze business-process in DBS and devide constructability review territory into site, building, space and element. And, To constructability review, constructability review information that composed constructability information, site information, design information, and each activity construction information creat.

## 3. PRELIMINARY CONSIDERATION

### 3.1 Definition and Procedure of Design-Build Delivery System

Design-Build delivery System(DBS) is contract method which supply for owner concerned against construction all services – resource supply, land purchase, design, construction and operation. This system which is developed form the United States is applied from world-wide multi nation. DBS performs form which owner make contract with

contractor. From our country DBS was provided “a blanket contract” in ‘the legal regarding the contract National Anthem with the person concerned’.

An order of DBS divides with important process 4 phase(bidding method consideration, bidding notification, evaluation of design consideration and contract). A construction company submits the bidding document and the basic design blueprint which is based to bidding guidebook. An ordering organization selects construction-document qualified person passed by the evaluation of the design advisory committ with bidding evaluation data(basic design, construction abaility evaluation data and cost)

Finally, a construction-document qualified person submits the construction-document blueprint and after evaluating of the design advisory commit it makes a contract with a ordering organization as a successful bidder.

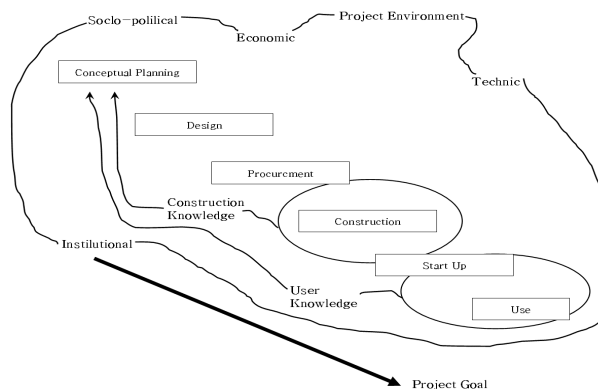
### 3.2 Definition of Constructability

Constructability is defined a concept as the optimization which improves the quality of project and construction easiness against the whole step of construction process(planning construction, design, resource supply, construction, maintenance). Definition of constructability each country is Table 1.

**Table 1.** Definition of constructability each country

Country	Associate	Definition
England	CIRIA	General requirement of the construction facility is satisfied and degree of the architectural design which ease does construction
America	CII	It attains the whole objective of project the integration which optimization of spatial-temporal knowledge and experience from plan, supply and spatial-temporal phase the plan for, becomes
Australia	CIIA	To obtain the object of project and the optimization of performance balance between project and environmental restriction and system to attain optimum integration of construction information in whole step of project
Japan	Kyo-To University	Management method which improves realization of construction reviews design side of economical efficiency and safety of quality in design step

The figure 1 is the diagram which is showed possibility of doing efficient management must consider constructability based idea suggested the owner and contractor from early step of project. As seeing from this figure, the concept of constructability integrate construction information optimally in construction process. And in order to maximize the object of project and the performance of building it is the system which maintains the balance of various projects and environmental restriction.



**Figure 1.** Constructability concept and flow diagram

## 4. DBS BUSINESS-PROCESS

### 4.1 Process analysis of DBS

It grasped important business each process phased of DBS and with figure-2 it analyzed and arranged at 12 phases. The important business is divided with previously bid planning, basic design, construction document, consert, contract and evaluation. Basic design decide to develop decide materialize a bidding guidebook contents and the owner requirement. It is step which is accomplished many-sidedness reviews to minimize motification possibility of construction document step which consumed lots of cost review.

But, It can't system review process side of constructability, cost and performance against design blueprint of review and evaluation phase. And because of imperfect review standard, there is consumed that many the hour and effort to do feedback in the point of view where the design is completed.

Consequently, if the system evaluation concerning design blueprint in the basic design step is progressed, it will be able to shorten the hour and cost compared with design feedback process of after phase.

Also, if cooperation design company which participates the design process reviews the design documents from point of view a engineering in design review process, it is judged that design quality improve more effectively.

### 4.2 Constructability review business and expectation effect in basic design step

Figure-2 is showing the business-process for constructability review each contractor in the basic design step. It draws up the basic design documents based the data about similar project, itemized statement about project budget, design requirement keynote, design keynotes and laws. In the basic design documents construction-specialist who has an experience and the knowledge which relate whit a construction checked which review of a construction method, site information of project, constructability information and interference-item of each relational trades through enough discussion.

Also, in the basic design step of DBS the epective effectiveness optimized constructability reviews is able to show as follows.

- reduction of cost and a term of work which is caused

by reduction change of design

- The design development which constructability is excellent
- The Improve communication and team-work each other of a designer and contractor
- The minimum of trouble and claim each other participation subjects

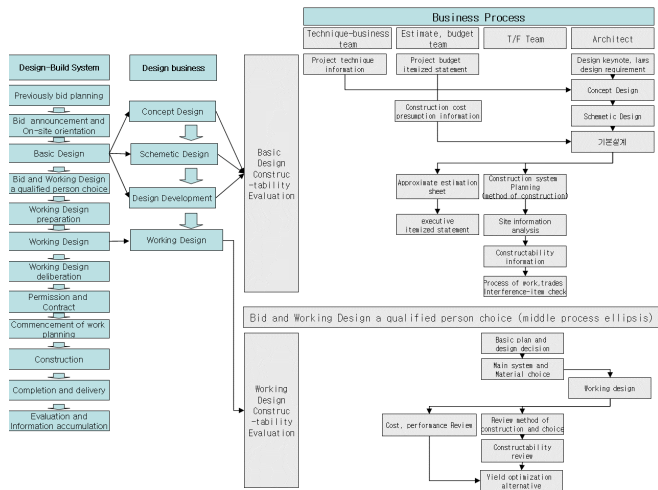


Figure 2. business-process analysis of DBS diagram

## 5. THE METHOD OF CONSTRUCTABILITY REVIEW

The constructability review method which it is presented from this study is method that created and evaluated the constructability review knowledge combined relation information against element composed each space and space.

For this study, it divides architectural design information into 4 provinces(site, building, space and element province). And it evaluate as checklist type that derived constructability review knowledge must be reviewed. It evaluates quantitative figure that make use of Binary Weighting Analysis method Constructability review conclusion evaluated by checklist

### 5.1 Constructability review province classification

This step classify constructability review province with the basic design blueprint. Namely, it divides architectural design into site, building, space and element province.

### 5.2 Constructability review knowledge creation

To review constructability Against design blueprint, it creates constructability review information composed 4 phase(construction information, field information, design information and construction information of each trades.

Constructability knowledge creation process is the process created review-item, as knowledge, compound informations stated previously by each equivalent province. Through this process, it is able to create constructability knowledge that must be reviewed by plan of design, structure, space and

element.

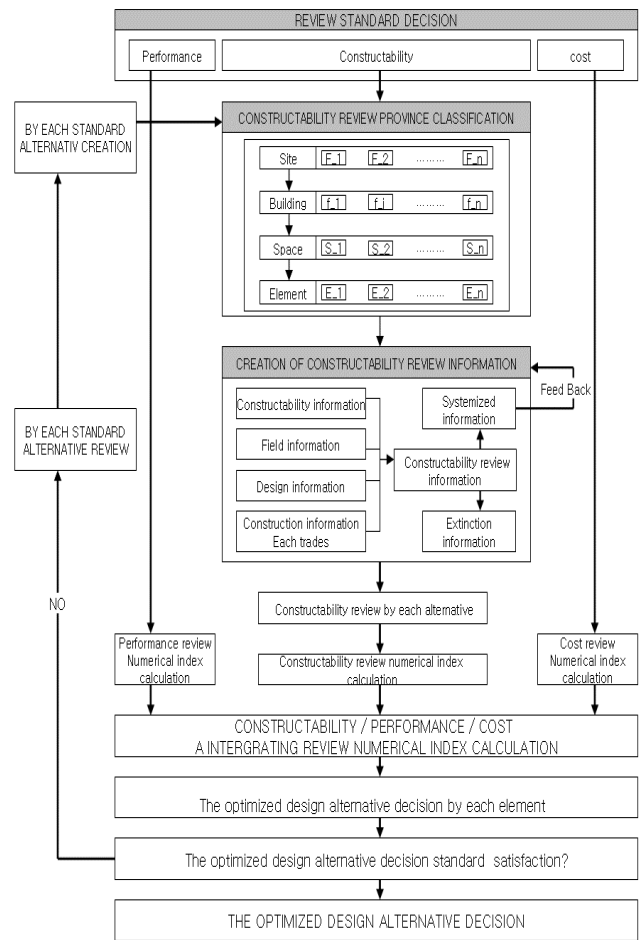


Figure 3. Constructability review concept diagram

### (1) Constructability information

Constructability information is composed with the field condition, ground/underground structure, building structure, building equipment stand on constructability concept main items suggested CII(Construction Industry Institute) of America and CIRIA(Construction Industry Research and Information Association)

### (2) Field information

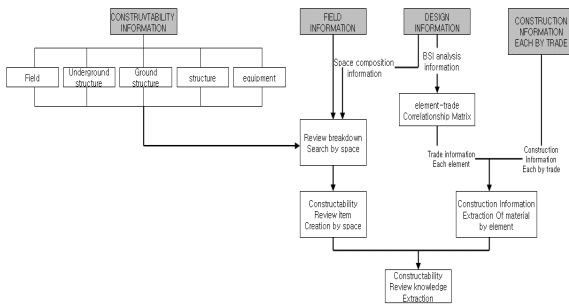
As information of Field, it is composed information about shape of lot, difference of altitude, neighboring road and structure

### (3) Design information

As information appeared design drawing, it is included the basic design, floor plan, elevation, section drawing and the part detail information.

### (4) Construction information each specialist work

It includes the matters to be attended to each trades construction method, quality management method, design and construction standars.



**Figure 4.** Constructability review knowledge creation process diagram

**Table 2.** Example of constructability review knowledge

Division		Contents(example)
Constructability information	Field condition	ground level and neighboring status (road / neighboring building)
	Underground and ground structure	interference-item of each relational trades (equipment pipe, mechanism installation position, ceiling finish)
	Structure of building	structural calculation load standard and each element structural calculation review
	Equipment of building	review relation of mechanism installation position and architectural finish
Site information	Information about shape of lot, difference of altitude	
design information	Layout planning, floor plan, elevation plan and party detail information	
Construction information by specialist work	Ston Execution	anchor fastner method The optimum board thickness(30mm) was considered?
		steel truss method The use method of lifting equipment was considered?
		G.P.C method The measure of Efflorescence prevention was considered?

### 5.3 Constructability review index calculation

The constructability-review-items calculates the constructability-review-index that draw up type of checklist. The constructability-review-conclusion is quantitated figure that make use of Binary Weighting Analysis method. The figure-5 is the Constructability-review-index expression that make use of Binary Weighting Analysis method.

$$C_k = 1 - \frac{MEDV - EDV}{MEDV}$$

$$EDV = \sum_{i=1}^n (w_i \cdot 2^{n-1})$$

$$MEDV = \sum_{i=1}^n (1 \cdot 2^{n-1})$$

$C_k$  = Constructability-review-index

EDV(Equivalent Decimal Value) = The binary number of constructability-review-knowledge

MEDV(Maximum Equivalent Decimal Value) = The Maximum binary number of constructability-review-knowledge

$w$  = From checklist, the score which is given each constructability-review-knowledge item

**Figure 5.** Constructability-review-index expression

## 6. DISCUSSION AND CONCLUSION

This report is to suggest constructability review a plan for building element optimization which is satisfied the constructability in the basic design step of DBS. The method which is suggested this study divides constructability review province 4 phase(site, building, space and element) in the basic design step for DBS. And To review constructability against design drawing, it creates constructability review information composed construction information, field information, design information and construction information of each trades. The constructability-review-conclusion is quantitated figure that make use of Binary Weighting Analysis method. Also, if important the order about constructability-review-knowledge is decided person in charge of the constructability-review, it will be able to reflect the experience and knowledge of reviewer.

Late on, this study needs review province classification make use of analysis model which it is presenting from BSI a theory and element a code which is suggested UNIFORMAT II and CSI specifications system.

And, through calculation total review index of construction, cost and performance index, it is thought that it is able to calculate the optimum design alternative.

### ACKNOWLEDGMENT

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